LM

ORIENTATION

COURSE NO. 30005-012

For Training Purposes Only

DATE: April 12, 1966
REVISED: November 1966

Prepared by:

Product Support Department

LESSON PLAN

I. Introduction

A. Objective

To provide the student with an orientation of the LM spacecraft. Included will be a brief functional description of each LM operational subsystems to a block diagram level with emphasis on the major signal flow paths.

B. Motivation

In order to provide adequate operational support to the Apollo Mission one must have a basic functional knowledge of LM operational subsystems and the associated subsystem interfaces.

II. Presentation

A. Film - Apollo Lunar Mission Profile

B. LM Basic Design Concept

1. Ascent Stage

a. Cabin area
b. Aft equipment bay

2. Descent Stage

3. Summary

C. Crew Station

1. Controls and Display Panels

D. Propulsion Subsystem

1. General Configuration

a. Descent
b. Ascent
c. Reaction Control

2. Descent Propulsion

   a. Propellant Pressurization
   b. Propellant Feed
   c. Engine Control

3. Ascent Propulsion

   a. Propellant Pressurization
   b. Propellant Feed
   c. Thrust Control
   d. RCS Crossfeed

4. Reaction Control

   a. Cluster Configuration
   b. Attitude and Translational Control
   c. Propellant Pressurization
   d. Propellant Feed

5. Controls and Displays

6. Summary

E. Environmental Control Subsystem

1. Atmosphere Revitalization Section

   a. Pressure Schedules
   b. Closed Suit Loop Operation
   c. Open Suit Loop Operation

2. Oxygen Supply and Cabin Pressure Control Section

   a. Tankage
   b. Descent Feed
   c. Ascent Feed

3. Water Management Section

   a. Tankage
   b. Descent Feed
   c. Ascent Feed

4. Heat Transport Section

   a. Primary Loop Operation
   b. Secondary Loop Operation

5. Controls and Displays

6. Summary

F. Electrical Power Subsystem

1. General Configuration

   a. Ascent Stage
   b. Descent Stage

2. System Functional Description

   a. Batteries
   b. Electrical Control Assembly (ECA)
   c. Relay Junction Box (RJB)
   d. Deadface Relay Box (DFRB)
   e. Inverters
   f. Electroexplosive Devices

3. Controls and Displays

4. Summary

G. Guidance, Navigation, and Control Subsystem

1. System Concept

2. Functional Description

   a. Hand Controllers
   b. Primary Guidance and Navigation Section (PGNS)
   c. Abort Guidance Section (AGS)
   d. Control Electronics Section (CES)

3. Controls and Displays

4. Summary

H. Instrumentation

1. System Concept

2. Functional Description

   a. Signal Conditioning Electronics Assembly (SCEA)
   b. Caution and Warning Electronics Assembly (CWEA)
   c. Pulse Code Modulation Timing Electronics Assembly (PCMTEA)
   d. Data Storage Electronics Assembly (DSEA)

3. Controls and Displays

I. Communications

1. Operational Capabilities

   a. IN FLIGHT
   b. LUNAR STAY

2. System Concept

3. Functional Description

   a. SIGNAL PROCESSOR ASSEMBLY
   b. S-Band
   c. VHF

4. Controls and Displays

J. Final Summary

LM ORIENTATION

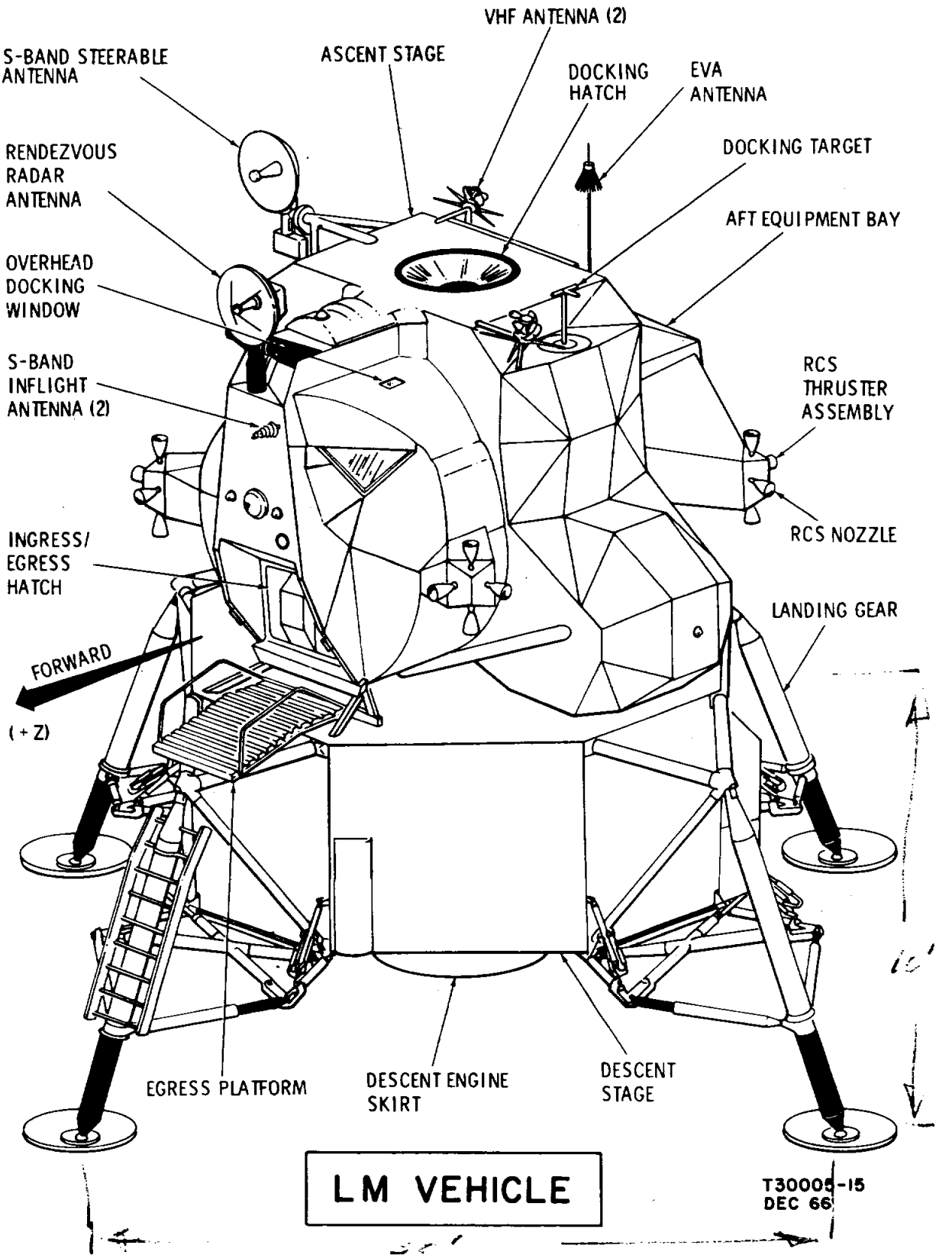
Abbreviation Document

AEA	Abort Electronics Assembly
AGS	Abort Guidance Section
AOT	Alignment Optical Telescope
ARS	Atmospheric Revitalization Section
ASA	Abort Sensor Assembly
ATCA	Attitude and Translation Control Assembly
CES	Control Electronic Section
CM	Command Module
CSM	Command and Service Module
C/W	Caution/Warning
CWEA	Caution and Warning Electronics Assembly
DECA	Descent Engine Control Assembly
DEDA	Data Entry and Display Assembly
DFRB	Deadface Relay Box
DSEA	Data Storage Electronics Assembly
DSKY	Display and Keyboard
ECA	Electric Control Assembly
ECS	Environmental Control Subsystem
EPS	Electrical Power Subsystem
EVA	Extravehicular Astronaut
GN&C	Guidance, Navigation and Control Subsystem

GOX	Gaseous Oxygen
He	Helium
H_2O	Water
HTS	Heat Transport Section
IMU	Inertial Measuring Unit
LM	Lunar Module
LGC	LM Guidance Computer
LR	Landing Radar
LUT	Launch Umbilical Tower
MSC	Manned Spacecraft Center (Houston)
MSFN	Manned Space Flight Network
OSCPS	Oxygen Supply and Cabin Pressure Section
Ox	Oxidizer
PCM	Pulse Code Modulation
PCMTEA	Pulse Code Modulation and Timing Electronics Assembly
PGNS	Primary Guidance and Navigation Section
PLSS	Portable Life Support System
RCS	Reaction Control Subsystem
RJB	Relay Junction Box
RR	Rendezvous Radar
S & C	Stabilization and Control
SCA	Signal Conditioner Assembly
SCEA	Signal Conditioning Electronics Assembly

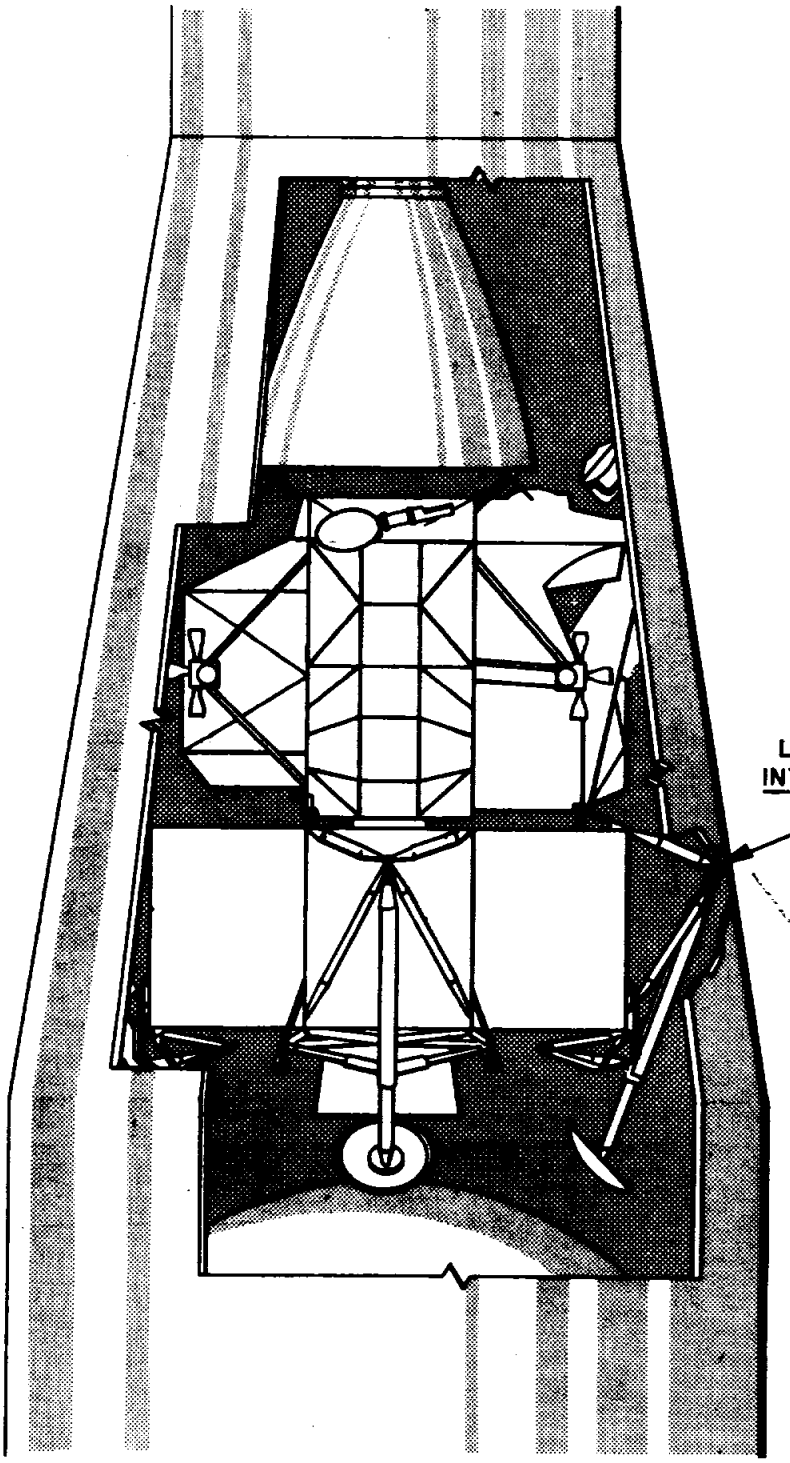
SM	Service Module
TEA	Timing Electronics Assembly
TV	Television
VHF	Very High Frequency (30-300 mc)
WMS	Water Management Section

This does not constitute a complete list of LM abbreviations. Grumman document LLI-790-1 may be consulted for abbreviations not listed here.



LM VEHICLE

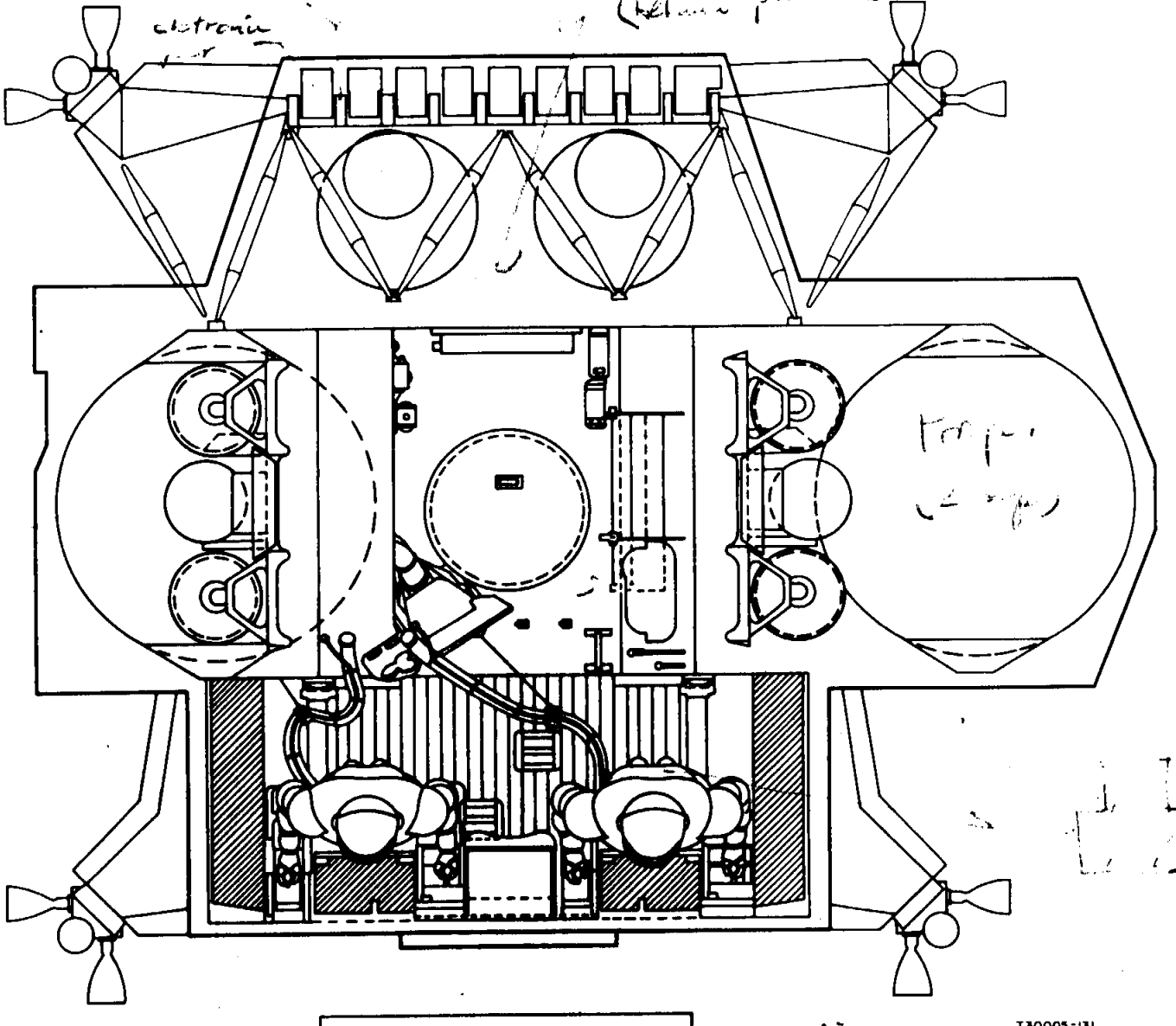
T30005-15
DEC 66



LM SIVB BOOSTER INTERFACE

T30005-14
DEC 66

How long for transposition & docking?

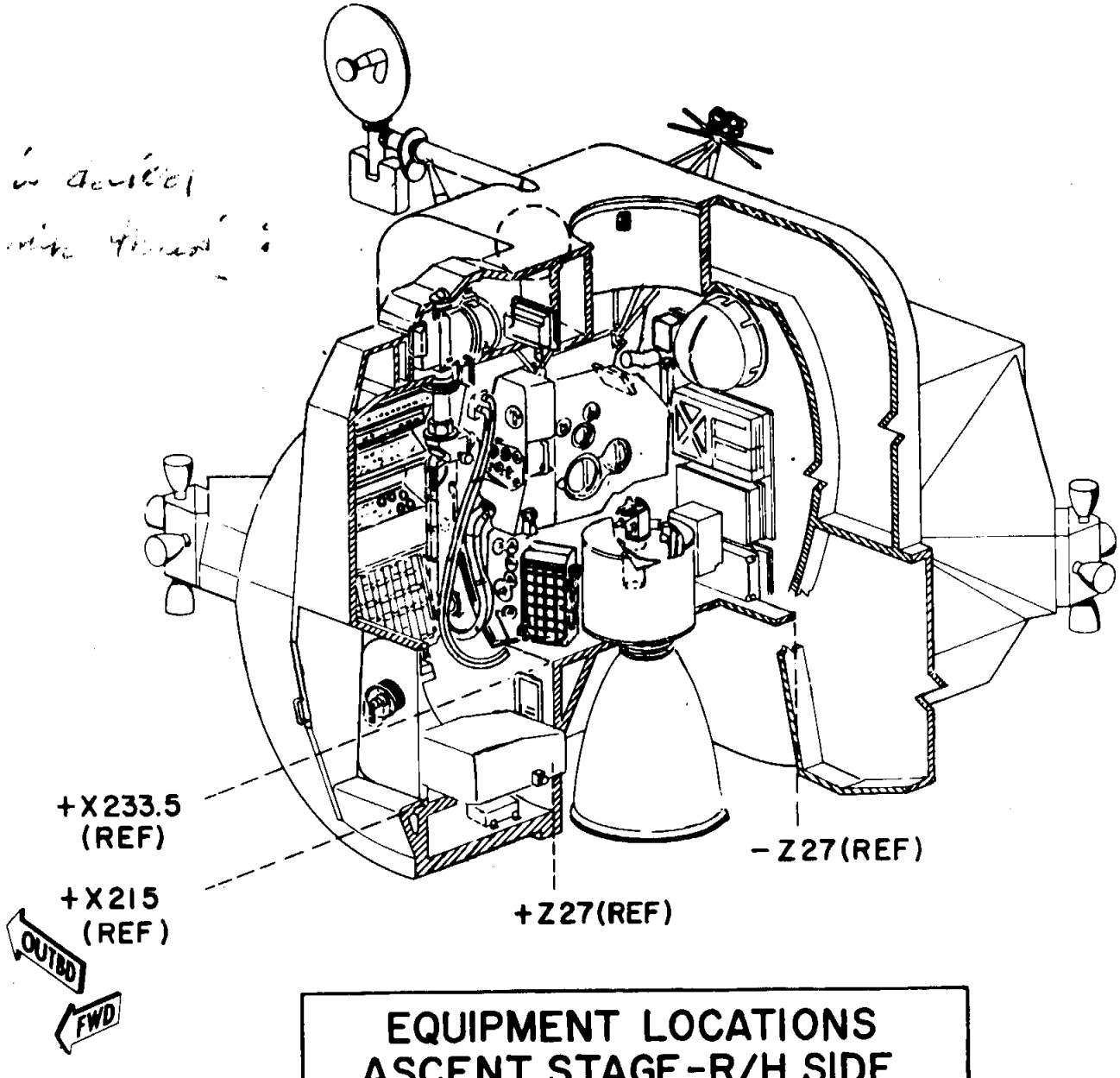


ASCENT STAGE PLAN VIEW

Top View

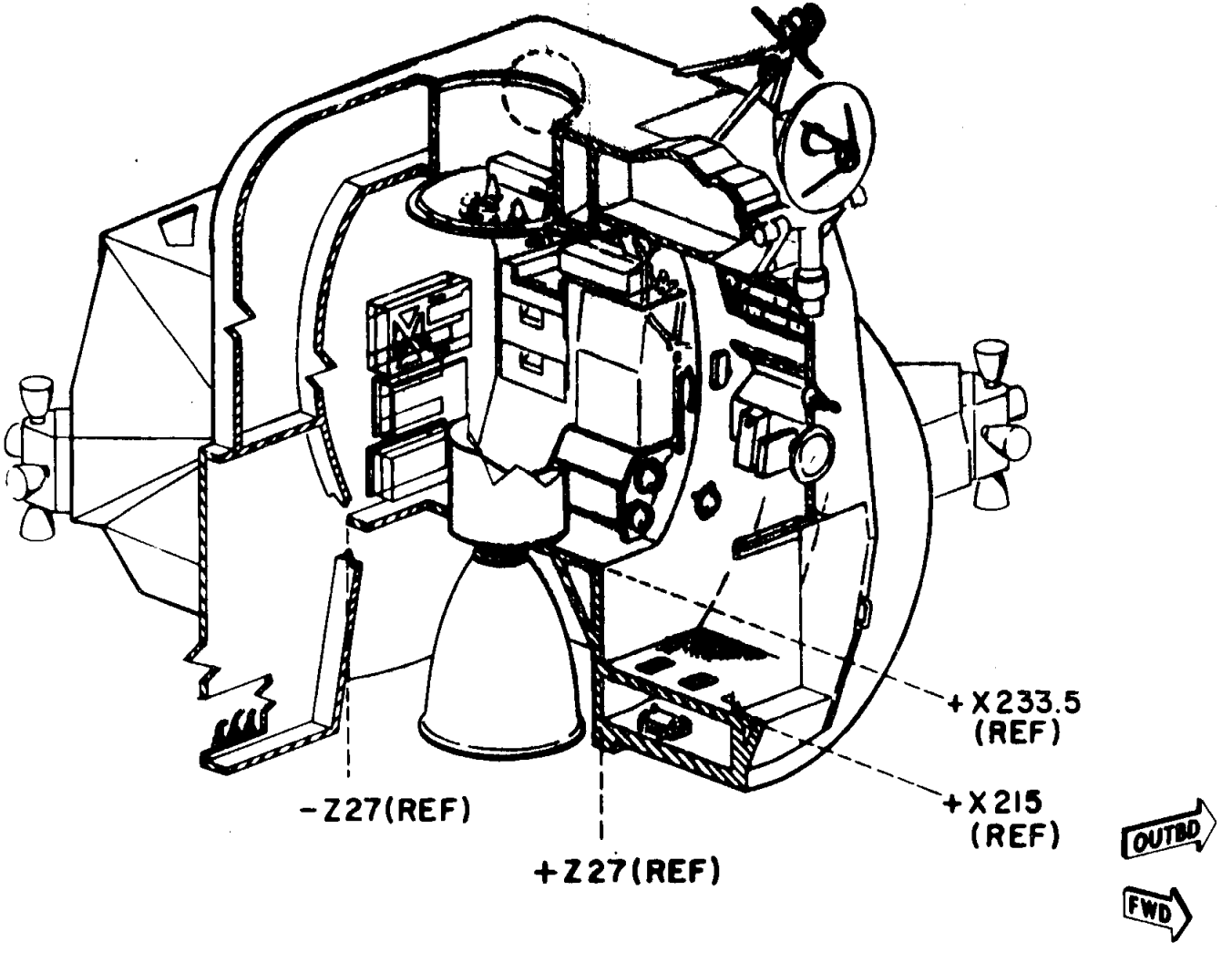
T30005-131
MAR 66

What is desired
in the white block?



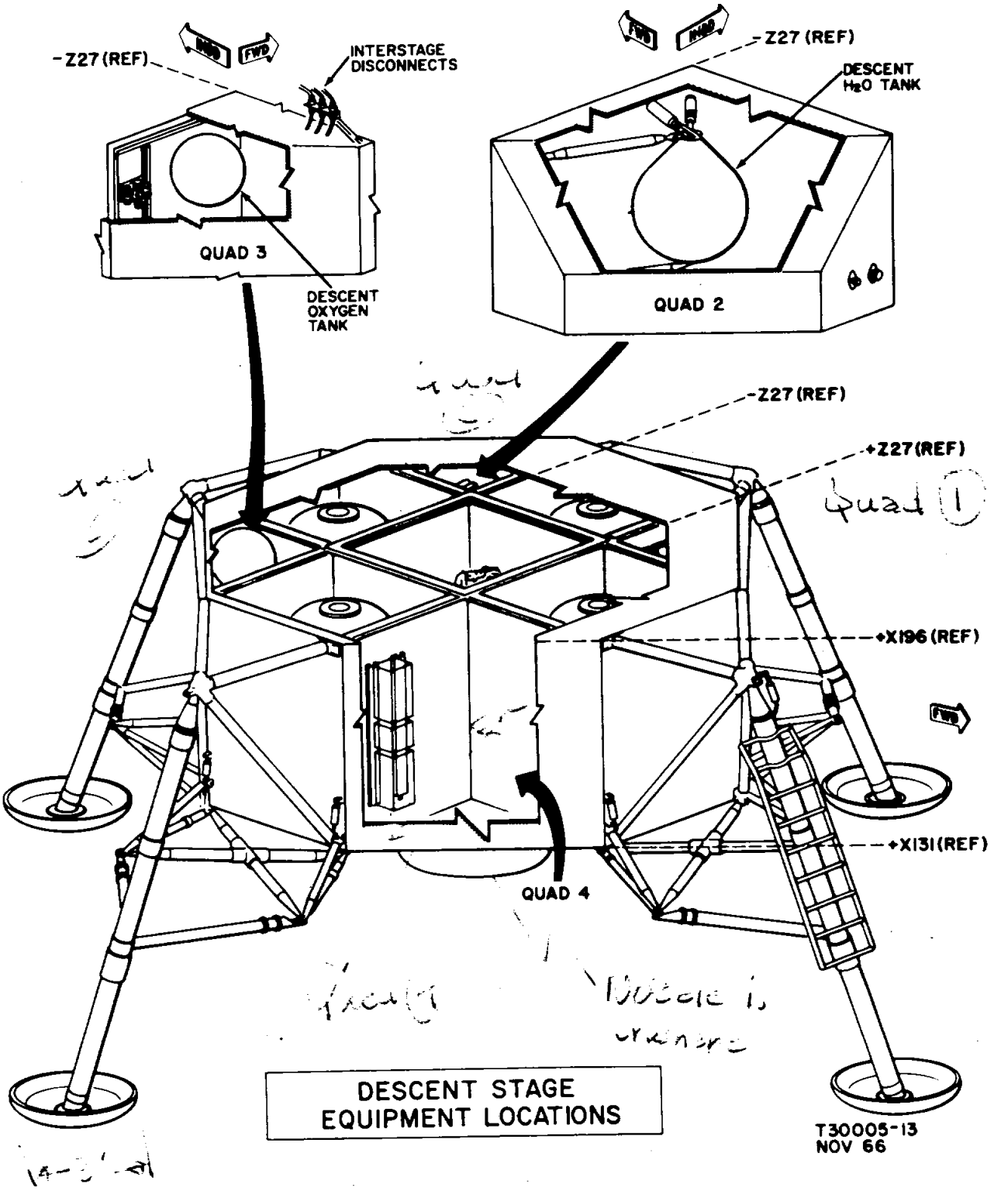
EQUIPMENT LOCATIONS
ASCENT STAGE-R/H SIDE

T30005-32
NOV 66



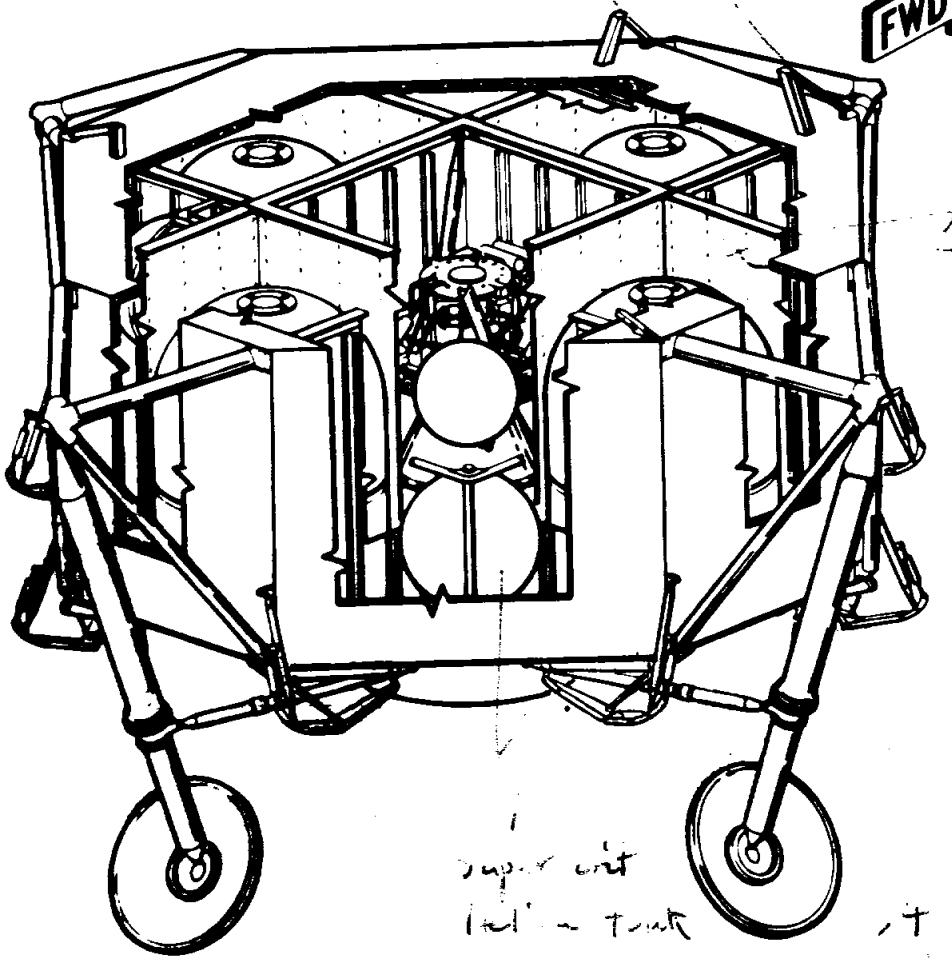
EQUIPMENT LOCATIONS
ASCENT STAGE-L/H SIDE

