HERMON LABORATORIES

ELECTRICAL TESTING
0839.01

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TEST REPORT

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

FOR:

SCR Engineers Ltd.
LU Module
Model: LD-LU-MODULE
FCC ID:AMULDLUMODULE

This report is in conformity with ISO/ IEC 17025. The "A2LA Accredited" symbol endorsement applies only to the tests and calibrations that are listed in the scope of Hermon Laboratories accreditation. The test results relate only to the items tested. This test report shall not be reproduced in any form except in full with the written approval of Hermon Laboratories Ltd.

Report ID: SCRRAD_FCC.24298.docx
Date of Issue:20-May-13

Table of contents

1 Applicant information

Client name:	SCR Engineers Ltd.
Address:	6 Haomanut street, Industrial zone, P.O.B. 13564, Netanya 42138, Israel
Telephone:	+972 73 240 6053
Fax:	+972 9865 0703
E-mail:	zeevk@scr.co.il
Contact name:	Mr. Zeev Kapelnik

2 Equipment under test attributes

Product name:	LU module
Product type:	Transceiver
Model(s):	LD-LU-MODULE
Serial number:	200
Hardware version:	221
Software release:	B-1.10_M-2.19
Receipt date	4/4/2013

3 Manufacturer information

Manufacturer name:	SCR Engineers Ltd.
Address:	6 Haomanut street, Industrial zone, P.O.B. 13564, Netanya 42138, Israel
Telephone:	+972 73 240 6053
Fax:	+972 9865 0703
E-Mail:	zeevk@scr.co.il
Contact name:	Mr. Zeev Kapelnik

4 Test details

Project ID:	24298
Location:	Hermon Laboratories Ltd. Harakevet Industrial Zone, Binyamina 30500, Israel
Test started:	4/4/2013
Test completed:	5/14/2013
Test specification(s):	FCC 47 CFR Part 15, subpart C, §15.249; subpart B §15.109

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 15.203, Antenna requirement	Pass
Section 15.215(c), Occupied bandwidth	Pass
Section 15.207(a), Conducted emission	Not required
Unintentional emissions	
Section 15.107, Conducted emission at AC power port	Not required
Section 15.109, Radiated emission	Pass

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

	Name and Title	Date	Signature
Tested by:	Mr. A. Chaplik, test engineer	May 14, 2013	
Reviewed by:	Mrs. M. Cherniavsky, certification engineer	May 20, 2013	
Approved by:	Mr. M. Nikishin, EMC and Radio group manager	May 31, 2013	

6 EUT description

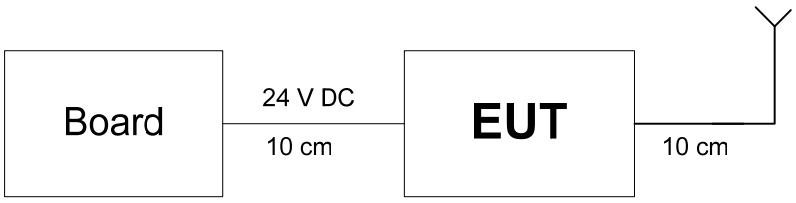
6.1 General information

The EUT, LU module, is a part of BU500-LU base unit used to collect messages from tags and send them to central management system.

6.2 Changes made in EUT

No changes were performed in the EUT.

6.3 Test configuration



6.4 Transmitter characteristics

Type of equipment							
V	Stand-alone (Equipment with or without its own control provisions)						
	Combined equipment (Equipment where the radio part is fully integrated within another type of equipment)						
	Plug-in card (Equipment intended for a variety of host systems)						
Assigned frequency range	2400 – 2483.5 MHz						
Operating frequency range	2405 – 2480 MHz						
RF channel spacing	5 MHz						
Maximum field strength of carrier	105.3 dBµV/m at 3 m distance						
Is transmitter output power variable?	**V**	No					
		Yes		continuous variable			
				stepped variable with stepsize	dB		
				minimum RF power	dBm		
				maximum RF power	dBm		
Antenna connection							
unique coupling	standard connector	**V**	Integral	with temporary RF connector			
				V without temporary RF connector			
Antenna/s technical characteristics							
Type	Manufacturer	Model number	Gain				
Integral	SCR Engineers Ltd.	NA	10 dBi				
Transmitter aggregate data rate/s	250 kbps						
Type of modulation	QPSK						
Modulating test signal (baseband)	PRBS						
Transmitter power source							
	Battery	**Nominal rated voltage**		Battery type			
V	DC	**Nominal rated voltage**	24 V				
	AC mains	**Nominal rated voltage**		Frequency	Hz		

Test specification:	Section 15.249(a)(d)/RSS-210, section A2.9, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	4/4/2013 - 5/7/2013		
Temperature: 21.3 ºC	Air Pressure: 1014 hPa	Relative Humidity: 52 %	Power Supply: 24VDC
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, Table 7.1.3.

Table 7.1.1 Radiated fundamental emission limits

Fundamental frequency, MHz	Field strength at 3 m, dB(μV/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(μV/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)/RSS-210, section A2.9, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	4/4/2013 - 5/7/2013		
Temperature: 21.3 ºC	Air Pressure: 1014 hPa	Relative Humidity: 52 %	Power Supply: 24VDC
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 measurements were performed with the EUT antenna always installed in vertical position.

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

7.1.2.4 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 measurements were performed with the EUT antenna always installed in vertical position

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 recorded in the associated tables and shown in the associated plots.

Test specification:	Section 15.249(a)(d)/RSS-210, section A2.9, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	4/4/2013 - 5/7/2013		
Temperature: 21.3 ºC	Air Pressure: 1014 hPa	Relative Humidity: 52 %	Power Supply: 24VDC
Remarks:			

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

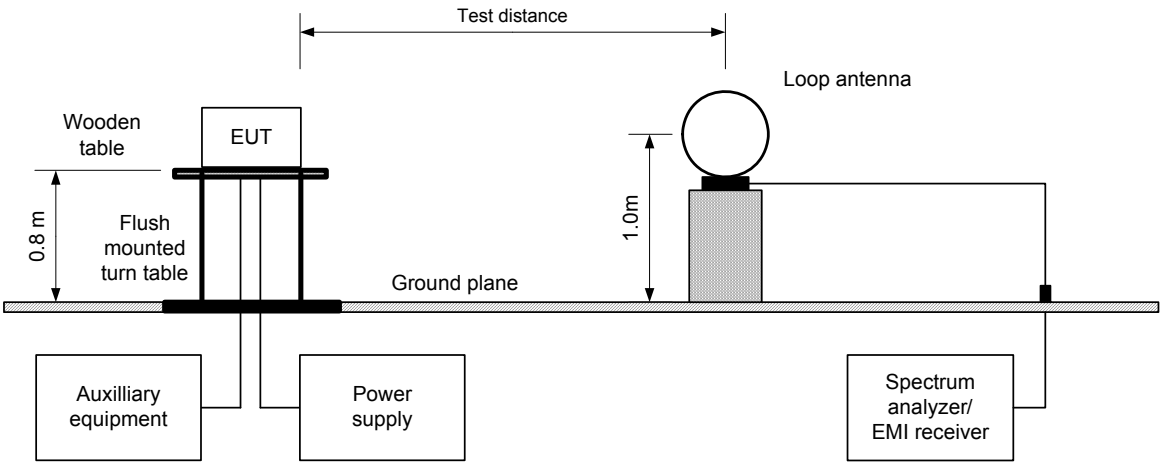
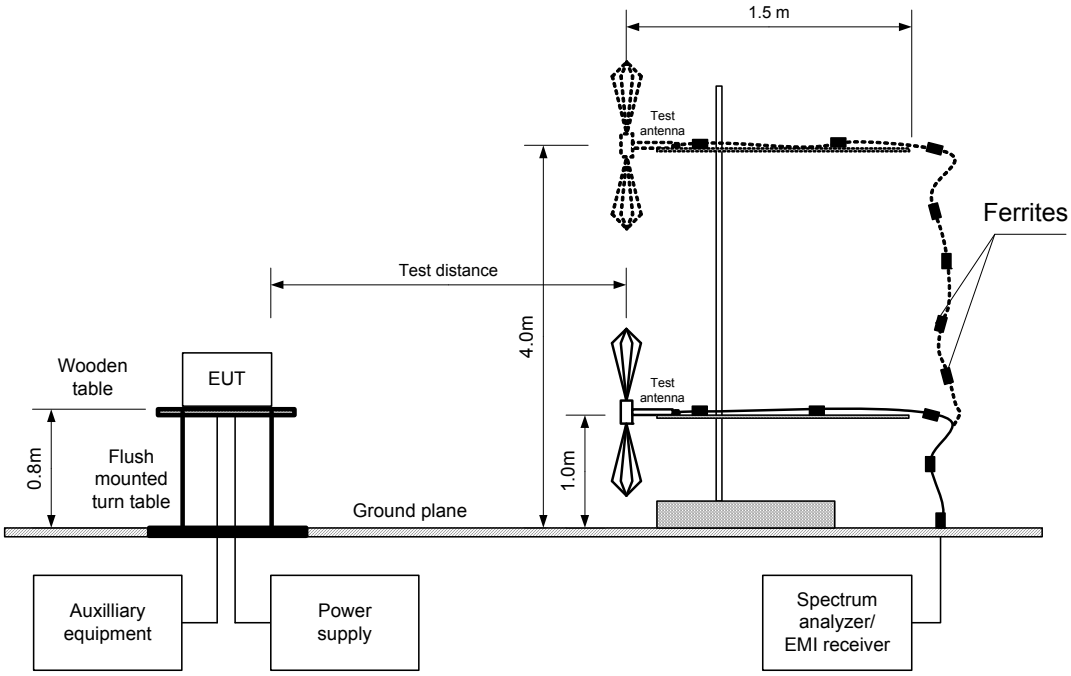


Figure 7.1.2 Setup for spurious emission field strength measurements above 30 MHz



Test specification:	Section 15.249(a)(d)/RSS-210, section A2.9, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	4/4/2013 - 5/7/2013		
Temperature: 21.3 ºC	Air Pressure: 1014 hPa	Relative Humidity: 52 %	Power Supply: 24VDC
Remarks:			

Table 7.1.4 Field strength of fundamental emission and spurious emissions

TEST DISTANCE:	3 m
EUT POSITION:	Typical with antenna in vertical position
MODULATION:	QPSK
TRANSMITTER OUTPUT POWER SETTINGS:	Maximum
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)

Fundamental emission

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**		Calculated, dB(μV/m)	Limit, dB(μV/m)	Margin, dB**	
2405.0	H	1.1	95	103.10	114.00	-10.90	40.90	58.97	94.00	-35.03	Pass
2445.0	V	1.2	105	103.00	114.00	-11.00	40.90	58.57	94.00	-35.43	Pass
2480.0	H	1.3	100	105.30	114.00	-8.70	40.90	60.60	94.00	-33.40	Pass

Spurious emission

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*				
36.688	48.8	34.57	40.0	-5.43	Vertical	1.2	285	Pass
51.348	49.7	21.71	40.0	-18.29	Vertical	1.2	320	
95.810	52.8	23.57	43.5	-19.93	Horizontal	1.3	330	
102.433	36.29	29.59	43.5	-13.91	Vertical	1.3	300	
127.507	44.63	19.39	43.5	-24.11	Vertical	1.3	350	
134.708	45.6	23.37	43.5	-20.13	Horizontal	1.3	360	

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

**- Margin, dB =Measured (calculated) value, dB(μV/m)-Limit, dB(μV/m).

Table 7.1.5 Average factor calculation

Transmission pulse		Transmission burst		Transmission train duration, ms	Average factor, dB
Duration, ms	Period, ms	Duration, ms	Period, ms		
0.9	102.5	NA	NA	NA	-40.9

*- 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

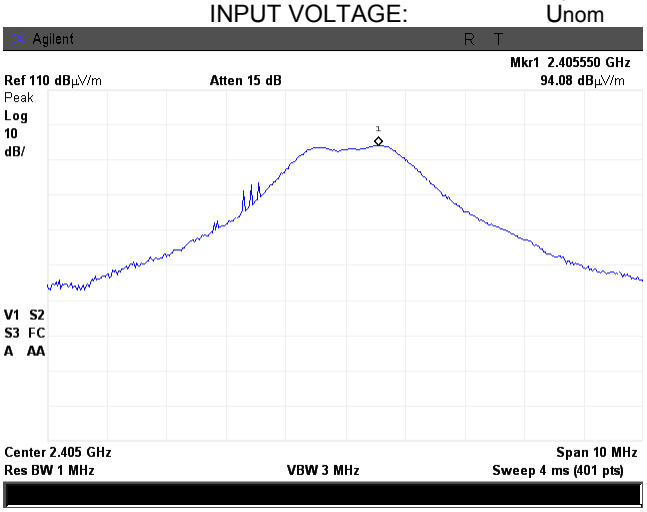
HL 0446	HL 0604	HL 0768	HL 1984	HL 2780	HL 2871	HL 3533	HL 3535
HL 3818	HL 3901	HL 4150	HL 4160	HL 4353			

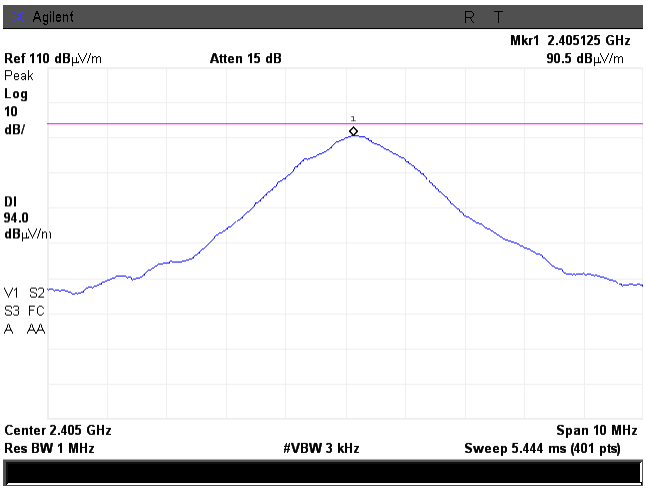
Full description is given in Appendix A.

