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Electrical

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ELECTROMAGNETIC EMISSIONS TEST REPORT

ACCORDING TO 47CFR PART 15

for

ElmoTech Ltd.

EQUIPMENT UNDER TEST:

Data collection unit
Model: DCU 2010

Document ID: ELMEMC_FCC.14591.doc
Date of Issue: September 2002

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Description of equipment under test

Test item	Data collection unit
Manufacturer	ElmoTech Ltd.
Type (Model)	DCU 2010
Hardware version	1.4
Software release	1.50
Serial number	29010312
Receipt date	March 20, 2001

Applicant information

Applicant's responsible person	Mr. Alex Rachman, R&D Manager
Company	ElmoTech Ltd.
P.O.Box	13236
Address	2 Habarzel street
City	Tel Aviv
Postal code	61132
Country	Israel
Telephone number	+972 36478871
Telefax number	+972 36478872

Test performance

Project number:	14591
Location	Hermon Laboratories
Test perfromed	August 27, 2002
Purpose of test	Apparatus compliance verification in accordance with emission requirements
Test specification	47CFR part 15, subpart B, Class B

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1 Summary and signatures

The EUT was found complying with the limits of 47CFR part 15: 2001, subpart B, Class B.

Standard ref.	Report ref.	Method	Emissions limits	Ports / enclosure tested	Tested by	Date tested	P/F/NA/ NT[1]	Rationale
Emissions								
Mains terminal radio interference voltage measurements								
47CFR part 15	Table 4.1.2	ANSI C63.4	Class B	120 V AC power	Mrs. E. Pitt, test engineer	August 27, 2002	**P**	
Radiated emission measurements								
47CFR part 15	Table 4.2.2	ANSI C63.4	Class B	Enclosure	Mrs. E. Pitt, test engineer	August 27, 2002	**P**	

Test report prepared by: Ms. N. Averin, certification engineer

Test report approved by: Dr. E. Usoskin, C.E.O.

[1] **P = Pass, F = Fail, NA = Not applicable, NT = Not tested**

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Contents

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2 General information

2.1 Abbreviations and acronyms

The following abbreviations and acronyms are applicable to this test report:

AC	alternating current
cm	centimeter
dB	decibel
dBm	decibel referred to one milliwatt
dB(μV)	decibel referred to one microvolt
dB(μV/m)	decibel referred to one microvolt per meter
DC	direct current
EMC	electromagnetic compatibility
EMI	electromagnetic interference
EUT	equipment under test
GHz	gigahertz
H	height
Hz	hertz
kHz	kilohertz
kV	kilovolt
L	length
LISN	line impedance stabilization network
m	meter
NA	not applicable
QP	quasi-peak
RF	radio frequency
RE	radiated emission
rms	root mean square
s	second
V	volt
W	width

2.2 Specification references

47CFR part 15 subpart B: 2001	Radio Frequency Devices
ANSI C63.2: 1996	American National Standard for Instrumentation-Electromagnetic Noise and Field Strength, 10 kHz to 40 GHz-Specifications.
ANSI C63.4: 1992	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

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2.3 EUT description

The EUT, DCU 2010, is a data collection unit, which receives data form 318 MHz alarm transmitters. It provides communication with monitoring center through modem and POTS lines and infrared communication with a computer.
The device is powered from 12 V DC via AC/DC adapter, manufactured by Egston Ltd, model number N2EFSW3.

2.4 EUT test configuration

The EUT ports and lines description is given in Table 2.4.1, support/test equipment is provided in Table 2.4.2 and test configuration is shown in Figure 2.4.1.
The device operating frequencies generated by clocks and oscillators are 3.87; 4.096; 16.0 and 153.65 MHz.

Table 2.4.1 EUT ports and lines

Port type	Port description	Connector type	Quantity	Cable type description	Indoor/ outdoor cable	Cable length, m	Connected to
Power	12 V DC	DC jack	1	Unshielded	Indoor	1.5	AC/DC adapter
Power	120 V AC	IEC 320	1	–––	–––	–––	AC mains
Signal	Telecommunication	RJ 11	1	UTP	Outdoor	1.5*	Line simulator
Signal	Telephone	RJ 11	1	UTP	Indoor	1.5	Telephone set

* May be longer than 10 m.

Table 2.4.2 EUT support/test equipment

Description	Manufacturer	Model number	Serial number
Line simulator	Hermon Labs	LS-01	1856
Telephone set	Typical		

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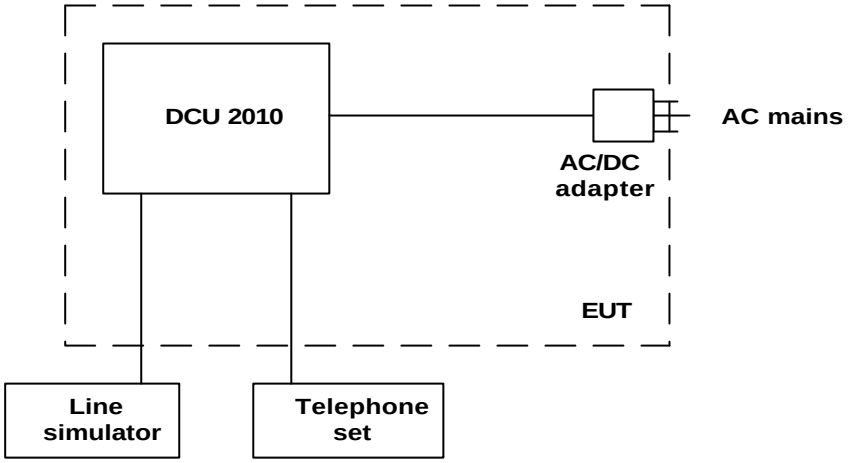
Figure 2.4.1 EUT test configuration



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3 Test facility description

3.1 General

Tests were performed at Hermon Laboratories Ltd., which is a fully independent, private EMC, Safety and Telecommunication testing facility. Hermon Laboratories is listed by the Federal Communications Commission (USA) for all parts of Code of Federal Regulations 47 (CFR 47) and by Industry Canada for electromagnetic emissions (file numbers IC 2186-1 for OATS and IC 2186-2 for anechoic chamber), certified by VCCI, Japan (the registration numbers are R-808 for OATS, R-1082 for anechoic chamber, C-845 for conducted emissions site), assessed by TNO Certification EP&S (Netherlands) for a number of EMC, Telecommunications, Safety standards, and by AMTAC (UK) for safety of Medical Devices. The laboratory is accredited by American Association for Laboratory Accreditation (USA) according to ISO/IEC 17025 for Electromagnetic Compatibility, Product Safety, Telecommunications Testing and Environmental Simulation (for exact scope please refer to Certificate No. 839.01).

