NTIA Report 08-450

POTENTIAL INTERFERENCE FROM BROADBAND OVER POWER LINE (BPL) SYSTEMS TO FEDERAL GOVERNMENT RADIOCOMMUNICATION SYSTEMS AT 1.7 - 80 MHz

Phase 2 Study

VOLUME II

technical report

U.S. DEPARTMENT OF COMMERCE • National Telecommunications and Information Administration

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Phase 2 Study

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TECHNICAL APPENDICES

GLOSSARY

AWG	American Wire Gauge
BPL	Broadband over Power Line(s)
BW	Bandwidth
CISPR	International Special Committee on Radio Interference
CONUS	Continental United States
COTHEN	Customs Over The Horizon Enforcement Network
dB	Decibel
dBi	Decibel referenced to an isotropic radiator
dBm	Decibel referenced to 1 milliwatt
dBμV	Decibel referenced to 1 microvolt
dBW	Decibels referenced to 1 Watt
E	Electric Field Strength
EMC	Electromagnetic Compatibility
EUT	Equipment Under Test
FCC	Federal Communications Commission
G	Gain
GHz	Gigahertz
H	Magnetic Field Strength
HF	High Frequency
Hz	Hertz
I	Interference Power
ICAO	International Civil Aviation Organization
IRAC	Interdepartment Radio Advisory Committee
ITM	Irregular Terrain Model
ITS	Institute for Telecommunication Sciences
ITU	International Telecommunication Union
ITU-R	International Telecommunication Union Radiocommunication Sector
kHz	Kilohertz
km	Kilometer
LV	Low Voltage
m	Meter
MHz	Megahertz
mm	millimeter
mS	Siemens/meter
ms	Millisecond
MV	Medium Voltage
N	Noise Power
NEC	Numerical Electromagnetic Code
NOI	Notice of Inquiry
NPRM	Notice of Proposed Rulemaking
NTIA	National Telecommunications and Information Administration
OR	Off-Route

OTH	Over the Horizon
PFD	Power Flux Density
PLC	Power Line Communications
PLT	Power Line Telecommunications
R	Route
RF	Radio Frequency
RMS	Root Mean Square
RSMS	Radio Spectrum Measurement System
S	Signal Power
SNR	Signal-to-Noise Ratio
SSB	Single Sideband
SSN	Smoothed Sunspot Number
URD	Underground Residential Distribution
US&P	United States and Possessions
UTC	Universal Coordinated Time
VHF	Very High Frequency
VLA	Very Large Array
VOA	Voice of America
VOACAP	Voice of America Coverage Analysis Program
W	Watt
μA	Microampere
μV	Microvolt

APPENDIX A
MEASUREMENT ANTENNA HEIGHT

A.1 INTRODUCTION

Section A.2 describes NTIA's Numerical Electromagnetics Code (NEC) simulation results showing the height where the peak field strength is expected in close proximity to an Access Broadband over Power Line (BPL) system operating on overhead Medium Voltage (MV) power lines. Section A.3 shows the effectiveness of the 1 meter measurement height in estimating the peak field strength at frequencies between 1.7 and 30 MHz. Section A.4 provides results from simulations performed in the 30 – 50 MHz range, using the 1 to 4 meter measurement height range defined in the compliance measurement guidelines for Access BPL systems operating above 30 MHz. In Section A.5, the optional 5-dB height correction factor for measurements at a 1 meter height is compared to the use of the 1 to 4 meter measurement height for the various power line simulations at frequencies above 30 MHz.

A.2 HEIGHT OF PEAK FIELD STRENGTH

Figures A-1 through A-18 show the heights where the peak electric field strength occurred over the frequency range of 2 to 50 MHz for the NEC power line models described in Section 2.2. The height of the modeled power lines was 12 meters. These results assume field strength values are calculated at a horizontal distance of 10 meters.

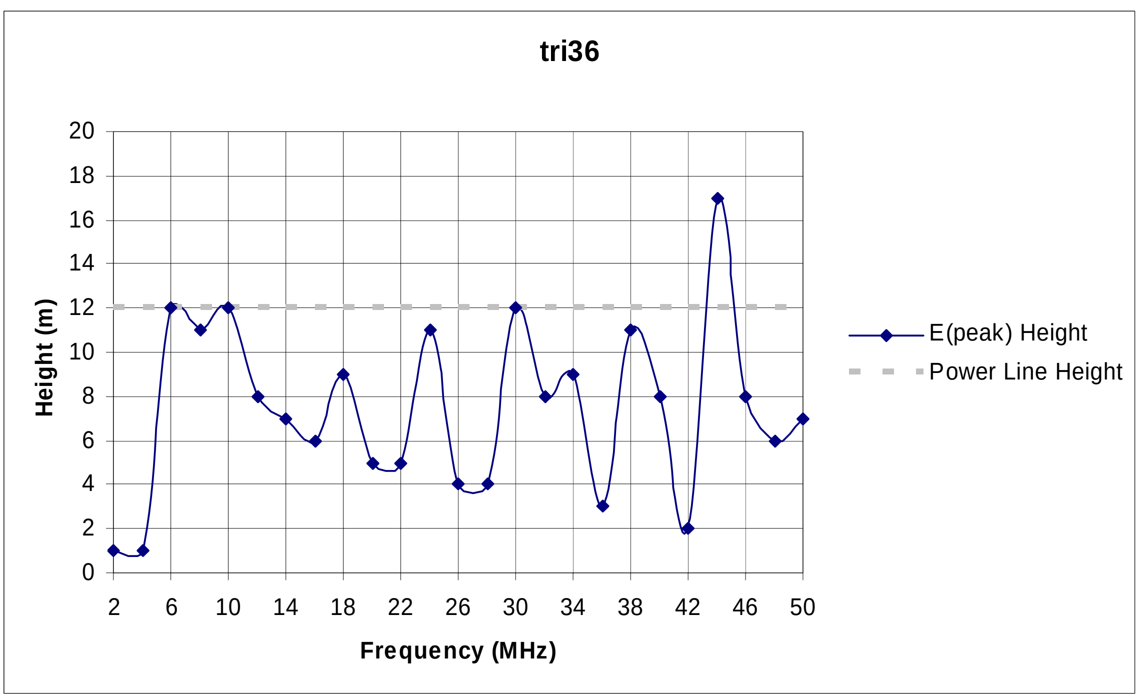


Figure A-1: Height corresponding to peak electric field strength as a function of frequency

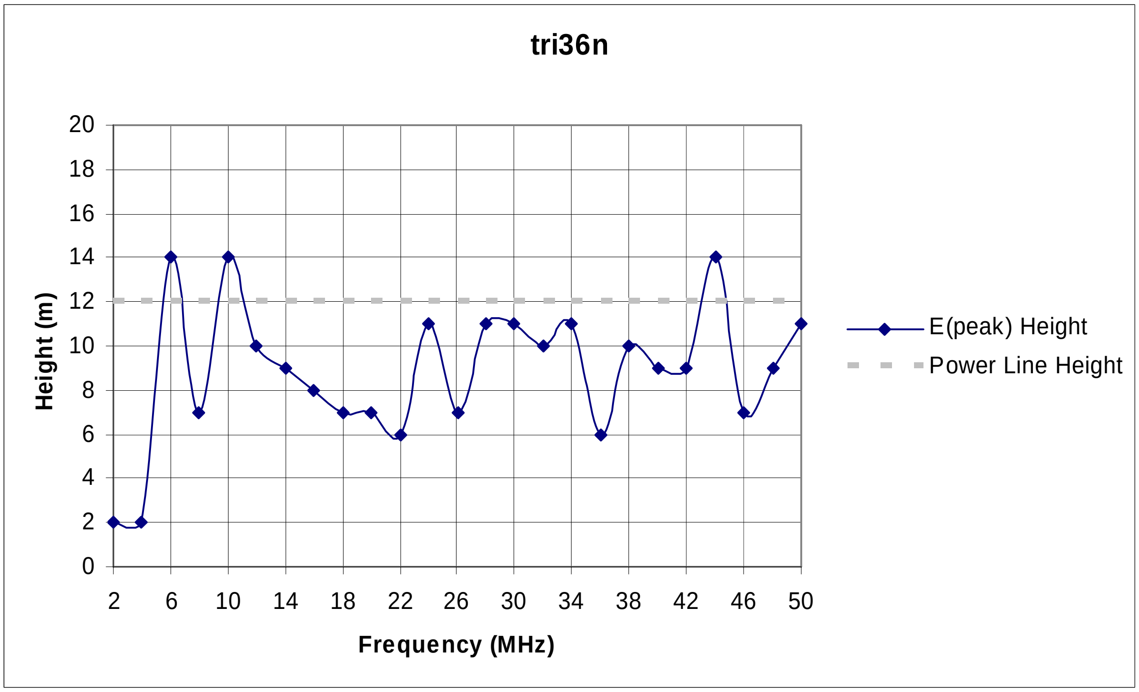


Figure A-2: Height corresponding to peak electric field strength as a function of frequency

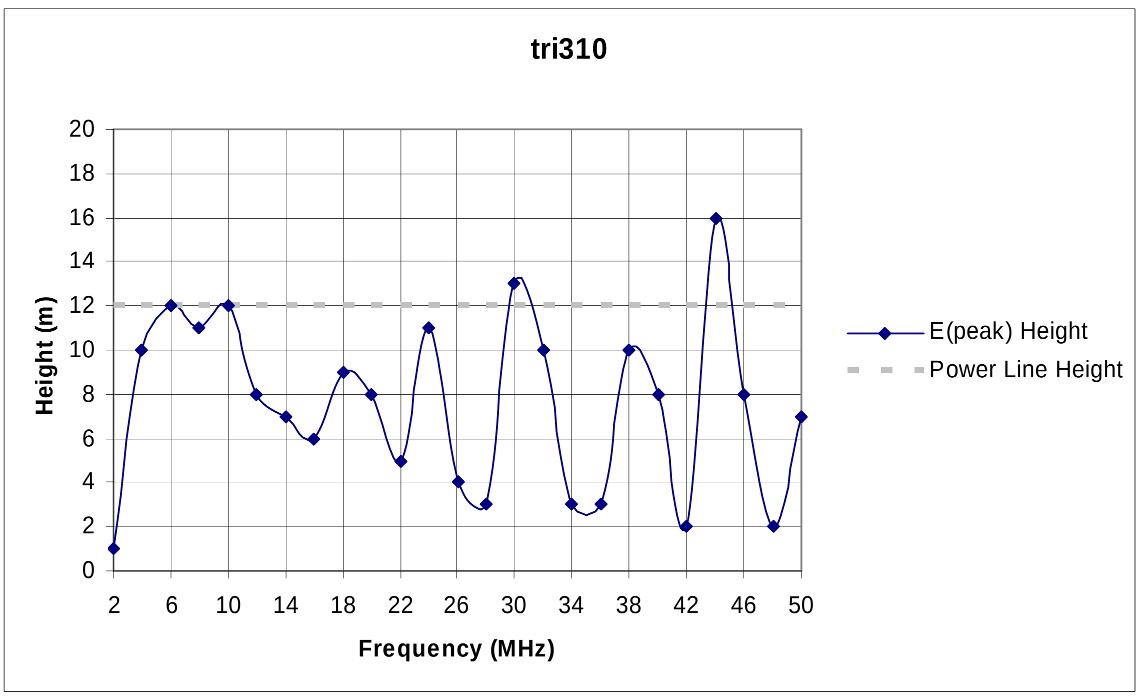


Figure A-3: Height corresponding to peak electric field strength as a function of frequency

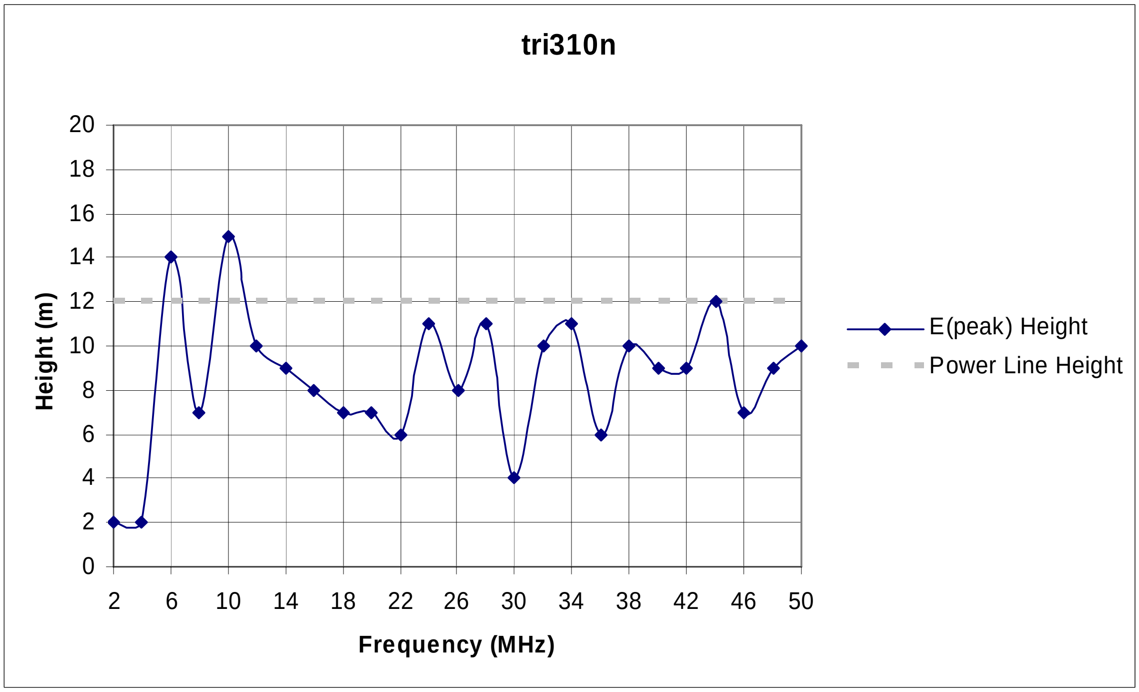


Figure A-4: Height corresponding to peak electric field strength as a function of frequency

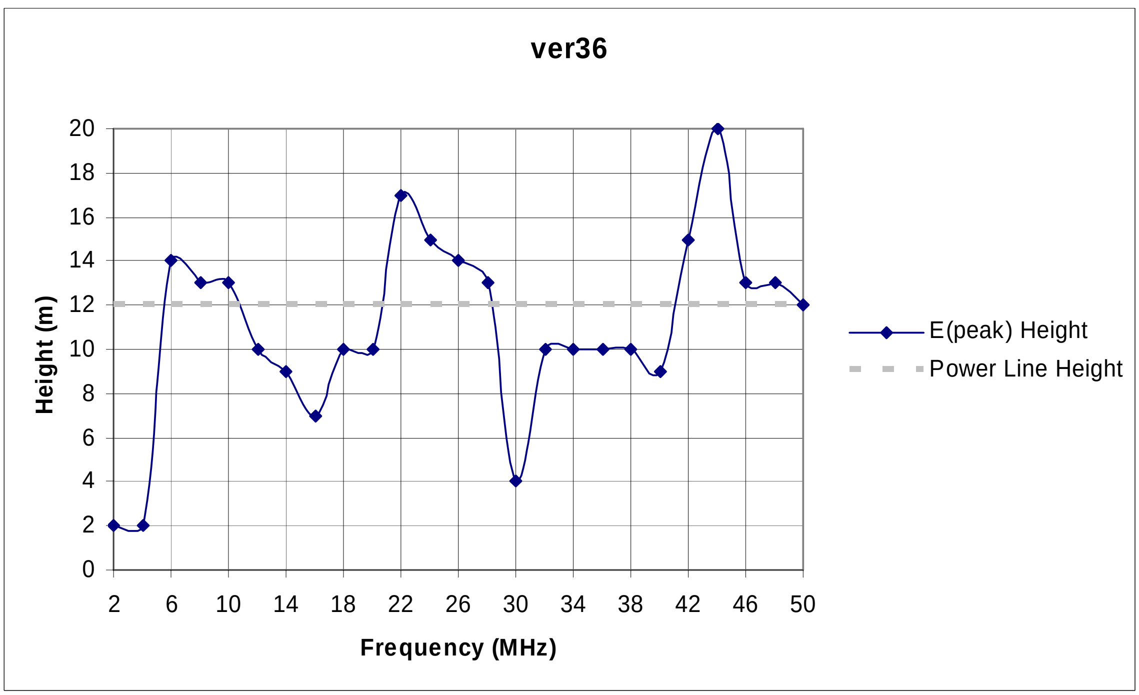


Figure A-5: Height corresponding to peak electric field strength as a function of frequency

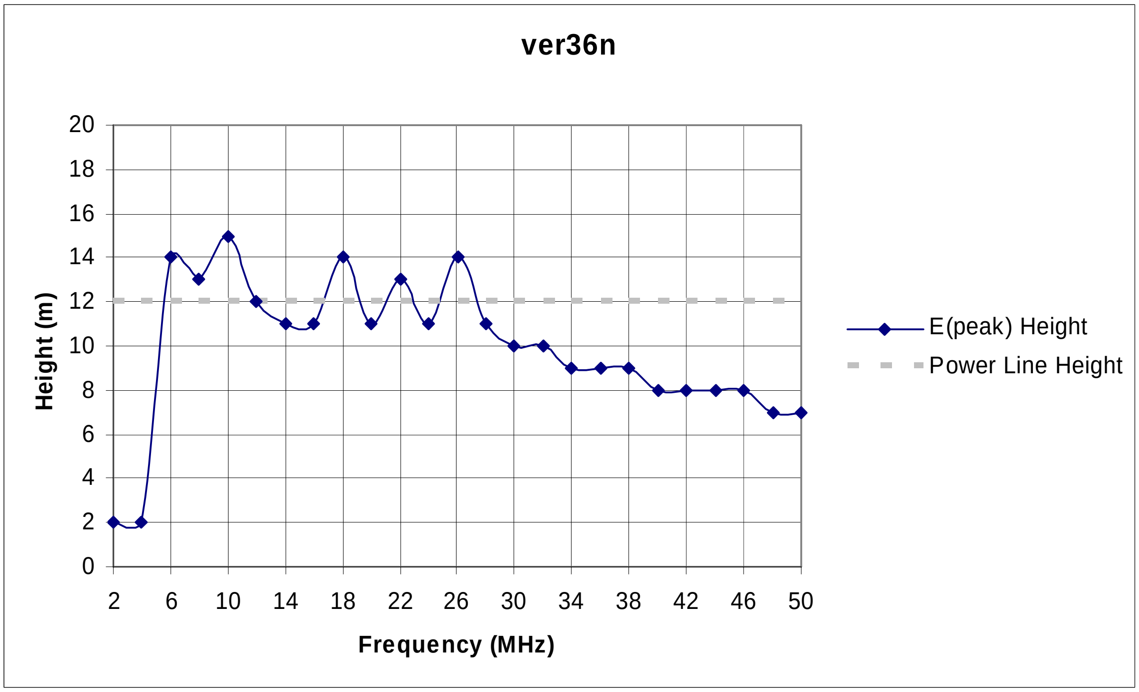


Figure A-6: Height corresponding to peak electric field strength as a function of frequency

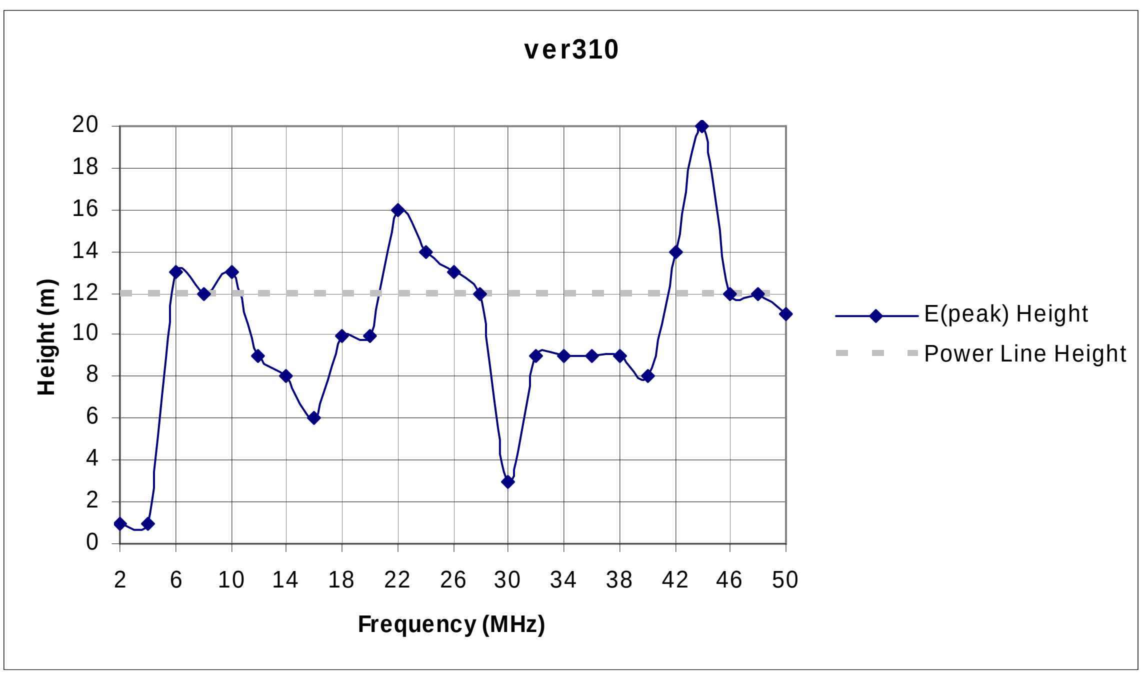


Figure A-7: Height corresponding to peak electric field strength as a function of frequency

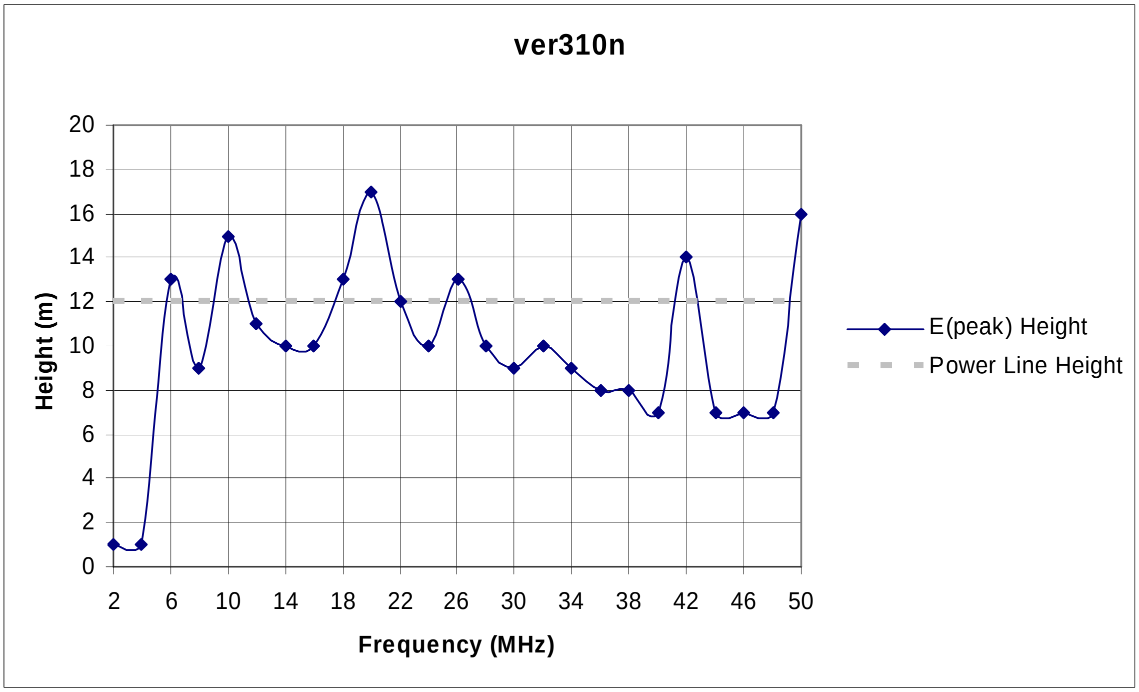


Figure A-8: Height corresponding to peak electric field strength as a function of frequency

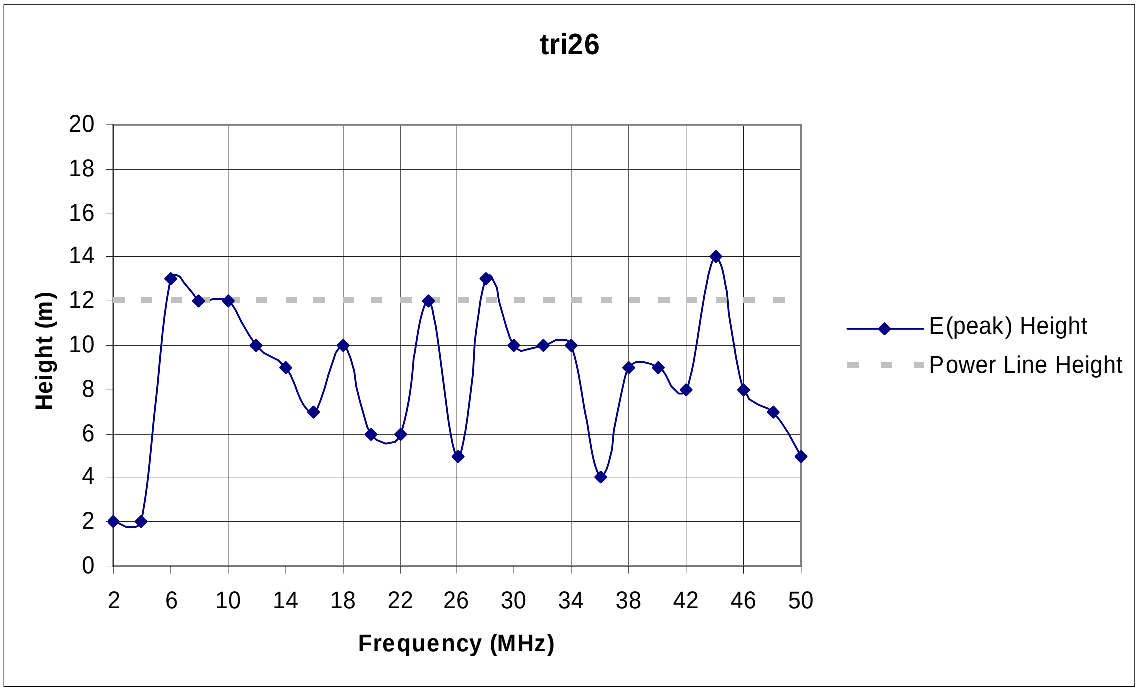


Figure A-9: Height corresponding to peak electric field strength as a function of frequency

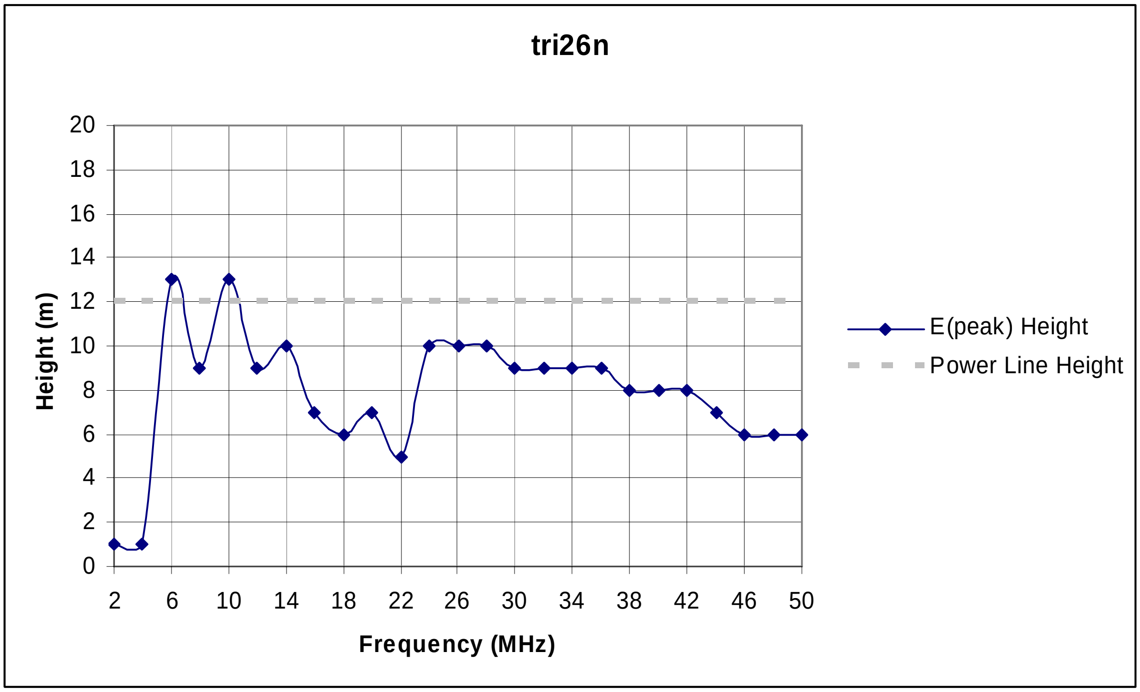


Figure A-10: Height corresponding to peak electric field strength as a function of frequency

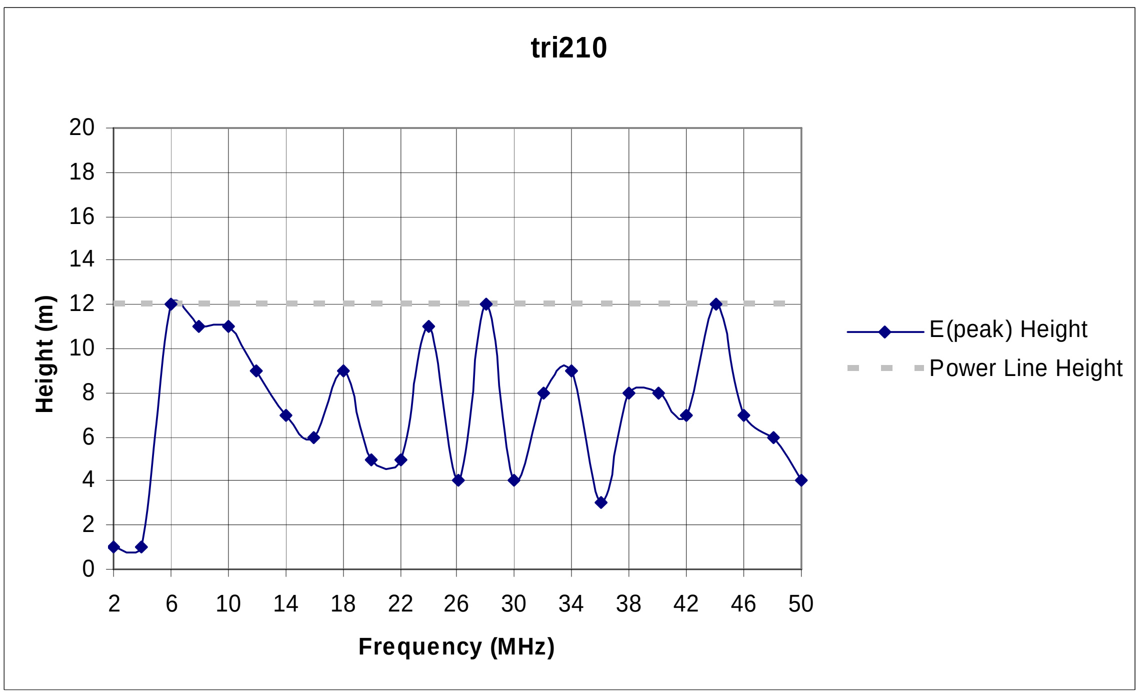


Figure A-11: Height corresponding to peak electric field strength as a function of frequency

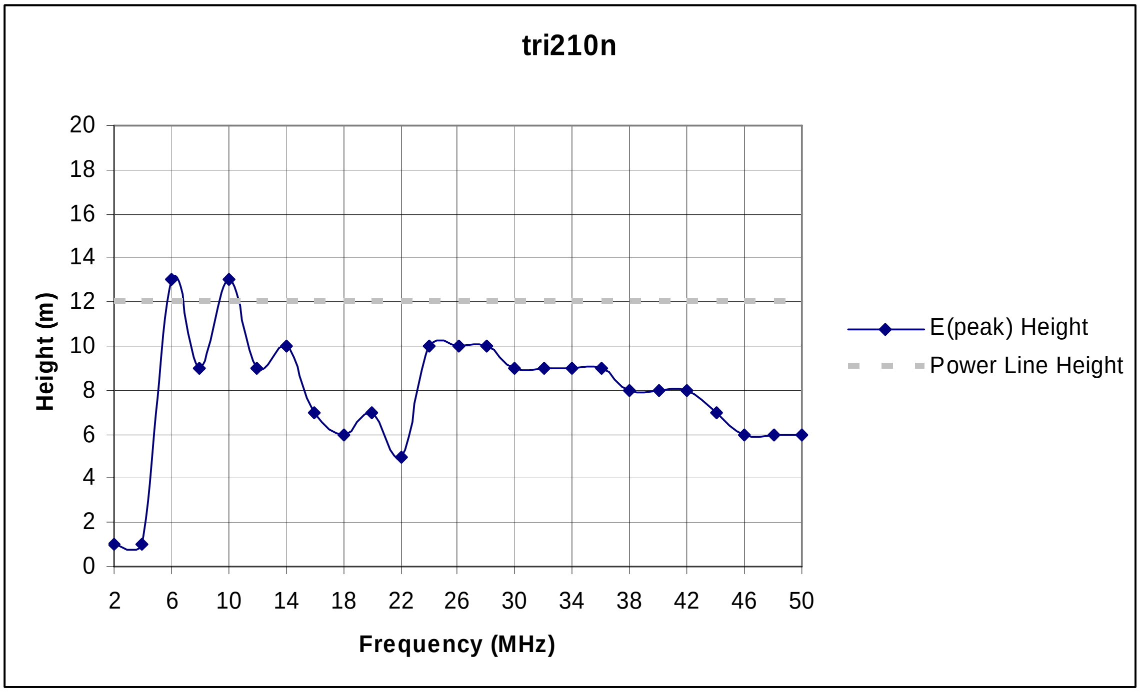


Figure A-12: Height corresponding to peak electric field strength as a function of frequency

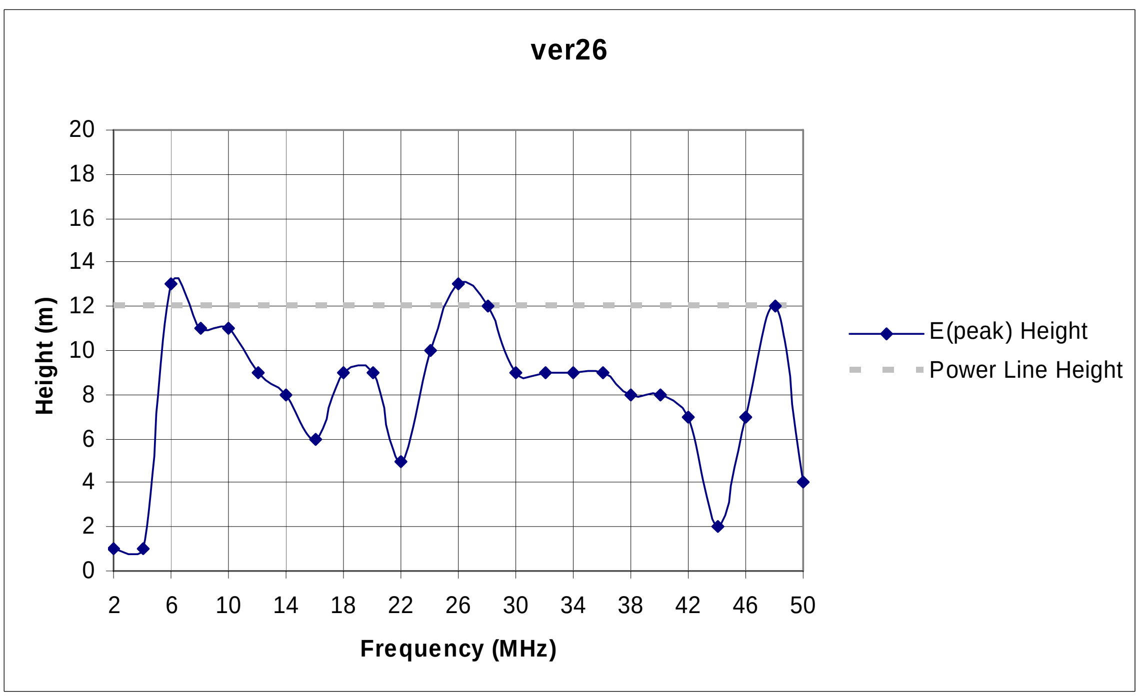


Figure A-13: Height corresponding to peak electric field strength as a function of frequency

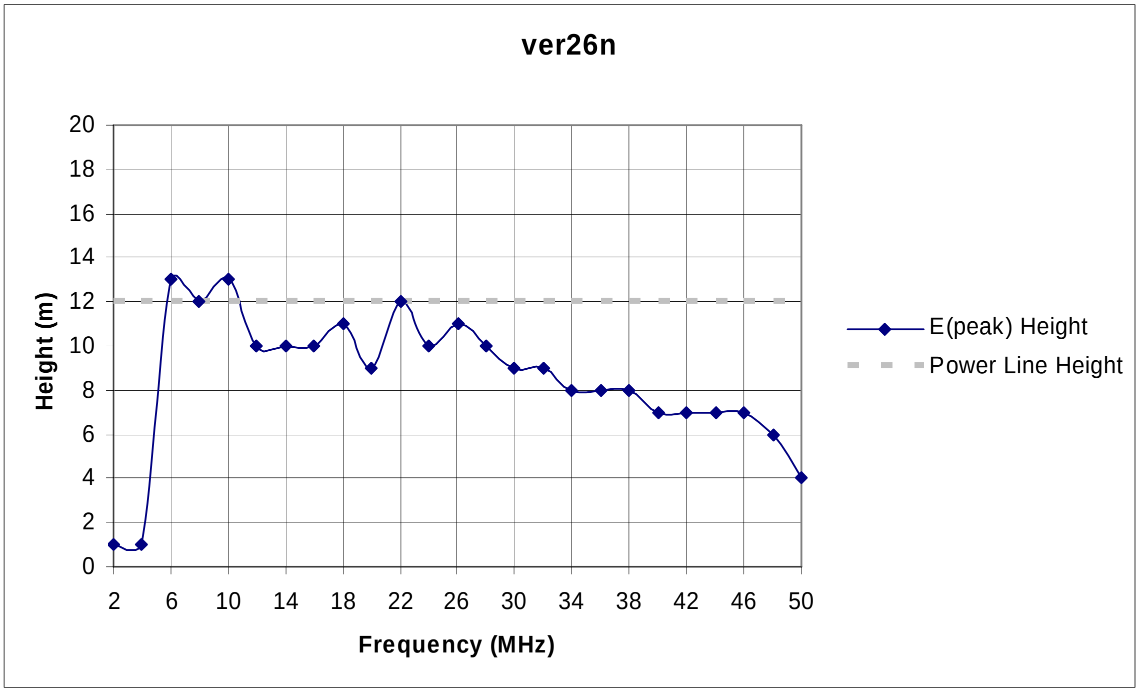


Figure A-14: Height corresponding to peak electric field strength as a function of frequency

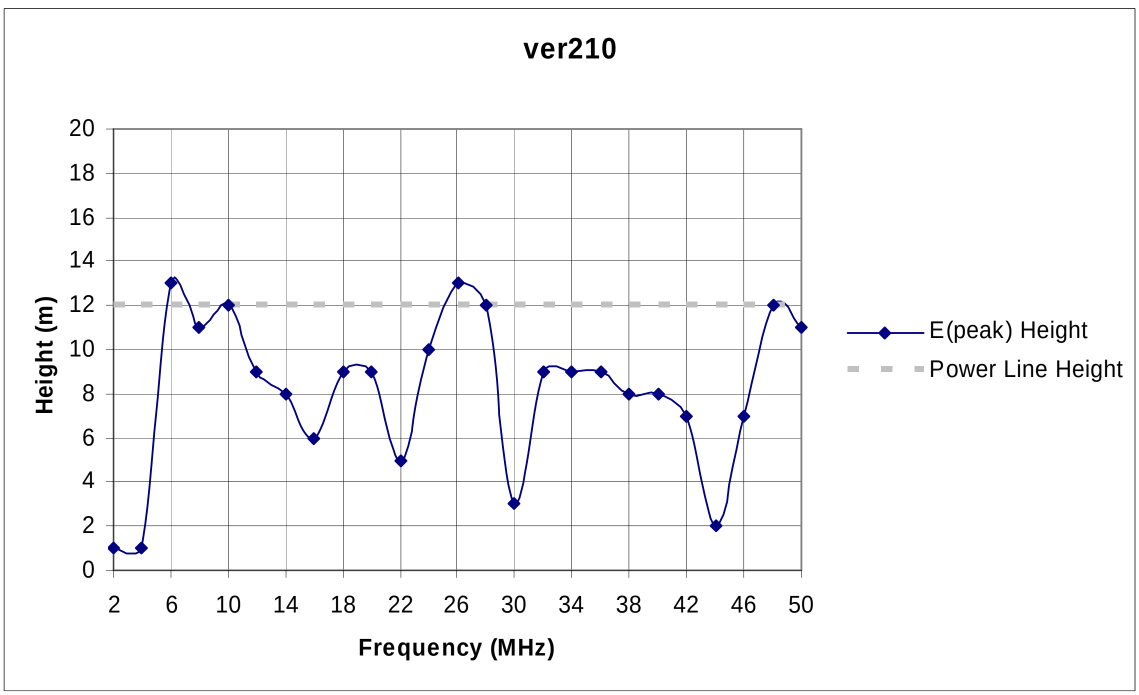


Figure A-15: Height corresponding to peak electric field strength as a function of frequency

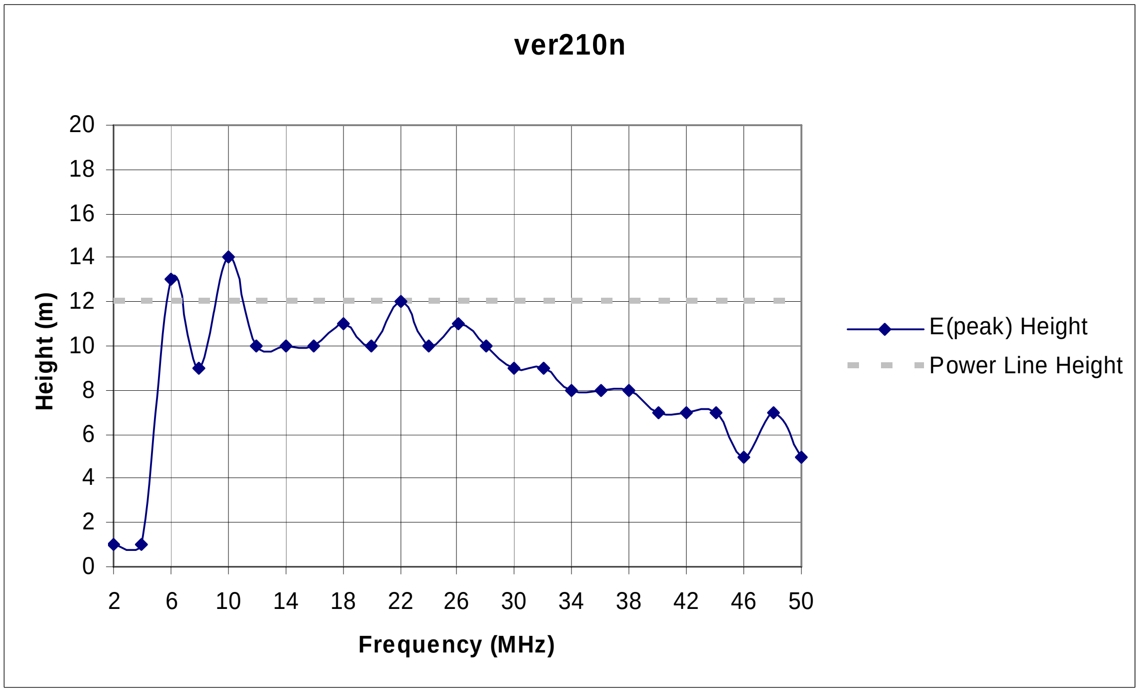


Figure A-16: Height corresponding to peak electric field strength as a function of frequency

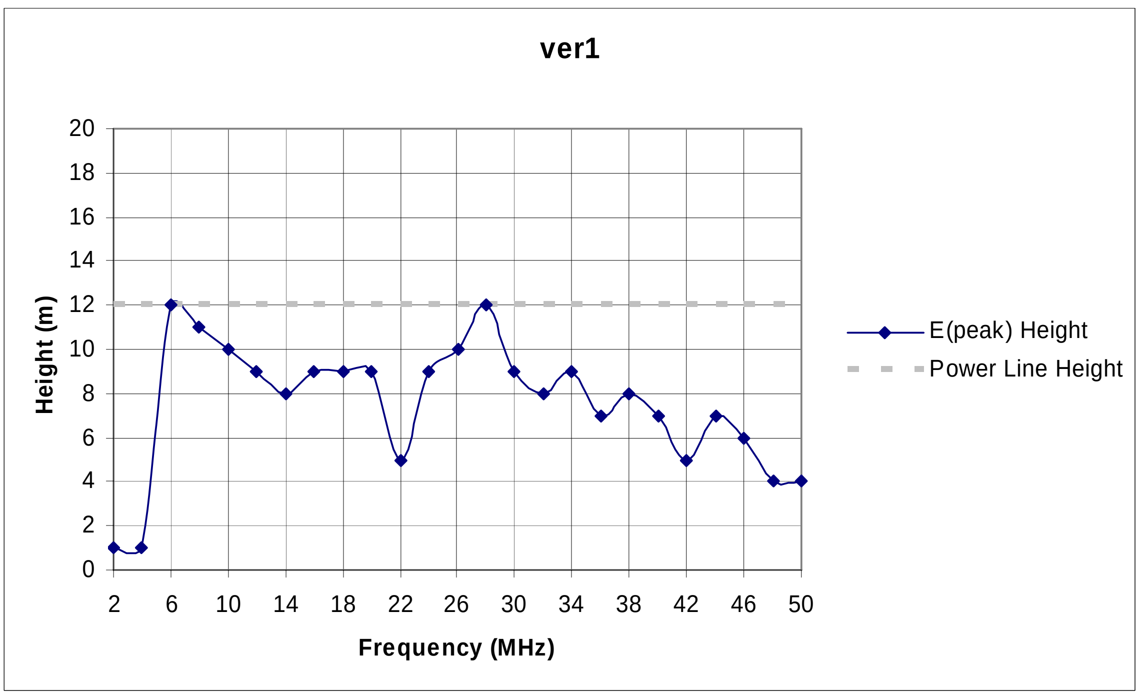


Figure A-17: Height corresponding to peak electric field strength as a function of frequency

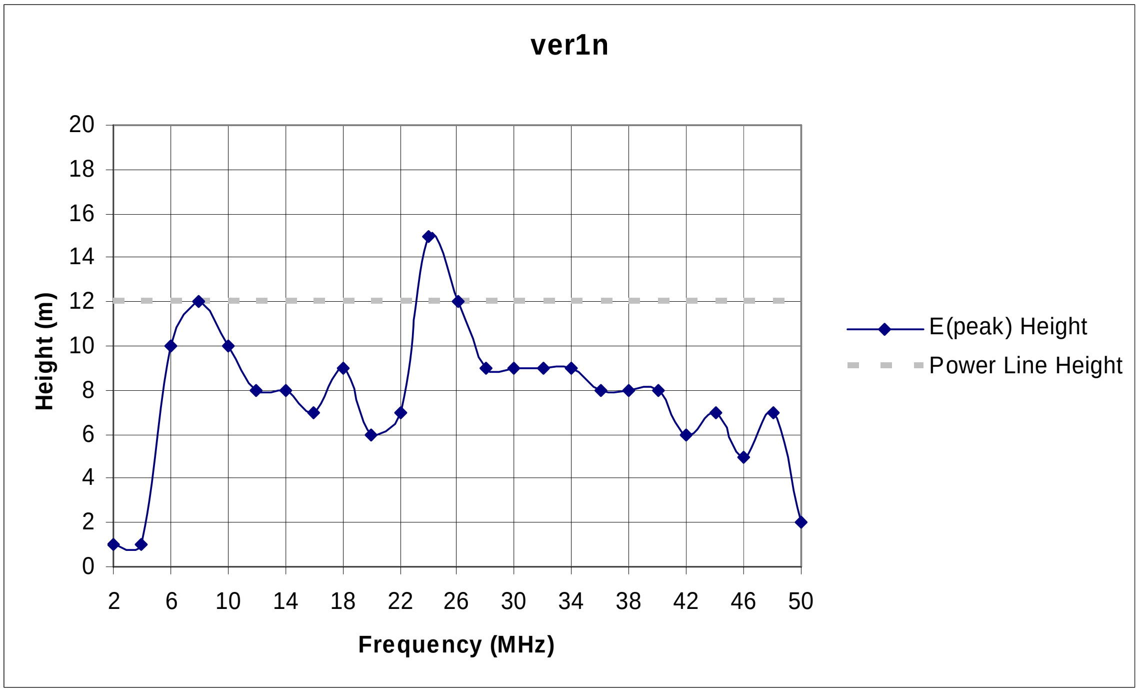


Figure A-18: Height corresponding to peak electric field strength as a function of frequency

A.3 COMPLIANCE MEASUREMENT HEIGHT FOR OPERATION BETWEEN 1.7 - 30 MHz

The Federal Communication Commission (Commission or FCC) Part 15 measurement guidelines specify that below 30 MHz, measurements are to be made with the antenna positioned at a height of 1 meter. In Section A.2, the height corresponding to the peak field strength was often located well above the 1 meter measurement height. The following plots show a comparison between the peak field strength determined from the measurement guidelines and the 80th percentile of peak electric field strength at any height along the length of the power line. The 80th percentile values eliminate the localized peaks that are unlikely to be encountered by a radio receiver randomly located in close proximity to an Access BPL power line.[1] The plots are shown for a number of NEC power line models at frequencies from 2 to 28 MHz.

[1] *See* NTIA Comments, at Technical Appendix, pp. 2-18.