Test specification:	Section 15.249(a)(d)/RSS-210, section A2.9, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	4/4/2013 - 5/7/2013		
Temperature: 21.3 ºC	Air Pressure: 1014 hPa	Relative Humidity: 52 %	Power Supply: 24VDC
Remarks:			

Plot 7.1.1 Radiated emission measurements at the low fundamental frequency

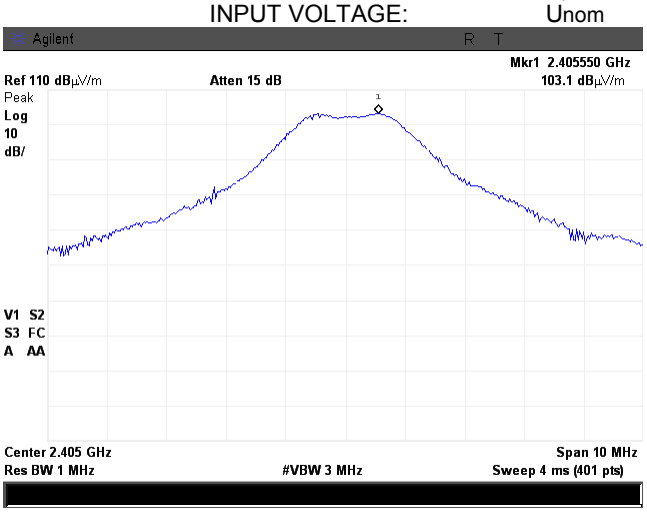
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Typical with antenna in vertical position
INPUT VOLTAGE: Unom

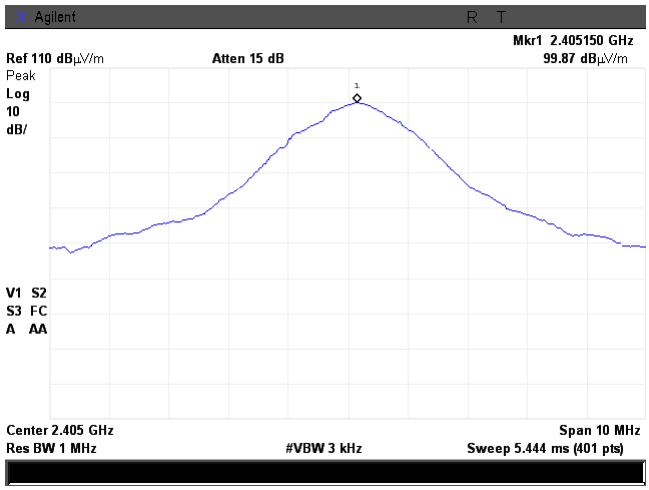




Plot 7.1.2 Radiated emission measurements at the low fundamental frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal
EUT POSITION: Typical with antenna in vertical position
INPUT VOLTAGE: Unom

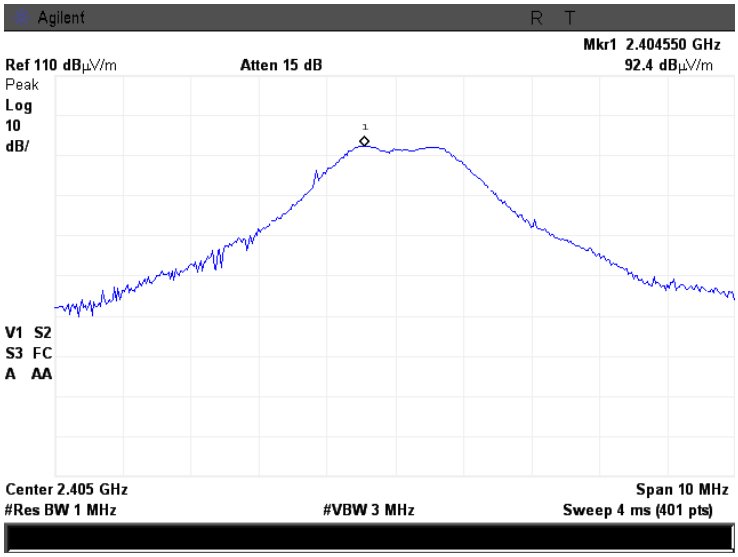




Test specification:	Section 15.249(a)(d)/RSS-210, section A2.9, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	4/4/2013 - 5/7/2013		
Temperature: 21.3 ºC	Air Pressure: 1014 hPa	Relative Humidity: 52 %	Power Supply: 24VDC
Remarks:			

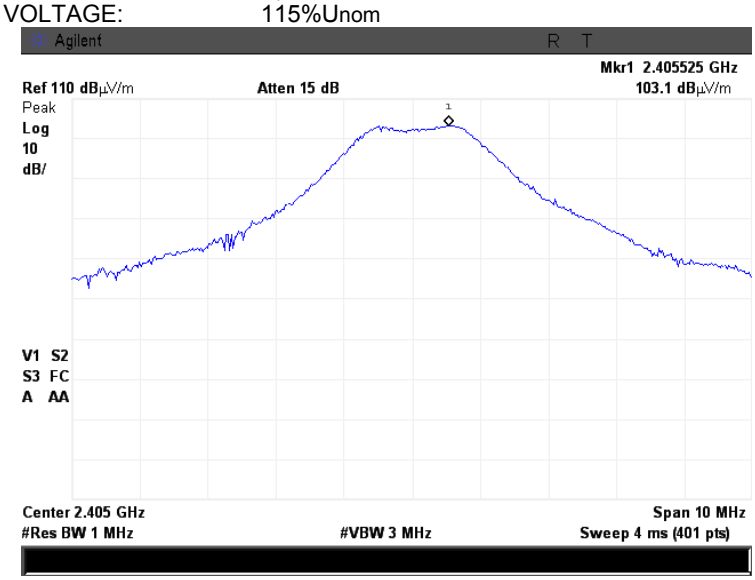
Plot 7.1.3 Radiated emission measurements at the low fundamental frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Typical with antenna in vertical position
INPUT VOLTAGE: 115%Unom



Plot 7.1.4 Radiated emission measurements at the low fundamental frequency

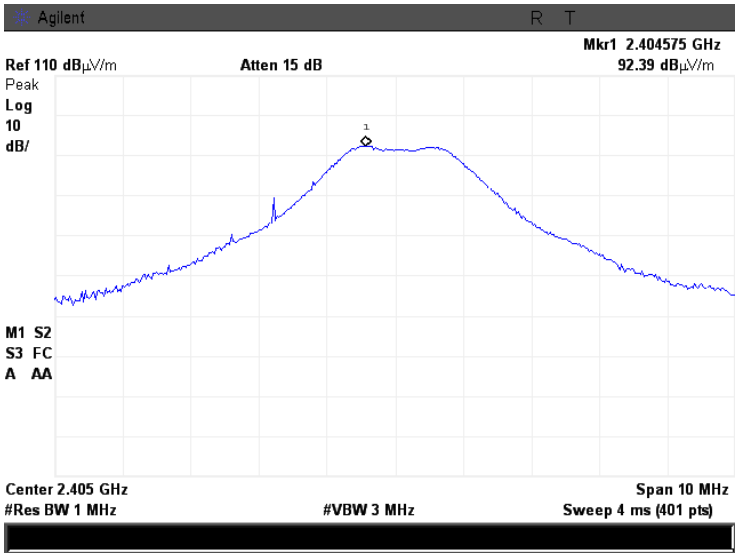
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal
EUT POSITION: Typical with antenna in vertical position
INPUT VOLTAGE: 115%Unom



Test specification:	Section 15.249(a)(d)/RSS-210, section A2.9, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	4/4/2013 - 5/7/2013		
Temperature: 21.3 ºC	Air Pressure: 1014 hPa	Relative Humidity: 52 %	Power Supply: 24VDC
Remarks:			

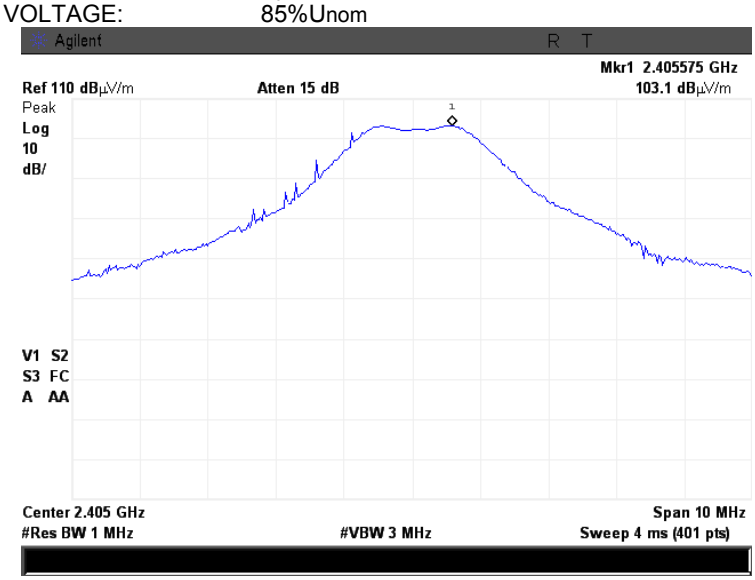
Plot 7.1.5 Radiated emission measurements at the low fundamental frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Typical with antenna in vertical position
INPUT VOLTAGE: 85%Unom



Plot 7.1.6 Radiated emission measurements at the low fundamental frequency

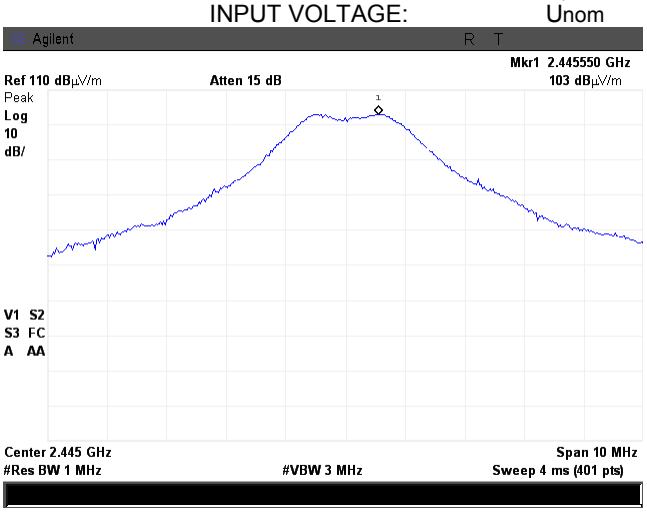
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal
EUT POSITION: Typical with antenna in vertical position
INPUT VOLTAGE: 85%Unom

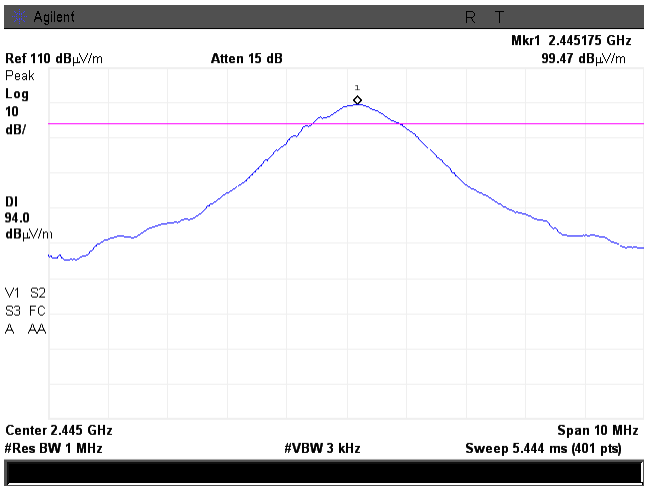


Test specification:	Section 15.249(a)(d)/RSS-210, section A2.9, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	4/4/2013 - 5/7/2013		
Temperature: 21.3 ºC	Air Pressure: 1014 hPa	Relative Humidity: 52 %	Power Supply: 24VDC
Remarks:			

Plot 7.1.7 Radiated emission measurements at the mid fundamental frequency

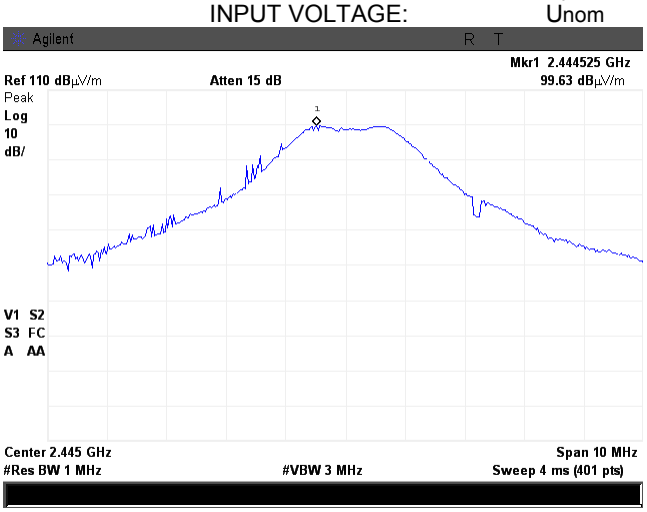
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Typical with antenna in vertical position
INPUT VOLTAGE: Unom

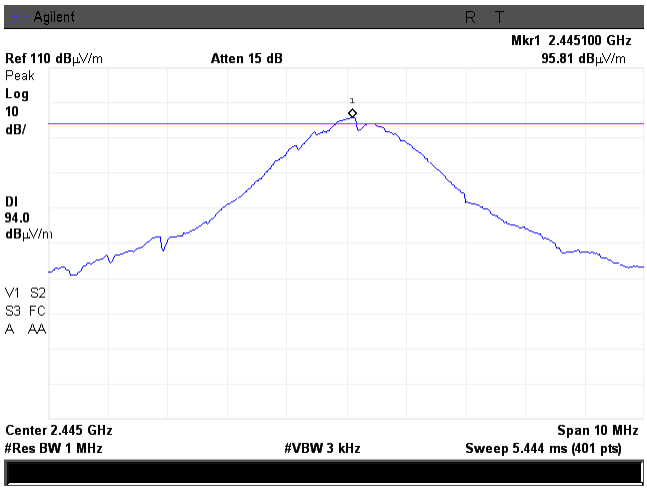




Plot 7.1.8 Radiated emission measurements at the mid fundamental frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal
EUT POSITION: Typical with antenna in vertical position
INPUT VOLTAGE: Unom

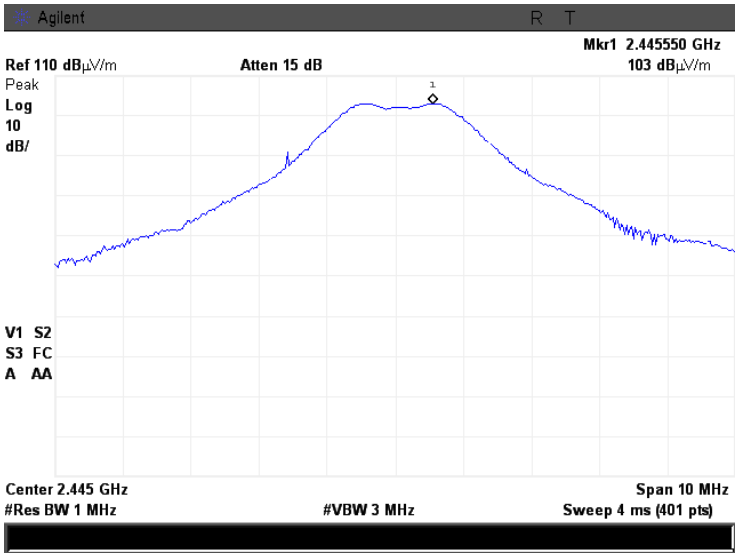




Test specification:	Section 15.249(a)(d)/RSS-210, section A2.9, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	4/4/2013 - 5/7/2013		
Temperature: 21.3 ºC	Air Pressure: 1014 hPa	Relative Humidity: 52 %	Power Supply: 24VDC
Remarks:			

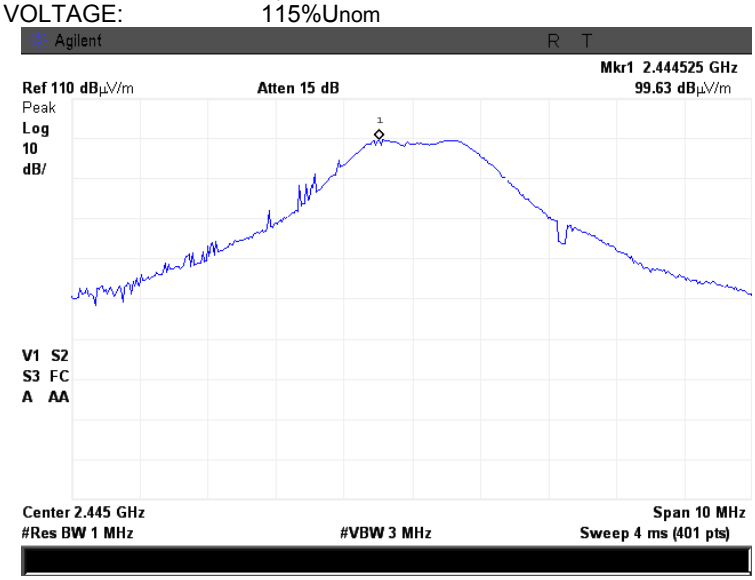
Plot 7.1.9 Radiated emission measurements at the mid fundamental frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Typical with antenna in vertical position
INPUT VOLTAGE: 115%Unom



