

# PARTIAL TEST REPORT

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

FOR:

**Roseman Engineering Ltd.  
Car Data Logger  
Model: Fleet Journal 3  
FCC ID: JAKFG3E**

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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## Table of contents

1	Applicant information.....	3
2	Equipment under test attributes .....	3
3	Manufacturer information .....	3
4	Test details.....	3
5	Tests summary.....	4
6	EUT description.....	5
6.1	General information.....	5
6.2	Support and test equipment .....	5
6.3	Test configuration.....	5
6.4	Changes made in EUT .....	5
6.5	Transmitter characteristics .....	6
7	Transmitter tests according to 47CFR part 15 subpart C requirements .....	7
7.1	Peak output power .....	7
7.2	Field strength of spurious emissions .....	16
8	Unintentional emissions according to 47CFR part 15 subpart B requirements .....	34
8.1	Radiated emission measurements .....	34
9	APPENDIX A Test equipment and ancillaries used for tests.....	39
10	APPENDIX B Test equipment correction factors.....	40
11	APPENDIX C Test laboratory description .....	42
12	APPENDIX D Measurement uncertainties .....	43
13	APPENDIX E Specification references.....	44
14	APPENDIX F Abbreviations and acronyms.....	44



## 1 Applicant information

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**Contact name:** Mr. Haim Kashi

## 2 Equipment under test attributes

**Product name:** Car Data Logger  
**Product type:** Transceiver  
**Model(s):** Fleet Journal 3  
**Serial number:** 50500010  
**Hardware version:** ASS-22-84Kx-01  
**Software release:** 9.0.xx  
**Receipt date** 23-Jan-22

## 3 Manufacturer information

**Manufacturer name:** Roseman Engineering Ltd.  
**Address:** Kiryat Atidim, Building 7, P.O.B 58181, Tel Aviv 6158101, Israel  
**Telephone:** +972-3-573-1801  
**Fax:** +972-3-573-1807  
**E-Mail:** [haim@roseman.co.il](mailto:haim@roseman.co.il)  
**Contact name:** Mr. Haim Kashi

## 4 Test details

**Project ID:** 45842  
**Location:** Hermon Laboratories Ltd. P.O. Box 23, Binyamina 3055001, Israel  
**Test started:** 28-Mar-22  
**Test completed:** 18-May-22  
**Test specification(s):** FCC 47CFR part 15, subpart C, §15.247 (FHSS) and subpart B



## 5 Tests summary

Test	Status
<b>Transmitter characteristics</b>	
Section 15.247(a)1, 20 dB bandwidth	Pass
Section 15.247(a)1, Frequency separation	Pass
Section 15.247(a)1, Number of hopping frequencies	Pass
Section 15.247(a)1, Average time of occupancy	Pass
Section 15.247(b), Peak output power	Pass*
Section 15.247(d), Radiated spurious emissions	Pass*
Section 15.247(d), Emissions at band edges	Pass
Section 15.247(i)5, RF exposure	Pass, the exhibit to the application of certification is provided
<b>Unintentional emissions</b>	
Section 15.109, Radiated emission	Pass

The EUT were certified by FCC under FCC ID: JAKFG3E. The EUT was revised with the following changes:

1. Added Serial Flash (4/8Mb) connect to the CPU on Radio SPI bus (sharing).
2. Replacement of the Green TB3-TB13 connector with 2x10pin Molex.
3. Added CAN 2 (Total of 2 CANBUS). CAN 2 was connected to ACC plug (EM) and was not assembled.
4. Added Digital Inputs (total of 4) and 2 Digital Outputs (total of 4).
5. Added a protected power out ~3.8V to power ext. sensors.

\* The relevant tests were performed to support Application for Class II permissive changes certification, all other tests are referenced to the original certification.

This test report supersedes the previously issued test report identified by Doc ID: TelRad\_FCC\_45842\_31572

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

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

	Name and Title	Date	Signature
<b>Tested by:</b>	Mr. H. N. Abayev, test engineer, EMC & Radio	28-Mar-22 – 18-May-22	
<b>Reviewed by:</b>	Mrs. S. Peysahov Sheynin, test engineer, EMC & Radio	10-Aug-22	
<b>Approved by:</b>	Mr. M. Nikishin, group leader, EMC & Radio	10-Aug-22	

## 6 EUT description

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

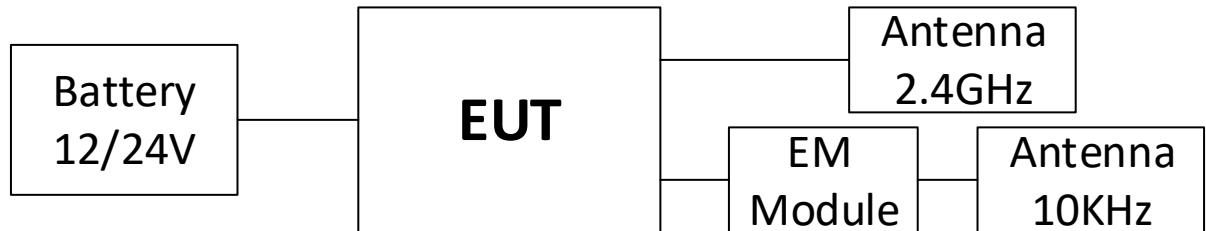
### 6.1 General information

The EUT, model: Fleet Journal 3, is a Canbus connection platform collecting data on car, driver and fleet. Web based access and reporting services providing management efficient tools to optimize fleet usage. The EUT is powered by a separate cable with a fuse connected to the vehicle battery. During the testing the device was powered by 12 VDC battery.

### 6.2 Support and test equipment

Description	Manufacturer	Model number	Serial number
GPS antenna	Locosys	LS23033C	177200531
EM module with 10 kHz Antenna	Roseman	RID-EM-02 / RVC-01-80U	AL17114671201273 / NA
Battery	NA	NA	NA

### 6.3 Test configuration



### 6.4 Changes made in EUT

No changes were implemented in the EUT during testing.



## 6.5 Transmitter characteristics

Type of equipment				
X	Stand-alone (Equipment with or without its own control provisions)			
	Combined equipment (Equipment where the radio part is fully integrated within another type of equipment)			
	Plug-in card (Equipment intended for a variety of host systems)			
Intended use		Condition of use		
	fixed	Always at a distance more than 2 m from all people		
X	mobile	Always at a distance more than 20 cm from all people		
	portable	May operate at a distance closer than 20 cm to human body		
Assigned frequency ranges		2400-2483.5 MHz		
Operating frequencies		2401-2478.3 MHz		
Maximum rated output power		At transmitter 50 Ω RF output connector		
		Peak output power		
Is transmitter output power variable?		X	No	
		Yes		continuous variable
				stepped variable with stepsize
				dB
				minimum RF power
				dBm
				maximum RF power
				dBm
Antenna connection				
unique coupling	standard connector	X	integral	with temporary RF connector
				X without temporary RF connector
Antenna/s technical characteristics				
Type	Manufacturer		Model number	Gain
2.4GHz Stick Adhesive Antenna	Fatti Components		YT2400-3-SMA-R/P	5 dBi
2.4GHz Stick Adhesive Antenna	Fatti Components		YT-2.4G-1.5M	5 dBi*
2.4GHz Stick Adhesive Antenna	YueYoung Electronics		YUE-WXUG-2400TB	2.5 dBi
2.4GHz Stick Adhesive Antenna	Cirocomm		EWFAWA50	2.26 dBi
Transmitter aggregate data rate/s		250 kbps		
Type of modulation		MSK		
Modulating test signal (baseband)		PRBS		
Transmitter power source				
	Battery	Nominal rated voltage	VDC	Battery type
X	DC	Nominal rated voltage	12 VDC	
	AC mains	Nominal rated voltage	VAC	Frequency
Common power source for transmitter and receiver		X	yes	no
Spread spectrum technique used		X	Frequency hopping (FHSS)	
			Digital transmission system (DTS)	
			Hybrid	
Spread spectrum parameters for transmitters tested per FCC 15.247 only				
FHSS	Total number of hops		16	
	Bandwidth per hop		1704.6 kHz	
	Max. separation of hops		5185.0 kHz	

\* - The antennas are interchangeable. The EUT was tested with YT-2.4G-1.5M Fatti Components antenna as worst case.



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<b>Test specification:</b> Section 15.247(b), Peak output power			
<b>Test procedure:</b> ANSI C63.10, section 7.8.5			
<b>Test mode:</b> Compliance			<b>Verdict:</b> PASS
<b>Date(s):</b> 28-Mar-22			
Temperature: 20 °C	Relative Humidity: 45 %	Air Pressure: 1010 hPa	Power: 12 VDC
<b>Remarks:</b>			

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

### 7.1 Peak output power

#### 7.1.1 General

This test was performed to measure the maximum peak output power radiated by transmitter. Specification test limits are given in Table 7.1.1.

Table 7.1.1 Peak output power limits

Assigned frequency range, MHz	Peak output power*		Equivalent field strength limit @ 3m, dB(µV/m)*	Maximum antenna gain, dBi
	W	dBm		
902.0 – 928.0	0.25 (<50 hopping channels)	24.0 (<50 hopping channels)	125.2 (<50 hopping channels)	6.0*
	1.0 (≥50 hopping channels)	30.0 (≥50 hopping channels)	131.2 (≥50 hopping channels)	
2400.0 – 2483.5	<b>0.125 (&lt;75 hopping channels)</b>	<b>21.0 (&lt;75 hopping channels)</b>	<b>122.2 (&lt;75 hopping channels)</b>	6.0*
	1.0 (≥75 hopping channels)	30.0 (≥75 hopping channels)	131.2 (≥75 hopping channels)	
5725.0 – 5850.0	1.0	30.0	131.2	

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

\*\*- The limit is provided in terms of conducted RF power at the antenna connector. If transmitting antennas of directional gain greater than 6 dBi are used, the peak output power limit shall be reduced below the stated value as follows:

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

#### 7.1.2 Test procedure

- 7.1.2.1 The EUT was set up as shown in Figure 7.1.1, energized and its proper operation was checked.
- 7.1.2.2 The EUT was adjusted to produce maximum available to end user RF output power.
- 7.1.2.3 The frequency span of spectrum analyzer was set approximately 5 times wider than 20 dB bandwidth of the EUT and the resolution bandwidth was set wider than 20 dB bandwidth of the EUT. To find maximum radiation the turntable was rotated 3600 and the measuring antenna height was swept in both vertical and horizontal polarizations.
- 7.1.2.4 The maximum field strength of the EUT carrier frequency was measured as provided in Table 7.1.2 and associated plots.
- 7.1.2.5 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:

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

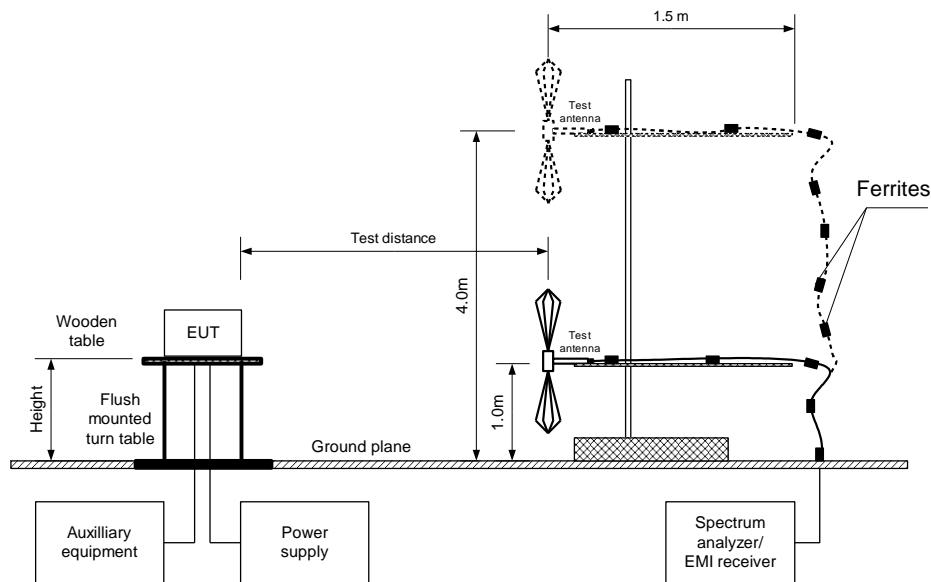
- 7.1.2.6 The worst test results (the lowest margins) were recorded in Table 7.1.2.



