HERMON LABORATORIES

ELECTRICAL TESTING
0839.01

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TEST REPORT

ACCORDING TO: FCC CFR 47 PART 15 subpart C, section 15.249 and subpart B

FOR:

Essence Home and Family Ltd.
Control Panel
Model:ES8000CP
FCC ID:Y4I-ES8000CP

Report ID: ESSRAD_FCC.23822.docx
Date of Issue: 20-Nov-12

Table of contents

1 Applicant information 3
2 Equipment under test attributes 3
3 Manufacturer information 3
4 Test details 3
5 Tests summary 4
6 EUT description 5
6.1 General information 5
6.2 Test configuration 5
6.3 Operating frequencies 5
6.4 Changes made in the EUT 5
6.5 Transmitter characteristics 6
7 Transmitter tests according to 47CFR part 15 subpart C requirements 7
7.1 Field strength of emissions 7
7.2 Band edge emission 22
7.3 Antenna requirements 26
7.4 Occupied bandwidth test 27
7.5 Conducted emissions 31
8 Emission tests according to 47CFR part 15 subpart B requirements 34
8.1 Conducted emissions 34
8.2 Radiated emission measurements 37
9 APPENDIX A Test equipment and ancillaries used for tests 40
10 APPENDIX B Measurement uncertainties 41
11 APPENDIX C Test laboratory description 42
12 APPENDIX D Specification references 42
13 APPENDIX E Test equipment correction factors 43
14 APPENDIX F Abbreviations and acronyms 53

1 Applicant information

Client name:	Essence Home and Family Ltd.
Address:	12 Abba Even Avenue, Ackerstein Towers Bldg. D, P.O.B. 2073, Herzliya 46120, Israel
Telephone:	+972 73 244 7735
Fax:	+972 9772 9962
E-mail:	israelgo@essence-grp.com
Contact name:	Mr. Israel Gottesman

2 Equipment under test attributes

Product name:	Control Panel
Product type:	Transceiver
Model(s):	ES8000CP
Serial number:	1121031900152515
Hardware version:	3.C
Software release:	02.74.03.00.01
Receipt date	11/8/2012

3 Manufacturer information

Manufacturer name:	Essence Home and Family Ltd.
Address:	12 Abba Even Avenue, Ackerstein Towers Bldg. D, P.O.B. 2073, Herzliya 46120, Israel
Telephone:	+972 73 244 7735
Fax:	+972 9772 9962
E-Mail:	israelgo@essence-grp.com
Contact name:	Mr. Israel Gottesman

4 Test details

Project ID:	23822
Location:	Hermon Laboratories Ltd. Harakevet Industrial Zone, Binyamina 30500, Israel
Test started:	11/8/2012
Test completed:	11/13/2012
Test specification(s):	FCC 47 CFR Part 15, subpart C, §15.249; subpart B class B

5 Tests summary

Test	Status
Transmitter characteristics	
Section 15.249(a)(d), Field strength of emissions	Pass
Section 15.249(d), Band edge emissions	Pass
Section 15.207(a), Conducted emission	Pass
Section 15.203, Antenna requirement	Pass
Section 15.215(c), Occupied bandwidth	Pass
Unintentional emissions	
Section 15.107, Conducted emission at AC power port	Pass
Section 15.109, Radiated emission	Pass

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

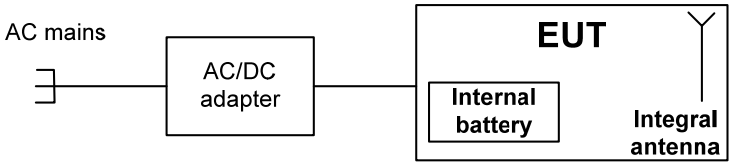
	Name and Title	Date	Signature
Tested by:	Mrs. E. Pitt, test engineer	November 13, 2012	
Reviewed by:	Mrs. M. Cherniavsky, certification engineer	November 20, 2012	
Approved by:	Mr. M. Nikishin, EMC and Radio group manager	November 26, 2012	

6 EUT description

6.1 General information

The EUT is a control panel used the bi-directional communication with the control system peripherals.

6.2 Test configuration



6.3 Operating frequencies

Source	Frequency, MHz
Microcontroller oscillator	12.28
RF signal	2425

6.4 Changes made in the EUT

No changes were implemented in the EUT.

6.5 Transmitter characteristics

Type of equipment	
X	Stand-alone (Equipment with or without its own control provisions)
	Combined equipment (Equipment where the radio part is fully integrated within another type of equipment)
	Plug-in card (Equipment intended for a variety of host systems)

Intended use		**Condition of use**
	fixed	Always at a distance more than 2 m from all people
X	mobile	Always at a distance more than 20 cm from all people
	portable	May operate at a distance closer than 20 cm to human body

Assigned frequency range	2400 - 2483.5 MHz
Operating frequency	2425 MHz
Maximum field strength of carrier	112.71 dBµV/m at 3 m distance

Is transmitter output power variable?				
	X	No		
		Yes		continuous variable
				stepped variable with stepsize dB
			minimum RF power	dBm
			maximum RF power	dBm

Antenna connection			
unique coupling	standard connector	X integral	with temporary RF connector
			X without temporary RF connector

Antenna/s technical characteristics			
Type	Manufacturer	Model number	Gain
Integral	YIPSHING METAL MFY	11434	0 dBi

Modulation	QPSK
Transmitter aggregate data rate/s	250 kbps
Modulating test signal (baseband)	PRBS

Transmitter power source					
	Battery	**Nominal rated voltage**		Battery type	
	DC	**Nominal rated voltage**			
X	AC mains	**Nominal rated voltage**	via AC/DC adapter		

Common power source for transmitter and receiver	**V**	yes	no

Test specification:	Section 15.249(a)(d), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	11/8/2012		
Temperature: 24 ºC	Air Pressure: 1015 hPa	Relative Humidity: 54 %	Power Supply: 3.7 VDC
Remarks:			

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

7.1 Field strength of emissions

7.1.1 General

This test was performed to measure field strength of fundamental and spurious emissions from the EUT. Specification test limits are given in Table 7.1.1, Table 7.1.2 and Table 7.1.3.

Table 7.1.1 Radiated fundamental emission limits

Fundamental frequency, MHz	Field strength at 3 m, dB(□V/m)		
	Peak	Average	Quasi-Peak
2400 – 2483.5	114.0	94.0	NA

Table 7.1.2 Harmonics limits

Fundamental frequency, MHz	Field strength at 3 m, dB(□V/m)	
	Peak	Average
2400 – 2483.5	74.0	54.0

Table 7.1.3 Radiated spurious emissions limits (other than harmonics)

Frequency, MHz	Field strength at 3 m, dB(μV/m)*			
	Peak	Quasi Peak	Average	Attenuation below carrier
0.009 – 0.090	148.5 – 128.5	NA	128.5 – 108.5**	50 dBc (whichever is the less stringent)
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: 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 but not exceeding 40 GHz for intentional radiators operated below 10 GHz and up to the fifth harmonic of the highest fundamental frequency but not exceeding 100 GHz for intentional radiators operated above 10 GHz.

Test specification:	Section 15.249(a)(d), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	11/8/2012		
Temperature: 24 ºC	Air Pressure: 1015 hPa	Relative Humidity: 54 %	Power Supply: 3.7 VDC
Remarks:			

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 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.

7.1.2.3 The worst test results (the lowest margins) were recorded in the associated tables 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 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.

7.1.3.3 The worst test results (the lowest margins) were recorded in the associated tables and shown in the associated plots.

Test specification:	Section 15.249(a)(d), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	11/8/2012		
Temperature: 24 ºC	Air Pressure: 1015 hPa	Relative Humidity: 54 %	Power Supply: 3.7 VDC
Remarks:			

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

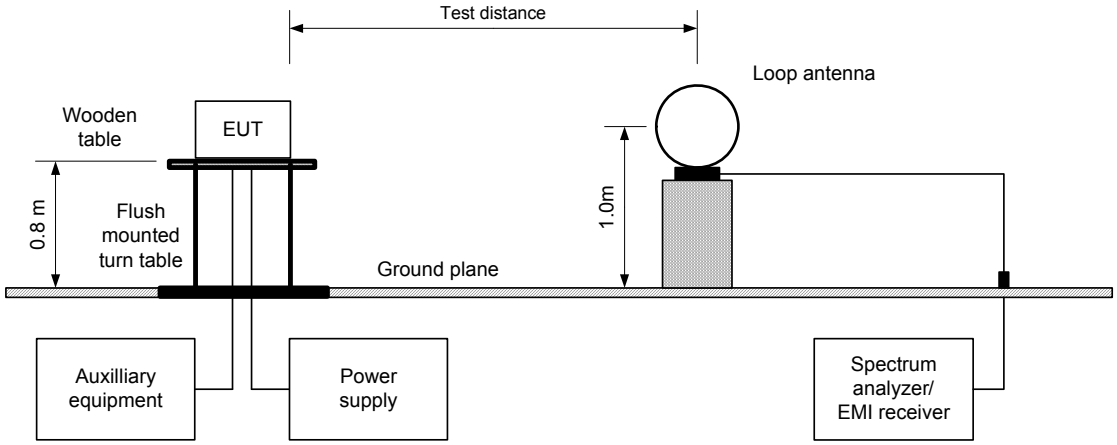
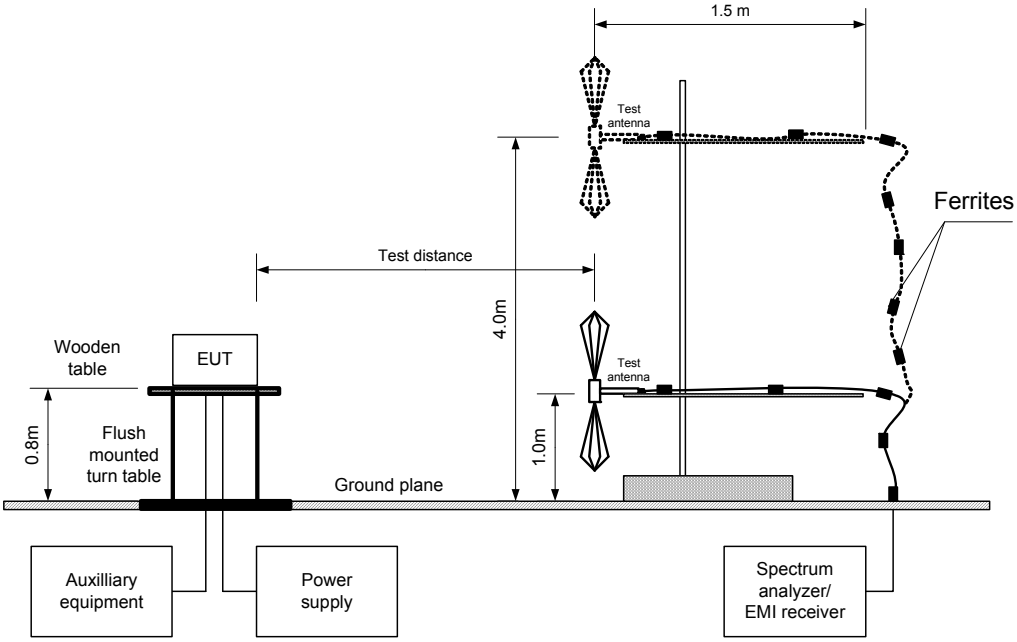


Figure 7.1.2 Setup for spurious emission field strength measurements above 30 MHz