Plot 7.1.10 Radiated emission measurements at the mid fundamental frequency

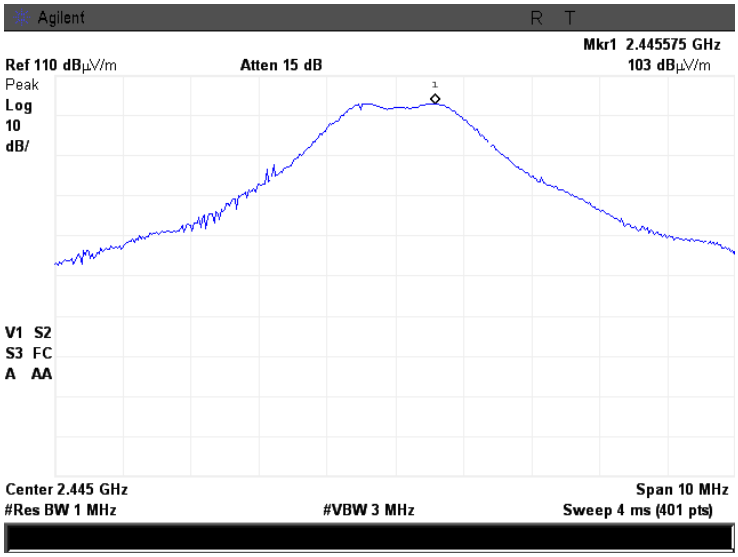
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal
EUT POSITION: Typical with antenna in vertical position
INPUT VOLTAGE: 115%Unom



Test specification:	Section 15.249(a)(d)/RSS-210, section A2.9, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	4/4/2013 - 5/7/2013		
Temperature: 21.3 ºC	Air Pressure: 1014 hPa	Relative Humidity: 52 %	Power Supply: 24VDC
Remarks:			

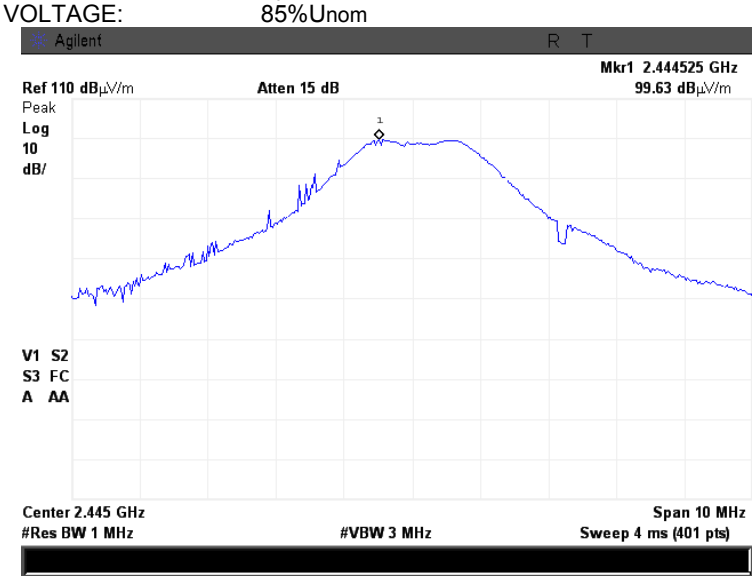
Plot 7.1.11 Radiated emission measurements at the mid fundamental frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Typical with antenna in vertical position
INPUT VOLTAGE: 85%Unom



Plot 7.1.12 Radiated emission measurements at the mid fundamental frequency

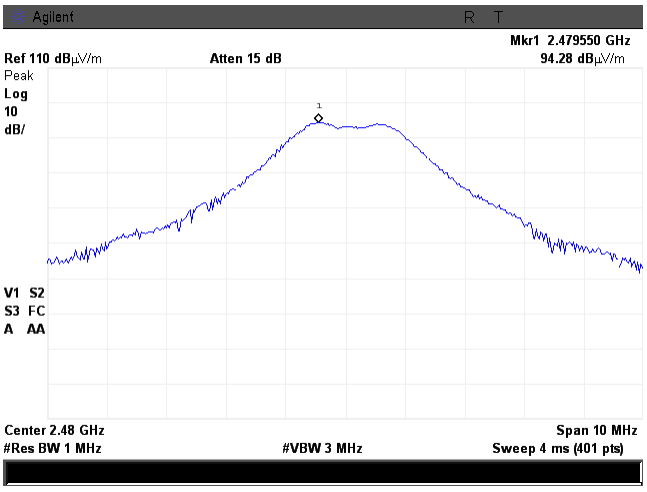
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal
EUT POSITION: Typical with antenna in vertical position
INPUT VOLTAGE: 85%Unom

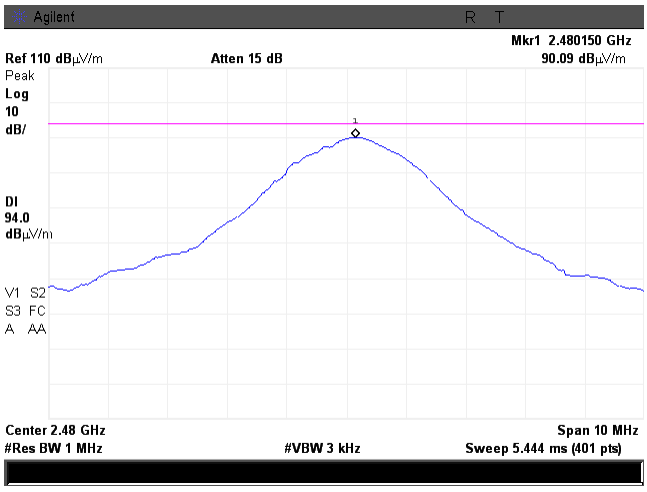


Test specification:	Section 15.249(a)(d)/RSS-210, section A2.9, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	4/4/2013 - 5/7/2013		
Temperature: 21.3 ºC	Air Pressure: 1014 hPa	Relative Humidity: 52 %	Power Supply: 24VDC
Remarks:			

Plot 7.1.13 Radiated emission measurements at the high fundamental frequency

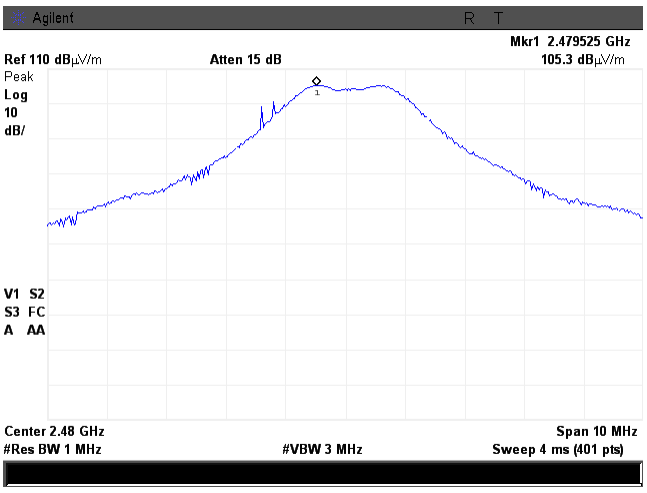
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Typical with antenna in vertical position
INPUT VOLTAGE: Unom

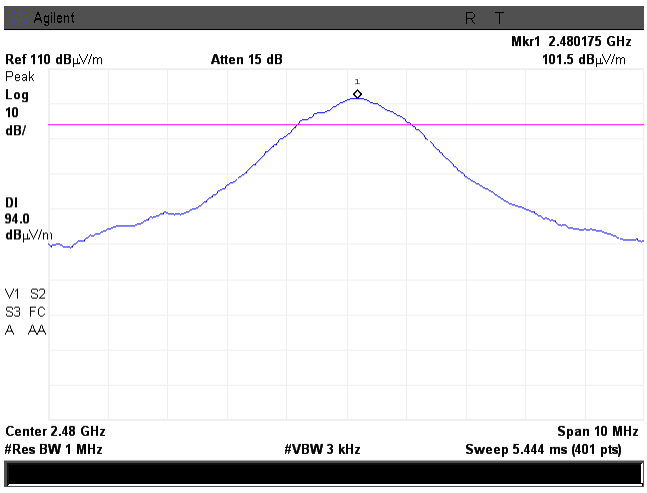




Plot 7.1.14 Radiated emission measurements at the high fundamental frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal
EUT POSITION: Typical with antenna in vertical position
INPUT VOLTAGE: Unom

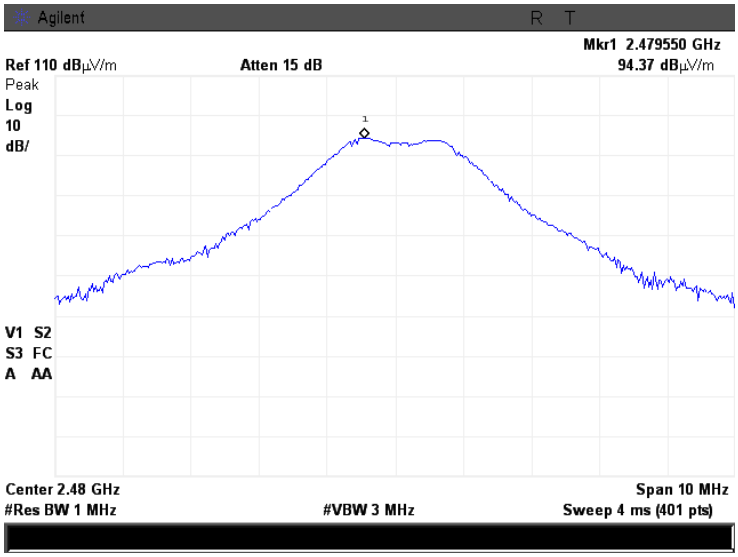




Test specification:	Section 15.249(a)(d)/RSS-210, section A2.9, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	4/4/2013 - 5/7/2013		
Temperature: 21.3 ºC	Air Pressure: 1014 hPa	Relative Humidity: 52 %	Power Supply: 24VDC
Remarks:			

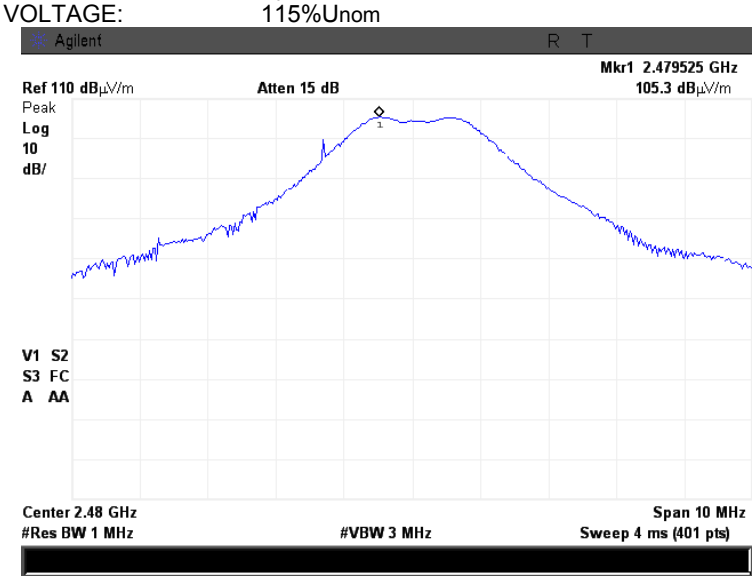
Plot 7.1.15 Radiated emission measurements at the high fundamental frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Typical with antenna in vertical position
INPUT VOLTAGE: 115%Unom



Plot 7.1.16 Radiated emission measurements at the high fundamental frequency

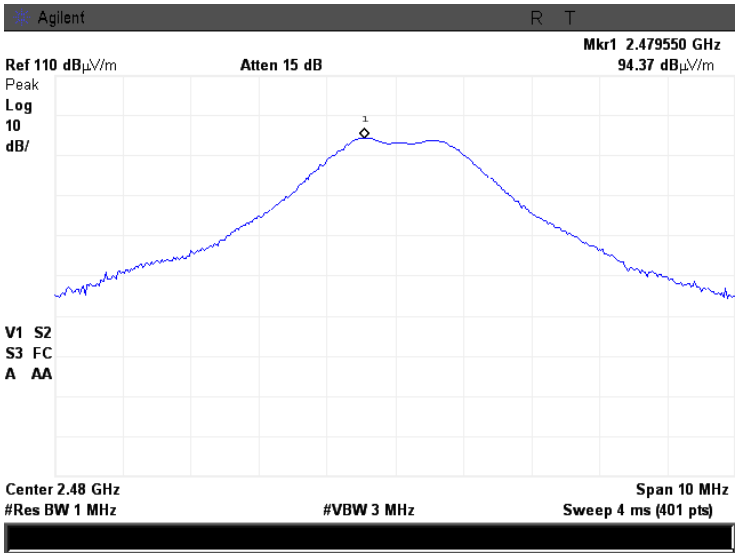
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal
EUT POSITION: Typical with antenna in vertical position
INPUT VOLTAGE: 115%Unom



Test specification:	Section 15.249(a)(d)/RSS-210, section A2.9, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	4/4/2013 - 5/7/2013		
Temperature: 21.3 ºC	Air Pressure: 1014 hPa	Relative Humidity: 52 %	Power Supply: 24VDC
Remarks:			

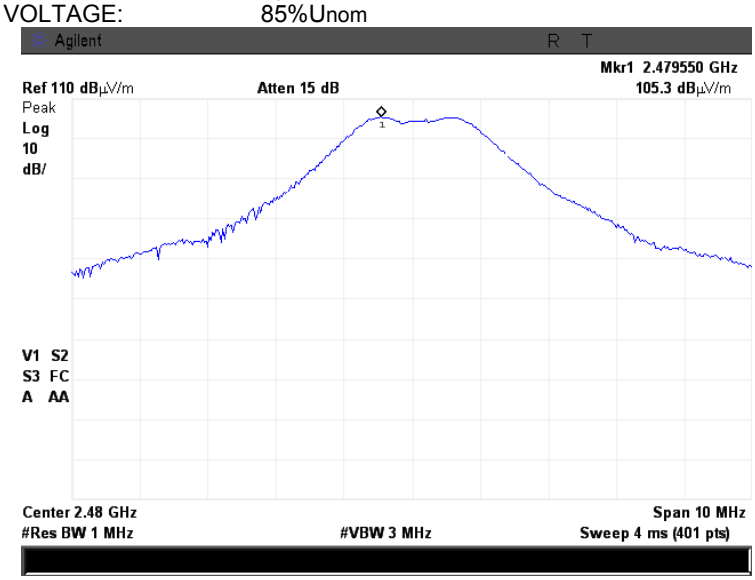
Plot 7.1.17 Radiated emission measurements at the high fundamental frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Typical with antenna in vertical position
INPUT VOLTAGE: 85%Unom



