MIL-STD-285
SHIELDED CABINET TEST

OPTIMA ENCLOSURES
Tucker, Georgia 30084-5088
TEST REPORT NO. 224314
PO NO. 14230

Prepared for:

Optima Enclosures
2166 Mountain Industrial Boulevard
Tucker, Georgia 30084-5088

Report Prepared by:

Christopher R. Bush Date 19 July 1994
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Report Approved by:

J. Fred Gardener Date 19 July 1994
J. Fred Gardener, EMC Quality Control Specialist

FILE: 224314.OPT/NB27-P25

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ADMINISTRATIVE SUMMARY

REASON FOR TEST:

To determine the shielding effectiveness of a shielded cabinet.

TEST SPECIFICATION:

MIL-STD-285 dated 25 June 1956 modified for shielded cabinets
Test Frequencies: 10 kHz - 10 GHz

DATE OF TEST:

30 June 1994

TEST SAMPLE:

Form 4 Cabinet
S/N: F4701930RF-2D-SR-CB-ST-S

MANUFACTURER:

Optima Enclosures
2166 Mountain Industrial Boulevard
Tucker, Georgia 30084-5088

MANUFACTURERS REPRESENTATIVE:

Al Domeshek, Optima Enclosures

TEST LOCATION:

Instrument Specialties Co., Inc.
P.O. Box A
Delaware Water Gap, PA 18327

TEST PERSONNEL:

Christopher R. Bush, Instrument Specialties Co., Inc.

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1. INTRODUCTION:

This report documents the worst case results of a series of EMI/EMC measurements performed on a shielded cabinet manufactured by Optima Enclosures of Tucker, Georgia.

This series of tests was performed by Instrument Specialties Co., Inc. Delaware Water Gap, PA at their EMC test facilities.

2. PURPOSE OF TEST:

The purpose of this series of tests was to determine the shielding effectiveness of the cabinet after a modification from the original cabinet design to utilize a Form 4 tin plated wire mesh gasket for the door seams.

3. APPLICABLE DOCUMENTS:

Mil-Std-285
25 June 1956
(modified for shielded cabinets)

4. TEST SAMPLE:

The Equipment Under Test (EUT) consisted of a shielded cabinet used for housing electronic equipment. The EUT was designated as a Form 4 Cabinet (Model No.: F4701930RF-2D-SR-CB-ST-S).

5. TEST SETUPS:

The cabinet was located in the center of the shielded test chamber with the receiving antenna inside the cabinet and the transmitting antenna located one meter from the cabinet door.

An RF signal generator and a spectrum analyzer were located outside the semi-anechoic test chamber in a separate shielded enclosure. The signal generator was connected through a penetration panel to a power amplifier located inside of the test chamber in which the EUT was located. The output of the power amplifier was then connected to the transmitting antenna. The receiving antenna was connected with coaxial cable to a shielded adaptor plate mounted in the bottom panel of the shielded cabinet. To minimize crosstalk between the transmitting and receiving equipment, a copper pipe containing the shielded coaxial cable of the receiving antenna was connected from the shielded adaptor plate at the bottom of the EMI cabinet to the wall of the shielded enclosure.

5.1 TEST SITE, FACILITIES, CONDITIONS, AND TOLERANCES:

The Mil-Std-285 tests were performed in a 16 ft. x 28 ft. x 12 ft. high semi-anechoic enclosure at the Instrument Specialties EMC test facility. This enclosure meets the applicable requirements of NSA 65-6. AC power is supplied to this enclosure from a dedicated isolation transformer through low-pass line filters which provide a minimum of 120 dB of attenuation from 10 kHz to 10 GHz. Power available is 0 to 250 V, 0 to 1 kHz, 100 Amps max.

