HERMON LABORATORIES

ELECTRICAL TESTING
0839.01

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TEST REPORT

ACCORDING TO: FCC Part 90 Subpart I, Part 15 subpart B class B

FOR:

NextNav LLC
WAPS Beacon LBS System
Part number: 100-0007-01
FCC ID:A4P-100-0007-01

Table of contents

1 Applicant information

Client name:	NextNav LLC
Address:	484 Oakmead Pkwy, Sunnyvale, CA, 94085
Telephone:	001-800-775-0982
E-mail:	subbu@nextnav.com
Contact name:	Mr. Subbu Meiyappan

2 Equipment under test attributes

Product name:	WAPS Beacon LBS System
Part number:	100-0007-01
Serial number:	0000001
Hardware version:	Rev A
Software release:	1.17
Receipt date	7/22/2012

3 Manufacturer information

Manufacturer name:	NextNav LLC
Address:	484 Oakmead Pkwy, Sunnyvale, CA, 94085
Telephone:	001-800-775-0982
E-mail:	anarayan@nextnav.com
Contact name:	Mr. Arun Narayan

4 Test details

Project ID:	23128
Location:	Hermon Laboratories Ltd. Harakevet Industrial Zone, Binyamina 30500, Israel
Test started:	7/22/2012
Test completed:	9/05/2012
Test specification(s):	FCC part 90 subpart I, part 15 subpart B class B

5 Tests summary

Test	Status
Transmitter characteristics	
Section 90.205, Maximum output power	Pass
Section 90.209, Occupied bandwidth	Pass
Section 90.210, Emission mask	Pass
Section 90.210, Radiated spurious emissions	Pass
Section 90.210, Conducted spurious emissions	Pass
Section 90.213, Frequency stability	Pass
Section 90.214, Transient frequency behaviour	Not required
Section 2.1091, RF radiation exposure evaluation	Pass, exhibit provided in Application for certification
Unintentional emissions	
Section 15.107, Conducted emission at AC power port	Pass
Section 15.109, Radiated emission	Pass

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

This test report supersedes the previously issued test report identified by Doc ID:KARRAD_FCC.23128.

	Name and Title	Date	Signature
Tested by:	Mr. S.Samokha, test engineer	September 5, 2012	
Reviewed by:	Mrs. M. Cherniavsky, certification engineer	November 18, 2012	
Approved by:	Mr. M. Nikishin, EMC and Radio group leader	November 18, 2012	

6 EUT description

6.1 General information

The EUT, WAPS Beacon, is an M -LMS band LBS transmitter powered from 48 VDC delivered via DC power + Ethernet cable.

6.2 Ports and lines

Port type	Port description	Connected from	Connected to	Qty.	Cable type	Cable length, m
Power+ telecom	DC Power + Ethernet	EUT (Master)	Power system	1	Shielded	10
RF IN	GPS IN (GPS MSTR)	EUT (Tx Switch)	EUT (Master)	1	Coax	0.5
RF OUT	RF OUT	EUT (Master)	EUT (Tx Switch)	1	Coax	0.5
Signal	TXSW MSTR	EUT (Master)	EUT (Tx Switch)	1	Shielded	0.5
Signal	RB MSTR	EUT (Master)	EUT (Clock)	1	Shielded	0.5
RF OUT	Antenna	EUT (Tx Switch)	Attenuator 40 dB	1	Coax	3
Signal	WB I/F	EUT (Tx Switch)	Weather Box	1	Shielded	30

6.3 Support and test equipment

Description	Manufacturer	Model number	Serial number
Power system	Charles	RL1003NN	SO#727541
Weather box	NextNav	Rev1.1	24
Spectrum analyzer	Anritsu	MS2601B	NA
Power supply	Mean Well	SP-500-48	RB00085918

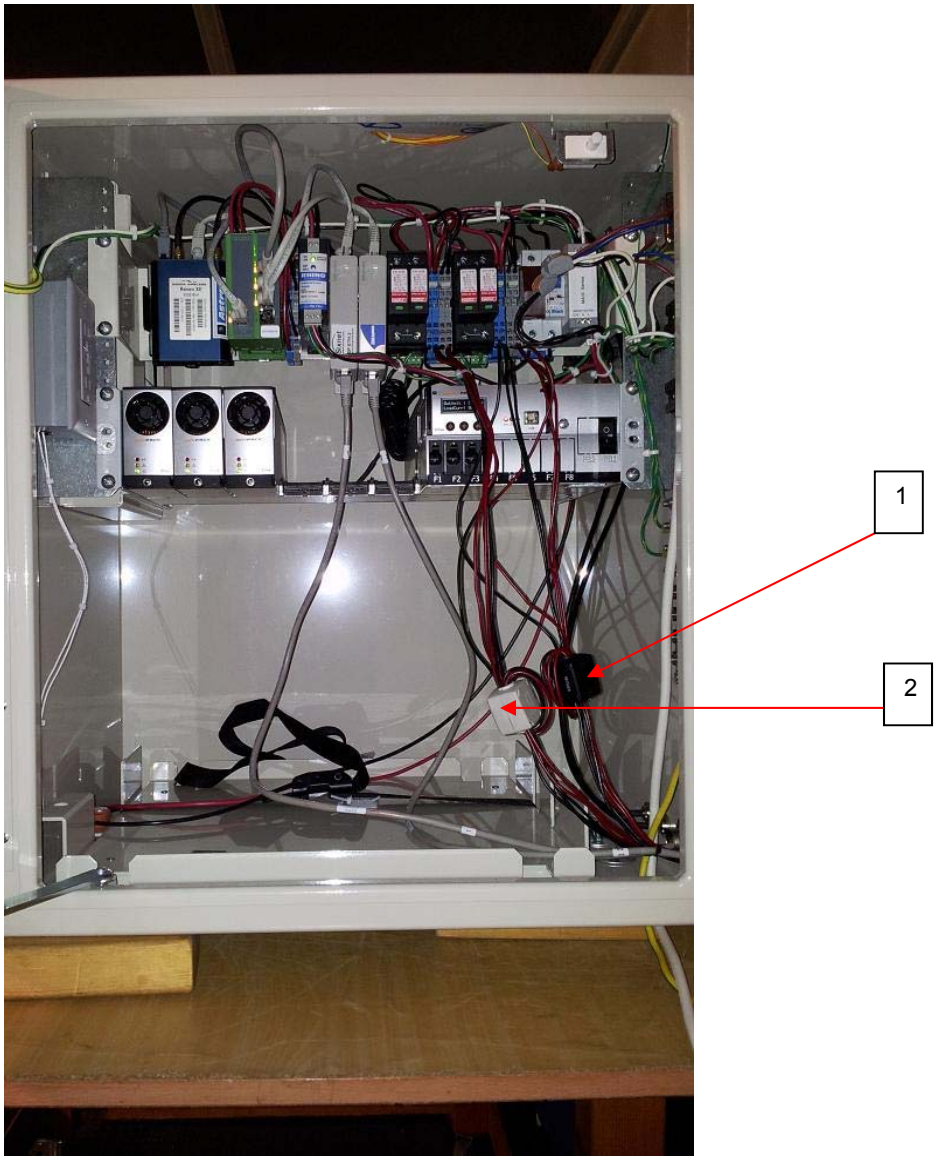
6.4 Operating frequencies

Source	Frequency, MHz	
Tx	919.75 – 927.25	
LO	926.227	
Clock	81.84	10

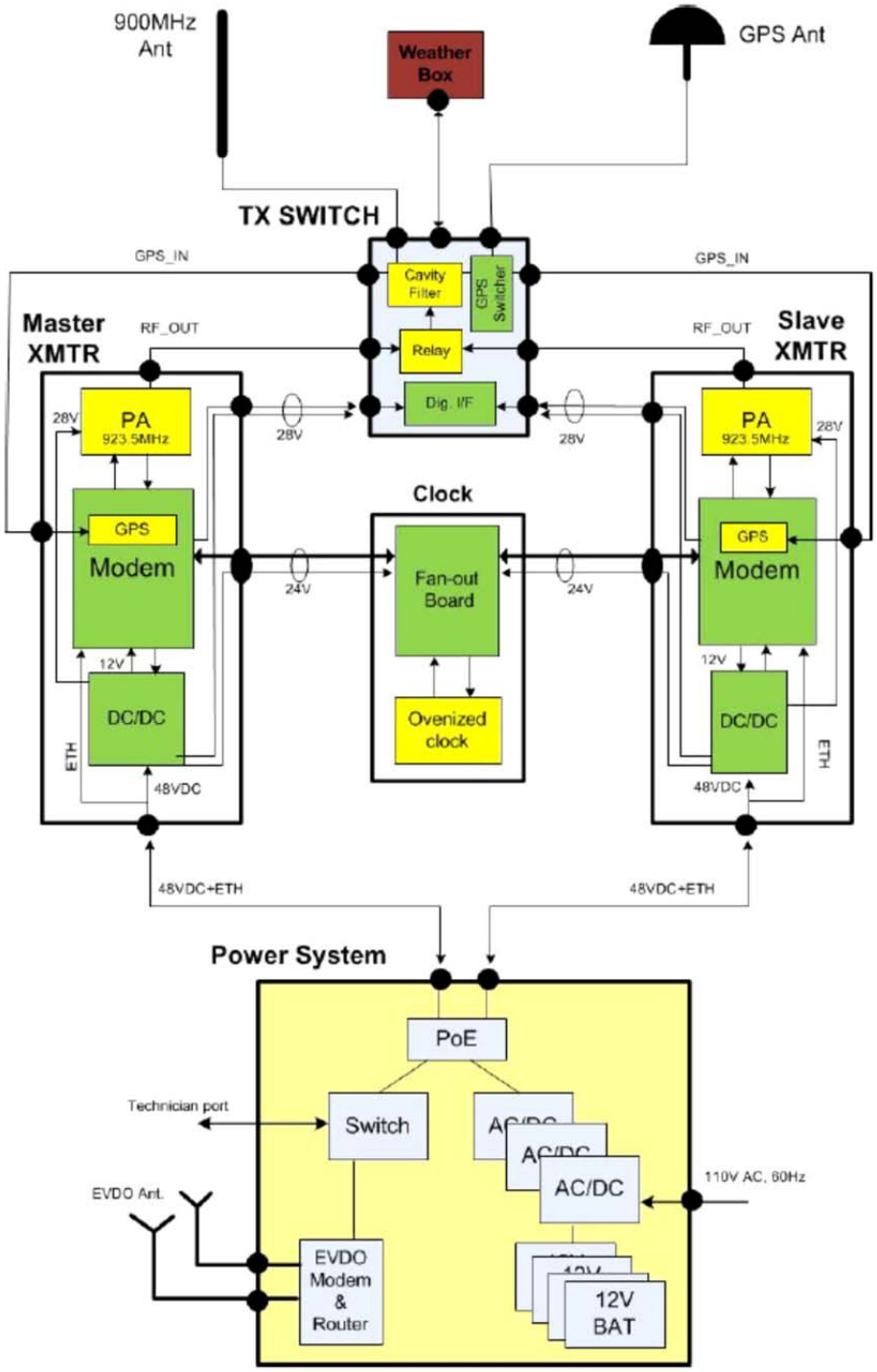
6.5 Changes made in EUT

The following changes we implemented in the EUT during testing:
1) One ferrite bead, P/N 74271222S, produced by Wurth Electronics was added at the Master DC harness from Panel Power connector (20 cm from connector) to 48 VDC terminal blocks as shown in attached photograph.
2) One ferrite bead, P/N 74271222, produced by Wurth Electronics was added at the Slave DC harness from Panel Power connector (20 cm from connector) to 48 VDC terminal blocks as shown in attached photograph.
It is manufacturer responsibility to implement the change in the production version of the EUT. In any case the test report applies to the tested item only.

Photograph 6.5.1 Changes made in the EUT



6.6 EUT block diagram



6.7 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**
V	fixed	Always at a distance more than 2 m from all people
	mobile	Always at a distance more than 20 cm from all people
	portable	May operate at a distance closer than 20 cm to human body

Assigned frequency range	902.0 – 928.0 MHz
Operating frequency range	919.75 – 927.25 MHz for 2.046 MHz OBW
RF channel spacing	2.046 MHz

Maximum rated output power	At transmitter 50 Ω RF output connector	44.48 dBm
	EIRP density dBm / MHz (aggregate power of both RF chains) with maximum declared antenna gain	NA

Is transmitter output power variable?		No		
	V	Yes		continuous variable
			V	stepped variable with stepsize 1.0 dB
			minimum RF power	0 dBm
			maximum RF power	44.48 dBm

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

Antenna/s technical characteristics					
Type	Manufacturer	Model number	Antenna gain	Feeder loss	Antenna assembly gain*
Omni-Directional	Amphenol Antel, Inc	BCD-8707	6.5 dBd	6.5 dB	0 dBd

Transmitter aggregate data rate/s, Mbps		
Transmitter 99% power bandwidth	Type of modulation	Bit rate, bps
2.046 MHz	BPSK	100

Type of multiplexing	TDD
Modulating test signal (baseband)	PRBS
Maximum transmitter duty cycle in normal use	20%

Transmitter power source			
V	DC	Nominal rated voltage	48 VDC (via PoE powered by 120 VAC)
	AC	Nominal rated voltage	

Common power source for transmitter and receiver	V	no

***-** the manufacturer statement provided on page 5 of WAPS Beacon NOC User Manual,
Document No: JGR-NN-OP-102.00-Rev1.0 (exhibit ‘User_manual_23182” of Application for certification)

Test specification:	Section 90.205, Maximum output power		
Test procedure:	47 CFR, Section 2.1046; TIA/EIA-603-A, Section 2.2.1		
Test mode:	Compliance	Verdict:	PASS
Date(s):	7/22/2012		
Temperature: 24.2 ºC	Air Pressure: 1004 hPa	Relative Humidity: 46 %	Power Supply: 48VDC
Remarks:			

7 Transmitter tests according to 47CFR part 90 requirements

7.1 Effective radiated power of carrier

7.1.1 General

This test was performed to measure the peak output power at RF antenna connector. Specification test limits are given in Table 7.1.1.