Plot 7.1.18 Radiated emission measurements at the high fundamental frequency

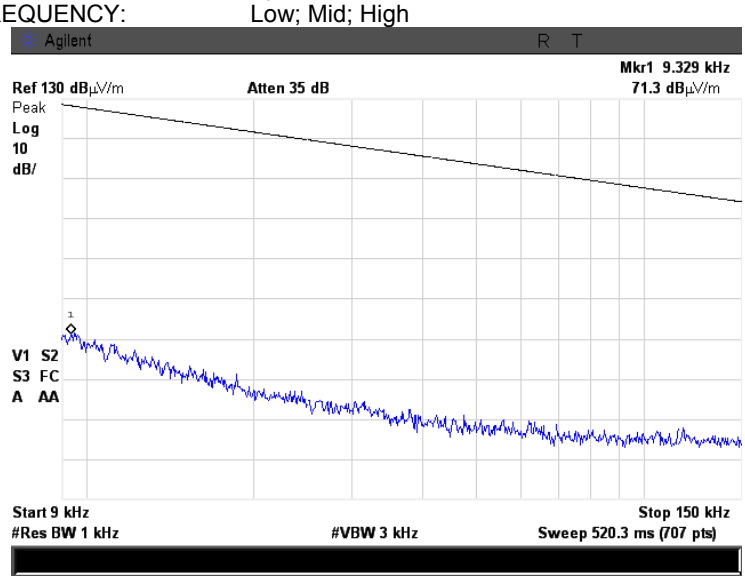
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal
EUT POSITION: Typical with antenna in vertical position
INPUT VOLTAGE: 85%Unom



Test specification:	Section 15.249(a)(d)/RSS-210, section A2.9, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	4/4/2013 - 5/7/2013		
Temperature: 21.3 ºC	Air Pressure: 1014 hPa	Relative Humidity: 52 %	Power Supply: 24VDC
Remarks:			

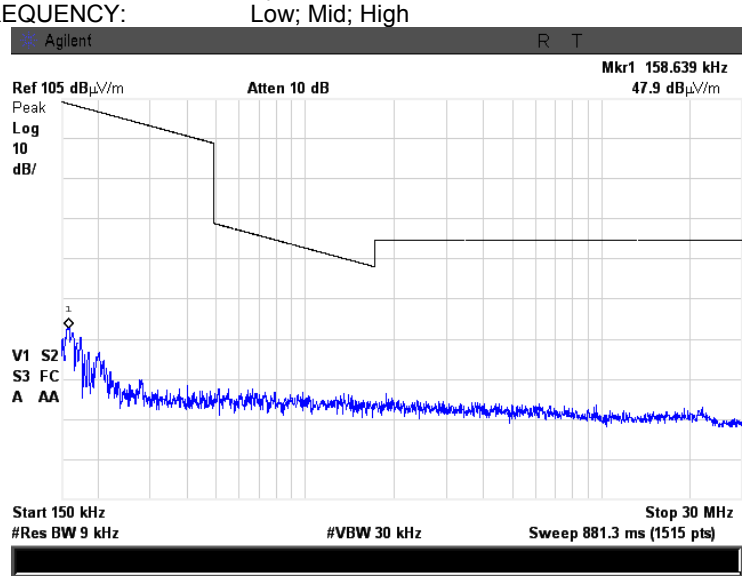
Plot 7.1.19 Radiated emission measurements from 9 to 150 kHz

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Typical with antenna in vertical position
EUT FREQUENCY: Low; Mid; High



Plot 7.1.20 Radiated emission measurements from 0.15 to 30 MHz

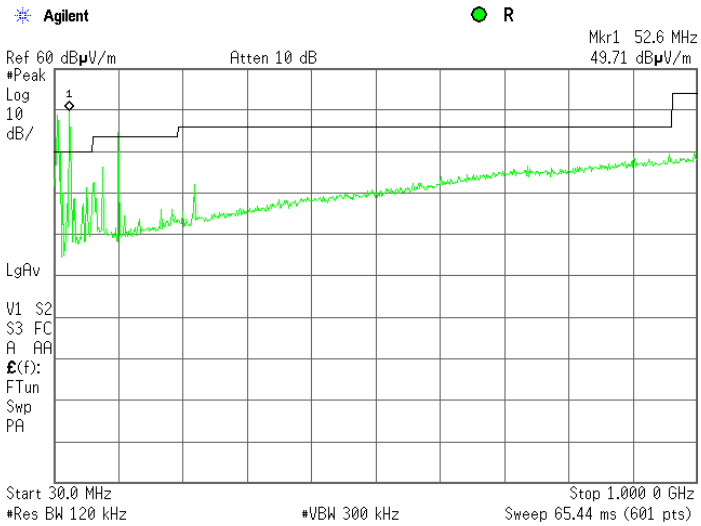
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Typical with antenna in vertical position
EUT FREQUENCY: Low; Mid; High



Test specification:	Section 15.249(a)(d)/RSS-210, section A2.9, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	4/4/2013 - 5/7/2013		
Temperature: 21.3 ºC	Air Pressure: 1014 hPa	Relative Humidity: 52 %	Power Supply: 24VDC
Remarks:			

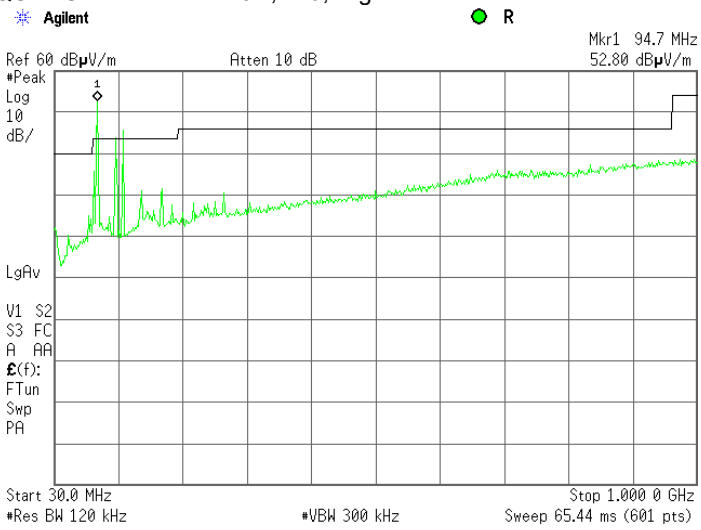
Plot 7.1.21 Radiated emission measurements from 30 to 1000 MHz

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Typical with antenna in vertical position
EUT FREQUENCY: Low; Mid; High



Plot 7.1.22 Radiated emission measurements from 30 to 1000 MHz

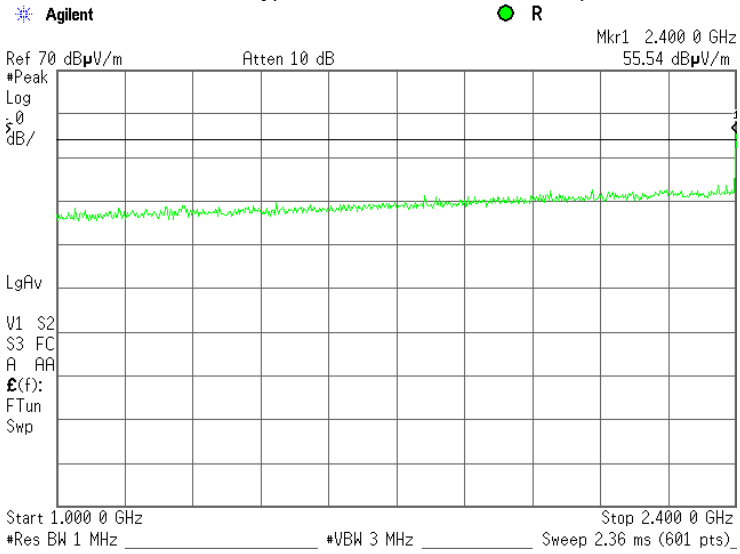
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal
EUT POSITION: Typical with antenna in vertical position
EUT FREQUENCY: Low; Mid; High



Test specification:	Section 15.249(a)(d)/RSS-210, section A2.9, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	4/4/2013 - 5/7/2013		
Temperature: 21.3 ºC	Air Pressure: 1014 hPa	Relative Humidity: 52 %	Power Supply: 24VDC
Remarks:			

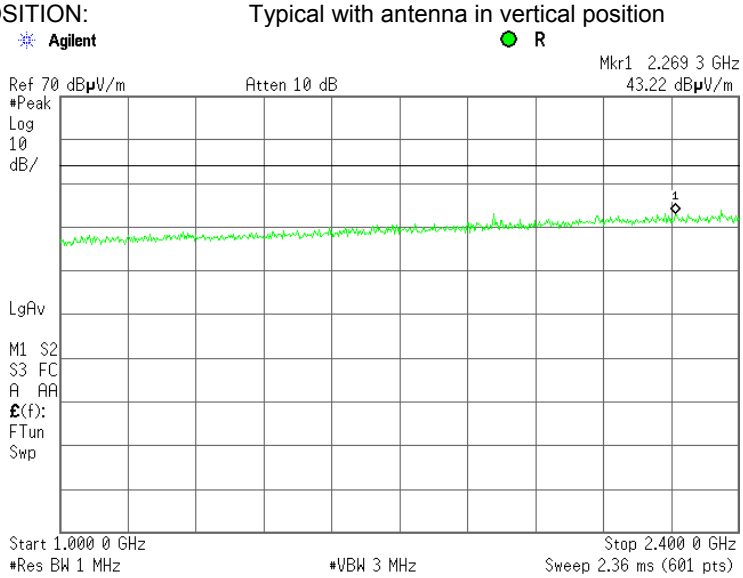
Plot 7.1.23 Radiated emission measurements at low frequency from 1.0 to 2.4 MHz

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POSITION: Typical with antenna in vertical position



Plot 7.1.24 Radiated emission measurements at mid frequency from 1.0 to 2.4 MHz

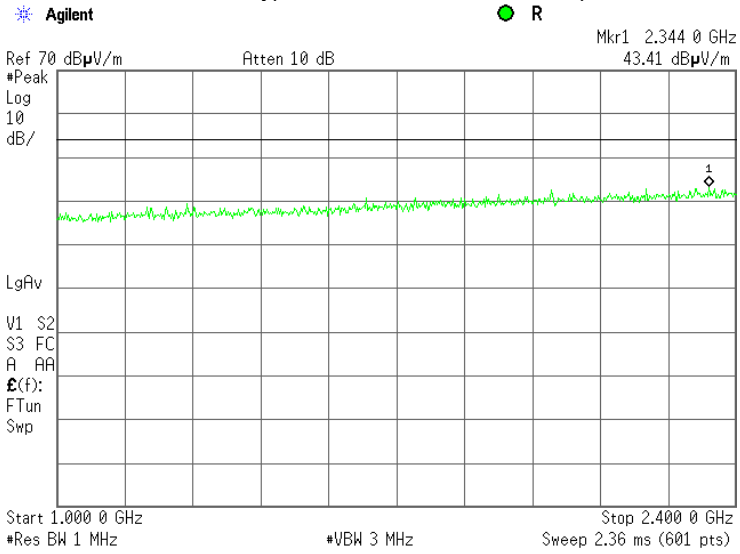
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POSITION: Typical with antenna in vertical position



Test specification:	Section 15.249(a)(d)/RSS-210, section A2.9, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	4/4/2013 - 5/7/2013		
Temperature: 21.3 ºC	Air Pressure: 1014 hPa	Relative Humidity: 52 %	Power Supply: 24VDC
Remarks:			

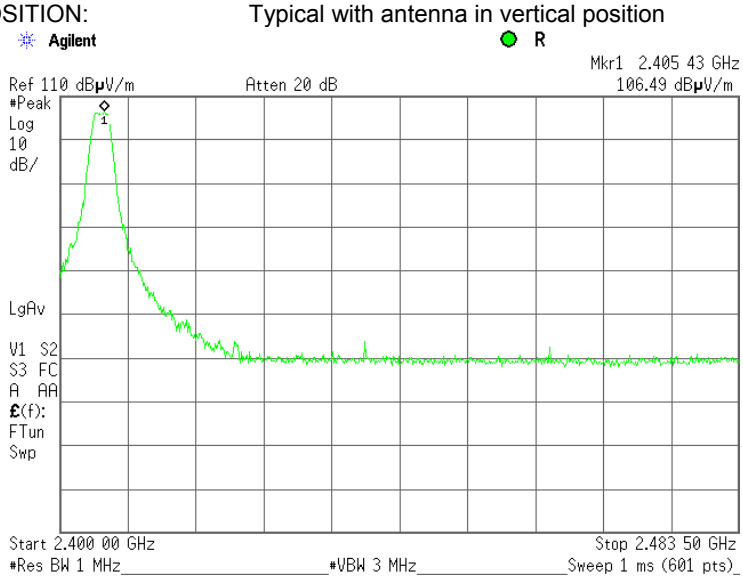
Plot 7.1.25 Radiated emission measurements at high frequency from 1.0 to 2.4 MHz

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POSITION: Typical with antenna in vertical position



Plot 7.1.26 Radiated emission measurements at low frequency from 2.4 to 2.4835 MHz

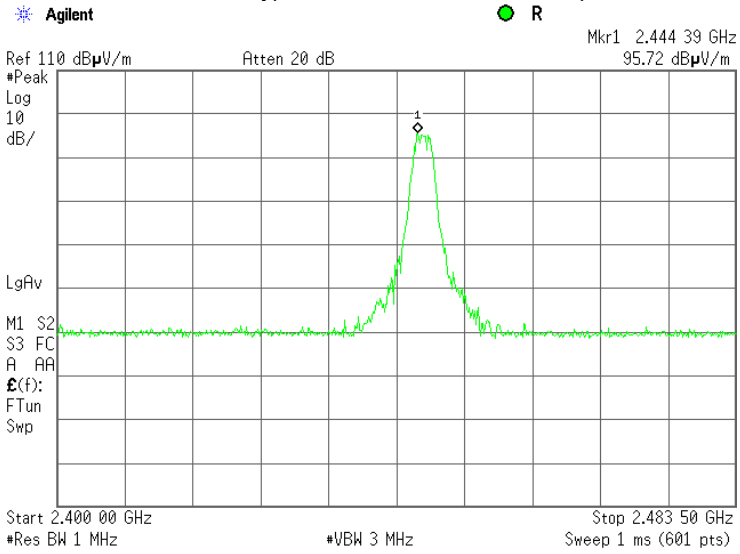
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POSITION: Typical with antenna in vertical position



Test specification:	Section 15.249(a)(d)/RSS-210, section A2.9, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	4/4/2013 - 5/7/2013		
Temperature: 21.3 ºC	Air Pressure: 1014 hPa	Relative Humidity: 52 %	Power Supply: 24VDC
Remarks:			

