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 section 15.109

FOR:

On Track Innovations Ltd.

RF nozzle reader (SC transceiver)

Model: EFP RFN900

FCC ID:JNXOTI-EFPRFN900A

Report ID: OTIRAD_FCC.23143_15.249.doc
Date of Issue: 29-May-12

Table of contents

1 Applicant information

Client name:	On Track Innovations Ltd.
Address:	Z.H.R. Industrial zone, P.O. Box 32, Rosh Pina, 12000, Israel
Telephone:	+972 4686 8000
Fax:	+972 4693 8887
E-mail:	h_itay@otiglobal.com
Contact name:	Mr. Hemi Itay

2 Equipment under test attributes

Product name:	RF nozzle reader
Product type:	SC transceiver
Model(s):	EFP RFN900
Serial number:	87225222
Hardware version:	4.4.0
Software release:	0200
Receipt date	4/23/2012

3 Manufacturer information

Manufacturer name:	On Track Innovations Ltd.
Address:	Z.H.R. Industrial zone, P.O. Box 32, Rosh Pina, 12000, Israel
Telephone:	+972 4686 8000
Fax:	+972 4693 8887
E-Mail:	h_itay@otiglobal.com
Contact name:	Mr. Hemi Itay

4 Test details

Project ID:	23143
Location:	Hermon Laboratories Ltd. Harakevet Industrial Zone, Binyamina 30500, Israel
Test started:	4/23/2012
Test completed:	5/06/2012
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 15.207(a), Conducted emission	Not required
Section 15.203, Antenna requirement	Pass
Section 15.215(c), Occupied bandwidth	Pass
Unintentional emissions	
Section 15.107 class B, Conducted emission at AC power port	Not required
Section 15.109 class B, 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. Troupiansky, test engineer Mr. S. Samokha, test engineer	May 6, 2012	
Reviewed by:	Mrs. M. Cherniavsky, certification engineer	May 13, 2012	
Approved by:	Mr. M. Nikishin, EMC and Radio group manager	May 29, 2012	

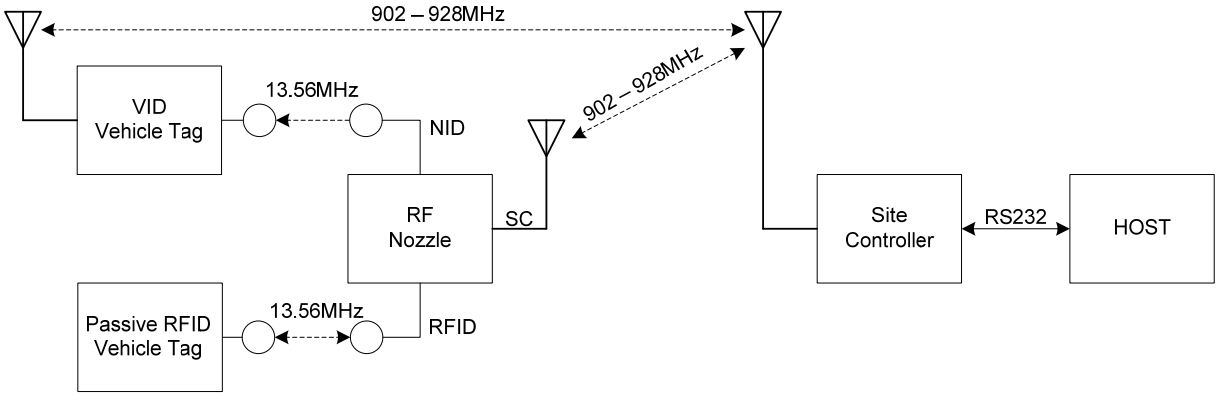
6 EUT description

6.1 General information

The EUT, RF Nozzle reader, is designed to serve as an interface between the refueled vehicle and the pump/station Site Controller to facilitate controlled and secured refueling. The RFN is mounted on the refueling nozzle.

The EUT is a battery powered unit, comprising three different transceivers: a RFID 13.56 MHz transceiver, a NID (Nozzle ID) 13.56 MHz transmitter and a SC (Site Controller) 902-928 MHz transceiver, all operating under the control of a local microprocessor.

The principle of the EUT operation is shown in the diagram below.



6.2 Changes made in EUT

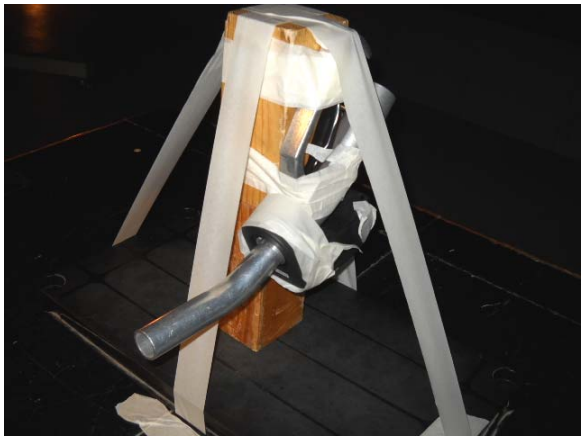
No changes were performed in the EUT.

6.3 EUT positions during testing

Photograph 6.3.1 EUT X-axis position

Photograph 6.3.2 EUT Y-axis position

Photograph 6.3.3 EUT Z-axis position



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)

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

Assigned frequency range	902 - 928 MHz
Operating frequency range	902.3600 – 927.4888 MHz
Maximum field strength	94.23 dB(µV/m) at 3 m test distance

Is transmitter output power variable?		No			
	V	Yes		continuous variable	
			V	stepped variable with stepsize, software controlled	1 dB
			Maximum field strength		94.23 dB(µV/m) at 3 m test distance

Antenna connection					
unique coupling	**V**	standard connector	Integral	**V**	with temporary RF connector
					without temporary RF connector

Antenna/s technical characteristics			
Type	Manufacturer	Model number	Gain
Helical	OTI	NA	Not defined

Transmitter aggregate data rate/s	9.6 Mbps						
Type of modulation	FSK						
Modulating test signal (baseband)	HEX code 55, continuous transmission						
Transmitter duty cycle supplied for test	100%						

Transmitter power source						
V	Battery	**Nominal rated voltage**	3.6 V	Battery type	Lithium	
	DC	**Nominal rated voltage**				
	AC mains	**Nominal rated voltage**		Frequency		

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):	4/23/2012 - 4/30/2012		
Temperature: 22.8 ºC	Air Pressure: 1012 hPa	Relative Humidity: 48 %	Power Supply: Battery
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(μV/m)
	Quasi-Peak
902 – 928	94

Table 7.1.2 Harmonics limits

Fundamental frequency, MHz	Field strength at 3 m, dB(μV/m)	
	Peak	Average
902 – 928	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):	4/23/2012 - 4/30/2012		
Temperature: 22.8 ºC	Air Pressure: 1012 hPa	Relative Humidity: 48 %	Power Supply: Battery
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 in three EUT orthogonal positions.

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 in three EUT orthogonal positions.

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

7.1.3.4 The worst test results (the lowest margins) were 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):	4/23/2012 - 4/30/2012		
Temperature: 22.8 ºC	Air Pressure: 1012 hPa	Relative Humidity: 48 %	Power Supply: Battery
Remarks:			

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

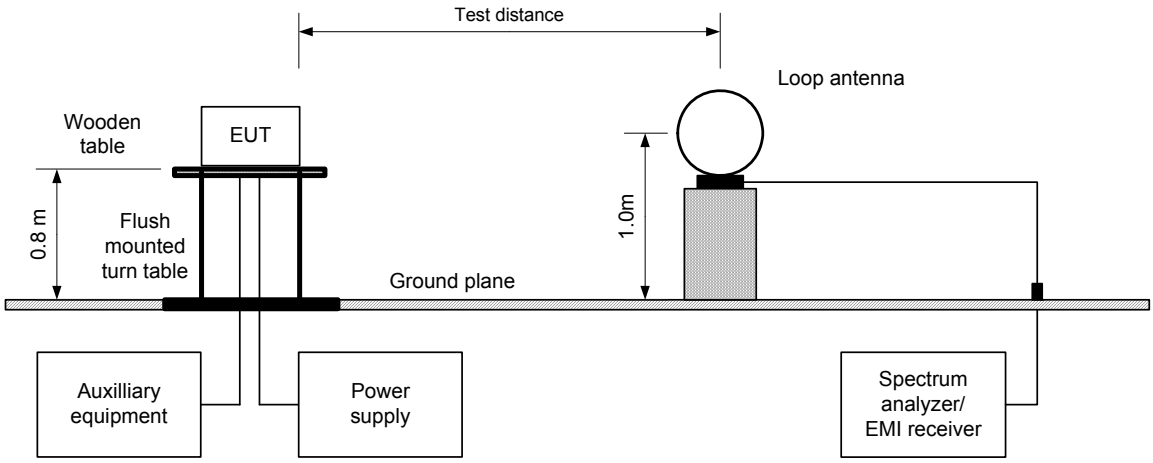
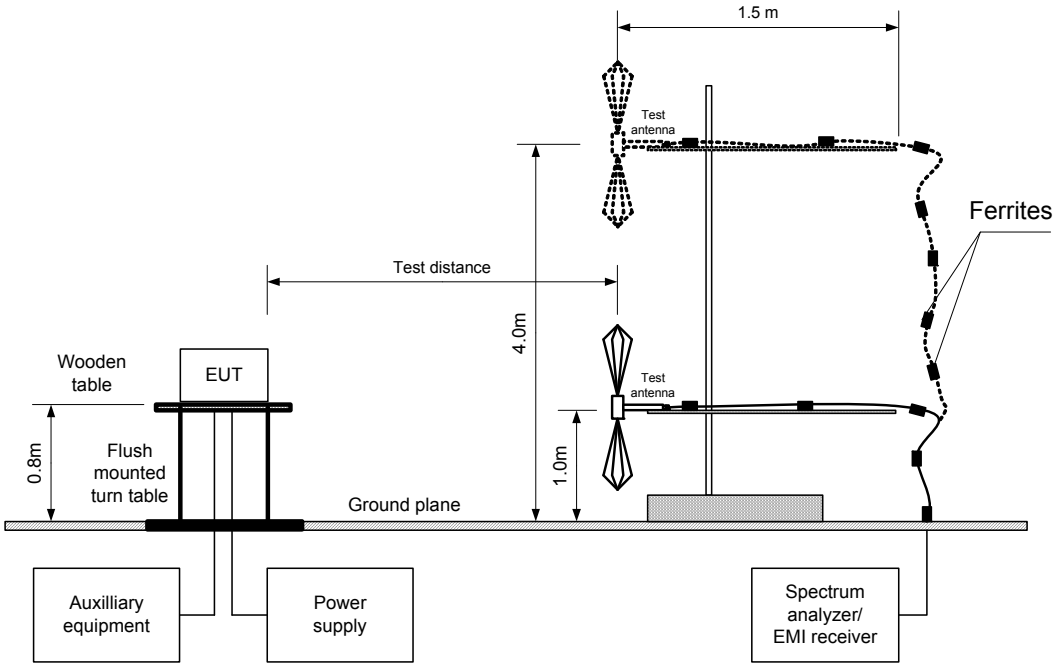


Figure 7.1.2 Setup for spurious emission field strength measurements above 30 MHz



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):	4/23/2012 - 4/30/2012		
Temperature: 22.8 ºC	Air Pressure: 1012 hPa	Relative Humidity: 48 %	Power Supply: Battery
Remarks:			

Table 7.1.4 Field strength of fundamental emission and spurious emissions

TEST DISTANCE:	3 m
EUT POSITION:	3 orthogonal X / Y / Z, Z-axis considered as the worst case
MODULATION:	FSK
MODULATING SIGNAL:	ID code
TRANSMITTER OUTPUT POWER SETTINGS:	Maximum
INVESTIGATED FREQUENCY RANGE:	0.009 – 9.3 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

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**	
902.3600	H	1.6	300	94.05	93.27	94	-0.73	Pass
914.9988	V	1.2	80	93.51	91.20	94	-2.80	Pass
927.4888	V	1.3	330	94.23	93.10	94	-0.90	Pass

Spurious emissions

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**	
Low channel											
3609.44	H	1.1	77	47.60	74.00	-26.40	-17.65	29.95	54.00	-24.05	
7216.51	V	1.3	58	48.70	74.00	-25.30	-17.65	31.05	54.00	-22.95	Pass
7218.88	V	1.3	15	49.00	74.00	-25.00	-17.65	31.35	54.00	-22.65	
Mid channel											
3660.00	H	1.2	85	45.50	74.00	-28.50	-17.65	27.85	54.00	-26.15	
7317.63	V	1.4	66	47.10	74.00	-26.90	-17.65	29.45	54.00	-24.55	Pass
7320.00	V	1.4	12	46.90	74.00	-27.10	-17.65	29.25	54.00	-24.75	
High channel											
3710.00	H	1.3	80	48.80	74.00	-25.20	-17.65	31.15	54.00	-22.85	
7417.68	H	1.1	154	48.90	74.00	-25.10	-17.65	31.25	54.00	-22.75	Pass
7420.00	H	1.1	120	48.60	74.00	-25.40	-17.65	30.95	54.00	-23.05	

*- EUT front panel refers to 0 degrees position of turntable.
**- Margin, dB =Measured (calculated) value, dB(μV/m)-Limit, dB(μV/m).
*** Max value was obtained in Z-axis orthogonal position and at Unom input power voltage.

