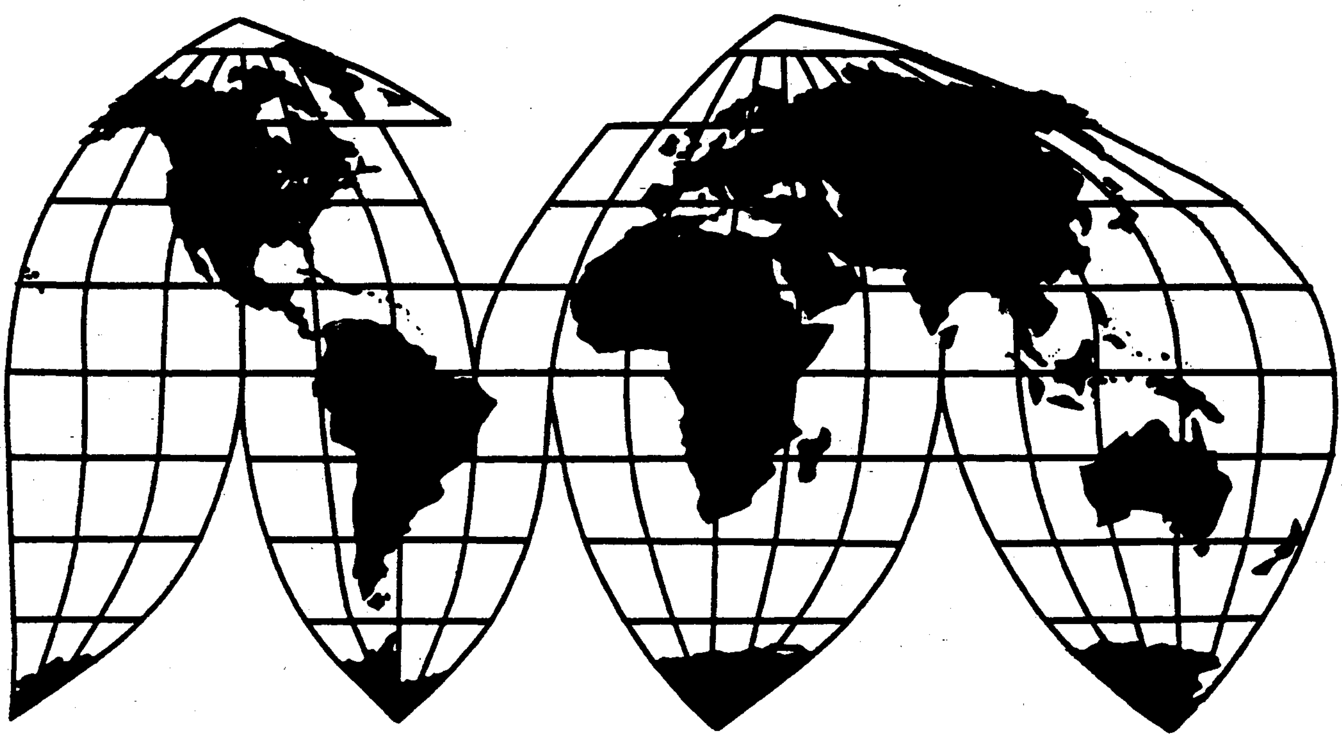
In the Matter of

Certain Integrated Circuit Telecommunication Chips and Products Containing Same Including Dialing Apparatus

Investigation No. 337-TA-337

Publication 2670 August 1993

U.S. International Trade Commission



Washington, DC 20436

U.S. International Trade Commission

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United States International Trade Commission
Washington, DC 20436

UNITED STATES INTERNATIONAL TRADE COMMISSION
Washington, DC 20436

In the Matter of	)	
	)	Investigation No. 337-TA-337
CERTAIN INTEGRATED CIRCUIT TELECOMMUNICATION CHIPS AND PRODUCTS CONTAINING SAME INCLUDING DIALING APPARATUS	)	

NOTICE OF ISSUANCE OF LIMITED EXCLUSION ORDER AND CEASE AND DESIST ORDERS

AGENCY: U.S. International Trade Commission.

ACTION: Notice

SUMMARY: Notice is hereby given that the Commission has issued a limited exclusion order and five cease and desist orders in the above-captioned investigation.

FOR FURTHER INFORMATION CONTACT: Judith M. Czako, Esq., or Matthew T. Bailey, Esq., Office of the General Counsel, U.S. International Trade Commission, 500 E Street, S.W., Washington, D.C. 20436, telephone 202-205-3093 and 202-205-3108, respectively.

SUPPLEMENTARY INFORMATION: The authority for the Commission's determination is contained in section 337 of the Tariff Act of 1930, as amended (19 U.S.C. § 1337), and in section 210.58 of the Commission's Interim Rules of Practice and Procedure (19 C.F.R. § 210.58).

The Commission instituted this investigation on April 8, 1992, based on a complaint filed on March 5, 1992, by SGS-Thomson Microelectronics Corporation (ST). 57 Fed. Reg. 11966 (April 8, 1992). ST's complaint alleged a violation of section 337 of the Tariff Act of 1930, as amended, by reason of the importation into the United States, sale for importation, or sale in the United States after importation, of certain integrated circuit telecommunication chips, and products containing such chips, that infringed various claims of U.S. Letters Patent Nos. 4,061,886, 4,315,108, and 4,446,436 owned by ST. The complaint, and the Commission's original notice of investigation, named twelve respondents allegedly engaged in the manufacture, importation, and sale of allegedly infringing integrated circuit telecommunication chips or products containing such chips. Two additional respondents were subsequently added to the investigation. 57 Fed. Reg. 33520 (July 29, 1992); 57 Fed. Reg. 38855 (August 27, 1992).

On March 9, 1993, the presiding administrative law judge (ALJ) issued his final ID finding that there was a violation of section 337 in the manufacture, sale for importation, and importation of certain integrated circuit telecommunication chips. On April 27, 1993, the Commission ordered review of certain portions of the final ID, and requested written submissions addressing certain specific questions raised by the issues under review. Specifically, the Commission ordered review of (1) whether the '108 patent is valid under the enablement and best mode provisions of 35 U.S.C. § 112, first paragraph; (2) whether the ALJ properly construed the claims at issue of the '886 patent; (3) whether claims 1 and/or 6 of the '436 patent are invalid as obvious under 35 U.S.C. § 103 and, if not, does a violation of section 337 exist as to those claims. The Commission determined not to review the remainder of the ID, which thereby became the determination of the Commission. The Commission also requested written submissions concerning the issues of remedy, the public interest, and bonding. 58 Fed. Reg. 26004 (April 29, 1993).

Having reviewed the record in this investigation, including the written submissions of the parties addressing the specific questions raised by the portions of the ID under review, the Commission made its determinations disposing of the issues on review, and the issues of remedy, the public interest, and bonding.

The Commission determined to (1) revise the ALJ's determination of the level of ordinary skill in the art for the '108 patent to the extent that the determination fails to include all relevant fields of technology; (2) vacate the ALJ's utility analysis of independent claims 6 and 13 of the '886 patent and one sentence in ALJ Finding of Fact number 329; and (3) reverse the ALJ's determination of invalidity with regard to claim 1 of the '436 patent and affirm his determination of invalidity with regard to claim 6 of the '436 patent. Thus, the Commission determined that there is a violation of section 337 of the Tariff Act of 1930 in the unauthorized importation and sale of certain integrated circuit telecommunication chips which infringe claims 1, 2, 3, or 4 of U.S. Letters Patent 4,446,436.

The Commission also determined that the appropriate form of relief is a limited exclusion order prohibiting the importation of infringing integrated circuit telecommunication chips, and prohibiting the importation of certain telephones and telephone sets containing such chips. The Commission further determined to issue cease and desist orders directed to each domestic respondent. Finally, the Commission determined that the public interest factors enumerated in 19 U.S.C. § 1337(d) and (f) do not preclude the issuance of the aforementioned relief, and that the bond during the Presidential review period shall be in the amount of $0.08 per integrated circuit telecommunication chip or telephone or telephone set containing such chip(s).

Copies of the Commission's orders, the Commission's opinion in support thereof, and all other nonconfidential documents filed in connection with this investigation are or will be available for public inspection during official business hours (8:45 a.m. to 5:15 p.m.) in the Office of the Secretary, U.S. International Trade Commission, 500 E Street, S.W., Washington, D.C. 20436, telephone 202-205-2000. Hearing-impaired persons are advised that information on this matter can be obtained by contacting the Commission's TDD terminal on 202-205-1810.

By order of the Commission.

Paul R Bardos

Paul R. Bardos
Acting Secretary

Issued: June 22, 1993

UNITED STATES INTERNATIONAL TRADE COMMISSION
Washington, DC 20436

In the Matter of CERTAIN INTEGRATED CIRCUIT TELECOMMUNICATION CHIPS AND PRODUCTS CONTAINING SAME INCLUDING DIALING APPARATUS	Investigation No. 337-TA-337

ORDER

The Commission instituted this investigation on April 8, 1992, based on a complaint filed on March 5, 1992, by SGS-Thomson Microelectronics Corporation (ST). 57 Fed. Reg. 11966 (April 8, 1992). ST's complaint alleged a violation of section 337 of the Tariff Act of 1930, as amended, by reason of the importation into the United States, sale for importation, or sale in the United States after importation, of certain telecommunication chips that infringed various claims of U.S. Letters Patent Nos. 4,061,886, 4,315,108, and 4,446,436 owned by ST. The complaint, and the Commission's original notice of investigation, named eleven respondents allegedly engaged in the manufacture, importation, or sale of allegedly infringing telecommunication chips or products containing such chips. Two additional respondents were subsequently added to the investigation. 57 Fed. Reg. 33520 (July 29, 1992); 57 Fed. Reg. 38855 (August 27, 1992).

On March 9, 1993, the presiding ALJ issued his final ID finding that there was a violation of section 337 in the manufacture, sale for importation, and importation of certain telecommunication chips. On April 27, 1993, the Commission ordered review of certain portions of the final ID. Specifically, the Commission ordered review of (1) whether the '108 patent is valid under the enablement and best mode provisions of 35 U.S.C. § 112, first paragraph;

(2) whether the ALJ properly construed the claims at issue of the '886 patent; (3) whether claims 1 and/or 6 of the '436 patent are invalid as obvious under 35 U.S.C. § 103 and, if not, does a violation of section 337 exist as to those claims. The Commission requested written submissions addressing certain specific questions raised by the portions of the ID under review. The Commission determined not to review the remainder of the ID, which thereby became the determination of the Commission. The Commission also requested written submissions concerning the questions of remedy, the public interest, and bonding. 58 Fed. Reg. 26004 (April 29, 1993).

Having reviewed the record in this investigation, including the written submissions of the parties concerning the issues under review, the Commission has determined to (1) revise the ALJ's determination of the level of ordinary skill in the art for the '108 patent to the extent that the determination fails to include all relevant fields of technology and affirm the remainder of his determination regarding the validity of the '108 patent; (2) vacate the ALJ's utility analysis of independent claims 6 and 13 of the '886 patent and one sentence in ALJ Finding of Fact number 329 and affirm the remainder of his determination of non-infringement of the '886 patent; and (3) reverse the ALJ's determination of invalidity with regard to claim 1 of the '436 patent and affirm his determination of invalidity with regard to claim 6 of the '436 patent. Thus, the Commission has determined that there is a violation of section 337 of the Tariff Act of 1930 in the unauthorized importation and sale of certain integrated circuit telecommunication chips which infringe claims 1, 2, 3, or 4 of U.S. Letters Patent 4,446,436.

Having determined that there is a violation of section 337, the Commission considered the questions of the appropriate remedy, whether the public interest precludes the issuance of a remedy, and bonding during the Presidential review period. The Commission considered the submissions of the parties and the entire record in this investigation. There were no comments from members of the public concerning these issues.

The Commission has determined to issue a limited exclusion order prohibiting the unlicensed importation into the United States of infringing integrated circuit telecommunication chips manufactured by Hualon Microelectronics Corporation of Taiwan, and prohibiting the unlicensed importation into the United States of certain telephones and telephone sets containing such chips. In addition, the Commission has issued cease and desist orders directed to five domestic respondents -- Spectra Merchandising Inc., Lonestar Technologies, Ltd., Conair Corp., Columbia Telecommunications Group, Inc., and North American Foreign Trading Corporation -- ordering them to cease and desist from the following activities in the United States: the unlicensed assembly, testing, marketing, distributing, offering for sale, selling, or otherwise transferring (except for exportation) of imported integrated circuit telecommunication chips covered by claims 1, 2, 3, or 4 of U.S. Letters Patent 4,446,436, and low end telephones or telephone sets containing such chips. The orders apply to any of the affiliated companies, parents, subsidiaries, licensees, contractors, or other related business entities, or their successors or assigns, of the above-named companies.

The Commission has also determined that the public interest factors enumerated in 19 U.S.C. §§ 1337(d) and (f) do not preclude the issuance of the limited exclusion and cease and desist orders, and that the bond during the Presidential review period shall be in the amount of $0.08 per integrated circuit telecommunication chip or telephone or telephone set containing such chip(s).

Accordingly, the Commission hereby **ORDERS THAT** --

1. Integrated circuit telecommunication chips covered by claims 1, 2, 3, or 4 of U.S. Letters Patent 4,446,436, and manufactured by or on behalf of Hualon Microelectronics Corp. or any of its affiliated companies, parents, subsidiaries, licensees, or other related business entities, or their successors or assigns, are excluded from entry into the United States for the remaining term of the patent, except under license of the patent owner or as provided by law.

2. Telephones and telephone sets, currently entered under HTSUS numbers 8517.10.00.20, 8517.10.00.40, or 8517.10.00.70, containing integrated circuit telecommunication chips excluded under paragraph 1 of this Order, are excluded from entry into the United States for the remaining term of the patent, except under license of the patent owner or as provided by law, unless accompanied by a certification satisfactory to the U.S. Customs Service stating that they contain one or more of the following features: autodial, call transfer, conferencing, call waiting, or visual display (such as LCD display).

3. Pursuant to procedures to be specified by the U.S. Customs Service, as the Customs Service deems necessary, telephones and telephone sets identified in paragraph 2 of this Order may be permitted entry into the United States if the importer provides a certification to accompany the invoice (whether filed electronically or otherwise) stating that the manufacturer of the telephone or telephone set certifies that, upon appropriate inquiry and to the best of its knowledge and belief, the telephones or telephone sets sought to be imported do not contain integrated circuit telecommunication chips excluded under paragraph 1 of this Order.

4. The products excluded under paragraphs 1 and 2 of this Order are entitled to entry into the United States under bond in the amount of $0.08 per article, from the day after this Order is received by the President, pursuant to subsection (j) of section 337 of the Tariff Act of 1930, as amended, until such time as the President notifies the Commission that he approves or disapproves this action, but no later than 60 days after the date of receipt of this Order by the President.

5. In accordance with 19 U.S.C. § 1337(l), the provisions of this Order shall not apply to integrated circuit telecommunication chips or telephones or telephone sets containing such chips imported by and for the use of the United States, or imported for, and to be used for, the United States with the authorization or consent of the Government.

6. The provisions of this Order do not apply to products licensed by SGS-Thomson Microelectronics, Inc. of Carrollton, Texas.

7. The Commission may amend this Order in accordance with the procedure described in section 211.57 of the Commission's Interim Rules of Practice and Procedure (19 C.F.R. § 211.57).

8. The motion filed by respondents Spectra Merchandising, Inc., Lonestar Technologies, Ltd., and Conair Corp., domestic importer respondents, requesting the Commission to strike portions of the Reply Brief of the Office of Unfair Import Investigations to the Briefs of Complainant and Respondents on Remedy, the Public Interest, and Bonding, is hereby denied.

9. The motion filed by respondents United Microelectronics Corporation and Hualon Microelectronics Corporation requesting oral argument and a hearing before the Commission, and seeking to extend the deadline for completion of this investigation, is hereby denied.

10. The submission filed by complainant SGS-Thomson Microelectronics, Inc., dated May 21, 1993, and the letter filed by the Office of Unfair Import Investigations on May 27, 1993, are hereby accepted as part of the record in this investigation.

11. The Secretary shall serve copies of this Order upon each party of record in this investigation and upon the Department of Health and Human Services, the Department of Justice, the Federal Trade Commission, and the U.S. Customs Service.

12. Notice of this Order shall be published in the Federal Register.

By order of the Commission.

Paul R. Bardos
Paul R. Bardos
Acting Secretary

Issued: June 22, 1993.

UNITED STATES INTERNATIONAL TRADE COMMISSION
Washington, DC 20436

In the Matter of CERTAIN INTEGRATED CIRCUIT TELECOMMUNICATION CHIPS AND PRODUCTS CONTAINING SAME INCLUDING DIALING APPARATUS	)	Investigation No. 337-TA-337

ERRATA TO CEASE AND DESIST ORDERS

On June 22, 1993, the Commission issued cease and desist orders in the above-captioned investigation to each of domestic respondents: Spectra Merchandising Inc., Lonestar Technologies, Ltd., Conair Corp., Columbia Telecommunications Group, Inc., and North American Foreign Trading Corporation. It has come to the Commission's attention that the cease and desist orders contain typographical errors concerning the date of issuance of the Commission's limited exclusion order and cease and desist orders. Therefore, the Commission is issuing this errata.

The cease and desist orders issued to each of the above-named parties is corrected to replace the date "June 9, 1993" with the date "June 22, 1993" in line 2 of Paragraph V (Reporting) and lines 6, 8, and 18 of Paragraph XI (Bonding).

By order of the Commission.

Paul R. Bardos
Paul R. Bardos
Acting Secretary

Issued: June 25, 1993

UNITED STATES INTERNATIONAL TRADE COMMISSION
Washington, DC 20436

In the Matter of CERTAIN INTEGRATED CIRCUIT TELECOMMUNICATION CHIPS AND PRODUCTS CONTAINING SAME INCLUDING DIALING APPARATUS	Investigation No. 337-TA-337

ORDER TO CEASE AND DESIST

IT IS HEREBY ORDERED THAT Spectra Merchandising, Inc, 3425 North Kimball, Chicago, Illinois, 60618-5505, cease and desist in the United States from any unlicensed assembling, testing, marketing, distributing, offering for sale, selling, or otherwise transferring (except for exportation) of imported integrated circuit telecommunication chips covered by claims 1, 2, 3, or 4 of U.S. Letters Patent 4,446,436, and low end telephones or telephone sets containing such chips, in violation of section 337 of the Tariff Act of 1930, as amended, 19 U.S.C. § 1337.

I.

(Definitions)

As used in this Order:

(A) "Commission" shall mean the United States International Trade Commission.

(B) "Complainant" shall mean SGS-Thomson Microelectronics, Inc. (ST), 1310 Electronics Drive, Carrollton, Texas, 75006.

(C) "Respondents" shall mean the party set forth in the first paragraph of this Order.

(D) "Person" shall mean an individual, or any non-governmental partnership, firm, association, corporation, or other legal or business entity other than the above Respondent or its majority owned and/or controlled subsidiaries, their successors, or assigns.

(E) "United States" shall mean the fifty States, the District of Columbia, and Puerto Rico;

(F) "Covered product" shall mean (a) integrated circuit telecommunication chips covered by claims 1, 2, 3, or 4 of U.S. Letters Patent 4,446,436 manufactured by or on behalf of Hualon Microelectronics Corp., No. 1 R & D Road, Sec. 4, Science-Based Industrial Park, Hsin Chu City, Taiwan, and (b) any imported low end telephone or telephone set which contains an integrated circuit telecommunication chip or chips covered by claims 1, 2, 3, or 4 of U.S. Letters Patent 4,446,436 manufactured by or on behalf of Hualon Microelectronics Corp., No. 1 R&D Road, Sec. 4, Science-Based Industrial Park, Hsin Chu City, Taiwan.

(G) "Low end telephone or telephone set" shall mean any telephone or telephone set currently entered into the United States under HTSUS numbers 8517.10.00.20, 8517.10.00.40, or 8517.10.00.70. "Low end telephone or telephone set" shall not mean any telephone or telephone set containing one or more of the following features: autodial, call transfer, conferencing, call waiting, or visual display (such as LCD display).

II

(Applicability)

The provisions of this Cease and Desist Order shall apply to Respondent and to its principals, stockholders, officers, directors, employees, agents, licensees, distributors, controlled (whether by stock ownership or otherwise)

and/or majority owned business entities, successors and assigns, and to each of them, in accordance with Section VII hereof.

III

(Conduct Prohibited)

The following conduct of Respondent in the United States is prohibited by this Order: Respondent shall not assemble, test, market, distribute, offer for sale, sell, or otherwise transfer (except for exportation) covered products, for the remaining term of U.S. Letters Patent 4,446,436. U.S. Letters Patent 4,446,436 is scheduled to expire on May 1, 2001, subject to applicable law.

IV

(Conduct Permitted)

Notwithstanding any other provision of this Order, specific conduct otherwise prohibited by the terms of this Order shall be permitted if, in a written instrument, Complainant licenses or authorizes such specific conduct, or such specific conduct is related to the importation or sale of covered products by or for the United States.

V

(Reporting)

Respondent shall each submit quarterly reports during the period commencing on June 9, 1993, and extending through the remaining term of U.S. Letters Patent 4,446,436. The first report of Respondent shall be submitted within 60 days of the issuance of this Order. Thereafter, reports shall be submitted within 21 days of the close of each quarter. This reporting requirement shall continue in force until the expiration of U.S. Letters Patent 4,446,436 on May 1, 2001, unless, pursuant to subsection (j) of section

337 of the Tariff Act of 1930, the President notifies the Commission within 60 days after the date he receives this Order, that he disapproves this Order.

Respondent shall report to the Commission its importation and sales in the United States, measured in units and in U.S. dollars, of covered products, if any, during the reporting period in question.

Any failure to report shall constitute a violation of this Order.

VI.

(Recordkeeping and Inspection)

(A) For the purpose of securing compliance with this Order, Respondent shall retain any and all records relating to the sale, offer for sale, marketing, or distribution in the United States of covered products, made and received in the usual and ordinary course of business, whether in detail or in summary form, for a period of two years from the close of the fiscal year to which they pertain.

(B) For the purposes of determining or securing compliance with this Order and for no other purpose, and subject to any privilege recognized by the Federal Courts of the United States, duly authorized representatives of the Commission shall, upon reasonable written notice by the Commission or its staff, be permitted access and the right to inspect and copy in the principal offices of Respondent during office hours, and in the presence of counsel or other representatives if Respondent so chooses, all books, ledgers, accounts, correspondence, memoranda, financial reports, and other records and documents, both in detail and in summary form, for the purpose of verifying any matter or statement contained in the reports required to be retained under subparagraph VI(A) of this Order.

VII

(Service of Cease and Desist Order)

Respondent is ordered and directed to:

(A) Serve, within thirty (30) days after the effective date of this Order, a copy of this Order upon each of its officers, directors, managing agents, agents, and employees who have any responsibility for the marketing, distribution, or sale of covered products in the United States;

(B) Serve, within thirty (30) days after the succession of any persons referred to in subparagraph VII(A) of this Order, a copy of the Order upon each successor; and

(C) Maintain such records as will show the name, title, and address of each person upon whom the Order has been served, as described in subparagraphs VII(A) and VII(B) of this Order, together with the date on which service was made.

The obligations set forth in subparagraphs VII(B) and VII(C) shall remain in effect until the date of expiration of U.S. Letters Patent 4,446,436.

VIII

(Confidentiality)

Information obtained by means provided for in Sections V and VI of this Order will be made available only to the Commission and its authorized representatives, will be entitled to confidential treatment, and will not be divulged by any authorized representative of the Commission to any person other than duly authorized representatives of the Commission, except as may be required in the course of securing compliance with this Order, or as otherwise

required by law. Disclosure hereunder will not be made by the Commission without ten (10) days prior notice in writing to Respondent.

IX

(Enforcement)

Violation of this Order may result in any of the actions specified in section 211.56 of the Commission's Interim Rules of Practice and Procedure, 19 C.F.R. § 211.56, including an action for civil penalties in accordance with section 337(f) of the Tariff Act of 1930, 19 U.S.C. § 1337(f), and any other action as the Commission may deem appropriate. In determining whether Respondent is in violation of this Order, the Commission may infer facts adverse to Respondent if Respondent fails to provide adequate or timely information.

X

(Modification)

The Commission may amend this Order on its own motion or in accordance with the procedure described in section 211.57 of the Commission's Interim Rules of Practice and Procedure, 19 C.F.R. § 211.57.

XI

(Bonding)

The conduct prohibited by Section III of this Order may be continued during the period in which this Order is under review by the President pursuant to section 337(j) of the Tariff Act of 1930 (19 U.S.C. § 1337(j)), subject to the posting of a bond in the amount of $0.08 per covered product. This bond provision does not apply to conduct that is otherwise permitted by Section IV of this Order. Infringing products imported on or after June 9, 1993, are subject to the entry bond as set forth in the limited exclusion

order issued by the Commission on June 9, 1993, and are not subject to this bond provision.

The bond is to be posted in accordance with the procedures established by the Commission for the posting of bonds by complainants in connection with the issuance of temporary exclusion orders. See Commission Interim Rule 210.58, 19 C.F.R. § 210.58. The bond and any accompanying documentation is to be provided to and approved by the Commission prior to the commencement of conduct which is otherwise prohibited by Section III of this Order.

The bond is to be forfeited in the event that the President approves, or does not disapprove within the Presidential review period, the Commission's Orders of June 9, 1993, or any subsequent final order issued after the completion of Investigation 337-TA-337, unless the U.S. Court of Appeals for the Federal Circuit, in a final judgment, reverses any Commission final determination and order on appeal, or unless the products subject to this bond are exported or destroyed, and certification to that effect satisfactory to the Commission is provided.

The bond is to be released in the event the President disapproves this Order and no subsequent order is issued by the Commission and approved, or not disapproved, by the President, upon service on Respondent of an Order issued by the Commission based upon application therefor made to the Commission.

By order of the Commission.

Paul R. Bardos
Acting Secretary

Issued:: June 22, 1993

UNITED STATES INTERNATIONAL TRADE COMMISSION
Washington, DC 20436

In the Matter of CERTAIN INTEGRATED CIRCUIT TELECOMMUNICATION CHIPS AND PRODUCTS CONTAINING SAME INCLUDING DIALING APPARATUS	Investigation No. 337-TA-337

ORDER TO CEASE AND DESIST

IT IS HEREBY ORDERED THAT Lonestar Technologies, Ltd., (AKA Planned Technologies, Inc.), 920 South Oyster Bay Road, Hicksville, New York, 11801-3516, cease and desist in the United States from any unlicensed assembling, testing, marketing, distributing, offering for sale, selling, or otherwise transferring (except for exportation) of imported integrated circuit telecommunication chips covered by claims 1, 2, 3, or 4 of U.S. Letters Patent 4,446,436, and low end telephones or telephone sets containing such chips, in violation of section 337 of the Tariff Act of 1930, as amended, 19 U.S.C. § 1337.

I.

(Definitions)

As used in this Order:

(A) "Commission" shall mean the United States International Trade Commission.

(B) "Complainant" shall mean SGS-Thomson Microelectronics, Inc. (ST), 1310 Electronics Drive, Carrollton, Texas, 75006.

(C) "Respondents" shall mean the party set forth in the first paragraph of this Order.

(D) "Person" shall mean an individual, or any non-governmental partnership, firm, association, corporation, or other legal or business entity other than the above Respondent or its majority owned and/or controlled subsidiaries, their successors, or assigns.

(E) "United States" shall mean the fifty States, the District of Columbia, and Puerto Rico;

(F) "Covered product" shall mean (a) integrated circuit telecommunication chips covered by claims 1, 2, 3, or 4 of U.S. Letters Patent 4,446,436 manufactured by or on behalf of Hualon Microelectronics Corp., No. 1 R & D Road, Sec. 4, Science-Based Industrial Park, Hsin Chu City, Taiwan, and (b) any imported low end telephone or telephone set which contains an integrated circuit telecommunication chip or chips covered by claims 1, 2, 3, or 4 of U.S. Letters Patent 4,446,436 manufactured by or on behalf of Hualon Microelectronics Corp., No. 1 R&D Road, Sec. 4, Science-Based Industrial Park, Hsin Chu City, Taiwan.

(G) "Low end telephone or telephone set" shall mean any telephone or telephone set currently entered into the United States under HTSUS numbers 8517.10.00.20, 8517.10.00.40, or 8517.10.00.70. "Low end telephone or telephone set" shall not mean any telephone or telephone set containing one or more of the following features: autodial, call transfer, conferencing, call waiting, or visual display (such as LCD display).

II

(Applicability)

The provisions of this Cease and Desist Order shall apply to Respondent and to its principals, stockholders, officers, directors, employees, agents, licensees, distributors, controlled (whether by stock ownership or otherwise)

and/or majority owned business entities, successors and assigns, and to each of them, in accordance with Section VII hereof.

III

(Conduct Prohibited)

The following conduct of Respondent in the United States is prohibited by this Order: Respondent shall not assemble, test, market, distribute, offer for sale, sell, or otherwise transfer (except for exportation) covered products, for the remaining term of U.S. Letters Patent 4,446,436. U.S. Letters Patent 4,446,436 is scheduled to expire on May 1, 2001, subject to applicable law.

IV

(Conduct Permitted)

Notwithstanding any other provision of this Order, specific conduct otherwise prohibited by the terms of this Order shall be permitted if, in a written instrument, Complainant licenses or authorizes such specific conduct, or such specific conduct is related to the importation or sale of covered products by or for the United States.

V

(Reporting)

Respondent shall each submit quarterly reports during the period commencing on June 9, 1993, and extending through the remaining term of U.S. Letters Patent 4,446,436. The first report of Respondent shall be submitted within 60 days of the issuance of this Order. Thereafter, reports shall be submitted within 21 days of the close of each quarter. This reporting requirement shall continue in force until the expiration of U.S. Letters Patent 4,446,436 on May 1, 2001, unless, pursuant to subsection (j) of section

337 of the Tariff Act of 1930, the President notifies the Commission within 60 days after the date he receives this Order, that he disapproves this Order.

Respondent shall report to the Commission its importation and sales in the United States, measured in units and in U.S. dollars, of covered products, if any, during the reporting period in question.

Any failure to report shall constitute a violation of this Order.

VI.

(Recordkeeping and Inspection)

(A) For the purpose of securing compliance with this Order, Respondent shall retain any and all records relating to the sale, offer for sale, marketing, or distribution in the United States of covered products, made and received in the usual and ordinary course of business, whether in detail or in summary form, for a period of two years from the close of the fiscal year to which they pertain.

(B) For the purposes of determining or securing compliance with this Order and for no other purpose, and subject to any privilege recognized by the Federal Courts of the United States, duly authorized representatives of the Commission shall, upon reasonable written notice by the Commission or its staff, be permitted access and the right to inspect and copy in the principal offices of Respondent during office hours, and in the presence of counsel or other representatives if Respondent so chooses, all books, ledgers, accounts, correspondence, memoranda, financial reports, and other records and documents, both in detail and in summary form, for the purpose of verifying any matter or statement contained in the reports required to be retained under subparagraph VI(A) of this Order.

VII

(Service of Cease and Desist Order)

Respondent is ordered and directed to:

(A) Serve, within thirty (30) days after the effective date of this Order, a copy of this Order upon each of its officers, directors, managing agents, agents, and employees who have any responsibility for the marketing, distribution, or sale of covered products in the United States;

(B) Serve, within thirty (30) days after the succession of any persons referred to in subparagraph VII(A) of this Order, a copy of the Order upon each successor; and

(C) Maintain such records as will show the name, title, and address of each person upon whom the Order has been served, as described in subparagraphs VII(A) and VII(B) of this Order, together with the date on which service was made.

The obligations set forth in subparagraphs VII(B) and VII(C) shall remain in effect until the date of expiration of U.S. Letters Patent 4,446,436.

VIII

(Confidentiality)

Information obtained by means provided for in Sections V and VI of this Order will be made available only to the Commission and its authorized representatives, will be entitled to confidential treatment, and will not be divulged by any authorized representative of the Commission to any person other than duly authorized representatives of the Commission, except as may be required in the course of securing compliance with this Order, or as otherwise

required by law. Disclosure hereunder will not be made by the Commission without ten (10) days prior notice in writing to Respondent.

IX

(Enforcement)

Violation of this Order may result in any of the actions specified in section 211.56 of the Commission's Interim Rules of Practice and Procedure, 19 C.F.R. § 211.56, including an action for civil penalties in accordance with section 337(f) of the Tariff Act of 1930, 19 U.S.C. § 1337(f), and any other action as the Commission may deem appropriate. In determining whether Respondent is in violation of this Order, the Commission may infer facts adverse to Respondent if Respondent fails to provide adequate or timely information.

X

(Modification)

The Commission may amend this Order on its own motion or in accordance with the procedure described in section 211.57 of the Commission's Interim Rules of Practice and Procedure, 19 C.F.R. § 211.57.

XI

(Bonding)

The conduct prohibited by Section III of this Order may be continued during the period in which this Order is under review by the President pursuant to section 337(j) of the Tariff Act of 1930 (19 U.S.C. § 1337(j)), subject to the posting of a bond in the amount of $0.08 per covered product. This bond provision does not apply to conduct that is otherwise permitted by Section IV of this Order. Infringing products imported on or after June 9, 1993, are subject to the entry bond as set forth in the limited exclusion

order issued by the Commission on June 9, 1993, and are not subject to this bond provision.

The bond is to be posted in accordance with the procedures established by the Commission for the posting of bonds by complainants in connection with the issuance of temporary exclusion orders. See Commission Interim Rule 210.58, 19 C.F.R. § 210.58. The bond and any accompanying documentation is to be provided to and approved by the Commission prior to the commencement of conduct which is otherwise prohibited by Section III of this Order.

The bond is to be forfeited in the event that the President approves, or does not disapprove within the Presidential review period, the Commission's Orders of June 9, 1993, or any subsequent final order issued after the completion of Investigation 337-TA-337, unless the U.S. Court of Appeals for the Federal Circuit, in a final judgment, reverses any Commission final determination and order on appeal, or unless the products subject to this bond are exported or destroyed, and certification to that effect satisfactory to the Commission is provided.

The bond is to be released in the event the President disapproves this Order and no subsequent order is issued by the Commission and approved, or not disapproved, by the President, upon service on Respondent of an Order issued by the Commission based upon application therefor made to the Commission.

By order of the Commission.

Paul R. Bardos
Paul R. Bardos
Acting Secretary

Issued: June 22, 1993

UNITED STATES INTERNATIONAL TRADE COMMISSION
Washington, DC 20436

In the Matter of CERTAIN INTEGRATED CIRCUIT TELECOMMUNICATION CHIPS AND PRODUCTS CONTAINING SAME INCLUDING DIALING APPARATUS	)	Investigation No. 337-TA-337

ORDER TO CEASE AND DESIST

IT IS HEREBY ORDERED THAT Conair Corporation, 150 Milford Road, East Windsor, New Jersey, 08250, cease and desist in the United States from any unlicensed assembling, testing, marketing, distributing, offering for sale, selling, or otherwise transferring (except for exportation) of imported integrated circuit telecommunication chips covered by claims 1, 2, 3, or 4 of U.S. Letters Patent 4,446,436, and low end telephones or telephone sets containing such chips, in violation of section 337 of the Tariff Act of 1930, as amended, 19 U.S.C. § 1337.

I.

(Definitions)

As used in this Order:

(A) "Commission" shall mean the United States International Trade Commission.

(B) "Complainant" shall mean SGS-Thomson Microelectronics, Inc. (ST), 1310 Electronics Drive, Carrollton, Texas, 75006.

(C) "Respondents" shall mean the party set forth in the first paragraph of this Order.

(D) "Person" shall mean an individual, or any non-governmental partnership, firm, association, corporation, or other legal or business entity other than the above Respondent or its majority owned and/or controlled subsidiaries, their successors, or assigns.

(E) "United States" shall mean the fifty States, the District of Columbia, and Puerto Rico;

(F) "Covered product" shall mean (a) integrated circuit telecommunication chips covered by claims 1, 2, 3, or 4 of U.S. Letters Patent 4,446,436 manufactured by or on behalf of Hualon Microelectronics Corp., No. 1 R & D Road, Sec. 4, Science-Based Industrial Park, Hsin Chu City, Taiwan, and (b) any imported low end telephone or telephone set which contains an integrated circuit telecommunication chip or chips covered by claims 1, 2, 3, or 4 of U.S. Letters Patent 4,446,436 manufactured by or on behalf of Hualon Microelectronics Corp., No. 1 R&D Road, Sec. 4, Science-Based Industrial Park, Hsin Chu City, Taiwan.

(G) "Low end telephone or telephone set" shall mean any telephone or telephone set currently entered into the United States under HTSUS numbers 8517.10.00.20, 8517.10.00.40, or 8517.10.00.70. "Low end telephone or telephone set" shall not mean any telephone or telephone set containing one or more of the following features: autodial, call transfer, conferencing, call waiting, or visual display (such as LCD display).

II

(Applicability)

The provisions of this Cease and Desist Order shall apply to Respondent and to its principals, stockholders, officers, directors, employees, agents, licensees, distributors, controlled (whether by stock ownership or otherwise)

and/or majority owned business entities, successors and assigns, and to each of them, in accordance with Section VII hereof.

III

(Conduct Prohibited)

The following conduct of Respondent in the United States is prohibited by this Order: Respondent shall not assemble, test, market, distribute, offer for sale, sell, or otherwise transfer (except for exportation) covered products, for the remaining term of U.S. Letters Patent 4,446,436. U.S. Letters Patent 4,446,436 is scheduled to expire on May 1, 2001, subject to applicable law.

IV

(Conduct Permitted)

Notwithstanding any other provision of this Order, specific conduct otherwise prohibited by the terms of this Order shall be permitted if, in a written instrument, Complainant licenses or authorizes such specific conduct, or such specific conduct is related to the importation or sale of covered products by or for the United States.

V

(Reporting)

Respondent shall each submit quarterly reports during the period commencing on June 9, 1993, and extending through the remaining term of U.S. Letters Patent 4,446,436. The first report of Respondent shall be submitted within 60 days of the issuance of this Order. Thereafter, reports shall be submitted within 21 days of the close of each quarter. This reporting requirement shall continue in force until the expiration of U.S. Letters Patent 4,446,436 on May 1, 2001, unless, pursuant to subsection (j) of section

337 of the Tariff Act of 1930, the President notifies the Commission within 60 days after the date he receives this Order, that he disapproves this Order.

Respondent shall report to the Commission its importation and sales in the United States, measured in units and in U.S. dollars, of covered products, if any, during the reporting period in question.

Any failure to report shall constitute a violation of this Order.

VI.

(Recordkeeping and Inspection)

(A) For the purpose of securing compliance with this Order, Respondent shall retain any and all records relating to the sale, offer for sale, marketing, or distribution in the United States of covered products, made and received in the usual and ordinary course of business, whether in detail or in summary form, for a period of two years from the close of the fiscal year to which they pertain.

(B) For the purposes of determining or securing compliance with this Order and for no other purpose, and subject to any privilege recognized by the Federal Courts of the United States, duly authorized representatives of the Commission shall, upon reasonable written notice by the Commission or its staff, be permitted access and the right to inspect and copy in the principal offices of Respondent during office hours, and in the presence of counsel or other representatives if Respondent so chooses, all books, ledgers, accounts, correspondence, memoranda, financial reports, and other records and documents, both in detail and in summary form, for the purpose of verifying any matter or statement contained in the reports required to be retained under subparagraph VI(A) of this Order.

VII

(Service of Cease and Desist Order)

Respondent is ordered and directed to:

(A) Serve, within thirty (30) days after the effective date of this Order, a copy of this Order upon each of its officers, directors, managing agents, agents, and employees who have any responsibility for the marketing, distribution, or sale of covered products in the United States;

(B) Serve, within thirty (30) days after the succession of any persons referred to in subparagraph VII(A) of this Order, a copy of the Order upon each successor; and

(C) Maintain such records as will show the name, title, and address of each person upon whom the Order has been served, as described in subparagraphs VII(A) and VII(B) of this Order, together with the date on which service was made.

The obligations set forth in subparagraphs VII(B) and VII(C) shall remain in effect until the date of expiration of U.S. Letters Patent 4,446,436.

VIII

(Confidentiality)

Information obtained by means provided for in Sections V and VI of this Order will be made available only to the Commission and its authorized representatives, will be entitled to confidential treatment, and will not be divulged by any authorized representative of the Commission to any person other than duly authorized representatives of the Commission, except as may be required in the course of securing compliance with this Order, or as otherwise

required by law. Disclosure hereunder will not be made by the Commission without ten (10) days prior notice in writing to Respondent.

IX

(Enforcement)

Violation of this Order may result in any of the actions specified in section 211.56 of the Commission's Interim Rules of Practice and Procedure, 19 C.F.R. § 211.56, including an action for civil penalties in accordance with section 337(f) of the Tariff Act of 1930, 19 U.S.C. § 1337(f), and any other action as the Commission may deem appropriate. In determining whether Respondent is in violation of this Order, the Commission may infer facts adverse to Respondent if Respondent fails to provide adequate or timely information.

X

(Modification)

The Commission may amend this Order on its own motion or in accordance with the procedure described in section 211.57 of the Commission's Interim Rules of Practice and Procedure, 19 C.F.R. § 211.57.

XI

(Bonding)

The conduct prohibited by Section III of this Order may be continued during the period in which this Order is under review by the President pursuant to section 337(j) of the Tariff Act of 1930 (19 U.S.C. § 1337(j)), subject to the posting of a bond in the amount of $0.08 per covered product. This bond provision does not apply to conduct that is otherwise permitted by Section IV of this Order. Infringing products imported on or after June 9, 1993, are subject to the entry bond as set forth in the limited exclusion

order issued by the Commission on June 9, 1993, and are not subject to this bond provision.

The bond is to be posted in accordance with the procedures established by the Commission for the posting of bonds by complainants in connection with the issuance of temporary exclusion orders. See Commission Interim Rule 210.58, 19 C.F.R. § 210.58. The bond and any accompanying documentation is to be provided to and approved by the Commission prior to the commencement of conduct which is otherwise prohibited by Section III of this Order.

The bond is to be forfeited in the event that the President approves, or does not disapprove within the Presidential review period, the Commission's Orders of June 9, 1993, or any subsequent final order issued after the completion of Investigation 337-TA-337, unless the U.S. Court of Appeals for the Federal Circuit, in a final judgment, reverses any Commission final determination and order on appeal, or unless the products subject to this bond are exported or destroyed, and certification to that effect satisfactory to the Commission is provided.

The bond is to be released in the event the President disapproves this Order and no subsequent order is issued by the Commission and approved, or not disapproved, by the President, upon service on Respondent of an Order issued by the Commission based upon application therefor made to the Commission.

By order of the Commission.

Paul R. Bardos
Paul R. Bardos
Acting Secretary

Issued: June 22, 1993

UNITED STATES INTERNATIONAL TRADE COMMISSION
Washington, DC 20436

In the Matter of CERTAIN INTEGRATED CIRCUIT TELECOMMUNICATION CHIPS AND PRODUCTS CONTAINING SAME INCLUDING DIALING APPARATUS	)	Investigation No. 337-TA-337

ORDER TO CEASE AND DESIST

IT IS HEREBY ORDERED THAT Columbia Telecommunications Group, Inc., 395 Atlantic Avenue, East Rockaway, New York, 11518, cease and desist in the United States from any unlicensed assembling, testing, marketing, distributing, offering for sale, selling, or otherwise transferring (except for exportation) of imported integrated circuit telecommunication chips covered by claims 1, 2, 3, or 4 of U.S. Letters Patent 4,446,436, and low end telephones or telephone sets containing such chips, in violation of section 337 of the Tariff Act of 1930, as amended, 19 U.S.C. § 1337.

I.

(Definitions)

As used in this Order:

(A) "Commission" shall mean the United States International Trade Commission.

(B) "Complainant" shall mean SGS-Thomson Microelectronics, Inc. (ST), 1310 Electronics Drive, Carrollton, Texas, 75006.

(C) "Respondents" shall mean the party set forth in the first paragraph of this Order.

(D) "Person" shall mean an individual, or any non-governmental partnership, firm, association, corporation, or other legal or business entity other than the above Respondent or its majority owned and/or controlled subsidiaries, their successors, or assigns.

(E) "United States" shall mean the fifty States, the District of Columbia, and Puerto Rico;

(F) "Covered product" shall mean (a) integrated circuit telecommunication chips covered by claims 1, 2, 3, or 4 of U.S. Letters Patent 4,446,436 manufactured by or on behalf of Hualon Microelectronics Corp., No. 1 R & D Road, Sec. 4, Science-Based Industrial Park, Hsin Chu City, Taiwan, and (b) any imported low end telephone or telephone set which contains an integrated circuit telecommunication chip or chips covered by claims 1, 2, 3, or 4 of U.S. Letters Patent 4,446,436 manufactured by or on behalf of Hualon Microelectronics Corp., No. 1 R&D Road, Sec. 4, Science-Based Industrial Park, Hsin Chu City, Taiwan.

(G) "Low end telephone or telephone set" shall mean any telephone or telephone set currently entered into the United States under HTSUS numbers 8517.10.00.20, 8517.10.00.40, or 8517.10.00.70. "Low end telephone or telephone set" shall not mean any telephone or telephone set containing one or more of the following features: autodial, call transfer, conferencing, call waiting, or visual display (such as LCD display).

II

(Applicability)

The provisions of this Cease and Desist Order shall apply to Respondent and to its principals, stockholders, officers, directors, employees, agents, licensees, distributors, controlled (whether by stock ownership or otherwise)

and/or majority owned business entities, successors and assigns, and to each of them, in accordance with Section VII hereof.

III

(Conduct Prohibited)

The following conduct of Respondent in the United States is prohibited by this Order: Respondent shall not assemble, test, market, distribute, offer for sale, sell, or otherwise transfer (except for exportation) covered products, for the remaining term of U.S. Letters Patent 4,446,436. U.S. Letters Patent 4,446,436 is scheduled to expire on May 1, 2001, subject to applicable law.

IV

(Conduct Permitted)

Notwithstanding any other provision of this Order, specific conduct otherwise prohibited by the terms of this Order shall be permitted if, in a written instrument, Complainant licenses or authorizes such specific conduct, or such specific conduct is related to the importation or sale of covered products by or for the United States.

V

(Reporting)

Respondent shall each submit quarterly reports during the period commencing on June 9, 1993, and extending through the remaining term of U.S. Letters Patent 4,446,436. The first report of Respondent shall be submitted within 60 days of the issuance of this Order. Thereafter, reports shall be submitted within 21 days of the close of each quarter. This reporting requirement shall continue in force until the expiration of U.S. Letters Patent 4,446,436 on May 1, 2001, unless, pursuant to subsection (j) of section

337 of the Tariff Act of 1930, the President notifies the Commission within 60 days after the date he receives this Order, that he disapproves this Order.

Respondent shall report to the Commission its importation and sales in the United States, measured in units and in U.S. dollars, of covered products, if any, during the reporting period in question.

Any failure to report shall constitute a violation of this Order.

VI.

(Recordkeeping and Inspection)

(A) For the purpose of securing compliance with this Order, Respondent shall retain any and all records relating to the sale, offer for sale, marketing, or distribution in the United States of covered products, made and received in the usual and ordinary course of business, whether in detail or in summary form, for a period of two years from the close of the fiscal year to which they pertain.

(B) For the purposes of determining or securing compliance with this Order and for no other purpose, and subject to any privilege recognized by the Federal Courts of the United States, duly authorized representatives of the Commission shall, upon reasonable written notice by the Commission or its staff, be permitted access and the right to inspect and copy in the principal offices of Respondent during office hours, and in the presence of counsel or other representatives if Respondent so chooses, all books, ledgers, accounts, correspondence, memoranda, financial reports, and other records and documents, both in detail and in summary form, for the purpose of verifying any matter or statement contained in the reports required to be retained under subparagraph VI(A) of this Order.

VII

(Service of Cease and Desist Order)

Respondent is ordered and directed to:

(A) Serve, within thirty (30) days after the effective date of this Order, a copy of this Order upon each of its officers, directors, managing agents, agents, and employees who have any responsibility for the marketing, distribution, or sale of covered products in the United States;

(B) Serve, within thirty (30) days after the succession of any persons referred to in subparagraph VII(A) of this Order, a copy of the Order upon each successor; and

(C) Maintain such records as will show the name, title, and address of each person upon whom the Order has been served, as described in subparagraphs VII(A) and VII(B) of this Order, together with the date on which service was made.

The obligations set forth in subparagraphs VII(B) and VII(C) shall remain in effect until the date of expiration of U.S. Letters Patent 4,446,436.

VIII

(Confidentiality)

Information obtained by means provided for in Sections V and VI of this Order will be made available only to the Commission and its authorized representatives, will be entitled to confidential treatment, and will not be divulged by any authorized representative of the Commission to any person other than duly authorized representatives of the Commission, except as may be required in the course of securing compliance with this Order, or as otherwise

required by law. Disclosure hereunder will not be made by the Commission without ten (10) days prior notice in writing to Respondent.

IX

(Enforcement)

Violation of this Order may result in any of the actions specified in section 211.56 of the Commission's Interim Rules of Practice and Procedure, 19 C.F.R. § 211.56, including an action for civil penalties in accordance with section 337(f) of the Tariff Act of 1930, 19 U.S.C. § 1337(f), and any other action as the Commission may deem appropriate. In determining whether Respondent is in violation of this Order, the Commission may infer facts adverse to Respondent if Respondent fails to provide adequate or timely information.

X

(Modification)

The Commission may amend this Order on its own motion or in accordance with the procedure described in section 211.57 of the Commission's Interim Rules of Practice and Procedure, 19 C.F.R. § 211.57.

XI

(Bonding)

The conduct prohibited by Section III of this Order may be continued during the period in which this Order is under review by the President pursuant to section 337(j) of the Tariff Act of 1930 (19 U.S.C. § 1337(j)), subject to the posting of a bond in the amount of $0.08 per covered product. This bond provision does not apply to conduct that is otherwise permitted by Section IV of this Order. Infringing products imported on or after June 9, 1993, are subject to the entry bond as set forth in the limited exclusion

order issued by the Commission on June 9, 1993, and are not subject to this bond provision.

The bond is to be posted in accordance with the procedures established by the Commission for the posting of bonds by complainants in connection with the issuance of temporary exclusion orders. See Commission Interim Rule 210.58, 19 C.F.R. § 210.58. The bond and any accompanying documentation is to be provided to and approved by the Commission prior to the commencement of conduct which is otherwise prohibited by Section III of this Order.

The bond is to be forfeited in the event that the President approves, or does not disapprove within the Presidential review period, the Commission's Orders of June 9, 1993, or any subsequent final order issued after the completion of Investigation 337-TA-337, unless the U.S. Court of Appeals for the Federal Circuit, in a final judgment, reverses any Commission final determination and order on appeal, or unless the products subject to this bond are exported or destroyed, and certification to that effect satisfactory to the Commission is provided.

The bond is to be released in the event the President disapproves this Order and no subsequent order is issued by the Commission and approved, or not disapproved, by the President, upon service on Respondent of an Order issued by the Commission based upon application therefor made to the Commission.

By order of the Commission.

Paul R Bardos

Paul R. Bardos
Acting Secretary

Issued: June 22, 1993

UNITED STATES INTERNATIONAL TRADE COMMISSION
Washington, DC 20436

In the Matter of CERTAIN INTEGRATED CIRCUIT TELECOMMUNICATION CHIPS AND PRODUCTS CONTAINING SAME INCLUDING DIALING APPARATUS	Investigation No. 337-TA-337

ORDER TO CEASE AND DESIST

IT IS HEREBY ORDERED THAT North American Foreign Trading Corporation (NAFTC), 1115 Broadway, New York, New York, 10010, cease and desist in the United States from any unlicensed assembling, testing, marketing, distributing, offering for sale, selling, or otherwise transferring (except for exportation) of imported integrated circuit telecommunication chips covered by claims 1, 2, 3, or 4 of U.S. Letters Patent 4,446,436, and low end telephones or telephone sets containing such chips, in violation of section 337 of the Tariff Act of 1930, as amended, 19 U.S.C. § 1337.

I.

(Definitions)

As used in this Order:

(A) "Commission" shall mean the United States International Trade Commission.

(B) "Complainant" shall mean SGS-Thomson Microelectronics, Inc. (ST), 1310 Electronics Drive, Carrollton, Texas, 75006.

(C) "Respondents" shall mean the party set forth in the first paragraph of this Order.

(D) "Person" shall mean an individual, or any non-governmental partnership, firm, association, corporation, or other legal or business entity other than the above Respondent or its majority owned and/or controlled subsidiaries, their successors, or assigns.

(E) "United States" shall mean the fifty States, the District of Columbia, and Puerto Rico;

(F) "Covered product" shall mean (a) integrated circuit telecommunication chips covered by claims 1, 2, 3, or 4 of U.S. Letters Patent 4,446,436 manufactured by or on behalf of Hualon Microelectronics Corp., No. 1 R & D Road, Sec. 4, Science-Based Industrial Park, Hsin Chu City, Taiwan, and (b) any imported low end telephone or telephone set which contains an integrated circuit telecommunication chip or chips covered by claims 1, 2, 3, or 4 of U.S. Letters Patent 4,446,436 manufactured by or on behalf of Hualon Microelectronics Corp., No. 1 R&D Road, Sec. 4, Science-Based Industrial Park, Hsin Chu City, Taiwan.

(G) "Low end telephone or telephone set" shall mean any telephone or telephone set currently entered into the United States under HTSUS numbers 8517.10.00.20, 8517.10.00.40, or 8517.10.00.70. "Low end telephone or telephone set" shall not mean any telephone or telephone set containing one or more of the following features: autodial, call transfer, conferencing, call waiting, or visual display (such as LCD display).

II

(Applicability)

The provisions of this Cease and Desist Order shall apply to Respondent and to its principals, stockholders, officers, directors, employees, agents, licensees, distributors, controlled (whether by stock ownership or otherwise)

and/or majority owned business entities, successors and assigns, and to each of them, in accordance with Section VII hereof.

III

(Conduct Prohibited)

The following conduct of Respondent in the United States is prohibited by this Order: Respondent shall not assemble, test, market, distribute, offer for sale, sell, or otherwise transfer (except for exportation) covered products, for the remaining term of U.S. Letters Patent 4,446,436. U.S. Letters Patent 4,446,436 is scheduled to expire on May 1, 2001, subject to applicable law.

IV

(Conduct Permitted)

Notwithstanding any other provision of this Order, specific conduct otherwise prohibited by the terms of this Order shall be permitted if, in a written instrument, Complainant licenses or authorizes such specific conduct, or such specific conduct is related to the importation or sale of covered products by or for the United States.

V

(Reporting)

Respondent shall each submit quarterly reports during the period commencing on June 9, 1993, and extending through the remaining term of U.S. Letters Patent 4,446,436. The first report of Respondent shall be submitted within 60 days of the issuance of this Order. Thereafter, reports shall be submitted within 21 days of the close of each quarter. This reporting requirement shall continue in force until the expiration of U.S. Letters Patent 4,446,436 on May 1, 2001, unless, pursuant to subsection (j) of section

337 of the Tariff Act of 1930, the President notifies the Commission within 60 days after the date he receives this Order, that he disapproves this Order.

Respondent shall report to the Commission its importation and sales in the United States, measured in units and in U.S. dollars, of covered products, if any, during the reporting period in question.

Any failure to report shall constitute a violation of this Order.

VI.

(Recordkeeping and Inspection)

(A) For the purpose of securing compliance with this Order, Respondent shall retain any and all records relating to the sale, offer for sale, marketing, or distribution in the United States of covered products, made and received in the usual and ordinary course of business, whether in detail or in summary form, for a period of two years from the close of the fiscal year to which they pertain.

(B) For the purposes of determining or securing compliance with this Order and for no other purpose, and subject to any privilege recognized by the Federal Courts of the United States, duly authorized representatives of the Commission shall, upon reasonable written notice by the Commission or its staff, be permitted access and the right to inspect and copy in the principal offices of Respondent during office hours, and in the presence of counsel or other representatives if Respondent so chooses, all books, ledgers, accounts, correspondence, memoranda, financial reports, and other records and documents, both in detail and in summary form, for the purpose of verifying any matter or statement contained in the reports required to be retained under subparagraph VI(A) of this Order.

VII

(Service of Cease and Desist Order)

Respondent is ordered and directed to:

(A) Serve, within thirty (30) days after the effective date of this Order, a copy of this Order upon each of its officers, directors, managing agents, agents, and employees who have any responsibility for the marketing, distribution, or sale of covered products in the United States;

(B) Serve, within thirty (30) days after the succession of any persons referred to in subparagraph VII(A) of this Order, a copy of the Order upon each successor; and

(C) Maintain such records as will show the name, title, and address of each person upon whom the Order has been served, as described in subparagraphs VII(A) and VII(B) of this Order, together with the date on which service was made.

The obligations set forth in subparagraphs VII(B) and VII(C) shall remain in effect until the date of expiration of U.S. Letters Patent 4,446,436.

VIII

(Confidentiality)

Information obtained by means provided for in Sections V and VI of this Order will be made available only to the Commission and its authorized representatives, will be entitled to confidential treatment, and will not be divulged by any authorized representative of the Commission to any person other than duly authorized representatives of the Commission, except as may be required in the course of securing compliance with this Order, or as otherwise

required by law. Disclosure hereunder will not be made by the Commission without ten (10) days prior notice in writing to Respondent.

IX

(Enforcement)

Violation of this Order may result in any of the actions specified in section 211.56 of the Commission's Interim Rules of Practice and Procedure, 19 C.F.R. § 211.56, including an action for civil penalties in accordance with section 337(f) of the Tariff Act of 1930, 19 U.S.C. § 1337(f), and any other action as the Commission may deem appropriate. In determining whether Respondent is in violation of this Order, the Commission may infer facts adverse to Respondent if Respondent fails to provide adequate or timely information.

X

(Modification)

The Commission may amend this Order on its own motion or in accordance with the procedure described in section 211.57 of the Commission's Interim Rules of Practice and Procedure, 19 C.F.R. § 211.57.

XI

(Bonding)

The conduct prohibited by Section III of this Order may be continued during the period in which this Order is under review by the President pursuant to section 337(j) of the Tariff Act of 1930 (19 U.S.C. § 1337(j)), subject to the posting of a bond in the amount of $0.08 per covered product. This bond provision does not apply to conduct that is otherwise permitted by Section IV of this Order. Infringing products imported on or after June 9, 1993, are subject to the entry bond as set forth in the limited exclusion

order issued by the Commission on June 9, 1993, and are not subject to this bond provision.

The bond is to be posted in accordance with the procedures established by the Commission for the posting of bonds by complainants in connection with the issuance of temporary exclusion orders. See Commission Interim Rule 210.58, 19 C.F.R. § 210.58. The bond and any accompanying documentation is to be provided to and approved by the Commission prior to the commencement of conduct which is otherwise prohibited by Section III of this Order.

The bond is to be forfeited in the event that the President approves, or does not disapprove within the Presidential review period, the Commission's Orders of June 9, 1993, or any subsequent final order issued after the completion of Investigation 337-TA-337, unless the U.S. Court of Appeals for the Federal Circuit, in a final judgment, reverses any Commission final determination and order on appeal, or unless the products subject to this bond are exported or destroyed, and certification to that effect satisfactory to the Commission is provided.

The bond is to be released in the event the President disapproves this Order and no subsequent order is issued by the Commission and approved, or not disapproved, by the President, upon service on Respondent of an Order issued by the Commission based upon application therefor made to the Commission.

By order of the Commission.

Paul R. Bardos
Paul R. Bardos
Acting Secretary

Issued: June 22, 1993

PUBLIC VERSION

UNITED STATES INTERNATIONAL TRADE COMMISSION
Washington, D.C. 20436

In the Matter of CERTAIN INTEGRATED CIRCUIT TELECOMMUNICATION CHIPS AND PRODUCTS CONTAINING SAME, INCLUDING DIALING APPARATUS	Investigation No. 337-TA-337

COMMISSION OPINION ON THE ISSUES UNDER REVIEW AND ON REMEDY, THE PUBLIC INTEREST, AND BONDING

I. INTRODUCTION

This investigation is before us for final disposition of certain issues contained in an initial determination (ID) that we determined to review on April 27, 1993. After review of those issues, we determine that a violation of Section 337 exists and that the appropriate remedy is a limited exclusion order and cease and desist orders, that the public interest does not preclude the issuance of that remedy, and that the amount of the bond during the 60-day Presidential review period shall be $0.08 per unit.

II. PROCEDURAL HISTORY

On March 5, 1992, SGS-Thomson, Inc. (ST) filed a complaint under section 337 of the Tariff Act of 1930, 19 U.S.C. § 1337, alleging unfair acts in the importation and sale of certain integrated circuit telecommunication chips and products containing such chips. The complaint alleged infringement of three U.S. patents: U.S. Letters Patent Nos. 4,061,886 ('886 patent), 4,315,108 ('108 patent), and 4,446,436 ('436 patent), and the existence of an industry in the United States as required by subsection (a)(2) of section 337. We instituted an investigation of ST's complaint by notice published in the Federal Register on April 8, 1992. 57 Fed. Reg. 11966-67 (1992).

The '886 patent, the '108 patent, and the '436 patent generally relate to integrated circuit chips used to generate the dual tone multifrequency (DTMF) signals used in most touch tone telephones.

The notice of investigation named the following 12 companies as respondents: Winbond Electronics Corp.; Winbond North America Corp.; United Microelectronics Corp.; Hualon Microelectronics Corp. (Taiwan and U.S.); Kingtel Telecommunication Corp.; North American Foreign Trade; A&A Int'l, Inc.; Conair Corp.; Lonestar Technologies, Ltd.; Spectra Merchandising Int'l; and Columbia Telecommunication Group, Inc.. SMC Microtronic Co. Ltd. and Tranbon were added as respondents after institution. 57 Fed. Reg. 33520-21 and 38855-56 (1992).

Respondents United Microelectronics Corp. (UMC), Hualon Microelectronics Corps. (HMC), and Winbond Electronics Corp. were alleged to manufacture infringing chips abroad; respondents Kingtel, SMC Microtronic, and Tranbon were alleged to incorporate these chips into telephones; and the remaining respondents were alleged to import such telephones into the United States and sell them here.[1]

In the ID, the presiding administrative law judge (ALJ) found a violation of section 337 based on his finding that respondents have infringed

1. During the course of the investigation, respondents A&A International Inc., 57 Fed. Reg. 57077 (1992), and Winbond Electronics Corporation and Winbond Electronics North America Corporation were terminated, 58 Fed. Reg. 19467 (1993); Hualon Microelectronics Corp. of California, 58 Fed. Reg. 11244 (1993) was dismissed; and respondent Kingtel was found to be in default, 58 Fed. Reg. 4181 (1993).

dependent claims 2, 3, and 4 of the '436 patent. However, the ALJ found no violation with respect to any claim in controversy of either the '108 patent or the '886 patent, or with respect to independent claims 1 and 6 of the '436 patent.

On April 27, 1993, we issued a notice of review of certain limited portions of the ID with regard to three patent issues. 58 Fed. Reg. 26004-06 (1993). In that notice of review, we set forth the patent issues for review as follows: (1) whether the '108 patent is valid under the enablement and best mode provisions of 35 U.S.C. § 112, first paragraph; (2) whether the ALJ properly construed the claims at issue of the '886 patent; and (3) whether claims 1 and/or 6 of the '436 patent are invalid as obvious under 35 U.S.C. § 103 and, if not, whether a violation of section 337 exists as to those claims. By reviewing only certain limited portions of the ID, we adopted the majority of the ALJ's findings.[2] We received briefs from the parties on those issues, and on the issues of remedy, the public interest, and bonding.

After consideration of the arguments and evidence on the issues under review, we affirm in part and modify in part the ALJ's findings on enablement and best mode with respect to the '108 patent; we modify in part the ALJ's findings on claim construction and affirm his findings of non-infringement with respect to the '886 patent; and we affirm the ALJ's invalidity finding of claim 6 of the '436 patent and reverse the ALJ's invalidity finding of claim 1

2. The Commission adopted the ALJ's thorough and well reasoned findings with regard to: (1) non-infringement, enforceability, validity over the prior art, and domestic industry for the '108 patent; (2) validity, enforceability, and domestic industry for the '886 patent; and (3) infringement, enforceability, and domestic industry with regard to all asserted claims, and validity with regard to claims 2, 3, and 4 for the '436 patent.

of the '436 patent. We also find a violation of section 337 with respect to claim 1.[3]

III. THE VIOLATION ISSUES UNDER REVIEW

A. The '108 Patent

1. Introduction

With regard to the '108 patent, the ALJ found that the asserted claims were not invalid (i.e., valid) under 35 U.S.C. §§ 102 and 103 in view of the prior art, but were invalid under 35 U.S.C. § 112 for failure to comply with the enablement and best mode requirements. He also found that there was no infringement of those claims. The ALJ made several alternate findings on enablement and best mode, and it is those findings that we have reviewed.

Claim 1 of the '108 patent is the only asserted independent claim and reads as follows:

> 1. A telephone communication system adapted to be powered solely by telephone line inputs and including a multiple frequency signal generator on a complementary symmetry, metal oxide, semiconductor integrated circuitry chip for digitally synthesizing a dual-tone sinusoidal representative signal of a selected key on a keyboard comprising:
> a keyboard decode means on the chip responsive to the keyboard for generating a keyboard signal representative of the selected key;
> means on the chip responsive to the keyboard signal for generating a control signal in response to the selected key being enabled; and

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3. Commissioner Brunsdale notes that the issues reviewed by the Commission had no practical effect for the parties involved: not one chip more or less would have been affected had the Commission's decision on those issues been decided differently. However, she recognizes at least the possibility that the extension of the order to cover chips infringing claim 1 of the '436 patent may at least theoretically have an effect in the future. Therefore, she joins this opinion, but questions the pursuit of flawless determinations on review, and suggests that the better course might be to adopt the findings and conclusions of the ALJ that support the ultimate finding on violation, on the basis of the petitions for review, rather than compel the parties to spend enormous sums on lawyers for the sake of arguing what is literally dicta.

> common switching means on the chip responsive to the control signal for performing the common switching functions of the telephone communication system during generation of the sinusoidal representative signal including means for enabling oscillatory circuitry in said multiple frequency generator, means for disabling an audio transmitter and means for attenuating the output of a receiver.

Complainant's Exhibit-4 (CX-4) at col 26, lines 28-64.

The important claim element for purposes of our review is the "common switching means," which includes "enabling means," "means for disabling," and "means for attenuating." As recited in claim 1, the common switching means must be "on the chip." The ALJ interpreted the common switching means such that "the claimed telephone communication system comprises a common switching means or elements that must be <u>on the chip</u> and must effectuate the functions of enabling the oscillator, disabling the transmitter and attenuating the receiver." ID at 11 (emphasis in original). We agree with and adopt the ALJ's interpretation of claim 1.

After construing claim 1, the ALJ then found that the '108 patent was invalid under the enablement provision of 35 U.S.C. § 112, first para., for failure to disclose how to make such a chip.[4] ID at 56.

The ALJ also found that the '108 patent was invalid under the best mode requirement of 35 U.S.C. § 112 since the specification failed to disclose how to make a chip having the means for enabling, the means for disabling, and the means for attenuating "on the chip." ID at 56.

We agree with the ALJ's findings and analysis with regard to those grounds for invalidity of the '108 patent and adopt them as our own.

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4. The inability of the fabrication technology existing at the time of the invention to incorporate both NPN and PNP transistors on the same chip is the technical problem underlying this finding. <u>See</u> ID at 52-56.

The ALJ also concluded that the '108 patent was invalid for lack of enablement because of the combined effect of four specific deficiencies he found in the specification. ID at 62. The four deficiencies are: (1) errors in the specification; (2) failure to disclose an "arbitration" circuit; (3) lack of detail with regard to a certain embodiment; and (4) failure to disclose the relative amplitudes of the high group and low group tone signals (i.e., the preemphasis requirement). Id.; see ID at 56-62 for a more detailed explanation of the four deficiencies. The ALJ also found that the '108 patent was invalid under the best mode requirement in view of the same four deficiencies in the specification. ID at 62. We agree with the ALJ's findings and analysis on enablement and best mode with respect to the first three of the four deficiencies, but disagree with respect to the preemphasis requirement, as discussed below.

2. The Preemphasis Requirement

In a dual tone multifrequency (DTMF) scheme, each button on the telephone keypad has associated with it a unique pair of tones that are generated when that button is depressed. Each unique pair of tones consists of a high frequency tone and a low frequency tone, and is used by the telephone system to identify which button a user has depressed. The high frequency tone is attenuated (i.e., reduced in amplitude) during transmission by the telephone system. Therefore, to assure proper transmission by the telephone system, the high frequency tone must be amplified or "preemphasized" prior to transmission. See, e.g., Hearing Transcript pp. 475-82 (Callahan), pp. 1066-74 (Bodine); CX-26; CRX-75. There was evidence that the preemphasis requirement was known in the telephony art due to its disclosure in a prior art telephony patent to Meacham[5] published in 1962, about 13 years before the invention of the '108 patent.

Whether a patent specification satisfies the enablement and best mode requirements is evaluated through the eyes of one of ordinary skill in the art. See, e.g., Fromson v Advance Offset Plate, Inc., 720 F.2d 1565, 1574 (Fed. Cir. 1983). Well known principles and facts preferably should not be disclosed in a patent. Hybritech, Inc. v. Monoclonal Antibodies, Inc., 802 F.2d 1367, 1384 (Fed. Cir.), cert. denied 480 U.S. 831 (1990). A patent is not intended to be a production specification. DeGeorge v. Bernier, 768 F.2d 1318, 1323 (Fed. Cir. 1985).

Turning now to the ID, the ALJ defined the level of ordinary skill as:

> [/o]ne of ordinary skill in the art at the time of the purported inventions disclosed in the '108 patent would be an engineer with a B.S. in electrical engineering and would have several years experience in logic design of circuits of the kind described in the '108 patent.

ID Finding of Fact (FF) 21. In particular, with regard to the preemphasis requirement, the ALJ found that --

> [a] person of ordinary skill in the art in the relevant time period would not necessarily have to be skilled in the telephony art but would have experience in logic and circuit designs. Such a person would not have the knowledge that the amplitude of the high group frequency signals has to be different from the amplitude of the low group tone signals.

ID FF 22 (emphasis added). See ID FF 25. As can be seen, the ALJ's invalidity findings on nonenablement and best mode were based, in part, on his conclusion that one of ordinary skill would not have known of the preemphasis requirement.

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5. U.S. Letters Patent 3,064,084 to Meacham; CX-14. Meacham was cited by the patent examiner during the prosecution of the '108 patent.

However, in In re Naquin, 393 F.2d 863 (C.C.P.A. 1968), the U.S. Court of Customs and Patent Appeals stated that:

> [w]hen an invention, in its different aspects, involves distinct arts, that specification is adequate which enables the adepts of each art, those who have the best chance of being enabled, to carry out the aspect proper to their specialty.

Id. at 866 (emphasis added). Since the asserted claims are clearly directed to "a telephone communication system," and in view of Naquin, we disagree with the ALJ's findings of fact to the extent that those findings suggest that one of ordinary skill would not be knowledgeable about well known principles of telephony. One of ordinary skill would have been knowledgeable about telephony, and would have been aware of pertinent telephony prior art. Custom Accessories, Inc. v. Jeffrey-Allan Indus., Inc., 807 F.2d 955, 962 (Fed. Cir. 1986) ("The person of ordinary skill is a hypothetical person who is presumed to be aware of all pertinent prior art."). Therefore, such a person would have been aware of the prior art Meacham patent which disclosed the preemphasis requirement.[6] See Fig. 3 of U.S. Letters Patent 3,064,084 to Meacham; CX-14. We disagree with the ALJ's conclusion that one of ordinary skill would not have known "that the amplitude of the high group frequency signals has to be different from the amplitude of the low group tone signals," ID FF 21, i.e., would not have known about the preemphasis requirement.

Accordingly, we modify the ALJ's definition of the level of ordinary skill and find that such a person would have been knowledgeable about telephony and would have known of the preemphasis requirement. We adopt the ALJ's definition of the level of ordinary skill in all other respects.

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6. As noted supra n.5, the patent examiner apparently considered Meacham to be pertinent to the claims since he cited Meacham during prosecution.

We also modify the ALJ's independent findings of invalidity on enablement and best mode based upon the four deficiencies in the '108 specification to remove any reliance upon the last deficiency, i.e., the one pertaining to the failure to disclose the preemphasis requirement. We adopt the ALJ's findings and analysis with regard to the first three specification deficiencies and conclude that the '108 patent is invalid under the enablement and best mode provisions based upon the combination of the remaining three deficiencies in the specification of the '108 patent.

Finally, we disagree with the ALJ's findings of fact to the extent they suggest that the low frequency signal must be amplified over the high frequency signal. See ID FF 487 and 517-527. The ALJ clearly erred on this point. Staff's Physical Exhibit-7 at 30, lines 6-7 (Deposition transcript of Woodworth stating that the high-frequency tone must be larger in amplitude than the low-frequency tone). We vacate the ALJ's findings of fact to the extent necessary to clarify this point, and find that the preemphasis requirement requires that the high frequency signal be amplified over the low frequency signal.

B. The '886 Patent

1. Introduction

The ALJ found the '886 patent valid and enforceable. However, he found no violation of section 337 because ST had not proven direct infringement, ID at 31, and because it had not proven the additional elements necessary to support findings of either contributory infringement, ID at 34, or induced infringement, ID at 39-40.

The '886 patent shares a common specification with the '108 patent. Independent claims 6 and 13 are directed to a signal generator for providing an output signal representative of a keyboard selection. The signal generator generally includes a keyboard means which generates pulses representative of an actuated key and various electronic elements which cooperate to generate a sine wave having a frequency representative of the selected key.

Independent claims 6 and 13 read as follows:

> 6. A signal generator for providing an output signal representative of a keyboard selection, comprising:
> keyboard means having actuable keys on said keyboard for generating pulses representative of an actuated key of said keys;
> reference means for generating a reference frequency signal;
> means for dividing said reference frequency signal in response to said pulses to generate a digital signal having a frequency representative of said actuated key;
> programmed logic array means having a memory matrix for generating a plurality of digitally coded signals in response to said digital signal, said digitally coded signals being representative of a sinusoidal waveform having the frequency of said digital signal; and
> conversion means connected to the output of said programmed logic array means for converting said digitally coded signals to an analog sine wave having a frequency representative of said selected key.
>
> 13. A signal generator for providing an output signal representative of a keyboard selection, comprising:
> keyboard means having actuable keys on said keyboard for generating pulses representative of an actuated key of said keys;
> reference means for generating a reference frequency signal;
> means for dividing said reference frequency signal in response to said pulses to generate a digital signal having a frequency representative of said actuated key; and
> memory means having a plurality of stored codes representative of a preselected waveform and actuable by said digital signal to generate a large number of digitally coded signals closely approximately (sic) said waveform having a frequency representative of said actuated key.

CX-3 at col 27, line 56 through col. 28, line 8 and at col 28, line 51-67. As can be seen, the first three elements of both claims 6 and 13 identically recite the elements of "keyboard means," "reference means," and "means for dividing." Claims 6 and 13 differ in their recitation of their last elements.

Fig. 1 of the '886 patent discloses a block diagram of a signal generator circuit. The elements shown generally in the upper half of Fig. 1 generate a signal representative of the row of the depressed key, and the elements shown generally in the lower half generate a signal representative of the column of the depressed key. The reference oscillator 12 and the keyboard circuit 14 provide signals to the elements in both the upper and lower half of Fig. 1. See CX-3 at col. 3, line 62 through col. 4, line 38.

2. Claim Construction

We determined to review the ALJ's construction of the claims of the '886 patent, and now modify that construction as explained below. Respondents UMC and HMC and the Commission investigative attorney (IA) argued that the language of the claims requires that the output signal represents a single key, and complainant ST argued that the output signal represents the row or column of a key. See ID at 22-26. ST further argued that the asserted claims were a "subcombination" or, in other words, that the elements of the asserted claims correspond to several, but not all, of the components shown in Fig. 1 of the '886 patent. ID at 23-24. In particular, ST argued that the asserted claims generally covered either the upper or lower portion of the disclosed circuit that generates the row tone or the column tone, respectively. ST's Petition For Review Of Initial Determination at 67-75.

The ALJ looked to the specification of the '886 patent, its prosecution history, and non-asserted claims 1 and 15 of the '886 patent to interpret the asserted claims. ID at 26-27. He agreed with the interpretation argued by respondents and the IA and found that claims 6 and 13:

> are construed as directed to a single signal frequency generator which ultimately produces a single frequency output signal in response to the pressing of a key which generator is an 'aspect of the present invention' (FF 50) in the '886 patent and which is distinct from the dual tone multiple frequency (DTMF) tone generator that is 'another aspect of the present invention.

ID at 30-31. We agree with and adopt this construction.

The ALJ also undertook an analysis of ST's assertion that claims 6 and 13 are directed to a "subcombination" and analyzed several cases that discussed whether subcombination claims had utility. ID at 27-30. After this analysis, he made a contingent finding that the asserted claims "do not claim subject matter which has utility, in the absence of components of the dual tone multiple frequency generator." ID at 30. That finding was contingent upon the acceptance of ST's asserted claim construction, which the ALJ did not adopt. We do not believe that that contingent finding is necessary or appropriate, and accordingly modify the ALJ's claim construction as explained below.

35 U.S.C. § 101 sets forth the basic requirements for the subject matter that qualifies for patent protection and requires that all claims have utility, or, in other words, define useful subject matter. When a properly claimed invention meets at least one stated objective, utility under § 101 is clearly shown. Raytheon Co. v. Roper Corp., 724 F.2d 951, 958 (Fed. Cir. 1983) cert. denied, 469 U.S. 835 (1984). The fact that an invention only has limited ability and is operable in certain applications is not grounds for finding lack of utility. Envirotech Corp. v. Al George, Inc., 730 F.2d 753, 762 (Fed. Cir. 1984).

Prior to the issuance of the ID, neither complainant ST nor respondents UMC and HMC had presented arguments concerning whether the asserted claims would have utility under ST's claim construction. ST's Response To The Commission's Request For Briefing On Certain Issues Relating To The Patents-In-Suit at 12; UMC and HMC's Written Submission In Response To Notice Of Commission Decision To Review Certain Limited Portions Of An Initial Determination at 10-11.

In view of the lack of development of the utility issue, and because we view the ALJ's contingent finding and analysis unnecessary to proper claim construction, we vacate the contingent finding and the supporting analysis.[7]

As noted above, we adopt the ALJ's claim interpretation, but not his contingent finding that claims 6 and 13 would not have utility in the absence of certain components. Furthermore, after consideration of the arguments and review of the evidence, we find that ST's argument concerning the construction of claims 6 and 13 is inconsistent with the language of the claims, the specification, the prosecution history, and the non-asserted claims, and therefore decline to adopt it.[8]

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7. We note that In re Simon, 302 F.2d 737, 133 U.S.P.Q. 524 (C.C.P.A. 1962), the only case supporting the ALJ's finding of non-utility, ID at 29-30, is distinguishable from the present situation because the fields of technology differ. Simon involved the utility of a chemical compound, and the ALJ's contingent finding involves the utility of an electrical circuit which generates a signal in response to the actuation of a key. See, e.g., Chisum, Patents, § 4.01, at 4-2 ("[t]his [utility] requirement is easily met with most mechanical devices and processes but is a frequent problem with chemical compounds and processes."); Simon, 302 F.2d at 740 ("there is little, if any, resemblance between five reacting chemical compounds which form a new compound and the mechanical elements of a machine."). In view of this distinction, we would require further development and evidence before deciding this issue.

8. We vacate the second sentence of ID FF 329 since that sentence can only be interpreted to support ST's incorrect claim construction.

C. The '436 Patent

1. Introduction

The ALJ found that independent claims 1 and 6 of the '436 patent were invalid as obvious under 35 U.S.C § 103 in view of a combination of two prior art patents -- U.S. Letters Patent 3,657,657 to Jefferson (RX-331) and U.S. Letters Patent 4,281,319 to Roberts, Jr. (RX-330). The ALJ found that dependent claims 2, 3, and 4 were valid, enforceable, and infringed. He also found that a domestic industry exists with respect to those claims, and therefore, found a violation of section 337.

We determined to review the ALJ's determination that claims 1 and 6 were invalid in view of the combination of Jefferson and Roberts. Claim 1 is directed to a circuit for producing an analog signal. Claim 6 is directed to a method for generating an analog signal.

2. Claim 1 of the '436 patent

Claim 1 is reproduced below:

1. A circuit for producing an analog signal, comprising:
first and second power terminals;
a multi-tap resistor connected between said first and second power terminals;
a plurality of first switches formed into plural groups connected respectively to the taps of said resistor;
means responsive to a digital input signal for generating a plurality of first control signals each controlling a separate group of said first switches;
a plurality of second switches each connected to a plurality of said first switches wherein each second switch is connected to no more than one of said first switches within each of said groups of first switches, and each first switch is connected to no more than one of said second switches;
means responsive to said digital input signal for generating a plurality of second control signals each controlling a separate group of said second switches;
a plurality of third switches each connected to a plurality of said second switches and to an output terminal wherein each third switch is connected to no more than one of said second switches

within each of said groups of second switches and each second switch is connected to no more than one of said third switches; and

means responsive to said digital input signal for generating a plurality of third control signals for controlling said third switches wherein the operation of said third switches connects said taps one at a time to said output terminal to produce said analog signal of said output terminal.

CX-5 at col. 5, line 6 through col. 6, line 11. Thus, independent claim 1 recites a multi-tap resistor, a first, second, and third set of switches, and three means elements for generating first, second, and third control signals. The three "means" elements of claim 1 are the focus of our review.

A patent is presumed valid. 35 U.S.C. § 282. The burden of proving invalidity is on the party asserting it, and the burden must be carried by clear and convincing evidence. Hybritech, Inc. v. Monoclonal Antibodies, Inc., 802 F.2d 1367, 1375 (Fed. Cir. 1986).

In determining whether a claim is invalid over prior art, the decisionmaker must, as a preliminarily matter, construe the claim to determine its meaning. Kalman v. Kimberly-Clark Corp., 713 F.2d 760, 771 (Fed. Cir. 1983) cert. denied, 104 S.Ct. 1284 (1984). After the claim has been construed, it may then be compared to the prior art. See id.

35 U.S.C. § 112, para. 6, specifically authorizes the use of "means-plus-function" elements in a claim and provides that:

> such claim shall be construed to cover the corresponding structure, material, or acts described in the specification and equivalents thereof.

When means-plus-function claims are being considered, the patent specification must first be looked at to determine what disclosed structure exactly corresponds to the recited function. Radio Steel & Mfg. v. MTD Products, Inc., 731 F.2d 840, 848 (Fed. Cir.) cert. denied, 469 U.S. 831

(1984). With regard to the three "means" elements of claim 1, the ALJ identified the exact structure disclosed in the specification that corresponds to the recited functions. In particular, he found that:

> [w]ith reference to Fig. 1 of the '436 patent the claimed means responsive to a digital input signal for generating a plurality of first control signals comprises elements 22, 24, 34, 36, 38, 46, 48, 50, and 52. Each of the first control signals controls a separate group of the first switches. The control signals appear on lines 66, 68, 70, and 72,

ID FF 764;

> [f]igure 1 of the '436 patent illustrates a means responsive to the digital input signal for generating a plurality of second control signals as elements 26, 40, 58, and 60 with the second control signals being on lines 74 and 76. The digital input signal is present on lines 16 and 18,

ID FF 766; and

> [f]igure 1 of the '436 patent shows the means for generating a plurality of third control signals as elements 20, 62, 64, and 66. The third control signals occur on lines 78 and 80.

ID FF 771. We agree with and adopt the ALJ's identification of the structure disclosed in the '436 patent specification that exactly corresponds to each of the three "means" elements in claim 1.

35 U.S.C. § 112 requires that means-plus-function elements be construed to cover the disclosed structure, identified above, and "equivalents" of that structure. 35 U.S.C. § 112, para. 6. The Federal Circuit recently addressed the scope of an equivalent under § 112, para. 6 in Valmont Indus., Inc. v. Reinke Mfg. Co., 983 F.2d 1039, 1043 (Fed. Cir. 1993), wherein it stated that "[i]n the context of section 112, however, an equivalent results from an insubstantial change which adds nothing of significance to the structure."[9]

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9. We note that Valmont discusses § 112, para. 6 claim interpretation in an (continued...)

Therefore, to fall within the scope of the each of the "means" elements in claim 1, a structure must be identical to that disclosed in the '436 specification for the element or an equivalent which results from an insubstantial change which adds nothing of significance to the structure.

We now turn to the question of whether claim 1 is rendered obvious in view of the combination of Jefferson and Roberts. The criterion of obviousness is set forth in 35 U.S.C. § 103. The leading decision on obviousness is that of the Supreme Court in Graham v. John Deere Co., 383 U.S. 1 (1966), which sets out four factors which must be considered: (1) the scope and content of the prior art; (2) the differences between the prior art and the claimed invention; (3) the level of ordinary skill in the pertinent art; and (4) objective evidence of non-obviousness (the so-called "secondary considerations").

The relevant prior art for purposes of our review of the ALJ's decision is Jefferson and Roberts. Jefferson discloses a digital sine wave generator which includes a block diagram representation of an up-down counter 23 connected to a sine wave decoder 25. An up-down control 24 senses the output of up-down counter 23 and provides an output 34 to control the direction of counting for the up-down counter. See Fig. 5 of Jefferson and col. 3, lines 1-11. In particular, the sine wave decoder 25 shown in Fig. 5 of Jefferson includes eight AND gates (35, 40, 45, 50, 60, 65, 70, and 75) and two OR gates

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9.(...continued)
infringement context whereas we interpret § 112, para. 6 for the purposes of validity. We believe this distinction is unimportant since claims must be interpreted in the same way for purposes of infringement as for validity. E.g., W.L. Gore & Assoc., v. Garlock, Inc., 842 F.2d 1275, 1279 (Fed. Cir. 1988).

(55 and 80). That logic of Jefferson receives a four-bit (including complements) signal from the up-down counter 23 and outputs a four-bit signal which is a stepwise approximation of a sine wave. See Jefferson at col 1, line 55 through col. 2, line 43.

Roberts discloses a digital-to-analog converter which receives control signals to control voltage selection off of a resistor tree. The teachings of Roberts correspond to the non-means-plus-function elements in claim 1, and therefore we have not discussed them in detail.

In order to combine two or more prior art references, there must be some suggestion or motivation in the prior art to make that combination. Northern Telecom Inc. v. Datapoint Corp., 908 F.2d 931, 934 (Fed. Cir. 1990). The ALJ provided a well reasoned analysis with appropriate findings to support his conclusion that one of ordinary skill in the art would readily recognize the suggestion to combine Roberts with Jefferson. ID at 83-85. We agree with and adopt that analysis.

We now look at the differences between the claimed invention and the prior art, as required by Graham. Each of the three means elements of claim 1 generates a plurality of control signals. Nothing in the Jefferson and Roberts combination suggests generating three pluralities of control signals. The sine wave decoder 25 of Jefferson simply receives a four-bit binary signal with complements and outputs a binary representation of a stepwise approximation of a sine wave.

Moreover, the sine wave decoder 25 shown in Fig. 5 of Jefferson involves very different logic than that used by the each of the three means elements of claim 1. Compare Fig. 5 of Jefferson (RX-331) with Fig. 1 of the '436 Patent

(CX-5). Since the logical function of the Jefferson circuitry differs significantly from that of the relevant structure of the '436 patent, we do not believe that it is possible to meaningfully compare particular elements of Jefferson with the structure corresponding to the individual means elements of claim 1.

In view of the above described differences between claim 1 and the logic of the Jefferson and Roberts combination, we conclude that the prior art teachings of Jefferson clearly fall outside the scope of equivalents to be afforded each of the three means elements of claim 1. We believe that such differences do not amount to insubstantial changes which add nothing of significance to the structure. Valmont, 983 F.2d at 1043. Therefore, we find that the prior art fails to teach or suggest the three means elements of claim 1.

In view of this analysis, we reverse the ID and find that the differences between the invention of claim 1 and the combination of Jefferson and Roberts would not have been obvious to one of ordinary skill in the art. Therefore, claim 1 has not been proven invalid.[10] We also find a violation of section 337 with respect to that claim.[11]

3. Claim 6 of the '436 Patent

Claim 6 of the '436 patent is a method claim and reads as follows:

10. With regard to the so-called "secondary considerations" of non-obviousness, we find the evidence of record to be inconclusive.

11. The ALJ made findings that HMC's chips contain all of the elements of that claim, ID FF 728-763, that ST's chips practice that claim, ID FF 721-727, and that those chips are imported, ID FF 1026-1089. We adopt those findings.

6. A method for generating an analog signal in response to a digital input signal, comprising the steps of:
generating a plurality of discrete voltage signals;
generating a plurality of first command signals in response to said digital input signal;
selectively routing a group of said discrete voltage signals through a set of first switches in response to said first command signals which operate said first switches;
generating a plurality of second command signals in response to said digital input signal;
selectively routing a subgroup of said discrete voltage signals, where said subgroup at discrete voltage signals is derived from said group of discrete voltage signals, through a set of second switches in response to said second command signals which operate said second switches;
generating a plurality of third control signals in response to said digital input signal;
selectively routing a one of said discrete voltage signals where said one of said discrete voltage signals is derived from said subgroup of discrete voltage signals, through a set of third switches to an output terminal in response to said third control signals which operate said third switches; and
repeating the above steps to produce an analog output signal which comprises a series of said discrete voltage signals.

CX-5 at col. 8, lines 15-43.

Initially, we note that claim 6 is not a "step for function" claim within the meaning of 35 U.S.C. § 112, ¶ 6. See ID at 79. Therefore, normal rules of claim construction apply, and those rules require that "words in a claim will be given their ordinary and accustomed meaning, unless it appears that the inventor used them differently." Envirotech Corp. v. Al George, Inc., 730 F.2d 753, 759 (Fed. Cir. 1984).

ST's only argument supporting the validity of claim 6 is that since the claim recites a "method for generating an analog signal in response to a digital input signal," and since the only disclosed embodiment receives a "single"[12] digital input signal as a clock signal,[13] the claimed "digital input

12. We note that ST argued that the "single" signal in the disclosed (continued...)

signal" should be construed to cover only a single digital input signal. ST's Response To The Commission's Request For Briefing On Certain Issues Relating To The Patents-In-Suit at 21-23.

We are not persuaded that ST's proffered claim construction, that a "single" digital input signal is received by the circuit, is required by the language of claim 6. Upon review of the evidence and consideration of the arguments, we believe the ALJ correctly construed claim 6 and determined that that claim was invalid as obvious under 35 U.S.C. § 103 in view of the combination of Jefferson and Roberts, adopt his reasoning on that issue, and affirm his finding. See ID at 83-87. Therefore, we affirm the ALJ's finding of no violation of section 337 with respect to claim 6 of the '436 patent.

IV. REMEDY

The Commission has broad discretion in selecting the form, scope, and extent of the remedy in a section 337 proceeding.[14] In addition, the

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12.(...continued)
embodiment is in fact the CLOCK signal and its complement, CLOCKbar. See ID FF 774.

13. See ID FF 782.

14. Viscofan, S.A. v. United States International Trade Commission, 787 F.2d 544, 548 (Fed. Cir. 1986) (affirming Commission remedy determination in Certain Processes for the Manufacture of Skinless Sausage Casings and Resulting Products, Inv. Nos. 337-TA-148/169, USITC Pub. 1624 (December 1984)); Hyundai Electronics Industries Col, Ltd. v. U.S. International Trade Commission, 899 F.2d 1204 (Fed. Cir. 1990)(affirming Commission remedy determination in Certain Erasable Programmable Read-Only Memories, Components Thereof, Products Containing Such Memories, and Processes for Making Such Memories, Inv. No. 337-TA-276, USITC Pub. 2196 (May 1989)). The Federal Circuit has upheld a Commission remedy which effectively shifted the burden of proof on infringement issues to require a company seeking to import goods to prove that its product does not infringe, despite the fact that, in general, the burden of proof is on the patentee to prove, by a preponderance of the evidence, that a given article does infringe the patent in question. Sealed
(continued...)

