



HERMON LABORATORIES



Hermon Laboratories Ltd.
P.O.Box 23
Binyamina 30550, Israel
Tel.+972 46288001
Fax.+972 46288277
e-mail: mail@hermonlabs.com

ELECTROMAGNETIC EMISSIONS TEST REPORT

ACCORDING TO 47CFR PART 15

for

On Track Innovations Ltd.

EQUIPMENT UNDER TEST:

Reader

Model: Saturn M.B V-2

This report is in conformity with ISO/IEC 17025. The A2LA logo endorsement applies only to the test methods and the standards that are listed in the scope of Hermon Laboratories accreditation.
The test results relate only to the items tested. **This test report must not be reproduced in any form except in full with the approval of Hermon Laboratories Ltd.**



Description of equipment under test

Test items :Reader
Manufacturer :On Track Innovations Ltd.
Types (Models) :Saturn M.B V-2
Receipt date :November 26, 2002

Applicant information

Applicant's responsible person :Mr. Hemy Itay, project manager
Company : On Track Innovations Ltd.
Address :Zahar industrial zone, P.O.B. 32
City :Rosh Pina
Postal code :12000
Country :Israel
Telephone number :+972 4 6868000
Telefax number :+972 4 6938887

Test performance

Project number: 14816
Location Hermon Laboratories
Test performed November 26, 2002
Purpose of test Apparatus compliance verification in accordance with emission requirements
Test specification 47CFR part 15, subpart B, Class B



1 Summary and signatures

The EUT was found complying with the limits of 47CFR part 15: 2002, 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	Mr. E. Pitt, test engineer	November 26, 2002	P	
Radiated emission measurements								
47CFR part 15	Table 4.2.2	ANSI C63.4	Class B	Enclosure 30 – 1000 MHz	Mr. E. Pitt, test engineer	November 26, 2002	P²	

Test report prepared by: Mrs. V. Mednikov, certification engineer

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

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

² Pass decision was made on nominal values.



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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
AVRG	average (detector)
cm	centimeter
dB	decibel
dBm	decibel referred to one milliwatt
dB(μ V)	decibel referred to one microvolt
dB(μ V/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
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: 2002	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.



2.3 EUT description

The Saturn reader is a compact electronic interface unit, which provides bi-directional contact and non-contact communication with smart cards and RS232 communication with local controller.

The EUT is powered by 12 V DC from AC/ DC adapter.

2.4 EUT test configuration

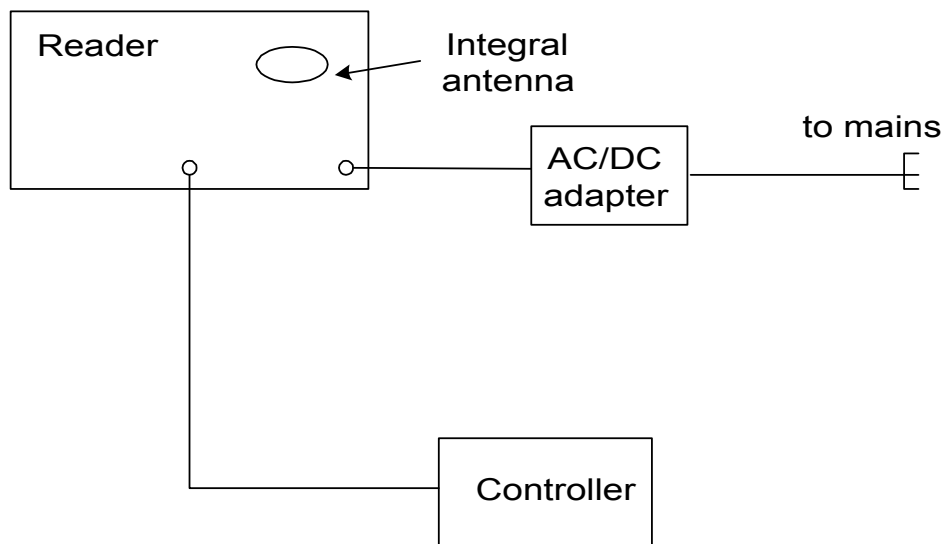
The EUT ports and lines description is given in Table 2.4.1, test configuration is shown in Figure 2.4.1. Local oscillator frequencies are 4 MHz, 13.56 MHz, 24 MHz.

Table 2.4.1 EUT ports and lines

Port type	Port description	Connector type	Quantity	Cable type description	Cable length, m	Connected to
Power	DC power	non-detachable	1	unshielded	1.5	AC/DC adapter
Signal	RS232	D-type 9 pin	1	shielded	10	controller



Figure 2.4.1 EUT test configuration





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).