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):	4/23/2012 - 4/30/2012		
Temperature: 22.8 ºC	**Air Pressure:** 1012 hPa	**Relative Humidity:** 48 %	**Power Supply:** Battery
Remarks:			

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		
13.1	1250	NA	NA	NA	-17.65

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

$$Average\ factor = 20 \times \log_{10}\left(\frac{13.1}{100} \times\right) = -17.65dB$$

Reference numbers of test equipment used

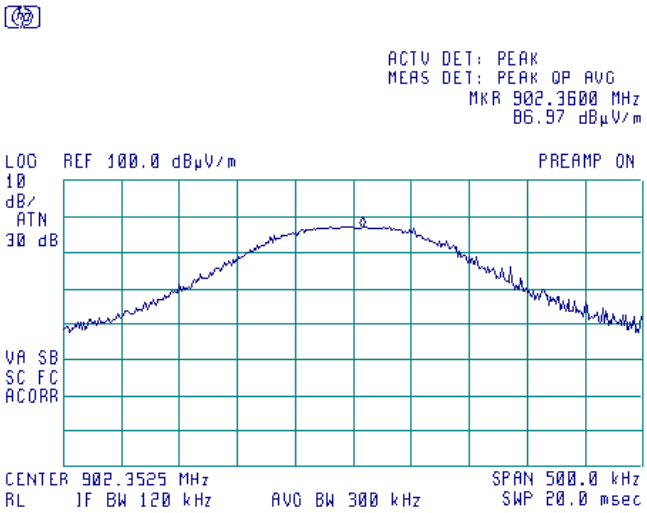
HL 0446	HL 0521	HL 0593	HL 0594	HL 0604	HL 2432	HL 2871	HL 2909
HL 3622							

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):	4/23/2012 - 4/30/2012		
Temperature: 22.8 ºC	Air Pressure: 1012 hPa	Relative Humidity: 48 %	Power Supply: Battery
Remarks:			

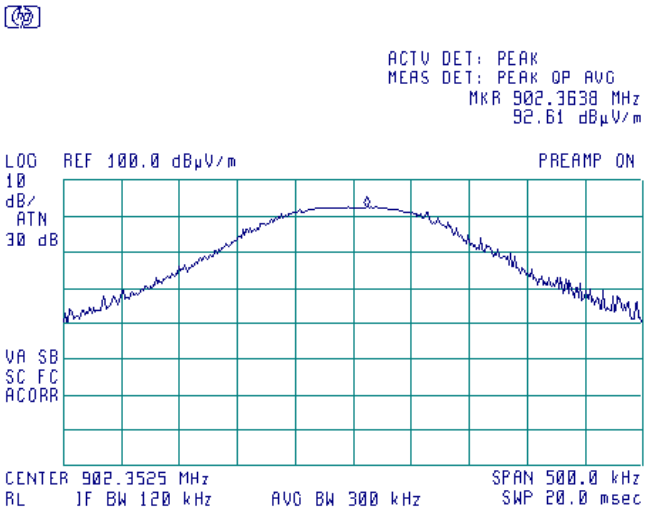
Plot 7.1.1 Radiated emission measurements at the fundamental low frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: X-axis
EUT FREQUENCY: Low



Plot 7.1.2 Radiated emission measurements at the fundamental low frequency

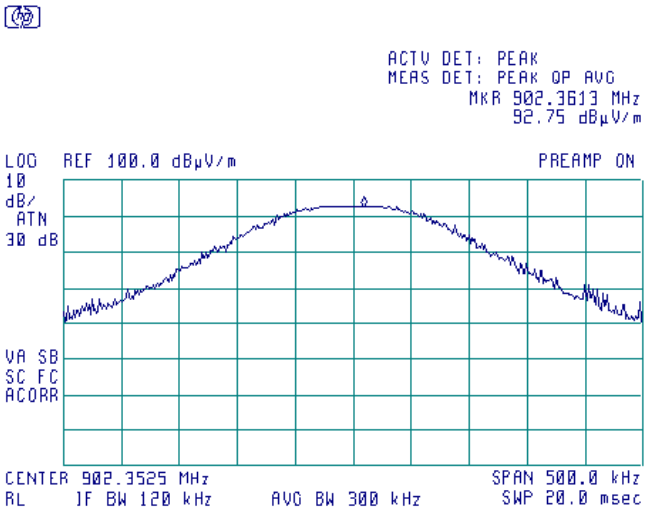
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal
EUT POSITION: X-axis
EUT FREQUENCY: Low



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):	4/23/2012 - 4/30/2012		
Temperature: 22.8 ºC	Air Pressure: 1012 hPa	Relative Humidity: 48 %	Power Supply: Battery
Remarks:			

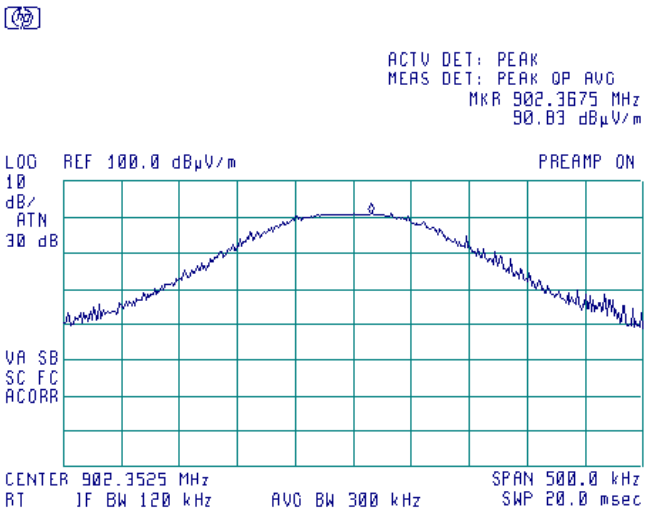
Plot 7.1.3 Radiated emission measurements at the fundamental low frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Y-axis
EUT FREQUENCY: Low



Plot 7.1.4 Radiated emission measurements at the fundamental low frequency

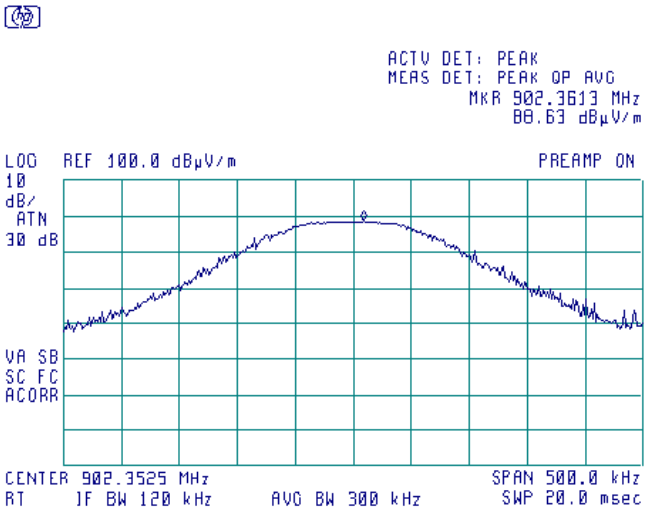
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal
EUT POSITION: Y-axis
EUT FREQUENCY: Low



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):	4/23/2012 - 4/30/2012		
Temperature: 22.8 ºC	Air Pressure: 1012 hPa	Relative Humidity: 48 %	Power Supply: Battery
Remarks:			

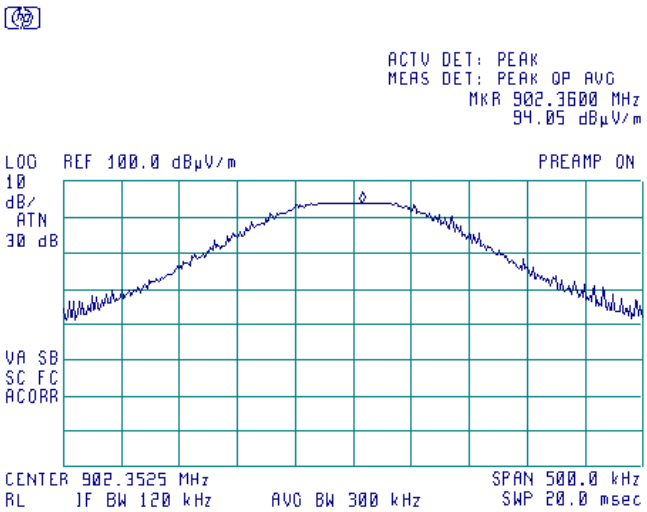
Plot 7.1.5 Radiated emission measurements at the fundamental low frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Z-axis
EUT FREQUENCY: Low



Plot 7.1.6 Radiated emission measurements at the fundamental low frequency

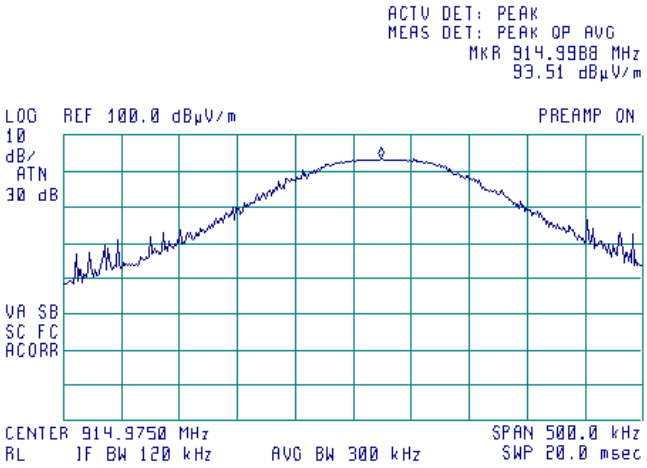
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal
EUT POSITION: Z-axis
EUT FREQUENCY: Low



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):	4/23/2012 - 4/30/2012		
Temperature: 22.8 ºC	Air Pressure: 1012 hPa	Relative Humidity: 48 %	Power Supply: Battery
Remarks:			

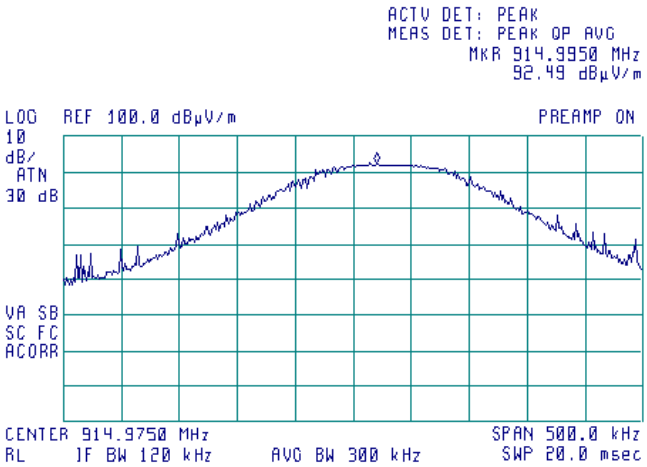
Plot 7.1.7 Radiated emission measurements at the fundamental mid frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: 3 orthogonal (X/ Y/ Z)
EUT FREQUENCY: Mid



Plot 7.1.8 Radiated emission measurements at the fundamental mid frequency

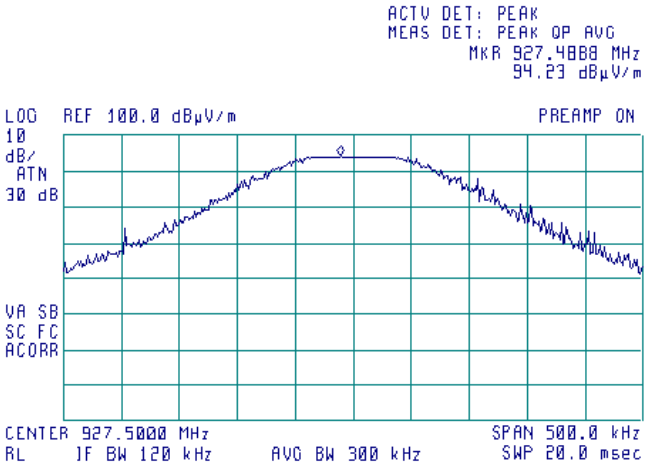
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal
EUT POSITION: 3 orthogonal (X/ Y/ Z)
EUT FREQUENCY: Mid



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):	4/23/2012 - 4/30/2012		
Temperature: 22.8 ºC	Air Pressure: 1012 hPa	Relative Humidity: 48 %	Power Supply: Battery
Remarks:			

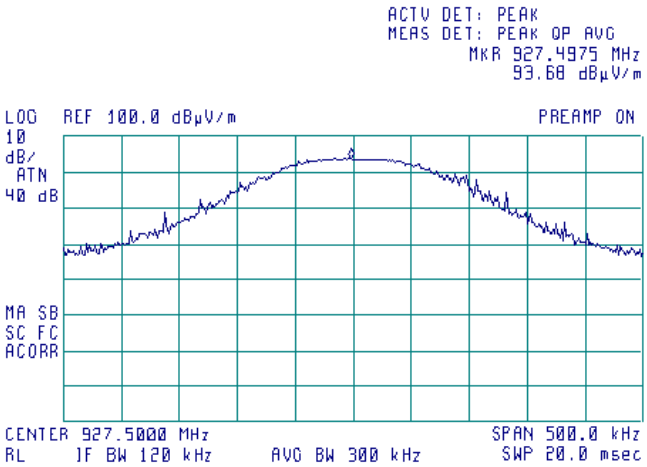
Plot 7.1.9 Radiated emission measurements at the fundamental high frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: 3 orthogonal (X/ Y/ Z)
EUT FREQUENCY: High