Table 7.1.1 Effective radiated power limit

Assigned frequency range, MHz	ERP	
	W	dBm
919.75 – 927.25	30.0	44.77

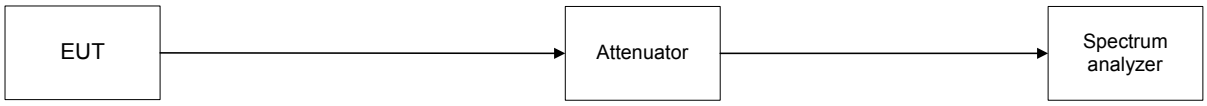
7.1.2 Test procedure

7.1.2.1 The EUT was set up as shown in Figure 7.1.1, energized and its proper operation was checked.

7.1.2.2 The EUT was adjusted to produce maximum available to the end user RF output power.

7.1.2.3 The peak output power was measured with spectrum analyzer as provided in Table 7.1.2 and the associated plots.

Figure 7.1.1 Output power test setup



Test specification:	Section 90.205, Maximum output power		
Test procedure:	47 CFR, Section 2.1046; TIA/EIA-603-A, Section 2.2.1		
Test mode:	Compliance	Verdict:	PASS
Date(s):	7/22/2012		
Temperature: 24.2 ºC	Air Pressure: 1004 hPa	Relative Humidity: 46 %	Power Supply: 48VDC
Remarks:			

Table 7.1.2 Peak output power test results

OPERATING FREQUENCY RANGE: 919.75 – 927.25 MHz
DETECTOR USED: Peak
RESOLUTION BANDWIDTH: 8 MHz
VIDEO BANDWIDTH: 50 MHz
MODULATION: BPSK
MODULATING SIGNAL: PRBS
BIT RATE: 50 bps
TRANSMITTER OUTPUT POWER SETTINGS: Maximum

Carrier frequency, MHz	Spectrum analyzer reading, dBm	Attenuation, dB	Cable loss, dB	RF output power, dBm	Limit, dBm	Margin, dB	Verdict
920.773	44.31	Included	Included	44.31	44.77	-0.46	Pass
926.227	44.48	Included	Included	44.48	44.77	-0.29	Pass

* - Margin = RF output power – Specification limit

Table 7.1.3 ERP test results

OPERATING FREQUENCY RANGE: 919.75 – 927.25 MHz
DETECTOR USED: Peak
RESOLUTION BANDWIDTH: 8 MHz
VIDEO BANDWIDTH: 50 MHz
MODULATION: BPSK
MODULATING SIGNAL: PRBS
BIT RATE: 50 bps
TRANSMITTER OUTPUT POWER SETTINGS: Maximum

Carrier frequency, MHz	Spectrum analyzer reading, dBm	Antenna gain, dBd	Feeder loss, dB	ERP, dBm	Limit, dBm	Margin, dB**	Verdict
920.773	44.31	6.5	6.5	44.31	44.77	-0.46	Pass
926.227	44.48	6.5	6.5	44.48	44.77	-0.29	Pass

* - RF output power = SA reading + Antenna gain – Feeder loss
** - Margin = RF output power – Specification limit

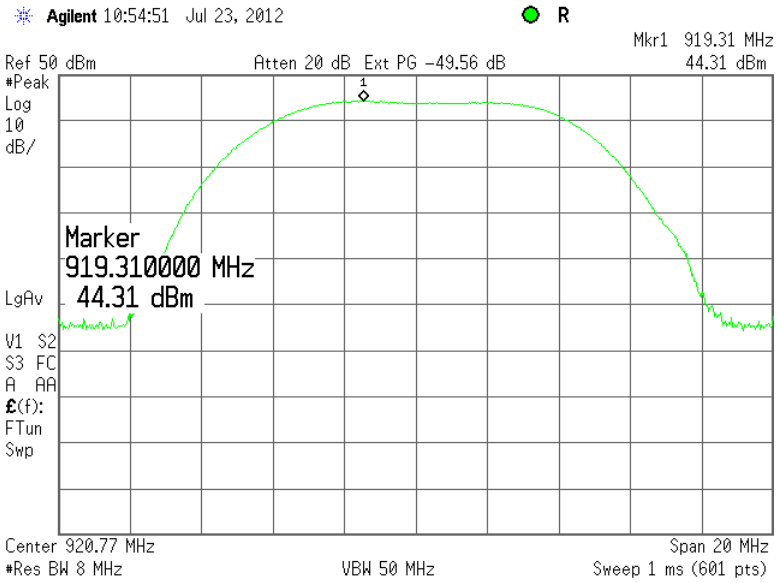
Reference numbers of test equipment used

HL 1876	HL 2991	HL 3768	HL 3776	HL 3818	HL 3903		

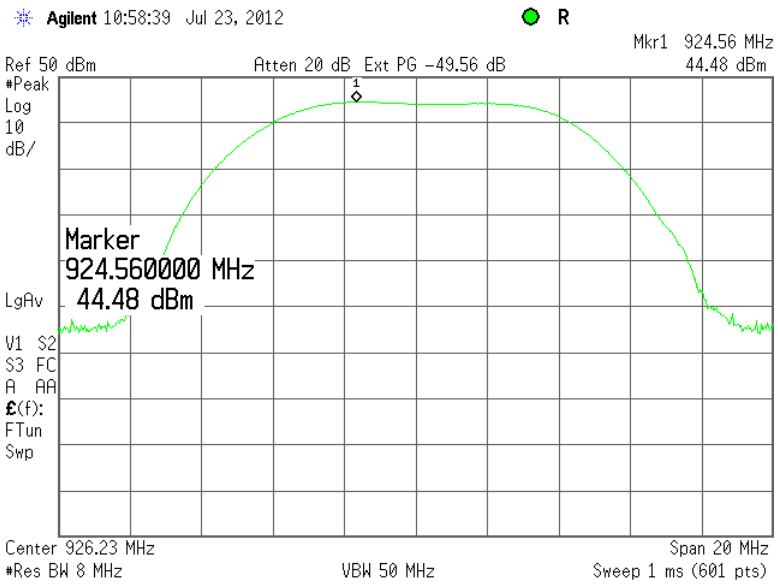
Full description is given in Appendix A.

Test specification:	Section 90.205, Maximum output power		
Test procedure:	47 CFR, Section 2.1046; TIA/EIA-603-A, Section 2.2.1		
Test mode:	Compliance	Verdict:	PASS
Date(s):	7/22/2012		
Temperature: 24.2 °C	Air Pressure: 1004 hPa	Relative Humidity: 46 %	Power Supply: 48VDC
Remarks:			

Plot 7.1.1 Peak output power test results at low frequency



Plot 7.1.2 Peak output power test results at high frequency



Test specification:	Section 90.209, Occupied bandwidth		
Test procedure:	47 CFR, Section 2.1049		
Test mode:	Compliance	Verdict:	PASS
Date(s):	7/22/2012		
Temperature: 24.2 ºC	Air Pressure: 1004 hPa	Relative Humidity: 46 %	Power Supply: 48 VDC
Remarks:			

7.2 Occupied bandwidth test

7.2.1 General

This test was performed to measure transmitter occupied bandwidth. Specification test limits are given in Table 7.2.1.

Table 7.2.1 Occupied bandwidth limits

Assigned frequency, MHz	Modulation envelope reference points*, %	Maximum allowed bandwidth, kHz
919.75 – 927.75	99%	2000

* - Modulation envelope reference points are provided in terms of attenuation below the unmodulated carrier.

7.2.2 Test procedure

7.2.2.1 The EUT was set up as shown in Figure 7.2.1, energized and its proper operation was checked.

7.2.2.2 The EUT was set to transmit the unmodulated carrier and the reference peak power level was measured.

7.2.2.3 The EUT was set to transmit the normally modulated carrier.

7.2.2.4 The transmitter occupied bandwidth was measured with spectrum analyzer as a frequency delta between the reference points on modulation envelope and provided in Table 7.2.2 and the associated plots.

Figure 7.2.1 Occupied bandwidth test setup

Test specification:	**Section 90.209, Occupied bandwidth**		
Test procedure:	47 CFR, Section 2.1049		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	7/22/2012		
Temperature: 24.2 ºC	**Air Pressure:** 1004 hPa	**Relative Humidity:** 46 %	**Power Supply:** 48 VDC
Remarks:			

Table 7.2.2 Occupied bandwidth test results

DETECTOR USED:	Peak
RESOLUTION BANDWIDTH:	30 kHz
VIDEO BANDWIDTH:	100 kHz
MODULATION ENVELOPE REFERENCE POINTS:	99%
MODULATION:	BPSK
MODULATING SIGNAL:	PRBS
BIT RATE:	50 bps

Carrier frequency, MHz	Occupied bandwidth, kHz	Limit, kHz	Margin, kHz	Verdict
920.773	1616.3	2000	-383.7	Pass
926.227	1576.9	2000	-423.1	Pass

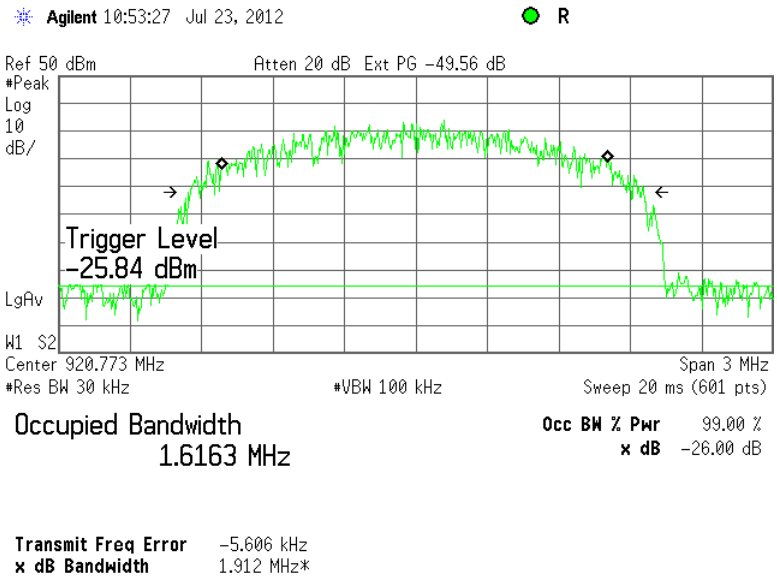
Reference numbers of test equipment used

HL 1876	HL 2991	HL 3768	HL 3776	HL 3818			

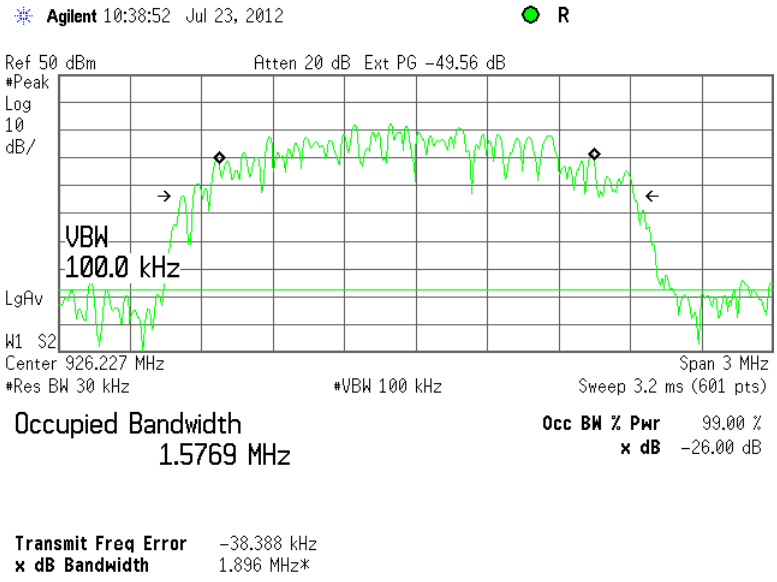
Full description is given in Appendix A.

Test specification:	Section 90.209, Occupied bandwidth		
Test procedure:	47 CFR, Section 2.1049		
Test mode:	Compliance	Verdict:	PASS
Date(s):	7/22/2012		
Temperature: 24.2 °C	Air Pressure: 1004 hPa	Relative Humidity: 46 %	Power Supply: 48 VDC
Remarks:			

Plot 7.2.1 Occupied bandwidth test result at low frequency



Plot 7.2.2 Occupied bandwidth test result at high frequency



Test specification:	Section 90.210, Emission mask		
Test procedure:	47 CFR, Sections 2.1051, 2.1047 and 90.210(m); TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date(s):	7/23/2012		
Temperature: 24.1 ºC	Air Pressure: 1006 hPa	Relative Humidity: 43 %	Power Supply: 48 VDC
Remarks:			

7.3 Emission mask test

7.3.1 General

This test was performed to measure emission mask at RF antenna connector. Specification test limits are given in Table 7.3.1.

Table 7.3.1 Emission mask limits

Frequency displacement from carrier,%	Attenuation below carrier, dBc
Emission mask K	
0 – 50	0
50 – 250	By following equation, but in no case less than 31dB: A = 16 + 0.4(D-50) + 10logB (attenuation greater than 66 dB is not required)
More than 250%	66.0

Where:

A = attenuation (in decibels) below the maximum permitted output power level;
D = displacement of the center frequency of the measurement bandwidth from the center frequency of the authorized sub-band, expressed as a percentage pf the authorized bandwidth B;
B = authorized bandwidth in megahertz.

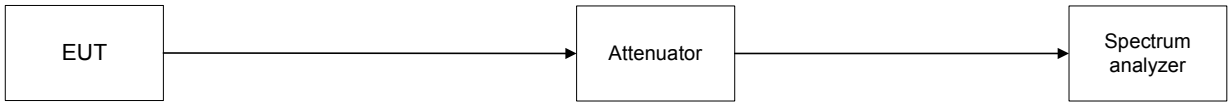
7.3.2 Test procedure

7.3.2.1 The EUT was set up as shown in Figure 7.3.1, energized and its proper operation was checked.

7.3.2.2 The emission mask was measured with spectrum analyzer as provided in the associated plots.

7.3.2.3 The test results provided in Table 7.3.2.

Figure 7.3.1 Emission mask test setup



Test specification:	**Section 90.210, Emission mask**		
Test procedure:	47 CFR, Sections 2.1051, 2.1047 and 90.210(m); TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	7/23/2012		
Temperature: 24.1 ºC	**Air Pressure:** 1006 hPa	**Relative Humidity:** 43 %	**Power Supply:** 48 VDC
Remarks:			

Table 7.3.2 Emission mask test results

Carrier frequency, MHz	Limit	Verdict
920.773	Emission mask K	Pass
926.227		

Reference numbers of test equipment used

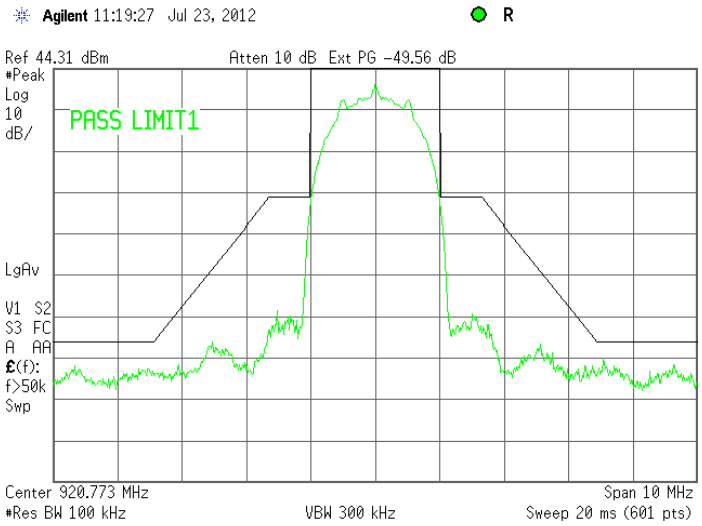
HL 1876	HL 2991	HL 3768	HL 3776	HL 3818	HL 3903		

Full description is given in Appendix A.

