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839.01
Electrical

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TEST REPORT

ACCORDING TO: FCC part 90, subpart I and RSS-137 Issue 2:2009

FOR:

Telematics Wireless Ltd.

Roadside mini reader

Model: FP310RAM-X

Table of contents

1 Applicant information

Client name:	Telematics Wireless Ltd.
Address:	26 Hamelaha street, POB 1911, Holon, 58117, Israel
Telephone:	+972 3557 5706
Fax:	+972 3557 5703
E-mail:	itsikk@tlmw.com
Contact name:	Mr. Itsik Kanner

2 Equipment under test attributes

Product name:	Roadside mini reader
Product type:	Transceiver
Model(s):	FP310RAM-X
Serial number:	FCC0001
Hardware version:	B
Software release:	4.01
Receipt date	3/22/2010

3 Manufacturer information

Manufacturer name:	Telematics Wireless Ltd.
Address:	26 Hamelaha street, POB 1911, Holon, 58117, Israel
Telephone:	+972 3557 5706
Fax:	+972 3557 5703
E-Mail:	itsikk@tlmw.com
Contact name:	Mr. Itsik Kanner

4 Test details

Project ID:	20641
Location:	Hermon Laboratories Ltd. Harakevet Industrial Zone, Binyamina 30500, Israel
Test started:	3/22/2010
Test completed:	3/29/2010
Test specification(s):	FCC part 90, subpart I; RSS-137 Issue 2

5 Tests summary

Test	Status
Transmitter characteristics	
FCC part 90 Section 90.205(I)/ RSS-137 Section 6.4, Maximum output power	Pass
FCC part 90 Section 90.209/ RSS-137 Section 6.1 Occupied bandwidth	Pass
FCC part 90 Section 90.210/ RSS-137 Section 6.5.3, Emission mask	Pass
FCC part 90 Section 90.210/ RSS-137 Section 6.5.3, Radiated spurious emissions	Pass
FCC part 90 Section 90.210/ RSS-137 Section 6.5.3, Conducted spurious emissions	Pass
FCC part 90 Section 90.213/ RSS-137 Section 6.3, Frequency stability	Tested with no limit
FCC part 90 Section 2.1091/ RSS-Gen Section 5.5, RF radiation exposure evaluation	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. E. Plotnichenko, test engineer	March 29, 2010	
Reviewed by:	Mrs. M. Cherniavsky, certification engineer	April 11, 2010	
Approved by:	Mr. M. Nikishin, EMC and radio group manager	April 12, 2010	

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6 EUT description

6.1 General information

The EUT is a roadside reader of a vehicle identification system, operating at 915 MHz and utilizing an external antenna. The modulation is ASK. Data bit rate is 500 kbps.

6.2 Ports and lines

Port type	Port description	Conn. from	Conn. to	Qty.	Cable type	Cable length, m	Indoor / outdoor
Power	DC power	DC power supply	EUT	1	Unshielded	1.5	Indoor
Power	AC power	AC mains	DC power supply	1	Unshielded	1.5	Indoor
RF	Antenna	EUT	50 Ohm termination	1	Coax	1	Outdoor
Control	RS-232	EUT	Laptop	1	Shielded	1.5	Indoor
Signal	IO	EUT	Open circuit	1	Unshielded	1	Indoor
Power	AC power	AC mains	AC/DC adaptor	1	Unshielded	0.8	Indoor
Power	DC power	AC/DC adaptor	Laptop	1	Unshielded	2	Indoor
Telecom	Ethernet	Laptop	Open circuit	1	Unshielded	2	Indoor
Signal	USB	Laptop	Open circuit	1	Unshielded	2	Indoor
Signal	Audio	Laptop	Microphone	1	Unshielded	2	Indoor

6.3 Support and test equipment

Description	Manufacturer	Model number	Serial number
Antenna	OR ANTENNA	OR-900-930-8	033
Laptop	Dell	Latitude D650	HX8VV2J
DC power supply	Horizon Electronics	SR 60-25	72-7138
AC/DC adapter	Dell	90W-AC	CN-0DF2667161571F0161

6.4 Changes made in the EUT

No changes were implemented.

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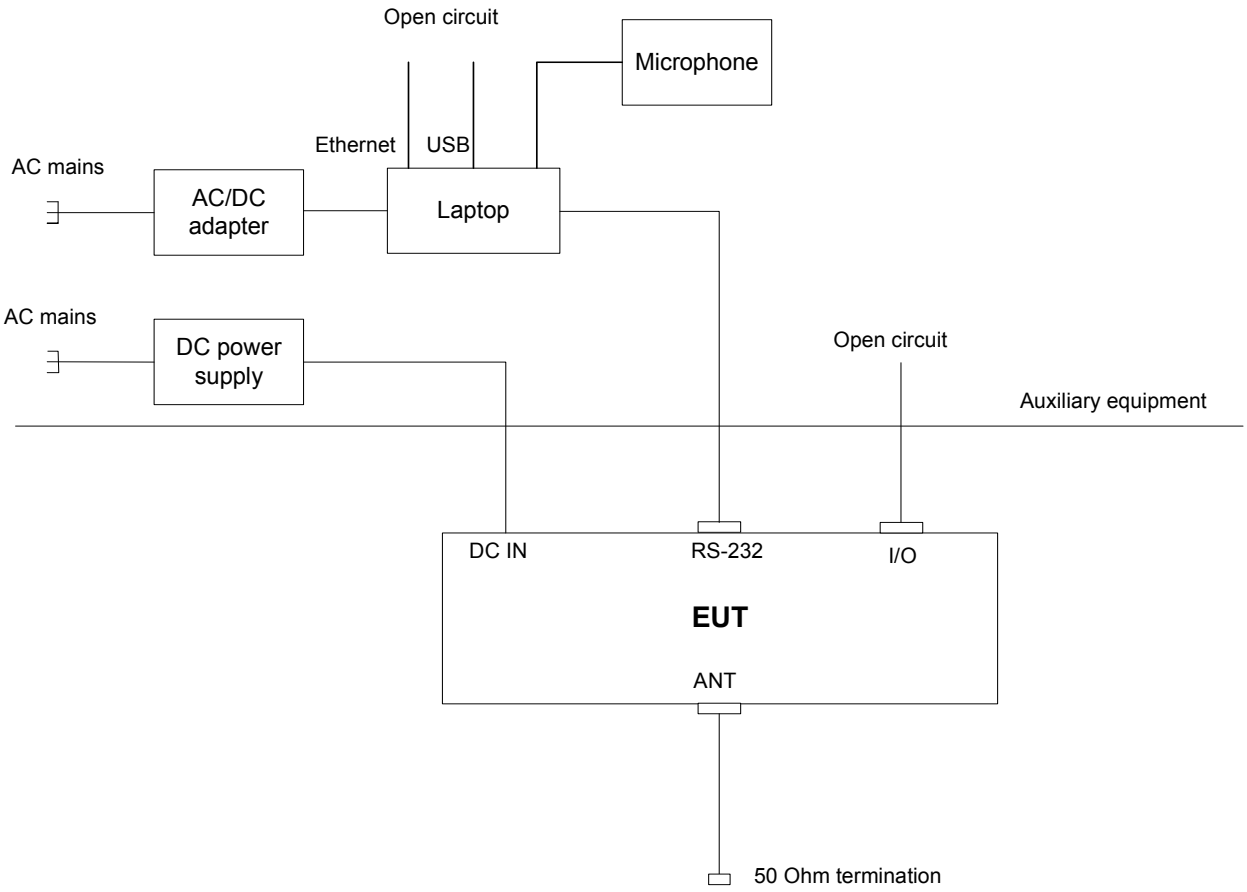
6.5 Test configuration



6.6 Transmitter characteristics

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

Intended use		**Condition of use**
X	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 - 928 MHz		
Operating frequencies	915 MHz		
Maximum rated output power	At transmitter 50 Ω RF output connector		18.25 dBm
	Effective radiated power (for equipment with no RF connector)		

Is transmitter output power variable?	X	No			
		Yes		continuous variable	
				stepped variable with stepsize	
			minimum RF power		
			maximum RF power		18.25 dBm

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

Antenna/s technical characteristics			
Type	Manufacturer	Model number	Gain
Flat	OR ANTENNA	OR-900-930-8	8 dBi

Transmitter 99% power bandwidth	5 MHz					
Transmitter aggregate data rate/s	0.5 Mbps					
Type of modulation	ASK					
Modulating test signal (baseband)	PRBS					
Maximum transmitter duty cycle in normal use	12 %	**Tx ON time**	1.2 ms	**Period**	10 ms	
Transmitter duty cycle supplied for test	12 %	**Tx ON time**	1.2 ms	**Period**	10 ms	

Transmitter power source						
	Battery	**Nominal rated voltage**	VDC	Battery type		
X	DC	**Nominal rated voltage**	12 VDC			
	AC mains	**Nominal rated voltage**	VAC	Frequency	Hz	

Common power source for transmitter and receiver	X	yes	no

Test specification:	FCC Section 90.205(l)/RSS-137 Section 6.4, Maximum output power		
Test procedure:	47 CFR, Section 2.1046; TIA/EIA-603-C, Section 2.2.1		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	3/29/2010 8:39:13 AM		
Temperature: 23.3 ºC	Air Pressure: 1018 hPa	Relative Humidity: 31 %	Power Supply: 12VDC
Remarks:			

7 Transmitter tests according to 47CFR part 90 and RSS-137 requirements

7.1 Peak output power test

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.

