

TEST REPORT

ACCORDING TO:

**FCC 47 CFR: 2017, part 15, subpart C § 15.247(DTS) and subpart B;
ICES-003, Issue 6, Class B; RSS-247, Issue 2; RSS-Gen, Issue 5, section 7**

FOR:

**SureFlap Ltd. trading as Sure Petcare
Pets Tag**

Model: iBM001

FCC ID: XO9-IBM001

IC: 8906A-IBM001

This report is in conformity with ISO/ IEC 17025. The "A2LA Accredited" symbol endorsement applies only to the tests and calibrations that are listed in the scope of Hermon Laboratories accreditation. The test results relate only to the items tested.
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1 Applicant information

Client name: SureFlap Ltd. trading as Sure Petcare
Address: 7 The Irwin Centre, Dry Drayton, Cambridge, CB23 8AR, United Kingdom
Telephone: +44 (0) 1954 266 004
E-mail: N.Hill@surepetcare.com
Contact name: Mr. Nick Hill

2 Equipment under test attributes

Product name: Pets Tag
Product type: Transceiver
Models: iBM001
Serial number: 26483590051A
Hardware version: Rev. 02.02.0
Software release: 221.3x
Receipt date 30-Apr-18

3 Manufacturer information

Manufacturer name: SureFlap Ltd. trading as Sure Petcare
Address: 7 The Irwin Centre, Dry Drayton, Cambridge, CB23 8AR, United Kingdom
Telephone: +44 (0) 1954 266 004
E-Mail: N.Hill@surepetcare.com
Contact name: Mr. Nick Hill

4 Test details

Project ID: 30907
Location: Hermon Laboratories Ltd. P.O. Box 23, Binyamina 3055001, Israel
Test started: 13-Jun-18
Test completed: 19-Jun-18
Test specifications: FCC 47 CFR: 2017, part 15, subpart C § 15.247(DTS) and subpart B;
ICES-003, Issue 6, Class B; RSS-247, Issue 2; RSS-Gen, Issue 5, section 7

5 Tests summary

Test	Status
Transmitter characteristics	
FCC Section 15.247(a)2 / RSS-247 section 5.2, 6 dB bandwidth	Pass
FCC Section 15.247(b)3/ RSS-247 section 5.4(d), Peak output power	Pass
FCC section 15.247(i) / RSS-102 section 2.5.1, RF exposure	Pass, the exhibit to the application of certification is provided
FCC Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions	Pass
FCC Section 15.247(d)/ RSS-247 section 5.5, Emissions at band edges	Pass
FCC Section 15.247(e) / RSS-247 section 5.2(b), Peak power density	Pass
FCC section 15.203 / RSS-Gen section 6.8, Antenna requirement	Pass
FCC section 15.207(a) / RSS-Gen section 8.8, Conducted emission	Not required
Unintentional emissions	
FCC section 15.107/ RSS-Gen section 8.8, Conducted emission at AC power port	Not required
FCC section 15.109, RSS-Gen section 7.1.2, Radiated emission	Pass

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

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

This test report supersedes the previously issued test report identified by Doc ID:SCRRAD_FCC.30907_rev.1.

	Name and Title	Date	Signature
Tested by:	Mrs. E. Pitt, test engineer	June 13-19, 2018	
	Mr. A. Morozov, test engineer		
Reviewed by:	Mrs. Y. Rapin, technical writer	September 20, 2018	
Approved by:	Mr. S. Samokha, technical manager, EMC and radio group	September 20, 2018	

6 EUT description

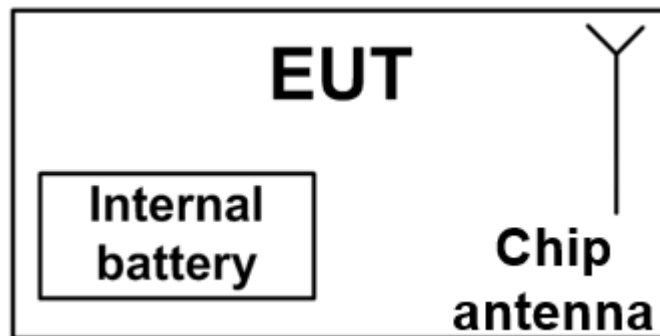
6.1 General information

Pets Tag is a small electronic device, battery powered, for outdoor installation which is comprised of a MCU (microcontroller unit responsible for processing and connectivity) and a 3D accelerometer (sensor). The tag communicates with the mobile device via BLE interface. The tag will act as a BLE peripheral device.

6.2 Operating frequencies

Source	Frequency, MHz					
Tx/Rx	2400	NA	NA	NA	NA	NA

6.3 Test configuration

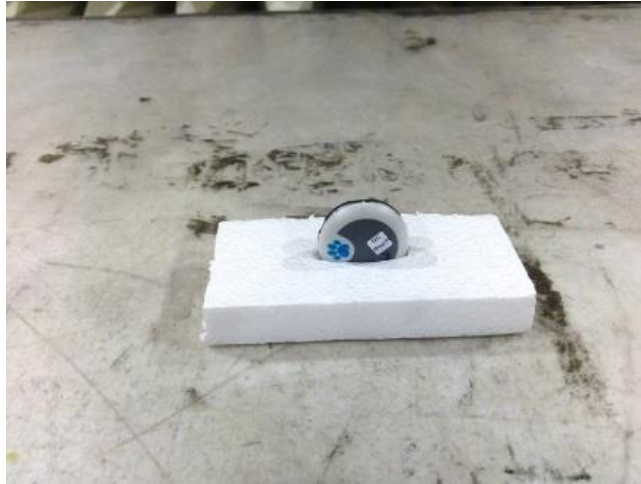


6.4 Changes made in EUT

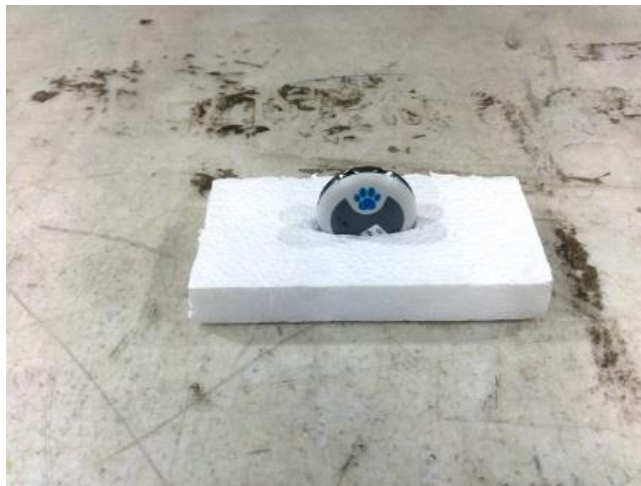
No changes were implemented in the EUT during the testing.

6.5 EUT test positions

Photograph 6.5.1 EUT in X-axis orthogonal position



Photograph 6.5.2 EUT in Y-axis orthogonal position



Photograph 6.5.3 EUT in Z-axis orthogonal position



6.6 Transmitter characteristics

Type of equipment							
X	Stand-alone (Equipment with or without its own control provisions)						
	Combined equipment (Equipment where the radio part is fully integrated within another type of equipment)						
	Plug-in card (Equipment intended for a variety of host systems)						
Assigned frequency range		2400 -2483.5 MHz					
Operating frequencies		2402-2480 MHz					
Maximum rated output power		Peak output power 8.7 dBm					
Is transmitter output power variable?		X	No				
		Yes	continuous variable				
			stepped variable with stepsize				
			dB				
			minimum RF power				
			dBm				
			maximum RF power				
			dBm				
Antenna connection							
unique coupling		standard connector		X	integral	X	with temporary RF connector
							without temporary RF connector
Antenna/s technical characteristics							
Type		Manufacturer		Model number		Peak gain	
Fusca 2.4GHz SMD		Antenova		A10192		0.8 dbi	
Transmitter aggregate data rate/s				800 kbps			
Type of modulation				GFSK			
Modulating test signal (baseband)				PRBS			
Transmitter power source							
V	Battery	Nominal rated voltage	3.0 V	Battery type	Lithium		
	DC	Nominal rated voltage					
	AC mains	Nominal rated voltage		Frequency	Hz		



Test specification:	FCC section 15.247(a)(2) / RSS-247 section 5.2, 6 dB bandwidth		
Test procedure:	ANSI C63.10, Section 11.8.1		
Test mode:	Compliance	Verdict:	PASS
Date(s):	19-Jun-18		
Temperature: 23 °C	Relative Humidity: 55 %	Air Pressure: 1008 hPa	Power: 3 VDC
Remarks:			

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

7.1 Minimum 6 dB bandwidth

7.1.1 General

This test was performed to measure 6 dB bandwidth of the EUT carrier frequency. Specification test limits are given in Table 7.1.1.

Table 7.1.1 6 dB bandwidth limits

Assigned frequency, MHz	Modulation envelope reference points*, dBc	Minimum bandwidth, kHz
902.0 – 928.0	6.0	500.0
2400.0 – 2483.5		
5725.0 – 5850.0		

* - 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.

7.1.2.3 The transmitter minimum 6 dB bandwidth was measured with spectrum analyzer as frequency delta between reference points on modulation envelope and provided in Table 7.1.2 and associated plot.

Figure 7.1.1 6 dB bandwidth test setup





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Test specification:	FCC section 15.247(a)(2) / RSS-247 section 5.2, 6 dB bandwidth		
Test procedure:	ANSI C63.10, Section 11.8.1		
Test mode:	Compliance	Verdict: PASS	
Date(s):	19-Jun-18		
Temperature: 23 °C	Relative Humidity: 55 %	Air Pressure: 1008 hPa	Power: 3 VDC
Remarks:			

Table 7.1.2 6 dB bandwidth test results

ASSIGNED FREQUENCY BAND: 2400-2483.5 MHz
 DETECTOR USED: Peak
 SWEEP MODE: Single
 SWEEP TIME: Auto
 RESOLUTION BANDWIDTH: 100 kHz
 VIDEO BANDWIDTH: 300 kHz
 MODULATION ENVELOPE REFERENCE POINTS: 6.0 dBc
 MODULATION: GFSK
 BIT RATE: 800 kbps

Carrier frequency, MHz	6 dB bandwidth, kHz	Limit, kHz	Margin, kHz	Verdict
2402	710.461	500	210.461	Pass
2426	735.564	500	235.564	Pass
2480	721.674	500	221.674	Pass

Reference numbers of test equipment used

HL 4136	HL 2909							
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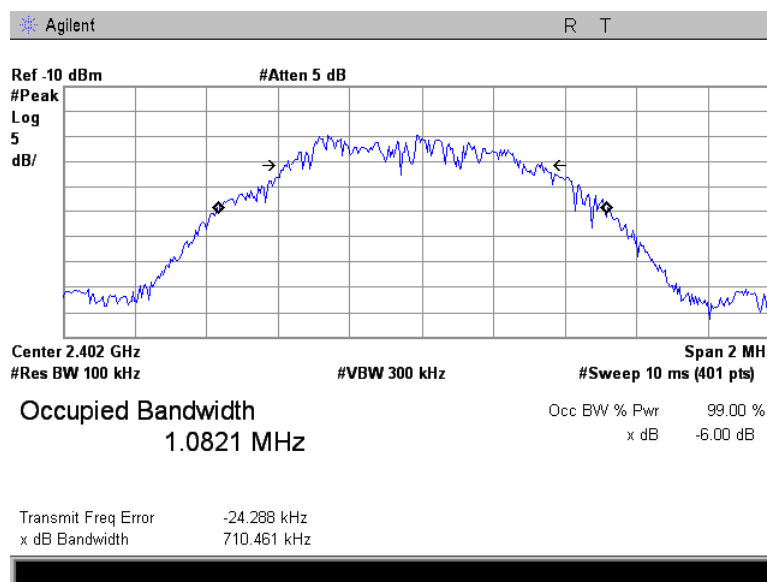
Full description is given in Appendix A.



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Test specification:	FCC section 15.247(a)(2) / RSS-247 section 5.2, 6 dB bandwidth		
Test procedure:	ANSI C63.10, Section 11.8.1		
Test mode:	Compliance	Verdict:	PASS
Date(s):	19-Jun-18		
Temperature: 23 °C	Relative Humidity: 55 %	Air Pressure: 1008 hPa	Power: 3 VDC
Remarks:			

Plot 7.1.1 6 dB bandwidth test result at low frequency

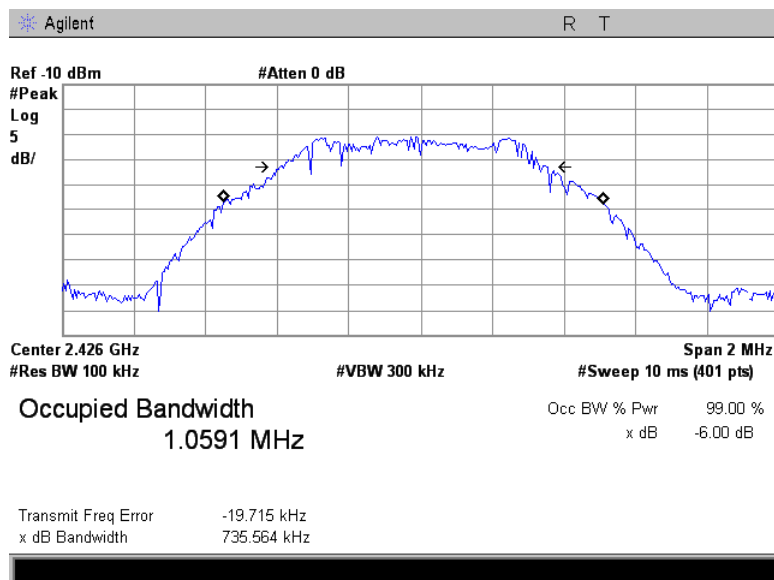




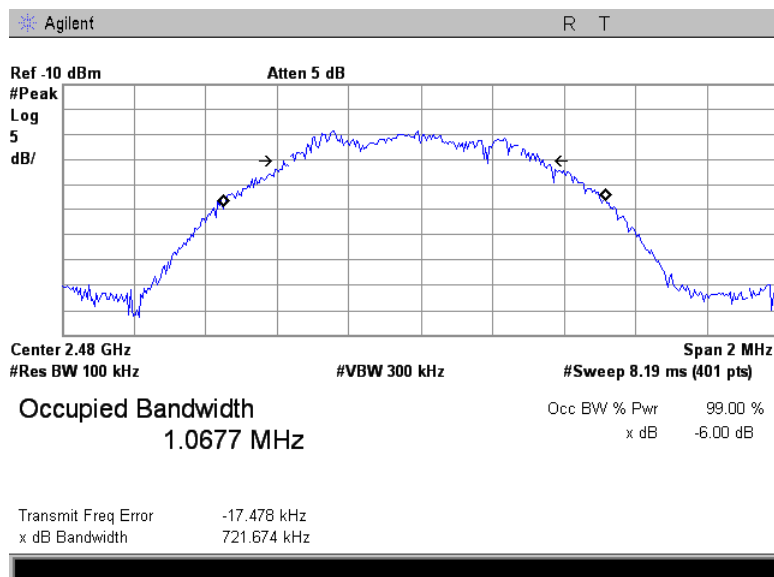
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Test specification:	FCC section 15.247(a)(2) / RSS-247 section 5.2, 6 dB bandwidth		
Test procedure:	ANSI C63.10, Section 11.8.1		
Test mode:	Compliance	Verdict:	PASS
Date(s):	19-Jun-18		
Temperature: 23 °C	Relative Humidity: 55 %	Air Pressure: 1008 hPa	Power: 3 VDC
Remarks:			

Plot 7.1.2 6 dB bandwidth test result at mid frequency



Plot 7.1.3 6 dB bandwidth test result at high frequency





Test specification:	FCC section 15.247(b)3 / RSS-247 section 5.4(d), Peak output power		
Test procedure:	ANSI C63.10, Section 11.9.1.1		
Test mode:	Compliance	Verdict:	PASS
Date(s):	19-Jun-18		
Temperature: 23 °C	Relative Humidity: 55 %	Air Pressure: 1010 hPa	Power: 3 VDC
Remarks:			

7.2 Peak output power

7.2.1 General

This test was performed to measure the maximum peak output power radiated by transmitter. Specification test limits are given in Table 7.2.1.

Table 7.2.1 Peak output power limits

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

*- 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.

** - 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.

7.2.2 Test procedure

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

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

7.2.2.3 The resolution bandwidth of spectrum analyzer was set wider than 6 dB bandwidth of the EUT and the field strength of the EUT carrier frequency was measured with antenna connected to spectrum analyzer/ EMI receiver. To find maximum radiation the turntable was rotated 360° and the measuring antenna height was swept in both vertical and horizontal polarizations.

7.2.2.4 The maximum field strength of the EUT carrier frequency was measured as provided in Table 7.2.2 and associated plots.

7.2.2.5 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:

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

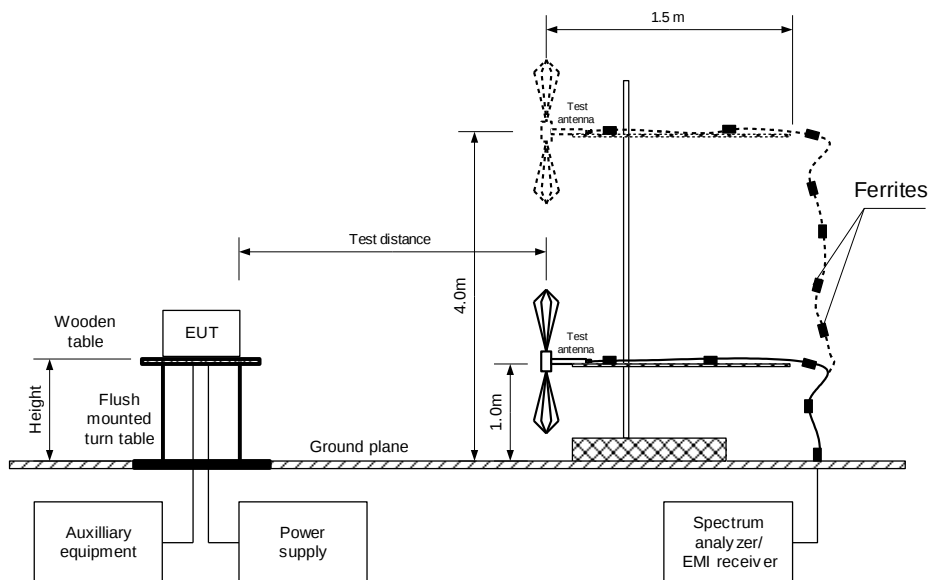
7.2.2.6 The worst test results (the lowest margins) were recorded in Table 7.2.2.