T30005-31
NOV 66



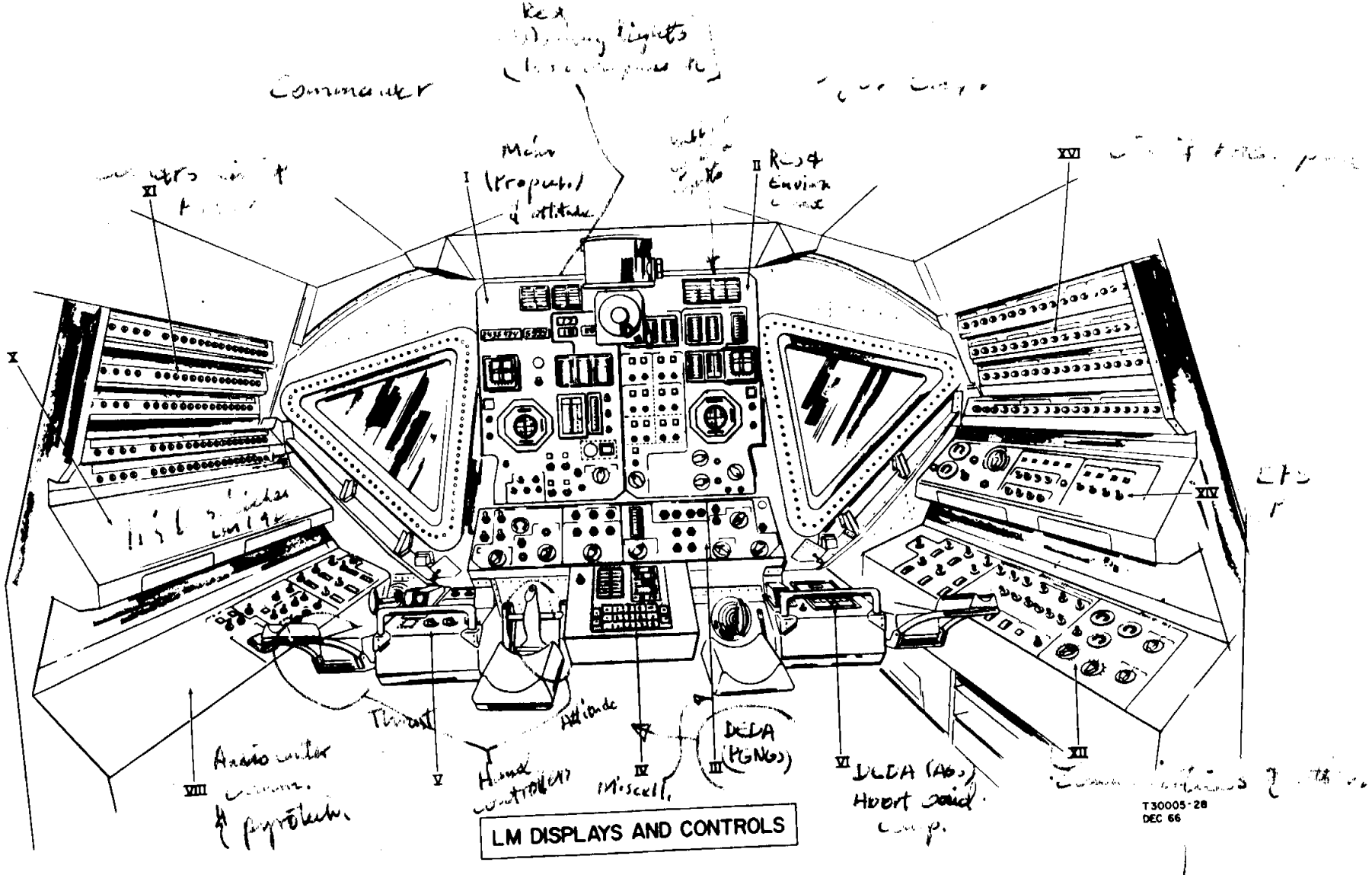
DESCENT STAGE EQUIPMENT LOCATIONS

T30005-13
NOV 66

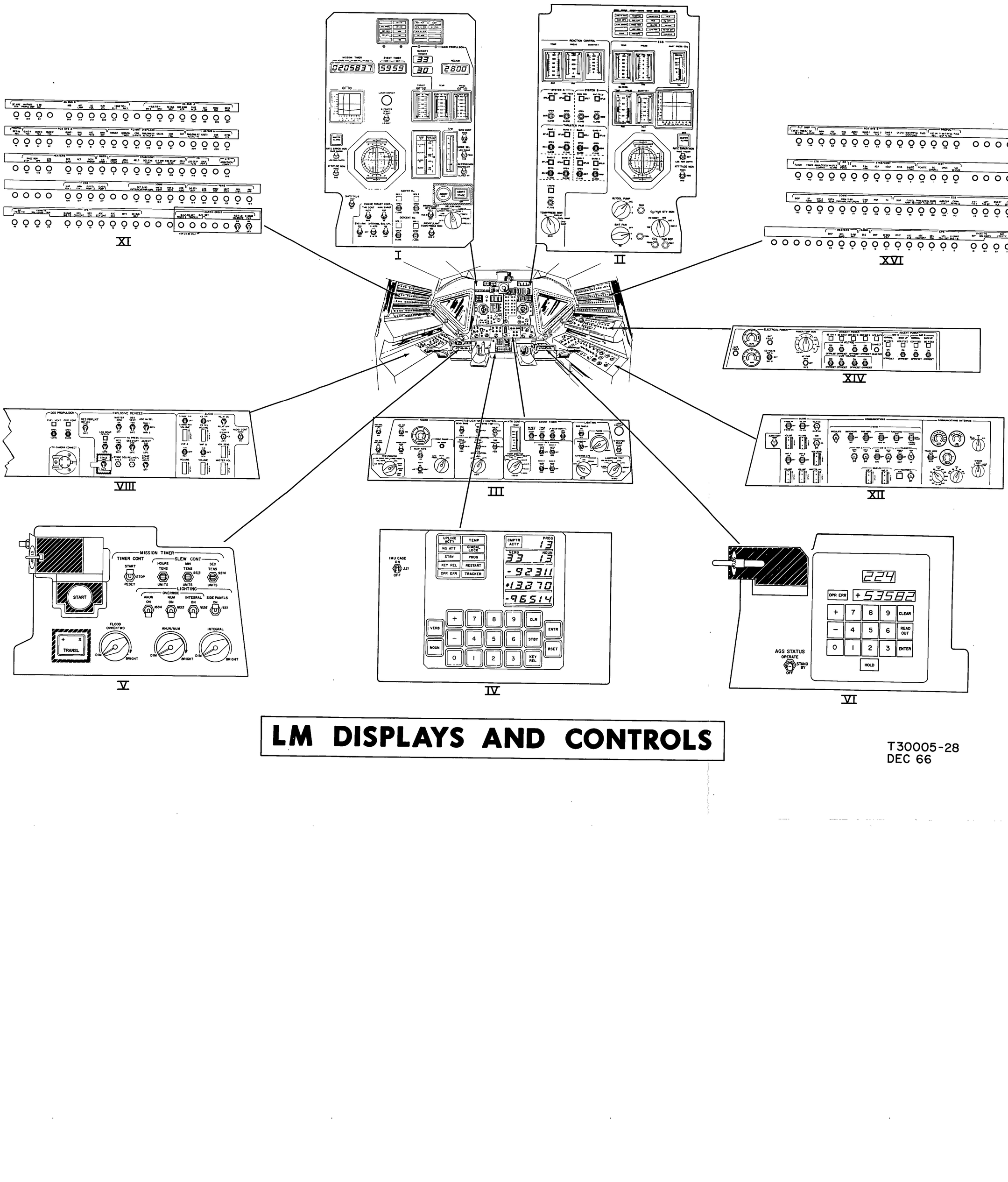


LM DESCENT STAGE

T30005-18
NOV 66

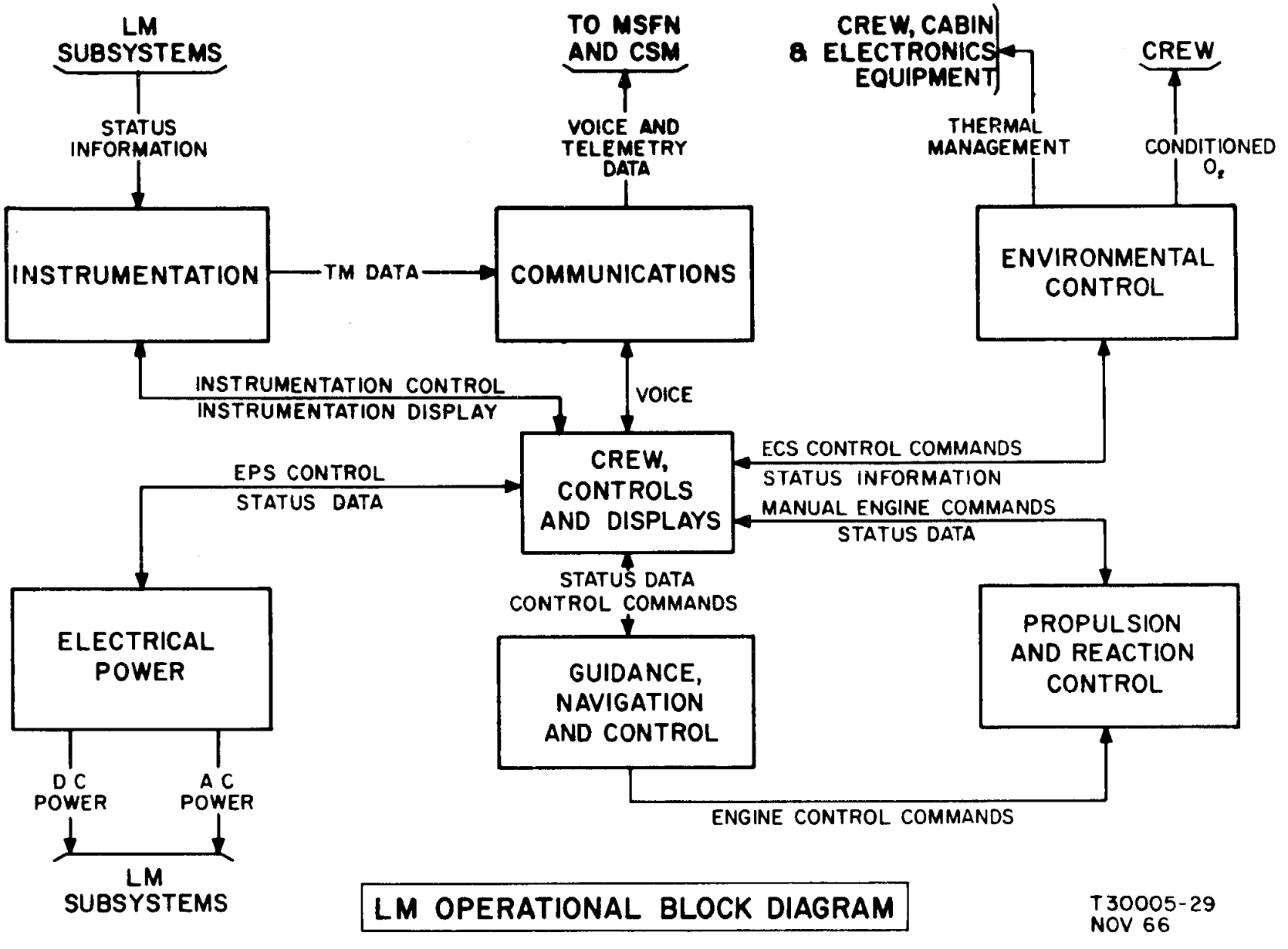


LM DISPLAYS AND CONTROLS



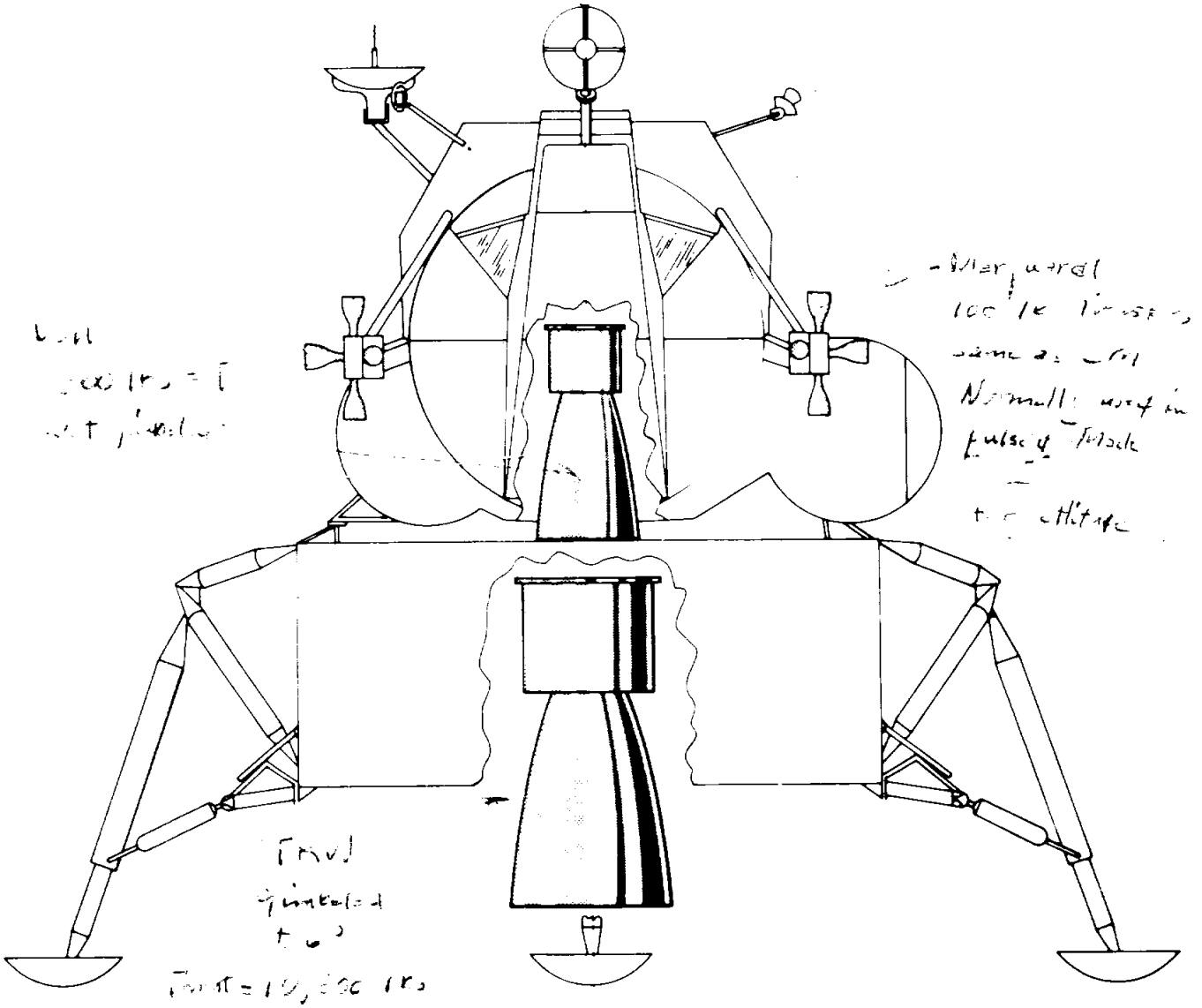
LM DISPLAYS AND CONTROLS

T30005-28
DEC 66



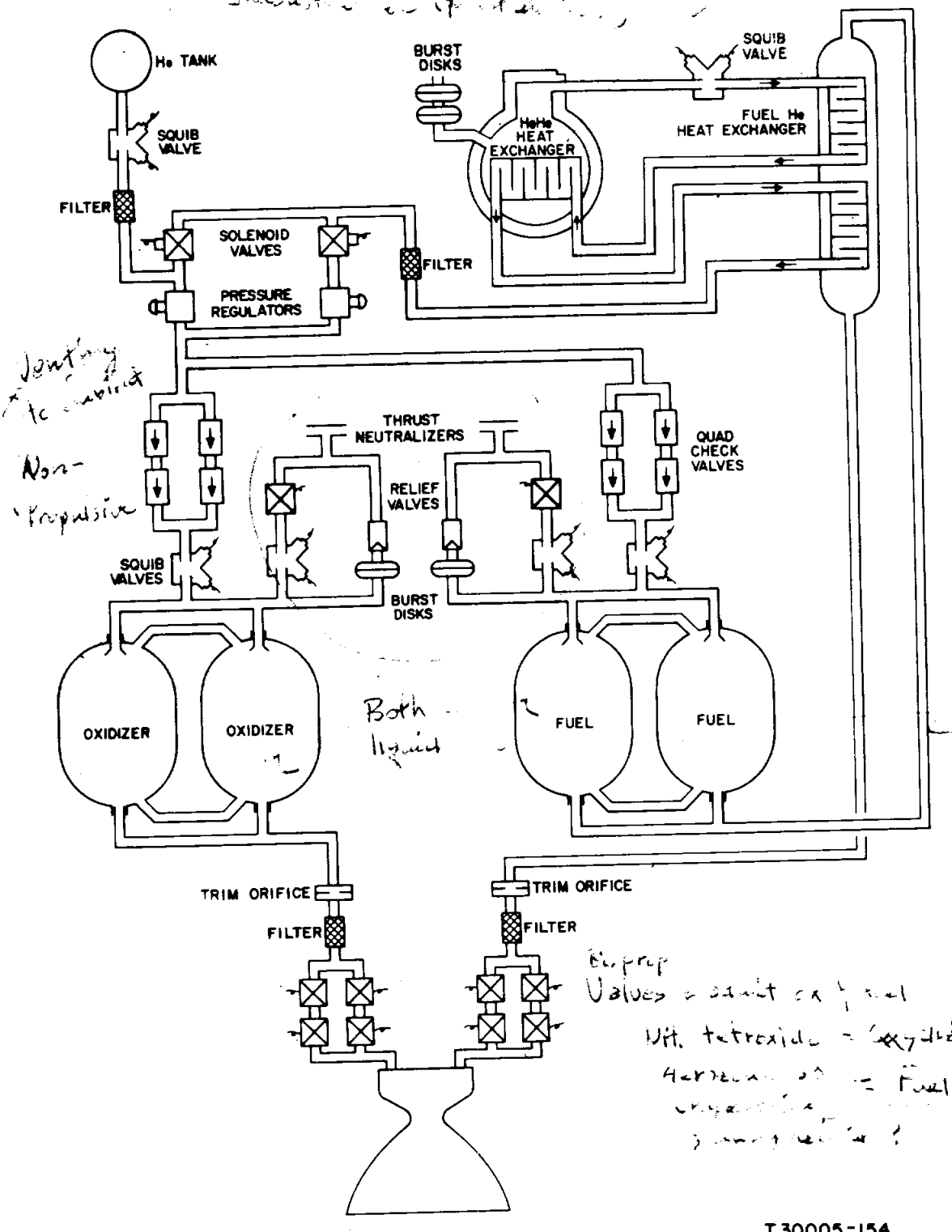
LM OPERATIONAL BLOCK DIAGRAM

T30005-29
NOV 66



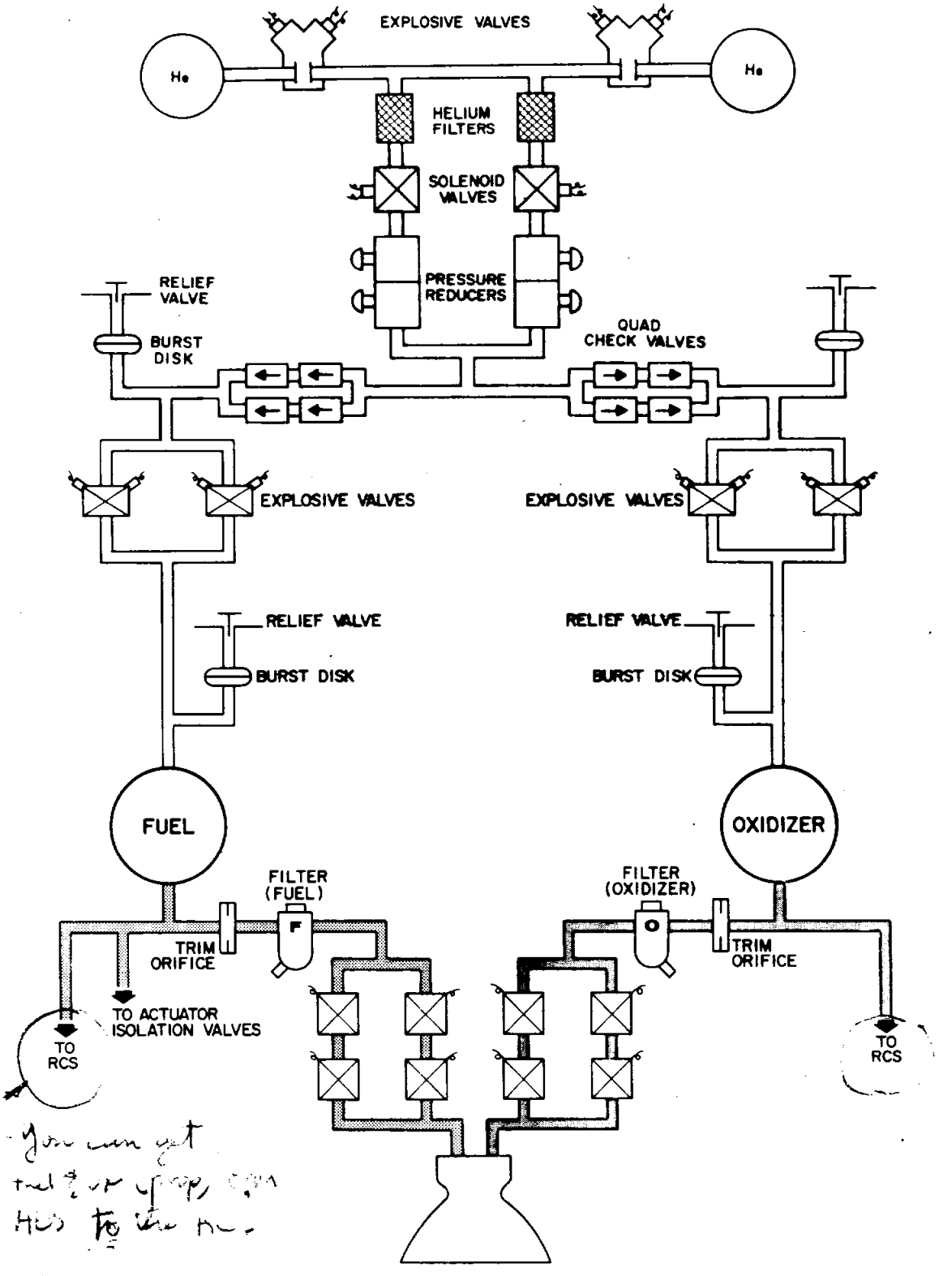
LEM PROPULSION

T30005-66
FEB 66



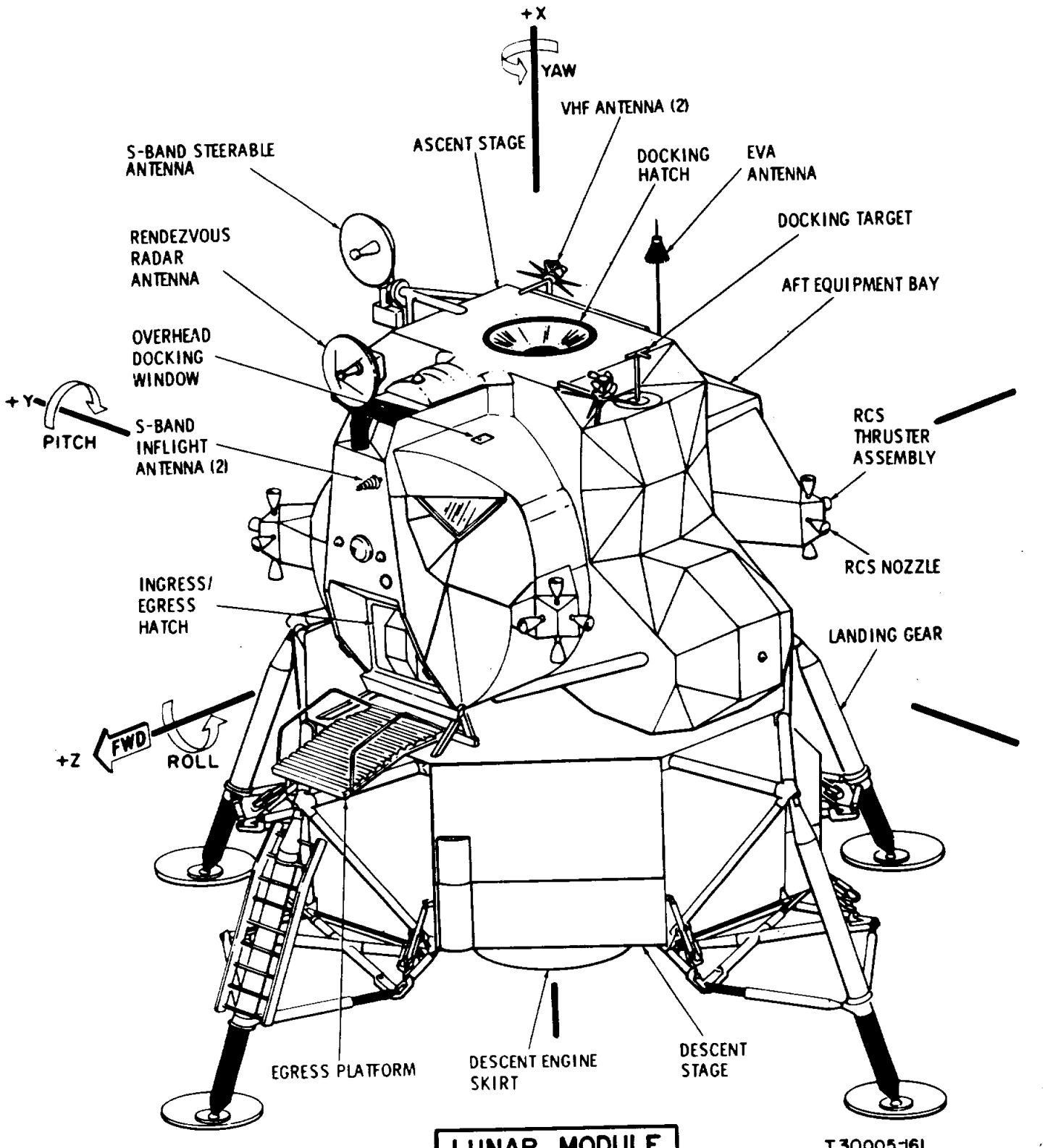
DESCENT PROPULSION SCHEMATIC

T 30005-154
NOV 66



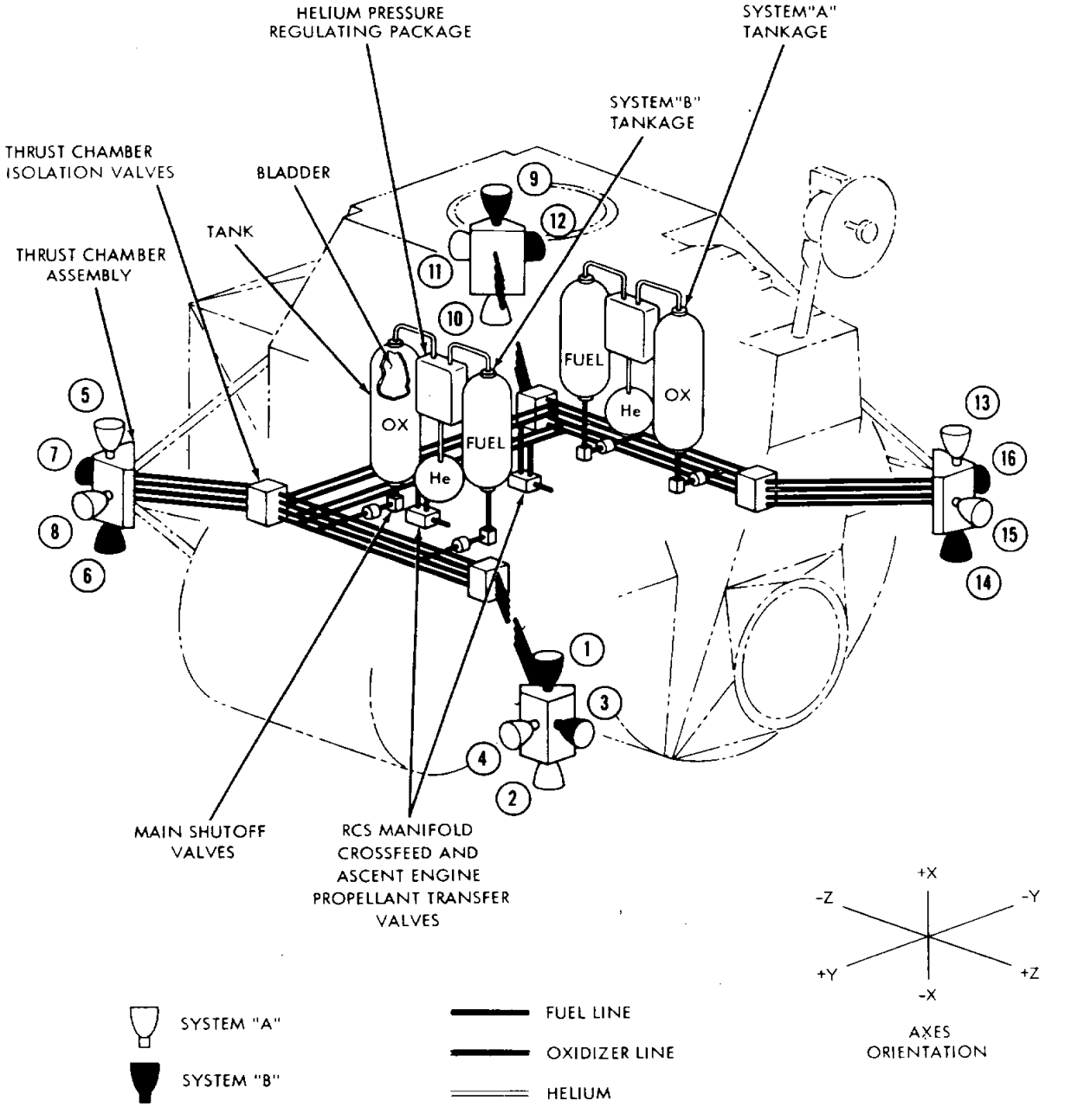
ASCENT PROPELLANT SYSTEM

T30005-155
NOV 66



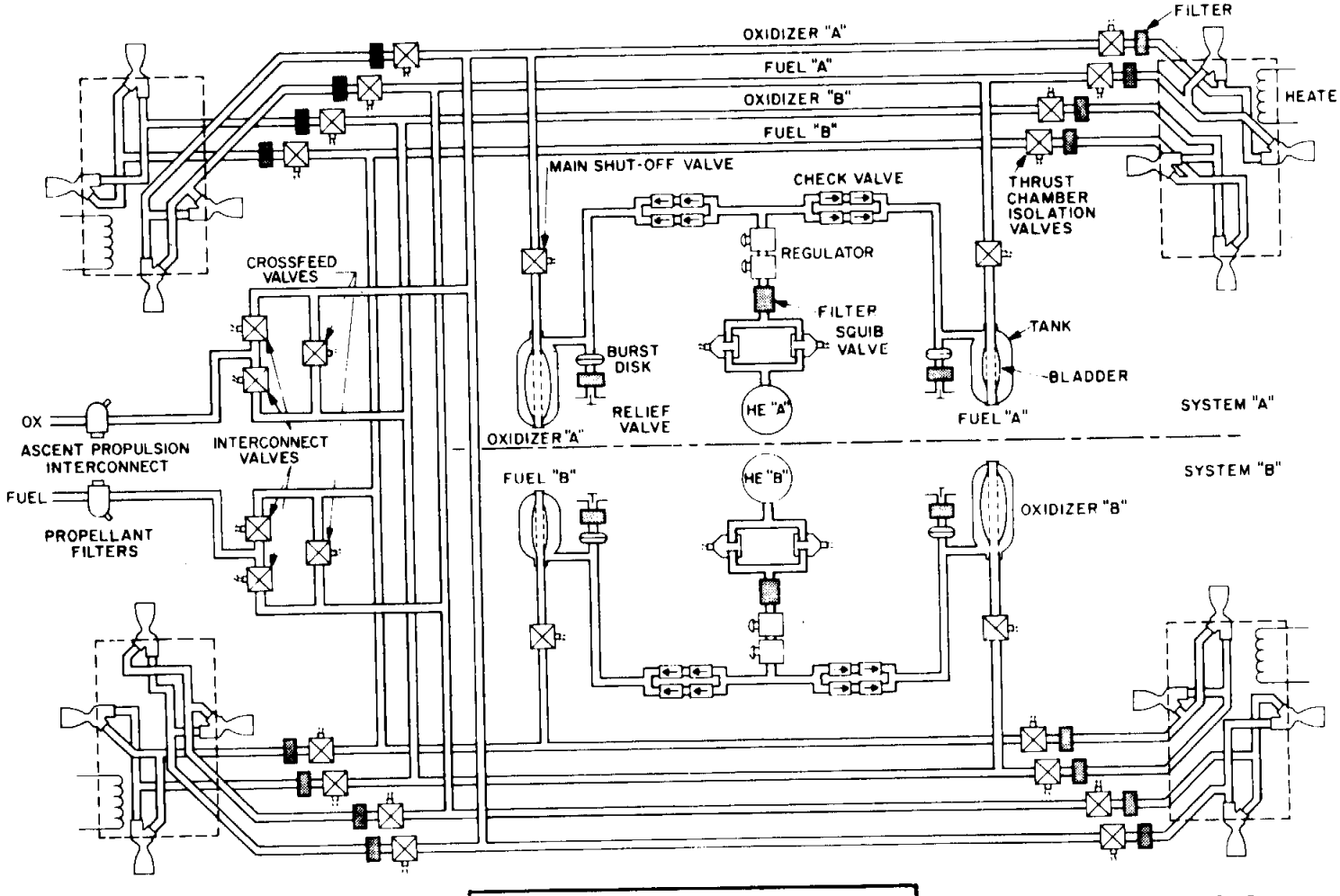
LUNAR MODULE AXES

T 30005-161
NOV 66



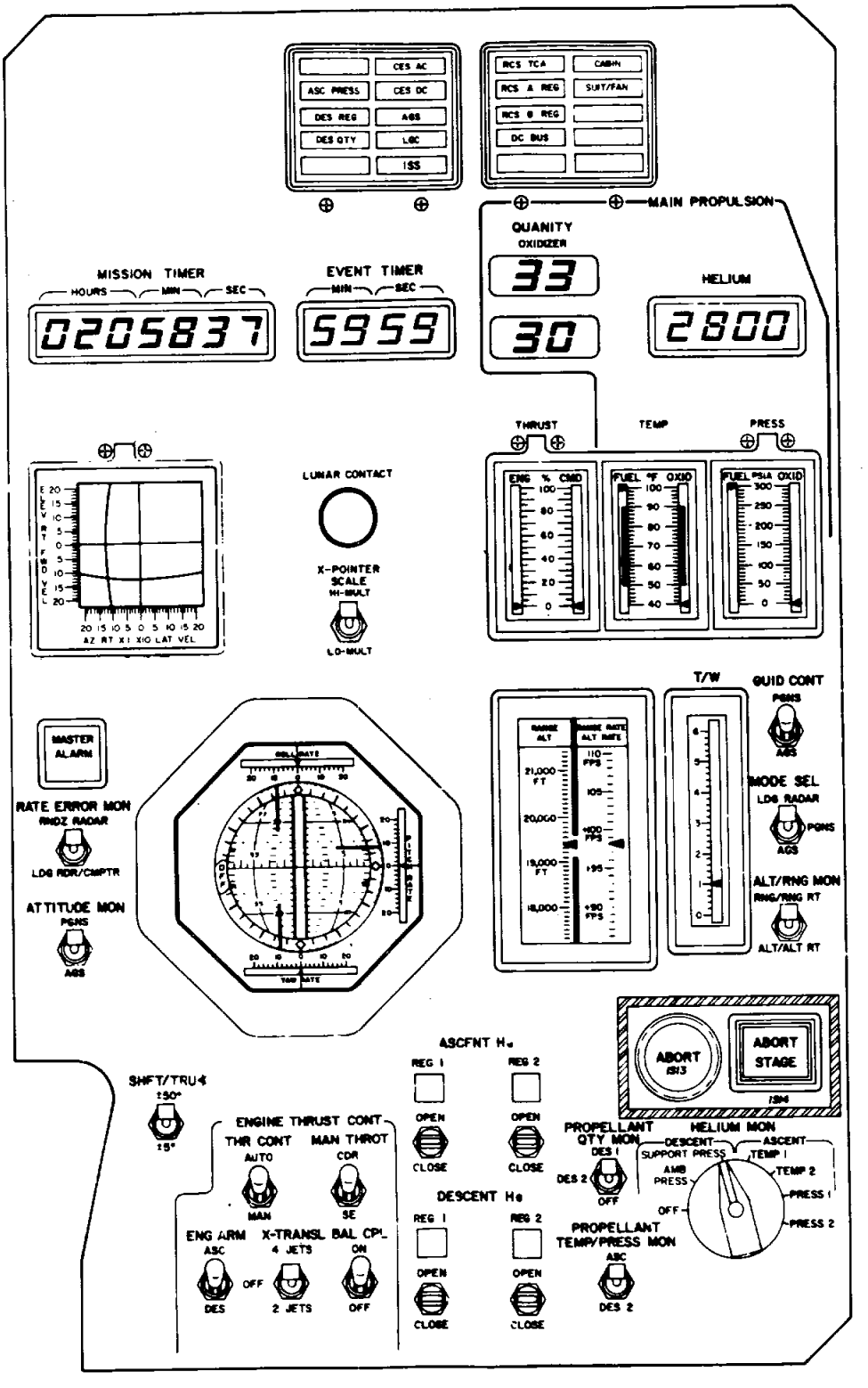
RCS INSTALLATION

T30005-149
NOV 66



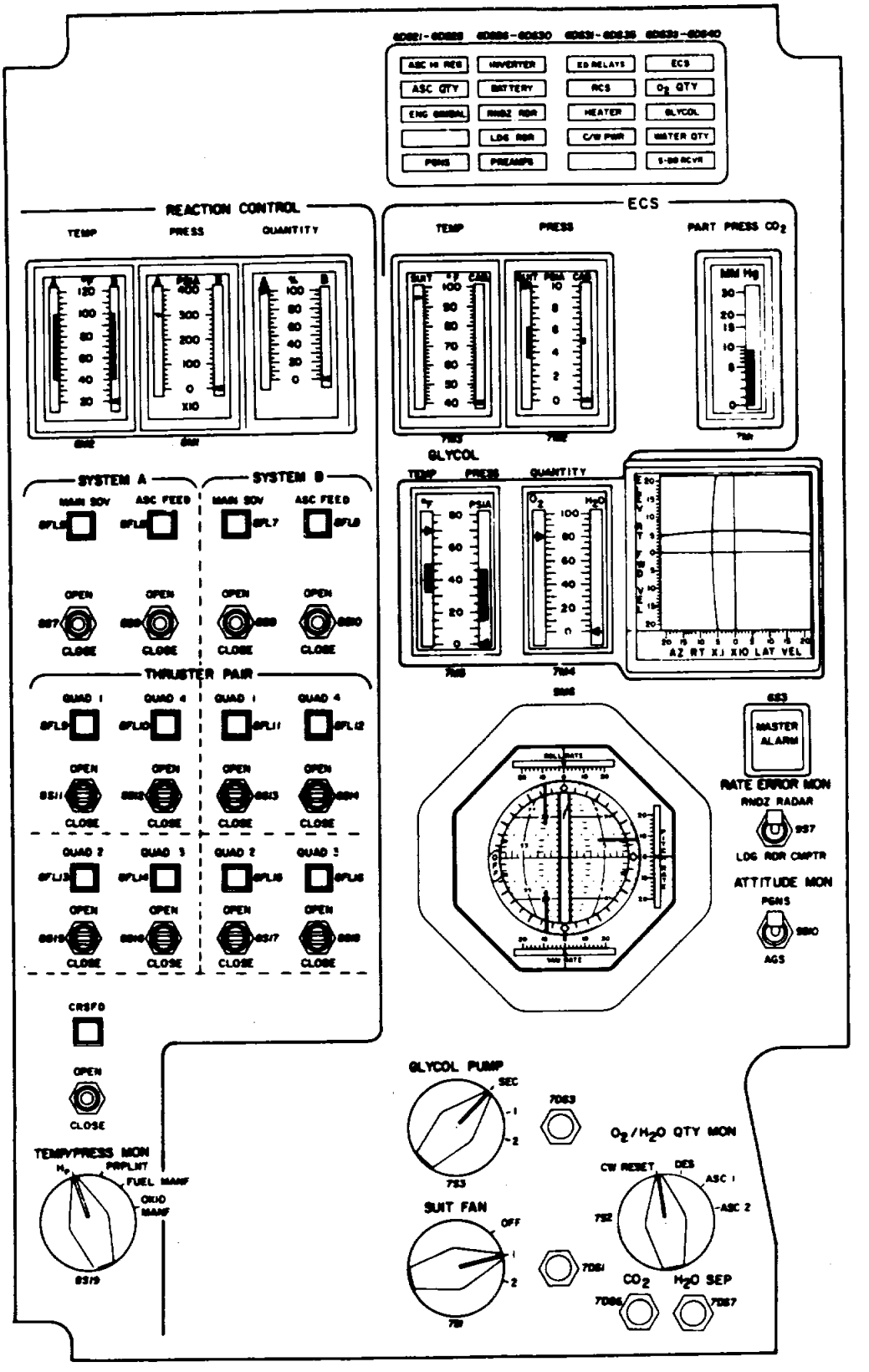
REACTION CONTROL SUBSYSTEM SCHEMATIC

T30005-151
NOV 66



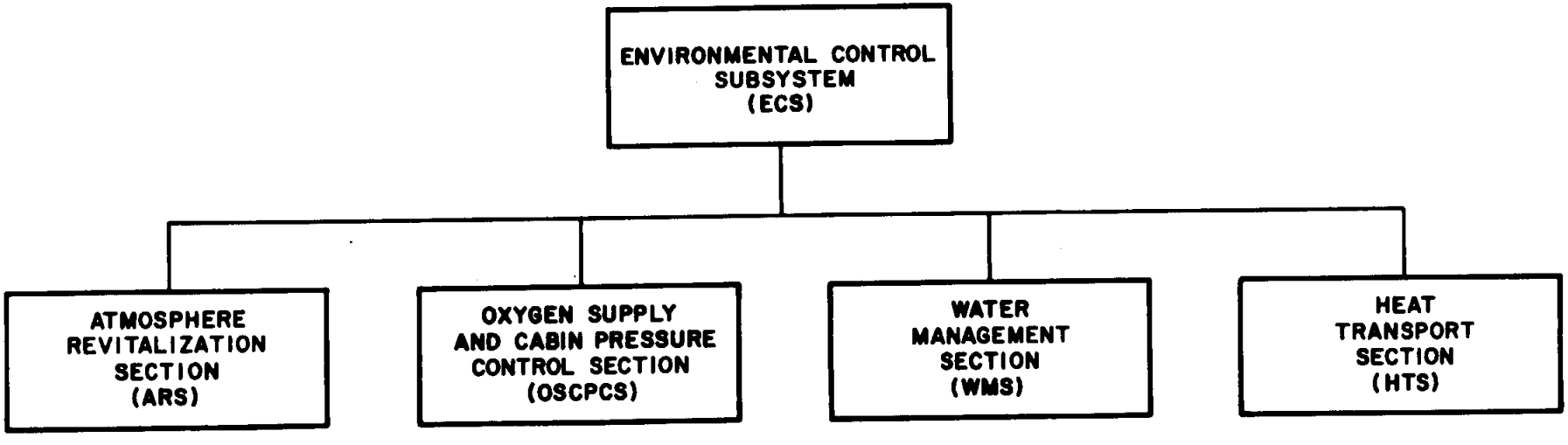
PANEL I

T30005-152
DEC 66



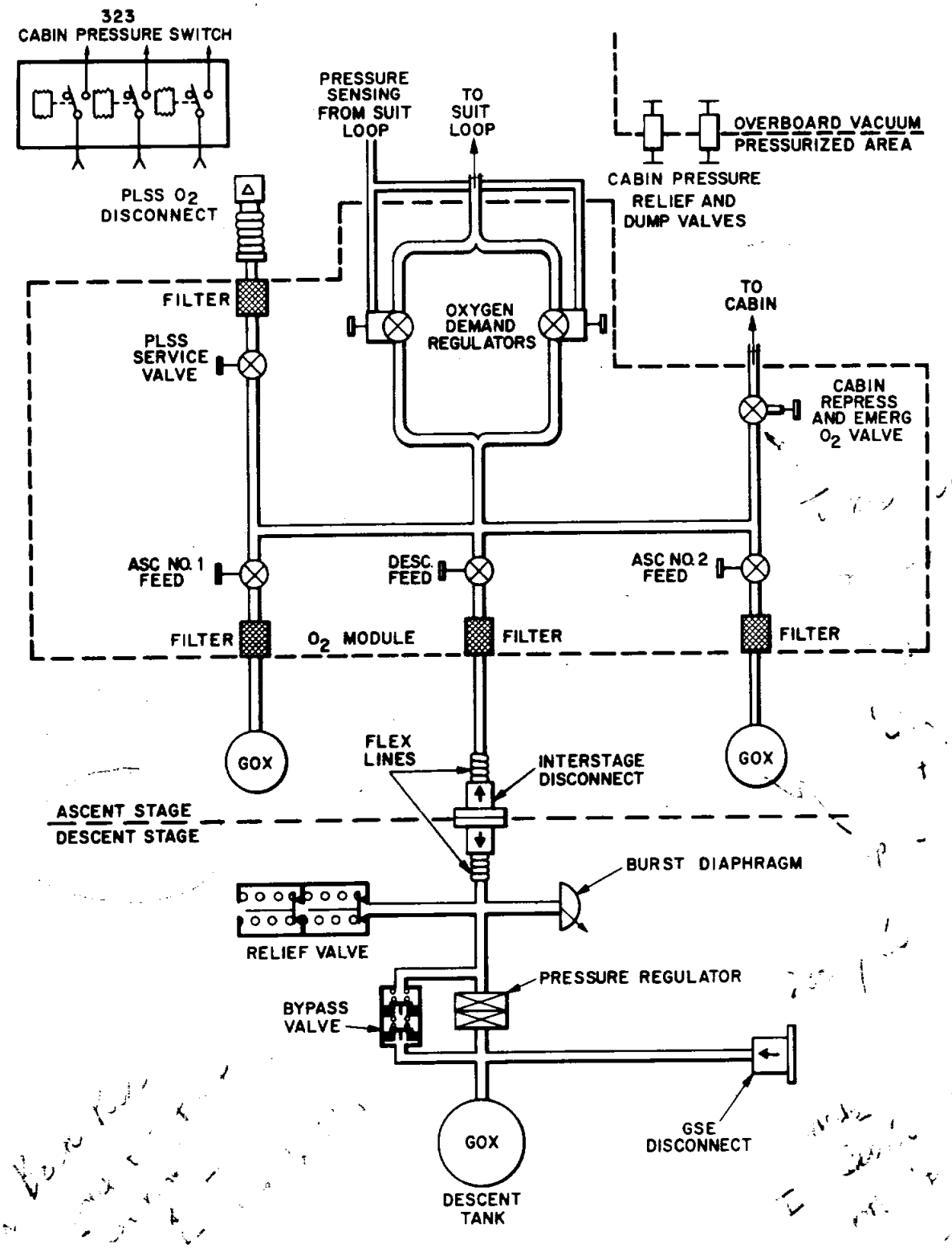
PANEL II

T30005-160
DEC 66



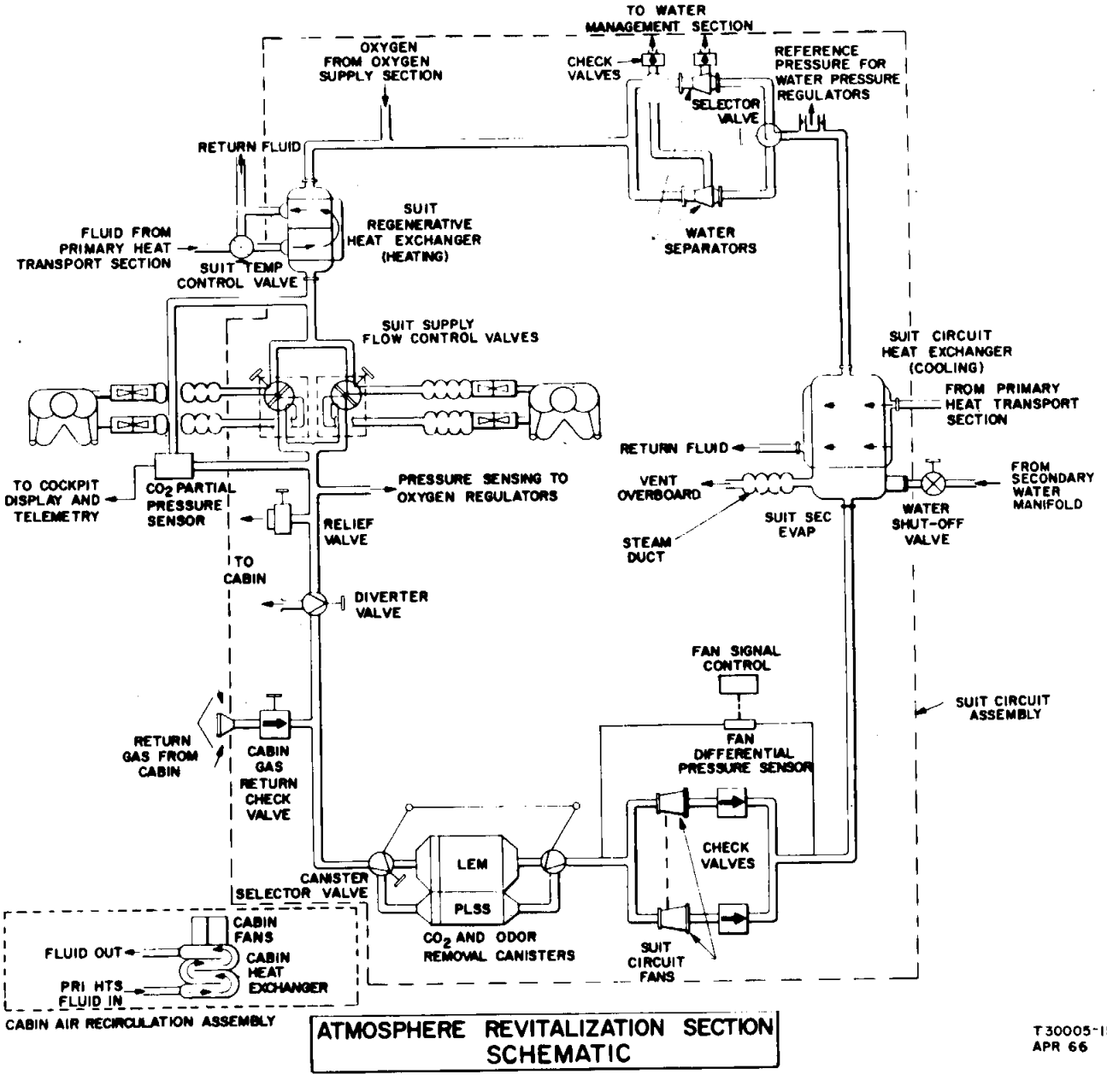
LM ECS BASIC BLOCK DIAGRAM

T30005-61
FEB. 66



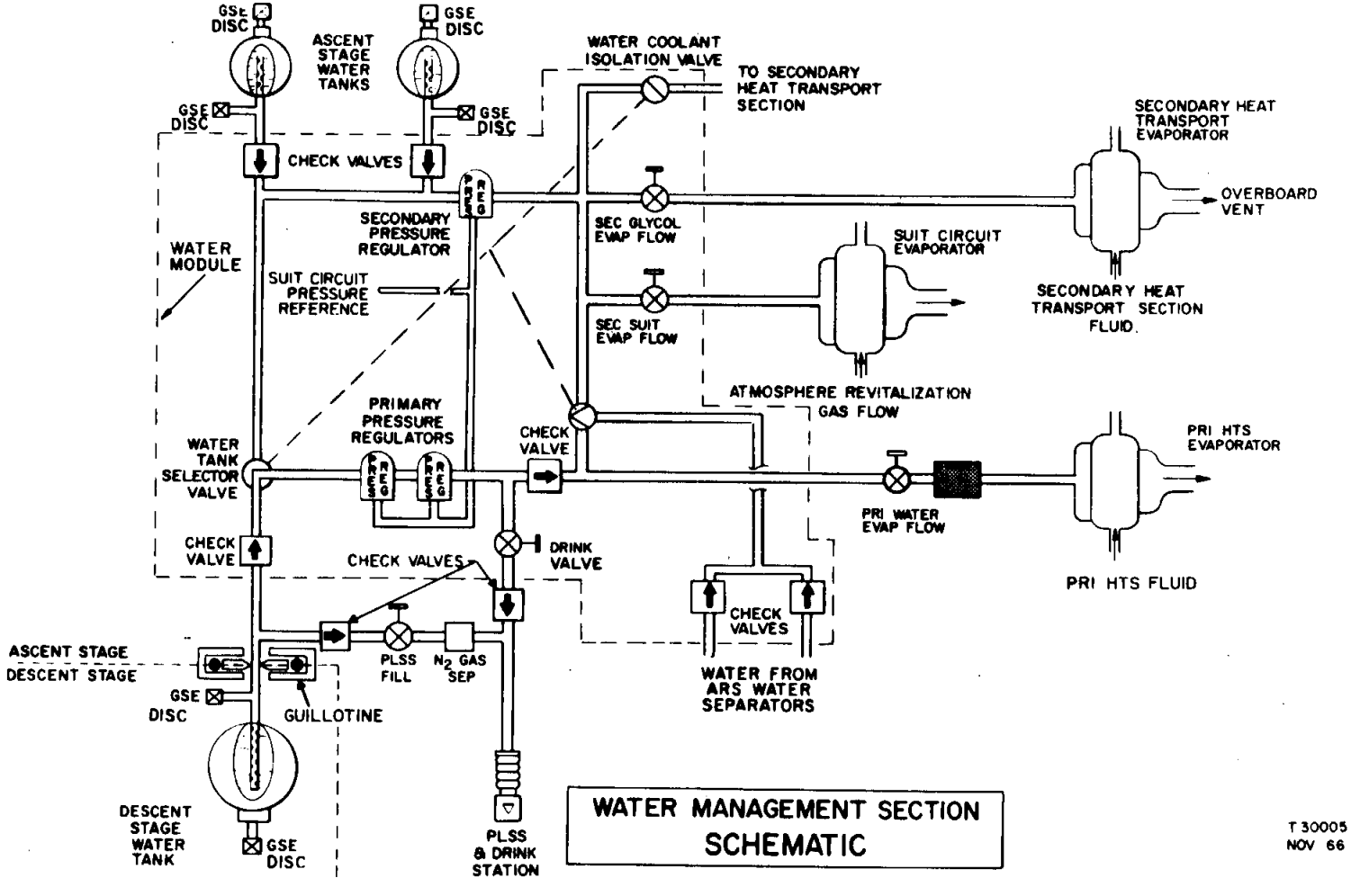
OXYGEN SUPPLY AND CABIN PRESSURE CONTROL SECTION SCHEMATIC

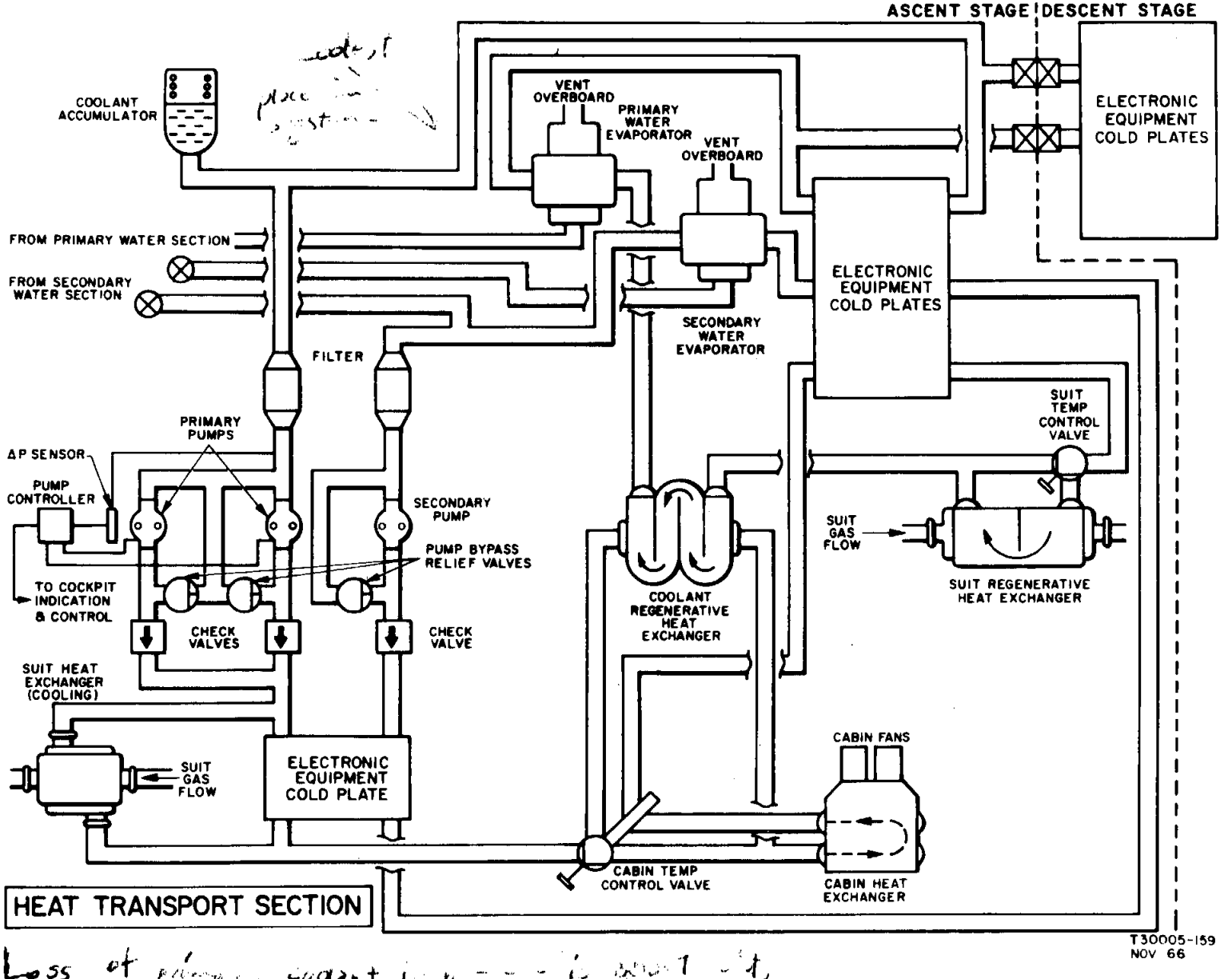
T30005-158
APR 66

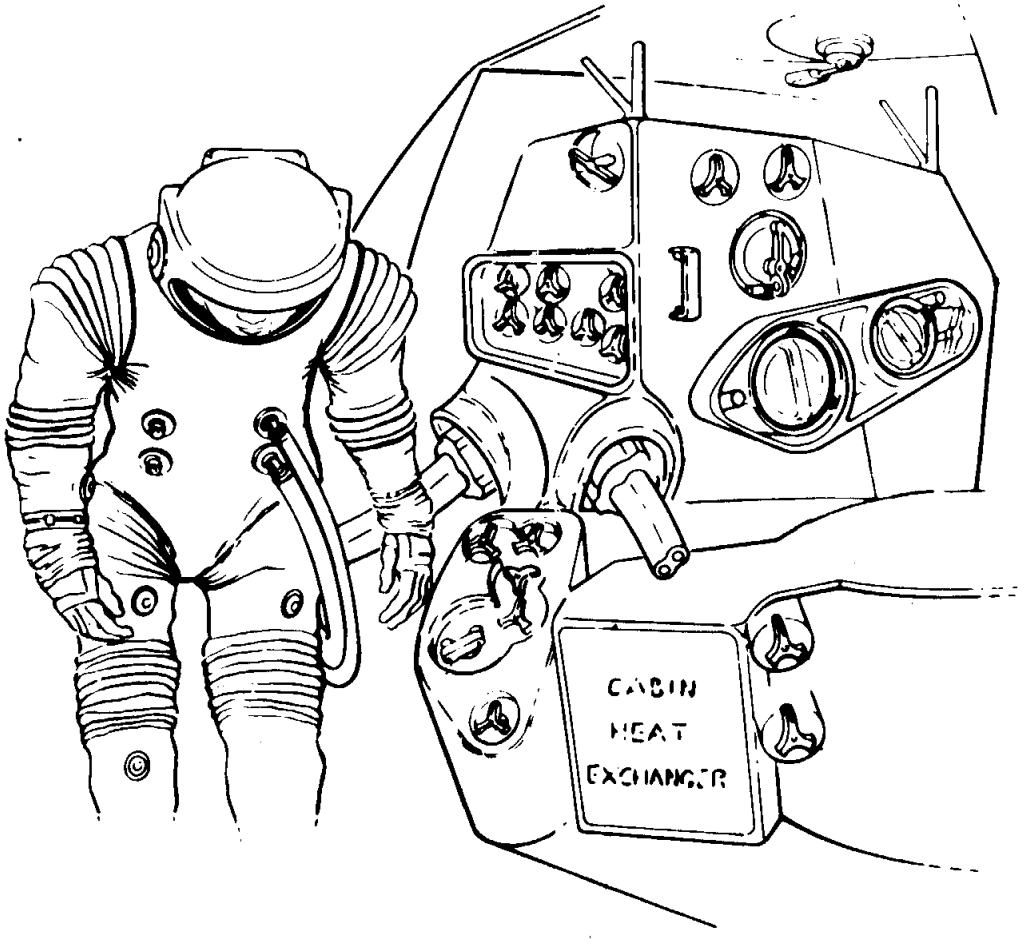


ATMOSPHERE REVITALIZATION SECTION SCHEMATIC

T30005-157
APR 66

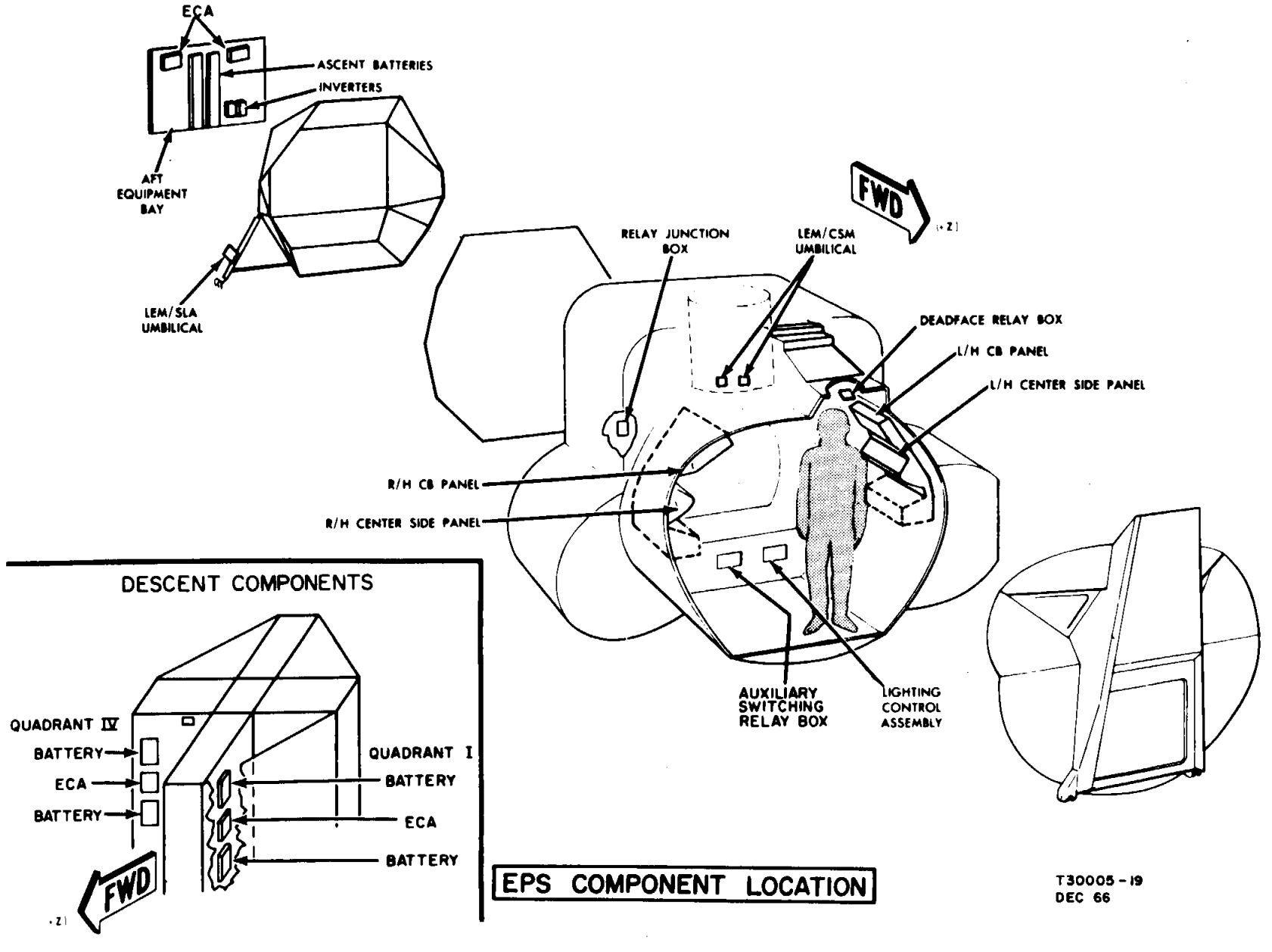

