HERMON LABORATORIES

ELECTRICAL TESTING
0839.01

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TEST REPORT

ACCORDING TO: FCC 47CFR part 15 subpart C § 15.247 (FHSS) and subpart B
RSS-247 issue 1, RSS-Gen issue 4, ICES-003 Issue 6:2016

FOR:

Visonic Ltd.
Wireless Digital Pet Immune PIR Detector
Model:MP-802 K9-85 PG2 (915)
FCC ID:WP3MP802PG2
IC:1467C-MP802PG2

Table of contents

1 Applicant information

Client name:	Visonic Ltd.
Address:	24 Habarzel street, Tel Aviv 69710, Israel
Telephone:	+972 3645 6832
Fax:	+972 3645 6788
E-mail:	zurir@tycoint.com
Contact name:	Mr. Zuri Rubin

2 Equipment under test attributes

Product name:	Wireless Digital Pet Immune PIR Detector
Product type:	Transceiver
Model(s):	MP-802 K9-85 PG2 (915)
Serial number:	Prototype
Hardware version:	90-207863
Software release:	JS-703052
Receipt date	13-Sep-16

3 Manufacturer information

Manufacturer name:	Visonic Ltd.
Address:	24 Habarzel street, Tel Aviv 69710, Israel
Telephone:	+972 3645 6832
Fax:	+972 3645 6788
E-Mail:	zurir@tycoint.com
Contact name:	Mr. Zuri Rubin

4 Test details

Project ID:	28802
Location:	Primary: Hermon Laboratories Ltd. Harakevet Industrial Zone, Binyamina 30500, Israel Satellite: Hermon Laboratories Ltd. Hefetz-Haim 10, Tel Aviv 6744124, Israel
Test started:	20-Sep-16
Test completed:	28-Sep-16
Test specification(s):	FCC 47CFR part 15, subpart C, §15.247(FHSS) and subpart B; RSS-247 issue 1, RSS-Gen issue 4, ICES-003 issue 6:2016

5 Tests summary

Test	Status
Transmitter characteristics	
Section 15.247(a)1, (g), (h) / RSS-247 section 5.1, Frequency hopping requirements	Pass
Section 15.247(a)1/ RSS-247 section 5.1(3), 20 dB bandwidth	Pass
Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions	Pass
Section 15.247(a)1/ RSS-247 section 5.1(2), Frequency separation	Pass
Section 15.247(a)1/ RSS-247 section 5.1(3), Number of hopping frequencies	Pass
Section 15.247(a)1/ RSS-247 section 5.1(3), Average time of occupancy	Pass
Section 15.247(b) / RSS-247 section 5.4(1), Peak output power	Pass
Section 15.247(i)5/ RSS-102 section 2.5, RF exposure	Pass, the exhibit to the application of certification is provided
Section 15.247(d) / RSS-247 section 5.5, Emissions at band edges	Pass
Section 15.203/ RSS-Gen section 8.3, Antenna requirements	Pass
Section 15.207(a) / RSS-Gen section 8.8, Conducted emission	Not required
Unintentional emissions	
Section 15.107/ICES-003, Section 6.1, Class B, Conducted emission at AC power port	Not required
Section 15.109/ RSS-Gen section 7.1.2 /ICES-003, Section 6.2, Class B, Radiated emission	Pass

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

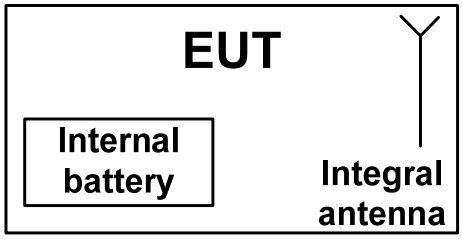
	Name and Title	Date	Signature
Tested by:	Mr. I. Zilberstein, test engineer Mrs. E. Pitt, test engineer	September 28, 2016	
Reviewed by:	Mrs. M. Cherniavsky, certification engineer	October 18, 2016	
Approved by:	Mr. M. Nikishin, EMC and Radio group manager	January 18, 2017	

6 EUT description

6.1 General information

The EUT is a wireless indoor PIR detector, battery fed. It comprises a radio module operating at 915 MHz.

6.2 Test configuration



6.3 Changes made in EUT

No changes were implemented in the EUT during the testing.

6.4 Transmitter characteristics

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

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

Assigned frequency ranges	902 – 928 MHz
Operating frequencies	912.750 – 919.108 MHz

Maximum rated output power	At transmitter 50 Ω RF output connector	dBm
	Peak output power	14.86 dBm

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

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

Antenna/s technical characteristics			
Type	Manufacturer	Model number	Gain
Internal	Ocean	Capacitive Coupling Antenna, Visonic P.N--H-306097	-1 dBi

Transmitter aggregate data rate/s	50 kbps
Type of modulation	GFSK
Modulating test signal (baseband)	PRBS

Transmitter power source					
X	Battery	**Nominal rated voltage**	3.0 VDC	Battery type	CR123A
	DC	**Nominal rated voltage**			
	AC mains	**Nominal rated voltage**		Frequency	

Common power source for transmitter and receiver	X	yes	no

Spread spectrum technique used	X	Frequency hopping (FHSS)
		Digital transmission system (DTS)
		Hybrid

Spread spectrum parameters for transmitters tested per FCC 15.247 only		
FHSS	Total number of hops	50
	Bandwidth per hop	90.13 kHz
	Max. separation of hops	133 kHz

Test specification:	Section 15.247(a)1, (g), (h), RSS-247 section 5.1, Frequency hopping requirements		
Test procedure:			
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	20-Sep-16		
Temperature: 26 ºC	**Relative Humidity:** 39 %	**Air Pressure:** 1005 hPa	**Power:** 3 VDC
Remarks:			

7 Transmitter tests according to 47CFR part 15 subpart C and RSS-247 requirements

7.1 Frequency hopping requirements

The EUT was verified for compliance with frequency hopping requirements listed below:

- The EUT shall hop to channel frequencies that are selected from a pseudorandomly ordered list;
- Each hopping frequency shall be used equally on the average;
- The EUT receiver shall have input bandwidth that match the hopping channel bandwidth of the corresponding transmitter and shall shift frequencies in synchronization with the transmitted signals;
- The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

The rationale for compliance with the above requirements was either test results or supplier declaration. The summary of results is provided in Table 7.1.1.

Table 7.1.1 Frequency hopping requirements

Requirement	Rationale	Verdict
The EUT shall hop to channel frequencies that are selected from a pseudorandomly ordered list	Supplier declaration	Pass
Each hopping frequency shall be used equally on the average	Supplier declaration	Pass
The EUT receiver shall have input bandwidth that match the hopping channel bandwidth of the corresponding transmitter	Supplier declaration	Pass
The EUT receiver shall shift frequencies in synchronization with the transmitted signals	Supplier declaration	Pass
Each transmitter operates independently and there is no synchronization with other transmitters for purposes other than to avoid simultaneous channel occupancy	Supplier declaration	Pass

Test specification:	Section 15.247(a)1, RSS-247 section 5.1(3), 20 dB bandwidth		
Test procedure:	ANSI C63.10, section 7.8.7		
Test mode:	Compliance	Verdict:	PASS
Date(s):	20-Sep-16		
Temperature: 26 ºC	Relative Humidity: 54 %	Air Pressure: 1010 hPa	Power: 3 VDC
Remarks:			

7.2 20 dB bandwidth

7.2.1 General

This test was performed to measure the 20 dB bandwidth of the transmitter hopping channel. Specification test limits are given in Table 7.2.1.

Table 7.2.1 The 20 dB bandwidth limits

Assigned frequency, MHz	Maximum bandwidth, kHz	Modulation envelope reference points*, dBc
902.0 – 928.0	250	20
2400.0 – 2483.5	NA	
5725.0 – 5850.0	1000	

* - Modulation envelope reference points provided in terms of attenuation below the peak of modulated 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 modulated carrier at maximum data rate.

7.2.2.3 The transmitter bandwidth was measured with spectrum analyzer as frequency delta between reference points on modulation envelope and provided in Table 7.2.2 and associated plot.

7.2.2.4 The test was repeated for each data rate and each modulation format.

Figure 7.2.1 The 20 dB bandwidth test setup

Test specification:	Section 15.247(a)1, RSS-247 section 5.1(3), 20 dB bandwidth		
Test procedure:	ANSI C63.10, section 7.8.7		
Test mode:	Compliance	Verdict:	PASS
Date(s):	20-Sep-16		
Temperature: 26 ºC	Relative Humidity: 54 %	Air Pressure: 1010 hPa	Power: 3 VDC
Remarks:			

Table 7.2.2 The 20 dB bandwidth test results

ASSIGNED FREQUENCY BAND: 902-928 MHz
DETECTOR USED: Peak
SWEEP TIME: Auto
VIDEO BANDWIDTH: ≥ RBW
MODULATION ENVELOPE REFERENCE POINTS: 20.0 dBc
FREQUENCY HOPPING: Disabled

Carrier frequency, MHz	Type of modulation	Data rate, kbps	99% BW, kHz	20 dB bandwidth, kHz	Limit, kHz	Margin, kHz	Verdict
912.750	GFSK	50	90.184	89.67	250	-160.33	Pass
915.990			90.941	89.14	250	-160.86	Pass
919.106			90.026	90.13	250	-159.87	Pass

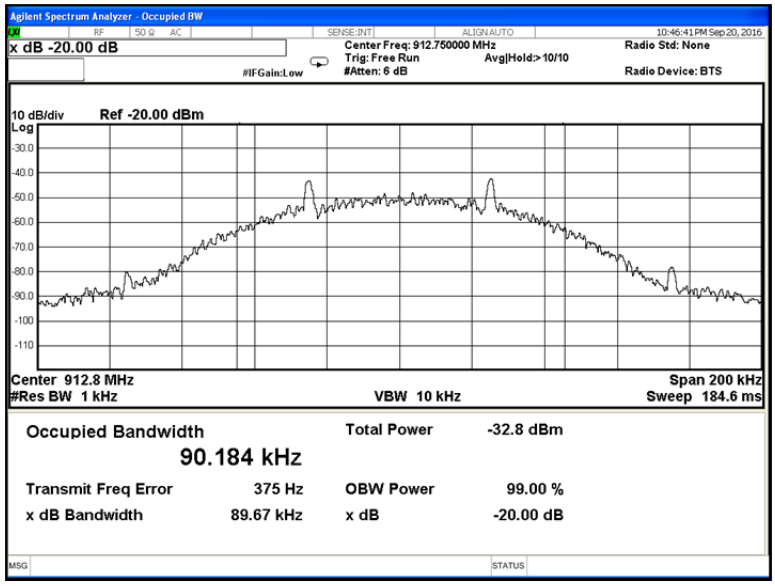
Reference numbers of test equipment used

HL 4575								

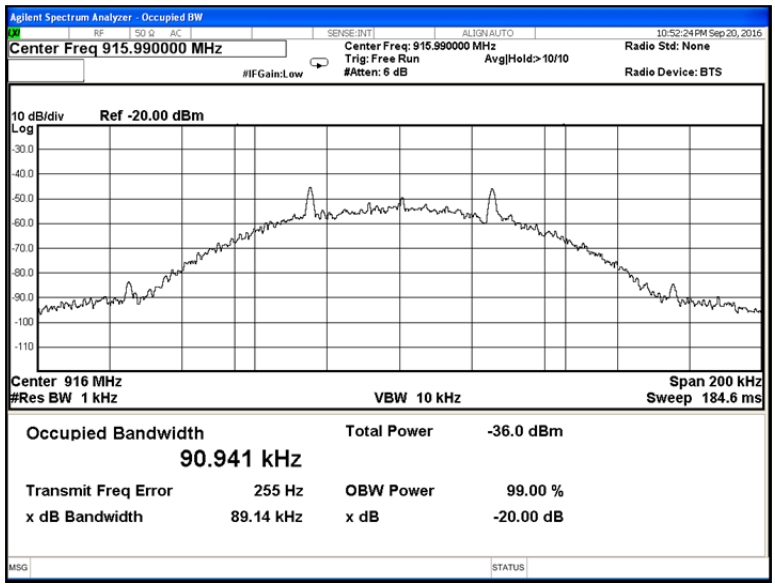
Full description is given in Appendix A.

Test specification:	Section 15.247(a)1, RSS-247 section 5.1(3), 20 dB bandwidth		
Test procedure:	ANSI C63.10, section 7.8.7		
Test mode:	Compliance	Verdict:	PASS
Date(s):	20-Sep-16		
Temperature: 26 ºC	Relative Humidity: 54 %	Air Pressure: 1010 hPa	Power: 3 VDC
Remarks:			

Plot 7.2.1 The 20 dB bandwidth test result at low frequency

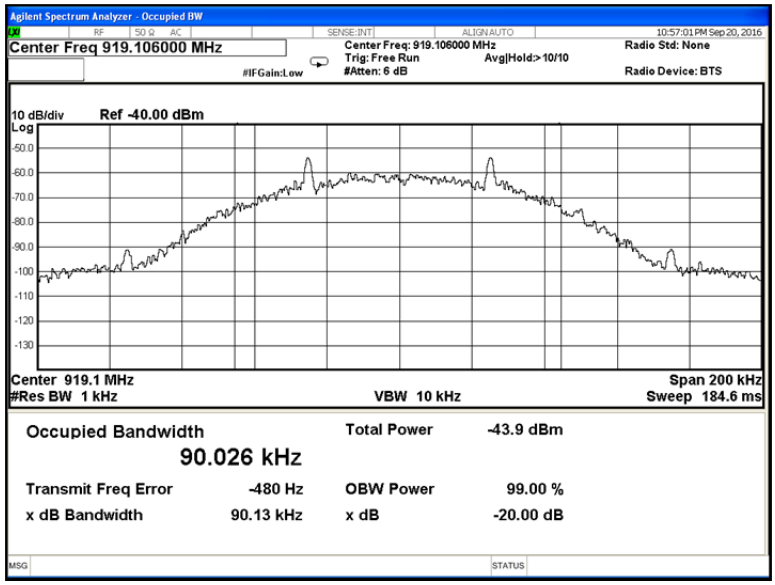


Plot 7.2.2 The 20 dB bandwidth test result at mid frequency



Test specification:	Section 15.247(a)1, RSS-247 section 5.1(3), 20 dB bandwidth		
Test procedure:	ANSI C63.10, section 7.8.7		
Test mode:	Compliance	Verdict:	PASS
Date(s):	20-Sep-16		
Temperature: 26 ºC	Relative Humidity: 54 %	Air Pressure: 1010 hPa	Power: 3 VDC
Remarks:			

Plot 7.2.3 The 20 dB bandwidth test result at high frequency



Test specification:	Section 15.247(a)1, RSS-247 section 5.1(2), Frequency separation		
Test procedure:	ANSI C63.10, section 7.8.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	25-Sep-16		
Temperature: 26.8 ºC	Relative Humidity: 46 %	Air Pressure: 1009 hPa	Power: 3 VDC
Remarks:			

7.3 Carrier frequency separation

7.3.1 General

This test was performed to measure frequency separation between the peaks of adjacent channels. Specification test limits are given in Table 7.3.1.

Table 7.3.1 Carrier frequency separation limits

Assigned frequency range, MHz	Carrier frequency separation	
	Output power 30 dBm	Output power 21 dBm
902.0 – 928.0	25 kHz or 20 dB bandwidth of the hopping channel, whichever is greater	25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater
2400.0 – 2483.5		
5725.0 – 5850.0		

7.3.2 Test procedure

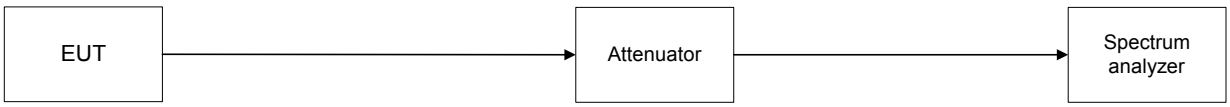
7.3.2.1 The EUT was set up as shown in Figure 7.3.1, energized with frequency hopping function enabled and its proper operation was checked.

7.3.2.2 The spectrum analyzer span was set to capture the carrier frequency and both of adjacent channels, the lower and the higher. The resolution bandwidth was set wider than 1 % of the frequency span.

7.3.2.3 The spectrum analyzer was set in max hold mode and allowed trace to stabilize.

7.3.2.4 The frequency separation between the peaks of adjacent channels was measured as provided in Table 7.3.2 and the associated plots.

Figure 7.3.1 Carrier frequency separation test setup



Test specification:	Section 15.247(a)1, RSS-247 section 5.1(2), Frequency separation		
Test procedure:	ANSI C63.10, section 7.8.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	25-Sep-16		
Temperature: 26.8 ºC	Relative Humidity: 46 %	Air Pressure: 1009 hPa	Power: 3 VDC
Remarks:			

Table 7.3.2 Carrier frequency separation test results

ASSIGNED FREQUENCY BAND:	902 – 928 MHz
MODULATION:	GFSK
MODULATING SIGNAL:	PRBS
BIT RATE:	50 kbps
DETECTOR USED:	Peak
RESOLUTION BANDWIDTH:	≥ 1% of the span
VIDEO BANDWIDTH:	≥ RBW
FREQUENCY HOPPING:	Enabled
20 dB BANDWIDTH:	89.67 kHz at Low carrier frequency 89.14 kHz at Mid carrier frequency 90.13 kHz at High carrier frequency

Carrier frequency separation, kHz	Limit, kHz	Margin*	Verdict
133.0	90.13	42.87	Pass

* - Margin = Carrier frequency separation – specification limit.

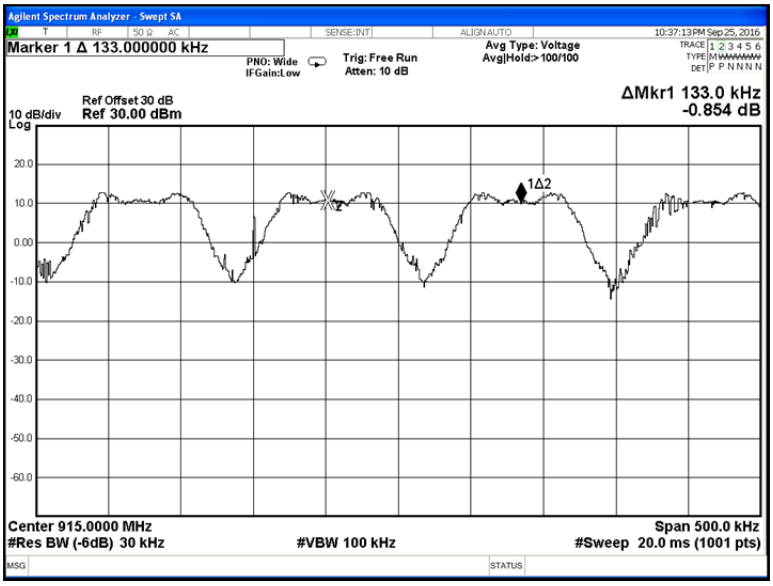
Reference numbers of test equipment used

HL 4274	HL 4575						

Full description is given in Appendix A.

Test specification:	Section 15.247(a)1, RSS-247 section 5.1(2), Frequency separation		
Test procedure:	ANSI C63.10, section 7.8.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	25-Sep-16		
Temperature: 26.8 ºC	Relative Humidity: 46 %	Air Pressure: 1009 hPa	Power: 3 VDC
Remarks:			

Plot 7.3.1 Carrier frequency separation



Test specification:	Section 15.247(a)1, RSS-247 section 5.1(3), Number of hopping frequencies		
Test procedure:	ANSI C63.10, section 7.8.3		
Test mode:	Compliance	Verdict:	PASS
Date(s):	25-Sep-16		
Temperature: 27.5 ºC	Relative Humidity: 46 %	Air Pressure: 1009 hPa	Power: 3 VDC
Remarks:			

7.4 Number of hopping frequencies

7.4.1 General

This test was performed to calculate the number of hopping frequencies used by the EUT. Specification test limits are given in Table 7.4.1.

Table 7.4.1 Minimum number of hopping frequencies

Assigned frequency range, MHz	Number of hopping frequencies
902.0 – 928.0	50 (if the 20 dB bandwidth is less than 250 kHz) 25 (if the 20 dB bandwidth is 250 kHz or greater)
2400.0 – 2483.5	15
5725.0 – 5850.0	75

7.4.2 Test procedure

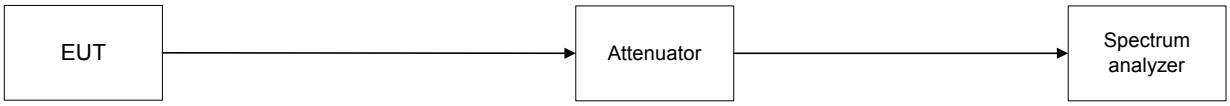
7.4.2.1 The EUT was set up as shown in Figure 7.4.1, energized with frequency hopping function enabled and its proper operation was checked.

7.4.2.2 Initially the spectrum analyzer span was set equal to frequency band of operation and the resolution bandwidth was set wider than 1 % of the frequency span. If the separate hopping channels were not clearly resolved the frequency band of operation was broken to sections and the resolution bandwidth was set wider than 1 % of the frequency span of each section.

7.4.2.3 The spectrum analyzer was set in max hold mode and allowed trace to stabilize.

7.4.2.4 The number of frequency hopping channels was calculated as provided in Table 7.4.2 and the associated plots.

Figure 7.4.1 Hopping frequencies test setup



Test specification:	**Section 15.247(a)1, RSS-247 section 5.1(3), Number of hopping frequencies**		
Test procedure:	ANSI C63.10, section 7.8.3		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	25-Sep-16		
Temperature: 27.5 ºC	**Relative Humidity:** 46 %	**Air Pressure:** 1009 hPa	**Power:** 3 VDC
Remarks:			

Table 7.4.2 Hopping frequencies test results

ASSIGNED FREQUENCY BAND:	902 – 928 MHz
MODULATION:	GFSK
MODULATING SIGNAL:	PRBS
BIT RATE:	50 kbps
DETECTOR USED:	Peak
RESOLUTION BANDWIDTH:	100 kHz
VIDEO BANDWIDTH:	≥ RBW
FREQUENCY HOPPING:	Enabled

Number of hopping frequencies	Minimum number of hopping frequencies	Margin*	Verdict
50	50	0	Pass

* - Margin = Number of hopping frequencies – Minimum number of hopping frequencies.