Test specification:	**Section 15.249(a)(d), Field strength of emissions**		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	11/8/2012		
Temperature: 24 ºC	**Air Pressure:** 1015 hPa	**Relative Humidity:** 54 %	**Power Supply:** 3.7 VDC
Remarks:			

Table 7.1.4 Field strength of fundamental emission and spurious emissions

TEST DISTANCE: 3 m
EUT POSITION: Vertical
MODULATION: QPSK
MODULATING SIGNAL: PRBS
INVESTIGATED FREQUENCY RANGE: 0.009 –25000 MHz
DETECTOR USED: Peak
RESOLUTION BANDWIDTH: 1.0 kHz (9 kHz – 150 kHz)
9.0 kHz (150 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 – 1000 MHz)
Double ridged guide (above 1000 MHz)

Frequency, 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**		Calculated, dB(μV/m)	Limit, dB(μV/m)	Margin, dB**	
Fundamental emission											
2425	V	1.4	0	112.71	114	-1.29	-44.9	67.81	94	-26.19	Pass

Frequency, MHz	Antenna		Azimuth, degrees*	Peak field strength (VBW=3 MHz)			Average field strength (VBW=10 Hz)				Verdict
	Pol.	Height, m		Measured, dB(μV/m)	Limit, dB(μV/m)	Margin, dB**	Measured, dB(μV/m)	Calculated, dB(μV/m)	Limit, dB(μV/m)	Margin, dB**	
Spurious emissions											
4850	V	1.3	20	62.14	74.0	-11.86	53.29	8.39	54.0	-45.61	Pass
7275	V	1.3	26	56.65	74.0	-17.35	47.74	2.84	54.0	-51.16	
9700	V	1.4	0	51.77	74.0	-22.23	41.86	-3.04	54.0	-57.04	

Spurious emissions

Frequency, MHz	Antenna		Azimuth, degrees*	Peak emission, dB(μV/m)	Quasi-peak			Verdict
	Pol.	Height, m			Measured emission, dB(μV/m)	Limit, dB(μV/m)	Margin, dB**	
450	V	1.3	26	33.6	31.4	46	-14.6	Pass
650	V	1.2	35	37.7	35.3	46	-10.7	Pass
850	V	1.3	30	42.8	41.1	46	-4.9	Pass
900	V	1.3	26	42.8	41.1	46	-4.9	Pass
950	V	1.4	42	47.1	45.8	46	-0.2	Pass

*- EUT front panel refers to 0 degrees position of turntable.
**- Margin, dB =Measured (calculated) value, dB(μV/m)-Limit, dB(μV/m).

Test specification:	Section 15.249(a)(d), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	11/8/2012		
Temperature: 24 ºC	Air Pressure: 1015 hPa	Relative Humidity: 54 %	Power Supply: 3.7 VDC
Remarks:			

Table 7.1.5 Average factor calculation

Transmission pulse			Transmission burst		Transmission train duration, ms	Average factor, dB
Duration, ms	Pulse period, ms	Max number during 100 ms	Duration, ms	Period, ms		
0.585	102.7	1	NA	NA	NA	-44.9

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

Reference numbers of test equipment used

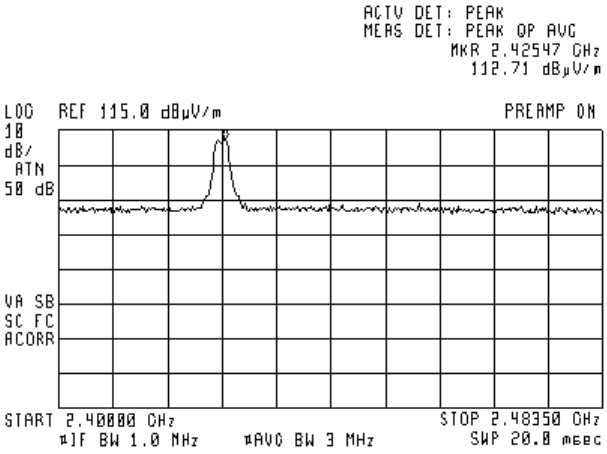
HL 0446	HL 0521	HL 0604	HL 0768	HL 2432	HL 2952	HL 3347	HL 3533
HL 3535	HL 3818	HL 3901	HL 4352	HL 4353			

Full description is given in Appendix A.

Test specification:	Section 15.249(a)(d), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	11/8/2012		
Temperature: 24 ºC	Air Pressure: 1015 hPa	Relative Humidity: 54 %	Power Supply: 3.7 VDC
Remarks:			

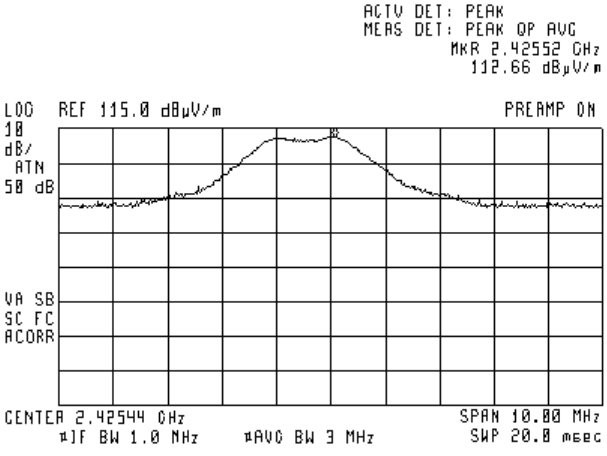
Plot 7.1.1 Radiated emission measurements at the fundamental frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POSITION: Typical (Vertical)
INPUT VOLTAGE: Unom



Plot 7.1.2 Radiated emission measurements at the fundamental frequency

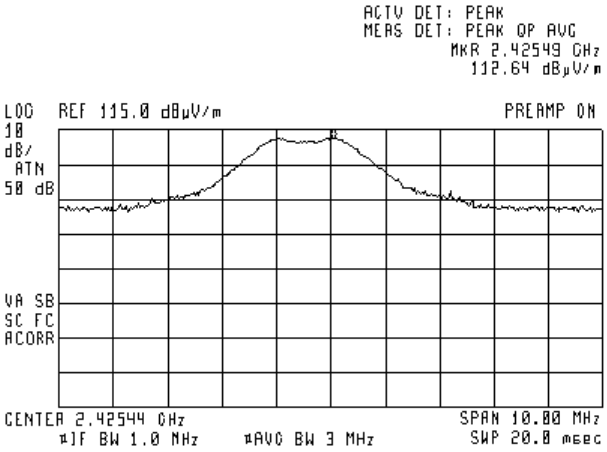
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POSITION: Typical (Vertical)
INPUT VOLTAGE: 115%Unom



Test specification:	**Section 15.249(a)(d), Field strength of emissions**		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	11/8/2012		
Temperature: 24 ºC	**Air Pressure:** 1015 hPa	**Relative Humidity:** 54 %	**Power Supply:** 3.7 VDC
Remarks:			

Plot 7.1.3 Radiated emission measurements at the fundamental frequency

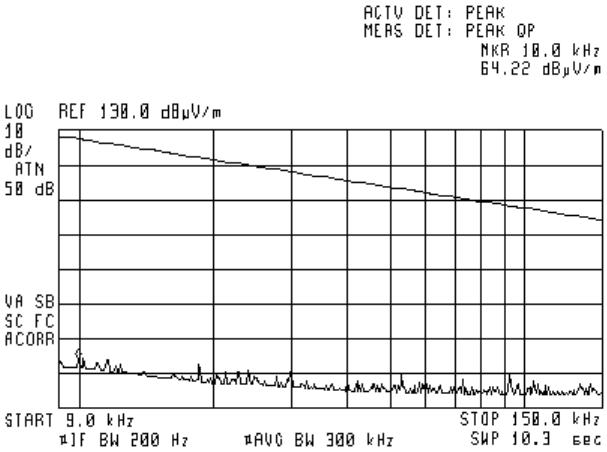
TEST SITE:	Semi anechoic chamber
TEST DISTANCE:	3 m
ANTENNA POLARIZATION:	Vertical and Horizontal
EUT POSITION:	Typical (Vertical)
INPUT VOLTAGE:	85%Unom



Test specification:	**Section 15.249(a)(d), Field strength of emissions**		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	11/8/2012		
Temperature: 24 ºC	**Air Pressure:** 1015 hPa	**Relative Humidity:** 54 %	**Power Supply:** 3.7 VDC
Remarks:			

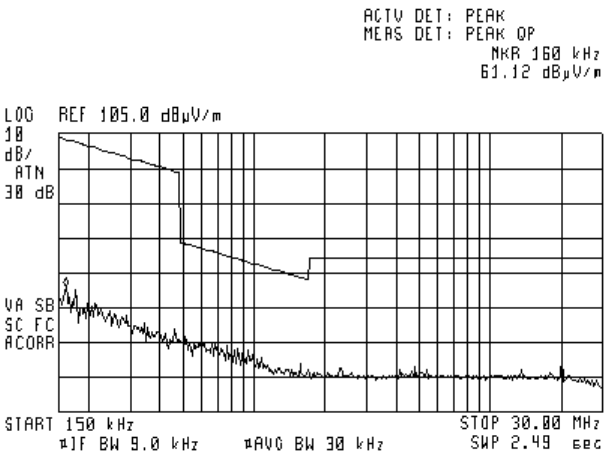
Plot 7.1.4 Radiated emission measurements from 9 to 150 kHz

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



Plot 7.1.5 Radiated emission measurements from 0.15 to 30 MHz

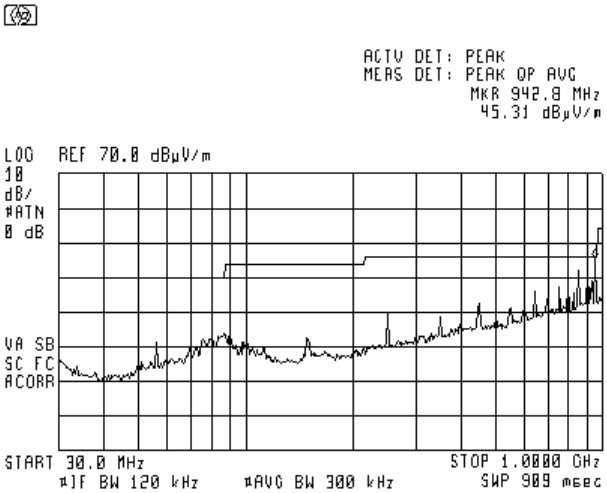
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Typical (Vertical)



Test specification:	Section 15.249(a)(d), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	11/8/2012		
Temperature: 24 ºC	Air Pressure: 1015 hPa	Relative Humidity: 54 %	Power Supply: 3.7 VDC
Remarks:			

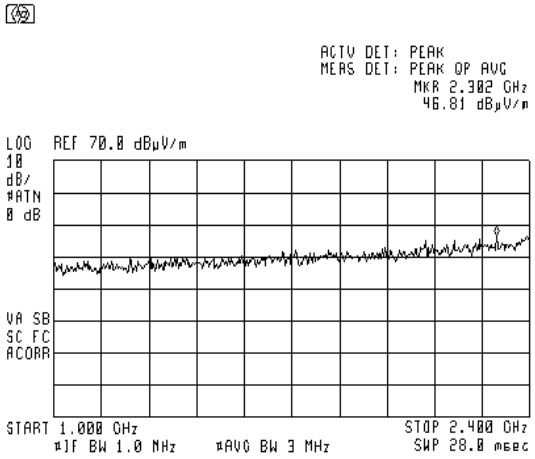
Plot 7.1.6 Radiated emission measurements from 30 to 1000 MHz