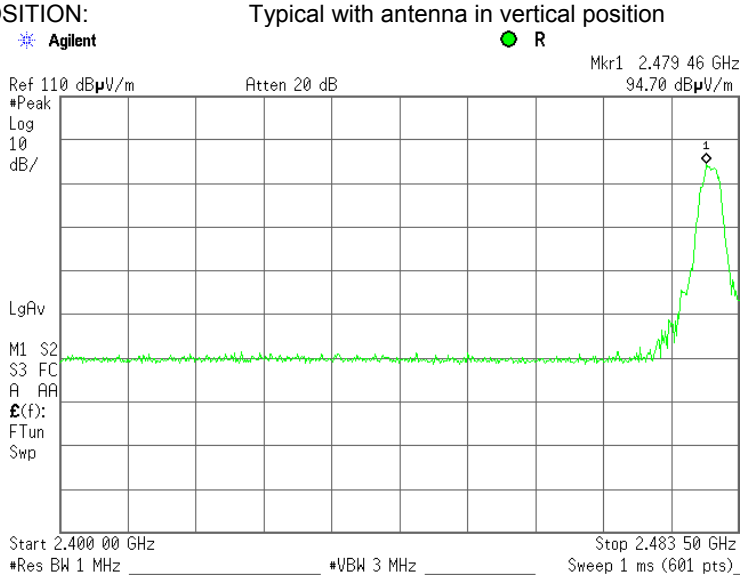
Plot 7.1.27 Radiated emission measurements at mid frequency from 2.4 to 2.4835 MHz

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POSITION: Typical with antenna in vertical position



Plot 7.1.28 Radiated emission measurements at high frequency from 2.4 to 2.4835 MHz

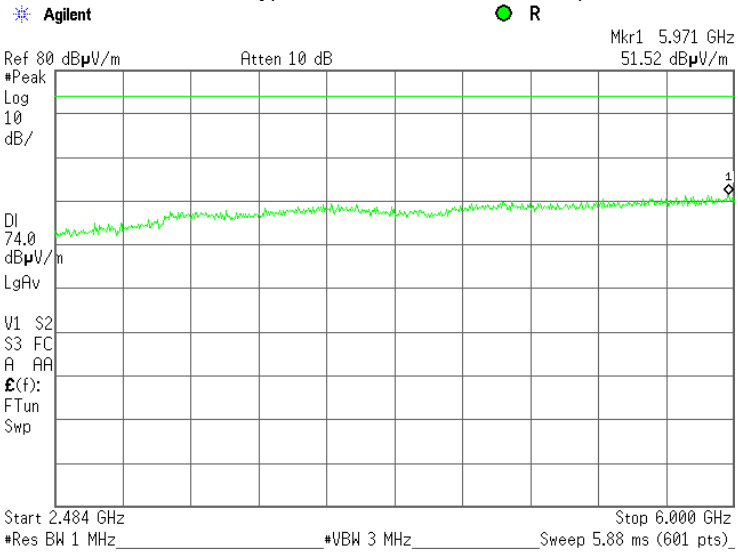
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POSITION: Typical with antenna in vertical position



Test specification:	Section 15.249(a)(d)/RSS-210, section A2.9, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	4/4/2013 - 5/7/2013		
Temperature: 21.3 ºC	Air Pressure: 1014 hPa	Relative Humidity: 52 %	Power Supply: 24VDC
Remarks:			

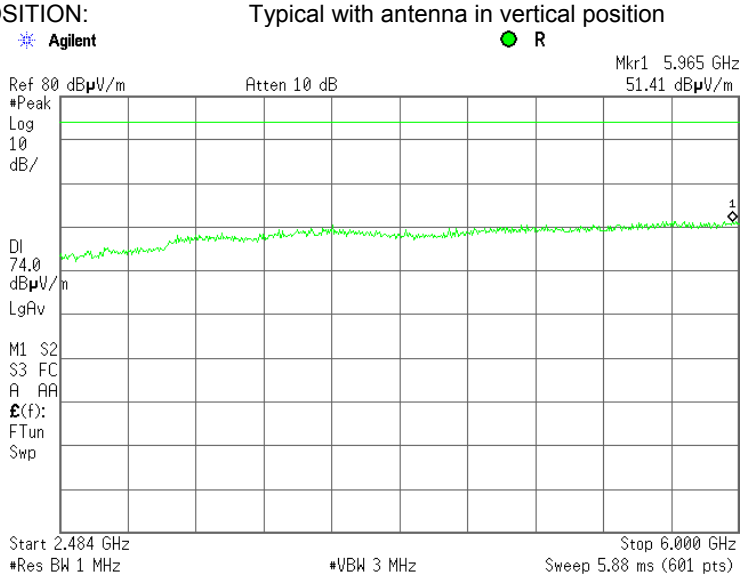
Plot 7.1.29 Radiated emission measurements at low frequency from 2.4835 to 6.0 GHz

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POSITION: Typical with antenna in vertical position



Plot 7.1.30 Radiated emission measurements at mid frequency from 2.4835 to 6.0 GHz

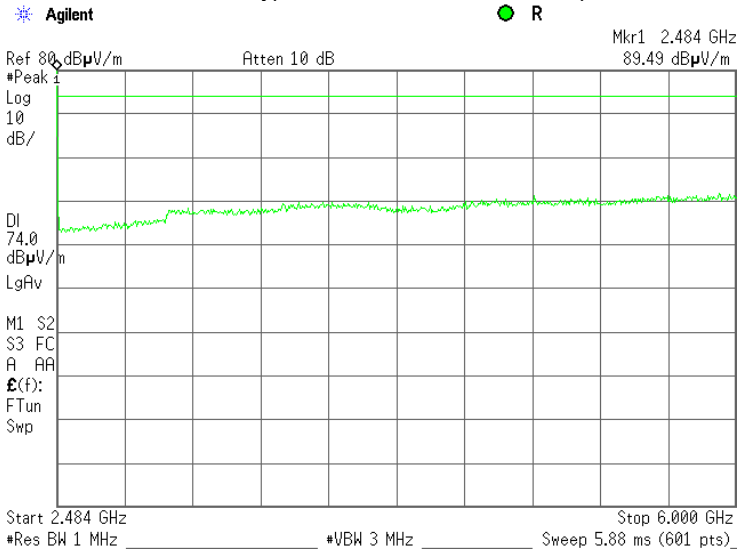
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POSITION: Typical with antenna in vertical position



Test specification:	Section 15.249(a)(d)/RSS-210, section A2.9, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	4/4/2013 - 5/7/2013		
Temperature: 21.3 ºC	Air Pressure: 1014 hPa	Relative Humidity: 52 %	Power Supply: 24VDC
Remarks:			

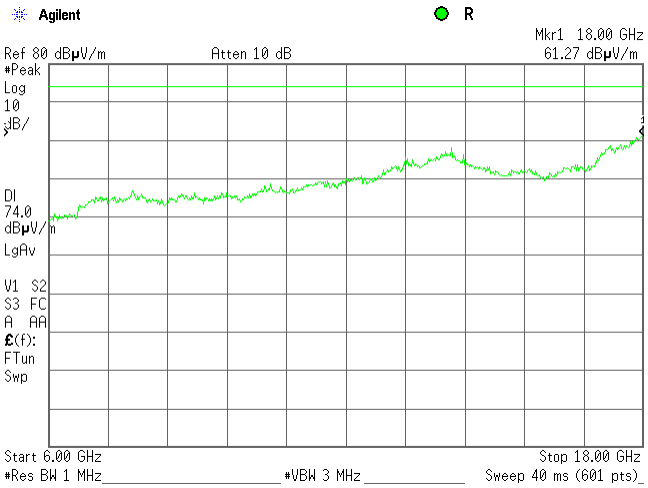
Plot 7.1.31 Radiated emission measurements at high frequency from 2.4835 to 6.0 GHz

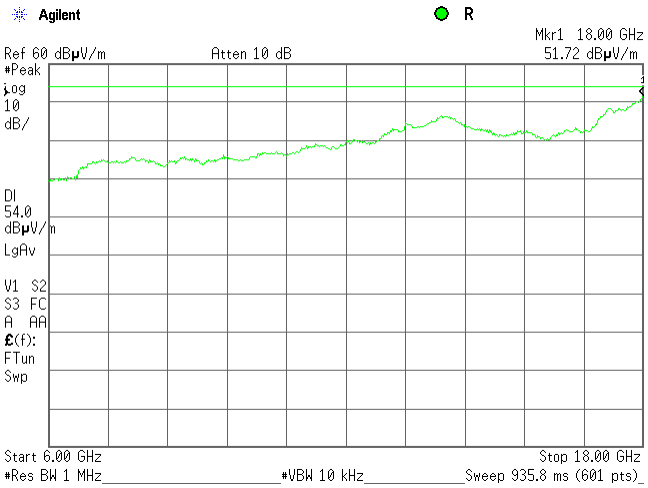
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POSITION: Typical with antenna in vertical position



Plot 7.1.32 Radiated emission measurements at low, mid, high frequency from 6 to 18.0 GHz

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POSITION: Typical with antenna in vertical position

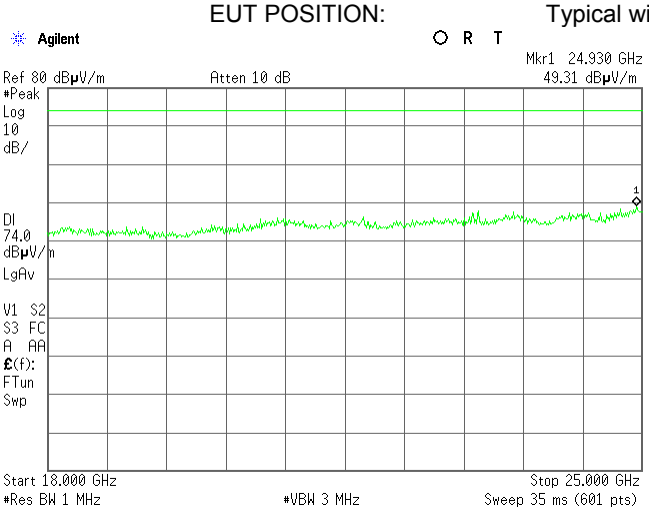


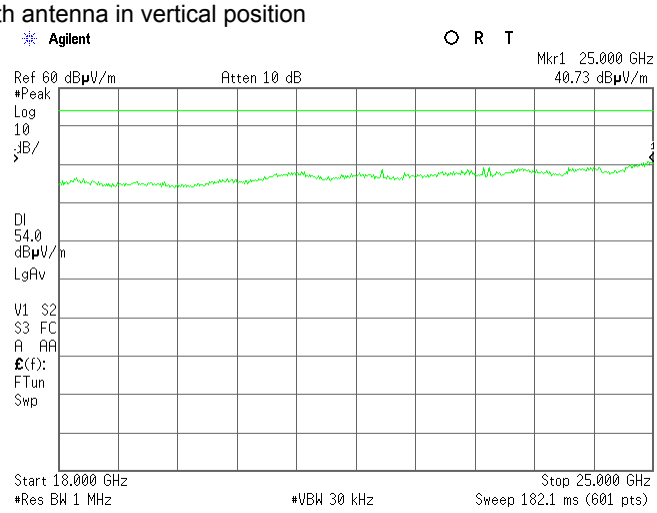


Test specification:	Section 15.249(a)(d)/RSS-210, section A2.9, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	4/4/2013 - 5/7/2013		
Temperature: 21.3 ºC	Air Pressure: 1014 hPa	Relative Humidity: 52 %	Power Supply: 24VDC
Remarks:			

Plot 7.1.33 Radiated emission measurements at low, mid, high frequency from 18.0 to 25 GHz

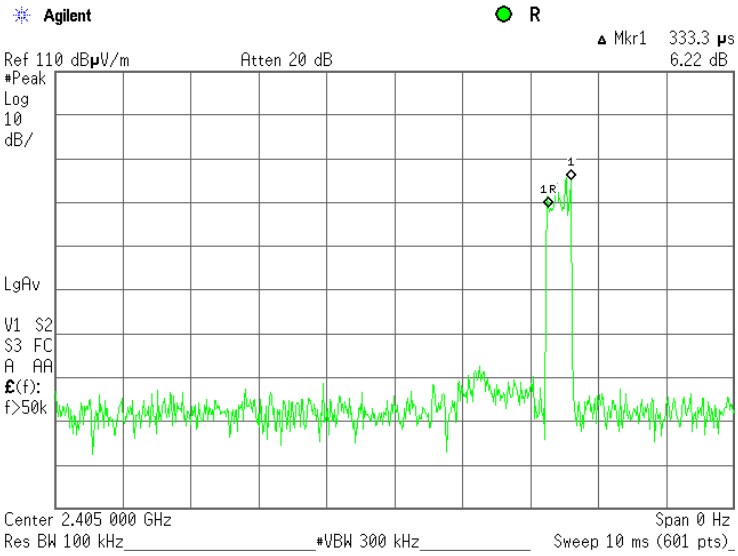
TEST SITE: OATS
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POSITION: Typical with antenna in vertical position



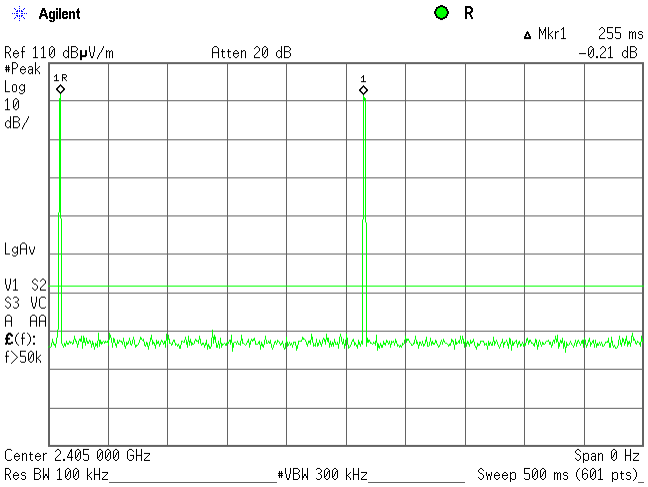


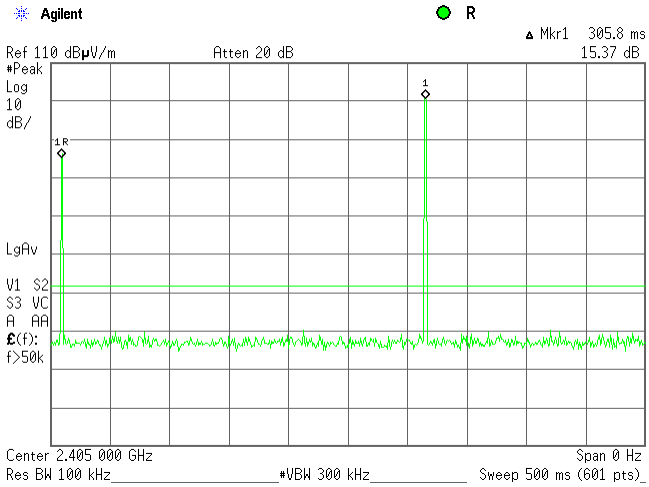
Test specification:	Section 15.249(a)(d)/RSS-210, section A2.9, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	4/4/2013 - 5/7/2013		
Temperature: 21.3 ºC	Air Pressure: 1014 hPa	Relative Humidity: 52 %	Power Supply: 24VDC
Remarks:			

Plot 7.1.34 Transmission pulse duration



Plot 7.1.35 Transmission pulse period





Test specification:	Section 15.249(d)/RSS-210, section A2.9, Band edge emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	4/4/2013 - 4/9/2013		
Temperature: 21.2 ºC	Air Pressure: 1014 hPa	Relative Humidity: 53 %	Power Supply: 24VDC
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	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.