Test specification:	Section 90.210, Emission mask		
Test procedure:	47 CFR, Sections 2.1051, 2.1047 and 90.210(m); TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date(s):	7/23/2012		
Temperature: 24.1 ºC	Air Pressure: 1006 hPa	Relative Humidity: 43 %	Power Supply: 48 VDC
Remarks:			

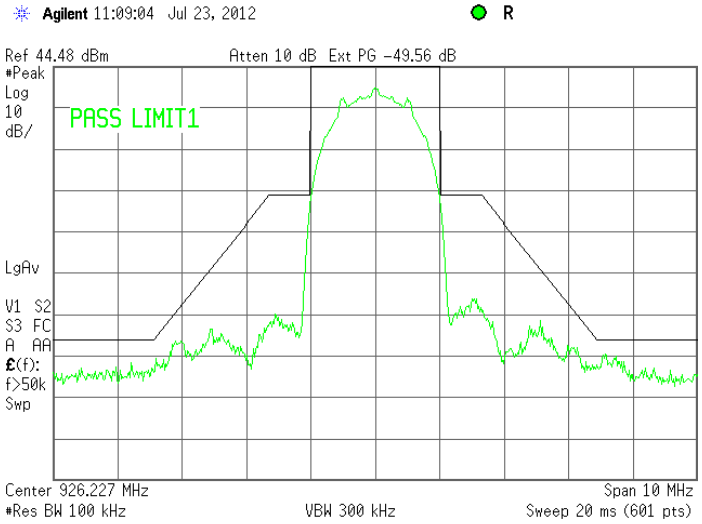
Plot 7.3.1 Emission mask test results at low carrier frequency

CARRIER FREQUENCY:	920.773 MHz
DETECTOR USED:	Peak
MODULATION:	BPSK
MODULATING SIGNAL:	PRBS
BIT RATE:	50 bps
TRANSMITTER OUTPUT POWER SETTINGS:	Maximum



Plot 7.3.2 Emission mask test results at high carrier frequency

CARRIER FREQUENCY:	926.227 MHz
DETECTOR USED:	Peak
MODULATION:	BPSK
MODULATING SIGNAL:	PRBS
BIT RATE:	50 bps
TRANSMITTER OUTPUT POWER SETTINGS:	Maximum



Test specification:	Section 90.210, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date(s):	7/23/2012		
Temperature: 23.8 ºC	Air Pressure: 1006 hPa	Relative Humidity: 42 %	Power Supply: 48 VDC
Remarks:			

7.4 Radiated spurious emission measurements

7.4.1 General

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

Table 7.4.1 Radiated spurious emission test limits

Frequency, MHz	Attenuation below carrier, dBc	ERP of spurious, dBm	Equivalent field strength limit @ 3m, dB(μV/m)**
0.009 – 10th harmonic*	66.0	The limit shall be taken from FCC part 90.210 Emission mask K	The limit shall be calculated

* - Excluding the in band emission within ± 250 % of the authorized bandwidth from the carrier

** - Equivalent field strength limit was calculated from maximum allowed ERP of spurious as follows: E=sqrt(30×P×1.64)/r, where P is ERP in Watts, 1.64 is numeric gain of ideal dipole and r is antenna to EUT distance in meters

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

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

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

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

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

7.4.3.1 The EUT was set up as shown in Figure 7.4.2, energized and the performance check was conducted.

7.4.3.2 The specified frequency range was investigated with antenna connected to spectrum analyzer. To find maximum radiation the turntable was rotated 360^0 and the measuring antenna height was swept from 1 to 4 m in both, vertical and horizontal, polarizations.

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

7.4.4 Test procedure for substitution ERP measurements of spurious

7.4.4.1 The test equipment was set up as shown in Figure 7.4.3 and energized.

7.4.4.2 RF signal generator was set to the frequency of investigated spurious emission and the RF output level was preliminary adjusted to produce the same field strength as it was measured from the EUT.

7.4.4.3 The test antenna height was swept from 1 to 4 m to find maximum emission from substitution antenna and RF signal generator output was fine adjusted to produce the same field strength as it was measured from the EUT.

7.4.4.4 The above procedure was performed in both, horizontal and vertical, polarizations of the test and substitution antennas.

7.4.4.5 The ERP of spurious emissions was calculated as a sum of signal generator output power in dBm and antenna gain in dBd reduced by cable loss in dB.

7.4.4.6 The above procedure was repeated at the rest of investigated frequencies.

7.4.4.7 The worst test results (the lowest margins) were recorded in Table 7.4.3 and shown in the associated plots.

Test specification:	Section 90.210, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date(s):	7/23/2012		
Temperature: 23.8 ºC	Air Pressure: 1006 hPa	Relative Humidity: 42 %	Power Supply: 48 VDC
Remarks:			

Figure 7.4.1 Setup for spurious emission field strength measurements in 9 kHz to 30 MHz band

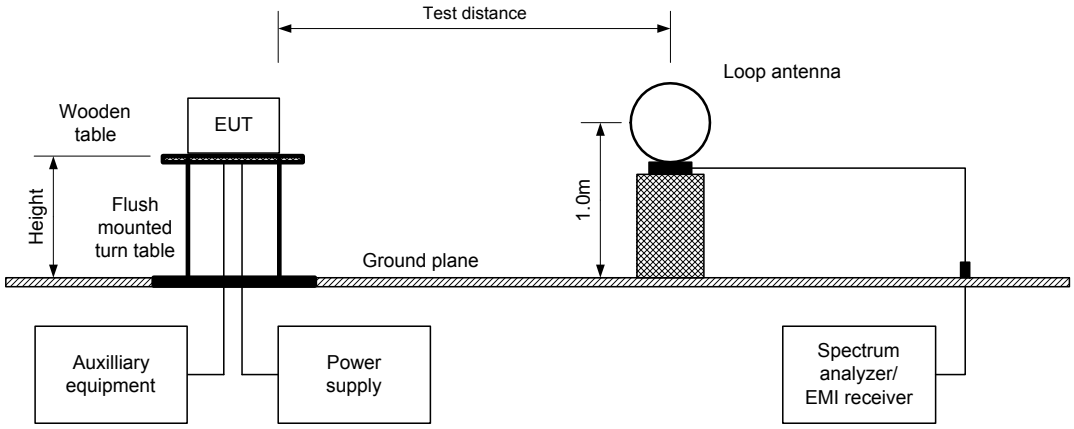
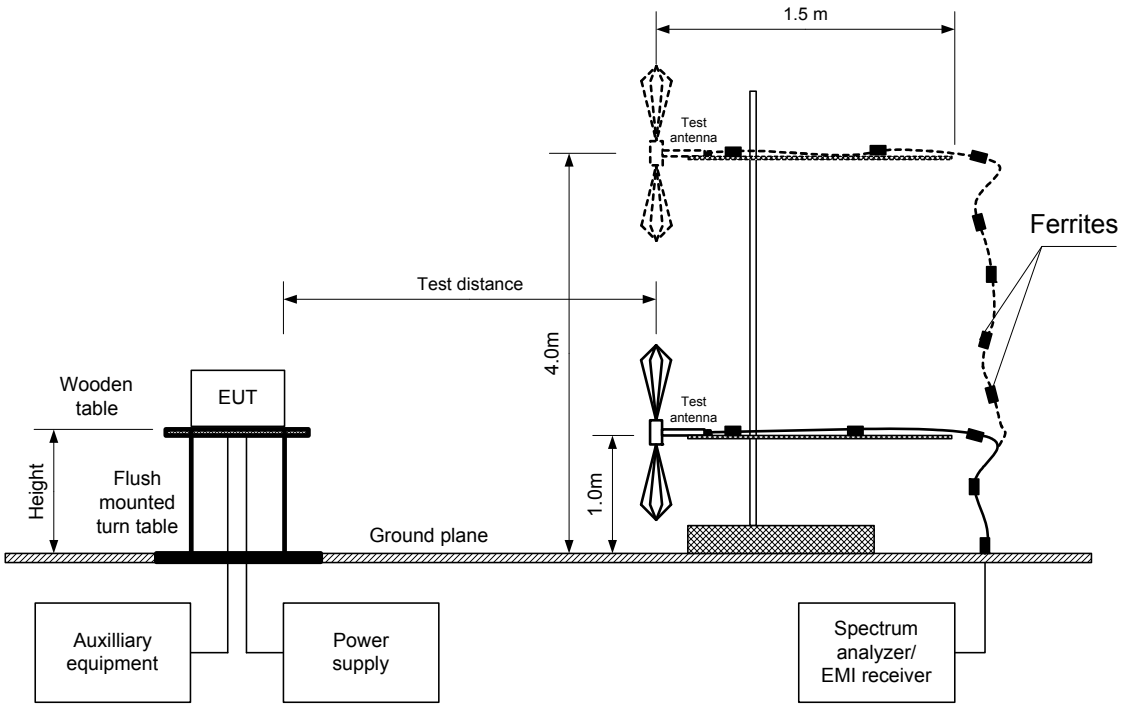
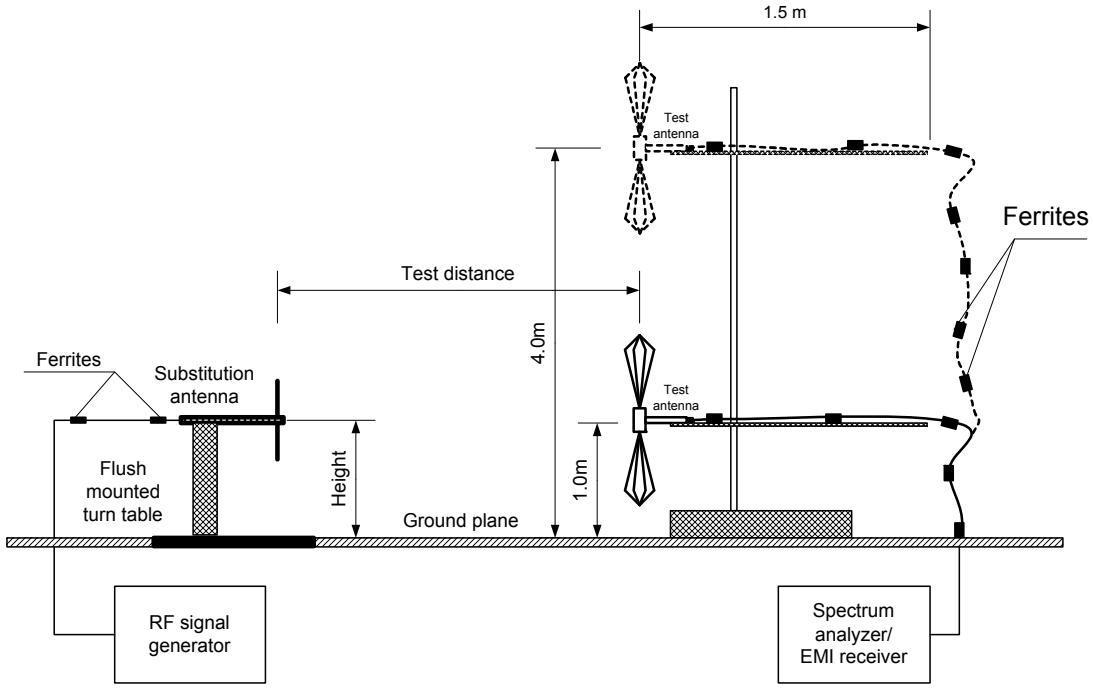


Figure 7.4.2 Setup for spurious emission field strength measurements above 30 MHz



Test specification:	Section 90.210, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date(s):	7/23/2012		
Temperature: 23.8 ºC	Air Pressure: 1006 hPa	Relative Humidity: 42 %	Power Supply: 48 VDC
Remarks:			

Figure 7.4.3 Setup for substitution ERP measurements of spurious



Test specification:	Section 90.210, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date(s):	7/23/2012		
Temperature: 23.8 ºC	Air Pressure: 1006 hPa	Relative Humidity: 42 %	Power Supply: 48 VDC
Remarks:			

Table 7.4.2 Spurious emission field strength test results

ASSIGNED FREQUENCY RANGE: 919.75 – 927.25 MHz
TEST DISTANCE: 3 m
TEST SITE: Semi anechoic chamber
EUT HEIGHT: 0.8 m
INVESTIGATED FREQUENCY RANGE: 0.009 – 9300 MHz
DETECTOR USED: Peak
VIDEO BANDWIDTH: > Resolution bandwidth
TEST ANTENNA TYPE: Biconilog (30 MHz – 1000 MHz)
Double ridged guide (above 1000 MHz)
MODULATION: BPSK
MODULATING SIGNAL: PRBS
BIT RATE: 50 bps
TRANSMITTER OUTPUT POWER SETTINGS: Maximum

Frequency, MHz	Field strength, dB(μV/m)	Limit, dB(μV/m)	Margin, dB*	RBW, kHz	Antenna polarization	Antenna height, m	Turn-table position**, degrees
Low carrier frequency MHz							
1841.571	45.57	73.53	-27.96	1000	Vert	1.2	282
2762.494	44.88	73.73	-28.85	1000	Vert	1.0	39
High carrier frequency MHz							
1852.479	51.54	73.53	-21.99	1000	Vert	1.0	239
2778.631	43.08	73.73	-30.65	1000	Vert	1.0	36

*****- Margin = Field strength of spurious – calculated field strength limit.
******- EUT front panel refers to 0 degrees position of turntable.