5.2 TEST EQUIPMENT:

A complete test system equipment list is provided in Table I. The equipment absolute performance calibration, of the equipment requiring calibration, is performed on an as needed basis in accordance with MIL-STD-45662. However, calibration periods do not exceed one (1) year. The test equipment is capable of making measurements within tolerances of at least +/- 2 dB amplitude and +/- 2% frequency deviation. Equipment certifications showing traceability to NIST (National institute of Standards and Technology) are maintained on file at Instrument Specialties Corporate offices in Delaware Water Gap, PA.

All equipment is checked and verified for proper operation before and after each series of tests.

8. EMI TEST PROCEDURES:

Final measurements were made over the frequency range of 10 kHz to 10 GHz. A biconical antenna was used to transmit and receive from 30 MHz to 200 MHz. A 41" rod antenna was used to transmit and a 41" active rod antenna was used to receive from 10 kHz to 30 MHz. For the frequency range of 200 MHz to 1 GHz, a log conical spiral was used to transmit and a tuned dipole antenna tuned to 500 MHz was used to receive. Both vertical and horizontal polarizations were tested to find the worst case shielding effectiveness from 200 MHz - 1 GHz. From 2 GHz to 10 GHz a double ridged horn antenna was used to transmit and receive in vertical polarity.

8.1.2 TEST RESULTS

The final results include the data based on two tests. Test No. 1 includes testing performed on the EUT in a normal configuration. Test No. 2 provides investigative data collected with paint removed from the door flange which mounts the door gasketing. Tabulated data sheets with the test results are provided in Appendix A and plotted graphs are provided in Appendix B.

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TABLE I

TEST EQUIPMENT

MFG/MODEL NO.	DESCRIPTION	SERIAL NO.
MIC/2022C	RF Signal Generator (10k - 1 GHz)	119062172
WIL/6648A	MW Signal Generator (10M-20 GHz)	614003
ARC/AR-150L	PWR Amplifier 100 W(10k-220MHz)	8587
ARC/AR-10W1000	PWR Amplifier 10 W(1 M-1 GHz)	4283
HU/1277H	PWR Amplifier 20 W TWT(2-4GHz)	109649
VAR/VZH6970KIDH	PWR Amplifier 20W TWT(4-10GHz)	5040
ISC/PEF-1	Passive E-Field Antenna	307
EMO/3301B	Active Rod Antenna (41",30H-50M)	2645
EMO/3109	Biconical Antenna (20-300M)2kW	2689
EMC/TDS-25	Tunable Dipole Ant Set (200M-1G)	281
ISC/Ba-25	Bic/Dip Ant.(w/short elements 30M-1GHz)	25
EMO/3115	Double Ridge WG Antenna (1-18G)	2485
EMO/3115	Double Ridge WG Antenna (1-18G)	2486
HP/8562A	Spectrum Analyzer (1k - 23 G)	2712A00402

Legend of Manufacturers:
ARC - Amplifier Research
EMC - Electro-Metrics Co., Inc.
EMO - Electro-Mechanics Co.
HP - Hewlett-Packard
HU - Hughes Aircraft Company
ISC - Instrument Specialties Co., Inc.
VAR - Varian
WIL - Wiltron

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APPENDIX A

TABULATED EMI TEST RESULTS

TEST NO. 1: NOTES/EUT CONFIGURATION: Original design floor panel with paint removed from flange. The 97-555 gasketing was re-installed beneath the floor panel. The door gasketing was double woven I/S gasket.

E-FIELD

FREQUENCY	REFERENCE (dBuV)	CORR./PREAMP (dB)	CROSSTALK (dBuV)	TEST LEVEL (dBuV)	ATTENUA (dB)
10 kHz	90	-	-	NDS (12)	>78
100 kHz	91	-	-	NDS (12)	>87
1 MHz	90	-	-	NDS (05)	>85
10 MHz	66	-	-	NDS (02)	>64
30 MHz	74	-	-	13	61

PLANE WAVE

FREQUENCY	REFERENCE (dBuV)	CORR./PREAMP (dB)	CROSSTALK (dBuV)	TEST LEVEL (dBuV)	ATTENUA (dB)
30 MHz	86	-	17	32	54
40 MHz	66	-	-5	15	51
50 MHz	79	-	7	8	71
60 MHz	98	-	8	13	85
70 MHz	92	-	3	33	59
80 MHz	105	-	-4	9	96
90 MHz	105	-	0	16	89
100 MHz	102	-	0	23	79
120 MHz	106	-	4	32	74
140 MHz	109	-	2	27	82
160 MHz	104	-	0	40	64
180 MHz	104	-	2	17	87
200 MHz	94	-	7	23	71

APPENDIX A

TABULATED EMI TEST RESULTS (continued)

TEST NO.1: (CONT.)