Commission has the power to make factual determinations in the remedy phase of a section 337 investigation, to the extent necessary, in order to reach its determination. These factual determination may be made on the basis of the evidence of record in the violation phase of the investigation, or on the basis of information submitted by the parties in the remedy phase of the investigation.[15]

Complainant ST requested that the Commission enter a limited exclusion order excluding infringing integrated circuit telecommunication chips (hereinafter referred to as "tone dialer chips") manufactured by respondents UMC and HMC, and excluding certain "low end telephones" containing infringing tone dialer chips. ST also requested that the Commission enter cease and desist orders against the five domestic respondents, who are importers of telephones, including telephones containing infringing tone dialer chips.[16] The IA also proposed that the Commission enter a limited exclusion order

14.(...continued)
Air Corporation v. United States International Trade Commission, 645 F.2d 976 (C.C.P.A. 1981).

15. Respondents HMC and UMC filed a motion asking the Commission for oral argument and a hearing on the issues of remedy, public interest, and bonding. The motion was supported by respondent North American Foreign Trading Corporation (NAFTC), and opposed by both complainant ST and the IA.

We deny the motion. Nothing in respondents' motion distinguishes this case from any other section 337 case in which the Commission must make decisions concerning the appropriate scope of any remedy, bonding, and public interest issues. The parties have thoroughly briefed these issues, and while the evidence they present is conflicting on some issues, there is no indication that the Commission would be in a better position to decide the issues following a hearing. Accordingly, we see no reason to extend further the deadline for completion of the investigation, as would be necessary, in order to schedule a hearing which would not, in our view, be of any particular benefit to the Commission's decision-making process.

16. Brief of Complainant SGS-Thomson Microelectronics, Inc.'s [sic] on Remedy, Public Interest, and Bonding (hereinafter ST Brief) at Exhibit 1.

excluding from importation infringing tone dialer chips manufactured by HMC, and excluding low end telephones containing such chips,[17] and cease and desist orders against the domestic importer respondents.[18] Respondents HMC and UMC opposed issuance of any remedy.[19] Several domestic importer respondents also filed submissions on the issue of remedy, arguing that issuance of cease and

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17. Brief of the Office of Unfair Import Investigations on Remedy, the Public Interest, and Bonding (hereinafter IA Brief) at 3.

18. Reply Brief of the Office of Unfair Import Investigations to the Briefs of Complainant and Respondents on Remedy, the Public Interest, and Bonding (hereinafter IA Reply Brief) at 7-9.

The IA originally did not propose cease and desist orders, but noted that he would comment on any such request in his response submission, and did so. IA Brief at 5. Spectra Merchandising, Inc., Lonestar Technologies, Ltd., and Conair Corp., domestic importer respondents, filed a motion to strike those portions of the IA's reply brief proposing the issuance of cease and desist orders, asserting that the IA's proposal is out of time, and improperly places the IA in the internal decision-making apparatus in this investigation. The IA opposed the motion, noting that the remedy phase of section 337 investigations is not subject to the Administrative Procedure Act, and that he was not foreclosed from responding to new information concerning respondents' inventories contained in their initial briefs on remedy. The IA also noted that he appears on behalf of the public interest, asserting that it would not be in the public interest to require him to adhere to the position set forth in his original remedy brief, when new information becomes available which supports a different position.

We deny the motion to strike. The IA has, as is appropriate, responded to complainant ST's request that the Commission issue cease and desist orders. Merely because the IA has concluded that he supports the issuance of such orders, and has provided the Commission with a draft cease and desist order, does not improperly inject him into the Commission's decision-making process.

19. Written Submission of Respondents Hualon Microelectronics Corporation (HMC) and United Microelectronics Corporation (UMC on the Issues of Remedy, Public Interest, and Bonding (hereinafter Respondents' Brief) at 1.

desist orders against them would be inappropriate.[20] One foreign manufacturer of telephones imported into the United States filed a submission arguing that any remedy should be structured so as not to exclude telephones which do not contain infringing tone dialer chips.[21]

We determine that the issuance of a limited exclusion order, prohibiting the importation of infringing tone dialer chips manufactured by HMC, is appropriate in this case. Exclusion of the specific articles found to infringe the patents at issue in the investigation is obviously appropriate. However, we limit the order to infringing tone dialer chips manufactured by HMC, and do not issue any remedy with respect to infringing chips manufactured by UMC. It appears from the record that there is no evidence of importation of the single UMC tone dialer chip, the UM 91265, found to be infringing. Indeed, although ST continued to argue in its reply that a remedy should issue against UMC, it cited no evidence of importation of the infringing UMC chip. ST merely asserted that a finding of importation is implicit in the ALJ's determination of jurisdiction and violation.

Importation (or at least a sale for importation) of the infringing articles is an essential element of a violation of section 337. In the absence of evidence of importation or sale for importation of the infringing

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20. Submission on Remedy, the Public Interest and Bonding filed by Domestic Respondents Spectra Merchandising, Inc., Lonestar Technologies, Ltd., and Conair Corp. (hereinafter Spectra respondents's Brief) at 1-2; Submission of Columbia Telecommunications Group, Inc. on the Issues of Remedy, Bonding and Public Interest (hereinafter CTG Brief) at 2; Respondent North American Foreign Trading Corporation's Comments in Response to Notice of Commission to Review (hereinafter NAFTC Brief) at 2.

21. Submission of SMC Microtronic Co., Ltd. Regarding Remedy and Bonding (hereinafter SMC Brief) at 1.

UMC chip, we conclude that complainant has failed to prove a violation of section 337 against UMC. We decline to assume importation, or conclude that a finding of importation is implicit in the ALJ's determination of violation.

It is clear that the ALJ found that the UM 91265 tone dialer chip infringes valid and enforceable claims of the '436 patent. See ID FF 758-763. Therefore, we would consider modifying the limited exclusion order to exclude infringing UMC tone dialer chips upon a request filed by ST supported by evidence of importation of the infringing UMC chip. At this juncture, however, we do not believe there is any basis for ordering a remedy against UMC.[22]

Complainant has not requested a general exclusion order, and no information or evidence has been provided to us which would suggest that a general exclusion order is appropriate. The IA addressed the possibility of a general exclusion order, and concluded that the conditions the Commission has required in order to warrant issuance of a general exclusion order do not

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22. The IA suggested that the Commission require UMC to submit a semi-annual sworn statement to the Commission stating whether it has produced or sold the UM 91265 chip or a chip containing the same circuitry, so that the Commission could for itself determine in the future whether an infringing UMC chip is being imported into the United States, either alone or in a telephone.

We decline to impose such a requirement. Although the Commission has personal jurisdiction over UMC, and thus may issue such an order, we determine that it is more appropriate to place the burden on complainant ST to demonstrate importation of infringing articles, since ST has not proven a violation of section 337 against UMC. This is in contrast to the certification provisions in exclusion orders, where the shifting of the burden from complainant to importers and/or respondents is justified in part because a violation of section 337, and a consequent entitlement to relief, has been demonstrated. See Hyundai, 899 F.2d at 1210; Sealed Air Corporation, 645 F.2d at 988-89.

exist here.[23] The more difficult questions in this investigation concern the appropriate scope of any limited exclusion order with respect to downstream products, specifically certain telephones and telephone sets containing infringing tone dialer chips.

Respondents HMC and UMC suggest that the exclusion of downstream products manufactured by persons other than named respondents is effectively a general exclusion order with respect to those products.[24] We disagree. A general exclusion order prohibits importation of infringing articles regardless of source or manufacturer. The limited exclusion order we issue in this case prohibits only importation of infringing tone dialer chips manufactured by HMC, and extends that exclusion to certain downstream products containing such chips. That the source or manufacturer of those downstream products is not specified or limited is a factor we considered in determining whether the exclusion of those products is warranted, but does not turn the order into a general exclusion order.

Respondents HMC and UMC also argue that there is no evidence of business conditions that would support the conclusion that foreign entrepreneurs could or would commence manufacturing infringing tone dialer chips, so as to warrant extending the remedy to non-respondent third parties.[25] They cite the

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23. See Certain Airless Paint Spray Pumps and Components Thereof, Inv. No. 337-TA-90, USITC Pub. 1199 at 17-20, for a discussion of the factors the Commission has examined in order to determine whether a general exclusion order is warranted.

24. Respondents' Reply Brief at 2-4.

25. Id. at 4.

Commission's determination in Certain Crystalline Cefadroxil Monohydrate,[26] in support of their position that the Commission should not issue any relief that may affect non-respondents.

The circumstances of this case are significantly different from those in Cefadroxil, and the Commission's determination there does not preclude exclusion of downstream products in this case. In Cefadroxil, complainant requested a general exclusion order. The Commission determined that a general exclusion order was not warranted under the criteria established in Spray Pumps. The Commission then considered whether, in the interest of granting "complete relief" to complainant, it should issue an order excluding all infringing cefadroxil, notwithstanding complainant's failure to satisfy the Spray Pumps criteria. Such an order would have affected imports from a single manufacturer, imported by a single importer. The Commission concluded that complainant could have named those companies in its complaint, and that extension of a remedy against those companies would subvert the policy of encouraging complainants to include all foreign manufacturers believed to be in, or about to enter, the domestic market, with infringing goods.

In this case the non-respondents who would be affected by the exclusion of telephones containing infringing tone dialer chips do not themselves manufacture or import the infringing chips. Instead, they manufacture and sell telephones containing such chips, which are ultimately imported into the United States by other companies. Complainant named three such manufacturers of telephones in its complaint in order to establish the chain of commerce and importation of the infringing tone dialer chips, not specifically to establish

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26. Inv. No. 337-TA-293, USITC Pub. 2391 (June 1991).

that the telephone manufacturers themselves were in violation of section 337. There appear to be numerous telephone manufacturers, most of whom are not respondents in this investigation, who have the capacity to manufacture and sell telephones containing infringing tone dialer chips.[27] In the circumstances of this case, given that virtually all tone dialer chips are imported into the United States already installed in telephones, it would be inequitable to deprive ST of relief merely because it did not name all possible telephone manufacturers as respondents.

The Commission's authority to fashion an effective remedy that does not overly intrude on legitimate trade allows it to limit the exclusion of downstream products which contain the excluded infringing products. This was the approach taken by the Commission in EPROMs, and approved by the Federal Circuit on review.[28] Therefore, we may reasonably circumscribe the scope of a limited exclusion order with respect to downstream products.

In its remedy determination in Certain Erasable Programmable Read-Only Memories, Components Thereof, Products Containing Such Memories, and Processes for Making Such Memories,[29] the Commission established a test for determining

27. HMC's customer list names at least 30 customers for its tone dialer chips. It is unclear, however, how many of those customers purchase infringing tone dialer chips, and how many of them manufacture and sell telephones that are imported into the United States.

28. Hyundai, 899 F.2d at 1209 ("Commission fashioned the remedy with sensitivity and objectivity" in declining to exclude Hyundai automobiles containing infringing EPROMs because exclusion of those downstream products would not significantly increase the relief afforded the complainant.)

29. Inv. No. 337-TA-276, USITC Pub. 2196 (May 1989) (hereinafter EPROMs); aff'd Hyundai Electronics Industries Co., Ltd. v. U.S. International Trade Commission, 899 F.2d 1204, 1209 (Fed. Cir. 1990) (specifically approving balancing of various factors in Commission remedy determination involving exclusion of downstream products and certification requirement).

whether the exclusion of downstream products was warranted. The test is intended to balance the complainant's interest in obtaining complete protection from all infringing imports by means of exclusion of downstream products against the inherent potential of even a limited exclusion order, when extended to downstream products, to disrupt legitimate trade in products which were not themselves the subject of a finding of violation of section 337. That test was approved by the Federal Circuit on review of the Commission's determination.[30]

> In performing this balancing, the Commission may consider such matters as the value of the infringing articles compared to the value of the downstream products in which they are incorporated, the identity of the manufacturer of the downstream products (i.e., are the downstream products manufactured by the party found to have committed the unfair act, or by third parties), the incremental value to complainant of the exclusion of downstream products, the incremental detriment to respondents of such exclusion, the burdens imposed on third parties resulting from exclusion of downstream products, the availability of alternative downstream products which do not contain the infringing articles, the likelihood that the downstream products actually contain the infringing articles and are thereby subject to exclusion, the opportunity for evasion of an exclusion order which does not include downstream products, the enforceability of an order by Customs, etc.[31]

The Commission noted that this list is not exclusive, and that it could identify and take into account any other factors which it believes may bear on the question.

On the facts of this investigation, there is justification for exclusion of some downstream products. Exclusion of low end telephones containing infringing tone dialer chips is warranted in order to ensure that the

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30. Hyundai, 899 F.2d at 1209.

31. EPROMs at 125.

exclusion order is reasonably effective.[32] There is no domestic production of low end telephones incorporating such chips. In addition, there are virtually no imports of tone dialer chips into the United States. An order excluding solely infringing tone dialer chips would effectively grant complainant no relief at all. Thus, the incremental value to complainant of exclusion of low end telephones is, in this case, very substantial.

The evidence of record indicates that each low end telephone contains a single tone dialer chip. That chip is vital to the operation of the telephone, which could not be manufactured and sold inexpensively using alternatives to a tone dialer chip. The parties presented differing estimates as to the value of the tone dialer chips in low end telephones.[33] Respondents do not, however, dispute the fact that the tone dialer chip is vital to the operation of such telephones.

We agree with complainant ST that tone dialer chips are vital to the operation of the telephones, and particularly vital to the ability of manufacturers to produce low end telephones. Moreover, ST has not sought exclusion of all downstream products which contain infringing tone dialer

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32. Unlike the situation in EPROMs, there is no question in this case that downstream products containing infringing tone dialer chips have been imported into the United States.

33. ST asserts that the price of tone dialer chips is [ ] of the total material cost of a low end telephone. ST Brief at 7. Respondents HMC and UMC assert that the tone dialer chips are of minimal value compared to the overall value of the low end telephones, allegedly no more than [ ] of the overall cost of the telephone. Respondents' Reply Brief at 9. Respondent SMC asserts that the chip represents approximately [ ] of the cost of a telephone. SMC Brief at 2. Respondent CTG asserts that its telephones have retail values from $19.95 to $150, indicating that the value of the telephones may far exceed the value of the tone dialer chip. CTG Brief at 2-3.

chips, only those, low end telephones, which it asserts account for the bulk of imports of infringing tone dialer chips.

In addition, the burden which would be imposed on non-respondent manufacturers and importers of low end telephones by the exclusion of low end telephones is essentially that of complying with the certification requirements of the limited exclusion order. In Hyundai, the Federal Circuit noted that Hyundai's challenge to the Commission's remedial order was specifically directed at the certification requirement in the limited exclusion order. The Court concluded that the inclusion of a certification requirement was "both reasonable and well within [the Commission's] authority"[34] and further noted that it could not conclude that the Commission had "abused its discretion by concluding that Hyundai rather than [complainant] Intel should bear whatever additional burden the certification provision entails."[35]

There are numerous sources of non-infringing tone dialer chips, including complainant ST and its licensees. According to complainant ST, approximately 25 percent of the low end telephones imported into the United States in 1992 contained tone dialer chips manufactured by HMC or UMC. Since

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34. Hyundai, 899 F.2d at 1210.

35. Id. One element underlying the Court's approval of the Commission's decision in that case was that Hyundai had itself been determined to have violated section 337. That element is lacking with respect to the manufacturers of low end telephones who would be affected by the certification provision of the proposed limited exclusion order in this case. Nonetheless, given the Commission's broad discretion to fashion an effective remedy, the relatively low burden imposed by a certification requirement, and the availability of non-infringing tone dialer chips from numerous sources, we believe that exclusion of low end telephones containing infringing tone dialer chips manufactured by HMC is appropriate in this case.

the exclusion order does not apply to tone dialer chips manufactured by UMC, and not all HMC chips were found to be infringing, it is apparent that there are numerous sources of low end telephones containing non-infringing tone dialer chips.

We are mindful that exclusion of downstream products of non-respondent manufacturers has been the basis of Presidential disapproval of an exclusion order.[36] Nonetheless, on the basis of the record in this investigation, we believe that including certain products manufactured by non-respondents containing infringing tone dialer chips manufactured by HMC within the scope of the order is necessary to provide justified and effective relief.[37]

We agree with the IA that the definition of "low end telephone" proposed by complainant ST is likely to cause problems in enforcement. Not only is that definition subject to dispute and interpretation, but an exclusion order incorporating that definition would require Customs to examine all entries of telephones in order to determine whether they are low end, and therefore must either be certified as containing non-infringing tone dialer chips or excluded. Therefore, we believe it is appropriate to limit the exclusion to telephones in the HTSUS categories identified as those most commonly used in entering low end telephones.[38]

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36. Certain Dynamic Random Access Memories, Components Thereof, and Products Containing Same, Inv. No. 337-TA-242, USITC Pub. 2034 (November 1987).

37. The broader considerations the President may bring to bear on a decision whether to disapprove a Commission remedial order are not determinative of our statutory mandate, namely, to order relief that is appropriate and necessary based on the facts of a particular investigation.

38. There were several submissions filed with the Commission concerning the question of whether exclusion of telephones in specific HTSUS categories was (continued...)

Complainant ST stated that it is not opposed to the concept of relying on HTSUS numbers in the exclusion order,[39] but expressed concern that the HTSUS categories originally proposed by the IA would encompass few, if any, of the low end telephones proposed by ST for exclusion.[40] Based on our evaluation of the proposed HTSUS categories, we agree with ST. However, as ST recognized, HTSUS number 8517.10.00.70 is broader than the definition of "low end telephone" ST proposed for exclusion. We agree with the IA that ST's proposed definition of "low end telephones" would require the Customs Service to inspect all telephones and telephone sets unaccompanied by a certification stating that they do not contain infringing tone dialer chips manufactured by HMC. The burden of administering such an order would be significant. Therefore, we have included in the limited exclusion order a certification provision exempting from the scope of the order telephones and telephone sets entered under the specified HTSUS categories if the importer certifies that the articles sought to be entered contain one or more of the following features: autodial, call transfer, conferencing, call waiting, or a visual display (such as an LCD display). This certification is in addition to the provision allowing importation of telephones and telephone sets certified not to contain an infringing tone dialer chip, and will, we believe, make it

38.(...continued)
appropriate, and if so, which HTSUS categories were relevant. While these submissions were filed after the deadline established in our notice ordering review, we have accepted them into the record in this case.

39. ST's Comments at 3.

40. Id.

easier for Customs to administer the order.[41] Ease of administration by Customs is only one factor to be considered in determining whether downstream products, in this case low end telephones, should be excluded. However, where there are two possible alternatives to effectuate exclusion, we believe it is appropriate to chose the one likely to be least burdensome on Customs.

The order also specifies that low end telephones of the type defined in the order would be excluded even if the applicable HTSUS numbers change. Because the HTSUS statistical breakouts we have used to identify telephones and telephone sets subject to exclusion are subject to change by administrative action, we believe it is necessary to make it clear that a change in the HTSUS number applicable to entries of telephones and telephone sets does not affect the articles subject to exclusion. Moreover, Customs may be able to request a separate statistical breakout for telephones which coincides with the definition in the order, and thus ease further the burden of administering the order.

We also find it appropriate to include in the limited exclusion order a certification provision, allowing importation of low end telephones in the specified HTSUS categories if accompanied by a certification from either the manufacturer of the telephone or the importer that tone dialer chips contained in the telephones sought to be imported are not covered by the exclusion order. We recognize that in previous cases, certification has generally been required of the importer. In this case, since the importers do not manufacture the telephones, it would be difficult for them to make such

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41. The IA consulted with Customs, and Customs indicated that a certification provision would be far less burdensome than inspection of import entries. IA's letter at 3.

certification. Therefore, we believe it is appropriate to provide that the importers may obtain the necessary certification from the manufacturer of the telephones in question. The manufacturers are in the best position to have knowledge of the tone dialer chips in the telephones they manufacture, and can ensure that the tone dialer chips they purchase are not infringing. We do not believe it would be appropriate or useful to require HMC to certify that the chips it sells are non-infringing. Infringing chips may be used in telephones not destined for the United States, and it would be difficult if not impossible for HMC to ascertain the eventual destination of the chips it manufactures. Similarly, telephone manufacturers would not necessarily know the destination of the telephones they manufacture. Therefore, we believe the certification could be obtained by the importer from the manufacturer.

Section 337(g)(1), added to section 337 by the Omnibus Trade and Competitiveness Act of 1988, mandates that the Commission issue limited exclusion orders and/or cease and desist orders against defaulting respondents in certain circumstances. It provides that if a respondent is found in default, and a remedy is requested against that respondent --

> the Commission shall presume the facts alleged in the complaint to be true and shall, upon request, issue an exclusion from entry or a cease and desist order, or both, limited to that person unless, after considering the effect of such exclusion or order upon the public health and welfare, competitive conditions in the United States economy, the production of like or directly competitive articles in the United States, and United States consumers, the Commission finds that such exclusion or order should not be issued.[42]

42. 19 U.S.C. § 1337(g)(1). The Commission's interim section 337 rules track the statutory language. <u>See</u> 19 C.F.R. § 210.25(c).

The legislative history of section 337(g)(1) confirms that its effect is to require issuance of limited relief against defaulting respondents when certain conditions are met:

> [W]hen a respondent fails to appear, the ITC shall presume the facts alleged in the complaint to be true and shall, upon request, issue appropriate relief solely against that person.[43]

Complainant ST has not requested relief specifically directed against defaulting respondent Kingtel. If Kingtel seeks to import low end telephones containing tone dialer chips, it would be subject to the downstream products exclusion and certification provisions of the proposed order. However, we agree with the IA that no specific remedy should be issued against Kingtel. Kingtel is a Taiwanese manufacturer of telephones containing a UMC tone dialer chip which was alleged to infringe the '108 patent. The Commission has not found a violation of section 337 with respect to the '108 patent. In addition, as discussed above, there is no evidence that any infringing UMC tone dialer chips have been imported into the United States. We believe that the public interest precludes issuing a remedy specific to Kingtel in the circumstances of this case.

Finally, we do not believe it is appropriate to deny relief based on HMC's assertion that its redesigned tone dialer chips do not infringe the claims of the '436 patent at issue. We agree with ST that the remedy phase is not the appropriate time to raise such an argument. The proposed exclusion order can be modified upon request. HMC is free to seek a modification of the order, or an advisory opinion, as to whether its redesigned chips are non-infringing. At that time, the Commission could institute the appropriate

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43. H.R. Rep. No. 576, 100th Cong., 2d Sess. 636 (1988)(emphasis added).

investigation, allowing for discovery and presentation of evidence, as necessary, in order to provide it with an adequate record on which to base a decision.

We also determine that it is appropriate to enter cease and desist orders against each of the five domestic importer respondents. Section 337 gives the Commission the authority to enter both an exclusion order and cease and desist orders to remedy the same unfair act in violation of section 337.[44] Issuance of cease and desist orders would afford complainant ST more effective relief, because as the record indicates, and several of the domestic importer respondents have acknowledged, there are significant inventories of imported low end telephones which may contain infringing tone dialer chips.[45]

Domestic importer respondents assert that there is no evidence of stockpiling of inventories, and therefore that no cease and desist orders are warranted. However, as the Commission found in Cefadroxil, cease and desist orders are justified if evidence exists of significant inventories, and not only if there is evidence that inventories exceed some historical level, indicating stockpiling.[46] In this case, the domestic importer respondents have themselves acknowledged that they currently have 120 days worth of inventories, and in some cases more. We conclude that these inventory levels are significant. Complainant would not be afforded complete relief if

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44. 19 U.S.C. § 1337(f)(1).

45. See Submission of Remedy, the Public Interest, and Bonding filed by Domestic Respondents Spectra Merchandising, Inc., Lonestar Technologies, Ltd., and Conair Corp. at 3-4.

46. USITC Pub. 2391 at 38.

domestic importer respondents were allowed to dispose of those inventories in the United States in the normal course of business.

Respondents argue that there is no simple, inexpensive method of determining whether telephones in inventory contain infringing tone dialer chips, and therefore a cease and desist order would be costly to them, and would punish them for actions which were legal when made. At least some of this difficulty may be alleviated by the provision in the cease and desist orders allowing sales under bond of previously imported telephones during the period of Presidential review. Moreover, we determined that a violation of section 337 existed on April 27, 1993, when we determined not to review the bulk of the ALJ's final ID. Thus, domestic importer respondents have had since at least that date to dispose of current inventories, and to ensure that new imports do not contain infringing tone dialer chips. We do not believe that the possible expense[47] and competitive disadvantage to these respondents of a cease and desist order justifies denying complainant ST the relief to which it is entitled.

V. THE PUBLIC INTEREST

ST asserts that its proposed remedy will not adversely affect the public interest.[48] The IA agrees that the statutory public interest factors do not preclude the issuance of a remedy in this investigation.[49] Respondents HMC and UMC argue that an exclusion order will not promote the public interest,

47. Respondents submitted no evidence concerning the asserted expense of compliance with cease and desist orders in this case.

48. ST Brief at 16-17.

49. IA Brief at 8-9.

and that denial of relief in a "marginal" case such as this one is especially appropriate in view of the GATT Panel decision finding that section 337 is inconsistent with the United States' obligations under the GATT.[50] The Spectra respondents argue that it would not be in the public interest to penalize them, as "innocent third party purchasers of telephones," for HMC and UMC's unfair act of infringement.[51]

Section 337(d) provides that the Commission shall issue an order excluding the goods in question unless, after considering the effect of such remedy upon (1) the public health and welfare, (2) competitive conditions in the U.S. economy, (3) the U.S. production of articles that are like or directly competitive with those which are the subject of the investigation, and (4) U.S. consumers, it finds that a remedy should not be issued.[52] This provision was added by the Trade Act of 1974. The legislative history makes clear that these statutory public interest factors are to be the overriding consideration in the administration of the statute.[53]

The Commission has invoked the public interest as a basis for denying relief to a prevailing complainant on only three occasions. In Certain Automatic Crankpin Grinders, Inv. No. 337-TA-60, USITC Pub. 1022 (Dec. 1979), the Commission denied relief because of an overriding national policy in maintaining and increasing the supply of fuel efficient automobiles, coupled

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50. Respondents' Brief at 11.

51. Spectra respondents' Brief at 5-6.

52. Section 337(f)(1) contains an identical provision regarding the Commission's issuance of cease and desist orders after considering the effects of such orders on the same public interest factors.

53. S. Rep. No. 1298, 93d Cong., 2d Sess. 193 (1974).

with the domestic industry's inability to supply domestic demand. In Certain Inclined Field Acceleration Tubes, Inv. No. 337-TA-67, USITC Pub. 1119 (1980), the Commission denied relief because there was an overriding public interest in continuing basic atomic research using the imported acceleration tubes, which were of a higher quality than the domestic product. In Certain Fluidized Supporting Apparatus, Inv. No. 337-TA-182/188, USITC Pub. No. 1667 (1984), the Commission denied relief because the domestic producer could not supply demand for hospital beds for burn patients within a commercially reasonable time, and no therapeutically comparable substitute for care of burn patients was available.

We do not believe that the public interest considerations in this investigation preclude the issuance of the recommended limited exclusion and cease and desist orders. Neither tone dialer chips nor low end telephones containing such chips are products which have general implications for the public health and welfare of the type implicated in the previous cases in which the Commission denied relief based upon the public interest. It is clear that ST and its licensees have adequate capacity to supply tone dialer chips sufficient to supply low end telephones to the U.S. market. Moreover, there are alternative products, i.e., other telephones, available which do not incorporate the tone dialer chips found to be infringing in this case, and are not subject to the orders. We do not believe that the concerns expressed by the Spectra respondents raise public interest issues sufficient to warrant denying complainant ST of relief. The public interest in protecting intellectual property rights of complainants under section 337 in our view outweighs domestic importers' interest in avoiding the expense or harm to their competitive position which may occur if they are prevented by cease and desist orders from disposing of inventories of telephones containing infringing tone dialer chips. Similarly, the question of the United States' compliance with its GATT obligations in light of the Panel decision is a policy matter for President and Congress to decide in the first instance in amending section 337. We do not believe it is a matter of public interest which the Commission should consider in determining whether to issue a remedy in a section 337 investigation.

VI. BONDING

Complainant ST proposes that the Commission impose a bond of 60 percent of the entered value of each chip during the Presidential review period.[54] The IA agrees that the bond should be imposed on a per chip basis, but proposes that it be based on a "reasonable royalty" rate, citing the Commission's determination in Inv. No. 337-TA-315, Certain Plastic Encapsulated Integrated Circuits.[55] The IA proposes a bond of $0.08 per infringing chip or telephone containing such a chip. Respondents HMC and UMC argue that any bond should be set at a reasonable royalty rate for the one patent found to have been infringed.[56] They suggest that the bond should therefore be set at something less than $0.08 per chip or telephone. The Spectra respondents propose that the Commission establish a bond reflecting the difference in cost between the infringing tone dialer chips and alternative tone dialer chips, calculated as a percentage of the cost of the

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54. ST Brief at 17-18.

55. IA Brief at 7-8.

56. Respondents' Brief at 12-13.

accused tone dialer chips,[57] and assert that a bond of $0.03 to $0.04 per chip would be appropriate.

Section 337(g)(3) provides for the entry of infringing articles upon the payment of a bond during the 60-day Presidential review period. In reviewing the original cease and desist orders issued in the EPROMs investigation, the Federal Circuit held that the statute requires the inclusion of provisions in cease and desist orders allowing respondents to sell imported products under bond during the Presidential review period.[58] The bond is to be set at a level sufficient to "offset any competitive advantage resulting from the unfair method of competition or unfair act enjoyed by persons benefitting from the importation." The bond should not be set so high as to effectively prevent importation during the Presidential review period. However, the period of the Presidential review is relatively short, and therefore the consequences of any bond will be short-lived.

Unfortunately, competitive advantage in this investigation cannot be calculated precisely. The lack of precise, recent price information concerning the tone dialer chips actually determined to be infringing, in our view precludes using direct price comparisons as a basis of the bond amount. The price information submitted by ST is based on the average selling price of all HMC and UMC tone dialer chips, and is not limited to infringing tone dialer chips.

57. Spectra respondents' Brief at 4-5.

58. In re Atmel Corp., No. 89-1382 (Fed. Cir. April 27, 1989) (on petition for writ of mandamus).

We determine that a bond of $0.08 per infringing chip and $0.08 per low end telephone containing such a chip is appropriate. We agree with the IA that this represents a reasonable royalty rate, and therefore an appropriate bond during the Presidential review period.

PUBLIC VERSION

UNITED STATES INTERNATIONAL TRADE COMMISSION
Washington, D.C. 20436

In the Matter of CERTAIN INTEGRATED CIRCUIT TELECOMMUNICATION CHIPS AND PRODUCTS CONTAINING SAME, INCLUDING DIALING APPARATUS	)))))))	Investigation No. 337-TA-337

Initial Determination

Paul J. Luckern, Administrative Law Judge

Pursuant to the Notice of Investigation (57 Fed. Reg. 11966-67 (April 8, 1992)), this is the administrative law judge's initial determination, under Commission interim rule 210.53 (19 C.F.R. § 210.53). The administrative law judge hereby determines, after a review of the record developed, that there is a violation of subsection (a)(1)(B)(i) of the Tariff Act of 1930, as amended (19 U.S.C. § 1337), in the importation into the United States, the sale for importation, or the sale within the United States after importation, of certain integrated circuit telecommunications chips and products containing same, including dialing apparatus.

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TABLE OF CONTENTS

	PAGE
PROCEDURAL HISTORY	1
JURISDICTION	3
OPINION ON VIOLATION	4
I. PARTIES	4
II. IMPORTATION AND SALE	4
III. THE '108 PATENT	4
A. Alleged Infringement of Asserted Claims 1, 4, 10, 11, 14, 15 and 16 by HMC and UMC	4
1. Claim Construction	5
2. The Accused Products	11
B. Validity of Asserted Claims Under 35 U.S.C. §103	12
IV. THE '886 PATENT	21
A. Alleged Infringement of Asserted Claims 6, 7, 8, 9, 13 and 14 by UMC	21
1. Claim Construction	22
2. The UM 95087 Tone Dialer Chip of UMC and Direct Infringement	31
3. Contributory Infringement	31
4. Induced Infringement	36
B. Validity of Asserted Claims	41
1. 35 U.S.C. §102	41
2. 35 U.S.C. §103	43
V. VALIDITY OF THE '108 AND '886 PATENTS UNDER 35 U.S.C. §112	45
A. The "on the chip" Limitation of the Asserted Claims of the '108 Patent	51

B. Alleged Deficiencies in the '108 and '886 Patent Specifications. 56

VI. ENFORCEABILITY OF THE '108 AND '886 PATENTS 63

VII. THE '436 PATENT 66

A. Validity of Asserted Claims 1, 2, 3, 4 and 6 Under 35 U.S.C. §§102 and 103 66

1. Claim Construction. 68

2. 35 U.S.C. §102. 80

3. 35 U.S.C §103 83

(a) Jefferson/Roberts Combination and Independent Claims 1 and 6. 83

(b) Dependent Claims 2, 3 and 4. 87

B. Validity of the Asserted Claims Under 35 USC §112 and Enforceability of the '436 Patent 88

C. Alleged Infringement of the Asserted Claims by HMC and UMC. 90

D. Alleged Infringement of the Asserted Claims by the Other Respondents 91

VIII. DOMESTIC INDUSTRY 91

A. Economic Prong with Respect to the '436 Patent. 93

B. Practice of the Asserted Claims of the '436 Patent by Complainant 99

C. Practice of the Asserted Claims of the '108 and '886 Patents by Complainant and TI 99

FINDINGS OF FACT. 101

I. PARTIES 101

A. Complainant 101

B. Respondents 101

II. EXPERTS 105

III. PERSON HAVING ORDINARY SKILL IN THE ART TO WHICH THE SUBJECT MATTER PERTAINS 106

IV. THE '108 AND THE '886 PATENT. 107

A. Interrelationship of the '108 Patent and the '886 Patent. . 107

B. Claims of the '886 Patent 108

C. Claims of the '108 Patent 111

D. The Abstract of the '108 and '886 Patents 118

E. The Specification of the '108 and '886 Patents. 119

F. Prosecution of Serial No. 617,955 126

G. Prosecution of Serial No. 831,736 (Involves Only '108 Patent) 133

H. Prosecution of Serial No. 2,424 (Involves Only '108 Patent) 138

I. Terminology 141

J. Facts Relating to and Subsequent to the Filing of Serial No. 617,955 155

K. GTE (DTMF Telephones) 169

L. The '886 Patent 185

M. The '108 Patent 192

N. Prior Art on Mechanical Switching 204

O. Infringement of the '108 Patent Involving HMC and UMC . . . 207

P. Enablement and Best Mode Re '108 and '886 Patents 209

Q. Prior Art - '108 Patent 232

R. Prior Art - '886 Patent 239

IC Guide. 243

S. Inequitable Conduct 252

T. Infringement of the '886 Patent Involving UMC 256

U. Practice of the Asserted Claims of the '886 and '108 Patents 257

1. The '108 Patent 257

2. The '886 Patent 258

V. THE '436 PATENT 258

A. The '436 Patent and the Claims at Issue 258

B. Practice of the Asserted Claims of the '436 Patent. 266

C. Infringement of the '436 Patent Involving HMC and UMC . . . 268

1. HMC 268

2. UMC 273

D. The Disclosure of the '436 Patent 275

E. Best Mode Re '436 Patent. 288

F. Prior Art - '436 Patent 288

VI. INFRINGEMENT OF THE '436 PATENT INVOLVING RESPONDENTS, OTHER THAN HMC AND UMC. 336

A. SMC and Lonestar. 336

B. Tranbon and Columbia. 337

C. Conair. 338

D. NAFTC 338

E. Spectra 338

VII. IMPORTATION AND SALE. 339

VIII. DOMESTIC INDUSTRY - ECONOMIC PRONG ('436 PATENT). 353

CONCLUSIONS OF LAW. 389

INITIAL DETERMINATION AND ORDER 391

ABBREVIATIONS

CB1	Complainant's Brief Re '436 Patent
CBR1	Complainant's Reply Brief Re '436 Patent
CB2	Complainant's Brief Re '108 and '886 Patent
CBR2	Complainant's Reply Brief Re '108 and '886 Patent
CPHB	Complainant's Prehearing Brief
CPX	Complainant's Physical Exhibit
CRX	Complainant's Rebuttal Exhibit
CX	Complainant's Documentary Exhibit
FF	Findings of Fact
RB1	Respondents' Brief Re '436 Patent
RBR1	Respondent's Reply Brief Re '436 Patent
RB2	Respondents' Brief Re '108 and '886 Patents
RBR2	Respondents' Reply Brief Re '108 and '886 Patent
RPHB	Respondents' Prehearing Brief
RPX	Respondents' Physical Exhibit
RX	Respondents' Documentary Exhibit
SB1	Staff's Brief Re '436 Patent
SBR1	Staff's Reply Brief Re '436 Patent
SB2	Staff's Brief Re '108 and '886 Patents
SBR2	Staff's Reply Brief Re '108 and '886 Patents
SPX	Staff's Physical Exhibit
SX	Staff's Documentary Exhibit
Tr	Transcript of Hearing

PROCEDURAL HISTORY

By notice dated April 1, 1992, the Commission instituted an investigation, pursuant to subsection (b) of section 337 of the Tariff Act of 1930, as amended, to determine whether there is a violation of subsection (a)(1)(B)(i) of section 337 in the importation into the United States, the sale for importation, or the sale within the United States after importation of certain integrated circuit telecommunication chips and products containing same, including dialing apparatus, which allegedly infringe

1. claims 1, 4, 10, 11 or 14-16 of U.S. Letters Patent 4,315,108 (the '108 patent);

2. claims 6-9 or 13-14 of U.S. Letters Patent 4,061,886 (the '886 patent); or

3. claims 1-4 or 6 of U.S. Letters Patent 4, 446,436, (the '436 patent);

and whether there exists an industry in the United States as required by subsection (a)(2) of section 337.

The notice was published in the Federal Register on April 8, 1992, (57 Fed. Reg. at 11966-67). By notice dated November 9, 1992, the Commission determined not to review an initial determination (Order No. 86) extending by thirty days the deadline for filing the administrative law judge's final initial determination, i.e., no later than March 10, 1993, and extending the administrative deadline for completion of the investigation by 30 days, i.e., from May 10, 1993 to June 9, 1993.

The matter is now ready for decision.

This initial determination is based on the entire record compiled at the hearing, the exhibits admitted into evidence and four exhibits of the administrative law judge. The administrative law judge has also taken into account his observation of the witnesses who appeared before him during the hearing. Proposed findings submitted by the parties participating in the hearing not herein adopted, in the form submitted or in substance, are rejected either as not supported by the evidence or as involving immaterial matters. The findings of fact of this initial determination include references to supporting evidentiary items in the record. Such references are intended to serve as guides to the testimony and exhibits supporting the findings of fact of the administrative law judge. They do not necessarily represent complete summaries of the evidence supporting said finding.[1]

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[1] On November 6, 1992, in oral argument of Cypress Semiconductor Corp. v. U.S. International Trade Commission, Appeal No. 92-1282 before the U.S. Court of Appeals for the Federal Circuit (Federal Circuit), which involved an appeal from the Commission's decision under 19 U.S.C. § 1337 in Certain Plastic Encapsulated Integrated Circuits, Chief Judge Nies on the public record stated:

> Before you get started, because I won't be with you again after your argument--is there anything we can do to persuade the ITC to write opinions that one can deal with? I mean, this is summer reading. You know, I could spend the whole summer on the opinion. For the benefit of those in the back, that is the opinion [holding up bound appendix containing the Initial Determination, the ALJ's Findings of Fact and Conclusions of Law, the Commission's Opinion on Issues Under Review and On Remedy, the Public Interest and Bonding, the limited exclusion order, and the cease and desists orders]. That's all it is and that's impossible . . . . This is in every case from the ITC. You get numbered paragraphs up into the hundreds and hundreds, and what is this, 400 pages of an opinion, single spaced, with footnotes and a separate index. And it's not possible to deal with it. Now district court cases are equally comparable in complexity and we get opinions that have weeded out the chaff. This is everything and that is very unhelpful to the court. Can you at least tell the people over there that this is not helpful?

On February 8, 1993, at closing argument in this investigation at which some fifteen lawyers representing the four active parties attended, the administrative law judge brought to the attention of the parties the foregoing statement of Chief Judge Nies. (Tr. 4329 to 4339). He further pointed out that in this investigation the height of only the post hearing submissions amounted to some nine inches, 4,120 pages of hearing transcript were generated, over 1000 exhibits were admitted into evidence, and a great many

(continued...)

[1](...continued)
issues were generated. He then asked for suggestions from the parties with respect to how he could structure his initial determination in view of Chief Judge Nies' statement.

Complainant's counsel stated that "while we sympathize with the plight that [the administrative law judge]... has, especially in view of Chief Judge Nies' comments, we would certainly wish that all the major issues were decided with accompanying findings" (Tr. at 4336). He also referenced Beloit Corp. v. Valmet OY, 742 F.2d 1421, 223 USPQ 193, 194 (Fed. Cir. 1984) (Tr. at 4337). In that case the Federal Circuit stated that the Commission is at perfect liberty to reach a "no violation" determination on a single dispositive issue and that the Commission should not be precluded from taking that "risk" where the conclusion reached on one dispositive issue appears to the Commission "inevitable and unassailable." Complainant's counsel also referenced Colico Industries, Inc. v. U.S. Intern. Trade Com'n, 573 F.2d 1247, 147 USPQ 472, 476 (CCPA 1978) (Tr. at 4345). In that case a Court, which is a predecessor to the Federal Circuit, stated that "it would be advisable for the Commission to render a decision on all appealable issues presented to it (Emphasis added), citing Sinclair & Carroll Co. v. International Corp., 325 U.S. 327, 65 USPQ 297 (1945).

At closing argument on February 8 the staff referenced Certain Circuit Board Testers, Inv. 337-TA-342, "Notice of Commission Determination to Designate Temporary Relief Proceedings More Complicated; Setting of Administrative Deadline" (February 1, 1993) (Tr. at 4335). In that notice the Commission extended the statutory deadline because the presiding administrative law judge's initial determination contained "insufficient factual findings" to support a denial of relief. The staff also stated that to the extent that it would obviously ease the burden of the administrative law judge to complete and have "a clear record on all of these issues, to the extent that one more month does not enable you to do that -- obviously, you have it within your discretion to extend that time to some degree if that were necessary, and we certainly could understand that in this case" (Tr. at 4335).

In the opinion section of this initial determination, this administrative law judge has taken into consideration the statement of Chief Judge Nies. However, in light of the comments made by complainant's counsel and by the staff at closing argument, the Commission notice of February 1, 1993, the duties of an administrative law judge as set forth in the Administrative Procedure Act (see in particular 5 U.S.C. § 554(d) and § 557(b)), and Commission interim rule 210.53(d), he has included extensive findings to support his ultimate legal conclusions. While his initial determination may be lengthy because of those findings, it should be recognized that, depending on what issues a party may take exception to (which the administrative law judge has no way to determine), many of said findings could be irrelevant on any appeal.

JURISDICTION

The Commission has in rem and subject matter jurisdiction.

OPINION ON VIOLATION

As the caption of this investigation shows, the products in issue relate to certain integrated circuit telecommunication chips and products containing same, including dialing apparatus.

I. PARTIES

Incorporated by reference are FF 2 to 14 which identify the parties and indicates their respective status. The only respondents who participated at the hearing and filed any prehearing and posthearing submissions were Hualon Microelectronics Corporation [Taiwan](HMC) and United Microelectronics Corporation (UMC).

II. IMPORTATION AND SALE

Incorporated by reference are FF 1026 to 1089 which relate to the importation and sale of the accused products.

III. THE '108 PATENT

A. Alleged Infringement of Asserted Claims 1, 4, 10, 11, 14 15 and 16 by HMC and UMC

Complainant has the burden of proving infringement of the claims in issue by a preponderance of the evidence. Under Sea Industries, Inc. v. Dacor Corp., 833 F.2d 1551, 4 USPQ2d 1772, 1776 (Fed. Cir. 1987); Hughes Aircraft v. United States, 717 F.2d 1351, 1361, 219 USPQ 473, 480 (Fed. Cir. 1983) (Hughes Aircraft). Moreover, "[t]o establish infringement of a patent, every limitation set forth in a claim must be found in an accused product exactly or by a substantial equivalent." Corning Glass Works v. Sumitomo Elec. U.S.A., Inc., 868 F.2d 1251, 1259, 9 USPQ2d 1962, 1967 (Fed. Cir. 1989); Pennwalt Corp. v. Durand-Wayland, Inc., 833 F.2d 931, 4 USPQ2d 1737 (Fed. Cir. 1987) (en banc), cert. denied, 485 U.S 961 (1988).

Any analysis of infringement involves two inquiries: a proper construction of the claims to determine their scope and a determination of whether the properly construed claims encompass the accused products. Palumbo v. Don-Joy Co., 762 F.2d 969, 974, 226 USPQ 5 (Fed. Cir. 1985). Construction of a claim is necessary to define the metes and bound of the protection afforded it. McGill Inc. v. John Zink Co., 736 F.2d 666, 674, 221 USPQ 944, cert. denied, 469 U.S. 1037 (1984).

1. Claim Construction

In issue are independent claim 1, claims 4, 10 and 16 (each dependent on claim 1), claims 11 and 14 (each dependent on claim 10) and claim 15 (dependent on claim 14) (FF 31). The last clause of independent claim 1 reads in pertinent part:

> common switching means on the chip responsive to the control signal for performing the common switching functions ... including means for enabling oscillatory circuitry ... means for disabling an audio transmitter and means for attenuating the output of a receiver. [Emphasis added][2] [FF 31]

HMC and UMC, as well as the staff, argued that the phrase "common switching means on the chip" in the above clause must be construed to include

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[2] A transmitter may be called a microphone or mouthpiece. A receiver can be referred to as an earpiece. The receiver operates very similar to a speaker in a stereo (FF 161). The "common switching functions" include enabling the oscillator, disabling the microphone and attenuating or muting the earpiece (FF 37). It is necessary to disable the transmitter during tone dialing operation because extraneous noise, such as a voice, could go into the transmitter and cause the phone to misdial (FF 355, 358, 383). It is also necessary to attenuate the receiver, when a tone is being generated, to keep from having too loud a signal in the ear of the telephone user (FF 356, 359, 383). The oscillator must be shut off when a person using the telephone is trying to talk, and it must be turned on when the person using the telephone is trying to dial or create tones (FF 357, 383). (See also FF 337)

certain transistors[3] "on the chip" that act as the "switches"[4] which actually perform the claimed common switching functions, viz., the "means for enabling oscillatory circuitry ..., means for disabling an audio transmitter and means for attenuating the output of a receiver." (RB2 at 4, SB2 at 21, 22). Complainant argued that the "common switching means need only perform the common switching functions in such a way as to enable the use of the simple, calculator type keyboard." (CBR2 at 7). Inventor Callahan,[5] who testified as a fact and expert witness at the hearing,[6] interpreted the claimed phrase "common switching means on the chip" as the "VKB signal ... that's on the chip and that can be used to drive all chip components" (FF 34, 35). Complainant's Fair interpreted the claimed "common switching means on the chip" as a "means whereby a voltage is created in an output pin or a current is enabled to flow from that output pin to control the common switching functions, the common key functions" (FF 349). Each of Callahan (FF 350) and Fair (FF 349), and also complainant at closing argument (Tr. 4409, 4410), admitted that the "common

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[3] A transistor is a single device which can conduct current. From an economic standpoint, it is preferred to put as many transistors as possible onto an integrated circuit chip (FF 117).

[4] A switch is used to cause current to flow, or not flow, on a selected path and it may also transmit voltage (FF 365). Inventor Hoffman testified that a control signal is used to drive a switch but is not a switch (FF 351, 363). Moreover it is an undisputed fact that a control signal is not a switch (FF 363).

[5] The named inventors of the '108 and '886 patents are Michael J. Callahan, Jr. and Gordon B. Hoffman (FF 27).

[6] HMC and UMC rely on expert testimony of Magleby and Kooi to support their construction of the claimed language in dispute. See eg., RX-1 and RX-3. Complainant relies on expert testimony of Fair and Callahan to support its construction. See eg., CX-503, CRX-112. The record reflects that Magleby, Fair and Callahan were compensated for their time, with Callahan compensated not only in his role as an expert witness but also in his role as a fact witness (FF 15 to 19).

switching means" as construed by them would not effectuate the functions of disabling the transmitter and muting the receiver.[7] [8]

Referring to the claimed language in dispute, the language is not couched merely in means-plus-function language.[9] Thus the language does not merely state a common switching means for performing the common switching functions including means for disabling an audio transmitter and means for attenuating the output of a receiver. Rather, the plain language in dispute contains the following express limitation not subject to means-plus-function language, viz.

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[7] While complainant takes the position that independent claim 1 in issue does not require that there be on the chip elements which would effectuate the functions of disabling the transmitter and muting the receiver, complainant argued that in addition to the "preferred embodiment" the specification of the '108 patent includes an embodiment in which the entire system is included on a single chip using solely MOS integrated circuitry with only crystal, keypad and the telephone handset, including the microphone (transmitter) and speaker (receiver) not on the chip. (CB2 at 16, 17). Although an "Invention Disclosure" form does not form a portion of a patent specification, complainant also argued that "the inventors 'Invention Disclosure' form, prepared prior to the patent application" refers to an alternative embodiment using "a combination of 'CMOS and/or bipolar transistors'". (CB2 at 17, 18).

[8] It is undisputed that the "common switching means" disclosed in the '108 patent for disabling the microphone and muting the receiver are means which are provided electronically as part of the chip of integrated circuitry (FF 348).

[9] Pursuant to the last paragraph of 35 U.S.C. § 112:

> An element in a claim for a combination may be expressed as a means or step for performing a specified function without the recital of structure, material, or acts in support thereof, and such claim shall be construed to cover the corresponding structure, material or acts described in the specification and equivalents thereof. (Emphasis added)

As seen from the above, the statute states that an element may be expressed as a "means". In this investigation complainant contends that the "element" or "means" of 35 U.S.C. §112, supra is merely a VKB signal that is on the chip, but which does not effectuate the functions of disabling the transmitter and muting the receiver.

common switching means "on the chip responsive to the control signal." (Emphasis added). Accordingly the term "on the chip"[10] should be given its ordinary and plain meaning to one having ordinary skill in the art to which the subject matter pertains, unless it appears from the '108 patent specification and the file history of the '108 patent that the term was used differently by the inventors. Envirotech Corp. v. Al George Inc., 730 F.2d 753, 759, 221 USPQ 473, 477 (Fed. Cir. 1984) (Envirotech);[11] Senmed Inc. v. Richard-Allen Medical Industries, Inc., 888 F.2d 813, 12 USPQ2d 1508, 1511-13 (Fed. Cir. 1989) (Senmed);[12] Jonsson v. The Stanley Works 903 F.2d 812, 820, 14 USPQ2d 1863, 1871 (Fed. Cir. 1990).

At the outset, while complainant has argued that the language in independent claim 1, viz. "common switching means on the chip," can refer to merely a "VKB signal... that's on the chip," independent claim 1 refers to "common switching means on the chip responsive to the control signal". (Emphasis added). Also complainant at closing argument (Tr. at 4162) and its expert Fair have admitted that the claimed term can include means "on the chip" which effectuate all the common switching functions (FF 554).

Referring to the specification of the '108 patent under the subheading

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10 See FF 117, 118, 119 for the ordinary meaning of the word "chip".

11 In Envirotech the Federal Circuit held that if an inventor chooses to be his own lexicographer and to give terms uncommon meanings, the inventor must set out the uncommon definition in some manner within the patent specification, citing Lear Siegler, Inc. v. Aerogrip Corp., 733 F.2d 881, 889, 221 USPQ 1025, 1031 (Fed. Cir. 1984); Intellicall Inc. v. Phonometrics Inc. 952 F.2d 1384, 21 USPQ2d 1383, 1386-87 (Fed. Cir. 1992).

12 In Senmed, the Federal Circuit noted that nothing of record indicated that an inventor used "on" differently from how it was used in the specification and during prosecution until he was in Court, and that an inventor may not be heard to proffer an interpretation that would alter the undisputed public record (claim, specification, prosecution history).

"Summary of the Invention," the '108 patent states that the common key functions such as powering up the circuitry, switching out the transmitter and connecting muting resistance into the receiver circuit are provided electronically as part of the chip of integrated circuitry (FF 50). Later, in discussing the preferred embodiment the specification states that with the exception of the crystal of reference oscillator, the signal generator is fabricated as a single integrated circuit (FF 56). Such language in the specification is found to be consistent with the claim requiring that the common switching means or the elements (which effectuate the functions of disabling the transmitter and mutting the receiver) be on the chip. The administrative law judge finds nothing in the '108 specification that suggests that the term "on the chip" in independent claim 1 refers merely to a "VKB signal".

Referring to the file history of the '108 patent (FF 67 to 116), initial claim 45 of the earliest of the three applications, which resulted in the '108 patent, contained the language

> "common switching means on said chip for enabling said oscillator, disabling on off-chip audio transmitter and attenuating an off-chip receiver during generation of said dual-tone output signal" [Emphasis added]

(FF 67). Also, in prosecution of that application the inventors' attorney argued that another major difference in the present system and those of the references is with respect to the common switching functions which are included on the same integrated circuitry chip in the present invention and which help to represent a major change in system design that leads to a much simpler, less expensive and more compact system than those of the prior art (FF 83).

In continuation divisional application Ser. No. 831,736, proposed claim

49 had the language

> "common switching means _on said chip_ responsive to said control signal for performing the common switching functions ..." [Emphasis added]

(FF 92). In response to a rejection of the Patent Office, claim 49 was amended on August 7, 1978 to read in part:

> A telephone communication system including a multiple frequency signal generator _on a complementary symmetry, metal-oxide, semiconductor circuitry chip_ .... [Emphasis added]

(FF 96). Amended claim 49 also referred to "common switching means... _on said chip_ responsive to said control signal for performing the common switching functions" (Emphasis added) (FF 96). Comparable language is found in rewritten independent claims 51 and 53 (FF 99). In the remarks section of the August 7, 1978, amendment the inventors' attorney argued that the common key functions such as powering up the circuitry, switching out the transmitter and connecting muting resistance into the receiver circuit are provided electronically _as part of the chip of the integrated circuitry_ (FF 97). It was also argued, in the same amendment, that by including the common key functions _on the chip_, the size and maintenance requirements of the system are further reduced (FF 97). In the third application, _viz_. continuation Ser. No. 2,424, the inventors' attorney amended claim 49 such that it read "common switching means _on the chip_ responsive to the control signal for performing the common switching functions" (Emphasis added) (FF 107) which language is also found in twice-amended claim 49 (FF 110). The administrative law judge finds no disclosure in the '108 file history that the language "as part of the chip of integrated circuitry" in the '108 patent specification, or "common switching means" with the express limitation _on the chip_ in independent claim 1, should be construed as merely an "element" or a "means" (as that term is used in 35 U.S.C. §112) which is a "VKB signal ... that's on the chip and that can be used to drive all chip components," but which "element" or "means" would not effectuate the functions of disabling the transmitter and muting the receiver.[13] [14]

Based on the express language of independent claim 1, the '108 patent specification and the file history of the '108 patent, the language "common switching means" in independent claim 1 is construed such that the claimed "telephone communication system" comprises a common switching means or elements that must be <u>on the chip</u> and must effectuate the functions of enabling the oscillator, disabling the transmitter and attenuating the receiver.

2. The Accused Products

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[13] A contemporaneous publication of complainant's predecessor Mostek commenting on the invention of the asserted claims and dated July 1974, stated in part that "the single C-MOS chip contains <u>all</u> the switching functions handled by the dual-contact, sliding matrix keyboard now used ..." (FF 558, 566 to 568) (Emphasis added). As inventor Hoffman testified, a control signal is not a switch (FF 351). Moreover, as inventor Callahan testified, a transistor can be used for a switch (FF 352). Nothing in the July 1974 publication suggests that the quoted language refers to merely a "VKB signal ... that's on the chip" and which will not effectuate <u>all</u> the switching functions or key functions (the terms "common key functions" and "common switching functions" are used interchangeably (FF 345)).

[14] At the time inventors Hoffman and Callahan filed their application on September 29, 1975, for the '108 patent, the common switching functions of a telephone included applying power to the oscillator, disconnecting the audio transmitter, and attenuating the receiver (FF 385, 387) and the common switch directly carried out the functions of enabling the oscillator, disabling the transmitter and attenuating the output of the ear piece (FF 237, 389). When Callahan started work on the DTMF dialer chip invention he took apart many of the phones used during that time period to determine what kinds of prior art telephones generated DTMF signals (FF 171). In replacing the mechanical switch inventor Hoffman testified that it was desirable to put the common switch on the chip for reasons of cost and because the entire thrust of integrated circuits is to get as much of the system value onto the chip as possible (FF 390).

The administrative law judge finds that the chips of UMC and HMC have their means for disabling an audio transmitter and for attenuating the output of a receiver off the chip (FF 396 to 402). Accordingly, he finds that complainant has not established by a preponderance of evidence that the accused chips of HMC and UMC infringe independent claim 1 and dependent claims 4, 10, 11, 14, 15 and 16.[15]

B. Validity of Asserted Claims Under 35 U.S. C. §103

35 U.S.C. § 282 creates a presumption that a United States patent is valid. A patent challenger must establish invalidity by clear and convincing evidence. Jones v. Hardy, 727 F.2d 1524, 1528, 220 USPQ 1021, 1024 (Fed. Cir. 1984). When no prior art other than that which was considered by the Patent and Trademark office (PTO) is relied on by an alleged infringer, there is the added burden of overcoming the deference that is due to a qualified government agency presumed to have done its job. American Hoist & Derrick Co. v. Sowa & Sons, Inc., 725 F.2d 1350, 1359, 220 USPQ 763, 770 (Fed. Cir.) cert. denied, 469 U.S. 821 (1984). See also Fromson v. Advance Offset Plate, Inc., 755 F.2d 1549, 225 USPQ 26, 31 (Fed. Cir. 1985). However the fact that the basis for holding a claim invalid does not include different or additional references than the references cited by the PTO is not dispositive of the issue of validity. Rather the issue is whether substantial evidence in the record supports a factual determination underlying any legal conclusion that a patent is not valid. See Tyler Refrigeration v. Kyson Industrial Corp., 777 F.2d 687, 690, 227 USPQ2d 845 (Fed. Cir. 1985); Surface Technology Inc. v. U.S.

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[15] If the accused chips do not include each limitation present in independent claim 1 of the '108 patent, they cannot infringe dependent claims 4, 10, 11, 14, 15 and 16 in issue. Wahpeton Canvas Co., Inc. v. Frontier, Inc., 870 F.2d 1546, 1552 n.9, 10 USPQ2d 1201, 1207 n. 9 (Fed. Cir. 1989).

Intern. Trade Com'n, 801 F.2d 1336, 1340, 231 USPQ2d 192 (Fed. Cir. 1986).

HMC and UMC, at closing argument, admitted that they do not challenge the validity of the asserted claims under 35 U.S.C. §102 (Tr. at 4393, 4394). HMC and UMC, as well as the staff, however contend that the asserted claims of the '108 patent are not valid under 35 U.S.C. §103.

Under 35 U.S.C. §103, a patent may be held not valid if the invention claimed does not satisfy the requirement for nonobviousness as set forth in 35 U.S.C. §103:

> A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.

Graham v. John Deere Co., 383 U.S. 1, 17-18, 148 USPQ 459, 467 (1966) articulated the test for determining obviousness under 35 U.S.C. §103:

> [T]he scope and content of the prior art are to be determined; differences between the prior art and the claims at issue are to be ascertained; and the level of ordinary skill in the art resolved. Against this background, the obviousness of the subject matter is determined. Such secondary considerations as commercial success, long feld but unsolved needs, failure of others, etc., might be utilized to give light to the circumstances surrounding the origin of the subject matter sought to be patented. As indicia of obviousness or nonobviousness, these inquires may have relevancy.

Obviousness is a question of law based on factual inquires. Akzo N.V. v. U.S. Intern. Trade Com'n, 808 F.2d 1471, 1480, 1 USPQ2d 1241, 1246 (Fed. Cir. 1986), cert. denied, 469 U.S. 851 (1989) (Akzo); Ashland Oil, Inc. v. Delta Resins & Refractories, Inc., 776 F.2d 281, 227 USPQ 657, 667 (Fed. Cir. 1985). A reference for use under 35 U.S.C. §103 need not be enabling as complainant stated in closing argument (Tr. at 4403) A patent challenger, however, under

35 U.S.C. §103, "cannot pick and choose among the individual elements of assorted prior art references to recreate the claimed invention." Smithkline Diagnostics, Inc. v. Helena Laboratories Corp., 859 F.2d 878, 887, 8 USPQ2d 1468 (Fed. Cir. 1988) (Smithkline). Indeed, as the Federal Circuit has held:

> [i]t is insufficient that the prior art disclosed the components of the patented device, either separately or used in other combinations; there must be some teaching, suggestion, or incentive to make the combination made by the inventor.

Northern Telecom, Inc. v. Datapoint Corp., 908 F.2d 931, 934, 15 USPQ2d 1321 (Fed. Cir.), cert. denied, Datapoint Corp. v. Northern Telecom, Inc., 111 S.Ct. 296 (1990) (Northern Telecom).[16] In making such an analysis, the claim must be viewed as a whole. It is improper to treat a claim as a mere catalog of separate parts, in disregard of the part-to-part relationships set forth in the claim and which give the claim its meaning. Lindemann Maschinenfabrik GmbH v. American Hoist and Derrick Co., 730 F.2d 1452, 1459, 221 USPQ2d 481 (Fed. Cir. 1984). A "hindsight reconstruction" cannot be used to render an

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[16] In Intel Corp. v. U.S. Intern. Trade Com'n, 946 F.2d 821, 20 USPQ 2d 1161, 1172-73 (Fed. Cir. 1991) (Intel Corp.), under the subheading "Validity of the '050 Patent," the Federal Circuit noted that a claim 1 in issue, which related to a metal oxide semiconductor (MOS) electronically programmable read only-memory (EPROM), was allowed when it was narrowed to include the extension of a shield's side walls down to the substrate, blocking horizontally-traveling radiation. As the Federal Circuit stated, the administrative law judge had considered the prior art which taught that the use of shielding side walls would reduce the amount of light reaching the cells, but had found that the prior art did not teach that the side walls should extend all the way to the substrate (as was claimed) and that the prior art did not describe a method of shielding a circuit thoroughly enough to last for the normal life of an EPROM. (The claim 1 there in issue concluded "whereby said EPROM cell can be permanently programmed so that said redundant elements are always used in place of said defective elements") The Federal Circuit, in affirming the conclusions of the Commission and the administrative law judge that respondents had failed to prove by clear and convincing evidence that claim 1 was invalid for obviousness under 35 U.S.C. §103, concluded that the evidence showed that the results of extending the sidewalls in the manner claimed in the '050 patent were surprising.

asserted claim obvious. Interconnect Planning Corp. v. Feil, 774 F.2d 1132, 1143, 227 USPQ2d 543 (Fed. Cir. 1985). (Interconnect).

HMC and UMC argued that independent claim 1 is obvious and hence invalid in view of the combined teachings of an Electronics publication (Electronics) and a Meacham '084 or a Hoff '709 or a Proebsting '254 patent;[17] that a Thomas '028 patent when considered in combination with Electronics or with a Borison '090 patent would render claim 1 obvious; that dependent claim 4 is obvious in view of the combined teachings of the Meacham '084 patent and Electronics in the manner described with respect to claim 1 in view of the teaching of a Jackson '819 patent or in view of the Thomas '028 patent, the Borison '090 patent and a Jackson '819 patent; that dependent claim 10 is obvious in view of the combined teachings of the Thomas '028 patent, the Meacham '084 patent and Electronics as applied in the manner described with respect to claim 1, that dependent claim 11 is obvious for the same reasons that claim 10 is obvious; that dependent claim 14 is obvious in view of the Thomas '028 patent when considered in conjunction with the prior art which renders claim 1 of the '108 patent obvious; that dependent claim 15 is obvious in view of teachings in the Meacham '084 patent or the Jackson '819 patent; and that dependent claim 16 is obvious in view of the combined teachings of Electronics and the Hoff '709 patent or an article of Cowpland et. al. entitled "Microcircuits For

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[17] Under the subheading "Claim 1 of the '108 patent is invalid in view of a the prior art," HMC and UMC argued that on page 139 of Mostek August 1974 Integrated Circuit Guide (IC Guide) there is shown, as a product to be announced, the MK5085 (RX164) and that a block diagram in the IC Guide shows this telephone tone generator to be essentially identical to Figure 1 of the '108 patent. (RB2 at 53, 54). HMC and UMC, however, have not alleged that any claim of the '108 patent is anticipated by any prior art (Tr. at 4393, 4394). Moreover in the proposed findings of UMC and HMC it is not alleged that the claims in issue of the '108 patent are obvious over the IC Guide or any combination comprising the IC Guide.

An All Electric Telephone", International Electrical Electronics Conference and Exposition Digest, October 1973 at 134-35. (RB2 at 53-64).

The staff argued that the "108 patent is obvious" based upon the combination of the "concepts contained in the Meacham, Jackson, Thomas and Electronics article prior art references." (SB2 at 52).

Complainant argued that no prior art reference in the record even approaches the claims in issue of the '108 patent; that HMC and UMC "rely upon a patchwork of seven unrelated references, carefully picking only bits and pieces to recreate the '108 patent claims," which assembly is "contrary to long-standing precedent and not supported by the evidence." (CB2 at 46).

Electronics, the Meacham '084 patent, the Jackson '819 patent, the Thomas '028 patent and/or the Proebsting '254 patent, relied on by HMC and UMC and the staff, are prior art under 35 U.S.C. §102(b) in view of their respective publication dates (FF 557, 558, 560 to 563).[18] Moreover, a

[18] HMC and UMC objected to complainant's proposed finding 832 which states that the tone dialer chip invention was conceived on December 28, 1973, and which relies on patent invention disclosure form CX-30 and the live testimony of inventor Callahan at Tr. 566-67. It was argued by HMC and UMC that the date of conception of an invention cannot be established by the uncorroborated testimony of an inventor "under applicable law" and hence complainant provides "insufficient corroborating evidence" to support the alleged date of conception.

In Refac Electronics Corp. v. R.H. Mary & Co., 9 USPQ2d 1497, 1502 (D.N.J. 1988), aff'd in unpublished opinion, 871 F.2d 1097 (Fed. Cir. 1989) (Refac) the district court held that the patentee's assertion of a pre-filing date of invention "is not supported by any documentation or contemporaneous written materials which describe [the invention]." However in Sun Studs, Inc. v. ATA Equipment Leasing, Inc. 872 F.2d 978, 983, 10 USPQ2d 1338 (Fed. Cir. 1989) (Sun Studs), where the patentees had adduced evidence to show conception of the invention of the patents in issue before the filing date of a cited reference, the Federal Circuit concluded that the "district court allowed the jury to consider this evidence, although the court erroneously instructed the jury that corroboration was required and adopted other criteria derived from interference practice ... which errors placed a greater burden on the ... [patentees] than the law requires." As the Federal Circuit stated, the
(continued...)

reference relied on in challenging a patent under 35 U.S.C. §103 need not be enabling, as complainant stated (Tr. at 4403). An analysis for patent validity, like an analysis for patent infringement, requires interpretation of the claim in issue. However, a claim must be given the same meaning for the purpose of analyzing both validity and infringement issues. White v. Dunbar, 119 U.S. 47, 51 (1886); Senmed, 888 F.2d at, 818 n.7, 12 USPQ2d at 1511; W.L. Gore & Associates, Inc. v. Garlock, Inc., 721 F.2d 1540, 220 USPQ 303, (Fed. Cir. 1983), cert. denied, 469 U.S. 851 (1984). The administrative law judge in his infringement analysis has construed the language of the asserted claims as comprising a common switching means or elements that must be on the chip

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[18](...continued)
patentees told the district court, and its expert testified, that prior art was removed as a reference against the claimed inventions on a procedure regulated by 37 C.F.R. §1.131 (the filing of a 131 affidavit or declaration) during prosecution before the PTO. Id. at 983. PTO rule 131 states in pertinent part that original exhibits of drawings or records or photocopies thereof "must accompany and form part of the affidavit or declaration of their absence satisfactorily explained." 37 C.F.R. §1.131(b).

At the hearing in this investigation there was sworn testimony of the inventor Callahan and he was subjected to unlimited live cross examination. Moreover, even in Lockheed Aircraft Corp. v. United States, 593 F.2d 69, 193 USPQ 449 454 (Ct. Cl. 1977) (Lockheed) relied on by HMC and UMC, the Court found that "the oral testimony of the inventor" and the patent attorney coupled with contemporaneous documentary evidence of record was sufficient to establish that the inventor conceived the invention before the effective date of a reference and exercised reasonable diligence from that date until he filed a patent application. Accordingly, the administrative law judge rejects the argument that the oral testimony of inventor Callahan must be rejected outright because it was not corroborated.

Based on the evidence (FF 165 to 224, 409 to 556) the administrative law judge finds that the tone dialer chip inventions, as claimed in the '108 and '886 patents, were conceived on December 28, 1973 followed by diligence and the filing of Ser. No. 617,955 on September 29, 1975 (FF 178). Accordingly, he finds that the Hoff '709 patent and the Borison '090 patent are not prior art under 35 U.S.C. §102(b) in view of the March 7, 1974, filing date of the Hoff '709 patent (FF 559) and the February 13, 1975 filing date of the Borison '090 patent (FF 564).

and effectuate the functions of enabling the oscillator, disabling the transmitter and attenuating the receiver. The administrative law judge finds nothing in any of the cited references which shows how a "telephone communication system" can be made in which the common switching means or elements on the chip in the system effectuate the functions of enabling the oscillator, disabling the transmitter and attenuating the receiver. Accordingly, the administrative law judge finds that HMC, UMC and the staff have not established that the asserted claims in issue are not valid under 35 U.S.C. §103.

Assuming arguendo, independent claim 1 can be construed such that the claimed telephone communication system involves a chip and the system has a switching means which "need only perform the common switching functions in such a way as to enable the use of the simple, calculator type keyboard" (CB2 at 7), then the administrative law judge finds that HMC, UMC and the staff have established by clear and convincing evidence that independent claim 1 and dependent claims 4, 10, 11, 14, 15 and 16 are obvious under 35 U.S.C. §103 in view of Electronics, when taken with the Thomas '028, Meacham '084, Jackson '819 and Proebsting '254 patents, and hence that they would not be valid under 35 U.S.C. §103.

As inventor Callahan testified it was inventor Hoffman's idea in the early seventies when he was working for Mostek to initiate a project which would build a chip that would dial a phone using DTMF dialing.[19] Incorporated

[19] In dual tone multiple frequency (DTMF) dialing as developed, there are always two tones created together in any particular button depression. Row frequency tones are 697 Hz, 770 Hz, 852 Hz and 941 Hz Column frequency tones are 1209 Hz, 1336 Hz, and 1477 Hz. If a number, such as "5", is pressed on the keypad, and referring to CX-26, the two tones generated would have a row frequency of 770 Hz and a column frequency of 1336 Hz. Those two tones are (continued...)

with that idea was to include, as a frequency standard, a 3.58 megahertz (MHz)[20] color burst crystal which was commonly used in color television sets, as well as to utilize an inexpensive calculator type keyboard as opposed to the common telephone keyboard (FF 172). The statutory bar reference Electronics expresses that idea. Thus Electronics discloses that Mostek, the named assignee of the '108 patent (FF 27), was developing a telephone tone-keying module that Mostek estimated could shave about half the cost from its electromechanical counterpart. It further discloses that in the Mostek approach, instead of two coils with four windings each then in use in telephones, an inexpensive, off-chip 3.58 megahertz crystal is used "for reference, and divides down to obtain the audio frequencies" standardized by the telephone industry; that "[o]n the chip, an op amp performs current-to-voltage conversion, as well as summing the two sine waves to get the time pairs used"; that besides the tone generator the single C-MOS chip contains switching functions then handled by the dual-contact sliding matrix, which allows touch pads of the calculator one-contact-per-key type; and that despite the high frequency, "the chip will operate at voltages down to 3V." Electronics also discloses that the Mostek approach "boasts a low-impedance buffer capable of driving telephone lines" (FF 566). As inventor Callahan testified, Electronics has subject matter of the invention of the '108 patent (FF 567, 568). Moreover, as confirmed by Magleby, Electronics discloses that a CMOS chip teaches the use of touch pads of the calculator one-contact-per-

[19](...continued)
mixed to produce the dual tone signal which is sent out to the central office, where it is detected and recognized as key number 5 (FF 62, 146, 149, 150, 151, 233). DTMF dialing technology was introduced in the mid 1960's (FF 229).

[20] "Hertz" is an abbreviation for cycles per second (FF 147).

key type to generate on chip a tone-pair (FF 569). While there is no detail in Electronics of how the single CMOS chip will be designed and built to allow the single CMOS chip to contain switching functions and to allow use of touch pads of the calculator one contact per key type, the administrative law judge finds that there is a "teaching, suggestion, or incentive"[21] to effectively abandon the sliding matrix keyboard and allow use of the touch pads of the calculator one contact per key type (FF 575, 576).

Although Electronics does not tell one how frequency dividing is done, frequency dividing was well known in the art (FF 575). Moreover, the Thomas '028 patent discloses a crystal oscillator generating a signal having a frequency of a 3.57 megahertz in combination with dividing circuitry and logic gates (FF 579).[22] The Thomas '028 patent also discloses a digital tone signal generator for use in a telephone application and the use of a multiple frequency signal generator on a complementary symmetix, metal oxide, semiconductor integrated circuit chip for digitally synthesizing a dual-tone sinusoided representative signal of a selected key in a keyboard (FF 587). While the telephone company specification requires integrated circuits of this type to be powered by the telephone line power, Meacham shows that a telephone communication system can be powered solely by telephone lines (FF 572). The Proebsting '254 patent shows the generation of a common control signal responsive to the pushing of a button (FF 573).

With respect to dependent claim 4 of the '108 patent, which relates to specific transistors and a bleeding resistor (FF 31), the Jackson '819 patent

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21 See Northern Telecom, supra, at 1314.

22 See FF 314 and 316 for a discussion of the dividing down functions in Fig. 1 of the '108 patent.

shows bipolar transistors for disabling the receiver and driving the transmitter and the use of a bleeding resistor is shown in Meacham '084 patent (FF 577, 578). Referring to dependent claim 10 and its reference to oscillator circuitry (FF 31), the Meacham '084 patent teaches enabling an oscillator circuit (FF 579). The use of a field effect transistor for enabling the oscillator as a switch between a positive line voltage and a terminal of the oscillator circuit recited in claim 11 is found obvious in view of the Jackson '813 and Meacham '084 patents (FF 580, 581). Claim 14, which depends on dependent claim 10 and which recites that the common switching means connects the signal generator to a power supply in response to the control signal (FF 31), is found obvious in view of the Meacham '084 or Thomas '028 patents (FF 582, 583).

Referring to claim 15 and its reference to telephone input lines (FF 31) the Meacham '084 patent or the Thomas '028 patent shows a bipolar transistor coupled between conductors from the central office which bipolar transistor is driven at its base by the signal generator comprising coils and related RLC circuits (FF 584, 585). With respect to claim 16, Electronics discloses the use of a plurality of single-pole single-throw switches for the keyboard (FF 586).

IV. THE '886 PATENT

A. Alleged Infringement of Asserted Claims 6, 7, 8, 9, 13 and 14 by UMC

Complainant has not alleged that HMC or UMC directly infringe the '886 patent nor that HMC contributorily infringes or infringes by inducement the '886 patent. It has alleged that UMC contributorily infringes and infringes by inducement claims 6 to 9, and 13 14 of the '886 patent (ALJ Ex.1). As indicated in Section III of this opinion, which dealt with the '108 patent, any analysis of infringement first requires a construction of the claims in issue to determine their scope and then a determination as to whether the properly interpreted claims encompass the accused products.

1. Claim Construction

In issue are independent claims 6 and 13, claims 7, 8 (each dependent on claim 6), claim 9 (dependent on claim 8) and claim 14 (dependent on claim 13) (FF 28).

UMC has argued that each of independent claims 6 and 13 describes a single tone generator rather than a dual tone generator. (RB2 at 82). The staff argued that claims 6 and 13, by their express language, are limited to a tone generator that produces a single sine wave representative of a selected key. (SB2 at 15).

Complainant argued that UMC has the "mistaken assumption" that independent claims 6 and 13 are directed solely to signal generators that produce an output signal that is uniquely representative of a single key which means that each key on the keyboard has a signal that uniquely represents it; that UMC and the staff ignore the fact that asserted claims 6 and 13 are written in means-plus-function language, and that one of the indispensable elements in both claims is "keyboard means"; that by the very nature of how a matrix-type (i.e., telephone) keypad works, the signals produced when a key is pressed are common to each row of keys and each column of keys; and that because the part-to-part relationships of a claim cannot be ignored, the signals produced in accordance with independent claims 6 and 13 must be representative of a row or column of keys from a telephone type keyboard. (CBR2 at 19). It is argued that independent claims 6 and 13 are directed to one-half of the type of signal produced by the dual tone generators of claims

1 and 15 which are not in issue, viz. that the asserted claims are directed to the production of a signal representative of a row of keys, or a signal representative of a column of keys. (CBR2 at 20).[23] [24] Complainant argued that its concept is easily explained with reference to Figure 1 of the '886 patent; and that while Figure 1 is indisputedly directed to a dual-tone signal generator with the top half of Figure 1 generating "the row tone and the bottom half the column tone," independent claims 6 and 13 are directed to a subcombination of Figure 1, i.e., they read on the circuitry that produces

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23 In support, complainant referenced its proposed finding of fact 1022 which reads:

> The signal generator described in Claim 6 of the '886 patent is accurately represented by the figures and the text of the '886 patent. In looking at Figure 1 of the '886 patent with respect to claim 6, the sine wave generated will be outputted at block 28. "Keyboard means, having actuable keys on said keyboard for generating pulses representative of an actuated key," are represented in the '886 patent, Figure 1, by blocks 14, 16, and 18. The "reference means for generating a reference frequency signal" is shown in block 12 of Figure 1. The "means for dividing the reference frequency in response to pulses to generate a digital signal having a frequency representative of an actuated key," corresponds to the circuitry in block 20 or block 22 of Figure 1 of the '886 patent. These are the programmable dividers. The frequency coming out of block 20 is representative of the key which has been selected. The "programmed logic array means, having a memory matrix for generating a plurality of digitally coded signals in response to said digital signal, and digitally coded signals being representative of a sinusoidal waveform having the frequency of said digital signal," is the circuitry shown in block 24 of Figure 1. The "conversion means connected to the output of the programmed logic array means for converting said digitally cored signals to an analog sine wave" corresponds to block 28 in Figure 1, which is the converter. (Callahan, Tr. 655-58; CX-3)

24 See also testimony of inventor Callahan (FF 329).

either the row tone or the column tone. (CBR2 at 20, 21).[25]

All the parties are in agreement that independent claim 6 describes a signal generator for producing a single signal which represents a depression of a key on a keyboard.[26] Where the parties differ is in the construction of the term "output" in the preamble of claim 6 as well as in the preamble of claim 13 (FF 28). Complainant argued, with reference to claim 6, that the

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25 The preamble of independent claim 6 states:

> "A signal generator for providing an output signal representative of a keyboard selection, comprising ..." [Emphasis added]

(FF 28). At closing argument on February 8, 1993, complainant represented that the "output signal" of the preamble for claim 6, with reference to Figure 1 of the '886 patent would be the output of one of the two conversion means, i.e., either of box 28 or box 30, and that it would not be a DTMF output signal. (Tr. at 4435, 4436) Complainant represented that the "output signal" recited in the preamble of claim 13, which is identical to the preamble of claim 6, is not an analog signal and that with reference to Figure 1 the output would be from sine wave PLA box 26 or box 24. (Tr. at 4436)

26 For example, see complainant's proposed finding 1021 and the following testimony of UMC's Magleby:

> THE WITNESS: I think Claim 6 describes a signal generator to produce an output signal which represents a depression of a key on a keyboard. And it does this by starting with a frequency reference and divides that frequency by the appropriate number to get the frequency representing the desired key, and then converting that frequency to a series of digitally coded signals and then converting those digitally converted signals to an analog waveform to produce the desired output signal.
>
> And so in lay terms, I think that's what this claim calls for.
>
> BY MR. LUPO:
>
> Q It is a single signal general [sic] ? It's not a DTMF generator; is that correct?
>
> A That's correct.

(Tr. at 2678, 2679).

term "output signal" covers _only_ an _intermediate_ single tone which is representative, for example, of a row in the dual tone multiple frequency generator.[27]

UMC and the staff argued that the "output signal" of the preambles of the claims 6 and 13 should not be construed as covering intermediate signals that are produced in a dual tone multiple frequency generator but rather should be limited to the ultimate generation of a single sine wave that is representative of the selected key of a single frequency tone generator. In support UMC argued that its expert Magleby demonstrated that there are devices in the prior art, such as shown in U.S. Patent No. 3,851,015 (RX 321), which teach the use of a single key to select a single frequency which is representative of the key being depressed (citing Magleby, RX1B at 118Q), and that Magleby pointed out prior art that uses MOS/LSI technology in electronic organs to create tone generators which generate a single frequency in response to the depression of a single key. (citing Magleby, RX1C at 120Q-124Q). (RB2 at 42).

UMC and the staff also argued that when all the claims of the '886 patent, including claims 1 and 15 which are not in issue, are considered it is clear that claims 6 and 13 are intended to cover a structure which ultimately produces a single frequency sinusoided output signal in response to pressing of a key and are not intended to relate to a system which produces a DTMF

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27 It is undisputed that when the dual tone multiple frequency generator is in operation said intermediate signal tone is subsequently summed with a second _intermediate_ single tone that is representative of a column to produce the desired dual tone. Both complainant and UMC agree that in a dual tone multi-frequency generator, a single frequency signal is not uniquely representative of an actuated key but rather would represent either a row or column (_see_ UMC's proposed finding 581, which was not disputed by complainant).

output signal in responses to the memory of a key. (RB2 at 43, 44; SB2 at 13, 14).

The specification of the '886 patent for the most part relates to a touch-tone telephone as shown by the lengthy description which respect to Figure 2 of the '886 patent (FF 64). However, under the subheading "Summary of the Invention," in addition to the touch-tone telephone embodiment (FF 51), the patent teaches that in accordance with another aspect of the present invention, a signal generator provides an output signal representative of a keyboard selection. In describing the final step of that aspect the '886 patent states that "[c]onversion means generate a sinusoided output signal in response to the digital signal (emphasis added) (FF 50). No reference is made here to the touch-tone telephone embodiment (FF 50).[28] The "Summary of the Invention" also teaches that the features of the invention are broad enough to be included in burglar alarms, electronic combination locks, low-speed modems for data transfer and remote control/signalling systems (FF 54). In addition the prosecution history for claims 6 and 13 do not relate, or restrict,[29]

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[28] Under the subheading "Summary of the Invention" it is stated that "[i]n accordance with a further important aspect of the present invention, a signal generator provides an output signal in response to an input signal from one of a plurality of monitored sources" (FF 52).

[29] In Polaroid Corp. v. Eastman Kodak Co., 789 F.2d 1556, 229 USPQ2d 561, 572 (Fed. Cir.), cert. denied, 479 U.S. 850 (1986), the Federal Circuit rejected appellant's argument that the district court improperly limited the "first film-advancing means" in claim 1 to a preferred embodiment in the '392 specification (i.e., a "rear pick, which is shaped like a hook"), and that the district court improperly permitted that "narrow" construction to dominate its analysis of the prior art contrary to § 112, which appellant argued required that a means-plus-function claim be construed to encompass "equivalents". In rejecting appellant's arguments the Federal Circuit stated that said arguments were based on a truncation of the claim language on which it rests which claimed language the Court stated was limited to film advancing means "adapted to extend into said opening for engaging said foremost film unit at said second edge thereof and moving said foremost film unit, subsequent to
(continued...)

those claims to any touch-tone telephone embodiment (FF 82, 84).

All the parties have agreed that independent claims 1 and 15, which are not in issue, are directed to signal generators that produce two tones--one representative of a row and one representative of a column of keys--that are summed to produce the dual-tone signals that are used in tone dialing. (CBR2 at 20). Complainant, however, argued in support of its interpretation of claims 6 and 13 that the Federal Circuit has explicitly approved subcombination claims, citing Stiftung v. Renishaw PLC, 945 F.2d 1173, 1181, 20 USPQ2d 1094 (Fed. Cir. 1991) (Stiftung); Bendix v. U.S. 600 F.2d 1364, 1369, 204 USPQ 617, 620 (Ct. Cl. 1979). In Bendix the subcombination claims in issue had a "utility [speed-responsive aspect] in a fuel control separate and apart from altitude compensation" to which other claims were directed and the Court found that it was clear both from the original application and the issued patent that altitude compensation is but one feature of the control. Id. In Stiftung the Court found that the record was clear that the subcombination claim claimed subject matter which had its own utility Id. Stiftung, 945 F.2d at 1181, 20 USPQ2d at 1090.

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[29](...continued)
exposure, through said exit" (Emphasis added); and that the "first film-advancing means" read, as it must, in the context of the entire claim, limited the "means" to that disclosed in the patent and equivalents which engage the "second edge". It further pointed out that as an initial matter, the district court properly construed the "first film advancing means" in light of the structure described in the specification; that the district court went on to note appellee's statement to the PTO during prosecution that the claims were limited to "a rear pick that engaged the film unit ... only at the trailing 'edge'"; that appellant had not shown error in the district court's finding that, in view of the prosecution history, the district court was compelled to read the claims as limited to a rear pick; and that the Federal Circuit would not "undertake the speculative inquiry" into why the limitation was entered, or whether it was directed to one purpose as appellant alleged but not to others.

Consistent with the interpretation by the administrative law judge of Bendix and Stiftung, is Special Equipment Co. v. Coe, 324 U.S. 370, 372-74 (1945) (Equipment). In issue in Equipment was whether a patent should issue upon a renewed application for a subcombination of certain elements of an apparatus. The plaintiff in the district court had made an original application for a patent on a "fruit-treating apparatus" claiming the combination of the elements embodied in the apparatus. The apparatus in the original application was for automatically performing the successive operations of bobbing (cutting off the stems) of pears, splitting the pears with a fixed vertically positioned knife straddled by overhead traveling clamps, paring the pears, and coring the pears, in preparation for canning or other processing of the pears. Certain claims to the combination in the original application were allowed. The renewed application claimed the apparatus of the original application but without the splitting knife. In the operation of the apparatus in the renewed application the pears were pre-split by hand, the split sections were placed face to face in a receiving and clamping means upon a first turntable, after which the operation, except the splitting by the splitting knife, proceeded in exactly the same way and accomplished the same result as when the splitting knife was present. Id. at 371-73. The district court sustained the rejection of the PTO, inter alia, for the reason that the subcombination claims did not "combine to produce any useful result." The Court of Appeals affirmed. Significantly the Court of Appeals, after observing the operation of the subcombination without the cutting knife, concluded that the subcombination was far more useful in its operation as shown by moving pictures than the old method of preparing fruit by hand. In reversing the lower courts, the Supreme Court stated:

> Petitioner's intended use of the patent to prevent others from appropriating it and by that means from appropriating an essential part of his complete machine is in no way inconsistent with petitioner's making other permissible uses of the subcombination patent. In fact, he does use the subcombination as a part of his completed machine and proposes to continue to use it. Execution of his declared purpose to prevent appropriation of either of his inventions, whether used separately or together, would not prevent his licensing others to make, use and vend the subcombination, on terms which would adequately protect the value of the monopoly of both his inventions to which he is entitled by the patent laws. <u>And we cannot say that others, who could not secure a license to use the complete machine, would not find it profitable to secure, or that petitioner would not find it profitable to grant, licenses to use the subcombination which the court below has found to be a useful device which has advanced the art</u>. [Emphasis added]

<u>Id.</u> at 379-80.

In <u>In re Simon, Thomas, and Burney</u>, 302 F.2d 733, 133 USPQ 524 (CCPA 1962), (<u>Simon</u>) the Court, with Judge Rich writing the opinion, while affirming a decision of the PTO rejecting two claims, commented on <u>Equipment</u>. The invention in <u>Simon</u> was for preparing expanded or cellular resin products from castor oil [A], polyhydric alcohol, mono and diesters of fatty acids containing from 1 to 3 free OH groups per molecule [D], a disocycante [B], a catalyst [E] and water [C]. Appellants argued that while allowed claims 1 to 18 were directed in essence to the combination of A +B + C + D + E, the two claims on appeal were directed to the subcombination A + B + C and that <u>Equipment</u> was controlling. In rejecting appellants' argument Judge Rich stated that the argument was made on the "assumption" that the two claims in issue were to a "subcombination." In examining <u>Equipment</u> he stated that the most it stands for is the proposition that if appellants had disclosed in their specification that their ingredients A + B + C would "<u>by themselves</u>," and in the absence of D + E, react to produce a "useful cellular product, which they did not disclose" it would have been proper to issue a patent on A

+ B + C. Id. 302 F.2d at 735, 133 USPQ at 526. (Emphasis added).

On the record before the administrative law judge he finds that independent claims 6 and 13 do not claim subject matter which has utility, in the absence of components of the dual tone multiple frequency tone generator which components are not recited in asserted claims 6 and 13.[30] Accordingly, claims 6 and 13, as UMC and the staff argued, are construed as directed to a

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[30] In Certain Erasable Programmable Read-Only Memories, Components Thereof, Products Containing Such Memories, and Processes for Making Such Memories (EPROMs), Inv. No. 337-TA-276, Com'n Op. (USITC Pub. No. 2196), aff'd in part, rev'd in part and vacated in part, Intel Corp., supra, the administrative law judge found that certain claims of a '108 patent were not invalid, not infringed and practiced by the domestic industry. In so finding the judge construed the term "sense amplifier" as requiring a differential sense amplifier and found that the claimed circuit must perform a differential function, of which a comparator function is a part. On review complainant Intel Corporation argued that the claims do not require that a comparator or differential function take place in the claimed sense amplifier branches and also contended that a combination or part of a device may be claimed separately, even though it cannot do useful work separately from the remainder of the device. Rejecting the conclusion of the administrative law judge that the "claimed branches must at least compare two inputs," the Commission found that a comparator function is not required by either the claims or the specification." Also while the Commission stated that it is reasonable to infer from the claims that the reason that two branches are claimed and that one of them contains a memory cell that establishes a reference is that a comparator function is to take place in the claimed sense amplifier, the law does not require that all of the claims recite each and every element necessary to the operation of the invention, citing In re Myers, 410 F.2d 420, 161 USPQ 668 (CCPA 1969). It further stated that the comparator function could be performed by some comparator means not recited, but also not excluded by the scope of the claims at issue. EPROMs, Com'n Op., (USITC Pub. No. 2196) at 30, 31.

In In re Myers the solicitor argued that independent claim 16 omitted an essential limitation, viz. an iron group binder. The Court rejected that argument on the ground that the following language in claim 16 "bonded hard metal carbide rim" had but one meaning to those skilled in the art, viz. a hard metal carbide bonded by an iron group metal. In re Myers, 410 F.2d at 423, 161 USPQ at 672. In this investigation the asserted claims, as construed by complainant, are intended to exclude essential components of the dual tone multiple frequency generator but yet are to find use, as the '886 specification discloses, only in a dial tone multiple frequency tone generator which has been claimed in independent claims 1 and 15, not in issue (FF 29).

single signal frequency generator which ultimately produces a single frequency output signal in response to the pressing of a key which generator is an "aspect of the present invention" (FF 50) in the '886 patent and which is distinct from the dual tone multiple frequency (DTMF) tone generator that is "another aspect of the present invention" (FF 51).[31]

2. The UM 95087 Tone Dialer Chip of UMC And Direct Infringement

It is undisputed that the UM 95087 chip of UMC, the only accused product in issue, is a dual-tone multiple frequency generator (FF 675, 676). Hence because independent claims 6 and 13 have been construed to cover a single frequency generator and not a dual-tone multiple frequency generator, it is found that there is no direct infringement involving UMC of asserted independent claims 6 and 13 and dependent claims 7, 8, 9 and 14.

