

TEST REPORT

ACCORDING TO: FCC 47CFR part 15 subpart C § 15.247 (DTS),
RSS-247 issue 2, RSS-Gen issue 5

FOR:

Essence Security International Ltd.
Mobile Personal Emergency Response System
Model: ES900MPRS
FCC ID: YXG-ES900MPRS
IC: 11061A-ES900MPRS

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: Essence Security International Ltd.
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Telephone: +972 732 447 735
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E-mail: israelgo@essence-grp.com
Contact name: Mr. Israel Gottesman

2 Equipment under test attributes

Product name: Mobile Personal Emergency Response System
Product type: Transceiver
Model(s): ES900MPRS
Serial number: 22082021
Hardware version: 1.2
Software release: 01.01
Receipt date 28-Jun-21

3 Manufacturer information

Manufacturer name: Essence Security International Ltd.
Address: 12 Abba Eban Avenue, Ackerstein Towers Bldg. D, P.O.Box 2073, Herzliya 4612001, Israel
Telephone: +972 732 447 735
Fax: +972 9956 4182
E-Mail: israelgo@essence-grp.com
Contact name: Mr. Israel Gottesman

4 Test details

Project ID: 42299
Location: Hermon Laboratories Ltd. P.O. Box 23, Binyamina 3055001, Israel
Test started: 28-Jun-21
Test completed: 06-Jul-21
Test specification(s): FCC 47CFR part 15 subpart C § 15.247 (DTS);
RSS-247 issue 2, RSS-Gen issue 5

5 Tests summary

Test	Status
Transmitter characteristics	
FCC section 15.247(a)2 / RSS-247 section 5.2(a), 6 dB and 99% 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 2.5.2, 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), Band edge emissions	Pass
FCC section 15.203 / RSS-Gen section 6.8, Antenna requirement	Pass
FCC section 15.247(e) / RSS-247 section 5.2(b), Peak power density	Pass
FCC section 15.207(a) / RSS-Gen section 8.8, Conducted emission	Not required

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:ESSRAD_FCC.42299.

	Name and Title	Date	Signature
Tested by:	Mr. A. Morozov, test engineer	July 6, 2021	
Reviewed by:	Mrs. M. Cherniavsky, certification engineer	November 17, 2021	
Approved by:	Mr. S. Samokha, Technical Manager, EMC and Radio	November 17, 2021	

6 EUT description

Note: The following data in this clause is provided by the customer and represents his sole responsibility.

6.1 General information

The EUT, Mobile Personal Emergency Response System (mPERS) is a small emergency device that a person can put in his pocket while travelling outside home.

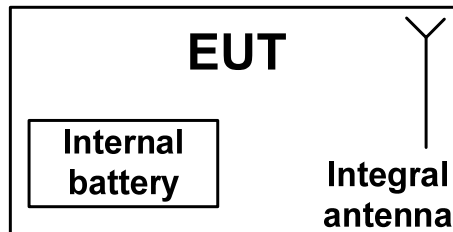
When emergency happened (feeling bad, fall detection) the LTE module will send a message to the monitoring center/family member with the person location (by using the Wi-Fi as receiver to locate positioning). The LTE module ES900BG77 approved by FCC and IC, FCC ID:YXG-ES900BG77, IC:11061A-ES900BG77. The BLE module is used in manufacture line to update the device configuration (since the device is hermetic close) before sending to customer.

The system includes a pendant and a charging cradle.

The EUT in charging mode is receiving power wirelessly from a WPT source (charging cradle).

This test report represents test results for 2.4 GHz BLE radio of the pendant.

6.2 Test configuration



6.3 Changes made in EUT

No changes were implemented in the EUT during the testing.

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					
☒	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 5.82 dBm			
Is transmitter output power variable?		☒	No		
		☐	Yes	continuous variable	
				stepped variable with stepsize dB	
				minimum RF power	dBm
				maximum RF power	dBm
Antenna connection					
☐	☐	☒	Integral	☐ with temporary RF connector	
				☒	without temporary RF connector
Antenna/s technical characteristics					
Type	Manufacturer	Model number		Gain	
Integral	INPAQ	ACA-5036-A2-CC-S		Typical peak gain: 3 dBi	
Transmitter aggregate data rate/s		1 Mbps			
Type of modulation		GFSK			
Modulating test signal (baseband)		PRBS			
Transmitter power source					
☒	Battery	Nominal rated voltage	3.8 VDC	Battery type	Lithium Rechargeable
☐	DC	Nominal rated voltage			
☐	AC mains	Nominal rated voltage		Frequency	Hz

Test specification: Section 15.247(a)2 / RSS-247 section 5.2(a), 6 dB and 99% bandwidth			
Test procedure: ANSI C63.10 section 11.8.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 29-Jun-21			
Temperature: 25 °C	Relative Humidity: 49 %	Air Pressure: 1004 hPa	Power: 3.8 VDC
Remarks:			

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

7.1 Minimum 6 dB and 99% bandwidth

7.1.1 General

This test was performed to measure 6 dB and 99% bandwidth of the EUT carrier frequency. Specification test limits are given in Table 7.1.1, Table 7.1.2.

Table 7.1.1 The 6 dB bandwidth limits

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

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

Table 7.1.2 The 99% bandwidth limits

Assigned frequency, MHz	Modulation envelope reference points	Limit, kHz
2400.0 – 2483.5	99%	NA

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 7.1.3, Table 7.1.4 and the associated plots.

Figure 7.1.1 The 6 dB bandwidth test setup





Test specification: Section 15.247(a)2 / RSS-247 section 5.2(a), 6 dB and 99% bandwidth			
Test procedure: ANSI C63.10 section 11.8.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 29-Jun-21			
Temperature: 25 °C	Relative Humidity: 49 %	Air Pressure: 1004 hPa	Power: 3.8 VDC
Remarks:			

Table 7.1.3 The 6 dB bandwidth test results

ASSIGNED FREQUENCY BAND: 2400.0 – 2483.5 MHz
 DETECTOR USED: Peak
 RESOLUTION BANDWIDTH: 100 kHz
 VIDEO BANDWIDTH: 300 kHz
 MODULATION: GFSK
 BITRATE: 1 Mbps

Carrier frequency, MHz	6 dB bandwidth, kHz	Limit, kHz	Margin, kHz	Verdict
Low frequency				
2402.0	698.3	500.0	198.3	Pass
Mid frequency				
2440.0	707.3	500.0	207.3	Pass
High frequency				
2480.0	704.3	500.0	204.3	Pass

Table 7.1.4 The 99% bandwidth test results

ASSIGNED FREQUENCY BAND: 2400.0 – 2483.5 MHz
 DETECTOR USED: Peak
 RESOLUTION BANDWIDTH: 100 kHz
 VIDEO BANDWIDTH: 300 kHz
 MODULATION: GFSK
 BITRATE: 1 Mbps

Carrier frequency, MHz	99% bandwidth, kHz	Limit, kHz	Margin, kHz	Verdict
Low frequency				
2402.0	1036.96	NA	NA	Pass
Mid frequency				
2440.0	1036.96	NA	NA	Pass
High frequency				
2480.0	1030.97	NA	NA	Pass

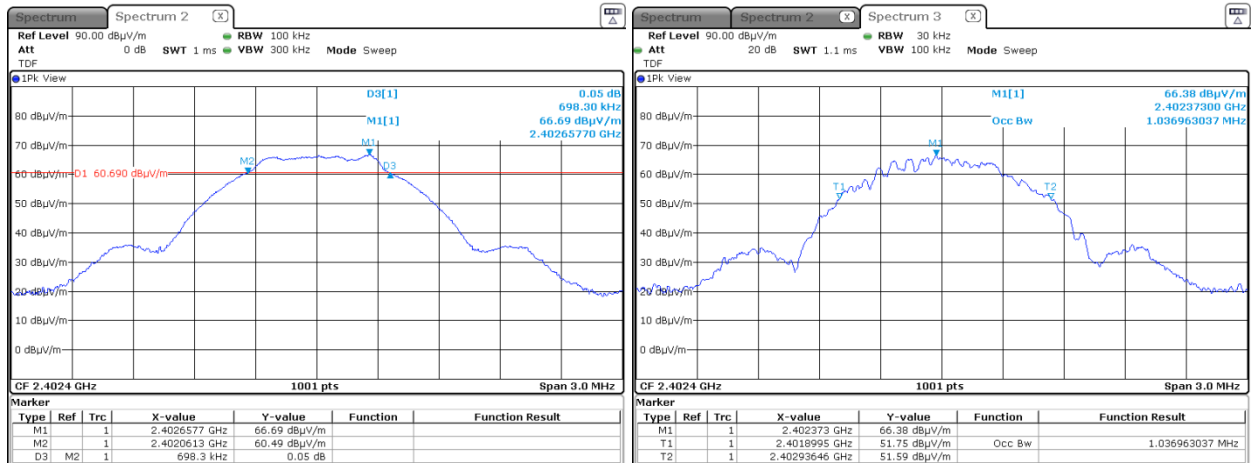
Reference numbers of test equipment used

HL 4355								
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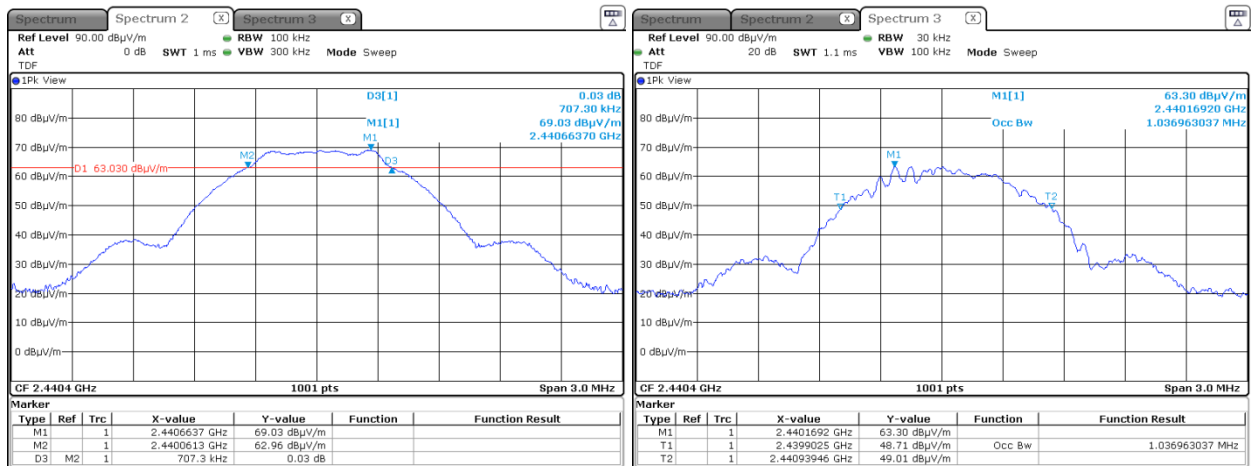
Full description is given in Appendix A.

Test specification: Section 15.247(a)2 / RSS-247 section 5.2(a), 6 dB and 99% bandwidth			
Test procedure: ANSI C63.10 section 11.8.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 29-Jun-21			
Temperature: 25 °C	Relative Humidity: 49 %	Air Pressure: 1004 hPa	Power: 3.8 VDC
Remarks:			

Plot 7.1.1 The 6 dB and 99% bandwidth test result at low frequency

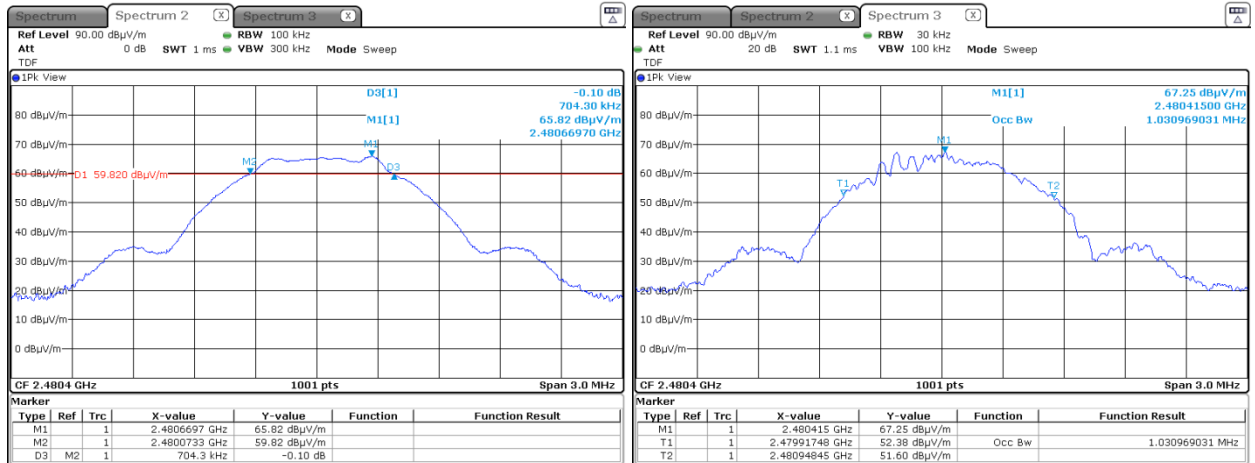


Plot 7.1.2 The 6 dB and 99% bandwidth test result at mid frequency



Test specification:		Section 15.247(a)2 / RSS-247 section 5.2(a), 6 dB and 99% bandwidth	
Test procedure:		ANSI C63.10 section 11.8.1	
Test mode:		Verdict: PASS	
Date(s):			
29-Jun-21			
Temperature: 25 °C	Relative Humidity: 49 %	Air Pressure: 1004 hPa	Power: 3.8 VDC
Remarks:			

Plot 7.1.3 The 6 dB and 99% bandwidth test result at high frequency





Test specification: Section 15.247(b)3/ RSS-247 section 5.4(d), Maximum output power			
Test procedure: ANSI C63.10 section 11.9.2.2.4			
Test mode: Compliance		Verdict: PASS	
Date(s): 28-Jun-21 - 29-Jun-21			
Temperature: 25 °C	Relative Humidity: 48 %	Air Pressure: 1004 hPa	Power: 3.8 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	
2400.0 – 2483.5	6.0	1.0	30.0	131.2

*- 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 the 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.