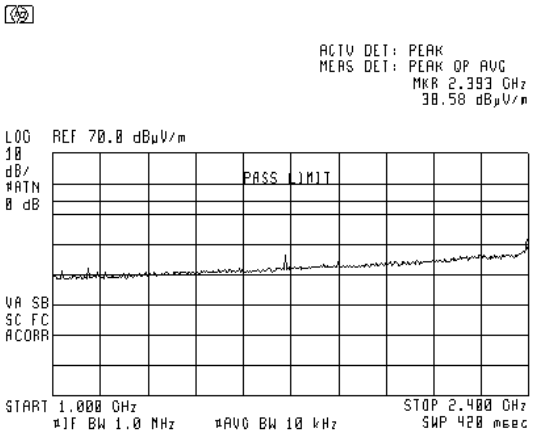
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal



Plot 7.1.7 Radiated emission measurements from 1000 to 2400 MHz

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal

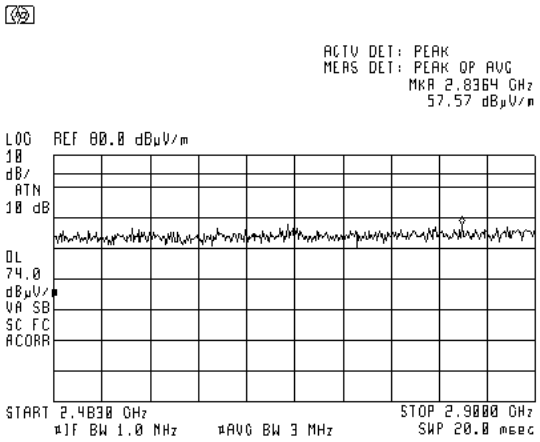


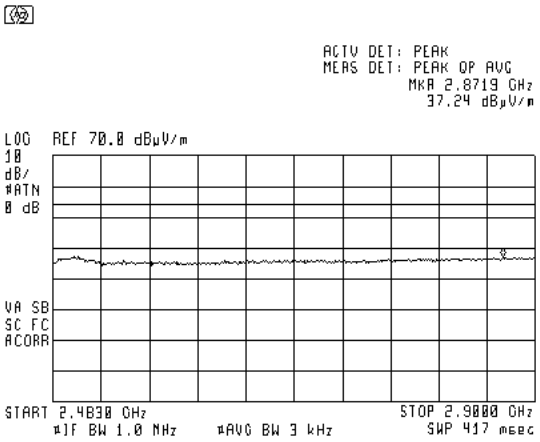


Test specification:	Section 15.249(a)(d), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	11/8/2012		
Temperature: 24 ºC	Air Pressure: 1015 hPa	Relative Humidity: 54 %	Power Supply: 3.7 VDC
Remarks:			

Plot 7.1.8 Radiated emission measurements from 2483.5 to 2900 MHz

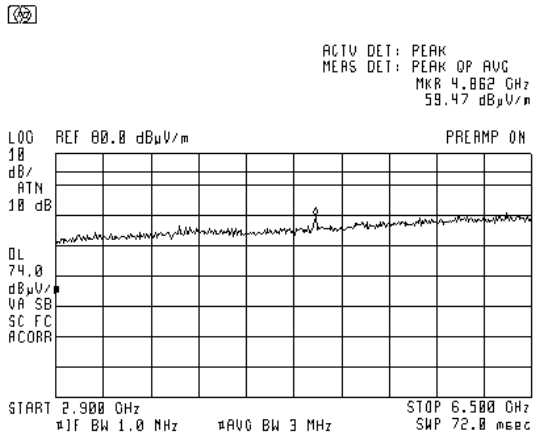
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal

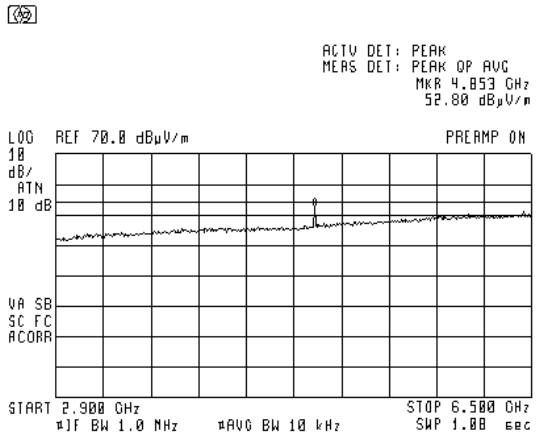




Plot 7.1.9 Radiated emission measurements from 2900 to 6500 MHz

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal

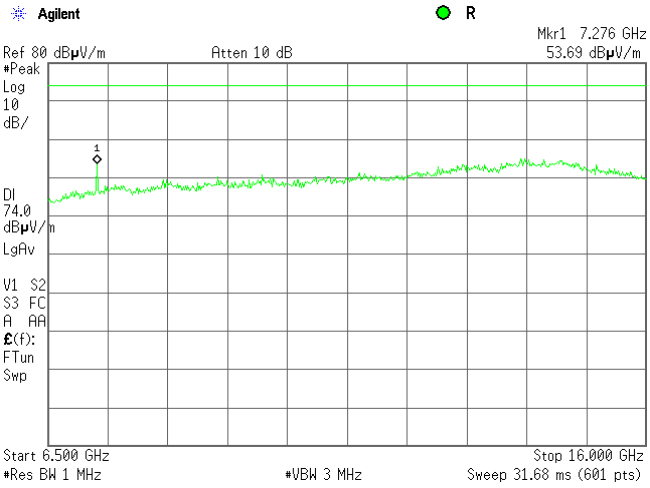


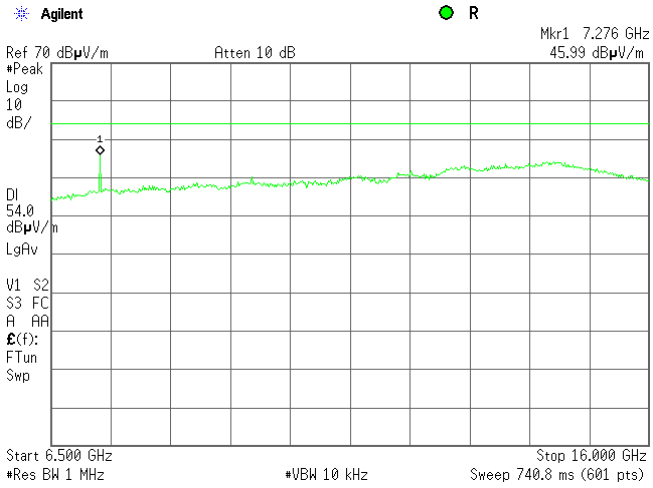


Test specification:	Section 15.249(a)(d), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	11/8/2012		
Temperature: 24 ºC	Air Pressure: 1015 hPa	Relative Humidity: 54 %	Power Supply: 3.7 VDC
Remarks:			

Plot 7.1.10 Radiated emission measurements from 6500 to 16000 MHz

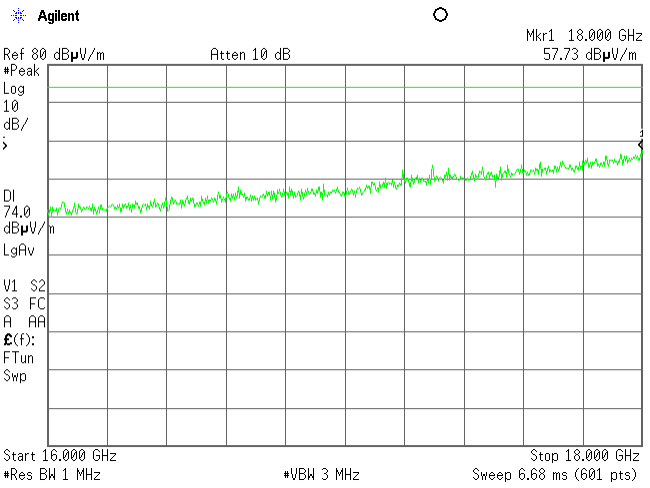
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal

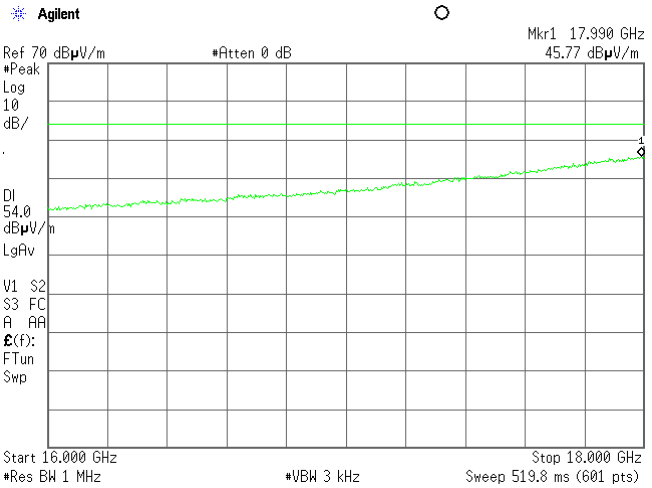




Plot 7.1.11 Radiated emission measurements from 16.0 to 18.0 GHz

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

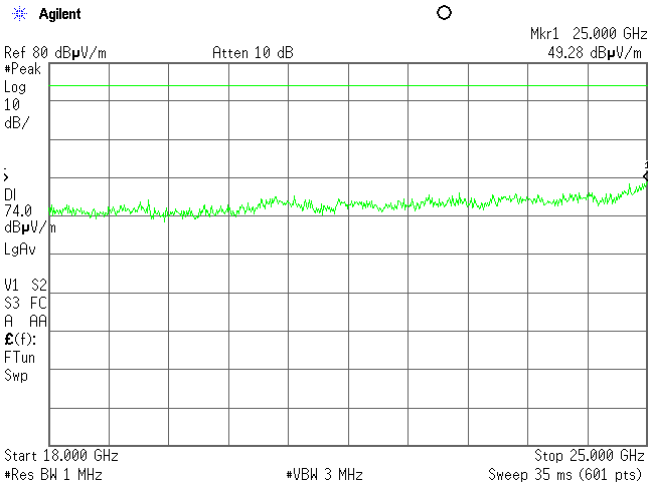


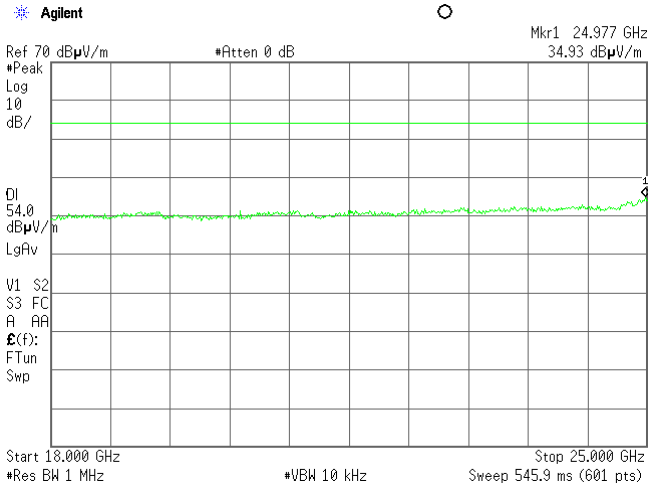


Test specification:	Section 15.249(a)(d), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	11/8/2012		
Temperature: 24 ºC	Air Pressure: 1015 hPa	Relative Humidity: 54 %	Power Supply: 3.7 VDC
Remarks:			

