HERMON LABORATORIES

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839.01
Electrical

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TEST REPORT

ACCORDING TO:

FCC CFR 47 PART 15 Subpart C, Sections 15.231(e), 15.207, 15.209

FCC CFR 47 PART 15 Subpart B

FOR:

Visonic Technologies Ltd.

LF Exciter

Model: 5-RLE00125B

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1 Applicant information

Client name:	Visonic Technologies Ltd.
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Telephone:	+972 3768 1408
Fax:	+972 3768 1415
E-mail:	ZachiH@visonic.com
Contact name:	Mr. Zachi Holzman

2 Equipment under test attributes

Product name:	LF Exciter
Product type:	Transmitter
Product family:	ELPAS Local Positioning Systems
Model:	5-RLE00125B
Receipt date:	8/22/2005

3 Manufacturer information

Manufacturer name:	Visonic Technologies Ltd.
Address:	Habarzel street 30, Tel Aviv, 69710, Israel
Telephone:	+972 3768 1408
Fax:	+972 3768 1415
E-mail:	ZachiH@visonic.com
Contact name:	Mr. Zachi Holzman

4 Test details

Project ID:	16647
Location:	Hermon Laboratories Ltd. P.O.Box 23, Binyamina 30500, Israel
Test started:	8/22/2005
Test completed:	5/3/2007
Test specifications:	FCC CFR 47 PART 15 Subpart C, Sections 15.231(e), 15.207, 15.209
	FCC CFR 47 PART 15 Subpart B

5 Tests summary

Test	Status
EUT operating at 125 kHz	
Transmitter characteristics	
Section 15.209 (a), Fundamental radiated emissions	Pass
Section 15. 209 (c), Unwanted radiated emissions	Pass
Section 15.207 (a), Conducted emissions	Pass
Section 15.203, Antenna requirement	Pass
Unintentional emissions	
Section 15.107, Conducted emissions at AC power port, Class B	Pass
Section 15.109, Radiated emissions, Class B	Pass
Section 15.111, Conducted emission at receiver antenna port	Not required
EUT operating at 433.9 MHz	
Transmitter characteristics	
Section 15.231(e), Periodic operation requirements	Pass
Section 15.231(b)/(e), Field strength of emissions	Pass
Section 15.231(c), Occupied bandwidth	Pass
Section 15.207(a), Conducted emission	Pass
Section 15.203, Antenna requirement	Pass
Unintentional emissions	
Section 15.107, Conducted emissions at AC power port, Class B	Pass
Section 15.109, Radiated emissions, Class B	Pass
Section 15.111, Conducted emission at receiver antenna port	Not required

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. A. Adelberg, test engineer	May 3, 2007	
	Mr. S. Samokha, test engineer		
Reviewed by:	Ms. N. Averin, certification engineer	May 8, 2007	
Approved by:	Mr. M. Nikishin, EMC and radio group leader	May 9, 2007	

6 EUT description

6.1 General information

The EUT is a ceiling-mounted LF exciter, which enables tag detection in exit locations or other specific zones of a building. The EUT is equipped with two integral antennas and is powered from 24 VDC.
The EUT has two modes of operation.

1) LF mode: the EUT operates at 125 kHz and transmits low frequency signals within a range of 2 to 3 meters by low frequency receivers of RFID tags. As soon as LF exciter signals are identified, an RFID data message including the ID number of the exciter is triggered and transmitted. This information enables the precise location of the tag.
2) RF mode: the EUT operates at 433.9 MHz and transmits supervision signals.

The EUT cannot operate in both modes simultaneously.

6.2 Ports and lines

Port type	Port description	Connected		Connector type	Qty.	Cable type	Cable length	Indoor / outdoor
		From	To					
Power / signal	DC / signal	EUT	Junction box	RJ 11	1	Unshielded	3 m	Indoor
Power	DC power	Junction box	Power supply	Terminal block	1	Unshielded	1.5 m	Indoor
Power	AC power*	Power supply	AC mains	IEC 320	1	Unshielded	1.5 m	Indoor

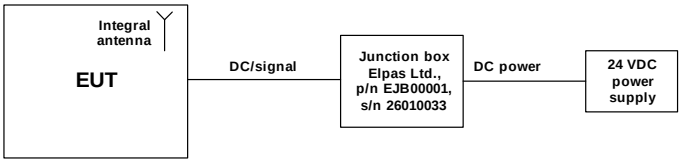
* For conducted emission test.

6.3 Auxiliary equipment

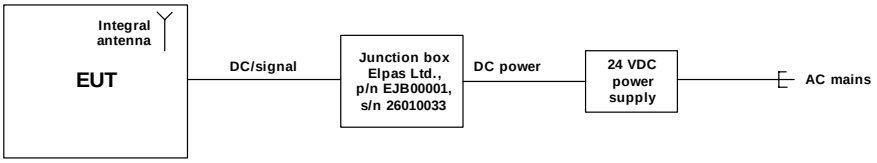
Description	Manufacturer	Model number	Serial number
Power supply	POWER-WIN TECHNOLOGY CORP.	PW-060A-014240	PW7158363

6.4 Test configuration

6.4.1 Radiated emission test



6.4.2 Conducted emission test



Test specification:	Section 15.209(a), (c) - Field strength of fundamental and unwanted emissions		
Test procedure:	ANSI C63.4, Sections 5.3 and 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	1/13/2006 4:04:30 PM		
Temperature: 24 ºC	Air Pressure: 1010 hPa	Relative Humidity: 40 %	Power Supply: 24 VDC
Remarks:			

7 Transmitter tests, EUT operating at 125 kHz

7.1 Field strength of fundamental and unwanted emissions according to FCC CFR 47 PART 15 Subpart C, Section 15.209

7.1.1 General

This test was performed to measure field strength of spurious emissions from the EUT. Specification test limits are given in Table 7.1.1 and Table 7.1.2.

Table 7.1.1 Radiated emission limits

Frequency, MHz	Class B limit, dB(µV/m) @3 m distance*		
	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	
1000 –10thharmonic	74.0	NA	54.0

* The limit for test distance other than specified was calculated using the inverse linear distance extrapolation factor as follows: $Lim_{S2} = Lim_{S1} + 40 \log (S_1/S_2)$,
where S_1 and S_2 – standard defined and test distance respectively in meters
***- The limit decreases linearly with the logarithm of frequency.

Table 7.1.2 Radiated fundamental emission limits

Fundamental frequency, kHz	Field strength at 3 m, dB(µV/m)
	Average
125	105.67

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

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 measurements were performed in three EUT orthogonal positions.

7.1.2.3 The specified frequency range was investigated with loop antenna connected to spectrum analyzer/ EMI receiver. To find maximum radiation the turntable was rotated 360^0, the measuring antenna was rotated around its vertical axis and the measuring antenna polarization was switched from vertical to horizontal.

7.1.2.4 The worst test results (the lowest margins) were found in the EUT typical (towards the antenna) position, recorded in Table 7.1.3 and shown in the associated plots.

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

7.1.3.1 The EUT was set up as shown in Figure 7.1.2, energized and the performance check was conducted.

7.1.3.2 The measurements were performed in three EUT orthogonal positions.

7.1.3.3 The specified frequency range was investigated with antenna connected to spectrum analyzer/ EMI receiver. To find maximum radiation the turntable was rotated 360^0, the measuring antenna height was changed from 1 to 4 m, its polarization was switched from vertical to horizontal.

7.1.3.4 The worst test results (the lowest margins) were found in the EUT typical (towards the antenna) position, recorded in Table 7.1.3 and shown in the associated plots.

Test specification:	Section 15.209(a), (c) - Field strength of fundamental and unwanted emissions		
Test procedure:	ANSI C63.4, Sections 5.3 and 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	1/13/2006 4:04:30 PM		
Temperature: 24 °C	Air Pressure: 1010 hPa	Relative Humidity: 40 %	Power Supply: 24 VDC
Remarks:			

Figure 7.1.1 Setup for spurious emission field strength measurements below 30 MHz

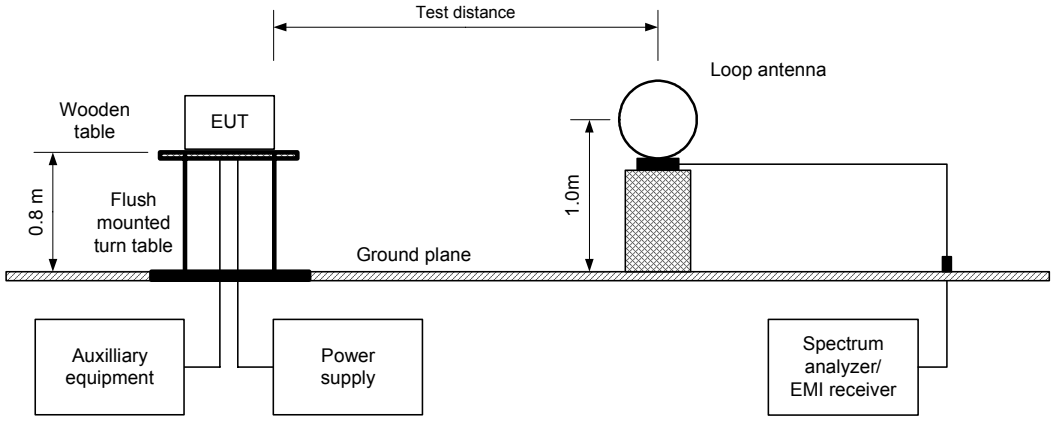
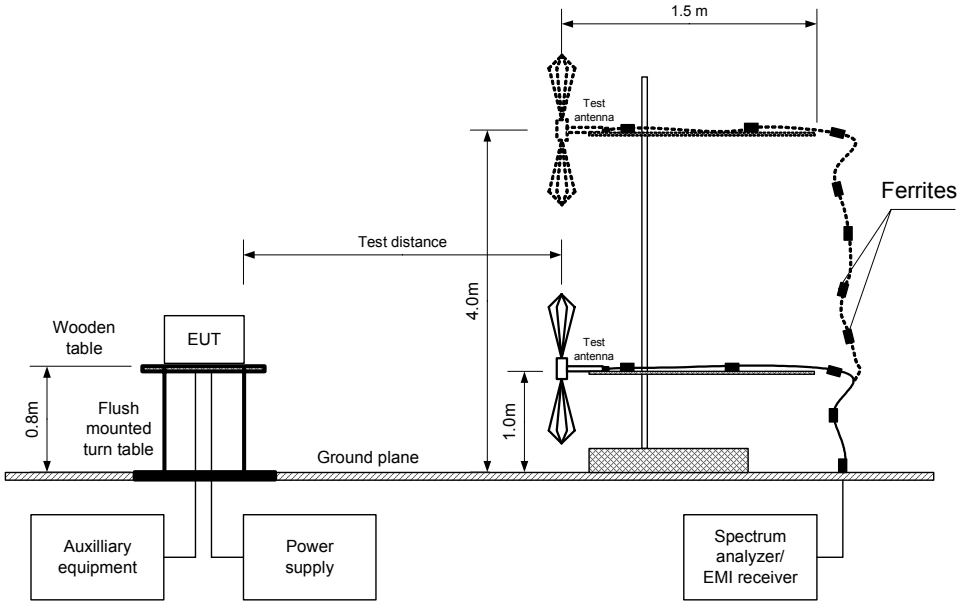


Figure 7.1.2 Setup for spurious emission field strength measurements above 30 MHz



Test specification:	**Section 15.209(a), (c) - Field strength of fundamental and unwanted emissions**		
Test procedure:	ANSI C63.4, Sections 5.3 and 13.1.4		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	1/13/2006 4:04:30 PM		
Temperature: 24 ºC	**Air Pressure:** 1010 hPa	**Relative Humidity:** 40 %	**Power Supply:** 24 VDC
Remarks:			

Table 7.1.3 Field strength of emissions test results

TEST DISTANCE: 3 m
EUT POSITION: Typical (Towards the antenna)
MODULATION: FM
TRANSMITTER OUTPUT POWER SETTINGS: Maximum
INVESTIGATED FREQUENCY RANGE: 0.009 – 1000 MHz
DETECTOR USED: Peak
RESOLUTION BANDWIDTH: 0.2 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)
Biconilog (30 MHz – 1000 MHz)

Frequency, kHz	Antenna		Azimuth, degrees*	Peak field strength			Average field strength			Verdict
	Polarization	Height, m		Measured, dB(µV/m)	Limit, dB(µV/m)	Margin*, dB	Measured, dB(µV/m)	Limit, dB(µV/m)	Margin*, dB	
124.98	Vertical	1.0	360	101.85	125.69	-23.84	96.43	105.67	-9.24	Pass
250.30	Vertical	1.0	5	61.55	119.65	-58.10	43.84	99.65	-55.81	
374.88	Vertical	1.0	0	63.27	116.13	-52.86	45.68	96.13	-23.45	

Frequency, kHz	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*				
500.63	52.98	49.95	73.61	-23.66	Vertical	1.0	358	Pass
624.38	54.93	53.47	71.70	-18.23	Vertical	1.0	5	
751.20	46.62	41.62	70.10	-28.48	Vertical	1.0	10	
874.40	49.08	46.31	68.78	-22.47	Vertical	1.0	0	
1000.95	40.94	36.55	67.61	-31.06	Vertical	1.0	5	
1126.50	43.55	40.01	66.59	-26.58	Vertical	1.0	2	
1248.38	39.64	33.98	65.70	-31.72	Vertical	1.0	360	
36730.0	27.50	20.10	40.00	-19.90	Vertical	1.0	143	
67260.0	30.70	21.70	40.00	-18.30	Vertical	1.0	341	
79080.0	34.00	26.60	40.00	-13.40	Vertical	1.0	45	
130600.0	42.00	30.50	43.50	-13.00	Vertical	1.0	193	
191500.0	32.90	28.30	43.50	-15.20	Vertical	1.0	77	

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

Reference numbers of test equipment used

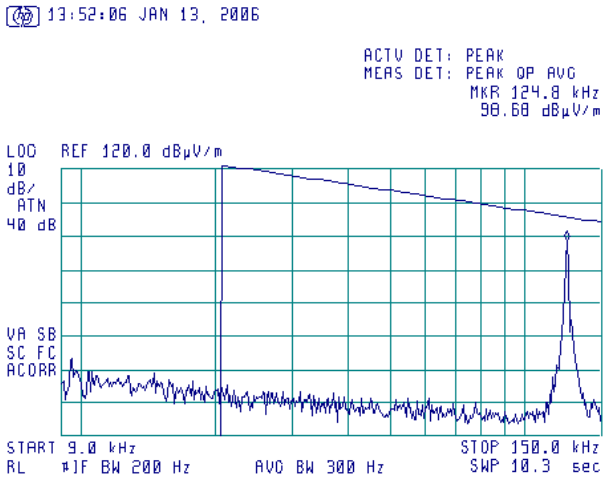
HL 0446	HL 0465	HL 0521	HL 0589	HL 0593	HL 0594	HL 0604	HL 1004
HL 2009							

Full description is given in Appendix A.

Test specification:	Section 15.209(a), (c) - Field strength of fundamental and unwanted emissions		
Test procedure:	ANSI C63.4, Sections 5.3 and 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	1/13/2006 4:04:30 PM		
Temperature: 24 ºC	Air Pressure: 1010 hPa	Relative Humidity: 40 %	Power Supply: 24 VDC
Remarks:			

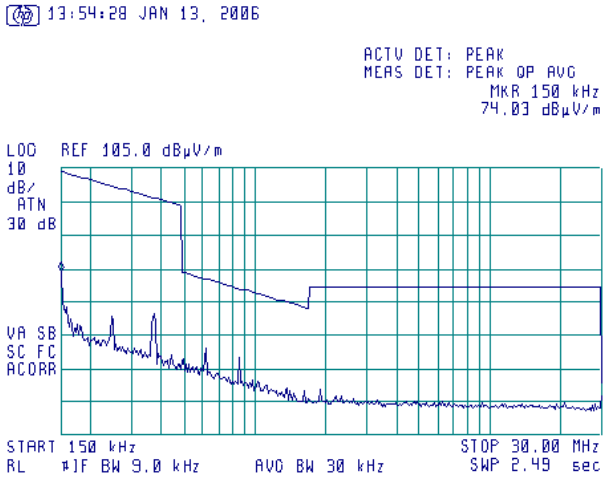
Plot 7.1.1 Radiated emission measurements from 9 to 150 kHz

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Typical (Towards the antenna)



Plot 7.1.2 Radiated emission measurements from 0.15 to 30 MHz

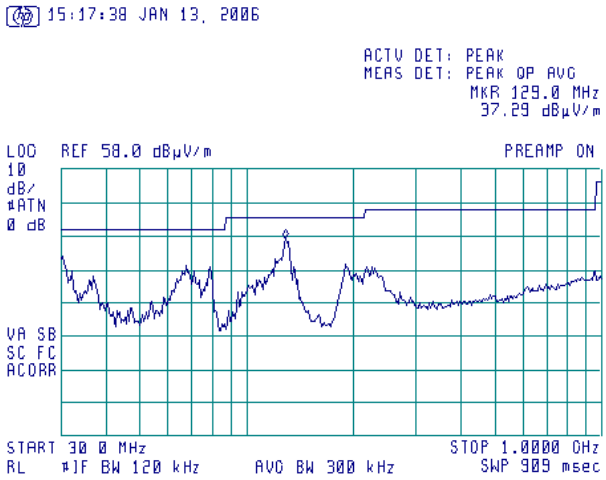
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Typical (Towards the antenna)



Test specification:	Section 15.209(a), (c) - Field strength of fundamental and unwanted emissions		
Test procedure:	ANSI C63.4, Sections 5.3 and 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	1/13/2006 4:04:30 PM		
Temperature: 24 ºC	Air Pressure: 1010 hPa	Relative Humidity: 40 %	Power Supply: 24 VDC
Remarks:			

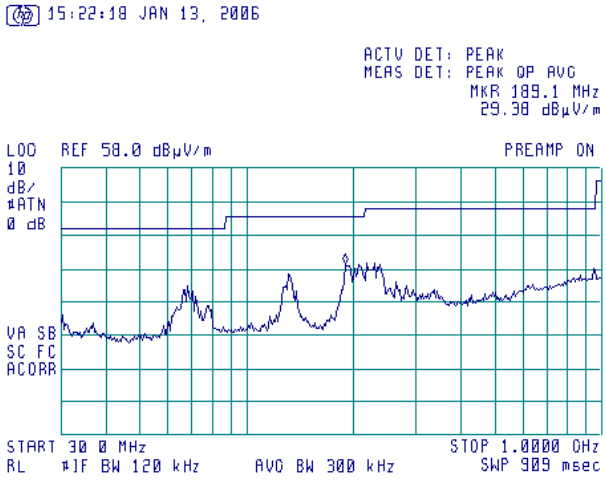
Plot 7.1.3 Radiated emission measurements from 30 to 1000 MHz

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Typical (Towards the antenna)



Plot 7.1.4 Radiated emission measurements from 30 to 1000 MHz

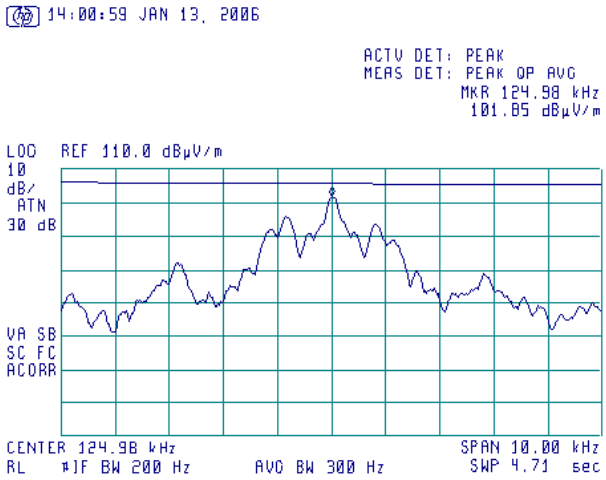
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal
EUT POSITION: Typical (Towards the antenna)



Test specification:	Section 15.209(a), (c) - Field strength of fundamental and unwanted emissions		
Test procedure:	ANSI C63.4, Sections 5.3 and 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	1/13/2006 4:04:30 PM		
Temperature: 24 ºC	Air Pressure: 1010 hPa	Relative Humidity: 40 %	Power Supply: 24 VDC
Remarks:			

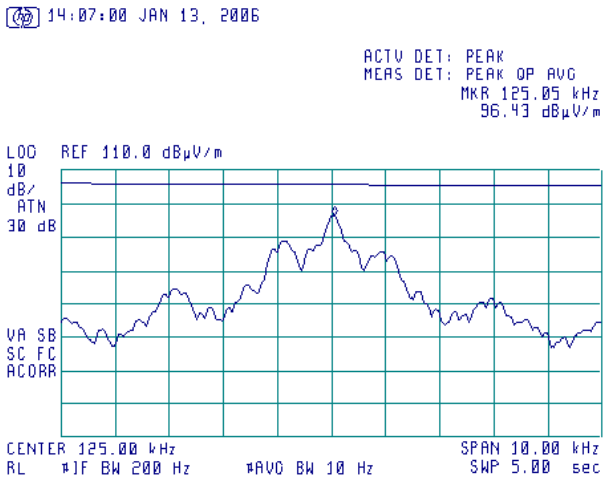
Plot 7.1.5 Radiated emission measurements of the intentional transmission

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Typical (Towards the antenna)
DETECTOR: Peak