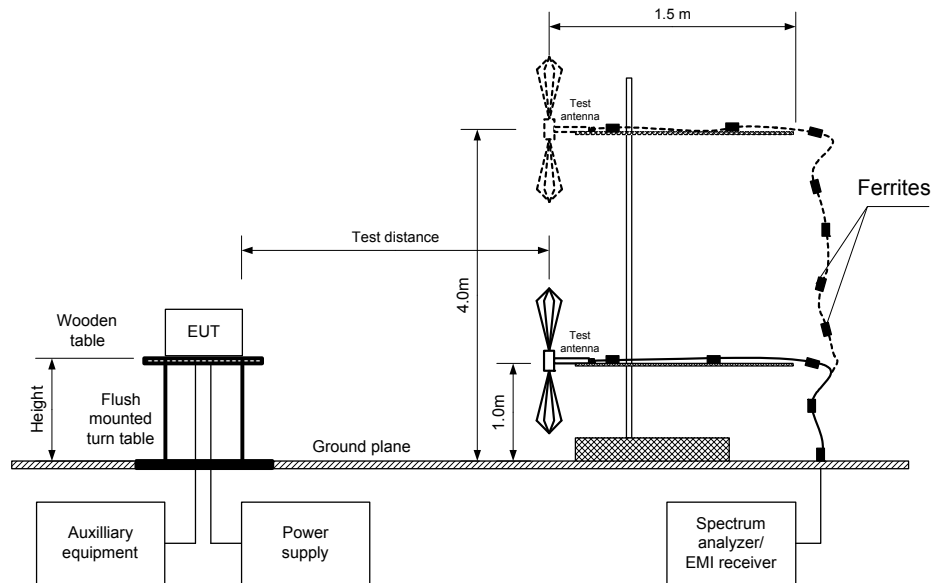
The above equation was converted in logarithmic units for 3 m test distance:

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

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

Test specification:		Section 15.247(b)3/ RSS-247 section 5.4(d), Maximum output power	
Test procedure:		ANSI C63.10 section 11.9.2.2.4	
Test mode:		Verdict: PASS	
Date(s):			
28-Jun-21 - 29-Jun-21			
Temperature: 25 °C	Relative Humidity: 48 %	Air Pressure: 1004 hPa	Power: 3.8 VDC
Remarks:			

Figure 7.2.1 Setup for carrier field strength measurements



Test specification: Section 15.247(b)3/ RSS-247 section 5.4(d), Maximum output power			
Test procedure: ANSI C63.10 section 11.9.2.2.4			
Test mode: Compliance		Verdict: PASS	
Date(s): 28-Jun-21 - 29-Jun-21			
Temperature: 25 °C	Relative Humidity: 48 %	Air Pressure: 1004 hPa	Power: 3.8 VDC
Remarks:			

Table 7.2.2 Peak output power test results

ASSIGNED FREQUENCY: 2400.0 – 2483.5 MHz
 TEST DISTANCE: 3 m
 TEST SITE: Semi anechoic chamber
 EUT HEIGHT: 1.5 m
 DETECTOR USED: Peak
 TEST ANTENNA TYPE: Double ridged guide (above 1000 MHz)
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum
 DETECTOR USED: Peak
 RESOLUTION BANDWIDTH: 3 MHz
 VIDEO BANDWIDTH: 10 MHz

MODULATION: GFSK
 BITRATE: 1 Mbps

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
2402.0	102.16	Horizontal	1.25	230	3.0	3.96	30	-26.04	Pass
2440.0	103.45	Horizontal	1.49	225	3.0	5.25	30	-24.75	Pass
2480.0	104.02	Horizontal	1.30	235	3.0	5.82	30	-24.18	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 Z-axis position.

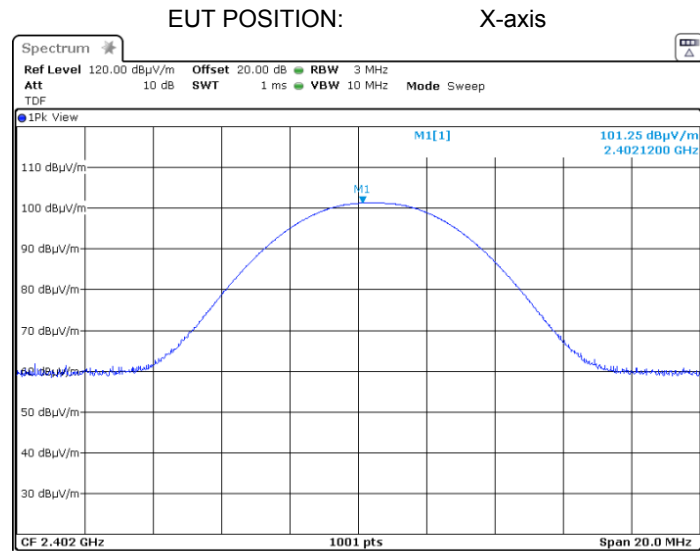
Reference numbers of test equipment used

HL 3903	HL 4355	HL 4933	HL 5902				
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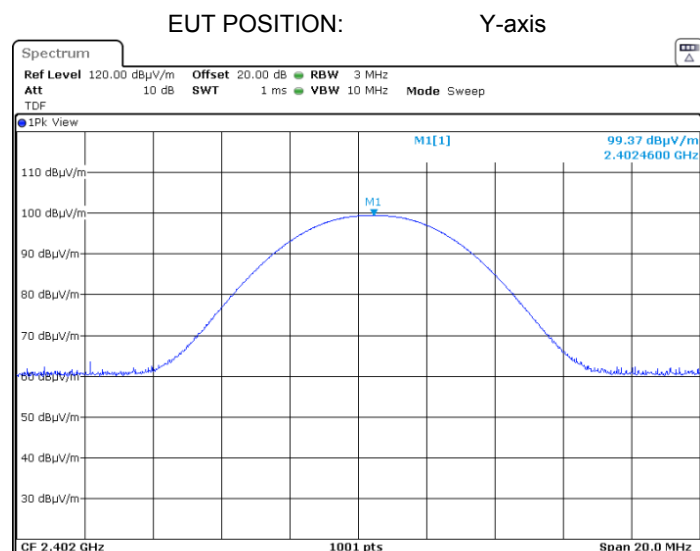
Full description is given in Appendix A.

Test specification: Section 15.247(b)3/ RSS-247 section 5.4(d), Maximum output power			
Test procedure: ANSI C63.10 section 11.9.2.2.4			
Test mode: Compliance		Verdict: PASS	
Date(s): 28-Jun-21 - 29-Jun-21			
Temperature: 25 °C	Relative Humidity: 48 %	Air Pressure: 1004 hPa	Power: 3.8 VDC
Remarks:			

Plot 7.2.1 Field strength of carrier at low frequency

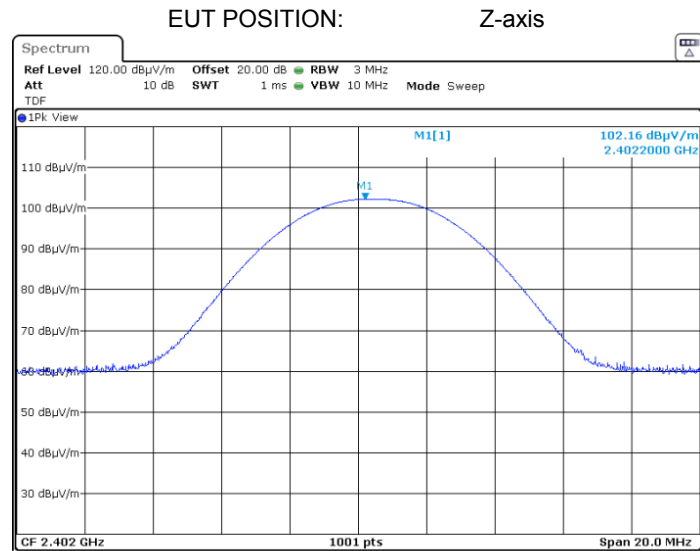


Plot 7.2.2 Field strength of carrier at low frequency

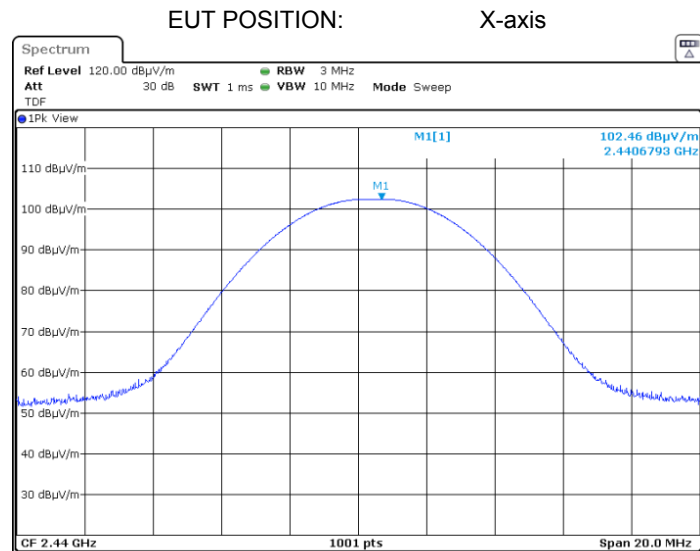


Test specification:		Section 15.247(b)3/ RSS-247 section 5.4(d), Maximum output power	
Test procedure:		ANSI C63.10 section 11.9.2.2.4	
Test mode:		Verdict: PASS	
Date(s):			
28-Jun-21 - 29-Jun-21			
Temperature: 25 °C	Relative Humidity: 48 %	Air Pressure: 1004 hPa	Power: 3.8 VDC
Remarks:			

Plot 7.2.3 Field strength of carrier at low frequency

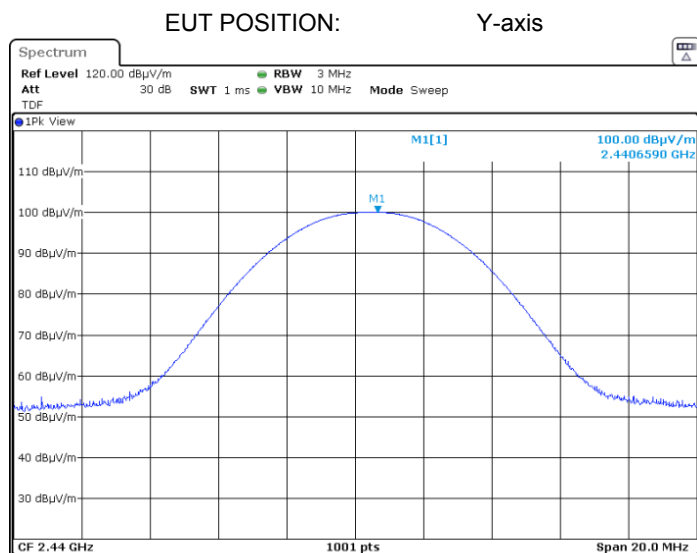


Plot 7.2.4 Field strength of carrier at mid frequency

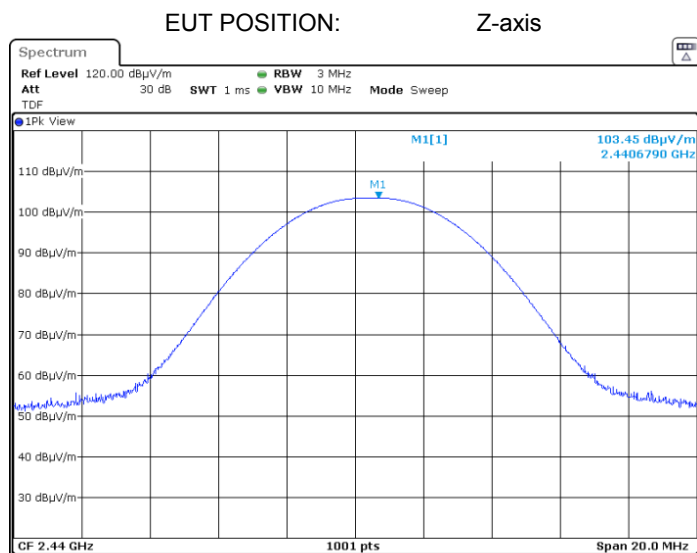


Test specification: Section 15.247(b)3/ RSS-247 section 5.4(d), Maximum output power			
Test procedure: ANSI C63.10 section 11.9.2.2.4			
Test mode: Compliance		Verdict: PASS	
Date(s): 28-Jun-21 - 29-Jun-21			
Temperature: 25 °C	Relative Humidity: 48 %	Air Pressure: 1004 hPa	Power: 3.8 VDC
Remarks:			