GSE DISC
ASCENT STAGE WATER TANKS
GSE DISC
GSE DISC
GSE DISC
WATER COOLANT ISOLATION VALVE
TO SECONDARY HEAT TRANSPORT SECTION
SECONDARY HEAT TRANSPORT EVAPORATOR
OVERBOARD VENT
CHECK VALVES
SECONDARY PRESSURE REGULATOR
WATER MODULE
SUIT CIRCUIT PRESSURE REFERENCE
SEC GLYCOL EVAP FLOW
SUIT CIRCUIT EVAPORATOR
SEC SUIT EVAP FLOW
SECONDARY HEAT TRANSPORT SECTION FLUID
ATMOSPHERE REVITALIZATION GAS FLOW
PRIMARY PRESSURE REGULATORS
CHECK VALVE
WATER TANK SELECTOR VALVE
PRI HTS EVAPORATOR
PRI WATER EVAP FLOW
CHECK VALVE
CHECK VALVES
DRINK VALVE
PRI HTS FLUID
CHECK VALVES
ASCENT STAGE
DESCENT STAGE
PLSS FILL
N_2 GAS SEP
WATER FROM ARS WATER SEPARATORS
GSE DISC
GUILLOTINE
DESCENT STAGE WATER TANK
GSE DISC
PLSS & DRINK STATION
WATER MANAGEMENT SECTION SCHEMATIC
T 30005-156
NOV 66


ASCENT STAGE
DESCENT STAGE
COOLANT ACCUMULATOR
VENT OVERBOARD
PRIMARY WATER EVAPORATOR
VENT OVERBOARD
ELECTRONIC EQUIPMENT COLD PLATES
FROM PRIMARY WATER SECTION
FROM SECONDARY WATER SECTION
FILTER
SECONDARY WATER EVAPORATOR
ELECTRONIC EQUIPMENT COLD PLATES
SUIT TEMP CONTROL VALVE
PRIMARY PUMPS
ΔP SENSOR
PUMP CONTROLLER
SECONDARY PUMP
PUMP BYPASS RELIEF VALVES
SUIT GAS FLOW
SUIT REGENERATIVE HEAT EXCHANGER
TO COCKPIT INDICATION & CONTROL
CHECK VALVES
CHECK VALVE
COOLANT REGENERATIVE HEAT EXCHANGER
SUIT HEAT EXCHANGER (COOLING)
CABIN FANS
SUIT GAS FLOW
ELECTRONIC EQUIPMENT COLD PLATE
CABIN TEMP CONTROL VALVE
CABIN HEAT EXCHANGER
HEAT TRANSPORT SECTION
T30005-159
NOV 66