3. Contributory Infringement

Complainant argued that under 35 U.S.C. §271(c), contributory infringement has occurred because (1) the UM95087 is a material part of the claimed '886 patent invention since it has every element except the keyboard, and (2) the evidence shows that there is direct infringement, that UMC knew of the infringement, and that there is no substantial non-infringing use for the UM95087 in that the only circuit application shown in the UM95087 data sheet (UMC's technical instructions to its consumer) is a telephone application connected to a keyboard, citing Preemption Devices v. Minnesota & Mfg. Co.,

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31 Claims should be construed to uphold their validity, if possible Whittaker Corp. v. UNR Industries, Inc., 911 F.2d 709, 712 15 USPQ2d 1742 (Fed. Cir. 1990). See also Lewmar Marine, Inc. v. Barient, Inc., 827 F.2d 744, 3 USPQ2d 1766 (Fed. Cir. 1987) cert. denied, 484 U.S. 1007 (1988); ACS Hospital Systems, Inc. v. Montifiore Hospital, 732 F.2d 1572, 221 USPQ 929 (Fed. Cir. 1984).

630 F.Supp. 460 (E.D. Pa. 1985) aff'd in part, vacated in part, and remanded, 803 F.2d 1170, 231 USPQ 297 (Fed. Cir. 1986) (Preemption). It is argued that an "[o]ccasional aberrant use of a product that is clearly designed to be used in a particular manner . . . does not make defendant's device 'a staple article' or commodity of commerce suitable for substantial nonfringing use," citing Dennison Mfg. Co. v. Ben Clements and Sons, Inc., 467 F. Supp. 391, 428 (S.D.N.Y. 1979) (Dennison); and that the mere "possibility" that someone may use the UM95087 for some application other than with a keyboard does not exculpate UMC from its liability for contributory infringement, referring to the following district court's statement in Preemption, 630 F. Supp. at 471: "[e]ven if the article has some significant noninfringing use, a manufacturer's knowledge that the component is to be used by an owner of an infringing system is sufficient to meet the burden under Section 271 (c)." (CB2 at 81-82).

UMC argued that it does not contributorily infringe the '886 patent because the evidence is uncontroverted that UM95087 is suitable for use in products which do not infringe the '886 patent. (RB2 at 45-48). Citing Sony Corp. of Am. v. Universal City Studios, Inv., 464 U.S. 417, 441-42 (1984) (Sony) it argued that the Supreme Court has held that for contributory infringement, the accused product must have virtually no other use, except for use in an infringing product. UMC argued that unlike the product in Dennison which involved "breaking" connections on the accused product and using the product in a manner for which it was not designed, UM95087 is designed to function in response to electronic inputs not generated by a keyboard; and that in Preemption the Federal Circuit in reviewing the District Court's decision stated that "section 271(c) . . . also requires a showing that a component especially made or adapted for use in a patented combination is not a staple article suitable for substantial nonfringing use." Preemption 803 F.2d at 1174. (RBR2 at 21).

The staff argued that the evidence of record shows that UM95087 may be used with or without a keyboard and hence UM95087 has substantial non-infringing uses and would not contributorily infringe the '886 patent, even if the claims at issue are construed to cover the DTMF dialers. (SB2 at 17-18).

Complainant, responding to UMC's arguments, argued that whether a product is a staple article that has substantial noninfringing use is essentially a question of fact, citing 4 Chisum, Patents 17.03[3]; that the portion of Sony relied on by UMC is based on a quotation from Dawson Chemical Co. v. Rohm & Hass Co., 448 U.S. 176 (1980) (Dawson) which is from dicta in Dawson that discussed cases decided before 35 U.S.C. 271(c) was enacted in 1952, citing Dawson, 448 U.S. at 198; and that the Court in Dawson did not determine whether the article was a staple article and the parties admitted that the article was not a staple article or commodity of commerce suitable for substantial noninfringing use, within the language of 35 U.S.C. §271(c), citing Dawson, 448 U.S. at 185-86. Complainant also argued that UMC cannot rely upon hypothetical substantial noninfringing uses to avoid infringement; that "[m]ere theoretical capability" is not sufficient, citing Fromberg, Inc. v. Thornhill, 315 F.2d 407, 415, 137 USPQ 84, 90 (5th Cir. 1963) (Fromberg) and 4 Chisum Patents §17.03[3]; and that one must show "an actual and substantial noninfringing use," citing Alcon Lab. Inc. v. Allergan Inc., 17 USPQ2d 1365, 1377 (N.D. Tex. 1990) (Alcon) which was said to cite Fromberg. (CBR2 at 22-23).

It is well settled that if there is no direct infringement, there can be no contributory infringement. Aro Mfg. Co. v. Convertible Top Replacement Co., 365 U.S. 336, 341 (1961) (Aro). The administrative law judge has found that complainant has not established that there is any direct infringement involving the use of UMC's UM95087.

Assuming arguendo that complainant had established direct infringement, the administrative law judge finds that complainant has not met its burden of proving contributory infringement of the asserted claims by a preponderance of evidence. UMC's product brochure and catalog for its UM95087 show that the UM95087 may be electrically accessed as well as manually accessed and that it may be used with or without a keyboard. Also the UMC literature provide instructions for keyboard use and electrical use (FF 682, 683, 685). Even complainant has alleged that the circuitry of the UM95087 is essentially identical to circuitry of its MK5087; and that UM95087 is a direct substitute for the MK5087, which MK5087 is designed specially for both electrical and keyboard selection at the user's discretion (FF 677 to 681). Accordingly the administrative law judge finds that the UM95087 of UMC has substantial noninfringing uses.

The cited Preemption, Dennison, and Fromberg cases are inapposite. In Preemption the Federal Circuit stated that the district court expressly found that the accused product had no substantial noninfringing use which therefore made it a non-staple article. Preemption, 803 F. 2d at 1174, 231 USPQ at 300. In Dennison, the district court found that there was only an "occasional aberrant [abnormal] use of a product that is clearly designed to be used" in the manner specified in the method claims that were in issue. Dennison 467 F. Supp. at 428. In Fromberg the Fifth Circuit Court of Appeals had the initial impression that the alleged use, unrelated to the patent in issue, was an "afterthought" since several witnesses acknowledged that they had never known of said use until "this capability was demonstrated during some pretrial depositions." Fromberg, 315 F.2d at 415, 137 USPQ at 90. In the cited Alcon, supra, while the district court used the term "actual and substantial noninfringing use" (emphasis added), 35 U.S.C. §271(c) does not use the word "actual."

In comparison to the facts in this investigation, in Aro, where contributory infringement was found, Aro's factory manager admitted that the fabric replacements in question not only were specially designed for the Ford convertibles but would not, to his knowledge, fit the top-structures of any other cars. Aro, 476 U. S. at 488. In Polysius Corp. v. Fuller Co., 709 F. Supp. 560, 10 USPQ2d 1417, 1429 (E.D. Pa. 1989) aff'd, 889 F.2d 1100 (Fed. Cir. 1989) the district court stated that a non-staple article is one which was designed to carry out a patented process and has little or no utility outside of the patented process while a staple article of commerce is one that was not specifically designed for use with a patented process and has substantial, efficient and feasible uses outside of the patent Polysius, 709 F.Supp. at 571, 10 USPQ2d at 1428-29. In Dawson the Supreme Court specifically found that the accused "propanol is a nonstaple commodity which has no use except through practice of the patented method." Dawson 176 U. S. at 199.

The evidence in this investigation, which originated not only from UMC but also from complainant, conclusively establishes that the "substantial noninfringing use" found for UM95087 (FF 674 to 685) was no "afterthought," and that the accused UM95087 has substantial use or uses not connected with the DTMF generator.

4. Induced Infringement

Complainant argued that under 35 U.S.C. §271(b), a party induces the infringement of a patent when it knowingly encourages others to directly infringe a patent, citing Water Technologies Corp. v. Calco, Ltd., 850 F.2d 660, 668, 7 USPQ2d 1097, cert. denied, 488 U.S. 968 (1988) (Water); and that UMC has induced infringement because UMC knew of complainant's claim that UM95087 in combination with a keyboard infringed the '886 patent at least as early as October 1990 but yet continued to market the chip expressly for use with a keyboard in a telephone application with its data sheets showing only one circuit application, viz. a combination with a keyboard in a telephone circuit which satisfies the intent element. (CB2 at 81-2).

The staff argued that UMC's product brochures provide instructions for both keyboard and electrical use of UM95087 dialer chip and hence assuming claims 6 and 13 are construed to cover a dual-tone multiple frequency generator and the other elements of the claims are found to be present, UMC, by providing instructions for an allegedly infringing use, has induced the infringement of the '886 patent. (SB2 at 19).

UMC argued that under 35 U.S.C. §271(b), "Whoever actively induces infringement of a patent shall be liable as an infringer"; that complainant "has the burden of showing that [UMC's] actions induced infringing acts and that [UMC] knew or should have known [its] actions would induce actual infringements," citing Manville Sales Corp. v. Paramount Sys., Inc., 917 F.2d 544, 553, 16 USPQ2d 1587 (Fed. Cir. 1990) (Manville Sales) (emphasis in original); that the requirement of specific intent is rigorous in that "[i]t must be established that the defendant possessed specific intent to encourage another's infringement and not merely that the defendant had knowledge of the acts alleged to constitute inducement," citing Manville Sales, 917 F.2d at 553, 16 USPQ2d at 1594, and Hewlett-Packard Co. v. Bausch & Lomb, Inc., 909 F.2d 1464, 1469, 15 USPQ2d 1525, 1528-29 (Fed. Cir. 1990) (Hewlett); that under §271(b), an inducing act "refers to action 'by which one in fact causes, or urges, or encourages, or aids another to infringe a patent'" citing Mirafi Inc. v. Murphy, 14 USPQ2d 1337, 1349 (W.D.N.C. 1989) (quoting Fromberg, 315 F.2d at 411, 137 USPQ at 87); and that "[a] person induces infringement under §271(b) by actively and knowingly aiding and abetting another's direct infringement;" quoting C.R. Bard, Inc. v. Advanced Cardiovascular Sys., Inc., 911 F.2d 670, 675, 15 USPQ2d 1540 (Fed. Cir. 1990) (emphasis in original). It is argued that complainant has failed to produce a scintilla of evidence showing either specific intent or a knowing act of inducement.

UMC also argued that there is no evidence that UMC had any knowledge of the importation into the United States of telephones containing the UM95087 or that UMC encouraged or induced any such importation. It is argued that the U.S. patent laws only prohibit the making, using or selling of an infringing product "within the United States." 35 U.S.C. §271(a). UMC argued that consequently the use of UM95087 in a telephone that is made outside the United States does not constitute direct infringement and, even encouraging such foreign use would not constitute contributory or induced infringement under the U. S. patent laws; and that the fact that UMC data books contain a telephone application circuit does not, in and of itself, constitute evidence that UMC encouraged or induced use of the UM95087 in any manner which would constitute an infringement of U. S. patent laws, in the absence of evidence, of which UMC maintains there is none, that UMC encouraged importation of the infringing telephone into the United States. (RBR2 at 21-22).

Section 271(b) does not require that the acts of inducement occur within the United States, and it has been held that active inducement may be found in certain events outside the United States if they result in a direct infringement in the United States. See Honeywell, Inc. v. Metz Apparatewerke, 509 F.2d 1137, 1139-1142, 184 USPQ 387, 389-342 (7th Cir. 1975) where the German defendant Metz had an exclusive distribution agreement specifically for United States sales, and Nippon Electric Glass Co., Ltd. v. Sheldon, 489 F.Supp. 119, 122, 209 USPQ 1023 (S.D.N.Y. 1980) where the Japanese manufacturer had agreed to indemnify the distributors in America against liability relating to the subject patents.

Complainant has the burden of proving that UMC specifically intended for its sales of the UM95087, even assuming arguendo there is direct infringement of the '886 patent in the United States. Manville Sales, 917 F.2d at 553. In Manville Sales, relied on by UMC, the district court had found that certain corporate officers were liable for inducing infringement even through it found that they were not aware of the U.S. patent until suit was filed and that the subsequent infringing acts continued upon a "good faith belief," based on advice of counsel. The Federal Circuit however, reversing the district court, concluded that there was simply neither compelling evidence nor any findings that the officers had specific intent to cause another to infringe. Manville Sales, 554 F.2d at 553-554, 16 USPQ at 1594.

In Water cited by complainant, in finding inducement to infringe by one Gartner, the district court relied, inter alia, on Gartner in the United States having given all of certain resin formulae to the direct infringer, helping the alleged infringer make the infringing resins and preparing consumer use instructions. The district court also referred to Gartner's ability to exert control over the direct infringer's manufacture of the infringing resins. Rejecting Gartner's assertion that a finding of intent is negated by evidence showing a subjective belief of Gartner that he had a noninfringing resin, the Federal Circuit found proper the district court's contrary finding on the basis of other circumstantial evidence, and stated that "[i]ntent is a factual determination particularly within the province of the trier of fact." Water, 850 F.2d at 668, 669, 7 USPQ2d at 1104, quoting Allen Organ Co. v. Kimball Int'l, Inc., 839 F.2d 1556, 1557, 5 USPQ2d 1769, 1778 (Fed. Cir. 1988).

In Hewlett, cited by UMC, the Federal Circuit required proof of actual intent to cause the acts which constitute the direct infringement a necessary prerequisite to finding active inducement. In finding no inducement the Court looked at certain circumstantial evidence, viz. the totality of events surrounding the sale of certain assets, and found that it was clear from those events that the seller of the assets accused of inducing infringement had no interest in what the purchaser (the direct infringer) did with the assets.

The record in this investigation demonstrates that respondent SMC, which is located in Hong Kong and is a manufacturer of telecommunication products (FF 4), purchased quantities of the UM95087 from UMC (FF 1038, 1039a); that UMC provided the UM95087 to Conso. Ltd., (FF 1035(a)) which is also located in Hong Kong and is a supplier of telecommunication products (FF 1059); and that the UM95087 is found in the Honey Phone (CPX-57) which is in the United States.[32]

In this investigation however the administrative law judge finds that

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[32] UMC did not take issue with the fact in complainant's proposed finding 1265 that "CPX-57 is an example of a telephone using the UMC UM95087 chip."

complainant has not established a specific intent of UMC to cause a direct infringement of the asserted claims, within the United States, assuming arguendo, complainant had established direct infringement in the United States. Thus, while UMC provided UM95087 to SMC and Conso. Ltd. and the UM95087 was used by SMC and Conso. Ltd. for DTMF generators, SMC and Conso. Ltd. are located in Hong Kong. At the hearing the direct source for the UM95087 in the Honey Phone was not identified.[33] Also, the fact that UMC's product brochures are printed in English does not show that UMC had a specific intent to cause another to infringe in the United States.[34] [35]

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[33] UMC objected to the admissibility of CPX-57 because "we don't know the chain of possession" of the exhibit (Tr. at 1514). Complainant made reference to invoices attached to the complaint (Tr. at 1514). CPX-57 was received into evidence with the opportunity given to UMC to cross examine on the exhibit. (Tr. at 1515). On a review of the exhibits to the complaint, referenced by complainant's counsel, the complaint did have an exhibit (Exhibit No. 6) titled "Invoices and other sales-type documentation for infringing parts." Included in that section were documents titled "Invoices and Sales-Type Documentation for Hualon Microelectronics, Corp." and "Invoices and Sales-Type Documentation for Winbond Electronics Corp." (ALJ Ex. 4). The administrative law judge finds nothing in ALJ Ex. 4 that makes reference to the Honey Phone.

[34] Complainant at the hearing did not indicate that UMC sent its brochures to the United States.

[35] UMC argued that "in alleging such unlawful activity [as inducement to infringe] at the complainant must meet the requirements of 19 U.S.C. §1337 (a)(1)(A), which concerns unfair methods of competition as opposed to the requirements of 1337 (a)(1)(B) which addresses importation and sale of infringing products in the United States," and that under 337(a)(1)(A) complainant would have to show injury. (RB2 at 50). UMC cited no authority for this proposition.

The scope section of the notice of investigation, which issued on April 1, 1992, states that this investigation was instituted in order to determine whether there is a violation of section 337(a)(1)(B)(i), not 337(a)(1)(A). Moreover, the Commission has in the past expressly included allegations such as induced and/or contributory infringement within the scope of an investigation instituted under section 337(a)(1)(B). See e.g., Certain Microporous Nylon Membrane and Products Containing Same, Inv. No. 337-TA-322, Notice of Investigation (Jan. 11, 1991) at 2; Certain Scanning Multiple-Beam (continued...)

B. Validity of Asserted Claims

UMC challenged the claims in issue of the '886 patent under 35 U.S.C. §102 and 35 U.S.C. §103. The staff concluded that "the '886 patent is not anticipated" and "is not obvious." (SB2 at 74).

1. 35 U.S.C. §102

Anticipation under 35 U.S.C. §102 requires, in a single prior art reference, a disclosure of each and every element of the claimed invention. Connell v. Sears, Roebuck & Co., 772 F.2d 1542, 220 USPQ 193 (Fed. Cir. 1983) (Connell); SSIH Equip. S.A. v. U.S. Intern. Trade Com'n, 718 F.2d 365, 218 USPQ 678 (Fed. Cir. 1983). To anticipate, the reference must be a "direct teaching." In re Brown, 329 F.2d 1006, 141 USPQ 245 (CCPA 1964). In other words "the prior art reference in question must be enabling, placing the allegedly disclosed matter in the possession of the public." Akzo, 808 F.2d at 1479, 1 USPQ2d at 1248. For a reference to be enabling, it must allow a person having ordinary skill in the art to make and use the invention without undue experimentation. Connell, 721 F.2d at 1557, 220 USPQ2d at 309. Elements missing in a prior art reference, may not be supplied by the knowledge of "one skilled in the art." Structural Rubber Products Co. v. Park Rubber Co., 749 F.2d 707, 716, 223 USPQ 1264 (Fed. Cir. 1984). Anticipation under 35 U.S.C. §102 can be found only when the reference discloses exactly what is claimed. Titanium Metals Corp. v. Banner 778 F.2d 775, 227 USPQ 773,

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[35](...continued)
Equalization Systems for Chest Radiography and Components Thereof, Inv. No. 337-TA-326, Notice of Investigation (Feb. 20, 1991) at 2; Certain Computer System State Save/Restore Software and Associated Backup Power Supplies for Use in Power Outages, Inv. No. 337-TA-330, Notice of Investigation (Sept. 18, 1991) at 2. Accordingly, the administrative law judge rejects any argument that the requirements of 19 U.S.C. §1337(a) (1) (A) must be met for any allegation of complainant in this investigation.

777 (Fed. Cir. 1985). Anticipation cannot be predicated on teachings in a reference that are vague or based on conjuncture. Datascope Corp. v. SMEC, Inc., 224 USPQ 694, 698 (D.N.J. 1984) aff'd in part & rev'd in part, 776 F.2d 320, 227 USPQ 838 (Fed. Cir. 1985).

UMC argued that an IC Guide or a Hoff '015 patent shows all the elements of independent claims 6 and 13 "when those claims are interpreted" as alleged by complainant, and hence the IC Guide or the Hoff '015 patent anticipates claims 6 and 13. (RB2 at 84, 85, 88).[36] It is argued that dependent claims 7, 8, 9, and 14 are anticipated by the Hoff '015 patent. (RB2 at 92, 94, 95).

Complainant argued that the Hoff '015 patent is very different from the claims in issue in that it neither contains all of the claimed elements nor operates in the same way. (CB2 at 85 to 88). It argued that the IC Guide is not prior art to the '886 patent and that even if it were prior art, the IC Guide does not anticipate asserted claims 6 and 13 of the '886 patent because it does not enable one of ordinary skill in the art to make the device described in the IC Guide.

The administrative law judge finds that UMC has not established by clear and convincing evidence that the IC Guide had "public accessibility" on or before the critical date of September 29, 1979. See FF 605 to 640. Accordingly pursuant to In re Cronyn, 890 F.2d 1158, 1160, 13 USPQ2d 1070 (Fed. Cir. 1989), the administrative law judge finds that the IC Guide is not

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[36] UMC, in its submission of proposed findings, presented no findings involving the IC Guide. UMC in its reply brief did argue that the IC Guide, regardless of whether it is or is not enabling under 35 U.S.C. §102, is material prior art for a determination of obviousness under 35 U.S.C. 103 and argued that the figure on page 139 of the IC Guide is "substantially identical "to Figure 1 of the '886 patent, differing only by the substitution of the word "ROM" in the IC Guide for the acronym "PLA" in the '886 patent. (RBR2 at 25).

prior art under the applicable statute. Moreover, assuming arguendo the IC Guide is prior art, the administrative law judge finds that the IC Guide is irrelevant even assuming arguendo that the asserted claims are construed as complainant argued (FF 642 to 647).

With respect to the Hoff '015 patent (FF 593) which is directed to a system for generating a multiplicity of frequencies from a single reference frequency (FF 596, 597), UMC's expert in his direct testimony in support of his opinion that the Hoff '015 patent anticipates the asserted claims relied specifically on an alleged teaching in the '886 patent for "the equivalence of a ROM to a PLA" (FF 594). In addition, the administrative law judge finds that the Hoff '015 patent does not tell one whether it is tones or pulses that are being sent to the keyboard (FF 598) and does not describe exactly how the keyboard is scanned (FF 599).[37] Accordingly the administrative law judge finds, assuming arguendo the asserted claims are construed as complainant interpreted them, that UMC has not established by clear and convincing evidence that the asserted claims are anticipated by the Hoff '015 patent.

2. 35 U.S.C. §103

UMC argued that an Allen/NRMEC article relating to organs renders both claims 6 and 13 of the '886 patent obvious (RB2 at 87); that claims 6 to 9, 13 and 14 are also obvious to a person having ordinary skill in the art in light of the Thomas '028 patent in combination with the Hoff '015 patent or a Newsom '604 patent (RB2 at 89); that claim 7 is obvious in view of the Thomas '028 and Hoff '015 patent (RB2 at 91); that the combined teachings of the Thomas

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[37] Magleby makes a distinction between "pulses" and "tones" (FF 143). The distinction between rotary dial telephones and the DTMF dialer telephones is that the rotary dial telephones utilized pulse dialing techniques while the DTMF phones utilized a tone dialing technique (FF 230).

'028 patent and the Newsom '604 patent render claims 8 and 9 obvious (RB2 at 94); and that the combined teachings of the Thomas '028 patent, the Hoff '015 patent and the Newsom '064 patent renders claim 14 obvious. (RB2 at 95).

Complainant argued that UMC's contention that the combination of the Thomas '028 patent with the Hoff '015 or Newsom '604 patents belies UMC's earlier position that Hoff '015 alone anticipates the claims in issue; and that the Hoff '015 patent in combination with the Thomas '028 or Newsom '604 patents fares no better in presenting a case for invalidating the asserted claims. Thus it argued that the Hoff '015 patent is defective for the same reasons stated with respect to 35 U.S.C. §102; that the Newsom '604 patent is not prior art[38] and that even if it was prior art, the Newsom '604 patent does not fill the missing elements of the Thomas '028 patent; and that there is no teaching or suggestion in any of the Hoff '015 patent, Thomas '028 patent or Newsom '604 patent for their combination as a finding of obviousness requires. (CB2 at 89, 91, 93, 94). Complainant also argued, as to the reference of UMC to electric organs, that art is not analogous if a reference is not within the field of the inventor's endeavor and is not directly pertinent to the particular problem with which an inventor was involved; and that UMC's expert Magleby admitted that "a DTMF dialer chip --the type the '886 patent is directed to -- could not be used in an electric organ." (CB2 at 93).

Regarding the organ art, the administrative law judge finds that it lacks details as to what is disclosed (FF 603). With respect to the other art cited by UMC and assuming arguendo the asserted claims are to be interpreted as

38 The administrative law judge finds that the Newsom '604 patent, which has a filing date of April 7, 1975 (FF 565), is not prior art under 35 U.S.C. §102(b) for the same reason that he has found, earlier in this opinion, that the Hoff '709 and Borison '090 patents are not prior art.

complainant contended, the administrative law judge finds as to the Thomas '028 patent (RX-325) that the output waveform is very crude and requires external filtering (FF 602); that the patent has only a two-bit DAC equivalent and it does not have any kind of memory means at all (FF 602); that the sine wave outputs are summed off chip; that regulation of tones is not provided for in any manner, that the reference oscillator oscillates all the time; that the patent has no control function to do any of the common functions necessary; and that the patent does not have pulses representatives of keys (FF 602). Regarding the Hoff '015 patent, the patent has deficiencies as found in the foregoing section dealing with 35 U.S.C. §102. Moreover, the administrative law judge finds that the memory configuration in Hoff is not equivalent to the PLA embodiments in the '886 patent (FF 604).

Based on the foregoing the administrative law judge finds that UMC has not established by clear and convincing evidence that the asserted claims are not valid under of 35 U.S.C. §103, in view of any of the cited art.

V. VALIDITY OF THE '108 AND '886 PATENTS UNDER 35 U.S.C. §112

HMC and/or UMC and the staff have argued that the '108 and '886 specifications fail to comply with the enablement requirement of 35 U.S.C. §112.[34] HMC and/or UMC and the staff also argued that the best modes of the inventions in the '108 and '886 patents are not disclosed in the '108 and '886

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[34] The pertinent portion of the first paragraph of section 112 reads:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same....

specifications, in violation of the requirement of 35 U.S.C. §112.[35] The arguments of HMC and/or UMC and the staff involve the "on the chip" limitation of independent claim 1 of the '108 patent and alleged deficiencies in the '108 and '886 specifications.

To sustain their allegations that the '108 and '886 patents are invalid under 35 U.S.C. §112, HMC, UMC and the staff must carry the burden of proving by clear and convincing evidence that the patents do not satisfy 35 U.S.C. §282. See, Railroad Dynamics, Inc. v. A. Stucki Co., 727 F.2d 1506, 1517, 220 USPQ 929, 939-40 (Fed. Cir.) cert. denied 469 U.S. 871, 224 USPQ 520 (1984).

It is a fact that the claimed inventions of the '108 and '886 patents in issue, as construed by complainant, have been alleged to have been constructively reduced to practice on September 29, 1975, through the filing of Ser. No. 617,955 in the Patent and Trademark Office (PTO).[36] It is also a fact that the inventions of the claims in issue of the '108 patent and '886 patent were not actually reduced to practice[37] until after the September 29,

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[35] The best mode defense to patentability is grounded in the following requirement for a patent specification under 35 U.S.C. §112 (first paragraph):

> The specification ... shall set forth the best mode contemplated by the inventor of carrying out his invention.

[36] The filing of an application for a patent disclosing the invention in compliance with 35 U.S.C. §112 constitutes a constructive reduction to practice of the invention and may be relied on as the date of reduction to practice for purposes of determining priority and patentability even though the applicant never actually reduced the claimed invention to practice. Corning Glass Works v. Sumitomo Electric USA Inc., 671 F. Supp. 1369, 5 USPQ2d 1545, 1562 (S.D.N.Y. 1987), aff'd, 868 F.2d 1251, 9 USPQ2d 1962 (Fed. Cir. 1989).

[37] Actual reduction to practice occurs when the inventor constructs a product or performs a process that is within the scope of the patent claims and demonstrates the capacity of the inventive idea to achieve its intended purpose. See Newkirk v. Lulejian, 825 F.2d 1581, 1582, 3 USPQ2d 1793, 1794 (continued...)

1975 filing date, i.e. until early 1976 (Tr. at 4415-4417).[38] Hence there was actually no functioning chip until after the September 29, 1975 initial filing dates of the '108 and '886 patents. (Tr. at 4415-4417).[39]

The requirement of 35 U.S.C. §112 for an adequate disclosure assures that the public receives a "quid pro quo" for the limited monopoly granted to the inventor and that the public knows what may or may not be safely used or manufactured without a license. See Permutit Co. v. Graver Corp., 284 U.S. 52, 60 (1931) (Permutit Co.), which involved the predecessor of 35 U.S.C. §112.[40] [41] See also Schriber Schroth Co. v. Cleveland Trust Co., 305 U.S. 47,

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[37](...continued)
(Fed. Cir. 1987).

[38] Referring to Figure 12 of the '108 patent, the first commercial version for DTMF built by Mostek in 1976 had everything integrated on the chip except bipolar transistor 594. Subsequent to the first commercial version there were times when bipolar transistors 588 and 604 were not found necessary to be on the chip (FF 341).

[39] While complainant has admitted at least to errors in the '108 and '886 specifications, the record does not show any attempt by complainant to correct the errors in the specifications, either while the applications involving the '108 and '886 patents were pending at the PTO, or after the patents had issued.

[40] The language of the first paragraph of 35 U.S.C. §112 is based upon, and derived from, §33 of the 1946 edition of 35 U.S.C. (the former R.S. 4888) which was repealed by the 1952 Patent Act. A major change in the first paragraph of 35 U.S.C. §112 over old §33 was in the best mode language. In 35 U.S.C. §112 the clause relating to machines in old §33 was omitted as unnecessary, and the best mode requirement was made applicable to all statutory classes of invention.

[41] In Permutit Co. the Court found that a patent on an improved zeolite water softening device was not valid. The patent owner had relied upon the substitution of a "free," for a "locked," zeolite bed. In prior filters the bed was "locked" by placement of a screen over the bed to prevent light grains from washing out. The patentee discovered that such locking caused erratic performance and cured the problem by substituting a space between the screen and the layer of zeolite. The space feature was not mentioned in either the claims or the language of the specification, although a drawing attached to the patent did seem to indicate the space feature. Nevertheless, the Court
(continued...)

57, (1938); Long Manufacturing Co. v. Lilliston Implement Co., 328 F. Supp. 268, 277, 278, 171 USPQ 228 (E.D.N.C. 1971) affd., 457 F.2d 1317 (4th Cir. 1972), cert. denied, 409 U.S. 274 (1972); Certain Limited Cell Culture Microcarriers, Inv. No. 337-TA-129, Com'n Op., 221 USPQ 1165, 1171 (USITC Pub. No. 198)(Microcarriers).[42]

To satisfy 35 U.S.C. §112, a patent specification must be sufficiently complete to enable a person having ordinary skill in the art to make the invention without undue experimentation, although the need for a minimum amount of experimentation is not fatal. Enablement is the criterion. Every experimental detail need not be set forth in the written specification if the disclosure enables one having ordinary skill in the art to make the invention.

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[41](...continued)
held that the specification was incomplete because the free bed was neither described in the specification nor claimed. Permutit Co., 284 U.S. at 60.

[42] The Commission in Microcarriers held that "[e]xperimentation is not inconsistent with enablement" and that "the fact that experimentation may be complex, as testified to ... does not necessarily make it undue, if the art typically engages in such experimentation." Microcarries, 221 UPSQ at 1174. However, the Commission in Microcarriers stated that "undue" experimentation would defeat the enabling requirements of 35 U.S.C. §112. See also In re Ghiron and Ulrich, 442 F.2d 985, 169 USPQ 723 (1971); In re Brandstadter, Kienzler and Sykes, 484 F.2d 1395, 179 USPQ 286 (CCPA 1973) (Brandstadter); In re Scarbrough, 500 F.2d 560, 182 USPQ 298 (CCPA 1974).

In Brandstadter, Judge Rich in affirming a rejection under the enablement provision of 35 U.S.C. §112, stated that affidavits submitted by appellants generally express the affiants' opinions on the ultimate legal question of whether the specification is enabling, but, as "appellants admit in their brief, 'opinions directed to ultimate legal questions are not competent expressive of opinion'." Id. 179 U.S.P.Q. at 293 (Emphasis in original). Judge Rich thereupon noted that "affiants' statements that they would themselves be able to practice the invention are certainly some evidence on the ultimate legal question of enablement, but we must agree with the examiner's statement that 'the affidavits fail in their purpose since they recite conclusions and few facts to buttress said conclusions ...'" Id. at 294. (Emphasis added).

Martin, Aebi and Ebner v. Johnson, 454 F.2d 746, 172 USPQ 391 (CCPA 1972). A patent specification is not required to be a production blueprint. Douglas v. United States, 510 F.2d 364, 184 USPQ 613 (Ct. Cl.) cert. denied, 423 U.S. 825 (1975). Moreover, a patentee cannot be expected to foresee every technological problem that may be encountered in adapting his idea to a particular use. Some experimentation and exercise of judgement is to be expected. Id. at 615.

In determining what constitutes undue experimentation, many factors are taken into account. Thus, any necessary experimentation would be undue when ingenuity beyond that to be expected of a person having ordinary skill in the art is required. Other factors to be considered are the presence or absence of working examples, the nature of the invention, the state of the prior art, the relative skill of those in the art and the predictability or unpredictability of the art. In re Colianni, 561 F.2d 220, 195 USPQ 150, 153 (CCPA 1977) (Colianni).[43]

A patentee may offer evidence, such as patents, publications and

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[43] In Colianni the majority found certain claims to a method of mending fractured bone by applications of ultrasonic energy properly rejected for inadequate disclosure under 35 U.S.C. §112. Illustrative claim 1 read:

> 1. The method of rapidly mending fractured animal bones which comprises applying sufficient ultrasonic energy by direct mechanical subcutaneous connection to the bone on at least one side of the fracture therein to join the bone together at the fracture.

In affirming the board and the PTO, the majority stated that the PTO rightly questioned the adequacy of appellant's disclosure; that while the application of sufficient ultrasonic energy is essential to appellant's claimed method, the specification did not disclose what a "sufficient" dosage of ultrasonic energy might be or how one skilled in the art might make the appropriate selection of frequency, intensity and duration. Colianni 561 F.2d at 222, 195 USPQ at 152.

testimony, to show the knowledge possessed by a person having ordinary skill in the art and thereby establish that a given specification is enabling. However, in such a situation "it is the knowledge possessed by those skilled in the art as of the filing date [of the application which resulted in the patent] that is of relevance." In re Eynde, Pollet, and deCat, 480 F.2d 1364, 178 USPQ 470, 474 (CCPA 1973). (Emphasis added). Thus, the critical date for determining whether a patent is in compliance with 35 U.S.C. §112 is the date the application for the patent is filed, not some years after the issuance of the patent. In re Koller, Hartl and Kirchner, 613 F.2d 819, 204 USPQ 702, 706 (CCPA 1980). Furthermore, when an application based on a previously filed application in the United States is involved in the issuance of a patent, compliance under 35 U.S.C. §112 should be tested as of the date of the earliest filed application. In re Hogan and Banks, 559 F.2d 595, 194 USPQ 527, 536 (CCPA 1977).

Pursuant to the best mode requirement of 35 U.S.C. §112, an inventor must disclose the best mode of carrying out the invention contemplated by him in the patent specification, as of the time the inventor executed the application. In re Gay, 309 F.2d 769, 135 USPQ 311 (CCPA 1962). An inventor is in compliance with the best mode requirement if he does not conceal what he feels is a preferred embodiment of his invention. Id. 135 USPQ at 315. For a concealment of the best mode, the evidence need not have been to show an intentional concealment. The concealment can be merely accidental. In re Sherwood, 613 F.2d 809, 204 USPQ 537, 544 (CCPA 1980), cert. denied, 450 U.S. 994 (1981).

Determination of whether the best mode requirement has been met is a question of fact, Spectra-Physics, Inc. v. Coherent, Inc., 827 F.2d 1524, 1535-36, 3 USPQ2d 1737, 1745 (Fed. Cir.), cert. denied, 484 U.S. 954 (1987). Moreover it is concealment of the best mode of practicing the claimed invention that section 112 is designed to prohibit. Randomex v. Scopus Corp., 849 F.2d 585, 588, 7 USPQ2d 1050, 1053 (Fed. Cir. 1988); Chemcast Corp. v. Arco Indus. Corp., 913 F.2d 923, 927-28, 16 USPQ2d 1033, 1036-37 (Fed. Cir. 1990). Unclaimed subject matter is not subject to the disclosure requirement of §112. Engal Industries Inc. v. The Lockformer Co., 946 F.2d 1528, 1531, 20 USPQ2d 1300, 1302 (Fed. Cir. 1991).

A. The "on the chip" Limitation of the Asserted Claims of the '108 Patent

HMC and UMC argued that the '108 patent shows in Figure 12 and describes in detail the "only disclosed embodiment as including on the same integrated circuit a PNP transistor 594 and numerous NPN transistors";[44] that, as testified to by Kooi (citing RX3 at 6, 8), according to Fair and inventor Callahan PNP transistor 594 could not be formed on the chip using the "conventional CMOS process referenced in the '108 patent" (citing Tr. at 1691 to 1693, 680 to 682); and that inventor Callahan knew this fact at the time the first patent application was filed on September 29, 1975, but failed to disclose it in any of the patent applications for the '108 patent (citing Tr. at 734 to 736). Hence HMC and UMC argued that the "only disclosed embodiment" of the '108 patent does not enable a person having ordinary skill in the art to make and use the claimed invention and thus that the asserted claims of the '108 patent are invalid under 35 U.S.C. §112. (RB2 at 65). HMC and UMC also argued that it is clear that the best mode of the invention in the '108 patent

[44] See FF 126 for an understanding of "NPN" and "PNP."

(the formation of PNP transistor 594 off the chip) is not disclosed in the '108 specification in violation of the requirements of 35 U.S.C. §112. (RB2 at 74).

The staff argued that the '108 patent specification does not disclose how to fabricate a chip having N and P type transistors on the same chip with the rest of the circuitry (citing Callahan Tr. 650, 734 to 736, 738, Kooi RX3 Ans. 22) and that the record contains uncontradicted testimony that, at the time the '108 patent application was filed on September 29, 1975, an integrated circuit containing functional bipolar PNP and NPN transistors on the same chip could not be fabricated "using normal CMOS technology" (citing Kooi Tr. 3327-3328, 3346; RX3 at 6, 7). It is argued that inventor Callahan testified that he was aware at least from December 19, 1973 that neither he nor Mostek (the named assignee of the '108 patent) knew how to fabricate a chip containing functional PNP and NPN transistors on the same integrated circuit (citing Callahan Tr. 736). (SB2 at 59, 60). Therefore, it is argued by the staff that the '108 patent specification does not enable a person having ordinary skill in the art to fabricate each component of the common switching means on the chip and further that the best mode was concealed because the inventors knew that the PNP transistor 594 could not be fabricated on the chip and failed to disclose that fact in the '108 patent specification. (SB2 at 60, 61).

As stated supra, while a patentee may offer evidence to show the knowledge possessed by a person having ordinary skill in the art, it is the knowledge possessed by those skilled in the art, as of the filing date of the patent in issue, not as of the date of any hearing in a section 337 investigation, which is relevant. In this investigation the controlling filing date for each of the '108 and '886 patents is September 29, 1975.

The parties have agreed that in 1975 a person having ordinary skill in the art would have a B.S. in electrical engineering and would have several years experience in logic design of circuits of the kind described in the '108 patent (FF 21).[45] Such a person however would not necessarily have skill in the telephony art (FF 22). Moreover while such a person in 1975 would know how to build CMOS elements, the administrative law judge finds that that person would not know how to implement on the same chip NPN transistors and a functional PNP transistor which is isolated from the rest of the circuitry (FF 23 to 25).

At closing argument complainant did reference a preferred embodiment in the '108 patent where all the means for enabling the oscillator, disabling the transmitter and attenuating the receiver including bipolar transistor 594[46] are "on the chip" as that term has been construed by the administrative law

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45 While witnesses with technical backgrounds, who testified at the hearing in this investigation, have discussed with attorneys at great length before the hearing the subject matter of the '108 and '886 patents (see for example the written direct testimony in CX503, CRX118, CRX112, RX1, RX1A, RX1B, RX1C and RX3) the record does not show that a person having ordinary skill in the art in 1975 would have had such discussions with any attorney. The record does reflect that the inventors named on the '108 and '886 patents did have conversations with the attorney who filed the earliest application for the '108 and '886 patents before the application was filed on September 29, 1975 (FF 661, 667, 670). However the record does not reflect the length of such conversations.

46 A bipolar transistor, particularly at the time when the inventions of the '108 and '886 patents were made, was known to carry more current than MOS transistors (FF 127, 128). According to inventor Callahan bipolar transistor 610 was included in the '108 on chip circuitry, because during the time period of the development of the '108 invention, driving the telephone lines with MOS transistors was difficult to do (FF 338). Consistent with the testimony of Callahan is Magleby's testimony that bipolar transistor were used in the invention of the '108 patent because of their inherent capability of handling the high current requirements necessary to perform the functions of disabling the microphone and muting the earpiece (FF 361).

judge. (Tr. at 4162). Complainant's expert Fair also testified that in the "preferred" embodiment of the '108 patent all the numbered devices in Figure 12 would be "on the chip" for effectuating the common switching functions, which meant that bipolar transistors 588 and 594, in Fair's opinion, are taught in the '108 patent specification to be on the chip (FF 552, 554).[47] However, while inventor Callahan testified that at least by September 29, 1975 when the '108 patent application was filed he knew that a PNP bipolar transistor which effectuated a common switching function could not be formed on the same CMOS integrated circuit chip with the rest of the tone dialer circuitry (FF 542, 548, 549),[48] there is neither a disclosure in the '108 patent specification to make the claimed invention of the asserted claims wherein bipolar transistor 594 is on the chip or where all the means for enabling the oscillator, disabling the transmitter and attenuating the receiver are on the chip (FF 546), nor even a disclosure in the '108 patent specification of the fact that a particular PNP bipolar transistor, which

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[47] The circuit of Figure 12 of the '108 patent can be implemented on a breadboard using a discrete element for transistor 594 since it would be completely isolated from the rest of the circuit (FF 194, 513). However while a breadboard may contain a replica of the circuitry for a chip (FF 42), all parties have agreed that a breadboard is not a chip. Before attempting to implement the tone dialer circuit into silicon Callahan and Hoffman first completed a breadboard design of the chip (FF 438, 440, 441). However as inventor Callahan testified the actual implementation of integrated circuitry onto a silicon chip requires a considerable amount of time and effort (FF 490).

[48] Under subheadings "Description of the Drawings" and "Description of the Preferred Embodiment" of the '108 and '886 patents, there are only <u>two</u> embodiments disclosed, <u>viz</u>. Fig. 1 which is a "simplified block diagram showing one embodiment of the present invention" and Fig. 2 which is a "block diagram of another embodiment of the present invention". (As the '108 patent discloses each of its remaining Figs. 3 to 10 and 12 is a circuit diagram "of the system of Fig. 2" and Fig. 11 is "a graphic depiction of the output wave-form of the programmed logic array of Fig. 10" (FF 61 to 64).

effectuated a common switching function, could not be formed on the same CMOS integrated circuit chip with certain NPN transistors (FF 542, 547).[49]

Complainant, relying on the following portion of the '108 patent:

> Using MOS-LSI integrated circuitry, the entire system except for the crystal of the reference oscillator is included on a single chip, thereby providing a compact, low maintenance package capable of operating at high frequencies and low voltage. By including the common key functions on the chip, the size and maintenance of the system are further reduced."

(FF 53), argued that the '108 patent specification describes an embodiment in which the entire system (except the crystal, the keypad and the telephone handset including the microphone (transmitter) and speaker (receiver)) is included on a single chip using solely integrated circuitry and in which system all of the common key functions are carried out with MOS transistors on the chip. (CB2 at 66, 67).[50] The administrative law judge finds that said portion does not support complainant's argument. Thus the phrase "MOS-LSI integrated circuitry" to a person having ordinary skill in the art in 1975 was not restricted to only MOS transistors. As inventor Callahan testified, while "MOS-LSI integrated circuitry" in 1975 defined the technology and the technology of interest is called out in the specification as CMOS, when the '108 patent application was filed on September 29, 1975 CMOS "naturally includes bipolar if you so care to use them" which were used by Callahan and Hoffman "a number of places," and also the specification's reference to "MOS-

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[49] When the invention of the '108 patent was made, placing bipolar transistors on the chip was desirable because i.e. would eliminate the requirement for extra components to be purchased (FF 186).

[50] According to inventor Hoffman results of an analysis he did at Mostek showed that an MOS transistor which could handle the currents required to disable and drive the transmitter would have too large of an area of the overall chip to be practical "at that time" (FF 346).

LSI integrated circuitry" included the reference to CMOS which includes parasitic bipolar transistors (FF 55, 123, 124, 187, 193, 211).

Accordingly the administrative law judge finds that the '108 patent is not valid under the enabling paragraph of 35 U.S.C. §112 for its failure to disclose how to fabricate a chip having the means for enabling the oscillator, disabling the transmitter and attenuating the receiver to be on the chip.

Assuming arguendo that the '108 specification is enabling in view of testimony at the hearing to the effect that in September 1975 possibly a relatively poor performance embodiment could be fabricated which has N and P transistors on the chip which effectuate all the common switching functions (FF 502, 503, 506, 508, 509, 510, 544) although it would require extensive experimentation (FF 496) or possibly an embodiment could be fabricated which has N and P transistors on the chip which effectuate the common switching functions using non-conventional, unpublished techniques (FF 554 to 556), the administrative law judge finds that HMC and UMC and the staff have established by clear and convincing evidence that the best mode of the invention claimed in the '108 patent and required under 35 U.S.C. §112, is not disclosed in the '108 specification for disclosing how to make a chip having such means on the chip.

B. Alleged Deficiencies in the 108 and '886 Patent Specifications[51]

HMC and UMC argued that numerous errors exist in the '108 and '886 patent specifications so that a working configuration is not described and that there is not sufficient information in said specifications to allow one having ordinary skill in the art to implement the described circuitry correctly

[51] The specifications of the '108 and '886 patents are in substance identical. (Tr. at 4392).

without undue experimentation. Hence they argued that each of the '886 and '108 patents should be found invalid for their failure to satisfy the enablement requirement of 35 U.S.C. §112. (RB2 at 68, 69).

Complainant argued that errors shown in Figs. 4, 7, 8 and 9 are routine problems that could be corrected without any undue experimentation and that a person having ordinary skill in the art would be able to make a workable tone dialer chip from the specifications and drawings in the '108 and '886 patents. (CB2 at 66).

HMC and UMC further argued that the arbitration circuit, which was implemented in the breadboard prior to the earliest September 29, 1975 filing date of the '108 patent was never disclosed in the specifications of the '108 and '886 patents (citing Callahan Tr. at 636-637, 825-826); that inventor Callahan testified that in the first breadboard implementation the breadboard did not work correctly and it was found that there was a design problem with the multiplexer and an improvement (an arbitration circuitry)[52] was made in the multiplexer, and then the breadboard tests were successful although there was still no integrated circuit and the arbitration circuitry was left out of the first prototype silicon (citing Tr. at 637-639); that instead of determining the cause of an inoperativeness in the first prototype silicon chip, a different solution involving replacing the multiplexer of the one PLA (Programmed Logic Array) revision and using a two PLA embodiment for storing the DTMF (dial tone multiple frequency) sine waves (citing Callahan Tr. at 638-643); that neither the embodiment with the arbitration circuit, nor a

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52 An arbitration circuit is used when data is coming in from two paths and is trying to get to one path. The arbitration circuit ensures that the information on each path does not collide with that on the other path and distort it (FF 457).

detailed description of how the two PLA embodiment should be implemented in lieu of the one PLA version to eliminate the multiplexer, was disclosed and that since those undisclosed modes were known to the inventors, either one of those modes would necessarily be considered a better mode than the mode disclosed, and that consequently the best mode contemplated by the inventors was not disclosed in violation of 35 U.S.C. §112. (RB2 at 76, 77).

The staff argued that the record shows that during tests of the breadboard prototype, problems were experienced in correctly dialing a number (citing Callahan Tr. 637); that the requisite additions were not added to the circuitry shown in Figure 9 of the '108 and '886 patents (citing Callahan Tr. 646 to 647, 825-26); and that inventor Callahan testified that the omission was a mistake (citing Tr. 827), which omission expert Magleby testified would lead to occasions when the central telephone office would not be able to identify the tone that is dialed (citing Tr. 2440-2441). Accordingly the staff argued that by not disclosing the arbitration circuit in the '108 and '886 specifications, the inventors failed to disclose the best mode of practicing the one PLA embodiment of the "inventions" of the '108 and '886 patents. (SB2 at 61, 62).

Complainant argued, as to the one PLA embodiment, that inventor Callahan "in his capacity as an expert" testified that a person having ordinary skill in the art, upon review of the entire '108 patent could construct a working circuit of the one PLA embodiment from the specification without undergoing undue experimentation. (CB2 at 64).

Complainant argued, with respect to the two PLA embodiment, that the '108 patent in at least the following two portions describes the relation of the one PLA and two PLA embodiments:

> Multiplexer 58 [in Fig. 2] may be eliminated from system 40 [the one PLA embodiment] by adding a second programmed logic array similar to PLA 64. One PLA would be between the shift register 60 and latch 66, and the other would process the output of shift register 62 for the latch 68 input. [CX 4, col. 5, line 68- col. 6, line 5]
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> * * *
>
> Although the previously described embodiment includes a multiplexer circuit, it is understood that the multiplexer may be eliminated and a second programmed logic array may be implemented for simplicity of design without departing from the scope of the present invention. [CX 4, col. 26, lines 13-18]

(CB2 at 63, 64).

UMC and HMC also argued that the '108 and '886 patent specifications fail to disclose the relative amplitudes of the high group and the low group tone signals which are combined to form the DTMF signal; that as explained by inventor Callahan, the proper amplitudes for the high group and the low group signals were essential to have an acceptable product (citing Tr. at 785 to 787); and that Callahan agreed that there is no disclosure in the '108 or the '886 patents of the different amplitudes of the two groups of tone signals (citing Tr. at 781). Accordingly UMC and/or HMC argued that the '108 and '886 patents are invalid for failing to disclose the best mode known to inventor Callahan at the time of filing for implementing the high group and the low group tone signals. (RBR2 at 17).

The staff argued that the evidence shows that the sole reference in the '108 and '886 patent specifications to "amplitudes", viz. "[c]onvertors 562 and 564 are provided with reference voltage inputs ... to adjust the amplitude of the sine waves" (col. 25, lines 46-50 of the '886 patent (CX-3)), is insufficient to be enabling to a person having ordinary skill in the art; and that while said specifications may teach that one may adjust the frequencies, they do not provide any information as to the amount of any increase in amplitude that is required for each low frequency signal in relation to its companion high frequency signal, or any decrease in the high frequency signal, or how to regulate the tones in a manner that is independent of loop length. It is argued that the record shows that such information is required to make the specifications enabling under 35 U.S.C. §112. (SB2 at 58, 59).

Complainant argued that the actual numerical difference in amplitudes between the high and low group output signals was well known to anyone working in the telephony field at the time of the inventions in issue that such a requirement was an AT&T standard; that the Meacham '084 patent (which issued in 1962) graphically depicts the amplitude difference and describes it (referring to CX14, col. 5, lines 59-75 and Fig. 3), and that the '108 and '886 patent specifications states that "[c]onverters 562 and 564 are provided with reference voltage inputs... to adjust the amplitude of the sine waves," which language the staff argued was insufficient.

Figure 1 of the '108 patent is a simplified block diagram of a signal generator system in accordance with one embodiment of the present invention of the '108 and '886 patents (FF 61, 62). The system generates a dual-tone multiple frequency waveform output suitable for telephone signalling. (FF 62). The only other embodiment in the '108 patent illustrated by figures is that shown in Figure 2 with its associated Figures 3 to 12 (FF 61). The Figure 2 embodiment shows also a telephone generator system (FF 61, 62). While Figure 1 includes one block 24 and one block 26, each of which is designated "Sine Wave Programmed Logic Array" (FF 320), the '108 patent specification has very little detail concerning the circuitry of the specific blocks of Figure 1 (FF 63). In comparison to Figure 1, Figure 2 of the '108 patent includes only one block (not two blocks) designated "Programmed Logic Array"[53] (FF 321), and a block designated "Multiplexer" which block is not found in Figure 1.[54] The circuitry of Figure 2 is described in considerable detail in the '108 patent specification (FF 64).

The evidence also establishes that there are uncorrected errors in Figures 4, 7, 8 and 9 of each of the '108 and '886 patents (FF 410 to 417, 419 to 424, 428, 430, 431)[55]; that the circuit in Figure 9 is not effective in addressing the arbitration problem and would not allow a one PLA embodiment to work (FF 409); that in Figure 1 of the '108 and '886 patents, block numbers 16, 20 and 22 are inoperative (FF 424); that while the inventors made design changes to solve the problem with the circuitry in Figure 9, the design changes are not shown in the specification (FF 425, 427); that while the breadboard was successfully tested, the changes that made the breadboard a success are not disclosed in the '108 specification (FF 413, 438, 439, 442, 444, 446, 456, 457, 461, 488);[56] that while the difference in amplitudes is important because given the extremely high volume of telephone production, one must increase the amplitude of the low frequency group to meet the telephone company specification (FF 517 to 524, 526) there is no statement in the '108

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53 Callahan had thought in the early seventies that less silicon would be required if only one PLA was used (FF 459).

54 The multiplexer block 58 in Figure 2 is circuitry that allows information to enter the PLA first from the row group and then from the column group. It was important that the information from the row group and the column group not access the PLA at the same time (FF 323, 325, 327).

55 During the relevant time frame, a person having ordinary skill in the art would take at least six months to a year to go through the '108 specification and sort out the errors and retesting would have to be done (FF 432 to 437).

56 The breadboard built by Callahan utilized a one PLA embodiment (FF 328).

patent specification, as admitted by inventor Callahan, that the amplitudes of a high group and a low group frequency have to be different to operate properly on the telephone system (FF 527); and that in 1976 the tone dialer at Mostek required internal changes within the integrated circuit (FF 537). (See also FF 215, 217, 445, 449, 450 to 453, 463 to 472, 475 to 480, 483, 487, 489, 500, 532 to 536).

Based on the foregoing the administrative law judge finds, on an independent ground, that the '108 patent is not valid under the enabling paragraph of 35 U.S.C. §112 because of the combined effects of the following deficiencies: (1) errors in the '108 patent specification; (2) the failure to disclose an arbitration circuit; (3) the lack of detail with respect to the two PLA embodiment; and (4) the failure to disclose the relative amplitudes of the high group and the low group tone signals which are combined to form the DTMF signal. Assuming arguendo that the '108 specification is enabling, the administrative law judge finds that HMC, UMC and the staff have established by clear and convincing evidence, and as an independent ground, that in view of the foregoing deficiencies the best mode of carrying out the invention claimed in the '108 patent, as required under 35 U.S.C. §112, is not disclosed.[57]

[57] In view of the language of the asserted claims of the '886 patent as construed by the administrative law judge and the fact that the only figures in the '886 patent are directed to a dual tone multiple frequency waveform output (FF 62, 64), and considering only the grounds advanced by UMC and the staff, he does not find that the '886 patent is not enabling or that the best mode is not set forth for the asserted claims. See Lannom Manufacturing Co. v Intern. Trade Com'n, 779 F.2d 1572, 231 USPQ 32 (Fed. Cir. 1986) where the Federal Circuit stated that Congress did not authorize the Commission to redetermine patent validity, where no defense of invalidity has been raised.

Assuming arguendo that the asserted claims of the '886 patent are construed as directed to an intermediate signal generated in a DTMF tone generator, the administrative law judge would find that the '886 patent is not enabling and/or fails to disclose the best mode for the same reasons as set (continued...)

VI. ENFORCEABILITY OF THE '108 and '886 PATENTS

HMC and UMC argued that Electronics, a North American Rockwell product data sheet for the NR 10198 (with respect to each of the '108 patent and '886 patent) and the IC Guide (with respect to the '886 patent) were not produced to the PTO at the time the patent applications which matured into the '108 and '886 patents were prosecuted, and hence that the '108 and '886 patents should be declared unenforceable due to inequitable conduct. (RB2 at 80-82; 97, 98).

In addition, HMC and UMC argued that the inventors of the '108 and '886 patents knew before they filed the initial application for their '108 patent that it would be "difficult or impossible" to implement both the PNP and NPN transistors on the same chip "as was called for in the invention" (citing Callahan Tr. at 736-737) and that the PTO would want to know that "the disclosed structure is a fictitious inoperable embodiment, or at best, an impractical implementation". It is argued that the withholding of such information is an additional ground for declaring the '108 and '886 patents unenforceable. (RB2 at 81, 82).

The staff argued that the withholding of Electronics constitutes inequitable conduct which should render both the '108 and '886 patents unenforceable. (SB2 at 72, 73). With respect to the North American Rockwell reference, it argued that the reference is also material, "although its degree of materiality is not as high" as Electronics, and that this reference may well have been "merely cumulative to the cited references". (SB2 at 63, 64). The staff noted that given the staff's conclusion that there was inequitable conduct in failing to disclose Electronics, it did not reach the argument of

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[57](...continued)
forth, supra, with respect to the '108 patent.

HMC and UMC for unenforceability based on the failure to disclose how to form both NPN and PNP transistors on the same chip. (SB2 at 63).

Complainant argued that the IC Guide is neither §102(b) prior art nor enabling; that the prior art of record before the PTO disclosed at least as much as the Electronics and that there is no indication in Electronics at all how a person of ordinary skill in the art would even begin to implement the "short list of features the press release provides"; that the North American Rockwell product data sheet is not material; and that persons having ordinary skill in the art at the time of the inventions "would have realized that PNP transistor 594 in Figure 12 would not have been on the chip". (CB2 at 71 to 73, 95 to 98).

A challenger of a patent to establish that a patentee acted inequitably must demonstrate the materiality of the undisclosed information and that the patentee intended to mislead or deceive the PTO. LaBounty Mfg., Inc. v. U.S. Intern. Trade Com'n, 958 F.2d 1066, 1076, 9 USPQ2d 1995 (Fed. Cir. 1992) (LaBounty).

Earlier in this opinion the administrative law judge, based on his construction of the claims in issue of the '108 and '886 patents, found that HMC, UMC and the staff had not established that any of the asserted claims of the '108 patent were not valid under 35 U.S.C. §103 and that UMC had not established that any of the asserted claims of the '886 patent were not valid under 35 U.S.C. §102 and 35 U.S.C. §103. Based on the construction of the asserted claims of the '108 patent and of the '886 patent by the administrative law judge he likewise finds that HMC and UMC and the staff have not established that either patent is unenforceable.

Assuming arguendo, independent claim 1 of the '108 patent should be construed such that the claimed telephone communication system merely involves a chip and the system has a switching means which need only perform the common switching functions in such a way as to enable the use of the simple, calculator type keyboard (CBR2 at 7), he would find that HMC, UMC and the staff have established that the '108 patent is unenforceable due to inequitable conduct in withholding Electronics in the prosecution of the '108 patent.[58] The administrative law judges rejects complainant's argument that the prior art of record before the PTO disclosed at least as much as Electronics and finds that the evidence shows that Electronics would be material (FF 566, 567, 568, 569, 576). Indeed, as the record shows, when the inventors named on the '108 patent were asked, before any application was filed for the '108 patent, "[h]as any of the subject matter of this invention been described in any publication, proposal or report, or is such a publication, proposal or report anticipated," they answered "yes" and identified Electronics (FF 660).

Concerning whether the patentees intended to mislead or deceive the PTO, direct proof of wrongful intent is rarely available. However, it may be inferred from clear and convincing evidence of the surrounding circumstances. Id.

In this investigation, the record shows that while the patent attorney

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[58] The North American Rockwell product data sheet for the NR 10198 is not in evidence, and hence the administrative law judge makes no finding concerning the alleged withholding of that data sheet. Also in view of the finding of the administrative law judge, earlier in this opinion, that the '108 patent is not enabling, he makes no finding on the argument of HMC and UMC related to implementing both the PNP and NPN transistors on the same chip. With respect to UMC's reliance on the IC Guide, the administrative law judge has already found in this opinion that the IC Guide is not prior art, and that even if it was, the IC Guide was irrelevant to any prior art allegation. See Section IV B 1.

who filed the '108 patent application in 1975 testified that prior to preparation for this investigation, he did not recall seeing the patent disclosure form nor Electronics (FF 659, 663) and inventor Callahan testified that he did not know why Electronics was not called to the attention of the PTO during prosecution of the applications which matured into the '108 patent (FF 663), and that said patent attorney had conversations with the inventors (FF 661, 667, 670). That patent attorney further testified that just about all of the information on the patent disclosure form, which identified Electronics, would be of interest to him in preparing a patent application (FF 659).[59] Accordingly the administrative law judge would find clear and convincing evidence of a culpable lack of candor on the basis of the inventors and the attorney who filed the initial application for the '108 patent in the withholding of Electronics from the PTO, assuming arguendo the asserted claims of the '108 patent are construed as complainant contended.

VII. THE '436 PATENT

The claims in issue in the '436 patent (FF 692) are independent claims 1 and 6 and claims 2, 3, and 4, each of which is dependent on claim 1.

A. Validity of Asserted Claims 1, 2, 3, 4, and 6 Under 35 U.S.C. §§102 and 103

HMC and UMC argued that each of claims 1 and 6 is not valid under 35

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[59] In addition to identifying Electronics as describing "subject matter of this invention", the form recited a conception date and a "successful" test completion date, all of which information should be of interest to any patent attorney who files a patent application. The administrative law judge does not understand how the patent attorney, who prepared and filed the earliest application for the '108 patent, could testify that he did not recall seeing the patent disclosure form or Electronics. Because the parties agreed that the testimony of that patent attorney could be presented thru deposition however, the administrative law judge makes no finding on the credibility of his testimony.

U.S.C. §102 in view of a Hamade article or a Hamade file wrapper or Takanashi U.S. Patent No. 4,366,470 (the '470 patent) or Roberts U.S. Patent No. 4,281,319 (the '319 patent) (RB1 at 33-38, 44 and Appendix A). It is argued that claim 3 is not valid because "all of the elements of claim 3 are present in the teachings of Figure 4 of the Roberts ['319] patent." (RB1 at 41, Appendix A).

HMC and UMC also argued that each of claims 1, 2, 3 and 6 is not valid under 35 U.S.C. §103 in light of the combination of Jefferson U.S. Patent No. 3,657,657 (the '657 patent) and Roberts U.S. 4,281,319 (the '319 patent) or the combination of the '657 patent and Hoff U.S. Patent No. 4,146,882 (the '882 patent). (RB1 at 29-33, 39, 40, 42, 43 and 44 and Appendix A). It is argued that claim 4 is not valid under 35 U.S.C. §103 in view of the Jefferson/Roberts combination taken with data sheets and testimony showing known disable structures or in view of the Jefferson/Hoff combination. (RB1 at 42-43 and Appendix A).

The staff argued that the record does not support a finding that any of the asserted claims is not valid under either 35 U.S.C. §102 or 35 U.S.C. §103 (SB1 at 13-27).

Complainant argued that none of the alleged prior art discloses all of the elements of the asserted claims and that it has not been proven that any reference or combination of references would have rendered obvious any of the asserted claims. (CB1 at 17 to 26).

In determining whether HMC and UMC have established by clear and convincing evidence that the asserted claims are not valid over the prior art the administrative law judge must engage in a two-step process. Thus the claims are first construed to determine its meaning and then the claims are compared to the prior art. <u>See</u> Section III A(1), <u>supra</u>.

1. Claim Construction

Independent claims 1 and 6 read:

> 1. A circuit for producing an analog signal, comprising: first and second power terminals;
>
> a multi-tap resistor connected between said first and second power terminals;
>
> a plurality of first switches formed into plural groups connected respectively to the taps of said resistor;
>
> means responsive to a digital input signal for generating a plurality of first control signals each controlling a separate group of said first switches;
>
> a plurality of second switches each connected to a plurality of said first switches wherein each second switch is connected to no more than one or said first switches within each of said groups of first switches, and each first switch is connected to no more than one of said second switches;
>
> means responsive to said digital input signal for generating a plurality of second control signals each controlling a separate group of said second switches;
>
> a plurality of third switches each connected to a plurality of said second switches and to an output terminal wherein each third switch is connected to no more than one of said second switches within each of said groups of second switches and each second switch is connected to no more than one of said third switches; and
>
> means responsive to said digital input signal for generating a plurality of third control signals for controlling said third switches wherein the operation of said third switches connect said taps one at a time to said output terminal to produce said analog signal of said output terminal.
>
> * * *
>
> 6. A method for generating an analog signal in response to a digital input signal, comprising the steps of:
>
> generating a plurality of discrete voltage signals;
>
> generating a plurality of first command signals in

response to said digital input signal;

selectively routing a group of said discrete voltage signals through a set of first switches in response to said first command signals which operate said first switches;

generating a plurality of second command signals in response to said digital input signal;

selectively routing a subgroup of said discrete voltage signals, where said subgroup at discrete voltage signals is derived from said group of discrete voltage signals, through a set of second switches in response to said second command signals which operate said second switches;

generating a plurality of third control signals in response to said digital input signal;

selectively routing a one of said discrete voltage signals where said one of said discrete voltage signals is derived from said subgroup of discrete voltage signals, through a set of third switches to an output terminal in response to said third control signals which operate said third switches; and

repeating the above steps to produce an analog output signal which comprises a series of said discrete voltage signals.

(FF 693).

Complainant argued that Fair explained the detailed correspondence of the asserted claims to the only structure shown in the '436 patent, i.e., Figure 1; that Fair's interpretation is required because of the means-plus-function language used for several of the elements of the claims and the "ultimate interrelation" between the claim elements; and that the interpretation of Fair, which is summarized in graphic form in CX 305, is the proper interpretation of the asserted claims. (CB1 at 3).

HMC and UMC argued that complainant reads limitations into claim 1 which would require a multi-tap resistor with sixteen taps organized in four groups with four first control signals, four second switches, two second control switches, two third switches and two third control signals, even though (1) no such limitations are recited in the text of the claim, (2) reading into claim 1 those limitations, which are limitations of dependent claim 3, would violate the principals of the doctrine of claim differentiation,[60] and (3) such a narrow interpretation ignores the statutory language of 35 U.S.C. §112, ¶ 6, which mandates that any means-plus-function element of a claim include not only the structure in the patent specification but also "equivalents thereof." It is further argued that while complainant maintains that claim 1 of the '436 patent covers only structures which generate analog signals having left-right symmetric waveforms and reaches that conclusion by requiring all embodiments within the scope of equivalents to use an up-down counter which generates a symmetrical waveform because the preferred embodiment uses an up-down counter, such interpretation ignores clear, contrary language of the '436 patent at col. 1, lines 66-67 that, for example "the analog signal can have any desired waveform." (RB1 at 15, 16).

HMC and UMC also argued that in construing the non means-plus-function elements of claim 1, in accordance with general claim construction rules, claim 1 should be read as not limited by the number of taps of the multi-tap resistor, the number of switches, or the number of control signals shown in Figure 1 of the '436 patent. (RB1 at 17, 18).

Referring to independent claim 6, HMC and UMC argued that claim 6 contains no elements written in means-plus-function or step-for-function format and hence the steps of claim 6 are not to be construed using the rules

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60 According to this doctrine, the presence of an express limitation in one claim negates an intent to limit similarly by implication a claim in which the limitation is not expressed. Chisum §18.03[2]. See also Kalman v. Kimberly-Clark Corp., 713 F.2d 760, 218 USPQ 781 (Fed. Cir. 1983) (Kalman).

applicable to 35 U.S.C. §112; and that all the terms used in claim 6 should be interpreted in accordance with the accepted rules of claim construction. (RB1 at 43,44).

The staff argued that complainant's witnesses, inventor Ireland and expert Fair, construed the three respective means elements in claim 1 as follows: (1) the means responsive to the digital signal to create the first control signals "consists of blocks 22, 24, 34 (a XNOR gate, a/k/a/ and exclusive NOR gate), 36, 38, and NOR gates 46, 48, 50, and 52"; (2) the means responsive to the digital signal for generating the second set of control signals "consists of flip-flops 26, 40, and NOR gates 58 and 60"; and (3) the means responsive to the digital signal for generating the third set of control signals "consists of flip-flop 20, invertor 62, and NOR gates 64 and 66." The staff also argued that for the purposes of this investigation, respondents' expert Hoff, has adopted the foregoing construction.[61] (SB1 at 9, 10).

Referring to the arguments advanced by complainant, in Texas Instruments, Inc. v. U.S. Int'l Trade Com'n, 805 F.2d 1558, 1569, 231 USPQ 833, 839-40 (Fed. Cir. 1986), opinion on denial of rehearing, 846 F.2d 1369, 6 USPQ2d 1986 (Fed. Cir.), rehearing en banc denied, 7 USPQ2d 1414 (Fed. Cir. 1988) (Texas

[61] The staff, for its support, referenced Tr. at 2780 to 2782 and Tr. at 3090 to 3092. The administrative law judge does not find in those portions of the transcript that Hoff limited the third means responsive to the digital signal for generating third set of control signals as recited in claim 1 to only flip-flop 20, invertor 62, and NOR gates 64 and 66, nor does he find that Hoff limited the other two means recited in claim 1 to the only elements specified by the staff. Thus at Tr. 2780 to 2782 Hoff made no reference to the specific elements recited by the staff. At Tr. 3091-92, the question was whether "the first means element in Claim 1 . . . can be found in the structure consisting the four Norgates, 46, 48, 50 and 52. 52 flip flops 38,38. The exclusive Norgate 34 flip flops 22 and 24" (emphasis added), to which Hoff answered "Yes. And in that testimony, I was repeating essentially what I heard from Mr. Ireland and Dr. Fair." (Emphasis added).

Instruments), the representative patent claim was to a miniature, portable, battery operated electronic calculator. Texas Instruments, 805 F.2d at 1561, 231 USPQ at 836. This administrative law judge, in findings and conclusions adopted by the Commission, found that each of the claimed functions of input means clause a, electronic means clause b and display means claim c was performed in the accused devices by a means that was not described in the '921 patent in issue, and that each such means was not equivalent to the means shown in the '921 specification.[62]

The claimed integrated semiconductor array in Texas Instruments, provided the logic of the calculator performing the arithmetic, memory and transfer functions set forth in claimed sub-clauses (i), (ii) and (iii) of the claimed electronic means clause b. The specification of the patent in issue in Texas Instruments described each integrated circuit as having a series of interconnected gates or logic circuits, constructed of, *inter alia*, bipolar transistors and the shift registers therein also used bipolar transistors. Appellant argued that the corresponding electronic means in the claimed and accused devices all performed arithmetic calculations and generated control signals using integrated circuitry and that the prosecution history of the claims in issue did not require the restricted definition of "integrated semiconductor circuit array" that was imposed by this administrative law judge. Although the Federal Circuit stated that this administrative law judge

[62] The "electronic means clause b in Texas Instruments was claimed as an "integrated semiconductor circuit array". The specification showed an array of four integrated semiconductor circuits, three integrated semiconductor shift registers, and two resistors, interconnected by printed conductors located in one plane on an insulating substrate. An alternative embodiment in the '921 specification, and claimed specifically in claim 2, located the array on a single semiconductor wafer. Texas Instruments, 805 F.2d at 1566, 231 USPQ at 837.

"interpreted the claims too narrowly when he, in effect, limited each means to the embodiment shown in the specification" the Court concluded that the accused devices did not infringe the claims in issue when the invention and the accused devices were viewed as a whole because all of the modifications in the accused devices reflected more than mere substitution of "an embellishment, made possible by [improved] technology," as discussed in Hughes Aircraft Co., 717 F.2d at 1365, 219 USPQ at 483; Texas Instruments, 805 F.2d at 1568-70, 231 USPQ at 339-40. The Federal Circuit did state that were the electronic means of claimed clause b the only change, the record may not contain substantial evidence in support of the non-infringement finding of this administrative law judge. Id. 805 F.2d at 1564, 1566, 1568, 1570, 231 USPQ at 839, 840.

In Intel Corp., the Federal Circuit, referring to the alleged infringers' contention that a means of controlling the voltage level on the column line was not structurally equivalent to that described in the patent in issue, affirmed the Commission's findings of literal infringement of claim 2, stating that the Commission had reversed the finding of the administrative law judge of non-infringement on the grounds that the administrative law judge had improperly limited the "column biasing means" to the precise two-transistor method disclosed in the '394 specification and did not consider equivalents to that structure. Intel Corp. 946 F.2d at 843, 20 USPQ2d at 1177-78.[63]

At the hearing in this investigation, complainant did present extensive testimony of its expert Fair relative to CX 305 which is titled "Element-By-

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[63] 35 U.S.C. §112(6) was enacted to prevent courts from holding that means-plus-function limitations cover only the means disclosed in the specification DMI Inc. v. Deere & Co., 755 F.2d 1570, 1574, 225 USPQ 236, 238 (Fed. Cir. 1985).

Element Correspondence Between Claim 1 and Figure 1 of the '436 Patent". The administrative law judge gives no weight to such testimony for his construction of the means-plus-function or step-for-function clauses of independent claim 1. See Texas Instruments and Intel Corp., supra.

Complainant, at the hearing in this investigation, also presented extensive testimony of Fair relative to its CX 457A which relates to a comparison of the accused product with claim 1. The Commission, however, in its opinion in EPROMs stated:

> The Federal Circuit has stated: "A claim is construed in light of claim language, the other claims, the prior art, the prosecution history and the specification, not in light of the accused device." SRI Intern v. Matsushita Elec. Corp. of America, 775 F.2d 1107, 1118, 227 USPQ 577, 583 (Fed. Cir. 1985) (emphasis in original). The Federal Circuit further noted in SRI that "claims are not construed 'to cover' the accused device" because that procedure would make infringement a matter of judicial whim. Id. The claims must be construed without reference to the accused device. Id. Therefore, the ALJ's reference to a transistor in saturation (the accused device) was not proper when construing the term "decoupling transistor" and the Commission does not adopt that part of ... [the] claim construction. (Emphasis in original)

EPROMs, Com'n Op., USITC Pub. 2196 at 43. Accordingly, the administrative law judge gives no weight to the testimony of Fair relative to CX 457A for construction of independent claims 1 and 6.

Complainant's Fair did testify:

> Q Well, isn't there a teaching that the Figure 1 in the structure shown there is capable of numerous rearrangements, modifications and substitutions without departing from the scope of the invention?
>
> A Well, that may be a teaching but I am not sure what that, what those, what that teaching is. I don't -- there is no embodiment taught in this patent as to what those rearrangements are.
>
> Q So it is your opinion that in order to have Claim 1 be interpreted to cover other than what is shown in Figure 1 of the 436 patent, there must be another embodiment shown in the patent showing

how the circuit elements of Figure 1 could be rearranged, is that correct?

A <u>I believe the limits that I place on what is teachable are substitutions for the gates that are shown here. For example substituting a NOR gate with a NAND gate, or maybe adding an invertor or adding some taps, which do not really distort or change the invention that is described.</u>[[64]]

Q Now, there is no teaching in this patent of the substitution of NAND gates for NOR gates, is there?

A No, that is correct, but we are taught that substitutions are possible without departing from the scope of the invention. So that would be such a substitution as I would envision would fit the terminology there.

Q But wouldn't rearrangement also apply to a rearrangement of the control elements so as to access the taps in a different sequence?

A Well, I believe that might be possible if it didn't depart from the scope of the invention.

Q But isn't the scope of the invention determined, under your interpretation of Claim 1, by looking at what is disclosed in the specification, Dr. Fair?

A Yes.

Q And doesn't it say in the specification that rearrangements are possible?

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64 NAND gate and NOR gate are elementary logic blocks (FF 139). Fair gave no detail as to which NOR gate(s) he was referring to. The '436 patent under the subheading "Detailed Description of the Invention" and referring to Figure 1 which is "a schematic logic circuit illustrating the tone generating circuit of the present invention" (col. 2, lines 10-11) makes reference to exclusive OR gate 34 (col. 2, lines 35, 50; col. 4, line 47, 50), NOR gates 46, 48, 50 and 52 (col. 2, lines 58, 60, 61, 64; col. 3, line 3; col. 4, line 55), NOR gate 58 (col. 2, line 66, 68; col 3, line 2, 13; col. 4 line 66, 67; col. 5 line 22), NOR gate 60 (col. 2, line 67; col. 3, line 1, 13; col. 4, lines 66, 67; col. 5, line 22), inverter 62 (col. 3, line 4, 5; col. 5, line 19), NOR gate 64 (col. 3, line 5, 6, 9, 13; col. 5, line 20, 24), NOR gate 66 (col. 3, line 6, 7, 8, 13; col. 4, line 58; col. 5, line 20, 24), NOR gates 68, 70, 72 (col. 4, line 58), and Taps T1-T16 (col. 3, line 22, 27).

Fair's reference to "<u>maybe</u> adding an inverter or adding some taps" is found indefinite and ambiguous. (Emphasis added).

A It says that, but we are not taught what those rearrangements, possible rearrangements would be that would be within the scope of the invention.

Q And you don't think rearrangements would be apparent to one of ordinary skill in the art based upon the teachings in the patent to achieve any desired wave form, is that your testimony?

A Yes.

(FF 821)

Hoff, an expert of UMC and HMC, testified:

Q What type of analog signal does the circuit of claim 1 of the '436 patent generate?

A The claim itself, when you read the language, is not specific. It says a circuit for producing an analog signal and , so, in going to the disclosure for some more clues as to what might be represented by that term and I find at Column 1, line 66, and at this point, they've already explained a bit about the operation of this circuit and how it's producing an analog signal, and at line 66, it says the analog signal can have any desired waveform, depending on the weighing and connection of the taps to the resistor.

So, it implies at this point that this circuit can generate a wide variety of waveforms and, again --

* * *

Just point out again that at Column 5, line 39, it points out that the embodiment that has been shown here is really just one embodiment, and there are others.

It says although one embodiment of the invention has been illustrated in the accompanying drawings and described in the foregoing detailed description, it will be understood that the invention is not limited to the embodiment disclosed but is capable of numerous rearrangements, modifications and substitutions without departing from the scope of the invention, and that language would appear to be consistent with the concept that the analog signal can have any desired waveform.

And for those who are skilled in the art, the basic ideas that are disclosed here of having a counter generating digital control signals, one could apply the same technique to a wide variety of waveforms. From that, figure out what taps need to be connected and what sequence and then design the logic that will do that using the same type of components that are disclosed in Figure 1 of the patent.

(Tr. at 2787-88)

The elements of claim 1 can readily be divided into two groups, viz. five elements and three additional elements. Said five elements serve to describe a digital to analog converter. Thus one element talks about a multitap resistor while another element points out that the resistor is connected to power terminals and other elements describe a network of switches that serve to eventually connect taps from the resistor to the output which is the analog signal (FF 806). The three additional elements of claim 1 of the '436 patent are written in means plus function form and each serves to provide the function of generating a plurality of digital control signals. Each of the three structures which implements the functions called for in the means plus function claim are a variety of logic elements which primarily consist of a counter followed by some additional logic (FF 807). The three means functions of claim 1 produce a plurality of control signals which can be determined to be actually three pluralities of control signals (FF 808).

According to Fair, the claimed invention in the '436 patent is to a sine wave generator. In support Fair relies on the disclosures in the '436 patent that the invention pertains "more particularly to the synthesis of sinusoidal signals" (col. 1, lines 5-7), and in a "telephone application for producing DTMF signaling the taps are weighted and connected such that a sinusoidal type of analog output signal is produced" (col. 1, line 68, col. 2, lines 1-3) and also on the Figure 1 embodiment (FF 821).[65] The specification of the '436

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[65] Figure 1 generates an upwardly going wave form and then a downwardly going wave form that is symmetical to the upwardly going wave form (FF 819). An up-down counter that first counts up to reach some maximum value and then turns around and starts counting down is what the "selected tap" number represents in the Figure 2 embodiment of the '436 patent which is an
(continued...)

patent however also states that the present invention "pertains to digital-to-analog conversion circuitry" (FF 707). It further states that the analog signal can have "any desired waveform," depending on the weighting and connection of the taps to the resistor (FF 711). Fair has testified that the phrase "any desired waveform" appearing in the specification of the '436 patent is not limited to a symmetrical waveform (FF 712).

The '436 patent does teach only a single embodiment which is shown in Figure 1 of the patent (FF 714, 716). However referring to the Figure 1 embodiment of the '436 patent, the '436 patent in column 3 discloses that taps can be selected in such a manner to produce a waveform of almost any shape. (FF 718) Later the '436 patent in column 4, referring again to the Figure 1 embodiment, discloses that the taps and switch connections could be easily altered to produce other types of waveforms (FF 717).

Claim 1 is for a "circuit for producing an analog signal." Claims 6 is for a "method for generating an analog signal in response to a digital input signal." (FF 693). Asserted claims 1 and 6 are not specific as to the type of analog signal produced (FF 696). Thus claims 1 and 6 are not limited to a circuit which produces just a sine wave (FF 697). While the only example of an output analog signal shown in the '436 patent is a step approximation of a sine wave shown in Figure 2, the analog signal referred to in claims 1 and 6 belongs to a class of overall analog signals.[66] That class includes not only

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[65](...continued)
illustration of selected waveforms which occur in the circuit illustrated in Figure 1. The 14 digital signals in Figure 2 are used in an intermediate step in the generation of the analog signal 166 (FF 809).

[66] In contrast to a digital signal which has two possible values an analog signal can have a multiplicity of values (FF 790). The values can be continuous or they can be in discrete steps (FF 791), (See also FF 129 to 131,
(continued...)

a sine wave but also may include other symmetrical signals having both positive-going and negative-going segments (FF 788). A ramp signal can even be an analog signal (FF 794).

In claim 1 neither the "multi-tap resistor"[67] nor the number of first switches, second switches or third switches is recited in means plus function language (FF 693). Claim 6 has no elements in a means-plus-function format (FF 693). While inventor Ireland considered a sixteen tap multi-tap resistor essential to the invention as set forth in claim 3 of the '436 patent, a sixteen tap multi-tap resistor is not essential for the invention of claim 1. There is no reference to "sixteen" in either claim 1 or claim 6 and those claims have no limitations on the number of taps, the number of switches and the number of control signals (FF 693).

The '436 specification contains no disclosure that asserted independent claims 1 and 6 should be limited to the Figure 1 embodiment. Rather it contains language to the contrary (FF 720). The prosecution of the '436 patent in the PTO was minimal (FF 703) and provides no guide for construction of the claims 1 and 6.

Accordingly based on the express language of asserted claims 1 and 6 of the '436 patent and the language of the '436 specification, the administrative law judge construes independent claims 1 and 6 such that they are not limited to the Figure 1 embodiment. Thus he will not limit those claims to a specific number of taps of the multi-tap resistor, a specific number of switches, or a

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[66](...continued)
135).

[67] The term "multi-tap resistor" is a resistor where the voltages can be taken off the resistor at a number of places (FF 800).

specific number of control signals as shown in Figure 1 of the '436 patent nor to producing a specific type of analog signal with a particular waveform and using an up-down counter or to the particular decode structures of accessing the multi-tap resistor shown in the Figure 1 embodiment or to the sequential logic circuit of the Figure 1 embodiment. However while the administrative law judge, in construing independent claims 1 and 6, does not limit those claims to the Figure 1 embodiment of the '436 patent, he does not exclude the '436 specification in his construction of all of the asserted claims. Claims cannot be construed in a vacuum. If only the claims are to be considered there would be no need for a patent specification, which the statute requires.[68]

2. 35 U.S.C. §102[69]

HMC and UMC has not denied that any analog signal that is generated in Takanashi is involved in an intermediate step only in the Takanashi patent. Also it is admitted that the Takanashi patent functions "somewhat differently and is structured somewhat differently" than the Figure 1 embodiment disclosed in the '436 patent; that at least the counter 56 shown in Figure 6 of the Takanashi patent has to be modified to become an up/down counter so that the digital-to-analog converter is driven to produce merely a triangular wave; that Figure 1 of the '436 patent illustrates a circuit having different tap connections, and a different matrix of first, second and third switches as compared to the circuit illustrated in Figure 6 of the Takanashi patent; that

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68 See first paragraph of 35 U.S.C. §112 quoted in Section V in this opinion.

69 The discussion of the law with respect to 35 U.S.C. §102 contained in Section IV B(1) of this opinion is incorporated by reference.

counter 56 shown in Figure 6 of the Takanashi patent "inherently" has a digital input signal which it counts; that the output waveform shown in Figure 9 of the Takanashi patent is a saw toothed waveform which does not possess a sequential upward and downward waveform; and that the circuit in Figure 6 of the Takanashi patent is part of a larger system which produces a more complicated signal. See responses of HMC and UMC to complainant's proposed findings 269 to 274, 276, 277 and 281. Moreover HMC and UMC did not deny complainant's proposed findings 273 and 280 that if the teachings of the Takanashi patent were extended to a 16-tap resistor, the result would yield four stages of switches instead of three stages of switches and that the single digital output signal 54 in Takanashi actually consists of three separate digital signals. Accordingly assuming arguendo the Takanashi patent is prior art[70], the administrative law judge finds that HMC and UMC have not established by clear and convincing evidence that the Takanashi patent anticipates claims 1 and 6.

Referring to the Hamade references (FF 965, 966), according to Hoff, the

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70 HMC and UMC in their response dated January 21, 1993, to complainant's proposed findings of fact at 6 objected to complainant's FF 180 to 247 relating to the conception and reduction to practice of the '436 patent on the ground that the "recited facts [many of which rely on the sworn testimony of inventor Ireland at the hearing] are insufficient to establish 'corroboration' under applicable law." However see discussion of Refac, Sun Studs and Lockheed supra, at section III B.

At the hearing in this investigation there was sworn testimony of the inventor Ireland and the inventor was subjected to unlimited live cross examination. Accordingly, the administrative law judge rejects the argument of respondents that the oral testimony of inventor Ireland must be rejected outright if it was not corroborated. Moreover, based on the evidence (FF 882 to 962) the administrative law judge finds that the asserted claims were conceived before the February 6, 1981 filing date of the Takanashi patent (FF 881) and at least reasonable diligence was exercised up to the filing of the '436 patent application on May 18, 1981. Hence he finds that the Takanashi patent is not prior art under 35 U.S.C. §102(b).

expert of HMC and UMC, there is a distinction between digital-to-analog converters and analog-to-digital converters (FF 810). The technical field of the '436 patent "pertains to digital-to-analog conversion circuitry" (FF 707). The Hamade article shows an analog to digital conversion technique implemented as an eight bit D to A converter on a single chip and uses a string of resistors and a matrix of analog switches to perform high speed successive approximation conversion (FF 973). The circuit described in the Hamade patent application, which involves a successive approximation analog-to-digital converter, is very similar to the circuit described in the Hamade article although the application describes in significant detail the structure and operation of the successive approximation register shown in Fig. 6 of the Hamade article (FF 976). There is no disclosure of any successive approximation circuit in the '436 patent (FF 979). The Hamade article and the Hamade patent application address a different problem than the '436 patent in that they start with an analog signal and seek to create a digital signal (FF 983). The block diagram in Figure 6 of the Hamade article published in the December 1978 IEEE Journal of Solid State Circuits requires an analog input signal (V_{IN}), a comparator circuit, a successive approximation register, and a D-To-A converter receiver feedback signals from the successive approximation register (FF 984). Moreover, while HMC and UMC argued that the analog-to-digital converter of Figure 4 of the Roberts '319 patent anticipates each of claims 1, 3 and 6 of the '436 patent (RB1 at 37), the '436 patent pertains to digital-to-analog conversion circuitry (FF 707). In addition, Roberts discloses a block labeled "Successive Approximation Register 36'" but the block reveals no structure whatsoever for generating control signals (FF 837).

The administrative law judge finds that HMC and UMC have not established by clear and convincing evidence that any of the asserted claims is anticipated by the Takanashi patent, assuming it was prior art under 35 U.SC. 102(b), the Hamade article, any Hamade patent application or the Roberts '319 patent.

3. U.S.C. §103

Referring to the argument of HMC and UMC that independent claims 1 and 6 and dependent claims 2, 3 and 4 are not valid in view of the combination of the Jefferson '657 patent and Hoff '882 patent, HMC and UMC rely on, for example the use of "any well-known D/A technique"; that "taken together" Figures 1, 2 and 3 of the '882 patent[71] show that a "combination of decoded and undecoded signals can be used"; that the teaching of "Figures 1, 2 and 3 together is that decoded and undecoded switch arrays can be used"; and that a "trival" modification is made in Figure 3 of the '882 patent for the proposed combination (FF 986). Under 35 U.S. §103, HMC and UMC cannot pick and choose individual elements of references, without some teaching in the references to combine those elements, to recreate the asserted claims. Northern Telecom, 908 F.2d at 934, 15 USPQ2d at 1323. The administrative law judge finds that HMC and UMC have not established by clear and convincing evidence that the asserted claims are not valid in view of the Jefferson/Hoff combination.

(a) Jefferson/Roberts Combination and Independent Claims 1 and 6

To support the allegation that independent claims 1 and 6 and are not valid under 35 U.S.C. §103 in light of the combination of the Jefferson '657 and Roberts '319 patents HMC and UMC rely on placing in the block 26, labeled DIGITAL-to-ANALOG CONVERTER of the Jefferson '657 patent, the digital-to-

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71 The Hoff '882 patent has a total of nine figures (FF 687).

analog converter structure of Figure 5 of the Roberts '319 patent[72] (FF 838).

The Jefferson patent discloses an up down counter,[73] some intermediate logic and it shows the logic being connected to drive a digital to analog converter (FF 879). The abstract of the Jefferson '657 patent[74] reads in pertinent part:

> A conventional digital-to-analog converter[[75]] converts the binary sine wave decoder into a corresponding analog signal, which is filtered to remove undesirable frequency components. The result is a reasonably pure sine wave whose frequency is accurately controlled by the pulse repetition rate from the variable modulus divider.

(FF 856)(Emphasis added). Thus it it found that there is a suggestion in the Jefferson '657 patent that in the practice of the '657 patent a conventional digital-to-analog converter is used (FF 858, 859, 862). Moreover, using the Roberts digital-to-analog converter to implement the "DIGITAL TO ANALOG CONVERTER" block 26 of the Jefferson circuit poses no engineering problems (FF 870). In addition chip designers have long been motivated to achieve smaller

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72 The Jefferson '657 patent which issued on April 18, 1972, was listed under "References Cited" in the '436 patent which issued on May 1, 1984, on an application filed on May 16, 1981 (FF 702, 835). The Roberts '319 patent however, which issued on July 28, 1981 approximately three years before the issuance of the '436 patent on an application filed on June 30, 1980 which was some four months prior to the claims conception of the asserted claims of the '436 patent (FF 836, 959), was not cited by the PTO.

73 In the Figure 1 embodiment of the '436 patent, the clock decodes acts as an up-down-counter (FF 819). At the hearing inventor Ireland referred to the presence of an up/down counter in Figure 1 of the '436 patent (FF 773).

74 A digital-to-analog (D/A) converter is a circuit that takes a plurality of digital input signals and produces an analog output signal in which the analog output signal has a relationship to the digital input signals. Thus a D/A converter "takes a digital input and produces a corresponding analog output." (FF 812)

75 An abstract is embraced by the word "specification" as that term is used in 35 U.S.C. 112, first paragraph. In re Armbruster, 512 F.2d 676, 185 USPQ 152, 154 (CCPA 1975).

chip areas. With this motivation in mind, one having ordinary skill in the art would readily recognize the suggestion to use to digital-to-analo, converter structure of Figure 5 of Roberts in the DIGITAL SINE WAVE GENERATOR structure of Figure 3 of Jefferson in view of the fact that Roberts expressly taches that this structure of Figure 5 is "a compact" digital-to-analog converter structure (FF 855, 857, 860, 864). Complainant's Fair in fact agreed that if the digital-to-analog converter shown in Fig. 5 of the Roberts '319 patent is placed in block 26, labeled "DIGITAL TO ANALOG CONVERTER", of Fig. 3 of the Jefferson '657 patent, then Jefferson would produce an analog signal which is a step wise "approximation" to a sine wave (FF 839).