2 MHz Plots

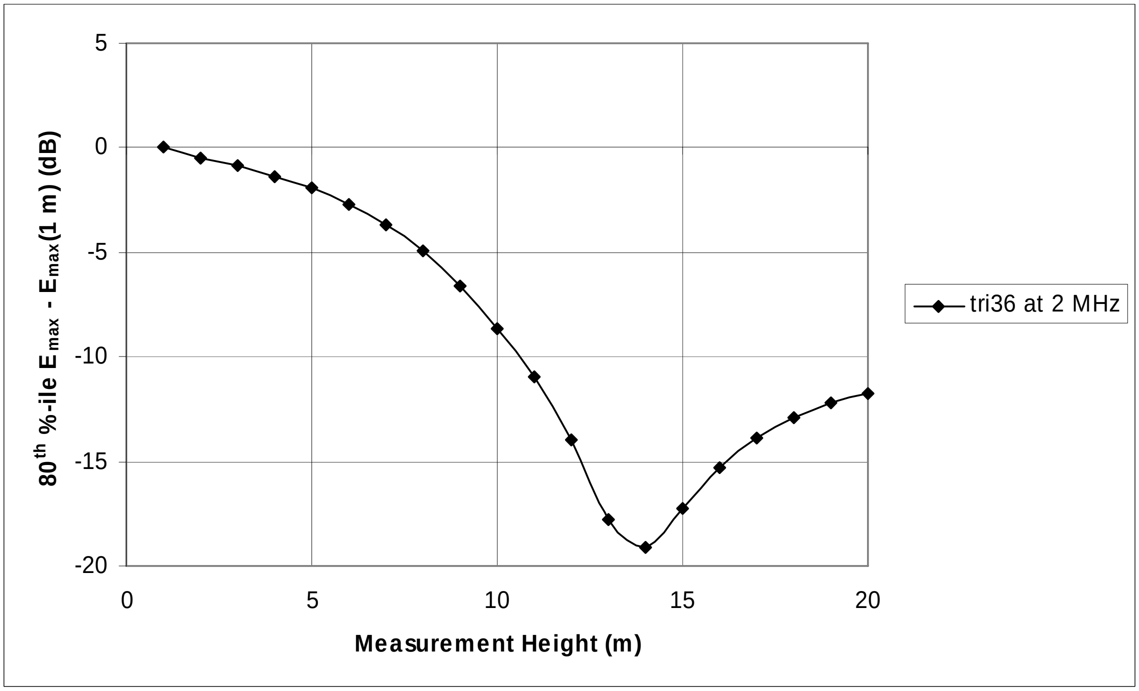


Figure A-19: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

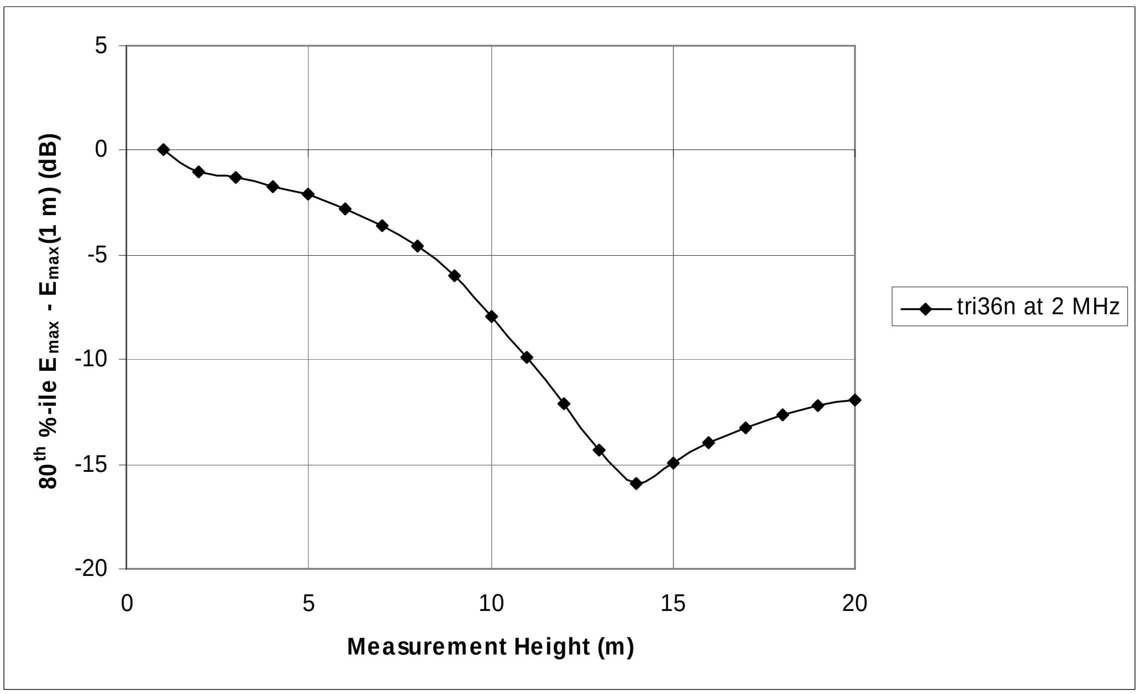


Figure A-20: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

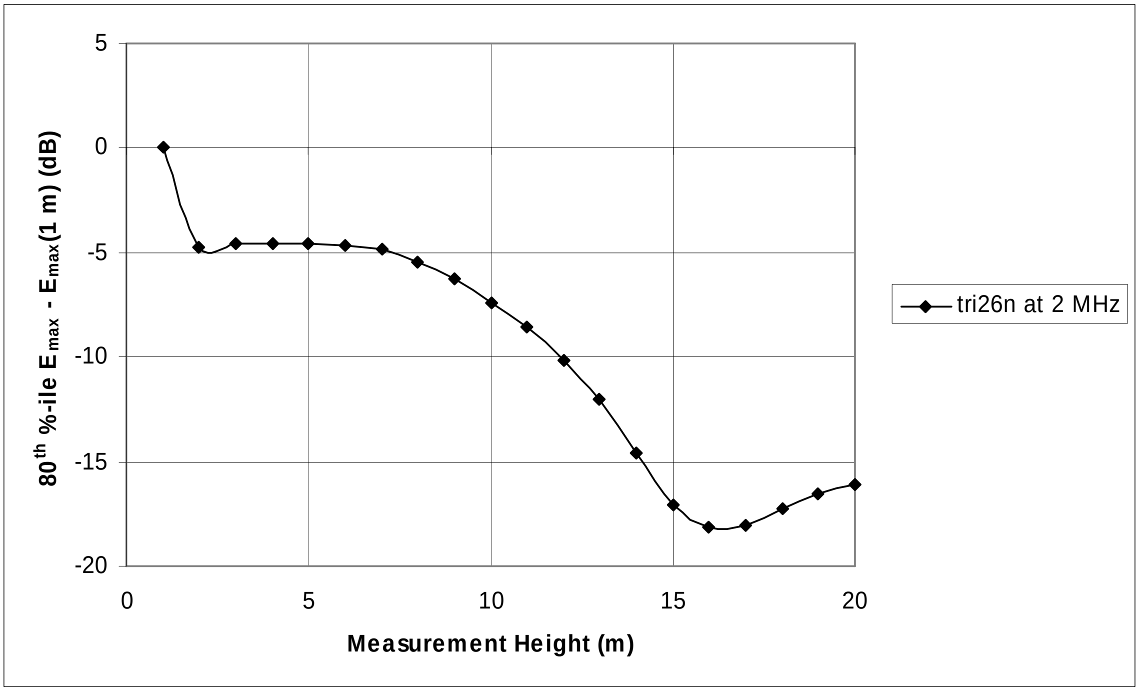


Figure A-21: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

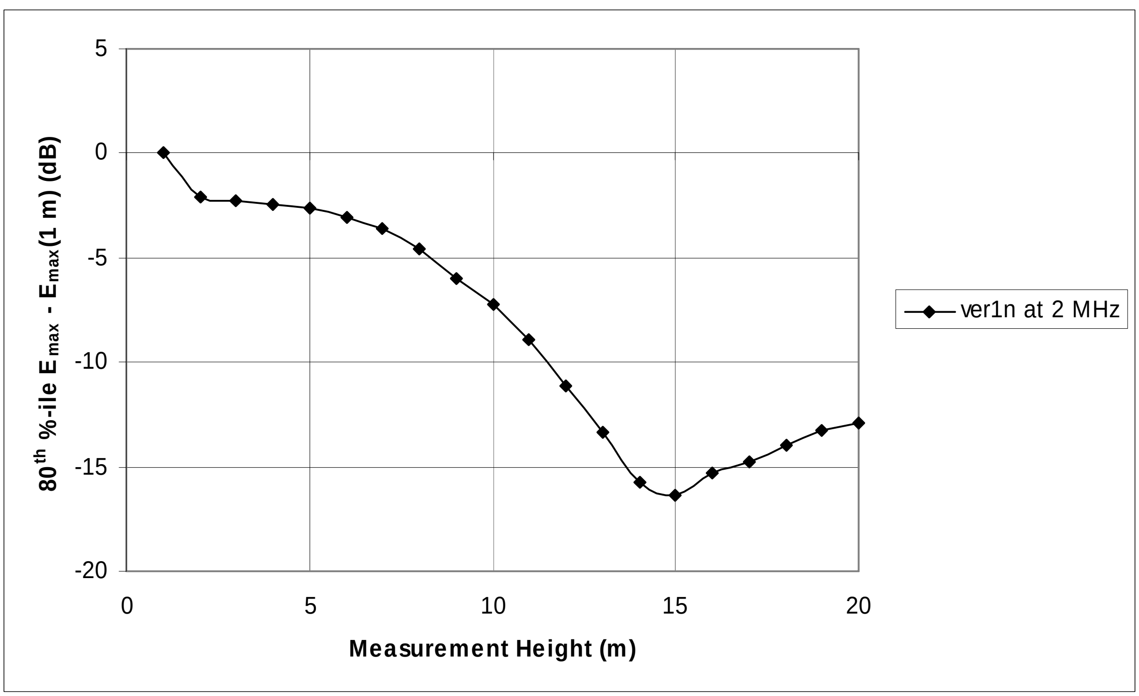


Figure A-22: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

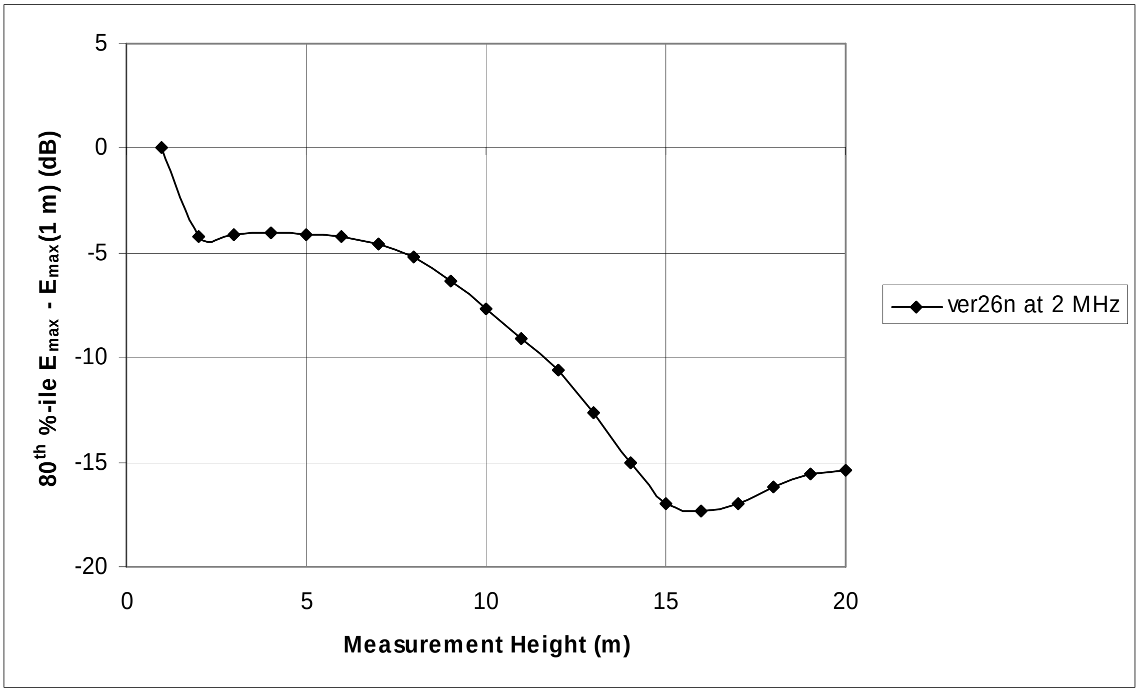


Figure A-23: 80^{th} percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

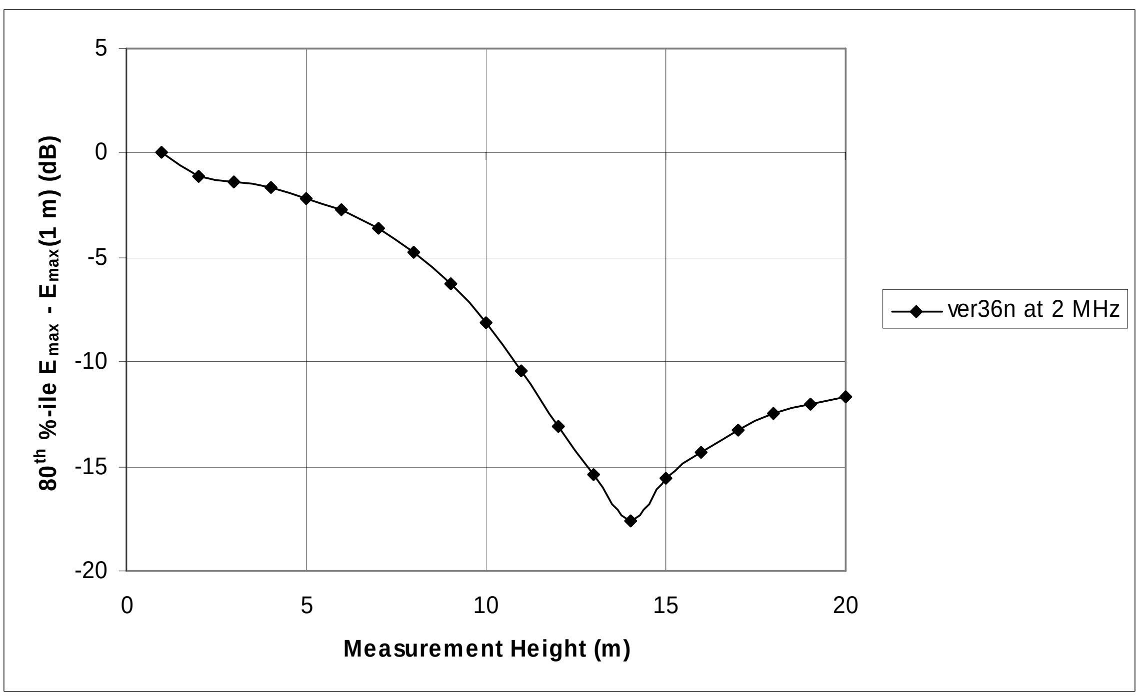


Figure A-24: 80^{th} percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

4 MHz Plots

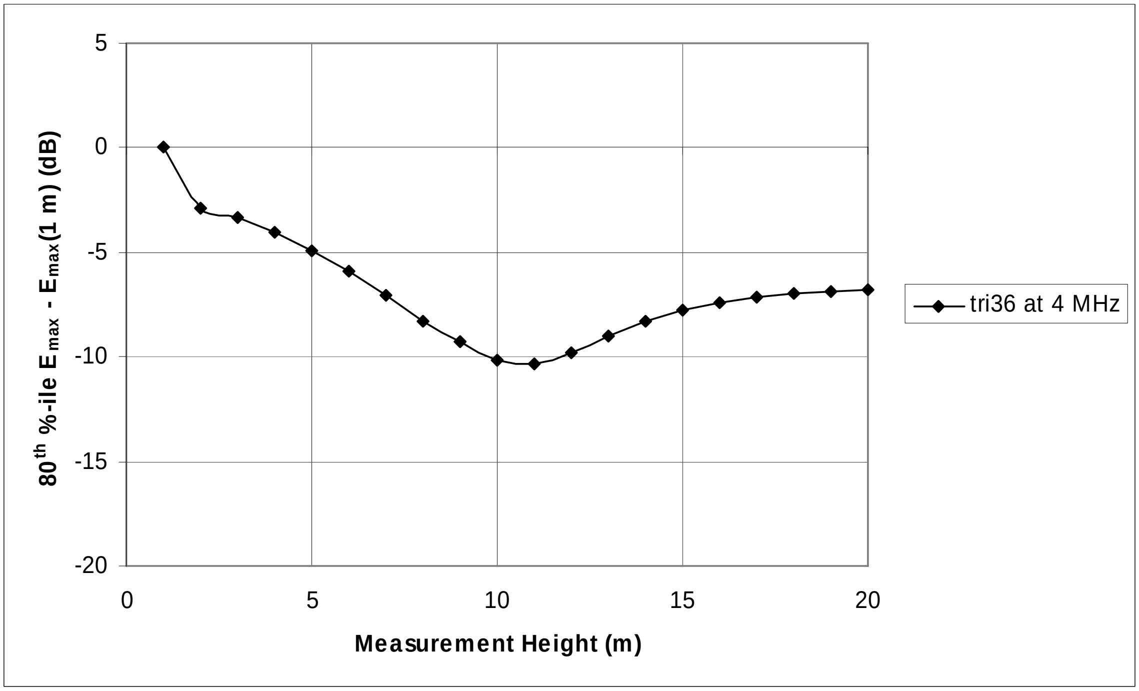


Figure A-25: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

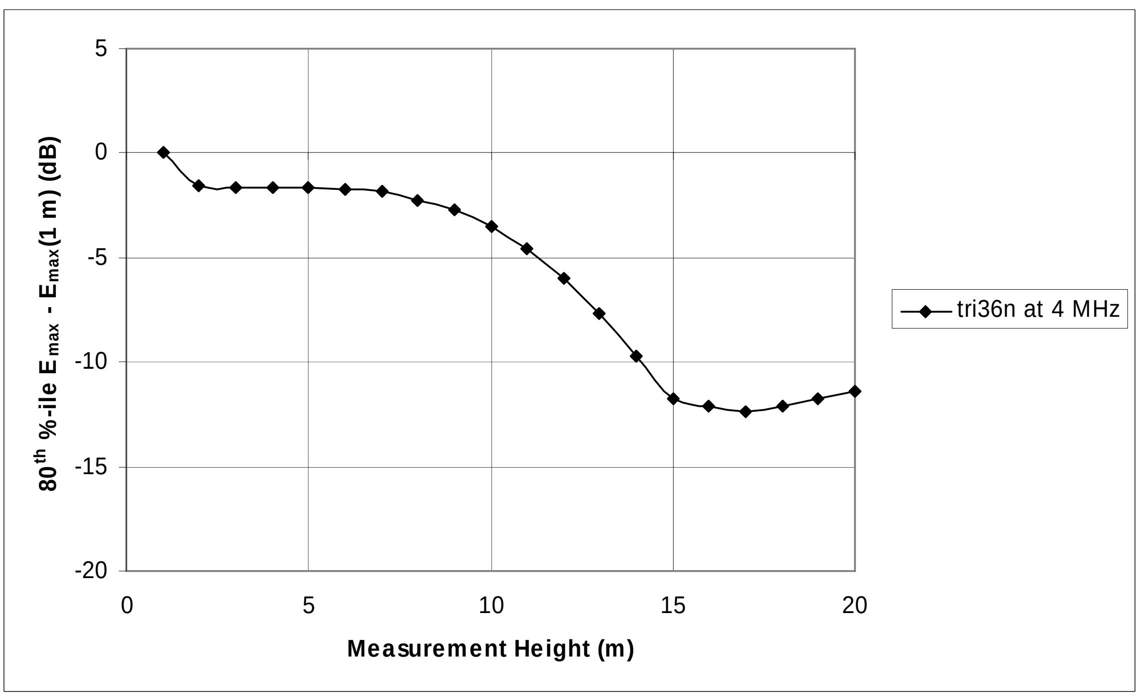


Figure A-26: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

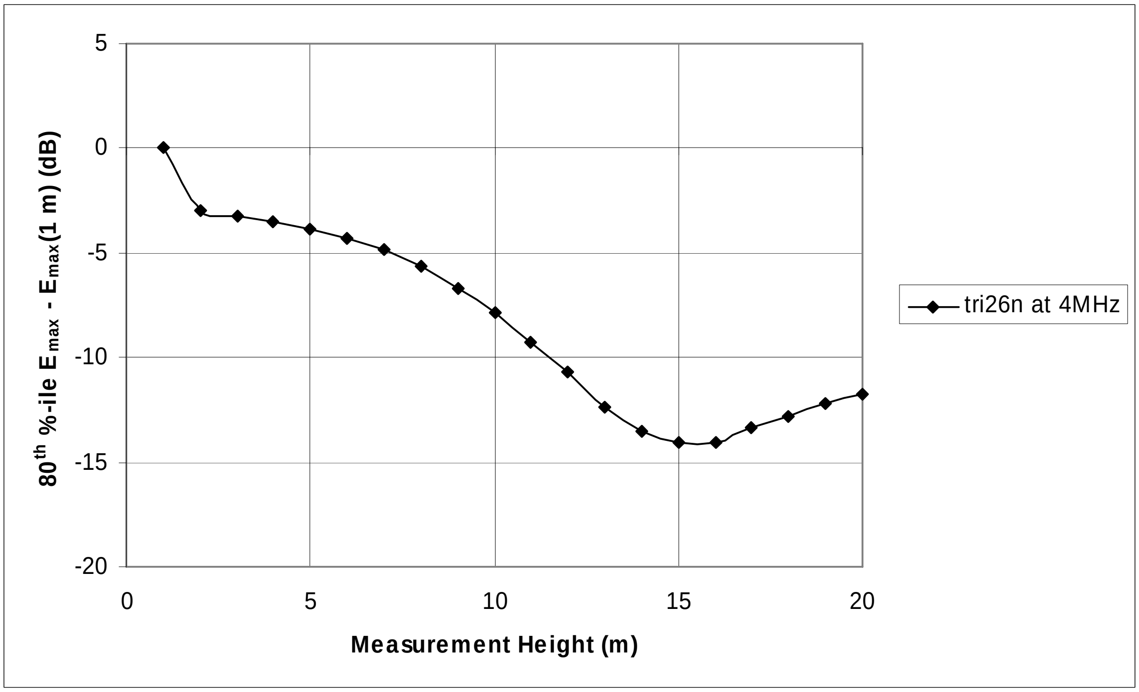


Figure A-27: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

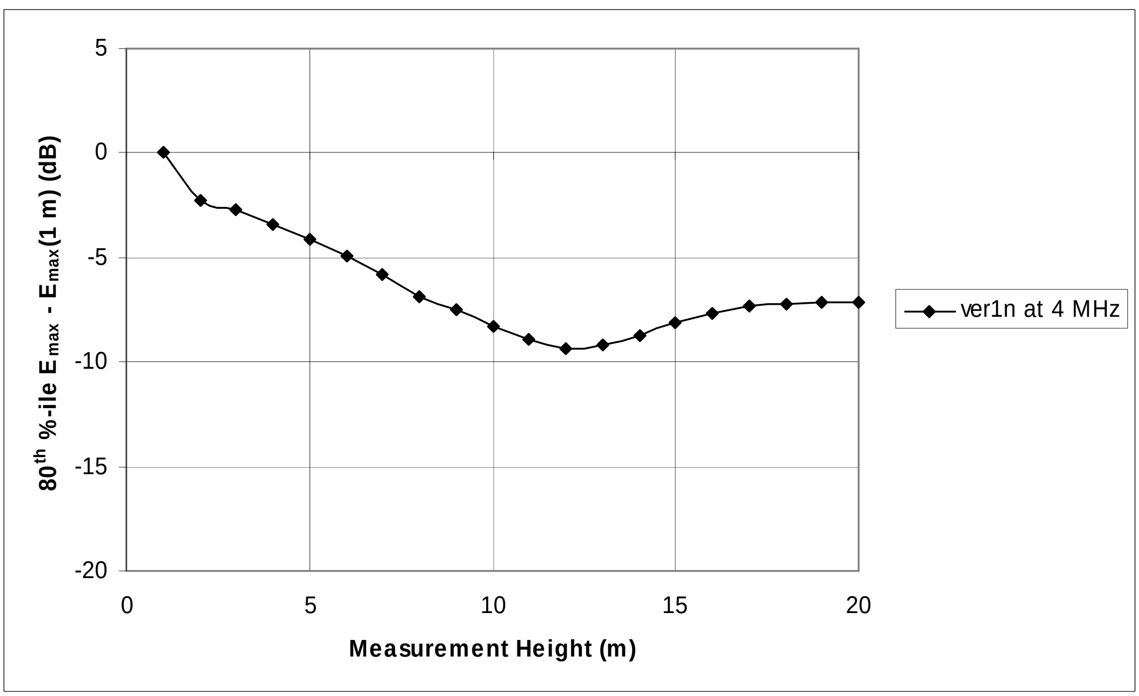


Figure A-28: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

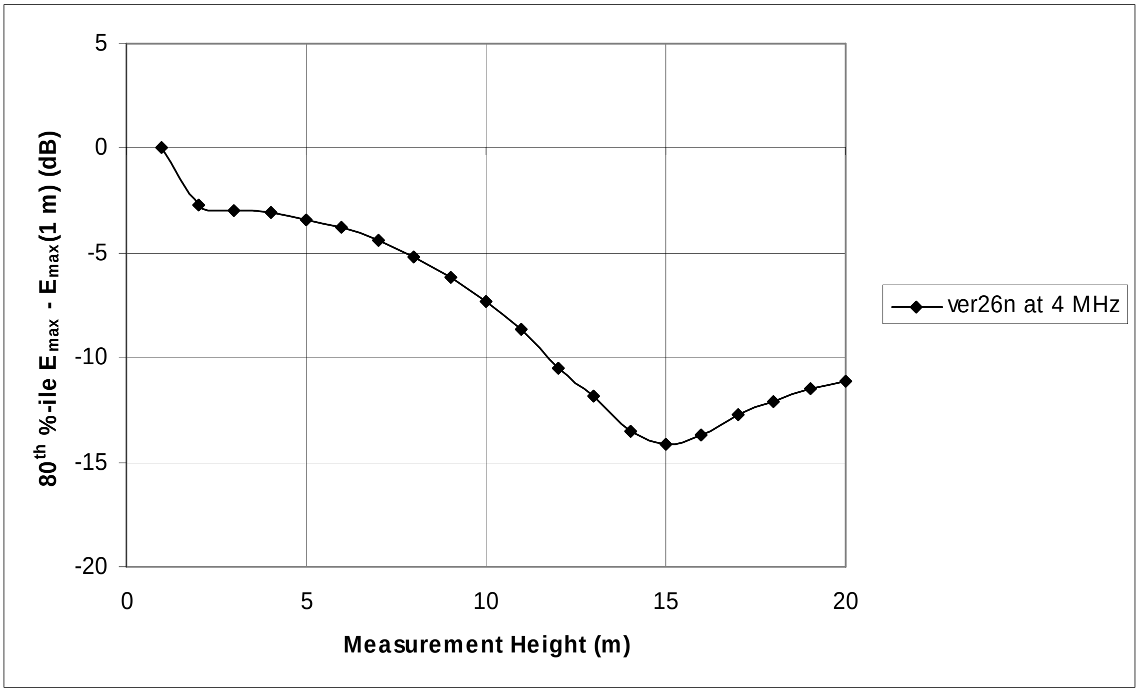


Figure A-29: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

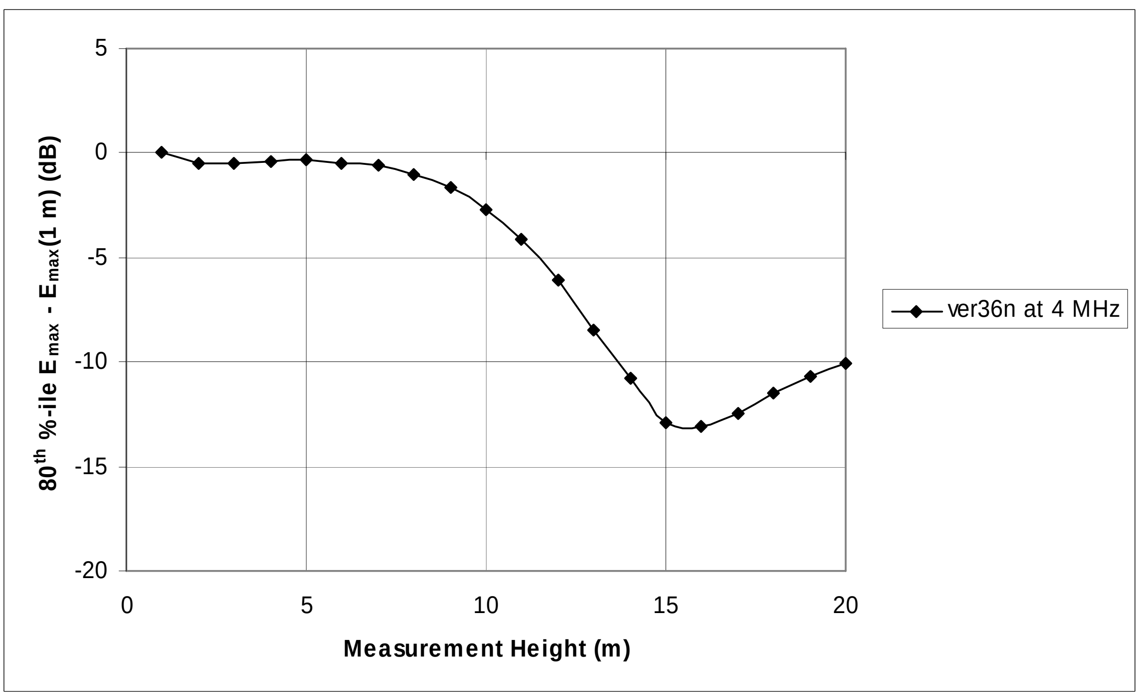


Figure A-30: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

6 MHz Plots

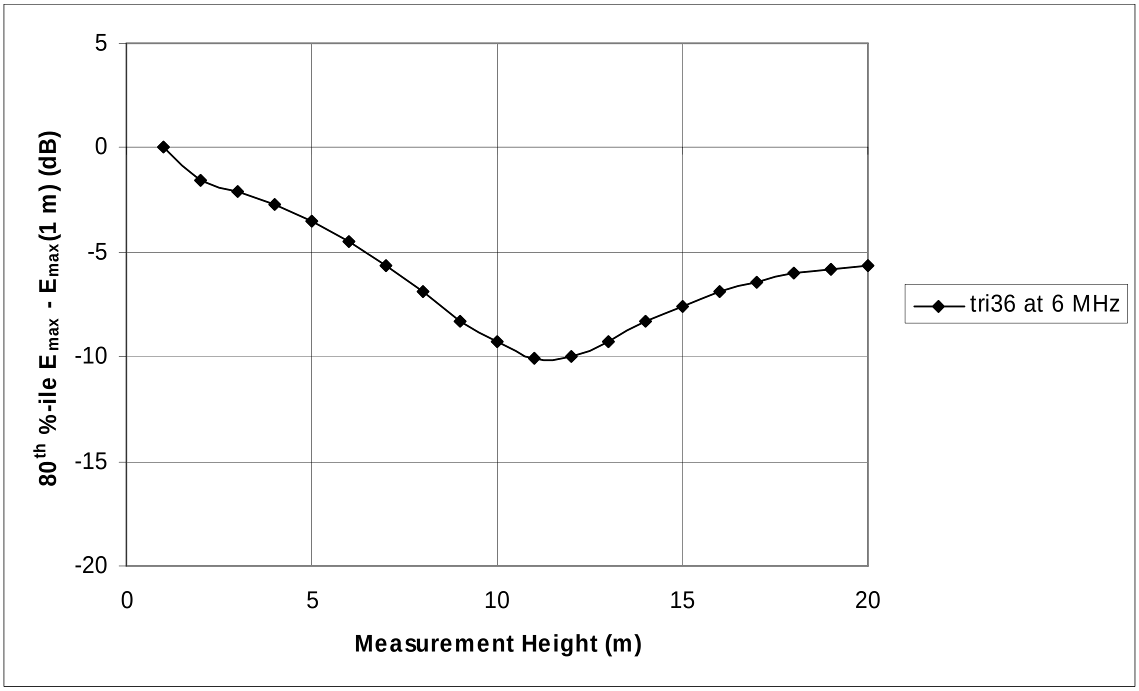


Figure A-31: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

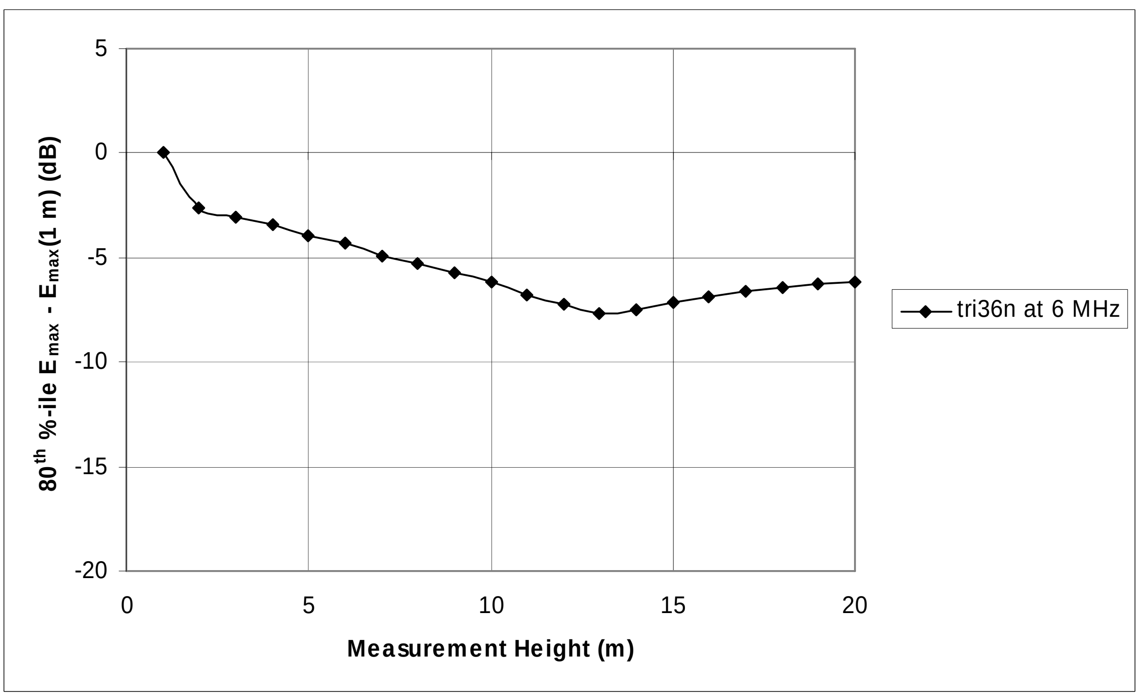


Figure A-32: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

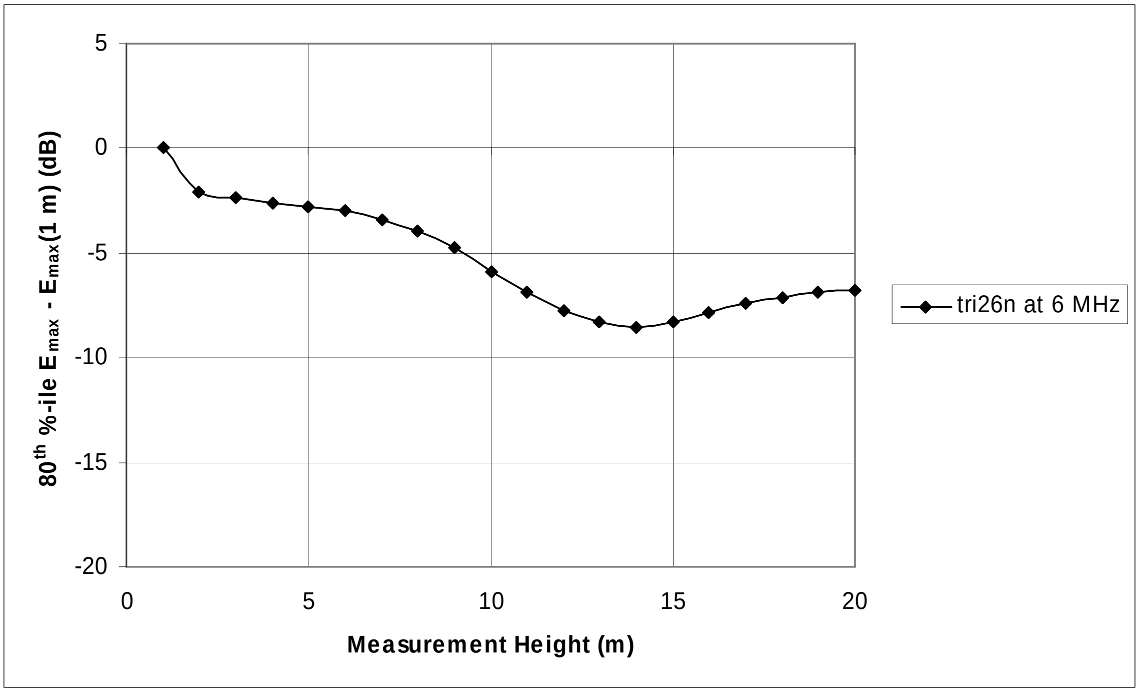


Figure A-33: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

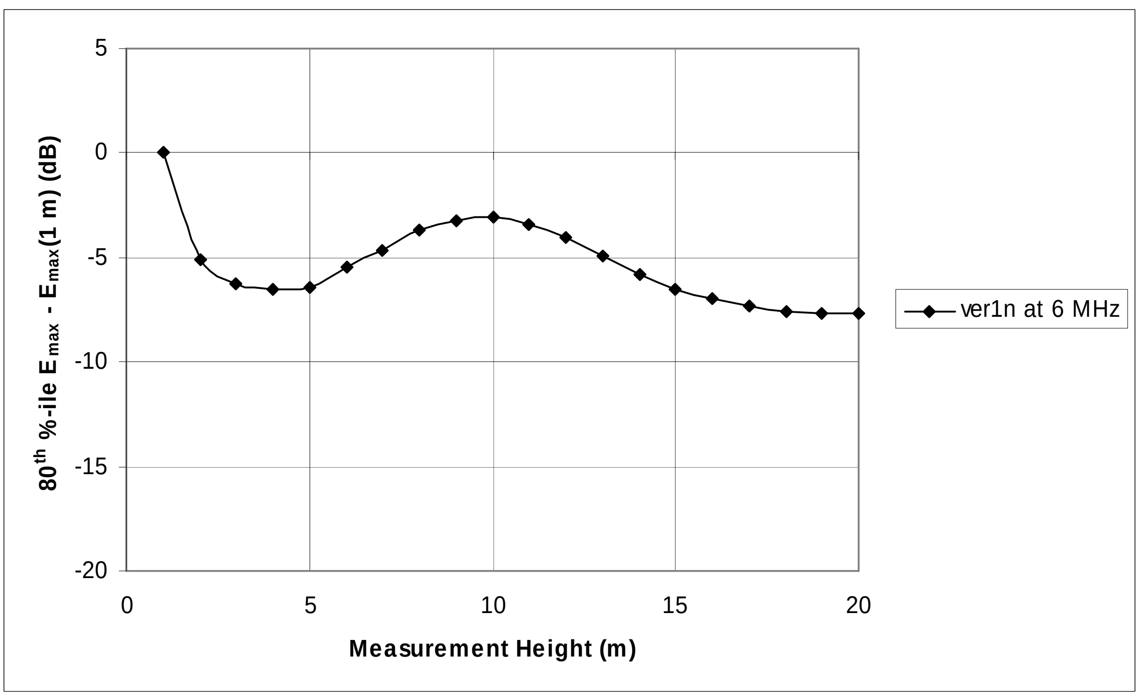


Figure A-34: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

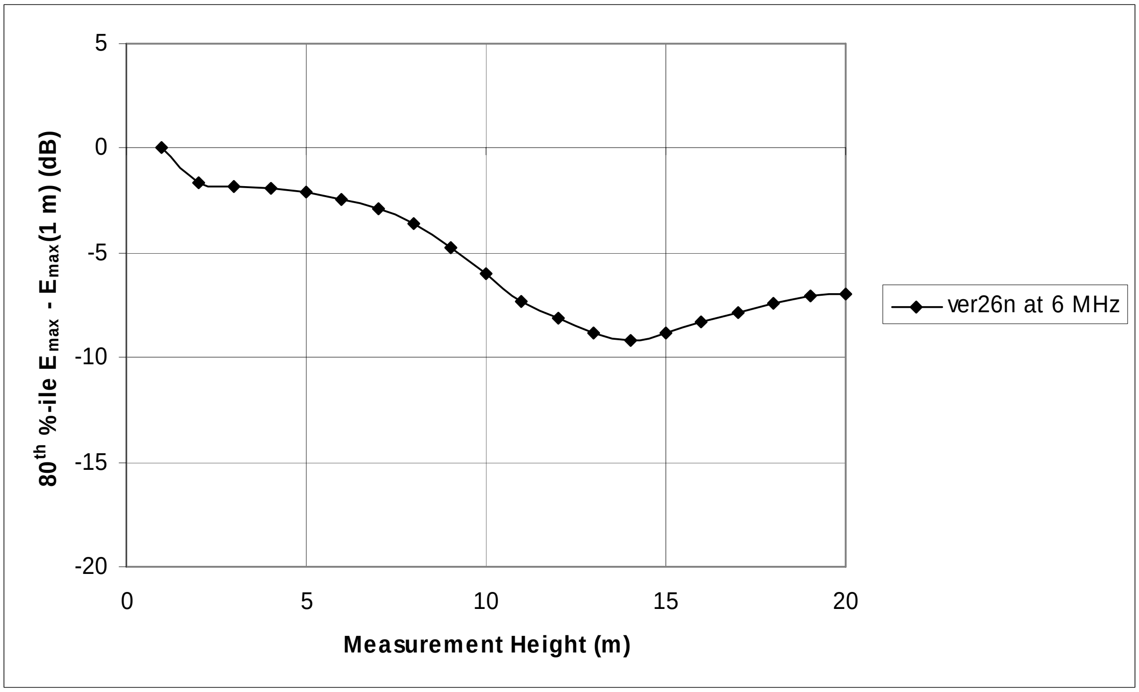


Figure A-35: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

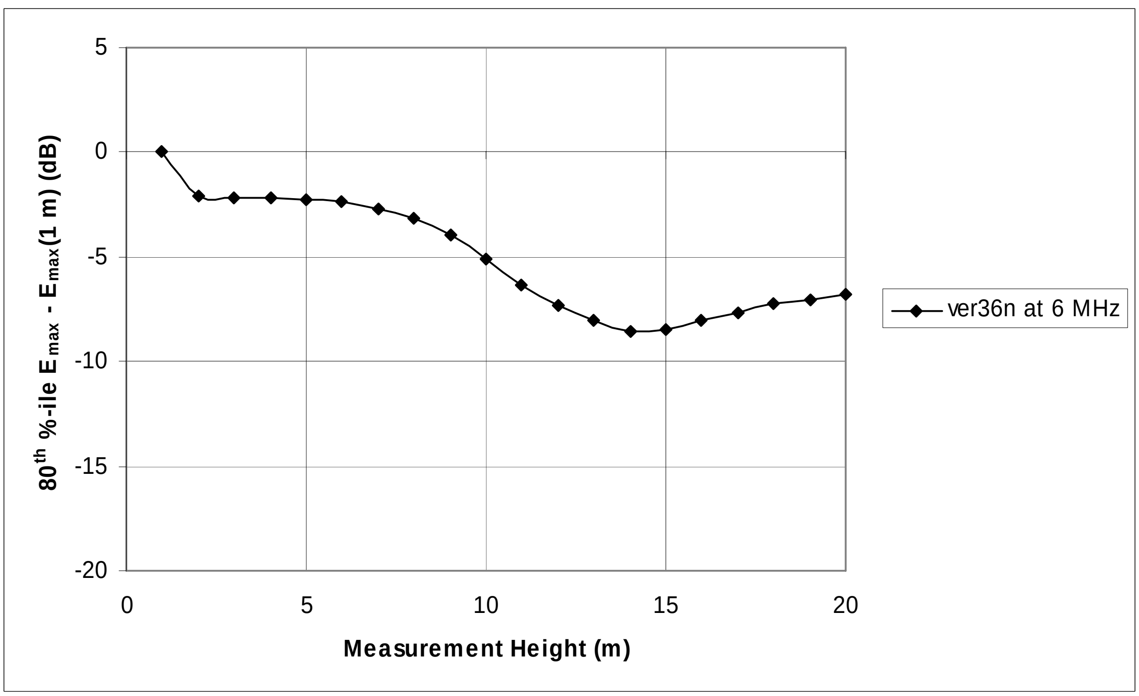


Figure A-36: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

8 MHz Plots

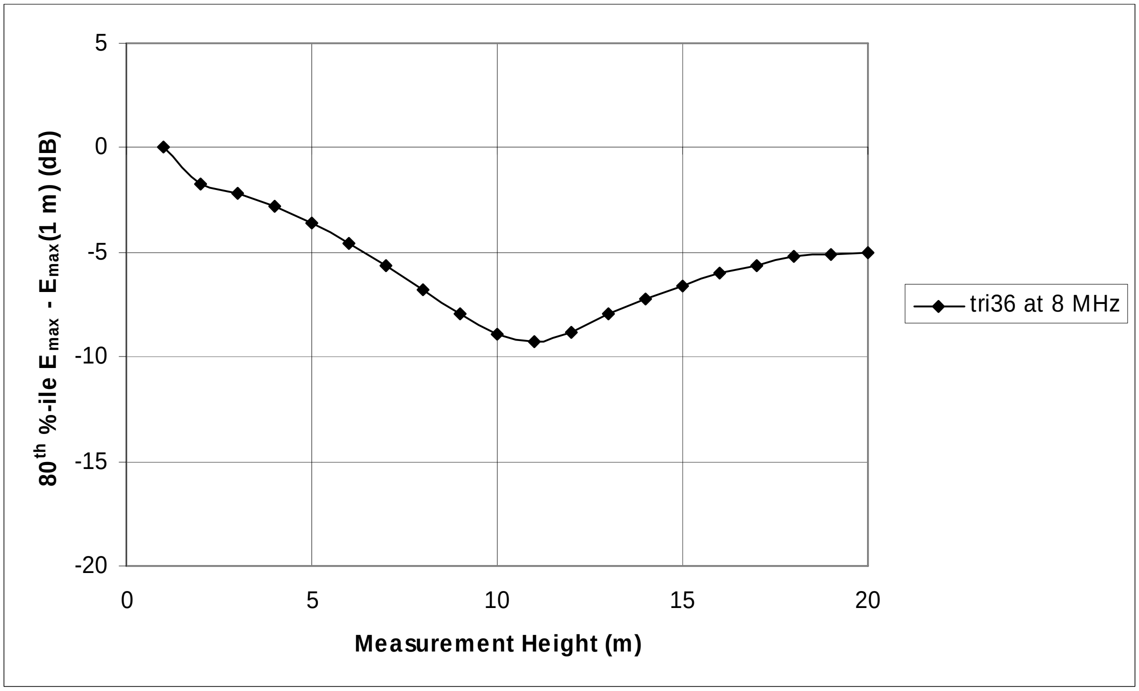


Figure A-37: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

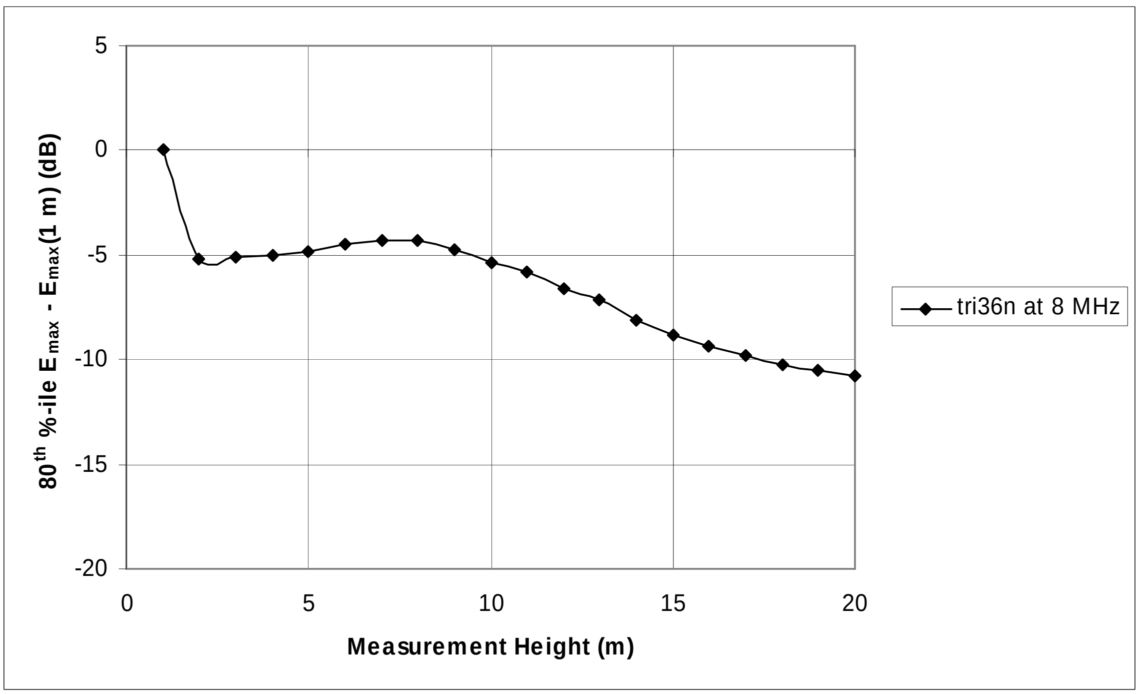


Figure A-38: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

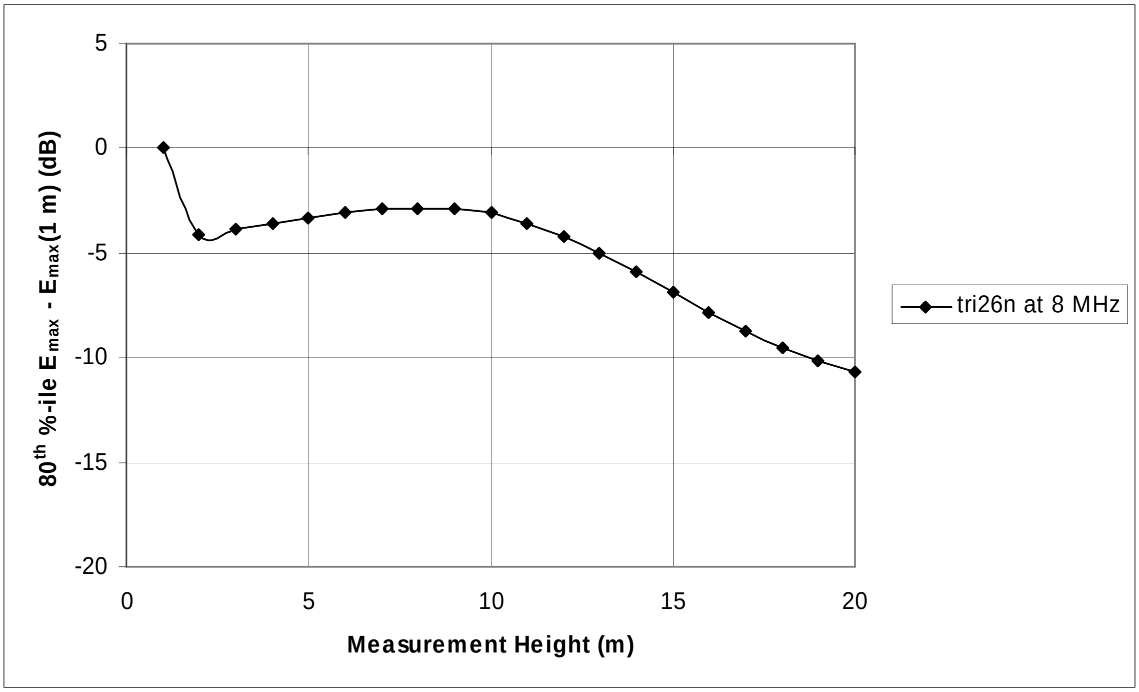


Figure A-39: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

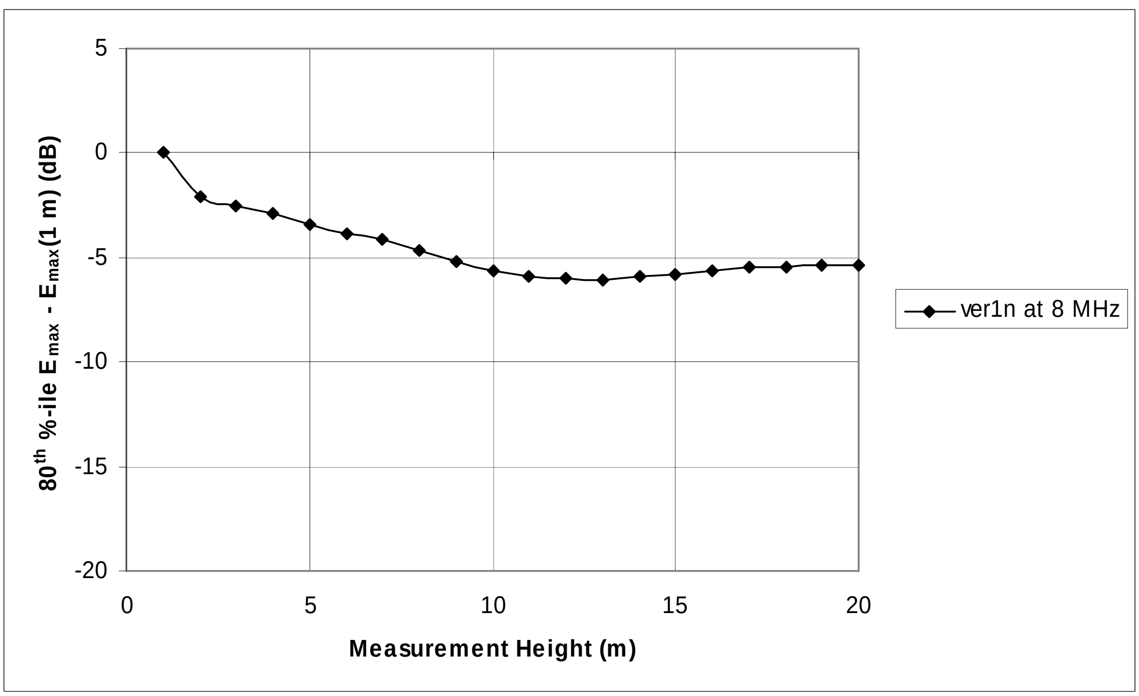


Figure A-40: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

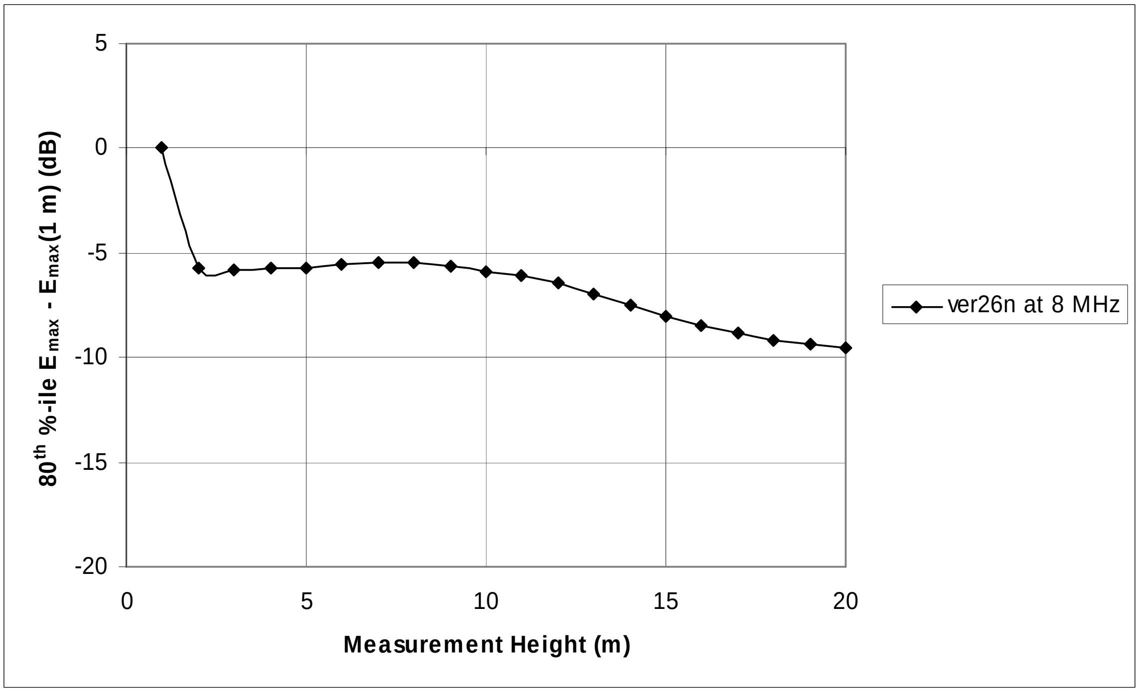


Figure A-41: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

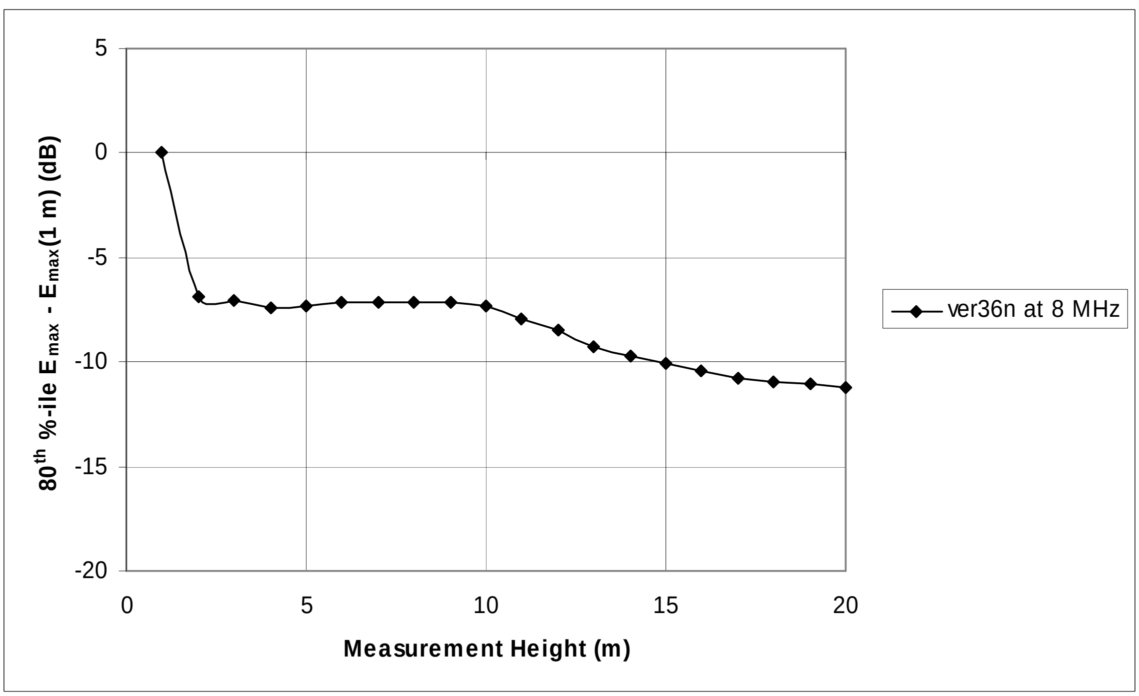


Figure A-42: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

10 MHz Plots

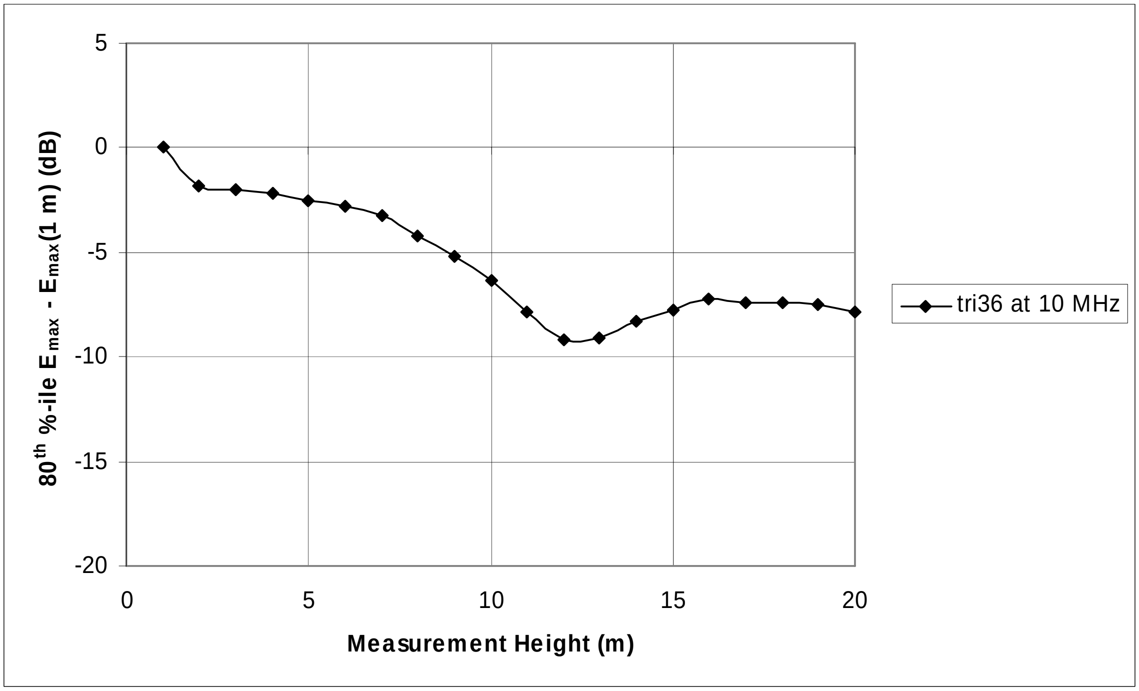


Figure A-43: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

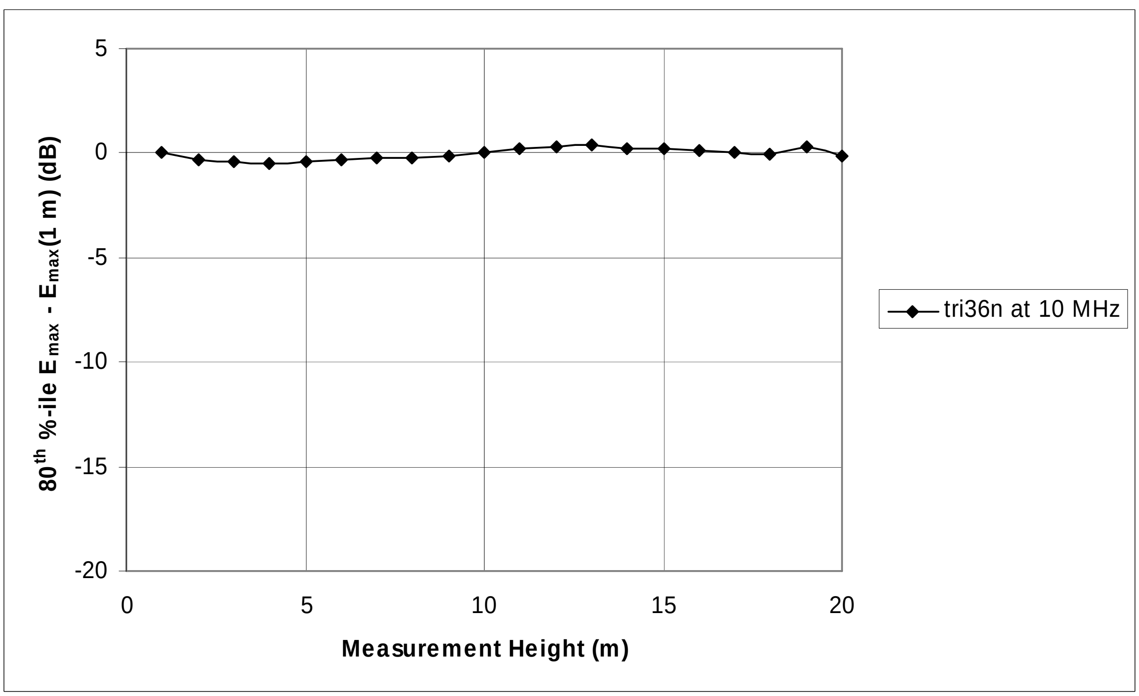


Figure A-44: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

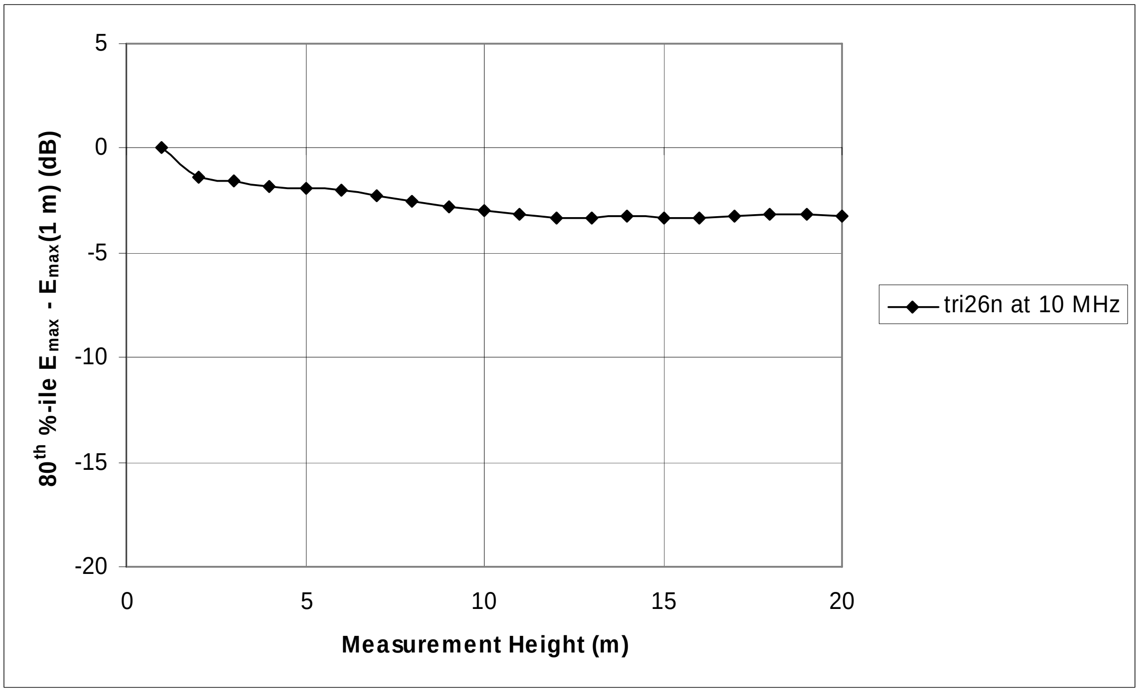


Figure A-45: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

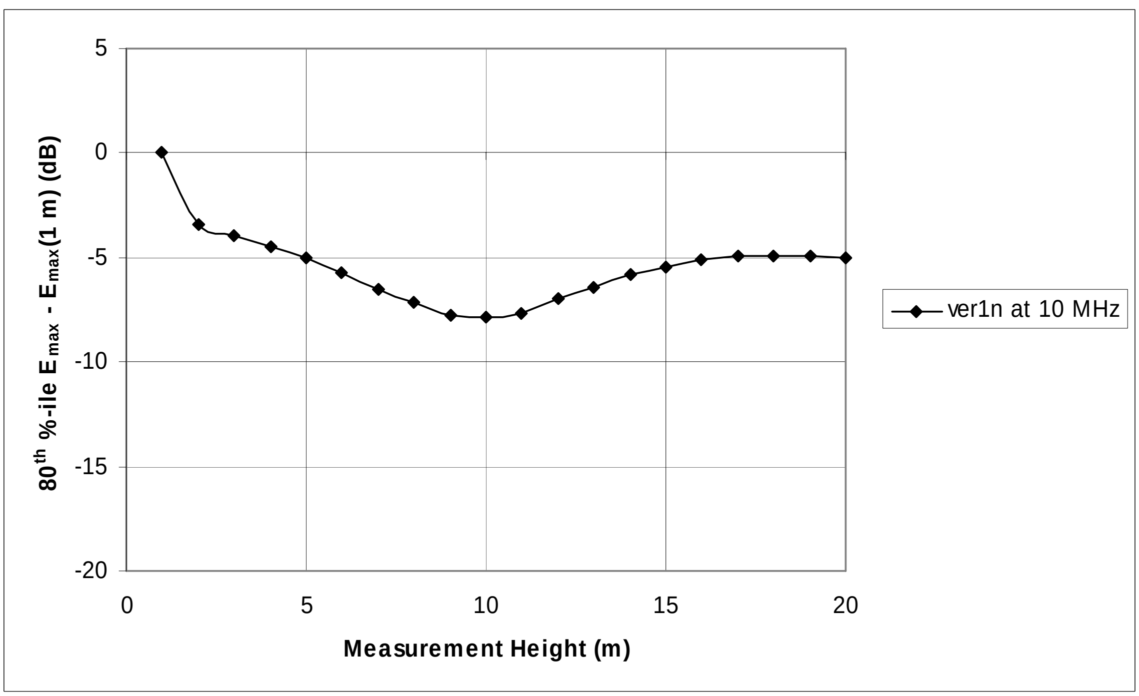


Figure A-46: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

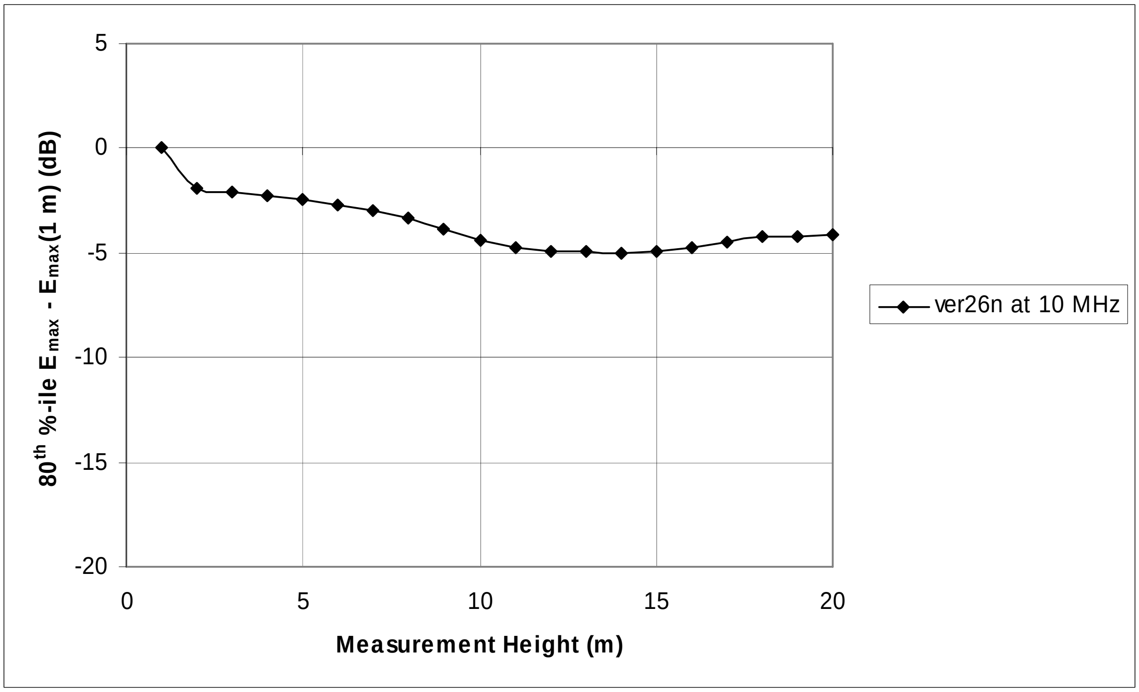


Figure A-47: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

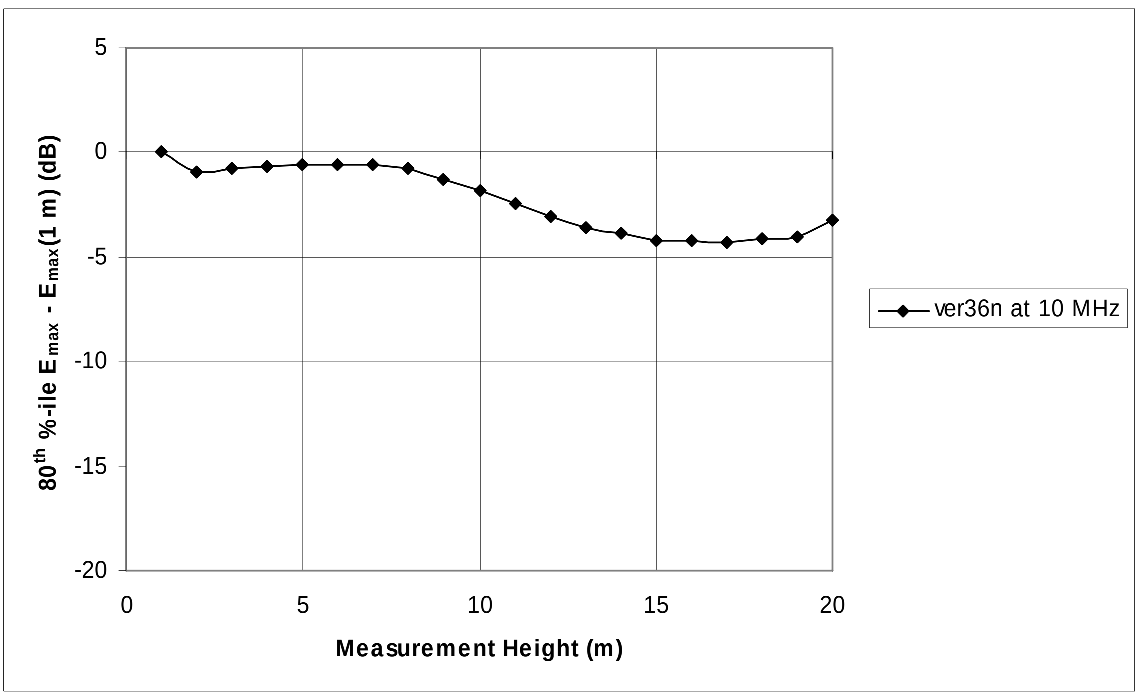


Figure A-48: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

12 MHz Plots

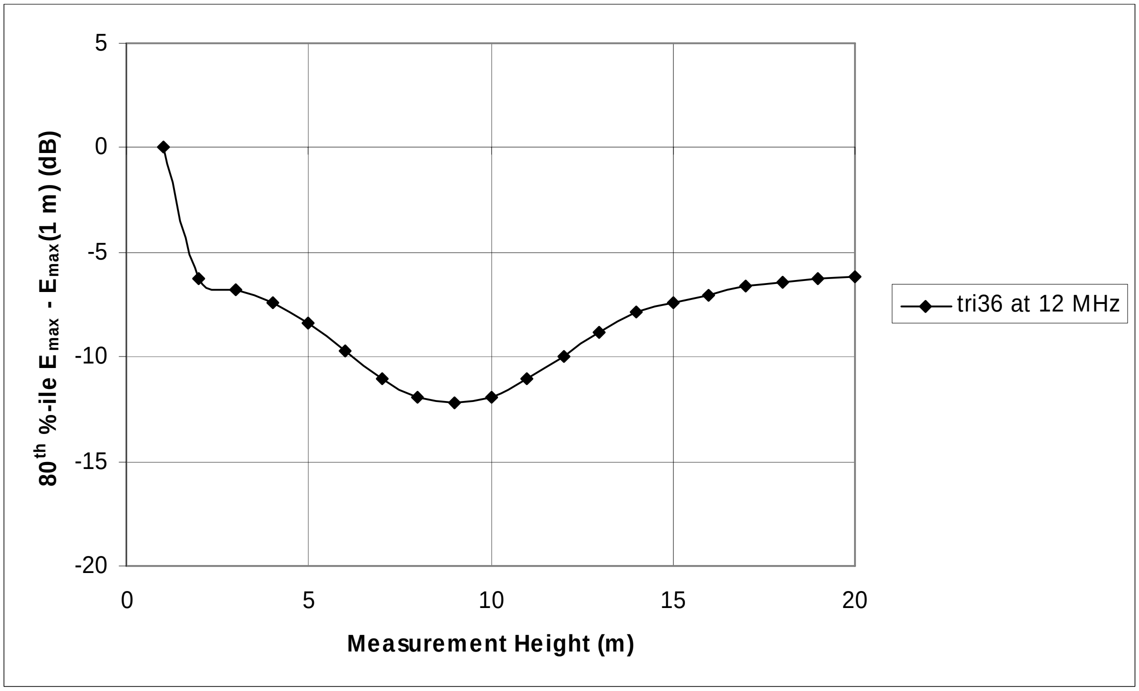


Figure A-49: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

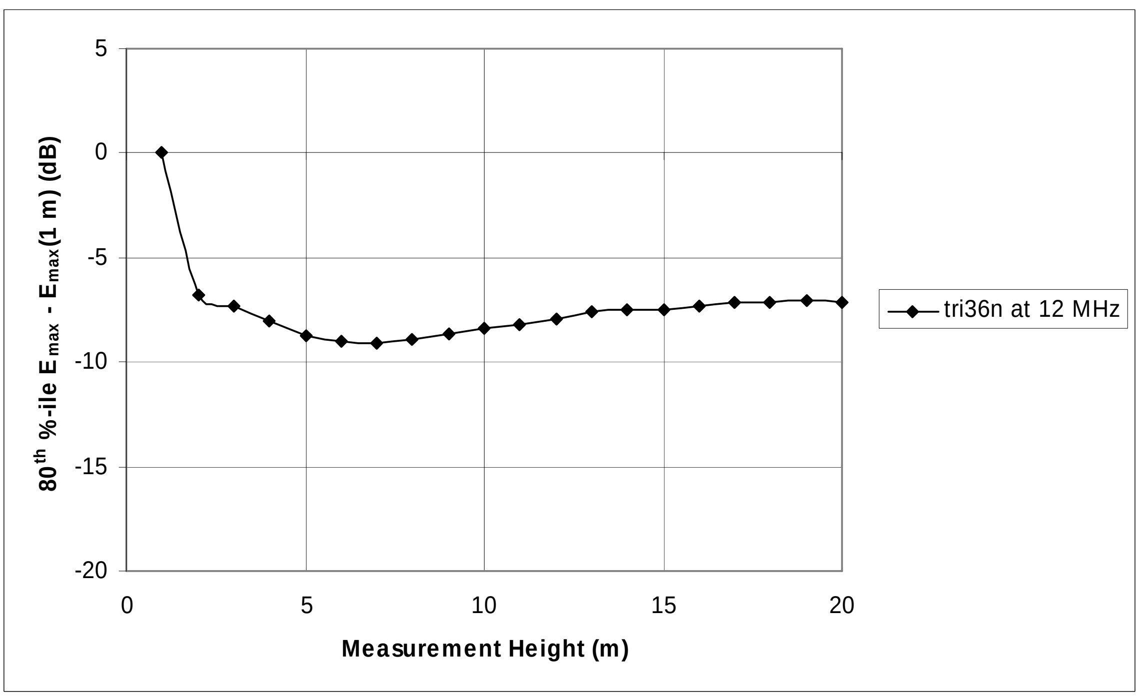


Figure A-50: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

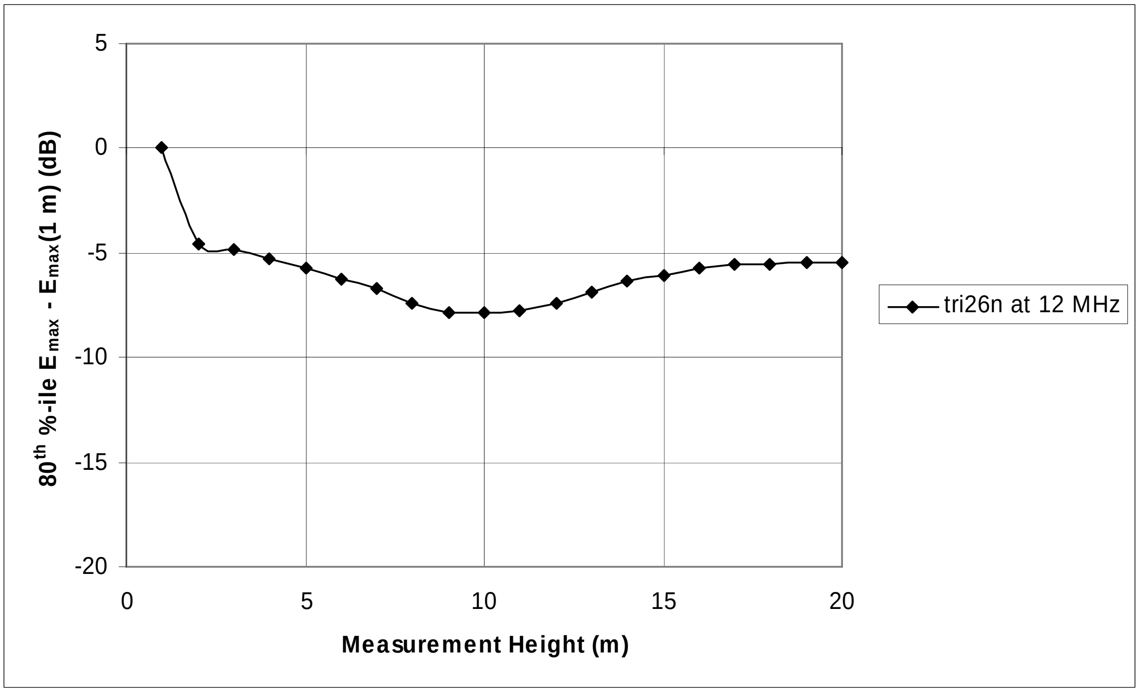


Figure A-51: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

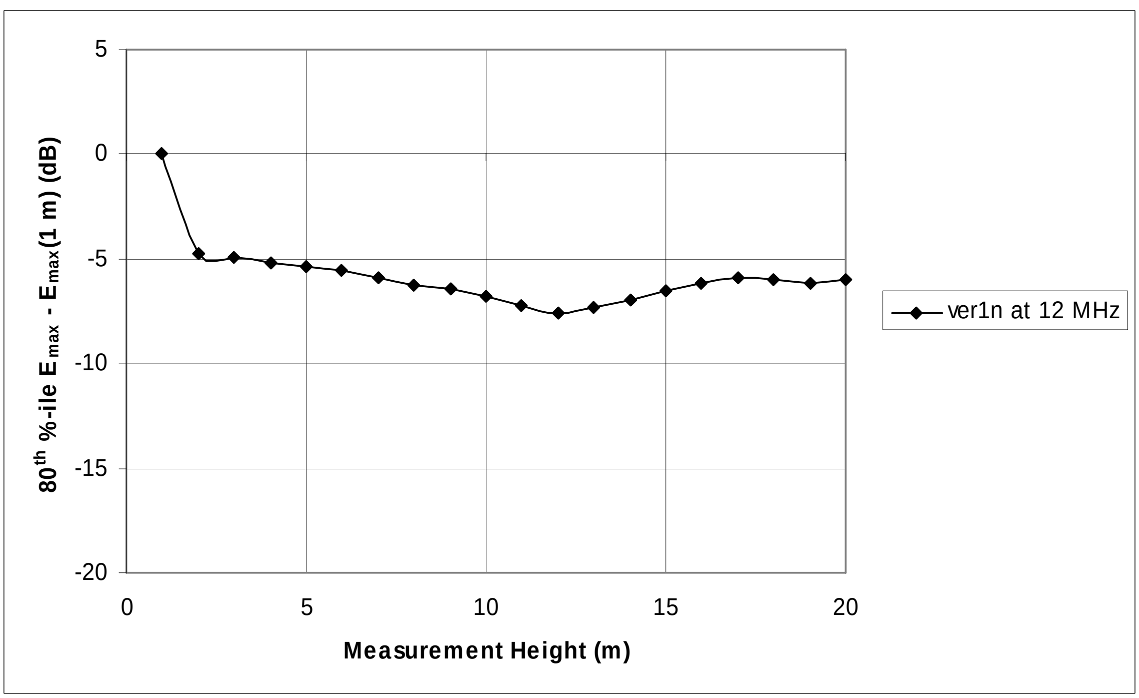


Figure A-52: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

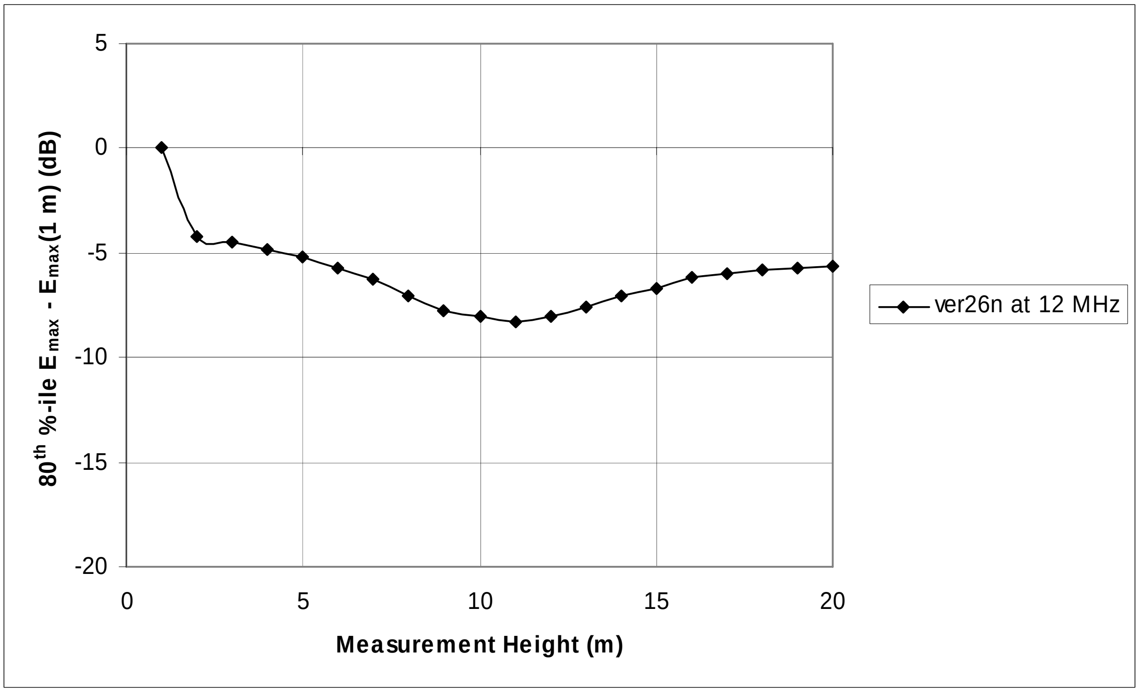


Figure A-53: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

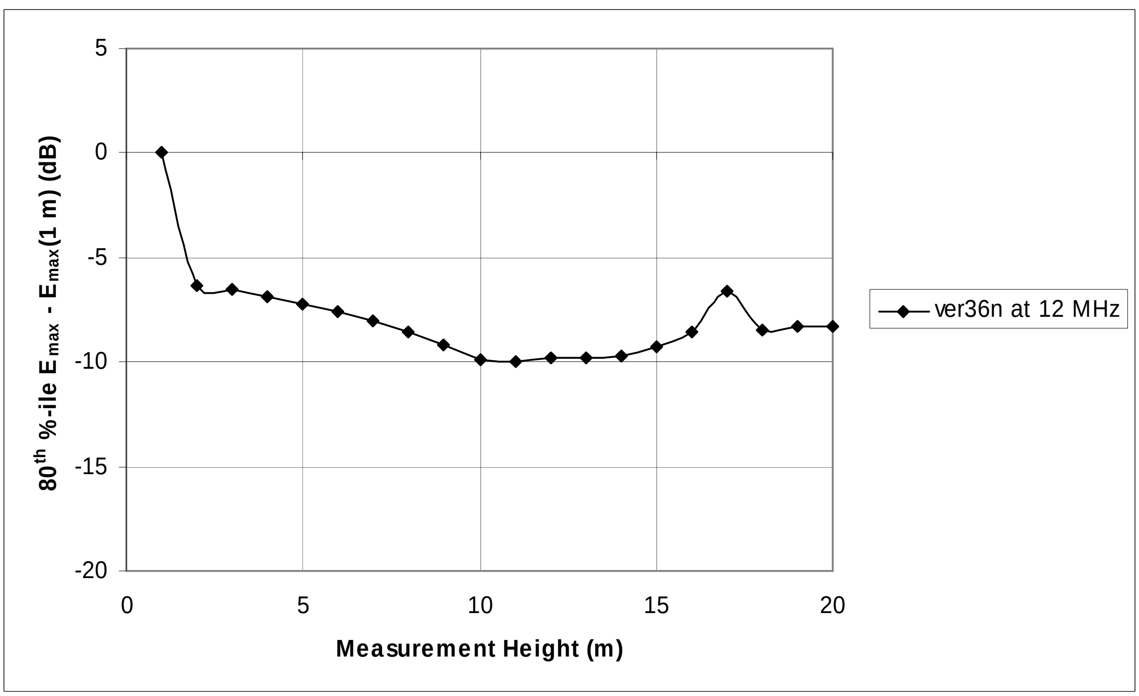


Figure A-54: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

14 MHz Plots

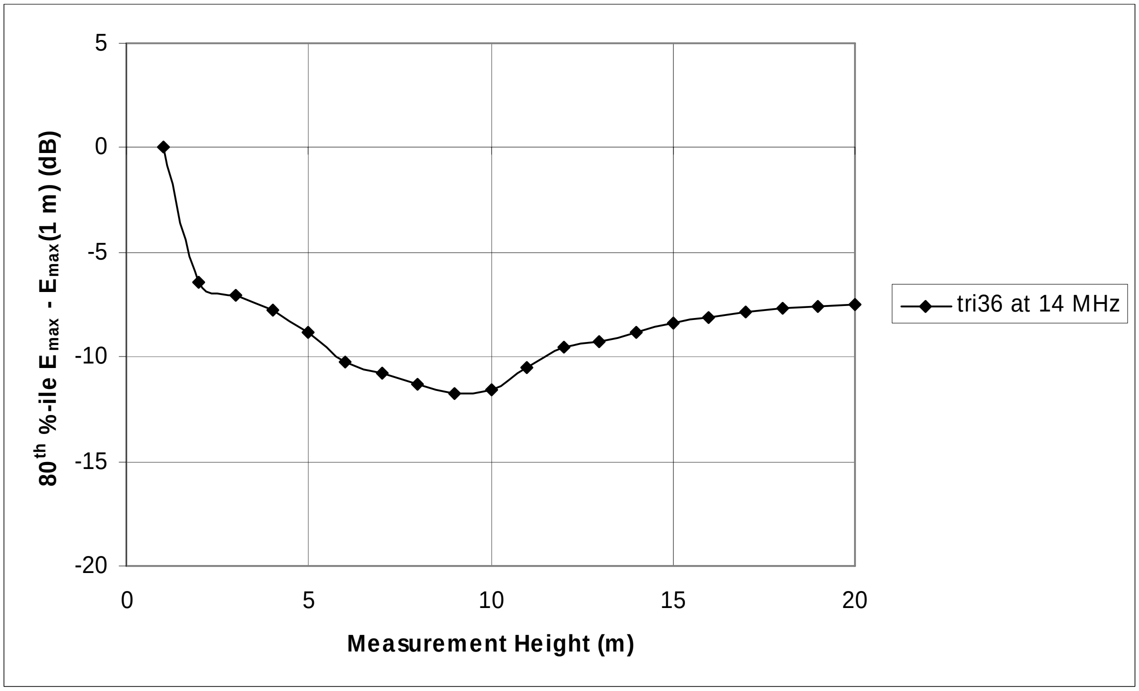


Figure A-55: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

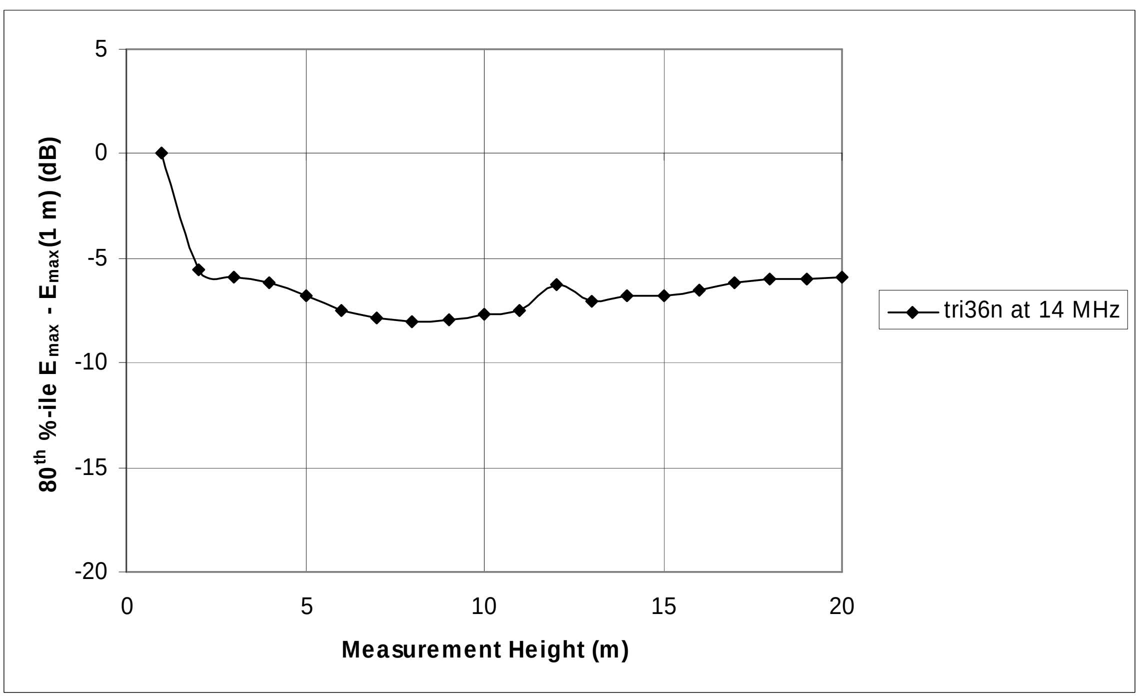


Figure A-56: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

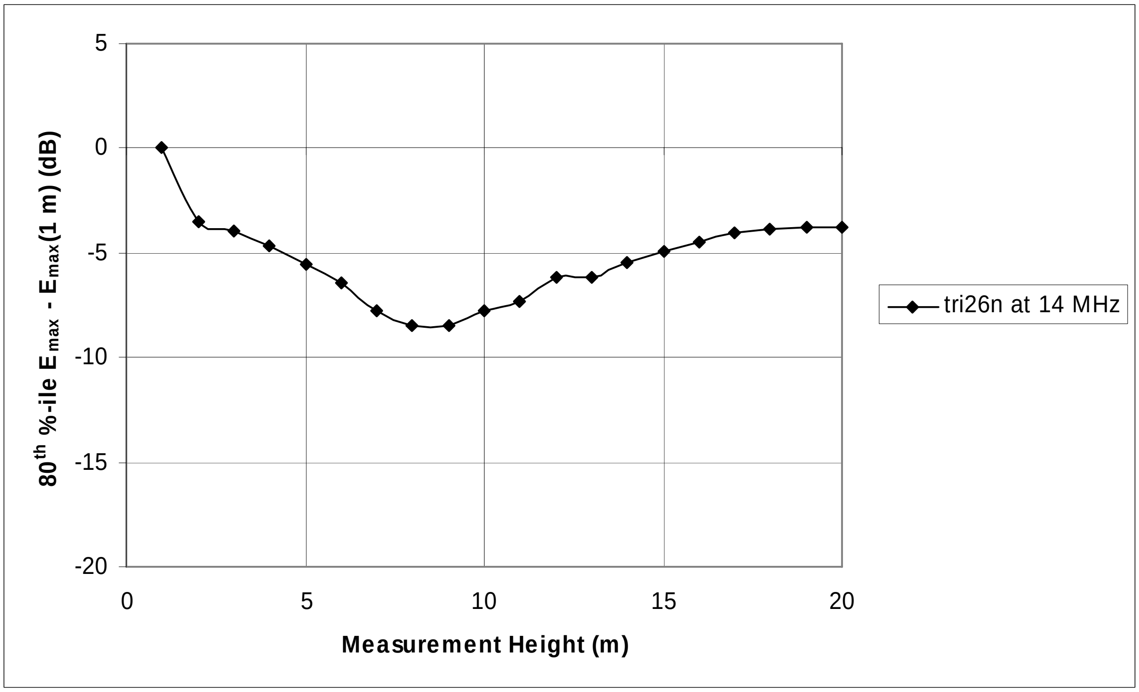


Figure A-57: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

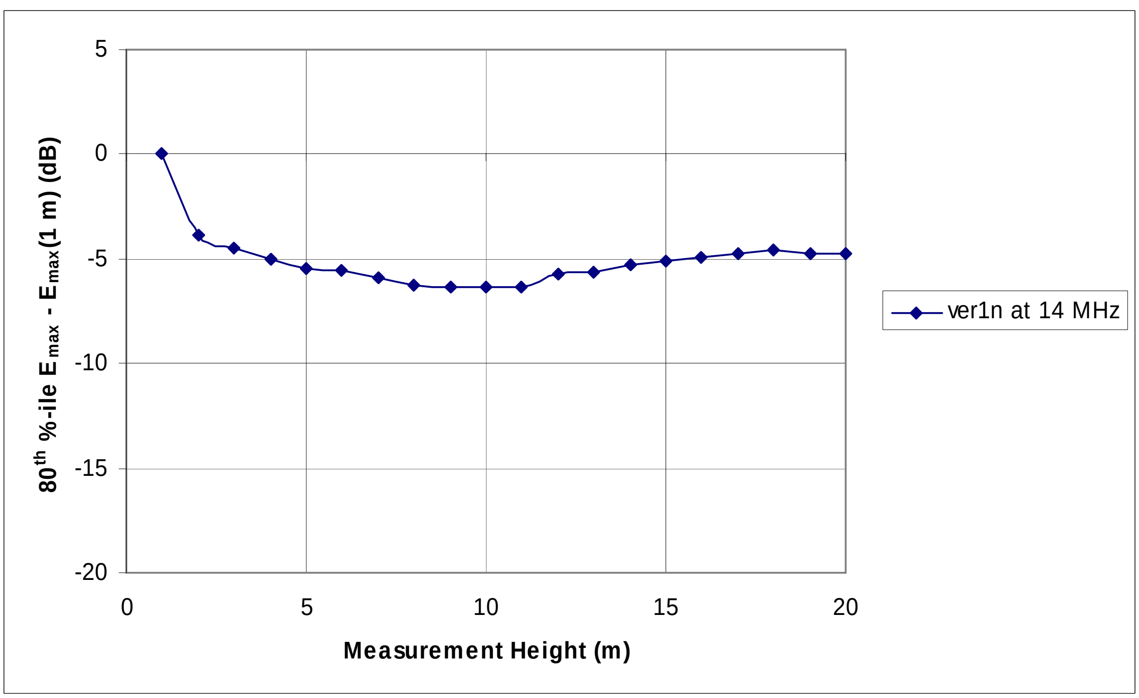


Figure A-58: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

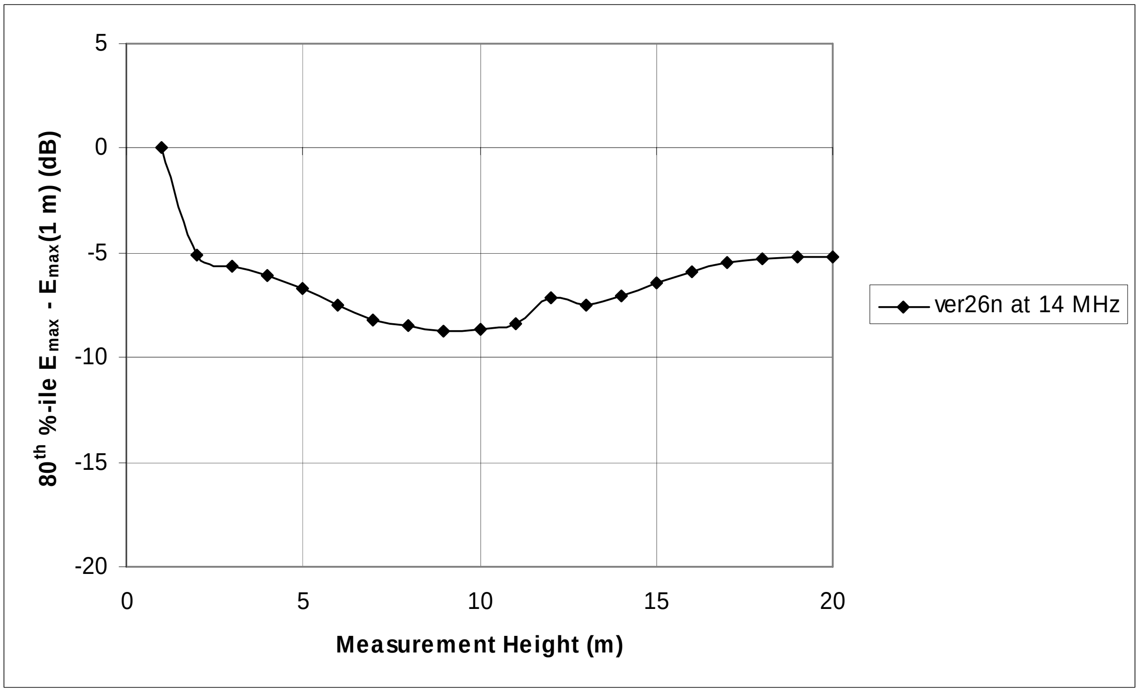


Figure A-59: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

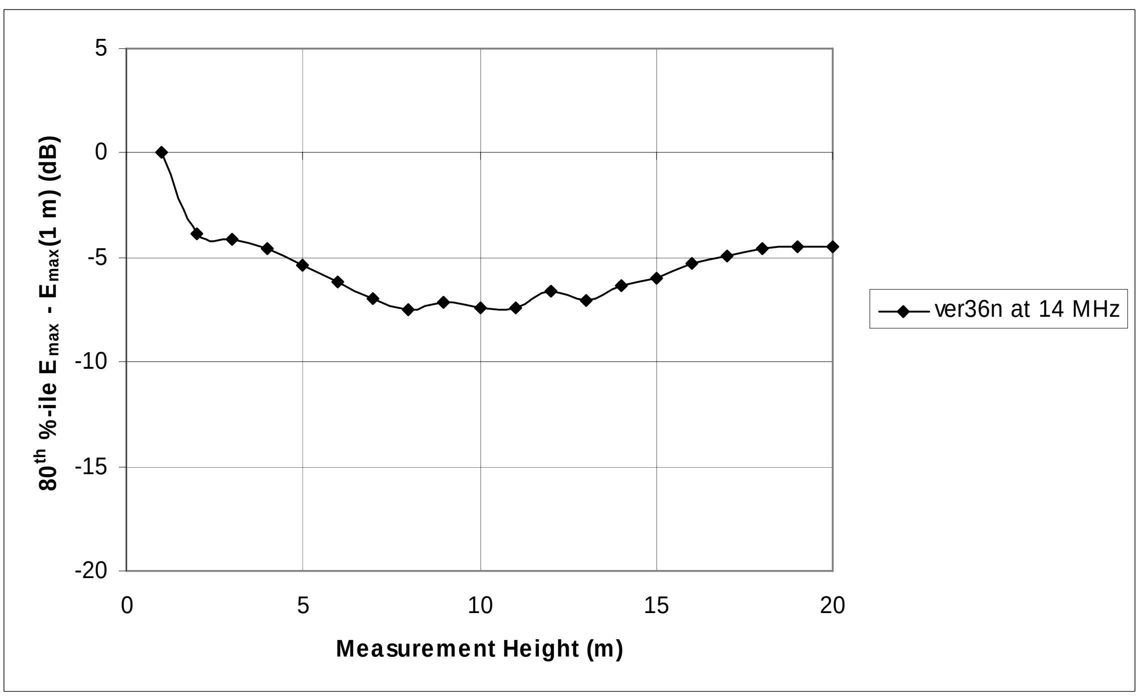