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Person for contact: Mr. Alex Usoskin, QA manager.

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4 Emissions tests

4.1 Mains terminal radio interference voltage measurements

4.1.1 General

This test was performed to measure common mode conducted emissions at the power port. Specification test limits are given in Table 4.1.1. The worst test results (the lowest margins) were recorded in Table 4.1.2 and shown in the associated plots.

TEST SPECIFICATION: 47CFR part 15, subpart B, Class B

Table 4.1.1 Mains terminal radio interference voltage specification test limits

Frequency, MHz	Class B equipment, dB(μV)
0.45 – 30	48.0

4.1.2 Test procedure

4.1.2.1 The EUT was set up as shown in Figure 4.1.1 and the associated photograph, energized and the performance check was conducted.

4.1.2.2 The measurements were performed at mains terminals by means of the LISN, connected to a spectrum analyzer in the frequency range referred to in Table 4.1.1. Unused coaxial connector of the LISN was terminated with 50 Ω. Quasi-peak detector was used throughout the testing as referred to in Table 4.1.2.

4.1.2.3 The position of the device cables was varied to determine maximum emission level.

4.1.2.4 The EUT was found to be in compliance with the standard requirements and passed the test.

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Table 4.1.2 Radio frequency interference voltage test results

TEST SPECIFICATION:	47CFR part 15, subpart B, Class B
DATE:	August 27, 2002
RELATIVE HUMIDITY:	39%
AMBIENT TEMPERATURE:	24°C
AIR PRESSURE:	1008 hPa
THE EUT WAS TESTED AS:	TABLE-TOP
DETECTOR USED:	QUASI-PEAK
FREQUENCY RANGE:	150 kHz – 30 MHz
RESOLUTION BANDWIDTH:	9 kHz

Quasi-peak detector

Frequency, MHz	Line ID	Measured emissions, dB (μV)	Specification limit, dB (μV)	Margin, dB	Pass/ Fail
0.667560	Ph	35.11	48.00	12.89	**Pass**
0.800995	Ph	34.19	48.00	13.81	**Pass**
0.961395	N	36.67	48.00	11.33	**Pass**
1.216960	N	36.77	48.00	11.23	**Pass**
1.361233	N	35.29	48.00	12.71	**Pass**
6.916655	Ph	33.87	48.00	14.13	**Pass**

Table calculations and abbreviations:

- Line ID = line identification (Ph - phase, N - neutral).
- Measured conducted emissions = EMI meter reading (dBμV) + cable loss (dB) + LISN correction factor (dB). (For LISN correction factor refer to Appendix B).
- Margin = dB below (negative if above) specification limit.

Reference numbers of test equipment used

HL 0163	HL 0672	HL 0787	HL 1204	HL 1430	HL 1512	HL 1856

Full description is given in Appendix A.

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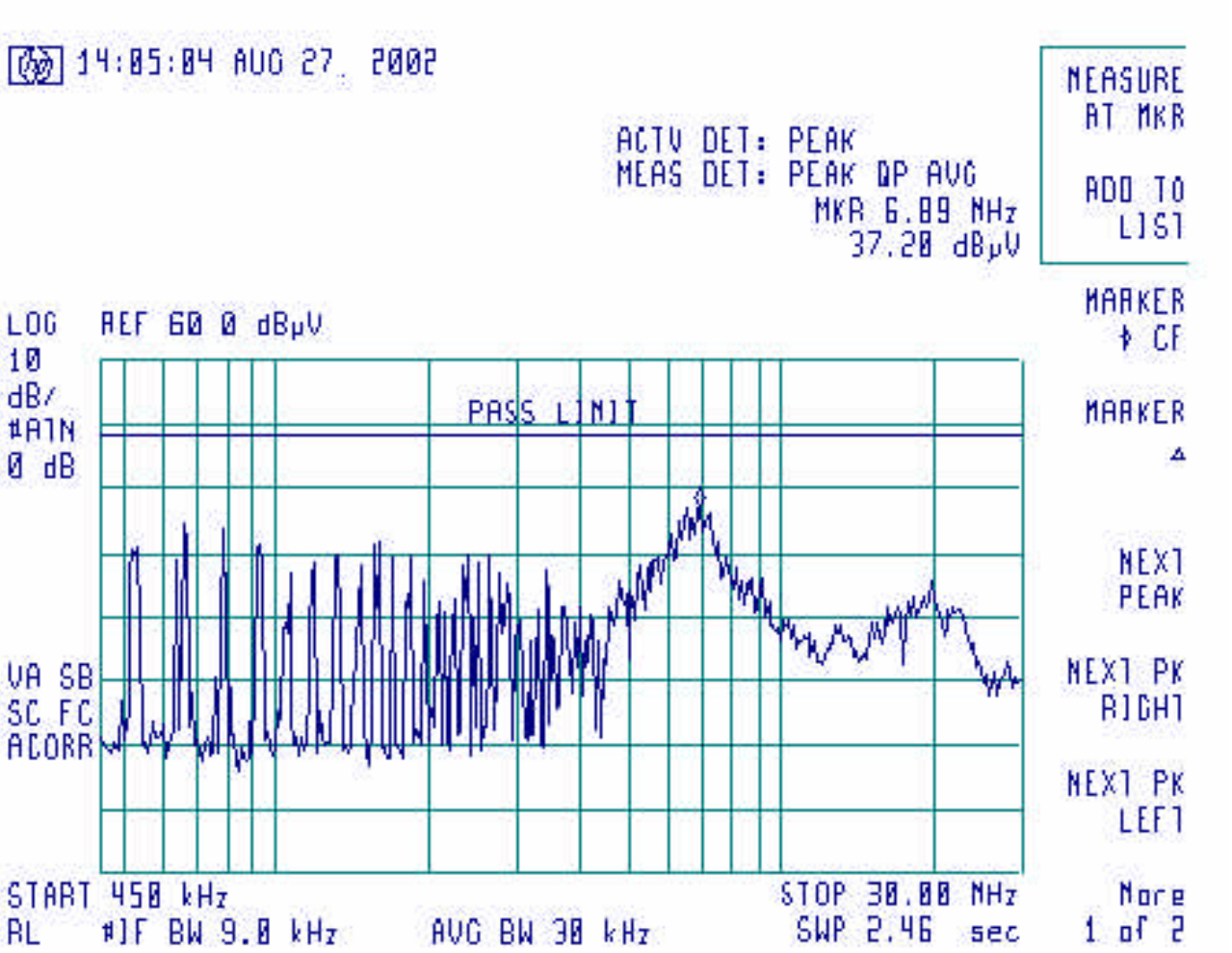
Plot 4.1.1 Mains terminal radio interference voltage test results