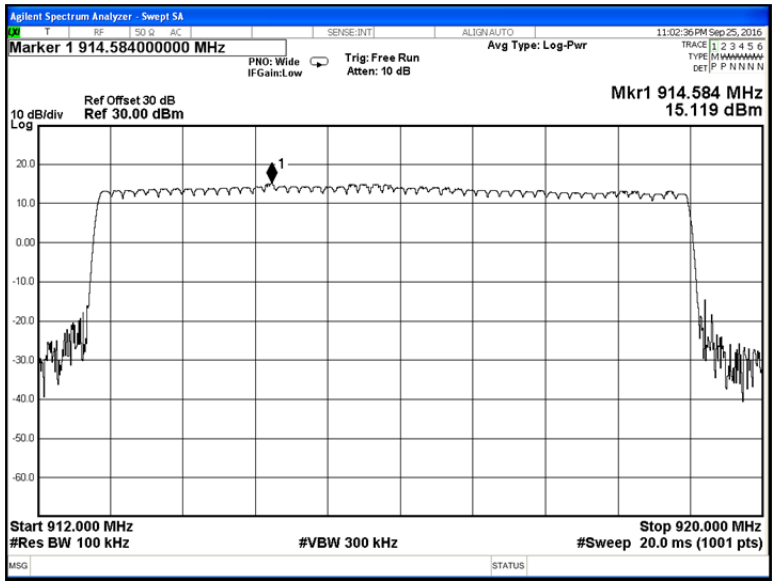
Reference numbers of test equipment used

HL 4274	HL 4575						

Full description is given in Appendix A.

Test specification:	Section 15.247(a)1, RSS-247 section 5.1(3), Number of hopping frequencies		
Test procedure:	ANSI C63.10, section 7.8.3		
Test mode:	Compliance	Verdict:	PASS
Date(s):	25-Sep-16		
Temperature: 27.5 ºC	Relative Humidity: 46 %	Air Pressure: 1009 hPa	Power: 3 VDC
Remarks:			

Plot 7.4.1 Number of hopping frequencies



Test specification:	Section 15.247(a)1, RSS-247 section 5.1(3), Average time of occupancy		
Test procedure:	ANSI C63.10, section 7.8.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	26-Sep-16		
Temperature: 25.7 ºC	Relative Humidity: 46 %	Air Pressure: 1009 hPa	Power: 3 VDC
Remarks:			

7.5 Average time of occupancy

7.5.1 General

This test was performed to calculate the average time of occupancy (dwell time) on any frequency channel of the EUT. Specification test limits are given in Table 7.5.1.

Table 7.5.1 Average time of occupancy limits

Assigned frequency range, MHz	Maximum average time of occupancy, s	Investigated period, s	Number of hopping frequencies
902.0 – 928.0	**0.4**	**20.0**	**≥ 50**
902.0 – 928.0	0.4	10.0	< 50
2400.0 – 2483.5	0.4	0.4 × N	N (≥ 15)
5725.0 – 5850.0	0.4	30.0	≥ 75

7.5.2 Test procedure

7.5.2.1 The EUT was set up as shown in Figure 7.5.1, energized with frequency hopping function enabled and its proper operation was checked.

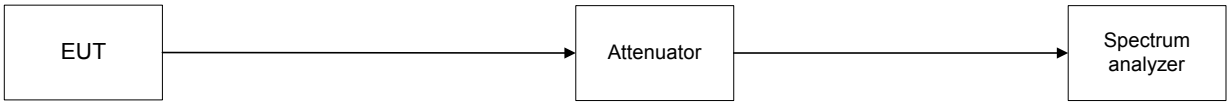
7.5.2.2 The spectrum analyzer span was set to zero centered on a hopping channel.

7.5.2.3 The single transmission duration and period were measured with oscilloscope.

7.5.2.4 The average time of occupancy was calculated as the single transmission time multiplied by the investigated period and divided by the single transmission period.

7.5.2.5 The test was repeated at each data rate and modulation type as provided in Table 7.5.2 and the associated plots.

Figure 7.5.1 Average time of occupancy test setup



Test specification:	Section 15.247(a)1, RSS-247 section 5.1(3), Average time of occupancy		
Test procedure:	ANSI C63.10, section 7.8.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	26-Sep-16		
Temperature: 25.7 ºC	Relative Humidity: 46 %	Air Pressure: 1009 hPa	Power: 3 VDC
Remarks:			

Table 7.5.2 Average time of occupancy test results

ASSIGNED FREQUENCY BAND: 902 – 928 MHz
MODULATION: GFSK
MODULATING SIGNAL: PRBS
DETECTOR USED: Peak
RESOLUTION BANDWIDTH: 100 kHz
VIDEO BANDWIDTH: RBW
NUMBER OF HOPPING FREQUENCIES: 50
INVESTIGATED PERIOD: 20 s
FREQUENCY HOPPING: Enabled

Carrier frequency, MHz	Single transmission duration, ms	Single transmission period, s	Average time of occupancy, s	Bit rate, kbps	Symbol rate, Msymbol/s	Limit, s	Margin, s*	Verdict
912.75	4.020	256	0.004	50	NA	0.400	0.3996	Pass

* - Margin = Average time of occupancy – specification limit.

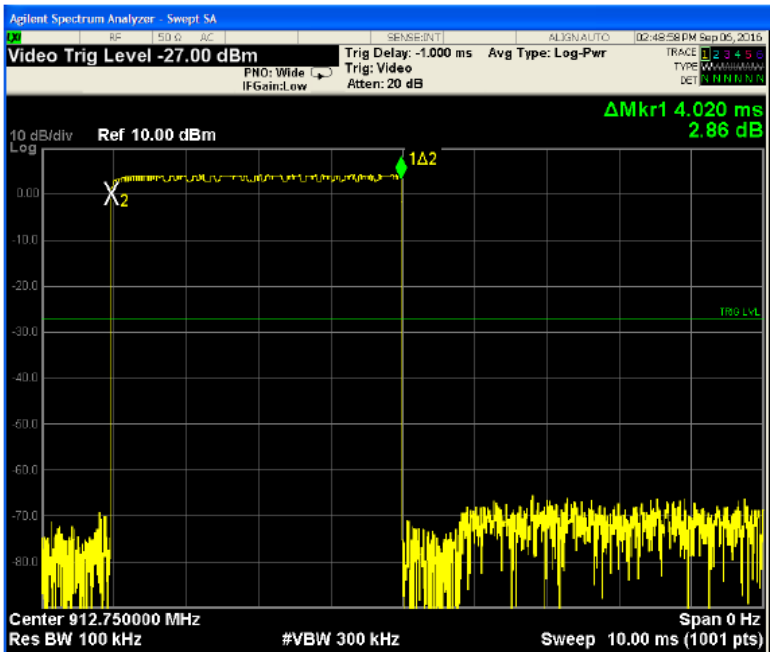
Reference numbers of test equipment used

HL 4274	HL 4575						

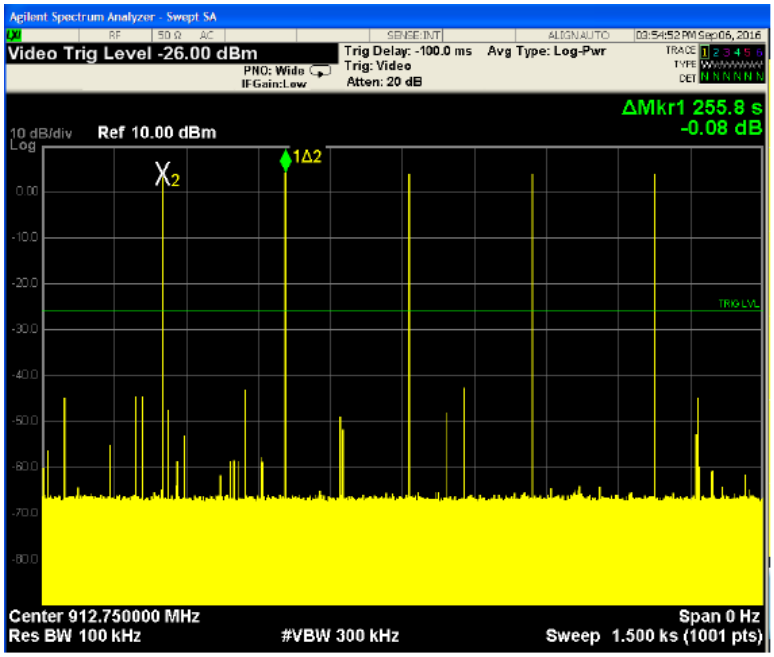
Full description is given in Appendix A.

Test specification:	Section 15.247(a)1, RSS-247 section 5.1(3), Average time of occupancy		
Test procedure:	ANSI C63.10, section 7.8.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	26-Sep-16		
Temperature: 25.7 ºC	Relative Humidity: 46 %	Air Pressure: 1009 hPa	Power: 3 VDC
Remarks:			

Plot 7.5.1 Single transmission duration



Plot 7.5.2 Single transmission period



Test specification:	Section 15.247(b), RSS-247 section 5.4(1), Peak output power		
Test procedure:	ANSI C63.10, section 7.8.5		
Test mode:	Compliance	Verdict:	PASS
Date(s):	28-Sep-16		
Temperature: 24 ºC	Relative Humidity: 47 %	Air Pressure: 1010 hPa	Power: 3 VDC
Remarks:			

7.6 Peak output power

7.6.1 General

This test was performed to measure the maximum peak output power radiated by transmitter. Specification test limits are given in Table 7.6.1.

Table 7.6.1 Peak output power limits

Assigned frequency range, MHz	Peak output power*		Equivalent field strength limit @ 3m, dB(μV/m)*	Maximum antenna gain, dBi
	W	dBm		
902.0 – 928.0	1.0	30.0	131.2	6.0*
2400.0 – 2483.5	0.125 (<75 hopping channels) 1.0 (≥75 hopping channels)	21.0(<75 hopping channels) 30.0 (≥75 hopping channels)	122.2 (<75 hopping channels) 131.2 (≥75 hopping channels)	
5725.0 – 5850.0	1.0	30.0	131.2	

*- Equivalent field strength limit was calculated from the peak output power as follows: E=sqrt(30×P×G)/r, where P is peak output power in Watts, r is antenna to EUT distance in meters and G is transmitter antenna gain in dBi.
**- The limit is provided in terms of conducted RF power at the antenna connector. If transmitting antennas of directional gain greater than 6 dBi are used, the peak output power limit shall be reduced below the stated value as follows:

- by 1 dB for every 3 dB that the directional gain of antenna exceeds 6 dBi for fixed point-to-point transmitters operate in 2400-2483.5 MHz band;
- without any corresponding reduction for fixed point-to-point transmitters operate in 5725-5850 MHz band;
- by the amount in dB that the directional gain of antenna exceeds 6 dBi for the rest of transmitters.

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 was adjusted to produce maximum available to end user RF output power.

7.6.2.3 The resolution bandwidth was set wider than 20 dB bandwidth of the EUT. To find maximum radiation the turntable was rotated 360^0 and the measuring antenna height was swept in both vertical and horizontal polarizations.

7.6.2.4 The maximum field strength of the EUT carrier frequency was measured as provided in Table 7.6.2 and associated plots.

7.6.2.5 The maximum peak output power was calculated from the field strength of carrier as follows:

$$P = (E \times d)^2 / (30 \times G),$$

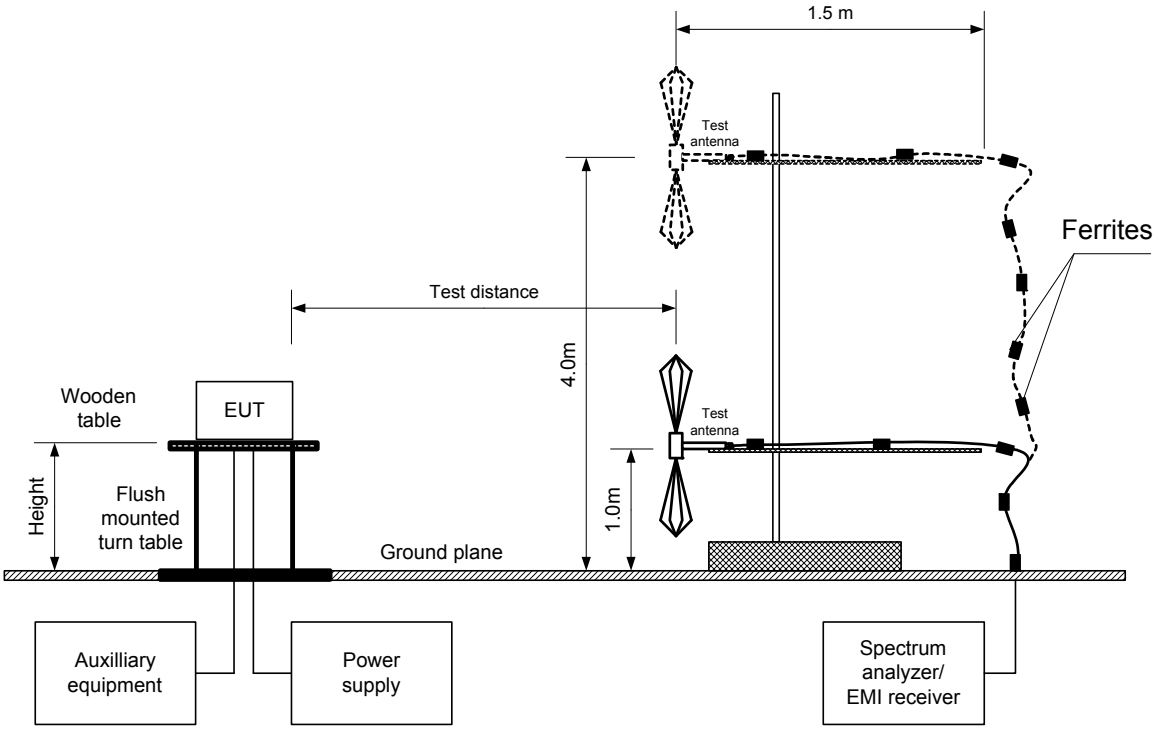
where P is the peak output power in W, E is the field strength in V/m, d is the test distance and G is the transmitter numeric antenna gain over an isotropic radiator.
The above equation was converted in logarithmic units for 3 m test distance:

Peak output power in dBm = Field strength in dB(μV/m) - Transmitter antenna gain in dBi – 95.2 dB

7.6.2.6 The worst test results (the lowest margins) were recorded in Table 7.6.2 and shown in the associated plots.

Test specification:	Section 15.247(b), RSS-247 section 5.4(1), Peak output power		
Test procedure:	ANSI C63.10, section 7.8.5		
Test mode:	Compliance	Verdict:	PASS
Date(s):	28-Sep-16		
Temperature: 24 ºC	Relative Humidity: 47 %	Air Pressure: 1010 hPa	Power: 3 VDC
Remarks:			

Figure 7.6.1 Setup for carrier field strength measurements



Test specification:	Section 15.247(b), RSS-247 section 5.4(1), Peak output power		
Test procedure:	ANSI C63.10, section 7.8.5		
Test mode:	Compliance	Verdict:	PASS
Date(s):	28-Sep-16		
Temperature: 24 ºC	Relative Humidity: 47 %	Air Pressure: 1010 hPa	Power: 3 VDC
Remarks:			

Table 7.6.2 Peak output power test results

ASSIGNED FREQUENCY BAND: 902-928 MHz
TEST DISTANCE: 3 m
TEST SITE: OATS
EUT HEIGHT: 0.8 m
DETECTOR USED: Peak
TEST ANTENNA TYPE: Biconilog (30 MHz – 1000 MHz)
MODULATION: GFSK
MODULATING SIGNAL: PRBS
BIT RATE: 50 kbps
DETECTOR USED: Peak
RESOLUTION BANDWIDTH: 120 kHz
VIDEO BANDWIDTH: 300 kHz
FREQUENCY HOPPING: Disabled

Frequency, MHz	Field strength, dB(μV/m)	Antenna polarization	Antenna height, m	Azimuth, degrees*	EUT antenna gain, dBi	Peak output power, dBm**	Limit, dBm	Margin, dB***	Verdict
912.750	106.88	V	1.3	309	-1	12.68	30	-17.32	Pass
915.990	109.06	V	1.0	250	-1	14.86	30	-15.14	Pass
919.106	107.31	V	1.1	263	-1	13.11	30	-16.89	Pass

*- EUT front panel refer to 0 degrees position of turntable.
**- Peak output power was calculated from the field strength of carrier as follows: $P = (E \times d)^2 / (30 \times G)$,
where P is the peak output power in W, E is the field strength in V/m, d is the test distance in meters and G is the transmitter numeric antenna gain over an isotropic radiator. The above equation was converted in logarithmic units for 3 m test distance: *Peak output power in dBm = Field strength in dB(μV/m) - Transmitter antenna gain in dBi – 95.2 dB*
***- Margin = Peak output power – specification limit.

Reference numbers of test equipment used

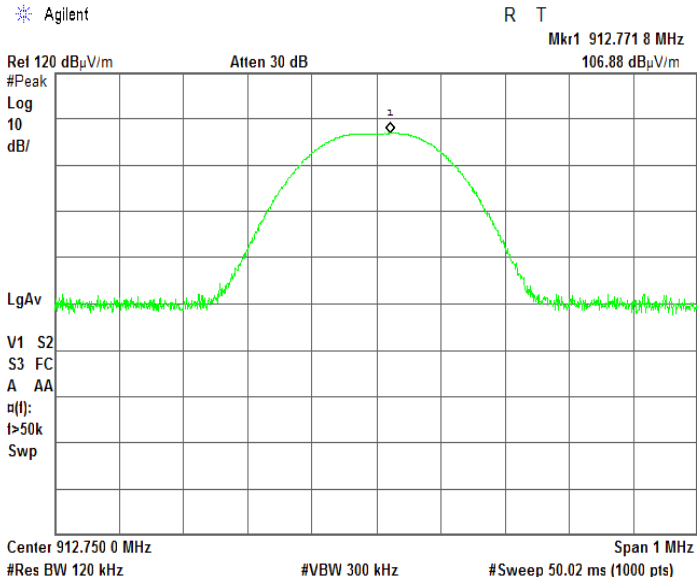
HL 0415	HL 0583	HL 3818	HL 4294				

Full description is given in Appendix A.

Test specification:	Section 15.247(b), RSS-247 section 5.4(1), Peak output power		
Test procedure:	ANSI C63.10, section 7.8.5		
Test mode:	Compliance	Verdict:	PASS
Date(s):	28-Sep-16		
Temperature: 24 ºC	Relative Humidity: 47 %	Air Pressure: 1010 hPa	Power: 3 VDC
Remarks:			

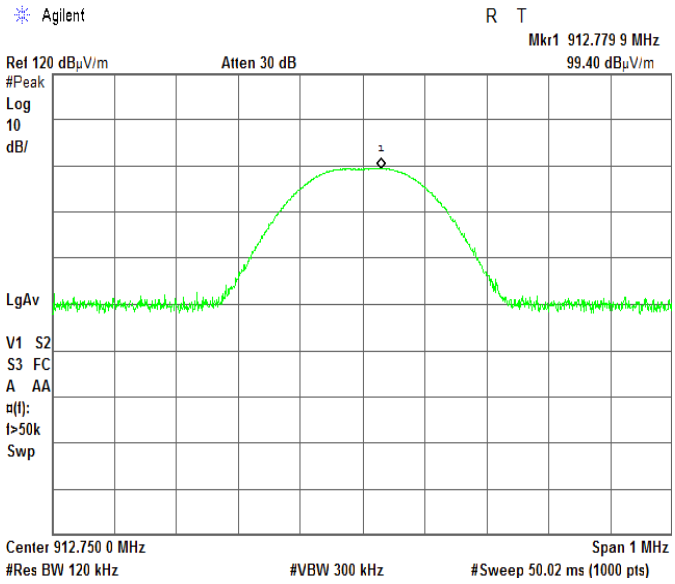
Plot 7.6.1 Field strength of carrier at low frequency

ANTENNA POLARIZATION: Vertical



Plot 7.6.2 Field strength of carrier at low frequency

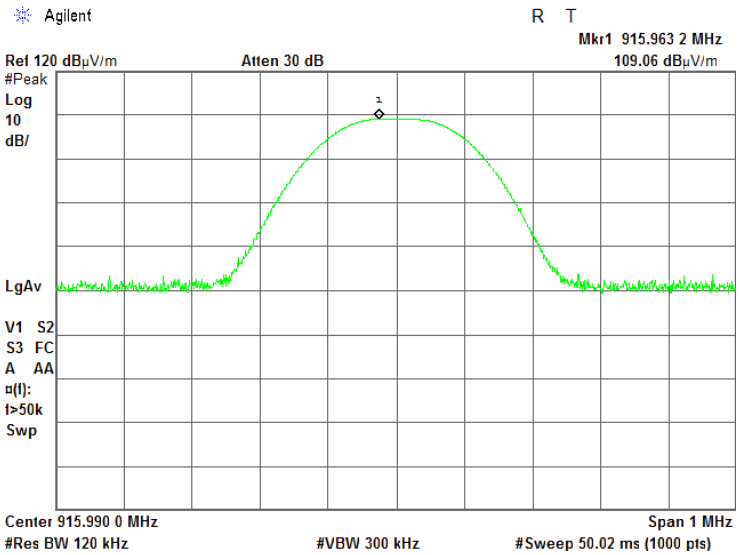
ANTENNA POLARIZATION: Horizontal



Test specification:	Section 15.247(b), RSS-247 section 5.4(1), Peak output power		
Test procedure:	ANSI C63.10, section 7.8.5		
Test mode:	Compliance	Verdict:	PASS
Date(s):	28-Sep-16		
Temperature: 24 ºC	Relative Humidity: 47 %	Air Pressure: 1010 hPa	Power: 3 VDC
Remarks:			

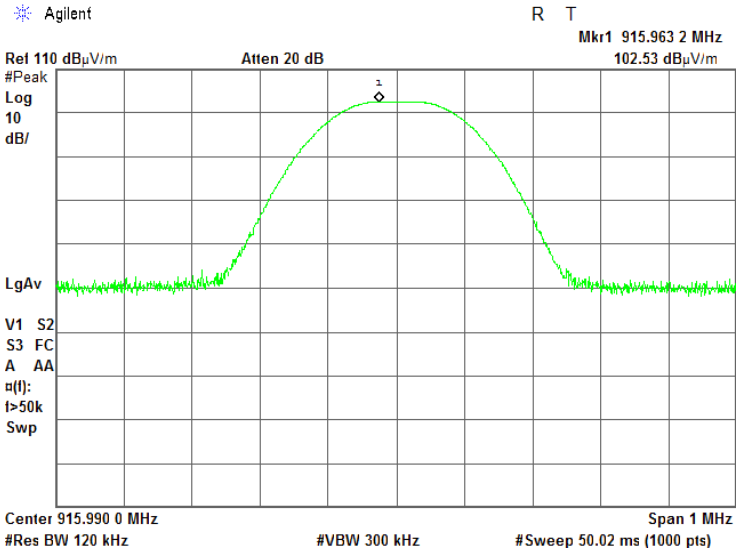
Plot 7.6.3 Field strength of carrier at mid frequency

