

TEST REPORT

ACCORDING TO: FCC CFR 47 PART 15 subpart C, §15.247 and subpart B

FOR:

Xsense Ltd.

XSENSE RTL

**Model: XRT10010, XRT10110, XRT10210, XRT20010,
XRT20110, XRT20210, XRT20029, XRT20129,
XRT20229, XRT30010, XRT30110, XRT30210,
XRT30029, XRT30129, XRT30229**

FCC ID: 2BG8G-XSENSE-RTL

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1 Applicant information

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Telephone: 04-9122800
Fax: 04-9122801
E-mail: Kasemg@xsense.co
Contact name: Mr. Kasem Gadban

2 Equipment under test attributes

Product name: XSENSE RTL
Product type: Transceiver
Model(s): XRT20229*
Serial number: XS110000000452
Hardware version: V67
Software release: V0.7.3.b
Receipt date 01-May-24

*According to manufacturer's declaration provided in Appendix H the XRT20229 is a Super Set product that is fully identical to XRT10010, XRT10110, XRT10210, XRT20010, XRT20110, XRT20210, XRT20029, XRT20129, XRT30010, XRT30110, XRT30210, XRT30029, XRT30129, XRT30229, behind the sensors that are removed and do not change the radio functions. In addition, some of the subsets may have another cellular modem and different batteries. Therefore, only the model XRT20229 was tested.

3 Manufacturer information

Manufacturer name: Xsense Ltd.
Address: Dolev 33, Migdal Tefen, Israel 2495900
Telephone: 04-9122800
Fax: 04-9122801
E-Mail: Kasemg@xsense.co
Contact name: Mr. Kasem Gadban

4 Test details

Project ID: 53897
Location: Hermon Laboratories Ltd. 66 HaTachana str., P.O. Box 23, Binyamina 3055001, Israel
Test started: 23-May-24
Test completed: 22-Jul-24
Test specification(s): FCC CFR 47 PART 15 subpart C, §15.247 and subpart B



5 Tests summary

Test	Status
Transmitter characteristics	
FCC Section 15.247(a)2, 6 dB bandwidth	Pass
FCC Section 15.247(b)3, Peak output power	Pass
FCC Section 15.247(d), Radiated spurious emissions	Pass
FCC Section 15.247(d), Emissions at band edges	Pass
FCC Section 15.247(e), Peak power density	Pass
FCC section 15.203, Antenna requirement	Pass
Unintentional emissions	
FCC Part 15, Section 107, Conducted emission at AC power port	Not required
FCC Part 15, Section 109, Section 6.2 class B, Radiated emission	Pass

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

	Name and Title	Date	Signature
Tested by:	Mrs. E. Pitt, test engineer, EMC & Radio Mr. S. Sugatov, test engineer, EMC & Radio	23-May-24 – 22-Jun-24	 
Reviewed by:	Mrs. S. Peysahov Sheynin, certification specialist, EMC & Radio	20-Jul-24	
Approved by:	Mr. M. Nikishin, group leader, EMC & Radio	14-Aug-24	

6 EUT description

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

6.1 General information

RTL - a unit that includes several sensors for measuring temperature, humidity, light power, shock, etc. The reading from the sensors can be stored in the RTL when the unit is offline 7.2 VDC and will be transferred to our company cloud/server by cellular or Bluetooth modem as soon the unit is connected online. The RTL will be used to monitor shipments of food (fruits, vegetables, meat, etc.) or shipments of pharmacies, and medicine around the world. The number of sensors connected to the unit and their types may vary depending on the client's request

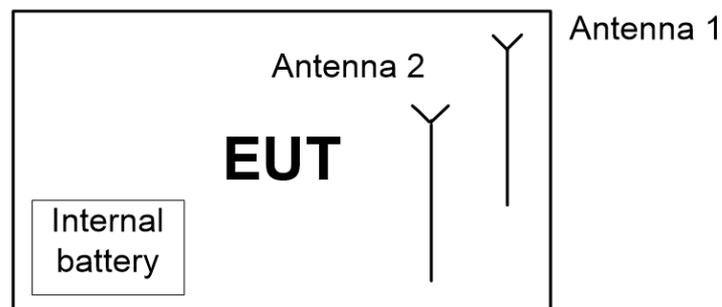
Communication options: 4G cellular modem that is backward compatible with 3G and 2G bands and BLE transceiver.

The unit is powered by Alkaline 6xAA or 6xAAA or 6xLR61 (6xAAAA) disposable batteries, 9 volts, Current – 10-30 μ A.

There are +9 type of models:

- 1: 2G modem + BLE (Alkaline AA battery)
- 2: 2G modem + BLE (Alkaline AAA battery)
- 3: 2G modem + BLE (Alkaline AAAA battery)
- 4: 4G_CatM1 modem + BLE (Alkaline AA battery)
- 5: 4G_CatM1 modem + BLE (Alkaline AAA battery)
- 6: 4G_CatM1 modem + BLE (Alkaline AAAA battery)
- 7: 4G_Cat1 modem + BLE (Alkaline AA battery)
- 8: 4G_Cat1 modem + BLE (Alkaline AAA battery)
- 9: 4G_Cat1 modem + BLE (Alkaline AAAA battery)

6.2 Test configuration



6.3 Changes made in EUT

No changes were implemented in the EUT during testing.



6.4 Transmitter characteristics

Type of equipment						
V	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 0.21 dBm				
Is transmitter output power variable?		V	No			
			continuous variable			
			stepped variable with stepsize			dB
		Yes	minimum RF power			dBm
			maximum RF power			dBm
Antenna connection						
unique coupling		standard connector		V	Integral	
				V	without temporary RF connector	
Antenna/s technical characteristics						
Type	Manufacturer	Model number		Gain		
PCB antenna	Xsense	X1		Typical peak gain: 2.3 dBi		
Transmitter aggregate data rate/s		1 Mbps				
Type of modulation		GFSK				
Modulating test signal (baseband)		PRBS				
Transmitter power source						
V	Battery	Nominal rated voltage	9 VDC	Battery type	Alkaline battery	
	DC	Nominal rated voltage				
	AC mains	Nominal rated voltage		Frequency	Hz	



Test specification: Section 15.247(a)2, 6 dB bandwidth			
Test procedure: ANSI C63.10 section 11.8.1			
Test mode: Compliance		Verdict:	
Date(s): 02-Jun-24			
Temperature: 24 °C	Relative Humidity: 48 %	Air Pressure: 1012 hPa	Power: 9 VDC
Remarks:			

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

7.1 Minimum 6 dB bandwidth

7.1.1 General

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

Table 7.1.1 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.

7.1.2 Test procedure

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

7.1.2.2 The EUT was set to transmit modulated carrier.

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

Figure 7.1.1 6 dB bandwidth test setup





Test specification: Section 15.247(a)2, 6 dB bandwidth			
Test procedure: ANSI C63.10 section 11.8.1			
Test mode: Compliance		Verdict:	
Date(s): 02-Jun-24			
Temperature: 24 °C	Relative Humidity: 48 %	Air Pressure: 1012 hPa	Power: 9 VDC
Remarks:			

Table 7.1.2 6 dB bandwidth test results

ASSIGNED FREQUENCY BAND: MHz
DETECTOR USED: Peak
SWEEP MODE: Single
SWEEP TIME: Auto
RESOLUTION BANDWIDTH: 100 kHz
VIDEO BANDWIDTH: 300 kHz
MODULATION ENVELOPE REFERENCE POINTS: 6.0 dBc
MODULATION: GFSK
MODULATING SIGNAL: PRBS
BIT RATE: 1 Mbps

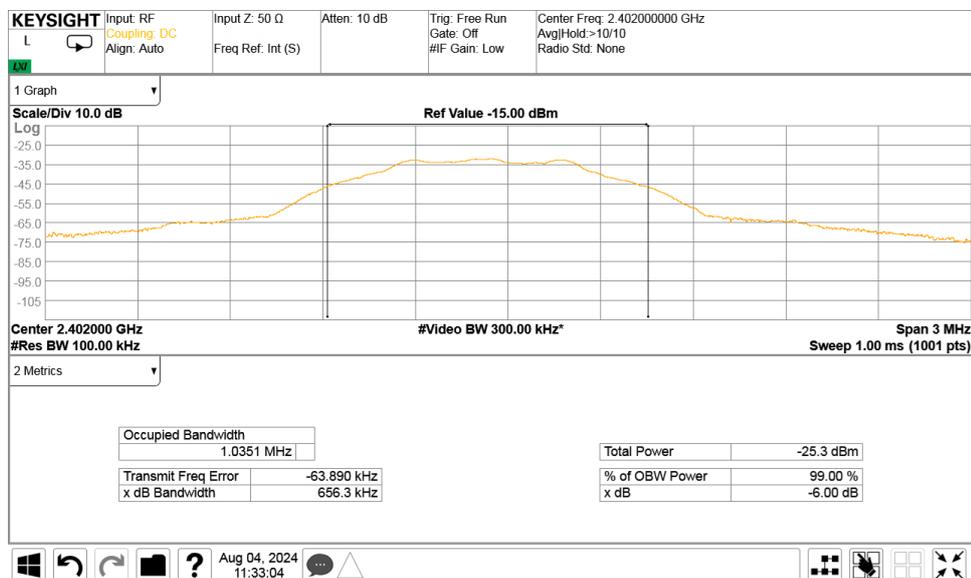
Carrier frequency, MHz	6 dB bandwidth, kHz	Limit, kHz	Margin, kHz	Verdict
Low frequency				
2402.0	656.3	500	156.3	Pass
Mid frequency				
2442.0	652.5	500	152.5	Pass
High frequency				
2480.0	652.4	500	152.4	Pass

Reference numbers of test equipment used

HL 4136	HL 5376	HL 5636	HL 5838				
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Full description is given in Appendix A.