Plot 7.1.10 Radiated emission measurements at the fundamental high frequency

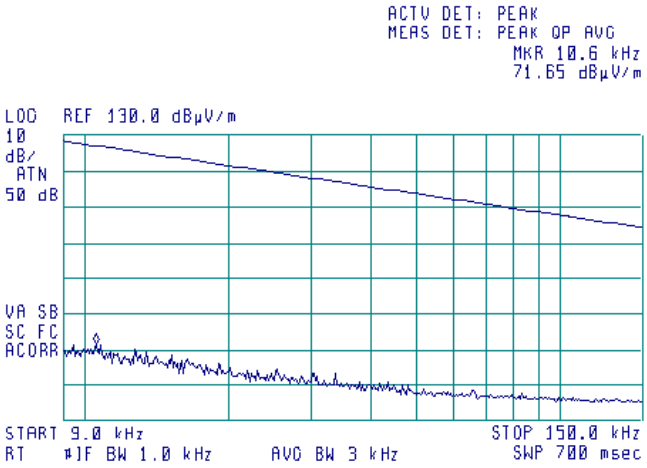
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal
EUT POSITION: 3 orthogonal (X/ Y/ Z)
EUT FREQUENCY: High



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):	4/23/2012 - 4/30/2012		
Temperature: 22.8 ºC	Air Pressure: 1012 hPa	Relative Humidity: 48 %	Power Supply: Battery
Remarks:			

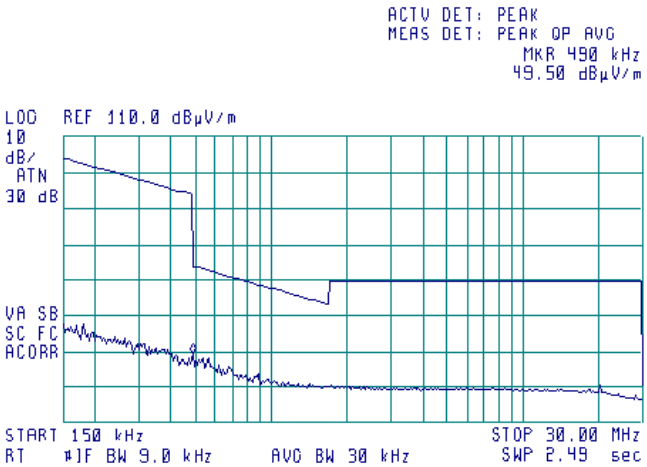
Plot 7.1.11 Radiated emission measurements from 9 to 150 kHz

TEST SITE:	Semi anechoic chamber
TEST DISTANCE:	3 m
ANTENNA POLARIZATION:	Vertical
EUT POSITION:	Z-axis
EUT FREQUENCY:	Low



Plot 7.1.12 Radiated emission measurements from 0.15 to 30 MHz

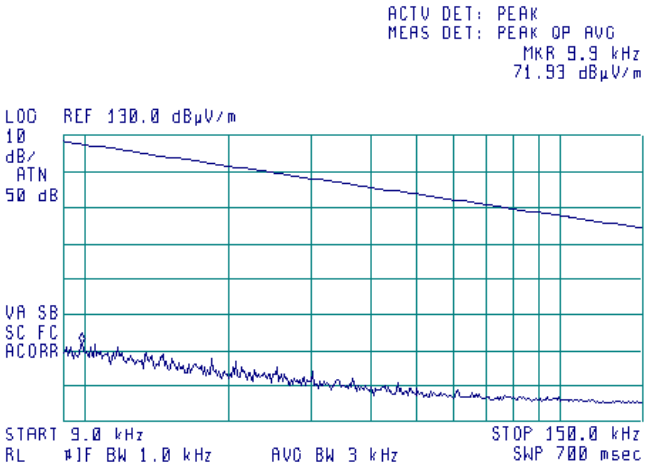
TEST SITE:	Semi anechoic chamber
TEST DISTANCE:	3 m
ANTENNA POLARIZATION:	Vertical
EUT POSITION:	Z-axis
EUT FREQUENCY:	Low



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):	4/23/2012 - 4/30/2012		
Temperature: 22.8 ºC	Air Pressure: 1012 hPa	Relative Humidity: 48 %	Power Supply: Battery
Remarks:			

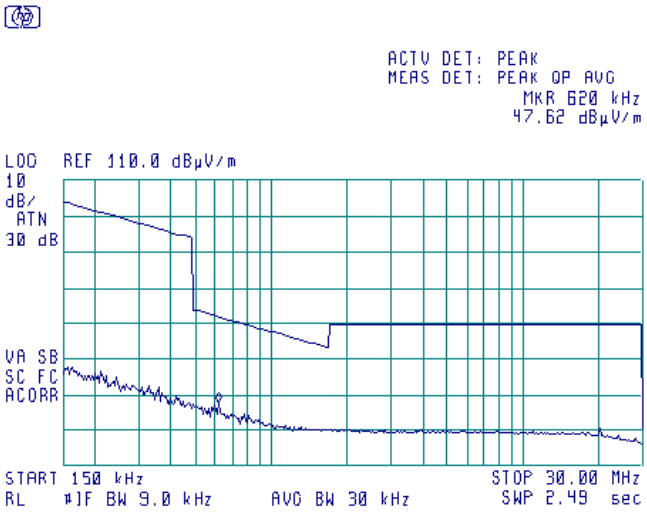
Plot 7.1.13 Radiated emission measurements from 9 to 150 kHz

TEST SITE:	Semi anechoic chamber
TEST DISTANCE:	3 m
ANTENNA POLARIZATION:	Vertical
EUT POSITION:	Z-axis
EUT FREQUENCY:	Mid



Plot 7.1.14 Radiated emission measurements from 0.15 to 30 MHz

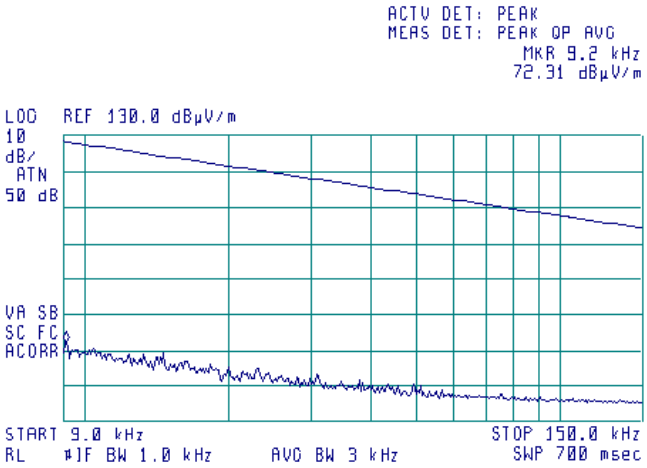
TEST SITE:	Semi anechoic chamber
TEST DISTANCE:	3 m
ANTENNA POLARIZATION:	Vertical
EUT POSITION:	Z-axis
EUT FREQUENCY:	Mid



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):	4/23/2012 - 4/30/2012		
Temperature: 22.8 ºC	Air Pressure: 1012 hPa	Relative Humidity: 48 %	Power Supply: Battery
Remarks:			

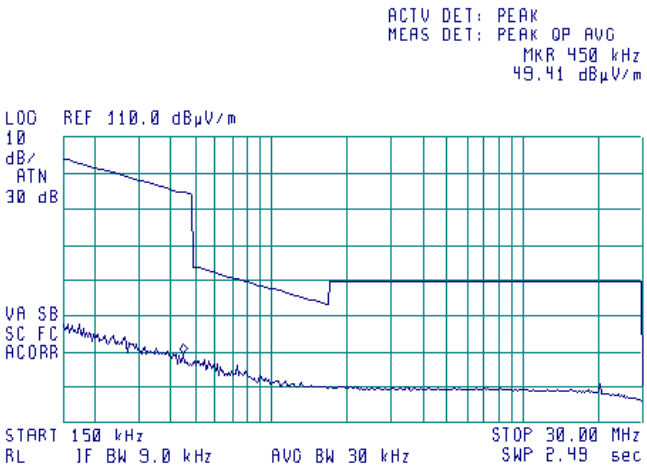
Plot 7.1.15 Radiated emission measurements from 9 to 150 kHz

TEST SITE:	Semi anechoic chamber
TEST DISTANCE:	3 m
ANTENNA POLARIZATION:	Vertical
EUT POSITION:	Z-axis
EUT FREQUENCY:	High



Plot 7.1.16 Radiated emission measurements from 0.15 to 30 MHz

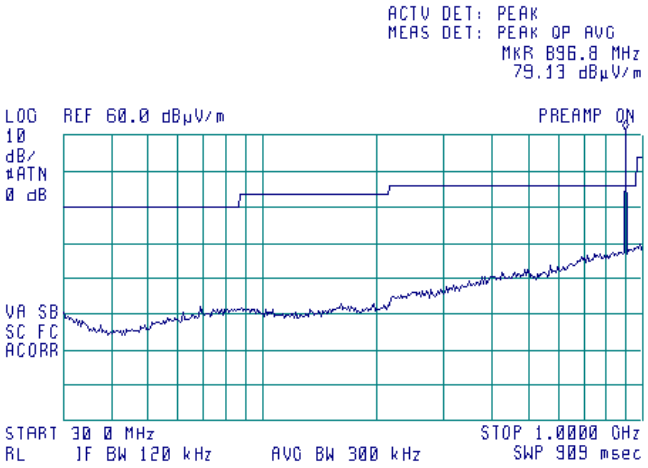
TEST SITE:	Semi anechoic chamber
TEST DISTANCE:	3 m
ANTENNA POLARIZATION:	Vertical
EUT POSITION:	Z-axis
EUT FREQUENCY:	High



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):	4/23/2012 - 4/30/2012		
Temperature: 22.8 ºC	Air Pressure: 1012 hPa	Relative Humidity: 48 %	Power Supply: Battery
Remarks:			

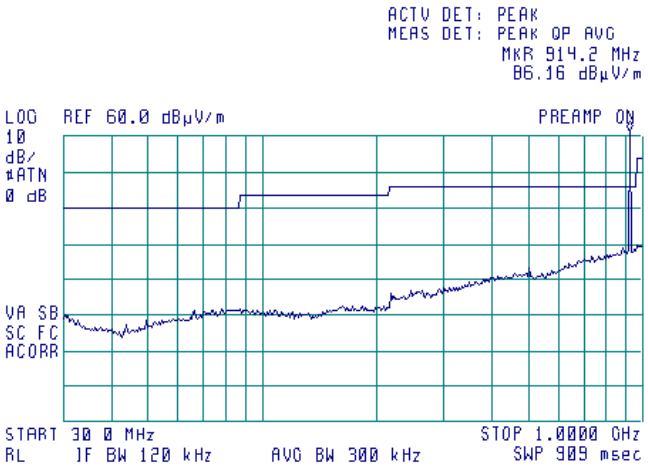
Plot 7.1.17 Radiated emission measurements from 30 to 1000 MHz

TEST SITE:	Semi anechoic chamber
TEST DISTANCE:	3 m
ANTENNA POLARIZATION:	Vertical and Horizontal
EUT POSITION:	Z-axis
EUT FREQUENCY:	Low



Plot 7.1.18 Radiated emission measurements from 30 to 1000 MHz

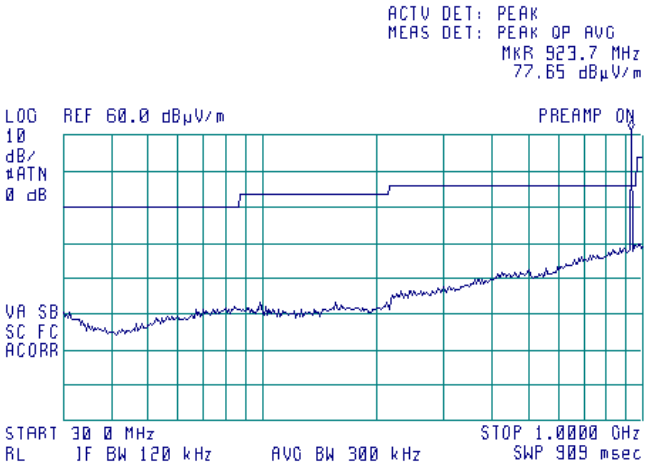
TEST SITE:	Semi anechoic chamber
TEST DISTANCE:	3 m
ANTENNA POLARIZATION:	Vertical and Horizontal
EUT POSITION:	Z-axis
EUT FREQUENCY:	Mid



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):	4/23/2012 - 4/30/2012		
Temperature: 22.8 ºC	Air Pressure: 1012 hPa	Relative Humidity: 48 %	Power Supply: Battery
Remarks:			

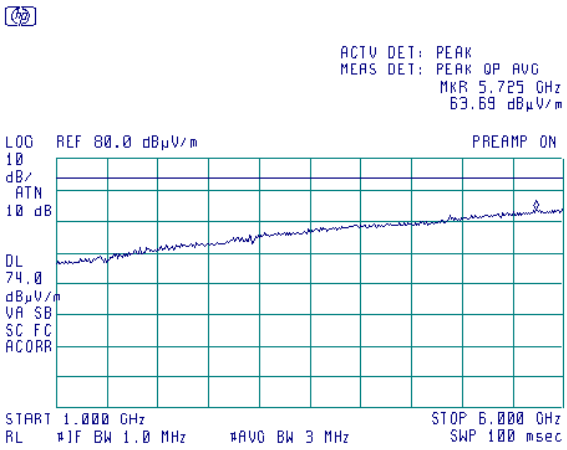
Plot 7.1.19 Radiated emission measurements from 30 to 1000 MHz