Plot 7.2.5 Field strength of carrier at mid frequency

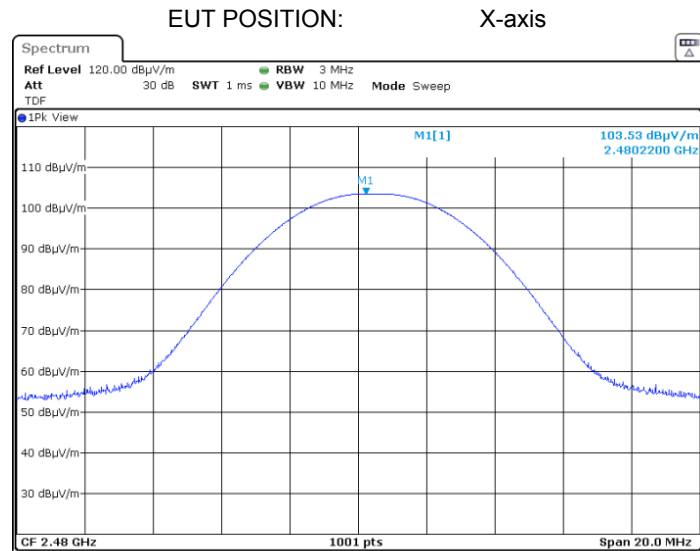


Plot 7.2.6 Field strength of carrier at mid frequency

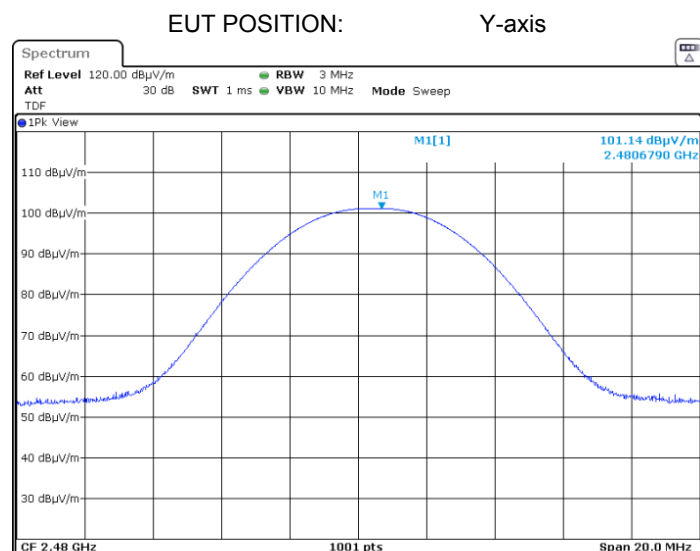


Test specification: Section 15.247(b)3/ RSS-247 section 5.4(d), Maximum output power			
Test procedure: ANSI C63.10 section 11.9.2.2.4			
Test mode: Compliance		Verdict: PASS	
Date(s): 28-Jun-21 - 29-Jun-21			
Temperature: 25 °C	Relative Humidity: 48 %	Air Pressure: 1004 hPa	Power: 3.8 VDC
Remarks:			

Plot 7.2.7 Field strength of carrier at high frequency



Plot 7.2.8 Field strength of carrier at high frequency



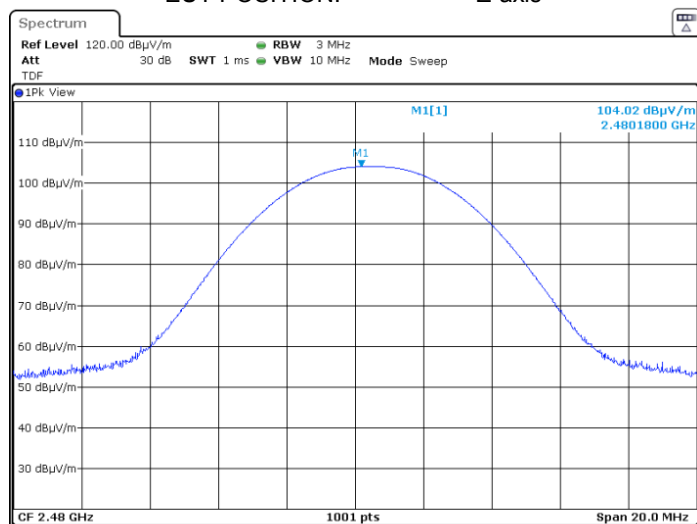


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Test specification: Section 15.247(b)3/ RSS-247 section 5.4(d), Maximum output power			
Test procedure: ANSI C63.10 section 11.9.2.2.4			
Test mode: Compliance		Verdict: PASS	
Date(s): 28-Jun-21 - 29-Jun-21			
Temperature: 25 °C	Relative Humidity: 48 %	Air Pressure: 1004 hPa	Power: 3.8 VDC
Remarks:			

Plot 7.2.9 Field strength of carrier at high frequency

EUT POSITION: Z-axis





Test specification:		Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions	
Test procedure:		ANSI C63.10 section 11.12.1	
Test mode:		Verdict: PASS	
Date(s):			
28-Jun-21 - 29-Jun-21			
Temperature: 25 °C	Relative Humidity: 48 %	Air Pressure: 1004 hPa	Power: 3.8 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 tenth 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: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 28-Jun-21 - 29-Jun-21			
Temperature: 25 °C	Relative Humidity: 48 %	Air Pressure: 1004 hPa	Power: 3.8 VDC
Remarks:			

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

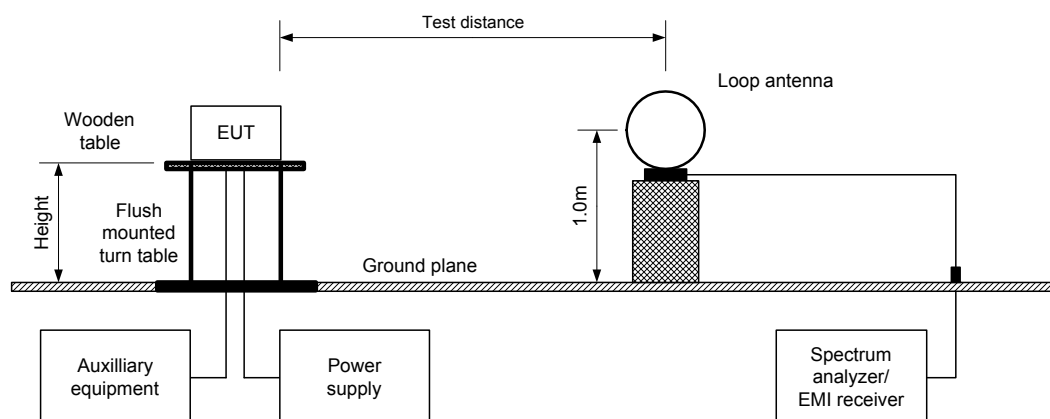
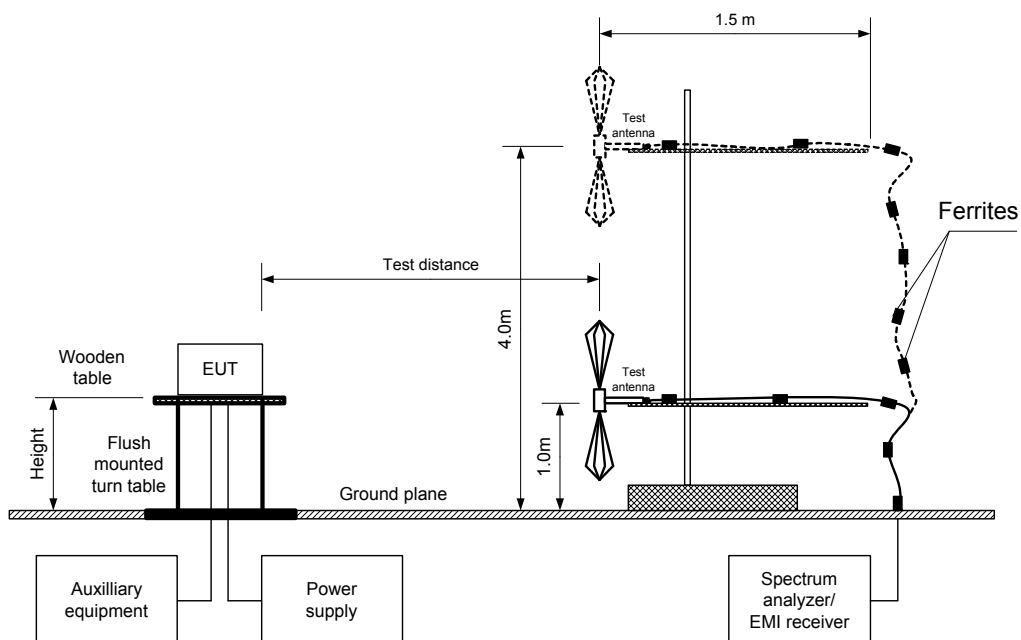
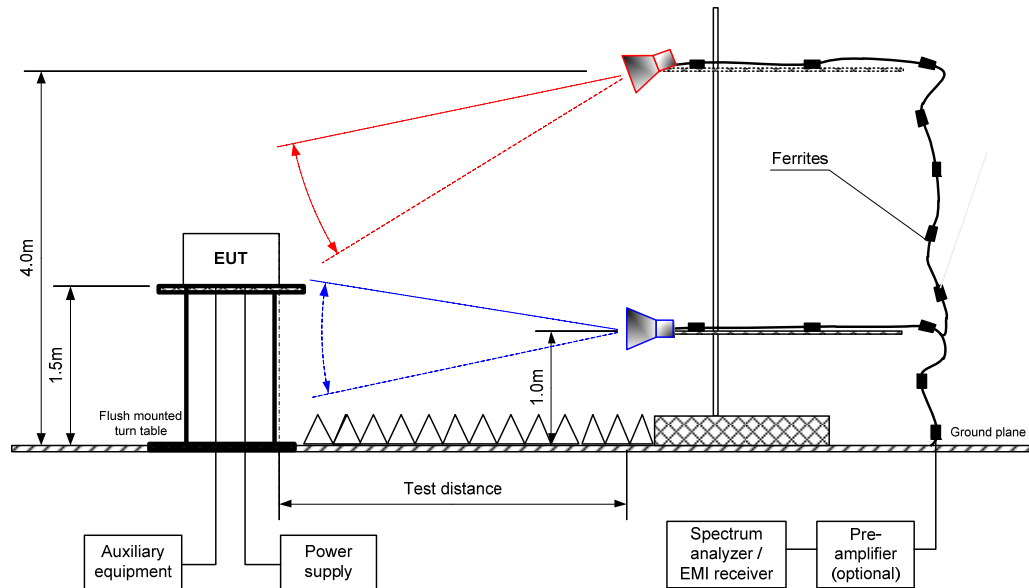


Figure 7.3.2 Setup for spurious emission field strength measurements in 30 – 1000 MHz



Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 28-Jun-21 - 29-Jun-21			
Temperature: 25 °C	Relative Humidity: 48 %	Air Pressure: 1004 hPa	Power: 3.8 VDC
Remarks:			

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





Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 28-Jun-21 - 29-Jun-21			
Temperature: 25 °C	Relative Humidity: 48 %	Air Pressure: 1004 hPa	Power: 3.8 VDC
Remarks:			

Table 7.3.2 Field strength of emissions outside restricted bands

ASSIGNED FREQUENCY BAND:	2400.0 – 2483.5 MHz
INVESTIGATED FREQUENCY RANGE:	0.009 - 25000 MHz
TEST DISTANCE:	3 m
MODULATION:	GFSK
BIT RATE:	1 Mbps
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, 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 2402 MHz									
No emissions were found									Pass
Mid carrier frequency 2440 MHz									
No emissions were found									Pass
High carrier frequency 2480 MHz									
No emissions were found									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 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
BIT RATE:	1 Mbps
DUTY CYCLE:	100 %
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(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 2402 MHz											
4804.327	Horizontal	1.93	143	49.61	74.0	-24.39	46.86	NA	54.0	-7.14	Pass
Mid carrier frequency 2440 MHz											
4881.080	Horizontal	1.62	146	49.86	74.0	-24.14	46.48	NA	54.0	-7.52	Pass
High carrier frequency 2480 MHz											
4961.320	Vertical	1.02	44	50.20	74.0	-23.80	45.69	NA	54.0	-8.31	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: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance	Verdict: PASS		
Date(s): 28-Jun-21 - 29-Jun-21			
Temperature: 25 °C	Relative Humidity: 48 %	Air Pressure: 1004 hPa	Power: 3.8 VDC
Remarks:			

Table 7.3.4 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
 BIT RATE: 1 Mbps
 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, 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 2402 MHz								
No emissions were found								Pass
Mid carrier frequency 2440 MHz								
No emissions were found								Pass
High carrier frequency 2480 MHz								
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 3903	HL 4360	HL 4933	HL 4956	HL 5288	HL 5112	HL 5902	HL 0446
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Full description is given in Appendix A.