Table 7.4.3 Substitution ERP of spurious test results

ASSIGNED FREQUENCY RANGE: 919.75 – 927.25 MHz
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
SUBSTITUTION ANTENNA HEIGHT: 0.8 m
DETECTOR USED: Peak
VIDEO BANDWIDTH: > Resolution bandwidth
SUBSTITUTION ANTENNA TYPE: Tunable dipole (30 MHz – 1000 MHz)
Double ridged guide (above 1000 MHz)

Frequency, MHz	Field strength, dB(μV/m)	RBW, kHz	Antenna polarization	RF generator output, dBm	Ant gain, dBd	Cable loss, dB	ERP, dBm	Limit, dBc	Margin, dB*	Verdict
Low carrier frequency										
1841.571	45.57	1000	Vert	-51.44	2.04	1.26	-50.66	-21.69	-28.97	Pass
2762.494	44.88	1000	Vert	-53.66	4.99	1.58	-50.25	-21.52	-28.73	Pass
High carrier frequency										
1852.479	51.54	1000	Vert	-45.49	2.10	1.26	-44.65	-21.69	-22.96	Pass
2778.631	43.08	1000	Vert	-55.69	5.04	1.58	-52.23	-21.52	-30.71	Pass

*****- Margin = Spurious emission – specification limit.

Reference numbers of test equipment used

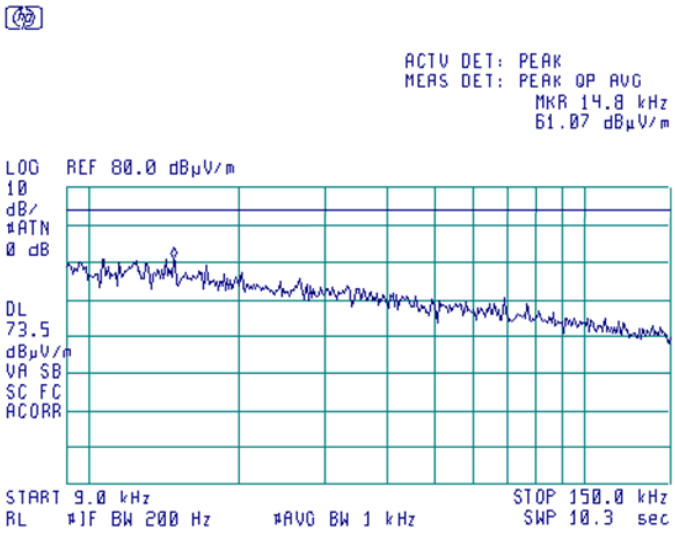
HL 0446	HL 0521	HL 0604	HL 1984	HL 2909	HL 4352	HL 4353	

Full description is given in Appendix A.

Test specification:	Section 90.210, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date(s):	7/23/2012		
Temperature: 23.8 ºC	Air Pressure: 1006 hPa	Relative Humidity: 42 %	Power Supply: 48 VDC
Remarks:			

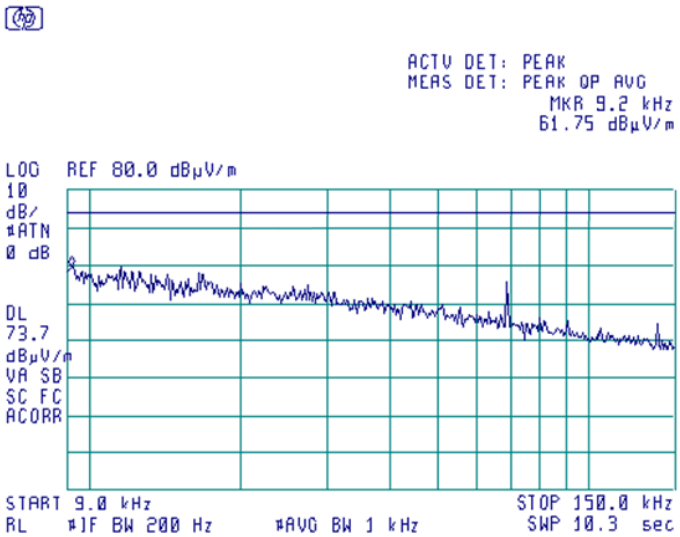
Plot 7.4.1 Radiated emission measurements in 9 - 150 kHz range

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



Plot 7.4.2 Radiated emission measurements in 9 - 150 kHz range

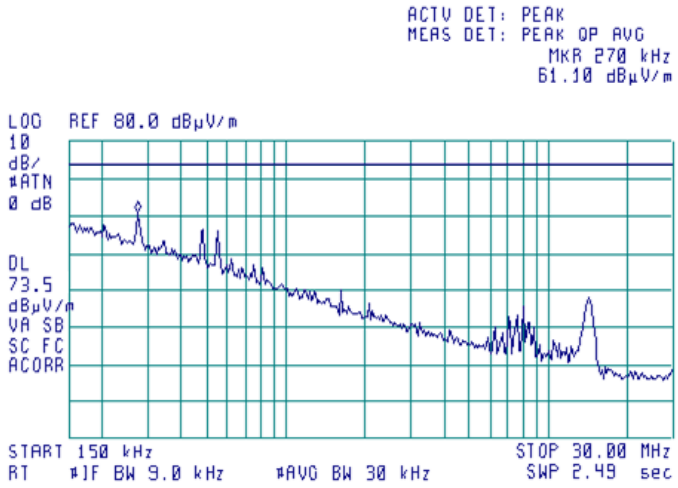
TEST SITE:	Semi anechoic chamber
CARRIER FREQUENCY:	High
ANTENNA POLARIZATION:	Vertical and Horizontal
TEST DISTANCE:	3 m



Test specification:	Section 90.210, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date(s):	7/23/2012		
Temperature: 23.8 ºC	Air Pressure: 1006 hPa	Relative Humidity: 42 %	Power Supply: 48 VDC
Remarks:			

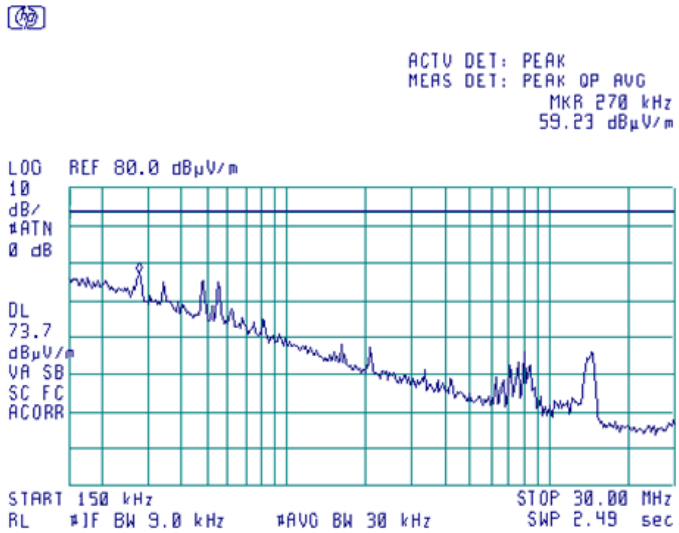
Plot 7.4.3 Radiated emission measurements in 0.15 - 30 MHz range

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



Plot 7.4.4 Radiated emission measurements in 0.15 - 30 MHz range

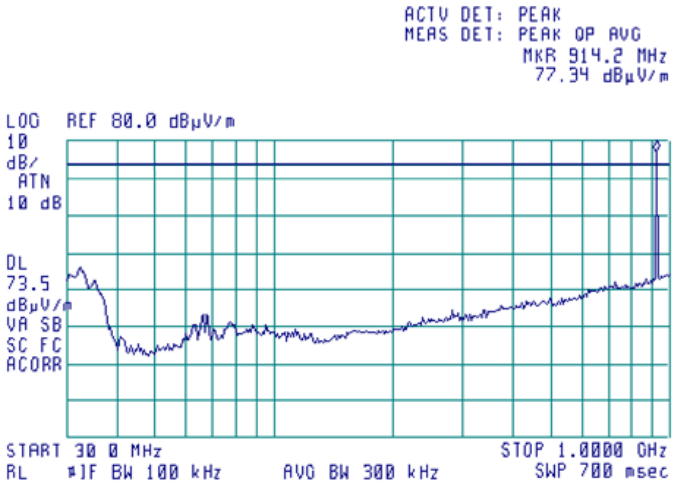
TEST SITE:	Semi anechoic chamber
CARRIER FREQUENCY:	High
ANTENNA POLARIZATION:	Vertical and Horizontal
TEST DISTANCE:	3 m



Test specification:	Section 90.210, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date(s):	7/23/2012		
Temperature: 23.8 ºC	Air Pressure: 1006 hPa	Relative Humidity: 42 %	Power Supply: 48 VDC
Remarks:			

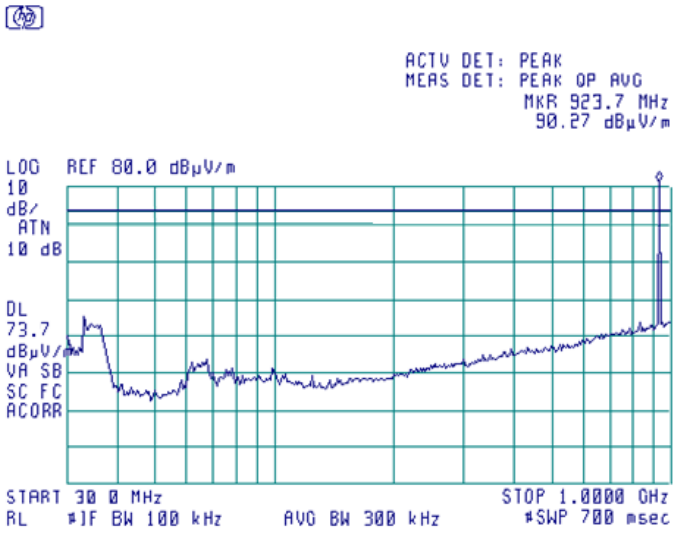
Plot 7.4.5 Radiated emission measurements in 30 - 1000 MHz range

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



Plot 7.4.6 Radiated emission measurements in 30 - 1000 MHz range

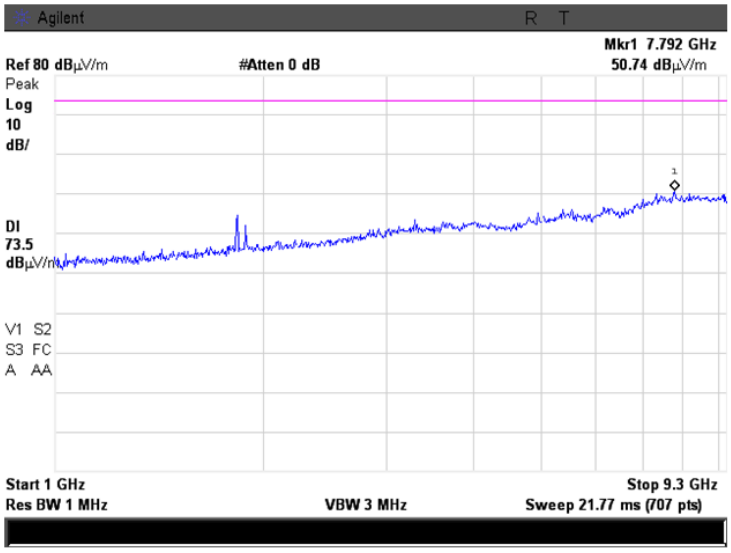
TEST SITE:	Semi anechoic chamber
CARRIER FREQUENCY:	High
ANTENNA POLARIZATION:	Vertical and Horizontal
TEST DISTANCE:	3 m



Test specification:	Section 90.210, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date(s):	7/23/2012		
Temperature: 23.8 ºC	Air Pressure: 1006 hPa	Relative Humidity: 42 %	Power Supply: 48 VDC
Remarks:			

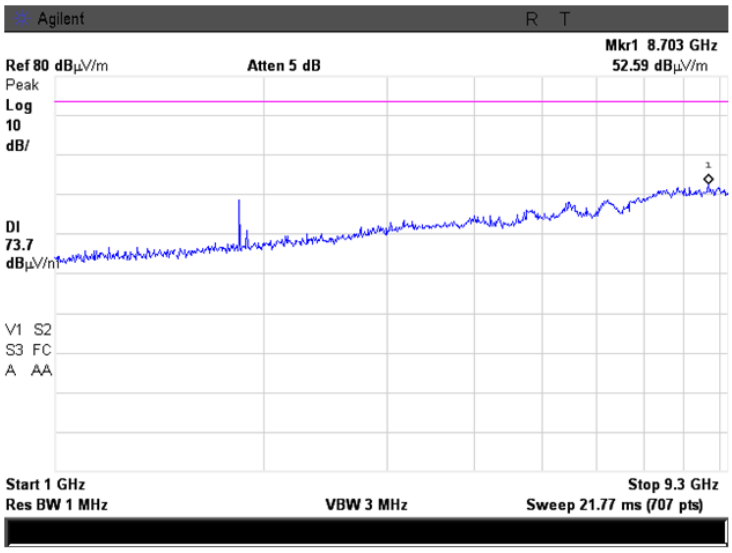
Plot 7.4.7 Radiated emission measurements in 1000 – 9300 MHz range

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



Plot 7.4.8 Radiated emission measurements in 1000 – 9300 MHz range

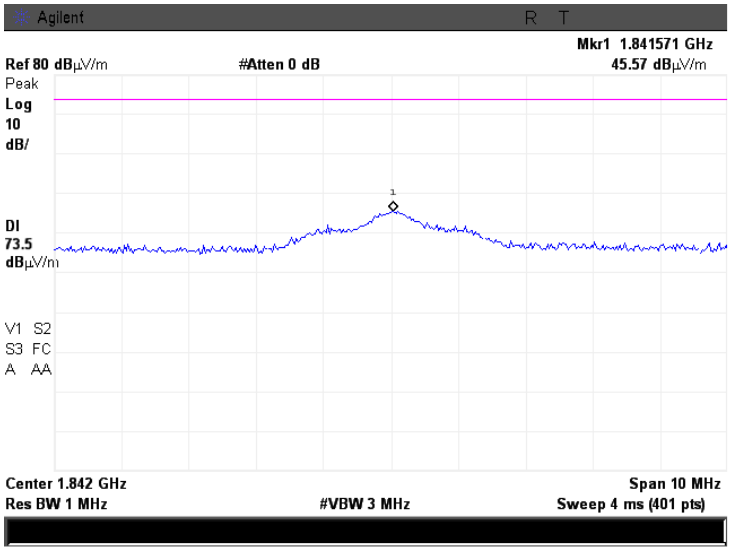
TEST SITE: Semi anechoic chamber
CARRIER FREQUENCY: High
ANTENNA POLARIZATION: Vertical and Horizontal
TEST DISTANCE: 3 m



Test specification:	Section 90.210, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date(s):	7/23/2012		
Temperature: 23.8 ºC	Air Pressure: 1006 hPa	Relative Humidity: 42 %	Power Supply: 48 VDC
Remarks:			

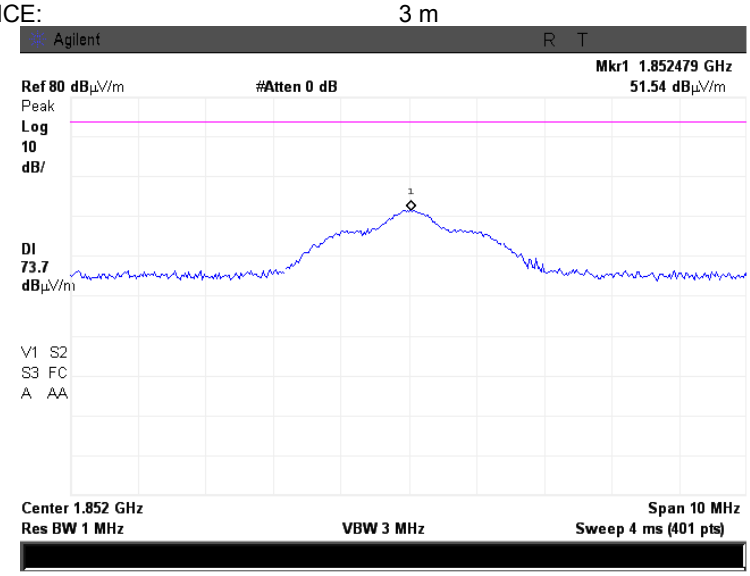
Plot 7.4.9 Radiated emission measurements at the 2nd harmonic

