

TEST REPORT

ACCORDING TO: FCC 47CFR part 15 subpart C § 15.247 (FHSS) and subpart B

FOR:

Digital Security Controls Ltd.
Magnetic Contact Device
Model: PG9945E
FCC ID:F5317PG9945E

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1 Applicant information

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2 Equipment under test attributes

Product name: Magnetic contact device (contact sensor)
Product type: Transceiver
Model(s): PG9945E
Hardware version: 8-306455
Software release: JS-702015
Receipt date 6/21/2011

3 Manufacturer information

Manufacturer name: Visonic Ltd.
Address: Habarzel street 24, 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: 29734
Location: Hermon Laboratories Ltd. Harakevet Industrial Zone, Binyamina 30500, Israel
Test started: 6/21/2011
Test completed: 9/12/2011, 30/08/2017
Test specification(s): FCC 47CFR part 15, subpart C, §15.247 (FHSS); subpart B

5 Tests summary

Test	Status
Transmitter characteristics	
FCC Section 15.247(a)1, The 20 dB bandwidth	Pass
FCC Section 15.247(a)1, Frequency separation	Pass
FCC Section 15.247(a)1, Number of hopping frequencies	Pass
FCC Section 15.247(a)1, Average time of occupancy	Pass
FCC Section 15.247(b), Peak output power	Pass
FCC Section 15.247(d), Emissions at band edges	Pass
FCC Section 15.247(d), Radiated spurious emissions	Pass
FCC Section 15.203, Antenna requirements	Pass
FCC Section 15.207(a), Conducted emission	Not required
FCC Section 15.247(i), RF exposure	Pass, the exhibit to the application of certification is provided
Unintentional emissions	
FCC Section 15.107, Class B, Conducted emission at AC power port	Not required
FCC Section 15.109, Class B, Radiated emission	Pass

Testing was completed against all relevant requirements of the test standard. The results obtained indicate that the product under test complies in full with the requirements tested.

The test results relate only to the items tested. Pass/ fail decision was based on nominal values.

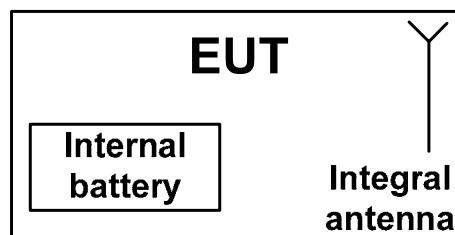
	Name and Title	Date	Signature
Tested by:	Mrs. E. Pitt, test engineer	August 30, 2017	
Reviewed by:	Mrs. M. Cherniavsky, certification engineer	August 31, 2017	
Approved by:	Mr. M. Nikishin, EMC and radio group manager	September 28, 2017	

6 EUT description

6.1 General information

The EUT is a fully supervised PowerG magnetic contact device. The device includes a built-in reed switch that opens upon removal of a magnet placed near it. The EUT is equipped with an integral antenna and is powered by 3 V internal battery.

6.2 Test configuration



6.3 Changes made in the EUT

No changes were implemented in the EUT.

6.4 EUT test positions

Photograph 6.4.1 EUT in X-axis orthogonal position



Photograph 6.4.2 EUT in Y-axis orthogonal position



Photograph 6.4.3 EUT in Z-axis orthogonal position



6.5 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 – 919.106 MHz			
Maximum rated output power		At transmitter 50 Ω RF output connector			dBm
		Peak output power			22.7 dBm
Is transmitter output power variable?		X	No		
			continuous variable		
			stepped variable with stepsize		
		Yes	minimum RF power		
			maximum RF power		
Antenna connection					
unique coupling		standard connector		X	integral
				X	with temporary RF connector
					without temporary RF connector
Antenna/s technical characteristics					
Type	Manufacturer		Model number		Gain
Internal	Visonic		Built-in helical antenna		-7 dBi
Transmitter aggregate data rate/s		50 kbps			
Type of modulation		GFSK			
Modulating test signal (baseband)		PRBS			
Maximum transmitter duty cycle in normal use		0.1%			
Transmitter power source					
X	Battery	Nominal rated voltage	3.0 VDC	Battery type	Lithium
	DC	Nominal rated voltage	VDC		
	AC mains	Nominal rated voltage	VAC	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		107 kHz		
	Max. separation of hops		131 kHz		

Test specification:		Section 15.247(a)1, 20 dB bandwidth	
Test procedure:		ANSI C63.10, section 7.8.7	
Test mode:		Compliance	Verdict: PASS
Date(s):		8/30/2017	
Temperature: 23 °C	Air Pressure: 1010 hPa	Relative Humidity: 55 %	Power Supply: 3 V battery
Remarks:			

7 Transmitter tests according to 47CFR part 15 subpart C requirements

7.1 20 dB bandwidth

7.1.1 General

This test was performed to measure the 20 dB bandwidth of the transmitter hopping channel. Specification test limits are given in Table 7.1.1.

Table 7.1.1 The 20 dB bandwidth limits

Assigned frequency, MHz	Maximum bandwidth, kHz	Modulation envelope reference points*, dBc
902.0 – 928.0	500	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.

7.1.2 Test procedure

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

7.1.2.2 The EUT was set to transmit modulated carrier at maximum data rate.

7.1.2.3 The transmitter bandwidth was measured with spectrum analyzer as frequency delta between reference points on modulation envelope and provided in Table 7.1.2 and the associated plots.

7.1.2.4 The test was repeated for mid and high carrier frequencies.

Figure 7.1.1 The 20 dB bandwidth test setup



Test specification:		Section 15.247(a)1, 20 dB bandwidth	
Test procedure:		ANSI C63.10, section 7.8.7	
Test mode:		Compliance	Verdict: PASS
Date(s):		8/30/2017	
Temperature: 23 °C	Air Pressure: 1010 hPa	Relative Humidity: 55 %	Power Supply: 3 V battery
Remarks:			

Table 7.1.2 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	Symbol rate, Msymbols/s	20 dB bandwidth, kHz	Limit, kHz	Margin, kHz	Verdict
912.750	GFSK	50	NA	101.243	500	-398.757	Pass
915.863				98.954	500	-401.046	
919.106				100.465	500	-399.535	

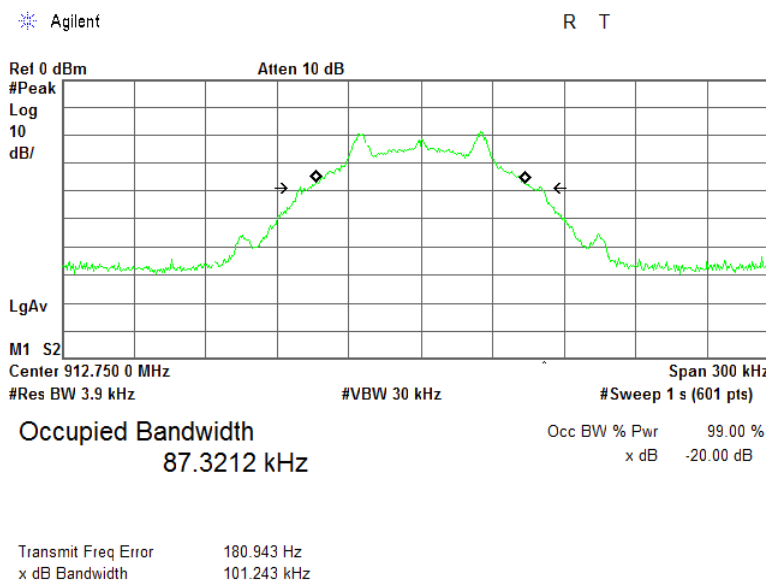
Reference numbers of test equipment used

HL 3818								
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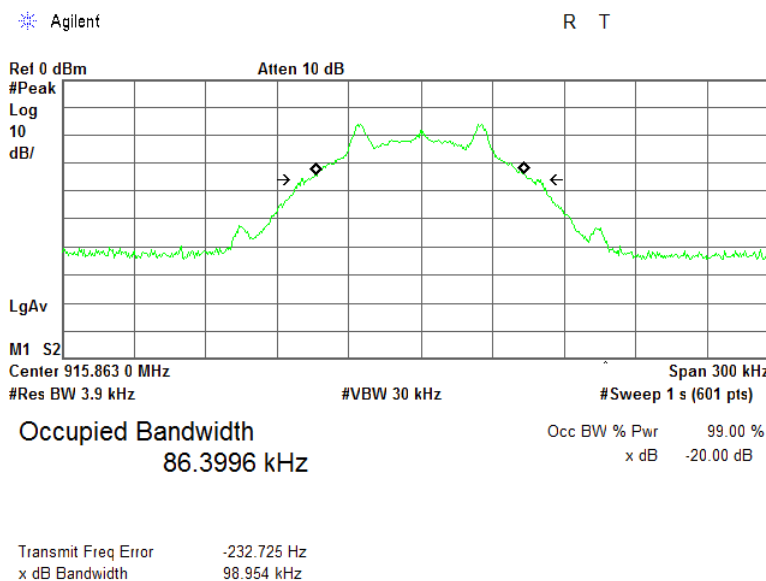
Full description is given in Appendix A.

Test specification:		Section 15.247(a)1, 20 dB bandwidth	
Test procedure:		ANSI C63.10, section 7.8.7	
Test mode:		Compliance	Verdict: PASS
Date(s):		8/30/2017	
Temperature: 23 °C	Air Pressure: 1010 hPa	Relative Humidity: 55 %	Power Supply: 3 V battery
Remarks:			

Plot 7.1.1 The 20 dB bandwidth test result at low frequency

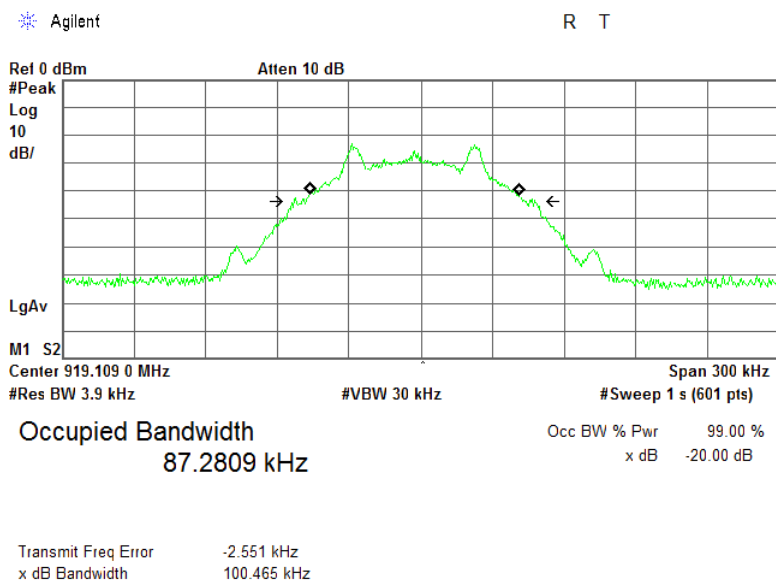


Plot 7.1.2 The 20 dB bandwidth test result at mid frequency



Test specification:		Section 15.247(a)1, 20 dB bandwidth	
Test procedure:		ANSI C63.10, section 7.8.7	
Test mode:		Compliance	Verdict: PASS
Date(s):		8/30/2017	
Temperature: 23 °C	Air Pressure: 1010 hPa	Relative Humidity: 55 %	Power Supply: 3 V battery
Remarks:			

Plot 7.1.3 The 20 dB bandwidth test result at high frequency



Test specification:		Section 15.247(a)1, Frequency separation	
Test procedure:		ANSI C63.10, section 7.8.2	
Test mode:		Compliance	Verdict: PASS
Date(s):		8/31/2011	
Temperature: 23 °C	Air Pressure: 1010 hPa	Relative Humidity: 41 %	Power Supply: 3 V battery
Remarks:			

7.2 Carrier frequency separation

7.2.1 General

This test was performed to measure frequency separation between the peaks of adjacent channels. Specification test limits are given in Table 7.2.1.

Table 7.2.1 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		

7.2.2 Test procedure

- 7.2.2.1 The EUT was set up as shown in Figure 7.2.1, energized with frequency hopping function enabled and its proper operation was checked.
- 7.2.2.2 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.
- 7.2.2.3 The spectrum analyzer was set in max hold mode and allowed trace to stabilize.
- 7.2.2.4 The frequency separation between the peaks of adjacent channels was measured as provided in Table 7.2.2 and the associated plots.

Figure 7.2.1 Carrier frequency separation test setup



Test specification:		Section 15.247(a)1, Frequency separation	
Test procedure:		ANSI C63.10, section 7.8.2	
Test mode:		Compliance	Verdict: PASS
Date(s):		8/31/2011	
Temperature: 23 °C	Air Pressure: 1010 hPa	Relative Humidity: 41 %	Power Supply: 3 V battery
Remarks:			

Table 7.2.2 Carrier frequency separation test results

ASSIGNED FREQUENCY: 902-928 MHz
 MODULATION: GFSK
 BIT RATE: 50 kbps
 DETECTOR USED: Peak
 RESOLUTION BANDWIDTH: $\geq 1\%$ of the span
 VIDEO BANDWIDTH: $\geq$ RBW
 FREQUENCY HOPPING: Enabled
 20 dB BANDWIDTH: 101.24 kHz

Carrier frequency separation, kHz	Limit, kHz	Margin*	Verdict
131	101.24	29.76	Pass

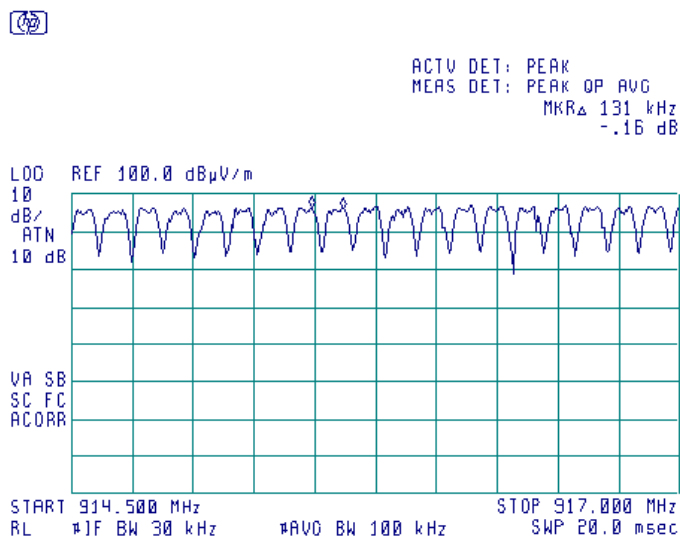
* - Margin = Carrier frequency separation – specification limit.

Reference numbers of test equipment used

HL 1431	HL 1984	HL 2883	HL 3386				
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Full description is given in Appendix A.

Plot 7.2.1 Carrier frequency separation



Test specification:		Section 15.247(a)1, Number of hopping frequencies	
Test procedure:		ANSI C63.10, section 7.8.3	
Test mode:		Compliance	Verdict: PASS
Date(s):		8/31/2011	
Temperature: 23 °C	Air Pressure: 1010 hPa	Relative Humidity: 41 %	Power Supply: 3 V battery
Remarks:			

7.3 Number of hopping frequencies

7.3.1 General

This test was performed to calculate the number of hopping frequencies used by the EUT. Specification test limits are given in Table 7.3.1.

Table 7.3.1 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

7.3.2 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 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.

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

7.3.2.4 The number of frequency hopping channels was calculated as provided in Table 7.3.2 and the associated plots.

Figure 7.3.1 Hopping frequencies test setup



Test specification:		Section 15.247(a)1, Number of hopping frequencies	
Test procedure:		ANSI C63.10, section 7.8.3	
Test mode:		Compliance	Verdict: PASS
Date(s):		8/31/2011	
Temperature: 23 °C	Air Pressure: 1010 hPa	Relative Humidity: 41 %	Power Supply: 3 V battery
Remarks:			

Table 7.3.2 Hopping frequencies test results

ASSIGNED FREQUENCY: 902-928 MHz
 MODULATION: GFSK
 BIT RATE: 50 kbps
 DETECTOR USED: Peak
 RESOLUTION BANDWIDTH: $\geq 1\%$ of the span
 VIDEO BANDWIDTH: $\geq$ RBW
 FREQUENCY HOPPING: Enabled

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

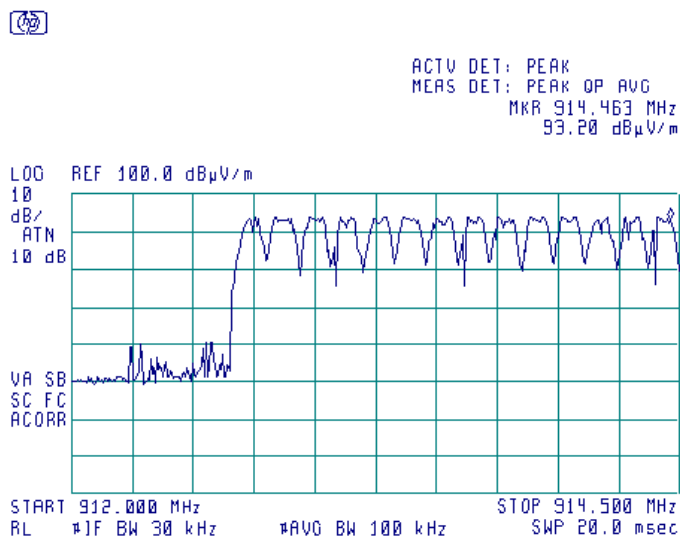
* - Margin = Number of hopping frequencies – Minimum number of hopping frequencies.

Reference numbers of test equipment used

HL 1431	HL 1984	HL 2883	HL 3386				
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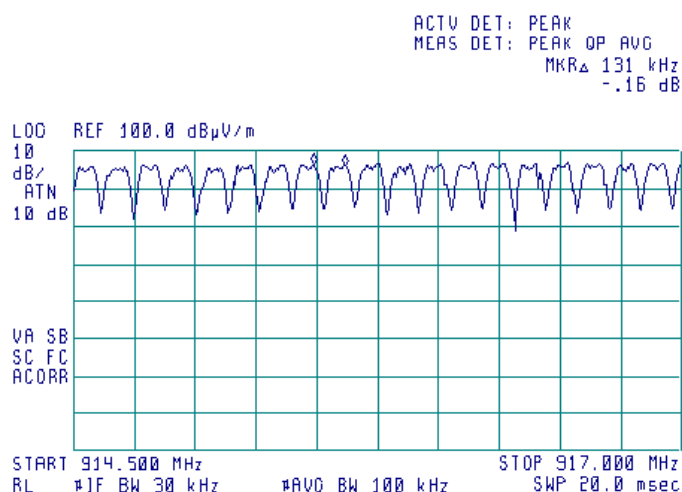
Full description is given in Appendix A.

Plot 7.3.1 Number of hopping frequencies in the frequency range 912 –914.5 MHz (fourteen)

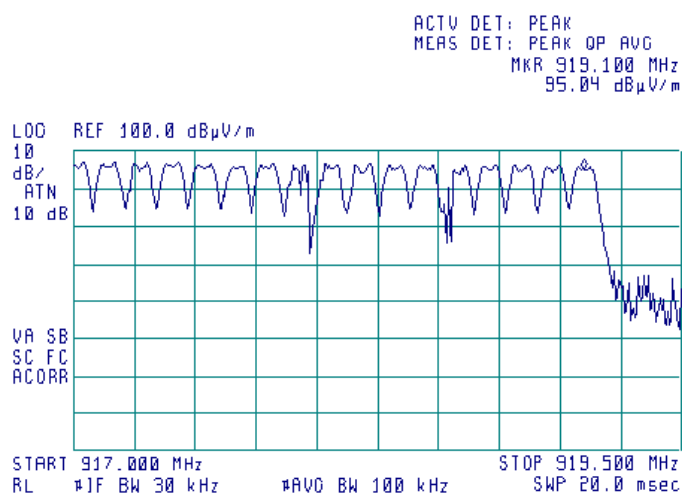


Test specification:		Section 15.247(a)1, Number of hopping frequencies	
Test procedure:		ANSI C63.10, section 7.8.3	
Test mode:		Compliance	Verdict: PASS
Date(s):		8/31/2011	
Temperature: 23 °C	Air Pressure: 1010 hPa	Relative Humidity: 41 %	Power Supply: 3 V battery
Remarks:			

Plot 7.3.2 Number of hopping frequencies in the frequency range 914.5 –917.0 MHz (nineteen)



Plot 7.3.3 Number of hopping frequencies in the frequency range 917 –919.5 MHz (seventeen)



Test specification:		Section 15.247(a)1, Average time of occupancy	
Test procedure:		ANSI C63.10, section 7.8.4	
Test mode:		Compliance	Verdict: PASS
Date(s):		8/31/2011	
Temperature: 23 °C	Air Pressure: 1010 hPa	Relative Humidity: 41 %	Power Supply: 3 V battery
Remarks:			

7.4 Average time of occupancy

7.4.1 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 7.4.1.

Table 7.4.1 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	$0.4 \times N$	$N (\geq 15)$
5725.0 – 5850.0	0.4	30.0	≥ 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.

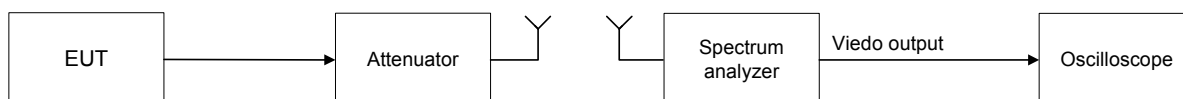
7.4.2.2 The spectrum analyzer span was set to zero centered on a hopping channel.

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

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

7.4.2.5 The test results provided in Table 7.4.2 and the associated plots.

Figure 7.4.1 Average time of occupancy test setup



Test specification:		Section 15.247(a)1, Average time of occupancy	
Test procedure:		ANSI C63.10, section 7.8.4	
Test mode:		Compliance	Verdict: PASS
Date(s):		8/31/2011	
Temperature: 23 °C	Air Pressure: 1010 hPa	Relative Humidity: 41 %	Power Supply: 3 V battery
Remarks:			

Table 7.4.2 Average time of occupancy test results

ASSIGNED FREQUENCY: 902-928 MHz
 MODULATION: GFSK
 DETECTOR USED: Peak
 RESOLUTION BANDWIDTH: 1 MHz
 VIDEO BANDWIDTH: 3 MHz
 NUMBER OF HOPPING FREQUENCIES: 50
 INVESTIGATED PERIOD: 20s
 FREQUENCY HOPPING: Enabled

Carrier frequency, MHz	Single transmission duration, s	Single transmission period, s	Average time of occupancy*, s	Bit rate, kbps	Limit, s	Margin, s**	Verdict
915.863	0.004312	2	0.043	50	0.4	-0.357	Pass

* - Average time of occupancy = (Single transmission duration × Investigated period) / Single transmission period.

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

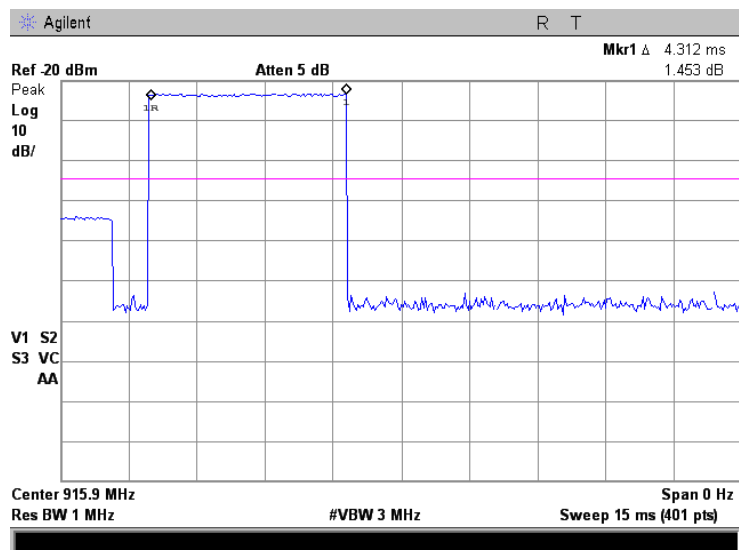
Reference numbers of test equipment used

HL 1431	HL 1984	HL 2883	HL 3386				
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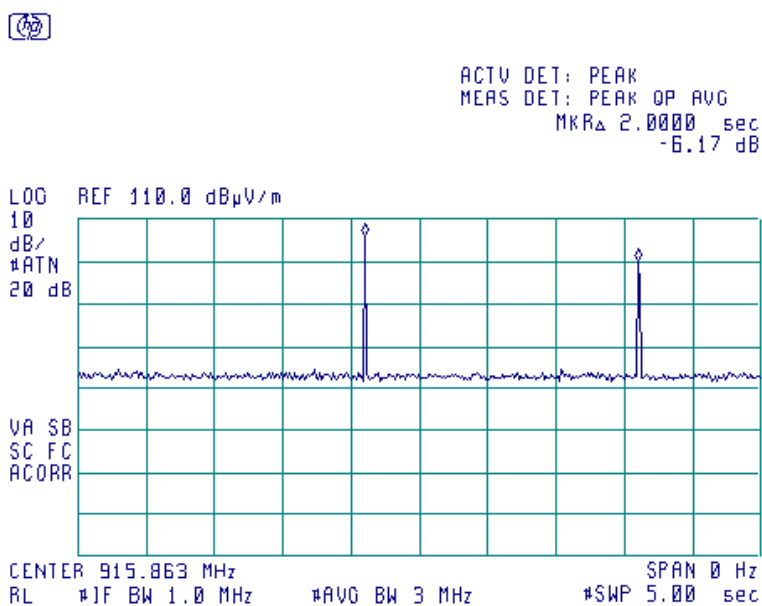
Full description is given in Appendix A.

Test specification:		Section 15.247(a)1, Average time of occupancy	
Test procedure:		ANSI C63.10, section 7.8.4	
Test mode:		Compliance	Verdict: PASS
Date(s):		8/31/2011	
Temperature: 23 °C	Air Pressure: 1010 hPa	Relative Humidity: 41 %	Power Supply: 3 V battery
Remarks:			

Plot 7.4.1 Single transmission duration



Plot 7.4.2 Single transmission period



Test specification:		Section 15.247(b), Peak output power	
Test procedure:		ANSI C63.10, section 7.8.5	
Test mode:		Compliance	Verdict: PASS
Date(s):		7/30/2017	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 41 %	Power Supply: 3 V battery
Remarks:			

7.5 Peak output power

7.5.1 General

This test was performed to measure the maximum peak output power radiated by transmitter. Specification test limits are given in Table 7.5.1.

Table 7.5.1 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	30	131.2	6.0*
2400.0 – 2483.5	0.125 (<75 hopping channels)	21.0(<75 hopping channels)	122.2 (<75 hopping channels)	
	1.0 (≥75 hopping channels)	30.0 (≥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: $E = \sqrt{30 \times P \times G} / r$, 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.

7.5.2 Test procedure

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

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

7.5.2.3 The frequency span of spectrum analyzer was set approximately 5 times wider than 20 dB bandwidth of the EUT and the resolution bandwidth was set wider than 20 dB bandwidth of the EUT. To find maximum radiation the turntable was rotated 360° and the measuring antenna height was swept in both vertical and horizontal polarizations.

7.5.2.4 The maximum field strength of the EUT carrier frequency was measured as provided in Table 7.5.2 and associated plots.

7.5.2.5 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.