HERMON LABORATORIES

Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 28-Jun-21 - 29-Jun-21			
Temperature: 25 °C	Relative Humidity: 48 %	Air Pressure: 1004 hPa	Power: 3.8 VDC
Remarks:			

Table 7.3.5 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	

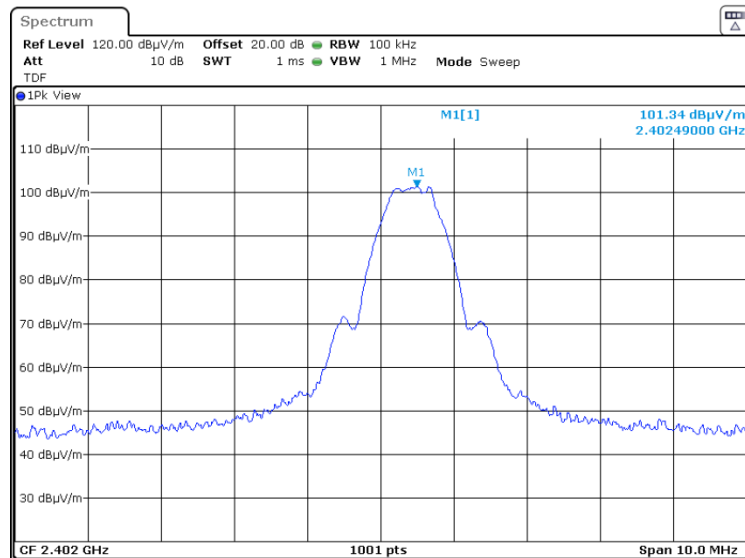
Table 7.3.6 Restricted bands according to RSS-Gen

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

Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 28-Jun-21 - 29-Jun-21			
Temperature: 25 °C	Relative Humidity: 48 %	Air Pressure: 1004 hPa	Power: 3.8 VDC
Remarks:			

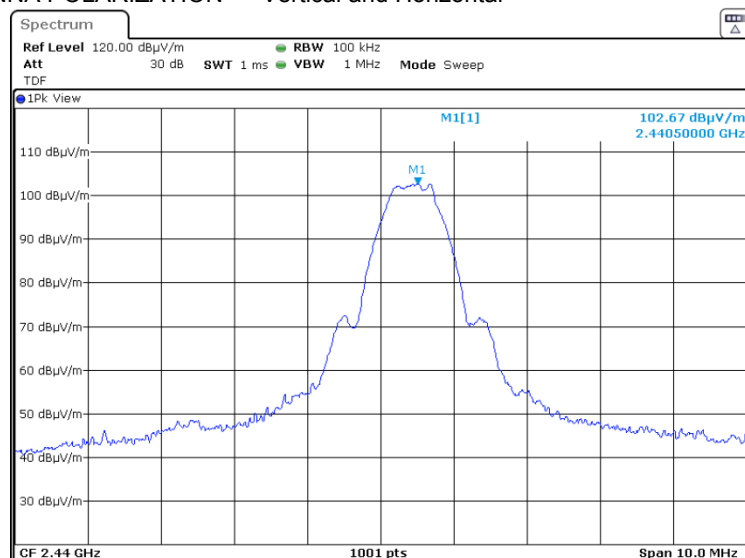
Plot 7.3.1 Radiated emission measurements at the low carrier frequency

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





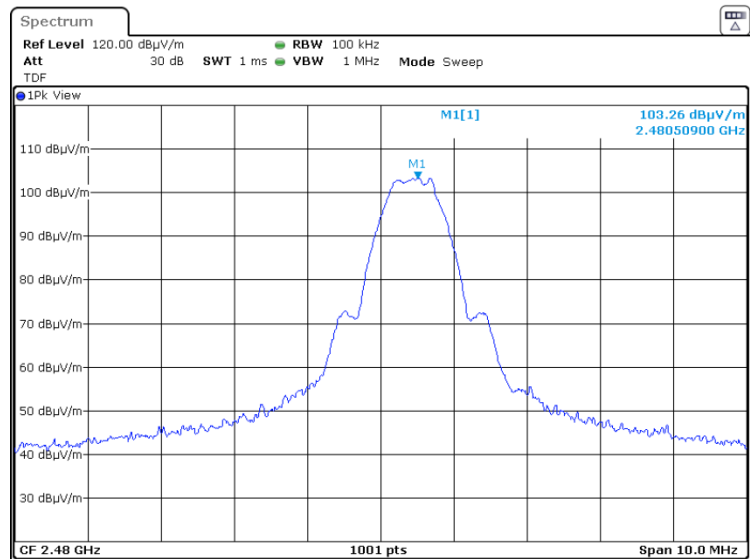
HERMON LABORATORIES

Report ID: ESSRAD_FCC.42299_rev1.docx
Date of Issue: 17-Nov-21

Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 28-Jun-21 - 29-Jun-21			
Temperature: 25 °C	Relative Humidity: 48 %	Air Pressure: 1004 hPa	Power: 3.8 VDC
Remarks:			

Plot 7.3.3 Radiated emission measurements at the high carrier frequency

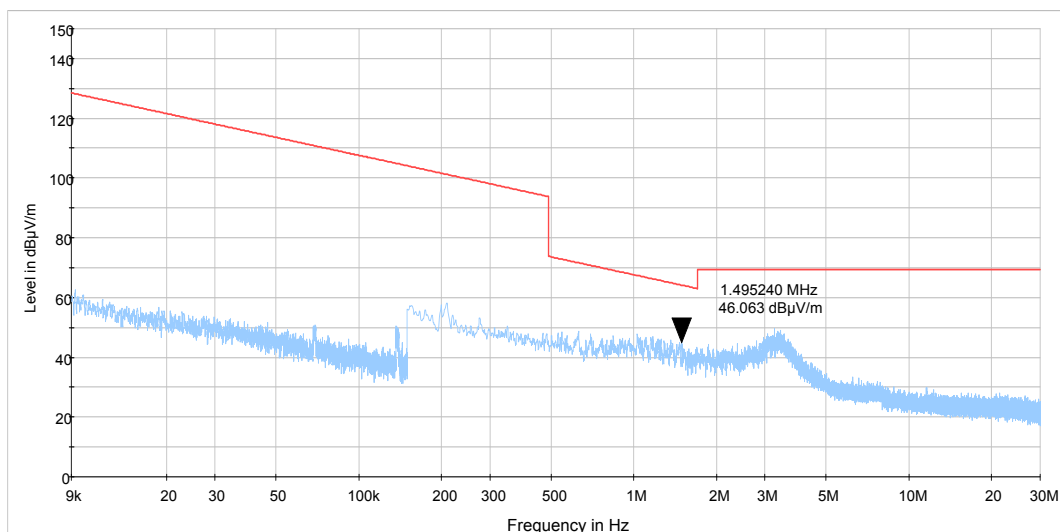
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal



Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 28-Jun-21 - 29-Jun-21			
Temperature: 25 °C	Relative Humidity: 48 %	Air Pressure: 1004 hPa	Power: 3.8 VDC
Remarks:			

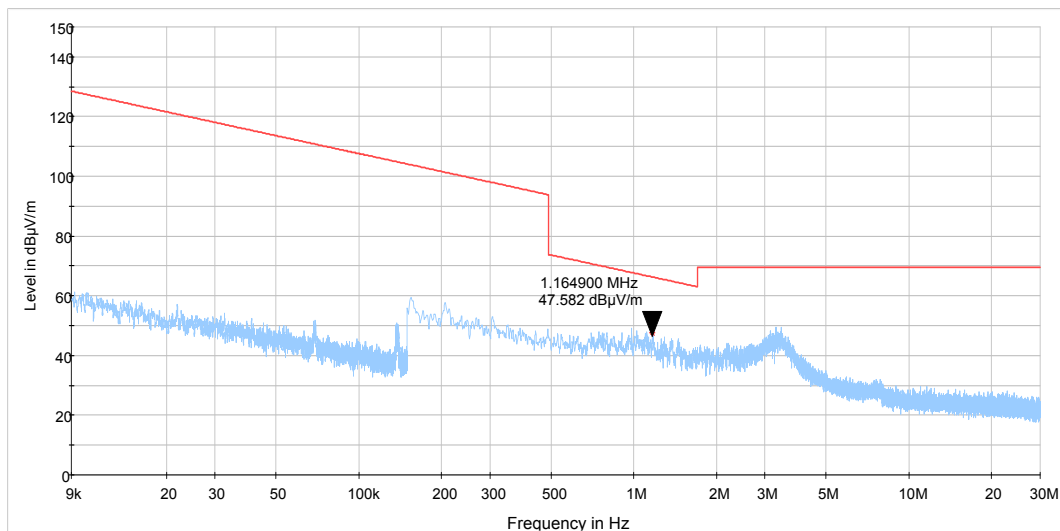
Plot 7.3.4 Radiated emission measurements from 9 kHz to 30 MHz at the low carrier frequency

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



Plot 7.3.5 Radiated emission measurements from 9 kHz to 30 MHz at the mid carrier frequency

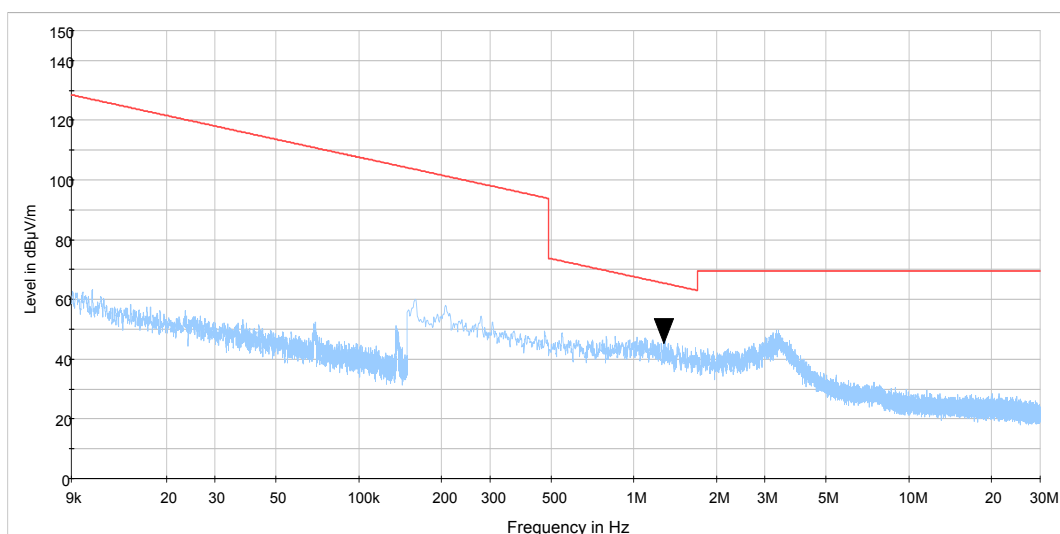
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical



Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 28-Jun-21 - 29-Jun-21			
Temperature: 25 °C	Relative Humidity: 48 %	Air Pressure: 1004 hPa	Power: 3.8 VDC
Remarks:			

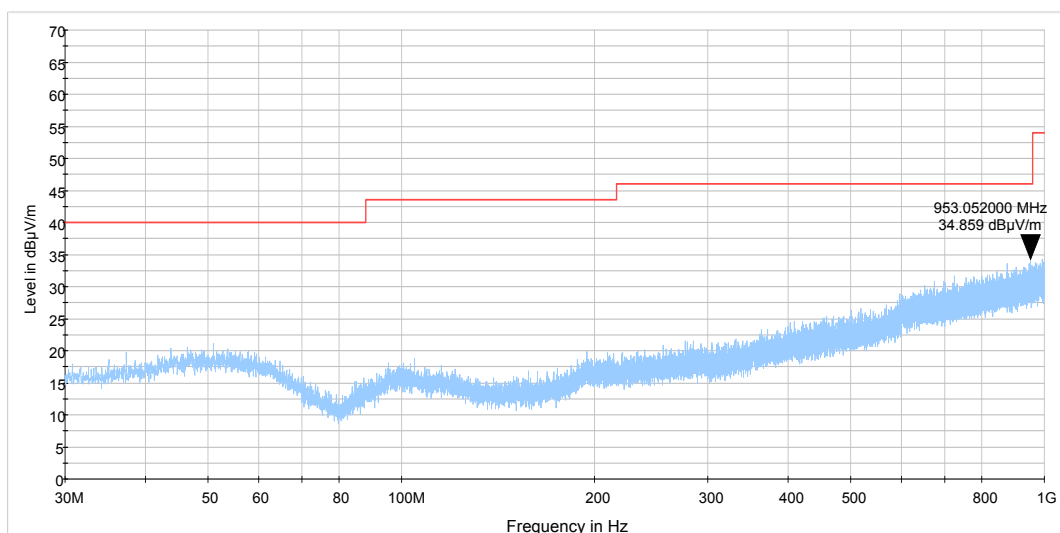
Plot 7.3.6 Radiated emission measurements from 9 kHz to 30 MHz at the high carrier frequency

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



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

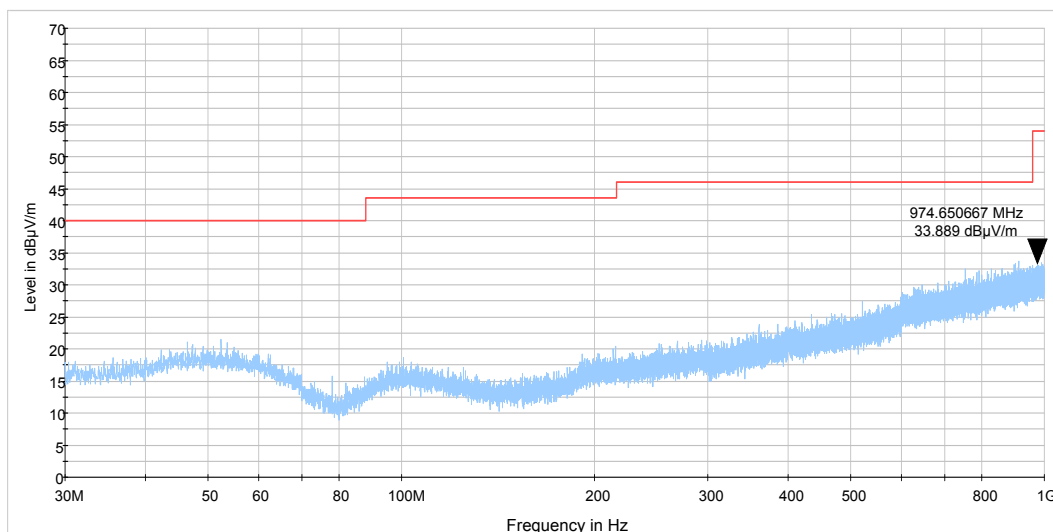
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal



Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 28-Jun-21 - 29-Jun-21			
Temperature: 25 °C	Relative Humidity: 48 %	Air Pressure: 1004 hPa	Power: 3.8 VDC
Remarks:			

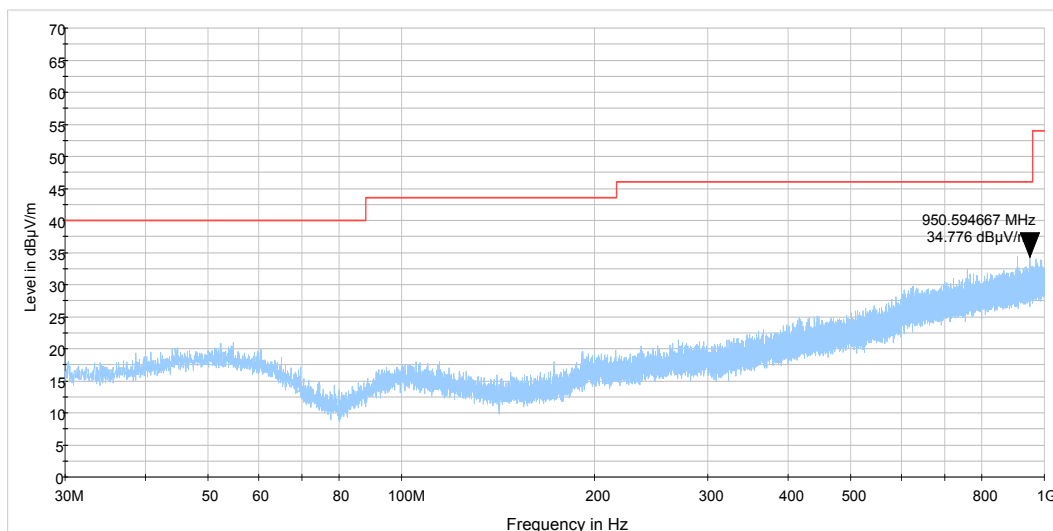
Plot 7.3.8 Radiated emission measurements from 30 to 1000 MHz at the mid carrier frequency

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



Plot 7.3.9 Radiated emission measurements from 30 to 1000 MHz at the high carrier frequency

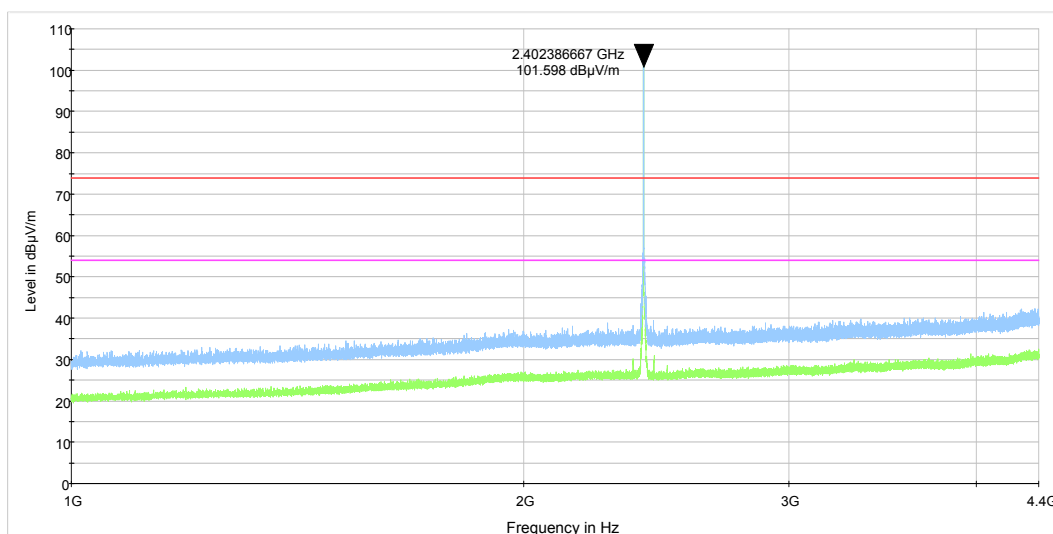
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal



Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 28-Jun-21 - 29-Jun-21			
Temperature: 25 °C	Relative Humidity: 48 %	Air Pressure: 1004 hPa	Power: 3.8 VDC
Remarks:			

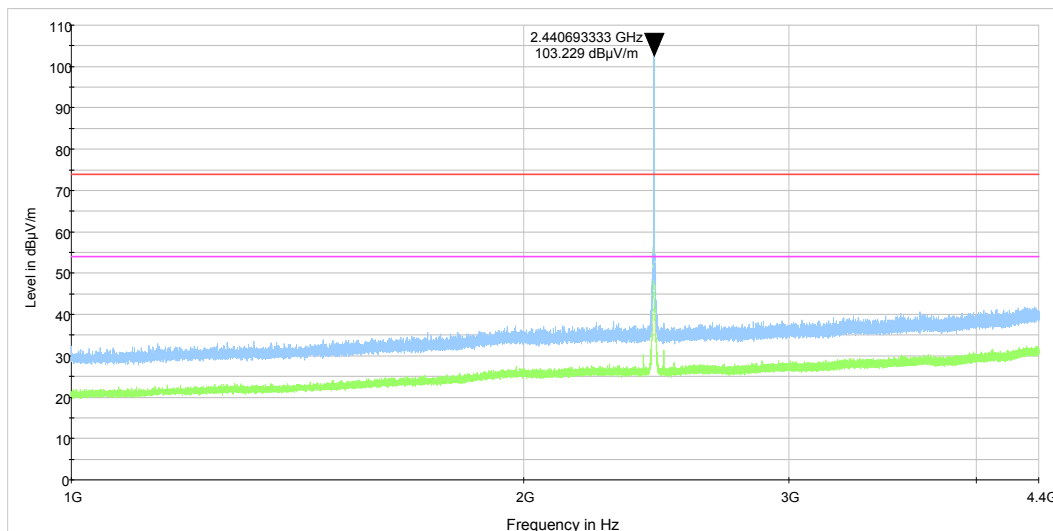
Plot 7.3.10 Radiated emission measurements from 1000 to 4400 MHz at the low carrier frequency

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



Plot 7.3.11 Radiated emission measurements from 1000 to 4400 MHz at the mid carrier frequency

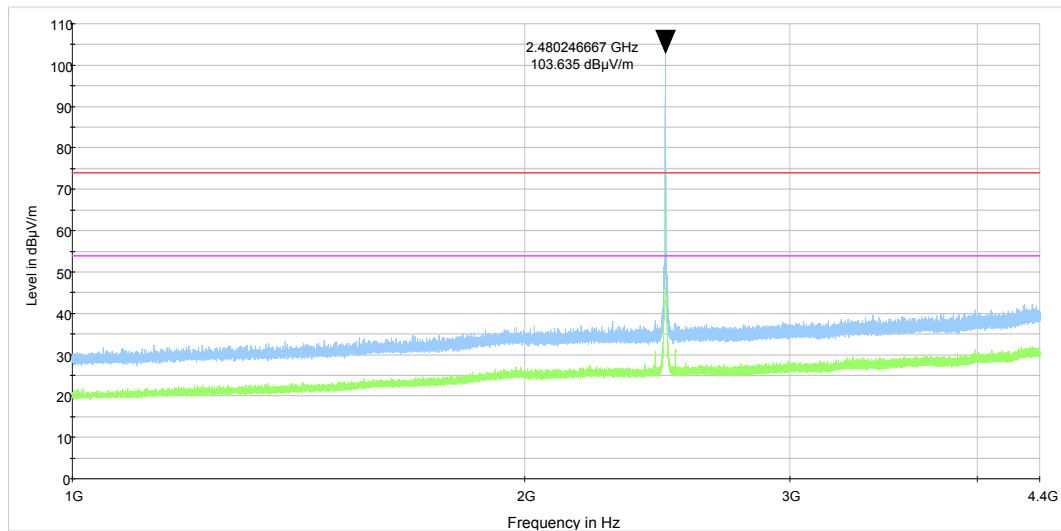
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal



Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 28-Jun-21 - 29-Jun-21			
Temperature: 25 °C	Relative Humidity: 48 %	Air Pressure: 1004 hPa	Power: 3.8 VDC
Remarks:			

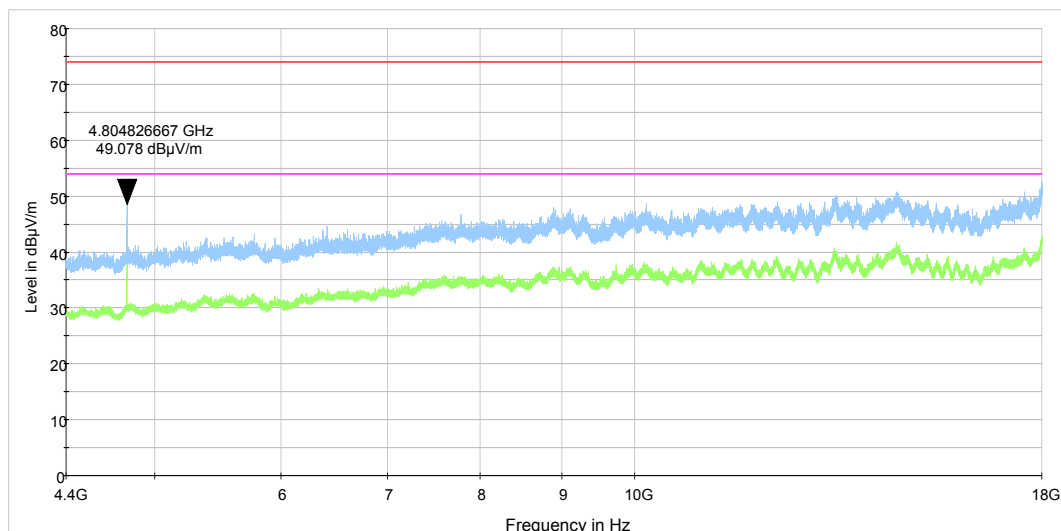
Plot 7.3.12 Radiated emission measurements from 1000 to 4400 MHz at the high carrier frequency

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



Plot 7.3.13 Radiated emission measurements from 4400 to 18000 MHz at the low carrier frequency

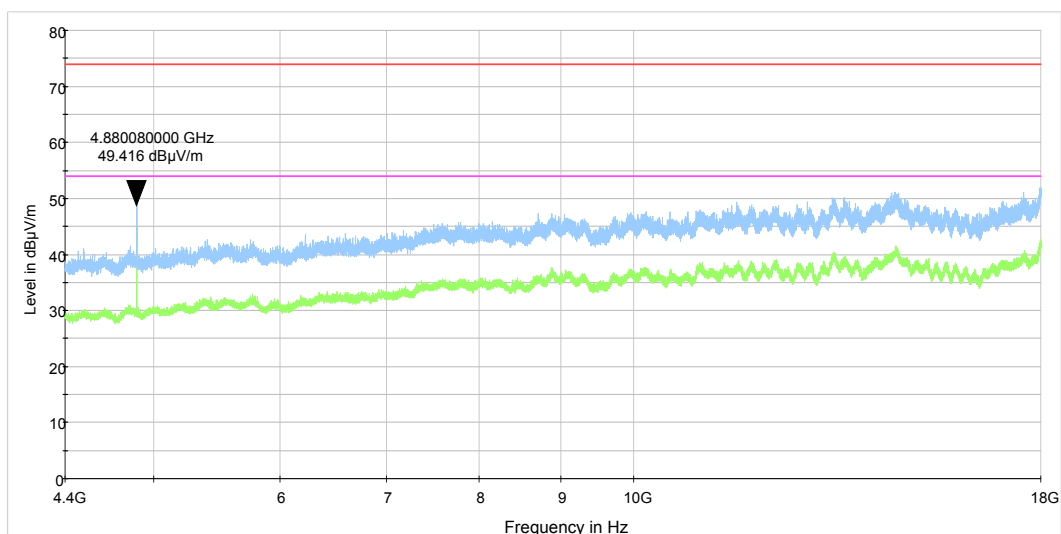
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal



Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 28-Jun-21 - 29-Jun-21			
Temperature: 25 °C	Relative Humidity: 48 %	Air Pressure: 1004 hPa	Power: 3.8 VDC
Remarks:			

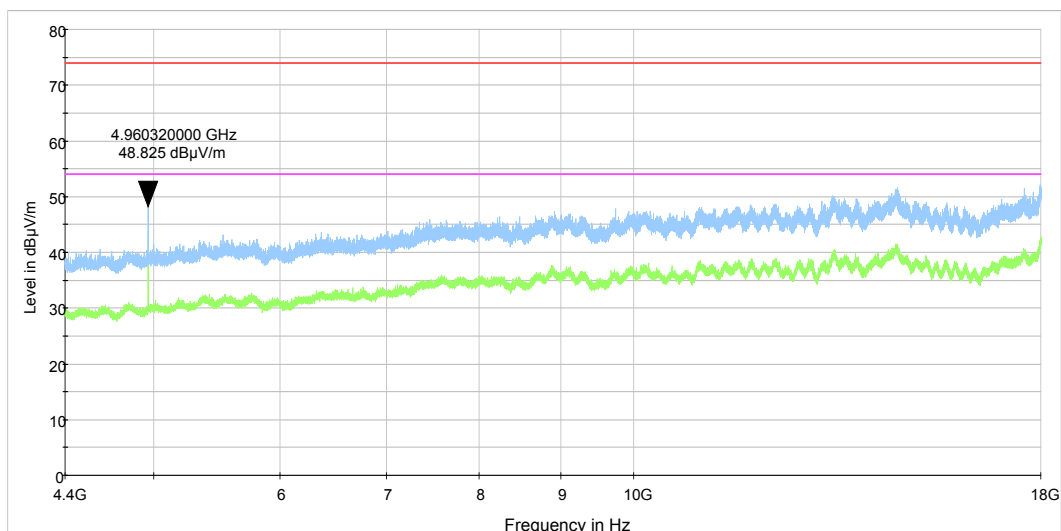
Plot 7.3.14 Radiated emission measurements from 4400 to 18000 MHz at the mid carrier frequency