Referring to independent claim 1, Fair agreed that Figure 5 of the Roberts '319 patent shows a circuit for producing an analog signal (FF 842). He also agreed that the digital-to-analog converter of Fig. 5 of the Roberts '319 comprises a first power terminal and a second power terminal, a multitap resistor between a first power terminal and a second power terminal, a plurality of first switches formed into plural groups connected respectively to the taps of a multitap resistor, means responsive to a digital input signal for generating a plurality of first control signals, each controlling a separate group of said first switches, a plurality of second switches, each connected to a plurality of said first switches, wherein each second switch is connected to no more than one of said first switches within each of said groups of first switches, and each first switch is connected to no more than one of said second switches, means responsive to the digital input signal for generating a plurality of second control signals, each controlling a separate group of said second switches, a plurality of third switches, each connected to a plurality of said second switches and to an output terminal, wherein each third switch is connected to no more than one of said second switches within each of said groups of second switches, and each second switch is connected to no more than one of said third switches, and means responsive to said digital input signal for generating a plurality of third control signals for controlling said third switches, wherein the operation of said third switches connects said taps one at a time to said output terminal to produce said analog signal of said output terminal (FF 843 to 852).

Complainant's Fair maintained that NOR gates 58 and 60 and NOR gates 64 and 66 in the Figure 1 embodiment of the '436 patent perform de-glitching while Roberts introduces glitches in his Figure 5 (FF 853, 854). There is nothing however in claim 1 which requires that the means-plus-function elements perform a de-glitching function and claim 6 makes no reference to any de-glitching.

Fair also testified that the decode logic gates of the Jefferson/Roberts combination are "not tied to the groupings and weighting of the resistor taps" as in the '436 patent (FF 867). The administrative law judge however agrees with HMC and UMC (RB1 at 32) that with respect to "weightings," this is reading limitations from dependent claim 2, into independent claim 1 which the doctrine of claim differentation[76] prevents and that with respect to the "groupings of the decode logic" this also is an attempt to read into claim 1, limitations of dependent claim 3.

With respect to claim 6 of the '436 patent, the administrative law judge finds that all of its steps are found in the Jefferson/Roberts combination (FF 1008). Thus the claim is not limited to the particular switching arrangement

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76 See Kalman, supra.

to which Fair referred (FF 1007).

Based on the foregoing the administrative law judge finds that HMC and UMC have established by clear and convincing evidence that independent claims 1 and 6 are not valid under 35 U.S.C. §103 in view of the Jefferson/Roberts combination.

(b) Dependent Claims 2, 3 and 4

Each of dependent claims 2, 3 and 4 include a minimal number of components to reduce the cost and complexity of making the circuit (FF 719). Claim 2, which is dependent on claim 1, requires that the taps recited in claim 1 "are selected on said resistor to produce voltage steps weighted such that said analog signal is a sinusoid" (FF 693). Hoff testified that because the digital-to-analog converter disclosed in Figure 5 of the Roberts '319 patent generates an output signal by selecting a tap on the multi-tap resistor and connecting that tap to the output terminal, the combination of the Jefferson '657 patent and the Roberts patent discloses all the recitations of claim 2 (FF 988). Hoff however agreed that when claim 2 is read in accordance with the '436 specification each tap on the resistor string is sequentially selected one at a time and the resistors values are weighted to produce a voltage step so that by sequential selection of resistors there is generated a sine wave (FF 989). He also agreed that the combination of Jefferson with Roberts, with reference to asserted claim 2, operates differently with Roberts leaving certain switches off all the time to produce the sine wave (FF 989).

Claim 3, which is dependent on claim 1, requires that in the circuit of claim 1 there are: (1) sixteen taps; (2) sixteen first switches organized in four groups; (3) four first control signals; (4) four second switches organized in two groups; (5) two second control signals; (6) two third switches; and (7) two third control signals (FF 693). HMC and UMC admit that claim 3 recites "groupings of the decode logic." (RB1 at 32). The Figure 1 embodiment shows that the taps are addressed sequentially one after another with no taps skipped (FF 867, 867(a), 989). The administrative law judge finds no such teaching in the Jefferson/Roberts combination.

Claim 4, which is dependent on claim 1, requires that claim 1 includes means for driving the first control signals of claim 1 to the off state in response to a disable signal (FF 693). HMC and UMC acknowledged that the Roberts '319 patent does not show a means for driving "said first control signals" to the off state thereof in response to a disable signal (FF 1003). It relies however on inventor Ireland's deposition testimony that it was known to use a disable signal to drive control signals to an off state (FF 1004), and to general knowledge that analog multiplexers have a common disable function (FF 1005). In the absence of the disclosure of the '436 patent, the administrative law judge can find nothing in the cited references (FF 1005) to suggest means for driving said <u>first control signals</u> of independent claim 1 to the off state in response to a disable signal (FF 1006).

Based on the foregoing, the administrative law judge finds that HMC and UMC have not established by clear and convincing evidence that dependent claims 2, 3 and 4 of the '436 patent are not valid under 35 U.S.C. §103.

B. Validity of the Asserted Claims Under 35 U.S.C. §112 and Enforceability of the '436 Patent

HMC and UMC, who have the burden of showing that the '436 patent is not valid under 35 U.S.C. §112, argued that the '436 patent is invalid because the specification of the '436 patent fails to set forth the best mode contemplated by inventor Ireland of carrying out his invention. (RB1 at 2 to 12).

The staff argued that HMC and UMC have failed to establish by clear and convincing evidence that the absence of a disclosure of a single resistor shared by two sets of switches and associated logic constitutes a failure to disclose the best mode of practicing the invention because the asserted claims are limited to a device that generates single tones. (SB1 at 28 to 30).

Complainant argued that the claims of the '436 patent are directed to "a circuit for producing an analog signal" and a corresponding method; that the '436 patent specification clearly depicts and describes the best circuit inventor Ireland was aware of, at the time he filed the application, for producing an analog signal; and that the position of HMC and UMC that Ireland should have disclosed Mostek's commercial circuity for producing <u>two</u> analog signals, the high and the low signals in a DTMF signal, is irrelevant to the best mode contemplated by Ireland for carrying but the invention of his '436 patent because the <u>claimed</u> invention in the '436 that is in issue in not a DTMF signal generator. (CB1 at 11-12).

The claims in issue of the '436 patent are directed to "a circuit for producing <u>an</u> analog signal" (emphasis added) and a corresponding method. The administrative law judge finds that inventor Ireland has set forth the best mode for those claims in the '436 specification (FF 824 to 829). HMC and UMC, in fact, admit that the "invention claimed in the '436 patent is a circuit for producing <u>an</u> analog signal (RPHB at 5). While HMC and UMC argued that inventor "Ireland intended to practice the '436 invention by using the circuit in the generation of a dual tone multifrequency (DTMF) signal in a dialer chips" (RPHB at 5, 6), the claims in issue are not directed to a use of the claimed circuit in the generation of a DTMF signal in dialer chips. Moreover, contrary to the arguments of HMC and UMC (RBR1 at 4, 5), the Federal Circuit in Chemcast stated that an essential element for any proper best mode analysis is "whether, at the time the inventor filed his patent application, he knew of a mode of practicing his claimed invention that he considered to be better than any other." Chemcast, 913 F. 2d at 936, 16 USPQ2d at 1036 (emphasis added).

Based on the foregoing, the administrative law judge finds that HMC and UMC have failed to show by clear and convincing evidence that the best mode contemplated by inventor Ireland for carrying out his claimed invention is not set forth in the '436 patent.[77]

C. Alleged Infringement of Asserted Claims by HMC and UMC

Complainant bears the burden to establish infringement by a preponderance of the evidence. Hughes Aircraft, 717 F.2d at 1361, 219 USPQ at 480. The staff argued that complainant has met its burden.

Reference is made to certain findings (FF 728 to 763)[78] which support complainant's allegations that all the accused chips of HMC, with the exception of HM 9187 at issue in this investigation, and the UM91265 of UMC infringe asserted claims 2, 3 and 4 of the '436 patent. Based on those findings, the administrative law judge finds that complainant has met its burden in establishing infringement by HMC and UMC of all of the asserted claims of the '436 patent by a preponderance of evidence.

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77 In view of this ultimate finding, the administrative law judge rejects the contention of HMC and UMC that the '436 patent is unenforceable due to inequitable conduct because inventor Ireland intentionally failed to disclose the best mode. (RB1 at 12 to 14).

78 HMC and UMC in its post hearing submissions did not refute any of those findings. Their sole defense was that an invalid and/or unenforceable patent can not be infringed. See e.g. UMC's response to complainant's proposed findings 1623 to 1628.

D. Alleged Infringement Of the Asserted Claims By the Other Respondents

The evidence establishes that respondents SMC, Lonestar, Tranbon, Columbia, Conair, NAFTC and Spectra infringe claims 2, 3, and 4 of the '436 patent (FF 1009 to 1025).[79]

VIII. DOMESTIC INDUSTRY

Complainant argued that there are two ways to establish the existence of a domestic industry: (1) the "traditional method" of production and sale of a product in the United States, and (2) proof of one of the three factors set forth in 29 U.S.C. §1337(a)(3); that complainant's current and projected domestic production of tone dialer chips embodying the '436 patent is sufficient to satisfy the traditional method of establishing a domestic industry, notwithstanding arguments of HMC and UMC that complainant's domestic production of such tone dialer chips is a sham maintained to support a finding of a domestic industry in this investigation (CB1 at 31-35; CBR1 at 24-25). In addition, complainant argued that its activities satisfy each of the three prongs of section 337(a)(3), i.e., complainant has made significant investment in plant and equipment (CB1 at 37-39); there has been significant employment in labor or capital (CB1 at 40-41; CBR1 at 21-22); and complainant has made significant investment in exploitation of the '436 patent through engineering, customer support, research and development and licensing (CB1 at 41-46; CBR1 at 22-24).

HMC and UMC argued that complainant has not shown significant investment in plant and equipment with respect to the articles protected by the '436

79 Respondent Kingtel, which is in default, has not been accused of infringing any claim of the '436 patent. (Amended Complaint at 4-5).

patent because all of the equipment (except the masks) in the fab used to make the tone dialer chips at Carrollton is also used to make other semiconductor products unrelated to the '436 patent, and there is thus no rational means of allocating complainant's investment to any one product or group of products (RB1 at 1-2); that complainant has not shown significant employment of labor or capital related to the '436 patent because complainant has not shown what portion of its capital investment is used to produce tone dialer chips, as opposed to other semiconductor products, and because the labor devoted to production of tone dialer chips on an annualized basis for 1992 was <u>de minimis</u> (RB1 at 2-3); and that complainant has failed to show substantial investment in exploitation of the patent either through research and development or through licensing because (1) complainant's evidence regarding research and development is unreliable, (2) under the statute revenues received from licensing is irrelevant and, in any event, cannot be allocated to the '436 patent, and (3) without including labor attributable to litigation, on which complainant should not be allowed to rely since merely preparing for litigation would give rise to a domestic industry, the labor employed by complainant for licensing is <u>de minimis</u> (RB1 at 3-4). HMC and UMC also argued that complainant

that no dialer chips were produced in Carrollton in April, May and June of 1992; and that in July of 1992, when the administrative law judge refused to grant complainant's motion for summary determination on the economic prong of the domestic industry requirement with respect to the '436 patent, complainant developed a

(RB1 at 5-6).

The staff argued that the evidence adduced at the hearing shows that at the present time and for the near future (mid-1993) complainant is producing, and will continue to produce, tone dialer chips at Carrollton; that the domestic industry requirement under A and B of section 337(a)(3) is "generally" satisfied if a complainant and/or one of its licensees make the product in the United States; and that complainant's production of tone dialer chips through October 1992, its projected production, and its investment in plant and equipment, labor and capital, establish that a domestic industry currently exists at Carrollton with respect to the '436 patent (SB1 at 32-37).

In issue with respect to the '436 patent is whether the economic prong of the domestic industry is satisfied by complainant's domestic activities and whether complainant practices the '436 patent. At issue with respect to the '108 and '886 patents is whether complainant or its licensee,

practices those patents.[80]

A. <u>Economic Prong with Respect to the '436 Patent</u>

A complainant may show that a domestic industry exist by showing sufficient production in the United States of articles embodying the asserted patent(s). <u>Certain Static Random Access Memories, Components Thereof, and</u>

[80] An initial determination (Order No. 44), which issued on July 22, 1992, and which the Commission determined on August 21, 1992 not to review, granted in part complainant's motion for summary determination on the economic prong of the domestic industry requirement, and found that there was sufficient economic activity in the United States with respect to the '108 and '886 patents, as the asserted claims of those patents were construed by complainant, to satisfy the economic prong of the domestic industry requirement. Order No. 44 at 23. With respect to the '436 patent, however, complainant's motion for summary determination was denied "to permit additional discovery concerning

<u>Id</u>. at 26.

Products Containing Same (SRAMs), Inv. No. 337-TA-341, Order No. 9, unreviewed ID granting partial summary determination on domestic industry (Dec. 30, 1992) (see also Notice of Decision Not to Review an Initial Determination Granting in Part Motion for Summary Determination on the Issue of Domestic Industry (Jan. 25, 1993). Alternatively, a complainant may show that a domestic industry exists or is in the process of being established under any of the three statutory grounds set forth in section 337(a)(3). Id. Section 337(a)(3) provides as follows:

> (3) For purposes of paragraph (2),[81] an industry in the United States shall be considered to exist if there is in the United States, with respect to the articles protected by the patent, copyright, trademark, or mask work concerned --
>
> (A) significant investment in plant and equipment;
>
> (B) significant employment of labor or capital; or
>
> (C) substantial investment in its exploitation, including engineering, research and development, or licensing.

19 U.S.C. §1337(a)(3).

The record in this investigation demonstrates that complainant has produced, and will continue to produce, tone dialer chips which it alleges embody the '436 patent at its facility in Carrollton, Texas (FF 1133, 1135-37, 1139-44, 1151-55). Complainant's domestic production and sales (FF 1149) of chips allegedly covered by the '436 patent since 1989 are greater than the domestic production and sales by   of chips allegedly covered by the '886

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81 Section 337(a)(2) provides as follows:

> (2) Subparagraphs (B), (C), an (D) of paragraph (1) apply only if an industry in the United States, relating to the articles protected by the patent, copyright, trademark, or mask work concerned, exists or is in the process of being established.

19 U.S.C. §1337(a)(2).

patent since 1989, which activities of supported a finding that the economic prong of the domestic industry requirement was satisfied with respect to the '886 patent. See Order No. 44 at 13-14. Moreover, complainant's domestic production of tone dialer chips compares favorably with the production found sufficient to support a finding of a domestic industry in SRAMs.

The argument of HMC and UMC that a domestic industry for the '436 patent cannot be found since ST

is rejected. Although HMC and UMC are correct that the record contains

(see e.g., FF 1174-89), the record also demonstrates that complainant has continued production of tone dialer chips at Carrollton throughout 1992 (FF 1142, 1143, 1151-54) and has taken steps to continue production of tone dialer chips in Carrollton at least through March of 1993 (FF 1154). While HMC and UMC argued that such production is a "sham" which intended to create the appearance of a domestic industry and alleged that complainant's plan to create such an illusion was formulated in July of 1992, following issuance of Order No. 44, the record, demonstrates that complainant contemplated 1992 production of tone dialer chips at Carrollton before Order No. 44 was issued (FF 1171-73), and even before the complaint in this investigation was filed (FF 1169-70).

The record also demonstrates that complainant does not intend to cease production of tone dialer chips at Carrollton in the future, but intends to maintain Carrollton

(FF 1095, 1097-99, 1105, 1123-25, 1135-38).

Indeed, there is evidence that Carrollton may even again become the primary source

(FF 1102, 1104, 1108, 1138-40, 1158-62). Moreover, even if complainant does intend to cease production of tone dialer chips at Carrollton in the future, such a consideration is not relevant to whether a domestic exists for purposes of a violation of section 337, although the Commission may consider it relevant to its decision regarding remedy. SRAMs, Order No. 9, unreviewed ID at 5.

The record further reflects that complainant's predecessor acquired the Carrollton facility at a cost of approximately in 1985 (FF 1190); that since 1986, additional capital investments of more than have been made in the Carrollton facility (FF 1192); that complainant has invested approximately since 1986 in fab 4,[82] where the tone dialer chips are fabricated (FF 1193); and that the value of the plant attributable to fab 4 is at least and the value of the equipment in fab 4 used to make tone dialer chips, as well as other semiconductor products, is at least making the total value of plant and equipment in fab 4 at least (FF 1194). In addition, of the employees at Carrollton work in fab 4 (FF 1198), with more than paid to employees of fab 4 in 1991 (FF 1199), and about full-time employees support the activities of fabs 4 and 6 together (FF 1212).

Referring to the argument of HMC and UMC that because fab 4 produces semiconductor products other than tone dialer chips, complainant cannot prove

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82 A "fab" is a production line. There are two fabs at the Carrollton facility, the fab 4 and fab 6, of which only the fab 4 is used for production of tone dialer chips (FF 1109).

by "non-arbitrary" means that the investment is related to the articles protected by the patent is rejected (RB1 at 1-3), the record establishes that with the exception of masks, the same equipment that is used to fabricate tone dialer chips is also used to fabricate other products in fab 4 (FF 1207). Also, there is evidence that such "job lot production" is used when the quantity of individual products that need to be produced is not sufficient to support continuous production using "dedicated" equipment, and is merely a reflection of the realities of the marketplace (FF 1208). The mere fact that the same plant, equipment and labor are used to produce several different products does not preclude a finding that a domestic industry exists. In previous investigations domestic industries have been found to exist even where, as here, different products were produced with the same equipment and labor. *See e.g.*, *SRAMs*, Order No. 9, unreviewed ID; *Certain Strip Lights*, Inv. No. 337-TA-287, unreviewed portion of ID (June 27, 1989) (*see also* Decision to Review a Portion of an Initial Decision (Aug. 14, 1989)). With respect to the argument of HMC and UMC that complainant's employment of labor in Carrollton with respect to production of tone dialer chips is *de minimis*, in Order No. 44 it was held that the economic element of the domestic industry requirement with respect to the '886 patent was met where   of employees worked on fabrication of semiconductor products, including the chips at issue, and where production of the chips at issue constituted only about of   output. Order No. 44 at 13. Here, a smaller percentage of the total number of employees produces a larger percentage of output covered by the '436 patent (FF 1150, 1198).

The record also establishes that complainant invested substantial sums until 1985 in developing the chips allegedly embodying the '436 patent, and until at least 1991 in developing processes to build such chips (FF 1225-28).[83] Although there is currently no research and development taking place in Carrollton with respect to product or process design, complainant continues to perform research and development at Carrollton with a view toward developing new applications for chips embodying the patents at issue (FF 1224, 1264, 1267, 1270-73). In Certain Micromemory Controllers, Components Thereof and Products Containing Same, Inv. No. 337-TA-331, Order No. 6, unreviewed ID granting summary determination summary determination (Jan. 8, 1992),[84] "pure research and development" was included with customer related research and development and customer support as within the meaning of section 337(a)(3)(C). Id. at 3-4.

With respect to complainant's investment in licensing, the record establishes that complainant has developed a system of enforcing its patent rights through the solicitation and negotiation of license agreements (FF 1246-51); that complainant has realized substantial revenues from licensing the '436 patent (FF 1255, 1258, 1259); and that complainant has spent substantial sums on identification of prospective licensees and negotiation of licenses with respect to the '436 patent (FF 1260-62).

Based on the foregoing, the administrative law judge finds that complainant has satisfied the economic prong of the domestic industry

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[83] The administrative law judge finds the reliability of complainant's calculations of the amounts invested in research and development to have been established by the testimony of Neuenschwander regarding their compilation (FF 1228).

[84] See also Notice of Commission Determination Not to Review an Initial Determination Granting in Part Complainant's Motion for Summary Determination on the Issue of Domestic Industry (Feb. 5, 1992).

requirement with respect to the '436 patent under section 337(a)(2) and (a)(3).[85]

B. Practice of the Asserted Claims of the '436 Patent by Complainant

Complainant bears the burden of establishing that it currently practices the asserted claims 1-4 and 6 of the '436 patent. The staff argued that complainant currently practices said claims. Based on FF 721 to 727,[86] the administrative law judge finds that complainant has met its burden in establishing that it practices dependent claims 2, 3 and 4 the '436 patent.

C. Practice of the Asserted Claims of the '108 and '886 Patents by Complainant and

In view of the asserted claims of the '108 and '886 patents as properly construed by the administrative law judge he finds that complainant has not established that it practices those claims (See FF 686 to 691).[87]

[85] Because it is found that complainant's past and current production of tone dialer chips support a finding that a domestic industry exists with respect to the '436 patent at the present time, as well as at the time the complaint was filed, it is not necessary to determine whether Commission precedent, and Bally/Midway Mfg. Co. v. U.S. Intern. Trade Com'n, 714 F.2d 1117 (Fed. Cir. 1983) in particular, requires that the existence of a domestic industry be determined as of the filing of the complaint.

[86] HMC and UMC did not dispute those findings and presented no evidence on this point.

[87] Complainant's argument, made without any cited authority, that to the extent that a domestic industry with respect to the '108 and '886 patents is based on complainant's licensing or research and development activities, the domestic industry requirement is satisfied even if it is found that complainant and do not practice the '108 and '886 patents (CB2 at 36, n.12) is rejected. Section 337(a)(2) requires that the domestic industry relate to the articles protected by the patent. In interpreting that section the Commission has held:

> The language reflects the Commission's long-standing practice of holding that a domestic industry does not exist if the complainant, or its licensees, is not exploiting the asserted patent. Complainants have not sustained their burden of proving that the domestic industry is producing carbonated candy in accordance with

(continued...)

[87](...continued)
claim 1 of the '910 patent.

Certain Methods of Making Carbonated Candy Products, Inv. No. 337-TA-292, Commission Opinion (March 8, 1990) at 34-35.

FINDINGS OF FACT

I. PARTIES

A. Complainant

1. SGS-Thomson Microelectronics, Inc. (ST) is a Delaware corporation having its principal place of business at 1310 Electronics Drive, Carrollton, Texas 75006. (SX 1, Resp. of ST to Staff's Int. No. 1). ST is a leading manufacturer of general purpose integrated circuits, including the telecommunication chips at issue. (CX 498, Neuenswander W.S., 15. A).

B. Respondents

2. United Microelectronics Corporation (UMC) is a Taiwanese corporation having a principal place of business at No. 3 Industrial East 3rd Road, Science-Based Industrial Park, Hsin Chu City, Taiwan. (CX 382, Resp. of UMC to Staff's Int. No. 1). UMC manufactures in Taiwan and exports to the United States telecommunication chips which allegedly infringe the relevant claims of the '108 and '886 patents. Certain of those telecommunication chips have been incorporated into telephones manufactured in Taiwan by respondent SMC Microtronc Co., Ltd. (SMC) and imported into the United States. (CX 325, Resp. to SMC to ST Int. No. 1).

3. Hualon Microelectronics Corp. (HMC) is a Taiwanese corporation having a principal place of business at No. 1, R&D Road, Sec. 4, Science-Based Industrial Park, Hsin Chu City, Taiwan. (CX 81). HMC allegedly manufactures in Taiwan and exports to the United States telecommunication chips which infringe the relevant claims of the '108 and '436 patents. Certain of these telecommunication chips have been incorporated into telephones manufactured in Taiwan by respondent SMC and then imported into the United States. (CX 325, Resp. of SMC to ST Int. No. 1).

4. SMC is a Hong Kong corporation having a principal place of business

at 10/F, Shell Industrial Building, 12 Lee Chung Street, Chai Wan, Hong Kong. (CX 380, Resp. of SMC to Staff's Int. No. 1). SMC manufactures in Hong Kong telecommunications products imported by respondent Lonestar Technologies, Ltd. (Lonestar) that contain telecommunication chips produced by UMC and HMC which allegedly infringe all three patents at issue. (CX 378, Resp. of Lonestar to Staff's Int. No. 4(b)). SMC was added as a respondent by an initial determination (Order No. 33) which the Commission on July 22, 1992, determined not to review.

5. Tranbon Electronic Industrial Co., Ltd. (Tranbon) is a Taiwanese corporation having a principal place of business at No. 6, Lane 315, Sec. 2, Chung Shan Rd., Chung-Ho City, Taipei Hsien, Taiwan. (CX-447). Tranbon manufactures in Taiwan telecommunications products imported by respondent Columbia Telecommunications Group, Inc. (Columbia) that contain telecommunication chips produced by HMC and UMC which allegedly infringe at least the '108 and '436 patents. (Tien, CPX-24 at 100-101; Oung, CPX-23 at 12-13). Respondent Tranbon was added as a respondent by an initial determination (Order No. 47) which the Commission on August 21, 1992, determined not to review.

6. North American Foreign Trading Corporation (NAFTC) is a United States corporation having a principal place of business at 1115 Broadway, New York, New York 10010. (CX-379, Resp. of NAFTC to Staff's Int. No. 1). NAFTC allegedly imports into the United States and sells telecommunication products containing telecommunication chips manufactured by HMC and UMC which allegedly infringe at least the '108 and '436 patents. (CX-323, Resp. of NAFTC to ST's Int. No. 7).

7. Conair Corporation (Conair) is a United States corporation having a

principal place of business at 1 Cummings Point Road, Stamford, Connecticut 06904. (CX-375, Resp. of Conair to Staff's Int. No. 1). Conair allegedly imports into the United States and sells telecommunication products containing telecommunication chips manufactured by UMC and HMC which allegedly infringe at least the '108 and 436 patents. (CX 375, Resp. of Conair to Staff's Int. No. 3).

8. Lonestar (f/k/a Planned Technologies, Ltd.) is a United States corporation having a principal place of business at 920 South Oyster Bay Road, Hicksville, New York 118 1-3518. (CX-378, Resp. of Lonestar to Staff's Int. No. 1). Lonestar has allegedly imported into the United States and sold telecommunication products purchased from SMC containing telecommunication chips manufactured by UMC and HMC which allegedly infringe all three of the patents at issue. (CX-378, Resp. of Lonestar to Staff's Int. Nos. 3 and 4).

9. Spectra Merchandizing International, Inc. (Spectra) is a United States corporation having a principal place of business at 3425 North Kimball Avenue, Chicago, Illinois 60618-5505. (CX 381, Resp. of Spectra to Staff's Int. No. 1). Spectra allegedly imports into the United States and sells telecommunication products containing infringing telecommunication chips manufactured by UMC and HMC, which allegedly infringe at least the '108 and '436 patents. (CX-381, Resp. of Spectra to Staff's Int. No. 3).

10. Columbia is a United States corporation having a principal place of business at 395 Atlantic Avenue East Rockaway, New York 11518. (CX-310, Resp. of Columbia to Staff's Int. No. 1). Columbia allegedly imports into the United States and sells telecommunication products containing telecommunication chips manufactured by UMC and HMC which allegedly infringe at least the '108 and '436 patents. (CX-310, Resp. of Columbia to Staff's

Int. Nos. 7, 9).

11. Kingtel Communication Corp. (Kingtel) is a Taiwanese corporation having a principal place of business at 12F1 #127 Nanking E Rd. Sec. 4, Taipei, Taipei City TW-10569. Kingtel manufactures in Taiwan telecommunications products containing telecommunication chips produced by UMC that allegedly infringe at least the '108 patent. Kingtel was found to be in default in an initial determination (Order No. 131) which the Commission on January 7, 1993, determined not to review.

12. Respondents Winbond Electronic Corporation (Winbond) and Winbond Electronics North American Corporation (Winbond North American) were movants with complainant on Motion No. 337-21 filed June 12, 1992, to terminate the investigation as to Winbond and Winbond North American on the basis of an attached license agreement. Order No. 151, which issued on March 1, 1993, denied Motion No. 337-21 without prejudice because the movants had not obtained approval of the Taiwanese government. On March 8, 1993, the movants filed Motion No. 337-93 renewing Motion No. 337-21 and attaching the approval of the Taiwanese government. Order No. 155, which issued on March 9, 1993, granted Motion No. 337-93.

13. Respondent A & A International, Inc. was terminated from the investigation on the basis of a license agreement in an initial determination (Order No. 93) which the Commission, on November 23, 1992, determined not to review.

14. Hualon Microelectronics Corp. (HMC US) is a U.S. corporation with a mailing address at 2460 N. 1st Street, San Jose, California 95131. HMC US alleges that it does not currently conduct any business at all with respect to the accused telecommunication chips. (CX-377, Resp. of HMC US to ST's Int.

No. 1). HMC US was dismissed from the investigation in an initial determination (Order No. 139), which the Commission on February 16, 1993, determined not to review.

II. EXPERTS

15. In this investigation, Richard Fair was qualified as complainant's expert and Kay Magleby, Marcian Hoff and Else Kooi were qualified as experts for UMC and HMC. Each were qualified with respect to integrated circuits as they apply to the patents in issue. (Tr. at 1329, 1330, 1356, 1357). In addition, no objection was made to offering Michael Callahan, the named inventor on the '886 and '108 patents as "an expert with regard to the prior art issues concerning the '108 and '886 patents." (Tr. at 3611).

16. Callahan was compensated for his time by complainant as both a fact witness and an expert witness at $200 an hour. (Callahan, Tr. at 833).

17. Fair was compensated at $175 an hour for pre-hearing work and while at the hearing at $275 an hour which included travel and work during the hearing. (Fair, Tr. at 1876, 1877).

18. Teklicon employs 20 or 30 technical experts to provide their clients with services. Teklicon charged HMC and UMC §250 an hour for Magleby's time and Magleby received half of that amount from Teklicon. (Magleby, Tr. at 2741, 2742).

19. Teklicon charged UMC and HMC §300 and hour for Hoff's service and Hoff received $180 an hour from that Tekicon. Hoff has an option to purchase stock in Teklicon. (Hoff, Tr. at 3274, 3275).

20. John Haldi was qualified, without objection, as an expert in economics for complainant. Christopher Pleatsikas was qualified, without objection, as an expert in economics for UMC and HMC. (Haldi, Tr. at 2259;

Pleatsikas, Tr. at 3385).

III. PERSON HAVING ORDINARY SKILL IN THE ART TO WHICH THE SUBJECT MATTER PERTAINS

21. The parties agreed in closing arguments (Tr. at 4351 to 4357) that a person having ordinary skill in the art in this investigation and for the three patents in issue would be the following:

> One of ordinary skill in the art at the time of the purported inventions disclosed in the '108 patent would be an engineer with a B.S. in electrical engineering and would have several years experience in logic design of circuits of the kind described in the '108 patent.

22. A person of ordinary skill in the art in the relevant time period would not necessarily have to be skilled in the telephony art but would have experience in logic and circuit designs. Such a person would not have the knowledge that the amplitude of the high group frequency signals has to be different from the amplitude of the low group tone signals. (Kooi Tr. at 3352 to 3354) (Magleby RX1, Q109, Q110).

23. Larry Arnold Woodworth received a B.S.E.E from the University of Illinois in 1971. He was employed by Motorola Communications Division from June 1971 until May 1974. From about May 1974 until February 1976 he was employed with SCI Systems. In March 1976 he began employment at GTE Automatic Electric and was employed there until July 1986. Woodworth's work at Motorola included digital communication. At SCI, Woodworth's work included a design of the electronics for a coin-sorting machine. When Woodworth joined GTE in 1976 his job entailed design work working with vendors. His portion of the design work at GTE was to adapt a tone dialer that had been designed by Mostek into operation of a touchcall system. The key element was that the tone dialer must be of low enough power that it could be powered by the telephone line. Mostek knew very little about the telephone. (Woodworth SPX-7 at 15, 16, 17,

20).

24. In 1975 when the '108 patent issued with respect to a person having ordinary skill in the art, the '108 patent would look exciting and would be given to a design department and because the '108 patent says it needs to be done in CMOS technology the '108 patent would be given to CMOS designers who would know how to build the CMOS elements but would not know how to implement on the same chip NPN transistors and a functional PNP transistor which is isolated from the rest of the circuitry. A CMOS designer would have to sit down with people skilled in the processing of semiconductor circuits and ask is there a way "we can do this". (Kooi Tr. at 3352 to 3354).

25. By complainant's own admission, before the inventions in the '108 and '886 patents inventors Hoffman and Callahan had not worked previously with telephone technology. The technical requirements of a telephony system would not be known to one of ordinary skill in the art of designing electrical logic circuits because a telephone designer talked a completely different language from an integrated circuit designer. (ALJ Ex. 2 at 22).

IV. THE '108 PATENT AND THE '886 PATENT

A. Interrelationship of the '108 Patent and the '886 Patent

26. Each of the '886 patent, titled "Dual Tone Multiple Frequency Generator," and the '108 patent, titled "Integrated Circuit Chip Telephone Communication System," is based on an identical original application Ser. No. 617,955 filed Sept. 29, 1975 and accordingly the patent specifications for the two patents are substantially identical. The difference is the reference to the application history in the '108 patent at col. 1, lines 5-8. (The illustrations on the title pages are also different). (CX-3, CX-4).

27. The named inventors of the '886 patent, which issued on December 6,

1977, and the '108 patent, which issued on February 9, 1982, are Michael James Callahan, Jr. and Gordon Bates Hoffman. Each of the patents is assigned, on its face, to Mostek Corporation of Carrollton Texas. (CX-3, CX-4).

B. Claims of the '886 Patent

28. Claim 6-9 and 13-14 of the '886 patent in issue and which are derived from Ser. No. 617,955 read:

> 6. A signal generator for providing an output signal representative of a keyboard selection, comprising:
>
> keyboard means having actuable keys on said keyboard for generating pulses representative of an actuated key of said keys;
>
> reference means for generating a reference signal;
>
> means for dividing said reference frequency signal in response to said pulses to generate a digital signal having a frequency representative of said actuated key;
>
> programmed logic means having a memory matrix in electrical connection with said dividing means for generating a plurality of digitally coded signals being representative of a sinusoidal waveform having the frequency of said digital signal; and
>
> conversion means connected to the output of said programmed logic array means for converting said digitally coded signals to an analog sine wave having a frequency representative of said key.

(CX-3, Col. 27: 56 thru Col. 28: 8).

> 7. The signal generator of claim 6 wherein said programmed logic array means comprises an MOS read only memory.

(CX-3, Col. 28: 9-11).

> 8. The signal generator of claim 6 wherein said programmed logic array means comprises an input portion including a digital counter clocked by said digital signal to generate a plurality of parallel counter pulses and a first memory matrix connected to the outputs of said counter and responsive to said counter pulses to successively actuate different rows in said first matrix, and an output portion including a second memory matrix responsive to the actuation of the rows of said first matrix to successively generate said digitally coded

signals.

(CX-3, Col. 28: 12-14).

9. The signal generator of claim 8 wherein said second memory matrix generates a succession of binary coded digital signals having successively increasing or decreasing stepped binary values simulating a sinusoidal waveform.

(CX-3, Col. 28: 12-14).

13. A signal generator for providing an output signal representative of a keyboard selection, comprising;

keyboard means having actuable keys on said keyboard for generating pulses representative of an actuated key of said keys;

reference means for generating a reference frequency signal;

means for dividing said reference frequency signal in response to said pulses to generate a digital signal having a frequency representative of said actuated key; and

memory means having a plurality of stored codes representative of a preselected waveform and actuable by said digital signal to generate a large number of digitally coded signals closely approximately said waveform having a frequency representative of said actuated key.

(CX-3, Col. 28: 52 thru Col. 29: 52-69).

14. The signal generator of claim 13 wherein said memory means comprises means having a plurality of stored codes representative of a sinusoidal waveform.

(CX-3, Col. 29: 1-3).

29. Claims 1 and 15 of the '886 patent, which have not been asserted in this investigation, expressly cover dual tone multiple frequency dialers. They read as follows:

1. A multiple frequency signal generator on an MOS integrated circuitry chip for providing a dual-tone output signal representative of a selected key on a keyboard connected to said chip, comprising;

keyboard decode means for generating pulse signals representative of said selected key, including means for directing first synchronized pulses to said keyboard, means for receiving second synchronized pulses from said keyboard and means for decoding said first and second synchronized pulses to generate said pulse signals;

means for generating a fixed frequency;

means for dividing said fixed frequency in response to said pulse signals to generate digital signals having frequencies representative of said selected key;

programmed logic array means having an MOS read-only memory matrix for translating said digital signals to digitally coded signals having code values representative of sinusoidal waveforms; and

conversion means for converting said digitally coded signals to analog sine wave signals having frequencies representative of said selected key; and

output means for combining said sine wave signals to generate said dual-tone signal on the output of said chip.

(CX-3, Col. 27: 15-39).

15. A signal generating system for generating a dual tone, multiple frequency signal, comprising;

keyboard means including a plurality of actuable selector keys arranged in rows and columns with electrical inputs and outputs;

scan signal generator means for generating a series of timed pulses sequentially directed to the inputs of said keys;

first decoder means for generating a first pulse signal responsive to said timed pulses and representative of the row of a selected key of said keys;

second decoder means for generating a second pulse signal responsive to said timed pulses and representative of the column of said selected key;

reference oscillator means connected to said scan signal generator means for generating a reference frequency signal;

first divider means connected to said reference oscillator means and said first decoder means for generating a first digital signal by dividing said reference frequency signal by a factor representative of said first pulse signal;

second divider means connected to said reference oscillator means and said second decoder means for generating a second digital signal by dividing said reference frequency signal by a factor representative of said pulse signal;

programmed logic array means having a memory matrix for generating first and second digital binary coded signals in response to said first and second digital signals from said first and second divider means respectively, said first and second binary coded signals being digital representations of sinusoidal waveforms;

digital-to-analog converter means for converting said first and second digital binary coded signals to first and second analog sinusoidal signals respectively; and

means for combining said first and second sinusoidal signals to generate said dual tone, multiple frequency signal.

(CX-3, Col. 29: 4-44).

30. Claim 6 of the '886 patent describes a signal generator for producing an output signal which represents a depression of a key on a keyboard. This is accomplished by starting with a frequency reference, and dividing that frequency by an appropriate number to get the frequency representative of the desired key. This desired frequency is then converted to a series of digitally coded signals, which are converted to an analog wave form to produce the desired output signal. (Magleby, Tr. at 2678-79; CX-3).

C. <u>Claims of the '108 Patent</u>

31. Claims 1, 4, 10, 11, 14, 15 and 16 of the '108 patent in issue and which are derived from application Ser. No. 2,424 filed Jan. 10, 1979, which is a continuation of abandoned Ser. No. 831,736 filed Sept. 9, 1977, which in turn is a division of Ser. No. 617,955 filed September 29, 1975 read:

1. A telephone communication system adapted to be powered solely by telephone line inputs and including a multiple frequency signal generator on a complementary symmetry, metal oxide, semiconductor integrated circuitry chip for digitally synthesizing a dual-tone sinusoidal representative signal of a selected key on a keyboard comprising:

a keyboard decode means on the chip responsive to the keyboard for generating a keyboard signal representative of the selected key;

means on the chip responsive to the keyboard signal for generating a control signal in response to the selected key being enabled; and,

common switching means on the chip responsive to the control signal for performing the common switching functions of the telephone communication system during generation of the sinusoidal representative signal including means for enabling oscillatory circuitry in said multiple frequency generator, means for disabling an audio transmitter and means for attenuating the output of a receiver.

(CX-4, Col. 26: 28-64).

4. The telephone communication system of claim 1 wherein the audio transmitter disabling means comprises;

a bipolar transistor having its collector connected to a positive line voltage of the telephone line inputs and its emitter connected to the audio transmitter;

a field effect transistor connected across the collector and base of the bipolar transistor and gated by the control signal; and,

a bleeding resistor connected across the base and emitter of the bipolar transistor.

(CX-4, Col. 27: 24-34).

10. The telephone communication system of claim 1 including reference oscillator circuitry and wherein the common switching means further comprises means for enabling the reference oscillator circuitry.

(CX-4, Col. 29: 10-14).

11. The telephone communication system of claim 10 wherein the means for enabling the reference oscillator circuitry comprises a field effect transistor gated by the control signal and connected between a positive line voltage of the telephone line inputs and a first terminal of the reference oscillator circuit.

(CX-4, Col. 29: 14-19).

14. The telephone communication system of claim 10 wherein the common switching means connects the signal generator to a power supply in response to the control signal.

(CX-4, Col. 29: 45-48).

> 15. The telephone communication system of claim 14 wherein the power supply is the telephone input lines and the common switching means includes a bipolar transistor connected between the power supply and the system output and with its base driven by the signal generator.

(CX-4, Col. 29: 48-55).

> 16. The telephone communication system of claim 1 wherein the keyboard is comprised of a plurality of single-pole single-throw switches

(CX-4, Col. 1, 30: 1-3).

32. All the claims in issue of the '108 patent relate to a telephone communication system adapted to be powered solely by telephone line inputs and including a multiple frequency signal generator on a complementary symmetry, metal oxide (CMOS), semiconductor integrated circuitry chip for digitally synthesizing the dual-tone sinusoidal signal representative of a selected key on a keyboard. (CX-4).

33. The asserted claims do not relate to the entire telephone, but to an integrated device or component that allows the electromechanical telephone elements to work together. (Fair, CX-503 at 5, 6; CX-4).

34. With respect to the to the language in Claim 1 of the '108 patent:

A. The "keyboard decode means on the chip responsive to the keyboard" would be shown in Figure 1, which shows the keyboard circuit 14 and the decode blocks 16 and 18. The decode blocks would take keystroke information and put it into a form that the chip would understand and utilize.

B. The next clause of Claim 1 has "means on the chip responsive to the keyboard signals for generating a control signal in response to the selected key being enabled." Callahan testified that this is illustrated by the control signal VKB Bar shown in Figure 4 and that as displayed in Figure

2, signal VKB Bar enters a number of the elements on the chip, thereby controlling a number of functions on the chip with the means on the chip responsive to the keyboard signal for generating the control signal being NOR gate 166, shown in Figure 4. (Callahan, Tr. at 673-675).

35. As to the last clause of independent claim 1, Callahan testified:

A Okay. The last paragraph says common switching means on the chip responsive to control signal for performing common switching functions of the telephone system. They're in generation of the tones including means for enabling the oscillator circuitry and that includes this block here in Figure 6. If we look at Figure 6 we'll see VKB bar --

JUDGE LUCKERN: What block is it? Is there a number or something?

THE WITNESS: Figure 6, it would be right near the top where the signal is labeled VKB bar. That's the same signal that came out of element '166 of Figure 4. So this is the control signal and this is where it's going over to this other piece to perform the first of the so-named common functions. VKB bar comes in and controls the enablement of the oscillator. The oscillator has previously defined would be elements 244, 250 and 257.

Q BY MR. LUPO: Again, now just so the records complete, is transistor 242 bi-polar?

A No, 242 is a MOS transistor.

Q Is it on chip?

A It is on chip.

JUDGE LUCKERN: Where did we get 242? I thought you just said 244, 250 and 257?

THE WITNESS: Well, the oscillator is comprised of elements 244, 250 and 257. But what turns it on and off is transistor 242 which is controlled by first VKB bar and then it gets inverted into VKB.

JUDGE LUCKERN: And that's a MOS transistor or bi-polar?

THE WITNESS: This one is a MOS transistor.

JUDGE LUCKERN: All right. Go ahead.

THE WITNESS: And then -- so that's this piece right here where it says for enabling the oscillatory circuitry in the claim. Means for disabling an audio transmitter -- The means for disabling an audio transmitter on a chip is this output signal right here, VKB, which in turn has been, of course, controlled from VKB bar.

So the VKB bar at the bottom of Figure 12, left-hand side is the same signal coming out of element '166 in Figure 4. It's going over to this block and is now going to go through this -- This is going to be a little larger invert of the normal but, in any event, it's logically the inverse of VKB presented to the output of the chip and then it can be used to drive a PNP transistor which is off-chip to go --

Q BY MR. LUPO: Is that PNP transistor bi-polar?

A It is a bi-polar transistor and it is an off-chip.

JUDGE LUCKERN: What transistor item is that number?

THE WITNESS: 594.

* * *

THE WITNESS: And the action of this transistor turning on and off will either insert the resistance 596 in series with the ear piece or not. And during toning the resistor 596 would be inserted with the ear piece to keep from having too loud a signal in your ear.

And I said that was going to be disabling the audio transmitter, but I just described the last means and that is the continuation of the output of the received. So I did that kind of in reverse order.

JUDGE LUCKERN: All right.

THE WITNESS: But the other piece which I should have described in sequence is means for disabling audio transmitter. Now, the audio transmitter is element 584 of Figure 12. And the method of enabling or disabling it is merely allowing a lot of current to flow through it or not. So, it is going to be controlled from our control signal VKB bar which goes through an invertor 598 and then goes to a P-channel transistor on the chip, 592 and then a bi-polar transistor, 598 and this is happens to be on the chip at that particular time.

And also, an element, 590, which is a lead resistor coupled across base and admitter of this transistor. And this could be the output of that particular chip which would be connected to the transmitter of the carbon microphone and your telephone.

> So, this means for disabling the audio transmitter and this embodiment would include all the circuitry shown here and that would include both the transistor 588, 592 and 590 in this embodiment.

(Callahan, Tr. at 673-675).

36. Inventor Callahan testified that the claimed phrase "common switching means on the chip "is the VKB signal that is "on the chip and ... can be used to drive all chip components". (Callahan, Tr. at 668, 675).

37. Callahan testified that the "common switching functions" include enabling the oscillator, disabling the microphone and attenuating or "muting" the earpiece. (Callahan, Tr. at 659 to 662).

38. The means for enabling the oscillator as recited in claim 1 of the '108 patent is shown in Fig. 6. MOS transistor 242 is responsive to signal VKB in order to enable the oscillator to oscillate during the period of time that tones are being generated. MOS transistor 242 is not a current carrying transistor. (Magleby, Tr. at 2474-75; CX-4).

39. Referring to claim 8 of the '108 patent which is dependent on claim 1 but which claim 8 is not issue, Callahan testified that excluding the receiver and transmitter, the elements recited in claim 8 are not part of the common switching means. He further testified that the common switching means of claim 8 does not comprise at least a first bipolar transistor, a first field effect transistor, a first bleeding resistor, a load resistor, a second bipolar transistor, a second field effect transistor and a second bleeding resistor. (Tr. at 745, 746, 747).

40. Claim 8 of the '108 patent, which is not in issue, reads:

> The telephone communication system of claim 1 wherein the common switching means comprises:
>
> a first bipolar transistor having its collector connected to a positive line voltage of the telephone line inputs;

a first field effect transistor connected across the collector and base of the first bipolar transistor and gated by the control signal;

a first bleeding resistor connected across the base and emitter of the first bipolar transistor;

a load resistor connected between the emitter of the first bipolar transistor and a negative line voltage of the telephone line inputs;

a second bipolar transistor having its collector connected to the positive line voltage;

a second field effect transistor connected across the collector and base of the second bipolar transistor and gated by the control signal;

a second bleeding resistor connected across the base and emitter of the second bipolar transistor;

the audio transmitter having a first terminal connected to the emitter of the second bipolar transistor and a second terminal connected to the negative line voltage;

a third bipolar transistor having its emitter connected to the positive line voltage and its base connected to the control signal;

a muting resistor connected across the emitter and collector of the third bipolar transistor;

the receiver having a first terminal connected to the collector of the third bipolar transistor and a second terminal connected to the negative line voltage; and,

a third field effect transistor connected between the positive line voltage and the output circuitry of the telephone communication system and gated by the control signal.

(CX-4, Column 27:64-28:33).

41. Claim 8 of the '108 patent states that the "common switching means" comprises specified circuitry which includes bipolar transistors. (Order No. 117, ¶ 2, Fact No. 5).

42. In claim 8 of the '108 patent, the transistor described as "a third bipolar transistor having its emitter connected to the positive line voltage and its base connected to the control signal" is shown as PNP transistor 594 in Figure 12 of the '108 patent. (Callahan, Tr. at 738, 741).

43. In claim 8 of the '108 patent, the transistor described in the claim as "a second bipolar transistor having its collector connected to the positive line voltage," is shown in Figure 12 of the '108 patent as transistor 588. (Callahan, Tr. at 738, 740).

44. With respect to claim 14, the common switching means which connect the signal generator to a power supply in response to the control signal includes MOS transistor 614 which connects the V+ power supply connection to the signal generator comprising amplifier 600 and feedback resistor 612. (Fair, Tr. at 1422, 1423).

45. The claims of the '886 and '108 patents are not restricted to either the 1PLA or the 2PLA embodiments. (Magleby, Tr. at 2660; CX-3; CX-4).

D. The Abstract of the '108 and '886 Patents

46. The abstract reads:

A dual-tone multiple frequency signal generator is provided for use with telecommunication systems, data transfer systems and other application. The tone encoding systems utilizes MOS/LSI integrated circuitry on a single chip powered directly by telephone line voltages. An electronic keyboard circuit provides synchrozined pulses to decode single-pole, single-throw keyboard switches by row and column. A crystal-controlled oscillator generates a reference frequency which is divided according to the row and column of an activated keyboard switch to obtain two pulse signals having frequencies representative of the activated switch. The outputs of the divider circuitry are fed to a programmed logic array which generates two digitally coded signals each representing a sinusoidal waveform. A digital-to-analog ladder network converts the digitally coded signals to continuous sine waves, and an operational amplifier combines the sinusoidal waveforms to provide a dual-tone output. The integrated circuitry also utilizes electronic switches for the common functions of tone transmission, including applying power to the oscillator, disconnecting the audio transmitter and attenuating the input to the receiver. Complementary-symmetry, metal-oxide semi-conductor elements implement the circuitry design with bi-polar transistors on the same chip performing some of the common function switching.[1]

(CX-3, CX-4).

E. The Specification of the '108 and '886 Patents

47. Each of the '886 and '108 patents has the following subheadings: "Background of the Invention," "Summary of the Invention" "Description of the Drawings" and "Description of the Preferred Embodiment". (CX-3, CX-4).

48. Under the subheading "Background of the Invention", each of the '886 and '108 patents state in part:

> This invention relates to tone encoding systems for communications networks. More particularly, the invention concerns a dual-tone multiple frequency signal generator for keyboard input tones to standard telephone systems.

(CX-3, CX-4, col. 1).

49. Under the subheading "Summary of the Invention", each of the '108 and '886 patents state in part:

> The present invention is concerned with an improved electronic signal generating system and method for providing a dual-tone output. The system utilizes MOS-LSI integrated circuitry powered by standard line voltage. A keyboard assembly preferably uses single-pole, single-throw key switches. The keyboard is decoded by synchronized timing circuitry to provide keyboard input signals representative of the actuated keys. A reference frequency signal, generated by a crystal controlled oscillator, is divided in response to the keyboard input signals to obtain digital pulses having a frequency representative of the row and column of an actuated key. These digital signals are converted by a progammed logic array to binary words approximating sine waves. A conventional digital to analog converter translates the binary words to a sinusodial output waveform.

(CX-3, CX-4, col 1 and 2).

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1 Rule 72(b) of the PTO rules of practice (37 CFR § 1.72(b)(July 1988)) states in part that "The abstract shall not be used for interpreting the scope of the claims."

50. Under the subheading "Summary of the Invention, each of the '108 and '886 patents state in part:

> The common key functions such as powering up the circuitry, switching out the transmitter and connecting muting resistance into the receiver circuit are provided electronically as part of the chip of integrated circuitry. Complementary-symmetry, metal-oxide, semi-conductor (CMOS) elements are utilized to provide high-frequency, low-voltage operation. A number of bipolar transistors are included in the integrated circuitry to handle the high current requirements for the common functions and to drive the low-impedance telephone lines.
>
> In accordance with another aspect of the present invention, a signal generator provides an output signal representative of a keyboard selection. Keyboard means are provided having actuable keys on the keyboard and means for generating pulses representative of an actuated key. A reference oscillator generates a reference frequency signal which is modified in response to the pulses from the keyboard to provide a digital signal representative of the actuated key. Conversion means generate a sinusoidal output signal in response to the digital signal.

(CX-3, CX-4, col. 2 and col. 3).

51. As to another aspect of the invention the "Summary of the Invention" states:

> In accordance with another aspect of the present invention, a signal generating system is provided for producing a dual-tone, multiple frequency signal. A keyboard includes a plurality of actuable selector keys with a scan signal generator for sequentially directing timed pulses to the inputs of the keys. First and second decorder circuits provide a pair of pulse signal trains responsive to the timed pulses and representative of the row and column of a selected key. A reference oscillator generates a reference frequency signal which is divided by counting circuitry in response to the pair of pulse signal trains to produce a pair of digital signals having frequencies which are multiples of standard telephone output frequencies. Programmed logic array means convert the digital signals to binary coded words which represent sinusoidal waveforms having standard telephone output frequencies. Finally, a conventional digital-to-analog converter converts the binary words to sinusoidal signals which are combined to generate the dual-tone multiple frequency output signal.

(CX-3, CX-4, col. 2).

52. Under the subheading "Summary of the Invention", each of the '108 and '886 patents state in part:

> In accordance with a further important aspect of the present invention, a signal generator provides an output signal in response to an input signal from one of a plurality of monitored sources. Actuator means are in communication with each of the sources and generic timed pulses representative of the location of the sources relative to each other. A reference means generates a standard reference signal which is modified in response to the timed pulses to generate a digital signal. Programmed means convert the digital signal to a digitally coded signal which is then converted to a sinusoidal analog signal for the output.

(CX-3 and CX-4, col. 2).

53. The "Summary of the Invention of the Invention" after referring to "another aspect" and "another aspect" and a "further important aspect" supra states:

> From the foregoing, it is apparent that the present invention provides several advantages over the prior art... Using MOS-LSI integrated circuitry, the entire system except for the crystal of the reference oscillator is included on a single chip, thereby providing a compact low-maintenance package capable of operating at high frequencies and low voltage. By including the common key functions on the chip, the size and maintenance requirements of the system are further reduced.

(CX-3, CX-4, col. 2).

54. The last paragraph under the subheading "Summary of the Invention" reads:

> Although the present invention is contemplated primarily for use in the input portion of standard telephone operating systems, the features of the invention are broad enough to be included in burglar alarms, electronics combination locks, low-speed modems for data transfer, such as credit verification systems, and remote control/signalling systems such as VHF-UHF, autopatch repeaters and control signalling.

(CX-3, CX-4, col. 3).

55. Column 3, line 18 of the '108 patent as does the corresponding

portion of the '886 patent uses the expression "MOS-LSI" integrated circuitry. The expression is interchangeable with "MOS-FET," and refers to having a large number of MOS-FETs and MOS-LSI integrated circuits "FET" is really like one transistor. (Callahan, Tr. at 423-25). According to Callahan, MOS-LSI integrated circuitry defines the technology and the technology of interest is called out in the specification a number of times as CMOS and CMOS "naturally includes bipolars if one cares to use them" and the inventors did in fact use them "a number of places". Callahan agreed that the reference to "MOS-LSI integrated circuitry includes the reference to CMOS, which includes those parasitic bipolars." (Callahan, Tr. at 423-425, 831).

56. Under the subheading "Description of the Preferred Embodiment," each of the '108 and '886 patents state in part:

> Referring now to FIG. 1, a simplified block diagram of a signal generator system in accordance with one embodiment of the present invention is indicated generally by the reference numeral 10. With the exception of the crystal of reference oscillator 12, signal generator system 10 is fabricated as a single integrated circuit using primarily CMOS (complementary-symmetry, metal-oxide semiconductor) field effect transistor technology. System 10 generates a dual-tone multiple frequently wavefore output of low harmonic distortion which is suitable for telephone signalling or other applications. It can operate from telephone lines or a fixed DC supply and is designed for economy and compactness.
>
> The input to system 10 is provided by a keyboard circuit 14 having actuable keys arranged in rows and columns. The outputs of keyboard circuit 14 feed to a row decord circuit 16 and a column decode circuit 18 which electroncially sense the row and column of an actuated key. Timed pulses are generated by circuits 16 to 18 which are fed respectively to a low group programmable divide circuit 20 and a high group programmable divide circuit 22. The frequency of the reference signal from reference oscillator 12 is divided by circuits 20 to 22 to provide output digital signals having frequencies which are representative of the row and column of the selected key and which are multiples of standard frequencies for conventional communication systems. These digital signals are fed to sine wave programmed logic arrays (PLA) 24 and 26 which convert the digital frequency signals from circuits 20 and 22, respectively, to digitally coded words having binary values representing different

levels of the amplitude of sine waves having standard communication frequencies. These coded words are then fed into conversion net works 28 and 30 which generate analog sinusoidal waveforms at the frequencies indicated. The sine waves are then combined by circuit 32 and fed to an operational amplifier 34 for current to voltage conversion. The output signal 36 of system 10 is a dual-tone sinusoidal signal having frequencies which are compatible to interface with standard communication systems. The frequencies of the output signal will vary with the row and column of the selected key so that a unique output signal is provided for each actuated key.

In FIG. 2, a detailed block diagram of another embodiment is shown. A telephone tone generator system 40 is shown for providing a multiple frequency keyboard output signal to conventional telephone circuitry. The system 40 is preferably a monolithic integrated circuit which is fabricated with the complementary-symmetry MOS process. ... Preferably the common key functions such as switching out the transmitter and switching in muting resistance are included in the integrated circuitry.

* * *

... the configuration and function of the system shown in FIG. 2, and each of its components shown in [remaining] FIGS. 3-12 will be discussed, ...

* * *

As shown in FIG. 12, the common function switching operations are performed electronically using bipolar transistor logic preferably on the same integrated circuit chip with the rest of the system...

* * *

As shown in FIG. 12, the common functions of disconnecting the audio transmitter and attenuating the input to the receiver are performed electronically during the off-hook transmit mode. When a VKB signal is applied to the gates of transistors 592 and 594, transmitter 584 is disconnected from the telephone line and the muting resistor 596 is connected in series with the receiver 586. Transistor 604 is turned on placing dummy load 608 across the telephone lines to compensate for the removal of the audio transmitter load. When the system switches back to the off-hook standby mode, transistors 588 and 594 are switched on, placing the audio transmitter 594 and the audio receiver 586 directly across the telephone lines. Also during the standby mode, transistor 604 is switched off removing the dummy load resistor 608 from the telephone lines. As previously shown in FIG. 6, the common function of switching the oscillator off and on is also performed electronically using the input VKB and VKB bar signals acting on MOS circuitry.

(CX-3 to CX-4, col 3 and 4, col 21 and 25).

57. Under the subheading "Description of the Preferred Embodiment" each of the '108 and '886 patents state in part:

> ... digital signals are fed to sine wave programmed logic arrays (PLA) 24 and 26 which convert the digital frequency signals from circuits 20 and 22, respectively, to digitally coded words having binary values representing different levels of the amplitude of side waves having standard communication frequencies.

(CX-3 and CX-4, col. 4).

58. Col. 5, lines 2-5 of the '108 patent states "[p]referably the common key functions such as switching out the transmitter and switching in muting resistance are included in the integrated circuitry". (CX-4).

59. Col. 21, lines 31-34 of the '108 patent states as follows: "[a]s shown in Figure 12, the common function switching operations are performed electronically using bipolar transistor logic, preferably on the same integrated circuit chip with the rest of the system". (CX-4).

60. Col. 26, lines 19-22 of the '108 patent states that a preferred embodiment of the present invention has been described in the specification of the patent. (CX-4).

61. With respect to <u>all</u> of the Figures of the '108 and '886 patents the figures are:

> FIG. 1 is a simplified block diagram showing one embodiment of the present invention;
>
> FIG. 2 is block diagram of another embodiment of the present invention;
>
> FIG. 3 is a circuit diagram of the keyboard and scan circuitry of the system shown in FIG. 2;
>
> FIG. 4 is a circuit diagram of the row decorder of the system of FIG. 2;
>
> FIG. 5 is a circuit diagram of the column decoder of t he

system of FIG. 2;

FIG. 6 is a circuit diagram of the scan signal generator and reference osciallator of the system of FIG. 2.

FIGS. 7 and 8 are circuit diagrams of the programmed divider circuitry of the system of FIG. 2;

FIG. 9 is a circuit diagram of the multiplexer of the system of FIG. 2;

FIG. 10 is a circuit diagram of the programmed logic array and accompanying circuitry of the system of FIG. 2;

FIG. 11 is a graphic depiction of the output waveform of the programmed logic array of FIG. 10; and

FIG. 12 is a circuit diagram of the digital-to-analog converter and output circuitry of the system of FIG. 2.

(CX-3, CX-4, col. 3).

62. Figure 1 of the '108 and '886 patents is a block diagram of a touch-tone telephone. It shows the generation of both the row and column tone signals from the single reference signal source. The system shown responds to keys being pressed on the key pad to generate the appropriate frequency for the row and for the column of the key. The desired tone waveform is stored in the Programmed Logic Arrays (PLA), one for the row, one for the column. The row or the column of the key that was pressed determines how fast the stored information is accessed and available for output. The digital to analog conversion circuits transform the digital information from the PLAs into an analog form that the central telephone station can recognize for successful dialing. (Fair, CX-503 at 11-12; Fair, Tr. at 1495; CX-3).

63. Fig. 1 of each of the '108 and '886 patents which is designated "signal generator system 10" includes one block 24 and one block 26, each block designated "Sine Wave PLA [Programmed Logic Array]". There is very little detail in the patents with respect to system 10 of Figure 1. (CX-3,

CX-4).

64. The circuitry of Figure 2 of the '108 and '886 patents "which is designated system 40" and is directed to a telephone tone generator system is explained in considerable detail in the patents. Figure 2 includes a block 58 designated "multiplexer" and a block 64 designated "Programmed Logic Array." Figure 2 shows only one "Programmed Logic Array." (CX-3, CX-4; Callahan, Tr. at 613).

65. Col. 5, lines 64-68 of the '886 patent (col. 5, line 68 - col. 6, line 5 of the '108 patent) states "multiplexer 58 may be eliminated from system 40 by adding a second programmed logic array [PLA] similar to PLA 64. One PLA would be connected between shift register 60 and latch 66 and the other would process the output of shift register 62 for the latch 68 input." (CX-3).

66. Col. 26, line 68 - col. 27, line 5 of the '886 patent (col. 26, line 13-18 of the '108 patent) states "Although the previously described embodiments includes a multiplexer circuit, it is understood that the multiplexer may be eliminated and a second programmed logic array [PLA] may be implemented for simplicity of design without departing from the scope of the present invention". (CX-3, CX-4).

F. <u>Prosecution of Serial No. 617,955</u>

67. Application Serial No. 617,955 filed September 29, 1975, and which resulted in the '886 patent included 48 claims, which claim 45 provided:

> "45. The signal generator of Claim 44 and further comprising common switching means on said chip for enabling said oscillator, disabling an off-chip audio transmitter and attenuating an off-chip receiver during generation of said dual-tone output signal."

(Order No. 117, ¶ 2, Fact No. 7)

68. There were nine independent original claims, _viz_. original claims 1, 10, 17, 30, 31, 36, 40, 43 and 44. (CX-6).

69. The preamble of independent original claim 1 reads "A signal generator for providing an output signal representative of a keyboard selection comprising ...." (CX-6).

70. Dependent original claims 6, 7, and 8 read:

6. The signal generator of Claim 1 wherein said keyboard means comprises a plurality of actuable keys arranged in rows and columns, and means for generating first and second pulse trains representative of the row and the column, respectively, of said actuated key.

7. The signal generator of Claim 6 wherein said modifying means comprises first divider means for dividing the frequency of said reference frequency signal by a first factor representative of the row of said actuated key in response to said first pulse train to generate a first digital signal, and second divider means for dividing the frequency of said reference frequency signal by a second factor representative of the column of said actuated key in response to said second pulse train to generate a second digital signal.

8. The signal generator of Claim 7 wherein said conversion means comprises first converter means for generating a first sinusoidal signal in response to said first digital signal, second converter means for generating a second sinusoidal signal in response to said second digital signal, and summing means for combining said first and second sinusoidal signals to generate said output signal.

(CX-6).

71. The preamble of independent original claim 10 read "A multiple frequency signal generator for providing a dual-tone output signal comprising....." (CX-6).

72. The preamble of independent original claim 17 read "A signal generating system for generating a dual tone, multiple frequency signal, comprising ..." (CX-6).

73. The preamble of independent original claim 27 read "A signal

generator for generating an output signal in response to an input signal from one of a plurality of monitored sources, comprising..." (CX-6).

74. The preamble of independent original claim 30 read "A signal generator for generating a multiple frequency signal in response to input signals from one of a plurality of sources, comprising..." (CX-6).

75. The preamble of independent original claim 31 read "A method for providing an output signal representative of a keyboard selection, comprising..." (CX-6).

76. The preamble of independent original claim 36 read "A method for providing a dual-tone multiple frequency signal using a keyboard having actuable keys arranged in rows and columns, comprising..." (CX-6).

77. The preamble of independent original claim 40 read "A method for providing a dual-tone multiple frequency signal for use in a telephone system having a keyboard with a plurality of actuable selector keys with electrical inputs and outputs, comprising..." (CX-6).

78. The preamble of independent original claim 43 read "A method for generating an output signal responsive to input signals from one of plurality of sources, comprising..." (CX-6).

79. The preamble of independent original claim 44 read "A multiple frequency signal generator on an MOS integrated circuitry chip for providing a dual-tone output signal representative of a selected key on a keyboard in communication with said chip, comprising...." (CX-6).

80. On May 12, 1976, the PTO rejected Claims 1-48, citing 35 U.S.C. 102. In rejecting claim 45, the PTO rejection refers to Hagelberger U.S. 3,787,836 and the Nash U.S. 3,941,942 stating: "Both references clearly anticipates applicants claimed invention." (Emphasis in original). (RX 89, 000100-101).

81. In response to the PTO rejection of May 12, 1976, the applicants' attorney, Ronald Thurman, submitted an Amendment on October 12, 1976, cancelling Claims 1 through 43 of the original forty eight claims and adding a number of claims, including proposed claim 58 which is substantially identical to issued claim 1 of the 108 patent. Proposed claim 58 read as follows:

> "58. In a telephone communication system including a multiple frequency signal generator on an integrated circuitry chip for digitally synthesizing a dual-tone sinusoidal signal representative of a selected key on a keyboard in communication with said chip, the combination comprising:
>
> keyboard decode means on said chip responsive to said keyboard for generating a keyboard signal representative of said selected key;
>
> means on said chip responsive to said keyboard signal for generating a control signal in response to said selected key being enabled; and
>
> common switching means on said chip responsive to said control signal for performing the control switching functions of said telephone communication system during generation of said sinusoidal signal including means for enabling oscillator circuitry, means for disabling an audio transmitter and means for attenuating the output of a receiver."

(RX-89 at 110, 111, 116).

82. Newly added claim 49 was identical to claim 6 of the '886 patent in issue. Newly added claim 56 was identical to claim 13 of the '886 patent in issue with the exception that claim 56 had the language "in electrical communication with said keyboard means and said reference means" after the third occurrence of "means" in the claim 13 in issue.

83. In the "Remarks" section of the October 12, 1976 amendment, attorney Thurman at pages 13, 16 and 18 of this amendment stated:

> The Claims now pending in the present application describe a signal generator for use with a keyboard, preferably a keyboard of a telephone system, to generate signals represen-

tative of selected keys on the keyboard. Electrical pulses are first generated which are representative of a selected key. The pulses are then used to divide a reference frequency by a preselected divisor, depending upon which key was selected to generate a digital signal having a frequency representative of the selected key. A programmed logic array means having at least one memory matrix is then used to generate a preselected waveform having the frequency of the digital signal. The waveform is preferably a sinusoidal waveform which can be used in telephone communications systems.The output waveform is then converted to an analog waveform and combined with another similar waveform to produce a dual tone signal for use in a telephone system.

Preferably the system is assembled entirely on a single integrated circuitry chip. A common switching means circuitry is preferably included on the same chip for performing the usual common switching functions, either by CMOS circuitry or by using partially or totally bipolar transistors on the same chip....

"The Examiner has rejected the previously submitted Claims, citing the Hagelbarger and Nash patents. The systems of both patents are concerned with digitally generating sinusoidal wave forms for keyboard signalling in telephone systems. However, the system of the present invention differs from the references in a number of important respects.

* * *

Another major difference in the present system and those of the references is with respect to the common switching functions which are included on the same integrated circuitry chip in the present invention. This approach, together with the use of electronic decoding circuitry for the keyboard, enables the use of single-pole, single-throw type keyboards. This approach represents a major change in system design which leads to a much simpler less expensive and more compact system than those of the prior art. Also, the operating voltage of such a system can be substantially lower than possible with prior art systems, thereby enabling the system to be powered directly from the telephone lines with no external power supply. The foregoing constitutes a substantial improvement over the keyboard systems of the prior art wherein all common switching was enabled by mechanical keyboard linkages and off-chip transistor circuitry."

* * *

"Claim 58 describes a combination used in a telephone communication system including means for decoding the keyboard and means for generating a control signal in response to the

> selection of a key. Common switching means are provided on the chip and are responsive to the control signal to perform the common switching functions of enabling oscillator circuitry, disabling an audio transmitter and attenuating the output of the receiver. As previously mentioned, the references make no suggestion of including the common switching means on a single integrated chip.
>
> Claims 59-63 further describe features of the single chip system..."

(Order No. 117, ¶ 2, Fact No. 10, CX-6, RX-89).

84. In the "Remarks" section of the October 12, 1976, amendment, attorney Thurman at pages 16 and 17 and concerning newly added claims 49 and 56 stated:

> Turning briefly to the Claims, Claim 49 is concerned with a signal generator for providing an output signal representative of a keyboard selection. The system includes programmed logic array means having a memory matrix for generating a plurality of digitally coded signals which represent a sine wave. As mentioned previously, neither Hagelbarger nor Nash disclose such a programmed logic array element. Both references teach much more crude circuitry for attempting to generate sine waves.
>
> * * *
>
> Claim 56 is concerned with a signal generator similar to that of Claim 49, but including memory means using a plurality of stored codes which are representative of a preselected wave form. The memory means may be configured to generate whatever type of wave form may be desired and is not limited to sinusoidal wave form generation. Moreover, the memory means is actuable to generate digitally coded signals which closely approximate the desired wave form, so that conversion of the digitally coded signals to an analog sine wave is not necessary. The circuitry of the present invention easily enables the generation of a large number of digitally coded signals to provide a very refined wave form output. In contrast, Hagelbarger discloses only three levels for the wave form output, and the circuitry of Nash could yield no more than eight different levels. To attempt to add significantly to the incremental steps of the system shown in either patent would require a great amount of unwieldy circuitry so as to render the resulting system impractical.

85. On February 1, 1977, the PTO subjected proposed claims 58-63 of

application 617,935 to restriction pursuant to 35 U.S.C. 112. (RX 89 000137).

86. On April 5, 1977, the applicants submitted an amendment to the PTO stating the intent to file subsequently a divisional application applicable to Claims 58-63. Thereafter, the PTO cancelled claims 58-63 in application No. 617,955. (Order No. 117, ¶ 2, Fact No. 12).

87. In the October 12, 1976 Amendment which added new claim 58 above, several new claims dependent from claim 58 were also presented for the first time. New claim 59, dependent from claim 58, read as follows:

> 59. The combination of Claim 58 wherein said integrated circuitry chip comprises complementary symmetry, metal-oxide, semiconductor circuitry and wherein said common switching means includes a plurality of bipolar transistors on said chip.

(CX-6).

88. New claim 60 also depended from claim 58, while new claim 61 depended from claim 60. New claims 60 and 61 read as follows:

> 60. The combination of Claim 58 wherein said common switching means further comprises electronic switching means for connecting said signal generator to an external source of electrical power in response to said control signal.
>
> 61. The combination of Claim 60 wherein said electronic switching means includes a bipolar transistor and wherein said external source of electrical power comprises the telephone power lines of said telephone communications system.

(CX-6).

89. In the "Remarks" section of the October 12, 1976 amendment, attorney Thurman at page 14 of this amendment stated:

> Preferably the system is assembled entirely on a single integrated circuitry chip. A common switching means circuitry is preferably included on the same chip for performing the usual common switching functions, either by CMOS circuitry or by using partially or totally bipolar transistors on the same chip.

(CX-6).

90. Claim 58 and the claims dependent thereon were subject to a restriction requirement by the Examiner. (CX-6).

G. <u>Prosecution of Serial No. 831,736 (Involves Only '108 Patent)</u>

91. Continuation divisional application 831,736 was filed on September 9, 1977, as a division of application No. 617,955. (Order No. 117, ¶ 2, Fact No. 13).

92. On January 11, 1978, the applicants submitted an Amendment to continuation application 831,736, cancelling pending claims 1-48 and adding claims 49-54. Proposed claim 49 read as follows:

> "49. In a telephone communication system including a multiple frequency signal generator on an integrated circuitry chip for digitally synthesizing a dual-tone sinusoidal signal representative of a selected key on a keyboard in communication with said chip, the combination comprising:
>
> keyboard decode means on said chip responsive to said keyboard for generating a keyboard signal representative of said selected key;
>
> means on said chip responsive to said keyboard signal for generating a control signal in response to said selected key being enabled;
>
> and common switching means on said chip responsive to said control signal for performing the common switching functions of said telephone communication system during generation of said sinusoidal signal including means for enabling oscillator circuitry, means for disabling an audio transmitter and means for attenuating the output of a receiver."

(Order No. 117, ¶ 2 Fact No. 14).

93. Claims 58 and the claims dependent therein of Ser. No. 617,955 reappeared in the divisional application, Serial No. 831,736. Claim 58 was renumbered claim 49 in the amendment dated January 11, 1978 in the divisional application. Claim 49 is identical to claim 58 of the original application.

(CX-6; CX-7).

94. Dependent claim 59 was remembered as claim 50; dependent claim 60 was renumbered as claim 51; and, dependent claim 61 was renumbered as claim 52. These claims were presented for consideration along with claim 49 in the amendment dated January 11, 1978 in the divisional application, Serial No. 831,736. (CX-6; CX-7).

95. The PTO rejected Claim 49 on May 9, 1978 under 35 U.S.C. 103 "as being unpatentable over Meacham or Burns in view of Newsom." In connection with this rejection, the Examiner states:

> ". . . it would be obvious to include the switching means of Meacham or Burns on the integrated circuit chip of Newsom.
>
> The patented references to Meacham and Burns both disclose a common switching device including means for enabling oscillator circuitry, means for disabling an audio transmitter and means for attenuating the output of a receiver.
>
> Further, it would be obvious to include the common switching device of Meacham or Burns on the integrated circuitry chip of Newsom because no new or unexpected results would occur. (RX 90 000284-286)"

96. In response to the PTO rejection of May 9, 1978, the applicants submitted an amendment on August 7, 1978, amending Claim 49 to read as follows:

> "--49. (Amended) [In a] A telephone communication system including a multiple frequency signal generator on a complementary symmetry, metal-oxide, semiconductor integrated circuitry chip for digitally synthesizing a dual-tone sinusoidal representative of a selected key on a keyboard in communication with said chip [the combination] comprising:
>
> keyboard decode means on said chip responsive to said keyboard for generating a keyboard signal representative of said selected key;
>
> means on said chip responsive to said keyboard signal for generating a control signal in response to said selected key being enabled; and,

common switching means including a plurality of bipolar transistors on said chip responsive to said control signal for performing the common switching functions of said telephone communication system during generation of said sinusoidal signal including means for enabling oscillator circuitry, means for disabling an audio transmitter and means for attenuating the output of a receiver."

(Order No. 117, ¶ 2 Fact No. 16)

97. In the "Remarks" section of the amendment at 5, 6, 7 submitted by the applicants' attorney on August 7, 1978, the attorney for applicants, Mr. Mullen, stated:

> "The applicant's invention utilizes MOS-LSI integrated circuitry powered by standard line voltages. The keyboard is capable of using single-pole, single throw key switches. The common key functions such as powering up the circuitry, switching out the transmitter and connecting muting resistance into the receiver circuit are provided electronically as part of the chip of the integrated circuitry. Complementary symmetry, metal-oxide, semi-conductor (CMOS) elements are utilized to provide high frequency, low voltage operation. A number of bipolar transistors are included in the integrated circuitry to handle the high current requirements for the common function and to drive the low-impedance telephone lines.
>
> This system can operate directly from the telephone line voltage with no external power supply necessary. It is further capable of using a low-profile simple keyboard assembly having single-pole, single-throw switches. This keyboard assembly requires considerably less expense and maintenance than prior assemblies. Thus, using MOS-LSI integrated circuitry, the entire system except for the crystal of the reference oscillator is included on a single chip, thereby providing a compact low-maintenance package capable of operating at high frequencies and low voltage. By including the common key functions on the chip, the size and maintenance requirements [of] the system are further reduced.
>
> On the other hand, the mechanical systems of Meacham and Burns are mechanically complex and difficult to manufacture. Numerous moving parts are required and many contacts must be made by hand. The systems have reduced reliability and provide a larger, bulkier unit. Further, frequency adjustment is required due to variations and protective circuitry must usually be included. The device of Meacham is the typical Bell system LC pad with a mechanical keyboard system. Inductive circuits are included, all of which are mechanically

actuated. It is not clear as to how switching might be obtained electronically. The mechanical systems require a greater current and are unable to electronically. The mechanical systems require a greater current and are unable to operate at the precise values usable in the semiconductor chip of applicant's invention.

The Burns General Telephone system is quite similar to the Meacham system and the same comments apply. Again, it is a mechanically actuated LC system although it seeks to overcome some of the frequency generation problems of the mechanical switching of Meacham. Burns seeks to obtain a simultaneous generation of two frequencies and enablement of the amplifier, thereby eliminating the problem of transition time. Further there is no direct current imposed on the tank coil which eliminates the frequency shift which would normally result. As clearly stated in Burns, column 3, line 10-13:

> "Theoretically it is possible that without resistances 58 and 59 the time between closure of crosspoints 46, 47 and contact 56 could be short enough so as to be insufficient for excitation. Tests have indicated, however, that at less than 0.2 milliseconds are for charging and mechanical linkage provide 10-30 milliseconds even with the most rapid button depression."

In order to avoid transition time problems of the break-make action of Meacham, Burns devised a system operating off the mark action of the mechanically actuated switch.

Therefore, while the patented references to Meacham and Burns may both disclose a common switching device including means for enabling oscillator circuitry, means for disabling an audio transmitter and means for attenuating the output of a receiver, these are found in any telephone system and are merely the elements of a telephone system. The inventive aspects come in the methods of overcoming the problems that may exist in a telephone communication system. Meacham and Burns devised telephone systems compatible with the common mechanical operations of the telephone art. Further, the mechanical devices of Meacham and Burns use LC circuits which cannot be implemented on a single integrated circuit chip using MOS technology. Applicant has invented an entirely new and different telephone communication system."

(Order No. 117, ¶ 2 Fact No. 17)

98. At the time claim 49 was amended, claim 50 which previously depended from claim 49 and added bipolar transistors as part of the common switching

means was cancelled. (CX-7).

99. At the time that claim 49 was amended to include the reference to bipolar transistors, claims 51 and 53 were rewritten in independent form. Rewritten independent claims 51 and 53 read as follows:

> --51. (Amended) A telephone communication system including a multiple frequency signal generator on an integrated circuitry chip for digitally synthesizing a dual-tone sinusoidal signal representative of a selected key on a keyboard in communication with said chip comprising:
>
> keyboard decode means on said chip responsive to said keyboard for generating a keyboard signal representative of said selected key;
>
> means on said chip responsive to said keyboard signal for generating a control signal in response to said selected key being enabled; and,
>
> common switching means on said chip responsive to said control signal for performing the common switching functions of said telephone communication system during generation of said sinusoidal signal including means for enabling oscillator circuitry, means for disabling an audio transmitter and means for attenuating the output of a receiver, and electronic switching means for connecting said signal generator to an external source of electrical power in response to said control signal.
>
> --53. (Amended) A telephone communication system including a multiple frequency signal generator on an integrated circuitry chip for digitally synthesizing a dual-tone sinusoidal signal representative of a selected key on a single-pole, single-throw keyboard in communication with said chip comprising:
>
> keyboard decode means on said chip responsive to said single-pole, single-throw keyboard for generating pulse signals representative of said selected key;
>
> means on said chip responsive to said keyboard signal for generating a control signal in response to said selected key being enabled; and,
>
> common switching means on said chip responsive to said control signal for performing the common switching functions of said telephone communication system during generation of said sinusoidal signal including means for enabling oscillator circuitry, means for disabling an audio transmitter and means

for attenuating the output of a receiver.

(CX-7)

100. While neither rewritten independent claim 51 nor rewritten claim 53 contained any reference to bipolar transistors as part of the common switching means, the common switching means of each element was expressly stated as being on the chip. (CX-7).

101. On Oct. 23, 1978, the PTO rejected amended claim 49 and amended claims 51 to 54 under 35 U.S.C. § 103 as being unpatentable over Meacham or Burns in view of Newsom. The Examiner stated, inter alia,

> "Integrated circuit technology is a well known tool to the routineer in the art. For this reason, the use of integrated circuitry in a system cannot be given any weight in determining the patentability of a claimed invention. It would certainly be obvious to one of ordinary skill in the art to include a common switching device on the single integrated circuit chip of Newsom."

Application Serial No. 831,736 was thereafter abandoned. (Order No. 117, ¶ 2 Fact Nos. #18 and 46)

H. Prosecution of Serial No. 2,424 (Involves Only the '108 Patent)

102. On January 10, 1979, prior to the abandonment of Serial No. 831,736 applicants filed a continuation application Serial No 2,424 which was a continuation of application 831,736 which was a division of application 617,955. (Order No. 117, ¶ 2 Fact No. 19 and 47).

103. Continuation application Serial No. 2,424 was ruled informal by the PTO on January 21, 1980, for procedural reasons. (Order No. 117, ¶ 2 Fact No. 20).

104. On April 24, 1980, in response to the PTO action of January 21, 1980, applicants cancelled Claims 1-48, and added Claims 49-68, and submitted proposed claim 49 reading as follows:

--49. A telephone communication system including an audio transmitter, a receiver, and a multiple frequency signal generator on a complementary symmetry, metal oxide, semiconductor integrated circuitry chip for digitally synthesizing a dual-tone sinusoidal representative of a selected key on a keyboard in communication with the chip comprising:

a keyboard decode means on the chip responsive to the keyboard for generating a keyboard signal representative of the selected key;

means on the chip responsive to the keyboard signal for generating a control signal in response to the selected key being enabled; and,

common switching means including a dummy load circuit, an audio transmitter disabling circuit and a receiver attenuating circuit all responsive to the control signal and activated when the control signal indicates that the keyboard is in use.--

(Order No. 117, ¶ 2 Fact No. 21)

105. Claim 49 appeared in the form as set forth in the previous finding in a preliminary amendment filed on April 21, 1980. The April 21, 1980, amendment also presented new dependent claims 50 through 64, dependent from claim 49. (CX-8).

106. Claim 49 were rejected by PTO action dated June 17, 1980 under 35 U.S.C. §112 for vagueness, and the applicants were given three (3) months to respond. All of the other claims were rejected also. (Order No. 117, ¶ 2 Fact No. 22; CX-8).

107. On October 17, 1980 the applicants amended Claim 49 to read as follows:

49. (Amended) A telephone communication system adapted to be powered solely by telephone line inputs and including an audio transmitter, a receiver, and a multiple frequency signal generator on a complementary symmetry, metal oxide, semiconductor integrated circuitry chip for digitally synthesizing a dual-tone sinusoidal representative signal of a selected key on a keyboard in communication with a chip comprising:

a keyboard decode means on the chip responsive to the keyboard for generating a keyboard signal representative of the selected key;

means on the chip responsive to the keyboard signal for generating a control signal in response to the selected key being enabled; and,

common switching means [including a dummy load circuit, an audio transmitter disabling circuit and a receiver attenuating circuit all] on the chip responsive to the control signal [and activated when the control signal indicates that the keyboard is in use] for performing the common switching functions of the telephone communication system during generation of the sinusoidal representative signal including means for enabling oscillatory circuitry, means for disabling an audio transmitter and means for attenuating the output of a receiver.

(Order No. 117, ¶ 2 Fact No. 24)

108. In the PTO action of June 17, 1980, the Examiner also cites the Meacham Patent #3064084, the Burns, et al. patent, 3,284,577, and the Newsom et al. patent 3,959,604. (RX 90 p. 000442).

109. On January 12, 1981, the PTO rejected proposed amended Claim 49 for vagueness and indefiniteness under 35 U.S.C. § 112. All of the claims dependent from claim 49 were rejected also. (Order No. 117, ¶ 2; CX-8)

110. In response to the PTO's rejection of January 12, 1981, the applicants amended proposed claim 49 further as follows:

49. (Twice Amended) A telephone communication system adapted to be powered solely by telephone line inputs and including [an audio transmitter, a receiver, and] a multiple frequency signal generator on a complementary symmetry, metal oxide, semiconductor integrated circuitry chip for digitally synthesizing a dual-tone sinusoidal representative signal of a selected key on a keyboard in communication with a chip comprising:

A keyboard decode means on the chip responsive to the keyboard for generating a keyboard signal representative of the selected key;

means on the chip responsive to the keyboard signal for generating a control signal in response to the selected key being enabled; and,

common switching means on the chip responsive to the control signal for performing the common switching functions of the telephone communication system during generation of the sinusoidal representative signal including means for enabling oscillatory circuitry in said multiple frequency generator, means for disabling an audio transmitter and means for attenuating the output of a receiver.

(Order No. 117, ¶ 2, Fact No. 26)

111. The title of the invention described in continuation application Serial No. 2,424 filed January 10, 1979 (and in previous applications) was "Dual Tone Multiple Frequency Generator." (Order No. 117, ¶ 2, Fact No. 29)

112. By PTO action dated June 17, 1980, the Examiner of continuation application Serial No. 2,424 stated, inter alia, "[a] new title which is more aptly descriptive of the invention claimed is required." (Order No. 117, ¶ 2, Fact No. 30)

113. In response to PTO action dated June 17, 1980, the applicants submitted an Amendment to the PTO on October 20, 1980. In the Amendment, the title of the claimed invention was amended to read "Integrated Circuit Chip Telephone Communication System". This is the name of the invention in the '108 patent as issued. (Order No. 117, ¶ 2, Fact No. 31).

114. Proposed claim 49 was discussed in a telephone conversation between the Examiner and the applicants' attorney on May 5, 1981, resulting in additional changes to the wording of Claim 49. (Order No. 117, ¶ 2, Fact No. 27).

115. A notice of allowability was issued by Examiner Popek on May 12, 1981, and a notice of allowance for the '108 patent was issued on June 5, 1981. (CX-8).

116. Claim 49, as amended, became Claim 1 of the '108 patent. (Order No. 117, ¶ 2, Fact No. 28).

I. Terminology

117. A transistor is a single device which can conduct current. A transistor is implemented in silicon. The first silicon chips were single

transistors. The advent of integrated circuit technology allowed for many transistors to be integrated onto a single silicon chip. Said advent also allowed for more complex functions to be performed in a smaller area. Thus, such things as calculators and computers were able to be reduced greatly in size with increased functional ability. From an economic standpoint, it is preferred to put as many transistors as possible onto an integrated circuit chip. In modern technological terms, a chip would be considered an integrated circuit chip if it contained many transistors. A physical example of an integrated circuit chip is CPX-47. The silver thimble-shaped object in CPX-44 is a silicon chip which contains just one transistor. The integrated circuit chip in CPX-47 is not much larger than the single transistor chip in CPX-44. However, because there are many more transistors and elements within the integrated circuit chip, it can perform more powerful functions or more complete electronic functions than the single transistor chip. (Callahan, Tr. at 560-65; CPX-44; CPX-47).

118. A chip is a piece of silicon which contains a number of transistors. The chip is the basic ingredient in many electrical components such as calculators, televisions, telephones and personal computers. (Callahan, Tr. at 426; CPX-46; CPX-47).

119. An integrated circuit is a semiconductor chip which contains multiple transistors and other components which allows performance of more complicated functions than a single transistor can perform. (Callahan, Tr. at 409).

120. CPX-46 is an integrated circuit wafer. On this particular wafer there may be several hundred integrated circuit chips. The wafer is broken up and individual chips are then encapsulated into a plastic package that is

suitable for installation into certain electrical components, such as a personal computer. An example of an encapsulated chip is CPX-47. Thus, a chip is a packaged integrated circuit that can be used in calculators, telephones, and personal computers. (Callahan, Tr. at 429-30; CPX-46; CPX-47).

121. Bipolar technology and MOS (metaloxide semiconductor) technology are the two most common technologies used in integrated circuitry. (Callahan, Tr. at 410-12; CX-434).

122. One of the major differences between MOS and bipolar technology is in the fabrication or processing techniques used to implement the particular functions. Bipolar technology is referred to as a "bulk" process because the actual transistor operation occurs down within the bulk of the transistor device. This is opposed to MOS technology, wherein all the activity of the transistor is lateral across the surface of the device. For this reason, MOS technology is sometimes referred to as a "surface operated technology". (Callahan, Tr. at 412-13; CX-434).

123. The use of MOS processing technology resulted in a bipolar transistor occurring naturally within the surface of the semiconductor chip. This naturally occurring bipolar transistor is often referred to as a "parasitic" transistor because it was there whether the designer wanted it to be there or not. Callahan and Hoffman used this naturally occurring bipolar transistor in the inventions that resulted in the '886 and '108 patents for a number of different functions. (Callahan, Tr. at 415-16).

124. Digital integrated circuit designers typically would not have noticed nor have used the naturally occurring bipolar transistor. Analog integrated circuit designers, on the other hand, would recognize the

capability of this naturally occurring transistor and would attempt to utilize and exploit it in their design. Because Callahan was an analog integrated circuit designer, he recognized the potential of the naturally occurring transistor and it was utilized in the inventions of the '886 and '108 patents. (Callahan, Tr. at 416-17).

125. There are two types of bipolar transistors. One is referred to as "NPN" and the other is referred to as "PNP". Each transistor has three terminals; a collector, an emitter, and a base. In each case, the base is the control electrode. The base controls the current that flows through the collector to the emitter. This base current is typically a relatively small current. The emitter is responsible for emitting a number of electrons, a number of which end up in the collector. This transition would be measured as current that would be present in the collector. (Callahan, Tr. at 419-21; CX-434).

126. The letters N and P in the abbreviations NPN and PNP stand for negative and positive, respectively. The first letter in the NPN and PNP abbreviations refers to the emitter. The second refers to the base. The third refers to the collector and thus an NPN transistor would have a negative emitter, a positive base, and a negative collector. The arrow at the end of the emitter indicates whether the transistor is a PNP or an NPN transistor. If the arrow is pointing out of the base, the transistor is NPN; if the arrow is pointing into the base, the transistor is a PNP. A design engineer will use a PNP transistor or an NPN transistor depending upon the polarity of the voltage to which the transistor is connected, as well as for other reasons, such as economical considerations or the application to which the transistor will be used. (Callahan, Tr. at 420-22; CX-434).

127. MOS transistors are referred to as "FET's" which stands for "field effect transistor". These transistors are also biased in terms of NPN and PNP polarities. A field effect transistor has three elements: a drain, a gate and a source. The control electrode is the gate, which controls the amount of current flowing from the drain to the source. If the arrow is pointing out of the FET, the transistor is an NPN transistor. If the arrow is pointing into the FET, the transistor is a PNP type. (Callahan, Tr. at 422; CX-434).

128. A primary difference between a MOSFET transistor and a bipolar transistor is that a FET transistor is a voltage controlled device, whereas a polar transistor is a current controlled device. The MOS transistor is known as a high impedance device, which means it can conduct less current in general. A bipolar transistor, particularly at the time of Callahan's and Hoffman's inventions, was known to be capable of carrying more current than a FET. (Callahan, Tr. at 422-423).

129. "Analog" refers to information which can have many different levels. "Digital" information generally only has two levels: a high level, for example, "one", and a low level, for example, "zero". (Callahan, Tr. at 408-09, 434).

130. Digital circuits are used to perform logic functions. Examples of digital devices are digital calculators, digital watch chips and computer chips. (Callahan, Tr. at 434).

131. Examples of analog circuits are devices such as voltage regulators, amplifiers, comparators, radios and televisions. (Callahan, Tr. at 434).