ANTENNA POLARIZATION: Vertical



Plot 7.6.4 Field strength of carrier at mid frequency

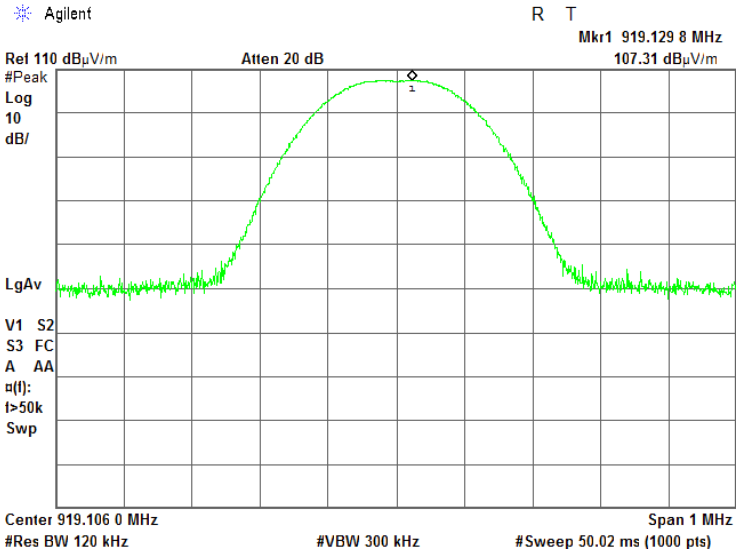
ANTENNA POLARIZATION: Horizontal



Test specification:	Section 15.247(b), RSS-247 section 5.4(1), Peak output power		
Test procedure:	ANSI C63.10, section 7.8.5		
Test mode:	Compliance	Verdict:	PASS
Date(s):	28-Sep-16		
Temperature: 24 ºC	Relative Humidity: 47 %	Air Pressure: 1010 hPa	Power: 3 VDC
Remarks:			

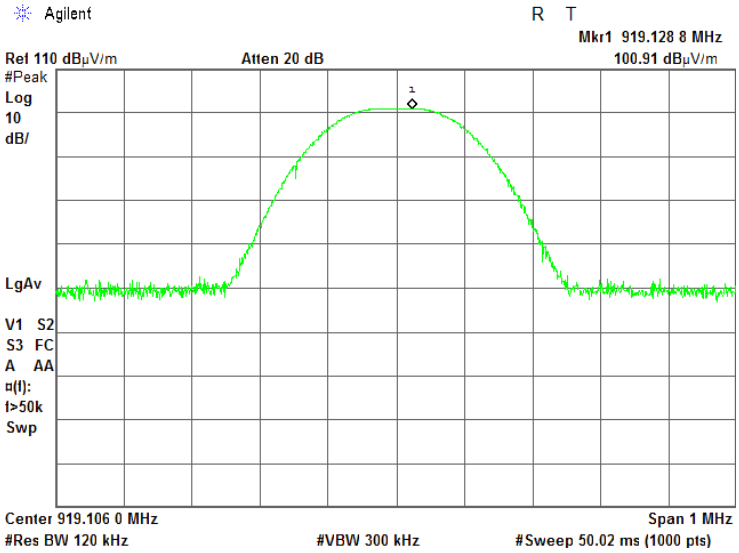
Plot 7.6.5 Field strength of carrier at high frequency

ANTENNA POLARIZATION: Vertical



Plot 7.6.6 Field strength of carrier at high frequency

ANTENNA POLARIZATION: Horizontal



Test specification:	Section 15.247(d), RSS-247 section 5.5, Radiated spurious emissions		
Test procedure:	ANSI C63.10, sections 6.5, 6.6		
Test mode:	Compliance	Verdict:	PASS
Date(s):	28-Sep-16		
Temperature: 26 ºC	Relative Humidity: 43 %	Air Pressure: 1010 hPa	Power: 3 VDC
Remarks:			

7.7 Field strength of spurious emissions

7.7.1 General

This test was performed to measure field strength of spurious emissions from the EUT. Specification test limits are given in Table 7.7.1.

Table 7.7.1 Radiated spurious emissions limits

Frequency, MHz	Field strength at 3 m within restricted bands, dB(μV/m)***			Attenuation of field strength of spurious versus carrier outside restricted bands, dBc***
	Peak	Quasi Peak	Average	
0.009 – 0.090	148.5 – 128.5	NA	128.5 – 108.5**	20.0
0.090 – 0.110	NA	108.5 – 106.8**	NA	
0.110 – 0.490	126.8 – 113.8	NA	106.8 – 93.8**	
0.490 – 1.705	NA	73.8 – 63.0**	NA	
1.705 – 30.0*		69.5		
30 – 88		40.0		
88 – 216		43.5		
216 – 960		46.0		
960 - 1000		54.0		
1000 – 10thharmonic	74.0	NA	54.0	

*- The limit for 3 m test distance was calculated using the inverse square distance extrapolation factor as follows:

$$Lim_{S2} = Lim_{S1} + 40 \log (S_1/S_2),$$

where S_1 and S_2 – standard defined and test distance respectively in meters.

**- The limit decreases linearly with the logarithm of frequency.

*** - The field strength limits applied from the lowest radio frequency generated in the device, without going below 9 kHz up to the tenth harmonic of the highest fundamental frequency.

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

7.7.2.1 The EUT was set up as shown in Figure 7.7.1, energized and the performance check was conducted.

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

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

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

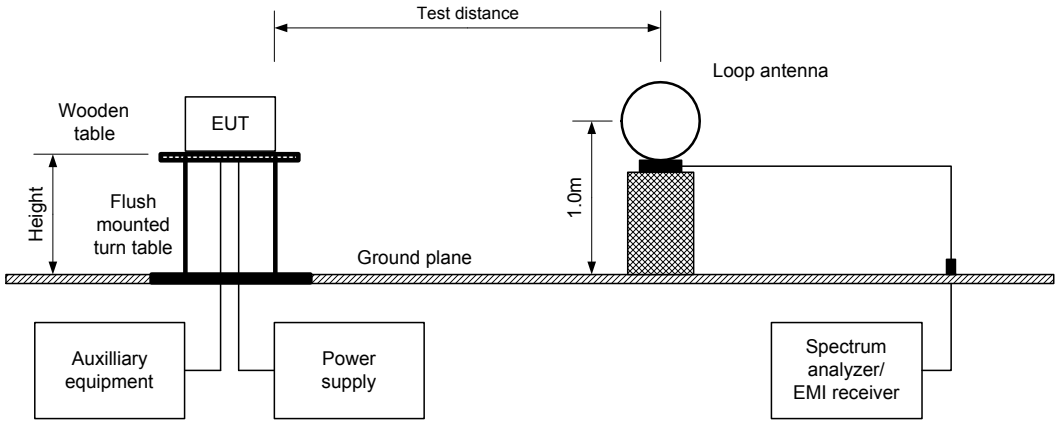
7.7.3.1 The EUT was set up as shown in Figure 7.7.2, Figure 7.7.3, energized and the performance check was conducted.

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

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

Test specification:	Section 15.247(d), RSS-247 section 5.5, Radiated spurious emissions		
Test procedure:	ANSI C63.10, sections 6.5, 6.6		
Test mode:	Compliance	Verdict:	PASS
Date(s):	28-Sep-16		
Temperature: 26 ºC	Relative Humidity: 43 %	Air Pressure: 1010 hPa	Power: 3 VDC
Remarks:			

Figure 7.7.1 Setup for spurious emission field strength measurements below 30 MHz



Test specification:	Section 15.247(d), RSS-247 section 5.5, Radiated spurious emissions		
Test procedure:	ANSI C63.10, sections 6.5, 6.6		
Test mode:	Compliance	Verdict:	PASS
Date(s):	28-Sep-16		
Temperature: 26 ºC	Relative Humidity: 43 %	Air Pressure: 1010 hPa	Power: 3 VDC
Remarks:			

Figure 7.7.2 Setup for spurious emission field strength measurements in 30 to 1000 MHz

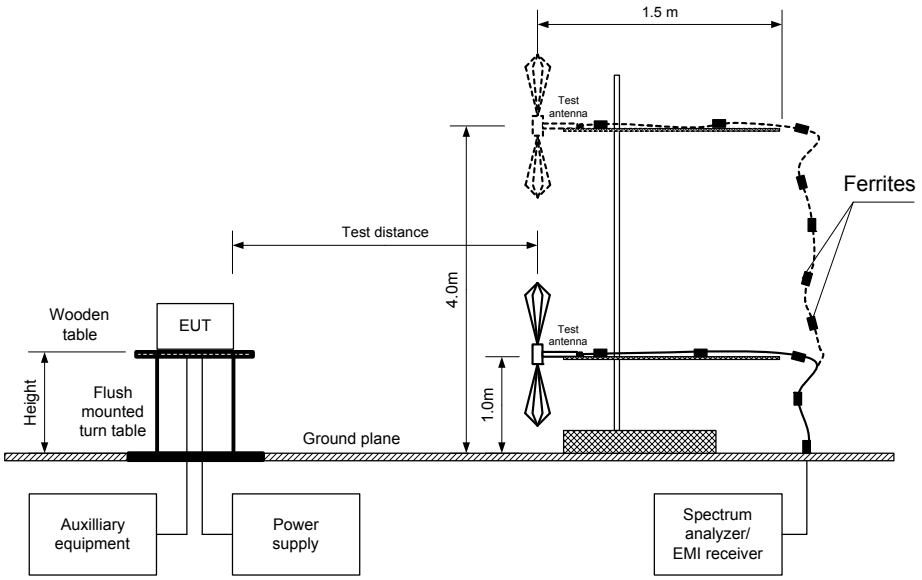
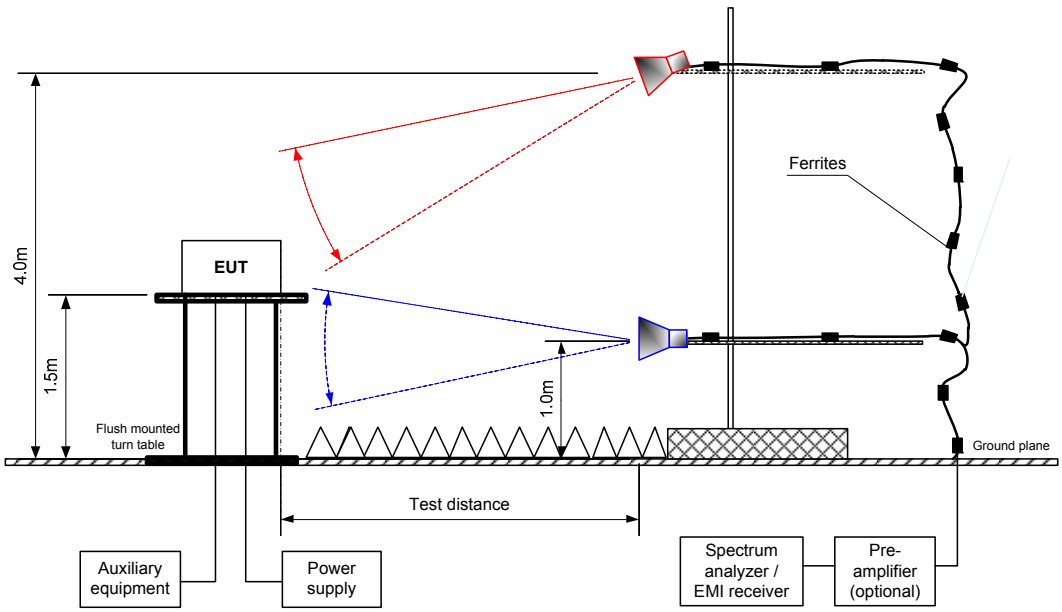


Figure 7.7.3 Setup for spurious emission field strength measurements above1000 MHz



Test specification:	Section 15.247(d), RSS-247 section 5.5, Radiated spurious emissions		
Test procedure:	ANSI C63.10, sections 6.5, 6.6		
Test mode:	Compliance	Verdict:	PASS
Date(s):	28-Sep-16		
Temperature: 26 ºC	Relative Humidity: 43 %	Air Pressure: 1010 hPa	Power: 3 VDC
Remarks:			

Table 7.7.2 Field strength of emissions outside restricted bands

ASSIGNED FREQUENCY: 902-928MHz
INVESTIGATED FREQUENCY RANGE: 0.009 -9500 MHz
TEST DISTANCE: 3 m
MODULATION: GFSK
BIT RATE: 50 kbps
DUTY CYCLE: 100 %
DETECTOR USED: Peak
RESOLUTION BANDWIDTH: 100 kHz
VIDEO BANDWIDTH: 300 kHz
TEST ANTENNA TYPE: Active loop (9 kHz – 30 MHz)
Biconilog (30 MHz – 1000 MHz)
Double ridged guide (above 1000 MHz)
FREQUENCY HOPPING: Disabled

Frequency, MHz	Field strength of spurious, dB(μV/m)	Antenna polarization	Antenna height, m	Azimuth, degrees*	Field strength of carrier, dB(μV/m)	Attenuation below carrier, dBc	Limit, dBc	Margin, dB**	Verdict
1825.556	51.61	V	1.5	190	106.50	54.89	20	-34.89	Pass
1831.934	64.14	V	1.5	285	109.05	44.91	20	-24.91	
1838.263	60.05	V	1.5	300	107.10	47.05	20	-27.05	

*- EUT front panel refers to 0 degrees position of turntable.
**- Margin = Attenuation below carrier – specification limit.

Test specification:	Section 15.247(d), RSS-247 section 5.5, Radiated spurious emissions		
Test procedure:	ANSI C63.10, sections 6.5, 6.6		
Test mode:	Compliance	Verdict:	PASS
Date(s):	28-Sep-16		
Temperature: 26 ºC	Relative Humidity: 43 %	Air Pressure: 1010 hPa	Power: 3 VDC
Remarks:			

Table 7.7.3 Field strength of spurious emissions above 1 GHz within restricted bands

ASSIGNED FREQUENCY: 902-928MHz
INVESTIGATED FREQUENCY RANGE: 1000 -9500 MHz
TEST DISTANCE: 3 m
MODULATION: GFSK
BIT RATE: 50 kbps
DUTY CYCLE: 100 %
DETECTOR USED: Peak
RESOLUTION BANDWIDTH: 1000 kHz
TEST ANTENNA TYPE: Double ridged guide
FREQUENCY HOPPING: Disabled

Frequency, MHz	Antenna		Azimuth, degrees*	Peak field strength(VBW=3 MHz)			Average field strength(VBW=10 Hz)				Verdict
	Polarization	Height, m		Measured, dB(μV/m)	Limit, dB(μV/m)	Margin, dB**	Measured, dB(μV/m)	Calculated, dB(μV/m)	Limit, dB(μV/m)	Margin, dB***	
Low carrier frequency											
2738.25	H	1.5	154	52.55	74.00	-21.45	52.55	24.55	54.00	-29.45	Pass
7302.00	H	2.0	154	54.30	74.00	-19.70	54.30	26.30	54.00	-27.70	
Mid carrier frequency											
2747.97	H	1.6	6	52.48	74.00	-21.52	52.48	24.48	54.00	-29.52	Pass
7327.92	H	1.6	345	56.86	74.00	-17.14	56.86	28.86	54.00	-25.14	
High carrier frequency											
2757.228	H	1.4	0	54.19	74.00	-19.81	54.19	26.19	54.00	-27.81	Pass
7352.848	H	1.4	0	56.69	74.00	-17.31	56.69	28.69	54.00	-25.31	

*- EUT front panel refers to 0 degrees position of turntable.
**- Margin = Measured field strength - specification limit.
***- Margin = Calculated field strength - specification limit,
where Calculated field strength = Measured field strength + average factor.

Table 7.7.4 Average factor calculation

Transmission pulse		Transmission burst		Transmission train duration, ms	Average factor, dB
Duration, ms	Period, s	Duration, ms	Period, ms		
4	256	NA	NA	NA	-28

*- Average factor was calculated as follows

for pulse train shorter than 100 ms:

$$Average\ factor = 20 \times \log_{10}\left(\frac{Pulse\ duration}{Pulse\ period} \times \frac{Burst\ duration}{Train\ duration} \times Number\ of\ bursts\ within\ pulse\ train\right)$$

for pulse train longer than 100 ms:

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

Test specification:	Section 15.247(d), RSS-247 section 5.5, Radiated spurious emissions		
Test procedure:	ANSI C63.10, sections 6.5, 6.6		
Test mode:	Compliance	Verdict:	PASS
Date(s):	28-Sep-16		
Temperature: 26 ºC	Relative Humidity: 43 %	Air Pressure: 1010 hPa	Power: 3 VDC
Remarks:			

Table 7.7.5 Field strength of spurious emissions below 1 GHz within restricted bands

ASSIGNED FREQUENCY:	902-928MHz
INVESTIGATED FREQUENCY RANGE:	0.009 -1000 MHz
TEST DISTANCE:	3 m
MODULATION:	GFSK
BIT RATE:	50 kbps
DUTY CYCLE:	100 %
RESOLUTION BANDWIDTH:	0.2 kHz (9 kHz – 150 kHz) 9.0 kHz (150 kHz – 30 MHz) 120 kHz (30 MHz – 1000 MHz)
VIDEO BANDWIDTH:	> Resolution bandwidth
TEST ANTENNA TYPE:	Active loop (9 kHz – 30 MHz) Biconical (30 MHz – 200 MHz) Log periodic (200 MHz – 1000 MHz) Biconilog (30 MHz – 1000 MHz)
FREQUENCY HOPPING:	Disabled

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*				
No emission was found								Pass

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

Reference numbers of test equipment used

HL 3818	HL 4294	HL 4295	HL 4535	HL 4541	HL 4542	HL 4543	HL 4549
HL 4551	HL 4575	HL 4603	HL 4604	HL 4933	HL 5103		

Full description is given in Appendix A.

Test specification:	Section 15.247(d), RSS-247 section 5.5, Radiated spurious emissions		
Test procedure:	ANSI C63.10, sections 6.5, 6.6		
Test mode:	Compliance	Verdict:	PASS
Date(s):	28-Sep-16		
Temperature: 26 ºC	Relative Humidity: 43 %	Air Pressure: 1010 hPa	Power: 3 VDC
Remarks:			

Table 7.7.6 Restricted bands according to FCC section 15.205

MHz	MHz	MHz	MHz	MHz	GHz
0.09 - 0.11	8.37625 - 8.38675	73 - 74.6	399.9 - 410	2690 - 2900	10.6 - 12.7
0.495 - 0.505	8.41425 - 8.41475	74.8 - 75.2	608 - 614	3260 - 3267	13.25 - 13.4
2.1735 - 2.1905	12.29 - 12.293	108 - 121.94	960 - 1240	3332 - 3339	14.47 - 14.5
4.125 - 4.128	12.51975 - 12.52025	123 - 138	1300 - 1427	3345.8 - 3358	15.35 - 16.2
4.17725 - 4.17775	12.57675 - 12.57725	149.9 - 150.05	1435 - 1626.5	3600 - 4400	17.7 - 21.4
4.20725 - 4.20775	13.36 - 13.41	156.52475 - 156.52525	1645.5 - 1646.5	4500 - 5150	22.01 - 23.12
6.215 - 6.218	16.42 - 16.423	156.7 - 156.9	1660 - 1710	5350 – 5460	23.6 - 24
6.26775 - 6.26825	16.69475 - 16.69525	162.0125 - 167.17	1718.8 - 1722.2	7250 - 7750	31.2 - 31.8
6.31175 - 6.31225	16.80425 - 16.80475	167.72 - 173.2	2200 - 2300	8025 – 8500	36.43 - 36.5
8.291 - 8.294	25.5 - 25.67	240 - 285	2310 - 2390	9000 - 9200	Above 38.6
8.362 - 8.366	37.5 - 38.25	322 - 335.4	2483.5 - 2500	9300 - 9500	

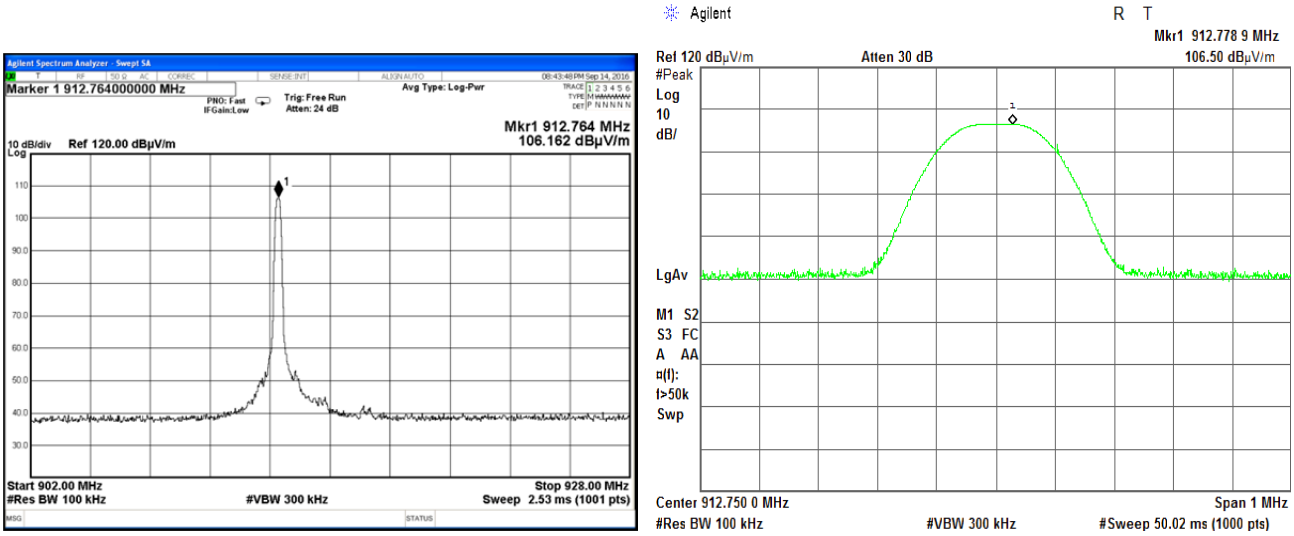
Table 7.7.7 Restricted bands according to RSS-Gen

MHz	MHz	MHz	MHz	MHz	GHz
0.09 - 0.11	8.291 - 8.294	16.80425 - 16.80475	399.9 - 410	3260 - 3267	10.6 - 12.7
2.1735 - 2.1905	8.362 - 8.366	25.5 - 25.67	608 - 614	3332 – 3339	13.25 - 13.4
3.020 – 3.026	8.37625 - 8.38675	37.5 - 38.25	960 – 1427	3345.8 – 3358	14.47 – 14.5
4.125 – 4.128	8.41425 - 8.41475	73 - 74.6	1435 – 1626.5	3500 – 4400	15.35 – 16.2
4.17725 – 4.17775	12.29 – 12.293	74.8 - 75.2	1645.5 – 1646.5	4500 – 5150	17.7 – 21.4
4.20725 – 4.20775	12.51975 – 12.52025	108 – 138	1660 - 1710	5350 – 5460	22.01 – 23.12
5.677 – 5.683	12.57675 – 12.57725	156.52475 – 156.52525	1718.8 - 1722.2	7250 - 7750	23.6 - 24
6.215 - 6.218	13.36 – 13.41	156.7 - 156.9	2200 - 2300	8025 – 8500	31.2 - 31.8
6.26775 - 6.26825	16.42 - 16.423	240 - 285	2310 - 2390	9000 - 9200	36.43 - 36.5
6.31175 - 6.31225	16.69475 - 16.69525	322 - 335.4	2655 - 2900	9300 - 9500	Above 38.6