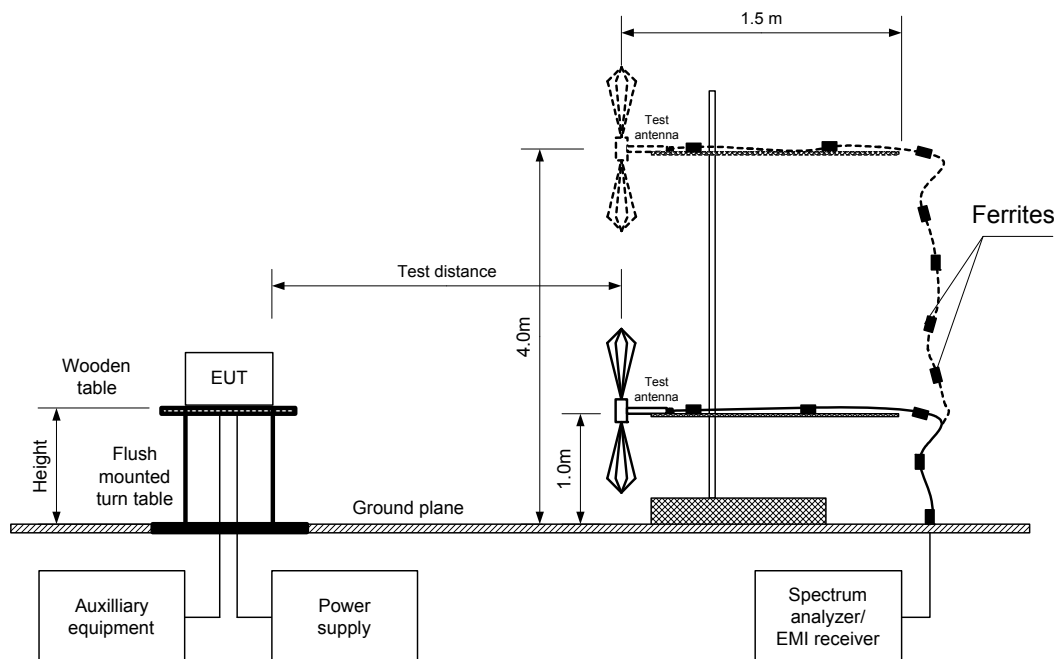
The above equation was converted in logarithmic units for 3 m test distance:

$$\text{Peak output power in dBm} = \text{Field strength in dB}(\mu\text{V/m}) - \text{Transmitter antenna gain in dBi} - 95.2 \text{ dB}$$

7.5.2.6 The worst test results (the lowest margins) were recorded in Table 7.5.2.

Test specification:		Section 15.247(b), Peak output power	
Test procedure:		ANSI C63.10, section 7.8.5	
Test mode:		Compliance	Verdict: PASS
Date(s):		7/30/2017	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 41 %	Power Supply: 3 V battery
Remarks:			

Figure 7.5.1 Setup for carrier field strength measurements



Test specification:		Section 15.247(b), Peak output power	
Test procedure:		ANSI C63.10, section 7.8.5	
Test mode:		Compliance	Verdict: PASS
Date(s):		7/30/2017	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 41 %	Power Supply: 3 V battery
Remarks:			

Table 7.5.2 Peak output power test results

ASSIGNED FREQUENCY: 902-928 MHz
 TEST DISTANCE: 3 m
 TEST SITE: Semi anechoic chamber
 EUT HEIGHT: 0.8 m
 DETECTOR USED: Peak
 TEST ANTENNA TYPE: Biconilog (30 MHz – 1000 MHz)
 MODULATION: GFSK
 BIT RATE: 50 kbps
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum
 DETECTOR USED: Peak
 RESOLUTION BANDWIDTH: 120 MHz
 VIDEO BANDWIDTH: 300 MHz
 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
912.775	109.22	H	1.17	0	-7.0	21.02	30.0	-8.98	Pass
915.837	110.92	H	1.35	60	-7.0	22.72	30.0	-7.28	Pass
919.081	106.31	H	1.1	0	-7.0	18.11	30.0	-11.89	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.

Note: Maximum peak output power was obtained in Y-axis orthogonal position.

Reference numbers of test equipment used

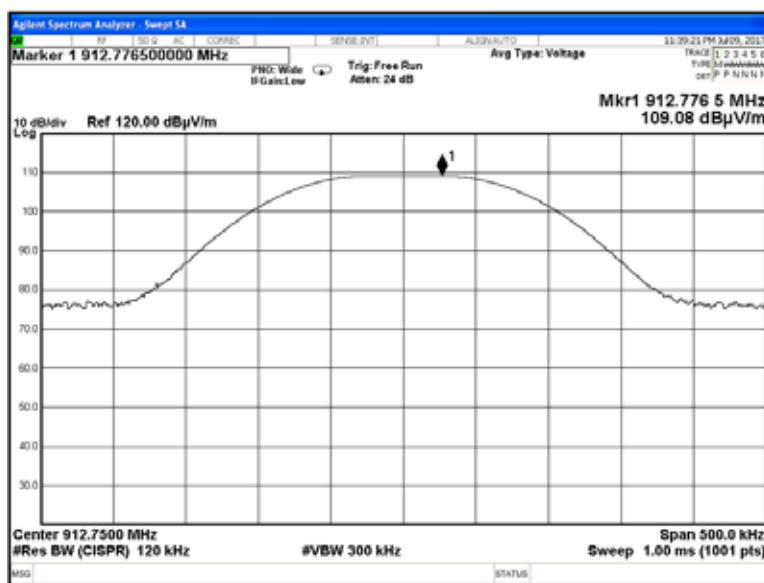
HL 4541	HL 4542	HL 4575	HL 4604	HL 5102	HL 5105		
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Full description is given in Appendix A.

Test specification:		Section 15.247(b), Peak output power	
Test procedure:		ANSI C63.10, section 7.8.5	
Test mode:		Compliance	Verdict: PASS
Date(s):		7/30/2017	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 41 %	Power Supply: 3 V battery
Remarks:			

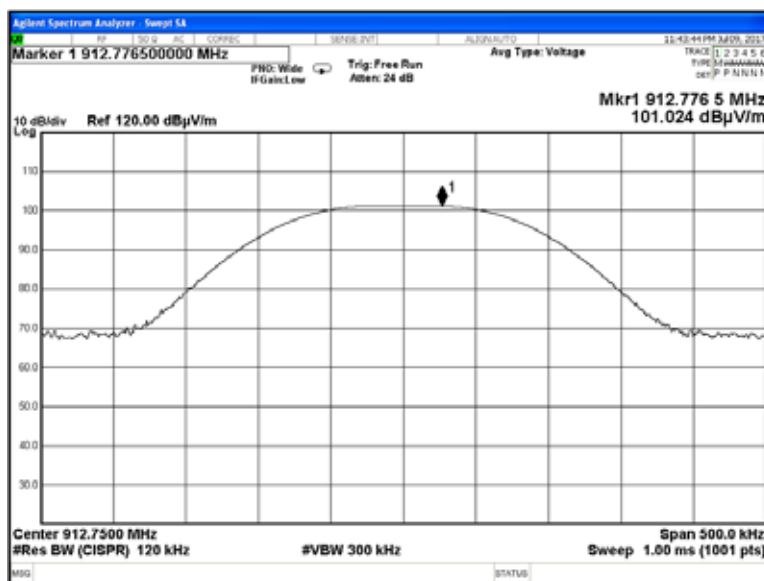
Plot 7.5.1 Field strength of carrier at low frequency and Unom

Antenna polarization: Vertical
EUT position: X-axis



Plot 7.5.2 Field strength of carrier at low frequency and Unom

Antenna polarization: Horizontal
EUT position: X-axis



Test specification:		Section 15.247(b), Peak output power	
Test procedure:		ANSI C63.10, section 7.8.5	
Test mode:		Compliance	Verdict: PASS
Date(s):		7/30/2017	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 41 %	Power Supply: 3 V battery
Remarks:			

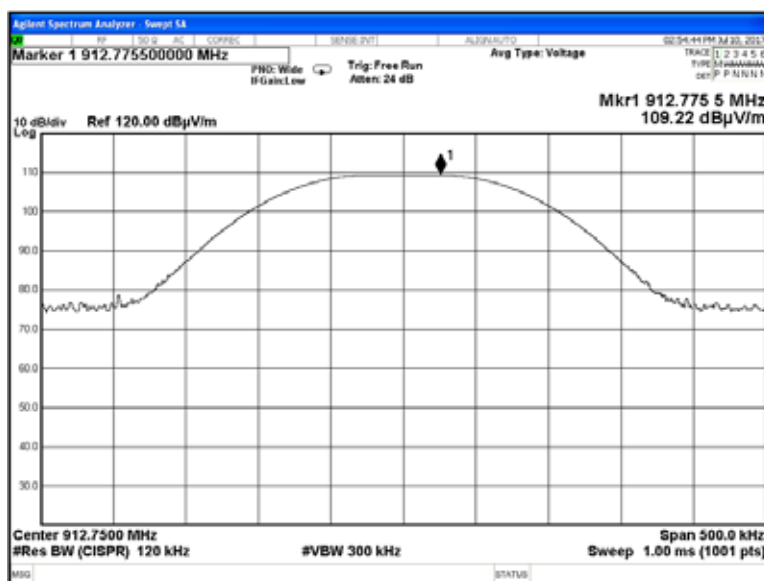
Plot 7.5.3 Field strength of carrier at low frequency and Unom

Antenna polarization: Vertical
EUT position: Y-axis



Plot 7.5.4 Field strength of carrier at low frequency and Unom

Antenna polarization: Horizontal
EUT position: Y-axis



Test specification:		Section 15.247(b), Peak output power	
Test procedure:		ANSI C63.10, section 7.8.5	
Test mode:		Compliance	Verdict: PASS
Date(s):		7/30/2017	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 41 %	Power Supply: 3 V battery
Remarks:			

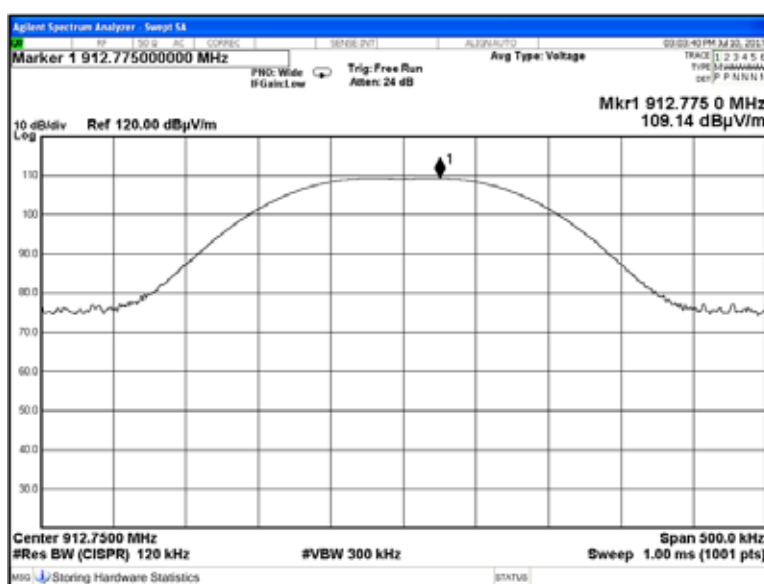
Plot 7.5.5 Field strength of carrier at low frequency and Unom

Antenna polarization: Vertical
EUT position: Z-axis



Plot 7.5.6 Field strength of carrier at low frequency and Unom

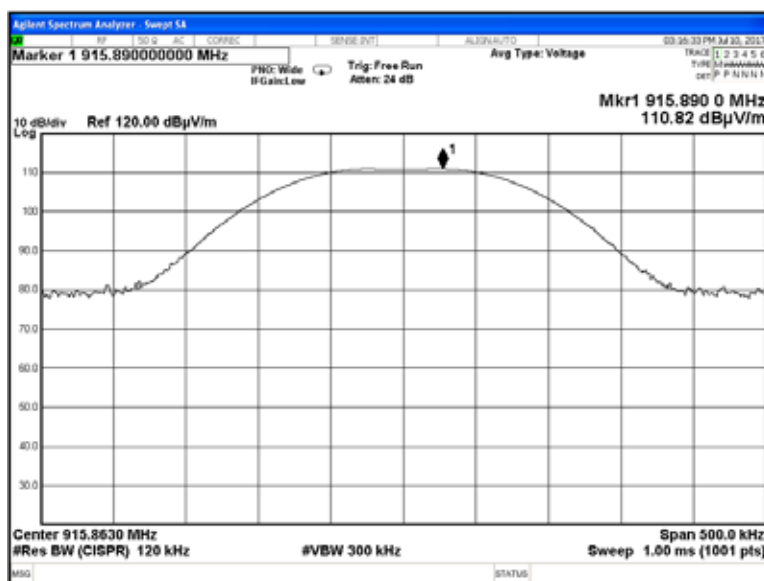
Antenna polarization: Horizontal
EUT position: Z-axis



Test specification:		Section 15.247(b), Peak output power	
Test procedure:		ANSI C63.10, section 7.8.5	
Test mode:		Compliance	Verdict: PASS
Date(s):		7/30/2017	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 41 %	Power Supply: 3 V battery
Remarks:			

Plot 7.5.7 Field strength of carrier at mid frequency and Unom

Antenna polarization: Vertical
EUT position: X-axis



Plot 7.5.8 Field strength of carrier at mid frequency and Unom

Antenna polarization: Horizontal
EUT position: X-axis



Test specification:		Section 15.247(b), Peak output power	
Test procedure:		ANSI C63.10, section 7.8.5	
Test mode:		Compliance	Verdict: PASS
Date(s):		7/30/2017	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 41 %	Power Supply: 3 V battery
Remarks:			

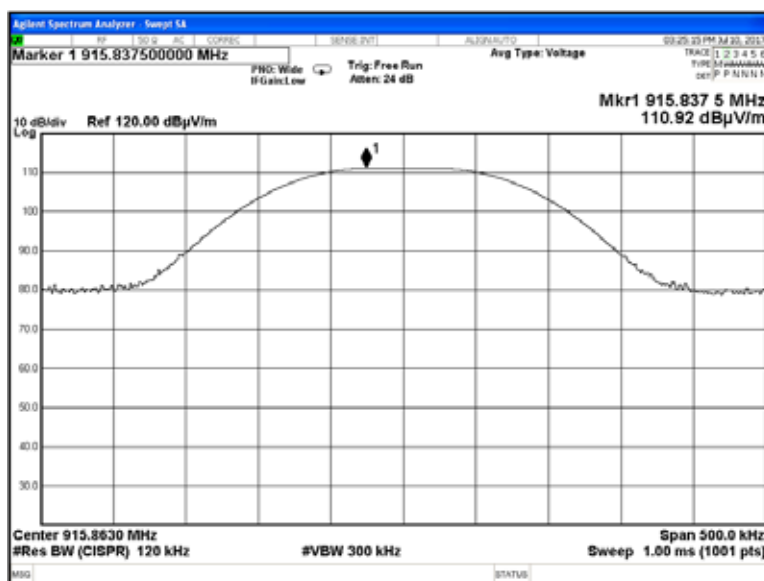
Plot 7.5.9 Field strength of carrier at mid frequency and Unom

Antenna polarization: Vertical
EUT position: Y-axis



Plot 7.5.10 Field strength of carrier at mid frequency and Unom

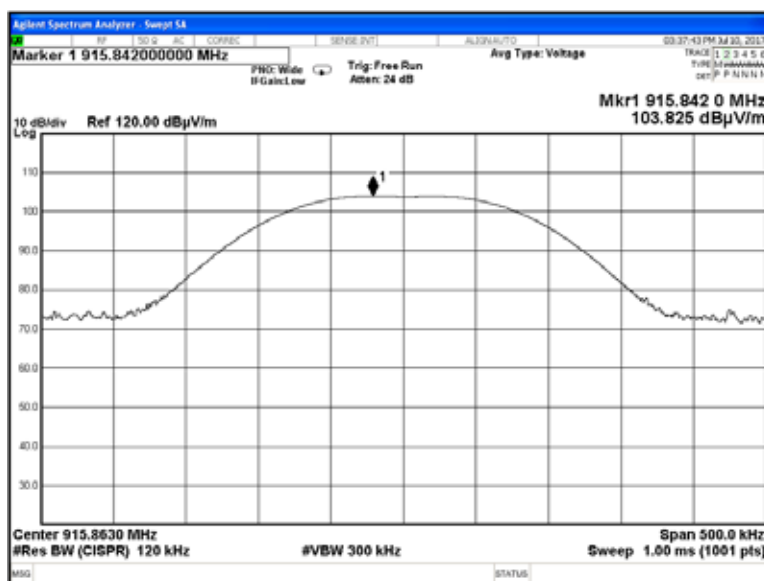
Antenna polarization: Horizontal
EUT position: Y-axis



Test specification:		Section 15.247(b), Peak output power	
Test procedure:		ANSI C63.10, section 7.8.5	
Test mode:		Compliance	Verdict: PASS
Date(s):		7/30/2017	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 41 %	Power Supply: 3 V battery
Remarks:			

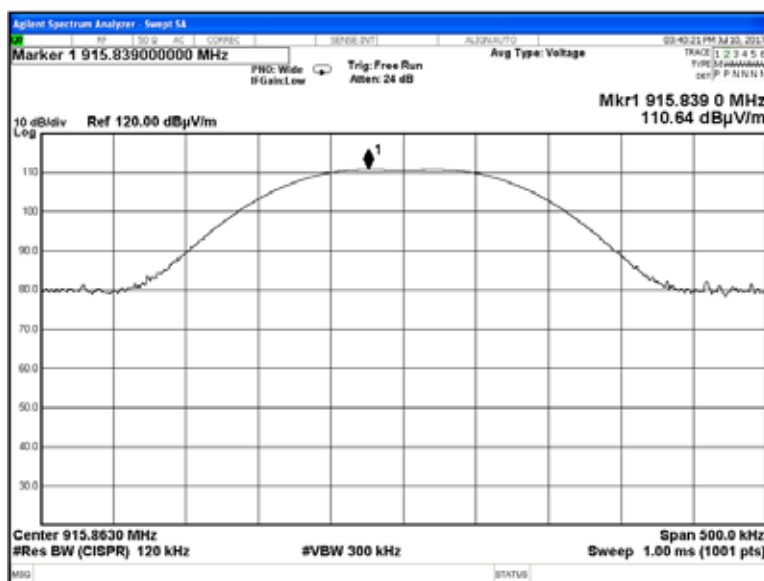
Plot 7.5.11 Field strength of carrier at mid frequency and Unom

Antenna polarization: Vertical
EUT position: Z-axis



Plot 7.5.12 Field strength of carrier at mid frequency and Unom

Antenna polarization: Horizontal
EUT position: Z-axis



Test specification: Section 15.247(b), Peak output power			
Test procedure: ANSI C63.10, section 7.8.5			
Test mode: Compliance		Verdict: PASS	
Date(s): 7/30/2017			
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 41 %	Power Supply: 3 V battery
Remarks:			

Plot 7.5.13 Field strength of carrier at high frequency and Unom

Antenna polarization: Vertical
EUT position: X-axis



Plot 7.5.14 Field strength of carrier at high frequency and Unom

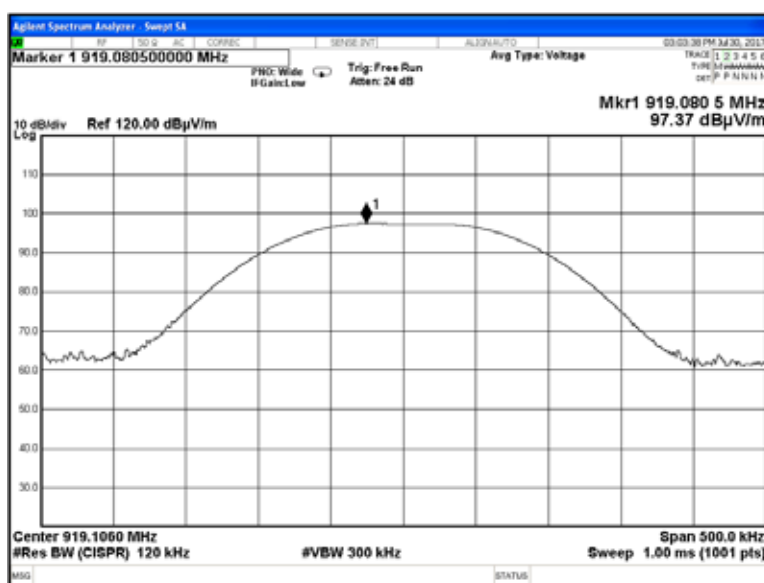
Antenna polarization: Horizontal
EUT position: X-axis



Test specification:		Section 15.247(b), Peak output power	
Test procedure:		ANSI C63.10, section 7.8.5	
Test mode:		Compliance	Verdict: PASS
Date(s):		7/30/2017	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 41 %	Power Supply: 3 V battery
Remarks:			

Plot 7.5.15 Field strength of carrier at high frequency and Unom

Antenna polarization: Vertical
EUT position: Y-axis



Plot 7.5.16 Field strength of carrier at high frequency and Unom

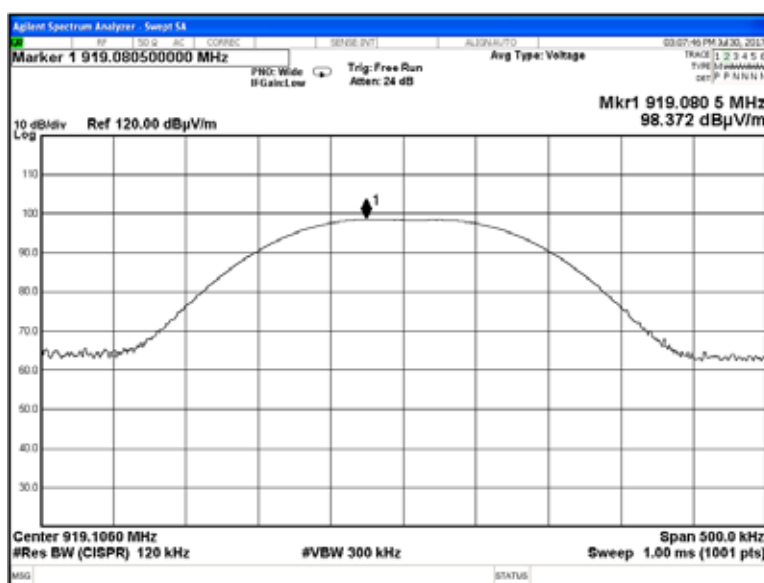
Antenna polarization: Horizontal
EUT position: Y-axis



Test specification:		Section 15.247(b), Peak output power	
Test procedure:		ANSI C63.10, section 7.8.5	
Test mode:		Compliance	Verdict: PASS
Date(s):		7/30/2017	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 41 %	Power Supply: 3 V battery
Remarks:			

Plot 7.5.17 Field strength of carrier at high frequency and Unom

Antenna polarization: Vertical
EUT position: Z-axis



Plot 7.5.18 Field strength of carrier at high frequency and Unom

Antenna polarization: Horizontal
EUT position: Z-axis



Test specification:		Section 15.247(d), Emissions at band edges	
Test procedure:		ANSI C63.10, section 7.8.6	
Test mode:		Compliance	Verdict: PASS
Date(s):		8/31/2011 - 9/6/2011	
Temperature: 24.1 °C	Air Pressure: 1010 hPa	Relative Humidity: 34 %	Power Supply: 3 V battery
Remarks:			

7.6 Band edge radiated emissions

7.6.1 General

This test was performed to measure emissions, radiated from the EUT at the assigned frequency band edges. Specification test limits are given in Table 7.6.1.

Table 7.6.1 Band edge emission limits

Assigned frequency, MHz	Attenuation below carrier*, dBc	Field strength at 3 m within restricted bands, dB(μV/m)	
		Peak	Average
902.0 – 928.0	20.0	74.0	54.0
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.

7.6.2 Test procedure

7.6.2.1 The EUT was set up as shown in Figure 7.6.1, energized normally modulated at the maximum data rate with its hopping function disabled and its proper operation was checked.

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

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

7.6.2.4 The maximum band edge emission and modulation product outside of the band were measured as provided in Table 7.6.2 and associated plots and referenced to the highest emission level measured within the authorized band.

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

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

Figure 7.6.1 Band edge emission test setup



Test specification:		Section 15.247(d), Emissions at band edges	
Test procedure:		ANSI C63.10, section 7.8.6	
Test mode:		Compliance	Verdict: PASS
Date(s):		8/31/2011 - 9/6/2011	
Temperature: 24.1 °C	Air Pressure: 1010 hPa	Relative Humidity: 34 %	Power Supply: 3 V battery
Remarks:			

Table 7.6.2 Band edge emission test results

ASSIGNED FREQUENCY RANGE: 902 – 928 MHz
DETECTOR USED: Peak
MODULATION: FSK
MODULATING SIGNAL: PRBS
BIT RATE: 50 kbps
TRANSMITTER OUTPUT POWER SETTINGS: Maximum
RESOLUTION BANDWIDTH: ≥ 1% of the span
VIDEO BANDWIDTH: ≥ RBW

Frequency, MHz		Band edge emission, dBuV	Emission at carrier, dBuV	Attenuation below carrier, dBc	Limit, dBc	Margin, dB*	Verdict
Frequency hopping disabled							
902.00	28.22	84.32	56.10	20.0	36.10	Pass	
928.00	28.77		83.63		54.86		
Frequency hopping enabled							
902.00	36.04	84.32	48.28	20.0	28.28	Pass	
928.00	36.22		83.63		47.41		

*- Margin = Attenuation below carrier – specification limit.

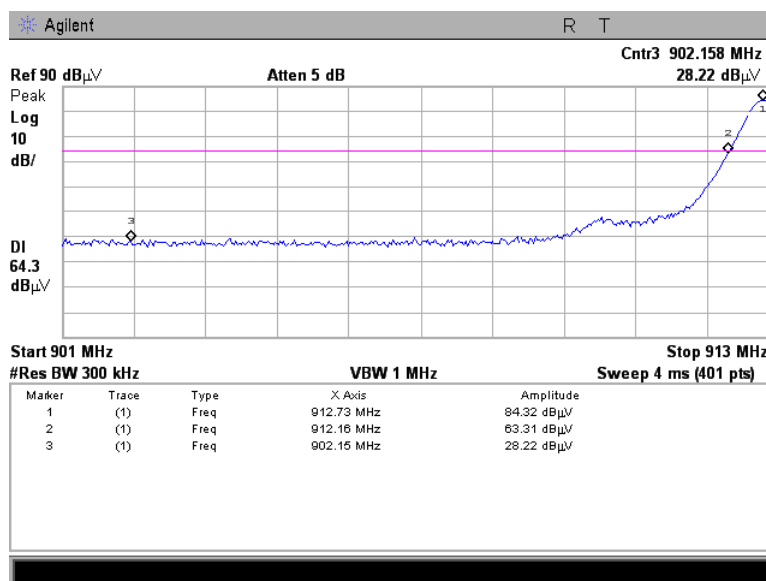
Reference numbers of test equipment used

HL 0337	HL 1457	HL 2909					
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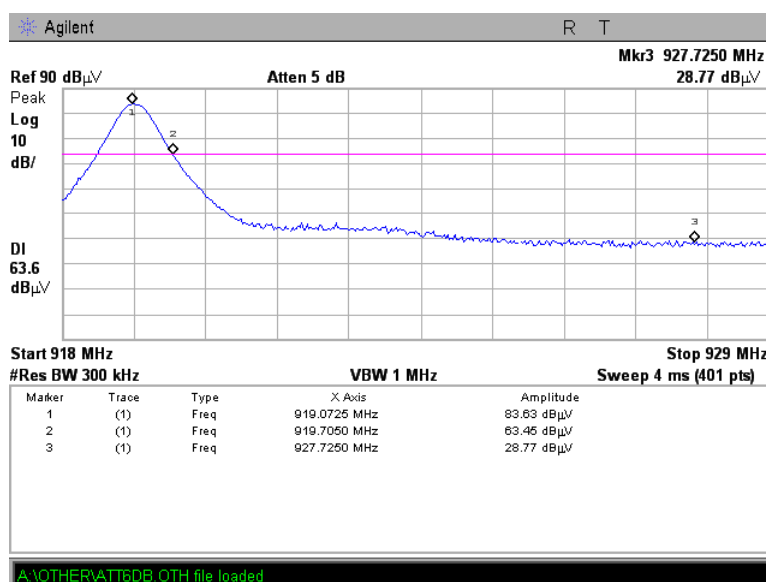
Full description is given in Appendix A.

