

TEST REPORT

ACCORDING TO: FCC CFR 47 PART 15 Subpart C, section 15.225 and subpart B

FOR:

On Track Innovations Ltd.

Card reader

Model:Saturn 6000

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1 Applicant information

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Telephone: +972 4686 8000
Fax: +972 4693 8887
E-mail: h_itay@otiglobal.com
Contact name: Mr. Hemy Itay

2 Equipment under test attributes

Product name: Card reader
Product type: Transceiver
Model(s): Saturn 6000
Serial number: 69300F0085V1.0A
Part number: 10069300F
Receipt date: 11/30/2006

3 Manufacturer information

Manufacturer name: On Track Innovations Ltd.
Address: P.O.B. 32, ZHR Industrial Zone, Rosh Pina 12000, Israel
Telephone: +972 4686 8000
Fax: +972 4693 8887
E-Mail: h_itay@otiglobal.com
Contact name: Mr. Hemy Itay




4 Test details

Project ID: 17560
Location: Hermon Laboratories Ltd. P.O.Box 23, Binyamina 30550, Israel
Test started: 11/30/2006
Test completed: 12/24/2006
Test specification(s): FCC Part 15, subpart C, §15.225; subpart B, §15.107, §15.109

5 Tests summary

Test	Status
Transmitter characteristics	
Sections 15.225(a) (b) (c), In band radiated emissions	Pass
Sections 15.225(d), Out of band radiated emissions	Pass
Section 15.225(e), Frequency stability	Pass
Section 15.207(a), Conducted emission	Pass
Unintentional emissions	
Section 15.107, Conducted emission at AC power port	Pass
Section 15.109, Radiated emission	Pass

Testing was completed against all relevant requirements of the test standard. The results obtained indicate that the product under test complies in full with the requirements tested.
The test results relate only to the items tested. Pass/ fail decision was based on nominal values.

	Name and Title	Date	Signature
Tested by:	Mr. P. Kagan, test engineer	December 24, 2006	
Reviewed by:	Mrs. M. Cherniavsky, certification engineer	January 8, 2007	
Approved by:	Mr. M. Nikishin, EMC and Radio group leader	January 9, 2007	

6 EUT description

6.1 General information

The product is a smart card reader designed for contactless (proximity transceiver 13.56 MHz) payment and loyalty applications. The device is powered from mains via AC/DC adapter.

6.2 Ports and lines

Port type	Port description	Connected		Connector type	Qty.	Cable type	Cable length	Indoor / outdoor
		From	To					
Signal	12 VDC+data	EUT	Connector	RS232+DC	1	shielded	0.8 m	Indoor
Signal	RS232	Connector	Laptop via RS232/USB adapter	D-type 9 pin	1	shielded	2 m	Indoor
Power	12 VDC	Connector	AC/DC adapter	DC jack	1	Unshielded	1 m	Indoor
Power	AC mains	AC/DC adapter	AC mains	IEC 60320	1	Unshielded	1 m	Indoor

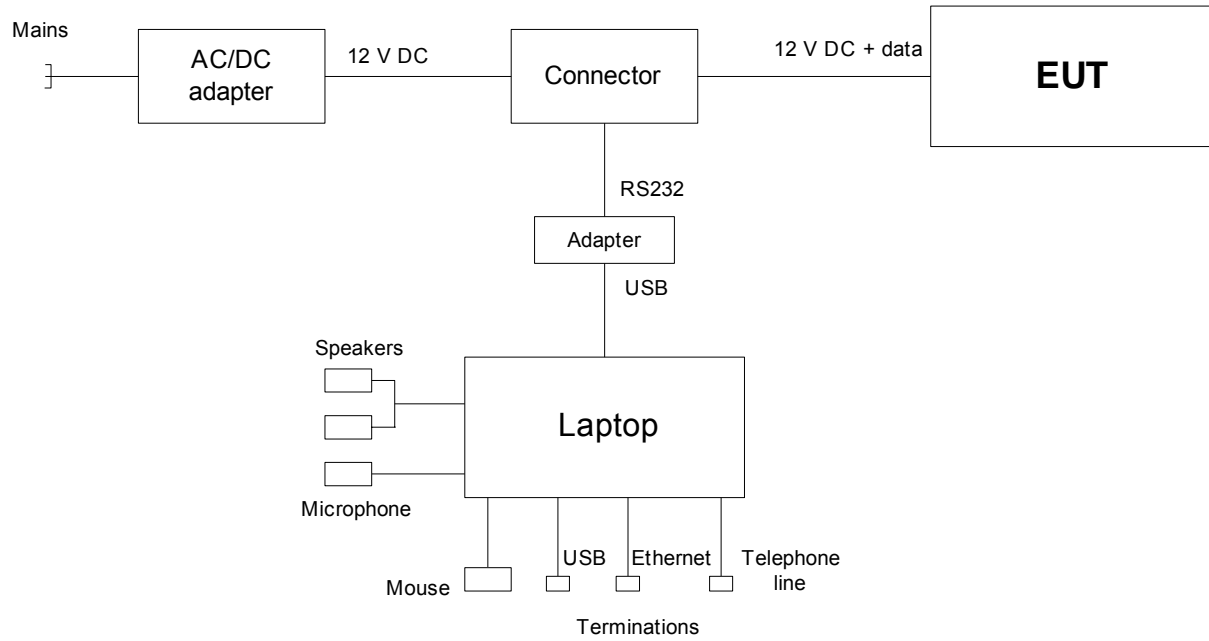
6.3 Support and test equipment

Description	Manufacturer	Model number	Serial number
Laptop	Dell	D420	JF945A01
AC/DC adapter	NA	MD242-120070	NA
Mouse	Microsoft	56180	X08-70400

6.4 Operating frequencies

Source	Frequency, MHz	
Radio portion	13.56	
Digital clock	4	24

6.5 Test configuration





6.6 Transmitter characteristics

Type of equipment					
V	Stand-alone (Equipment with or without its own control provisions)				
	Combined equipment (Equipment where the radio part is fully integrated within another type of equipment)				
	Plug-in card (Equipment intended for a variety of host systems)				
Intended use		Condition of use			
	Fixed	Always at a distance more than 2 m from all people			
V	mobile	Always at a distance more than 20 cm from all people			
	portable	May operate at a distance closer than 20 cm to human body			
Assigned frequency range		13.56 MHz			
Operating frequency range		13.56 MHz			
Maximum rated output power		Equivalent isotropically radiated power		0.002 mW	
Is transmitter output power variable?		V		No	
				continuous variable	
				stepped variable with stepsize	
				minimum RF power	
				maximum RF power	
Antenna connection					
V	unique coupling	standard connector	Integral	with temporary RF connector	
				without temporary RF connector	
Antenna/s technical characteristics					
Type	Manufacturer		Model number		Gain
Loop	On Track Innovations		NA		NA
Type of modulation			ASK		
Type of multiplexing			TDMA		
Transmitter duty cycle supplied for test			100%		
Transmitter power source					
	Battery	Nominal rated voltage		Battery type	
	DC	Nominal rated voltage			
V	AC mains	Nominal rated voltage	120 V	Frequency	60 Hz



Test specification:		Sections 15.225(a) (b) (c), In band radiated emissions	
Test procedure:		ANSI C63.4, Sections 5.3 and 13.1.4	
Test mode:	Compliance	Verdict:	PASS
Date & Time:	12/11/2006 8:40:31 AM		
Temperature: 22°C	Air Pressure: 1008 hPa	Relative Humidity: 48 %	Power Supply: 120 VAC
Remarks:			

7 Transmitter tests according to 47CFR part 15 subpart C requirements

7.1 In band radiated emissions

7.1.1 General

This test was performed to measure field strength of fundamental emission and modulation products from the EUT within the assigned band. Specification test limits are given in Table 7.1.1.

Table 7.1.1 Radiated emission limits

Frequency, MHz	Field strength at 30 m distance*		Field strength at 3 m distance*	
	$\mu\text{V/m}$	$\text{dB}(\mu\text{V/m})$	$\mu\text{V/m}$	$\text{dB}(\mu\text{V/m})^{**}$
13.110 – 13.410	106	40.5	10600	80.5
13.410 – 13.553	334	50.5	33400	90.5
13.553 – 13.567	15848	84.0	1584800	124.0
13.567 – 13.710	334	50.5	33400	90.5
13.710 – 14.010	106	40.5	10600	80.5

*- The limit is provided in quasi peak values.

** - The limit for 3 m test distance was calculated using the inverse square distance extrapolation factor as follows:

$$\text{Lim}_{S_2} = \text{Lim}_{S_1} + 40 \log(S_1/S_2),$$

where S_1 and S_2 – standard defined and test distance respectively in meters.

7.1.2 Test procedure

7.1.2.1 The EUT was set up as shown in Figure 7.1.1 energized and the performance check was conducted.

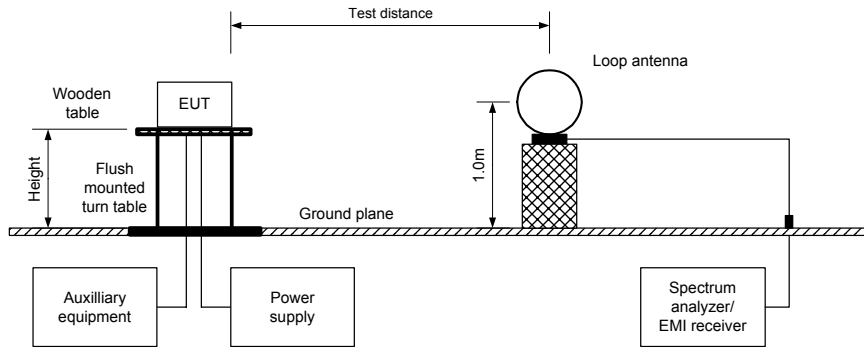
7.1.2.2 The specified frequency range was investigated with loop antenna connected to spectrum analyzer/ EMI receiver. To find maximum radiation the turntable was rotated 360° , the measuring antenna was rotated around its vertical axis and the measuring antenna polarization was switched from vertical to horizontal.

7.1.2.3 The worst test results (the lowest margins) were recorded in Table 7.1.2 and shown in the associated plots.



Test specification: Sections 15.225(a) (b) (c), In band radiated emissions			
Test procedure: ANSI C63.4, Sections 5.3 and 13.1.4			
Test mode: Compliance	Verdict: PASS		
Date & Time: 12/11/2006 8:40:31 AM			
Temperature: 22°C	Air Pressure: 1008 hPa	Relative Humidity: 48 %	Power Supply: 120 VAC
Remarks:			

Figure 7.1.1 Setup for in band radiated emission measurements



Test specification:		Sections 15.225(a) (b) (c), In band radiated emissions	
Test procedure:		ANSI C63.4, Sections 5.3 and 13.1.4	
Test mode:	Compliance	Verdict:	PASS
Date & Time:	12/11/2006 8:40:31 AM		
Temperature: 22°C	Air Pressure: 1008 hPa	Relative Humidity: 48 %	Power Supply: 120 VAC
Remarks:			

Table 7.1.2 In band radiated emission test results

TEST DISTANCE: 3 m
 EUT POSITION: Typical (Vertical)
 MODULATION: ASK
 MODULATING SIGNAL: ID code
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum
 INVESTIGATED FREQUENCY RANGE: 13.553 – 13.567 MHz
 RESOLUTION BANDWIDTH: 9.0 kHz
 VIDEO BANDWIDTH: 30.0 kHz

Frequency, MHz	Peak emission, dB(μV/m)	Quasi-peak			Antenna polarization	Azimuth**, degrees	Verdict
		Measured emission, dB(μV/m)	Limit, dB(μV/m)	Margin, dB*			
13.56	87.76	87.62	124	-36.38	v	5	Pass

*- Margin = Measured emission - specification limit.
 **- EUT front panel refer to 0 degrees position of turntable.