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<b>Test specification:</b> Section 15.247(b), Peak output power			
<b>Test procedure:</b> ANSI C63.10, section 7.8.5			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 28-Mar-22			
Temperature: 20 °C	Relative Humidity: 45 %	Air Pressure: 1010 hPa	Power: 12 VDC
<b>Remarks:</b>			

Figure 7.1.1 Setup for peak output power measurements





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<b>Test specification:</b> Section 15.247(b), Peak output power	
<b>Test procedure:</b> ANSI C63.10, section 7.8.5	
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS
<b>Date(s):</b> 28-Mar-22	
<b>Temperature:</b> 20 °C	<b>Relative Humidity:</b> 45 %
	<b>Air Pressure:</b> 1010 hPa
	<b>Power:</b> 12 VDC
<b>Remarks:</b>	

**Table 7.1.2 Peak output power test results**

ASSIGNED FREQUENCY: 2400 – 2483.5 MHz  
 TEST DISTANCE: 3 m  
 TEST SITE: Semi anechoic chamber  
 DETECTOR USED: Peak  
 TEST ANTENNA TYPE: Double ridged guide  
 MODULATION: MSK  
 MODULATING SIGNAL: PRBS  
 BIT RATE: 250 kbps  
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum  
 DETECTOR USED: Peak  
 FREQUENCY HOPPING: Disabled

Frequency, MHz	Field strength, dB(µV/m)	Antenna polarization	Antenna height, m	Azimuth, degrees*	EUT antenna gain, dBi	Peak output power, dBm**	Limit, dBm	Margin, dB***	Verdict
2400.92	107.06	Vertical	1.20	60	5.0	6.86	21.0	-14.14	Pass
2441.83	108.12	Vertical	1.50	-120	5.0	7.92	21.0	-13.08	Pass
2478.21	101.38	Horizontal	1.50	10	5.0	1.18	21.0	-19.82	Pass

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

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

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

**Reference numbers of test equipment used**

HL 3902	HL 4355	HL 4360	HL 4933	HL 5902			
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Full description is given in Appendix A.



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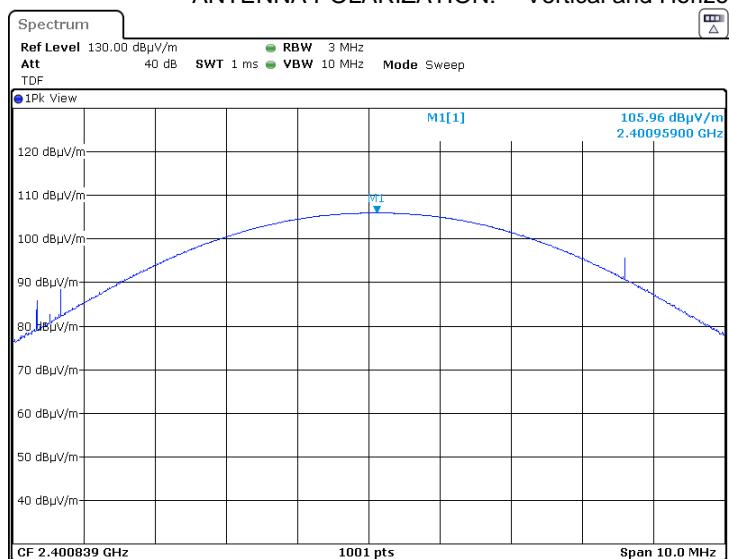
<b>Test specification:</b> Section 15.247(b), Peak output power			
<b>Test procedure:</b> ANSI C63.10, section 7.8.5			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 28-Mar-22			
Temperature: 20 °C	Relative Humidity: 45 %	Air Pressure: 1010 hPa	Power: 12 VDC
<b>Remarks:</b>			

**Plot 7.1.1 Peak output power at low frequency**

EUT POSITION: X  
ANTENNA POLARIZATION: Vertical and Horizontal



EUT POSITION: Y  
ANTENNA POLARIZATION: Vertical and Horizontal

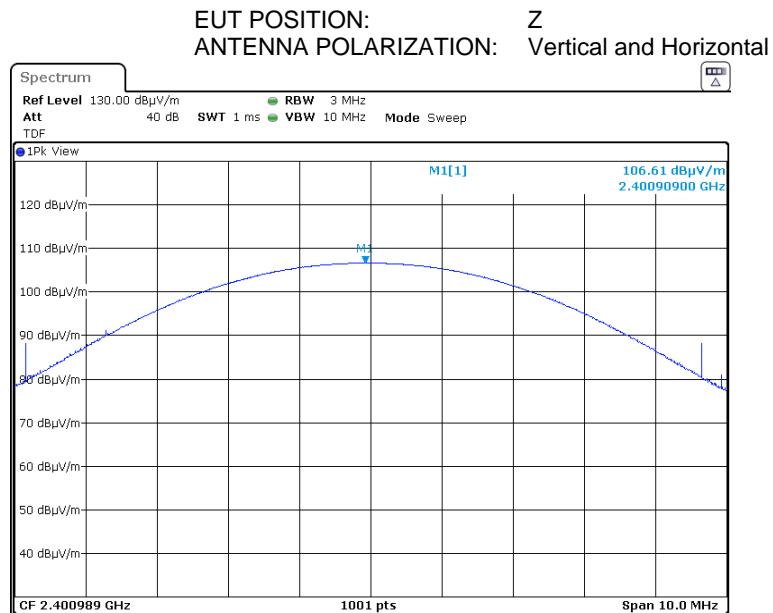




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<b>Test specification:</b> Section 15.247(b), Peak output power			
<b>Test procedure:</b>	ANSI C63.10, section 7.8.5		
<b>Test mode:</b>	Compliance		
<b>Date(s):</b>	28-Mar-22		
<b>Temperature:</b> 20 °C	<b>Relative Humidity:</b> 45 %	<b>Air Pressure:</b> 1010 hPa	<b>Power:</b> 12 VDC
<b>Remarks:</b>			

**Plot 7.1.2 Field strength of carrier at low frequency (continuation)**



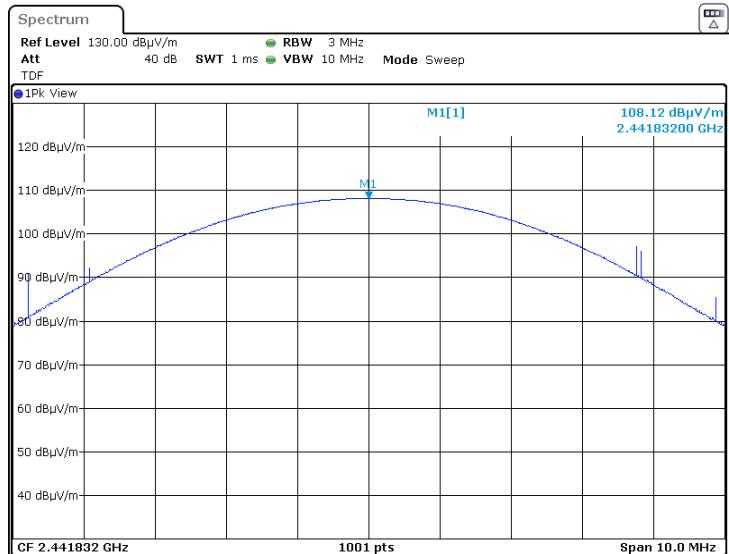


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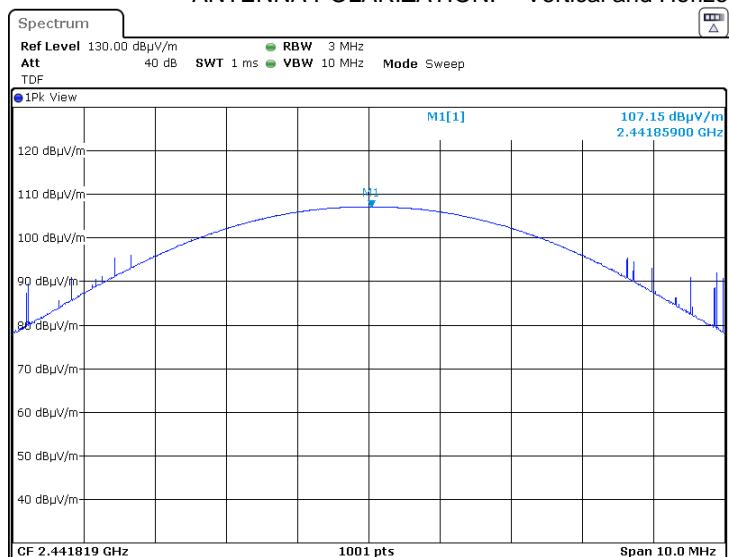
<b>Test specification:</b> Section 15.247(b), Peak output power			
<b>Test procedure:</b>	ANSI C63.10, section 7.8.5		
<b>Test mode:</b>	Compliance		
<b>Date(s):</b>	28-Mar-22		
<b>Temperature:</b> 20 °C	<b>Relative Humidity:</b> 45 %	<b>Air Pressure:</b> 1010 hPa	<b>Power:</b> 12 VDC
<b>Remarks:</b>			

**Plot 7.1.3 Peak output power at mid frequency**

EUT POSITION: X  
ANTENNA POLARIZATION: Vertical and Horizontal



EUT POSITION: Y  
ANTENNA POLARIZATION: Vertical and Horizontal



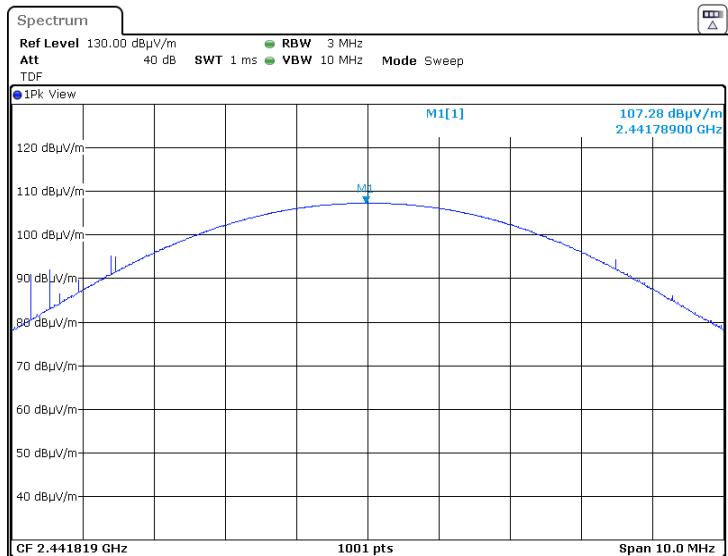


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<b>Test specification:</b>	<b>Section 15.247(b), Peak output power</b>		
<b>Test procedure:</b>	ANSI C63.10, section 7.8.5		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	PASS
<b>Date(s):</b>	28-Mar-22		
<b>Temperature:</b> 20 °C	<b>Relative Humidity:</b> 45 %	<b>Air Pressure:</b> 1010 hPa	<b>Power:</b> 12 VDC
<b>Remarks:</b>			