Plot 7.1.6 Radiated emission measurements of the intentional transmission

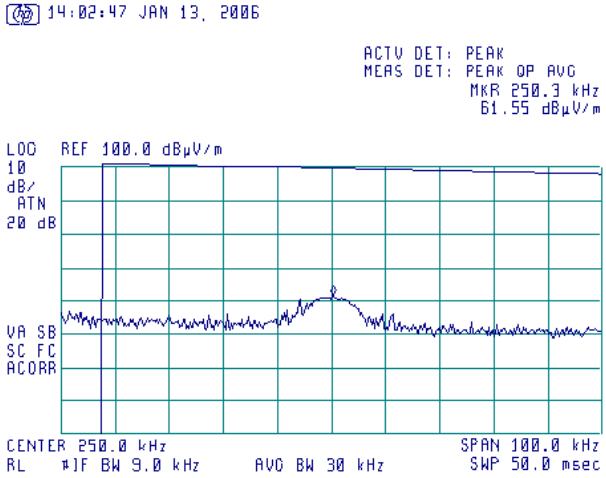
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Typical (Towards the antenna)
DETECTOR: Average



Test specification:	Section 15.209(a), (c) - Field strength of fundamental and unwanted emissions		
Test procedure:	ANSI C63.4, Sections 5.3 and 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	1/13/2006 4:04:30 PM		
Temperature: 24 °C	Air Pressure: 1010 hPa	Relative Humidity: 40 %	Power Supply: 24 VDC
Remarks:			

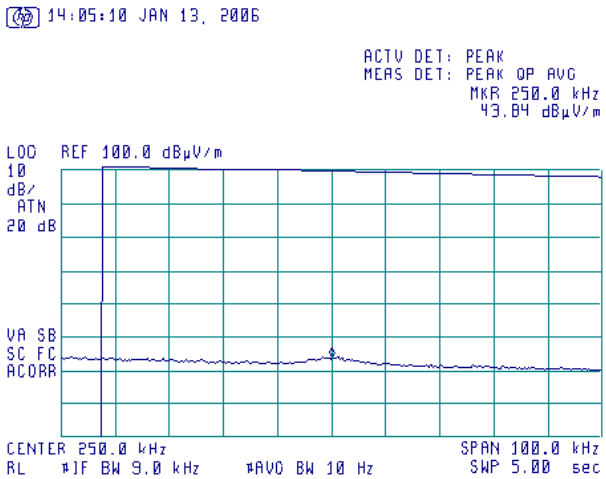
Plot 7.1.7 Radiated emission measurements at the second harmonic frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Typical (Towards the antenna)
DETECTOR: Peak



Plot 7.1.8 Radiated emission measurements at the second harmonic frequency

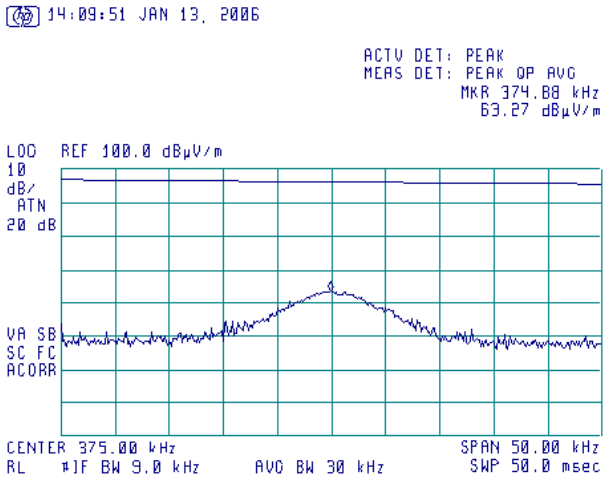
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Typical (Towards the antenna)
DETECTOR: Average



Test specification:	Section 15.209(a), (c) - Field strength of fundamental and unwanted emissions		
Test procedure:	ANSI C63.4, Sections 5.3 and 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	1/13/2006 4:04:30 PM		
Temperature: 24 ºC	Air Pressure: 1010 hPa	Relative Humidity: 40 %	Power Supply: 24 VDC
Remarks:			

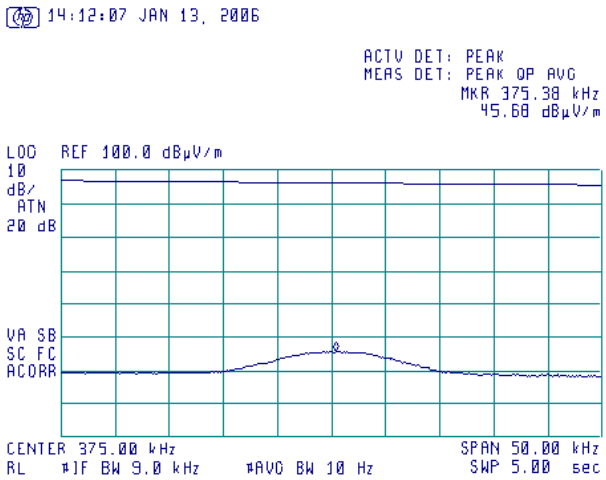
Plot 7.1.9 Radiated emission measurements at the third harmonic frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Typical (Towards the antenna)
DETECTOR: Peak



Plot 7.1.10 Radiated emission measurements at the third harmonic frequency

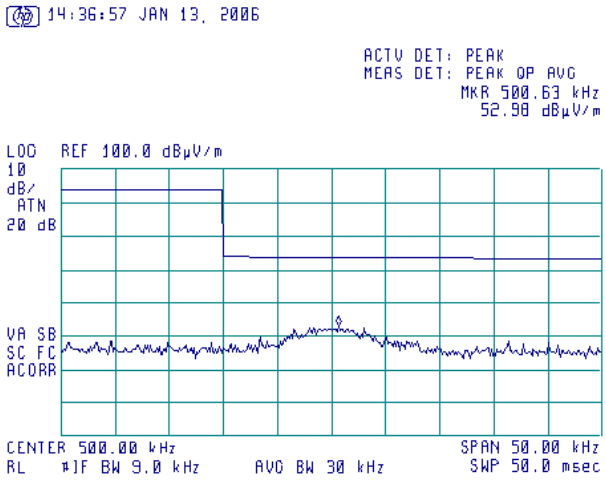
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Typical (Towards the antenna)
DETECTOR: Average



Test specification:	Section 15.209(a), (c) - Field strength of fundamental and unwanted emissions		
Test procedure:	ANSI C63.4, Sections 5.3 and 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	1/13/2006 4:04:30 PM		
Temperature: 24 ºC	Air Pressure: 1010 hPa	Relative Humidity: 40 %	Power Supply: 24 VDC
Remarks:			

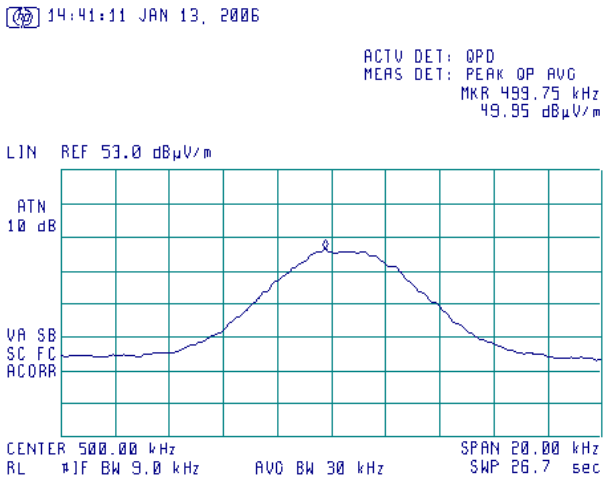
Plot 7.1.11 Radiated emission measurements at the forth harmonic frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Typical (Towards the antenna)
DETECTOR: Peak



Plot 7.1.12 Radiated emission measurements at the forth harmonic frequency

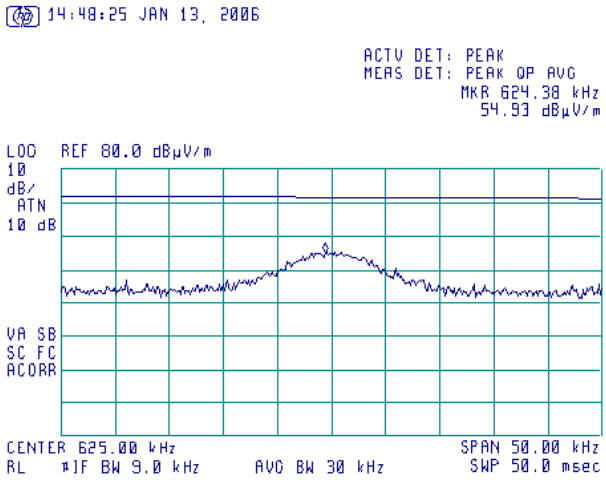
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Typical (Towards the antenna)
DETECTOR: Quasi-peak



Test specification:	Section 15.209(a), (c) - Field strength of fundamental and unwanted emissions		
Test procedure:	ANSI C63.4, Sections 5.3 and 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	1/13/2006 4:04:30 PM		
Temperature: 24 °C	Air Pressure: 1010 hPa	Relative Humidity: 40 %	Power Supply: 24 VDC
Remarks:			

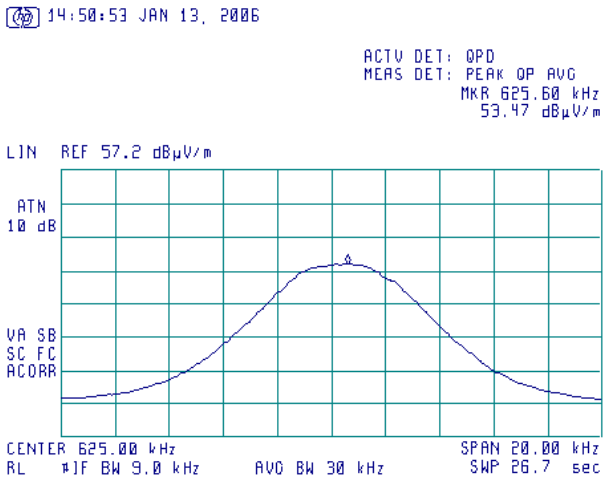
Plot 7.1.13 Radiated emission measurements at the fifth harmonic frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Typical (Towards the antenna)
DETECTOR: Peak



Plot 7.1.14 Radiated emission measurements at the fifth harmonic frequency

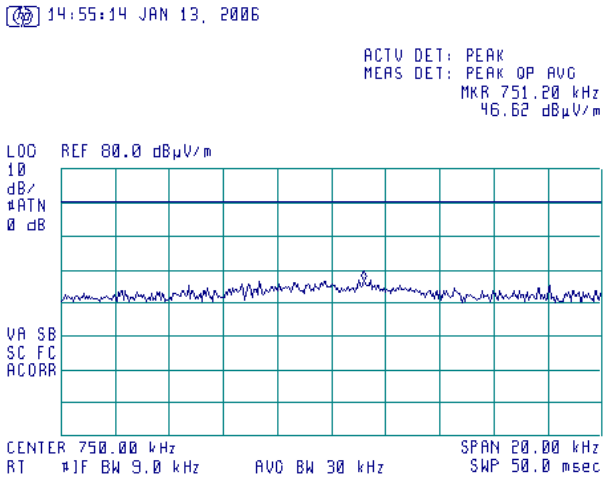
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Typical (Towards the antenna)
DETECTOR: Quasi-peak



Test specification:	Section 15.209(a), (c) - Field strength of fundamental and unwanted emissions		
Test procedure:	ANSI C63.4, Sections 5.3 and 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	1/13/2006 4:04:30 PM		
Temperature: 24 ºC	Air Pressure: 1010 hPa	Relative Humidity: 40 %	Power Supply: 24 VDC
Remarks:			

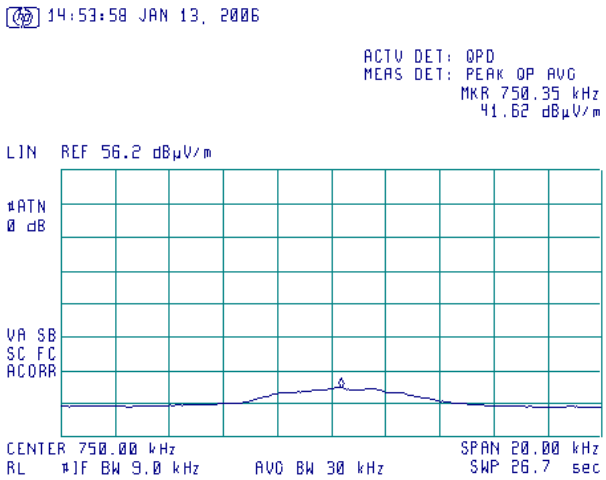
Plot 7.1.15 Radiated emission measurements at the sixth harmonic frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Typical (Towards the antenna)
DETECTOR: Peak



Plot 7.1.16 Radiated emission measurements at the sixth harmonic frequency

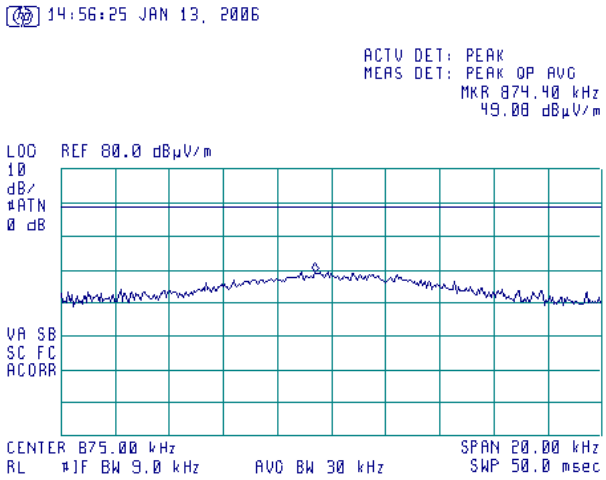
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Typical (Towards the antenna)
DETECTOR: Quasi-peak



Test specification:	Section 15.209(a), (c) - Field strength of fundamental and unwanted emissions		
Test procedure:	ANSI C63.4, Sections 5.3 and 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	1/13/2006 4:04:30 PM		
Temperature: 24 °C	Air Pressure: 1010 hPa	Relative Humidity: 40 %	Power Supply: 24 VDC
Remarks:			

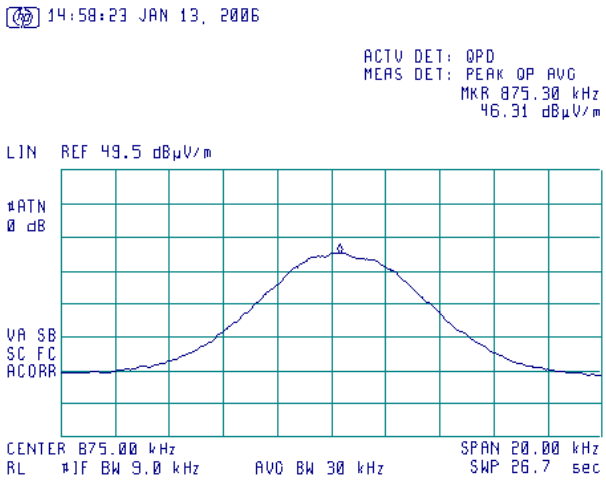
Plot 7.1.17 Radiated emission measurements at the seventh harmonic frequency

TEST SITE:	Semi anechoic chamber
TEST DISTANCE:	3 m
ANTENNA POLARIZATION:	Vertical
EUT POSITION:	Typical (Towards the antenna)
DETECTOR:	Peak



Plot 7.1.18 Radiated emission measurements at the seventh harmonic frequency

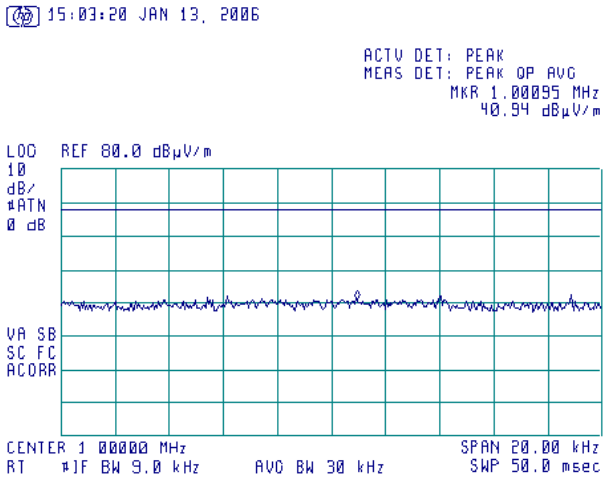
TEST SITE:	Semi anechoic chamber
TEST DISTANCE:	3 m
ANTENNA POLARIZATION:	Vertical
EUT POSITION:	Typical (Towards the antenna)
DETECTOR:	Quasi-peak



Test specification:	Section 15.209(a), (c) - Field strength of fundamental and unwanted emissions		
Test procedure:	ANSI C63.4, Sections 5.3 and 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	1/13/2006 4:04:30 PM		
Temperature: 24 °C	Air Pressure: 1010 hPa	Relative Humidity: 40 %	Power Supply: 24 VDC
Remarks:			

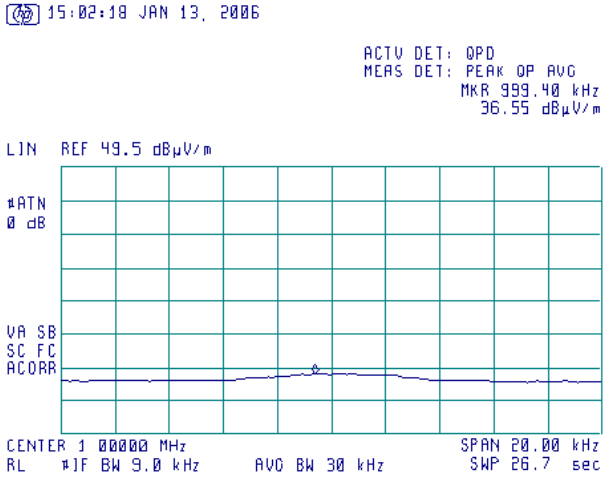
Plot 7.1.19 Radiated emission measurements at the eighth harmonic frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Typical (Towards the antenna)
DETECTOR: Peak



Plot 7.1.20 Radiated emission measurements at the eighth harmonic frequency

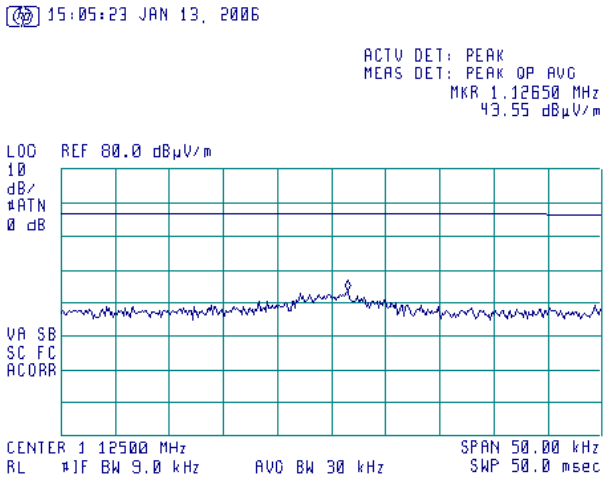
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Typical (Towards the antenna)
DETECTOR: Quasi-peak



Test specification:	Section 15.209(a), (c) - Field strength of fundamental and unwanted emissions		
Test procedure:	ANSI C63.4, Sections 5.3 and 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	1/13/2006 4:04:30 PM		
Temperature: 24 ºC	Air Pressure: 1010 hPa	Relative Humidity: 40 %	Power Supply: 24 VDC
Remarks:			

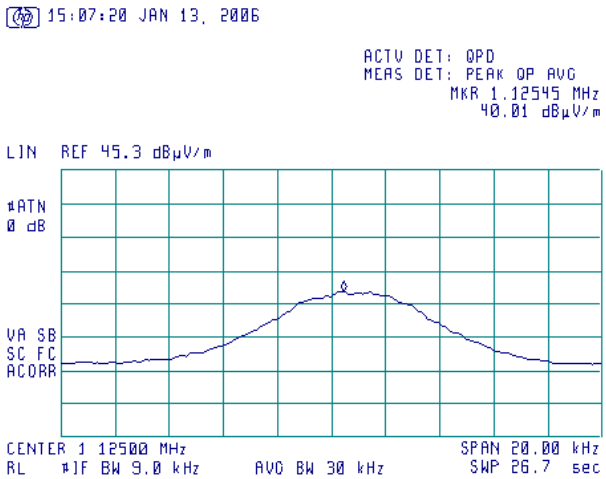
Plot 7.1.21 Radiated emission measurements at the ninth harmonic frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Typical (Towards the antenna)
DETECTOR: Peak



Plot 7.1.22 Radiated emission measurements at the ninth harmonic frequency

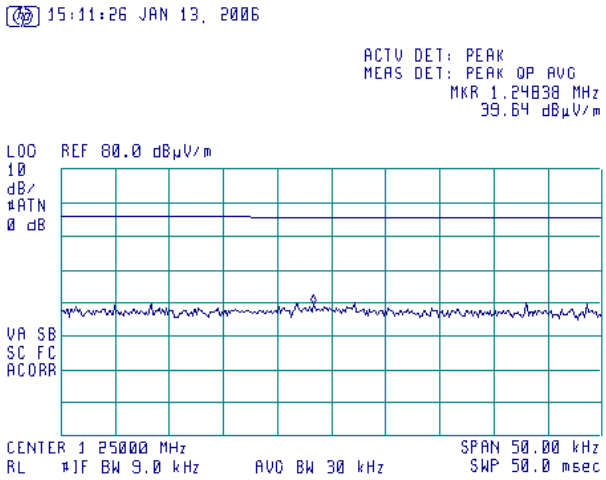
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Typical (Towards the antenna)
DETECTOR: Quasi-peak