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



Plot 7.4.10 Radiated emission measurements at the 2nd harmonic

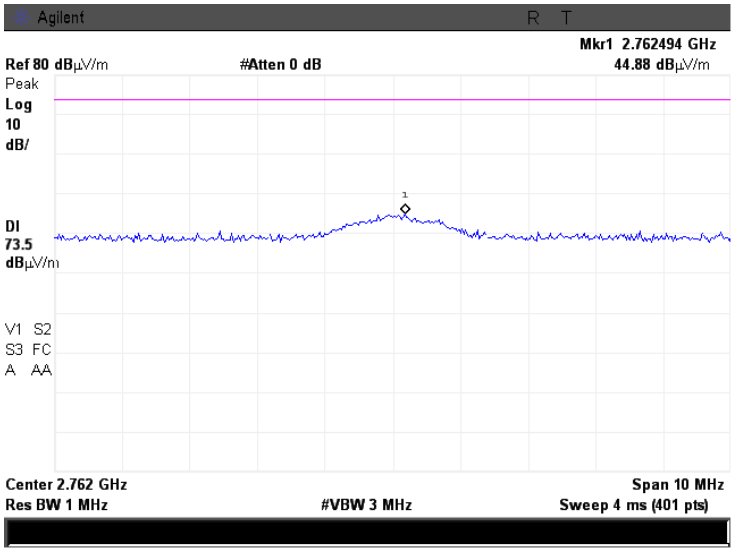
TEST SITE: Semi anechoic chamber
CARRIER FREQUENCY: High
ANTENNA POLARIZATION: Vertical and Horizontal
TEST DISTANCE: 3 m



Test specification:	Section 90.210, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date(s):	7/23/2012		
Temperature: 23.8 ºC	Air Pressure: 1006 hPa	Relative Humidity: 42 %	Power Supply: 48 VDC
Remarks:			

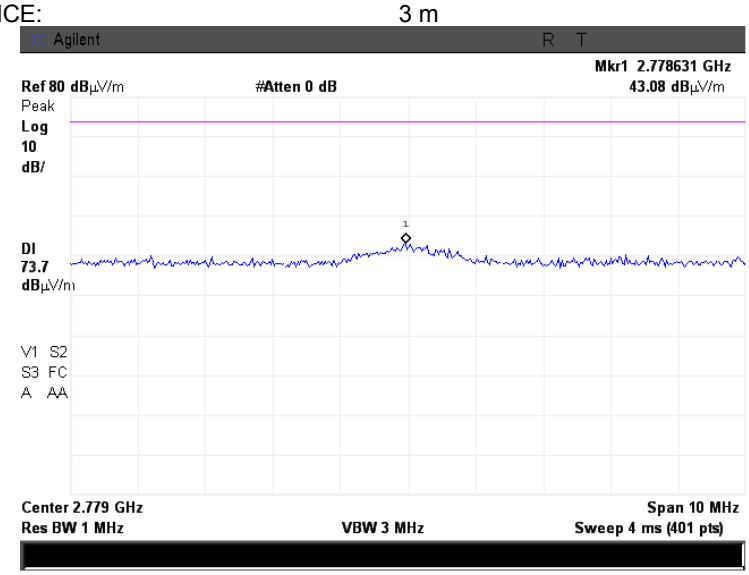
Plot 7.4.11 Radiated emission measurements at the 3rd harmonic

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



Plot 7.4.12 Radiated emission measurements at the 3rd harmonic

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



Test specification:	Section 90.210, Conducted spurious emissions		
Test procedure:	47 CFR, Sections 2.1051 and 90.210(m); TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date(s):	7/23/2012		
Temperature: 24.1 ºC	Air Pressure: 1006 hPa	Relative Humidity: 43 %	Power Supply: 48 VDC
Remarks:			

7.5 Spurious emissions at RF antenna connector test

7.5.1 General

This test was performed to measure spurious emissions at RF antenna connector. Specification test limits are given in Table 7.5.1.

Table 7.5.1 Spurious emission limits

Frequency, MHz	Attenuation below carrier, dBc	ERP of spurious, dBm
0.009 – 10th harmonic*	66.0	The limit shall be taken from FCC part 90.210 Emission mask K1

* - spurious emission limits do not apply to the in band emission within ± 250 % of the authorized bandwidth from the carrier; investigated in course of emission mask testing
** - P is transmitter output power in Watts

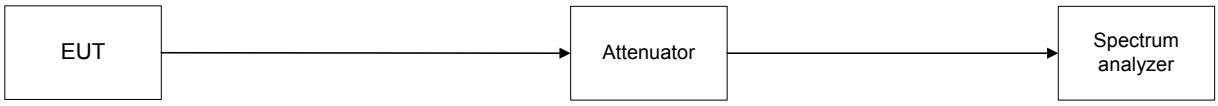
7.5.2 Test procedure

7.5.2.1 The EUT was set up as shown in Figure 7.5.1, energized and its proper operation was checked.

7.5.2.2 The EUT was adjusted to produce maximum available for end user RF output power.

7.5.2.3 The spurious emission was measured with spectrum analyzer as provided in Table 7.5.2 and the associated plots.

Figure 7.5.1 Spurious emission test setup



Test specification:	**Section 90.210, Conducted spurious emissions**		
Test procedure:	47 CFR, Sections 2.1051 and 90.210(m); TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	7/23/2012		
Temperature: 24.1 ºC	**Air Pressure:** 1006 hPa	**Relative Humidity:** 43 %	**Power Supply:** 48 VDC
Remarks:			

Table 7.5.2 Spurious emission test results

ASSIGNED FREQUENCY RANGE: 919.75 – 927.25 MHz
INVESTIGATED FREQUENCY RANGE: 0.009 – 9300 MHz
DETECTOR USED: Peak
VIDEO BANDWIDTH: ≥ Resolution bandwidth
MODULATION: BPSK
MODULATING SIGNAL: PRBS
BIT RATE: 50 bps
TRANSMITTER OUTPUT POWER SETTINGS: Maximum

Frequency, MHz	SA reading, dBm	Attenuator, dB	Cable loss, dB	RBW, kHz	Spurious emission, dBm	Attenuation below carrier, dBc	Limit, dBc	Margin, dB*	Verdict
Low carrier frequency									
1841.546	-39.38	Included	Included	100	-39.38	83.69	66.0	17.69	Pass
2762.352	-45.10	Included	Included	100	-45.10	89.58	66.0	23.58	Pass
High carrier frequency									
-1852.467	-41.79	Included	Included	100	-39.38	86.1	68.0	18.10	Pass
2778.164	-51.58	Included	Included	100	-45.10	96.06	69.0	27.06	Pass

*****- Margin = Attenuation below carrier – specification limit.

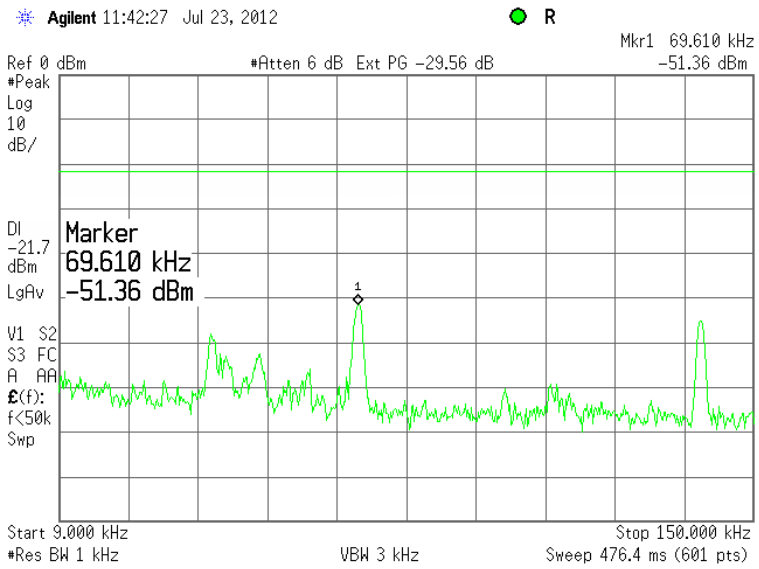
Reference numbers of test equipment used

HL 1876	HL 2991	HL 3768	HL 3776	HL 3818			

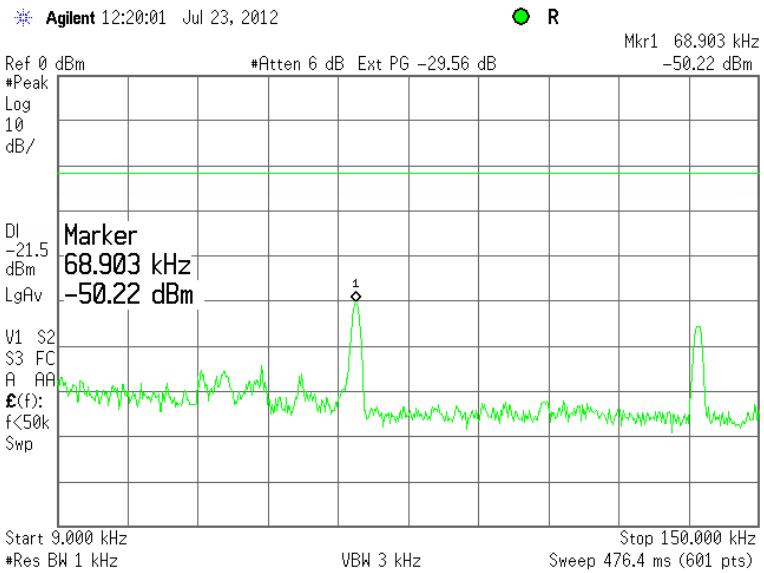
Full description is given in Appendix A.

Test specification:	Section 90.210, Conducted spurious emissions		
Test procedure:	47 CFR, Sections 2.1051 and 90.210(m); TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date(s):	7/23/2012		
Temperature: 24.1 °C	Air Pressure: 1006 hPa	Relative Humidity: 43 %	Power Supply: 48 VDC
Remarks:			

Plot 7.5.1 Spurious emission measurements in 9 - 150 kHz range at low carrier frequency

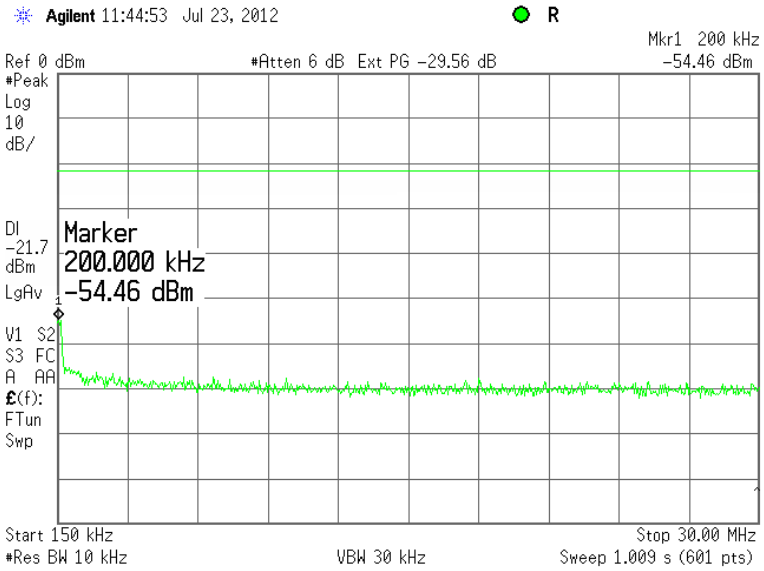


Plot 7.5.2 Spurious emission measurements in 9 - 150 kHz range at high carrier frequency

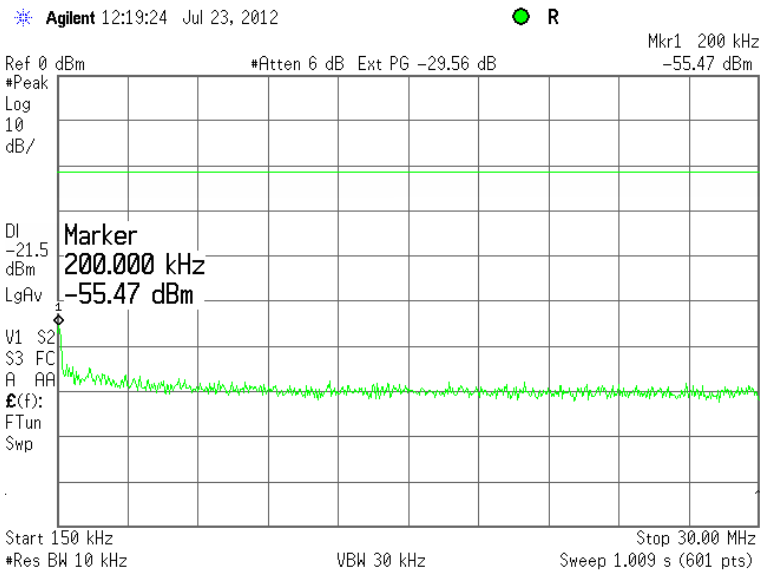


Test specification:	Section 90.210, Conducted spurious emissions		
Test procedure:	47 CFR, Sections 2.1051 and 90.210(m); TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date(s):	7/23/2012		
Temperature: 24.1 °C	Air Pressure: 1006 hPa	Relative Humidity: 43 %	Power Supply: 48 VDC
Remarks:			

Plot 7.5.3 Spurious emission measurements in 0.150 - 30.0 MHz range at low carrier frequency