#### Plot 7.1.4 Field strength of carrier at mid frequency (continuation)

EUT POSITION: Z  
ANTENNA POLARIZATION: Vertical and Horizontal



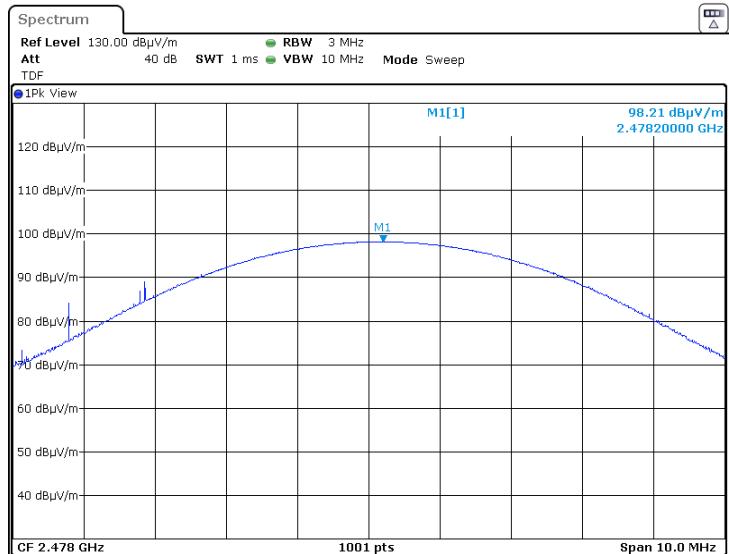


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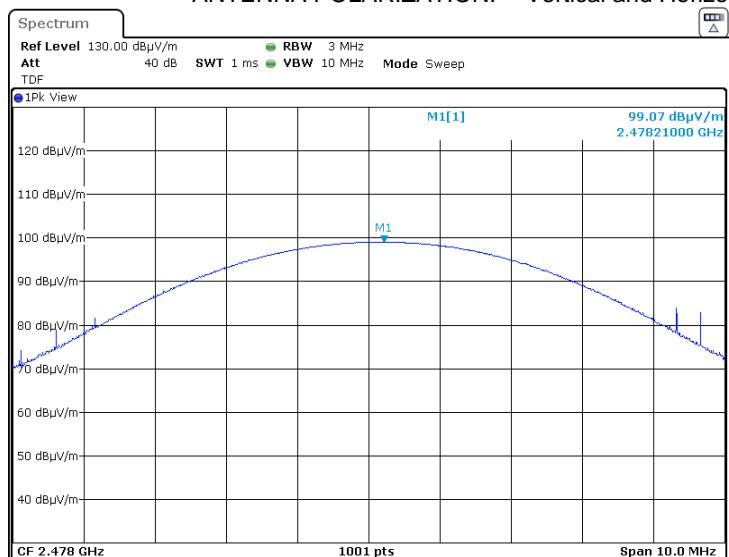
<b>Test specification:</b> Section 15.247(b), Peak output power			
<b>Test procedure:</b>	ANSI C63.10, section 7.8.5		
<b>Test mode:</b>	Compliance		
<b>Date(s):</b>	28-Mar-22		
<b>Temperature:</b> 20 °C	<b>Relative Humidity:</b> 45 %	<b>Air Pressure:</b> 1010 hPa	<b>Power:</b> 12 VDC
<b>Remarks:</b>			

**Plot 7.1.5 Peak output power at high frequency**

EUT POSITION: X  
ANTENNA POLARIZATION: Vertical and Horizontal



EUT POSITION: Y  
ANTENNA POLARIZATION: Vertical and Horizontal



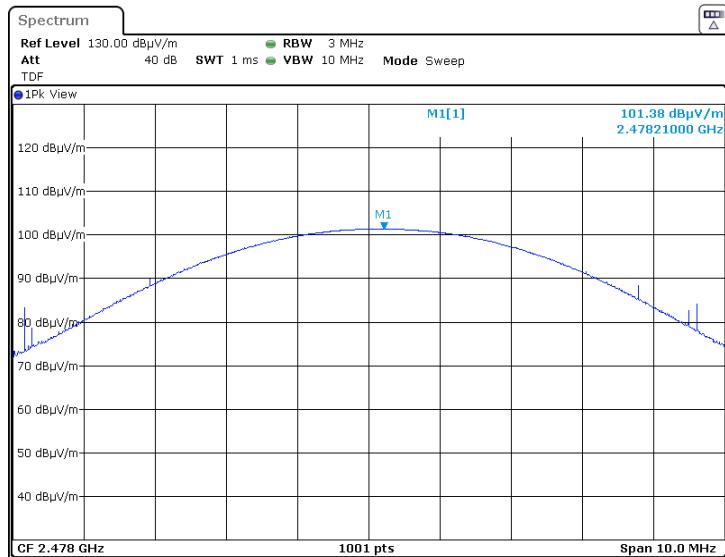


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<b>Test specification:</b> Section 15.247(b), Peak output power			
<b>Test procedure:</b> ANSI C63.10, section 7.8.5			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 28-Mar-22			
Temperature: 20 °C	<b>Relative Humidity:</b> 45 %	<b>Air Pressure:</b> 1010 hPa	<b>Power:</b> 12 VDC
<b>Remarks:</b>			

**Plot 7.1.6 Field strength of carrier at high frequency (continuation)**

EUT POSITION: Z  
ANTENNA POLARIZATION: Vertical and Horizontal





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<b>Test specification:</b> Section 15.247(c), Radiated spurious emissions			
<b>Test procedure:</b> ANSI C63.10, sections 6.5, 6.6			
<b>Test mode:</b> Compliance			<b>Verdict:</b> PASS
<b>Date(s):</b> 28-Mar-22 - 06-May-22			
Temperature: 50 °C	Relative Humidity: 45 %	Air Pressure: 1010 hPa	Power: 12 VDC
<b>Remarks:</b>			

## 7.2 Field strength of spurious emissions

### 7.2.1 General

This test was performed to measure field strength of spurious emissions from the EUT. Specification test limits are given in Table 7.2.1.

**Table 7.2.1 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		73.8 – 63.0**	NA		
1.705 – 30.0*		69.5			
30 – 88	NA	40.0			
88 – 216		43.5			
216 – 960		46.0			
960 - 1000		54.0			
1000 – 10 <sup>th</sup> harmonic	74.0	NA	54.0		

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

$$\text{Lim}_{S_2} = \text{Lim}_{S_1} + 40 \log \left( \frac{S_1}{S_2} \right)$$

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.

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

7.2.2.1 The EUT was set up as shown in Figure 7.2.1, energized and the performance check was conducted.

7.2.2.2 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.

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

### 7.2.3 Test procedure for spurious emission field strength measurements above 30 MHz

7.2.3.1 The EUT was set up as shown in Figure 7.2.2, Figure 7.2.3, energized and the performance check was conducted.

7.2.3.2 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.

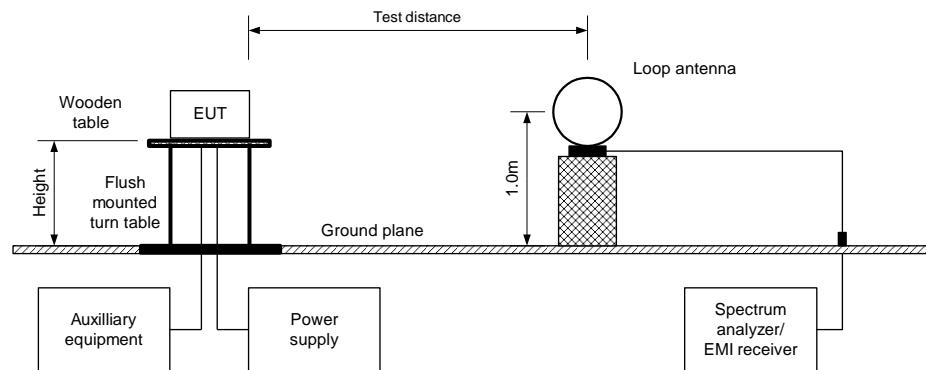
7.2.3.3 The worst test results (the lowest margins) were recorded and shown in the associated plots.



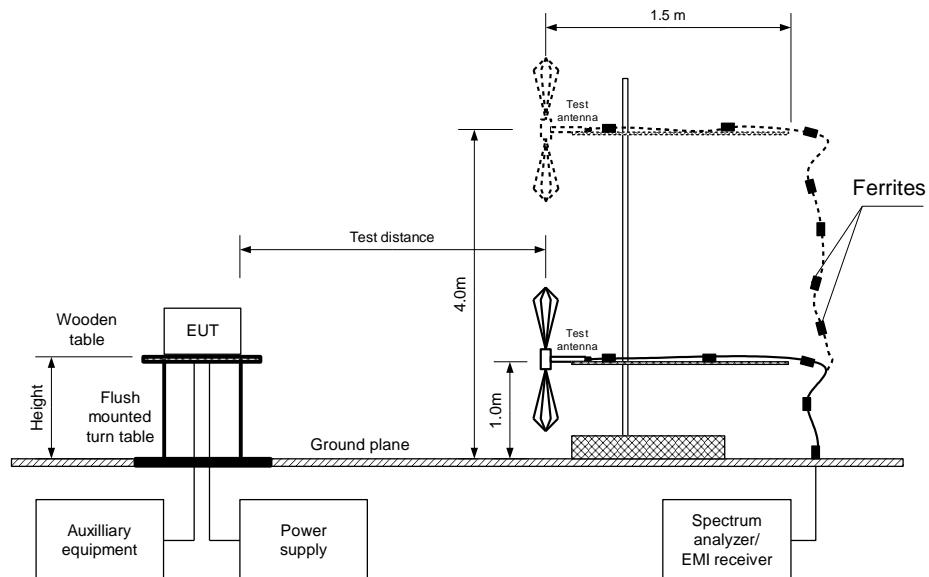
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<b>Test specification: Section 15.247(c), Radiated spurious emissions</b>			
<b>Test procedure:</b> ANSI C63.10, sections 6.5, 6.6			
<b>Test mode:</b> Compliance			<b>Verdict:</b> PASS
<b>Date(s):</b> 28-Mar-22 - 06-May-22			
Temperature: 50 °C	<b>Relative Humidity:</b> 45 %	<b>Air Pressure:</b> 1010 hPa	<b>Power:</b> 12 VDC
<b>Remarks:</b>			

**Figure 7.2.1 Setup for spurious emission field strength measurements below 30 MHz**



**Figure 7.2.2 Setup for spurious emission field strength measurements from 30 to 1000 MHz**

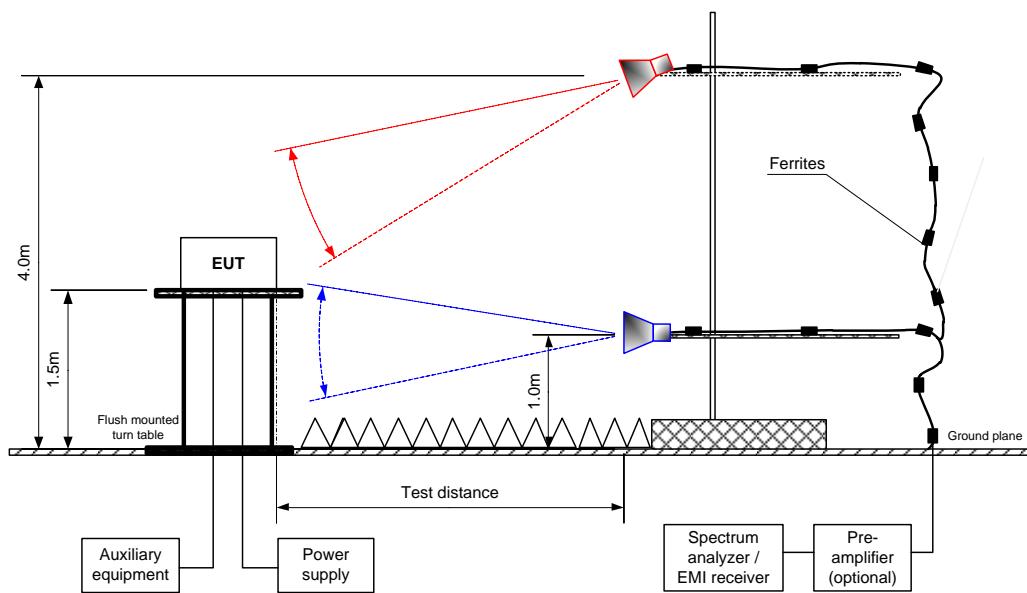




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<b>Test specification:</b> Section 15.247(c), Radiated spurious emissions			
<b>Test procedure:</b> ANSI C63.10, sections 6.5, 6.6			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 28-Mar-22 - 06-May-22			
Temperature: 50 °C	<b>Relative Humidity:</b> 45 %	<b>Air Pressure:</b> 1010 hPa	<b>Power:</b> 12 VDC
<b>Remarks:</b>			

Figure 7.2.3 Setup for spurious emission field strength measurements above 1000 MHz





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<b>Test specification:</b> Section 15.247(c), Radiated spurious emissions	
<b>Test procedure:</b> ANSI C63.10, sections 6.5, 6.6	
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS
<b>Date(s):</b> 28-Mar-22 - 06-May-22	
<b>Temperature:</b> 50 °C	<b>Relative Humidity:</b> 45 %
	<b>Air Pressure:</b> 1010 hPa
	<b>Power:</b> 12 VDC
<b>Remarks:</b>	

**Table 7.2.2 Field strength of emissions outside restricted bands**

ASSIGNED FREQUENCY:	2400.0 – 2483.5 MHz
INVESTIGATED FREQUENCY RANGE:	0.009 – 25000 MHz
TEST DISTANCE:	3 m
MODULATION:	MSK
MODULATING SIGNAL:	PRBS
BIT RATE:	250 kbps
DUTY CYCLE:	100 %
TRANSMITTER OUTPUT POWER SETTINGS:	Maximum
DETECTOR USED:	Peak
RESOLUTION BANDWIDTH:	100 kHz
VIDEO BANDWIDTH:	300 kHz
TEST ANTENNA TYPE:	Active loop (9 kHz – 30 MHz) Biconilog (30 MHz – 1000 MHz) Double ridged guide (above 1000 MHz)
FREQUENCY HOPPING:	Disabled

Frequency, 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
<b>Low carrier frequency</b>									
215.56	37.99	Vertical	1.04	-42	107.06	69.07	20.0	-49.07	Pass
7202.50	60.57	Vertical	1.50	142		46.49		-26.49	
<b>Mid carrier frequency</b>									
13705.57	49.45	Vertical	1.5	-156	108.12	58.67	20.0	-38.67	Pass
<b>High carrier frequency</b>									
31.54	38.39	Vertical	1.00	36	101.38	62.99	20.0	-42.99	Pass
210.48	40.21	Vertical	1.02	-117		61.17		-41.17	
9912.98	51.77	Vertical	1.5	115		49.61		-29.61	

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

\*\*- Margin = Specification limit- attenuation below carrier.