Test specification:	Section 15.209(a), (c) - Field strength of fundamental and unwanted emissions		
Test procedure:	ANSI C63.4, Sections 5.3 and 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	1/13/2006 4:04:30 PM		
Temperature: 24 °C	Air Pressure: 1010 hPa	Relative Humidity: 40 %	Power Supply: 24 VDC
Remarks:			

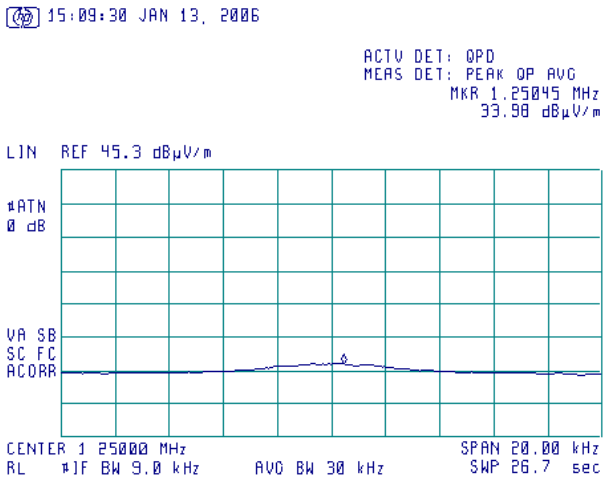
Plot 7.1.23 Radiated emission measurements at the tenth harmonic frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Typical (Towards the antenna)
DETECTOR: Peak



Plot 7.1.24 Radiated emission measurements at the tenth harmonic frequency

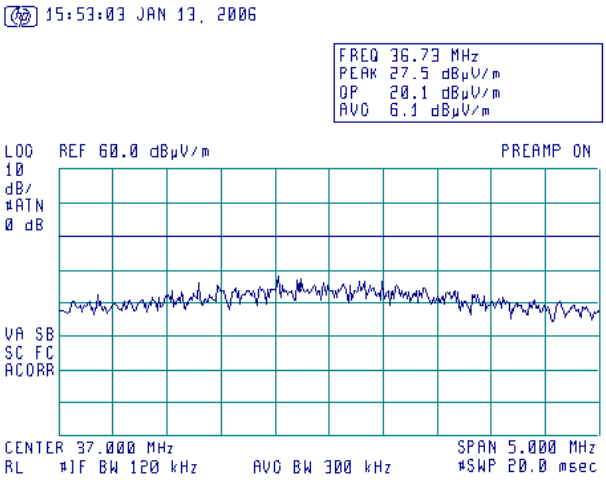
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Typical (Towards the antenna)
DETECTOR: Quasi-peak



Test specification:	Section 15.209(a), (c) - Field strength of fundamental and unwanted emissions		
Test procedure:	ANSI C63.4, Sections 5.3 and 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	1/13/2006 4:04:30 PM		
Temperature: 24 ºC	Air Pressure: 1010 hPa	Relative Humidity: 40 %	Power Supply: 24 VDC
Remarks:			

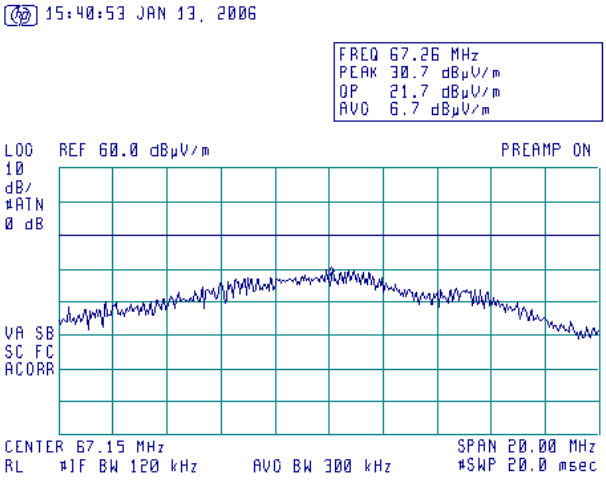
Plot 7.1.25 Radiated emission measurements at 36.7 MHz

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Typical (Towards the antenna)



Plot 7.1.26 Radiated emission measurements at 67.2 MHz

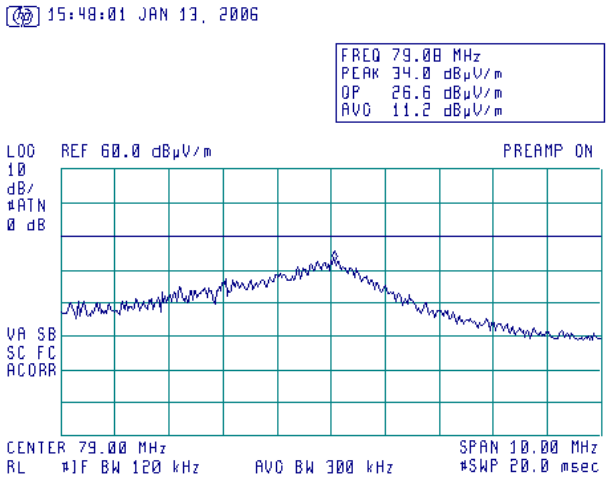
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Typical (Towards the antenna)



Test specification:	Section 15.209(a), (c) - Field strength of fundamental and unwanted emissions		
Test procedure:	ANSI C63.4, Sections 5.3 and 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	1/13/2006 4:04:30 PM		
Temperature: 24 °C	Air Pressure: 1010 hPa	Relative Humidity: 40 %	Power Supply: 24 VDC
Remarks:			

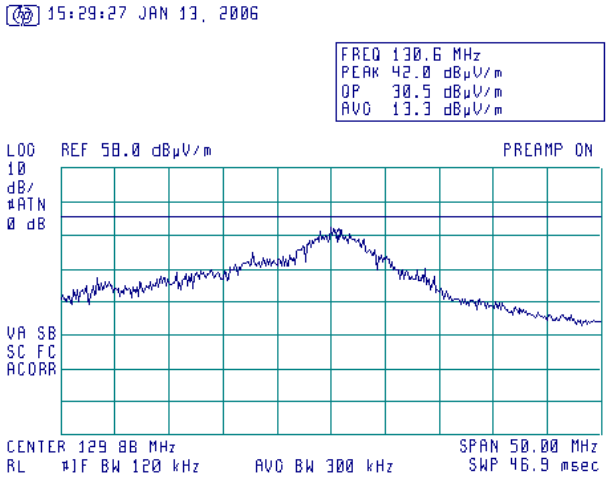
Plot 7.1.27 Radiated emission measurements at 79 MHz

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Typical (Towards the antenna)



Plot 7.1.28 Radiated emission measurements at 130.6 MHz

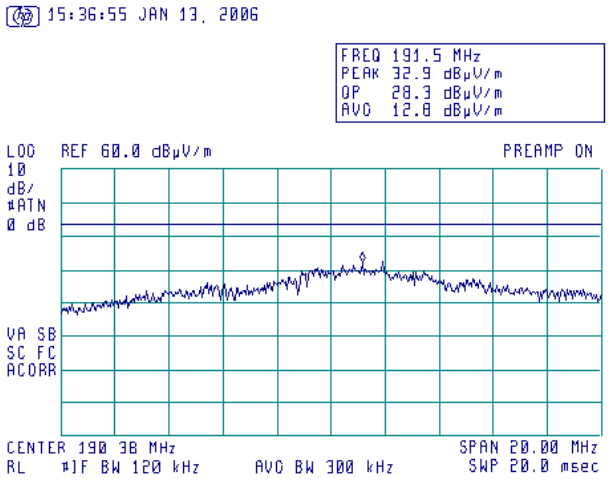
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Typical (Towards the antenna)



Test specification:	Section 15.209(a), (c) - Field strength of fundamental and unwanted emissions		
Test procedure:	ANSI C63.4, Sections 5.3 and 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	1/13/2006 4:04:30 PM		
Temperature: 24 ºC	Air Pressure: 1010 hPa	Relative Humidity: 40 %	Power Supply: 24 VDC
Remarks:			

Plot 7.1.29 Radiated emission measurements at 191.5 MHz

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Typical (Towards the antenna)



Test specification:	Section 15.207(a), Conducted emission		
Test procedure:	ANSI C63.4, Section 13.1.3		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	5/3/2007 7:44:08 PM		
Temperature: 22.4 ºC	Air Pressure: 1011 hPa	Relative Humidity: 51 %	Power Supply: 120 VAC
Remarks:			

7.2 Conducted emissions according to FCC CFR 47 PART 15 Subpart C, Section 15.207

7.2.1 General

This test was performed to measure common mode conducted emissions at the power port. Specification test limits are given in Table 7.2.1. The worst test results (the lowest margins) were recorded in Table 7.2.2 and shown in the associated plots.

Table 7.2.1 Limits for conducted emissions

Frequency, MHz	Class B limit, dB(µV)	
	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.

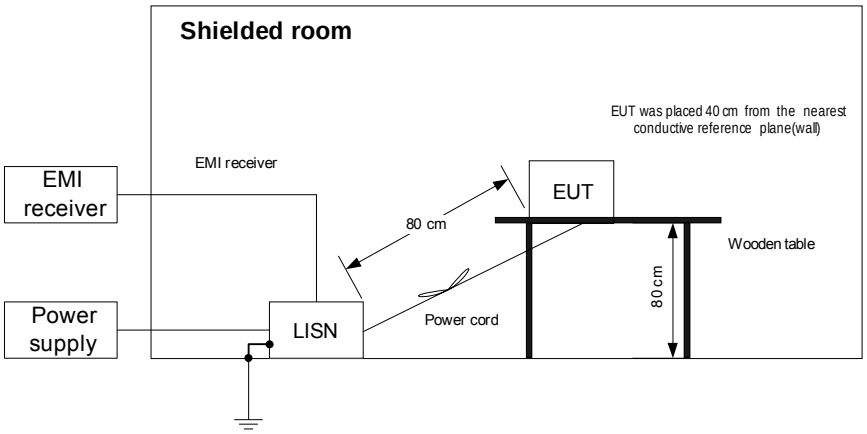
7.2.2 Test procedure

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 measurements were performed at power terminals with the LISN, connected to a spectrum analyzer in the frequency range referred to in Table 7.2.2. Unused coaxial connector of the LISN was terminated with 50 Ohm. Quasi-peak and average detectors were used throughout the testing.

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

Figure 7.2.1 Setup for conducted emission measurements



Test specification:	**Section 15.207(a), Conducted emission**		
Test procedure:	ANSI C63.4, Section 13.1.3		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	5/3/2007 7:44:08 PM		
Temperature: 22.4 ºC	**Air Pressure:** 1011 hPa	**Relative Humidity:** 51 %	**Power Supply:** 120 VAC
Remarks:			

Table 7.2.2 Conducted emission test results

LINE: AC mains input of power supply
EUT OPERATING MODE: Transmit at 125 kHz
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*		
0.204645	44.13	42.43	63.48	-21.05	37.86	53.48	-15.62	L1	Pass
0.237664	41.85	39.67	62.21	-22.54	34.86	52.21	-17.35		
18.875461	47.42	45.44	60.00	-14.56	38.59	50.00	-11.41		
21.000479	48.24	46.43	60.00	-13.57	39.43	50.00	-10.57		
23.625555	54.15	51.30	60.00	-8.70	45.27	50.00	-4.73		
24.125565	53.29	51.19	60.00	-8.81	45.91	50.00	-4.09		
0.202886	43.78	42.33	63.54	-21.21	37.89	53.54	-15.65	L2	Pass
0.238624	41.87	39.52	62.17	-22.65	34.32	52.17	-17.85		
19.875290	46.67	45.00	60.00	-15.00	38.50	50.00	-11.50		
23.625333	53.68	50.88	60.00	-9.12	44.68	50.00	-5.32		
23.875181	53.69	51.21	60.00	-8.79	45.54	50.00	-4.46		
24.375101	52.00	49.76	60.00	-10.24	44.78	50.00	-5.22		

*****- Margin = Measured emission - specification limit.

Reference numbers of test equipment used

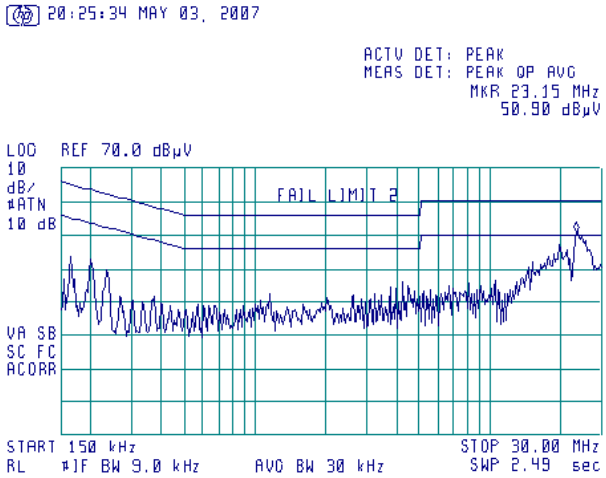
HL 0672	HL 0787	HL 1430	HL 1502	HL 1510	HL 2888	HL 2897	

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:	5/3/2007 7:44:08 PM		
Temperature: 22.4 ºC	Air Pressure: 1011 hPa	Relative Humidity: 51 %	Power Supply: 120 VAC
Remarks:			

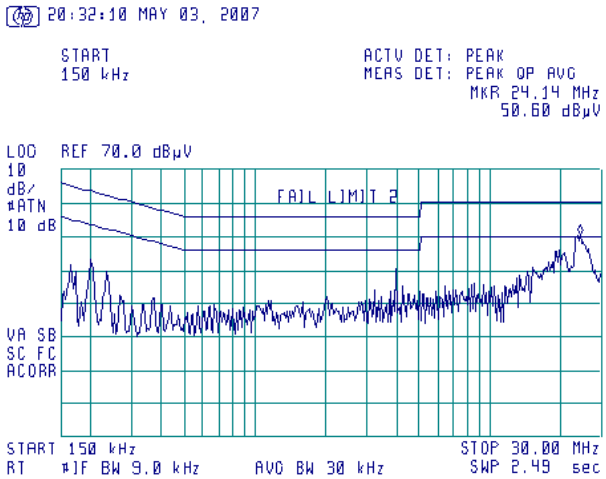
Plot 7.2.1 Conducted emission measurements, AC mains input of power supply

LINE: L1
LIMIT: QUASI-PEAK, AVERAGE
DETECTOR: PEAK



Plot 7.2.2 Conducted emission measurements, AC mains input of power supply

LINE: L2
LIMIT: QUASI-PEAK, AVERAGE
DETECTOR: PEAK



Test specification:	Section 15.107, Conducted emission at AC power port, Class B		
Test procedure:	ANSI C63.4, Sections 11.5 and 12.1.3		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	5/3/2007 7:44:08 PM		
Temperature: 22.4 ºC	Air Pressure: 1011 hPa	Relative Humidity: 51 %	Power Supply: 120 VAC
Remarks:			

7.3 Conducted emissions according to FCC CFR 47 PART 15 Subpart B, Section 15.107

7.3.1 General

This test was performed to measure common mode conducted emissions at the mains power port.
Specification test limits are given in Table 7.3.1. The worst test results (the lowest margins) were recorded in Table 7.2.2 and shown in the associated plots.

Table 7.3.1 Limits for conducted emissions

Frequency, MHz	Class B limit, dB(µV)		Class A limit, dB(µV)	
	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.

7.3.2 Test procedure

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

7.3.2.2 The EUT operates in normal operation mode only. The EUT passed Class B conducted emission limits as referred in Table 7.2.2 and shown in the associated plots (Section 7.2 of the test report).

Test specification:	Section 15.109, Radiated emission, Class B		
Test procedure:	ANSI C63.4, Sections 11.6 and 12.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	1/13/2006 4:04:30 PM		
Temperature: 24 ºC	Air Pressure: 1010 hPa	Relative Humidity: 40 %	Power Supply: 24 VDC
Remarks:			

7.4 Radiated emissions according to FCC CFR 47 PART 15 Subpart B, Section 15.109

7.4.1 General

This test was performed to measure radiated emissions from the EUT enclosure. Specification test limits are given in Table 7.4.1.

Table 7.4.1 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: $Lim_{S2} = Lim_{S1} + 20 \log (S_1/S_2)$,
where S_1 and S_2 – standard defined and test distance respectively in meters.

7.4.2 Test procedure

7.4.2.1 The EUT was set up as shown in Figure 7.1.2, energized and the performance check was conducted.

7.4.2.2 The EUT operates in normal operation mode only. The EUT passed Class B radiated emission limits as referred in Table 7.1.3 and shown in the associated plots (Section 7.1 of the test report).

Test specification:	Section 15.231(e), Periodic operation requirements		
Test procedure:	Supplier declaration		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	3/30/2007 12:23:31 PM		
Temperature: 22.7 ºC	Air Pressure: 1018 hPa	Relative Humidity: 48 %	Power Supply: 24 VDC
Remarks:			

8 Transmitter tests, EUT operating at 433.9 MHz

8.1 Periodic operation requirements according to FCC CFR 47 PART 15 Subpart C, Section 15.231(e)

8.1.1 General

The EUT was verified for compliance with periodic operation requirements listed below:
- Continuous transmissions such as voice, video and the radio control of toys are not permitted;
- Duration of each transmission shall not be greater than 1 second;
- Silent period between transmissions shall be at least 30 times the duration of the transmission;
- Silent period between transmissions shall be in no case less than 10 seconds.

The rationale for compliance with the above requirements was either test results or supplier declaration. The summary of results is provided in Table 8.1.1.

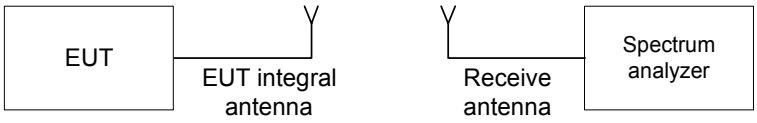
8.1.2 Test procedure for measurements of transmission duration

8.1.2.1 The EUT was set up as shown in Figure 8.1.1.

8.1.2.2 The spectrum analyzer center frequency was adjusted to the EUT carrier, span set to zero and video triggered for transmission.

8.1.2.3 The transmission time was captured and shown in Table 8.1.2.

Figure 8.1.1 Setup for transmitter shut down test



Test specification:	**Section 15.231(e), Periodic operation requirements**		
Test procedure:	Supplier declaration		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	3/30/2007 12:23:31 PM		
Temperature: 22.7 ºC	**Air Pressure:** 1018 hPa	**Relative Humidity:** 48 %	**Power Supply:** 24 VDC
Remarks:			

Table 8.1.1 Periodic operation requirements

Requirement	Rationale	Verdict
Continuous transmissions are permitted	Supplier declaration	Comply
Duration of each transmission shall not be greater than 1 second	Plot 8.1.5	Comply
Silent period between transmissions shall be at least 30 times the duration of the transmission	Plot 8.1.6	Comply
Silent period between transmissions shall be in no case less than 10 seconds	Plot 8.1.6	Comply

Table 8.1.2 Total duration of transmissions

Pulse duration*, ms		Pulse period, ms		Total transmission duration, ms	Silent period between transmissions, s	Silent period between transmissions limit, s	Margin, s
Preamble	Data	Preamble	Data				
0.495	0.195	0.533	0.222	1.86	10.95	10	0.95

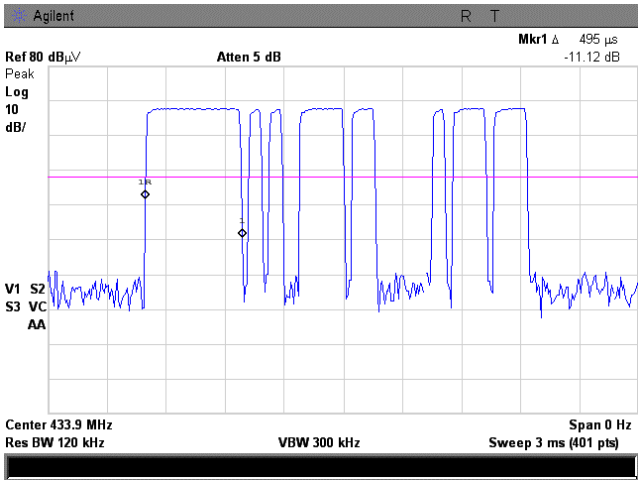
Reference numbers of test equipment used

HL 0337	HL 2909						

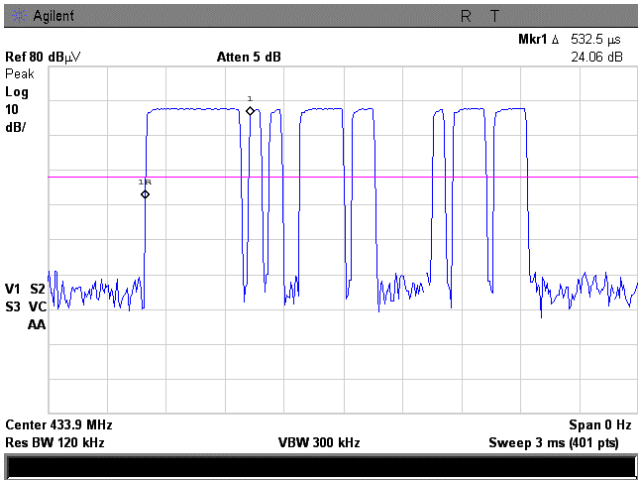
Full description is given in Appendix A.