LINE:	PHASE
LIMIT:	QUASI-PEAK
DETECTOR:	PEAK



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Plot 4.1.2 Mains terminal radio interference voltage test results

LINE:	NEUTRAL
LIMIT:	QUASI-PEAK
DETECTOR:	PEAK

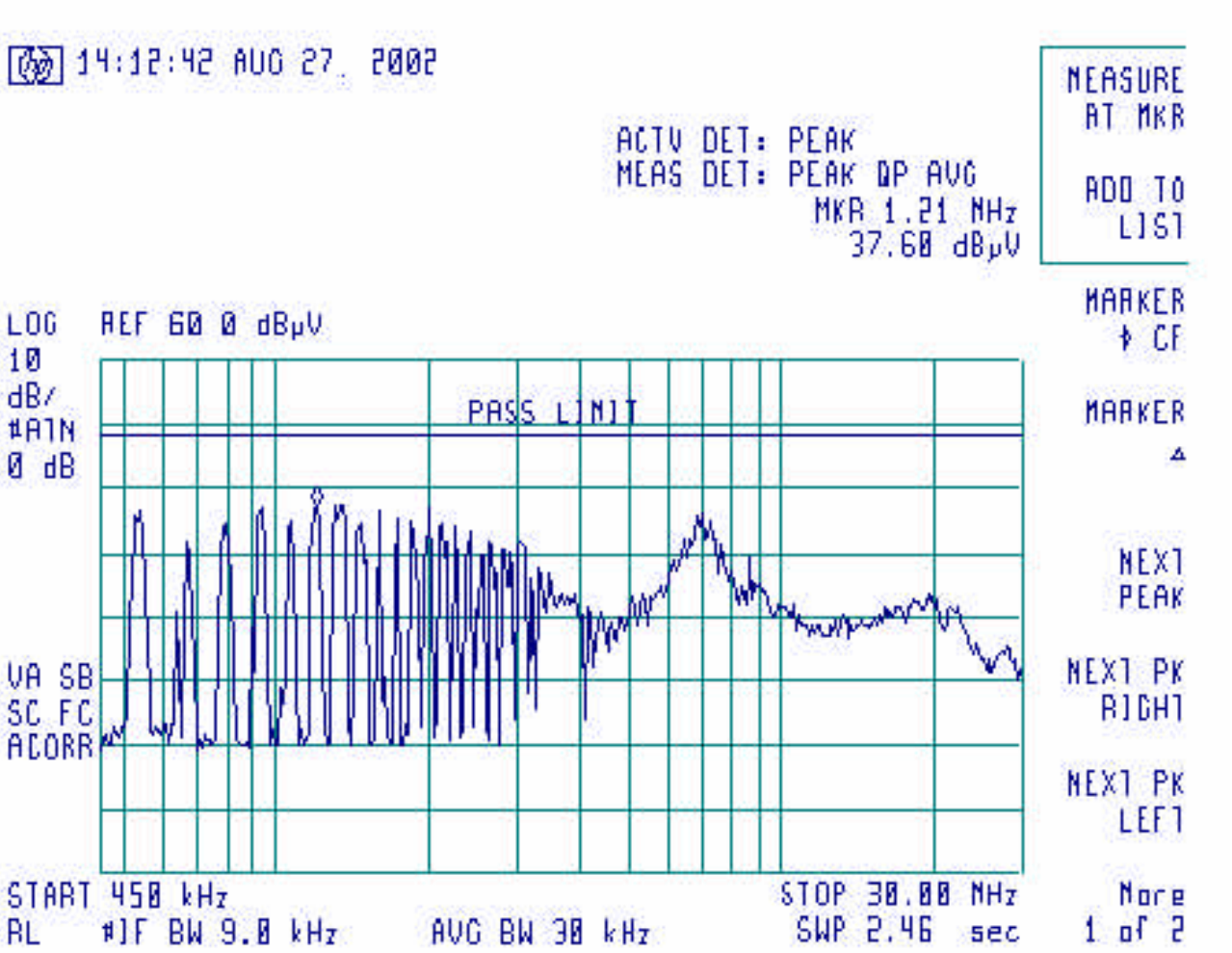

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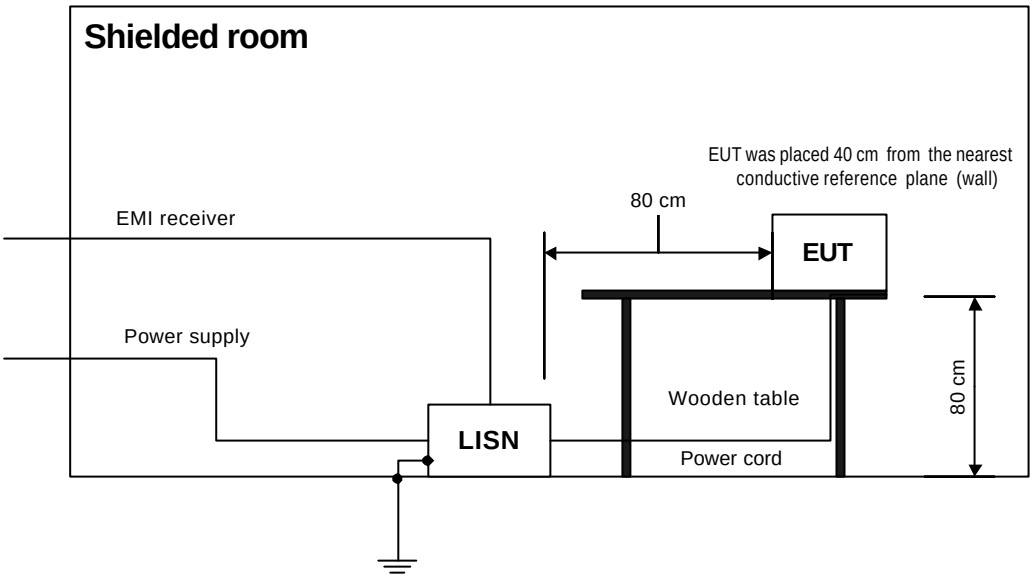
Figure 4.1.1 Setup for mains terminal radio interference voltage test, table-top equipment



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Photograph 4.1.1 Setup for mains terminal radio interference voltage test

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4.2 Radiated emission measurements

4.2.1 General

This test was performed to measure radiated emissions from the EUT enclosure. Specification test limits are given in Table 4.2.1. The worst test results (the lowest margins) were recorded in Table 4.2.2 and shown in the associated plots.