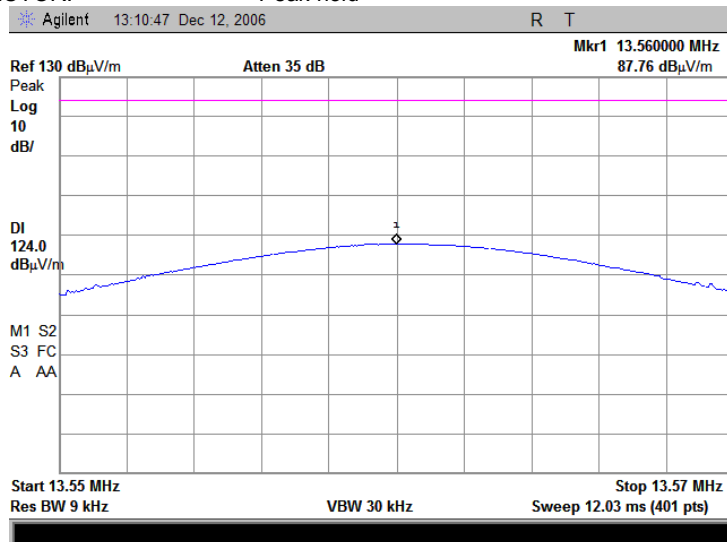
Reference numbers of test equipment used

HL 0446	HL 0521	HL 0569	HL 0589	HL 0593	HL 0594	HL 0604	HL 0784
HL 0813	HL 1424	HL 1430	HL 1552	HL 1848	HL 1947	HL 1984	HL 2009
HL 2259							

Full description is given in Appendix A.

Plot 7.1.1 In band radiated emission test results

TEST SITE: OATS
 TEST DISTANCE: 3 m
 DETECTOR: Peak hold



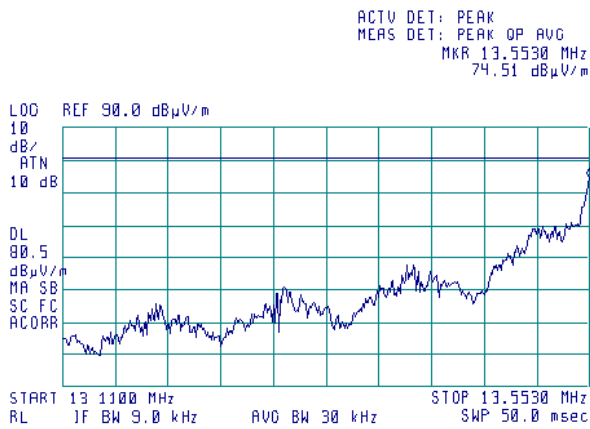


Test specification:	Sections 15.225(a) (b) (c), In band radiated emissions		
Test procedure:	ANSI C63.4, Sections 5.3 and 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	12/11/2006 8:40:31 AM		
Temperature: 22°C	Air Pressure: 1008 hPa	Relative Humidity: 48 %	Power Supply: 120 VAC
Remarks:			

Plot 7.1.2 In band radiated emission test results, low band edge

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
DETECTOR: Peak hold

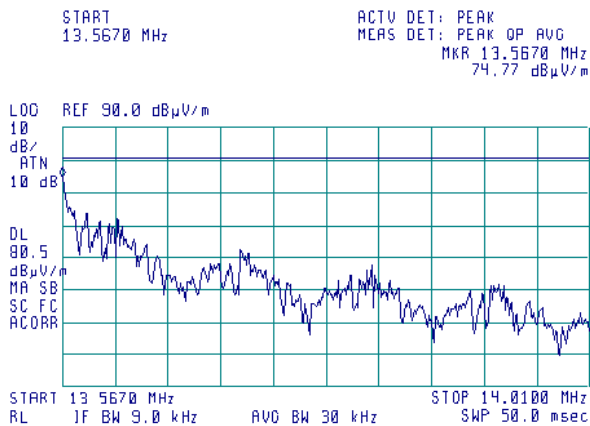
10:30:35 DEC 24, 2006



Plot 7.1.3 In band radiated emission test results, high band edge

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
DETECTOR: Peak hold

10:25:36 DEC 24, 2006





Test specification:	Sections 15.225(d), Out of band radiated emissions		
Test procedure:	ANSI C63.4, Sections 5.3 and 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	12/8/2006 12:36:34 PM		
Temperature: 22°C	Air Pressure: 1011 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks:			

7.2 Out of band radiated emissions

7.2.1 General

This test was performed to measure field strength of spurious emissions from the EUT. Specification test limits are given in Table 7.2.1.

Table 7.2.1 Radiated emission limits

Frequency, MHz	Field strength at 3 m within restricted bands, dB(μV/m)***		
	Peak	Quasi Peak	Average
0.009 – 0.090	148.5 – 128.5	NA	128.5 – 108.5**
0.090 – 0.110	NA	108.5 – 106.8**	NA
0.110 – 0.490	126.8 – 113.8	NA	106.8 – 93.8**
0.490 – 1.705	NA	73.8 – 63.0**	NA
1.705 – 30.0*		69.5**	
30 – 88		40.0	
88 – 216		43.5	
216 – 960		46.0	
960 - 1000		54.0	

*- The above field strength limits applied from the lowest radio frequency generated in the device, without going below 9 kHz up to the tenth harmonic of the highest fundamental frequency.

** - The limit for 3 m test distance was calculated using the inverse square distance extrapolation factor as follows:

$$\text{Lim}_{S_2} = \text{Lim}_{S_1} + 40 \log(S_1/S_2),$$

where S_1 and S_2 – standard defined and test distance respectively in meters.

*** - The limit decreases linearly with the logarithm of frequency.

7.2.2 Test procedure for spurious emission field strength measurements in 9 kHz to 30 MHz band

7.2.2.1 The EUT was set up as shown in Figure 7.2.1, energized and the performance check was conducted.

7.2.2.2 The specified frequency range was investigated with loop antenna connected to spectrum analyzer/ EMI receiver. To find maximum radiation the turntable was rotated 360°, the measuring antenna was rotated around its vertical axis and the measuring antenna polarization was switched from vertical to horizontal.

7.2.2.3 The worst test results (the lowest margins) were recorded in Table 7.2.2 and shown in the associated plots.

7.2.3 Test procedure for spurious emission field strength measurements above 30 MHz

7.2.3.1 The EUT was set up as shown in Figure 7.2.2, energized and the performance check was conducted.

7.2.3.2 The specified frequency range was investigated with antenna connected to spectrum analyzer/ EMI receiver. To find maximum radiation the turntable was rotated 360°, the measuring antenna height was changed from 1 to 4 m, its polarization was switched from vertical to horizontal.

7.2.3.3 The worst test results (the lowest margins) were recorded in Table 7.2.2 and shown in the associated plots.

Test specification: Sections 15.225(d), Out of band radiated emissions			
Test procedure: ANSI C63.4, Sections 5.3 and 13.1.4			
Test mode: Compliance	Verdict: PASS		
Date & Time: 12/8/2006 12:36:34 PM			
Temperature: 22°C	Air Pressure: 1011 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks:			

Figure 7.2.1 Radiated emissions below 30 MHz test set up

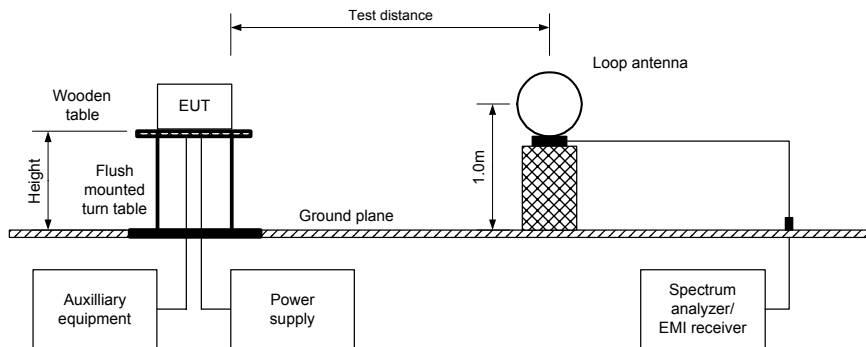
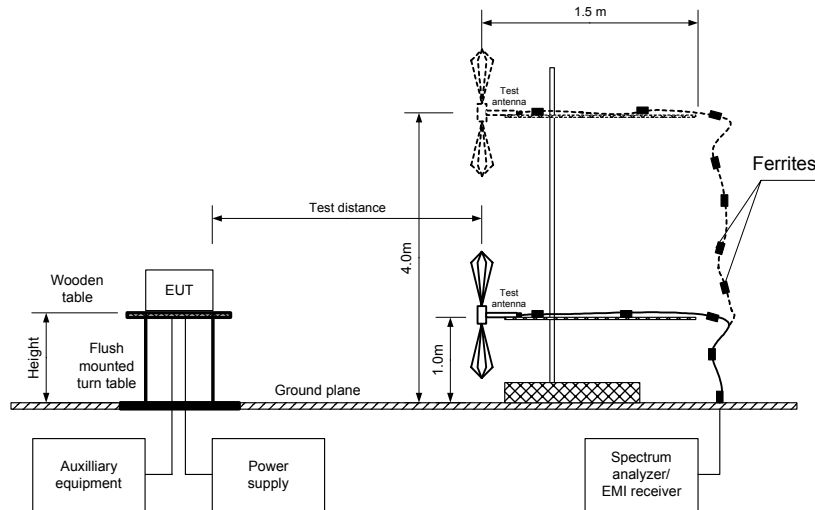


Figure 7.2.2 Radiated emissions above 30 MHz test set up





Test specification:	Sections 15.225(d), Out of band radiated emissions		
Test procedure:	ANSI C63.4, Sections 5.3 and 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	12/8/2006 12:36:34 PM		
Temperature: 22°C	Air Pressure: 1011 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks:			

Table 7.2.2 Out of band radiated emissions test results

TEST DISTANCE: 10 m
EUT POSITION: Typical (Vertical)
MODULATION: ASK
MODULATING SIGNAL: ID code
TRANSMITTER OUTPUT POWER SETTINGS: Maximum
INVESTIGATED FREQUENCY RANGE: 0.009 – 1000 MHz
RESOLUTION BANDWIDTH: 1 kHz (9 kHz – 150 kHz)
9.0 kHz (150 kHz – 30 MHz)
120 kHz (30 MHz – 1000 MHz)
VIDEO BANDWIDTH: ≥ Resolution bandwidth
TEST ANTENNA TYPE: Active loop (9 kHz – 30 MHz)
Biconical (30 MHz – 200 MHz)
Log periodic (200 MHz – 1000 MHz)
Biconilog (30 MHz – 1000 MHz)

Frequency, MHz	Peak emission, dB(μV/m)	Quasi-peak			Antenna polarization	Antenna height, m	Turn-table position**, degrees	Verdict
		Measured emission, dB(μV/m)	Limit, dB(μV/m)	Margin, dB*				
40.680000	29.11	26.61	29.50	-2.89	V	1	180	Pass
365.315000	24.25	22.10	35.50	-13.40	V	1	180	
431.983500	32.93	29.56	35.50	-5.94	V	1	180	
499.395000	22.94	20.37	35.50	-15.13	V	1	180	
566.045000	32.49	28.36	35.50	-7.14	V	1	180	
699.079600	30.11	25.94	35.50	-9.56	V	1	180	
40.680000	29.11	26.61	29.50	-2.89	V	1	180	

*- Margin = Measured emission - specification limit.