Test specification:	Section 15.247(d), RSS-247 section 5.5, Radiated spurious emissions		
Test procedure:	ANSI C63.10, sections 6.5, 6.6		
Test mode:	Compliance	Verdict:	PASS
Date(s):	28-Sep-16		
Temperature: 26 ºC	Relative Humidity: 43 %	Air Pressure: 1010 hPa	Power: 3 VDC
Remarks:			

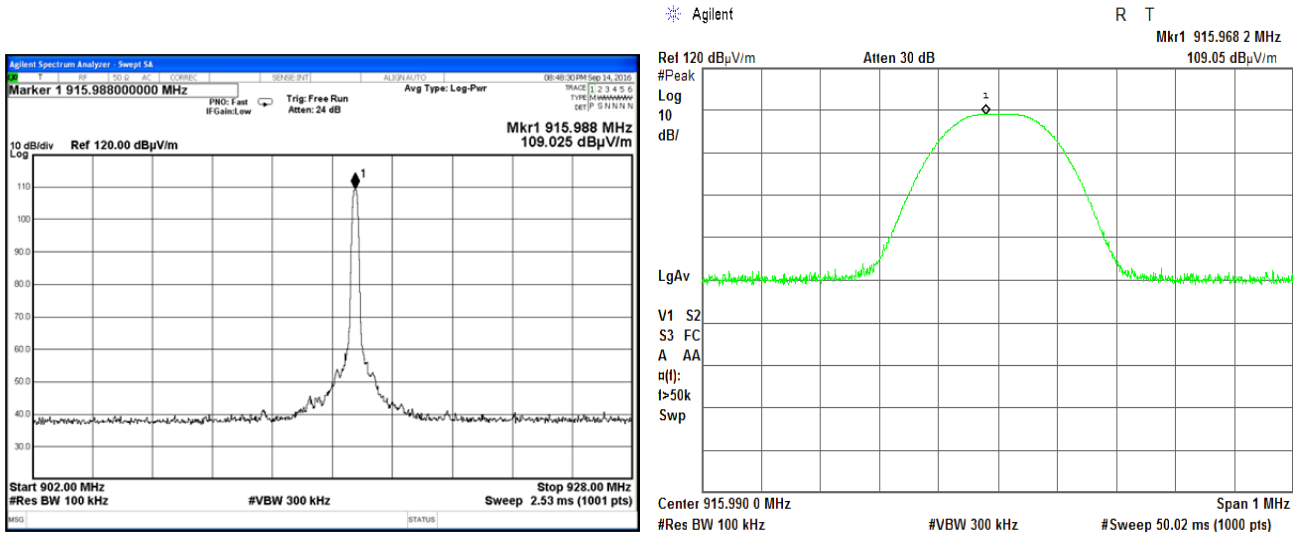
Plot 7.7.1 Radiated emission measurements at the low carrier frequency

TEST SITE: Semi anechoic chamber; OATS
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical & Horizontal



Plot 7.7.2 Radiated emission measurements at the mid carrier frequency

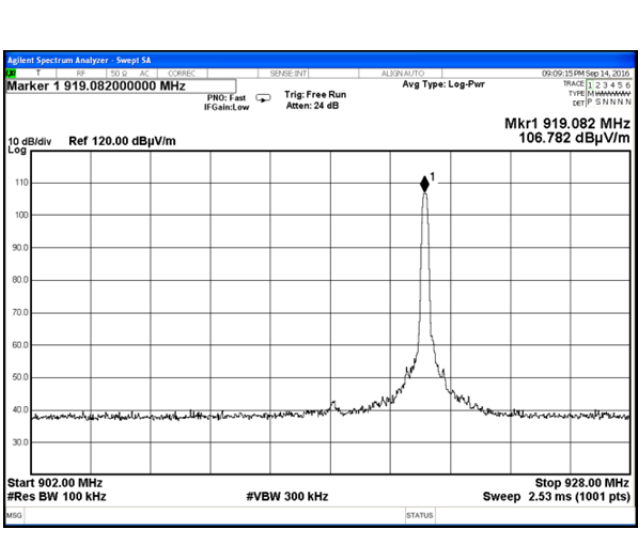
TEST SITE: Semi anechoic chamber; OATS
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical & Horizontal

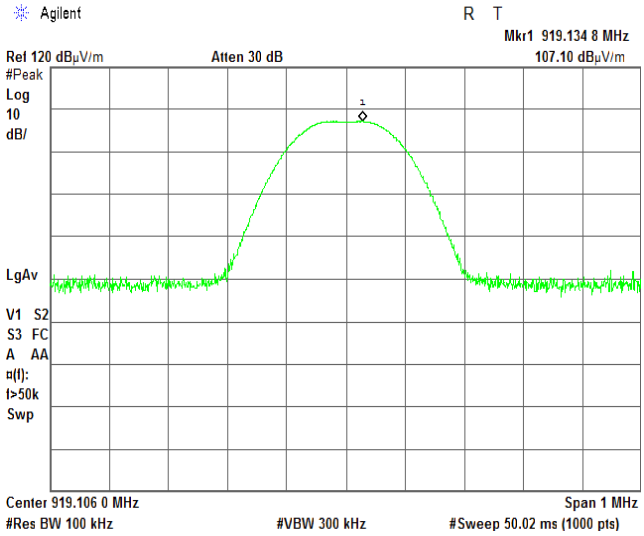


Test specification:	Section 15.247(d), RSS-247 section 5.5, Radiated spurious emissions		
Test procedure:	ANSI C63.10, sections 6.5, 6.6		
Test mode:	Compliance	Verdict:	PASS
Date(s):	28-Sep-16		
Temperature: 26 ºC	Relative Humidity: 43 %	Air Pressure: 1010 hPa	Power: 3 VDC
Remarks:			

Plot 7.7.3 Radiated emission measurements at the high carrier frequency

TEST SITE: Semi anechoic chamber; OATS
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical & Horizontal

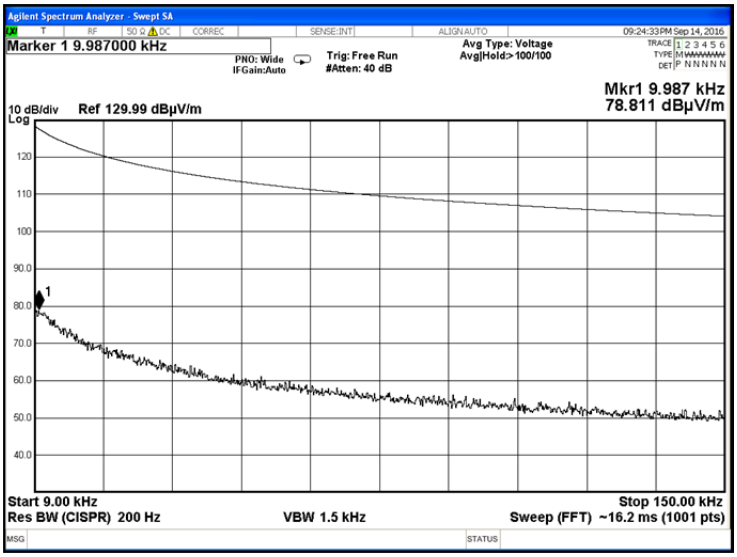




Test specification:	Section 15.247(d), RSS-247 section 5.5, Radiated spurious emissions		
Test procedure:	ANSI C63.10, sections 6.5, 6.6		
Test mode:	Compliance	Verdict:	PASS
Date(s):	28-Sep-16		
Temperature: 26 ºC	Relative Humidity: 43 %	Air Pressure: 1010 hPa	Power: 3 VDC
Remarks:			

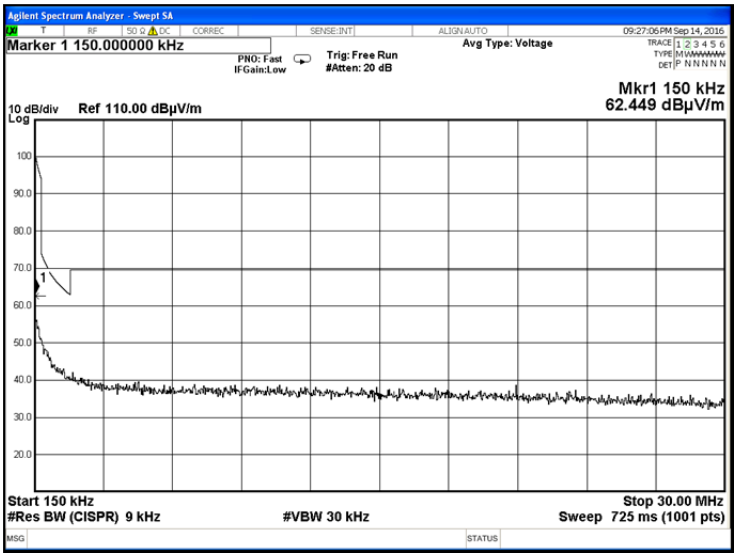
Plot 7.7.4 Radiated emission measurements from 9 to 150 kHz at the low; mid and high carrier frequency

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



Plot 7.7.5 Radiated emission measurements from 0.15 to 30 MHz at the low; mid and high carrier frequency

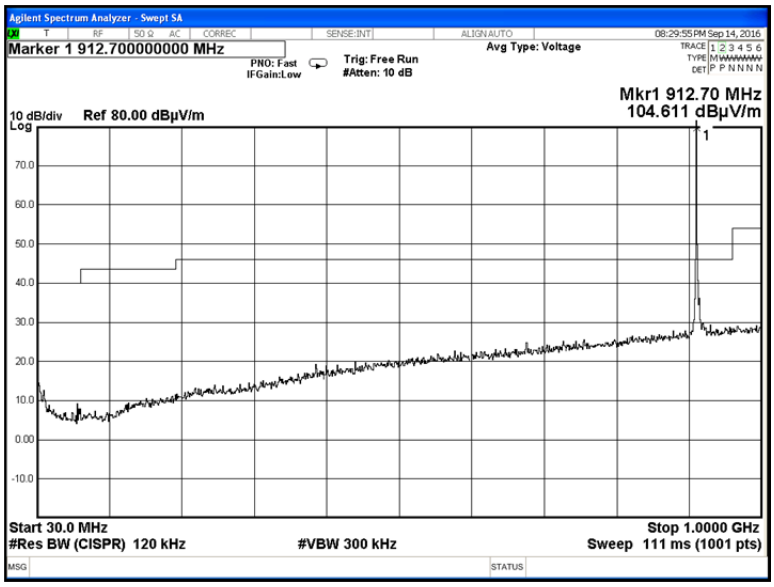
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical

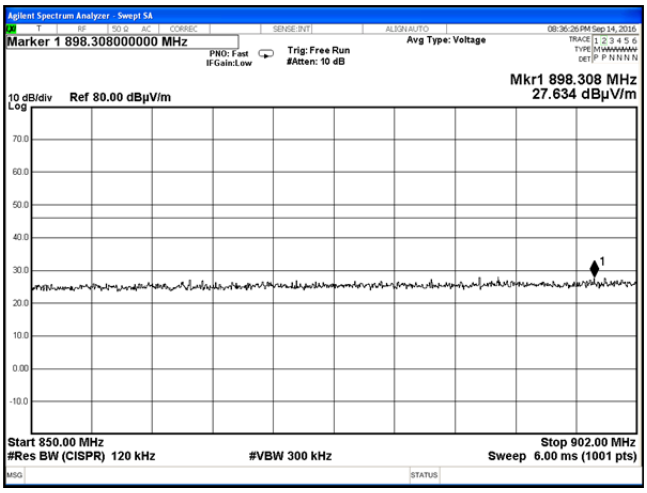


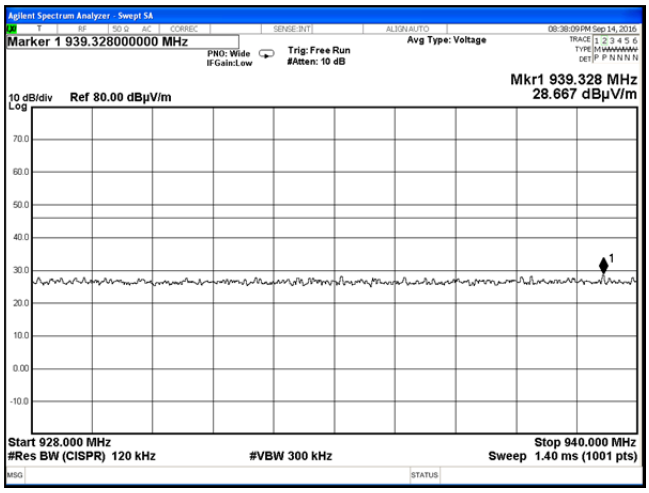
Test specification:	Section 15.247(d), RSS-247 section 5.5, Radiated spurious emissions		
Test procedure:	ANSI C63.10, sections 6.5, 6.6		
Test mode:	Compliance	Verdict:	PASS
Date(s):	28-Sep-16		
Temperature: 26 ºC	Relative Humidity: 43 %	Air Pressure: 1010 hPa	Power: 3 VDC
Remarks:			

Plot 7.7.6 Radiated emission measurements from 30 to 1000 MHz at the low carrier frequency

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



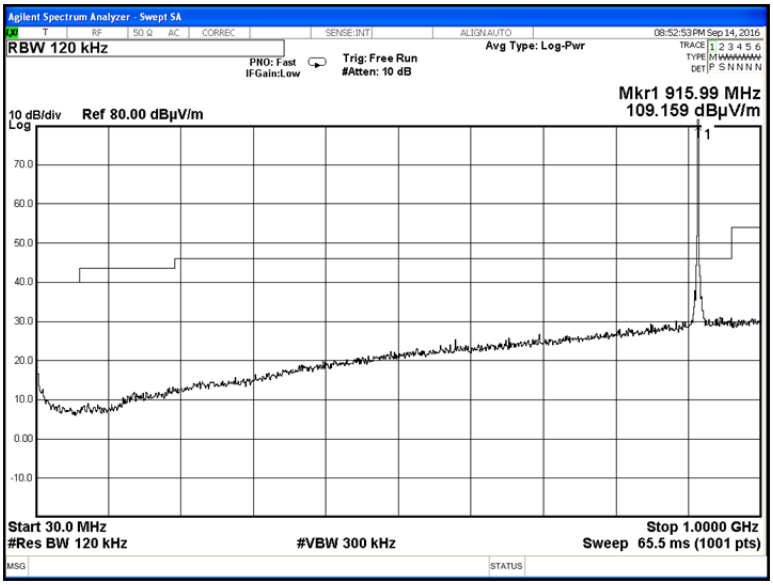


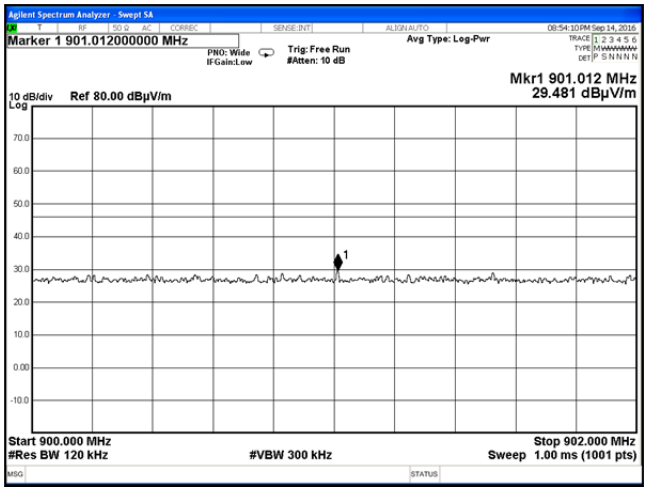


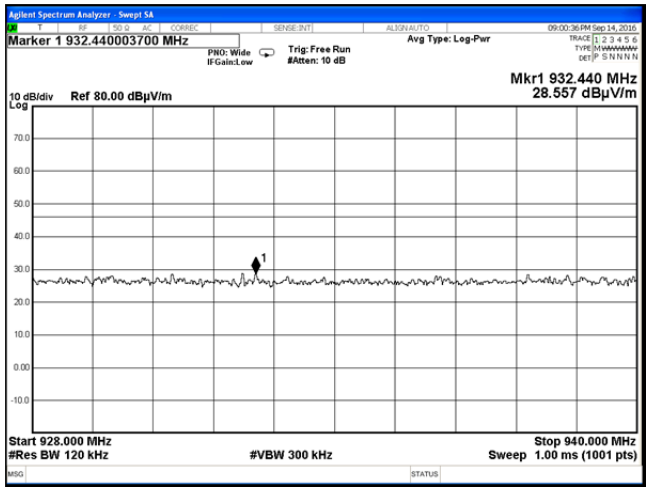
Test specification:	Section 15.247(d), RSS-247 section 5.5, Radiated spurious emissions		
Test procedure:	ANSI C63.10, sections 6.5, 6.6		
Test mode:	Compliance	Verdict:	PASS
Date(s):	28-Sep-16		
Temperature: 26 ºC	Relative Humidity: 43 %	Air Pressure: 1010 hPa	Power: 3 VDC
Remarks:			

Plot 7.7.7 Radiated emission measurements from 30 to 1000 MHz at the mid carrier frequency

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



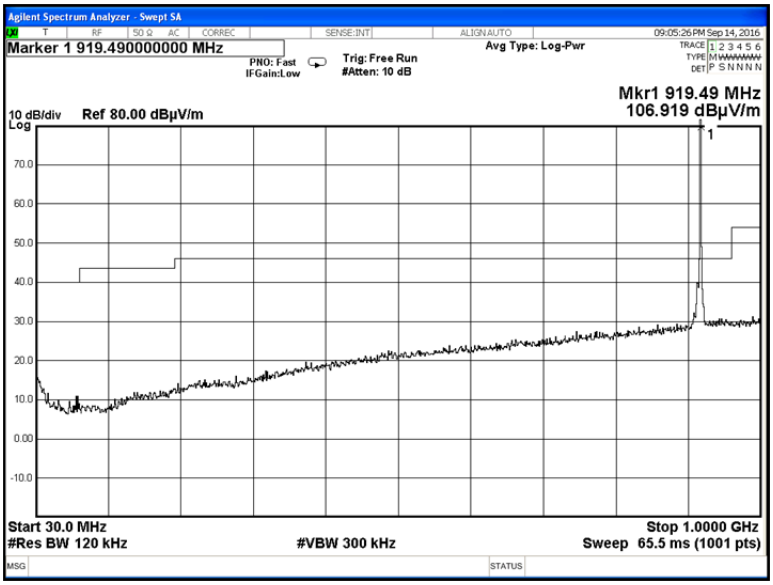


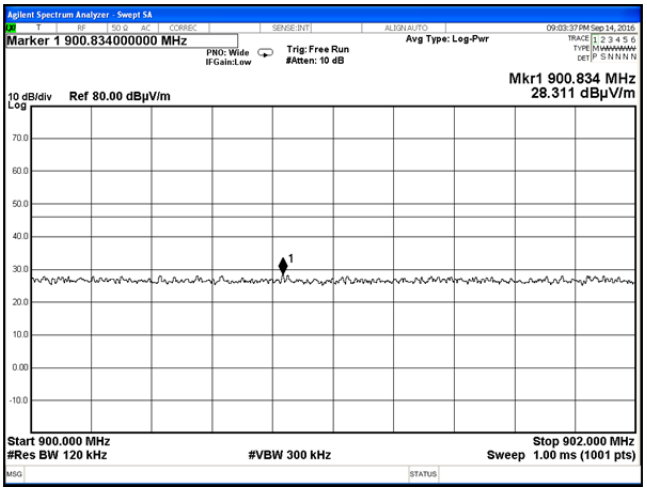


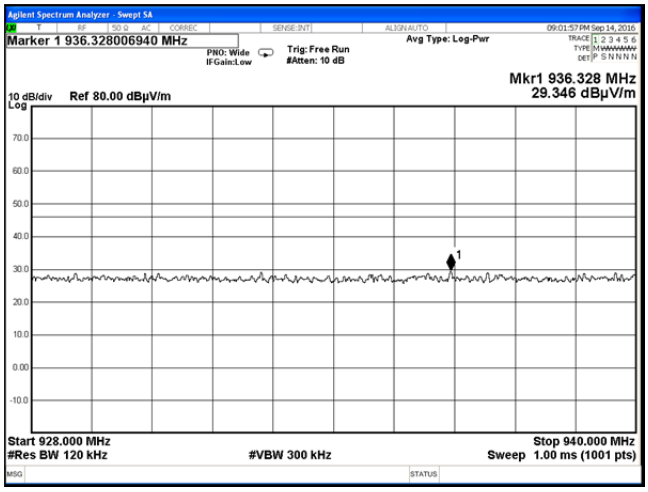
Test specification:	Section 15.247(d), RSS-247 section 5.5, Radiated spurious emissions		
Test procedure:	ANSI C63.10, sections 6.5, 6.6		
Test mode:	Compliance	Verdict:	PASS
Date(s):	28-Sep-16		
Temperature: 26 ºC	Relative Humidity: 43 %	Air Pressure: 1010 hPa	Power: 3 VDC
Remarks:			

Plot 7.7.8 Radiated emission measurements from 30 to 1000 MHz at the high carrier frequency

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



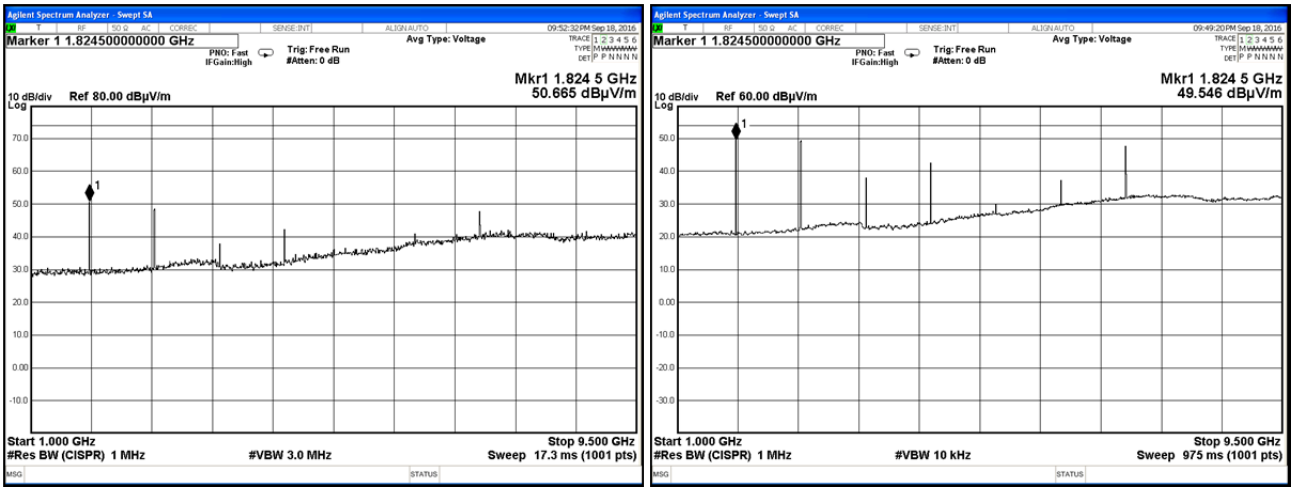




Test specification:	Section 15.247(d), RSS-247 section 5.5, Radiated spurious emissions		
Test procedure:	ANSI C63.10, sections 6.5, 6.6		
Test mode:	Compliance	Verdict:	PASS
Date(s):	28-Sep-16		
Temperature: 26 ºC	Relative Humidity: 43 %	Air Pressure: 1010 hPa	Power: 3 VDC
Remarks:			