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Test specification:	FCC section 15.247(b)3 / RSS-247 section 5.4(d), Peak output power		
Test procedure:	ANSI C63.10, Section 11.9.1.1		
Test mode:	Compliance	Verdict:	PASS
Date(s):	19-Jun-18		
Temperature: 23 °C	Relative Humidity: 55 %	Air Pressure: 1010 hPa	Power: 3 VDC
Remarks:			

Figure 7.2.1 Setup for carrier field strength measurements





Test specification:	FCC section 15.247(b)3 / RSS-247 section 5.4(d), Peak output power		
Test procedure:	ANSI C63.10, Section 11.9.1.1		
Test mode:	Compliance	Verdict:	PASS
Date(s):	19-Jun-18		
Temperature: 23 °C	Relative Humidity: 55 %	Air Pressure: 1010 hPa	Power: 3 VDC
Remarks:			

Table 7.2.2 Peak output power test results

ASSIGNED FREQUENCY: 2400-2483.5 MHz
 TEST DISTANCE: 3 m
 TEST SITE: Semi anechoic chamber
 EUT HEIGHT: 1.5 m
 TEST ANTENNA TYPE: Double ridged guide (above 1000 MHz)
 MODULATION: GFSK
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum
 DETECTOR USED: Peak
 EUT 6 dB BANDWIDTH: 0.736 MHz
 RESOLUTION BANDWIDTH: 3 MHz
 VIDEO BANDWIDTH: 3 MHz

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
2402	104.7	Horizontal	1.6	0	0.8	8.7	30	-21.3	Pass
2426	104.1	Horizontal	1.6	0	0.8	8.1	30	-21.9	Pass
2480	103.8	Horizontal	1.6	0	0.8	7.8	30	-22.2	Pass

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

** - Peak output power was calculated from the field strength of carrier as follows: $P = (E \times d)^2 / (30 \times G)$,

where P is the peak output power in W, E is the field strength in V/m, d is the test distance in meters and G is the transmitter numeric antenna gain over an isotropic radiator. The above equation was converted in logarithmic units for 3 m test distance: Peak output power in dBm = Field strength in dB(μV/m) - Transmitter antenna gain in dBi - 95.2 dB

*** - Margin = Peak output power - specification limit.

Reference numbers of test equipment used

HL 2780	HL 4933	HL 3901	HL 4276				
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Full description is given in Appendix A.

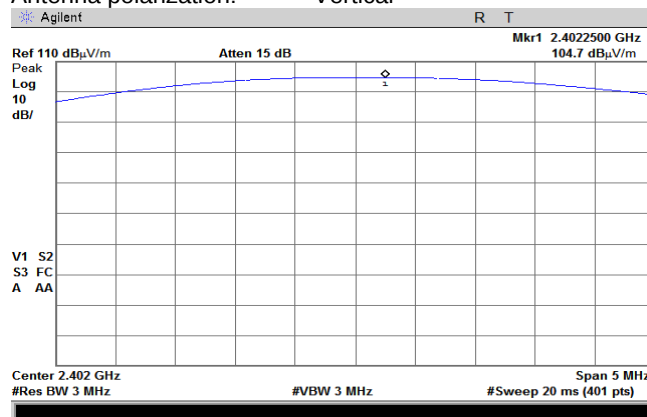
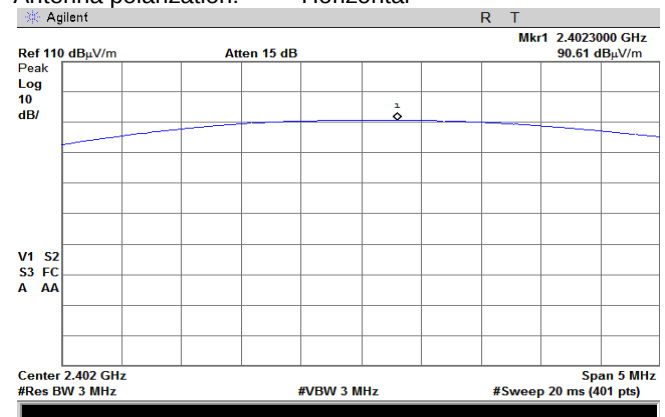
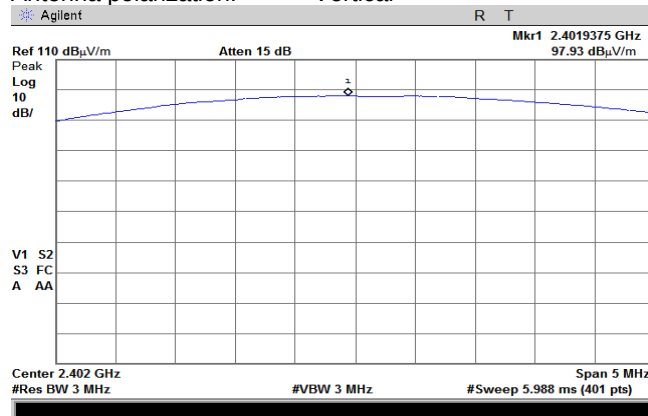
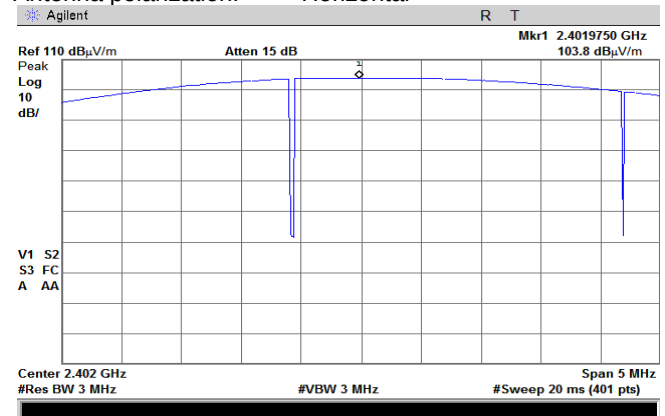
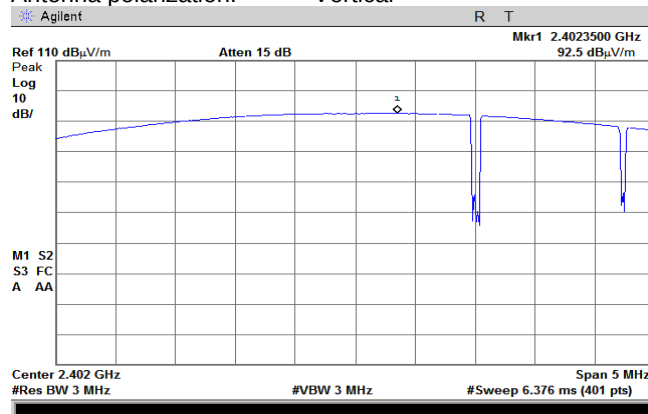
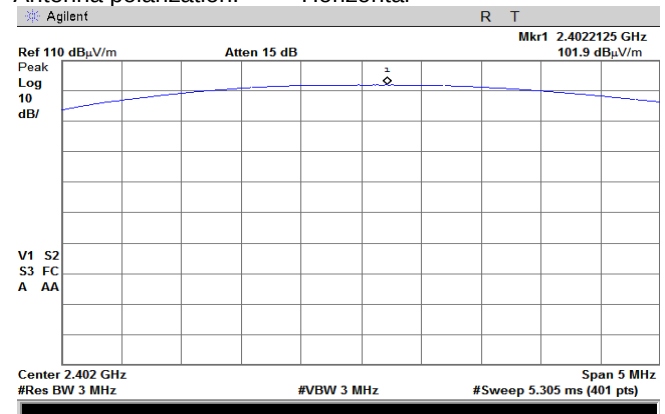


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Report ID: SCRRAD_FCC.30907_rev.2
Date of Issue: 20-Sep-18

Test specification:	FCC section 15.247(b)3 / RSS-247 section 5.4(d), Peak output power		
Test procedure:	ANSI C63.10, Section 11.9.1.1		
Test mode:	Compliance	Verdict: PASS	
Date(s):	19-Jun-18		
Temperature: 23 °C	Relative Humidity: 55 %	Air Pressure: 1010 hPa	Power: 3 VDC
Remarks:			

Plot 7.2.1 Transmitter carrier field strength at low frequency in vertical and horizontal antenna polarization

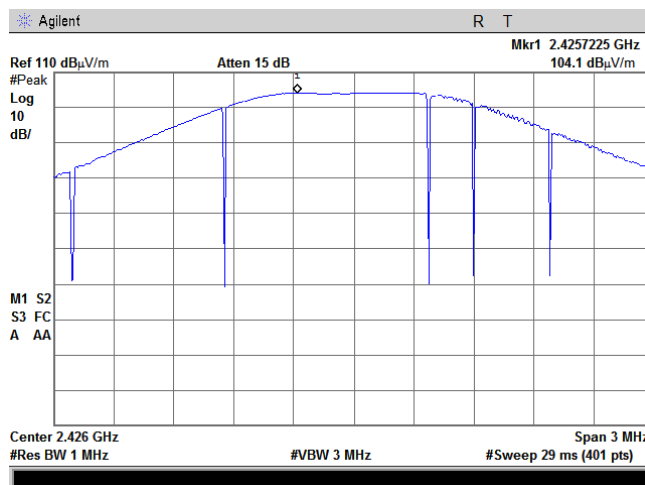
EUT position: X
Antenna polarization: VerticalEUT position: X
Antenna polarization: HorizontalEUT position: Y
Antenna polarization: VerticalEUT position: Y
Antenna polarization: HorizontalEUT position: Z
Antenna polarization: VerticalEUT position: Z
Antenna polarization: Horizontal



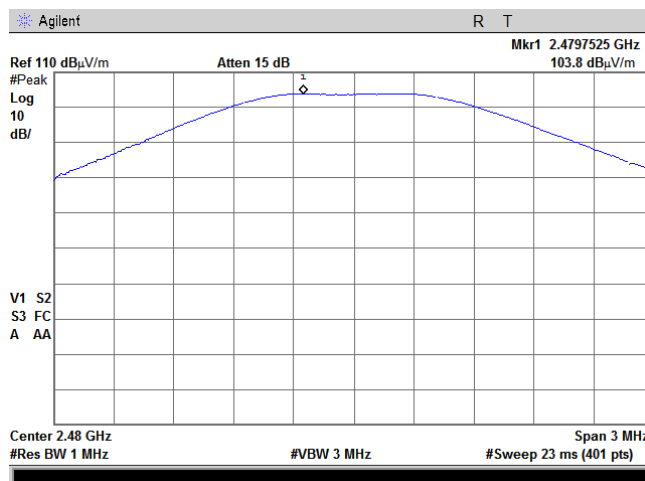
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Test specification:	FCC section 15.247(b)3 / RSS-247 section 5.4(d), Peak output power		
Test procedure:	ANSI C63.10, Section 11.9.1.1		
Test mode:	Compliance	Verdict:	PASS
Date(s):	19-Jun-18		
Temperature: 23 °C	Relative Humidity: 55 %	Air Pressure: 1010 hPa	Power: 3 VDC
Remarks:			

Plot 7.2.2 Field strength of carrier at mid frequency



Plot 7.2.3 Field strength of carrier at high frequency





Test specification:	FCC section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions		
Test procedure:	ANSI C63.10, sections 11.11 and 11.12.1		
Test mode:	Compliance	Verdict:	PASS
Date(s):	17-Jun-18		
Temperature: 28 °C	Relative Humidity: 59 %	Air Pressure: 999 hPa	Power: 3 VDC
Remarks:			

7.3 Field strength of spurious emissions

7.3.1 General

This test was performed to measure field strength of spurious emissions from the EUT. Specification test limits are given in Table 7.3.1.

Table 7.3.1 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:

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

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

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

*** - The field strength limits applied from the lowest radio frequency generated in the device, without going below 9 kHz up to the 10th harmonic of the highest fundamental frequency.

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

7.3.2.1 The EUT was set up as shown in Figure 7.3.1, energized and the performance check was conducted.

7.3.2.2 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.

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

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

7.3.3.1 The EUT was set up as shown in Figure 7.3.2, Figure 7.3.3, energized and the performance check was conducted.

7.3.3.2 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.

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



Test specification:	FCC section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions		
Test procedure:	ANSI C63.10, sections 11.11 and 11.12.1		
Test mode:	Compliance	Verdict:	PASS
Date(s):	17-Jun-18		
Temperature: 28 °C	Relative Humidity: 59 %	Air Pressure: 999 hPa	Power: 3 VDC
Remarks:			

Figure 7.3.1 Setup for spurious emission field strength measurements below 30 MHz

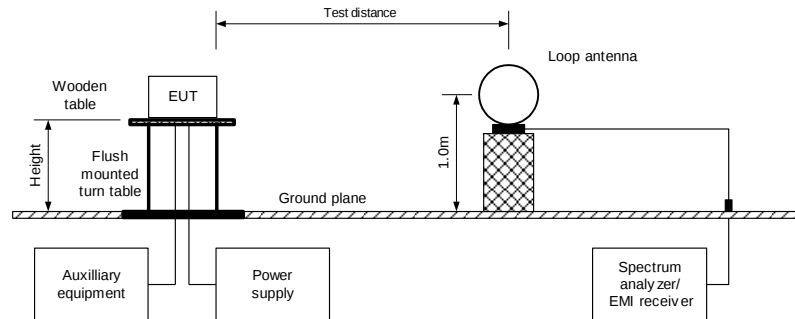


Figure 7.3.2 Setup for spurious emission field strength measurements in 30 – 1000 MHz

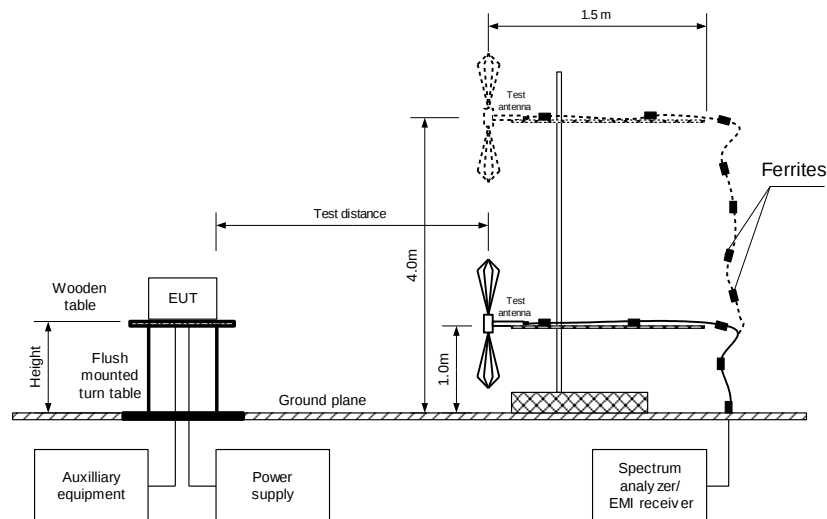
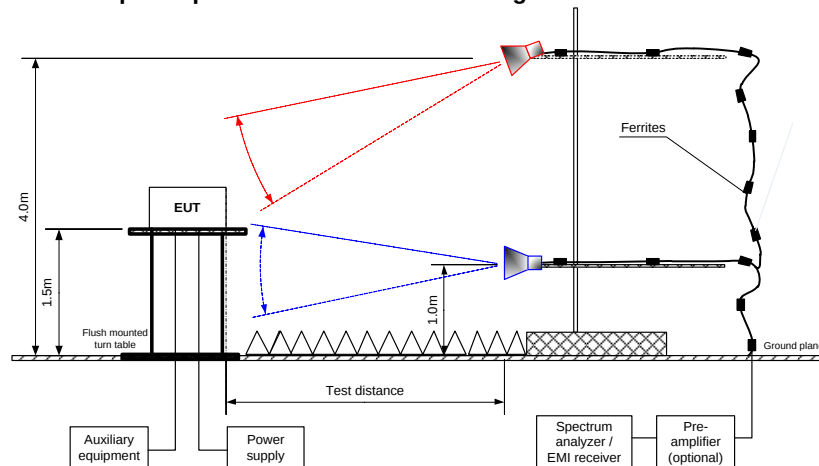


Figure 7.3.3 Setup for spurious emission field strength measurements above 1000 MHz





Test specification:	FCC section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions		
Test procedure:	ANSI C63.10, sections 11.11 and 11.12.1		
Test mode:	Compliance	Verdict:	PASS
Date(s):	17-Jun-18		
Temperature: 28 °C	Relative Humidity: 59 %	Air Pressure: 999 hPa	Power: 3 VDC
Remarks:			

Table 7.3.2 Field strength of emissions outside restricted bands

ASSIGNED FREQUENCY: 2400.0 – 2483.5 MHz
 INVESTIGATED FREQUENCY RANGE: 0.009 – 25 000.0 MHz
 TEST DISTANCE: 3 m
 MODULATION: GFSK
 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, 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									
99.927167	31.37	Horizontal	224.0	180.0	101.99	70.62	20.0	50.62	Pass
Mid carrier frequency									
99.611833	32.82	Horizontal	222.0	-110.0	101.89	69.07	20.0	49.07	Pass
High carrier frequency									
99.583167	29.97	Horizontal	231.0	81.0	102.98	73.01	20.0	53.01	Pass

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

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

Table 7.3.3 Field strength of spurious emissions below 1 GHz within restricted bands

ASSIGNED FREQUENCY: 2400.0 – 2483.5 MHz
 INVESTIGATED FREQUENCY RANGE: 0.009 - 1000 MHz
 TEST DISTANCE: 3 m
 MODULATION: GFSK
 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, 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*				
Low carrier frequency								
119.984167	32.95	31.34	43.50	-12.16	Horizontal	133.0	-122.0	Pass
Mid carrier frequency								
119.984167	32.78	31.04	43.50	-12.46	Horizontal	133.0	161.0	Pass
High carrier frequency								
119.984167	31.86	30.09	43.50	-13.41	Horizontal	132.0	-54.0	Pass

* - Margin = Measured emission - specification limit.