Plot 7.1.12 Radiated emission measurements from 18.0 to 25 GHz

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

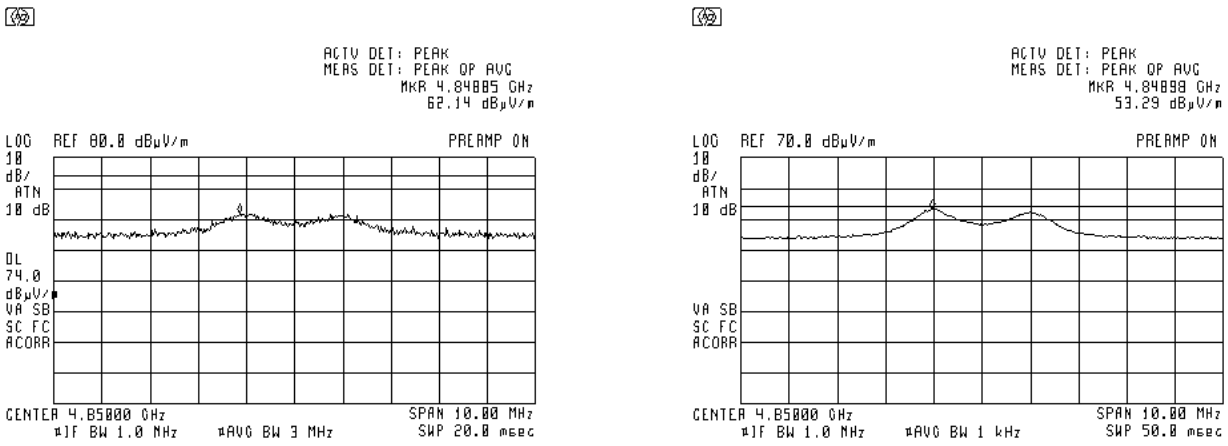




Test specification:	Section 15.249(a)(d), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	11/8/2012		
Temperature: 24 ºC	Air Pressure: 1015 hPa	Relative Humidity: 54 %	Power Supply: 3.7 VDC
Remarks:			

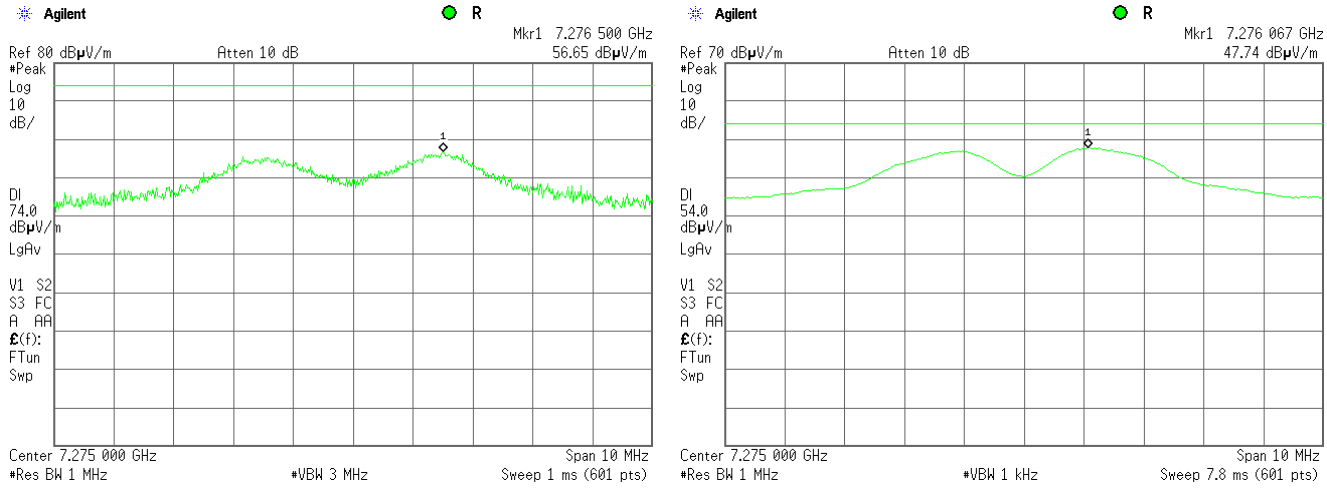
Plot 7.1.13 Radiated emission measurements at the second harmonic

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m



Plot 7.1.14 Radiated emission measurements at the third harmonic

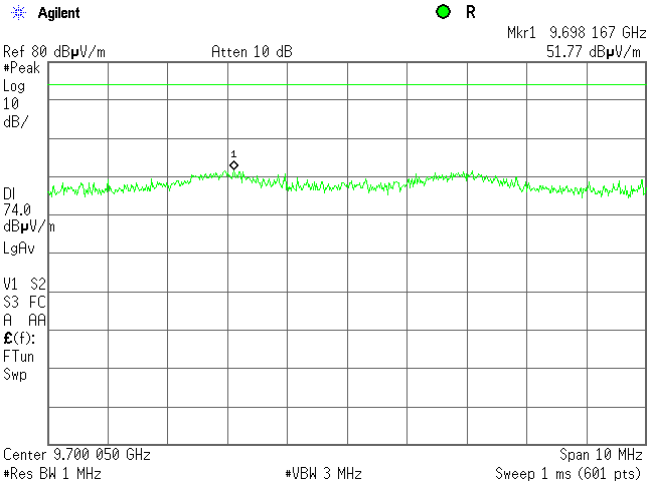
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m

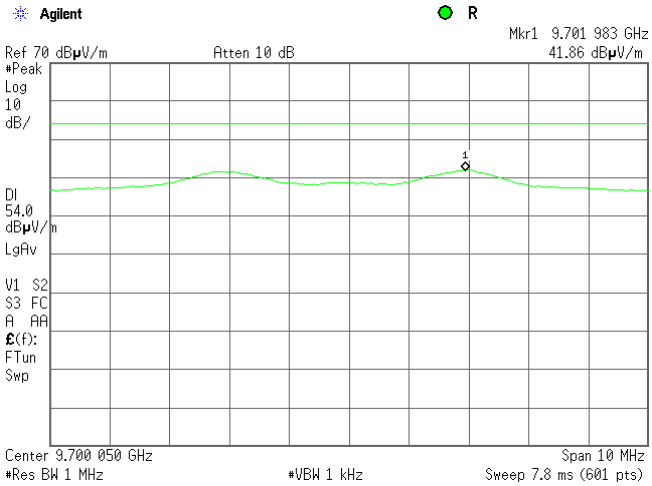


Test specification:	Section 15.249(a)(d), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	11/8/2012		
Temperature: 24 ºC	Air Pressure: 1015 hPa	Relative Humidity: 54 %	Power Supply: 3.7 VDC
Remarks:			

Plot 7.1.15 Radiated emission measurements at the fourth harmonic

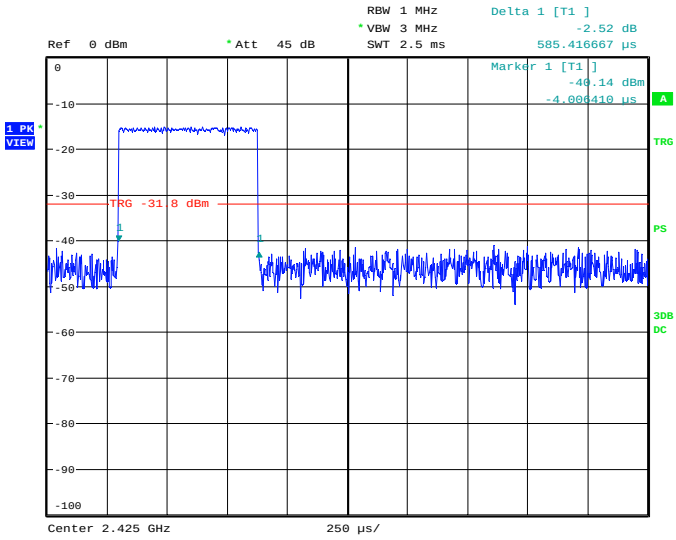
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m





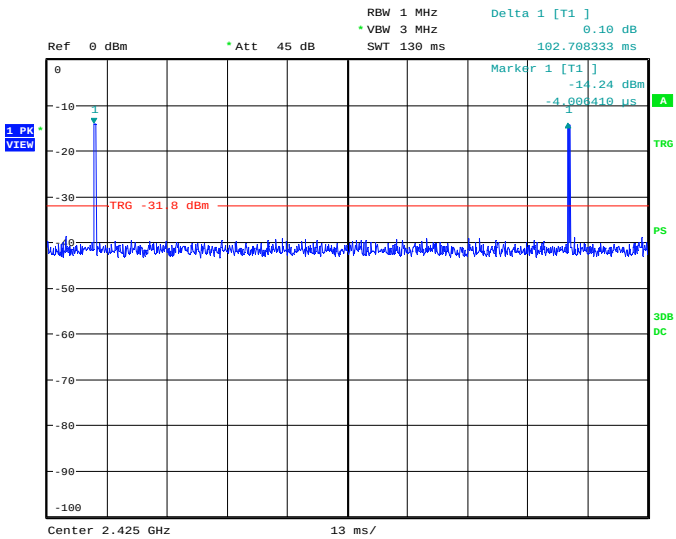
Test specification:	Section 15.249(a)(d), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	11/8/2012		
Temperature: 24 ºC	Air Pressure: 1015 hPa	Relative Humidity: 54 %	Power Supply: 3.7 VDC
Remarks:			

Plot 7.1.16 Transmission pulse duration



Date: 21.NOV.2012 08:28:56

Plot 7.1.17 Transmission pulse period



Date: 21.NOV.2012 08:30:35

Test specification:	Section 15.249(d), Band edge emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	11/11/2012		
Temperature: 24 ºC	Air Pressure: 1015 hPa	Relative Humidity: 48 %	Power Supply: 3.7 VDC
Remarks:			

7.2 Band edge emission

7.2.1 General

This test was performed to verify the EUT band edge emission including all associated side bands was attenuated at least 50 dB below the unmodulated carrier level or below the general spurious emission limit. Specification test limits are given in Table 7.2.1.

Table 7.2.1 Band edge emission limits

Frequency band, MHz	Field strength limit at 3 m, dBµV/m		Attenuation below carrier, dBc
	Peak	Average	
2400-2483.5 MHz	74.0	54.0	50

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.