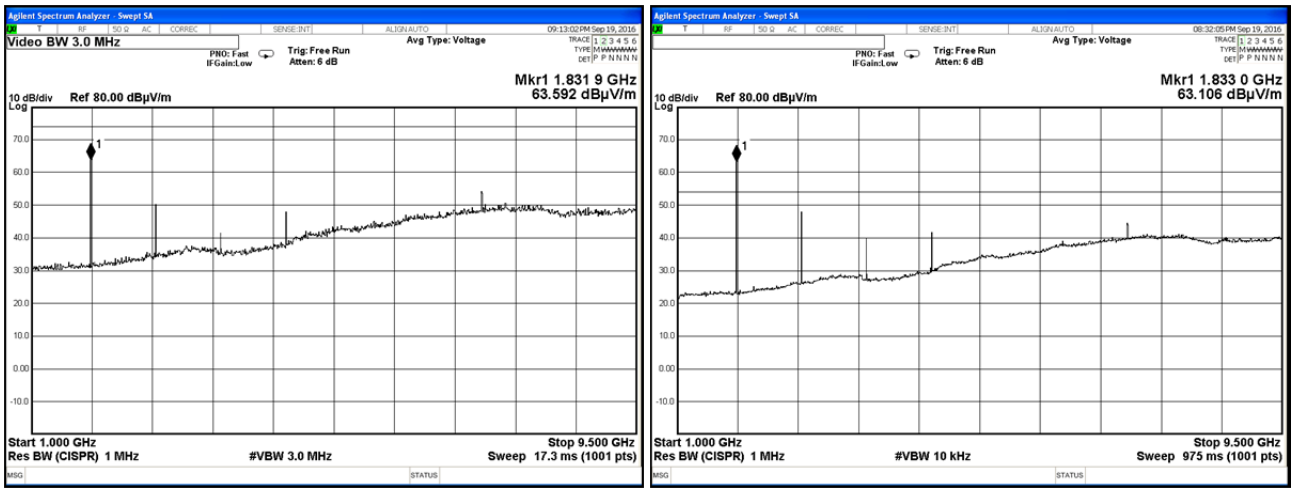
Plot 7.7.9 Radiated emission measurements from 1000 to 9500 MHz at the low carrier frequency

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



Plot 7.7.10 Radiated emission measurements from 1000 to 9500 MHz at the mid carrier frequency

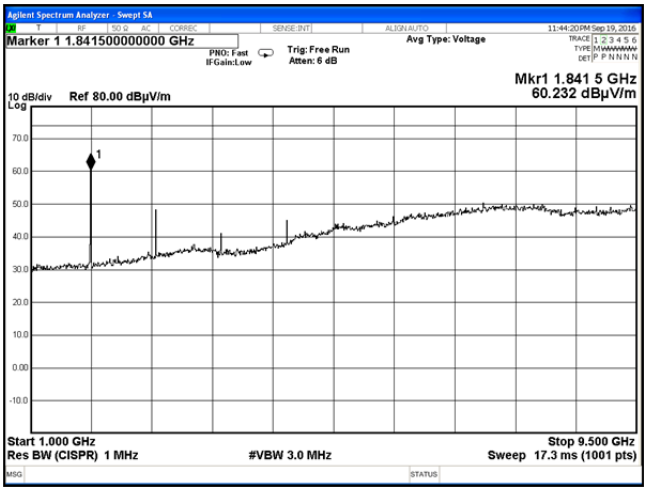
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal

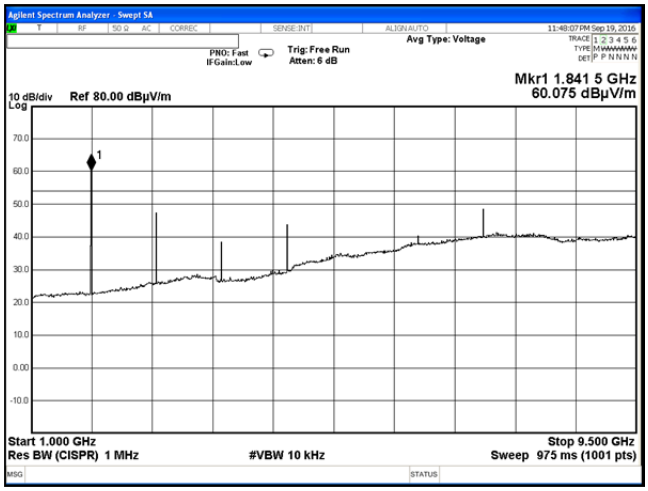


Test specification:	Section 15.247(d), RSS-247 section 5.5, Radiated spurious emissions		
Test procedure:	ANSI C63.10, sections 6.5, 6.6		
Test mode:	Compliance	Verdict:	PASS
Date(s):	28-Sep-16		
Temperature: 26 ºC	Relative Humidity: 43 %	Air Pressure: 1010 hPa	Power: 3 VDC
Remarks:			

Plot 7.7.11 Radiated emission measurements from 1000 to 95000 MHz at the high carrier frequency

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

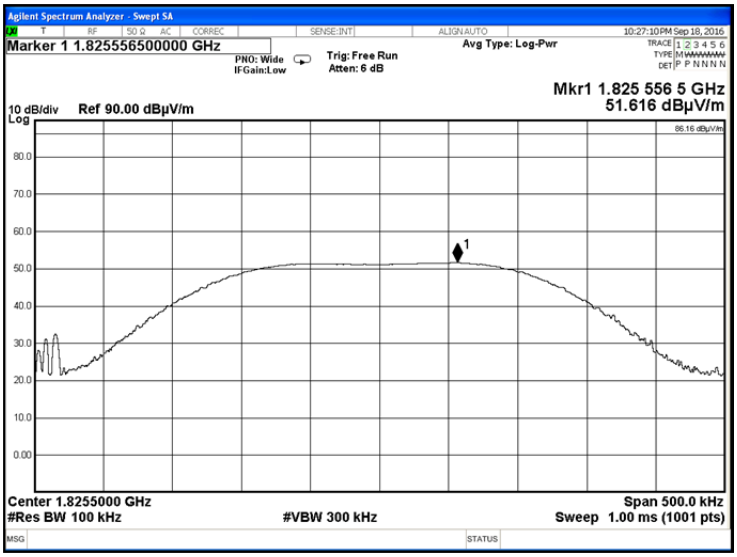




Test specification:	Section 15.247(d), RSS-247 section 5.5, Radiated spurious emissions		
Test procedure:	ANSI C63.10, sections 6.5, 6.6		
Test mode:	Compliance	Verdict:	PASS
Date(s):	28-Sep-16		
Temperature: 26 ºC	Relative Humidity: 43 %	Air Pressure: 1010 hPa	Power: 3 VDC
Remarks:			

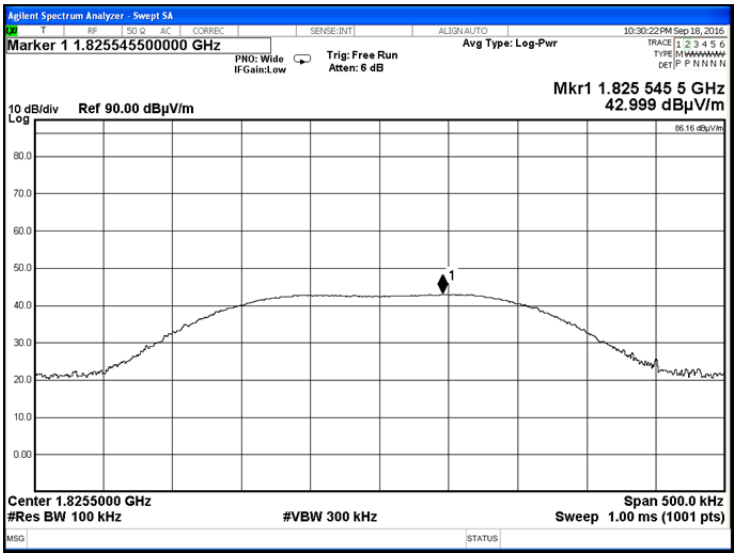
Plot 7.7.12 Radiated emission measurements at the second harmonic of low carrier frequency

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



Plot 7.7.13 Radiated emission measurements at the second harmonic of low carrier frequency

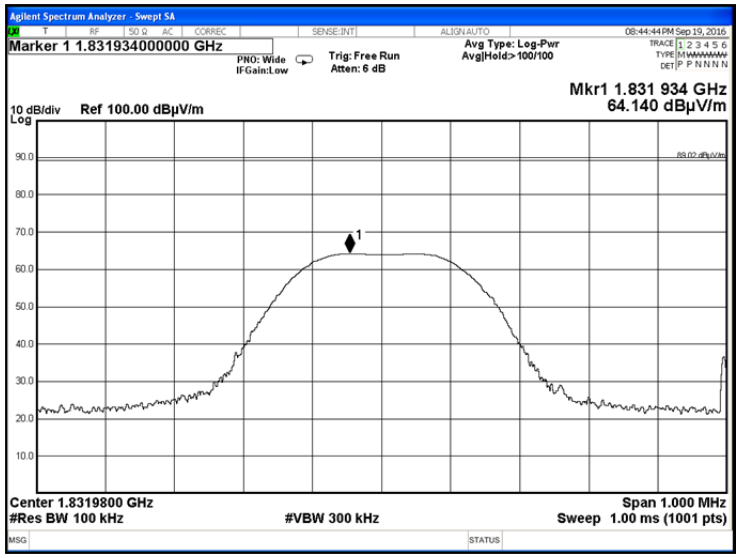
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal



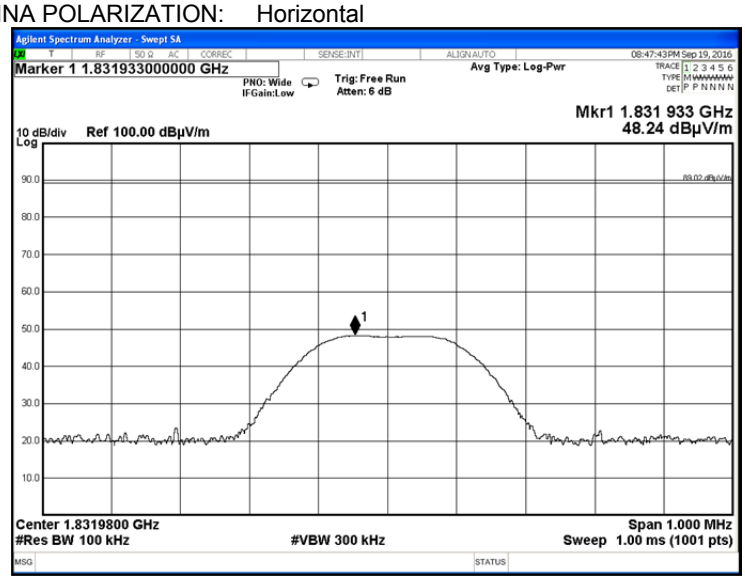
Test specification:	Section 15.247(d), RSS-247 section 5.5, Radiated spurious emissions		
Test procedure:	ANSI C63.10, sections 6.5, 6.6		
Test mode:	Compliance	Verdict:	PASS
Date(s):	28-Sep-16		
Temperature: 26 ºC	Relative Humidity: 43 %	Air Pressure: 1010 hPa	Power: 3 VDC
Remarks:			

Plot 7.7.14 Radiated emission measurements at the second harmonic of mid carrier frequency

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



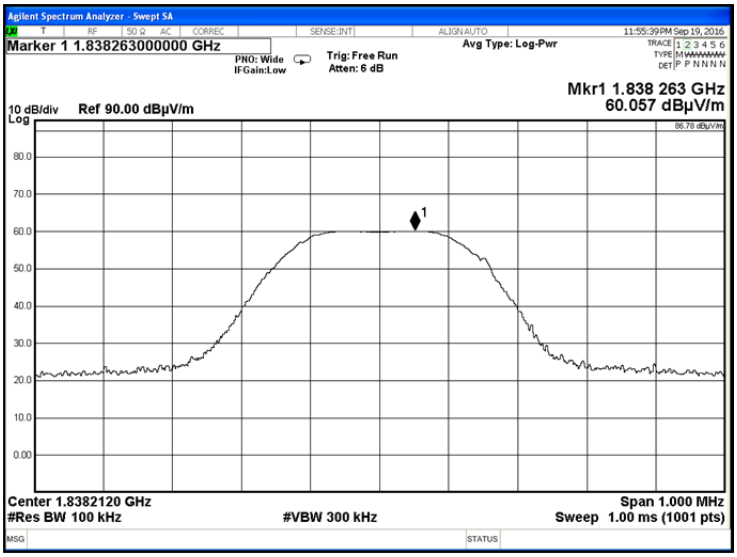
ANTENNA POLARIZATION: Horizontal



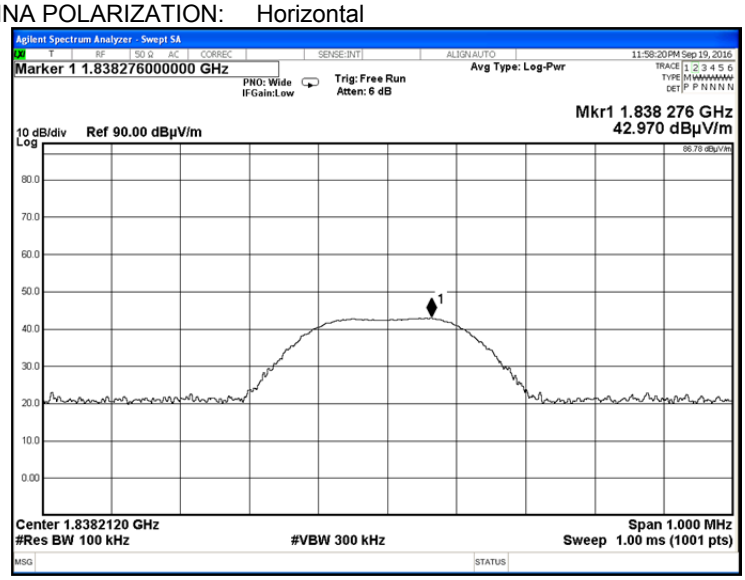
Test specification:	Section 15.247(d), RSS-247 section 5.5, Radiated spurious emissions		
Test procedure:	ANSI C63.10, sections 6.5, 6.6		
Test mode:	Compliance	Verdict:	PASS
Date(s):	28-Sep-16		
Temperature: 26 ºC	Relative Humidity: 43 %	Air Pressure: 1010 hPa	Power: 3 VDC
Remarks:			

Plot 7.7.15 Radiated emission measurements at the second harmonic of high carrier frequency

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



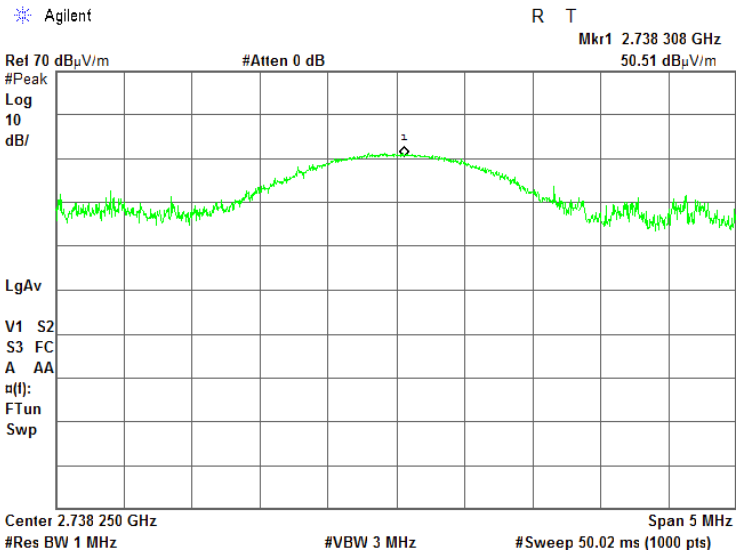
ANTENNA POLARIZATION: Horizontal



Test specification:	Section 15.247(d), RSS-247 section 5.5, Radiated spurious emissions		
Test procedure:	ANSI C63.10, sections 6.5, 6.6		
Test mode:	Compliance	Verdict:	PASS
Date(s):	28-Sep-16		
Temperature: 26 ºC	Relative Humidity: 43 %	Air Pressure: 1010 hPa	Power: 3 VDC
Remarks:			

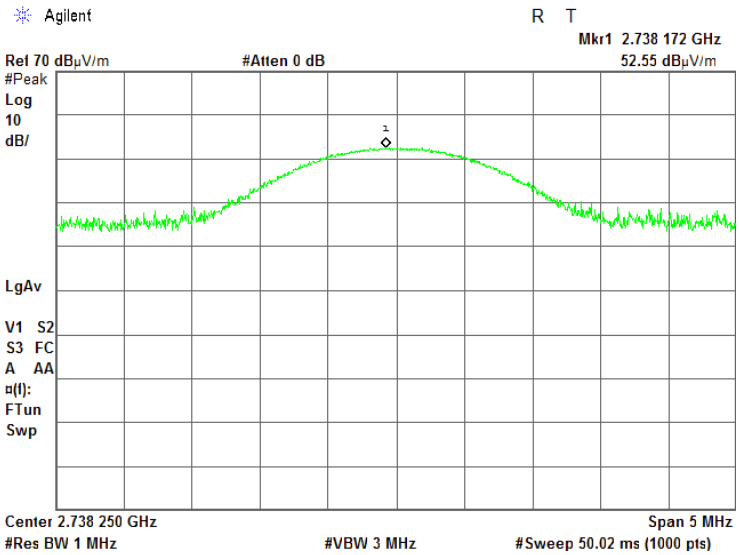
Plot 7.7.16 Radiated emission measurements at the third harmonic of low carrier frequency

TEST SITE: OATS
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical



Plot 7.7.17 Radiated emission measurements at the third harmonic of low carrier frequency

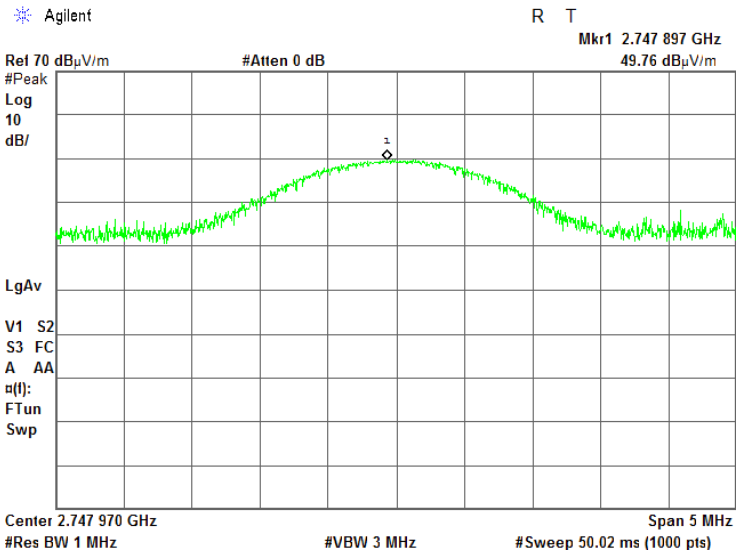
TEST SITE: OATS
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal



Test specification:	Section 15.247(d), RSS-247 section 5.5, Radiated spurious emissions		
Test procedure:	ANSI C63.10, sections 6.5, 6.6		
Test mode:	Compliance	Verdict:	PASS
Date(s):	28-Sep-16		
Temperature: 26 ºC	Relative Humidity: 43 %	Air Pressure: 1010 hPa	Power: 3 VDC
Remarks:			

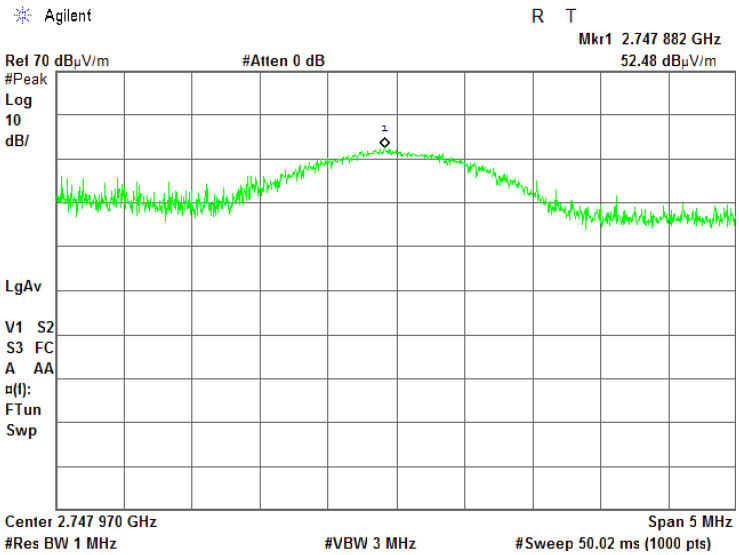
Plot 7.7.18 Radiated emission measurements at the third harmonic of mid carrier frequency

TEST SITE: OATS
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical



Plot 7.7.19 Radiated emission measurements at the third harmonic of mid carrier frequency

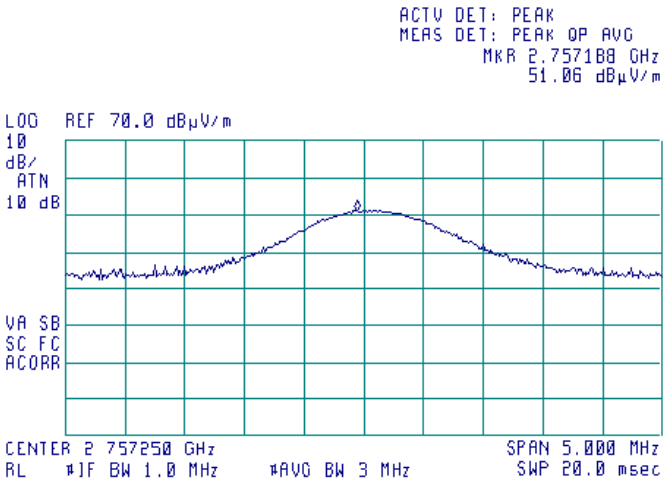
TEST SITE: OATS
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal