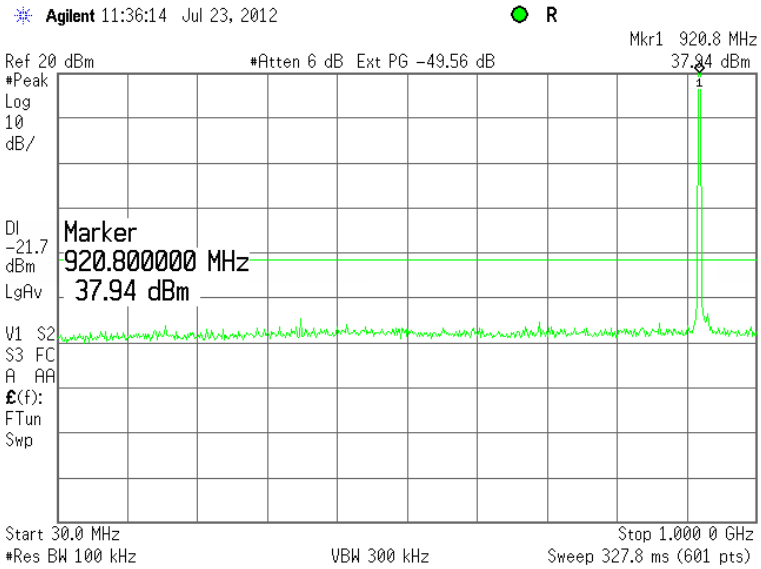


Plot 7.5.4 Spurious emission measurements in 0.150 – 30.0 MHz range at high carrier frequency

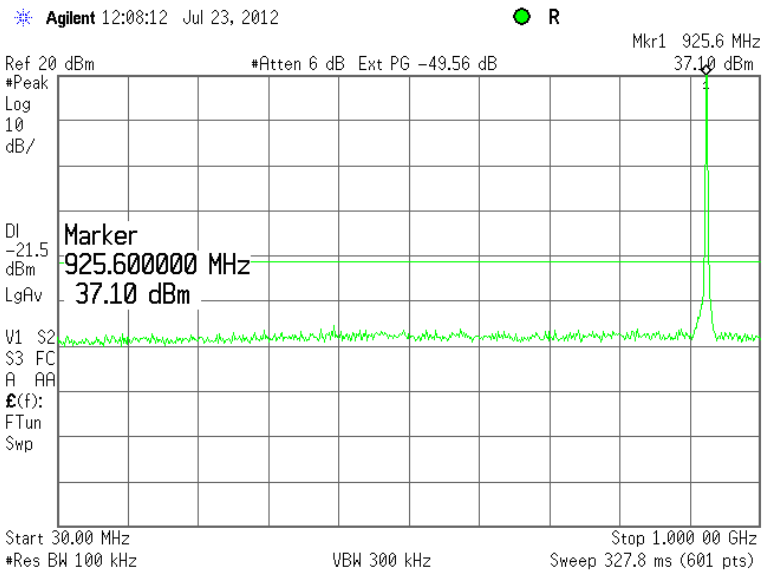


Test specification:	Section 90.210, Conducted spurious emissions		
Test procedure:	47 CFR, Sections 2.1051 and 90.210(m); TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date(s):	7/23/2012		
Temperature: 24.1 °C	Air Pressure: 1006 hPa	Relative Humidity: 43 %	Power Supply: 48 VDC
Remarks:			

Plot 7.5.5 Spurious emission measurements in 30.0 - 1000 MHz range at low carrier frequency

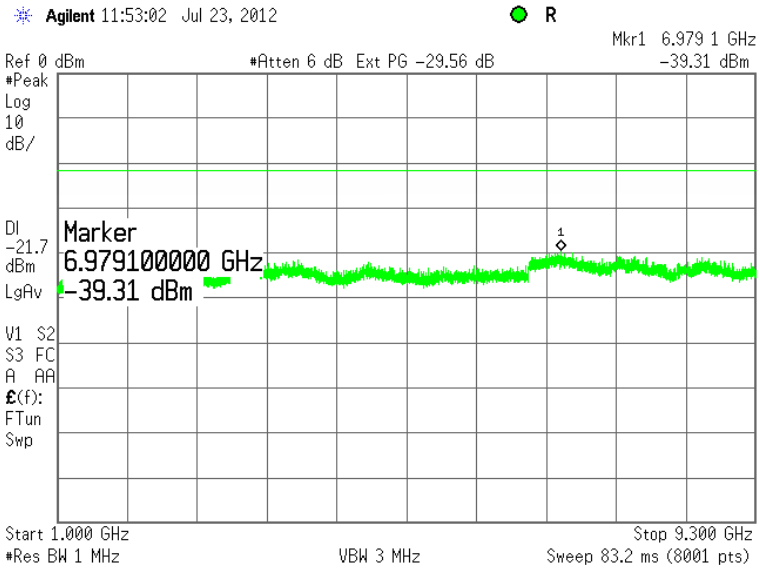


Plot 7.5.6 Spurious emission measurements in 30.0 - 1000 MHz range at high carrier frequency

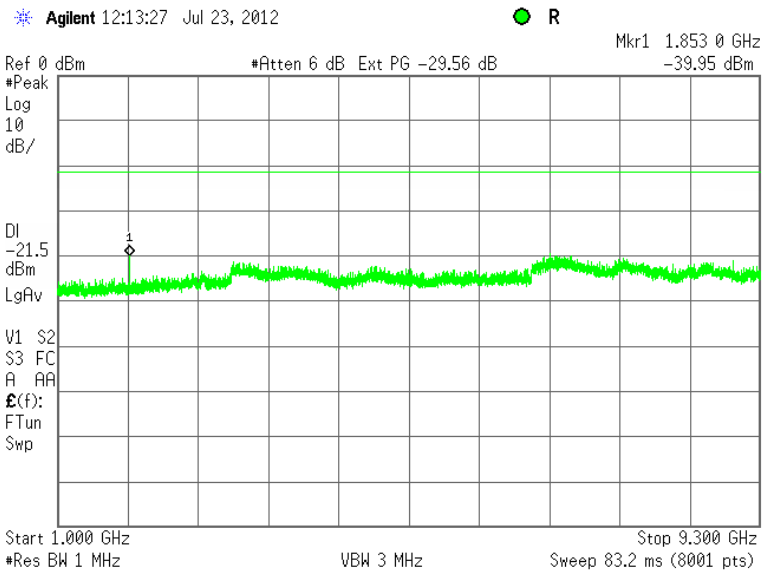


Test specification:	Section 90.210, Conducted spurious emissions		
Test procedure:	47 CFR, Sections 2.1051 and 90.210(m); TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date(s):	7/23/2012		
Temperature: 24.1 °C	Air Pressure: 1006 hPa	Relative Humidity: 43 %	Power Supply: 48 VDC
Remarks:			

Plot 7.5.7 Spurious emission measurements in 1000 - 9300 MHz range at low carrier frequency

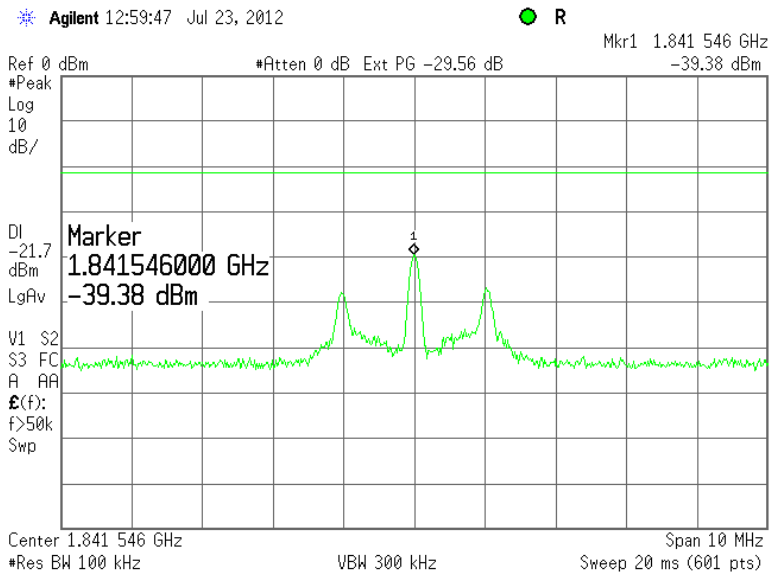


Plot 7.5.8 Spurious emission measurements in 1000 - 9300 MHz at high carrier frequency



Test specification:	Section 90.210, Conducted spurious emissions		
Test procedure:	47 CFR, Sections 2.1051 and 90.210(m); TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date(s):	7/23/2012		
Temperature: 24.1 °C	Air Pressure: 1006 hPa	Relative Humidity: 43 %	Power Supply: 48 VDC
Remarks:			

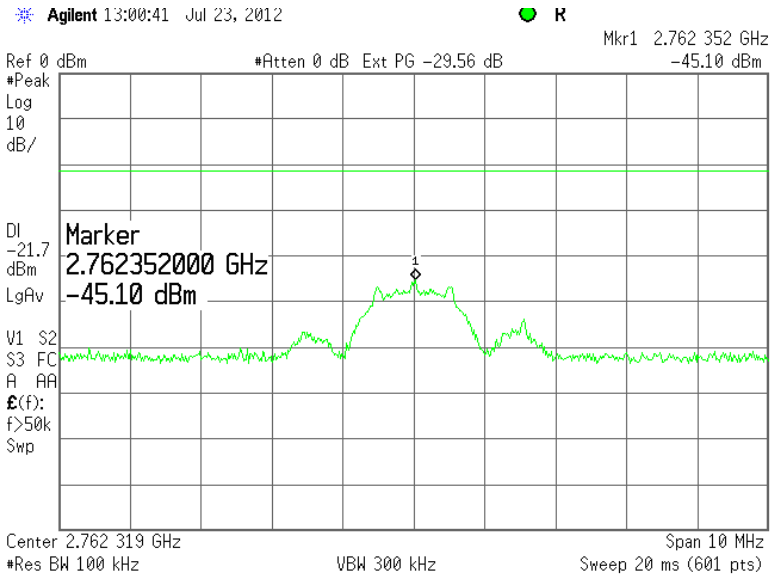
Plot 7.5.9 Conducted spurious emission measurements at the 2nd harmonic of low carrier frequency



Plot 7.5.10 Conducted spurious emission measurements at the 2nd harmonic of high carrier frequency

Test specification:	Section 90.210, Conducted spurious emissions		
Test procedure:	47 CFR, Sections 2.1051 and 90.210(m); TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date(s):	7/23/2012		
Temperature: 24.1 °C	Air Pressure: 1006 hPa	Relative Humidity: 43 %	Power Supply: 48 VDC
Remarks:			

Plot 7.5.11 Conducted spurious emission measurements at the 3rd harmonic of low carrier frequency



Plot 7.5.12 Conducted spurious emission measurements at the 3rd harmonic of high carrier frequency

Test specification:	Section 90.213, Frequency stability		
Test procedure:	47 CFR, Section 2.1055; TIA/EIA-603-A Section 2.2.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	7/25/2012		
Temperature: 24.3 ºC	Air Pressure: 1005 hPa	Relative Humidity: 40 %	Power Supply: 48VDC
Remarks:			

7.6 Frequency stability test

7.6.1 General

This test was performed to measure frequency stability of transmitter RF carrier. Specification test limits are given in Table 7.6.1.

Table 7.6.1 Frequency stability limits

Assigned frequency, MHz	Maximum allowed frequency displacement	
	ppm	Hz
920.773	2.5	2502
926.227		2513

7.6.2 Test procedure

7.6.2.1 The EUT was set up as shown in Figure 7.6.1, energized and its proper operation was checked.

7.6.2.2 The EUT power was turned off. Temperature within test chamber was set to +30˚C and a period of time sufficient to stabilize all of the oscillator circuit components was allowed.

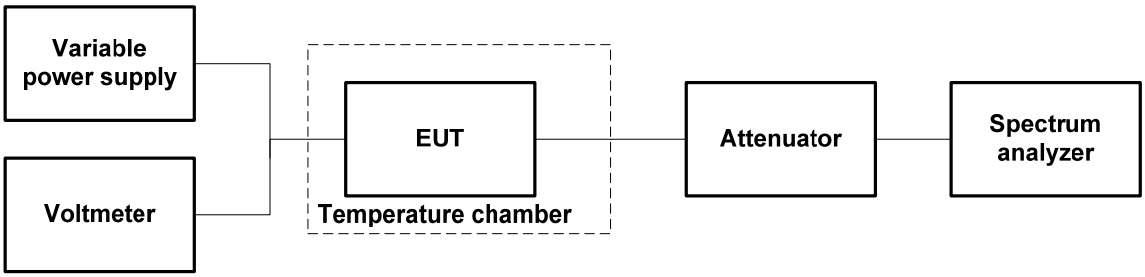
7.6.2.3 The EUT was powered on and carrier frequency was measured at start up moment and then every minute until frequency had been stabilized or 10 minutes elapsed whichever reached the last. The EUT was powered off.

7.6.2.4 The above procedure was repeated at 0˚C and at the lowest test temperature.

7.6.2.5 The EUT was powered on and carrier frequency was measured at start up moment and at the end of stabilization period at the rest of test temperatures and voltages. The EUT was powered off.

7.6.2.6 Frequency displacement was calculated and compared with the limit as provided in Table 7.6.2.

Figure 7.6.1 Frequency stability test setup



Test specification:	**Section 90.213, Frequency stability**		
Test procedure:	47 CFR, Section 2.1055; TIA/EIA-603-A Section 2.2.2		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	7/25/2012		
Temperature: 24.3 ºC	**Air Pressure:** 1005 hPa	**Relative Humidity:** 40 %	**Power Supply:** 48VDC
Remarks:			

Table 7.6.2 Frequency stability test results

OPERATING FREQUENCY: 919.75 – 927.25 MHz
NOMINAL POWER VOLTAGE: 48 V
TEMPERATURE STABILIZATION PERIOD: 20 min
POWER DURING TEMPERATURE TRANSITION: Off
SPECTRUM ANALYZER MODE: Counter
RESOLUTION BANDWIDTH: 1 kHz
VIDEO BANDWIDTH: 3 kHz
MODULATION: Unmodulated

T, ºC	Voltage, V	Frequency, MHz							Max frequency drift, Hz		Limit, Hz	Margin, Hz	Verdict
		Start up	1st min	2nd min	3rd min	4th min	5th min	10th min	Positive	Negative			
Low frequency													
-30	nominal	920.772987	920.772978	920.772986	920.772953	920.772996	920.772998	920.773036	33	-50		-2252	Pass
-20	nominal	920.772993	NA	NA	NA	NA	NA	920.772946	0	-57		-2245	Pass
-10	nominal	920.772993	NA	NA	NA	NA	NA	920.772979	0	-24		-2278	Pass
0	nominal	920.773042	920.772966	920.772996	920.773019	920.772990	920.773052	920.773003	49	-37		-2253	Pass
10	nominal	920.773059	NA	NA	NA	NA	NA	920.772912	56	-91		-2211	Pass
20	+15%	920.772906	NA	NA	NA	NA	NA	920.772941	0	-97	2502	-2205	Pass
20	nominal	920.772993	NA	NA	NA	NA	NA	920.773003	0	-10		-2292	Pass
20	-15%	920.772993	NA	NA	NA	NA	NA	920.772977	0	-26		-2276	Pass
30	nominal	920.772993	920.772993	920.772964	920.772939	920.772957	920.772962	920.772994	0	-64		-2238	Pass
40	nominal	920.772993	NA	NA	NA	NA	NA	920.772933	0	-70		-2232	Pass
50	nominal	920.772993	NA	NA	NA	NA	NA	920.772916	0	-87		-2215	Pass
High frequency													
-30	nominal	926.226956	926.226948	926.226933	926.226957	926.226920	926.226894	926.226967	0	-85		-2230	Pass
-20	nominal	926.226972	NA	NA	NA	NA	NA	926.227030	51	-7		-2264	Pass
-10	nominal	926.226933	NA	NA	NA	NA	NA	926.227008	29	-46		-2269	Pass
0	nominal	926.226994	926.226944	926.226954	926.226965	926.226963	926.226970	926.226963	15	-35		-2280	Pass
10	nominal	926.226982	NA	NA	NA	NA	NA	926.226982	3	0		-2312	Pass
20	+15%	926.226991	NA	NA	NA	NA	NA	926.226965	12	-14	2315	-2301	Pass
20	nominal	926.226993	NA	NA	NA	NA	NA	926.226979	14	0		-2301	Pass
20	-15%	926.226968	NA	NA	NA	NA	NA	926.226998	19	-11		-2296	Pass
30	nominal	926.226993	926.226972	926.226921	926.226977	926.226975	926.226995	926.227030	51	-58		-2257	Pass
40	nominal	926.226993	NA	NA	NA	NA	NA	926.226945	14	-34		-2281	Pass
50	nominal	926.226969	NA	NA	NA	NA	NA	926.227006	27	-10		-2288	Pass

* - Reference frequency

Reference numbers of test equipment used

HL 1876	HL 2991	HL 3768	HL 3776	HL 3818			

Full description is given in Appendix A.