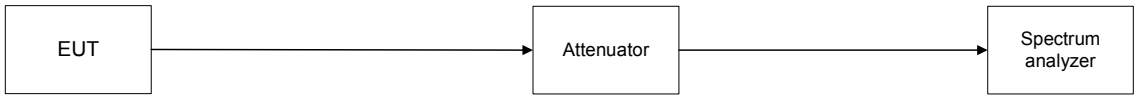
Table 7.1.1 Peak output power limits

Assigned frequency range, MHz	Maximum peak output power	
	W	dBm
902 - 928	30	44.7

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 Peak output power test setup



Test specification:	FCC Section 90.205(l)/RSS-137 Section 6.4, Maximum output power		
Test procedure:	47 CFR, Section 2.1046; TIA/EIA-603-C, Section 2.2.1		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	3/29/2010 8:39:13 AM		
Temperature: 23.3 ºC	Air Pressure: 1018 hPa	Relative Humidity: 31 %	Power Supply: 12VDC
Remarks:			

Table 7.1.2 Peak output power test results

OPERATING FREQUENCY RANGE:	902 – 928 MHz
DETECTOR USED:	Peak
RESOLUTION BANDWIDTH:	3000 kHz
VIDEO BANDWIDTH:	3000 kHz
MODULATION:	ASK
MODULATING SIGNAL:	PRBS
BIT RATE:	0.5 Mbps
TRANSMITTER OUTPUT POWER SETTINGS:	Maximum

Carrier frequency, MHz	SA reading, dBm	External attenuation, dB	Cable loss, dB	RF output power, dBm	Antenna gain, dBd	ERP, dBm	Limit, dBm	Margin, dB	Verdict
915.0	18.07	Included	0.18	18.25	5.85	24.10	44.7	-20.60	Pass

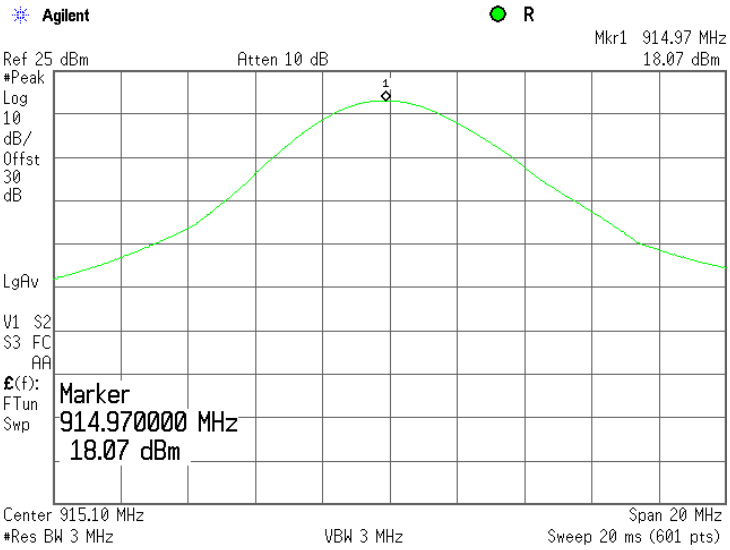
Reference numbers of test equipment used

HL 3440	HL 3474	HL 3784	HL 3818				

Full description is given in Appendix A.

Test specification:	FCC Section 90.205(l)/RSS-137 Section 6.4, Maximum output power		
Test procedure:	47 CFR, Section 2.1046; TIA/EIA-603-C, Section 2.2.1		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	3/29/2010 8:39:13 AM		
Temperature: 23.3 ºC	Air Pressure: 1018 hPa	Relative Humidity: 31 %	Power Supply: 12VDC
Remarks:			

Plot 7.1.1 Peak output power test result



Test specification:	FCC Section 90.209)/RSS-137 Section 6.1, Occupied bandwidth		
Test procedure:	47 CFR, Section 2.1049		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	3/25/2010 4:53:16 PM		
Temperature: 23.3 ºC	Air Pressure: 1018 hPa	Relative Humidity: 31 %	Power Supply: 12VDC
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

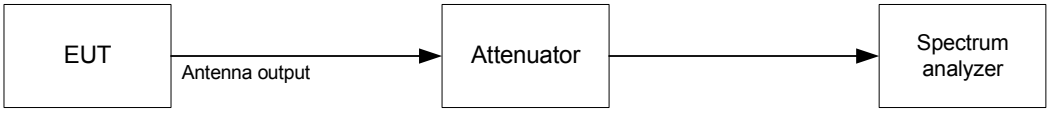
Assigned frequency, MHz	Modulation envelope reference points*, dBc / %power	Maximum allowed bandwidth, MHz
902 - 928	26 / 99	12

* - 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:	**FCC Section 90.209)/RSS-137 Section 6.1, Occupied bandwidth**		
Test procedure:	47 CFR, Section 2.1049		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	3/25/2010 4:53:16 PM		
Temperature: 23.3 ºC	**Air Pressure:** 1018 hPa	**Relative Humidity:** 31 %	**Power Supply:** 12VDC
Remarks:			

Table 7.2.2 Occupied bandwidth test results

STANDARD REFERENCE:	Part 90 subpart M
DETECTOR USED:	Peak hold
RESOLUTION BANDWIDTH:	51 kHz
VIDEO BANDWIDTH:	51 kHz
MODULATION ENVELOPE REFERENCE POINTS:	26 dBc
MODULATION:	ASK
MODULATING SIGNAL:	PRBS
BIT RATE:	500 kbps

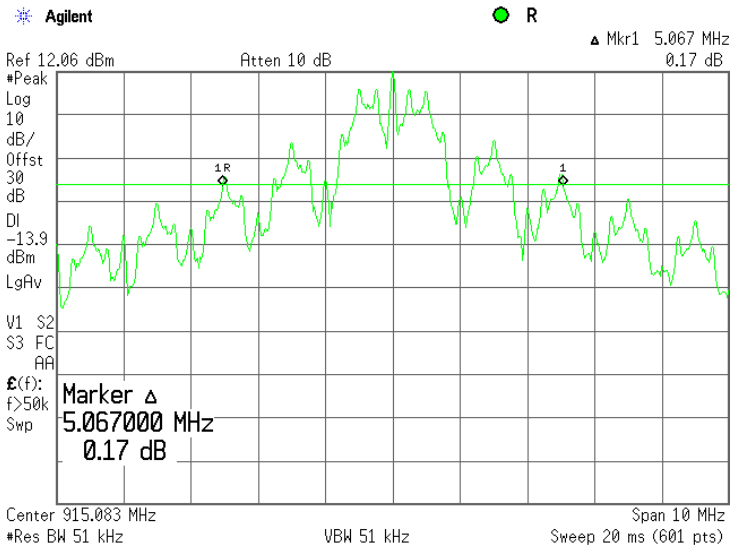
Carrier frequency, MHz	Occupied bandwidth, MHz	Limit, MHz	Margin, MHz	Verdict
915.08	5.067	12	6.933	Pass

Reference numbers of test equipment used

HL 3440	HL 3474	HL 3784	HL 3818				

Full description is given in Appendix A.

Plot 7.2.1 Occupied bandwidth test result



Test specification:	FCC Section 90.209)/RSS-137 Section 6.1, Occupied bandwidth		
Test procedure:	47 CFR, Section 2.1049		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	3/25/2010 4:53:16 PM		
Temperature: 23.3 ºC	Air Pressure: 1018 hPa	Relative Humidity: 31 %	Power Supply: 12VDC
Remarks:			

Table 7.2.3 Occupied bandwidth test results

STANDARD REFERENCE:	RSS-137 (RSS-Gen)
DETECTOR USED:	Peak hold
RESOLUTION BANDWIDTH:	100 kHz
VIDEO BANDWIDTH:	300 kHz
MODULATION ENVELOPE REFERENCE POINTS:	99% power
MODULATION:	ASK
MODULATING SIGNAL:	PRBS
BIT RATE:	500 kbps

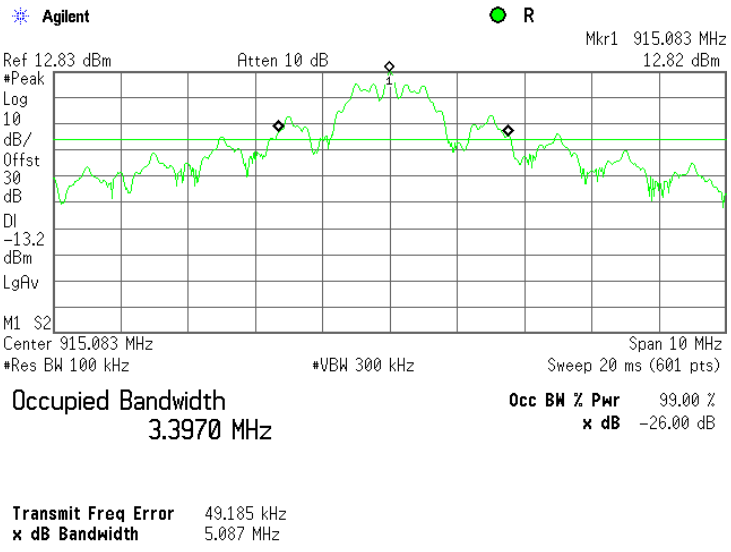
Carrier frequency, MHz	Occupied bandwidth, MHz	Limit, MHz	Margin, MHz	Verdict
915.08	3.397	12	8.603	Pass

Reference numbers of test equipment used

HL 3440	HL 3474	HL 3784	HL 3818				

Full description is given in Appendix A.

Plot 7.2.2 Occupied bandwidth test result



Test specification:	FCC Section 90.210(k)(3)/RSS-137 Section 6.5.3, Emission mask		
Test procedure:	47 CFR, Sections 2.1051, 2.1047 and 90.210(m); TIA/EIA-603-C, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	3/22/2010 3:11:55 PM		
Temperature: 23.3 ºC	Air Pressure: 1018 hPa	Relative Humidity: 31 %	Power Supply: 12VDC
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

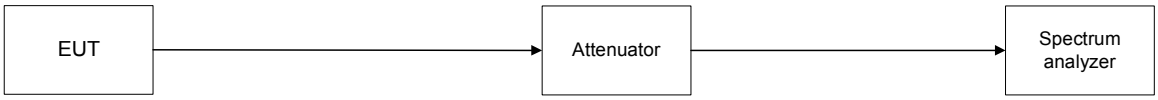
Frequency displacement from carrier	Attenuation below carrier, dBc
FCC section 90.210 emission mask K/RSS-137 section 6.5.3 emission mask C	
909.75 – 921.75 MHz	0
Below 909.75 MHz	55+10logP(W)
Above 921.75 MHz	55+10logP(W)

* - linearly increase with frequency
** - emission mask includes carrier modulation envelope within ± 250 % of the authorized bandwidth; the frequency range removed beyond ± 250 % of the authorized bandwidth from carrier was investigated as spurious emission

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 are provided in Table 7.3.2 and the associated plots.