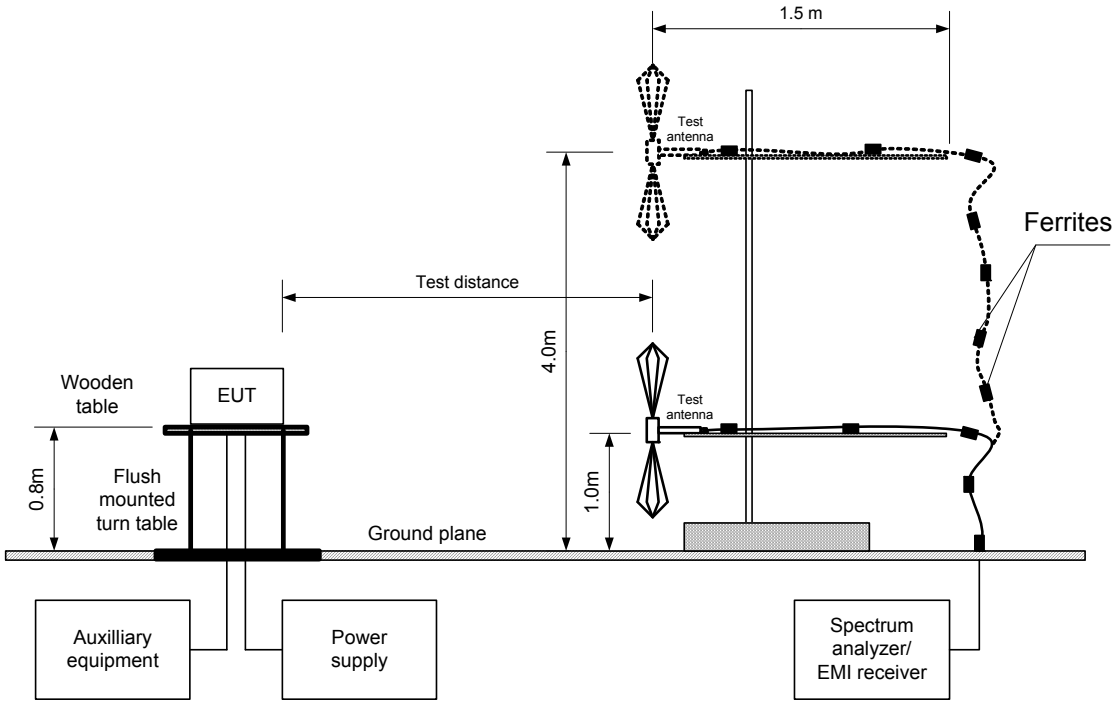
7.2.2.2 The spectrum analyzer frequency span was set to capture all major modulation sidebands of emission and sweep time was set sufficiently slow to ensure peak measurements. Spectrum analyzer was set in peak hold mode and time sufficient for trace stabilization was allowed.

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)/RSS-210, section A2.9, Band edge emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	4/4/2013 - 4/9/2013		
Temperature: 21.2 ºC	Air Pressure: 1014 hPa	Relative Humidity: 53 %	Power Supply: 24VDC
Remarks:			

Figure 7.2.1 Band edge emission measurement set up



Test specification:	**Section 15.249(d)/RSS-210, section A2.9, Band edge emissions**		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	4/4/2013 - 4/9/2013		
Temperature: 21.2 ºC	**Air Pressure:** 1014 hPa	**Relative Humidity:** 53 %	**Power Supply:** 24VDC
Remarks:			

Table 7.2.2 Band edge emission test results

OPERATING FREQUENCY RANGE: 2400 – 2483.5MHz
DETECTOR USED: Peak hold
RESOLUTION BANDWIDTH: 30 kHz
VIDEO BANDWIDTH: 100 kHz
MODULATION: QPSK
BIT RATE: 250 kbps
TRANSMITTER OUTPUT POWER SETTINGS: Maximum

Modulation envelope		**Band edge limit, MHz**	**Margin, kHz*** **	**Verdict**
Edge	**Frequency, MHz***			
Low	2401.92	2400.00	-1920	Pass
High	2483.23	2483.50	270	Pass

* - Measured frequency beyond which the emission dropped 50 dB below the carrier emission or below the field strength limit whichever was a less stringent
** - Margin = Band edge limit – Band edge frequency

Reference numbers of test equipment used

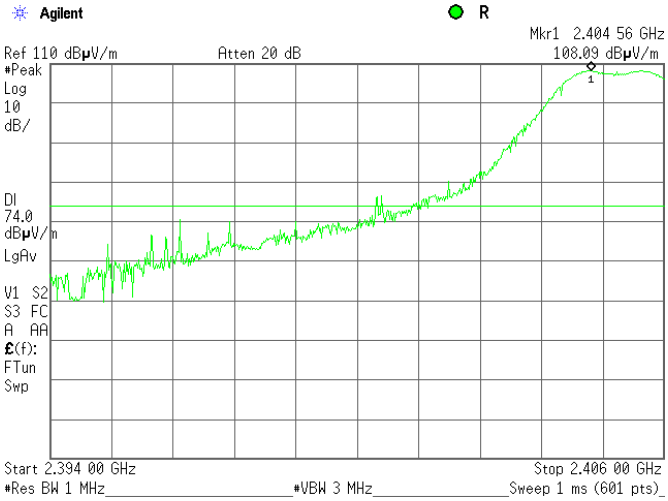
HL 1984	HL 2873	HL 3818	HL 4160	HL 4353			

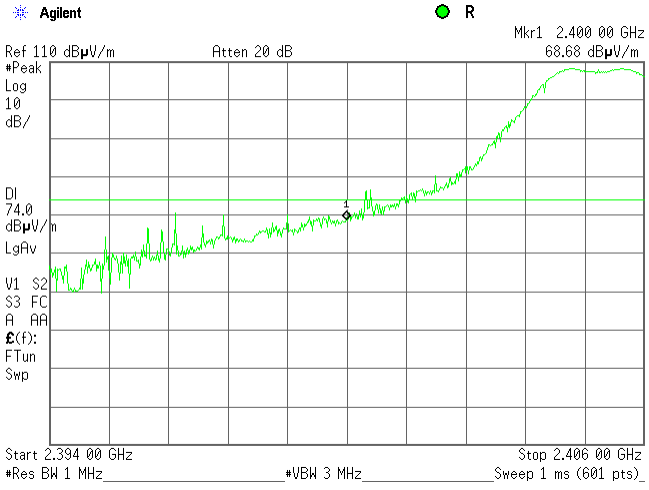
Full description is given in Appendix A.

Test specification:	Section 15.249(d)/RSS-210, section A2.9, Band edge emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	4/4/2013 - 4/9/2013		
Temperature: 21.2 °C	Air Pressure: 1014 hPa	Relative Humidity: 53 %	Power Supply: 24VDC
Remarks:			

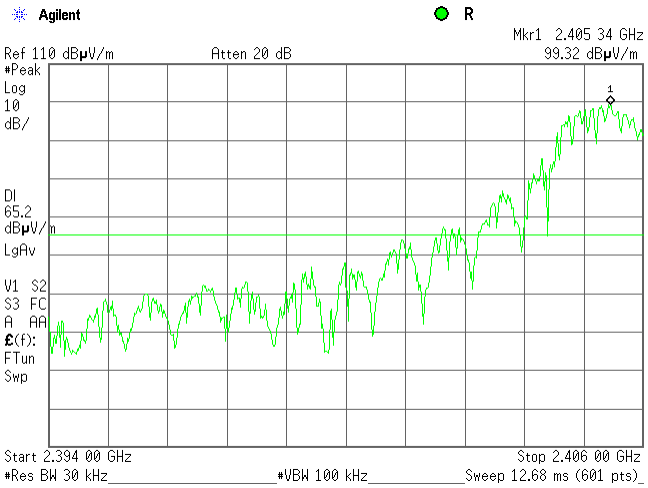
Plot 7.2.1 Low band edge emission test result

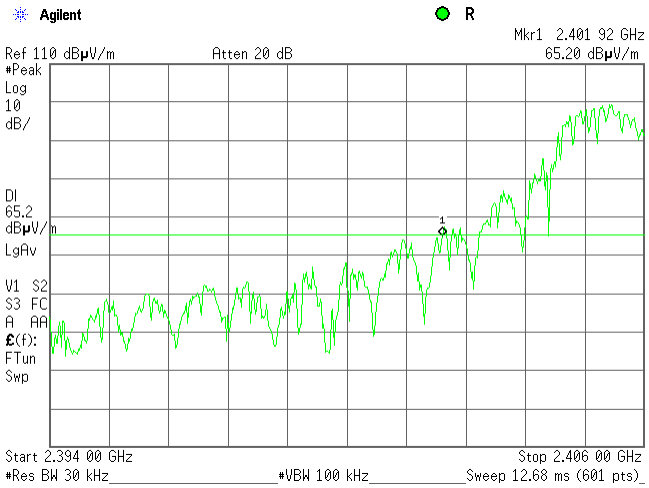
TEST SITE: Semi Anechoic Chamber
FREQUENCY F min=2405 MHz
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal
EUT POSITION: Typical with antenna in vertical position





Delta = 108.09 dBuV/m – 74 dBuV/m = 34.09 dB



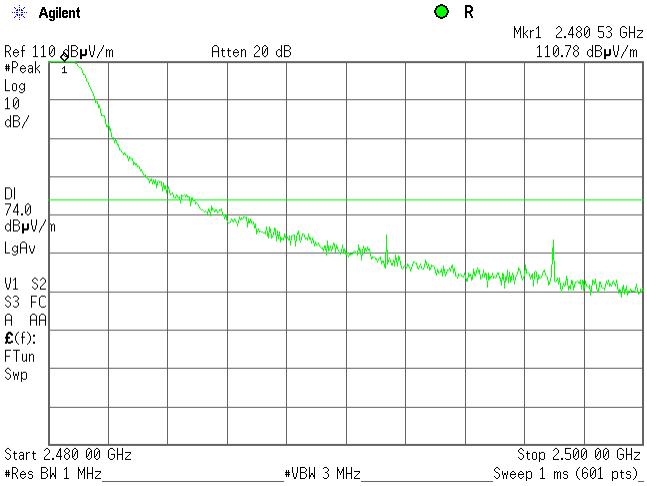


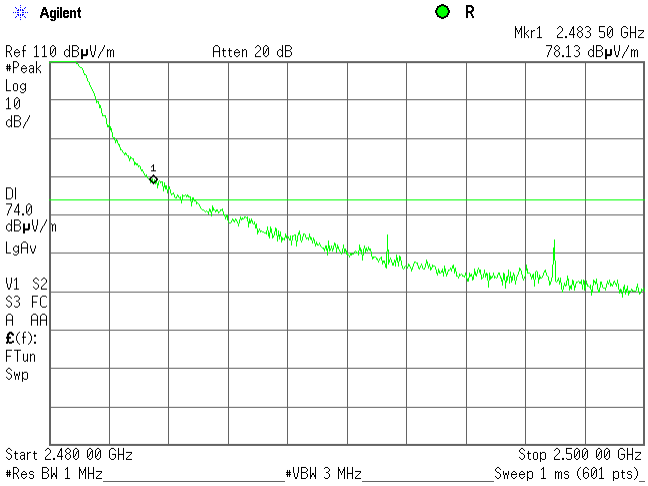
DL= 99.32 dBuV/m - 34.09 dB = 65.23 dBuV/m

Test specification:	Section 15.249(d)/RSS-210, section A2.9, Band edge emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	4/4/2013 - 4/9/2013		
Temperature: 21.2 °C	Air Pressure: 1014 hPa	Relative Humidity: 53 %	Power Supply: 24VDC
Remarks:			

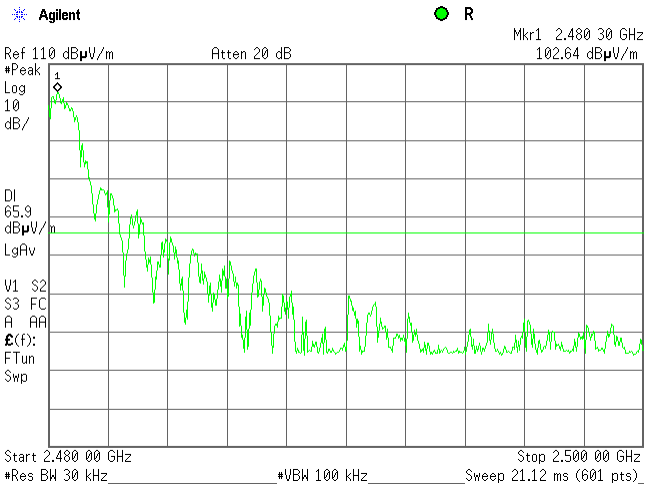
Plot 7.2.2 High band edge emission test result

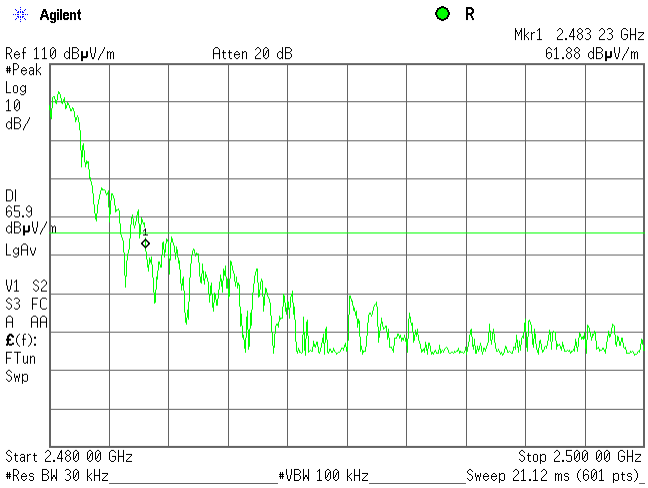
TEST SITE: Semi Anechoic Chamber
FREQUENCY F max=2480 MHz
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal
EUT POSITION: Typical with antenna in vertical position





Delta = 110.78 dBuV/m – 74 dBuV/m = 36.78 dB





DL=102.64 dBuV/m - 36.78 dB = 65.86 dBuV/m

Test specification:	Section 15.203, Antenna requirement		
Test procedure:	Visual inspection / supplier declaration		
Test mode:	Compliance	Verdict:	PASS
Date(s):	5/14/2013		
Temperature: 21.3 ºC	Air Pressure: 1014 hPa	Relative Humidity: 52 %	Power Supply: 24VDC
Remarks:			

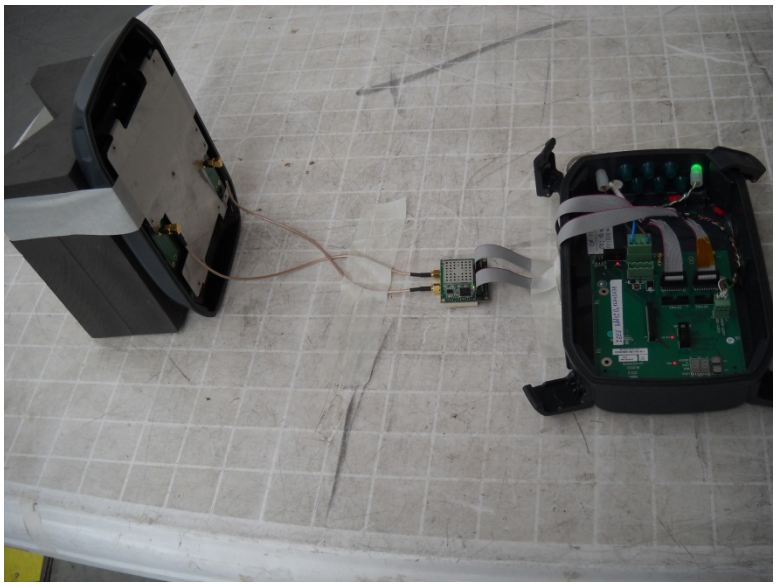
7.3 Antenna requirements

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	

Photograph 7.3.1 Antenna assembly



Test specification:	Section 15.215(c), Occupied bandwidth		
Test procedure:	ANSI C63.4, Section 13.1.7		
Test mode:	Compliance	Verdict:	PASS
Date(s):	4/4/2013 - 4/9/2013		
Temperature: 21.2 ºC	Air Pressure: 1014 hPa	Relative Humidity: 53 %	Power Supply: 24VDC
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 associated plot.