** - EUT front panel refer to 0 degrees position of turntable.

Reference numbers of test equipment used

HL 0446	HL 0521	HL 0569	HL 0589	HL 0593	HL 0594	HL 0604	HL 0813
HL 1424	HL 1430	HL 1552	HL 1848	HL 1947	HL 1984	HL 2009	HL 2697

Full description is given in Appendix A.



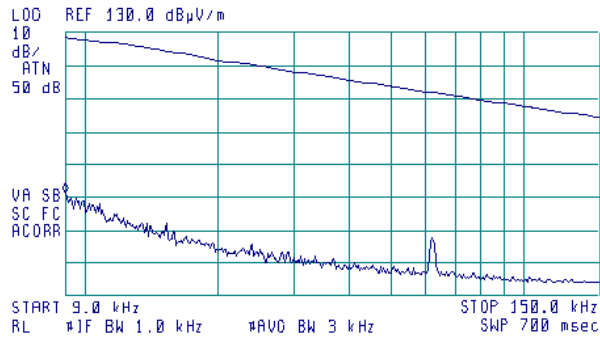
Test specification: Sections 15.225(d), Out of band radiated emissions			
Test procedure: ANSI C63.4, Sections 5.3 and 13.1.4			
Test mode: Compliance	Verdict: PASS		
Date & Time: 12/8/2006 12:36:34 PM			
Temperature: 22°C	Air Pressure: 1011 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks:			

Plot 7.2.1 Radiated emission measurements from 9 to 150 kHz

TEST SITE: Anechoic chamber
 TEST DISTANCE: 3 m
 ANTENNA POLARIZATION: Vertical
 DETECTOR: Peak hold

16:54:03 11 DEC 2006
 CMD ERR: MIDEFNTP]:

ACTV DET: PEAK
 MEAS DET: PEAK OP AVG
 MKR 9.0 kHz
 61.51 dBµV/m

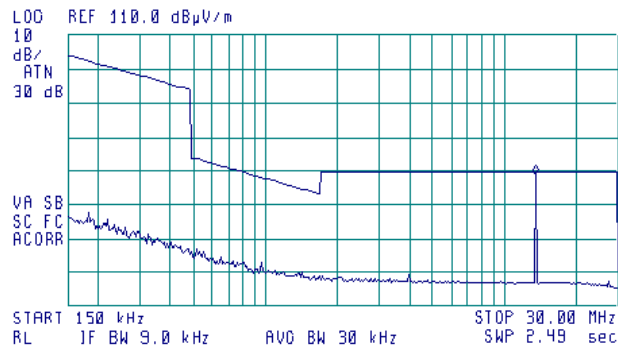


Plot 7.2.2 Radiated emission measurements from 0.15 to 30 MHz

TEST SITE: Anechoic chamber
 TEST DISTANCE: 3 m
 ANTENNA POLARIZATION: Vertical
 DETECTOR: Peak hold

16:49:04 11 DEC 2006
 CMD ERR: MIDEFNTP]:

ACTV DET: PEAK
 MEAS DET: PEAK OP AVG
 MKR 13.53 MHz
 68.72 dBµV/m



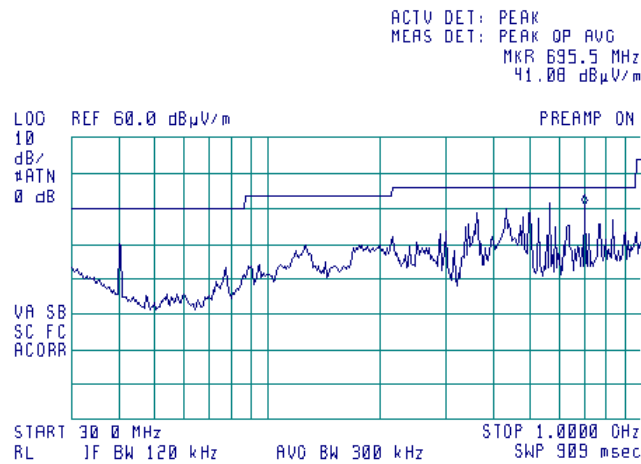


Test specification: Sections 15.225(d), Out of band radiated emissions			
Test procedure: ANSI C63.4, Sections 5.3 and 13.1.4			
Test mode: Compliance	Verdict: PASS		
Date & Time: 12/8/2006 12:36:34 PM			
Temperature: 22°C	Air Pressure: 1011 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks:			

Plot 7.2.3 Radiated emission measurements from 30 to 1000 MHz

TEST SITE: Anechoic chamber
 TEST DISTANCE: 3 m
 ANTENNA POLARIZATION: Vertical
 DETECTOR: Peak hold

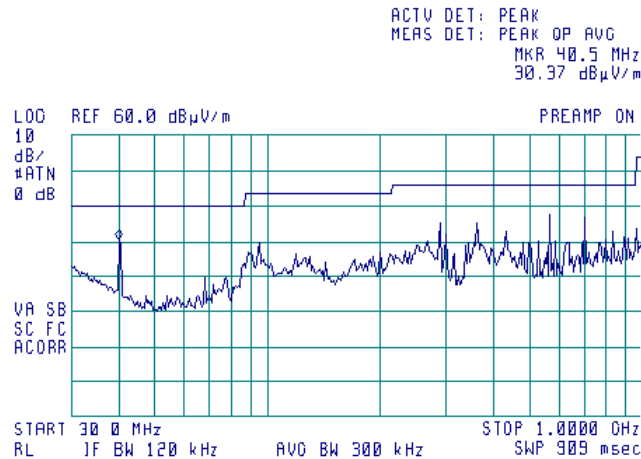
13:03:40 08 DEC 2006



Plot 7.2.4 Radiated emission measurements from 30 to 1000 MHz

TEST SITE: Anechoic chamber
 TEST DISTANCE: 3 m
 ANTENNA POLARIZATION: Horizontal
 DETECTOR: Peak hold

13:09:51 08 DEC 2006



Test specification:		Section 15.225(e), Frequency stability	
Test procedure:		ANSI C63.4, Section 13.1.6	
Test mode:	Compliance	Verdict:	PASS
Date & Time:	12/17/2006 11:47:40 AM		
Temperature: 21°C	Air Pressure: 1012 hPa	Relative Humidity: 39 %	Power Supply: 120 VAC
Remarks:			

7.3 Frequency stability test

7.3.1 General

This test was performed to measure frequency stability of transmitter RF carrier. Specification test limits are given in Table 7.3.1.

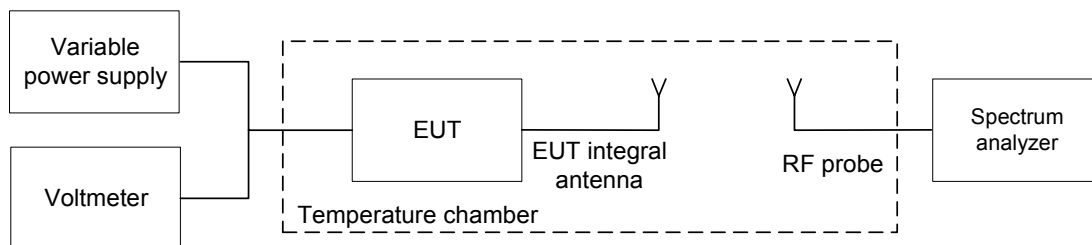
Table 7.3.1 Frequency stability limits

Assigned frequency, MHz	Maximum allowed frequency displacement	
	%	Hz
13.560	± 0.01 %	1356

7.3.2 Test procedure

- 7.3.2.1 The EUT was set up as shown in Figure 7.3.1, energized and its proper operation was checked.
- 7.3.2.2 The EUT power was turned off. Temperature within test chamber was set to the required one and a period of time sufficient to stabilize all of the oscillator circuit components was allowed.
- 7.3.2.3 The EUT was powered on and carrier frequency was measured at start up moment and then after 2, 5 and 10 minutes. The EUT was powered off.
- 7.3.2.4 The above procedure was repeated at the rest of the test temperatures and voltages as provided in Table 7.3.2.
- 7.3.2.5 Frequency displacement was calculated and compared with the limit as provided in Table 7.3.2.

Figure 7.3.1 Frequency stability test setup





Test specification: Section 15.225(e), Frequency stability			
Test procedure: ANSI C63.4, Section 13.1.6			
Test mode: Compliance	Verdict: PASS		
Date & Time: 12/17/2006 11:47:40 AM			
Temperature: 21°C	Air Pressure: 1012 hPa	Relative Humidity: 39 %	Power Supply: 120 VAC
Remarks:			

Table 7.3.2 Frequency stability test results

OPERATING FREQUENCY: 13.560 MHz
 NOMINAL POWER VOLTAGE: 120V
 TEMPERATURE STABILIZATION PERIOD: 20 min
 POWER DURING TEMPERATURE TRANSITION: Off
 SPECTRUM ANALYZER MODE: Counter
 RESOLUTION BANDWIDTH: 100 Hz
 VIDEO BANDWIDTH: 3000 Hz
 MODULATION: Unmodulated

Temperature, °C	Voltage, V	Frequency, MHz				Max frequency drift, Hz		Limit, Hz	Margin, Hz	Verdict
		Start up	2 nd min	5 th min	10 th min	Positive	Negative			
-20	nominal	13.560194	13.560229	13.560230	13.560225	99	0	1356	1257	Pass
20	nominal +15%	13.560194	13.560156	13.560139	13.560131	63	0		1293	
20	nominal	13.560189	13.560154	13.560142	13.560131*	58	0		1298	
20	nominal -15%	13.560189	13.560153	13.560137	13.560131	58	0		1298	
50	nominal	13.560136	13.560131	13.560144	13.560163	32	0		1324	

* - Reference frequency

Reference numbers of test equipment used

HL 0337	HL 0495	HL 0892	HL 2004	HL 3001			
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Full description is given in Appendix A.