PLANE WAVE - VERTICAL

FREQUENCY	REFERENCE (dBuV)	CORR./PREAMP (dB)	CROSSTALK (dBuV)	TEST LEVEL (dBuV)	ATTENUA (dB)
200 MHz	86	-	-5	13	73
240 MHz	99	-	-5	19	80
300 MHz	113	-	-2	33	80
400 MHz	108	-	-4	26	82
500 MHz	112	-	13	24	88
600 MHz	113	-	15	48	65
700 MHz	113	-	-6	38	75
800 MHz	107	-	0	45	62
900 MHz	106	-	4	44	62
1000 MHz	90	-	4	39	51

PLANE WAVE - HORIZONTAL

FREQUENCY	REFERENCE (dBuV)	CORR./PREAMP (dB)	CROSSTALK (dBuV)	TEST LEVEL (dBuV)	ATTENUA (dB)
200 MHz	101	-	-	49	52
240 MHz	109	-	-	24	85
300 MHz	107	-	-	45	62
400 MHz	114	-	-	47	67
500 MHz	112	-	-	47	65
600 MHz	117	-	-	69	48
700 MHz	110	-	-	57	53
800 MHz	98	-	-	50	48
900 MHz	104	-	-	51	53
1000 MHz	88	-	-	33	55

PLANE WAVE - STATIONARY RECEIVE ANTENNA

FREQUENCY	REFERENCE (dBuV)	CORR./PREAMP (dB)	CROSSTALK (dBuV)	TEST LEVEL (dBuV)	ATTENUA (dB)
2 GHz	114	-	-	57	57
4 GHz	101	-	-	44	57
6 GHz	90	-	-	43	47
8 GHz	80	-	-	17	63
10 GHz	47	-	-	0	47

APPENDIX A

TABULATED EMI TEST RESULTS (continued)

TEST NO.2: NOTES/EUT CONFIGURATION: Investigative testing was then performed with the paint removed from the door flange which holds the door gasketing increasing the surface contact of the gasketing to the cabinet. Only a minimum of frequencies were tested in horizontal polarization.

PLANE WAVE-HORIZONTAL

FREQUENCY	REFERENCE (dBuV)	CORR./PREAMP (dB)	CROSSTALK (dBuV)	TEST LEVEL (dBuV)	ATTENU. (dB
200 MHz	101	-	-	46	55
240 MHz	100	-	-	15	85
300 MHz	116	-	-	37	79
400 MHz	115	-	-	30	85
500 MHz	119	-	-	33	86
600 MHz	119	-	-	50	69
700 MHz	112	-	-	32	80
800 MHz	101	-	-	43	58
900 MHz	110	-	-	50	60
1000 MHz	98	-	-	35	63

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APPENDIX B

GRAPHICAL EMI TEST RESULTS

The following list describes the data plots used in graphing the final test results.