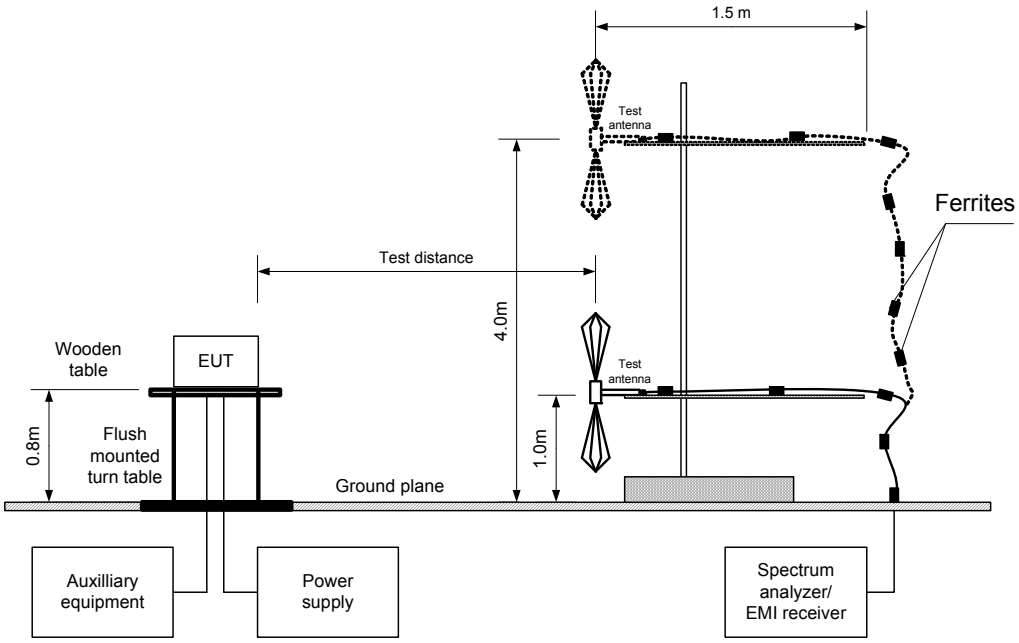
7.2.2.2 The spectrum analyzer frequency span was set to capture all major modulation sidebands of emission and sweep time was set sufficiently slow to ensure peak measurements. Spectrum analyzer was set in peak hold mode and time sufficient for trace stabilization was allowed.

7.2.2.3 The frequency of modulation envelope points beyond which power level drops below the band edge emission limit was measured.

7.2.2.4 The test results were recorded in Table 7.2.2 and shown in the associated plots.

Test specification:	Section 15.249(d), Band edge emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	11/11/2012		
Temperature: 24 ºC	Air Pressure: 1015 hPa	Relative Humidity: 48 %	Power Supply: 3.7 VDC
Remarks:			

Figure 7.2.1 Band edge emission measurement set up



Test specification:	**Section 15.249(d), Band edge emissions**		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	11/11/2012		
Temperature: 24 ºC	**Air Pressure:** 1015 hPa	**Relative Humidity:** 48 %	**Power Supply:** 3.7 VDC
Remarks:			

Table 7.2.2 Band edge emission test results

OPERATING FREQUENCY RANGE: 2400-2483.5 MHz
DETECTOR USED: Peak hold
MODULATION: QPSK
MODULATING SIGNAL: PRBS
BIT RATE: 250 kbps
TRANSMITTER OUTPUT POWER SETTINGS: Maximum

Frequency, 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**	
2388.8	V	1.3	0	56.46	74	-17.54	NA	36.69	54	-17.31	Pass
2497.1	V	1.3	0	57.34	74	-16.66	NA	36.61	54	-17.39	

* - Measured frequency beyond which the emission was below the field strength limit
** - Margin = Band edge limit – measured value

Reference numbers of test equipment used

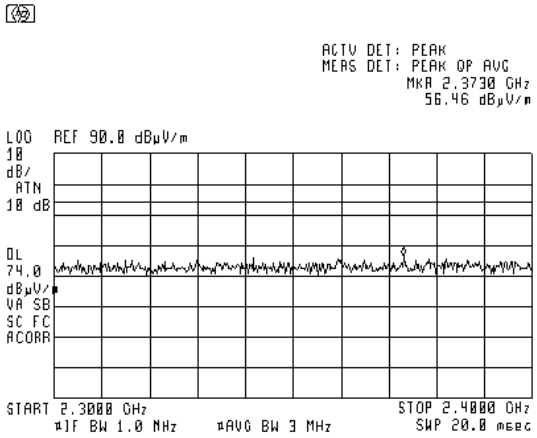
HL 0521	HL 1984	HL 4352	HL 4353				

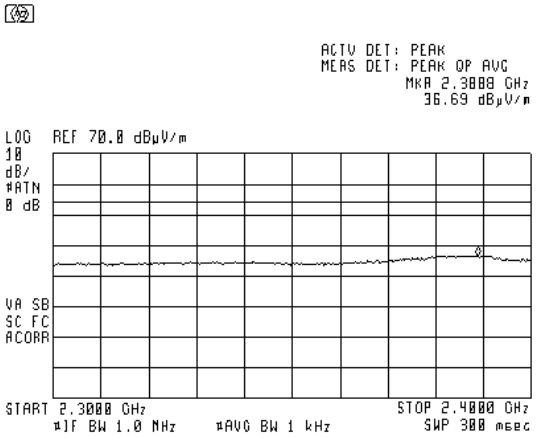
Full description is given in Appendix A.

Test specification:	**Section 15.249(d), Band edge emissions**		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	11/11/2012		
Temperature: 24 ºC	**Air Pressure:** 1015 hPa	**Relative Humidity:** 48 %	**Power Supply:** 3.7 VDC
Remarks:			

Plot 7.2.1 Low band edge emission test result

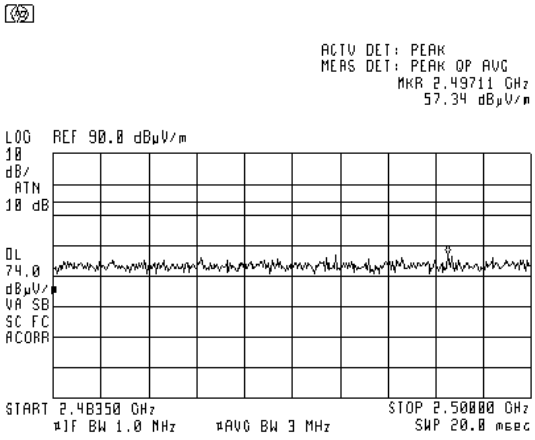
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal

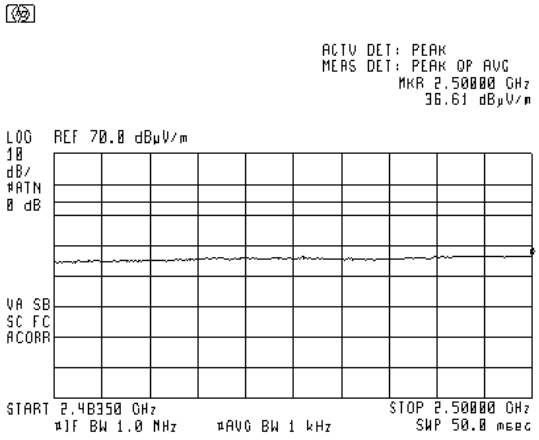




Plot 7.2.2 High band edge emission test result

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal





Test specification:	Section 15.203, Antenna requirement		
Test procedure:	Visual inspection / supplier declaration		
Test mode:	Compliance	Verdict:	PASS
Date(s):	11/11/2012		
Temperature: 24 ºC	Air Pressure: 1015 hPa	Relative Humidity: 48 %	Power Supply: 3.7 VDC
Remarks:			

7.3 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 7.3.1.

Table 7.3.1 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	

Test specification:	Section 15.215(c), Occupied bandwidth		
Test procedure:	ANSI C63.4, Section 13.1.7		
Test mode:	Compliance	Verdict:	PASS
Date(s):	11/8/2012		
Temperature: 24 ºC	Air Pressure: 1015 hPa	Relative Humidity: 54 %	Power Supply: 3.7 VDC
Remarks:			

7.4 Occupied bandwidth test

7.4.1 General

This test was performed to verify that the 20 dB bandwidth of the emissions was contained within the standard specified frequency band according to FCC §15.215 requirements. Specification test limits are given in Table 7.4.1.

Table 7.4.1 Occupied bandwidth limits

Assigned frequency, MHz	Modulation envelope reference points*, dBc
902 - 928	20.0
2400 – 2483.5	
5725 – 5875	
24000 – 24250	

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

7.4.2 Test procedure

7.4.2.1 The EUT was set up as shown in Figure 7.4.1, energized and its proper operation was checked.

7.4.2.2 The spectrum analyzer sweep time and bandwidth were set to capture all major modulation sidebands of emission and sweep time was set sufficiently slow to ensure peak measurements. Spectrum analyzer was set in peak hold mode and time sufficient for trace stabilization was allowed.

7.4.2.3 The peak of emission was measured. The transmitter occupied bandwidth was measured with spectrum analyzer as frequency delta between reference points on modulation envelope and provided in Table 7.4.2 and the associated plot.

Figure 7.4.1 Occupied bandwidth test setup

Test specification:	**Section 15.215(c), Occupied bandwidth**		
Test procedure:	ANSI C63.4, Section 13.1.7		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	11/8/2012		
Temperature: 24 ºC	**Air Pressure:** 1015 hPa	**Relative Humidity:** 54 %	**Power Supply:** 3.7 VDC
Remarks:			

Table 7.4.2 Occupied bandwidth test results

ASSIGNED FREQUENCY BAND 2400-2483.5 MHz
DETECTOR USED: Peak hold
RESOLUTION BANDWIDTH: 300 kHz
VIDEO BANDWIDTH: 1000 kHz
MODULATION ENVELOPE REFERENCE POINTS: 20 dBc

Band edge	Cross point frequency, MHz	Frequency drift, kHz		Modulation band edge, MHz	Assigned band edge, MHz	Verdict
		Negative	Positive			
Low	2423.528	NA	NA	2423.528	2400.0	Pass
High	2426.496	NA	NA	2426.496	2483.5	Pass

Reference numbers of test equipment used

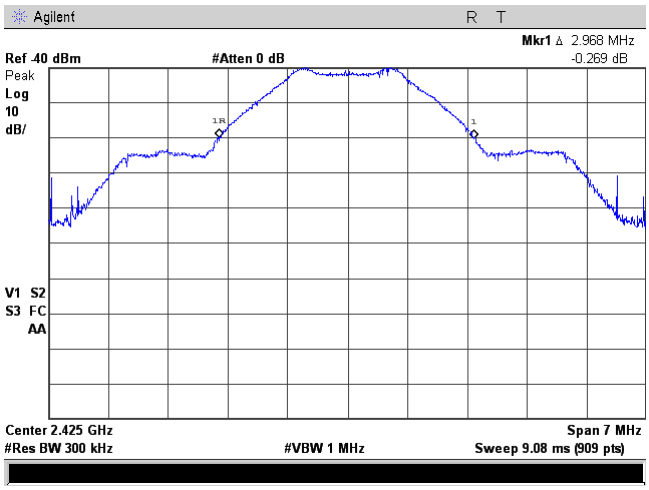
HL 3001								

Full description is given in Appendix A.