HERMON LABORATORIES

<b>Test specification:</b> Section 15.247(c), Radiated spurious emissions			
<b>Test procedure:</b> ANSI C63.10, sections 6.5, 6.6			
<b>Test mode:</b> Compliance			<b>Verdict:</b> PASS
<b>Date(s):</b> 28-Mar-22 - 06-May-22			
<b>Temperature:</b> 50 °C	<b>Relative Humidity:</b> 45 %	<b>Air Pressure:</b> 1010 hPa	<b>Power:</b> 12 VDC
<b>Remarks:</b>			

**Table 7.2.3 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: MSK  
 MODULATING SIGNAL: PRBS  
 BIT RATE: 250 kbps  
 DUTY CYCLE: 100 %  
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum  
 DETECTOR USED: Peak  
 RESOLUTION BANDWIDTH: 1000 kHz  
 TEST ANTENNA TYPE: Double ridged guide  
 FREQUENCY HOPPING: Disabled

Frequency, MHz	Antenna		Azimuth, degrees*	Peak field strength(VBW=3 MHz)			Average field strength(VBW=1 kHz)			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)	
<b>Low carrier frequency</b>										
4801.65	Vertical	1.50	-180	49.96	74.0	-24.04	48.43	NA	54.0	-5.57
12004.66	Vertical	1.50	-158	53.53	74.0	-20.47	50.85	NA	54.0	-3.15
<b>Mid carrier frequency</b>										
4883.672	Vertical	1.34	-33	47.55	74.0	-26.45	43.38	NA	54.0	-10.62
7325.226	Vertical	1.53	3	49.98	74.0	-24.02	44.78	NA	54.0	-9.22
<b>High carrier frequency</b>										
2484.50	Vertical	1.50	0	57.95	74.0	-16.05	45.59	NA	54.0	-8.41
4956.24	Vertical	1.50	168	51.24	74.0	-22.76	49.63	NA	54.0	-4.37
7434.61	Vertical	1.50	168	52.73	74.0	-21.27	49.99	NA	54.0	-4.01

\*- 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.



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<b>Test specification:</b> Section 15.247(c), Radiated spurious emissions	
<b>Test procedure:</b> ANSI C63.10, sections 6.5, 6.6	
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS
<b>Date(s):</b> 28-Mar-22 - 06-May-22	
<b>Temperature:</b> 50 °C	<b>Relative Humidity:</b> 45 %
	<b>Air Pressure:</b> 1010 hPa
	<b>Power:</b> 12 VDC
<b>Remarks:</b>	

**Table 7.2.4 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:	MSK
MODULATING SIGNAL:	PRBS
BIT RATE:	250 kbps
DUTY CYCLE:	100 %
TRANSMITTER OUTPUT POWER SETTINGS:	Maximum
RESOLUTION BANDWIDTH:	0.2 kHz (9 kHz – 150 kHz) 9.0 kHz (150 kHz – 30 MHz) 120 kHz (30 MHz – 1000 MHz)
VIDEO BANDWIDTH:	> Resolution bandwidth
TEST ANTENNA TYPE:	Active loop (9 kHz – 30 MHz) Biconilog (30 MHz – 1000 MHz)
FREQUENCY HOPPING:	Disabled

Frequency, MHz	Peak emission, dB(µV/m)	Quasi-peak			Antenna polarization	Antenna height, m	Turn-table position**, degrees	Verdict
		Measured emission, dB(µV/m)	Limit, dB(µV/m)	Margin, dB*				
<b>Low carrier frequency</b>								
163.87	38.32	36.86	43.50	6.64	Vertical	1.02	114	Pass
<b>Mid carrier frequency</b>								
163.00	38.12	36.60	43.50	6.9	Vertical	1.00	47	Pass
<b>High carrier frequency</b>								
162.10	37.76	35.76	43.50	7.74	Vertical	1.04	58	Pass

\*- Margin = Measured emission - specification limit.

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



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<b>Test specification:</b> Section 15.247(c), Radiated spurious emissions					
<b>Test procedure:</b> ANSI C63.10, sections 6.5, 6.6					
<b>Test mode:</b> Compliance				<b>Verdict:</b>	PASS
<b>Date(s):</b> 28-Mar-22 - 06-May-22					
<b>Temperature:</b> 50 °C	<b>Relative Humidity:</b> 45 %		<b>Air Pressure:</b> 1010 hPa	<b>Power:</b> 12 VDC	
<b>Remarks:</b>					

Table 7.2.5 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	
8.362 - 8.366	37.5 - 38.25	322 - 335.4	2483.5 - 2500	9300 - 9500	Above 38.6

**Reference numbers of test equipment used**

HL 0446	HL 0604	HL 3902	HL 4355	HL 4360	HL 4933	HL 4956	HL 5112
HL 5902							

Full description is given in Appendix A.

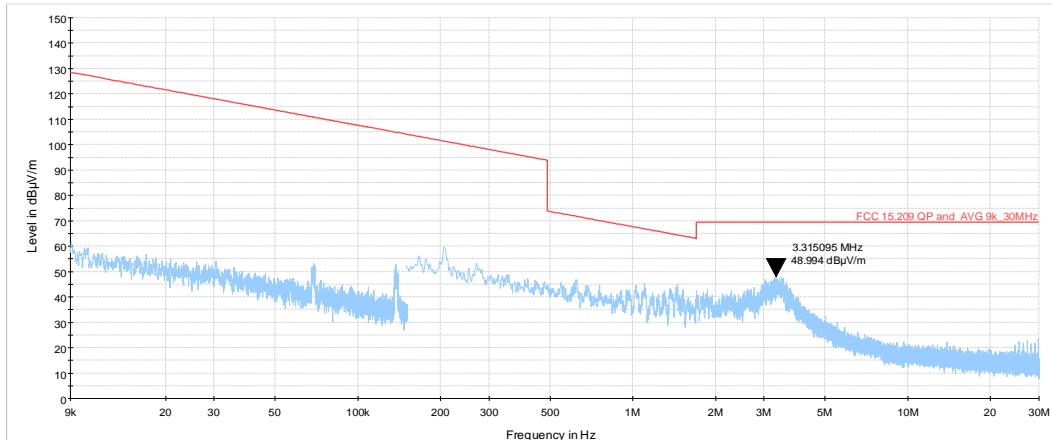


HERMON LABORATORIES

<b>Test specification:</b> Section 15.247(c), Radiated spurious emissions			
<b>Test procedure:</b> ANSI C63.10, sections 6.5, 6.6			
<b>Test mode:</b> Compliance			
<b>Date(s):</b> 28-Mar-22 - 06-May-22			<b>Verdict:</b> PASS
Temperature: 50 °C	<b>Relative Humidity:</b> 45 %	<b>Air Pressure:</b> 1010 hPa	<b>Power:</b> 12 VDC
<b>Remarks:</b>			

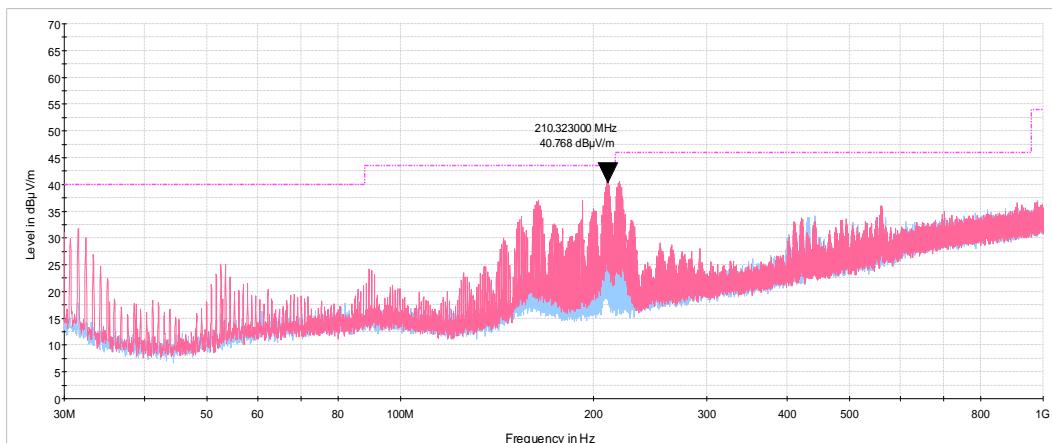
**Plot 7.2.1 Radiated emission measurements from 9 kHz to 30 MHz at the low, mid, high carrier frequency**

TEST SITE: Semi anechoic chamber  
TEST DISTANCE: 3 m



**Plot 7.2.2 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



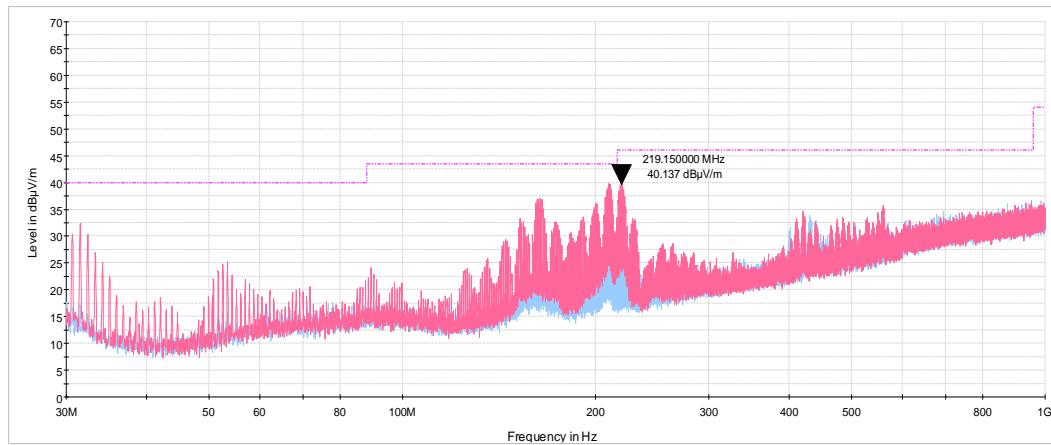


HERMON LABORATORIES

<b>Test specification:</b> Section 15.247(c), Radiated spurious emissions			
<b>Test procedure:</b> ANSI C63.10, sections 6.5, 6.6			
<b>Test mode:</b> Compliance			
<b>Date(s):</b> 28-Mar-22 - 06-May-22			
<b>Temperature:</b> 50 °C	<b>Relative Humidity:</b> 45 %	<b>Air Pressure:</b> 1010 hPa	<b>Power:</b> 12 VDC
<b>Remarks:</b>			

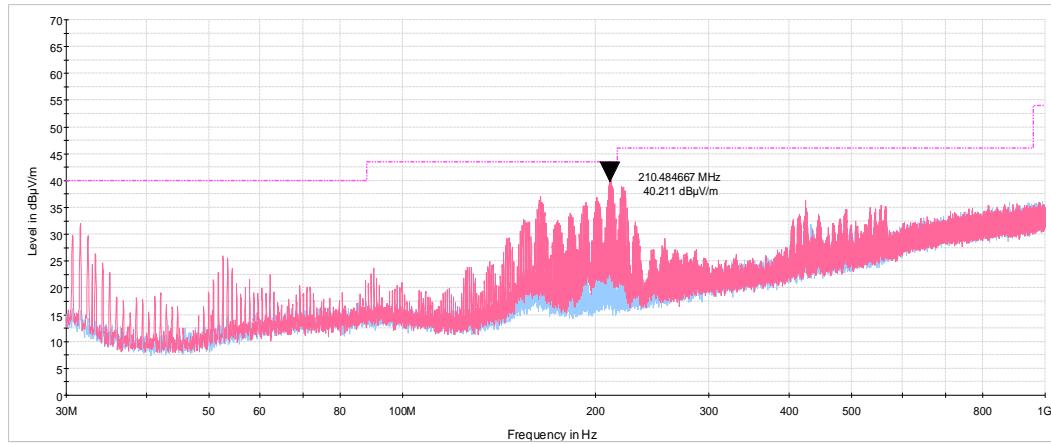
**Plot 7.2.3 Radiated emission measurements from 30 to 1000 MHz at the mid carrier frequency**