Plot #1 - Test No. 1 / Worst Case Measurements (10 kHz - 1 GHz)
/ Vertical Polarity (10 kHz - 10 GHz)
/ Horizontal Polarity (200 MHz - 1 GHz)

Plot #2 - Test No. 1 / Worst Case Measurements (30 MHz - 1 GHz)
/ Vertical Polarity (30 MHz - 1 GHz)
/ Horizontal Polarity (200 MHz - 1 GHz)

Plot #3 - Test No. 2 / Horizontal Polarity (200 MHz - 1 GHz)

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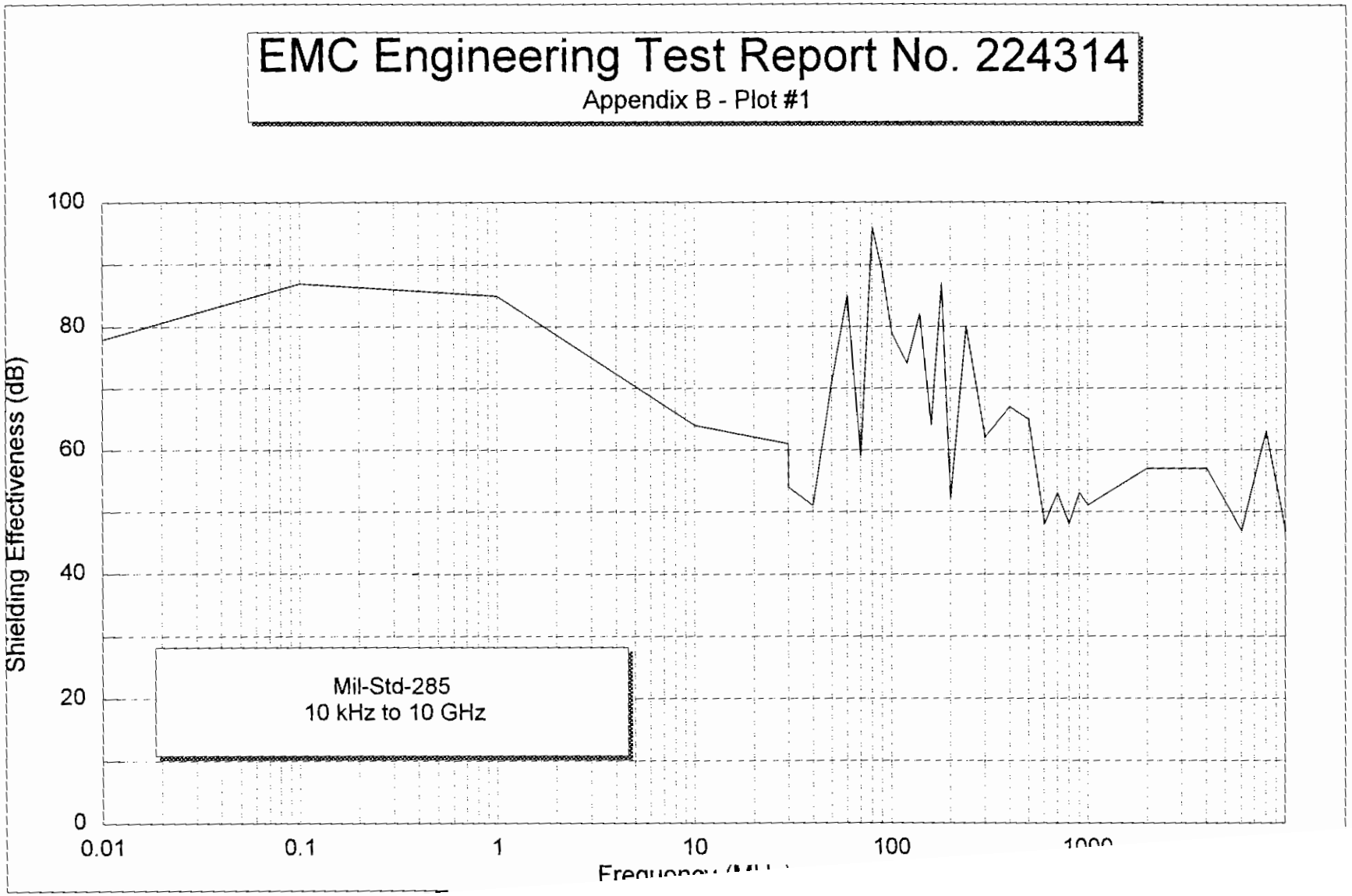
Appendix B - Plot #1