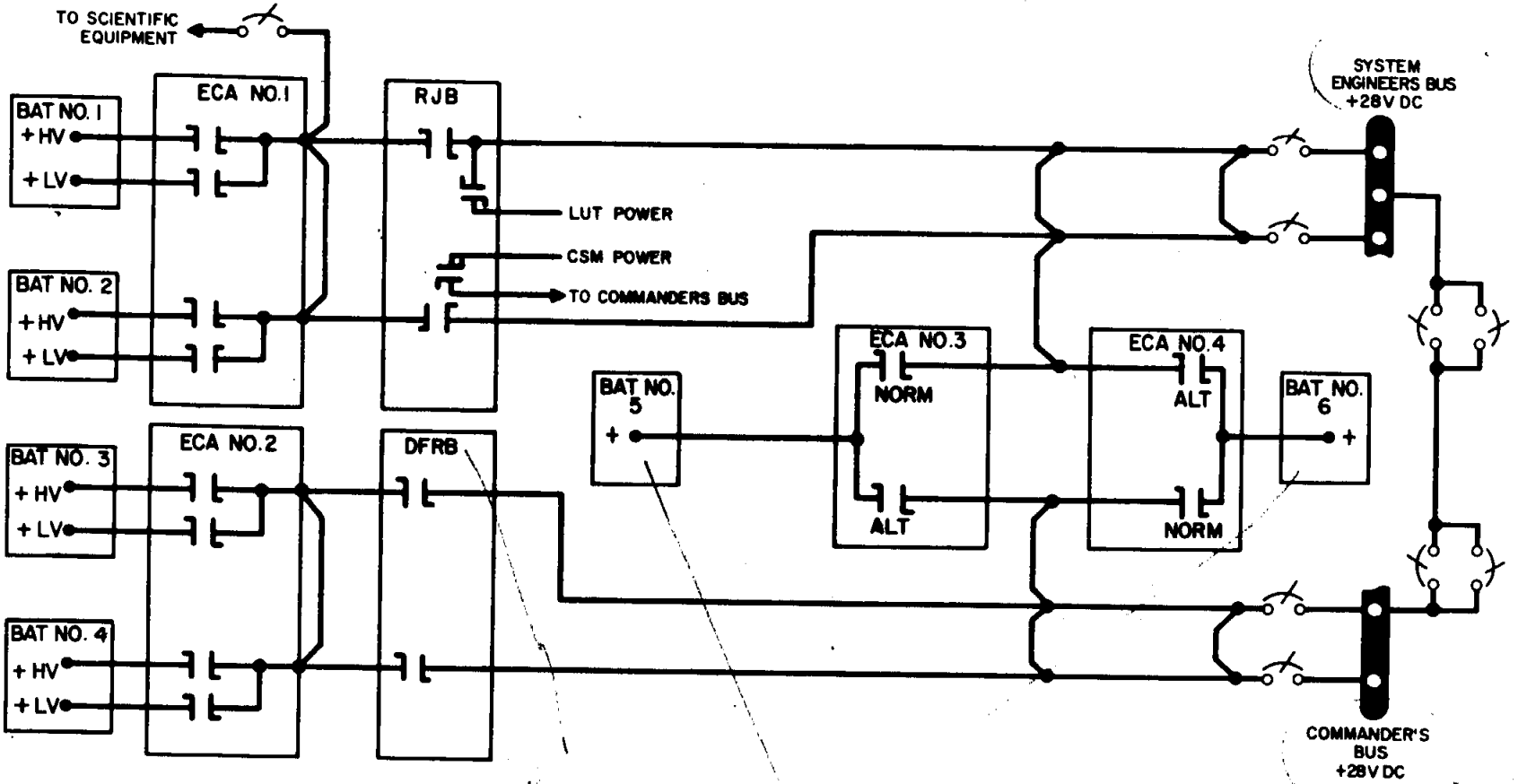
ECS - SPACE SUIT INTERFACE

T30005-33
NOV 66



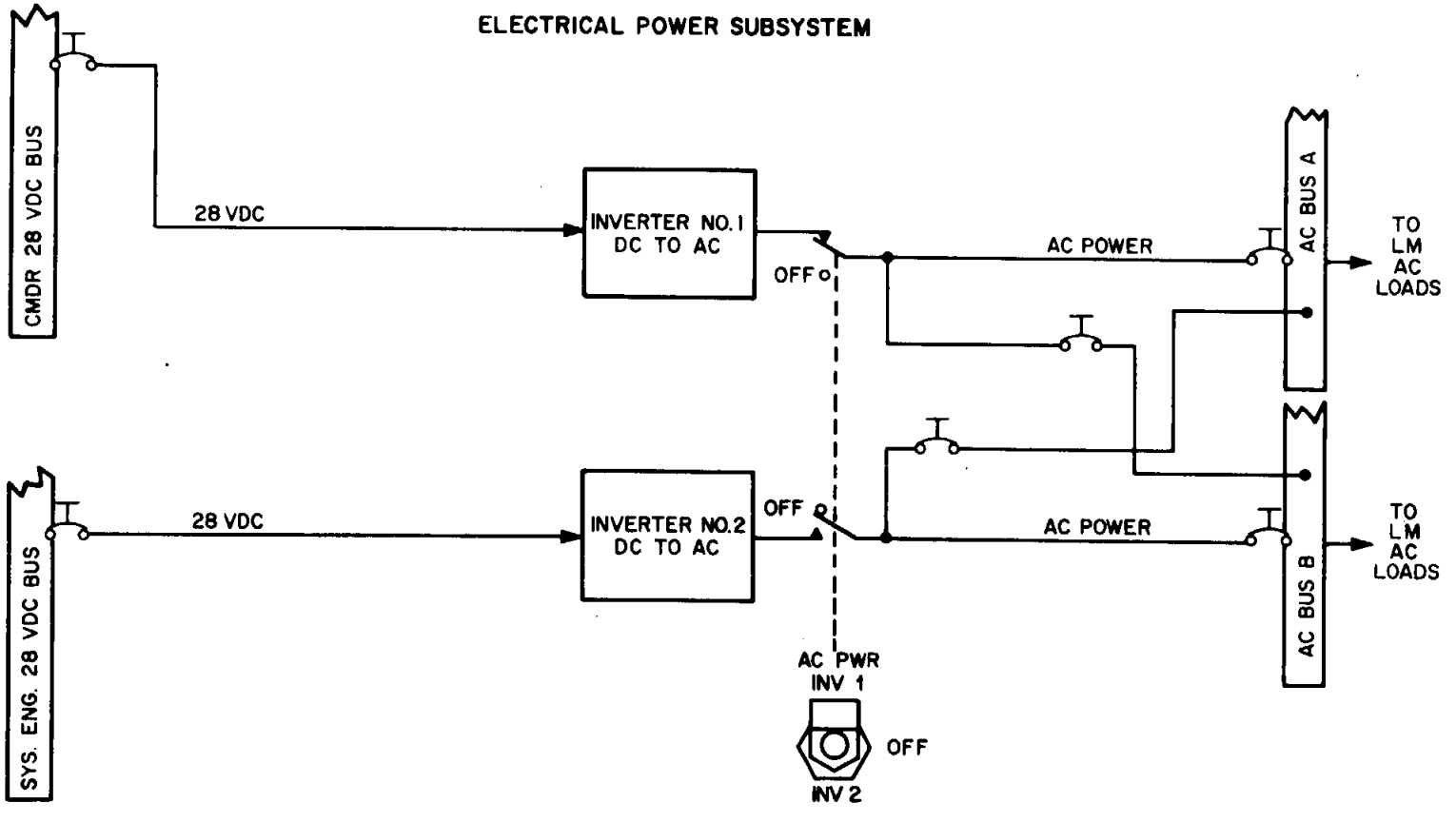
EPS COMPONENT LOCATION

T30005-19
DEC 66



EPS FEEDER SYSTEM

T30005-126
NOV 66

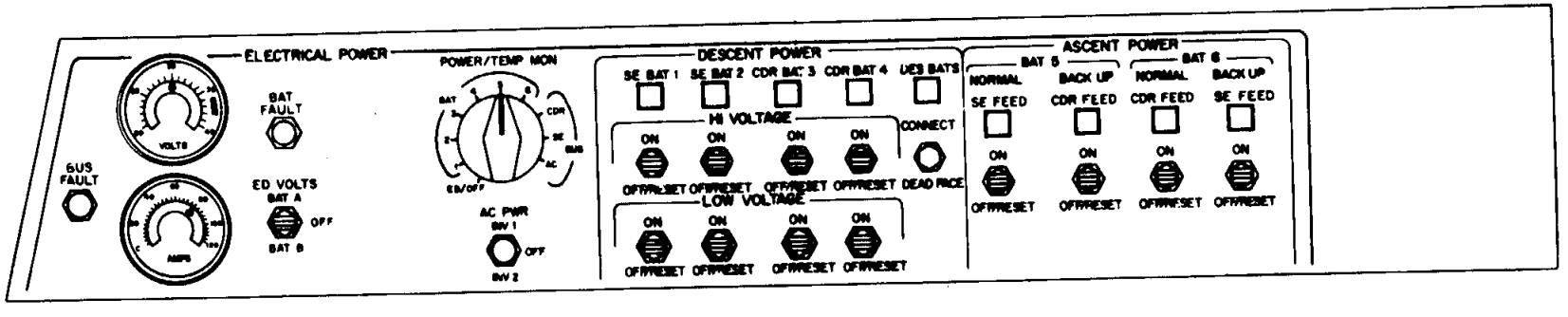


AC DISTRIBUTION BLOCK DIAGRAM

T30005-21
NOV 66

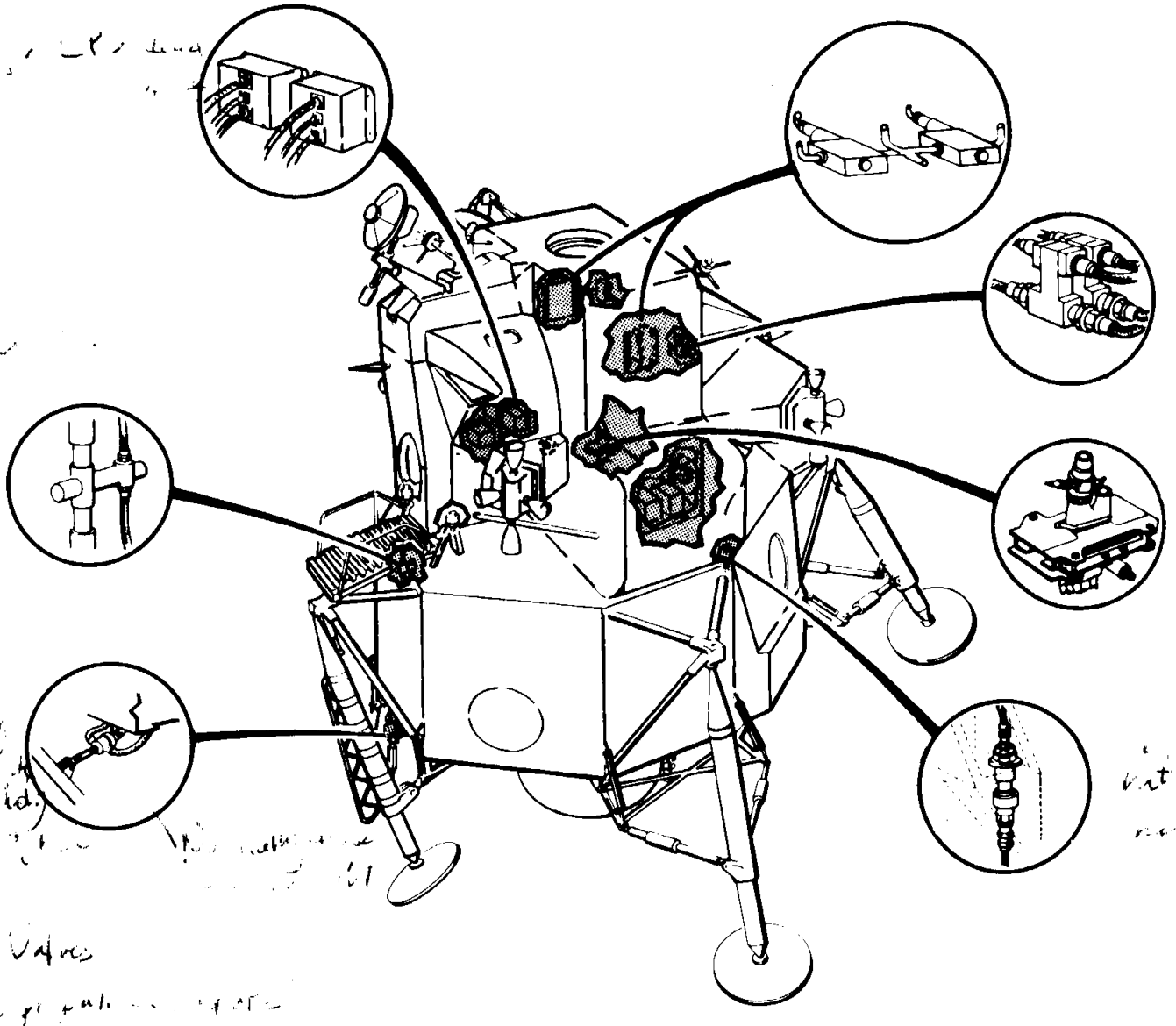
ELECTRICAL POWER SUBSYSTEM

PANEL XIV



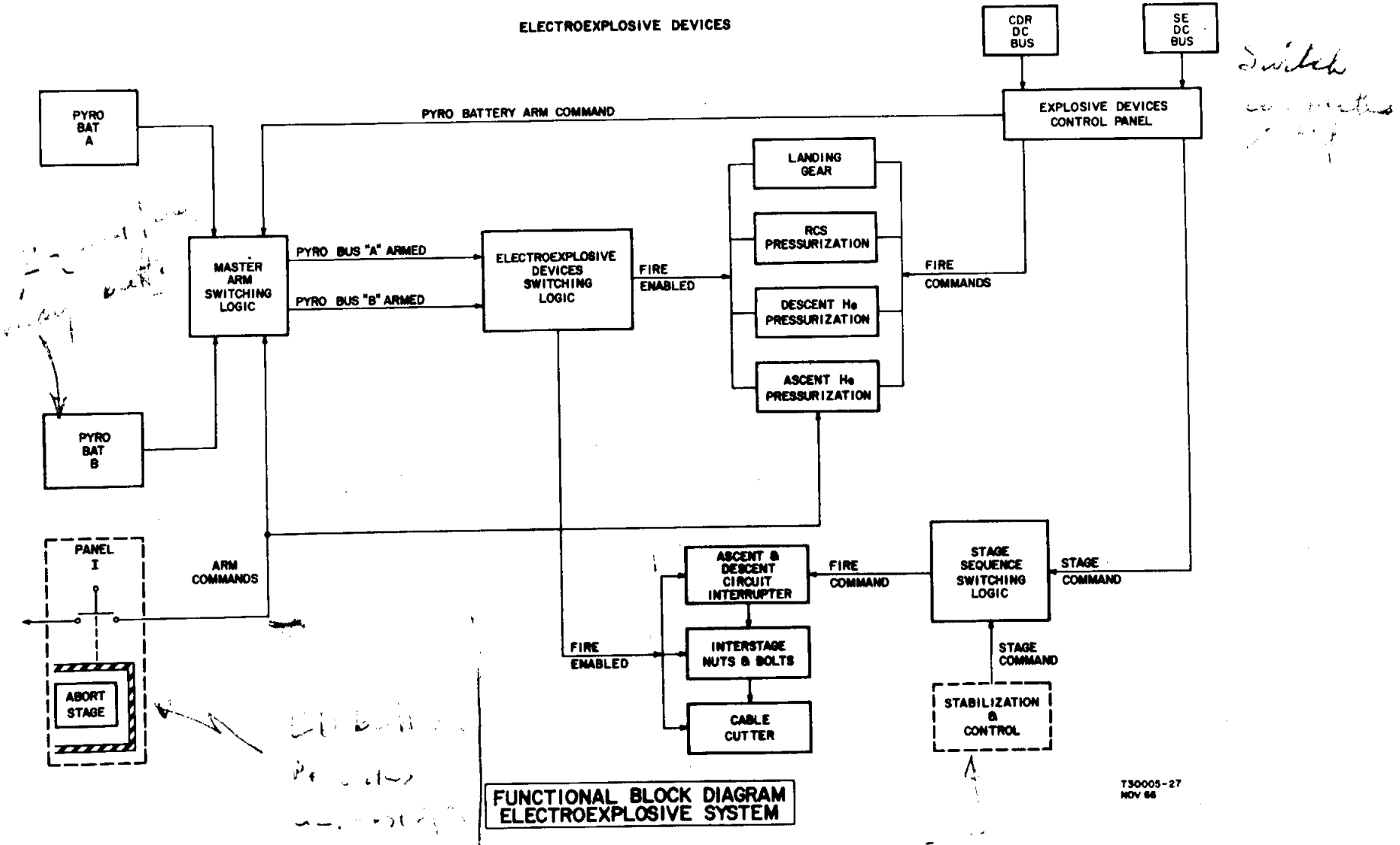
CONTROLS AND DISPLAYS

T30005-128
DEC 66

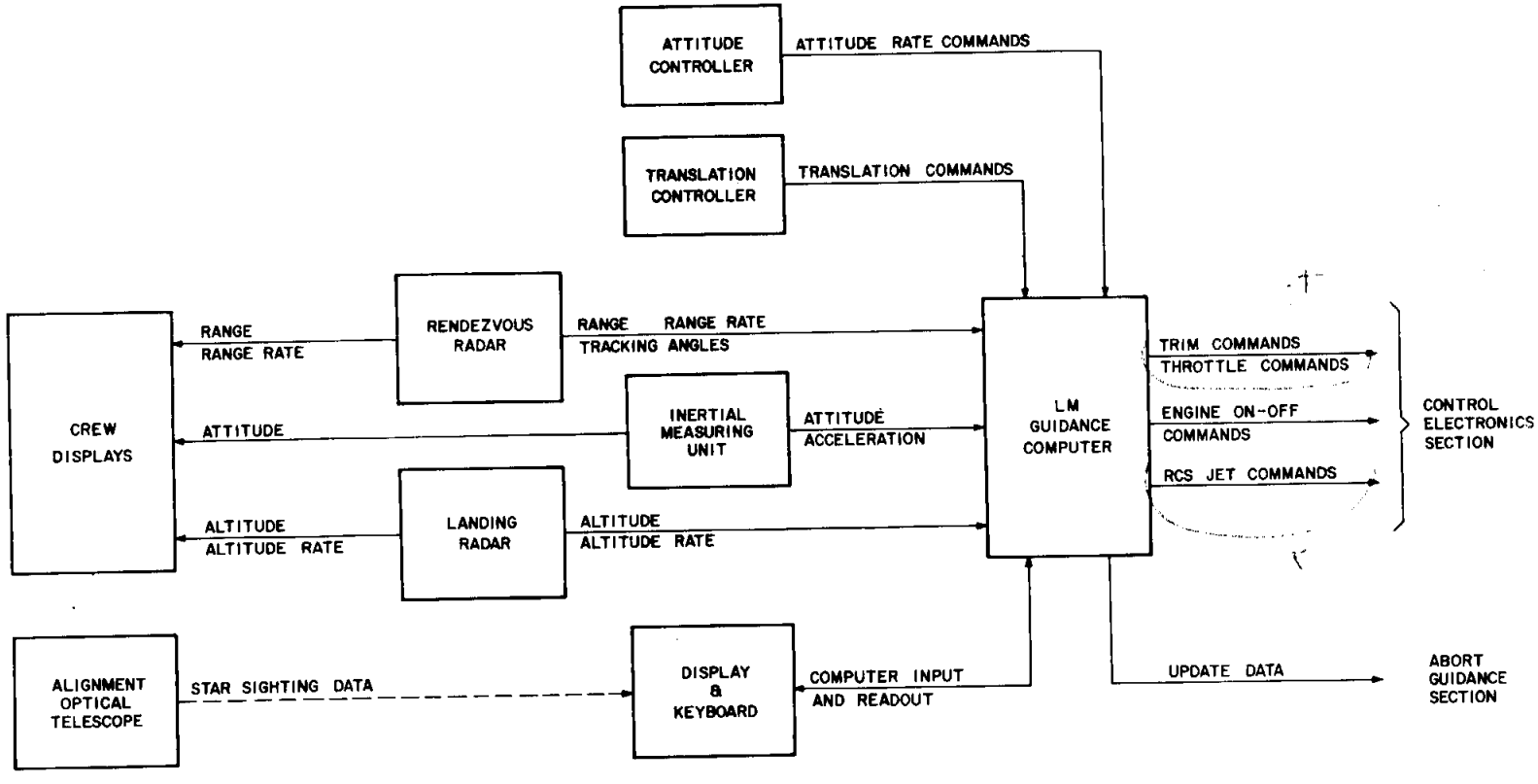


EXPLOSIVE DEVICES – LOCATIONS

T30005-26
JUNE 66

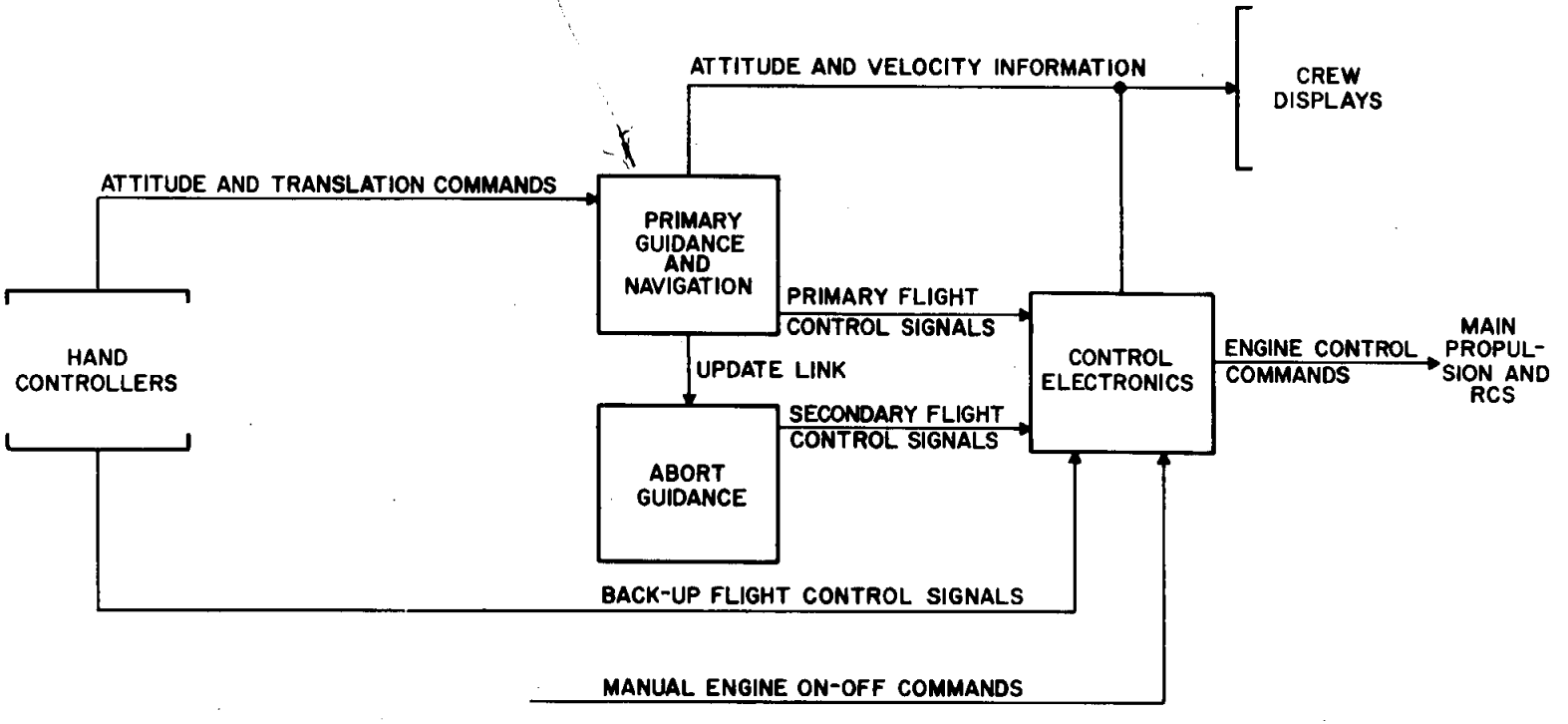


FUNCTIONAL BLOCK DIAGRAM
ELECTROEXPLOSIVE SYSTEM



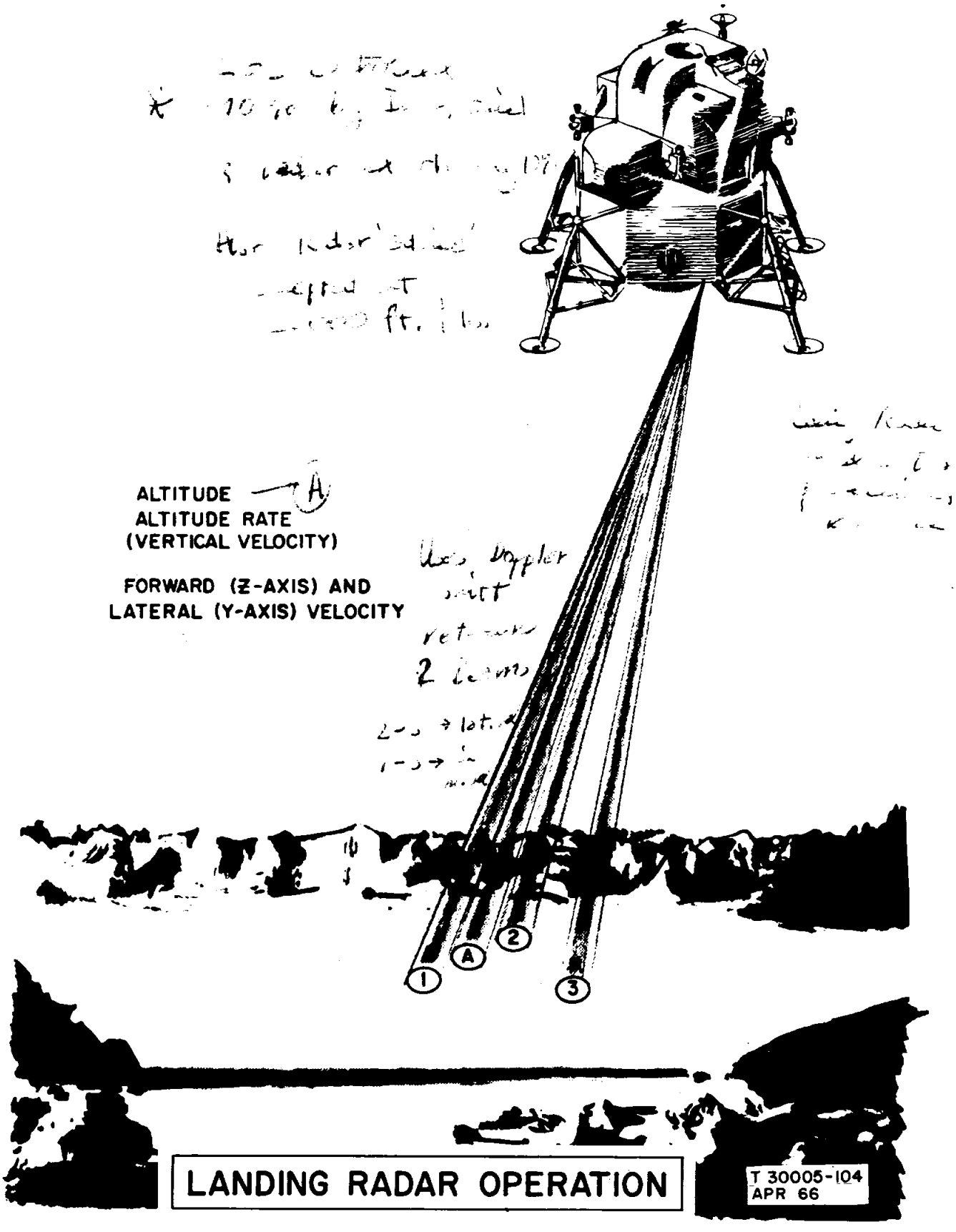
PRIMARY GUIDANCE AND NAVIGATION SECTION

T30005-45
DEC 66



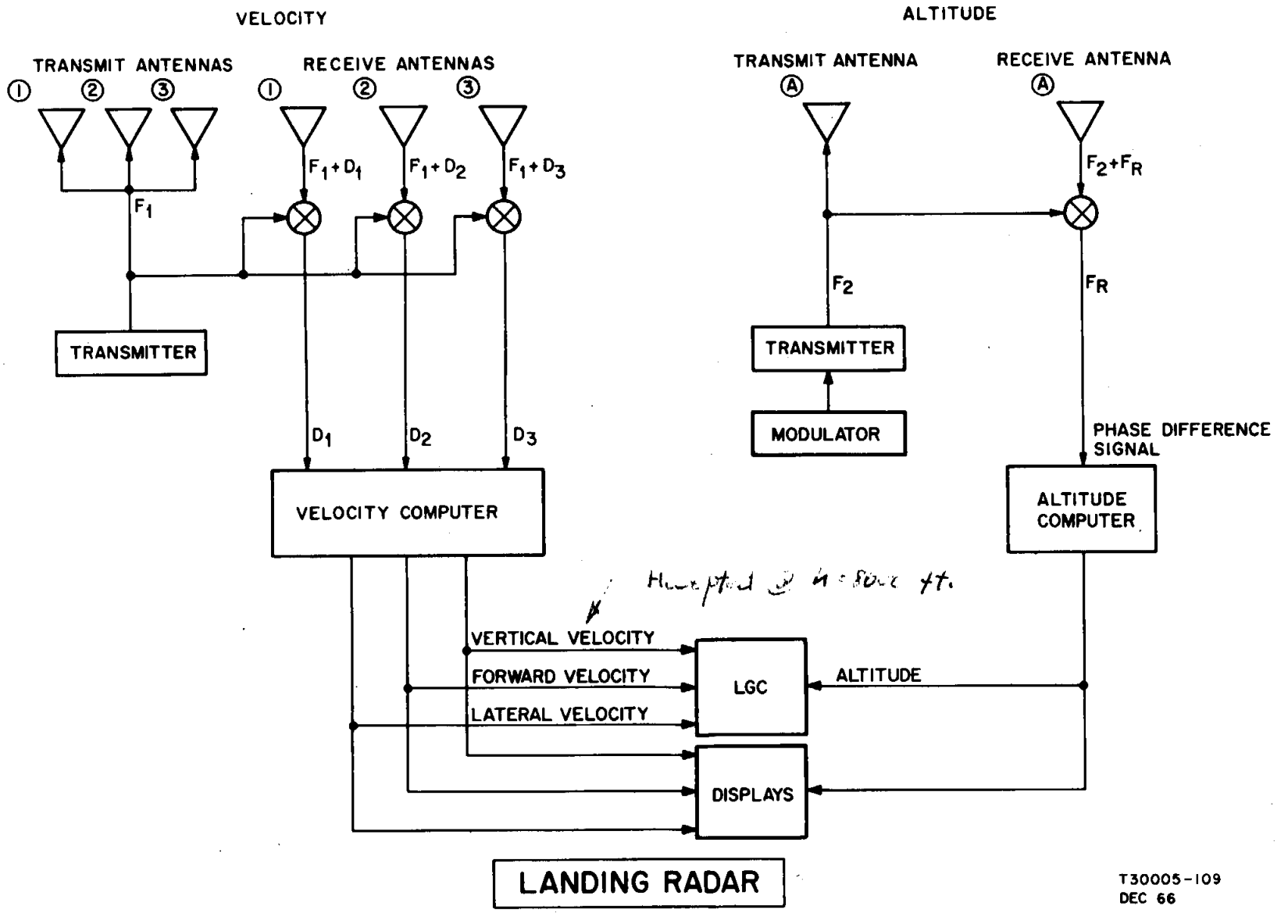
LM GUIDANCE, NAVIGATION AND CONTROL SUBSYSTEM

T30005-44
DEC 66



LANDING RADAR OPERATION

T 30005-104
APR 66



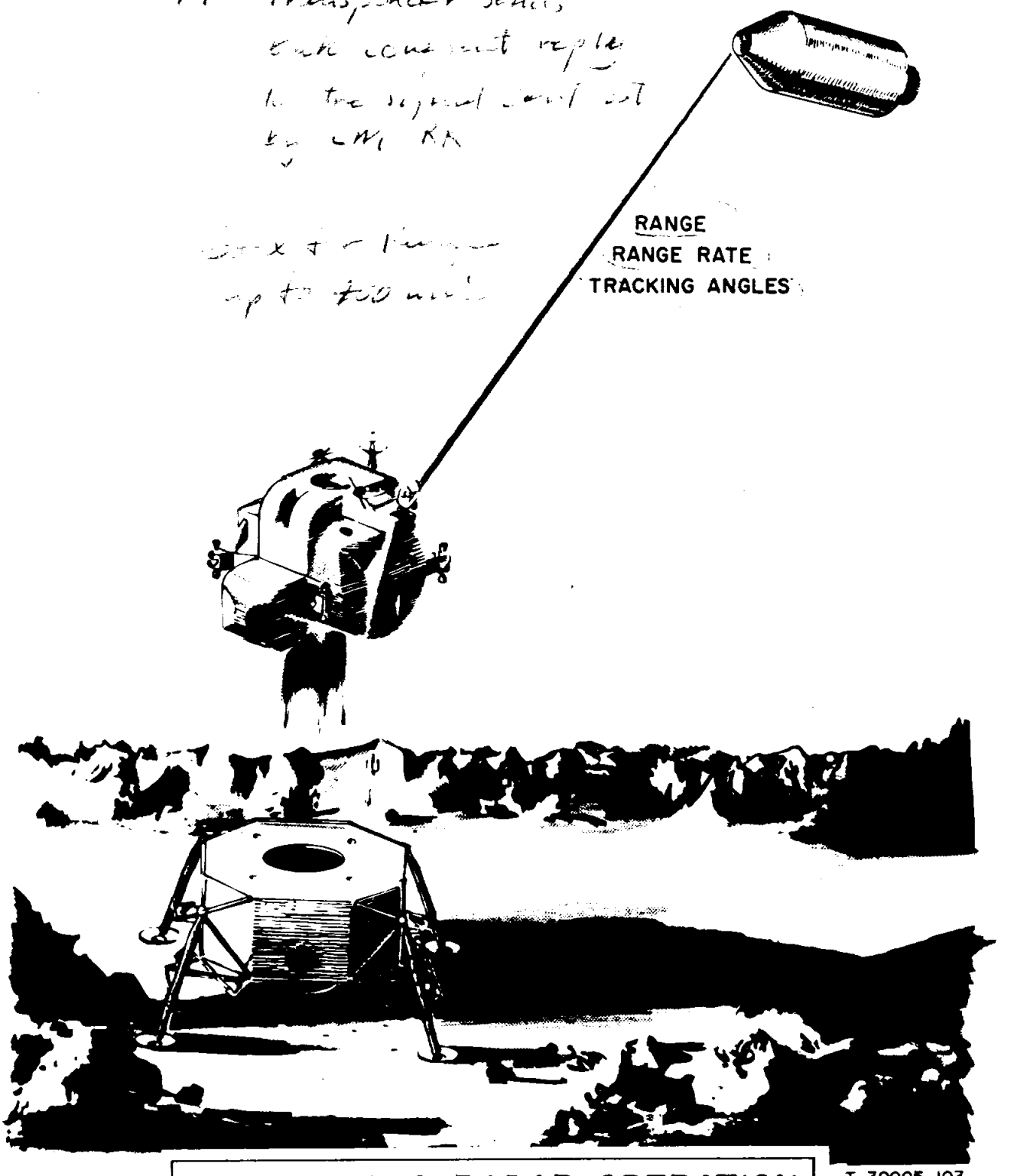
Accepted @ 4 = 500 ft.

LANDING RADAR

T30005-109
DEC 66

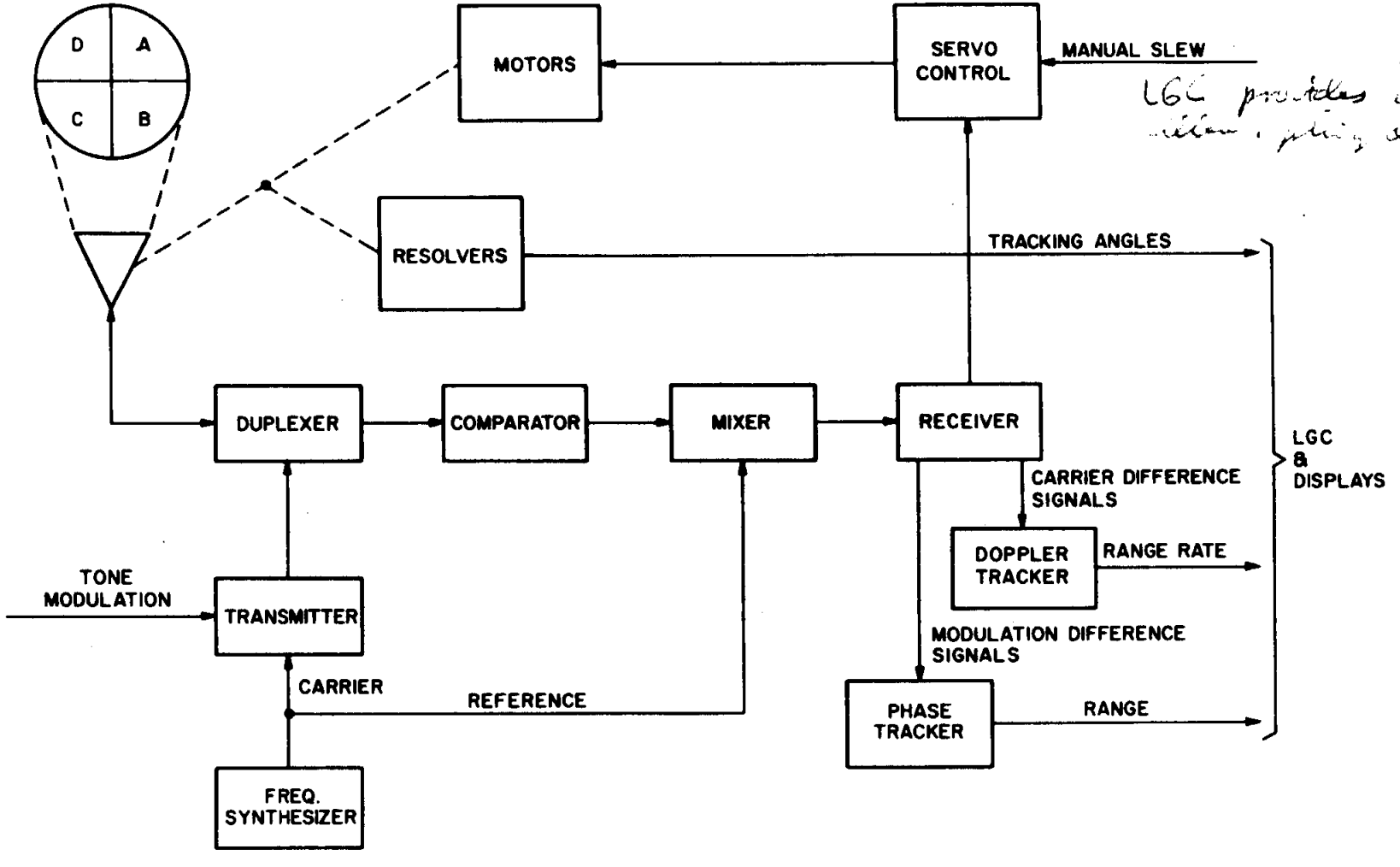
CM – transponder sends
back coherent replie
to the signal sent out
by CM RR