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



Test specification:	FCC section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions		
Test procedure:	ANSI C63.10, sections 11.11 and 11.12.1		
Test mode:	Compliance	Verdict:	PASS
Date(s):	17-Jun-18		
Temperature: 28 °C	Relative Humidity: 59 %	Air Pressure: 999 hPa	Power: 3 VDC
Remarks:			

Table 7.3.4 Field strength of spurious emissions above 1 GHz within restricted bands

ASSIGNED FREQUENCY: 2400.0 – 2483.5 MHz
 INVESTIGATED FREQUENCY RANGE: 1000 – 25000 MHz
 TEST DISTANCE: 3 m
 MODULATION: GFSK
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum
 DETECTOR USED: Peak
 RESOLUTION BANDWIDTH: 1000 kHz
 TEST ANTENNA TYPE: Double ridged guide

Frequency, MHz	Antenna		Azimuth, degrees*	Peak field strength			Average field strength				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											
4804.402	Horizontal	165.0	-102.0	48.99	74.0	-25.01	48.99	0.99	54.0	-53.01	Pass
Mid carrier frequency											
4852.120	Horizontal	152.0	-100.0	50.06	74.0	-23.94	50.06	2.06	54.0	-51.94	Pass
High carrier frequency											
4960.252	Horizontal	158.0	-83.0	50.81	74.0	-23.19	50.81	2.81	54.0	-51.19	Pass

* - 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:	FCC section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions		
Test procedure:	ANSI C63.10, sections 11.11 and 11.12.1		
Test mode:	Compliance	Verdict:	PASS
Date(s):	17-Jun-18		
Temperature: 28 °C	Relative Humidity: 59 %	Air Pressure: 999 hPa	Power: 3 VDC
Remarks:			

Table 7.3.5 Average factor calculation

Transmission pulse		Transmission burst		Transmission train duration, ms	Average factor, dB
Duration, ms	Number pulse during 100 msec	Duration, ms	Period, ms		
0.4	1	NA	NA	NA	-48

*- 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:

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

Table 7.3.6 Restricted bands according to FCC section 15.205

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

Table 7.3.7 Restricted bands according to RSS-Gen

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

Reference numbers of test equipment used

HL 3615	HL 4277	HL 4355	HL 4360	HL 4933	HL 4956	HL 5111	HL 5288
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Full description is given in Appendix A.

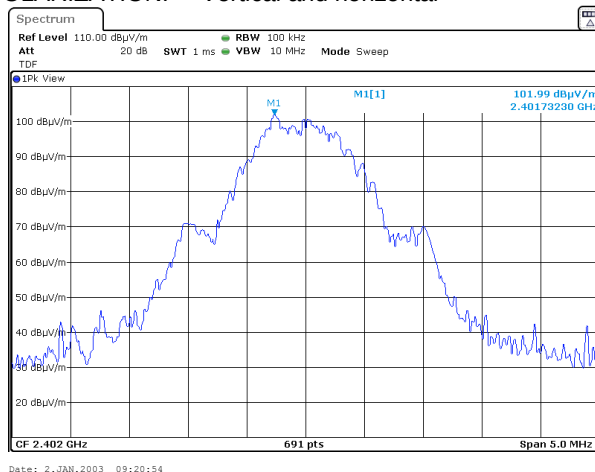


HERMON LABORATORIES

Test specification:	FCC section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions		
Test procedure:	ANSI C63.10, sections 11.11 and 11.12.1		
Test mode:	Compliance	Verdict:	PASS
Date(s):	17-Jun-18		
Temperature: 28 °C	Relative Humidity: 59 %	Air Pressure: 999 hPa	Power: 3 VDC
Remarks:			

Plot 7.3.1 Radiated emission measurements at the low carrier frequency

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



Plot 7.3.2 Radiated emission measurements at the mid carrier frequency

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





HERMON LABORATORIES

Test specification:	FCC section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions		
Test procedure:	ANSI C63.10, sections 11.11 and 11.12.1		
Test mode:	Compliance	Verdict:	PASS
Date(s):	17-Jun-18		
Temperature: 28 °C	Relative Humidity: 59 %	Air Pressure: 999 hPa	Power: 3 VDC
Remarks:			

Plot 7.3.3 Radiated emission measurements at the high carrier frequency

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



Date: 1.JAN.2003 05:23:26

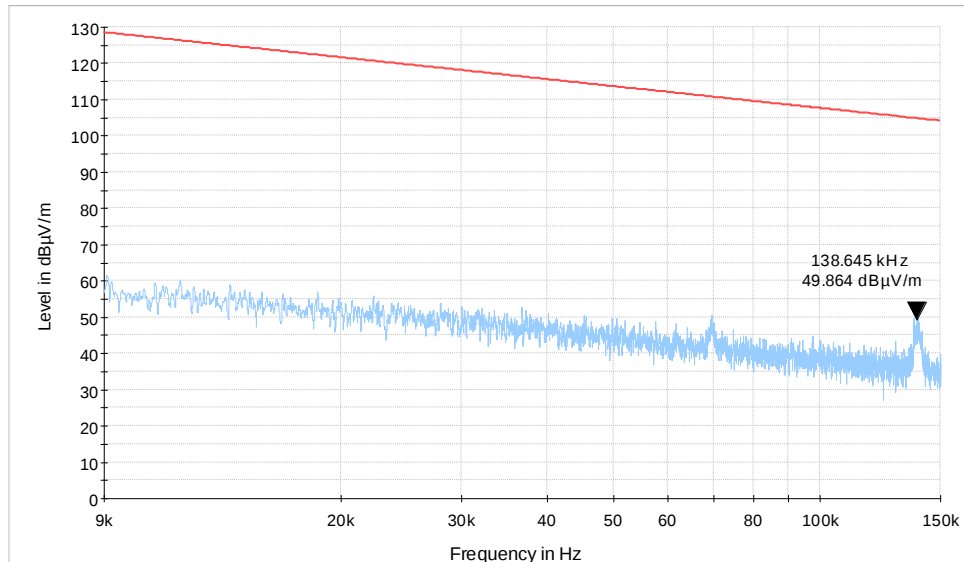


HERMON LABORATORIES

Test specification:	FCC section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions		
Test procedure:	ANSI C63.10, sections 11.11 and 11.12.1		
Test mode:	Compliance	Verdict:	PASS
Date(s):	17-Jun-18		
Temperature: 28 °C	Relative Humidity: 59 %	Air Pressure: 999 hPa	Power: 3 VDC
Remarks:			

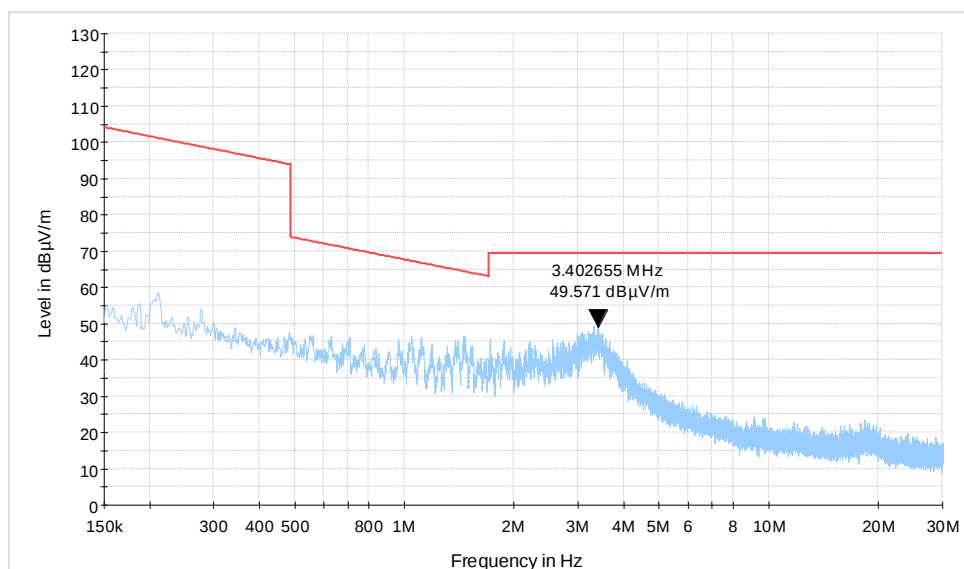
Plot 7.3.4 Radiated emission measurements from 9 to 150 kHz at the low, mid, high carrier frequency

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



Plot 7.3.5 Radiated emission measurements from 0.15 to 30 MHz at the low, mid, high carrier frequency

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



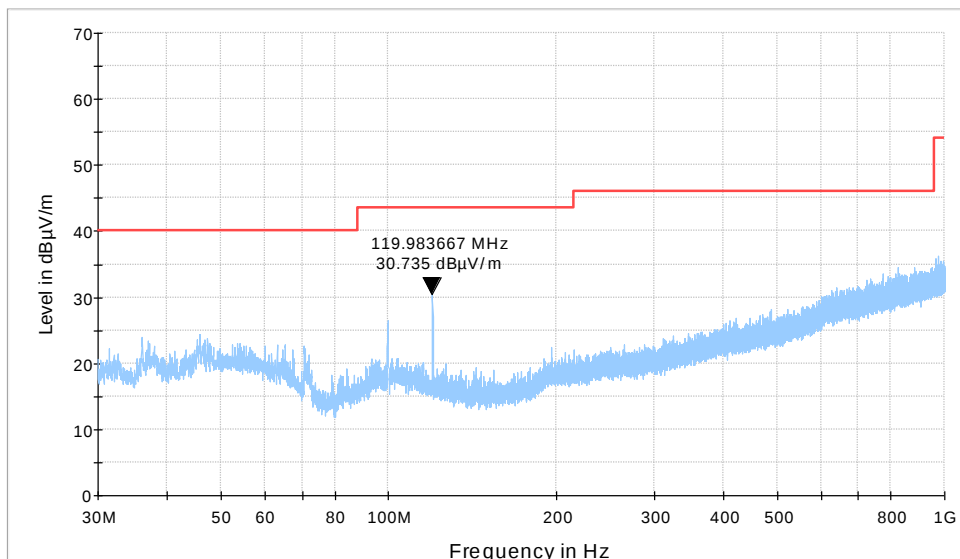


HERMON LABORATORIES

Test specification:	FCC section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions		
Test procedure:	ANSI C63.10, sections 11.11 and 11.12.1		
Test mode:	Compliance	Verdict:	PASS
Date(s):	17-Jun-18		
Temperature: 28 °C	Relative Humidity: 59 %	Air Pressure: 999 hPa	Power: 3 VDC
Remarks:			

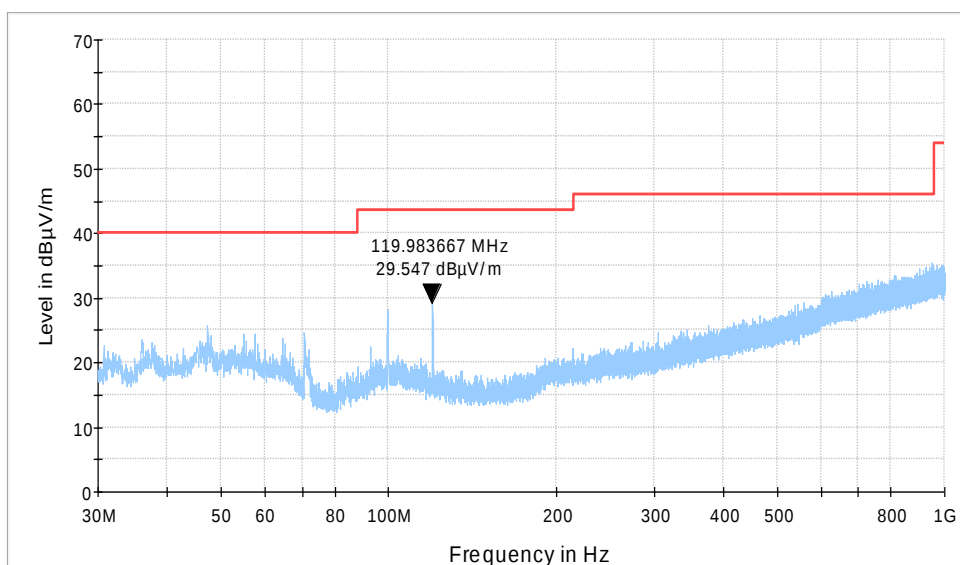
Plot 7.3.6 Radiated emission measurements from 30 to 1000 MHz at the low carrier frequency

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



Plot 7.3.7 Radiated emission measurements from 30 to 1000 MHz at the mid carrier frequency

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



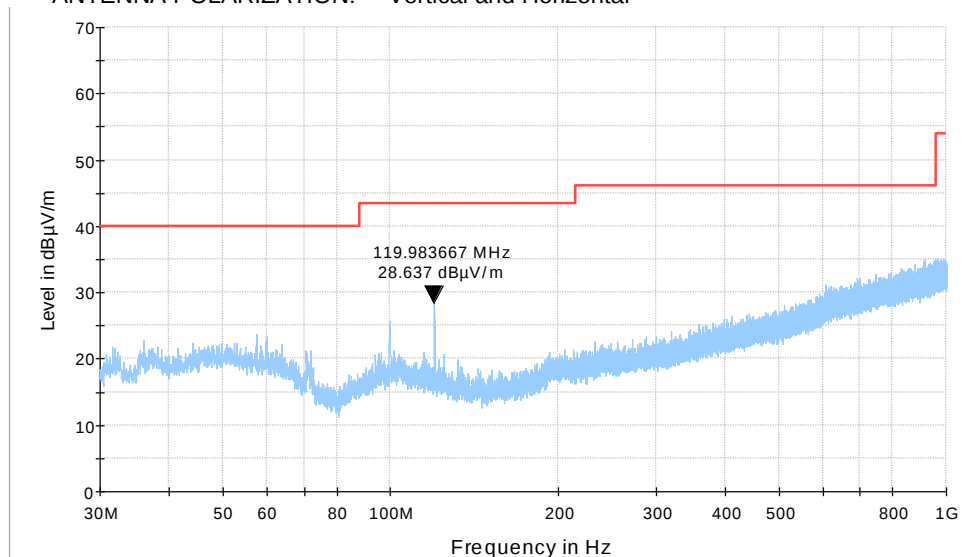


HERMON LABORATORIES

Test specification:	FCC section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions		
Test procedure:	ANSI C63.10, sections 11.11 and 11.12.1		
Test mode:	Compliance	Verdict:	PASS
Date(s):	17-Jun-18		
Temperature: 28 °C	Relative Humidity: 59 %	Air Pressure: 999 hPa	Power: 3 VDC
Remarks:			

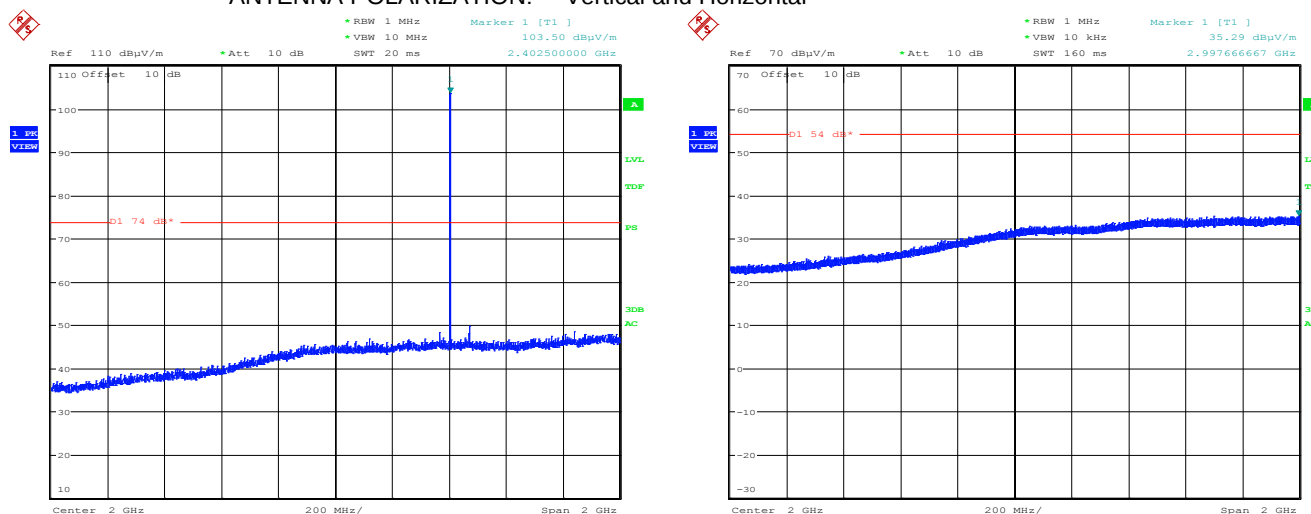
Plot 7.3.8 Radiated emission measurements from 30 to 1000 MHz at the high carrier frequency

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



Plot 7.3.9 Radiated emission measurements from 1 to 3 GHz at the low carrier frequency