Figure A-60: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

16 MHz Plots

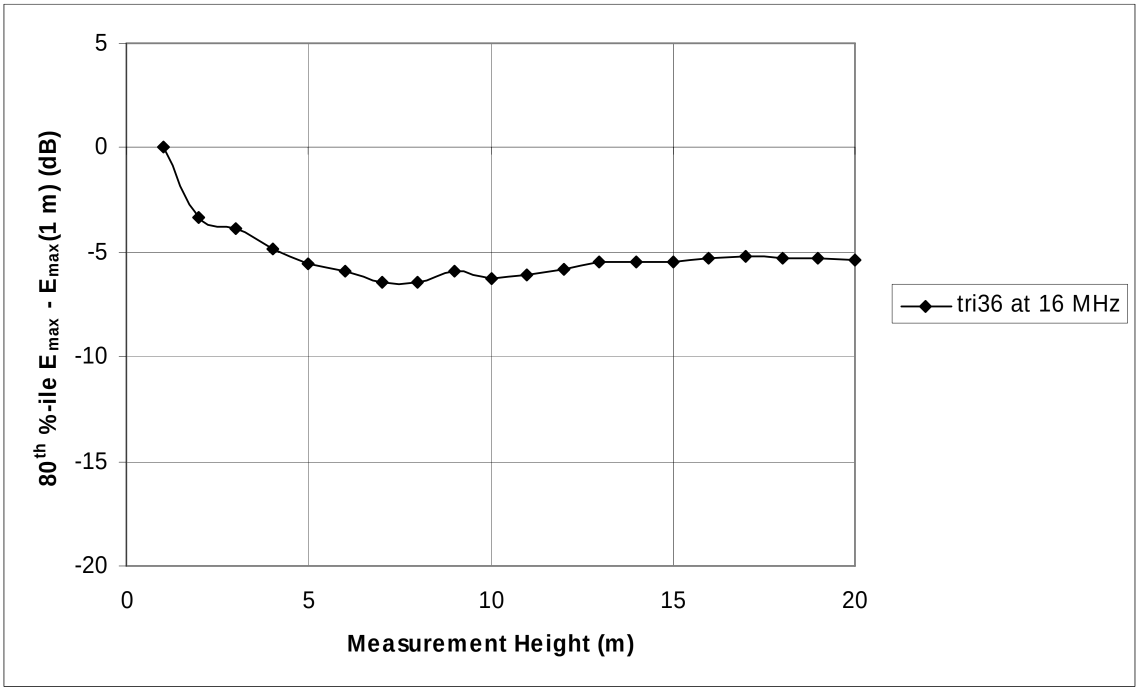


Figure A-61: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

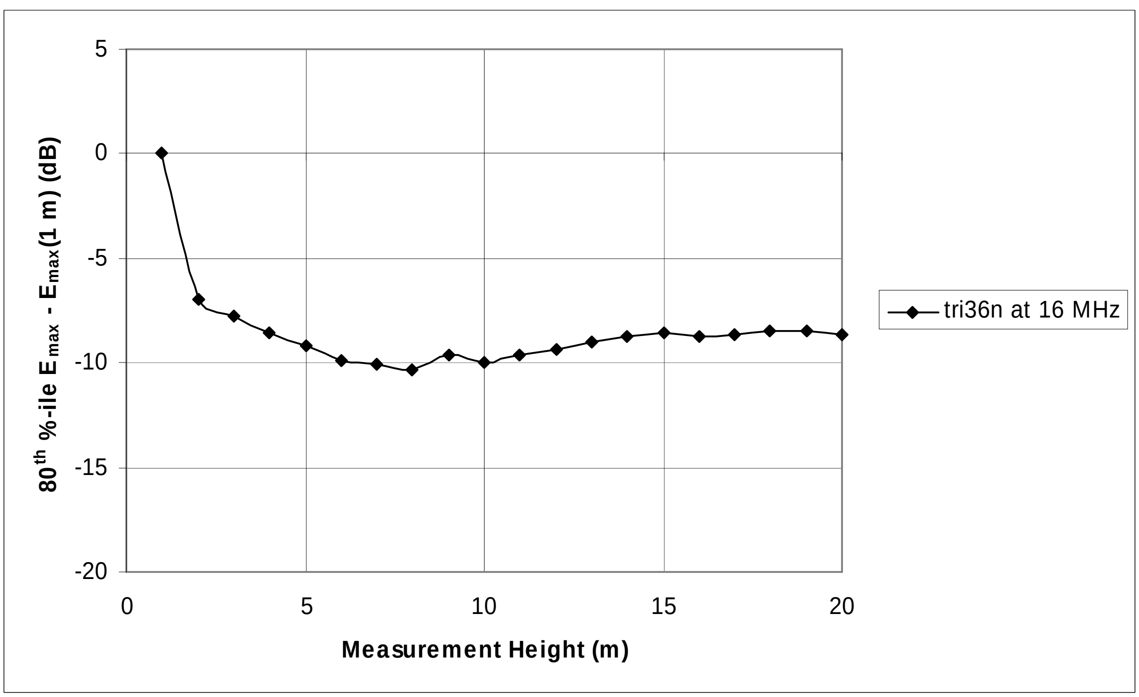


Figure A-62: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

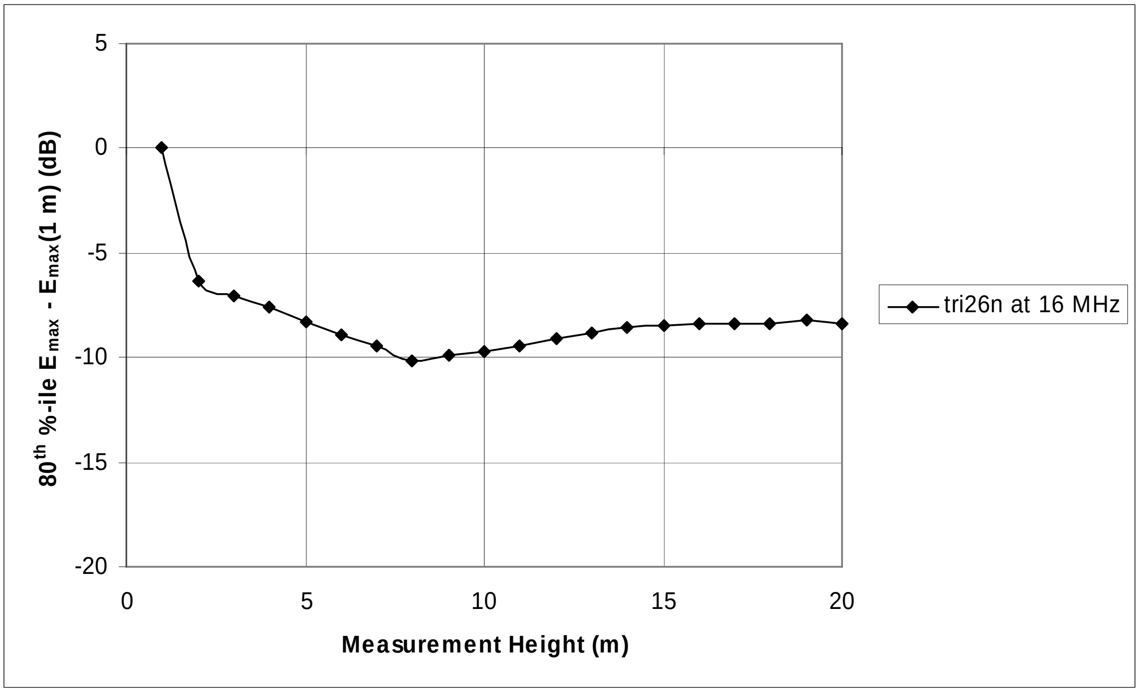


Figure A-63: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

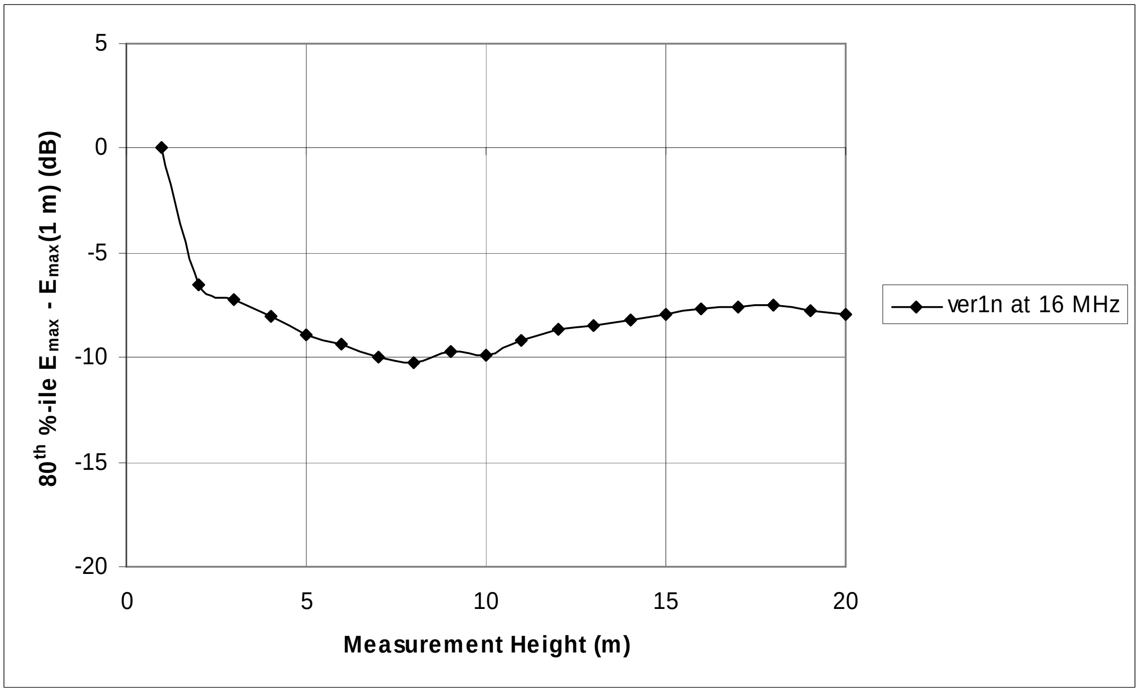


Figure A-64: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

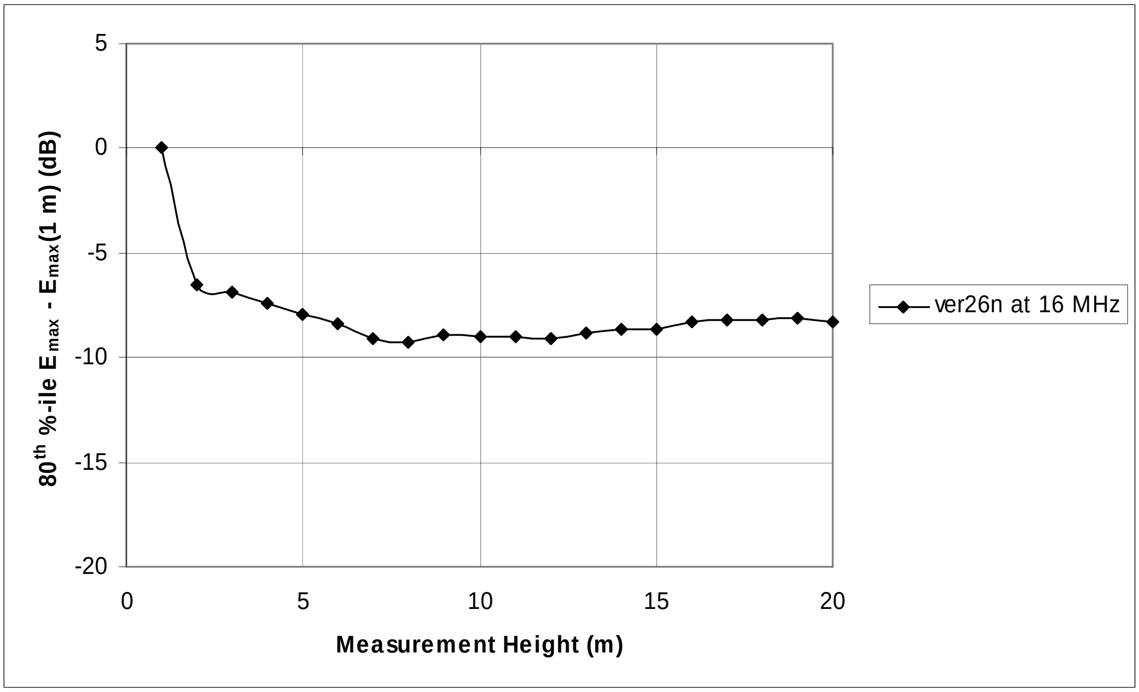


Figure A-65: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

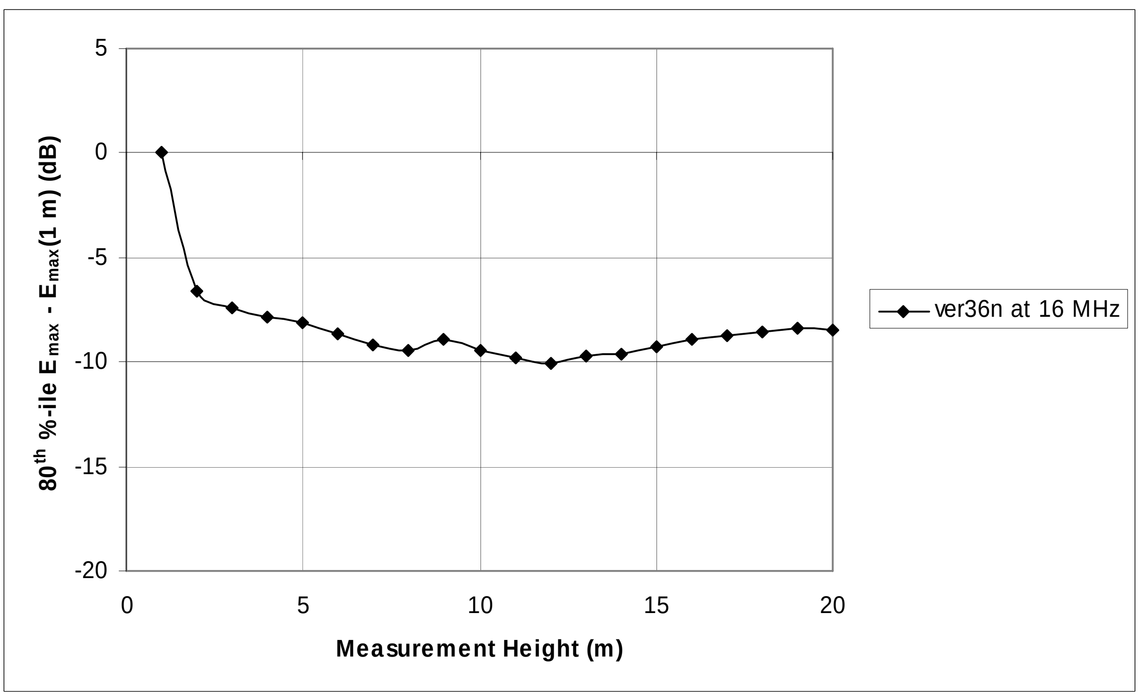


Figure A-66: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

18 MHz Plots

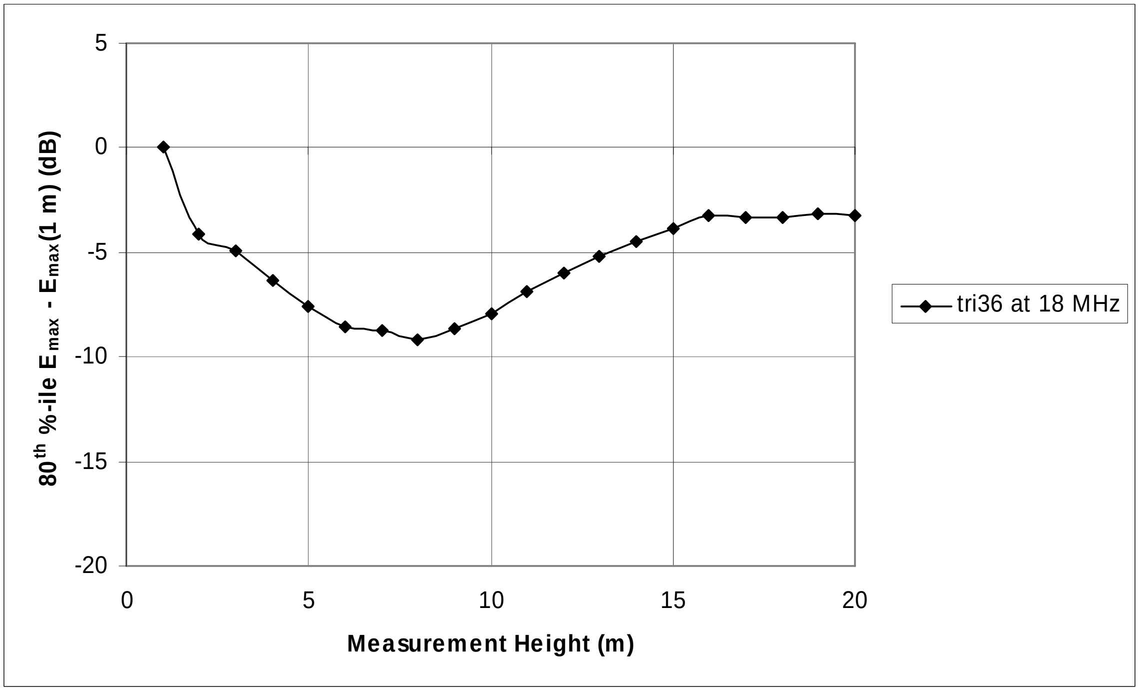


Figure A-67: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

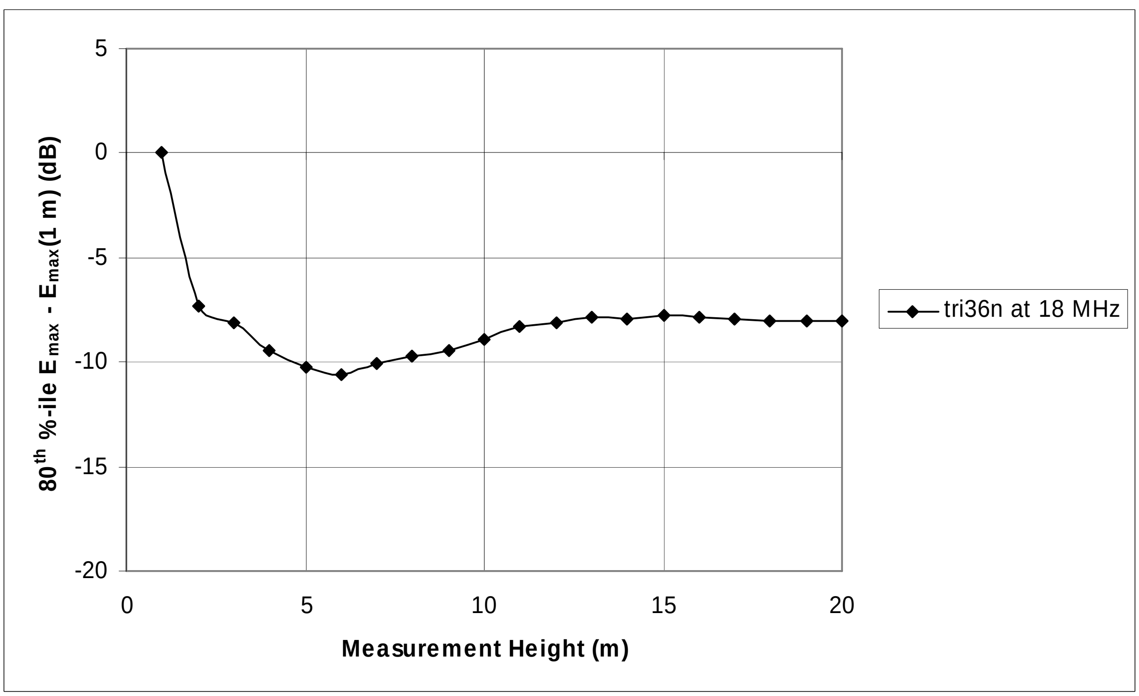


Figure A-68: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

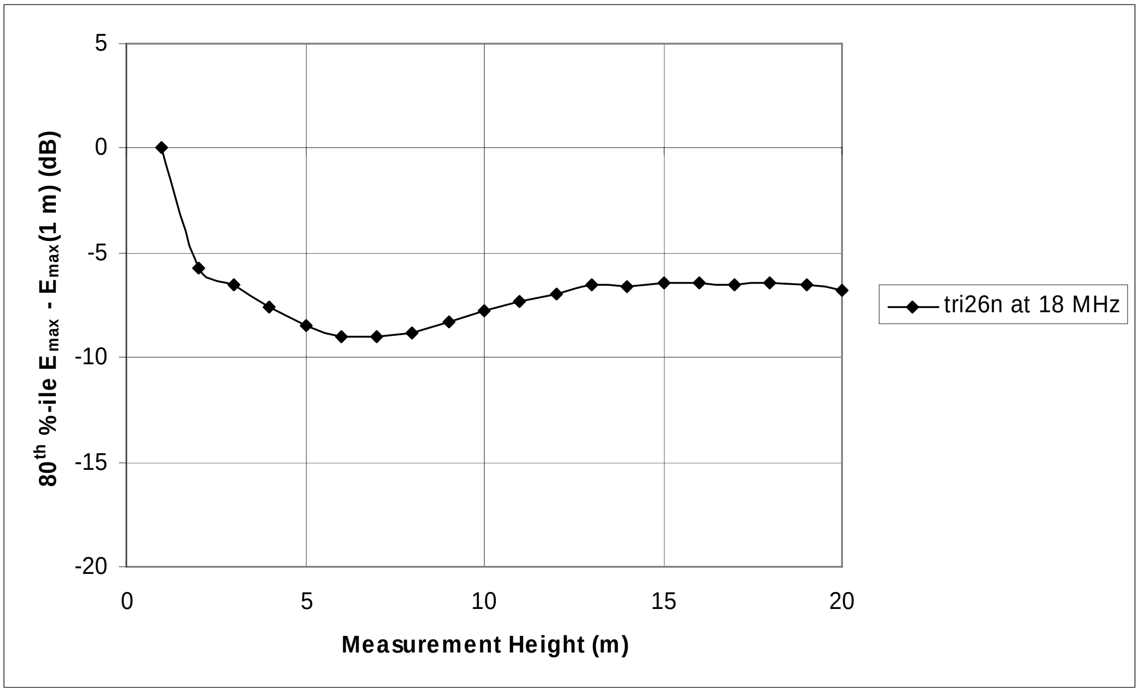


Figure A-69: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

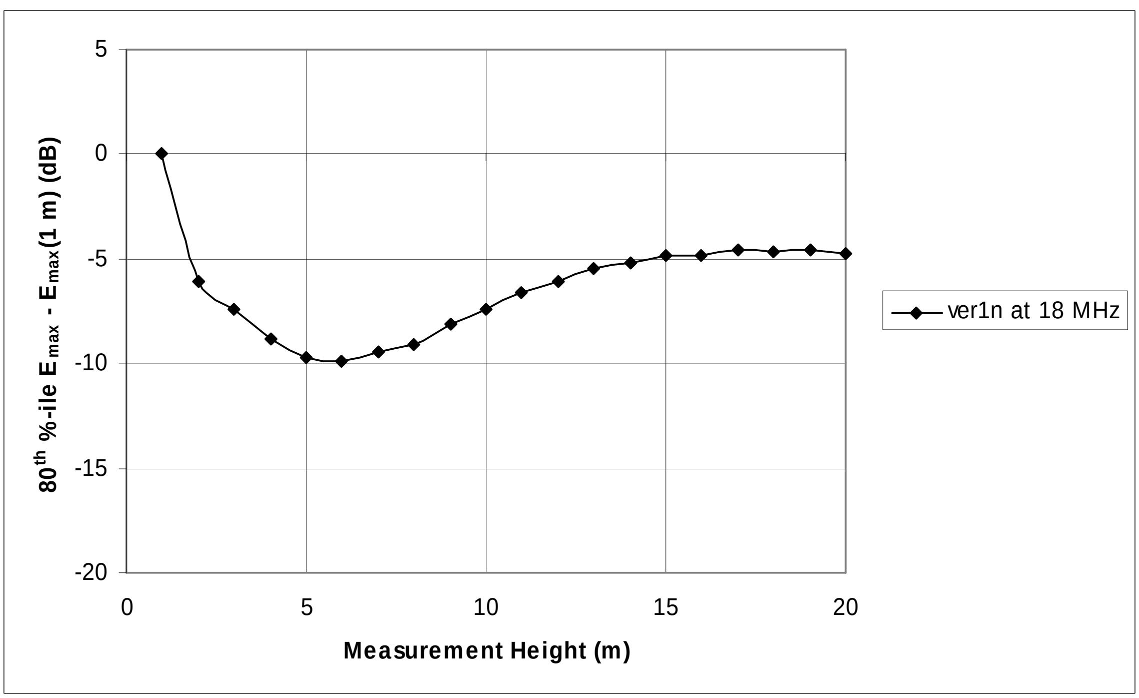


Figure A-70: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

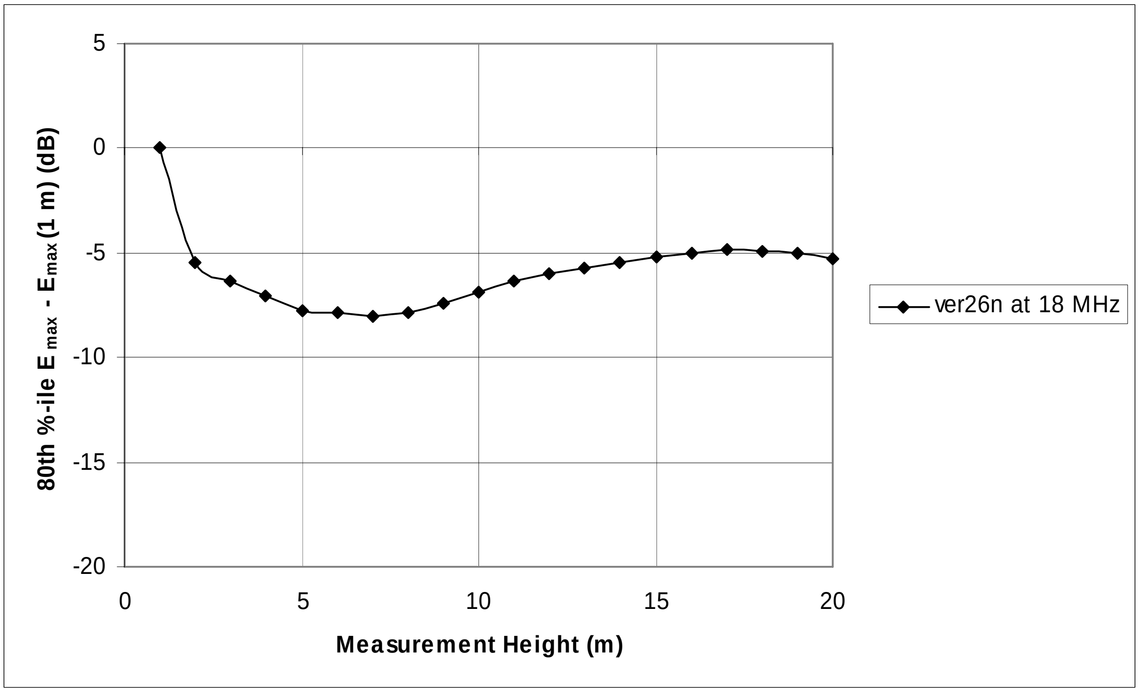


Figure A-71: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

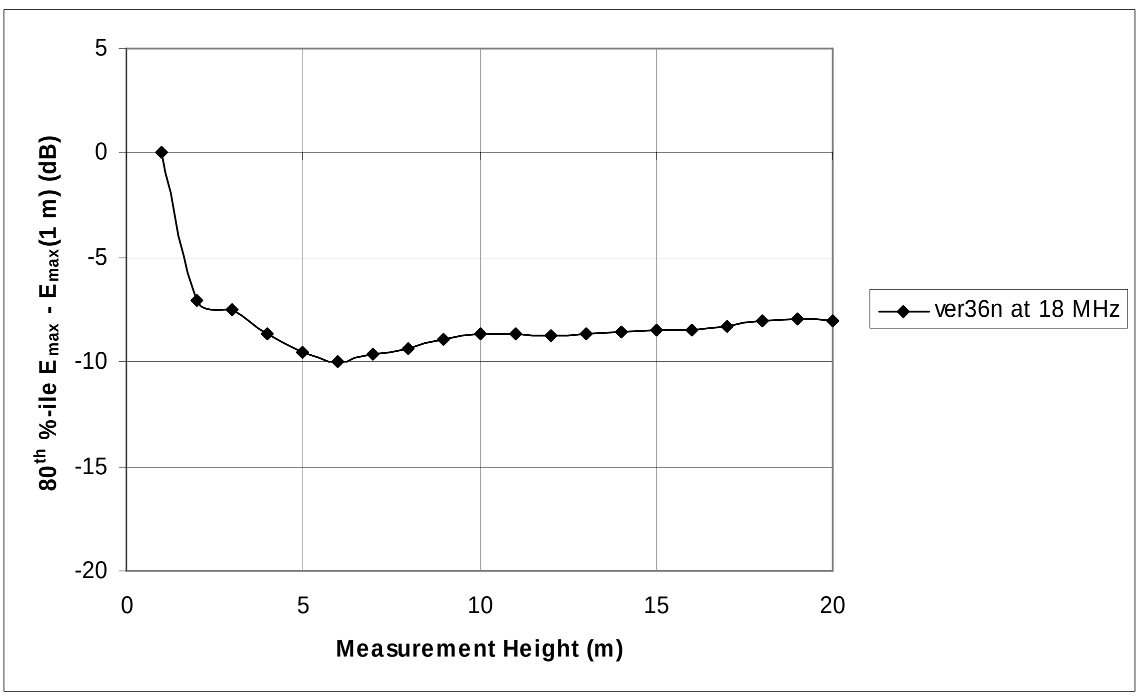


Figure A-72: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

20 MHz Plots

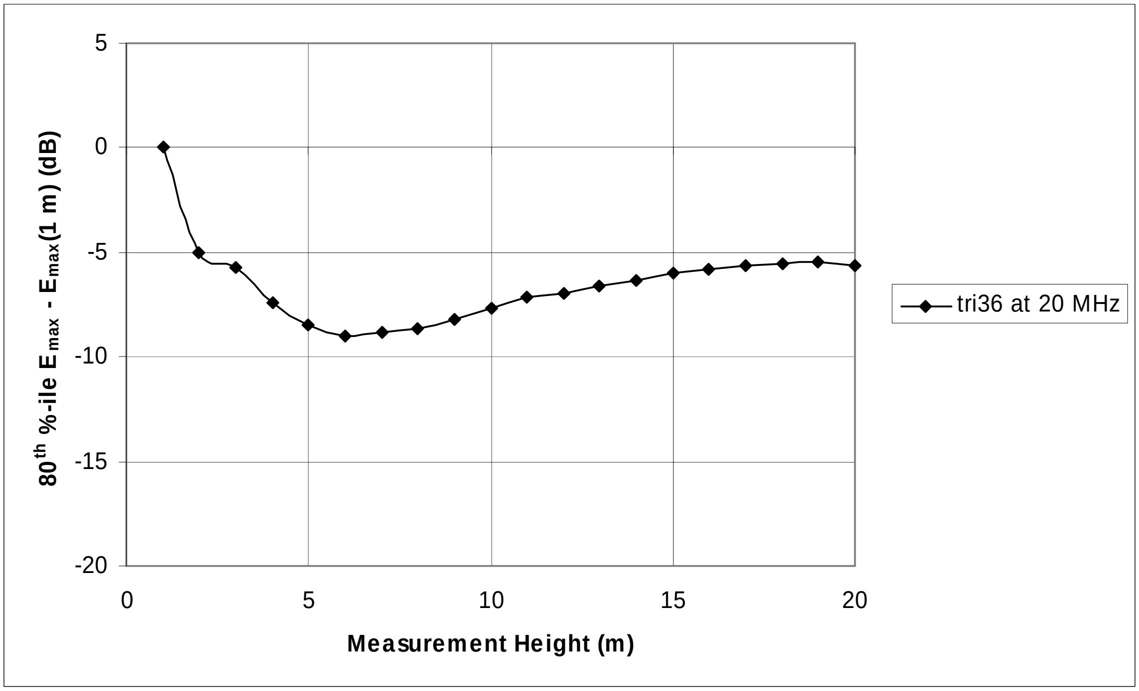


Figure A-73: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

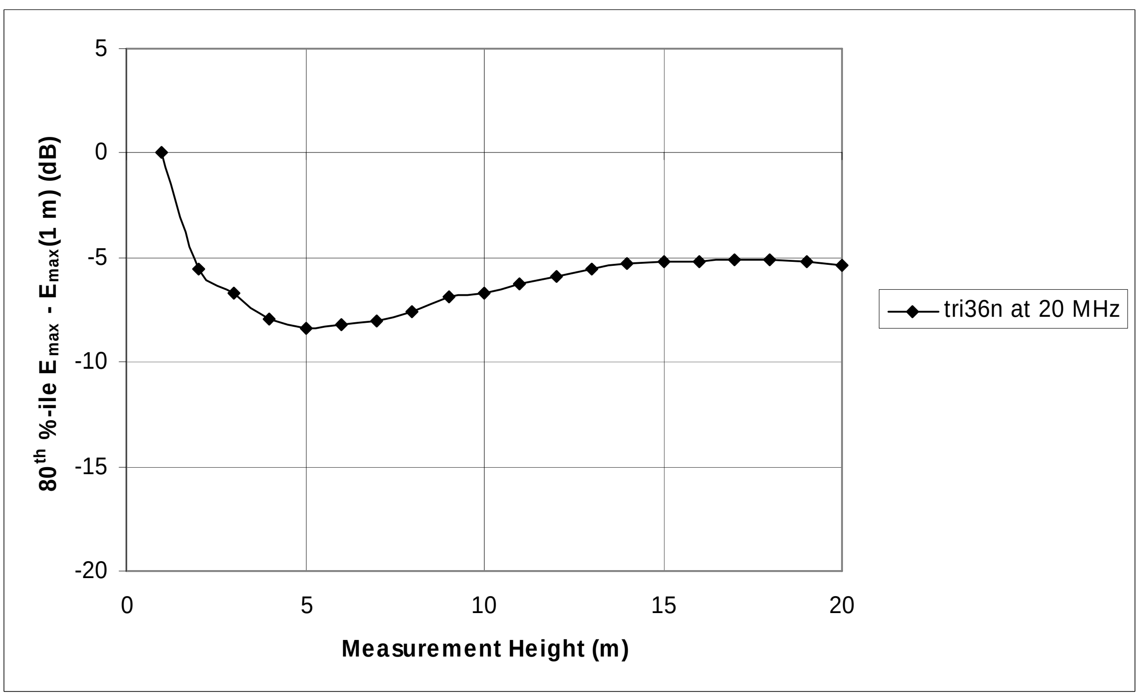


Figure A-74: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

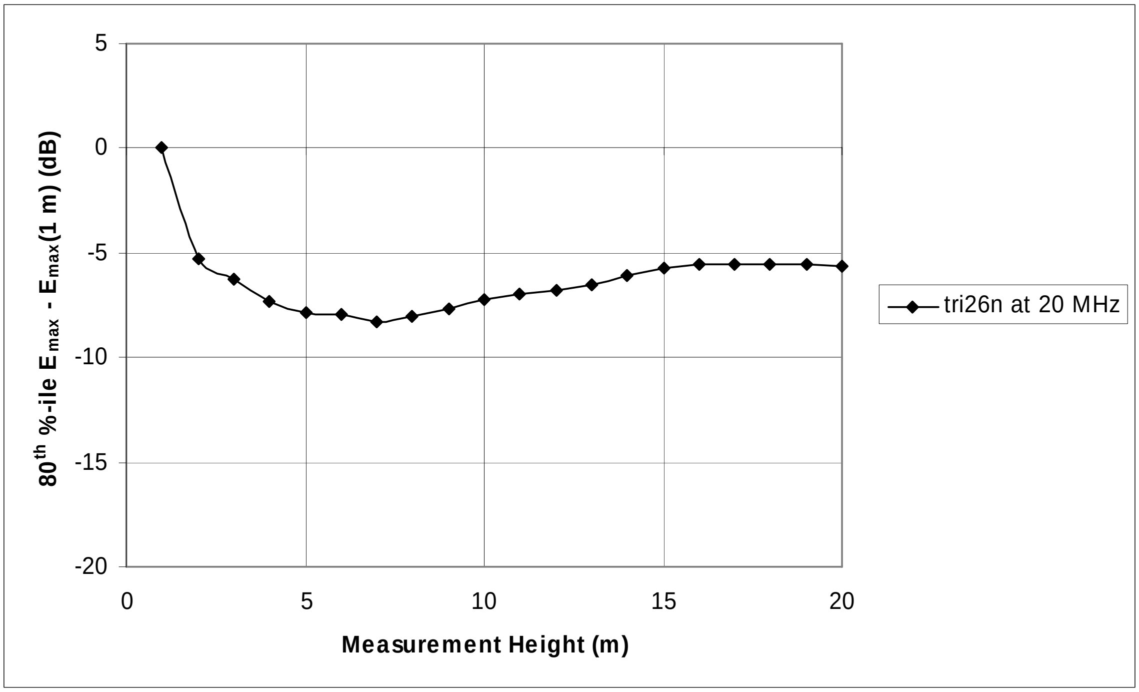


Figure A-75: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

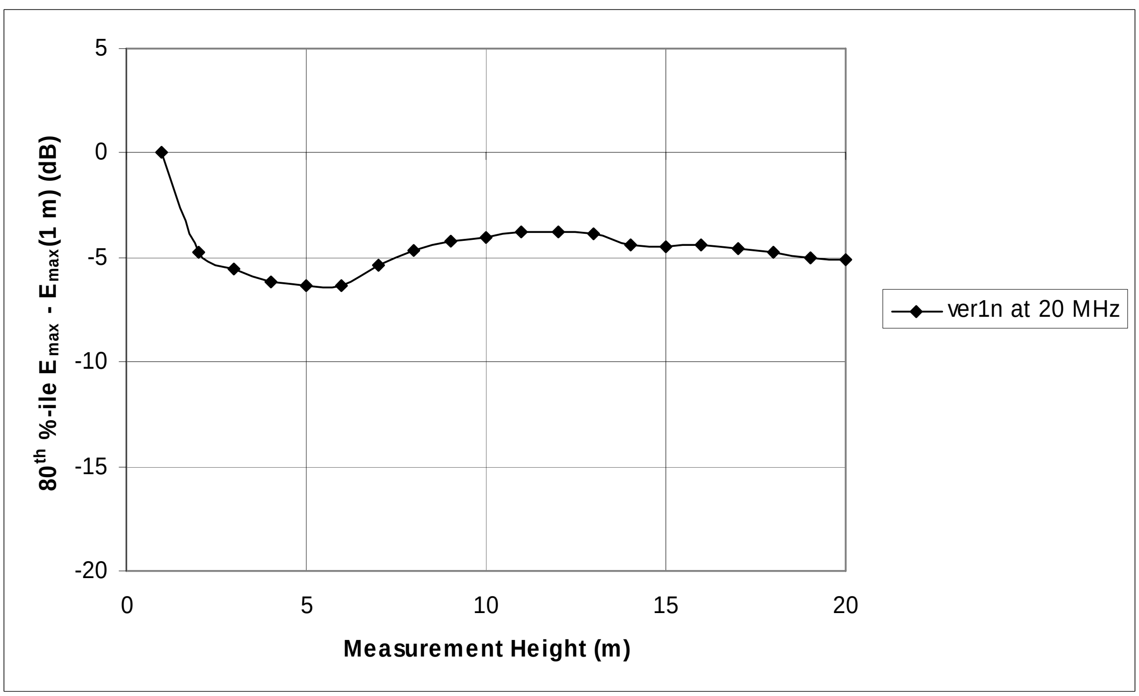


Figure A-76: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

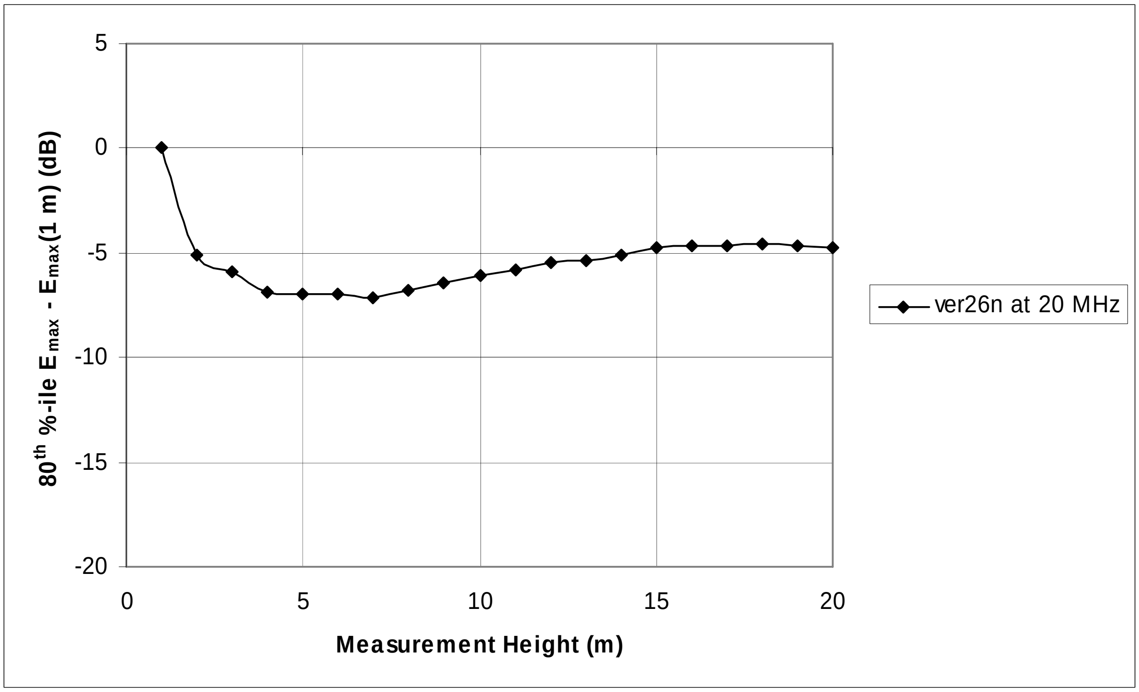


Figure A-77: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

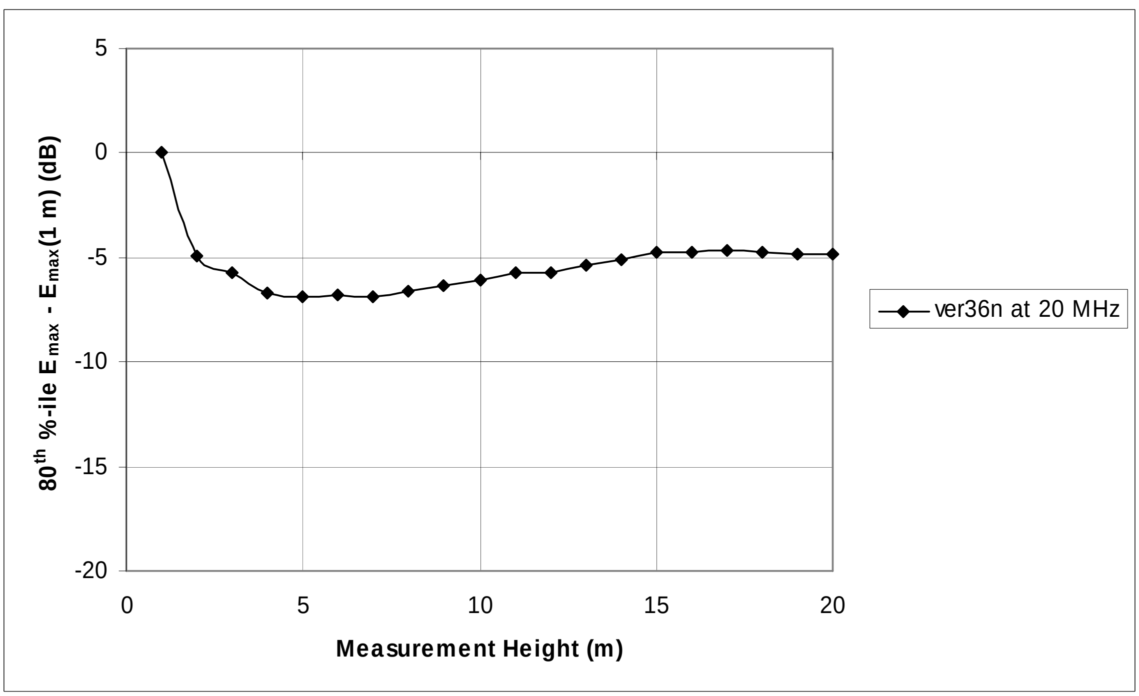


Figure A-78: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

22 MHz Plots

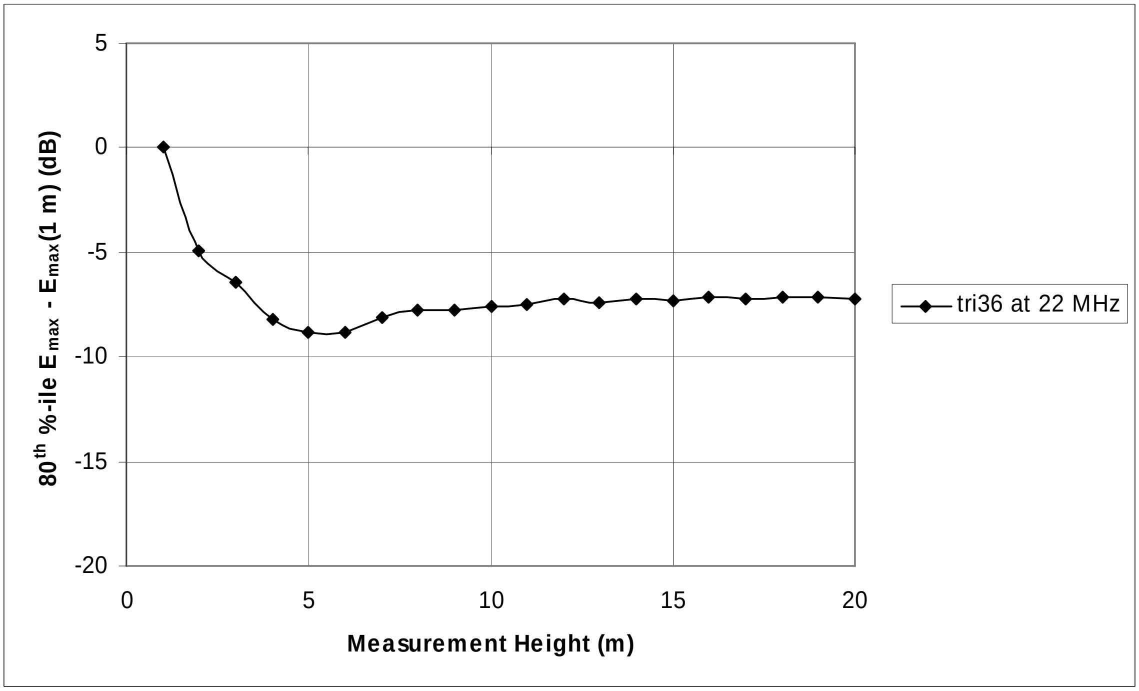


Figure A-79: 80^{th} percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

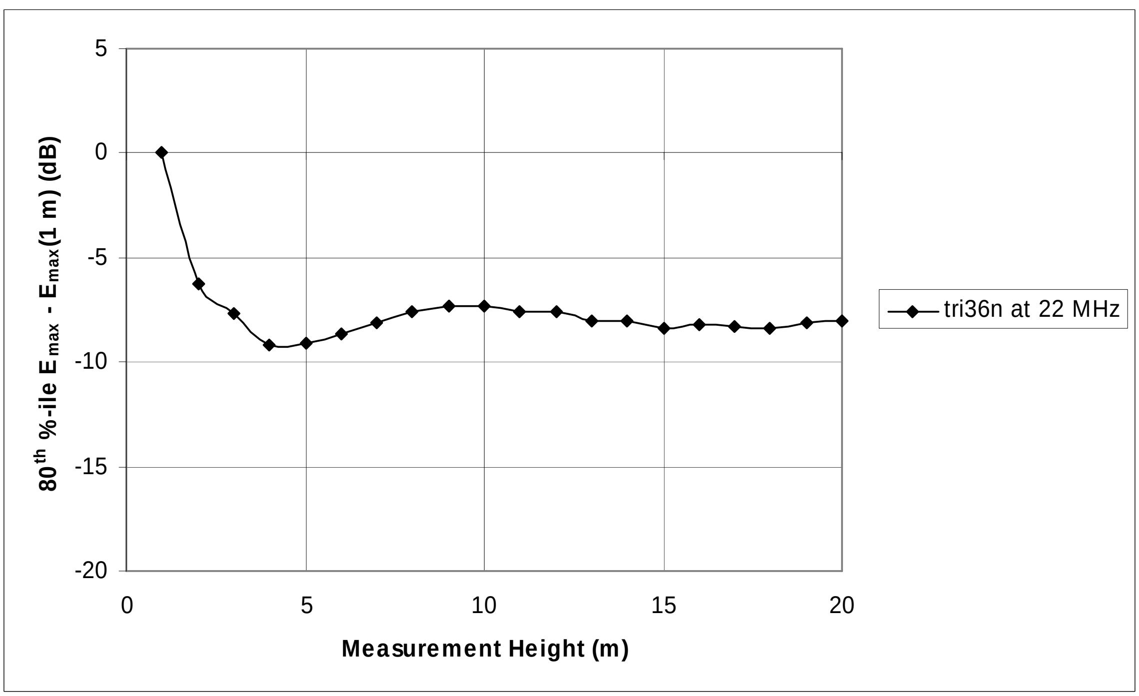


Figure A-80: 80^{th} percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

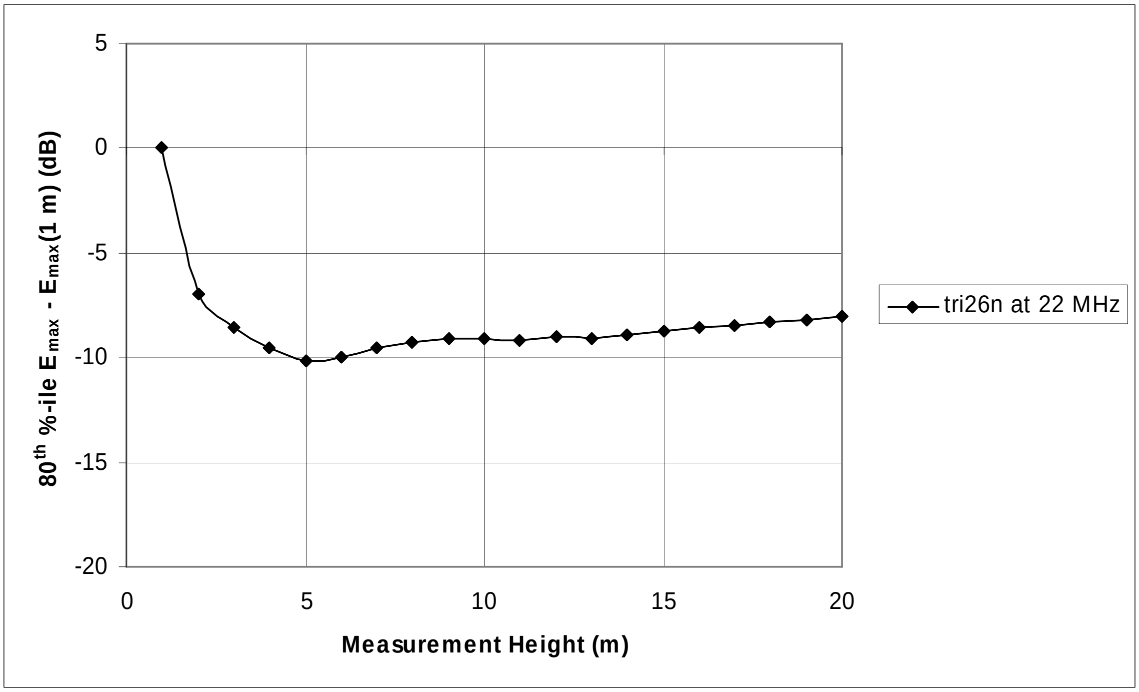


Figure A-81: 80^{th} percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

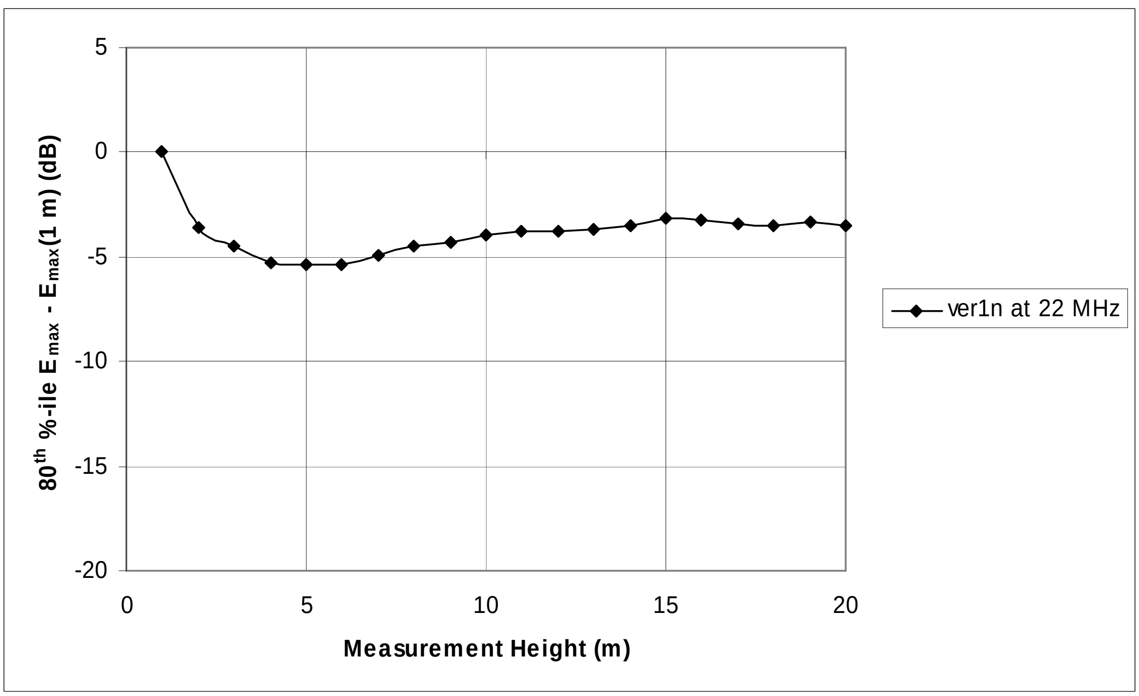


Figure A-82: 80^{th} percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

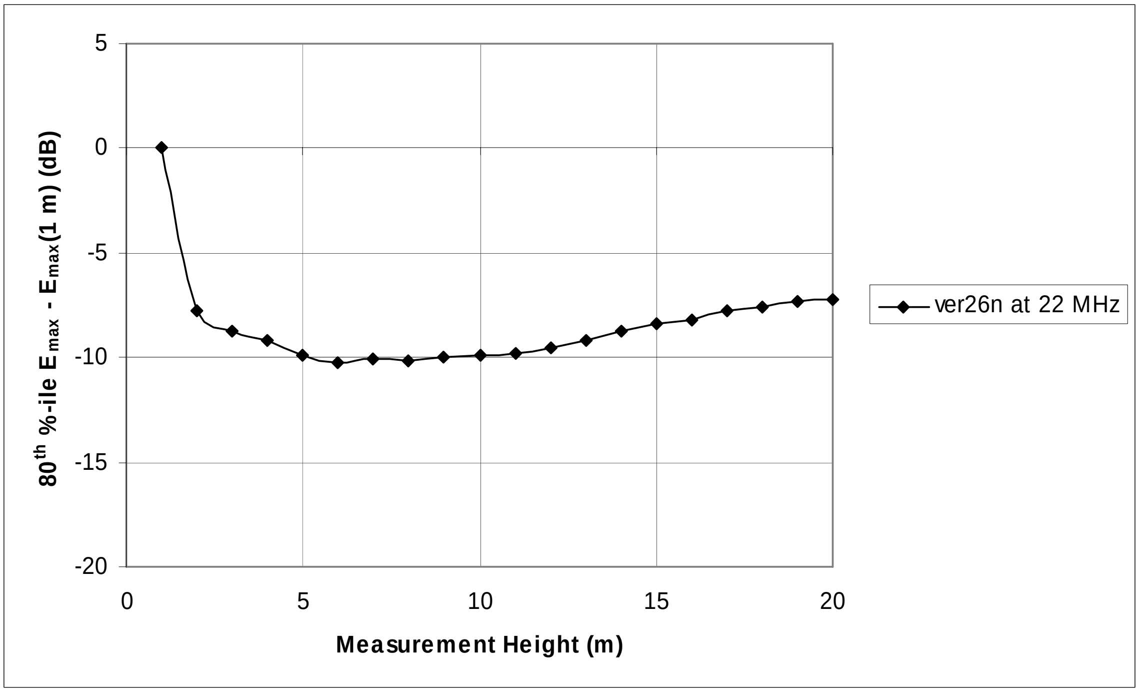


Figure A-83: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

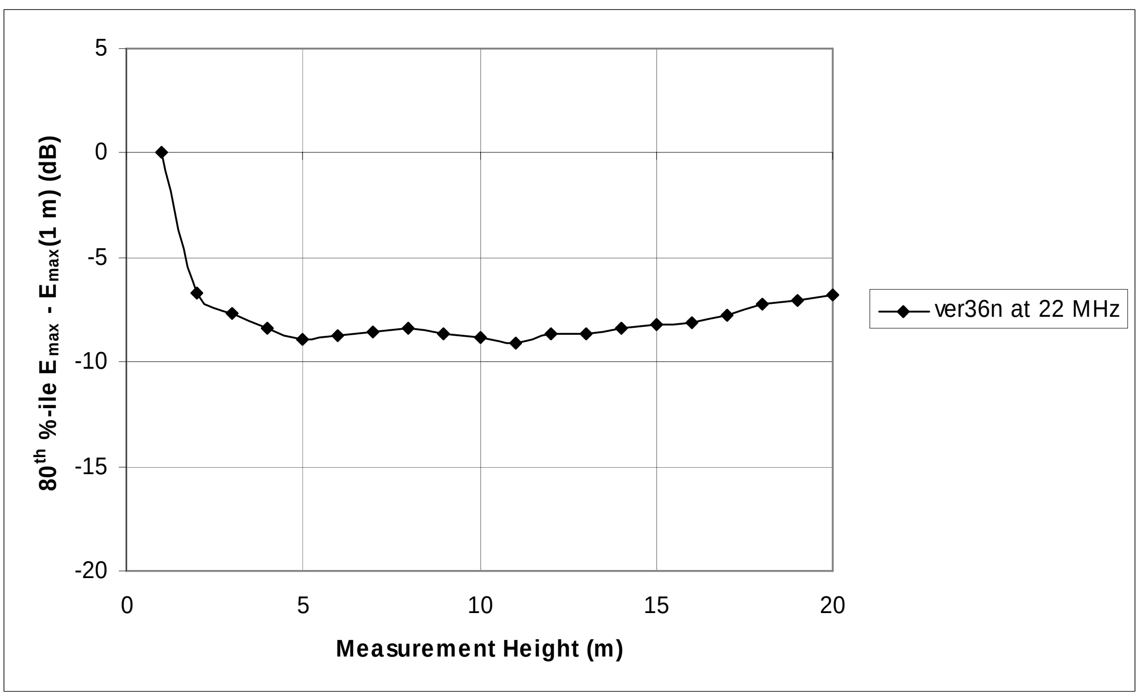


Figure A-84: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

24 MHz Plots

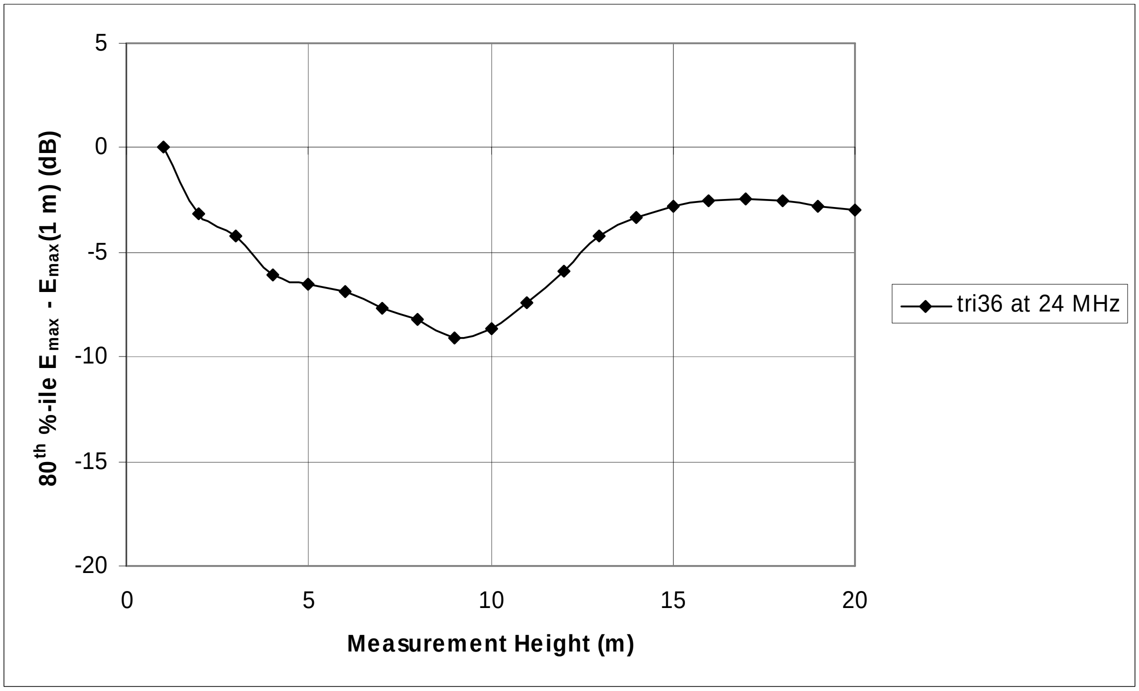


Figure A-85: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

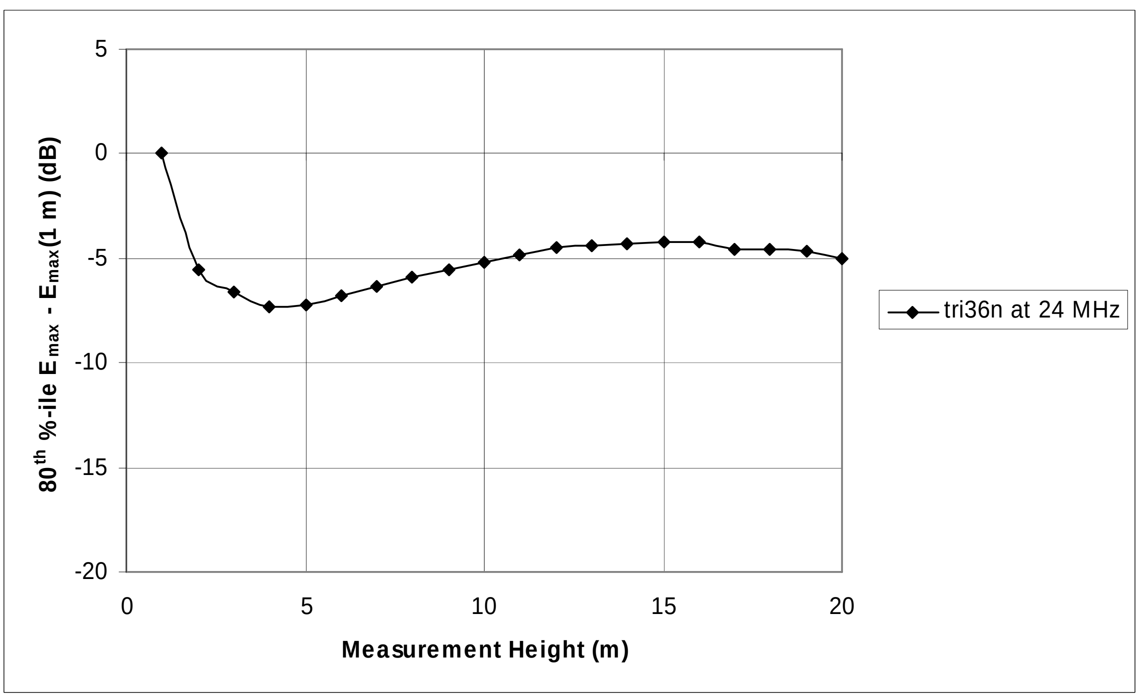


Figure A-86: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

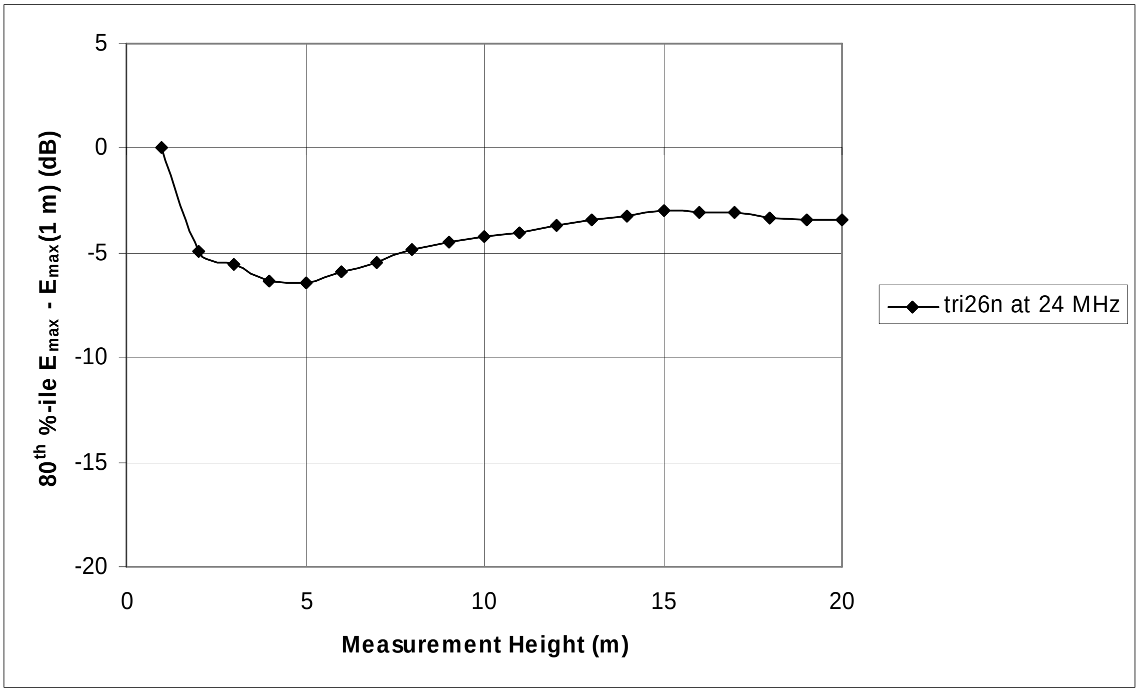


Figure A-87: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

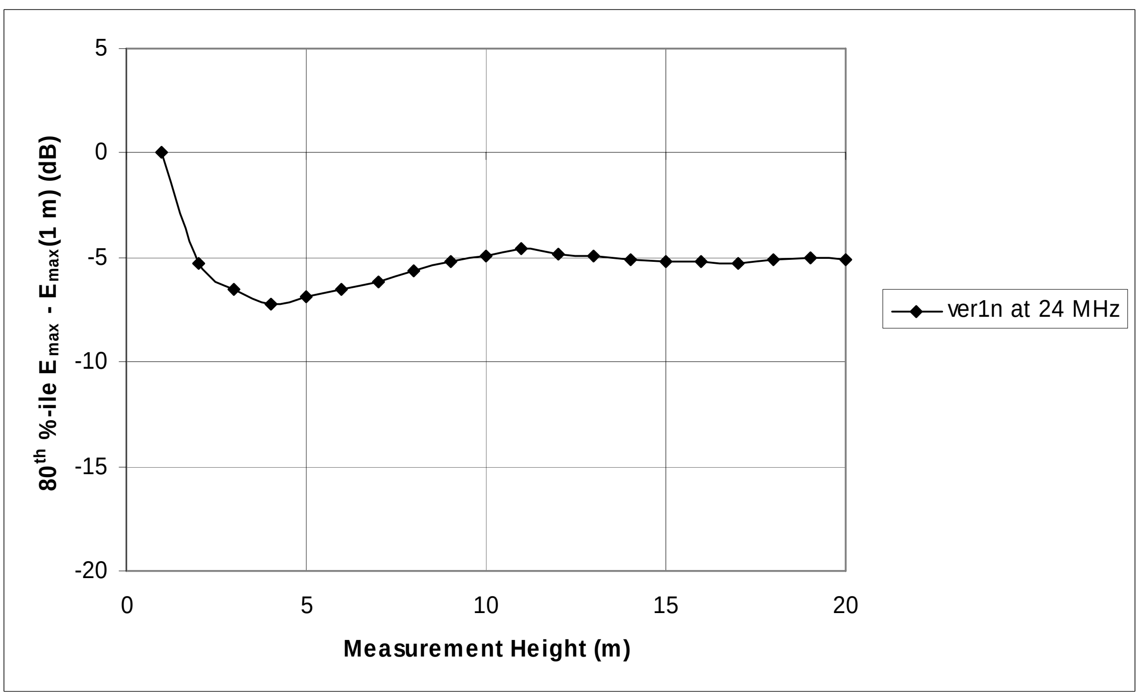


Figure A-88: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

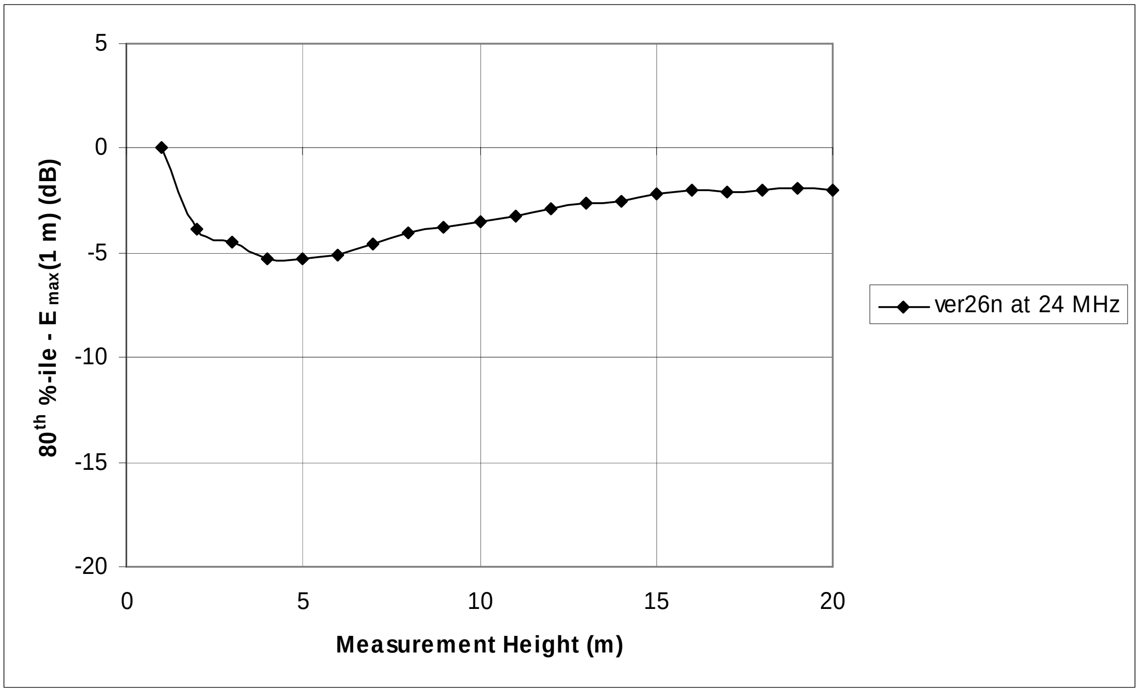


Figure A-89: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

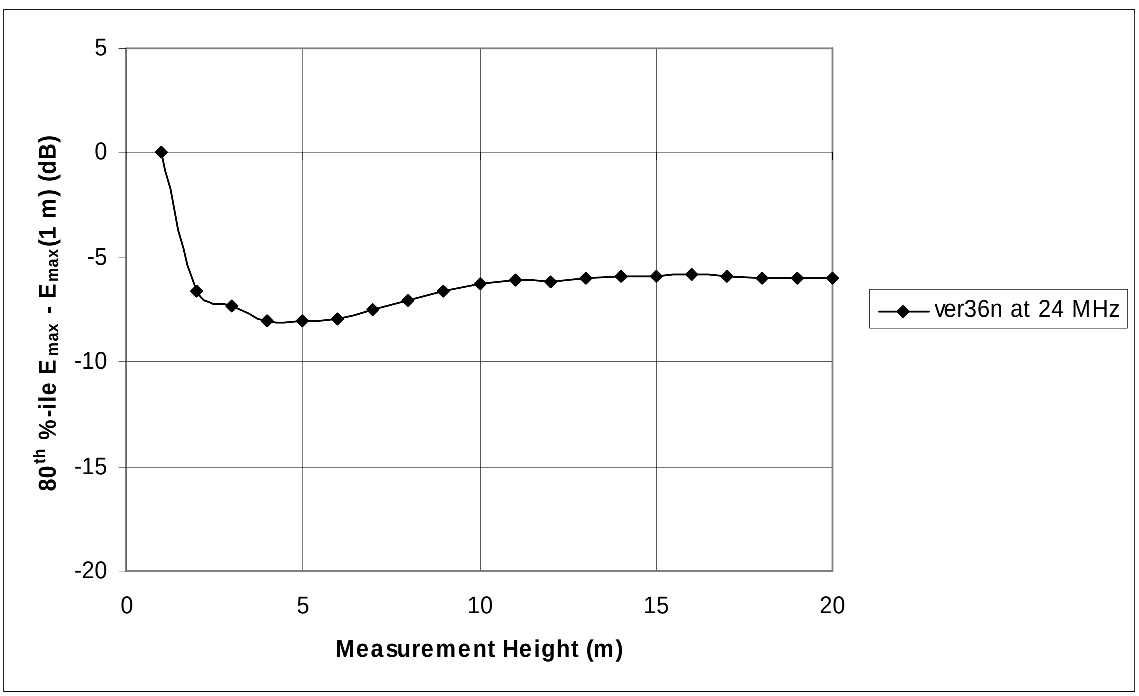


Figure A-90: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

26 MHz Plots

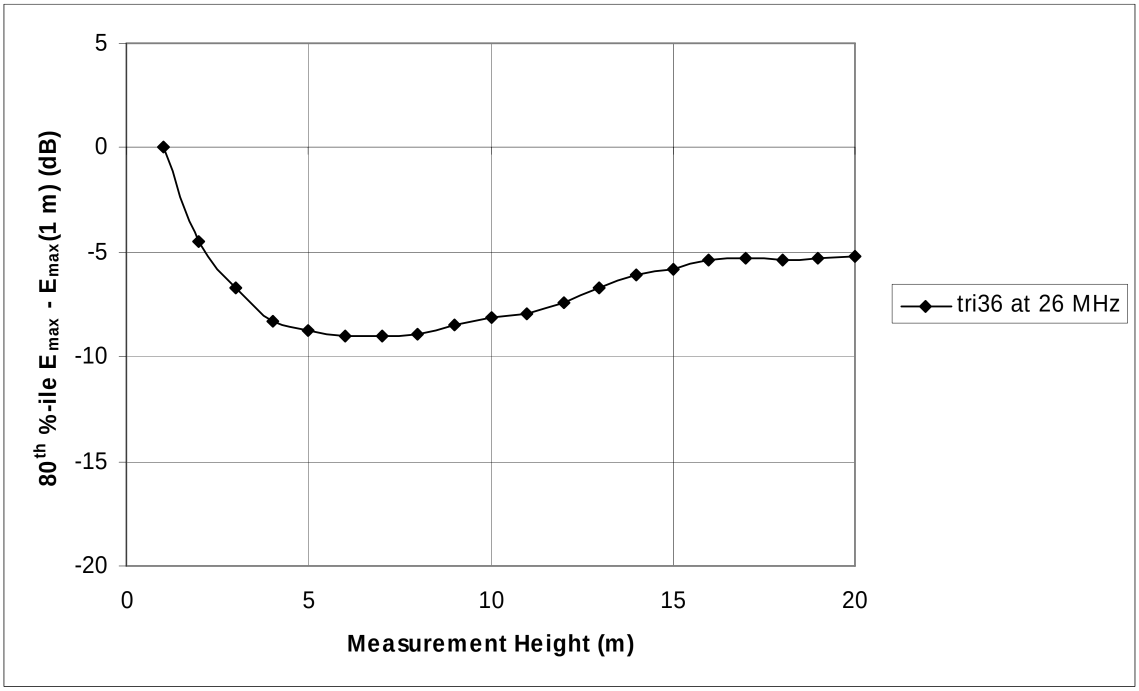


Figure A-91: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

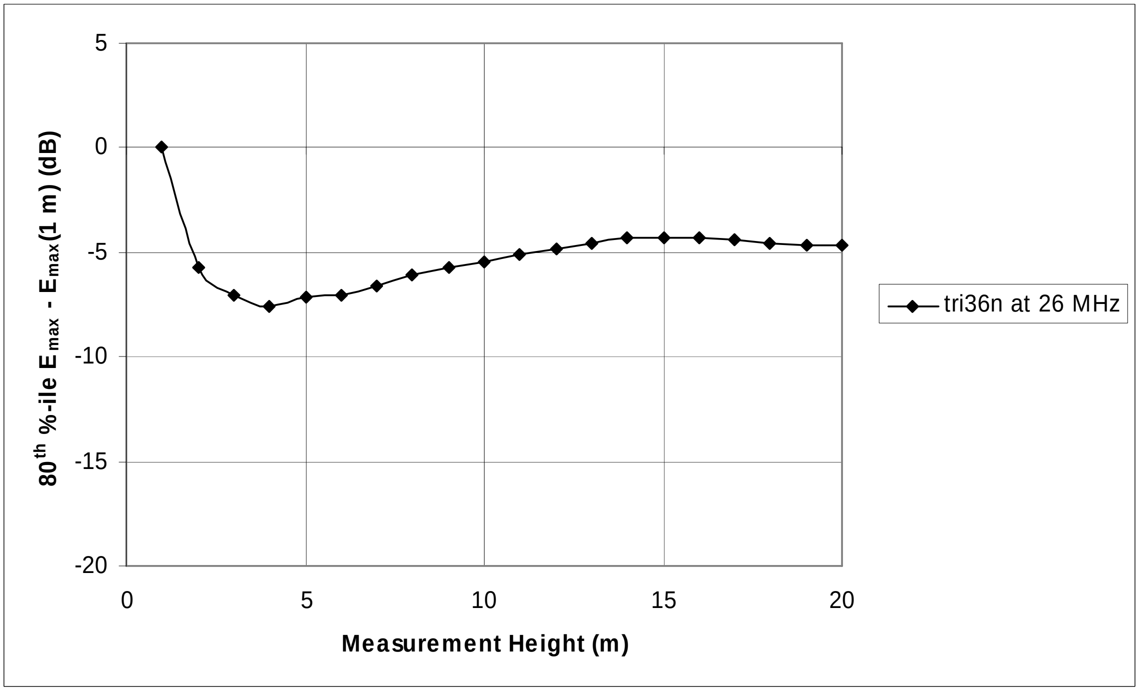


Figure A-92: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

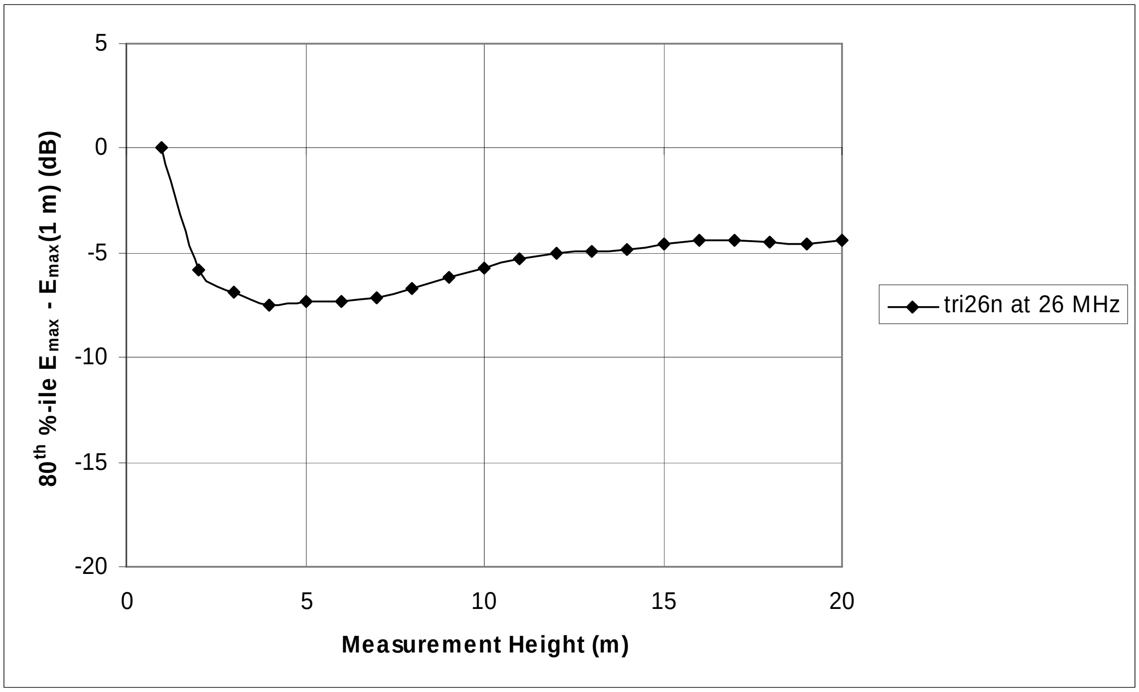


Figure A-93: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

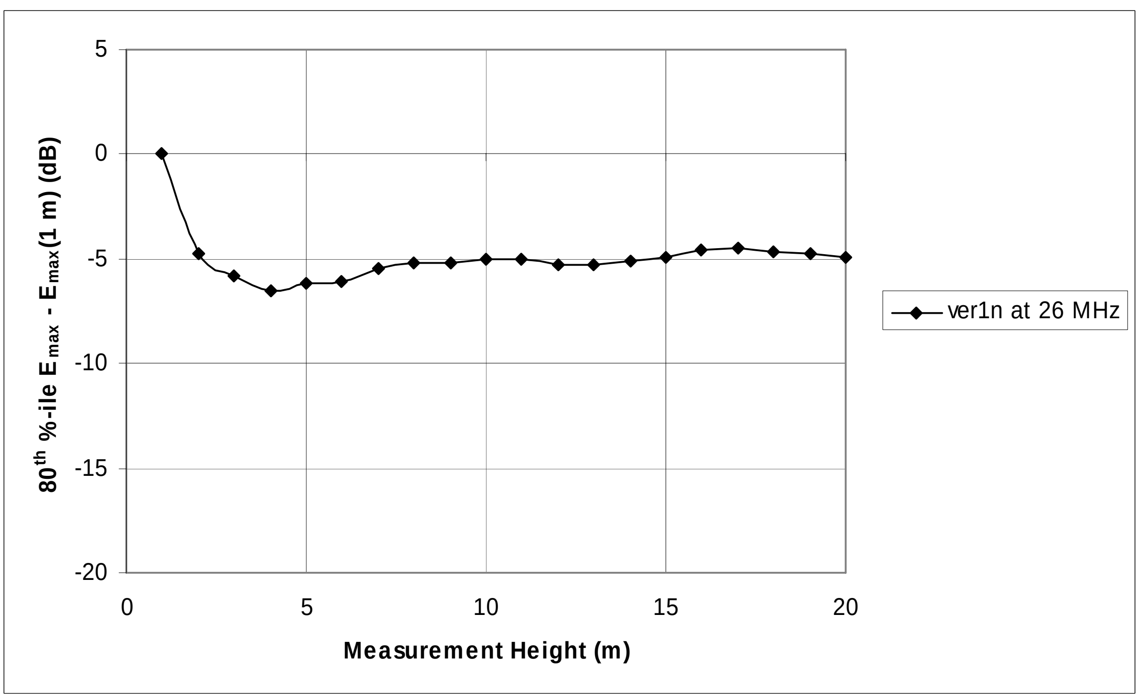


Figure A-94: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

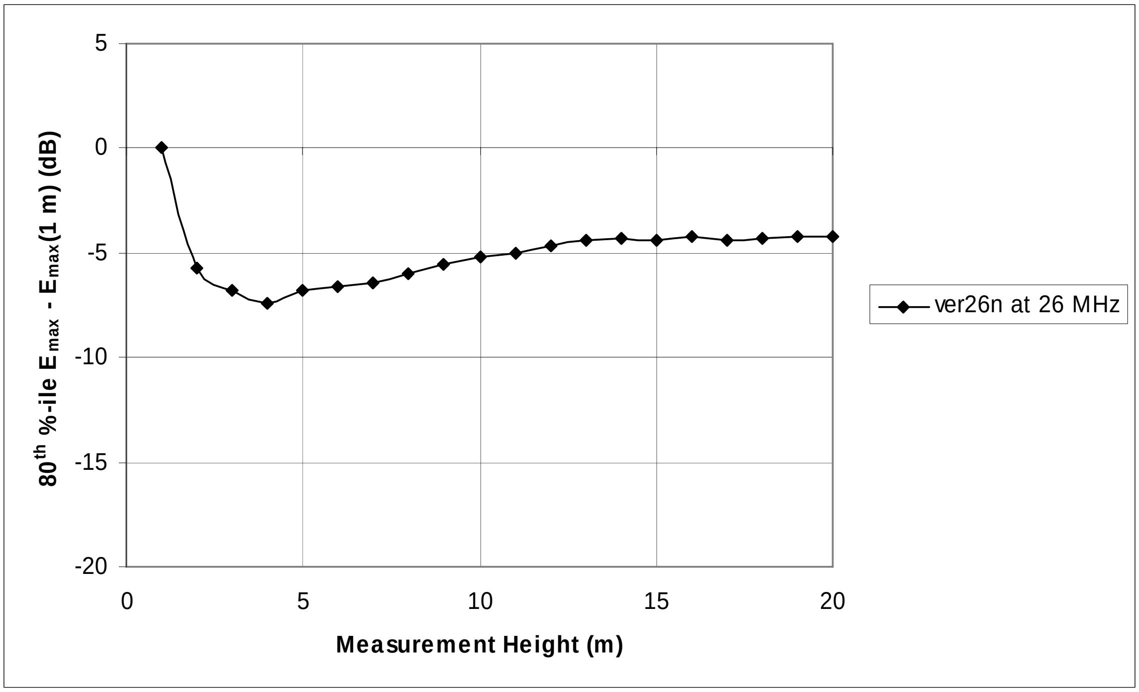


Figure A-95: 80^{th} percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

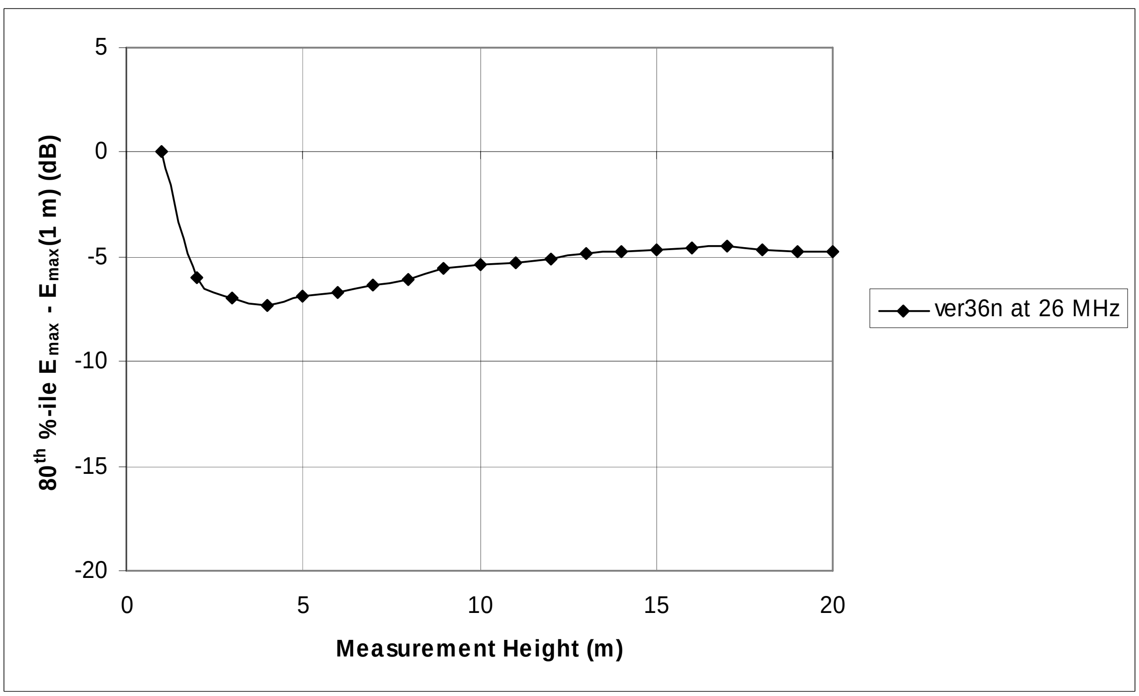


Figure A-96: 80^{th} percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

28 MHz Plots

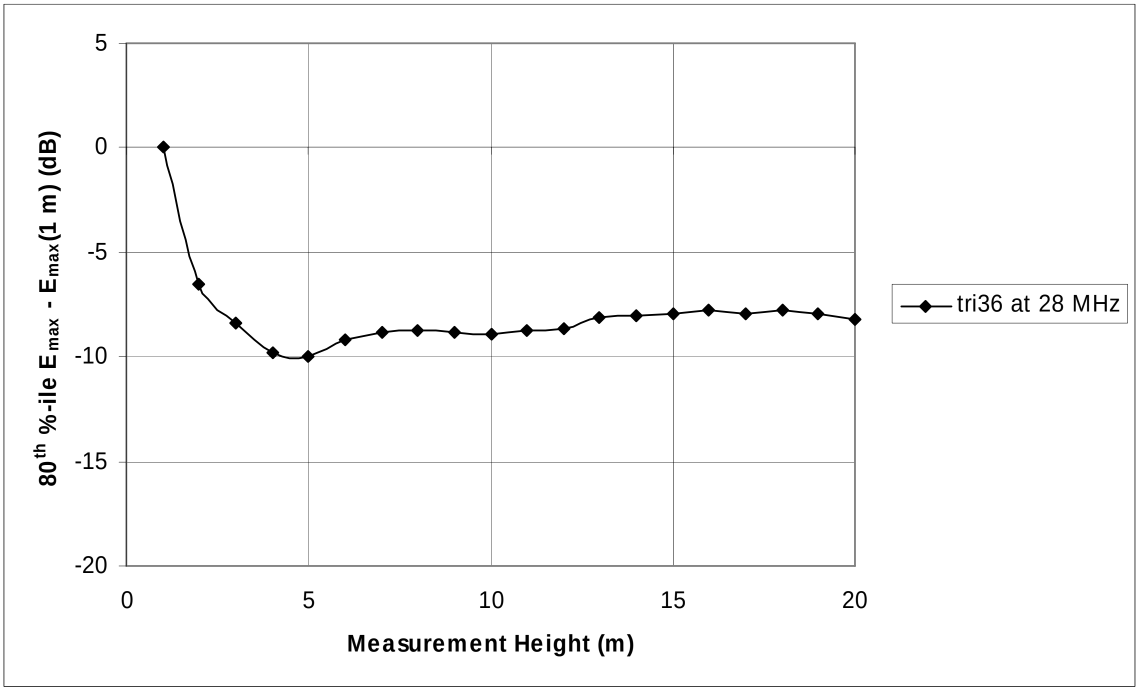


Figure A-97: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

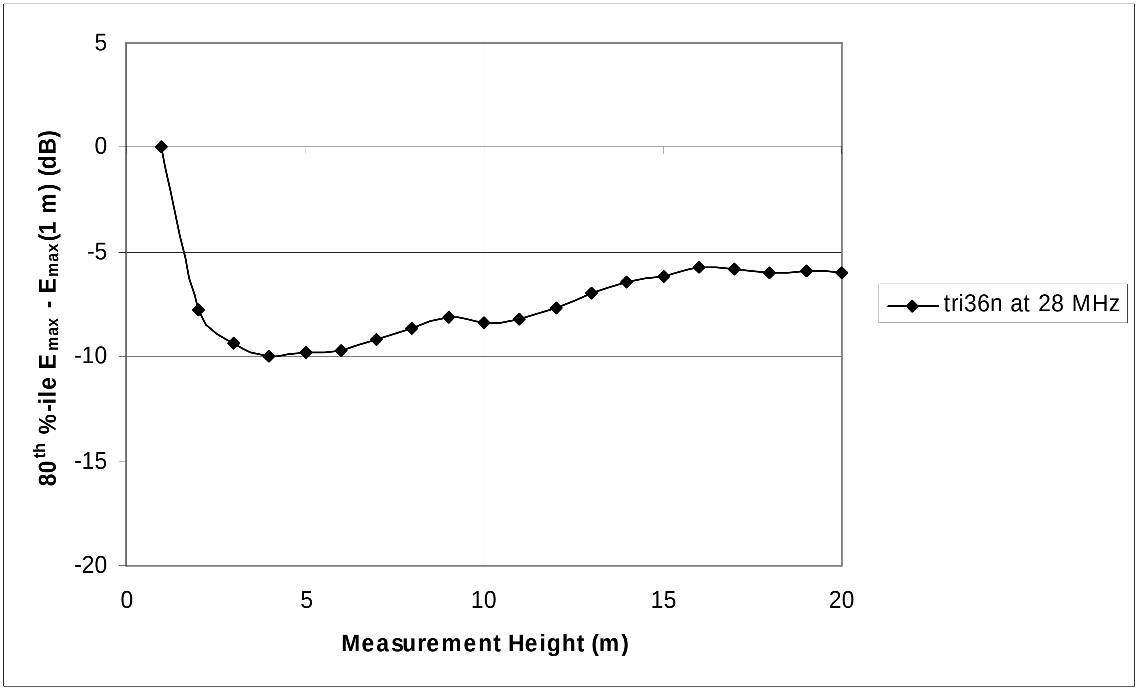


Figure A-98: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

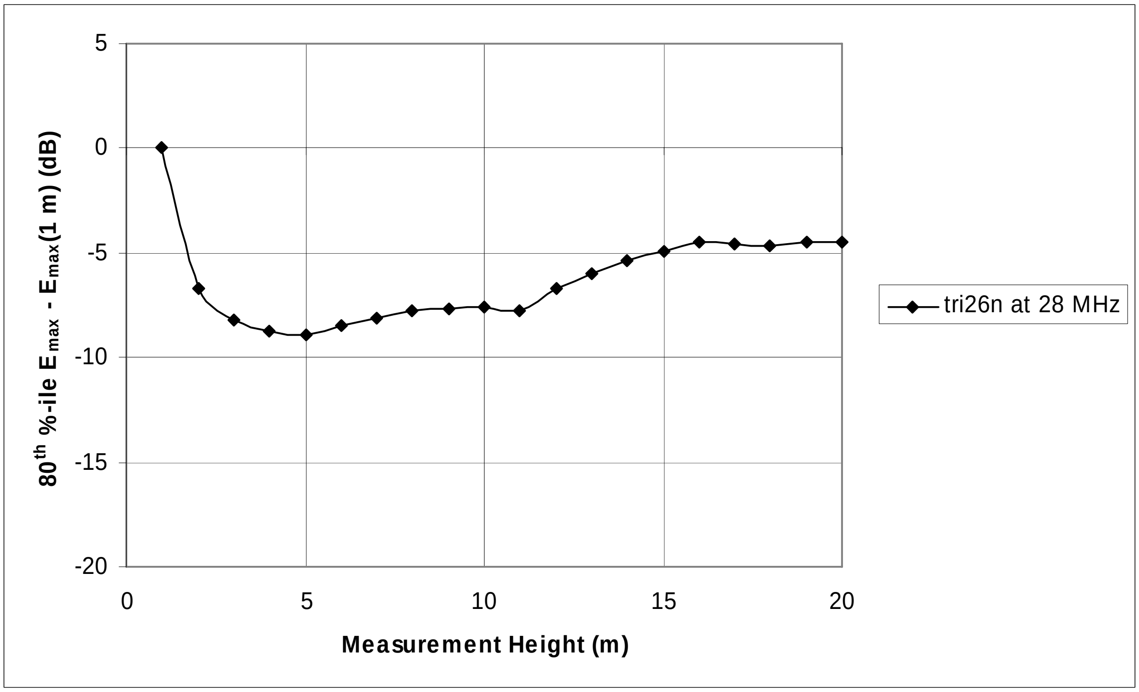


Figure A-99: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

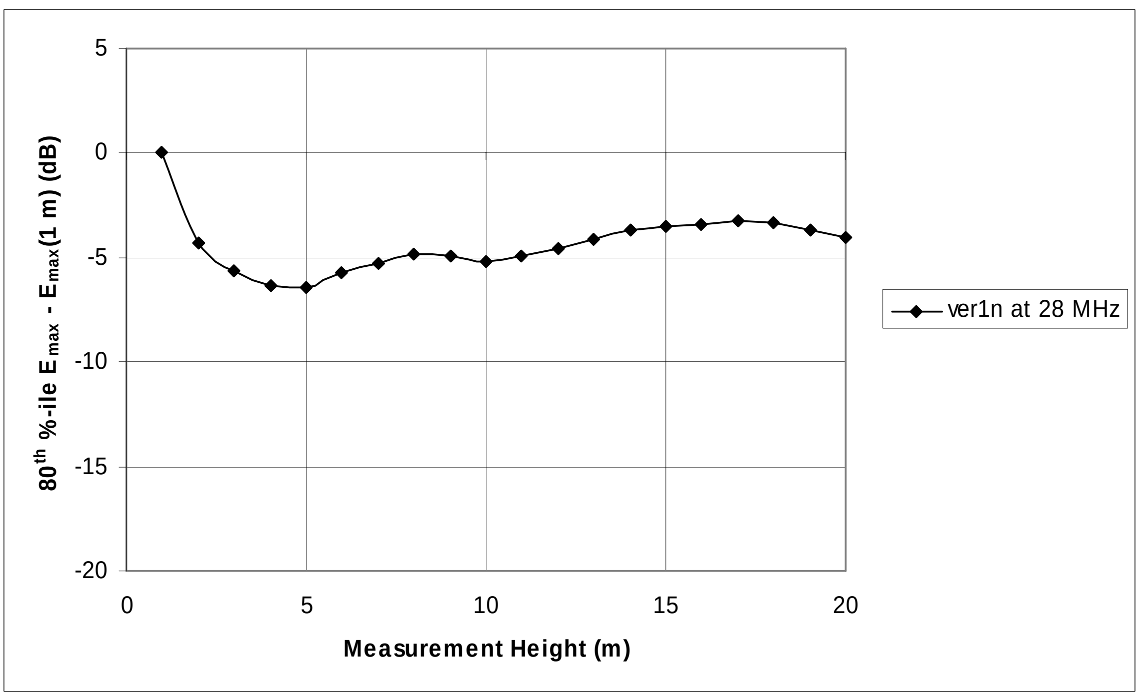


Figure A-100: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

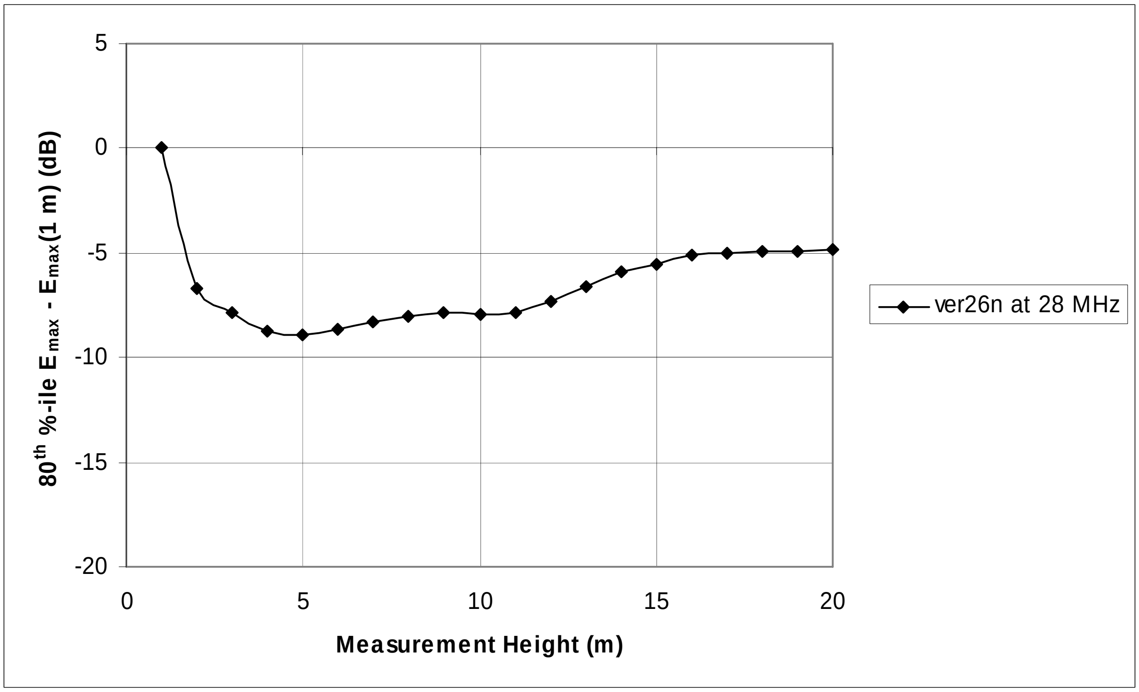