Test specification:	Section 15.107, Conducted emission at AC power port		
Test procedure:	ANSI C63.4, Sections 11.5 and 12.1.3		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/5/2012		
Temperature: 24 ºC	Air Pressure: 1007 hPa	Relative Humidity: 38 %	Power Supply: 120 VAC
Remarks:			

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

8.1 Conducted emissions

8.1.1 General

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

Table 8.1.1 Limits for conducted emissions

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

* The limit decreases linearly with the logarithm of frequency.

8.1.2 Test procedure

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

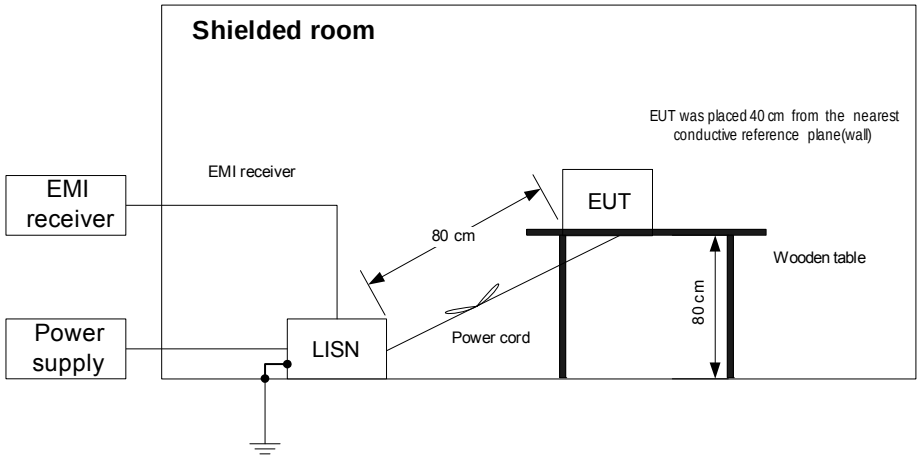
8.1.2.2 The measurements were performed at power terminals with the LISN, connected to a spectrum analyzer in the frequency range referred to in Table 8.1.2. Unused coaxial connector of the LISN was terminated with 50 Ohm. Quasi-peak and average detectors were used throughout the testing.

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

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

Test specification:	Section 15.107, Conducted emission at AC power port		
Test procedure:	ANSI C63.4, Sections 11.5 and 12.1.3		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/5/2012		
Temperature: 24 ºC	Air Pressure: 1007 hPa	Relative Humidity: 38 %	Power Supply: 120 VAC
Remarks:			

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



Photograph 8.1.1 Setup for conducted emission measurements

Test specification:	**Section 15.107, Conducted emission at AC power port**		
Test procedure:	ANSI C63.4, Sections 11.5 and 12.1.3		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	9/5/2012		
Temperature: 24 ºC	**Air Pressure:** 1007 hPa	**Relative Humidity:** 38 %	**Power Supply:** 120 VAC
Remarks:			

Table 8.1.2 Conducted emission test results

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

Frequency, MHz	Peak emission, dB(µV)	Quasi-peak			Average			Line ID	Verdict
		Measured emission, dB(µV)	Limit, dB(µV)	Margin, dB*	Measured emission, dB(µV)	Limit, dB(µV)	Margin, dB*		
0.182160	62.16	53.57	64.43	-10.86	37.06	54.43	-17.37	L1	Pass
2.077270	40.85	38.36	56.00	-17.64	37.43	46.00	-8.57		
2.492895	42.83	41.73	56.00	-14.27	41.31	46.00	-4.69		
2.541895	40.70	39.58	56.00	-16.42	38.95	46.00	-7.05		
2.908050	39.53	36.77	56.00	-19.23	35.82	46.00	-10.18		
4.237925	36.96	36.24	56.00	-19.76	33.57	46.00	-12.43		
0.181137	60.03	50.17	64.48	-14.31	36.95	54.48	-17.53	L2	Pass
2.077500	40.35	38.50	56.00	-17.50	37.76	46.00	-8.24		
2.492475	40.57	39.02	56.00	-16.98	38.03	46.00	-7.97		
2.806550	38.27	35.68	56.00	-20.32	33.61	46.00	-12.39		
8.477800	38.99	34.77	60.00	-25.23	32.05	50.00	-17.95		

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

Reference numbers of test equipment used

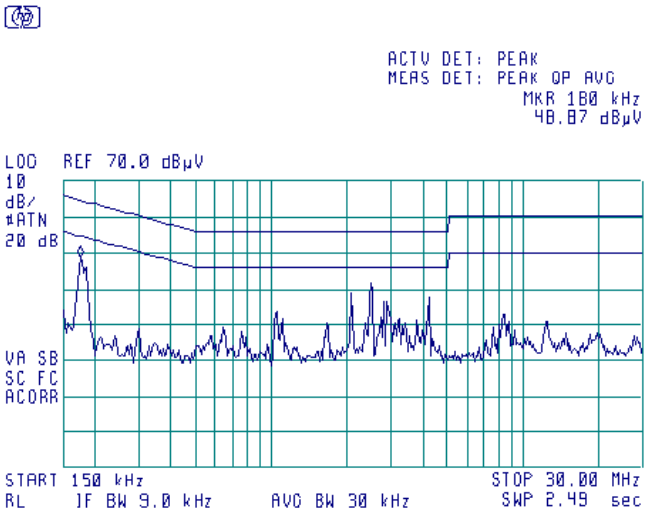
HL 0787	HL 1425	HL 1513	HL 2563	HL 2924	HL 3612		

Full description is given in Appendix A.

Test specification:	Section 15.107, Conducted emission at AC power port		
Test procedure:	ANSI C63.4, Sections 11.5 and 12.1.3		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/5/2012		
Temperature: 24 ºC	Air Pressure: 1007 hPa	Relative Humidity: 38 %	Power Supply: 120 VAC
Remarks:			

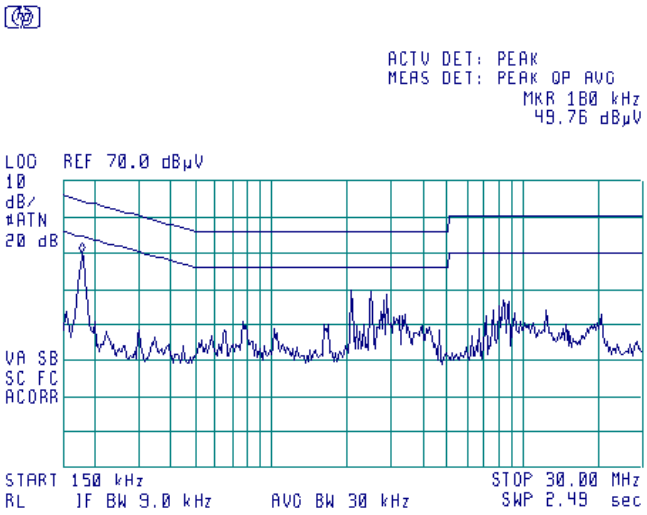
Plot 8.1.1 Conducted emission measurements

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



Plot 8.1.2 Conducted emission measurements

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



Test specification:	**Section 15.109, Radiated emission**		
Test procedure:	ANSI C63.4, Sections 11.6 and 12.1.4		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	7/23/2012		
Temperature: 25.7 ºC	**Air Pressure:** 1004 hPa	**Relative Humidity:** 46 %	**Power Supply:** 48VDC
Remarks:			

8.2 Radiated emission measurements

8.2.1 General

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

Table 8.2.1 Radiated emission test limits

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

* The limit for test distance other than specified was calculated using the inverse linear distance extrapolation factor as follows: $Lim_{S2} = Lim_{S1} + 20 \log (S_1/S_2)$,
where S_1 and S_2 – standard defined and test distance respectively in meters.

8.2.2 Test procedure for measurements in semi-anechoic chamber

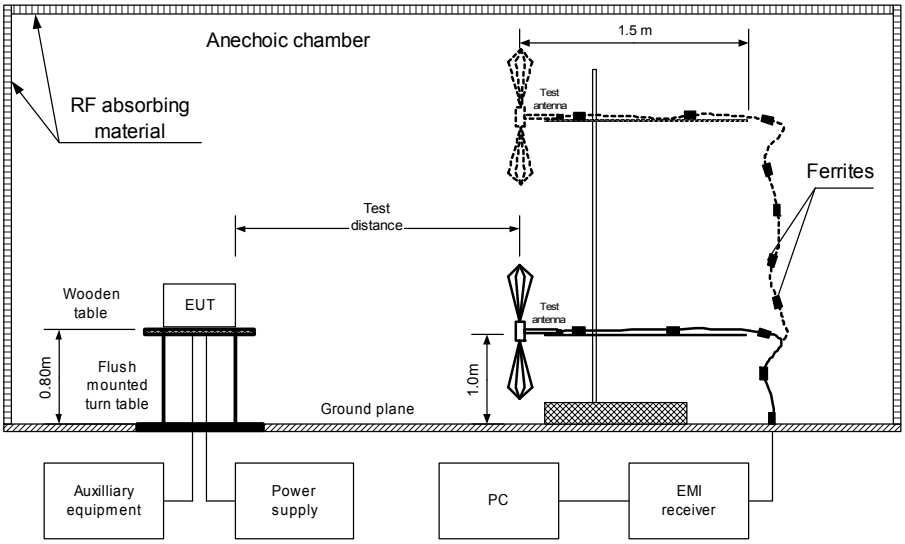
8.2.2.1 The EUT was set up as shown in Figure 8.2.1 and associated photograph/s, energized and the performance check was conducted.

8.2.2.2 The specified frequency range was investigated with biconilog antenna connected to EMI receiver. To find maximum radiation the turntable was rotated 360^0, the measuring antenna height was changed from 1 to 4 m, its polarization was switched from vertical to horizontal and the EUT cables position was varied.

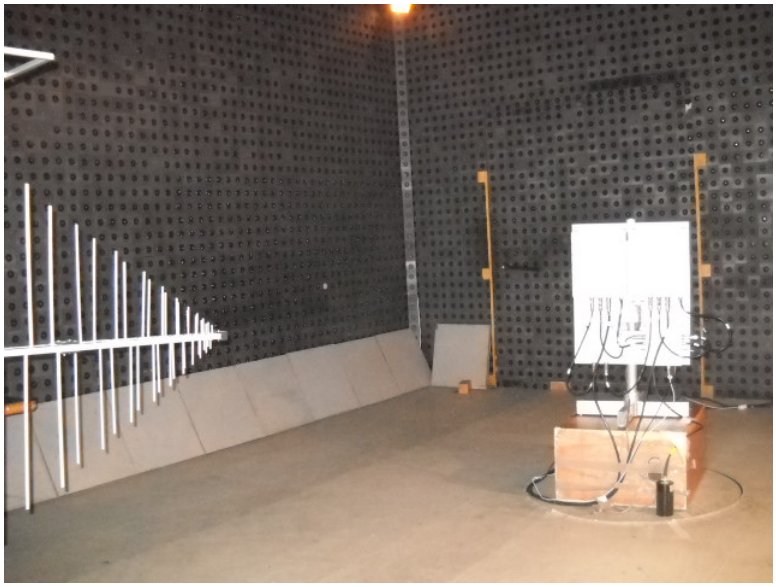
8.2.2.3 The worst test results (the lowest margins) were recorded in Table 8.2.2 and shown in the associated plots.