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



Date: 13.JUN.2018 09:53:07

Date: 15.JUL.2018 10:59:35



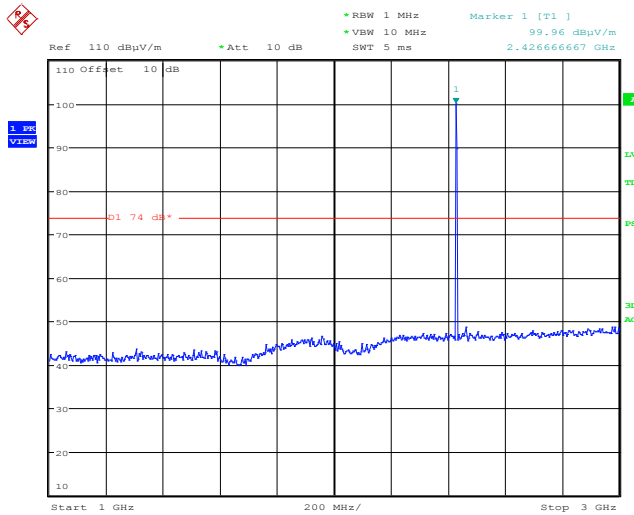
HERMON LABORATORIES

Report ID: SCRRAD_FCC.30907_rev.2
Date of Issue: 20-Sep-18

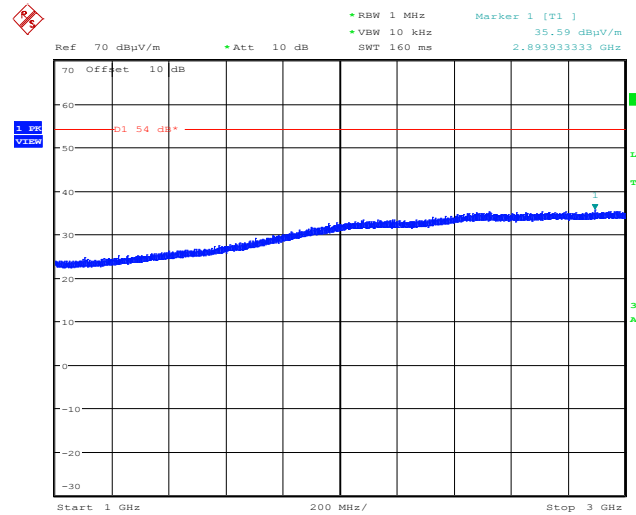
Test specification:	FCC section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions		
Test procedure:	ANSI C63.10, sections 11.11 and 11.12.1		
Test mode:	Compliance	Verdict:	PASS
Date(s):	17-Jun-18		
Temperature: 28 °C	Relative Humidity: 59 %	Air Pressure: 999 hPa	Power: 3 VDC
Remarks:			

Plot 7.3.10 Radiated emission measurements from 1 to 3 GHz at the mid carrier frequency

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



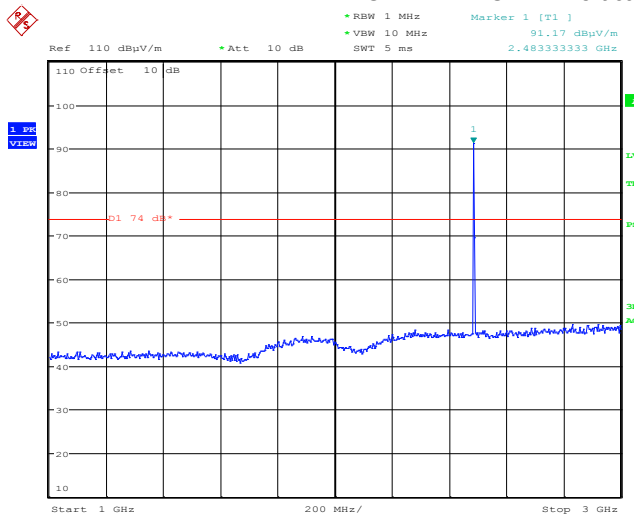
Date: 17.JUN.2018 05:33:10



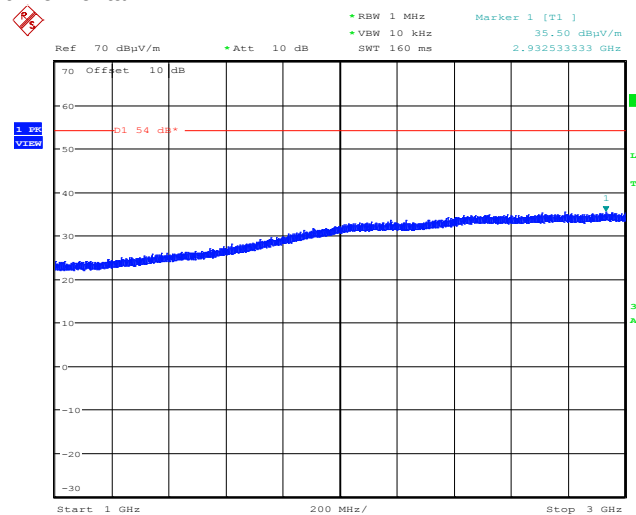
Date: 15.JUL.2018 11:00:38

Plot 7.3.11 Radiated emission measurements from 1 to 3 GHz at the high carrier frequency

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



Date: 17.JUN.2018 05:41:20



Date: 15.JUL.2018 11:01:17



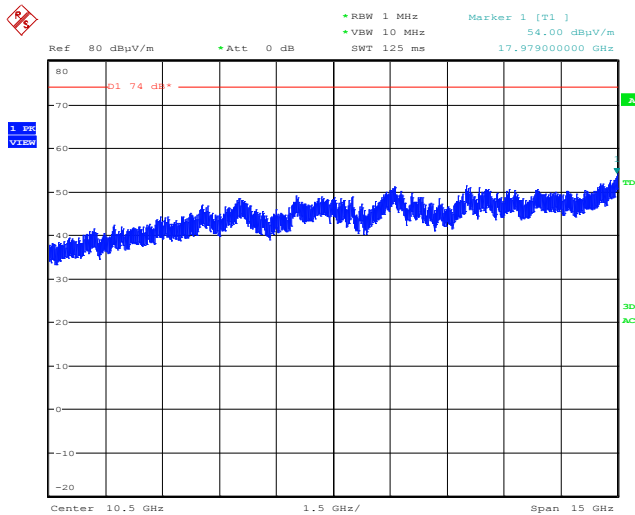
HERMON LABORATORIES

Report ID: SCRRAD_FCC.30907_rev.2
Date of Issue: 20-Sep-18

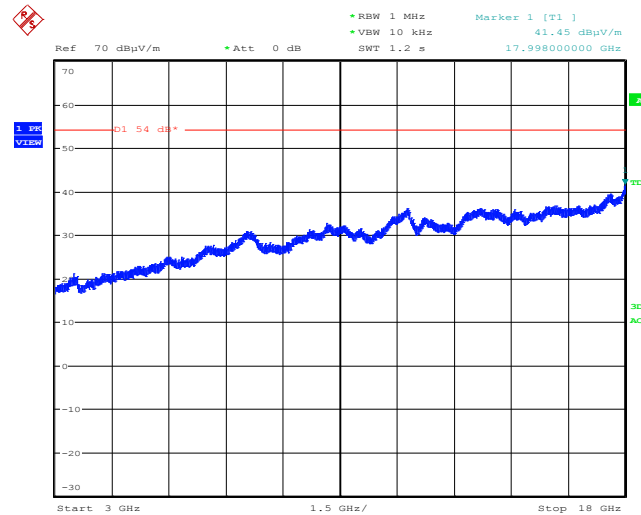
Test specification:	FCC section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions		
Test procedure:	ANSI C63.10, sections 11.11 and 11.12.1		
Test mode:	Compliance	Verdict:	PASS
Date(s):	17-Jun-18		
Temperature: 28 °C	Relative Humidity: 59 %	Air Pressure: 999 hPa	Power: 3 VDC
Remarks:			

Plot 7.3.12 Radiated emission measurements from 3 to 18 GHz at the low carrier frequency

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



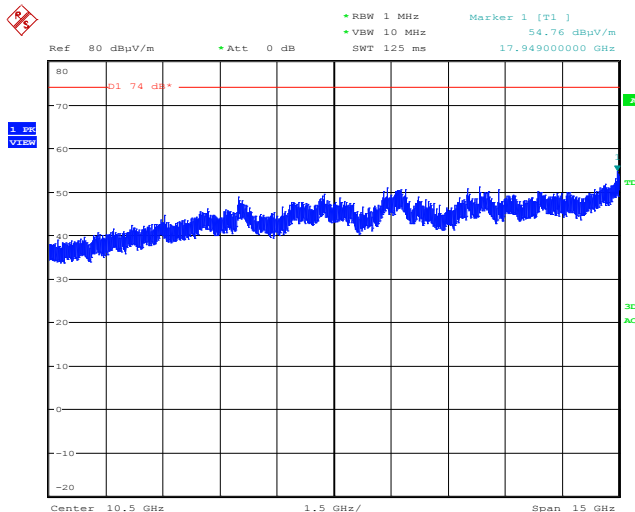
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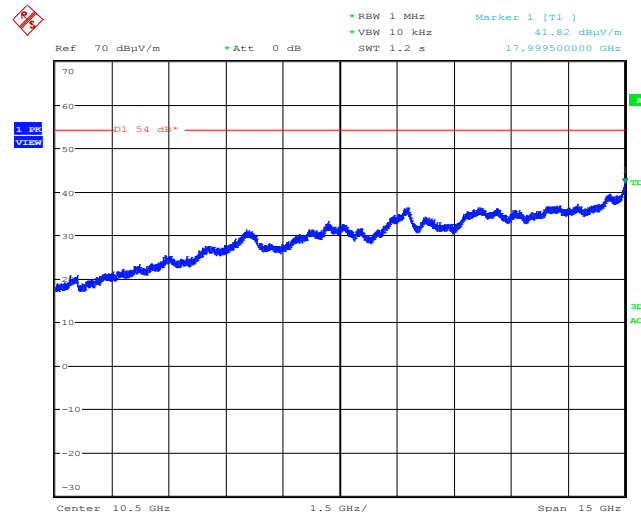
Date: 15.JUL.2018 11:02:39

Plot 7.3.13 Radiated emission measurements from 3 to 18 GHz at the mid carrier frequency

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



Date: 17.JUN.2018 04:51:57



Date: 15.JUL.2018 11:03:35



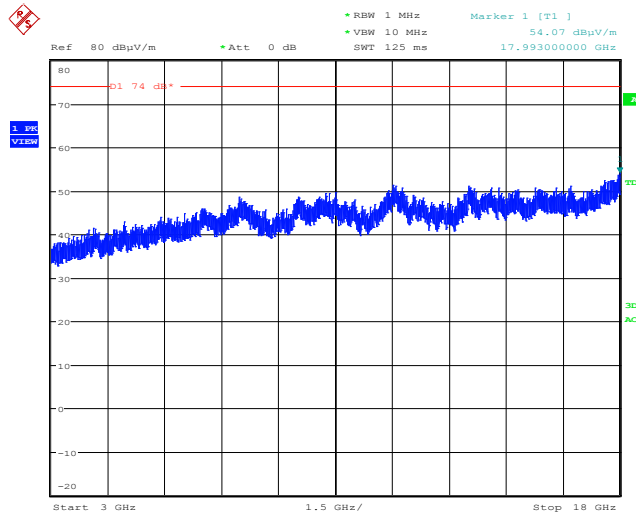
HERMON LABORATORIES

Report ID: SCRRAD_FCC.30907_rev.2
Date of Issue: 20-Sep-18

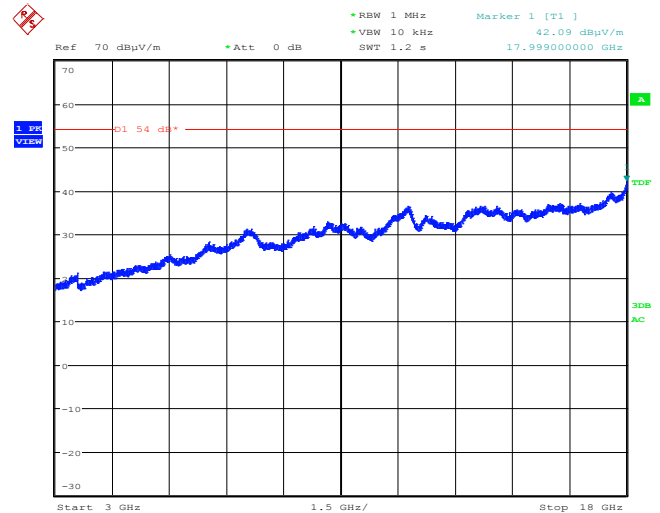
Test specification:	FCC section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions		
Test procedure:	ANSI C63.10, sections 11.11 and 11.12.1		
Test mode:	Compliance	Verdict:	PASS
Date(s):	17-Jun-18		
Temperature: 28 °C	Relative Humidity: 59 %	Air Pressure: 999 hPa	Power: 3 VDC
Remarks:			

Plot 7.3.14 Radiated emission measurements from 3 to 18 GHz at the high carrier frequency

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



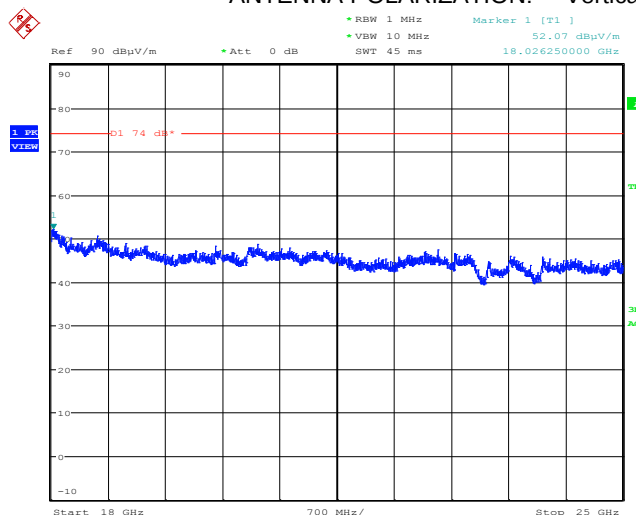
Date: 17.JUN.2018 05:45:10



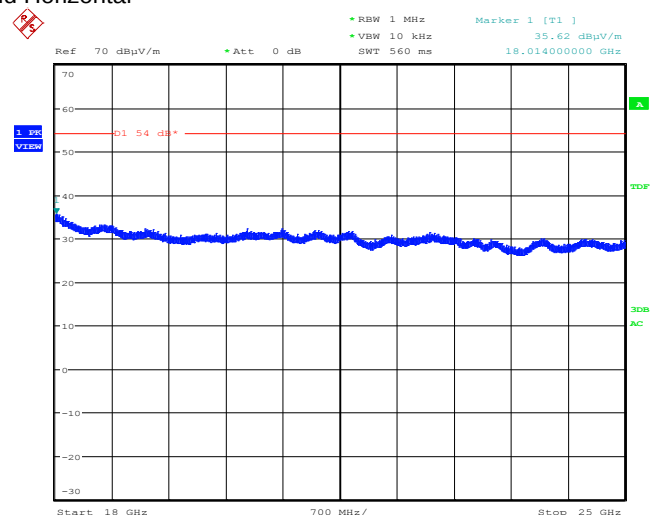
Date: 15.JUL.2018 11:05:12

Plot 7.3.15 Radiated emission measurements from 18 to 25 GHz at the low carrier frequency

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



Date: 17.JUN.2018 07:52:56



Date: 15.JUL.2018 11:08:32



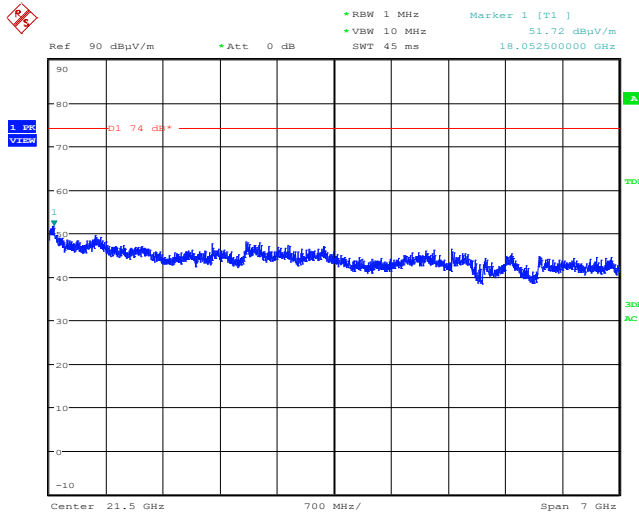
HERMON LABORATORIES

Report ID: SCRRAD_FCC.30907_rev.2
Date of Issue: 20-Sep-18

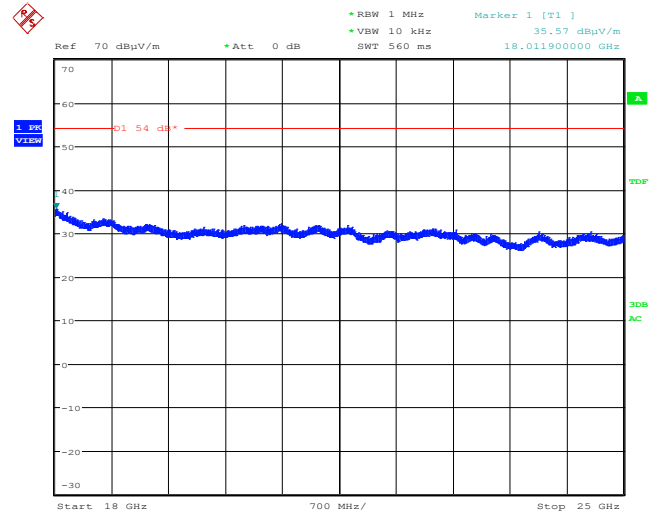
Test specification:	FCC section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions		
Test procedure:	ANSI C63.10, sections 11.11 and 11.12.1		
Test mode:	Compliance	Verdict: PASS	
Date(s):	17-Jun-18		
Temperature: 28 °C	Relative Humidity: 59 %	Air Pressure: 999 hPa	Power: 3 VDC
Remarks:			