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



Plot 7.3.15 Radiated emission measurements from 4400 to 18000 MHz at the high carrier frequency

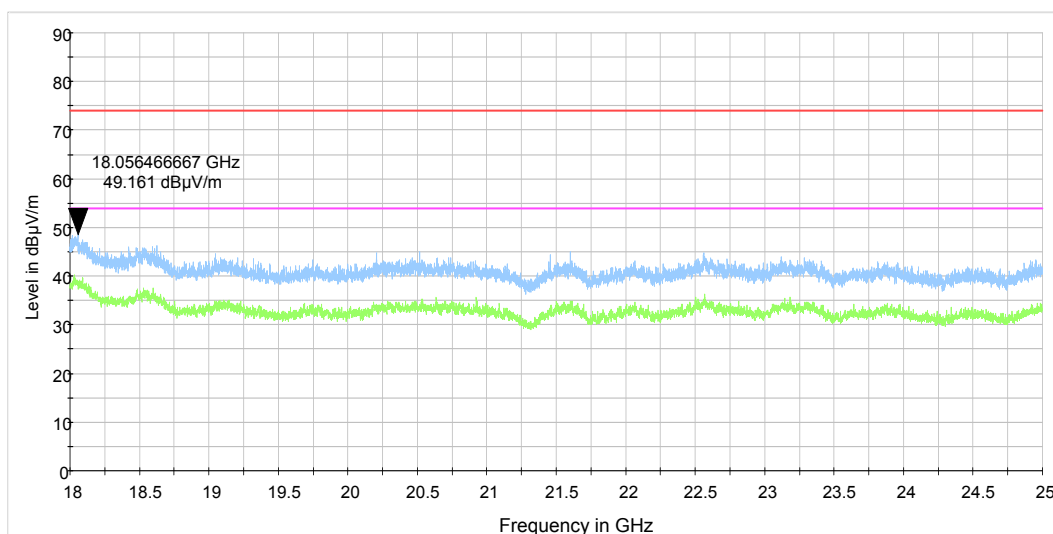
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal



Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 28-Jun-21 - 29-Jun-21			
Temperature: 25 °C	Relative Humidity: 48 %	Air Pressure: 1004 hPa	Power: 3.8 VDC
Remarks:			

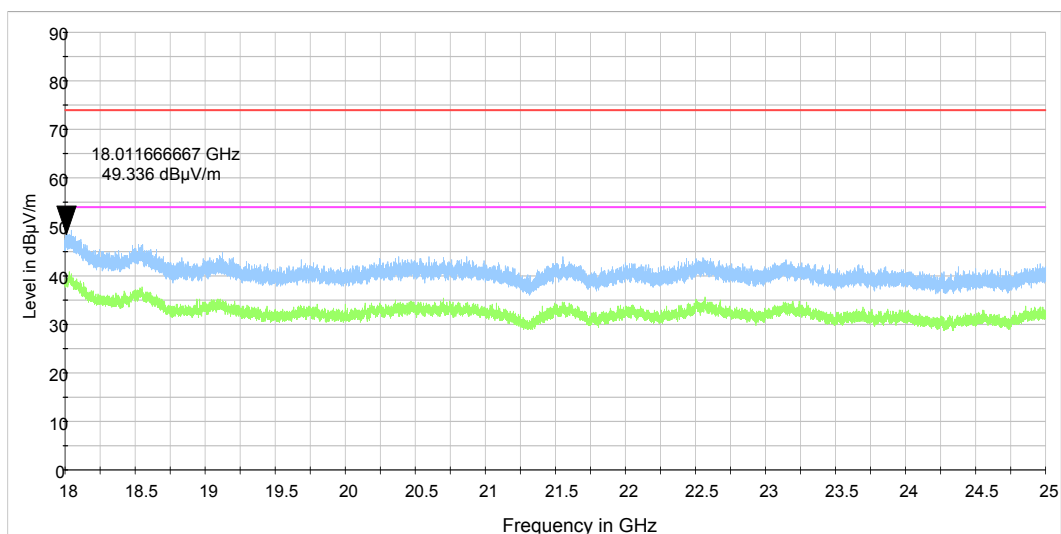
Plot 7.3.16 Radiated emission measurements from 18 GHz to 25 GHz at the low carrier frequency

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



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

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



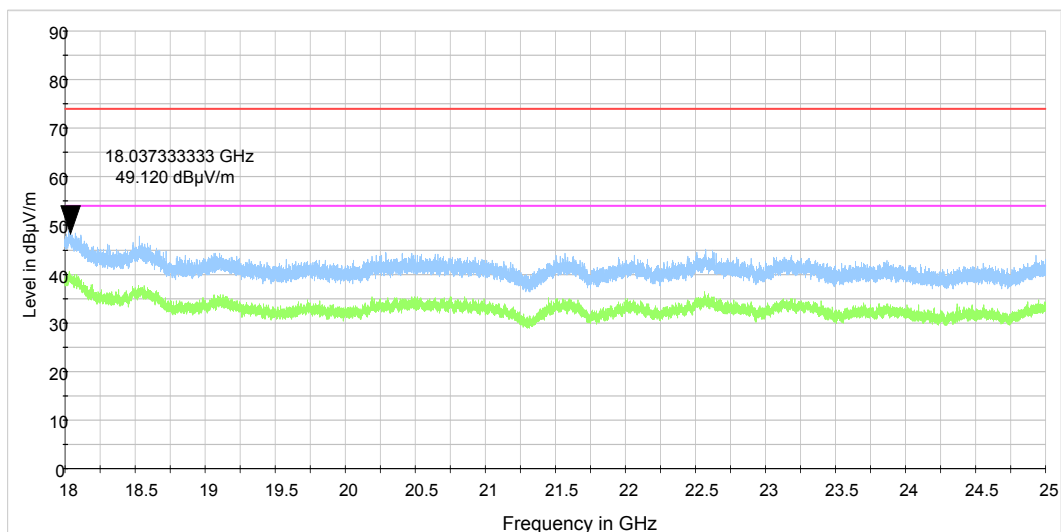


HERMON LABORATORIES

Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 28-Jun-21 - 29-Jun-21			
Temperature: 25 °C	Relative Humidity: 48 %	Air Pressure: 1004 hPa	Power: 3.8 VDC
Remarks:			

Plot 7.3.18 Radiated emission measurements from 18 GHz to 25 GHz at the high carrier frequency

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





Test specification: Section 15.247(d) / RSS-247 section 5.5, Band edge emissions			
Test procedure: ANSI C63.10 section 11.13.2			
Test mode: Compliance		Verdict: PASS	
Date(s): 29-Jun-21 - 30-Jun-21			
Temperature: 25 °C	Relative Humidity: 47 %	Air Pressure: 1004 hPa	Power: 3.8 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(μ V/m)	
			Peak	Average
Peak	2400.0 – 2483.5	20.0	74.0	54.0

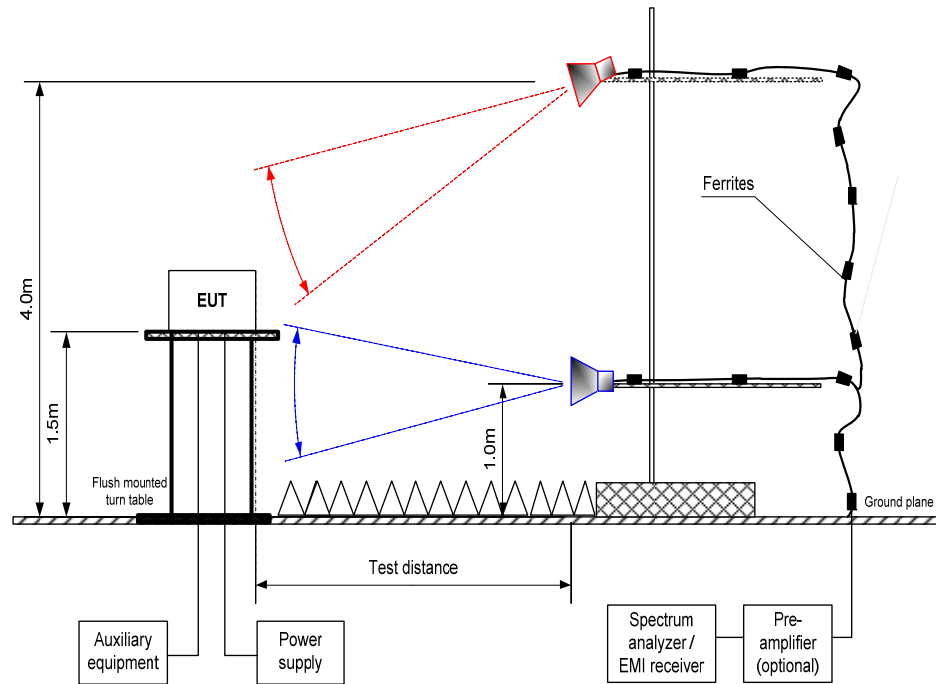
* - Band edge emission limit is provided in terms of attenuation below the peak of modulated carrier measured with the same resolution bandwidth.

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

Test specification: Section 15.247(d) / RSS-247 section 5.5, Band edge emissions			
Test procedure: ANSI C63.10 section 11.13.2			
Test mode: Compliance		Verdict: PASS	
Date(s): 29-Jun-21 - 30-Jun-21			
Temperature: 25 °C	Relative Humidity: 47 %	Air Pressure: 1004 hPa	Power: 3.8 VDC
Remarks:			

Figure 7.4.1 Band edge emission test setup





Test specification: Section 15.247(d) / RSS-247 section 5.5, Band edge emissions			
Test procedure: ANSI C63.10 section 11.13.2			
Test mode:	Compliance	Verdict: PASS	
Date(s):	29-Jun-21 - 30-Jun-21		
Temperature: 25 °C	Relative Humidity: 47 %	Air Pressure: 1004 hPa	Power: 3.8 VDC
Remarks:			

Table 7.4.2 Band edge emission outside restricted bands test results

ASSIGNED FREQUENCY RANGE: 2400.0 – 2483.5 MHz
DETECTOR USED: Peak
TRANSMITTER OUTPUT POWER SETTINGS: Maximum
RESOLUTION BANDWIDTH: 100 kHz
VIDEO BANDWIDTH: ≥ RBW

MODULATION/BITRATE: GFSK / 1 Mbps

Frequency, MHz	Band edge emission, dBm	Emission at carrier, dBm	Attenuation below carrier, dBc	Limit, dBc	Margin, dB*	Verdict
2400.000	45.44	101.22	55.78	20.0	35.78	Pass

*- Margin = Attenuation below carrier – specification limit.

Table 7.4.3 Band edge emission inside restricted bands test results

ASSIGNED FREQUENCY RANGE: 2400.0 – 2483.5 MHz
DETECTOR USED: Peak
TRANSMITTER OUTPUT POWER SETTINGS: Maximum
VIDEO BANDWIDTH: ≥ RBW

MODULATION/BITRATE: GFSK / 1 Mbps

Frequency, MHz	Peak field strength(VBW=3 MHz)			Average field strength(VBW=1 kHz)			Verdict
	Measured, dB(μV/m)	Limit, dB(μV/m)	Margin, dB**	Measured, dB(μV/m)	Limit, dB(μV/m)	Margin, dB**	
2389.860	39.20	74.0	-34.80	28.88	54.0	-25.12	Pass
2483.760	54.35	74.0	-19.55	46.54	54.0	-7.46	Pass

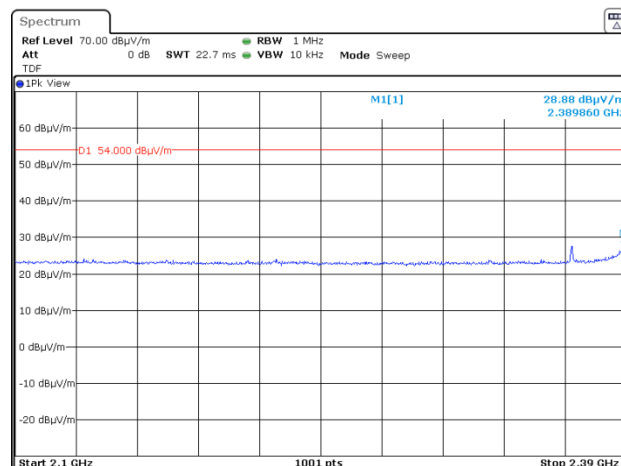
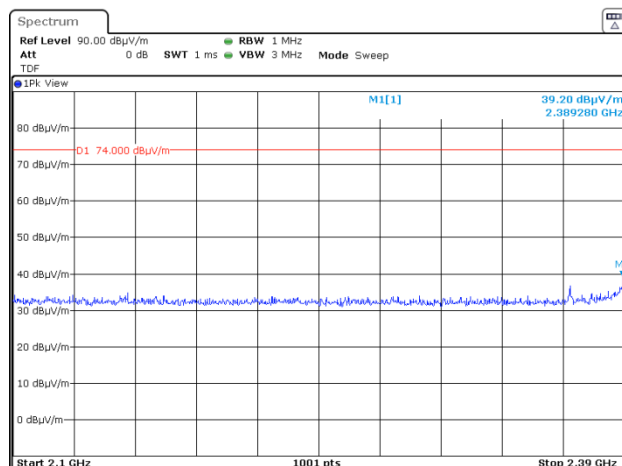
Reference numbers of test equipment used

HL 3903	HL 4355	HL 4933	HL 5902				
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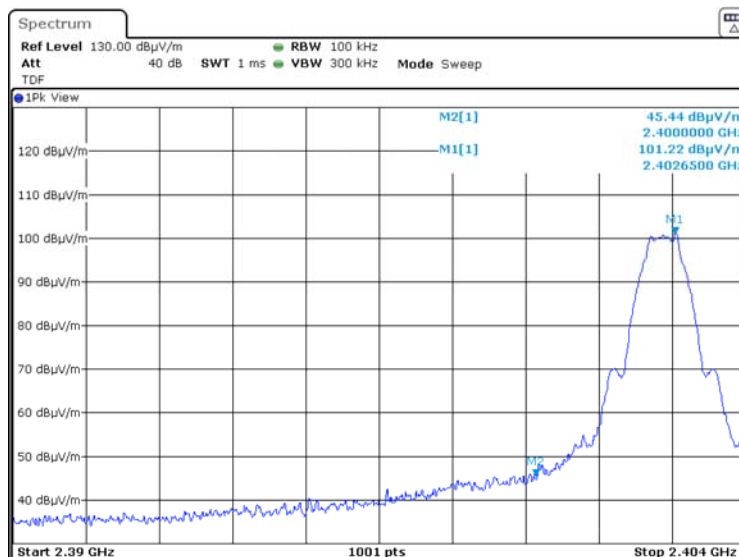
Full description is given in Appendix A.