Figure A-101: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

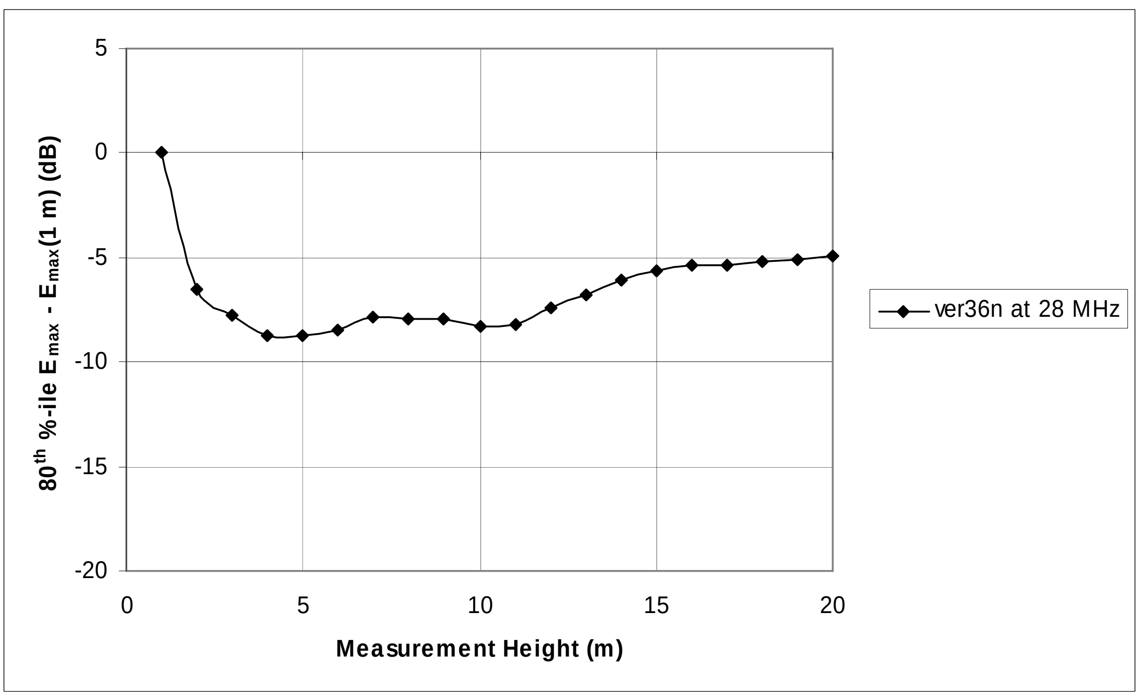


Figure A-102: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at a 1 meter measurement height

A.4 COMPLIANCE MEASUREMENT HEIGHT FOR OPERATION AT 30 MHz AND ABOVE

The Commission's Part 15 measurement guidelines specify that at or above 30 MHz, measurements are to be made with the antenna positioned at a height ranging from 1 to 4 meters. The electric field strength should be measured in both the horizontal and vertical planes. The following plots show a comparison between the peak field strength determined from applying the measurement guidelines to the power line simulations to compute the 80th percentile of peak field strength at any height along the length of the power line. The rationale for use of 80th percentile values was previously addressed in Section A.3. The plots are shown for a number of NEC power line models at the frequencies of 30, 40 and 50 MHz.

30 MHz Plots

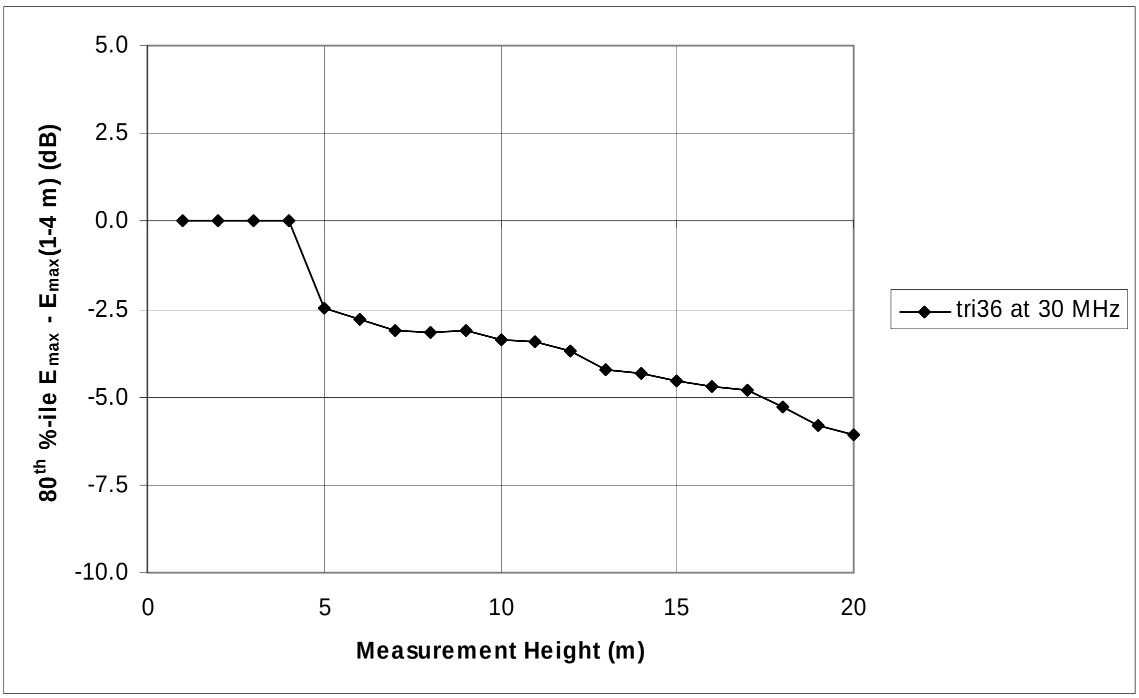


Figure A-103: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at the 1 to 4 meter measurement height

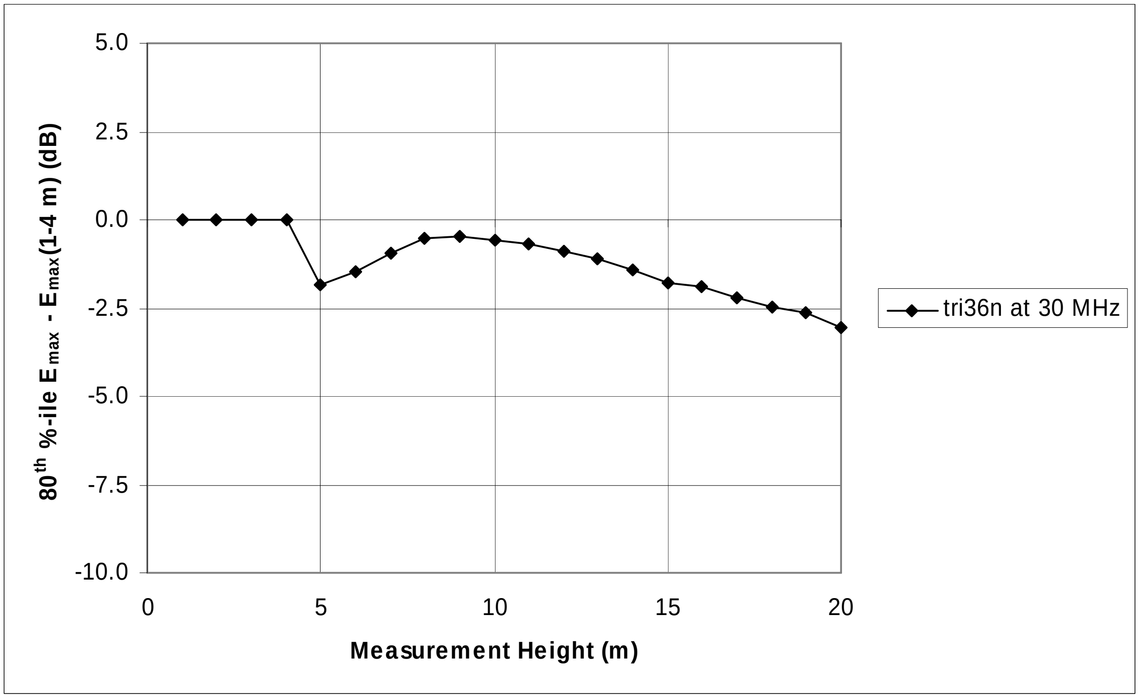


Figure A-104: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at the 1 to 4 meter measurement height

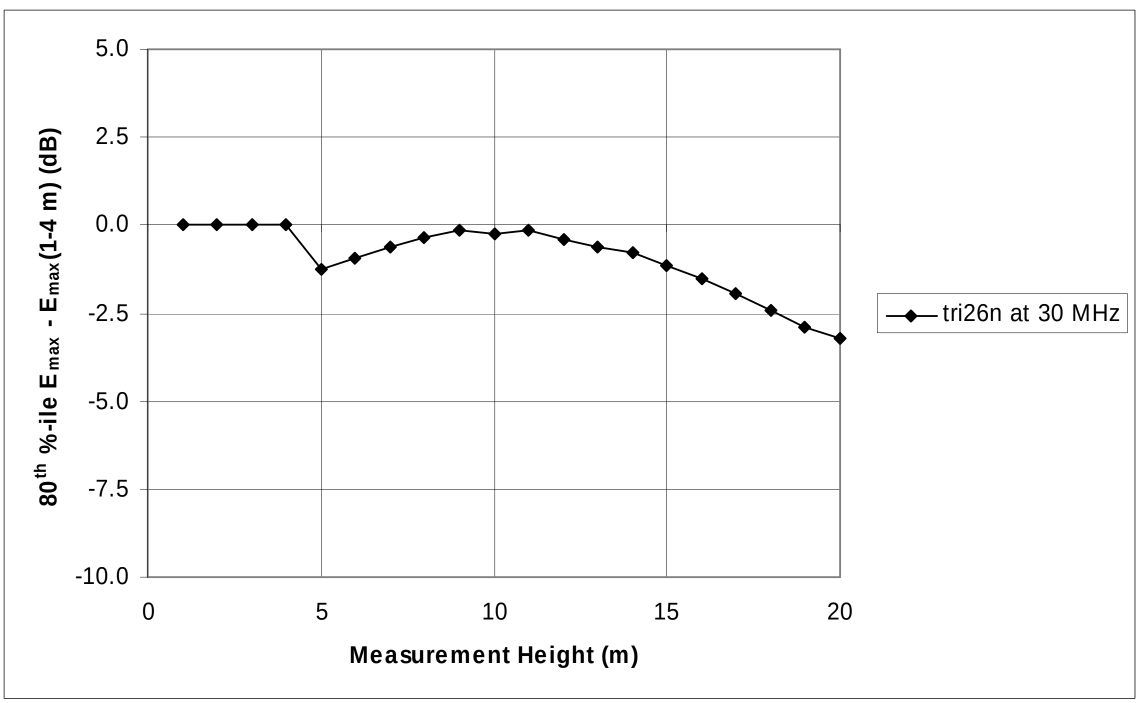


Figure A-105: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at the 1 to 4 meter measurement height

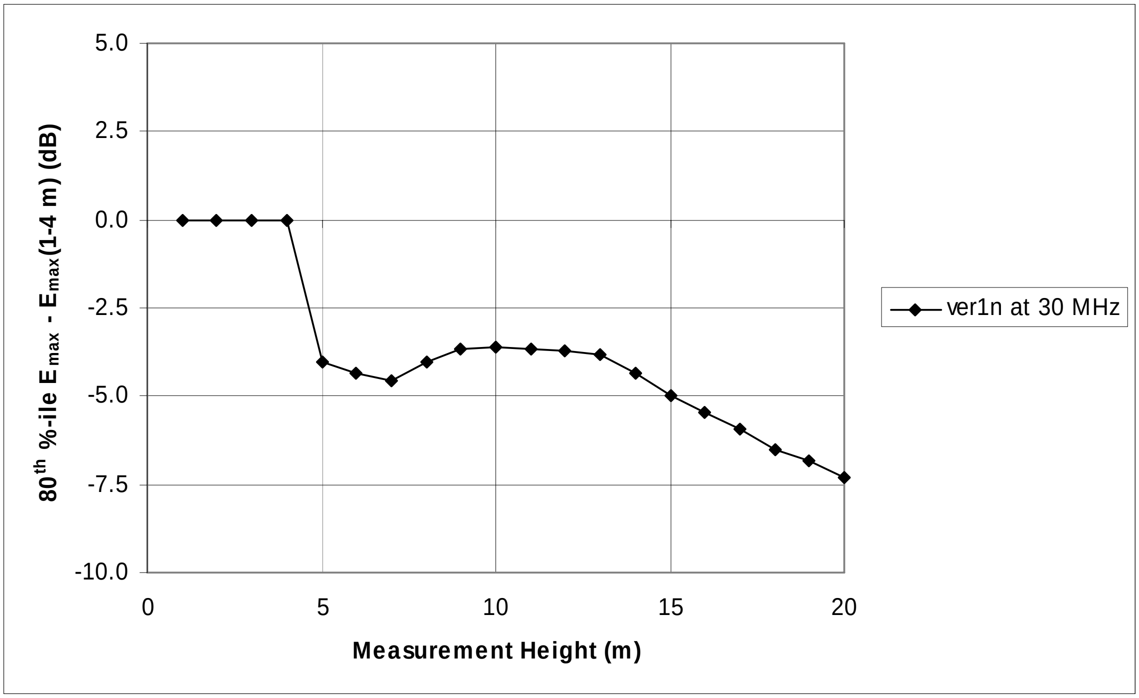


Figure A-106: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at the 1 to 4 meter measurement height

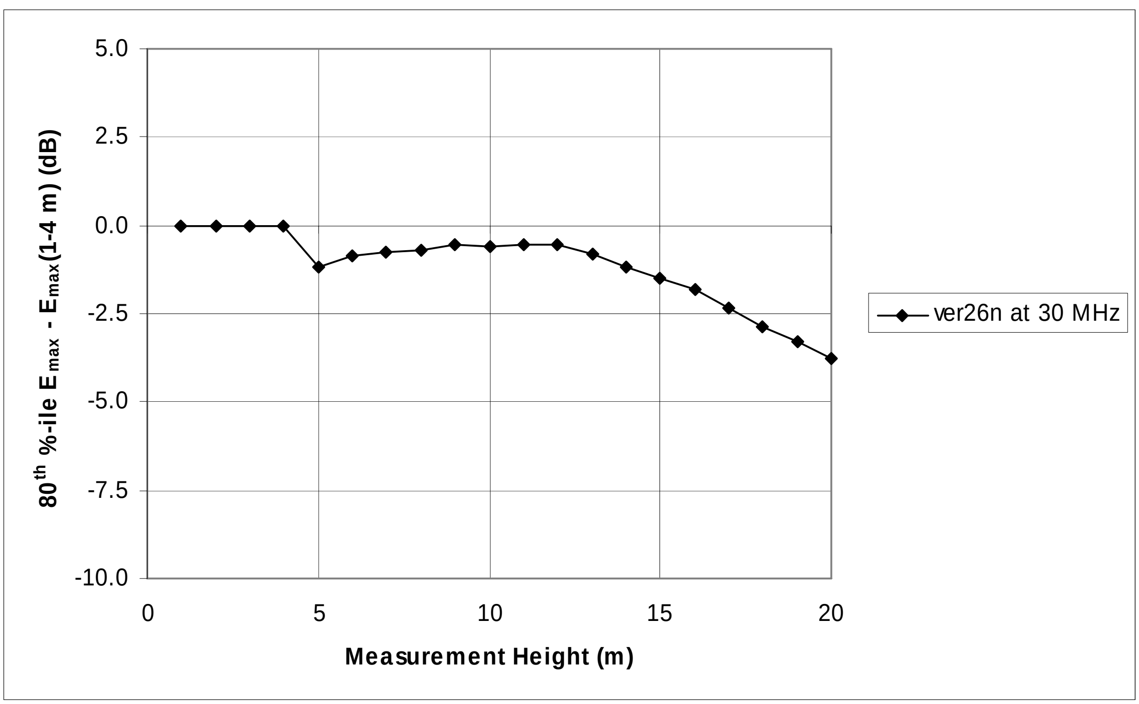


Figure A-107: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at the 1 to 4 meter measurement height

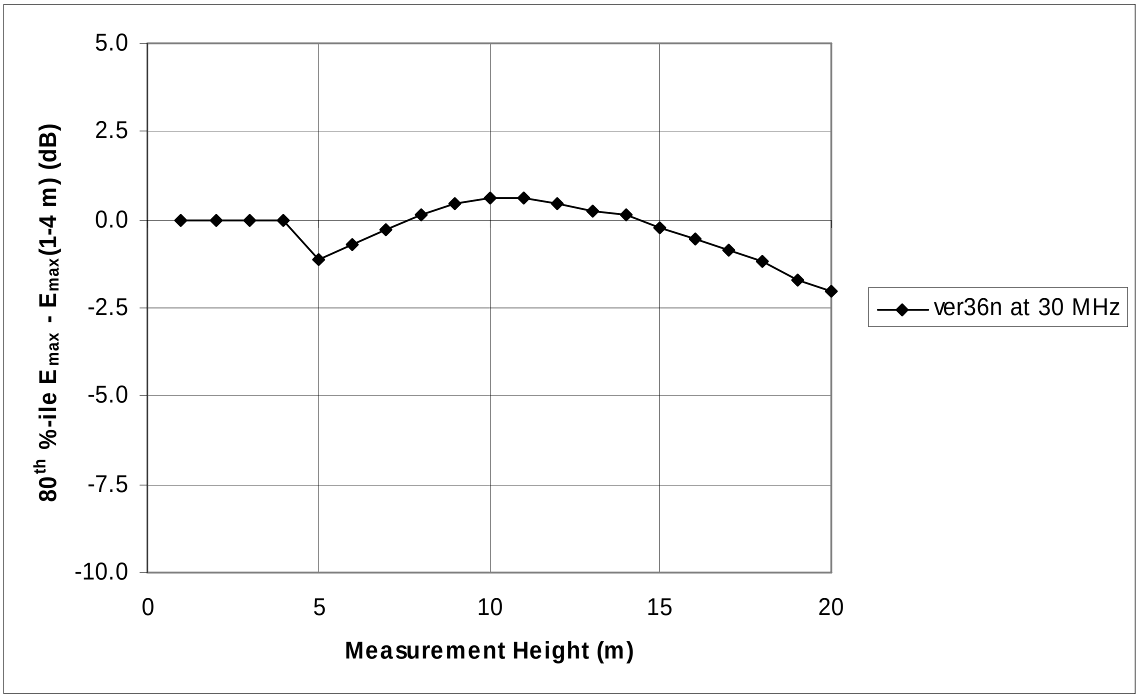


Figure A-108: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at the 1 to 4 meter measurement height

40 MHz Plots

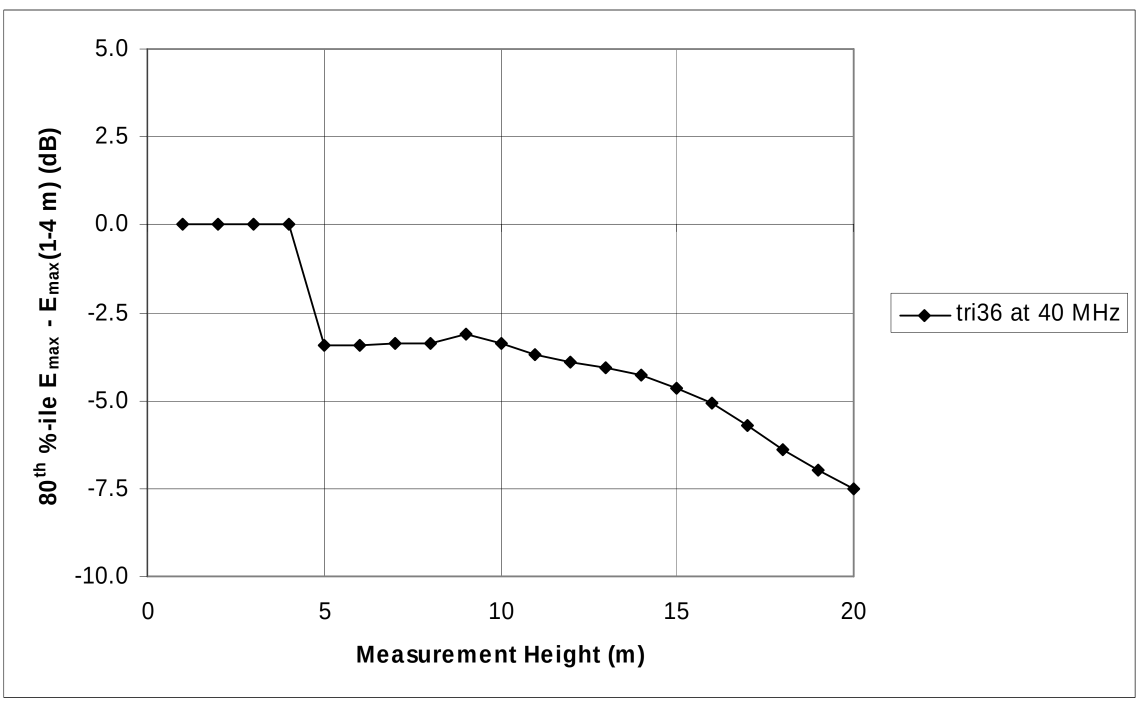


Figure A-109: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at the 1 to 4 meter measurement height

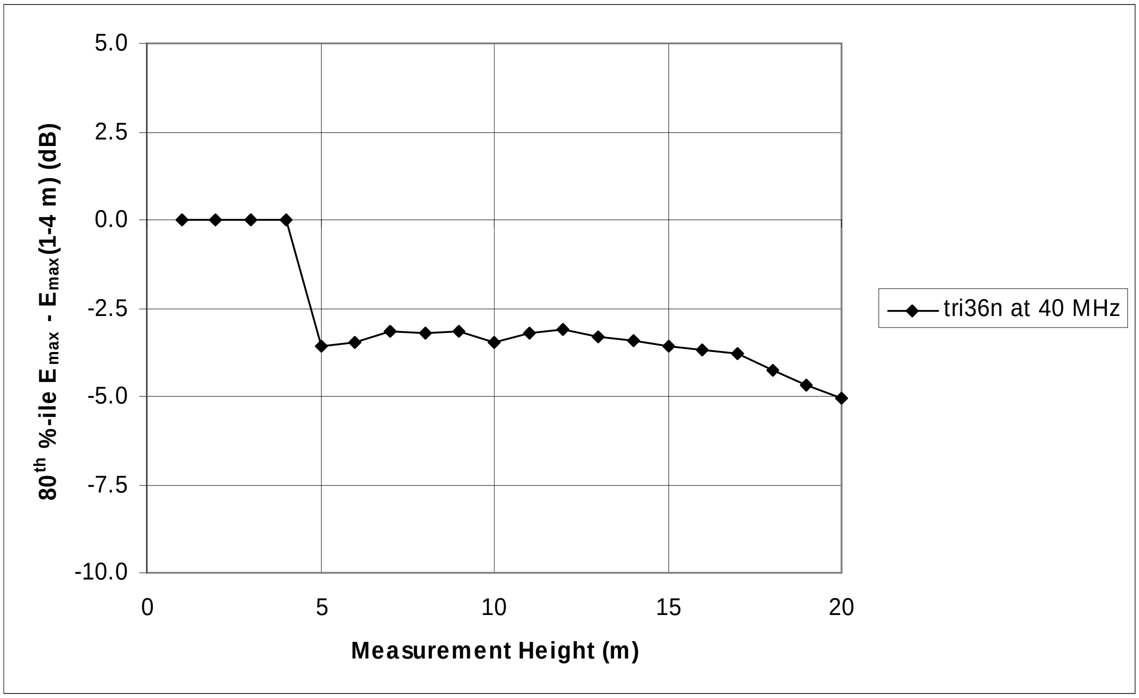


Figure A-110: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at the 1 to 4 meter measurement height

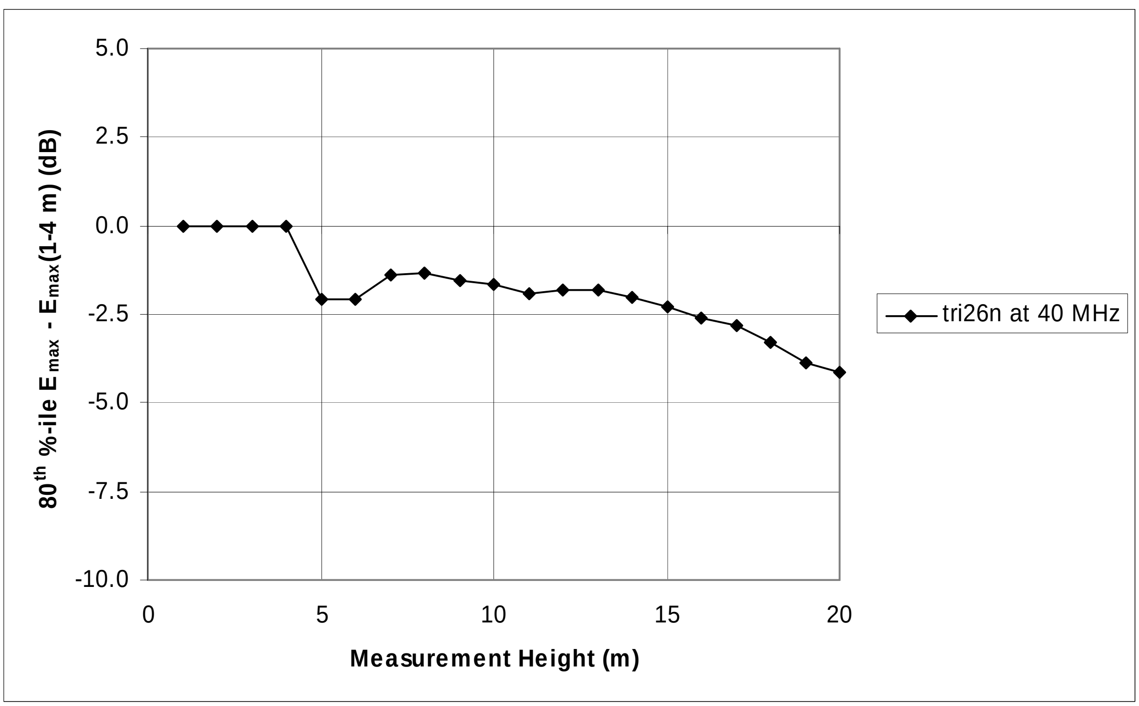


Figure A-111: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at the 1 to 4 meter measurement height

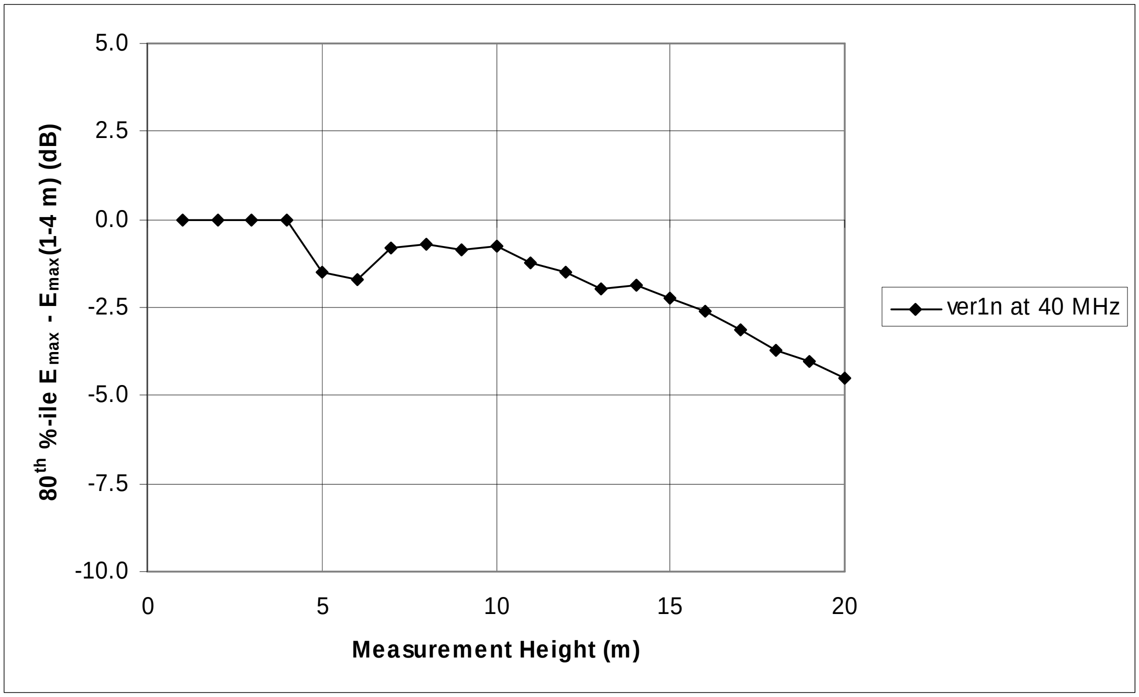


Figure A-112: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at the 1 to 4 meter measurement height

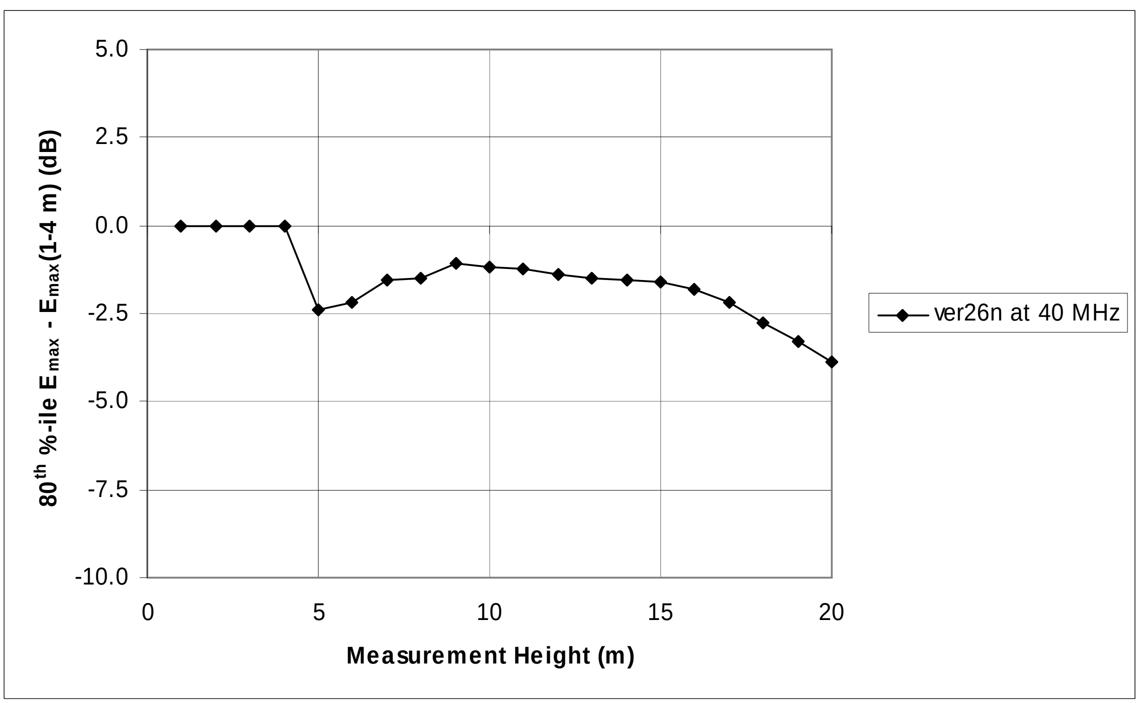


Figure A-113: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at the 1 to 4 meter measurement height

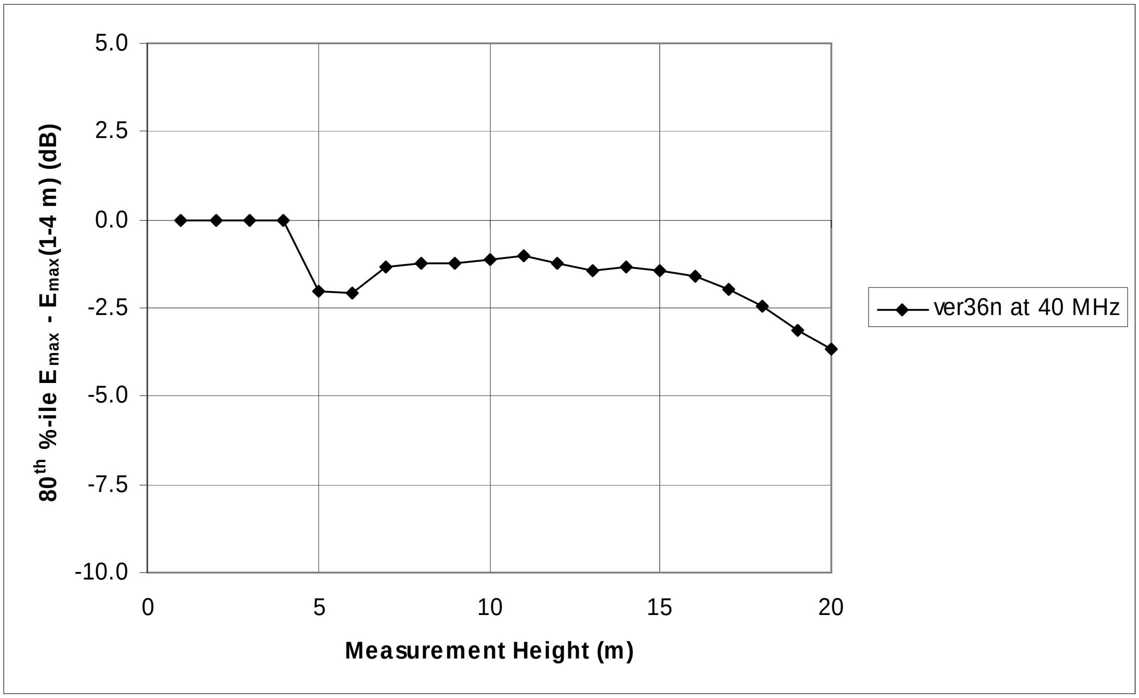


Figure A-114: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at the 1 to 4 meter measurement height

50 MHz Plots

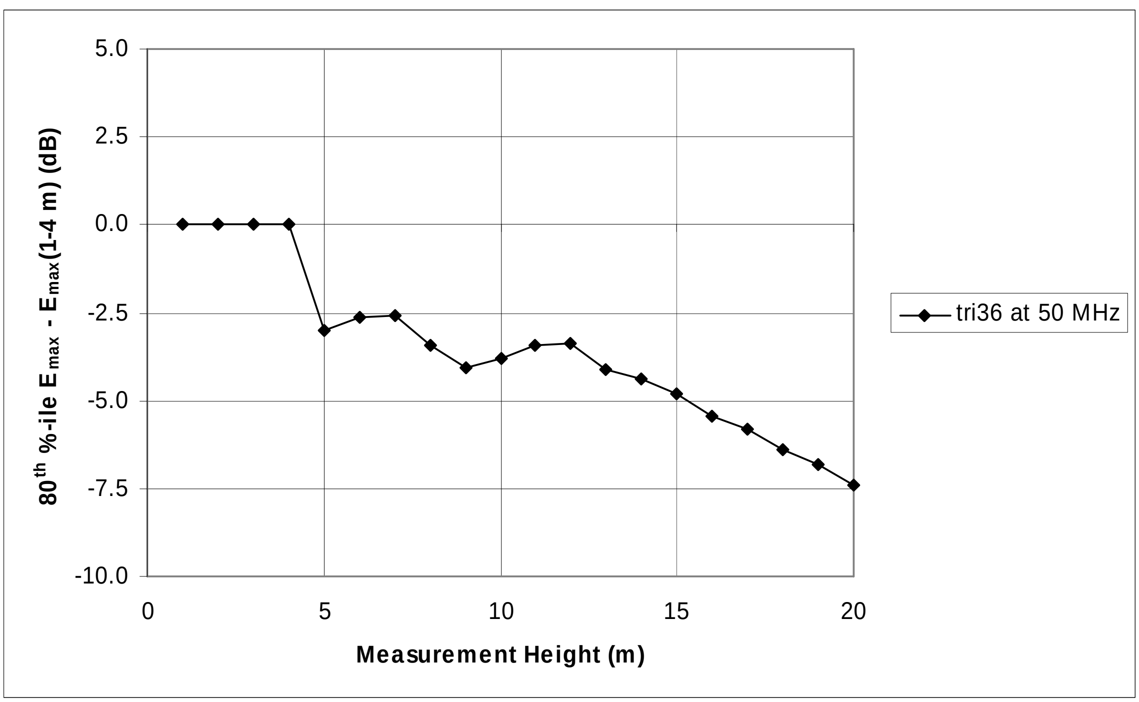


Figure A-115: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at the 1 to 4 meter measurement height

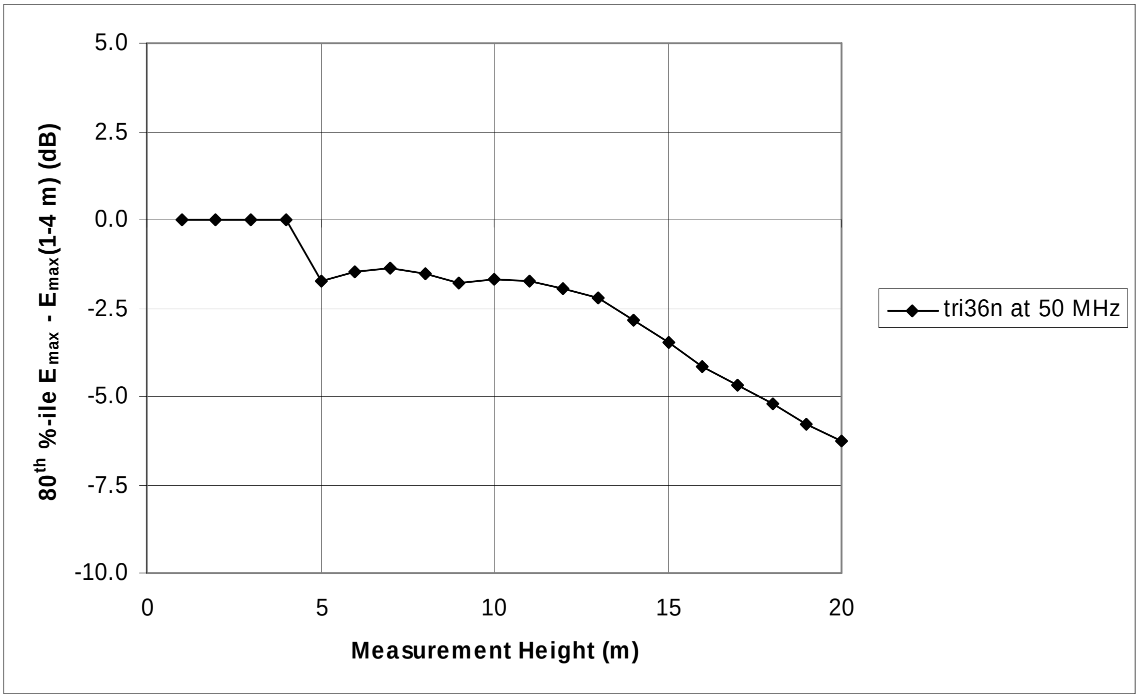


Figure A-116: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at the 1 to 4 meter measurement height

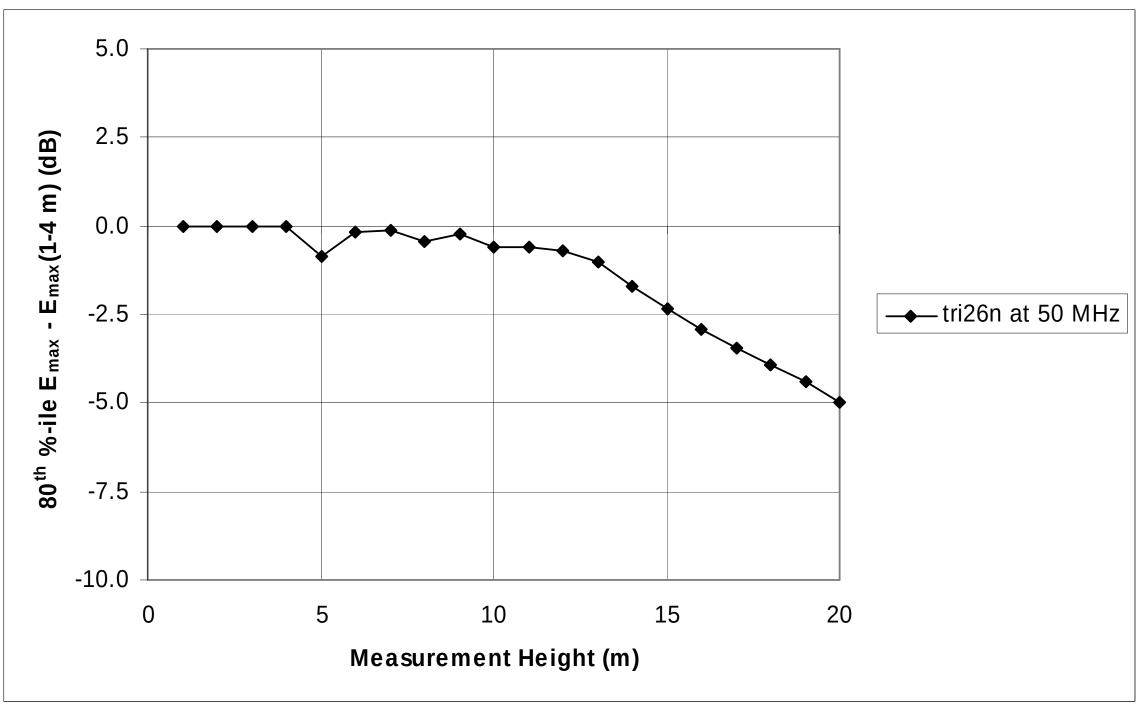


Figure A-117: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at the 1 to 4 meter measurement height

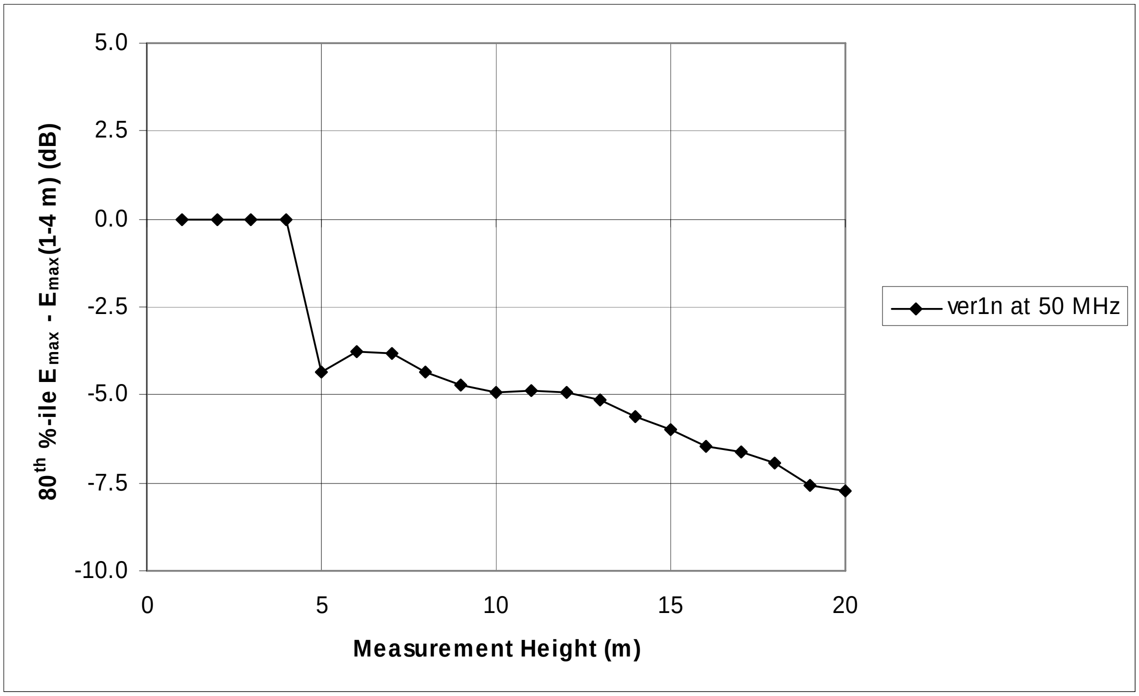


Figure A-118: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at the 1 to 4 meter measurement height

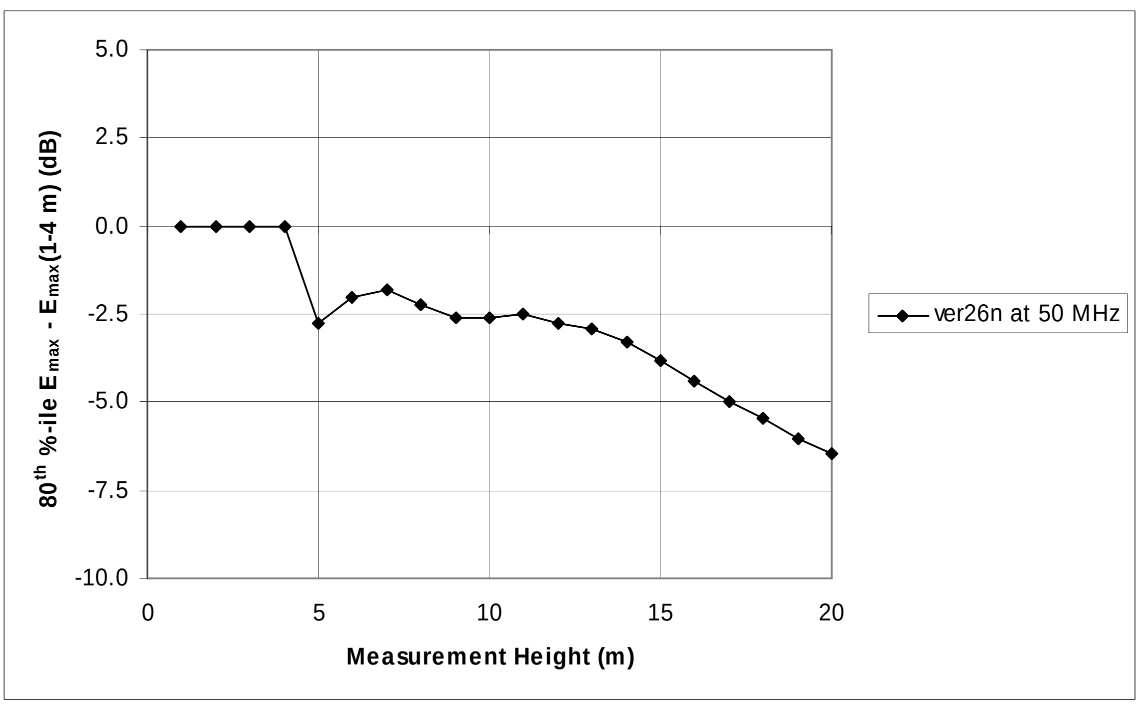


Figure A-119: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at the 1 to 4 meter measurement height

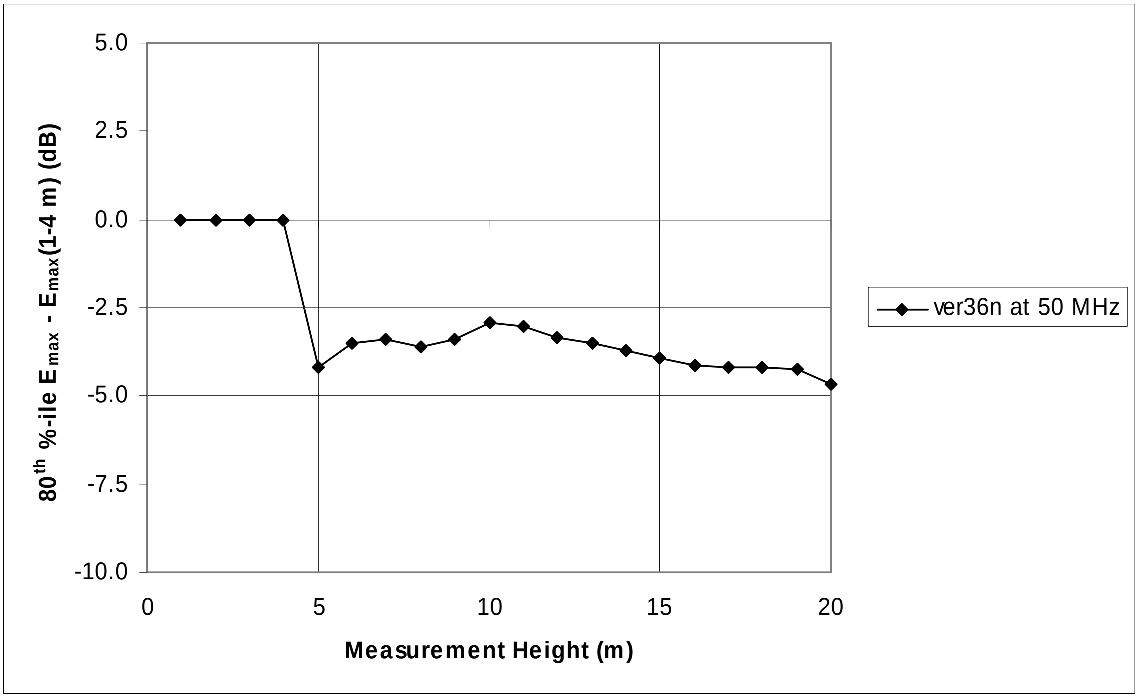


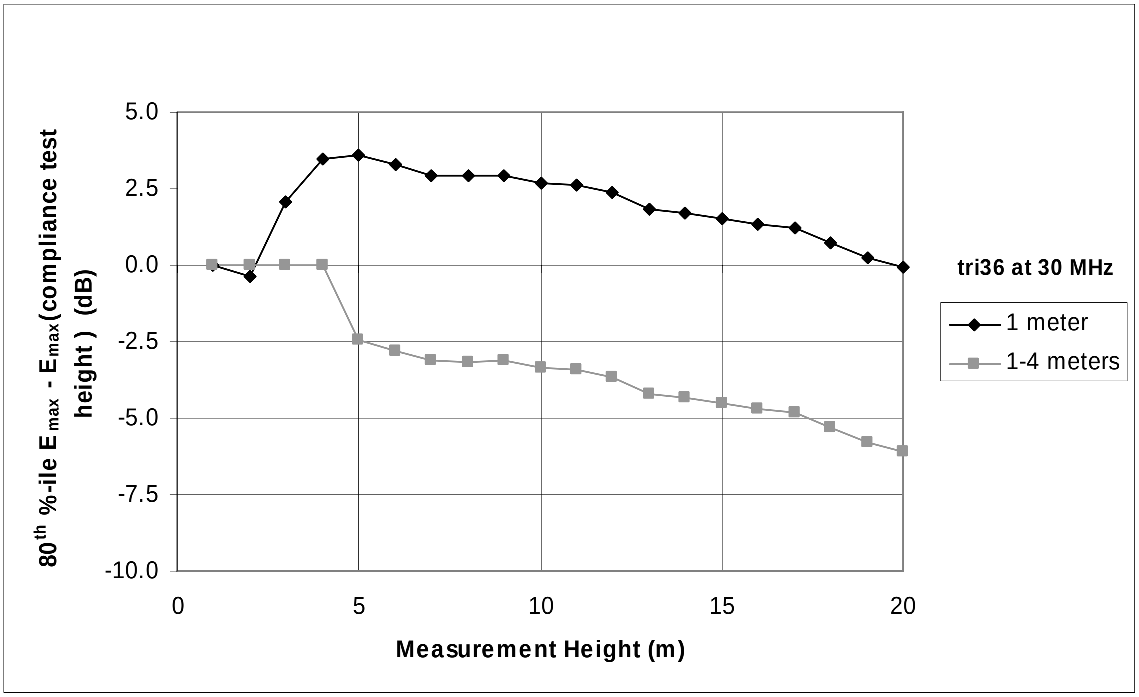
Figure A-120: 80th percentile of peak electric field strength along the power line relative to the peak electric field strength at the 1 to 4 meter measurement height

A.5 HEIGHT CORRECTION FACTOR ABOVE 30 MHz

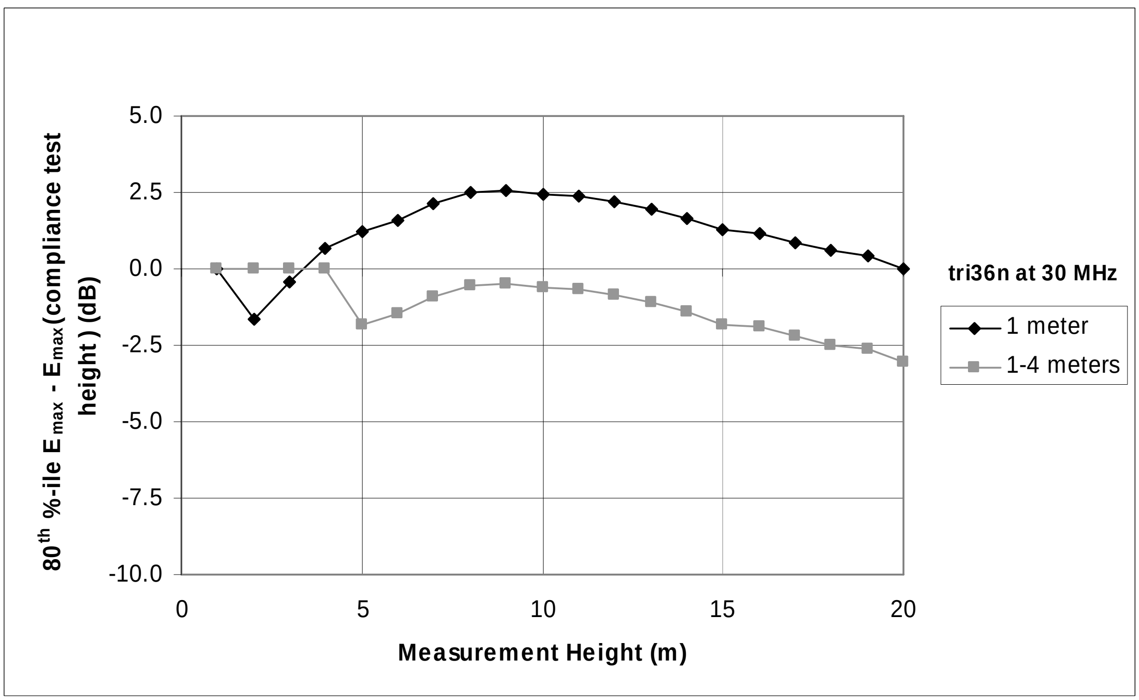
Above 30 MHz, the option to perform compliance measurements at a 1 meter measurement height coupled with a 5 dB height correction factor provides a much simpler measurement approach than to perform measurements over a 1 to 4 meter range of measurement antenna heights. Figures A-121 through A-138 show the comparison between use of a 1 to 4 meter measurement height and the optional use of a 1 meter measurement height.

The results shown in these figures indicate that use of the optional 1 meter measurement height tends to underestimate the peak electric field strength by 2.5 to 7.5 dB. Thus, the use of the optional 1 meter measurement height coupled with a 5 dB correction factor will, in general, provide similar results to measurements performed using a 1 to 4 meter measurement height.