Address: PO Box 23, Binyamina 30550, Israel.
Telephone: +972 4628 8001
Fax: +972 4628 8277
e-mail: mail@hermonlabs.com

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



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(μ V)	
	QP	AVRG
0.15 - 0.5	66-56*	56-46*
0.5 - 5	56	46
5 - 30	60	50

*The limit decreases linearly with the logarithm of frequency.

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 and average detectors were 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.



Table 4.1.2 Radio frequency interference voltage test results

TEST SPECIFICATION: 47CFR part 15, subpart B, Class B
DATE: November 26, 2002
RELATIVE HUMIDITY: 38%
AMBIENT TEMPERATURE: 27°C
AIR PRESSURE: 1006 hPa
THE EUT WAS TESTED AS: TABLE-TOP
DETECTORS USED: QUASI-PEAK, AVERAGE
FREQUENCY RANGE: 150 kHz – 30 MHz
RESOLUTION BANDWIDTH: 9 kHz

Quasi-peak detector

Frequency, MHz	Line ID	Measured emissions, dB (μV)	Specification class B limit, dB (μV)	Margin, dB	Pass/ Fail
0.150450	N	48.82	65.98	17.16	Pass
0.170450	N	48.38	65.00	16.62	Pass
0.230450	N	45.68	62.48	16.80	Pass
0.249775	Ph	44.76	60.00	17.03	Pass
0.799775	Ph	39.57	56.00	16.43	Pass
13.559820	Ph	45.21	61.79	14.79	Pass

Average detector

Frequency, MHz	Line ID	Measured emissions, dB (μV)	Specification class B limit, dB (μV)	Margin, dB	Pass/ Fail
13.559820	Ph	44.91	50	5.09	Pass
13.560335	N	42.31	50.00	7.69	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 0521	HL 0580	HL 0590	HL 1003
---------	---------	---------	---------	---------

Full description is given in Appendix A.