Test specification:	Section 15.231(e), Periodic operation requirements		
Test procedure:	Supplier declaration		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	3/30/2007 12:23:31 PM		
Temperature: 22.7 ºC	Air Pressure: 1018 hPa	Relative Humidity: 48 %	Power Supply: 24 VDC
Remarks:			

Plot 8.1.1 Pulse duration, preamble

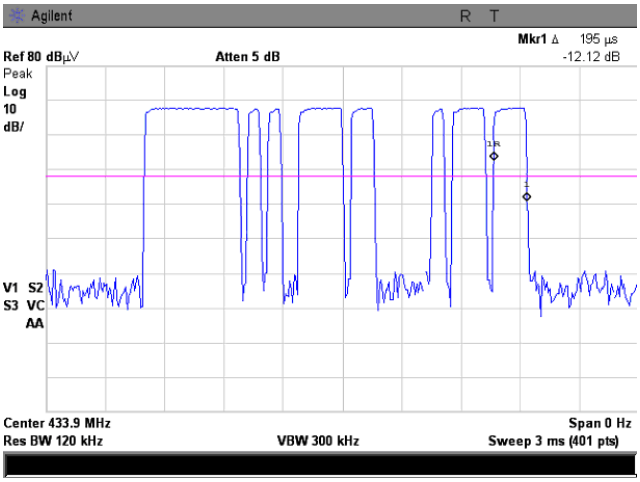


Plot 8.1.2 Pulse period, preamble

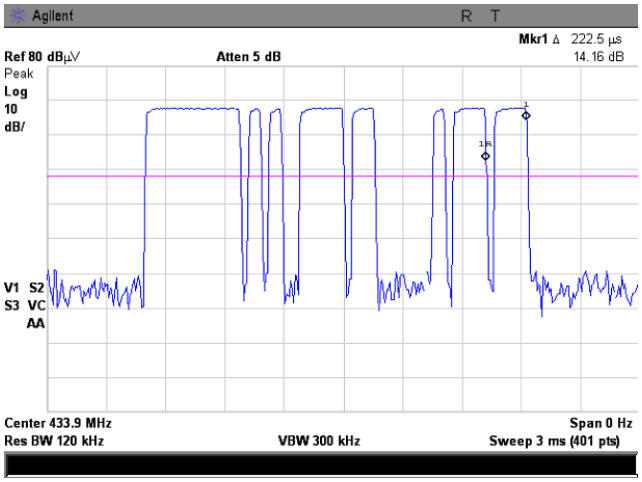


Test specification:	Section 15.231(e), Periodic operation requirements		
Test procedure:	Supplier declaration		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	3/30/2007 12:23:31 PM		
Temperature: 22.7 ºC	Air Pressure: 1018 hPa	Relative Humidity: 48 %	Power Supply: 24 VDC
Remarks:			

Plot 8.1.3 Pulse duration, data

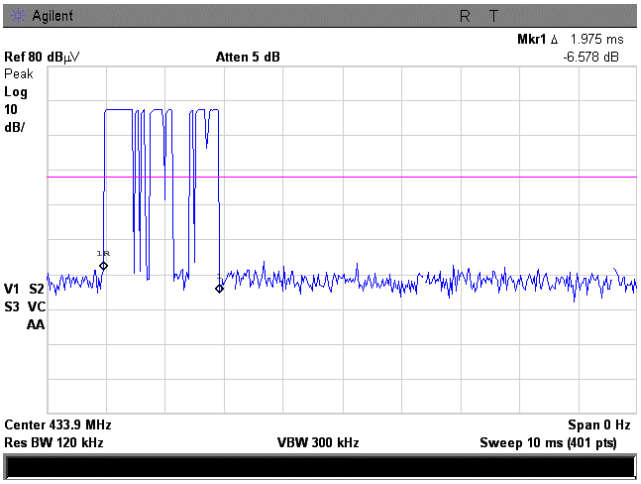


Plot 8.1.4 Pulse period, data

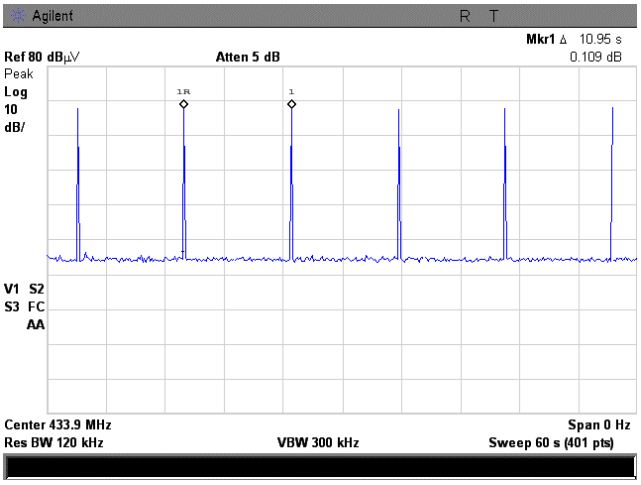


Test specification:	Section 15.231(e), Periodic operation requirements		
Test procedure:	Supplier declaration		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	3/30/2007 12:23:31 PM		
Temperature: 22.7 ºC	Air Pressure: 1018 hPa	Relative Humidity: 48 %	Power Supply: 24 VDC
Remarks:			

Plot 8.1.5 Transmission duration



Plot 8.1.6 Silent period between two adjacent transmissions



Test specification:	Section 15.231(b)/(e), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/1/2007 4:14:52 PM		
Temperature: 22.7 ºC	Air Pressure: 1018 hPa	Relative Humidity: 48 %	Power Supply: 24 VDC
Remarks:			

8.2 Field strength of emissions according to FCC CFR 47 PART 15 Subpart C, Section 15.231(b)/(e)

8.2.1 General

This test was performed to measure field strength of fundamental and spurious emissions from the EUT. Specification test limits are given in Table 8.2.1 and Table 8.2.2.

Table 8.2.1 Radiated fundamental emission limits

Fundamental frequency, MHz	Field strength at 3 m, dB(μV/m)	
	Peak	Average
433.92	92.87	72.87

Table 8.2.2 Radiated spurious emissions limits

Frequency, MHz	Field strength at 3 m, dB(μV/m)				
	Within restricted bands			Outside restricted bands	
	Peak	Quasi Peak	Average	Peak	Average
0.009 – 0.090	148.5 – 128.5	NA	128.5 – 108.5**	72.87	52.87
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			
Above 1000	74.0	NA	54.0		

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

$$Lim_{S2} = Lim_{S1} + 40 \log (S_1/S_2),$$

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

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

Note 1: The fundamental emission limit in dB(μV/m) was calculated as follows:

$$Lim_{AVR} = 20 \times \log(56.81818 \times F - 6136.3636)$$ - within 130 – 174 MHz band;

$$Lim_{AVR} = 20 \times \log(41.6667 \times F - 7083.3333)$$ - within 260 – 470 MHz band,

where F is the carrier frequency in MHz.

The limit for spurious emissions was 20 dB lower than fundamental emission limit.

The above limits provided in terms of average values, peak limit was 20 dB above the average limit.

Note 2: 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.

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

8.2.3 The EUT was set up as shown in Test procedure for spurious emission field strength measurements in 9 kHz to 30 MHz band

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

8.2.3.2 The measurements were performed in three EUT orthogonal positions.

8.2.3.3 The specified frequency range was investigated with loop antenna connected to spectrum analyzer/ EMI receiver. To find maximum radiation the turntable was rotated 360^0, the measuring antenna was rotated around its vertical axis and the measuring antenna polarization was switched from vertical to horizontal.

8.2.3.4 The worst test results (the lowest margins) were found in the EUT typical (towards the antenna) position, recorded in Table 7.1.3 and shown in the associated plots.

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

8.2.4.1 The EUT was set up as shown in Figure 7.1.2, energized and the performance check was conducted.

Test specification:	Section 15.231(b)/(e), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/1/2007 4:14:52 PM		
Temperature: 22.7 ºC	Air Pressure: 1018 hPa	Relative Humidity: 48 %	Power Supply: 24 VDC
Remarks:			

8.2.4.2 The measurements were performed in three EUT orthogonal positions.

8.2.4.3 The specified frequency range was investigated with antenna connected to spectrum analyzer/ EMI receiver. To find maximum radiation the turntable was rotated 360^0, the measuring antenna height was changed from 1 to 4 m, its polarization was switched from vertical to horizontal.

8.2.4.4 The worst test results (the lowest margins) were found in the EUT typical (towards the antenna) position, recorded in Table 7.1.3 and shown in the associated plots.

Test specification:	Section 15.231(b)/(e), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/1/2007 4:14:52 PM		
Temperature: 22.7 ºC	Air Pressure: 1018 hPa	Relative Humidity: 48 %	Power Supply: 24 VDC
Remarks:			

8.2.4.5 Figure 7.1.1, energized and the performance check was conducted.
8.2.4.6 The measurements were performed in three EUT orthogonal positions.
8.2.4.7 The specified frequency range was investigated with antenna connected to spectrum analyzer/ EMI receiver. To find maximum radiation the turntable was rotated 360^0 and the measuring antenna was rotated around its vertical axis.
8.2.4.8 The worst test results (the lowest margins) were found in the EUT vertical (Y) position, recorded in Table 8.2.3, Table 8.2.5 and shown in the associated plots.

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

8.2.5.1 The EUT was set up as shown in Figure 7.1.2, energized and the performance check was conducted.
8.2.5.2 The measurements were performed in three EUT orthogonal positions.
8.2.5.3 The specified frequency range was investigated with antenna connected to spectrum analyzer/ EMI receiver. To find maximum radiation the turntable was rotated 360^0, the measuring antenna height was changed from 1 to 4 m, its polarization was switched from vertical to horizontal.
8.2.5.4 The worst test results (the lowest margins) were found in the EUT vertical (Y) position, recorded in Table 8.2.3, Table 8.2.5 and shown in the associated plots.

Test specification:	Section 15.231(b)/(e), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/1/2007 4:14:52 PM		
Temperature: 22.7 ºC	Air Pressure: 1018 hPa	Relative Humidity: 48 %	Power Supply: 24 VDC
Remarks:			

Figure 8.2.1 Setup for spurious emission field strength measurements below 30 MHz

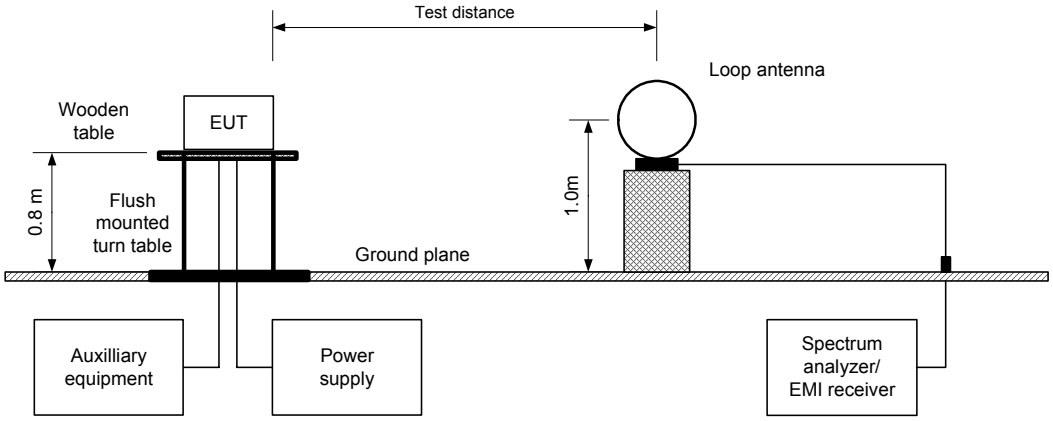
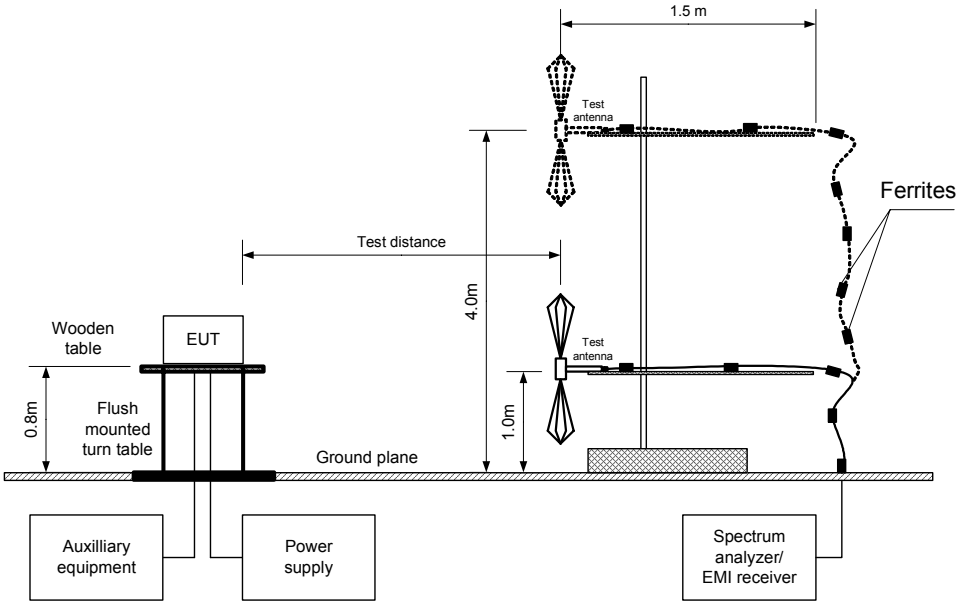


Figure 8.2.2 Setup for spurious emission field strength measurements above 30 MHz



Test specification:	Section 15.231(b)/(e), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/1/2007 4:14:52 PM		
Temperature: 22.7 ºC	Air Pressure: 1018 hPa	Relative Humidity: 48 %	Power Supply: 24 VDC
Remarks:			

Table 8.2.3 Field strength of fundamental emission, spurious emissions outside restricted bands and within restricted bands at frequencies above 1 GHz

TEST DISTANCE:	3 m
EUT POSITION:	Vertical (Y)
MODULATION:	ASK
TRANSMITTER OUTPUT POWER SETTINGS:	Maximum
INVESTIGATED FREQUENCY RANGE:	0.009 - 4500 MHz
DETECTOR USED:	Peak
RESOLUTION BANDWIDTH:	9.0 kHz (9 kHz – 30 MHz) 120 kHz (30 MHz – 1000 MHz) 1.0 MHz (above 1000 MHz)
VIDEO BANDWIDTH:	≥ Resolution bandwidth
TEST ANTENNA TYPE:	Active loop (9 kHz – 30 MHz) Biconilog (30 MHz – 2000 MHz) Double ridged guide (above 1000 MHz)

F, MHz	Antenna		Azimuth, degrees*	Peak field strength			Avr factor, dB	Average field strength			Verdict
	Pol.	Height, m		Measured, dB(μV/m)	Limit, dB(μV/m)	Margin, dB**		Measured, dB(μV/m)	Limit, dB(μV/m)	Margin, dB**	
Fundamental emission											
433.910	Vert.	1.0	210	77.96	92.87	-14.91	-34.6	43.36	72.87	-29.51	Pass
Spurious emissions											
867.816	Vert.	1.0	224	62.85	72.87	-10.02	-34.6	28.25	52.87	-24.62	Pass
1301.69	Horiz.	1.4	360	61.26	74.00	-12.74	-34.6	26.66	54.00	-27.34	
1735.61	Horiz.	1.6	321	52.24	72.87	-20.63	-34.6	17.64	52.87	-35.23	
2169.54	Horiz.	1.2	192	55.98	72.87	-16.89	-34.6	21.38	52.87	-31.49	
2603.68	Horiz.	1.4	225	56.15	72.87	-16.72	-34.6	21.55	52.87	-31.32	
3037.11	Vert.	1.0	221	55.58	72.87	-17.29	-34.6	20.98	52.87	-31.89	
3471.40	Horiz.	1.4	38	54.70	72.87	-18.17	-34.6	20.10	52.87	-31.77	
3905.47	Vert.	1.6	28	54.51	74.00	-19.49	-34.6	19.91	54.00	-34.09	

*****- EUT front panel refers to 0 degrees position of turntable.
******- Margin = dB below (negative if above) specification limit.

Table 8.2.4 Average factor calculation

Transmission pulse		Transmission burst		Transmission train duration, ms	Average factor, dB
Duration, ms	Period, ms	Duration, ms	Period, s		
0.495	0.533	1.86	10.95	1.86	-34.6

*- Average factor was calculated as follows

for pulse train shorter than 100 ms: $$Average\ factor = 20 \times \log_{10}\left(\frac{Pulse\ duration}{Pulse\ period} \times \frac{Burst\ duration}{Train\ duration} \times Number\ of\ bursts\ within\ pulse\ train\right)$$

for pulse train longer than 100 ms: $$Average\ factor = 20 \times \log_{10}\left(\frac{Pulse\ duration}{Pulse\ period} \times \frac{Burst\ duration}{100\,ms} \times Number\ of\ bursts\ within\ 100\,ms\right)$$

Test specification:	Section 15.231(b)/(e), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/1/2007 4:14:52 PM		
Temperature: 22.7 ºC	Air Pressure: 1018 hPa	Relative Humidity: 48 %	Power Supply: 24 VDC
Remarks:			

Table 8.2.5 Field strength of emissions below 1 GHz within restricted bands

TEST DISTANCE:	3 m
EUT POSITION:	Vertical (Y)
MODULATION:	ASK
TRANSMITTER OUTPUT POWER SETTINGS:	Maximum
INVESTIGATED FREQUENCY RANGE:	0.009 – 1000 MHz
DETECTOR USED:	Peak
RESOLUTION BANDWIDTH:	9.0 kHz (9 kHz – 30 MHz) 120 kHz (30 MHz – 1000 MHz)
VIDEO BANDWIDTH:	≥ Resolution bandwidth
TEST ANTENNA TYPE:	Active loop (9 kHz – 30 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*				
No spurious emissions were found.								Pass

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

Table 8.2.6 Restricted bands

MHz	MHz	MHz	MHz	MHz	GHz
0.09 - 0.11	8.37625 - 8.38675	73 - 74.6	399.9 - 410	2655 - 2900	10.6 - 12.7
0.495 - 0.505	8.41425 - 8.41475	74.8 - 75.2	608 - 614	3260 - 3267	13.25 - 13.4
2.1735 - 2.1905	12.29 - 12.293	108 - 121.94	960 - 1240	3332 - 3339	14.47 - 14.5
4.125 - 4.128	12.51975 - 12.52025	123 - 138	1300 - 1427	3345.8 - 3358	15.35 - 16.2
4.17725 - 4.17775	12.57675 - 12.57725	149.9 - 150.05	1435 - 1626.5	3600 - 4400	17.7 - 21.4
4.20725 - 4.20775	13.36 - 13.41	156.52475 - 156.52525	1645.5 - 1646.5	4500 - 5150	22.01 - 23.12
6.215 - 6.218	16.42 - 16.423	156.7 - 156.9	1660 - 1710	5350 – 5460	23.6 - 24
6.26775 - 6.26825	16.69475 - 16.69525	162.0125 - 167.17	1718.8 - 1722.2	7250 - 7750	31.2 - 31.8
6.31175 - 6.31225	16.80425 - 16.80475	167.72 - 173.2	2200 - 2300	8025 – 8500	36.43 - 36.5
8.291 - 8.294	25.5 - 25.67	240 - 285	2310 - 2390	9000 - 9200	Above 38.6
8.362 - 8.366	37.5 - 38.25	322 - 335.4	2483.5 - 2500	9300 - 9500	

Reference numbers of test equipment used

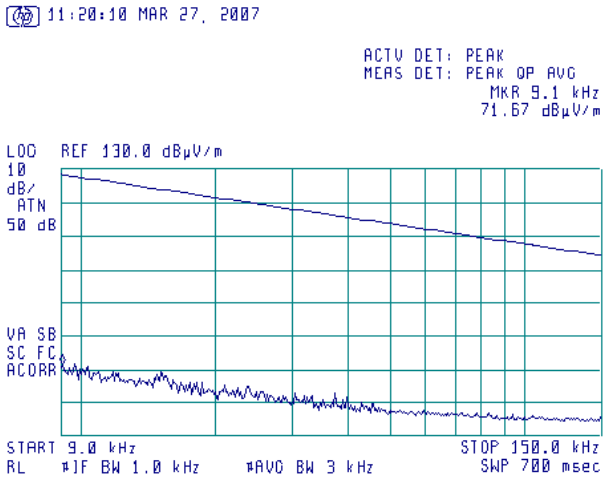
HL 0446	HL 0465	HL 0521	HL 0554	HL 0589	HL 0593	HL 0594	HL 0604
HL 1004	HL 1365	HL 1424	HL 1947	HL 2009	HL 2432	HL 2909	

Full description is given in Appendix A.