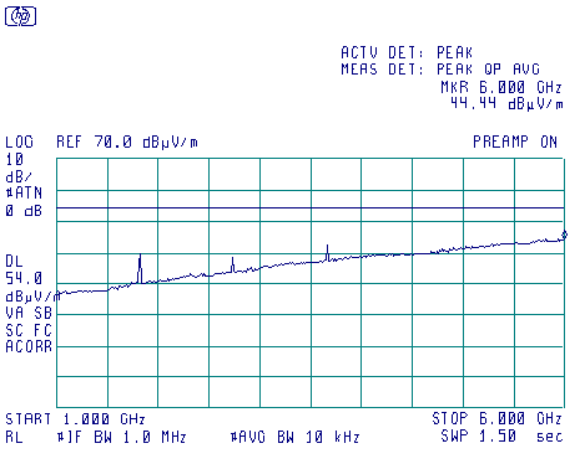
TEST SITE:	Semi anechoic chamber
TEST DISTANCE:	3 m
ANTENNA POLARIZATION:	Vertical and Horizontal
EUT POSITION:	Z-axis
EUT FREQUENCY:	High



Plot 7.1.20 Radiated emission measurements from 1.0 to 6.0 MHz

TEST SITE:	Semi anechoic chamber
TEST DISTANCE:	3 m
ANTENNA POLARIZATION:	Vertical and Horizontal
EUT POSITION:	Z-axis
EUT FREQUENCY:	Low

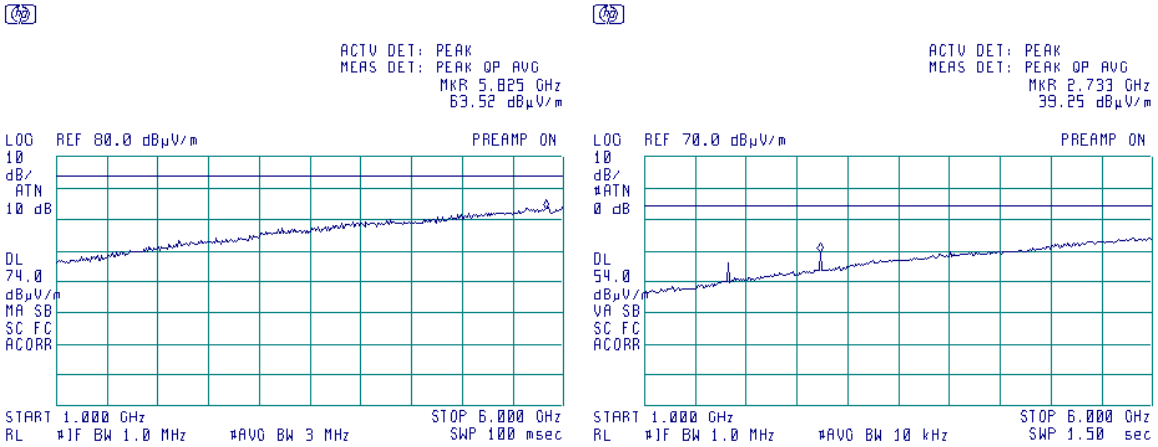




Test specification:	Section 15.249(a)(d), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	4/23/2012 - 4/30/2012		
Temperature: 22.8 ºC	Air Pressure: 1012 hPa	Relative Humidity: 48 %	Power Supply: Battery
Remarks:			

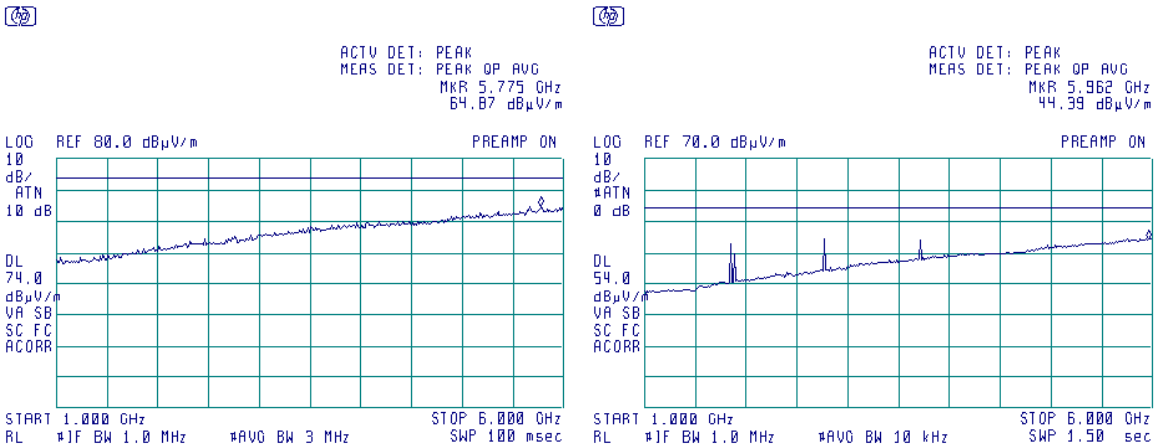
Plot 7.1.21 Radiated emission measurements from 1.0 to 6.0 MHz

TEST SITE:	Semi anechoic chamber
TEST DISTANCE:	3 m
ANTENNA POLARIZATION:	Vertical and Horizontal
EUT POSITION:	Z-axis
EUT FREQUENCY:	Mid



Plot 7.1.22 Radiated emission measurements from 1.0 to 6.0 MHz

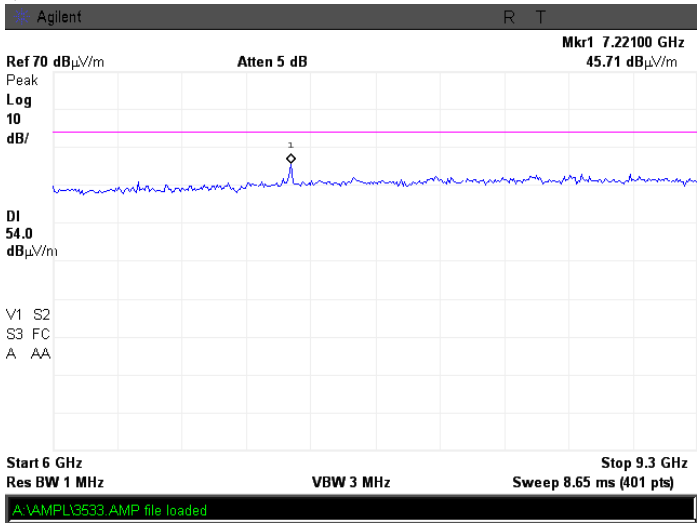
TEST SITE:	Semi anechoic chamber
TEST DISTANCE:	3 m
ANTENNA POLARIZATION:	Vertical and Horizontal
EUT POSITION:	Z-axis
EUT FREQUENCY:	High



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):	4/23/2012 - 4/30/2012		
Temperature: 22.8 ºC	Air Pressure: 1012 hPa	Relative Humidity: 48 %	Power Supply: Battery
Remarks:			

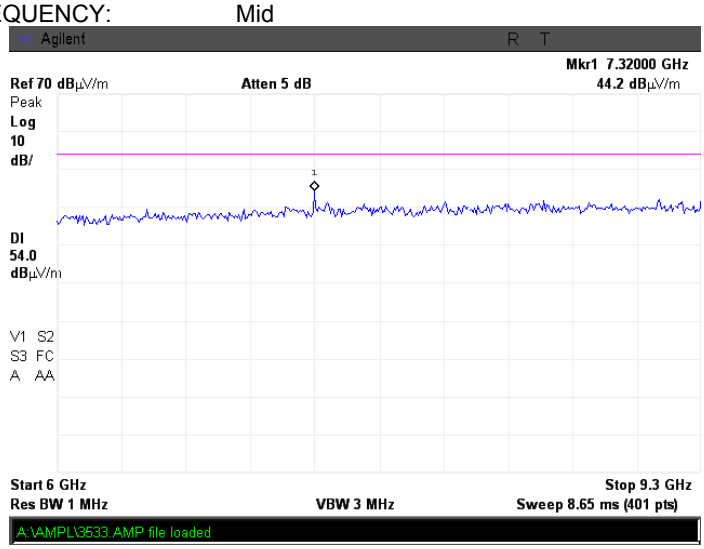
Plot 7.1.23 Radiated emission measurements from 6.0 to 9.3 GHz

TEST SITE: OATS
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POSITION: Z-axis
EUT FREQUENCY: Low



Plot 7.1.24 Radiated emission measurements from 6 to 9.3 GHz

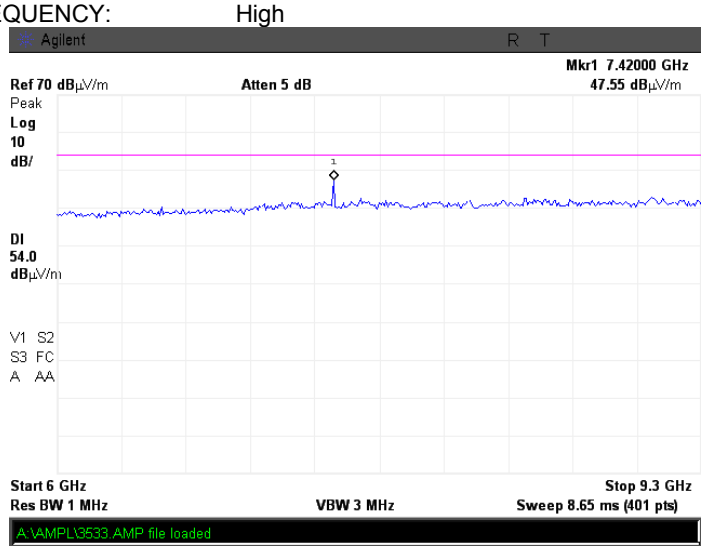
TEST SITE: OATS
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POSITION: Z-axis
EUT FREQUENCY: Mid



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):	4/23/2012 - 4/30/2012		
Temperature: 22.8 ºC	Air Pressure: 1012 hPa	Relative Humidity: 48 %	Power Supply: Battery
Remarks:			

Plot 7.1.25 Radiated emission measurements from 6 to 9.3 GHz

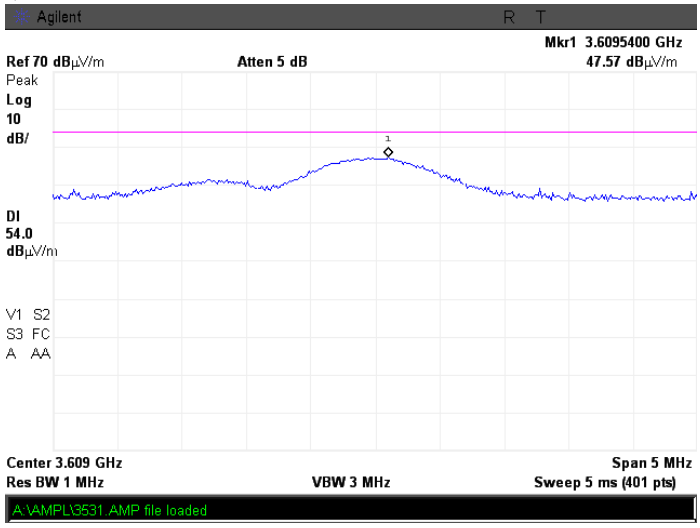
TEST SITE: OATS
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POSITION: Z-axis
EUT FREQUENCY: High



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):	4/23/2012 - 4/30/2012		
Temperature: 22.8 ºC	Air Pressure: 1012 hPa	Relative Humidity: 48 %	Power Supply: Battery
Remarks:			

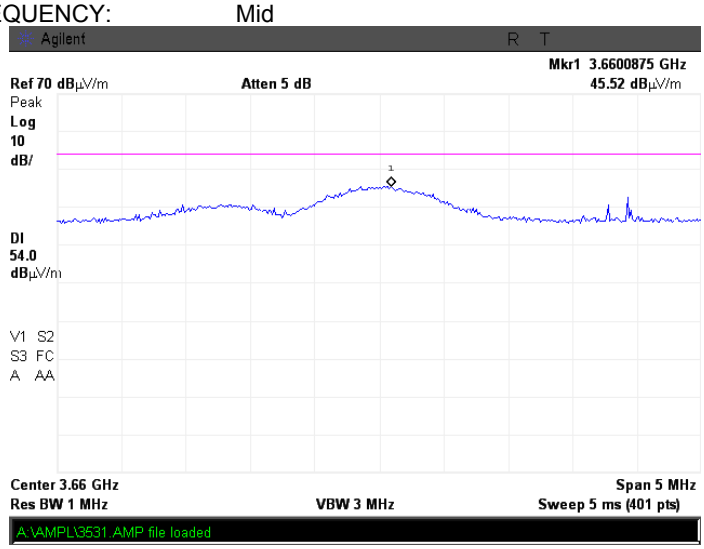
Plot 7.1.26 Radiated emission measurements at the fourth harmonic frequency

TEST SITE: OATS
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POSITION: Z-axis
EUT FREQUENCY: Low