132. Digital and analog designs may be combined depending upon the need and the skill of the designer. (Callahan, Tr. at 435).

133. Digital designers design circuits using logical elements such as

NAND gates, NOR gates and flip-flops. (Callahan, Tr. at 435).

134. Analog designers use individual transistors in order to build amplifiers, regulator circuits, feedback networks and D to A and A to D converters. (Callahan, Tr. at 436).

135. The difference between digital circuits and analog circuits can be explained by reference to the use of a clock or by reference to the different types of fuel gauges that are in cars. A fuel gauge that uses a needle is an analog fuel gauge because the needle can achieve any angular position across the fuel gauge. This multiplicity of angular possibilities is known as an analog function. A digital fuel gauge may use a series of dots to represent the amount of fuel left in the tank; for example, if there are twenty dots on the fuel gauge, and all twenty dots are lighted, the tank is full. If only fifteen dots are lighted, the tank would be three-quarters full. This type of digital fuel gauge is a way of representing an analog variable in terms of digital information. The digital type of fuel gauge does not have the ability to represent the exact amount of gas at any particular time, as does the analog fuel gauge which uses the needle. However, it may be a close enough approximation so that the user is able to conveniently receive the information that he or she needs. As for the clock, an analog clock is one that uses a small hand and a big hand. The hands on the clock can represent an infinite number of different angles of position. By contrast, a digital clock, such as the type that would display to the user the time in numbers (for example, 6:30) may not be capable of displaying to the user the time down to a particular number of seconds, or even tenths or one-hundredths of seconds. However, the digital clock is still able to conveniently give a normal user the information that he or she desires. (Callahan, Tr. at 440-45; CPX-61).

136. The digital clock or the digital fuel gauge uses what is known as an A to D converter in order to convert what is an analog variable into a digital representation. There are also devices known as D to A converters, or DAC, that can change digital information into analog information. (Callahan, Tr. at 444).

137. Digital designers work with logic circuits. A logic circuit operates in only two states, one and zero, or low and high. The simplest logical element is an inverter. Thus, if a logical zero is presented at the input of the inverter, a logical one will appear at the output. A digital zero is often representative of a low voltage value, such as zero volts, while a logical one will be representative of a higher voltage value, which may be defined by the user, such as five volts or ten volts or any other voltage value as long as this other voltage value is distinct from the defined low voltage value. Thus, in logical design, if zero volts is presented to the input of an inverter and the logical one has been defined as five volts, the output of the inverter would be five volts. Logical values such as zero and one are referred to as binary bits. (Callahan, Tr. at 445-46; CPX-62; CX-434).

138. Digital designers use only binary bits in their applications. These binary bits may be converted into decimal equivalents wherein the decimal is the number system. Thus, the binary digits 001, when converted into the decimal system equates to the number 1 which is used. The binary word "101" would correspond to the number 5. As a further example, the binary word "111" corresponds to the decimal value of 7. Thus, there is a logical conversion between binary values and decimal values. This is the information that the logic circuits in an integrated circuit would utilize. Using these

logical values, one can take a pure analog signal, such as the time on a clock, and convert it into binary form. The binary value can then be converted back into decimal form, so that the user can read and understand the clock. (Callahan, Tr. at 445-50; CPX-61; CPX-62).

139. The elementary logic blocks used in logic design are depicted in CX-434 which has an inverter, a NAND gate, an AND gate, a NOR gate, an OR gate and an exclusive-OR gate (XOR). A NAND gate is an inverted AND gate. It stands for "not" AND gate. Likewise, a NOR gate is a "not" OR gate. An OR gate will have a logical one output when either or both of the inputs is a logic one. By contrast, an exclusive-OR gate will achieve a one at the output if one and only one input is a logical one and thus if both of the inputs to an exclusive-OR gate are zero, the output is zero. If both of the inputs are one, the output would be zero. The output will only be one if either but not both of the two inputs is one. (Callahan, Tr. at 451-56; CRX-62).

140. All the logic gates shown on CX-434 are used in binary digital technology and are the building blocks in building digital integrated circuits. (Callahan, Tr. at 456; CX-434).

141. A person places a telephone call to another person in the following manner. A person who has a telephone in his house is called a "subscriber" because he or she is subscribing to the telephone service. The central office is responsible for providing the wires going out to the individual subscriber's house. CX-24 shows two wires, one going from the central office to the subscriber's house and the other running from the subscriber's house to the central office. These two wires make up what is called a "loop". A loop provides DC information, namely, power for the telephone, as well as AC information, such as signalling information or voice information that must be

passed back and forth along that particular set of wires. Every subscriber has a telephone number which acts like an address, in that it is the unique number which will represent a connection within the central telephone office as shown on CX-24. When dialing another party, the information that is incorporated in the dialing is received by the central office. The central office attempts to determine if one is trying to dial a friend's house as opposed to dialing the fire department or some other number. After dialing is completed, a connection is made to the other remote telephone that has the number to which the dialed number corresponds to, and then there is a connection made inside the central office so that these two parties are able to speak. (Callahan, Tr. at 464-66; CX-24).

142. At the time of Callahan's and Hoffman's inventions, there were two types of telephone dialing techniques. The more common was the "rotary" or pulse dialing method. The less common was the "DTMF" or "dual tone" dialing method. Hoffman and Callahan wanted to build a single integrated circuit chip that would be able to perform DTMF dialing. (Callahan, Tr. at 459).

143. The term "pulses" refers to a waveform that changes from a value of zero to another value, and then changes back to zero in a repetitive manner. The term "tone" typically means a single constant sinusoidal waveform. (Magleby, Tr. at 2689-90).

144. Pulse dialing is most commonly explained in terms of a rotary dialing telephone. A person rotates the rotary dial around to the finger stop and then allows the dialer to return on its own. As the dialer passes through the finger stop, current pulses are generated by means of a make-and-break switch as shown in the dialer circuit depicted in CX-25. This switch would make and break the same number of times as the number which has been indicated

on the rotary dial mechanism. Thus, if a person dials the number 5 on the rotary dial, there will be 5 current pulses which will be sent across the loop back to the central office. When all the digits of a particular number are dialed, the connection would then be made to the other party by the central office. The switch hook shown in CX-25 is a switch which is thrown when one puts the handset back onto the cradle. (Callahan, Tr. at 468-70; CX-25; CPX-40).

145. Touch tone dialing as it existed in the 1973 to 1975 time period is illustrated by CPX-39 and CX-27. When one lifts the handset on CPX-39, the switch hook is connected and power from the central office is then brought into the rest of the circuit. The circuit is comprised of the keypad, the dialer circuits and the speech circuit which includes the transmitter and receiver. When a person is talking or listening on the telephone, the speech circuit is activated. When a person initiates a call and lifts the handset off the phone, which is referred to as "going off hook", an individual depression of the buttons on the keypad would create the signalling tones which would be sent across the loop back to the central office. The central office would then determine these signals electronically and wait for the remaining buttons to be pressed to know what number had been dialed. At that point a connection is made. (Callahan, Tr. at 472-74; CPX-39; CX-27).

146. Dual tone multiple frequency dialing, or DTMF dialing, is explained with reference to CX-26. There are always two tones created together in any particular button depression. The row frequency tones are 697 Hz, 770 Hz, 852 Hz, and 941 Hz. The column frequency tones are 1209 Hz, 1336 Hz, and 1477 Hz. Thus, if someone were to press the number 5 on the keypad, the two tones generated would have a row frequency of 770 Hz and a column frequency of 1336

Hz. These two tones are mixed to produce the dual tone signal which is sent out to the central office, where it would be detected and recognized as key number 5. (Callahan, Tr. at 475-77; CX-26).

147. Hertz (Hz) is an abbreviation for cycles per second. A sine wave is a mathematical relationship having a corresponding predictable shape which completes itself exactly once every cycle. Thus, when one refers to a frequency of 697 Hz, it represents 697 sine wave cycles generated within one second. (Callahan, Tr. at 477-78; CPX-63).

148. One sine wave has a higher frequency than a second sine wave when it completes its cycle faster than the second one. A higher frequency would be represented by a higher number of cycles per second, or a larger number in terms of hertz. (Callahan, Tr. at 478-81; CPX-63).

149. The row tones in telephone tone dialing are of a lesser frequency value than the column tones. For that reason, the row tones are referred to as the "low group" frequency tones while the column tones are referred to as the "high group" frequency tones. The low group and high group frequency tones are standard throughout the telephone industry. (Callahan, Tr. at 481-82; CX-26).

150. When a key is pressed, the frequency from the selected row and the frequency from the selected column are combined to form a dual tone multiple frequency (DTMF) signal. The combination of the row tone and column tone is shown on CX-463 and CPX-63. The audio frequency had been standardized by the industry prior to the inventions in the '886 and '108 patents. (Callahan, Tr. at 482-84, 792, 793, CX-463; CPX-63; RX-49).

151. The sound of the single row tone and the sound of the single column tone may be demonstrated by use of CPX-41, a tone dialer. When one depresses

two keys in any single row, the single tone sinusoidal signal generated by and representative of that row may be heard. Likewise, when one depresses two keys in any given column, the single tone sinusoidal signal generated by and representative of that column may be heard. When one presses a single key they will hear the corresponding dual tone multiple frequency signal that's uniquely representative of that key. (Callahan, Tr. at 491-500; CPX-41).

152. The telephone company required that the high group tones be outputted at a different level than the low group tones, because the higher the frequency of a signal the greater the attenuation of the signal as it travels down the transmission line. Therefore, the signal amplitude of the higher frequencies must be greater than that for the lower frequencies because of the increased losses associated with the higher frequencies during transmission. (Bodin, Tr. at 1066).

153. The GTE specification, RX-132 at AI000298, discloses the preemphasis requirement of the high tones on the top of the drawing. The difference in levels between the fundamental frequencies in a frequency pair should not exceed the limits of 2.75 plus or minus one db, with the level of the high frequency component pre-emphasized. The drawing allows the high and low signals to be easily measured by test equipment. (Bodin, Tr. at 1072-73; RX-132).

154. [THERE IS NO FF 154]

155. An oscillator is a circuit used for the particular purpose of generating a frequency signal, such as a sine wave. (Callahan, Tr. at 506).

156. The frequency selective circuit shown in CX-28 will oscillate at a particular frequency which is controlled by the electrical values of the capacitor L2C and the inductor L2B. The particular circuit in CX-28 is

arranged to allow different values of inductance to be selected. The inductance value is selected through use of the column rods which are shown on the left side of CX-28. These column rods are individual mechanical switches which will ultimately determine which of the column frequencies will be selected. The column rods are connected to a keyboard, such that when one presses a particular key in a column, the column rod associated with the column of the key selected will close and a frequency selective circuit will be formed, which will oscillate in conjunction with transistor Q1 so as to generate one of the two tones necessary to dial the phone. There are also row rods shown on CX-28, one of which will close depending on which row the selected key is in. The closed row rod switch will allow the second frequency to be created in order to create the dual tone multiple frequency necessary for tone dialing. Thus, when a single key is pressed on a keyboard such as the one shown in CX-26, one row rod and one column rod, both corresponding to the row and column of the selected key, will close and therefore activate the frequency selective circuits which will oscillate at frequencies corresponding to the selected row and selected column. This is how the prior art tone dialing telephones worked. (Callahan, Tr. at 506-11; CX-26; CX-28).

157. The activation of the row rod and column rod switches shown in CX-28 is depicted in CX-29 in conjunction with CPX-44. CPX-44 is a prior art touchtone telephone utilizing the circuitry shown in CX-28 and the keypad shown in CX-29. The black cylindrical objects in CPX-44 are the inductors corresponding to L1B and L2B shown in CX-28. The capacitors in CPX-44 are about an inch long, yellow in color with red on the ends, and correspond to capacitors L1C and L2C in CX-28. The steel-colored object resembling a thimble in CPX-44 is the physical embodiment of transistor Q1 shown in CX-28.

The inductors, capacitors, transistor and keypad collectively form what is known as the dialer assembly of the telephone. (Callahan, Tr. at 537-42; CX-28; CX-29; CPX-44).

158. The column rods and row rods are depicted in CX-29. They form a criss-crossing pattern underneath the keys of the keypad. Each row rod corresponds to a particular row of keys and each column rod corresponds to a particular column of keys. When a particular key is pressed, the corresponding row rod and column rod will rotate and connect to a switch at the edge of the circuit as shown in CX-29. Rods A and B in CX-29 are the ones that activate the switches when key 4 is pressed. (Callahan, Tr. at 541-46; CX-29).

159. CX-29 also shows an additional switch which is called a "common switch". This switch is mechanically connected to all of the keys in the keypad and will activate whenever any key is pressed. Therefore, with reference to CX-29, when key 4 is pressed, rods A and B are actuated and the common switch is also actuated. (Callahan, Tr. at 546-47; CX-29).

160. The actual movement of the row rods and column rods and the common switch can be seen by activating the keys on physical exhibit CPX-44. The switches in CPX-44 are seven in number and correspond to the seven switches depicted in CX-29. There are four along the horizontal edge of the keypad and three along the vertical edge of the keypad, corresponding to the four rows and three columns of the keypad itself. (Callahan, Tr. at 547-49; CX-29; CPX-44).

161. The microphone may be called a transmitter, a mouthpiece, or other appropriate terminology. The earpiece is often referred to as the receiver. The receiver operates very similar to a speaker in a stereo set. (Callahan,

Tr. at 552).

162. [THERE IS NO FF 162]

163. The common function of providing power to the amplifier circuitry results in enabling the oscillator so as to generate the frequencies necessary for the dual tone multiple frequency signal when a key is pressed. (Callahan, Tr. at 553).

164. The inductors of prior art telephones (such as the black cylindrical objects in CPX-44) are comprised of coils of wire wrapped around a central core. This is a fairly intensive mechanical type of construction. It requires many individual pieces to move around with some amount of precision. As a result, this type of construction was expensive to build and required many small parts. Additionally, the switches along the edges of the keypad were sensitive to elements of the outside environment such as dust, humidity and physical wear and tear. The wires that make up the inductors themselves had to be twisted together first in a separate operation and then wound around the central core. This is known as bi-filar wiring. In order to generate the precise frequency necessary for the dual-tone multiple frequency signal, each of these inductors had to be individually tuned. This required actual physical tuning by individuals who would watch a meter while they tuned each particular inductor. These inductors would often drift out of tune, such that the phone would no longer properly dial. (Callahan, Tr. at 553-56; CPX-44).

J. Facts Relating to and Subsequent to the Filing of Serial No. 617,955

165. Hoffman worked at Mostek from December 1969 to March 1976 and from August 1978 until October 1983. (Hoffman, RPX-22 at 33-34).

166. Hoffman had the original idea of implementing a tone dialer in a MOS chip. Sometime in 1971-72, Hoffman was at a pay phone and found that when

he pressed the button, the oscillating tone was very slow to start and was very unreliable. He remembers being impressed with the notion that there should be a way of applying integrated electronics to solve that problem. (Hoffman, RPX-22 at 60-61).

167. Hoffman always looked for the opportunity of integrating some portion of any system into MOS circuitry, so that Mostek could garner revenues from that system's market. (Hoffman, RPX-22 at 51-52).

168. When Hoffman first thought of the tone dialer chip, the functions he wanted to integrate on the chip included the tone generation function, and the key pad function. (Hoffman, RPX-22 at 62-63).

169. In either late 1972 or early 1973, Hoffman replaced Bob Crawford as the Director of Engineering at Mostek. As Director of Engineering, Hoffman was responsible for managing the product development for all of Mostek's integrated circuits and layout. With regard to process development, Hoffman was responsible for the design requirements on the process. (Hoffman, RPX-22 at 41-43).

170. With regard to implementing parts of the Private Branch Telephone Exchange System with MOS circuitry, Hoffman initially looked at implementing the switching functions and some of the peripheral and key station in MOS circuitry. The telephone is part of the key station. The switching functions are the large number of line and trunk switching that occurs in said systems. (Hoffman, RPX-22 at 52-53).

171. When Callahan started work on the DTMF dialer chip invention, he took apart many of the phones used during that time period in order to determine what kinds of prior art telephones generated DTMF signals. Generally these prior art phones used a single transistor LC oscillator

circuit. This type of circuit is depicted in CX-28. The only transistor in the circuit (Q1) in CX-28 is used as a gain element in the oscillator circuit. The oscillator circuit is comprised of inductors and capacitors, which in combination can form a tuned circuit to produce a particular frequency. In CX-28 for example, capacitor L2C and inductor L2B form one of the oscillator circuits. The capacitor and inductor circuit form what is known as a frequency selector circuit. Transistor Q1 operates as an amplifier when hooked up to inductor L2B and capacitor L2C. This combination of transistor, inductor, and capacitor forms an oscillator. (Callahan, Tr. at 501-06; CX-28).

172. At the time of the first meeting between Hoffman and Callahan, it was Hoffman's idea to initiate a project which would build a chip that would dial a phone using DTMF dialing. Incorporated with that idea, if it was possible, was to include as a frequency standard a 3.58 MHz color burst crystal which was commonly used in color television sets, as well as to utilize an inexpensive calculator-type keyboard as opposed to the common telephone keyboard. (Callahan, Tr. at 500-01).

173. At the time of Callahan's and Hoffman's meeting, there were two types of dialing. The more common was the rotary dialing method. The less common was the DTMF dialing method. Hoffman and Callahan wanted to build a single integrated circuit chip that would be able to perform DTMF dialing. (Callahan, Tr. at 459).

174. The 3.58 MHz crystal produces a constant frequency of 3.58 million cycles per second. This is much higher than the frequencies corresponding to the column tones and row tones of the keyboard as shown in CX-26. The 3.58 MHz frequency signal is divided down digitally to produce those row tone and

column tone frequencies of interest. (Callahan, Tr. at 501; CX-26).

175. At the time Callahan was assigned the tone dialer project at Mostek, he had a meeting with Hoffman, who was Callahan's immediate supervisor. Hoffman had the concept of doing an integrated circuit which would dial the phone in a dual tone multiple frequency (DTMF) manner. Hoffman discussed his idea regarding the tone-dialer chip with Callahan. (Callahan, Tr. at 457-58, Hoffman, RPX 22 at 60, 61).

176. It was Hoffman's and Callahan's intent to replace some of the troublesome features of the prior art telephones such as the inductors, the mechanical type switches and the cumbersome telephone keyboard with a circuit that could perform all the functions of the prior art telephone electronically, such as generation of the particular dual tone frequencies and all of the common switching functions, thereby allowing a complete calculator keyboard to function in the telephone. This was to be done using transistors on a single integrated circuit chip. (Callahan, Tr. at 558-60).

177. Callahan and Hoffman realized that if they wanted the telephone to operate similar to the prior art telephone they could use only the power supply source available on the telephone line. (Callahan, Tr. at 590, 591).

178. Callahan testified that as of December 28, 1973 Callahan and Hoffman thought they knew how to build an integrated circuit chip which would dial the telephone using dual tones, would be powered solely from the telephone lines, would be able to use a 3.58 MHz crystal as a frequency reference, would use an inexpensive calculator-type keyboard, and would be able to perform the common switching functions electronically. (Callahan, Tr. at 574; CX-30).

179. At the time Callahan and Hoffman formed the idea for their

invention, it was their intent to use an MOS (metal oxide semiconductor) process to implement the integrated circuit chip. MOS technology was the only process technology that Mostek utilized. (Callahan, Tr. at 565-66).

180. CX-30 is a patent disclosure form from Mostek with respect to the inventions in issue. The second page of CX-30 shows Callahan's signature dated August 13, 1974. According to CX-30, the tone dialer chip "invention" was conceived on December 28, 1973. (Callahan, Tr. at 566-67; CX-30).

181. In "5085 Patent Disclosure" (CX-30 at ST 50439-47), the inventors stated that "by providing the 'common' functions electronically on the integrated circuit, the keyboard may be simplified considerably." This means to Magleby that the switches for carrying out the common switching were provided electronically on the integrated circuit containing the remainder of the tone dialer circuitry and that it was the inventors' intent that this be so. In the patent "5085 Patent Disclosure" under the heading "C. Description of Invention" the inventors stated:

> The invention is an electronic signaling means that is comprised of an MOS/LSI integrated circuit and a low cost keyboard featuring single-pole, single-thou switches. By using the proper technology for the electronics, the circuit is made to be operated from conventional telephone lines, drawing its necessary power therefrom. By providing the "common" functions electronically on the integrated circuit, the keyboard may be simplified considerably. Each key may now be a single pole, single-throw type, and these can be made very inexpensively and reliably. The reference is obtained via a crystal-controlled oscillator, which has inherent accuracy better than 0.04%. By digitally dividing the reference frequency down to the desired frequency, no additional inaccuracies are introduced in the output signal. Therefore, its frequency accuracy and stability will be substantially that of the crystal, and will need neither initial nor periodic adjustment, and hence is easier to manufacture and maintain. In addition, this technique allows for extreme miniaturization and reliability, and immunity from environmental effects.
>
> In order to meet the extremely low-voltage operation requirements, the process chooses for the integrated circuit is CMOS or complementary-symmetry metal-oxide-semiconductor. A problem with

> most MOS technologies is the fact that they have high impedance components, and they are relatively difficult to operate at moderately high currents (greater that 25 mA). In order to perform the "common" functions, a relatively high current (up to 100 mA) must be switched for the transmitter. This is accomplished by a bipolar transistor on the integrated circuit. This low-impedance, high-current device is obtained without any additional processing steps or controls. Without the use of the bipolar component, the "common" functions could not have been done on the integrated circuit and therefore would have necessitated a different keyboard arrangement. There are other bipolar transistors located on the circuit, and one has the function to drive the relatively low impedance telephone lines with the dual-tone audio signal.
>
> Experiments conducted involved the building of a breadboard with the logic block diagram of Figure 2, and successfully using it with an inexpensive keyboard in the telephone system.

The second of the three paragraphs supra is very important to Magleby because it shows him that the inventors intended to make use of the bipolar transistors which are inherently formed using a CMOS process but which are commonly known as "parasitic" bipolar transistors. Referring to the last page of the 5085 patent disclosure wherein suggested claim No. 5 refers to an "[e]mbodiment using CMOS and/or bipolar transistors in a monolithic structure," Magleby does not read this phrase as suggesting alternative embodiments, viz. one using all CMOS transistors and another using all bipolar transistors, but rather Magleby sees this as merely an "ambiguous" statement by the inventors which is intended to capture the concept that the CMOS circuitry which was going to be used to implement the tone dialer chip would also yield certain bipolar transistors in the same monolithic structure. (Magleby, RX-1 at 25 to 27; CX-30; RX-302).

182. The inventors of the '108 and '886 patents intended to replace the mechanical common switching elements present in some prior art telephones with transistors. (Callahan, Tr. at 559-560; CX 29).

183. Inventor Callahan knew that in order to electrically perform the column function switching he needed to use transistors. (Callahan, Tr. at 563; CX-29).

184. Hoffman agrees that there is no explicit statement in the '5085 Patent Disclosure" (RX50) that says specifically that bipolar transistor referred to on ST 50443 can be off the chip. (Hoffman, RPX-22 Tr. at 187-190).

185. Referring to the term in paragraph 3 of the "5085 Patent Disclosure" form (RX-50), page 50437, which says "replacing currently used tone generation and keyboard switching functions commonly found in telephone stations with an integrated circuit", the switching functions referred to are, according to Hoffman, commonly called the "common switching functions" and these common switching functions were disabling of the transmitter, the muting of the receiver and the turning on of the oscillator. (Hoffman, RPX-22 at 107-109).

186. Placing the bipolar transistors that perform the common switching functions on the chip is desirable because it would eliminate the requirement for other extra components to be purchased by the consumer or the manufacturer. (Callahan, Tr. at 684).

187. At some point during discussions between Hoffman and Callahan, Callahan felt that a parasitic bipolar transistor might or could be used in an on-chip implementation which they obviously preferred to do if they could. (Hoffman, RPX-22, Tr. at 127).

188. Callahan considers that the patent disclosure CX30 is "a fairly complete description of work which was done by Gordon Hoffman and [Callahan] regarding tone dialers." (Callahan, Tr. at 566).

189. The switch that is referred to in Fig. 2 of the "5085 Patent Disclosure" (RX-30) (at ST50447) is a bipolar NPN transistor, and the base of that switch is driven by an inverter. (Callahan, Tr. at 73-74).

190. The switch in series with the transmitter as shown on last page of the the "5085 Patent Disclosure" (RX-30) (ST50447) is an NPN bipolar transistor. (Hoffman, RPX-22 at 76).

191. [THERE IS NO FF 191]

192. The inventors of the '108 and '886 patents knew that they had to comply with the exact same standards that the telephone industry had set. (Callahan, Tr. at 558).

193. Callahan told Hoffman at the time of the development of the invention that he thought a parasitic transistor could be used in an on-chip implementation of the switch shown for example on the patent disclosure form (RX-30), at ST50447 above the circle label transmitter. Callahan said, in this regard, that parasitic bipolar devices do exist from the CMOS process, although normally they are not used. He felt that they could be used and the advantage would be that you would have a better switch quality in a smaller space. (Hoffman, RPX-22 at 130-131).

194. A breadboard is a replica of an integrated circuit which is built out of electronic components, such as NAND gates, NOR gates, flip-flops, amplifiers, resistors and capacitors. At the time the inventors of the '108 and '886 patents filed their application, breadboards were being used to verify that the design of an integrated circuit was in fact accurate. (Callahan, Tr. at 592).

195. Callahan began preliminary work on the tone dialer chip project in September 1973. At this time, Callahan was studying a number of the

requirements that the chip would have to perform. These were primarily telephony-type specifications. Thus, at the beginning of the project, Callahan and Hoffman were attempting to determine whether or not such an integrated circuit could in fact be built. In order to do this, Hoffman and Callahan talked to a number of potential customers, one or two outside consultants, and read a number of specifications from Bell Telephone and other places that were responsible for creating specifications for telephones, including foreign telephone specifications. (Callahan, Tr. at 567-69; Hoffman RPX-22 at 57-60).

196. Callahan and Hoffman wanted an integrated circuit that would tone dial telephones. (Callahan, Tr. at 569).

197. Callahan and Hoffman encountered problems in attempting to determine whether or not such a tone dialer integrated circuit chip could be built. To begin with, none of the people they contacted knew what the specifications would be for such a chip because such a chip did not exist. Additionally, the people involved in the telephony industry had their own nomenclature and their own ways of gathering data. While this made sense to people within the telephony field, it was not in the format that was easily usable by an integrated circuit design person. Thus, Callahan and Hoffman had to take the time to understand the telephony nomenclature and the specifications and requirements within that field. (Callahan, Tr. at 569-70).

198. Prior tone dialer chips did exist before the Hoffman-Callahan invention of the '886 and '108 patents. (RX-316, CX-40).

199. A tone dialer chip that is powered by a battery is equivalent to a tone dialer chip powered by telephone lines. Such chips would perform

substantially the same function in substantially the same way producing substantially the same result. (Fair, Tr. at 1633).

200. According to Callahan in making the inventions in issue, the "biggest problem" was the variation in power supply voltage where in some cases one would have telephones which would be close to the central office and thus alot of voltage would be available to the chip while in other cases one might be fairly remote from the central office and not have enough voltage to operate the chip. (Callahan, Tr. at 570).

201. Another problem encountered by Hoffman and Callahan was that the dual tone frequency signal outputs were analog in nature while most of the components of the chip were digital in operation. In fact, almost all of Mostek's integrated circuit chips at that time were digitally designed. (Callahan, Tr. at 573-74).

202. Hoffman recalls a technician building the breadboard circuit for the tone-dialer. (Hoffman, RPX-22 at 92-93).

203. Callahan recorded much of the work that he did on the integrated circuit chip in an engineering notebook which has been identified as CX-31. (Callahan, Tr. at 575-77; CX-31).

204. Page 2398 is the only page of CX-31 that Callahan knows "for sure" came out of his notebook. Page 2398 contains Callahan's handwritting and represents part of his original work toward the inventions. Page 2389 of CX-31 is representative of some of the work as well. Page 2389 has an approximation of a sine wave and 2398 shows a portion of the sine wave. As to the latter Callahan testified that "this is the time that we first determined the number of bits that were required in a D to A converter" with more bits meaning a more perfect approximation to the sine wave but would also be larger

in silicon. Page 2398 shows two approximations, one of which is represented by a three binary bit D to A converter. A Fourier analysis was performed. (Callahan, Tr. at 576 to 584).

205. A four-bit D to A converter has a total of 16 states. Corresponding to the 16 states would be analog voltage values that would be appropriate to each of the 16 steps. The four-bit D to A converter sine wave approximation shown on page 2398 of CX-31 has 16 states which in decimal language would be from 0 to 15. The approximation of the sine wave on page 2398 constitutes a digital synthesis of a sine wave. (Callahan, Tr. at 588-89; CX-31).

206. Page 2389 of CX-31 shows a column of digital numbers that are similar to the binary numbers on page 2398. At the top of the wave form shown on 2389 are the abbreviations MSB and LSB. These stand for "most significant bit" and "least significant bit" of the particular digital word. Thus, this particular word counts up in binary until it reaches the most significant bit 1111. This corresponds to the digital number 15. After reaching the most significant bit, the word counts back down the other side of the sine wave until it reaches 0000, which is the least significant bit. This would be done in a repetitive binary cycle and would be used to create the analog wave form that would be one of the sinusoidal tones used in telephone dialing. (Callahan, Tr. at 589-90; CX-31).

207. Following the meeting with a phone system consultant, Callahan went to his office and began drawing out schematics and doing calculations. Hoffman went back to running the engineering division and meeting with Callahan on a fairly regular basis, because he was both interested and pleased. (Hoffman, RPX-22 at 95).

208. Hoffman helped implement the microprocessor group in 1975. Callahan continued working with tone dialers. The telephone area of Mostek was growing. Hoffman believes that it was made into a separate group. (Hoffman, RPX-22 at 120-21).

209. With regard to whether the CMOS process would be adequate for the implementation of certain switches, Hoffman and Callahan looked at the suitability of a MOS transmitter for on-chip implementation. They also looked at the possibility of CMOS driving an external bipolar transistor. (Hoffman, RPX-22 at 125-27; CX-30).

210. Tone dialer chips containing a parasitic bipolar transistor that could successfully function as a switch were fabricated at Mostek. (Hoffman, RPX-22 at 131-32).

211. To the best of Hoffman's knowledge, the use of the parasitic bipolar transistor that was obtained as part of the Mostek CMOS process on the tone-dialer chip was the first time such a parasitic bipolar had been used as a functioning element in a product at Mostek. Hoffman was unaware of a parasitic bipolar transistor obtained as part of a CMOS product as a functioning element in any product made by any third party prior to the use of the parasitic bipolar transistor in the tone generator. (Hoffman, RPX-22 at 174).

212. The element that performs the switching to disable the transmitter or to mute the receiver is controlled by a control signal. (Hoffman, RPX-22 at 186-87).

213. CRX-16, CRX-19, CRX-20, and CRX-27 reflect the problems Mr. Callahan referred to at the hearing regarding the development of the MK5085 product into silicon. (CRX-16; CRX-19; CRX-20; CRX-27; Callahan, CRX-112 at

37).

214. CRX-16 is a memorandum dated January 30, 1975 that indicates a schedule of events for producing the first samples of the MK5085 chip. This is consistent with Callahan's memory regarding the events leading up to the development of the MK5085 and MK5086 chips. (Callahan, Tr. at 3621-22; CRX-16).

215. CRX-19 is a memorandum dated April 12, 1975 that indicates that there were two design problems observed with respect to the MK5085 chip. Callahan testified that this is consistent with his memory of the design problems relating to the first silicon chip. (Callahan, Tr. at 3622-23; CRX-19).

216. CRX-19 details a shift in priority within Mostek to proceed with the MK5086 chip, which did not use the scanning type of keyboard, because there was a circuit malfunction associated with the keyboard in the MK5085. (Callahan, Tr. at 3629; CRX-19).

217. CRX-20 is a memorandum dated April 15, 1975, from Bob Paluck to Bob Banks and Berry Cash. It refers to "some of the unusual processing, circuit design and production requirements of the 5086." It stated that this is not a typical random logic circuit that can be made to work the first time and then zip into production using standard process and techniques; that after the first phototypes were evaluated, the author "foresee considerable process tweaking, spec changes, and several redesign cycles to achieve a circuit suitable for volume productions." (CRX-20).

218. The Mostek MK5085 was the first tone dialer chip. Hoffman believes the chip was sold to the public. (Hoffman, RPX-22 at 118-19).

219. The Mostek 5085 chip summed two sine waves to obtain the tone pairs

required to properly signal to the central office. The summing of the two sine waves produces what is known as a DTMF signal. The DTMF signal is the signal that is sent over the telephone line to the central office when the user is dialing a telephone number. Each unique DTMF signal represents a particular key being pressed on the telephone. (Hoffman, RPX-22 at 179-80).

220. Although initially intended to be fabricated with all the common switching functions on chips, Mostek's tone dialer chips were actually subsequently produced by Mostek without all the common switching functions on chip. (Magleby, RX-1, Q42).

221. Mostek did not begin selling tone-dialer chips until late 1975 or early 1976. Hoffman's basis for remembering late 1975 or early 1976 as the time period of the first sale of tone dialer chips is that he recalls the publishing of data sheets during that time. Mostek never introduced products without data sheets. (Hoffman, RPX-22 at 312-13, 316).

222. A letter (ST 02201) dated January 29, 1976, states that Mostek is just beginning production of a CMOS touch tone dialer, the MK5085 circuit for telephone applications. (Hoffman, RPX-22 at 338) The first commercial embodiments of the invention of the '886 and '108 patents were the MK5085 and MK5086 integrated circuit chips. The difference between the MK5085 and MK5086 chips was that the MK5085 was intended to be used with calculator-type keyboards, while the MK5086 was intended to be used with the standard telephone keyboard. (Callahan, Tr. at 693-94; CX-32).

223. Mostek's practice was to assign a part number to a project once the project had been authorized and a chip was about to be started. The number for the MK5086 chip was assigned on November 12, 1974. The number for the MK5087 chip was assigned on July 1, 1976. (Callahan, Tr. at 702-03; CRX-15).

224. The MK5085 and MK5086 chips produced at Mostek differed in that the MK5085 was intended to operate with a scanning type of keyboard, while the MK5086 had static keyboard inputs. (Callahan, Tr. at 3685-86).

K. GTE (DTMF Telephones)

225. In 1971, Bruce H. Bodin went to work as a Test Engineer for General Telephone & Electronics (GTE) at Huntsville, Alabama. Bodin worked there a little over 12 years, leaving in 1984. (Bodin, Tr. at 958; Bodin, CX-500 at 2).

226. Bodin was the manager of electrical design at GTE, Huntsville. (Bodin, CX-500 at 2).

227. The GTE Huntsville facility assembled telephone instruments and related hardware. (Bodin, CX-500 at 3).

228. There were two types of telephones manufactured by GTE at Huntsville when Bodin initially joined the company in 1971. GTE made rotary dial telephones and dual tone multifrequency dial telephones. "Dual tone multifrequency" is often referred to in the industry as "DTMF." (Bodin, Tr. at 958; Bodin, CX-500 at 3).

229. The DTMF dialing technology was introduced in the mid 1960's. (Bodin, Tr. at 959).

230. The difference between the rotary dial telephones and the DTMF dialer telephones is that the rotary dial telephones utilize pulse dialing techniques. The DTMF phones utilized a tone dialing technique. A dual tone multiple frequency or "DTMF" signal was generated for each of the numbers on the keypad of the phone. (Bodin, CX-500 at 3).

231. In 1971, GTE was producing two types of DTMF phones. The first was called the "Style-Line Phone" and the other was referred to as the "Desk-Set

Style." Both of these phones can be referred to as push-button phones. (Bodin, Tr. at 958-60).

232. The DTMF dialer consists of a circuit on a keypad mounted in the instrument which generates specific tones. These tones comprise two sinusoidal signals which are mixed together at the telephone instrument and are transmitted down a telephone line to a circuit caller receiver. The circuit caller receiver decodes the sinusoidal signals and connects it to the instrument of the line that you want to call. In the older units, two oscillators are turned on at the moment that you press a button by supplying voltage to the oscillators. The voltage was dumped into a capacitor which caused a transistor to turn on. One must run a current through the tank coils and it starts oscillating, which is sustained by the gain in the transistor. In the older models there were eight (8) peripheral switches around the edge of the keyboard, along with the common switch, which is mounted on the back of the printed circuit card on the printed circuit card assembly, and all of those switches had to be timed or sequenced together so that certain switches would "make" or connect, at a certain time in relation to each other and "break" or disconnect at a certain time in relation to each other. In the manufacture and tuning of the switches, the leafs on the switches were bent so the switches would make and break in the right sequence with respect to each other. The pot cores were a relatively precise part of the circuit, in that the pot cores had to be manufactured with certain air gaps which were created by taking a coiled wire, which had several tabs on it for different frequencies, and mounting the coil inside of the two pieces of ferrite material and gluing them with proxy and running them into an oven. The oscillators were then tested and if any of the frequencies that were supposed

to be used with the specific ferrite core were wrong, they would break up the pot core portion, throw it away, and put in another pot core and run it through the oven again and so on, until it was correct. This process was required because of the precision needed in the tone frequencies and the tone levels. (Bodin, Tr. at 977-79).

233. Some of the components that went into making a DTMF dial telephone included a keypad with mechanical contacts for selecting the two frequencies associated with each of the 12 keys or push buttons for the numbers 1-9, 0, * and #. Each push button selects combinations of precisely controlled dual tone frequencies generated by the telephone instrument oscillator circuit. This DTMF circuit interfaces with the telephone network and is powered from the central office battery feed when a button or key is depressed. (Bodin, CX-500 at 3-4).

234. Bodin was able to find an example of the mechanical type keyboard made by GTE in the early 70's (CPX-44). (Bodin, CX-500 at 4; CPX-44).

235. CPX-44 is a keypad with mechanical contacts like the keypads made by GTE. It so happens the one Bodin was able to find was made by Western Electric. One can observe the mechanical switching by looking at the back side of the device through the clear plastic shield as a key is depressed. There are also eight frequency selection matrix switches built around all four sides of the keypad. (Bodin, CX-500 at 4; CPX-44).

236. CPX-45 is a keypad for a GTE telephone model number 980 called "Trimline." (Bodin, Tr. at 929; CPX-45).

237. In the earlier systems the common switch on the keypad assembly in CPX-45 carried out three functions, specifically, enabling the oscillator, disabling the transmitter, and muting the earpiece. (Bodin, Tr. at 934; CPX-

45).

238. The keypad assembly in CPX-45 does not contain a tone dialer chip. It does contain one semiconductor, which is a transistor. (Bodin, Tr. at 934; CPX-45).

239. The keypad assembly in CPX-45 does not use a Mostek tone dialer chip, nor does it use any other tone dialer chip. No tone dialer chip works with the assembly in CPX-45. (Bodin, Tr. at 936; CPX-45).

240. The keypad assembly in CPX-45 was made by GTE. (Bodin, Tr. at 935; CPX-45).

241. The DTMF oscillator assembly made by GTE when Bodin joined the company consisted of the keypad, push buttons for the keypad, discrete resistors, pot core inductors, switches, transistors and capacitors mounted on a printed circuit card. The card was located under the 12-button keypad. These circuits tended to be difficult and costly to manufacture. (Bodin, Tr. at 973-74; Bodin, CX-500 at 4).

242. In order to generate the precise dual frequency tones, an oscillator is required, and the pot core structure was the oscillator. (Bodin, Tr. at 980).

243. Old rotary dialer phones do not require an oscillator. (Bodin, Tr. at 980).

244. The function of the transistor in the DTMF oscillator assembly was to provide gain to sustain oscillations. (Bodin, CX-500 at 4-5).

245. The "pot core" inductors for the DTMF telephones were labor intensive assemblies. These assemblies were constructed on "pot core" forms made of powderized magnetic material. Copper wire was wrapped around spools by expensive automatic winding machines. The coiled spooled wire was a

frequency oscillator capable of generating the required frequencies for tone dialing. The spool carrying the coiled wire was lowered over the center peg of the pre-formed "pot core" in a precisely spaced arrangement. Separate electrical taps had to be placed at precise locations on the coil and carefully positioned on the exterior edge of the spool to provide access for external electrical connections. Epoxy was used to glue the two halves of the "pot core" material together, and the entire unit was placed in an oven to set the epoxy. (Bodin, CX-500 at 5).

246. The assembled "pot core" inductors were carefully adjusted or "trimmed" to assure that precise frequencies required by touch tone dialing were present. (Bodin, CX-500 at 5).

247. The "pot core" inductors are the two dark gray, doughnut-shaped objects on the back side of the keypad of CPX-44. (Bodin, CX-500 at 6; CPX-44).

248. Over 100 hundred employees were involved with this "pot core" fabrication process at the GTE Huntsville facility. It was a labor intensive process. Bodin remembers one room where many test stations were set up and each "pot core" oscillator assembly was carefully tested to see if it had the proper inductance at the various taps. Proper inductance at the taps assures that the required dialing frequencies occur upon depression of the selected telephone key. Where a unit failed the inductance test, the assembled "pot core" unit would be broken open so that the coiled assembly could be used again. Not only was the oscillator assembly labor intensive, it had the highest failure and scrap rate in the GTE Huntsville plant. (Bodin, Tr. at 977-79; Bodin, CX-500 at 6).

249. The "pot core" inductor-capacitor oscillator assembly required

returning. (Bodin, CX-500 at 7).

250. Returning of the "pot-core" inductor capacitor assembly was required when a phone was being rehabbed, the oscillator had to be returned. This operation also was labor intensive. (Bodin, CX-500 at 7).

251. The DTMF dialer assembly utilizing the "pot core" inductors (like the one in CPX-45) had an assembly cost of approximately $23.00 for a trim style phone that GTE called its Style-Line telephone and approximately $15.00 for the desk set style telephone. The dialer assembly cost was the major cost component of the completed phone. The Style-Line phone was sold to the telephone companies for approximately $30.00 and the desk set for approximately $22.00. The oscillator assembly for the Style-Line phone was more expensive because of the labor requirements for the smaller sized assembly. Not as many Style-Line phones were made so it also did not have the same economy of scale as the higher volume desk set phones. (Bodin, Tr. at 966-67, 972-73; Bodin, CX-500 at 6-7; CPX-45).

252. The cost of the Style-Line and Desk-Style phones were constantly updated. In general, the prices tended to go up. (Bodin, Tr. at 970-71).

253. As of 1974, GTE was still selling more of the old rotary dialer phones than DTMF phones. (Bodin, Tr. at 966).

254. In 1974 the GTE Huntsville facility was manufacturing approximately 45,000 to 55,000 telephones per week. Of these, approximately 20,000 to 25,000 were DTMF or tone dialers and the remainder were the old style rotary telephones. (Bodin, Tr. at 959, 961; Bodin, CX-500 at 7).

255. GTE's share of the market for DTMF phones in 1974 was roughly ten percent (10%) of AT&T's market share. Everyone else was about ten (10%) of GTE's market share. (Bodin, Tr. at 1041-42).

256. The old rotary dial phones contained a rotary dialer assembly unit, which was a circular unit you turned with your finger. The cost of manufacturing a rotary dialer assembly unit was slightly less than a DTMF dialer. The old rotary dialer phone sold for one to two dollars less than a DTMF dialer phone. (Bodin, Tr. at 974-75).

257. One advantage of DTMF dialer over the old rotary dialer, was that operating companies could get more money from subscribers for a DTMF dialer and additional services were made available through the newer switches in the DTMF dialer that were not available in the old rotary dialer, such as call forwarding and other very fast dialing features. (Bodin, Tr. at 975-76).

258. In GTE's effort to reduce the manufacturing cost of the DTMF phone, GTE's primary concern was with finding some type of substitute for the pot core oscillator, because it was the most difficult and expensive part to manufacture. (Bodin, Tr. at 983).

259. The motivation to look for alternatives to the DTMF phones with the "pot core" inductor-capacitor oscillator was that the cost of manufacture was too high because of the number of workers and amount of time involved with manufacture. Additionally, GTE was anticipating the need to purchase additional automatic winder machines to increase production of "pot core" inductors. The purchasing of additional winders would have entailed a substantial cash investment. GTE was also going to have to enlarge the building to house the machines and hire more people. Bodin talked to the plant manager about finding a more cost effective way of manufacturing DTMF phones. (Bodin, Tr. at 980; Bodin, CX-500 at 8).

260. As an alternative to the "pot core" inductor-capacitor oscillator assembly Bodin was searching for a keypad dialer assembly that would not

require coils or inductors to generate the frequencies and also one that would be less labor intensive to build. (Bodin, CX-500 at 8).

261. As alternative structures to the "pot core" inductor-capacitor oscillator assembly, Bodin tried Resistor-Capacitor or R-C oscillators which use capacitances in the oscillator circuitry rather than coils. These R-C oscillators proved to be too inaccurate. (Bodin, CX-500 at 8).

262. Bodin also look at separate modules for generating the DTMF signals, but the separate modules were unacceptable to GTE because modules required an external power supply and were also very expensive. (Bodin, CX-500 at 9).

263. It was mandatory to GTE that the replacement for the "pot core" inductor operate off the phone line power. It was unacceptable if it did not operate off the phone line. GTE did not want customers to open the telephone to replace the batteries. The telephone is considered an emergency instrument and GTE did not want it to fail for loss of battery power. (Bodin, Tr. at 1052-53; Bodin, CX-500 at 9).

264. Bodin next looked to integrated circuits as a means of generating the DTMF signals. (Bodin, Tr. at 983; Bodin, CX-500 at 9).

265. In an effort to lower manufacturing costs, Bodin wanted to substitute integrated circuit chip components for mechanical components, such as those in the pot core oscillator. (Bodin, Tr. at 990-91).

266. With regard to the integrated tone dialer chip operating on central office battery power, the integrated circuit chip would have to operate over a voltage range from three (3) volts to fifteen (15) volts. Normally, integrated circuit chips operate around five (5) volts, plus or minus ten percent (10%). (Bodin, Tr. at 1059-60).

267. CMOS devices have many inherent characteristics which made them well suited for use in telephone applications. Bodin expected that integrated circuit manufacturers would be able to make a CMOS chip that would perform the DTMF dialing functions. (Bodin, Tr. at 991).

268. During GTE's search for an integrated circuit tone dialer, GTE called integrated circuit manufacturers to see if such a product existed. GTE found nothing. (Bodin, Tr. at 983-84, 988, 996; Bodin, CX-500 at 9).

269. GTE dealt with Mostek, American Microsystems and Texas Instruments in an attempt to obtain a part that met GTE's requirements for the DTMF chip. (Bodin, Tr. at 1053).

270. Bodin was one of the first people that Mostek employees met regarding definition of circuits and their design into telephones. Callahan met with Bodin on several occasions to determine the specifications required for such a circuit. Mostek had promised workable samples of the MK5085 and MK5086 to GTE, but because of the problems in implementing the first and second revisions of silicon, Mostek was unable to keep some of the schedule commitments which had been made to GTE. CRX-27 reflects the fact that the schedule for producing working samples of the MK5085 and MK5086 was going to be pushed back until the fourth quarter of 1975 or the first quarter of 1976. (Callahan, Tr. at 3652-56; CRX-27).

271. In Bodin's search for an alternative structure to the pot core IC oscillator, Bodin also contacted GTE laboratories. GTE laboratories tried to get the 3.58 megahertz crystal to function as a sustaining oscillator and they were unable to do it. (Bodin, Tr. at 1064-65).

272. Bodin went to Mostek to explain the characteristics of the chip that GTE needed to perform the DTMF dialing functions. Mostek was already

well along in its design process of a tone dialer chip. Mostek designed a chip for GTE. The Mostek chip replaced the pot core oscillator. The chips that Mostek built for GTE had oscillators that were based on a vibrating crystal which was a 3.58 megahertz color burst crystal. The chip also had circuitry that would divide the frequencies of the color burst crystal so that it could create the two sine waves necessary for the DTMF phone dialer. (Bodin, Tr. at 991-93).

273. Of the companies GTE contacted, Mostek appeared to be the most knowledgeable regarding telephone technologies. Mostek was already working on a DTMF integrated circuit chip when Bodin first contacted Mostek. Mostek already had obtained some telephone company's specifications prior to Bodin's visit to Mostek. Bodin does not know whose specifications that Mostek obtained, but it was apparent to Bodin that Mostek had a talking knowledge of the kinds of things required by GTE. (Bodin, Tr. at 1054, 1065-66).

274. Mostek was the integrated circuit manufacturer that developed a product for GTE. Mostek engineers, such as Michael Callahan, Charles Johnson, Robert Paluck and Berry Cash, were frequent visitors to GTE's plant during the design period of the Mostek dialer chip. Larry Woodworth of GTE and Bodin worked with the engineers. (Bodin, Tr. at 1045-46; Bodin, CX-500 at 10).

275. The Mostek MK5085 integrated tone dialer was developed in conjunction with GTE engineers wherein the Mostek engineers developed the integrated circuit chip and the GTE engineers developed the supporting phone circuits that would accept the chip. (Cash, CPX-64 at 16-19).

276. CX-54 contains a letter dated January 16, 1976, from Robert Paluck to Bruce Bodin. Paluck wrote the letter to inform Bodin that he had succeeded in getting the tone dialer chips that Bodin had been waiting to receive.

Bodin wanted the parts so that GTE could begin testing. (Paluck, RPX-36 at 265)

277. The first Mostek chip that Bodin recalls GTE using in its tone dialing telephones was the Mostek MK5086 dialer chip, which was the initial product that GTE accepted for use in its phones to replace the "pot core" oscillator tone dialer assembly. This product was later replaced with the Mostek MK5087 chip. At first, GTE used the MK5086 chip with the existing mechanical switch matrix arrangement to see how well the chip performed the dialing function and to consume the existing stock of mechanical switches in GTE's existing assembly procedures. When Boden left GTE in 1984 GTE may have been using mechanical switches in the DTMF phones with the Mostek chips as opposed to an off chip bypolar transistor. (Bodin, Tr. at 1063, 1076-77; Bodin, CX-500 at 10).

278. The use of the integrated circuit comprising the 3.58 megahertz crystal significantly reduced the manufacturing cost of DTMF phones. The Mostek chip led to a simple keypad which is where the majority of the cost of the assembly was located. Subsequently, the cost of the Mostek IC circuit also came down in price with volume. (Bodin, Tr. at 993).

279. The Mostek chip allowed GTE to eliminate many of the switching and timing functions. It also allowed GTE to replace the entire pot core oscillator and to use a single-sided printed circuit card as opposed to a double-sided circuit card which is significantly more expensive. The timing functions that were eliminated dealt with the way GTE had to manufacture the switches. The switches had to be sequenced so that certain switches would close before other switches were opened or closed, when someone pushed each of the twelve (12) buttons. The switches were part of the dialer assembly and

were located around the periphery and the common switch. (Bodin, Tr. at 994-95).

280. Some of the suppliers that GTE called searching for the DTMF oscillator did in fact have a DTMF oscillator, but for one reason or another those oscillators did not meet the requirements of GTE. GTE usually found that if a supplier did have a DTMF oscillator, the oscillator was intended to be powered by a battery and not by the telephone line. (Bodin, Tr. at 998-99).

281. Bodin personally called some of the integrated circuit manufacturers, and some of the people who worked for Bodin also made calls. (Bodin, Tr. at 1001).

282. Bodin received some samples of integrated circuit chips, but did not receive any chip that met all of the requirements that a telephone had to operate under. (Bodin, Tr. at 1003).

283. Some of the integrated circuit manufacturers thought they had a chip that could be used in DTMF telephones to perform the dialing functions. Bodin states that some of those chips may have been able to work if they were connected to an external power supply. (Bodin, Tr. at 1004-05).

284. [THERE IS NO FF 284]

285. When Bodin went to Mostek looking for a tone dialer chip, one of the functions Bodin wanted the chip to perform was to turn the microphone in the telephone on and off. The function of turning the microphone on and off was required in all DTMF phones. Originally GTE wanted a switch on the integrated circuit that would directly control the microphone. (Bodin, Tr. at 1007).

286. RX-132 contains a GTE specification for an integrated circuit for a

DTMF generation dialer from the mid 1970's. The GTE specification for the DTMF tone generator integrated circuit was probably given to Mostek. (Bodin, Tr. at 1007; RX-132).

287. Most of the non-speakerphones that GTE sold in the mid-to-late seventies did not use bipolar transistors to switch the microphone on and off. The phones used the common switch on the keyboard which was a mechanical type switch to switch the microphone on and off. The mechanical type switch was technically superior to the semiconductor switch because the semiconductor switch did not turn on and off as efficiently as a mechanical switch did. The performance difference between the semiconductor and mechanical switches are not perceivable by the user. (Bodin, Tr. at 1017-18).

288. Mostek had given GTE samples of other Mostek parts that GTE tested but the parts did not qualify. The number of samples Mostek gave GTE was probably around the order of one hundred (100). (Bodin, Tr. at 1022-23).

289. GTE qualified the Mostek chips after GTE tested sample chips from Mostek against the GTE specification and conducted environmental testing on the chip. (Bodin, Tr. at 1021).

290. There were improvements that GTE found needed to be made to the chips initially bought from Mostek and the telephones using them. First, the keyboard was scanning all the time. The keyboard scan signal created noise on the telephone line. There was also an electrostatic discharge problem. In touching the keypad, the user could generate enough voltage to cause failure of the integrated circuit device. GTE solved the problem by putting insulation around the keypad. GTE also had to put a metal-oxide varistor across the telephone line to insulate the chip from abnormal transient voltages, such as might be caused by lightning. (Bodin, CX-500 at 10-11).

291. Mostek solved some of the problems that were discovered when GTE put the MK5084 chip into their telephone. (Jarrett, RPX-35 at 245).

292. Mostek helped to solve the problems associated with using the Mostek chip in GTE's phones. Mostek engineers did the failure analysis to tell GTE what caused the failure and how to fix it. (Bodin, CX-500 at 11).

293. The subassemblies employing the Mostek MK5086 and MK5087 chips were far more reliable than the predecessor "pot core" inductor-capacitor oscillator design. The subassemblies using the Mostek MK5086 and MK5087 were far lighter than their predecessor due to the absence of the copper windings and associated structure. The Mostek MK5086 and MK5087 chips also occupied far less space than the dual coil oscillator assembly. Additionally, the integrated circuit tone dialer required far less maintenance and re-tuning than the "pot core" oscillator circuitry. It was virtually maintenance free. (Bodin, CX-500 at 13).

294. Mostek's MK5086 and MK5087 tone dialers reduced the production costs of GTE's telephone dialer assemblies. The microphone costs went down, because the carbon microphone was replaced with an electra microphone. The cost of the Style-Line dialer assembly was reduced to approximately $5.50 from $23.00 by approximately 1979, a saving of about $17.00 per phone. For the desk set, the cost of the dialer assembly was reduced in 1978 from approximately $15.00 to $3.50 by using the Mostek dialer chip, a saving of about $12.00 per phone. The new dialing assembly was less labor intensive in its construction than its "pot core" inductors-capacitor oscillator predecessor. It also took less employees to fabricate each individual phone. GTE increased production of tone dialer telephones, however, to the point where all the employees who had been previously performing the "pot core"

inductor-capacitor subassembly were reassigned to other duties in the integrated circuit tone dialer production. (Bodin, Tr. at 1029-33; Bodin, CX-500 at 11-12).

295. The Mostek tone dialer chips reduced the manufacturing cost associated with producing a telephone. Component costs and labor costs were reduced by use of the tone dialer chip. Mostek provided their customers with estimates of how the customer would save. (Jarrett, SPX-2 at 245).

296. With regard to the cost information for the Style-Line and Desk-Set phones, Bodin's information is based on cost studies which were prepared by GTE before the introduction of the parts. (Bodin, Tr. at 1033-34).

297. GTE's share of the market for everything it manufactured in 1974 ran roughly 10 percent of what AT&T's market was and everybody else together was about 10 percent of what GTE had. Bodin was not able to tell what GTE's market share of the DTMF push button phone market was in 1984. (Bodin Tr. at 1042, 1043).

298. Bodin was able to locate a dialer assembly made by GTE with the Mostek integrated tone dialer (CPX-45A). Specifically, Bodin found a push button dialer made by GTE Automatic Electric. It used a Mostek tone dialer with Part No. MK5094N. (Bodin, CX-500 at 12; CPX-45A).

299. GTE started selling a DTMF telephone containing a Mostek chip in the mid part of 1977. (Bodin, Tr. 1019).

300. Over one million Mostek MK 5084 tone dialer chips were sold to GTE by the summer of 1977. The MK 5084 chip eliminated the two pot core transformers, a germanium transistor, and a number of resistors and capacitors from the GTE's telephone assembly. (Jarrett, RPX-35 at 140-41).

301. By 1984 when Bodin left GTE, GTE's phone production rose to 110,000

unites per week in which approximately 80,000 telephone incorporated the Mostek dialer chip. GTE was using about 4,000,000 Mostek tone dialer chips in that year. (Bodin CX-500 at 12).

302. Before Bodin left GTE, in the early eighties (1980's) the number of DTMF phones sold rose. GTE began direct sales through organizations like Penney's, Sears, and K-Mart. (Bodin, Tr. at 963).

303. In 1977 Bodin published a paper entitled "The Use of Microelectronics in Telephones" in the GTE Automatic Electric Journal (CX-306). The paper set forth the development leading to the use of such integrated circuit devices in telephones, and was published after the first sales of GTE DTMF phones containing Mostek chips. (Bodin, Tr. at 1020; Bodin, CX-500 at 13; CX-306).

304. The GTE specification (RX-132 at AI000280) has the notation PIN connection, which denotes a rectangle. (Bodin, Tr. at 1012, RX-132).

305. The date on RX-132, October 25, 1976 (10/25/76), is on the first page of the specification. The page corresponds to Bates Number AI000280. (Bodin, Tr. at 1061-62; RX-132).

306. There were GTE specifications published earlier than the one in RX-132. (Bodin, Tr. at 1080; RX-132).

307. Mostek provided input for the GTE specifications for the DTMF chip. Mostek worked with GTE on the pinout configuration to specify which PIN numbers would have which signals on them so that GTE could lay out the printed circuit card. The pinout is in the upper right hand portion of the first page of the specification page AI000280 of RX-132. (Bodin, Tr. at 1063; RX-132).

308. Next to the PIN connection rectangle on page AI000280 of RX-132, there is the number two (2) and it is labelled XMTR switch. The XMTR switch

included on the integrated circuit was intended to control the transmitter or the microphone. GTE's original intent was that the transmitter switch would directly control the microphone. Controlling the microphone entailed running all the microphone current through the integrated circuit and using the transistor internal to the integrated circuit as a switch for the microphone. (Bodin, Tr. at 1012-14; RX-132).

309. Bodin recalls having problems directly controlling the microphone with a transistor on the chip because the small CMOS junction transistor could not handle the necessary current. A CMOS transistor would have trouble handling the amount of current required to control the microphone. Specifically, the CMOS transistor could not handle the amount of power required to switch the microphone on and off. One way to use a transistor to switch the microphone on and off would be to use an off-chip bipolar transistor. The off-chip bipolar transistor can handle the high current required to switch the microphone on and off. GTE did use an off-chip bipolar transistor to switch the microphone on and off in some types of phones, namely speakerphones. (Bodin, Tr. at 1015-16).

310. In 1984 GTE was only using the off-chip bipolar transistor in the speakerphone and linear phones. If GTE did not have the bipolar transistor then GTE would use the mechanical switch. (Bodin Tr. at 1077-78).

311. The block diagram on the lower left corner of CX-41 is a diagram of the Motorola chip MC14410. Bodin has seen a data sheet for the Motorola part MC14410. This chip has separate outputs for the high and low frequencies. (Bodin, Tr. at 1087; CX-40).

L. The '886 Patent

312. While inventor Callahan testified that the '886 patent is directed

to primarily a dual tones sinusoidal signal generator which can be ultimately used in a DTMF telephone dialing application (Callahan, Tr. at 603), each of independent claims 6 and 13 is directed to "A signal generator for providing an output signal representative of a keyboard selection, comprising ..." (CX-3).

313. A type of signal generated by the circuit shown in the '886 patent is depicted in Figure 11 of the '886 patent. Figure 11 shows a stepped sine wave approximation similar to that shown in CX-31, page 2398. This signal is representative of the sine wave that can be synthesized by the integrated circuit. (Callahan, Tr. at 605; CX-3; CX-31).

314. Figure 1 of the '886 patent shows how the pieces of the integrated circuit chip relate to one another. In the center of Figure 1 is a keyboard circuit, which translates mechanical information coming from the depression of a key, into electrical signals that the chip can then understand. Figure 1 depicts a reference oscillator, block 12, which contains the crystal oscillator elements. The crystal would be attached to the chip at this particular point in the circuit. The signal from the crystal oscillator would be divided down by divide-down circuits which are row and column decoders block 16 and block 20. After the signal from the crystal is divided down, a signal having a frequency of appropriate predetermined value is passed into a sine wave memory element, called a PLA. PLA is an acronym for Programmed Logic Array and is shown as items 24 and 26 in Figure 1. It is in this particular memory element where the information about the sine wave and what it should look like is stored. A PLA is implemented as one ROM attached to another ROM. ROM stands for Read Only Memory. The next block in the circuitry of Figure 1 receives digital information from the PLA and is shown

as converter network blocks 28 and 30. This converter block is a digital-to-analog converter. At the output of the digital-to-analog converter is one of the sine waves necessary to create the dual-tone multiple frequency signal. One can see by reference to Figure 1 that the two tones necessary for tone dialing may be generated simultaneously. The two tones meet at the circle labeled 32 and are summed together and amplified so as to be delivered to the output by block 34. The upper half of Figure 1 creates the low frequency, or the row group tones, and the higher frequency, or column group tones, would be constructed by the circuitry shown at the bottom of Figure 1. The two tones are summed together and delivered to the output by means of elements 32 and 34. The row group circuitry comprises items 16, 20, 24 and 28. The high group frequency circuitry comprises items 18, 22, 26, and 30. (Callahan, Tr. at 605-09; CX-3).

315. The keyboard circuitry shown in Figure 1 is the circuitry that translates to the chip what number a person has pressed down. This is information that the chip can use. (Callahan, Tr. at 609-10; CX-3).

316. The oscillator circuitry used in the '886 and '108 inventions is a high frequency color burst crystal commonly used in television sets, which is utilized as the master frequency reference for the entire chip. The crystal has a frequency of 3.58 megahertz. The high frequency signal generated by the crystal oscillator is divided down in order to derive the row and column frequencies required for generation of the dual-tone sinusoidal signal. The reference frequency is divided using digital elements such as flip-flops and other circuits that preserve the accuracy of the frequency signal. Therefore, no frequency adjustments will be required at the output of the circuit. The frequencies that are outputted are determined by the keyboard selection. No

tuning of the frequency signal is required because the crystal oscillator used in the '886 and '108 inventions is inherently accurate, thus there is never any initial or maintenance tuning required. (Callahan, Tr. at 610-12; CX-3).

317. At the output of the circuitry shown in Figure 1 of the '886 patent is a dual-tone sinusoidal signal necessary for tone dialing. This represents the combination of the single sine wave signal produced by the row frequency circuitry, and the single sine wave signal produced by the column frequency circuitry. (Callahan, Tr. at 612-13; CX-3).

318. The quality of the digital approximation of the sine wave is discussed in the '886 patent at column 25, beginning at line 39 which states that the close digital simulation of a sine wave eliminates the need for the use of filters or other complicated circuitry to generate an accurate sinusoidal waveform. This is consistent with the approximations of the sine wave shown on pages 2389 and 2398 of Callahan's engineering notebook, CX-31. It was always the intent of Callahan and Hoffman to deliver a sine wave of sufficient purity so as to require no extra filtering. (Callahan, Tr. at 653-54; CX-3; CX-31).

319. The amplitude of the sine waves produced by the tone dialer chip is described in the '886 patent beginning at col. 25, l. 46. (Callahan, Tr. at 654-55; CX-3).

320. The circuitry shown in Figure 1 of the '886 patent is an embodiment utilizing two PLAs. (Callahan, Tr. at 613; CX-3).

321. Figure 2 of the '886 patent shows another embodiment that uses only one PLA. This one PLA is shown in Figure 2 as block 64. Figure 2 also shows a reference oscillator block and keyboard circuitry, complete with row decoder and column decoder circuitry that operate as dividers depending upon the

keyboard information. In Figure 2, information will pass into the programmed logic array by means of the multiplexer block 58, and the shift register generator block 60. The information contained in the programmed logic array is sine wave information. That information is then outputted to a latch, block 66, and then provided to converter block 70 where it is delivered to the output. This would constitute the path for the column frequencies, or the high tones. (Callahan, Tr. at 615-16; CX-3).

322. The row decoder in Figure 2 of the '886 patent selects a particular divider based on information from the keyboard circuitry, enters the PLA by means of a path labeled LGP1, and then enters the programmed logic array where sine wave information is found. The information from the programmed logic array is outputted to a digital-to-analog convertor, wherein a sine wave representative of the row for the selected key is present. The sine wave forms of the row and column signals are then summed and sent to the output circuitry labeled 74. (Callahan, Tr. at 613, 618-19; CX-3).

323. The multiplexer block 58 in Figure 2 of '886 patent is circuitry that allows information to enter the PLA first from the row group and then from the column group. It was important at the time of the invention that the information from the row group and the column group would not access the programmed logic array at the same time. The multiplexer was designed to prevent this from occurring. If the row and column information attempted to access the PLA at the same time, the result would be corrupted data at the output. (Callahan, Tr. at 619-20; CX-3).

324. [THERE IS NO FF 324]

325. When asked to explain Figure 2 with regard to the one PLA embodiment of Figure 1. Callahan testified:

A   Okay. Yes. This block operates much in the manner as Figure 1 where there is a referenced oscillator block, a keyboard circuitry complete with ROW decoder and column decoder just as in Figure 1 that operates dividers which are dependent upon the keyboard information. And these dividers are then brought into a PLA mechanism similar to how it was done in Figure 1.

But, in this case, information will be going in to the Programmed Logic Array by means of this multiplexer block 58 and shift registered generator block 60. The information contained in the Programmed Logic Array again, is sine waved information. That information is then brought out and put into this latch, block 66 and then it is provided next to a converter block 70 and then delivered to the output. That would constitute a path for the column frequencies or the high tones.

Q   So the high tones come out where you just pointed there out of the latch?

A   Yes, that's correct. Actually, no, the sine wave would be present at the output of the DOA converter right here.

Q   Right above it?

A   Right above it.

* * *

Q   Now does the figure 2 embodiment show where a high group signal will come out?

A   Yes. The high group signal is the one that I followed, I thought. Maybe I misfiled it. But anyway, column decoder impinges upon a high group divider. This block goes into the program logic tray in this manner and comes out as a sine wave right here. The opposite would be coming from the row decoder. That's again from the keyboard circuitry. It selects a particular divider, goes into the PLA by means of this path that I just traced out, namely a signal called LGP1. End of the program logic array where sine wave information again is found. That information is brought to a digital to analogue converted. It's sine wave is present.

Also at the top of block 70 and in this particular block, the two wave forms are summed together and sent to the output labeled 74.

JUDGE LUCKERN: And that particular block was item 72. Correct?

THE WITNESS: The output circuitry block, yes it is.

JUDGE LUCKERN: All right.

BY MR. LUPO:

Q What's the multiplexer?

A Included in this multiplexer box 58 is some circuitry to first allow the proper operation design to operate into the PLA first from the low group and then from the high group. And the way that this particular idea is, since the program logic array is only storing information about what a sine wave must look like, and since this particular chip is trying to build two sine waves that look the same, it was thought that perhaps a smaller amount of silicon to be used in order to be able to just use one program logic array to store this information.

Now it was conceived at the time that we needed to make sure that the information coming from the row group and the column group would not access the row at the same time. Part of this exclusivity was taken care of with some circuitry inside this multiplexer box.

Q When you say the multiplexer was there to make sure that the high group and low group weren't accessed at the same time, why is that?

A Well, if you try to doubly access a PLA at the same time with conflicting inputs, then you'll get corrupted data at the output.

(Callahan, Tr. at 615, 616, 618, 619, 620).

326. [THERE IS NO FF 326]

327. The purpose of multiplexer 58 in Figure 2 is as follows: the signals coming from blocks 52 and 54 are of two different frequencies. These signals eventually enter the PLA. The purpose of the multiplexer is to act as a switch which will allow information from one group to enter the PLA and then switch to allow information from the other group to enter the PLA. (Callahan, Tr. at 626-27; CX-3).

328. The breadboard built by Callahan utilized a one PLA embodiment. (Callahan, Tr. at 634-35).

329. CX-435 illustrates the waveforms which will be present at the output of the conversion network 28 for the row tone, the output of conversion

network 30 for the column tone and the output of the amplifier 34 for the DTMF tone. Asserted claim 6 refers to one half of the signal generator of Figure 1, either the bottom (column) half or the top (row) half. (Fair, Tr. at 1497-98, 1501; CX-435). In a DTMF generator a single frequency signal is not uniquely representative of an actuated key but rather would represent either a row or a column. (Callahan, Tr. at 842, 843). A single tone cannot successfully dial a telephone. (Callahan, Tr. at 844).

330. In 1974, it was known in the telephony art to use static inputs to interface with mechanical switches of the single pole, single throw type. (Callahan, Tr. at 3661-62).

M. The '108 Patent

331. The '108 patent is directed to an entire system using an integrated circuit to dial a telephone, powered solely from the telephone lines and including common switching means. (Callahan, Tr. at 659; CX-4).

332. The common switching functions are those functions that occur anytime a key on a telephone keyboard is depressed. (Callahan, Tr. at 659).

333. Figure 6 of the '108 patent shows the reference oscillator. The reference oscillator is comprised of elements 244, 250, and 257 in Figure 6. The reference oscillator must be shut off when a person is trying to speak over the telephone lines and must be turned on when a person is trying to create the tones necessary to dial the telephone. The common function of turning the oscillator on and off is performed by transistor 242 responsive to control signal VKB in Figure 6 of the '108 patent. Transistor 242 is a P-channel MOS transistor which is not a bipolar transistor. Fig. 6 is described in the '108 patent as a "circuit diagram of the scan signal generator and reference oscillator of the system of FIG. 2." (Callahan, Tr. at 659-660;

CX-4, col. 3, Fair, Tr. at 2472).

334. Figure 12 of the '108 patent shows MOS non-bipolar transistor 614 performing the common switching function of enabling the output signal generator. Both transistors 242 and 614 are MOS transistors which are located on the chip. (Callahan, Tr. at 685-88; CX-4)

335. Other common switching functions which must be performed are those associated with the earpiece and the mouthpiece. The earpiece is referred to in the '108 patent as the receiver, and the mouthpiece is referred to as the transmitter. In Figure 12, the receiver is element 586 and the transmitter is 584. Neither the receiver nor the transmitter are located on the integrated circuit chip. (Callahan, Tr. at 660-61, CX-4).

336. [THERE IS NO FF 336]

337. The three most important common switching functions of Figure 12 of the '108 patent are the attenuation of the receiver; the disabling of the transmitter; and the enabling of the output signal generator, in order to allow it to send out tones through the telephone line. All of those common switching functions occur when a key is pressed on the telephone keyboard in order to create the DTMF tone signal. The enabling of the output signal generator is accomplished by elements comprising transistor 610, amplifier 600, and feedback resistor 612, which all work in conjunction with D to A converters 562 and 564. This particular group of elements must be shut off during speech activity and must be turned on during tone signalling, and this function of turning off and on these elements is accomplished by means of resistor 616 and P-channel MOS transistor 614. These elements are on the integrated circuit chip. As shown, this circuitry performs the common switching function of enabling and powering up the output amplifier, which is

used as the output signal generator to drive the telephone lines. (Callahan, Tr. at 662-63; CX-4).

338. Transistor 610 in Figure 12 is a bipolar transistor, which is capable of driving the telephone lines. Bipolar transistor 610 was included in the '108 on-chip circuitry, because during the time period of the development of the '108 invention, driving the telephone lines with MOS transistors was difficult to do. (Callahan, Tr. at 663-64; CX-4).

339. Because the '108 patent claims are directed to an integrated circuit which is powered solely by the telephone line inputs, it is important that the integrated circuit be a low power device. The use of CMOS technology aids the use of such a chip solely with telephone line power. (Fair, CX-503 at 5-6).

340. The bipolar transistors in Figure 12 are labeled 572, 588, 594, 604, and 610. The MOS transistors in Figure 12 are labelled 602, and 614. The inverter 598 in Figure 12 is also comprised of MOS transistors. (Callahan, Tr. at 664-65; CX-4).

341. According to inventor Callahan, the first commercial version of the circuit for DTMF built in 1976 had everything integrated on the chip with the exception of bipolar transistor 594. There are five bipolar transistors in Figure 12 of the '108 patent, viz. 572, 588, 594, 604 and 610. All but bipolar transistor 594 were on the chip in the first, intermediary and first commercial version of the circuitry. Subsequent to the first commercial version there were times when bipolar transistor 588 and 604 were not found necessary to be on the chip. (Callahan, Tr. at 666 to 668; CX-4).

342. The signal at the left of Figure 12 of the '108 patent, VKB Bar, stands for Valid Keyboard. The signal is created by the circuitry shown in

Figure 4 of the '108 patent. (Callahan, Tr. at 668-69; CX-4).

343. Figure 4 of the '108 patent is a detailed circuit schematic of the row keyboard decoder, which is circuitry attached directly to the keyboard. The keyboard signals are shown at the left-hand side of the schematic: R1, R2, R3, and R4. A VKB signal (the complement of VKB Bar) is created by means of NOR gate 66 and invertor 166 in Figure 4. (Callahan, Tr. at 669-70; CX-4).

344. According to Kooi from his review of the specification for the '108 and '886 patents, any embodiment disclosed in those patents specifically calls for common switching transistors, including NPN bipolar transistor 588 and PNP bipolar transistor 594 to be formed on the same integrated circuit chip with the CMOS tone dialer circuitry. He stated that both the '108 and the '886 patents call for certain bipolar NPN and PNP transistors to be formed on an integrated circuit chip fabricated using a CMOS process. (Kooi RX 3 at 5 to 7).

345. The terms "common key functions" and "common switching functions" can be used interchangeably and synonymously. (Fair, Tr. at 1755, 1884).

346. Inventor Hoffman testified that the results of an analysis he did at Mostek showed that an MOS transistor which could handle the currents required to disable and drive the transmitter would have too large "of an area of the overall chip to be practical, at that time." (Hoffman, RPX-22 at 75).

347. Complainant has admitted that there is no dispute that the common switching means recited in claim 1 of the '108 patent must be on the chip, and that complainant's position is that the dispute is whether or not "bipolar transistors are required to be on the chip as part of that common switching means." (Tr. at 306, 307).

348. The "common switching means" disclosed by the '108 patent for disabling the microphone and muting the receiver are means which are provided electronically as part of the chip of integrated circuitry. (Order No. 117, ¶ 2, Fact No. 49).

349. With respect to the Figure 12 embodiment of the '108 patent, unless the PNP transistor 594 has been turned off, the common switching function of attenuating the output of the receiver 586 has not been performed. Thus Fair testified:

> A I have testified that the common switching functions include enabling an oscillator, disabling a transmitter, attenuating a receiver and powering the signal generator.
>
> Q Do the common switching functions include switching into the circuit a dummy resistor?
>
> A Yes, that is also recited in the patent.
>
> Q Now, isn't it true, Dr. Fair, that the common switching function has not been carried out or performed unless the audio transmitter is disabled?
>
> A That's correct.
>
> Q And the way the audio transmitter is disabled is by cutting off the current that drives the audio transmitter; isn't that correct?
>
> A That's correct.
>
> Q And the way this is done in the '108 patent is by turning off NPN Bipolar Transistor 588 shown in Figure 12; isn't that correct?
>
> A That's correct.
>
> Q And unless NPN Transistor 588 is turned off, the common switching function of disabling transmitter 584 has not been performed; isn't that correct?
>
> A That's correct.
>
> Q Now, with respect to receiver 586, isn't it correct that the output signal of receiver 586 has not been attenuated unless PNP Transistor 594 has been turned off, thereby inserting resistor 596

in series with receiver 586?

A That's correct.

Q And unless PNP Transistor 594 has been turned off, the common switching function of attenuating the output of the receiver 586 has not been performed; isn't that correct?

A That's correct.

Q So, under your definition of common switching means, if transistors 588 and 594 are off the tone dialer chip, these two transistors would not be part of the common switching means; isn't that correct?

A That's correct.

Q And without these two transistors off the chip connected in some way to the chip, the common switching function of disabling the transmitter and attenuating the output signal from the receiver would not be performed; isn't that correct?

A That's correct.

Q So, to actually perform the function of disabling transmitter 584, you would need some other switch or chip that would be driven by a control signal from the chip if you did not have transistor 588; isn't that correct?

A That's correct.

Q And to attenuate the output of receiver 586, you would also need a switching device such as bipolar transistor 594 to cut off the current to receive 586 and resistor 596 in series with the receiver; isn't that correct?

A Yes.

Q And this device which functioned to do this would act as a switch; isn't that correct?

A This device.

Q The device switch function to attenuate the output of the receiver would act as a switch; isn't that correct?

A That's right.

Q So, if you do not have a switch such as NPN bipolar 588 on chip, you need a switch off chip to actually perform the function of disabling transmitter 584; isn't that correct?

A Well, it's correct to the extent that that off chip device does not by itself disable the transmitter or attenuate the receiver. It performs that function in concert with the integrated circuit.

Q But the integrated circuit itself also does not disable the transmitter, does it? It performs that function in concert with an off chip switch; isn't that correct?

A That's correct.

Q And, likewise, if you do not have a switch such as PNP bipolar transistor 594 on chip, you need a switch off chip to actually perform the switching function to attenuate the output of the receiver; isn't that correct?

A That's correct.

Q And if you have bipolar transistors 588 and 594 on chip, the same switching function would be performed by these devices on the chip; isn't that correct?

A Yes.

Q I take it that under your definition of the common switching means, the common switching structure on chip as disclosed in the '108 patent really is a structure for generating a control signal to drive an off-chip transistor to attenuate the receiver and possibly to drive an off-chip transistor to disable the transmitter; isn't that correct?

A In my testimony on Saturday, I said that my understanding of the common switching means on chip was a means whereby a voltage is created in an output pin or a current is enabled to flow from that output pin to control the common switching functions, the common key functions.

Q And that voltage would be a control signal, would it not?

* * *

Q Well, isn't it true, Dr. Fair, that the common switching function of disabling the transmitter has not been performed until the transmitter is disabled?

A Well, I have testified and answered that question several times.

Q And the answer is --

A Yes.

Q -- that is true, isn't it?

JUDGE LUCKERN: Your answer is yes?

THE WITNESS: Yes.

BY MR. MacPHERSON:

Q And the common switching function of attenuating the receiver has not been performed unless and until the receiver output is attenuated? That is correct; isn't it?

A Yes. That's right. [Emphasis added]

(Fair Tr. at 1623 to 1626; 1637).

350. Inventor Callahan also testified:

Q. And to disable the transmitter, you have to turn off the current that flows to the transmitter, isn't that correct?

A. That's correct.

Q. And another of those functions is to mute the receiver, isn't that correct?

A. That is correct.

Q. And to mute the receiver, you have to insert in series with the receiver a resistor, isn't that correct?

A. That's correct.

Q. And the way that resistor is inserted in series with the receiver is by turning off a transistor that was in series with the receiver, but in parallel with the resistor, isn't that correct?

A. Yes, it is.

Q. And unless the transistor, of which is in parallel with that resistor is turned off, the common function of attenuating the receiver will not be performed, isn't that correct?

A. That's correct.

Q. And unless the transistor that is in series with the transmitter is turned off, the common function of disabling the transmitter will not be performed, isn't that correct?

A. That's correct.

(Callahan, Tr. at 728, 729)

351. An electronic switch is essentially hardware in the sense of physical electronic embodiment. It would be like a transistor. A control signal could be used to drive a switch, i.e. control the switch. A control signal is not a switch. A control signal is something else than a switch. (Hoffman, RPX-22 at 130).

352. A transistor can be used for a switch in both bipolar and MOS technology. (Callahan, Tr. at 412, 413).

353. The function of generating a control signal on chip is different from the functions of disabling the audio transmitter and attenuating the receiver, which are the functions performed "on chip" by the bipolar transistors disclosed and claimed in the '108 patent as part of the common switching means on the chip. (Magleby, RX-1 30Q).

354. The particular elements that actually implement the common switching functions of disabling the transmitter and attenuating the output of the receiver in Figure 12 of the '108 patent are bipolar transistor 588 and bipolar transistor 594. (Magleby, Tr. at 2408, 2409).

355. It is necessary to disable the transmitter during tone dialing operation because extraneous noise such as a voice could go into the transmitter and cause the phone to misdial. (Kincaid, RPX-40 at 86-87).

356. It is necessary to attenuate the receiver when a tone is being generated to keep from having too loud of a signal in the ear of the telephone user. (Callahan, Tr. at 677-678).

357. The oscillator must be shut off when a person using the telephone is trying to talk, and it must be turned on when the person using the telephone is trying to dial or create tones. An oscillator is a circuit which is used for generating a sine wave. (Callahan, Tr. at 659-660).

358. Unless the current to the audio transmitter has been cut off, the audio transmitter has not been disabled and the function of disabling the audio transmitter has not been carried out. (Callahan, Tr. at 734).

359. Unless the transistor which is in parallel with the muting resistor is turned off, the common switching function of attenuating the receiver will not be performed. (Callahan, Tr. at 728).

360. The only structures disclosed in the '108 patent for performing the common switching functions of disabling the transmitter or microphone and for attenuating the output of the receiver (that is, muting the earpiece) include bipolar transistors. (Magleby, RX-1 21Q, 31Q).

361. One reading the '108 patent must conclude that the "means" for disabling the microphone and muting the earpiece must include bipolar transistors which have the inherent capability of handling the high current requirements necessary to perform those functions and the '108 patent does not disclose any structures that are equivalent to bipolar transistors for performing the two common switching functions involving the transmitter and the receiver. (Magleby, RX-1 31Q).

362. A control signal would be used or could be used to drive or control a switch. (Hoffman, RPX-22 130).

363. A control signal is not a switch. (Order No. 117, ¶ 2, Fact No. 52).

364. Hoffman's definition of a switch is that it is an electronic element that tends to have either an on-state or an off-state and nothing in between. (Hoffman, RPX-22 129-130).

365. A switch is used to cause current to flow on a selected path or not flow and it may also transmit voltage. (Hoffman, RPX-22 130).

366. Common switching means for disabling the transmitter in the Figure 12 embodiment include invertor amplifier 598, MOS transistor 592 and bipolar transistor 588. (Fair, Tr. at 1388).

367. The '108 patent teaches that the audio transmitter is turned off by NPN bipolar transistor 588 shown in Figure 12. (Fair, Tr. at 1623-1624).

368. Audio transmitter is disabled by cutting off the current that drives the audio transmitter. (Fair, Tr. at 1623).

369. The mouthpiece (i.e. transmitter) is element 584 in Figure 12 of the '108 patent. (Callahan, Tr. at 662:1-2).

370. The way that the resistor 596 is inserted in series with the receiver 586 is by turning off a transistor 594 that was in series with the receiver 586, but in parallel with the resistor 596. (Callahan, Tr. at 728).

371. [THERE IS NO FF 371]

372. [THERE IS NO FF 372]

373. The embodiment disclosed in the '108 and '886 patents specifically calls for common switching transistors including NPN bipolar transistor 588 and PNP bipolar transistor 594 as shown in Fig. 12 to be formed on the same integrated circuit chip with the CMOS tone dialer circuitry. (Kooi, RX-3, Q8).

374. Magleby testified that there is circuitry shown on Figure 6 to enable the oscillator to oscillate (transistor 242 which is responsive to a signal VKB) during the period of time that tones are being generated and it is VKB which is the output of the invertor 598 which controls the common switching means of Figure 12 and thus there is the same control signal VKB that is controlling the common switching means in both Figure 12 and Figure 6. (Magleby, Tr. at 2472, 2475).

375. Leaving all of the other circuitry on the chip, and merely taking the VKB signal off chip from the output of invertor 167, Fair testified that invertor 167 would not make up the common switching means on the chip because 167 would not be sufficiently sized in order to enable the current to flow off chip. Thus Fair testified:

> And you're driving the input gates on 598, which has almost no current requirement. That, to me, tells me that the invertor in Figure 4, invertor 167, is relatively small compared to what would be required to -- for 598 to operate in that Figure 12 circuit.
>
> Q But wouldn't one, under your definition of common switching means, and your testimony as to what one ordinarily skilled in the art would know, be able to properly size invertor 167 to produce the control signal VKB to be taken off chip to do these common switching functions?
>
> A Well, it's hypothetical, because within this patent, the output of 167 is not the common switching means.
>
> Q But it could be, couldn't it?
>
> A Well, that's hypothetical, sir. It's not taught to me in this patent.
>
> Q Well, isn't it true that the VKB signal output from 167 is the same as the VKG signal output from 598?
>
> A I really do not consider them the same. Because not only is the -- there is a labeling that says this is VKB, but the magnitude of that signal and the current that that signal is able to produce could be substantially different.
>
> Q Could you look in the patent specification, and -- for the 108 patent, and tell me where that statement is made, that the output signal VKB from 598 is different from the output system from '167?
>
> A It's my recollection that there is no statement in the specification, but keep in mind this patent is being used by one skilled in the art to build a system and, with the knowledge contained by one skilled in the art, this would be known.
>
> Q And by this would be known, you're referring to what?
>
> A I am referring to the sizing of invertor 598 relative to the sizing of invertor 167.

Q Well, my point is, there is no differentiation in the '108 patent, is there, between the signal VKB as output from 167, invertor 167, and the signal VKB as output from invertor 598; isn't that correct?

A I disagree. There certainly is a differentiation.

Q There's no statement in the patent that these two signals are different, is there?

A There are no words in the specification, that's correct.

(Fair, Tr. at 1654 to 1656).

376. The gates of transistors 592 and 594 are both controlled by the VKB signal provided by invertor 598. The '108 specification does not disclose invertor 598 as sizing the control signal VKB bar. There is no disclosure in the '108 or '886 patents of control signals of different sizes. (CX-4, col. 21, lines 49-51).

377. Signal VKB and VKB bar are control signals. (Fair, Tr. at 1652).

378. [THERE IS NO FF 378]

379. [THERE IS NO FF 379]

380. Magleby has found no reference to an all MOS embodiment in either of the '108 or '886 patents. (Magleby, Tr. at 2407).

381. If bipolar transistors is on the chip then the chip performs the common switching functions. If the bipolar transistor is off the chip then the chip merely generates a control signal which is sent off chip to a device which off chip will perform the common switching functions. (Fair, Tr. at 1395, 1396, 1623, 1624, 1625, 1626, 1637; Callahan, Tr. at 728, 729).

N. Prior Art On Mechanical Switching

382. The common switch relates to the common switching functions that are performed any time a key on a keypad is depressed. The common switch in

CPX-44 is made up of a series of leafs and posts, which are the gold fingers with the posts attached to them. There are electrical connections which are made along the edge of the keypad regardless of which key is depressed. Activating a key on CPX-44 results in movement of the common switch regardless of which key is actuated. (Callahan, Tr. at 549-51; CPX-44).

383. One of the functions of the common switch is to disconnect the microphone during dialing. This is done so that outside noises do not compete with the signal created by activation of the key during dialing. Another function of the common switch is to assert some amount of attenuation into the earpiece. This is important because generation of a tone in response to a key being actuated produces a fairly loud signal which could be damaging to a person's ear. A third function of the common switch is to provide power to the oscillator so as to produce the tone corresponding to the actuated key. (Callahan, Tr. at 551-52).

384. In the prior art that predated electronic switching the common switching functions were performed by a mechanical common switch (Fair, Tr. at 1754)

385. The common switching functions in the prior art include applying power to the oscillator, disconnecting the audio transmitter, and attenuating the ear piece of the receiver. (Fair, Tr. at 1753-1754, 1755).

386. The functions that were performed by the mechanical switch were to power up the oscillator, to disable the transmitter by cutting off the current to the transmitter, and to attenuate the ear piece by inserting a resistance in series with the ear piece. (Fair, Tr. at 1756).

387. The term "common function" is a telephone company term referring to a specific set of switch contacts in the phones of that era (i.e. prior to

1973-74) using two coils and a specialized keyboard. These switch contacts were used to disconnect the transmitter, to insert a resistor or allow a resistor to diminish the intensity of the tones in the earpiece. They also function in the two coil phone to start the oscillations. (Hoffman, RPX-22 at 84-85).

388. Common key function or common switching function meant the functions were performed by the pressing of a key. (Fair, Tr. at 1755-1756).

389. In the prior art, the common switch directly carried out the functions of enabling the oscillator, disabling the transmitter and attenuating the output of the ear piece. (Callahan, Tr. at 551-553; Fair, Tr. at 1756).

390. In replacing the mechanical common switch to something, it was desirable from a system's standpoint if the common switch could be put on the chip for reasons of cost and because the entire thrust of integrated circuits is to get as much of the system value onto the chip as possible. (Hoffman, RPX-22 at 74-75).

391. The mechanical switch acts directly on the power supply to connect the power supply to the oscillator and does not merely provide a control signal. (Magleby, Tr. at 2480-2481).

392. The mechanical switch muted the earpiece directly by opening up so that the current normally passing through the switch would pass through the resistor and thereby be attenuated. This switch did not send a control signal to some other device that muted the earpiece. (Magleby, Tr. at 2481-2482).

393. The mechanical common switch physically interrupts the current that would normally be passing through the transmitter of the microphone, provides a bypass of the muting resistor and provides power to enable the oscillator.

(Mableby, Tr. at 2479-2481).

394. In prior art telephones which a mechanical "common switch" was used the common switch was activated when any key on the telephone keyboard was depressed. (Callahan, Tr. at 546-547; CX 29).

395. The meaning of the term "common switching functions" is well known in the telephone arts. (Magleby, RX-1 42Q).

O. Infringement of The '108 Patent Involving HMC and UMC

396. In the chips of HMC and UMC there are MOS transistors used to generate a control signal which is sent off the chip to external circuitry that carries the drive current necessary to disable the microphone or mute the earpiece. (Magleby, RX-1 30Q). This fact was not disputed by complainant.

397. The chips of HMC and UMC have their means for disabling an audio transmitter and means for attenuating the output of a receiver off the chip. The accused UMC and HMC dialer chips utilize discrete transistors external to the dialer chip to attenuate the receiver and disable the transmitter. In the case of HMC's chips, a field effect (MOS) transistor and related circuitry generates a control signal transmitted through a mute pin. This control signal can be used to activate a switch such as a bipolar transistor off the chip, UMC's chips also produce a control signal at an XMUTE pin. Both experts of complainant and HMC and UMC agree that neither HMC's nor UMC's dialer chips have actual switching elements on the chip that effectuate the common switching functions of muting the receiver and disabling the transmitter. (Magleby, RX-1 19Q, Ans. 17, 31Q, 37Q; Magleby, Tr. at 2401-2403, 2407, 2412; Fair, Tr. at 1746-1747).

398. Means for disabling the audio transmitter and means for attenuating the output of the receiver are the two key common switching functions not

found in the accused HMC or UMC chips. (Magleby, Tr. at 2414).

399. None of HMC's and UMC's dialer chips have the common switching means for performing the function of muting the receiver or disabling the transmitter by using bipolar transistors that are on the integrated circuit. (Magleby, Tr. at 2406, 2407).

400. In HMC's chips, a field effect (MOS) transistor and related circuitry generates a control signal transmitted through a mute pin. This control signal can be used to activate a switch, such as a bipolar transistor off the chip. UMC's chips also produce a control signal at an "XMUTE" pin. This control signal can be used in telephone applications to control bipolar switching transistors that are external to the chip. (Magleby, RX 1, Ans. 37, p. 23-24).

401. None of HMC's or UMC's accused dialer chips has an on-chip transistor that corresponds to transistor 594 in Figure 12 of the '108 patent. (Fair, Tr. at 1746-1747).