Test specification:	Section 15.231(b)/(e), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/1/2007 4:14:52 PM		
Temperature: 22.7 ºC	Air Pressure: 1018 hPa	Relative Humidity: 48 %	Power Supply: 24 VDC
Remarks:			

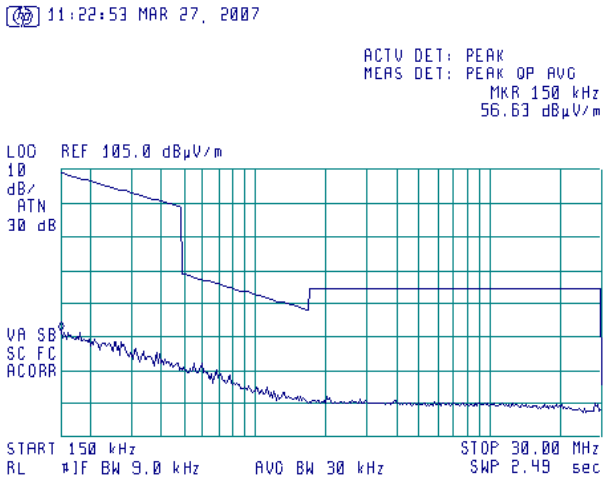
Plot 8.2.1 Radiated emission measurements from 9 to 150 kHz

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Vertical (Y)



Plot 8.2.2 Radiated emission measurements from 0.15 to 30 MHz

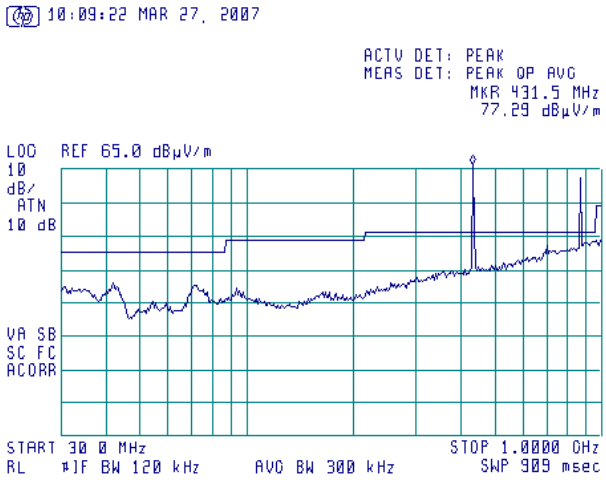
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Vertical (Y)



Test specification:	Section 15.231(b)/(e), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/1/2007 4:14:52 PM		
Temperature: 22.7 ºC	Air Pressure: 1018 hPa	Relative Humidity: 48 %	Power Supply: 24 VDC
Remarks:			

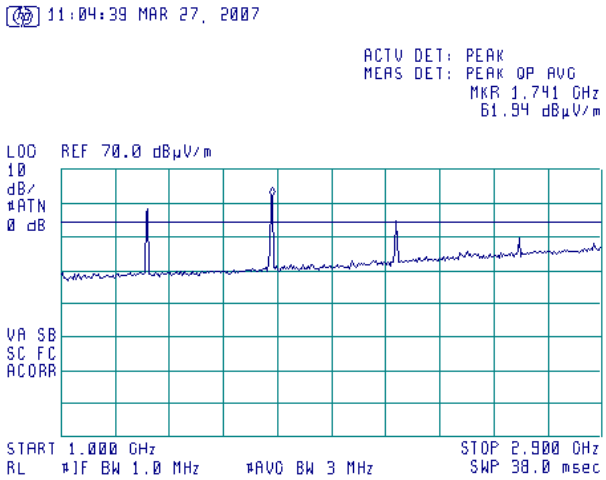
Plot 8.2.3 Radiated emission measurements from 30 to 1000 MHz

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POSITION: Vertical (Y)



Plot 8.2.4 Radiated emission measurements from 1000 to 2900 MHz

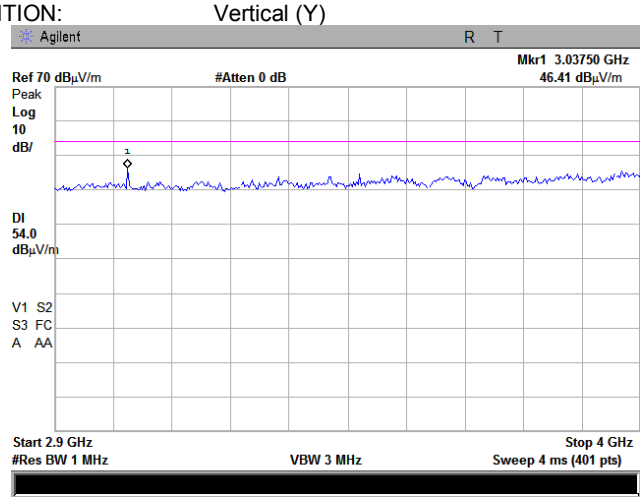
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POSITION: Vertical (Y)



Test specification:	Section 15.231(b)/(e), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/1/2007 4:14:52 PM		
Temperature: 22.7 ºC	Air Pressure: 1018 hPa	Relative Humidity: 48 %	Power Supply: 24 VDC
Remarks:			

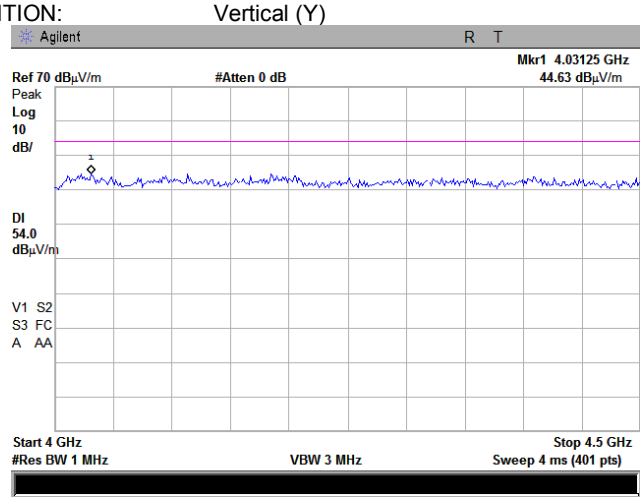
Plot 8.2.5 Radiated emission measurements from 2900 to 4000 MHz

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POSITION: Vertical (Y)



Plot 8.2.6 Radiated emission measurements from 4000 to 4500 MHz

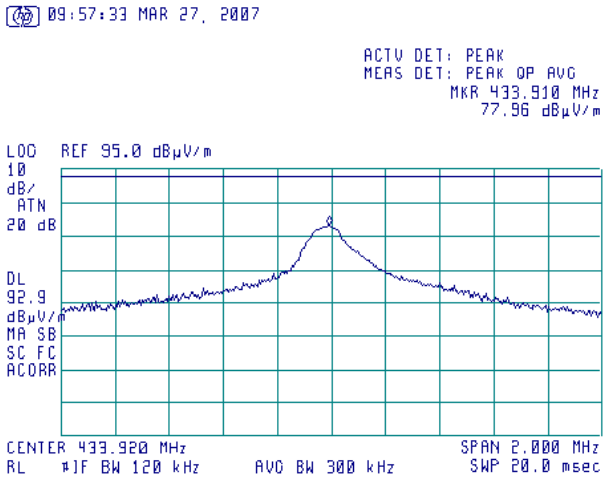
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POSITION: Vertical (Y)



Test specification:	Section 15.231(b)/(e), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/1/2007 4:14:52 PM		
Temperature: 22.7 ºC	Air Pressure: 1018 hPa	Relative Humidity: 48 %	Power Supply: 24 VDC
Remarks:			

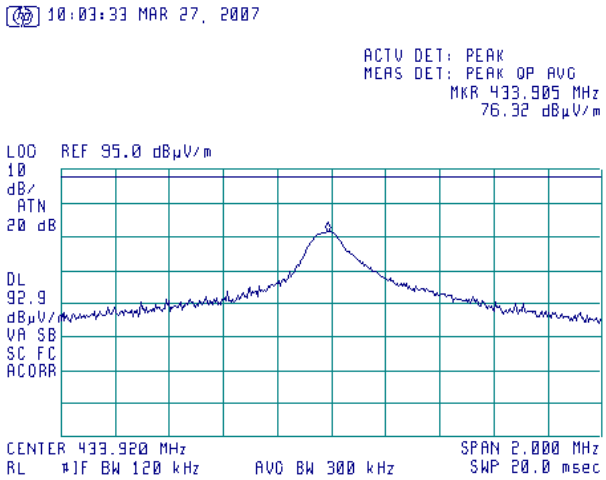
Plot 8.2.7 Radiated emission measurements at the fundamental frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Vertical (Y)



Plot 8.2.8 Radiated emission measurements at the fundamental frequency

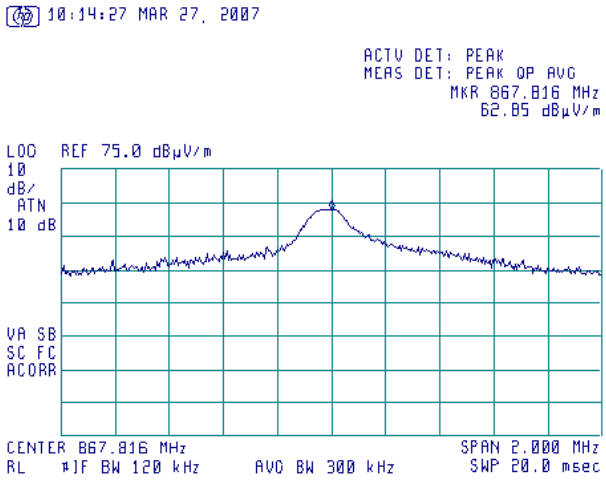
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal
EUT POSITION: Vertical (Y)



Test specification:	Section 15.231(b)/(e), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/1/2007 4:14:52 PM		
Temperature: 22.7 ºC	Air Pressure: 1018 hPa	Relative Humidity: 48 %	Power Supply: 24 VDC
Remarks:			

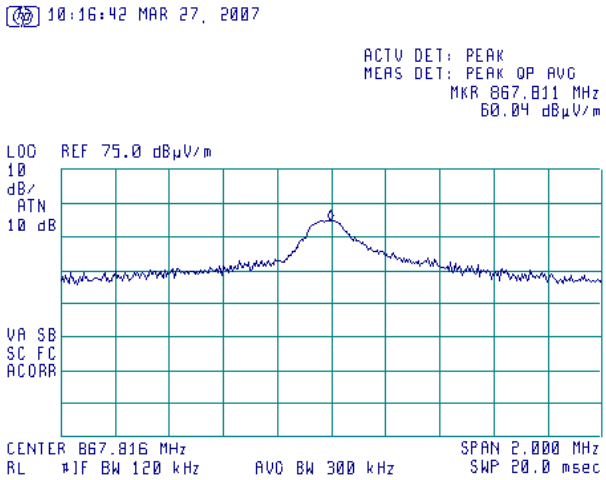
Plot 8.2.9 Radiated emission measurements at the second harmonic frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Vertical (Y)



Plot 8.2.10 Radiated emission measurements at the second harmonic frequency

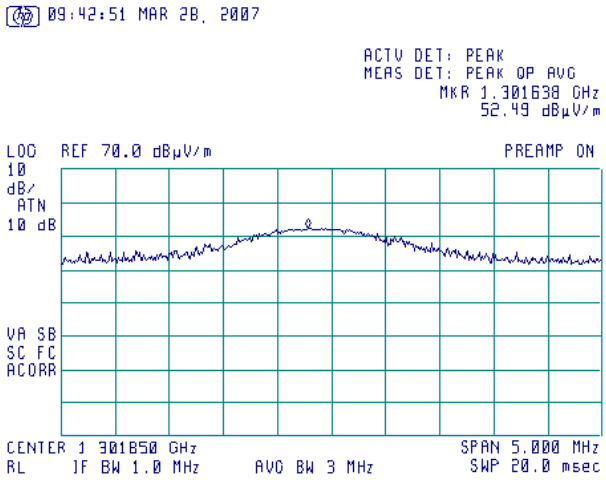
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal
EUT POSITION: Vertical (Y)



Test specification:	Section 15.231(b)/(e), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/1/2007 4:14:52 PM		
Temperature: 22.7 ºC	Air Pressure: 1018 hPa	Relative Humidity: 48 %	Power Supply: 24 VDC
Remarks:			

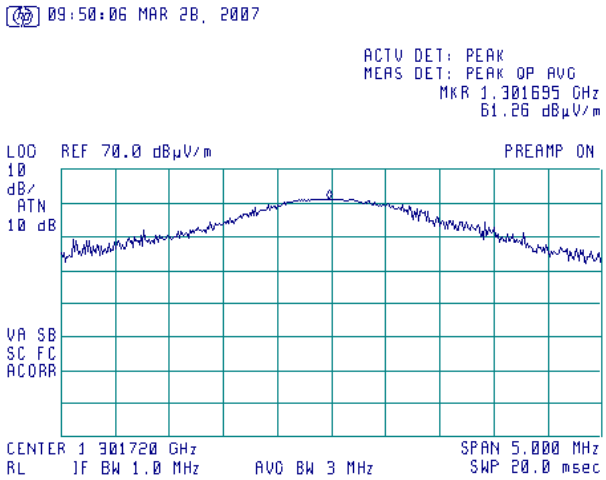
Plot 8.2.11 Radiated emission measurements at the third harmonic frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Vertical (Y)



Plot 8.2.12 Radiated emission measurements at the third harmonic frequency

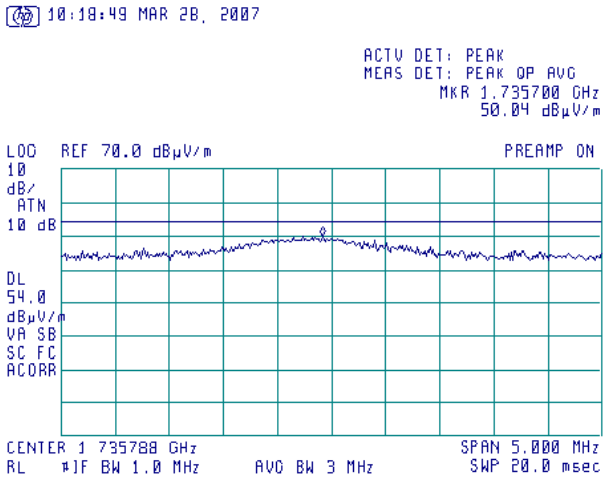
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal
EUT POSITION: Vertical (Y)



Test specification:	Section 15.231(b)/(e), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/1/2007 4:14:52 PM		
Temperature: 22.7 ºC	Air Pressure: 1018 hPa	Relative Humidity: 48 %	Power Supply: 24 VDC
Remarks:			

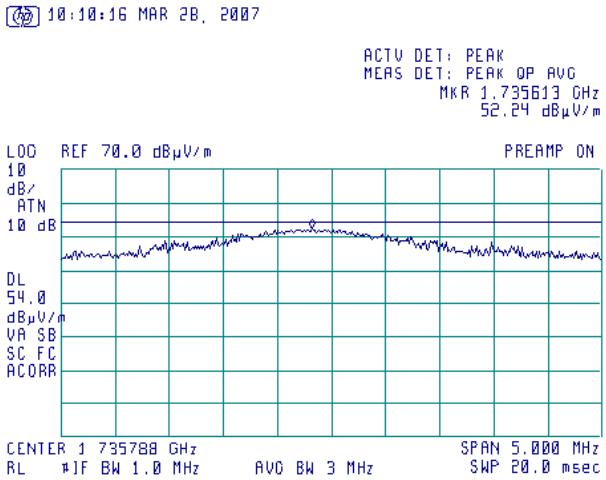
Plot 8.2.13 Radiated emission measurements at the forth harmonic frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Vertical (Y)



Plot 8.2.14 Radiated emission measurements at the forth harmonic frequency

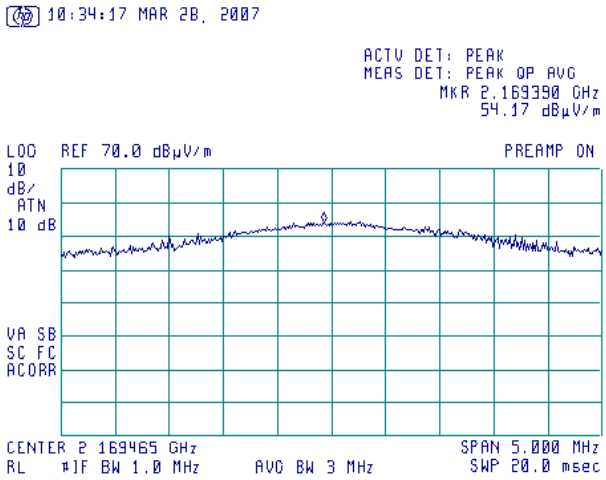
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal
EUT POSITION: Vertical (Y)



Test specification:	Section 15.231(b)/(e), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/1/2007 4:14:52 PM		
Temperature: 22.7 ºC	Air Pressure: 1018 hPa	Relative Humidity: 48 %	Power Supply: 24 VDC
Remarks:			

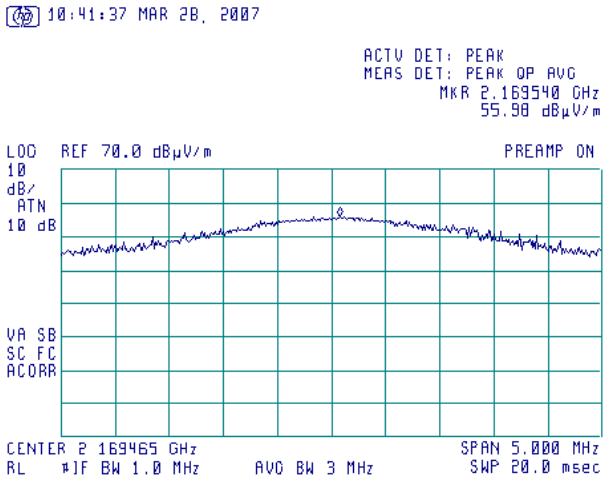
Plot 8.2.15 Radiated emission measurements at the fifth harmonic frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Vertical (Y)



Plot 8.2.16 Radiated emission measurements at the fifth harmonic frequency

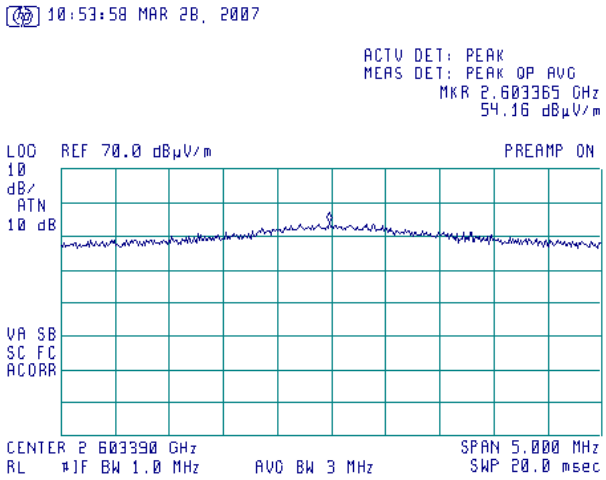
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal
EUT POSITION: Vertical (Y)



Test specification:	Section 15.231(b)/(e), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/1/2007 4:14:52 PM		
Temperature: 22.7 ºC	Air Pressure: 1018 hPa	Relative Humidity: 48 %	Power Supply: 24 VDC
Remarks:			

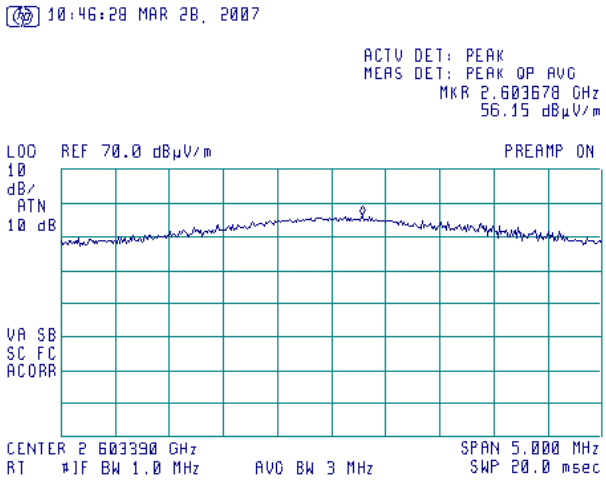
Plot 8.2.17 Radiated emission measurements at the sixth harmonic frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Vertical (Y)



Plot 8.2.18 Radiated emission measurements at the sixth harmonic frequency

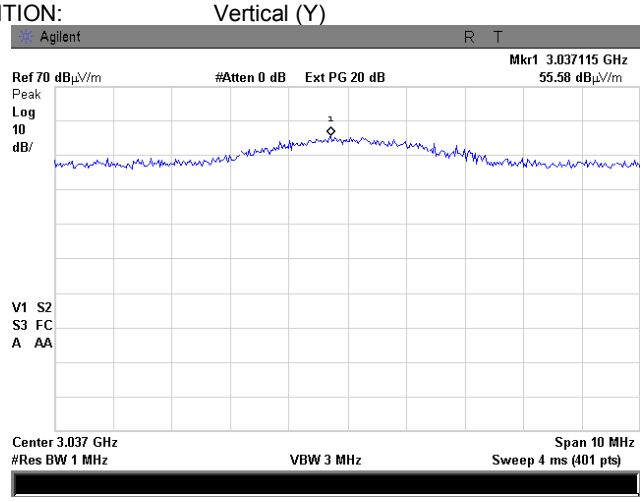
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal
EUT POSITION: Vertical (Y)



Test specification:	Section 15.231(b)/(e), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/1/2007 4:14:52 PM		
Temperature: 22.7 ºC	Air Pressure: 1018 hPa	Relative Humidity: 48 %	Power Supply: 24 VDC
Remarks:			