Plot 4.1.1 Mains terminal radio interference voltage test results

LINE: PHASE
LIMIT: QUASI-PEAK, AVERAGE
DETECTOR: PEAK

13:48:39 NOV 26, 2002

ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKR 170 kHz
55.04 dB μ V

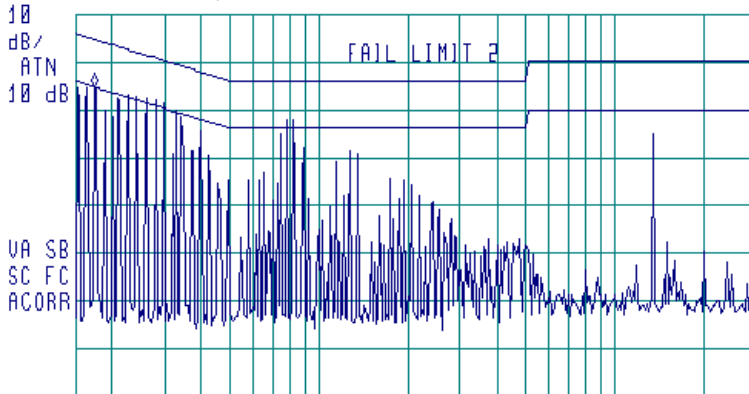
MEASURE
AT MKR

ADD TO
LIST

LOG REF 70.0 dB μ V

PREAMP ON

MARKER
CF



MARKER
A

NEXT
PEAK

NEXT PK
RIGHT

NEXT PK
LEFT

START 150 kHz STOP 30.00 MHz
R IF BW 9.0 kHz AVG BW 30 kHz SWP 2.49 sec

More
1 of 2



Plot 4.1.2 Mains terminal radio interference voltage test results

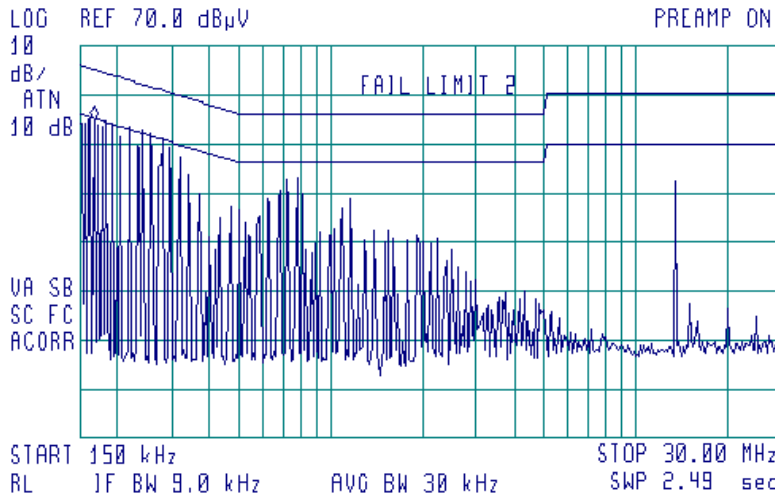
LINE: NEUTRAL
LIMIT: QUASI-PEAK, AVERAGE
DETECTOR: PEAK

13:57:29 NOV 26, 2002

ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 170 kHz
54.88 dBμV

MEASURE
AT MKR

ADD TO
LIST



MARKER
↓ CF

MARKER
▲

NEXT
PEAK

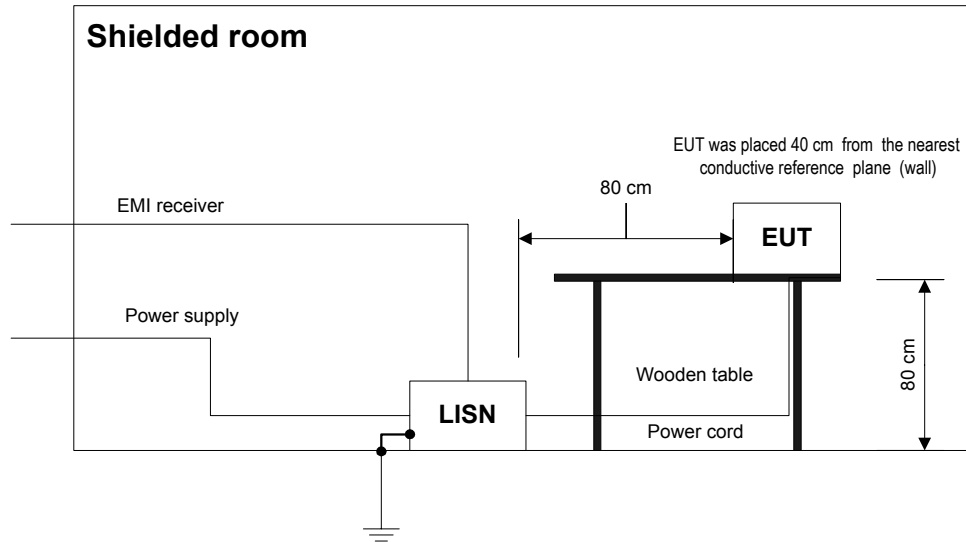
NEXT PK
RIGHT

NEXT PK
LEFT

More
1 of 2



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





Photograph 4.1.1 Conducted emission measurement setup





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 plot.

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(μ V/m) @ 3m distance
30 - 88	40.0
88 - 216	43.5
216 - 960	46.0
960 – 1000*	54.0

* As the highest frequency used in the device is 24 MHz (below 108 MHz), the measurements were performed from 30 to 1000 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 was investigated by means of biconilog antenna connected to EMI receiver. To find maximum radiation the turntable was rotated 360⁰, the measuring antenna height was changed from 1 to 4 m, its polarization was changed from vertical to horizontal and the cables were moved.

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



Table 4.2.2 Radiated emission measurements test results

TEST SPECIFICATION: 47CFR part 15, subpart B, Class B
THE EUT WAS TESTED AS: TABLE-TOP
DATE: November 26, 2002
RELATIVE HUMIDITY: 42%
AMBIENT TEMPERATURE: 25°C
AIR PRESSURE: 1011 hPa
DETECTOR TYPE: QUASI-PEAK
RESOLUTION BANDWIDTH: 120 kHz
TEST PERFORMED AT: Anechoic chamber
DISTANCE BETWEEN ANTENNA AND EUT: 3 m

Frequency, MHz	Antenna polarization	Antenna height, m	TT pos., (°)	Radiated emission, dB (µV/m)	Specification 3m limit, dB (µV/m)	Margin, dB	Pass/ Fail
48.015000	V	1.0	231	35.57	40	4.43	Pass
598.286200	V	1.0	222	42.82	46	3.18	Pass
731.255400	V	1.0	178	40.03	46	5.97	Pass
797.749450	V	1.0	185	40.53	46	5.47	Pass
598.295500	H	1.1	148	42.66	46	3.34	Pass
864.208650	H	1.0	290	40.62	46	5.38	Pass

Table abbreviations:

TT pos. = turntable position in degrees, (EUT front panel = 0°).
Margin = dB below (negative if above) specification limit.