Plot 7.1.1 6 dB bandwidth test result at low frequency





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Test specification: Section 15.247(a)2, 6 dB bandwidth			
Test procedure: ANSI C63.10 section 11.8.1			
Test mode: Compliance		Verdict:	
Date(s): 02-Jun-24			
Temperature: 24 °C	Relative Humidity: 48 %	Air Pressure: 1012 hPa	Power: 9 VDC
Remarks:			

Plot 7.1.2 6 dB bandwidth test result at mid frequency



Plot 7.1.3 6 dB bandwidth test result at high frequency





Test specification: Section 15.247(b)3, Maximum output power			
Test procedure: ANSI C63.10 sections 11.9.2.2.4			
Test mode: Compliance		Verdict:	
Date(s): 02-Jun-24			
Temperature: 24 °C	Relative Humidity: 48 %	Air Pressure: 1012 hPa	Power: 9 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 3600 and the measuring antenna height was swept in both vertical and horizontal polarizations.

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

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

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

where P is the peak output power in W, E is the field strength in V/m, d is the test distance and G is the transmitter numeric antenna gain over an isotropic radiator.

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

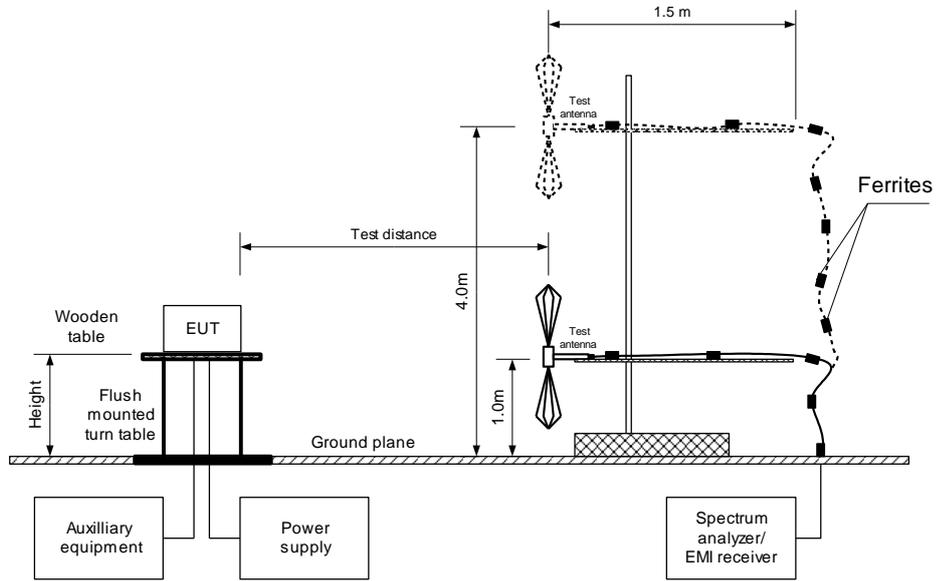
$$\text{Peak output power in dBm} = \text{Field strength in dB}(\mu\text{V/m}) - \text{Transmitter antenna gain in dBi} - 95.2 \text{ dB}$$

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



Test specification: Section 15.247(b)3, Maximum output power			
Test procedure: ANSI C63.10 sections 11.9.2.2.4			
Test mode: Compliance		Verdict:	
Date(s): 02-Jun-24			
Temperature: 24 °C	Relative Humidity: 48 %	Air Pressure: 1012 hPa	Power: 9 VDC
Remarks:			

Figure 7.2.1 Setup for carrier field strength measurements





Test specification: Section 15.247(b)3, Maximum output power			
Test procedure: ANSI C63.10 sections 11.9.2.2.4			
Test mode: Compliance		Verdict:	
Date(s): 02-Jun-24			
Temperature: 24 °C	Relative Humidity: 48 %	Air Pressure: 1012 hPa	Power: 9 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	96.16	Vertical	1.35	180	2.3	-1.34	30	-31.34	Pass
2442.0	96.30	Vertical	1.38	-180	2.3	-1.20	30	-31.20	Pass
2480.0	97.71	Vertical	1.13	-140	2.3	0.21	30	-29.79	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 at Unom (115%Unom, 85%Unom) input power voltage.

Reference numbers of test equipment used

HL 3903	HL 4933	HL 5902	HL 7585	HL 4015			
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Full description is given in Appendix A.



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Test specification: Section 15.247(b)3, Maximum output power			
Test procedure: ANSI C63.10 sections 11.9.2.2.4			
Test mode: Compliance		Verdict:	
Date(s): 02-Jun-24			
Temperature: 24 °C	Relative Humidity: 48 %	Air Pressure: 1012 hPa	Power: 9 VDC
Remarks:			

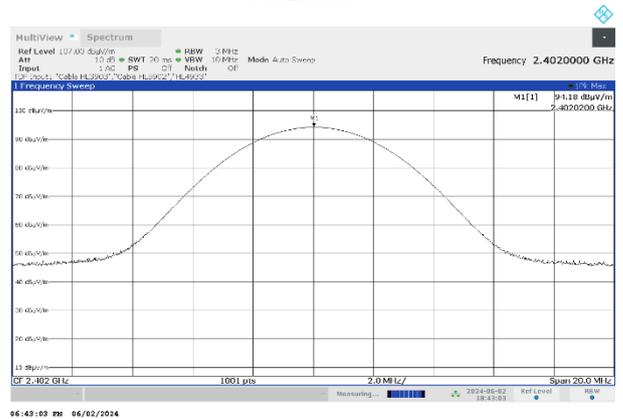
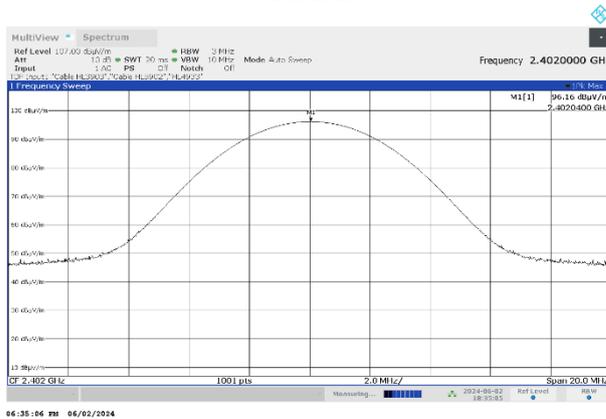
Plot 7.2.1 Field strength of carrier at low frequency

EUT POSITION:

Vertical

X-axis

Horizontal

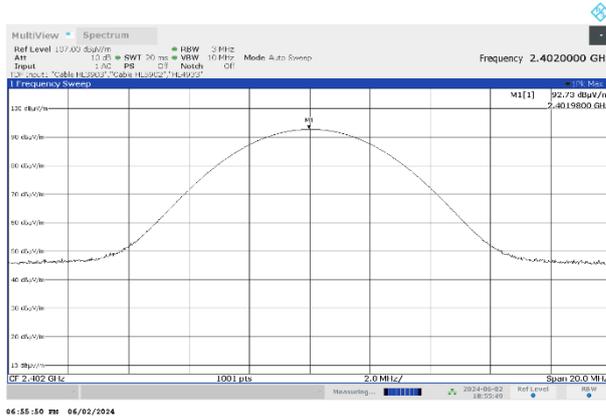


EUT POSITION:

Vertical

Y-axis

Horizontal

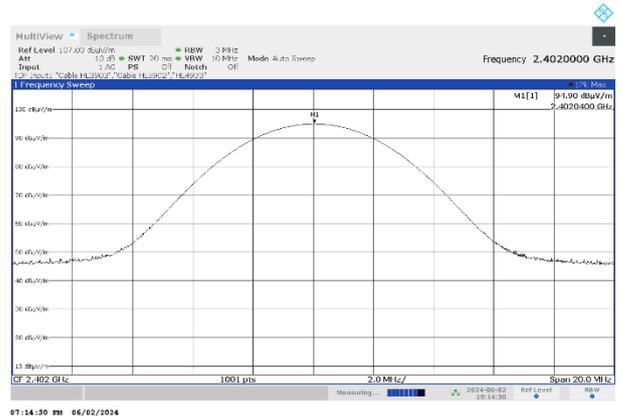
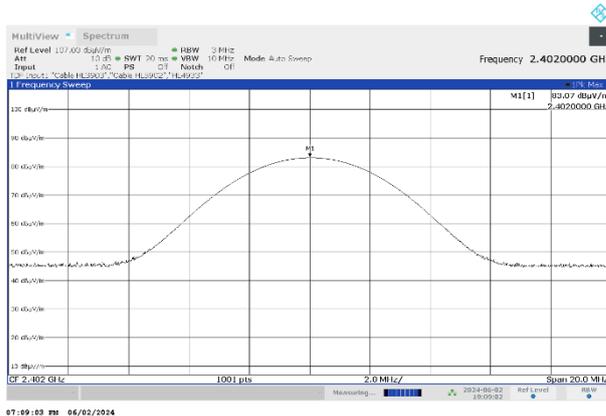