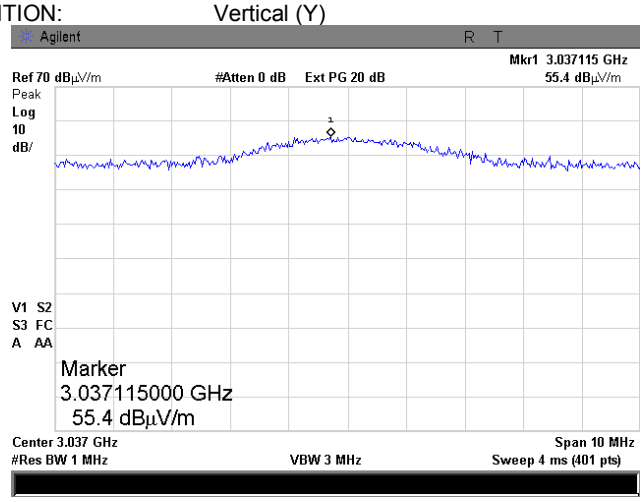
Plot 8.2.19 Radiated emission measurements at the seventh harmonic frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Vertical (Y)



Plot 8.2.20 Radiated emission measurements at the seventh harmonic frequency

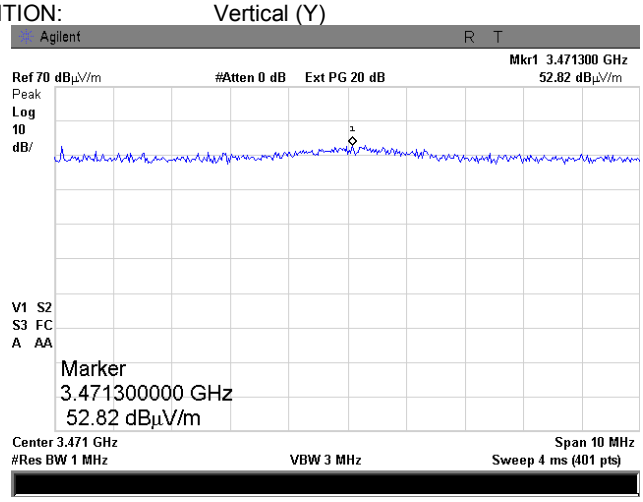
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal
EUT POSITION: Vertical (Y)



Test specification:	Section 15.231(b)/(e), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/1/2007 4:14:52 PM		
Temperature: 22.7 ºC	Air Pressure: 1018 hPa	Relative Humidity: 48 %	Power Supply: 24 VDC
Remarks:			

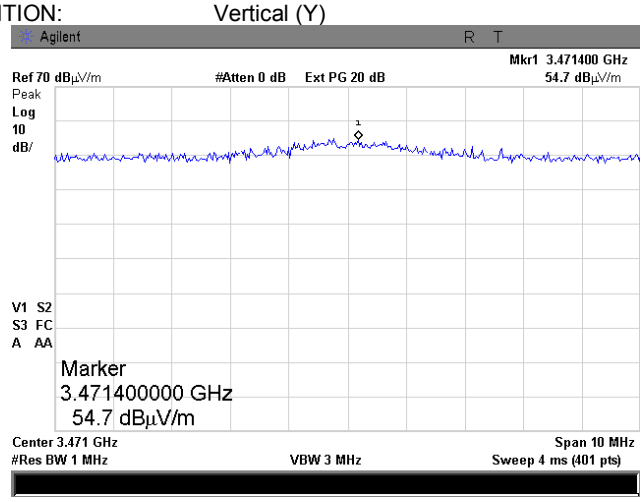
Plot 8.2.21 Radiated emission measurements at the eighth harmonic frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Vertical (Y)



Plot 8.2.22 Radiated emission measurements at the eighth harmonic frequency

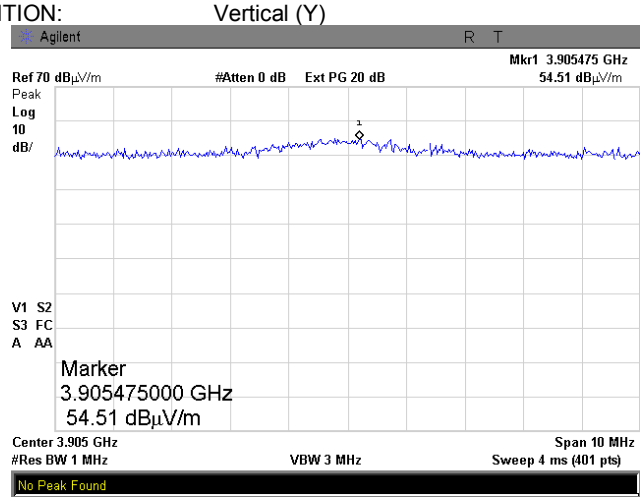
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal
EUT POSITION: Vertical (Y)



Test specification:	Section 15.231(b)/(e), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/1/2007 4:14:52 PM		
Temperature: 22.7 ºC	Air Pressure: 1018 hPa	Relative Humidity: 48 %	Power Supply: 24 VDC
Remarks:			

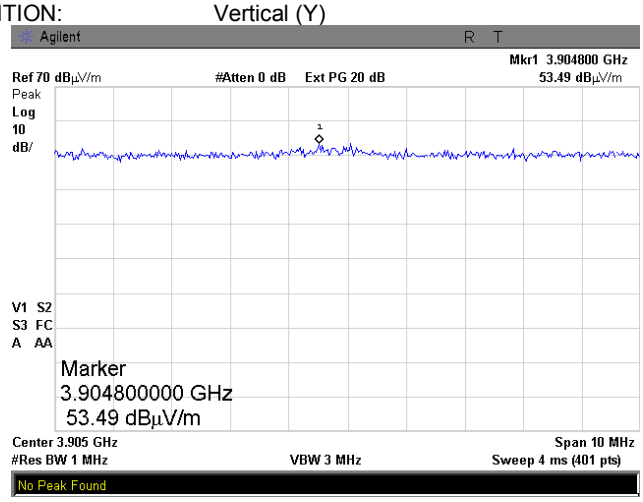
Plot 8.2.23 Radiated emission measurements at the ninth harmonic frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Vertical (Y)



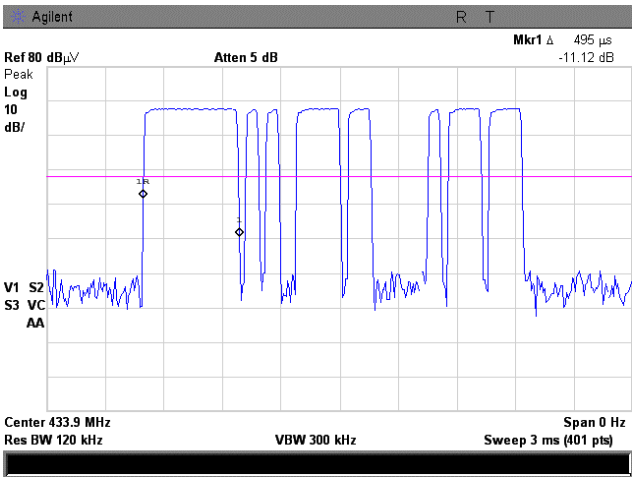
Plot 8.2.24 Radiated emission measurements at the ninth harmonic frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal
EUT POSITION: Vertical (Y)

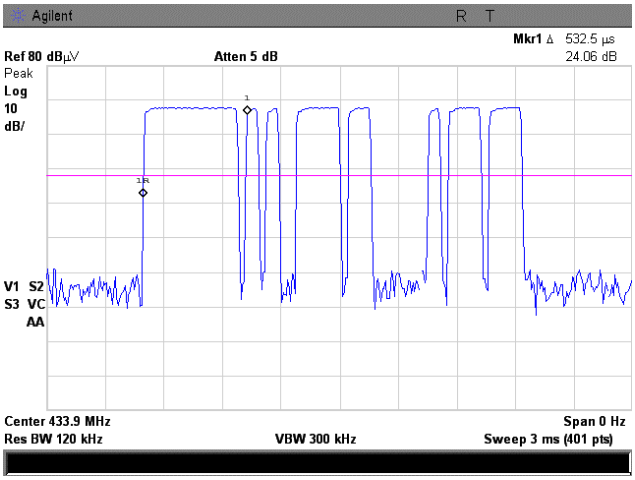


Test specification:	Section 15.231(b)/(e), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/1/2007 4:14:52 PM		
Temperature: 22.7 ºC	Air Pressure: 1018 hPa	Relative Humidity: 48 %	Power Supply: 24 VDC
Remarks:			

Plot 8.2.25 Pulse duration

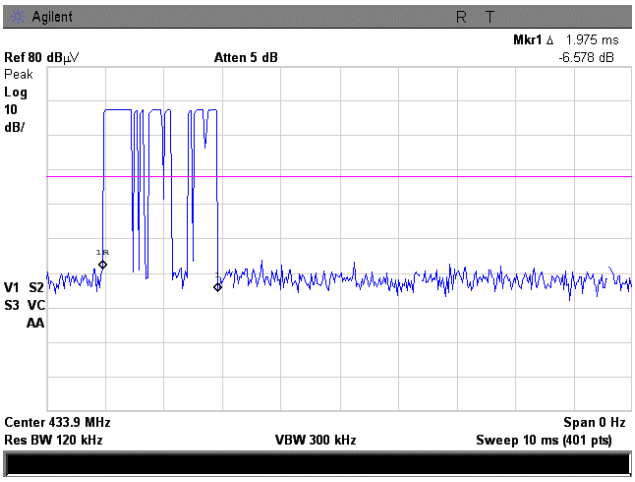


Plot 8.2.26 Pulse period

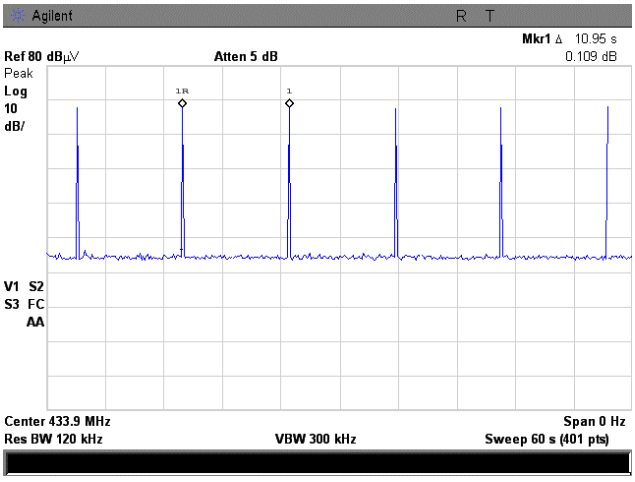


Test specification:	Section 15.231(b)/(e), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/1/2007 4:14:52 PM		
Temperature: 22.7 ºC	Air Pressure: 1018 hPa	Relative Humidity: 48 %	Power Supply: 24 VDC
Remarks:			

Plot 8.2.27 Transmission duration



Plot 8.2.28 Transmission period



Test specification:	Section 15.231(c), Occupied bandwidth		
Test procedure:	ANSI C63.4, Section 13.1.7		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	3/29/2007 9:17:39 AM		
Temperature: 22.7 ºC	Air Pressure: 1018 hPa	Relative Humidity: 48 %	Power Supply: 24 VDC
Remarks:			

8.3 Occupied bandwidth test

8.3.1 General

This test was performed to measure transmitter occupied bandwidth. Specification test limits are given in Table 8.3.1. The test results are provided in Table 8.3.2 and associated plots.

Table 8.3.1 Occupied bandwidth limits

Assigned frequency, MHz	Modulation envelope reference points*, dBc	Maximum allowed bandwidth, % of the carrier frequency
70 - 900	20.0	0.25

*- Modulation envelope reference points provided in terms of attenuation below modulated carrier.

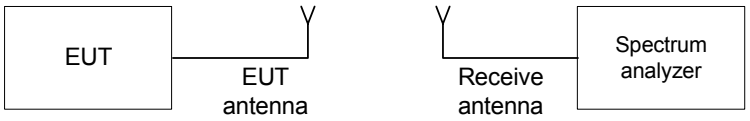
8.3.2 Test procedure

8.3.2.1 The EUT was set up as shown in Figure 8.3.1, energized and its proper operation was checked.

8.3.2.2 The EUT was set to transmit modulated carrier.

8.3.2.3 The transmitter occupied bandwidth was measured with spectrum analyzer as frequency delta between reference points on modulation envelope and provided in Table 8.3.2 and associated plots.

Figure 8.3.1 Occupied bandwidth test setup



Test specification:	Section 15.231(c), Occupied bandwidth		
Test procedure:	ANSI C63.4, Section 13.1.7		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	3/29/2007 9:17:39 AM		
Temperature: 22.7 ºC	Air Pressure: 1018 hPa	Relative Humidity: 48 %	Power Supply: 24 VDC
Remarks:			

Table 8.3.2 Occupied bandwidth test results

DETECTOR USED: Peak hold
RESOLUTION BANDWIDTH: 100 kHz
VIDEO BANDWIDTH: 300 kHz
MODULATION ENVELOPE REFERENCE POINTS: 20 dBc
MODULATION: ASK

Carrier frequency, MHz	Occupied bandwidth, kHz	Limit		Margin, kHz	Verdict
		% of the carrier frequency	kHz		
433.925	1000.0	0.25	1082.5	-82.5	Pass

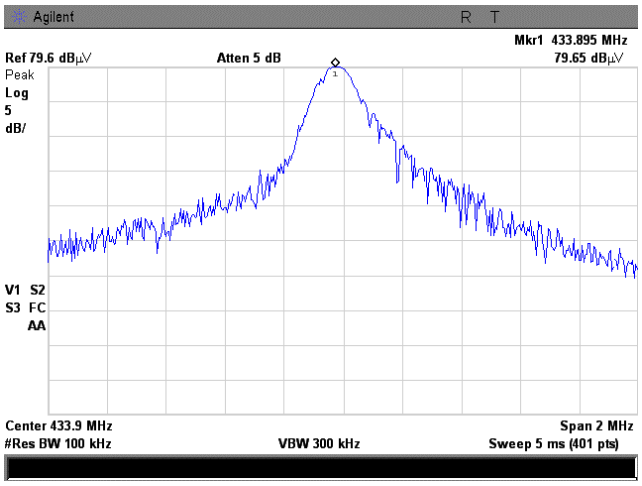
Reference numbers of test equipment used

HL 0337	HL 2909							

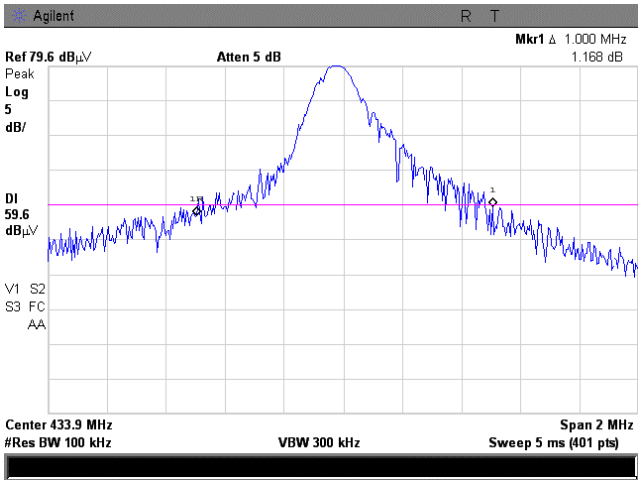
Full description is given in Appendix A.

Test specification:	Section 15.231(c), Occupied bandwidth		
Test procedure:	ANSI C63.4, Section 13.1.7		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	3/29/2007 9:17:39 AM		
Temperature: 22.7 ºC	Air Pressure: 1018 hPa	Relative Humidity: 48 %	Power Supply: 24 VDC
Remarks:			

Plot 8.3.1 Occupied bandwidth test result



Plot 8.3.2 Occupied bandwidth test result



Test specification:	Section 15.207(a), Conducted emission		
Test procedure:	ANSI C63.4, Section 13.1.3		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/22/2007 9:25:34 AM		
Temperature: 24.8 ºC	Air Pressure: 1012 hPa	Relative Humidity: 36 %	Power Supply: 120 VAC
Remarks:			

8.4 Conducted emissions according to FCC CFR 47 PART 15 Subpart C, Section 15.207

8.4.1 General

This test was performed to measure common mode conducted emissions at the power port. Specification test limits are given in Table 8.4.1. The worst test results (the lowest margins) were recorded in Table 8.4.2 and shown in the associated plots.

Table 8.4.1 Limits for conducted emissions

Frequency, MHz	Class B limit, dB(µV)	
	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.

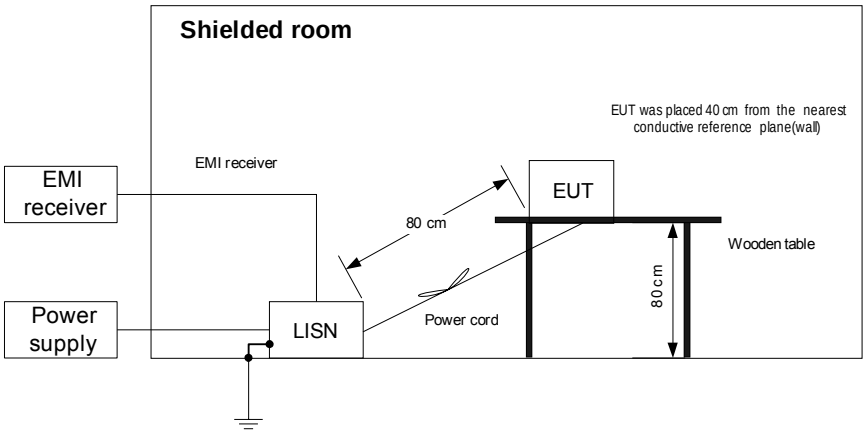
8.4.2 Test procedure

8.4.2.1 The EUT was set up as shown in Figure 8.4.1, energized and the performance check was conducted.

8.4.2.2 The measurements were performed at power terminals with the LISN, connected to a spectrum analyzer in the frequency range referred to in Table 8.4.2. Unused coaxial connector of the LISN was terminated with 50 Ohm. Quasi-peak and average detectors were used throughout the testing.

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

Figure 8.4.1 Setup for conducted emission measurements



Test specification:	Section 15.207(a), Conducted emission		
Test procedure:	ANSI C63.4, Section 13.1.3		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/22/2007 9:25:34 AM		
Temperature: 24.8 ºC	Air Pressure: 1012 hPa	Relative Humidity: 36 %	Power Supply: 120 VAC
Remarks:			

Table 8.4.2 Conducted emission test results

LINE: AC mains input of power supply
EUT OPERATING MODE: Transmit at 433.9 MHz
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*		
0.169778	49.48	47.96	65.04	-17.08	42.31	55.04	-12.73	L1	Pass
0.203545	47.89	46.42	63.52	-17.10	45.06	53.52	-8.46		
0.237797	49.85	49.18	62.20	-13.02	47.79	52.20	-4.41		
0.610258	38.49	37.77	56.00	-18.23	37.36	46.00	-8.64		
1.016676	37.25	36.42	56.00	-19.58	35.82	46.00	-10.18		
21.745816	46.23	44.90	60.00	-15.10	34.75	50.00	-15.25		
0.169462	50.64	48.43	65.05	-16.62	42.21	55.05	-12.84	L2	Pass
0.202845	48.01	46.39	63.54	-17.15	44.54	53.54	-9.00		
0.237047	50.05	49.43	62.23	-12.80	47.66	52.23	-4.57		
0.643490	38.86	37.90	56.00	-18.10	37.51	46.00	-8.49		
15.570591	43.07	42.25	60.00	-17.75	35.06	50.00	-14.94		
21.738799	45.76	44.25	60.00	-15.75	34.39	50.00	-15.61		

*- Margin = Measured emission - specification limit.

Reference numbers of test equipment used

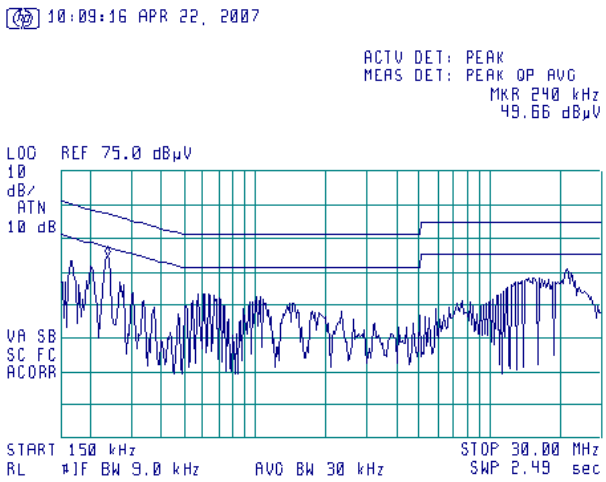
HL 0447	HL 0672	HL 0787	HL 1430	HL 1502	HL 1510		

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:	4/22/2007 9:25:34 AM		
Temperature: 24.8 ºC	Air Pressure: 1012 hPa	Relative Humidity: 36 %	Power Supply: 120 VAC
Remarks:			

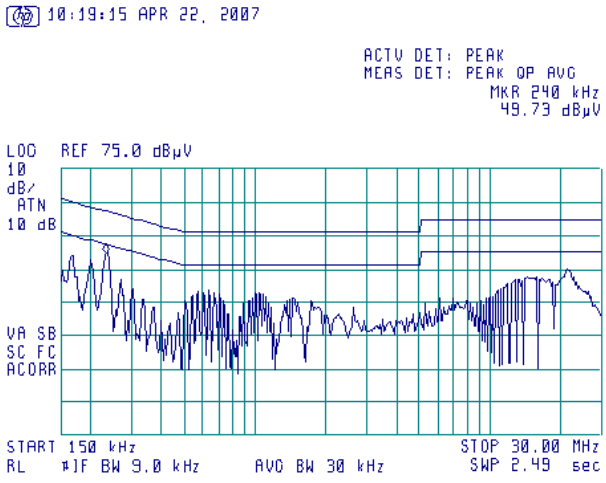
Plot 8.4.1 Conducted emission measurements, AC mains input of power supply

LINE: L1
LIMIT: QUASI-PEAK, AVERAGE
DETECTOR: PEAK



Plot 8.4.2 Conducted emission measurements, AC mains input of power supply

LINE: L2
LIMIT: QUASI-PEAK, AVERAGE
DETECTOR: PEAK



Test specification:	Section 15.107, Conducted emission at AC power port, Class B		
Test procedure:	ANSI C63.4, Sections 11.5 and 12.1.3		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/22/2007 9:25:34 AM		
Temperature: 24.8 ºC	Air Pressure: 1012 hPa	Relative Humidity: 36 %	Power Supply: 120 VAC
Remarks:			

8.5 Conducted emissions according to FCC CFR 47 PART 15 Subpart B, Section 15.107

8.5.1 General

This test was performed to measure common mode conducted emissions at the mains power port.
Specification test limits are given in Table 8.5.1. The worst test results (the lowest margins) were recorded in Table 8.4.2 and shown in the associated plots.