TEST SPECIFICATION: 47CFR part 15, subpart B, Class B

Table 4.2.1 Limits for electric field strength, quasi-peak detector

Frequency, MHz	Class B equipment, dB(■V/m) @ 3m distance
30 - 88	40.0
88 - 216	43.5
216 - 960	46.0
960 – 2000*	54.0

* As the highest frequency used in the device is 153.65 MHz (between 108 and 500 MHz), the measurements were performed in frequency range 30 – 2000 MHz.

4.2.2 Test procedure

4.2.2.1 The EUT was set up as shown in Figure 4.2.1 and the associated photographs; energized and the performance check was conducted.

4.2.2.2 The frequency range specified in Table 4.2.1 was investigated by means of biconilog antenna connected to EMI receiver.

4.2.2.3 To find maximum radiation the turntable was rotated 360^0, the measuring antenna height was changed from 1 to 4 m, its polarization was changed from vertical to horizontal and the cables were moved.

4.2.2.4 The EUT was found to be in compliance with the standard requirements and passed the test.

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Table 4.2.2 Radiated emission measurements test results

TEST SPECIFICATION:	47CFR part 15, subpart B, Class B
DATE:	August 27, 2002
RELATIVE HUMIDITY:	43%
AMBIENT TEMPERATURE:	24°C
AIR PRESSURE:	1008 hPa
THE EUT WAS TESTED AS:	TABLE-TOP
TEST PERFORMED IN:	ANECHOIC CHAMBER
DISTANCE BETWEEN ANTENNA AND EUT:	3 m
FREQUENCY RANGE:	30 MHz – 2 GHz
DETECTOR TYPE:	QUASI-PEAK
RESOLUTION BANDWIDTH:	120 kHz
ANTENNA TYPE:	BICONILOG

Frequency, MHz	Ant. pol.	Ant. hgt., m	TT pos., (^{o})	Radiated emissions, dB (μV/m)	Specification limit, dB (μV/m)	Margin, dB	Pass/ Fail
32.777200	V	1.0	184	24.47	40.00	15.53	**Pass**
102.400000	V	1.0	184	21.92	43.50	21.58	**Pass**
163.849700	H	1.4	74	36.42	43.50	7.08	**Pass**
393.212500	H	1.4	74	33.13	46.00	12.87	**Pass**
425.983700	H	1.4	74	37.63	46.00	8.37	**Pass**
552.940600	V	1.0	184	25.77	46.00	20.23	**Pass**

Table calculations and abbreviations:

Radiated emission dB(μV/m) = measured results dB(μV) + correction factor dB(1/m).
Correction factor = antenna factor + cable loss (for antenna factor and cable loss refer to Appendix B).
Ant. pol. = antenna polarization (V-vertical, H-horizontal).
Ant. hgt. = antenna height.
TT pos. = turntable position in degrees, (EUT front panel = 0^o).
Margin = dB below (negative if above) specification limit.

Reference numbers of test equipment used

HL 0465	HL 0521	HL 0589	HL 0592	HL 0593	HL 0594	HL 0604	HL 1003

Full description is given in Appendix A.

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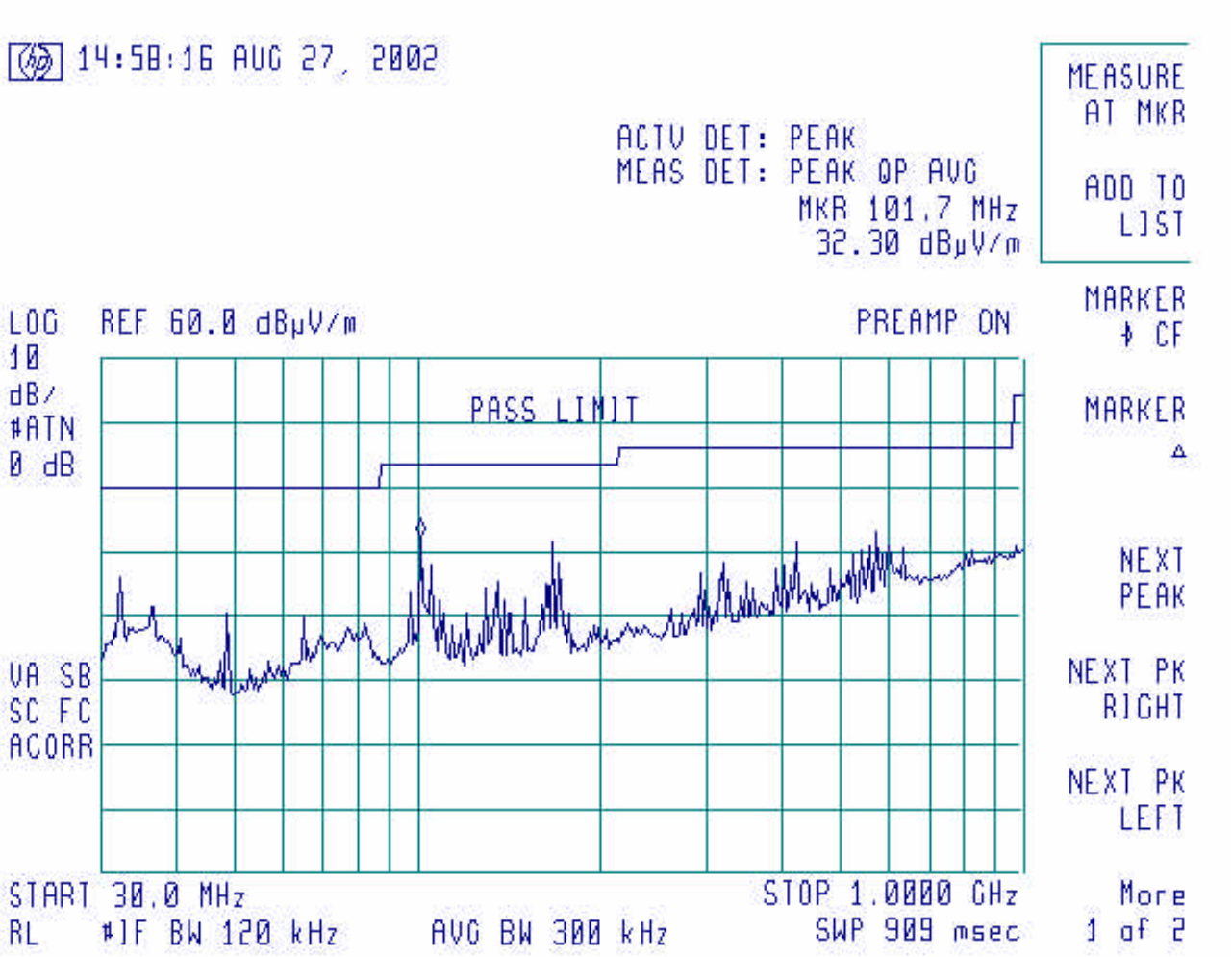
Plot 4.2.1 Radiated emission measurements test results