Test specification:	Section 15.207(a), Conducted emission		
Test procedure:	ANSI C63.4, Section 13.1.3		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	12/19/2006 11:36:19 AM		
Temperature: 22 °C	Air Pressure: 1007 hPa	Relative Humidity: 42 %	Power Supply: 120 VAC
Remarks:			

7.4 Conducted emissions

7.4.1 General

This test was performed to measure common mode conducted emissions at the power port. Specification test limits are given in Table 7.4.1.

Table 7.4.1 Limits for conducted emissions

Frequency, MHz	Class B limit, dB(μ V)	
	QP	AVRG
0.15 - 0.5	66 - 56*	56 - 46*
0.5 - 5.0	56	46
5.0 - 30	60	50

* The limit decreases linearly with the logarithm of frequency.

7.4.2 Test procedure

7.4.2.1 The EUT was set up as shown in Figure 7.4.1, energized and the performance check was conducted.

7.4.2.2 The measurements were performed at power terminals with the LISN, connected to a spectrum analyzer in the frequency range referred to in Table 7.4.2. Unused coaxial connector of the LISN was terminated with 50 Ohm. Quasi-peak and average detectors were used throughout the testing.

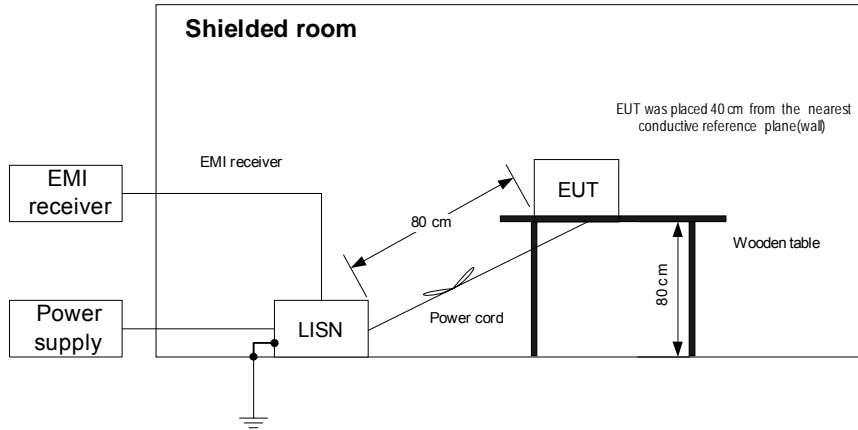
7.4.2.3 The position of the device cables was varied to determine maximum emission level.

7.4.2.4 The worst test results (the lowest margins) were recorded in Table 7.4.2 and shown in the associated plots.



Test specification:	Section 15.207(a), Conducted emission		
Test procedure:	ANSI C63.4, Section 13.1.3		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	12/19/2006 11:36:19 AM		
Temperature: 22 °C	Air Pressure: 1007 hPa	Relative Humidity: 42 %	Power Supply: 120 VAC
Remarks:			

Figure 7.4.1 Setup for conducted emission measurements, table-top equipment





Test specification:	Section 15.207(a), Conducted emission		
Test procedure:	ANSI C63.4, Section 13.1.3		
Test mode:	Compliance	Verdict: PASS	
Date & Time:	12/19/2006 11:36:19 AM		
Temperature: 22 °C	Air Pressure: 1007 hPa	Relative Humidity: 42 %	Power Supply: 120 VAC
Remarks:			

Table 7.4.2 Conducted emission test results at the EUT power ports

LINE: AC mains
EUT OPERATING MODE: Transmit
EUT SET UP: TABLE-TOP
TEST SITE: SHIELDED ROOM
DETECTORS USED: PEAK / QUASI-PEAK / AVERAGE
FREQUENCY RANGE: 150 kHz - 30 MHz
RESOLUTION BANDWIDTH: 9 kHz

Frequency, MHz	Peak emission, dB(μV)	Quasi-peak			Average			Line ID	Verdict
		Measured emission, dB(μV)	Limit, dB(μV)	Margin, dB*	Measured emission, dB(μV)	Limit, dB(μV)	Margin, dB*		
0.167849	56.03	49.65	65.13	-15.48	18.33	55.13	-36.80	L1	Pass
0.198388	55.16	48.83	63.72	-14.89	17.77	53.72	-35.95		
0.239433	53.97	47.58	62.14	-14.56	16.25	52.14	-35.89		
0.258190	53.81	47.15	61.54	-14.39	15.83	51.54	-35.71		
0.267529	53.58	46.89	61.26	-14.37	15.59	51.26	-35.67		
0.338040	52.08	45.14	59.31	-14.17	14.04	49.31	-35.27		
0.455579	49.76	42.44	56.83	-14.39	12.04	46.83	-34.79		
0.513026	48.31	40.85	56.00	-15.15	10.34	46.00	-35.66		
0.545182	47.13	39.64	56.00	-16.36	9.31	46.00	-36.69		
0.178353	56.65	49.46	64.62	-15.16	18.34	54.62	-36.28		
0.254357	54.98	47.27	61.66	-14.39	16.15	51.66	-35.51		
0.291430	53.81	46.22	60.53	-14.31	15.17	50.53	-35.36		
0.333674	53.20	45.70	59.41	-13.71	14.58	49.41	-34.83		
0.361519	53.04	45.24	58.75	-13.51	14.15	48.75	-34.60		
0.381943	52.59	44.72	58.26	-13.54	13.43	48.26	-34.83		
0.409294	52.13	43.97	57.70	-13.73	12.82	47.70	-34.88		
0.417641	52.18	43.95	57.54	-13.59	12.86	47.54	-34.68		
0.437218	51.84	43.63	57.17	-13.54	12.58	47.17	-34.59		
0.469542	51.40	42.97	56.57	-13.60	11.77	46.57	-34.80		
0.520888	50.13	41.67	56.00	-14.33	10.94	46.00	-35.06		

*- Margin = Measured emission - specification limit.



Test specification: Section 15.207(a), Conducted emission			
Test procedure: ANSI C63.4, Section 13.1.3			
Test mode: Compliance	Verdict: PASS		
Date & Time: 12/19/2006 11:36:19 AM			
Temperature: 22 °C	Air Pressure: 1007 hPa	Relative Humidity: 42 %	Power Supply: 120 VAC
Remarks:			

Table 7.4.3 Conducted emission test results at the laptop power ports

LINE: AC mains
EUT OPERATING MODE: Transmit
EUT SET UP: TABLE-TOP
TEST SITE: SHIELDED ROOM
DETECTORS USED: PEAK / QUASI-PEAK / AVERAGE
FREQUENCY RANGE: 150 kHz - 30 MHz
RESOLUTION BANDWIDTH: 9 kHz

Frequency, MHz	Peak emission, dB(μV)	Quasi-peak			Average			Line ID	Verdict
		Measured emission, dB(μV)	Limit, dB(μV)	Margin, dB*	Measured emission, dB(μV)	Limit, dB(μV)	Margin, dB*		
0.151065	56.02	43.86	65.95	-22.09	17.51	55.95	-38.44	L1	Pass
0.171878	53.22	39.89	64.93	-25.04	11.47	54.93	-43.46		
0.194802	51.61	49.11	63.85	-14.74	39.22	53.85	-14.63		
0.201462	52.40	47.11	63.60	-16.49	37.15	53.60	-16.45		
0.223112	44.77	34.85	62.76	-27.91	6.32	52.76	-46.44		
0.152713	54.49	44.62	65.87	-21.25	15.33	55.87	-40.54	L2	Pass
0.175258	51.47	40.72	64.77	-24.05	12.23	54.77	-42.54		
0.198149	55.78	51.57	63.73	-12.16	42.01	53.73	-11.72		
0.219550	48.87	34.51	62.90	-28.39	7.90	52.90	-45.00		
0.264523	47.29	42.09	61.35	-19.26	33.33	51.35	-18.02		

*- Margin = Measured emission - specification limit.

Reference numbers of test equipment used

HL 0163	HL 0447	HL 0787	HL 1430	HL 1502	HL 1510		
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Full description is given in Appendix A.



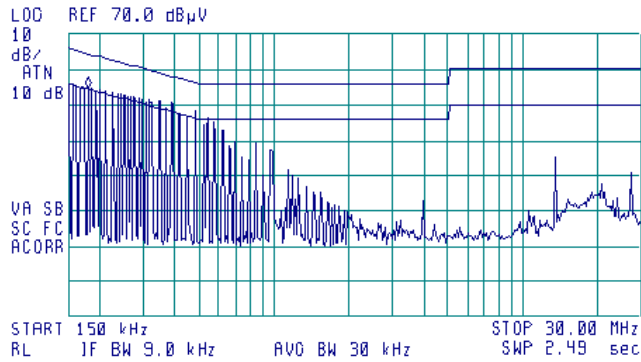
Test specification: Section 15.207(a), Conducted emission			
Test procedure: ANSI C63.4, Section 13.1.3			
Test mode: Compliance	Verdict: PASS		
Date & Time: 12/19/2006 11:36:19 AM			
Temperature: 22 °C	Air Pressure: 1007 hPa	Relative Humidity: 42 %	Power Supply: 120 VAC
Remarks:			

Plot 7.4.1 Conducted emission measurements at the EUT power ports

LINE: L1
 EUT OPERATING MODE: Transmit
 LIMIT: QUASI-PEAK, AVERAGE
 DETECTOR: PEAK

10:08:15 DEC 19, 2006

ACTV DET: PEAK
 MEAS DET: PEAK OP AVG
 MKR 100 kHz
 54.84 dBµV

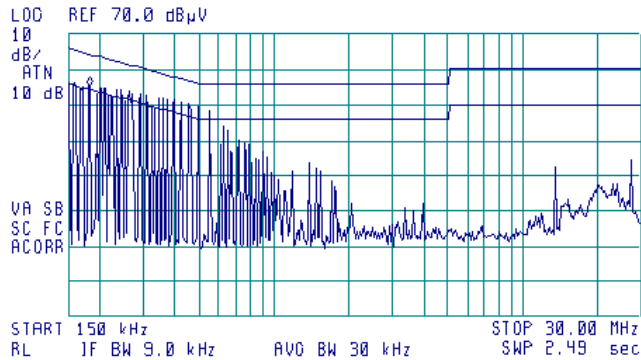


Plot 7.4.2 Conducted emission measurements at the EUT power ports

LINE: L2
 EUT OPERATING MODE: Transmit
 LIMIT: QUASI-PEAK, AVERAGE
 DETECTOR: PEAK

09:56:00 DEC 19, 2006

ACTV DET: PEAK
 MEAS DET: PEAK OP AVG
 MKR 100 kHz
 55.19 dBµV





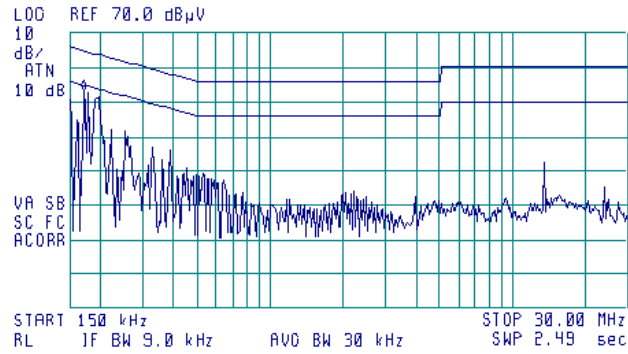
Test specification: Section 15.207(a), Conducted emission			
Test procedure: ANSI C63.4, Section 13.1.3			
Test mode: Compliance	Verdict: PASS		
Date & Time: 12/19/2006 11:36:19 AM			
Temperature: 22 °C	Air Pressure: 1007 hPa	Relative Humidity: 42 %	Power Supply: 120 VAC
Remarks:			