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):	7/23/2012		
Temperature: 25.7 ºC	Air Pressure: 1004 hPa	Relative Humidity: 46 %	Power Supply: 48VDC
Remarks:			

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

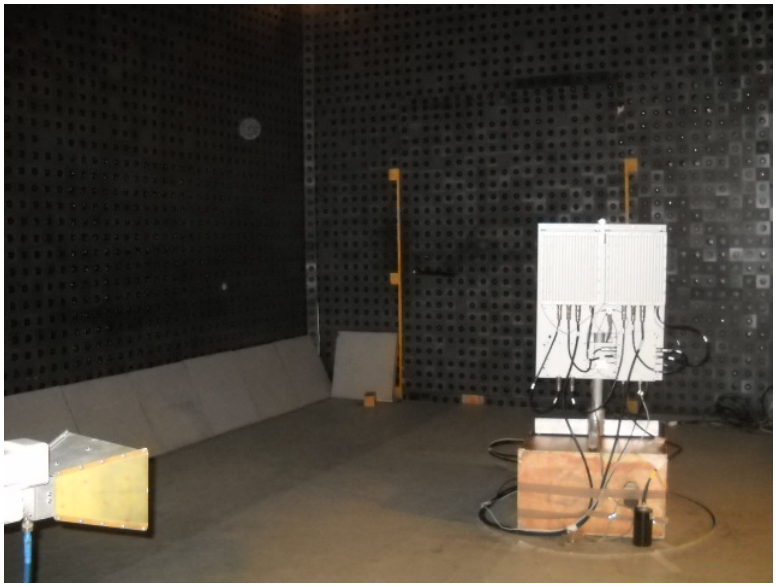


Photograph 8.2.1 Setup for radiated emission measurements



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):	7/23/2012		
Temperature: 25.7 ºC	Air Pressure: 1004 hPa	Relative Humidity: 46 %	Power Supply: 48VDC
Remarks:			

Photograph 8.2.2 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):	7/23/2012		
Temperature: 25.7 ºC	**Air Pressure:** 1004 hPa	**Relative Humidity:** 46 %	**Power Supply:** 48VDC
Remarks:			

Table 8.2.2 Radiated emission test results

EUT SET UP: TABLE-TOP
LIMIT: Class B
EUT OPERATING MODE: Stand-by
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*				
30.648500	40.28	34.98	40.50	-5.52	Vert	1.0	80	Pass
32.611000	37.36	32.51	40.50	-7.99	Vert	1.0	205	
35.353000	32.64	27.61	40.50	-12.89	Vert	1.0	350	
72.395500	23.71	17.90	40.50	-22.60	Vert	1.0	45	
77.549000	25.96	19.52	40.50	-20.98	Vert	1.0	99	
106.726500	25.93	20.57	40.50	-19.93	Vert	1.0	170	

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

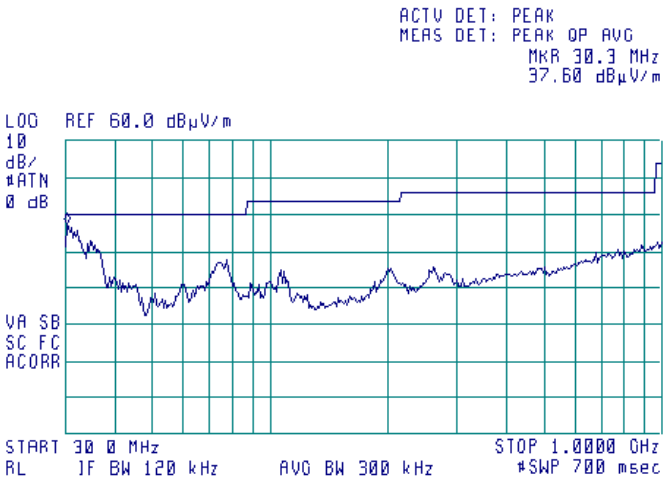
HL 0521	HL 0604	HL 1984	HL 4352	HL 4353			

Full description is given in Appendix A.

Test specification:	Section 15.109, Radiated emission		
Test procedure:	ANSI C63.4, Sections 11.6 and 12.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	7/23/2012		
Temperature: 25.7 ºC	Air Pressure: 1004 hPa	Relative Humidity: 46 %	Power Supply: 48VDC
Remarks:			

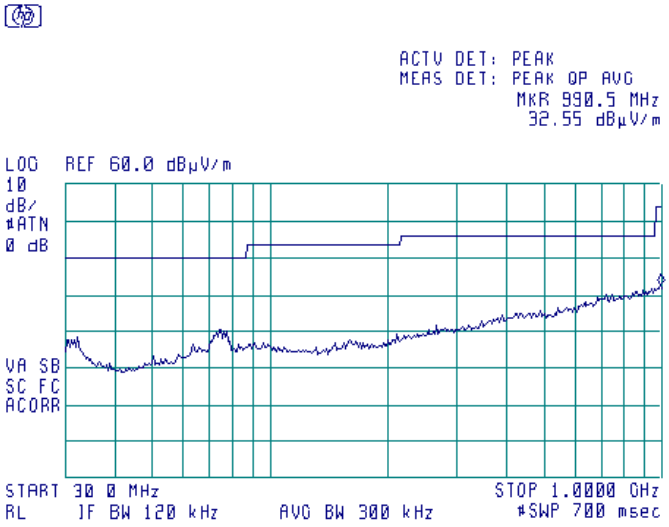
Plot 8.2.1 Radiated emission measurements in 30 - 1000 MHz range, vertical antenna polarization

TEST SITE: Semi anechoic chamber
LIMIT: Class B
TEST DISTANCE: 3 m
EUT OPERATING MODE: Stand-by



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

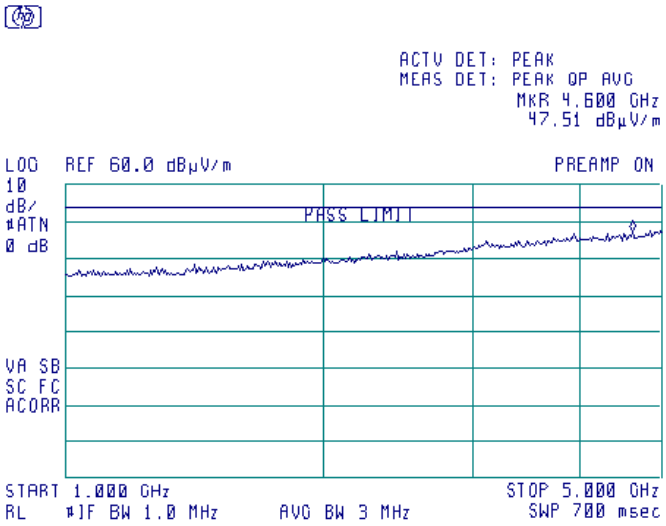
TEST SITE: Semi anechoic chamber
LIMIT: Class B
TEST DISTANCE: 3 m
EUT OPERATING MODE: Stand-by



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):	7/23/2012		
Temperature: 25.7 ºC	Air Pressure: 1004 hPa	Relative Humidity: 46 %	Power Supply: 48VDC
Remarks:			

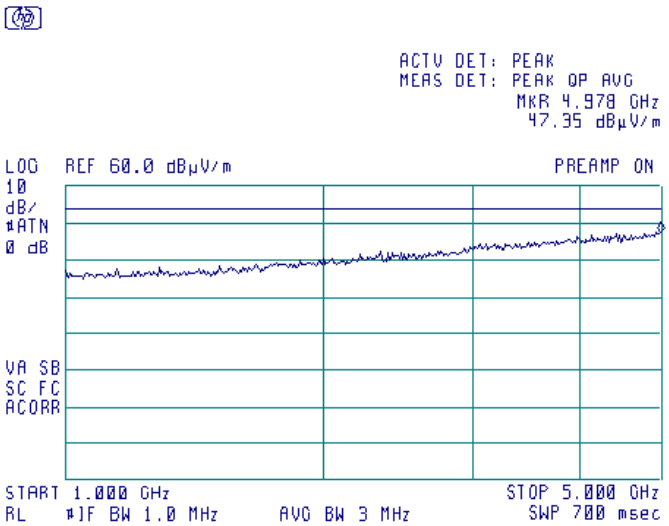
Plot 8.2.3 Radiated emission measurements above 1000 MHz, vertical antenna polarization

TEST SITE: Semi anechoic chamber
LIMIT: Class B
TEST DISTANCE: 3 m
EUT OPERATING MODE: Stand-by



Plot 8.2.4 Radiated emission measurements above 1000 MHz, horizontal antenna polarization

TEST SITE: Semi anechoic chamber
LIMIT: Class B
TEST DISTANCE: 3 m
EUT OPERATING MODE: Stand-by



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
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
0604	Antenna BiconiLog Log-Periodic/T Bow-TIE, 26 - 2000 MHz	EMCO	3141	9611-1011	20-May-12	20-May-14
0787	Transient Limiter 9 kHz-200 MHz	Hewlett Packard	11947A	3107A018 77	18-Oct-11	18-Oct-12
1425	EMI Receiver, 9 kHz - 2.9 GHz, System: HL1426, HL1427	Agilent Technologies	8542E	3710A002 22, 3705A002 04	26-Aug-12	26-Aug-13
1513	Cable RF, 8 m, BNC/BNC	Belden	M17/167 MIL-C-17	1513	02-Sep-12	02-Sep-13
1876	Attenuator, 50 Ohm, 100 W, 20 dB	Bird Electronic Corp.	8343-200	2200	01-Feb-12	01-Feb-13
1984	Antenna, Double-Ridged Waveguide Horn, 1-18 GHz, 300 W	EMC Test Systems	3115	9911-5964	25-Nov-11	25-Nov-12
2563	Load Termination, BNC, 50 Ohm	Hermon Laboratories	TBNC-50	2563	17-Nov-11	17-Nov-12
2909	Spectrum analyzer, ESA-E, 100 Hz to 26.5 GHz	Agilent Technologies	E4407B	MY414447 62	08-May-12	08-May-13
2924	Line Impedance Stabilization Network (LISN), 50Ohm/50 µH+5Ohm, 25 A, 2 lines,STD: MIL-461E,CISPR 16-1	Electro-Metrics	FCC VDE 25-2	1178	01-Jul-12	01-Jul-13
2991	Cable RF 1.0 m N type-N type	Hermon Laboratories	RG213	NA	02-Sep-12	02-Sep-13
3612	Cable RF, 17.5 m, N type-N type	Teldor	RG-214/U	NA	01-Dec-11	01-Dec-12
3768	Attenuator, N-type, 20 dB, DC to 18 GHz, 5 W	Mini-Circuits	BW-N20W5+	NA	22-Aug-12	22-Aug-13
3776	Attenuator, N-type, 10 dB, DC to 18 GHz, 5 W	Mini-Circuits	BW-N10W5+	NA	22-Aug-12	22-Oct-12
3818	PSA Series Spectrum Analyzer, 3 Hz- 44 GHz	Agilent Technologies	E4446A	MY482502 88	16-Feb-12	16-Feb-13
3839	Load Termination, BNC Male, 50 Ohm, 0.5 W, DC - 500 MHz	Hermon Laboratories	TBNC-50	NA	17-Nov-11	17-Nov-12
3903	Microwave Cable Assembly, 40.0 GHz, 1.5 m, SMA/SMA	Huber-Suhner	SUCOFLEX 102A	1226/2A	08-Feb-12	08-Feb-13
4352	Low Loss Armored Test Cable, DC - 18 GHz, 6.2 m, N type-M/N type-M	MegaPhase	NC29-N1N1-244	12025101 002	06-Jun-12	06-Mar-13
4353	Low Loss Armored Test Cable, DC - 18 GHz, 6.2 m, N type-M/N type-M	MegaPhase	NC29-N1N1-244	12025101 003	06-Jun-12	06-Mar-13

10 APPENDIX B Measurement uncertainties

Expanded uncertainty at 95% confidence in Hermon Labs EMC measurements

Test description	Expanded uncertainty
Transmitter tests	
Carrier power conducted at antenna connector	± 1.7 dB
Carrier power radiated (substitution method)	± 4.5 dB
Occupied bandwidth	±8%
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
Spurious emissions radiated 30 MHz – 40 GHz (substitution method)	± 4.5 dB
Frequency error	30 – 300 MHz: ± 50.5 Hz (1.68 ppm) 300 – 1000 MHz: ± 168 Hz (0.56 ppm)
Transient frequency behaviour	187 Hz ± 13.9 %
Duty cycle, timing (Tx ON / OFF) and average factor measurements	± 1.0 %
Unintentional radiator tests	
Conducted emissions with LISN	9 kHz to 150 kHz: ± 3.9 dB 150 kHz to 30 MHz: ± 3.8 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

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.

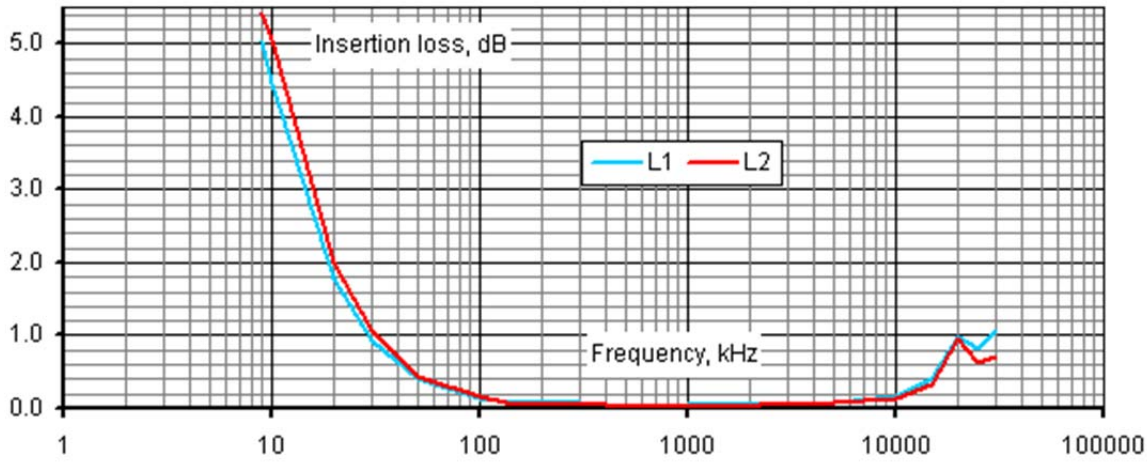
12 APPENDIX D Specification references

FCC 47CFR part 90: 2011	Private land mobile radio services
FCC 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.
ANSI/TIA/EIA-603-C:2004	Land Mobile FM or PM Communications Equipment Measurement and Performance Standards

13 APPENDIX E Test equipment correction factors

Correction factor
Line impedance stabilization network
Model FCC VDE 25-2, Electro-Metrics, HL 2924

Frequency, kHz	Insertion loss, dB		Measurement uncertainty, dB
	L1	L2	
9	5.03	5.43	0.6
10	4.47	5.07	
20	1.77	2.00	
30	0.93	1.07	
50	0.41	0.45	
100	0.14	0.16	
150	0.09	0.06	
200	0.07	0.07	
300	0.07	0.05	
400	0.05	0.05	
500	0.02	0.03	
1000	0.05	0.02	
5000	0.07	0.08	
10000	0.17	0.15	
15000	0.42	0.32	
20000	0.99	0.97	
25000	0.83	0.63	
30000	1.07	0.71	



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 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 strength in dB(μV/m).

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

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

Cable loss
Microwave Cable Assembly, Huber-Suhner, 40 GHz, 1.5 m, SMA-SMA, S/N 1226/2A
HL 3903

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	-0.02	9500	1.84	21000	2.98
100	0.15	10000	1.86	22000	3.07
500	0.38	10500	1.93	23000	3.13
1000	0.56	11000	1.99	24000	3.21
1500	0.69	11500	2.04	25000	3.26
2000	0.82	12000	2.10	26000	3.48
2500	0.90	12500	2.15	27000	3.44
3000	0.98	13000	2.21	28000	3.53
3500	1.06	13500	2.25	29000	3.59
4000	1.11	14000	2.29	30000	3.66
4500	1.17	14500	2.34	31000	3.70
5000	1.24	15000	2.36	32000	3.79
5500	1.32	15500	2.40	33000	3.88
6000	1.40	16000	2.45	34000	3.94
6500	1.50	16500	2.48	35000	3.91
7000	1.56	17000	2.56	36000	4.05
7500	1.62	17500	2.58	37000	4.22
8000	1.68	18000	2.60	38000	4.25
8500	1.74	19000	2.84	39000	4.27
9000	1.78	20000	2.88	40000	4.33

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

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

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

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

14 APPENDIX F Abbreviations and acronyms

A	ampere
AC	alternating current
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

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