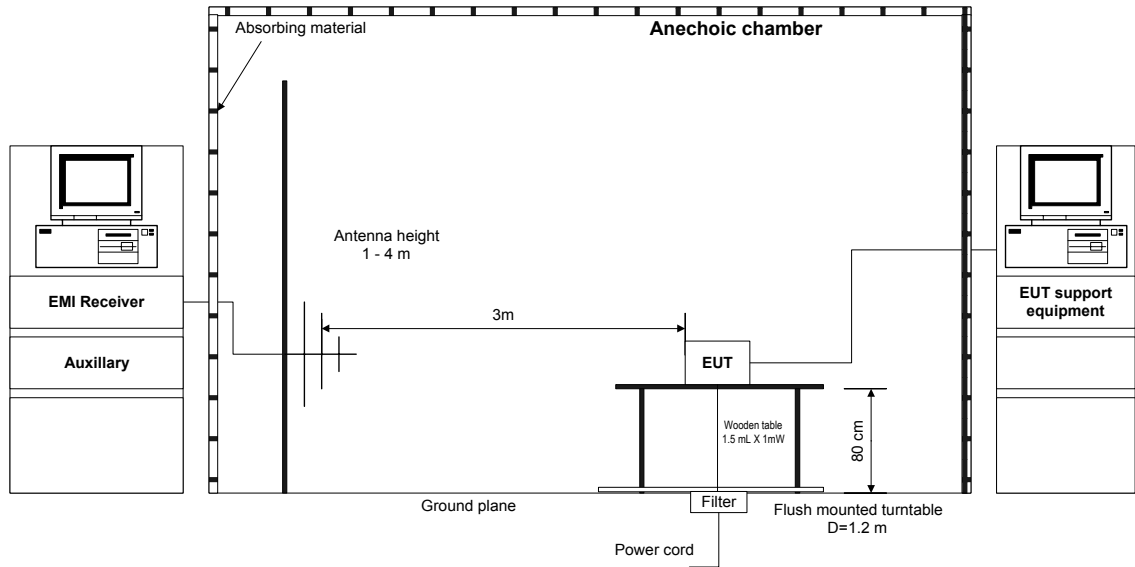
Reference numbers of test equipment used

HL 0465	HL 0521	HL 0604	HL 0589	HL 1004			
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Full description is given in Appendix A.