RANGE
RANGE RATE
TRACKING ANGLES



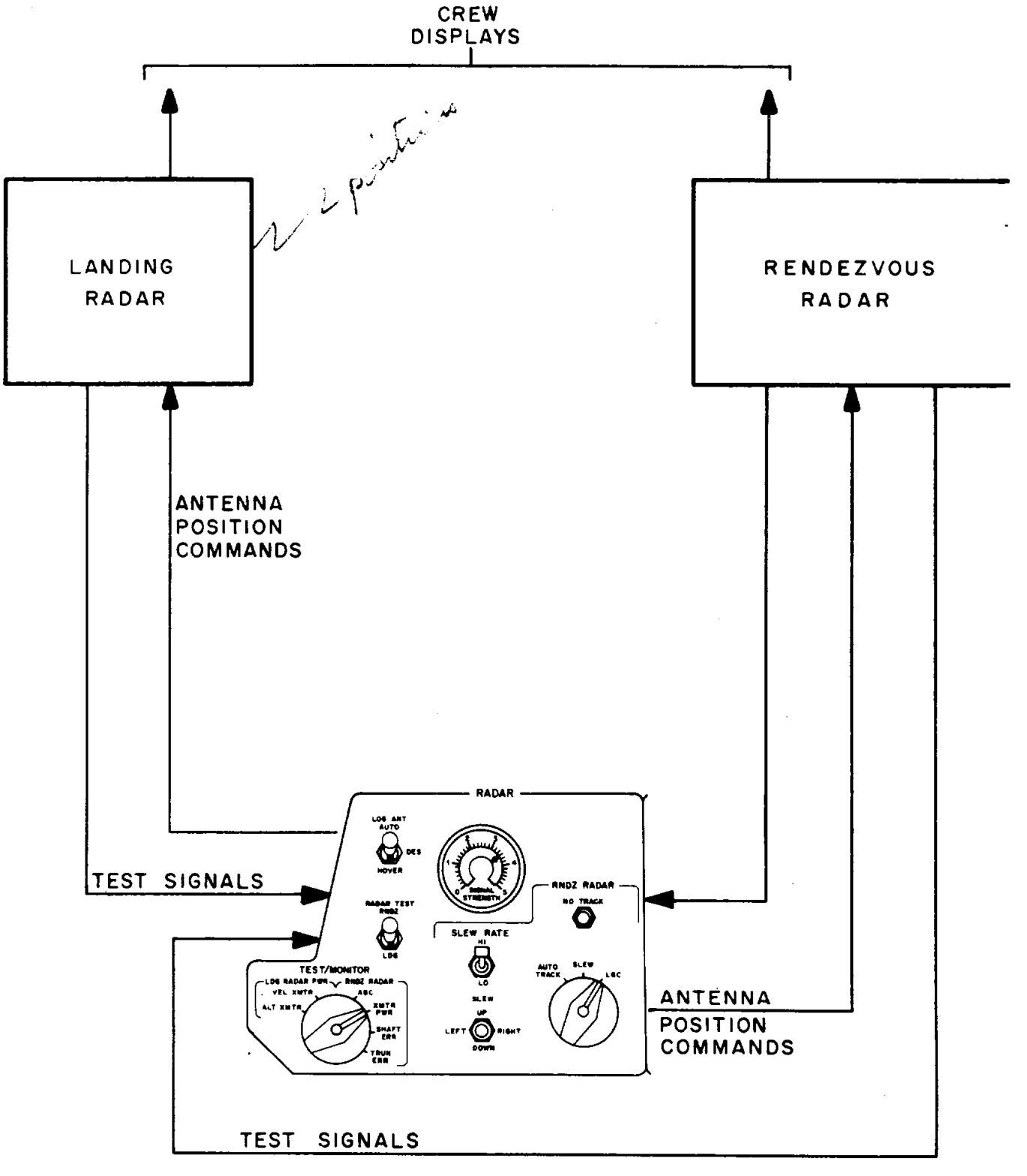
RENDEZVOUS RADAR OPERATION

T 30005-103
APR 66



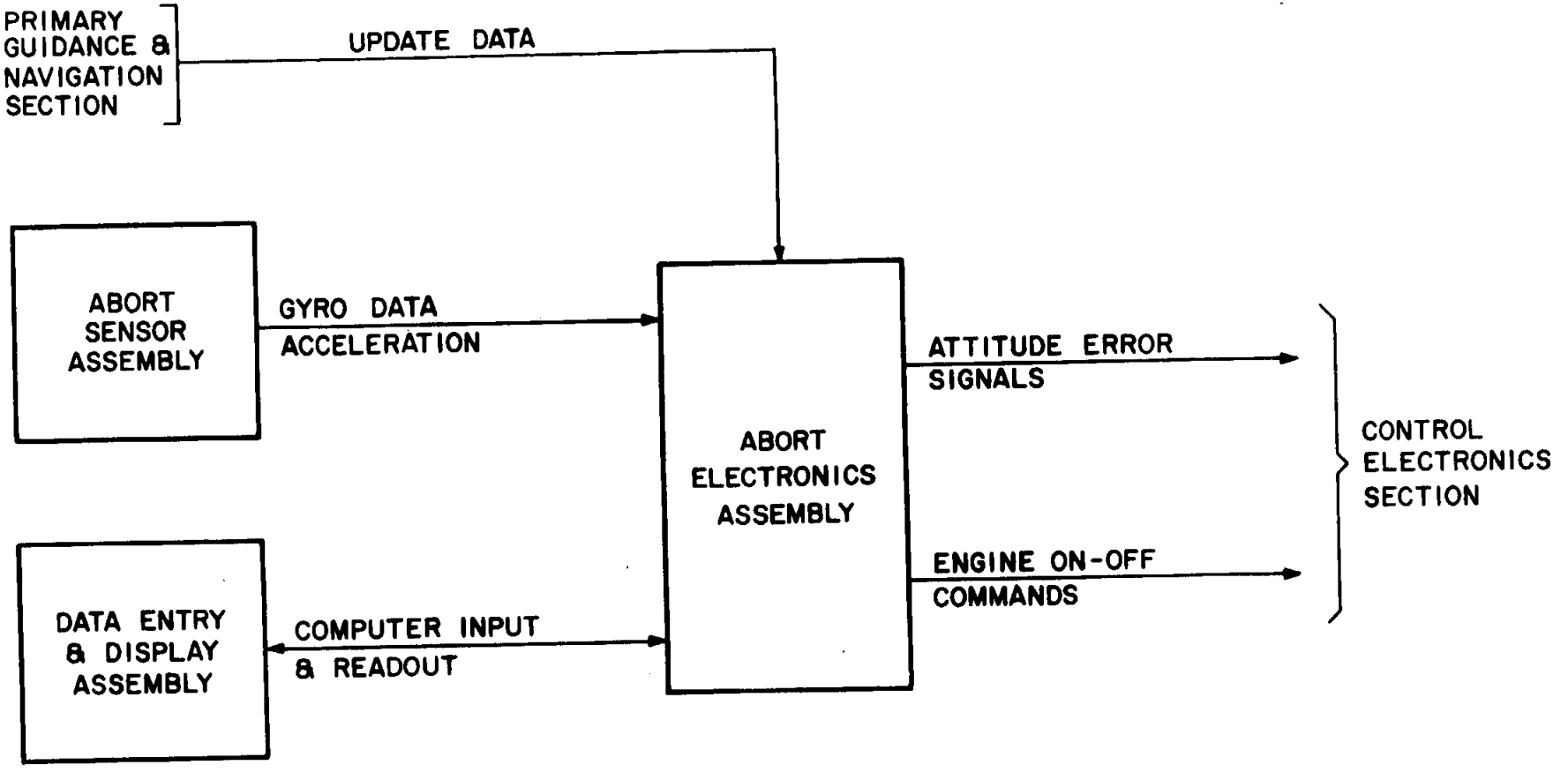
RENDEZVOUS RADAR

T30005-108
APR 66



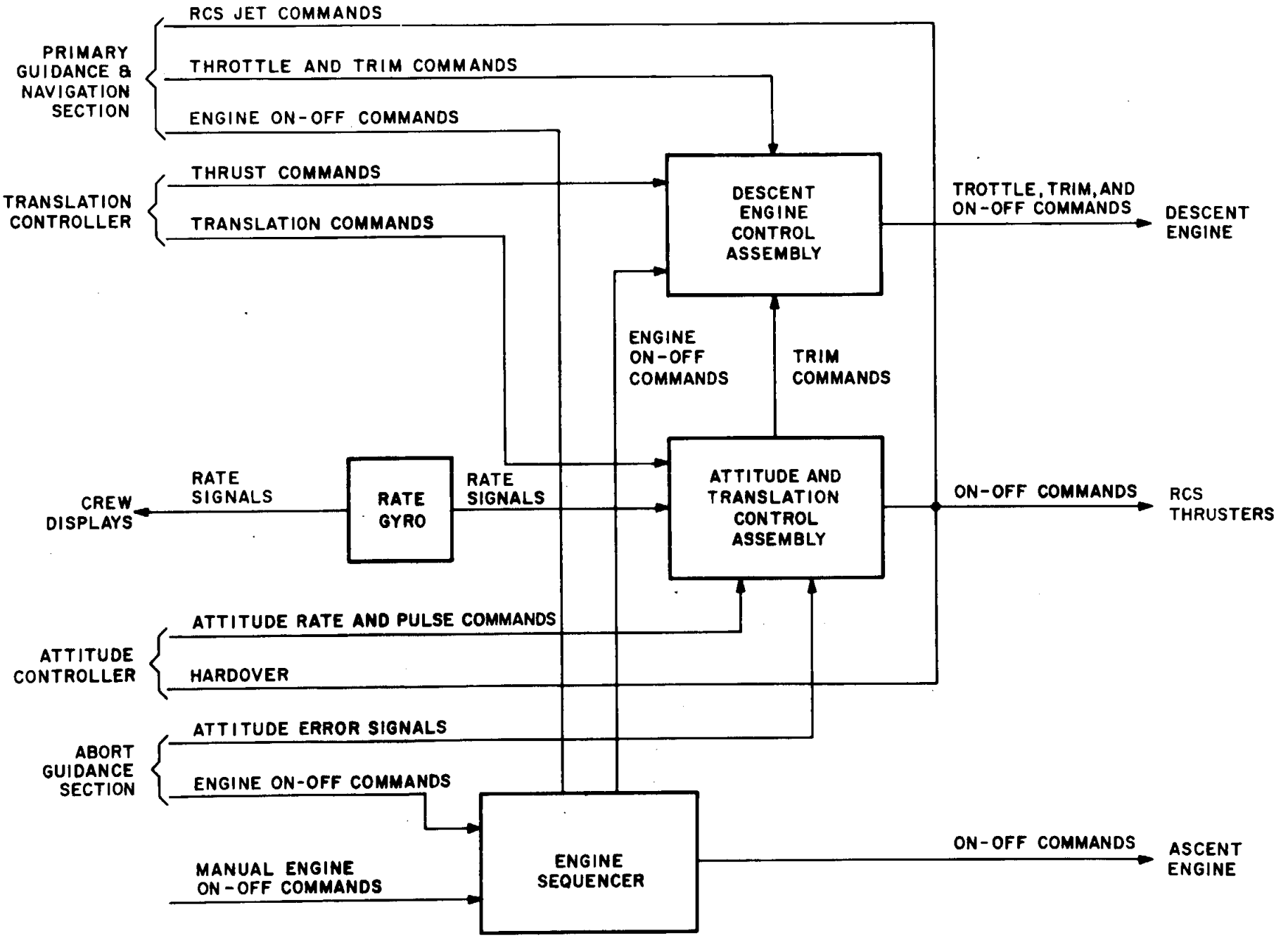
PANEL III
RADAR CONTROL

T30005-54
DEC 66



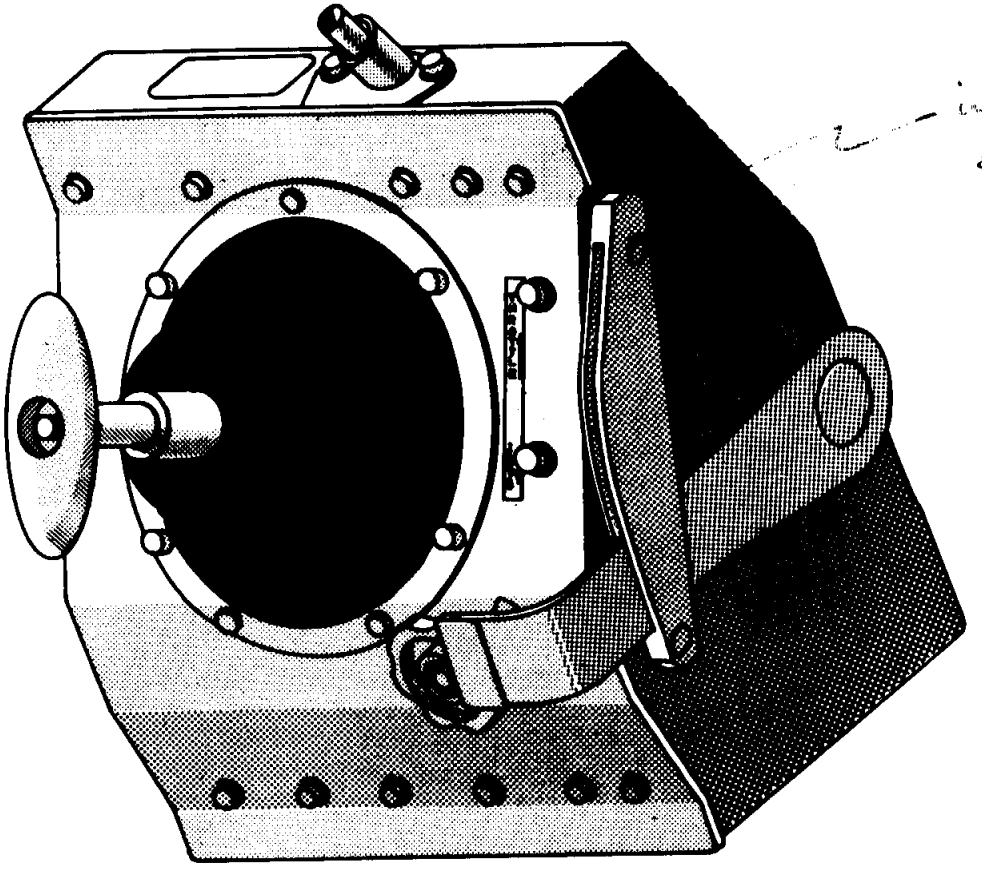
ABORT GUIDANCE SECTION

T30005-46
FEB 66



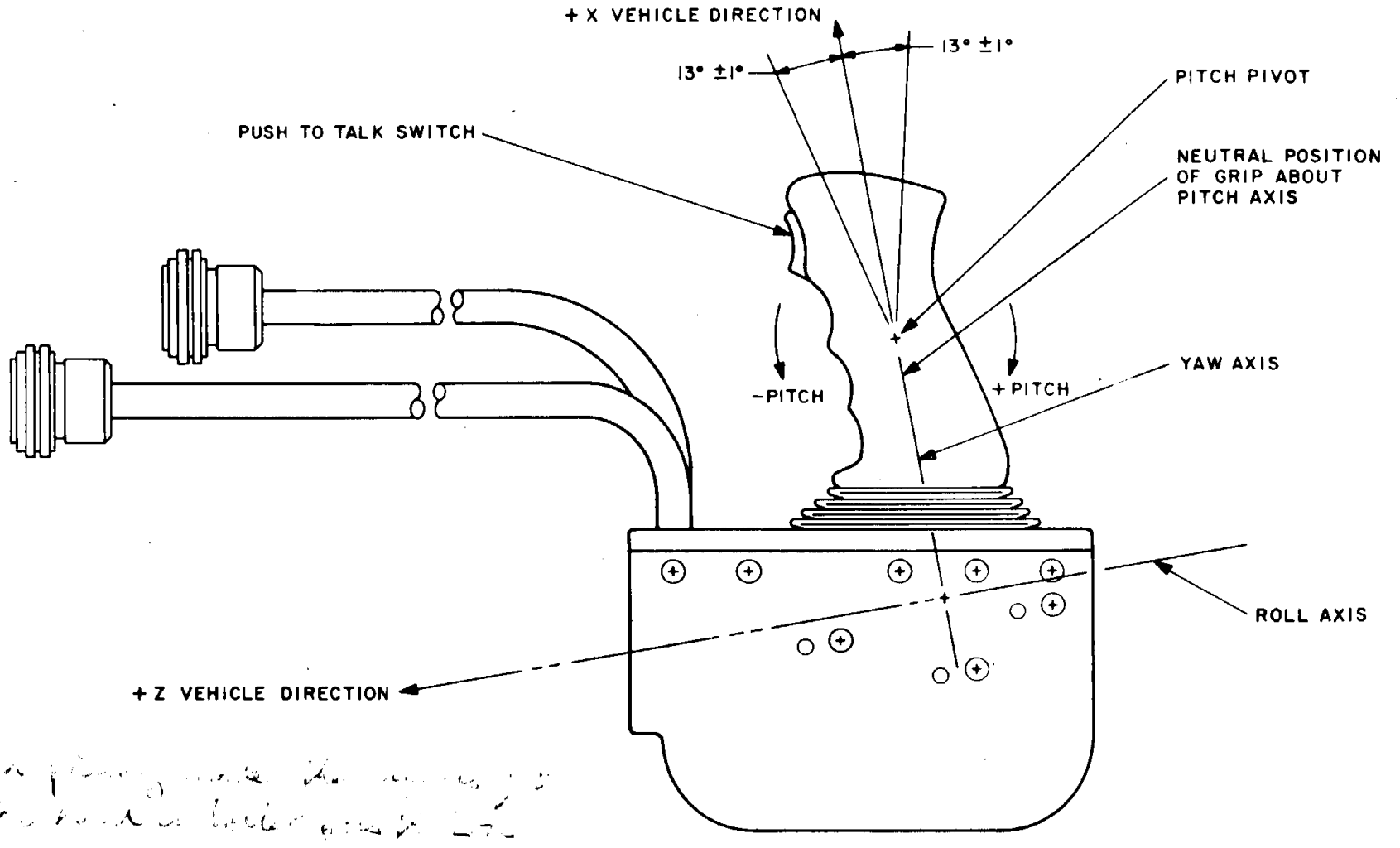
CONTROL ELECTRONICS SECTION

T30005-47
FEB. 66



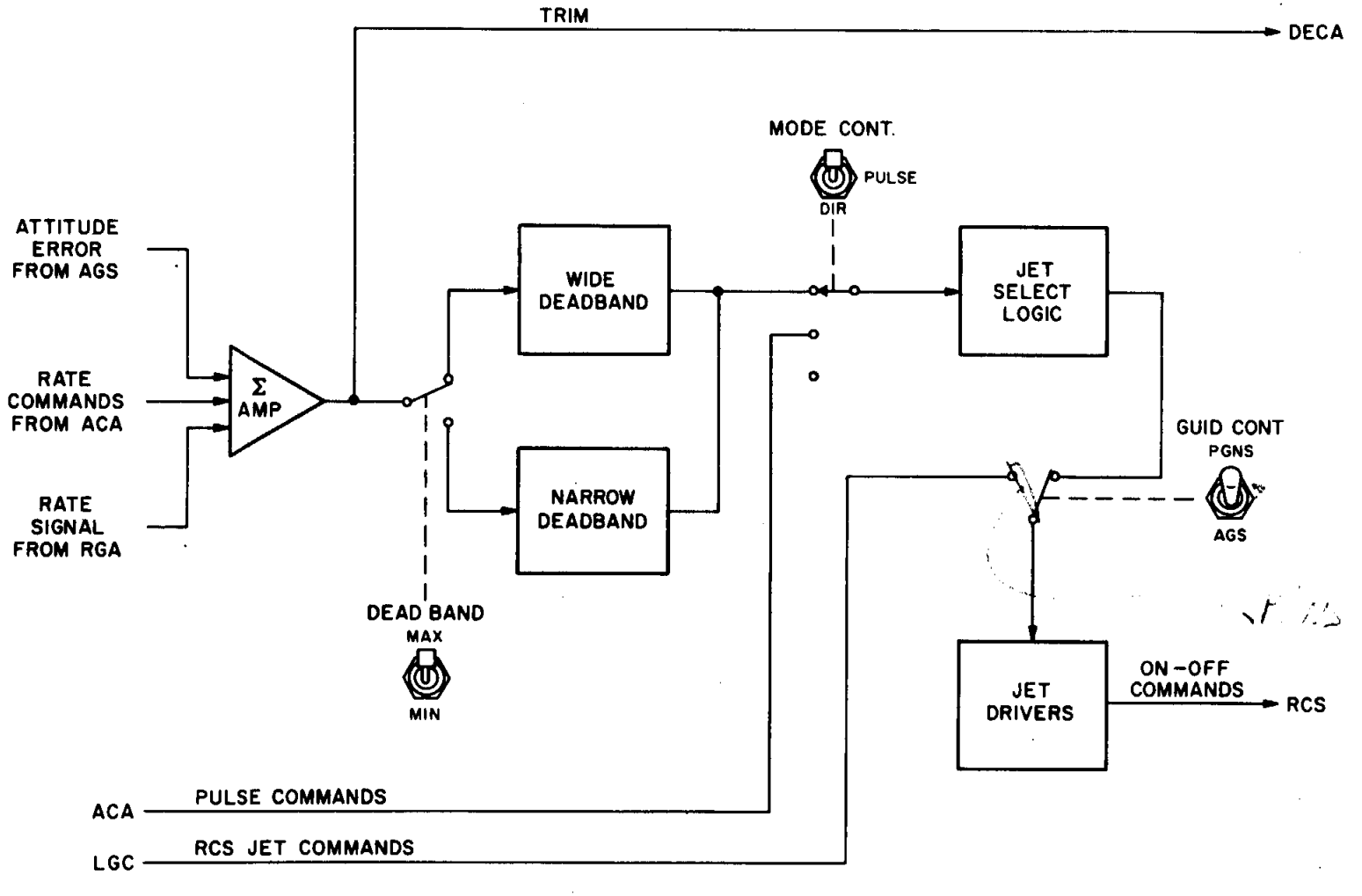
THRUST TRANSLATION CONTROLLER ASSEMBLY

T30005-51
DEC 66



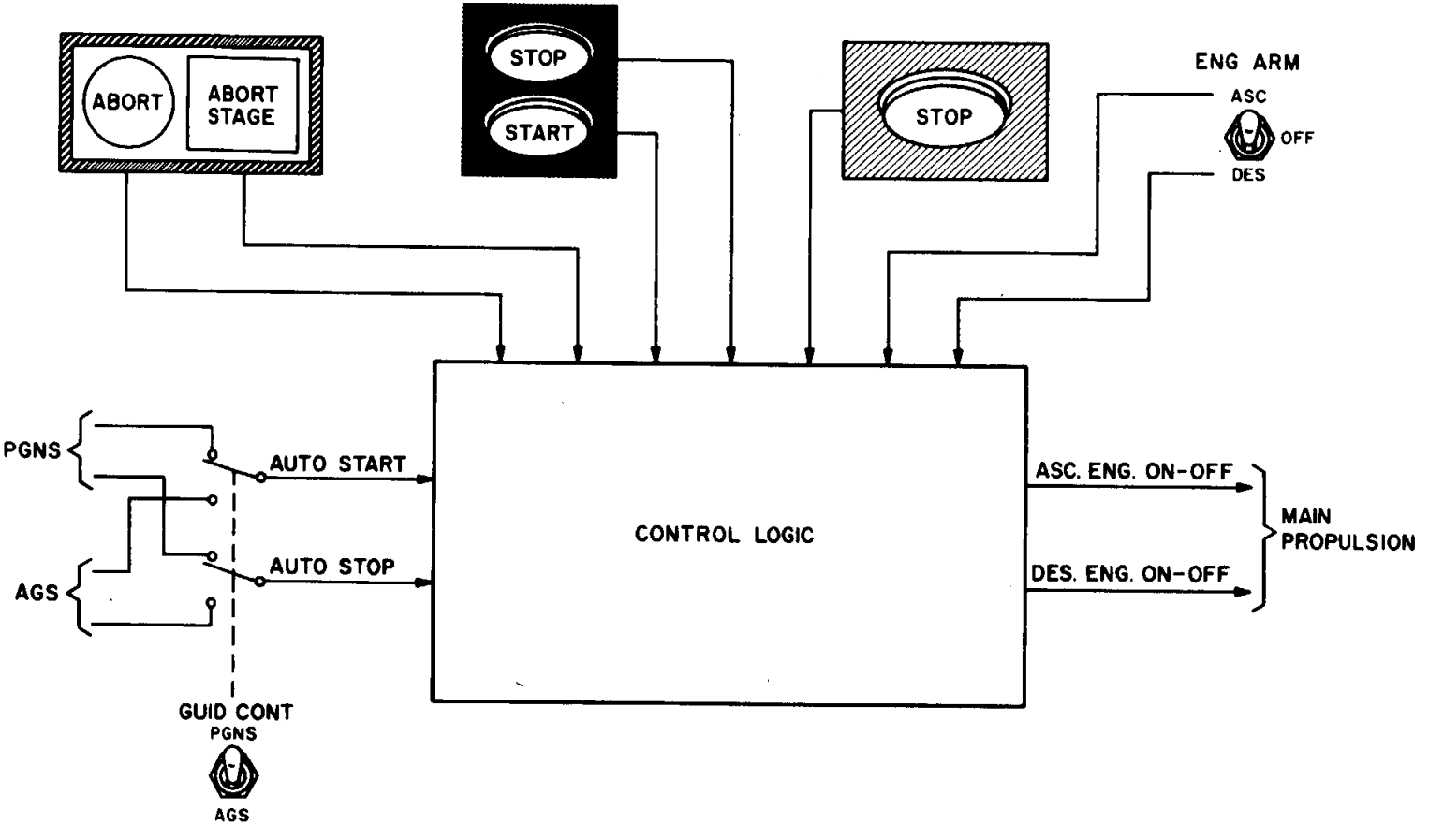
ACA MANIPULATION

T30005-52
DEC 66