Plot 7.1.27 Radiated emission measurements at the fourth harmonic frequency

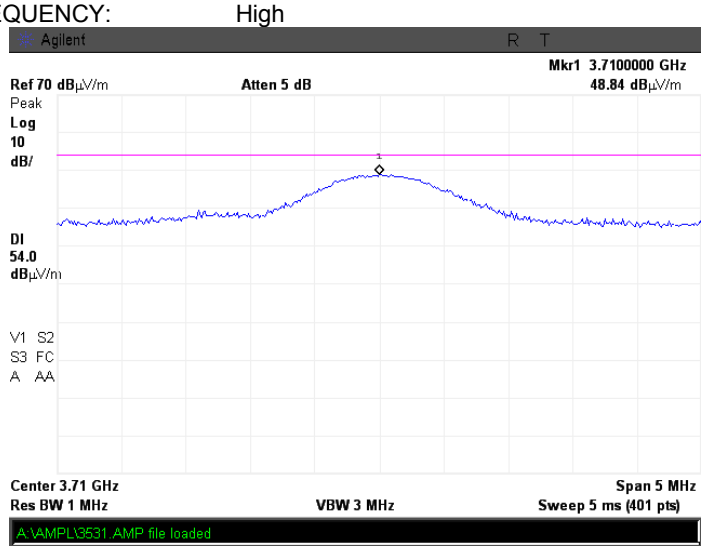
TEST SITE: OATS
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POSITION: Z-axis
EUT FREQUENCY: Mid



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):	4/23/2012 - 4/30/2012		
Temperature: 22.8 ºC	Air Pressure: 1012 hPa	Relative Humidity: 48 %	Power Supply: Battery
Remarks:			

Plot 7.1.28 Radiated emission measurements at the fourth harmonic frequency

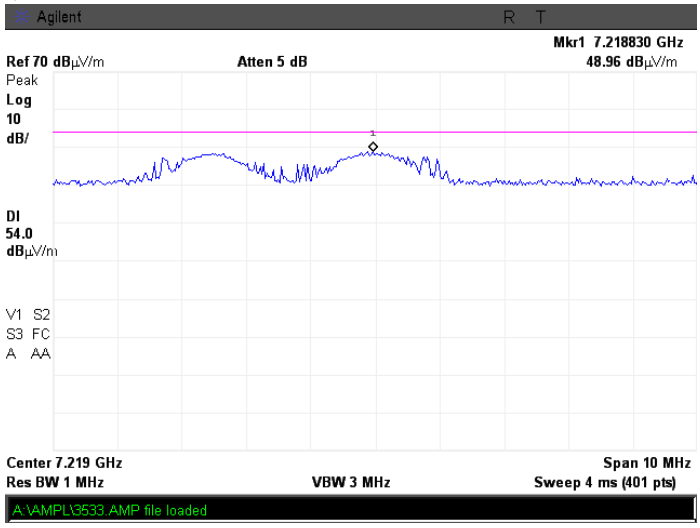
TEST SITE: OATS
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POSITION: Z-axis
EUT FREQUENCY: High



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):	4/23/2012 - 4/30/2012		
Temperature: 22.8 ºC	Air Pressure: 1012 hPa	Relative Humidity: 48 %	Power Supply: Battery
Remarks:			

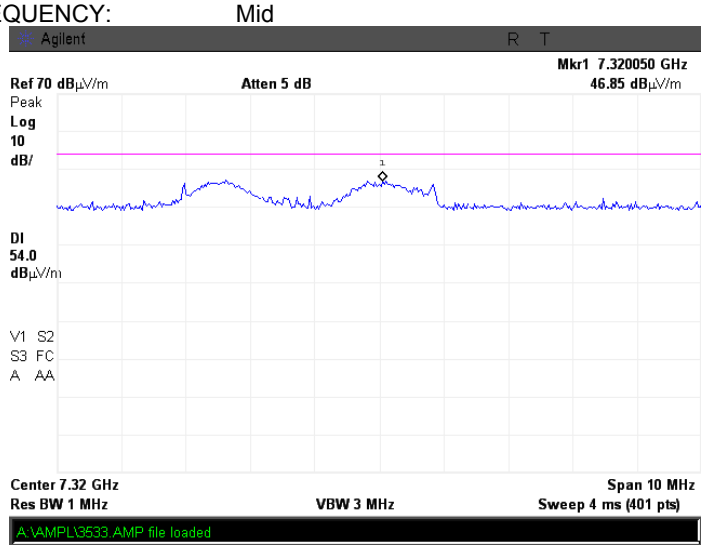
Plot 7.1.29 Radiated emission measurements at the eighth harmonic frequency

TEST SITE: OATS
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and horizontal
EUT POSITION: Z-axis
EUT FREQUENCY: Low



Plot 7.1.30 Radiated emission measurements at the eighth harmonic frequency

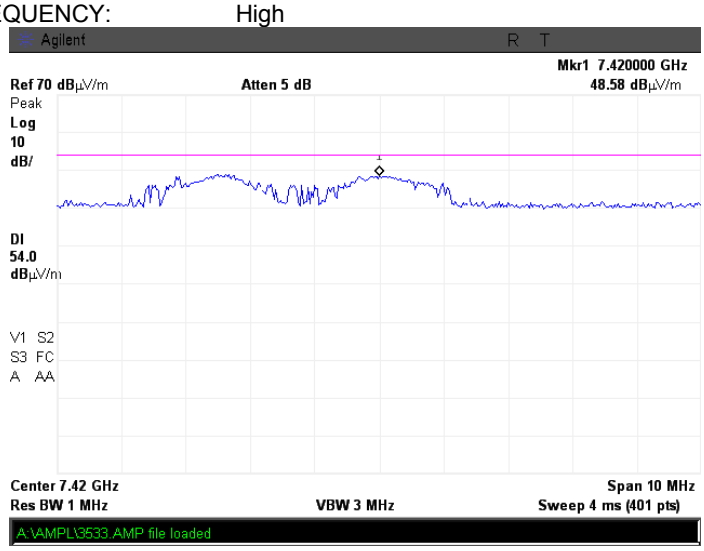
TEST SITE: OATS
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and horizontal
EUT POSITION: Z-axis
EUT FREQUENCY: Mid



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):	4/23/2012 - 4/30/2012		
Temperature: 22.8 ºC	Air Pressure: 1012 hPa	Relative Humidity: 48 %	Power Supply: Battery
Remarks:			

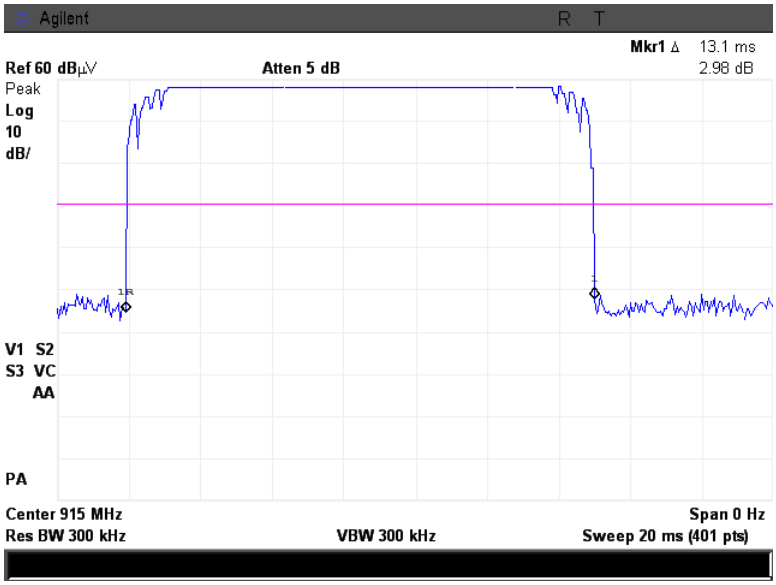
Plot 7.1.31 Radiated emission measurements at the eighth harmonic frequency

TEST SITE: OATS
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and horizontal
EUT POSITION: Z-axis
EUT FREQUENCY: High



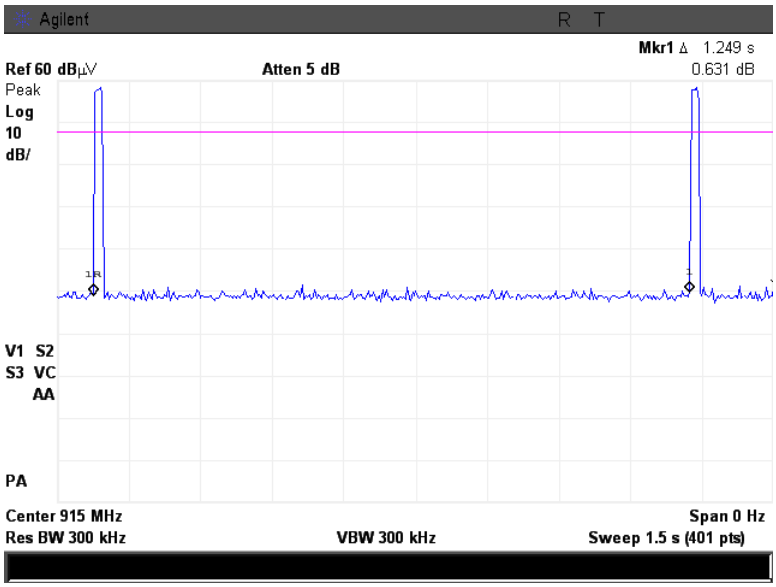
Test specification:	Section 15.249(a)(d), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	4/23/2012 - 4/30/2012		
Temperature: 22.8 ºC	Air Pressure: 1012 hPa	Relative Humidity: 48 %	Power Supply: Battery
Remarks:			

Plot 7.1.32 Transmission pulse duration



Pulse duration 13.1 ms

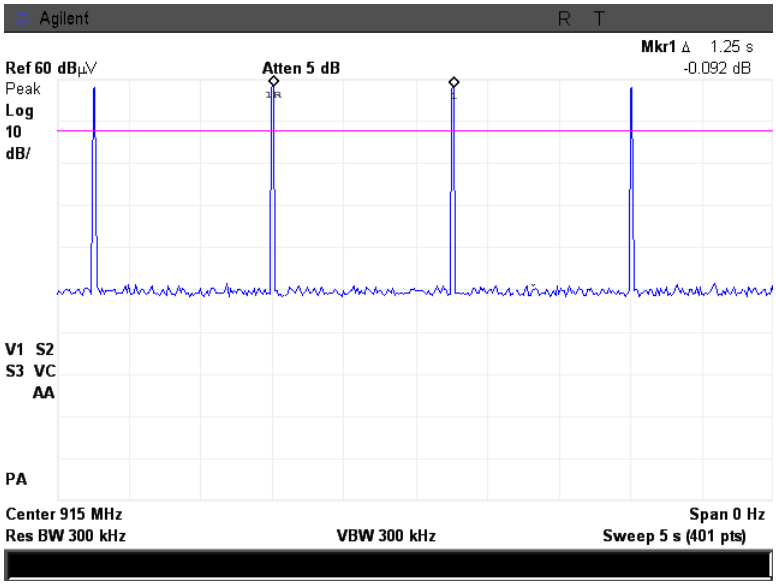
Plot 7.1.33 Transmission pulse period



Pulse period 1.25 s

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):	4/23/2012 - 4/30/2012		
Temperature: 22.8 ºC	Air Pressure: 1012 hPa	Relative Humidity: 48 %	Power Supply: Battery
Remarks:			

Plot 7.1.34 Transmission pulse period



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):	5/2/2012 - 5/6/2012		
Temperature: 24 ºC	Air Pressure: 1004 hPa	Relative Humidity: 67 %	Power Supply: Battery
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	QP	
902.000 - 928.000	NA	46.0	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.

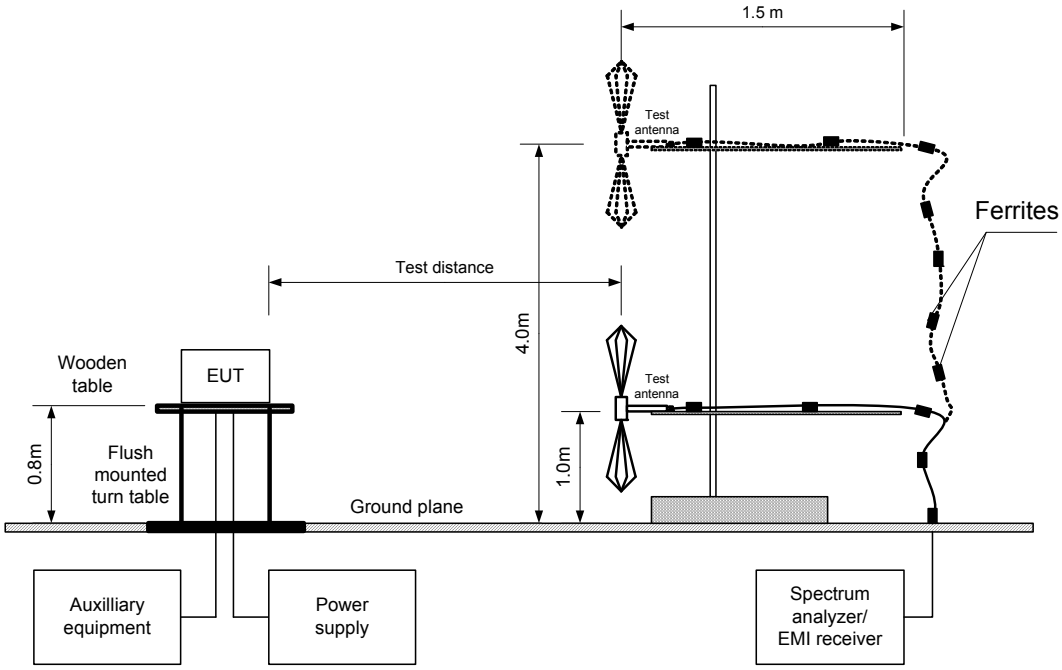
7.2.2.2 The spectrum analyzer frequency span was set to capture all major modulation sidebands of emission and sweep time was set sufficiently slow to ensure peak measurements. Spectrum analyzer was set in peak hold mode and time sufficient for trace stabilization was allowed.