Figure 7.3.1 Emission mask test setup



Test specification:	FCC Section 90.210(k)(3)/RSS-137 Section 6.5.3, Emission mask		
Test procedure:	47 CFR, Sections 2.1051, 2.1047 and 90.210(m); TIA/EIA-603-C, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	3/22/2010 3:11:55 PM		
Temperature: 23.3 ºC	Air Pressure: 1018 hPa	Relative Humidity: 31 %	Power Supply: 12VDC
Remarks:			

Table 7.3.2 Emission mask test results

Carrier frequency, MHz	Limit	Verdict
915	Emission mask K (FCC) / C (RSS-137)	Pass

Reference numbers of test equipment used

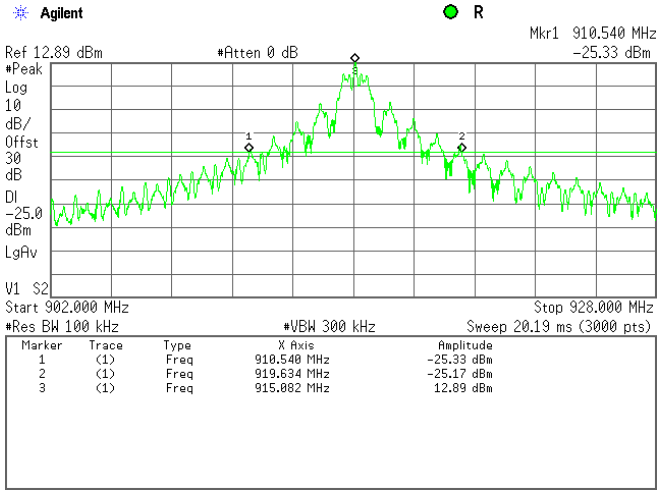
HL 3440	HL 3474	HL 3784	HL 3818				

Full description is given in Appendix A.

Test specification:	FCC Section 90.210(k)(3)/RSS-137 Section 6.5.3, Emission mask		
Test procedure:	47 CFR, Sections 2.1051, 2.1047 and 90.210(m); TIA/EIA-603-C, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	3/22/2010 3:11:55 PM		
Temperature: 23.3 ºC	Air Pressure: 1018 hPa	Relative Humidity: 31 %	Power Supply: 12VDC
Remarks:			

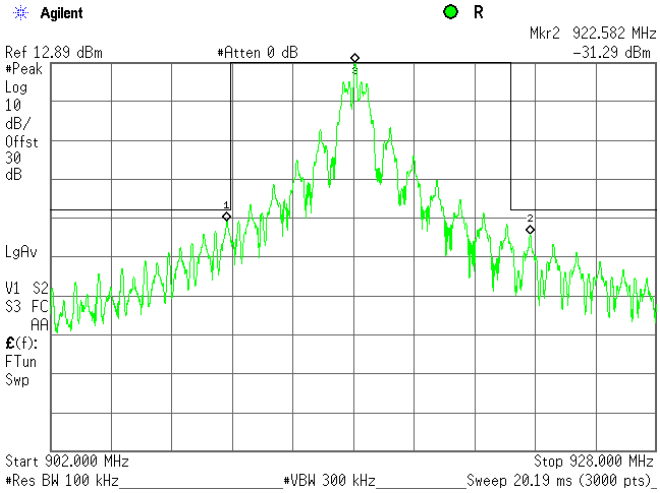
Plot 7.3.1 Emission mask test results at spurious limit level

ASSIGNED FREQUENCY RANGE:	902 -928 MHz
DETECTOR USED:	Peak
MODULATION:	ASK
MODULATING SIGNAL:	PRBS
BIT RATE:	0.5 Mbps
TRANSMITTER OUTPUT POWER SETTINGS:	Maximum



Plot 7.3.2 Emission mask test results at the frequency edges

ASSIGNED FREQUENCY RANGE:	902 -928 MHz
DETECTOR USED:	Peak
MODULATION:	ASK
MODULATING SIGNAL:	PRBS
BIT RATE:	0.5 Mbps
TRANSMITTER OUTPUT POWER SETTINGS:	Maximum



Test specification:	FCC Section 90.210 / RSS-137 Section 6.5.3, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-C, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	3/25/2010 5:30:27 PM		
Temperature: 22 ºC	Air Pressure: 1014 hPa	Relative Humidity: 42 %	Power Supply: 12VDC
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*	55+10logP**	-25	72.4

* - Excluding the in band emission within ± 250 % of the authorized bandwidth from the carrier
** - P is transmitter output power in Watts
*** - 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:	FCC Section 90.210 / RSS-137 Section 6.5.3, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-C, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	3/25/2010 5:30:27 PM		
Temperature: 22 ºC	Air Pressure: 1014 hPa	Relative Humidity: 42 %	Power Supply: 12VDC
Remarks:			

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

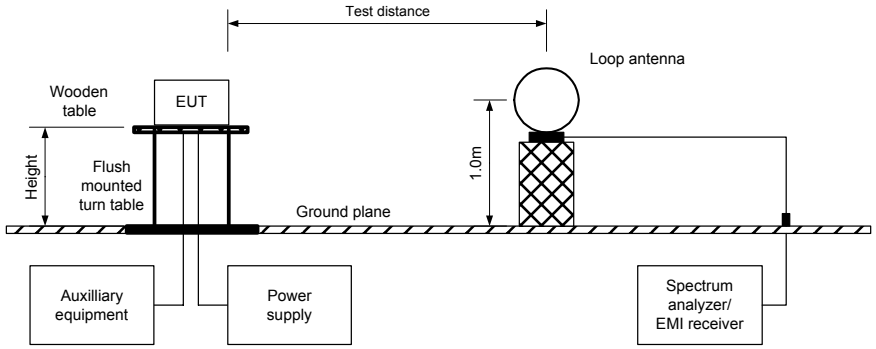
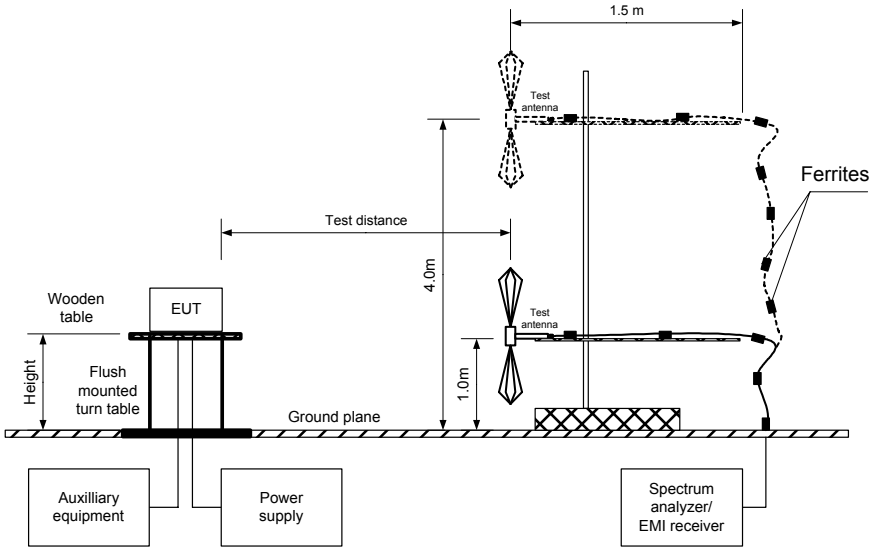
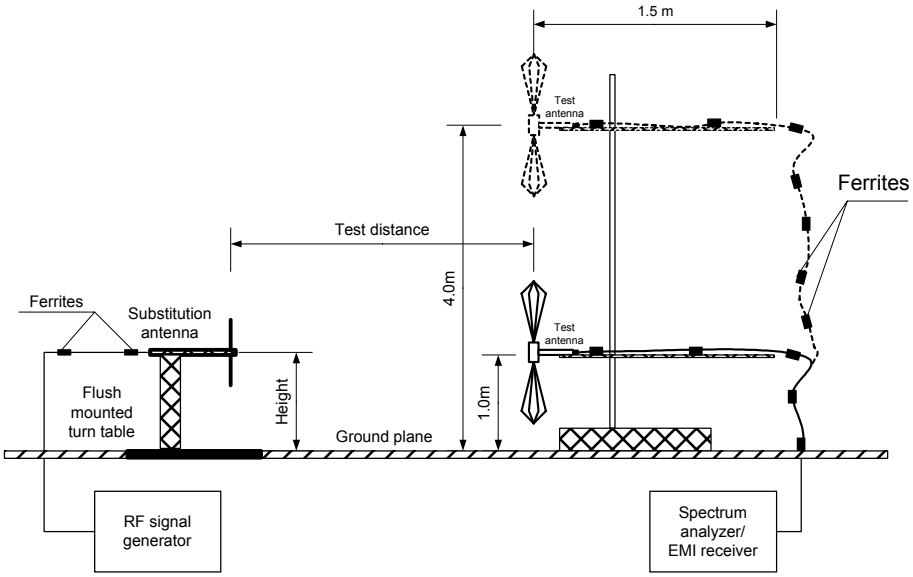


Figure 7.4.2 Setup for spurious emission field strength measurements above 30 MHz



Test specification:	FCC Section 90.210 / RSS-137 Section 6.5.3, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-C, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	3/25/2010 5:30:27 PM		
Temperature: 22 ºC	Air Pressure: 1014 hPa	Relative Humidity: 42 %	Power Supply: 12VDC
Remarks:			

Figure 7.4.3 Setup for substitution ERP measurements of spurious



Test specification:	**FCC Section 90.210 / RSS-137 Section 6.5.3, Radiated spurious emissions**		
Test procedure:	47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-C, Section 2.2.12		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	3/25/2010 5:30:27 PM		
Temperature: 22 ºC	**Air Pressure:** 1014 hPa	**Relative Humidity:** 42 %	**Power Supply:** 12VDC
Remarks:			