Plot 7.3.16 Radiated emission measurements from 18 to 25 GHz at the mid carrier frequency

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



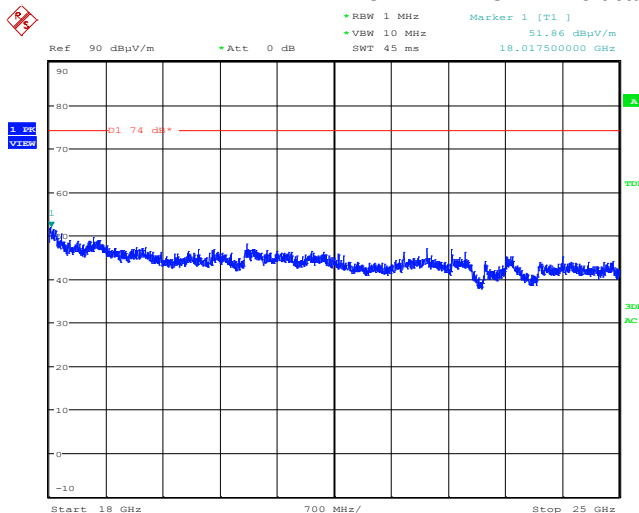
Date: 17.JUN.2018 07:53:54



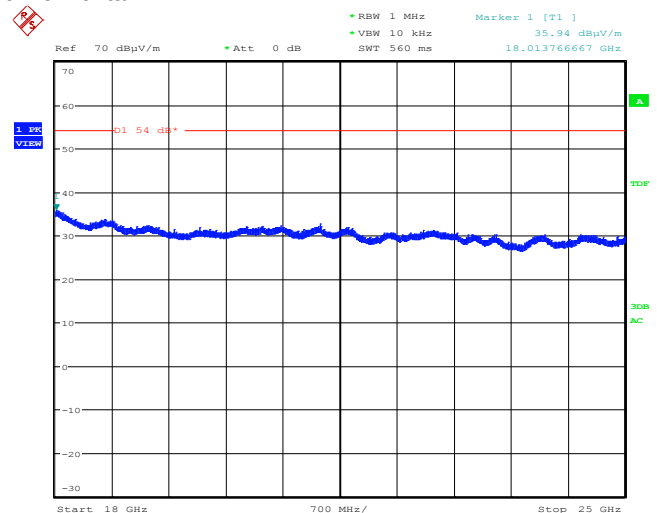
Date: 15.JUL.2018 11:09:39

Plot 7.3.17 Radiated emission measurements from 18 to 25 GHz at the high carrier frequency

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



Date: 17.JUN.2018 07:54:51



Date: 15.JUL.2018 11:12:30

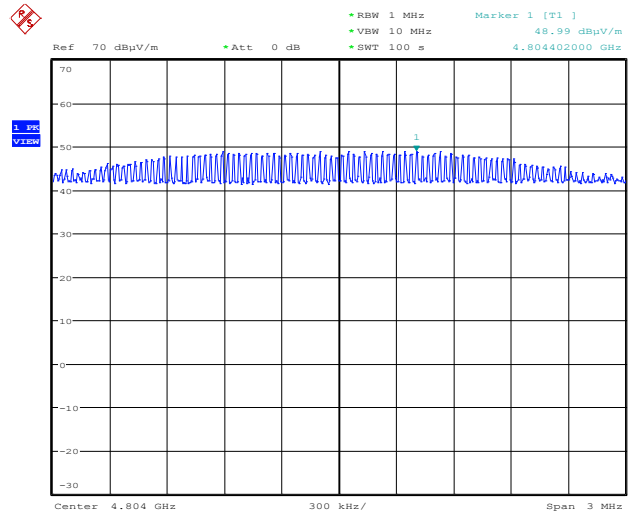


HERMON LABORATORIES

Test specification:	FCC section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions		
Test procedure:	ANSI C63.10, sections 11.11 and 11.12.1		
Test mode:	Compliance	Verdict:	PASS
Date(s):	17-Jun-18		
Temperature: 28 °C	Relative Humidity: 59 %	Air Pressure: 999 hPa	Power: 3 VDC
Remarks:			

Plot 7.3.18 Radiated emission measurements at the second harmonic of low carrier frequency

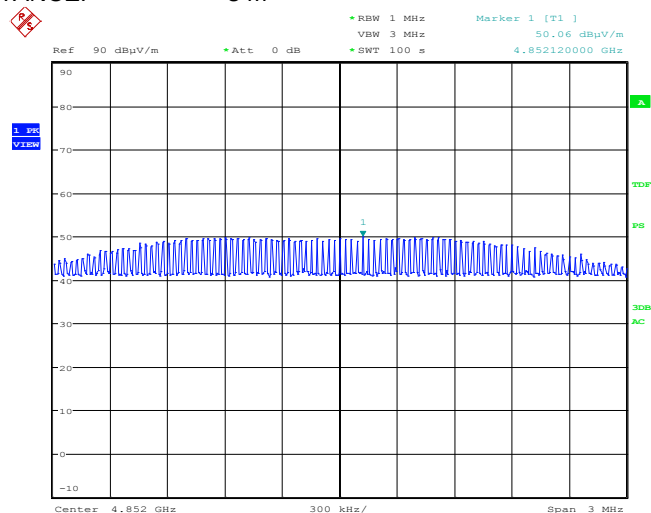
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m



Date: 17.JUN.2018 06:28:11

Plot 7.3.19 Radiated emission measurements at the second harmonic of mid carrier frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m



Date: 17.JUN.2018 04:30:20



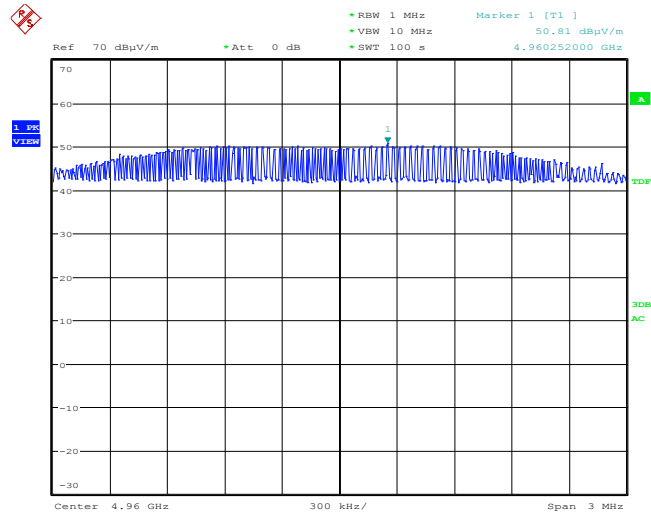
HERMON LABORATORIES

Report ID: SCRRAD_FCC.30907_rev.2
Date of Issue: 20-Sep-18

Test specification:	FCC section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions		
Test procedure:	ANSI C63.10, sections 11.11 and 11.12.1		
Test mode:	Compliance	Verdict:	PASS
Date(s):	17-Jun-18		
Temperature: 28 °C	Relative Humidity: 59 %	Air Pressure: 999 hPa	Power: 3 VDC
Remarks:			

Plot 7.3.20 Radiated emission measurements at the second harmonic of high carrier frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m



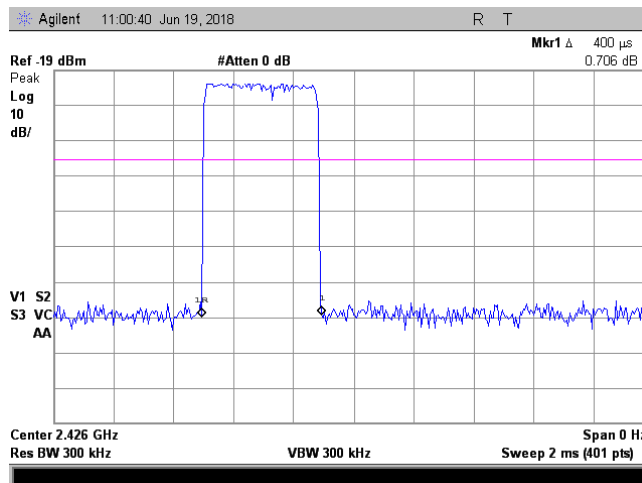
Date: 17.JUN.2018 06:12:52



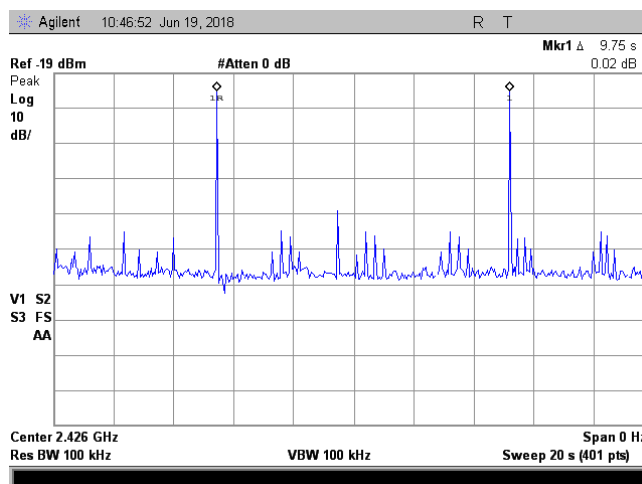
HERMON LABORATORIES

Test specification:	FCC section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions		
Test procedure:	ANSI C63.10, sections 11.11 and 11.12.1		
Test mode:	Compliance	Verdict:	PASS
Date(s):	17-Jun-18		
Temperature: 28 °C	Relative Humidity: 59 %	Air Pressure: 999 hPa	Power: 3 VDC
Remarks:			

Plot 7.3.21 Transmission pulse duration



Plot 7.3.22 Transmission pulse period





Test specification:	FCC section 15.247(d) / RSS-247 section 5.5, Band edge emissions		
Test procedure:	ANSI C63.10, section 11.13		
Test mode:	Compliance	Verdict:	PASS
Date(s):	13-Jun-18		
Temperature: 28 °C	Relative Humidity: 59 %	Air Pressure: 999 hPa	Power: 3 VDC
Remarks:			

7.4 Band edge radiated emissions

7.4.1 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 7.4.1.

Table 7.4.1 Band edge emission limits

Output power	Assigned frequency, MHz	Attenuation below carrier*, dBc	Field strength at 3 m within restricted bands, dB(μV/m)	
			Peak	Average
Peak	902.0 – 928.0	20.0	74.0	54.0
	2400.0 – 2483.5			
	5725.0 – 5850.0			
Averaged over a time interval	902.0 – 928.0	30.0	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.

7.4.2 Test procedure

- 7.4.2.1** The EUT was set up as shown in Figure 7.4.1, energized normally modulated at the maximum data rate and its proper operation was checked.
- 7.4.2.2** The EUT was adjusted to produce maximum available to end user RF output power at the lowest carrier frequency.
- 7.4.2.3** The spectrum analyzer span was set to capture the carrier frequency and associated modulation products. The resolution bandwidth was set wider than 1 % of the frequency span.
- 7.4.2.4** The spectrum analyzer was set in max hold mode and allowed trace to stabilize. The highest emission level within the authorized band was measured.
- 7.4.2.5** The maximum band edge emission and modulation product outside of the band were measured as provided in Table 7.4.2 and associated plots and referenced to the highest emission level measured within the authorized band.
- 7.4.2.6** The above procedure was repeated with the EUT adjusted to produce maximum RF output power at the highest carrier frequency.

Figure 7.4.1 Band edge emission test setup





HERMON LABORATORIES

Report ID: SCRRAD_FCC.30907_rev.2
Date of Issue: 20-Sep-18

Test specification:	FCC section 15.247(d) / RSS-247 section 5.5, Band edge emissions		
Test procedure:	ANSI C63.10, section 11.13		
Test mode:	Compliance	Verdict: PASS	
Date(s):	13-Jun-18		
Temperature: 28 °C	Relative Humidity: 59 %	Air Pressure: 999 hPa	Power: 3 VDC
Remarks:			

Table 7.4.2 Band edge emission test results

ASSIGNED FREQUENCY: 2400.0 – 2483.5 MHz
 TEST DISTANCE: 3 m
 MODULATION: GFSK
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum
 DETECTOR USED: Peak
 RESOLUTION BANDWIDTH: 1000 kHz
 TEST ANTENNA TYPE: Double ridged guide

Frequency, MHz	Peak field strength			Average field strength				Verdict
	Measured, dB(μV/m)	Limit, dB(μV/m)	Margin, dB**	Measured, dB(μV/m)	Calculated, dB(μV/m)	Limit, dB(μV/m)	Margin, dB***	
2368.400	45.62	74.0	-28.38	45.62	-2.38	54.0	-56.38	Pass
2483.822	48.26	74.0	-25.74	48.26	0.26	54.0	-53.74	

Reference numbers of test equipment used

HL 4277	HL 4360	HL 4933	HL 5111				
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Full description is given in Appendix A.

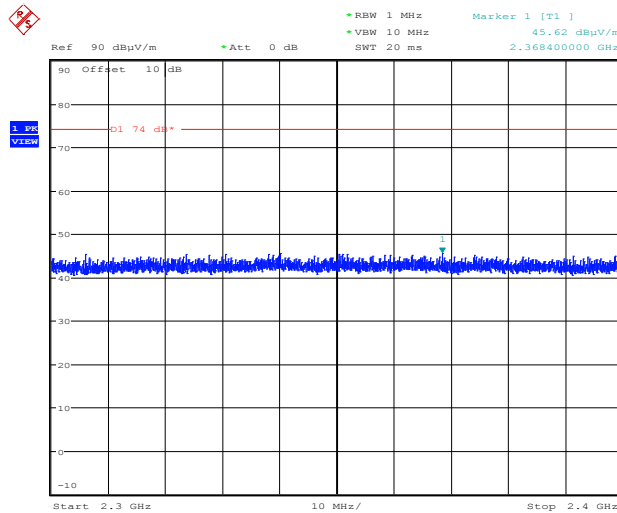


HERMON LABORATORIES

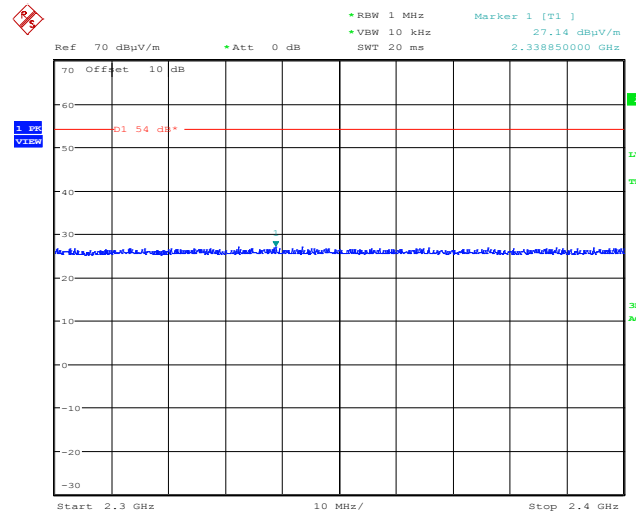
Report ID: SCRRAD_FCC.30907_rev.2
Date of Issue: 20-Sep-18

Test specification:	FCC section 15.247(d) / RSS-247 section 5.5, Band edge emissions		
Test procedure:	ANSI C63.10, section 11.13		
Test mode:	Compliance	Verdict: PASS	
Date(s):	13-Jun-18		
Temperature: 28 °C	Relative Humidity: 59 %	Air Pressure: 999 hPa	Power: 3 VDC
Remarks:			

Plot 7.4.1 The highest band edge emission at low carrier frequency

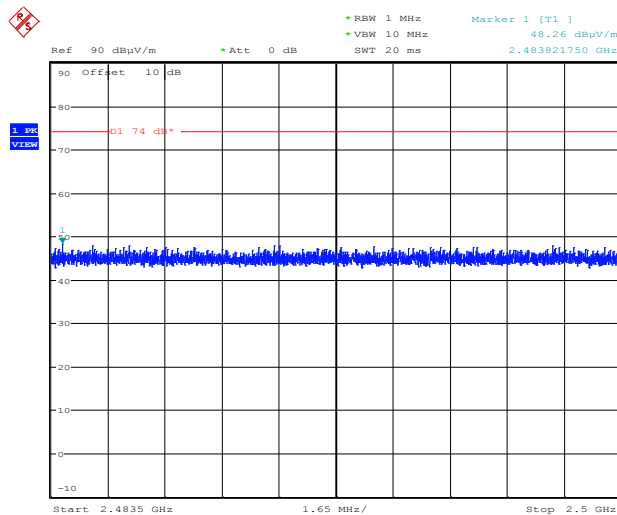


Date: 13.JUN.2018 10:14:07

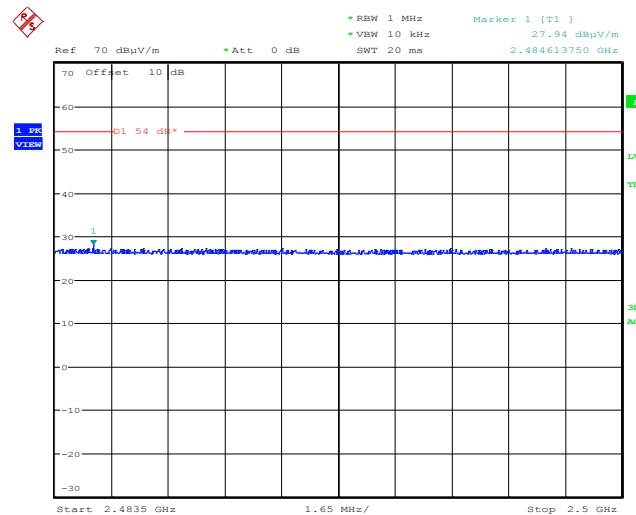


Date: 15.JUL.2018 11:17:10

Plot 7.4.2 The highest band edge emission at high carrier frequency



Date: 17.JUN.2018 07:17:59



Date: 15.JUL.2018 11:19:12



Test specification:	FCC section 15.247(e) / RSS-247 section 5.2(b), Peak power density		
Test procedure:	ANSI C63.10 section 11.10		
Test mode:	Compliance	Verdict:	PASS
Date(s):	18-Jun-18		
Temperature: 28 °C	Relative Humidity: 59 %	Air Pressure: 1005 hPa	Power: 3 VDC
Remarks:			

7.5 Peak spectral power density

7.5.1 General

This test was performed to measure the peak spectral power density radiated by the transmitter RF antenna. Specification test limits are given in Table 7.5.1.