7.4.2.4 Modulation bandwidth was calculated by adding of the negative frequency drift to the lower measured frequency and the positive frequency drift to the higher measured frequency. The obtained modulation bandwidth was verified to be within the allowed frequency range.

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):	4/4/2013 - 4/9/2013		
Temperature: 21.2 ºC	**Air Pressure:** 1014 hPa	**Relative Humidity:** 53 %	**Power Supply:** 24VDC
Remarks:			

Table 7.4.2 Occupied bandwidth test results

ASSIGNED FREQUENCY BAND	2400 - 2483.5 MHz
DETECTOR USED:	Peak hold
RESOLUTION BANDWIDTH:	100 kHz
VIDEO BANDWIDTH:	300 kHz
MODULATION ENVELOPE REFERENCE POINTS:	20 dBc
MODULATION:	QPSK
MODULATING SIGNAL:	Enable

Band edge	Cross point frequency, MHz	Frequency drift, kHz		Modulation band edge, MHz	Assigned band edge, MHz	Verdict
		Negative	Positive			
Low	2403.267	NA	NA	2403.267	2400.000	Pass
High	2481.350	NA	NA	2481.350	2483.500	Pass

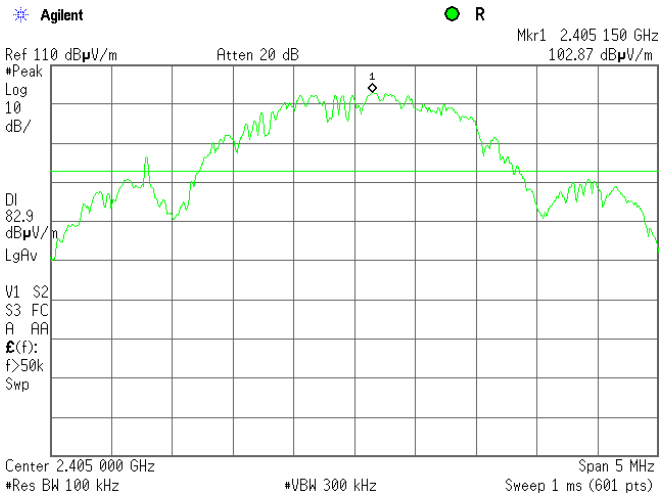
Reference numbers of test equipment used

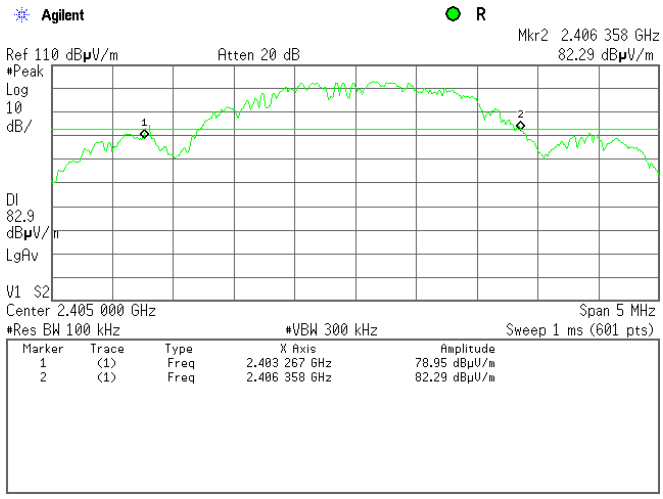
HL 1984	HL 2871	HL 3818	HL 4160	HL 4353				

Full description is given in Appendix A.

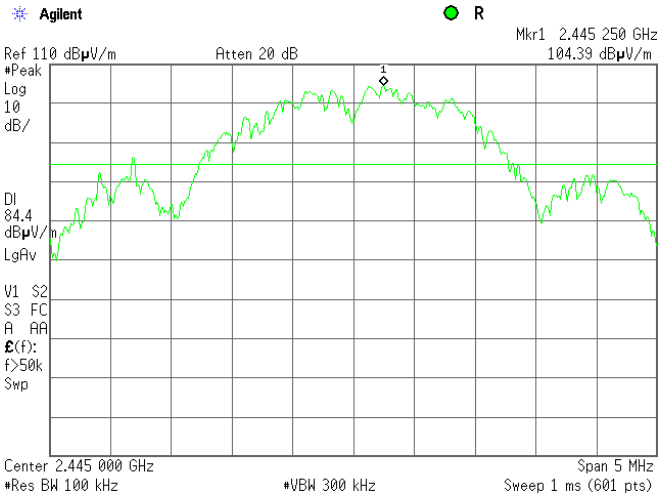
Test specification:	Section 15.215(c), Occupied bandwidth		
Test procedure:	ANSI C63.4, Section 13.1.7		
Test mode:	Compliance	Verdict:	PASS
Date(s):	4/4/2013 - 4/9/2013		
Temperature: 21.2 °C	Air Pressure: 1014 hPa	Relative Humidity: 53 %	Power Supply: 24VDC
Remarks:			

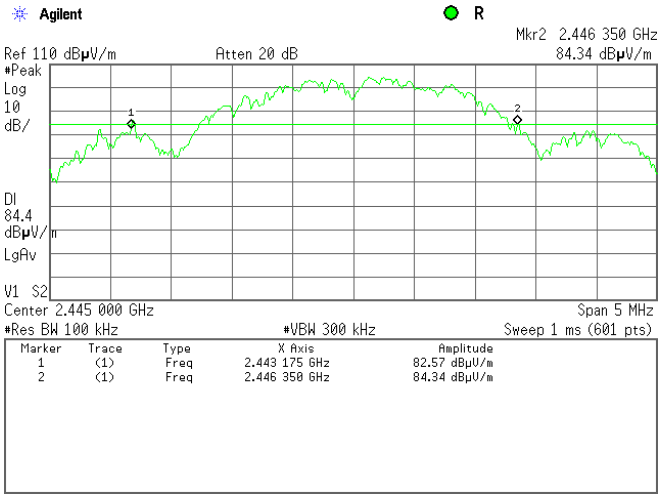
Plot 7.4.1 Occupied bandwidth test result at low frequency





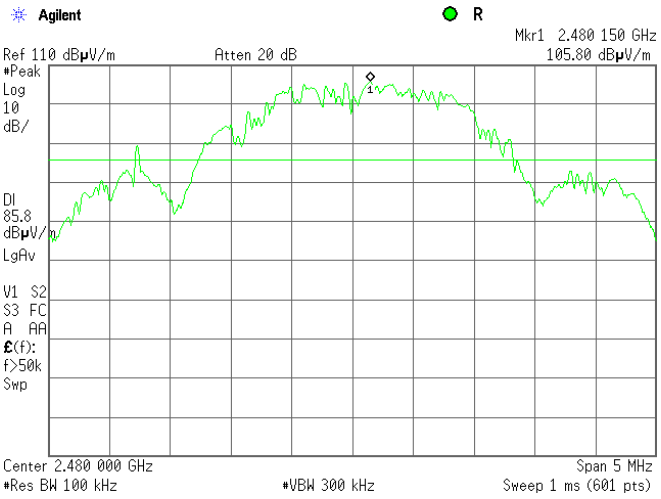
Plot 7.4.2 Occupied bandwidth test result at mid frequency

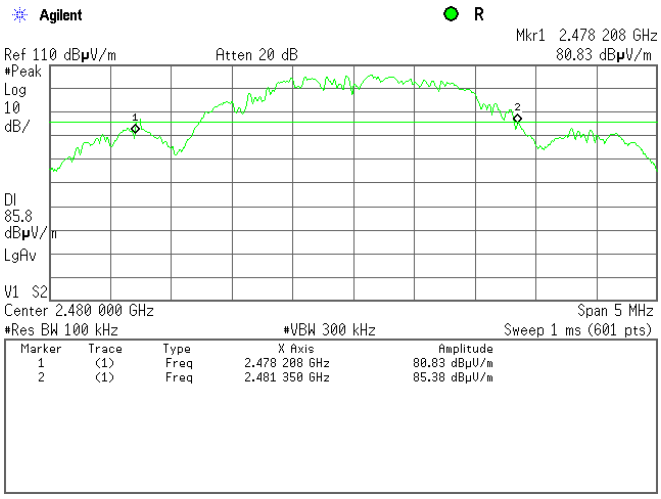




Test specification:	Section 15.215(c), Occupied bandwidth		
Test procedure:	ANSI C63.4, Section 13.1.7		
Test mode:	Compliance	Verdict:	PASS
Date(s):	4/4/2013 - 4/9/2013		
Temperature: 21.2 °C	Air Pressure: 1014 hPa	Relative Humidity: 53 %	Power Supply: 24VDC
Remarks:			

Plot 7.4.3 Occupied bandwidth test result at high frequency





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):	4/7/2013 - 5/7/2013		
Temperature: 23.2 ºC	Air Pressure: 1010 hPa	Relative Humidity: 43 %	Power Supply: 24VDC
Remarks:			

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

8.1 Radiated emission measurements

8.1.1 General

This test was performed to measure radiated emissions from the EUT enclosure. Specification test limits are given in Table 8.1.1.

Table 8.1.1 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*

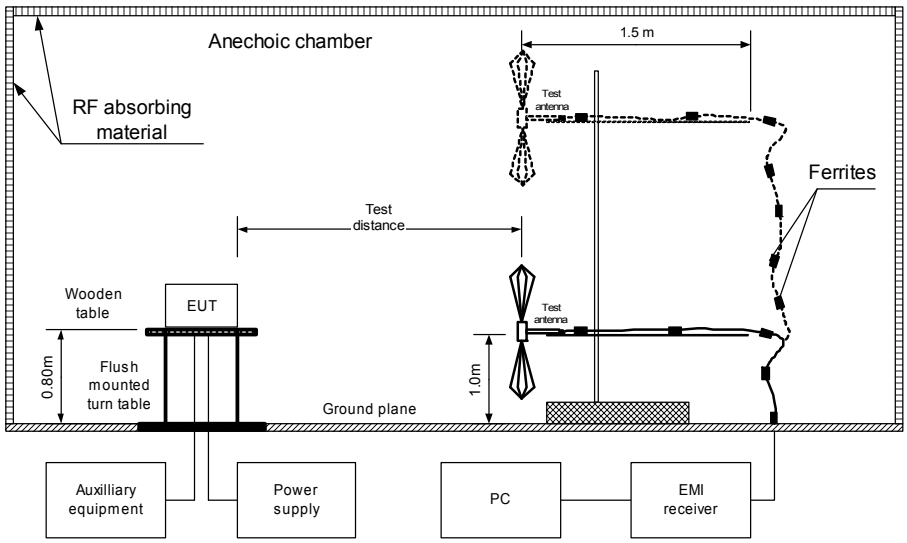
8.1.2 Test procedure

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

8.1.2.2 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.

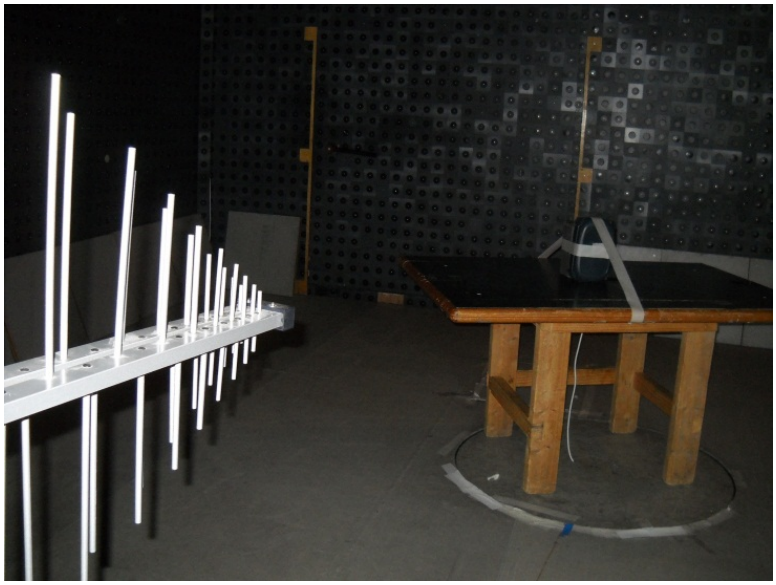
8.1.2.3 The worst test results (the lowest margins) were recorded in Table 8.1.2 and shown in the associated plots.

Figure 8.1.1 Setup for 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):	4/7/2013 - 5/7/2013		
Temperature: 23.2 ºC	Air Pressure: 1010 hPa	Relative Humidity: 43 %	Power Supply: 24VDC
Remarks:			

Photograph 8.1.1 Setup for radiated emission measurements



Photograph 8.1.2 Setup for radiated emission measurements

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):	4/7/2013 - 5/7/2013		
Temperature: 23.2 ºC	**Air Pressure:** 1010 hPa	**Relative Humidity:** 43 %	**Power Supply:** 24VDC
Remarks:			

Table 8.1.2 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*				
36.688	48.8	34.57	40.0	-5.43	Vertical	1.2	285	Pass
51.348	49.7	21.71	40.0	-18.29	Vertical	1.2	320	
95.810	52.8	23.57	43.5	-19.93	Horizontal	1.3	330	
102.433	36.29	29.59	43.5	-13.91	Vertical	1.3	300	
127.507	44.63	19.39	43.5	-24.11	Vertical	1.3	350	
134.708	45.6	23.37	43.5	-20.13	Horizontal	1.3	360	

TEST SITE: SEMI ANECHOIC CHAMBER
TEST DISTANCE: 3 m
DETECTORS USED: PEAK / AVERAGE
FREQUENCY RANGE: 1000 MHz – 12000 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*				
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

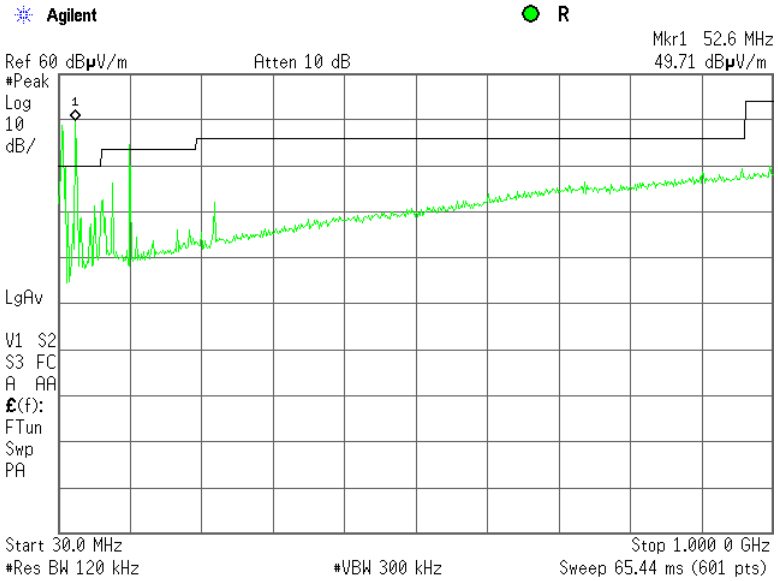
HL 0604	HL 1984	HL 2871	HL 3533	HL 3818	HL 4160	HL 4353	