Table 8.5.1 Limits for conducted emissions

Frequency, MHz	Class B limit, dB(μV)		Class A limit, dB(μV)	
	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.

8.5.2 Test procedure

8.5.2.1 The EUT was set up as shown in Figure 8.4.1, energized and the performance check was conducted.

8.5.2.2 The EUT passed Class B conducted emission limits in transmit mode as referred in Table 8.4.2 and shown in the associated plots (Section 8.4 of the test report).

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:	4/1/2007 6:19:58 PM		
Temperature: 22.7 ºC	Air Pressure: 1018 hPa	Relative Humidity: 48 %	Power Supply: 24 VDC
Remarks:			

8.6 Radiated emissions according to FCC CFR 47 PART 15 Subpart B, Section 15.109

8.6.1 General

This test was performed to measure radiated emissions from the EUT enclosure. Specification test limits are given in Table 7.4.1.

Table 8.6.1 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: $Lim_{S2} = Lim_{S1} + 20 \log (S_1/S_2)$,
where S_1 and S_2 – standard defined and test distance respectively in meters.

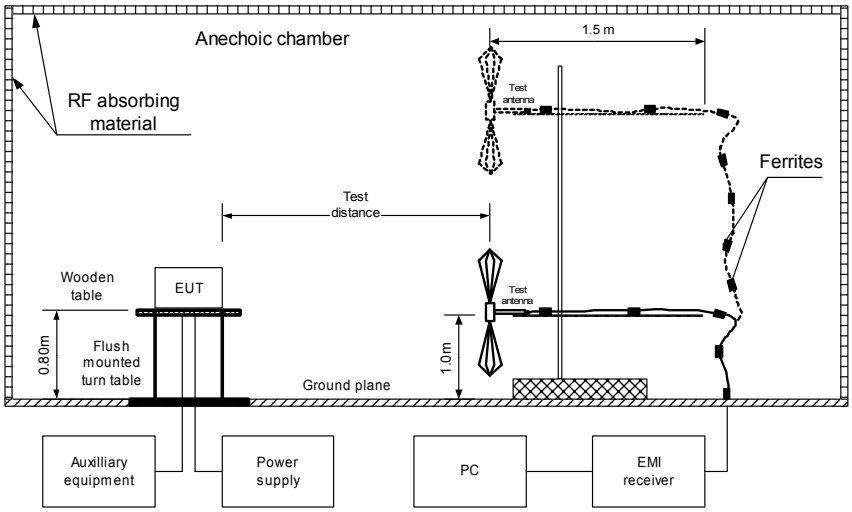
8.6.2 Test procedure

8.6.2.1 The EUT was set up as shown in Figure 8.6.1, energized and the performance check was conducted.

8.6.2.2 The measurements were performed in the semi anechoic chamber at 3 m test distance. The specified frequency range was investigated with biconilog antenna connected to EMI receiver. To find maximum radiation the turntable was rotated 360^0, 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.

8.6.2.3 The worst test results (the lowest margins) were recorded in Table 8.6.2 and shown in the associated plots.

Figure 8.6.1 Setup for radiated emission measurements in semi anechoic chamber



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:	4/1/2007 6:19:58 PM		
Temperature: 22.7 ºC	Air Pressure: 1018 hPa	Relative Humidity: 48 %	Power Supply: 24 VDC
Remarks:			

Table 8.6.2 Radiated emission test results

EUT SET UP: TABLE-TOP
LIMIT: Class B
EUT OPERATING MODE: Standby
TEST SITE: SEMI ANECHOIC CHAMBER
TEST DISTANCE: 3 m
FREQUENCY RANGE: 30 MHz – 1000 MHz
DETECTORS USED: PEAK / QUASI-PEAK
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*				
41.325000	36.06	35.10	40.00	-4.90	V	1.0	28	Pass
72.881600	35.92	32.18	40.00	-7.82	V	1.0	0	
157.855975	24.99	21.99	43.50	-21.51	H	1.4	182	
947.447200	37.00	32.29	46.00	-13.71	V	1.2	316	

FREQUENCY RANGE: 1000 MHz – 2000 MHz
DETECTOR USED: PEAK
RESOLUTION BANDWIDTH: 1000 kHz

Frequency, MHz	Peak emission, dB(µV/m)	Average			Antenna polarization	Antenna height, m	Turn-table position**, degrees	Verdict
		Measured emission, dB(µV/m)	Limit, dB(µV/m)	Margin, dB*				
No emissions were found.								Pass

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

Reference numbers of test equipment used

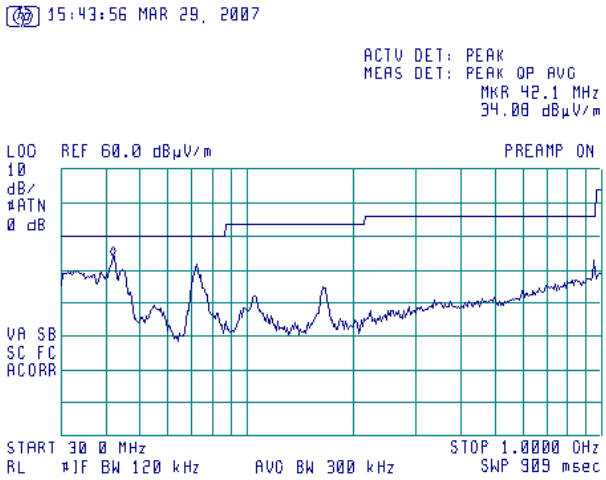
HL 0465	HL 0521	HL 0589	HL 0593	HL 0594	HL 0604	HL 1004	HL 2009

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:	4/1/2007 6:19:58 PM		
Temperature: 22.7 ºC	Air Pressure: 1018 hPa	Relative Humidity: 48 %	Power Supply: 24 VDC
Remarks:			

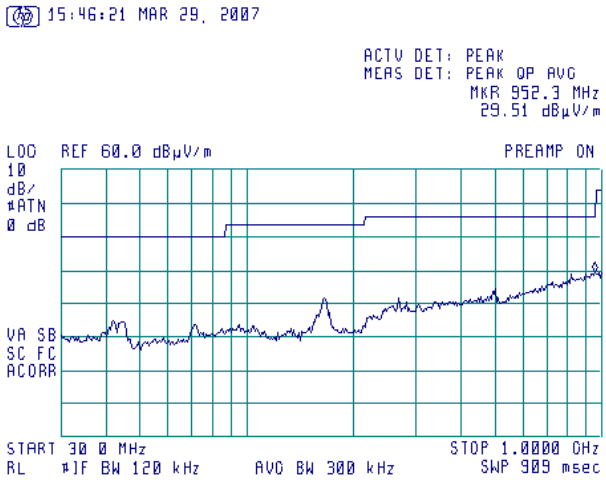
Plot 8.6.1 Radiated emission measurements in 30 - 1000 MHz, vertical antenna polarization

TEST SITE: Semi anechoic chamber
LIMIT: Class B
TEST DISTANCE: 3 m
EUT OPERATING MODE: Standby



Plot 8.6.2 Radiated emission measurements in 30 - 1000 MHz, horizontal antenna polarization

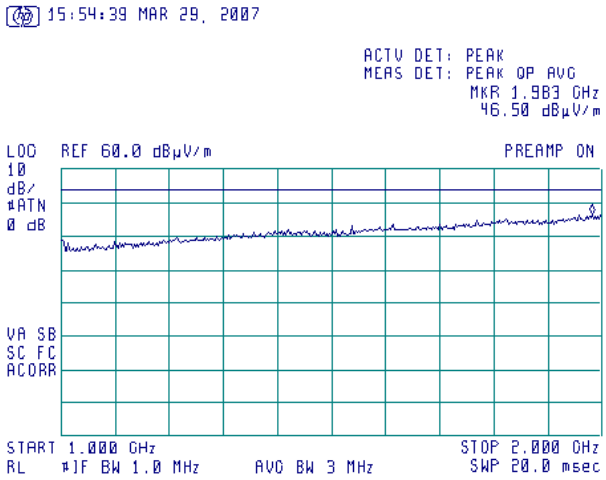
TEST SITE: Semi anechoic chamber
LIMIT: Class B
TEST DISTANCE: 3 m
EUT OPERATING MODE: Standby



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:	4/1/2007 6:19:58 PM		
Temperature: 22.7 ºC	Air Pressure: 1018 hPa	Relative Humidity: 48 %	Power Supply: 24 VDC
Remarks:			

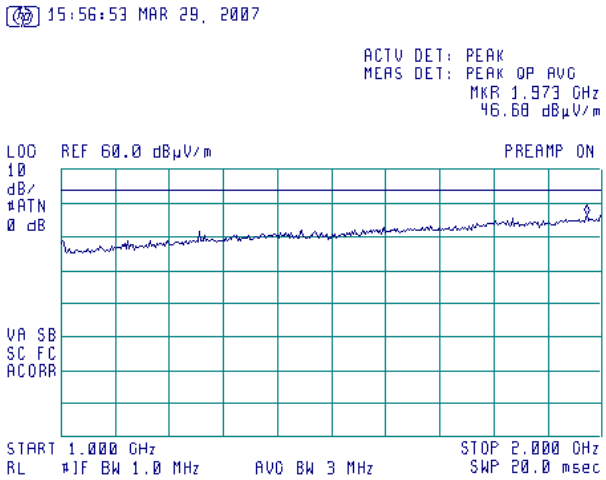
Plot 8.6.3 Radiated emission measurements in 1000 – 2000 MHz, vertical antenna polarization

TEST SITE: Semi anechoic chamber
LIMIT: Class B
TEST DISTANCE: 3 m
EUT OPERATING MODE: Standby



Plot 8.6.4 Radiated emission measurements in 1000 – 2000 MHz, horizontal antenna polarization

TEST SITE: Semi anechoic chamber
LIMIT: Class B
TEST DISTANCE: 3 m
EUT OPERATING MODE: Standby



Test specification:	Section 15.203, Antenna requirement		
Test procedure:	Visual inspection / supplier declaration		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/22/2007 9:43:38 AM		
Temperature: 24.8 ºC	Air Pressure: 1012 hPa	Relative Humidity: 36 %	Power Supply: 24 VDC
Remarks:			

9 Antenna requirements according to FCC CFR 47 PART 15 Subpart C, Section 15.203

9.1 Antenna requirements

The EUT was verified for compliance with antenna requirements. A transmitter shall be designed to ensure that no antenna other than that furnished by the responsible party will be used with the device. It may be either permanently attached or employs a unique antenna connector for every antenna proposed for use with the EUT. This requirement does not apply to professionally installed transmitters.
The rationale for compliance with the above requirements was either visual inspection results or supplier declaration. The summary of results is provided in Table 9.1.1.

Table 9.1.1 Antenna requirements

Requirement	Rationale	Verdict
The transmitter antenna is permanently attached	Visual inspection	Comply
The transmitter employs a unique antenna connector	NA	
The transmitter requires professional installation	NA	

Photograph 9.1.1 Antenna assembly, transmitter operating at 433.9 MHz

Photograph 9.1.2 Antenna assembly, transmitter operating at 125 kHz

10 APPENDIX A Test equipment and ancillaries used for tests

HL No	Description	Manufacturer	Model	Ser. No.	Last Cal.	Due Cal.
0337	Probe Set, Hand held, 5 probes	Electro-Metrics	EHFP-30	238	12-Jun-06	12-Jun-07
0446	Antenna, Loop active, 10kHz-30MHz	EMCO	6502	2857	28-Jun-05	28-Jun-06
0447	LISN, 16/2, 300 V RMS	HL	LISN 16-1	066	03-Nov-06	03-Nov-07
0465	Anechoic Chamber 9(L) x 6.5(W) x 5.5(H) m	HL	AC - 1	023	10-Oct-05	10-Oct-06
0521	EMI Receiver (Spectrum Analyzer) with RF filter section 9 kHz-6.5 GHz	Hewlett Packard	8546A	3617A 00319, 3448A002 53	10-Oct-05	10-Oct-06
0554	Amplifier, 2-18 GHz RF	Miteq	AFD4	104300	28-Feb-07	28-Feb-08
0589	Cable Coaxial, GORE A2P01POL118, 2.3 m	HL	GORE-3	176	10-Oct-05	10-Oct-06
0593	Antenna Mast, 1-4 m Pneumatic	Madgesh	AM-F1	101	03-Feb-06	03-Feb-07
0594	Turn Table for anechoic chamber flush mount d=1.2 m Pneumatic	HL	TT-WDC1	102	27-Jan-06	27-Jan-07
0604	Antenna BiconiLog Log-Periodic/T Bow-TIE 26 - 2000 MHz	EMCO	3141	9611-1011	27-Jan-06	27-Jan-07
0672	Shielded Room 4,6(L) x 4,2(W) x 2,4(H) m	HL	SR - 3	027	10-Jan-06	10-Jan-07
0787	Transient Limiter	Hewlett Packard	11947A	3107A018 77	21-Nov-05	21-Nov-06
1004	Cable Coaxial , ANDREW PSWJ4 , 6m	HL	ANDREW -6	163	27-Jan-06	27-Jan-07
1365	Cable Coaxial, S-FLC 12-50, 5 m	HL	C214-5	1365	02-Dec-06	02-Dec-07
1424	Spectrum Analyzer, 30 Hz- 40 GHz	Agilent Technologies (HP)	8564EC	3946A002 19	12-Jun-06	12-Jun-07
1430	EMI Receiver, 9 kHz - 2.9 GHz	Agilent Technologies (HP)	8542E	3807A002 62,3705A0 0217	11-Nov-05	11-Nov-06
1502	Cable RF, 6 m	Belden	M17/167 MIL-C-17	1502	12-Feb-06	12-Feb-07
1510	Cable RF, 8 m	Belden	M17/167 MIL-C-17	1510	02-Dec-05	02-Dec-06
1947	Cable 18GHz, 6.5 m, blue	Rhophase Microwave Limited	NPS-1803A-6500-NPS	T4974	17-Oct-06	17-Oct-07
2009	Cable RF, 8 m	Alpha Wire	RG-214	C-56	12-Dec-05	12-Dec-06
2432	Antenna, Double-Ridged Waveguide Horn 1-18 GHz	EMC Test Systems	3115	00027177	03-Mar-07	03-Mar-08
2888	LISN Two-line V-Network 50 Ohm / 50 uH + 5 Ohm, 16A, MIL STD 461E, CISPR 16-1	Rolf Heine	NNB-2/16Z	02/10018	29-Mar-07	29-Mar-08
2897	Attenuator, 20 dB, DC to 1500 MHz, BNC	Mini-Circuits	CAT-20	2897	05-Apr-07	05-Apr-08
2909	Spectrum analyzer, ESA-E, 100 Hz to 26.5 GHz	Agilent Technologies	E4407B	MY414447 62	10-Apr-07	10-Apr-08

11 APPENDIX B 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.

12 APPENDIX C Test laboratory 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).

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Telephone: +972 4628 8001
Fax: +972 4628 8277
e-mail: mail@hermonlabs.com
website: www.hermonlabs.com

Person for contact: Mr. Alex Usoskin, CEO.

13 APPENDIX D 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.

14 APPENDIX E Abbreviations and acronyms

A	ampere
AC	alternating current
A/m	ampere per meter
AM	amplitude modulation
AVRG	average (detector)
BB	broad band
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
dB(μA)	decibel referred to one microampere
dBΩ	decibel referred to one Ohm
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
MHz	megahertz
min	minute
mm	millimeter
ms	millisecond
μs	microsecond
NA	not applicable
NB	narrow band
NT	not tested
OATS	open area test site
Ω	Ohm
PCB	printed circuit board
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
VA	volt-ampere
WB	wideband

15 APPENDIX F Test equipment correction factors

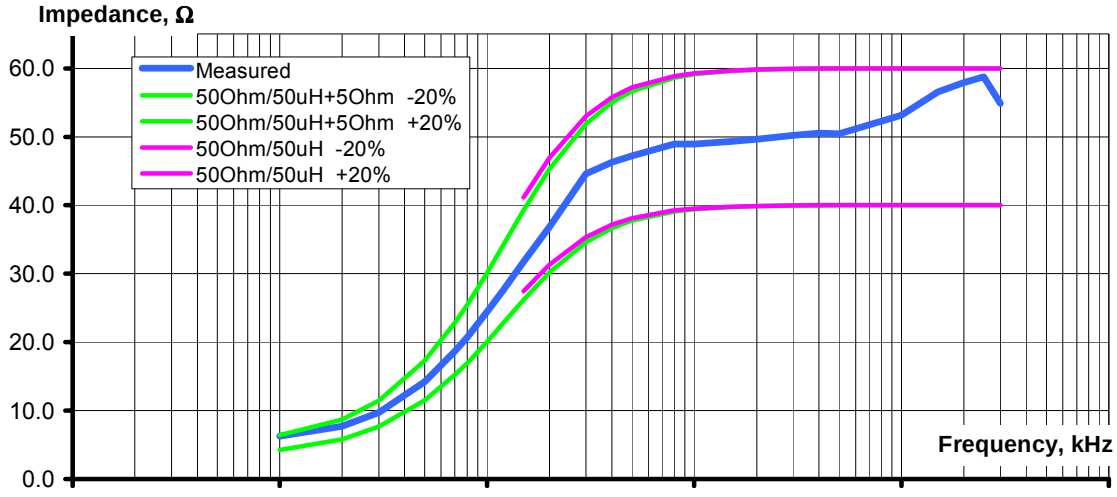
Correction factor
Line impedance stabilization network
Model LISN 16 - 1
Hermon Laboratories

Frequency, MHz	Correction factor, dB
0.01	5.0
0.02	2.2
0.03	1.1
0.04	0.7
0.05	0.5
0.1	0.2
0.2	0.1
0.4	0.1
0.6	0.1
0.8	0.1
1	0.1
2	0.1
3	0.1
4	0.1
6	0.2
10	0.3
12	0.4
16	0.5
18	0.6
20	0.7
25	0.9
28	1.2
30	1.3

The correction factor in dB is to be added to meter readings of an interference analyzer or a spectrum analyzer.