Plot 7.4.3 Conducted emission measurements at the laptop power ports

LINE: L1
EUT OPERATING MODE: Transmit
LIMIT: QUASI-PEAK, AVERAGE
DETECTOR: PEAK

10:18:36 DEC 19, 2006

ACTV DET: PEAK
MERS DET: PEAK OP AVG
MKR 170 kHz
53.31 dBµV

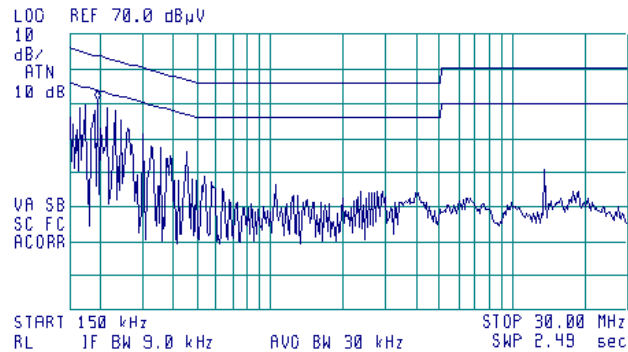


Plot 7.4.4 Conducted emission measurements at the laptop power ports

LINE: L2
EUT OPERATING MODE: Transmit
LIMIT: QUASI-PEAK, AVERAGE
DETECTOR: PEAK

10:23:47 DEC 19, 2006

ACTV DET: PEAK
MERS DET: PEAK OP AVG
MKR 200 kHz
51.16 dBµV





Test specification:		Section 15.107, Conducted emission at AC power port	
Test procedure:		ANSI C63.4, Sections 11.5 and 12.1.3	
Test mode:	Compliance	Verdict:	PASS
Date & Time:	12/19/2006 11:31:19 AM		
Temperature: 22 °C	Air Pressure: 1007 hPa	Relative Humidity: 42 %	Power Supply: 120 VAC
Remarks:			

8 Emission tests according to 47CFR part 15 subpart B requirements

8.1 Conducted emissions

8.1.1 General

This test was performed to measure common mode conducted emissions at the mains power port. Specification test limits are given in Table 8.1.1.

Table 8.1.1 Limits for conducted emissions

Frequency, MHz	Class B limit, dB(μ V)		Class A limit, dB(μ V)	
	QP	AVRG	QP	AVRG
0.15 - 0.5	66 - 56*	56 - 46*	79	66
0.5 - 5.0	56	46	73	60
5.0 - 30	60	50	73	60

* The limit decreases linearly with the logarithm of frequency.

8.1.2 Test procedure

8.1.2.1 The EUT was set up as shown in Figure 8.1.1, energized and the performance check was conducted.

8.1.2.2 The measurements were performed at power terminals with the LISN, connected to a spectrum analyzer in the frequency range referred to in Table 8.1.2. Unused coaxial connector of the LISN was terminated with 50 Ohm. Quasi-peak and average detectors were used throughout the testing.

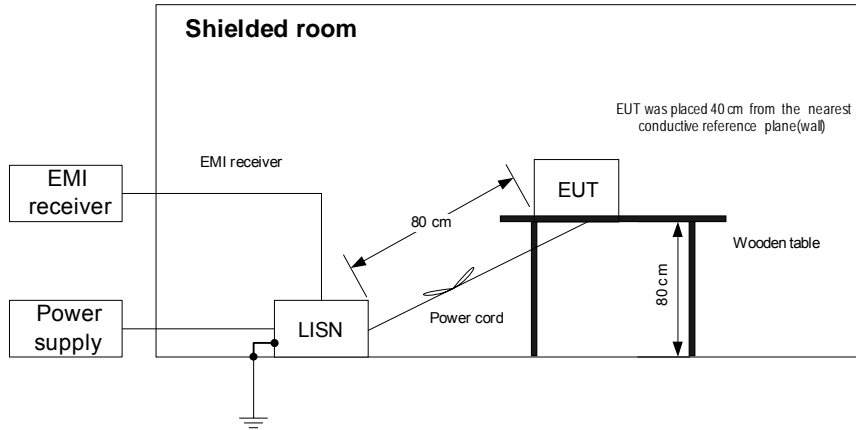
8.1.2.3 The position of the device cables was varied to determine maximum emission level.

8.1.2.4 The worst test results (the lowest margins) were recorded in Table 8.1.2 and shown in the associated plots.



Test specification:	Section 15.107, Conducted emission at AC power port		
Test procedure:	ANSI C63.4, Sections 11.5 and 12.1.3		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	12/19/2006 11:31:19 AM		
Temperature: 22 °C	Air Pressure: 1007 hPa	Relative Humidity: 42 %	Power Supply: 120 VAC
Remarks:			

Figure 8.1.1 Setup for conducted emission measurements, table-top equipment





Test specification: Section 15.107, Conducted emission at AC power port	
Test procedure: ANSI C63.4, Sections 11.5 and 12.1.3	
Test mode: Compliance	Verdict: PASS
Date & Time: 12/19/2006 11:31:19 AM	
Temperature: 22 °C	Air Pressure: 1007 hPa
Relative Humidity: 42 %	
Power Supply: 120 VAC	
Remarks:	

Table 8.1.2 Conducted emission test results at the EUT power ports

LINE: AC mains
 LIMIT: Class B
 EUT OPERATING MODE: Receive / Stand-by
 EUT SET UP: TABLE-TOP
 TEST SITE: SHIELDED ROOM
 DETECTORS USED: PEAK / QUASI-PEAK / AVERAGE
 FREQUENCY RANGE: 150 kHz - 30 MHz
 RESOLUTION BANDWIDTH: 9 kHz

Frequency, MHz	Peak emission, dB(μV)	Quasi-peak			Average			Line ID	Verdict
		Measured emission, dB(μV)	Limit, dB(μV)	Margin, dB*	Measured emission, dB(μV)	Limit, dB(μV)	Margin, dB*		
0.160143	53.67	47.27	65.51	-18.24	16.12	55.51	-39.39	L1	Pass
0.171299	53.49	46.95	64.96	-18.01	15.77	54.96	-39.19		
0.216945	52.08	45.72	63.00	-17.28	14.94	53.00	-38.06		
0.283328	50.94	44.36	60.78	-16.42	13.24	50.78	-37.54		
0.334514	49.76	42.71	59.39	-16.68	12.13	49.39	-37.26		
0.378749	49.19	41.83	58.34	-16.51	11.37	48.34	-36.97		
0.412285	48.26	40.91	57.64	-16.73	10.46	47.64	-37.18		
0.468648	47.06	39.63	56.59	-16.96	9.33	46.59	-37.26		
0.156794	54.69	47.67	65.67	-18.00	16.63	55.67	-39.04		
0.204679	53.45	46.37	63.47	-17.10	15.20	53.47	-38.27		
0.233135	52.67	45.50	62.38	-16.88	14.28	52.38	-38.10		
0.263044	52.00	44.58	61.39	-16.81	13.94	51.39	-37.45		
0.336474	50.47	42.95	59.35	-16.40	12.31	49.35	-37.04		
0.369690	49.64	42.09	58.56	-16.47	11.46	48.56	-37.10		
0.477388	48.09	39.77	56.42	-16.65	9.45	46.42	-36.97		
0.519263	47.51	38.91	56.00	-17.09	8.61	46.00	-37.39		

*- Margin = Measured emission - specification limit.



Test specification: Section 15.107, Conducted emission at AC power port	
Test procedure: ANSI C63.4, Sections 11.5 and 12.1.3	
Test mode: Compliance	Verdict: PASS
Date & Time: 12/19/2006 11:31:19 AM	
Temperature: 22 °C	Air Pressure: 1007 hPa
Relative Humidity: 42 %	
Power Supply: 120 VAC	
Remarks:	

Table 8.1.3 Conducted emission test results at the laptop power ports

LINE: AC mains
EUT OPERATING MODE: Receive / Stand-by
EUT SET UP: TABLE-TOP
TEST SITE: SHIELDED ROOM
DETECTORS USED: PEAK / QUASI-PEAK / AVERAGE
FREQUENCY RANGE: 150 kHz - 30 MHz
RESOLUTION BANDWIDTH: 9 kHz

Frequency, MHz	Peak emission, dB(μV)	Quasi-peak			Average			Line ID	Verdict
		Measured emission, dB(μV)	Limit, dB(μV)	Margin, dB*	Measured emission, dB(μV)	Limit, dB(μV)	Margin, dB*		
0.152620	57.50	41.48	65.87	-24.39	15.72	55.87	-40.15	L1	Pass
0.176112	53.32	36.98	64.73	-27.75	11.30	54.73	-43.43		
0.196168	53.00	51.89	63.80	-11.91	41.97	53.80	-11.83		
0.325256	42.40	34.69	59.61	-24.92	25.00	49.61	-24.61		
0.157366	56.26	41.93	65.64	-23.71	14.48	55.64	-41.16	L2	Pass
0.188032	55.59	39.60	64.14	-24.54	24.43	54.14	-29.71		
0.192231	54.92	44.22	63.95	-19.73	34.63	53.95	-19.32		
0.262143	47.36	42.47	61.42	-18.95	33.68	51.42	-17.74		
0.328696	39.60	37.28	59.53	-22.25	29.24	49.53	-20.29		

*- Margin = Measured emission - specification limit.

Reference numbers of test equipment used

HL 0163	HL 0447	HL 0787	HL 1430	HL 1502	HL 1510		
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Full description is given in Appendix A.