Test specification:		Section 15.247(d), Emissions at band edges	
Test procedure:		ANSI C63.10, section 7.8.6	
Test mode:		Compliance	Verdict: PASS
Date(s):		8/31/2011 - 9/6/2011	
Temperature: 24.1 °C	Air Pressure: 1010 hPa	Relative Humidity: 34 %	Power Supply: 3 V battery
Remarks:			

Plot 7.6.1 The highest band edge emission at low carrier frequency with hopping function disabled

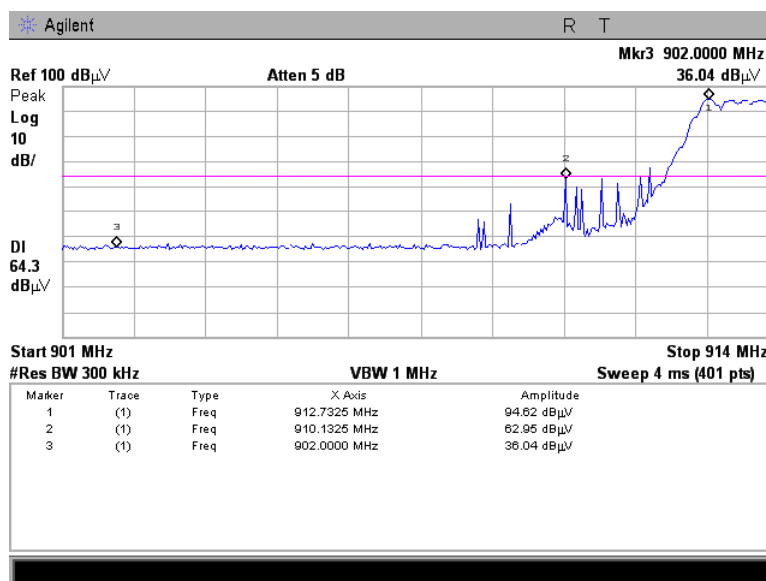


Plot 7.6.2 The highest band edge emission at high carrier frequency with hopping function disabled

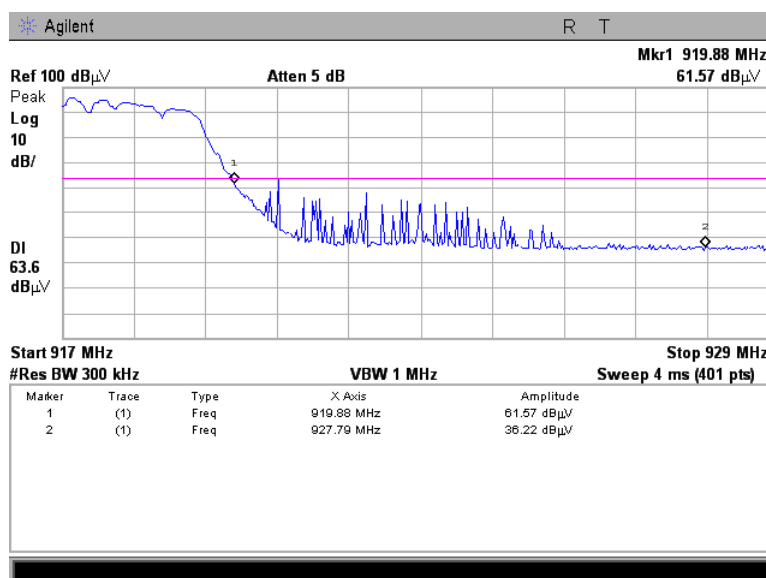


Test specification:		Section 15.247(d), Emissions at band edges	
Test procedure:		ANSI C63.10, section 7.8.6	
Test mode:		Compliance	Verdict: PASS
Date(s):		8/31/2011 - 9/6/2011	
Temperature: 24.1 °C	Air Pressure: 1010 hPa	Relative Humidity: 34 %	Power Supply: 3 V battery
Remarks:			

Plot 7.6.3 The highest band edge emission at low carrier frequency with hopping function enabled



Plot 7.6.4 The highest band edge emission at high carrier frequency with hopping function enabled



Test specification:		Section 15.247(d), Radiated spurious emissions	
Test procedure:		ANSI C63.10, sections 6.5, 6.6	
Test mode:		Compliance	Verdict: PASS
Date(s):		8/01/2017	
Temperature: 25 °C	Air Pressure: 1007 hPa	Relative Humidity: 54 %	Power Supply: 3 V battery
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 – 10 th harmonic	74.0	NA	54.0	

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

$$\text{Lim}_{S_2} = \text{Lim}_{S_1} + 40 \log(S_1/S_2),$$

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° 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°, 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), Radiated spurious emissions			
Test procedure: ANSI C63.10, sections 6.5, 6.6			
Test mode: Compliance		Verdict: PASS	
Date(s): 8/01/2017			
Temperature: 25 °C	Air Pressure: 1007 hPa	Relative Humidity: 54 %	Power Supply: 3 V battery
Remarks:			

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

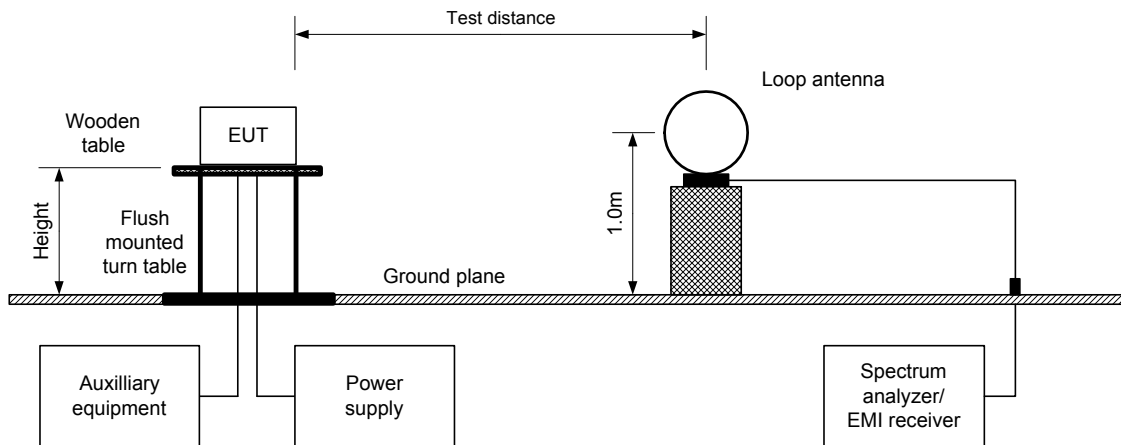
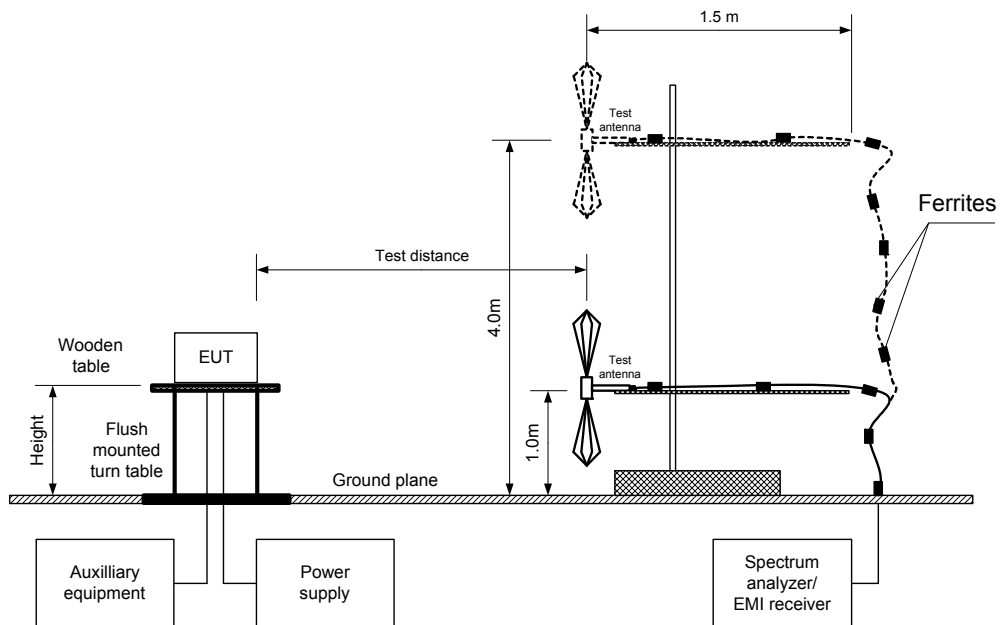
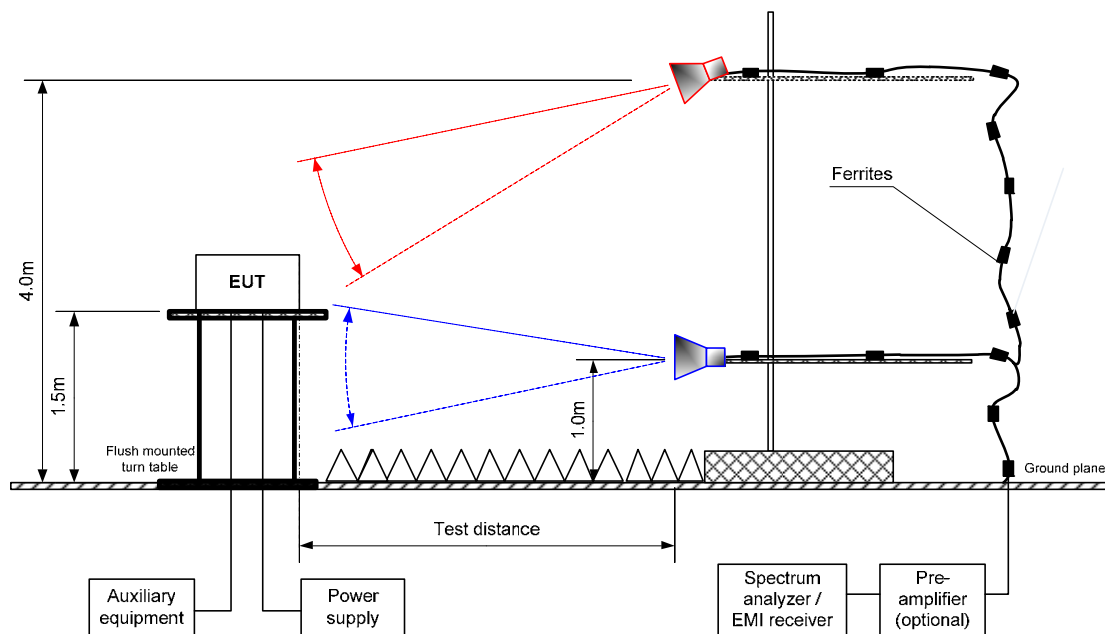


Figure 7.7.2 Setup for spurious emission field strength measurements above 30 MHz



Test specification:	Section 15.247(d), Radiated spurious emissions		
Test procedure:	ANSI C63.10, sections 6.5, 6.6		
Test mode:	Compliance	Verdict: PASS	
Date(s):	8/01/2017		
Temperature: 25 °C	Air Pressure: 1007 hPa	Relative Humidity: 54 %	Power Supply: 3 V battery
Remarks:			

Figure 7.7.3 Setup for spurious emission field strength measurements above 1000 MHz



Test specification:		Section 15.247(d), Radiated spurious emissions	
Test procedure:		ANSI C63.10, sections 6.5, 6.6	
Test mode:	Compliance	Verdict:	PASS
Date(s):	8/01/2017		
Temperature: 25 °C	Air Pressure: 1007 hPa	Relative Humidity: 54 %	Power Supply: 3 V battery
Remarks:			

Table 7.7.2 Field strength of emissions outside restricted bands

ASSIGNED FREQUENCY: 902-928 MHz
 INVESTIGATED FREQUENCY RANGE: 0.009 -9500 MHz
 TEST DISTANCE: 3 m
 MODULATION: GFSK
 MODULATING SIGNAL: PRBS
 BIT RATE: 50 kbps
 DUTY CYCLE: 100 %
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum
 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 NOT FINISHED									
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
Low carrier frequency 912.750 MHz									
1825.546	65.02	V	1.45	112	109.22	44.18	20.0	-24.18	Pass
5476.352	55.73	H	1.63	167		53.47		-33.47	
6389.070	55.59	V	1.90	166		53.61		-33.61	
Mid carrier frequency 915.863 MHz									
1831.675	70.32	V	1.97	94.5	110.83	40.51	20.0	-20.51	Pass
5495.020	59.16	V	1.54	253		51.67		-31.67	
6411.211	59.52	V	1.63	50		51.31		-31.31	
High carrier frequency 919.106 MHz									
1838.212	62.14	V	1.32	50	106.31	44.17	20.0	-24.17	Pass
5514.482	50.45	V	1.61	178		55.86		-35.86	
6433.902	45.06	H	2.0	00		61.25		-41.25	

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

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

Test specification:		Section 15.247(d), Radiated spurious emissions	
Test procedure:		ANSI C63.10, sections 6.5, 6.6	
Test mode:		Compliance	Verdict: PASS
Date(s):		8/01/2017	
Temperature: 25 °C	Air Pressure: 1007 hPa	Relative Humidity: 54 %	Power Supply: 3 V battery
Remarks:			

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

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

502-520 MHz											
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 912.750MHz											
2738.310	V	1.76	172	55.23	74.0	-18.77	54.42	27.12	54.0	-26.88	Pass
3650.890	V	1.72	180	53.77	74.0	-20.23	52.45	25.15	54.0	-28.85	
4563.770	V	1.75	185	57.66	74.0	-16.34	56.54	29.24	54.0	-24.76	
7302.015	V	1.92	228	54.77	74.0	-19.23	51.23	23.93	54.0	-30.07	
8215.115	H	1.93	145	55.65	74.0	-18.35	52.65	25.35	54.0	-28.65	
9127.550	H	1.7	158	60.14	74.0	-13.86	58.14	30.84	54.0	-23.16	
Mid carrier frequency 915.863 MHz											
2747.495	H	1.66	125	61.09	74.0	-12.91	58.10	30.80	54.0	-23.20	Pass
3663.412	H	1.60	0	60.38	74.0	-13.62	59.98	32.68	54.0	-21.32	
4579.310	V	1.88	116	64.53	74.0	-9.47	63.52	36.22	54.0	-17.78	
7326.644	V	1.78	200	59.90	74.0	-14.10	57.70	30.40	54.0	-23.60	
8242.847	H	1.74	178	55.16	74.0	-18.84	51.30	24.00	54.0	-30.00	
9158.625	H	1.51	120	60.79	74.0	-13.21	59.16	31.86	54.0	-22.14	
High carrier frequency 919.106 MHz											
2757.138	H	1.82	125	51.96	74.0	-22.04	51.06	23.76	54.0	-30.24	Pass
3676.349	H	1.40	165	48.50	74.0	-25.50	45.55	18.25	54.0	-35.75	
4595.645	V	1.59	179	51.20	74.0	-22.80	48.87	21.57	54.0	-32.43	
7352.938	H	1.86	170	52.34	74.0	-21.66	48.10	20.80	54.0	-33.20	
8271.849	H	1.56	214	50.71	74.0	-23.29	50.71	23.41	54.0	-30.59	
9191.210	H	1.67	194	51.66	74.0	-22.34	51.66	24.36	54.0	-29.64	

*- 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.

Test specification:		Section 15.247(d), Radiated spurious emissions	
Test procedure:		ANSI C63.10, sections 6.5, 6.6	
Test mode:		Compliance	Verdict: PASS
Date(s):		8/01/2017	
Temperature: 25 °C	Air Pressure: 1007 hPa	Relative Humidity: 54 %	Power Supply: 3 V battery
Remarks:			

Table 7.7.4 Average factor calculation

Transmission pulse		Transmission burst		Transmission train duration, ms	Average factor, dB
Duration, ms	Period, ms	Duration, ms	Period, ms		
4.312	2000	NA	NA	NA	-27.3

*- Average factor was calculated as follows

for pulse train shorter than 100 ms:

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

for pulse train longer than 100 ms:

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

Test specification:		Section 15.247(d), Radiated spurious emissions	
Test procedure:		ANSI C63.10, sections 6.5, 6.6	
Test mode:		Compliance	Verdict: PASS
Date(s):		8/01/2017	
Temperature: 25 °C	Air Pressure: 1007 hPa	Relative Humidity: 54 %	Power Supply: 3 V battery
Remarks:			

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

ASSIGNED FREQUENCY: 902-928 MHz
 INVESTIGATED FREQUENCY RANGE: 0.009 – 1000 MHz
 TEST DISTANCE: 3 m
 MODULATION: GFSK
 BIT RATE: 50 kbps
 DUTY CYCLE: 100 %
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum
 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)
 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 signals 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 1915	HL 3818	HL 4294	HL 4295	HL 4535	HL 4541	HL 4542	HL 4543
HL 4549	HL 4575	HL 4603	HL 4604	HL 4933	HL 5105		

Full description is given in Appendix A.

Test specification:		Section 15.247(d), Radiated spurious emissions	
Test procedure:		ANSI C63.10, sections 6.5, 6.6	
Test mode:		Compliance	Verdict: PASS
Date(s):		8/01/2017	
Temperature: 25 °C	Air Pressure: 1007 hPa	Relative Humidity: 54 %	Power Supply: 3 V battery
Remarks:			

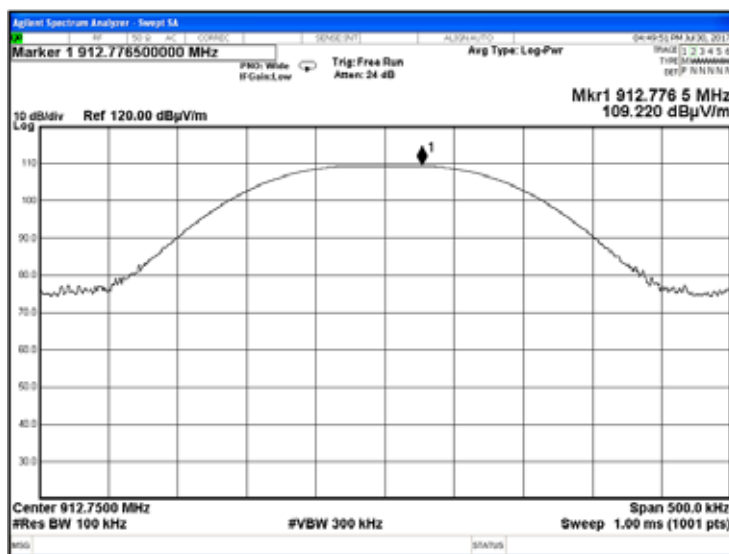
Table 7.7.6 Restricted bands

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	

Test specification:		Section 15.247(d), Radiated spurious emissions	
Test procedure:		ANSI C63.10, sections 6.5, 6.6	
Test mode:		Compliance	Verdict: PASS
Date(s):		8/01/2017	
Temperature: 25 °C	Air Pressure: 1007 hPa	Relative Humidity: 54 %	Power Supply: 3 V battery
Remarks:			

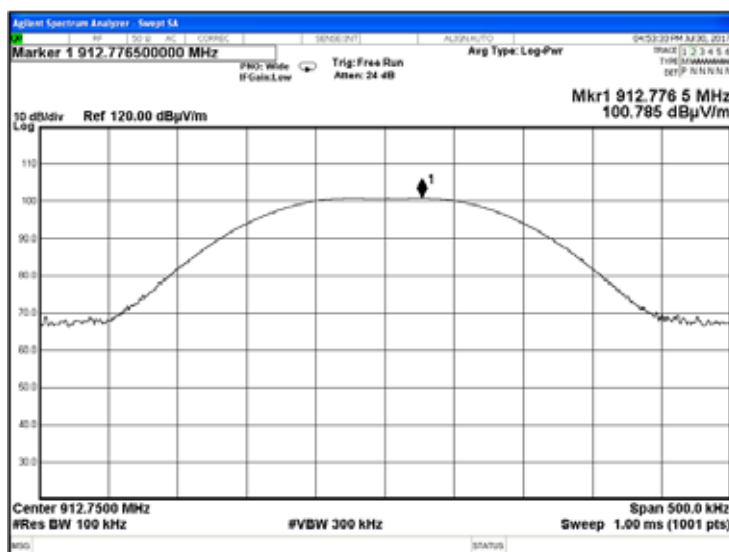
Plot 7.7.1 Radiated emission measurements at the low carrier frequency

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



Plot 7.7.2 Radiated emission measurements at the low carrier frequency

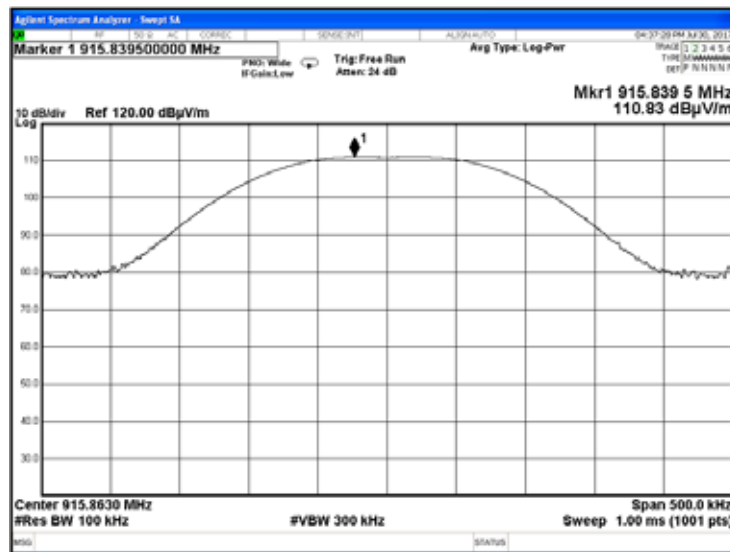
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal



Test specification:		Section 15.247(d), Radiated spurious emissions	
Test procedure:		ANSI C63.10, sections 6.5, 6.6	
Test mode:		Compliance	Verdict: PASS
Date(s):		8/01/2017	
Temperature: 25 °C	Air Pressure: 1007 hPa	Relative Humidity: 54 %	Power Supply: 3 V battery
Remarks:			

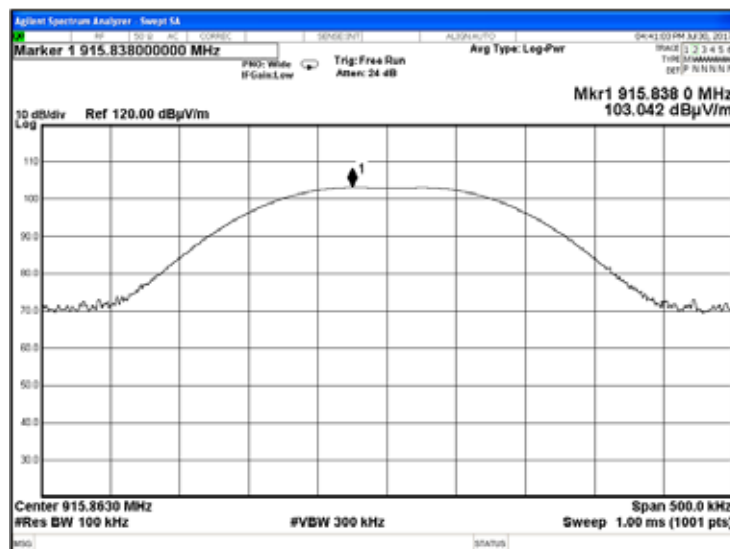
Plot 7.7.3 Radiated emission measurements at the mid carrier frequency

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



Plot 7.7.4 Radiated emission measurements at the mid carrier frequency

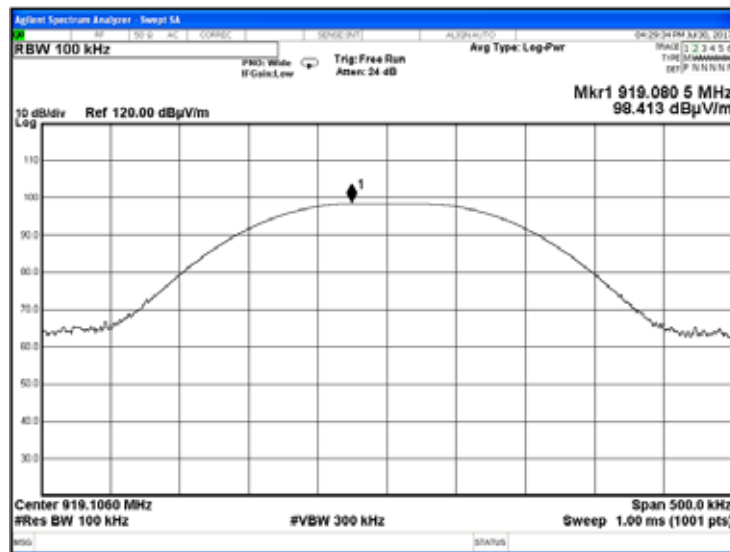
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal



Test specification:		Section 15.247(d), Radiated spurious emissions	
Test procedure:		ANSI C63.10, sections 6.5, 6.6	
Test mode:		Compliance	Verdict: PASS
Date(s):		8/01/2017	
Temperature: 25 °C	Air Pressure: 1007 hPa	Relative Humidity: 54 %	Power Supply: 3 V battery
Remarks:			

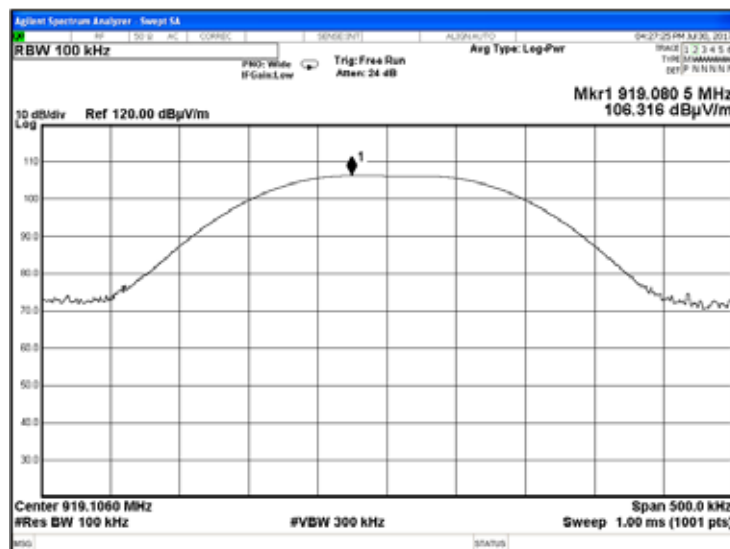
Plot 7.7.5 Radiated emission measurements at the high carrier frequency

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



Plot 7.7.6 Radiated emission measurements at the high carrier frequency

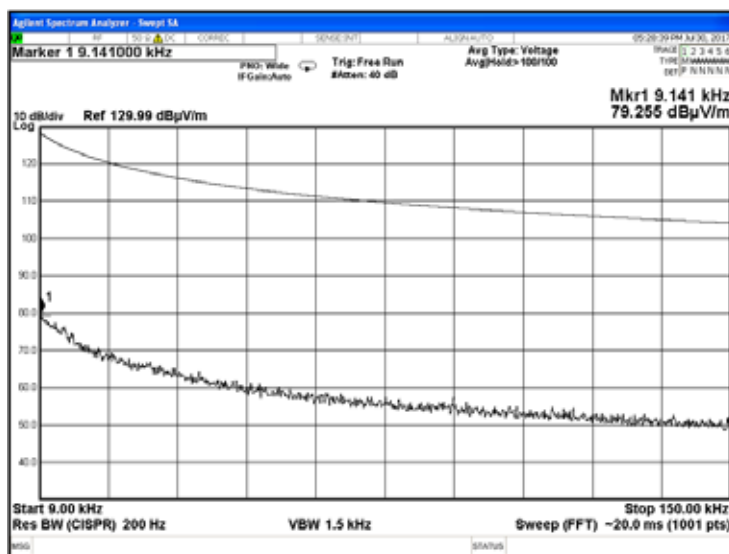
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal



Test specification:		Section 15.247(d), Radiated spurious emissions	
Test procedure:		ANSI C63.10, sections 6.5, 6.6	
Test mode:		Compliance	Verdict: PASS
Date(s):		8/01/2017	
Temperature: 25 °C	Air Pressure: 1007 hPa	Relative Humidity: 54 %	Power Supply: 3 V battery
Remarks:			

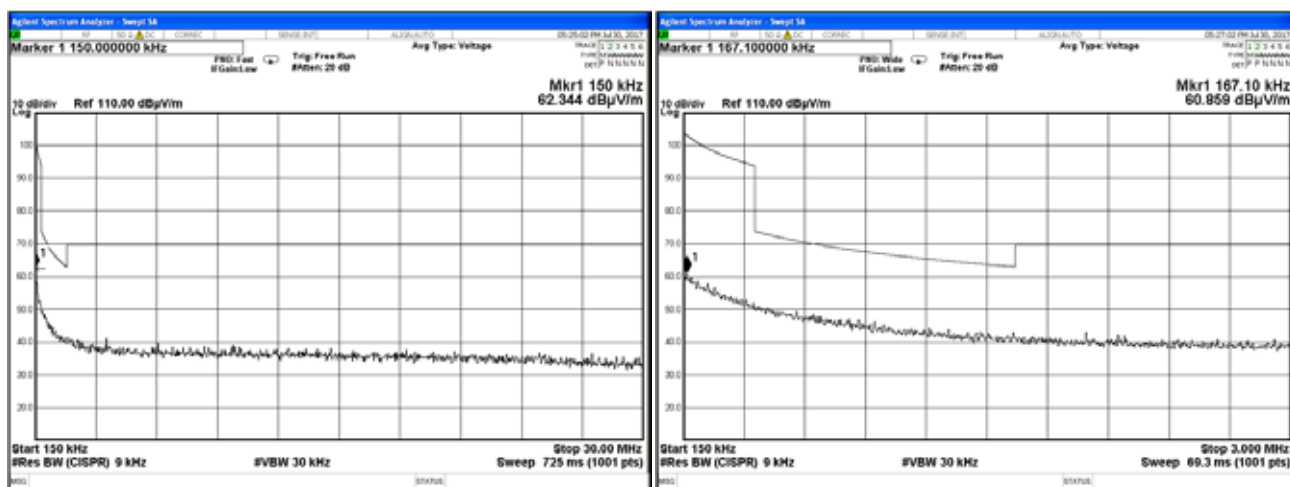
Plot 7.7.7 Radiated emission measurements from 9 to 150 kHz at the low, mid and high carrier frequency