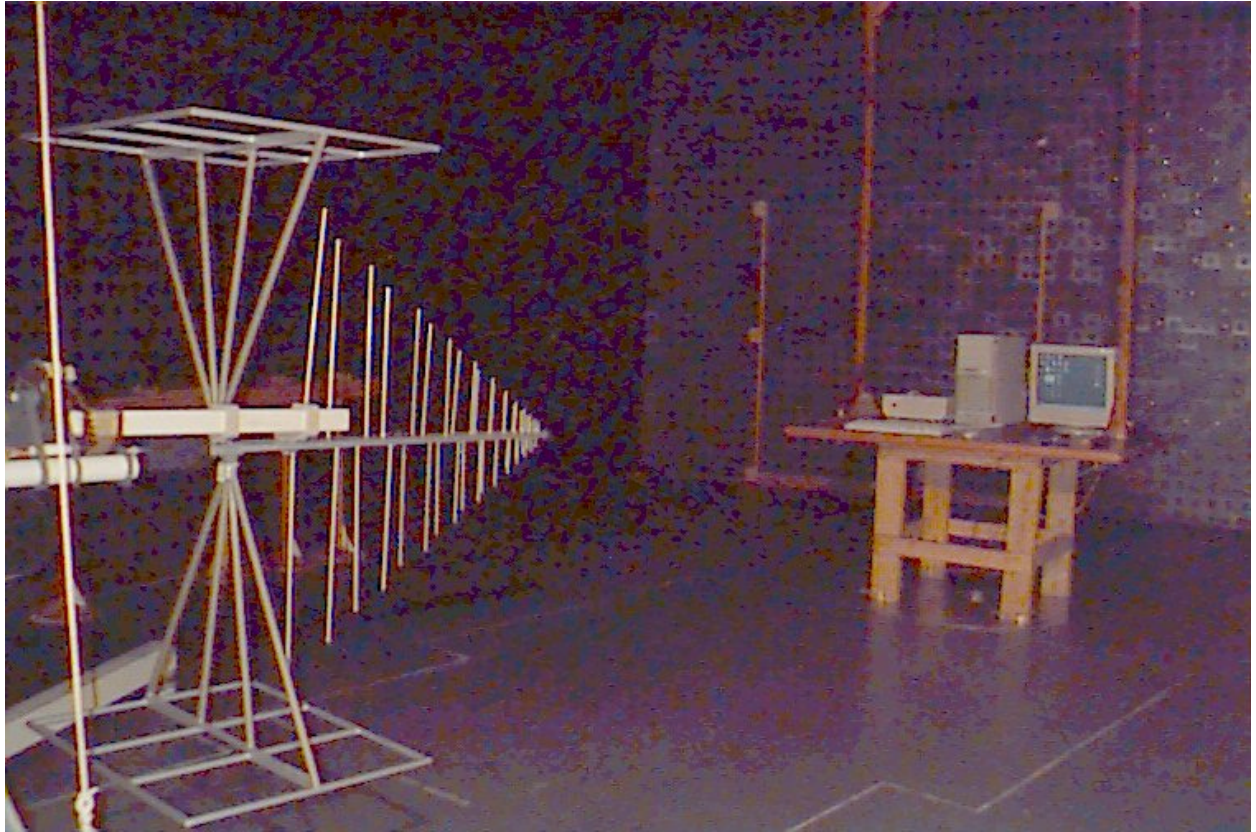


Figure 4.2.1 Setup for radiated emissions test





Photograph 4.2.1 Setup for radiated emission measurements
General view



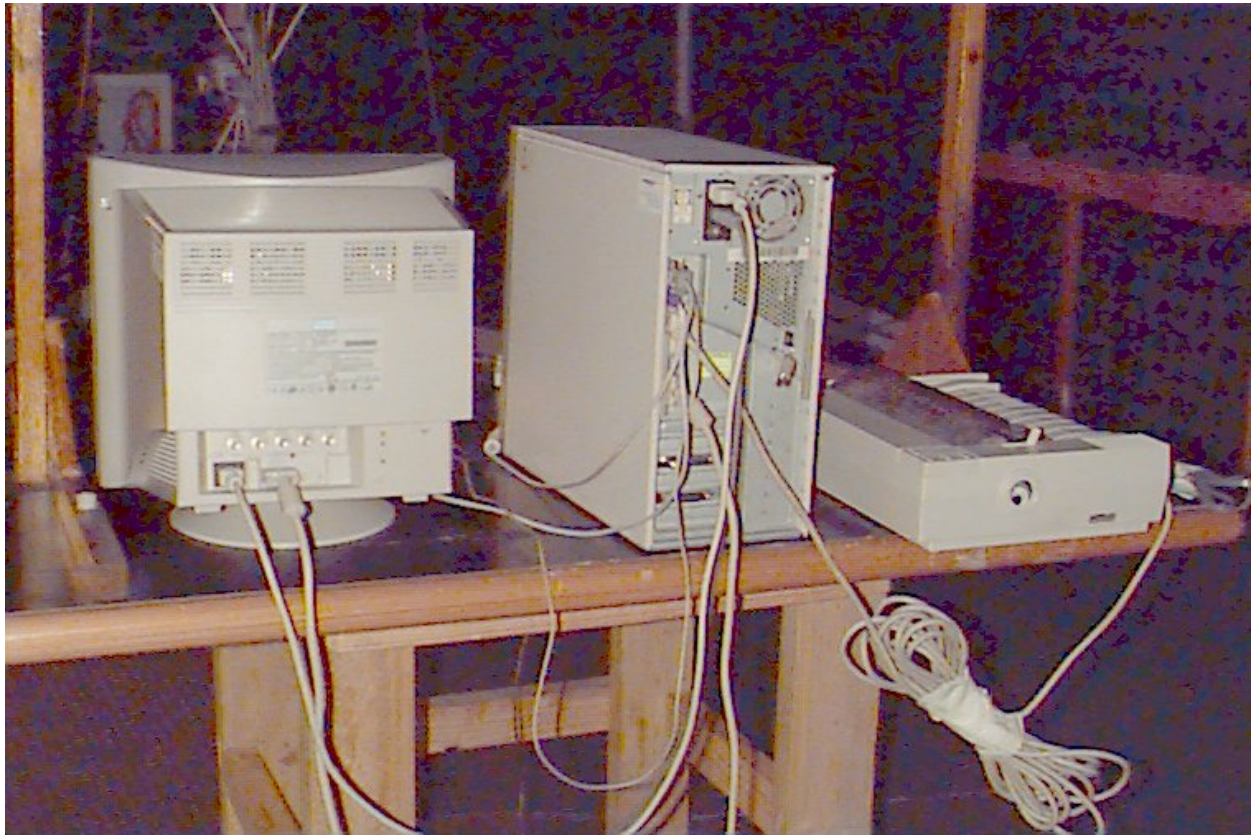


**Photograph 4.2.2 Setup for radiated emission measurements
The EUT view**





**Photograph 4.2.3 Setup for radiated emission measurements
The rear view**





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 8546A receiver	<ul style="list-style-type: none">▪ 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	<ul style="list-style-type: none">▪ 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	10/03
0465	Anechoic chamber 9 (L) x 6.5 (W) x 5.5 (H) m	Hermon Labs	AC-1	023	10/05
0521	Spectrum analyzer with RF filter section (EMI receiver 9 kHz - 6.5 GHz)	Hewlett Packard	8546A	0319	9/03
0580	DC block adaptor 10 kHz-2.2 GHz	Anritsu	MA8601 A	580	12/02
0589	Cable coaxial, GORE A2POL118.2, 3m	Hermon Labs	GORE-3	589	12/02
0590	Attenuator 10 dB, 50 Ohm, N-type, 2W	Elisra Electronic Systems	MW2100-N- Type	10	01/03
0604	Antenna biconilog log-periodic/T Bow- Tie, 26 - 2000 MHz	EMCO	3141	9611-1011	1/03
1003	Cable coaxial, M17/164, 10 m	Hermon Labs	C17164-10	161	11/03
1004	Cable, coaxial ANDREW PSWJ4, 6 m	Hermon Labs	ANDREW-6	163	12/02



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 in dB is to be added to the meter readings (dB/ μ V) of the interference analyzer or spectrum analyzer.



**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(μ V) to convert to field intensity in dB(μ V/meter)



**Cable Coaxial, GORE A2P01POL118, 2.3 m, model:GORE-3, s/n 176 (HL 0589)
+ Cable Coaxial, ANDREW PSWJ4, 6m, model: ANDREW-6, s/n 163 (HL 1004)