Table 7.4.2 Spurious emission field strength test results

ASSIGNED FREQUENCY RANGE:	902 - 928 MHz
TEST DISTANCE:	3 m
EUT HEIGHT:	0.8 m
INVESTIGATED FREQUENCY RANGE:	0.009 – 9150 MHz
DETECTOR USED:	Peak
VIDEO BANDWIDTH:	> Resolution bandwidth
TEST ANTENNA TYPE:	Active loop (9 kHz – 30 MHz); Biconilog (30 MHz – 1000 MHz) Double ridged guide (above 1000 MHz)
MODULATION:	ASK
MODULATING SIGNAL:	PRBS
BIT RATE:	0.5 Mbps
TRANSMITTER OUTPUT POWER SETTINGS:	Maximum
TEST SITE:	OATS

Frequency, MHz	Field strength, dB(μV/m)	Limit, dB(μV/m)	Margin, dB*	RBW, kHz	Antenna polarization	Antenna height, m	Turn-table position**, degrees
1830.16	52.00	72.4	-20.40	100	Horizontal	1.2	180

*- 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:	902 – 928 MHz
TRANSMITTER CARRIER ERP:	18.25 dBm
TEST DISTANCE:	3 m
SUBSTITUTION ANTENNA HEIGHT:	0.8 m
DETECTOR USED:	Peak
VIDEO BANDWIDTH:	> Resolution bandwidth
SUBSTITUTION ANTENNA TYPE:	Double ridged guide (above 1000 MHz)
TEST SITE:	OATS

Frequency MHz	Field strength, dB(μV/m)	RBW, kHz	Antenna polarization	RF generator output, dBm	Ant gain dBd	Cable loss, dB	ERP, dBm	Limit, dBm	Margin, dB*	Verdict
1830.16	52.00	100	Horizontal	-48.5	6.40	2.25	-44.34	-25.00	-19.34	Pass

*- Margin = Spurious emission – specification limit.

Reference numbers of test equipment used

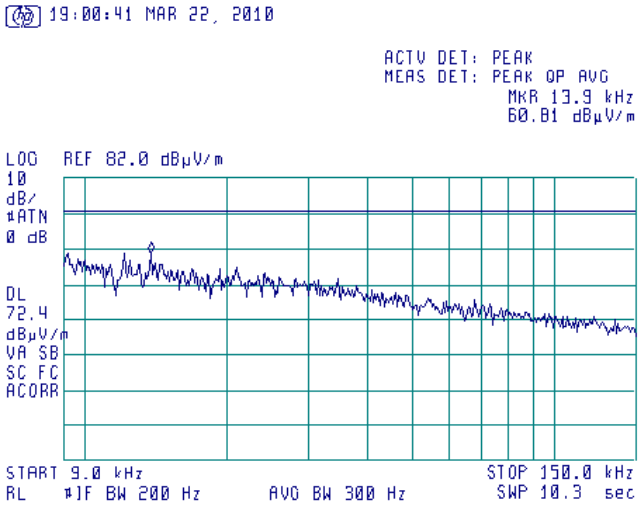
HL 0446	HL 0521	HL 0604	HL 0661	HL 1984	HL 2432	HL 2871	HL 3343
HL 3474	HL 3615	HL 3634	HL 3818				

Full description is given in Appendix A.

Test specification:	FCC Section 90.210 / RSS-137 Section 6.5.3, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-C, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	3/25/2010 5:30:27 PM		
Temperature: 22 ºC	Air Pressure: 1014 hPa	Relative Humidity: 42 %	Power Supply: 12VDC
Remarks:			

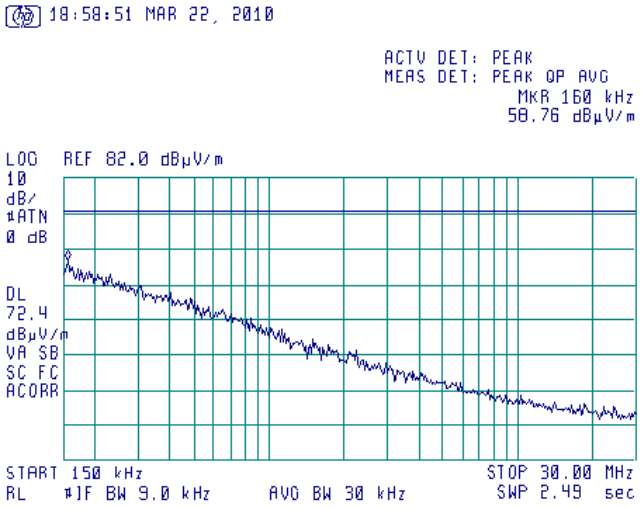
Plot 7.4.1 Radiated emission measurements in 9 - 150 kHz range

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



Plot 7.4.2 Radiated emission measurements in 0.15 - 30 MHz range

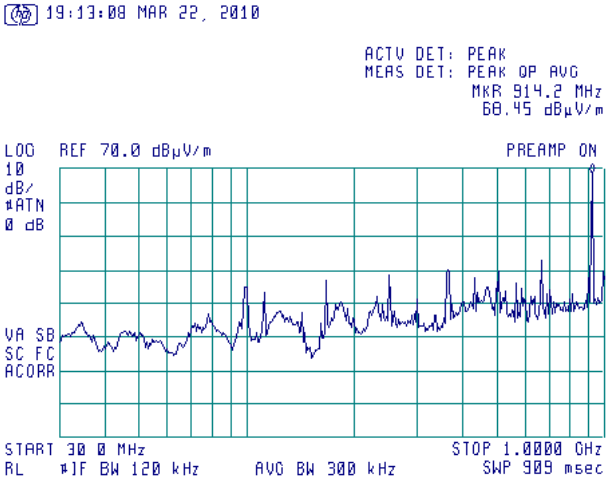
TEST SITE:	Semi anechoic chamber
ANTENNA POLARIZATION:	Vertical and Horizontal
TEST DISTANCE:	3 m



Test specification:	FCC Section 90.210 / RSS-137 Section 6.5.3, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-C, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	3/25/2010 5:30:27 PM		
Temperature: 22 ºC	Air Pressure: 1014 hPa	Relative Humidity: 42 %	Power Supply: 12VDC
Remarks:			

Plot 7.4.3 Radiated emission measurements in 30 - 1000 MHz range

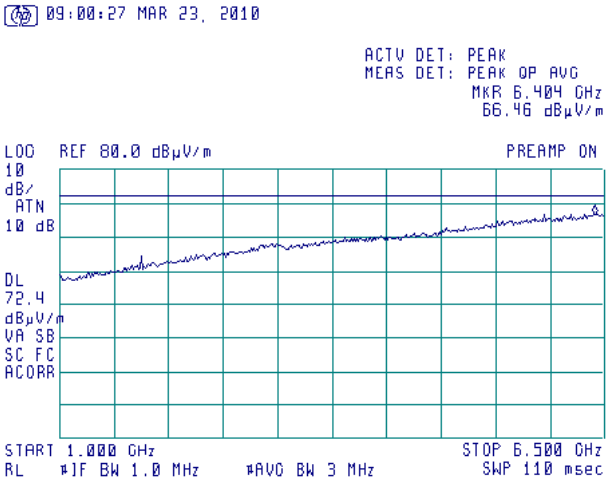
TEST SITE:	Semi anechoic chamber
ANTENNA POLARIZATION:	Vertical and Horizontal
TEST DISTANCE:	3 m



Note: 915 MHz is the carrier frequency. All emissions in 30 – 1000 MHz are caused by the digital part of the EUT and auxiliary laptop, were investigated in the receive/standby mode under the more stringent limits.

Plot 7.4.4 Radiated emission measurements in 1000 – 6500 MHz range

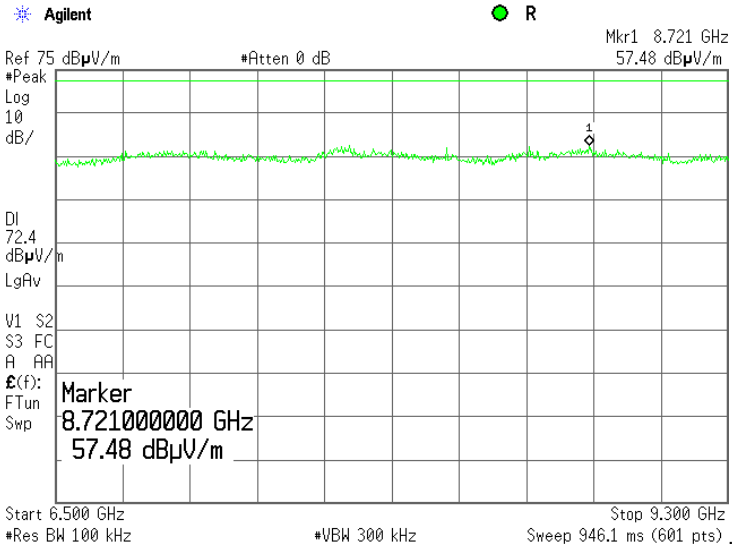
TEST SITE:	Semi anechoic chamber
CARRIER FREQUENCY:	High
ANTENNA POLARIZATION:	Vertical and Horizontal
TEST DISTANCE:	3 m



Test specification:	**FCC Section 90.210 / RSS-137 Section 6.5.3, Radiated spurious emissions**		
Test procedure:	47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-C, Section 2.2.12		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	3/25/2010 5:30:27 PM		
Temperature: 22 ºC	**Air Pressure:** 1014 hPa	**Relative Humidity:** 42 %	**Power Supply:** 12VDC
Remarks:			