EUT POSITION:

Vertical

Z-axis

Horizontal





Test specification: Section 15.247(d), Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 16-Jul-24 - 17-Jul-24			
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1000 hPa	Power: 9 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:

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

where S₁ and S₂ – 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 1.1.3, 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), Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 16-Jul-24 - 17-Jul-24			
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1000 hPa	Power: 9 VDC
Remarks:			

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

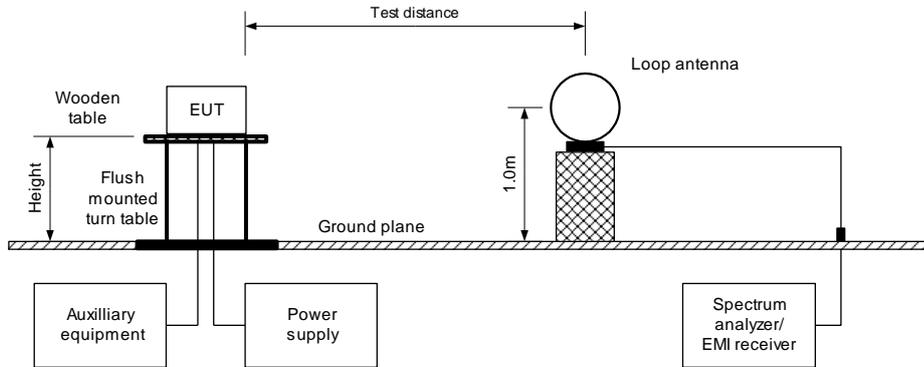
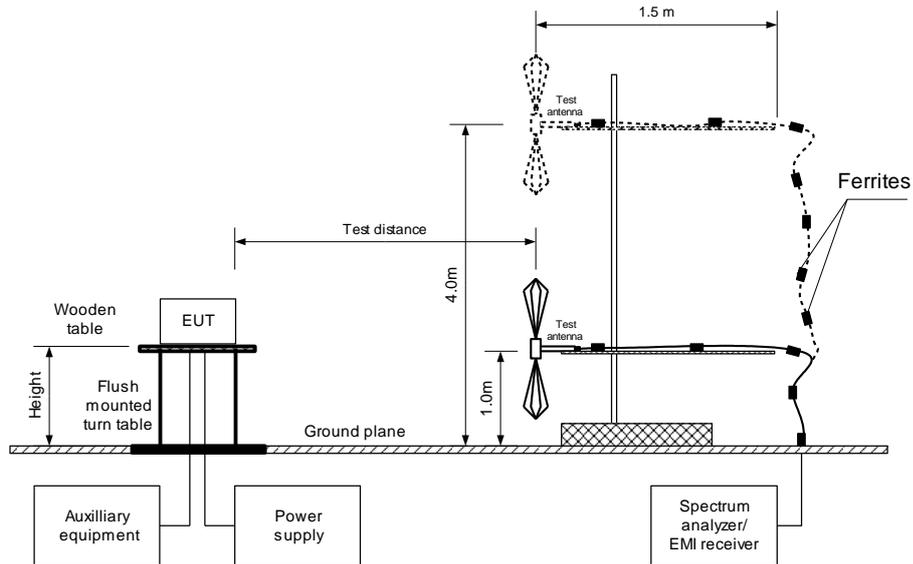


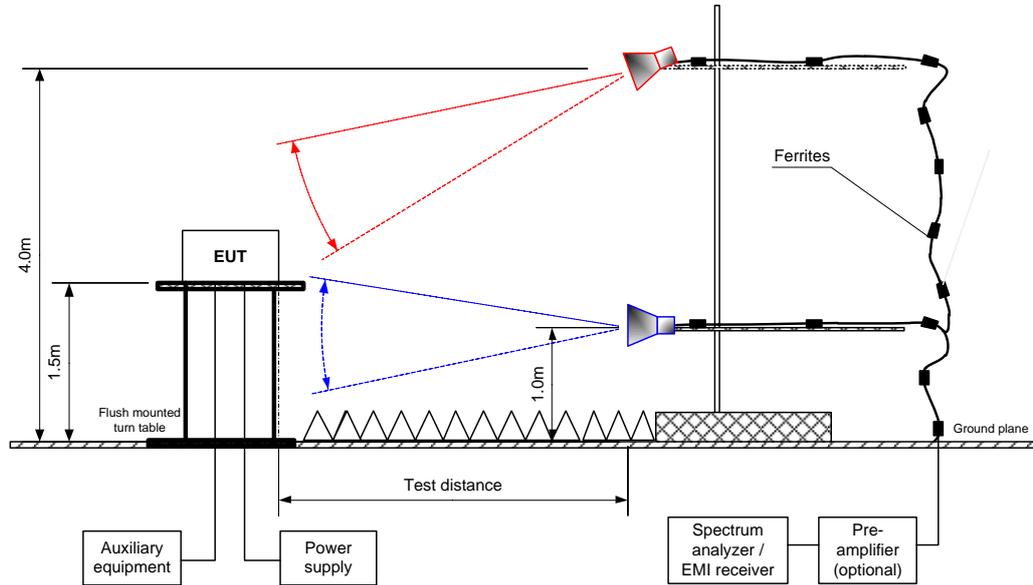
Figure 7.3.2 Setup for spurious emission field strength measurements in 30 – 1000 MHz





Test specification: Section 15.247(d), Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 16-Jul-24 - 17-Jul-24			
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1000 hPa	Power: 9 VDC
Remarks:			

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





Test specification: Section 15.247(d), Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 16-Jul-24 - 17-Jul-24			
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1000 hPa	Power: 9 VDC
Remarks:			

Table 7.3.2 Field strength of emissions outside restricted bands

ASSIGNED FREQUENCY: 2400-2483.5 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									
7206	61.24	Vertical	1.48	-30	95.99	-34.75	20.0	-14.75	Pass
16814	63.41	Vertical	1.38	80		-32.58		-12.58	
Mid carrier frequency									
17094	60.42	Horizontal	1.10	0	93.52	-33.1	20.0	-13.1	Pass
High carrier frequency									
17360	63.22	Horizontal	1.10	-38	95.07	-31.85	20.0	-11.85	Pass

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

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



Test specification: Section 15.247(d), Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 16-Jul-24 - 17-Jul-24			
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1000 hPa	Power: 9 VDC
Remarks:			

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

ASSIGNED FREQUENCY: 2400 – 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			Average field strength				Verdict
	Polarization	Height, m		Measured, dB(µV/m)	Limit, dB(µV/m)	Margin, dB**	Measured, dB(µV/m)	Calculated, dB(µV/m)	Limit, dB(µV/m)	Margin, dB***	
Low carrier frequency											
12010	Vertical	1.38	35	70.10	74.00	-3.90	63.34	14.68	54.00	-39.32	Pass
Mid carrier frequency											
7326	Vertical	1.10	0	62.28	74.00	-11.72	56.32	7.66	54.00	-46.34	Pass
12210	Vertical	1.40	0	68.05	74.00	-5.95	61.33	12.67	54.00	-41.33	
High carrier frequency											
7440	Horizontal	1.4	-5	61.65	74.00	-12.35	55.13	6.47	54.00	-47.53	Pass
12400	Vertical	1.1	10	67.37	74.00	-6.63	61.01	12.35	54.00	-41.65	

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

Table 7.3.4 Average factor calculation

Transmission pulse		Transmission burst		Transmission train duration, ms	Average factor, dB
Duration, ms	Period, ms	Duration, ms	Period, ms		
0.369	259	NA	NA	NA	-48.66

*- Average factor was calculated as follows
 for pulse train shorter than 100 ms: $Average\ factor = 20 \times \log_{10} \left(\frac{Pulse\ duration}{Pulse\ period} \times \frac{Burst\ duration}{Train\ duration} \times Number\ of\ bursts\ within\ pulse\ train \right)$
 for pulse train longer than 100 ms: $Average\ factor = 20 \times \log_{10} \left(\frac{Pulse\ duration}{Pulse\ period} \times \frac{Burst\ duration}{100\ ms} \times Number\ of\ bursts\ within\ 100\ ms \right)$



Test specification: Section 15.247(d), Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 16-Jul-24 - 17-Jul-24			
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1000 hPa	Power: 9 VDC
Remarks:			

Table 7.3.5 Field strength of spurious emissions below 1 GHz within restricted bands

ASSIGNED FREQUENCY: 2400 – 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, mid, high carrier frequency								
At least 20 dB bellow limit								Pass

*- Margin = Measured emission - specification limit.

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



Test specification: Section 15.247(d), Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 16-Jul-24 - 17-Jul-24			
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1000 hPa	Power: 9 VDC
Remarks:			

Table 7.3.6 Restricted bands according to FCC section 15.205

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

Reference numbers of test equipment used

HL 0446	HL 3903	HL 4114	HL 4338	HL 4933	HL 4956	HL 5112	HL 5288
HL 5902	HL 7585						

Full description is given in Appendix A.