Test specification: Section 15.247(d) / RSS-247 section 5.5, Band edge emissions			
Test procedure: ANSI C63.10 section 11.13.2			
Test mode: Compliance		Verdict: PASS	
Date(s): 29-Jun-21 - 30-Jun-21			
Temperature: 25 °C	Relative Humidity: 47 %	Air Pressure: 1004 hPa	Power: 3.8 VDC
Remarks:			

Plot 7.4.1 The highest emission level within restricted band at low carrier frequency

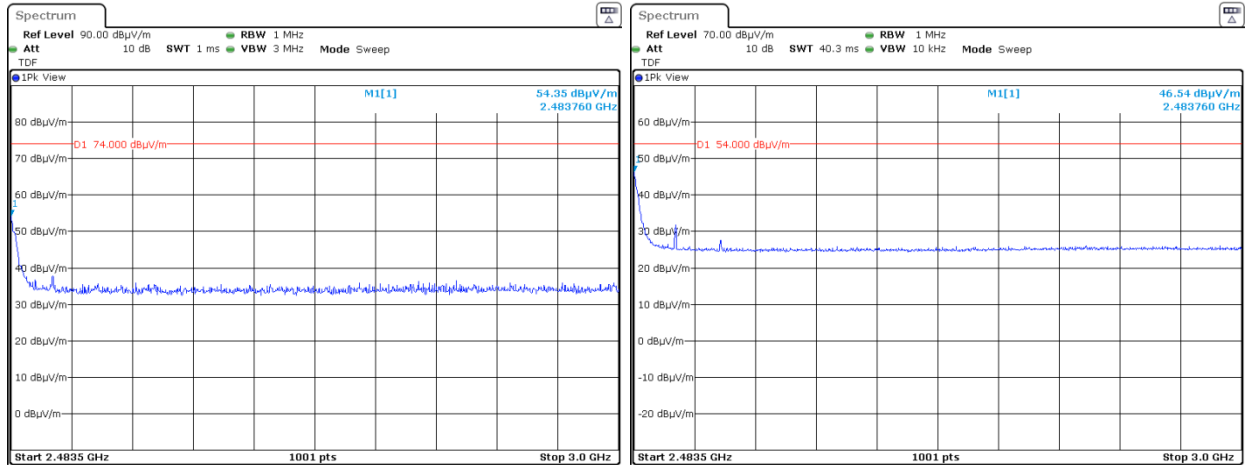


Plot 7.4.2 The highest emission level outside restricted band at low carrier frequency



Test specification:		Section 15.247(d) / RSS-247 section 5.5, Band edge emissions	
Test procedure:		ANSI C63.10 section 11.13.2	
Test mode:		Verdict: PASS	
Date(s):			
29-Jun-21 - 30-Jun-21			
Temperature: 25 °C	Relative Humidity: 47 %	Air Pressure: 1004 hPa	Power: 3.8 VDC
Remarks:			

Plot 7.4.3 The highest emission level within restricted band at high carrier frequency



Test specification: Section 15.247(e) / RSS-247 section 5.2(b), Maximum power spectral density			
Test procedure: ANSI C63.10 section 11.9.2.2.4			
Test mode: Compliance		Verdict: PASS	
Date(s): 28-Jun-21 - 06-Jul-21			
Temperature: 25 °C	Relative Humidity: 48 %	Air Pressure: 1004 hPa	Power: 3.8 VDC
Remarks:			

7.5 Maximum power spectral density (PSD)

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)*
2400.0 – 2483.5	3.0	8.0	103.2

* - Equivalent Peak spectral power density 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

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.

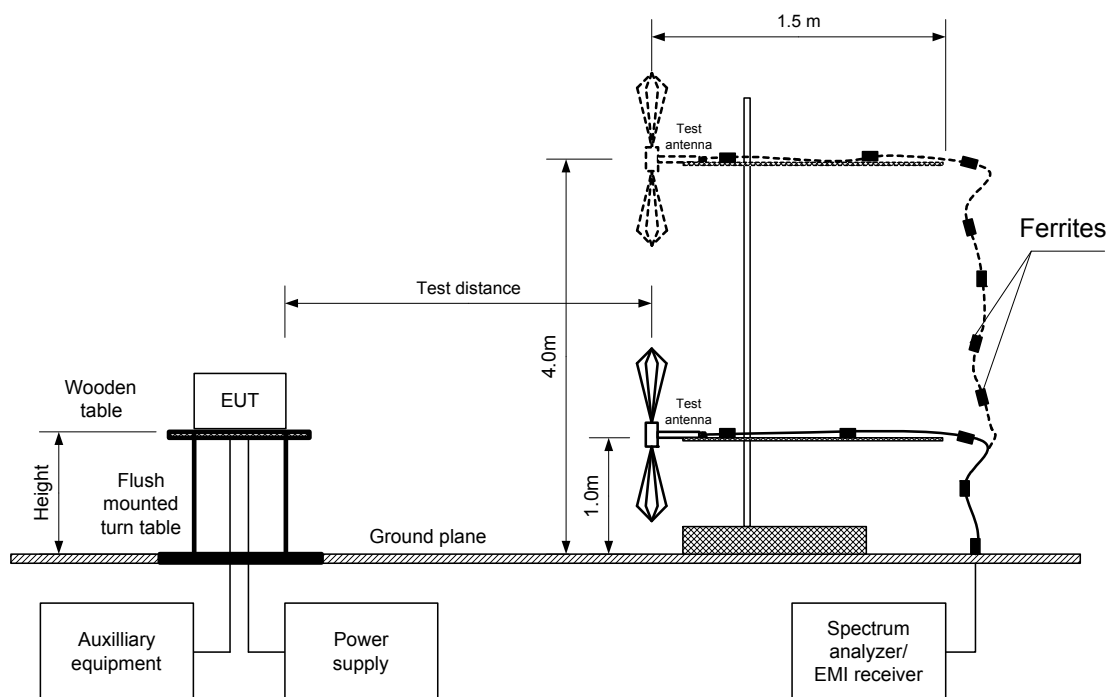
7.5.2.3 The Peak spectral power density of the EUT carrier frequency was measured with antenna connected to spectrum analyzer/ EMI receiver. To find maximum radiation the turntable was rotated 360° and the measuring antenna height was swept in both vertical and horizontal polarizations.

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 3.0 kHz, video bandwidth wider than resolution bandwidth, auto sweep time and sufficient number of sweeps was allowed for trace stabilization. The spectrum lines spacing was verified to be wider than 3 kHz. Otherwise the resolution bandwidth was reduced until individual spectrum lines were resolved and the power of individual spectrum lines was integrated over 3 kHz band.

7.5.2.5 The peak of emission was zoomed with span set just wide enough to capture the emission peak area and sweep time was set equal to span width divided by resolution bandwidth. Spectrum analyzer was set in peak hold mode, sufficient number of sweeps was allowed for trace stabilization and peak spectral power density was measured as provided in Table 7.5.2 and associated plots.

Test specification: Section 15.247(e) / RSS-247 section 5.2(b), Maximum power spectral density			
Test procedure: ANSI C63.10 section 11.9.2.2.4			
Test mode: Compliance		Verdict: PASS	
Date(s): 28-Jun-21 - 06-Jul-21			
Temperature: 25 °C	Relative Humidity: 48 %	Air Pressure: 1004 hPa	Power: 3.8 VDC
Remarks:			

Figure 7.5.1 Setup for carrier peak spectral power density measurements





Test specification: Section 15.247(e) / RSS-247 section 5.2(b), Maximum power spectral density			
Test procedure: ANSI C63.10 section 11.9.2.2.4			
Test mode: Compliance		Verdict: PASS	
Date(s): 28-Jun-21 - 06-Jul-21			
Temperature: 25 °C	Relative Humidity: 48 %	Air Pressure: 1004 hPa	Power: 3.8 VDC
Remarks:			

Table 7.5.2 Peak spectral power density measurement of peak spectral power density

ASSIGNED FREQUENCY: 2400.0 – 2483.5 MHz
 TEST DISTANCE: 3 m
 TEST SITE: Semi anechoic chamber
 EUT HEIGHT: 1.5 m
 DETECTOR USED: Peak
 RESOLUTION BANDWIDTH: 3 kHz
 VIDEO BANDWIDTH: 30 KHz
 TEST ANTENNA TYPE: Double ridged guide (above 1000 MHz)
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum

MODULATION/BITRATE: GFSK / 1 Mbps

Frequency, MHz	Peak spectral power density, dB(μV/m)	EUT antenna gain, dBi	Limit, dB(μV/m)	Margin, dB*	Antenna polarization	Antenna height, m	Turn-table position**, degrees	Verdict
2402.0	85.50	3.0	103.2	-20.70	Horizontal	1.25	230	Pass
2440.0	86.98	3.0	103.2	-19.22	Horizontal	1.49	225	Pass
2480.0	87.52	3.0	103.2	-18.68	Horizontal	1.30	235	Pass

*- Margin = Peak spectral power density - EUT antenna gain – Limit

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

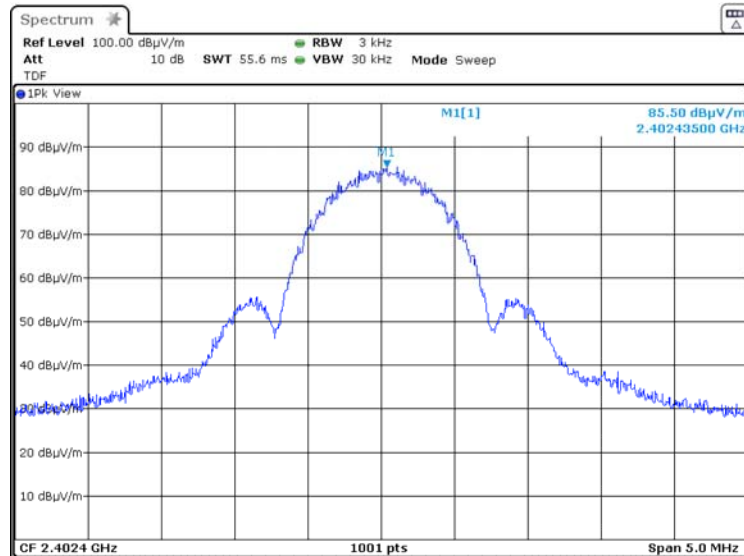
Reference numbers of test equipment used

HL 3903	HL 4355	HL 4933	HL 5902				
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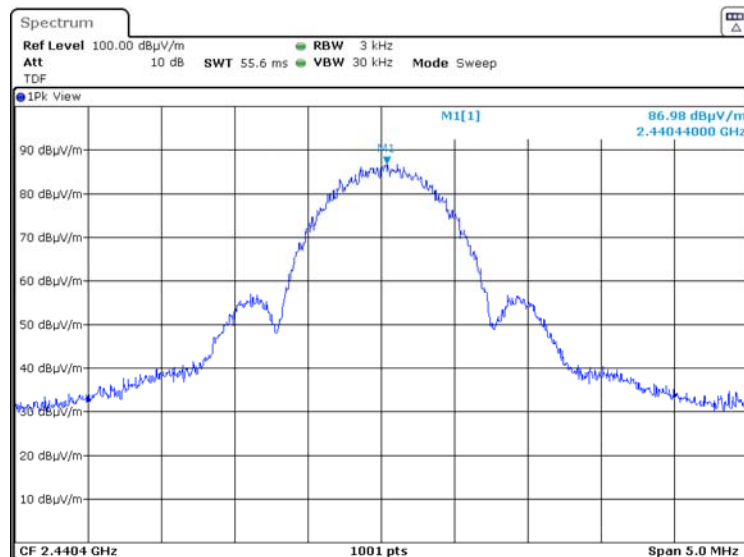
Full description is given in Appendix A.