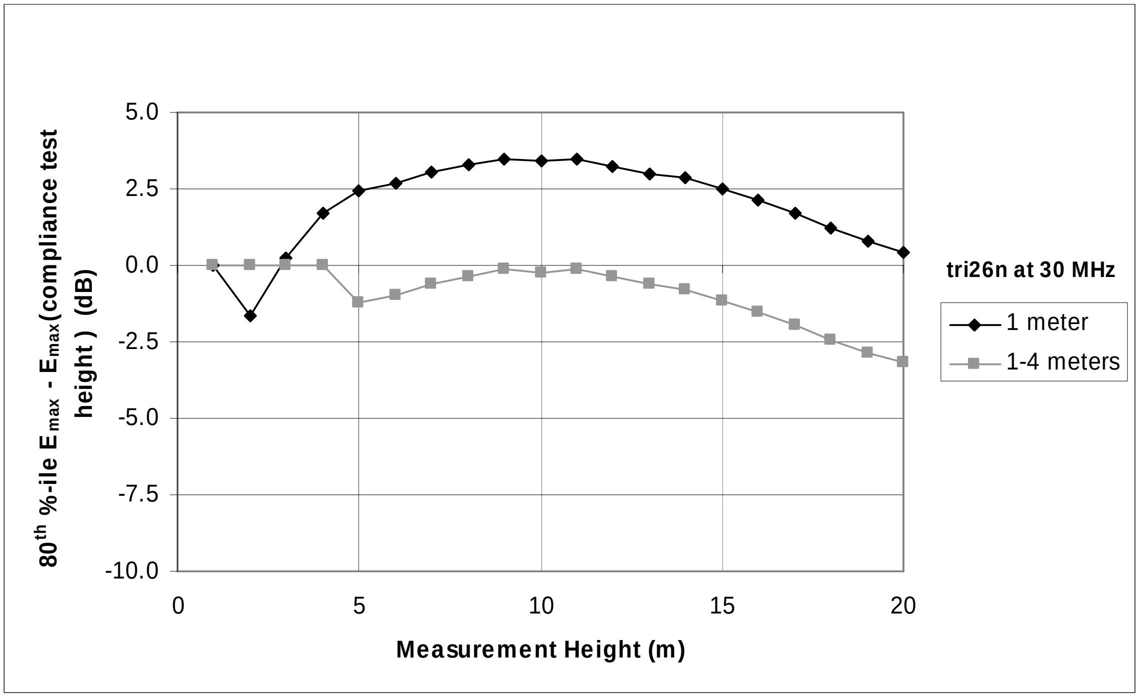
30 MHz Plots



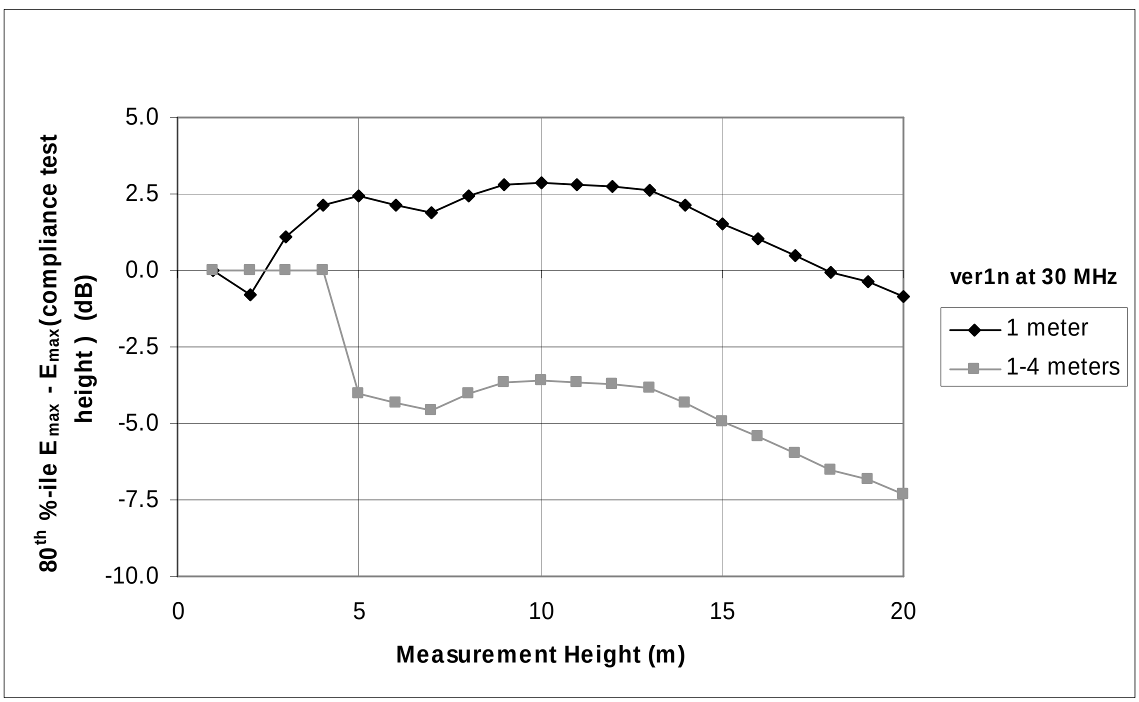
A-121: Comparison of electric field strength as a function of measurement height, if compliance measurements were performed at heights of 1 meter, or at 1 to 4 meters



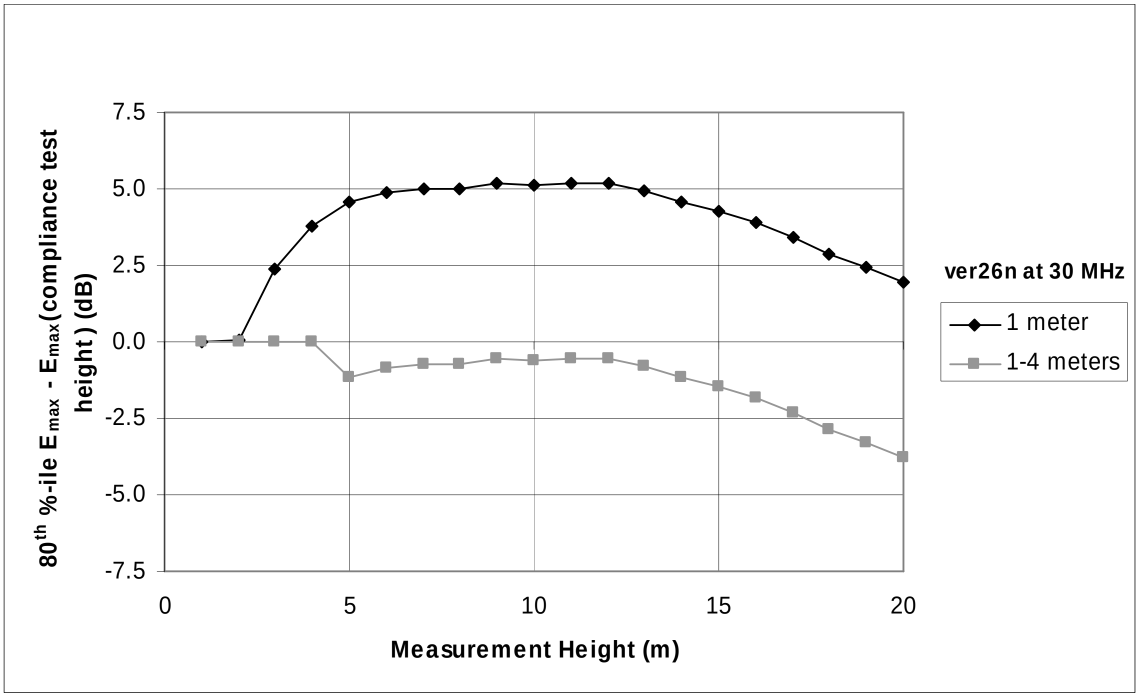
A-122: Comparison of electric field strength as a function of measurement height, if compliance measurements were performed at heights of 1 meter, or at 1 to 4 meters



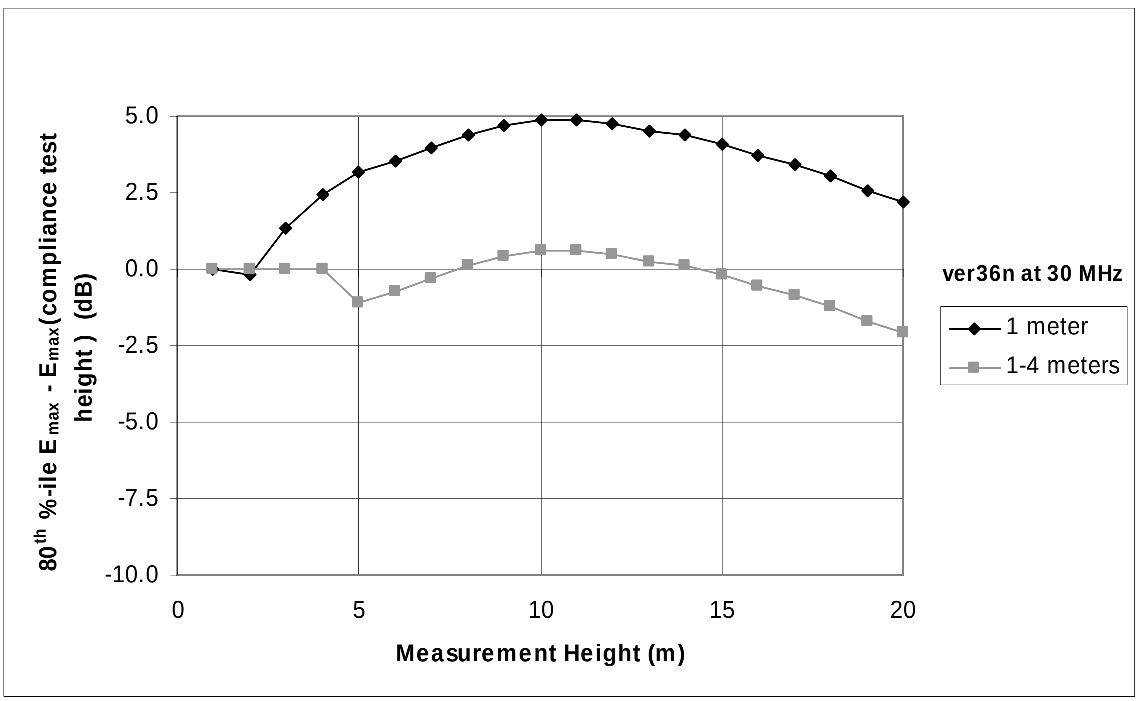
A-123: Comparison of electric field strength as a function of measurement height, if compliance measurements were performed at heights of 1 meter, or at 1 to 4 meters



A-124: Comparison of electric field strength as a function of measurement height, if compliance measurements were performed at heights of 1 meter, or at 1 to 4 meters

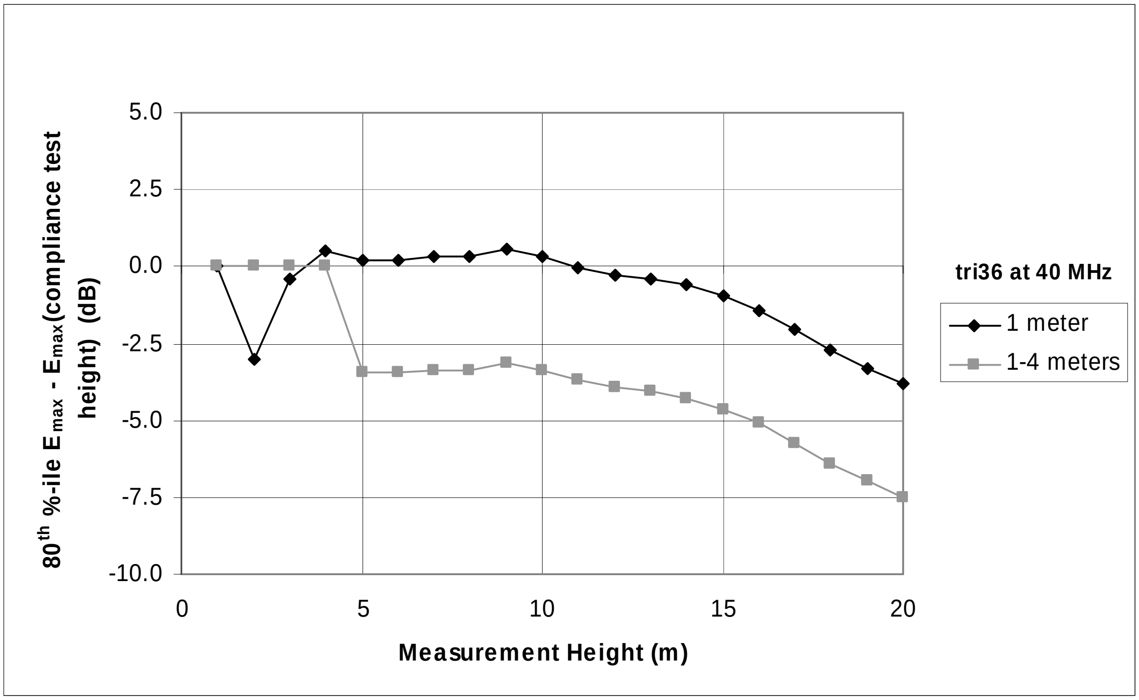


A-125: Comparison of electric field strength as a function of measurement height, if compliance measurements were performed at heights of 1 meter, or at 1 to 4 meters

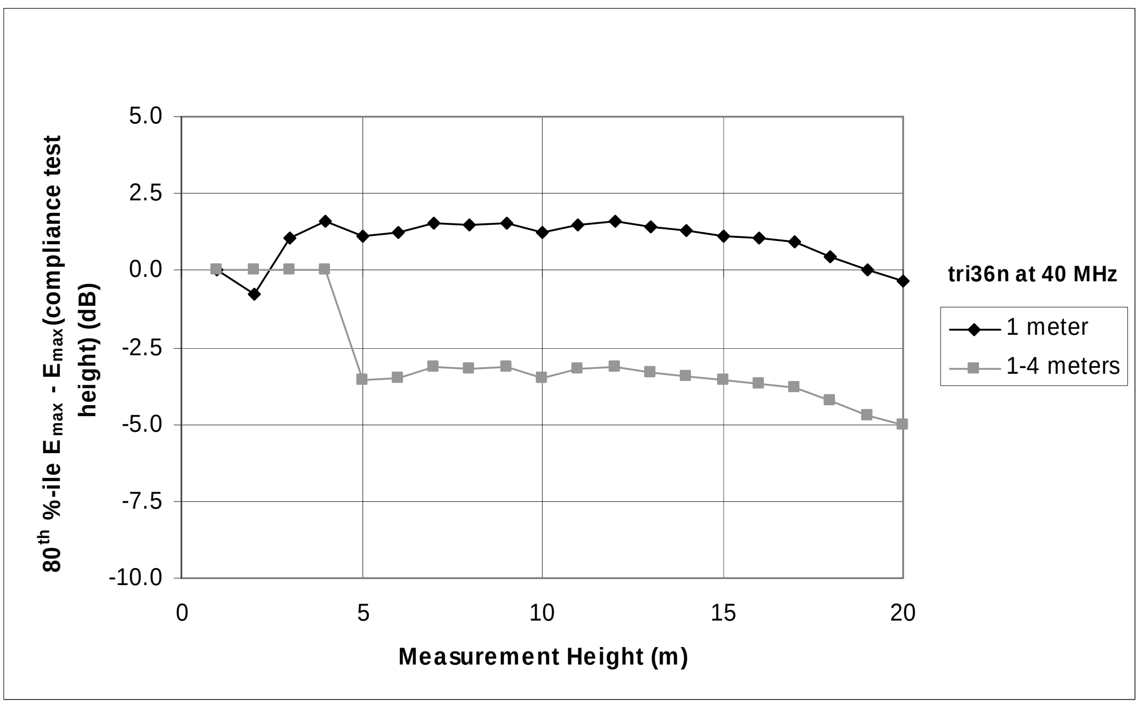


A-126: Comparison of electric field strength as a function of measurement height, if compliance measurements were performed at heights of 1 meter, or at 1 to 4 meters

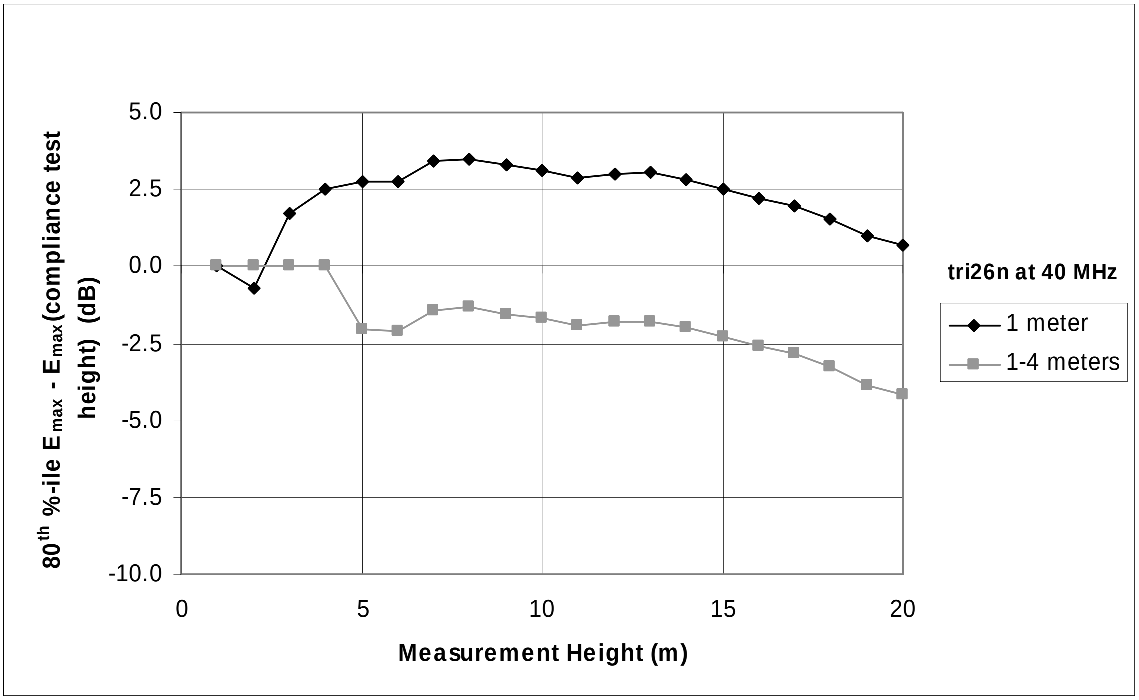
40 MHz Plots



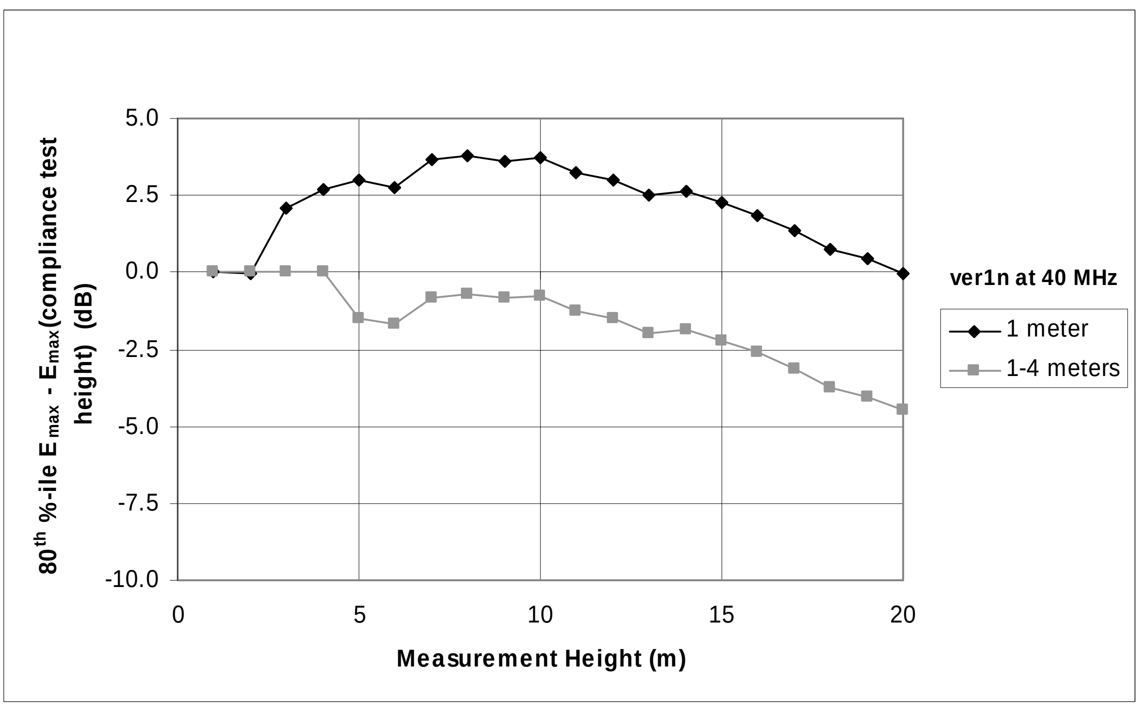
A-127: Comparison of electric field strength as a function of measurement height, if compliance measurements were performed at heights of 1 meter, or at 1 to 4 meters



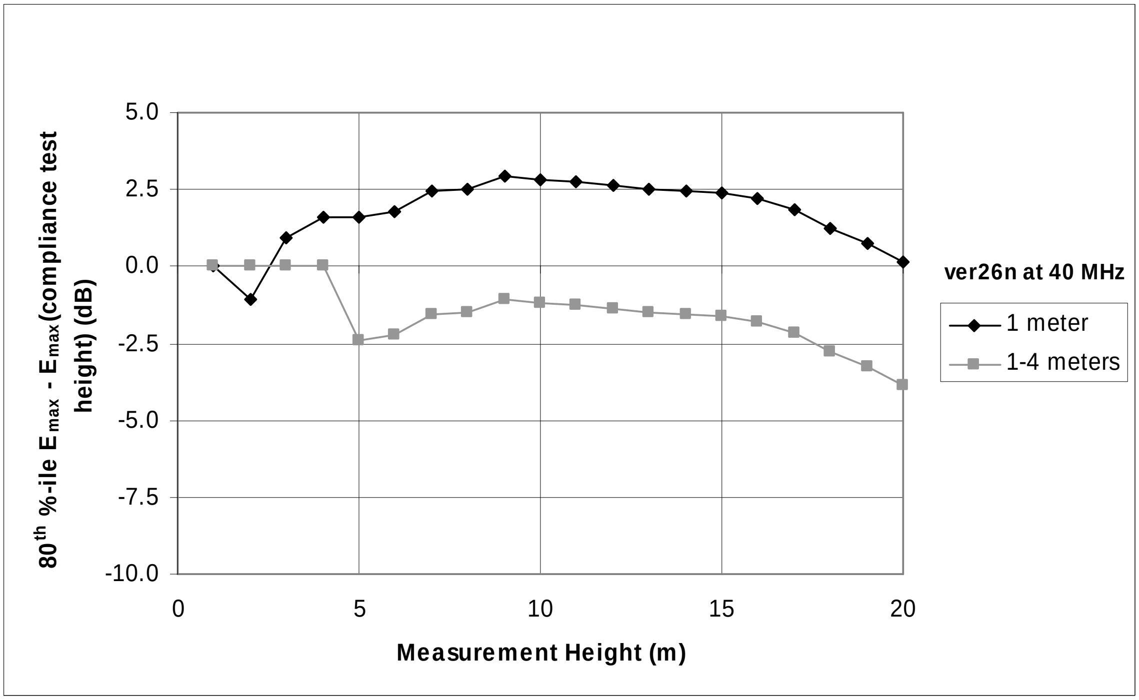
A-128: Comparison of electric field strength as a function of measurement height, if compliance measurements were performed at heights of 1 meter, or at 1 to 4 meters



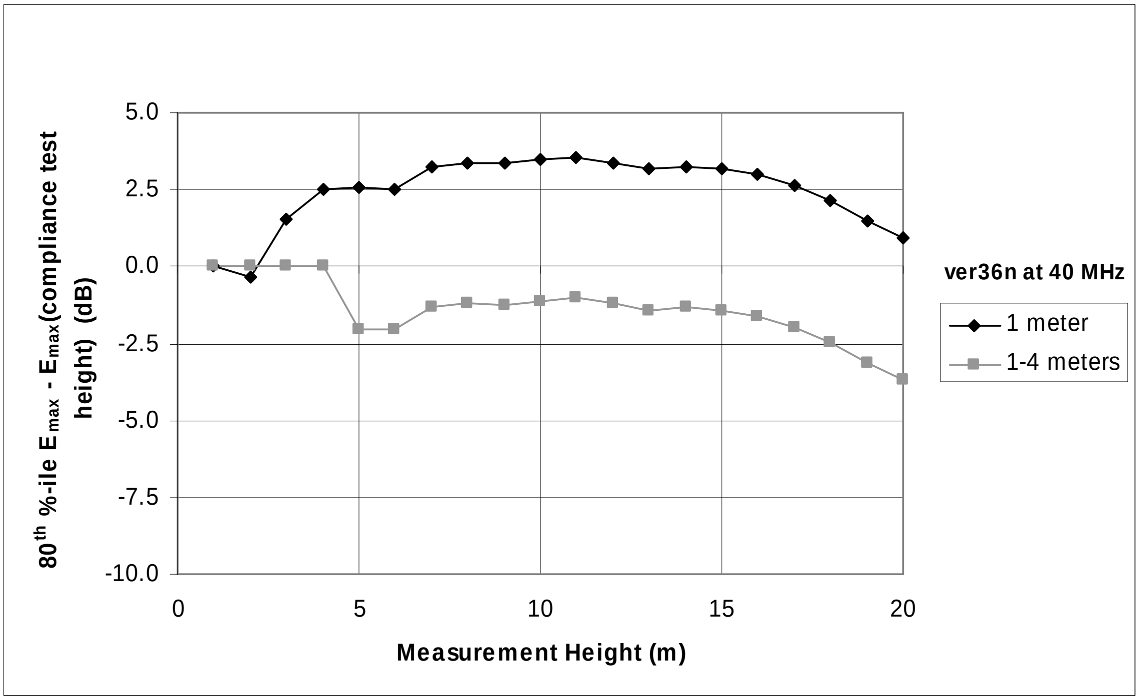
A-129: Comparison of electric field strength as a function of measurement height, if compliance measurements were performed at heights of 1 meter, or at 1 to 4 meters



A-130: Comparison of electric field strength as a function of measurement height, if compliance measurements were performed at heights of 1 meter, or at 1 to 4 meters

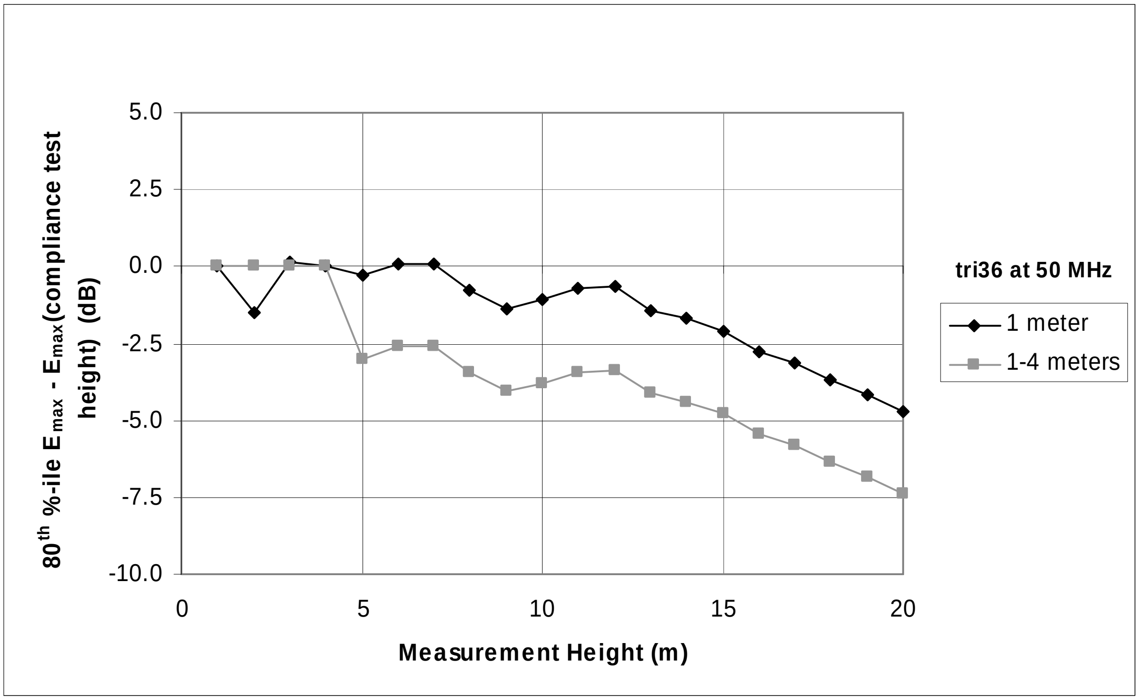


A-131: Comparison of electric field strength as a function of measurement height, if compliance measurements were performed at heights of 1 meter, or at 1 to 4 meters

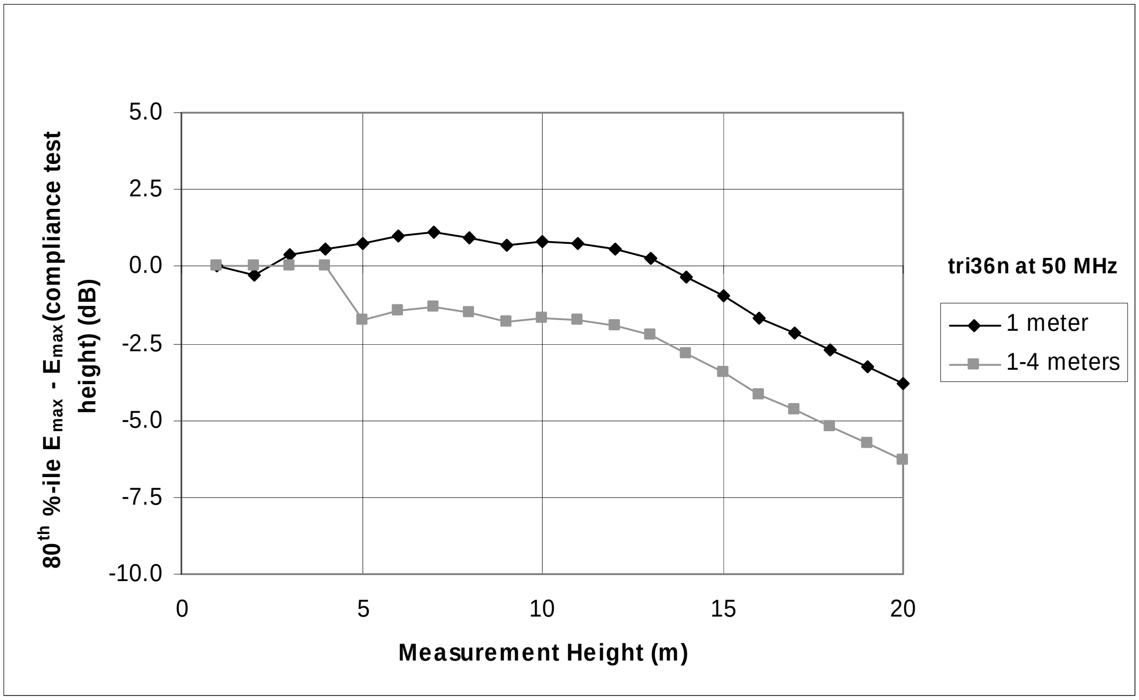


A-132: Comparison of electric field strength as a function of measurement height, if compliance measurements were performed at heights of 1 meter, or at 1 to 4 meters

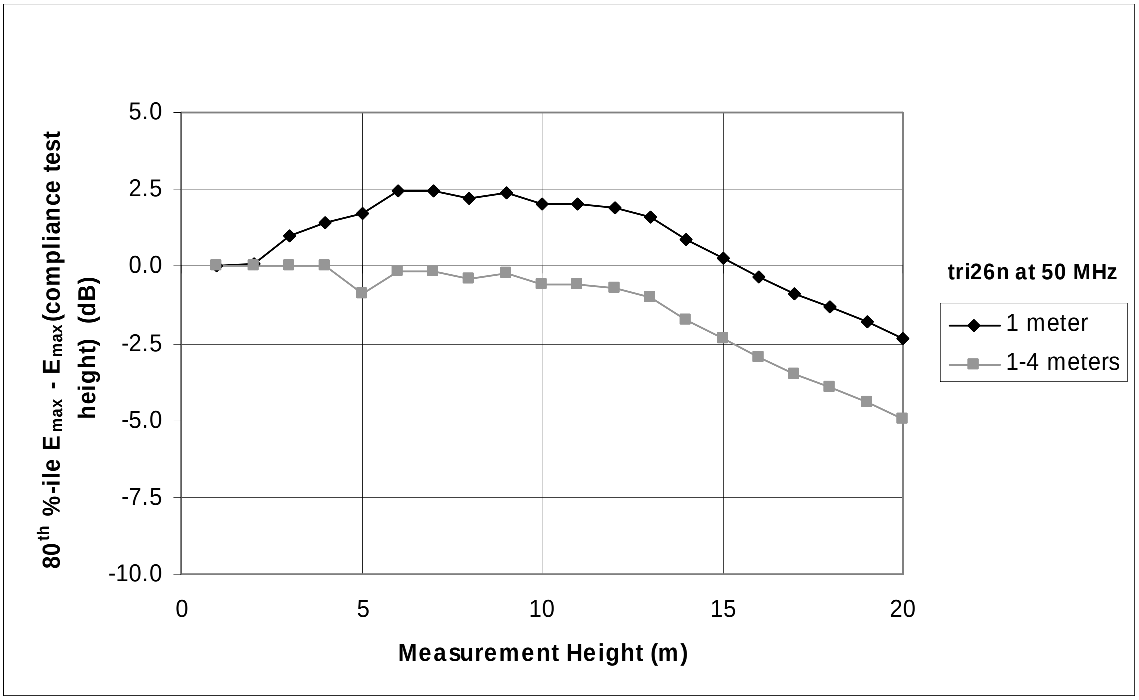
50 MHz Plots



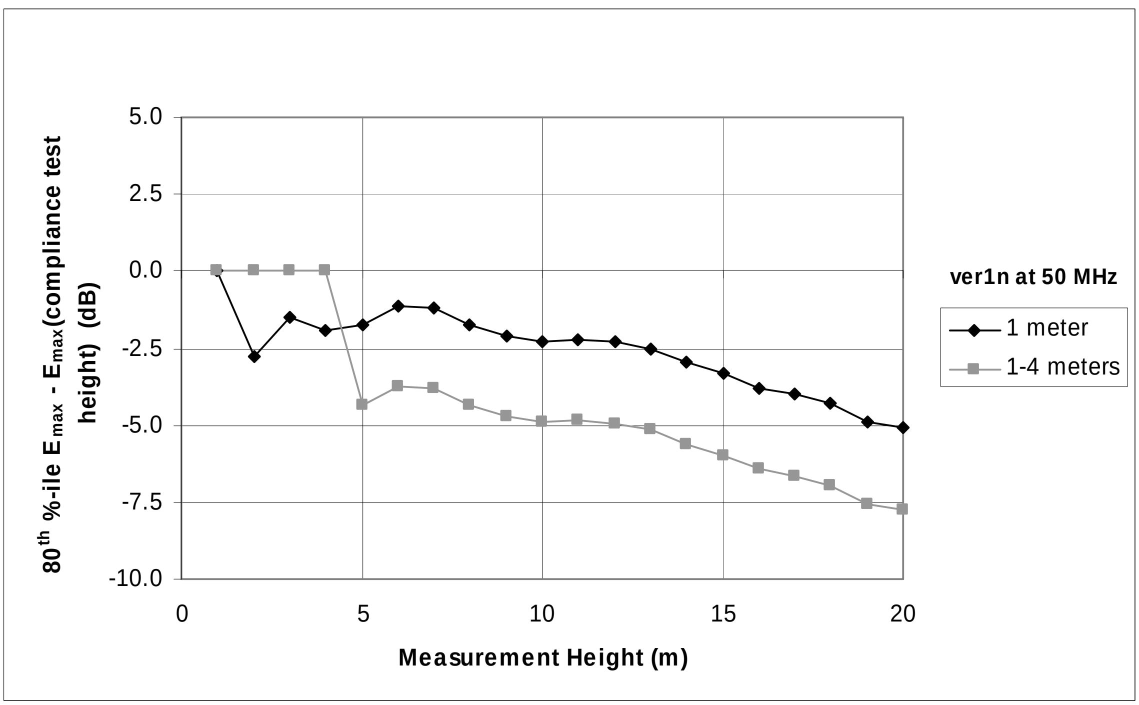
A-133: Comparison of electric field strength as a function of measurement height, if compliance measurements were performed at heights of 1 meter, or at 1 to 4 meters



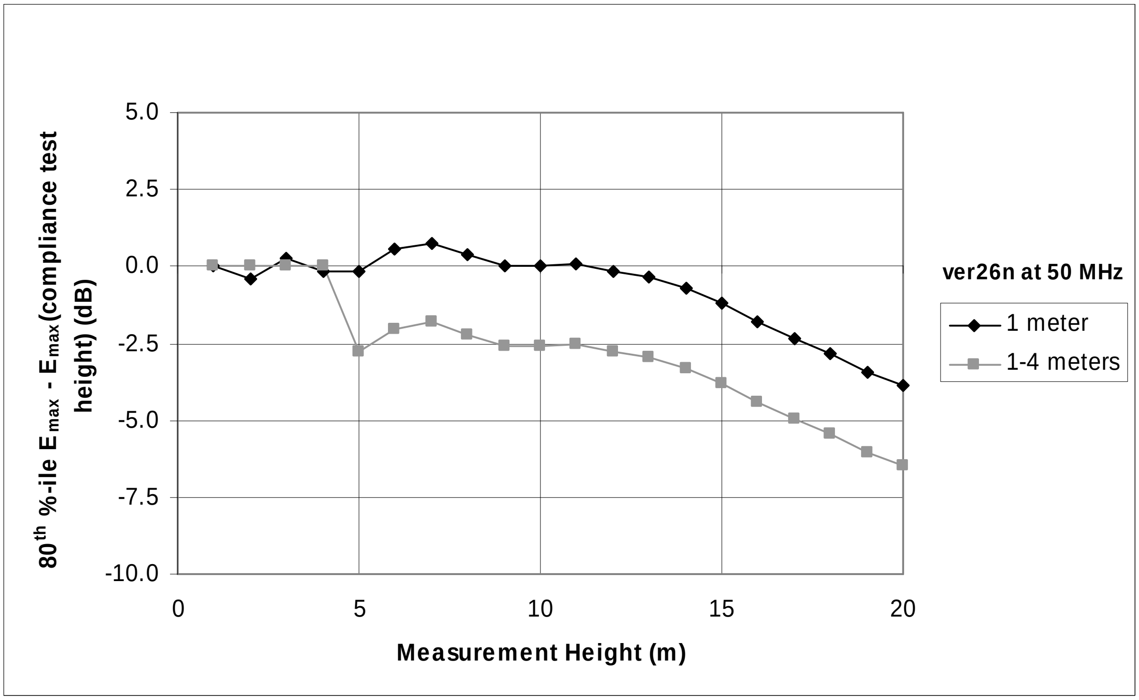
A-134: Comparison of electric field strength as a function of measurement height, if compliance measurements were performed at heights of 1 meter, or at 1 to 4 meters



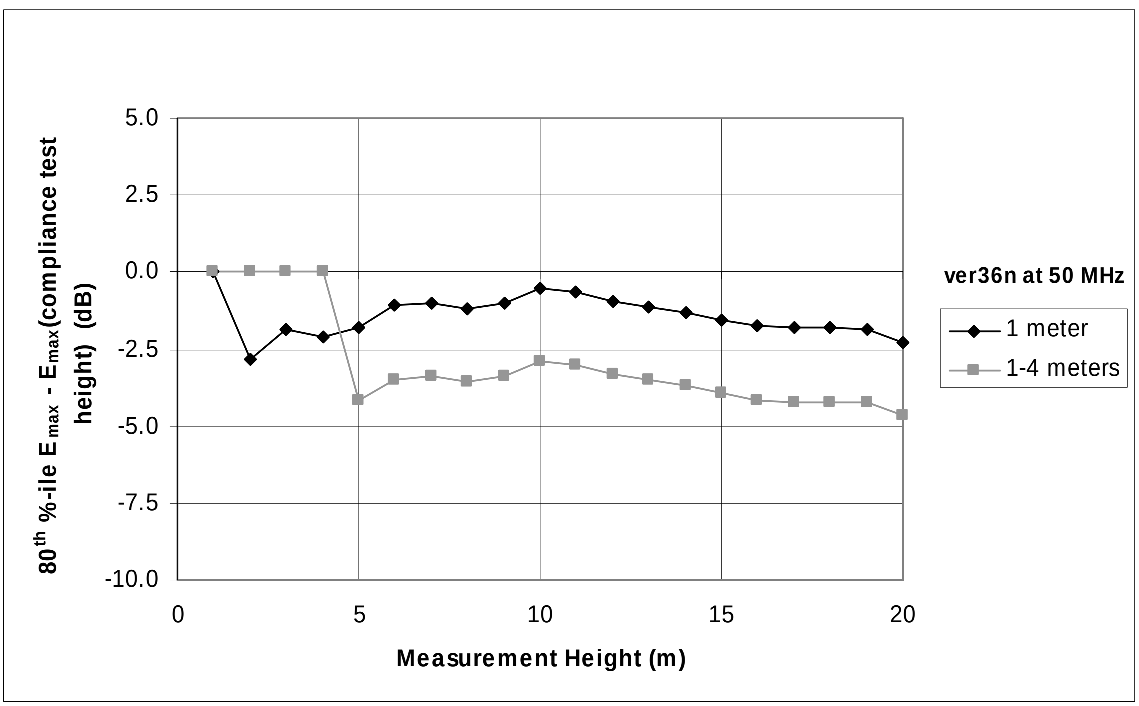
A-135: Comparison of electric field strength as a function of measurement height, if compliance measurements were performed at heights of 1 meter, or at 1 to 4 meters



A-136: Comparison of electric field strength as a function of measurement height, if compliance measurements were performed at heights of 1 meter, or at 1 to 4 meters



A-137: Comparison of electric field strength as a function of measurement height, if compliance measurements were performed at heights of 1 meter, or at 1 to 4 meters



A-138: Comparison of electric field strength as a function of measurement height, if compliance measurements were performed at heights of 1 meter, or at 1 to 4 meters

APPENDIX B
MEASUREMENT DISTANCE ALONG THE POWER LINE

B.1 INTRODUCTION

As noted in the NTIA Phase 1 Study, compliance measurement testing commissioned by BPL equipment vendors and service providers has generally focused on radiated emissions measured on radials from the BPL device under test. However, FCC rules state that Part 15 devices and all attached wiring should be considered when measuring radiated emissions.[2] The Commission's BPL measurement guidelines specify the locations along the power line away from a BPL device where field strength measurements are to be taken.[3] This Appendix provides NTIA's results from evaluating the field strength along the length of the power line and comparing this to the field strength levels at the prescribed measurement locations.

B.2 SIMULATION RESULTS

Figures B-1 through B-84 show the electric field strength level along the power line for a variety of simulated power line configurations, and over the frequency range of 2 to 28 MHz. Each figure includes the Part 15 radiated emissions limit extrapolated to a measurement distance of 10 meters assuming the power line height is 12 meters.[4] In addition, these figures show the measurement points specified in the measurement guidelines. The peak value of these points was used to scale the signal source level so that the power line model satisfies the Part 15 limit, as extrapolate to the 10 meter measurement distance. Electric field strength values were determined from NEC magnetic field strength simulations of the power line models using the methodology described in Section 2.2.

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[2] *See* 47 C.F.R. §15.31(g)-(k).

[3] *See* BPL Report and Order, at Appendix C ¶ 2.b.2 ("Testing shall be performed at distances of 0, ¼, ½, ¾, and 1 wavelength down the line from the BPL injection point on the power line. Wavelength spacing is based on the mid-band frequency…").

[4] *Id.* ¶ 2.b.4 (describing the slant range distance extrapolation methodology).

2 MHz Plots

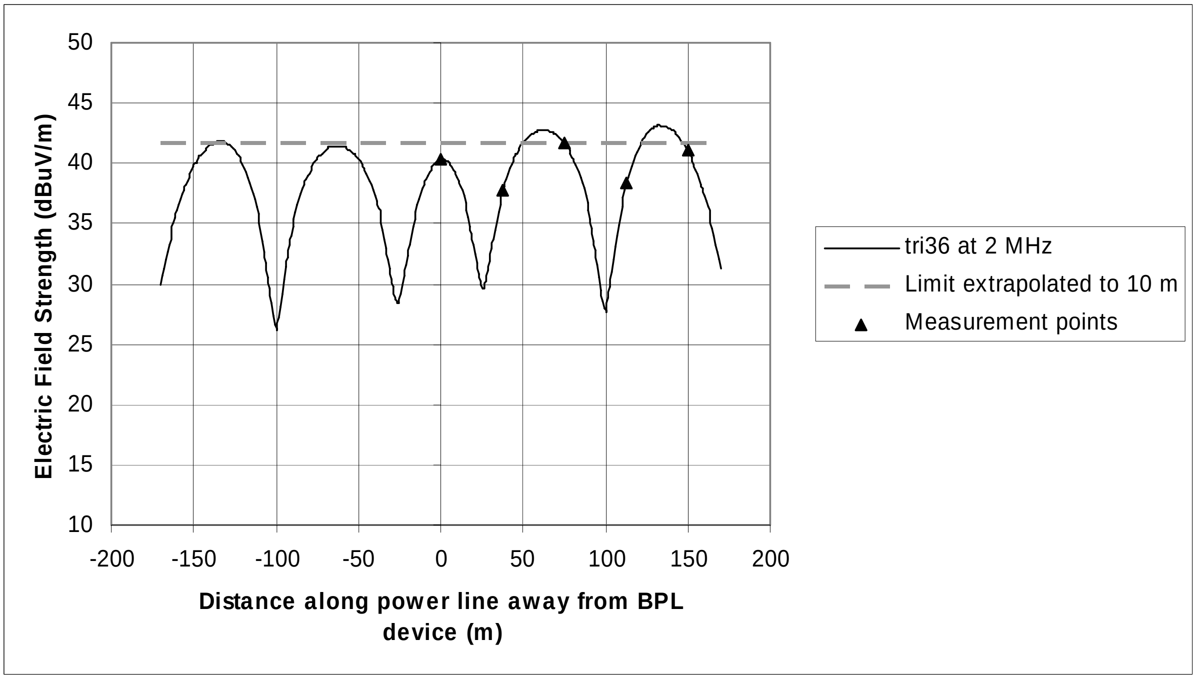

Figure B-1: Vertical electric field strength along power line for tri36 topology

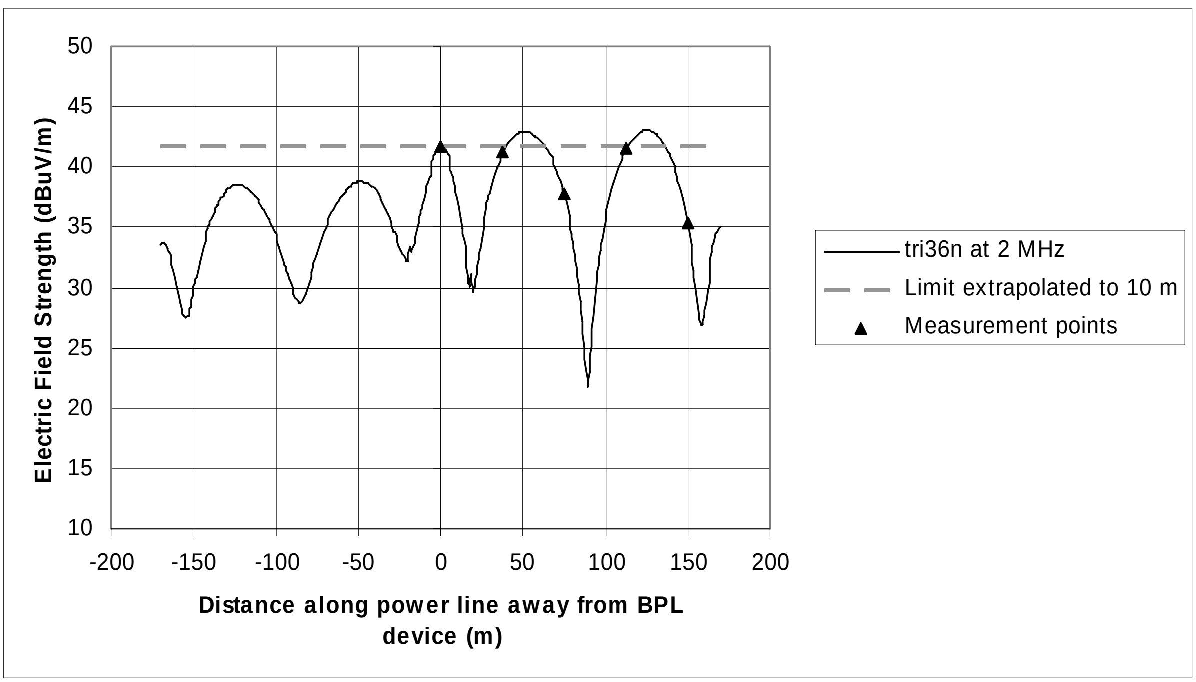

Figure B-2: Vertical electric field strength along power line for tri36n topology

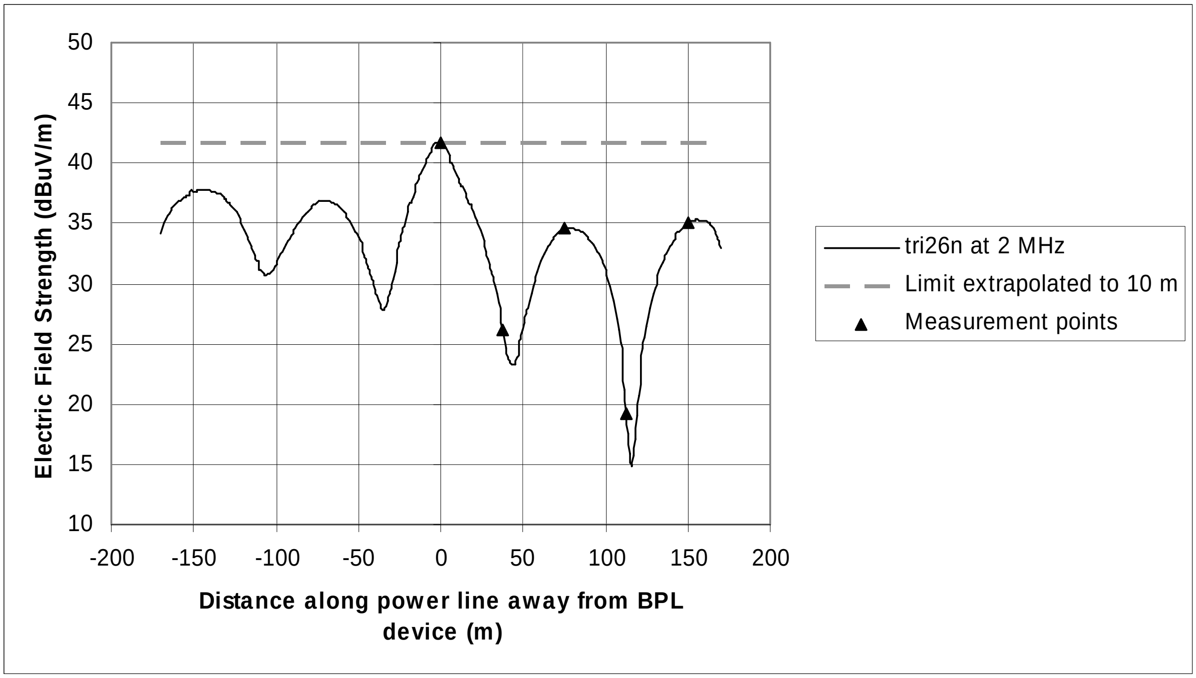

Figure B-3: Vertical electric field strength along power line for tri26n topology

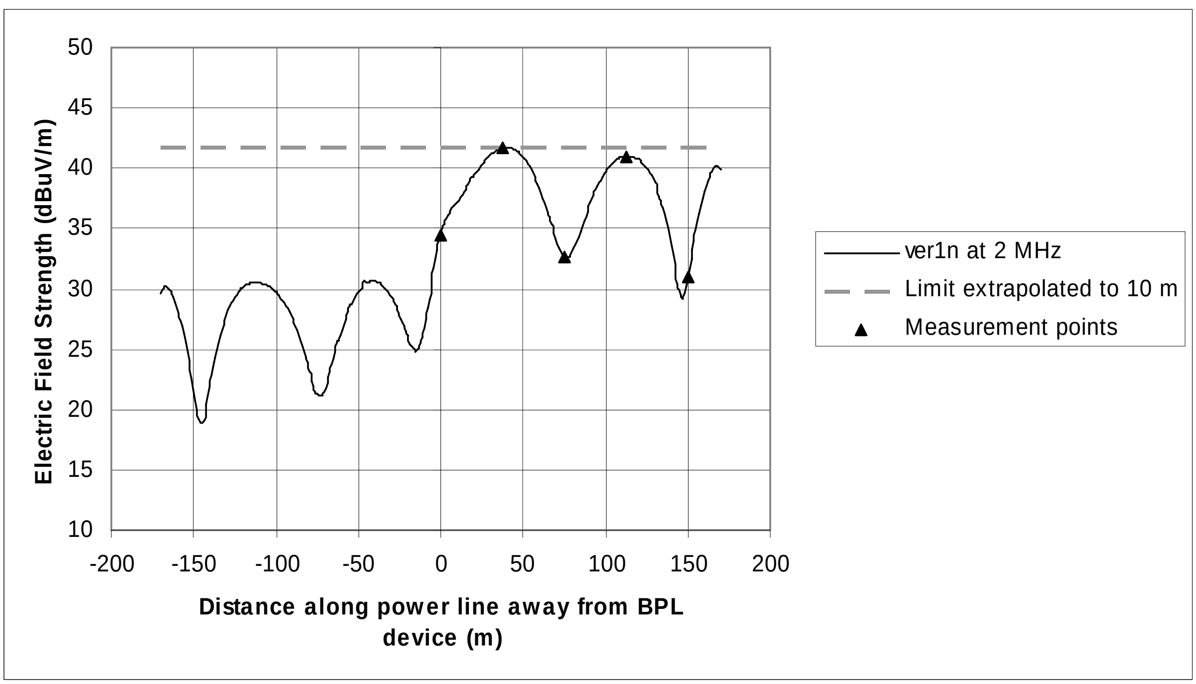

Figure B-4: Vertical electric field strength along power line for ver1n topology

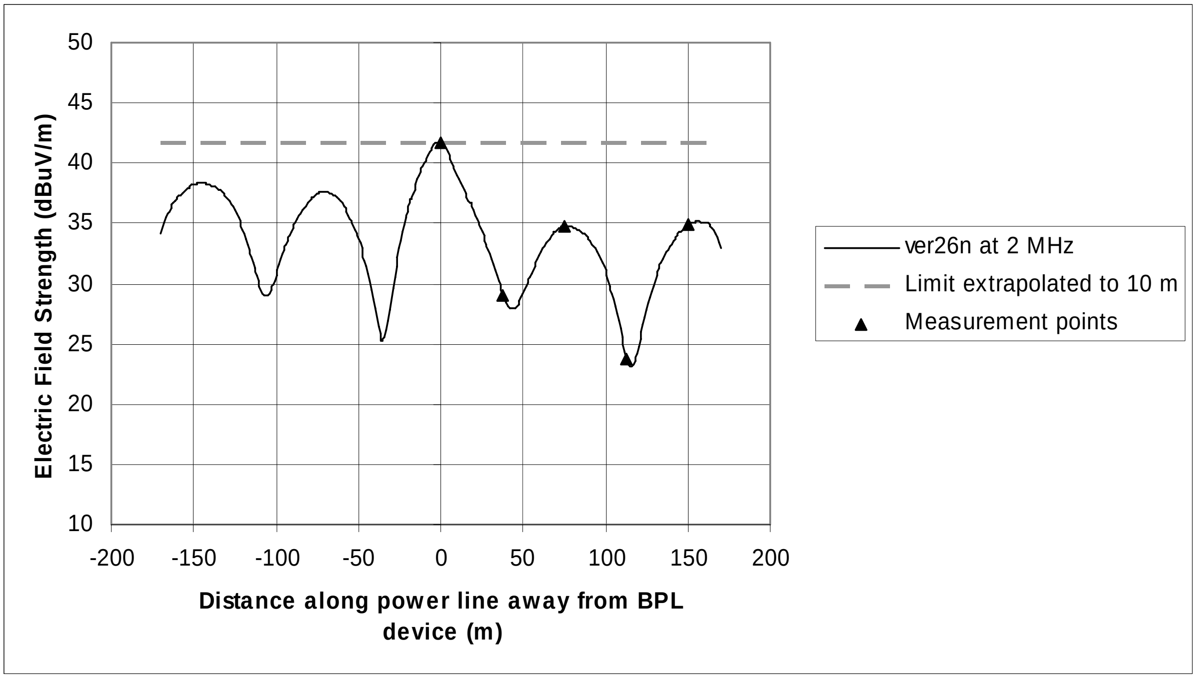

Figure B-5: Vertical electric field strength along power line for ver26n topology

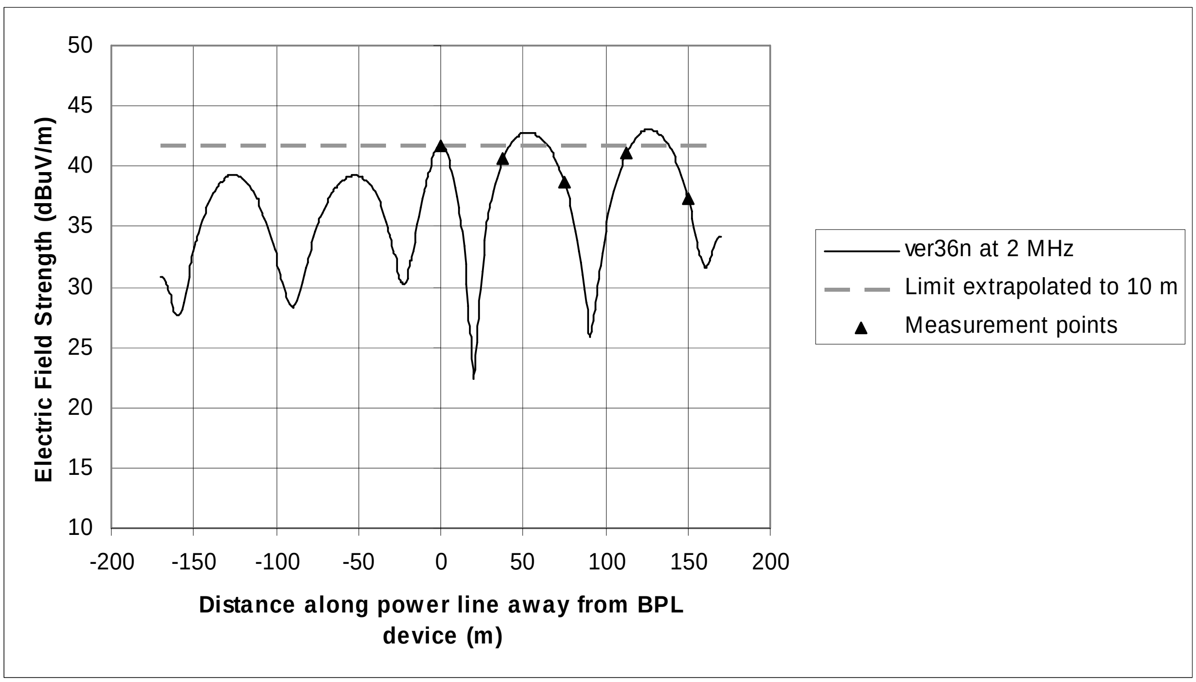

Figure B-6: Vertical electric field strength along power line for ver36n topology

4 MHz Plots

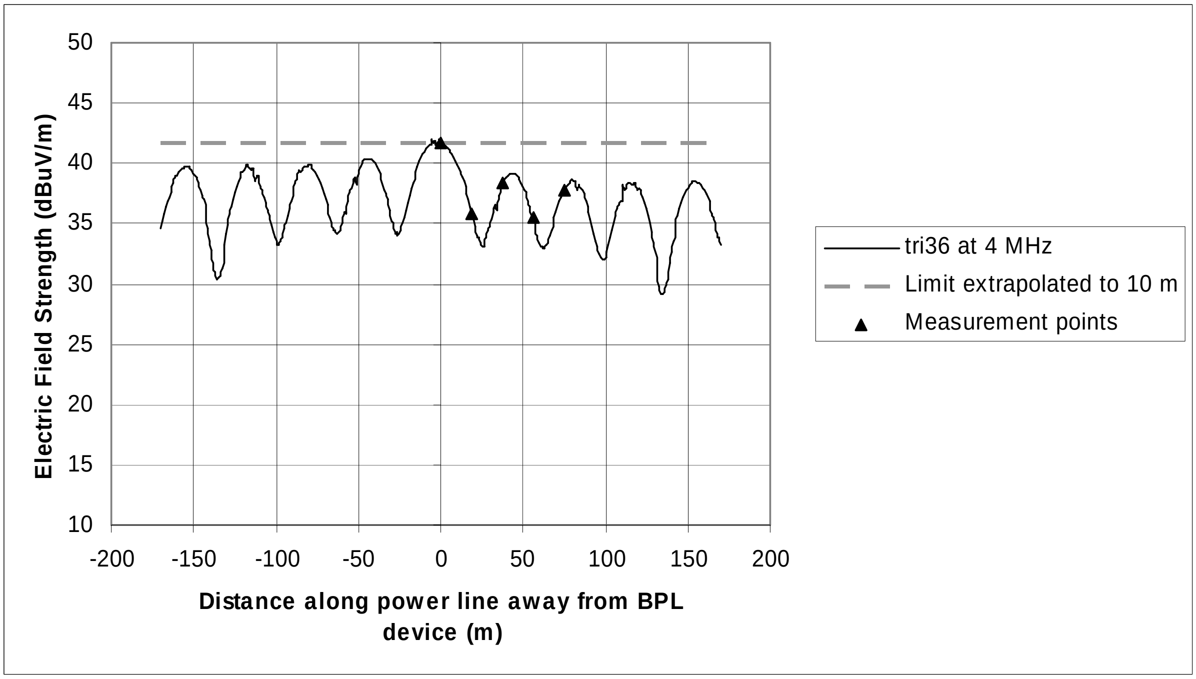

Figure B-7: Vertical electric field strength along power line for tri36 topology

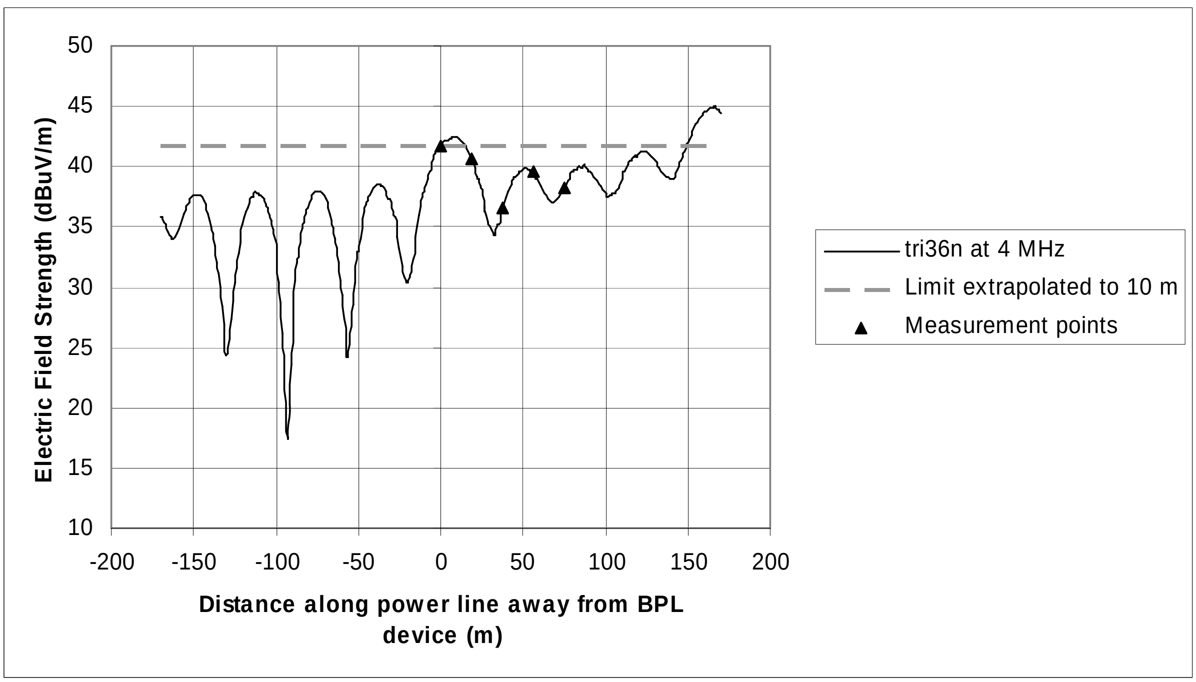

Figure B-8: Vertical electric field strength along power line for tri36n topology

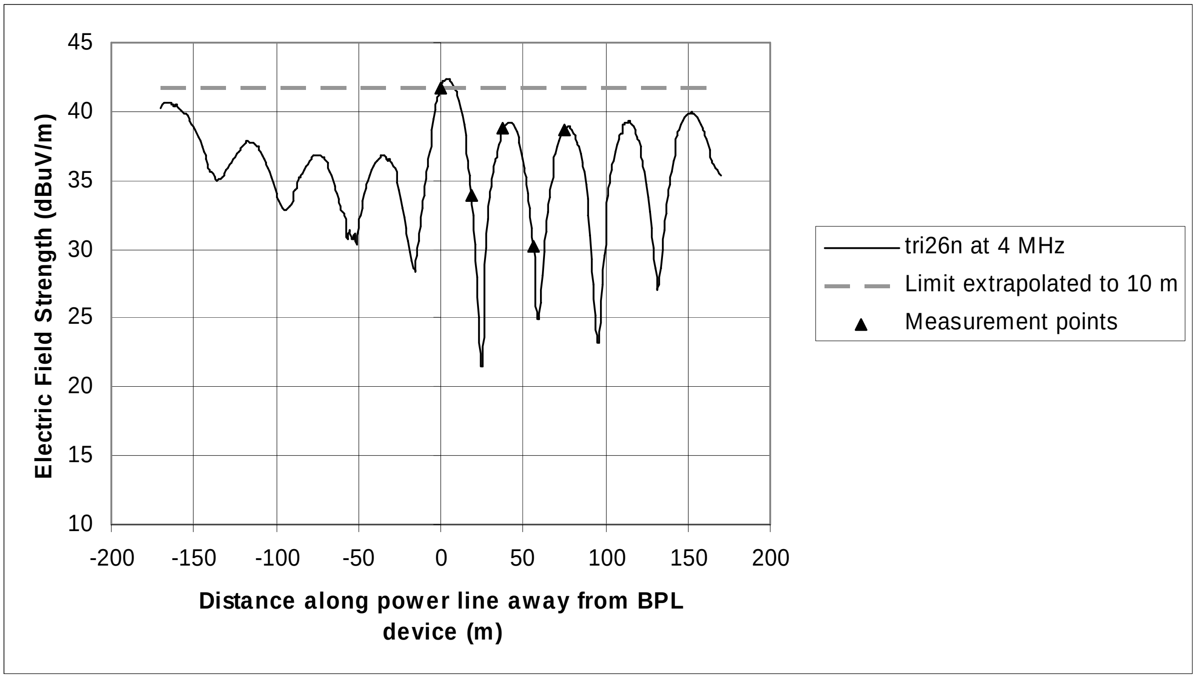

Figure B-9: Vertical electric field strength along power line for tri26n topology

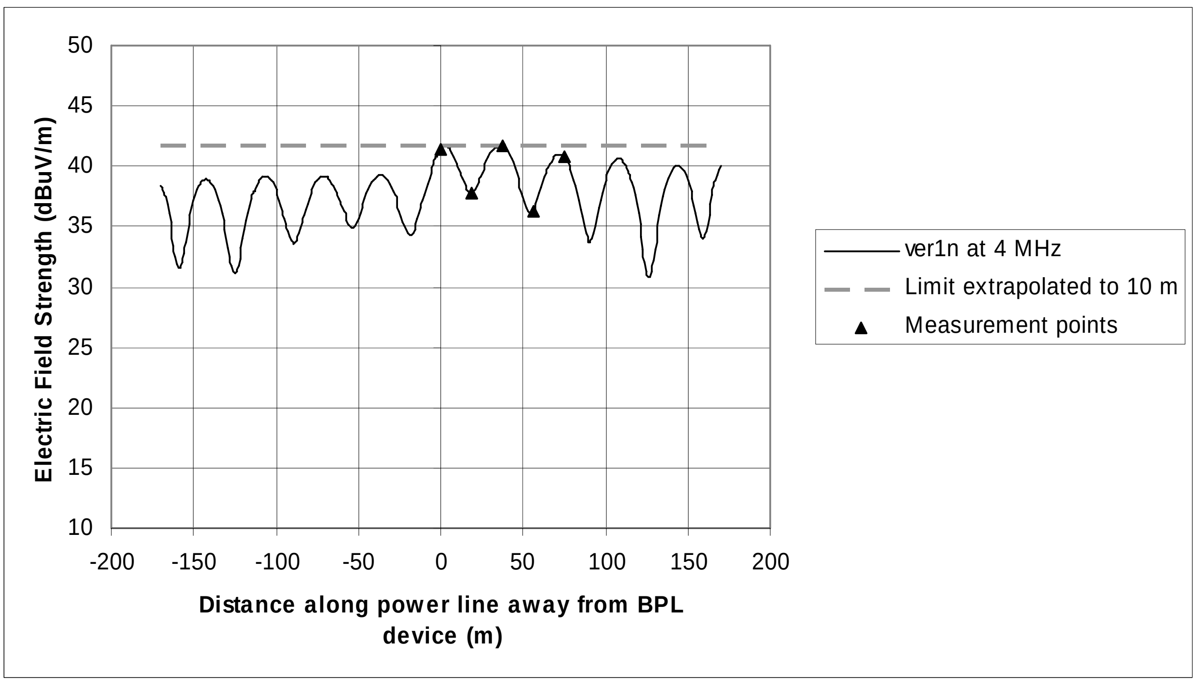

Figure B-10: Vertical electric field strength along power line for ver1n topology

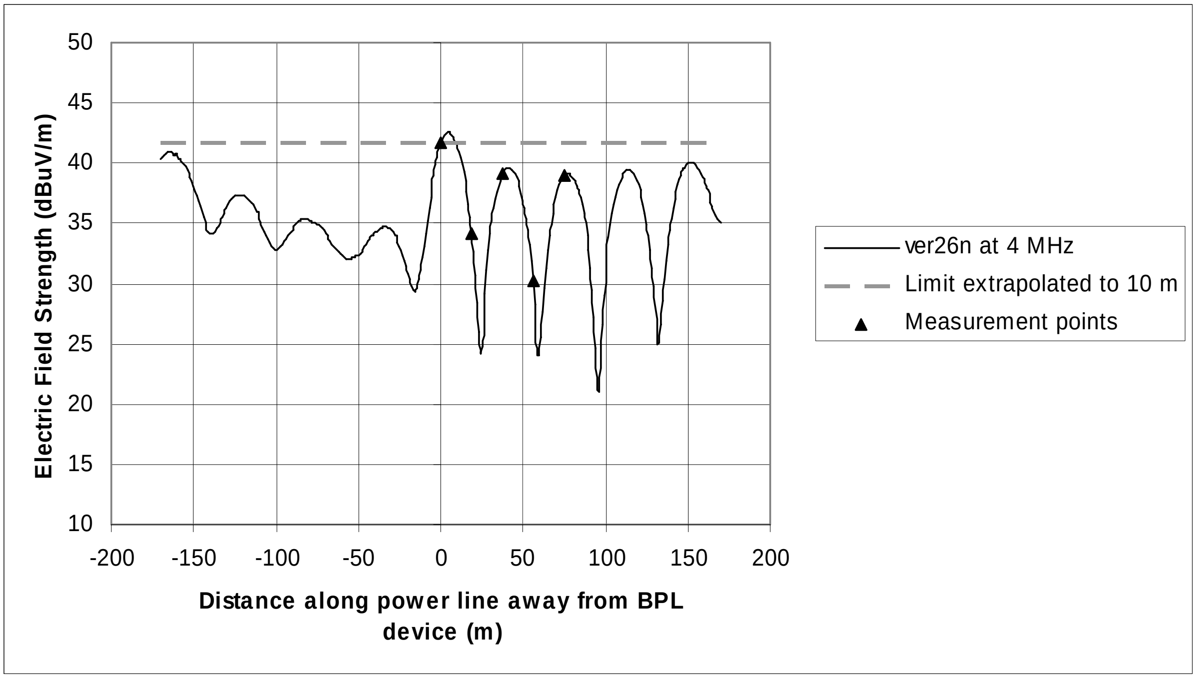

Figure B-11: Vertical electric field strength along power line for ver26n topology

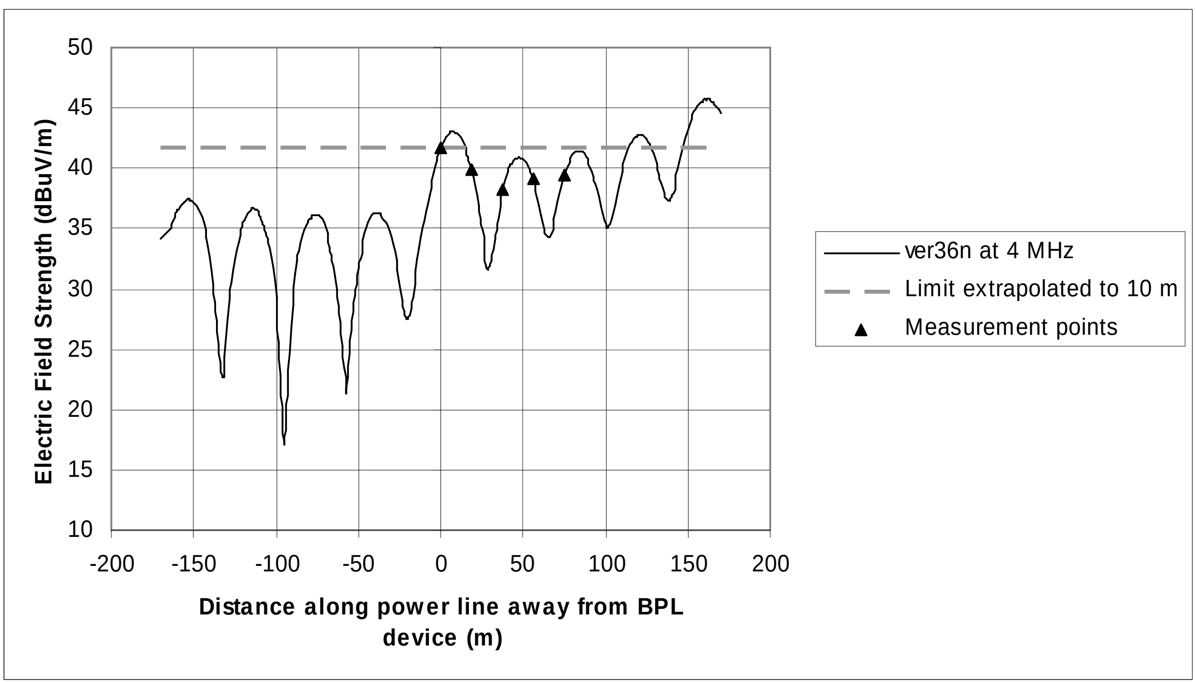

Figure B-12: Vertical electric field strength along power line for ver36n topology

6 MHz Plots

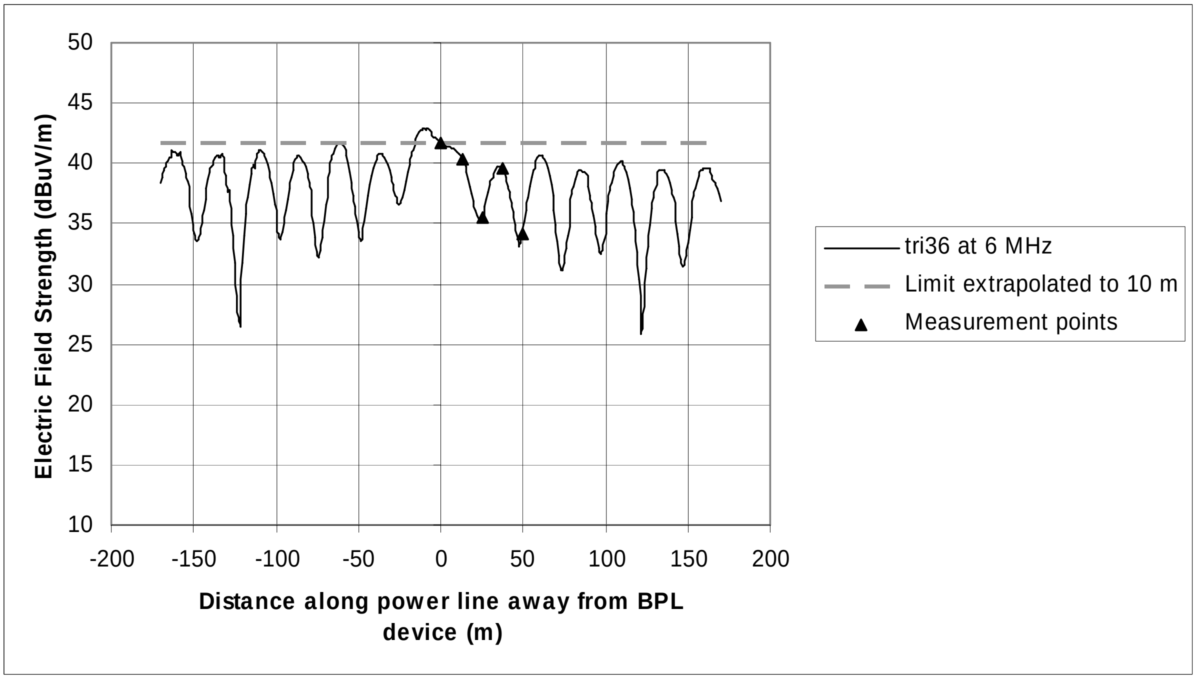

Figure B-13: Vertical electric field strength along power line for tri36 topology

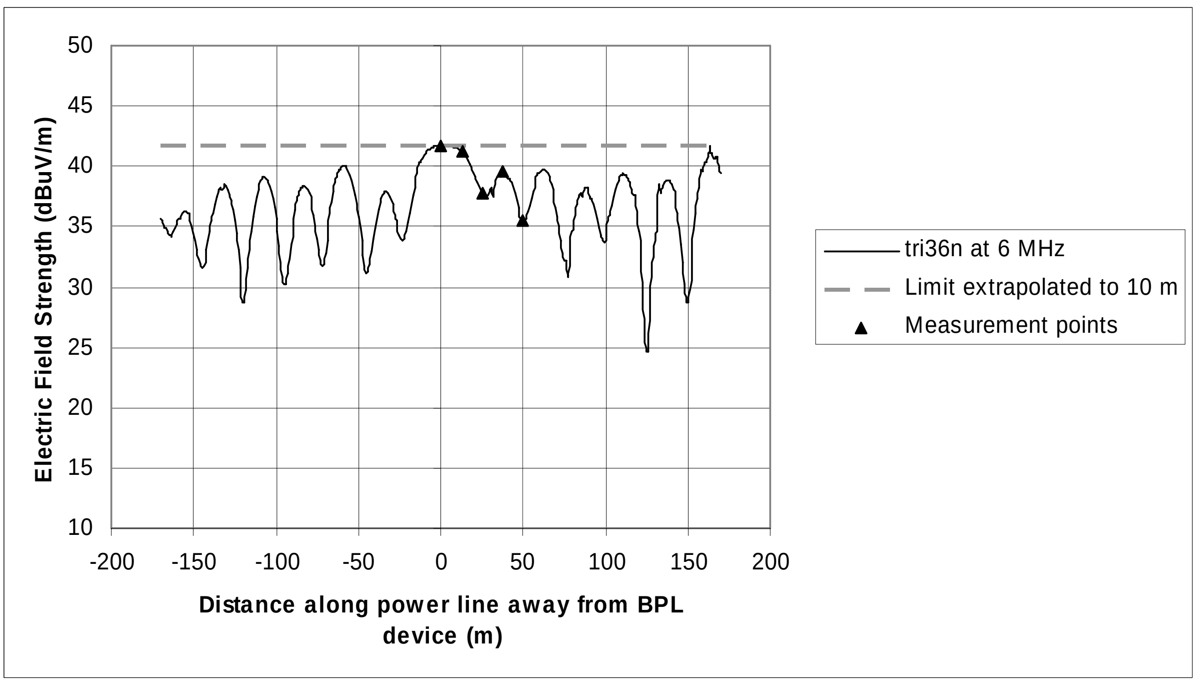

Figure B-14: Vertical electric field strength along power line for tri36n topology

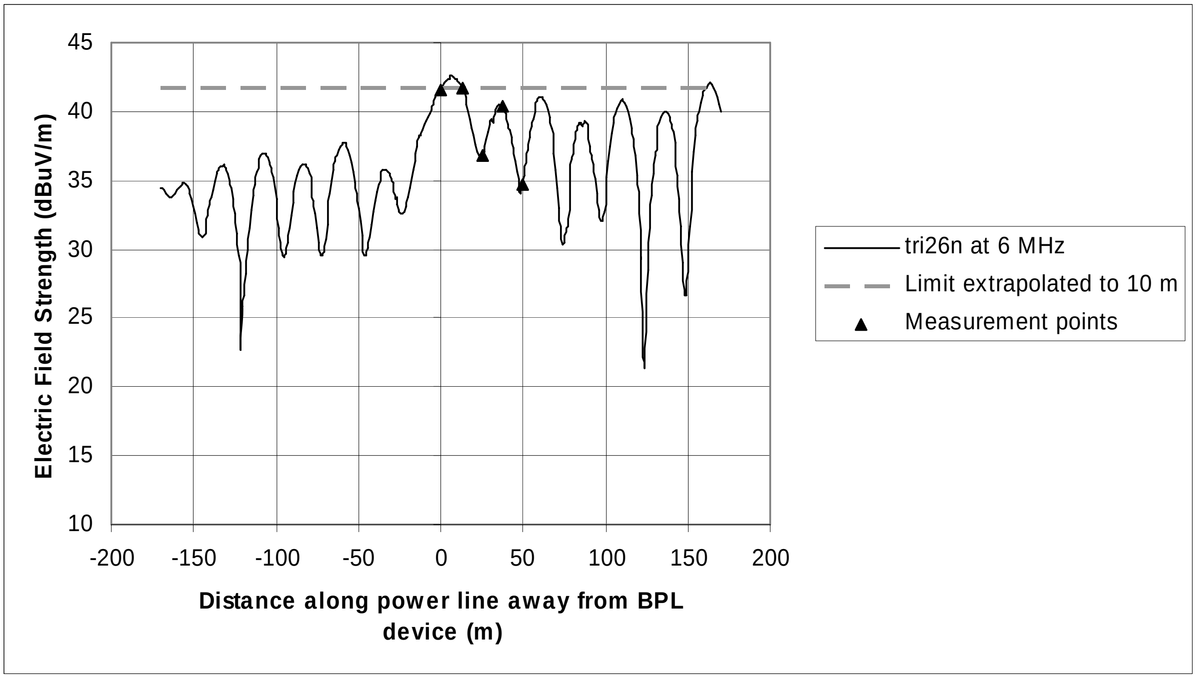

Figure B-15: Vertical electric field strength along power line for tri26n topology

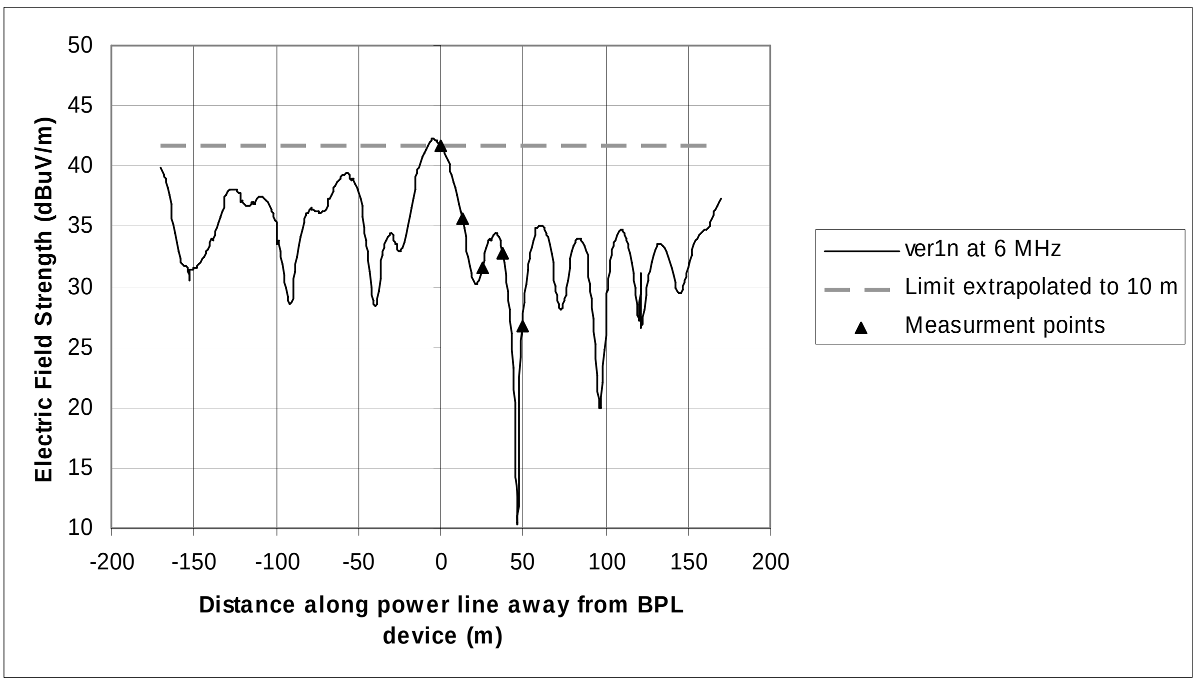

Figure B-16: Vertical electric field strength along power line for ver1n topology

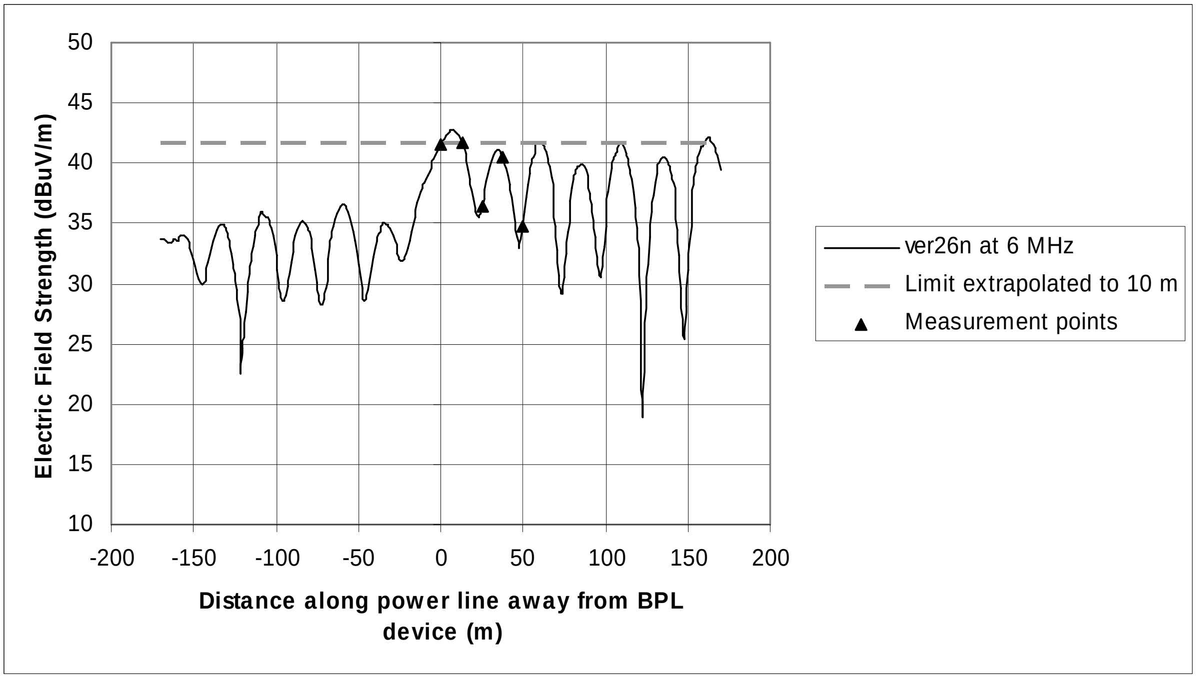

Figure B-17: Vertical electric field strength along power line for ver26n topology

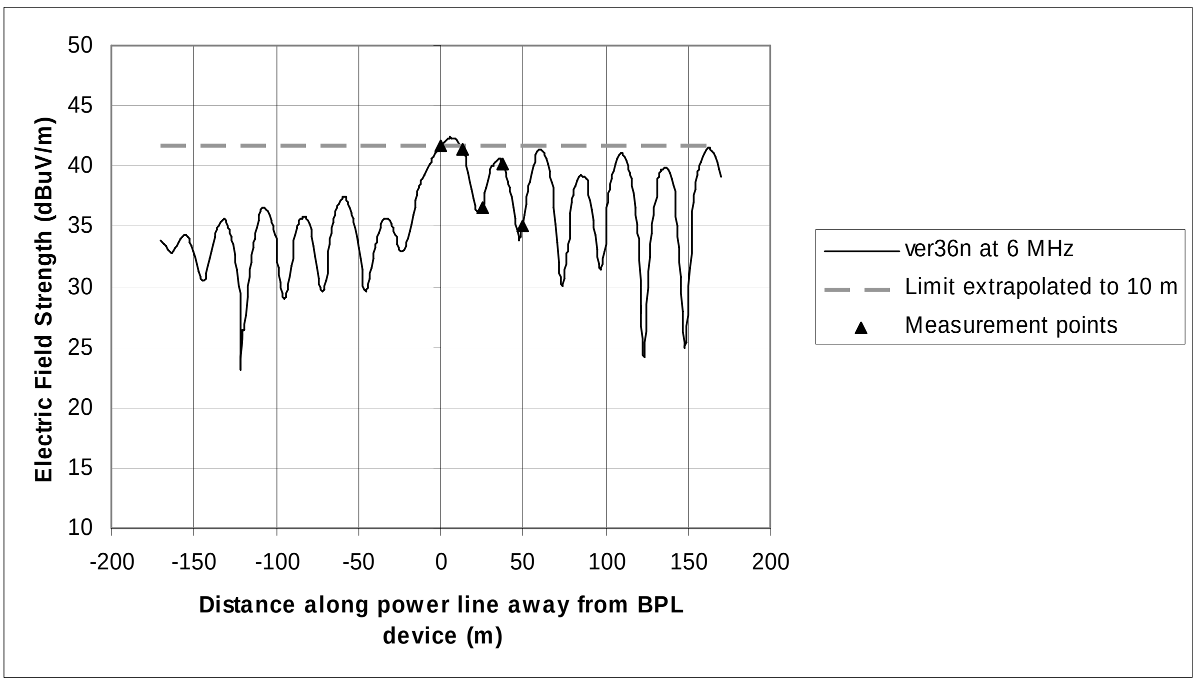

Figure B-18: Vertical electric field strength along power line for ver36n topology