Plot 7.4.5 Radiated emission measurements in 6500 – 9150 MHz range

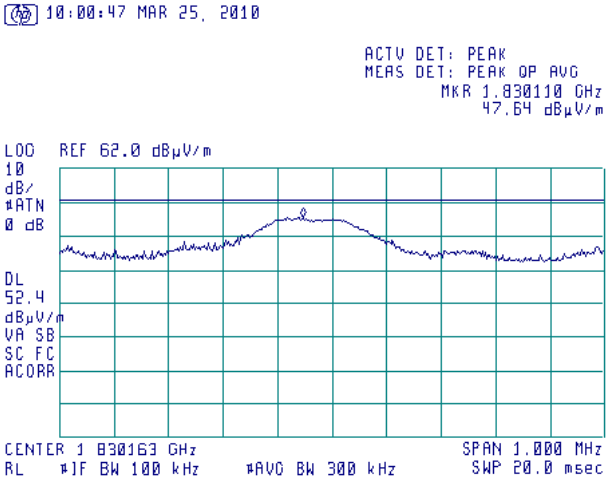
TEST SITE:	Semi anechoic chamber
CARRIER FREQUENCY:	High
ANTENNA POLARIZATION:	Vertical and Horizontal
TEST DISTANCE:	3 m



Test specification:	FCC Section 90.210 / RSS-137 Section 6.5.3, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-C, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	3/25/2010 5:30:27 PM		
Temperature: 22 ºC	Air Pressure: 1014 hPa	Relative Humidity: 42 %	Power Supply: 12VDC
Remarks:			

Plot 7.4.6 Radiated emission measurements at the 2nd harmonic

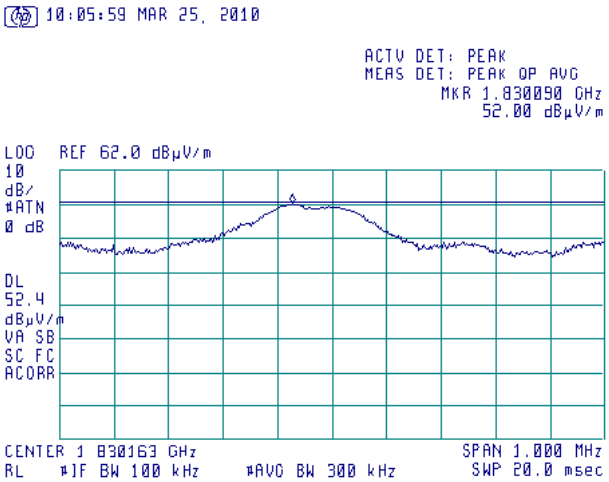
TEST SITE: Anechoic chamber
ANTENNA POLARIZATION: Vertical
TEST DISTANCE: 3 m



Note: The limit is 72.4 dBuV/m

Plot 7.4.7 Radiated emission measurements at the 2nd harmonic

TEST SITE: Anechoic chamber
ANTENNA POLARIZATION: Horizontal
TEST DISTANCE: 3 m



Note: The limit is 72.4 dBuV/m

Test specification:	Section 90.210 / RSS-137 Section 6.5.3, Conducted spurious emissions		
Test procedure:	47 CFR, Sections 2.1051 and 90.210(m); TIA/EIA-603-C, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	3/29/2010 8:45:01 AM		
Temperature: 23.3 ºC	Air Pressure: 1018 hPa	Relative Humidity: 31 %	Power Supply: 12VDC
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. The test results are provided in Table 7.5.2 and associated plots.

Table 7.5.1 Spurious emission limits

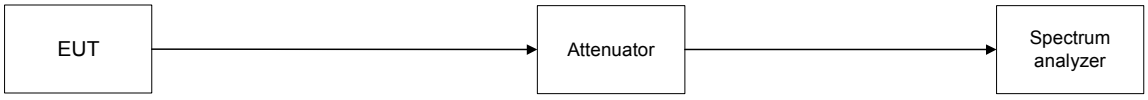
Frequency, MHz	Attenuation below carrier, dBc	ERP of spurious, dBm
0.009 – 10th harmonic*	55+10logP**	-25.0

* - Spurious emission limits do not apply to the inside the licensee's sub-band edge (909.75 – 921.75MHz)
** - 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 associated plots.

Figure 7.5.1 Spurious emission test setup



Test specification:	**Section 90.210 / RSS-137 Section 6.5.3, Conducted spurious emissions**		
Test procedure:	47 CFR, Sections 2.1051 and 90.210(m); TIA/EIA-603-C, Section 2.2.13		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	3/29/2010 8:45:01 AM		
Temperature: 23.3 ºC	**Air Pressure:** 1018 hPa	**Relative Humidity:** 31 %	**Power Supply:** 12VDC
Remarks:			

Table 7.5.2 Spurious emission test results

ASSIGNED FREQUENCY RANGE: 902 - 928 MHz
INVESTIGATED FREQUENCY RANGE: 0.009 – 9300 MHz
DETECTOR USED: Peak
VIDEO BANDWIDTH: ≥ Resolution bandwidth
MODULATION: ASK
MODULATING SIGNAL: PRBS
BIT RATE: 0.5Mbps
TRANSMITTER OUTPUT POWER SETTINGS: Maximum
TRANSMITTER OUTPUT POWER: 18.25 dBm

Frequency, MHz	SA reading, dBm	Attenuator, dB	Cable loss, dB	RBW, kHz	Spurious emission, dBm	Limit, dBm	Margin, dB*	Verdict
883.091	-45.09	Included	0.18	100	-44.91	-25	-19.91	Pass
947.089	-45.98	Included	0.18	100	-45.80	-25	-20.80	
1830.163	-27.82	Included	0.46	1000	-27.36	-25	-2.36	

*- Margin = Spurious emission – specification limit.

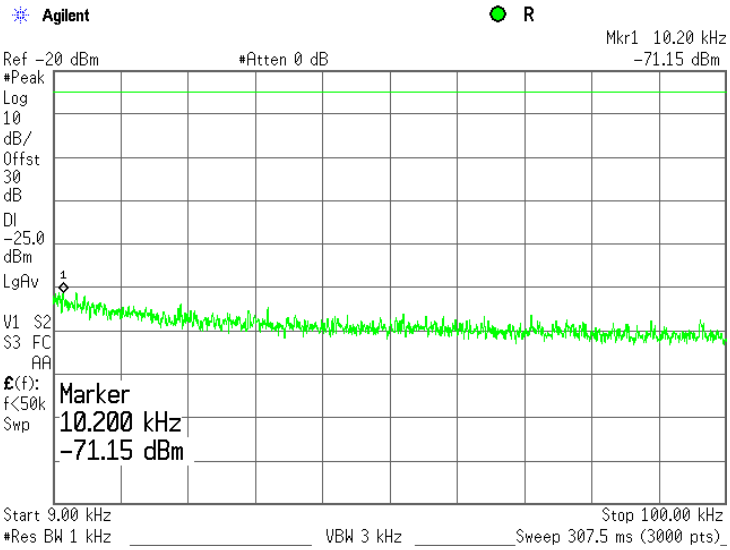
Reference numbers of test equipment used

HL 3341	HL 3440	HL 3474	HL 3784	HL 3818			

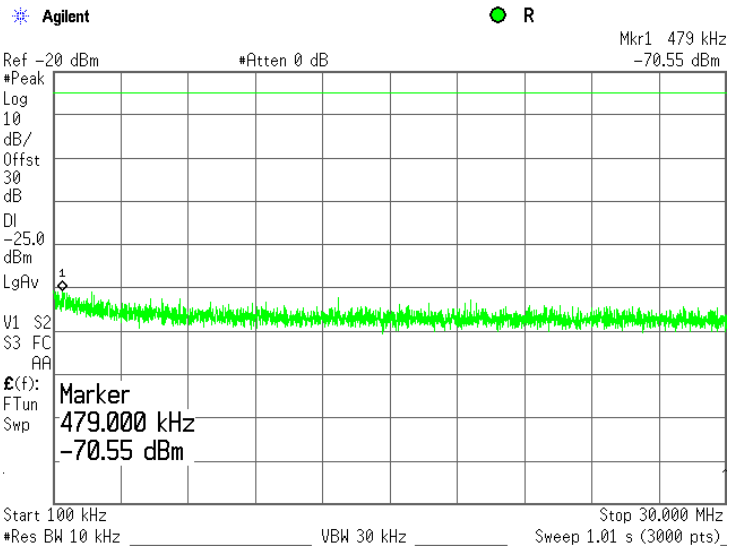
Full description is given in Appendix A.

Test specification:	Section 90.210 / RSS-137 Section 6.5.3, Conducted spurious emissions		
Test procedure:	47 CFR, Sections 2.1051 and 90.210(m); TIA/EIA-603-C, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	3/29/2010 8:45:01 AM		
Temperature: 23.3 ºC	Air Pressure: 1018 hPa	Relative Humidity: 31 %	Power Supply: 12VDC
Remarks:			