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



Plot 7.7.8 Radiated emission measurements from 0.15 to 30 MHz at the low, mid and high carrier frequency

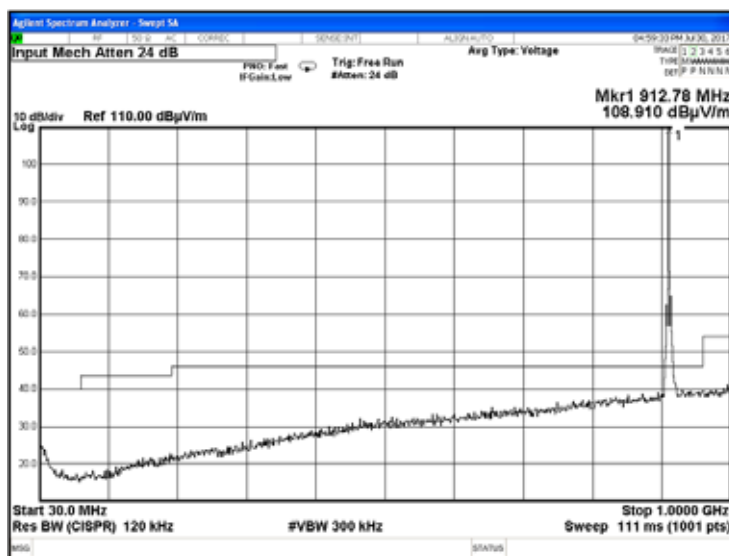
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical



Test specification:		Section 15.247(d), Radiated spurious emissions	
Test procedure:		ANSI C63.10, sections 6.5, 6.6	
Test mode:		Compliance	Verdict: PASS
Date(s):		8/01/2017	
Temperature: 25 °C	Air Pressure: 1007 hPa	Relative Humidity: 54 %	Power Supply: 3 V battery
Remarks:			

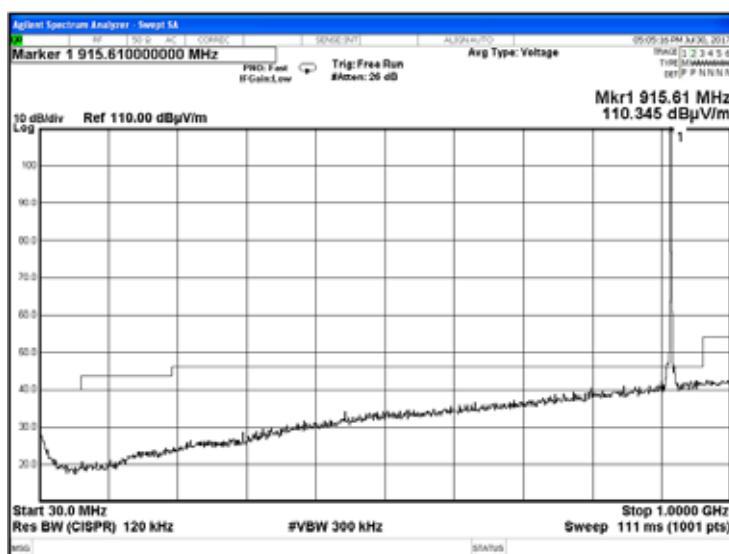
Plot 7.7.9 Radiated emission measurements from 30 to 1000 MHz at the low carrier frequency

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



Plot 7.7.10 Radiated emission measurements from 30 to 1000 MHz at the mid carrier frequency

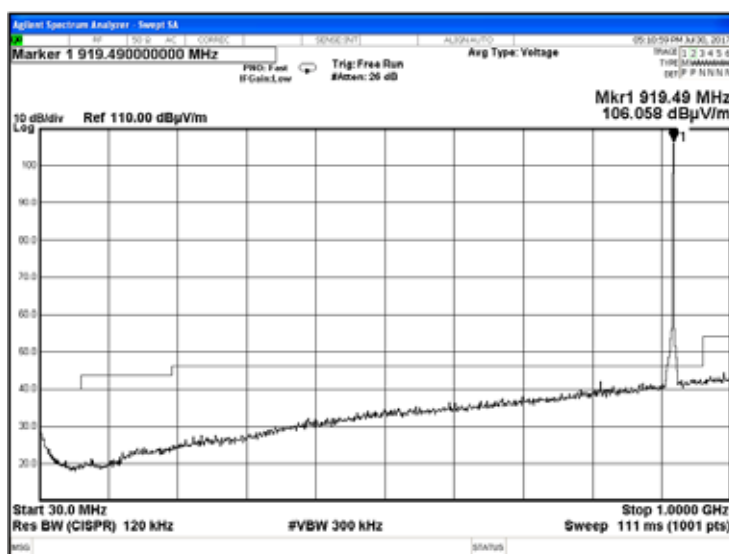
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal



Test specification:		Section 15.247(d), Radiated spurious emissions	
Test procedure:		ANSI C63.10, sections 6.5, 6.6	
Test mode:		Compliance	Verdict: PASS
Date(s):		8/01/2017	
Temperature: 25 °C	Air Pressure: 1007 hPa	Relative Humidity: 54 %	Power Supply: 3 V battery
Remarks:			

Plot 7.7.11 Radiated emission measurements from 30 to 1000 MHz at the high carrier frequency

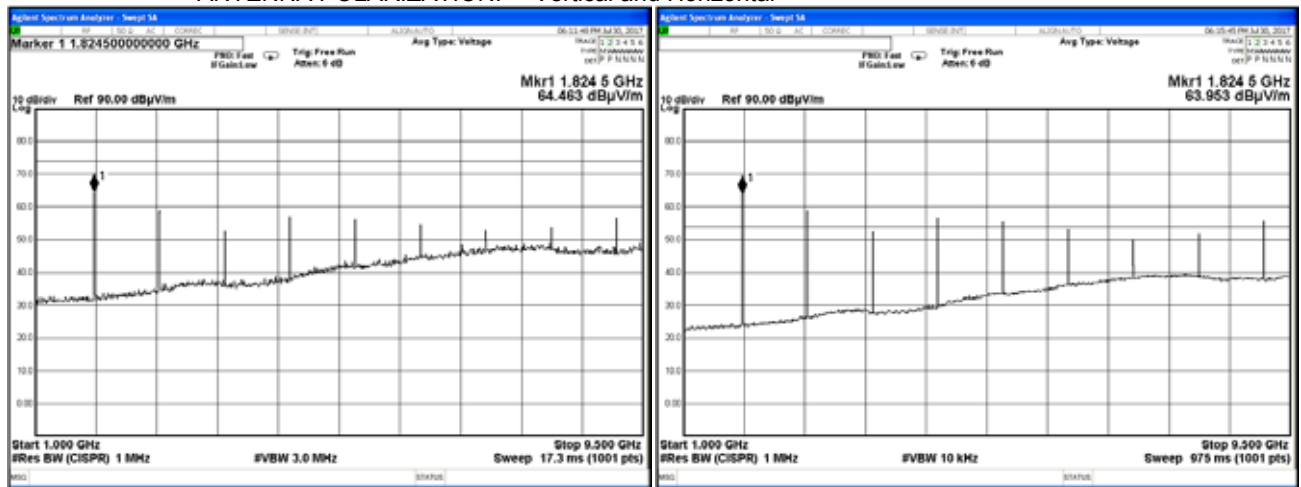
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal



Test specification:	Section 15.247(d), Radiated spurious emissions		
Test procedure:	ANSI C63.10, sections 6.5, 6.6		
Test mode:	Compliance	Verdict:	PASS
Date(s):	8/01/2017		
Temperature: 25 °C	Air Pressure: 1007 hPa	Relative Humidity: 54 %	Power Supply: 3 V battery
Remarks:			

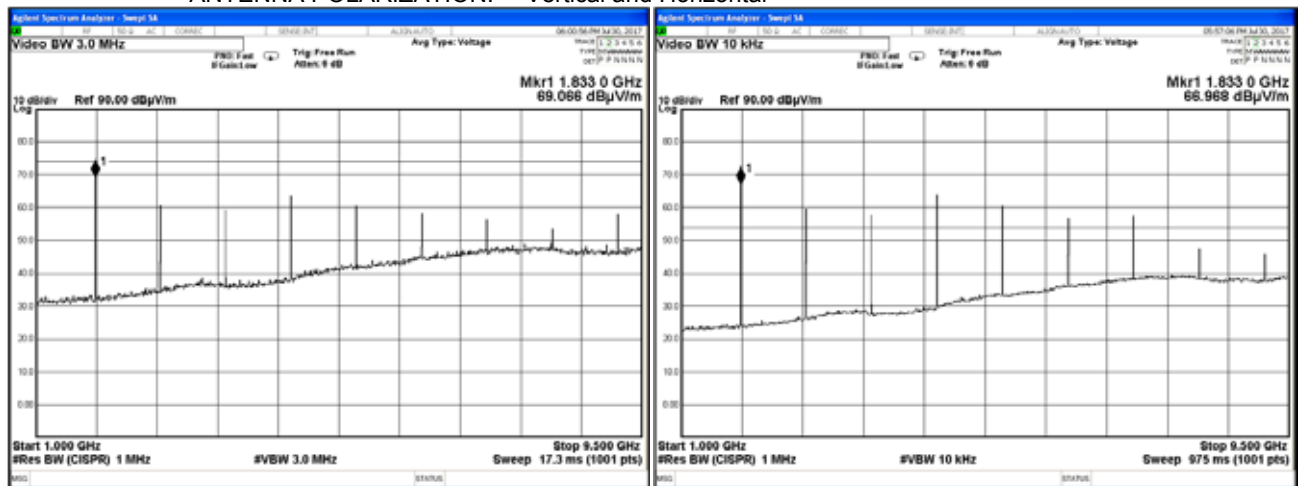
Plot 7.7.12 Radiated emission measurements from 1000 to 9500 MHz at the low carrier frequency

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



Plot 7.7.13 Radiated emission measurements from 1000 to 9500 MHz at the mid carrier frequency

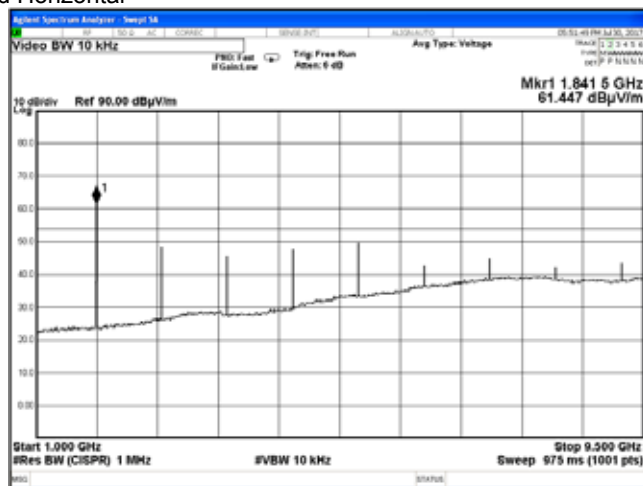
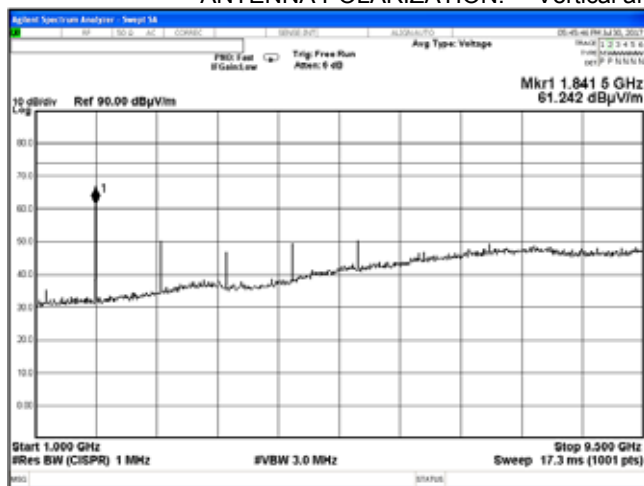
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal



Test specification:		Section 15.247(d), Radiated spurious emissions	
Test procedure:		ANSI C63.10, sections 6.5, 6.6	
Test mode:		Compliance	Verdict: PASS
Date(s):		8/01/2017	
Temperature: 25 °C	Air Pressure: 1007 hPa	Relative Humidity: 54 %	Power Supply: 3 V battery
Remarks:			

Plot 7.7.14 Radiated emission measurements from 1000 to 9500 MHz at the high carrier frequency

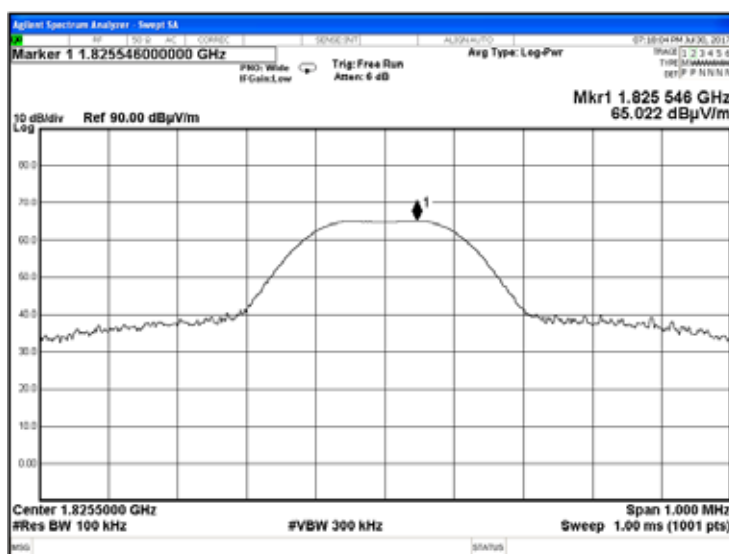
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal



Test specification:		Section 15.247(d), Radiated spurious emissions	
Test procedure:		ANSI C63.10, sections 6.5, 6.6	
Test mode:		Compliance	Verdict: PASS
Date(s):		8/01/2017	
Temperature: 25 °C	Air Pressure: 1007 hPa	Relative Humidity: 54 %	Power Supply: 3 V battery
Remarks:			

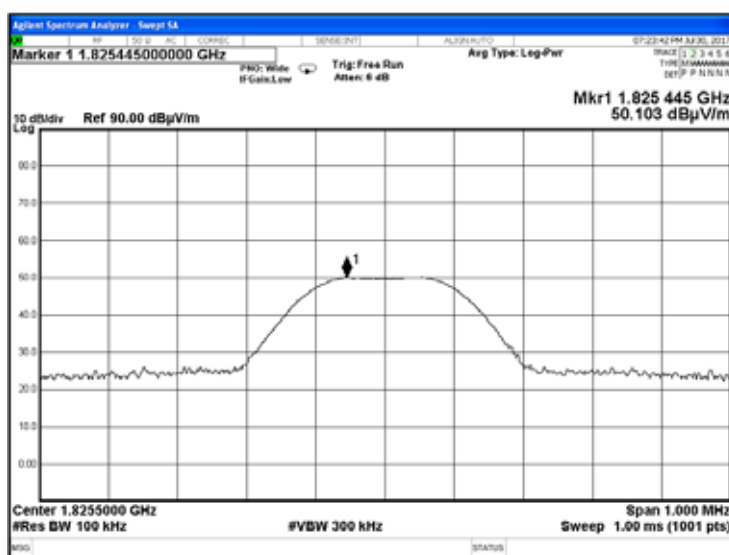
Plot 7.7.15 Radiated emission measurements at the second harmonic of low carrier frequency

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



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

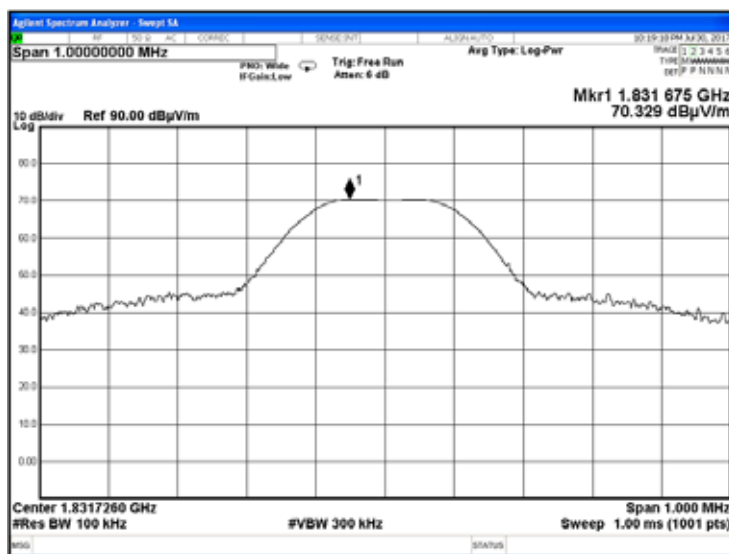
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal



Test specification:	Section 15.247(d), Radiated spurious emissions		
Test procedure:	ANSI C63.10, sections 6.5, 6.6		
Test mode:	Compliance	Verdict: PASS	
Date(s):	8/01/2017		
Temperature: 25 °C	Air Pressure: 1007 hPa	Relative Humidity: 54 %	Power Supply: 3 V battery
Remarks:			

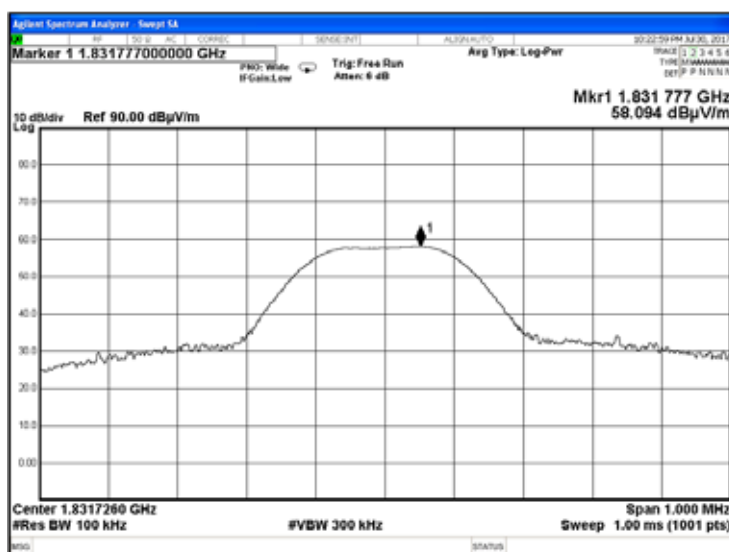
Plot 7.7.17 Radiated emission measurements at the second harmonic of mid carrier frequency

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



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

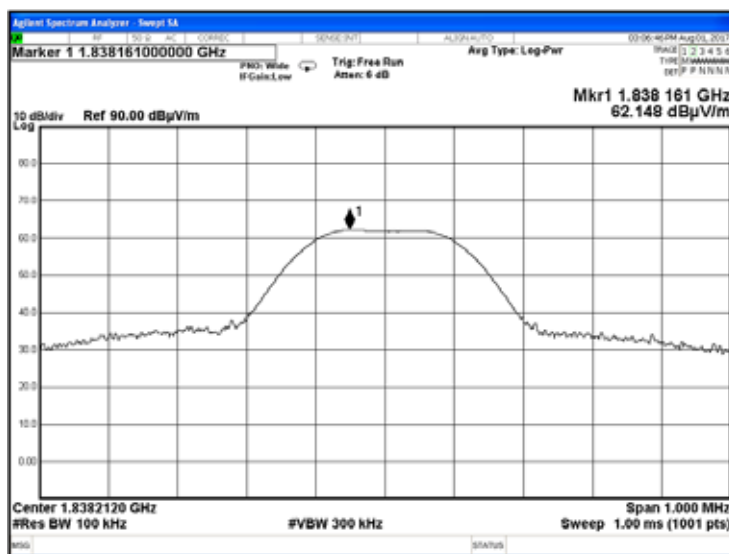
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal



Test specification:		Section 15.247(d), Radiated spurious emissions	
Test procedure:		ANSI C63.10, sections 6.5, 6.6	
Test mode:		Compliance	Verdict: PASS
Date(s):		8/01/2017	
Temperature: 25 °C	Air Pressure: 1007 hPa	Relative Humidity: 54 %	Power Supply: 3 V battery
Remarks:			

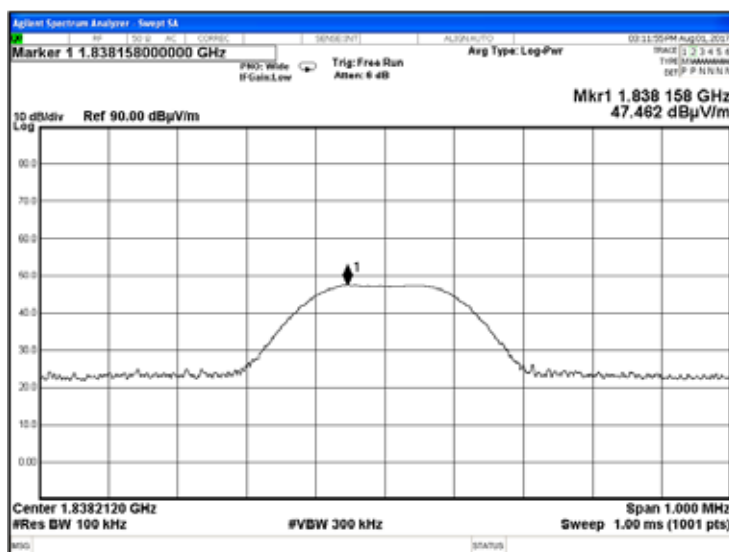
Plot 7.7.19 Radiated emission measurements at the second harmonic of high carrier frequency

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



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

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

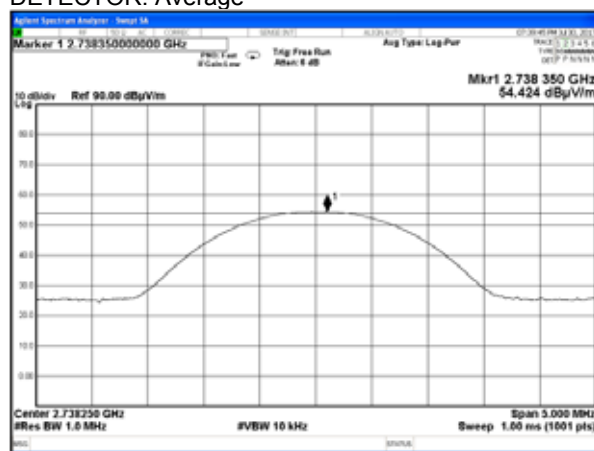


Test specification:	Section 15.247(d), Radiated spurious emissions		
Test procedure:	ANSI C63.10, sections 6.5, 6.6		
Test mode:	Compliance	Verdict:	PASS
Date(s):	8/01/2017		
Temperature: 25 °C	Air Pressure: 1007 hPa	Relative Humidity: 54 %	Power Supply: 3 V battery
Remarks:			

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

TEST SITE:
TEST DISTANCE:
ANTENNA POLARIZATION:
DETECTOR: Peak

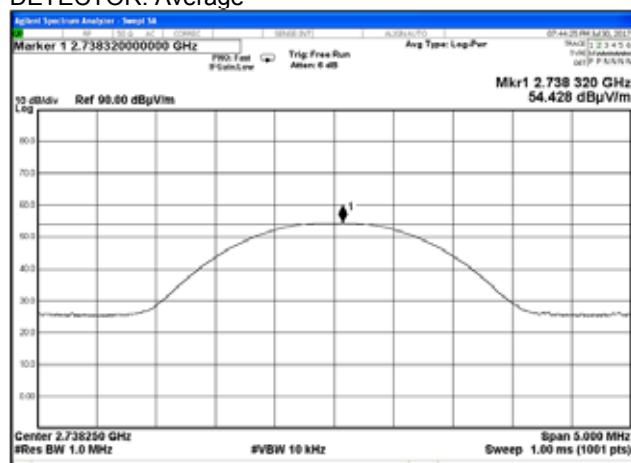
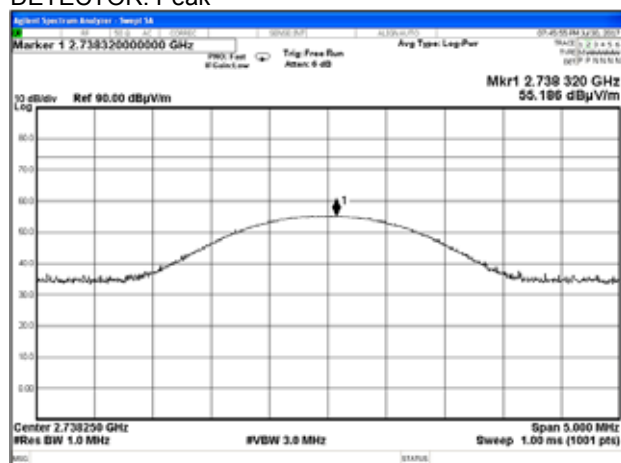
Semi Anechoic Chamber
3 m
Vertical
DETECTOR: Average



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

TEST SITE:
TEST DISTANCE:
ANTENNA POLARIZATION:
DETECTOR: Peak

Semi Anechoic Chamber
3 m
Horizontal
DETECTOR: Average

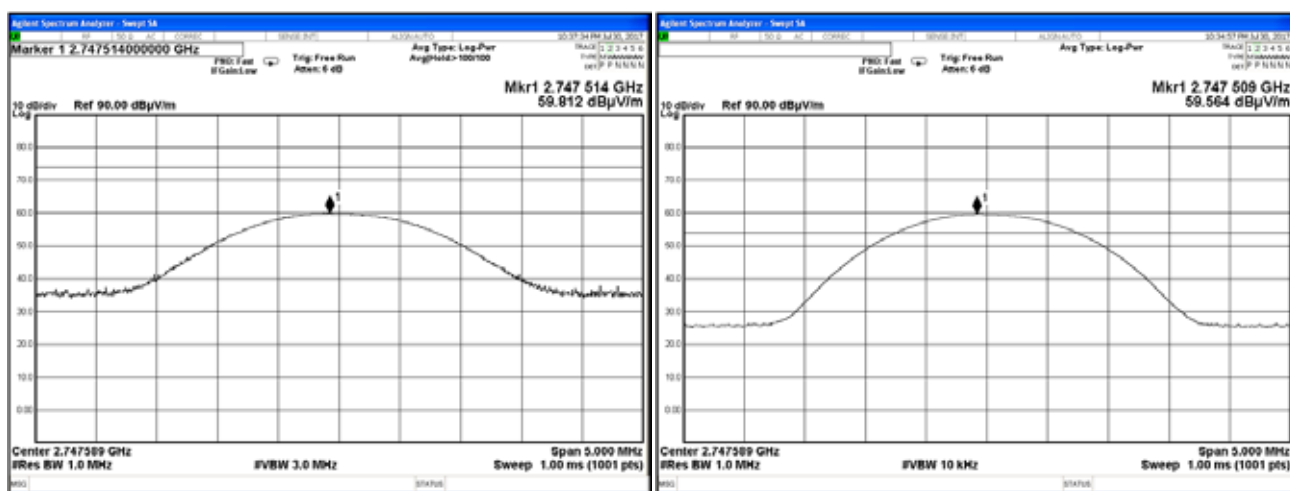


Test specification:	Section 15.247(d), Radiated spurious emissions		
Test procedure:	ANSI C63.10, sections 6.5, 6.6		
Test mode:	Compliance	Verdict: PASS	
Date(s):	8/01/2017		
Temperature: 25 °C	Air Pressure: 1007 hPa	Relative Humidity: 54 %	Power Supply: 3 V battery
Remarks:			

Plot 7.7.23 Radiated emission measurements at the third harmonic of mid carrier frequency

TEST SITE:
TEST DISTANCE:
ANTENNA POLARIZATION:
DETECTOR: Peak

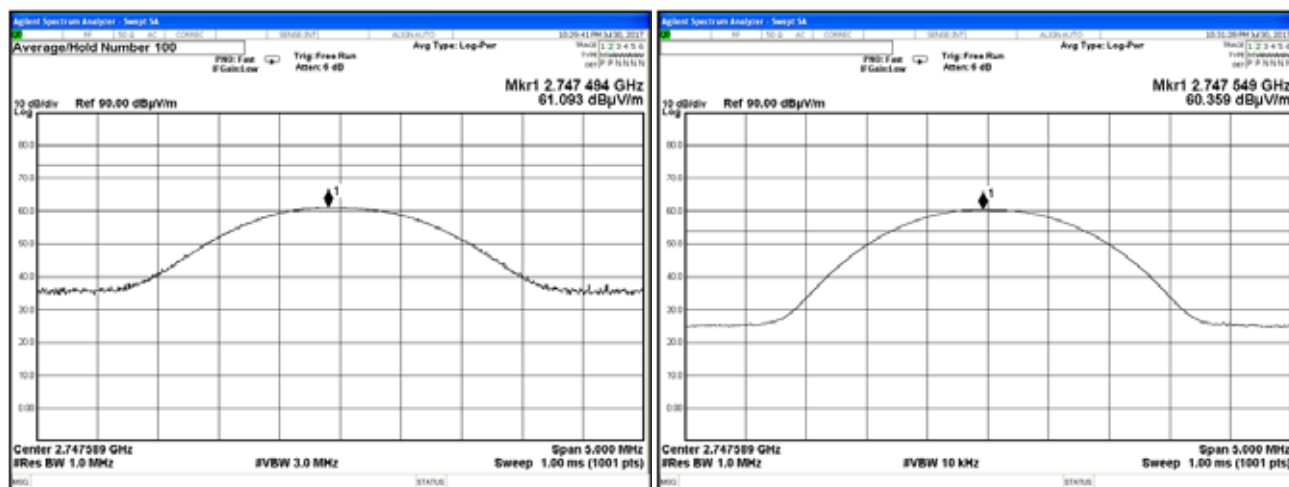
Semi Anechoic Chamber
3 m
Vertical
DETECTOR: Average