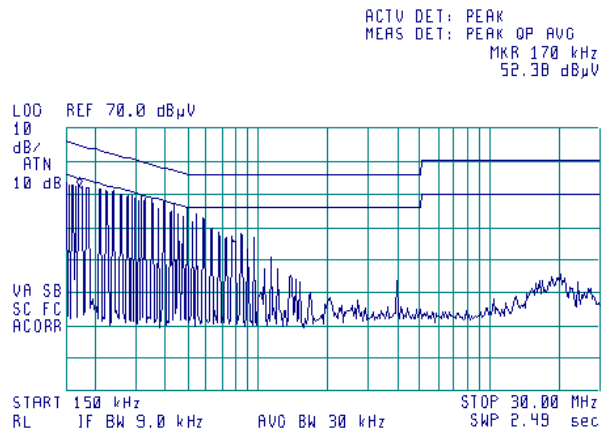


Test specification: Section 15.107, Conducted emission at AC power port			
Test procedure: ANSI C63.4, Sections 11.5 and 12.1.3			
Test mode: Compliance	Verdict: PASS		
Date & Time: 12/19/2006 11:31:19 AM			
Temperature: 22 °C	Air Pressure: 1007 hPa	Relative Humidity: 42 %	Power Supply: 120 VAC
Remarks:			

Plot 8.1.1 Conducted emission measurements at the EUT power ports

LINE: L1
LIMIT: Class B
EUT OPERATING MODE: Receive / Stand-by
LIMIT: QUASI-PEAK, AVERAGE
DETECTOR: PEAK

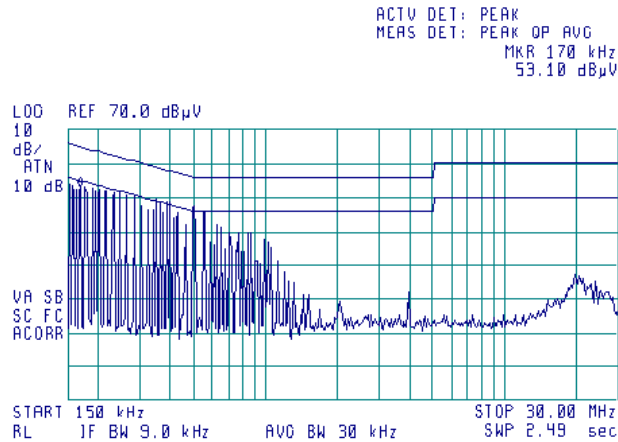
11:04:43 DEC 19, 2006



Plot 8.1.2 Conducted emission measurements at the EUT power ports

LINE: L2
LIMIT: Class B
EUT OPERATING MODE: Receive / Stand-by
LIMIT: QUASI-PEAK, AVERAGE
DETECTOR: PEAK

11:12:30 DEC 19, 2006



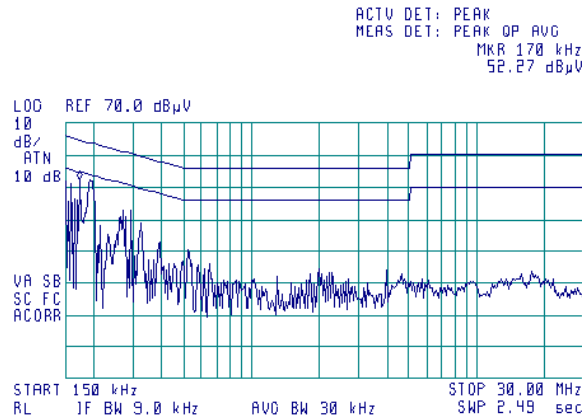


Test specification: Section 15.107, Conducted emission at AC power port			
Test procedure: ANSI C63.4, Sections 11.5 and 12.1.3			
Test mode: Compliance	Verdict: PASS		
Date & Time: 12/19/2006 11:31:19 AM			
Temperature: 22 °C	Air Pressure: 1007 hPa	Relative Humidity: 42 %	Power Supply: 120 VAC
Remarks:			

Plot 8.1.3 Conducted emission measurements at the laptop power ports

LINE: L1
LIMIT: Class B
EUT OPERATING MODE: Receive / Stand-by
LIMIT: QUASI-PEAK, AVERAGE
DETECTOR: PEAK

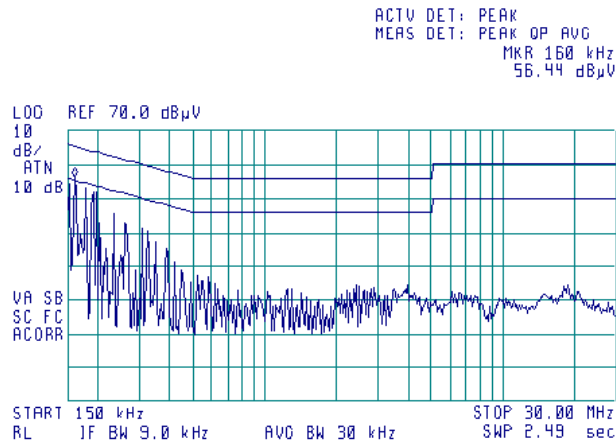
10:59:14 DEC 19, 2006



Plot 8.1.4 Conducted emission measurements at the laptop power ports

LINE: L2
LIMIT: Class B
EUT OPERATING MODE: Receive / Stand-by
LIMIT: QUASI-PEAK, AVERAGE
DETECTOR: PEAK

10:47:59 DEC 19, 2006



Test specification:	Section 15.109, Radiated emission		
Test procedure:	ANSI C63.4, Sections 11.6 and 12.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	12/8/2006 12:53:38 PM		
Temperature: 22°C	Air Pressure: 1011 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks:			

8.2 Radiated emission measurements

8.2.1 General

This test was performed to measure radiated emissions from the EUT enclosure. Specification test limits are given in Table 8.2.1.

Table 8.2.1 Radiated emission test limits

Frequency, MHz	Class B limit, dB(μV/m)		Class A limit, dB(μV/m)	
	10 m distance	3 m distance	10 m distance	3 m distance
30 - 88	29.5*	40.0	39.0	49.5*
88 - 216	33.0*	43.5	43.5	54.0*
216 - 960	35.5*	46.0	46.4	56.9*
Above 960	43.5*	54.0	49.5	60.0*

* The limit for test distance other than specified was calculated using the inverse linear distance extrapolation factor as follows: $\text{Lim}_{S_2} = \text{Lim}_{S_1} + 20 \log(S_1/S_2)$, where S_1 and S_2 – standard defined and test distance respectively in meters.

8.2.2 Test procedure for measurements in semi-anechoic chamber

- 8.2.2.1 The EUT was set up as shown in Figure 8.2.1, energized and the performance check was conducted.
- 8.2.2.2 The specified frequency range was investigated with biconilog antenna connected to EMI receiver. To find maximum radiation the turntable was rotated 360°, the measuring antenna height was changed from 1 to 4 m, its polarization was switched from vertical to horizontal and the EUT cables position was varied.
- 8.2.2.3 The worst test results (the lowest margins) were recorded in Table 8.2.2 and shown in the associated plots.

8.2.3 Test procedure for measurements at OATS

- 8.2.3.1 The EUT was set up as shown in Figure 8.2.1, energized and the performance check was conducted.
- 8.2.3.2 Preliminary measurements were performed in the anechoic chamber at 3 m test distance. The specified frequency range was investigated with biconical and log periodic antennas connected to EMI receiver. To find maximum radiation the turntable was rotated 360°, the measuring antenna height was changed, its polarization was switched from vertical to horizontal and the EUT cables position was varied.
- 8.2.3.3 The EUT was set up as shown in Figure 8.2.2, energized and the performance check was conducted.
- 8.2.3.4 Final measurements were performed at the open area test site at 10 m test distance. The EUT wires and cables were arranged to produce maximum emission as it was found during preliminary measurements. The frequencies yield the worst test results (the lowest margins) during preliminary testing were investigated with biconilog antenna connected to EMI receiver. To find maximum radiation the turntable was rotated 360°, the measuring antenna height was changed from 1 to 4 m and its polarization was changed from vertical to horizontal. At frequencies where high ambient noise was encountered, the final measurements were taken in the anechoic chamber at 3 m distance.
- 8.2.3.5 The worst test results (the lowest margins) were recorded in Table 8.2.2 and shown in the associated plots.

Test specification: Section 15.109, Radiated emission			
Test procedure: ANSI C63.4, Sections 11.6 and 12.1.4			
Test mode: Compliance		Verdict: PASS	
Date & Time: 12/8/2006 12:53:38 PM			
Temperature: 22°C	Air Pressure: 1011 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks:			

Figure 8.2.1 Setup for radiated emission measurements in anechoic chamber, table-top equipment

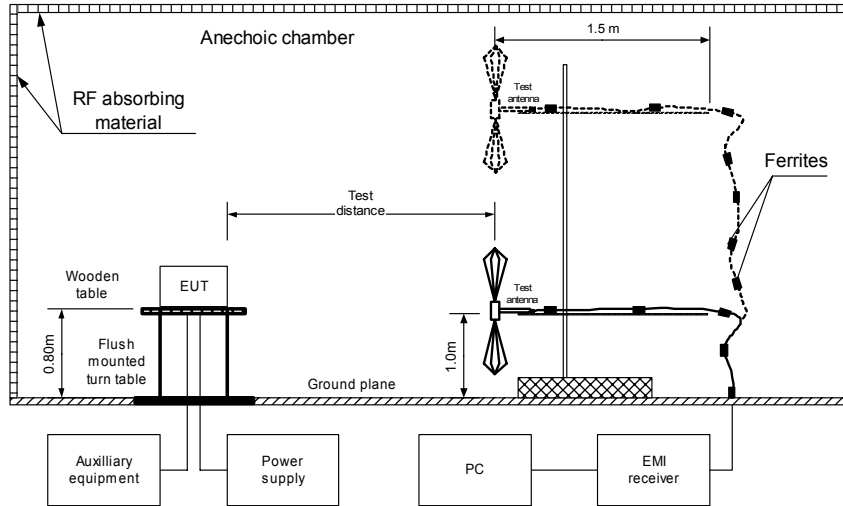
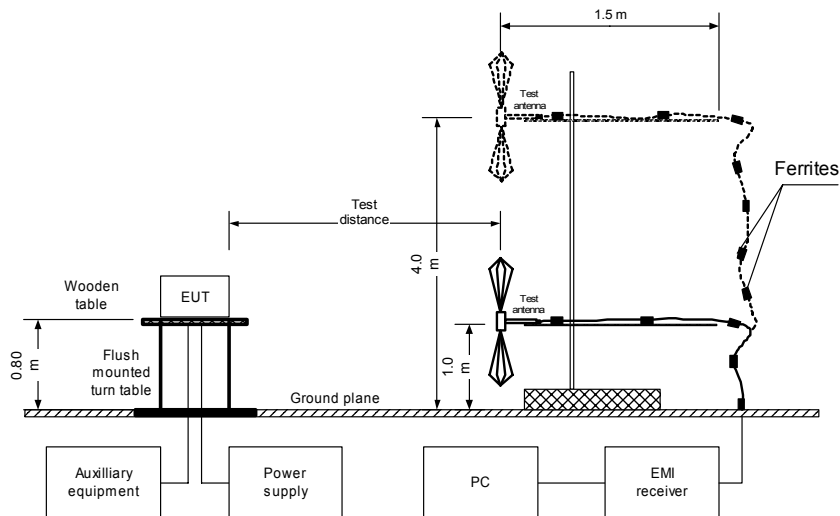