Test specification: Section 15.247(e) / RSS-247 section 5.2(b), Maximum power spectral density			
Test procedure: ANSI C63.10 section 11.9.2.2.4			
Test mode: Compliance		Verdict: PASS	
Date(s): 28-Jun-21 - 06-Jul-21			
Temperature: 25 °C	Relative Humidity: 48 %	Air Pressure: 1004 hPa	Power: 3.8 VDC
Remarks:			

Plot 7.5.1 Peak spectral power density of carrier at low frequency



Plot 7.5.2 Peak spectral power density of carrier at mid frequency

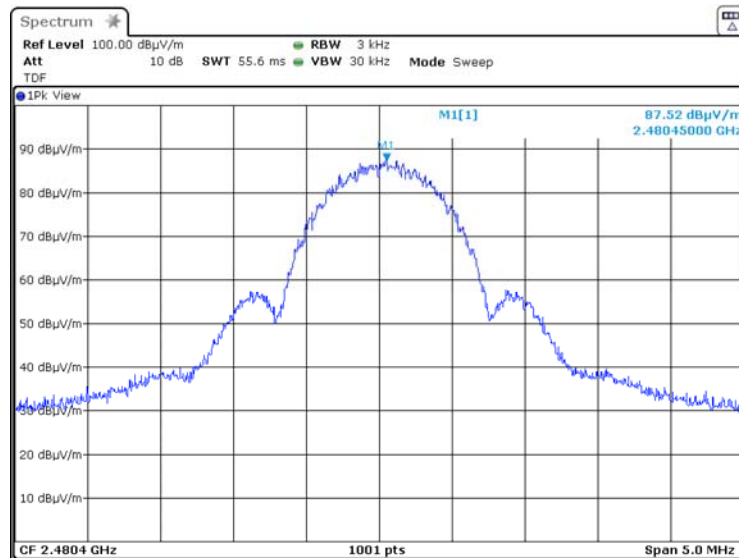




HERMON LABORATORIES

Test specification: Section 15.247(e) / RSS-247 section 5.2(b), Maximum power spectral density			
Test procedure: ANSI C63.10 section 11.9.2.2.4			
Test mode: Compliance		Verdict: PASS	
Date(s): 28-Jun-21 - 06-Jul-21			
Temperature: 25 °C	Relative Humidity: 48 %	Air Pressure: 1004 hPa	Power: 3.8 VDC
Remarks:			

Plot 7.5.3 Peak spectral power density of carrier at high frequency





Test specification: FCC section 15.203, RSS-Gen section 6.8, Antenna requirement			
Test procedure: Visual inspection			
Test mode: Compliance		Verdict: PASS	
Date(s): 06-Jul-21			
Temperature: 25 °C	Relative Humidity: 48 %	Air Pressure: 1004 hPa	Power: 3.8 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	

8 APPENDIX A Test equipment and ancillaries used for tests

HL No	Description	Manufacturer	Model	Ser. No.	Last Cal./ Check	Due Cal./ Check
0446	Antenna, Loop, Active, 10 (9) kHz - 30 MHz	EMCO	6502	2857	28-Feb-21	28-Feb-22
3903	Microwave Cable Assembly, 40.0 GHz, 1.5 m, SMA/SMA	Huber-Suhner	SUCOFLE X 102A	1226/2A	06-Apr-21	06-Apr-22
4355	Signal and Spectrum Analyzer, 9 kHz to 7 GHz	Rohde & Schwarz	FSV 7	101630	09-Sep-20	09-Sep-21
4360	EMI Test Receiver, 20 Hz to 40 GHz.	Rohde & Schwarz	ESU40	100322	19-Jan-21	19-Jan-22
4933	Active Horn Antenna, 1 GHz to 18 GHz	Com-Power Corporation	AHA-118	701046	26-Jan-21	26-Jan-22
4956	Active horn antenna, 18 to 40 GHz	Com-Power Corporation	AHA-840	105004	26-Jan-21	26-Jan-22
5112	RF cable, 40 GHz, 5.5 m, K-type	Huber-Suhner	SF102EA/11SK/11SK/5500M	502494/2EA	19-Apr-21	19-Apr-22
5288	Trilog Antenna, 25 MHz - 8 GHz, 100W	Frankonia	ALX-8000E	00809	08-Feb-19	08-Feb-22
5902	RF cable, 18 GHz, 6.0m, N-type	Huber-Suhner	SF126EA/11N/11N/6000		01-Dec-20	01-Dec-21

9 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.

10 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 relevant parts of Code of Federal Regulations 47 (CFR 47), Test Firm Registration Number is 927748, Designation Number is IL1001; Recognized by Innovation, Science and Economic Development Canada for wireless and terminal testing (ISED), ISED #2186A, CAB identifier is IL1001; Certified by VCCI, Japan (the registration numbers for OATS are R-10808 for RE measurements below 1 GHz, G-20112 for RE measurements above 1 GHz, R-11082 for anechoic chamber for RE measurements below 1 GHz, G-10869 for RE measurements above 1 GHz, C-10845 for conducted emissions site and T-11606 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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Person for contact: Mr. Michael Nikishin, EMC&Radio group manager

11 APPENDIX D Specification references

FCC 47CFR part 15: 2020	Radio Frequency Devices
ANSI C63.10: 2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
ANSI C63.2: 2016	American National Standard for Instrumentation-Electromagnetic Noise and Field Strength, 10 kHz to 40 GHz-Specifications
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 with Am.1: 2019	General Requirements for Compliance of Radio Apparatus

12 APPENDIX E Test equipment correction factors

Antenna factor
Active loop antenna
Model 6502, S/N 2857, HL 0446

Frequency, MHz	Measured antenna factor, dBS/m
0.009	-32.5
0.010	-33.4
0.020	-37.9
0.050	-40.6
0.075	-41.0
0.100	-41.2
0.150	-41.2
0.250	-41.2
0.500	-41.3
0.750	-41.3
1.000	-41.4
2.000	-41.4
3.000	-41.4
4.000	-41.5
5.000	-41.5
10.000	-41.8
15.000	-42.2
20.000	-42.9
25.000	-43.9
30.000	-45.4

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

Antenna factor
Trilog antenna
Model ALX-8000E, Frankonia, S/N 00809, HL 5288, 30-1000 MHz

Frequency, MHz	Antenna factor, dB/m		
	Vert Up	Vert Down	Delta
30	-51.19	-51.28	0.09
35	-44.03	-44.12	0.09
40	-43.07	-43.12	0.05
45	-39.61	-39.79	0.18
50	-37.84	-38.14	0.3
60	-34.93	-34.9	0.03
70	-29.76	-29.66	0.1
80	-27.69	-27.82	0.13
90	-29.05	-29.07	0.02
100	-31.19	-31.19	0
120	-31.61	-31.6	0.01
140	-28.13	-28.06	0.07
160	-27.71	-27.75	0.04
180	-26.19	-26.15	0.04
200	-28.2	-28.15	0.05
250	-27.45	-27.47	0.02
300	-29.61	-29.63	0.02
400	-31.77	-31.78	0.01
500	-32.81	-32.81	0
600	-33.64	-33.61	0.03
700	-34.21	-34.21	0
800	-35.66	-35.66	0
900	-36.99	-36.91	0.08
1000	-38	-37.91	0.09

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
Active Horn Antenna,
Com-Power Corporation, model: AHA-118, s/n 701046, HL 4933

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.

Antenna factor
Active Horn Antenna,
Com-Power Corporation, model: AHA-840, s/n 105004, HL 4956

Frequency, MHz	Measured antenna factor (with preamplifier), dB/m
18000	2.5
18500	0.5
19000	-1.0
19500	-2.4
20000	-2.5
20500	-2.2
21000	-2.0
21500	-2.7
22000	-3.7
22500	-3.8
23000	-3.7
23500	-5.0
24000	-4.5
24500	-5.0
25000	-4.7
25500	-4.4
26000	-4.3
26500	-5.6
27000	-4.3
27500	-4.9
28000	-5.2
28500	-4.4

Frequency, MHz	Measured antenna factor (with preamplifier), dB/m
29000	-2.7
29500	-2.6
30000	-1.4
30500	-1.5
31000	-1.0
31500	-2.6
32000	-3.3
32500	-3.3
33000	-5.1
33500	-5.2
34000	-1.5
34500	-5.4
35000	-3.3
35500	-4.2
36000	-2.8
36500	-2.6
37000	-1.0
38000	1.8
38500	2.8
39000	1.3
39500	1.3
40000	0.3

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

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

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

Cable loss
RF Cable, Huber-Suhner, 40 GHz, 5.5 m, K type,
SF102EA/11SK/11SK/5500MM, S/N 502494/2EA
HL 5112

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
100	0.69	20500	10.18
200	0.97	21000	10.32
300	1.18	21500	10.47
500	1.52	22000	10.60
1000	2.14	22500	10.75
1500	2.62	23000	10.87
2000	3.03	23500	11.00
2500	3.40	24000	11.12
3000	3.73	24500	11.23
3500	4.04	25000	11.35
4000	4.33	25500	11.52
4500	4.60	26000	11.64
5000	4.86	26500	11.73
5500	5.10	27000	11.84
6000	5.34	27500	11.93
6500	5.57	28000	12.05
7000	5.79	28500	12.19
7500	6.00	29000	12.33
8000	6.21	29500	12.44
8500	6.43	30000	12.53
9000	6.62	30500	12.58
9500	6.82	31000	12.71
10000	7.01	31500	12.86
10500	7.17	32000	13.00
11000	7.34	32500	13.11
11500	7.51	33000	13.24
12000	7.68	33500	13.33
12500	7.84	34000	13.44
13000	8.00	34500	13.58
13500	8.16	35000	13.69
14000	8.32	35500	13.81
14500	8.48	36000	13.93
15000	8.63	36500	14.05
15500	8.77	37000	14.24
16000	8.92	37500	14.28
16500	9.08	38000	14.38
17000	9.23	38500	14.50
17500	9.37	39000	14.61
18000	9.51	39500	14.70
18500	9.66	40000	14.83
19000	9.78		
19500	9.92		
20000	10.07		

Cable loss
RF cable, 18 GHz, 6.0m, N-type, Huber-Suhner, S/N 511435/126EA,
SF126EA/11N/11N/6000, HL 5902

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
0.1	0.00	4800	3.24	10000	4.82	15200	6.08
1	0.01	4900	3.30	10100	4.85	15300	6.11
10	0.07	5000	3.32	10200	4.87	15400	6.12
30	0.18	5100	3.37	10300	4.91	15500	6.14
50	0.25	5200	3.40	10400	4.93	15600	6.15
100	0.41	5300	3.42	10500	4.95	15700	6.18
200	0.56	5400	3.46	10600	4.99	15800	6.20
300	0.68	5500	3.50	10700	5.01	15900	6.23
400	0.76	5600	3.53	10800	5.03	16000	6.22
500	0.87	5700	3.56	10900	5.06	16100	6.26
600	1.03	5800	3.58	11000	5.08	16200	6.29
700	1.14	5900	3.63	11100	5.12	16300	6.30
800	1.23	6000	3.67	11200	5.13	16400	6.33
900	1.34	6100	3.69	11300	5.16	16500	6.35
1000	1.43	6200	3.73	11400	5.18	16600	6.37
1100	1.51	6300	3.76	11500	5.22	16700	6.40
1200	1.59	6400	3.80	11600	5.24	16800	6.43
1300	1.66	6500	3.81	11700	5.25	16900	6.46
1400	1.73	6600	3.83	11800	5.28	17000	6.47
1500	1.78	6700	3.87	11900	5.32	17100	6.49
1600	1.82	6800	3.91	12000	5.33	17200	6.51
1700	1.87	6900	3.91	12100	5.35	17300	6.53
1800	1.89	7000	3.93	12200	5.38	17400	6.56
1900	1.95	7100	3.95	12300	5.39	17500	6.60
2000	1.99	7200	3.98	12400	5.43	17600	6.62
2100	2.02	7300	4.02	12500	5.46	17700	6.60
2200	2.06	7400	4.04	12600	5.48	17800	6.63
2300	2.11	7500	4.07	12700	5.50	17900	6.64
2400	2.16	7600	4.11	12800	5.52	18000	6.66
2500	2.21	7700	4.15	12900	5.57		
2600	2.29	7800	4.17	13000	5.57		
2700	2.32	7900	4.20	13100	5.60		
2800	2.38	8000	4.22	13200	5.61		
2900	2.44	8100	4.26	13300	5.64		
3000	2.47	8200	4.30	13400	5.67		
3100	2.53	8300	4.32	13500	5.70		
3200	2.57	8400	4.35	13600	5.71		
3300	2.61	8500	4.39	13700	5.73		
3400	2.67	8600	4.43	13800	5.74		
3500	2.71	8700	4.45	13900	5.80		
3600	2.76	8800	4.47	14000	5.82		
3700	2.80	8900	4.49	14100	5.85		
3800	2.85	9000	4.53	14200	5.86		
3900	2.89	9100	4.55	14300	5.87		
4000	2.93	9200	4.57	14400	5.92		
4100	2.98	9300	4.61	14500	5.93		
4200	3.01	9400	4.64	14600	5.95		
4300	3.05	9500	4.68	14700	5.97		
4400	3.10	9600	4.70	14800	6.01		
4500	3.12	9700	4.73	14900	6.04		
4600	3.18	9800	4.78	15000	6.04		
4700	3.21	9900	4.80	15100	6.08		

13 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

END OF DOCUMENT