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

TEST SITE:
TEST DISTANCE:
ANTENNA POLARIZATION:
DETECTOR: Peak

Semi Anechoic Chamber
3 m
Horizontal
DETECTOR: Average

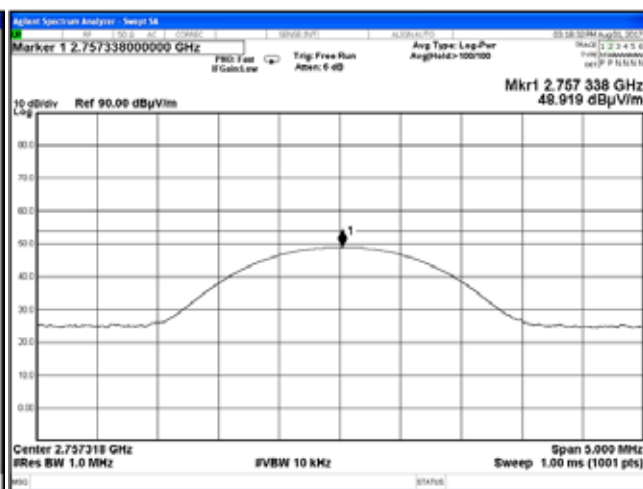
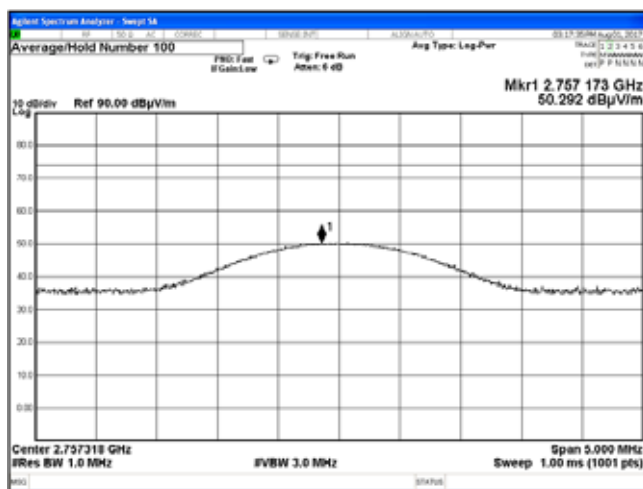


Test specification:		Section 15.247(d), Radiated spurious emissions	
Test procedure:		ANSI C63.10, sections 6.5, 6.6	
Test mode:		Compliance	Verdict: PASS
Date(s):		8/01/2017	
Temperature: 25 °C	Air Pressure: 1007 hPa	Relative Humidity: 54 %	Power Supply: 3 V battery
Remarks:			

Plot 7.7.25 Radiated emission measurements at the third harmonic of high carrier frequency

TEST SITE:
TEST DISTANCE:
ANTENNA POLARIZATION:
DETECTOR: Peak

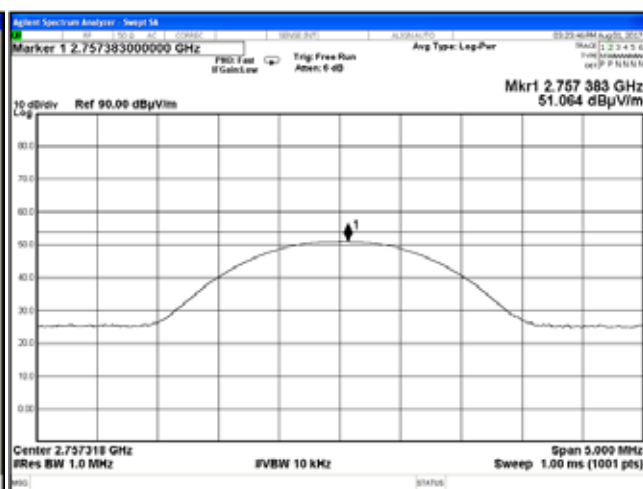
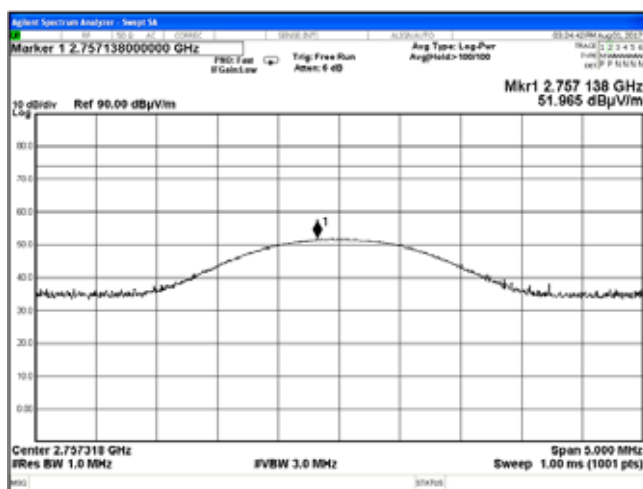
Semi Anechoic Chamber
3 m
Vertical
DETECTOR: Average



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

TEST SITE:
TEST DISTANCE:
ANTENNA POLARIZATION:
DETECTOR: Peak

Semi Anechoic Chamber
3 m
Horizontal
DETECTOR: Average

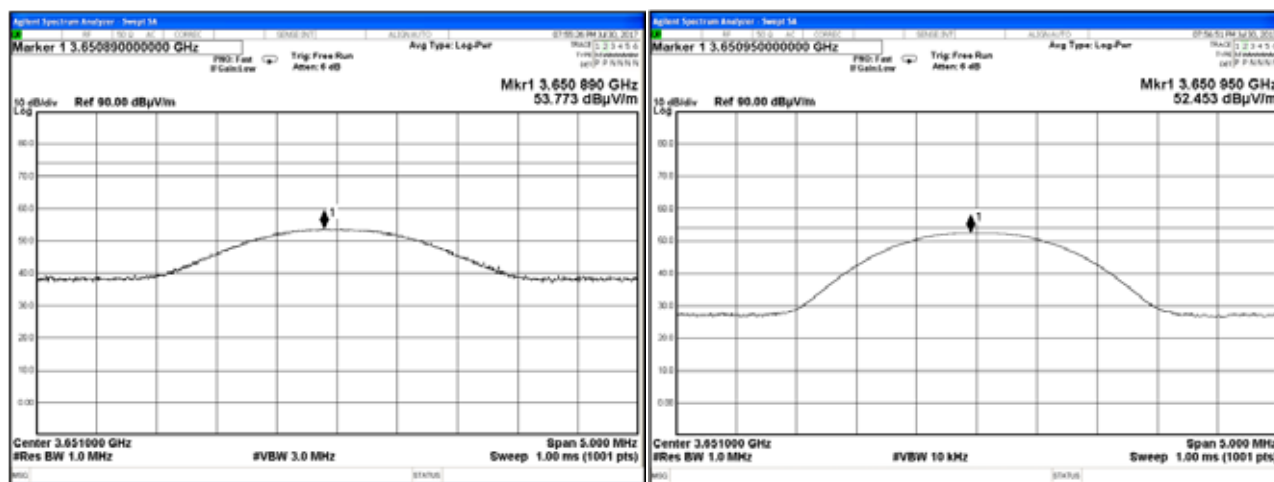


Test specification: Section 15.247(d), Radiated spurious emissions			
Test procedure: ANSI C63.10, sections 6.5, 6.6			
Test mode: Compliance		Verdict: PASS	
Date(s): 8/01/2017			
Temperature: 25 °C	Air Pressure: 1007 hPa	Relative Humidity: 54 %	Power Supply: 3 V battery
Remarks:			

Plot 7.7.27 Radiated emission measurements at the fourth harmonic of low carrier frequency

TEST SITE:
TEST DISTANCE:
ANTENNA POLARIZATION:
DETECTOR: Peak

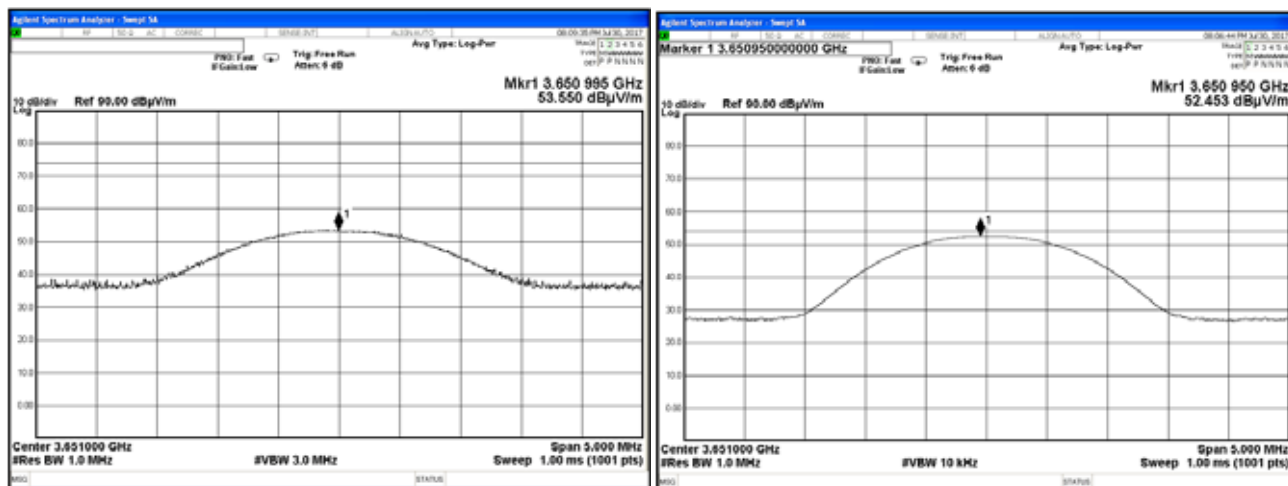
Semi Anechoic Chamber
3 m
Vertical
DETECTOR: Average



Plot 7.7.28 Radiated emission measurements at the fourth harmonic of low carrier frequency

TEST SITE:
TEST DISTANCE:
ANTENNA POLARIZATION:
DETECTOR: Peak

Semi Anechoic Chamber
3 m
Horizontal
DETECTOR: Average

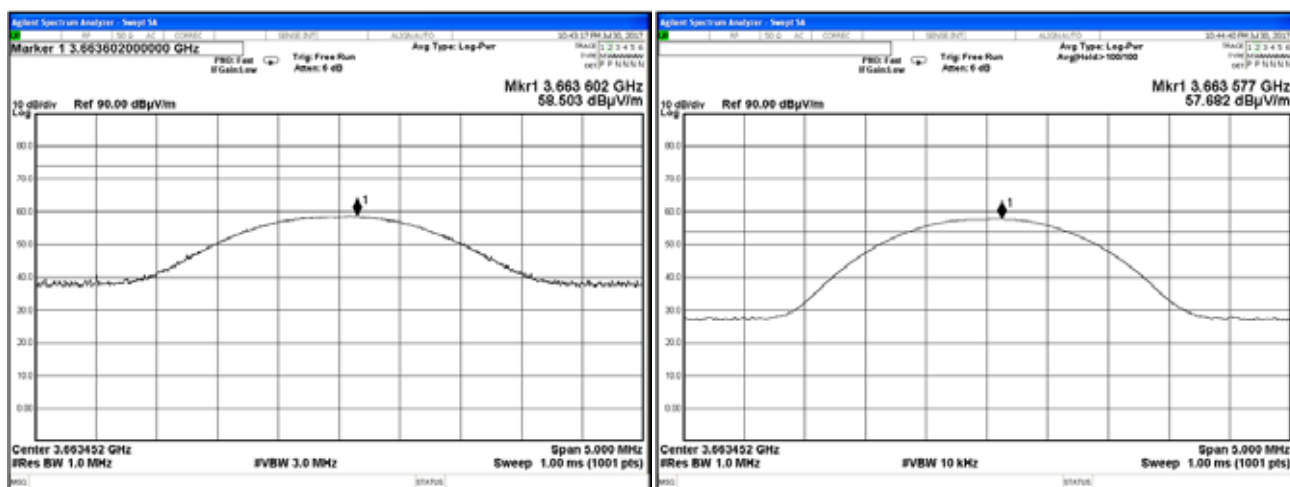


Test specification:		Section 15.247(d), Radiated spurious emissions	
Test procedure:		ANSI C63.10, sections 6.5, 6.6	
Test mode:		Compliance	Verdict: PASS
Date(s):		8/01/2017	
Temperature: 25 °C	Air Pressure: 1007 hPa	Relative Humidity: 54 %	Power Supply: 3 V battery
Remarks:			

Plot 7.7.29 Radiated emission measurements at the fourth harmonic of mid carrier frequency

TEST SITE:
TEST DISTANCE:
ANTENNA POLARIZATION:
DETECTOR: Peak

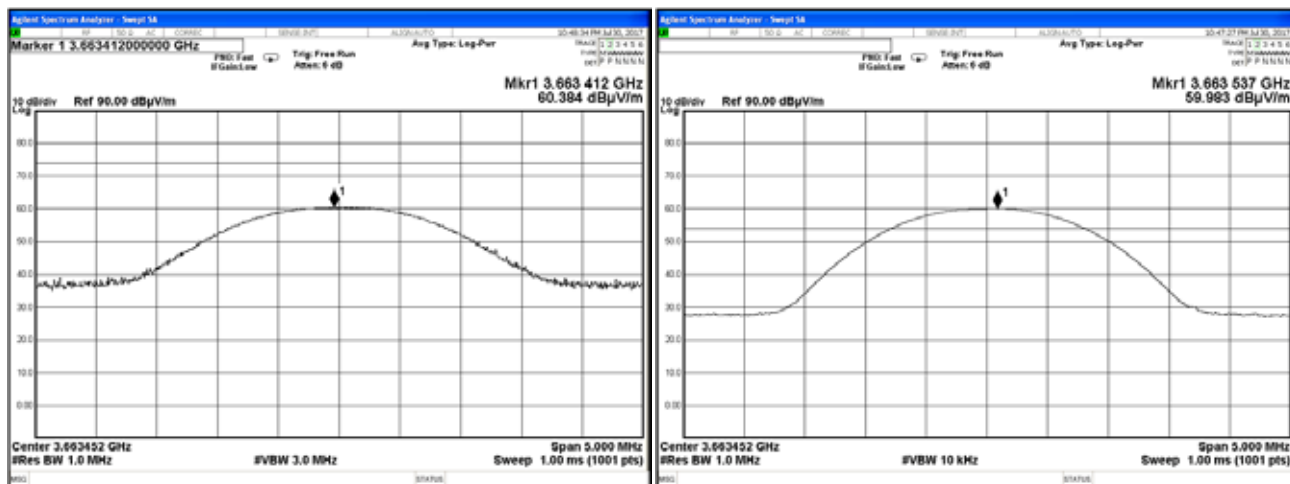
Semi Anechoic Chamber
3 m
Vertical
DETECTOR: Average



Plot 7.7.30 Radiated emission measurements at the fourth harmonic of low carrier frequency

TEST SITE:
TEST DISTANCE:
ANTENNA POLARIZATION:
DETECTOR: Peak

Semi Anechoic Chamber
3 m
Horizontal
DETECTOR: Average

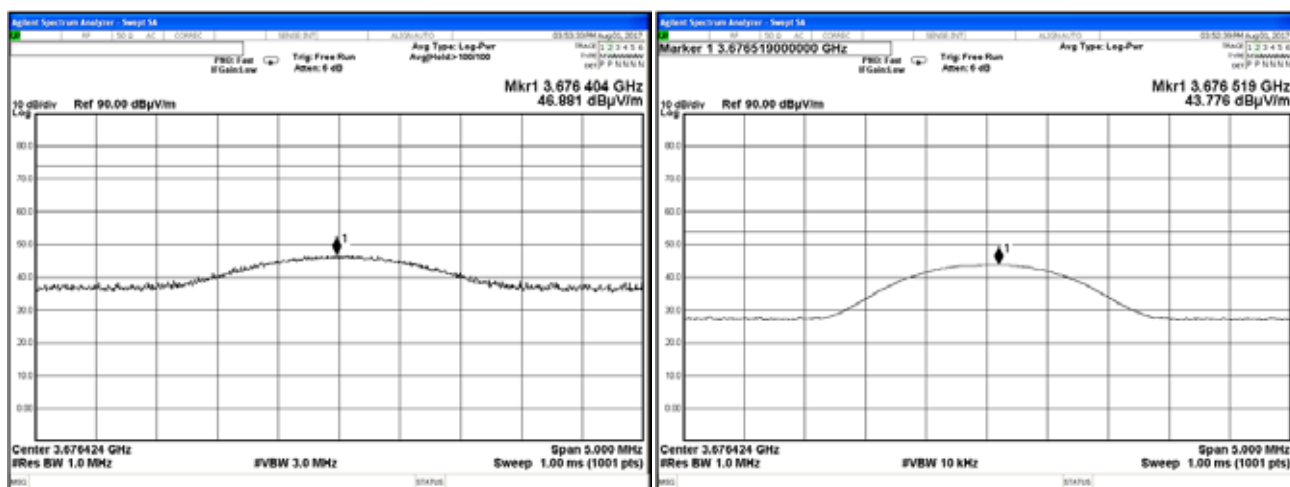


Test specification:		Section 15.247(d), Radiated spurious emissions	
Test procedure:		ANSI C63.10, sections 6.5, 6.6	
Test mode:		Compliance	Verdict: PASS
Date(s):		8/01/2017	
Temperature: 25 °C	Air Pressure: 1007 hPa	Relative Humidity: 54 %	Power Supply: 3 V battery
Remarks:			

Plot 7.7.31 Radiated emission measurements at the fourth harmonic of high carrier frequency

TEST SITE:
TEST DISTANCE:
ANTENNA POLARIZATION:
DETECTOR: Peak

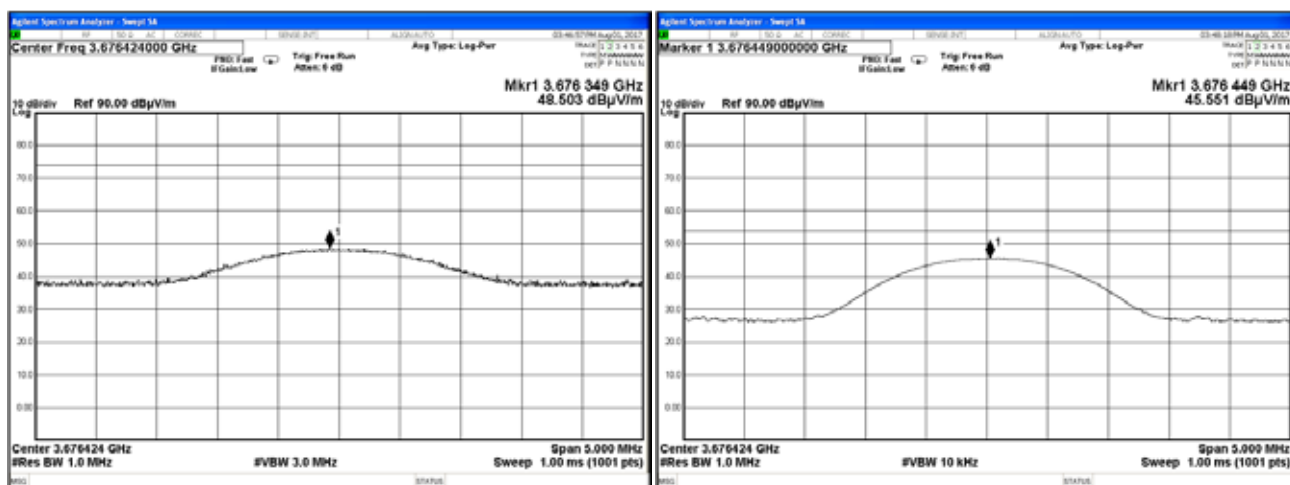
Semi Anechoic Chamber
3 m
Vertical
DETECTOR: Average



Plot 7.7.32 Radiated emission measurements at the fourth harmonic of high carrier frequency

TEST SITE:
TEST DISTANCE:
ANTENNA POLARIZATION:
DETECTOR: Peak

Semi Anechoic Chamber
3 m
Horizontal
DETECTOR: Average

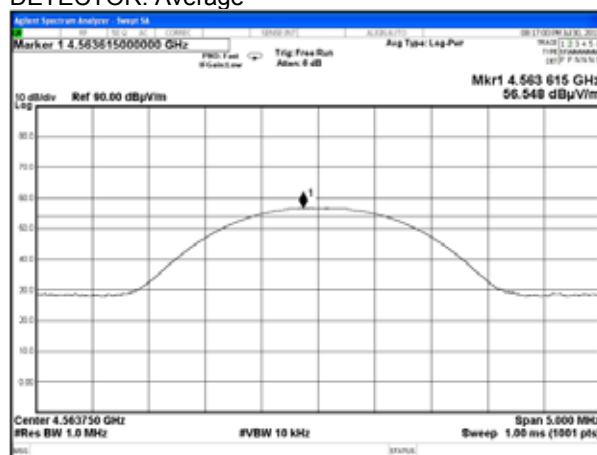


Test specification: Section 15.247(d), Radiated spurious emissions			
Test procedure: ANSI C63.10, sections 6.5, 6.6			
Test mode: Compliance		Verdict: PASS	
Date(s): 8/01/2017			
Temperature: 25 °C	Air Pressure: 1007 hPa	Relative Humidity: 54 %	Power Supply: 3 V battery
Remarks:			

Plot 7.7.33 Radiated emission measurements at the fifth harmonic of low carrier frequency

TEST SITE:
TEST DISTANCE:
ANTENNA POLARIZATION:
DETECTOR: Peak

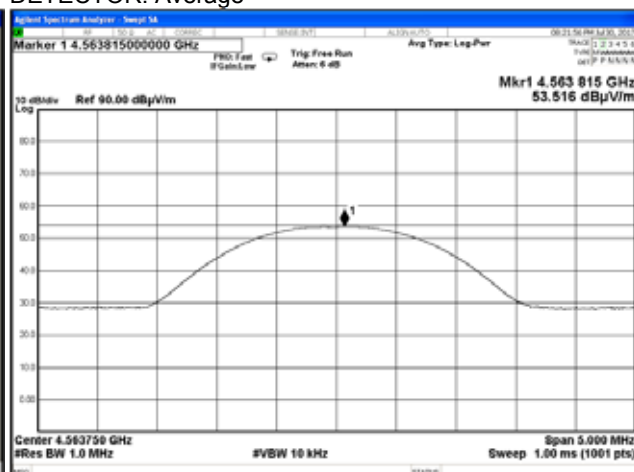
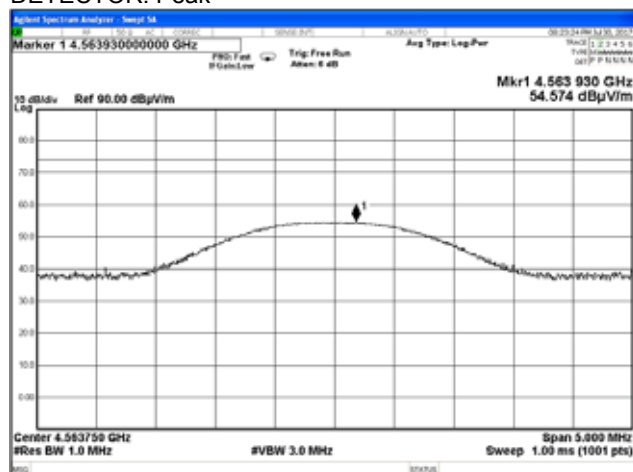
Semi Anechoic Chamber
3 m
Vertical
DETECTOR: Average



Plot 7.7.34 Radiated emission measurements at the fifth harmonic of low carrier frequency

TEST SITE:
TEST DISTANCE:
ANTENNA POLARIZATION:
DETECTOR: Peak

OATS
3 m
Horizontal
DETECTOR: Average

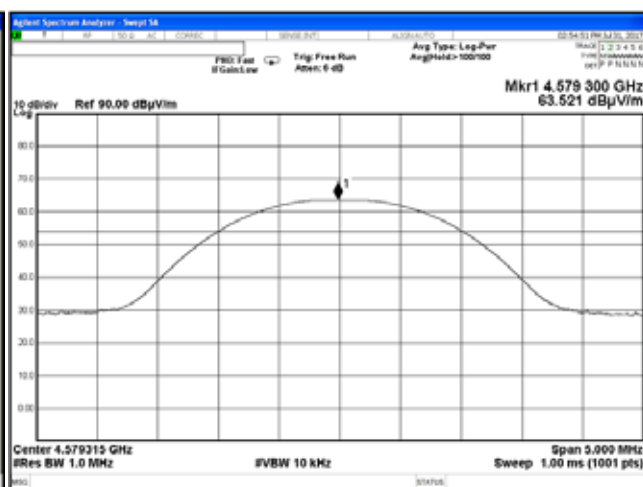
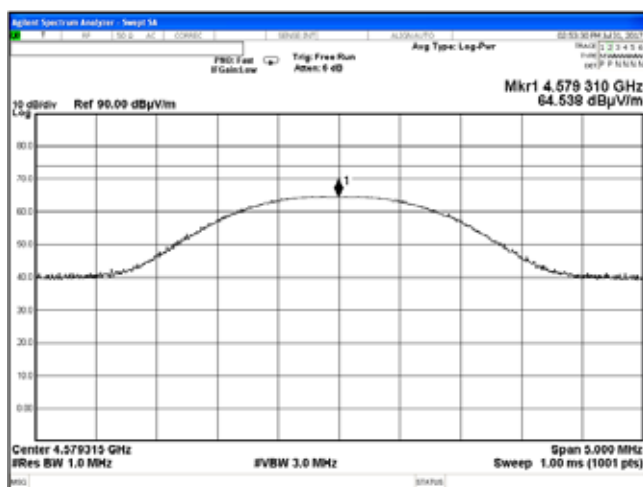


Test specification:		Section 15.247(d), Radiated spurious emissions	
Test procedure:		ANSI C63.10, sections 6.5, 6.6	
Test mode:		Compliance	Verdict: PASS
Date(s):		8/01/2017	
Temperature: 25 °C	Air Pressure: 1007 hPa	Relative Humidity: 54 %	Power Supply: 3 V battery
Remarks:			

Plot 7.7.35 Radiated emission measurements at the fifth harmonic of mid carrier frequency

TEST SITE:
TEST DISTANCE:
ANTENNA POLARIZATION:
DETECTOR: Peak

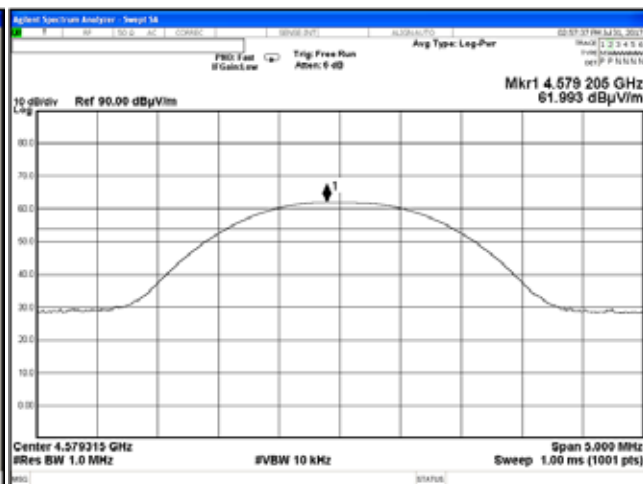
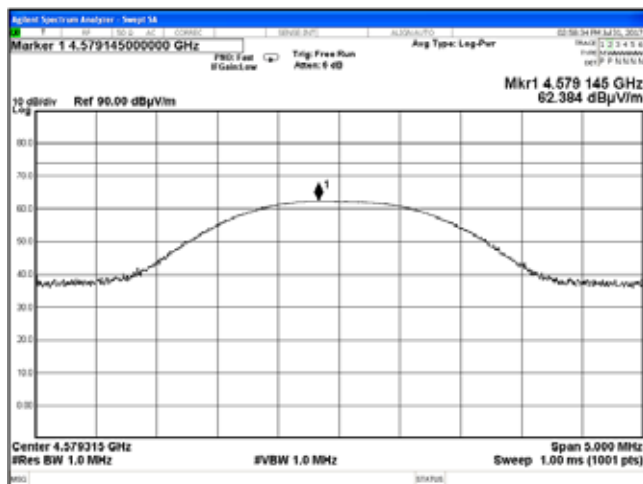
Semi Anechoic Chamber
3 m
Vertical
DETECTOR: Average