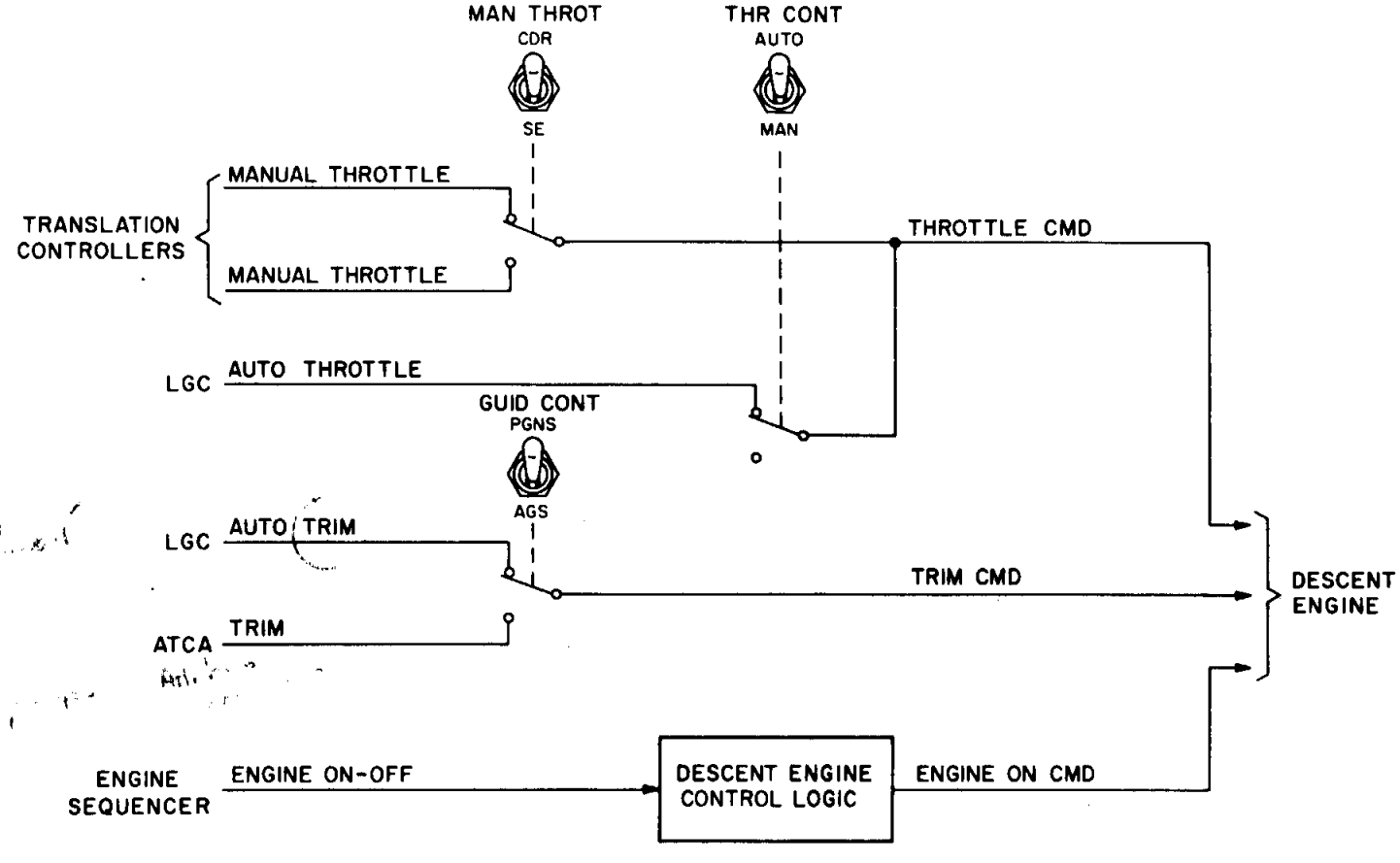
ATTITUDE AND TRANSLATION CONTROL ASSEMBLY

T30005-107
APR 66



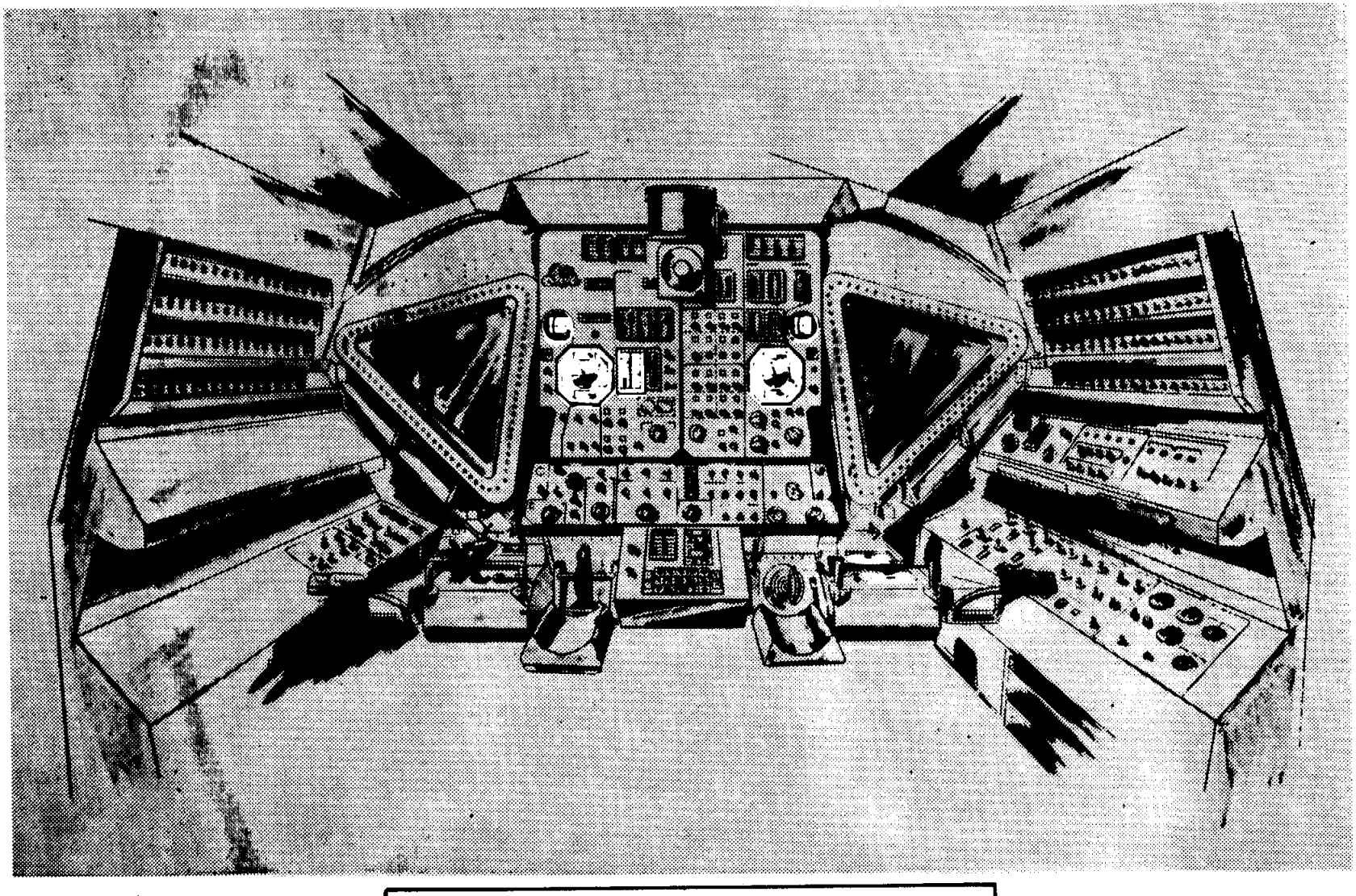
ENGINE SEQUENCER

T30005-105
APR 66



DESCENT ENGINE CONTROL ASSEMBLY

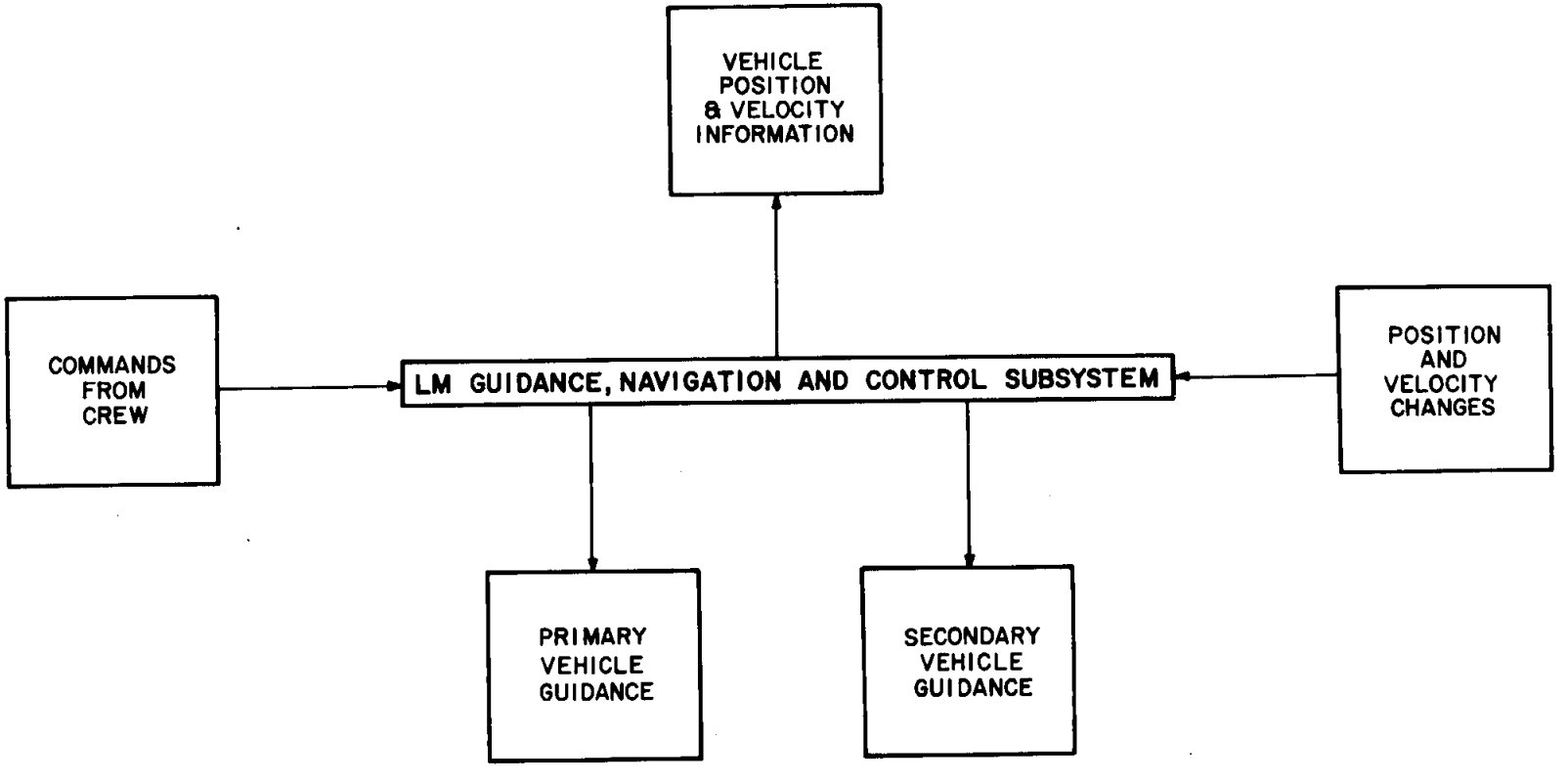
T30005-106
APR 66



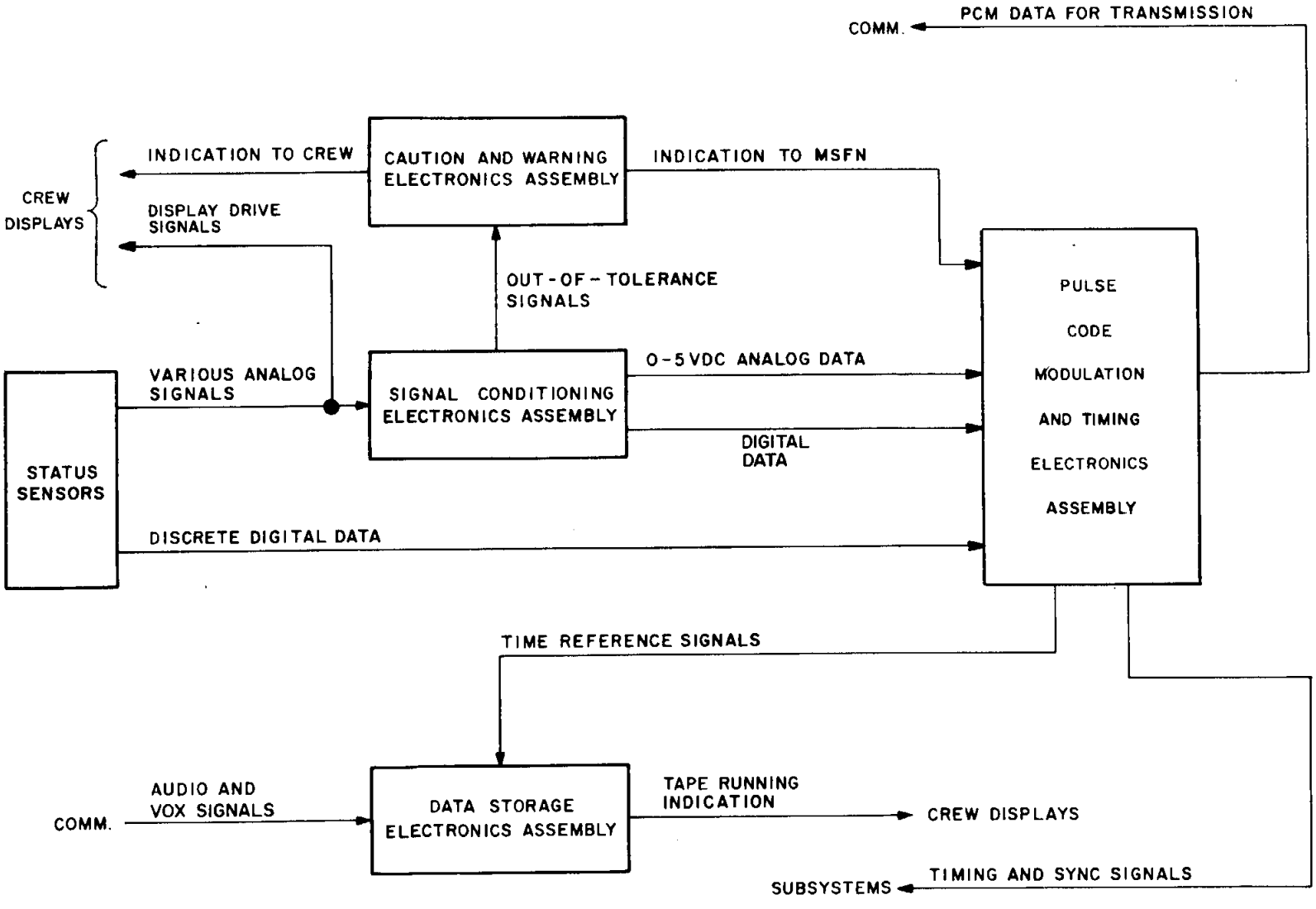
White views

G.N. AND C. ASSOCIATED DISPLAYS

T 30005-50
APR 66

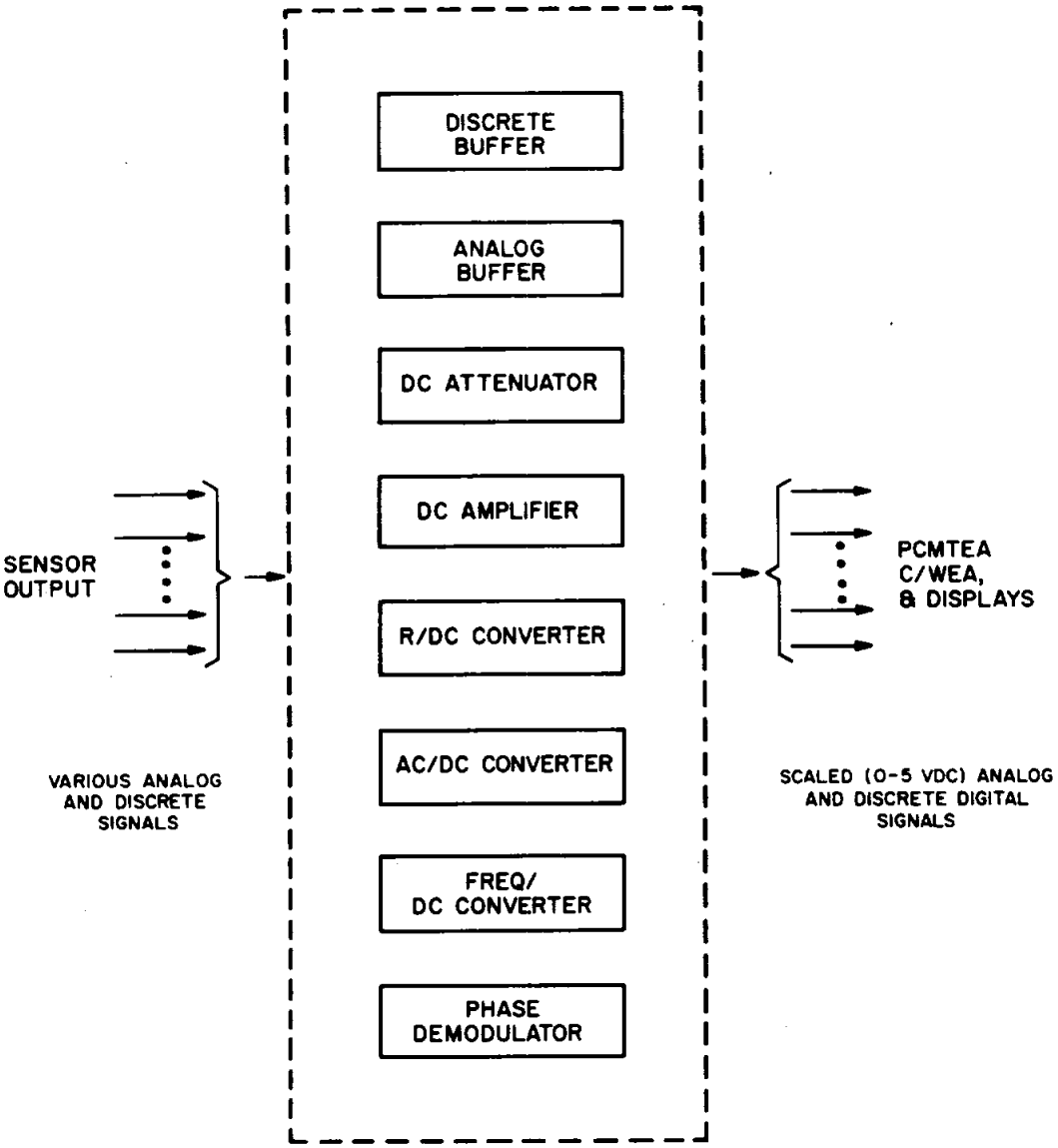


T30005-43
DEC 66



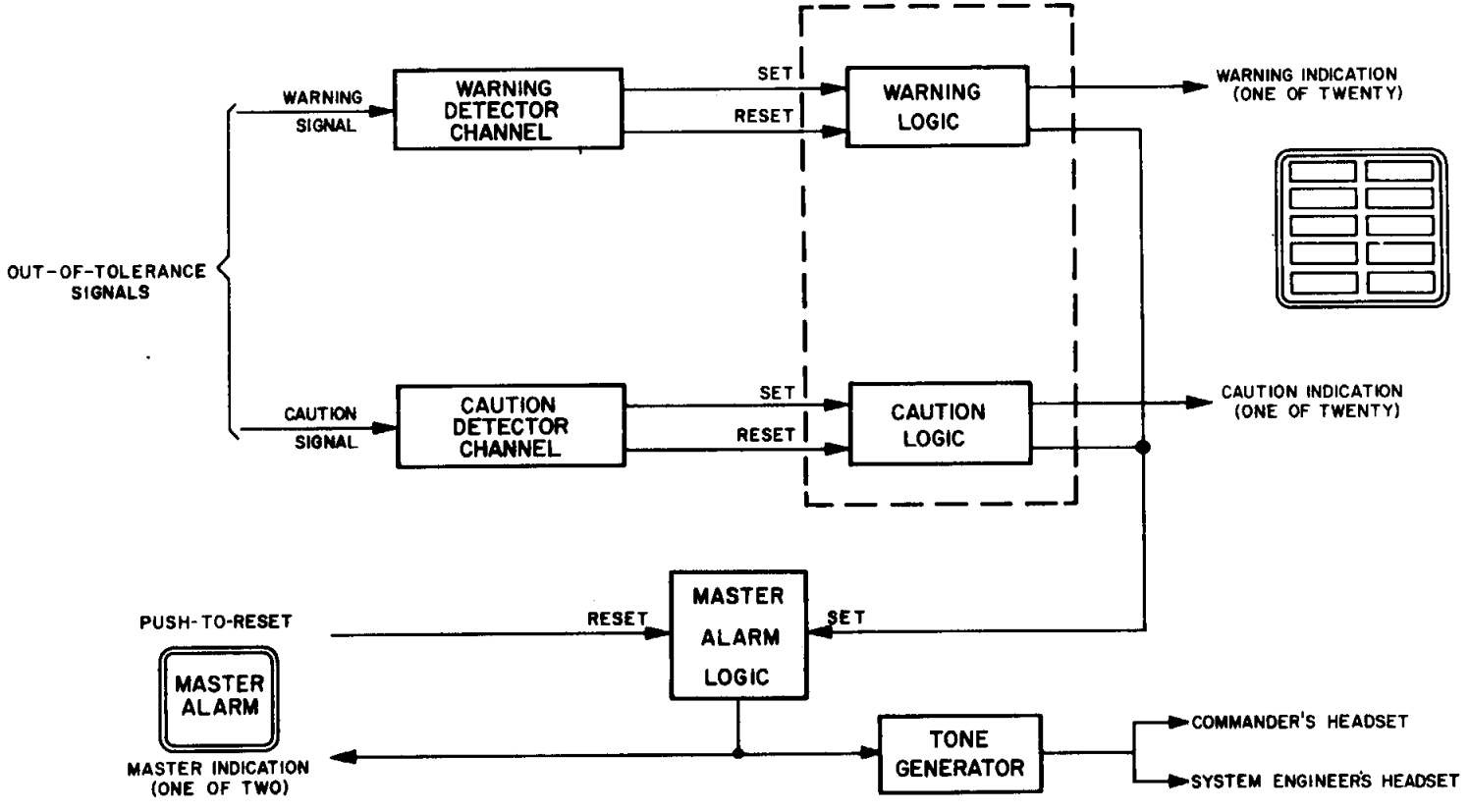
LM INSTRUMENTATION SUBSYSTEM

T30005-57
DEC 66



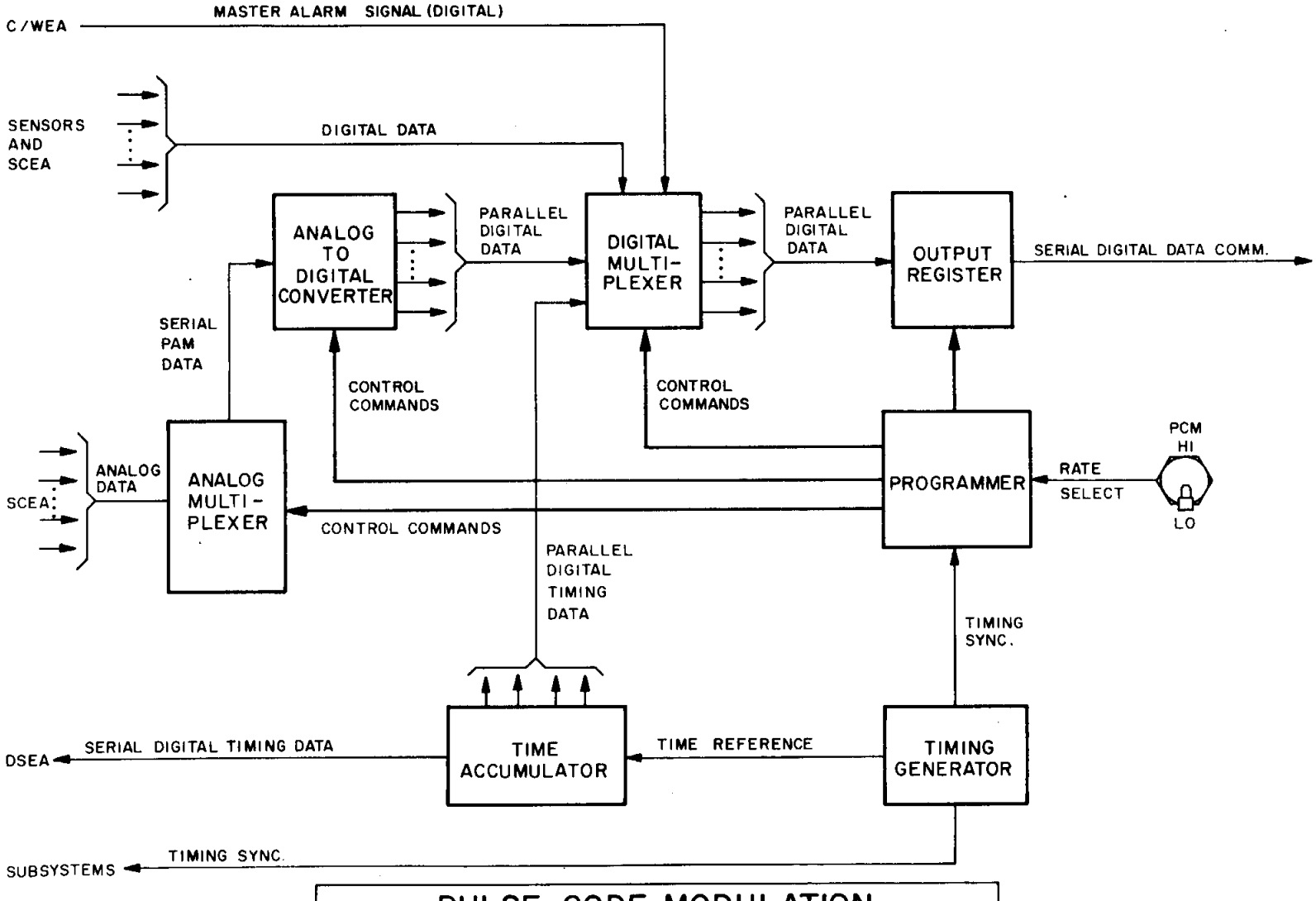
SIGNAL CONDITIONING ELECTRONICS ASSEMBLY

T30005-59
MAR 66