402. None of UMC's or HMC's accused dialer chips has an on-chip transistor that corresponds to transistor 588 in Figure 12 of the '108 patent. (Fair, Tr. at 1747).

403. The accused products use a static keyboard, where no active signals are sent to the keyboard to determine which key has been depressed. (Magleby, Tr. at 2427-2428).

404. The keyboard disclosed by the '108 patent is a scanning type keyboard where a pulse is sent out to the keyboard to interrogate the keyboard so as to determine which one of the keys have been depressed. (Magleby, Tr. at 2500).

405. Keyboard scanning is accomplished by sending pulses to the keyboard

to determine which key has been pressed. (Magleby, Tr. at 2427).

406. HMC and UMC products use what is called a static keyboard where there is no active signals being sent out to the keyboard to determine which key was pressed. (Magleby, Tr. at 2427-2428).

407. The '108 patent uses a single logic gate to sense decoded keyboard signals. The HM9187 uses a substitute logic gate to sense one or more decoded keyboard signals. (Fair, CX-503 at 90; CX-4).

408. All of the accused HMC tone dialer chips are designed for connection to a keyboard having single-pole, single-throw switches. (Fair, CX-503 at 98).

P. Enablement and Best Mode Re '108 and '886 Patents

409. In Figure 9, the multiplexer circuit for controlling the input signals to PLA of Figure 10 as set forth in Figure 9 is inoperative for the failure to include an arbitration circuit. (Magleby, RX-1 71Q; Magleby, Tr. at 2432-33).

410. There are errors in the programmable dividers for the row and column signals shown in Figures 7 and 8 of the '108 patent. (Magleby, Tr. at 2434, 2435).

411. There is missing circuitry in Figure 9 of the '108 patent. Even the breadboard did not work all the time. Figure 9 included a circuit which has a problem which was never fixed in the development of Mostek's first tone dialer products. (Magleby, Tr. at 2439-2440; Callahan, Tr. at 6464, 647, 653).

412. The circuit in Figure 9 is not effective in addressing the arbitration problem, and would not allow a one PLA embodiment to work. (Magleby, Tr. at 2440-2441).

413. Figure 9 in the '108 and '886 patents does not disclose the correction that is required to make the breadboard circuit work. (Callahan, Tr. at 825-826).

414. Figure 4 of the '108 and '886 patents is inoperative as shown. (Callahan, Tr. at 828).

415. Figure 7 of the '108 and '886 patents is inoperative as shown (Callahan, Tr. at 827-828).

416. Figure 8 of the '108 and '886 patents is inoperative. (Callahan, Tr. at 833).

417. Figure 9 of the '108 and '886 patents is also inoperative. (Callahan, Tr. at 824-827).

418. With respect to errors in Figures 4, 7, 8 and 9 inventor Callahan testified that they are routine type problems and mistakes that "can be corrected without a heck of a lot of experimentation." (Callahan, Tr. at 833).

419. Capacitors 142, 144, 146 and 148 of Figure 4 are not provided a discharge path. (Magleby, Tr. at 2433).

420. In Figure 7, there is a conflict that exists between the signal that would come on one of the column decoder lines and the signal that would be passed through the transistor to which the decoder line is attached. (Magleby, Tr. at 2434).

421. Figure 4 is inoperative due to the failure to provide a mechanism for discharging capacitors 142, 144, 146 and 148. (Magleby, RX-1 71Q).

422. There are problems with the connections of the incoming decoder lines that are shown in Figures 7 and 8. (Magleby, Tr. at 2434, 2435).

423. Figures 7 and 8 are inoperative because there's a conflict between

the signal on one of the CD1, CD2, CD3 and CD4 lines and the signal on one of leads 266, 268, 270 and 272 in Figure 7 and a similar conflict in Figure 8 involving the signal on one of the leads RD1, RD2, RD3 and RD4 and the signal on one of the leads 336, 338, 340 and 342. (Magleby, RX-1 71Q).

424. In the '108 and '886 patents, the row decoder, which is block number 16 in Figure 1, the low group programmable divide, block 20 and the high programmable divide, block 22 are inoperative. (Magleby, Tr. at 2432).

425. The design changes that were made to solve the problem with the circuitry are not shown in Figure 9 referenced in the specification. (Callahan, Tr. at 646, 647, 825).

426. The problems with Figure 9 were solved prior to the successful completion of tests in May 1973. (Callahan, Tr. at 827).

427. Figure 9 of the '108 and '886 patents at issue does not contain all of the circuitry required to solve the problems that were found in the breadboard and the first silicon prototypes. (Callahan, Tr. at 825). Figure 9 in the specifications of the '108 and '886 patents does not disclose the additional gates that solved the problems. (Callahan, Tr. at 826).

428. According to Callahan, the additional gates were omitted from Figure 9 by mistake. (Callahan, Tr. at 827).

429. If the circuit in Figure 9 of the '108 and '886 patents was implemented as disclosed, there would be times when the output would be meaningless, i.e., the central office would not be able to detect the tones that are generated. (Magleby, Tr. at 2440-2441).

430. The circuits shown in Figures 7 and 8 of the patents at issue contain features that would lead to a conflict between the signal on the column decoder lines into the programmable divider and the signal that would

be passed through the transistor to which the decoder line is attached. (Magleby, Tr. at 2434, 2435; RX-259, RX-260).

431. The errors identified in Figures 7 and 8 are called for by the specifications of the '108 and '886 patents because the drawings follow the language of the specifications. (Magleby, Tr. at 2435).

432. In Magleby's opinion, the specifications and drawings of the '108 and '886 patent contain so many errors that one having ordinary skill in the art would have difficulty in using the specification to make the product disclosed. (Magleby, Tr. at 2443-2444).

433. A person having ordinary skill in the art could recognize errors in the '108 and '886 specifications and correct them but it would take quite a bit of effort to do so. (Magleby, Tr. at 2446).

434. Magleby has had experience in licensing designs and trying to build devices using patent specifications and documentation provided by the licensor. If one does not have good working documents, it can take a lot of effort to go back and try to find all the errors in the documents and correct them. (Magleby, Tr. at 2445-2446).

435. During the relevant time frame it would take a person having ordinary skill in the art at least six months to a year to go through the specification and sort out the errors because they would not all be found initially. (Magleby, Tr. at 2447).

436. Correcting each error by itself in the '108 patent specification would not necessarily be very difficult but correcting all of them and making sure one has got all of them compounds the situation. (Magleby, Tr. at 2672).

437. Once one found the problem in each of Figures 4, 7 and 8 the problem could be fixed in a fairly short period of time. Retesting, however,

would have to be done. (Magleby, Tr. at 2652, 2654).

438. Before attempting to implement the tone dialer circuit into silicon, Callahan and Hoffman first completed a breadboard design of the chip. During that time period, it was common practice for a replica of the integrated circuit to be built out of discrete electronic components or elemental blocks, such as NAND gates, NOR gates, and flip-flops, along with other components, such as amplifiers, resisters, and capacitors. The breadboard was used to verify that the design was in fact accurate. The breadboard for the tone dialer was quite large, perhaps two or three feet wide by two feet tall. It consisted of four or five separate printed circuit boards, which had a number of components on them. They were able to dial the telephone line and make connections with the completed breadboard. The breadboard is first used because integration requires considerably more effort and expense, and Callahan and Hoffman were first interested in learning whether or not their idea would actually work. As shown on CX-30, the breadboard was completed with a successful test on May 30, 1974. (Callahan, Tr. at 592-93; CX-30).

439. The first breadboard implementation did not work correctly because of a design problem with the multiplexer. An improvement to the multiplexer was added to the breadboard and the breadboard successfully worked. This was done on or about May 30, 1974. (Callahan, Tr. at 637).

440. Callahan and Roden, a Mostek technician, built a breadboard circuit of the tone dialer. The invention disclosure statement (CX-30) indicates the bread board was built in the first half of 1974. (Callahan, Tr. at 592-93; Hoffman, RPX-22 at 97-98; CX-30).

441. The breadboard was used to test the tone-dialer circuit concept.

Hoffman actually dialed an outside line with the breadboard circuit. He called a pizza parlor. (Hoffman, RPX-22 at 98-99, 171).

442. When the inventors of the '108 and '886 patents built their breadboard which contained a replica of the circuitry for the dialer chip in issue, the breadboard was configured with one programmable logic array (PLA). (Callahan, Tr. at 634).

443. After completion of the breadboard, attempts at integrating the circuit onto a silicon chip began. The first commercial samples of an integrated circuit chip containing the tone dialer circuitry were completed in early 1976. During that time period, from the completion of the breadboard to the first samples of the integrated circuit chip, Callahan continued to work refining the circuitry of the tone dialer chip. (Callahan, Tr. at 593-94).

444. After the breadboard was successfully completed, Callahan worked effectively full-time in a consulting role with the engineers who were assigned to integrate the circuitry onto a single chip in silicon. The first engineer was Charles Blair, who was replaced by Charles Johnson. Callahan kept in continuous touch with the engineers, answering any questions they had regarding the circuitry. (Callahan, Tr. at 595, 3615).

445. The first attempts at implementing the '886 and '108 inventions in silicon were performed by a design engineer named Charles Blair who was an MOS engineer at Mostek. Blair helped Callahan do calculations concerning the the tone dialer circuit. In 1975, Blair's first attempt at implementing the integrated circuit in silicon was not successful. Blair's attempt at revising the first silicon was also not successful. At this point, Blair was removed from the project and replaced by Charles Johnson. Johnson's attempts at implementing the integrated circuit into silicon were successful, and

commercial samples of the MK5085 and MK5086 chips were available in early 1976. (Callahan, Tr. 3627; Hoffman, RPX-22 at 101).

446. The breadboard initially built by Callahan had essentially everything in Figure 2 of the '886 patent including block (58) designated multiplexer. Thus it had only 1 PLA. It had no integrated circuitry. The first silicon embodiment which was after the breadboard had only a single PLA and it did not work properly because some of the circuitry and the multiplexer was not completely included. A breadboard is an experimental device which one can experiment with and play around with and make measurements upon since a bread board is an attempt to prove out a design. In the first bread board implementation the bread board did not work correctly and it was found that there was a design problem with block 58 of Figure 2. When an improvement was made on block 58, the breadboard tests were successful. The improvement in block 58 was made on or about 5/30/74. However, there still was no integrated circuit. Ultimately, it was decided to replace the multiplexer 58 with a 2 PLA version. (Callahan, Tr. at 634, 636, 637, 638, 639).

447. One problem that existed with regard to the development of the MK5085 was that it was designed to work with a calculator-type keyboard that used a scanning oscillator to detect when a key had been depressed. The attempts at designing the MK5085 for use with this type of keyboard caused the initial schedule for having samples of the MK5085 available to customers to slip by about seven (7) or eight (8) months. (Callahan, Tr. at 3629-30).

448. Another problem that existed in the first implementation of the integrated circuitry of the MK5085 and MK5086 chips into silicon was the fact that Mostek during that time period did not have any equipment or capability to test analog chips with respect to their high voltage and high current

requirements. Some type of testing is required in order to determine if the chip will work. (Callahan, Tr. at 3634; CRX-20).

449. The second revision of silicon did not work properly. As a result, Blair, the engineer lost his job and was replaced with a second engineer named Johnson. (Callahan, Tr. at 3656).

450. After the second revision of silicon failed, there was a significant level of priority placed on the MK5085 and MK5086 project to reduce the circuit into fully functional silicon so that samples could be produced to customers. As a result of this priority, the engineers involved in development of the chip engaged in continuous effort to produce a fully functional chip. (Callahan, Tr. at 3658).

451. When the inventors of the '108 and '886 patents first began attempting to create their dialer chip in silicon, they used one PLA (Programmed Logic Array). (Callahan, Tr. at 635-636).

452. The first silicon dialer chip, which had one PLA, did not work properly because some of the circuitry in the multiplexer was not completely included. (Callahan, Tr. at 636).

453. The circuitry in the multiplexer that was not included was an improvement of block 58 in Figure 2 of the '886 patent. The improvement to block 58 had been done on a breadboard. (Callahan, Tr. at 638).

454. The improvement to block 58 of Figure 2 of the '886 patent that had been done to the breadboard had been completed by May 30, 1974. (Callahan, Tr. at 640-641).

455. The first version of the chip with the one PLA was done in approximately early 1975. (Callahan, Tr. at 641-642).

456. The use of an "arbitration circuit" is needed with the one PLA

embodiment shown in Figure 2 of the '886 patent. Figure 2 embodiment lacked gates. (Callahan, Tr. at 647-648).

457. An arbitration circuit is used when data is coming in from two paths and is trying to get to one path. The arbitration circuit ensures that the information on each path does not collide with that on the other path and distort it. (Callahan, Tr. at 649).

458. The one PLA design uses a multiplexer as shown in CX-3, Figs. 2 and 9. In the one PLA embodiment, data enters the PLA by means of multiplexer block 58 and shift register generator block 60. The sine wave information contained in the PLA is brought out and put into a latch (block 66) and then the data provided to a converter block 70 and delivered to the output. This would constitute a path for the column frequencies or the row frequencies. (Callahan, Tr. at 616).

459. Callahan thought that less silicon would be required if only one PLA was used. (Callahan, Tr. at 619).

460. If one PLA were used, a multiplexer is required to allow the proper signal input into the PLA -- first, the signal from the low group, and then from the high group but not allow both of them to enter the PLA at the same time. (Callahan, Tr. at 619-620, 630).

461. The breadboard design used the one PLA embodiment. (Callahan Tr. 634: 14-24). The first breadboard design had a design problem in the multiplexer. Changes were made and the breadboard was successfully tested. (Callahan, Tr. at 637).

462. The circuit changes that were made in the breadboard were not implemented in the first silicon prototype. (Callahan, Tr. at 636-637, 641, 644).

463. Charles Johnson replaced Charles Blair as the design engineer for the tone dialer circuit. The performance of Blair had been found by Bob Paluck to be inadequate. (Johnson, RPX-33 at 31).

464. Johnson was told that his new responsibilities were to be the design engineer for the tone dialer chip which was designated the MK 5085 chip which chip had derivatives MK 5084 and 5086. (Johnson, RPX-33 at 31).

465. Johnson's responsibilities were to understand "the problem that existed with the circuit at that time and to fix them." Paluck told Johnson that "certain elements of the circuit had not met the specification." Thus the circuit did not work. (Johnson, RPX-33 at 31, 32).

466. When Johnson took over his new responsibilities, silicon already had been obtained and tested. Johnson reviewed the test results of the silicon and found that the test results that had been conducted were not complete and that the results that had been conducted to date indicated several "significant" problems. (Johnson, RPX-33 at 33).

467. The first version Johnson tested contained the arbitration logic which logic had problems relative to synchronization between the two tones. Thus the tone output was distorted because there was a problem with the arbitration logic. (Johnson, RPX-27 at 68, 69).

468. The significant problems that Johnson found in the first silicon were that the counters did not count by the right divisors, the tone outputs that were generated were not within the frequency specifications, and occasionally the counters would not count at all and then no outputs from the tone output were obtained. (Johnson, RPX-33 at 33).

469. The reason for changing the design from a 1-PLA to a 2-PLA design was because of some performance problems with the 1-PLA design. Also the 2-

PLA design took less silicon to implement it than dial the 1-PLA design because the 1-PLA design had the complicated arbitration logic which took more space than an additional PLA. (Johnson, RPX-027 at 57, 58).

470. Johnson reviewed the arbitration logic with Bob Paluck and Mike Callahan during the same two of three months period in which the first silicon was tested. (Johnson, RPX-027 at 59).

471. With respect to going to the two PLA design rather than to keep the one PLA design with the arbitration circuitry the following is pertinent:

> A. We had from the previous layout the physical size required for the one-PLA design, including arbitration logic. I had the layout designer lay out the two-PLA approach, recognizing that the one-PLA approach still did not work correctly and the two-PLA design took less area than the one-PLA design on the previous version. And a decision was made that that two-PLA design was less area; therefore, we would implement that as opposed to fixing the one-PLA design.

(Johnson, RPX-27 at 59, 60).

472. Johnson made the decision to do the layout involving the two PLA design because in looking at the arbitration logic versus a PLA, it looked to Johnson to be roughly the same area. The source of the logic for the two PLA embodiment was the same as the one PLA design without the arbitration logic. (Johnson, RPX-27 at 61).

473. The 2-PLA design was adopted during the third quarter of 1975. Johnson remembered the MK5085 changing from the 1-PLA design to a 2-PLA design. (Johnson, RPX-027 at 45, 60).

474. A new schematic for the MK5085 with the two PLA design was drawn by a draftsman. (Johnson, RPX-027 at 61).

475. The redesigned activity on the MK5085 that Johnson was engaged in resulted in the removal of the arbitration circuitry and hence instead of the

arbitration circuitry, Johnson went to two PLA design on the chip. (Johnson, RPX-27 at 68).

476. Johnson did not determine what the problem was with the arbitration logic although the tone output was distorted in such a way that the circuit would not meet specification requirements and would not work. (Johnson, RPX-27 at 69).

477. Johnson did not test a specific distortion level because Johnson concluded there was a sufficient problem that a change needed to be made irregardless of what the specific distortion was. Johnson's conclusion was that the chip would not work. (Johnson, RPX-27 at 70).

478. Johnson talked with Bob Paluck and Mike Callahan about various solutions for the tone output problem. (Johnson RPX-27 at 70).

479. Callahan originally favored the one PLA design and he wanted to make sure that any alternative was given proper consideration. In analyzing the arbitration circuitry Johnson realized that a two PLA approach could solve the problem and use less silicon than the arbitration logic took. (Johnson, RPX-34 at 335).

480. It would not be obvious to most designers that the arbitration circuit would actually result in a larger circuit than would the use of a second PLA. (Johnson, RPX-34 at 336-337).

481. The multiplexer circuit in the '108 patent (Figure 9) was intended to ensure that the row group and the column group would not access the same row at the same time. (Callahan, Tr. at 619-620).

482. Boyce W. Jarrett is a field applications engineer and works for Information Storage. (Jarrett, RPX-35 at 4).

483. Jarrett stated that Johnson took over the project in May 1975 and started redesign. Jarrett remembered that Johnson fixed "those problems". Jarrett knows that Johnson understood what was wrong. Jarrett knew that Johnson internally "probed that part to determine what was wrong", and then observed that Johnson recreated the "defective logic externally to the part and effectively wire that into an actual die. And he made it work." (Jarrett, RPX-35 at 218, 219).

484. In April 1975, the first parts of the 5085/86 experienced a logic problem in which the high frequency counter divider chain was not operational and there were problems with the logic implementation of the keyboard. As a result, those first parts did not work right to generate a DTMF output signal. (Jarrett, RPX-35 216).

485. The first 5085 to be fabricated in silicon did not work and Jarrett observed the tests where it did not work. (Jarrett, SPX-2 at 39).

486. In the first 5085 to be fabricated the high frequency dividers did not work correctly and there were incorrect logic connections. As a result, the part was not functional. (Jarrett, SPX-2 at 40).

487. The chips initially fabricated by both AMI and TI experienced problems because of their designers' lack of knowledge of the telephony art, i.e., the need to increase the amplitude of the low frequency signal prior to transmission, and by how much. (Woodworth, SPX- 7, at 30).

488. The improvement in the multiplexer block that enabled the breadboard to work was not included in the silicon chip which had a single PLA. The bread board had a multiplexer block. The first silicon chip did not work because some of the circuitry of the multiplexer was not completely included. The improvement was made on or about May 30, 1974. (Callahan, Tr.

at 636-639, 840).

489. It still took about a year after the second silicon implementation was designed before commercially acceptable chips were produced. This was due to problems in integrated circuit silicon implementation, such as properly sizing the components on the chip and correcting errors in the integration itself. The integration of an integrated circuit onto silicon is a very lengthy and expensive process, whereby all the pieces of the circuit are condensed down onto one small chip. Any problems that are encountered in the implementation require a new design and new physical layout, which is a time consuming procedure. (Callahan, Tr. at 639-40).

490. The actual implementation of integrated circuitry onto a silicon chip requires a considerable amount of effort and time. In the case of the tone dialer chip, the first integrated circuit was not perfect and revisions were required. The second attempt required revisions as well, until silicon was produced that was suitable for commercial activity. (Callahan, Tr. at 597).

491. At the time the Callahan and Hoffman filled out their patent disclosure form, PNP bipolar transistor 594 could not be formed on the same CMOS integrated circuit chip with the rest of the tone dialer circuitry given the process technology that was then available. (Callahan, Tr. at 736-737; Magleby, RX-1 70Q).

492. [THERE IS NO FF 492]

493. In September 1975, an integrated circuit could not be fabricated in CMOS technology with functional NPN and PNP bipolar transistors on the same chip, with the use of what was then considered normal CMOS technology. (Kooi, RX-3 Q8; Tr. at 2441-2442; Callahan, Tr. at 680-681).

494. [THERE IS NO FF 494]

495. [THERE IS NO FF 495]

496. Any process which could be developed to make the PNP and NPN bipolar transistors of Figure 12 operative on a CMOS chip would be an extremely complex process and would require extensive experimentation. (Kooi, RX-3 Q11).

497. [THERE IS NO FF 497]

498. [THERE IS NO FF 498]

499. RX-60 shows that the field of the product in a process is dependent on the control of the process. (Kooi, RX-3 Q32-33).

500. There are two problems associated with placing a PNP transistor on the chip. One problem relates to the poor current driving capability such that it is inoperable in the circuit. The second problem relates to the fact that the base of the PNP transistor would be at a fixed voltage because it is connected to the collector circuit of the NPN transistors. (Magleby, Tr. at 3328:5-19).

501. The NPN bipolar transistors made on the MK5380 used the P-well as a base, and thus those transistors may be considered parasitic bipolar transistors present in the CMOS structure. (Kooi, RX-3 Q38-39).

502. It would be possible to fabricate NPN bipolar transistors as part of a P-well CMOS process, but such transistors are inferior in characteristics and in essence would be parasitic transistors. (Kooi, RX-3 Q15).

503. Parasitic bipolar transistors might be used as active devices when relatively poor performance would be acceptable. For example NPN parasitic bipolar transistors could be formed in a CMOS process where the N collector of the NPN transistor was the substrate, the P base was a P-well and the N

emitter of the NPN parasitic transistor was a source or drain diffusion in the P-well. (Kooi, TR-3 at 8).

504. One difference between bipolar transistors and CMOS transistors is that bipolar transistors need a specific isolation technique. (Magleby, Tr. at 3335).

505. Lateral bipolar transistors, as contrasted to vertical bipolar transistors, have a poor current drive capability. (Kooi, RX-3 Q8).

506. To make PNP transistor 594 as shown in the circuit Figure 12 of the '108 and '886 patents operative would demand several additional process steps to the CMOS technology. (Kooi, RX-3 Q10).

507. In bipolar integrated circuit technology, as known in 1975, isolation of transistors is achieved by forming additional PN junctions in the silicon chips. In CMOS technology, as known in 1975, such additional junctions, to be used for making isolated bipolar transistors, were not available. (Kooi, RX-3 Q8).

508. NPN parasitic bipolar transistors could be formed in a CMOS process wherein the N collector of the NPN transistor was the substrate, the P base was a P-well and the N emitter of the NPN parasitic transistor was a source or drain diffusion in the P-well. It is questionable whether such "parasitic" NPN bipolar transistors would be of sufficient quality to "handle the high current requirements for the common functions" as described in the '108 and '886 patents. (Kooi, RX-3 Q8).

509. CMOS circuits contain parasitic bipolar transistors due to the presence of a variety of P-type and N-type regions. In 1975 it was well known that the presence of these parasitic transistors could have an adverse, if not detrimental, effect on the performance of CMOS circuits. (Kooi, RX-3 Q8).

510. In a P-well CMOS process, PNP transistor 594 could only be fabricated as a lateral transistor with the emitter being the P-type source or drain diffusion, the base being the N type substrate and the collector being a P-well or another P type source or drain diffusion formed in the N type substrate. (Kooi, RX-3 Q8).

511. A difficulty arises to form the circuit in Figure 12 in the '108 patent with the PNP transistor 594 on chip along with the other transistors because the base of the PNP transistor would be the same material as the collector of the NPN transistors. (Magleby, Tr. at 3327).

512. Discrete PNP bipolar transistors are generally available. (Magleby, Tr. at 3336).

513. The circuit of Figure 12 can be implemented on a breadboard using a discrete element for transistor 594 since it would be completely isolated from the rest of the circuit. (Magleby, Tr. at 3327).

514. RX-135 discloses a need to include vertical bipolar NPN transistors in the MK5086 chip with a minimum beta of 60. (Kooi, RX-3 Q44).

515. No specific steps are shown in RX-106 to include or not to include bipolar transistors. (Kooi, RX-3 Q42).

516. The lateral PNP transistor will have its base tied to the voltage of the substrate and thus will be inoperative in the circuit shown in Fig. 12 and hence would not be formed on an integrated circuit chip along with the other transistors shown in Figure 12. (Kooi, RX-3 Q8).

517. The Mostek 5085 and 5086 tone dialer chips required the amplitudes of the high group and low group tone signals produced by the tone dialer chip to be different because of the different attenuation properties of the telephone line as a function of frequency. (Order No. 117, ¶ 3, Fact No. 36).

518. The fact that the high group signals and the low group signals, in the Mostek 5085 and 5086 tone dialer chips, were required to have different amplitudes because of the attenuation properties of the telephone line as a function of frequency was known at the time of filing the application for the '108 patent. (Order No. 117, ¶ 3).

519. Because the high group signals have a higher frequency than the low group signals in the Mostek 5085 and 5086 tone dialer chips, the high group signals would attenuate differently than the low group signals. (Order No. 117, ¶ 3).

520. The fact that the high group signals and the low group signals, in the Mostek 5085 and 5086 tone dialer chips, would attenuate differently was known at the time of filing the '108 patent application. (Order No. 117, ¶ 3, Fact No. 39).

521. In order to have a product capable of being produced in high volume, the product would have to be able to work with 100% of telephone systems loops which require that the high group and the low group tones be generated at different amplitudes. (Callahan, Tr. at 784).

522. There is no statement in the '108 and '886 patent specifications that the amplitude of a high group and a low group frequency have to be different in order to operate properly in the telephone system. (Callahan, Tr. at 779, 780-81).

523. Callahan had to learn that the amplitude of the high group has to be different than the amplitude of the low group. (Callahan, Tr. at 777).

524. A high frequency signal attenuates (dissipates) faster than a low frequency signal as it travels through a telephone line. Thus, the amplitude of a low frequency signal has to be increased prior to being combined with a

high frequency signal so that the combined signal (high and low frequency) will travel at the same speed through the telephone lines. (SPX-7, Woodworth Dep. Tr. 30).

525. [THERE IS NO FF 525]

526. Callahan testified that the difference in amplitudes is only important to a small percentage of users, but nevertheless it is a telephone company specification. (Callahan, Tr. at 782).

527. Inventor Callahan admitted that the difference in amplitudes is important because given the extremely high volume of telephone production, one must increase the amplitude of the low frequency group in order to meet the telephone company specification. (Callahan, Tr. at 786-787).

528. Some mask changes to accommodate processing parameter changes which were larger than anticipated were made to the masks for the MK5085. (Johnson, RPX-33 at 96).

529. The mask changes removed overlaps between the P-N junctions. (Johnson, RPX-33 at 96).

530. The MK5085 was the first CMOS chip produced at Mostek to function at a high voltage. (Johnson, RPX-33 at 97).

531. The masks were changed because the process parameter variations were not as well understood as they should have been, and to produce a chip that worked over wide ranges of process parameters. (Johnson, RPX-33 at 97).

532. Larry Arnold Woodworth is an electrical engineer employed at Natural Semiconductor as a field applications engineer. (Woodworth, SPX-9 at 25).

533. Woodworth testified:

Q Do you know when you joined GTE in March of 1976 if there had been any previous integrated circuits developed by

Mostek and delivered to GTE and tested there before your time?

A There may have been, but they did not work. Those were the original circuits that I had exposure to when I began my employment there. My original assignment was to work with Mostek, refine the problems -- I'm sorry -- define the problems -- and identify a solution -- what was necessary to make changes. It was a change on both parts. The tone dialer required changing internally, within the integrated circuit. The telephone required external adjustments, that is, external of the integrated circuit.

Q What is the nature of the problem?

A The problem was that there was not proper line level compensation relative to the variation of loop length of the telephone from the central office.

Q And how was that problem resolved?

A By electrical adjustments, compensation. Mostek implemented a feedback internally of the device, and it was a combination of that feed back and the external compensation which we applied that adjusted the levels to the proper perspective to meet the specific parameters required. That took place over approximately a year's period of time.

Q Did you say "a year's"?

A Yes. The refinement was somewhat lengthy because of the processes necessary to make adjustments in the original design, make mask changes, rebuild the integrated circuit. In the meantime, many, many tests were run relative to the adjustments, compensation.

Q Were you familiar with the internal design of the integrated circuit?

A Yes, pretty much so.

Q The adjustment internally to the integrated circuit, did it involve the tone output circuit?

A Yes. It was the output driver.

(Woodworth, SPX-7 at 25, 26).

534. The project to which Woodworth was assigned at GTE in 1976 was to adapt a tone generator designed by Mostek into a touch-tone system. The tone

dialer was to have been low enough in power that it could be powered by the telephone line. The telephone system had to adapt to various line changes. (Woodworth, SPX 7, at 20).

535. Woodworth's assignment was to define the problems and identify solutions or changes that had to be made both to the tone dialer internally, and the telephone. (Woodworth, SPX 7 at 25).

536. The problem was that there was not proper line compensation relative to the variation of loop length of the telephone lines from the central office. (Woodworth, SPX 7 at 25).

537. According to Woodworth, at the time he joined the project in 1976:

> Mostek knew very little about the telephone. We (GTE Automatic Electric) were suppose to be the experts on telephone internals, and it was a working relationship between us at GTE - - myself - - and various engineers - - chiefly one - - a Mr. Charles Johnson - -to refine the device, make the internal adjustments, such that the device would behave appropriately within the telephone.

(Woodworth SPX 7 at 20-21).

538. Correct and reliable circuit operation in the MK5085 depends on the minimum field threshold voltages of the P and N transistors (V_{TFP} and V_{TPN}). (RX-166).

539. The MK5086 has unusual processing, circuit design, and production requirements. (RX-135).

540. The MK5086 is not a typical random logic circuit that can be made to work the first time and then zip into production using standard process and techniques. (RX-135).

541. The MK5086 requires:

a) vertical NPN transistors (minimum β = 60);

b) special V_{TF} implant for operation above 10 volts;

c) matched low leakage P-well resistors; and

d) pinch resistors.

(RX 135).

542. Inventor Callahan, when the application Ser. No. 617, 955 was filed on September 29, 1975, was of the opinion that bipolar transistor 594 could not be found on the same integrated chip with the rest of the tone dialer circuitry using CMOS processing technology and he admitted that this fact is not stated in the '108 patent. (Callahan, Tr. at 734 to 736).

543. Building NPN transistor 588 of the '108 patent on a CMOS chip would be possible, but it would be a poor transistor. (Kooi, Tr. at 3324; CX-4).

544. PNP transistor 594 of the '108 patent would be an inferior transistor if it were to be built in P-well CMOS technology. Moreover, it would not be functional. If the PNP transistor 594 of Figure 12 were put on the same chip with the rest of the circuit of Figure 12, it would be impossible to make the circuit in a functional manner. (Kooi, Tr. at 3324; CX-4).

545. NPN transistor 604 of the '108 patent is a similar transistor to NPN transistor 588. It would have the same problems as transistor 588. (Kooi, Tr. at 3325; CX-4).

546. The specifications of the '108 and '886 patents do not disclose how to fabricate a chip having PNP transistor 594 and NPN transistor 588 and other NPN bypolar transistors on the same chip. (Callahan, Tr. at 650).

547. The specifications of the '108 and '886 patents do not disclose that the PNP transistor 594 shown in Figure 12 of the patents at issue could not be fabricated on a chip with NPN transistor 588 and the other NPN bypolar transistors shown in Fig. 12 of the '108 patent. (Callahan, Tr. at 734-736,

738; Kooi, RX-3 Q14).

548. Callahan knew prior to December 1973 that the PNP transistor could not be placed on the same circuit with a NPN transistor. (Callahan, Tr. at 736).

549. Callahan knew that Mostek was unable to fabricate it tone dialer chips with both of the two switching transistors on the chip at the time Serial No. 617,955 was filed on September 29, 1975. (Callahan, Tr. at 737).

550. Special isolation processing techniques and processing steps would have to be used to fabricate functional bipolar NPN and PNP transistors on the same chip. (Kooi, RX 3 at 9).

551. One of ordinary skill in the art during the relevant time period would not have known that PNP transistor 594 was not intended to be placed on the same chip because the specification of the '108 and '886 patents at issue would lead one to conclude that on-chip bipolar transistors performed all of the common switching functions. (Kooi, RX 3 at 19; Kooi, Tr. at 3336).

552. Complainant's expert Fair testified that in the preferred embodiment all the numbered devices in Figure 12 would be on the chip except for transmitter 584 and receiver 586. Hence Fair testified that the bipolar transistors 588 and 594 would be on the chip. (Tr. at 1416, 1417).

553. Inventor Callahan, who is neither an attorney nor a patent agent, testified that "we didn't craft a claim" for PNP bipolar transistor 594 to be on the chip. (Tr. at 754, 755).

554. In 1975 claim 1 of the '108 patent would cover the PNP bipolar transistor 594 on chip, the NPN bipolar transistor 588 on chip and the NPN bipolar transistor 604 on chip and Fair could have implemented this circuit at Bell Laboratories then because "we had the technology" which is the

"Twinwell" technology. The development of the "Twinwell" technology was under way in 1975. Fair testified that they "had a prototype process" running at Murrey Hill. The Twinwell technology was not available to anyone outside of Bell Labs. It was a trade secret to Bell Labs. The Twinwell technology was not comparable to any other technology generally used in the commercial industry to make CMOS devices. While Bell Labs was ahead in developing the Twinwell CMOS process, it was not necessarily ahead in developing single well processes. (Fair, Tr. at 1691 to 1693).

555. Twinwell CMOS technology was not in use in 1975. (Order No. 117, ¶ 3, Fact No. 15).

556. In or about 1982, Twinwell MOS processes were developed, which permitted the fabrication of functional PNP and NPN transistors on the same chip using CMOS technology. (Kooi, RX 3 at 10-11).

Q. Prior Art - '108 Patent

557. The Meacham patent, U.S. patent No. 3,064,084 filed December 16, 1959, issued November 13, 1962, ('084 Patent) (RX-324) is prior art to the '108 patent under 35 U.S.C. §102(b). (Order No. 117, ¶ 2, Fact No. 55).

558. The publication entitled "MOS Finds Way into Tone Keyer for Telephones," Electronics, July 11, 1974, p. 25, (Electronics) was published in July 1974. (Order No. 117, ¶ 2, Fact No. 58).

559. U.S. Patent No. 3,932,709 (Hoff '709 patent) issued on Jan. 13, 1976 on an application filed March 7, 1974 to Don G. Hoff and Patrick Young. (RX-359).

560. U.S. Patent No. 3,643,254 ('254 patent) issued on Feb. 15, 1972. on an application filed March 18, 1970 to Robert J. Proebsting. It is titled "Keybound Encoder System." (RX-370).

561. Jackson patent, U.S. Patent No. 3,525,819 filed April 9, 1968, issued August 25, 1970, (Jackson '819 patent) (RX-323) is prior art to the '108 patent under 35 U.S.C. §102(b). (Order No. 117, ¶ 2, Fact No. 54).

562. The Jackson '819 patent is titled "Electronic Common Switch For A Telephone Set." (CX-10).

563. The Thomas patent, U.S. patent No. 3,820,028 (RX-325) (Thomas '028 patent) filed April 9, 1973, issued June 25, 1974, is prior art to the '108 patent under 35 U.S.C. §102(b). (Order No. 117, ¶ 2, Fact No. 56).

564. U.S. Patent No. 3,938,090 issued Feb. 10, 1976, to Victor Scott Borison et al. It is based on an application filed Feb. 13, 1975, and is titled "Terminal Apparatus." (RX-327).

565. U.S. Patent No. 3,959,604 (the '604 patent) titled "Digital Calling Signal Tone Generating Circuitry "issued May 25, 1976 based in an application filed April 7, 1975 to Harley Monroe Newson et. al. (RX-322).

566. The Electronics reads:

> Suggesting a massive new market for MOS in telephones, engineers at Mostek Corp. are developing a telephone tone-keying module that could shave about half the cost from its electromechanical counterpart, the firm estimates. Instead of two coils with four windings each-which must be burned-in and tuned by hand-the Mostek approach uses an inexpensive, off-chip 3.58 megahertz crystal for reference, and divides down to obtain the audio frequencies standardized by the industry. On the chip, an op amp performs current-to-voltage conversion, as well as summing the two sine waves to get the tone pairs used. But besides the tone generator, the single C-MOS chip contains all the switching functions handled by the dual-contact, sliding-matrix keyboard now used, allowing touch pads of the calculator one-contact-per-key type.
>
> Despite the high frequency, the chip will operate at voltages down to 3 V, and it boasts a low-impedance buffer capable of driving telephone lines. Samples will be available this year, with production in 1975.

(CX-43).

567. Inventor Callahan testified that Electronics has subject matter of the invention of the '108 and '886 patents. (Callahan, Tr. at 846).

568. Callahan testified that Electronics did talk about a 3.58 megahertz crystal; that it did have an "op-amp" chip made out of CMOS; that it did attempt to use a calculator type keyboard; that it did contain switching functions handled by a dual contact sliding metrics keyboard; that it did have a low impedance buffer cable driving telephone line said to operate out of voltages at three volts; and that it did replace coils in a lot of the mechanical assembly of prior art telephones e.g. CPX-44. (Callahan, Tr. at 846, 847).

569. According to Magleby Electronics discloses that the CMOS chip allows "touch pads of the calculator one-contact-per-key type" to be used and teaches use of such keyboard to generate on chip a tone-pair and that the requirement to use such keyboard inherently requires on the chip a keyboard decode means for identifying the key selected. (Magleby, RX-1 49Q; CX-43).

570. The Meacham '084 patent is titled "Telephone Substation Apparatus." (CX-14).

571. According to Magleby the Electronics suggests combining the teachings of Meacham and the Electronics. (Magleby, RX-1 49Q).

572. The Meacham '084 patent shows a telephone communication system powered solely by telephone line inputs. (CX-14, Fig. 1, col. 4, lines 47-51; Magleby, RX-1 49Q).

573. The Proebsting '254 patent shows the generation of a common control signal "ANY KEY" (shown in Figure 1 and described in col. 3:75-4:2) responsive to the pushing of a button which generates the keyboard signal in the keyboard decode means of Claim 1 in the '108 patent. The control signal is sent off

the keyboard system encoder chip to peripheral equipment to activate the peripheral equipment in response to the pressing of the key. (Magleby, RX-1 49Q; RX-370; Magleby, Tr. at 2495-2496).

574. The "any key" control signal of Proebsting '254 works in essentially the same manner as the control signal that performs the common switching functions in the '108 patent. (Magleby, Tr. at 2496-2497).

575. There is no detail provided in Electronics of how the single CMOS chip will be designed or built to allow the single CMOS chip to contain all the switching functions handled allowing touch pads of the calculator one contact per key type. However there is an indication in Electronics that one wants to effectively get away from the sliding matrix keyboard and to allow touch pads of the calculator one contact per key type and implies that one wants to get away from the type of a keyboard shown in CPX-29. Electronics does not tell one how frequency dividing is done although such was will known in the art. (Magleby, Tr. at 2608-2610).

576. Electronics gives a motivation to make a combination of teachings in the prior art and, in combination with the prior art, enables one of ordinary skill in the art to make and practice the invention disclosed in the '108 patent. (Magleby, RX-1 52Q).

577. Referring to claim 4 of the '108 patent, Magleby testified:

> Jackson U.S. patent No. 3,525,819 shows structure for providing the common switching to disable to audio transmitter in a telephone. Jackson ... shows structure for providing common switching to disable an audio transmitter in a telephone. Jackson shows bipolar transistors for disabling the receiver and driving the transmitter. ....
>
> The use of field effect transistor to turn on and off a bipolar transistor by providing alternative low and high impedance paths between the collector and the base of the bipolar transistor is per se obvious (see e.g. Q4 in

Jackson's U.S. Patent 3,525,819). The equivalent function in Meacham's circuit is provided by switch 34.

> Meacham's resistor 83 acts as a bleeding resistor between the base and the emitter of the bipolar transistor 71.
>
> While no bleeding resistor across the base and the emitter of the transistor Q2 is shown in Jackson, Jackson is actually a more sophisticated structure which uses transistor Q1 connected with transistor Q2 in Darlington configuration to drive the transmitter. Transistor Q1 thus functions in a manner similar to a bleeding resistor. Accordingly, the use of a bleeding resistor as recited in this claim would be obvious to one of ordinary skill.

(Magleby, RX-1 at 64, 65, Q61).

578. The use of a bleeding resistor as recited in claim 4 of the '108 patent would be obvious to one of ordinary skill. (Magleby, RX-1 53Q).

579. Magleby testified as to claim 10 of the '108 patent:

A: Meacham teaches enabling the oscillator circuit (Meacham's col. 5, lines 34-38). U.S. Patent 3,820,028 [Thomas '028 patent] discloses a clock generator 72 in block form and discloses a crystal oscillator generating a signal having a frequency of 3.57 megahertz in combination with dividing circuitry and logic gates. The enablement of the clock generator optimizes at the appropriate times is taught by Meacham. See Exhibit RX-272 [col. 5 lines 31-33 of the Meacham '084 patent teaches enabling the oscillator during DTMF dialing]

(Magleby, RX-1, Q54, Q64).

580. Magleby testified as to claim 11 of the '108 patent:

A: The enablement of reference oscillator circuitry is disclosed in Meacham patent, col. 5, lines 31-38. Enabling the oscillator circuit is also disclosed in Jackson, at col. 1, lines 47-50. The use of a field effect transistor gated by the control signal and connected between a positive line voltage of the telephone line inputs and a first terminal of the reference oscillator circuit would be an obvious design choice.

(Magleby, RX-1, Q55, Q63).

581. Claim 11 is obvious in view of the prior art. (Magleby, RX-1 55Q).

582. Magleby testified as to claim 14 of the '108 patent:

A: Meacham shows switch 34 coupling the coils 61 and 62, which forms part of the signal generator, to the conductor L2, which is a power supply to the coils.

(Magleby, RX-1 Q56).

583. Claim 14 is obvious in view of the prior art. (Magleby, RX-1 56Q).

584. Magleby testified as to claim 15 of the '108 patent:

A: Meacham shows bipolar transistor 71 coupled between conductors L1 and L2 from the central office. Meacham's bipolar transistor 71 is driven at its base 72 by the signal generator comprising the coils 61 and 62, and related RLC circuits.

* * *

A: The use of telephone input lines for power supply is taught in numerous references (Meacham teaches the powering of a multifrequency push button calling system from the telephone line and also teaches common switching functions being implemented when a key is pressed). The use of bipolar transistors connected between the power supply and the system output and with the base driven by a signal generator for common switching is disclosed in Jackson. Moreover, using telephone input lines for a power supply is part of the specification for a telephone circuitry required at the time by the telephone company. (Jarrett, page 78, lines 10 to 13).

(Magleby, RX-1 Q57, Q65).

585. Claim 15 is obvious in view of the prior art. (Magleby, RX-1 57Q).

586. Magleby testified as to the basis for his opinion that claim 16 of the '108 patent is obvious:

A: The use of a plurality of single-pole single-throw switches for the keyboard is disclosed in a number of papers including for example the July 11, 1974 Electronics article and an article by Cowpland et al. entitled "Microcircuits For An All Electric Telephone", International Electrical Electronics Conference And Exposition Digest, October 1-3, 1973, pages 134-135.... Since these articles all concern the electrical components of a subscriber telephone, for the same reason stated above with respect to Claim 1, it would be obvious to one of ordinary skill to combine their teachings in an integrated circuit implementation.

(Magleby, RX-1, Q58, Q66).

587. Magleby testified as to how, in his opinion, claim 1 of the '108

patent is obvious in view of the Thomas '028 patent and Electronics as follows:

> A: Yes. U.S. Patent [Thomas] 3,820,028 ... discloses a digital tone signal generator for use in a telephone application and discloses the use of a multiple frequency signal generator on a complementary symmetry, metal oxide, semiconductor integrated circuit chip (see col. 9, lines 6-10) for digitally synthesizing a dual-tone sinusoidal representative signal of a selected key on a keyboard. As stated by Mr. Jarrett in his deposition, the telephone company specifications require integrated circuits of this type to be powered by the telephone line power. This was a system requirement (Jarrett, page 78:10-13)
>
> Decode logic 7 and 8 is shown on chip in Fig. 1 of the Thomas Patent. This decode logic generates a keyboard signal representative of the selected key. Decode logic 7 and 8 generate output signals which are used to control counters which generate a high frequency and a low frequency signal representative of the selected key (col. 3, line 40 to col. 4, line 29).
>
> ... Proebsting U.S. Patent 3,643,254 generates at the bottom of column 3, top of column 4 an ANY KEY SIGNAL which is in fact a control signal responsive to the pressing of a key on a keyboard and is a control signal which is sent off the keyboard system encoder chip to peripheral equipment to activate the peripheral equipment in response to the pressing of the key. This is shown in Fig. 1 of the '254 patent to Proebsting.
>
> While Thomas does not disclose common switching means on the chip of the type called for in this element of Claim 1, the Electronics Article discloses a telephone tone key module that uses a single CMOS chip which "contains all the switching functions handled by the dual-contact, sliding-matrix keyboard now used, allowing touch pads of the calculator one contact per key type." As stated by Callahan, this article refers to the 5085/5086 product (Callahan, page 204:3-12). The use of the ANY KEY SIGNAL of Proebsting to drive the common switching means on the chip would be obvious in view of the Electronics Article ... The trend towards higher level of integration, i.e. providing more electronic circuits on chip, was evident at the time of the '108 patent's earliest filing date (see, for example, "Metal Semiconductor Technology," Scientific American, August 1973, pp. 48-57) (Hoffman Depo., p. 74:22-75:2). Thus, since Thomas teaches placing the tone generation circuit of a subscriber telephone on an integrated circuit, ... and Electronics article suggest

> providing both the common switching functions and the tone generation on chip, it would be obvious to combine the teaching of Thomas with the teaching of ... the <u>Electronics</u> article.

(Magleby, RX-1, Q60).

588. It would be obvious to combine the teaching of Thomas with the teaching of or the <u>Electronics</u> article (RX-49). (Magleby, RX-1 60Q).

589. Magleby is of the opinion that claim 14 of the '108 patent is obvious in view of the prior art including the Thomas '028 patent. Thus he testified:

> A: Thomas discloses the generation of a dual tone multifrequency signal in response to the pressing of a key. The pressing of the key can be considered the generation of the control signal. See Thomas, col. 8, line 57 to col. 9, line 10. Note that Thomas teaches that the logic gates and circuitry in Fig. 1 "can be implemented by field effect transistors in an integrated circuit."

(Magleby, RX-1, Q64).

590. The Jackson '819 patent shows how to build an electronic switch. (Magleby, Tr. at 2470).

591. The Meacham '084 patent (RX-324) teaches a mechanical type of keyboard and electronic elements to perform the generation of DTMF signals. (Magleby, Tr. at 2492).

592. The Jackson '819 patent (RX-323) shows an electronic implementation of the common switching functions. (Magleby 2497-2498).

R. <u>Prior Art - '886 Patent</u>

593. U.S. patent 3,831,015 issued to Hoff (Hoff '015 patent) applied for on June 8, 1972, issued on August 20, 1974, is prior art to the '886 patent. (Order No. 117, ¶ 4, Fact No. 13).

594. Hoff named on the '015 patent is the Marcian E. Hoff Jr. who testified at this hearing as an expert for UMC. The '015 patent is titled

"System For Generating A Multiplicity of Frequencies From a Single Reference Frequency". (CX-504).

595. Magleby is of the opinion that the Hoff '015 patent anticipates each of claims 6, 7, 8, 9, 13 and 14 for the following reasons:

> Hoff '015 describes a circuit for generating multiple sinusoidal signals, thereby permitting distinct pairs of tones corresponding to keyboard positions to be produced on output lead 63. Col. 5, lines 55-59. ...
>
> Hoff discloses a keyboard means with keys that generate pulses representative of the keys being depressed. Col. 5, lines 65-67 and Col. 6, lines 1-12. Fig. 4.
>
> Hoff '015 discloses a reference means 10 for generating a reference frequency signal. Col. 2, lines 1-3. Fig. 1. Hoff '015 further discloses a crystal oscillator 50 which provides a reference frequency f_c. Col. 6, lines 13-15. Fig. 4.
>
> Hoff '015 discloses a divider 51, which divides the output from the crystal oscillator 50, a timing decoder 52, and a storage means 53 to determine which position of keyboard 64 is selected. Frequency ROM 54, Memory 56 and Adder 57 effectively function as a divider. Col. 6, lines 13015, lines 18-23; Fig. 4.
>
> Hoff '015 discloses a read only space memory (ROM) 17 for generating a sinusoidal waveform in response to a digital signal. col. 2, lines 24-53. Fig. 1. <u>The '886 patent teaches the equivalence of a ROM to a PLA Col. 19, lines 20-26 and Col. 20, lines 22-23</u>. Hoff '015 further discloses a sine table read only memory 59 which generates a sinusoidal waveform in response to a digital signal. Col. 6, lines 66-67 through Col. 7, lines 1-8. Fig. 4
>
> Hoff '015 discloses conversion means for converting digitally coded signals to an analog dual tone multifrequency signal representative of the selected key. Hoff '015 teaches that the output from the ROM 17 is coupled to a digital to analog converter 18 which converts the digital output signals from the ROM 17 to an analog form. Col. 2, lines 51-53. Fig. 1; Hoff '015 further teaches that the output of ROM 59, added by adder 60 and passed through register 61, is converted to an analog signal by converter 62. Col. 7, lines 42-49. Fig. 4. [Emphasis added]

(Magleby, RX-1 Q93).

596. Under the subheading "Summary of the Invention," the Hoff '015 patent discloses that the invention describes a system for digitally

generating a multiplicity of frequencies from a single reference. (CX-509, col. 1, lines 30-32).

597. FIG. 4 is a block diagram of a touch tone dialer which embodies the concept of the "present" invention and which is used to generate two sinusoidal functions. (CX-504 col. 1, lines 63-65).

598. The Hoff '015 patent does not tell one whether it is tones or pulses that are being sent to the keyboard. When asked whether the '105 patent is ambiguous as to whether it is scanned with tones or pulses, Magleby testified that the '015 patent simply says that a technique was being used that was well known in the arts. (Magleby, Tr. at 2701).

599. The Hoff '015 patent does not give a description of exactly how the keyboard is scanned. It merely states: "Frequency selector 13 may comprise any means for selecting a signal frequency or a plurality of frequencies for example, frequency selector 13 may comprise an ordinary keyboard such as the keyboards utilized on push bottom telephones or the keyboard associated with a musical instrument". (Magleby, Tr. at 2703).

600. Magleby, with respect to the use of pulses in the divide down means clause of claims 6 and 9 testified that while in deposition he testified that the Hoff '015 patent does not literally meet that means to the extent that Hoff '015 patent uses tones rather than pulses, he was testifying in deposition in the event that claim 6 was interpreted to be to a two tone generator rather than to a single frequency generator and that such deposition testimony has no bearing on the operations of FIG. 1 of the Hoff '015 patent. (Magleby, Tr. at 2680 to 2682).

601. [THERE IS NO FF 601]

602. The output waveform of the Thomas '028 patent (RX-325) is very

crude and requires external filtering. The '028 patent has only a two-bit DAC equivalent and it does not have any kind of memory means at all. The sine wave outputs are summed off chip. A regulation of tones is not provided for in any manner, and the reference oscillator oscillates all the time. There is no control function to do any of the common functions necessary and the patent does not have pulses representative of keys. (Callahan, CRX-112 at 15-16; RX-325).

603. Single tone signal generators are known in the art. For example, the article "Pipe Organ goes Digital" page 79, Electronics, May 24, 1971, describes an Allen/NRMEC digital organ electronic organ jointly designed by Allen Organ Co. and North American Rockwell Microelectronics Co. Another article, "How does an organ maker go LSI?" page 72, Electronics, April 26, 1973 describes an electronic organ jointly designed by the Hammond Organ Co., AMI, and Mostek. RX-365; RX-367). Magleby admitted that the April 26, 1973, article does not give many details of the design (Magleby, RX1C at 5). Magleby also admitted that the keyboard scanner used in the Allen/NRMEC electronic organ is not described in detail but stated that the "use of a keyboard of the type described in the Hoff '709 patent which satisfies this limitation, would be an obvious design choice at the time of the design of this product." (Magleby, RX1C at 3). As earlier found in this initial determination the Hoff '709 patent is not prior art.

604. The memory configuration in Hoff is not equivalent to the PLA embodiments disclosed in the '886 patent. Magleby had to rely on the '886 disclosure for his position that a ROM is equivalent to a PLA. Thomas '028 does not disclose memory means at all. Therefore, assuming the memory means in Hoff could be incorporated into Thomas, it still does not disclose the PLA

embodiment of the '886 patent. (Callahan, CRX-112 at 10-12, 15, 16; RX-321; RX-325).

IC Guide

605. The IC Guide has a 1974 copyright date and the date "August 1974" printed on its spine. (CX-40; RX-164).

606. RX-164 is a copy of the IC Guide bearing the Bates Stamp numbers UTC 010308-010450. (RX-164).

607. Harvey Berryman Cash was a founder of Mostek and worked at Mostek from July 1969 through September 1981. (Cash, CPX-64 at 4-5).

608. Throughout his period of employment at Mostek, Cash was responsible for sales and marketing, and for the first five years of his employment at Mostek he was responsible for the design engineering function. (Cash, CPX-64 at 5).

609. In deposition Cash defined the term "data book" as "[p]rimarilly a compilation of data sheets," and stated that an "Integrated Circuit Guide" is what was internally called at Mostek a "data book." (Cash, CPX-64 at 19, 22).

610. Cash testified that data sheets are generally published previous to being included in a data book, but that sometimes they were in the data books as they were made available, just in time to be included in the data books. (Cash, CPX-64 at 26).

611. Cash testified that publication of data books was often delayed in order to include the most current data sheet. (Cash, CPX-64 at 26).

612. Cash testified that there were problems with "one of" Mostek's data books, but could not specifically recall which one it was, stating

> ...there were so many delays in trying to put it together that we never printed very many of them. And it may well be this one. But I don't have a specific recollection of -- on this data book of when it was published or how many.

* * *

This particular year -- the pressure to get the data book out was more often to have it available at the sales meeting, and I don't think we had a sales meeting this year, so we did not have the pressure of trying to meet a specific date.

Q. Just so the record is clear, do you know if this data book was the data book that was delayed?

A. I'm not sure. But I do know that in all the data books after this -- starting in 1975, we had a sales meeting. And that sales meeting was sort of a demand date for a data book. And so since we didn't have a sales meeting this year, my conjecture would be that we didn't have that pressure; and therefore, this may well have been the one that was delayed, yes.

Q. But you don't have personal knowledge of that, right?

A. I don't have specific, oh-yeah-this-is-it knowledge, but I suspect that it was.

(Cash, CPX-64 at 35, 36-37).

613. Cash does not recall an occasion prior to 1975 when Mostek's sales representatives and manufacturer representatives gathered in one room to talk about sales. (Cash, CPX-64 at 38).

614. With respect to the accuracy of the date on the spine of a Mostek data book, Cash testified as follows:

The dates on there -- usually that was the date we started working on the book, and when it finally got out it was already obsolete oftentimes by the time it got printed -- obsolete, old. So the dates on there I always contended were meaningless; and later on, we just put a year -- rather than a specific month.

* * *

BY MR. KWOK:

Q. You testified that the date on the spine of the product guide tends to be the date on which the data book -- the work on the data book began. Do you remember that testimony?

A. It tends to be the date that we hoped to publish it. But as I said earlier, oftentimes, that date got pushed back, and yet the date wasn't changed. So sometimes the books would come out, and we wouldn't get them printed until after -- a date much later than that. So it would look like it was already an old book.

Q. Do you have personal information -- do you have personal knowledge as to the publication date of this particular data book?

A. I don't recall specifically when it was published, no.

(Cash, CPX-64 at 49, 50-51).

615. CRX-107A is Mostek's 1975 Integrated Circuit Guide. No date appears on the spine of CRX-107A, however, a copyright date of 1975 is shown on page 138. (CRX-107A at 138).

616. Donald Ward, reporting directly to Cash, was in charge of Marketing Communications at Mostek. (Cash, CPX-64 at 27; Gaspard, Tr. at 3032).

617. The Marketing Communications Department was in charge of publishing Mostek's data books. (Cash, CPX-64 at 27).

618. Regarding the regularity of Mostek's publication of its Integrated Circuit Guides, Cash testified as follows:

BY MR. KWOK:

Q. How often are they published?

MR. COHLER: During what period of time, please?

Q. During the period of time between, say, 1969 and 1975?

A. In the early years, they were not published on a regular basis; and in the later years, we tried to do it every fall.

MR. COHLER: Do you mind a little clarification? Later years during his employment up to '81? Is that what he meant?

THE WITNESS: Yes.

* * *

Q. Do you recall when the transition from not on a regular basis to every fall (sic)?

A. Not specifically, no.

(Cash, CPX-64 at 20).

619. The fall season was chosen for publication of the data books because Mostek had an annual sales meeting in the fall and Mostek tried to have the data books available at the time of the sales meeting. (Cash, CPX-64 at 21; Gaspard, Tr. at 3042-43).

620. Cash testified that the annual sales meeting was usually held in September or October. (Cash, CPX-64 at 21).

621. Cash testified that participants in trade shows in the United States were not supposed to sell or solicit sales out of their booths, and that he viewed participation in the trade shows as an expense Mostek did not need to incur. (Cash, CPX-64 at 42).

622. Cash testified that Mostek did attend some trade shows, but was unable to remember the specifics of which ones and which years, and testified that Mostek limited its participation in the trade shows, stating:

> Q. How did the sales people justify the expense?
>
> A. They typically would go to a show and there would be customers and they would meet with them. But in my view they didn't have to have -- we didn't have to have a booth. And oftentimes, we would go and have a hospitality suite so they could meet with the customers. But a booth and lavish product descriptions and stuff, I viewed as a waste.
>
> Q. Have you given any directions to the sales force as to your opinion about -- that trade shows were a waste?
>
> A. I did, and we limited them. We didn't go in a big way -- nearly as in a big way as many of our competitors did.

(Cash, CPX-64 at 43).

623. Gaspard testified that he moved from Texas Instruments to Corvus Corporation (Corvus), a consumer product subsidiary of Mostek, in November of 1973. (Gaspard, Tr. at 2972, 2974).

624. Gaspard testified that for the first six months of his employment, Corvus was physically located on the Mostek campus until Corvus moved off-

site sometime in the spring of 1974. (Gaspard, Tr. at 2973-74).

625. Gaspard testified that for the first year and a half to two years, the focus of his activities was on Corvus. (Gaspard, Tr. at 2972-73).

626. Gaspard was unsure when he moved from Corvus to Mostek, but felt that it was in late 1975 of in early 1976, stating that "I don't think it was in 1974 because we were strong in Corvus consumer products at least for a year and a half to two years before we started losing money." (Gaspard, 2975-76, 2979).

627. Based on personal knowledge and recollection, Gaspard does not know when the IC Guide was distributed to the public. (Gaspard, Tr. at 3029). Gaspard testified that the first Integrated Circuit Guide he personally worked on was 1975, or more probably 1976. (Gaspard, Tr. at 3032).

628. Gaspard does not recall a sales meeting in 1974. (Gaspard, Tr. at 3035).

629. Gaspard testified that the consumer electronics show, a large trade show held every summer in Chicago, which he attended on behalf of Corvus in 1975 and 1975, were the first trade shows he recalls attending. (Gaspard, Tr. at 3042).

630. Mostek did not have a national sales meeting in 1974. (CX-494 at 1; Cash, CPX-64 at 36).

631. With respect to the regularity of Mostek's publication of its Integrated Circuit Guides, Gaspard testified as follows:

> Q Now, while you were in charge of trade shows during your tenure at Mostek, did Mostek produce IC guides every year?
>
> A During my tenure at --
>
> Q At Mostek.
>
> A -- at Mostek? I don't know of any years when they didn't

produce one. I know in the years from '76 on -- well, '74 is here. I don't know anything prior to '73. I mean there may have been one. I'm sure there was, but I can't say without further investigation.

Q Okay. From '73 on, Mostek would have at least one IC guide like [RX] 164 out every year?

A Yes, sir.

(Gaspard, Tr. at 3012) (Emphasis added).

632. Gaspard could not testify from personal knowledge as to the pre-1976 practice of Mostek with respect to publication of Integrated Circuit Guides relative to the fall trade shows. Thus he testified:

Q And during the course of your employment at Corvus and Mostek, it was a goal, wasn't it, to get the IC guide out before those Fall trade shows?

A Yes, sir, in '76 and '77 and '78.

Q And before that, too, isn't that correct?

A Yes, yes. Well, again, I don't know. '76 for sure.

Q Well, the trade shows took place --

A The reason I'm being very cautious here is that I want to make sure I'm giving the correct answer.

* * *

BY MR. GRECO:

Q But prior to '76 the WESCON trade shows were taking place, weren't they?

A Yes, sir.

Q And prior to '76 Mostek still wanted to get the IC guides out before the Fall trade show; didn't they?

A I think that's an assumption you could probably make.

Q Is it a good assumption?

A I guess its a good assumption.

JUDGE LUCKERN: I guess? I don't like to have you guess, you know.

THE WITNESS: I'd rather not say. I mean, it's a fair assumption.

(Gaspard, Tr. at 3014-15)

633. From 1969 to 1981, Mostek sold its products through both its direct sales organization and through manufacture's representatives. (Cash, CPX-64 at 13).

634. The 1974 Western Electronic Show and Convention (WESCON) took place at the Los Angeles Convention Center in Los Angeles, California, between September 10 and 13, 1974. (CRX-111; RX-401; RX-402).

635. CRX-111 is the official program of the 1974 WESCON trade show. (CRX-111).

636. The "Quick Exhibit Guide" section of CRX-111 provides alphabetical listings of all exhibitors at the 1974 WESCON trade show, referenced by product category and location on the show floor. (CRX-111 at B1).

637. The "Exhibit Directory" section of CRX-111 provides an alphabetical list of all exhibitors at the 1974 WESCON trade show, as well as lists of the products exhibited by each. (CRX-111 at 40).

638. Neither Mostek nor Corvus is listed in the "Quick Exhibit Guide" or the "Exhibit Directory" sections of CRX-111 as having been an exhibitor at the 1974 WESCON trade show. (CRX-111 at B1, 40-72; Gaspard, Tr. at 3045-46).

639. Regarding the possibility that Mostek representatives attended the 1974 WESCON trade show, Gaspard testified as follows:

Q And obviously there were a lot of people who go to trade shows who aren't exhibitors; is that right?

A Yes, Sir.

Q Now, have you looked through this entire document [CRX-111] to satisfy yourself that no one who had any connection with Mostek was at that trade show?

A No, sir, I haven't.

Q Okay. So when you answered Mr. Pritiken's question that Mostek didn't exhibit there, you didn't think that there might be someone affiliated with Mostek who is exhibiting there; is that correct?

A That's correct. That was not the question so I didn't answer it that way.

Q So its conceivable, isn't it, that there's a Mostek representative listed in here; is that right?

A Yes, sir, it's conceivable.

Q And sometimes sales representatives work for more than one company, don't they?

A Yes, sir.

Q Now, even if Mostek didn't actually exhibit at a trade show, wouldn't sales representatives go to that trade show also?

A Yes, sir.

Q So just because there's no mention of a Mostek representative in here, if there isn't, that doesn't mean that there weren't Mostek representatives at that trade show; correct?

A That's correct.

Q And, of course, Mostek knew back in 1974 that the representatives were going to the trade shows, didn't they.

A I assume that's correct.

Q And I assume that you also would agree that trade shows are good place for representatives to talk about the products they represent even if there is no exhibit there; is that correct?

A I assume that's correct.

Q So Mostek would have known back in the seventies that having the IC circuit guide out for the representatives would have been beneficial even if there were no exhibits; correct?

A That's possible.

(Gaspard, Tr. at 3051-52).

640. The MK 5085 was listed in the IC Guide as a product to be

announced. (RX-164 at 139; CX-40 at 139; Paluck, RPX-36 at 182).

641. Magleby acknowledged that the figure shown on page 139 of IC Guide, directed towards the MK5085 "new product to be announced," is not enabling. (Magleby, Tr. at 2674-75; CX-40).

642. The IC Guide does not show how to drive the telephone line. Without the necessary drive capacity, dialing cannot be done. (Callahan, CRX-112, Exh. A at 3).

643. The IC Guide lacks any teachings as to how the telephone tone generator might be made to operate from the telephone lines. (Callahan, CRX-112, Exh. A at 3-4).

644. Modulation of the circuit power supply with the DTMF dialing tones instead of regulating the circuit power supply created the need to regulate the output tones. The IC Guide shows no information as to how to accomplish this. (Callahan, CRX-112, Exh. A at 4).

645. The IC Guide packs any specific teaching of how an integrated circuit might operate in a telephone system. Power considerations dictated that integrated circuits, such as the reference oscillator circuitry, not operate continuously. Power consumption had to be kept low. (Callahan, CRX-112, Exh. A at 4).

646. With respect to the common switching functions the IC Guide does not show how the desired telephone tone generator interfaces with the telephone. It does not show how the oscillator circuitry is powered up at the desired times or how the tone generator circuitry is cut out during non-dialing times. It does not show how the circuit controls the earpiece (receiver) and mouth piece (transmitter) of the telephone so as to not interfere with dialing. (Callahan, CRX-112, Exh. A at 4-5).

647. The IC Guide lacks any teaching of the central control signal. It does not show how it is generated nor how it is communicated to control the necessary common switching functions. The IC Guide does not even mention any such control signals. (Callahan, CRX-112, Exh. A at 5).

S. Inequitable Conduct

648. RX-316 is a Rockwell product bulletin of a product called the NR10198. This contains preliminary type of information which on some occasions may be sent out in advance of actually selling a chip. This is not a data sheet for the NR10198, as data sheets typically have specifications, tables of minimums and maximum electrical parameters, and performance parameters. The product referenced in the Mostek patent disclosure form (CX-30) is strictly a data sheet. Callahan is uncertain as to whether the data sheet and the product bulletin are the same because the data sheet cannot be found. The data sheet would have information like what exits in RX316 plus more. (Callahan, Tr. 80-8-12, CX-30; RX-316).

649. The North American Rockwell product data sheets which are of NR10198 and Electronics were not produced to the Examiner. (CX-6, CX-7, CX-8).

650. The Background of the Invention paraphrases the nine page "5085 Patent Disclosure" (ST50439-47), which is a separate document from the two-page "Mostek Patent Disclosure Form" (ST 50437-38). Mr. Thurman, who was primarily responsible for prosecuting the '886 application, recalls reviewing the separate nine-page disclosure, but both Thurman and Mr. Hubbard deny ever seeing the two-page "Mostek Patent Disclosure Form." (CX-30, Thurman CRX-79 at 16, 127 Hubbard CRX-77 at 72, 73).

651. Thurman recalled using the nine-page "5085 Patent Disclosure" (CX-

30 at ST 50439-47) to prepare the '886 patent application. (Thurman CRX-79 at 16 and RPX-21 at 16, 37, 38).

652. Inventor Callahan does not know why Electronics was not called to the attention of the PTO during the prosecution of the applications which matured into both the '108 and '886 patents. (Callahan, Tr. at 793).

653. Magleby testified that Electronics pointed out the telephone tone key module which was intended to replace its electromechanical counterpart. (Magleby, 2456-2457).

654. Thurman wrote the written material in the application which eventually became the '886 patent (CX-6) with the exception of the oath, power of attorney, and petition and drawings. Hubbard may have provided some assertance. (Thurman, RPX-021 at 30-31; 96; 99).

655. Thurman generated the final version of the '886 patent application, including the specification, claims and drawings. (Thurman, RPX-21 at 37).

656. Figure 2 of the "5085 Patent Disclosure" corresponds to Figure 2 in the '886 patent application. However, Figure 2 of the "5085 Patent Disclosure" has additional details not included in Figure 2 of the '886 patent application. (Thurman, RPX-21 at 38-39).

657. In preparing the material contained in Figures 3-12 of the '886 patent application, Thurman received information concerning the operation of these figures from the inventors. (Thurman, RPX-21 at 39-40).

658. Thurman reviewed certain patent sketch forms in RX 46 (ST 02354-58) during his preparation of the '886 patent application. (Thurman, RPX-21 at 42).

659. Thurman does not recall seeing patent disclosure form of RX 46 (ST 02367-68) at any time during the preparation of the patent applications that

resulted in the '886 and '108 patents. He testified that just about all of the information on the form would be of interest in preparing a patent application. Thurman does not recall asking for information of this type. (Thurman, RPX-21 at 43-45).

660. The inventors of the '108 and '886 patents answered "yes" on the patent disclosure form to the question "Has any of the subject matter of this invention been described in any publications, proposed or report, or is such a publications, proposal or report, or is such as publications, proposal or report anticipated?" Also when asked on the patent disclosure form to "identify and we date", they identified <u>Electronics</u> page of "5085 Patent Disclosure" has the subheading "<u>Reference</u>" and recites thereafter "NR 10198 Data Sheet, North American Rockwell Microelectronics Company, Anaheim, California" (SX-50445) (CX-30).

661. Thurman does not recall seeing Hoffman or Callahan's engineering notebooks. He does not recall Hoffman and/or Callahan calling prior art to his attention. He does not recall looking at, receiving, discussing, or asking to see the prior art listed in the 5085 patent disclosure form (RX 46, ST 02375). Thurman's belief based on his general practice would be to have discussions with inventors about prior art references. (Thurman, RPX-21 at 46-47, 130).

662. Thurman does not recall seeing the North American Rockwell Product bulletin (RX-316, RX-317) or any similar document. He does not recall any discussion of a North American Rockwell tone dialer product. (Thurman, RPX-21 Tr. at 47-48).

663. Prior to preparation for this investigation, Thurman does not recall seeing the <u>Electronics</u>, RX-49. (Thurman, RPX-21 at 48).

664. Thurman prepared a transmittal sheet for the application which eventually became the '886 patent. (RPX-021 at 22).

665. Thurman prepared the amendment to the application which eventually became the '886 patent. (RPX-021 at 24-25).

666. Thurman prepared the documents disclosing the list of prior art to the patent office (CX-6). (RPX-021 at 26-27, 28).

667. Thurman recalls meeting with Hoffman and/or Callahan in connection with the '886 patent application. (RPX-021 Tr. at 31-32).

668. Thurman does not remember if there came a time during the prosecution of the application that matured into the '886 patent when he ceased working on the application. Figure 1 of the application which eventually became the '886 patent (CX-6) was first disclosed to Thurman in a meeting with at least one of the inventors. (RPX-021 at 81-82).

669. Thurman had authority to contact Hoffman and Callahan directly by phone during the application for the '886 patent. (RPX-021 Tr. at 88-89).

670. Thurman discussed the program logic array with one of the inventors. (Thurman, RPX-21 at 106).

671. According to Magleby the block diagram of the 5085 on page 139 of the August 1974 Integrated Circuit Guide (RX-164) for Mostek is identical to the block diagram of Figure 1 in both the 108 and 886 patents. However, the Guide discloses the use of ROMs. PLAs are disclosed in the '108 and '886 patents. (Magleby at Tr. at 2488-2489; RX-169, RX-171).

672. The Mostek August 1974 Integrated Circuit Guide (RX-164) was not called to the attention of the U.S. Patent and Trademark Office. (Magleby, Tr. 2489).

673. According to Magleby all the elements of claim 1 of the '108 patent

were in fact contained in the August 1974 Mostek IC guide or Electronics. (Magleby 2490-2492).

T. Infringement of the '886 Patent Involving UMC

674. UMC has not been accused of directly infringing the '886 patent. It has only been accused of contributorily infringing and infringing by inducement the claims in issue of the '886 patent. HMC has not been accused of infringing the '886 patent. (ALJ Ex. 1).

675. The UM 95087 tone dialer of UMC is comprised of a reference oscillator, two divide-by-four circuits, a counter for the row and a counter for the column, each of which receives signals from the keyboard logic representative of the column and row of the selected key, respectively. (Magleby, RX 1 at 81).

676. The UM 95087 of UMC is a dual-tone multiple frequency generator. (CX 75 at 3-10; CX 455A-B; Fair CX 503 at 111-112).

677. One of the contemplated uses for the MK 5085/5086, MK 5087, and MK 5089 tone dialer chips is in microprocessors, which do not require the use of a keyboard because they can enter the data electronically. (Callahan, Tr. at 763-64, 771-72 Fair, Tr. at 1706-08, 1744 CX 465).

678. The MK 5087 is designed specifically for both electrical and keyboard selection at the user's discretion. Since the UM 95087 of UMC is a direct substitute for the MK 5087, the UM 95087 therefore also is not limited to use with a keyboard to dial a telephone number. (Fair, Tr. at 1706-08; CX-464 at ST 02919).

679. Since the circuitry of the UM 95087 of UMC is essentially identical to that of the MK 5087 (which does not need a keyboard) the UM 95087 also does not need a keyboard. (Fair, Tr. 1708-09; CX-35, p. 129; CX-464, Fig. 2).

Tone dialers can be used as part of a credit verification system which automatically dials a computer when the credit card is "slid" through the slot. (Callahan, Tr. at 766; Magleby, Tr. at 2391).

680. The TI (Texas Instruments, Inc.) model TCM 5087 dialer chip is essentially identical to the MK 5087 dialer chip. (CX- 503, Fair, at 103-106).

681. The TI TCM 5087 can be dialed manually through the use of a keyboard and electrically. (Magleby, Tr. at 2739; CX-37A, at 2-169).

682. The diagram in UMC's product brochure for the UM 95087 shows that it may be electrically accessed as well as manually accessed. (Compare CX 464, Fig. 2 (MK 5087) with CX-35, p. 129).

683. The figures on page 3-13 of the UMC catalog (CX-75) expressly show that the UM 95087 may be used with or without a keyboard. (CX-75 at 3-13).

684. The UM 95087 of UMC has substantially noninfringing uses. (Fair, Tr. at 1706-08).

685. UMC's product brochures provide instructions for keyboard use and electrical use. (See e.g. CX-35 at 129; CX-75 at 3-13).

U. Practice of the Asserted Claims of the '108 and '886 Patents

1. The '108 Patent

686. It is undisputed that none of complainant tone dialer chips listed in Dr. Fair's witness statement (except the MK 5085, MK 5086 and MK 5087) have or had an operative transistor on the chip that corresponds to transistor 588 in figure 12 of the '108 patent. (Fair, Tr. at 1746; CX 503 at 50, 51).

687. It is undisputed that the MK 5085, MK 5086 and MK 5087 dialer chips of complainant or its predecessor were produced from approximately 1975 through the early 1980s at the latest and none of those models have been

produced since 1986 and none have been sold since 1989. (Neuenschwander, CX 498, Table 3).

688. It is undisputed that none of complainant's tone dialer chips listed in Fair's witness statement have an operative transistor on the chip that corresponds to transistor 594 in Figure 12 of the '108 patent. (Fair, Tr. at 1746).

689. It is undisputed that the TCM 5089, TCM 5092, and TCM 5094 dialer chips fabricated by TI do not have operative transistors on the chip that correspond to transistors 588 and 594 in figure 12 of the '108 patent. (Fair, CX 503 at 54-55; CX 450B-CX 450E).

690. It is undisputed that each of complainant's chips in issue rely upon off-chip bipolar transistors in order to mute the receiver and disable the transmitter. (Fair, CX 503, at 50-51, 54-55; CX 450B-CX 450E).

2. <u>The '886 Patent</u>

691. It is undisputed that the TCM 5087, TCM 5089, TCM 5092, and TCM 5094 dialer chips fabricated by TI produce DTMF signals using two PLAs. (CX-450A-CX450F)

V. <u>THE '436 PATENT</u>

A. <u>The '436 Patent and the Claims at Issue</u>

692. U.S. Letters Patent No. 4,446,436 (the '436 patent), entitled "Circuit for Generating Analog Signals," issued on May 4, 1984, based on Application Serial No. 278,906 (the '906 application), filed May 18, 1981. Jeffrey R. Ireland is the named inventor of the '436 patent. The '436 patent on its face is assigned to Mostek Corporation of Carrollton, Texas. (CX 5).

693. The claims at issue, <u>viz</u>. claims 1, 2, 3, 4 and 6, read as follows:

1. A circuit for producing an analog signal, comprising:

first and second power terminals;

a multi-tap resistor connected between said first and second power terminals;

a plurality of first switches formed into plural groups connected respectively to the taps of said resistor;

means responsive to a digital input signal for generating a plurality of first control signals each controlling a separate group of said first switches;

a plurality of second switches each connected to a plurality of said first switches wherein each second switch is connected to no more than one or said first switches within each of said groups of first switches, and each first switch is connected to no more than one of said second switches;

means responsive to said digital input signal for generating a plurality of second control signals each controlling a separate group of said second switches;

a plurality of third switches each connected to a plurality of said second switches and to an output terminal wherein each third switch is connected to no more than one of said second switches within each of said groups of second switches and each second switch is connected to no more than one of said third switches; and

means responsive to said digital input signal for generating a plurality of third control signals for controlling said third switches wherein the operation of said third switches connect said taps one at a time to said output terminal to produce said analog signal of said output terminal.

(CX 5, Col. 5, Line 47 thru Col. 6, Line 11).

2. The circuit recited in claim 1 wherein said taps are selected on said resistor to produce voltage steps weighted such that said analog signal is a sinusoid.

(Id. Col. 6, Lines 12-14)

3. The circuit recited in claim 1 wherein there are sixteen taps, sixteen of said first switches organized in four groups, four of said first control signals, four of said second switches organized in two groups, two of said second control signals, two of said third switches and two of said third control signals.

(Id. Col. 6, Lines 12-14)

4. The circuit recited in claim 1 including means for driving said first control signals to the off state thereof in response to a disable signal.

(Id. Col. 6, Lines 21-23)

6. A method for generating an analog signal in response to a digital input signal, comprising the steps of:

generating a plurality of discrete voltage signals;

generating a plurality of first command signals in response to said digital input signal;

selectively routing a group of said discrete voltage signals through a set of first switches in response to said first command signals which operate said first switches;

generating a plurality of second command signals in response to said digital input signal;

selectively routing a subgroup of said discrete voltage signals, where said subgroup at discrete voltage signals is derived from said group of discrete voltage signals, through a set of second switches in response to said second command signals which operate said second switches;

generating a plurality of third control signals in response to said digital input signal;

selectively routing a one of said discrete voltage signals where said one of said discrete voltage signals is derived from said subgroup of discrete voltage signals, through a set of third switches to an output terminal in response to said third control signals which operate said third switches;

and

repeating the above steps to produce an analog output signal which comprises a series of said discrete voltage signals.

(Id., Col. 8, Lines 16 thru 43).

694. Claim 1 of the '436 patent has no limitations on the number of taps, the number of switches and the number of control signals. (CX-5).

695. Claim 1 of the '436 patent describes what is being claimed as a "circuit for producing an analog signal," so "there is going to be produced by the circuit an analog signal." (Hoff, Tr. at 2780).

696. Claim 1 of the '436 patent is not specific as to the type of analog signal produced. (Hoff, Tr. at 2787).

697. Claim 1 of the '436 patent is not limited to a circuit which produces just a sine wave. (Fair, Tr. at 3926).

698. There is no reference to the word "sixteen" or the number 16 in Claim 1. (CX-5, col. 5, line 46 - col. 6, line 11).

699. The multi-tap resistor is not recited in means plus function language. (CX-5, col. 5, lines 50-51).

700. The number of first switches, second switches or third switches in Claim 1 is not recited in means plus function language. (CX-5 col. 5, 6).

701. Complainant admitted that claims 1 and/or 6 are limited to 16 taps only. (Tr. at 3120).

702. The '436 patent under the subheading Reference Cited lists *inter alia* a Jefferson U. S. Pat. No. 3,657,657 ('657 patent) and a Takanashi et al. U.S. Pat. No. 4,366,470 ('470 patent). The listed field of search shows the following: 328/14, 142, 143, 186, 307/529, 260, 340/347 DA and 377/76. The listed primary examiner was John S. Hayman. (CX-5).

703. The only substantive action of the PTO during prosecution of the '436 patent, other than the allowance of the patent application, was a one page "Examiner Interview Summary Record" dated January 4, 1984 and conducted by telephone which stated that claim 1 has been amended by "inserting - formed into plural groups - after 'switches', in line 6 to thus provide proper antecedent support and clearly read over the prior art." Reproduced hereafter is claim 1 with the underlined portion referring to the insert:

1. A circuit for producing an analog signal, comprising:

first and second power terminals;

a multi-tap resistor connected between said first and second power terminals;

a plurality of first switches, formed into plural groups connected respectively to the taps of said resistor;

means responsive to a digital input signal for generating a plurality of first control signals each controlling a separate group of said first switches;

a plurality of second switches each connected to a plurality of said first switches wherein each second switch is connected to no more than one of said first switches within each of said groups of first switches, and each first switch is connected to no more than one of said second switches;

means responsive to said digital input signal for generating a plurality of second control signals each controlling a separate group of said second switches;

a plurality of third switches each connected to a plurality of said second switches and to an output terminal wherein each third switch is connected to no more than one of said second switches within each of said groups of second switches and each second switch is connected to no more than one of said third switches; and

means responsive to said digital input signal for generating a plurality of third control signals for controlling said third switches wherein the operation of said third switches connects said taps one at a time to said output terminal to produce said analog signal of said output terminal.

(CX-6)

704. The patents in issue in this investigation are owned by complainant (See Initial Determination (Order No. 86) which issued on October 14, 1992).

705. The abstract of the '436 patent reads:

> A tone synthesizer circuit (10) includes a multi-tap resistor (6) which produces a plurality of discrete voltages at the taps (T1-T16). A switch (88-118) is provided for each of the taps (T1-T16). The tap switches (88-118) are organized into four groups. A second group of switches are organized into two groups with each of the second switch groups having a connection to one of the switches in each of the first groups. A third group of switches (164-170) are each connected to one of the group of the second switches (132-138). Circuitry responsive to a digital clock input signal produces a group of control signals on control lines (66-72) which are respectively connected to operate each of the four groups of

> the first switches (88-108). Further circuitry means responsive to the digital input signal transmit control signals through control lines (74-76) to operate the second group of switches (132-138). Further circuitry is provided which operates in response to the digital input signal to produce control signals on control lines (78, 80) to operate third switches (164-170). The first, second and third switches are operated in such a manner that an output terminal (168) is sequentially connected to each of the taps (T1-T16) of the resistor (86). The tap connections are weighted and selected in such an order to produce a sinusoidal output signal at the output terminal (168).

(CX-5, title page)

706. The '436 patent has the following subheadings: "Technical Field", "Background of the Invention", "Summary of the Invention", "Brief Description of the Drawings", and "Detailed Description of the Invention." (CX-5).

707. Under the subheading "Technical Field", the '436 patent discloses that the invention of the '436 patent pertains to digital-to-analog conversion circuitry and more particularity to the synthesis of sinusoidal signals. (CX-5, col. 1, lines 5-7).

708. The reference to "more particularly to the synthesis of sinusoidal signals" at col. 1, lines 6-7, refers to the Figure 1 embodiment. (Hoff, Tr. at 2784).

709. Under the subheading "Background of the Invention" the '436 patent discloses that in DTMF (dual tone multifrequency) telephone signaling systems specified frequency sinusoidal signals must be generated when selected touch keys of the telephone are activated; that the original and still widely used approach for generating these tones has been the use of conventional LC, discrete component, although oscillators of this type are bulky and expensive; that integrated circuit tone dialing has been developed in response to the demand for economical and low power devices although integrated circuit tone dialers have suffered from a number of serious drawbacks which include the

difficulty of working at the extremely low voltages which can be supplied to telephone receivers and the relative complexity and resulting high cost of tone synthesizing circuits; that conventional tone generation circuits utilize a large number of components which increases the size of the integrated circuit which in turn increases the cost of the circuit; and that therefore there exists a need for a tone synthesizing circuit which has a minimum number of circuit elements in order to reduce the area required for the integrated circuit. (CX-5, col. 1, lines 10-32).

710. Under the subheading "Summary of the Invention" the '436 patent discloses that a selected embodiment of the invention of the '436 patent comprises a circuit for generating an analog signal. This circuit receives power from first and second power terminals. The circuit includes a multi-tap resistor which is connected between the first and second power terminals to produce a plurality of discrete voltages. A plurality of first switches are connected respectively to the taps of the resistor. Circuitry is provided which is responsive to a digital input signal for generating a plurality of first control signals each controlling a separate group of the first switches. A plurality of second switches are provided with each connected to a plurality of the first switches wherein each of the second switches is connected to no more than one of the first switches within each of the groups of first switches. Further, each first switch is connected to no more than one of the second switches. Circuitry is provided which is responsive to the digital input signal for generating a plurality of the second control signals each controlling a separate group of the second switches. A plurality of third switches are provided with each connected to a plurality of the second switches and to an output terminal wherein each of the third switches is

connected to no more than one of the second switches within each of the groups of second switches. Each second switch is connected to no more than one of the third switches. Circuitry is provided which is responsive to the digital input signal for generating a plurality of third control signals for controlling the third switches wherein the operation of the third switches connects the taps one at a time to the output terminal to produce an analog signal at the output terminal. The analog signal can have any desired waveform depending upon the weighting and connection of the taps to the resistor in a telephone application. For producing DTMF signaling the taps are weighted and connected such that a sinusoidal type of analog output signal is produced. (CX-5, col, 1, lines 35-68, col, 2. lines 1-36; Fair, Tr. at 3927:17 to 25).

711. The specification of the '436 patent states that the analog signal can have any desired waveform, depending on the weighting and connection of the taps to the resistor. (Fair, Tr. at 3927:17-25).

712. The phrase "any desired waveform" appearing in the specification of the '436 patent is not limited to a symmetrical waveform. (Fair, Tr. at 3928).

713. Under the subheading "Brief Description of the Drawings", the '436 patent discloses that for more complete understanding of the invention and advantages thereof, reference should be made to the following description taken in conjunction with accompanying Figures 1 and 2. (CX-5).

714. Figure 1 of the '436 patent is the only schematic logic circuit in the '436 patent illustrating the tone generating circuit of the invention of the '436 patent. Figure 1 illustrates each of the elements recited in claim 1. (CX-5, col. 2; Fair, Tr. at 1575-78).

715. Figure 2 of the '436 patent illustrates selected waveforms which occur in the circuit illustrated in Figure 1.

716. The '436 patent teaches only a single embodiment which is shown in Figure 1 of the patent. (Hoff, Tr. 2780; Fair, CRX-118 at 28, Q. 83-85).

717. Referring to the Figure 1 embodiment of the '436 patent, the '436 patent discloses that the taps and switch connections could be easily altered to produce other types of waveforms. (CX-5, col. 4, lines 42-44).

718. Referring to the Figure 1 embodiment of the '436 patent the '436 patent discloses that the taps can be selected in such a manner to produce a waveform of almost any shape. In said figure, the taps on resistor 86 are indicated by the reference numerals T_1-T_{16}. (CX-5, col. 3, lines 18-22).

719. The '436 patent states that "[i]n summary, the present invention provides a circuit for generating a synthesized waveform in response to a digital clock signal input. The circuit includes a minimal number of components to reduce the cost and complexity of manufacturing the circuit in integrated circuit form." (CX-5, col. 5, lines 32-38).

720. The '436 patent discloses that although one embodiment of the invention has been illustrated in the accompanying drawings and described in the Detailed Description, it should be understood that the invention is not limited to the embodiment disclosed, but is capable of numerous rearrangements, modifications and substitutions without departing from the scope of the invention. (CX-5, col. 5, lines 39-45).

B. <u>Practice of the Asserted Claims of the '436 Patent</u>

721. The following telecommunication chips produced by complainant and its predecessor practice claims 1, 2, 3, 4 and 6 of the '436 patent:

MK5380
MK5382

MK5375
MK5376
MK5371
MK5372
MK5370
MK5373
MK53731
MK53761
MK53762
MK53760
MK53721
MK53763
MK53732

(Fair, Tr. 1578)

722. All of complainant's Tone III telecommunication chips supra practice claims 1, 2, 3, 4 and 6 of the '436 patent and all of those chips include all of the elements of claim 1 of the '436 patent. (Fair, CX-503 at 113, Q. 443-44; Fair, Tr. 1580-82; CX-456A-F).

723. All of the listed telecommunication chips of complainant, supra, use essentially the identical circuit. (Fair, Tr. 1582).

724. All of the listed chips of complainant, supra, also contain all of the elements of Claim 2 of the '436 patent. All of the listed telecommunication chips of complainant, supra use the elements of claim 2 to generate a tone for DTMF dialing. (Fair, Tr. 1582; Fair, CX-503 at Q. 450).

725. All of the listed chips of complainant, supra, also contain all the elements of claim 3 of the '436 patent, specifically including 16 taps on the resistor connected to the 16 first switches. (Fair, Tr. 1582; CX-503 at 114-15, Q. 451).

726. All of the listed telecommunication chips of complainant, supra, also contain all the elements of Claim 4 of the '436 patent. (Fair, Tr. 1582; Fair, CX-503 at 115, Q. 452).

727. All of the listed telecommunication chips of complainant, supra,

also perform each of the steps of Claim 6 of the '436 patent. (Fair, Tr. 1582; Fair, CX-503 at 115-16, Q. 453).

C. Infringement of the '436 Patent Involving HMC and UMC

1. HMC

728. The following HMC telecommunication chips include all of the elements of Claims 1, 2, 3, 4, and 6 of the '436 patent:

HM9101	HM9121
HM9102	HM9122
HM9104	HM9123
HM9110	HM91510
HM9112	HM91520
HM9113	HM91530
HM9114	HM91550
HM9116	HM91610
HM9119	HM91620
HM9120	HM91650

(Fair, Tr. 1585)

729. All of the listed HMC chips supra include all of the elements of claim 1 of the '436 patent. (Fair, Tr. 1585-87; CX-457A-C).

730. All of the listed HMC telecommunication chips supra also include all of the elements of claim 2 of the '436 patent. All of the listed HMC telecommunication chips use the elements of claim 2 to generate a tone for DTMF dialing. (Fair, Tr. 1588; Fair, CX-503 at 118, Q. 463).

731. All of the listed HMC telecommunication chips, supra, also include all of the elements of claim 3 of the '436 patent, specifically using an implementation having 16 taps connected to the 16 first switches with the 16 first switches organized into 4 groups. (Fair, Tr. 1588; Fair, CX-503 at 118-19, Q. 464).

732. All of the listed HMC telecommunication chips, supra, also include all of the elements of claim 4 of the '436 patent. (Fair, CX-503 at 119, Q. 465).

733. All of the listed HMC telecommunication chips, supra, perform each of the steps recited in claim 6 of the '436 patent. (Fair, CX-503 at 119-20, Q. 466).

734. HMC's addition of one more tap to the resistor string, associated with the generation of a reference voltage, does not affect the correspondence of the circuits for the HMC telecommunication chips to the circuits shown in Figure 1 of the '436 patent as defined by the claims of the '436 patent. This extra tap is not used for generating the desired tone. (Fair, Tr. 1589, 1872-73).

735. All of the circuits shown for the HMC telecommunication chips are equivalent to the circuitry shown in Figure 1; they are nearly identical. (Fair, Tr. 1587).

736. The presence of an additional gate does not alter the correspondence of the HMC circuits to the circuit shown in Figure 1. (Fair, Tr. 1589).