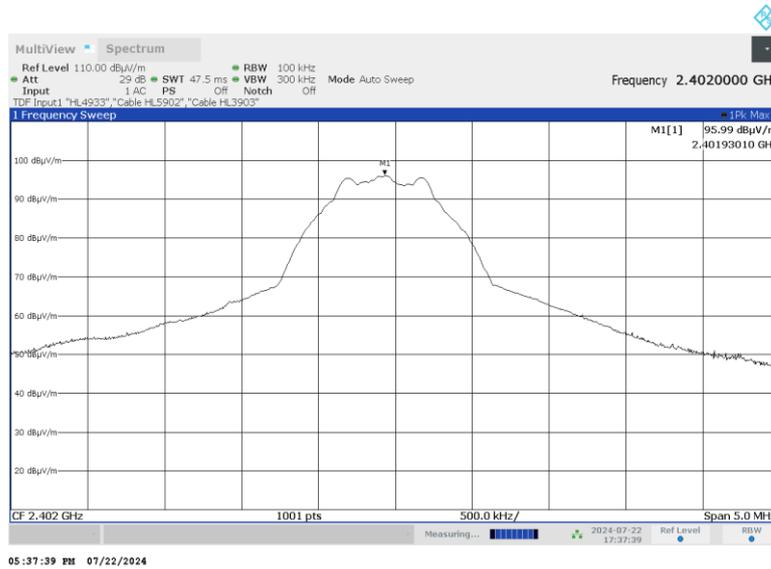


HERMON LABORATORIES

Test specification: Section 15.247(d), Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 16-Jul-24 - 17-Jul-24			
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1000 hPa	Power: 9 VDC
Remarks:			

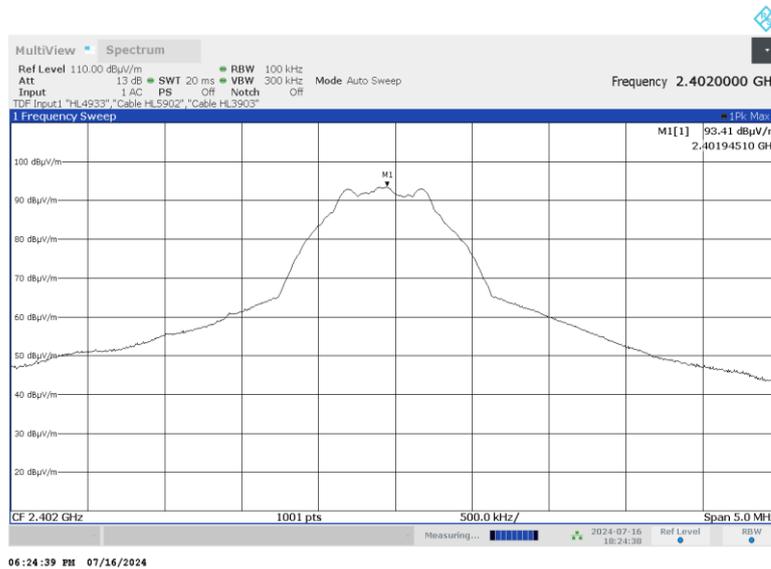
Plot 7.3.1 Radiated emission measurements at the low carrier frequency

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



Plot 7.3.2 Radiated emission measurements at the low carrier frequency

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



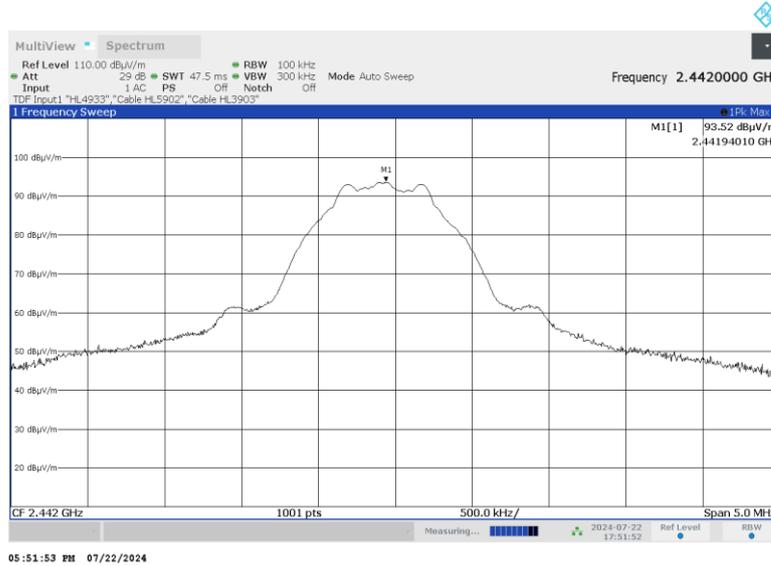


HERMON LABORATORIES

Test specification: Section 15.247(d), Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 16-Jul-24 - 17-Jul-24			
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1000 hPa	Power: 9 VDC
Remarks:			

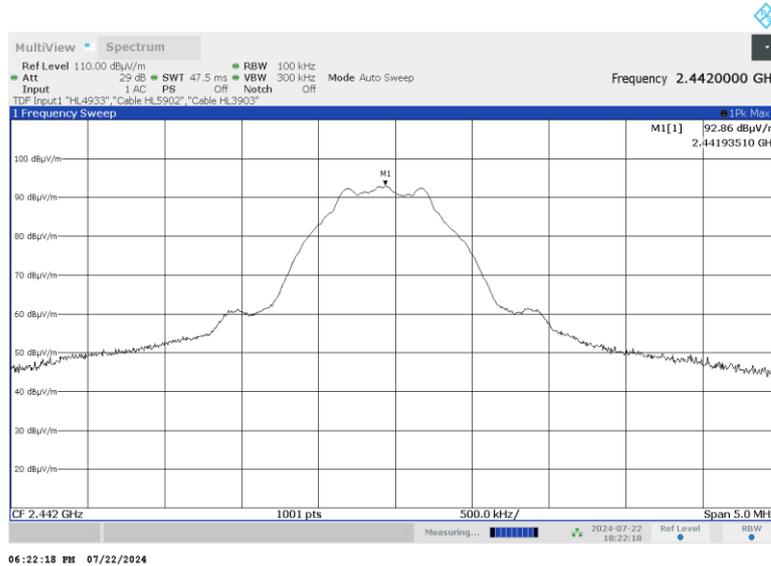
Plot 7.3.3 Radiated emission measurements at the mid carrier frequency

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



Plot 7.3.4 Radiated emission measurements at the mid carrier frequency

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



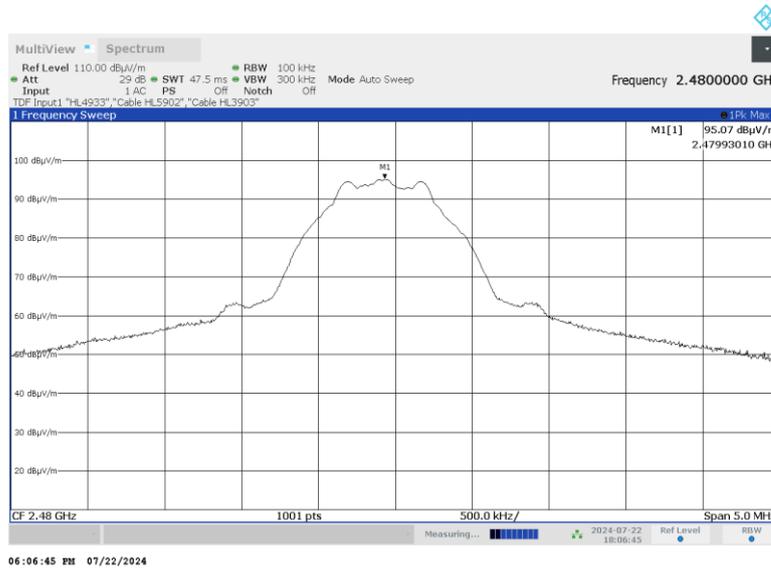


HERMON LABORATORIES

Test specification: Section 15.247(d), Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 16-Jul-24 - 17-Jul-24			
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1000 hPa	Power: 9 VDC
Remarks:			

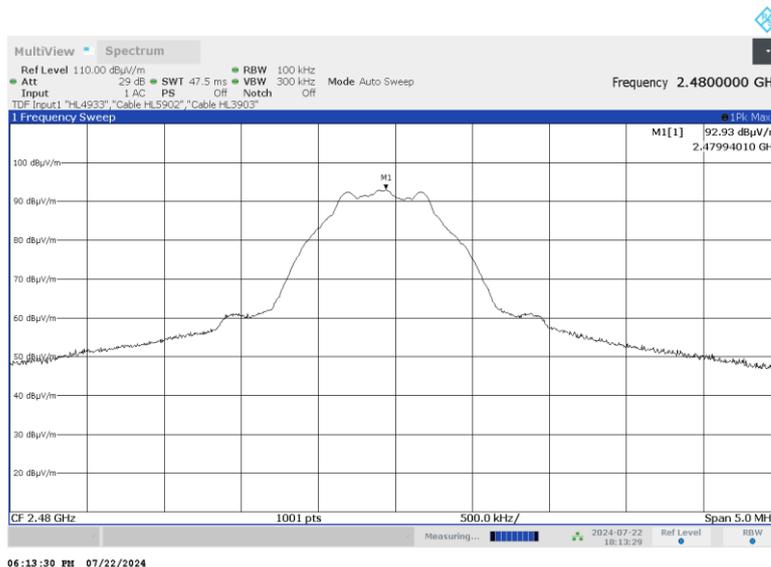
Plot 7.3.5 Radiated emission measurements at the high carrier frequency