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



**Plot 7.2.4 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



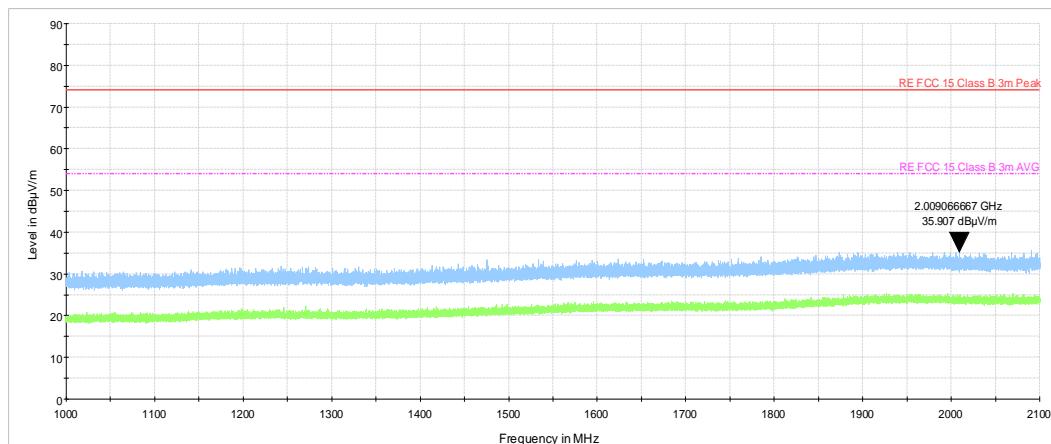


HERMON LABORATORIES

<b>Test specification:</b> Section 15.247(c), Radiated spurious emissions			
<b>Test procedure:</b> ANSI C63.10, sections 6.5, 6.6			
<b>Test mode:</b> Compliance			<b>Verdict:</b> PASS
<b>Date(s):</b> 28-Mar-22 - 06-May-22			
Temperature: 50 °C	<b>Relative Humidity:</b> 45 %	<b>Air Pressure:</b> 1010 hPa	<b>Power:</b> 12 VDC
<b>Remarks:</b>			

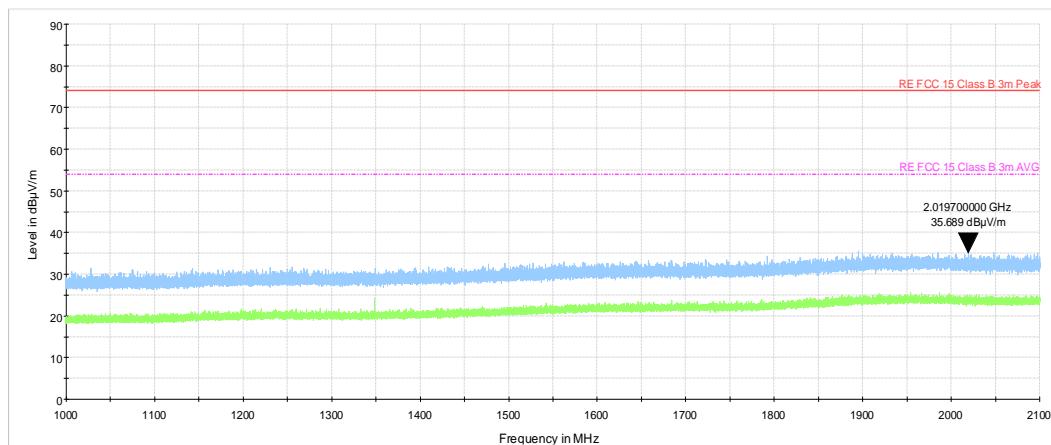
**Plot 7.2.5 Radiated emission measurements from 1000 to 2100 MHz at the low carrier frequency**

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



**Plot 7.2.6 Radiated emission measurements from 1000 to 2100 MHz at the mid carrier frequency**

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





HERMON LABORATORIES

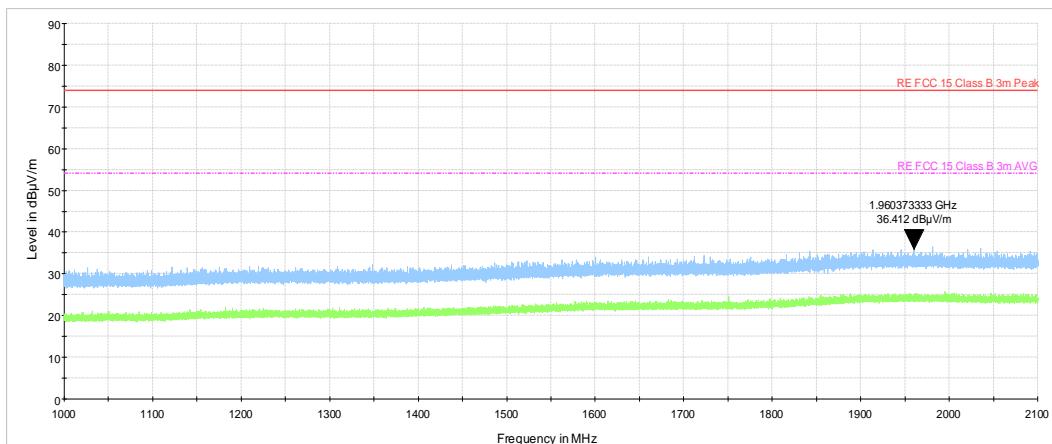
<b>Test specification:</b> Section 15.247(c), Radiated spurious emissions			
<b>Test procedure:</b> ANSI C63.10, sections 6.5, 6.6			
<b>Test mode:</b> Compliance			<b>Verdict:</b> PASS
<b>Date(s):</b> 28-Mar-22 - 06-May-22			
Temperature: 50 °C	<b>Relative Humidity:</b> 45 %	<b>Air Pressure:</b> 1010 hPa	<b>Power:</b> 12 VDC
<b>Remarks:</b>			

**Plot 7.2.7 Radiated emission measurements from 1000 to 2100 MHz at the high carrier frequency**

TEST SITE: Semi anechoic chamber

TEST DISTANCE: 3 m

ANTENNA POLARIZATION: Vertical and Horizontal





HERMON LABORATORIES

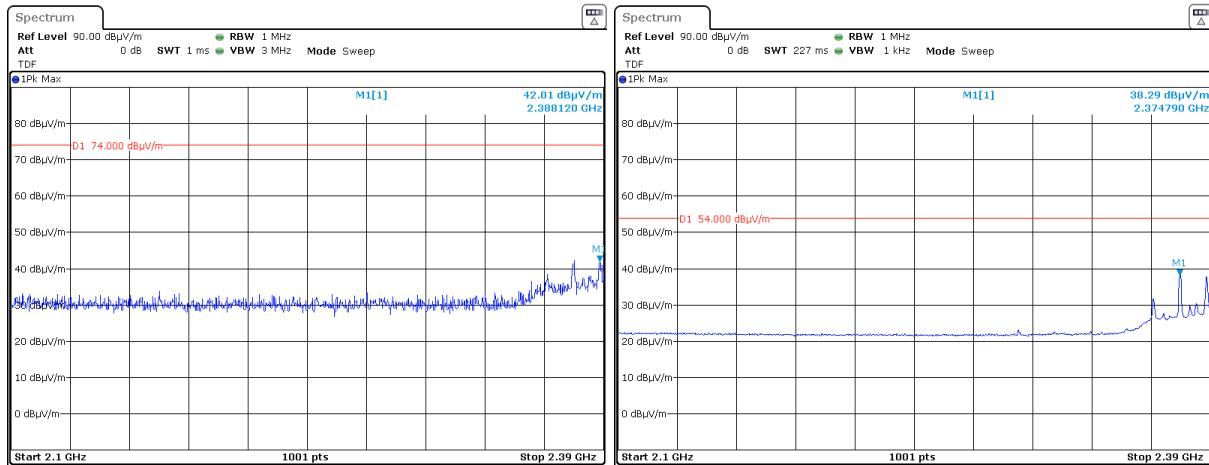
<b>Test specification: Section 15.247(c), Radiated spurious emissions</b>			
<b>Test procedure:</b>	ANSI C63.10, sections 6.5, 6.6		
<b>Test mode:</b>	Compliance		
<b>Date(s):</b>	28-Mar-22 - 06-May-22		
<b>Temperature:</b> 50 °C	<b>Relative Humidity:</b> 45 %	<b>Air Pressure:</b> 1010 hPa	<b>Power:</b> 12 VDC
<b>Remarks:</b>			

**Plot 7.2.8 Radiated emission measurements from 2100 to 2390 MHz at the low carrier frequency**

TEST SITE: Semi anechoic chamber

TEST DISTANCE: 3 m

ANTENNA POLARIZATION: Vertical and Horizontal

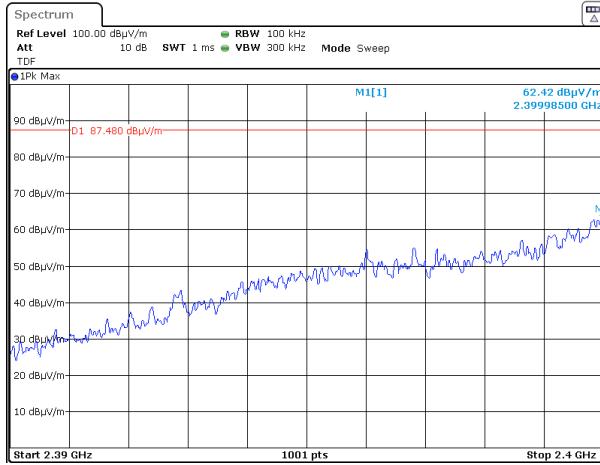


**Plot 7.2.9 Radiated emission measurements from 2390 to 2400 MHz at the low carrier frequency**

TEST SITE: Semi anechoic chamber

TEST DISTANCE: 3 m

ANTENNA POLARIZATION: Vertical and Horizontal





HERMON LABORATORIES

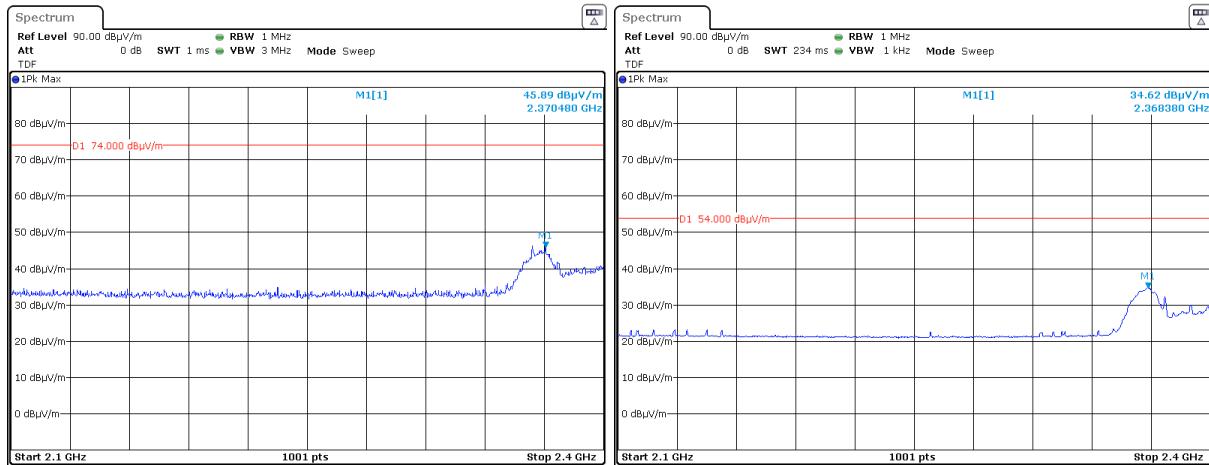
<b>Test specification: Section 15.247(c), Radiated spurious emissions</b>			
<b>Test procedure:</b>	ANSI C63.10, sections 6.5, 6.6		
<b>Test mode:</b>	Compliance		
<b>Date(s):</b>	28-Mar-22 - 06-May-22		
<b>Temperature:</b> 50 °C	<b>Relative Humidity:</b> 45 %	<b>Air Pressure:</b> 1010 hPa	<b>Power:</b> 12 VDC
<b>Remarks:</b>			