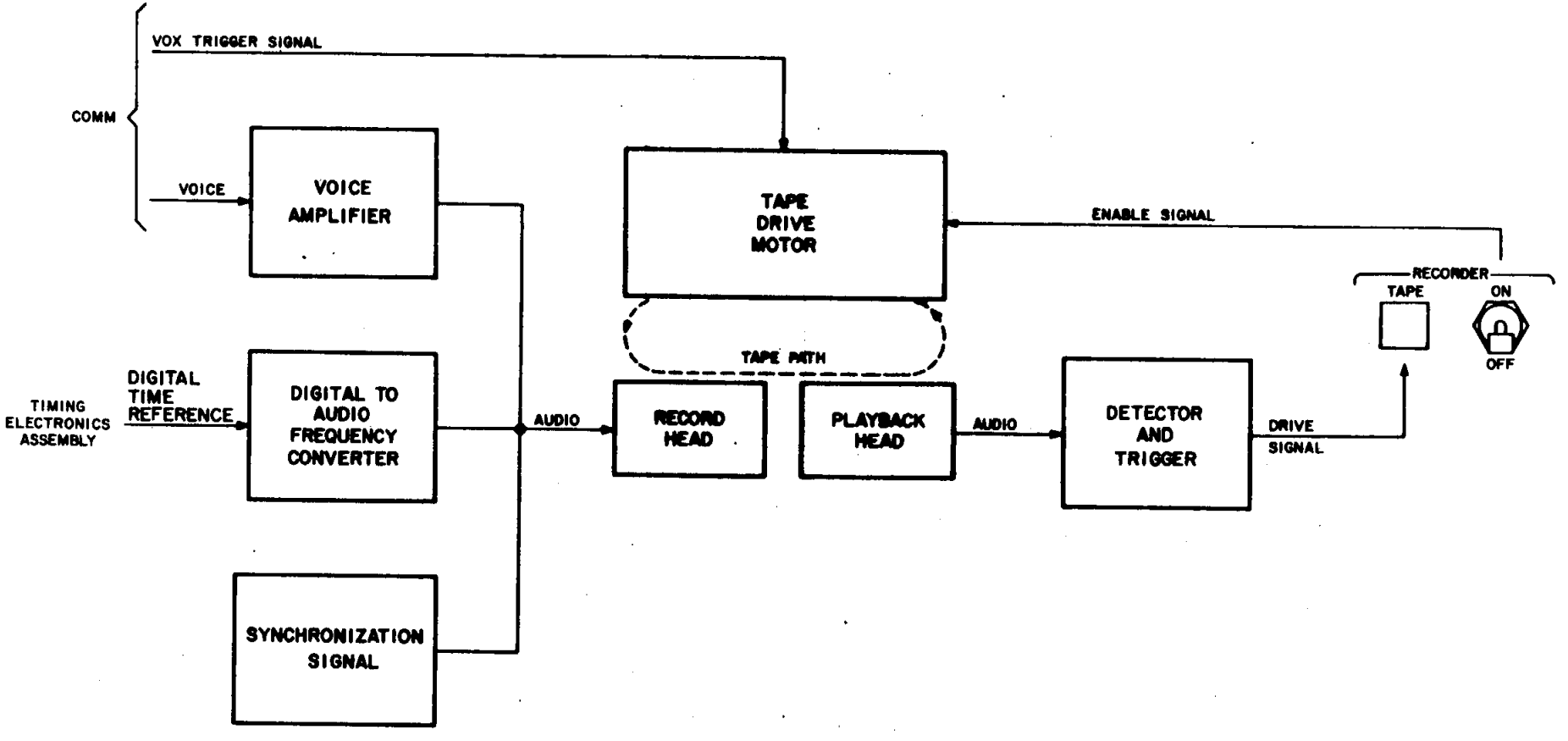
CAUTION AND WARNING ELECTRONICS ASSEMBLY

T30005-48
DEC 66



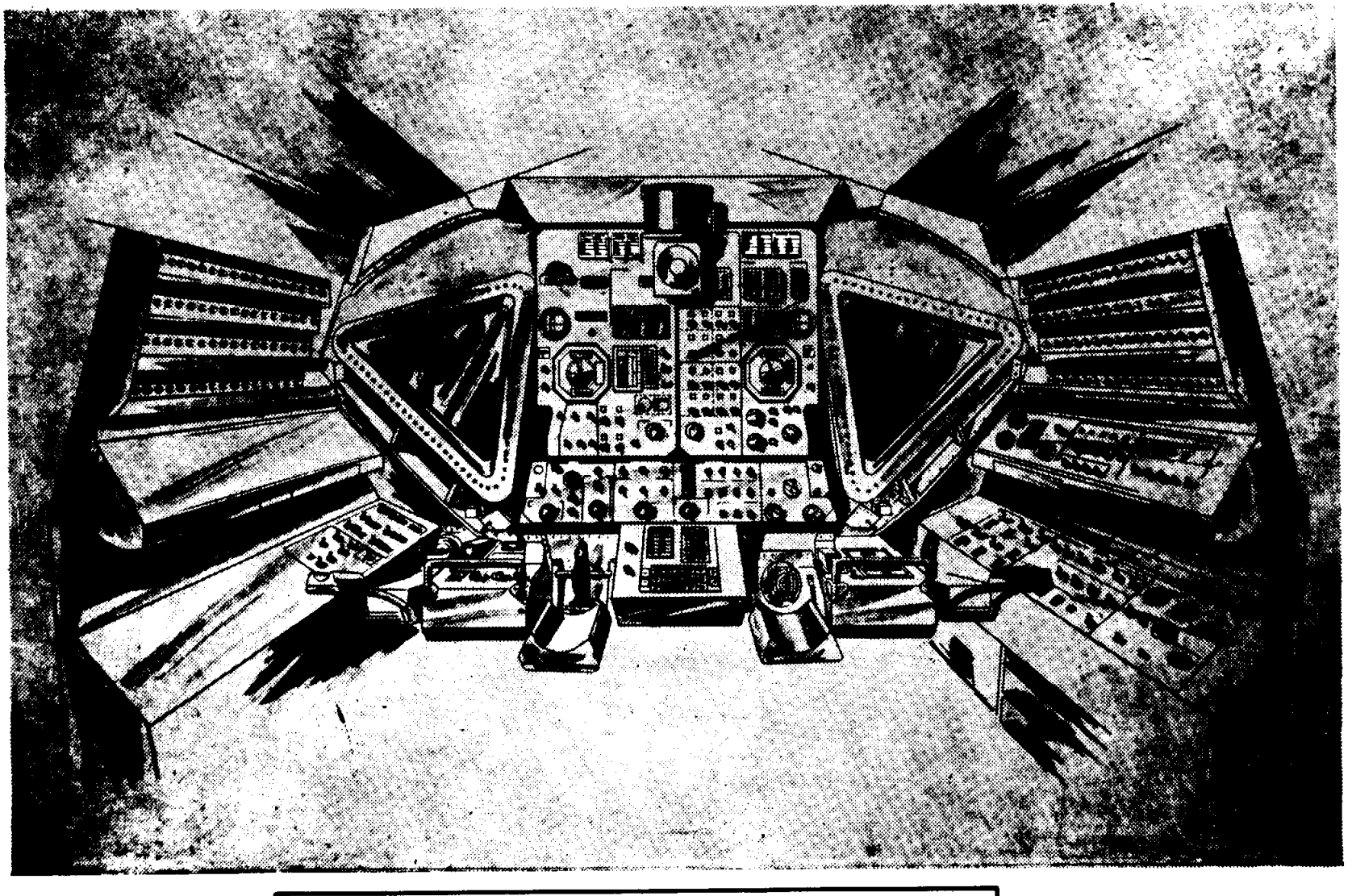
PULSE CODE MODULATION AND TIMING ELECTRONICS ASSEMBLY

T30005-58
APR 66



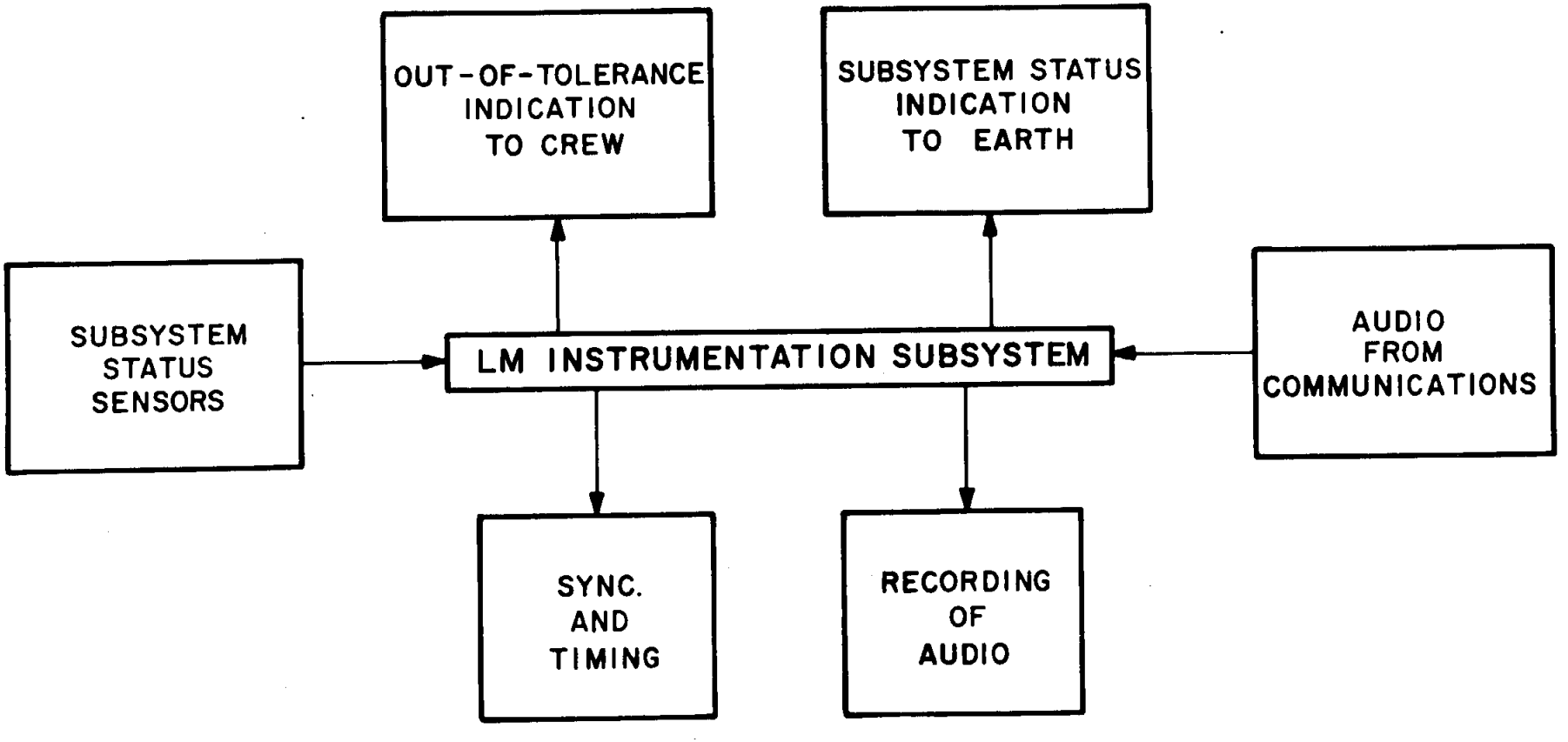
DATA STORAGE ELECTRONICS ASSEMBLY

T30005-49
MAR 66

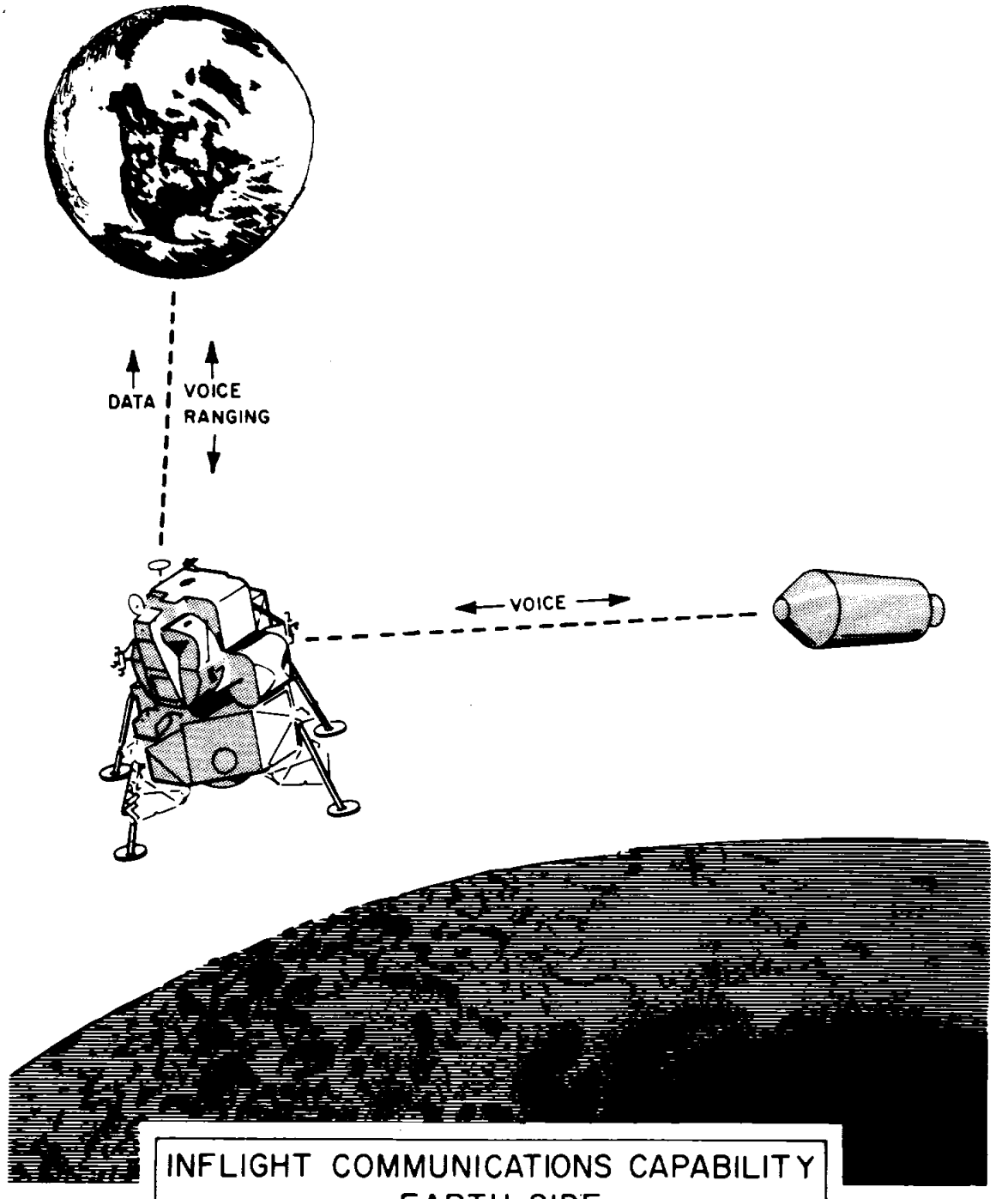


INSTRUMENTATION ASSOCIATED DISPLAYS

T30005-112
APR 66

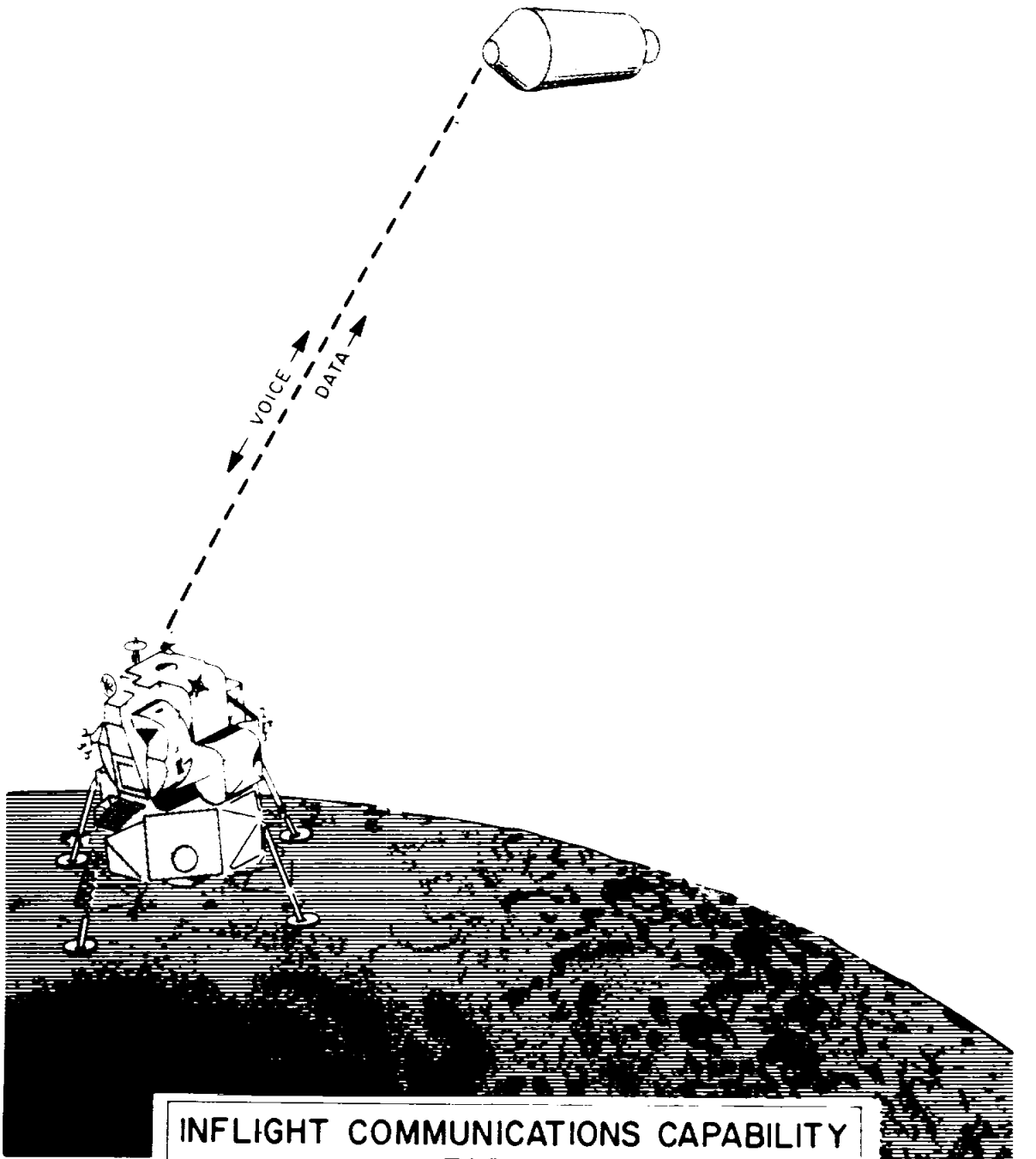


T30005-42
MAR 66



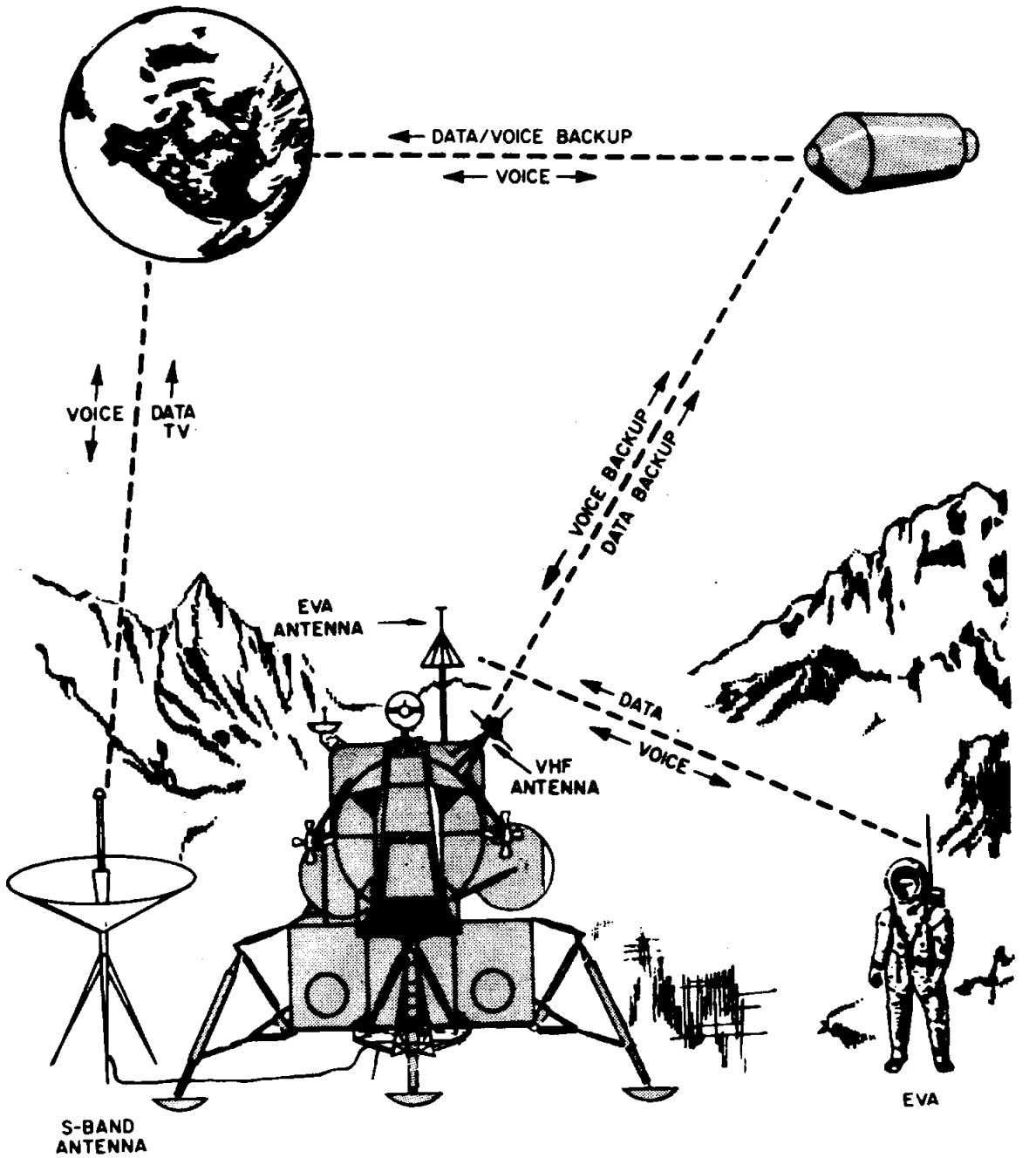
INFLIGHT COMMUNICATIONS CAPABILITY
EARTH SIDE

T30005-38
FEB 66



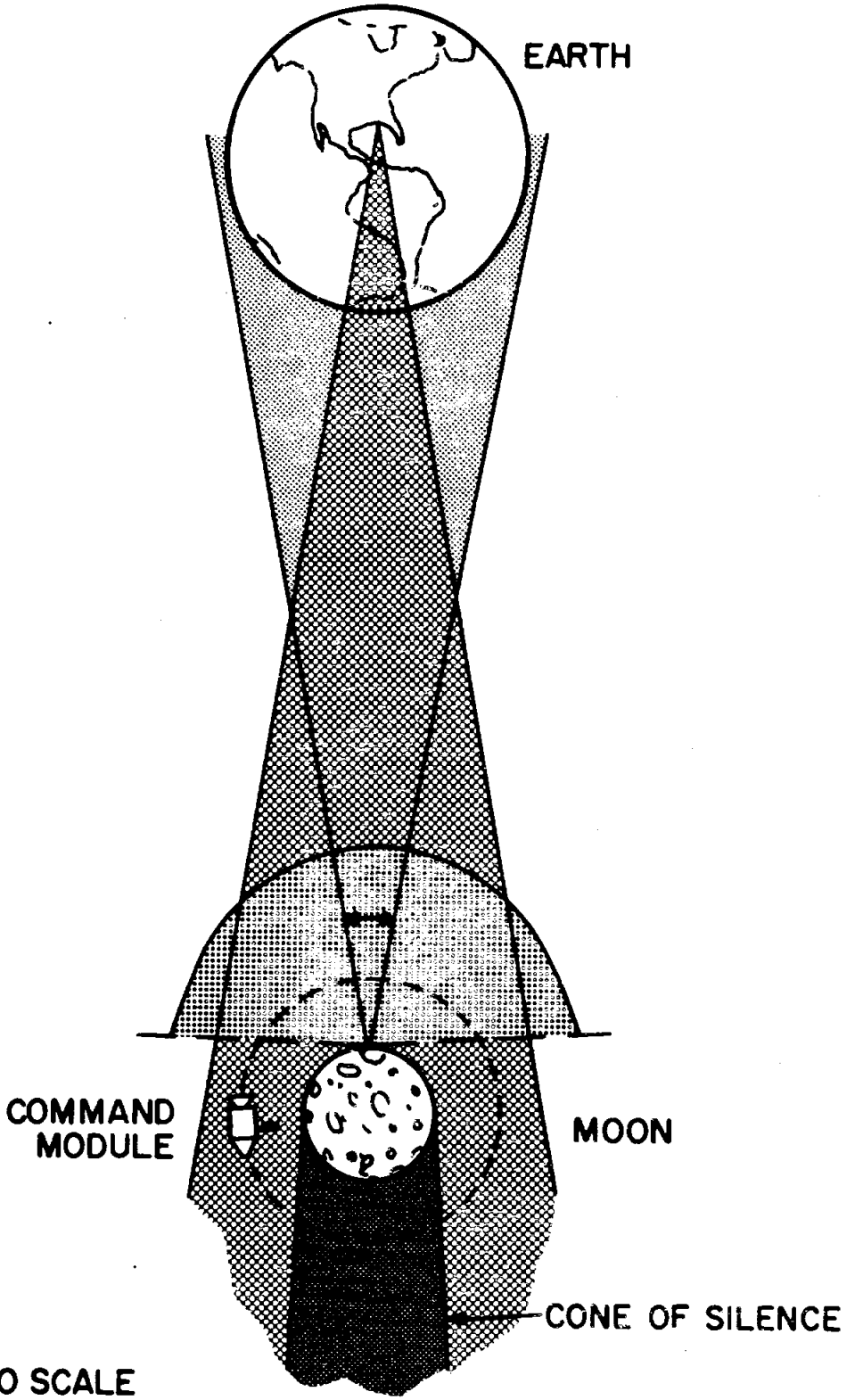
INFLIGHT COMMUNICATIONS CAPABILITY
FAR SIDE