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):	4/7/2013 - 5/7/2013		
Temperature: 23.2 ºC	**Air Pressure:** 1010 hPa	**Relative Humidity:** 43 %	**Power Supply:** 24VDC
Remarks:			

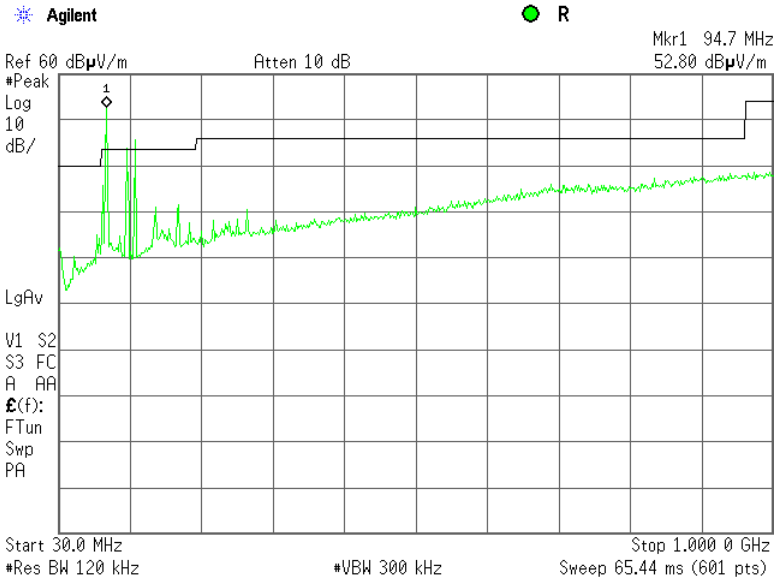
Plot 8.1.1 Radiated emission measurements in 30 - 1000 MHz range, vertical antenna polarization

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



Plot 8.1.2 Radiated emission measurements in 30 - 1000 MHz range, horizontal antenna polarization

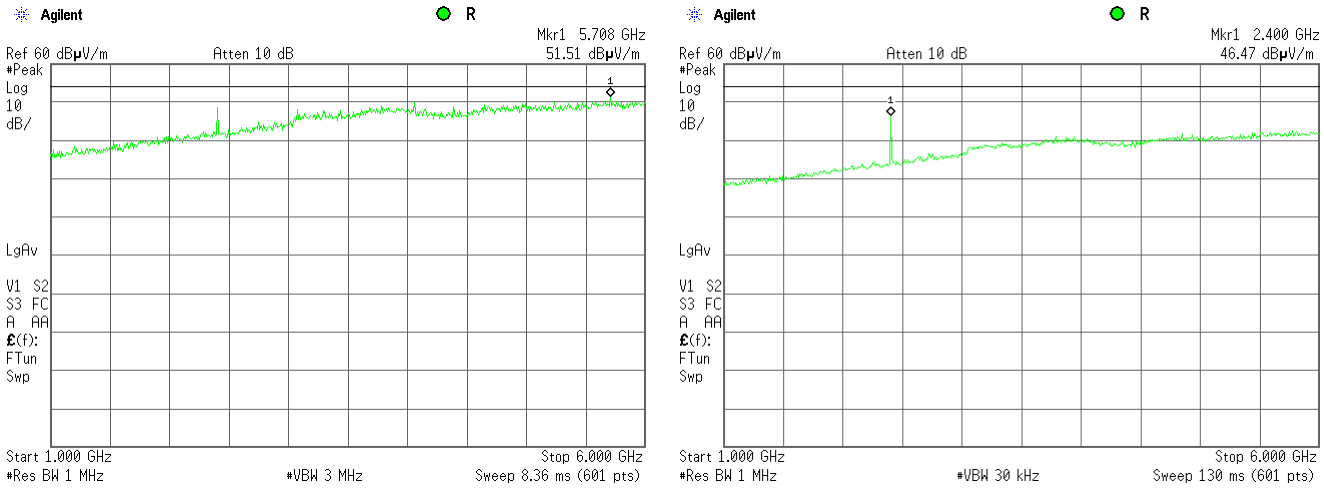
TEST SITE: Semi anechoic chamber
LIMIT: Class B
TEST DISTANCE: 3 m
EUT OPERATING MODE: Receive



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):	4/7/2013 - 5/7/2013		
Temperature: 23.2 °C	Air Pressure: 1010 hPa	Relative Humidity: 43 %	Power Supply: 24VDC
Remarks:			

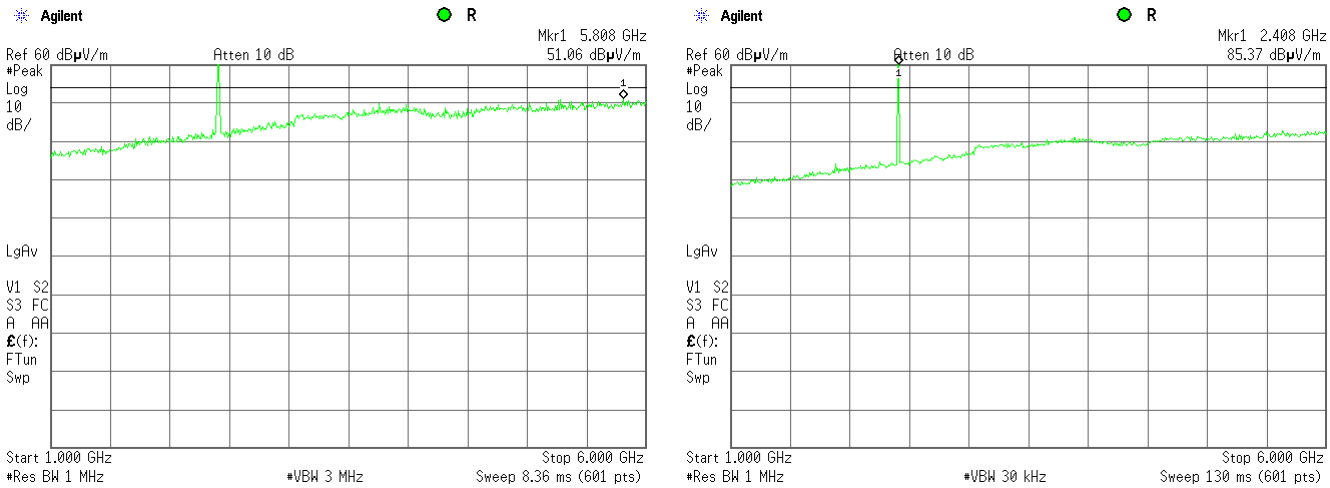
Plot 8.1.3 Radiated emission measurements in 1000 - 6000 MHz, vertical antenna polarization

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



Plot 8.1.4 Radiated emission measurements in 1000 - 6000 MHz, horizontal antenna polarization

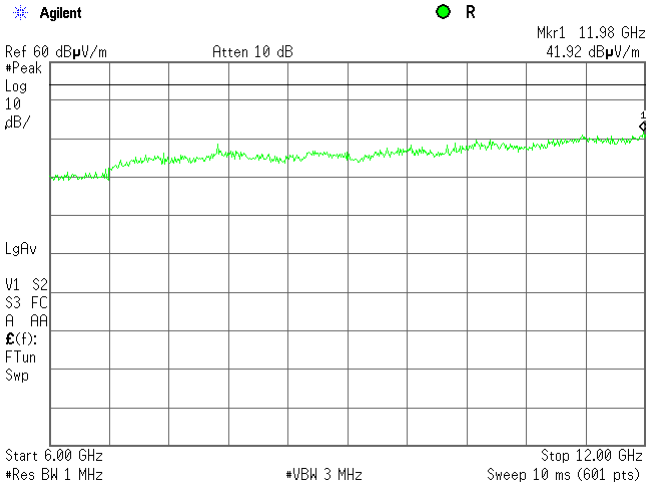
TEST SITE: Semi anechoic chamber
LIMIT: Class B
TEST DISTANCE: 3 m
EUT OPERATING MODE: Receive

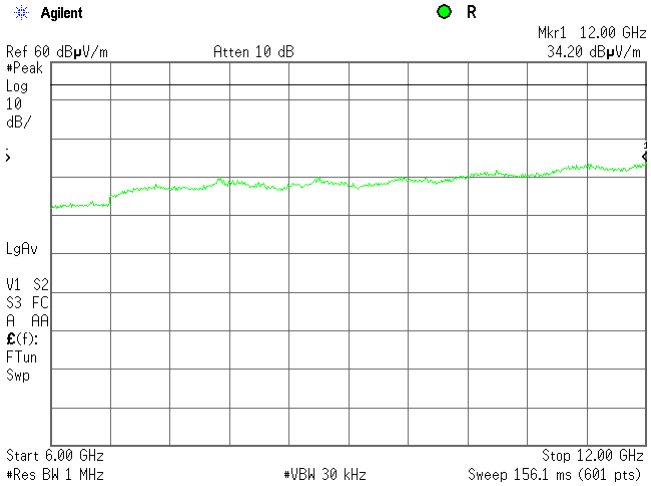


Test specification:	Section 15.109, Radiated emission		
Test procedure:	ANSI C63.4, Sections 11.6 and 12.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	4/7/2013 - 5/7/2013		
Temperature: 23.2 °C	Air Pressure: 1010 hPa	Relative Humidity: 43 %	Power Supply: 24VDC
Remarks:			

Plot 8.1.5 Radiated emission measurements in 6000 - 12000 MHz, vertical antenna polarization

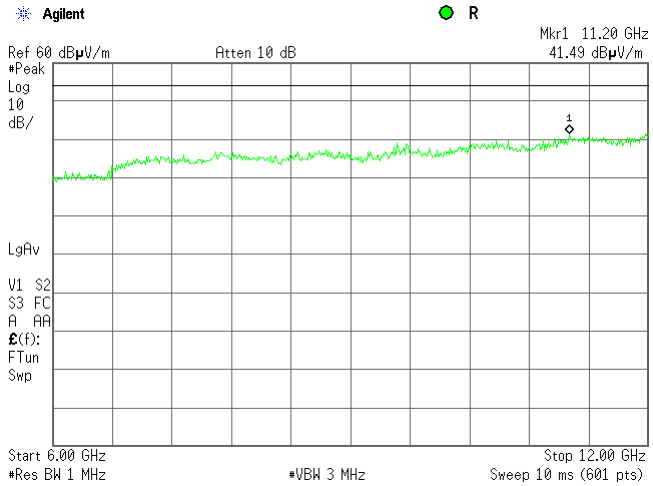
TEST SITE: Anechoic chamber
TEST DISTANCE: 3 m

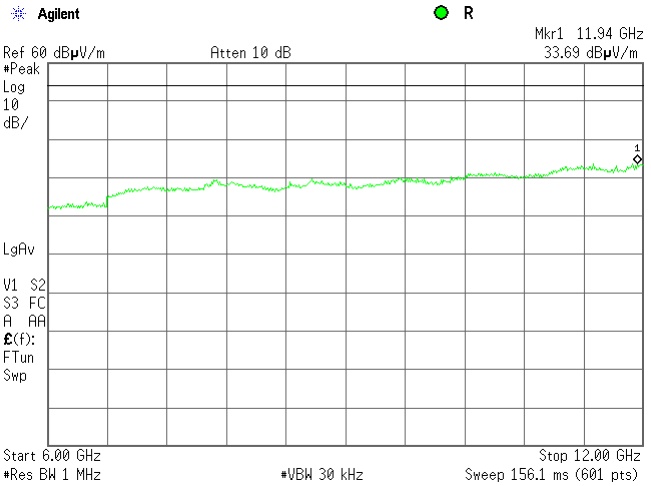




Plot 8.1.6 Radiated emission measurements in 6000 - 12000 MHz, horizontal antenna polarization

TEST SITE: Anechoic chamber
TEST DISTANCE: 3 m





9 APPENDIX A Test equipment and ancillaries used for tests

HL No	Description	Manufacturer	Model	Ser. No.	Last Cal./ Check	Due Cal./ Check
0446	Antenna, Loop, Active, 10 kHz - 30 MHz	EMCO	6502	2857	03-Jul-12	03-Jul-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	12-Dec-12	12-Dec-15
1984	Antenna, Double-Ridged Waveguide Horn, 1-18 GHz, 300 W	EMC Test Systems	3115	9911-5964	07-Dec-12	07-Dec-13
2780	EMC analyzer, 100 Hz to 26.5 GHz	Agilent Technologies	E7405A	MY45102462	09-Jul-12	09-Jul-13
2871	Microwave Cable Assembly, 18 GHz, 6.4 m, SMA - SMA	Huber-Suhner	198-8155-00	2871	04-Dec-12	04-Dec-13
3533	Amplifier, low noise, 6 to 18 GHz	Quinstar Technology	QLJ-06184040-J0	11159001001	25-Dec-12	25-Dec-13
3818	PSA Series Spectrum Analyzer, 3 Hz- 44 GHz	Agilent Technologies	E4446A	MY48250288	24-Apr-13	24-Apr-14
4150	Preamplifier, 0.1 to 18 GHz, Gain 25 dB, N-type(f) in, N-type(m) out.	Agilent Technologies	87405C	MY47010591	18-Jun-12	18-Jun-13
4160	Preamplifier, 0.1 to 18 GHz, Gain 25 dB, N-type(f) in, N-type(m) out.	Agilent Technologies	87405C	MY47010594	08-Aug-12	08-Aug-13
4353	Low Loss Armored Test Cable, DC - 18 GHz, 6.2 m, N type-M/N type-M	MegaPhase	NC29-N1N1-244	12025101003	06-Mar-13	06-Mar-14

10 APPENDIX B Measurement uncertainties

Expanded uncertainty at 95% confidence in Hermon Labs EMC measurements

Test description	Expanded uncertainty
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

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

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

Cable loss
Cable coaxial, Huber-Suhner, 18 GHz, 6.4 m, SMA - SMA, model 198-8155-00, HL 2871

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	0.12	5750	2.34	12000	3.55
30	0.14	6000	2.39	12250	3.61
100	0.27	6250	2.46	12500	3.67
250	0.45	6500	2.52	12750	3.74
500	0.63	6750	2.58	13000	3.79
750	0.76	7000	2.64	13250	3.82
1000	0.89	7250	2.68	13500	3.83
1250	1.01	7500	2.73	13750	3.83
1500	1.12	7750	2.78	14000	3.88
1750	1.23	8000	2.83	14250	3.93
2000	1.32	8250	2.88	14500	3.96
2250	1.41	8500	2.94	14750	4.01
2500	1.49	8750	2.97	15000	4.00
2750	1.58	9000	3.02	15250	4.01
3000	1.66	9250	3.07	15500	4.00
3250	1.73	9500	3.13	15750	4.13
3500	1.80	9750	3.18	16000	4.22
3750	1.87	10000	3.21	16250	4.29
4000	1.93	10250	3.26	16500	4.29
4250	2.01	10500	3.30	16750	4.32
4500	2.06	10750	3.36	17000	4.37
4750	2.12	11000	3.39	17250	4.45
5000	2.17	11250	3.44	17500	4.49
5250	2.24	11500	3.48	17750	4.53
5500	2.29	11750	3.52	18000	4.55

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