FREQUENCY RANGE:	30 – 1000 MHz
POLARIZATION:	VERTICAL



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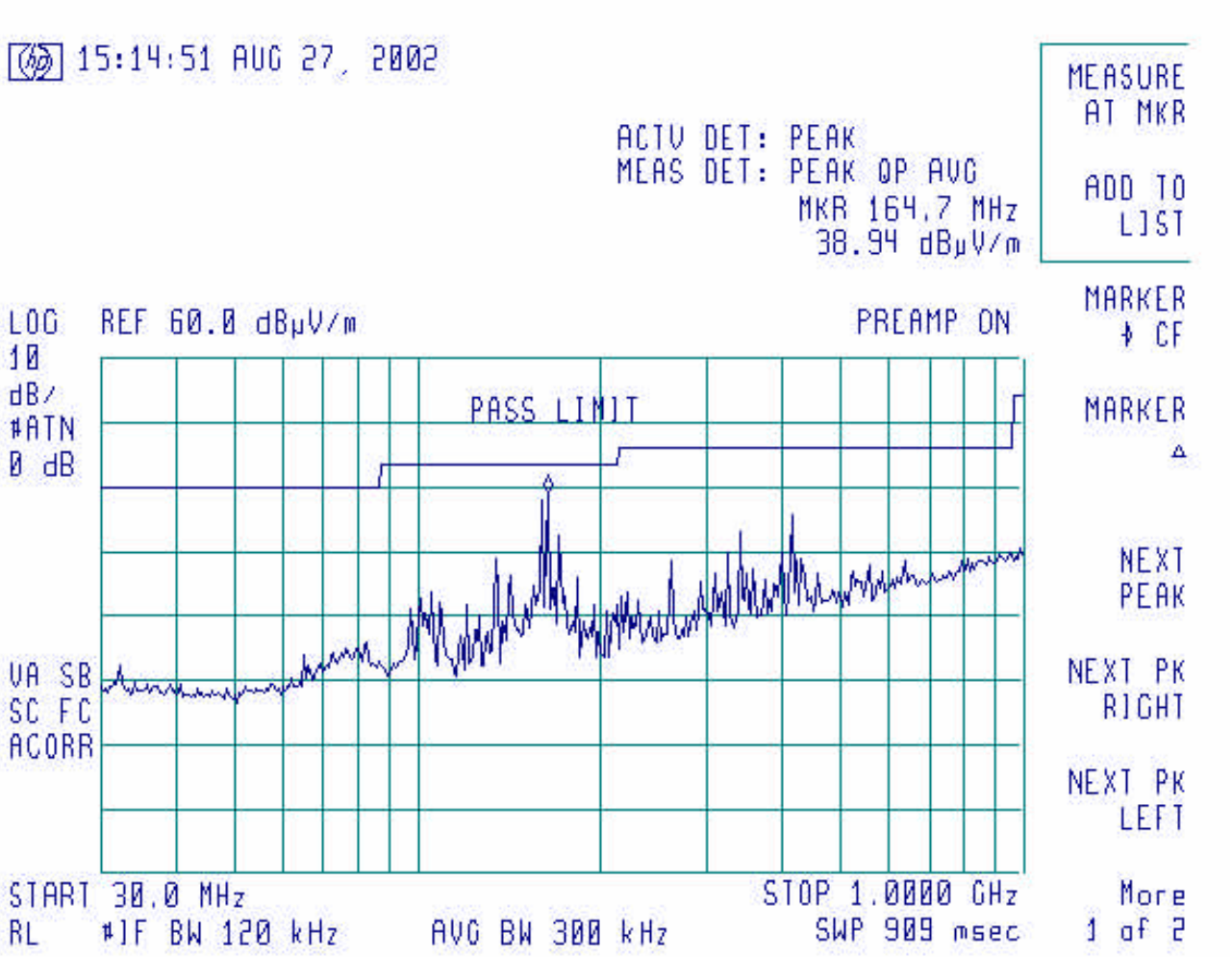
Plot 4.2.2 Radiated emission measurements test results

FREQUENCY RANGE:	30 – 1000 MHz
POLARIZATION:	HORIZONTAL



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Plot 4.2.3 Radiated emission measurements test results