Plot 7.5.1 Spurious emission measurements in 9 - 100 kHz range

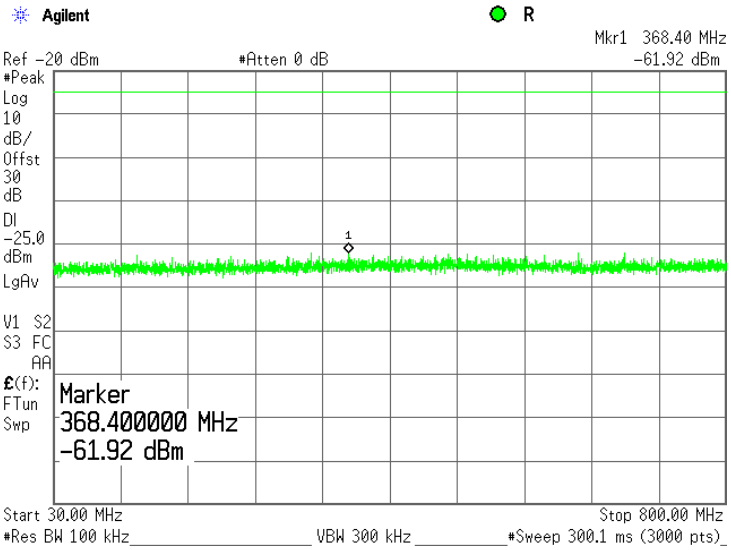


Plot 7.5.2 Spurious emission measurements in 0.10 – 30.0 MHz range

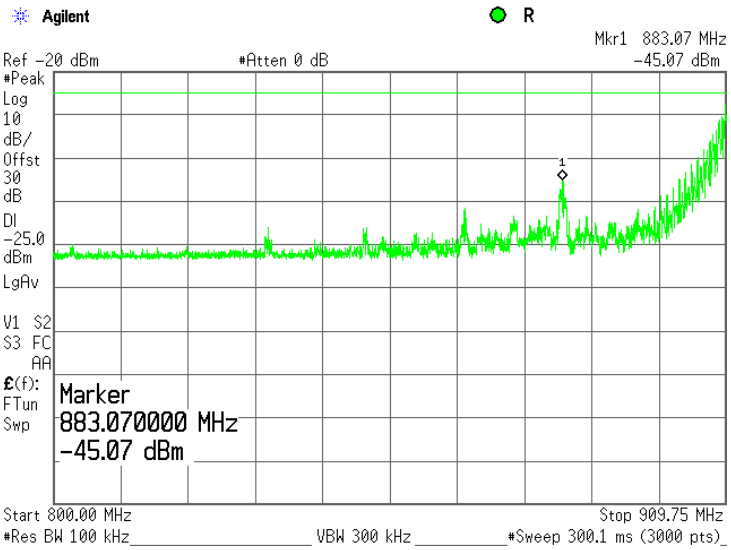


Test specification:	Section 90.210 / RSS-137 Section 6.5.3, Conducted spurious emissions		
Test procedure:	47 CFR, Sections 2.1051 and 90.210(m); TIA/EIA-603-C, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	3/29/2010 8:45:01 AM		
Temperature: 23.3 ºC	Air Pressure: 1018 hPa	Relative Humidity: 31 %	Power Supply: 12VDC
Remarks:			

Plot 7.5.3 Spurious emission measurements in 30 - 800 MHz

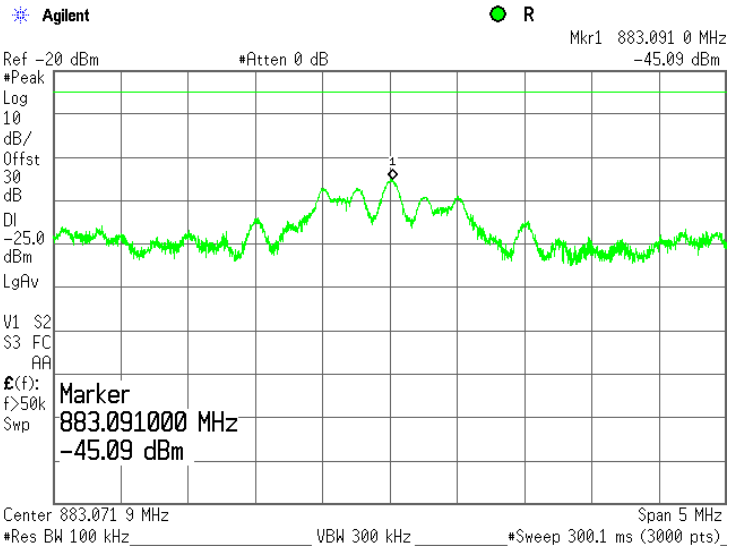


Plot 7.5.4 Spurious emission measurements in 800.0 – 909.75 MHz range

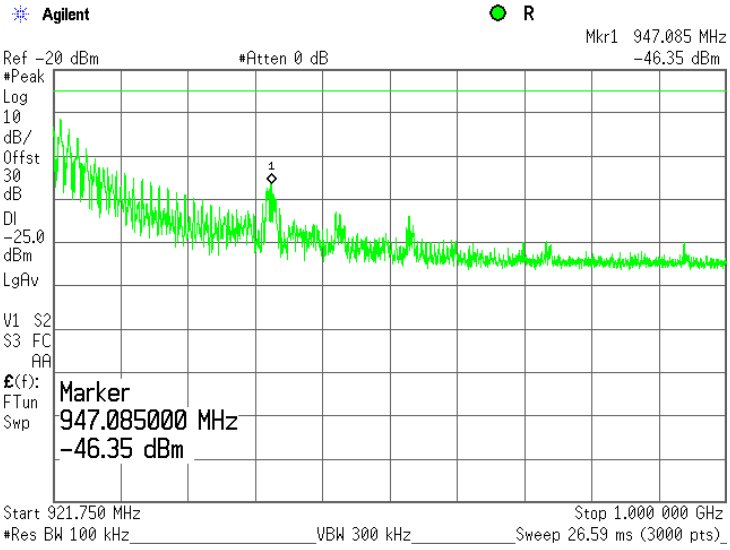


Test specification:	Section 90.210 / RSS-137 Section 6.5.3, Conducted spurious emissions		
Test procedure:	47 CFR, Sections 2.1051 and 90.210(m); TIA/EIA-603-C, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	3/29/2010 8:45:01 AM		
Temperature: 23.3 ºC	Air Pressure: 1018 hPa	Relative Humidity: 31 %	Power Supply: 12VDC
Remarks:			

Plot 7.5.5 Spurious emission measurements at 883.09 MHz

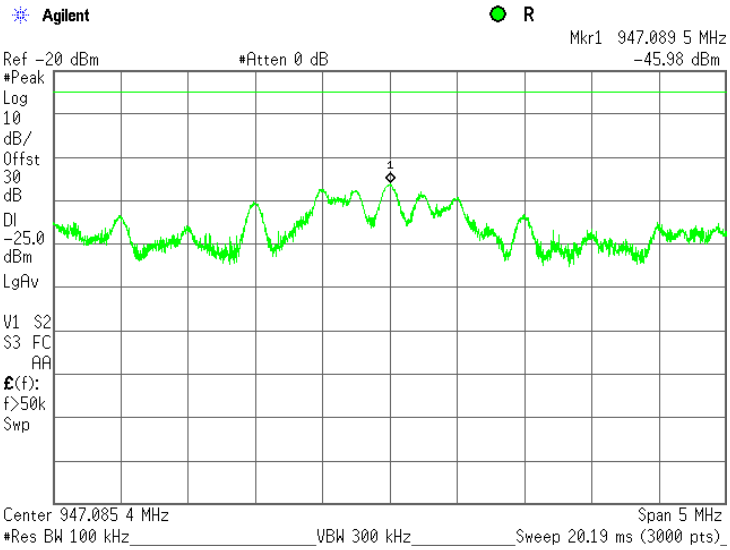


Plot 7.5.6 Spurious emission measurements in 921.75 - 1000 MHz

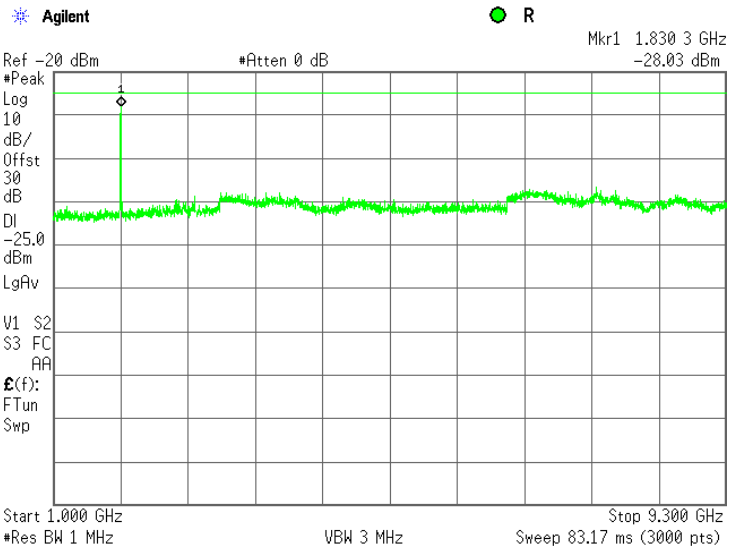


Test specification:	Section 90.210 / RSS-137 Section 6.5.3, Conducted spurious emissions		
Test procedure:	47 CFR, Sections 2.1051 and 90.210(m); TIA/EIA-603-C, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	3/29/2010 8:45:01 AM		
Temperature: 23.3 ºC	Air Pressure: 1018 hPa	Relative Humidity: 31 %	Power Supply: 12VDC
Remarks:			

Plot 7.5.7 Spurious emission measurements at 947.09 MHz

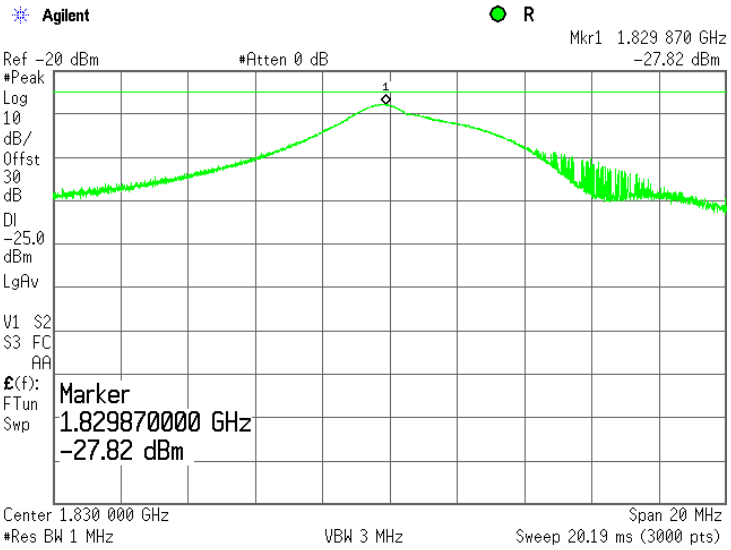


Plot 7.5.8 Spurious emission measurements in 1000 - 9300 MHz



Test specification:	**Section 90.210 / RSS-137 Section 6.5.3, Conducted spurious emissions**		
Test procedure:	47 CFR, Sections 2.1051 and 90.210(m); TIA/EIA-603-C, Section 2.2.13		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	3/29/2010 8:45:01 AM		
Temperature: 23.3 ºC	**Air Pressure:** 1018 hPa	**Relative Humidity:** 31 %	**Power Supply:** 12VDC
Remarks:			

Plot 7.5.9 Conducted spurious emission measurements at the 2nd harmonic



Test specification:	Section 90.213 / RSS-137 Section 6.3, Frequency stability		
Test procedure:	47 CFR, Section 2.1055; TIA/EIA-603-C Section 2.2.2		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	3/25/2010 4:39:58 PM		
Temperature: 24 ºC	Air Pressure: 1014 hPa	Relative Humidity: 42 %	Power Supply: 12VDC
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
915.0	2.5	2288

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.