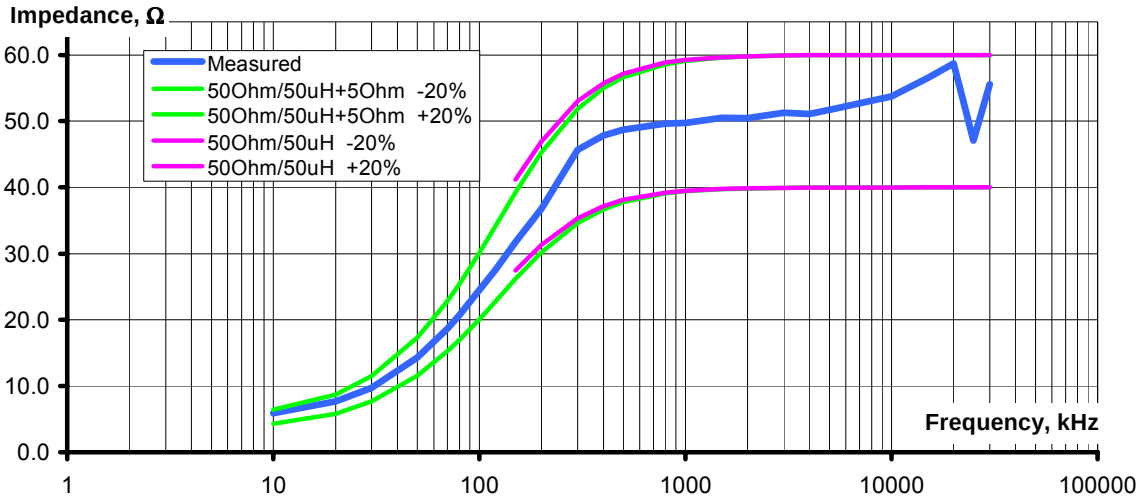
Correction factor
Line impedance stabilization network
Model LISN NNB-2/16Z
Rolf Heine
LISN L1 open circuit impedance calibration results

Frequency, kHz	Trace A-B, dB	Measured, Ω	LISN "50Ω/50µH+5Ω"				LISN "50Ω/50µH"				Meas. Uncert., %
			Standard, Ω	Tolerance, Ω		Verdict	Standard, Ω	Tolerance, Ω		Verdict	
				-20%	+20%			-20%	+20%		
10	*	6.2	5.4	4.3	6.4	Pass	NA				±9.8
20	*	7.7	7.3	5.8	8.7	Pass					
30	*	9.7	9.6	7.6	11.5	Pass					
50	*	14.3	14.4	11.5	17.3	Pass					
70	*	18.6	19.0	15.2	22.8	Pass					
80	*	20.7	21.2	16.9	25.4	Pass					
100	*	24.5	25.1	20.1	30.1	Pass					
120	*	27.7	28.5	22.8	34.2	Pass					
150	*	31.8	32.7	26.2	39.2	Pass	34.3	27.4	41.1	Pass	
200	*	36.8	37.7	30.2	45.3	Pass	39.1	31.3	46.9	Pass	
300	3.87	44.6	43.2	34.6	51.9	Pass	44.2	35.3	53.0	Pass	
400	3.75	46.3	45.8	36.7	55.0	Pass	46.5	37.2	55.7	Pass	
500	3.69	47.2	47.2	37.8	56.7	Pass	47.6	38.1	57.2	Pass	
800	3.59	48.9	48.9	39.1	58.6	Pass	49.0	39.2	58.8	Pass	
1000	3.59	48.9	49.3	39.4	59.1	Pass	49.4	39.5	59.3	Pass	
1500	3.56	49.3	49.7	39.7	59.6	Pass	49.7	39.8	59.7	Pass	
2000	3.54	49.6	49.8	39.8	59.8	Pass	49.8	39.9	59.8	Pass	
3000	3.51	50.2	49.9	39.9	59.9	Pass	49.9	39.9	59.9	Pass	
4000	3.49	50.5	50.0	40.0	59.9	Pass	50.0	40.0	60.0	Pass	
5000	3.50	50.4	50.0	40.0	60.0	Pass	50.0	40.0	60.0	Pass	
10000	3.35	53.2	50.0	40.0	60.0	Pass	50.0	40.0	60.0	Pass	
15000	3.18	56.5	50.0	40.0	60.0	Pass	50.0	40.0	60.0	Pass	
20000	3.12	57.9	50.0	40.0	60.0	Pass	50.0	40.0	60.0	Pass	
25000	3.08	58.7	50.0	40.0	60.0	Pass	50.0	40.0	60.0	Pass	
30000	3.26	54.9	50.0	40.0	60.0	Pass	50.0	40.0	60.0	Pass	



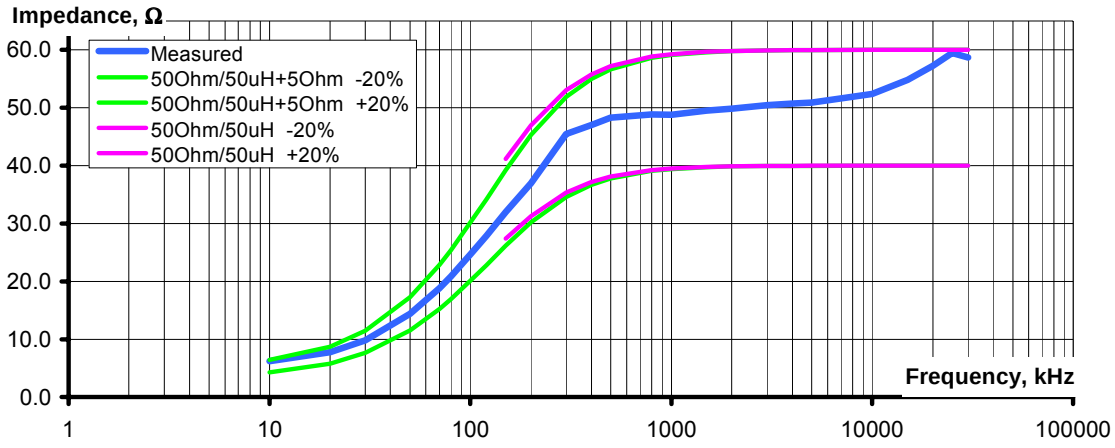
LISN L1 short circuit impedance calibration results

Frequency, kHz	Trace A-B, dB	Measured, Ω	LISN "50Ω/50µH+5Ω"				LISN "50Ω/50µH"				Meas. Uncert., %
			Standard, Ω	Tolerance, Ω		Verdict	Standard, Ω	Tolerance, Ω		Verdict	
				-20%	+20%			-20%	+20%		
10	14.10	5.9	5.4	4.3	6.4	Pass	NA				±9.8
20	12.29	7.7	7.3	5.8	8.7	Pass					
30	10.45	9.7	9.6	7.6	11.5	Pass					
50	7.85	14.3	14.4	11.5	17.3	Pass					
70	6.42	18.6	19.0	15.2	22.8	Pass					
80	5.92	20.7	21.2	16.9	25.4	Pass					
100	5.28	24.5	25.1	20.1	30.1	Pass					
120	4.82	27.6	28.5	22.8	34.2	Pass					
150	4.40	31.8	32.7	26.2	39.2	Pass	34.3	27.4	41.1	Pass	
200	4.05	36.8	37.7	30.2	45.3	Pass	39.1	31.3	46.9	Pass	
300	3.79	45.7	43.2	34.6	51.9	Pass	44.2	35.3	53.0	Pass	
400	3.65	47.9	45.8	36.7	55.0	Pass	46.5	37.2	55.7	Pass	
500	3.60	48.7	47.2	37.8	56.7	Pass	47.6	38.1	57.2	Pass	
800	3.54	49.6	48.9	39.1	58.6	Pass	49.0	39.2	58.8	Pass	
1000	3.54	49.8	49.3	39.4	59.1	Pass	49.4	39.5	59.3	Pass	
1500	3.49	50.5	49.7	39.7	59.6	Pass	49.7	39.8	59.7	Pass	
2000	3.49	50.5	49.8	39.8	59.8	Pass	49.8	39.9	59.8	Pass	
3000	3.45	51.3	49.9	39.9	59.9	Pass	49.9	39.9	59.9	Pass	
4000	3.46	51.1	50.0	40.0	59.9	Pass	50.0	40.0	60.0	Pass	
5000	3.43	51.7	50.0	40.0	60.0	Pass	50.0	40.0	60.0	Pass	
10000	3.32	53.7	50.0	40.0	60.0	Pass	50.0	40.0	60.0	Pass	
15000	3.18	56.6	50.0	40.0	60.0	Pass	50.0	40.0	60.0	Pass	
20000	3.08	58.7	50.0	40.0	60.0	Pass	50.0	40.0	60.0	Pass	
25000	3.70	47.1	50.0	40.0	60.0	Pass	50.0	40.0	60.0	Pass	
30000	3.23	55.6	50.0	40.0	60.0	Pass	50.0	40.0	60.0	Pass	



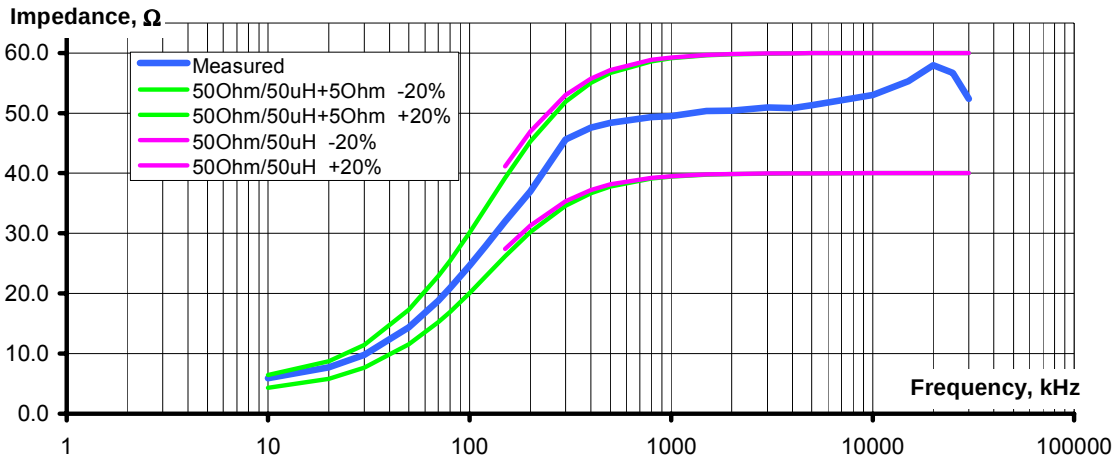
LISN N open circuit impedance calibration results

Frequency, kHz	Trace A-B, dB	Measured, Ω	LISN "50Ω/50µH+5Ω"				LISN "50Ω/50µH"				Meas. Uncert., %
			Standard, Ω	Tolerance, Ω		Verdict	Standard, Ω	Tolerance, Ω		Verdict	
				-20%	+20%			-20%	+20%		
10	13.60	6.2	5.4	4.3	6.4	Pass	NA				±9.8
20	13.59	7.8	7.3	5.8	8.7	Pass					
30	10.43	9.8	9.6	7.6	11.5	Pass					
50	7.81	14.4	14.4	11.5	17.3	Pass					
70	6.38	18.8	19.0	15.2	22.8	Pass					
80	5.88	20.9	21.2	16.9	25.4	Pass					
100	5.24	24.6	25.1	20.1	30.1	Pass					
120	4.80	27.9	28.5	22.8	34.2	Pass					
150	4.41	32.0	32.7	26.2	39.2	Pass	34.3	27.4	41.1	Pass	
200	4.09	37.0	37.7	30.2	45.3	Pass	39.1	31.3	46.9	Pass	
300	3.80	45.5	43.2	34.6	51.9	Pass	44.2	35.3	53.0	Pass	
400	3.70	47.0	45.8	36.7	55.0	Pass	46.5	37.2	55.7	Pass	
500	3.62	48.3	47.2	37.8	56.7	Pass	47.6	38.1	57.2	Pass	
800	3.59	48.9	48.9	39.1	58.6	Pass	49.0	39.2	58.8	Pass	
1000	3.60	48.8	49.3	39.4	59.1	Pass	49.4	39.5	59.3	Pass	
1500	3.55	49.5	49.7	39.7	59.6	Pass	49.7	39.8	59.7	Pass	
2000	3.53	49.8	49.8	39.8	59.8	Pass	49.8	39.9	59.8	Pass	
3000	3.50	50.4	49.9	39.9	59.9	Pass	49.9	39.9	59.9	Pass	
4000	3.48	50.7	50.0	40.0	59.9	Pass	50.0	40.0	60.0	Pass	
5000	3.47	50.9	50.0	40.0	60.0	Pass	50.0	40.0	60.0	Pass	
10000	3.39	52.4	50.0	40.0	60.0	Pass	50.0	40.0	60.0	Pass	
15000	3.26	54.8	50.0	40.0	60.0	Pass	50.0	40.0	60.0	Pass	
20000	3.15	57.3	50.0	40.0	60.0	Pass	50.0	40.0	60.0	Pass	
25000	3.05	59.4	50.0	40.0	60.0	Pass	50.0	40.0	60.0	Pass	
30000	3.08	58.7	50.0	40.0	60.0	Pass	50.0	40.0	60.0	Pass	



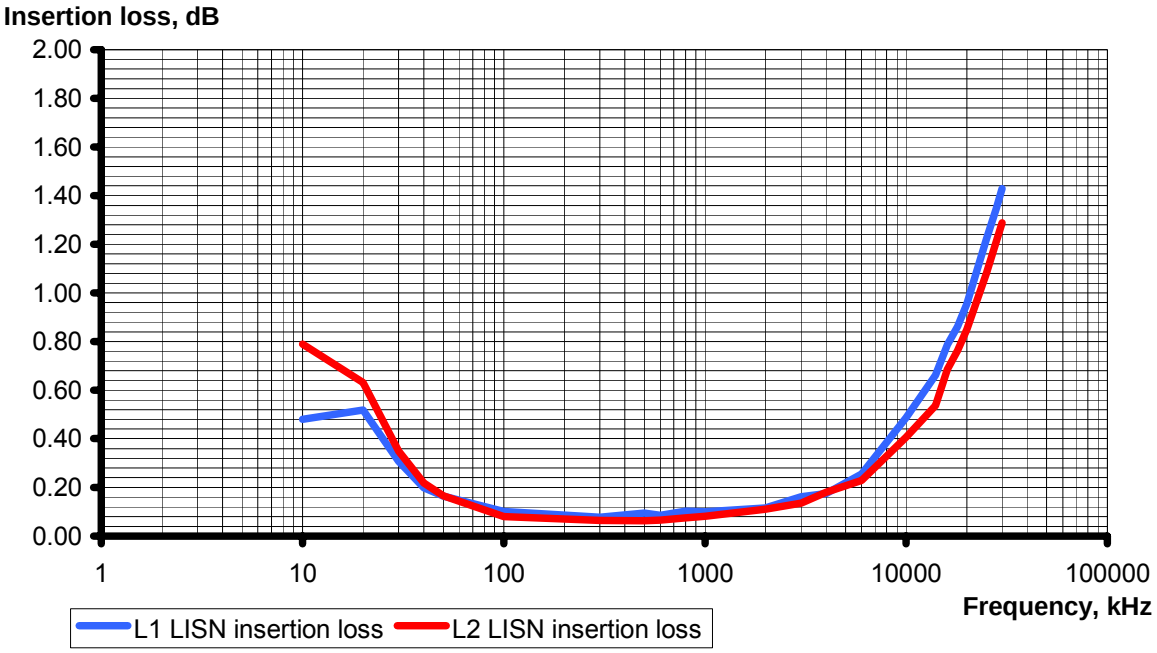
LISN N short circuit impedance calibration results

Frequency, kHz	Trace A-B, dB	Measured, Ω	LISN "50Ω/50µH+5Ω"				LISN "50Ω/50µH"				Meas. Uncert., %
			Standard, Ω	Tolerance, Ω		Verdict	Standard, Ω	Tolerance, Ω		Verdict	
				-20%	+20%			-20%	+20%		
10	14.08	5.9	5.4	4.3	6.4	Pass	NA				±9.8
20	12.24	7.7	7.3	5.8	8.7	Pass					
30	10.40	9.8	9.6	7.6	11.5	Pass					
50	7.80	14.4	14.4	11.5	17.3	Pass					
70	6.28	18.8	19.0	15.2	22.8	Pass					
80	5.88	20.9	21.2	16.9	25.4	Pass					
100	5.25	24.6	25.1	20.1	30.1	Pass					
120	4.80	27.9	28.5	22.8	34.2	Pass					
150	4.39	32.0	32.7	26.2	39.2	Pass	34.3	27.4	41.1	Pass	
200	4.07	37.0	37.7	30.2	45.3	Pass	39.1	31.3	46.9	Pass	
300	3.80	45.6	43.2	34.6	51.9	Pass	44.2	35.3	53.0	Pass	
400	3.67	47.6	45.8	36.7	55.0	Pass	46.5	37.2	55.7	Pass	
500	3.62	48.3	47.2	37.8	56.7	Pass	47.6	38.1	57.2	Pass	
800	3.56	49.3	48.9	39.1	58.6	Pass	49.0	39.2	58.8	Pass	
1000	3.55	49.5	49.3	39.4	59.1	Pass	49.4	39.5	59.3	Pass	
1500	3.50	50.3	49.7	39.7	59.6	Pass	49.7	39.8	59.7	Pass	
2000	3.50	50.4	49.8	39.8	59.8	Pass	49.8	39.9	59.8	Pass	
3000	3.47	50.9	49.9	39.9	59.9	Pass	49.9	39.9	59.9	Pass	
4000	3.48	50.8	50.0	40.0	59.9	Pass	50.0	40.0	60.0	Pass	
5000	3.45	51.3	50.0	40.0	60.0	Pass	50.0	40.0	60.0	Pass	
10000	3.36	53.0	50.0	40.0	60.0	Pass	50.0	40.0	60.0	Pass	
15000	3.24	55.3	50.0	40.0	60.0	Pass	50.0	40.0	60.0	Pass	
20000	3.12	58.0	50.0	40.0	60.0	Pass	50.0	40.0	60.0	Pass	
25000	3.18	56.7	50.0	40.0	60.0	Pass	50.0	40.0	60.0	Pass	
30000	3.39	52.4	50.0	40.0	60.0	Pass	50.0	40.0	60.0	Pass	



Insertion Loss Calibration result

Frequency, kHz	Insertion loss,dB		Measurement Uncertainty, dB
	L1	N	
10	0.48	0.79	±0.6
20	0.52	0.63	
30	0.31	0.35	
40	0.20	0.22	
50	0.16	0.17	
100	0.10	0.08	
300	0.08	0.06	
500	0.10	0.06	
600	0.09	0.07	
800	0.10	0.07	
1000	0.10	0.08	
2000	0.12	0.11	
3000	0.16	0.14	
4000	0.17	0.18	
6000	0.26	0.23	
10000	0.49	0.41	
14000	0.66	0.54	
16000	0.79	0.69	
18000	0.86	0.76	
20000	0.96	0.85	
25000	1.22	1.08	
28000	1.35	1.21	
30000	1.43	1.29	



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

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(μV) to convert it into field intensity in dB(μV/m).

Antenna factor

Biconilog antenna EMCO, model 3141, serial number 1011

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

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

Antenna factor
Double-ridged waveguide horn antenna
EMC Test Systems, model 3115, serial number: 00027177

Frequency, MHz	Antenna factor. dB(1/m)
1000.0	24.7
1500.0	25.7
2000.0	27.8
2500.0	28.9
3000.0	30.7
3500.0	31.8
4000.0	33.0
4500.0	32.8
5000.0	34.2
5500.0	34.9
6000.0	35.2
6500.0	35.4
7000.0	36.3
7500.0	37.3
8000.0	37.5
8500.0	38.0
9000.0	38.3
9500.0	38.3
10000.0	38.7
10500.0	38.7
11000.0	38.9
11500.0	39.5
12000.0	39.5
12500.0	39.4
13000.0	40.5
13500.0	40.8
14000.0	41.5
14500.0	41.3
15000.0	40.2
15500.0	38.7
16000.0	38.5
16500.0	39.8
17000.0	41.9
17500.0	45.8
18000.0	49.1

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

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	-		±0.17	
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	-			

Cable RF, 8 m, model:RG-214, s/n C-56 (HL 2009)
Calibration data

No.	Parameter	SET, MHz	Measured, dB	Deviation	Tolerance (Specification)	Meas. Uncert., dB	Notes
1	Insertion Loss	1	0.10	NA	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				

Cable RF, 6m, model: M17/167 MIL-C-17, s/n 1502 (HL 1502)
Calibration data (0.1 – 1000 MHz)

No.	Parameter	Set, MHz	Measured, dB	Deviation	Tolerance (specification), dB	Measured uncertainty dB
1	Attenuation	0.1	0.02	NA	NA	±0.12
2		1	0.07			
3		3	0.15			
4		5	0.17			
5		10	0.26			
6		30	0.43			
7		50	0.57			
8		80	0.72			
9		100	0.81			
10		300	1.48			
11		500	2.00			
12		800	2.70			
13		1000	3.09			

Cable RF, 8m, model: M17/167 MIL-C-17, s/n 1510 (HL 1510)
Calibration data (0.1 – 1000 MHz)

No.	Parameter	Set, MHz	Measured, dB	Deviation	Tolerance (specification), dB	Measured uncertainty dB
1	Attenuation	0.1	0.05	NA	NA	±0.12
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 coaxial, RG-214, 5m, model: C214-5, s/n 1365 (HL 1365)
Calibration data

No.	Parameter	Set, MHz	Measured, dB	Deviation, dB	Tolerance (specification), dB	Measured uncertainty dB
1	Insertion Loss	1000	0.41	-	NA	±0.12
2		1200	0.44	-		
3		1400	0.48	-		
4		1600	0.52	-		
5		1800	0.55	-		
6		2000	0.58	-		
7		2200	0.61	-		
8		2400	0.64	-		±0.17
9		2600	0.67	-		
10		2800	0.7	-		
11		3000	0.73	-		
12		3300	0.79	-		
13		3600	0.84	-		
14		3900	0.94	-		
15		4200	1.22	-		

Cable 18GHz, 6.5 m, blue, model: NPS-1803A-6500-NPS, s/n T4974 (HL 1947)
Calibration data

Frequency, GHz	Insertion Loss, dB
	HL1947
0.03	0.37
0.05	0.46
0.1	0.63
0.2	0.86
0.3	1.05
0.5	1.34
0.7	1.58
0.9	1.80
1.1	2.00
1.3	2.17
1.5	2.34
1.7	2.49
1.9	2.64
2.1	2.78
2.3	2.92
2.5	3.07
2.7	3.17
2.9	3.28
3.1	3.39
3.3	3.50
3.5	3.61
3.7	3.72
3.9	3.81
4.1	3.92
4.3	4.03
4.5	4.10
4.7	4.22
4.9	4.30
5.1	4.40
5.3	4.54
5.5	4.61
5.7	4.74
5.9	4.84
6.1	4.90
6.3	4.98
6.5	5.03
6.7	5.09
6.9	5.18
7.1	5.25
7.3	5.35
7.5	5.41
7.7	5.49

Frequency, GHz	Insertion Loss, dB
	HL1947
7.9	5.53
8.1	5.62
8.3	5.67
8.5	5.75
8.7	5.80
8.9	5.87
9.1	5.95
9.3	6.03
9.5	6.10
9.7	6.20
9.9	6.29
10.1	6.41
10.3	6.49
10.5	6.58
10.7	6.63
10.9	6.70
11.1	6.77
11.3	6.79
11.5	6.85
11.7	6.91
11.9	6.95
12.1	7.02
12.4	7.10
13.0	7.28
13.5	7.47
14.0	7.69
14.5	7.86
15.0	7.96
15.5	8.06
16.0	8.31
16.5	8.51
17.0	8.73
17.5	8.80
18.0	8.99