**Plot 7.2.10 Radiated emission measurements from 2100 to 2400 MHz at the mid carrier frequency**

TEST SITE: Semi anechoic chamber

TEST DISTANCE: 3 m

ANTENNA POLARIZATION: Vertical and Horizontal

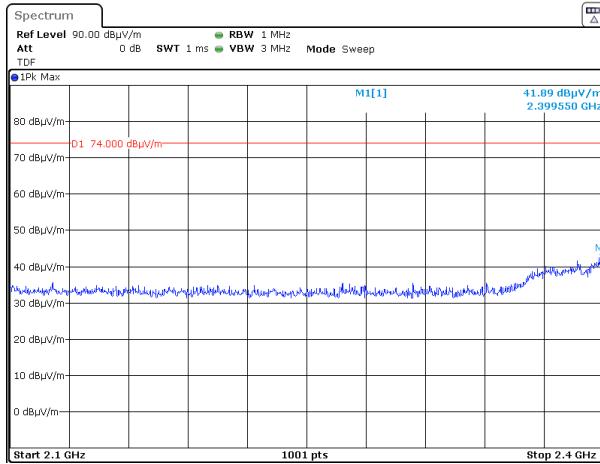


**Plot 7.2.11 Radiated emission measurements from 2100 to 2400 MHz at the high carrier frequency**

TEST SITE: Semi anechoic chamber

TEST DISTANCE: 3 m

ANTENNA POLARIZATION: Vertical and Horizontal





HERMON LABORATORIES

Report ID: ROSRAD\_FCC.45842\_31572\_Rev1.docx

Date of Issue: 10-Aug-22

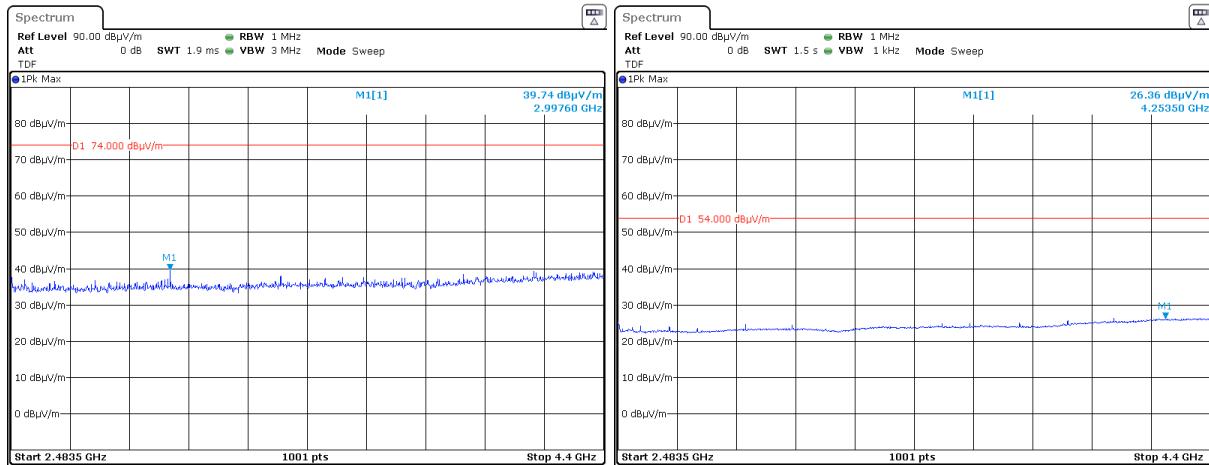
<b>Test specification:</b> Section 15.247(c), Radiated spurious emissions			
<b>Test procedure:</b> ANSI C63.10, sections 6.5, 6.6			
<b>Test mode:</b> Compliance			
<b>Date(s):</b> 28-Mar-22 - 06-May-22			
<b>Temperature:</b> 50 °C	<b>Relative Humidity:</b> 45 %	<b>Air Pressure:</b> 1010 hPa	<b>Power:</b> 12 VDC
<b>Remarks:</b>			

**Plot 7.2.12 Radiated emission measurements from 2483.5 to 4400 MHz at the low carrier frequency**

TEST SITE: Semi anechoic chamber

TEST DISTANCE: 3 m

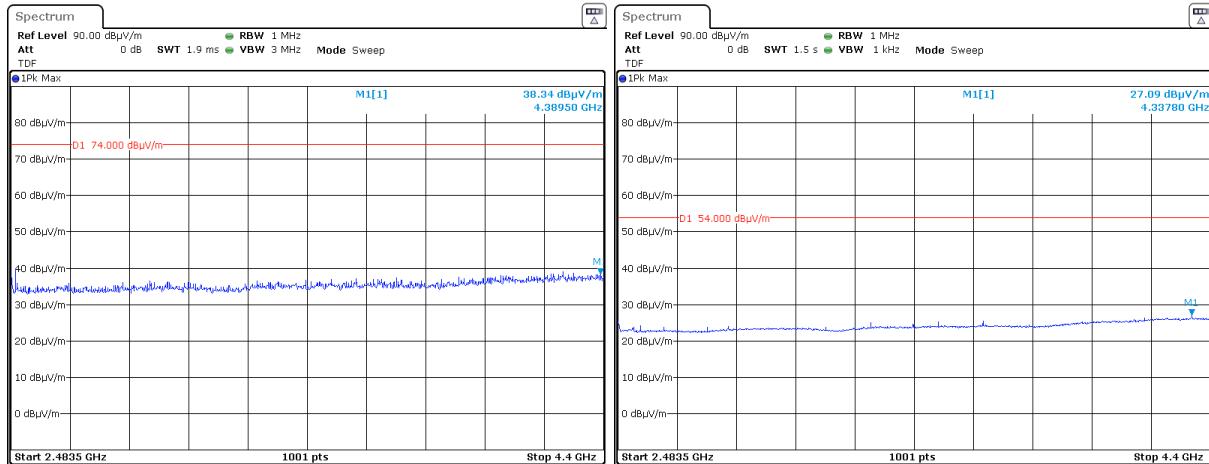
ANTENNA POLARIZATION: Vertical and Horizontal

**Plot 7.2.13 Radiated emission measurements from 2483.5 to 4400 MHz at the mid carrier frequency**

TEST SITE: Semi anechoic chamber

TEST DISTANCE: 3 m

ANTENNA POLARIZATION: Vertical and Horizontal





HERMON LABORATORIES

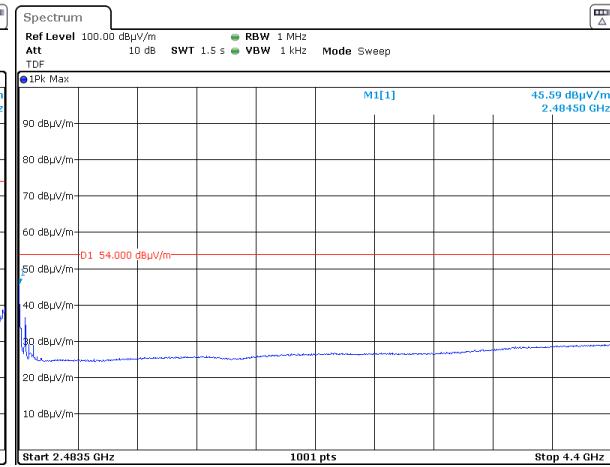
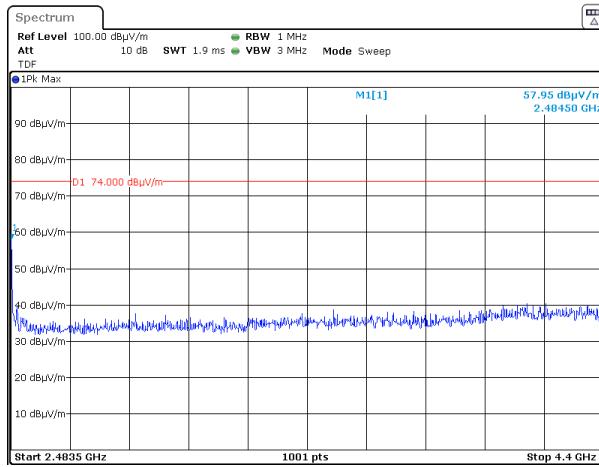
<b>Test specification:</b> Section 15.247(c), Radiated spurious emissions			
<b>Test procedure:</b> ANSI C63.10, sections 6.5, 6.6			
<b>Test mode:</b> Compliance			
<b>Date(s):</b> 28-Mar-22 - 06-May-22			
Temperature: 50 °C	<b>Relative Humidity:</b> 45 %	<b>Air Pressure:</b> 1010 hPa	<b>Power:</b> 12 VDC
<b>Remarks:</b>			

**Plot 7.2.14 Radiated emission measurements from 2483.5 to 4400 MHz at the high carrier frequency**

TEST SITE: Semi anechoic chamber

TEST DISTANCE: 3 m

ANTENNA POLARIZATION: Vertical and Horizontal



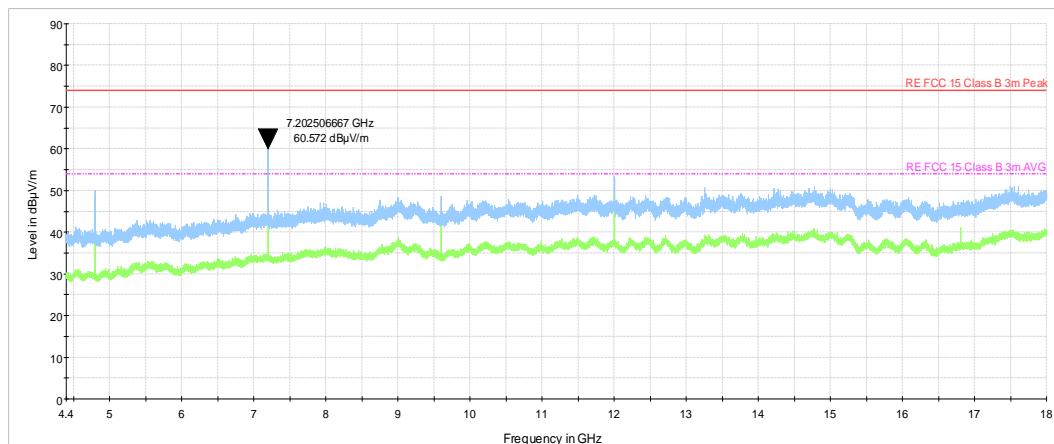


HERMON LABORATORIES

<b>Test specification:</b> Section 15.247(c), Radiated spurious emissions			
<b>Test procedure:</b> ANSI C63.10, sections 6.5, 6.6			
<b>Test mode:</b> Compliance			
<b>Date(s):</b> 28-Mar-22 - 06-May-22			
Temperature: 50 °C	<b>Relative Humidity:</b> 45 %	<b>Air Pressure:</b> 1010 hPa	<b>Power:</b> 12 VDC
<b>Remarks:</b>			

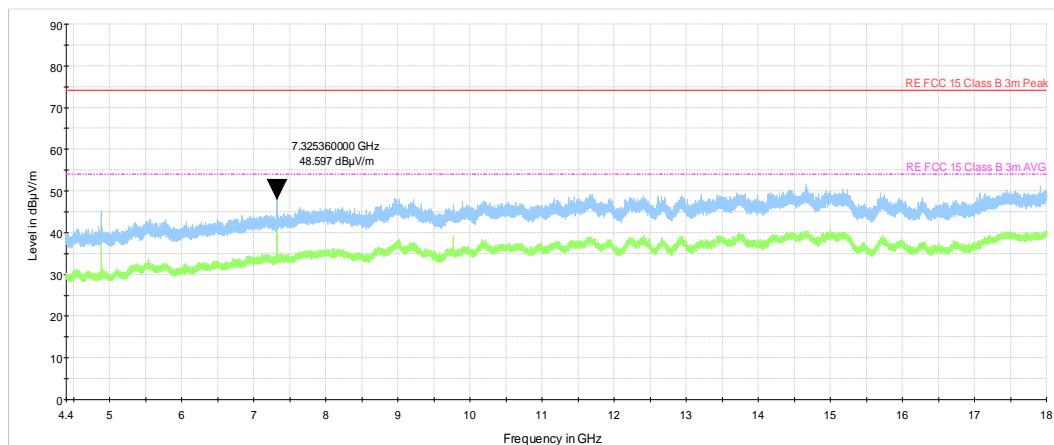
**Plot 7.2.15 Radiated emission measurements from 4400 to 18000 MHz at the low carrier frequency**