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):	5/2/2012 - 5/6/2012		
Temperature: 24 ºC	Air Pressure: 1004 hPa	Relative Humidity: 67 %	Power Supply: Battery
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):	5/2/2012 - 5/6/2012		
Temperature: 24 ºC	**Air Pressure:** 1004 hPa	**Relative Humidity:** 67 %	**Power Supply:** Battery
Remarks:			

Table 7.2.2 Band edge emission test results

ASSIGNED FREQUENCY RANGE: 902-928 MHz
DETECTOR USED: Peak hold
RESOLUTION BANDWIDTH: 120 kHz
VIDEO BANDWIDTH: 300 kHz
MODULATION: FSK
TRANSMITTER OUTPUT POWER SETTINGS: Maximum

Modulation envelope		**Measured peak emission, dBµV/m**	**Measured QP emission, dBµV/m**	**QP limit, dBµV/m**	**Margin, dB ***	**Verdict**
Edge	**Frequency, MHz**					
Low	902	57.93	45.29	46.0	-0.71	Pass
High	928	54.40	44.33	46.0	-1.67	Pass

* - Margin = measured value– limit

Reference numbers of test equipment used

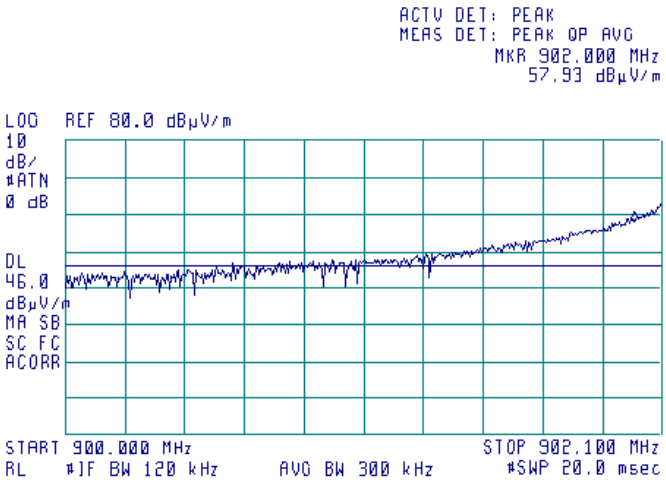
HL 0521	HL 0604	HL 2871	HL 3617				

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):	5/2/2012 - 5/6/2012		
Temperature: 24 ºC	Air Pressure: 1004 hPa	Relative Humidity: 67 %	Power Supply: Battery
Remarks:			

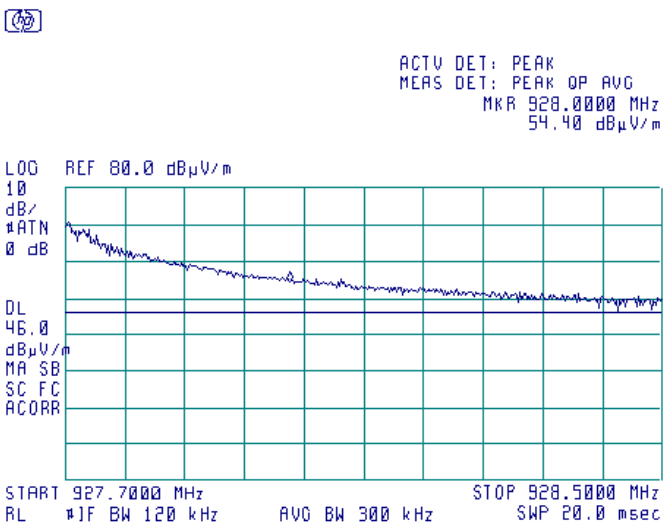
Plot 7.2.1 Low band edge emission test result

TEST SITE: OATS
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POSITION: Vertical



Plot 7.2.2 High band edge emission test result

TEST SITE: OATS
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POSITION: Vertical



Test specification:	Section 15.203, Antenna requirement		
Test procedure:	Visual inspection / supplier declaration		
Test mode:	Compliance	Verdict:	PASS
Date(s):	5/2/2012 - 5/6/2012		
Temperature: 24 ºC	Air Pressure: 1004 hPa	Relative Humidity: 67 %	Power Supply: Battery
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):	4/24/2012 - 4/24/2012		
Temperature: 23 ºC	Air Pressure: 1012 hPa	Relative Humidity: 49 %	Power Supply: Battery
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
902.0 – 928.0	20.0

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

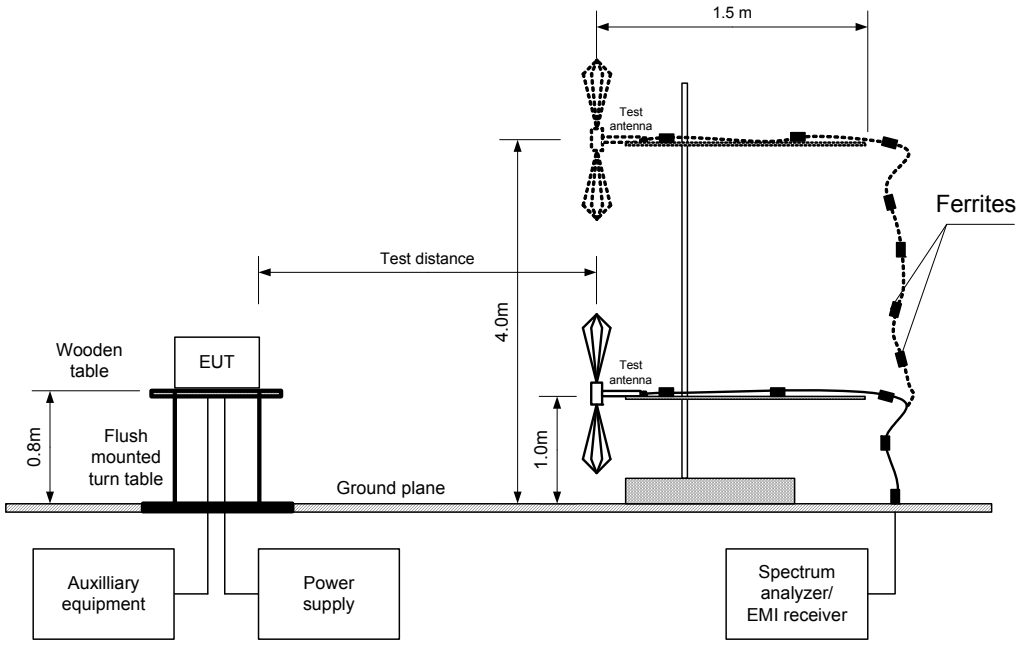
7.4.2 Test procedure

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.

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):	4/24/2012 - 4/24/2012		
Temperature: 23 ºC	**Air Pressure:** 1012 hPa	**Relative Humidity:** 49 %	**Power Supply:** Battery
Remarks:			

Table 7.4.2 Occupied bandwidth test results

ASSIGNED FREQUENCY BAND	902-928 MHz
DETECTOR USED:	Peak hold
RESOLUTION BANDWIDTH:	10 kHz
VIDEO BANDWIDTH:	30 kHz
MODULATION ENVELOPE REFERENCE POINTS:	20 dBc
MODULATION:	FSK
MODULATING SIGNAL:	Enable

Band edge	**Cross point frequency, MHz**	**Frequency drift, kHz**		**Modulation band edge, MHz**	**Assigned band edge, MHz**	**Verdict**
		Negative	**Positive**			
Low	902.280	NA	NA	902.280	902.000	Pass
High	927.572	NA	NA	927.572	928.000	Pass

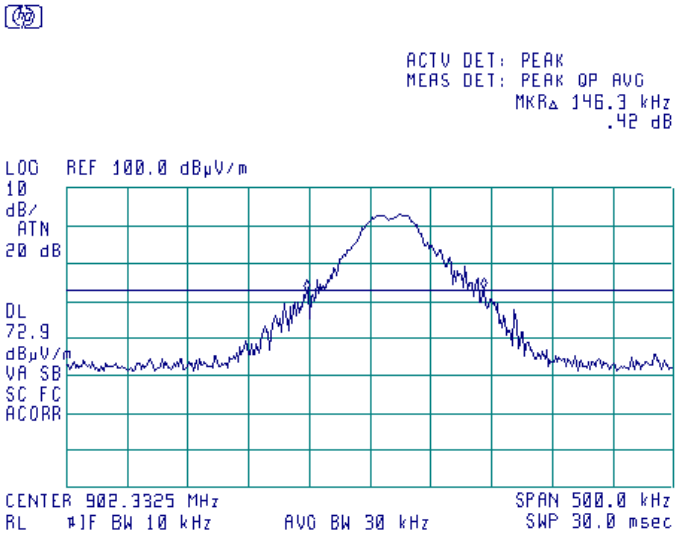
Reference numbers of test equipment used

HL 0521	HL 0604	HL 2871	HL 3617					

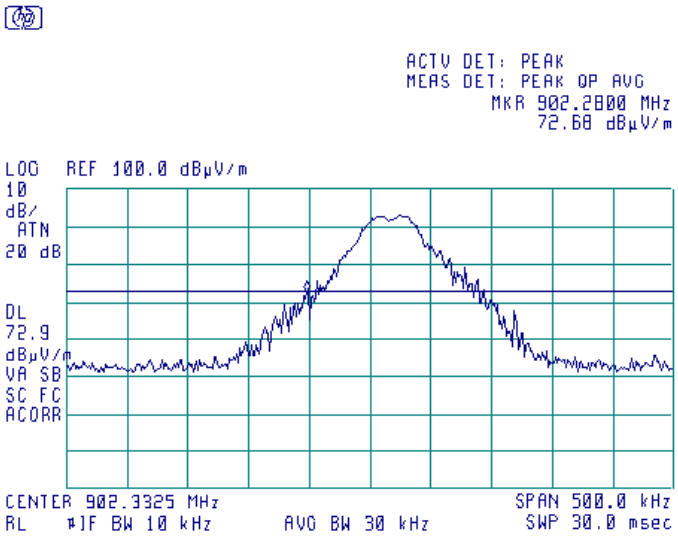
Full description is given in Appendix A.

Test specification:	Section 15.215(c), Occupied bandwidth		
Test procedure:	ANSI C63.4, Section 13.1.7		
Test mode:	Compliance	Verdict:	PASS
Date(s):	4/24/2012 - 4/24/2012		
Temperature: 23 ºC	Air Pressure: 1012 hPa	Relative Humidity: 49 %	Power Supply: Battery
Remarks:			

Plot 7.4.1 Occupied bandwidth test result at low frequency

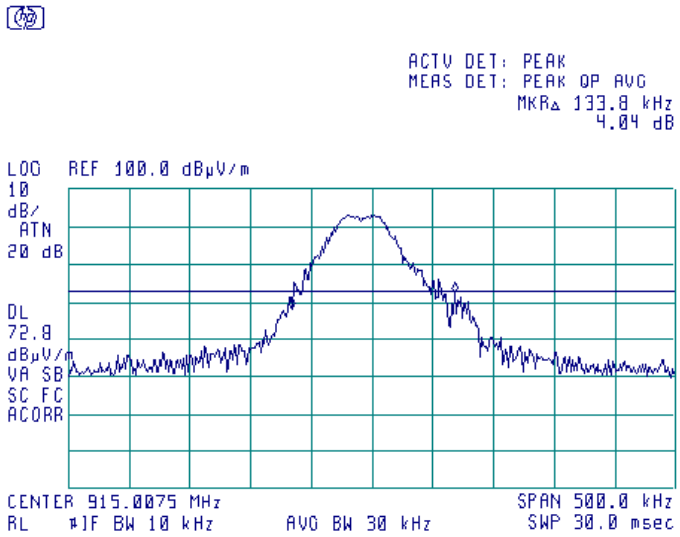


Plot 7.4.2 Occupied bandwidth test result at low channel, band edge



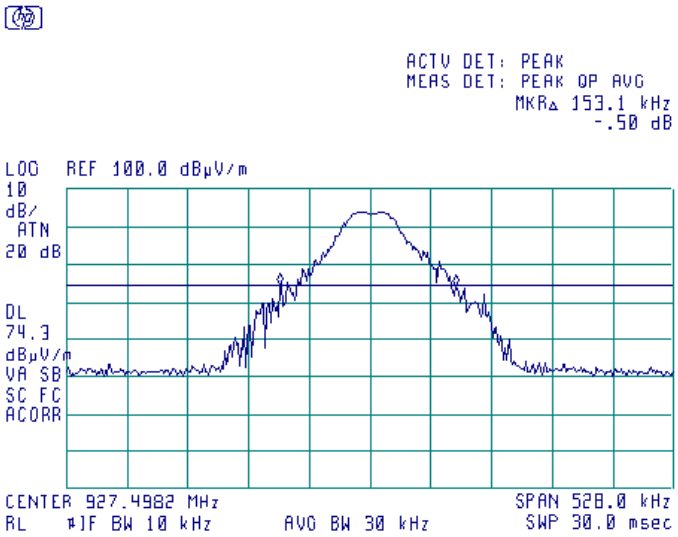
Test specification:	Section 15.215(c), Occupied bandwidth		
Test procedure:	ANSI C63.4, Section 13.1.7		
Test mode:	Compliance	Verdict:	PASS
Date(s):	4/24/2012 - 4/24/2012		
Temperature: 23 ºC	Air Pressure: 1012 hPa	Relative Humidity: 49 %	Power Supply: Battery
Remarks:			