Test specification:	**Section 15.215(c), Occupied bandwidth**		
Test procedure:	ANSI C63.4, Section 13.1.7		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	11/8/2012		
Temperature: 24 ºC	**Air Pressure:** 1015 hPa	**Relative Humidity:** 54 %	**Power Supply:** 3.7 VDC
Remarks:			

Plot 7.4.1 Occupied bandwidth test result

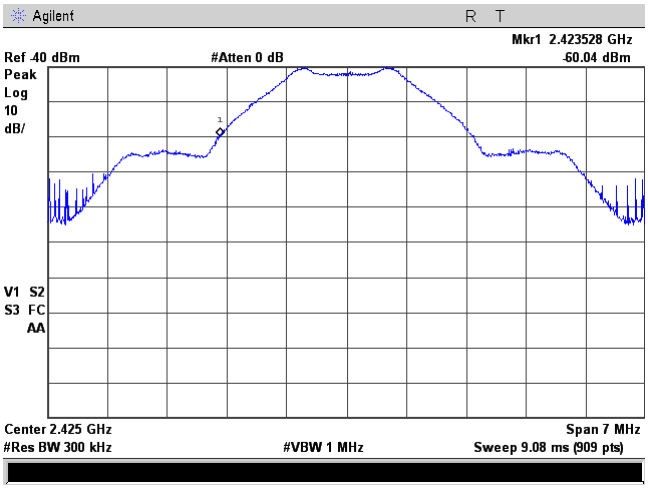
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POSITION: Typical (Vertical)



Test specification:	Section 15.215(c), Occupied bandwidth		
Test procedure:	ANSI C63.4, Section 13.1.7		
Test mode:	Compliance	Verdict:	PASS
Date(s):	11/8/2012		
Temperature: 24 ºC	Air Pressure: 1015 hPa	Relative Humidity: 54 %	Power Supply: 3.7 VDC
Remarks:			

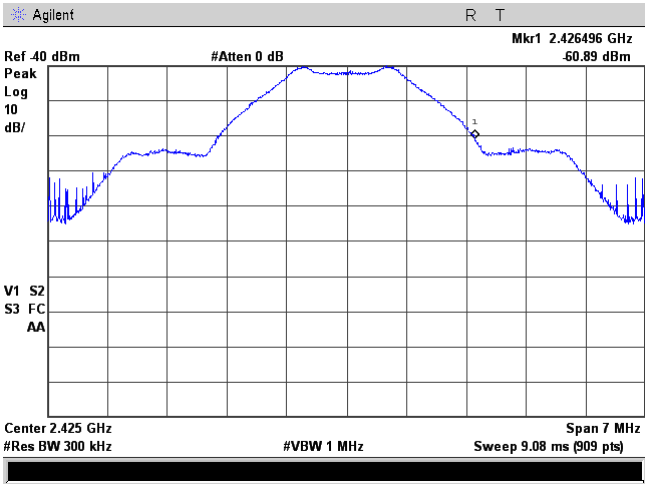
Plot 7.4.2 Occupied bandwidth test result, low band frequency

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



Plot 7.4.3 Occupied bandwidth test result, high band frequency

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



Test specification:	FCC section 15.207(a), Conducted emission		
Test procedure:	ANSI C63.4, Section 13.1.3		
Test mode:	Compliance	Verdict:	PASS
Date(s):	11/11/2012		
Temperature: 23.4 ºC	Air Pressure: 1011 hPa	Relative Humidity: 46 %	Power Supply: 120 VAC
Remarks:			

7.5 Conducted emissions

7.5.1 General

This test was performed to measure common mode conducted emissions at the mains power port. Specification test limits are given in Table 7.5.1.

Table 7.5.1 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.

7.5.2 Test procedure

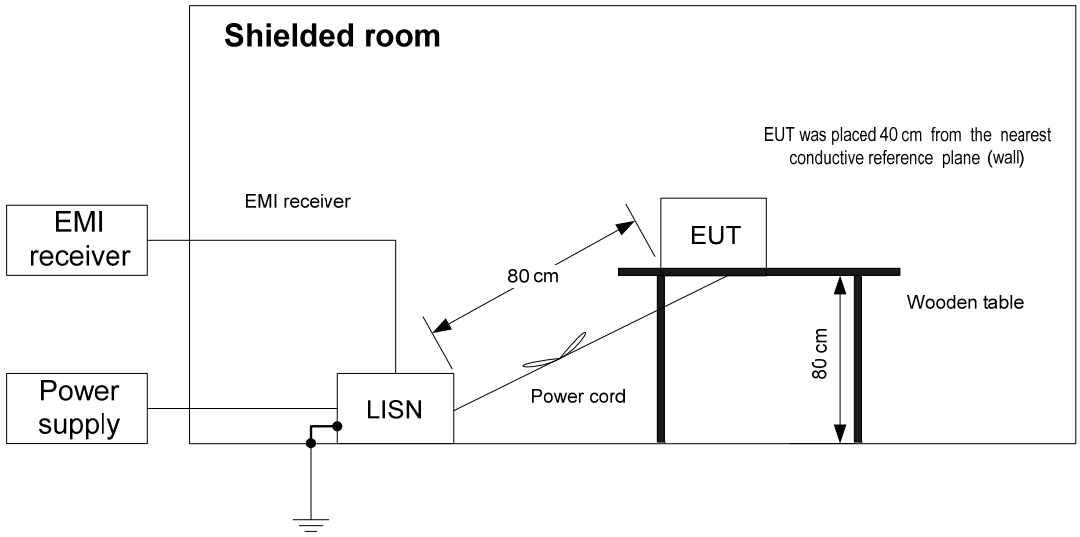
7.5.2.1 The EUT was set up as shown in Figure 7.5.1, energized and the performance check was conducted.

7.5.2.2 The measurements were performed at power terminals with the LISN, connected to a spectrum analyzer in the frequency range referred to in Table 7.5.2. Unused coaxial connector of the LISN was terminated with 50 Ohm. Quasi-peak and average detectors were used throughout the testing.

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

7.5.2.4 The worst test results (the lowest margins) were recorded in Table 7.5.2 and shown in the associated plots.

Figure 7.5.1 Setup for conducted emission measurements, table-top equipment



Test specification:	**FCC section 15.207(a), Conducted emission**		
Test procedure:	ANSI C63.4, Section 13.1.3		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	11/11/2012		
Temperature: 23.4 ºC	**Air Pressure:** 1011 hPa	**Relative Humidity:** 46 %	**Power Supply:** 120 VAC
Remarks:			

Table 7.5.2 Conducted emission test results

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

Frequency, MHz	Peak emission, dB(μV)	Quasi-peak			Average			Line ID	Verdict
		Measured emission, dB(μV)	Limit, dB(μV)	Margin, dB*	Measured emission, dB(μV)	Limit, dB(μV)	Margin, dB*		
0.189675	46.45	44.22	64.06	-19.84	34.50	54.06	-19.56	L1	Pass
0.258875	43.59	41.29	61.52	-20.23	34.22	51.52	-17.30		
0.329100	43.37	37.52	59.52	-22.00	28.46	49.52	-21.06		
0.521415	46.42	41.89	56.00	-14.11	35.27	46.00	-10.73		
0.687955	41.35	36.26	56.00	-19.74	28.64	46.00	-17.36		
15.884290	49.46	46.44	60.00	-13.56	34.95	50.00	-15.05		
0.191225	45.98	44.14	63.99	-19.85	36.66	53.99	-17.33	L2	Pass
0.257950	42.98	40.80	61.55	-20.75	34.88	51.55	-16.67		
0.321150	42.79	40.94	59.71	-18.77	36.23	49.71	-13.48		
0.517425	48.67	44.08	56.00	-11.92	36.98	46.00	-9.02		
0.687150	42.31	36.95	56.00	-19.05	28.25	46.00	-17.75		
13.891203	50.12	45.15	60.00	-14.85	33.61	50.00	-16.39		

*- Margin = Measured emission - specification limit.

Reference numbers of test equipment used

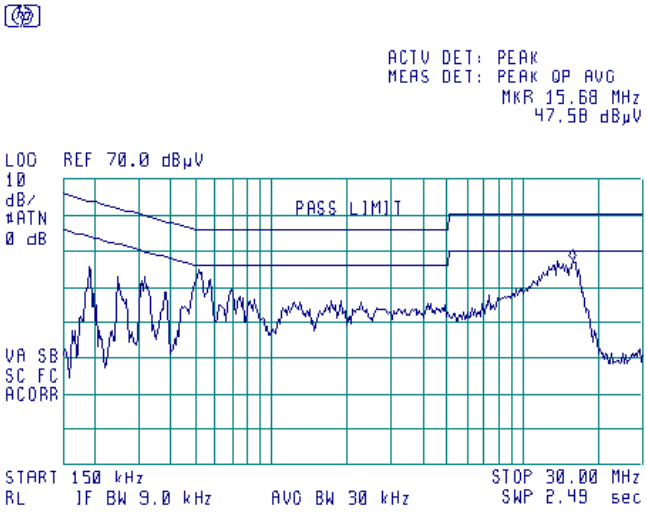
HL 0163	HL 0787	HL 1425	HL 1513	HL 3612			

Full description is given in Appendix A.

Test specification:	**FCC section 15.207(a), Conducted emission**		
Test procedure:	ANSI C63.4, Section 13.1.3		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	11/11/2012		
Temperature: 23.4 ºC	**Air Pressure:** 1011 hPa	**Relative Humidity:** 46 %	**Power Supply:** 120 VAC
Remarks:			

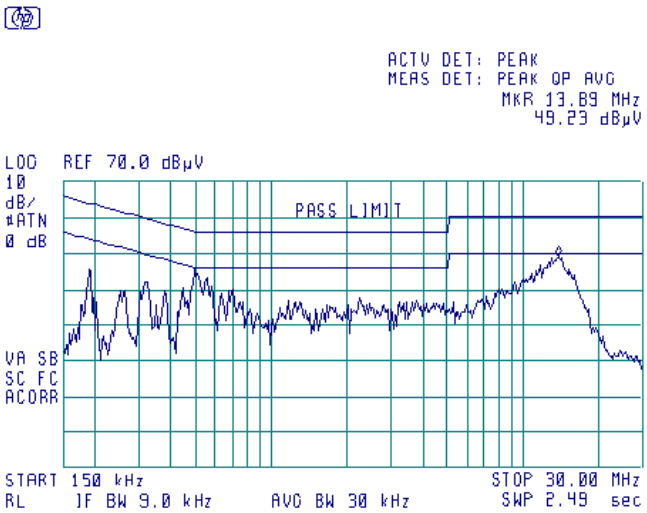
Plot 7.5.1 Conducted emission measurements

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



Plot 7.5.2 Conducted emission measurements

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



Test specification:	Section 15.107, Conducted emission at AC power port		
Test procedure:	ANSI C63.4, Sections 11.5 and 12.1.3		
Test mode:	Compliance	Verdict:	PASS
Date(s):	11/11/2012		
Temperature: 23.4 ºC	Air Pressure: 1011 hPa	Relative Humidity: 46 %	Power Supply: 120 VAC
Remarks:			

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

8.1 Conducted emissions

8.1.1 General

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

Table 8.1.1 Limits for conducted emissions

Frequency, MHz	Class B limit, dB(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.

8.1.2 Test procedure

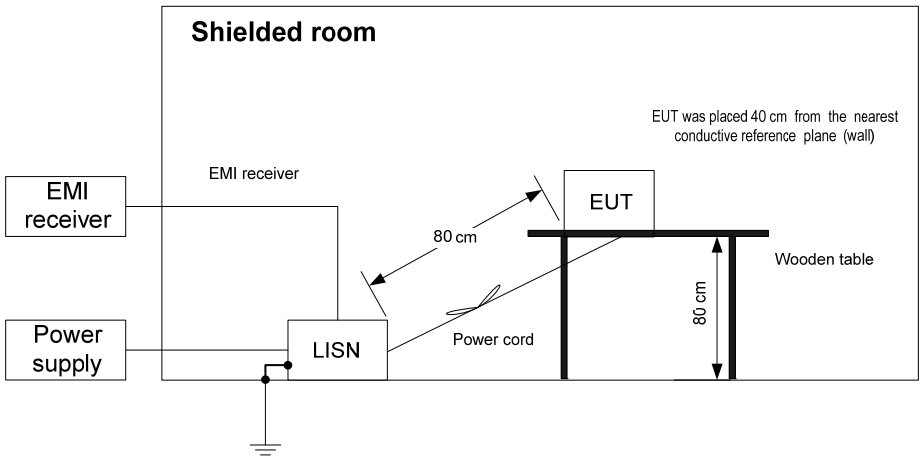
8.1.2.1 The EUT was set up as shown in Figure 8.1.1, energized and the performance check was conducted.