Table 7.5.1 Peak spectral power density limits

Assigned frequency range, MHz	Measurement bandwidth, kHz	Peak spectral power density, dBm	Equivalent field strength limit @ 3m, dB(μV/m)*
902.0 – 928.0	3.0	8.0	103.2
2400.0 – 2483.5			
5725.0 – 5850.0			

* - Equivalent field strength limit was calculated from the peak spectral power density as follows: $E = \sqrt{30 \times P} / r$, where P is peak spectral power density and r is antenna to EUT distance in meters.

7.5.2 Test procedure for field strength measurements

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 field strength of the EUT carrier frequency was measured with antenna connected to spectrum analyzer/EMI receiver. To find maximum radiation the turntable was rotated 360° and the measuring antenna height was swept in both vertical and horizontal polarizations.

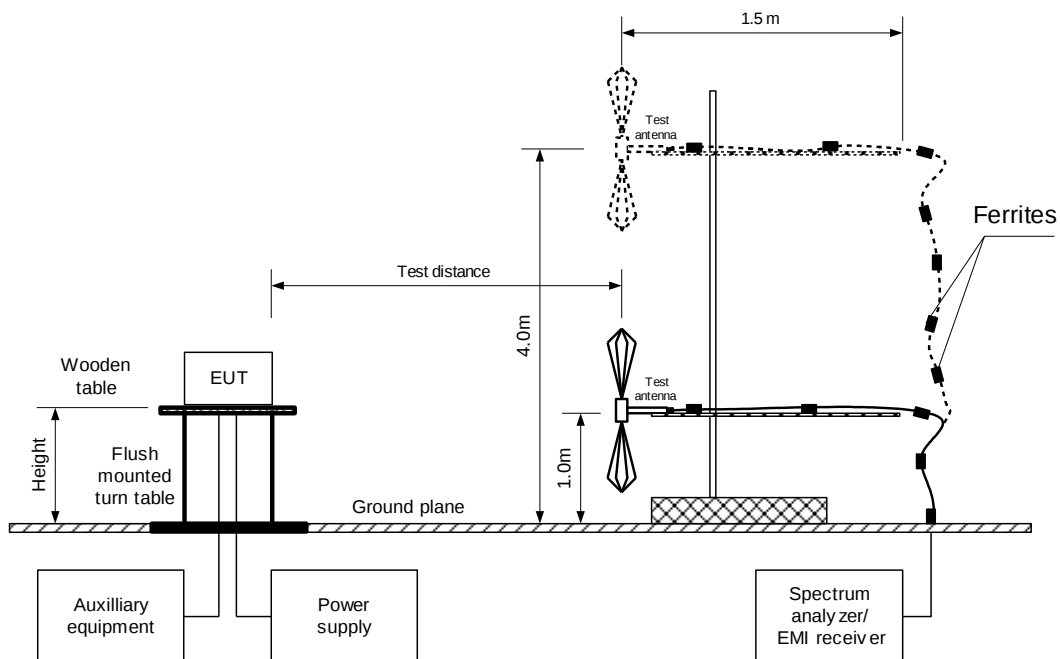
7.5.2.4 The frequency span of spectrum analyzer was set to capture the entire 6 dB band of the transmitter, in peak hold mode with resolution bandwidth set to 10.0 kHz, video bandwidth was set to 100 kHz, auto sweep time and sufficient number of sweeps was allowed for trace stabilization.

7.5.2.5 The peak spectral power density was measured as provided in Table 7.5.2 and associated plots.



Test specification:	FCC section 15.247(e) / RSS-247 section 5.2(b), Peak power density		
Test procedure:	ANSI C63.10 section 11.10		
Test mode:	Compliance	Verdict: PASS	
Date(s):	18-Jun-18		
Temperature: 28 °C	Relative Humidity: 59 %	Air Pressure: 1005 hPa	Power: 3 VDC
Remarks:			

Figure 7.5.1 Setup for carrier field strength measurements





Test specification:	FCC section 15.247(e) / RSS-247 section 5.2(b), Peak power density		
Test procedure:	ANSI C63.10 section 11.10		
Test mode:	Compliance	Verdict: PASS	
Date(s):	18-Jun-18		
Temperature: 28 °C	Relative Humidity: 59 %	Air Pressure: 1005 hPa	Power: 3 VDC
Remarks:			

Table 7.5.2 Field strength measurement of peak spectral power density

ASSIGNED FREQUENCY: 2400.0 - 2483.5 MHz
 TEST DISTANCE: 3 m
 TEST SITE: Semi anechoic chamber
 DETECTOR USED: Peak
 RESOLUTION BANDWIDTH: 10 kHz
 VIDEO BANDWIDTH: 100 kHz
 TEST ANTENNA TYPE: Double ridged guide (above 1000 MHz)
 MODULATION: GFSK
 BIT RATE: 800 kbps
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum

Frequency, MHz	Field strength, dB(μV/m)	EUT antenna gain, dBi	Limit, dB(μV/m)	Margin, dB*	Antenna polarization	Antenna height, m	Turn-table position**, degrees
2402.062	93.79	0.8	103.2	-10.21	Horizontal	1.6	0
2426.052	93.78	0.8	103.2	-10.22	Horizontal	1.6	0
2480.177	95.34	0.8	103.2	-8.66	Horizontal	1.6	0

* - Margin = Field strength - EUT antenna gain - calculated field strength limit.

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

Reference numbers of test equipment used

HL 4277	HL 4355	HL 4933	HL 5111				
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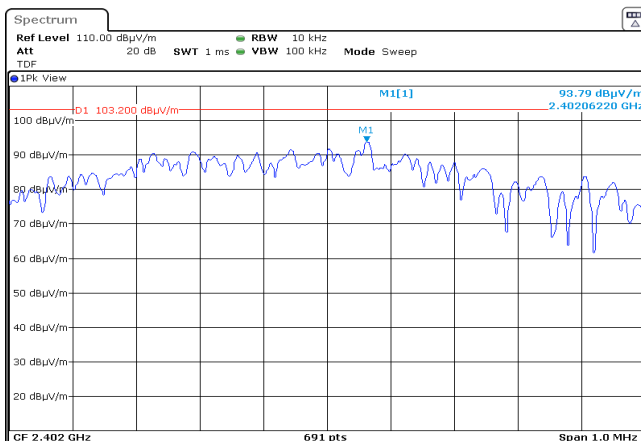
Full description is given in Appendix A.



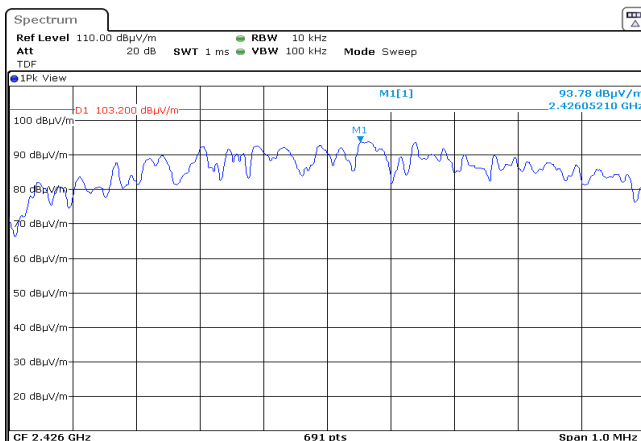
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Test specification:	FCC section 15.247(e) / RSS-247 section 5.2(b), Peak power density		
Test procedure:	ANSI C63.10 section 11.10		
Test mode:	Compliance	Verdict:	PASS
Date(s):	18-Jun-18		
Temperature: 28 °C	Relative Humidity: 59 %	Air Pressure: 1005 hPa	Power: 3 VDC
Remarks:			

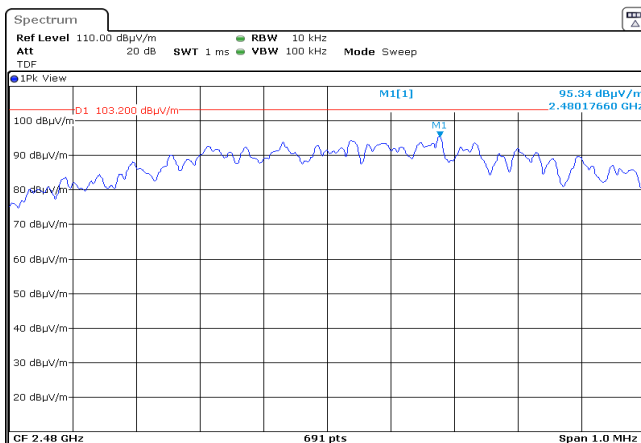
Plot 7.5.1 Peak spectral power density at low frequency zoomed at the peak



Plot 7.5.2 Peak spectral power density at mid frequency zoomed at the peak



Plot 7.5.3 Peak spectral power density at high frequency zoomed at the peak





Test specification:	FCC Part 15, Section 203 / RSS-Gen, Section 6.8, Antenna requirements		
Test procedure:	Visual inspection / supplier declaration		
Test mode:	Compliance	Verdict:	PASS
Date(s):	11-Jun-18		
Temperature: 24 °C	Air Pressure: 1010 hPa	Relative Humidity: 55 %	Power Supply: 3 VDC
Remarks:			

7.6 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 7.6.1.

Table 7.6.1 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 7.6.1 Antenna assembly





Test specification:	FCC, Section 15.109 / RSS-Gen, Section 7.1 / ICES-003, Section 6.2, Class B, Radiated emission		
Test procedure:	ANSI C63.4, Sections 8.3 and 12.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	13-Jun-18		
Temperature: 28 °C	Relative Humidity: 59 %	Air Pressure: 999 hPa	Power: 3 VDC
Remarks:			

8 Unintentional emissions

8.1 Radiated emission measurements

8.1.1 General

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

Table 8.1.1 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: $\text{Lim}_{S2} = \text{Lim}_{S1} + 20 \log (S1/S2)$, where $S1$ and $S2$ – standard defined and test distance respectively in meters.

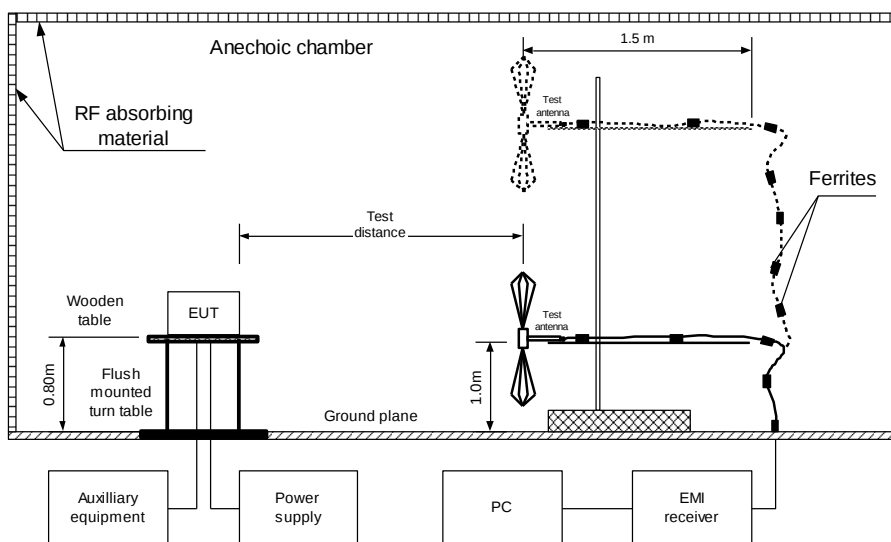
8.1.2 Test procedure for measurements in semi-anechoic chamber

8.1.2.1 The EUT was set up as shown in Figure 8.1.1 and associated photographs, 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.

Figure 8.1.1 Setup for radiated emission measurements

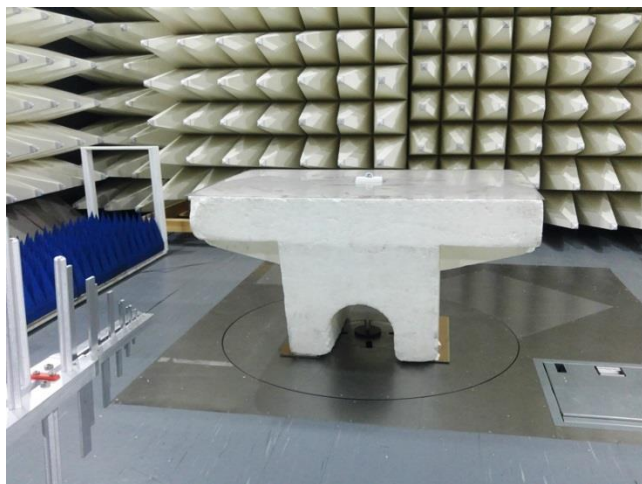




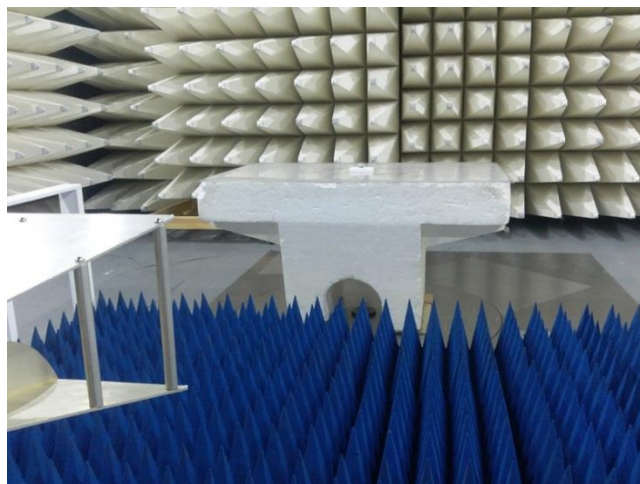
Test specification:	FCC, Section 15.109 / RSS-Gen, Section 7.1 / ICES-003, Section 6.2, Class B, Radiated emission		
Test procedure:	ANSI C63.4, Sections 8.3 and 12.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	13-Jun-18		
Temperature: 28 °C	Relative Humidity: 59 %	Air Pressure: 999 hPa	Power: 3 VDC
Remarks:			

Photograph 8.1.1 Setup for radiated emission measurements

30 MHz – 1000 MHz



1000 MHz – 13000 MHz





Test specification:	FCC, Section 15.109 / RSS-Gen, Section 7.1 / ICES-003, Section 6.2, Class B, Radiated emission		
Test procedure:	ANSI C63.4, Sections 8.3 and 12.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	13-Jun-18		
Temperature: 28 °C	Relative Humidity: 59 %	Air Pressure: 999 hPa	Power: 3 VDC
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	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*				
36.670833	24.10	17.14	40.00	22.86	Vertical	100.0	49.0	Pass
46.261167	26.57	20.67	40.00	19.33	Vertical	102.0	72.0	
54.936000	25.56	20.97	40.00	19.03	Vertical	100.0	92.0	
70.610667	27.42	22.67	40.00	17.33	Horizontal	222.0	81.0	
99.930333	30.48	27.16	43.50	16.34	Horizontal	177.0	15.0	
119.984167	33.13	31.50	43.50	12.00	Horizontal	133.0	180.0	

TEST SITE: SEMI ANECHOIC CHAMBER
TEST DISTANCE: 3 m
DETECTORS USED: PEAK / AVERAGE
FREQUENCY RANGE: 1000 MHz – 13 000 MHz
RESOLUTION BANDWIDTH: 1000 kHz

Frequency, MHz	Peak			Average			Antenna polarization	Antenna height, m	Turn-table position**, degrees	Verdict
	Measured emission, dB(μV/m)	Limit, dB(μV/m)	Margin, dB*	Measured emission, dB(μV/m)	Limit, dB(μV/m)	Margin, dB*				
4880.110000	45.42	74.00	28.58	37.54	54.00	16.46	Horizontal	104.0	-118.0	Pass

* - Margin = Measured emission - specification limit.

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

Reference numbers of test equipment used

HL 3615	HL 4277	HL 4360	HL 4933	HL 5111	HL 5288		
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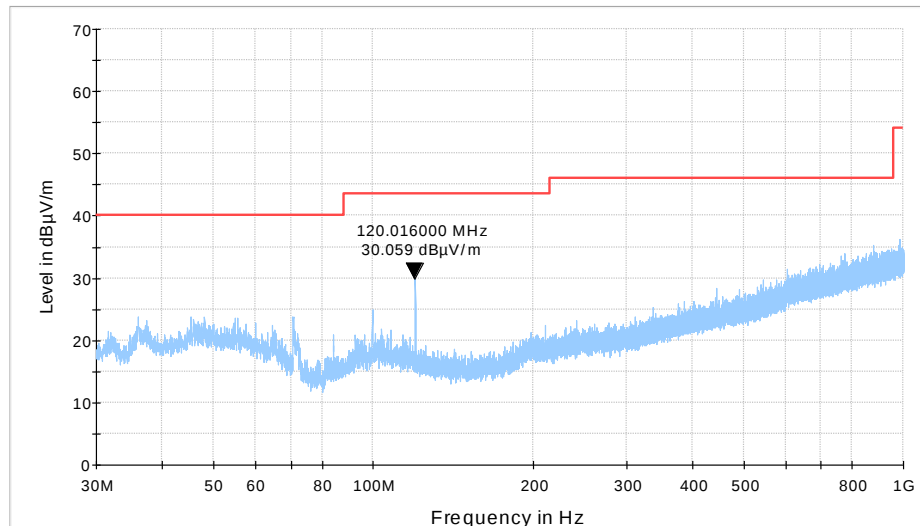
Full description is given in Appendix A.