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



Plot 7.3.6 Radiated emission measurements at the high carrier frequency

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

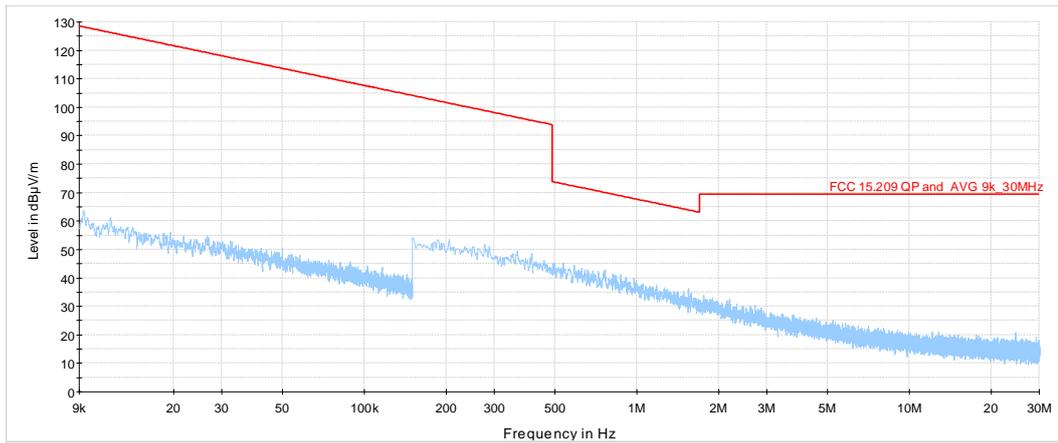




Test specification: Section 15.247(d), Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 16-Jul-24 - 17-Jul-24			
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1000 hPa	Power: 9 VDC
Remarks:			

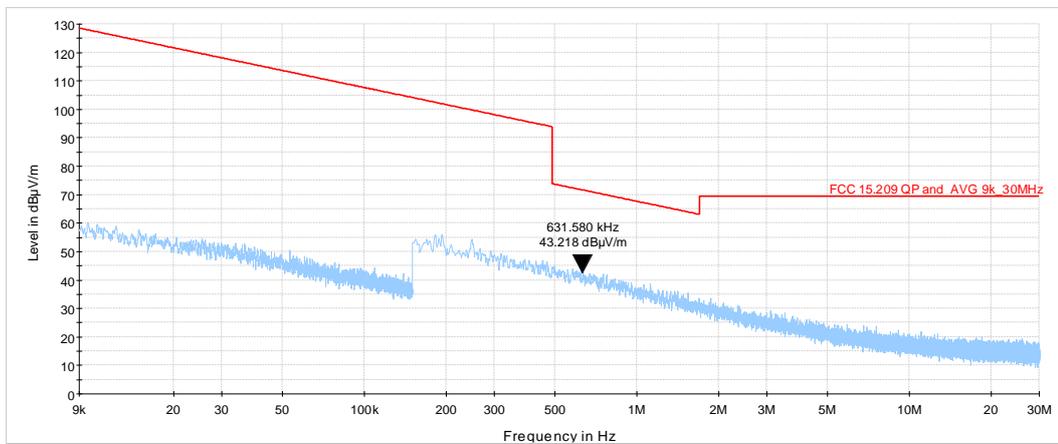
Plot 7.3.7 Radiated emission measurements from 9 kHz to 30 MHz at the low carrier frequency

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



Plot 7.3.8 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

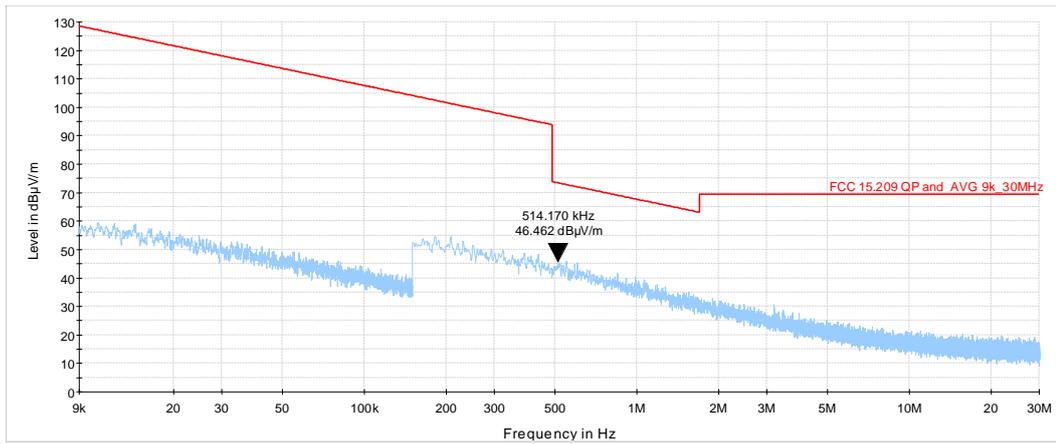




Test specification: Section 15.247(d), Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 16-Jul-24 - 17-Jul-24			
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1000 hPa	Power: 9 VDC
Remarks:			

Plot 7.3.9 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



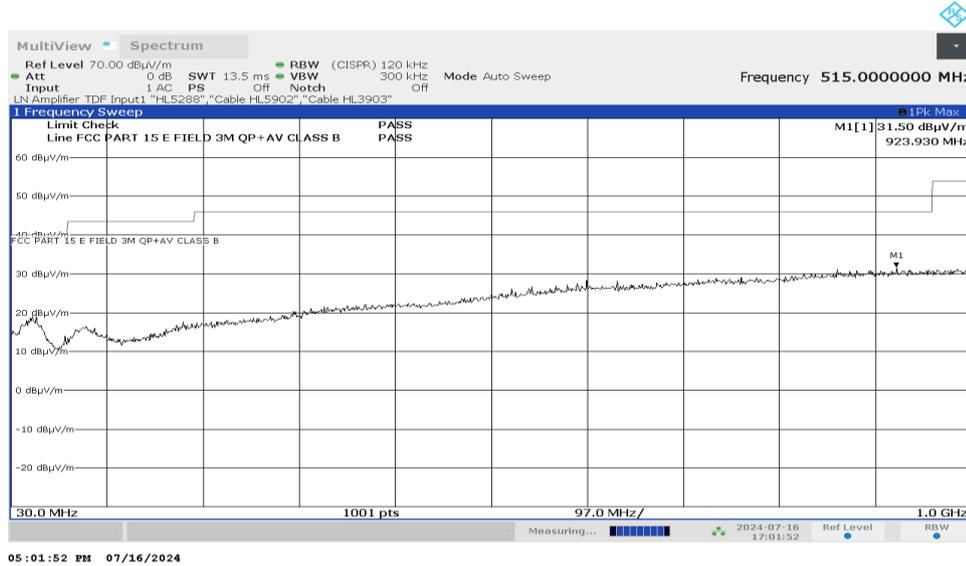


HERMON LABORATORIES

Test specification: Section 15.247(d), Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 16-Jul-24 - 17-Jul-24			
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1000 hPa	Power: 9 VDC
Remarks:			

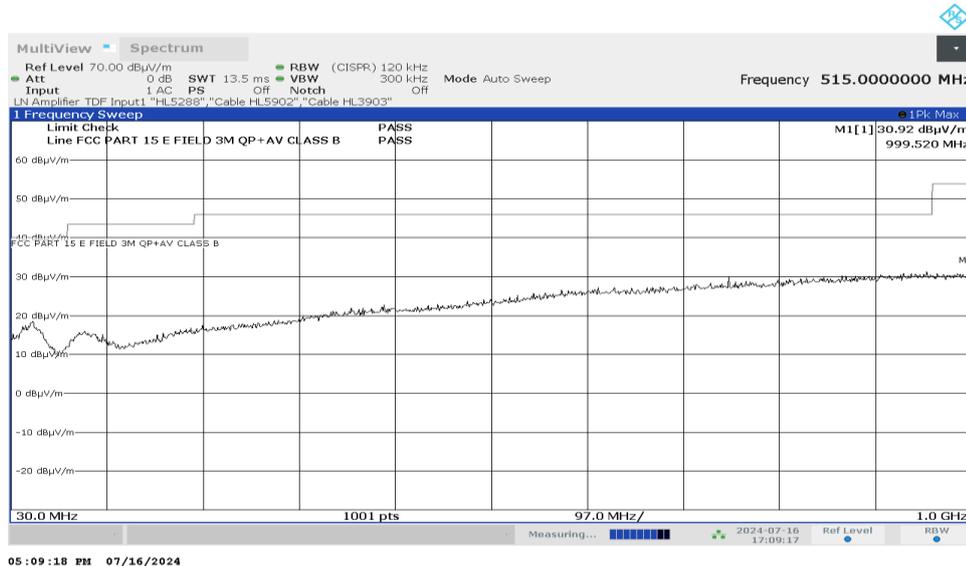
Plot 7.3.10 Radiated emission measurements from 30 to 1000 MHz at the low carrier frequency

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



Plot 7.3.11 Radiated emission measurements from 30 to 1000 MHz at the mid carrier frequency