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

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

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

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



Test specification:	Section 15.107, Conducted emission at AC power port		
Test procedure:	ANSI C63.4, Sections 11.5 and 12.1.3		
Test mode:	Compliance	Verdict:	PASS
Date(s):	11/11/2012		
Temperature: 23.4 ºC	Air Pressure: 1011 hPa	Relative Humidity: 46 %	Power Supply: 120 VAC
Remarks:			

Table 8.1.2 Conducted emission test results

LINE: AC mains
LIMIT: Class B
EUT OPERATING MODE: Receive
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*		
0.189675	46.45	44.22	64.06	-19.84	34.50	54.06	-19.56	L1	Pass
0.258875	43.59	41.29	61.52	-20.23	34.22	51.52	-17.30		
0.329100	43.37	37.52	59.52	-22.00	28.46	49.52	-21.06		
0.521415	46.42	41.89	56.00	-14.11	35.27	46.00	-10.73		
0.687955	41.35	36.26	56.00	-19.74	28.64	46.00	-17.36		
15.884290	49.46	46.44	60.00	-13.56	34.95	50.00	-15.05		
0.191225	45.98	44.14	63.99	-19.85	36.66	53.99	-17.33	L2	Pass
0.257950	42.98	40.80	61.55	-20.75	34.88	51.55	-16.67		
0.321150	42.79	40.94	59.71	-18.77	36.23	49.71	-13.48		
0.517425	48.67	44.08	56.00	-11.92	36.98	46.00	-9.02		
0.687150	42.31	36.95	56.00	-19.05	28.25	46.00	-17.75		
13.891203	50.12	45.15	60.00	-14.85	33.61	50.00	-16.39		

*- Margin = Measured emission - specification limit.

Reference numbers of test equipment used

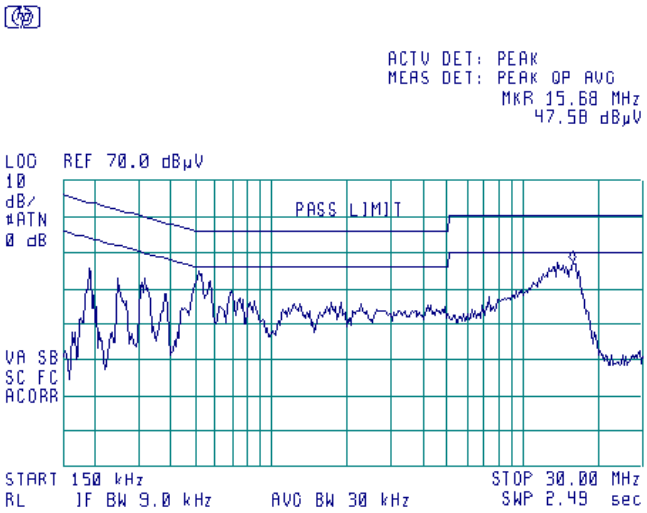
HL 0163	HL 0787	HL 1425	HL 1513	HL 3612			

Full description is given in Appendix A.

Test specification:	Section 15.107, Conducted emission at AC power port		
Test procedure:	ANSI C63.4, Sections 11.5 and 12.1.3		
Test mode:	Compliance	Verdict:	PASS
Date(s):	11/11/2012		
Temperature: 23.4 ºC	Air Pressure: 1011 hPa	Relative Humidity: 46 %	Power Supply: 120 VAC
Remarks:			

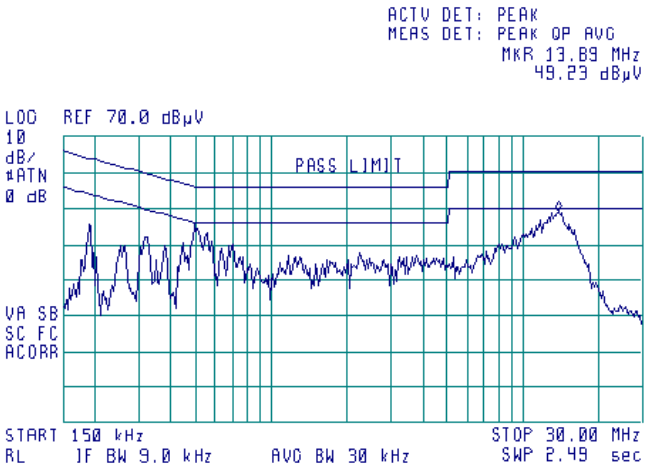
Plot 8.1.1 Conducted emission measurements

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



Plot 8.1.2 Conducted emission measurements

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



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(s):	11/13/2012		
Temperature: 22.5 ºC	Air Pressure: 1013 hPa	Relative Humidity: 56 %	Power Supply:
Remarks:			

8.2 Radiated emission measurements

8.2.1 General

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

Table 8.2.1 Radiated emission test limits

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

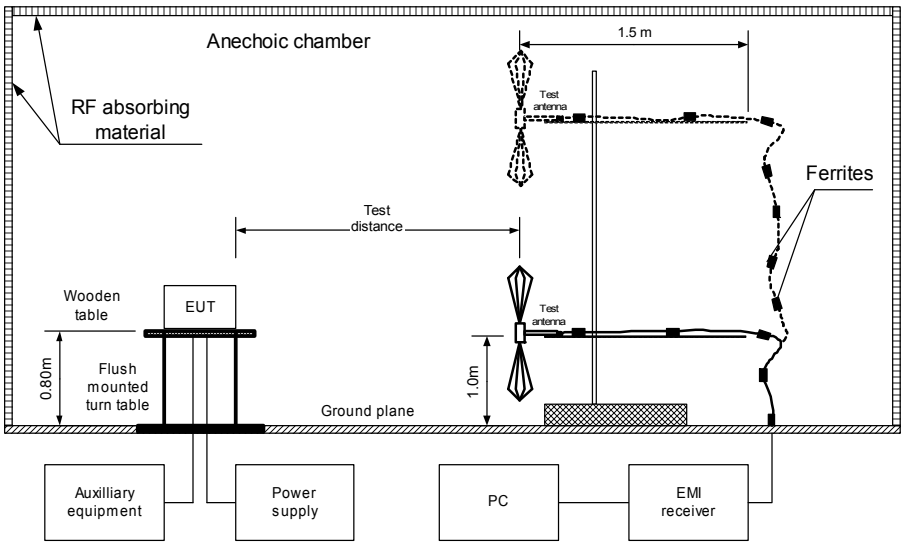
8.2.2 Test procedure

8.2.2.1 The EUT was set up as shown in Figure 8.2.1, energized and the performance check was conducted.

8.2.2.2 The specified frequency range was investigated with biconilog antenna connected to EMI receiver. To find maximum radiation the turntable was rotated 360^0, 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.

8.2.2.3 The worst test results (the lowest margins) were recorded in Table 8.2.2, and shown in the associated plots.

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



Test specification:	**Section 15.109, Radiated emission**		
Test procedure:	ANSI C63.4, Sections 11.6 and 12.1.4		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	11/13/2012		
Temperature: 22.5 ºC	**Air Pressure:** 1013 hPa	**Relative Humidity:** 56 %	**Power Supply:**
Remarks:			

Table 8.2.2 Radiated emission test results

EUT SET UP: TABLE-TOP
LIMIT: Class B
EUT OPERATING MODE: Receive
TEST SITE: SEMI ANECHOIC CHAMBER
TEST DISTANCE: 3 m
DETECTORS USED: PEAK / QUASI-PEAK
FREQUENCY RANGE: 30 MHz – 1000 MHz
RESOLUTION BANDWIDTH: 120 kHz

Frequency, MHz	Peak emission, dB(μV/m)	Quasi-peak			Antenna polarization	Antenna height, m	Turn-table position**, degrees	Verdict
		Measured emission, dB(μV/m)	Limit, dB(μV/m)	Margin, dB*				
79.4313	38.1	33.2	40.0	-6.8	Vertical	1.3	240	Pass
150.02500	38.4	36.6	43.5	-6.9	Vertical	1.0	360	
250.01500	44.1	42.5	46.0	-3.5	Vertical	1.8	360	
450.01225	40.0	38.3	46.0	-7.7	Vertical	1.0	300	
750.08250	42.9	42.4	46.0	-3.6	Vertical	1.0	315	
850.01350	43.7	42.5	46.0	-3.5	Vertical	1.1	15	
950.02575	46.7	45.8	46.0	-0.2	Vertical	1.0	330	

TEST SITE: SEMI ANECHOIC CHAMBER
TEST DISTANCE: 3 m
DETECTORS USED: PEAK / AVERAGE
FREQUENCY RANGE: 1000 MHz – 5000 MHz
RESOLUTION BANDWIDTH: 1000 kHz

Frequency, MHz	Peak			Average			Antenna polarization	Antenna height, m	Turn-table position**, degrees	Verdict
	Measured emission, dB(μV/m)	Limit, dB(μV/m)	Margin, dB*	Measured emission, dB(μV/m)	Limit, dB(μV/m)	Margin, dB*				
1050.0	47.3	74.0	-26.7	44.6	54.0	-9.4	Vertical	1.1	300	Pass
4850.0	51.7	74.0	-22.3	42.7	54.0	-11.3	Vertical	1.1	150	

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

Reference numbers of test equipment used

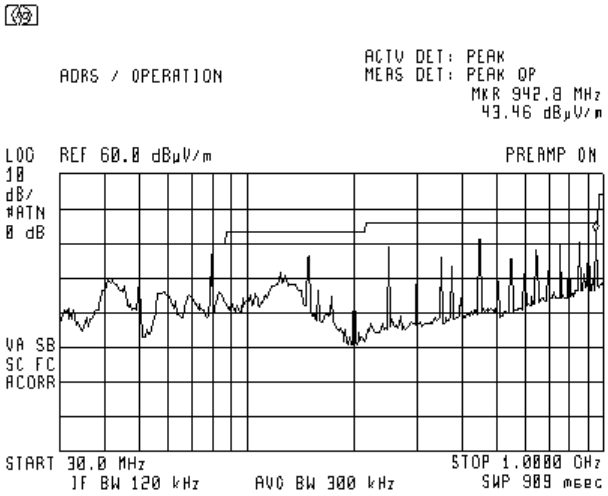
HL 0521	HL 0604	HL 1984	HL 4352	HL 4353			

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(s):	11/13/2012		
Temperature: 22.5 ºC	Air Pressure: 1013 hPa	Relative Humidity: 56 %	Power Supply:
Remarks:			

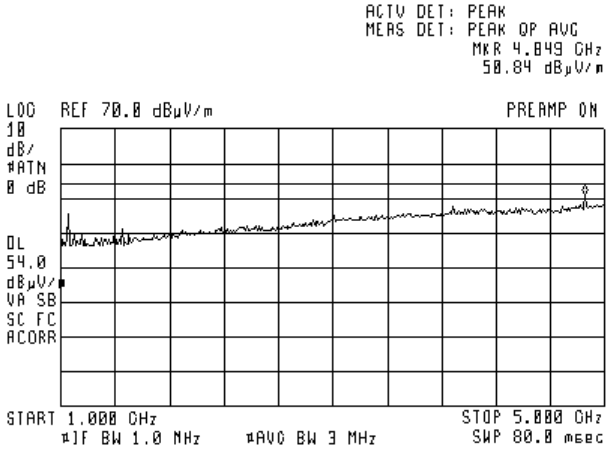
Plot 8.2.1 Radiated emission measurements in 30 - 1000 MHz range