FREQUENCY RANGE: 1 – 2 GHz
POLARIZATION: VERTICAL & HORIZONTAL

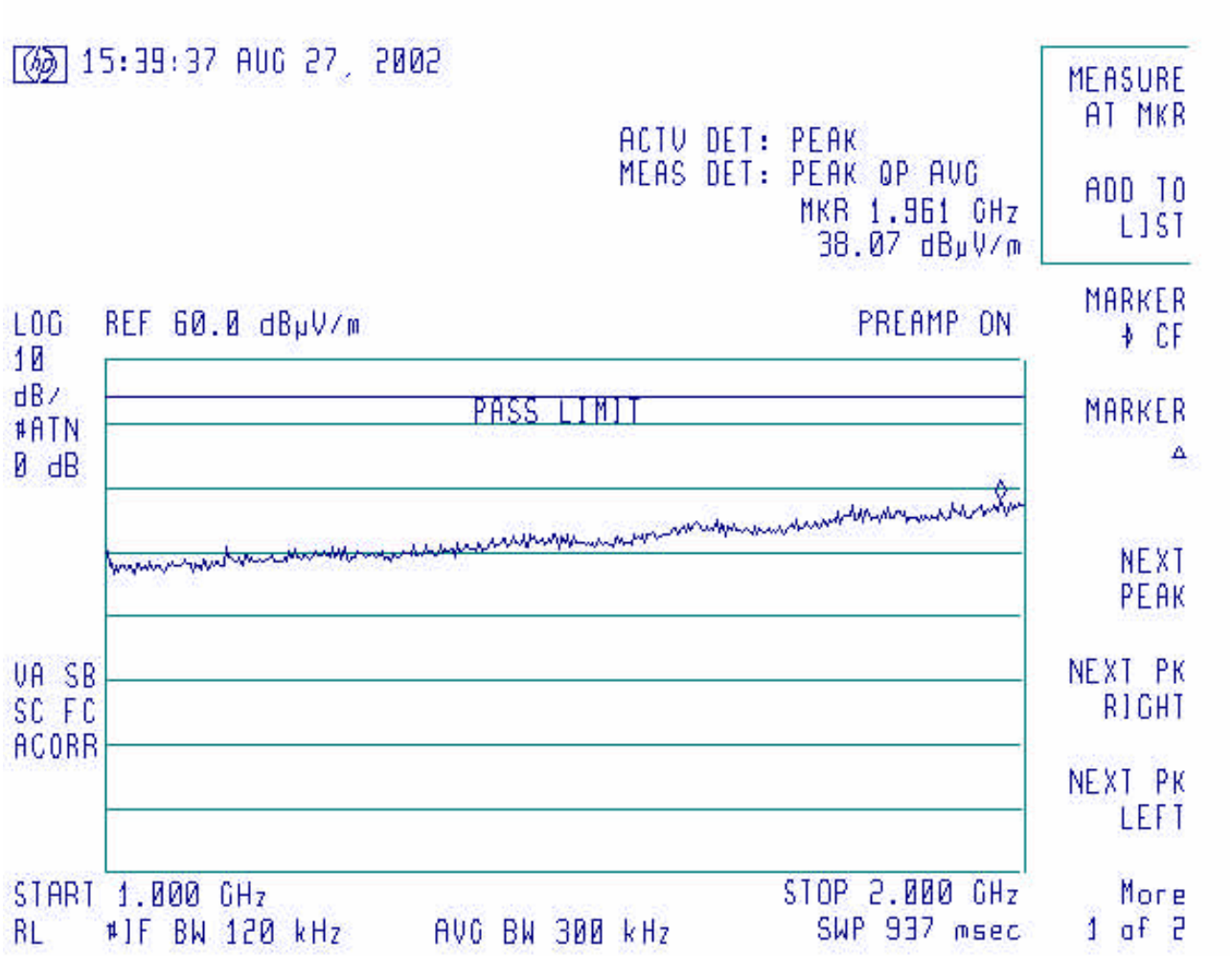

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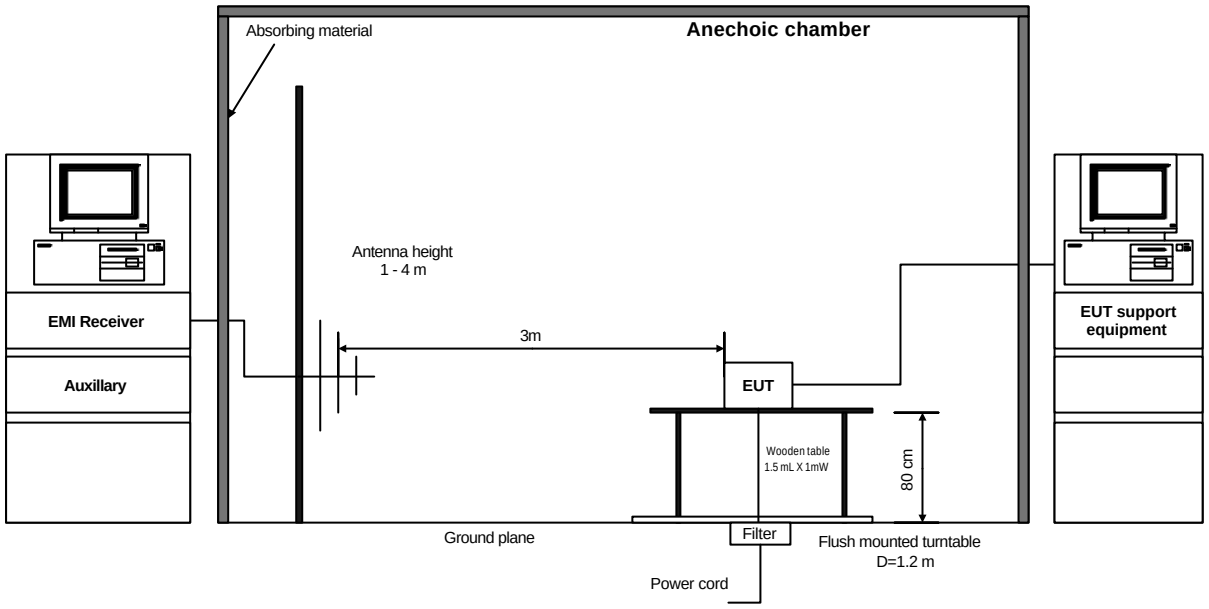
Figure 4.2.1 Setup for radiated emissions test performed in anechoic chamber, table-top equipment