Plot 7.4.3 Occupied bandwidth test result at mid frequency

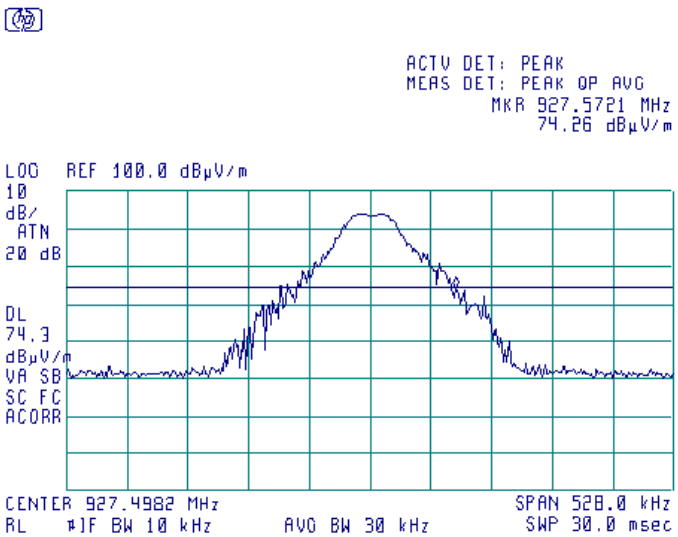


Test specification:	Section 15.215(c), Occupied bandwidth		
Test procedure:	ANSI C63.4, Section 13.1.7		
Test mode:	Compliance	Verdict:	PASS
Date(s):	4/24/2012 - 4/24/2012		
Temperature: 23 ºC	Air Pressure: 1012 hPa	Relative Humidity: 49 %	Power Supply: Battery
Remarks:			

Plot 7.4.4 Occupied bandwidth test result at high frequency



Plot 7.4.5 Occupied bandwidth test result at high channel, band edge



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):	4/25/2012		
Temperature: 23 ºC	Air Pressure: 1013 hPa	Relative Humidity: 48 %	Power Supply: Battery
Remarks:			

8 Unintentional radiation test according to 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 for measurements in semi-anechoic chamber

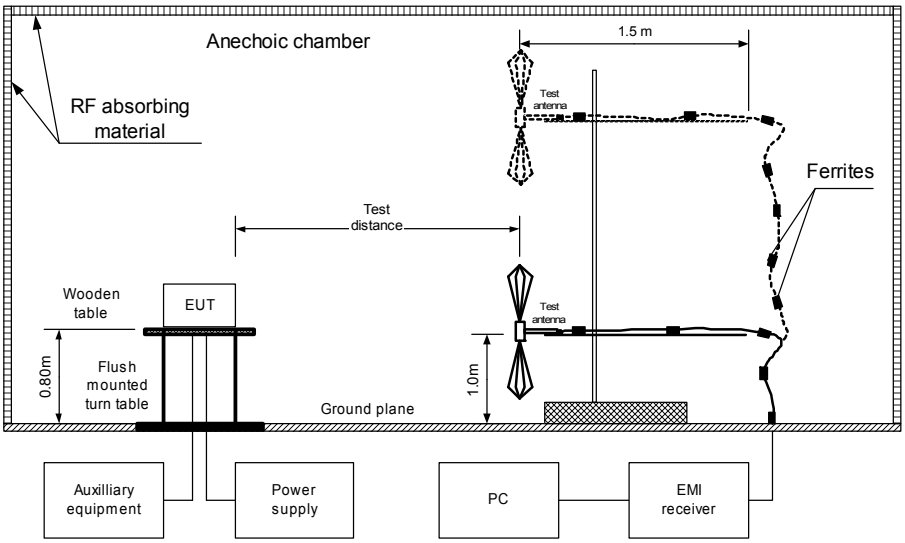
8.1.2.1 The EUT was set up as shown in Figure 8.1.1 and associated photograph/s, energized and the performance check was conducted.

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.

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):	4/25/2012		
Temperature: 23 ºC	Air Pressure: 1013 hPa	Relative Humidity: 48 %	Power Supply: Battery
Remarks:			

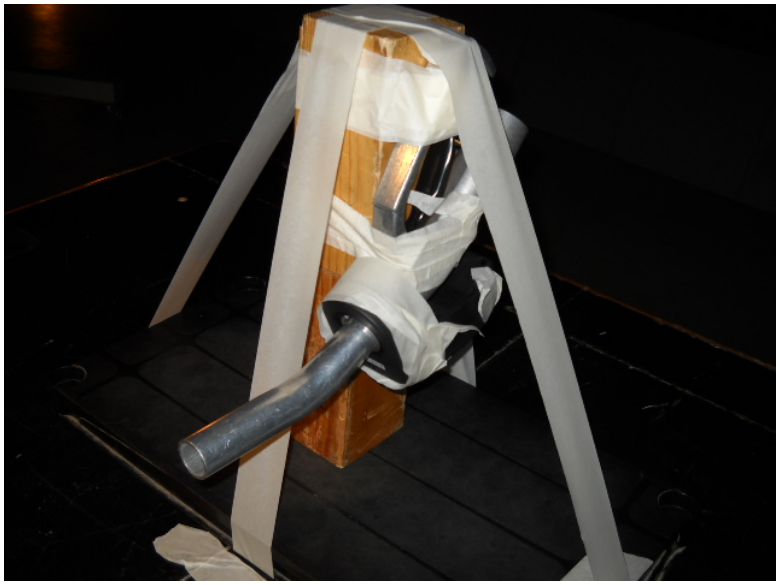
Figure 8.1.1 Setup for radiated emission measurements in anechoic chamber, table-top equipment



Photograph 8.1.1 Setup for radiated emission measurements, general view

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):	4/25/2012		
Temperature: 23 ºC	Air Pressure: 1013 hPa	Relative Humidity: 48 %	Power Supply: Battery
Remarks:			

Photograph 8.1.2 Setup for radiated emission measurements, EUT cabling



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):	4/25/2012		
Temperature: 23 ºC	**Air Pressure:** 1013 hPa	**Relative Humidity:** 48 %	**Power Supply:** Battery
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*				
56.750000	20.51	18.84	40.00	-21.16	Vertical	1.00	146	Pass

TEST SITE: SEMI ANECHOIC CHAMBER
TEST DISTANCE: 3 m
DETECTORS USED: PEAK / AVERAGE
FREQUENCY RANGE: 1000 MHz – 2900 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 emission was found										Pass

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

Reference numbers of test equipment used

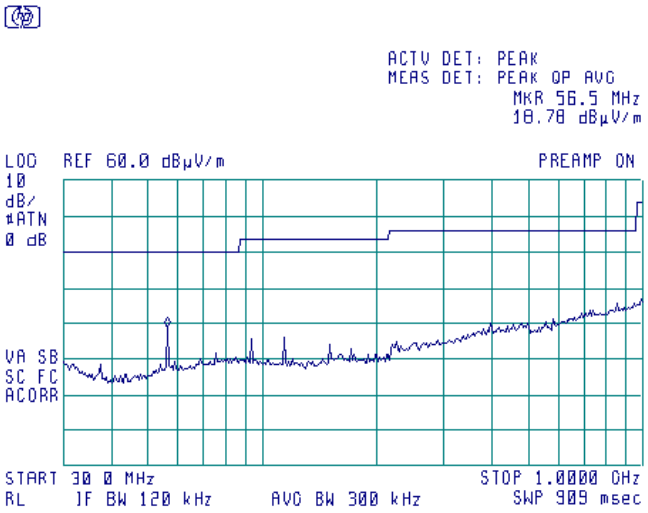
HL 0446	HL 0521	HL 0593	HL 0594	HL 0604	HL 2432	HL 2871	HL 2909
HL 3622							

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):	4/25/2012		
Temperature: 23 ºC	Air Pressure: 1013 hPa	Relative Humidity: 48 %	Power Supply: Battery
Remarks:			

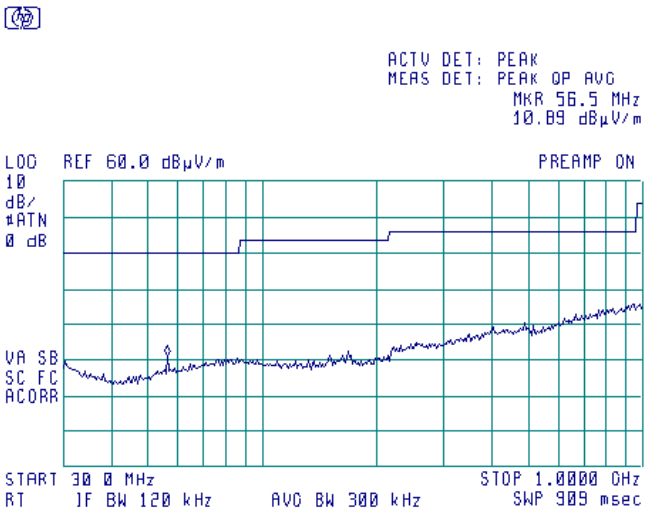
Plot 8.1.1 Radiated emission measurements in 30 - 1000 MHz range, vertical antenna polarization

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



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

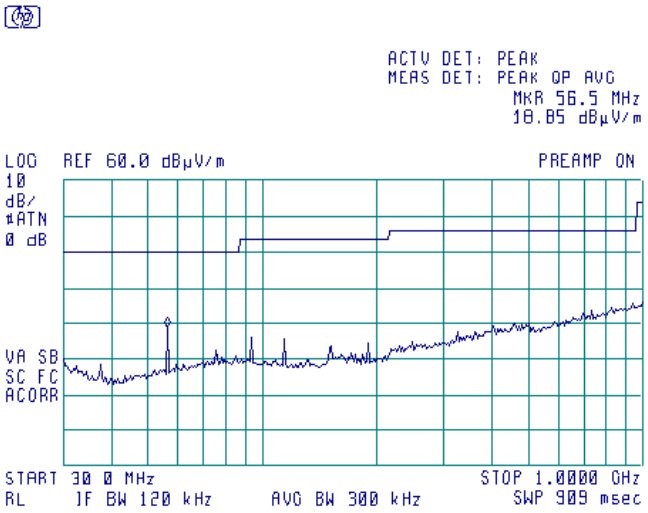
TEST SITE: Semi anechoic chamber
LIMIT: Class B
TEST DISTANCE: 3 m
EUT OPERATING MODE: Receive
EUT FREQUENCY: Low



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):	4/25/2012		
Temperature: 23 ºC	Air Pressure: 1013 hPa	Relative Humidity: 48 %	Power Supply: Battery
Remarks:			

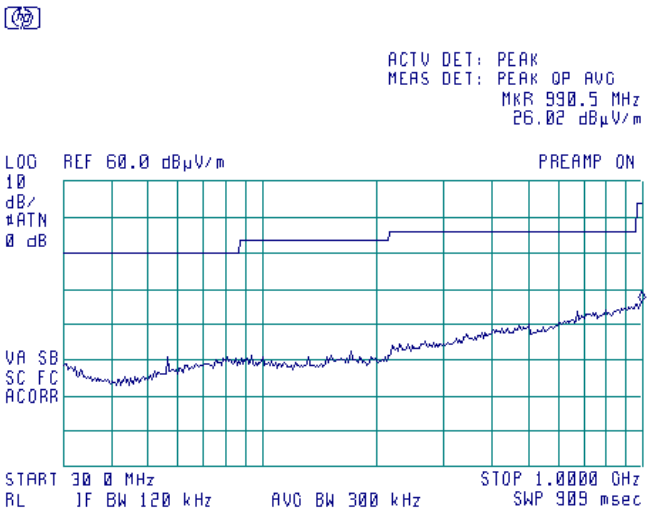
Plot 8.1.3 Radiated emission measurements in 30 - 1000 MHz range, vertical antenna polarization

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



Plot 8.1.4 Radiated emission measurements in 30 - 1000 MHz range, horizontal antenna polarization

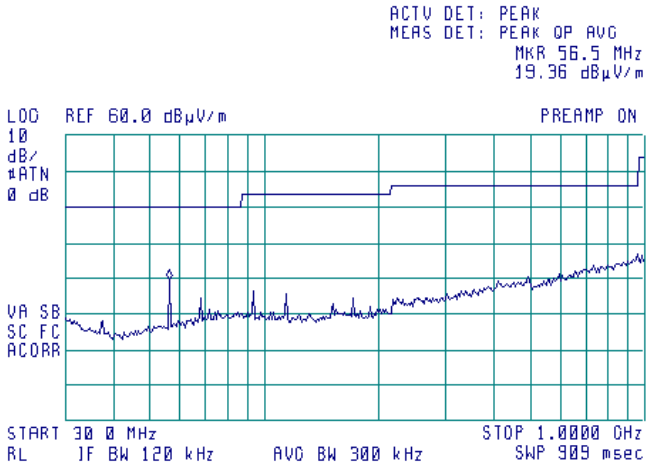
TEST SITE: Semi anechoic chamber
LIMIT: Class B
TEST DISTANCE: 3 m
EUT OPERATING MODE: Receive
EUT FREQUENCY: Mid



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):	4/25/2012		
Temperature: 23 ºC	Air Pressure: 1013 hPa	Relative Humidity: 48 %	Power Supply: Battery
Remarks:			