TEST SITE:	Semi anechoic chamber
LIMIT:	Class B
TEST DISTANCE:	3 m
ANTENNA POLARIZATION	Vertical & Horizontal
EUT OPERATING MODE:	Receive



Plot 8.2.2 Radiated emission measurements above 1000 MHz

TEST SITE:	Semi anechoic chamber
LIMIT:	Class B
TEST DISTANCE:	3 m
ANTENNA POLARIZATION	Vertical & Horizontal
EUT OPERATING MODE:	Receive



9 APPENDIX A Test equipment and ancillaries used for tests

HL No	Description	Manufacturer	Model	Ser. No.	Last Cal./ Check	Due Cal./ Check
0163	LISN FCC/VDE/50 Ohm/50 uH + 5 Ohm, MIL-STD-461E, CISPR 16-1	Electro-Metrics	ANS 25/2	1314	01-Jul-12	01-Jul-13
0446	Antenna, Loop, Active, 10 kHz - 30 MHz	EMCO	6502	2857	03-Jul-12	03-Jul-13
0521	EMI Receiver (Spectrum Analyzer) with RF filter section 9 kHz-6.5 GHz	Hewlett Packard	8546A	3617A 00319, 3448A002 53	24-Sep-12	24-Sep-13
0604	Antenna BiconiLog Log-Periodic/T Bow-TIE, 26 - 2000 MHz	EMCO	3141	9611-1011	20-May-12	20-May-14
0768	Antenna Standard Gain Horn, 18-26.5 GHz, WR-42, 25 dB gain	Quinstar Technology	QWH-4200-BA	110	03-Feb-12	03-Feb-15
0787	Transient Limiter 9 kHz-200 MHz	Hewlett Packard	11947A	3107A018 77	15-Oct-12	15-Oct-13
1425	EMI Receiver, 9 kHz - 2.9 GHz, System: HL1426, HL1427	Agilent Technologies	8542E	3710A002 22, 3705A002 04	26-Aug-12	26-Aug-13
1513	Cable RF, 8 m, BNC/BNC	Belden	M17/167 MIL-C-17	1513	02-Sep-12	02-Sep-13
1984	Antenna, Double-Ridged Waveguide Horn, 1-18 GHz, 300 W	EMC Test Systems	3115	9911-5964	25-Nov-11	25-Nov-12
2432	Antenna, Double-Ridged Waveguide Horn 1-18 GHz	EMC Test Systems	3115	00027177	25-Nov-11	25-Nov-12
2952	Cable, RF, 18 GHz, 1.2 m, SMA-SMA	Gore	10020014	NA	10-Oct-12	10-Oct-13
3001	EMC Analyzer, 9 kHz to 3 GHz	Agilent Technologies	E7402A	US394401 80	29-Dec-11	29-Dec-12
3347	High Pass Filter, 50 Ohm, 6000 to 11500 MHz	Mini-Circuits	VHF-5500+	NA	03-Oct-12	03-Oct-13
3533	Amplifier, low noise, 6 to 18 GHz	Quinstar Technology	QLJ-06184040 -J0	111590010 01	25-Dec-11	25-Dec-12
3535	Amplifier, low noise, 18 to 40 GHz	Quinstar Technology	QLJ-18404537 -J0	111590030 01	10-Jul-12	10-Jul-13
3612	Cable RF, 17.5 m, N type-N type	Teldor	RG-214/U	NA	01-Dec-11	01-Dec-12
3818	PSA Series Spectrum Analyzer, 3 Hz- 44 GHz	Agilent Technologies	E4446A	MY482502 88	16-Feb-12	16-Feb-13
3901	Microwave Cable Assembly, 40.0 GHz, 3.5 m, SMA/SMA	Huber-Suhner	SUCOFLE X 102A	1225/2A	08-Feb-12	08-Feb-13
4352	Low Loss Armored Test Cable, DC - 18 GHz, 6.2 m, N type-M/N type-M	MegaPhase	NC29-N1N1-244	12025101 002	06-Jun-12	06-Mar-13
4353	Low Loss Armored Test Cable, DC - 18 GHz, 6.2 m, N type-M/N type-M	MegaPhase	NC29-N1N1-244	12025101 003	06-Jun-12	06-Mar-13

10 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
Duty cycle, timing (Tx ON / OFF) and average factor measurements	± 1.0 %
Occupied bandwidth	± 8.0 %

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.

11 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), Registration Numbers 90624 for OATS and 90623 for the anechoic chamber; by Industry Canada for electromagnetic emissions (file numbers IC 2186A-1 for OATS, IC 2186A-2 for anechoic chamber, IC 2186A-3 for full-anechoic chamber for RE measurements above 1 GHz), certified by VCCI, Japan (the registration numbers are R-808 for OATS, R-1082 for anechoic chamber, G-27 for full-anechoic chamber for RE measurements above 1 GHz, C-845 for conducted emissions site, T-1606 for conducted emissions at telecommunication ports), has a status of a Telefication - Listed Testing Laboratory, Certificate No. L138/00. 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). The FCC Designation Number is US1003.

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Person for contact: Mr. Alex Usoskin, CEO.

12 APPENDIX D Specification references

47CFR part 15: 2011	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

13 APPENDIX E Test equipment correction factors

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

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

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

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

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

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

Antenna factor
Standard gain horn antenna
Quinstar Technology, Model QWH
Ser.No.110, HL 0768

Frequency min, GHz	Frequency max, GHz	Antenna factor, dB(1/m)
18.000	26.500	32.01
26.500	40.000	35.48
40.000	60.000	39.03
60.000	90.000	42.55
90.000	140.000	46.23
140.000	220.000	50.11

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
Ser.No.1011, HL 0604

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

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

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

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

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

Antenna factor
Double-ridged guide horn antenna
Model 3115, serial number: 00027177, HL 2432

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 loss
Cable coaxial, Gore, 18 GHz, 1.2 m, SMA-SMA, S/N 10020014
HL 2952

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	0.03	5750	0.97	12000	1.50
30	0.05	6000	1.01	12250	1.45
100	0.11	6250	1.03	12500	1.48
250	0.19	6500	1.06	12750	1.57
500	0.26	6750	1.08	13000	1.51
750	0.32	7000	1.10	13250	1.64
1000	0.38	7250	1.13	13500	1.60
1250	0.43	7500	1.13	13750	1.63
1500	0.47	7750	1.21	14000	1.59
1750	0.53	8000	1.20	14250	1.66
2000	0.55	8250	1.24	14500	1.60
2250	0.59	8500	1.29	14750	1.65
2500	0.63	8750	1.23	15000	1.72
2750	0.66	9000	1.27	15250	1.68
3000	0.69	9250	1.27	15500	1.73
3250	0.72	9500	1.29	15750	1.70
3500	0.75	9750	1.30	16000	1.82
3750	0.78	10000	1.38	16250	1.79
4000	0.82	10250	1.44	16500	1.81
4250	0.84	10500	1.47	16750	1.91
4500	0.86	10750	1.45	17000	1.92
4750	0.90	11000	1.50	17250	1.98
5000	0.91	11250	1.46	17500	2.05
5250	0.94	11500	1.47	17750	2.04
5500	0.96	11750	1.44	18000	2.05

Cable loss
Cable coaxial, RG-214/U, N type-N type, 17 m
Teldor, HL 3612

Frequency, MHz	Cable loss, dB
0.1	0.05
0.5	0.07
1	0.10
3	0.22
5	0.29
10	0.39
30	0.68
50	0.90
100	1.27
150	1.58
200	1.80
250	2.12
300	2.36
350	2.60
400	2.82
450	2.99
500	3.23
550	3.40
600	3.56
650	3.71
700	3.90
750	4.04
800	4.23
850	4.39
900	4.55
950	4.65
1000	4.79

Cable loss
Microwave Cable Assembly, Huber-Suhner, 40 GHz, 3.5 m, SMA-SMA, S/N 1225/2A
HL 3901

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	0.09	9500	4.29	21000	6.67
100	0.41	10000	4.40	22000	6.92
500	0.93	10500	4.52	23000	7.00
1000	1.33	11000	4.64	24000	7.18
1500	1.63	11500	4.76	25000	7.29
2000	1.90	12000	4.87	26000	7.55
2500	2.12	12500	4.99	27000	7.70
3000	2.33	13000	5.11	28000	7.88
3500	2.50	13500	5.20	29000	8.02
4000	2.67	14000	5.31	30000	8.15
4500	2.82	14500	5.42	31000	8.35
5000	2.99	15000	5.51	32000	8.40
5500	3.16	15500	5.58	33000	8.62
6000	3.32	16000	5.68	34000	8.73
6500	3.51	16500	5.78	35000	8.78
7000	3.65	17000	5.91	36000	8.94
7500	3.79	17500	5.99	37000	9.21
8000	3.92	18000	6.07	38000	9.37
8500	4.04	19000	6.36	39000	9.45
9000	4.18	20000	6.49	40000	9.52

Cable loss
Low Loss Armored Test Cable, MegaPhase, 18 GHz, 6.2 m, N type-M/N type-M, NC29-N1N1-244S/N 12025101 002,
HL 4352

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
50	0.20	9000	2.81
100	0.28	9500	2.89
300	0.49	10000	3.00
500	0.63	10500	3.07
1000	0.90	11000	3.15
1500	1.10	11500	3.23
2000	1.28	12000	3.30
2500	1.44	12500	3.38
3000	1.57	13000	3.47
3500	1.71	13500	3.55
4000	1.85	14000	3.61
4500	1.95	14500	3.68
5000	2.05	15000	3.76
5500	2.14	15500	3.86
6000	2.27	16000	3.92
6500	2.38	16500	3.97
7000	2.47	17000	4.03
7500	2.58	17500	4.10
8000	2.65	18000	4.18
8500	2.74		

Cable loss
Low Loss Armored Test Cable, MegaPhase, 18 GHz, 6.2 m, N type-M/N type-M,
NC29-N1N1-244S/N 12025101 003,
HL 4353

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
50	0.20	9000	2.71
100	0.27	9500	2.81
300	0.47	10000	2.90
500	0.61	10500	2.97
1000	0.87	11000	3.06
1500	1.07	11500	3.13
2000	1.24	12000	3.20
2500	1.39	12500	3.26
3000	1.53	13000	3.34
3500	1.65	13500	3.39
4000	1.77	14000	3.47
4500	1.89	14500	3.54
5000	1.99	15000	3.62
5500	2.07	15500	3.69
6000	2.20	16000	3.76
6500	2.30	16500	3.83
7000	2.39	17000	3.86
7500	2.51	17500	3.94
8000	2.58	18000	4.02
8500	2.65		

14 APPENDIX F Abbreviations and acronyms

A	ampere
AC	alternating current
AM	amplitude modulation
AVRG	average (detector)
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
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
k	kilo
kHz	kilohertz
LO	local oscillator
m	meter
MHz	megahertz
min	minute
mm	millimeter
ms	millisecond
μs	microsecond
NA	not applicable
NB	narrow band
OATS	open area test site
Ω	Ohm
PM	pulse modulation
PS	power supply
ppm	part per million (10^{-6})
QP	quasi-peak
RE	radiated emission
RF	radio frequency
rms	root mean square
Rx	receive
s	second
T	temperature
Tx	transmit
V	volt
WB	wideband

END OF DOCUMENT