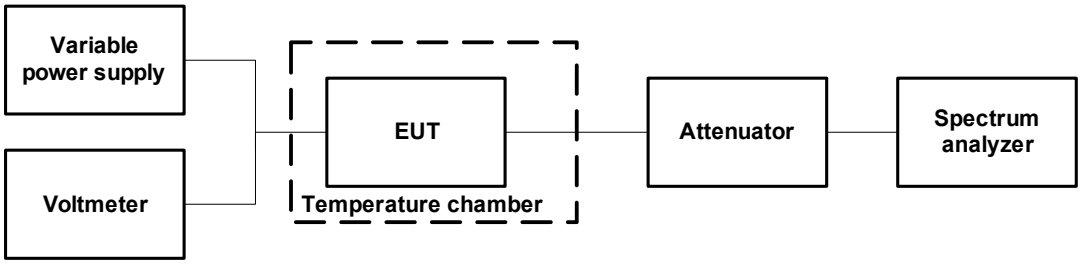
7.6.2.3 The EUT was powered on and carrier frequency was measured at start up moment and then every minute until frequency had been stabilized or 10 minutes elapsed whichever reached the last. The EUT was powered off.

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 / RSS-137 Section 6.3, Frequency stability**		
Test procedure:	47 CFR, Section 2.1055; TIA/EIA-603-C Section 2.2.2		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	3/25/2010 4:39:58 PM		
Temperature: 24 ºC	**Air Pressure:** 1014 hPa	**Relative Humidity:** 42 %	**Power Supply:** 12VDC
Remarks:			

Table 7.6.2 Frequency stability test results

OPERATING FREQUENCY: 915 MHz
NOMINAL POWER VOLTAGE: 12 VDC
TEMPERATURE STABILIZATION PERIOD: 20 min
POWER DURING TEMPERATURE TRANSITION: Off
SPECTRUM ANALYZER MODE: Counter
RESOLUTION BANDWIDTH: 1000 Hz
VIDEO BANDWIDTH: 1000 Hz
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	915.04100	915.04095	915.0353	915.03013	915.02556	915.02047	915.01975	0	79460	2288	77172	NA
-20	nominal	915.02567	NA	NA	NA	NA	NA	915.03429	0	73540		71252	
-10	nominal	915.04845	NA	NA	NA	NA	NA	915.05645	0	50760		48472	
0	nominal	915.08083	915.08155	915.08215	915.08278	915.08300	915.08316	915.08378	0	18380		16092	
10	nominal	915.09370	NA	NA	NA	NA	NA	915.09525	0	5510		3222	
20	+15%	915.09900	NA	NA	NA	NA	NA	915.09746	0	1750		-538	
20	nominal	915.09856	NA	NA	NA	NA	NA	**915.09921***	0	650		1638	
20	-15%	915.10005	NA	NA	NA	NA	NA	915.09699	840	2220		-68	
30	nominal	915.09613	915.09516	915.09491	915.09488	915.09486	915.09484	915.09487	0	4340		2052	
40	nominal	915.08231	NA	NA	NA	NA	NA	915.08103	0	18180		15892	
50	nominal	915.06800	NA	NA	NA	NA	NA	915.05810	0	41110		38822	

* - Reference frequency
Note: According to Note 13 of – FCC 47 CFR part 90 subpart I §90.213 (a) “Fixed non-multilateration transmitters with an authorized bandwidth is more than 40 kHz from the band edge are not subject to frequency tolerance restrictions”
According to occupied bandwidth test, authorized bandwidth is more than 40 kHz from the band edges.

Reference numbers of test equipment used

HL 0493	HL 1791	HL 3233	HL 3440	HL 3784			

Full description is given in Appendix A.

Test specification:	Section 2.1091 / RSS-Gen Section 5.5, RF radiation exposure evaluation		
Test procedure:	47 CFR, Section 1.1307(b)1		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	3/25/2010 4:26:38 PM		
Temperature: 24 ºC	Air Pressure: 1014 hPa	Relative Humidity: 42 %	Power Supply: 12VDC
Remarks:			

7.7 RF exposure

7.7.1 General

This test was performed to determine the minimum safe distance between the transmitter antenna and human to avoid public exposure in excess of limits for general population (uncontrolled exposure). Specification test limits are given in Table 7.7.1.

7.7.2 Safe distance calculation for fixed transmitter

The minimum safe distance was calculated from the following equation as provided in Table 7.7.1:

$$r = sqrt[P \times G / (4 \times \pi \times S)],$$

Where S is power density in mw/cm^2, P is the transmitter output power in mW, G is the transmitter antenna numeric gain and r is distance to transmit antenna in cm.
With power density equal to the RF exposure limit the minimum safe distance was calculated according to the following equation: $r = sqrt[P \times G / (4 \times \pi \times S])$

Table 7.7.1 Safe distance calculation

ASSIGNED FREQUENCY: 902 - 928 MHz
EQUIPMENT INTENDED USE: Fixed*

Carrier frequency, MHz	Peak output power, dBm	Antenna gain, dBi	EIRP		Power density limit, mw/cm^2	Safe distance, cm	Intended separation, m	Verdict
			dBm	W				
915.0	18.25	8	26.25	0.422	0.61	7.42	2.0	Pass

* - The equipment deemed fixed as intended for use at a distance of more than 2.0 m from humans.

8 APPENDIX A Test equipment and ancillaries used for tests

HL No	Description	Manufacturer	Model	Ser. No.	Last Cal.	Due Cal.
0446	Antenna, Loop, Active, 10 kHz - 30 MHz	EMCO	6502	2857	29-Jun-09	29-Jun-10
0493	Temperature Chamber -45…175 deg C	Thermotron	S-1.2 Mini-Max	14016	13-May-09	13-May-10
0521	EMI Receiver (Spectrum Analyzer) with RF filter section 9 kHz-6.5 GHz	Hewlett Packard	8546A	3617A 00319, 3448A002 53	27-Aug-09	27-Aug-10
0604	Antenna BiconiLog Log-Periodic/T Bow-TIE, 26 - 2000 MHz	EMCO	3141	9611-1011	11-Jan-10	11-Jan-11
0661	Generator Swept Signal, 10 MHz to 40 GHz, + 10 dBm	HP	83640B	3614A002 66	17-Dec-09	17-Dec-10
1791	Laboratory DC Power Supply, Dual Tracking Output	RACOM	PS-404	8800692	14-Oct-09	14-Oct-10
1984	Antenna, Double-Ridged Waveguide Horn, 1-18 GHz, 300 W	EMC Test Systems	3115	9911-5964	29-Jan-10	29-Jan-11
2432	Antenna, Double-Ridged Waveguide Horn 1-18 GHz	EMC Test Systems	3115	00027177	29-Jan-10	29-Jan-11
2871	Microwave Cable Assembly, 18 GHz, 6.4 m, SMA - SMA	Huber-Suhner	198-8155-00	2871	15-Sep-09	15-Sep-10
3233	Multimeter	Fluke	115C	93771523	05-Jul-09	05-Jul-10
3341	High Pass Filter, 50 Ohm, 1400 to 5000 MHz.	Mini-Circuits	VHF-1300+	NA	05-Oct-09	05-Oct-10
3343	High Pass Filter, 50 Ohm, 2650 to 6500 MHz	Mini-Circuits	VHF-2700+	NA	05-Oct-09	05-Oct-10
3440	Precision Fixed Attenuator, 50 Ohm, 5 W, 20 dB, DC to 18 GHz	Mini-Circuits	BW-S20W5+	NA	07-Mar-10	07-Mar-11
3474	Cable, Coax, Microwave, DC-18 GHz, SMA-SMA, 0.6 m	Gore	GORE 65475	1640102	09-May-09	09-May-10
3615	Cable RF, 6.5 m, N type-N type, DC-6 GHz	Suhner Switzerland	RG 214/U	NA	27-May-09	27-May-10
3634	Cable RF, 5.5 m, N type-N type, DC-6.5 GHz	Alpha Wire	RG 214/U	NA	27-May-09	27-May-10
3784	Precision Fixed Attenuator, 50 Ohm, 5 W, 10 dB, DC to 18 GHz	Mini-Circuits	BW-S10W5+	NA	07-Dec-09	07-Dec-10
3818	PSA Series Spectrum Analyzer, 3 Hz- 44 GHz	Agilent Technologies	E4446A	MY482502 88	25-Sep-09	25-Sep-10

9 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 %

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.

10 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).