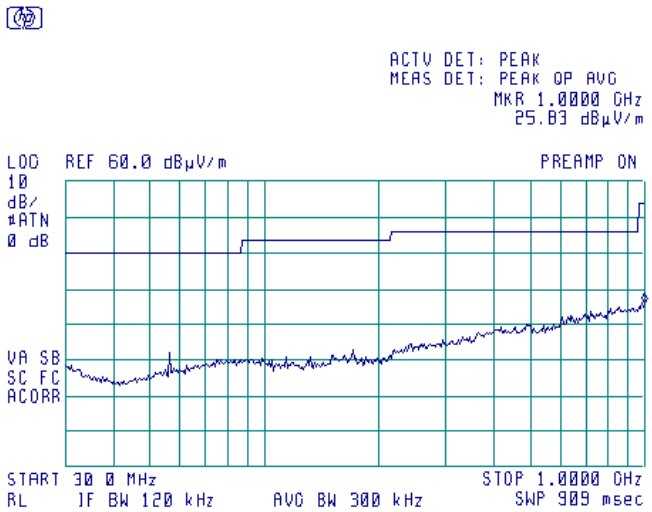
Plot 8.1.5 Radiated emission measurements in 30 - 1000 MHz range, vertical antenna polarization

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



Plot 8.1.6 Radiated emission measurements in 30 - 1000 MHz range, horizontal antenna polarization

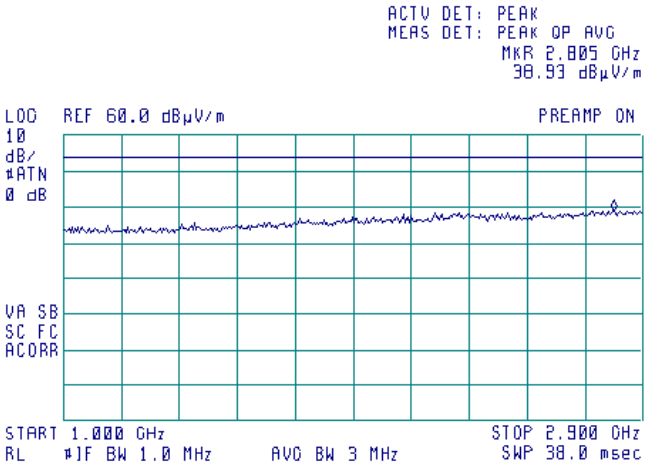
TEST SITE:	Semi anechoic chamber
LIMIT:	Class B
TEST DISTANCE:	3 m
EUT OPERATING MODE:	Receive
EUT FREQUENCY:	High



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):	4/25/2012		
Temperature: 23 ºC	Air Pressure: 1013 hPa	Relative Humidity: 48 %	Power Supply: Battery
Remarks:			

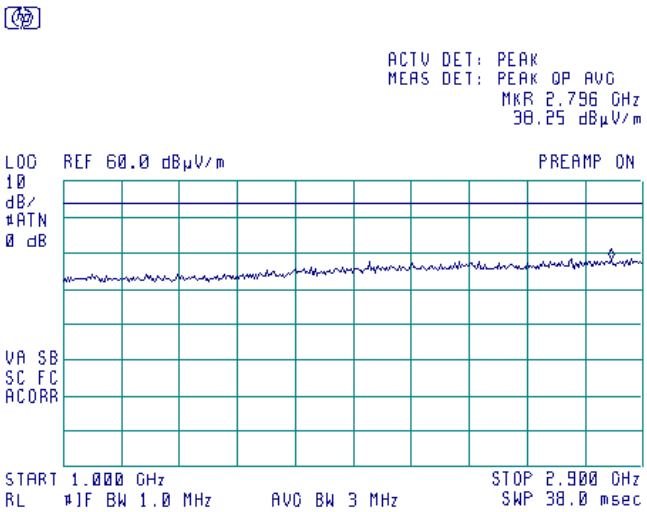
Plot 8.1.7 Radiated emission measurements above 1000 MHz, vertical antenna polarization

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



Plot 8.1.8 Radiated emission measurements above 1000 MHz, horizontal antenna polarization

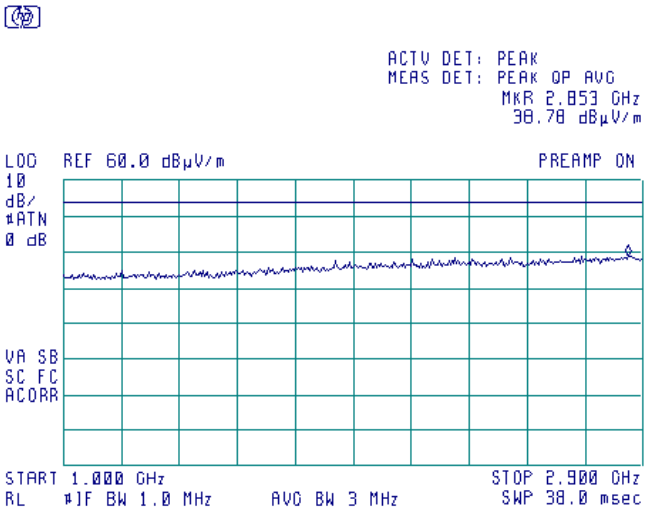
TEST SITE:	Semi anechoic chamber
LIMIT:	Class B
TEST DISTANCE:	3 m
EUT OPERATING MODE:	Receive
EUT FREQUENCY:	Low



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):	4/25/2012		
Temperature: 23 ºC	Air Pressure: 1013 hPa	Relative Humidity: 48 %	Power Supply: Battery
Remarks:			

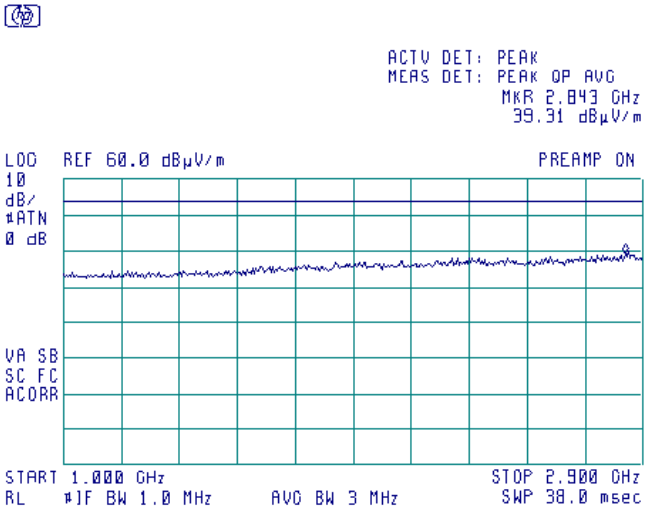
Plot 8.1.9 Radiated emission measurements above 1000 MHz, vertical antenna polarization

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



Plot 8.1.10 Radiated emission measurements above 1000 MHz, horizontal antenna polarization

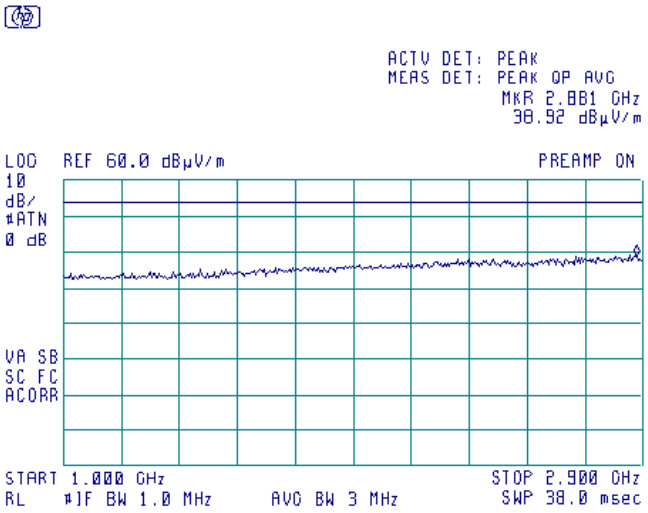
TEST SITE: Semi anechoic chamber
LIMIT: Class B
TEST DISTANCE: 3 m
EUT OPERATING MODE: Receive
EUT FREQUENCY: Mid



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):	4/25/2012		
Temperature: 23 ºC	Air Pressure: 1013 hPa	Relative Humidity: 48 %	Power Supply: Battery
Remarks:			

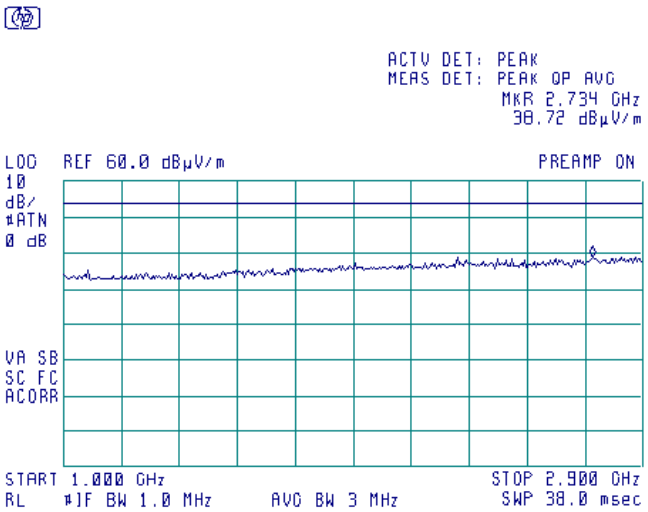
Plot 8.1.11 Radiated emission measurements above 1000 MHz, vertical antenna polarization

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



Plot 8.1.12 Radiated emission measurements above 1000 MHz, horizontal antenna polarization

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



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-11	03-Jul-12
0521	EMI Receiver (Spectrum Analyzer) with RF filter section 9 kHz-6.5 GHz	Hewlett Packard	8546A	3617A 00319, 3448A002 53	29-Aug-11	29-Sep-12
0593	Antenna Mast, 1-4 m Pneumatic	Madgesh	AM-F1	101	05-Feb-12	05-Feb-13
0594	Turn Table FOR ANECHOIC CHAMBER flush mount d=1.2 m Pneumatic	Hermon Laboratories	TT-WDC1	102	16-Oct-11	16-Oct-12
0604	Antenna BiconiLog Log-Periodic/T Bow-TIE, 26 - 2000 MHz	EMCO	3141	9611-1011	11-Jan-11	11-Jan-13
2432	Antenna, Double-Ridged Waveguide Horn 1-18 GHz	EMC Test Systems	3115	00027177	25-Nov-11	25-Nov-12
2871	Microwave Cable Assembly, 18 GHz, 6.4 m, SMA - SMA	Huber-Suhner	198-8155-00	2871	15-Jan-12	15-Jan-13
2909	Spectrum analyzer, ESA-E, 100 Hz to 26.5 GHz	Agilent Technologies	E4407B	MY41444762	08-May-12	08-May-13
3617	Cable RF, 6.5 m, N type-N type, DC-6.5 GHz	Suhner Switzerland	RG 214/U	NA	19-May-11	19-May-12
3622	Cable RF, 6.0 m, N type-N type, DC-6.5 GHz	Alpha Wire	RG 214/U	NA	09-May-12	09-May-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
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
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 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 strength 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
Cable coaxial, RG-214/U, N type-N type, 6.5 m
Suhner Switzerland, HL 3617

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	0.13	2200	2.97	4500	5.10
50	0.33	2300	3.06	4600	5.20
100	0.48	2400	3.16	4700	5.34
200	0.71	2500	3.23	4800	5.36
300	0.89	2600	3.34	4900	5.48
400	1.04	2700	3.42	5000	5.52
500	1.19	2800	3.52	5100	5.61
600	1.32	2900	3.61	5200	5.72
700	1.44	3000	3.69	5300	5.81
800	1.56	3100	3.80	5400	5.93
900	1.68	3200	3.86	5500	6.08
1000	1.80	3300	3.98	5600	6.12
1100	1.90	3400	4.07	5700	6.25
1200	2.00	3500	4.14	5800	6.31
1300	2.11	3600	4.27	5900	6.41
1400	2.21	3700	4.36	6000	6.51
1500	2.30	3800	4.47	6100	6.62
1600	2.40	3900	4.62	6200	6.73
1700	2.49	4000	4.63	6300	6.86
1800	2.61	4100	4.76	6400	6.94
1900	2.69	4200	4.83	6500	7.06
2000	2.79	4300	4.89		
2100	2.88	4400	5.04		

Cable loss
Cable coaxial, RG-214/U, N type-N type, 6 m
Alpha Wire, HL 3622

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	0.13	2100	2.95	4400	4.99
30	0.24	2200	2.99	4500	5.00
50	0.32	2300	3.11	4600	5.17
100	0.47	2400	3.16	4700	5.18
200	0.70	2500	3.31	4800	5.33
300	0.88	2600	3.36	4900	5.34
400	1.05	2700	3.46	5000	5.50
500	1.21	2800	3.52	5100	5.56
600	1.36	2900	3.65	5200	5.76
700	1.49	3000	3.70	5300	5.76
800	1.63	3100	3.82	5400	5.85
900	1.72	3200	3.88	5500	5.88
1000	1.84	3300	3.99	5600	5.96
1100	1.96	3400	4.08	5700	6.02
1200	2.06	3500	4.19	5800	6.06
1300	2.15	3600	4.28	5900	6.14
1400	2.28	3700	4.42	6000	6.17
1500	2.35	3800	4.40	6100	6.28
1600	2.43	3900	4.51	6200	6.36
1700	2.57	4000	4.62	6300	6.47
1800	2.62	4100	4.70	6400	6.51
1900	2.75	4200	4.78	6500	6.65
2000	2.80	4300	4.83		

14 APPENDIX F Abbreviations and acronyms

A	ampere
AC	alternating current
A/m	ampere per meter
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