Calibration data**

No.	Parameter	SET, MHz	Measured, dB	Deviation, dB	Tolerance (Specification), dB	Meas. Uncert., dB	Notes
1	Insertion Loss	30	0.33	-	≤ 6.5	±0.12	
2		50	0.40	-			
3		100	0.57	-			
4		300	0.97	-			
5		500	1.25	-			
6		800	1.59	-			
7		1000	1.81	-			
8		1200	1.97	-			
9		1400	2.15	-			
10		1600	2.28	-			
11		1800	2.43	-			
12		2000	2.61	-			
13		2200	2.75	-			
14		2400	2.89	-			
15		2600	2.97	-			
16	Insertion Loss	2800	3.21	-	≤ 6.5	±0.12	
17		3000	3.32	-			
18		3300	3.47	-			
19		3600	3.62	-			
20		3900	3.84	-			
21		4200	3.92	-			
22		4500	4.07	-		±0.17	
23		4800	4.36	-			
24		5100	4.62	-			
25		5400	4.78	-			
26		5700	5.16	-			
27		6000	5.67	-			
28		6500	5.99	-			



Cable coaxial M17/164
Model: C17164-10, s/n 161 (HL 1003)
Calibration data

No.	Parameter	SET, MHz	Measured, dB	Deviation, dB	Tolerance (Specification), dB	Meas. Uncert., dB	Notes
1	Insertion Loss	30	0.41	-	≤ 12.5	±0.12	
2		50	0.52	-			
3		100	0.75	-			
4		300	1.45	-			
5		500	2.01	-			
6		800	2.71	-			
7		1000	3.14	-			
8		1200	3.56	-			
9		1400	3.93	-			
10		1600	4.31	-			
11		1800	4.63	-			
12		2000	4.97	-			
13		2200	5.32	-			
14		2400	5.65	-			
15		2600	6.01	-			
16	Insertion Loss	2800	6.42	-	≤ 12.5	±0.12	
17		3000	6.76	-			
18		3300	7.12	-			
19		3600	7.53	-			
20		3900	7.95	-			
21		4200	8.32	-			
22		4500	8.72	-			
23		4800	9.14	-			
24		5100	9.59	-			
25		5400	10.00	-			
26		5700	10.49	-			
27		6000	11.07	-			
28		6500	11.80	-			