Plot 7.7.36 Radiated emission measurements at the fifth harmonic of mid carrier frequency

TEST SITE:
TEST DISTANCE:
ANTENNA POLARIZATION:
DETECTOR: Peak

Semi Anechoic Chamber
3 m
Horizontal
DETECTOR: Average

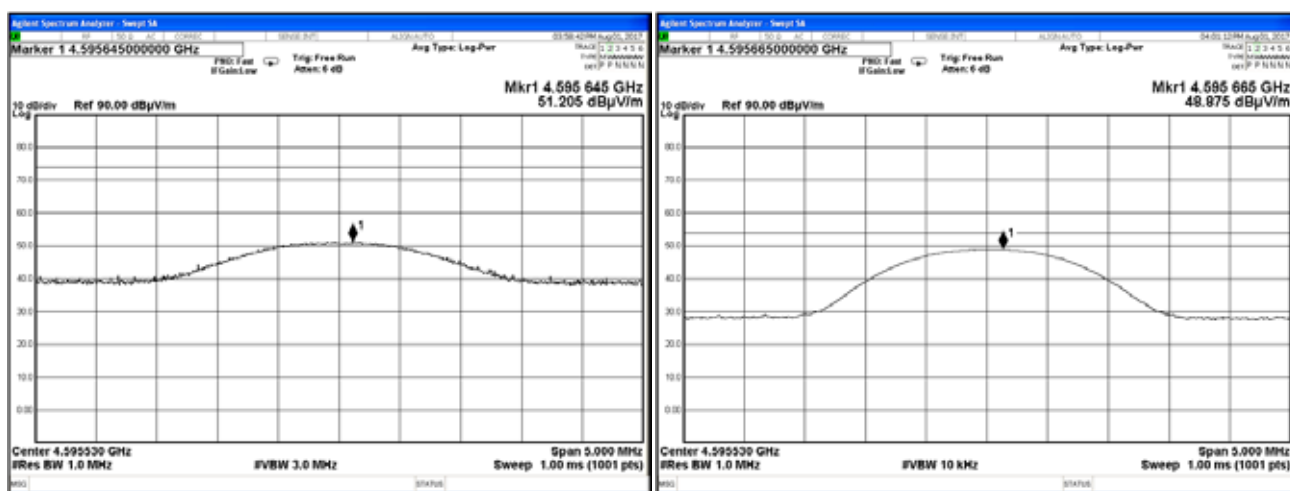


Test specification:		Section 15.247(d), Radiated spurious emissions	
Test procedure:		ANSI C63.10, sections 6.5, 6.6	
Test mode:		Compliance	Verdict: PASS
Date(s):		8/01/2017	
Temperature: 25 °C	Air Pressure: 1007 hPa	Relative Humidity: 54 %	Power Supply: 3 V battery
Remarks:			

Plot 7.7.37 Radiated emission measurements at the fifth harmonic of high carrier frequency

TEST SITE:
TEST DISTANCE:
ANTENNA POLARIZATION:
DETECTOR: Peak

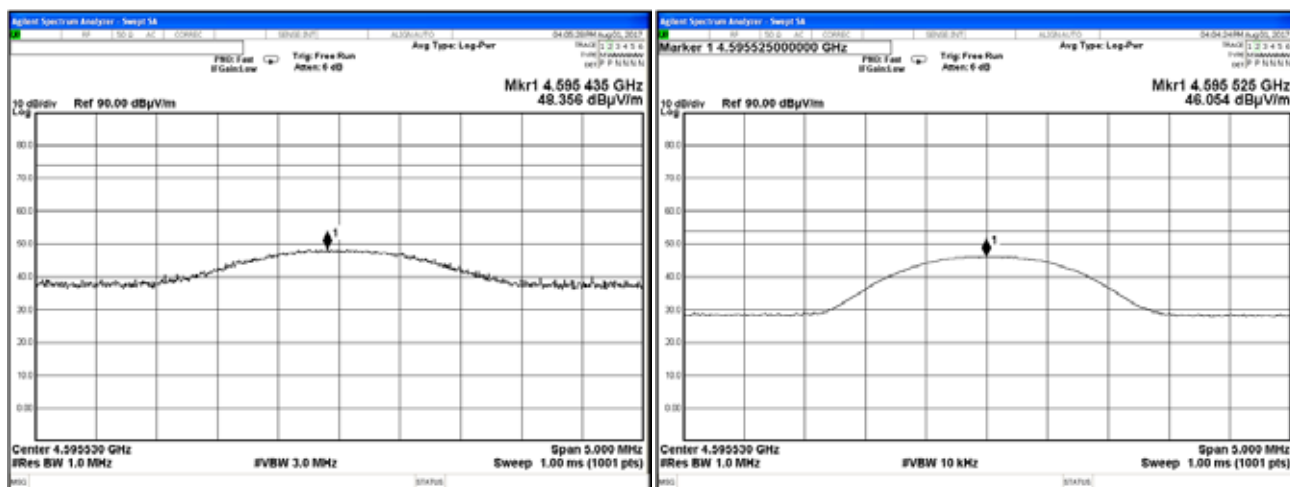
Semi Anechoic Chamber
3 m
Vertical
DETECTOR: Average



Plot 7.7.38 Radiated emission measurements at the fifth harmonic of high carrier frequency

TEST SITE:
TEST DISTANCE:
ANTENNA POLARIZATION:
DETECTOR: Peak

Semi Anechoic Chamber
3 m
Horizontal
DETECTOR: Average

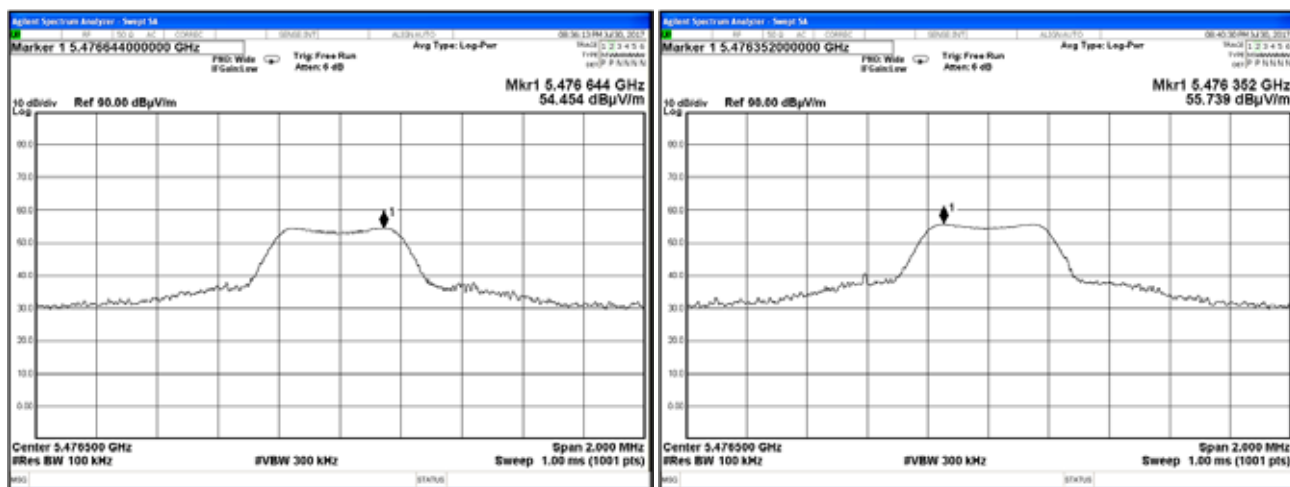


Test specification:		Section 15.247(d), Radiated spurious emissions	
Test procedure:		ANSI C63.10, sections 6.5, 6.6	
Test mode:		Compliance	Verdict: PASS
Date(s):		8/01/2017	
Temperature: 25 °C	Air Pressure: 1007 hPa	Relative Humidity: 54 %	Power Supply: 3 V battery
Remarks:			

Plot 7.7.39 Radiated emission measurements at the sixth harmonic of low carrier frequency

TEST SITE:
TEST DISTANCE:
ANTENNA POLARIZATION: Vertical

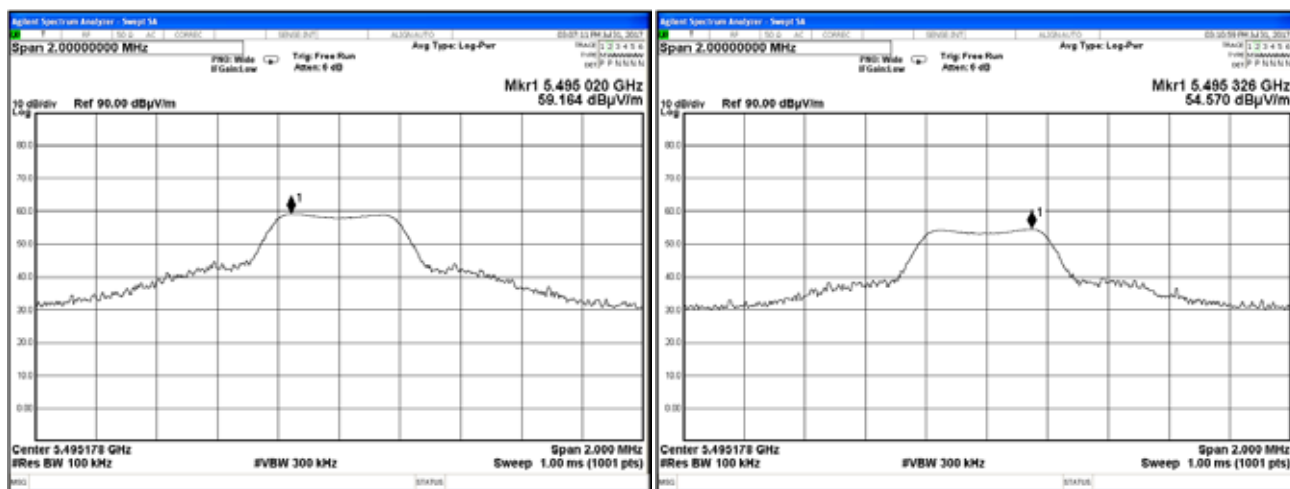
Semi Anechoic Chamber
3 m
ANTENNA POLARIZATION: Horizontal



Plot 7.7.40 Radiated emission measurements at the sixth harmonic of mid carrier frequency

TEST SITE:
TEST DISTANCE:
ANTENNA POLARIZATION: Vertical

Semi Anechoic Chamber
3 m
ANTENNA POLARIZATION: Horizontal

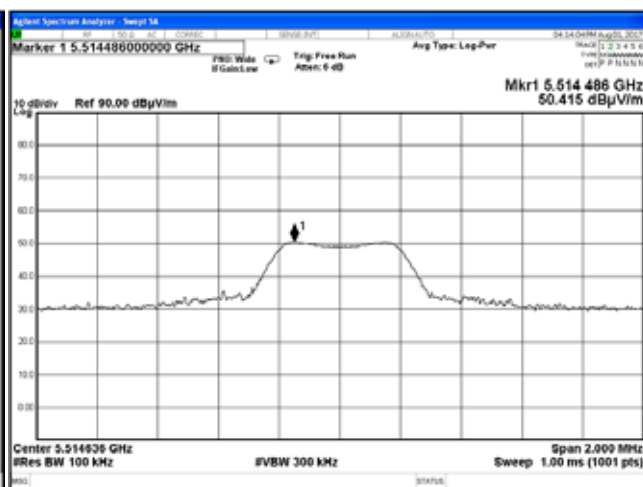
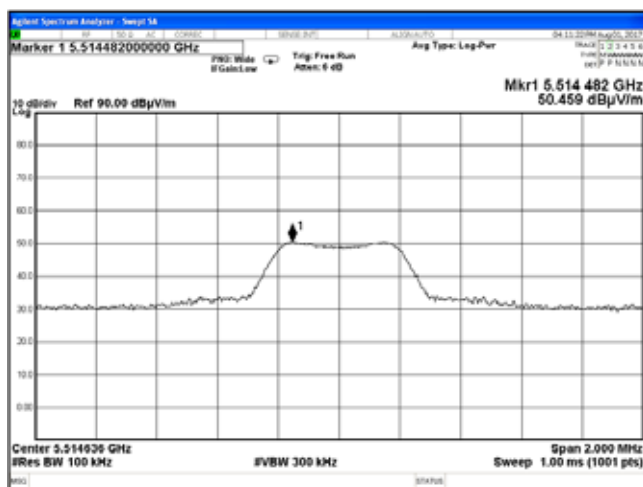


Test specification:		Section 15.247(d), Radiated spurious emissions	
Test procedure:		ANSI C63.10, sections 6.5, 6.6	
Test mode:		Compliance	Verdict: PASS
Date(s):		8/01/2017	
Temperature: 25 °C	Air Pressure: 1007 hPa	Relative Humidity: 54 %	Power Supply: 3 V battery
Remarks:			

Plot 7.7.41 Radiated emission measurements at the sixth harmonic of high carrier frequency

TEST SITE:
TEST DISTANCE:
ANTENNA POLARIZATION: Vertical

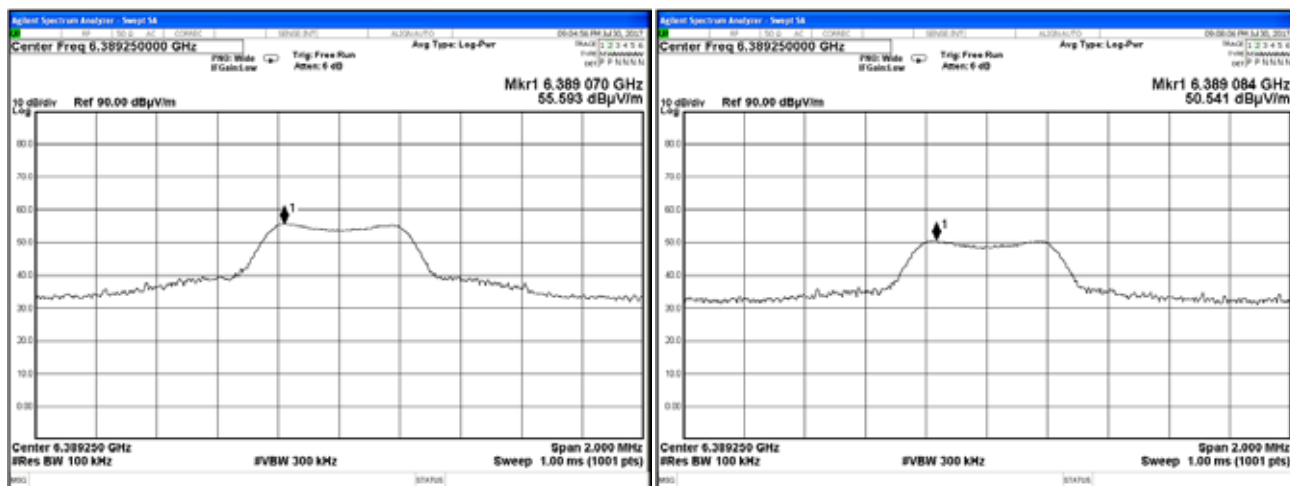
Semi Anechoic Chamber
3 m
ANTENNA POLARIZATION: Horizontal



Test specification:		Section 15.247(d), Radiated spurious emissions	
Test procedure:		ANSI C63.10, sections 6.5, 6.6	
Test mode:		Compliance	Verdict: PASS
Date(s):		8/01/2017	
Temperature: 25 °C	Air Pressure: 1007 hPa	Relative Humidity: 54 %	Power Supply: 3 V battery
Remarks:			

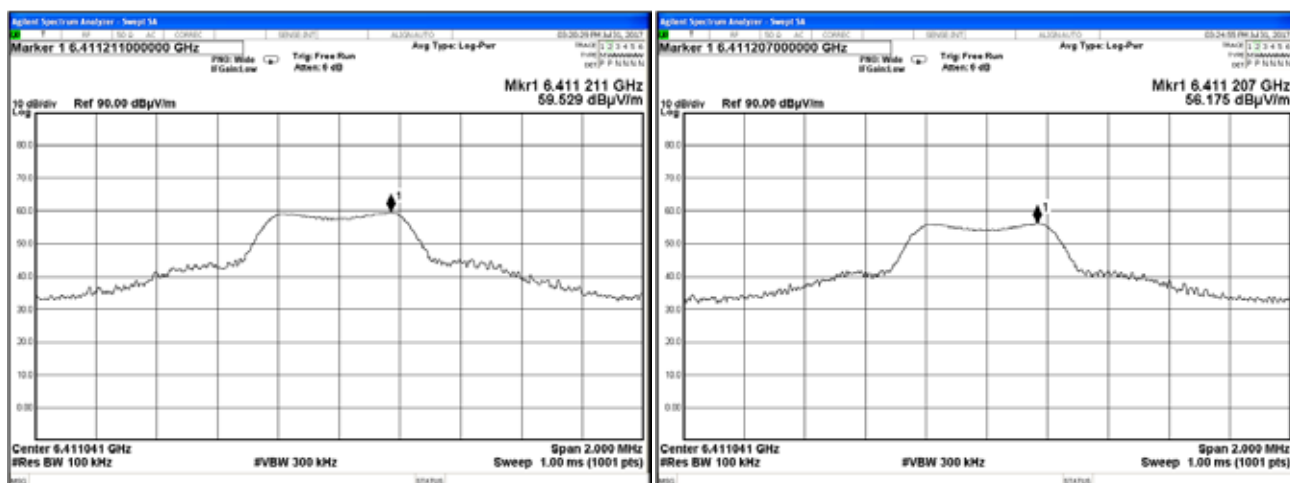
Plot 7.7.42 Radiated emission measurements at the seven harmonic of low carrier frequency

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



Plot 7.7.43 Radiated emission measurements at the seven 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), Radiated spurious emissions	
Test procedure:		ANSI C63.10, sections 6.5, 6.6	
Test mode:		Compliance	Verdict: PASS
Date(s):		8/01/2017	
Temperature: 25 °C	Air Pressure: 1007 hPa	Relative Humidity: 54 %	Power Supply: 3 V battery
Remarks:			

Plot 7.7.44 Radiated emission measurements at the seven harmonic of high carrier frequency

TEST SITE:

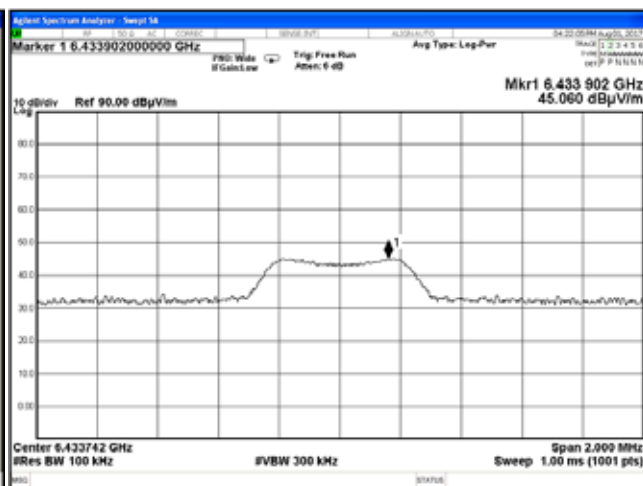
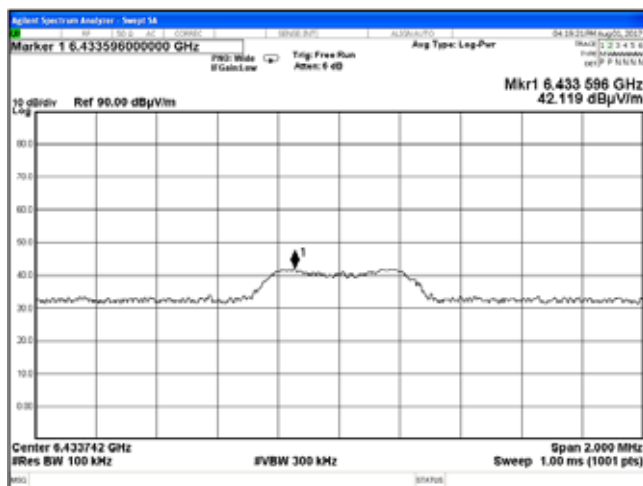
Semi anechoic chamber

TEST DISTANCE:

3 m

ANTENNA POLARIZATION: Vertical

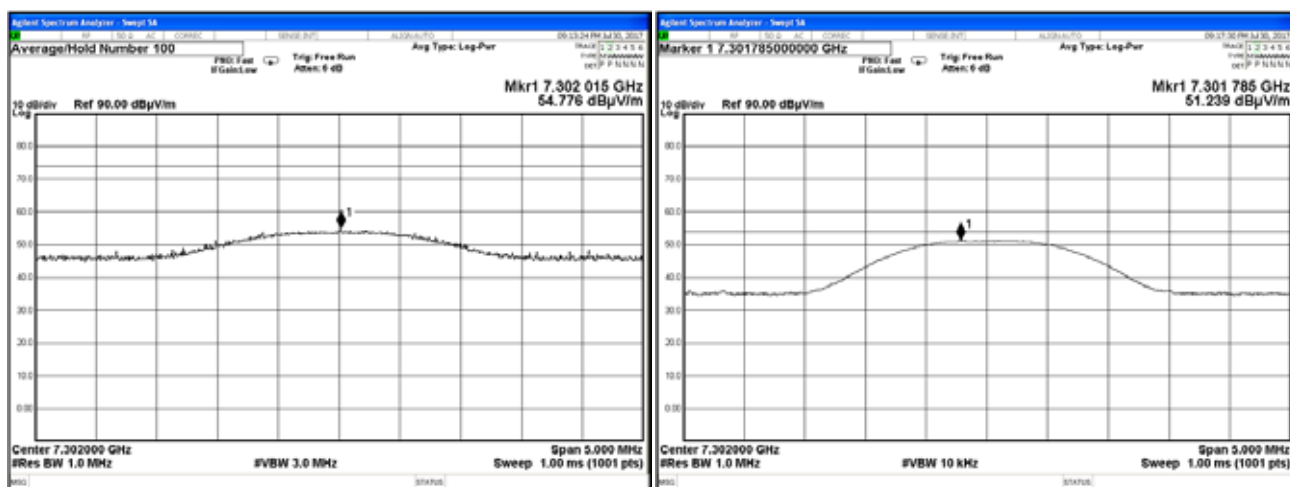
ANTENNA POLARIZATION: Horizontal



Test specification:		Section 15.247(d), Radiated spurious emissions	
Test procedure:		ANSI C63.10, sections 6.5, 6.6	
Test mode:		Compliance	Verdict: PASS
Date(s):		8/01/2017	
Temperature: 25 °C	Air Pressure: 1007 hPa	Relative Humidity: 54 %	Power Supply: 3 V battery
Remarks:			

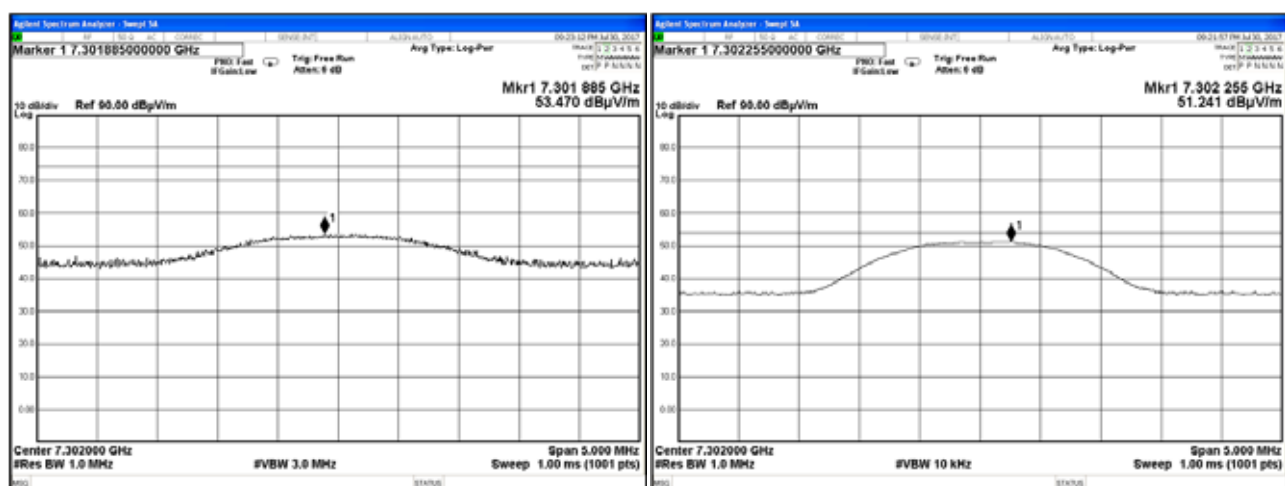
Plot 7.7.45 Radiated emission measurements at the eighth harmonic of low carrier frequency

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



Plot 7.7.46 Radiated emission measurements at the eighth harmonic of low carrier frequency

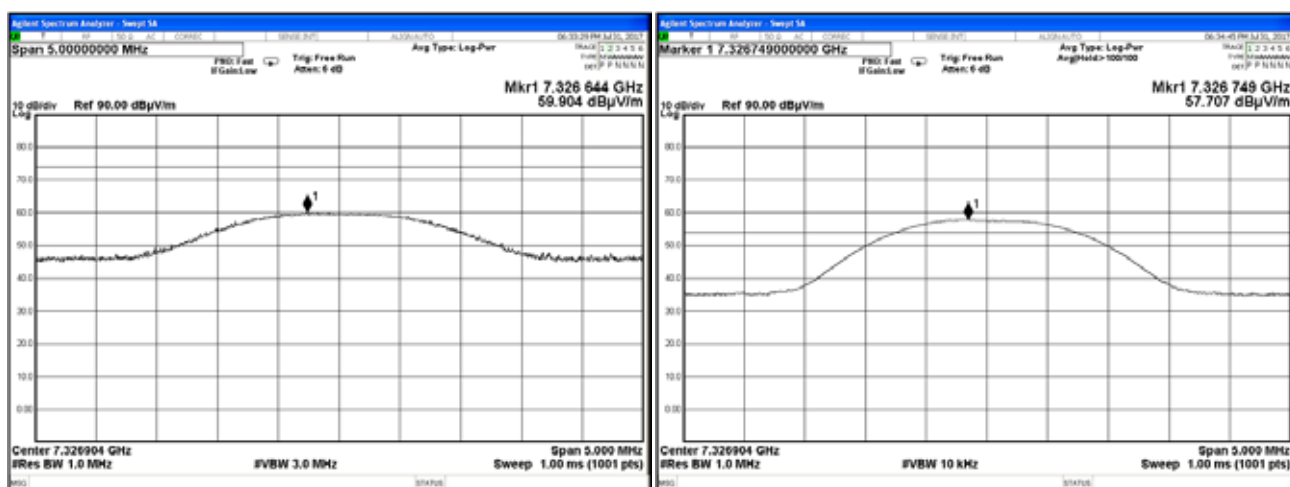
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal



Test specification:		Section 15.247(d), Radiated spurious emissions	
Test procedure:		ANSI C63.10, sections 6.5, 6.6	
Test mode:		Compliance	Verdict: PASS
Date(s):		8/01/2017	
Temperature: 25 °C	Air Pressure: 1007 hPa	Relative Humidity: 54 %	Power Supply: 3 V battery
Remarks:			