737. The extra tap does not change the way the HMC circuit generates an analog signal. (Fair, Tr. 1873).

738. With respect to a tone synthesizer circuit using a multi-tap resistor with 17 taps and claim 3 of the '436 patent Fair is of the opinion that the tone synthesizer would infringe claim 3 of the '436 patent. Thus he testified:

> Claim 3 specifies the physical circuit construction shown in Figure 1 of the '436 patent. The ST Tone III dialer chips use that circuit. CX456C provides an example with respect to the MK5380. Claim 3 calls for sixteen taps on the resistor with sixteen first switches. These are shown in element "C" in pink on CX456C by simply counting the transistors connected to the resistor "B" shown in yellow. Claim 3 requires four groups of the first switches and four first control signals; these are also shown in element "C" with inputs "F", shown in red, by simply counting. Claim 3 calls for four second switches in two groups; these are shown in element "G"

in green. Claim 3 requires two second control signals; these also are shown as input "I", in red, to element "G" in green. Finally, claim 3 calls for two third switches and two third control signals; element "J" shows these two switches and element "M" shows these two control signals.

* * *

A No. They're equivalent in the following way or nearly identical. The circuitry that decodes the clock and produces the control signals on the first sets of switches is equivalent or nearly identical.

The circuitry which drives the three decoder and the second sets the third sets of signals to drive the first, second and third sets of switches are identical.

The groupings of the switches and the groupings connecting to the taps in the -- to the resistor three are identical, and both systems' output perform the same function using basically the same structure, produce the same result.

And the 17th tap is -- does not change the way this circuit operates. It simply assists the process of what you do with the signal on pin 168 when you're finished processing it.

(Fair CX-503 at 118; Fair Tr. at 1873)

739. CX 457A is a schematic for HMC's allegedly infringing products. Fair testified that there are 17 taps on the resistor shown in CX 457A. He stated that the 17th tap would be used in the operational amplifier simply as a voltage reference. The 17th tap is in the center of the resistor string. Fair testified that the 17th tap does not change the function of the HMC structure in CX457A which is to have 16 taps for the purpose of generating an output signal from the "tree decoder." Fair testified that one half of the circuitry shown in CX 457A is equivalent to what is shown in Figure 1 of the '436 patent. (Fair, Tr. at 1848, 1850, 1852).

740. The second set of switches in Figure 1 of the '436 patent identified by reference numerals 132, 134, 136 and 138 are implemented utilizing two transistor pairs in order to minimize the generation of unwanted

spurious signals which could be generated if a single transistor configuration was utilized. (CRX-116 at 16).

741. HMC also uses four transistor pairs in each of HMC's second set of switches, which are identified by item G in the claim charts of CX-457. (CX-457).

742. Fair prepared CX 206, 209, 457, 457A, 457B and 457C which are representative of each of the accused HMC devices. The schematics in these exhibits are highlighted to identify each element of claim 1 of the '436 patent with an alpha identifier. CX 457C is highlighted to identify each element of claim 1 of the '436 patent. (CX 503, Fair W.S., Ans. 462; Fair, Tr. 1585: 24-25) Fair performed the same analysis of the circuits of each of the other HMC's accused devices listed on CX 443. (Fair, Tr. 1589).

743. In CX 457C B is the resistor, A represents the location of the power terminals, C is the location of the first switches, D shows the means responsive to E for generating the first control signals to drive the first switches (F), H shows the means for generating the second control signals to drive the second switches I and G shows the location of the second switches. L also shows the means for generating the third control signals to drive the third switches J, and K is the output terminal. (Fair, Tr. 1586).

744. Fair made a direct comparison between the structure as set forth in the claims and the structures in the accused devices to determine if the accused structures used the identical or an equivalent structure recited in the '436 patent. According to Fair, the analysis was extremely simple because the accused products are nearly identical to that disclosed in the '436 patent, and they perform the same function. (Fair, Tr. at 1586, 1844).

745. Fair did not find any significant difference between the disclosure

of the '436 patent and HMC's accused products. However, a number of HMC's products have an output that would disconnect the tone generator from the input of the operational amplifier. (Fair, Tr. 1845: 9-23). Fair does not believe that this difference alters the correspondence between the HMC models with this feature and the disclosure of the '436 patent. (Fair, Tr. at 1589).

746. HM 9101, 9102, 9104, 9110, 9112, 9113, 9116, 9119, 9120, 9122, 9123, 91510, 91520, 91530, 91550, 91610, 91620, and 91650 contain each of the elements of claim 1 of the '436 patent. (Fair, CX 503 at 116, 117; Tr. at 1846: 1-2CX 443; CX 457, 457A-C).

747. CX 205 and CX 219-220 are schematic diagrams showing the resistor tree and associated logic for the HM 9104, 9110, 9112, 9113, 9114, 9116, 9119, 9120, and 9121. (CX 205; CX 219-220).

748. CX 206 is a schematic diagram showing the resistor tree and associated logic for the HM HC 1018. (CX 206).

749. CX 209 is a schematic diagram showing the resistor tree and associated logic for the HM 9101, 9102, 9122, and 9123. (CX 209).

750. CX 226 is a schematic diagram showing the resistor tree and associated logic for the HM 91510/520/530. (CX 226).

751. CX 227 is a schematic diagram showing the resistor tree and associated logic for the HM 91650. (CX 227).

752. Each of the models identified in D39 through D44 above have sixteen first switches arranged in four groups connected to two groups of second switches which are connected to two third switches. (Fair, CX 503 at 118-119).

753. The circuitry of HMC's models that decodes the clock and produces the control signals on the first sets of switches is equivalent or nearly

identical to the device depicted in Figure 1 of the '436 patent. (Fair, Tr. at 1871).

754. The circuitry in HMC's accused products that drives the tree decoder and the second set and the third set of signals to drive the first, second and third sets of switches is identical to that depicted in figure 1 of the '436 patent. (Fair, Tr. at 1873).

755. The groupings of the switches and the groupings connected to the resistor tree are identical, and the output of both systems performs the same function, uses basically the same structure, and produces the same result. The 17th tap does not change the way the circuit operates. It simply assists the processing of the signal on pin 168. (Fair, Tr. at 1873).

756. According to Fair, there are no differences between the elements in HMC's accused products and figure 1 of the '436 patent from the clock bar inputs through the output pin 166. (Fair, Tr. at 1846).

757. HMC's products also contain a 17th tap on the resistor which serves as a voltage reference. The 17th tap does not affect the function of the 16 tap decoder tree for purposes of producing an analog output signal. (Fair, Tr. at 1848, 1849).

2. UMC

758. The UM91265 chip of UMC performs each of the functions recited in claims 1, 2, 3, 4, and 6 of the '436 patent using the circuitry disclosed in the '436 patent. (Fair, CX-503 at 120; CX-5).

759. The claim charts collected at CX-458 illustrate the correspondence between the elements of claim 1 and the tone generation circuitry for the UM91265 chip. (Fair, CX-503 at 121; CX-458)

760. Dependent claim 2 of the '436 patent calls for the resistor taps to

be chosen to produce a sine wave output. The UM91265 chip is a touch tone telephone dialer chip. It can operate accurately only if the row and column tone generation circuits each produce a sine wave. (Fair, CX-503 at 121; CX-5)

761. Dependent claim 3 specifies the physical circuit construction shown in Figure 1 of the '436 patent. The UM91265 chip uses that circuit as shown in CX-458A. Claim 3 calls for sixteen taps on the resistor with sixteen first switches. These are shown in element "C" in pink on CX-458A by simply counting the transistors connected to the resistor "B shown in yellow. Claim 3 requires four groups of the first switches and four first control signals; these are also shown in element "C" with inputs "F", shown in red, by simply counting. Claim 3 calls for four second switches in two groups; these are shown in element "G" in green. Claim 3 requires two second control signals; these also are shown as input "I", in red, to element "G" in green. Finally, claim 3 calls for two third switches and two third control signals; element "J" shows these two switches and element "M" shows these two control signals. (Fair, CX-503 at 121-22; CX-458A; CX-5)

762. Dependent claim 4 relates to a specific feature of the circuits shown in Figure 1 of the '436 patent. The UMC UM91265 uses that circuit. The specific feature of claim 4, disabling the first control signals, can be seen in, for example, CX-458A as the third input to the series of NOR gates shown in blue as part of element "D". The outputs of these NOR gates are the first control signals "F". This third input drives each control signal to an off state. (Fair, CX-503 at 122; CX-458A; CX-5)

763. With regard to UM91265 infringing dependent claim 6, element "E" in exhibit CX-458A is the digital input signal required by the preamble of claim

6. Elements "A" and "B," with its multiple taps, together generate a plurality of discrete voltage signals. Element "D" generates the first command signals "F". The first switches "C" selectively route a group of the discrete voltage signals in response to these command signals. Element "H" generates the second command signals "I". The second switches "G" selectively route a subgroup of the signals from the first switches. Element "L" generates the third command signals "M". Third switches "J" selectively route a subgroup of the signals from the second switches to an output terminal "K." The digital input signal causes the circuit to continually repeat these steps. The arrangement of the first, second and third switches create the analog output signal comprises of discrete voltage signals. (Fair, CX-503 at 122-23; CX-458A; CX-5).

D. <u>The Disclosure of the '436 Patent</u>

764. With reference to Fig. 1 of the '436 patent the claimed means responsive to a digital input signal for generating a plurality of first control signals comprises elements 22, 24, 34, 36, 38, 46, 48, 50, and 52. Each of the first control signals controls a separate group of the first switches. The control signals appear on lines 66, 68, 70 and 72. (Ireland, Tr. 1119).

765. With reference to Figure 1 of the '436 patent the first set of control signals 66, 68, 70 and 72 controls the first set of switches to select four of sixteen available taps on the multi-tap resistor. (Ireland, CX-501 at 6).

766. Figure 1 of the '436 patent illustrates a means responsive to the digital input signal for generating a plurality of second control signals as elements 26, 40, 58 and 60 with the second control signals being on lines 74

and 76. The digital input signal is present on lines 16 and 18. (Fair, Tr. 1576; CX-305).

767. The second switches of claim 1 of the '436 patent are illustrated in Figure 1 as elements 132, 134, 136 and 138. Each of these switches is connected to no more than one of the first switches within each of the four groups of the first switches shown in Figure 1. (Ireland, Tr. 1118; Fair, Tr. 1576-77; CX-305).

768. With reference to Figure 1 of the '436 patent, the second set of control signals 74 and 76 controls the second set of switches which select two of the four taps selected by the first set of switches. (Ireland, CX-501 at 6).

769. Figure 1 of the '436 patent illustrates a plurality of third switches as elements numbers 170 and 164. Each of the second switches connects to no more than one of these third switches. (Ireland, Tr. 1118-19; Fair, Tr. 1577; CX-305).

770. With reference to Figure 1 of the '436 patent, each of the third switches connects to an output terminal identified as element 168. (Fair, Tr. 1577; CX-305; Ireland, CX-501 at 6).

771. Figure 1 of the '436 patent shows the means for generating a plurality of third control signals as elements 20, 62, 64 and 66. The third control signals occur on lines 78 and 80. (Ireland, Tr. 1119; Fair, Tr. 1578; CX-305).

772. With reference to Figure 1 of the '436 patent the third set of control signals 78 and 80 controls the third switches which select one of the two taps selected by the second set of switches. (Ireland, CX-501 at 6).

773. Inventor Ireland testified that the binary up/down counter,

referred to in the title of the invention as written in the invention disclosure would be the elements 20, 22 24 and 26 on the left hand side of Figure 1 (The decode structure of Figure 1 includes those elements). As for the decoder in Figure 1 for producing one of sixteen analog voltage, Ireland testified that there are a set of switches in three stages; that the first stage is 16 switches labeled 88 through 118; that the second stage is four sets of composite switches or two transistor switches labeled 132 through 138 and the third stage is a set of two switches labeled 164 and 170. The switches are for selecting the voltages on the resistor string and presenting them at the output terminal 108 of Figure 1 and that is what is meant by the word "decode". Other structures that make up the decoding structures in Figure 1 are additional logic elements labeled 34 through 40, 46 through 52, 58 and 60 and elements 62, 64 and 66. In Figure 1 element 34 is an exclusive OR gate and element 36, 38 and 40 are D-latches (data latches); elements 46 to 52 are three input NOR gates; elements 58 and 60 are two-input NOR gates; element 62 is an invertor; and elements 64 and 66 are two input NOR gates. There is no other structure shown in Fig. 1 which is part of the decoder. Switches 88 through 118 are the structure in Figure 1 that corresponds to the plurality of first switches formed into plural groups, connected respectively to the taps of said resistor and element 86 is the resistor to which switches 88 through 118 are connected through taps on the resistor. In Figure 1 the first and second power terminals are labeled VR+ and VR- with arrows pointing up and down and resistor 86 is a multi-tap resistor which means that there are a number of places along the resistor where voltages can be taken off the resistor. In Figure 1 the plurality of second switches, each connected to a plurality of said first switches are switches 132 through 138 and the plurality of third switches are 164 and 170 with the means responsive to a digital input signal for generating a plurality of first control signals, each controlling a separate group of said first switches being elements 22, 24, 34, 36, 38, 46, 48, 50 and 52. The plurality of second switches in Figure 1 are elements 26, 40, 58 and 60 and the plurality of third switches are 20, 62, 64 and 66. (Ireland, Tr. at 1114 to 1119).

774. The digital input signal for generating a plurality of first control signals on Fig. 1 is either the input terminal labeled 12 or signal labeled 16. There is however, another line labeled "clock bar" and for the elements to operate properly, they must receive the clock which is line 16 and it's complements or inversion which is the clock bar. (Ireland, Tr. at 1120, 1121).

775. The circuit of Figure 1 of the '436 patent operates such that taps on the resistor are connected one at a time to the output terminal to produce an analog signal. (Fair, Tr. 1578; CX-305).

776. The means of generating a plurality of first, second and third control signals disclosed in Fig. 1 of the 436 patent relates to a structure which employs sequential digital logic circuitry and associated digital logic gates where necessary to generate the first, second and third control signals in response to a digital input signal. The up-down counter in the '436 patent comprises flip-flop 20, 22, 24 and 26. There is also intermediary gate 34 in the '436 patent, latches 36, 38 and 40 of the '436 patent and output gates 46, 48, 50, 52, 58, 60, 62, 64 and 66 in the '436 patent. (Hoff, RX 2B at 15 to 17).

777. With reference to Figure 1 of the '436 patent, the decode operation is the selection of voltages on the multi-tap resistor and the presentation of

that selected voltage at the output terminal 168 in Figure 1. (Ireland, Tr. 1115).

778. The logic circuitry shown in Figure 1 of the '436 patent selects taps on the multi-tap resistor in proper sequence to produce the stair-step waveform shown in Figure 2. (Ireland, CX-501 at 6).

779. There is reduced silicon area in the invention disclosed in the '436 patent as compared to conventional textbook approaches having four stages of switches with other required decode circuitry or other tone generators that were available on the market during the time frame of the conception of the invention disclosed in the '436 patent. (Ireland, Tr. 1232-33).

780. The textbook approaches with increased silicon area include utilizing four stages of switches with the binary resistor tree. (Ireland, Tr. 1232-33).

781. The second switches 132, 134, 136 and 138 in the Figure 1 embodiment of the '436 patent, each of which is connected to no more than one of the first switches within each of the four groups of the first switches shown in Fig. 1, comprise serial transistors having a common gate connection. This configuration is provided to ensure that there is not a sufficient voltage drop across either of the transistors to cause the formation of a bipolar transistor in the well and substrate in which the transistors of the switch are fabricated. (CX 5, col. 5, lines 11-17).

782. The single digital input signal shown as clock signal 16 in Fig. 2 of the '436 patent generates various control signals which control the three stages of switches in the tone synthesizer circuitry of Figure 1. (Ireland, CX-501 at 6).

783. Inventor Ireland's claimed invention produces a single analog

signal. (Ireland, Tr. 1207).

784. Inventor Ireland believes that the particular resistor string disclosed in his '436 patent would not have to generate a sine wave to come within what he thinks is his invention. Ireland thinks that his invention would have to generate a "periodic" analog signal. The word "periodic" is not found in claim 1 nor claim 6 of the '436 patent. (Ireland, Tr. at 1275, 1276; CX-5).

785. Analog signals are a broader class of signals than are tone signals although an analog signal could be a tone signal. A tone signal would be basically a sinusoidal wave form. (Ireland, Tr. at 1146, 1147).

786. The analog signal claimed in claim 1 is the output signal of the circuit. (Hoff, Tr. 2795).

787. The Figure 1 embodiment disclosed in the '436 patent necessarily generates an up/down output waveform based on the sequencing and selection of the tabs on the multi-tap resistor. (Hoff, Tr. 2807-08).

788. The analog signal referred to in Claim 1 of the '436 patent belongs to a class of overall analog signals. That class includes a sine wave and may include other symmetrical signals having both positive-going and negative-going segments. The only example shown in the '436 patent is a step approximation of a sine wave shown in Figure 2 which occurs in the circuit illustrated in Figure 1. (Fair, CRX-118 at 29-30, Q. 87-91; CX 5, col. 2).

789. A digital signal has two possible values whereas an analog signal can have a multiplicity of values. (Hoff, Tr. at 2786:8-10).

790. The difference between the digital signal and an analog signal is that a digital signal has two values, for example on and off, whereas an analog signal would have more than two values. (Fair, Tr. at 1814:3-9).

791. An analog signal would have a multiplicity of values. They can be continuous or they can be in discrete steps. (Fair, Tr. at 1814).

792. Waveforms 16, 20(Q), 22(Q), 24(Q), 26(Q), 34, 36(Q), 38(Q), 72, 70, 68, 66, 74, and 80 shown in Figure 2 of the '436 patent represent digital signals. (Hoff, Tr. at 2792:2-14).

793. Waveform 166 shown in Figure 2 of the '436 patent represents an analog signal. (Hoff, Tr. at 2795:9-11).

794. A ramp signal is an analog signal but it isn't necessarily included as a signal that would be produced by the structure of Figure 1 of the '436 patent. (Fair, Tr. at 3926:12-17).

795. Figure 1 of the '436 patent shows one half of the circuit diagram of the logic circuitry for the tone synthesizer of the MK5380 device. (Ireland, CX-501 at 6; Ireland, Tr. at 1223-24).

796. Figure 1 of the '436 patent was an extracted portion of the MK5380 schematic. (Ireland, Tr. 1223-24).

797. Two terminals identified by the reference numerals 12 and 14 in Figure 1 of the '436 patent are for receiving a digital input clock signal. The two signals are there because they were the Q bar output of a flip-flop present in another portion of the design of the MK5380 schematic but not shown in Figure 1. In other words they were the Q output and its complement from another flip-flop. (Ireland, Tr. 1221).

798. Figure 1 of the '436 patent shows the first power terminal at VR+ associated with the component 86 and the second power terminal, VR-, at the lower portion of the component 86 with multi-tap resistor part 86, connected between the first and second power terminals. (Ireland, Tr. 1118; Fair, Tr. 1575).

799. Figure 1 of the '436 patent shows a plurality of first switches formed into plural groups connected respectively to the taps of the multi-tap resistor 86 by references numerals 88 through 118. These first switches are connected to the taps, and comprise four groups as shown in Figure 1. (Ireland, Tr. 1116-17; Fair, Tr. 1575-76).

800. A multi-tap resistor is defined as a resistor where the voltages can be taken off the resistor at a number of places. (Ireland, Tr. 1118).

801. A sixteen tap multi-tap resistor is essential to the invention as set forth in Claim 3 of the '436 patent. (Ireland, Tr. 1224).

802. A sixteen tap multi-tap resistor is not essential for the invention as claimed in Claim 1 of the '436 patent. (Ireland, Tr. 1224-25).

803. The '436 specification as to Figure 1 states that circuit 10 includes "input terminals 12 and 14 which receive respectively a digital clock signal and its complement" and that this "clock signal preferably has a 50% duty cycle." (Ireland, Tr. 1221). (<u>See</u> col. 2 of CX-5; Hoff, Tr. at 2804).

804. A clock-bar signal is generated when a single clock is passed straight to the circuit shown in Figure 1 of the '436 patent and an inversion of that same clock signal is also passed. A simple structure, which is typically used for such a function, is the use of Q and $\bar{Q}$ outputs of a flip flop. In this typical structure, the clock signals are generated from a single input signal to a flip flop. (Fair, CRX-118 at 26).

805. The input clock signal is the Q and $\bar{Q}$ outputs which are complementary and related opposite signals of a flip-flop and not the output of an invertor. One clock bar signal is the complement, or an inversion, of the related clock signal. (Ireland, Tr. 1224).

806. The elements of claim 1 can readily be divided into two groups, <u>viz</u>

five elements and three additional elements. Said five elements serve to describe a digital to analog converter in some detail. Thus one element talks about a multi tap resistor while another element points out that the resistor is connected to power terminals and other elements describe a network of switches that serve to eventually connect taps from the resistor to the output which is the analog signal. (Hoff, Tr. at 2780, RPX 84).

807. The three additional elements within claim 1 of the '436 patent are written in means plus function form and each serves to provide the function of generating a plurality of digital control signals. Each of the three structures which implement each means is responsive to a digital input signal. Within the structure that implements the functions called for in the means plus function claim are a variety of logic elements which primarily consist of a counter followed by some additional logic. (Hoff, Tr. at 2780-2782, RPX 84).

808. The three means functions of claim 1 produce a plurality of control signals which can be determined to actually be three pluralities of control signals. (Hoff, Tr. at 2783, RPX 84).

809. An up-down counter that first counts up to reach some maximum value and then turns around and starts counting down is what the "selected tap" number represents in the Figure 2 embodiment of the '436 patent. The 14 digital signals in Figure 2 are used in an intermediate step in the generation of the analog signal 166. (Hoff, Tr. at 2807, 2808).

810. There is a distinction between digital-to-analog converters and analog-to-digital converters. (Hoff, Tr. at 2820).

811. A digital-to-analog (D/A) converter is a circuit that takes a plurality of digital input signals and produces an analog output signal in

which the analog output signal has a relationship to the digital input signals. Thus a D/A converter "takes a digital input and produces a corresponding analog output." (Hoff, Tr. at 2809:5-9; Fair Tr. at 1813).

812. A digital counter is a system that takes some type of clock input and divides it down so that binary arithmetic can be performed, i.e. carry out binary logic functions through whatever number of bits that are available. (Fair, Tr. at 1813-184).

813. Digital-to-analog converters were well known in the art prior to the filing of the '436 patent. There are a number of different design techniques that are intended to accomplish this function of taking digital plurality of digital inputs and producing a single analog output signal. (Hoff, Tr. at 2810).

814. According to Hoff the embodiment show in Fig. 1 of the '436 patent is an up/down counter and is constrained to have a left right symmetry so it would not be possible with that structure to produce a saw tooth wave form because it does not have left right symmetry. However he testified that if one would use the "circuit of Ireland" to produce a saw tooth wave one would provide a circuit that has a different sequence of taps that is produced by the up/down counter of Figure 1 of the '436 patent which would mean that one would have a different type of counter that would be used to implement the generation of the control signals, i.e. it means a rearrangement of the components of the counter. (Hoff, Tr. at 2884, 2885).

815. The structure for Fig. 1 of the '436 patent has been defined as an up/down counter because of the sequence it produces. (Hoff, Tr. at 2873).

816. The basic idea of a counter is a circuit that receives an input digital signal which may be thought of as consisting of a series of pulses an

by each pulse, the counter advances to its next condition. (Hoff, Tr. at 2874).

817. A counter can be used to drive a digital to analog converter. The '436 patent represents a counter driving a digital to analog converter with some intermediate logic. (Hoff, Tr. at 2875).

818. Figure 1 of the '436 patent illustrates a tone synthesizing circuit "designated generally by the reference numeral 10." Circuit 10 includes input terminals 12 and 14 which receive respectively a digital clock signal and its complement. The clock signal is transmitted through a line 16 and its complement is transmitted through a line 18. Circuit 10 receives the clock signal input and produces therefrom a plurality of control signals for activating a series of switches. For example in the first step of the decoding process, the clock signal and its complement "are provided to a group of four flip-flop circuits 20, 22, 24 ad 26." (CX-5, col. 2, lines 17-31).

819. In the Figure 1 embodiment of the '436 patent, the clock decoder acts as an up-down counter. Figure 1 generates an upwardly going wave form and then a downwardly going wave form that is symmetrical to the upwardly going wave form. (Fair, Tr. at 3927).

820. According to Fair, the circuitry of Fig. 1 of the '436 patent could produce a staircase approximation to a ramp signal over one-quarter of a cycle but "the way the structure is designed, it has symmetry, and so that ramp would have to come back down, so that both sides of the peak were symmetrical." (Fair, Tr. at 3926, 3927).

821. According to Fair, the invention in the '436 patent is to a sine wave generator. In support Fair relies on the disclosure that the invention pertains "more particularly to the synthesis of sinusoidal signals" (col. 1,

lines 5-7), that in a "telephone application for producing DTMF signaling the taps are weighted and connected such that a sinusoidal type of analog output signal is produced." (col. 1, line 68, col. 2, lines 1-3) and the Figure 1 embodiment. Fair testified with respect to his opinion as to the scope of the claimed subject matter:

> Q So that I understand your testimony, Dr. Fair, you believe that Claim 1 is limited to the generation of wave forms which can be generated by an up-down counter, but does not extend to cover circuits which can generate wave forms which would be generated by any other form of control mechanism, is that correct?
>
> A Well, it is not just an up-down counter, it is a two phase clock decoder that generates, using specific circuitry to generate specific control signals. So I would not just say any up-down counter.
>
> Q But it would be an up-down counter then using two phase, non-overlapping clock signal which generated an up and a down count, so as to sequentially access taps on a resistor tree, is that correct?
>
> A Let me qualify, by an up-down counter, is it [sic] the up-down counter shown in Figure 1 of the 436 patent. That is the structure which is referred to in the means for generating a plurality of control signals in the three means elements of Claim 1.
>
> Q And the changes that, in your opinion, were contemplated by the inventor in the resistor string, and the associated circuitry of switches and control elements used to access the taps on that resistor string, were changes only in the placement of taps on the resistor string, is that correct?
>
> A Well, I am not sure that that is correct, because I didn't, I don't really know what the inventor had in mind. All that I am taught, if I were trying to reduce to practice the concepts taught in this invention would be Figure 1. And there is no other teaching.
>
> Q Well, isn't there a teaching that the Figure 1 in the structure shown there is capable of numerous rearrangements, modifications and substitutions without departing from the scope of the invention?
>
> A Well, that may be a teaching but I am not sure what that, what those, what that teaching is. I don't -- there is no embodiment taught in this patent as to what those rearrangements are.

Q So it is your opinion that in order to have Claim 1 be interpreted to cover other than what is shown in Figure 1 of the 436 patent, there must be another embodiment shown in the patent showing how the circuit elements of Figure 1 could be rearranged, is that correct?

A I believe the limits that I place on what is teachable are substitutions for the gates that are shown here. For example substituting a NOR gate with a NAND gate, or maybe adding an invertor or adding some taps, which do not really distort or change the invention that is described.

Q Now, there is no teaching in this patent of the substitution of NAND gates for NOR gates, is there?

A No, that is correct, but we are taught that substitutions are possible without departing from the scope of the invention. So that would be such a substitution as I would envision would fit the terminology there.

Q But wouldn't rearrangement also apply to a rearrangement of the control elements so as to access the taps in a different sequence?

A Well, I believe that might be possible if it didn't depart from the scope of the invention.

Q But isn't the scope of the invention determined, under your interpretation of Claim 1, by looking at what is disclosed in the specification, Dr. Fair?

A Yes.

Q And doesn't it say in the specification that rearrangements are possible?

A It says that, but we are not taught what those rearrangements, possible rearrangements would be that would be within the scope of the invention.

Q And you don't think rearrangements would be apparent to one of ordinary skill in the art based upon the teachings in the patent to achieve any desired wave form, is that your testimony?

A Yes.

(Fair Tr. at 3929 to 3934, 3937 to 3940, 3982, 3986).

822. Fair testified that from a "technical perspective," the only distinction that exists between independent claim 1 and claim 3, which is

dependent on claim 1, is the number of taps. (Fair, Tr. at 3951).

823. A multi-tap resistor, all the resistances of which have equal resistance, could be the multi-tap resistor recited in claim 1. (Fair, Tr. at 3987).

E. Best Mode Re '436 Patent

824. Inventor Ireland provided his patent attorney with a complete circuit drawing of his invention, which is Figure 1 of the '436 patent. (Ireland, CRX-116 at 6).

825. The drawing Ireland provided to his patent attorney was the same circuit Mr. Ireland provided to Dan Dovi, his layout technician. (CRX-116 at 6).

826. Ireland provided his patent attorney with the drawing of the circuit as shown in Figure 1 of the '436 patent except for the reference numerals on the circuit components. (Ireland, CRX-116 at 5).

827. The invention claimed in the '436 patent is generally directed to a circuit for producing a single analog signal and more specifically directed to such a circuit for generating a single sinusoidal signal. (Ireland, CRX-116 at 1).

828. The invention claimed in the '436 patent does not include sharing a multi-tap resistor between two replications of the circuit in Figure 1 of the '436 patent to produce two separate signals. (Ireland, Tr. 3777-78; Ireland, CRX-116 at 2).

829. The actual implementation of the shared multi-tap resistor was not claimed in the '436 patent. (Ireland, Tr. 1211).

F. Prior Art - '436 Patent

830. When asked whether it would be obvious to combine "off-the-shelf

elements" in the manner specified by claim 1 of the '436 patent, Fair testified that it would not have been a routine matter to combine the logic components as specified in claim 1 because:

> A. Although the '436 patent as implemented in Figure 1 represents a combination of logic elements, all logic circuits are made up of individual logic elements. My understanding of the '436 patent invention is that it represents a specific implementation of logic elements that solves particular problems in a satisfactory way. It uses a relatively minimal number of gates to effect generation of an analog signal. This interconnection of logic elements is not apparent from the mere existence of the logic components. It is the interconnection and interplay between the elements that create the novel aspects of the circuitry called for in claim 1 of the '436 patent.
>
> * * *
>
> A. It is true that the '436 patent structure and Jefferson, as well as Roberts, Takanashi and Hoff '882 all use logic gates and switches in their structure. That all these structures use logic gates and switches does not mean they have one similar structure or operate on similar principles. For example, all microprocessors, T.V. controller circuits, computer controllers, and other digital circuits are made up of the same logic gates and switches used in the '436 patent, but they are also very different in structure and function. Logic gates and switches are the basic building blocks of most all digital circuits. The logic gates and switches are like the lumber and bricks used to build a home, a school, or a tree house. Each are made from the same basic components, but each has a different structure and function.
>
> The '436 patent is a combination patent that claims a specific combination of circuit elements to the claimed electric circuit. There is no prior art that shows or suggests the arrangement and combination shown and claimed in the '436 patent.
>
> Even though the individual components may exist in the prior art, the combination of those components in a new structure, that operate in a completely new way, is not found in or obvious from the prior art.
>
> * * *
>
> A. None of the references relied upon by the respondents use a digital input signal as that term is used in the '436 patent specification and claims.

* * *

A. Well, the digital input signal in the '436 patent is a two phase non-overlapping clock signal. This refers to a clock signal and its complement. In fact, the '436 patent specifies that this preferably is a 50% duty cycle clock signal (Col. 2, lines 21-24). This means that a clock signal, CK, on line 16, is high one-half of the time and low the other half of the time. This also means that the clock-bar signal, CK-bar, on line 18, is low during the one-half period that the CK signal is high and is high during the one-half period in which the CK signal is low.

* * *

A. In particular, the three elements that are set forth in means-plus-function language are absent in all of the references. Also, the interconnection between these means-plus-function elements and the other elements, as specified in claim 1, is absent in all of the references and the proposed combination of references.

(Fair CRX-118 at 23 to 27)

831. According to Fair NOR gates 64 and 66 and invertor 62 which are part of the means responsive to said digital input signal for generating a plurality of third control signals are not so arranged in any of the prior art references. Elements 64, 66 and 62, according to Fair, prevent glitches or voltage spikes in the output signal because the output of the NOR gates 64 and 66 cannot both be high at the same time and this ensures that switches 164 and 170 will never both be on at the same time and ensures that only one-half of the resistor 86 will be connected to the output at any one time, and that there will be no overlap. (Fair, CRX-118).

832. With respect to the prior art in issue Fair testified:

A. Each reference operates on very different principles and uses different structure from the claimed invention of the '436. Each of these references uses a cluster of logic gates and switches to provide decoding. Those logic gates are not tied to the groupings and weighting of the resistor taps as in the '436 patent to provide an analog signal. The logic elements shown in the '436 patent are intimately related to both the weighting and the manner of grouping of the taps of the resistor string. There is no teaching in any of these references about configuring the logic to correspond to the weighting and grouping of the resistor taps in relation to the desired analog output signal.

(Fair CRX-118 at 12)

833. Fair testified as to the Hamade article (RX-318), Hamade patent application (RX-360, RX-361), the Takanashi patent (RX-64) and the Roberts patent (RX-330):

> A. All of the references that employ a successive approximation register essentially repeat the steps that the '436 patent attempts to eliminate. That is, each of those references requires, as a practical matter, the input of an analog signal to generate any analog signal output which is in any way analogous to the analog signal which is generated by the elements of claim 1 of the '436 patent. This is the input signal which is shown in each of these references at the other input to the comparator which receives the output from the block shown as the D-to-A converter in these references. For example, it is labeled "V_{in}" in Figures 1 and 6 of the Hamade article, "analog input V_I" in Figure 4 of Roberts, and "V_x" in Figure of Takanashi.
>
> Q62. Why is that completely different?
>
> A. Because the '436 patent, as described in the elements of claim 1, generates an analog signal solely from a digital clock input. This analog signal is independent of any other digital signal. The '436 patent circuits do not use a successive approximation register. In fact, the '436 patent circuitry does not even use a comparator which is central to the successful operation of a successive approximation register in its intended application.

(Fair CRX-118 at 19, 20)

834. The prior art Hamade article (RX-318), the Takanashi patent (RX-319), and the Roberts patent (RX-330), all show circuits generating a single analog output. (Hoff, Tr. at 3272).

835. U.S. Patent 3,657,657 issued to Jefferson (the Jefferson '657 patent), applied for an August 3, 1970, issued on April 18, 1972, is prior art to the '436 patent (Order No. 117). The Jefferson '657 patent was cited by the examiner during prosecution for the '436 patent (CX 5).

836. U.S. Patent 4,281,319, entitled "Digital-To-Analog Converter,"

issued to Ben D. Roberts, Jr (the Roberts '319 patent), applied for on June 30, 1980, issued on July 28, 1981, is prior art to the '436 patent (RX 330). The Roberts patent was not cited by the PTO during prosecution for the '436 patent. (CX 5).

837. The Roberts '319 patent discloses a block labeled "Successive Approximation Register" 36' but the block reveals no structure whatsoever for generating control signals. (RX-330).

838. RX-227 is a representation by HMC and UMC of Figure 3 of Jefferson '657 patent with the digital-to-analog converter structure of Figure 5 of the Roberts '319 patent in place of the block 26 labelled DIGITAL-to-ANALOG CONVERTER in Figure 3 of Jefferson. The claim appearing on the right in RX-227 is a word for word replication or claim 1 of the '436 patent. (Hoff RX-2, Q59).

839. If the digital-to-analog converter shown in Fig. 5 of Roberts is placed in block 26, labeled "DIGITAL TO ANALOG CONVERTER", of Fig. 3 the Jefferson patent, then Jefferson would produce an analog signal which is a step-wise approximation to a sine wave. (Fair, Tr. at 3924).

840. The digital-to-analog converter of Fig. 5 of Roberts comprises a first power terminal and a second power terminal. (Fair, Tr. at 3952).

841. The digital-to-analog converter of Fig. 5 of Roberts comprises a multi-tap resistor connected between a first power terminal and a second power terminal. (Fair, Tr. at 3952).

842. Figure 5 of the Roberts patent shows a circuit for producing an analog signal. (Fair, Tr. at 3952).

843. Figure 5 of Roberts discloses a multi-tap resistor connected between first and second power terminals. (Fair, Tr. at 3952:17-20).

844. Figure 5 of Roberts discloses a plurality of first switches formed into plural groups connected respectively to the taps of the multi-tap resistor although Fair stated that the grouping is different from the invention in the '436 patent. In Figure 5 of the Roberts patent, the first group of four switches in the plurality of first switches are those switches the gates of which are connected to the output of the NOR gate with a little "a" right by the output at the top of Figure 5. (Fair, Tr. at 3952-3954).

845. In Figure 5 of the Roberts patent, the second group of four switches in the plurality of first switches are those switches the gates of which are connected to the output lead from the NOR gate with the little "b" above its output. (Fair, Tr. at 3953).

846. In Figure 5 of the Roberts patent, the third group of four switches in the plurality of first switches are the switches the gates of which are connected to the output from the NOR gate with the little "c" above its output. (Fair, Tr. at 3953).

847. In Figure 5 of the Roberts patent, the fourth group of four switches in the plurality of first switches are those switches the gates of which are connected to the output from the NOR gate with the little "d" above its output. (Fair, Tr. at 3953-3954).

848. Figure 5 of the Roberts patent discloses a means responsive to a digital input signal for generating a plurality of first control signals, each controlling a separate group of said first switches although Fair testified that the means is different from the means described in the '436 patent and the digital input signal is different in Roberts from the signal in the '436 patent. In Figure 5 of the Roberts patent, the means for generating a plurality of first control signals, each controlling a separate group of said

first switches, includes the NOR gates with the little "a", the little "b", the little "c" and the little "d" above their outputs in Figure 5. (Fair, Tr. at 3954-3955).

849. Figure 5 of Roberts discloses a plurality of second switches, each connected to a plurality of said first switches, wherein each second switch is connected to no more than one of said first switches within each of said groups of first switches, and each first switch is connected to no more than one of said second switches although Fair testified that the connections are in a different arrangement than the '436 patent. Figure 5 of Roberts discloses a plurality of second switches as set forth in Claim 1 of the '436 patent as being connected to the output signal from the exclusive-OR gate with the little "e" above its output and the invertor with the little "g" above its output. (Fair, Tr. at 3955-3956).

850. Figure 5 of Roberts also discloses means responsive to the digital input signal for generating a plurality of second control signals, each controlling a separate group of said second switches although Fair testified that the structure corresponding to the claim 1 means element is different. In Figure 5 of Roberts, the means for generating the plurality of second control signals includes the exclusive-OR gate with the little "e" above its output and the invertor with the little "g" above its output. (Fair, Tr. at 3956-3957).

851. Figure 5 of Roberts also discloses a plurality of third switches, each connected to a plurality of said second switches and to an output terminal, wherein each third switch is connected to no more than one of said second switches within each of said groups of second switches, and each second switch is connected to no more than one of said third switches. The plurality

of third switches recited in Claim 1 of the '436 patent is disclosed in Figure 5 of Roberts as the two MOS transistors, the gates of which are connected respectively to the output "f" of the exclusive-OR gate and the output "h" of the invertor shown near the bottom of Figure 5. (Fair, Tr. at 3957).

852. Figure 5 of Roberts also discloses means responsive to said digital input signal for generating a plurality of third control signals for controlling said third switches, wherein the operation of said third switches connects said taps one at a time to said output terminal to produce said analog signal of said output terminal although Fair testified that the digital input signal for the third means and for the second means is different from the digital input signal for the first means or the first set of switches and the structures that correspond to the means are different. (Fair, Tr. at 3957-3958).

853. Fair testified as to "glitches":

> Q You have previously identified NOR gates 64 and 66 and invertor 62 as being part of the means responsive to said digital input signal for generating a plurality of third control signals. Have you found these elements so arranged in any of the prior art references?
>
> A No, I have not.
>
> Q What purpose do these elements serve in the circuit specified by claim 1?
>
> A These elements prevent glitches or voltage spikes in the output signal. This is because the output of the NOR gates 64 and 66 cannot both be high at the same time. This ensures that switches 164 and 170 will never both be on at the same time. This ensures that only one-half of the resistor 86 will be connected to the output at any one time, and that there will be no overlap.
>
> Q Do any of the references relied upon by respondents include this same feature?
>
> A No. For example, Roberts (RX330) introduces glitches by using the inverters shown for the signals "g" and "h". Such problems would need to

be corrected and would merely add additional gates to the already extensive decoding structure required by Roberts.

Q Have you considered any embodiments other than that shown in Figure 1 in reaching your conclusions with respect tot he claims of the '436 patent?

A No, I have not.

(Fair, CRX-118 at 27, 28).

854. Fair testified that the resistor configuration shown in Figure 5 of Roberts is not equivalent to the 16 tap resistor configuration shown in Figure 1 of the '436 patent because:

A. Roberts uses substantially different decode circuitry that is tied to the manner in which Roberts connects the taps on his resistor string. He connects four taps in sequence together. Because Roberts does this, he must change both of the signals "e" and "g" at each step and signals "f" and "h" at every other step thereby increasing the likelihood of an overlap between those signals. This overlap would create ambiguous output signals for a "glitch". In contrast, the structure shown in the '436 patent groups the resistor taps in an entirely different fashion. This grouping is tied to the manner in which the resistor string is accessed to create the analog signal.

* * *

A. The '436 patent shows the grouping of the top two taps with the bottom two taps on the resistor string. The other groups are formed in a symmetrical fashion about a center point. The decoding circuitry is designed to take advantage of this grouping to minimize the number of gates required to generate an analog output signal. The corresponding simplification of the decode circuitry is illustrated by the control signals shown in Figure 2.

(Fair CRX-118 at 5)

855. As to the use of a digital-to-analog converter in the practice of the Jefferson patent, Hoff testified:

A: Figure 3 of the Jefferson patent shows, as the title clearly indicates, a DIGITAL SINE WAVE GENERATOR" comprising a counter block 23, a decoder block 25, and a block 26 labelled "DIGITAL TO ANALOG CONVERTER". There is an express teaching in the abstract of Jefferson to use "a conventional digital-to-analog converter" for block 26. Figures 5 of the Roberts patent is in fact entitled

"DIGITAL-TO-ANALOG CONVERTER". The text of the Roberts patent describes the structure of Figure 5 as a "digital-to-analog circuit". The suggestion to use the digital-to-analog converter structure of Roberts in the circuit of Jefferson is therefore plainly apparent in the Jefferson and Roberts documents themselves. Using the Roberts digital-to-analog converter to implement the "DIGITAL TO ANALOG CONVERTER" block 26 of the Jefferson circuit is a simple, straightforward combination which is clearly suggested and which poses no engineering problems.

Moreover, chip designers have long been motivated to achieve smaller chip areas. With this motivation in mind, one of ordinary skill in the art would have readily recognized the suggestion to use to digital-to-analog converter structure of Figure 5 of Roberts in the DIGITAL SINE WAVE GENERATOR structure of Figure 3 of Jefferson in view of the fact that Roberts expressly teaches that this structure of Figure 5 is "a compact" digital-to-analog converter structure.

(Hoff RX-2 at 47, 48)

856. The abstract of the Jefferson '657 patent reads:

An accurate source of constant frequency pulses drives an adjustable modules digital divider, which divides the input pulse repetition rate by exact integers. The pulse repetition rate of the output of the divider is made directly proportional to the desired frequency of a sine wave that is to be generated. The output of the divider continuously clocks a four-bit-binary up-down counter from the all-zero condition to the all-one condition and then back down cyclically. This up-down counter programs a digital sine wave decoder in which logic circuits convert the binary pattern from the output of the up-down counter into binary pattern that is a stepwise approximation to a sine wave. A conventional digital-to-analog converter converts the binary sine wave decoder into a corresponding analog signal, which is filtered to remove undesirable frequency components. The result is a reasonably pure sine wave whose frequency is accurately controlled by the pulse repetition rate from the variable modules divider.

(RX 331, title page)

857. Hoff testified:

THE WITNESS: When you have a patent like the Jefferson patent which doesn't specify a particular digital to analog converter, then the engineer must choose a digital to analog converter. I mean, that's just part of the design process.

JUDGE LUCKERN: And by choosing it he goes to Roberts, is what you're talking about?

THE WITNESS: Yes. Now he has presumably an assembly of art that he can choose from.

JUDGE LUCKERN: All right.

THE WITNESS: And Roberts states in the Roberts abstract that there are -- let's see. A matrix decoder is employed and a tree decoder to minimize the physical size and element count of the tree decoder.

So there's a goal here to produce a small area which is considered desirable.

Another thing. If one is developing an integrated circuit chip -- and that's the kind of environment that we are dealing with here -- even the fact that in the Roberts patent, at Figure 6, Roberts discloses an actual layout that can be used for his digital to analog converter. That would be a considerable labor savings for the engineer who now does not have to work with a layout designer and figure out how this structure must be produced.

So, Roberts is an excellent choice of digital to analog converter to meet the requirements that Jefferson puts on the user of his patent. So that's why I believe that combination is most reasonable.

* * *

THE WITNESS: It would be the same argument as I would make for claim one. Jefferson leaves it up to the engineer to find a digital to analog converter. And the Roberts is the natural choice for him to make, because as the engineer is searching, Roberts points out that he has the advantages that one would be looking for in terms of the small size. Also, he include lay-out information to show how to produce the converter. So he has the information necessary.

Generally, this is what one would do. When you are faced with a design situation and a block is unspecified in the patent, but its function is defined, you go to the art to find that function.

(Hoff Tr. at 2904, 2905, 2914)

858. The Jefferson '657 patent teaches that a conventional digital-to-analog converter is to be used to practice the Jefferson patent. (Hoff, Tr. 2903).

859. If an engineer were to practice the Jefferson patent, the engineer

would have to look to art outside the Jefferson patent to find a suitable digital-to-analog converter structure. (Hoff, Tr. at 2903, 2904).

860. The Roberts patent indicates that one of its goals is to make a smaller digital-to-analog converter. (Hoff, Tr. at 2903-2905).

861. The Jefferson patent leaves it up to the engineer to find a digital-to-analog converter. (Hoff, Tr. at 2914).

862. When one of ordinary skill is attempting to realize a circuit which is shown in a patent in block form, and a block of the circuit is unspecified in the patent but the function of the block is defined, one of ordinary skill in the art would look to the art to find a known circuit which realizes the defined function. (Hoff, Tr. at 2914).

863. The Roberts '319 patent teaches that his circuit possesses advantages that one having ordinary skill would be looking for in terms of small size. (Hoff, Tr. at 2914).

864. The abstract of the Roberts patent reads:

> A bipolar converter for analog and digital conversion is based on a single-ended MOS chip having grounded substrate. The MOS chip includes a 2^NR ladder and an on-chip output polarity switch which establishes the polarity and range of a separate bipolar output amplifier while it minimizes the number of power supplies. The resolution of the MOS chip is effectively doubled with-out substantially increasing element count. A matrix decoder is employed in a tree decoder to minimize the physical size and element count of the tree decoder.

(RX 330, title page).

865. There is an express teaching in the abstract of Jefferson to use "a conventional digital-to-analog converter" for block 26. Figure 5 of the Roberts patent is in fact entitled "DIGITAL-TO-ANALOG CONVERTER". The text of the Roberts patent describes the structure of Figure 5 as a "digital-to-analog circuit". (Hoff RX-2, 55A, 47:7-48:5).

866. Fair admitted that "there are some references in the Jefferson patent to include any D to A converter to complete the function described" but testified that which D to A converter one selects is really within the parameters of what one is trying to design and Fair sees no specific teachings to realize the goals of what are outlined in the '436 patent. (Fair, Tr. at 3911, 3912).

867. Fair testified as to the combination of the Jefferson patent with the Roberts '882 patent:

> A. Each reference operates on very different principles and uses different structure from the claimed invention of the '436. Each of these references used a cluster of logic gates and switches to provide decoding. Those logic gates are not tied to the groupings and weighting of the resistor taps as in the '436 patent to provide an analog signal. The logic elements shown in the '436 patent are intimately related to both the weighting and the manner of grouping of the taps of the resistor string. There is no teaching in any of these references about configuring the logic to correspond to the weighting and grouping of the resistor taps in relation to the desired analog output signal.

(Fair CRX-118 at 12). Moreover, Fair testified that a unique aspect about the Ireland circuit and method of operation referring to the Figure 1 embodiment is that only one stage of switches ever changes states at the same time. Thus as the analog sine wave is produced by turning various switches on and off, only switches which are in a specific set turn on and off as a group. For example, if any switches in the first set of switches are turning either on or off, then no switches in either the second or third set of switches will change. The switches of the second set or third set will stay if they are already on or stay off if they are already off. In addition, if any switch in the third stage of switches is turning on or off, no other switches in the first or second set of switches will turn from on to off or from off to on. Thus all of the switches will stay in their current condition. Similarly, if the second set of switches are changing from on to off or off to on, none of the switches in either the first set or the second set will switch. (Fair CRX 118 at 31).

867a. With respect to the operation of the combination of the Jefferson and Roberts patent, numerous taps on the resistor of Roberts have been skipped, particularly taps 4, taps 7, taps 10 and taps 13. (Hoff Tr. at 3228). There is nothing in claims 1 and 6 that requires the use of all the taps in a particular order. There are many analog signals that will require taps to be used several time and if some analog signals using a tap two or three times and some other use a tap only once, it is reasonable to assume that some taps don't have to be sued at all. (Hoff Tr. at 3232). Hoff acknowledged that looking at Figure 1 of the '436 patent, the placement shown of the resistor taps and the multitap resistor are positioned such that a sine wave is automatically generated from the resistor string when the taps are selected in sequence. (Hoff Tr. at 3235).

868. Hoff testified that RX 228 through RX 240 are diagrams which illustrate how the Jefferson and Roberts structure produces an analog signal. He testified:

> The Jefferson patent teaches one of ordinary skill in the art to use a conventional digital-to analog converter structure in place of the block 26 entitled DIGITAL TO ANALOG CONVERTER in Figure 3 of the Jefferson patent. When this is done, the resulting structure produces an analog signal on the output of the DIGITAL TO ANALOG CONVERTER block 26. This analog signal is illustrated in Figure 4f in the Jefferson patent. The digital input signal supplied to the UP-DOWN COUNTER block 23 of the Jefferson structure is illustrated in Figure 4a of the Jefferson patent. Figures 4a, 4b, 4c, 4d and 4e illustrate the signals at other locations in the digital sine wave generator circuit of Figure 3 of the Jefferson patent. Exhibit RX 228 is a fairly accurate representation of the waveforms of Figures 4a, 4b, 4c, 4d and 4f. Exhibit RX228 however adds the status of the first, second and third control signals, a, b, c, d, e, f, and h, as well as an indication of the tap connected to the output terminal, which result when the digital-to-analog converter of Figure 5 of the

Roberts patent is employed in a digital sine wave generator of Jefferson. As illustrated in Exhibit RX 228, the UP-DOWN COUNTER 23 of Jefferson changes state in response to the digital input signal. When the output of the UP-DOWN COUNTER is passed through the decoder disclosed in the Jefferson patent, the resulting signals are as appear in the waveforms labelled "WAVEFORM OUTPUT BY SINE WAVE DECODER" in Exhibit RX 228. Exhibits RX 229 through Exhibit RX 240 illustrate how the sequential connection of selected taps of the multi-tap resistor to the output terminal occurs to generate the analog signal illustrated in Exhibit RX 228.

The first vertical column of control signals a, b, c, d, e, f, g and h result in tap N1 being connected to the output terminal as illustrated in Exhibit RX 228. Exhibit RX230 shows the corresponding status of the first, second and third switches of the Jefferson and Roberts structure. As illustrated in Exhibit RX 229, tap n1 of the multi-tap resistor is connected to the output terminal so that the resulting analog signal illustrated in Exhibit RX 228 has a voltage of zero volts.

On the next pulse of the digital input signal illustrated in Exhibit RX 228, the UP-DOWN COUNTER and the decoder cause the control signals to change, thereby connecting tap N2 of the multi-tap resistor to the output terminal of the Jefferson and Roberts structure. Exhibit RX 230 shows tap N2 connected to the output terminal during this second count of the UP-DOWN COUNTER.

Next, in response to the next pulse of the digital input signal, the UP-DOWN COUNTER and the decoder cause the control signals a, b, c, d, e, f, g and h to remain the same. Accordingly, note that the voltage of the analog signal illustrated in Exhibit RX 228 is not changed on the next pulse of the digital input signal.

On the next pulse of the digital input signal, however, note that the UP-DOWN COUNTER and the decoder cause tap N3 to be connected to the output terminal as illustrated in Exhibit RX 231.

Next, during the next pulse digital input signal, the UP-DOWN COUNTER and the decoder cause the control signals to switch so that tap N5 of the multi-tap resistor is connected to the output terminal as illustrated in Exhibit RX 232 so that the analog signal will have a voltage corresponding to the voltage on node N5 of the multi-tap resistor.

This sequence of the counter and decoder changing the control signals so that the taps are connected to the output terminal in the sequence illustrated in Exhibit RX 228 is illustrated in Exhibits RX 233 through RX 240. That is how the Jefferson and Roberts structure operates to produce an analog signal.

(RX-2 at 60 to 63)

869. Jefferson discloses an up-down counter which drives a decoder which, when combined with the digital-to-analog converter disclosed in the Roberts patent, causes the taps of a multi-tap resistor to be successively connected to an output terminal to produce a weighting which produces a sinusoidal waveform at the output of the digital-to-analog converter. (Hoff, Tr. at 2902-2903).

870. The Roberts patent discloses an actual layout of a digital-to-analog converter. (Hoff, Tr. at 2905).

871. The layout of the digital-to-analog converter disclosed in the Roberts patent would be a considerable labor savings for an engineer who needs to lay out a digital-to-analog converter in silicon. (Hoff, Tr. at 2905).

872. According to Hoff all the elements of Claim 1 of the '436 patent are found in the combination of Roberts and Jefferson. (Hoff, Tr. at 2909, RX-2 at 47-59).

873. Roberts includes layout information to show how to produce his digital-to-analog converter. (Hoff, Tr. at 2914).

874. Figure 3 of the Jefferson patent shows, as the title clearly indicates, a "DIGITAL SINE WAVE GENERATOR" comprising a counter block 23, a decoder block 25, and a block 26 labelled "DIGITAL TO ANALOG CONVERTER". (Hoff RX-2 at 47-48, 55A).

875. Exhibit RX227 shows a reasonably accurate representation of Figure 3 of Jefferson with the digital-to-analog converter structure of Figure 5 of the Roberts patent in place of the block 26 labelled DIGITAL TO ANALOG CONVERTER in Figure 3 of Jefferson. (Hoff RX-2 at 49, 59A).

876. The structure recited in the preamble of claim 1 of the '436 patent is found in the structure disclosed in the Jefferson and Roberts patents.

Lines 1 and 2 of claim 1 of the '436 patent recite "a circuit for producing an analog signal, comprising". The circuit of Figure 3 of Jefferson is in fact a circuit which produces an analog signal. The analog signal is shown in Figure 4f of Jefferson. (Hoff RX-2, 60A, 50).

877. Line 3 of claim 1 of the '436 patent recites "first and second power terminals". The first power terminal of the structure disclosed in Jefferson and Roberts is labelled "V_{REF1}" in Figure 5 of the Roberts patent, whereas the second power terminal disclosed in the Jefferson and Roberts patents is labelled "V_{REF2}" in Figure 5 of the Roberts patent. (Hoff RX-2, 61A, 50).

878. Lines 3 and 4 of claim 1 of the '436 patent recite "a multi-tap resistor connected between said first and second power terminals". Roberts discloses a multi-tap resistor connected between the first and second power terminals. The multi-tap resistor is illustrated as a series of individual resistors oriented in a compact serpentine pattern. (Hoff RX-2, 62A, 51; RX-227).

879. The Jefferson patent discloses an up down counter, some intermediate logic and it shows that logic being connected to drive a digital to analog converter. (Hoff, Tr. at 2875).

880. RX-228 is what Hoff believes is the operation of the combination of the Jefferson patent with the Roberts patent. Numerous taps on the resistor of Roberts have been skipped, particularly taps 4, 7, taps 10 and taps 13 are never used. (Hoff, Tr. at 3228).

881. U.S. Letters Patent No. 4,366,470 (the '470 patent), entitled "Converter" issued on December 28, 1982 after the '436 patent was filed for on May 18, 1981 based on application Ser. No. 232,191 (the '191 application)

filed Feb. 6, 1981. Hence the effective date of the '470 patent is Feb. 6, 1981 (see 35 U.S.C. 102(e)). Akira Takanashi and Yasuhiko Ishigami are the named inventors of the '470 patent (RX 319, CX 5)

882. The particular circuit shown in Figure 1 of the '436 patent was developed by inventor Ireland for use in the Mostek MK5380 tone dialer. (Ireland, Tr. 1152)

883. Inventor Ireland was responsible for the design of integrated circuits at Mostek when he conceived and reduced to practice the subject matter of the '436 patent. (Ireland, CX 501 at 2).

884. Inventor Ireland's work on a project for designing a new integrated circuit chip known as the Mostek MK5380 integrated tone dialer led to the invention of the subject matter in the '436 patent (Ireland, CX 501 at 2).

885. The Mostek MK5380 integrated tone dialer was designed to produce a reduced distortion and low voltage tone dialer chip for Mostek's customers. (Ireland, CX 501 at 2).

886. Distortion is the measure of difference between the tone signal generated using the actual digital circuits and the ideal tone signal specified by the telephone company. (Ireland, CX 501 at 2).

887. There were many people involved in the development project of the MK5380 tone dialer project including design engineers, production engineers, application engineers, layout technicians and other technicians. (Ireland, Tr. 3804, 3813-15; Ireland, CRX-116 at 7-8).

888. Ireland and Jimi Hellums were the design engineers for the MK5380 project. (Ireland, CRX-116 at 8).

889. Ireland was responsible for the design of the logic circuitry of the tone synthesizer during the MK5380 design project. (Ireland, CX-501 at

3).

890. Mr. Hellums was responsible for the design of the oscillator circuitry and the analog amplifiers during the MK5380 design project. (Ireland, CX-501 at 3).

891. Sandy Wixon was the production engineer for the MK5380 development project. (Ireland, CRX-116 at 8).

892. Darin Kincaid was the application engineer for the MK5380 project. (Ireland, CRX-116 at 8).

893. Dan Dovi was one layout technician working on the MK5380 development project. (Ireland, Tr. 3776, 3871-72; Ireland, CRX-116 at 8; CRX-86).

894. Ireland met with Hellums to consider different approaches to the design problems encountered during the Mostek MK5380 project. (Ireland, CX-501 at 3).

895. The technical problems encountered during the design of Mostek's MK5380 integrated tone dialer included designing a tone synthesizer circuit having a minimal chip area implementation and reduced distortion. (Ireland, CX-501 at 2-3).

896. It is a primary objective in any chip design effort to implement the integrated circuit design so that it performs the desired function using minimal silicon chip area. (Ireland, CX-501 at 2-3).

897. One of the main objectives during the design of Ireland's invention was to minimize the number of circuit elements and to reduce the chip size consumed by the tone synthesizer circuit. (Ireland, Tr. 1167-68).

898. Ireland initially designed the electrical circuit disclosed and claimed in the '436 patent. (Ireland, CRX-116 at 9).

899. Ireland considered using switch capacitor technology, a resistor ladder and a multi-tap resistor as possible designs for the tone synthesizer circuit in the MK5380 integrated tone dialer. (Ireland, CX-501 at 4).

900. Ireland became aware of the switch capacitor technology from the design efforts of another engineer at Mostek. (Ireland, CX-501 at 4).

901. The switch capacitor technique for designing the tone synthesizer circuit was a failure because it possessed inferior performance characteristics and could not achieve the desired low voltage operation needed for the MK5380 design specifications. (Ireland, Tr. 1220; Ireland, CX-501 at 4).

902. Ireland was aware of the conventional or "textbook" approach for designing the tone synthesizer circuit using resistor ladders. (Ireland, CX-501 at 4).

903. The resistor ladder approach for designing the tone synthesizer circuit was not selected because this approach was limited to the selection of discrete voltage steps during the generation of a stair-step waveform which would negatively impact distortion levels beyond the design specifications for the MK5380 integrated tone dialer. (Ireland, CX-501 at 4).

904. Ireland selected the multi-tap resistor design for the tone synthesizer circuit of the MK5380 integrated tone dialer device. (Ireland, CX-501 at 4).

905. An example of the stair-step waveform closely approximating a sine wave is shown in Figure 2 of the '436 patent. (Ireland, CX-501 at 5).

906. The stair-step waveform in Figure 2 of the '436 patent is used to approximate a sine wave utilizing a 32-step sequence which defines one period of a sinusoidal waveform. (Ireland, CX-501 at 5).

907. Ireland initially considered using four stages of switches rather than the three stages of switches shown in the '436 patent because he was familiar with this design from textbooks and engineering school. (Ireland, CX-501 at 7).

908. Ireland determined that utilizing three stages of switches rather than four stages of switches would minimize the total chip area required to support the logic circuitry. (Ireland, CX-501 at 7).

909. Ireland also considered utilizing less than three stages of switches to control the selection of taps on the multi-tap resistor. (Ireland, CX-501 at 8).

910. Ireland contemplated using one or two stages of switches, but did not seriously consider using this design because he determined almost immediately that it would require more silicon chip area. (Ireland, Tr. 1229).

911. Ireland determined that utilizing less than three stages of switches would increase the complexity of the logic circuitry and would thereby increase the chip area required to support this logic circuitry. (Ireland, CX-501 at 8).

912. Ireland conceived the three stage implementation of the logic circuitry shown in the '436 patent in October, 1980. (Ireland, Tr. 1219-20; Ireland, CX-501 at 8).

913. Ireland provided Dovi with the schematic shown in Figure 1 of the '436 patent and instructed Mr. Dovi to accomplish the layout of this circuit while keeping in mind that two of these circuits would be used on the MK5380 integrated tone dialer chip. (Ireland, Tr. 3859-60).

914. Ireland provided layout technician Dovi, with the single signal

generator circuit shown in Figure 1 of the '436 patent and it took Dovi approximately one week to suggest using the single multi-tap resistor design shown in the MK5380 schematic (CX-259). (Ireland, Tr. 1216-17).

915. Dovi suggested utilizing a shared multi-tap resistor in Ireland's circuit design and both Ireland and Dovi implemented this shared resistor design in the breadboard and layout design. (Ireland, Tr. 3864-65; Ireland, CRX-116 at 9).

916. CX-259 (an MK5380 schematic) discloses a single multi-tap resistor and two sets of control circuitry on either side of the multi-tap resistor. (Ireland, Tr. 1217-18).

917. The invention was conceived in October 1980, which corresponded to the initiation of construction of the bread board and a design review of the invention. (Ireland, Tr. 1219-20).

918. The layout design and the breadboard implementations of the MK5380 were accomplished in parallel to get through the project as fast as possible. (Ireland, Tr. 3774-75; 3861-63; Ireland, CRX-116 at 9).

919. Ireland and the other individuals working on the MK5380 project began work on a bread board implementation of the circuitry in the MK5380 design in October 1980 so that tests could be run to verify the circuit's proper performance. (Ireland, CX-501 at 8).

920. The initial version of the bread board implementation was completed in November, 1980 and a slightly modified version of the bread board implementation was completed in December 1980. (Ireland, CX-501 at 9).

921. No modifications were made to the synthesizer portion of the breadboard circuitry between the initial version of the breadboard completed in November 1980 and the slightly modified version of the breadboard completed

in December 1980. (Ireland, Tr. 3779).

922. The MK5380 tone dialer chip circuit was implemented on a breadboard and silicon between November 1980 and early 1981. (CRX-101 and CRX-102).

923. CRX 101, prepared by Hellums, has a revised issuance date of August 22, 1980 and makes reference to "BREADBOARD; Construction Evaluate".

924. Oscilloscopes are commonly used for the purpose of displaying a waveform. (Hoff, Tr. 2789).

925. Oscilloscope readouts of the output signals of breadboard circuit designs were utilized to verify the proper operation of the circuit in Figure 1 of the '436 patent. (Ireland, CRX-116 at 12).

926. The oscilloscope readout on ST00584 of CRX-087A and ST00780 of CRX-089 verify the proper operation of the circuit shown in Figure 1 of the '436 patent because each photo discloses 32 dots in each full sine wave wherein each dot represents the activation of a tap in the multi-tap resistor and the 32 dots correspond to each of the 32 steps in the signal 166 in Figure 2 of the '436 patent. (Ireland, Tr. 3872-73; Ireland, CRX-116 at 12-13).

927. The photo on ST00584 in CRX-087A was taken on December 2, 1980 as demonstrated by the customary practice of placing dates and photographer initials on the back of photos of oscilloscope readouts wherein December 2, 1980 and initials DK appear on ST00585 of CRX-087A. (Ireland, CRX-116 at 13).

928. CRX 87A represents a sinusoidal waveform (Ireland Tr. at 3783) and includes the designations: "MK5380", "12/2/80" and "D.K.". With reference to CRX 87A the handwritten designations of ST 00585 appeared on the back of ST 00584.

929. CRX 87A represents frequency spectrum that resembles the spectrum one might expect on a DTMF signal. If one were to look at a tone dialer chip

using any tone synthesizer circuit one would expect to get the frequency spectrum of CRX 87A or one very close to it but "perhaps not with as low a distortion as this one [CRX 87A]." and Ireland was not aware of any other way to get low distortion besides his circuit (Ireland Tr. at 3785; CRX 87A)

930. RX 68 is an invention disclosure by inventor Jeffrey R. Ireland dated April 2, 1981. (RX 68).

931. RX 68 states that the invention was conceived in October 1980 and testing on the invention began November 1980 and that experimental use of the invention was used on the MK 5380 chip in January 1981. (RX 68).

932. The photo on ST00780 in CRX-089 was taken on December 5, 1980 as is shown by the date on ST00781 in CRX-089. (CRX-089).

933. Testing of the first prototypes in the silicon was done not according to a formal characterization plan, but by engineers working on the project to see if the circuit was functional. (Ireland, Tr. 3838-40).

934. Tests performed on the bread boards verified that the logic circuitry shown in Figure 1 of the '436 patent functioned properly and worked as intended. (Ireland, CX-501 at 9).

935. The invention described and claimed in the '436 patent was proven to be functional and properly operating as of December 1980 when the breadboard was operating correctly. (Ireland, Tr. 3780-81).

936. Ireland, Hellums and several other people working on the MK5380 project were present when some of the first photographs of the oscilloscope readouts were taken of the tone synthesizer working properly. (Ireland, Tr. 3782).

937. Ireland and the entire engineering team confirmed that the circuit disclosed in the '436 patent functioned properly at least as early as December

2, 1980 based upon pages identified as ST00584-ST00585 in CRX-087A. (Ireland, CRX-116 at 9).

938. Pages identified as ST00584-ST00585 of CRX-087A are copies of a photograph of a single tone sinusoidal output signal from the breadboard circuit of MK5380 taken on December 2, 1980 by Mr. Kincaid, the application engineer on the MK5380 project. (Ireland, CRX-116 at 9-10).

939. The people involved with the development program of the MK5380 were elated at the positive results received from testing of the circuit in December 1980. (Ireland, CRX-116 at 10).

940. The people involved in the development project of the MK5380 tone dialer project were working 15-18 hour days in order to complete the development project and achieve significant milestones like the positive results received from the testing done in December 1980. (Ireland, CRX-116 at 10).

941. Ireland and the other individuals working on the MK5380 project fabricated silicon prototypes of the MK5380 tone dialer device implementing the logic circuitry shown in the '436 patent. (Ireland, CX-501 at 9).

942. The first silicon prototypes of the MK5380 which were completed in January 1981. (Ireland, CX-501 at 10).

943. It required little time or effort to determine how the layout of the circuit shown in Figure 1 of the '436 patent would be implemented in the MK5380 circuit design because the layout project was neither difficult nor unusual. (Ireland, CRX-116 at 18).

944. Tests were performed on the first silicon prototypes of the MK5380 device verifying that the tone synthesizer logic circuitry described and claimed in the '436 patent was completely functional and performed as

intended. (Ireland, CX-501 at 10; Ireland, CRX-116 at 10).

945. There were some minor problems with the supporting circuitry of the MK5380 tone dialer in the first silicon prototypes, but the tone synthesizer circuit disclosed in Figure 1 of the '436 patent functioned properly when implemented in silicon. (Ireland, Tr. 3840-42, 3875-77).

946. Ireland's circuit in the '436 patent functioned properly in the first revision (revision A) of the first silicon MK5380 prototypes produced in January of 1981. (Ireland, Tr. 3880).

947. Formal characterization plan tests were done late in the development program to subsequent revisions of the MK5380 design to verify proper operation of the silicon construction of the circuit. (Ireland, CRX-116 at 14).

948. Unexpected problems can arise when implementing an electrical design into silicon because the circuit is placed into a new environment where unexpected interactions occur. (Ireland, CRX-116 at 10-11).

949. The unexpected problems which arise when implementing a circuit in silicon are dealt with on a case by case basis. (Ireland, CRX-116 at 11).

950. No unexpected problems occurred when implementing the electrical circuit design shown in Figure 1 of the '436 patent in silicon. (Ireland, CRX-116 at 11).

951. Scheduling tools such as monthly planning schedules are important in a development project. (Ireland, CRX-116 at 11-12).

952. Monthly planning schedules possess accurate information on many different steps in a development project such as breadboarding, layout design, generation of samples, testing and ramp up to production. (Ireland, CRX-116 at 11-12).

953. The seven month planning schedules and the design status reports for the "5380 TONE III" show substantiate completion and evaluation of the breadboard and silicon implementations of the '436 invention before February 6, 1981. (CRX-82, CRX-83, CRX-101).

954. Other design status reports provide the engineering department with weekly status updates on work in the development project. (Ireland, CRX-116 at 12).

955. Ireland substantially contributed to the preparation of the monthly planning schedule, other design status reports and memorandum. (Ireland, Tr. 3819-20, 3854-55, 3866-70, 3877-79, 3882-85; Ireland, CRX-116 at 12).

956. Charles Johnson prepared many of the status reports and memorandums during the MK5380 development project. (Ireland, Tr. 3856-57).

957. Ireland assisted in generating supporting documentation during the development of the MK5380 including the characterization plan and the specification sheet documentation disclosed in CRX-096 and CRX-097. (Ireland, Tr. 3873-74; Ireland, CRX-116 at 14-15).

958. Ireland was substantively involved in many aspects of the MK5380 development project including the design of other circuitry utilized in the MK5380 tone dialer, breadboard design, layout design, review of supporting documentation, design rule checking, solving problems with implementing the design in silicon, providing information for preparation of status reports and schedules, and testing the breadboard and silicon implementations to verify the proper operation of the entire MK 5380 circuit design. (Ireland, Tr. 3873-74; Ireland, CRX-116 at 15).

959. Ireland's reduction of the '436 patent to practice between October 1980 (the conception date) and February 6, 1981 (the filing date of the

Takanashi application) is documented. (CRX-82; CRX-83; CRX-84; CRX-85; CRX-86; CRX-87A (ST00584-ST00585 particularly); CRX-88; CRX-89; CRX-091; CRX-092; CRX-093; CRX-094; CRX-096; CRX-101; CRX-102).

960. Ireland's further work in the MK5380 tone dialer development project between February 6, 1981 (the filing date of the Takanashi application) and May 18, 1981 (the filing date of the application for the '436 patent) is also well documented. (CRX-097, CRX-098; CRX-099; CRX-100; CRX-101; CRX-102; CRX-103; CRX-104; CRX-105; CRX-106).

961. Ireland worked diligently to reduce to practice the invention disclosed and claimed in the '436 patent between the conception date (October 1980) and the filing date of the application for the '436 patent (May 18, 1981). (Ireland, CRX-116 at 16).

962. The testimony of inventor Ireland coupled with the contemporoeus documentary evidence of record is sufficient to establish that Ireland conceived the claimed invention at least before February 6, 1981, and exercised reasonable diligence from the conception date until the filing of the '436 patent application on May 18, 1981.

963. Fair testified that Takanashi does not teach all of the elements of claims 1 and 6 of the '436 patent for the following reasons:

> A. Again, my basis for this opinion is much the same as with respect to the Hamade and Roberts references. The generation of an analog signal is an intermediate step. To attempt to use this circuit for the purposes of the circuits shown in the '436 patent would not be practical. The analog signal produced would not be easily predictable.
>
> Have you formed an opinion as to whether Takanashi can be used to generate a sine wave as contended by the respondents?
>
> A. Yes, I have.
>
> What is that opinion?

A. No, it cannot be done without significant modification that is not taught in this patent.

What is the basis for that opinion?

A. In order to generate a sine wave with the circuitry of Takanashi, both DAC's would be needed along with other additional circuitry to provide phasing information critical to the intended operation. Of course, this recombination is not taught in the Takanashi reference, and it would not be a routine matter. Without additional circuitry, the combination of the two DAC's of Figure 6 simply would not produce a sine wave.

Furthermore, the counter block 56 does not show its input signal, any internal structure, or any specific structure at all. Without such structure, it does not necessarily follow that it would work in the way that the circuits of Figure 1 of the '436 patent operate. For example, counter 101 of Figure 5 of Takanashi uses three input signals, whereas the circuit of Figure 1 of the '436 patent uses a single digital input.

(Fair, CRX-118 at 7 to 9).

964. Ireland was aware at the time of the filing of the '436 application of numerous publications that describe the use of resistive ladders in the synthesis of analog signals in general. (Ireland, Tr. at 1146).

965. An article by A. Hamade entitled "A Single Chip All-Mos 8-bit A/D Converter," IEEE Journal of Solid-State Circuits, Vol. SC-13, pages 785-791, Dec. 1978 (the Hamade article) is prior art to the '436 patent. (Order No. 117).

966. The file wrapper of U.S. Patent Application (Exhibit RX360) (Hamade file wrapper) is publicly available because it is mentioned in U.S. Patent Number 4,198,622 issued on April 15, 1980, which is also assigned to National Semiconductor Corporation. (Hoff RX-2A, 133A at 3, 4).

967. The circuit described in the Hamade patent application (Exhibit RX360) is very similar to the circuit described in the Hamade article (Exhibit RX318). (Hoff RX-2A, 133A at 3, 4).

968. Fig. 1 of the Hamade article and Fig. 1 of the Hamade patent

application are similar. (Hoff RX-2A, 133A at 3, 4).

969. The Hamade patent application describes in significant detail the structure and operation of a successive approximation register such as the SUCCESSIVE APPROXIMATION REGISTER block shown in Fig. 6 of the Hamade article (Exhibit RX318). (Hoff RX-2A, 133A at 3, 4).

970. The composite circuit described in the Hamade patent application is a three-bit analog-to-digital converter such as the analog-to-digital converter shown in Fig. 6 of the Hamade article. (Hoff RX-2a, 133A at 3, 4).

971. The Hamades file wrapper contains much more detailed structure of the successive approximation register in the Hamade article. (Hoff, Tr. at 3117).

972. Figure 1 of the Takanashi patent and Figure 1 of the Hamade article both show a 3 bit digital analog converters with three stages of switches and both show 8 taps of a resistor string. (Hoff, Tr. at 3118).

973. The Hamade article shows an analog to digital conversion technique implemented as an 8 bit D to A converter on a single chip and uses a string of resistors and a matrix of analog switches to perform high speed successive approximation conversion. (Hoff, Tr. at 3118).

974. The 8 bit D to A converter in the Hamade article would consist of 256 series resistors and 510 analog switches. The 14 switches in the Hamade article are organized into three groups: S1 and S2 (first group), S3-S6 (second) and S7-S14 (third). (Hoff, Tr. at 3119).

975. According to Hoff, the Hamadé patent application discloses a circuit which produces an analog signal at the input of the comparator 56 shown in Fig. 3; that the circuitry of one embodiment of the block 58 labeled "CONTROL LOGIC" in Fig. 3 is shown in significant detail in Fig. 4 (lines 9-

11 on page 12); that Hamadé first discloses the use of the digital-to-analog converter structure of Fig. 1 used with a "CONTROL LOGIC" block 58 and a comparator 56 to implement one embodiment of a successive approximation analog-to-digital converter; and that Hamadé then goes on to disclose and illustrate a second embodiment which is an improvement on this first embodiment because the second embodiment does not require one of the switches. (Hoff RX2 B at 4, 5).

976. According to Hoff the operation of the circuit disclosed in the Hamadé patent application is similar to the operation of the circuit shown in the Hamadé article; that the process of varying an analog voltage on the output terminal 32 according to the successive approximation technique is described in detail in the Hamadé patent application page 12 line 21 through page 16 line 26; that as described on page 16 of the Hamadé patent application lines 2-20, the value of the most significant bit A is determined first; that next the value of the second most significant bit B is determined; and that third, the value of the third most significant bit C is determined. Hoff testified that this successive approximation technique causes the stepped analog voltage present on the output terminal 32 on the inverting input of comparator 56 to converge toward the input voltage V_X. (Hoff RX-2B at 13, 14).

977. Figure 4 of Takanashi is essentially the same circuit as Fig. 6 of the Hamade article and what is labeled a successive approximation register in Hamade Figure 6 is much the same thing as shown in block 28 and labeled a control circuit in Takanashi Fig. 4. (Hoff, Tr. at 3131, 3132).

978. The successive approximation register in Hamade RX-318 functions to use two complimentary signals identified as c and c bar and to select four of

eight resistor tabs while in the Fig. 1 embodiment of the '436 patent the first means element functions by using four distinct control signals to select four of 16 resistor tabs. (Hoff, Tr. at 3132, 3233).

979. On the Hamade article, Hoff testified:

Q So, all three input signals are required for the SAR of Hamade to operate, correct?

A It uses those three signals, yes.

* * *

Dr. Hoff, simply put, the Ireland patent is not a successive approximation technique, is it?

A This particular structure, no, is not a successive approximation circuit.

JUDGE LUCKERN: And this particular structure --

THE WITNESS: By that, I mean Figure 1.

* * *

In the '436 patent, it [Figure 1] does not function by the successive feedback of any resistor tap selections to any of the control logic elements in Figure 1, does it?

A I'm not aware of any feedback shown in Figure 1.

Q But in Hamade, you must supply data as input to it in order for Hamade to operate correctly?

A For it to operate as an analog to digital converter, yes.

Q Now, if you did not supply any data as input to the Hamade and you just let the clock run, the SAR would be loaded with ones at the output of every control signal, wouldn't it?

A Well, not if you use it in the normal fashion. You'd start off with the -- because you normally generate a start signal from the clock as well, and that sets the sample rate.]

So, you would have it going through the successive approximation sequence except it would never reset the bit. So, it would start 100, 110, 111, and then it would repeat that sequence. So, it would still generate an analog signal with probably a three-state sequence.

Q So, then the output would be loaded with ones; is that correct?

A At one point in time, but when it starts the process, it's loaded with zeroes or a 100, depending on which implementation you use.

Q And if you did not supply data into the successive approximation register of Hamade, it will remain at one until a clear signal is applied to change the state; isn't that correct?

A Well, I'm making the assumption that the start signal is used in the normal fashion for analog to digital converters which is a sub-multiple of the clock. You establish the sample rate for the converter.

Q And you will agree, won't you, that the successive approximation control logic in the Hamade sequences from the most significant bit to the least significant bit by selecting one switch from the third matrix, then two switches in the second matrix, and finally four switches in the third matrix of switches, correct?

A I believe that's correct, yes.

Q Now, in this ['436] patent, it functions to proceed sequentially to select, first, the group of four of 16 switches; second, selecting two of four switches in the second group; and then one of two switches in the third group?

A I wouldn't address Claim 1 that way; no.

JUDGE LUCKERN: Are you now talking about just Figure 1 or are you talking about all of the '436 patent?

MR. BRADLEY: I'm talking about Figure 1 of the '436 patent.

THE WITNESS: You said Claim 1? No. Figure 1; yes. That's a specific embodiment and it has the 16 taps and the four by four array, two by two and one by two.

BY MR. BRADLEY:

Q The structure of the '436 as shown in Figure 1, the means for generating the first control signals, thus functions differently form the successive approximation register as shown in Hamade; correct?

A Again, for Figure 1, there's different in the specific embodiment.

Q That's what the question is direct to, is to Figure 1.

A Yes.

(Hoff Tr. at 3137-3144).

980. As for whether the Hamade patent application structure is more relevant then the Takanashi patent, Hoff testified that on the basis of "what is disclosed, the only thing different I could see about the Hamade application, it's a lot earlier." (Hoff, Tr. at 3153).

981. The Hamade and Onhi application teach the identical circuit shown in Figure 4 of Takanashi although the application gives some additional details beyond the Hamade article, the more detailed figure in the application is essentially identical to Figure 5 of Takanashi. (Fair, CRX -118 at 3).

982. Fair testified:

> A. In order to generate a sine wave with the circuitry of Takanashi, both DAC's would be needed along with other additional circuitry to provide phasing information critical to the intended operation. Of course, this recombination is not taught in the Takanashi reference, and it would not be a routine matter. Without additional circuitry, the combination of the two DAC's of Figure 6 simply would not produce a sine wave.
>
> Furthermore, the counter block 56 does not show its input signal, any internal structure, or any specific structure at all. Without such structure, it does not necessarily follow that it would work in the way that the circuits of Figure 1 of the '436 patent operate. For example, counter 101 of Figure 5 of Takanashi uses three input signals, whereas the circuit of Figure 1 of the '436 patent uses a single digital input.

(Fair CRX-118 at 8, 9)

983. The Hamade article and the Hamade patent applications address a different problem than the '436 patent. They start with an analog signal and seek to create a digital signal. (Fair, CRX-118 at 2, 3).

984. The block diagram in Figure 6 of the Hamade article published in the December 1978 IEEE Journal of Solid State Circuits (RX-318) requires an analog input signal (V_{in}), a comparator circuit, a successive approximation

register, and a D-to-A converter receiving feedback signals from the successive approximation register. (Hoff, Tr. 2823-2829; RX-318 (Fig. 6)).

985. Hoff U.S. Patent No. 4,146,882 (the '882 patent), titled "Digital-To-Analog Converter Employing Two Levels of Decoding", issued on March 27, 1979 to Marcian E. Hoff Jr., who testified as an expert for respondents, in this investigation and to John M. Huggins. (RX-320).

986. Hoff is of the opinion that claims 1-4 and 6 of would have been obvious to one of ordinary skill in the art in light of the Jefferson patent combined with the Hoff patent. As the bases for his opinion, he referenced RX 332-334. He testified that Figures 2 and 3 of his '882 patent teach the use of different types of switch matrices to select a tap on a resistor string; that because in lines 12-14 of the abstract in Jefferson's '657 patent Jefferson teaches that "DIGITAL TO ANALOG CONVERTER" block 26 can be "a conventional digital-to-analog converter," it would be obvious to one of ordinary skill in the art to utilize any well-known D/A technique, including the resistor string and switch matrix technologies shown in his '882 patent, to implement the block 26 entitled "DIGITAL TO ANALOG CONVERTER", in the Jefferson '657 patent because such a combination would result in a structure having both the advantages of the '882 patent and the Jefferson '657 patent; that the power terminals elements are the terminals labelled "V" and the ground terminals shown in both Figure 2 and Figure 3 of his '882 patent; that in the '882 patent, in both Figure 2 and Figure 3, a multi-tap resistor is shown connecting between the "V" terminal and the "ground" terminals; that Figure 2 of the '882 patent shows a first level of switches controlled by a plurality of control lines A2 bar and A2, followed by a second level of switches 32-34 driven by decoder control signals A_1A_0, A_1A_0 bar, A_1 bar A_0, A_1

bar A_0 bar; that Figure 2 and Figure 1 of the '882 patent together show how a three level (i.e. prior art of Figure 1) decode structure can be reduced to two levels (i.e. the structure of Figure 2) by using decoding rather than driving switches directly; that Figure 3 of the '882 patent shows how two levels of switches can connect to a larger multi-tap resistor having 16 taps by using decoding to generate the necessary control signals for both levels of switches; that taken together, Figures 1, 2 and 3 of the '882 patent show that a combination of decoded and undecoded control signals can be used, or the designer could use no decoding as was done in the prior art to the '882 patent, to connect a selected tap of a 16-tap multi-tap resistor to an output terminal; that the "means for responsive to a digital input signal for generating a plurality of first control signals each controlling a separate group of said first switches" is seen as the combination in Jefferson's '657 patent consisting of the UP-DOWN COUNTER 23 and SINE WAVE DECODER 25 which combination is responsive to a digital input clock signal supplied to the counter 23 as indicated in Figure 3 of Jefferson, which is included as Exhibit RX334; that in Jefferson, the counter 23 and the decoder 25 together generate the appropriate control signals 2^0 to 2^3 to control the switches in the digital to analog converter block 26, so as to generate a sinusoidal output from the digital-to-analog converter block 26; that as seen in light of the '882 patent, the control signals 2^0 to 2^3 are addresses A_0 to A_3 which control the switches of a switch matrix: that as for a "plurality of second switches each connected to a plurality of said first switches wherein each second switch is connected to no more than one of said first switches within each of said groups of first switches, and each first switch is connected to no more than one of said second switches," although the '882 patent shows two levels of switches in Figure 3, the teaching of Figures 1, 2 and 3 together is that decoded and undecoded switch arrays can be used in different combinations and it is therefore obvious that the single-level four-to-one multiplexer represented by switches 63, 64, 65 and 66 of Figure 3 of the '882 patent could also be realized by a two level four-to-one multiplexer switch structure, as shown in Figure 1 of the '882 patent; that in Exhibit RX332, Hoff has redrawn Figure 3 to show this "trivial" modification; that in Exhibit RX332, a first group of second switches is controlled by a control signal A_1 and a second group of second switches is controlled by a signal A_1 bar; that each second switch is connected to no more than one of the first switches controlled by AND gate 69, to no more than one of the first switches controlled by AND gate 70, to no more than one of the first switches controlled by AND gate 71, and to no more than one of the first switches controlled by AND gate 72; that as for "means responsive to said digital input signal for generating a plurality of second control signals each controlling a separate group of said second switches," Figure 3 of the Jefferson '657 patents shows UP-DOWN COUNTER 23 and SINE WAVE DECODER 25 to be responsive to the digital input clock signal to the counter 23 and counter 23 and decoder 25 generate appropriate second control signals to control the switches in the digital-to-analog converter block 26; that as for "a plurality of third switches each connected to a plurality of said second switches and to an output terminal wherein each third switch is connected to no more than one of said second switches within each of said groups of second switches and each second switch is connected to no more than one of said third switches", in the obvious structure shown in Exhibit RX332, one third switch is controlled by third control signal A_0 whereas the other third switch is controlled by third control signal A_0 bar;

that the third switch controlled by signal A_0 is connected only to one second switch controlled by signal A_1 and only to one second switch controlled by signal A_1 bar; that similarly, the third switch controlled by signal A_0 bar is connected only to one second switch controlled by signal A_1 and only to one second switch controlled by signal A_1 bar; that as for "means responsive to said digital input signal for generating a plurality of third control signals for controlling said third switches wherein the operation of said third switches connects said taps one at a time to said output terminal to produce said analog signal of said output terminal," in Figure 3 of the Jefferson '657 patent, UP-DOWN COUNTER 23 and SINE WAVE DECODER 25 are responsive to the digital input clock signal input into counter 23; that counter 23 and decoder 25 together generate the appropriate third control signals to control the switches in the digital-to-analog converter block 26 to produce an analog output signal on the digital-to-analog converter output. (Hoff RX-2 at 89 to 95).

987. The Figures of the Hoff '882 patent are as follows:

> FIG. 1 is a schematic illustrating a prior art MOS digital-to-analog converter.
>
> FIG. 2 is a schematic drawing of an MOS digital-to-analog converter fabricated in accordance with the present invention. This schematic is primarily used to illustrate the switching logic employed in the present invention.
>
> FIG. 3 is a schematic drawing of a digital-to-analog converter of the present invention where the resistance strings are folded to eliminate cross-over connection.
>
> FIG. 4 is a schematic drawing illustrating alternate interconnections between resistance strings. This particular interconnection scheme is used to minimize the effects of MOS processing variations.
>
> FIG. 5 is a plan view of a portion of a substrate illustrating the circuit layout employed in the digital-to-analog converter array of the present invention.

FIG. 6 is a cross-sectional elevation view of the substrate of FIG. 5 taken generally through section line 6 -- 6 of FIG. 5.

FIG. 7 is a schematic drawing of the ends of two adjacent resistor strings of a converter. This drawing is used to describe the use of the "dummy" contacts employed in the presently preferred embodiment.

FIG. 8 is a schematic drawing of resistor strings in the converter coupled to additional resistors to provide non-linear conversion; and

FIG. 9 is a block diagram of a system which employs a plurality of converters coupled to operate as a single digital-to-analog converter.

(RX320, col. 2).

988. Hoff testified:

Claim 2 of the '436 patent recites "The circuit recited in claim 1 wherein said taps are selected on said resistor to produce voltage steps weighted such that said analog signal is a sinusoid". This claim does not recite that the resistances of any resistors are varied or weighted in any way. Claim 2 merely states that the taps of the multi-tap resistor are selected to produce voltage steps that are weighted such that the analog signal is a sinusoid.

As explicitly taught by Jefferson in Figure 4f of the Jefferson patent, the DIGITAL SINE WAVE GENERATOR of Jefferson operates to produce weighted voltage steps such that the analog signal output by the DIGITAL TO ANALOG CONVERTER better represents a sinusoid. As seen in Figure 4f of Jefferson, some of the voltage steps in the resulting analog signal have greater magnitudes than do other of the voltage steps in the analog signal. Because the DIGITAL-TO-ANALOG CONVERTER disclosed in Figure 5 of the Roberts patent generates an output signal by selecting a tap on the multi-tap resistor and connecting that tap to the output terminal, the Jefferson and Roberts structure discloses all the recitations of Claim 2 of the '436 patent.

(Hoff RX-2 at 81)

989. Hoff testified:

Q But isn't it true that in the '436 patent the taps are connected or weighted to produce sinusoids and this is set forth in the patent at Column 1, lines 66, 68 and Column 2, lines 1 to 4?

A Yes. That may be disclosed in the patent, but this does not appears to me to be a means plus function claim. So I'm reading the claim as it's written, defining the words as they're used in the patent. And the patent uses the word selected to include the process of operating the switches to choose a tap. And so, consistent with that, I believe it includes the method that would be disclosed by the combination of Jefferson and Roberts.

Q But you don't disagree that with respect to the structure described in column 2, it clearly states that taps are weighted and can be connected to produce a sine wave; correct? Column 2, lines 1 to 4?

A Yes.

Q And in operation, the teaching is that each tap on the resistor string in Figure 1 is sequentially selected one at a time and the resistors values are weighted to produce a voltage step so that by sequential selection of resistors it generates a sine wave; correct?

A Yes.

Q And that is how Claim 2 can be interpreted, if it is to be read in accordance with the specification; correct?

A But I'm saying it can also be read in this other manner, and I believe it is entirely consistent with the specifications.

Q But it can also be read in the manner that is taught in the specifications in Column 2; correct?

A It can be read both ways; yes.

Q The combination that you suggest of Jefferson with Roberts operates differently. That Roberts leaves certain switches off all the time in order to produce the sine wave; correct? Which would solve the unused taps in your combination?

A The Jefferson/Roberts combination does perform in that manner.

(Hoff, Tr. at 3240, 3241).

990. RX-228 is what Hoff testified is the operation of Jefferson and Roberts. In the combination, numerous taps on the resistor of Roberts have been skipped, particularly taps 4, taps 7, taps 10 and 13 are never used. CX-518 correctly shows the unused taps in the position of the analog signal that

one had shown in RX-228. In Roberts, it is necessary to omit certain taps because the resistors all have the same value, and some must be skipped to have different heights of stairs to more closely approximate the sine wave. In RX-228 it is the combination that is producing the sine wave. Certain taps are not used but the resistors are still used. (Hoff, Tr. at 3228, 3230, 3231, 3232).

991. In the Figure 1 embodiment each tap is used exactly twice in a cycle. (Hoff, Tr. at 3223).

992. In the Figure 1 embodiment of the '436 patent there are no taps that are not used and none of the taps are skipped. (Hoff, Tr. at 3234).

993. In the Figure 1 embodiment of the '436 patent the 16 taps are addressed sequentially one after another in building the sine wave. (Hoff, Tr. at 3235).