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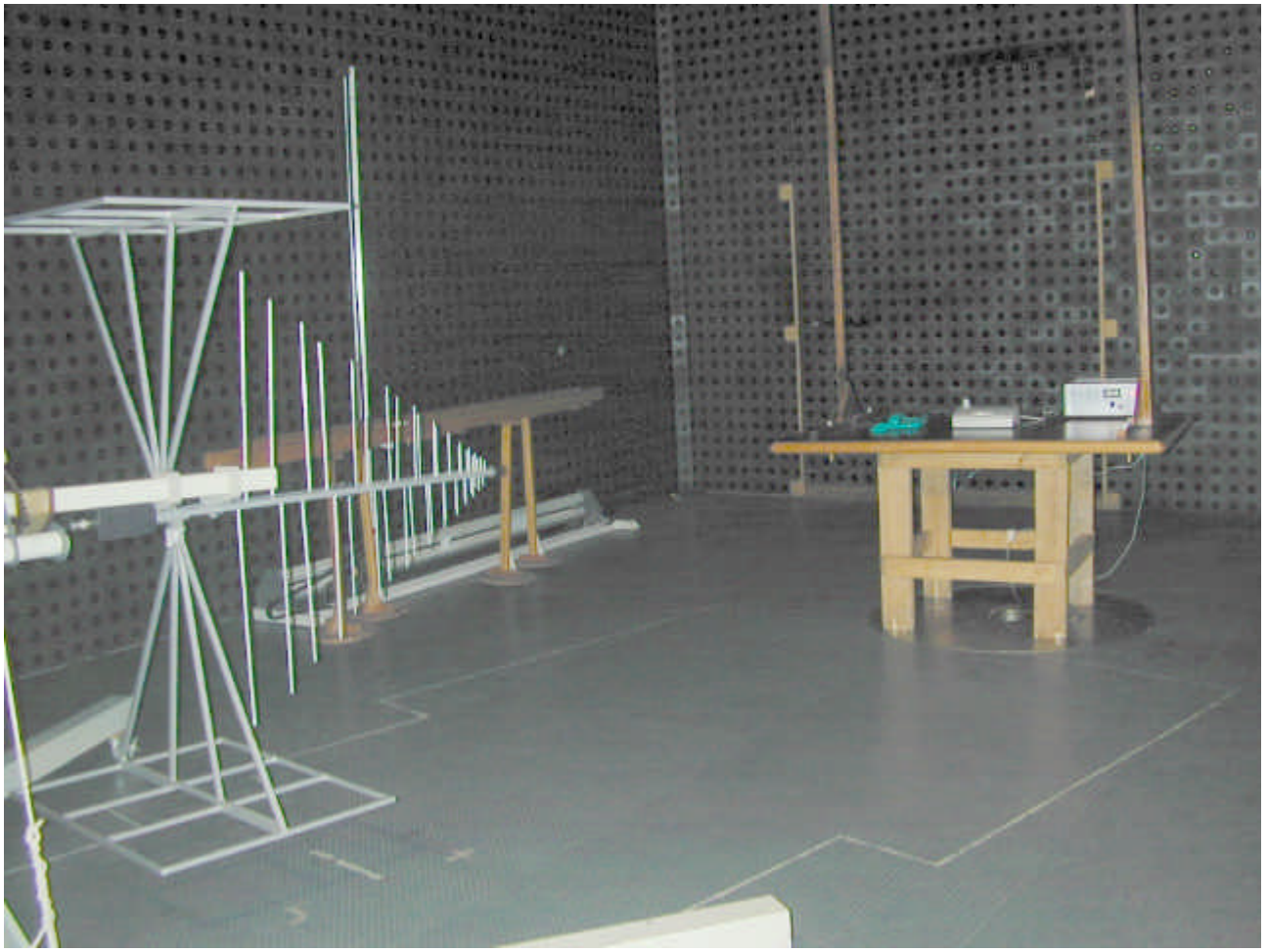
Photograph 4.2.1 Setup for radiated emission measurements



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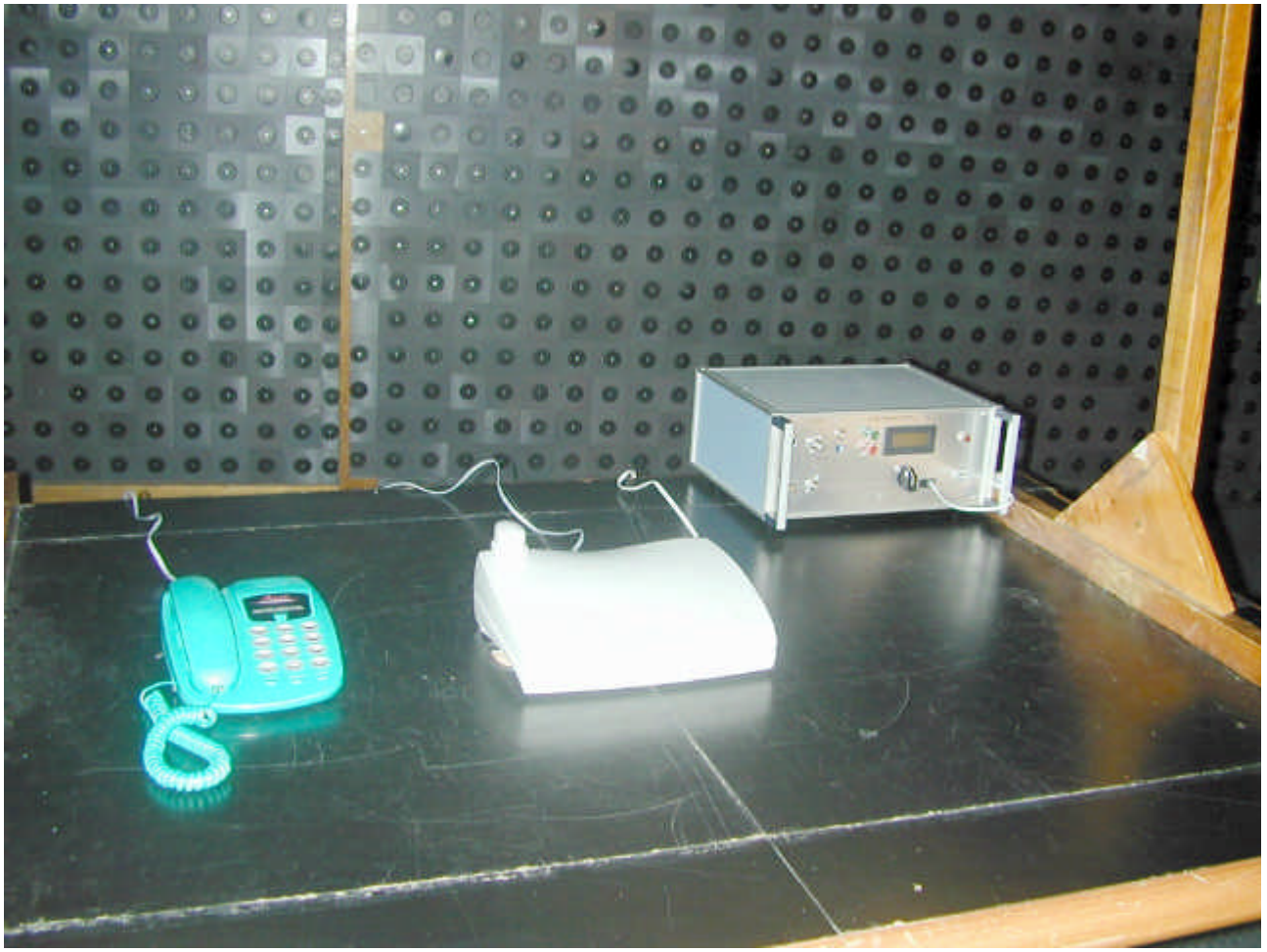
Photograph 4.2.2 Setup for radiated emission measurements