8 MHz Plots

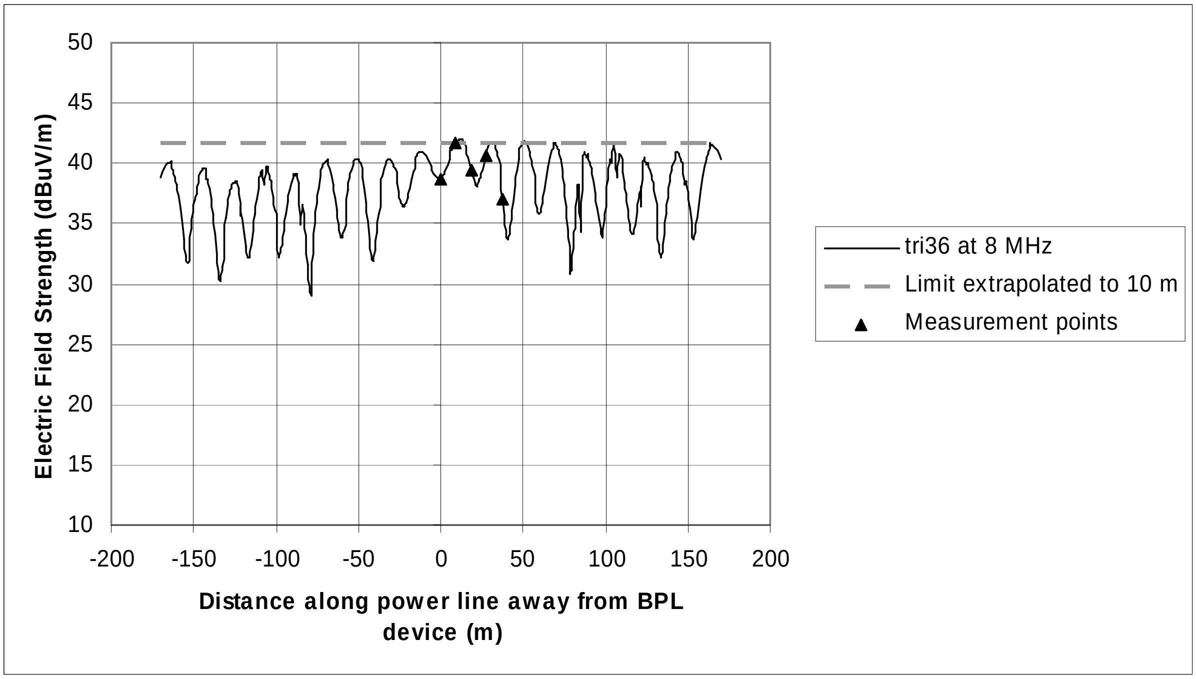

Figure B-19: Vertical electric field strength along power line for tri36 topology

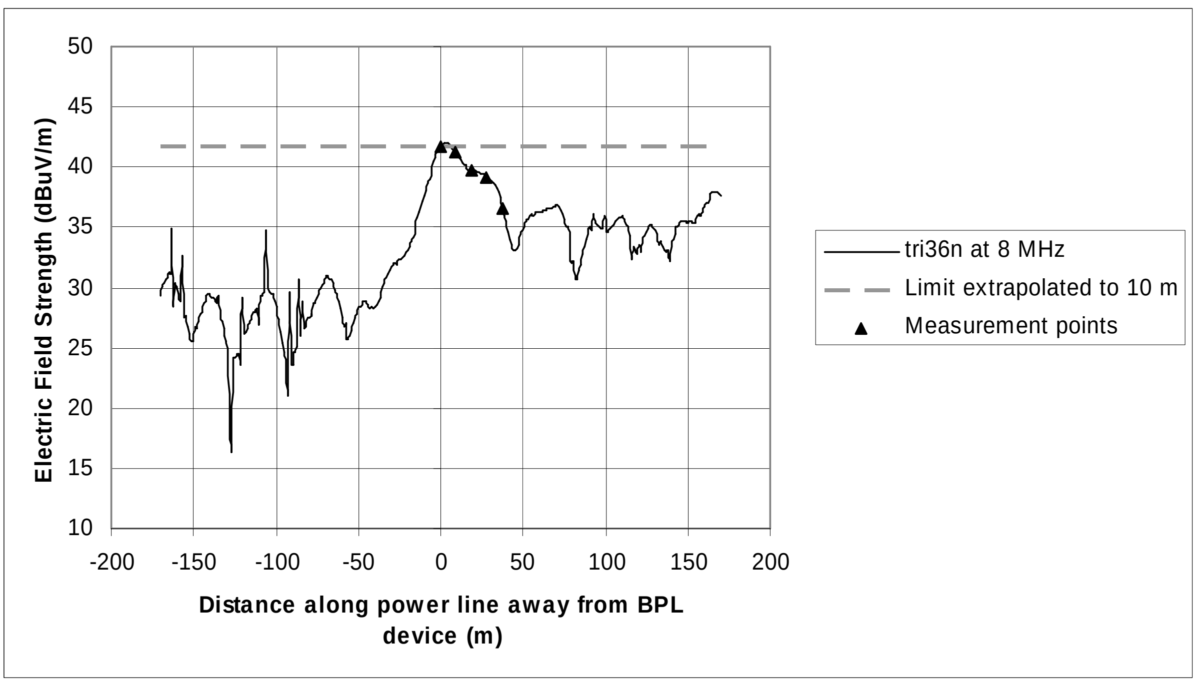

Figure B-20: Vertical electric field strength along power line for tri36n topology

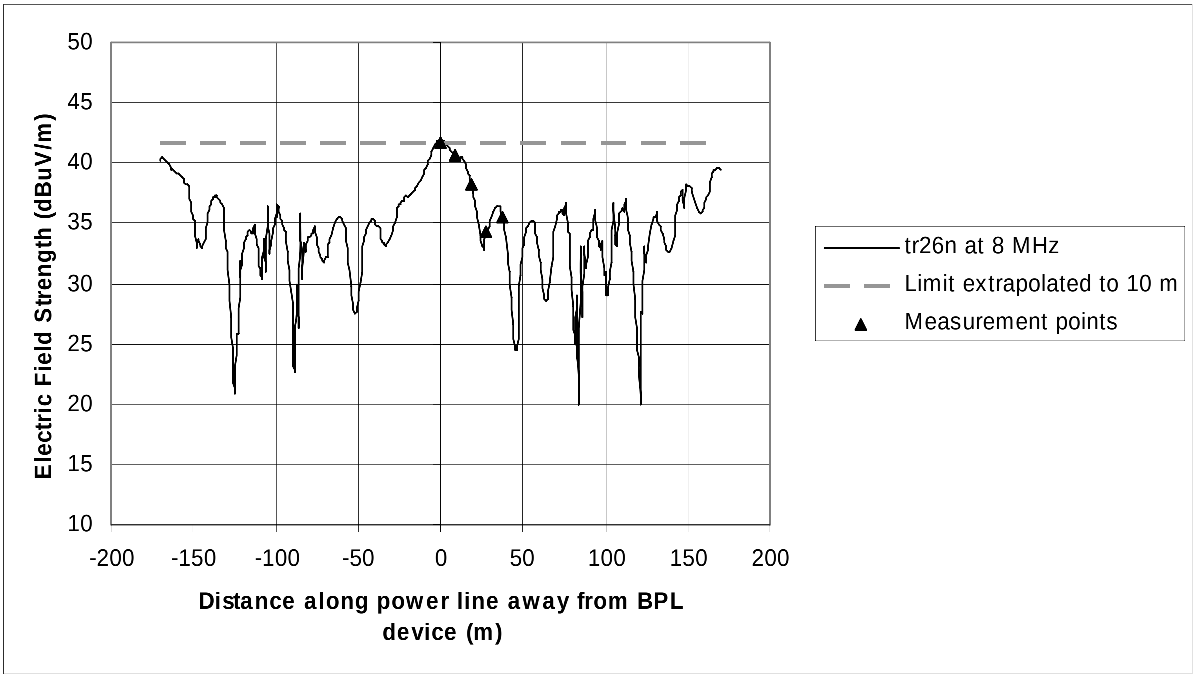

Figure B-21: Vertical electric field strength along power line for tri26n topology

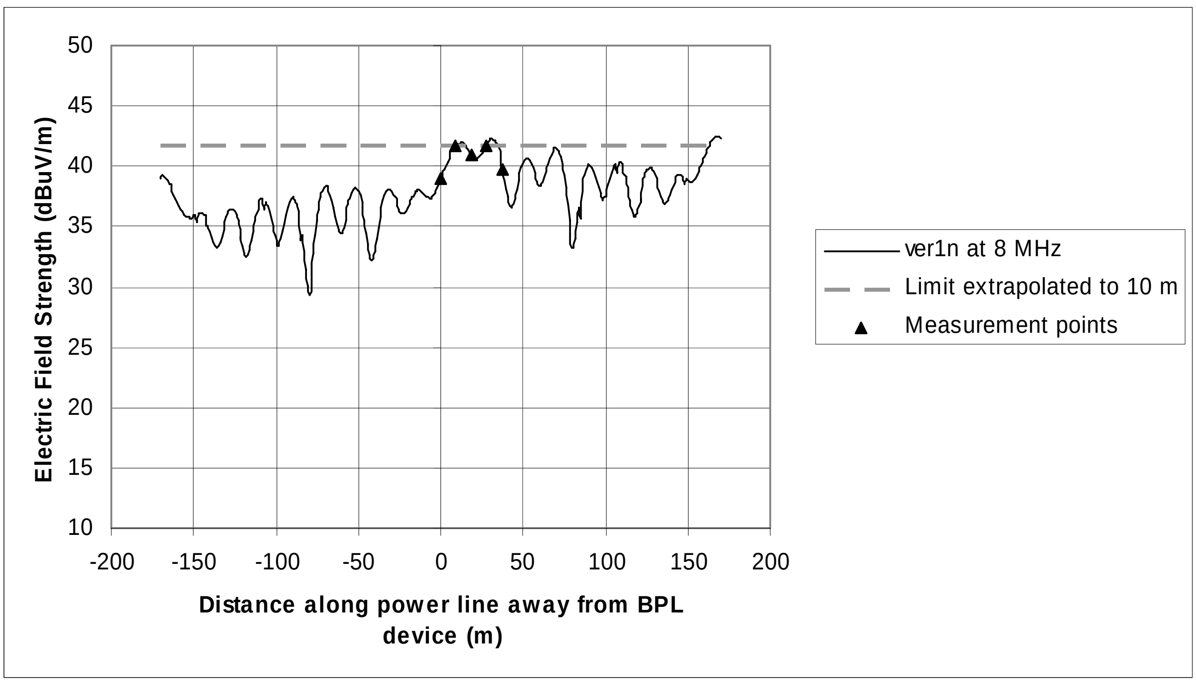

Figure B-22: Vertical electric field strength along power line for ver1n topology

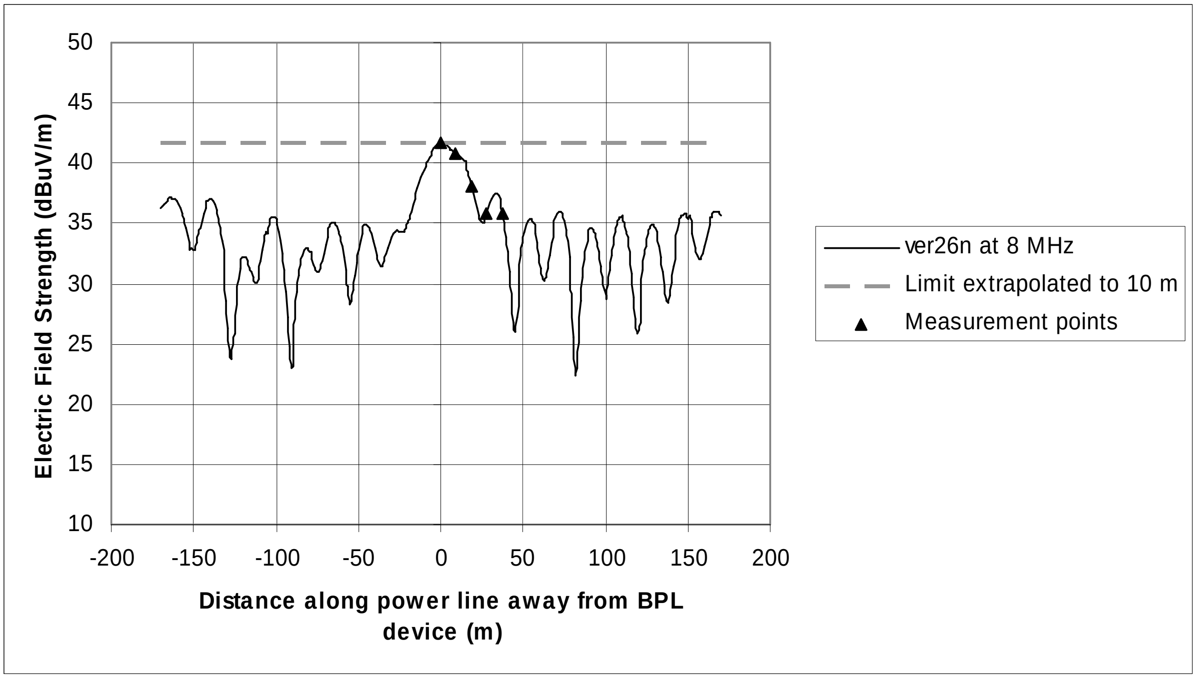

Figure B-23: Vertical electric field strength along power line for ver26n topology

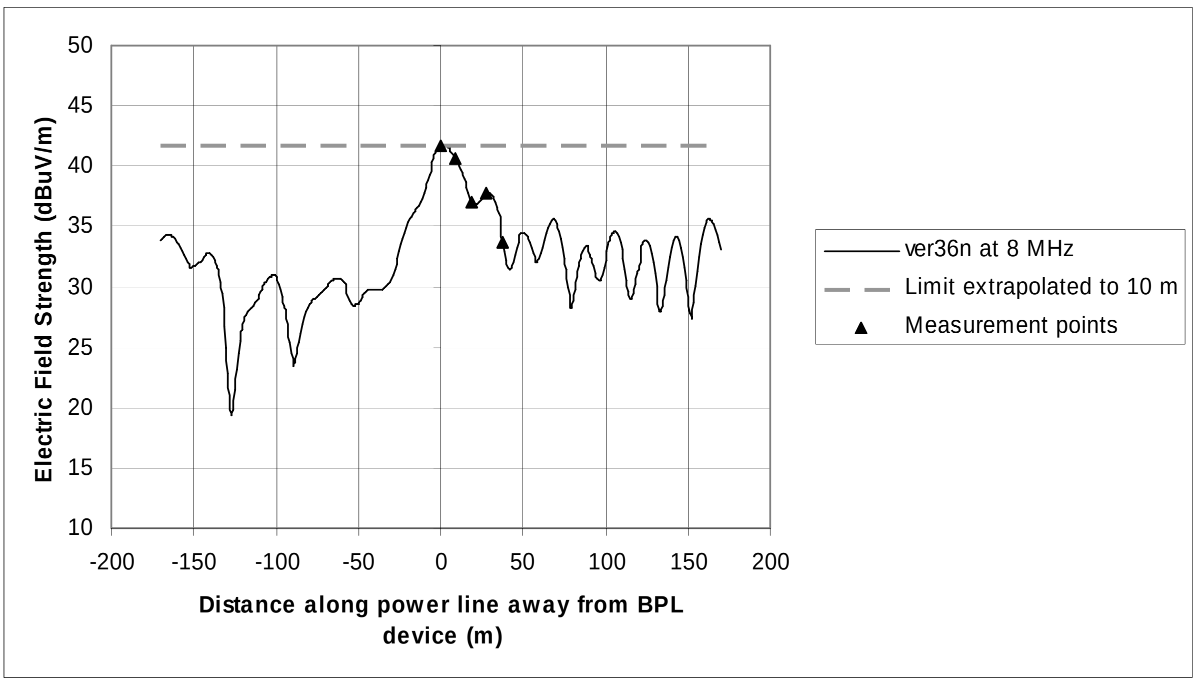

Figure B-24: Vertical electric field strength along power line for ver36n topology

<u>*10 MHz Plots*</u>

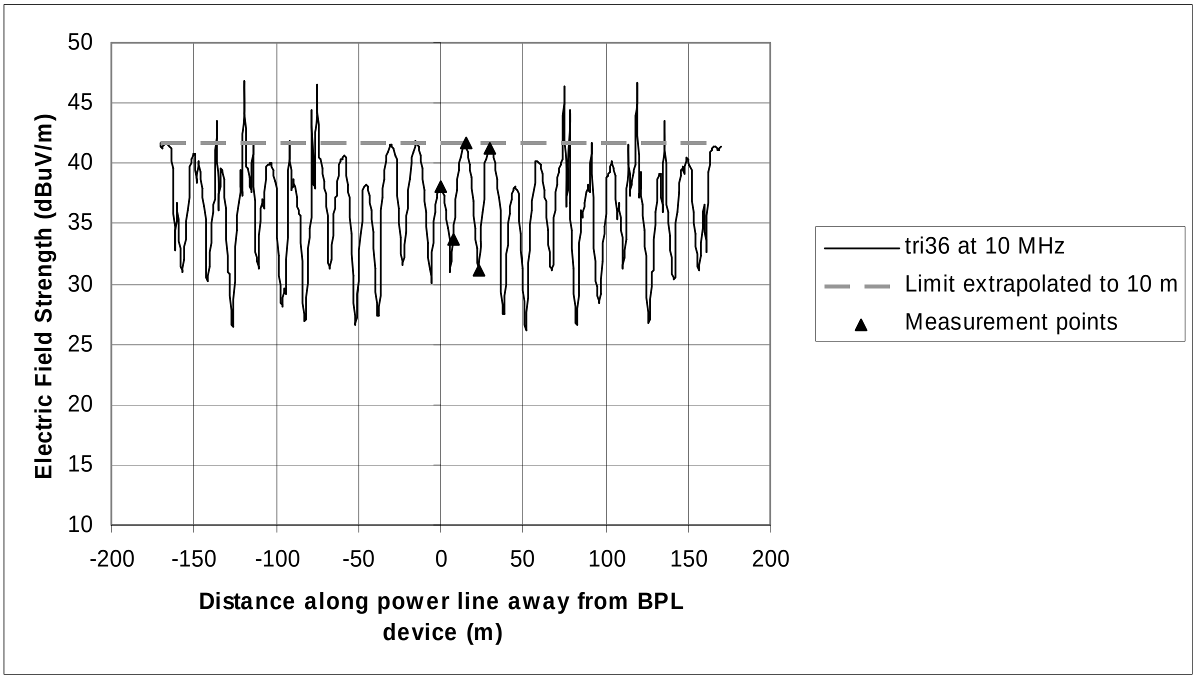

Figure B-25: Vertical electric field strength along power line for tri36 topology

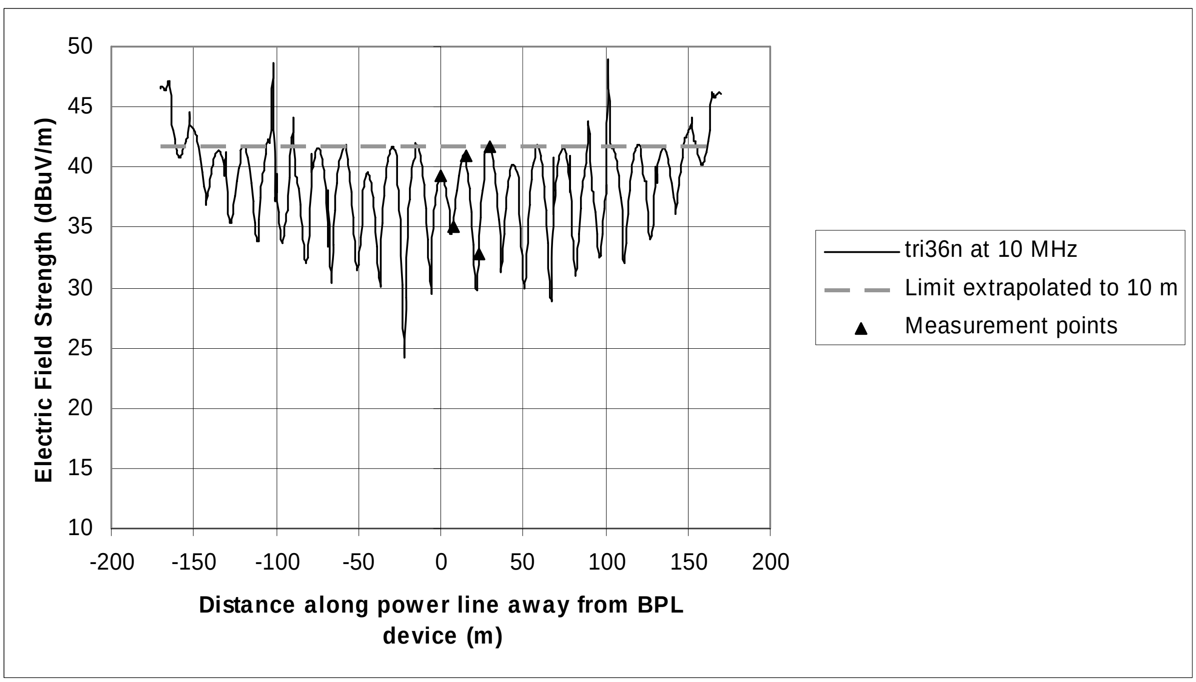

Figure B-26: Vertical electric field strength along power line for tri36n topology

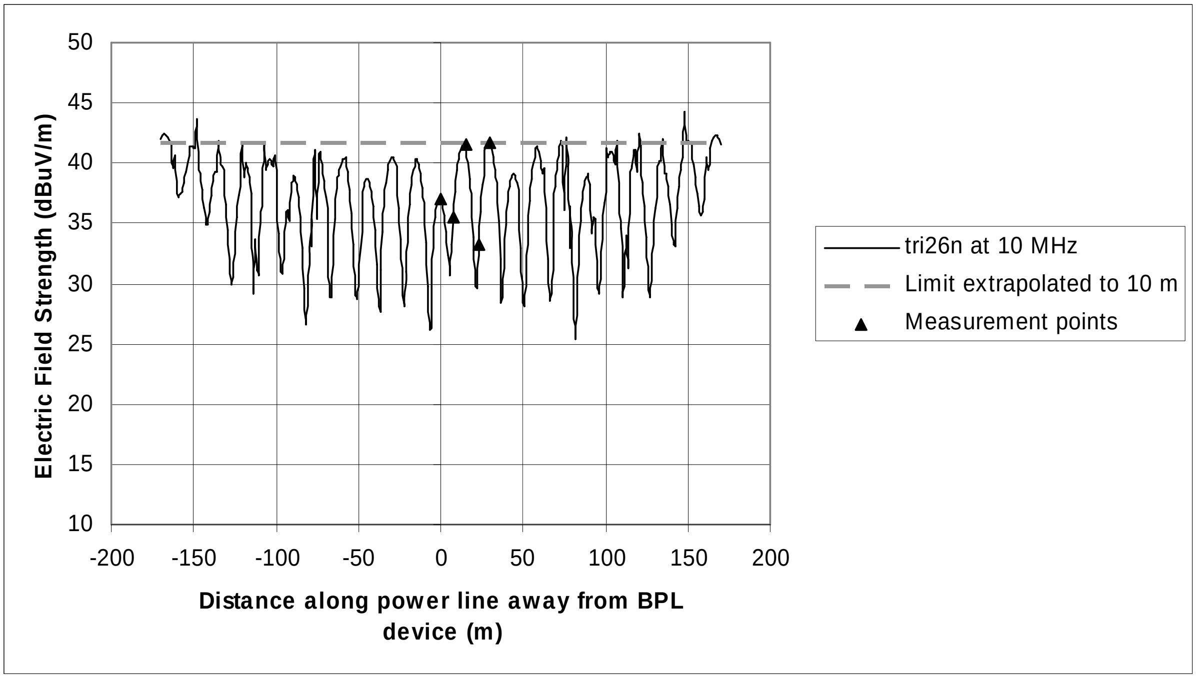

Figure B-27: Vertical electric field strength along power line for tri26n topology

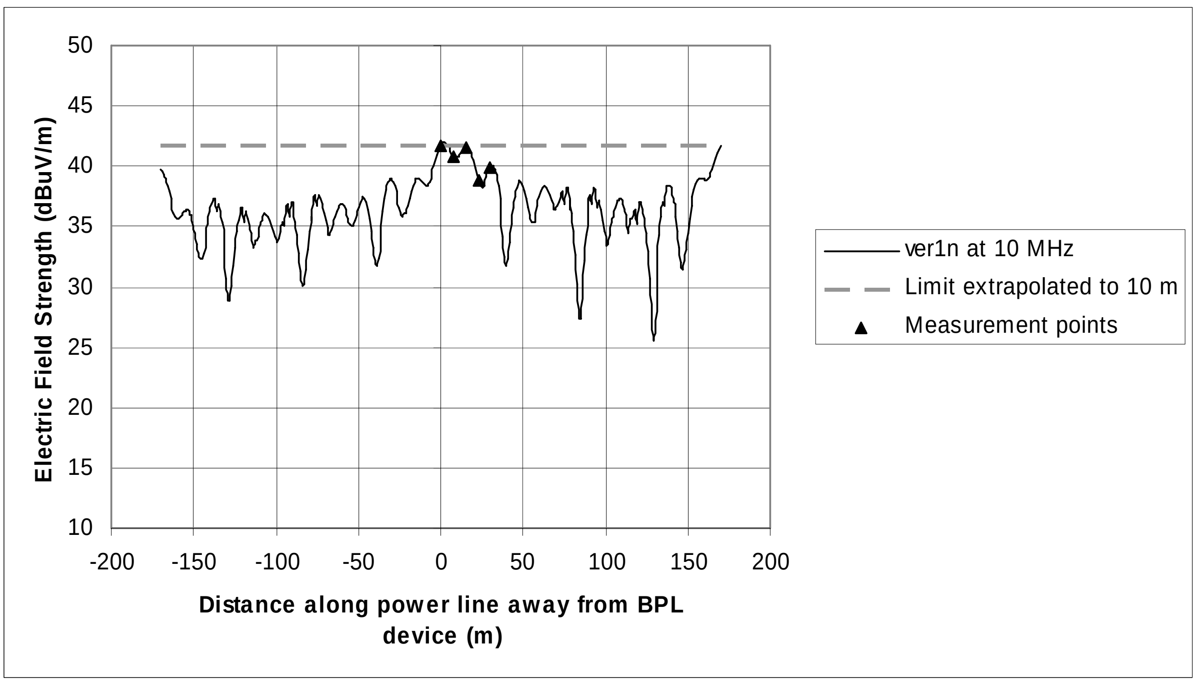

Figure B-28: Vertical electric field strength along power line for ver1n topology

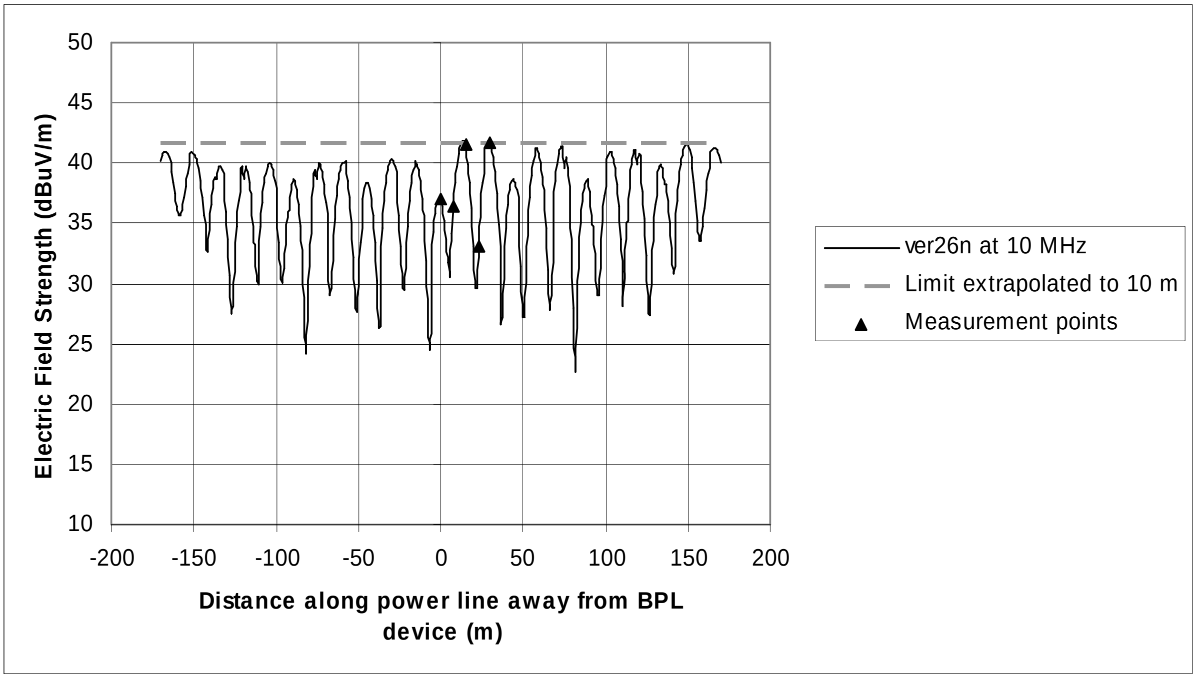

Figure B-29: Vertical electric field strength along power line for ver26n topology

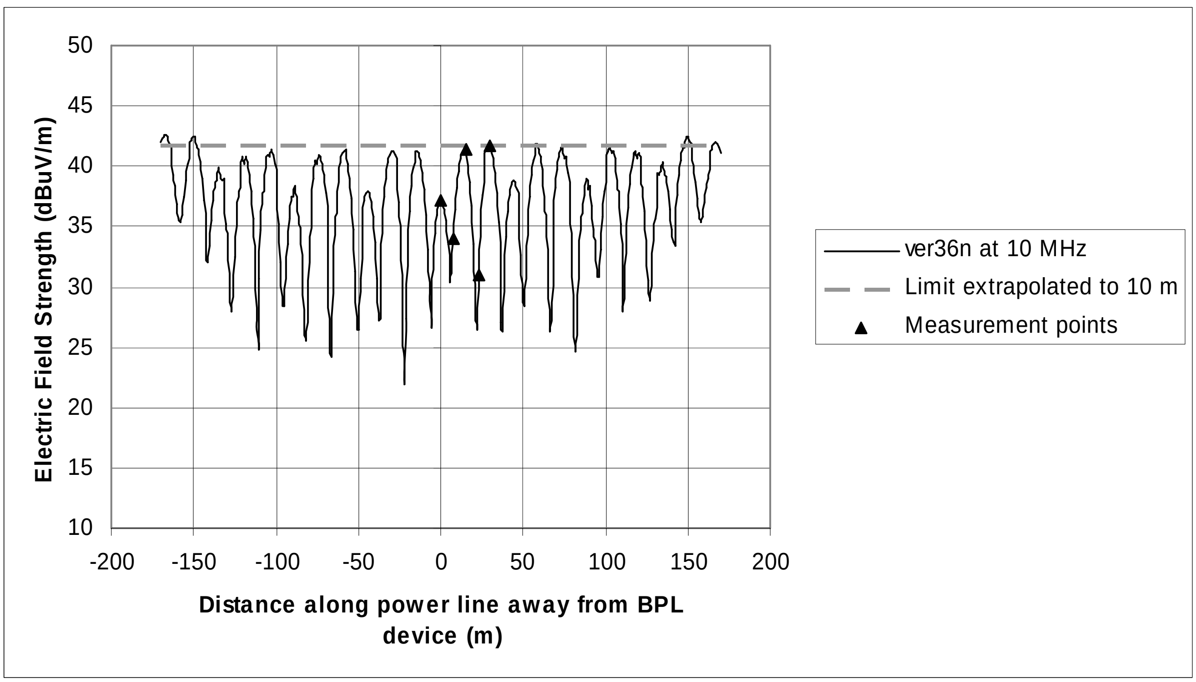

Figure B-30: Vertical electric field strength along power line for ver36n topology

12 MHz Plots

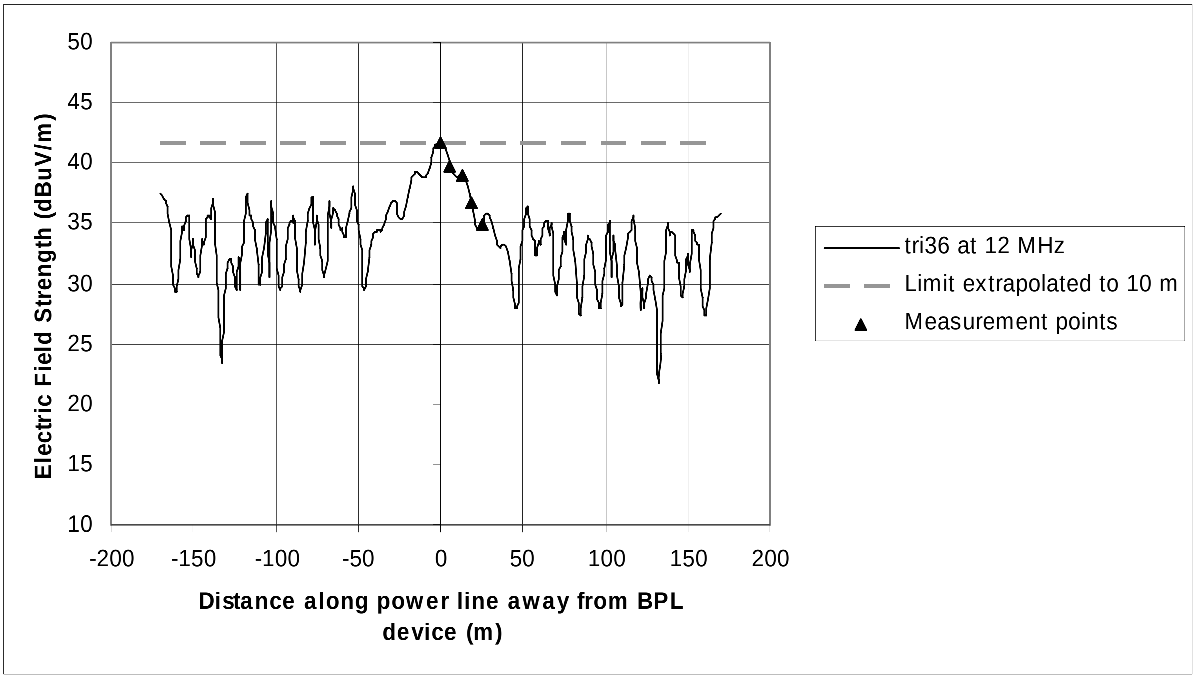

Figure B-31: Vertical electric field strength along power line for tri36 topology

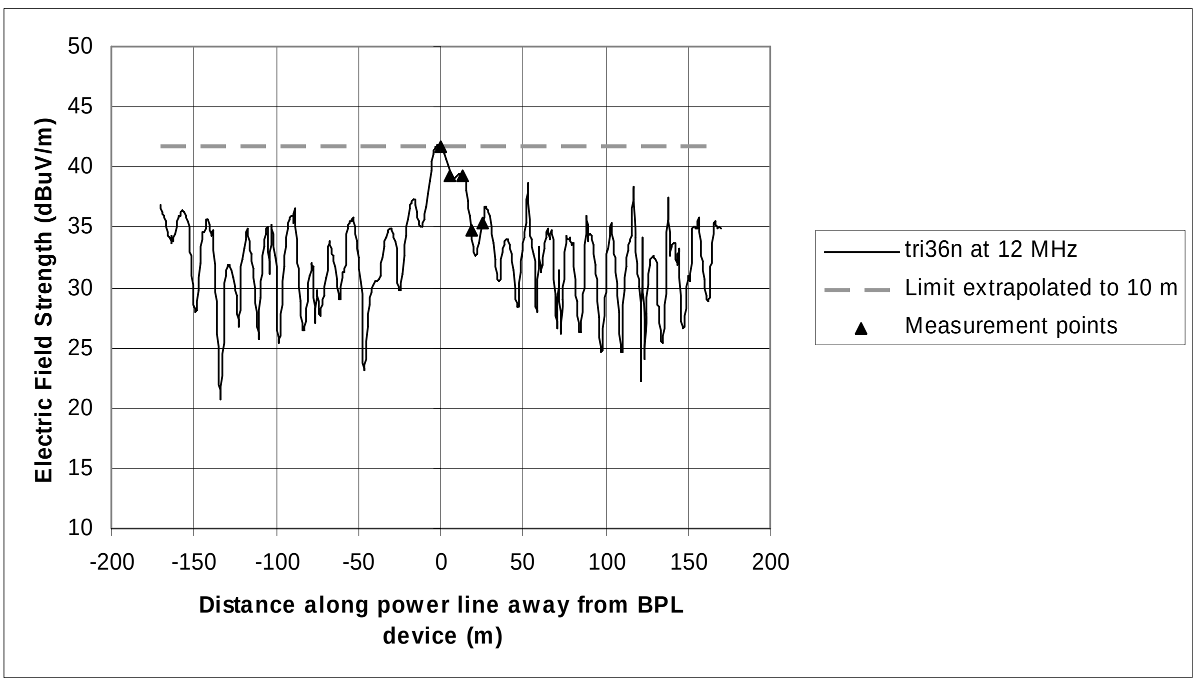

Figure B-32: Vertical electric field strength along power line for tri36n topology

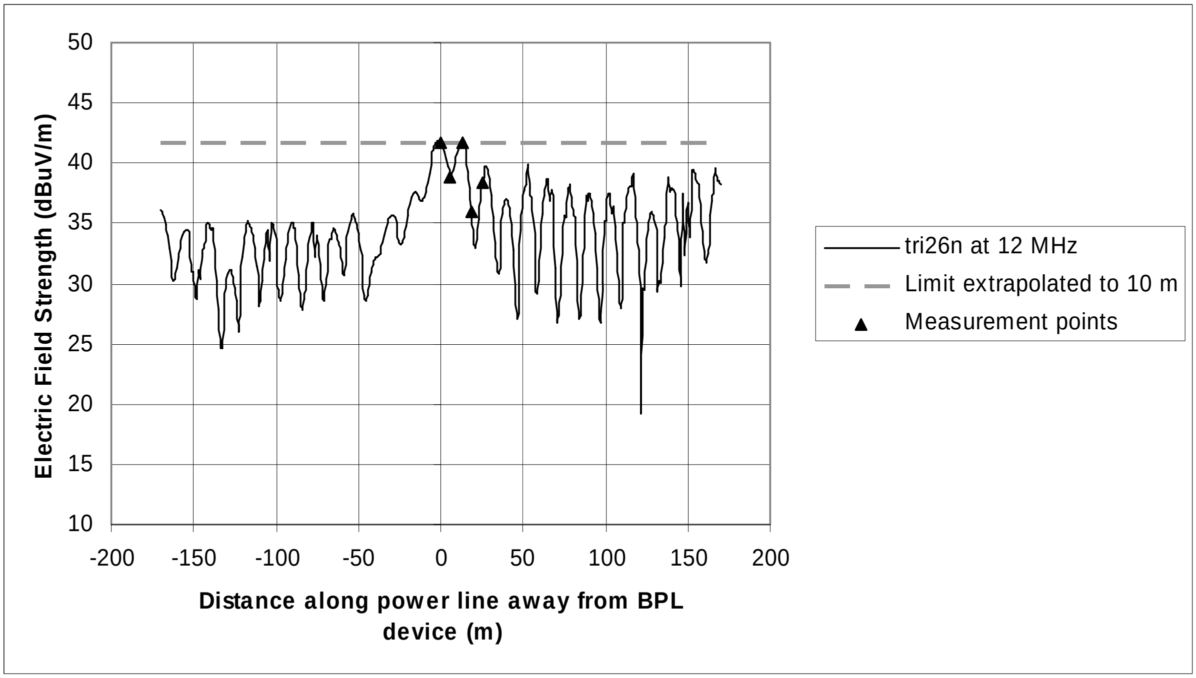

Figure B-33: Vertical electric field strength along power line for tri26n topology

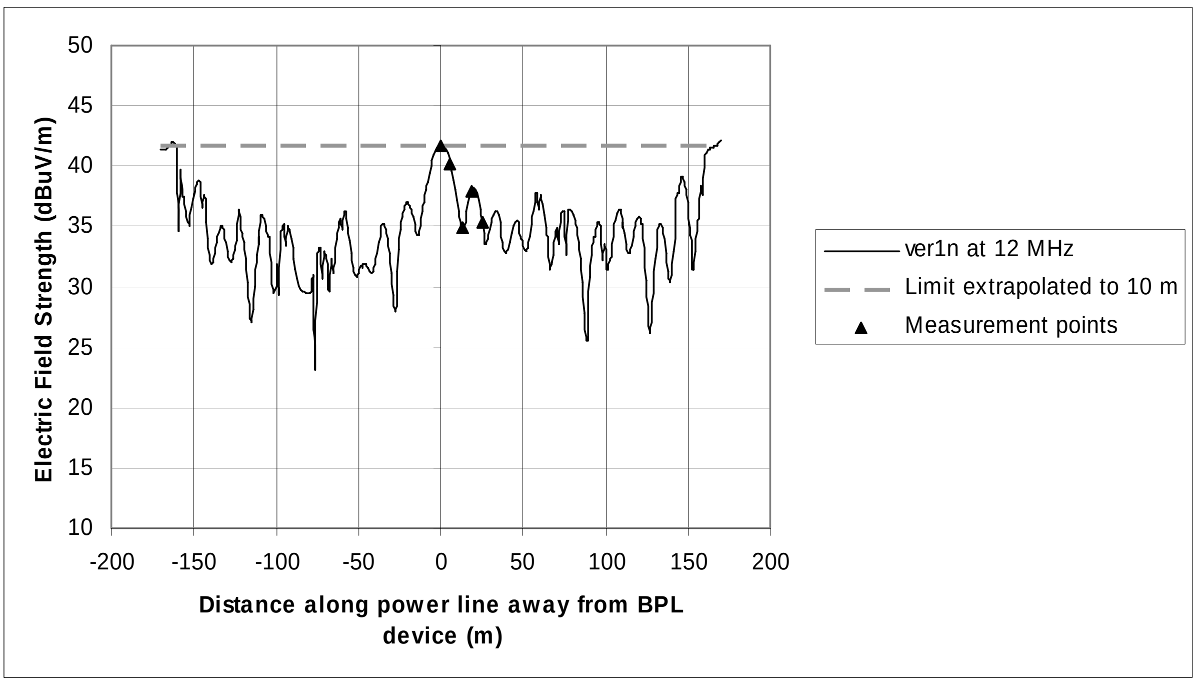

Figure B-34: Vertical electric field strength along power line for ver1n topology

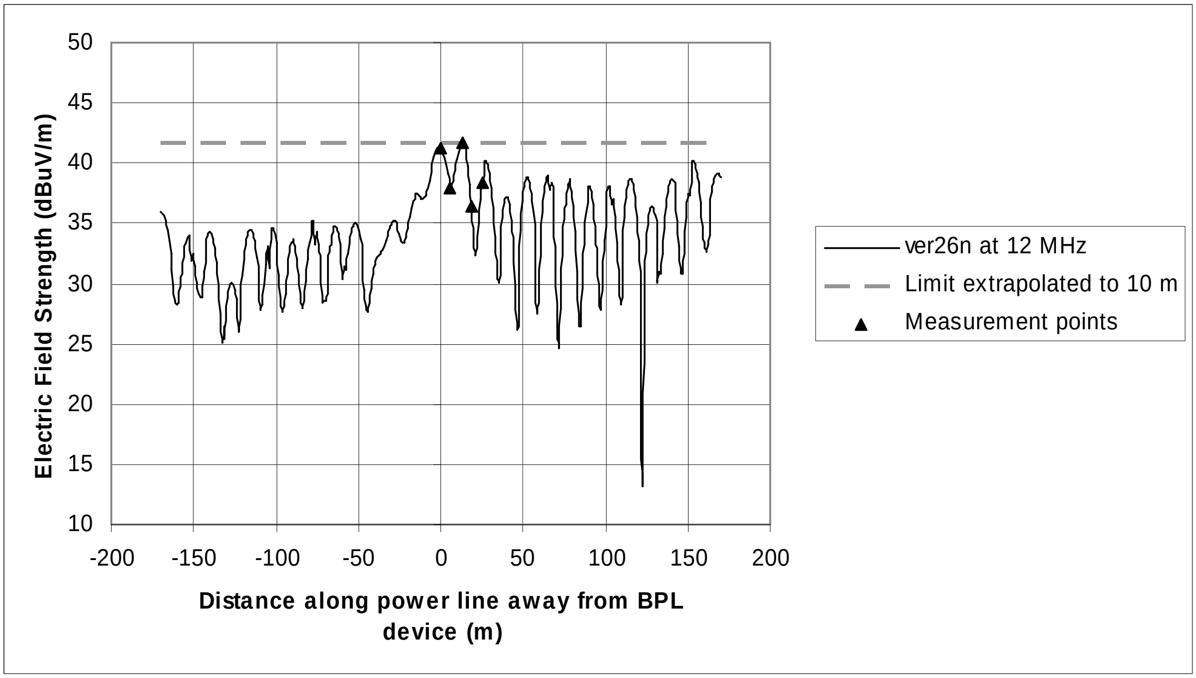

Figure B-35: Vertical electric field strength along power line for ver26n topology

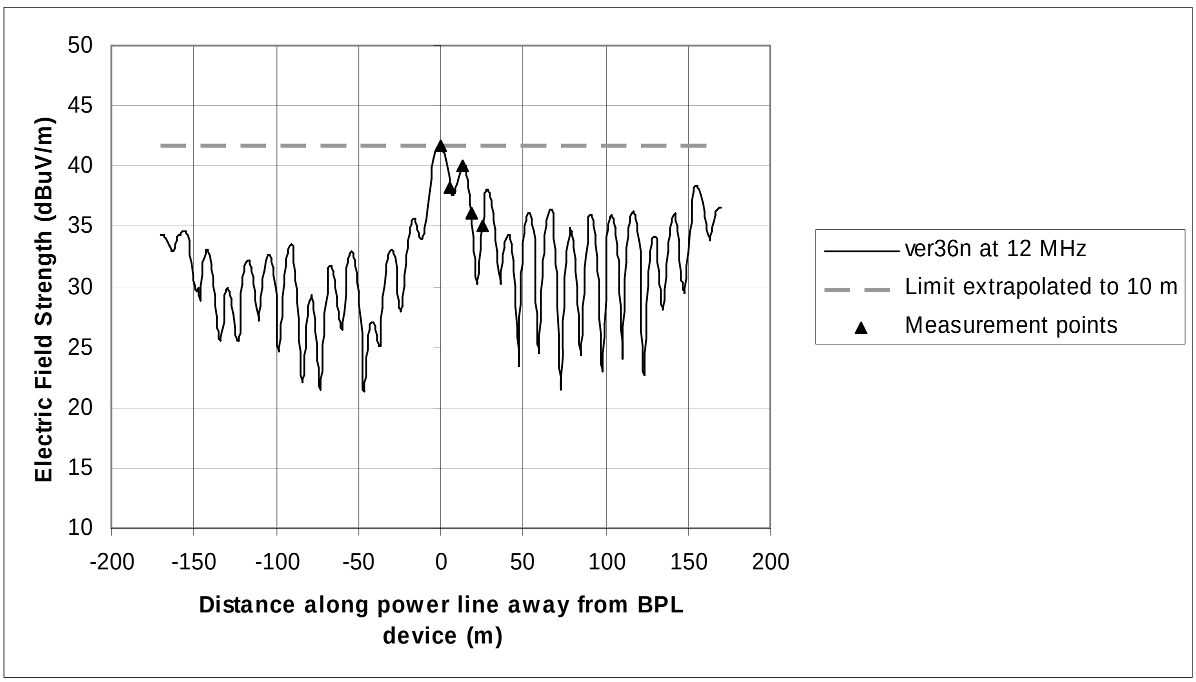

Figure B-36: Vertical electric field strength along power line for ver36n topology

<u>*14 MHz Plots*</u>

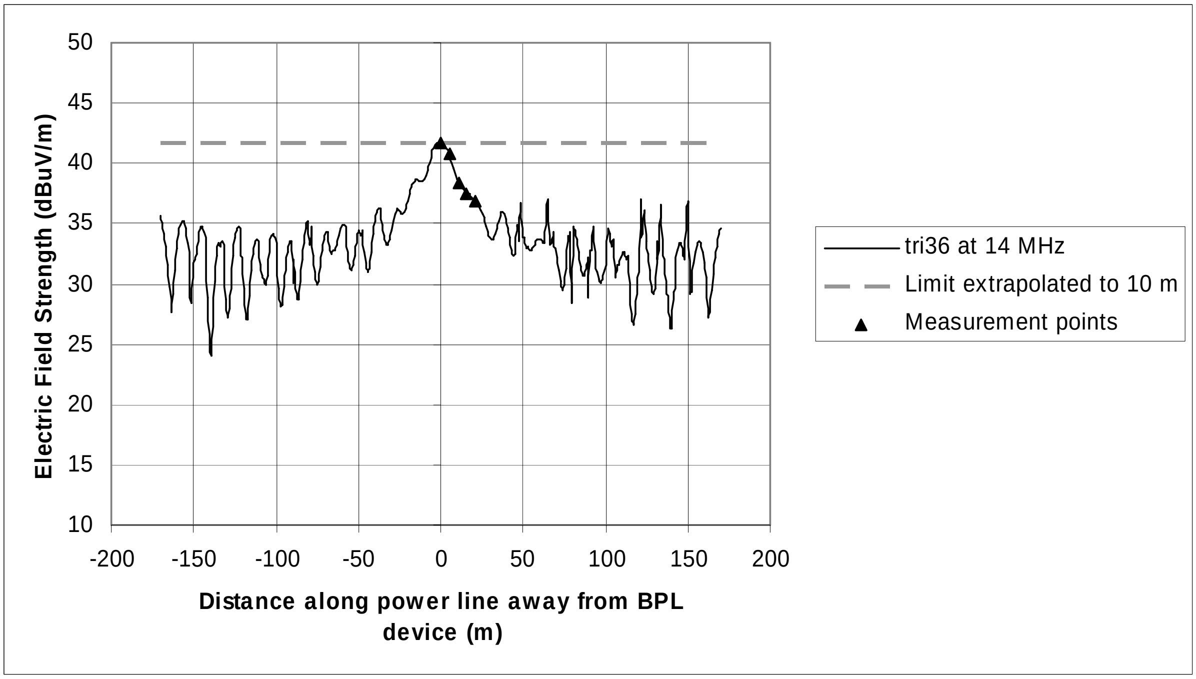

Figure B-37: Vertical electric field strength along power line for tri36 topology

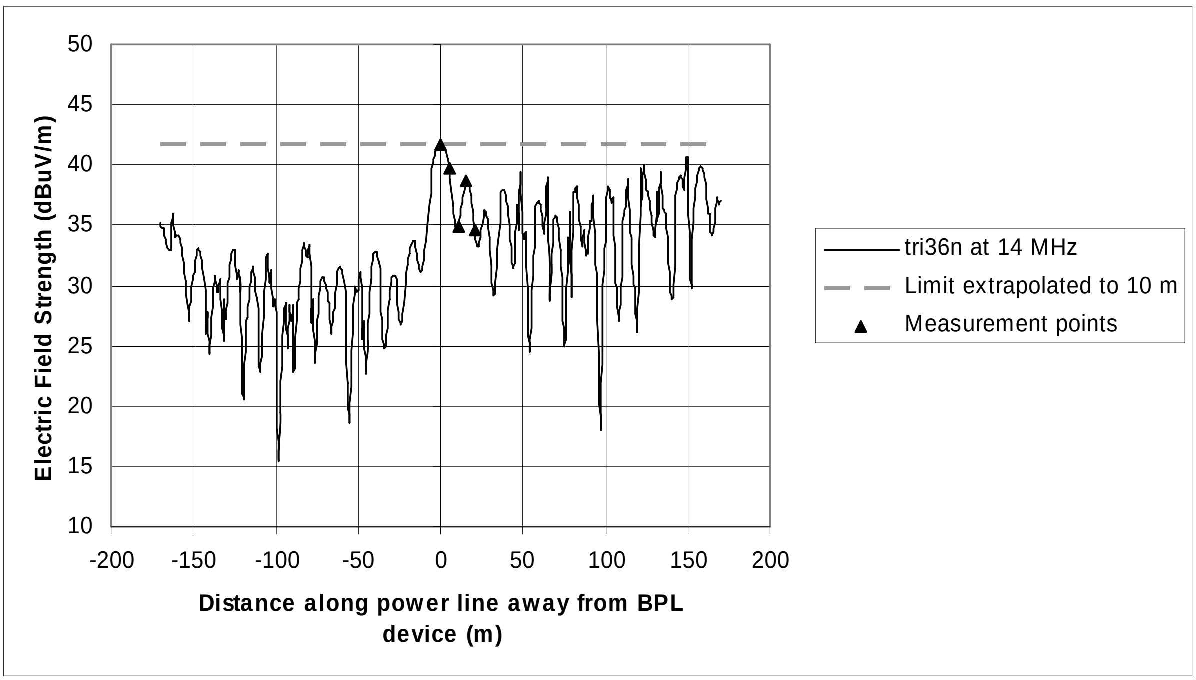

Figure B-38: Vertical electric field strength along power line for tri36n topology

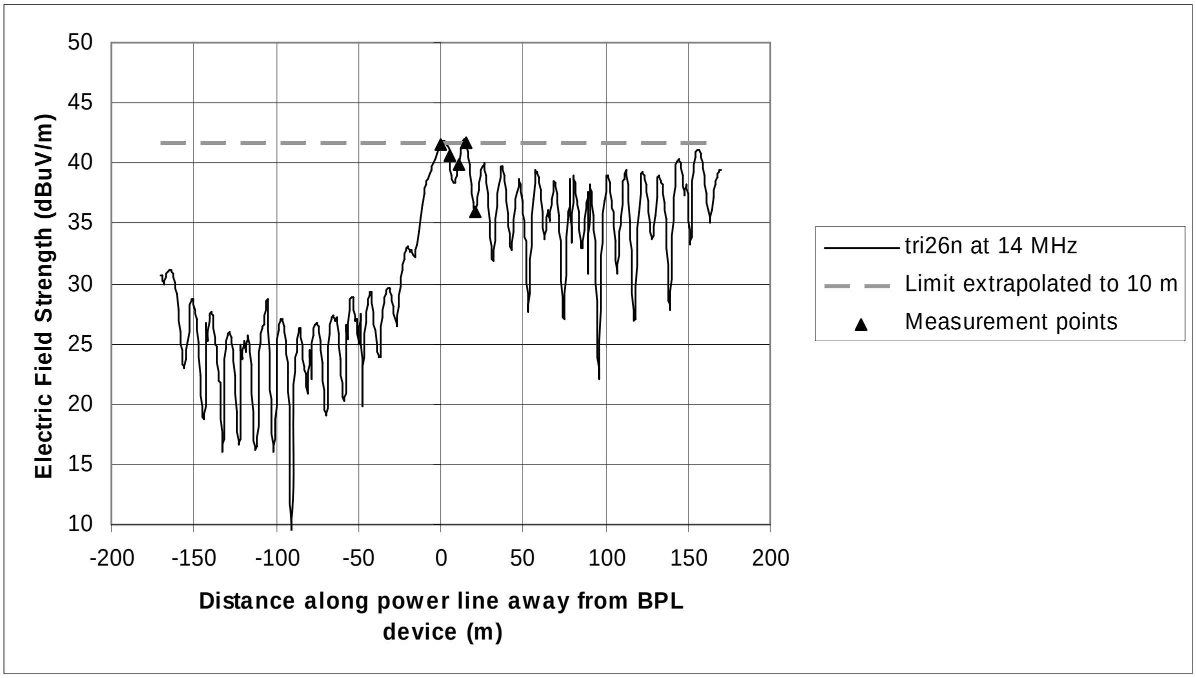

Figure B-39: Vertical electric field strength along power line for tri26n topology

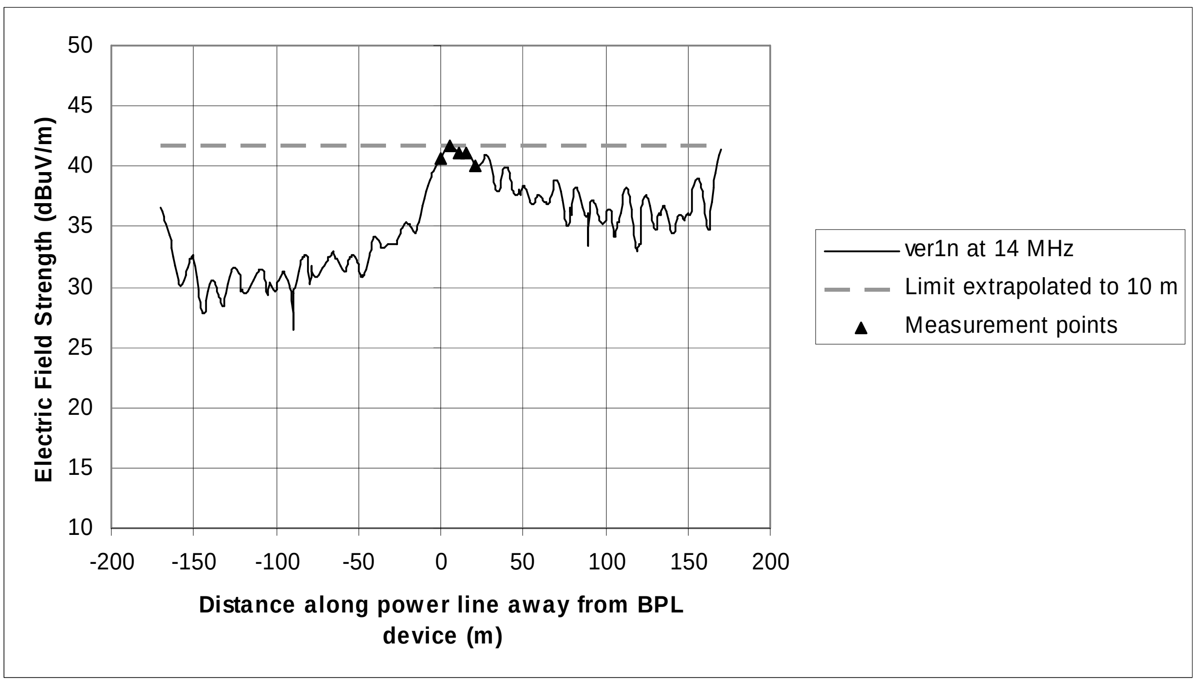

Figure B-40: Vertical electric field strength along power line for ver1n topology

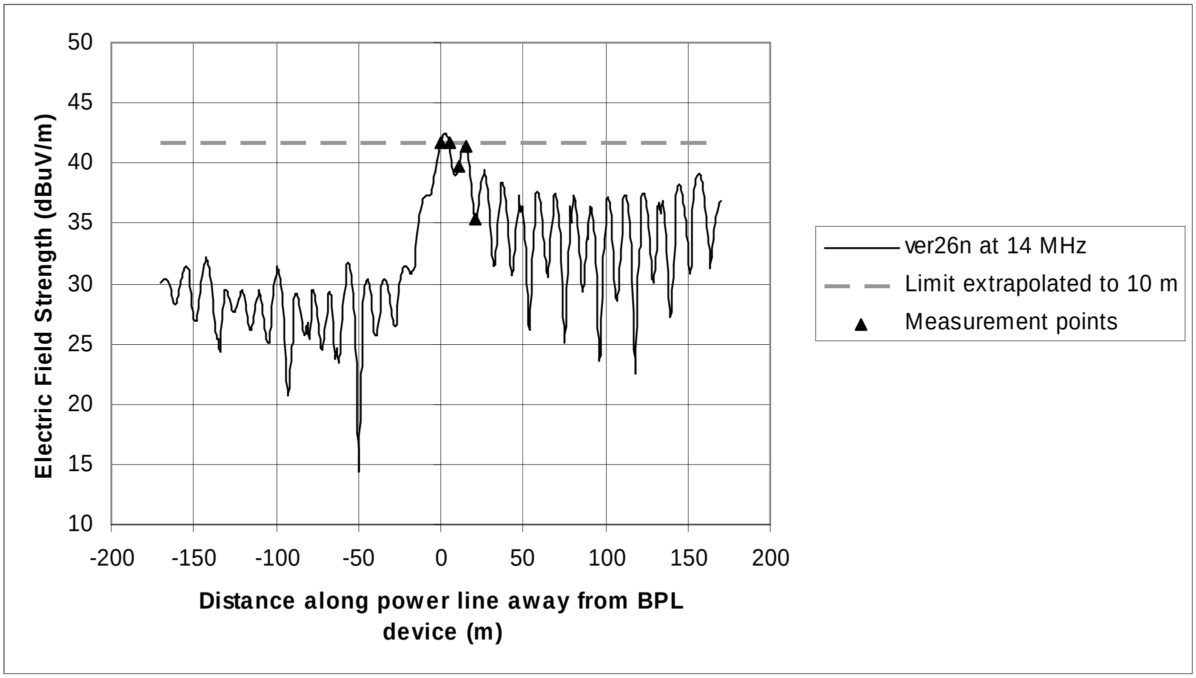

Figure B-41: Vertical electric field strength along power line for ver26n topology

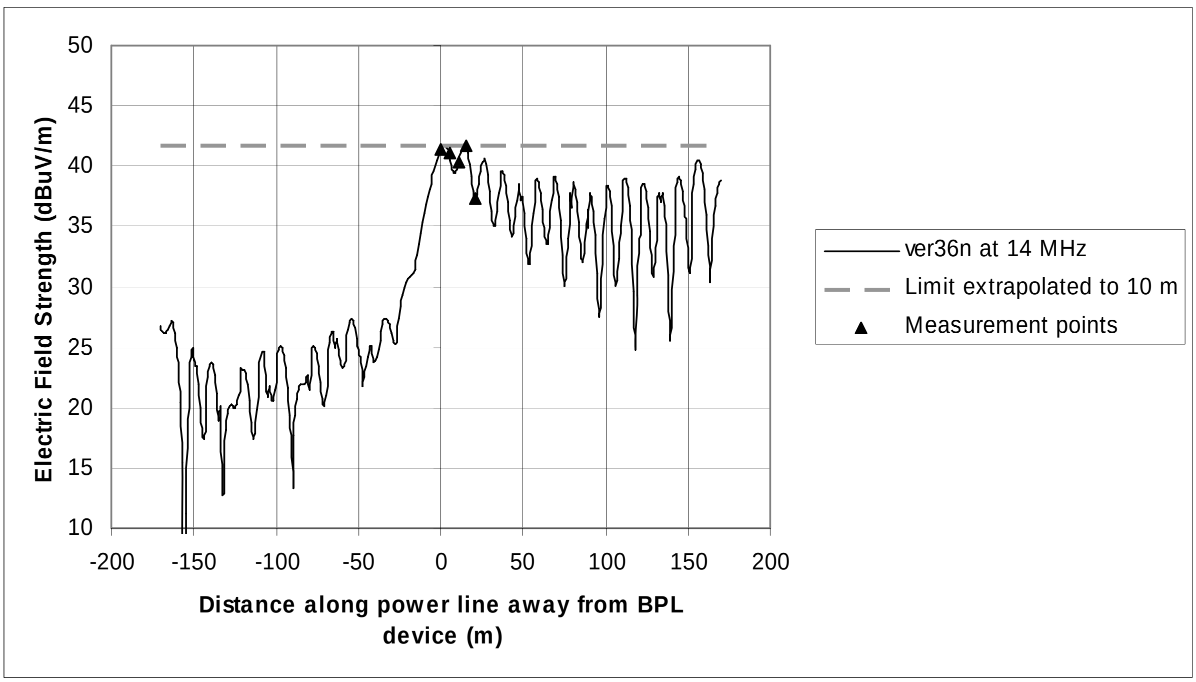

Figure B-42: Vertical electric field strength along power line for ver36n topology

16 MHz Plots

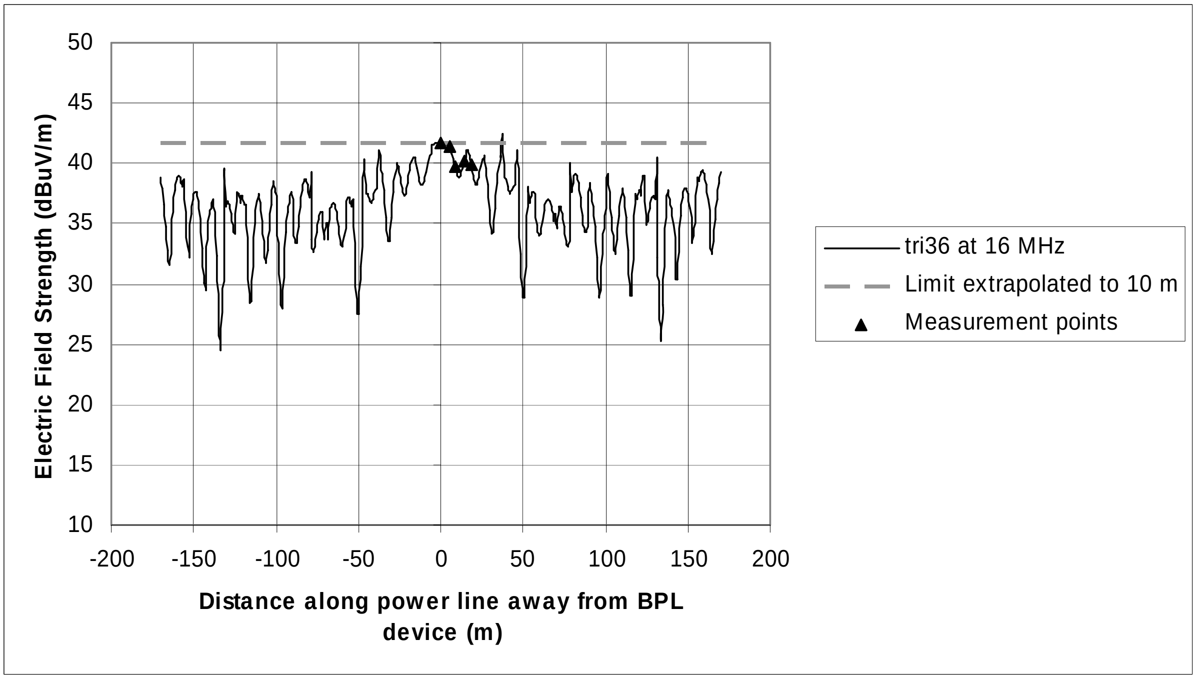

Figure B-43: Vertical electric field strength along power line for tri36 topology

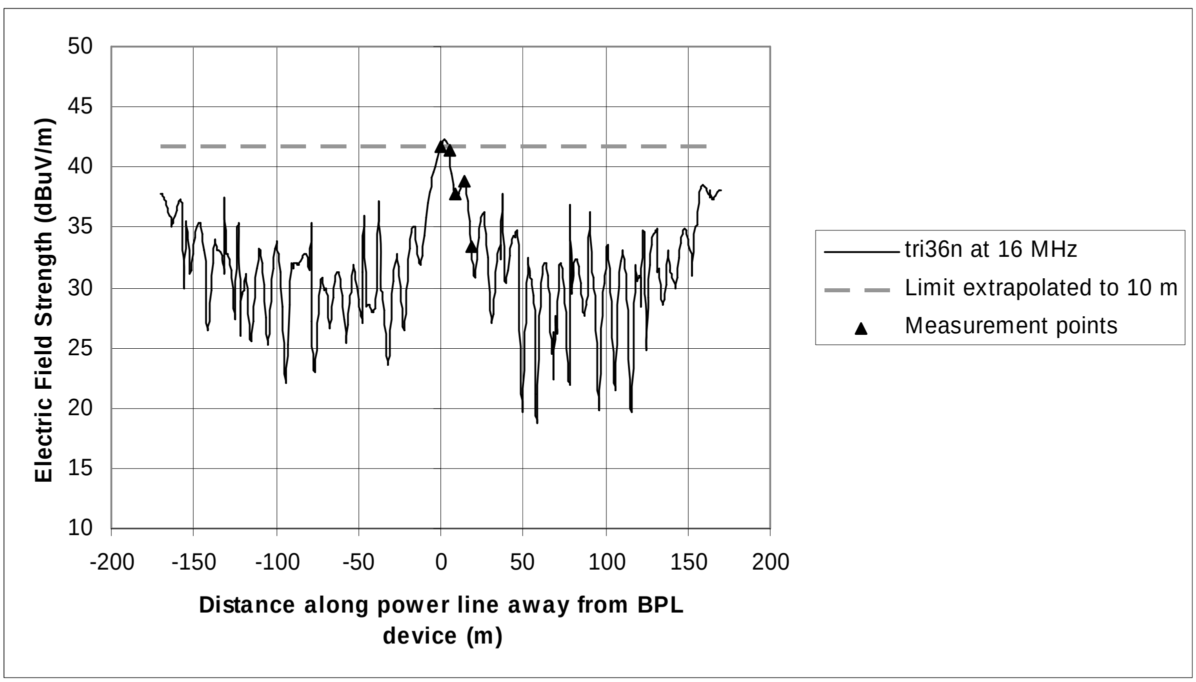

Figure B-44: Vertical electric field strength along power line for tri36n topology

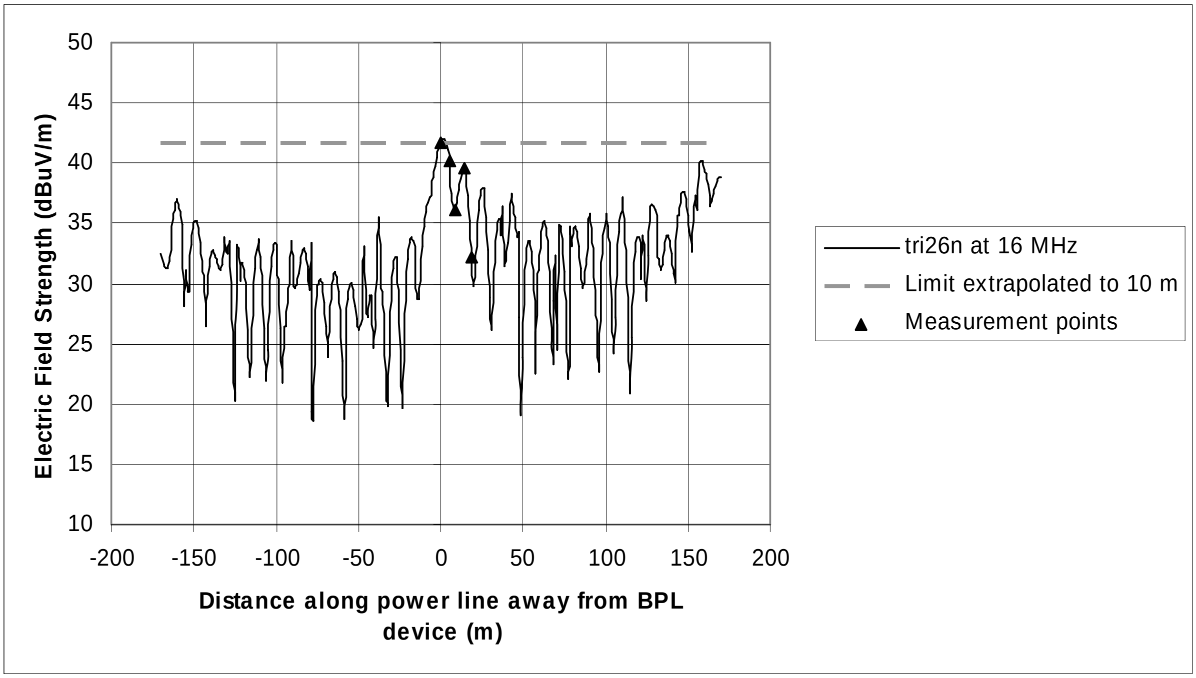

Figure B-45: Vertical electric field strength along power line for tri26n topology

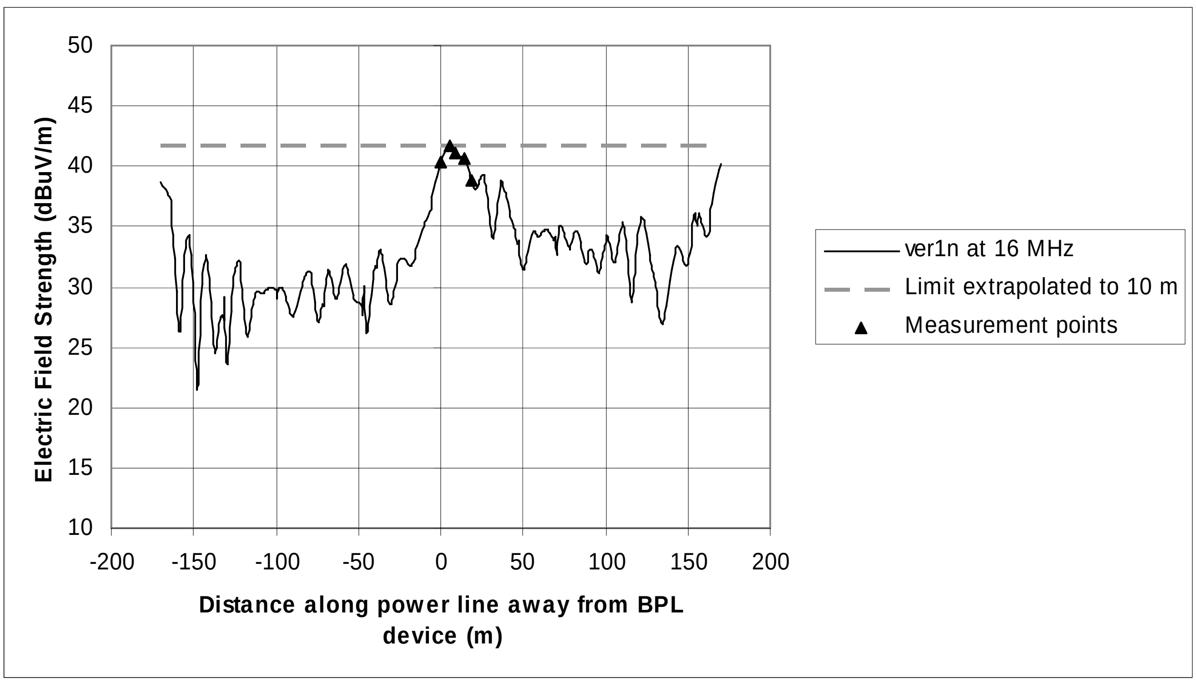

Figure B-46: Vertical electric field strength along power line for ver1n topology

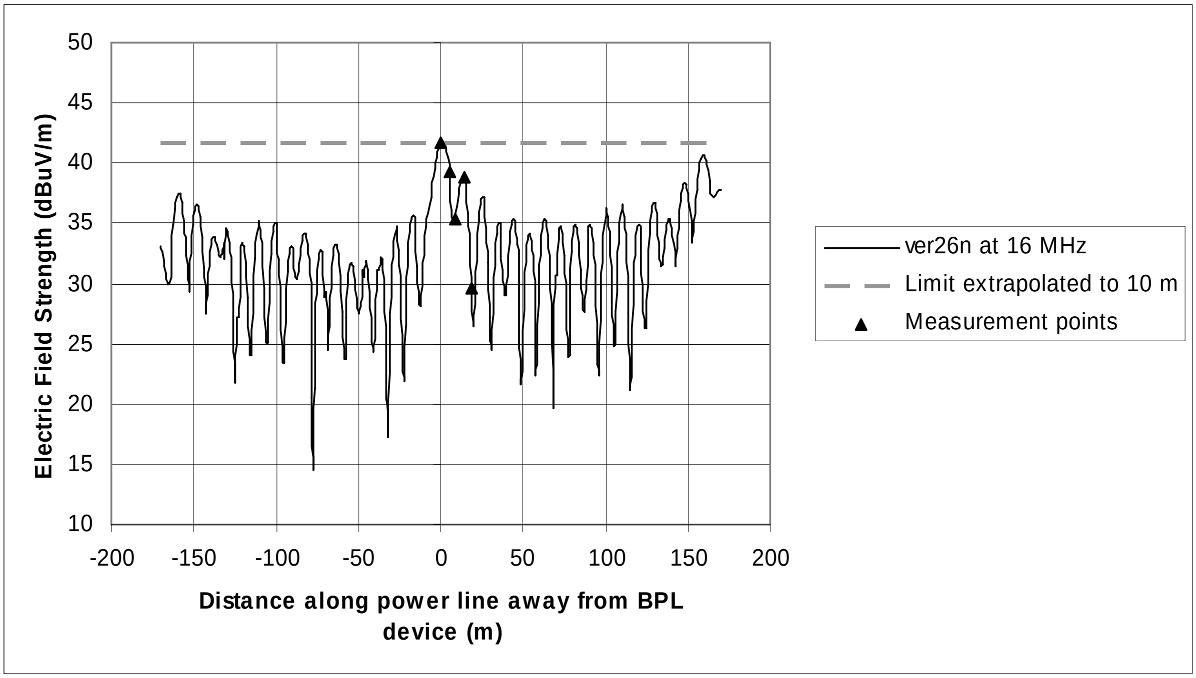

Figure B-47: Vertical electric field strength along power line for ver26n topology

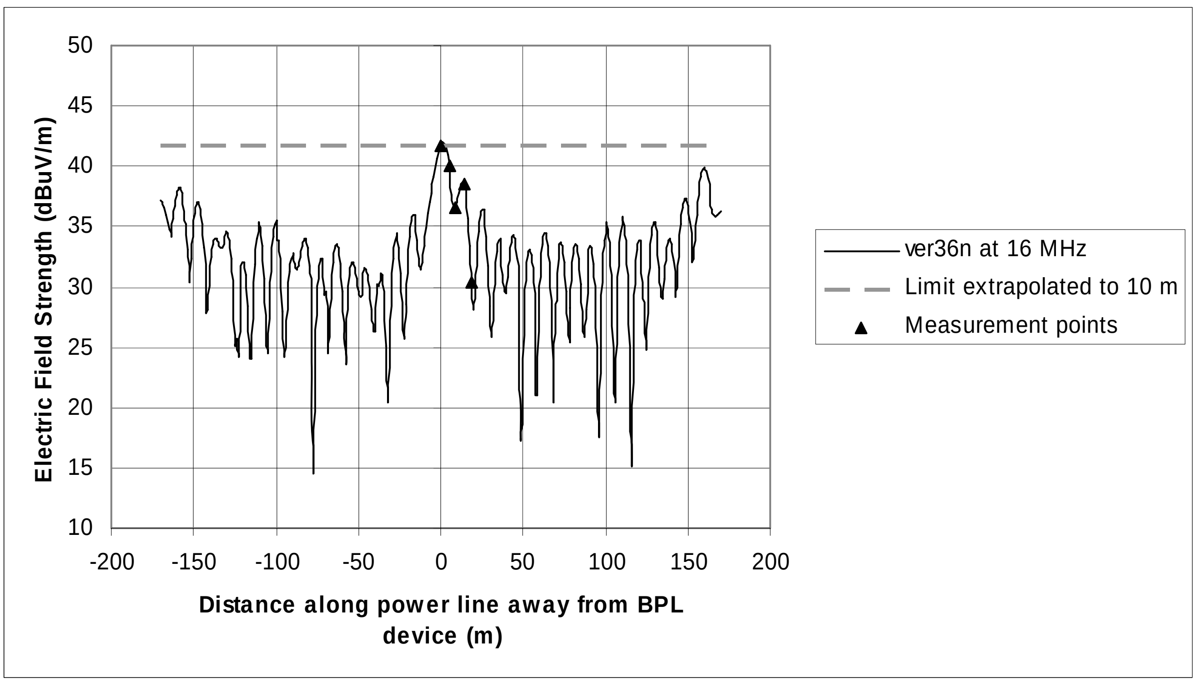

Figure B-48: Vertical electric field strength along power line for ver36n topology