994. In Figure 1 of the '436 patent, when one turn on switches 88, one turns on switch 90 at the same time and one accesses the two taps and turns on switches 116 and 116 and does the ultimate selection farther down the lines. (Hoff, Tr. at 3235).

995. In Figure 1 of the '436 patent when the taps are selected in sequence, the placement shown of the resistor taps and the multi-tap resistor are positioned such that a sine wave is automatically generated from the resistor string. (Hoff, Tr. at 3235).

996. Referring to the Jefferson-Hoff combination, Hoff testified that Figure 4 of Jefferson's '657 patent inherently performs and teaches sequential selection of taps to produce voltage steps weighted such that the output analog signal represents a sinusoid.

997. According to Fair the Roberts '319 patent does not generate a sine

wave as called for in claim 2 because claim 2 calls for weighted taps and although the '436 patent specification refers to the selection of the taps in some order, according to Fair the only way shown to create a desired wave shape is to place the taps on the resistor in a weighted fashion. In Figure 1 of the '436 patent the taps on the resistor are always accessed in the same sequence. (Fair CRX-118 at 7).

998. Fair testified:

> In addition, the '436 patent taught, and claimed in claim 2, a new combination of switches, decode and resistor structure in which the weighing of the resistor values, by the position of connections on the taps will automatically generate a sine wave. The sequential resistors do not have equal value; they each have a different value, to provide a smooth sine wave that sequentially uses each tap on the resistor. This combination is not found in or suggested in any prior art reference of record in this proceeding.

(Fair CRX-118 at 24, 25).

999. Hoff is of the opinion that the Jefferson and Roberts combination discloses all the elements of claim 3, in one instance referring to only Figure 5 of Roberts (RX-2 at 82, 83) but later testifying that each and every element of claim 3 "is present in the structure of Figures 4 and 5 of the Roberts patent "as follows":

> Figure 5 of the Roberts patent discloses all of the additional recitations contained in claim 3 of the '436 patent. For example, the multi-tap resistor of Figure 5 of Roberts has 16 taps just as is recited in claim 3 of the '436 patent. Furthermore, the digital-to-analog converter of Figure 5 of the Roberts patent has 16 first switches, organized into four groups. The first group is controlled by common first control signal a. The second group is controlled by common first control signal b. The third group is controlled by common first control signal c. The fourth group is controlled by common first control signal d. Accordingly, the structure of Figures 4 and 5 of the Roberts patent has the four control signals a, b, c and d recited in claim 3 of the '436 patent. Furthermore, the digital-to-analog converter of Figure 5 of the Roberts patent has four second switches organized into two groups. Two of the second groups are controlled by common second control signal e. The remaining two second switches are controlled by common second signal g. The structure of Figures 4 and 5 of the Roberts patent therefore

has the four second switches recited in claim 3 of the '436 patent. The digital-to-analog converter of Figure 5 of the Roberts patent also has two second control signals. The first second control signal is labeled e. The second control signal is labeled g. Roberts therefore also has the two second control signals recited in claim 3 of the '436 patent. The digital-to-analog converter of Figures 4 and 5 of the Roberts patent also has two third switches. One of the third switches is controlled by control signal f. The other third switch is controlled by third control signal h. The circuit of Figures 4 and 5 therefore also has the two third control signals recited in claim 3 of the '436 patent. The digital-to-analog converter structure of Figures 4 and 5 of the Roberts patent therefore also has the two third control signals, control signal f and control signal h.

(Hoff, RX-2B at 35-37).

1000. Hoff admitted that the 16 taps in the Figure 1 embodiment of the '436 patent are addressed sequentially one after another. (Hoff, Tr. at 3235).

1001. Hoff testified that the Jefferson patent renders obvious claim 4 for the reasons set forth in his analysis of claim 1 and further relied on certain deposition testimony of inventor Ireland. (Hoff RX-2 at 96, 97).

1002. Hoff testified that it is very common "in building this type of structure to do what we call a bread board"; that when one attempts to implement the various switches used in digital to analog converters one can buy a package "that has maybe two switches or four switches or eight switches" in it; that it is natural to use "one of those"; and that these devices most commonly have the disable lead as an integral part of the device. Hence Hoff testified that whenever one has one of these circuits and one builds a breadboard, one automatically gets the disable function. (Hoff. Tr. at 2917, 2919).

1003. The Roberts '319 patent does not show a means for driving said first control signals to the off-state thereof in response to a disable signal. (Hoff Tr. at 3243)

1004. Hoff testified as to claim 4:

Claim 4 calls for "The circuit recited in claim 1 including means for driving said first control signals to the off state thereof in response to a disable signal" Jefferson renders obvious claim 4 for the reasons set forth in my analysis of Claim 1 and further considering Jeffrey Ireland's deposition of July 17, 1992. Mr. Ireland testified as follows in his deposition (pages 130:21-131-18):

Q: By the way, you didn't consider it new at the time you filled out your invention disclosure, which was Respondent's Exhibit 65, to use a disable signal to drive control signals to an off state, did you?

A: I've stated a number of times what I felt was the invention disclosed in my disclosure and in the 436 Patent.

Q: So the answer is that you did not consider it novel to drive a control signal to an off state using a disable signal, is that correct?...

A: Yes, I knew that that technique had been used.

(Hoff, Tr. at 96, 97).

1005. Hoff testified:

The Hamadé article, Exhibit RX318C, teaches, in its Figure 8, that a resistor string digital to analog converter really comprises a resistor string and a switch matrix. Such a switch matrix is also commonly referred to as an analog multiplexer in the art of digital design. It was very common at the time of filing of the '436 patent for analog multiplexers to have a common disable function. Indeed, as admitted by Jeffrey Ireland, the alleged inventor of claim 4 of the '436 patent, it was not novel to drive a control signal to an off state using a disable signal. As examples of how common it was to provide a disable signal to disable a switch matrix multiplexer, consider the Fairchild F4052/34052 dual 4-channel analog multiplexer, the Fairchild F4051/34051 8-channel analog multiplexer, the National MM454/MM554 4-channel commutator, the National AH0140 series of dual DPST analog switches, the National AM3705/AM3705C eight-channel MOS analog multiplexers. All of these parts, all available well prior to the filing of the '436 patent, include an extra input which can disable the switches of the matrix by driving the control signals which control the switches to the off state. Using any of those switch matrix multiplexer structures to implement a first level of switching in a multi-tap resistor digital to analog converter, such as the digital to analog converters of Hamadé, Hoff, or Roberts, would have automatically provided the disabling of the first level of switches as recited in claim 4 of the '436 patent.

Moreover, even if one were not aware of the above analog multiplexers, it would nevertheless still have been obvious to one of ordinary skill in the art to disable the circuit from producing an analog signal by disconnecting the output terminal from all the taps of the multi-tap resistor. One of ordinary skill in the art would have readily recognized that disabling the first switches, in the digital-to-analog converter of Figure 5 of Roberts, would serve to disconnect the output terminal from all the taps of the multi-tap resistor. One obvious way to accomplish this, considering the fact that the first switches in Figure 5 of the Roberts patent are n-type FET switches, is to drive all the first control signals low during the disable condition. Extending a disable active high input into each of the four NOR gates of Roberts which control the first level of switches is therefore the most straightforward and easiest way of disabling the first switches. Because this is the exact structure disclosed in the '436 patent as represented by reference numerals 42 and 44, the well known disable structure of the prior art is structurally equivalent to the disable structure disclosed in the '436 patent.

Q: I hand you Exhibit RX329. What is this exhibit.

A: Exhibit RX329 is an exhibit which shows the circuit diagram of the National AM3705 data sheet RX328. I have circled one arrangement of transistors on this diagram. That arrangement of transistors implements a four input NOR gate. The top input to that NOR gate is the disable input. I have labelled that input "disable signal" on Exhibit RX329. I've labelled the other three inputs to the NOR gate with the letter designations "A", "B" and "C" on that same diagram. I've labelled the output of the NOR gate with a designation "control signal". The output of this NOR gate controls the analog switch. I've labelled that analog switch with the term "switch". The copy of this diagram is a little bit hard to read so I have labelled the input and output connections to the switch on the diagram.

Q: How does the structure of Exhibit RX329, the National AM3705, compare to the structure disclosed in Exhibit RX329 "for driving said first control signals to the off state thereof in response to a disable signal".

A: The structures are structurally equivalent. Both make use of NOR gates with an extra input provided to provide a disable signal. And in each case, the function of the disable signal is to drive the control signals output by the NOR gates to the off state.

(Hoff, RX-2 at 84 to 87)

1006. Referring to claim 4 of the '436 patent Fair testified that none of the references put forth by the respondents show such a disable signal in a circuit such as that specified by the combination of claim 1 and claim 4.

With respect to data sheet references RX 328, RX 350, RX 351, RX 352 and RX 353, Fair testified:

> A. Although these data sheets may be argued to show a disable signal in combination with logic gates, they do not suggest the combination specified by claim 4. In particular, they do not suggest the placement in the overall circuitry specified by claim 4. This placement provides an important advantage in the overall circuitry specified by the combination of claim 1 and claim 4. In operation, the discrete input voltages on the taps of the resistor are disconnected from the rest of the circuit during the disable operation. The placement of this disable function is not the simplest placement in the context of the overall circuit. However, it turns out to be the best placement in the circuit of Figure 1. None of these references suggest it.

(Fair, CRS-118 at 21, 22).

1007. Fair is of the opinion that claim 6 of the '436 patent is not found in the Jefferson/Roberts combination because of a difference in switching arrangement. Thus he testified:

> A. The switching arrangement of the Ireland patent is in sharp contrast to that taught by the Roberts patent (RX330) and other patents of prior art. Generally, in the prior art such as Roberts, from one state to the next many different switches will be turning on and off, including switches at each of the different levels. For example, in the invention of Roberts, if one wishes to switch the access from tap 2 to tap 3, switches in both the second and third set of switches must change simultaneously in order to accomplish the switching. In addition, if Roberts is building a sine wave using the combination suggested by respondents of Jefferson and as taught in their Exhibit RX228, the Roberts structure must switch from tap number 3 to tap number 5, while completely passing over tap number 4. This will cause switches in both the first set of switches and the second set of switches to be switched simultaneously, with the timing properly worked out to avoid discontinuities or glitches in the output wave. Unfortunately, the structure of Roberts would tend to introduce glitches and problems in the output because each of the signals has a different path length. For example, as previously discussed, the signals of switches G and H have a longer path length than the switches of signals E and F. This creates the situation in which both signals can be high at the same time, inadvertently providing two taps on the resistor connected to the output at the same time for a brief period of time. Roberts is required to have special structure after his D to A converter to deal with this potential problem.

On the other hand, Ireland avoids these numerous problems by providing automatic de-glitching structure NOR gates 58 and 60 which ensure that the outputs are never both high at the same time. In addition, only one set of switches in the Ireland patent switches at any one time, minimizing the noise which will be introduced into the line and permitting the output to be provided as quickly as possible.

(Fair, CRX-118 at 33, 34).

1008. Hoff testified as to claim 6 and the Jefferson/Roberts patent:

Q: Dr. Hoff, you have also testified that all the steps of Claim 6 of the '436 patent are found in the Jefferson and Roberts patents. Will you please tell the court where each and every one of these steps recited in Claim 6 of the '436 patent is found in the Jefferson and Roberts patents?

A: I'd be happy to. As I have previously testified, the Jefferson and Roberts patents suggest and in fact lead one of ordinary skill in the art to combine the DIGITAL-TO-ANALOG CONVERTER structure of Figure 5 of Roberts into the DIGITAL SINE WAVE GENERATOR structure of Figure 3 of Jefferson. The resulting structure performs all the steps recited in Claim 6 of the '436 patent.

Q: Where do you find the limitations of the preamble of Claim 6 of the '436 patent in the Jefferson and Roberts patents?

A: The preamble of Claim 6 of the '436 patent recites "a method for generating an analog signal in response to a digital input signal, comprising the steps of". The Jefferson and Roberts structure operates to generate an analog signal on the output terminal node 34 of Figure 5 of the Roberts digital to analog converter in response to a digital input clock signal supplied to UP-DOWN COUNTER 23 of Figure 3 of Jefferson.

Q: Where do you find the next element recited in Claim 6 of the '436 patent?

A: Line 3 of Claim 6 of the '436 patent recites "generating a plurality of discrete voltage signals". The multi-tap resistor disclosed in Figure 5 of the Roberts patent generates a plurality of discrete voltage signals on the respective taps of the multi-tap resistor.

Q: Where do you find the next step recited in Claim 6 of the '436 patent?

A: Lines 4 and 5 of Claim 6 of the '436 patent recite "generating a plurality of first command signals in response to said digital input signal". The Jefferson and Roberts structure generates the plurality of first command signals a, b, c and d as shown in Figure 5 of the Roberts patent in response to the digital input signal supplied to the UP-DOWN COUNTER 23 of Jefferson.

Q: Where do you find the next element of Claim 6 of the '436 patent?

A: Lines 6 through 9 of Claim 6 of the '436 patent recite "selectively routing a group of discrete voltage signals through a set of first switches in response to said first command signals which operate said first switches". First switches 84 of Figure 5 of the Roberts patent selectively route a group of the discrete voltage signals on the taps of Roberts' multi-tap resistor in response to the first command signals a, b, c and d which operate the first switches. There are four different sets of first switches shown in Figure 5 of the Roberts patent. Each set of first switches is controlled by a common first command signal.

Q: Where do you find the next step recited in Claim 6 of the '436 patent?

A: Lines 10 and 11 of Claim 6 of the '436 patent recite "generating a plurality of second command signals in response to said digital input signal". The Jefferson and Roberts structure generates a plurality of second command signals e and g in response to the digital input signal supplied to the UP-DOWN COUNTER 23 of Jefferson Figure 3.

Q: Where do you find the next step recited in Claim 6 of the '436 patent?

A: Lines 12 through 17 of Claim 6 of the '436 patent recite "selectively routing a subgroup of said discrete voltage signals, where said subgroup at discrete voltage signals is derived from said group of discrete voltage signals, through a set of second switches in response to said second command signals which operate said second switches". A first set of two second switches is shown in Figure 5 of Roberts connected by the common second command signal e. A second set of two second switches is also shown in Figure 5 of the Roberts patent commonly controlled by the common second command signal g. Second command signals e and g operate the four second switches. The four second switches selectively route a subgroup of the group of discrete voltage signals selectively routed through the first group of switches.

Q: Where do you find the next step recited in Claim 6 of the '436 patent?

A: Lines 18 and 19 of Claim 6 of the '436 patent recite "generating a plurality of third control signals in response to said digital input signal". The structure of Jefferson and Roberts generates a plurality of third control signals f and h in response to the digital input signal supplied to the UP-DOWN COUNTER 23 of Figure 3 of Jefferson.

Q: Where do you find the next step recited in Claim 6 of the '436 patent?

A: Lines 20 through 25 of Claim 6 of the '436 patent recite "selectively routing a one of said discrete voltage signals where said one of said discrete voltage signals is derived from said subgroup of discrete voltage signals, through a set of third switches to an output terminal in response to said third control signals which operate said third switches". Figure 5 of the Roberts patent discloses two third switches. One of said third switches is controlled by a third control signal f whereas the other third switch is controlled by another third control signal h. These two third switches selectively route one of the subgroup of discrete voltage signals routed through the second switches to the output terminal node 34.

Q: Where do you find the next step recited in Claim 6 of the '436 patent?

A: Lines 26 through 28 of Claim 6 of the '436 patent recite "repeating the above steps to produce an analog output signal which comprises a series of discrete voltage signals". The structure of Jefferson and Roberts operates by repeatedly connecting different taps of the multi-tap resistor to the output terminal in such a way that an "analog output signal" which comprises a series of "discrete voltage signals" is present on the output terminal. Jefferson in fact illustrates this "analog output signal" in Figure 4f of the Jefferson patent. Accordingly, the operation of the Jefferson and Roberts structure performs all the steps recited in Claim 6 of the '436 patent.

(Hoff, RX-2 at 74 to 80).

VI. INFRINGEMENT OF THE '436 PATENT INVOLVING RESPONDENTS, OTHER THAN HMC AND UMC[1]

A. SMC and Lonestar

1009. Respondent SMC has purchased from HMC telecommunication chips bearing the following model numbers: HM9102A, HM9110B, HM9112A, HM9122, HM9123, HM91530, HM91550, HM91620, HM91650, HM9187A, HM9101, HM9104, HM9114, HM9116, HM9119, HM9120, and HM9121. (CX-369, Response to Request No. 1; CX-519).

[1] See also the next Section VII on "Importation and Sale." This Section VI and Section VII are overlapping.

1010. SMC's telecommunication products containing HMC telecommunication chips are sold by SMC for importation into the United States. (CX-369, Response to Request No. 4).

1011. [THERE IS NO FF 1011]

1012. [THERE IS NO FF 1012]

1013. [THERE IS NO FF 1013]

B. <u>Tranbon and Columbia</u>

1014. [THERE IS NO FF 1014]

1015. (ST 142)[2] Tranbon has purchased telecommunication chips from HMC's agents

(CX-447; CX-509, Stipulation No. 104).

1016. (ST 143) Tranbon has purchased at least HMC telecommunication chips. (CX-447; CX-509, Stipulation No. 106).

1017. (ST 144) Tranbon has sold telephones containing HMC telecommunication chips to Columbia. (CX-448; CX-509, Stipulation No. 107).

1018. (ST 145) Tranbon has sold to Columbia telephones bearing Tranbon model nos. TE-601F and TE-605L that contain telecommunication chips manufactured by HMC or UMC. (CX-448; CX-509, Stipulation No. 112).

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[2] Included in this section is a reference to the corresponding finding of ST. Respondents have objected to the corresponding ST finding on the ground that the evidence relied on is not admissible against HMC and/or UMC. ST's finding 142 to 146 make reference to CX-447, CX-448, and CX-509. Order No. 135 did state that those exhibits were admitted with the express condition that they may not be used by ST to prove any of its claims against HMC and/or UMC.

C. Conair

1019. Conso Electronics, which has been one of Conair's suppliers, has purchased telecommunication chips (model numbers UM91260A and UM95087) directly from UMC. (CX-406, p. UM002718) The telecommunication products that Conair imports and sells include telephones containing telecommunication chips manufactured by, at least, HMC (Part No. HM9102) and UMC (Part No. UM912210). (CX-311, Response to Interrogatory No. 5(a); CPX-53) UMC and HMC supply, or have supplied, chips to Conair's telephone suppliers. (CX-311, Response to Interrogatory No. 5(a); CX-406, p. UM02718; CX-80, p. HT6140).

1020. The telecommunication products that Conair imports and sells include telephones containing telecommunication chips (Part No. HM9102) manufactured by HMC. (CPX-53).

1021. Dialer E. Business Electronics Co. and G-Tek Electronics Corporation, which are two of Conair's suppliers, have purchsed telecommunication chips directly from HMC. (CX-80, p. Ht6140; CX-311, Response to Interrogatory No. 9(c)).

D. NAFTC

1022. The telecommunication products that NAFTC imports and sells include telephone that contain telecommunication chips (Part No. HM9102) manufactured by HMC. (CPX-51).

1023. Huston Electronics Co., Ltd., which is one of the manufacturers of telecommunication products imported by NAFTC, has purchased HMC telecommunication chips. (CX-80, p. HT6142; CX-324).

E. Spectra

1024. Spectra buys, or has bought, telecommunications products from Cen Phone and Picotronics that contain the following chips: UM9151-3, UM91210C, UM91210, HM9102, UM9102D, UM91270, and HM91650. (CX-370, Response to Request No. 5, CPX-55).

1025. The following products that Spectra imports into the United States (and which have been identified above) contain the following telecommunication chips:

MODEL NUMBER	CHIP
OP-1, TP-3 (Pulse Only)	UM9151-3
OP-1/TPS, TP-3/TPS, KTP (Tone/Pulse)	UM91210C
DP-1, TL-6, TL-7A	HM9102, UMC91210 (before 1/92) HM9102 (after 1/92)
TL-8	UM9102D
TL-9, FP-90	HM91650
FP-102A	UM91270

(RX-370, Response to Requst No. 4)

VII. Importation and Sale[3]

1026. HMC has sold to entities in the United States telecommunication chips alleged by ST to infringe the patents-in-suit. (CX-376, Response of HMC to Staff's Int. No. 7).

1027. Telecommunication products manufactured by SMC and imported into the United States by Lonestar contain, or have contained, telecommunication chips manufactured by HMC. (CX-325, Response of SMC to ST's Int. No. 1; CX-519; CX-369, Response of SMC to ST's Request No. 1; see also CX-378, Response of Lonestar to ST's Int. No. 4(b)).

1028. The model numbers of telecommunication chips manufactured by HMC

[3] See also the preceding Section VI on Infringement. This Section VII and Section VI are overlapping.

and found in telecommunication products which have been imported into the United States include at least the following:

i. HM9102. (CX-370, Response of Spectra to ST's Request Nos. 4-5; CPX-51; CPX-53)

ii. HM91650. (CX-370, Response of Spectra to ST's Request No. 4)

1029. According to HMC's list of customers, HMC has sold telecommunication chips directly to:

i. Dialer E. Business Electronics Co., which has sold telecommunications products to respondents Conair Corporation and Columbia Telecommunications Group, Inc. (CX-80, p. HT6140; CX-311, Response of Conair to ST's Int. No. 9(c).

ii. G-Tek Electronics Corporation, which has sold telecommunications products to respondent Conair. (CX-80, p. HT6140; CX-311, Response of Conair to ST's Int. No. 9(c)).

iii. Huston Electronics Co., Ltd., which has sold telecommunications products to respondent North American Foreign Trading Corporation. (CX-80, p. HT6142; CX-324, Response of NAFTC to ST's Int.).

iv. Respondent Tranbon which has sold telecommunications products to respondent Columbia. (CX-80, p. HT 6141; CX-310, Response of Columbia to ST's Int. No. 9(c)).

1030. United Microelectronics Corporation (UMC) exports, or has exported, to the United States telecommunication chips that ST contends infringe the patents-in-suit. (CX-382, Response of Lonestar to Staff's Int. No. 3).

1031. Telecommunication chips manufactured by UMC are found in products such as telephones which are imported into the United States. (CX-368, Response to Request No. 1-3; CX-370, Response to Request No. 5-6).

1032. Unicorn Microelectronics (Unicorn) is subsidiary of UMC and is a California corporation with its principal place of business at 3350 Scott Blvd., Building 48 and 49, Santa Clara. California. (CX-382, Response to Interrogatory No. 4).

1033. During the past three years, UMC has had approximately twenty distributors that sell UMC's products in Europe, the Far East, and the United States. Unicorn is UMC's only distributor in the United States during the past three years. (Hsuan, CPX-16 at 75-76).

1034. UMC has sold to Unicorn in the United States telecommunication chips that ST contends infringe the patents-in-suit. (CX-382, Response to Interrogatory No. 7; CX-327, Response to Interrogatory No. 22).

1035. UMC has shipped to Unicorn telephone dialer products that were sold by Unicorn in the United States. (CX-382, Response to Interrogatory No. 6).

1035a. According to UMC's list of customers, UMC has sold telecommunication chips directly to:

a. Cen Phone Co., Ltd., which has sold telecommunications products to respondents North American Foreign Trading Corporation and Spectra Merchandising International, Inc. (CX-406, pp. UM002581, UM002715 (model nos. UM91210C and UM91260C); CX-324, Response to Interrogatories; CX-370, Response to Request No. 5)

b. Conso Electronics (Far East Ltd.), which has sold telecommunications products to respondent Conair Corporation. (CX-406, p. UM002718 (model nos. UM91260A and UM95087); CX-365, Response to Request Nos. 5-6).

c. Huston Electronics Co., Ltd, which has sold telecommunications products to respondent North American Foreign Trading Corporation. (CX-406, p. UM002754 (model UM91210C); CX-324, Response to Interrogatories).

d. Picotronics Industries, Ltd., which has sold telecommunications products to respondent Spectra. (CX-406, p. UM002796 (model nos. UM91210C and UM91270); CX-370, Response to Request No. 5).

e. Primatronix Ltd., which has sold telecommunications products to respondent Spectra. (CX-406, p. UM002797 (model no. UM91270); CX-370, Response to Request No. 5).

f. S.T.Y. Electronics Ltd., which has sold telecommunications products to respondent Columbia Telecommunications Group, Inc. (CX-406, p. UM002801 (model no. UM91210C); CX-371, Request Nos. 5 and 6)

g. Respondent Tranbon Electrical Co., Ltd., which has sold telecommunications products to respondent Columbia Telecommunications Group. (CX-406, p. UM002671 (model no. UM91215A); CX-310, Response to Interrogatory No. 9(c))

1036. SMC manufactures telecommunication products which are imported into the United States exclusively by Lonestar (CX-378, Response of Lonestar to Staff's Int. No. 4(b); CX-325, Response of SMC to ST's Int. No. 4).

1037. SMC has exported telecommunication equipment, or sold such equipment for export, to the United States. (CX-380, Response of SMC to Staff's Int. Nos. 3(a), 4(a)).

1038. The telecommunication products manufactured by SMC and imported by Lonestar into the United States contain telecommunication chips manufactured by UMC and HMC. (CX-325, Response of SMC to ST's Int. No. 1; CX-369, Response of SMC to ST's Request Nos. 1 and 2; see also CX-378, Response of Lonestar to Staff's Int. No. 4(b)).

1039. SMC has purchased from HMC or Hualon Electronics (H.K. Ltd.) telecommunication chips bearing the model numbers identified in Attachment A of CX-519. (CX-325, Response of SMC to ST's Int. No. 1; CX-519; CX-369, Response of SMC to ST's Request No. 1).

1039a. SMC has purchased from UMC or from Component Supplies Ltd. (The Hong Kong agent of UMC) telecommunications chips bearing the model numbers identified in Attachment A of CX-520, including the UM95087. (CX-325, Response of SMC to ST's Interrogatory No. 1; CX-520)

1040. SMC's telecommunications products containing HMC or UMC telecommunication chips are sold by SMC exclusively to Lonestar for importation into the United States. (CX-369, Response of SMC to ST's Request Nos. 4-6; CX-378, Response to Interrogatory No. 4(b)).

1041. The following telecommunication products, which SMC has sold to Lonestar for importation into the United States, contain telecommunication chips manufactured by HMC or UMC:

MODEL NUMBER	MODEL NAME
618 S	Hi-Tones SL
688	Mega Phone
911	Inner Works
912	Slim Star
933	Invisible Phone
888	Mega Phone
626	Multi Function Speaker Phone
955	Hands Free Dialing Phone
981	Neon Phone
639, 639 CVN, 639S	Lean Machine
Alf Phone	Alf Phone
659	Lighted Dial

(CX-369, Response of SMC to ST's Request No. 8)

1042. (ST 472)[1] Tranbon has a manufacturing facility located in Shenzen,

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[1] Included in this section is a reference to the corresponding finding of ST. Respondents have objected to the corresponding ST finding based "on evidence not admissible against HMC and UMC". ST's findings 472 to 479 make reference to CX 80, CX 310, CX 374, CX 404, CX 405, CX 447, CX 448 and CX 509. Of these, only CX 447, CX 448 and CX 509 were admitted with the express condition that they may not be used by ST to prove any of its claims against HMC and/or UMC. (_See_ Order No. 135 which issued on December 28, 1992. _See_ also ST's final exhibit list.)

China. All of Tranbon's export orders are manufactured at that location. (CX-509, Stipulation No. 116; CX-447).

1043. [THERE IS NO FF 1043]

1044. (ST 474) Tranbon has purchased HMC telecommunication chips bearing model no. HM91510A. (CX-509, Stipulation No. 105; CX-497; CX-80, p. HT6141).

1045. [THERE IS NO FF 1045]

1046. (ST 476) Tranbon manufactures telecommunications equipment which is imported into the U.S. by, inter alia, respondent Columbia (CX-374, Response of Columbia to Staff's Int. No. 4(b); CX-310, Response of Columbia to St's Int. No. 9(c); CX-404; CX-405; CX-448).

1047. (ST 477) The telecommunications equipment manufactured by Tranbon and imported by Columbia into the U.S. contains telecommunication chips that, ST alleges, infringe the patents-in-suit. (CX-374, Response of Columbia to ST's Int. No. 4(b); CX-310, Response to No. 9(c); CX-448).

1048. [THERE IS NO FF 1048]

1049. [THERE IS NO FF 1049]

1050. NAFTC imports and sells telecommunications products. (CX-379, Response of NAFTC to Staff's Int. No. 2; CX-323, Response of NAFTC to ST's Int. No. 7).

1051. The products that NAFTC imports are wholesaled to major retail chains by NAFTC's subsidiary, Unisonic Products Corporation. (CX-323, Response of NAFTC to ST's Int. Nos. 7-8; CX-379, Response of NAFTC to Staff's Int. No. 2).

1052. The following telecommunications products are imported into the United States by NAFTC (listed by type and model number):

FEATURE PHONES

MODEL	FEATURES
840V	Volume Control and Amplifier, 10 Memory
850V	Volume Control and Amplifier, 14 Memory
851V	Volume Control and Amplifier, 14 Memory
9170	Big Button
9191	Big Button, 10 Memory
9173	Big Button, 10 Memory
9178	14 Memory
170V	Big Button
173V	Big Button, 10 Memory

TRIMLINE PHONES

MODEL	FEATURES
433	Last Number Redial
443	Backlit Keypad, Last Number Redial
445	Big Button, Backlit Keypad, Last Number Redial
455V	Volume Control and Amplifier, Backlit Keypad, Electronic Hold
473	14 Memory, Backlit Keypad
475	14 Memory, Backlit Keypad, Big Button
477V	Volume Control and Amplifier, 14 Memory, Backlit Keypad, Big Button
478	Wide Base, 14 Memory, Backlit Keypad
479V	Wide Base, Volume Control, 14 Memory, Backlit Keypad
6913	See Through, 13 Memory
5430	Last Number Redial
6434	Big Button
6444	Big Button, Backlit Keypad
6452	Backlit Keypad
6462	3 Memory
6472	3 Memory
69002X	See Through
9603	See Through, 13 Memory

(CX-324, Response of NAFTC to ST's Interrogatories and Document Request).

1053. The following companies manufacture the telecommunications products that NAFTC imports into the United States:

(i) Sinopac International Corp., 2000 Belcher Street (FM2025), Cleveland, Texas, 77327;

(ii) National Telecommunication System Ltd., 14/F, Shing Dao Industrial Bldg., 232 Aberdeen Main Road, Aberdeen, Hong Kong;

(iii) Huston Electronics Co., Ltd., 6/F., No. 27 San Chun Street, Shu-Lin, Taipei, Taiwan; and

(iv) Cen Phone Co. Ltd., 3/F, Flat A & B, Universal Ind. Centre, 23-25 Shan Mei Street, Fotan Shatin New Territories, Hong Kong.

(CX-324, Response of NAFTC to ST's Interrogatories and Document Requests).

1054. Huston Electronics Co., Ltd., which is one of the manufacturers of the telecommunications products imported by NAFTC, has purchased telecommunication chips directly from HMC. (CX-80, p. HT6142; CX-324, Response of NAFTC to ST's Interrogatories and Requests for Documents).

1055. Conair imports finished telephones and answering machines from the Orient into the United States, and sells these products through its in-house personnel and rep organizations. (CX-311, Response to Interrogatory Nos. 7 and 10; CX-375, Responses to Interrogatory Nos. 2-3).

1056. Conair imports and sells telecommunication products, including telephones, that contain telecommunication chips. (CX-365, Response of Conair to ST's Request Nos. 1-2).

1057. Conair purchases finished telephones and answering machines from various suppliers in the Orient. (CX-311, Response of Conair to ST's Interrogatory No. 7; CX-375, Response of Conair to ST's Interrogatory Nos. 2-3).

1058. The following telecommunication products have been purchased by Conair for importation into the United States:

MODEL NUMBER	MODEL NAME
SW205BKN	Neon Brights Telephone
SW104-1	Slim Design Telephone (discontinued)
SW104	Slim Design Telephone
BE100	Cameo (private label)
BE100	Ultra Slim Design
CTP5000	Cordless Telephone
PR1004	Designer Desk Telephone (discontinued)
XS1004	Designer Desk Telephone
SW204	Slim Design Telephone
SW550	Neon Tube Desk Telephone
TCR1000	Telephone, Clock, Radio

PR1006	Prima Telephone with Lighted Dial (discontinued)
PR6231	2-Line Speakerphone
PR6204	Big Button Telephone
SW2550	Designer Desk Telephone
PR622113	Memory Speakerphone
PR6210	Platform Feature Telephone
PR6220	Platform Feature Telephone (discontinued)
PR6230	2-Line, 20 Memory Telephone
PR5001	Big Button, Slim Design Telephone
SW4502	Big Button Platform Telephone (discontinued)
SW2502	Traditional Desk Telephone
SW3502	Traditional Wall Telephone
PR62005	Memory Big Button Telephone
SW120BK	Cellular Slim-Line Telephone
SW120BKM	Wall-Mounted Slim Phone
XS1000	Designer Corded Telephone

(CX-365, Response to Request No. 3; CX-402)

1059. Conair buys, or has bought, telecommunication products containing telecommunication chips from the following companies, and has imported the telecommunication products from these companies into the United States: (a) Wisetronics Ltd. (Hong Kong); (b) G-Tek Electronics Corporation (Taiwan); (c) Hua Chang Electronics Co., Ltd. (Hong Kong); (d) Auraland Investments, Ltd. (Hong Kong); (e) Dialer E. Business Electronics Co. (Taiwan); (f) Dai Hwa Industrial Co., Ltd. (Taiwan); (g) Formula Electronic SDN/BHD (West Malaysia); (h) Conso Electronics (Far East Ltd.) (Hong Kong); and (i) Lintel Electronics Industries, Ltd. (Hong Kong). (CX-365, Response of Conair to ST's Request Nos. 5-6; CX-311, Response of Conair to ST's Interrogatory No. 9(c); CX-401; CX-413).

1060. Each of the companies from which Conair has purchased telephones is a manufacturer of telephones, with the exception of Dialer E. Business Electronics Co., which sells telephones manufactured by Formula Electronic. (CX-413).

1061. UMC and HMC supply, or have supplied, chips to Conair's telephone suppliers. (CX-311, Response of Conair to ST's Interrogatory No. 5(a); CX-

406, p. UM002718; CX-80, p. HT6140).

1062. The majority of the telephones that Conair imports are manufactured in Malaysia. (CX-311, Response to Interrogatory No. 9(e)).

1063. (ST 500)[2] Lonestar imports telecommunication products, including telephones, into the United States. Lonestar has sold telecommunications products within the United States after importation. (CX-506, Stipulation No. 140; CX-322, Response of Lonestar to ST's Interrogatory No. 7; CX-378, Response of Lonestar to Staff's Interrogatory No. 3).

1064. (ST 501) Lonestar wholesales to distributors and retailers the consumer electronics and telecommunication products that it imports. (CX-322, Response of Lonestar to ST's Interrogatory No. 7).

1065. (ST 502) Planned Technologies, H.K. Ltd., an affiliate of Lonestar, is Lonestar's buying company in Hong Kong. (CX-322, Response of Lonestar to ST's Interrogatory Nos. 5 and 7).

1066. (ST 503) The telecommunication products that Lonestar currently imports into the United States are manufactured in China and Hong Kong. (CX-322, Response of Lonestar to ST's Interrogatory No. 9(e)).

1067. (ST 504) SMC manufactures the telecommunication products that Lonestar imports. (CX-378, Response of Lonestar to Staff's Interrogatory No. 4(b)).

1068. (ST 505) Each of the telecommunication products identified above

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[2] Included in this section is a reference to the corresponding finding of ST. Respondents have objected to the corresponding ST finding based "on evidence not admissible against HMC and UMC." ST's findings 499 to 507 make reference to CX 322, CX 368, CX 369, CX 378, CX 397, CX 506 and CPX 54. Of these, only CX 397 and 506 were admitted with the express condition that they may not be used by ST to prove any of its claims against HMC and/or UMC (See ST's final exhibit list).

that Lonestar has purchased for importation into the United States contains telecommunication chips. (CX-368, Response of Lonestar to ST's Request No. 4).

1069. (ST 506) Lonestar buys, or has bought, for importation into the United States telecommunication products from SMC containing telecommunication chips manufactured by UMC or HMC. (CX-368, Response of Lonestar to ST's Request of Nos. 1-2; CPX-54; CX-369, Response to Request Nos. 4-6, 8).

1070. (ST 507) The following telecommunication products have been purchased by Lonestar for importation into the United States:

MODEL NUMBER	MODEL NAME
618 (618 P, 618 S)	Hi-Tones SL
718	Slim Star
939	Neo Classic
688	Mega Phone
911	Inner Works
912	Slim Star
699	Mega Phone Deluxe
922	Retro Phone
933	Invisible Phone
888	Mega Phone
623	Multi Function Telephone
626	Multi Function Speaker Phone
955	Hands Free Dialing Phone
981	Neon Phone
800	Uno
639, 639 CVN, 639P, 639S	Lean Machine
651	Granite Phone
Alf Phone	Alf Phone
989, 989 S	Decorator
696	Multi Function
Time/Life Phone	Time/Life Phone
641	Memory Telephone
659	Lighted Dial
966	Neo Classic

(CX-368, Response of Lonestar to ST's Request No. 3; CX-397; CX-398)

1071. Spectra imports and sells telecommunication products, including telephones, in the United States. (CX-506, Stipulation No. 150; CX-381, Response of Spectra to Staff's Interrogatory No. 3; CX-391).

1072. Spectra imports telecommunication products containing telecommunication chips into the United States. (CX-370, Response of Spectra to ST's Request No. 2).

1073. Spectra has sold in the U.S. imported telecommunication equipment containing chips that, ST contends, infringe the patents-in-suit. (CX-370, Response of Spectra to ST's Interrogatory No. 3).

1074. Spectra buys, or has bought, telecommunication products containing telecommunication chips from the following manufacturers: (a) Picotronics Industries, Ltd. (Hong Kong); (b) Primatronix Ltd. (Hong Kong); (c) Cen Phone Co., Ltd. (Hong Kong); (d) Wilson Electronics Co., Ltd. (Taiwan); and (e) H.A. Systems Taiwan Corp. (Taiwan). (CX-370, Response of Spectra to ST's Request No. 5; CX-394; CX-395).

1075. Spectra purchases, or has purchased, telecommunication products containing telecommunication chips from each of the five manufacturers identified above, and has imported such products into the United States. (CX-370, Response of Spectra to ST's Request No. 6).

1076. [THERE IS NO FF 1076]

1077. Spectra has purchased the following telecommunication products for importation into the United States:

MODEL NUMBER	MODEL NAME
OP-1	One-Piece Phone
DP-1	Decorator Phone
FP-102A	Feature Phone
FP-90	Euro-Style Phone
ITD-300	Telephone Answering Device
KTP	Two-Piece Phone
TAD-250	Telephone Answering Device
TL-7A, TL-6	Trim-Phone
TL-8	Transparent Trim-Phone
TL-9	Euro-Style Memory Phone
TP-3	Two-Piece/One-Piece Phone
TP-3/TPS	Two-Piece/One-Piece Phone

OP-3	Hands-Free Phone

(CX-370, Response of Spectra to ST's Request No. 3; CX-396; CPX-55)

1078. The telecommunication products that Spectra imports into the United States and which have been identified above contain telecommunication chips. (CX-370, Response of Spectra to ST's Request No. 4).

1079. The following products that Spectra imports into the United States contain the following telecommunication chips:

MODEL NUMBER	CHIP
OP-1, TP-3 (Pulse only)	UM9151-3
OP-1/TPS, TP-3/TPS, KTP (Tone/Pulse)	UM91210C
DP-1, TL-6, TL-7A	HM9102, UMC91210 (before 1/92) HM9102 (after 1/92)
TL-8	UM9102D
TL-9, FP-90	HM91650
FP-102A	UM91270

(CX-370, Response of Spectra to ST's Request No. 4)

1080. (ST 519)[3] Columbia markets, imports, and sells telecommunications products, including telephones. (CX-310, Response to Interrogatory Nos. 4 and 7).

1081. (ST 520) Tranbon, which is located in Taiwan, is a manufacturer and seller of telecommunications products to Columbia containing chips which

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[3] Included in this section is a reference to the corresponding finding of ST. Respondents have objected to the corresponding ST finding based "on evidence not admissible against HMC and UMC". ST's findings 518 to 528 make reference to CX 80, CX 310, CX 371, CX 374, CX 404, CX 405, CX 406, CX 410, CX 448, CX 507 and CPX 58. Of these, only CX 410, CX 448 and CX 507 were admitted with the express condition that they may not be used by ST to prove any of its claims against HMC and/or UMC. <u>See</u> Order No. 135. (<u>See</u> also ST's final exhibit list).

ST contends infringe the patents-in-suit. (CX-374, ALJ NEC East (213)NECALJ.PRSS05; CX-448). Columbia did not respond to ST's Requests for Admission (CX-371), which were served upon Columbia on October 6, 1992. ST's Requests for Admission to Columbia are therefore deemed admitted for purposes of this action. 19 C.F.R. § 210.34.

1082. (ST 521) Columbia has purchased from Tranbon, and imported and sold in the United States, telecommunication products containing telecommunication chips which ST contends infringe the patents-in-suit. (CX-310, Response of Columbia to ST's Interrogatory No. 9; CX-374, Response of Columbia to Staff's Interrogatory Nos. 3-4; CX-371, ST Request for Admission Nos. 1-4).

1083. (ST 522) Those telecommunication products sold by Tranbon to Columbia which ST contends infringe the patents-in-suit are manufactured in China. (CX-310, Response of Columbia to ST's Interrogatory No. 9(e)).

1084. (ST 523) Tranbon has purchased telecommunication chips directly from both UMC and HMC. (CX-80, p. HT6141; CX-406, p. UM002671).

1085. (ST 524) Columbia has imported into the United States and sold telecommunication products containing telecommunication chips which ST contends infringe the patents-in-suit. (CX-371, Request for Admission No. 2; CX-374, Response to Interrogatory Nos. 3-4; CX-448).

1086. (ST 525) Columbia also imports into the United States telecommunication products manufactured and/or sold by the following companies: (a) Browns Communications Ltd. (Hong Kong); (b) Cherish Enterprises Co., Ltd. (Taiwan); (c) Dialer E. Business Electronics Co., Ltd. (Taiwan); (d) Double Kingdom International Ltd. (Hong Kong); (e) Hentak Limited (Taiwan); (f) Teleken Limited (Taiwan); and (g) Youmax Enterprises Co., Ltd. (Taiwan), (CX-507, Stipulation No. 170; CX-410).

1087. (ST 526) Dialer E. Business Electronics Co., Ltd., one of Columbia's suppliers, has purchased telecommunication chips directly from HMC. (CX-80, p. HT6140).

1088. (ST 527) Columbia imports, or has imported, into the United States telephones manufactured by S.T.Y. Electronics Ltd. (Hong Kong) and Victory Concept Industries, Ltd. (Hong Kong). Certain of these telephones use telecommunication chips alleged by ST to infringe the patents-in-suit. (CX-371, Request Nos. 5 and 6).

1089. (ST 528) The following telecommunications products have been purchased by Columbia from S.T.Y Electronics or Victory Concept for importation into the United States: Heart Shaped Telephone, High-Heeled Shoe Telephone, and AC-400 Trimline Telephone. (CX-371, Request No. 7; CPX-58).

VIII. DOMESTIC INDUSTRY - ECONOMIC PRONG ('436 PATENT)

1090. Laurent Bosson is the President and Chief Executive Officer of SGS-Thomson America and Vice-President of Manufacturing for SGS-Thomson Microelectronics N.V., in charge of all matters relating to manufacturing activities world-wide. (Bosson, CX-496 at 1-3; Bosson, Tr. at 1958).

1091. Charles R. Neuenschwander is president of Neuenschwander Associates of Dallas, Texas. Neuenschwander worked for ST or its predecessors from 1980 through January 1991, holding the following positions: Manager of Application Systems Development (1980-1984; Manager of Financial Analysis and Reporting (1984-1988); and Manager of Internal Control (1988 - January 1991). Neuenschwander has had occasion to perform work for ST in connection with several legal proceedings and remains familiar with the business operations, records and information systems of ST and its predecessors. (Neuenschwander, CX-498 at 1-5).

1092. Richard Robinson has served as Director of Corporate Intellectual Property for ST in Carrollton, Texas and St. Genis, France, since January 1, 1992. (Robinson, CX-499 at 1-2).

1093. Lloyd E. Adams has served as Chief Accountant for ST at Carrollton, Texas, since October of 1988. (CX-495 at 1-2).

1094. ST has dialer production facilities at its plant in Carrollton, Texas and in Singapore. (Bosson, CX-496 at 1958).

1095. At the time of the decision to establish the Singapore facility,

(Bosson, CX-496 at 3, 6; Bosson, Tr. at 1970, 1972).

1096. Production of tone dialer chips in Singapore began in 1991. (Neuenschwander, CX-498 at 12; Neuenschwander, Tr. at 1920-21; Haldi, CX-497 at 21).

1097.

(Bosson, CX-496 at 4; Bosson, Tr. at 1963; Neuenschwander, Tr. at 1946).

1098. Bosson testified that competition over the last few years from UMC, HMC and Winbond required that ST do everything possible,

to continue to compete. (Bosson, CX-476 at 4). Bosson testified at the hearing as follows:

> Q My question, sir, to you is you -- ST-Thomson was not even aware of the presence of HMC, UMC or Winbond in the market for dialer chips until 1990; isn't that true?

* * *

THE WITNESS: So, okay. Thank you, Your Honor.

So the process was the following. In '88 I had been informed in our company that the competition was tough on those products and the competition was coming from some Taiwanese competitors. That's it.

After that, in the end of 1989 and beginning of '90, I try to understand why
and I tried to ask two marketing people what was happening.

At that time I heard that some competitors were called UMC, HMC, and Winbond. This is the process I know.

(Bosson, Tr. at 1962).

1099. ST intends to continue to make tone dialer chips at the Carrollton in order to maintain Carrollton as a secondary source for tone dialer chips. (Bosson, CX-496 at 6; Neuenschwander, Tr. at 1945-47)

1100. Bosson testified that consistent with ST's general practice for important products such as telecommunication products, ST is committed to having a second source that can manufacture tone dialer chips. (Bosson, Cx-496 at 6).

1101. "Second sourcing" is practiced frequently in the semiconductor industry. (Pleatsikas, Tr. at 3400).

1102. Customers prefer that manufacturer-suppliers have a second source to avoid interruptions in supply due to problems at the primary facility or excess demand. Secondary sourcing also provides the SGS-Thomson corporate family with the flexibility to shift production from Singapore to Carrollton as the need arises, or respond to external developments, such as changes in the exchange rates or the impending trade agreement between the United States, Mexico and Canada. (Bosson, CX-496 at 6-7; Haldi, CX-497 at 25-26).

1103. Haldi testified that Congressional approval of the North American Free Trade Agreement, in conjunction with further increases in the assembly of telephone instruments in Mexico, could be an important future consideration leading to an increase in tone dialer chip production at the Carrollton facility. (Haldi, Cx-497 at 26).

1104. Production of dialer chips at the Carrollton facility covered by the '436 patent will continue indefinitely. Because of ST's experience at its Singapore facility,

(Bosson, CX-496 at 5-6; Bosson, Tr. at 1989; Haldi, CX-497 at 25)

1105. Haldi testified that ST's production of tone dialer chips at Carrollton "is, and is projected to remain, significant," citing production of tone dialer chips through October of 1992 and the testimony of Bosson that ST will continue to produce at least tone dialer chips each year. (Haldi, CX-497 at 22).

1106. Haldi testified that second source capability at Carrollton provides real economic value to the SGS-Thomson family and means that the investment in the Carrollton plant and equipment and the employment of labor and capital in Carrollton provide significant value even if they are not currently used to produce volumes of tone dialer chips as large as the volumes produced in prior years. (Haldi, CX-497 at 26)

1107. Neuenschwander does not believe that Singapore was fully satisfying the demand for all chips practicing the '436 patent in 1992, stating that although Singapore has produced more chips than Carrollton, carrollton still produced something close to the order of .

(Neuenschwander, Tr. at 2097-98)

1108.

(Bosson, Tr. at 1989).

1109. A "fab" is a production line. There are two fabs at the Carrollton facility, the fab 4 and fab 6, of which only the fab 4 is used for production of tone dialer chips. (Neuenschwander, CX-489 at 7).

1110. Fabrication of tone dialer chips is a process in which a raw silicon wafer is passed through a number of manufacturing steps, including a series of photographic, chemical and heat treatments, creating layers of various materials on the surface of the silicon to form transistors, capacitors and connecting circuitry. The face of each wafer is broken into several hundred rectangles (called "dice"), each of which, when separated, becomes a separate tone dialer chip. (Neuenschwander, CX-498 at 10; Neuenschwander, Tr. at 1910; CPX-43).

1111. During fabrication, the circuit design is transferred photolithograhically to the wafer by means of a "mask," which is a thin glass plate on which the circuit pattern is printed. A "mask set" is a group of masks which, when processed in the proper order, help build the circuits of a wafer. The application of each mask is separate step or "level" in the manufacturing process. (Neuenschwander, CX-498 at 13; Neuenschwander, Tr. at 1911).

1112. There are mask levels for the tone dialer chips fabricated in Carrollton in 1992, and the average number of mask levels for all products fabricated in fab 4 at Carrollton in October 1992 was . (Neuenschwander, CX-498 at 13-14.

1113. Neuenschwander testified that there is a strong correlation between the number of masks and the time and labor required to make a given product. (Neuenschwander, CX-498 at 14).

1114. The time and labor required to build a tone dialer wafer as compared to other wafers fabricated in fab 4 is about the same. (Neuenschwander, CX-498 at 14).

1115. The per wafer standard direct labor cost for tone dialer chips is while the average direct labor cost for fab 4 is (Neuenschwander, CX-498 at 14).

1116. The costs of fabricating all of the tone dialer chips fabricated at Carrollton account for of the total labor costs, while EWS, encapsulation and testing account for only (Neuenschwander, CX-498 at 25-26; Neuenschwander, Tr. at 1912).

1117. All of the manufacturing of the circuits on the tone dialer chips is complete at the end of the wafer manufacturing process. (Neuenschwander, CX-498 at 11).

1118. Wafers can be sold upon completion of the fabrication process and ST has sold dialer chips in such a form within the last few years, however, most chips are encapsulated and subjected to final testing before sale. (Neuenschwander, CX-498 at 11).

1119. During encapsulation, wires are attached from the silicon to larger metal pins, and the chip and wires are encapsulated in a plastic or ceramic material with the pins protruding from the package for connection to electrical boards. (Neuenschwander, CX-498 at 11; Neuenschwander, Tr. at 1911).

1120. Neuenschwander testified that tone dialer chips are tested twice, "once just before the encapsulation -- actually, before they are separated into the individual dye, and then they go through a final test stage after encapsulation." (Neuenschwander, Tr. at 1911-12).

1121. All encapsulation and final testing is currently performed by ST's affiliate in Muar, Malaysia, although ST has conducted encapsulation and final testing of some tone dialer chips in the past. (Neuenschwander, CX-498 at 11-12).

1122. In the case of tone dialer chips, the number of gross dice on a wafer ranges from approximately to approximately typically yielding from approximately to approximately 600 "good" dice. (Neuenschwander, Tr. at 1912, 2083-84).

1123. In order to be an effective second source, a fab must manufacture product on a continuing basis to keep up the skills of the workforce and to maintain its status as a qualified customer. If the production process at Carrollton were not utilized, its capacity would be lost, and ST would be required to restart and requalify the process. (Bosson, CX-496 at 8-7; Neuenschwander, Tr. at 1927-28).

1124. In order for a Fab to maintain its ability to produce a product efficiently and to maintain its status as a qualified source, a fab should produce an optimal number in the range of wafers per month, however, a fab could retain its capabilities while producing only wafers per month, and some months may even be missed. (Bosson, CX-496 at 7; Bosson, Tr. at 1927; Neuenschwander, Tr. at 1927).

1125. Major customers "qualify" suppliers. Qualifying a supplier means that the fabs have been audited and approved by the customers as an authorized or qualified source. Fabs are also systematically re-audited. (Bosson, CX-596 at 7).

1126. The term "job lot production" refers to the practice of using the same equipment for fabrication of more than one product. (Haldi, CX-497 at 23).

1127. The dialers at issue are made in job lot production runs. Job lot production is used because the quantity that needs to be produced is not sufficient to support continuous production using dedicated equipment. (Haldi, CX-498 at 23).

1128. Directives to start wafers are called production requests or launch requests, and are issued by ST's European offices. Periodically, ST's European offices will send a forecast rather than a direct launch request, and that forecast serves to give warning to the Carrollton plant to think about their capacity in the future. (Neuenschwander, Tr. at 1918).

1129. Neuenschwander testified that upon receipt of a launch request, start up of production can be almost instantaneous and that launch requests can be acted on at any time, so long as there is an opening as to capacity on the production line. (Neuenschwander, Tr. at 1919-20).

1130. Regarding the process leading to the issuance of ST's launch requests, Neuenschwander testified that a production launch request begins with an analysis of market demand, sales, inventory levels, and the inventory level that management wants to maintain. Following such an analysis, the quantity of production over a specific time period is determined, and a launch request issues to each of the locations, i.e., Carrollton and Singapore. (Neuenschwander, Tr. at 2225-26).

1131. If there is too much inventory for a product, ST would not start production of more of that product, either at the primary or secondary fabrication plant. (Bosson, Tr. at 1986).

1132. Due to market demand and the level of inventory, ST can sometimes go as long as three months without fabricating a specific model of a product. (Bosson, Tr. at 1979).

1133. Mr. Bosson believes that ST will continue to produce at least a minimal level of dialer chips per year at its Carrollton facility, depending on demand. (Bosson, CX-596 at 8-9).

1134. Neuenschwander testified that Carrollton and Singapore facilities have a "split of devices," i.e., certain tone dialer chip models are only produced at the Carrollton facility. (Neuenschwander, Tr. at 1947).

1135. With respect to the number of tone dialer chip models produced in Singapore and Carrollton, Neuenschwander testified that the study he did in 1992 showed that six tone dialer chip models are produced in Singapore, and that if one counts the VO series the as one (as the MK 53732), the total number of models produced in Carrollton is four. (Neuenschwander, Tr. at 2094-95).

1136. There are three different models of the MK 53732: the VO 55, 56 and 60. (Neuenschwander, Tr. at 2094-95).

1137. Models MK 5371, MK 53761 and MK 53762 are also produced at Carrollton. (Neuenschwander, Tr. at 2095).

1138. With respect to whether the transfer of production from one location to another indicates anything about whether production at the first the first location will continue, Neuenschwander testified that, depending on whether masks were retained at the first location, whether the proper wafer stock was retained at the first location, and whether personnel at the first location retained the experience for running the process to produce the devices, the transfer of production from one location to another is no indication, one way or the other, as to whether production will continue at the first site. (Neuenschwander, Tr, at 2096-97).

1139. ST retains masks in Carrollton for a large number of tone dialer chip models, including the MK 5373, MK 5375, MK 5376, MK 53730, MK 53731, MK 53732, MK 53761, MK 53762 and MK 53763. (Neuenschwander, CX-498 at 15; Neuenschwander, Tr. at 2095, 2097).

1140. ST also has retained the masks, wafer stock, equipment, and experienced workforce at Carrollton to produce additional tone dialer chips. (Neuenschwander, Tr. 2095-97).

1141. From 1988 through October 1992, ST's total production of dialer chips covered by the '436 patent was as follows:

1988
1989
1990
1991
1992

(CX-485, Table 3).

1142. Of the tone dialer chips produced by ST in 1991, were produced in Carrollton, and were produced in Singapore. (CX-485, Table 5).

1143. Of the tone dialer chips produced by ST in 1992 (through October), were produced in Carrollton, and were produced in Singapore. (CX-485, Table 5).

1144. The breakdown, by quarters, of the tone dialer chips produced in 1992 (through October) at Carrollton and Singapore is as follows:

	Carrollton	Singapore
Q1		
Q2		
Q3		
Q4		

(CX-485, Table 5).

1145. With respect to the production of tone dialer chips at the Carrollton facility in 1992, Dr. Pleatsikas testified as follows:

> Q You were aware that in the first quarter of 1992, SGS-Thompson made over dialer chips in Carrollton?
>
> A I am aware of that, yes.
>
> Q And that on an annualized basis, that would be approximately [sic]?
>
> A Yes. I believe that is correct.
>
> Q And you would agree with me that these qualities [sic] are not diminimous [sic]?
>
> A I would agree that the quantity of chips is not diminimous [sic], yes.

(Pleatsikas, Tr. at 3400).

1146. As to what the term "significant," as used in 29 U.S.C. § 1337(a)(3)(A), means to an economist, Dr. Pleatsikas stated that "[e]conomists in general might disagree on precisely what the term "significant" means, but I think most, if not all, would agree that significant means something other than de minimis." (Pleatsikas, RX 5 at 19).

1147. Dr. Haldi stated that the level of domestic tone dialer production at Carrollton is highly significant from an economic perspective. ((Haldi, CX-497 at 19).

1148. During the first 10 months of 1992, approximately of the tone dialers produced by ST were fabricated at its Carrollton facility. (Haldi, CX-497 at 21; CX-485, Table 5).

1149. From 1988 through June 1992, ST's sales of tone dialer chips covered by the '436 patent were as follows:

1988

1989
1990
1991
1992

(CX-485, Table 4).

1150. The relationship between the total number of products fabricated in the Carrollton Fab 4 during 1992 (fourth quarter production forecasted) and the number of tone dialer chips fabricated in the Carrollton Fab 4 during 1992 (fourth quarter production forecasted) is as follows:

	Total Production	Dialer Production
Q1		
Q2		
Q3		
Q4		

(Neuenschwander, CX-498 at 20, Table 5).

1151. Neuenschwander testified that ST completed fabrication of tone dialers in October 1992 at Carrollton, and that ST also placed approximately additional tone dialers into the production line at Carrollton during the months of October and November 1992, which should result in the production of at least tone dialer chips by the end of 1992, bringing the total 1992 production of tone dialer chips at Carrollton to (Neuenschwander, CX-498 at 18-19, 26; CX 420).

1152. Neuenschwander testified that he contacted ST's production scheduler at Carrollton to confirm that the tone dialer chips have been placed into production. (Neuenschwander, Tr. at 2061).

1153. CX-420 is a production request for production of V055 tone dialer chips, which is a version of the MK53732, directing ST to produce V055 wafers. which should result in the production of approximately dice in November 1992. (Neuenschwander, CX-498 at 27-28; CX-420).

1154. CX-427 is a launch request, dated October 29, 1992, requesting ST to produce wafers of its MK53762 in December 1992; to produce wafers of the MK53761 and wafers of the MK53762 in each of January and February 1993; and wafers of the MK53761 in March 1993. (Neuenschwander, CX-498 at 29; CX 427).

1155. Based on the production requests received by ST for the first quarter of 1993, Neuenschwander projected production of tone dialer chips in Carrollton for the period January through March 1993. By annualizing the first quarter production request, Neuenschwander projected production of tone dialer chips at Carrollton for all of 1993, an increase in production over 1992 of (Neuenschwander, CX-498 at 19, Table 4).

1156. The production cycle for the dialer chips can run from three to six weeks from commencement to completion of fabrication (excluding encapsulation). (Neuenschwander Tr. 2028: 16-23).

1157. Having the Carrollton facility as a second source for dialer chips enhances the value and significance of ST's investments. By maintaining second source capability for tone dialer chip production, the Carrollton facility is able to ramp up to an even higher level of production upon short notice. (Haldi, CX-497 at 24-25).

1158.

(Bosson, CX-496 at 4-5; Neuenschwander, Tr. 1947; Haldi, CX-497 at 25).

1159. Bosson testified that start-up problems do occur with production of integrated circuit devices at a new site but generally are ironed out within a six to eight month period, not more,

(Bosson, Tr. 1981, 1987).

1160. (Bosson, Tr. 1987).

1161.

(Bosson, CX-496 at 4-5; Neuenschwander, Tr. 1947; Haldi, CX-497 at 25-26).

1162.

(Neuenschwander, CX-498 at 22, 25; Bosson, CX-496 at 5; Haldi, CX-497 at 26-27).

1163. Bosson testified that this investigation has not influenced ST's decision to continue to make tone dialer chips in Carrollton. (Bosson, Tr. 1988).

1164. In June 1992, wafers of the MK 5371 were produced in Carrollton. (CX-418A, ST 43638, ST 43494; Neuenschwander, Tr. at 2088-93).

1165. tone dialer chips were completed in Carrollton during the months of April, May and July of 1992. (Neuenschwander, Tr. at 2027-28; RX-374).

1166. RX-12, 14, and 15 are production forecasts, dated November 21, October 8, and August 2, 1991, respectively. RX-12 shows a for each of the months from January 1992 through November 1992 on the line relating to dialers. RX-14 shows for each of the months from December 1991 through September 1992 on the line relating to dialers. RX-15 shows for each of the months from December 1991 through July 1992 on the line relating to dialers. Neuenschwander testified that in RX-12, 14 and 15 on the lines relating to dialers do not demonstrate that at Carrollton in 1992, but reflect that the at the times that the forecasts were prepared. (Neuenschwander, Tr. 2102-05).

1167. CRX-56 is a production forecast, dated November 25, 1991, from the European offices to Sonnino, among others, showing a forecast of production of wafers per month starting in February 1992. wafers will produce approximately tone dialer chips. (Neuenschwander, Tr. 2105-07).

1168. CRX-57 is a production forecast, dated December 10, 1991, prepared in Carrollton, showing a forecast of production of wafers per month from February through December 1992. (Neuenschwander, Tr. 2107-09).

1169. CRX-58 is a production forecast, dated January 29, 1992, prepared in Carrollton, showing a forecast of production of wafers per month from February through November 1992, and wafers per month in December 1992 and January 1993. (Neuenschwander, Tr. 2109-10).

1170. CRX-59 is a production forecast, dated February 28, 1992, prepared in Carrollton, showing a forecast of wafers per month for March and April 1992, wafers in May 1992, and wafers per month from June 1992 through February 1993. (Neuenschwander, Tr. 2110-11).

1171. CRX-115 is a production request, dated June 2, 1992, requesting ST to complete wafers of the MK5371 dialer chip at Carrollton in each of July and August of 1992. (CRX-115).

1172. CRX-114 is a production request, dated July 6, 1992, requesting ST to complete wafers of the V055 tone dialer chip at Carrollton in each of

August and September 1992. (CRX-114).

1173. CX-419 is a production request, dated July 13, 1992, requesting ST to produce in Carrollton wafers of the V055 tone dialer chips in August, wafers of each of the V055 and V060 tone dialer chips in September, and wafers of the V060 in October 1992. (CX-419).

1174. RX-16 is a message from Reuben Sonnino, then head of production scheduling in Carrollton, to Amelio Viccardi in Itay, dated September 11, 1989, requesting to discuss of wafer production at an upcoming meeting. (RX-16; Neuenschwander, Tr. at 1921, 1924).

1175. RX-17 is a document entitled dated September 14, 1989, outlining considerations for (RX-17; Neuenschwander, Tr. at 1924-25).

1176. RX-18 is a memorandum from P. Picco and D. Rousset to various Carrollton personnel, dated October 13, 1989, regarding (RX-18).

1177. RX-19 is a September 19, 1989 memorandum from Gordon Totty, then an engineer at Carrollton, regarding (RX-19; Neuenschwander, Tr. at 1921-23).

1178. RX-20 is a October 2, 1989 memorandum from Barrington Nugent to various Carrollton personnel regarding a meeting to be held on October 10, 1989 on the (RX-20).

1179. RX-21 is a memorandum from P. Picco and D. Rousset to various Carrollton personnel regarding Meeting in Carrollton in Week 41." RX-21 contains extensive hand notations and its handwritten date is not clearly legible. (RX-20).

1180. RX-22 is a January 17, 1990 interoffice memorandum from Enzo Ferradino to Lenny Little in Dallas and Bernard Fontan in Agrate regarding (RX-22).

1181. RX-24 is a February 1, 1990 memorandum from P. Picco to K. Heath, B. Donley and B. Nugent regarding (RX-24).

1182. RX-25 is a February 6, 1990 memorandum from B. Nugent to P. Picco regarding mask sets involved (RX-25).

1183. RX-26 is a February 21, 1990 memorandum from D. Rousset to B. Nugent regarding

(RX-26).

1184. RX-27 is a May 8, 1990 memorandum from "CYNTHIA-TAN" to J. Nicholson and B. Nugent regarding delivery of certain C-MOS masks from Carrollton to Singapore. (RX-27).

1185. RX-28 is a January 10, 1991 memorandum from R. Sonnino to E. Ferradino and A. Viccardi regarding minimasters available in Carrollton for dialers probing. (RX-28).

1186. RX-33 is a February 25, 1991 memorandum from R. Sonnino to A. Viccardi confirming continued dialer "diffusion" in Carrollton and stating that "[i]f for any reason you will need to continue to input wafers also in Q4, I will need to have an official request by no later than the end of April." (RX-33).

1187. RX-36 is a June 27, 1991 memorandum from R. Sonnino to P. Fego and D. Gunsalves confirming an agreement with Viccardi regarding

noting that

(RX-36).

1188. RX-40 is a May 29, 1992 memorandum from R. Sonnino to W. Ghezzi regarding capacity at Carrollton which states that fab 4 is running at full capacity and that "When you asked me to start wafers last month,

(RX-40).

1189. RX-315 is "SGS-Thomson Microelectronics, Inc.'s Response to Respondents Winbond Electronics Corporation's and Hualon Microelectronics Corporation's First Set of Interrogatories to Complainant." Interrogatory No. 55 therein, and the answer thereto, state as follows:

<u>Interrogatory No. 55</u>:

> Describe with specificity any plans of ST to continue to produce any telecommunications chips embodying the '436 patent in the United States.

<u>Response to Interrogatory No. 55</u>:

(RX-315).

1190. ST's predecessor at interest acquired the Carrollton facility from Mostek in 1985 as a going concern at a cost of approximately which Neuenschwander testified was a "fire sale" price due to adverse market conditions resulting from importation of competing integrated circuit devices. (Neuenschwander, CX 498 at 6; Haldi, CX-497 at 17).

1191. The entire Carrollton facility has approximately square feet of space, with ST currently occupying approximately square feet, approximately square feet of which are directly devoted to production of semiconductor products, including the tone dialer chips covered by the '436 patent. Neuenschwander testified that "a substantial portion" of the remaining space is used to support that activity. (Neuenschwander, CX-498 at 6-7).

1192. Since 1986, additional capital investments of more than through the first half of 1992 have been made in the Carrollton facility. In addition, ST has approved capital appropriations for an additional for equipment. (Neuenschwander, CX-498 at 6; Haldi, CX-497 at 17).

1193. ST has invested approximately since 1986 in fab 4, and in addition to that, approximately (purchase accounting value) in equipment is still located in fab 4 from the time of the purchase of the Mostek assets. Neuenschwander testified that the appraised value of this in equipment, at the time of acquisition, was more than five times higher than the assigned to these assets for the purpose of placing them on Thomson's balance sheet. (Neuenschwander, Tr. at 2033; Neuenschwander, CX-498 at 8-9).

1194. Based on a valuation of the Carrollton plant performed by Arthur D. Little in 1986, Neuenschwander determined that the value of the plant attributable to fab 4 is at least and the value of the equipment in fab 4 used to make tone dialer chips, as well as other semiconductor products, is at least making the total value of plant and equipment in fab 4 at least (Neuenschwander, CX-498 at 9; Neuenschwander, Tr. at 2035).

1195. Neuenschwander testified that all of the equipment in fab 4 is used in the fabrication of tone dialer chips, excluding wafer steppers which are not used in the production of tone dialer chips, and that there is no equipment in fab 4 that is devoted exclusively to the production of tone dialer chips unless one includes mask equipment. (Neuenschwander, CX-498 at 9; Neuenschwander, Tr. at 2055, 2071).

1196. Pleatsikas testified that the only investment specific to the '436 patent at the Carrollton facility is the masks. (Pleatsikas, RX-5 at 16).

1197. Neuenschwander testified that the figures provided in CX-498 regarding the value of plant and equipment in fab 4 represent his opinion as to their values. Neuenschwander testified that he is neither a real estate appraiser, personal property appraiser, real estate salesman, real estate broker, nor a Certified Public Accountant, although he testified that he has "performed accounting duties" and has had "a lot of accounting education." (Neuenschwander, Tr. at 2006). Neuenschwander testified further as follows:

> Q Could you briefly explain how you determined the value of ST's capital investment in fab 4?
>
> A * * *
>
> Fundamentally, I relied on upon the outside independent appraisers for the asset values, the Arthur D. Little study, and they are the ones that determined how much each category of asset was appraised at the fair market value. Starting with that as a basis, I then took our internal business records for the square footage, which has also been produced as an exhibit in other parts of this trial.
>
> And with that square footage from those business records, then I simply applied a straightforward allocation of those dollars supplied by Arthur D. Little. The allocation that I used would be one that would be similar to the ones that I've used before in doing these kinds of analyses when I was an employee at SGS-Thompson and its predecessors.

(Neuenschwander, Tr. at 2067-68).

1198. Neuenschwander testified that as of the end of September 1992, out of the employees in the Carrollton facility worked in fab 4, which number represents an increase from at the beginning of 1992. Fab 6 employed people. (Neuenschwander, CX-498 at 8).

1199. More than was paid to fab 4 employees in 1991. (Neuenschwander, Cx-498 at 8).

1200. Fab 4 occupies approximately square feet. (Neuenschwander, CX-498 at 7; Haldi, CX-497 at 16).

1201. The Fab areas are specially constructed "clean rooms," designed to keep out dust and any other air-borne particles that might adversely affect the production yield. (Haldi, CX-497 at 16).

1202. Neuenschwander testified that his valuation of the plant and equipment used to make tone dialer chips is a conservative estimate, noting that replacement costs are substantially higher today than in 1986, when the independent consulting firm undertook its valuation, and that if he had used replacement costs the valuation would have been much higher. (Neuenschwander, Tr. 2216-18).

1203. Haldi and Pleatsikas each testified that the dollars invested in plant and equipment by ST are significant from an economic perspective. (Haldi, CX-497 at 18; Pleatsikas, Tr. 3403).

1204. Haldi testified that the fact that ST's investments in plant and equipment have resulted and continue to result in the production and sale of large quantities of tone dialer chips also demonstrates the significance of the investments. (Haldi, CX-497 at 18).

1205. Haldi believes that it is unnecessary to allocate ST's investment in plant and equipment to tone dialer chips, testifying that both the investment and the level of production of tone dialer chips are significant from an economic perspective, and that any allocation of such investment to tone dialer chips would be significant. (Haldi, Tr. 2348-50).

1206. Pleatsikas testified that in his opinion as an economist, because fab 4 was intended to, and does, produce numerous products, there is no non-arbitrary method of allocating investment to a single product or class of products. (Pleatsikas, RX 5 at 16-18; Pleatsikas, Tr. 3407, 3413, 3540).

1207. With the exception of masks, the same basic equipment that is used to fabricate tone dialer chips is also used to fabricate other products in Fab 4. (Haldi, CX-497 at 23).

1208. Job lot production is used when the quantity of individual products that need to be produced is not sufficient to support continuous production using dedicated equipment. Haldi testified that job lot production is simply a reflection of the realities of the marketplace. (Haldi, CX-497 at 23).

1209. Pleatsikas testified that there are many fabs that produce a variety of devices, and that he knew of no plant that makes only tone dialer chips. (Pleatsikas, Tr. 3416).

1210. Haldi testified that the fact that ST's equipment is not dedicated solely to tone dialer chip production did not alter his conclusions regarding the economic significance of ST's investments in plant and equipment at Carrollton, and its production of dialer chips there. (Haldi, CX-497 at 24).

1211. The remainder of ST's employees include personnel in research and development, engineering, sales and marketing, and licensing, as well as general and administrative personnel. These employees support the two Fabs, the products made by the two Fabs, and ST's U.S. business operations generally. (Neuenschwander, CX-498 at 8; Haldi, CX-497 at 16-17).

1212. Haldi testified that overall about full-time employees support the employees in fabs 4 and 6. The supporting employees include Carrollton employees plus employees in the field plus contract workers in security, food service and maintenance. (Haldi, Tr. 2324-27).

1213. Pleatsikas testified that the labor relating to production of products practicing the '436 patent in Carrollton in 1992 was de minimis, amounting to only about persons on an annualized basis, including production employees, licensing administrators, sales and marketing/engineering personnel and between license negotiators (on an annual basis). Pleatsikas further testified that to this figure one might add approximately persons for reverse engineering activities (on an annual basis). (Pleatsikas, RX-5A at 3).

1214. Pleatsikas testified that his calculations included only the people who were specifically identified by Haldi and Neuenschwander as having something to do with the '436 patent and did not account for the labor of "support" personnel such as finance, accounting, purchasing, personnel, security, cleaning/maintenance or food services personnel, although Pleatsikas acknowledged that a fab cannot be run without administrative support and that it would be "both necessary and prudent" to allocate their labor. (Pleatsikas, Tr. at 3561, 3562-65).

1215. Pleatsikas testified that with respect to employees involved in licensing, his calculations assumed the effort was expended over a three year period based on a hypothetical question asked him during his deposition, and acknowledged that if the three year period assumption is incorrect then his calculations would also be incorrect. (Pleatsikas, Tr. at 3569-71).

1216. When asked how many people would have to be attributable to dialer chip production in order to be significant, Pleatsikas testified that, through discussions with attorneys involved in this investigation, his opinion was that "if you got up in the neighborhood of employees, that would be -- it would not be unreasonable for some people to call that significant." (Pleatsikas, Tr. at 3551).

1217. Pleatsikas testified that the context of the industry is important in determining the significance of employment of labor, in part, because some industries are more labor intensive than others, and that capital investment per employee is higher in the semiconductor industry than it is in many others. (Pleatsikas, Tr. 3553-54).

1218. In Haldi's opinion, ST has employed, and continues to employ, significant amounts of labor and capital in the United States with respect to the manufacture and sale of tone dialer chips that allegedly incorporate the '436 patent. (Haldi, CX-497 at 15, 18; Haldi Supp., CX-497A at 4).

1219. ST and its predecessors have spent more than developing chips embodying the '108 and '886 patents, as their claims are construed by complainant, as well as the '436 patent, and in excess of developing processes to build these chips. More than man-years have been devoted to these research and development efforts. (Neuenschwander, CX-498 at 30, 32-37).

1220. The annual expenditures by ST to develop chips embodying the '108 and '886 patents, as their claims are construed by complainant, as well as the '436 patent ("product R&D costs"), and the annual expenditures by ST to develop processes to build these chips ("process R&D costs"), are as follows:

Year	Product R&D Costs	Process R&D Costs
1973		

1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
TOTAL

(CX-418B at ST41073-74).

1221. At its peak, ST or its predecessors had as many as engineers and technicians engaged in research and development relating to tone dialer chips embodying the '108 and '886 patents, as their claims are construed by complainant, as well as the '436 patent. (Neuenschwander, CX-498 at 30).

1222. Between 1973 and 1979, Mostek spent approximately on research and product development designed to exploit the '108 and '886 patents, as their claims are construed by complainant, and an additional on the processes used to make these products. By year, these expenditures were as follows:

Year	Product R&D Costs	Process R&D Costs
1973		
1974		
1975		
1976		
1977		
1978		
1979		
TOTAL		

Haldi testified that in 1992 dollars the amounts spent by Mostek in the 1970s would be considerably more. (Neuenschwander, CX-498 at 34; CX-418B at ST41075-76, ST41079-80; Haldi, CX-497 at 8).

1223. Haldi testified that Mostek's research and development that was designed to exploit the '108 and '886 patents, as their claims are construed by complainant, contributed to the exploitation of the '436 patent because it made possible the tone dialer chip and created a market for improvements to that chip, including such improvements as the '436 patent. (Haldi, CX-497 at 7-8).

1224. When asked if there is current research and development activity at Carrollton, Neuenschwander testified as follows:

> THE WITNESS: Research and development can mean different things to different people when they say it. I looked at two classes of activity: one is the design of a product, the layout engineers, things of that sort. At the time of my deposition, that's what I was speaking to, and it is correct that none of that is currently going on at the Carrollton facility.
>
> At the same time, I'm not certain what the legal definition of research and development is, but it certainly, I believe, includes the engineering activities which we include the application engineering where engineers do, in fact, go out to the customers and find new applications for these devices, and that does continue today.

(Neuenschwander, Tr. at 2046).

1225. Between 1980 and 1991, ST and its predecessors in Carrollton spent approximately on developing chips that embody and exploit the '436 patent. (Neuenschwander, CX-498 at 30; Neuenschwander, Tr. 2072-73; CX-418B at ST41077-78; Haldi, CX-497 at 8-9).

1226. ST and its predecessors at interest also have spent approximately to develop processes to make chips that embody and exploit the '436 patent. (Neuenschwander, CX-498 at 30; Neuenschwander, Tr. 2072-73; CX-

418B at ST41081-82; Haldi, CX-497 at 8-9).

1227. The product R&D costs and process R&D costs incurred by ST, by year, in connection with the '436 patent are as follows:

Year	Product R&D Costs	Process R&D Costs
1976		
1977		
1978		
1979		
1980		
1981		
1982		
1983		
1984		
1985		
1986		
1987		
1988		
1989		
1990		
1991		
TOTAL		

(CX-418B at ST41077-78, ST41081-82).

1228. The figures shown in CX-418B at ST41077-78 and ST41081-82 were prepared by Neuenschwander with the assistance of numerous ST employees. (CX-418B at ST41077-78, ST41081-82; Neuenschwander, Tr. at 2078-80). Neuenschwander testified that the totals represent a reasonable estimate of the costs expended to exploit the '436 patent. (Neuenschwander, Tr. 2082-83).

1229. The in product R&D costs and process R&D costs expended to exploit the '436 patent includes approximately man years that have been devoted to research and development efforts on the '436 patent for product development and for process development). (Neuenschwander, CX-498 at 30; Haldi, CX-497 at 9).

1230. Haldi testified that the product and process R&D investments by ST have exploited the '436 patent and continue to exploit the '436 patent insofar as they enable the continued production of dialer chips that embody the '436 patent. (Haldi, CX-497 at 9).

1231. ST and its predecessors performed 100% of the design work in Carrollton, Texas for each of the following dialer chip models: MK5055, MK5086, MK5084, MK5087, MK5088, MK5089, MK5090, MK5091, MK5092, MK5093, MK5094, MK5380, MK5382, MK5375/6, MK5371/2, MK5373, MK5370, MK53731, MK53761, MK53762, MK53730, MK53760, MK53721, and MK 53763. (Haldi, CX-497 at 11, Table 1).

1232. Some of the design work on one chip, the MK53732, was done in Singapore, however, Haldi testified that the MK53732 is nothing more than an MK53731 (designed in Carrollton) with a few modifications which were designed in Singapore. (Haldi, CX-497 at 11).

1233. After designing each of the different dialer chips, ST and its predecessors performed additional research and development work on the designed chips. (Haldi, CX-497 at 11-12).

1234. In order to make each different model of tone dialer chip, ST needed to design masks, which are used to build the circuits of a wafer. (Neuenschwander, CX-498 at 13; Haldi, CX-497 at 12).

1235. ST and its predecessors have designed a total of different masks in connection with dialer chips which incorporate the '436 patent, of which were designed at the ST facilities in Carrollton, Texas. All of the masks (including the designed in Singapore) were made in the United States. (Neuenschwander, CX-498 at 15; Haldi, CX-497 at 12 and Table 2).

1236. Some of the masks were made by ST and its predecessors in-house, while others were made from ST's computer tapes by outside suppliers in the

United States. (Neuenschwander, CX-498 at 15; Haldi, CX-497 at 12).

1237. Haldi testified that design and production of masks shows the continuing investment that ST has made over the years to exploit its '436 patent. (Haldi, CX-497 at 12).

1238. Other research and development work which enabled ST to produce dialer chips includes manufacture and testing of pilot lots of dialer chips, prior to commercial production. Haldi testified that following early pilot production runs, it is not uncommon to have to make design changes that, although relatively minor, nevertheless require new masks, followed by another pilot run. Haldi further testified that these pre-production activities represent additional investment that ST has made in order to exploit the '436 patent. (Haldi, CX-497 at 13).

1239. From an economic perspective, research and development activities that were undertaken in years prior to 1992 can be relevant when determining whether there is current exploitation of the patent. (Pleatsikas, Tr. 3525-27; Haldi, CX-497 at 13; Neuenschwander, Tr. 2075-78).

1240. Products that continue to be made and sold continue to benefit from past R&D expended by ST to develop those products, whether the products are made in Singapore or Carrollton. (Pleatsikas, Tr. 3527).

1241. Haldi testified that investments in R&D continue to support current production, just as investments in plant and equipment continue to support production long after the actual expenditures have been incurred. (Haldi, CX-497 at 13).

1242. Haldi testified that by manufacturing and selling commercial products that were the fruits of its extensive domestic research and development, and that practice the '436 patent, ST continues to benefit from its extensive prior investments in R&D, even with respect to production that occurs abroad. (Haldi, CX-497 at 13-14).

1243. Pleatsikas testified that research and development does not have to be successful in the sense of developing a profitable product for it to be an attempt to exploit a patent. (Pleatsikas, Tr. 3520-21).

1244. As of June 30, 1992, ST and its foreign affiliates owned patents. Of these patents, ST owned its U.K. affiliate owned the French affiliate owned and the Italian affiliate owned (Adams, CX-495 at 10; CX-423 at ST43567).

1245. Early in 1987, the SGS-Thomson corporate family (the "Company") made a strategic decision to exploit its patents by licensing them to others, which licensing program has subsequently become a major undertaking, resulting in substantial revenues and economic benefits for the entire SGS-Thomson corporate family, including ST. (Robinson, CX-499 at 2; Haldi, CX-497 at 28).

1246. In its licensing program, the Company identifies prospective licensees and attempts to negotiate licenses, and if the prospective licensee refuses to enter into a licensing agreement, it is the Company's policy to bring suit to enforce its patent rights. (Robinson, CX-499 at 3).

1247. To identify prospective licensees, (Robinson, CX-499 at 3).

1248. Depending upon the circumstances, the Company has its consultants prepare to determine whether there is possible infringement of a Company patent. (Robinson, CX-499 at 4).

1249. Where the Company hires technical consultants to perform to determine whether the product infringes its patent. A consultant buys the product, and then either that consultant or another consultant subjects it to a comprehensive engineering analysis to determine whether the product in fact practices the Company's patent. (Robinson, CX-499 at 4).

1250. Once the Company receives an indication that a product infringes a patent in its portfolio, it attempts to negotiate a license.

(Robinson, CX-499 at 4-5).

1251.

(Robinson, CX-499 at 5).

1252. If the Company determines that a product infringes a patent in its portfolio and the prospective licensee refuses to enter into a licensing agreement, it is the Company's policy to bring suit to enforce its intellectual property rights in the patent. (Robinson, CX-499 at 5).

1253. With respect to HMC and UMC, Robinson testified that ST followed the Company's regular licensing program procedures and believed that HMC and UMC both produced semiconductor devices that infringed one or more of the '108 and '886 patents, as their claims are construed by complainant, and the '436 patent. ST attempted to negotiate licenses with these companies, which negotiations proved unsuccessful. (Robinson, CX-499 at 9-15).

1254. The Company has now entered into licensing agreements covering the '108 and '886 patents, as their claims are construed by complainant, as well as the '436 patent, with more than companies, including manufacturers of semiconductor products such as

(Robinson, CX-499 at 6; Neuenschwander, CX-498 at 31; Haldi, CX-497 at 28-29).

1255. Haldi testified that reasonable and fair allocation of the in licensing revenues to the patents-in-suit yields allocations of approximately in licensing revenues to each of the '108 patent, as its claims are construed by complainant, and the '436 patent, and to the '886 patent, as its claims are construed by complainant. (Haldi, CX-497 at 29-35 and Tables 7-9).

1256. ST and its affiliates engage in an extensive allocation analysis each year for tax and accounting purposes. This is necessary because ST and its affiliates own a number of patents, and licenses typically give ST's licensees the right to practice all of the patents of ST and its foreign affiliates. (Adams, CX-495 at 3).

1257. In order to allocate licensing revenues among ST and its various affiliates, the Company has a large group of internal and external experts determine the relative value of each of the different patents owned by ST and its affiliates. This evaluation is performed annually and takes between three to five days to complete. The most recent review session involved 22 people. (Adams, CX-495 at 4).

1258. Haldi testified that the licensing revenues attributable to the '436 patent are substantial and help to demonstrate that ST has made substantial investments in the exploitation of the patents-in-suit through its licensing program. (Haldi, CX-497 at 35).

1259. Pleatsikas testified that, assuming the revenues attributed the '436 patent are accurate, then they are reasonably substantial and are "indicative of exploiting the patent." (Pleatsikas, Tr. 3513-14, 3597, 3606)

1260. ST has specifically spent approximately during 1991 and 1992 on pertaining to the '108 and '886 patents, as their claims are construed by complainant, and the '436 patent. (Neuenschwander, CX-498 at 31; Neuenschwander, Tr. 2112-13; Haldi, CX-497 at 36; Robinson, CX-499 at 8-9).

1261. Approximately employees at ST and outside consultants retained by ST have been engaged in implementing and administering ST's ongoing licensing program as it relates to the '108 and '886 patents, as their claims are construed by complainant, and the '436 patent. (Robinson, CX-499 at 8-9; Neuenschwander, Tr. 2112-13; Haldi, CX-497 at 36).

1262. The work of the ST employees who have been involved in ST's recent efforts to license the '108 and '886 patents, as their claims are construed by complainant, and the '436 patent to HMC and UMC represents approximately man-years of effort, and a cost of The work of the outside consultants who have been involved in ST's recent efforts to license the '108 and '886 patents, as their claims are construed by complainant, and the '436 patent to HMC and UMC represents approximately man-years of effort. (Robinson, CX-499 at 8-9; Neuenschwander, CX-498 at 31; Neuenschwander, Tr. 2112-13).

1263. ST's engineering and customer support activities have generated a demand for, and sales of, tone dialer chips that allegedly practice the '436 patent. (Haldi, CX-497 at 39).

1264. Haldi testified that "a number of" ST employees have worked and continue to work with actual and potential customers in the telecommunications industry in defining the function and circuitry requirements for future generations of tone dialer chips and future generations of products that will utilize dialer chips, which activity is highly technical, typically requiring that the person performing such service have an electrical engineering degree. (Haldi, CX-497 at 39-40).

1265. ST's personnel provide assistance to customers who are experiencing technical problems in the application of tone dialer chips. (Haldi, CX-497 at 40).

1266. Haldi testified that the work of these ST employees can be considered engineering and customer service, rather than traditional sales and marketing activities. (Haldi, CX-497 at 40).

1267. ST's engineering and customer support personnel have worked with customers to identify and conceptualize the customer needs that resulted in each of the various models of tone dialer chips that ST has designed and developed over the years. The principal application engineering work for nearly all the models of ST's tone dialer chips that have been developed over the years has been performed in Carrollton, Texas. (Haldi, CX-497 at 40).

1268. ST has employees in sales and marketing/applications engineering, at least half of whom support tone dialer chips as well as other products. Haldi testified that these employees do not record their work time by particular products and that it is thus difficult to determine how much time they spend on tone dialer chips or any other particular product. (Haldi, CX-497 at 41).

1269. Haldi testified that there are at least sales and marketing/engineering persons at ST who spend a sizeable portion of their time supporting tone dialer chips, and who collectively spend approximately man-years on tone dialer chips each year. (Haldi, CX-497 at 41).

1270. Haldi testified that ST's engineers and customer support personnel are currently working on two projects which appear to be close to completion, and that each one is likely to generate significant sales of chips that allegedly will practice the '108 patent, as its claims are construed by complainant, as well as the '436 patent. (Haldi, CX-497 at 41) .

1271. Haldi testified that the first such project involves the development of a

(Haldi, CX-497 at 41-42).

1272. Haldi testified that in the second such project, ST personnel are

incorporating the '108 patent, as its claims are construed by complainant, as well as the '436 patent, using the same basic cell configuration that is contained in the dialer chips which practice the

'436 patent, and

. (Haldi, CX-497 at 42-43).

1273. Haldi testified that the expected volume of sales projected from

(Haldi, CX-497 at 43).

CONCLUSIONS OF LAW

1. The Commission has in rem jurisdiction and subject matter jurisdiction.

2. The Commission has in personam jurisdiction over respondents UMC, HMC, SMC, NAFTC, Conair, Lonestar, Spectra, Columbia, Kingtel, Winbond, Winbond North American, A & A and HMC US, all of which personally appeared in this investigation. The remaining respondent Tranbon did participate in discovery.

3. There is no infringement of the asserted claims of the '108 patent.

4. The asserted claims of the '108 patent are not invalid under 35 U.S.C. § 102 and 35 U.S.C. § 103.

5. The asserted claims of the '108 patent are invalid under 35 U.S.C. § 112.

6. There is no infringement of the asserted claims of the '886 patent.

7. The asserted claims of the '886 patent are not invalid under 35 U.S.C. § 102 and 35 U.S.C. § 103.

8. UMC and the staff have not established that the asserted claims of the '886 patent are invalid under 35 U.S.C. § 112.

9. The asserted claims of the '886 patent are enforceable.

10. There is no domestic industry involving each of the '108 and '886 patents because complainant does not practice the asserted claims of the '108 and '886 patents.

11. Asserted independent claims 1 and 6 of the '436 patent are not valid under 35 U.S.C. § 103.

12. Asserted dependent claims 2, 3 and 4 of the '436 patent are not invalid under 35 U.S.C. § 102 or 35 U.S.C. § 103.

13. There is infringement of asserted dependent claims 2, 3 and 4 of the '436 patent.

14. Asserted dependent claims 2, 3 and 4 of the '436 patent are not invalid under 35 U.S.C. § 112.

15. Asserted dependent claims 2, 3 and 4 of the '436 patent are enforceable.

16. Complainant does practice the asserted claims of the '436 patent.

17. There is a domestic industry involving the '436 patent.

18. There are unfair acts in the importation of the subject matter in issue.

19. There is a violation of section 337.

INITIAL DETERMINATION AND ORDER

Based on the foregoing findings of fact, conclusions of law, the opinion, and the record as a whole, and having considered all of the pleadings and arguments presented orally and in briefs, as well as certain proposed findings of fact, it is the administrative law judge's determination that there is a violation of section 337 in the importation into the United States and sale for importation, or the sale within the United States after importation of certain integrated circuit telecommunication chips and products containing same, including dialing apparatus.

The administrative law judge hereby CERTIFIES to the Commission this initial determination, together with the record consisting of the following:

1. The transcript of the hearing;

2. The exhibits admitted into evidence and the exhibits as to which objections have been sustained; and

3. ALJ Exhibits 1, 2, 3 and 4. The pleadings of the parties filed with the Secretary are not certified, since they are already in the Commission's possession in accordance with Commission Rules of Practice and Procedure.

Further it is ORDERED that:

1. In accordance with Commission interim rule 210.44(b), all material heretofore marked _in camera_ because of business, financial, and marketing data found by the administrative law judge to be cognizable as confidential business information under Rule 201.6(a) is to be given _in camera_ treatment continuing after the date this investigation is terminated.

2. Counsel for the parties shall have in the hands of the administrative law judge those portions of the initial determination which contain bracketed

confidential business information to be deleted from the public version of the initial determination, and all attachments thereto, no later than Wednesday, March 24, 1993. Any such bracketed version shall not be served by telecopy on the administrative law judge. If no version is received from a party it will mean that the party has no objection to removing the confidential status, in its entirety, from this initial determination.

3. This initial determination shall become the determination of the Commission forty-five (45) days after the service thereof, unless the Commission, within forty-five (45) days after the date of filing of the initial determination shall have ordered review of the initial determination or certain issues therein pursuant to Commission interim rules 210.54(b) or 210.55 (19 C.F.R. § 210.54(b) or §210.55) or by order shall have changed the effective date of the initial determination.

Paul J. Luckern

Paul J. Luckern
Administrative Law Judge

Issued: March 9, 1993