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APPENDIX A – Measurement uncertainty, test equipment and ancillaries used for tests

The test equipment has been calibrated according to its recommended procedures and is within the manufacturer's published limit of error. The standards and instruments used in the calibration system conform to the present requirements of ISO/IEC 17025 (or alternately ANSI/NCSL Z540-1).
The laboratory calibrates its standards by a third party (traceable to NIST, USA) on a regular basis according to equipment manufacturer requirements. The Hermon Labs EMC measurements uncertainty is given in the table below.

Expanded uncertainty at 95% confidence in Hermon Labs EMC measurements

Test description	Expanded uncertainty
Conducted emissions with LISN and HP 8542E receiver	▪ 9 kHz to 150 kHz: +2.43 dB/-2.22 dB ▪ 150 kHz to 30 MHz: + 2.22 dB/-2.05 dB
Radiated emissions in the anechoic chamber at 3 m measuring distance	▪ Biconilog antenna: +5.73 dB/-5.57 dB

Test equipment and ancillaries used for tests

HL Serial No.	Description	Manufacturer information			Due Calibr. Month/Year
		Name	Model No.	Serial No.	
0163	LISN FCC/VDE/MIL -STD	Electro-Metrics	ANS-25/2	1314	10/02
0465	Anechoic chamber 9 (L) x 6.5 (W) x 5.5 (H) m	Hermon Labs	AC-1	023	11/02
0521	Spectrum analyzer with RF filter section (EMI receiver 9 kHz - 6.5 GHz)	Hewlett Packard	8546A	0319	9/03
0589	Cable coaxial, GORE A2POL118.2, 3m	Hermon Labs	GORE-3	589	12/02
0592	Position controller	Hermon Labs	L2-SR3000	100	5/03 Check
0593	Antenna mast, 1-4 m/ 1-6 m Pneumatic	Hermon Labs	AM-F1	101	2/03 Check
0594	Turntable for anechoic chamber, flush mounted, d=1.2 m, pneumatic	Hermon Labs	WDC1	102	1/03 Check
0604	Antenna biconilog log-periodic/T Bow-Tie, 26 - 2000 MHz	EMCO	3141	9611-1011	1/03
0672	Shielded room 4.6(L) x 4.2(W) x 2.4(H) m	Hermon Labs	SR-3	027	11/02 Check
0787	Transient limiter	Hewlett Packard	11947A-8ZE	3107A01877	11/02
1003	Cable coaxial, M17/164, 10 m	Hermon Labs	C17164-10	161	12/02
1204	One phase voltage regulator, 2kVA, 0-250V	Hermon Labs	TDGC-2	99	5/03 Check
1430	EMI receiver, 9 kHz – 2.9 GHz	Agilent Technologies	8542E	3807A00262, 3705A00217	9/03
1512	Cable RF, 8 m	Belden	M17/167 MIL-C-17	NA	12/02
1856	Line simulator	Hermon Labs	LS-01	1856	1/03

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APPENDIX B - Test equipment correction factors

Correction factor
Line impedance stabilization network
Model ANS-25/2
Electro-Metrics

Frequency, kHz	Correction Factor
10	4.9
15	2.86
20	1.83
25	1.25
30	0.91
35	0.69
40	0.53
50	0.35
60	0.25
70	0.18
80	0.14
90	0.11
100	0.09
125	0.06
150	0.04

The correction factor dB is to be added to the meter readings (dB/μV) of the interference analyzer or spectrum analyzer.

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Antenna factor
Biconilog antenna EMCO, model 3141
Ser.No.1011

Frequency, MHz	Antenna Factor, dB(1/m)	Frequency, MHz	Antenna Factor, dB(1/m)
26	7.8	940	24.0
28	7.8	960	24.1
30	7.8	980	24.5
40	7.2	1000	24.9
60	7.1	1020	25.0
70	8.5	1040	25.2
80	9.4	1060	25.4
90	9.8	1080	25.6
100	9.7	1100	25.7
110	9.3	1120	26.0
120	8.8	1140	26.4
130	8.7	1160	27.0
140	9.2	1180	27.0
150	9.8	1200	26.7
160	10.2	1220	26.5
170	10.4	1240	26.5
180	10.4	1260	26.5
190	10.3	1280	26.6
200	10.6	1300	27.0
220	11.6	1320	27.8
240	12.4	1340	28.3
260	12.8	1360	28.2
280	13.7	1380	27.9
300	14.7	1400	27.9
320	15.2	1420	27.9
340	15.4	1440	27.8
360	16.1	1460	27.8
380	16.4	1480	28.0
400	16.6	1500	28.5
420	16.7	1520	28.9
440	17.0	1540	29.6
460	17.7	1560	29.8
480	18.1	1580	29.6
500	18.5	1600	29.5
520	19.1	1620	29.3
540	19.5	1640	29.2
560	19.8	1660	29.4
580	20.6	1680	29.6
600	21.3	1700	29.8
620	21.5	1720	30.3
640	21.2	1740	30.8
660	21.4	1760	31.1
680	21.9	1780	31.0
700	22.2	1800	30.9
720	22.2	1820	30.7
740	22.1	1840	30.6
760	22.3	1860	30.6
780	22.6	1880	30.6
800	22.7	1900	30.6
820	22.9	1920	30.7
840	23.1	1940	30.9
860	23.4	1960	31.2
880	23.8	1980	31.6
900	24.1	2000	32.0
920	24.1		

Antenna factor is to be added to receiver meter reading in dB(μV) to convert to field intensity in dB(μV/meter)