18 MHz Plots

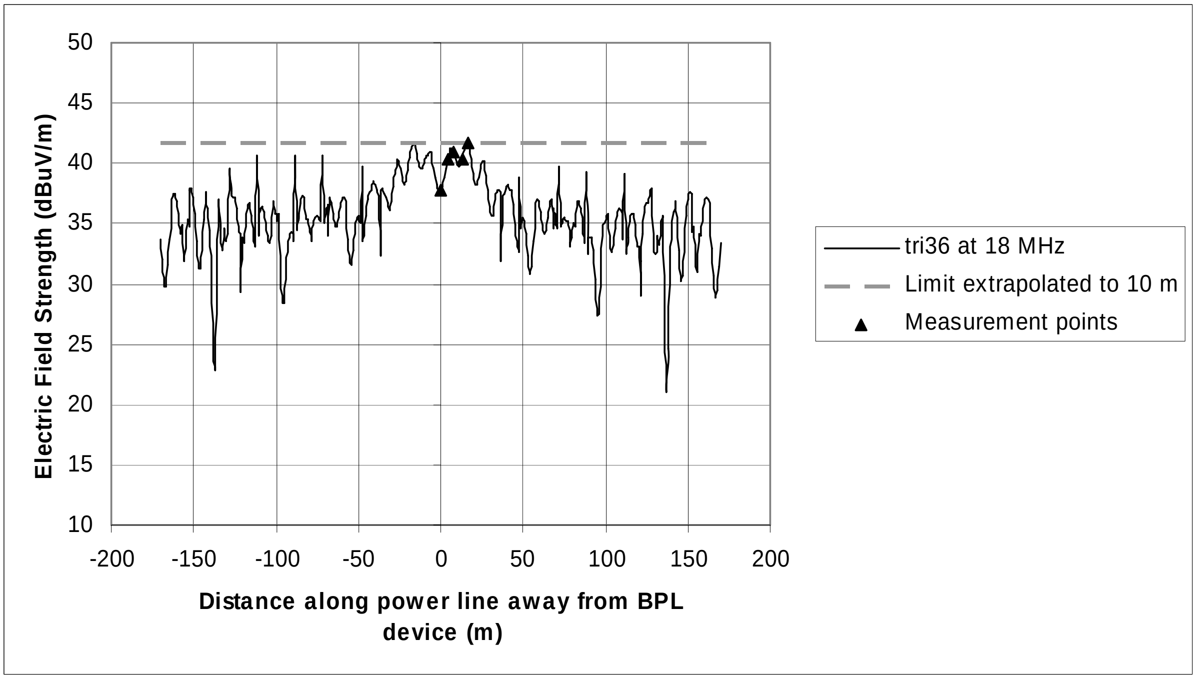

Figure B-49: Vertical electric field strength along power line for tri36 topology

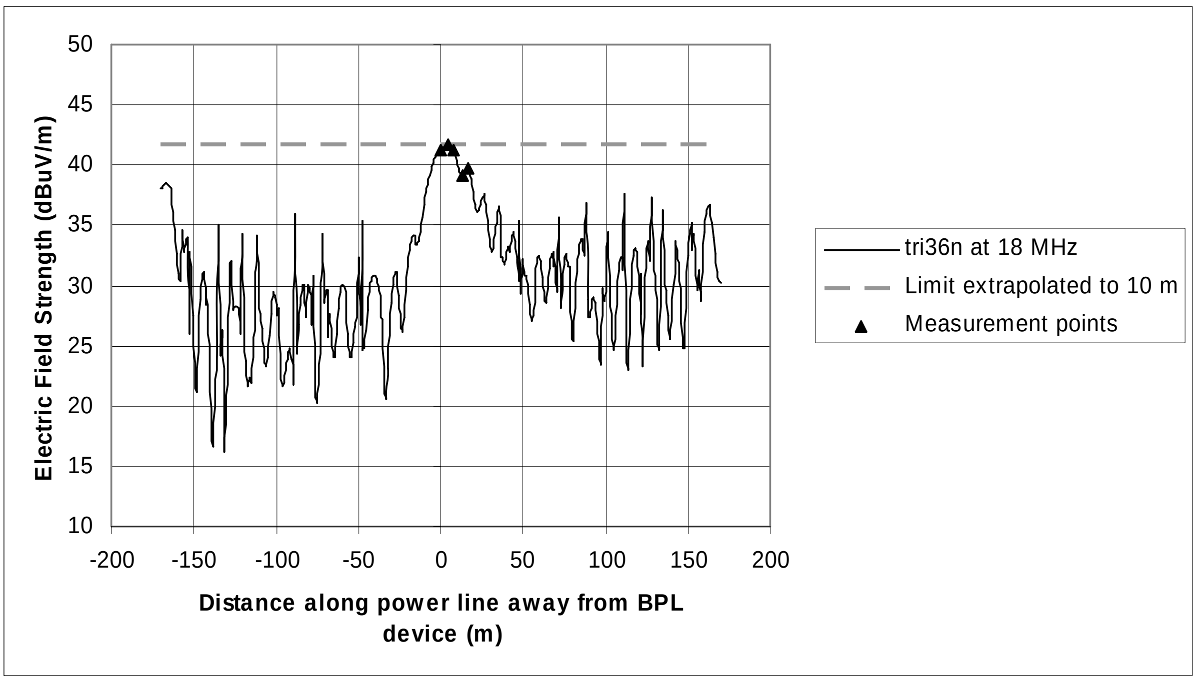

Figure B-50: Vertical electric field strength along power line for tri36n topology

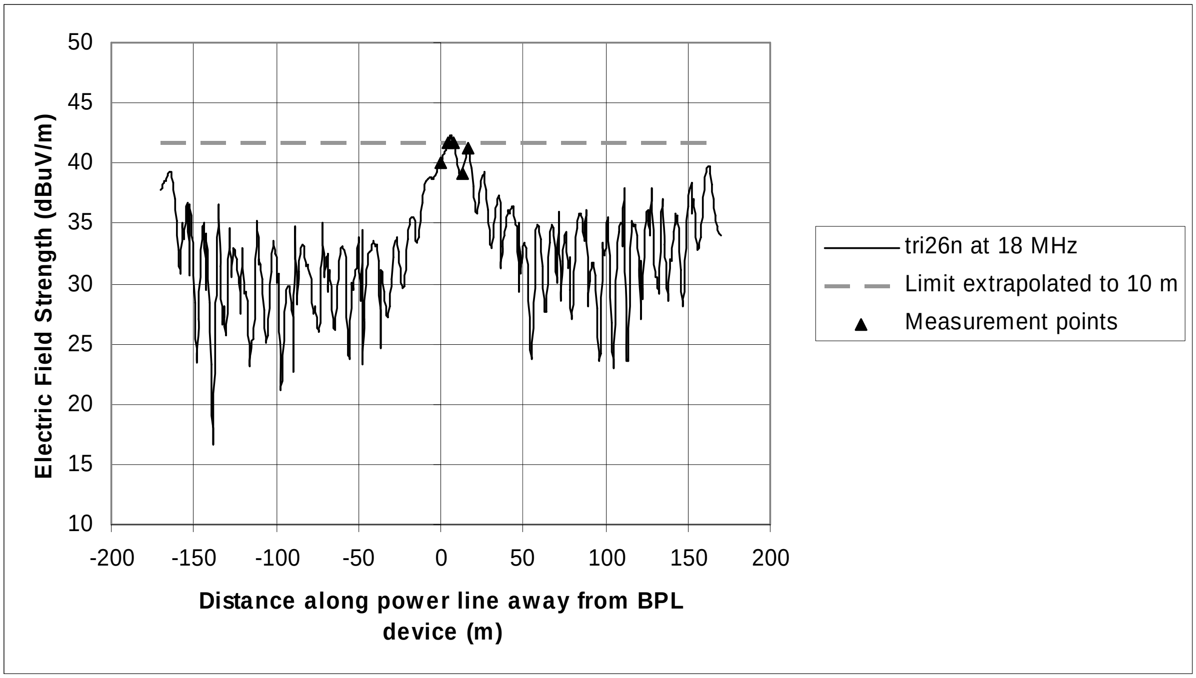

Figure B-51: Vertical electric field strength along power line for tri26n topology

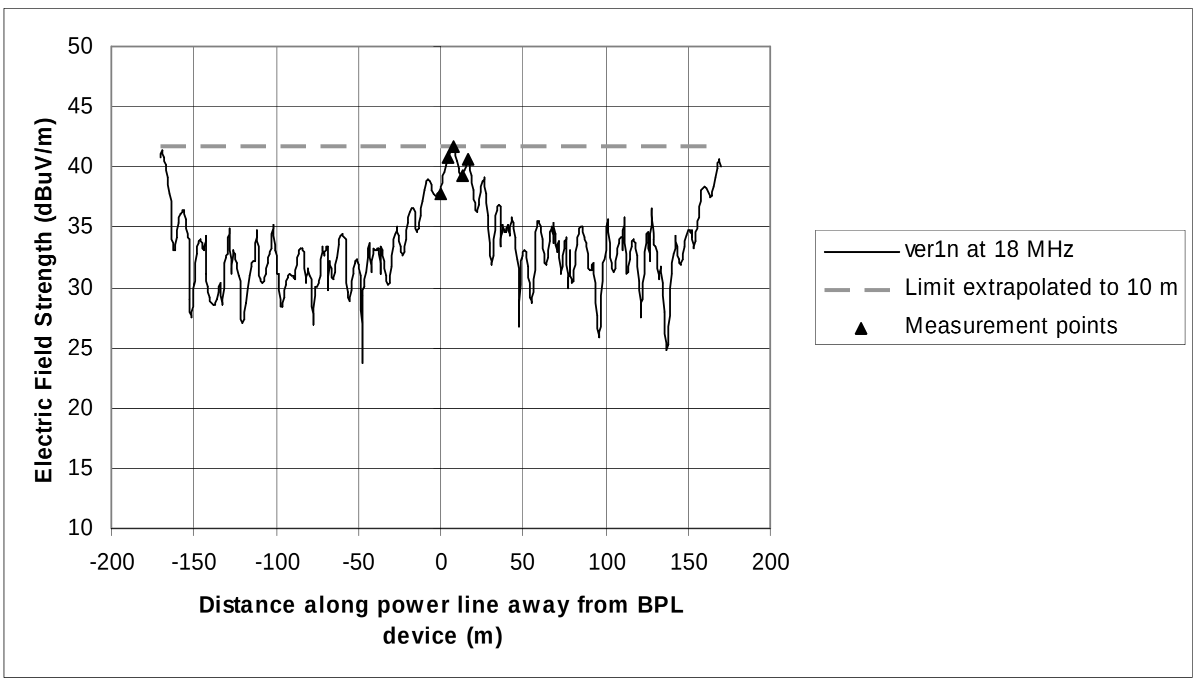

Figure B-52: Vertical electric field strength along power line for ver1n topology

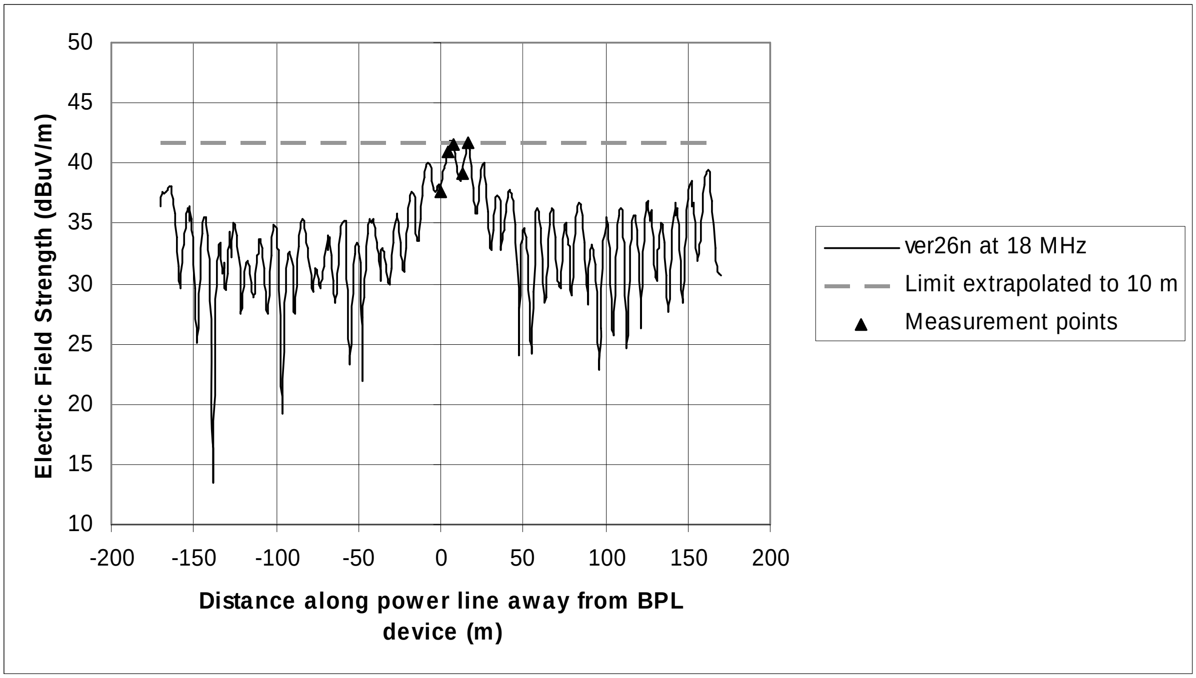

Figure B-53: Vertical electric field strength along power line for ver26n topology

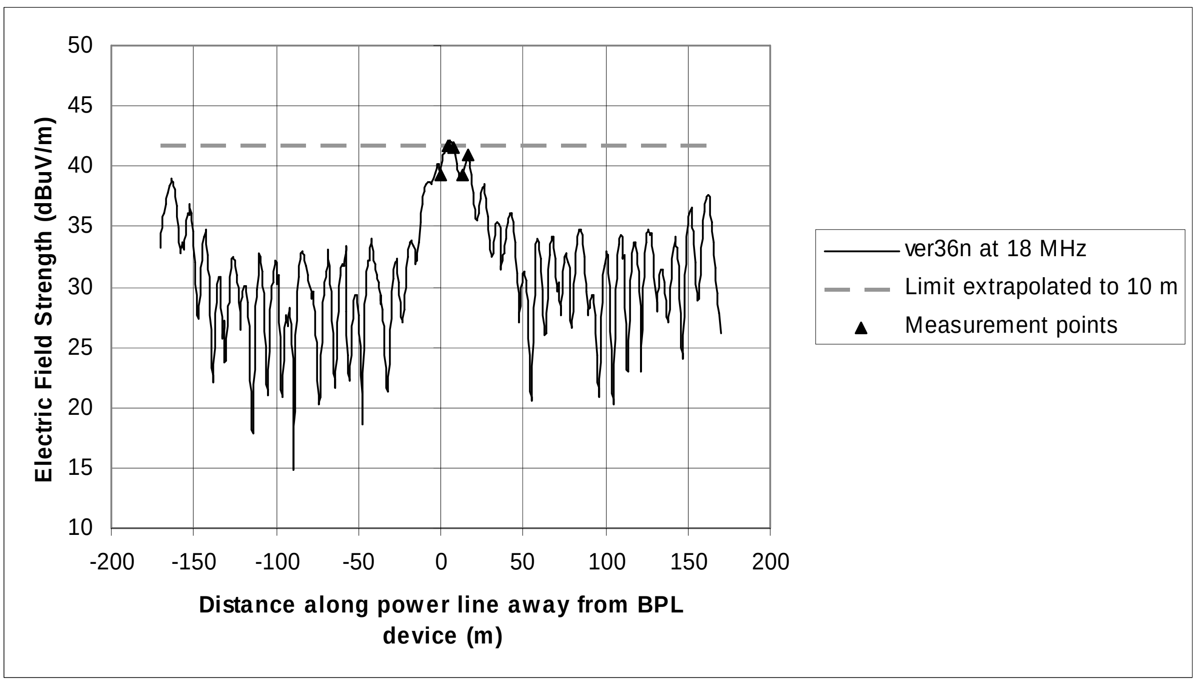

Figure B-54: Vertical electric field strength along power line for ver3n topology

20 MHz Plots

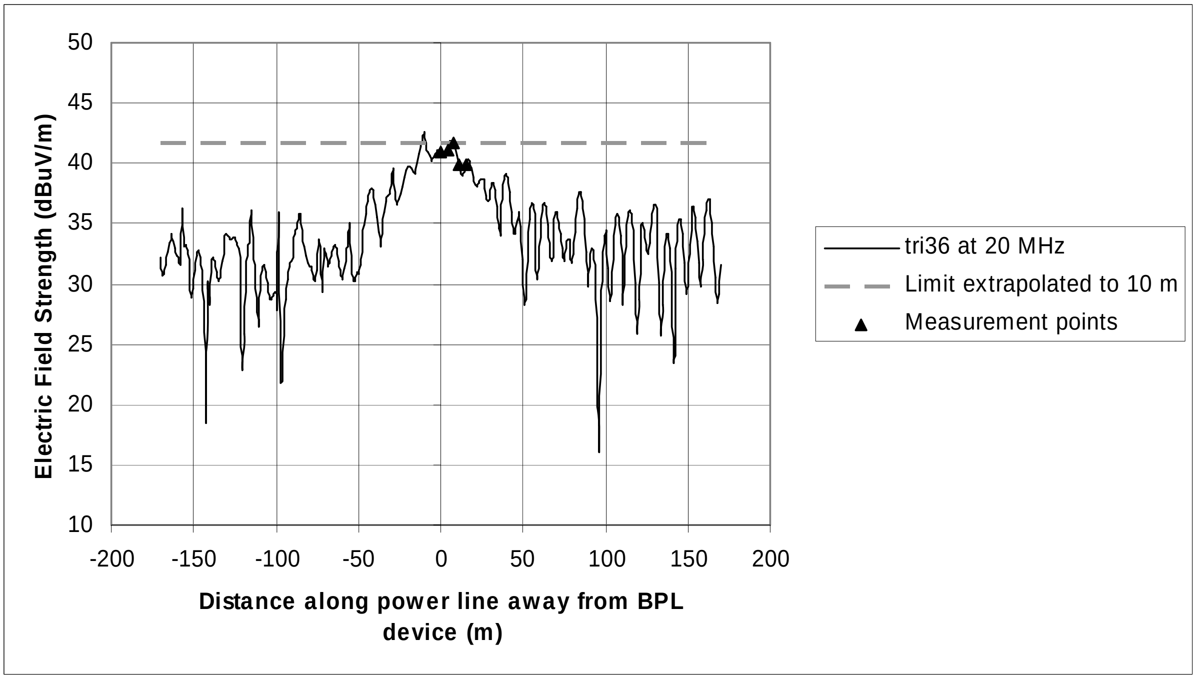

Figure B-55: Vertical electric field strength along power line for tri36 topology

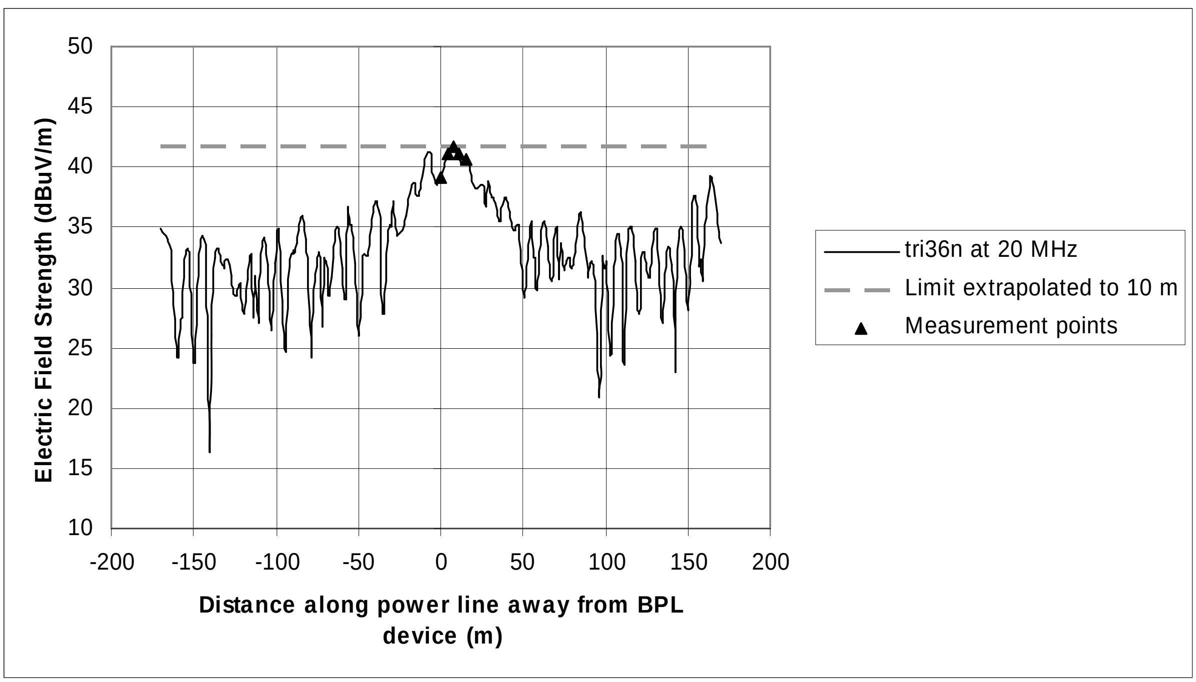

Figure B-56: Vertical electric field strength along power line for tri36n topology

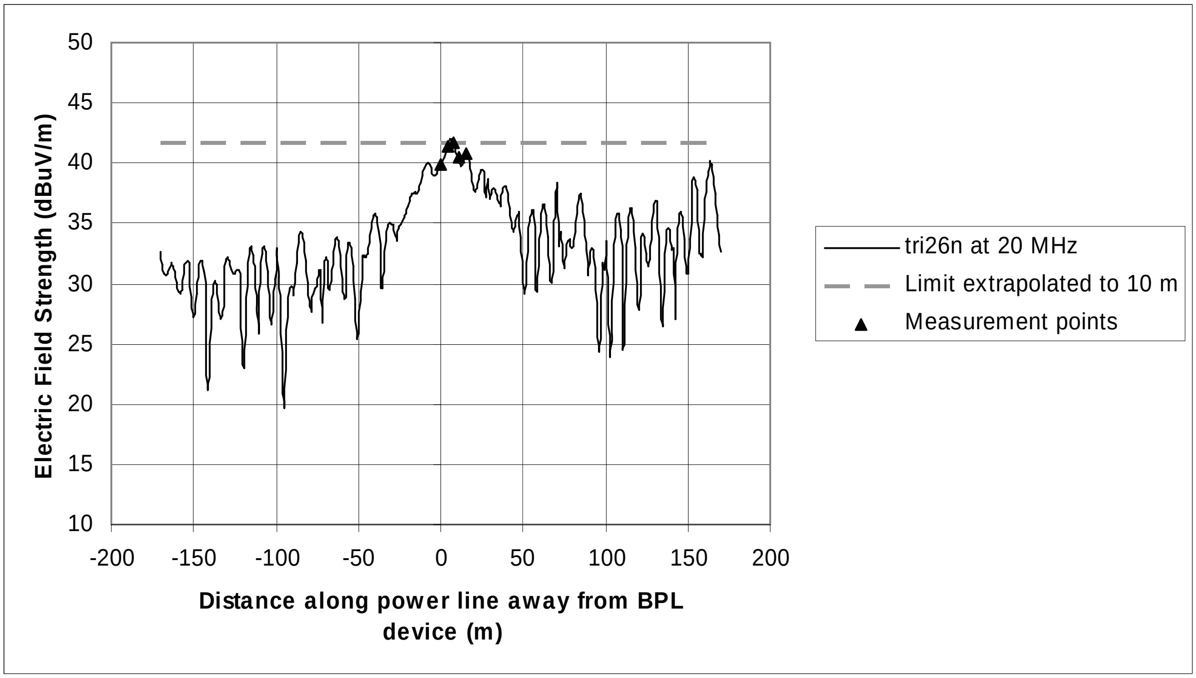

Figure B-57: Vertical electric field strength along power line for tri26n topology

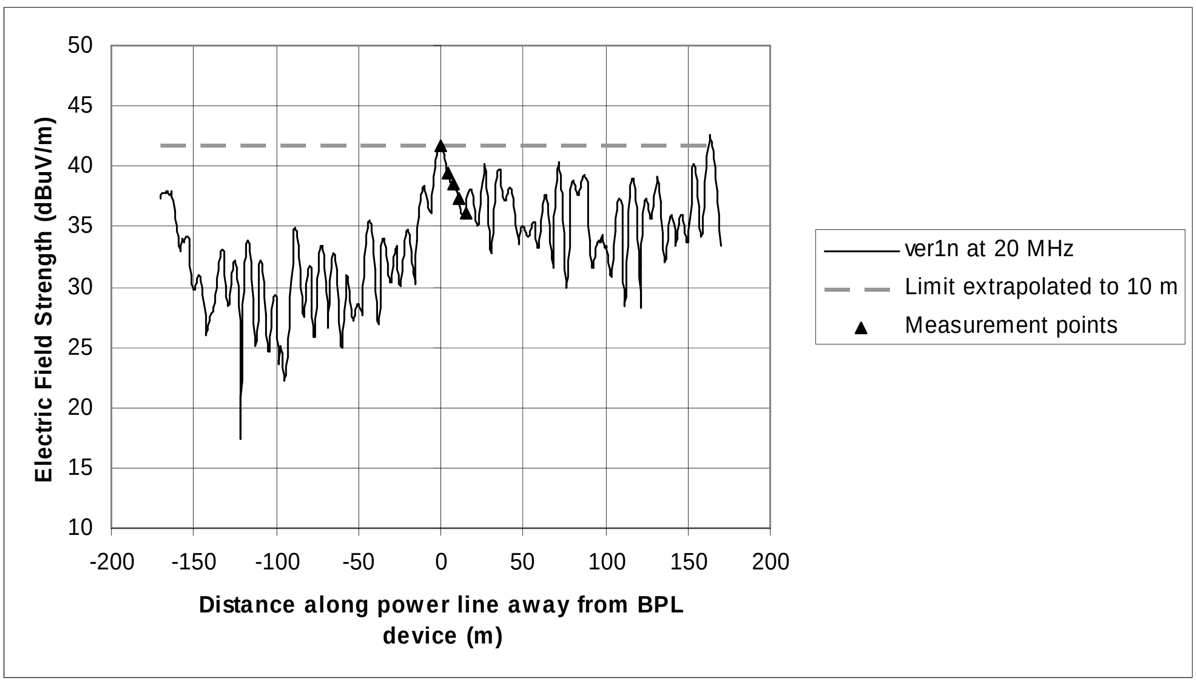

Figure B-58: Vertical electric field strength along power line for ver1n topology

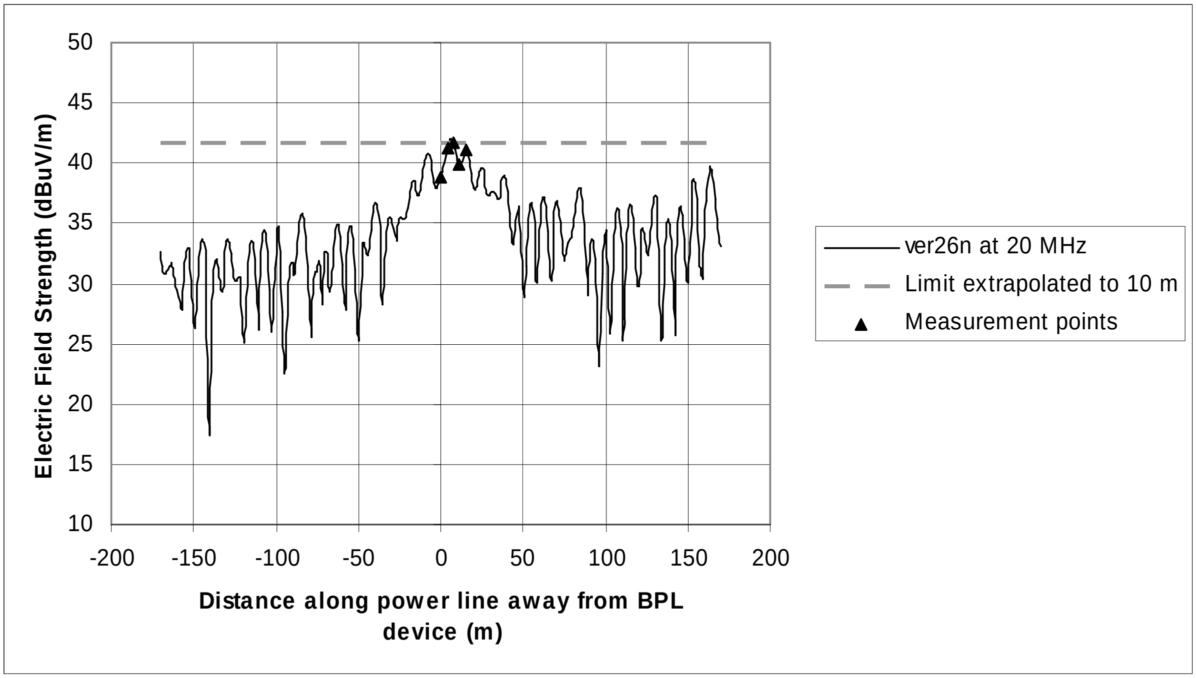

Figure B-59: Vertical electric field strength along power line for ver26n topology

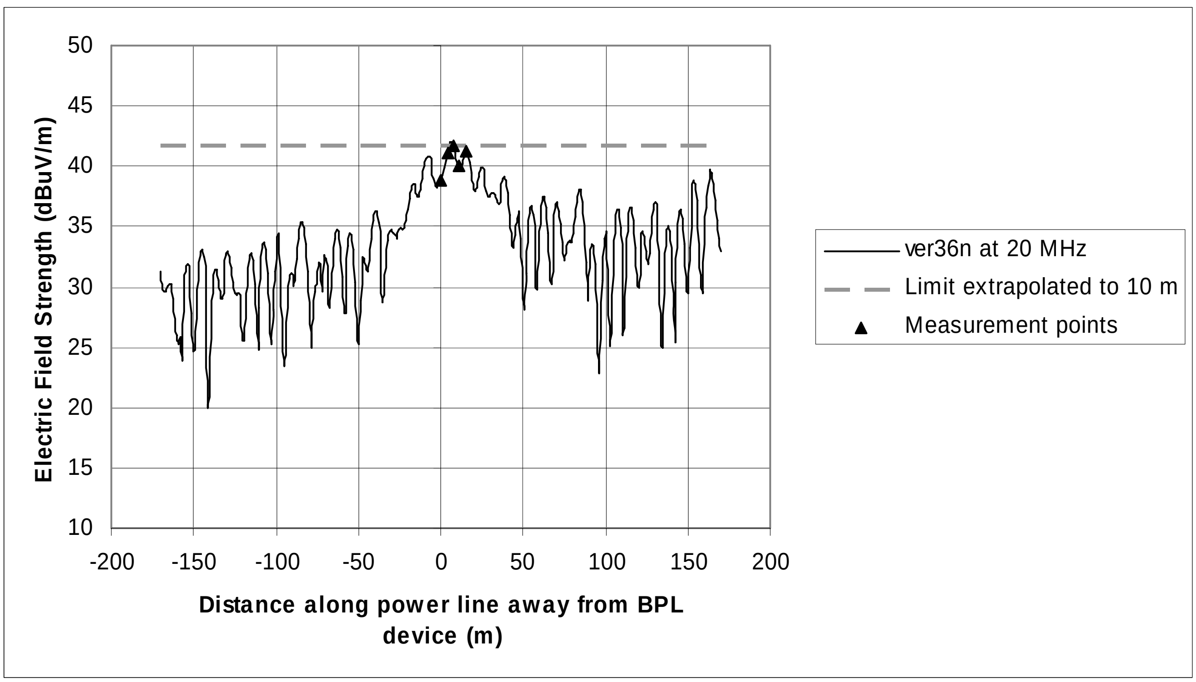

Figure B-60: Vertical electric field strength along power line for ver36n topology

22 MHz Plots

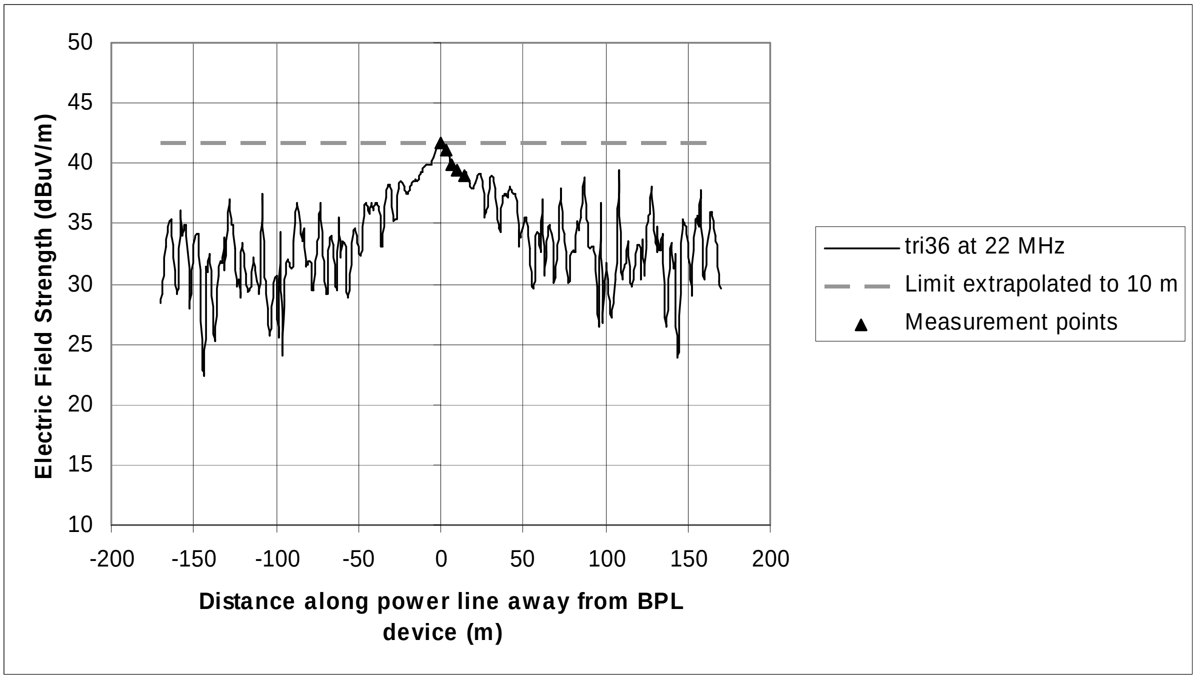

Figure B-61: Vertical electric field strength along power line for tri36 topology

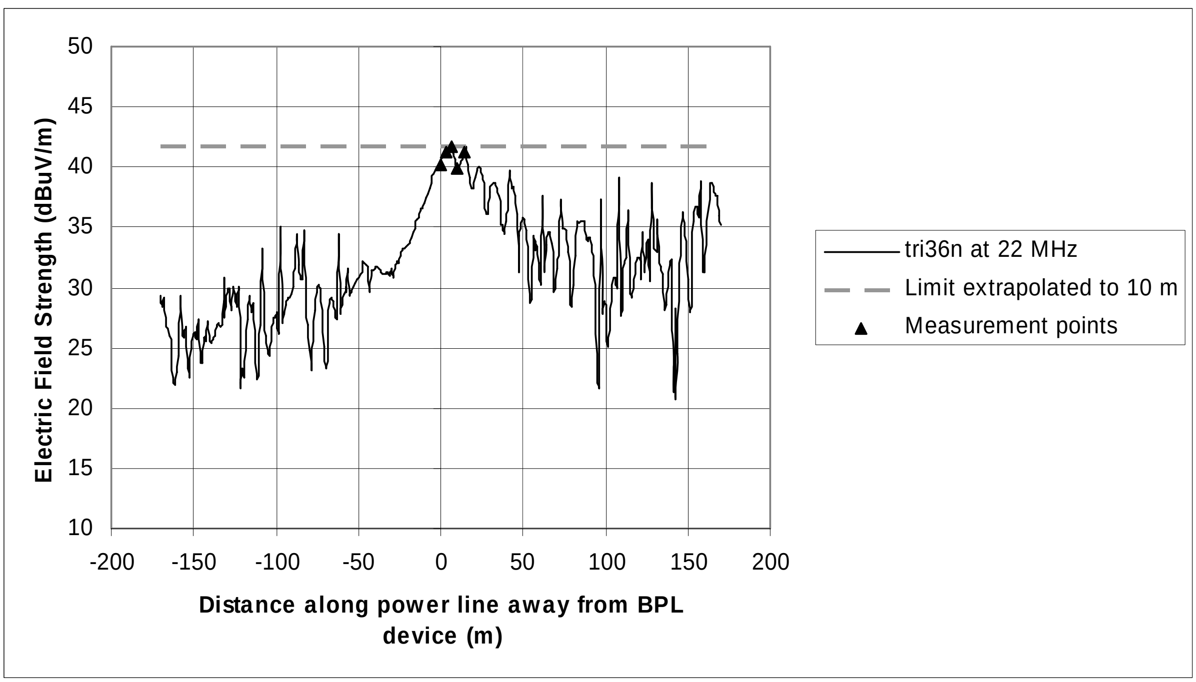

Figure B-62: Vertical electric field strength along power line for tri36n topology

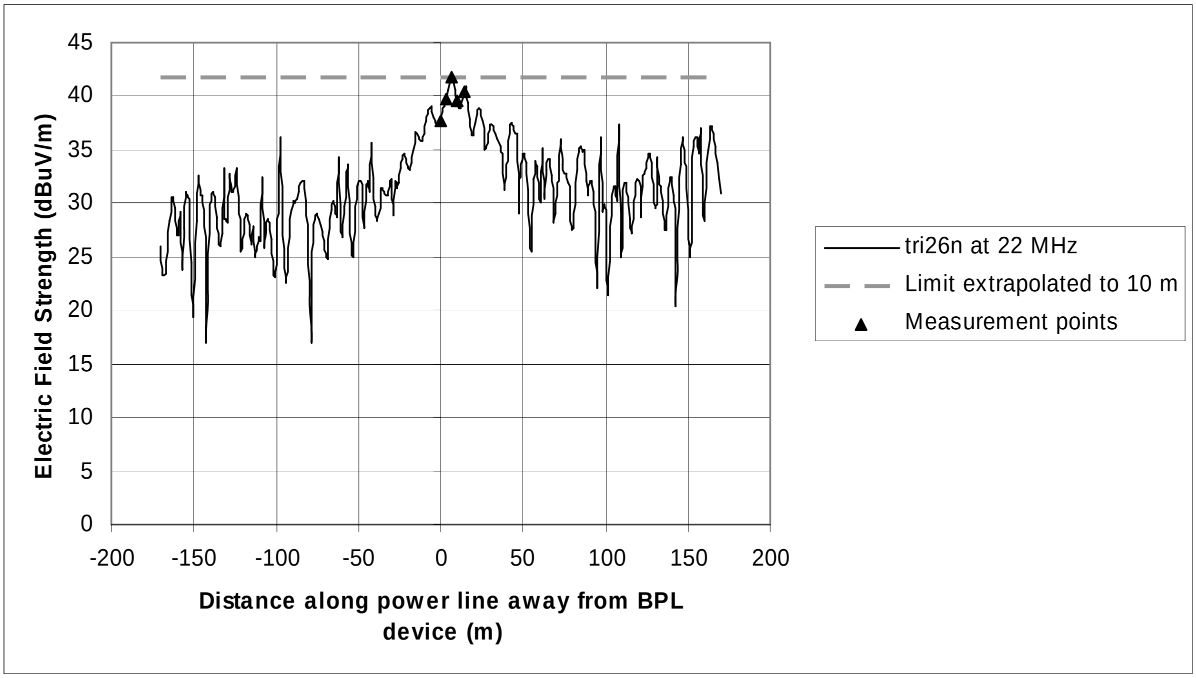

Figure B-63: Vertical electric field strength along power line for tri26n topology

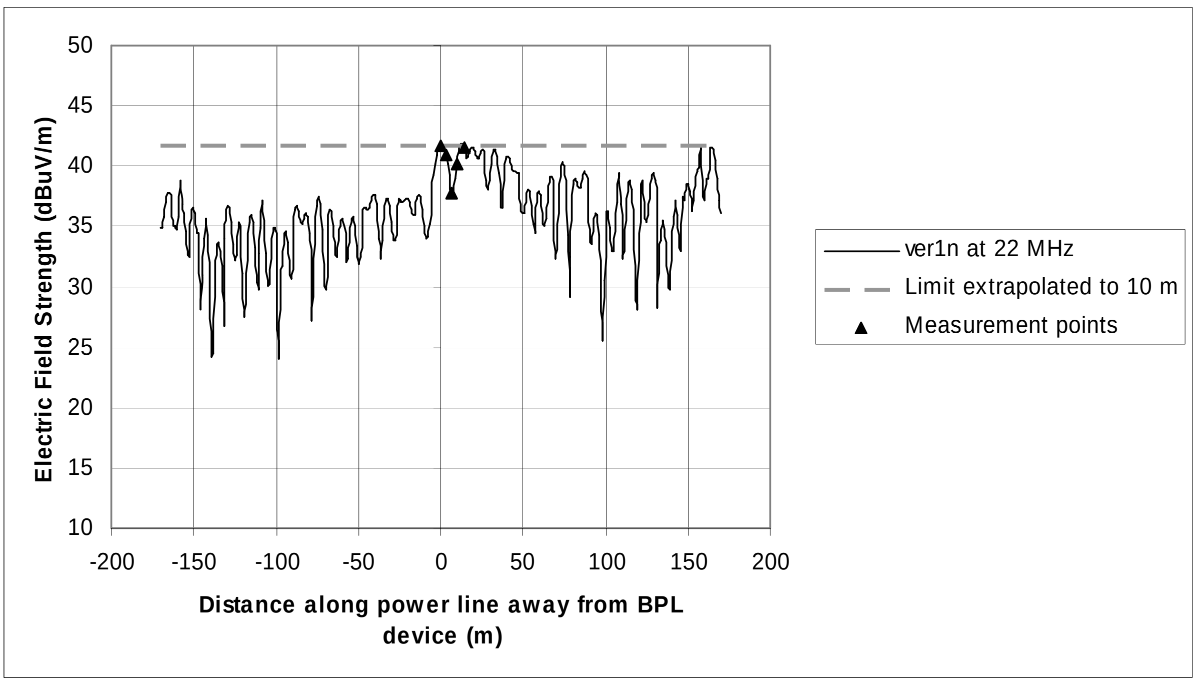

Figure B-64: Vertical electric field strength along power line for ver1n topology

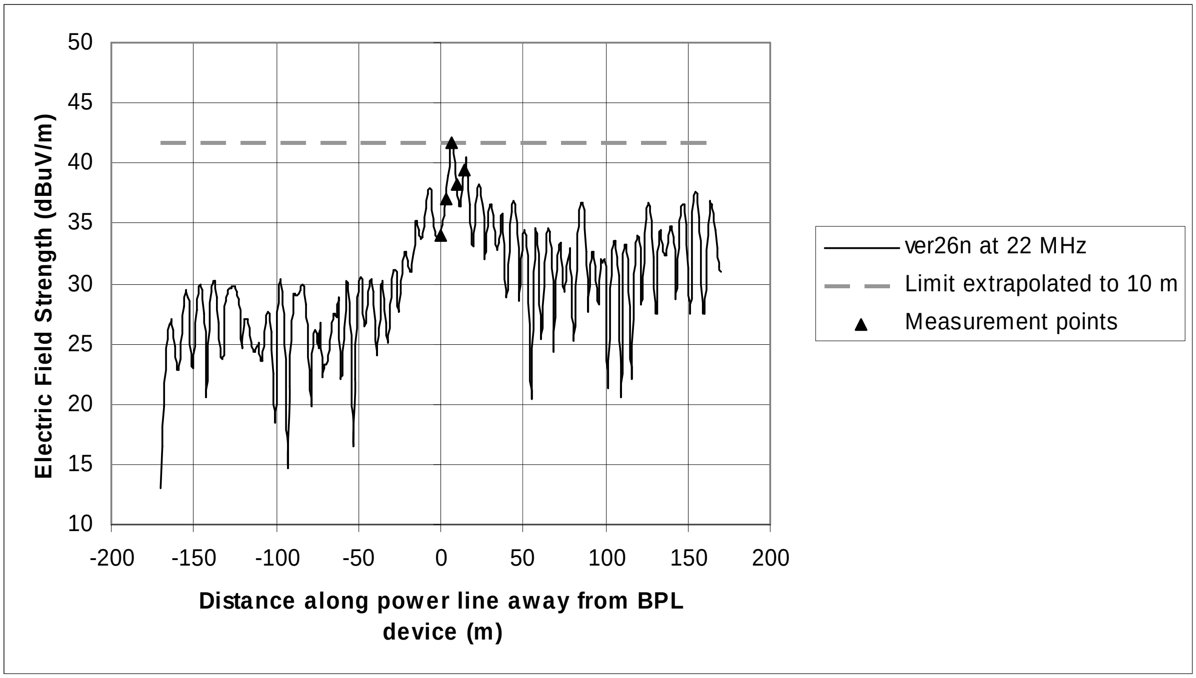

Figure B-65: Vertical electric field strength along power line for ver26n topology

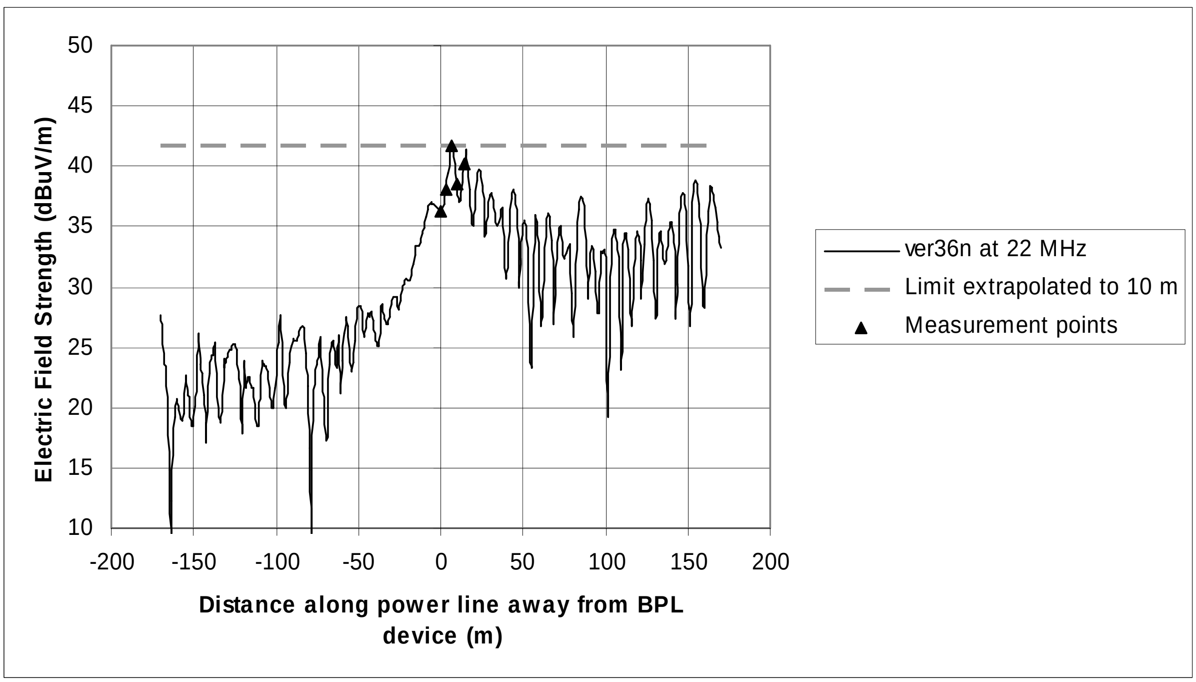

Figure B-66: Vertical electric field strength along power line for ver36n topology

24 MHz Plots

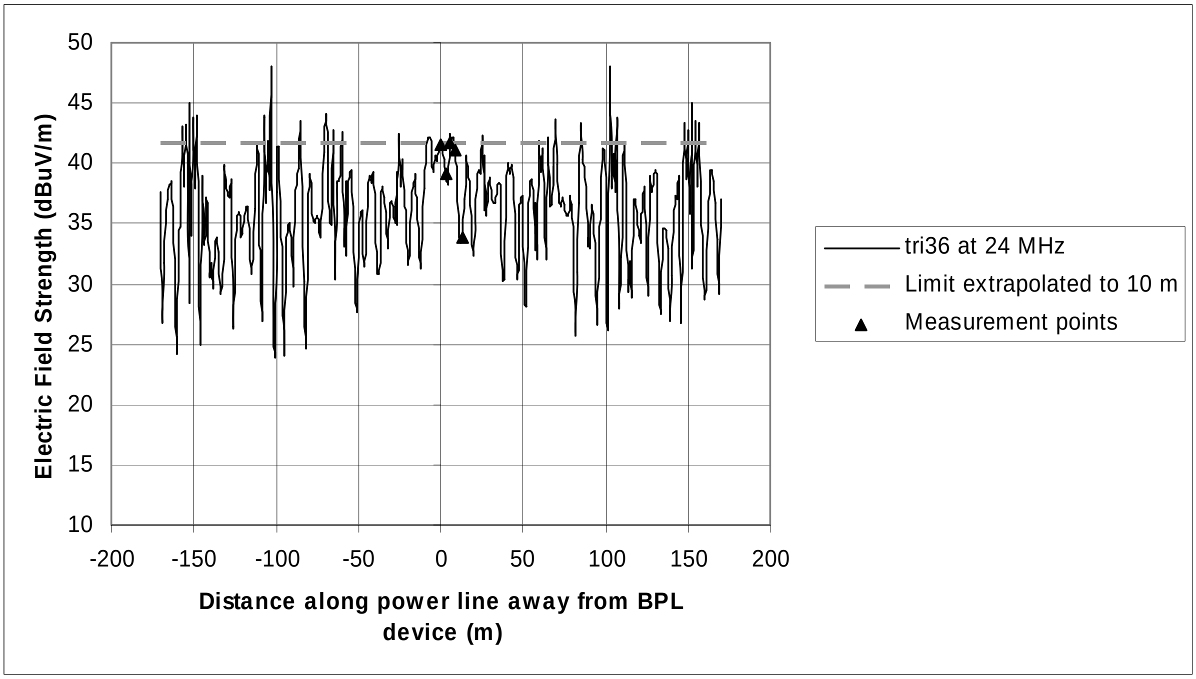

Figure B-67: Vertical electric field strength along power line for tri36 topology

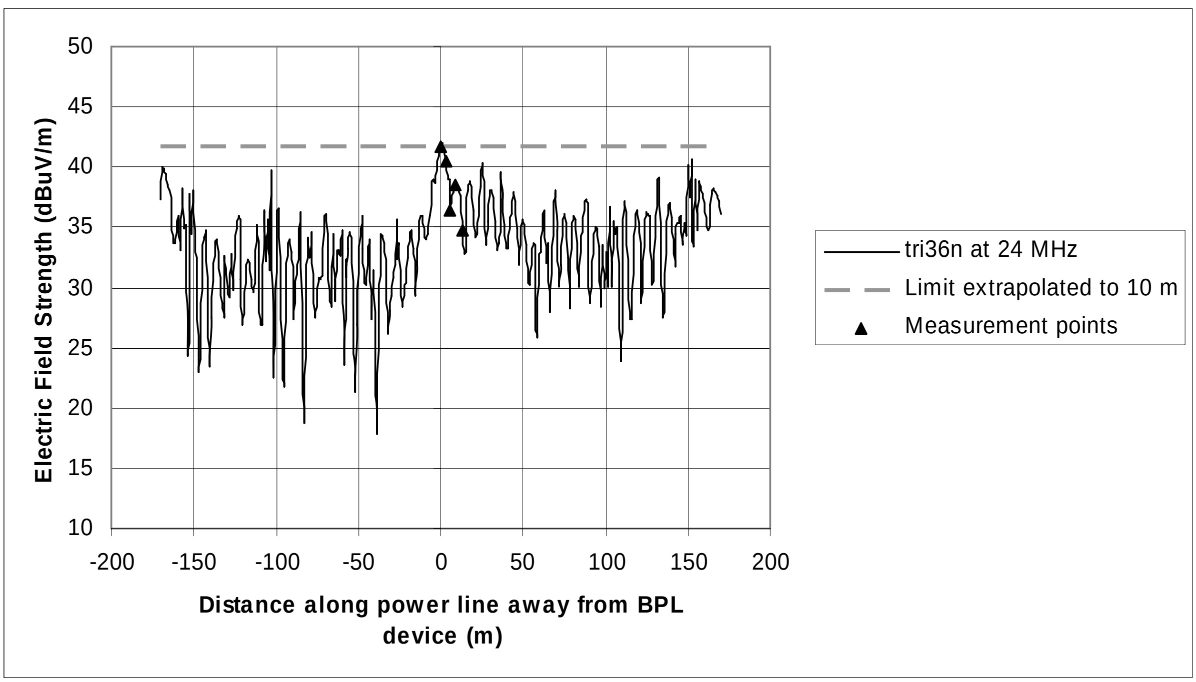

Figure B-68: Vertical electric field strength along power line for tri36n topology

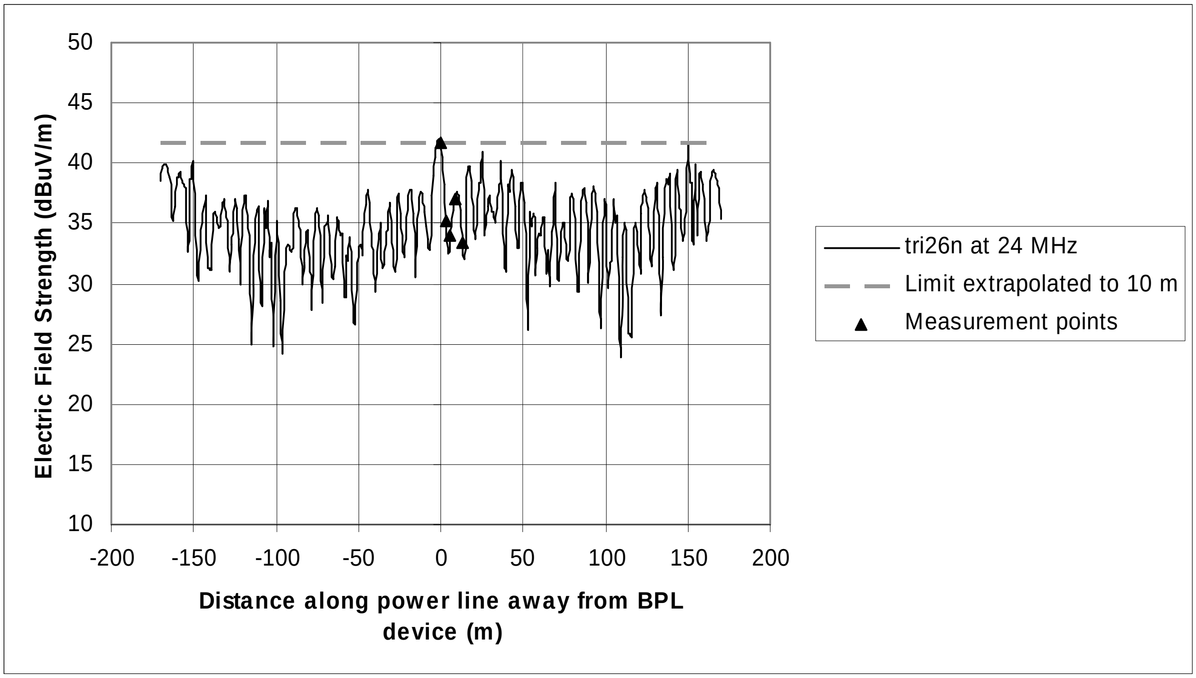

Figure B-69: Vertical electric field strength along power line for tri26n topology

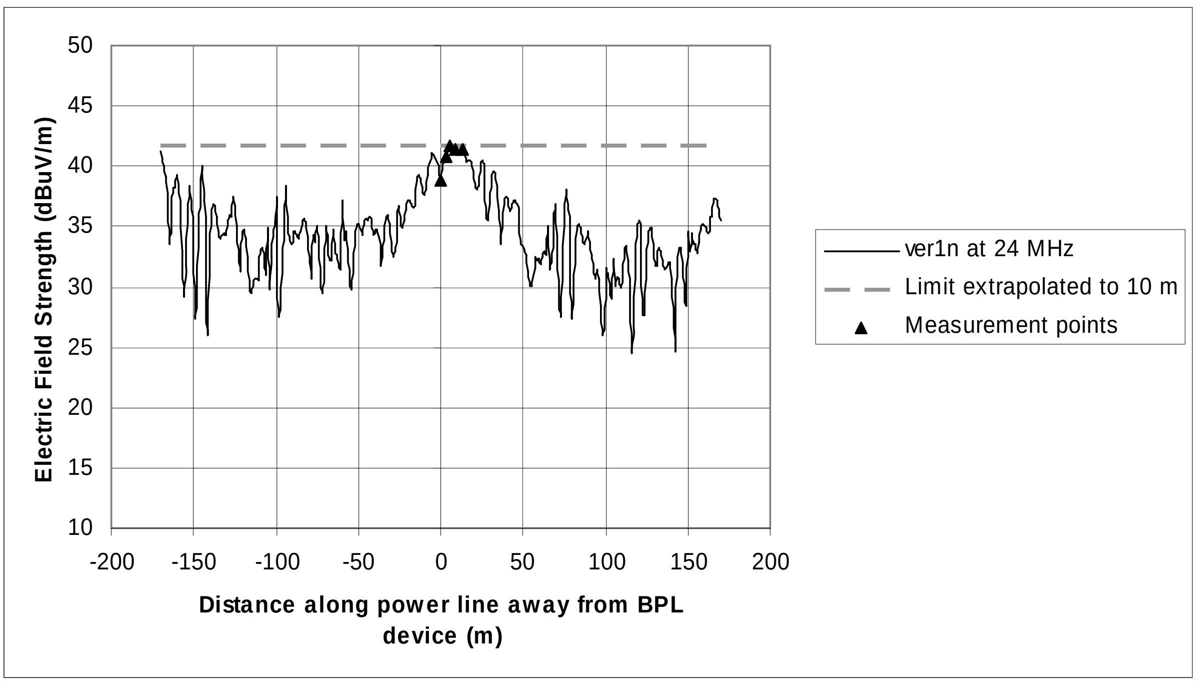

Figure B-70: Vertical electric field strength along power line for ver1n topology

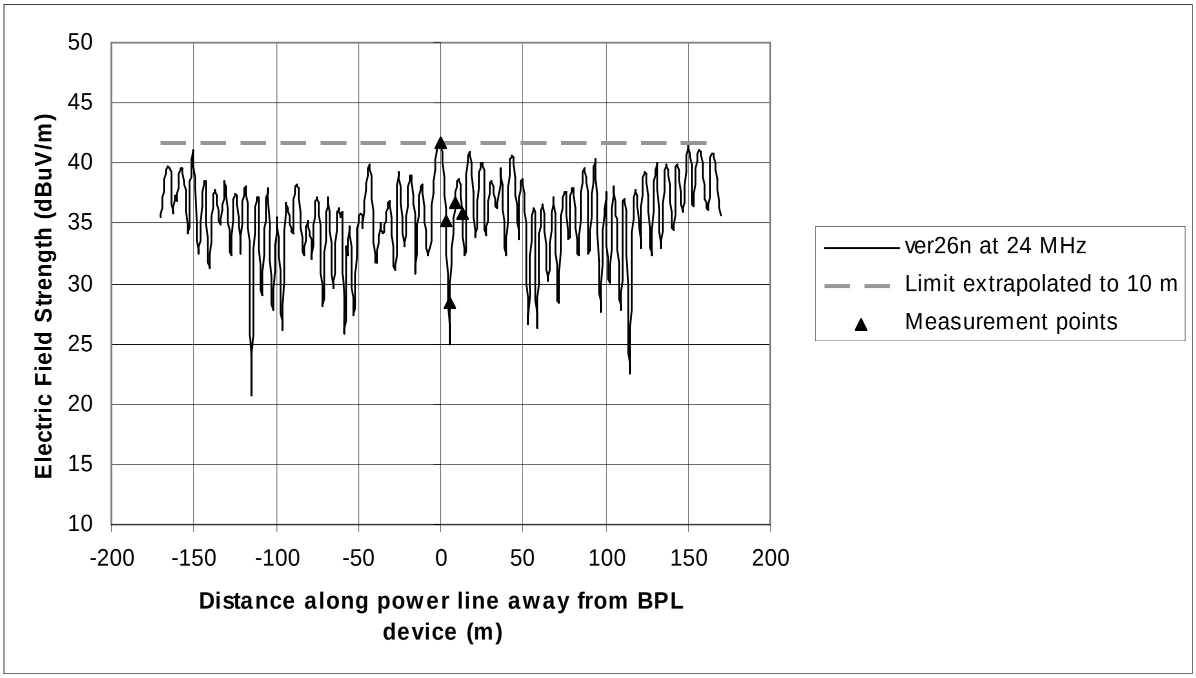

Figure B-71: Vertical electric field strength along power line for ver26n topology

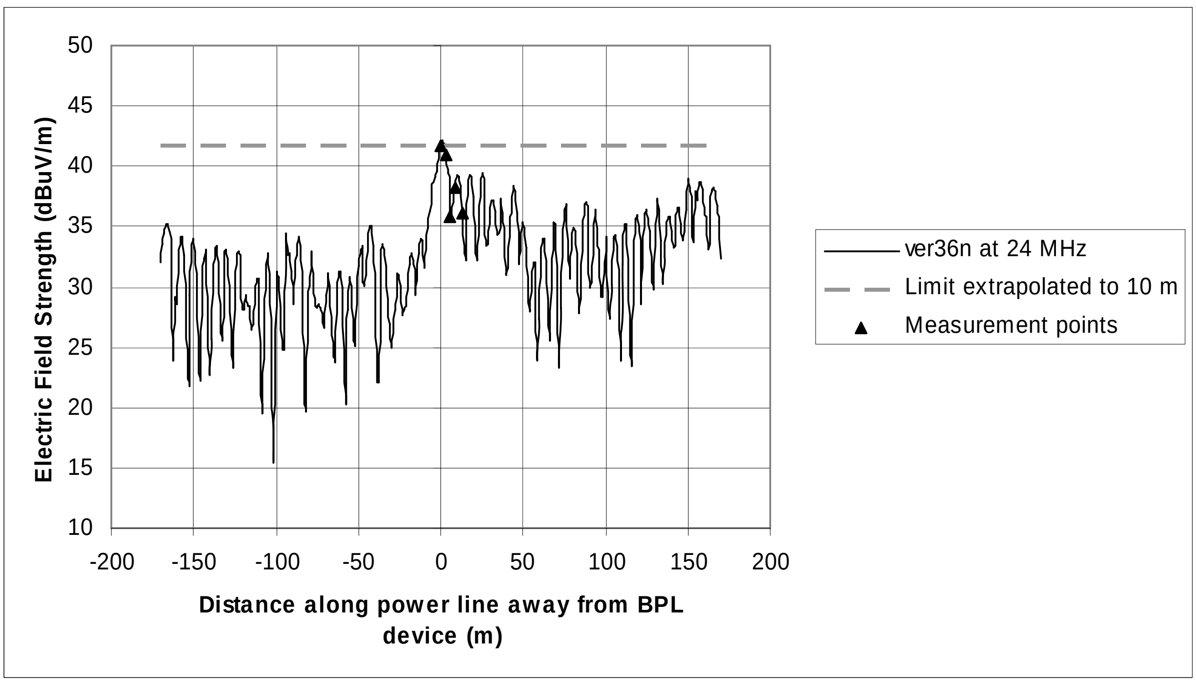

Figure B-72: Vertical electric field strength along power line for ver36n topology

26 MHz Plots

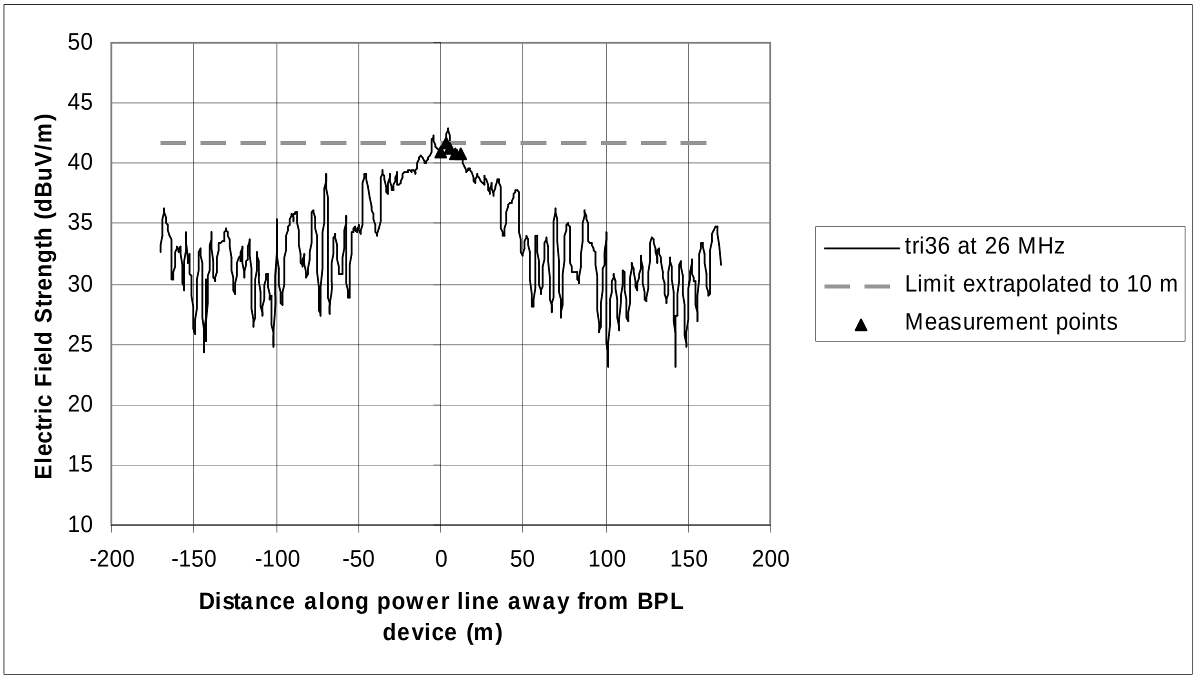

Figure B-73: Vertical electric field strength along power line for tri36 topology

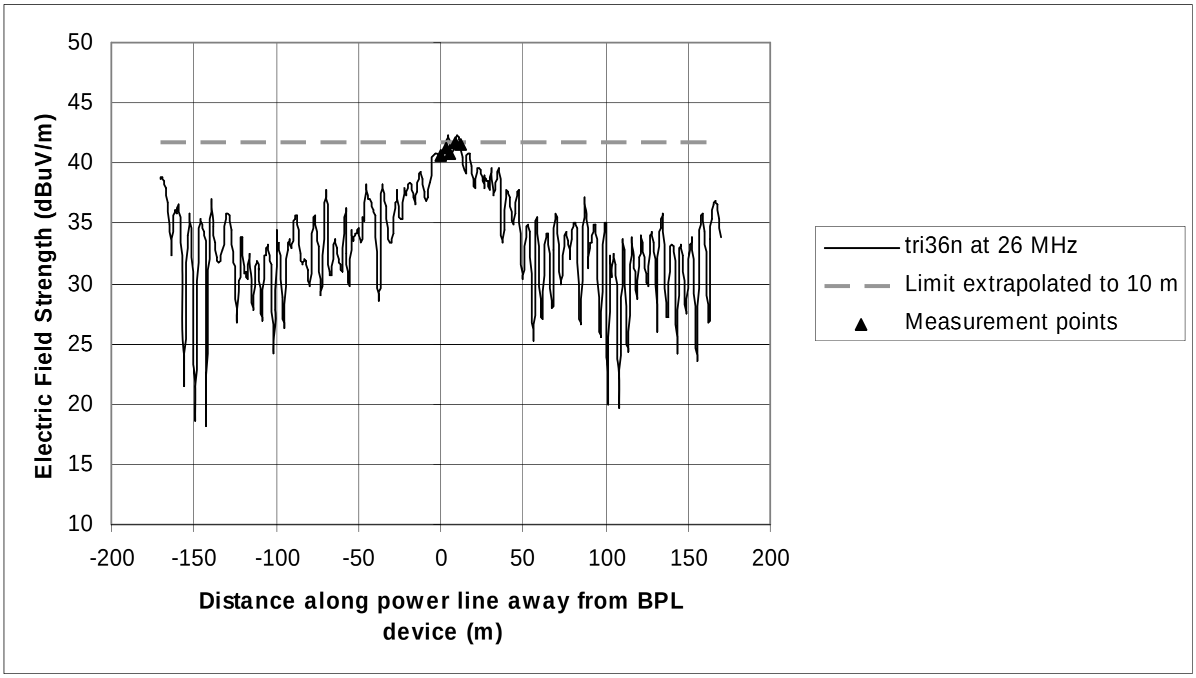

Figure B-74: Vertical electric field strength along power line for tri36n topology

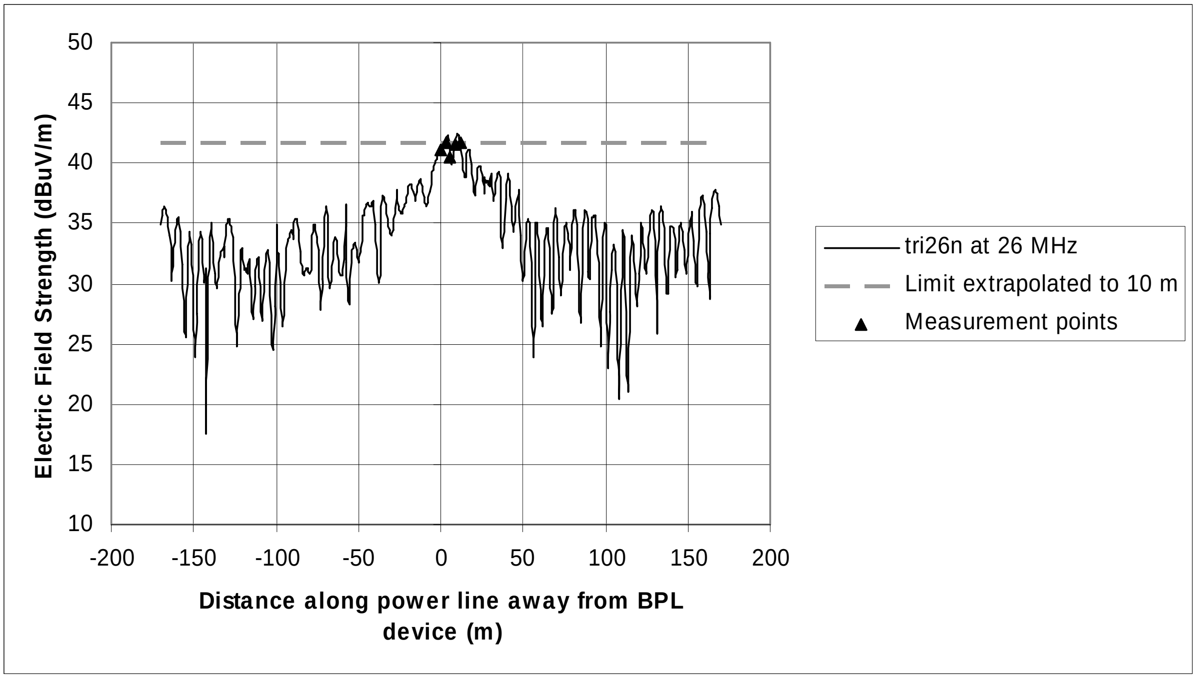

Figure B-75: Vertical electric field strength along power line for tri26n topology

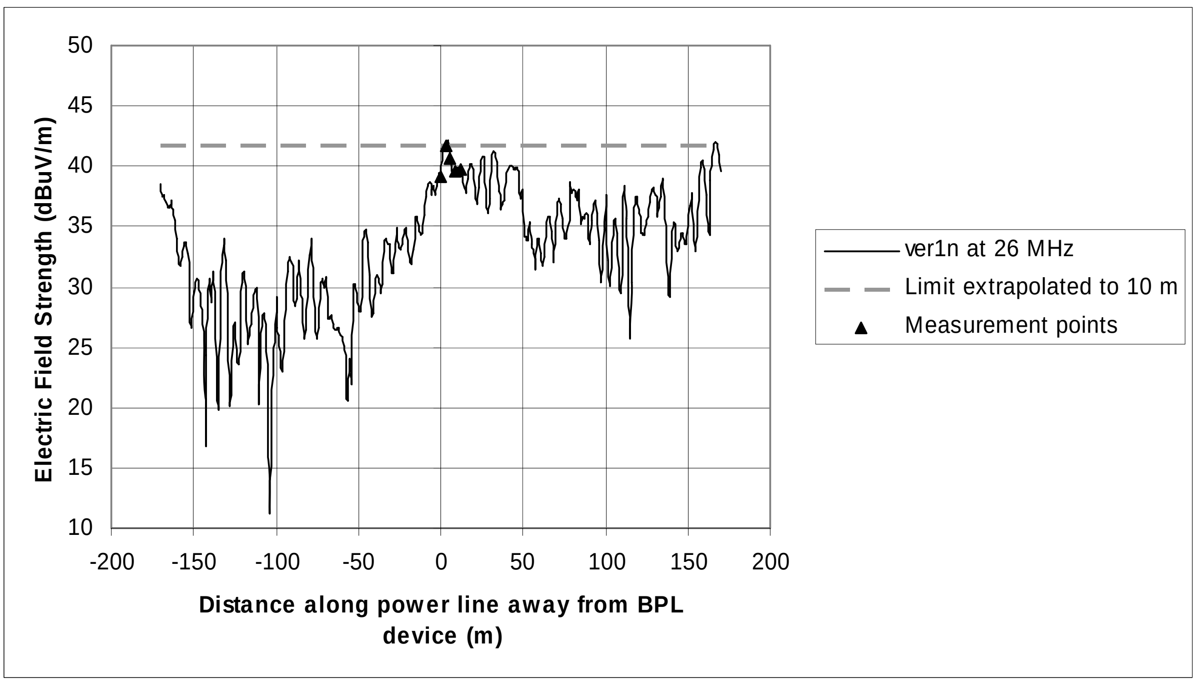

Figure B-76: Vertical electric field strength along power line for ver1n topology

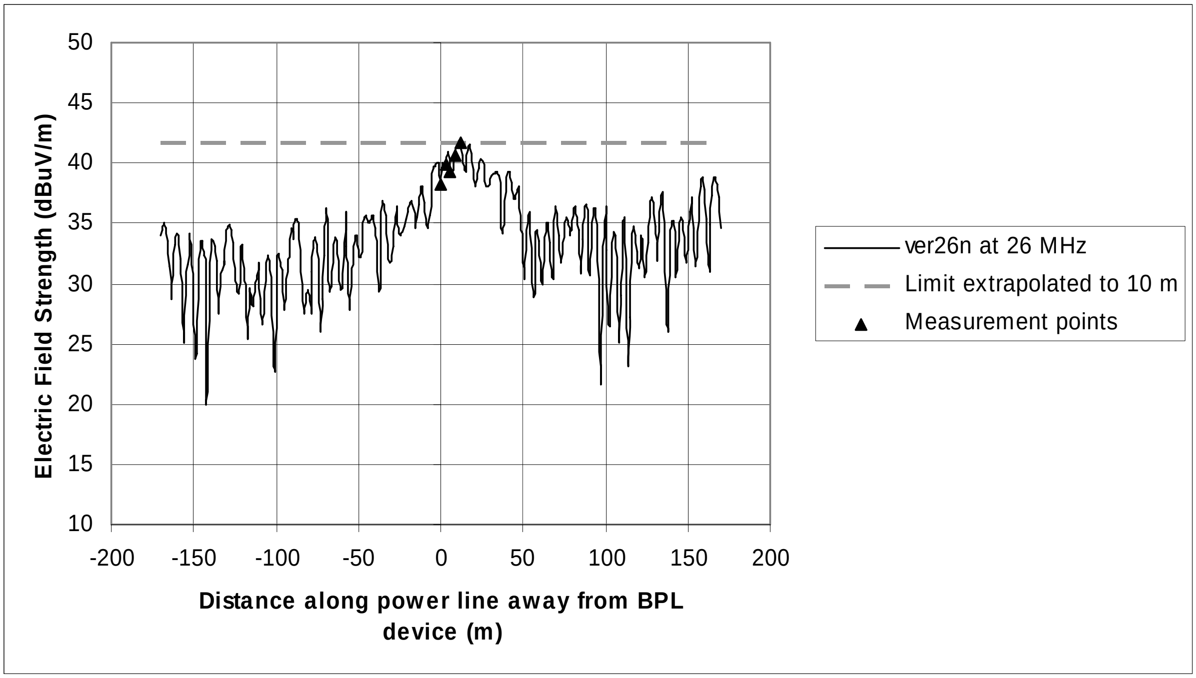

Figure B-77: Vertical electric field strength along power line for ver26n topology

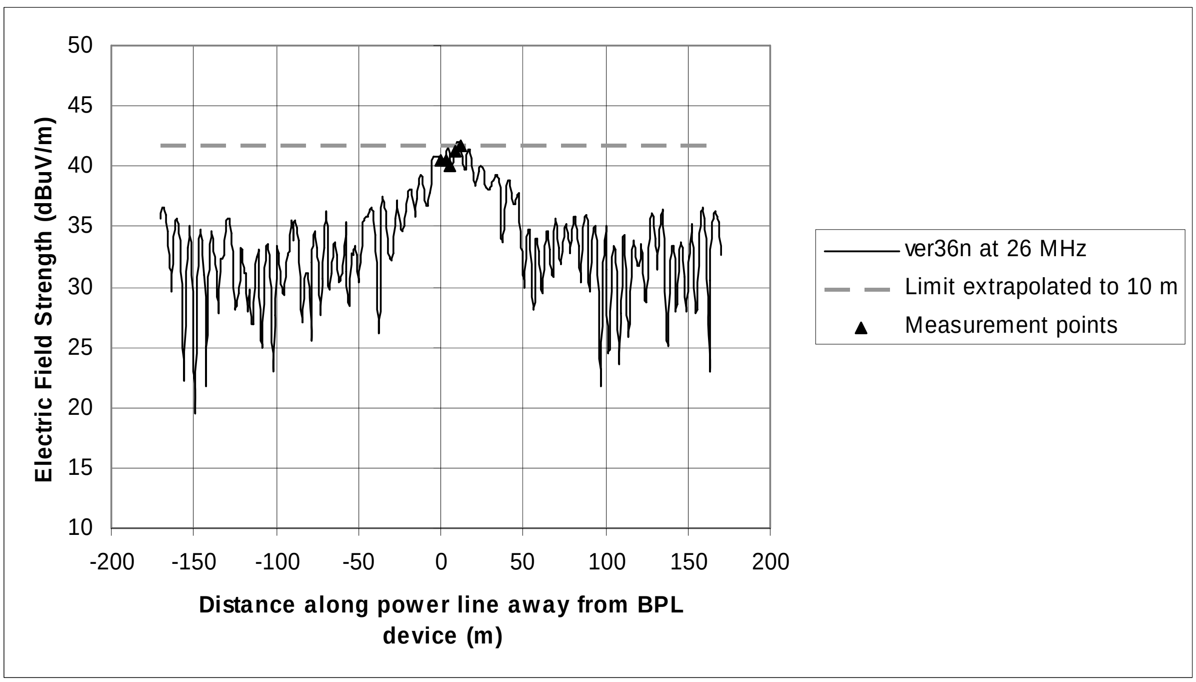

Figure B-78: Vertical electric field strength along power line for ver36n topology