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



**Plot 7.2.16 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





HERMON LABORATORIES

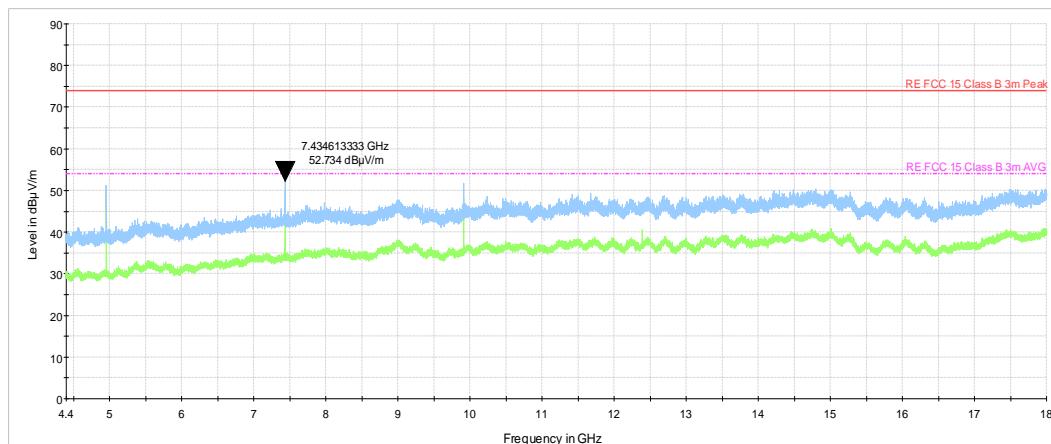
<b>Test specification:</b> Section 15.247(c), Radiated spurious emissions			
<b>Test procedure:</b> ANSI C63.10, sections 6.5, 6.6			
<b>Test mode:</b> Compliance			
<b>Date(s):</b> 28-Mar-22 - 06-May-22			<b>Verdict:</b> PASS
Temperature: 50 °C	<b>Relative Humidity:</b> 45 %	<b>Air Pressure:</b> 1010 hPa	<b>Power:</b> 12 VDC
<b>Remarks:</b>			

**Plot 7.2.17 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

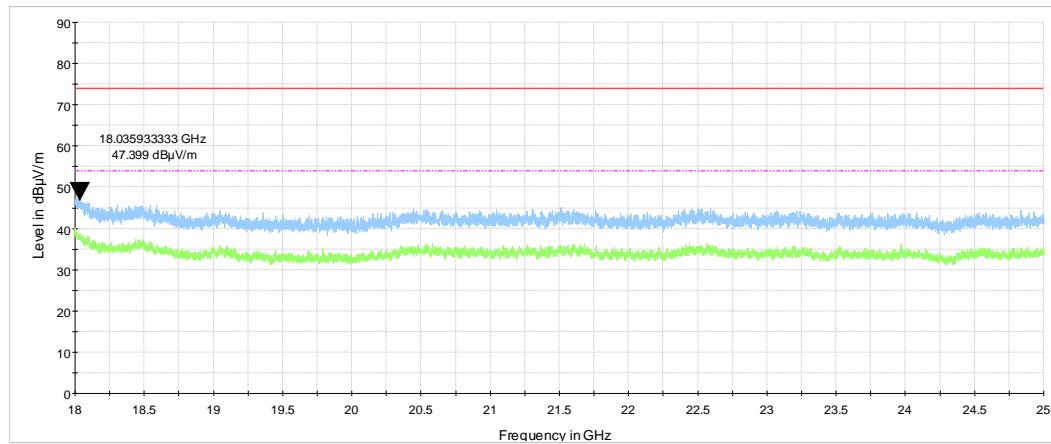


**Plot 7.2.18 Radiated emission measurements from 18000 to 25000 MHz at the low carrier frequency**

TEST SITE: Semi anechoic chamber

TEST DISTANCE: 3 m

ANTENNA POLARIZATION: Vertical and Horizontal



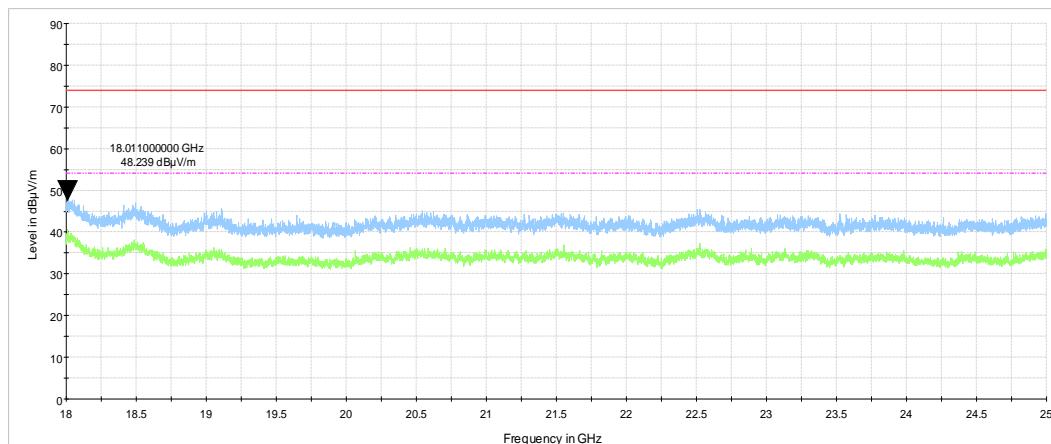


HERMON LABORATORIES

<b>Test specification:</b> Section 15.247(c), Radiated spurious emissions			
<b>Test procedure:</b> ANSI C63.10, sections 6.5, 6.6			
<b>Test mode:</b> Compliance			
<b>Date(s):</b> 28-Mar-22 - 06-May-22			
<b>Temperature:</b> 50 °C	<b>Relative Humidity:</b> 45 %	<b>Air Pressure:</b> 1010 hPa	<b>Power:</b> 12 VDC
<b>Remarks:</b>			

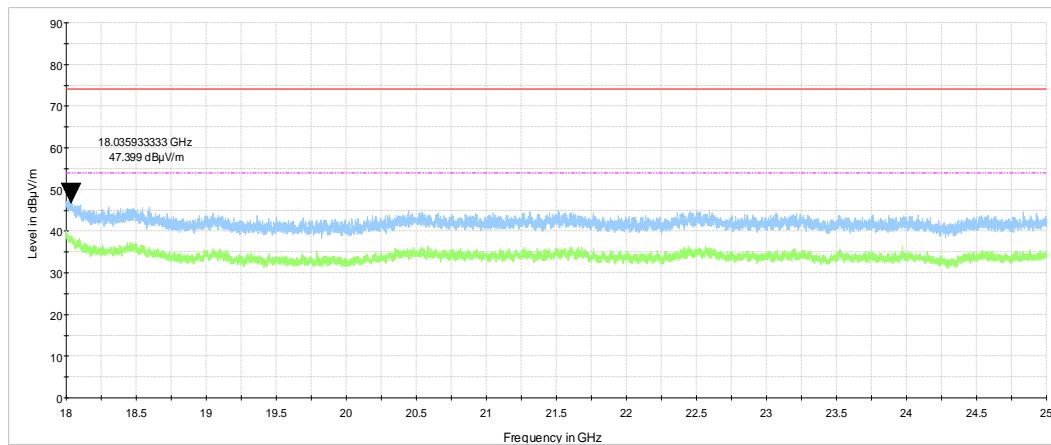
**Plot 7.2.19 Radiated emission measurements from 18000 to 25000 MHz at the mid carrier frequency**

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



**Plot 7.2.20 Radiated emission measurements from 18000 to 25000 MHz the high carrier frequency**

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





HERMON LABORATORIES

<b>Test specification:</b>	<b>Section 15.109, Radiated emission</b>		
<b>Test procedure:</b>	ANSI C63.4, Sections 11.6 and 12.1.4		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	PASS
<b>Date(s):</b>	29-Mar-22 - 16-May-22		
<b>Temperature:</b> 20 °C	<b>Relative Humidity:</b> 50 %	<b>Air Pressure:</b> 1007 hPa	<b>Power:</b> 12 VDC
<b>Remarks:</b>			

## 8 Unintentional emissions according to 47CFR part 15 subpart B requirements

### 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:  $L_{m2} = L_{m1} + 20 \log(S_1/S_2)$ , where  $S_1$  and  $S_2$  – standard defined and test distance respectively in meters.

#### 8.1.2 Test procedure for measurements in semi-anechoic chamber

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

8.1.2.2 The specified frequency range was investigated with biconilog antenna connected to EMI receiver. To find maximum radiation the turntable was rotated 3600, 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.

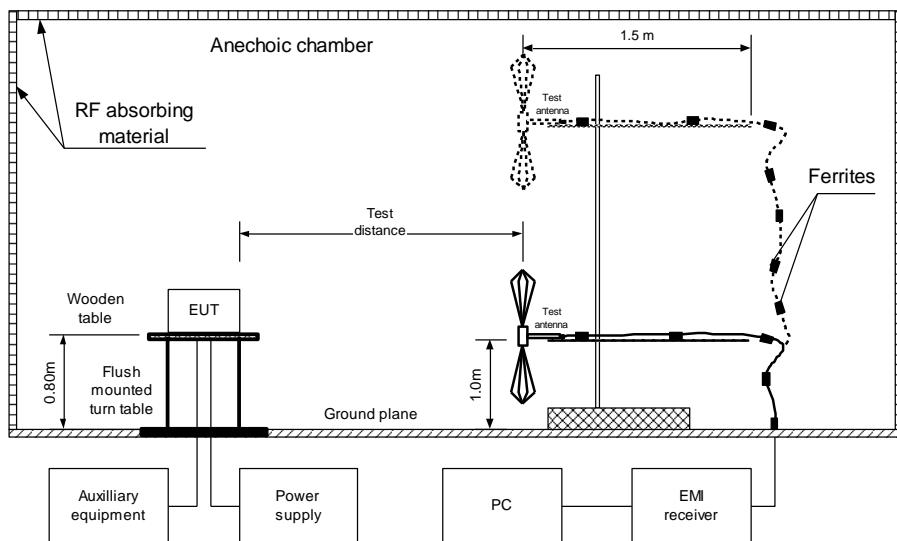
8.1.2.3 The worst test results (the lowest margins) were recorded in Table 8.1.2 and shown in the associated plots.



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<b>Test specification:</b>	<b>Section 15.109, Radiated emission</b>		
<b>Test procedure:</b>	ANSI C63.4, Sections 11.6 and 12.1.4		
<b>Test mode:</b>	Compliance		
<b>Date(s):</b>	29-Mar-22 - 16-May-22		
<b>Temperature:</b> 20 °C	<b>Relative Humidity:</b> 50 %	<b>Air Pressure:</b> 1007 hPa	<b>Power:</b> 12 VDC
<b>Remarks:</b>			

**Figure 8.1.1 Setup for radiated emission measurements, table-top equipment**





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<b>Test specification:</b> Section 15.109, Radiated emission			
<b>Test procedure:</b> ANSI C63.4, Sections 11.6 and 12.1.4			
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS		
<b>Date(s):</b> 29-Mar-22 - 16-May-22			
<b>Temperature:</b> 20 °C	<b>Relative Humidity:</b> 50 %	<b>Air Pressure:</b> 1007 hPa	<b>Power:</b> 12 VDC
<b>Remarks:</b>			

**Table 8.1.2 Radiated emission test results**

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

Frequency, MHz	Peak emission, dB(µV/m)	Quasi-peak			Antenna polarization	Antenna height, m	Turn-table position**, degrees	Verdict
		Measured emission, dB(µV/m)	Limit, dB(µV/m)	Margin, dB*				
188.482	40.02	36.25	43.5	-7.25	Vertical	1.00	178	Pass
196.834	40.53	38.59	43.5	-4.91	Vertical	1.00	-70	
204.782	41.92	39.28	43.5	-4.22	Vertical	1.00	-95	
215.650	42.96	41.50	43.5	-2.00	Vertical	1.00	64	

TEST SITE: SEMI ANECHOIC CHAMBER  
 TEST DISTANCE: 3 m  
 DETECTORS USED: PEAK / AVERAGE  
 FREQUENCY RANGE: 1000 MHz – 13000 MHz  
 RESOLUTION BANDWIDTH: 1000 kHz

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

\*- 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 5288			
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Full description is given in Appendix A.