Test specification:	Section 15.247(d), RSS-247 section 5.5, Radiated spurious emissions		
Test procedure:	ANSI C63.10, sections 6.5, 6.6		
Test mode:	Compliance	Verdict:	PASS
Date(s):	28-Sep-16		
Temperature: 26 ºC	Relative Humidity: 43 %	Air Pressure: 1010 hPa	Power: 3 VDC
Remarks:			

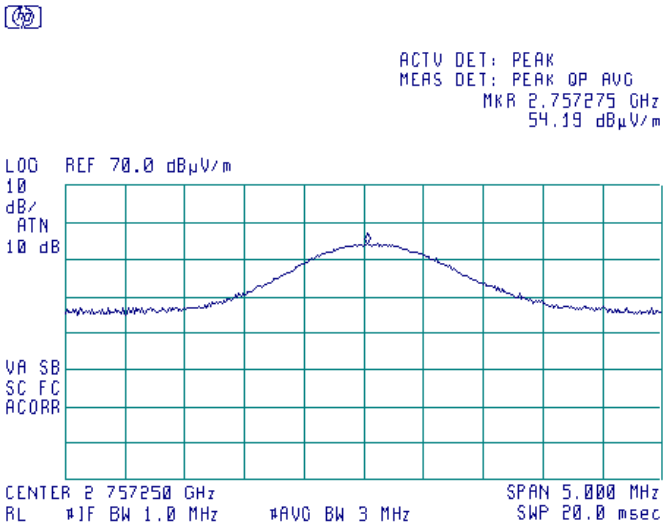
Plot 7.7.20 Radiated emission measurements at the third harmonic of high carrier frequency

TEST SITE: OATS
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical



Plot 7.7.21 Radiated emission measurements at the third harmonic of high carrier frequency

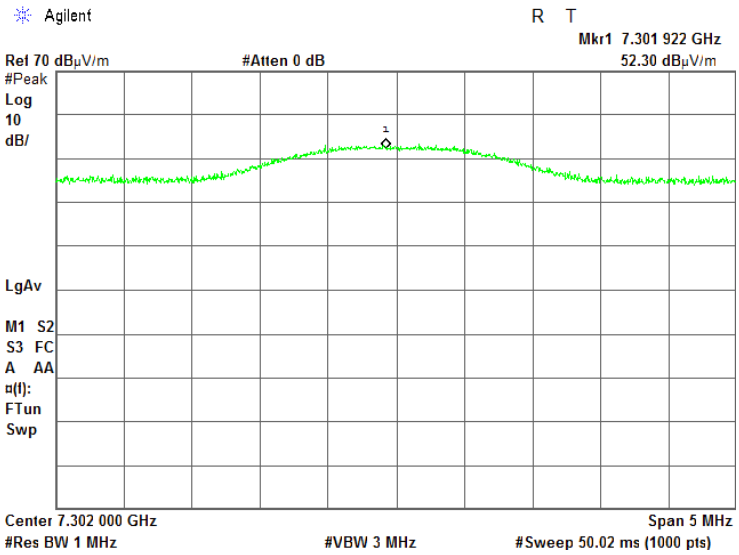
TEST SITE: OATS
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal



Test specification:	Section 15.247(d), RSS-247 section 5.5, Radiated spurious emissions		
Test procedure:	ANSI C63.10, sections 6.5, 6.6		
Test mode:	Compliance	Verdict:	PASS
Date(s):	28-Sep-16		
Temperature: 26 ºC	Relative Humidity: 43 %	Air Pressure: 1010 hPa	Power: 3 VDC
Remarks:			

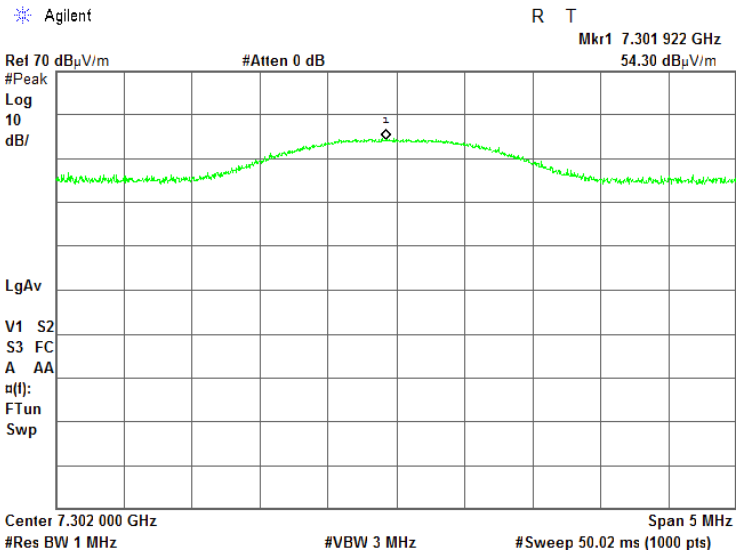
Plot 7.7.22 Radiated emission measurements at the eighth harmonic of low carrier frequency

TEST SITE: OATS
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical



Plot 7.7.23 Radiated emission measurements at the eighth harmonic of low carrier frequency

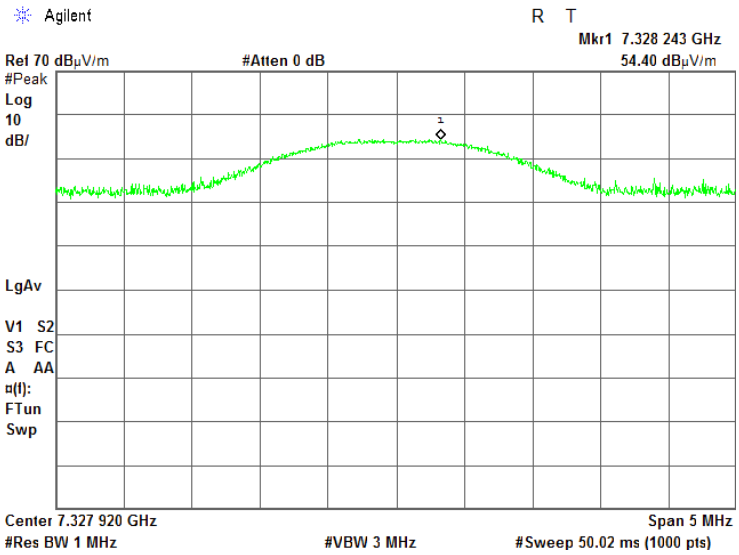
TEST SITE: OATS
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal



Test specification:	Section 15.247(d), RSS-247 section 5.5, Radiated spurious emissions		
Test procedure:	ANSI C63.10, sections 6.5, 6.6		
Test mode:	Compliance	Verdict:	PASS
Date(s):	28-Sep-16		
Temperature: 26 ºC	Relative Humidity: 43 %	Air Pressure: 1010 hPa	Power: 3 VDC
Remarks:			

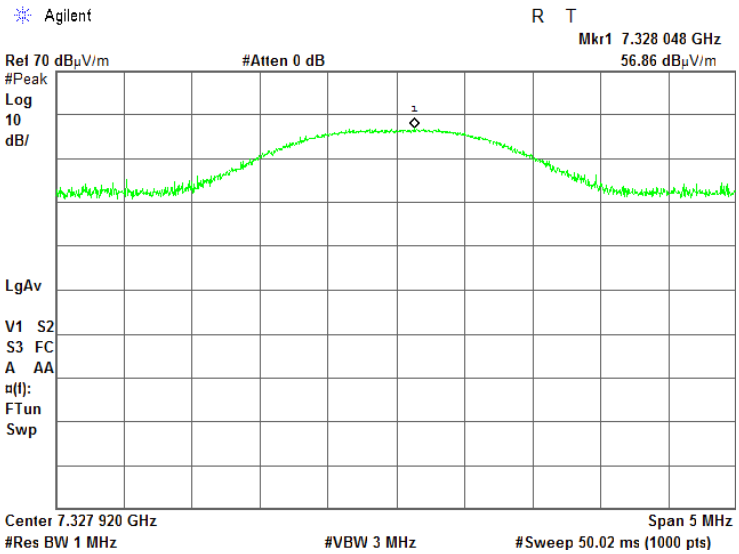
Plot 7.7.24 Radiated emission measurements at the eighth harmonic of mid carrier frequency

TEST SITE: OATS
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical



Plot 7.7.25 Radiated emission measurements at the eighth harmonic of mid carrier frequency

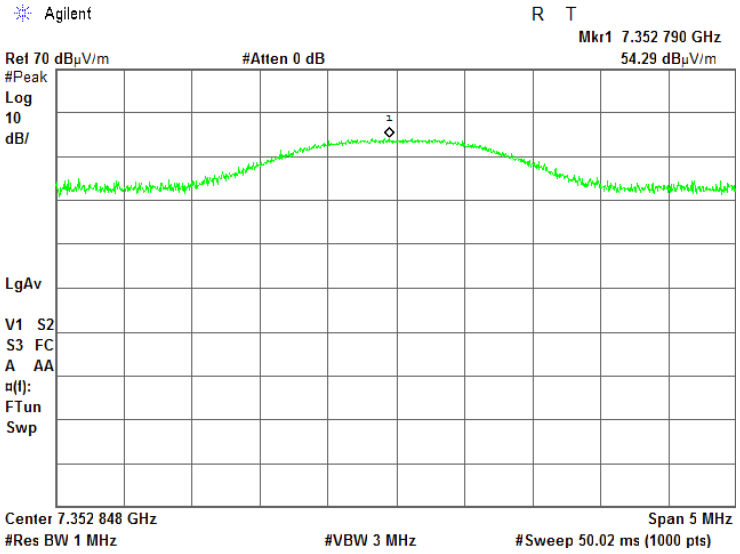
TEST SITE: OATS
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal



Test specification:	Section 15.247(d), RSS-247 section 5.5, Radiated spurious emissions		
Test procedure:	ANSI C63.10, sections 6.5, 6.6		
Test mode:	Compliance	Verdict:	PASS
Date(s):	28-Sep-16		
Temperature: 26 ºC	Relative Humidity: 43 %	Air Pressure: 1010 hPa	Power: 3 VDC
Remarks:			

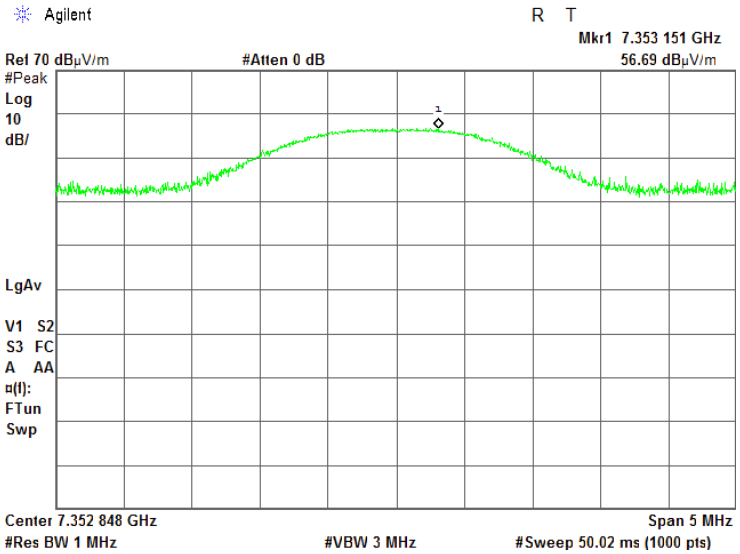
Plot 7.7.26 Radiated emission measurements at the eighth harmonic of high carrier frequency

TEST SITE: OATS
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical



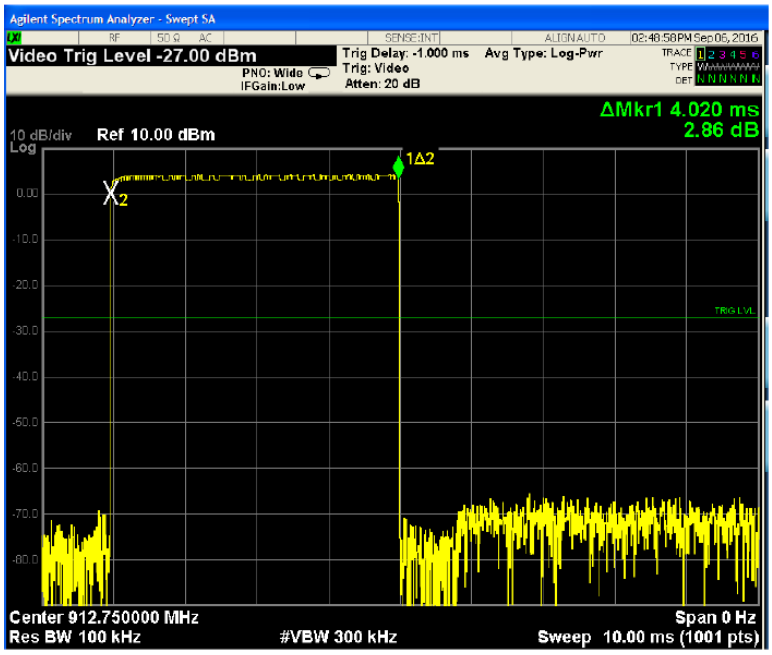
Plot 7.7.27 Radiated emission measurements at the eighth harmonic of high carrier frequency

TEST SITE: OATS
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal

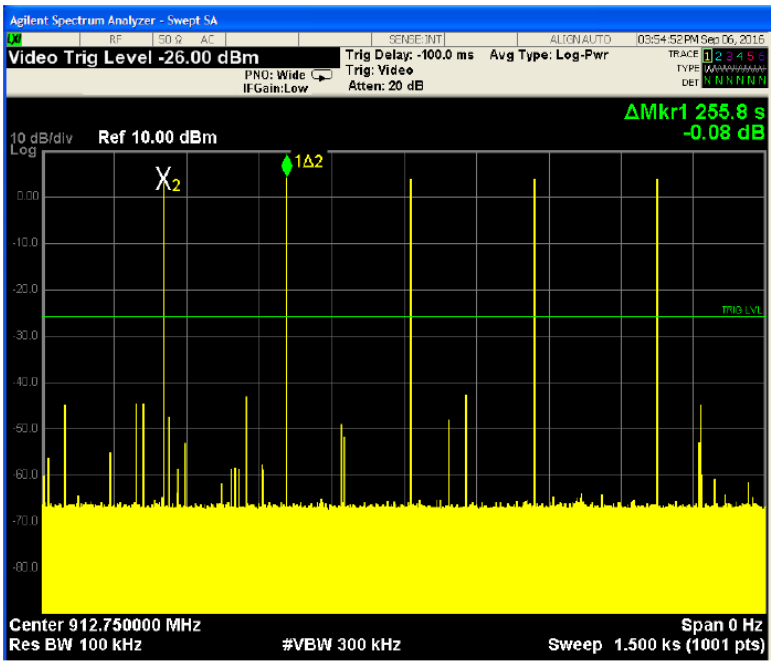


Test specification:	Section 15.247(d), RSS-247 section 5.5, Radiated spurious emissions		
Test procedure:	ANSI C63.10, sections 6.5, 6.6		
Test mode:	Compliance	Verdict:	PASS
Date(s):	28-Sep-16		
Temperature: 26 ºC	Relative Humidity: 43 %	Air Pressure: 1010 hPa	Power: 3 VDC
Remarks:			

Plot 7.7.28 Transmission pulse duration



Plot 7.7.29 Transmission pulse period



Test specification:	Section 15.247(d), RSS-247 section 5.5, Emissions at band edges		
Test procedure:	ANSI C63.10, section 7.8.6		
Test mode:	Compliance	Verdict:	PASS
Date(s):	25-Sep-16		
Temperature: 26.7 ºC	Relative Humidity: 46 %	Air Pressure: 1009 hPa	Power: 3 VDC
Remarks:			

7.8 Band edge emissions at RF antenna connector

7.8.1 General

This test was performed to measure band edge emissions at RF antenna connector. Specification test limits are given in Table 7.8.1.

Table 7.8.1 Band edge emission limits

Assigned frequency, MHz	Attenuation below carrier*, dBc
902.0 – 928.0	20.0
2400.0 – 2483.5	
5725.0 – 5850.0	

* - Band edge emission limit is provided in terms of attenuation below the peak of modulated carrier measured with the same resolution bandwidth.

7.8.2 Test procedure

7.8.2.1 The EUT was set up as shown in Figure 7.8.1, energized normally modulated at the maximum data rate with its hopping function disabled and its proper operation was checked.

7.8.2.2 The EUT was adjusted to produce maximum available to end user RF output power at the lowest carrier frequency.

7.8.2.3 The spectrum analyzer span was set to capture the carrier frequency and associated modulation products. The resolution bandwidth was set wider than 1 % of the frequency span.

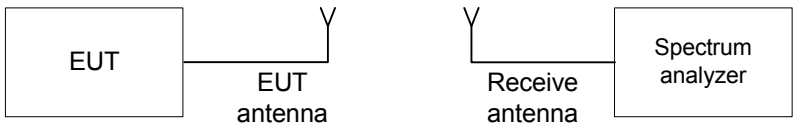
7.8.2.4 The spectrum analyzer was set in max hold mode and allowed trace to stabilize. The highest emission level within the authorized band was measured.

7.8.2.5 The maximum band edge emission and modulation product outside of the band were measured as provided in Table 7.8.2 and associated plots and referenced to the highest emission level measured within the authorized band.

7.8.2.6 The above procedure was repeated with the EUT adjusted to produce maximum RF output power at the highest carrier frequency.

7.8.2.7 The above procedure was repeated with the frequency hopping function enabled.

Figure 7.8.1 Band edge emission test setup



Test specification:	Section 15.247(d), RSS-247 section 5.5, Emissions at band edges		
Test procedure:	ANSI C63.10, section 7.8.6		
Test mode:	Compliance	Verdict:	PASS
Date(s):	25-Sep-16		
Temperature: 26.7 ºC	Relative Humidity: 46 %	Air Pressure: 1009 hPa	Power: 3 VDC
Remarks:			

Table 7.8.2 Band edge emission test results

ASSIGNED FREQUENCY RANGE: 902 – 928 MHz
DETECTOR USED: Peak
MODULATION: GFSK
MODULATING SIGNAL: PRBS
BIT RATE: 50 kbps
TRANSMITTER OUTPUT POWER SETTINGS: Maximum
RESOLUTION BANDWIDTH: 100 kHz
VIDEO BANDWIDTH: ≥ RBW

Frequency, MHz	Band edge emission, dBm	Emission at carrier, dBm	Attenuation below carrier, dBc	Limit, dBc	Margin, dB*	Verdict
Frequency hopping disabled						
902.00	-49.95	10.01	59.96	20.0	39.96	Pass
928.00	-50.53	10.02	60.55		30.55	
Frequency hopping enabled						
902.00	-48.69	12.45	61.14	20.0	41.14	Pass
928.00	-48.37	12.17	60.54		40.54	

*- Margin = Attenuation below carrier – specification limit.

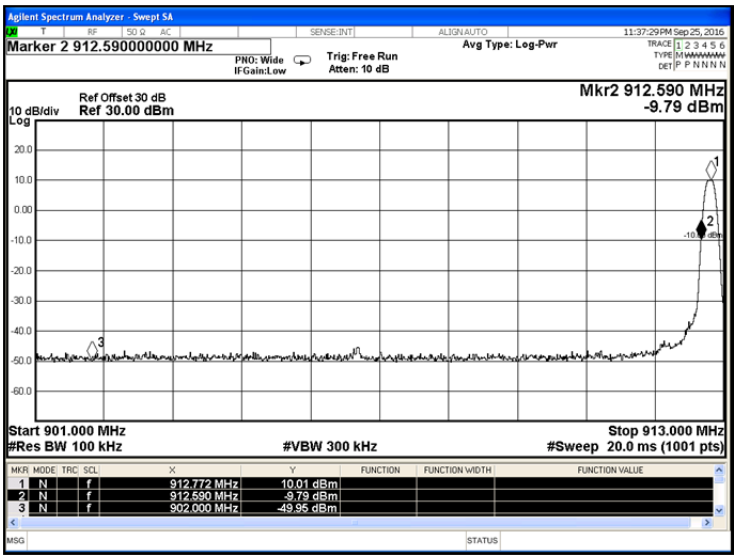
Reference numbers of test equipment used

HL 4274	HL 4575						

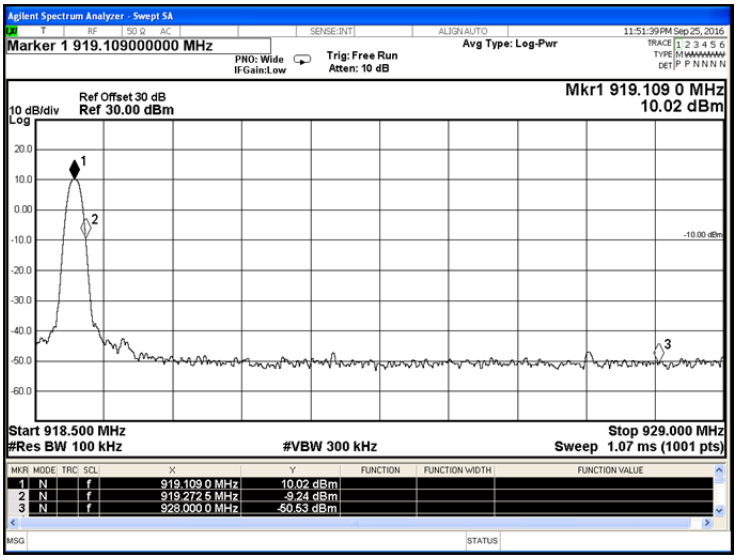
Full description is given in Appendix A.