T30005-39
JULY 66



LUNAR SURFACE COMMUNICATIONS CAPABILITY

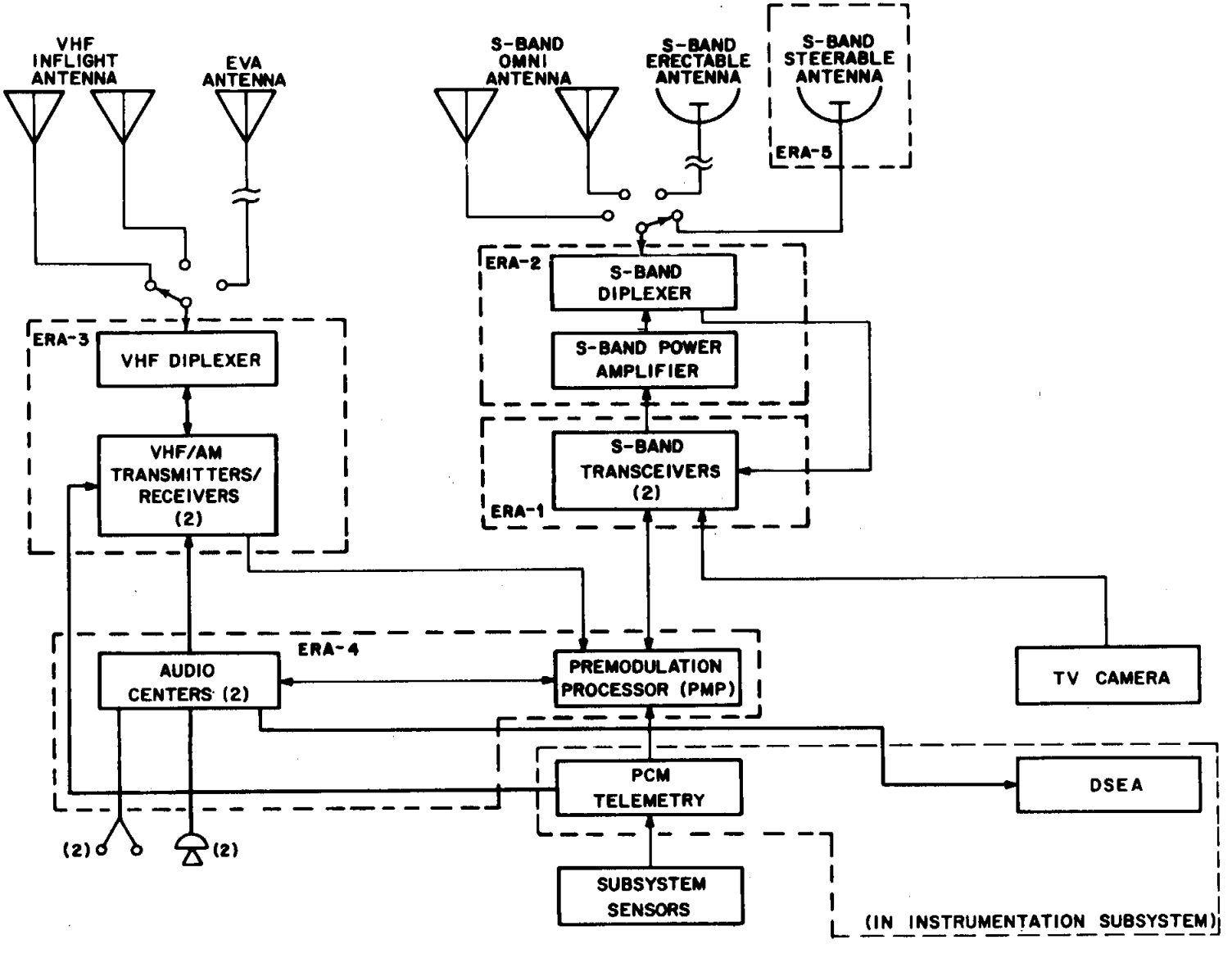
T30005-40
SEPT 66



NOT DRAWN TO SCALE

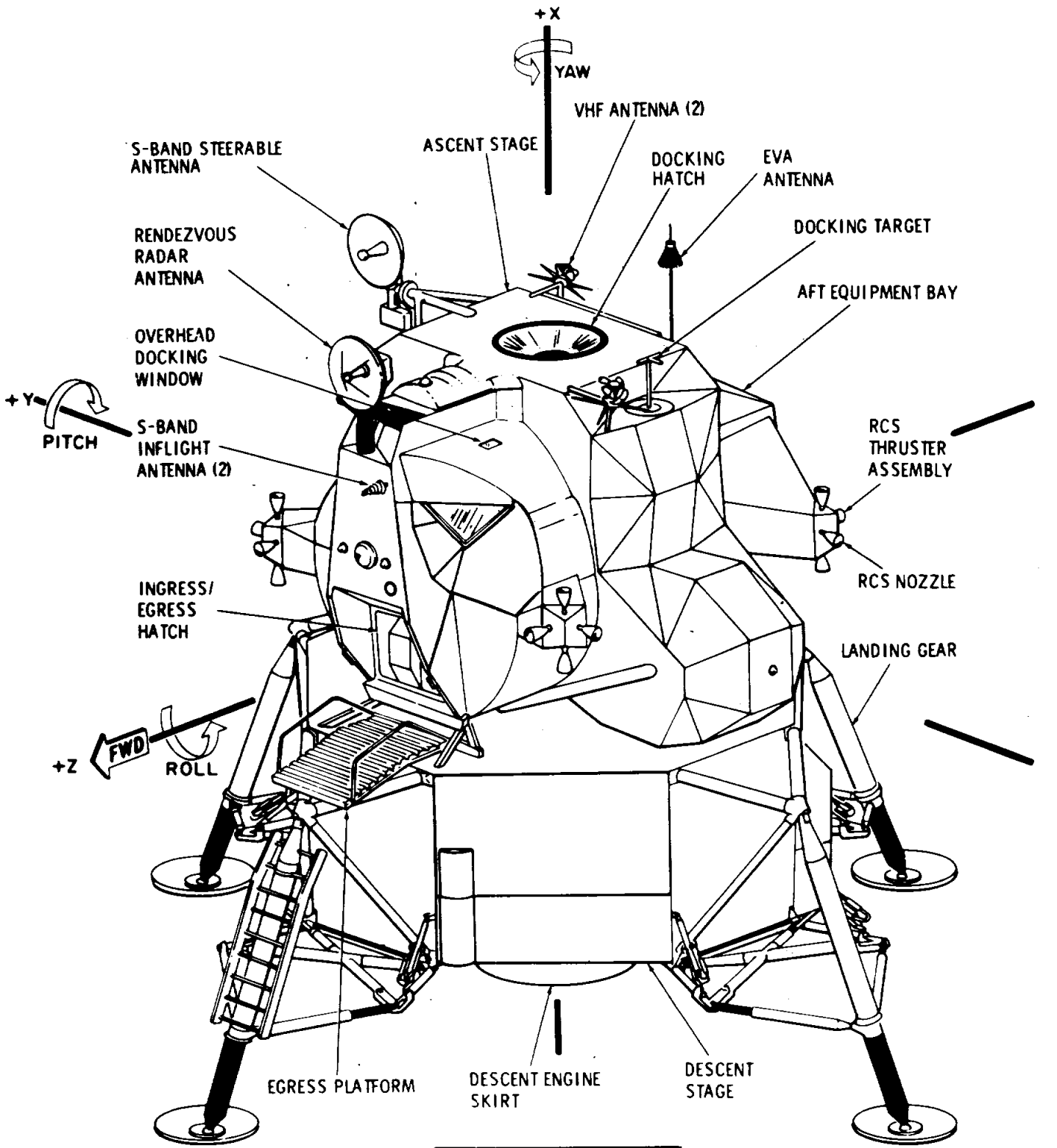
COMMUNICATIONS DURING LUNAR STAY

T30005-101
MAR 66



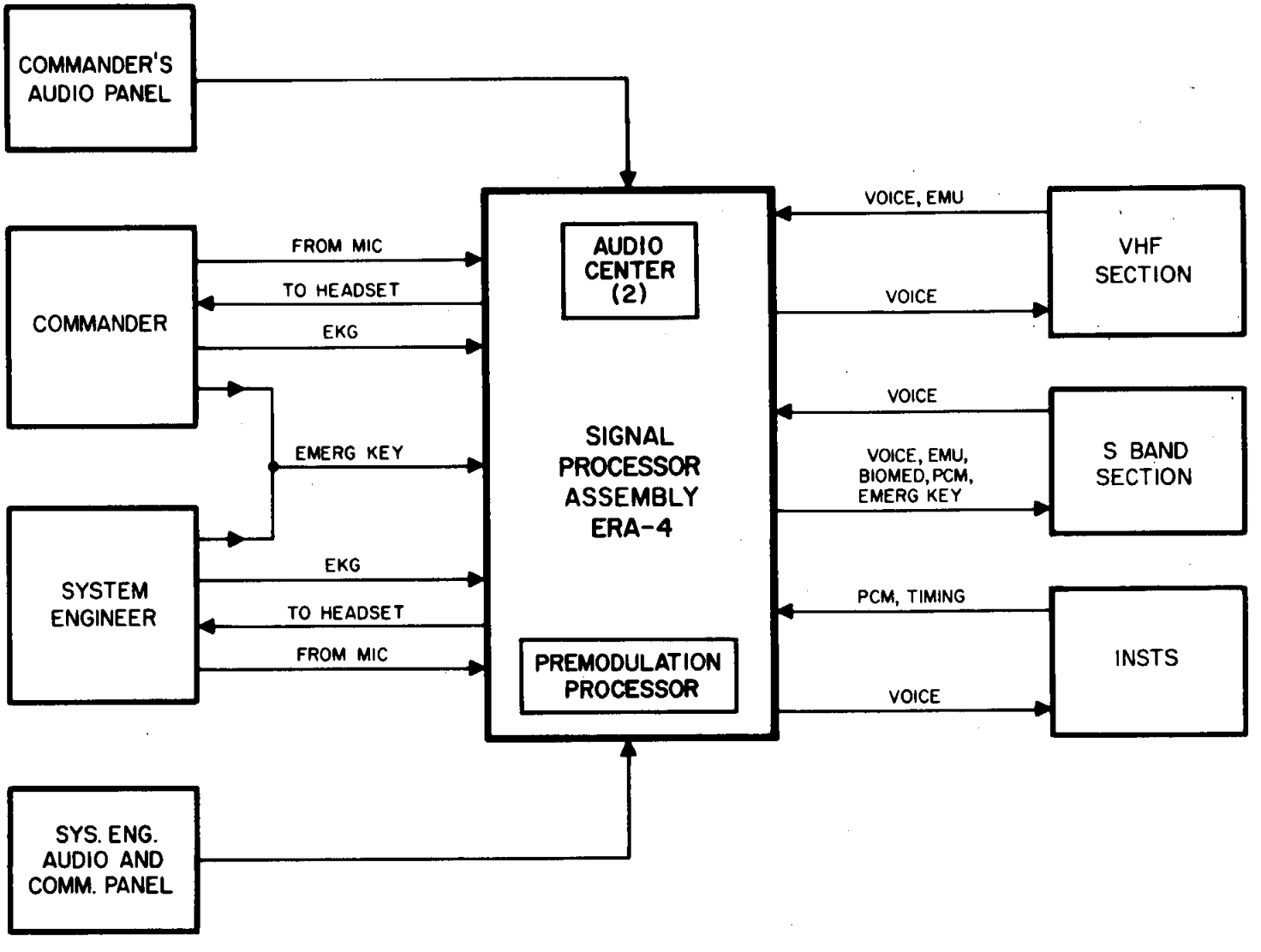
LM COMMUNICATIONS SUBSYSTEM

T30005-37
DEC 66



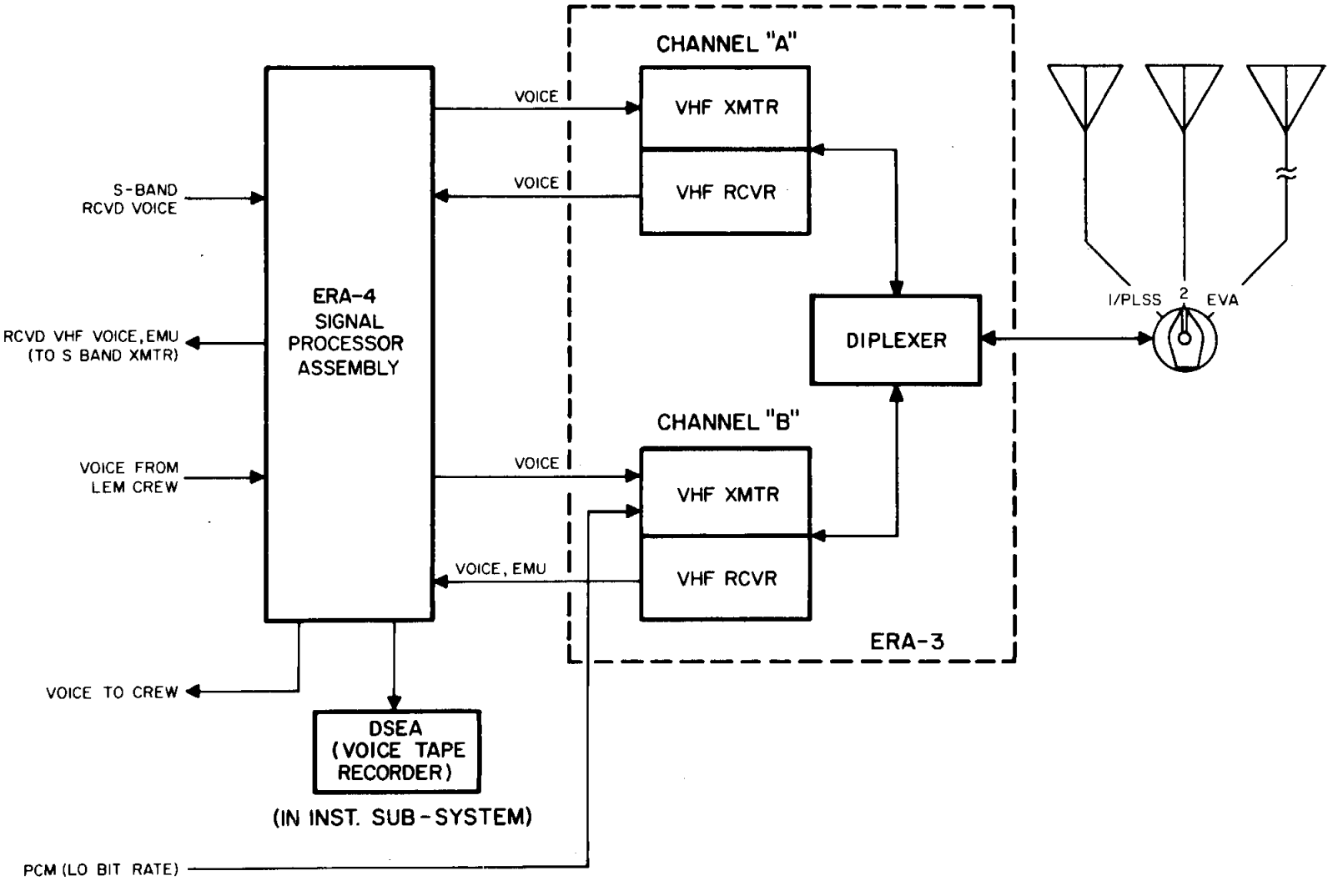
LUNAR MODULE AXES

T 30005-161
NOV 66



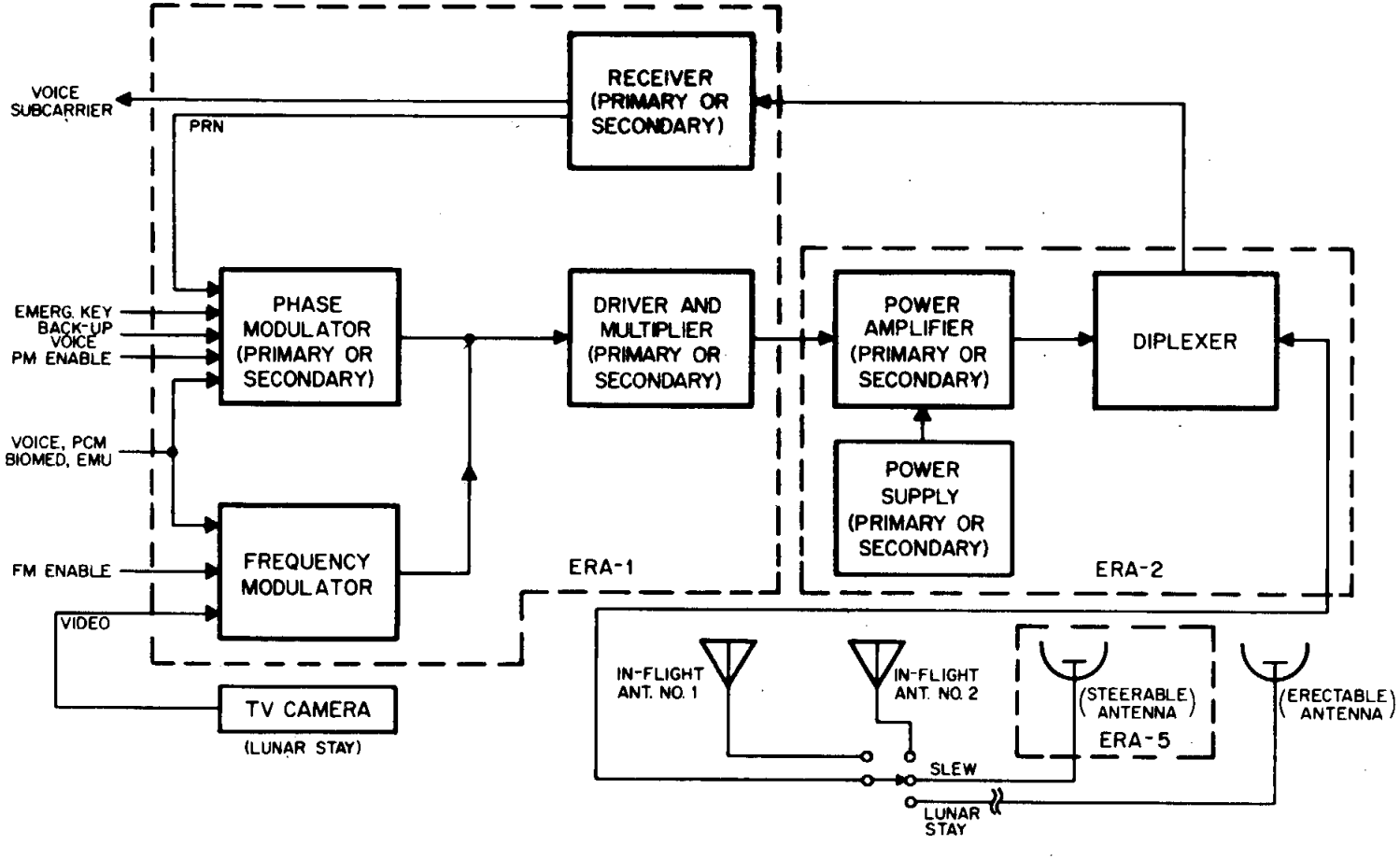
SIGNAL PROCESSOR ASSEMBLY INTERFACE

T30005-53
DEC 66



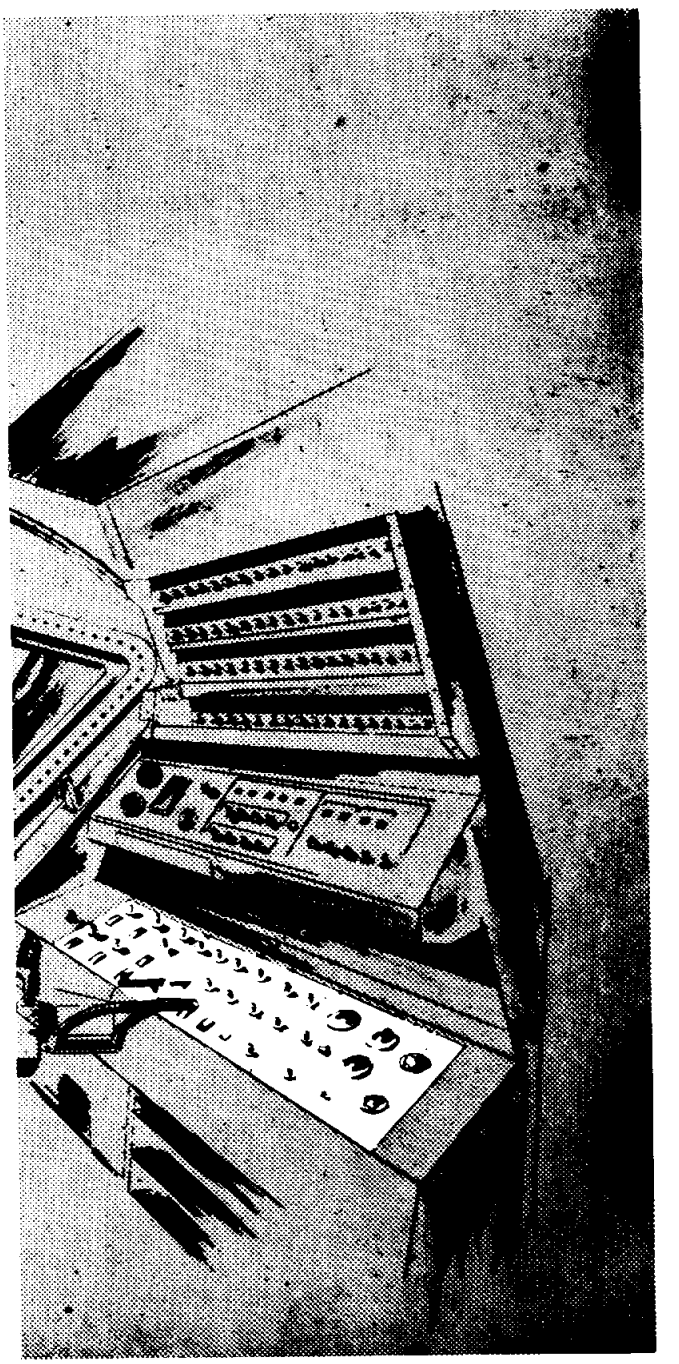
VHF-SECTION

T30005-55
DEC 66



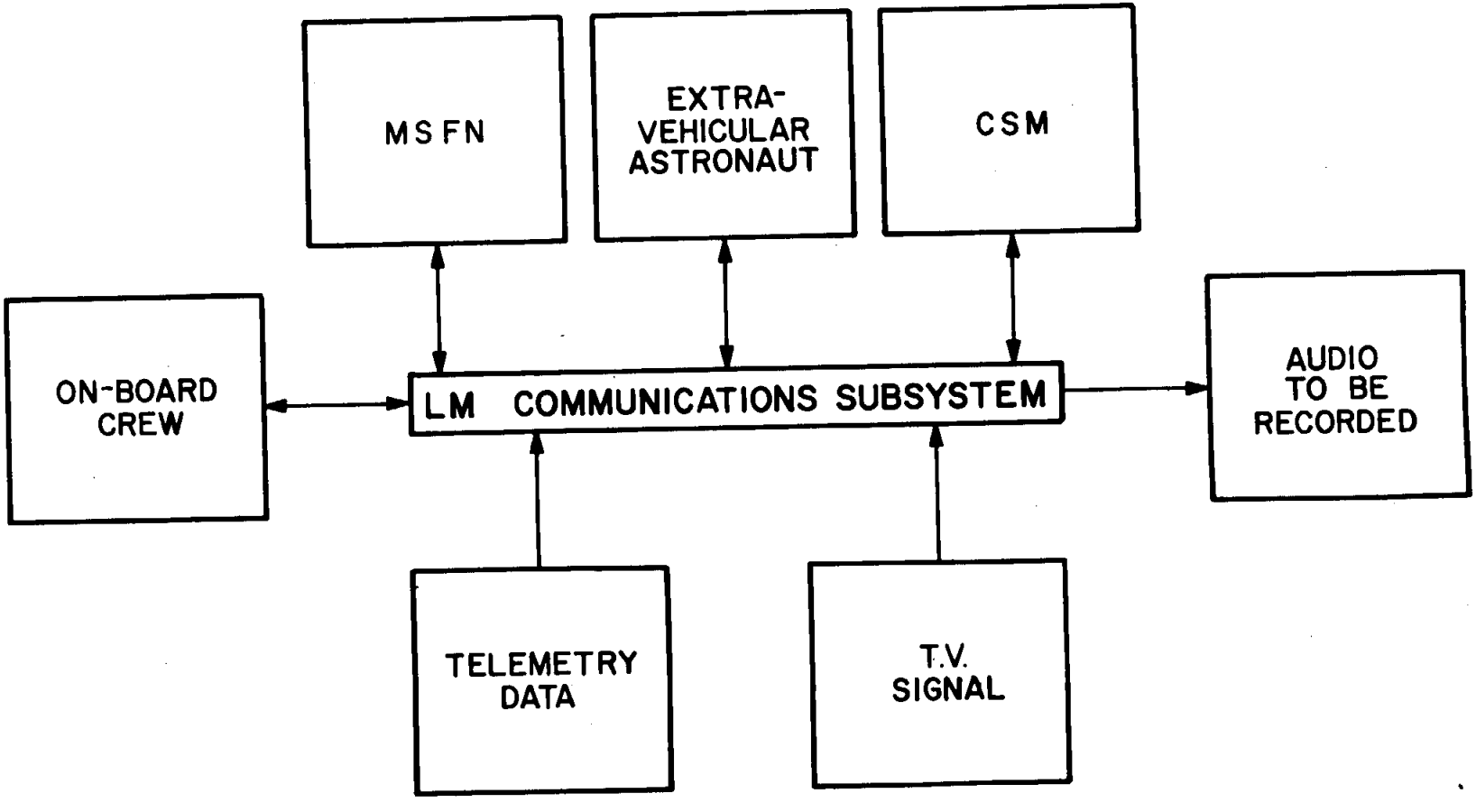
S-BAND SECTION

T30005-56
DEC 66

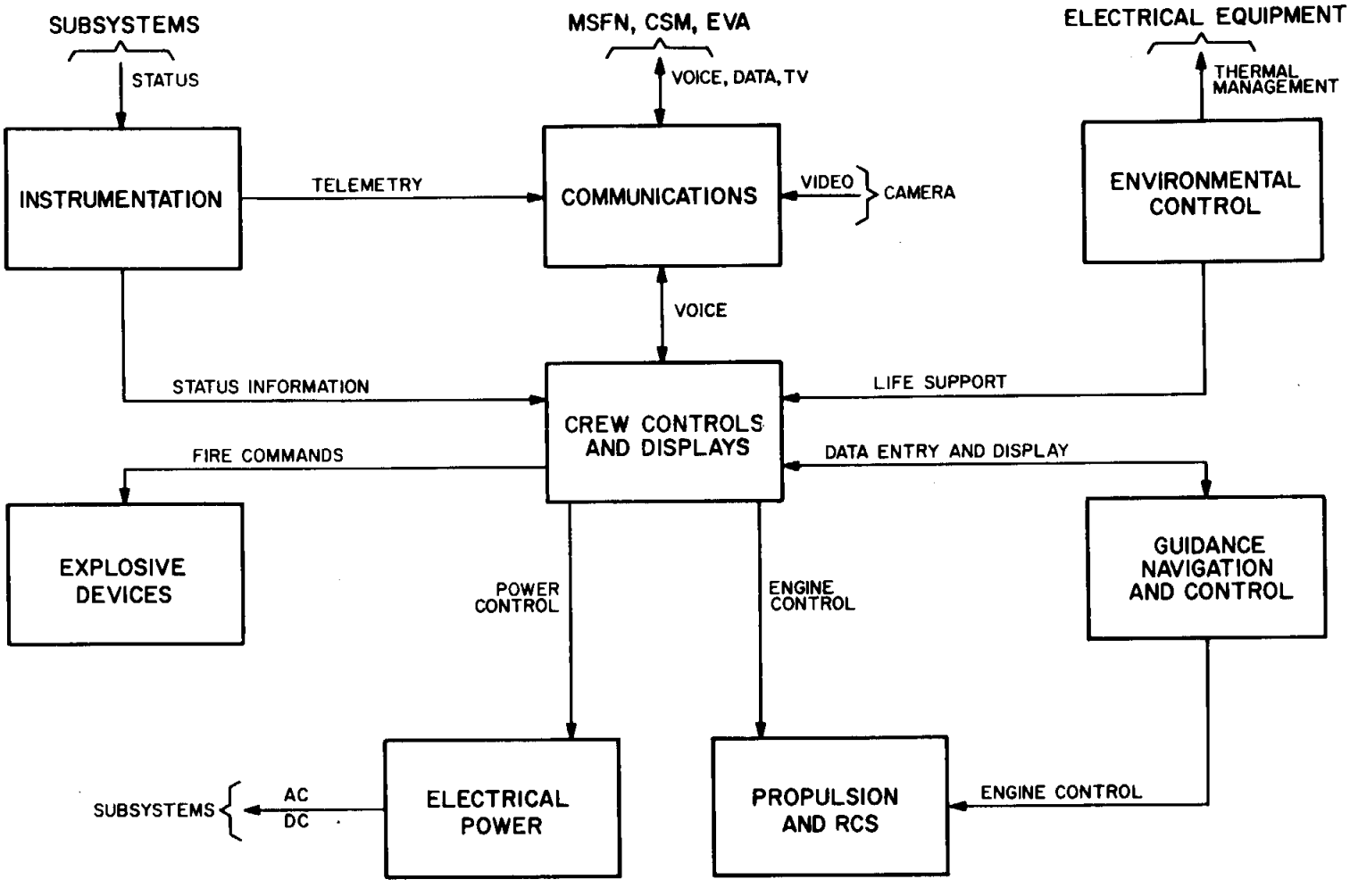


)NTROLS

T30005-113
APR 66



T30005-41
DEC 66



LM SUBSYSTEMS

T30005-60
DEC 66