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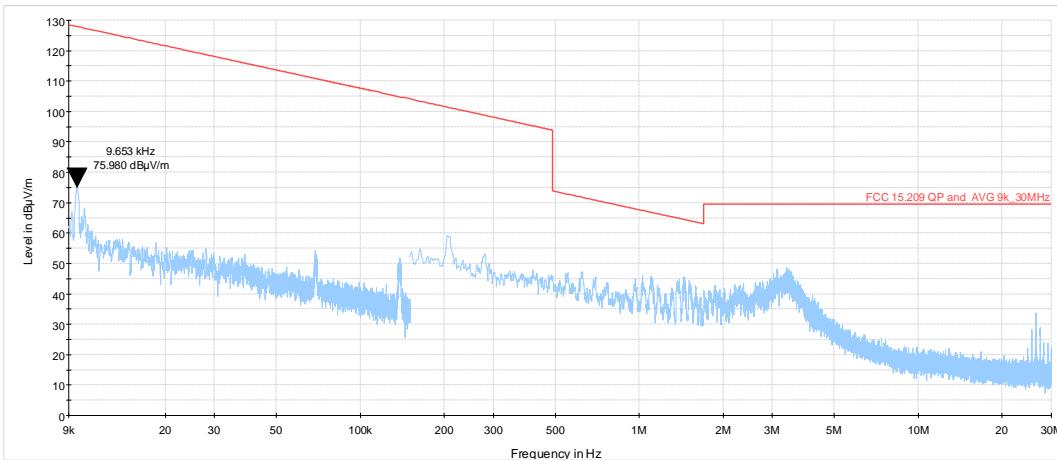
Report ID: ROSRAD\_FCC.45842\_31572\_Rev1.docx

Date of Issue: 10-Aug-22

<b>Test specification:</b> Section 15.109, Radiated emission			
<b>Test procedure:</b> ANSI C63.4, Sections 11.6 and 12.1.4			
<b>Test mode:</b> Compliance			<b>Verdict:</b> PASS
<b>Date(s):</b> 29-Mar-22 - 16-May-22			
Temperature: 20 °C	<b>Relative Humidity:</b> 50 %	<b>Air Pressure:</b> 1007 hPa	<b>Power:</b> 12 VDC
<b>Remarks:</b>			

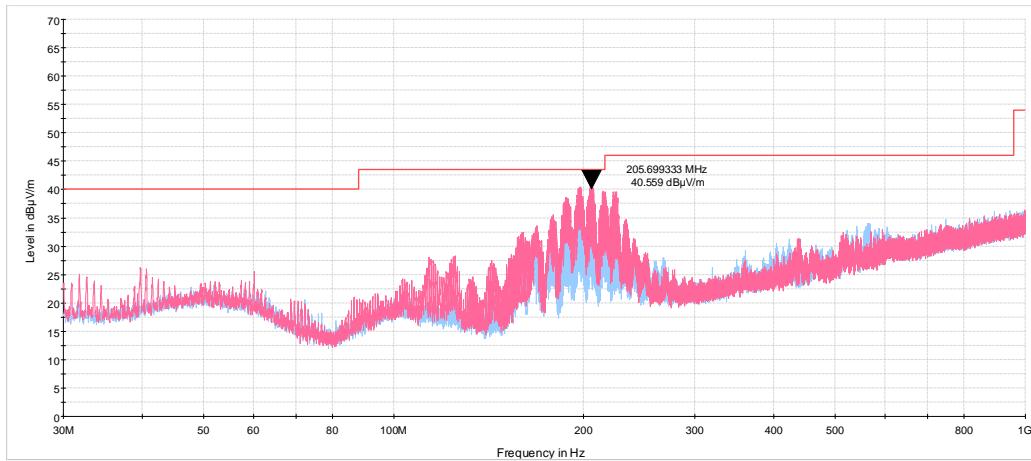
**Plot 8.1.1 Radiated emission measurements in 0.009 – 0.15 MHz range, vertical and horizontal antenna polarization**

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



**Plot 8.1.2 Radiated emission measurements in 30 – 1000 MHz range, vertical and horizontal antenna polarization**

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



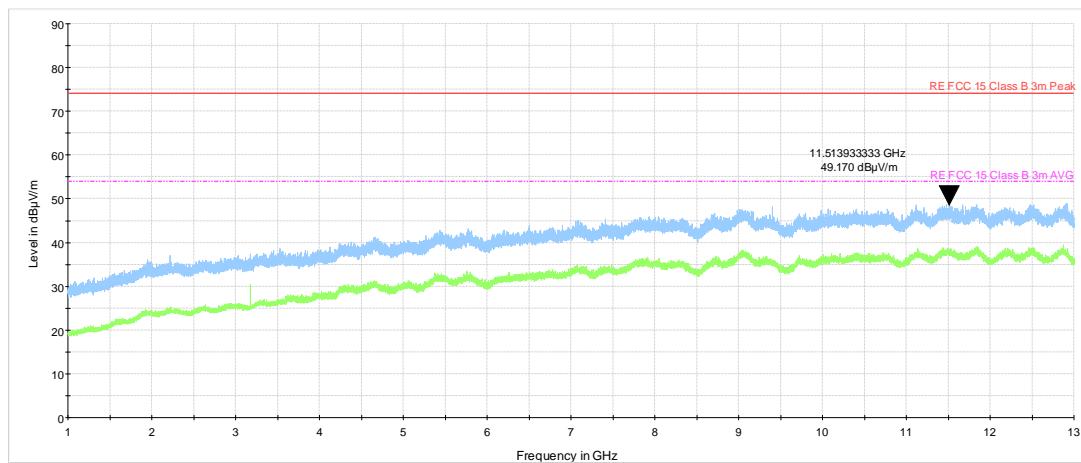


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<b>Test specification:</b>	<b>Section 15.109, Radiated emission</b>		
<b>Test procedure:</b>	ANSI C63.4, Sections 11.6 and 12.1.4		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	PASS
<b>Date(s):</b>	29-Mar-22 - 16-May-22		
<b>Temperature:</b> 20 °C	<b>Relative Humidity:</b> 50 %	<b>Air Pressure:</b> 1007 hPa	<b>Power:</b> 12 VDC
<b>Remarks:</b>			

**Plot 8.1.3 Radiated emission measurements in 1 – 13 GHz range, vertical and horizontal antenna polarization**

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





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## 9 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-22	28-Feb-23
0604	Antenna BiconiLog Log-Periodic/T Bow-TIE, 26 - 2000 MHz	EMCO	3141	9611-1011	11-May-21	11-May-22
3902	Microwave Cable Assembly, 40.0 GHz, 1.5 m, SMA/SMA	Huber-Suhner	SUCOFL EX 102A	1227/2A	06-Apr-21	06-May-22
3903	Microwave Cable Assembly, 40.0 GHz, 1.5 m, SMA/SMA	Huber-Suhner	SUCOFL EX 102A	1226/2A	06-Apr-21	06-Apr-22
4355	Signal and Spectrum Analyzer, 9 kHz to 7 GHz	Rohde & Schwarz	FSV 7	101630	20-Sep-21	20-Sep-22
4360	EMI Test Receiver, 20 Hz to 40 GHz.	Rohde & Schwarz	ESU40	100322	13-Jan-22	13-Jan-23
4933	Active Horn Antenna, 1 GHz to 18 GHz	COM-POWER CORPORATION	AHA-118	701046	13-Jan-22	13-Jan-23
4956	Active horn antenna, 18 to 40 GHz	COM-POWER CORPORATION	AHA-840	105004	07-Mar-22	07-Mar-23
5112	RF cable, 40 GHz, 5.5 m, K-type	Huber-Suhner	SF102EA/11SK/11SK/5500MM	502494/2EA	19-Apr-21	19-Apr-22
5288	Trilog Antenna, 25 MHz - 8 GHz, 100W	Frankonia	ALX-8000E	00809	24-Mar-22	24-Apr-25
5902	RF cable, 18 GHz, 6.0m, N-type	Huber-Suhner	SF126EA/11N/11N/6000	NA	16-Jan-22	16-Jan-23



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## 10 APPENDIX B Test equipment correction factors

HL 0604: Antenna BiconiLog Log-Periodic/T Bow-TIE  
EMCO, model 3141, serial number 9611-1011

Frequency, MHz	Antenna factor, dB/m		
	Measured	Last	Deviation
30	12.1	12.6	-0.5
35	9.1	9.5	-0.4
40	8.0	8.3	-0.3
45	8.3	8.6	-0.3
50	9.0	9.1	-0.1
60	10.5	10.7	-0.2
70	11.4	11.3	0.1
80	12.3	12.2	0.1
90	13.4	13.2	0.2
100	13.0	13.0	0.0
120	11.4	11.4	0.0
140	12.5	12.4	0.1
160	14.9	14.8	0.1
180	14.4	14.0	0.4
200	13.7	13.9	-0.2
250	16.3	16.4	-0.1
300	17.2	17.5	-0.3
400	19.8	20.2	-0.4
500	22.0	22.4	-0.4
600	24.3	24.5	-0.2
700	25.8	25.6	0.2
800	26.9	26.6	0.3
900	27.3	28.0	-0.7
1000	28.5	29.3	-0.8

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



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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 $\mu$ V to obtain field strength in dB $\mu$ V/m.



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## 11 APPENDIX C Test laboratory description

Tests were performed at Hermon Laboratories Ltd., which is a fully independent, private, EMC, Radio, Safety, Environmental and Telecommunication testing facility.

Hermon Laboratories is recognized and accredited by the Federal Communications Commission (USA) for 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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## 12 APPENDIX D 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: $\pm 1.7$ dB 12.4 GHz to 40 GHz: $\pm 2.3$ dB
Conducted emissions at RF antenna connector	9 kHz to 2.9 GHz: $\pm 2.6$ dB 2.9 GHz to 6.46 GHz: $\pm 3.5$ dB 6.46 GHz to 13.2 GHz: $\pm 4.3$ dB 13.2 GHz to 22.0 GHz: $\pm 5.0$ dB 22.0 GHz to 26.8 GHz: $\pm 5.5$ dB 26.8 GHz to 40.0 GHz: $\pm 4.8$ dB
Occupied bandwidth	$\pm 8.0$ %
Duty cycle, timing (Tx ON / OFF) and average factor measurements	$\pm 1.0$ %
Conducted emissions with LISN	9 kHz to 150 kHz: $\pm 3.9$ dB 150 kHz to 30 MHz: $\pm 3.8$ dB
Radiated emissions at 3 m measuring distance Horizontal polarization	Biconilog antenna: $\pm 5.3$ dB Biconical antenna: $\pm 5.0$ dB Log periodic antenna: $\pm 5.3$ dB Double ridged horn antenna: $\pm 5.3$ dB Biconilog antenna: $\pm 6.0$ dB Biconical antenna: $\pm 5.7$ dB Log periodic antenna: $\pm 6.0$ dB Double ridged horn antenna: $\pm 6.0$ dB
Vertical polarization	

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.



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## 13 APPENDIX E

### 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 C63.4: 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

## 14 APPENDIX F

### Abbreviations and acronyms

A	ampere	LISN	line impedance stabilization network
AC	alternating current	m	meter
A/m	ampere per meter	MHz	megahertz
AM	amplitude modulation	MIL	military
ASSL	abnormal steady state limits	mm	millimeter
ATP	acceptance test procedure	ms	millisecond
AVRG	average (detector)	μF	microfarad
BB	broad band	μs	microsecond
cm	centimeter	NA	not applicable
dB	decibel	NB	narrow band
dBm	decibel referred to one milliwatt	NP	normal performance
dB(μA)	decibel referred to one microampere	NSSL	normal steady state limits
dBμV	decibel referred to one microvolt	NT	not tested
dBμV/m	decibel referred to one microvolt per meter	OATS	open area test site
DC	direct current	Ω	Ohm
EMI	electromagnetic interference	QP	quasi-peak
ESS	environmental stress screening	PBIT	periodic built in test
ESSL	emergency steady state limits	PM	pulse modulation
EUT	equipment under test	PS	power supply
FTE	functional test equipment	RE	radiated emission
GHz	gigahertz	RF	radio frequency
GND	ground	rms	root mean square
H	height	s	second
HL	Hermon laboratories	STD	standard
Hz	hertz	TBD	to be defined
k	kilo	V	volt
kHz	kilohertz	VA	volt-ampere
kV	kilovolt	W	width
L	length	W	watt

END OF DOCUMENT