Test specification:	Section 15.247(d), RSS-247 section 5.5, Emissions at band edges		
Test procedure:	ANSI C63.10, section 7.8.6		
Test mode:	Compliance	Verdict:	PASS
Date(s):	25-Sep-16		
Temperature: 26.7 ºC	Relative Humidity: 46 %	Air Pressure: 1009 hPa	Power: 3 VDC
Remarks:			

Plot 7.8.1 The highest band edge emission at low carrier frequency with hopping function disabled

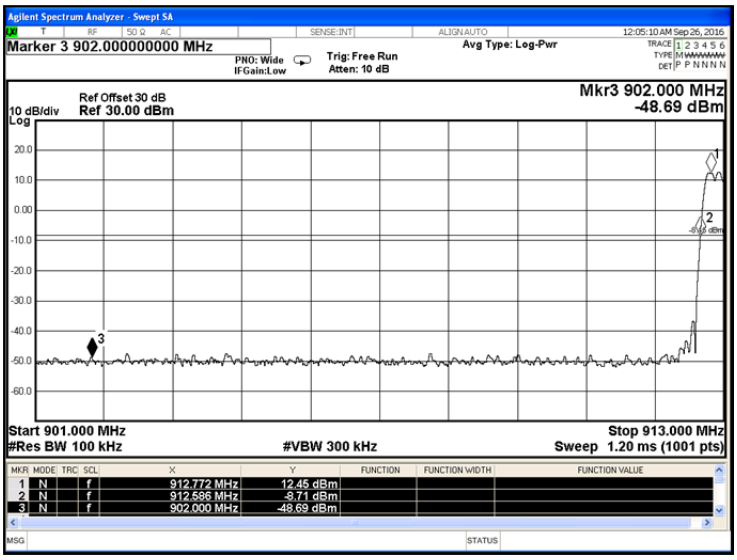


Plot 7.8.2 The highest band edge emission at high carrier frequency with hopping function disabled

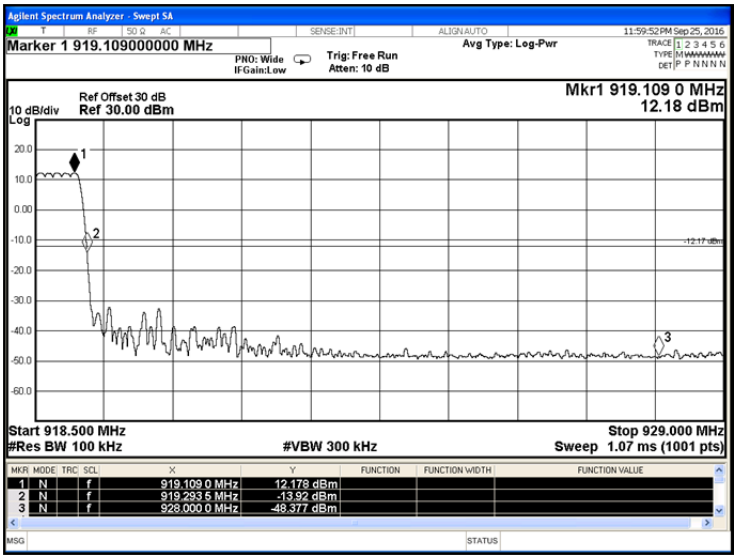


Test specification:	Section 15.247(d), RSS-247 section 5.5, Emissions at band edges		
Test procedure:	ANSI C63.10, section 7.8.6		
Test mode:	Compliance	Verdict:	PASS
Date(s):	25-Sep-16		
Temperature: 26.7 ºC	Relative Humidity: 46 %	Air Pressure: 1009 hPa	Power: 3 VDC
Remarks:			

Plot 7.8.3 The highest band edge emission at low carrier frequency with hopping function enabled



Plot 7.8.4 The highest band edge emission at high carrier frequency with hopping function enabled



Test specification:	Section 15.203, RSS-Gen, Section 7.1.4,Antenna requirements		
Test procedure:	Visual inspection		
Test mode:	Compliance	Verdict:	PASS
Date(s):	26-Sep-16		
Temperature: 26 ºC	Relative Humidity: 47 %	Air Pressure: 1010 hPa	Power: 3 VDC
Remarks:			

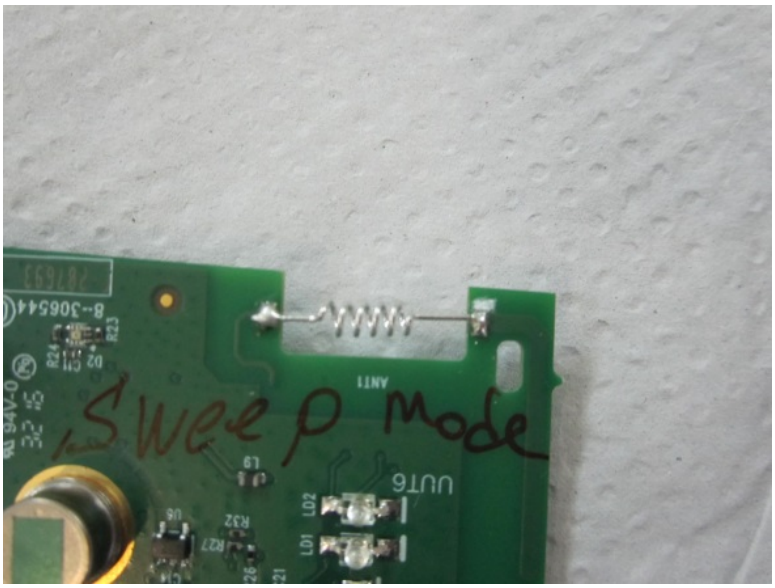
7.9 Antenna requirements

The EUT was verified for compliance with antenna requirements. A transmitter shall be designed to ensure that no antenna other than that furnished by the responsible party will be used with the device. It may be either permanently attached or employs a unique antenna connector for every antenna proposed for use with the EUT. This requirement does not apply to professionally installed transmitters.
The rationale for compliance with the above requirements was either visual inspection results or supplier declaration. The summary of results is provided in Table 7.9.1.

Table 7.9.1 Antenna requirements

Requirement	Rationale	Verdict
The transmitter antenna is permanently attached	Visual inspection	Comply
The transmitter employs a unique antenna connector	NA	
The transmitter requires professional installation	NA	

Photograph 7.9.1 Antenna assembly



Test specification:	Section 15.109, RSS-Gen, Section 7.1.2, ICES-003, Radiated emission		
Test procedure:	ANSI C63.4, Section 12.2.5		
Test mode:	Compliance	Verdict:	PASS
Date(s):	20-Sep-16		
Temperature: 26 ºC	Relative Humidity: 54 %	Air Pressure: 1010 hPa	Power: 3 VDC
Remarks:			

8 Unintentional emissions

8.1 Radiated emission measurements

8.1.1 General

This test was performed to measure radiated emissions from the EUT enclosure. Specification test limits are given in Table 8.1.1, Table 8.1.2.

Table 8.1.1 Radiated emission test limits

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

* 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.

Table 8.1.2 Radiated emission limits according to RSS-Gen, Section 7.1.2

Frequency, MHz	Field strength limit at 3 m test distance, dB(μV/m)
30 - 88	40.0
88 - 216	43.5
216 - 960	46.0
960 - 5th harmonic**	54.0

** - harmonic of the highest frequency the EUT generates, uses, operates or tunes to.

8.1.2 Test procedure

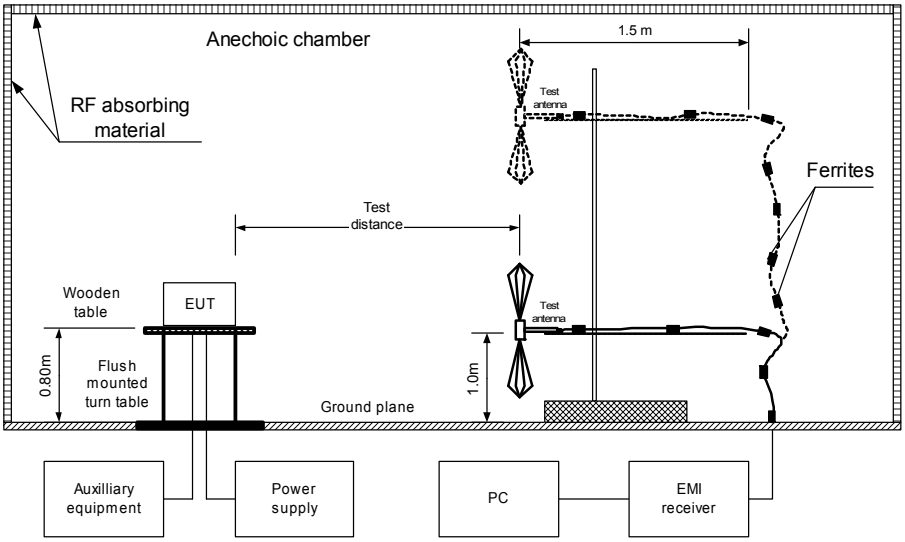
8.1.2.1 The EUT was set up as shown in Figure 8.1.1 and associated photograph/s, energized and the performance check was conducted.

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

8.1.2.3 The worst test results (the lowest margins) were recorded in Table 8.1.3 and shown in the associated plots.

Test specification:	Section 15.109, RSS-Gen, Section 7.1.2, ICES-003, Radiated emission		
Test procedure:	ANSI C63.4, Section 12.2.5		
Test mode:	Compliance	Verdict:	PASS
Date(s):	20-Sep-16		
Temperature: 26 ºC	Relative Humidity: 54 %	Air Pressure: 1010 hPa	Power: 3 VDC
Remarks:			

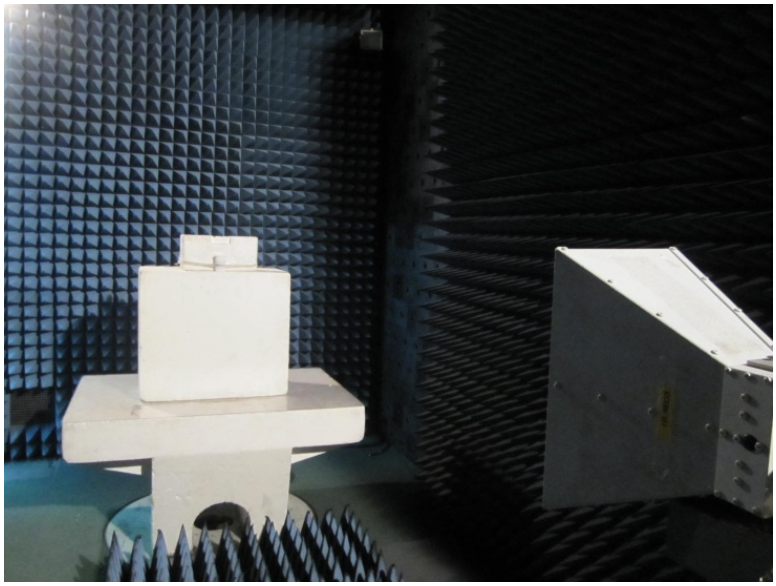
Figure 8.1.1 Setup for radiated emission measurements in anechoic chamber, table-top equipment



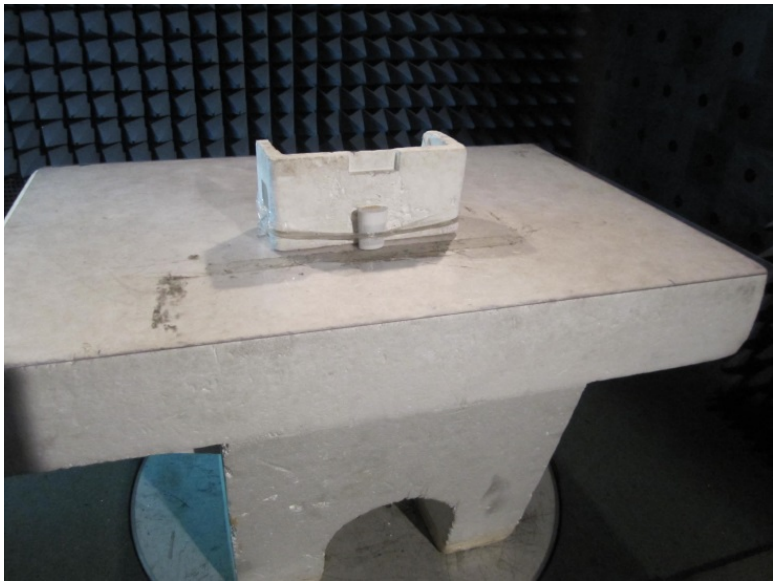
Photograph 8.1.1 Setup for radiated emission measurements in 30-1000 MHz

Test specification:	Section 15.109, RSS-Gen, Section 7.1.2, ICES-003, Radiated emission		
Test procedure:	ANSI C63.4, Section 12.2.5		
Test mode:	Compliance	Verdict:	PASS
Date(s):	20-Sep-16		
Temperature: 26 ºC	Relative Humidity: 54 %	Air Pressure: 1010 hPa	Power: 3 VDC
Remarks:			

Photograph 8.1.2 Setup for radiated emission measurements above 1 GHz



Photograph 8.1.3 Setup for final radiated emission measurements, EUT close view



Test specification:	Section 15.109, RSS-Gen, Section 7.1.2, ICES-003, Radiated emission		
Test procedure:	ANSI C63.4, Section 12.2.5		
Test mode:	Compliance	Verdict:	PASS
Date(s):	20-Sep-16		
Temperature: 26 ºC	Relative Humidity: 54 %	Air Pressure: 1010 hPa	Power: 3 VDC
Remarks:			

Table 8.1.3 Radiated emission test results

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

Frequency, MHz	Peak emission, dB(μV/m)	Quasi-peak			Antenna polarization	Antenna height, m	Turn-table position**, degrees	Verdict
		Measured emission, dB(μV/m)	Limit, dB(μV/m)	Margin, dB*				
No emissions were found								Pass

TEST SITE: SEMI ANECHOIC CHAMBER
TEST DISTANCE: 3 m
DETECTORS USED: PEAK / AVERAGE
FREQUENCY RANGE: 1000 MHz – 9500 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

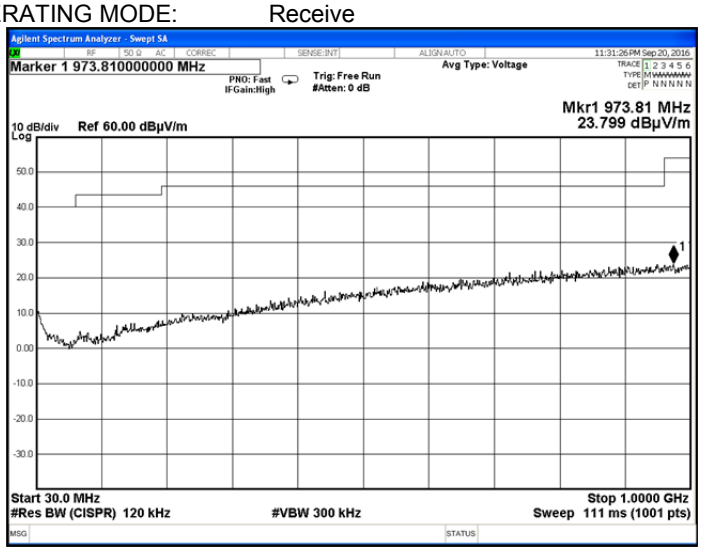
HL 4295	HL 4535	HL 4541	HL 4542	HL 4543	HL 4549	HL 4551	HL 4575
HL 4603	HL 4604						

Full description is given in Appendix A.

Test specification:	Section 15.109, RSS-Gen, Section 7.1.2, ICES-003, Radiated emission		
Test procedure:	ANSI C63.4, Section 12.2.5		
Test mode:	Compliance	Verdict:	PASS
Date(s):	20-Sep-16		
Temperature: 26 ºC	Relative Humidity: 54 %	Air Pressure: 1010 hPa	Power: 3 VDC
Remarks:			

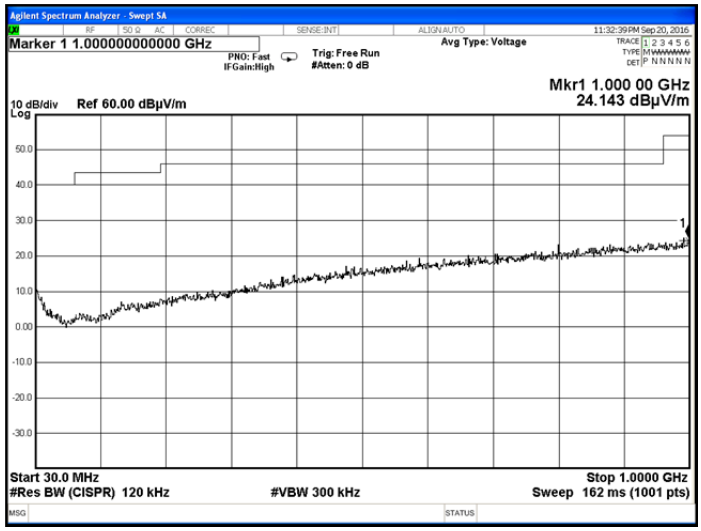
Plot 8.1.1 Radiated emission measurements in 30 - 1000 MHz range, vertical antenna polarization

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



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

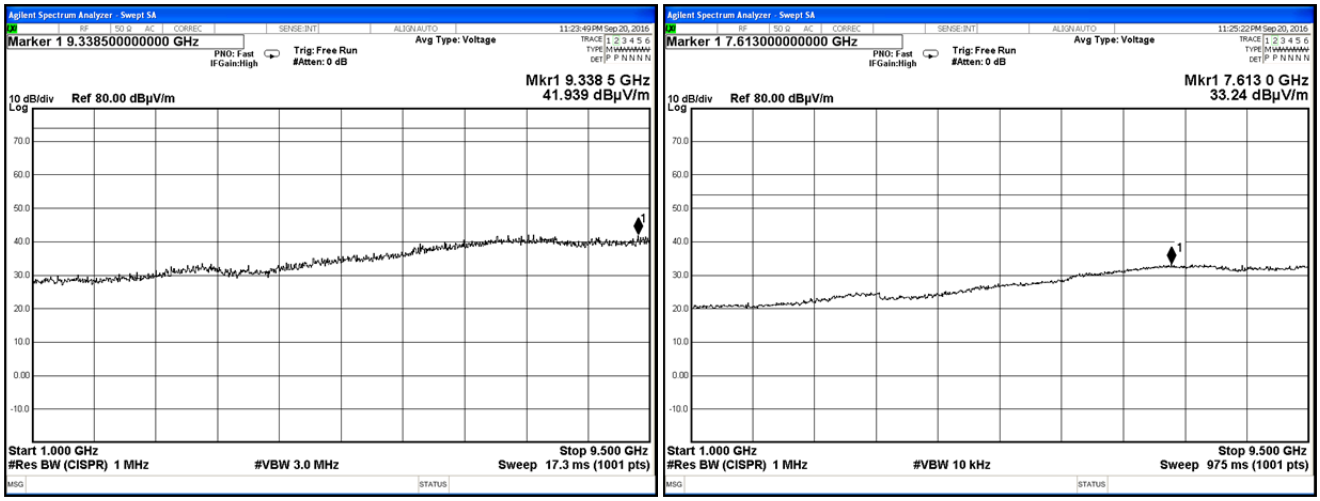
TEST SITE: Semi anechoic chamber
LIMIT: Class B
TEST DISTANCE: 3 m
EUT OPERATING MODE: Receive



Test specification:	Section 15.109, RSS-Gen, Section 7.1.2, ICES-003, Radiated emission		
Test procedure:	ANSI C63.4, Section 12.2.5		
Test mode:	Compliance	Verdict:	PASS
Date(s):	20-Sep-16		
Temperature: 26 ºC	Relative Humidity: 54 %	Air Pressure: 1010 hPa	Power: 3 VDC
Remarks:			

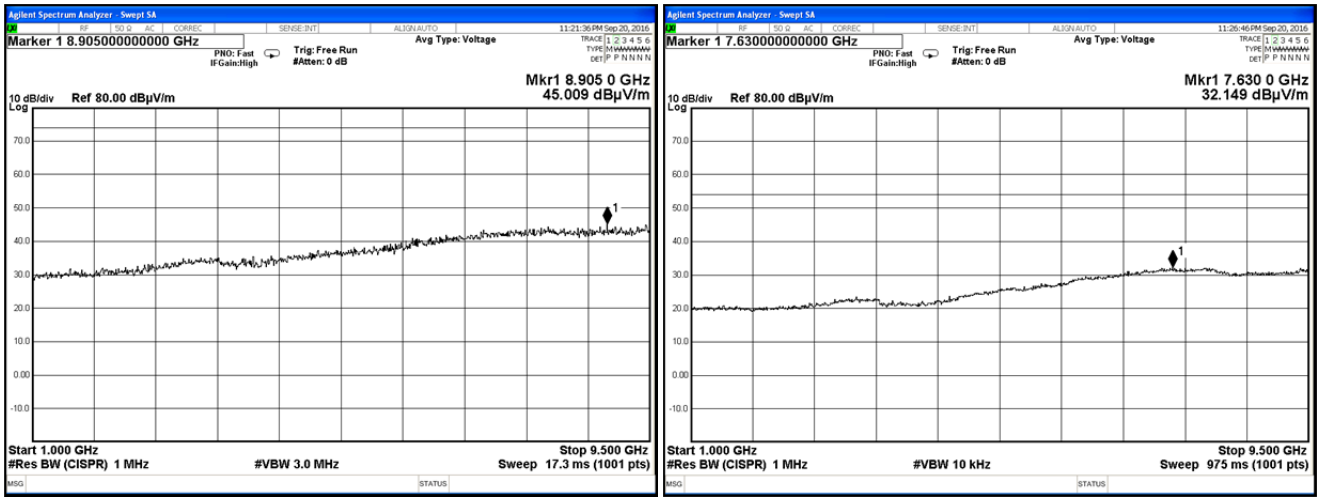
Plot 8.1.3 Radiated emission measurements above 1000 MHz, vertical antenna polarization

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



Plot 8.1.4 Radiated emission measurements above 1000 MHz, horizontal antenna polarization

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



9 APPENDIX A Test equipment and ancillaries used for tests

HL No	Description	Manufacturer	Model	Ser. No.	Last Cal./ Check	Due Cal./ Check
0415	Cable, Coax, RF, RG-214, 12.3 m	Hermon Laboratories	CC-3	056	07-Dec-15	07-Dec-16
0583	Antenna, Log Periodic, 200 - 1000 MHz	Hermon Laboratories	LP 200/1000	035	17-Mar-16	17-Mar-18
1915	Antenna, Loop, Active Receiving, 1 kHz - 30 MHz	EMC Test Systems	6507	1457	18-Jan-16	18-Jan-17
3818	PSA Series Spectrum Analyzer, 3 Hz- 44 GHz	Agilent Technologies	E4446A	MY48250288	03-May-16	03-May-17
4274	Test Cable , DC-18 GHz, 1.8 m, SMA/M - N/M	Mini-Circuits	CBL-6FT-SMNM+	70047	30-May-16	30-May-17
4294	Microwave Cable Assembly, 18.0 GHz, 3.4 m, SMA/SMA	Huber-Suhner	Sucoflex P103	NA	07-Dec-15	07-Dec-16
4295	Microwave Cable Assembly, 18.0 GHz, 3.4 m, SMA/SMA	Huber-Suhner	Sucoflex P103	NA	15-Dec-15	15-Dec-16
4535	Microwave Cable Assembly, 6.5 GHz, 5.0 m, N/M type-N/M type	Suhner Switzerland	214-U	NA	30-May-16	30-May-17
4541	Microwave Cable Assembly, 4.0 GHz, 1.0 m, N/M type-N/M type	Suhner Switzerland	214-U	NA	25-Sep-16	25-Sep-17
4542	Amplifier, 9 kHz to 1 GHz, 32 dB gain	Sonoma Instrument	310	0002A05639	10-Mar-16	10-Mar-17
4543	Broadband preamplifier, 0.5 to 18 GHz, 35 dB gain	Schwarzbeck mess-elektronik	BBV 9718	9718-134	03-Mar-16	03-Mar-17
4549	Cable RF, 6.8 m, N/N - type, up to 3 GHz	Suhner Switzerland	NA	07262	10-Mar-16	10-Mar-17
4551	Cable RF, 6.6 m, N/N - type, up to 18 GHz	Suhner Switzerland	Sucoflex 104E	22200/4E	10-Mar-16	10-Mar-17
4575	EXA Signal Analyzer, 9 kHz - 26.5 GHz	Agilent Technologies	N9010A	MY48030110	17-Feb-16	17-Mar-17
4603	Horn Antenna, 1 - 18 GHz	Schwarzbeck mess-elektronik	BBHA 9120 D	9120D-611	14-Oct-16	14-Oct-17
4604	Biconilog Antenna, 26 - 2000 MHz	EMCO	3142B	9909-1421	10-May-16	10-May-17
4933	Active Horn Antenna, 1 GHz to 18 GHz	Com-Power Corporation	AHA-118	701046	14-Oct-16	14-Oct-17
5103	RF cable, 18 GHz, 6 m, N-type	Huber-Suhner	SF106A/11N/11N/6000MM	500849/6A	26-Jul-16	26-Jul-17

10 APPENDIX B Measurement uncertainties

Expanded uncertainty at 95% confidence in Hermon Labs EMC measurements

Test description	Expanded uncertainty
Conducted carrier power at RF antenna connector	Below 12.4 GHz: ± 1.7 dB 12.4 GHz to 40 GHz: ± 2.3 dB
Conducted emissions at RF antenna connector	9 kHz to 2.9 GHz: ± 2.6 dB 2.9 GHz to 6.46 GHz: ± 3.5 dB 6.46 GHz to 13.2 GHz: ± 4.3 dB 13.2 GHz to 22.0 GHz: ± 5.0 dB 22.0 GHz to 26.8 GHz: ± 5.5 dB 26.8 GHz to 40.0 GHz: ± 4.8 dB
Occupied bandwidth	± 8.0 %
Duty cycle, timing (Tx ON / OFF) and average factor measurements	± 1.0 %
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 recognized and accredited by the Federal Communications Commission (USA) for 1, 2, 15, 18 parts of Code of Federal Regulations 47 (CFR 47), Test Firm Registration Number is 927748, Designation Number is IL1001; registered by Industry Canada for electromagnetic emissions, file number IC 2186A-1 for OATS, certified by VCCI, Japan (the registration numbers are R-808 for OATS, R-1082 for anechoic chamber, G-869 for RE measurements above 1 GHz, C-845 for conducted emissions site, T-1606 for conducted emissions at telecommunication ports). 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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Person for contact: Mr. Alex Usoskin, CEO.