Test specification:	FCC, Section 15.109 / RSS-Gen, Section 7.1 / ICES-003, Section 6.2, Class B, Radiated emission		
Test procedure:	ANSI C63.4, Sections 8.3 and 12.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	13-Jun-18		
Temperature: 28 °C	Relative Humidity: 59 %	Air Pressure: 999 hPa	Power: 3 VDC
Remarks:			

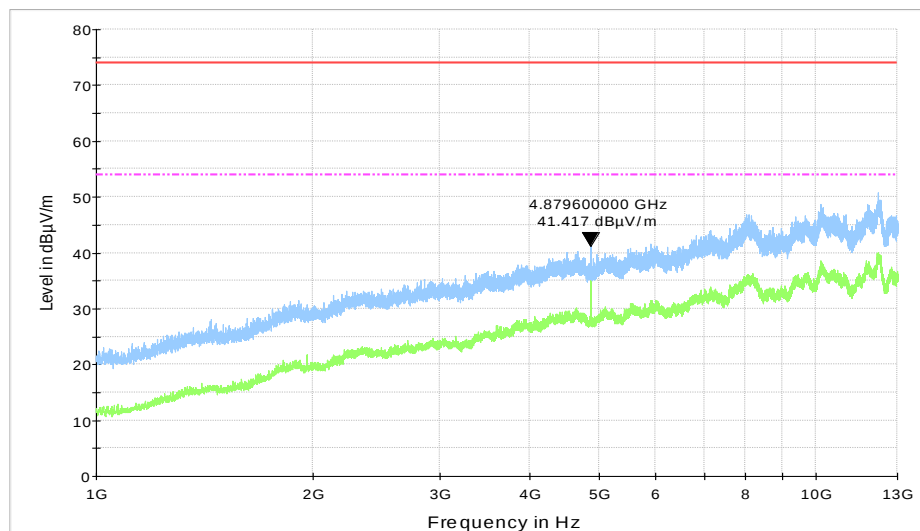
Plot 8.1.1 Radiated emission measurements in 30 - 1000 MHz range, vertical and horizontal antenna polarization

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



Plot 8.1.2 Radiated emission measurements above 1000 MHz, vertical and horizontal antenna polarization

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



9 APPENDIX A Test equipment and ancillaries used for tests

HL No	Description	Manufacturer	Model	Ser. No.	Last Cal./ Check	Due Cal./ Check
2780	EMC analyzer, 100 Hz to 26.5 GHz	Agilent Technologies	E7405A	MY45102462	25-Feb-18	25-Feb-19
2909	Spectrum analyzer, ESA-E, 100 Hz to 26.5 GHz	Agilent Technologies	E4407B	MY41444762	27-Mar-18	27-Mar-19
3615	Cable RF, 6.5 m, N type-N type, DC-6 GHz	Suhner Switzerland	RG 214/U	NA	10-Jun-18	10-Jun-19
3901	Microwave Cable Assembly, 40.0 GHz, 3.5 m, SMA/SMA	Huber-Suhner	SUCOFLEX 102A	1225/2A	07-Feb-18	07-Feb-19
4136	Shield Box	TESCOM CO., LTD	TC-5916A	5916A000137	04-Apr-18	04-Apr-19
4276	Test Cable , DC-18 GHz, 3.05 m, N/M - N/M	Mini-Circuits	APC-10FT-NMNM+	0747A	24-Aug-17	24-Aug-18
4277	Test Cable , DC-18 GHz, 3.05 m, N/M - N/M	Mini-Circuits	APC-10FT-NMNM+	0748A	10-Sep-17	10-Sep-18
4355	Signal and Spectrum Analyzer, 9 kHz to 7 GHz	Rohde & Schwarz	FSV 7	1.91E+11	20-Apr-17	20-Jun-18
4360	EMI Test Receiver, 20 Hz to 40 GHz.	Rohde & Schwarz	ESU40	100322	26-Dec-17	26-Dec-18
4933	Active Horn Antenna, 1 GHz to 18 GHz	COM-POWER CORPORATION	AHA-118	701046	04-Jan-18	04-Jan-19
4956	Active Horn Antenna, 18 to 40 GHz	COM-POWER CORPORATION	AHA-840	105004	11-Jan-18	11-Jan-19
5111	RF cable, 40 GHz, 5.5 m, K-type	Huber-Suhner	SF102EA/11SK/11SK/5500MM	502493/2EA	09-Apr-18	09-Apr-19
5288	Trilog Antenna, 25 MHz - 8 GHz, 100W	Frankonia	ALX-8000E	809	21-Jan-18	21-Jan-19

10 APPENDIX B Test equipment correction factors

HL 4933: Active Horn Antenna
COM-POWER CORPORATION, model: AHA-118, s/n 701046

Frequency, MHz	Measured antenna factor (with preamplifier), dB/m
1000	-16.1
1500	-15.1
2000	-10.9
2500	-11.9
3000	-11.1
3500	-10.6
4000	-8.6
4500	-8.3
5000	-5.9
5500	-5.7
6000	-3.3
6500	-4.0
7000	-2.2
7500	-1.7
8000	1.1
8500	-0.8
9000	-1.5
9500	-0.2

Frequency, MHz	Measured antenna factor (with preamplifier), dB/m
10000	1.8
10500	1.0
11000	0.3
11500	-0.5
12000	3.1
12500	1.4
13000	-0.3
13500	-0.4
14000	2.5
14500	2.2
15000	1.9
15500	0.5
16000	2.1
16500	1.2
17000	0.6
17500	3.1
18000	4.2

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

HL 4956: Active Horn Antenna
COM-POWER Corp., model: AHA-840, s/n 105004

Frequency, MHz	Measured antenna factor, dB/m
18000	5.1
18500	3.6
19000	2.2
19500	0.7
20000	0.7
20500	0.8
21000	0.5
21500	-1.3
22000	-2.1
22500	-2.0
23000	-1.6
23500	-2.9
24000	-2.3
24500	-2.6
25000	-1.8
25500	-1.2
26000	-0.5
26500	-1.2
27000	-0.1
27500	-1.0
28000	-0.7
28500	0.5

Frequency, MHz	Measured antenna factor, dB/m
29500	1.4
30000	2.9
30500	2.9
31000	2.9
31500	1.2
32000	0.7
32500	0.2
33000	-1.7
33500	-2.2
34000	2.3
34500	-1.1
35000	0.7
35500	-1.1
36000	0.1
36500	1.4
37000	3.7
37500	5.8
38000	6.6
38500	7.3
39000	6.5
39500	7.3
40000	7.1

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

HL 5288: Trilog Antenna
Frankonia, model: ALX-8000E, s/n: 00809

Frequency, MHz	Antenna factor, dB/m
30	14.96
35	15.33
40	16.37
45	17.56
50	17.95
60	16.87
70	13.22
80	10.56
90	13.61
100	15.46
120	14.03
140	12.23

Frequency, MHz	Antenna factor, dB/m
160	12.67
180	13.34
200	15.40
250	16.42
300	17.28
400	19.98
500	21.11
600	22.90
700	24.13
800	25.25
900	26.35
1000	27.18

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

HL 3615: Cable RF
Suhner Switzerland, model: RG 214/U, s/n: NA

Set / Applied, MHz	Measured, dB	Uncertainty, dB
50	0.31	+0.08 / -0.08 dB
100	0.45	+0.08 / -0.08 dB
200	0.66	+0.08 / -0.08 dB
300	0.83	+0.09 / -0.09 dB
400	0.98	+0.09 / -0.09 dB
500	1.12	+0.09 / -0.09 dB
600	1.26	+0.09 / -0.09 dB
700	1.38	+0.09 / -0.09 dB
800	1.50	+0.09 / -0.09 dB
900	1.63	+0.09 / -0.09 dB
1000	1.74	+0.09 / -0.09 dB
1100	1.85	+0.09 / -0.09 dB
1200	1.97	+0.09 / -0.09 dB
1300	2.08	+0.09 / -0.09 dB
1400	2.19	+0.09 / -0.09 dB
1500	2.30	+0.09 / -0.09 dB
1600	2.41	+0.09 / -0.09 dB
1700	2.53	+0.09 / -0.09 dB
1800	2.63	+0.09 / -0.09 dB
1900	2.74	+0.09 / -0.09 dB
2000	2.83	+0.09 / -0.09 dB
2100	2.93	+0.11 / -0.11 dB
2200	3.00	+0.11 / -0.11 dB
2300	3.07	+0.11 / -0.11 dB
2400	3.13	+0.11 / -0.11 dB
2500	3.19	+0.15 / -0.15 dB
2600	3.25	+0.15 / -0.15 dB
2700	3.33	+0.15 / -0.15 dB
2800	3.40	+0.15 / -0.15 dB
2900	3.48	+0.15 / -0.15 dB
3000	3.57	+0.15 / -0.15 dB
3100	3.63	+0.17 / -0.17 dB
3200	3.71	+0.17 / -0.17 dB

Set / Applied, MHz	Measured, dB	Uncertainty, dB
3300	3.78	+0.17 / -0.17 dB
3400	3.88	+0.17 / -0.17 dB
3500	3.96	+0.17 / -0.17 dB
3600	4.06	+0.17 / -0.17 dB
3700	4.15	+0.17 / -0.17 dB
3800	4.26	+0.17 / -0.17 dB
3900	4.36	+0.17 / -0.17 dB
4000	4.48	+0.17 / -0.17 dB
4100	4.58	+0.22 / -0.23 dB
4200	4.72	+0.22 / -0.23 dB
4300	4.80	+0.22 / -0.23 dB
4400	4.93	+0.22 / -0.23 dB
4500	5.00	+0.22 / -0.23 dB
4600	5.10	+0.22 / -0.23 dB
4700	5.20	+0.22 / -0.23 dB
4800	5.30	+0.22 / -0.23 dB
4900	5.43	+0.22 / -0.23 dB
5000	5.54	+0.22 / -0.23 dB
5100	5.65	+0.22 / -0.23 dB
5200	5.73	+0.22 / -0.23 dB
5300	5.86	+0.22 / -0.23 dB
5400	5.95	+0.22 / -0.23 dB
5500	6.05	+0.22 / -0.23 dB
5600	6.16	+0.22 / -0.23 dB
5700	6.28	+0.22 / -0.23 dB
5800	6.38	+0.22 / -0.23 dB
5900	6.53	+0.22 / -0.23 dB
6000	6.63	+0.22 / -0.23 dB
6100	6.75	+0.22 / -0.23 dB
6200	6.82	+0.22 / -0.23 dB
6300	6.93	+0.22 / -0.23 dB
6400	7.00	+0.22 / -0.23 dB
6500	7.05	+0.22 / -0.23 dB

HL 4276: Test Cable
Mini-Circuits, model: APC-10FT-NMNM+, s/n 0748A

Set / Applied, MHz	Measured, dB	Uncertainty, dB
0.1	0.02	+0.07 / -0.07 dB
50	0.26	+0.07 / -0.07 dB
100	0.38	+0.07 / -0.07 dB
200	0.55	+0.07 / -0.07 dB
300	0.68	+0.08 / -0.09 dB
400	0.79	+0.08 / -0.09 dB
500	0.89	+0.08 / -0.09 dB
600	0.98	+0.08 / -0.09 dB
700	1.07	+0.08 / -0.09 dB
800	1.15	+0.08 / -0.09 dB
900	1.23	+0.08 / -0.09 dB
1000	1.30	+0.08 / -0.09 dB
1100	1.37	+0.12 / -0.13 dB
1200	1.43	+0.12 / -0.13 dB
1300	1.49	+0.12 / -0.13 dB
1400	1.56	+0.12 / -0.13 dB
1500	1.62	+0.12 / -0.13 dB
1600	1.68	+0.12 / -0.13 dB
1700	1.73	+0.12 / -0.13 dB
1800	1.79	+0.12 / -0.13 dB
1900	1.84	+0.12 / -0.13 dB
2000	1.90	+0.12 / -0.13 dB
2100	1.96	+0.12 / -0.13 dB
2200	2.01	+0.12 / -0.13 dB
2300	2.06	+0.12 / -0.13 dB
2400	2.12	+0.12 / -0.13 dB
2500	2.17	+0.17 / -0.18 dB
2600	2.24	+0.17 / -0.18 dB
2700	2.30	+0.17 / -0.18 dB
2800	2.37	+0.17 / -0.18 dB
2900	2.44	+0.17 / -0.18 dB
3000	2.53	+0.17 / -0.18 dB
3100	2.59	+0.19 / -0.2 dB
3200	2.62	+0.19 / -0.2 dB
3300	2.64	+0.19 / -0.2 dB
3400	2.66	+0.19 / -0.2 dB
3500	2.68	+0.19 / -0.2 dB
3600	2.71	+0.19 / -0.2 dB
3700	2.74	+0.19 / -0.2 dB
3800	2.78	+0.19 / -0.2 dB
3900	2.81	+0.19 / -0.2 dB
4000	2.85	+0.19 / -0.2 dB

Set / Applied, MHz	Measured, dB	Uncertainty, dB
4100	2.89	+0.3 / -0.33 dB
4200	2.94	+0.3 / -0.33 dB
4300	2.97	+0.3 / -0.33 dB
4400	3.01	+0.3 / -0.33 dB
4500	3.05	+0.3 / -0.33 dB
4600	3.09	+0.3 / -0.33 dB
4700	3.12	+0.3 / -0.33 dB
4800	3.16	+0.3 / -0.33 dB
4900	3.20	+0.3 / -0.33 dB
5000	3.24	+0.3 / -0.33 dB
5100	3.28	+0.3 / -0.33 dB
5200	3.32	+0.3 / -0.33 dB
5300	3.35	+0.3 / -0.33 dB
5400	3.39	+0.3 / -0.33 dB
5500	3.42	+0.3 / -0.33 dB
5600	3.46	+0.3 / -0.33 dB
5700	3.50	+0.3 / -0.33 dB
5800	3.54	+0.3 / -0.33 dB
5900	3.59	+0.3 / -0.33 dB
6000	3.62	+0.3 / -0.33 dB
6100	3.66	+0.3 / -0.33 dB
6200	3.70	+0.3 / -0.33 dB
6300	3.73	+0.3 / -0.33 dB
6400	3.77	+0.3 / -0.33 dB
6500	3.80	+0.3 / -0.33 dB
6600	3.85	+0.3 / -0.33 dB
6700	3.88	+0.3 / -0.33 dB
6800	3.92	+0.3 / -0.33 dB
6900	3.95	+0.3 / -0.33 dB
7000	4.00	+0.3 / -0.33 dB
7100	4.04	+0.3 / -0.33 dB
7200	4.07	+0.3 / -0.33 dB
7300	4.12	+0.3 / -0.33 dB
7400	4.15	+0.3 / -0.33 dB
7500	4.19	+0.3 / -0.33 dB
7600	4.23	+0.3 / -0.33 dB
7700	4.26	+0.3 / -0.33 dB
7800	4.29	+0.3 / -0.33 dB
7900	4.33	+0.3 / -0.33 dB
8000	4.36	+0.3 / -0.33 dB
8100	4.40	+0.34 / -0.36 dB
8200	4.42	+0.34 / -0.36 dB

HL 4276: Test Cable (continued)

Set / Applied, MHz	Measured, dB	Uncertainty, dB
8300	4.45	+0.34 / -0.36 dB
8400	4.48	+0.34 / -0.36 dB
8500	4.52	+0.34 / -0.36 dB
8600	4.54	+0.34 / -0.36 dB
8700	4.56	+0.34 / -0.36 dB
8800	4.59	+0.34 / -0.36 dB
8900	4.62	+0.34 / -0.36 dB
9000	4.65	+0.34 / -0.36 dB
9100	4.68	+0.34 / -0.36 dB
9200	4.69	+0.34 / -0.36 dB
9300	4.71	+0.34 / -0.36 dB
9400	4.73	+0.34 / -0.36 dB
9500	4.75	+0.34 / -0.36 dB
9600	4.79	+0.34 / -0.36 dB
9700	4.81	+0.34 / -0.36 dB
9800	4.85	+0.34 / -0.36 dB
9900	4.88	+0.34 / -0.36 dB
10000	4.91	+0.34 / -0.36 dB
10100	4.93	+0.4 / -0.44 dB
10200	4.97	+0.4 / -0.44 dB
10300	5.00	+0.4 / -0.44 dB
10400	5.04	+0.4 / -0.44 dB
10500	5.07	+0.4 / -0.44 dB
10600	5.12	+0.4 / -0.44 dB
10700	5.14	+0.4 / -0.44 dB
10800	5.15	+0.4 / -0.44 dB
10900	5.18	+0.4 / -0.44 dB
11000	5.19	+0.4 / -0.44 dB
11100	5.21	+0.4 / -0.44 dB
11200	5.24	+0.4 / -0.44 dB
11300	5.28	+0.4 / -0.44 dB
11400	5.32	+0.4 / -0.44 dB
11500	5.35	+0.4 / -0.44 dB
11600	5.39	+0.4 / -0.44 dB
11700	5.42	+0.4 / -0.44 dB
11800	5.45	+0.4 / -0.44 dB
11900	5.47	+0.4 / -0.44 dB
12000	5.50	+0.4 / -0.44 dB
12100	5.54	+0.4 / -0.44 dB
12200	5.57	+0.4 / -0.44 dB
12300	5.60	+0.4 / -0.44 dB
12400	5.63	+0.4 / -0.44 dB
12500	5.64	+0.47 / -0.52 dB
12600	5.67	+0.47 / -0.52 dB
12700	5.68	+0.47 / -0.52 dB
12800	5.70	+0.47 / -0.52 dB
12900	5.72	+0.47 / -0.52 dB
13000	5.75	+0.47 / -0.52 dB
13100	5.47	+0.4 / -0.44 dB
13200	5.50	+0.4 / -0.44 dB
13300	5.54	+0.4 / -0.44 dB