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



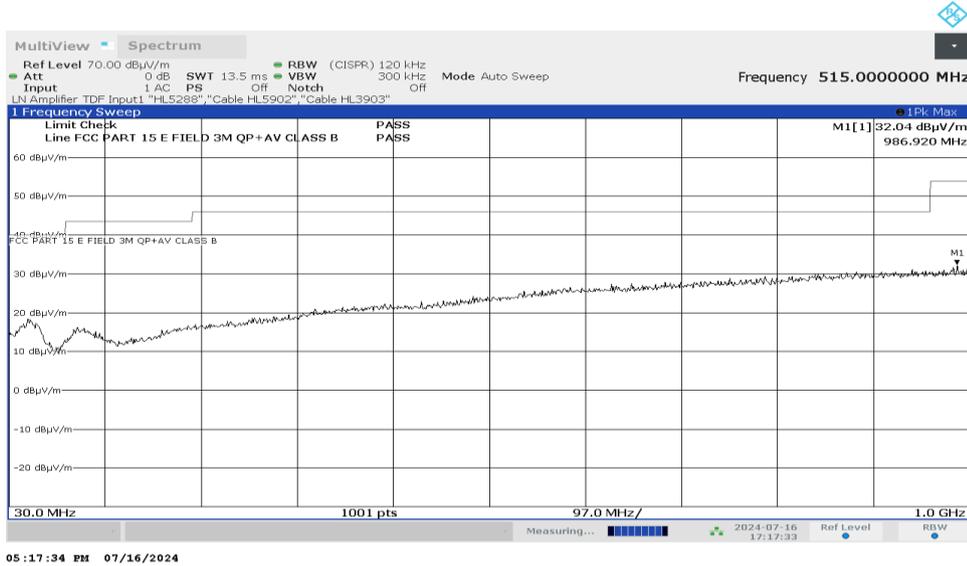


HERMON LABORATORIES

Test specification: Section 15.247(d), Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 16-Jul-24 - 17-Jul-24			
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1000 hPa	Power: 9 VDC
Remarks:			

Plot 7.3.12 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



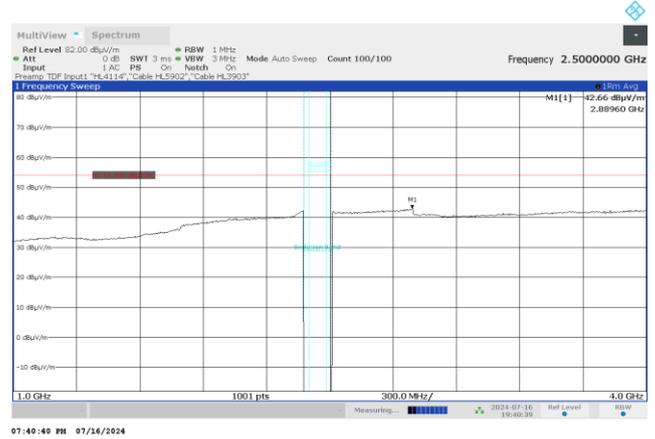
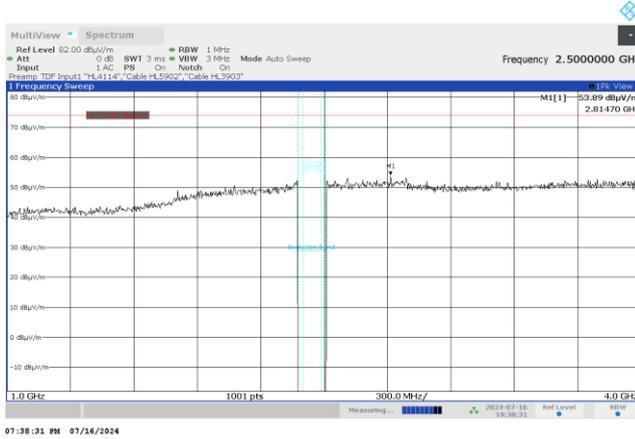


HERMON LABORATORIES

Test specification: Section 15.247(d), Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 16-Jul-24 - 17-Jul-24			
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1000 hPa	Power: 9 VDC
Remarks:			

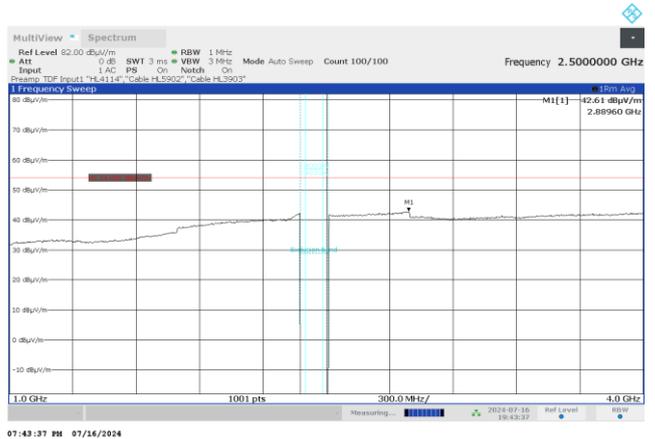
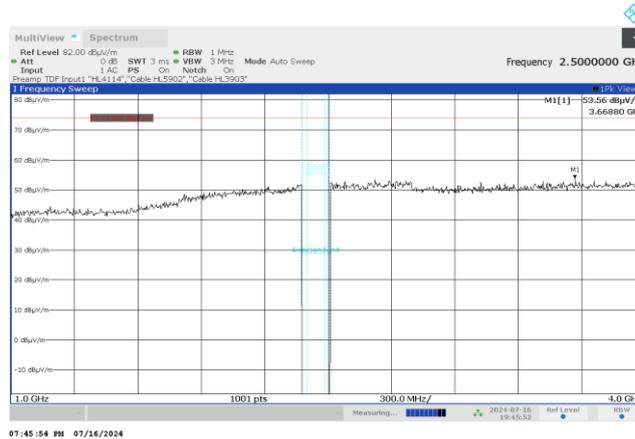
Plot 7.3.13 Radiated emission measurements from 1000 to 4000 MHz at the low carrier frequency

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



Plot 7.3.14 Radiated emission measurements from 1000 to 4000 MHz at the mid carrier frequency

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



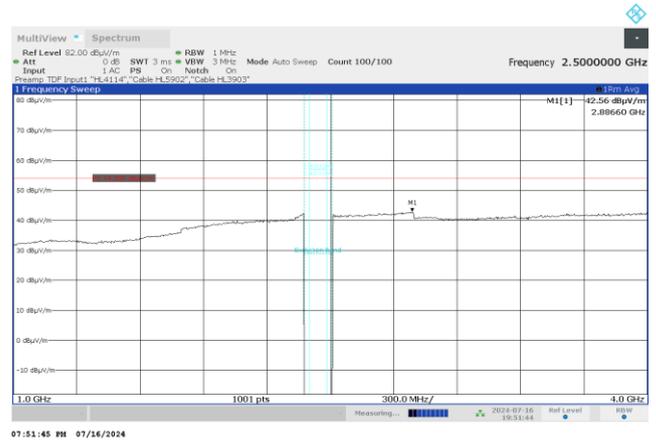
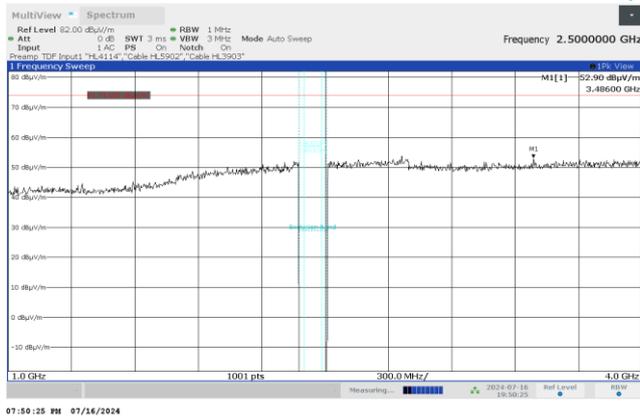


HERMON LABORATORIES

Test specification: Section 15.247(d), Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 16-Jul-24 - 17-Jul-24			
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1000 hPa	Power: 9 VDC
Remarks:			

Plot 7.3.15 Radiated emission measurements from 1000 to 4000 MHz at the high carrier frequency

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



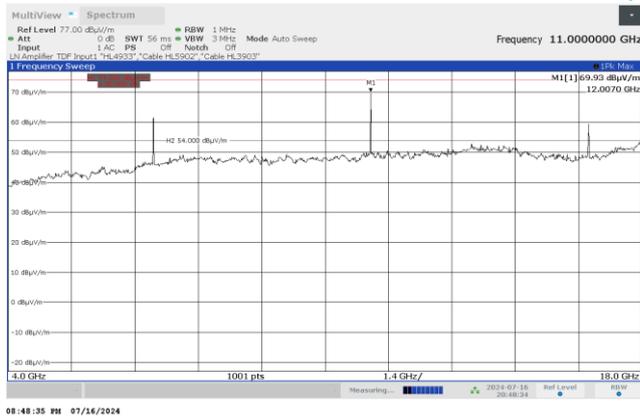


HERMON LABORATORIES

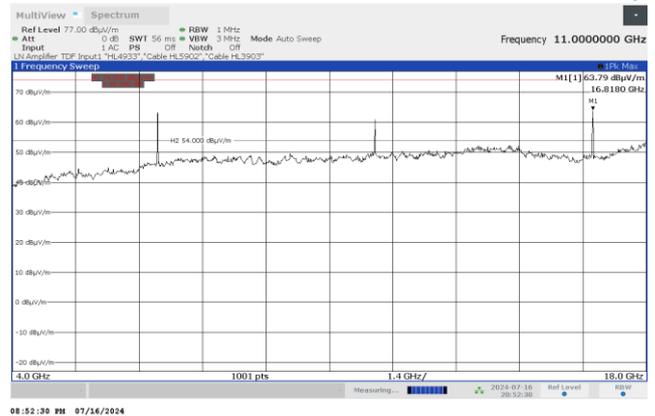
Test specification: Section 15.247(d), Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 16-Jul-24 - 17-Jul-24			
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1000 hPa	Power: 9 VDC
Remarks:			