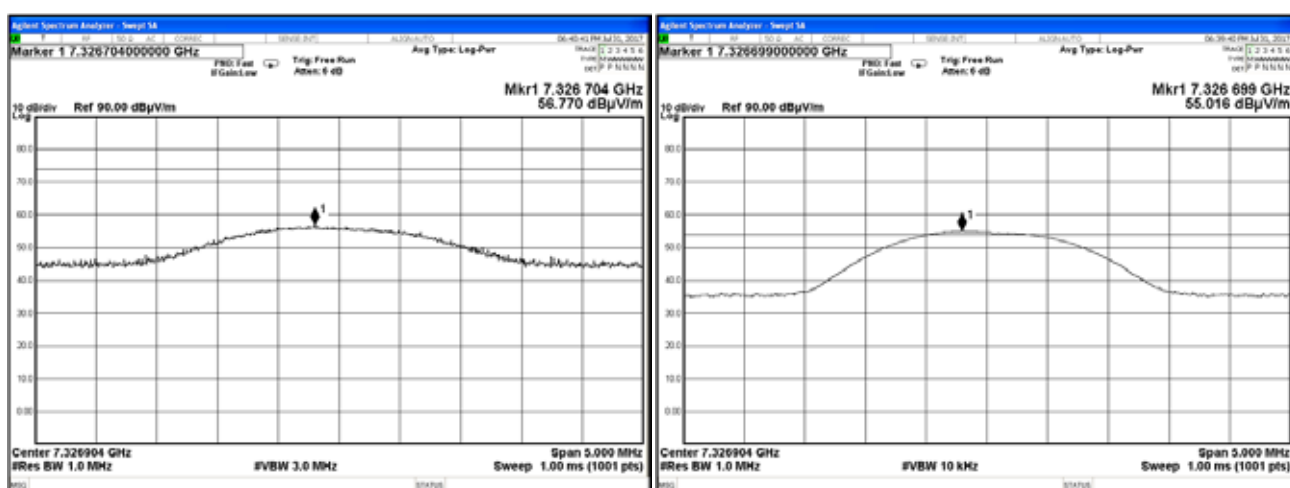
Plot 7.7.47 Radiated emission measurements at the eighth harmonic of mid carrier frequency

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



Plot 7.7.48 Radiated emission measurements at the eighth harmonic of mid carrier frequency

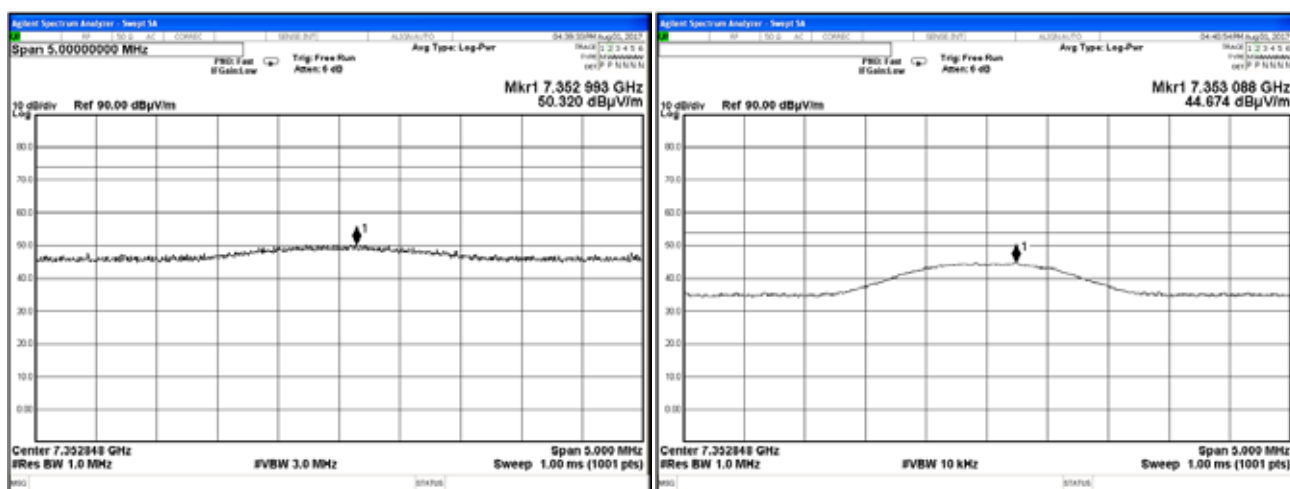
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal



Test specification:		Section 15.247(d), Radiated spurious emissions	
Test procedure:		ANSI C63.10, sections 6.5, 6.6	
Test mode:		Compliance	Verdict: PASS
Date(s):		8/01/2017	
Temperature: 25 °C	Air Pressure: 1007 hPa	Relative Humidity: 54 %	Power Supply: 3 V battery
Remarks:			

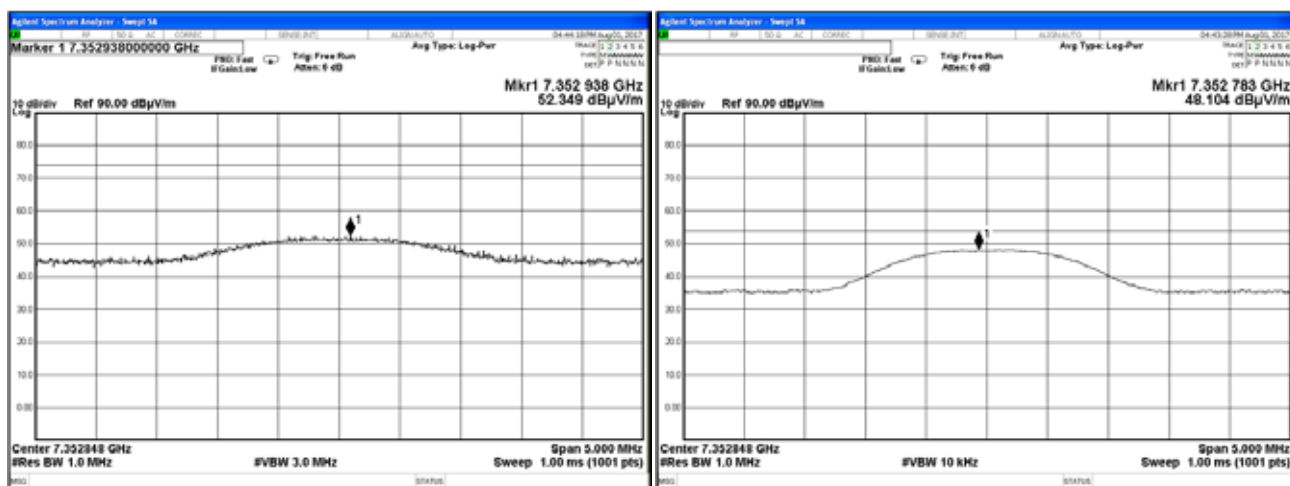
Plot 7.7.49 Radiated emission measurements at the eighth harmonic of high carrier frequency

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



Plot 7.7.50 Radiated emission measurements at the eighth harmonic of high carrier frequency

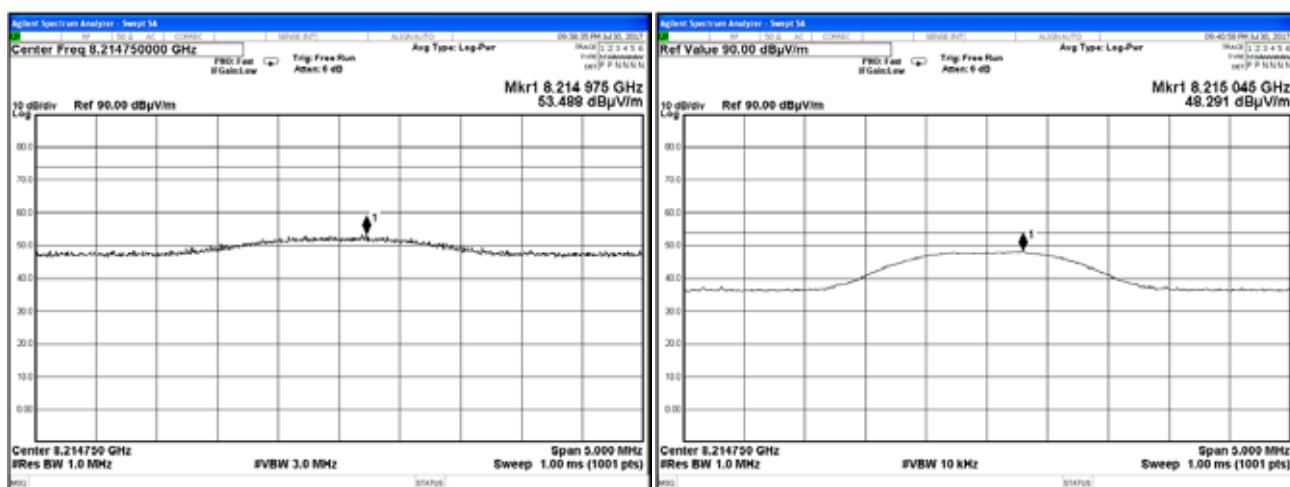
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal



Test specification:	Section 15.247(d), Radiated spurious emissions		
Test procedure:	ANSI C63.10, sections 6.5, 6.6		
Test mode:	Compliance	Verdict: PASS	
Date(s):	8/01/2017		
Temperature: 25 °C	Air Pressure: 1007 hPa	Relative Humidity: 54 %	Power Supply: 3 V battery
Remarks:			

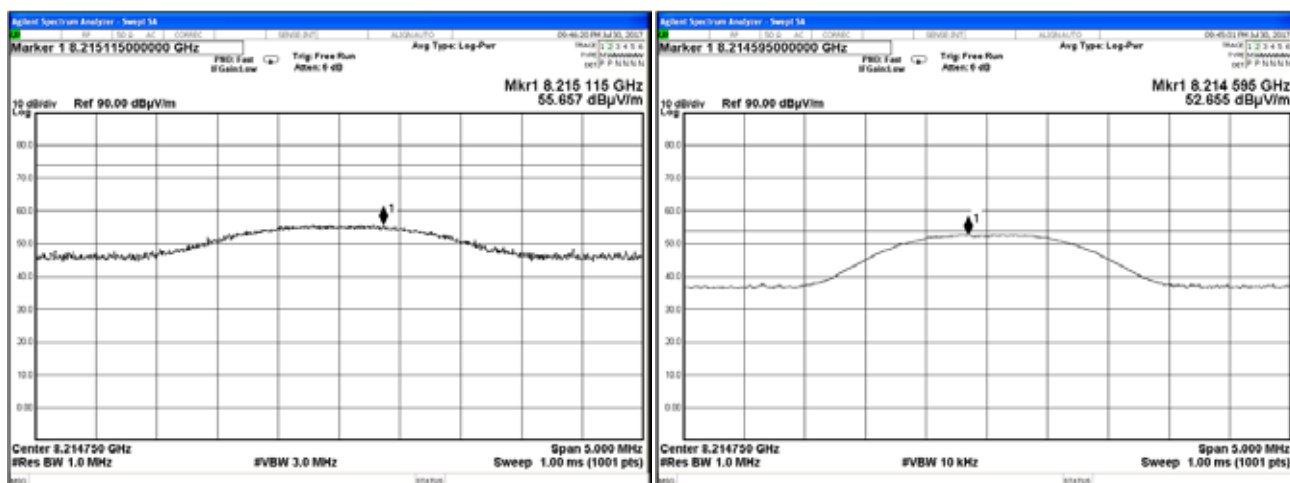
Plot 7.7.51 Radiated emission measurements at the ninth harmonic of low carrier frequency

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



Plot 7.7.52 Radiated emission measurements at the ninth harmonic of low carrier frequency

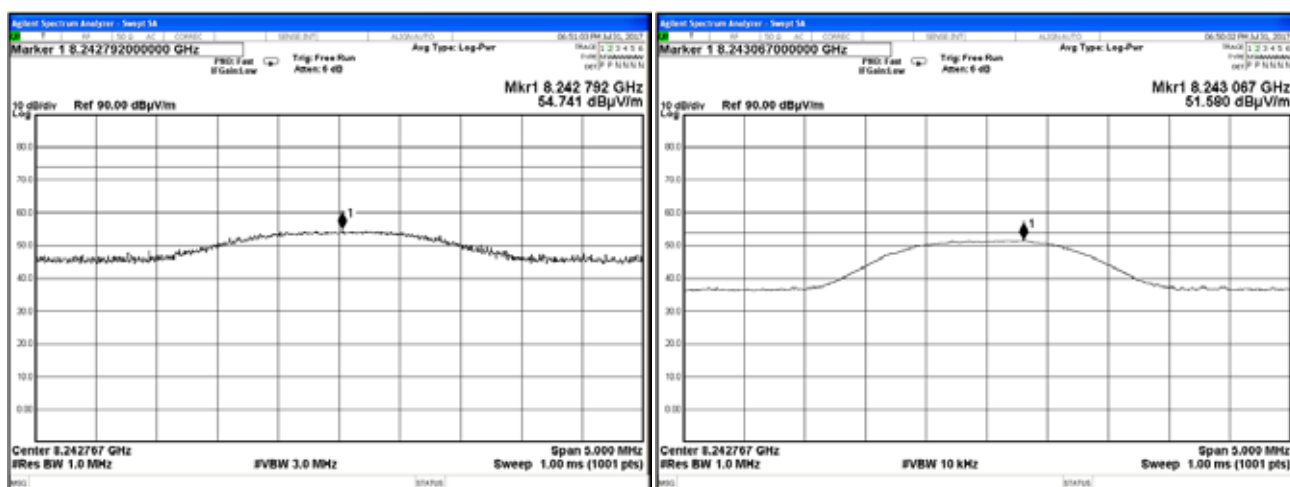
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal



Test specification: Section 15.247(d), Radiated spurious emissions			
Test procedure: ANSI C63.10, sections 6.5, 6.6			
Test mode: Compliance		Verdict: PASS	
Date(s): 8/01/2017			
Temperature: 25 °C	Air Pressure: 1007 hPa	Relative Humidity: 54 %	Power Supply: 3 V battery
Remarks:			

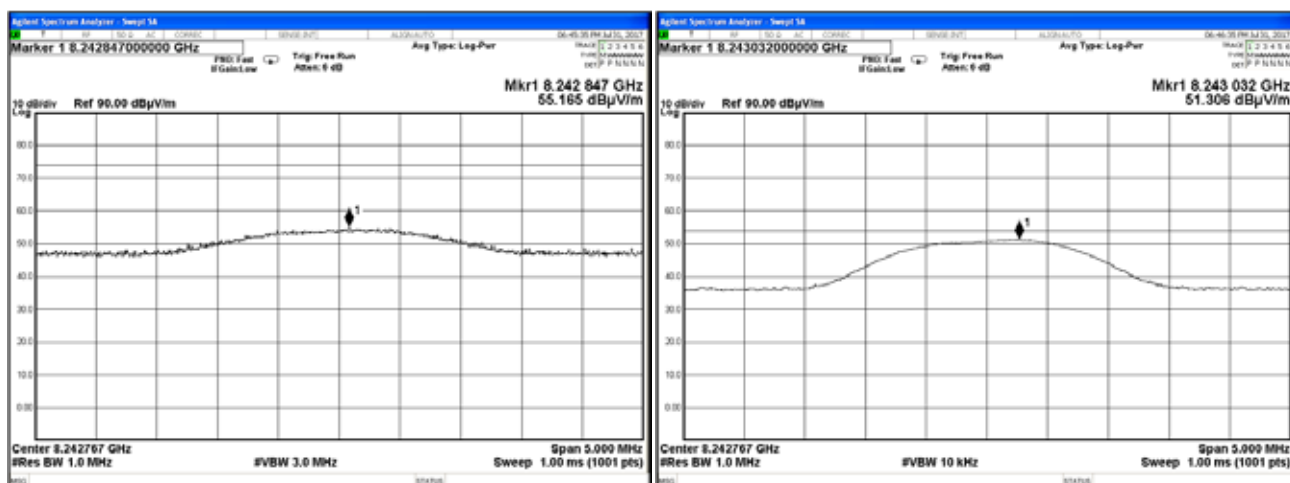
Plot 7.7.53 Radiated emission measurements at the ninth harmonic of mid carrier frequency

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



Plot 7.7.54 Radiated emission measurements at the ninth harmonic of mid carrier frequency

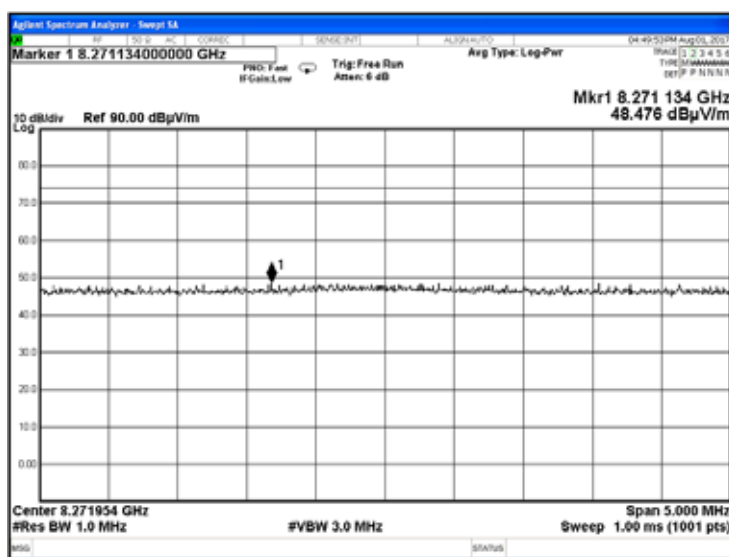
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal



Test specification:		Section 15.247(d), Radiated spurious emissions	
Test procedure:		ANSI C63.10, sections 6.5, 6.6	
Test mode:		Compliance	Verdict: PASS
Date(s):		8/01/2017	
Temperature: 25 °C	Air Pressure: 1007 hPa	Relative Humidity: 54 %	Power Supply: 3 V battery
Remarks:			

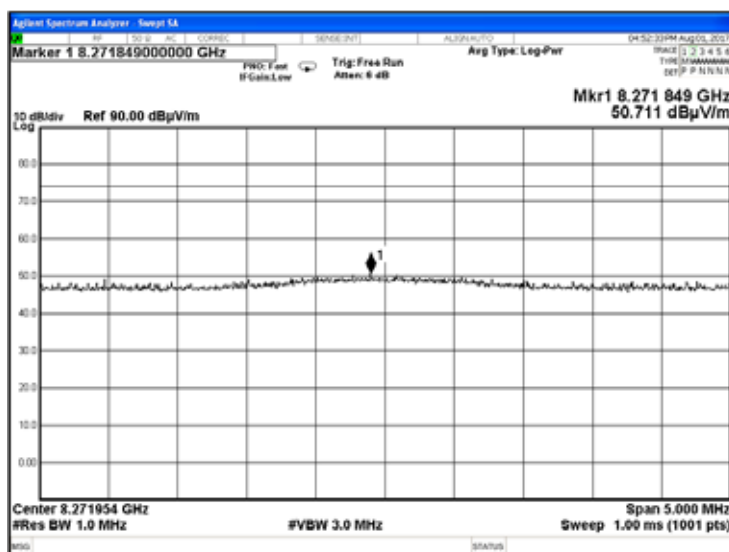
Plot 7.7.55 Radiated emission measurements at the ninth harmonic of high carrier frequency

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



Plot 7.7.56 Radiated emission measurements at the ninth harmonic of high carrier frequency

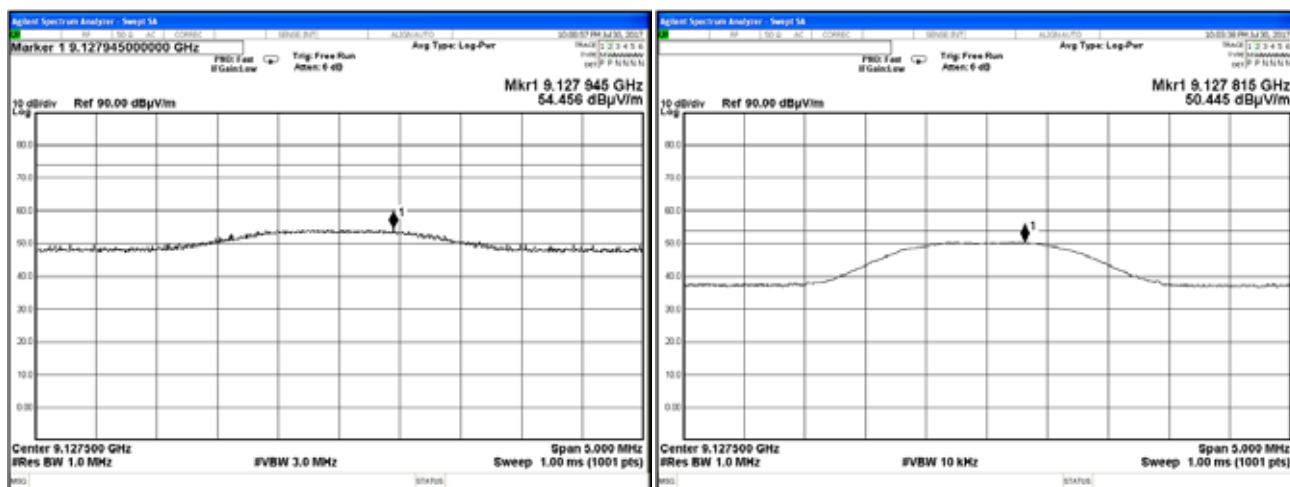
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal



Test specification:		Section 15.247(d), Radiated spurious emissions	
Test procedure:		ANSI C63.10, sections 6.5, 6.6	
Test mode:		Compliance	Verdict: PASS
Date(s):		8/01/2017	
Temperature: 25 °C	Air Pressure: 1007 hPa	Relative Humidity: 54 %	Power Supply: 3 V battery
Remarks:			

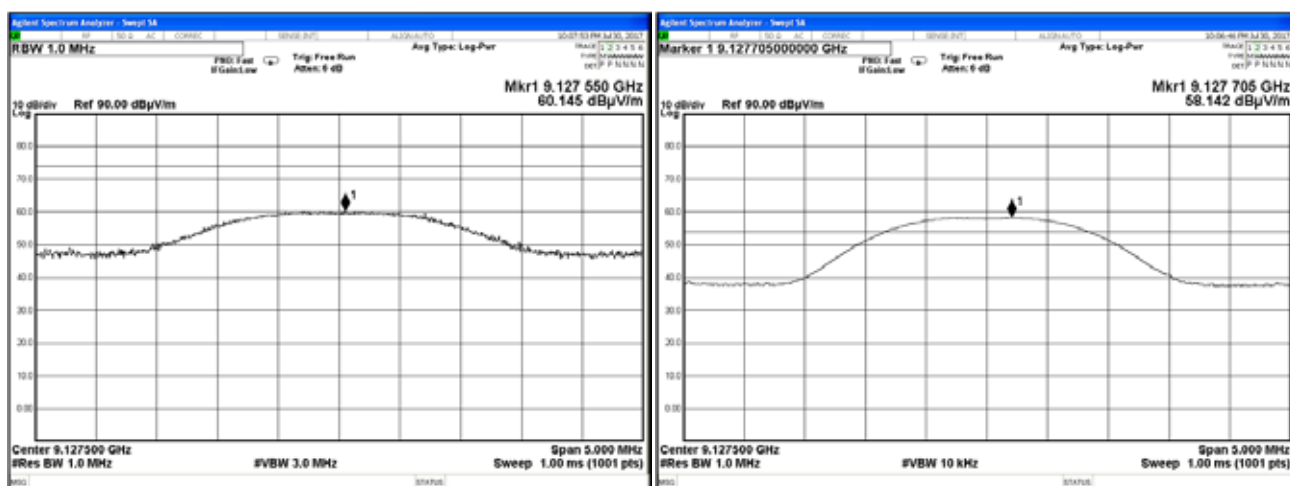
Plot 7.7.57 Radiated emission measurements at the tenth harmonic of low carrier frequency

TEST SITE: Semi Anechoic Chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical



Plot 7.7.58 Radiated emission measurements at the tenth harmonic of low carrier frequency

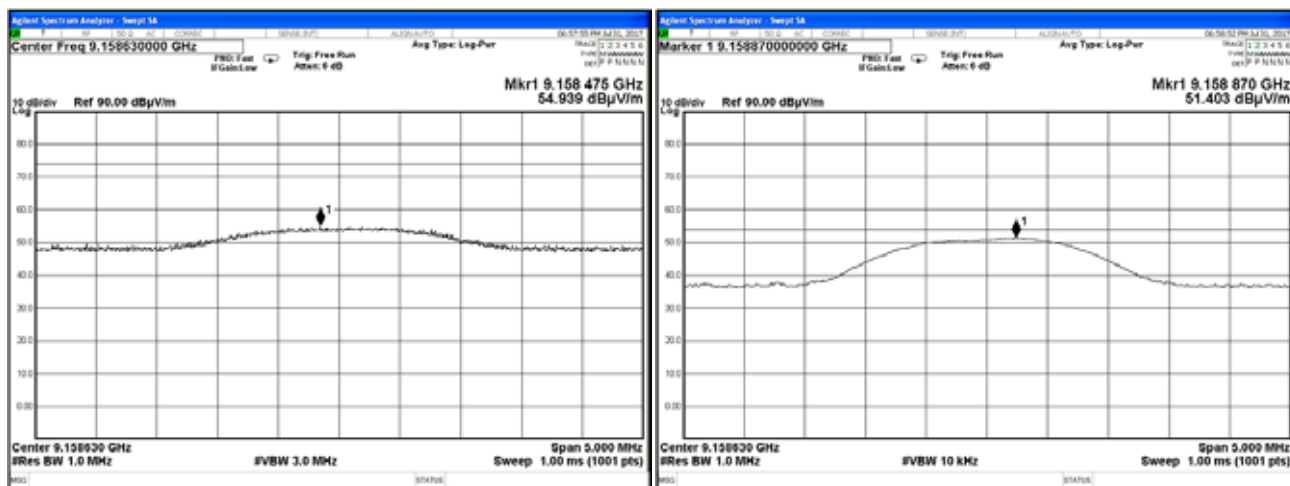
TEST SITE: Semi Anechoic Chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal



Test specification:	Section 15.247(d), Radiated spurious emissions		
Test procedure:	ANSI C63.10, sections 6.5, 6.6		
Test mode:	Compliance	Verdict: PASS	
Date(s):	8/01/2017		
Temperature: 25 °C	Air Pressure: 1007 hPa	Relative Humidity: 54 %	Power Supply: 3 V battery
Remarks:			

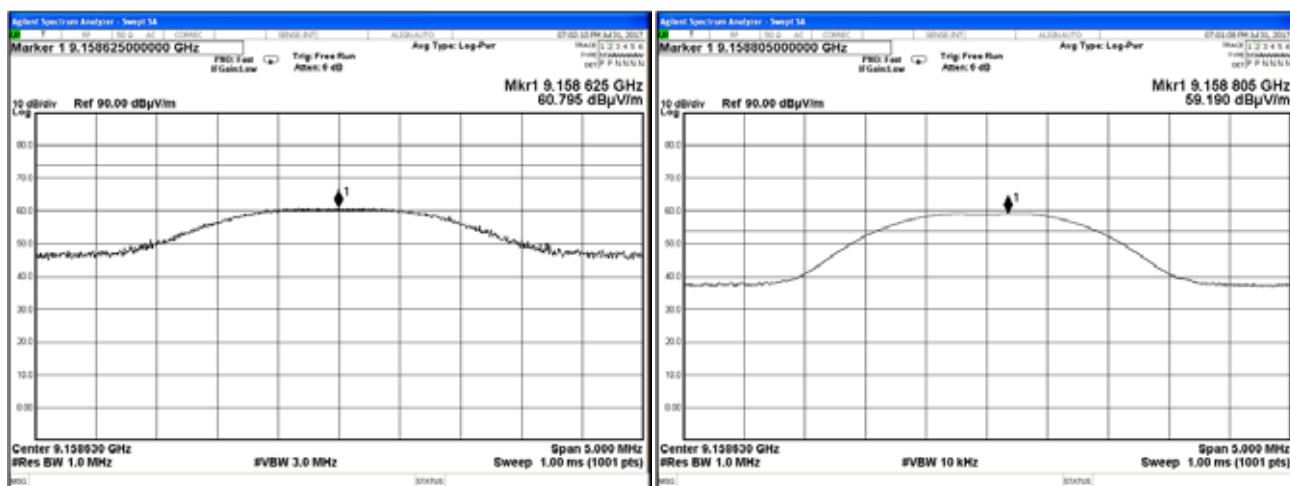
Plot 7.7.59 Radiated emission measurements at the tenth harmonic of mid carrier frequency

TEST SITE: Semi Anechoic Chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical



Plot 7.7.60 Radiated emission measurements at the tenth harmonic of mid carrier frequency

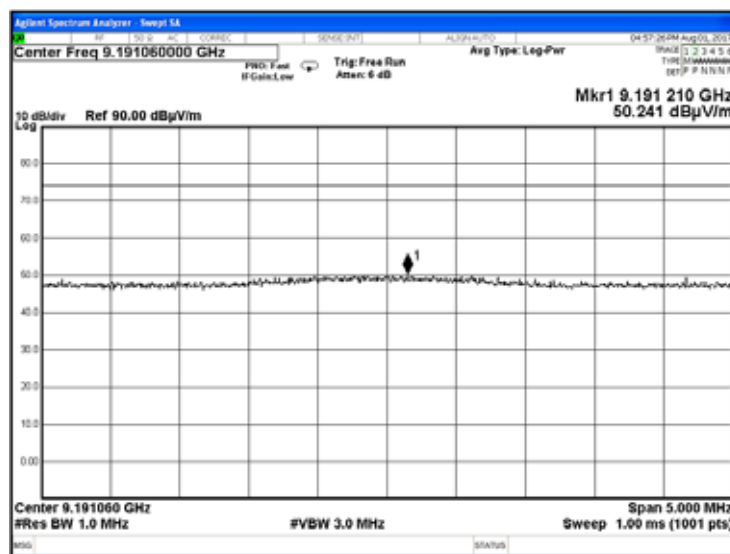
TEST SITE: Semi Anechoic Chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal



Test specification:		Section 15.247(d), Radiated spurious emissions	
Test procedure:		ANSI C63.10, sections 6.5, 6.6	
Test mode:		Compliance	Verdict: PASS
Date(s):		8/01/2017	
Temperature: 25 °C	Air Pressure: 1007 hPa	Relative Humidity: 54 %	Power Supply: 3 V battery
Remarks:			

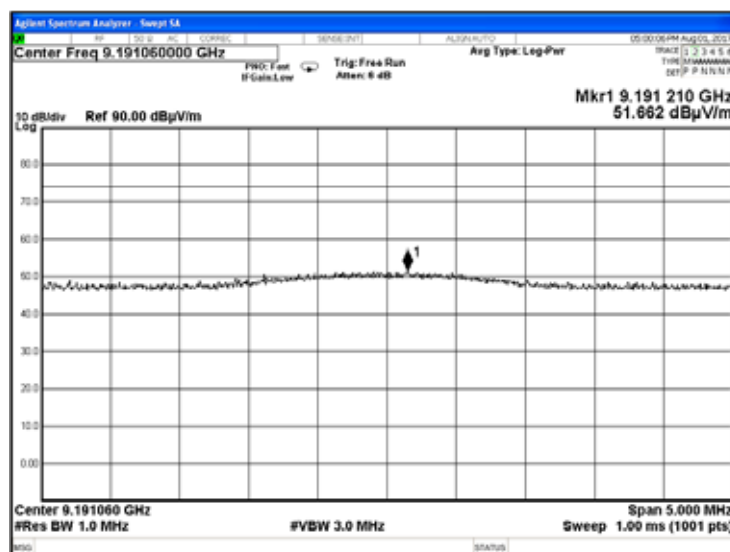
Plot 7.7.61 Radiated emission measurements at the tenth harmonic of high carrier frequency

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



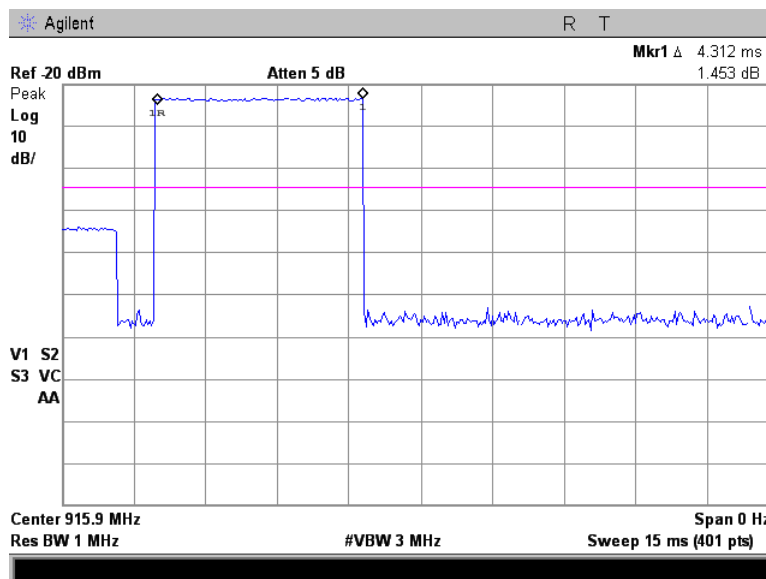
Plot 7.7.62 Radiated emission measurements at the tenth harmonic of high carrier frequency

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

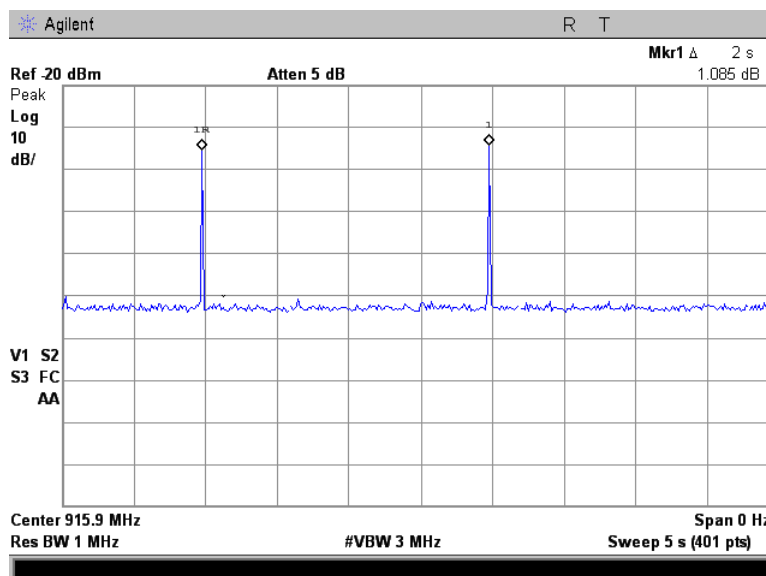


Test specification:		Section 15.247(d), Radiated spurious emissions	
Test procedure:		ANSI C63.10, sections 6.5, 6.6	
Test mode:		Compliance	Verdict: PASS
Date(s):		8/01/2017	
Temperature: 25 °C	Air Pressure: 1007 hPa	Relative Humidity: 54 %	Power Supply: 3 V battery
Remarks:			

Plot 7.7.63 Transmission pulse duration



Plot 7.7.64 Transmission pulse period



Test specification:		Section 15.203, Antenna requirements	
Test procedure:		Visual inspection	
Test mode:		Compliance	Verdict: PASS
Date(s):		9/7/2011	
Temperature: 23 °C	Air Pressure: 1008 hPa	Relative Humidity: 44 %	Power Supply: 3 V battery
Remarks:			

7.8 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 7.8.1.

Table 7.8.1 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 7.8.1 Antenna assembly



Test specification:		Section 15.109, Radiated emission	
Test procedure:		ANSI C63.4, Section 12.2.5	
Test mode:		Compliance	Verdict: PASS
Date(s):		9/12/2011	
Temperature: 21 °C	Air Pressure: hPa	Relative Humidity: 50 %	Power Supply: 3 V battery
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 8.1.1 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: $\text{Lim}_{S_2} = \text{Lim}_{S_1} + 20 \log(S_1/S_2)$, where S_1 and S_2 – standard defined and test distance respectively in meters.

8.1.2 Test procedure

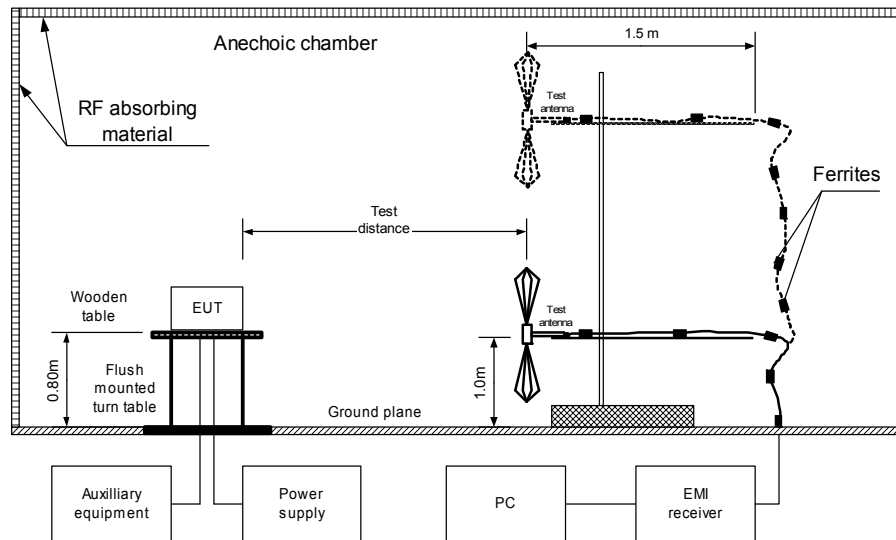
8.1.2.1 The EUT was set up as shown in Figure 8.1.1 and associated photograph/s, energized and the performance check was conducted.

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°, the measuring antenna height was changed from 1 to 4 m, its polarization was switched from vertical to horizontal and the EUT cables position was varied.

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

Test specification:		Section 15.109, Radiated emission	
Test procedure:		ANSI C63.4, Section 12.2.5	
Test mode:		Compliance	Verdict: PASS
Date(s):		9/12/2011	
Temperature: 21 °C	Air Pressure: hPa	Relative Humidity: 50 %	Power Supply: 3 V battery
Remarks:			

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



Photograph 8.1.1 Setup for radiated emission measurements



Test specification:		Section 15.109, Radiated emission	
Test procedure:		ANSI C63.4, Section 12.2.5	
Test mode:		Compliance	Verdict: PASS
Date(s):		9/12/2011	
Temperature: 21 °C	Air Pressure: hPa	Relative Humidity: 50 %	Power Supply: 3 V battery
Remarks:			

Table 8.1.2 Radiated emission test results

EUT SET UP: TABLE-TOP
LIMIT: Class B
EUT OPERATING MODE: Receive / Stand-by
TEST SITE: SEMI ANECHOIC CHAMBER
TEST DISTANCE: 3 m

DETECTORS USED: PEAK / QUASI-PEAK
FREQUENCY RANGE: 30 MHz – 1000 MHz
RESOLUTION BANDWIDTH: 120 kHz

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

DETECTORS USED: PEAK / AVERAGE
FREQUENCY RANGE: 1000 MHz – 6000 MHz
RESOLUTION BANDWIDTH: 1000 kHz

Resolution Bandwidth: 120 kHz				100 kHz			Antenna polarization	Antenna height, m	Turn-table position**, degrees	Verdict
Frequency, MHz	Peak			Average						
	Measured emission, dB(μV/m)	Limit, dB(μV/m)	Margin, dB*	Measured emission, dB(μV/m)	Limit, dB(μV/m)	Margin, dB*				
No emissions were found										Pass

*- Margin = Measured emission - specification limit.

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

Reference numbers of test equipment used

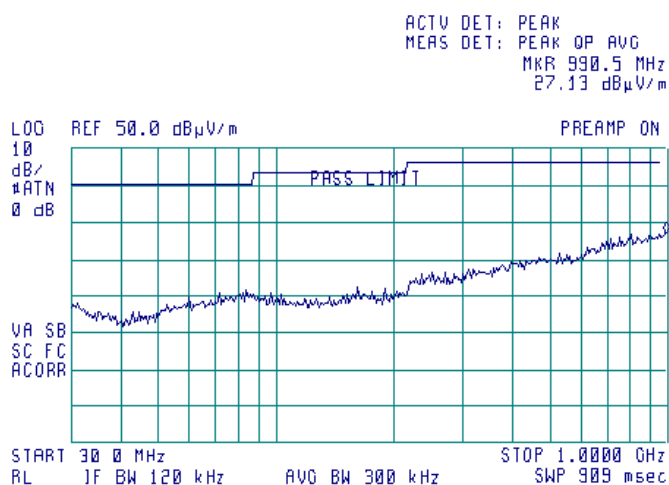
HL 0521	HL 0604	HL 1984	HL 2871	HL 3623			
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Full description is given in Appendix A.

Test specification:		Section 15.109, Radiated emission	
Test procedure:		ANSI C63.4, Section 12.2.5	
Test mode:		Compliance	Verdict: PASS
Date(s):		9/12/2011	
Temperature: 21 °C	Air Pressure: hPa	Relative Humidity: 50 %	Power Supply: 3 V battery
Remarks:			

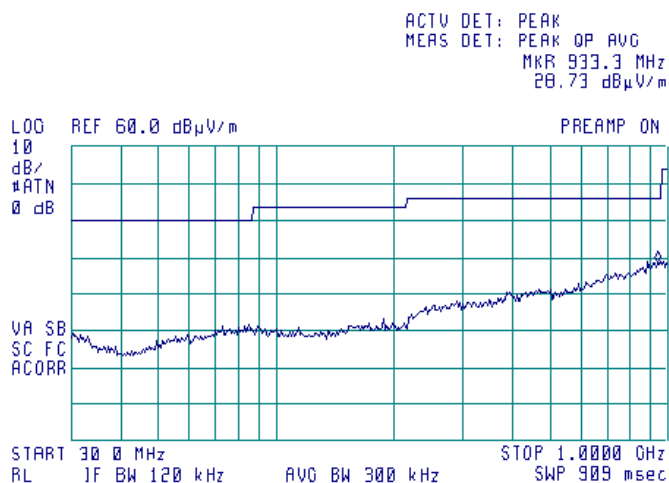
Plot 8.1.1 Radiated emission measurements in 30 - 1000 MHz range

TEST SITE: Semi anechoic chamber
LIMIT: Class B
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT OPERATING MODE: Receive / Stand-by



Plot 8.1.2 Radiated emission measurements in 30 - 1000 MHz range

TEST SITE: Semi anechoic chamber
LIMIT: Class B
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal
EUT OPERATING MODE: Receive / Stand-by



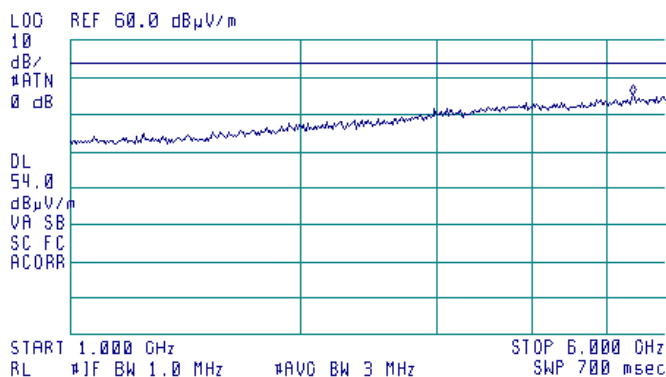
Test specification:		Section 15.109, Radiated emission	
Test procedure:		ANSI C63.4, Section 12.2.5	
Test mode:		Compliance	Verdict: PASS
Date(s):		9/12/2011	
Temperature: 21 °C	Air Pressure: hPa	Relative Humidity: 50 %	Power Supply: 3 V battery
Remarks:			

Plot 8.1.3 Radiated emission measurements above 1000 MHz

TEST SITE: Semi anechoic chamber
LIMIT: Class B
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT OPERATING MODE: Receive / Stand-by



ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 5.416 GHz
45.25 dBμV/m

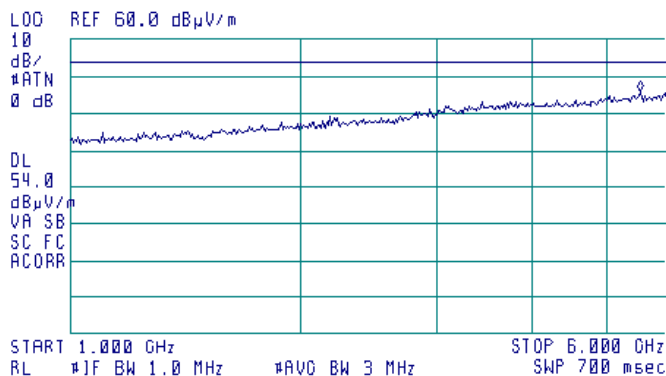


Plot 8.1.4 Radiated emission measurements above 1000 MHz

TEST SITE: Semi anechoic chamber
LIMIT: Class B
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal
EUT OPERATING MODE: Receive / Stand-by



ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 5.520 GHz
45.89 dBμV/m



9 APPENDIX A Test equipment and ancillaries used for tests

HL No	Description	Manufacturer	Model	Ser. No.	Last Cal./ Check	Due Cal./ Check
0337	Probe Set, Hand held, 5 probes	Electro-Metrics	EHFP-30	238	13-Jun-17	13-Jun-18
0521	EMI Receiver (Spectrum Analyzer) with RF filter section 9 kHz-6.5 GHz	Hewlett Packard	8546A	3617A 00319, 3448A002 53	27-Oct-16	27-Oct-17
0604	Antenna BiconiLog Log-Periodic/T Bow-TIE, 26 - 2000 MHz	EMCO	3141	9611-1011	12-May-17	12-May-18
1431	Receiver RF Section, 9 kHz-2.9 GHz, part of HL1430 system	Agilent Technologies	85422E	30807A00 262	01-Jan-17	01-Jan-18
1457	Cable, 1 m	Harbour Industries	MIL 17/60-RG142	1457	18-Sep-16	18-Sep-17
1915	Antenna, Loop, Active Receiving, 1 kHz - 30 MHz	EMC Test Systems	6507	1457	19-Jan-17	19-Jan-18
1984	Antenna, Double-Ridged Waveguide Horn, 1 to 18 GHz, 300 W	EMC Test Systems	3115	9911-5964	16-Aug-17	16-Aug-18
2871	Microwave Cable Assembly, 18 GHz, 6.4 m, SMA - SMA	Huber-Suhner	198-8155-00	2871	01-Jan-17	01-Jan-18
2883	Cable, 18 GHz N-type, M-F, 3 m	Bird Electronic Corp.	TC-MNFN-3.0	211539 003	01-Jan-17	01-Jan-18
2909	Spectrum analyzer, ESA-E, 100 Hz to 26.5 GHz	Agilent Technologies	E4407B	MY414447 62	09-Mar-17	09-Mar-18
3386	Microwave Cable Assembly, 26.5 GHz, 1.0 m, N type/N type	Suhner Sucoflex	104EA	3386	01-Jan-17	01-Jan-18
3623	Cable RF, 6.0 m, N type-N type, DC-6.5 GHz	Belden	MIL C-17	NA	04-Jun-17	04-Jun-18
3818	PSA Series Spectrum Analyzer, 3 Hz- 44 GHz	Agilent Technologies	E4446A	MY482502 88	07-May-17	07-May-18
4294	Microwave Cable Assembly, 18.0 GHz, 3.4 m, SMA/SMA	Huber-Suhner	Sucoflex P103	NA	18-Dec-16	18-Dec-17
4295	Microwave Cable Assembly, 18.0 GHz, 3.4 m, SMA/SMA	Huber-Suhner	Sucoflex P103	NA	16-Oct-16	16-Oct-17
4535	Microwave Cable Assembly, 6.5 GHz, 5.0 m, N/M type-N/M type	Suhner Switzerland	214-U	NA	04-Jun-17	04-Jun-18
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	0002A056 39	15-Mar-17	15-Mar-18
4543	Broadband preamplifier, 0.5 to 18 GHz, 35 dB gain	Schwarzbeck mess-elektronik	BBV 9718	9718-134	15-Mar-17	15-Mar-18
4549	Cable RF, 6.8 m, N/N - type, up to 3 GHz	Suhner Switzerland	NA	07262	14-Mar-17	14-Mar-18
4575	EXA Signal Analyzer, 9 kHz - 26.5 GHz	Agilent Technologies	N9010A	MY480301 10	06-Apr-17	06-Apr-18
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	12-May-17	12-May-18
4933	Active Horn Antenna, 1 GHz to 18 GHz	Com-Power Corporation	AHA-118	701046	14-Oct-16	14-Oct-17

HL No	Description	Manufacturer	Model	Ser. No.	Last Cal./ Check	Due Cal./ Check
5102	RF cable, 18 GHz, 6 m, N-type	Huber-Suhner	SF106A/1 1N/11N/6 000MM	500848/6A	27-Jul-17	27-Jul-18
5105	RF cable, 18 GHz, 6 m, N-type Cable RF	Huber-Suhner	SF106A/1 1N/11N/6 000MM	500851/6A	27-Jul-17	27-Jul-18

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, Radio, 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 and 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, environmental simulation and calibration (for exact scope please refer to Certificate No. 839.01, 839.03 and 839.04).

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website: www.hermonlabs.com

Person for contact: Mr. Michael Nikishin, EMC&Radio group manager

12 APPENDIX D Specification references

FCC 47CFR part 15: 2016	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

13 APPENDIX E Test equipment correction factors

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 dB μ V to obtain field strength in dB μ A/m.

Antenna factor
Biconilog antenna EMCO Model 3141
Ser.No.1011, HL 0604

Frequency, MHz	Antenna Factor, dB(1/m)	Frequency, MHz	Antenna Factor, dB(1/m)
26	7.8	940	24.0
28	7.8	960	24.1
30	7.8	980	24.5
40	7.2	1000	24.9
60	7.1	1020	25.0
70	8.5	1040	25.2
80	9.4	1060	25.4
90	9.8	1080	25.6
100	9.7	1100	25.7
110	9.3	1120	26.0
120	8.8	1140	26.4
130	8.7	1160	27.0
140	9.2	1180	27.0
150	9.8	1200	26.7
160	10.2	1220	26.5
170	10.4	1240	26.5
180	10.4	1260	26.5
190	10.3	1280	26.6
200	10.6	1300	27.0
220	11.6	1320	27.8
240	12.4	1340	28.3
260	12.8	1360	28.2
280	13.7	1380	27.9
300	14.7	1400	27.9
320	15.2	1420	27.9
340	15.4	1440	27.8
360	16.1	1460	27.8
380	16.4	1480	28.0
400	16.6	1500	28.5
420	16.7	1520	28.9
440	17.0	1540	29.6
460	17.7	1560	29.8
480	18.1	1580	29.6
500	18.5	1600	29.5
520	19.1	1620	29.3
540	19.5	1640	29.2
560	19.8	1660	29.4
580	20.6	1680	29.6
600	21.3	1700	29.8
620	21.5	1720	30.3
640	21.2	1740	30.8
660	21.4	1760	31.1
680	21.9	1780	31.0
700	22.2	1800	30.9
720	22.2	1820	30.7
740	22.1	1840	30.6
760	22.3	1860	30.6
780	22.6	1880	30.6
800	22.7	1900	30.6
820	22.9	1920	30.7
840	23.1	1940	30.9
860	23.4	1960	31.2
880	23.8	1980	31.6
900	24.1	2000	32.0
920	24.1		

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

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

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

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

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

5.2.2.1 The antenna factor shall be added to receiver reading in dB μ V to obtain field strength in dB μ V/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 dB μ V to obtain field strength in dB μ V/m

Antenna factor, HL 4933



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

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

Cable loss
Cable coaxial, Bird, 18 GHz, N-type, M-F, model TC-MNFN-3.0, S/N 211539 003
HL 2883

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	0.06	5750	1.70	12000	2.46
30	0.12	6000	1.75	12250	2.48
100	0.21	6250	1.80	12500	2.52
250	0.34	6500	1.81	12750	2.50
500	0.47	6750	1.86	13000	2.54
750	0.59	7000	1.86	13250	2.48
1000	0.67	7250	1.92	13500	2.63
1250	0.76	7500	1.96	13750	2.65
1500	0.84	7750	1.98	14000	2.72
1750	0.92	8000	2.02	14250	2.67
2000	0.98	8250	2.03	14500	2.70
2250	1.05	8500	2.05	14750	2.72
2500	1.12	8750	2.11	15000	2.79
2750	1.17	9000	2.17	15250	2.80
3000	1.22	9250	2.17	15500	2.83
3250	1.27	9500	2.20	15750	2.75
3500	1.33	9750	2.19	16000	2.82
3750	1.38	10000	2.22	16250	2.85
4000	1.42	10250	2.25	16500	2.90
4250	1.46	10500	2.30	16750	2.89
4500	1.51	10750	2.28	17000	2.88
4750	1.54	11000	2.32	17250	2.85
5000	1.59	11250	2.34	17500	2.96
5250	1.62	11500	2.39	17750	3.04
5500	1.65	11750	2.42	18000	3.04

Cable loss
Cable coaxial, Microwave Cable Assembly, 104EA, 18 GHz, 1.0 m
Suhner Sucoflex, HL 3386

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	0.05	5750	1.01	12000	1.29
30	0.07	6000	1.02	12250	1.33
100	0.12	6250	1.02	12500	1.36
250	0.18	6500	0.95	12750	1.35
500	0.26	6750	0.96	13000	1.36
750	0.32	7000	1.01	13250	1.39
1000	0.35	7250	1.04	13500	1.37
1250	0.41	7500	1.09	13750	1.43
1500	0.45	7750	1.12	14000	1.46
1750	0.50	8000	1.13	14250	1.39
2000	0.54	8250	1.15	14500	1.36
2250	0.57	8500	1.15	14750	1.47
2500	0.61	8750	1.15	15000	1.47
2750	0.64	9000	1.16	15250	1.41
3000	0.67	9250	1.14	15500	1.52
3250	0.70	9500	1.14	15750	1.54
3500	0.71	9750	1.19	16000	1.49
3750	0.74	10000	1.20	16250	1.48
4000	0.77	10250	1.22	16500	1.52
4250	0.80	10500	1.23	16750	1.56
4500	0.84	10750	1.22	17000	1.57
4750	0.85	11000	1.21	17250	1.53
5000	0.84	11250	1.24	17500	1.55
5250	0.85	11500	1.26	17750	1.55
5500	0.92	11750	1.28	18000	1.54

Cable loss
Cable coaxial, MIL C-17, N type-N type, 6 m
Belden, HL 3623

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	0.13	2600	4.38	5400	7.76
30	0.25	2700	4.53	5500	7.79
50	0.33	2800	4.64	5600	7.88
100	0.49	2900	4.79	5700	7.93
200	0.76	3000	4.93	5800	8.05
300	0.97	3100	5.02	5900	8.03
400	1.18	3200	5.18	6000	8.07
500	1.38	3300	5.27	6100	8.14
600	1.54	3400	5.41	6200	8.21
700	1.71	3500	5.57	6300	8.28
800	1.88	3600	5.65	6400	8.35
900	2.04	3700	5.82	6500	8.43
1000	2.19	3800	5.89		
1100	2.38	3900	6.02		
1200	2.61	4000	6.15		
1300	2.63	4100	6.26		
1400	2.79	4200	6.37		
1500	2.90	4300	6.52		
1600	3.08	4400	6.63		
1700	3.21	4500	6.74		
1800	3.31	4600	6.86		
1900	3.47	4700	6.98		
2000	3.59	4800	7.09		
2100	3.74	4900	7.17		
2200	3.86	5000	7.30		
2300	3.98	5100	7.41		
2400	4.12	5200	7.59		
2500	4.24	5300	7.71		

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 500848/6A
HL 5102

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
0.1	0.00	5500	2.43
50	0.23	6000	2.54
100	0.31	6500	2.65
200	0.44	7000	2.76
300	0.54	7500	2.87
400	0.62	8000	2.98
500	0.69	8500	3.06
600	0.76	9000	3.16
700	0.82	9500	3.27
800	0.87	10000	3.36
900	0.94	10500	3.45
1000	0.98	11000	3.55
1100	1.03	11500	3.63
1200	1.08	12000	3.72
1300	1.13	12500	3.82
1400	1.17	13000	3.90
1500	1.21	13500	3.99
1600	1.25	14000	4.06
1700	1.30	14500	4.15
1800	1.33	15000	4.24
1900	1.37	15500	4.30
2000	1.41	16000	4.37
2500	1.59	16500	4.45
3000	1.75	17000	4.53
3500	1.90	17500	4.62
4000	2.04	18000	4.67
4500	2.17		
5000	2.30		

Cable loss
RF Cable, Huber-Suhner, 18 GHz, 6 m, N- type,
SF106A/11N/11N/6000MM, S/N 500851/6A
HL 5105

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
0.1	0.01	5500	2.41
50	0.22	6000	2.53
100	0.31	6500	2.64
200	0.43	7000	2.75
300	0.53	7500	2.85
400	0.61	8000	2.96
500	0.68	8500	3.05
600	0.75	9000	3.15
700	0.81	9500	3.26
800	0.87	10000	3.34
900	0.93	10500	3.44
1000	0.98	11000	3.53
1100	1.03	11500	3.61
1200	1.07	12000	3.71
1300	1.12	12500	3.81
1400	1.16	13000	3.89
1500	1.21	13500	3.97
1600	1.25	14000	4.05
1700	1.28	14500	4.13
1800	1.32	15000	4.21
1900	1.37	15500	4.29
2000	1.40	16000	4.36
2500	1.58	16500	4.43
3000	1.74	17000	4.49
3500	1.89	17500	4.58
4000	2.03	18000	4.67
4500	2.17		
5000	2.29		

14 APPENDIX F Abbreviations and acronyms

A	ampere
AC	alternating current
A/m	ampere per meter
AM	amplitude modulation
AVRG	average (detector)
cm	centimeter
dB	decibel
dBm	decibel referred to one milliwatt
dB(μ V)	decibel referred to one microvolt
dB(μ V/m)	decibel referred to one microvolt per meter
dB(μ A)	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
μ s	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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