Figure 8.2.2 Setup for radiated emission measurements at OATS, table-top equipment





Test specification:		Section 15.109, Radiated emission	
Test procedure:		ANSI C63.4, Sections 11.6 and 12.1.4	
Test mode:	Compliance	Verdict:	PASS
Date & Time:	12/8/2006 12:53:38 PM		
Temperature: 22°C	Air Pressure: 1011 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks:			

Table 8.2.2 Radiated emission test results

EUT SET UP: TABLE-TOP
LIMIT: Class B
EUT OPERATING MODE: Tx/Rx
TEST SITE: OATS
TEST DISTANCE: 10 m
DETECTORS USED: PEAK / QUASI-PEAK
FREQUENCY RANGE: 30 MHz – 1000 MHz
RESOLUTION BANDWIDTH: 120 kHz

Frequency, MHz	Peak emission, dB(μV/m)	Quasi-peak			Antenna polarization	Antenna height, m	Turn-table position**, degrees	Verdict
		Measured emission, dB(μV/m)	Limit, dB(μV/m)	Margin, dB*				
40.680000	29.11	26.61	-2.89	29.50	V	1	180	Pass
365.315000	24.25	22.10	-13.40	35.50	V	1	180	
431.983500	32.93	29.56	-5.94	35.50	V	1	180	
499.395000	22.94	20.37	-15.13	35.50	V	1	180	
566.045000	32.49	28.36	-7.14	35.50	V	1	180	
699.079600	30.11	25.94	-9.56	35.50	V	1	180	

Note: 40.68 is a 3-th harmonic

*- Margin = Measured emission - specification limit.

** - EUT front panel refer to 0 degrees position of turntable.

Reference numbers of test equipment used

HL 0521	HL 0569	HL 0589	HL 0593	HL 0594	HL 0604	HL 0813	HL 1424
HL 1430	HL 1552	HL 1848	HL 1947	HL 1984	HL 2009	HL 2697	

Full description is given in Appendix A.

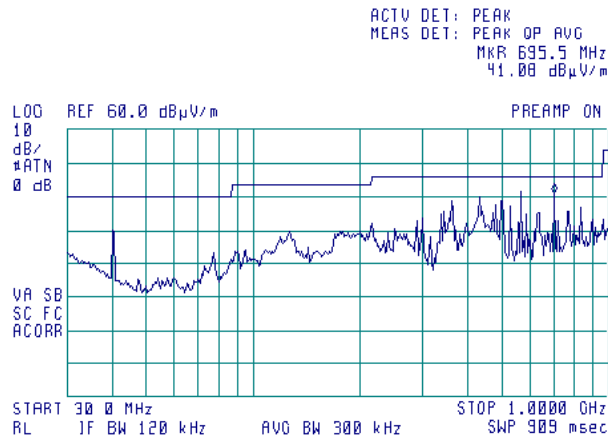


Test specification: Section 15.109, Radiated emission			
Test procedure: ANSI C63.4, Sections 11.6 and 12.1.4			
Test mode: Compliance	Verdict: PASS		
Date & Time: 12/8/2006 12:53:38 PM			
Temperature: 22°C	Air Pressure: 1011 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks:			

Plot 8.2.1 Radiated emission measurements in 30 - 1000 MHz range, vertical antenna polarization

TEST SITE: Anechoic chamber
LIMIT: Class B
TEST DISTANCE: 3 m
EUT OPERATING MODE: Tx/Rx

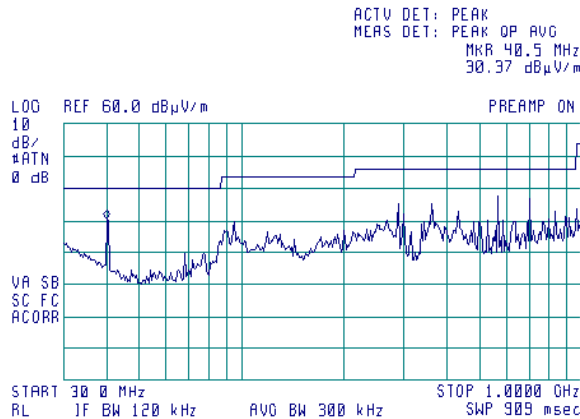
13:03:40 08 DEC 2006



Plot 8.2.2 Radiated emission measurements in 30 - 1000 MHz range, horizontal antenna polarization

TEST SITE: Anechoic
LIMIT: Class B
TEST DISTANCE: 3 m
EUT OPERATING MODE: Tx/Rx

13:09:51 08 DEC 2006



9 APPENDIX A Test facility description

Tests were performed at Hermon Laboratories Ltd., which is a fully independent, private, EMC, safety, environmental 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, environmental, 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) and approved by Israel Ministry of environmental protection, radiation hazards department (Permit number 1158).

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10 APPENDIX B Specification references

47CFR part 15: 2006	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: 2003	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.

11 APPENDIX C Test equipment and ancillaries used for tests

HL No	Description	Manufacturer	Model	Ser. No.	Last Cal.	Due Cal.
0163	LISN FCC/VDE/50 Ohm/50 uH + 5 Ohm, MIL-STD-461E, CISPR 16-1	Electro-Metrics	ANS 25/2	1314	01-Oct-06	01-Oct-07
0337	Probe Set, Hand held, 5 probes	Electro-Metrics	EHFP-30	238	08-Jun-06	08-Jun-07
0446	Antenna, Loop, Active, 10 kHz - 30 MHz	EMCO	6502	2857	28-Jun-06	28-Jun-07
0447	LISN, 16/2, 300V RMS, 50 Ohm/50 uH + 5 Ohm, STD CISPR 16-1	HL	LISN 16 - 1	066	03-Nov-06	03-Nov-07
0495	Autotransformer 0-255V, 10A	Variac	EMPL01	495	09-Mar-06	09-Mar-07
0521	EMI Receiver (Spectrum Analyzer) with RF filter section 9 kHz-6.5 GHz	Hewlett Packard	8546A	3617A 00319, 3448A002 53	26-Sep-06	26-Sep-07
0569	Antenna, Log Periodic, 200 - 1000 MHz	Electro-Metrics	LPA 25/30	1953	10-Jan-06	10-Jan-07
0589	Cable Coaxial, GORE A2P01POL118, 2.3 m	HL	GORE-3	176	02-Dec-06	02-Dec-07
0593	Antenna Mast, 1-4 m Pneumatic	Madgesh	AM-F1	101	02-Feb-06	02-Feb-07
0594	Turn Table FOR ANECHOIC CHAMBER flush mount d=1.2 m Pneumatic	HL	TT-WDC1	102	26-Jan-06	26-Jan-07
0604	Antenna BiconiLog Log-Periodic/T Bow-TIE 26 - 2000 MHz	EMCO	3141	9611-1011	10-Jan-06	10-Jan-07
0784	Antenna X-WING BILOG 20 MHz - 2 GHz	Schaffner-Chase EMC	CBL6140 A	1120	10-Jan-06	10-Jan-07
0787	Transient Limiter 9 kHz-200 MHz	Hewlett Packard	11947A	3107A018 77	21-Nov-06	21-Nov-07
0813	Cable Coax, RG-214, 12 m, N-type connectors	HL	C214-12	149	02-Dec-06	02-Dec-07
0892	Multimeter Digital	Tabor Electronics	DM 4021	232757	20-Jul-06	20-Jul-07
1424	Spectrum Analyzer, 30 Hz- 40 GHz	Agilent Technologies	8564EC	3946A002 19	30-Aug-06	30-Aug-07
1430	EMI Receiver, 9 kHz - 2.9 GHz, System: HL1431, HL1432	Agilent Technologies	8542E	3807A002 62,3705A0 0217	01-Sep-06	01-Sep-07
1502	Cable RF, 6 m, BNC/BNC	Belden	M17/167 MIL-C-17	1502	27-Nov-06	27-Nov-07
1510	Cable RF, 8 m, BNC/BNC	Belden	M17/167 MIL-C-17	1510	02-Dec-06	02-Dec-07
1552	Cable RF, 8 m	Alpha Wire	RG-214	1552	02-Dec-06	02-Dec-07
1848	Antenna mast 4m/6m with polarity control	Sh. I. Machines	AM-5	1	18-Apr-06	18-Apr-07
1947	Cable 18GHz, 6.5 m, blue	Rhophase Microwave Limited	NPS-1803A-6500-NPS	T4974	17-Oct-06	17-Oct-07
1984	Antenna, Double-Ridged Waveguide Horn, 1-18 GHz, 300 W, N-type	EMC Test Systems	3115	9911-5964	03-Mar-06	03-Mar-07
2004	Cable RF, 3 m, BNC/BNC	Alpha Wire	RG 58	2004	11-Sep-06	11-Sep-07
2009	Cable RF, 8 m	Alpha Wire	RG-214	C-56	02-Dec-06	02-Dec-07



HL No	Description	Manufacturer	Model	Ser. No.	Last Cal.	Due Cal.
2259	Amplifier Low Noise 2-20 GHz	Sophia Wireless	LNA0220-C	0223	05-Nov-06	05-Nov-07
2697	Antenna, 30 MHz - 3.0 GHz,	Sunol Sciences. Corp. Pleasanton, California USA	JB3	A022805	10-Jan-06	10-Jan-07
3001	EMC Analyzer, 9 kHz to 3 GHz	Agilent Technologies	E7402A	US394401 80	22-Nov-06	22-Nov-07

12 APPENDIX D Test equipment correction factors

Correction factor
Line impedance stabilization network
Model ANS-25/2, Electro-Metrics, HL 0163

Frequency, kHz	Correction factor, dB
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 meter readings of an interference analyzer or a spectrum analyzer.

Correction factor
Line impedance stabilization network
Model LISN 16 - 1
Hermon Laboratories

Frequency, kHz	Correction factor, dB
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 meter readings of an interference analyzer or a spectrum analyzer.



Antenna factor
Active loop antenna
Model 6502, S/N 2857, HL 0446

Frequency, MHz	Magnetic antenna factor, dB	Electric antenna factor, dB
0.009	-32.8	18.7
0.010	-33.8	17.7
0.020	-38.3	13.2
0.050	-41.1	10.4
0.075	-41.3	10.2
0.100	-41.6	9.9
0.150	-41.7	9.8
0.250	-41.6	9.9
0.500	-41.8	9.8
0.750	-41.9	9.7
1.000	-41.4	10.1
2.000	-41.5	10.0
3.000	-41.4	10.2
4.000	-41.4	10.1
5.000	-41.5	10.1
10.000	-41.9	9.6
15.000	-41.9	9.6
20.000	-42.2	9.3
25.000	-42.8	8.7
30.000	-44.0	7.5

Antenna factor in dB(1/m) is to be added to receiver meter reading in dB(μ V) to convert it into field intensity in dB(μ V/m).