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11 APPENDIX D Specification references

FCC 47CFR part 90: 2009	Private land mobile radio services
FCC 47CFR part 1: 2009	Practice and procedure
FCC 47CFR part 2: 2009	Frequency allocations and radio treaty matters; general rules and regulations
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
RSS-137 Issue 2, February 2009	Location and monitoring service in the Band 902 - 928 MHz

12 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)
26	7.8	940	24.0
28	7.8	960	24.1
30	7.8	980	24.5
40	7.2	1000	24.9
60	7.1	1020	25.0
70	8.5	1040	25.2
80	9.4	1060	25.4
90	9.8	1080	25.6
100	9.7	1100	25.7
110	9.3	1120	26.0
120	8.8	1140	26.4
130	8.7	1160	27.0
140	9.2	1180	27.0
150	9.8	1200	26.7
160	10.2	1220	26.5
170	10.4	1240	26.5
180	10.4	1260	26.5
190	10.3	1280	26.6
200	10.6	1300	27.0
220	11.6	1320	27.8
240	12.4	1340	28.3
260	12.8	1360	28.2
280	13.7	1380	27.9
300	14.7	1400	27.9
320	15.2	1420	27.9
340	15.4	1440	27.8
360	16.1	1460	27.8
380	16.4	1480	28.0
400	16.6	1500	28.5
420	16.7	1520	28.9
440	17.0	1540	29.6
460	17.7	1560	29.8
480	18.1	1580	29.6
500	18.5	1600	29.5
520	19.1	1620	29.3
540	19.5	1640	29.2
560	19.8	1660	29.4
580	20.6	1680	29.6
600	21.3	1700	29.8
620	21.5	1720	30.3
640	21.2	1740	30.8
660	21.4	1760	31.1
680	21.9	1780	31.0
700	22.2	1800	30.9
720	22.2	1820	30.7
740	22.1	1840	30.6
760	22.3	1860	30.6
780	22.6	1880	30.6
800	22.7	1900	30.6
820	22.9	1920	30.7
840	23.1	1940	30.9
860	23.4	1960	31.2
880	23.8	1980	31.6
900	24.1	2000	32.0
920	24.1		

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

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

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

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

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

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

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

Cable loss
Cable coaxial, 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, Microwave, SMA-SMA, 18 GHz, 0.6 m
Gore, HL 3474

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	0.00	5000	0.44	10200	0.72	15500	0.84
30	0.02	5100	0.44	10300	0.68	15600	0.95
50	0.03	5200	0.44	10400	0.75	15700	0.82
100	0.03	5300	0.44	10500	0.64	15800	0.94
200	0.07	5400	0.46	10600	0.75	15900	0.91
300	0.10	5500	0.45	10700	0.80	16000	0.91
400	0.11	5600	0.46	10800	0.77	16100	0.86
500	0.12	5700	0.47	10900	0.80	16200	0.86
600	0.14	5800	0.48	11000	0.79	16300	0.86
700	0.14	5900	0.48	11100	0.70	16400	0.84
800	0.15	6000	0.49	11200	0.76	16500	0.83
900	0.18	6100	0.51	11300	0.70	16600	0.87
1000	0.17	6200	0.50	11400	0.73	16700	0.90
1100	0.18	6300	0.50	11500	0.67	16800	0.91
1200	0.21	6400	0.51	11600	0.74	16900	0.90
1300	0.20	6500	0.51	11700	0.64	17000	0.97
1400	0.21	6600	0.52	11800	0.68	17100	0.94
1500	0.22	6700	0.54	11900	0.67	17200	1.01
1600	0.23	6800	0.51	12000	0.71	17300	0.97
1700	0.23	6900	0.55	12100	0.64	17400	1.02
1800	0.24	7000	0.54	12200	0.64	17500	1.06
1900	0.25	7100	0.55	12300	0.71	17600	1.01
2000	0.27	7200	0.55	12400	0.62	17700	1.10
2100	0.26	7300	0.54	12500	0.80	17800	1.16
2200	0.28	7400	0.52	12600	0.69	17900	1.12
2300	0.28	7500	0.58	12700	0.85	18000	1.00
2400	0.28	7600	0.56	12800	0.67		
2500	0.29	7700	0.57	12900	0.84		
2600	0.30	7800	0.62	13000	0.76		
2700	0.31	7900	0.57	13100	0.85		
2800	0.32	8000	0.55	13200	0.77		
2900	0.32	8100	0.59	13300	0.82		
3000	0.32	8200	0.59	13400	0.79		
3100	0.33	8300	0.60	13500	0.82		
3200	0.33	8400	0.66	13600	0.91		
3300	0.35	8500	0.60	13700	0.81		
3400	0.35	8600	0.59	13800	0.76		
3500	0.36	8700	0.59	13900	0.75		
3600	0.36	8800	0.58	14000	0.81		
3700	0.37	8900	0.60	14100	0.77		
3800	0.38	9000	0.60	14200	0.89		
3900	0.38	9100	0.60	14300	0.92		
4000	0.38	9200	0.57	14400	0.78		
4100	0.41	9300	0.57	14600	0.85		
4200	0.40	9400	0.58	14700	0.83		
4300	0.41	9500	0.60	14800	0.95		
4400	0.42	9600	0.62	14900	0.89		
4500	0.43	9700	0.58	15000	0.96		
4600	0.42	9800	0.63	15100	0.90		
4700	0.44	9900	0.58	15200	0.96		
4800	0.43	10000	0.67	15300	0.90		
4900	0.44	10100	0.69	15400	0.95		

Cable loss
Cable coaxial, RG-214/U, N type-N type, 6.5 m
Suhner Switzerland, HL 3615

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	0.13	1750	2.47	3550	4.10	5350	5.76
30	0.24	1800	2.53	3600	4.17	5400	5.84
50	0.31	1850	2.59	3650	4.21	5450	5.88
100	0.47	1900	2.61	3700	4.23	5500	5.90
150	0.58	1950	2.66	3750	4.33	5550	5.96
200	0.68	2000	2.74	3800	4.36	5600	6.02
250	0.77	2050	2.76	3850	4.38	5650	6.02
300	0.86	2100	2.80	3900	4.46	5700	6.09
350	0.94	2150	2.84	3950	4.52	5750	6.14
400	1.01	2200	2.89	4000	4.48	5800	6.15
450	1.08	2250	2.94	4050	4.52	5850	6.22
500	1.16	2300	2.98	4100	4.64	5900	6.29
550	1.21	2350	3.03	4150	4.62	5950	6.32
600	1.28	2400	3.07	4200	4.69	6000	6.39
650	1.35	2450	3.11	4250	4.75	6050	6.40
700	1.41	2500	3.15	4300	4.79	6100	6.48
750	1.48	2550	3.21	4350	4.83	6150	6.57
800	1.54	2600	3.25	4400	4.90	6200	6.62
850	1.58	2650	3.29	4450	4.95	6250	6.68
900	1.65	2700	3.33	4500	4.98	6300	6.74
950	1.67	2750	3.39	4550	5.04	6350	6.79
1000	1.74	2800	3.45	4600	5.08	6400	6.82
1050	1.79	2850	3.48	4650	5.12	6450	6.83
1100	1.84	2900	3.51	4700	5.15	6500	6.91
1150	1.91	2950	3.58	4750	5.22		
1200	1.94	3000	3.62	4800	5.26		
1250	1.99	3050	3.65	4850	5.29		
1300	2.06	3100	3.69	4900	5.33		
1350	2.11	3150	3.75	4950	5.36		
1400	2.16	3200	3.77	5000	5.38		
1450	2.21	3250	3.80	5050	5.46		
1500	2.25	3300	3.85	5100	5.49		
1550	2.30	3350	3.90	5150	5.56		
1600	2.35	3400	3.94	5200	5.58		
1650	2.38	3450	4.00	5250	5.64		
1700	2.42	3500	4.03	5300	5.69		

Cable loss
Cable coaxial, RG-214/U, N type-N type, 5.5 m
Alpha Wire, HL 3634

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	0.05	1750	2.12	3550	3.43	5350	4.66
30	0.18	1800	2.16	3600	3.50	5400	4.70
50	0.24	1850	2.17	3650	3.53	5450	4.76
100	0.36	1900	2.23	3700	3.55	5500	4.80
150	0.47	1950	2.25	3750	3.57	5550	4.86
200	0.55	2000	2.33	3800	3.63	5600	4.87
250	0.64	2050	2.34	3850	3.67	5650	4.91
300	0.70	2100	2.41	3900	3.73	5700	4.97
350	0.77	2150	2.44	3950	3.73	5750	5.02
400	0.83	2200	2.49	4000	3.78	5800	5.07
450	0.91	2250	2.52	4050	3.79	5850	5.07
500	0.95	2300	2.55	4100	3.90	5900	5.15
550	1.02	2350	2.56	4150	3.88	5950	5.20
600	1.08	2400	2.60	4200	3.88	6000	5.25
650	1.15	2450	2.68	4250	3.98	6050	5.26
700	1.19	2500	2.67	4300	4.00	6100	5.30
750	1.25	2550	2.73	4350	4.02	6150	5.37
800	1.31	2600	2.74	4400	4.03	6200	5.40
850	1.35	2650	2.77	4450	4.06	6250	5.45
900	1.39	2700	2.84	4500	4.14	6300	5.47
950	1.45	2750	2.85	4550	4.16	6350	5.50
1000	1.49	2800	2.89	4600	4.17	6400	5.57
1050	1.56	2850	2.91	4650	4.19	6450	5.62
1100	1.57	2900	2.99	4700	4.21	6500	5.61
1150	1.64	2950	3.00	4750	4.26		
1200	1.66	3000	3.03	4800	4.29		
1250	1.71	3050	3.06	4850	4.30		
1300	1.73	3100	3.14	4900	4.33		
1350	1.80	3150	3.20	4950	4.36		
1400	1.81	3200	3.20	5000	4.45		
1450	1.87	3250	3.22	5050	4.44		
1500	1.94	3300	3.24	5100	4.49		
1550	1.96	3350	3.33	5150	4.53		
1600	1.97	3400	3.35	5200	4.62		
1650	2.03	3450	3.38	5250	4.63		
1700	2.05	3500	3.39	5300	4.64		

13 APPENDIX F Abbreviations and acronyms

A	ampere
AC	alternating current
AM	amplitude modulation
AVRG	average (detector)
BB	broad band
cm	centimeter
dB	decibel
dBm	decibel referred to one milliwatt
dB(μV)	decibel referred to one microvolt
dB(μV/m)	decibel referred to one microvolt per meter
dB(μA)	decibel referred to one microampere
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
PCB	printed circuit board
PM	pulse modulation
ppm	part per million (10^{-6})
QP	quasi-peak
RE	radiated emission
RF	radio frequency
rms	root mean square
Rx	receive
s	second
T	temperature
Tx	transmit
V	volt
VA	volt-ampere
WB	wideband

END OF DOCUMENT