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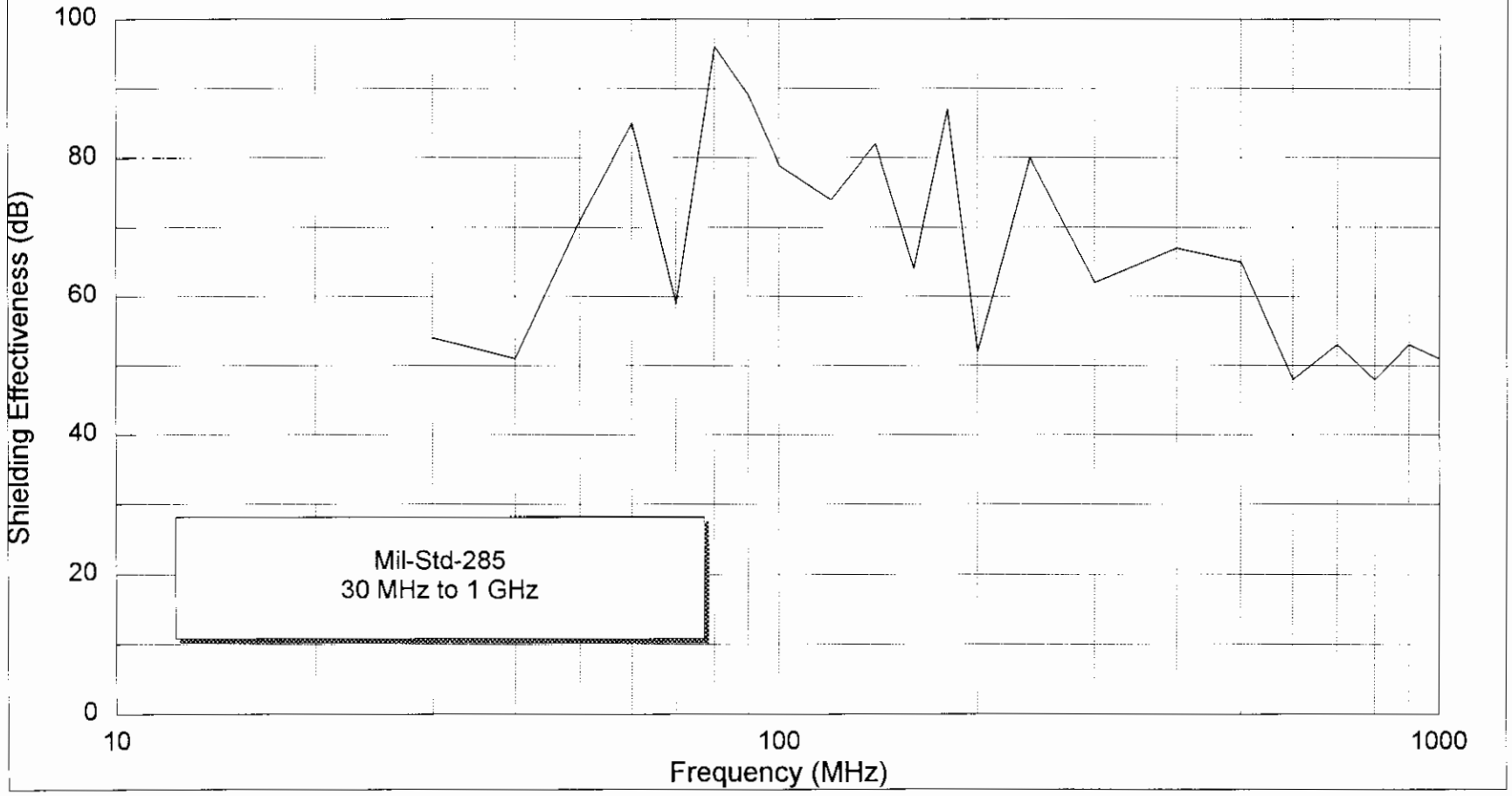
Appendix B - Plot #2



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Appendix B - Plot #3