**Antenna factor
Biconilog antenna EMCO Model 3141
Ser.No.1011, HL 0604**

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 in dB(1/m) is to be added to receiver meter reading in dB(μ V) to convert it into field intensity in dB(μ V/m).

**Antenna factor
Biconilog antenna
CHASE Model CBL6140A
Serial no: 1120, HL 0784**

Frequency, MHz	Antenna factor, dB
30.0	4.3
35.0	7.3
40.0	8.8
45.0	9.3
50.0	9.6
60.0	9.9
70.0	9.2
80.0	7.6
90.0	7.6
100.0	8.8
120.0	7.2
125.0	7.5
140.0	7.7
150.0	7.9
160.0	11.4
175.0	8.6
180.0	8.8
200.0	9.8
250.0	12.5
300.0	12.2
350.0	14.8
400.0	16.1
450.0	16.5
500.0	17.6
550.0	18.3
600.0	18.5
650.0	19.8
700.0	20.1
750.0	20.8
800.0	21.2
850.0	22.0
900.0	22.2
950.0	23.2
1000.0	23.8

Antenna factor in dB(1/m) is to be added to receiver meter reading in dB(μ V) to convert it into field intensity in dB(μ V/m).

**Antenna factor
Double-ridged wave guide horn antenna
Model 3115, S/N 9911-5964, HL1984**

Frequency, MHz	Antenna factor, dB(1/m)
1000.0	24.7
1500.0	25.7
2000.0	27.6
2500.0	28.9
3000.0	31.2
3500.0	32.0
4000.0	32.5
4500.0	32.7
5000.0	33.6
5500.0	35.1
6000.0	35.4
6500.0	34.9
7000.0	36.1
7500.0	37.8
8000.0	38.0
8500.0	38.1
9000.0	39.1
9500.0	38.3
10000.0	38.6
10500.0	38.2
11000.0	38.7
11500.0	39.5
12000.0	40.0
12500.0	40.4
13000.0	40.5
13500.0	41.1
14000.0	41.6
14500.0	41.7
15000.0	38.7
15500.0	38.2
16000.0	38.8
16500.0	40.5
17000.0	42.5
17500.0	45.9
18000.0	49.4

Antenna factor in dB(1/m) is to be added to receiver meter reading in dB(μ V) to convert it into field intensity in dB(μ V/m).

Cable loss
Cable Coaxial, GORE A2P01POL118, 2.3 m, model:GORE-3, HL 0589
+ Cable Coaxial, ANDREW PSWJ4, 6m, model: ANDREW-6, HL 1004

No.	Frequency, MHz	Cable loss, dB	Tolerance (Specification), dB	Measurement uncertainty, dB
1	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	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		
23	4800	4.36		
24	5100	4.62		
25	5400	4.78		
26	5700	5.16		
27	6000	5.67		
28	6500	5.99		
				±0.17



Cable loss
Cable RG-214, HL 0813

No.	Frequency, MHz	Cable loss, dB
1	10	0.15
2	20	0.40
3	30	0.51
4	40	0.61
5	50	0.68
6	60	0.76
7	70	0.80
8	80	0.92
9	90	0.96
10	100	0.99
11	200	1.60
12	300	1.85
13	400	2.25
14	500	2.43
15	600	2.80
16	700	3.14
17	800	3.34
18	900	3.75
19	1000	4.05
20	1200	4.41
21	1400	4.81
22	1600	5.18
23	1800	5.58
24	2000	6.09
25	2500	7.27
26	2900	8.01



Cable loss
Cable coaxial, 6 m, model: M17/167 MIL-C-17, HL 1502

Frequency, MHz	Cable loss, dB
0.1	0.02
1	0.07
3	0.15
5	0.17
10	0.26
30	0.43
50	0.57
80	0.72
100	0.81
300	1.48
500	2.00
800	2.70
1000	3.09

Cable loss
Cable M17/167 MIL-C-17, HL 1510

No.	Frequency, MHz	Cable loss, dB
1	0.1	0.05
2	1	0.09
3	3	0.16
4	5	0.18
5	10	0.27
6	30	0.44
7	50	0.58
8	80	0.69
9	100	0.82
10	300	1.48
11	500	2.01
12	800	2.65
13	1000	3.12



Cable loss
RF cable 8 m, model RG-214, HL 1552

No.	Frequency, MHz	Cable loss, dB	Measurement uncertainty, dB	Notes
1	0.010	0.01	±0.05	
2	0.1	0.01		
3	1	0.03		
4	10	0.12		
5	20	0.23		
6	30	0.30		
7	40	0.32		
8	50	0.34		
9	60	0.39		
10	70	0.43		
11	80	0.48		
12	90	0.50		
13	100	0.55		
14	200	0.78		
15	300	1.04		
16	400	1.16		
17	500	1.33		
18	600	1.51		
19	700	1.65		
20	800	1.77		
21	900	1.92		
22	1000	2.04		
23	1200	2.26		
24	1400	2.49		
25	1600	2.74		
26	1800	2.94		
27	2000	3.18		
28	2500	3.65		
29	2900	4.08		

Cable loss
Cable 18 GHz, 6.5 m, blue, model: NPS-1803A-6500-NPS, S/N T4974, HL 1947

Frequency, GHz	Cable loss, dB
0.03	0.30
0.05	0.38
0.10	0.53
0.20	0.74
0.30	0.91
0.40	1.05
0.50	1.18
0.60	1.29
0.70	1.40
0.80	1.50
0.90	1.59
1.00	1.68
1.10	1.77
1.20	1.86
1.30	1.94
1.40	2.01
1.50	2.08
1.60	2.16
1.70	2.22
1.80	2.29
1.90	2.36
2.00	2.42
2.10	2.48
2.20	2.54
2.30	2.60
2.40	2.66
2.50	2.71
2.60	2.77
2.70	2.83
2.80	2.89
2.90	2.95
3.10	3.06
3.30	3.17
3.50	3.28
3.70	3.39
3.90	3.51
4.10	3.62
4.30	3.76
4.50	3.87
4.70	4.01
4.90	4.10
5.10	4.21
5.30	4.31
5.50	4.43
5.70	4.56
5.90	4.71

Frequency, GHz	Cable loss, dB
6.10	4.87
6.30	4.95
6.50	4.94
6.70	4.88
6.90	4.87
7.10	4.83
7.30	4.85
7.50	4.86
7.70	4.91
7.90	4.96
8.10	5.03
8.30	5.08
8.50	5.13
8.70	5.21
8.90	5.22
9.10	5.34
9.30	5.35
9.50	5.52
9.70	5.51
9.90	5.66
10.10	5.70
10.30	5.78
10.50	5.79
10.70	5.82
10.90	5.86
11.10	5.94
11.30	6.06
11.50	6.21
11.70	6.44
11.90	6.61
12.10	6.76
12.40	6.68
13.00	6.66
13.50	6.81
14.00	6.90
14.50	6.90
15.00	6.97
15.50	7.17
16.00	7.28
16.50	7.27
17.00	7.38
17.50	7.68
18.00	7.92



Cable loss
RF cable 8 m, model RG-214, HL 2009

No.	Frequency, MHz	Cable loss, dB	Tolerance (Specification), dB	Measurement uncertainty, dB
1	1	0.10	NA	±0.12
2	10	0.14		
3	30	0.25		
4	50	0.34		
5	100	0.53		
6	300	0.99		
7	500	1.31		
8	800	1.73		
9	1000	1.98		
10	1100	2.11		
11	1200	2.21		
12	1300	2.35		
13	1400	2.46		
14	1500	2.55		
15	1600	2.68		
16	1700	2.78		
17	1800	2.88		
18	1900	2.98		
19	2000	3.09		

13 APPENDIX E Measurement uncertainties

Expanded uncertainty at 95% confidence in Hermon Labs EMC measurements

Test description	Expanded uncertainty
Conducted emissions with LISN	9 kHz to 150 kHz: ± 3.9 dB 150 kHz to 30 MHz: ± 3.8 dB
Radiated emissions at 10 m measuring distance Horizontal polarization Vertical polarization	Biconilog antenna: ± 5.0 dB Biconical antenna: ± 5.0 dB Log periodic antenna: ± 5.1 dB Double ridged horn antenna: ± 5.3 dB Biconilog antenna: ± 5.5 dB Biconical antenna: ± 5.5 dB Log periodic antenna: ± 5.6 dB Double ridged horn antenna: ± 5.8 dB
Radiated emissions at 3 m measuring distance Horizontal polarization Vertical polarization	Biconilog antenna: ± 5.3 dB Biconical antenna: ± 5.0 dB Log periodic antenna: ± 5.3 dB Double ridged horn antenna: ± 5.3 dB Biconilog antenna: ± 6.0 dB Biconical antenna: ± 5.7 dB Log periodic antenna: ± 6.0 dB Double ridged horn antenna: ± 6.0 dB
Conducted emissions at RF antenna connector	9 kHz to 2.9 GHz: ± 2.6 dB 2.9 GHz to 6.46 GHz: ± 3.5 dB 6.46 GHz to 13.2 GHz: ± 4.3 dB 13.2 GHz to 22.0 GHz: ± 5.0 dB 22.0 GHz to 26.8 GHz: ± 5.5 dB 26.8 GHz to 40.0 GHz: ± 4.8 dB

Hermon Laboratories is accredited by A2LA for calibration according to present requirements of ISO/IEC 17025 and NCSL Z540-1. The accreditation is granted to perform calibration of parameters that are listed in the Scope of Hermon Laboratories Accreditation.

Hermon Laboratories calibrates its reference and transfer standards by calibration laboratories accredited to ISO/IEC 17025 by a mutually recognized Accreditation Body or by a recognized national metrology institute. All reference and transfer standards used in the calibration system are traceable to national or international standards.

In-house calibration of all test and measurement equipment is performed on a regular basis according to Hermon Laboratories calibration procedures, manufacturer calibration/verification procedures or procedures defined in the relevant standards. The Hermon Laboratories test and measurement equipment is calibrated within the tolerances specified by the manufacturers and/or by the relevant standards.

14 APPENDIX F Abbreviations and acronyms

A	ampere
AC	alternating current
AM	amplitude modulation
AVRG	average (detector)
BB	broad band
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
dB(μ A)	decibel referred to one microampere
DC	direct current
EIRP	equivalent isotropically radiated power
ERP	effective radiated power
EUT	equipment under test
F	frequency
GHz	gigahertz
GND	ground
H	height
HL	Hermon laboratories
Hz	hertz
ITE	information technology equipment
k	kilo
kHz	kilohertz
LISN	line impedance stabilization network
LO	local oscillator
m	meter
Mbps	Mega but per second
MHz	megahertz
min	minute
mm	millimeter
ms	millisecond
μ s	microsecond
NA	not applicable
NB	narrow band
NT	not tested
OATS	open area test site
Ω	Ohm
PM	pulse modulation
PS	power supply
ppm	part per million (10^{-6})
QP	quasi-peak
RE	radiated emission
RF	radio frequency
rms	root mean square
Rx	receive
s	second
T	temperature
Tx	transmit
V	volt
WB	wideband