Plot 7.3.16 Radiated emission measurements from 4000 to 18000 MHz at the low carrier frequency

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



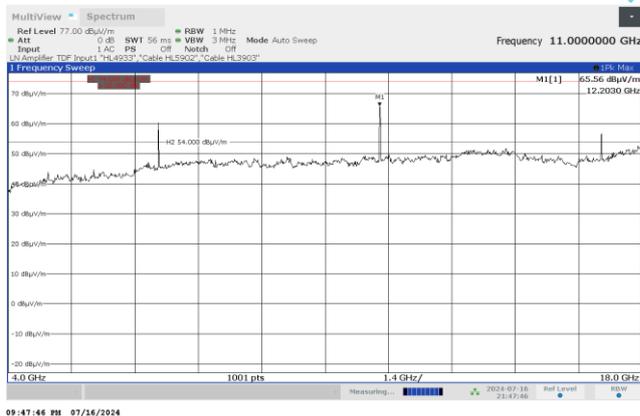
Vertical antenna polarization



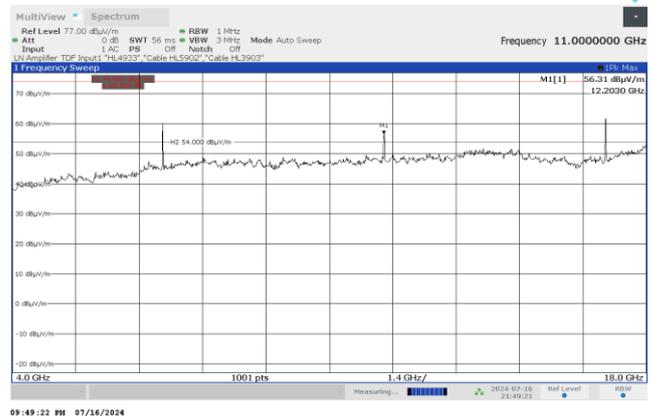
Horizontal antenna polarization

Plot 7.3.17 Radiated emission measurements from 4000 to 18000 MHz at the mid carrier frequency

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



Vertical antenna polarization



Horizontal antenna polarization

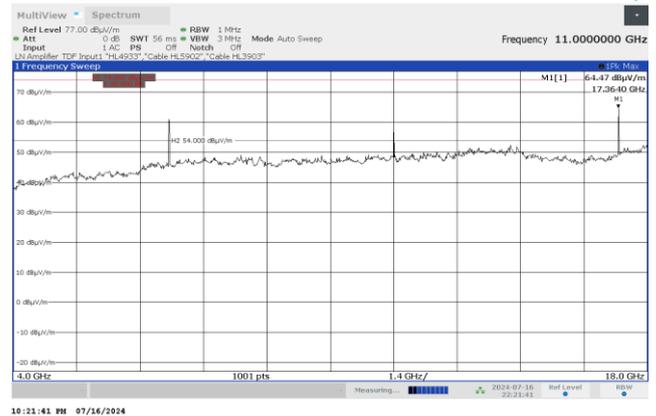
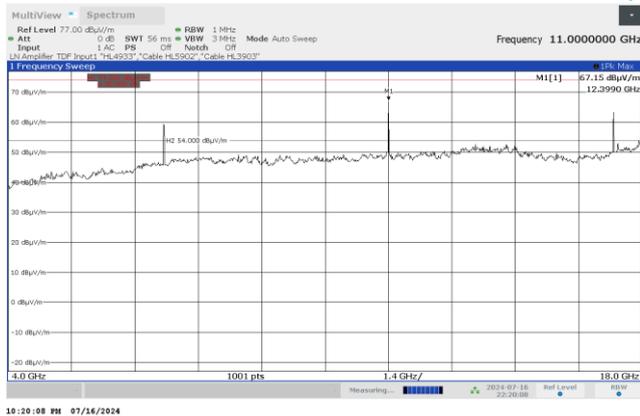


HERMON LABORATORIES

Test specification: Section 15.247(d), Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 16-Jul-24 - 17-Jul-24			
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1000 hPa	Power: 9 VDC
Remarks:			

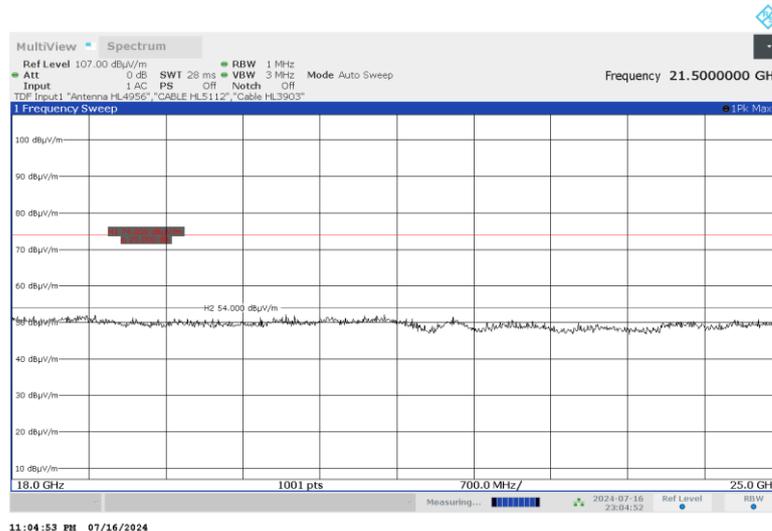
Plot 7.3.18 Radiated emission measurements from 4000 to 18000 MHz at the high carrier frequency

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



Plot 7.3.19 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



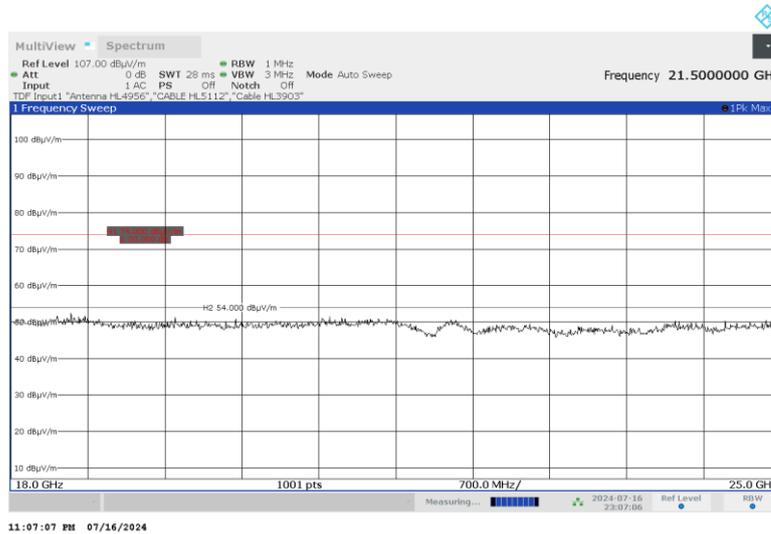


HERMON LABORATORIES

Test specification: Section 15.247(d), Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 16-Jul-24 - 17-Jul-24			
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1000 hPa	Power: 9 VDC
Remarks:			

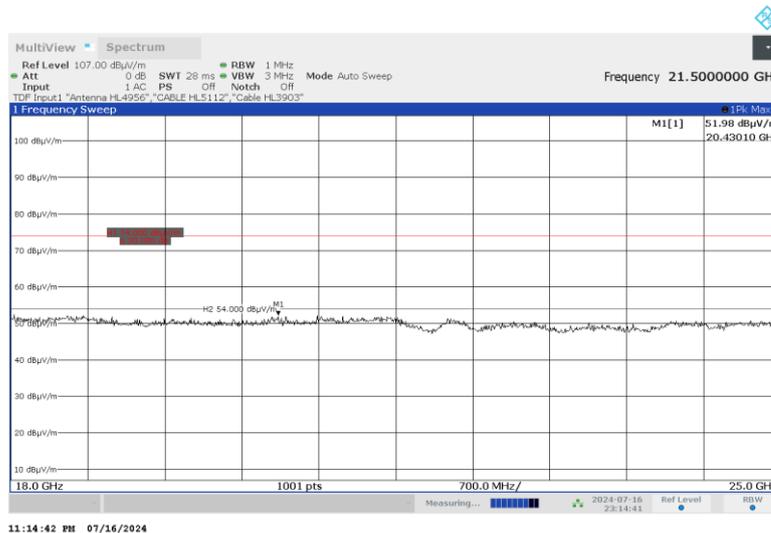
Plot 7.3.20 Radiated emission measurements from 18000 to 25000 MHz at the mid carrier frequency

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



Plot 7.3.21 Radiated emission measurements from 18000 to 25000 MHz at the high carrier frequency