Set / Applied, MHz	Measured, dB	Uncertainty, dB
13100	5.77	+0.47 / -0.52 dB
13200	5.82	+0.47 / -0.52 dB
13300	5.84	+0.47 / -0.52 dB
13400	5.88	+0.47 / -0.52 dB
13500	5.90	+0.47 / -0.52 dB
13600	5.93	+0.47 / -0.52 dB
13700	5.95	+0.47 / -0.52 dB
13800	6.00	+0.47 / -0.52 dB
13900	6.02	+0.47 / -0.52 dB
14000	6.05	+0.47 / -0.52 dB
14100	6.08	+0.47 / -0.52 dB
14200	6.11	+0.47 / -0.52 dB
14300	6.12	+0.47 / -0.52 dB
14400	6.15	+0.47 / -0.52 dB
14500	6.18	+0.47 / -0.52 dB
14600	6.22	+0.47 / -0.52 dB
14700	6.25	+0.47 / -0.52 dB
14800	6.29	+0.47 / -0.52 dB
14900	6.33	+0.47 / -0.52 dB
15000	6.35	+0.47 / -0.52 dB
15100	6.38	+0.47 / -0.52 dB
15200	6.40	+0.47 / -0.52 dB
15300	6.44	+0.47 / -0.52 dB
15400	6.48	+0.47 / -0.52 dB
15500	6.52	+0.47 / -0.52 dB
15600	6.54	+0.47 / -0.52 dB
15700	6.59	+0.47 / -0.52 dB
15800	6.60	+0.47 / -0.52 dB
15900	6.64	+0.47 / -0.52 dB
16000	6.62	+0.47 / -0.52 dB
16100	6.67	+0.47 / -0.52 dB
16200	6.71	+0.47 / -0.52 dB
16300	6.75	+0.47 / -0.52 dB
16400	6.79	+0.47 / -0.52 dB
16500	6.81	+0.47 / -0.52 dB
16600	6.85	+0.47 / -0.52 dB
16700	6.85	+0.47 / -0.52 dB
16800	6.89	+0.47 / -0.52 dB
16900	6.89	+0.47 / -0.52 dB
17000	6.93	+0.47 / -0.52 dB
17100	6.93	+0.47 / -0.52 dB
17200	6.99	+0.47 / -0.52 dB
17300	7.00	+0.47 / -0.52 dB
17400	7.01	+0.47 / -0.52 dB
17500	7.01	+0.47 / -0.52 dB
17600	7.02	+0.47 / -0.52 dB
17700	7.05	+0.47 / -0.52 dB
17800	7.06	+0.47 / -0.52 dB
17900	7.08	+0.47 / -0.52 dB
18000	7.09	+0.47 / -0.52 dB

HL 4277: Test Cable
Mini-Circuits, model: APC-10FT-NMNM+, s/n 0748A

Set / Applied, MHz	Measured, dB	Uncertainty, dB
0.1	0.26	+0.07 / -0.07 dB
50	0.27	+0.07 / -0.07 dB
100	0.38	+0.07 / -0.07 dB
200	0.55	+0.07 / -0.07 dB
300	0.69	+0.08 / -0.09 dB
400	0.80	+0.08 / -0.09 dB
500	0.91	+0.08 / -0.09 dB
600	1.00	+0.08 / -0.09 dB
700	1.08	+0.08 / -0.09 dB
800	1.17	+0.08 / -0.09 dB
900	1.24	+0.08 / -0.09 dB
1000	1.32	+0.08 / -0.09 dB
1100	1.39	+0.12 / -0.13 dB
1200	1.45	+0.12 / -0.13 dB
1300	1.52	+0.12 / -0.13 dB
1400	1.58	+0.12 / -0.13 dB
1500	1.65	+0.12 / -0.13 dB
1600	1.71	+0.12 / -0.13 dB
1700	1.77	+0.12 / -0.13 dB
1800	1.82	+0.12 / -0.13 dB
1900	1.88	+0.12 / -0.13 dB
2000	1.93	+0.12 / -0.13 dB
2100	1.99	+0.12 / -0.13 dB
2200	2.05	+0.12 / -0.13 dB
2300	2.10	+0.12 / -0.13 dB
2400	2.15	+0.12 / -0.13 dB
2500	2.20	+0.17 / -0.18 dB
2600	2.25	+0.17 / -0.18 dB
2700	2.30	+0.17 / -0.18 dB
2800	2.35	+0.17 / -0.18 dB
2900	2.40	+0.17 / -0.18 dB
3000	2.44	+0.17 / -0.18 dB
3100	2.49	+0.19 / -0.2 dB
3200	2.54	+0.19 / -0.2 dB
3300	2.58	+0.19 / -0.2 dB
3400	2.62	+0.19 / -0.2 dB
3500	2.66	+0.19 / -0.2 dB
3600	2.71	+0.19 / -0.2 dB
3700	2.75	+0.19 / -0.2 dB
3800	2.79	+0.19 / -0.2 dB
3900	2.84	+0.19 / -0.2 dB
4000	2.88	+0.19 / -0.2 dB

Set / Applied, MHz	Measured, dB	Uncertainty, dB
4100	2.84	+0.19 / -0.2 dB
4200	2.88	+0.19 / -0.2 dB
4300	2.92	+0.3 / -0.33 dB
4400	2.96	+0.3 / -0.33 dB
4500	3.01	+0.3 / -0.33 dB
4600	3.05	+0.3 / -0.33 dB
4700	3.09	+0.3 / -0.33 dB
4800	3.13	+0.3 / -0.33 dB
4900	3.18	+0.3 / -0.33 dB
5000	3.21	+0.3 / -0.33 dB
5100	3.25	+0.3 / -0.33 dB
5200	3.30	+0.3 / -0.33 dB
5300	3.34	+0.3 / -0.33 dB
5400	3.39	+0.3 / -0.33 dB
5500	3.44	+0.3 / -0.33 dB
5600	3.48	+0.3 / -0.33 dB
5700	3.53	+0.3 / -0.33 dB
5800	3.57	+0.3 / -0.33 dB
5900	3.60	+0.3 / -0.33 dB
6000	3.65	+0.3 / -0.33 dB
6100	3.68	+0.3 / -0.33 dB
6200	3.72	+0.3 / -0.33 dB
6300	3.77	+0.3 / -0.33 dB
6400	3.83	+0.3 / -0.33 dB
6500	3.86	+0.3 / -0.33 dB
6600	3.92	+0.3 / -0.33 dB
6700	3.96	+0.3 / -0.33 dB
6800	4.00	+0.3 / -0.33 dB
6900	4.04	+0.3 / -0.33 dB
7000	4.08	+0.3 / -0.33 dB
7100	4.11	+0.3 / -0.33 dB
7200	4.16	+0.3 / -0.33 dB
7300	4.20	+0.3 / -0.33 dB
7400	4.24	+0.3 / -0.33 dB
7500	4.29	+0.3 / -0.33 dB
7600	4.33	+0.3 / -0.33 dB
7700	4.38	+0.3 / -0.33 dB
7800	4.42	+0.3 / -0.33 dB
7900	4.51	+0.3 / -0.33 dB
8000	4.52	+0.3 / -0.33 dB
8100	4.55	+0.34 / -0.36 dB
8200	4.55	+0.34 / -0.36 dB

HL 4277: Test Cable (continued)

Set / Applied, MHz	Measured, dB	Uncertainty, dB
8300	4.57	+0.34 / -0.36 dB
8400	4.60	+0.34 / -0.36 dB
8500	4.60	+0.34 / -0.36 dB
8600	4.63	+0.34 / -0.36 dB
8700	4.63	+0.34 / -0.36 dB
8800	4.64	+0.34 / -0.36 dB
8900	4.65	+0.34 / -0.36 dB
9000	4.67	+0.34 / -0.36 dB
9100	4.69	+0.34 / -0.36 dB
9200	4.71	+0.34 / -0.36 dB
9300	4.73	+0.34 / -0.36 dB
9400	4.76	+0.34 / -0.36 dB
9500	4.78	+0.34 / -0.36 dB
9600	4.81	+0.34 / -0.36 dB
9700	4.85	+0.34 / -0.36 dB
9800	4.87	+0.34 / -0.36 dB
9900	4.89	+0.34 / -0.36 dB
10000	4.93	+0.34 / -0.36 dB
10100	4.96	+0.4 / -0.44 dB
10200	4.99	+0.4 / -0.44 dB
10300	5.02	+0.4 / -0.44 dB
10400	5.05	+0.4 / -0.44 dB
10500	5.08	+0.4 / -0.44 dB
10600	5.11	+0.4 / -0.44 dB
10700	5.14	+0.4 / -0.44 dB
10800	5.17	+0.4 / -0.44 dB
10900	5.19	+0.4 / -0.44 dB
11000	5.22	+0.4 / -0.44 dB
11100	5.25	+0.4 / -0.44 dB
11200	5.28	+0.4 / -0.44 dB
11300	5.31	+0.4 / -0.44 dB
11400	5.34	+0.4 / -0.44 dB
11500	5.38	+0.4 / -0.44 dB
11600	5.41	+0.4 / -0.44 dB
11700	5.45	+0.4 / -0.44 dB
11800	5.49	+0.4 / -0.44 dB
11900	5.53	+0.4 / -0.44 dB
12000	5.56	+0.4 / -0.44 dB
12100	5.60	+0.4 / -0.44 dB
12200	5.63	+0.4 / -0.44 dB
12300	5.68	+0.4 / -0.44 dB
12400	5.72	+0.4 / -0.44 dB
12500	5.75	+0.47 / -0.52 dB
12600	5.80	+0.47 / -0.52 dB
12700	5.84	+0.47 / -0.52 dB
12800	5.93	+0.47 / -0.52 dB
12900	5.94	+0.47 / -0.52 dB
13000	5.98	+0.47 / -0.52 dB
13100	6.03	+0.47 / -0.52 dB

Set / Applied, MHz	Measured, dB	Uncertainty, dB
13200	6.09	+0.47 / -0.52 dB
13300	6.17	+0.47 / -0.52 dB
13400	6.27	+0.47 / -0.52 dB
13500	6.37	+0.47 / -0.52 dB
13600	6.49	+0.47 / -0.52 dB
13700	6.57	+0.47 / -0.52 dB
13800	6.60	+0.47 / -0.52 dB
13900	6.61	+0.47 / -0.52 dB
14000	6.59	+0.47 / -0.52 dB
14100	6.57	+0.47 / -0.52 dB
14200	6.54	+0.47 / -0.52 dB
14300	6.53	+0.47 / -0.52 dB
14400	6.49	+0.47 / -0.52 dB
14500	6.48	+0.47 / -0.52 dB
14600	6.46	+0.47 / -0.52 dB
14700	6.46	+0.47 / -0.52 dB
14800	6.49	+0.47 / -0.52 dB
14900	6.51	+0.47 / -0.52 dB
15000	6.54	+0.47 / -0.52 dB
15100	6.57	+0.47 / -0.52 dB
15200	6.62	+0.47 / -0.52 dB
15300	6.64	+0.47 / -0.52 dB
15400	6.68	+0.47 / -0.52 dB
15500	6.71	+0.47 / -0.52 dB
15600	6.78	+0.47 / -0.52 dB
15700	6.79	+0.47 / -0.52 dB
15800	6.82	+0.47 / -0.52 dB
15900	6.88	+0.47 / -0.52 dB
16000	6.89	+0.47 / -0.52 dB
16100	6.96	+0.47 / -0.52 dB
16200	6.97	+0.47 / -0.52 dB
16300	7.02	+0.47 / -0.52 dB
16400	7.07	+0.47 / -0.52 dB
16500	7.12	+0.47 / -0.52 dB
16600	7.17	+0.47 / -0.52 dB
16700	7.20	+0.47 / -0.52 dB
16800	7.22	+0.47 / -0.52 dB
16900	7.23	+0.47 / -0.52 dB
17000	7.24	+0.47 / -0.52 dB
17100	7.27	+0.47 / -0.52 dB
17200	7.28	+0.47 / -0.52 dB
17300	7.28	+0.47 / -0.52 dB
17400	7.30	+0.47 / -0.52 dB
17500	7.34	+0.47 / -0.52 dB
17600	7.35	+0.47 / -0.52 dB
17700	7.39	+0.47 / -0.52 dB
17800	7.41	+0.47 / -0.52 dB
17900	7.41	+0.47 / -0.52 dB
18000	7.44	+0.47 / -0.52 dB

HL 5111: RF cable
Huber-Suhner, SF102EA/11SK/11SK/5500MM, s/n 502493/2EA

Set / Applied, MHz	Measured, dB	Uncertainty, dB
100	0.70	±0.07
200	0.99	±0.08
300	1.21	±0.08
500	1.56	±0.08
1000	2.20	±0.08
1500	2.69	±0.08
2000	3.11	±0.08
2500	3.50	±0.10
3000	3.85	±0.10
3500	4.16	±0.10
4000	4.47	±0.10
4500	4.74	±0.10
5000	5.03	±0.10
5500	5.30	±0.10
6000	5.57	±0.10
6500	5.76	±0.10
7000	6.00	±0.10
7500	6.20	±0.10
8000	6.44	±0.10
8500	6.67	±0.10
9000	6.82	±0.10
9500	7.04	±0.10
10000	7.18	±0.10
10500	7.36	±0.10
11000	7.55	±0.10
11500	7.75	±0.10
12000	7.90	±0.10
12500	8.08	±0.13
13000	8.19	±0.13
13500	8.39	±0.13
14000	8.58	±0.13
14500	8.76	±0.18
15000	8.92	±0.18
15500	9.03	±0.18
16000	9.18	±0.18
16500	9.34	±0.18
17000	9.51	±0.18
17500	9.66	±0.18
18000	9.80	±0.18
18500	9.94	±0.23
19000	10.05	±0.23
19500	10.22	±0.23

Set / Applied, MHz	Measured, dB	Uncertainty, dB
20000	10.32	±0.23
20500	10.48	±0.23
21000	10.60	±0.23
21500	10.73	±0.23
22000	10.87	±0.23
22500	10.97	±0.29
23000	11.09	±0.29
23500	11.26	±0.29
24000	11.37	±0.29
24500	11.50	±0.29
25000	11.61	±0.23
25500	11.72	±0.23
26000	11.87	±0.23
26500	11.99	±0.23
27000	12.09	±0.33
27500	12.24	±0.33
28000	12.34	±0.40
28500	12.47	±0.40
29000	12.61	±0.40
29500	12.70	±0.40
30000	12.86	±0.40
30500	12.92	±0.33
31000	13.09	±0.33
31500	13.16	±0.33
32000	13.33	±0.33
32500	13.40	±0.33
33000	13.62	±0.33
33500	13.70	±0.33
34000	13.88	±0.33
34500	13.97	±0.40
35000	14.05	±0.40
35500	14.23	±0.40
36000	14.25	±0.40
36500	14.46	±0.40
37000	14.49	±0.33
37500	14.72	±0.33
38000	14.77	±0.33
38500	14.97	±0.33
39000	15.04	±0.33
39500	15.22	±0.33
40000	15.63	±0.47

11 APPENDIX C 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.

12 APPENDIX D

Specification references

FCC 47CFR part 15: 2017	Radio Frequency Devices.
ANSI C63.2: 2006	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.
ANSI C63.10: 2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
ICES-003 Issue 6: 2016	Information Technology Equipment (Including Digital Apparatus) — Limits and Methods of Measurement
RSS-247 Issue 2: 2017	Digital Transmission Systems (DTSS), Frequency Hopping Systems (FHSS) and Licence-Exempt Local Area Network (LE-LAN) Devices
RSS-Gen Issue 5: 2018	General Requirements for Compliance of Radio Apparatus

13 APPENDIX E Abbreviations and acronyms

A	ampere	ms	millisecond
AC	alternating current	μs	microsecond
A/m	ampere per meter	NA	not applicable
AM	amplitude modulation	NB	narrow band
AVRG	average (detector)	NP	normal performance
BB	broad band	NT	not tested
cm	centimeter	OATS	open area test site
CCC	capacitive coupling clamp	Ω	Ohm
CDN	coupling/ decoupling network	QP	quasi-peak
CR	continuous phenomena applied to receivers	PM	pulse modulation
CT	continuous phenomena applied to transmitters	Pr	rated motor power
dB	decibel	PS	power supply
dBm	decibel referred to one milliwatt	pW	picowatt
dB(μV)	decibel referred to one microvolt	RE	radiated emission
dB(μV/m)	decibel referred to one microvolt per meter	RF	radio frequency
dB(μA)	decibel referred to one microampere	Ri	integral power supply resistance of the test pulse generator
dBΩ	decibel referred to one Ohm	rms	root mean square
DC	direct current	s	second
EMC	electromagnetic compatibility	THD	total harmonic distortion
EMI	electromagnetic interference	t _d	pulse duration
EN	European Norm	t _r	pulse rise time
EUT	equipment under test	t _f	pulse fall time
GHz	gigahertz	t ₁	pulse repetition rate
GND	ground	t ₄	burst duration
H	height	t ₅	time between bursts
HCP	horizontal coupling plane	t ₄ + t ₅	burst cycle time
HL	Hermon laboratories	TR	transient phenomena applied to receivers
Hz	hertz	TT	transient phenomena applied to transmitters
ITE	information technology equipment	U _s	peak amplitude
k	kilo	U _s *	clamped voltage
kHz	kilohertz	U _{s1}	peak amplitude, negative
kV	kilovolt	U _{s2}	peak amplitude, positive
L	length	V	volt
LISN	line impedance stabilization network	V _s	peak amplitude
m	meter	VA	volt-ampere
MHz	megahertz	VCP	vertical coupling plane
min	minute	W	width
mm	millimeter		

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