12 APPENDIX D Specification references

FCC 47CFR part 15: 2015	Radio Frequency Devices
ANSI C63.10: 2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
ANSI C63.2: 1996	American National Standard for Instrumentation-Electromagnetic Noise and Field Strength, 10 kHz to 40 GHz-Specifications
ANSI C63.4: 2014	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
RSS-247 Issue 1: 2015	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence- Exempt Local Area Network (LE-LAN) Devices
RSS-Gen Issue 4: 2014	General Requirements for Compliance of Radio Apparatus
ICES-003: 2016, Issue 6	Information Technology Equipment (Including Digital Apparatus) – Limits and methods of measurement

13 APPENDIX E Test equipment correction factors

Antenna factor
Log periodic antenna
Hermon Laboratories, model LP 200/1000
Ser.No.035, HL 0583

Frequency, MHz	Antenna factor, dB(1/m)
200	12.0
250	12.5
300	14.5
350	15.7
400	16.0
450	16.7
500	18.1
550	18.2
600	18.8
650	20.1
700	21.8
750	21.4
800	21.4
850	22.4
900	22.8
950	23.4
1000	24.6

The antenna factor shall be added to receiver reading in dBμV to obtain field strength in dBμV/m.

Antenna factor
Active loop antenna
EMC Test Systems
Model 6507, S/N 1457, HL 1915

Frequency, kHz	Measured antenna factor, dBS/m
10	-22.7
20	-27.6
50	-31.3
75	-31.8
100	-32.2
150	-32.3
250	-32.6
500	-32.8
750	-33.0
1000	-33.1
2000	-33.4
3000	-33.7
4000	-34.0
5000	-34.3
10000	-34.9
15000	-35.6
20000	-35.9
25000	-36.1
30000	-36.7

The antenna factor shall be added to receiver reading in dBμV to obtain field strength in dBμA/m.

5.2.2.1
Antenna factor
Horn antenna
Schwarzbeck mess-elektronik, Model BBHA 9120 D, serial number: 9120D-611, HL 4603

Frequency, MHz	Measured antenna factor, dB/m
1000	25.2
1500	25.7
2000	26.1
2500	27.5
3000	28.3
3500	29.0
4000	30.0
4500	30.8
5000	31.9
5500	32.2
6000	33.1
6500	34.6
7000	35.9
7500	36.6
8000	37.2
8500	36.6
9000	36.9
9500	37.5
10000	38.4
10500	39.5
11000	40.3
11500	40.0
12000	39.2
12500	38.7
13000	39.6
13500	40.8
14000	41.6
14500	42.1
15000	41.2
15500	39.1
16000	38.5
16500	39.9
17000	41.0
17500	44.1
18000	55.6

5.2.2.2 The antenna factor shall be added to receiver reading in dBμV to obtain field strength in dBμV/m.

Antenna factor
Biconilog Antenna, 26 - 2000 MHz
EMCO, Model 3142B, serial number: 9909-1421, HL 4604

Frequency, MHz	Measured, dB/m
30	17.9
35	14.8
40	12.1
45	10.0
50	8.7
60	8.1
70	7.3
80	6.6
90	7.6
100	7.9
120	7.0
140	7.7
160	9.6
180	10.0
200	10.2
250	12.7
300	13.4
400	16.7
500	18.2
600	20.2
700	22.0
800	22.7
900	24.1
1000	25.0

The antenna factor shall be added to receiver reading in dBμV to obtain field strength in dBμV/m

Antenna factor, HL 4933

COM-POWER CORPORATION

Active Horn Antenna Factor Calibration

1 GHz to 18 GHz

Equipment:	**ACTIVE HORN ANTENNA**
Model:	**AHA-118**
Serial Number:	**701046**
Calibration Distance:	**3 Meter**
Polarization:	**Horizontal**
Calibration Date:	**11/12/2014**

Frequency (GHz)	Preamplifier Gain (dB)	Antenna Factor with pre-amp (dB/m)	Frequency (GHz)	Preamplifier Gain (dB)	Antenna Factor with pre-amp (dB/m)
1	40.96	-16.47	10	40.94	-1.97
1.5	41.21	-14.53	10.5	40.63	-1.06
2	41.44	-13.30	11	40.74	-1.50
2.5	41.71	-12.87	11.5	40.65	-0.52
3	41.96	-12.26	12	40.76	-0.15
3.5	42.14	-11.77	12.5	41.03	-0.85
4	42.13	-10.91	13	41.37	-0.81
4.5	41.79	-9.41	13.5	41.18	0.05
5	41.44	-7.54	14	40.98	0.36
5.5	40.91	-6.47	14.5	40.81	1.26
6	40.69	-5.48	15	40.65	0.25
6.5	40.64	-5.53	15.5	40.93	-1.05
7	40.76	-4.12	16	41.31	-1.44
7.5	40.94	-3.12	16.5	40.96	-0.80
8	40.68	-1.69	17	40.64	-0.02
8.5	40.08	-1.71	17.5	40.57	1.81
9	40.41	-1.86	18	40.08	3.63
9.5	41.21	-2.73			

Calibration according to ARP 958

Antenna Factor to be added to receiver reading:

Meter Reading (dBuV) + Antenna Factor (dB/m) = Corrected Reading (dBuV/m)

Cable loss
Cable coax, RG-214, 12.3 m, s/n 056, HL 0415

No.	Frequency, MHz	Cable loss, dB	Measured uncertainty, dB
1	10	0.23	±0.12
2	30	0.44	±0.12
3	50	0.60	±0.12
4	100	0.89	±0.12
5	150	1.11	±0.13
6	200	1.30	±0.13
7	250	1.45	±0.13
8	300	1.61	±0.13
9	400	1.94	±0.13
10	500	2.18	±0.13
11	600	2.45	±0.14
12	700	2.67	±0.14
13	800	2.94	±0.14
14	900	3.16	±0.14
15	1000	3.38	±0.14

Cable loss
Test cable, Mini-Circuits, S/N 70047, 18 GHz, 1.8 m, SMA/M - N/M
CBL-6FT-SMNM+, HL 4274

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	0.07	4800	1.69	9800	2.62	14800	3.42
30	0.11	4900	1.70	9900	2.63	14900	3.39
50	0.14	5000	1.72	10000	2.64	15000	3.38
100	0.21	5100	1.75	10100	2.64	15100	3.40
200	0.26	5200	1.76	10200	2.66	15200	3.41
300	0.30	5300	1.77	10300	2.67	15300	3.40
400	0.37	5400	1.79	10400	2.68	15400	3.39
500	0.44	5500	1.82	10500	2.68	15500	3.41
600	0.49	5600	1.85	10600	2.70	15600	3.44
700	0.54	5700	1.86	10700	2.71	15700	3.46
800	0.58	5800	1.87	10800	2.73	15800	3.45
900	0.63	5900	1.91	10900	2.74	15900	3.47
1000	0.67	6000	1.94	11000	2.76	16000	3.51
1100	0.71	6100	1.97	11100	2.77	16100	3.56
1200	0.75	6200	1.98	11200	2.78	16200	3.55
1300	0.78	6300	1.99	11300	2.79	16300	3.54
1400	0.81	6400	2.02	11400	2.80	16400	3.57
1500	0.85	6500	2.05	11500	2.82	16500	3.62
1600	0.88	6600	2.06	11600	2.83	16600	3.61
1700	0.91	6700	2.06	11700	2.84	16700	3.60
1800	0.94	6800	2.08	11800	2.85	16800	3.62
1900	0.97	6900	2.10	11900	2.87	16900	3.68
2000	1.00	7000	2.12	12000	2.88	17000	3.70
2100	1.03	7100	2.12	12100	2.89	17100	3.68
2200	1.06	7200	2.13	12200	2.90	17200	3.70
2300	1.08	7300	2.16	12300	2.92	17300	3.80
2400	1.11	7400	2.19	12400	2.94	17400	3.84
2500	1.14	7500	2.22	12500	2.95	17500	3.83
2600	1.16	7600	2.23	12600	2.96	17600	3.83
2700	1.19	7700	2.26	12700	2.98	17700	3.86
2800	1.21	7800	2.30	12800	3.00	17800	3.86
2900	1.27	7900	2.33	12900	3.02	17900	3.80
3000	1.29	8000	2.35	13000	3.03	18000	3.79
3100	1.32	8100	2.37	13100	3.06		
3200	1.35	8200	2.41	13200	3.08		
3300	1.37	8300	2.44	13300	3.09		
3400	1.38	8400	2.47	13400	3.10		
3500	1.41	8500	2.48	13500	3.13		
3600	1.43	8600	2.51	13600	3.17		
3700	1.46	8700	2.53	13700	3.17		
3800	1.47	8800	2.55	13800	3.18		
3900	1.49	8900	2.56	13900	3.22		
4000	1.52	9000	2.57	14000	3.26		
4100	1.55	9100	2.58	14100	3.28		
4200	1.56	9200	2.59	14200	3.30		
4300	1.58	9300	2.59	14300	3.35		
4400	1.60	9400	2.60	14400	3.39		
4500	1.63	9500	2.60	14500	3.39		
4600	1.65	9600	2.61	14600	3.39		
4700	1.67	9700	2.61	14700	3.41		

Cable loss
Microwave Cable Assembly, 18.0 GHz, 3.4 m, SMA/SMA, Huber-Suhner, Sucoflex P103, HL 4294

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	0.11	4900	2.09	10000	2.90	15100	3.61
30	0.17	5000	2.10	10100	2.92	15200	3.67
50	0.22	5100	2.14	10200	2.95	15300	3.63
100	0.30	5200	2.16	10300	2.96	15400	3.64
200	0.42	5300	2.17	10400	2.99	15500	3.68
300	0.51	5400	2.19	10500	2.99	15600	3.71
400	0.59	5500	2.19	10600	3.03	15700	3.74
500	0.66	5600	2.22	10700	3.03	15800	3.71
600	0.72	5700	2.24	10800	3.04	15900	3.74
700	0.77	5800	2.23	10900	3.05	16000	3.71
800	0.82	5900	2.26	11000	3.09	16100	3.73
900	0.88	6000	2.27	11100	3.07	16200	3.76
1000	0.93	6100	2.26	11200	3.08	16300	3.82
1100	0.98	6200	2.29	11300	3.11	16400	3.90
1200	1.02	6300	2.30	11400	3.12	16500	3.81
1300	1.06	6400	2.34	11500	3.11	16600	3.88
1400	1.10	6500	2.34	11600	3.15	16700	3.87
1500	1.14	6600	2.36	11700	3.16	16800	3.89
1600	1.19	6700	2.36	11800	3.18	16900	3.95
1700	1.23	6800	2.39	11900	3.19	17000	4.02
1800	1.27	6900	2.39	12000	3.23	17100	4.04
1900	1.30	7000	2.44	12100	3.25	17200	3.99
2000	1.35	7100	2.46	12200	3.22	17300	4.03
2100	1.38	7200	2.44	12300	3.25	17400	4.03
2200	1.42	7300	2.48	12400	3.25	17500	4.06
2300	1.45	7400	2.47	12500	3.28	17600	4.05
2400	1.48	7500	2.48	12600	3.27	17700	4.12
2500	1.51	7600	2.50	12700	3.27	17800	4.14
2600	1.55	7700	2.53	12800	3.30	17900	4.18
2700	1.59	7800	2.56	12900	3.30	18000	4.14
2800	1.62	7900	2.55	13000	3.27		
2900	1.65	8000	2.56	13100	3.32		
3000	1.66	8100	2.56	13200	3.32		
3100	1.69	8200	2.57	13300	3.32		
3200	1.71	8300	2.59	13400	3.35		
3300	1.74	8400	2.62	13500	3.38		
3400	1.76	8500	2.67	13600	3.39		
3500	1.78	8600	2.65	13700	3.42		
3600	1.80	8700	2.68	13800	3.47		
3700	1.85	8800	2.68	13900	3.45		
3800	1.88	8900	2.68	14000	3.49		
3900	1.90	9000	2.74	14100	3.50		
4000	1.91	9100	2.74	14200	3.55		
4100	1.93	9200	2.76	14300	3.59		
4200	1.96	9300	2.78	14400	3.58		
4300	1.97	9400	2.79	14500	3.56		
4400	1.99	9500	2.80	14600	3.57		
4500	2.02	9600	2.83	14700	3.57		
4600	2.02	9700	2.84	14800	3.57		
4700	2.04	9800	2.86	14900	3.64		
4800	2.05	9900	2.92	15000	3.64		

Cable loss
Microwave Cable Assembly, 18.0 GHz, 3.4 m, SMA/SMA, Huber-Suhner, S/N 4295, Sucoflex P103, HL 4295

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	0.11	5000	2.09	10200	2.97	15400	3.63
30	0.18	5100	2.12	10300	3.01	15500	3.65
50	0.23	5200	2.13	10400	3.00	15600	3.63
100	0.31	5300	2.16	10500	3.05	15700	3.64
200	0.38	5400	2.19	10600	3.09	15800	3.64
300	0.43	5500	2.21	10700	3.05	15900	3.66
400	0.52	5600	2.21	10800	3.09	16000	3.71
500	0.60	5700	2.24	10900	3.10	16100	3.67
600	0.67	5800	2.24	11000	3.08	16200	3.71
700	0.72	5900	2.25	11100	3.11	16300	3.70
800	0.78	6000	2.27	11200	3.12	16400	3.71
900	0.83	6100	2.25	11300	3.12	16500	3.72
1000	0.89	6200	2.29	11400	3.20	16600	3.84
1100	0.94	6300	2.34	11500	3.16	16700	3.78
1200	0.98	6400	2.37	11600	3.16	16800	3.85
1300	1.03	6500	2.33	11700	3.20	16900	3.88
1400	1.06	6600	2.34	11800	3.19	17000	3.85
1500	1.11	6700	2.39	11900	3.21	17100	3.88
1600	1.14	6800	2.46	12000	3.28	17200	3.92
1700	1.19	6900	2.45	12100	3.23	17300	3.90
1800	1.22	7000	2.44	12200	3.26	17400	4.00
1900	1.26	7100	2.43	12300	3.30	17500	4.02
2000	1.30	7200	2.44	12400	3.25	17600	4.00
2100	1.34	7300	2.51	12500	3.26	17700	3.96
2200	1.37	7400	2.54	12600	3.30	17800	4.01
2300	1.40	7500	2.49	12700	3.26	17900	4.02
2400	1.44	7600	2.52	12800	3.34	18000	4.08
2500	1.47	7700	2.59	12900	3.37		
2600	1.50	7800	2.57	13000	3.30		
2700	1.55	7900	2.55	13100	3.35		
2800	1.58	8000	2.57	13200	3.31		
2900	1.60	8100	2.58	13300	3.33		
3000	1.63	8200	2.64	13400	3.42		
3100	1.64	8300	2.70	13500	3.43		
3200	1.67	8400	2.65	13600	3.40		
3300	1.69	8500	2.66	13700	3.47		
3400	1.73	8600	2.68	13800	3.45		
3500	1.74	8700	2.70	13900	3.43		
3600	1.76	8800	2.74	14000	3.52		
3700	1.79	8900	2.74	14100	3.51		
3800	1.82	9000	2.76	14200	3.54		
3900	1.85	9100	2.82	14300	3.55		
4000	1.87	9200	2.79	14400	3.52		
4100	1.90	9300	2.82	14500	3.52		
4200	1.92	9400	2.83	14600	3.56		
4300	1.93	9500	2.83	14700	3.55		
4400	1.94	9600	2.86	14800	3.55		
4500	1.97	9700	2.93	14900	3.59		
4600	1.99	9800	2.89	15000	3.56		
4700	2.01	9900	2.91	15100	3.59		
4800	2.02	10000	2.94	15200	3.59		
4900	2.04	10100	2.94	15300	3.59		

Cable loss
Microwave Cable Assembly, 6.5 GHz, 5.0 m, N/M type-N/M type
Suhner Switzerland, HL 4535

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	0.10	1700	1.79	4400	3.53
15	0.13	1800	1.86	4500	3.60
20	0.15	1900	1.93	4600	3.72
30	0.18	2000	2.00	4700	3.80
40	0.21	2100	2.06	4800	3.87
50	0.24	2200	2.13	4900	3.94
60	0.26	2300	2.19	5000	3.99
70	0.29	2400	2.25	5100	4.06
80	0.31	2500	2.32	5200	4.12
90	0.33	2600	2.38	5300	4.17
100	0.35	2700	2.45	5400	4.25
150	0.43	2800	2.51	5500	4.31
200	0.50	2900	2.57	5600	4.40
300	0.63	3000	2.64	5700	4.47
400	0.74	3100	2.73	5800	4.54
500	0.85	3200	2.79	5900	4.64
600	0.94	3300	2.86	6000	4.73
700	1.03	3400	2.91	6100	4.79
800	1.12	3500	2.97	6200	4.89
900	1.20	3600	3.02	6300	5.00
1000	1.28	3700	3.07	6400	5.06
1100	1.35	3800	3.14	6500	5.13
1200	1.43	3900	3.20		
1300	1.50	4000	3.25		
1400	1.58	4100	3.32		
1500	1.65	4200	3.38		
1600	1.72	4300	3.46		

Cable loss
Microwave Cable Assembly, 4.0 GHz, 1.0 m, N/M type-N/M type
Suhner Switzerland, HL 4541

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	0.02	1700	0.45
15	0.03	1800	0.46
20	0.03	1900	0.48
30	0.04	2000	0.49
40	0.04	2100	0.52
50	0.05	2200	0.54
60	0.06	2300	0.55
70	0.06	2400	0.56
80	0.07	2500	0.58
90	0.07	2600	0.59
100	0.08	2700	0.61
150	0.10	2800	0.63
200	0.12	2900	0.64
300	0.15	3000	0.67
400	0.18	3100	0.70
500	0.20	3200	0.74
600	0.23	3300	0.77
700	0.25	3400	0.80
800	0.28	3500	0.82
900	0.30	3600	0.86
1000	0.31	3700	0.88
1100	0.33	3800	0.94
1200	0.35	3900	0.95
1300	0.37	4000	0.99
1400	0.39		
1500	0.41		
1600	0.43		

Cable loss
RF Cable, Huber-Suhner, 18 GHz, 6 m, N- type,
SF106A/11N/11N/6000MM, S/N 500849/6A
HL 5103

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
0.1	0.01	5500	2.43
50	0.22	6000	2.54
100	0.31	6500	2.66
200	0.43	7000	2.76
300	0.53	7500	2.87
400	0.62	8000	2.97
500	0.69	8500	3.07
600	0.76	9000	3.17
700	0.82	9500	3.27
800	0.88	10000	3.36
900	0.94	10500	3.45
1000	0.99	11000	3.54
1100	1.04	11500	3.62
1200	1.08	12000	3.71
1300	1.13	12500	3.79
1400	1.17	13000	3.88
1500	1.21	13500	3.97
1600	1.26	14000	4.05
1700	1.30	14500	4.13
1800	1.33	15000	4.22
1900	1.37	15500	4.30
2000	1.41	16000	4.38
2500	1.59	16500	4.45
3000	1.75	17000	4.52
3500	1.90	17500	4.61
4000	2.04	18000	4.72
4500	2.17		
5000	2.30		

14 APPENDIX F Abbreviations and acronyms

A	ampere
AC	alternating current
AM	amplitude modulation
AVRG	average (detector)
cm	centimeter
dB	decibel
dBm	decibel referred to one milliwatt
dB(μV)	decibel referred to one microvolt
dB(μV/m)	decibel referred to one microvolt per meter
dB(μA)	decibel referred to one microampere
DC	direct current
EIRP	equivalent isotropically radiated power
ERP	effective radiated power
EUT	equipment under test
F	frequency
GHz	gigahertz
GND	ground
H	height
HL	Hermon laboratories
Hz	hertz
k	kilo
kHz	kilohertz
LO	local oscillator
m	meter
MHz	megahertz
min	minute
mm	millimeter
ms	millisecond
μs	microsecond
NA	not applicable
NB	narrow band
OATS	open area test site
Ω	Ohm
PM	pulse modulation
PS	power supply
ppm	part per million (10^{-6})
QP	quasi-peak
RE	radiated emission
RF	radio frequency
rms	root mean square
Rx	receive
s	second
T	temperature
Tx	transmit
V	volt
WB	wideband

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