28 MHz Plots

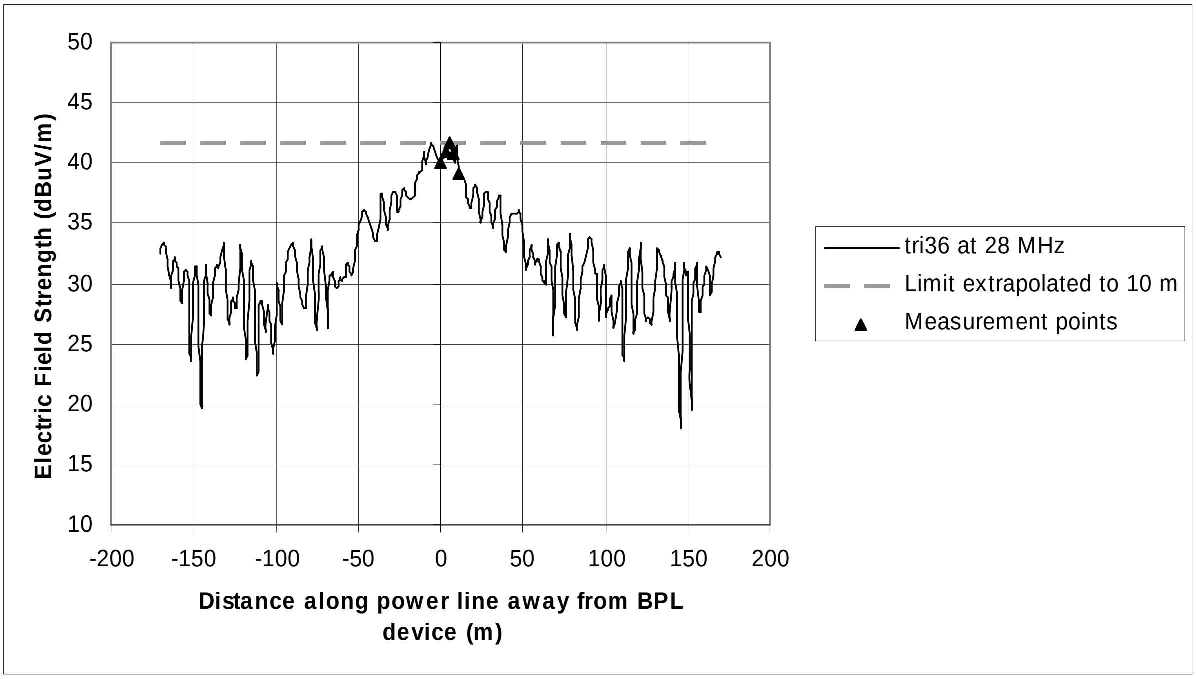

Figure B-79: Vertical electric field strength along power line for tri36 topology

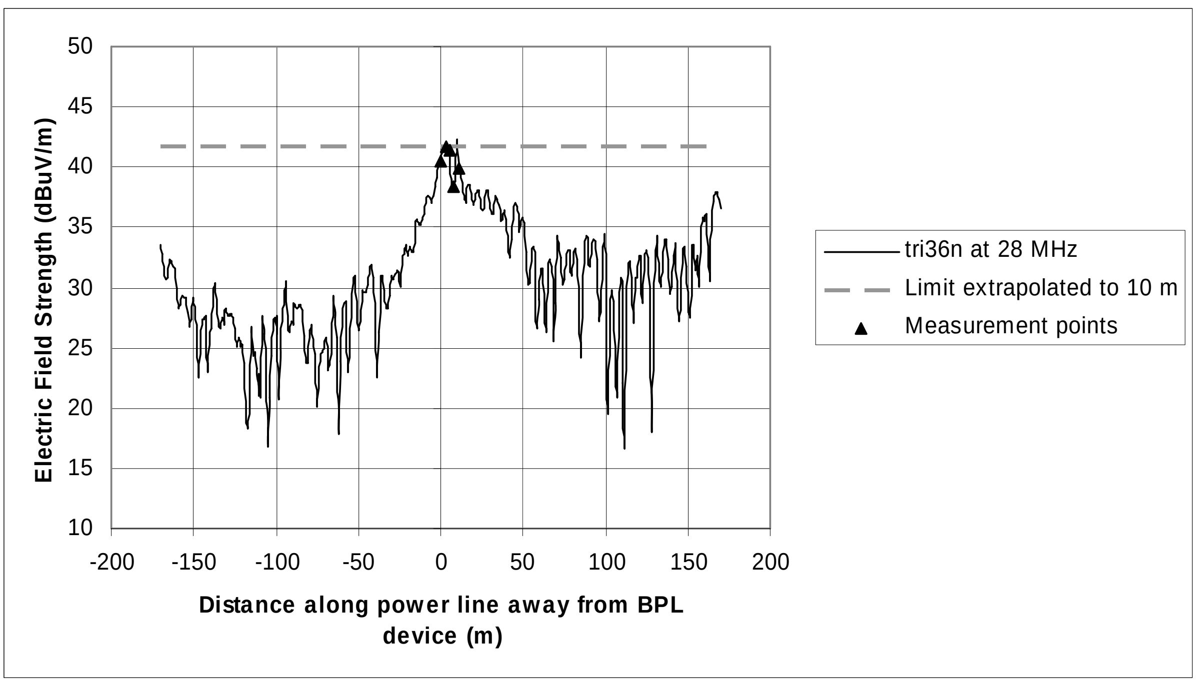

Figure B-80: Vertical electric field strength along power line for tri36n topology

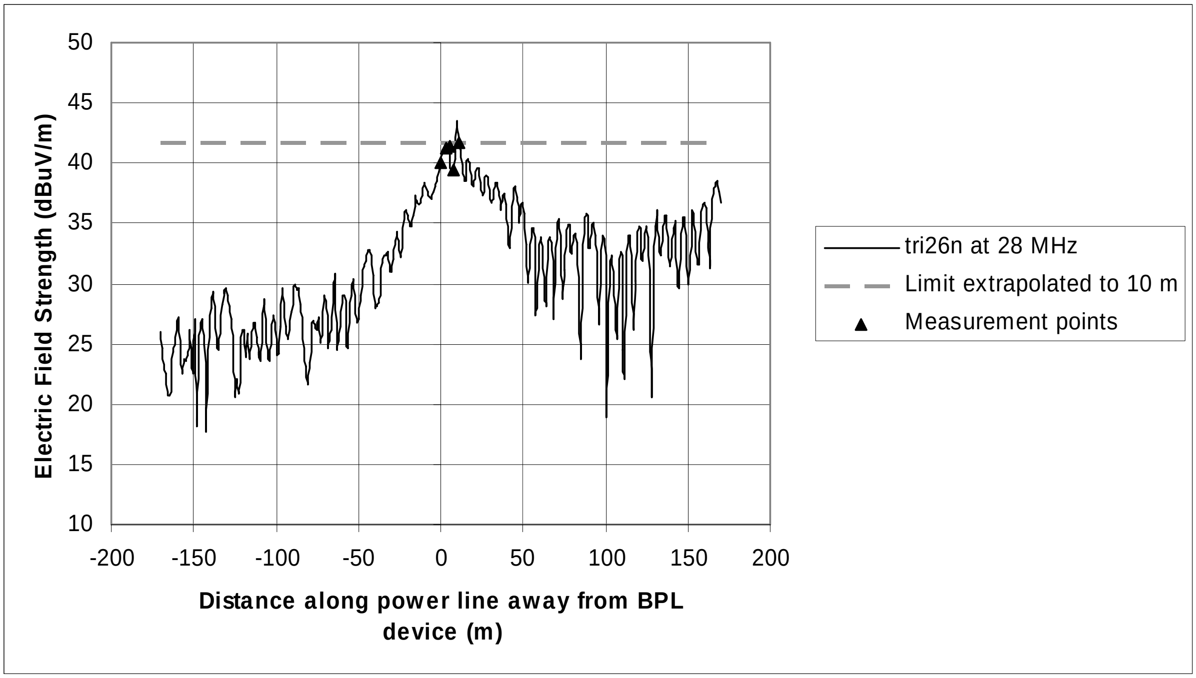

Figure B-81: Vertical electric field strength along power line for tri26 topology

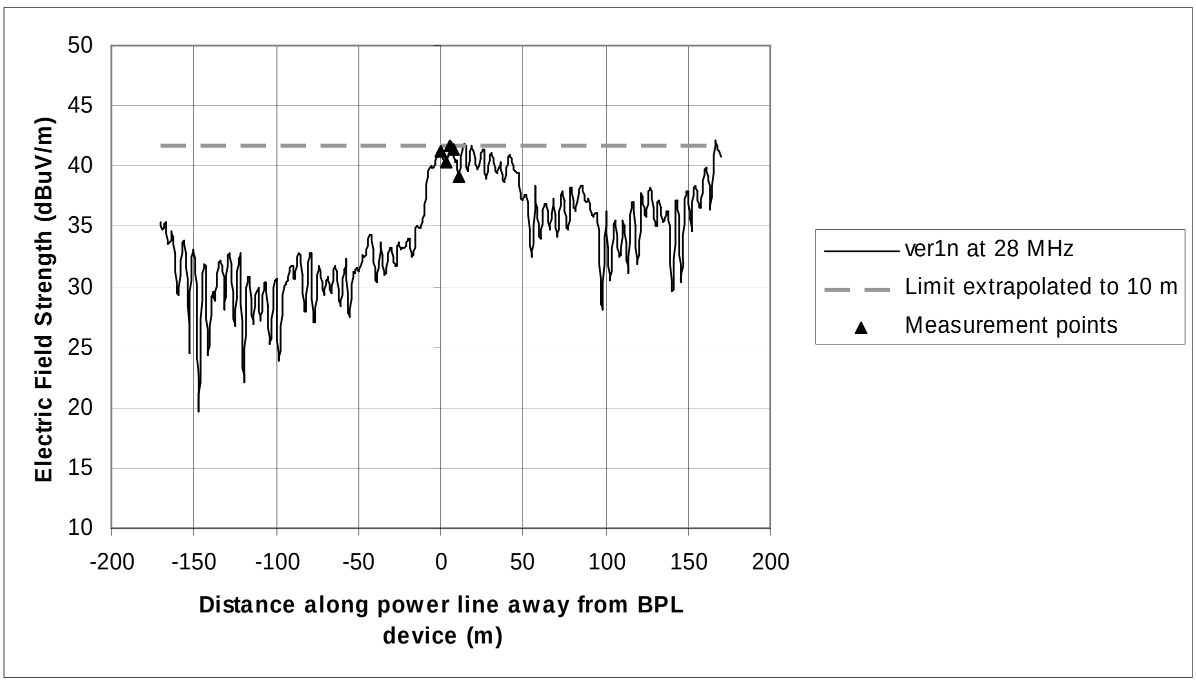

Figure B-82: Vertical electric field strength along power line for ver1n topology

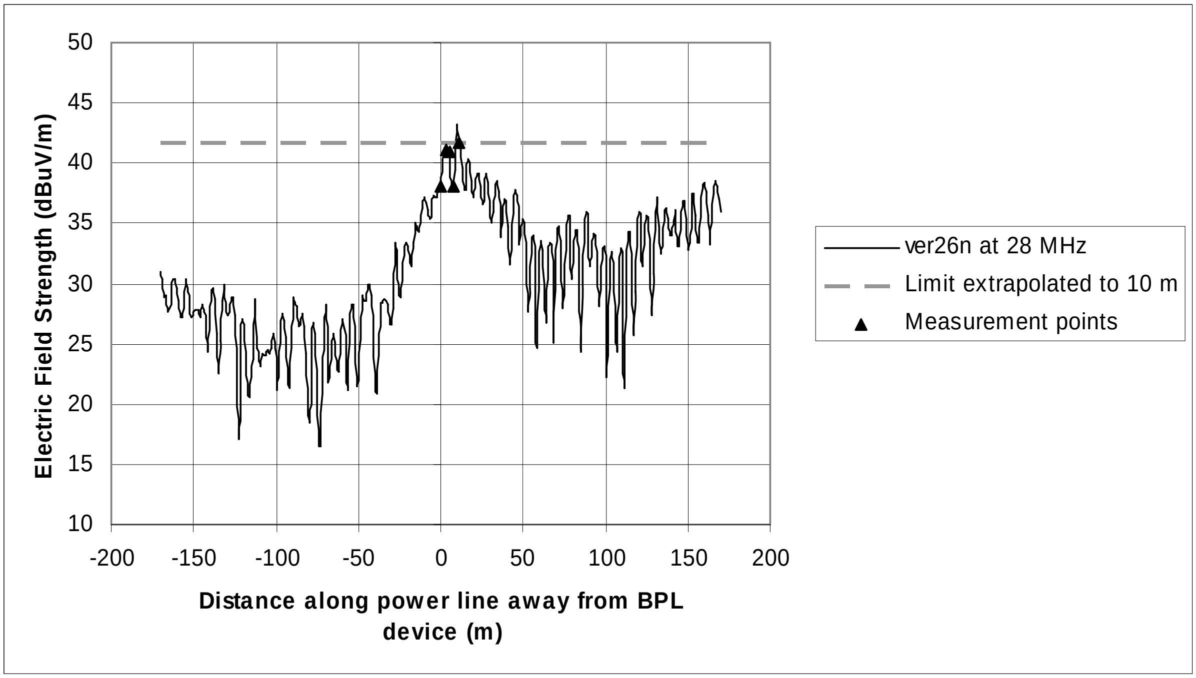

Figure B-83: Vertical electric field strength along power line for ver26n topology

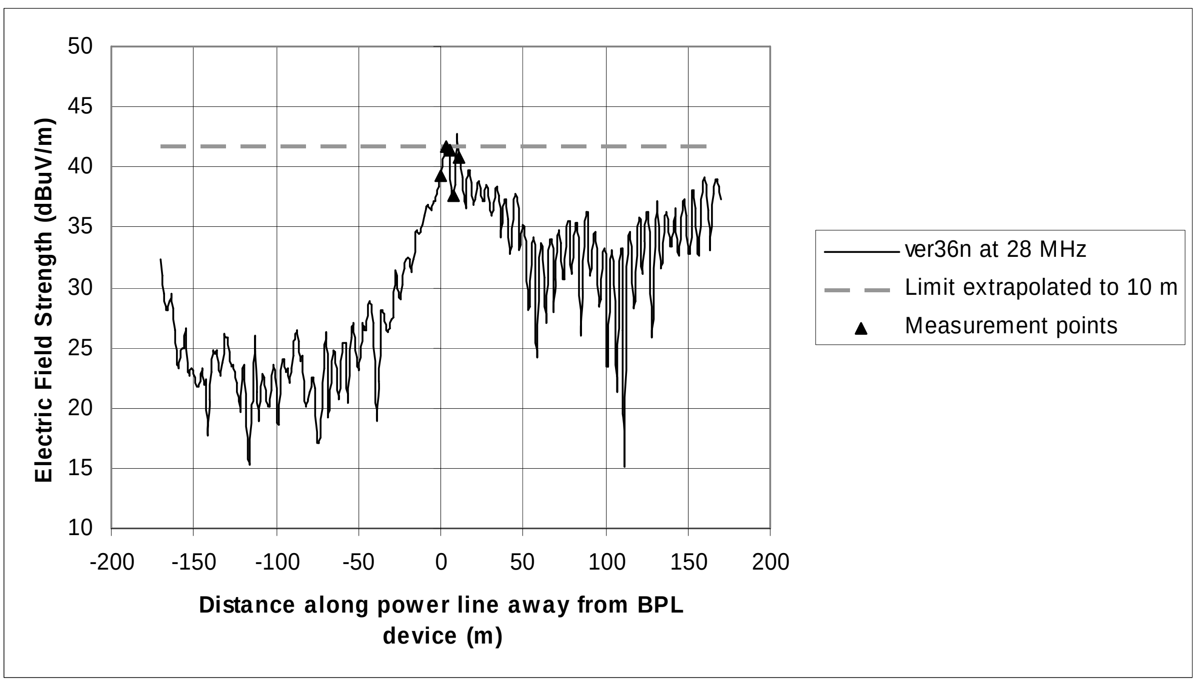

Figure B-84: Vertical electric field strength along power line for ver36n topology

APPENDIX C
MEASUREMENT DISTANCE EXTRAPOLATION

C.1 INTRODUCTION

The distance extrapolation calculation based on use of the slant path distance from the BPL device and power lines under test and the measurement antenna was discussed in Section 2.5 of the report. Some of the resulting plots from NTIA's NEC power line model simulations were reported in that section. The remaining plots are included in this appendix.

C.2 BPL FIELD STRENGTH SIMULATION RESULTS

C.2.1 Extrapolated Field Strength Levels Meeting the Part 15 Limits

Figure C-1 shows the extrapolated electric field strength levels that satisfy the Part 15 limits using slant range distance extrapolation, assuming a power line height of 12 meters. The simulated measurement antenna height is assumed to be 1 meter.

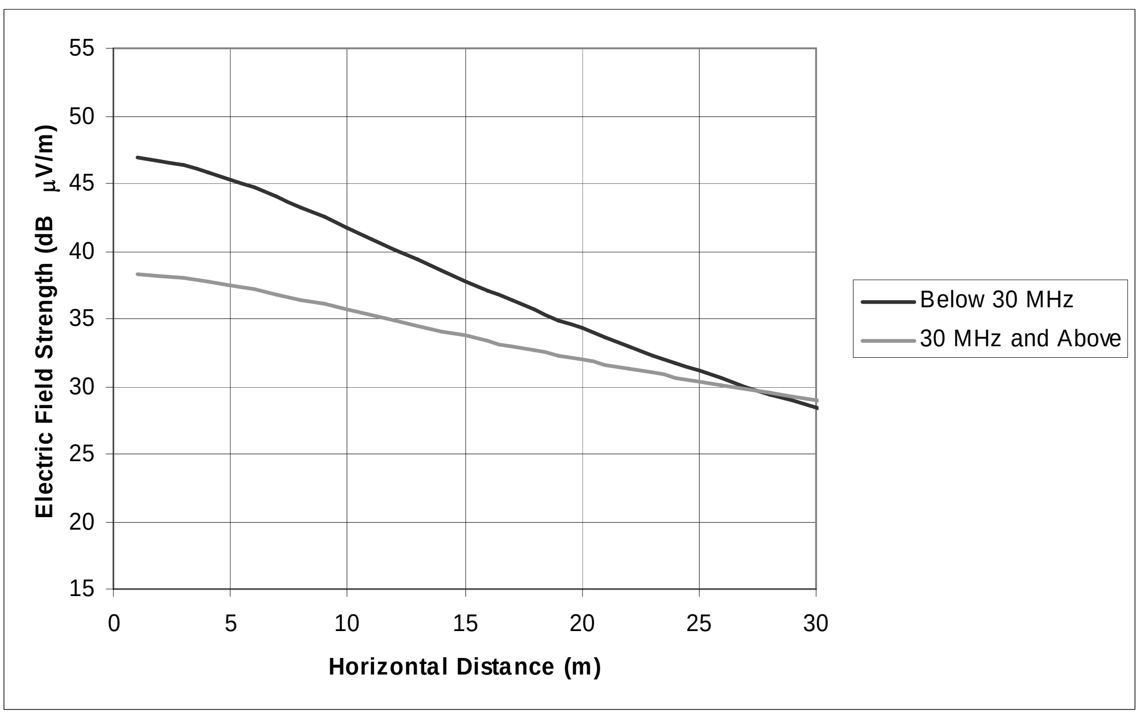

Figure C.1 - Extrapolated field strength levels meeting Part 15 emissions limits based on slant-range distance to the BPL device under test

C.2.2 Simulation Results

Figures C-2 through C-15 shows the simulated electric field strength moving away from the power line for a number of power line structures that were previously defined in Section 2.2 of the BPL Phase 2 Study. The extrapolated field strength levels meeting the Part 15 emissions limit below 30 MHz are displayed on each figure for comparison. The simulations determined the vertical electric field strength from the horizontal magnetic field strength using the methodology for compliance testing in the Part 15 rules for Access BPL and assuming the electric field strength is related to the magnetic field strength by η = 377 ohms (Ω). The peak field strength value was chosen from among the values calculated at points along the line, as defined in the measurement guidelines, at a distance of 10 meters away from the line. The plots of field strength relative to distance are taken from this corresponding location for each case.

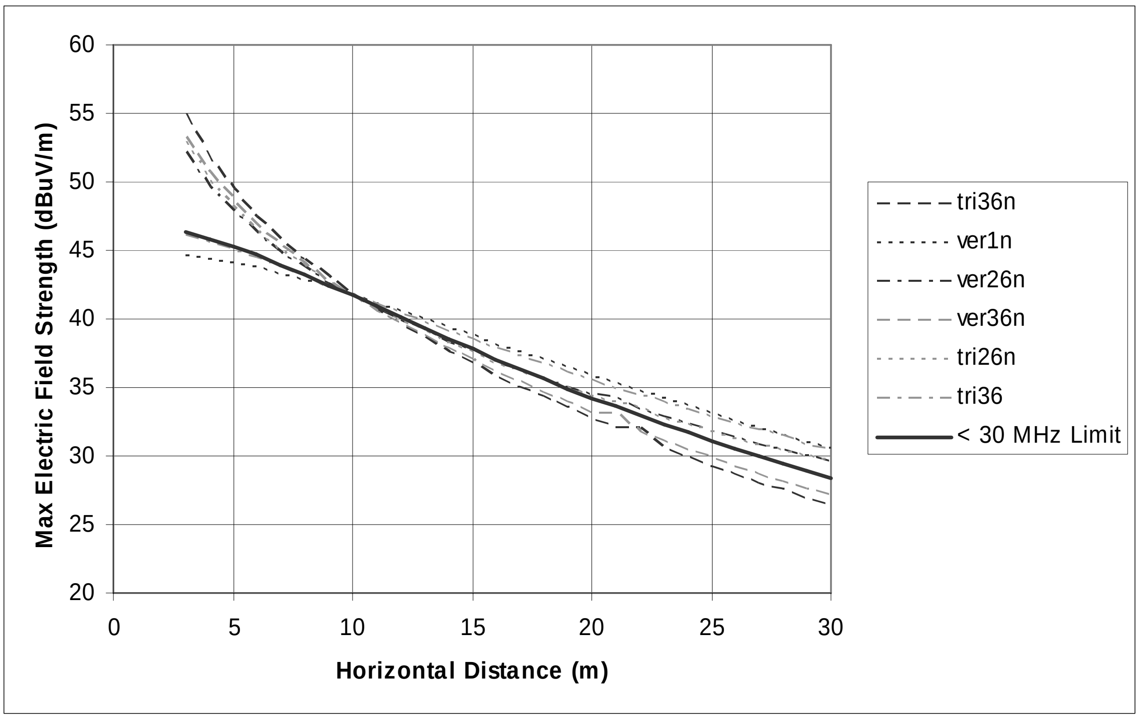

Figure C-2: Electric field strength compared to emissions limit based on slant-range extrapolation for various power line models – 2 MHz

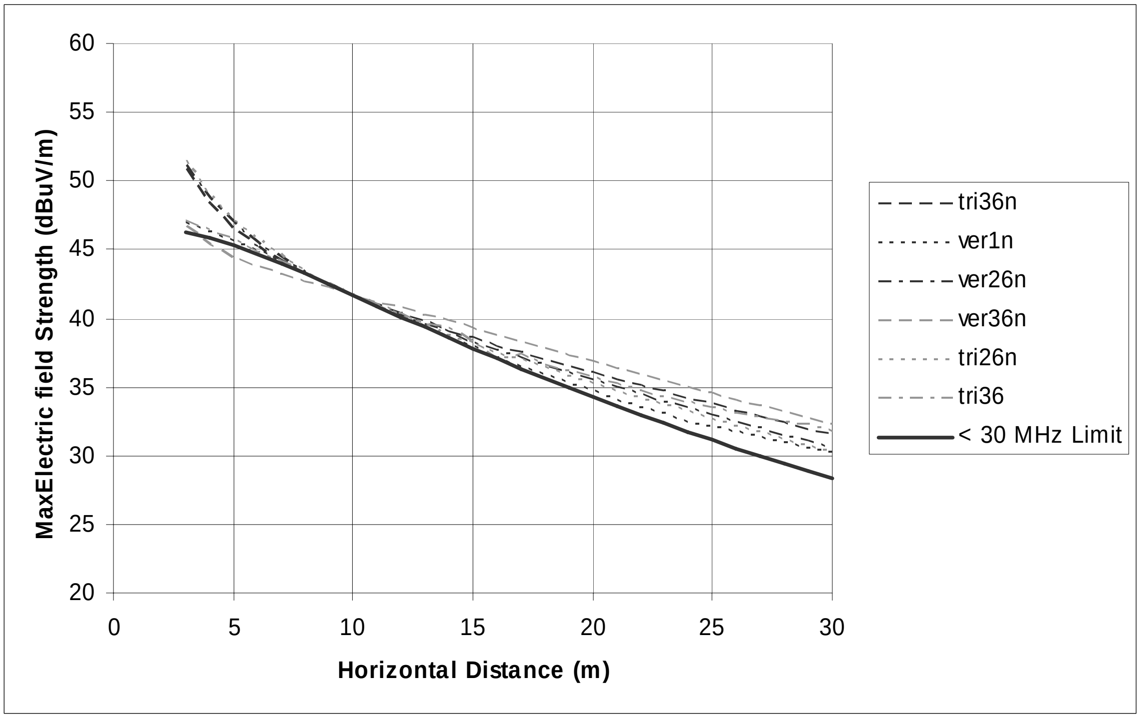

Figure C-3: Electric field strength compared to emissions limit based on slant-range extrapolation for various power line models – 4 MHz

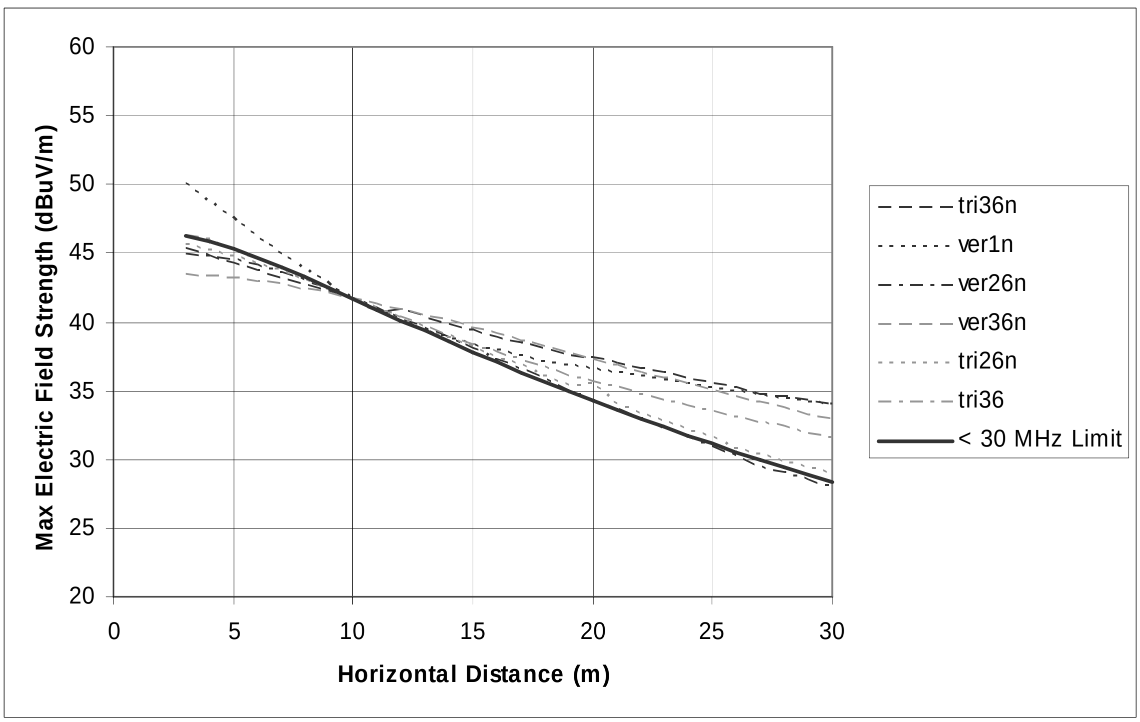

Figure C-4: Electric field strength compared to emissions limit based on slant-range extrapolation for various power line models – 6 MHz

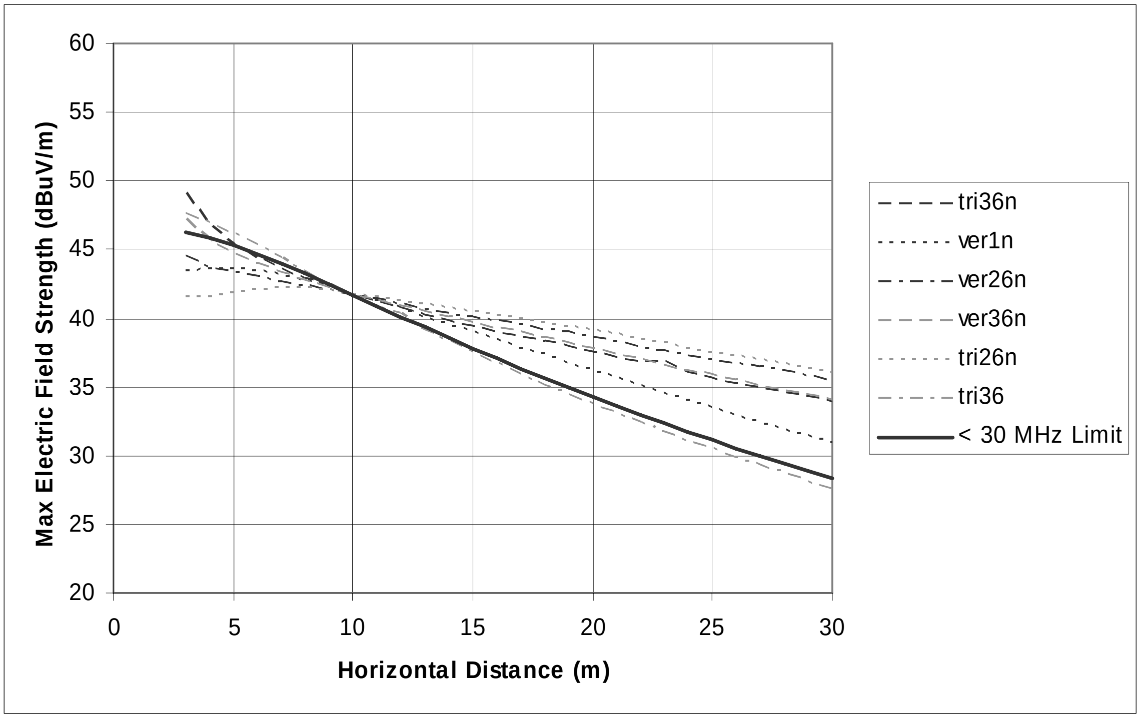

Figure C-5: Electric field strength compared to emissions limit based on slant-range extrapolation for various power line models – 8 MHz

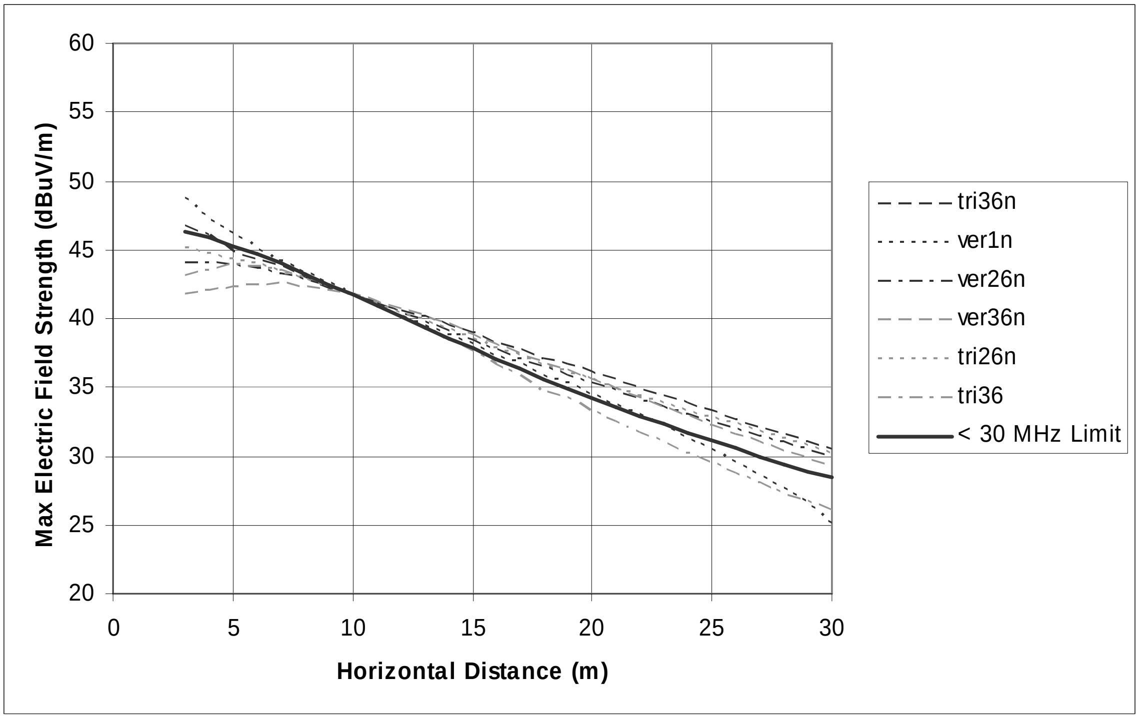

Figure C-6: Electric field strength compared to emissions limit based on slant-range extrapolation for various power line models – 10 MHz

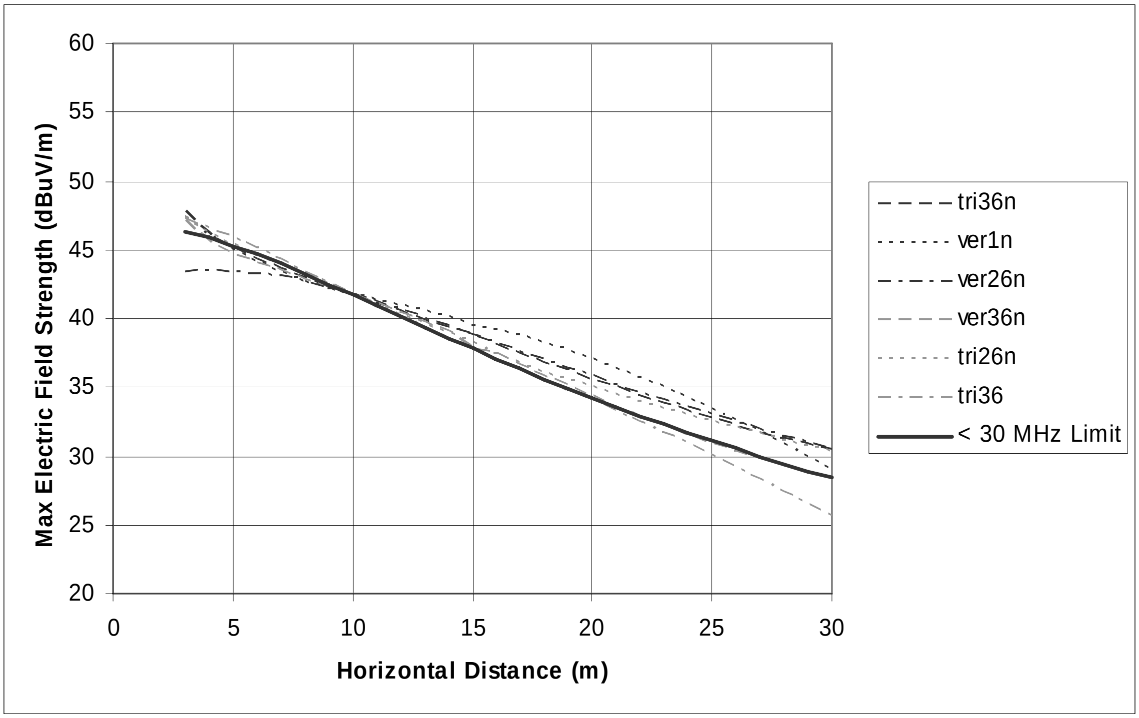

Figure C-7: Electric field strength compared to emissions limit based on slant-range extrapolation for various power line models – 12 MHz

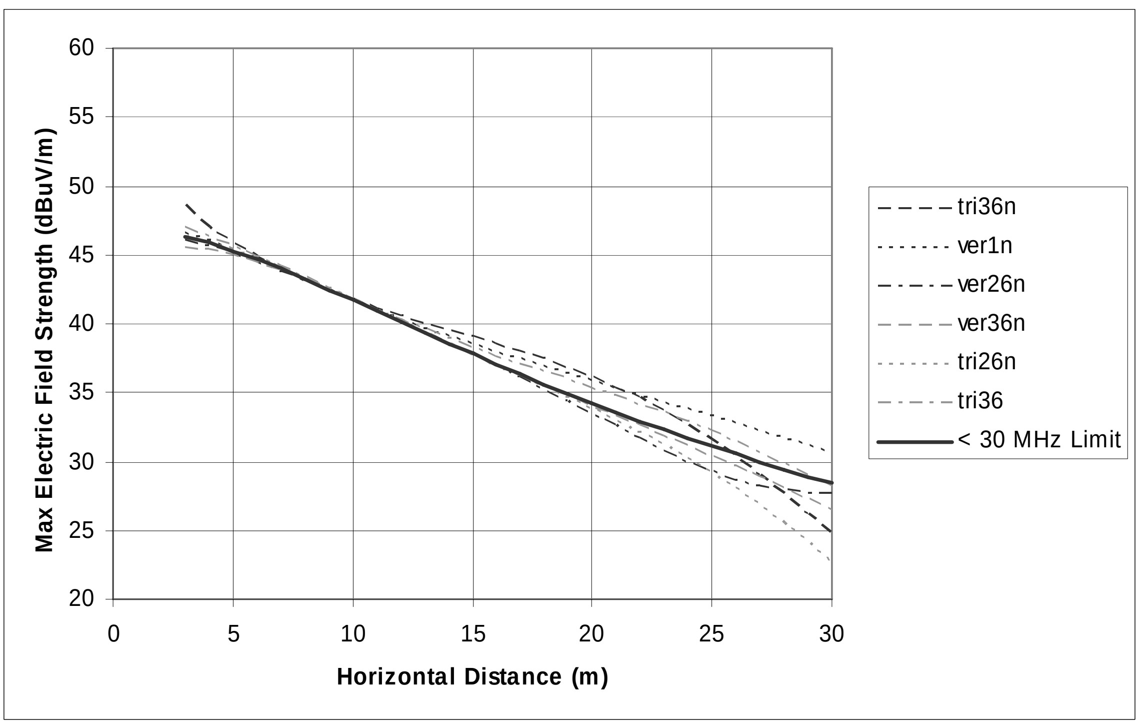

Figure C-8: Electric field strength compared to emissions limit based on slant-range extrapolation for various power line models – 14 MHz

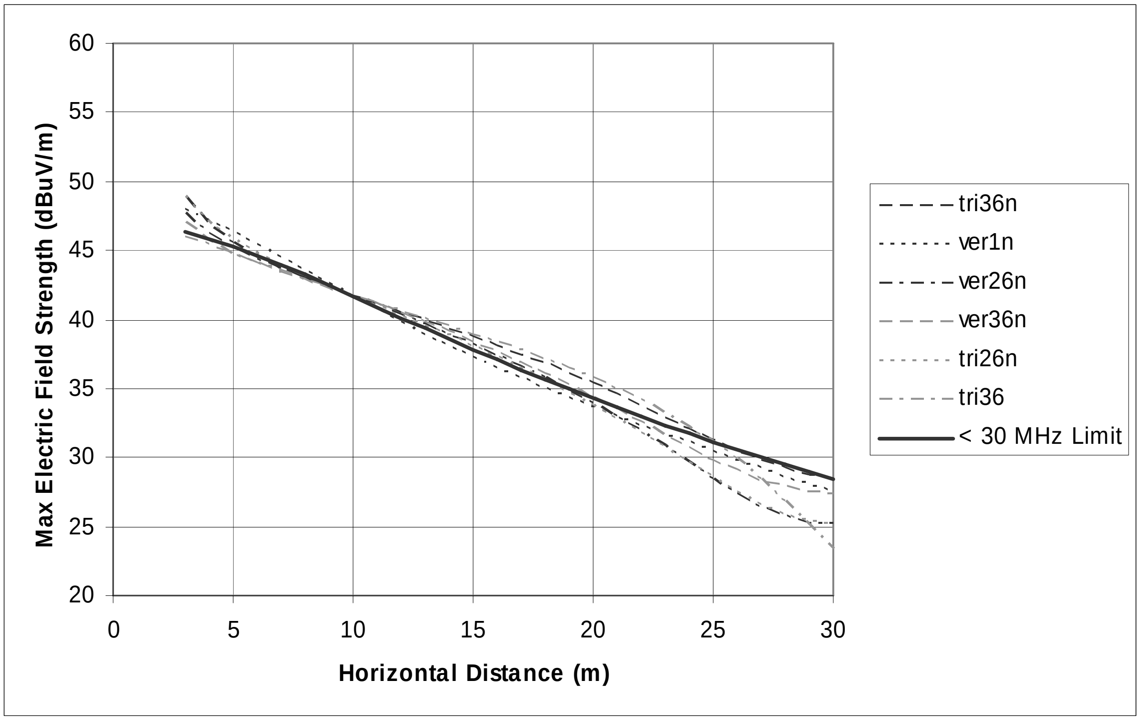

Figure C-9: Electric field strength compared to emissions limit based on slant-range extrapolation for various power line models – 16 MHz

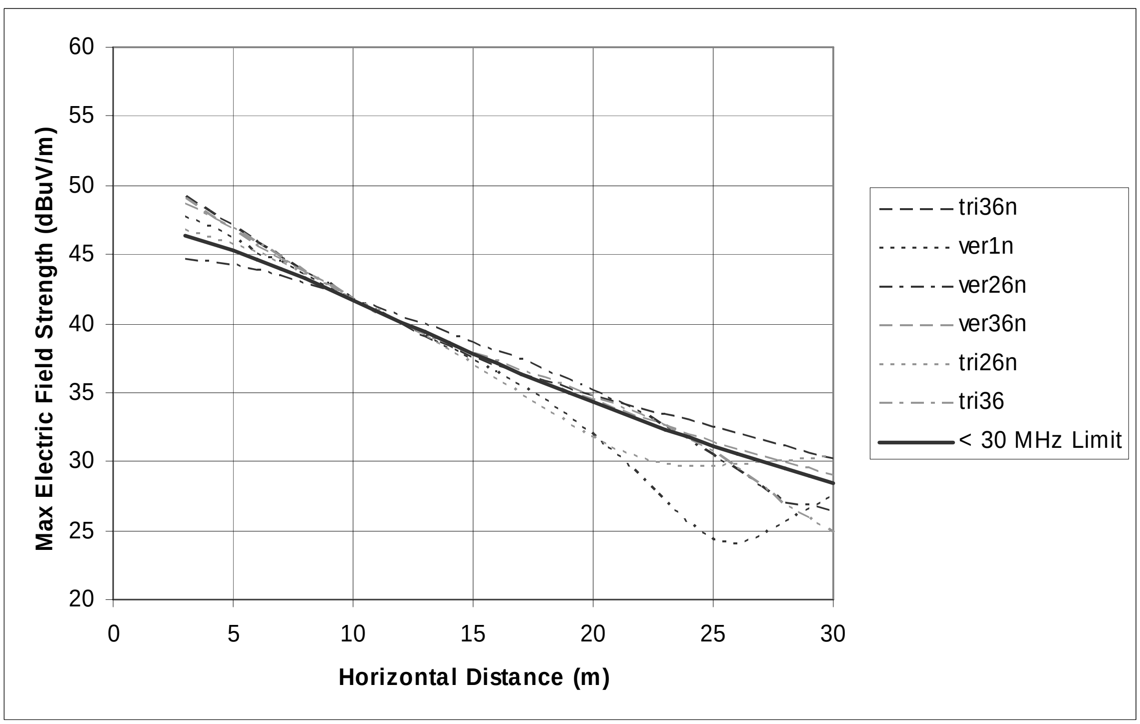

Figure C-10: Electric field strength compared to emissions limit based on slant-range extrapolation for various power line models – 18 MHz

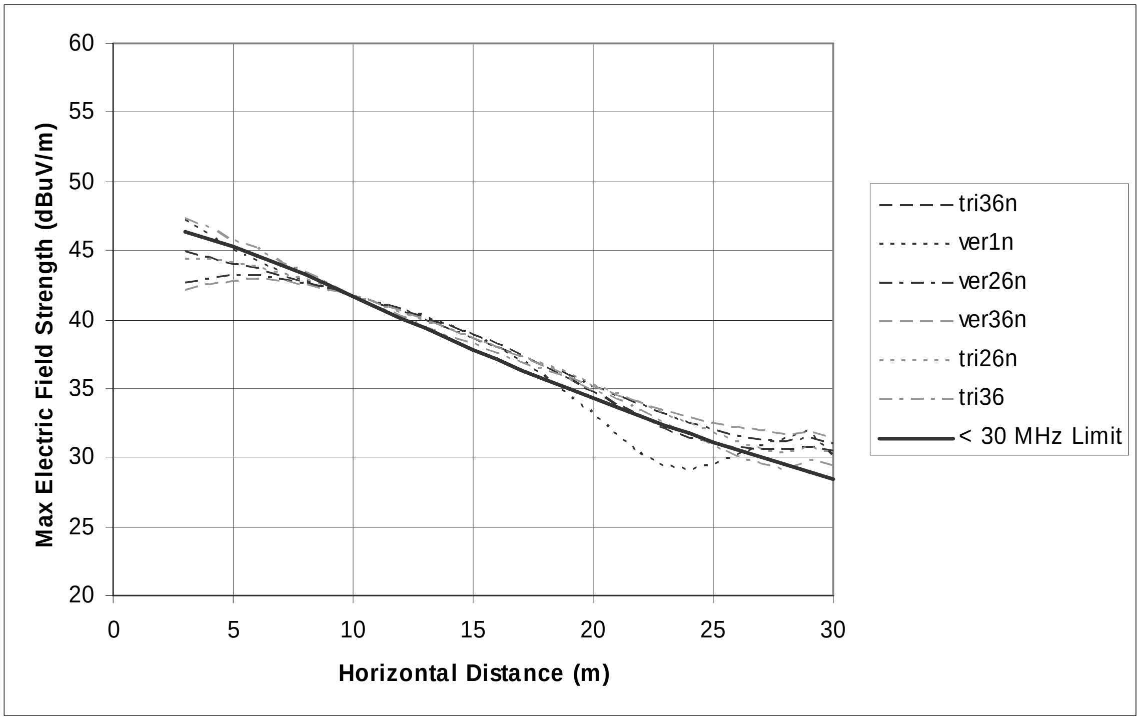

Figure C-11: Electric field strength compared to emissions limit based on slant-range extrapolation for various power line models – 20 MHz

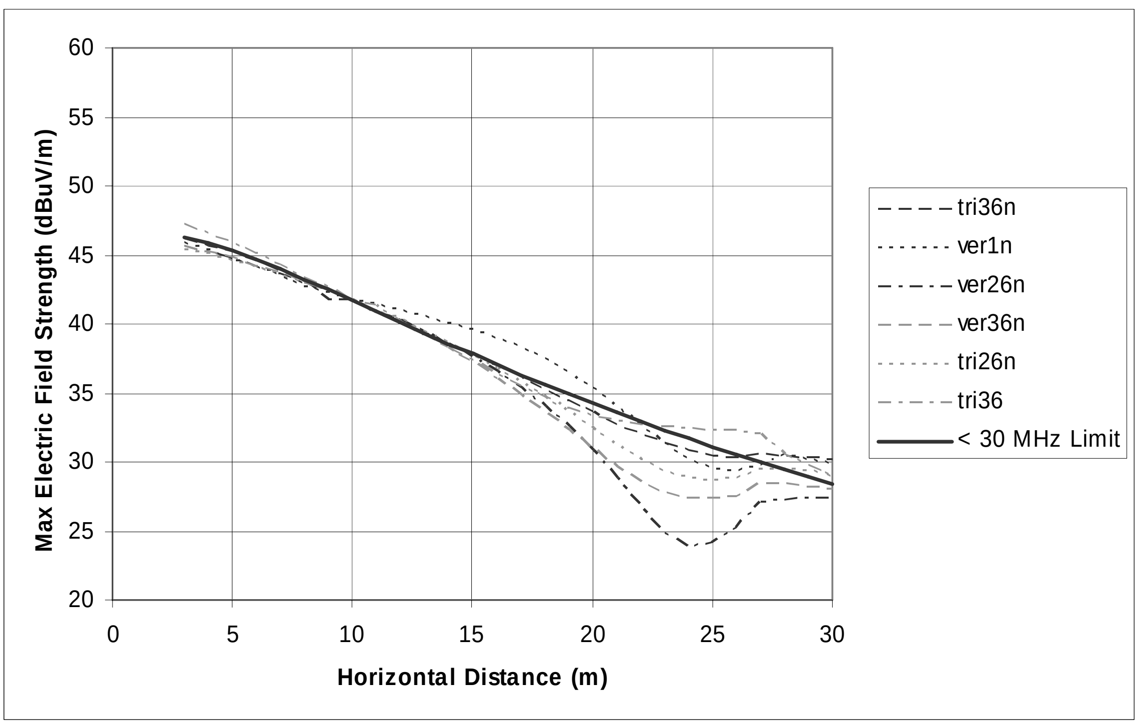

Figure C-12: Electric field strength compared to emissions limit based on slant-range extrapolation for various power line models – 22 MHz

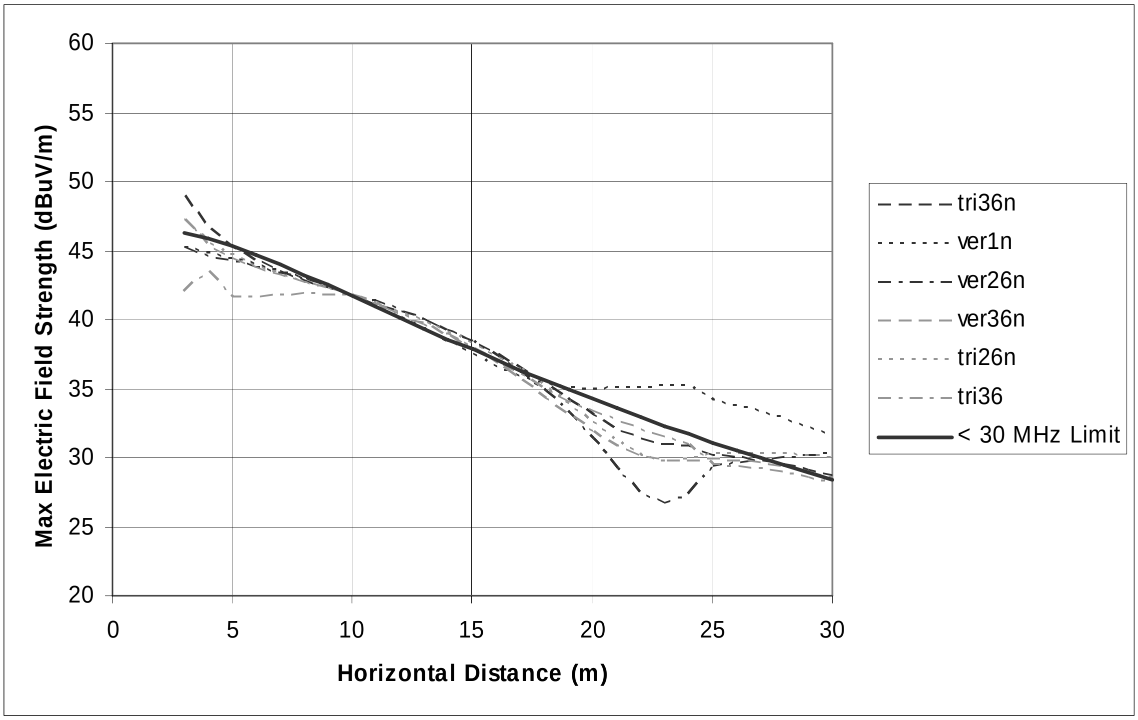

Figure C-13: Electric field strength compared to emissions limit based on slant-range extrapolation for various power line models – 24 MHz

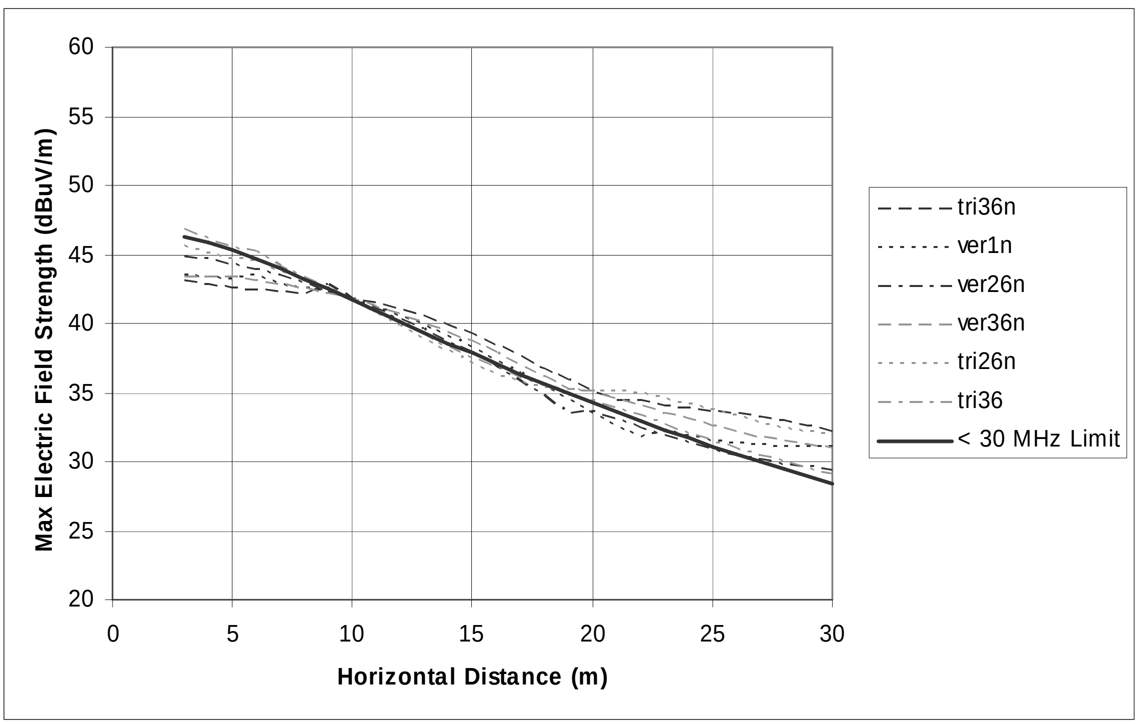

Figure C-14: Electric field strength compared to emissions limit based on slant-range extrapolation for various power line models – 26 MHz

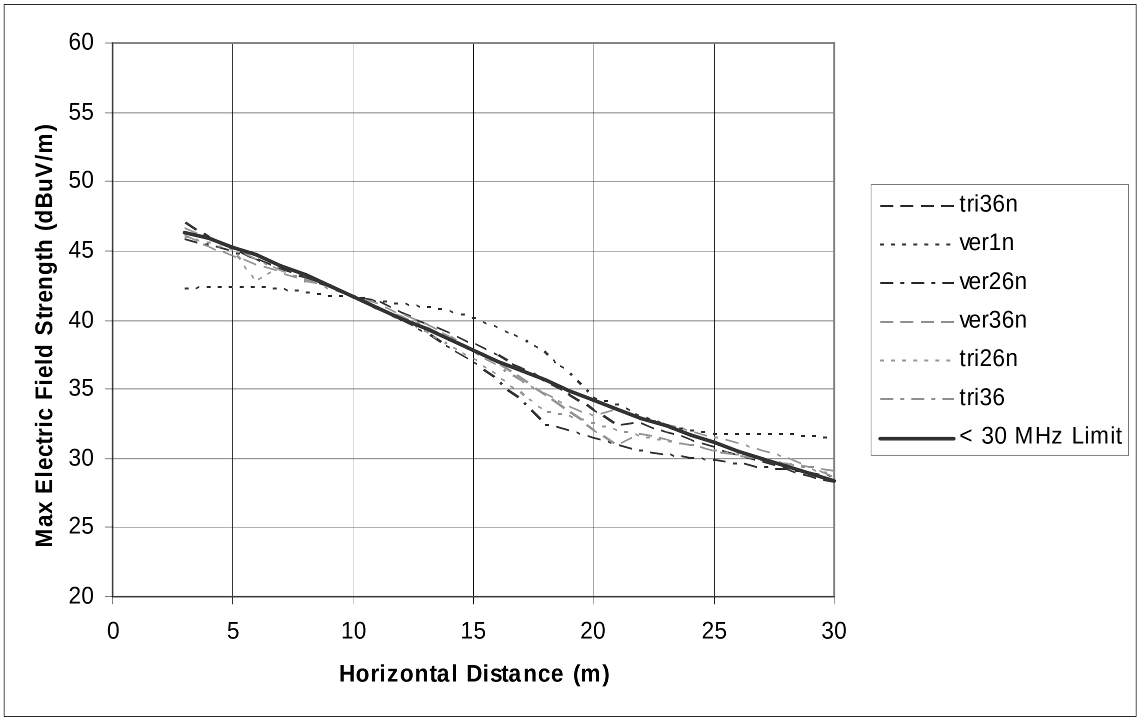

Figure C-15: Electric field strength compared to emissions limit based on slant-range extrapolation for various power line models – 28 MHz

APPENDIX D
SPECIAL PROTECTION PROVISIONS

D.1 EXCLUDED FREQUENCY BANDS

As adopted in the BPL Report and Order, Access BPL emissions from overhead MV power lines are excluded from aeronautical (R) mobile allocations in the 1.7 – 30 MHz frequency range and the 74.8 – 75.2 MHz aeronautical radionavigation band, as delineated in Table D-1. Otherwise, with mature deployments of BPL devices: (1) reception of aeronautical safety communications by aeronautical (land or “base”) stations would be endangered; (2) reception of aeronautical safety communications by aircraft would be endangered; and (3) at some aeronautical station or aircraft locations, emissions from In-House BPL devices at these frequencies will increase receiver noise levels such that additional interfering signals from Access BPL devices cannot be risked. This exclusion amounts to less than 2.18 percent of national spectrum resource between 1.7 MHz and 80 MHz.

Table D-1: Bands in Which Access BPL Emissions Are Prohibited

Frequency Band	Total Spectrum (kHz)
2,850 – 3,025 kHz	175
3,400 – 3,500 kHz	100
4,650 – 4,700 kHz	50
5,450 – 5,680 kHz	230
6,525 – 6,685 kHz	160
8,815 – 8,965 kHz	150
10,005 – 10,100 kHz	95
11,275 – 11,400 kHz	100
13,260 – 13,360 kHz	100
17,900 – 17,970 kHz	70
21,924 – 22,000 kHz	76
74.8 – 75.2 MHz	400
TOTAL BANDWIDTH	1,706
U.S. AREA FACTOR	1.0
PORTION OF NATIONAL SPECTRUM RESOURCE AT 1.7 – 80 MHz	< 2.18% (area factor x bandwidth factor)

D.2 EXCLUSION ZONES

D.2.1 Coast Stations

The analytical results of Section 3.3.1 lead to a requirement to define exclusion zones in the 2,173.5-2,190.5 kHz band within 1 km of coast station facilities, whose coordinates are listed in Tables D-2 and D-3. This amounts to 0.022 percent of the bandwidth between 1.7 MHz and 80 MHz and less than 0.004 percent of U.S. territorial area, or less than 0.0000008 percent of national spectrum resource between 1.7 MHz and 80 MHz. This special protection requirement will prevent substantial endangerment of distress alerting by ships and aircraft in oceanic areas. In the event that an Access BPL operator plans to deploy numerous Access BPL devices at these frequencies in areas near these exclusion zones, consult with the following point of contact may best ensure that harmful interference is prevented at these facilities:

Commandant (CG 622)
U.S. Coast Guard
2100 2nd Street, S.W.
Washington, DC 20593 – 0001
Telephone: (202) 267 – 2860
E-Mail: cgcomms@comdt.uscg.mil

Table D-2: Exclusion zones for U.S. Coast Guard Coast Stations

Locale	Latitude	Longitude
Group Guam	13º 35' 23" N	144º 50' 24" E
GANTSEC	18º 18' 00" N	65º 46' 59" W
Puerto Rico	18º 28' 11" N	66º 07' 47" W
Honolulu	21º 18' 21" N	157º 53' 23" W
Group Key West	24º 33' 35" N	81º 47' 59" W
Trumbo Point CG Base	24º 33' 58" N	81º 47' 57" W
Miami	25º 37' 28" N	80º 23' 07" W
Everglades Park	25º 50' 10" N	81º 23' 13" W
Group Saint Petersburg (Everglades)	25º 51' 00" N	81º 23' 24" W
Station Ft. Lauderdale	26º 05' 21" N	80º 06' 40" W
Station Ft. Myers Beach	26º 27' 34" N	81º 57' 15" W
Group Miami (Ft. Pierce)	27º 27' 36" N	80º 18' 36" W
Station Ft. Pierce	27º 27' 50" N	80º 18' 27" W
Group Corpus Christi	27º 42' 01" N	97º 16' 11" W
Group Corpus Christi	27º 42' 06" N	97º 16' 45" W
ESD Saint Petersburg	27º 45' 21" N	82º 37' 32" W
Group Saint Petersburg	27º 46' 11" N	82º 37' 47" W
Station Port O'Connor	28º 26' 03" N	96º 25' 39" W
S. Padre Island	28º 26' 22" N	97º 09' 56" W
Freeport	28º 55' 59" N	95º 16' 59" W
Group Galveston (Freeport)	28º 56' 24" N	95º 17' 59" W
Station YANKEETOWN	29º 01' 51" N	82º 43' 39" W
Station Ponce De Leon Inlet	29º 03' 50" N	81º 55' 01" W
Group New Orleans (Grand Isle)	29º 15' 53" N	89º 57' 26" W
Galveston	29º 19' 59" N	94º 46' 18" W
Kapalan	29º 20' 04" N	94º 47' 17" W
Sabine	29º 43' 42" N	93º 52' 14" W
New Orleans	30º 01' 17" N	90º 07' 24" W
Panama City	30º 10' 01" N	85º 45' 04" W
Group Mobile (Panama City)	30º 10' 12" N	85º 45' 36" W

Locale	Latitude	Longitude
ANT Jacksonville Beach	30º 17' 16" N	81º 24' 10" W
Pensacola	30º 20' 24" N	87º 18' 17" W
Group Mayport	30º 23' 10" N	81º 26' 01" W
Group Mayport	30º 23' 24" N	81º 25' 48" W
Ft. Morgan	30º 39' 07" N	88º 03' 12" W
Tybee Lighthouse	32º 01' 15" N	80º 50' 39" W
Point Loma Lighthouse	32º 39' 56" N	117º 14' 34" W
Point Loma	32º 40' 07" N	117º 14' 14" W
Activities San Diego	32º 43' 59" N	117º 11' 13" W
Group Charleston (Sullivan's Island)	32º 45' 00" N	79º 49' 47" W
Sullivan's Island Lights	32º 45' 02" N	79º 50' 03" W
Group Charleston	32º 46' 25" N	79º 56' 37" W
Group San Diego	32º 52' 48" N	118º 26' 23" W
San Pedro	33º 45' 00" N	118º 15' 58" W
Group Fort Macon	33º 53' 24" N	78º 01' 48" W
Point Mugu	33º 59' 32" N	119º 07' 18" W
Group LA / Long Beach	34º 07' 11" N	119º 06' 35" W
Channel Island	34º 09' 17" N	119º 13' 11" W
Station Oxnard Channel Island	34º 09' 43" N	119º 13' 19" W
Group Ft. Macon	34º 41' 48" N	76º 40' 59" W
Group Cape Hatteras	35º 13' 59" N	75º 31' 59" W
Group Cape Hatteras	35º 15' 35" N	75º 31' 48" W
Morro Bay (Cambria)	35º 31' 21" N	121º 03' 21" W
San Clemente Island	32º 50' 24" N	118º 23' 15" W
Point Pinos	36º 38' 12" N	121º 56' 06" W
CAMSLANT	36º 43' 47" N	76º 01' 11" W
Group Hampton Roads	36º 53' 01" N	76º 21' 10" W
Point Montara	37º 31' 23" N	122º 30' 47" W
Point Montara Lighthouse	37º 32' 09" N	122º 31' 08" W
Group San Francisco	37º 32' 23" N	122º 31' 11" W
Group San Francisco	37º 48' 34" N	122º 21' 55" W
Point Bonita	37º 49' 00" N	122º 31' 41" W
Group Eastern Shores	37º 55' 47" N	75º 22' 47" W
Group Eastern Shore	37º 55' 50" N	75º 22' 58" W
CAMSPAC	38º 06' 00" N	122º 55' 48" W
Point Arena Lighthouse	38º 57' 18" N	124º 44' 28" W
Point Arena	38º 57' 36" N	123º 44' 23" W
Group Atlantic City	39º 20' 59" N	74º 27' 42" W
Activities New York	40º 36' 06" N	74º 03' 36" W
Activities New York	40º 37' 11" N	74º 04' 11" W
ESD Moriches Hut	40º 47' 19" N	72º 44' 53" W
Group Moriches	40º 47' 23" N	72º 45' 00" W
Group Humboldt Bay	40º 58' 41" N	124º 06' 31" W
Group Humboldt Bay	40º 58' 47" N	124º 06' 35" W
Trinidad Head	41º 03' 15" N	124º 09' 02" W
Group Long Island Sound	41º 16' 12" N	72º 54' 00" W
Station New Haven	41º 16' 12" N	72º 54' 06" W

Locale	Latitude	Longitude
Station Brant Point	41º 17' 21" N	70º 05' 31" W
Group Woods Hole	41º 17' 23" N	70º 04' 47" W
Station Castle Hill	41º 27' 46" N	71º 21' 42" W
Group Woods Hole	41º 30' 30" N	70º 41' 42" W
Boston Area	41º 40' 12" N	70º 31' 48" W
Station Provincetown	42º 01' 48" N	70º 12' 42" W
Eastern Point	42º 36' 24" N	70º 39' 26" W
Cape Blanco	42º 50' 16" N	124º 33' 52" W
Group North Bend	43º 24' 16" N	124º 13' 22" W
Group North Bend	43º 24' 35" N	124º 14' 23" W
Cape Elizabeth	43º 33' 28" N	70º 12' 00" W
Group South Portland	43º 38' 24" N	70º 15' 00" W
Group South Portland	43º 38' 45" N	70º 14' 51" W
Group SW Harbor	44º 16' 19" N	68º 18' 27" W
Group Southwest Harbor	44º 16' 48" N	68º 18' 36" W
Fort Stevens, Oregon	46º 09' 14" N	123º 53' 07" W
Group Astoria	46º 09' 29" N	123º 31' 48" W
Group Astoria	46º 09' 35" N	123º 53' 24" W
La Push	47º 49' 00" N	124º 37' 59" W
Station Quillayute River	47º 54' 49" N	124º 38' 01" W
Port Angeles	48º 07' 59" N	123º 25' 59" W
Group Port Angeles	48º 08' 24" N	123º 24' 35" W
Juneau (Sitka)	57º 05' 24" N	135º 15' 35" W
Kodiak	57º 40' 47" N	152º 28' 47" W
Valdez (Cape Hinchinbrook)	60º 26' 23" N	146º 25' 48" W

Table D-3: Exclusion zones for Maritime Public Coast Stations

Licensee Name	Location	Latitude	Longitude
Shipcom LLC	Marina Del Ray, CA	33º 56' 21" N	118º 27' 14" W
Globe Wireless	Rio Vista, CA	38º 11' 55" N	121º 48' 34" W
Avalon Communications Corp	St. Thomas, VI	18º 21' 19" N	64º 56' 48" W
Globe Wireless	Bishopville, MD	38º 24' 10" N	75º 12' 59" W
Shipcom LLC	Mobile, AL	30º 40' 07" N	88º 10' 23" W
Shipcom, LLC	Coden, AL	30º 22' 35" N	88º 12' 20" W
Globe Wireless	Pearl River, LA	30º 22' 13" N	89º 47' 26" W
Globe Wireless	Kahalelani, HI	21º 10' 33" N	157º 10' 39" W
Globe Wireless	Palo Alto, CA	37º 26' 44" N	122º 06' 48" W
Globe Wireless	Agana, GU	13º 29' 22" N	144º 49' 39" E

D.2.2 Radioastronomy Observatories

Using correlation techniques, the Very Large Array (VLA) receivers operate with desired signal levels that are well below ambient noise levels and rely on the protection criteria specified by the International Telecommunication Union Radiocommunication Sector (ITU-R) for radioastronomy observatories. Figure D-1 illustrates the antenna array at this facility near Socorro, New Mexico. The BPL Memorandum Opinion and Order defined an exclusion zone where Access BPL systems operating on overhead MV power lines in the 73.0 – 74.6 MHz band should be no closer than 65 km from the coordinates of the VLA facility.[5] The coordinate at the center of the VLA is 34° 04' 43.50"N, 107° 37' 03.82"W. Figure D-2 shows the specified protection radii within the National Radio Astronomy Observatory. The BPL rules also state that Access BPL using LV power lines or underground power lines using the 73.0 – 74.6 MHz band should be excluded within 47 km from the coordinates of the VLA facility. The analyses in Section 3.3.3 confirmed that these exclusion zone radii are reasonable to limit the power flux density (PFD) to levels defined for this frequency band by the ITU-R. This amounts to 2.04 percent of the bandwidth between 1.7 MHz and 80 MHz and less than 0.028 percent of U.S. territorial area, or less than 0.0006 percent of national spectrum resource between 1.7 MHz and 80 MHz.

Figure D-1: Very Large Array (VLA) radioastronomy observatory

[5] *See* Amendment of Part 15 regarding new requirements and measurement guidelines for Access Broadband over Power Line Systems, ET Docket No. 04-37, Memorandum Opinion and Order, released August 7, 2006, ("BPL Memorandum Opinion and Order"), at ¶¶ 57 - 59.

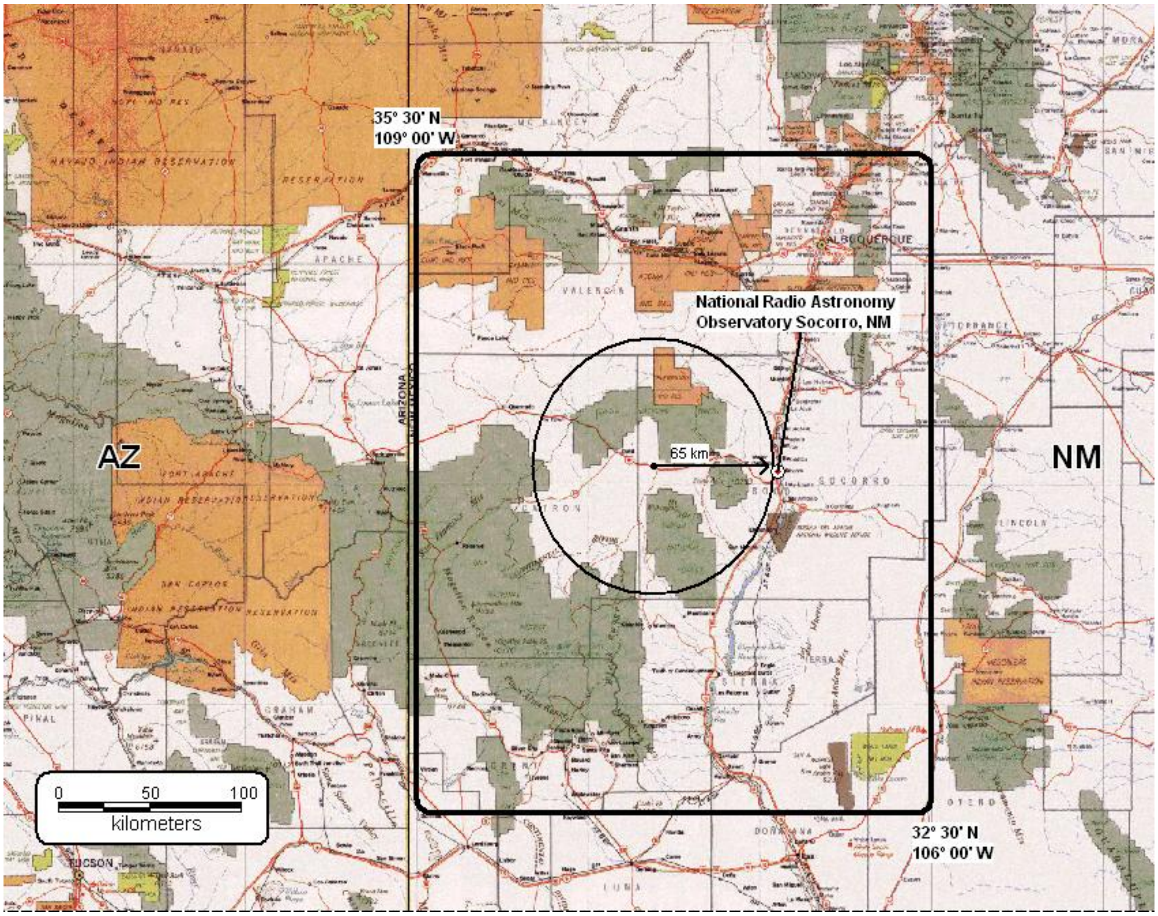

Figure D-2: VLA protection radii for overhead Access BPL shown within the National Radio Astronomy Observatory near Socorro, New Mexico.

D.3 CONSULTATION AREAS

Part 15 of the Commission's rules for carrier current systems apply the same field strength limits for wanted and unwanted emissions, and so, consultation between BPL service providers and radio operators should not be limited to the fundamental frequencies intentionally used in Access BPL systems. Moreover, frequencies used by many communications receivers in the 1.7 – 30 MHz frequency range are subject to change in the long-term and over hourly or shorter time frames. In light of these factors and given that the consultation areas needed for BPL systems are small, consultation should be required for all planned Access BPL operations at all frequencies of potential concern in these consultation areas. These consultation areas are:

- For frequencies in the 1.7 – 30 MHz frequency range, the areas within 4 km of facilities located at the following coordinates:
    - the Commission's protected field offices listed in 47 C.F.R. § 0.121, the point-of-contact for which is specified in that section;
    - the aeronautical stations listed in Tables D-4 and D-5;
    - the land stations listed in Tables D-6 and D-7;

- For frequencies in the 1.7 – 80 MHz frequency range, the areas within 4 km of facilities located at the coordinates specified for radio astronomy facilities in US 311.

- For frequencies in the 1.7 – 80 MHz frequency range, the area within 1 km of the Table Mountain Radio Receiving Zone, the coordinates and point of contact for which are specified in 47 C.F.R. § 21.113(b).

- For frequencies in the 1.7 – 30 MHz frequency range, the areas within 37 km of radar receiver facilities located at the coordinates specified in Table D-8.

Point of contact
U.S. Coast Guard HQ
Division of Spectrum Management CG-622
2100 Second St., SW. Rm. 6611
Washington, DC 20593
Tel: 202-267-6036
Fax: 202-267-4106
Email: jtaboada@comdt.uscg.mil

Table D-4: Consultation Area Coordinates for Aeronautical (OR) Stations (1.7 – 30 MHz)

Command Name	Location	Latitude	Longitude
Washington	Arlington, VA	38º 51' 07" N	77º 02' 15" W
Cape Cod	Cape Cod, MA	41º 42' 00" N	70º 30' 00" W
Atlantic City	Atlantic City, NJ	39º 20' 59" N	74º 27' 42" W
Elizabeth City	Elizabeth City. NC	36º 15' 53" N	76º 10' 32" W
Savannah	Savannah, GA	32º 01' 30" N	81º 08' 30" W
Miami	Opa Locka, FL	25º 54' 22" N	80º 16' 01" W
Clearwater	Clearwater, FL	27º 54' 27" N	82º 41' 29" W
Borinquen	Aguadilla, PR	18º 18' 36" N	67º 04' 48" W
New Orleans	New Orleans, LA	29º 49' 31" N	90º 02' 06" W
Traverse City	Traverse City, MI	44º 44' 24" N	85º 34' 54" W
San Diego	San Diego, CA	32º 43' 33" N	117º 10' 15" W
Sacramento	McClellan AFB, CA	38º 40' 06" N	121º 24' 04" W
Astoria	Warrenton, OR	46º 25' 18" N	123º 47' 46" W
North Bend	North Bend, OR	43º 24' 39" N	124º 14' 35" W
Barbers Point	Kapolei, HI	21º 18' 01" N	158º 04' 15" W
Kodiak	Kodiak, AK	57º 44' 19" N	152º 30' 18" W
Houston	Houston, TX	29º 45' 00" N	95º 22' 00" W
Detroit	Mt. Clemens, MI	42º 36' 05" N	82º 50' 12" W
San Francisco	San Francisco, CA	37º 37' 58" N	122º 23' 20" W
Los Angeles	Los Angeles, CA	33º 56' 36" N	118º 23' 48" W

Command Name	Location	Latitude	Longitude
Humboldt Bay	McKinleyville, CA	40º 58' 39" N	124º 06' 45" W
Port Angeles	Port Angeles, WA	48º 08' 25" N	123º 24' 48" W
Sitka	Sitka, AK	57º 05' 50" N	135º 21' 58" W

Point of contact
ARINC
2551 Riva Road
Annapolis, MD 21401
Tel: 1-800-633-6882
Fax: 410-266-2329
Email: bplnotifications@arinc.com
www.arinc.com

Table D-5: Consultation Area Coordinates for Aeronautical Receive Stations (1.7 – 30 MHz)

Locale	Latitude	Longitude
Southampton, NY	40º 55' 15"N	72º 23' 41" W
Molokai, HI	21º 12' 23" N	157º 12' 30" W
Oahu, HI	21º 22' 27" N	158º 05' 56" W
Half Moon Bay, CA	37º 39' 64" N	122º 24' 44" W
Pt. Reyes, CA	38º 06' 00" N	122º 56' 00" W
Barrow, AK	71º 17' 24" N	156º 40' 12" W
Guam	13º 25' 12" N	144º 48' 00" E (note: Eastern Hemisphere)
NY Comm Center, NY	40º 46' 48" N	73º 05' 46" W
Cedar Rapids, IA	42º 02' 05.0" N	91º 38' 37.6" W
Beaumont, CA	33º 54' 27.1" N	116º 59' 49.1" W
Fairfield, TX	31º 47' 02.6" N	96º 47' 03.0" W
Houston, TX	29º 36' 35.8" N	95º 16' 54.8" W
Miami, FL	25º 49' 05" N	80º 18' 28" W

Point Of Contact
U.S. Coast Guard HQ
Division of Spectrum Management CG-622
2100 Second St., SW. Rm. 6611
Washington, DC 20593
Tel: 202-267-6036
Fax: 202-267-4106
Email: jtaboada@comdt.uscg.mil

Table D-6: Consultation Area Coordinates for Land Stations, Set 1 (1.7–30 MHz)

Command Name	Location	Latitude	Longitude
COMMSTA Boston	Maspee, MA	41º 24' 00" N	70º 18' 57" W
Camslant	Chesapeake, VA	36º 33' 59" N	76º 15' 23" W
COMMSTA Miami	Miami, FL	25º 36' 58" N	80º 23' 04" W

Command Name	Location	Latitude	Longitude
COMMSTA New Orleans	Belle Chasse, IA	29º 52' 40" N	89º 54' 46" W
Camspac	Pt. Reyes Sta, CA	38º 06' 00" N	122º 55' 48" W
COMMSTA Honolulu	Wahiawa, HI	21º 31' 08" N	157º 59' 28" W
COMMSTA Kodiak	Kodiak, AK	57º 04' 26" N	152º 28' 20" W
Guam	Finegayan, GU	13º 53' 08" N	144º 50' 20" E

<u>Point of contact</u>
COTHEN Technical Support Center
COTHEN Program Manager
Tel: (800) 829-6336

Table D-7: Consultation Area Coordinates for Land Stations, Set 2 (1.7 – 30 MHz)

Site Name	Latitude	Longitude
Albuquerque, NM	35º 05' 02" N	105º 34' 23" W
Arecibo, PR	18º 17' 26" N	66º 22' 33" W
Atlanta, GA	32º 33' 06" N	84º 23' 35" W
Beaufort, SC	34º 34' 22" N	76º 09' 48" W
Cape Charles, VA	37º 05' 37" N	75º 58' 06" W
Cedar Rapids, IA	42º 00' 09" N	91º 17' 39" W
Denver, CO	39º 15' 45" N	103º 34' 23" W
Fort Myers, FL	81º 31' 20" N	26º 20' 01" W
Kansas City, MO	38º 22' 10" N	93º 21' 48" W
Las Vegas, NV	36º 21' 15" N	114º 17' 33" W
Lovelock, NV	40º 03' 07" N	118º 18' 56" W
Memphis, TN	34º 21' 57" N	90º 02' 43" W
Miami, FL	25º 46' 20" N	80º 28' 48" W
Morehead City, NC	34º 34' 50" N	78º 13' 59" W
Oklahoma City, OK	34º 30' 52" N	97º 30' 52" W
Orlando, FL	28º 31' 30" N	80º 48' 58" W
Reno, NV	38º 31' 12" N	119º 14' 37" W
Sarasota, FL	27º 12' 41" N	81º 31' 20" W
Wilmington, NC	34º 29' 24" N	78º 04' 31" W

<u>Point Of Contact</u>
ROTHR Deputy Program Manager
(540) 653-3624

Table D-8: Consultation Area Coordinates for Radar Receiver Stations (1.7 – 30 MHz)

Latitude/Longitude
18° 01' N / 66º 30' W
28° 05' N / 98° 43' W
36° 34' N / 76° 18' W