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

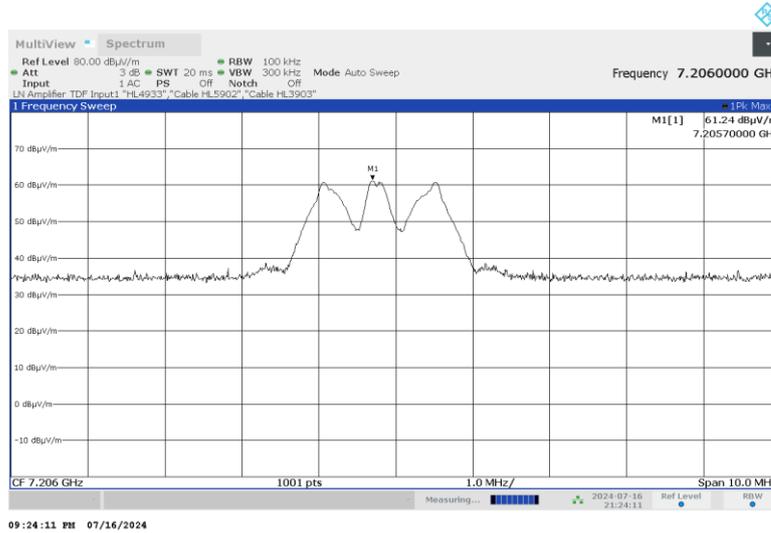




Test specification: Section 15.247(d), Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 16-Jul-24 - 17-Jul-24			
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1000 hPa	Power: 9 VDC
Remarks:			

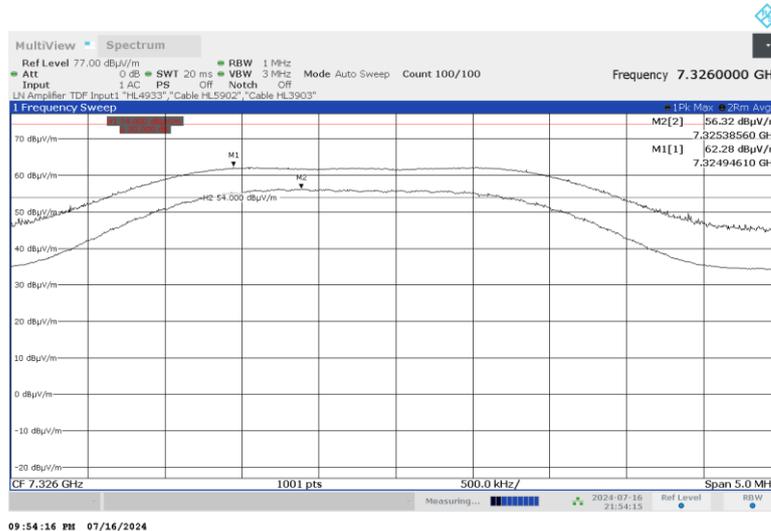
Plot 7.3.22 Radiated emission measurements at the third harmonic of low carrier frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m



Plot 7.3.23 Radiated emission measurements at the third harmonic of mid carrier frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m



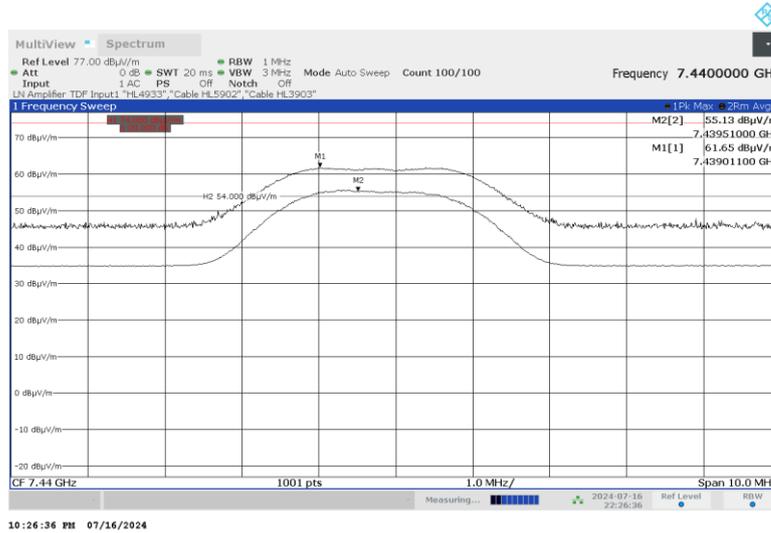


HERMON LABORATORIES

Test specification: Section 15.247(d), Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 16-Jul-24 - 17-Jul-24			
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1000 hPa	Power: 9 VDC
Remarks:			

Plot 7.3.24 Radiated emission measurements at the third harmonic of high carrier frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m



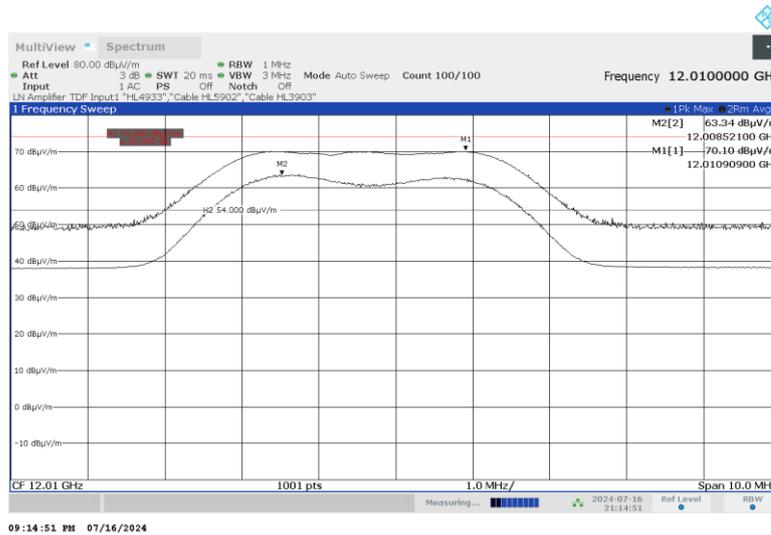


HERMON LABORATORIES

Test specification: Section 15.247(d), Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 16-Jul-24 - 17-Jul-24			
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1000 hPa	Power: 9 VDC
Remarks:			

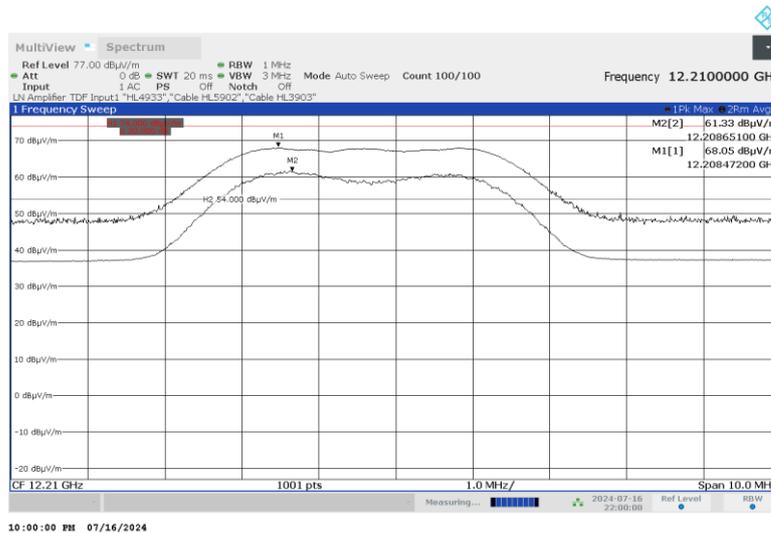
Plot 7.3.25 Radiated emission measurements at the fifth harmonic of low carrier frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m



Plot 7.3.26 Radiated emission measurements at the fifth harmonic of mid carrier frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m

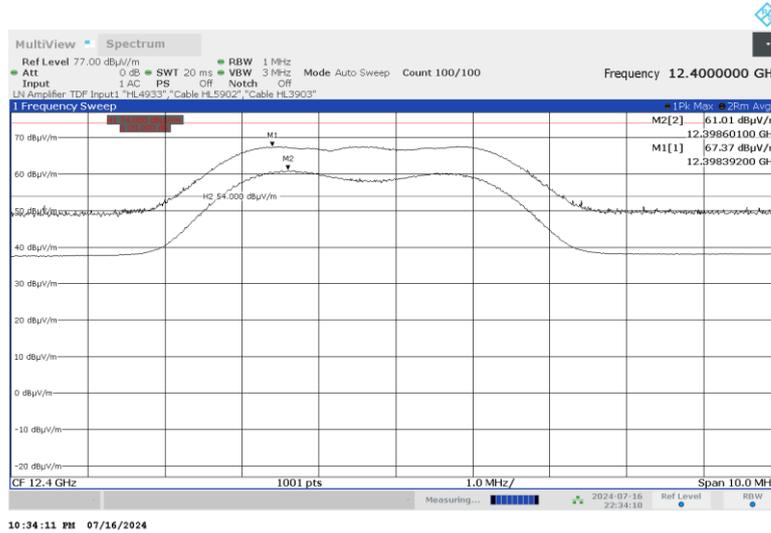




Test specification: Section 15.247(d), Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 16-Jul-24 - 17-Jul-24			
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1000 hPa	Power: 9 VDC
Remarks:			

Plot 7.3.27 Radiated emission measurements at the fifth harmonic of high carrier frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m



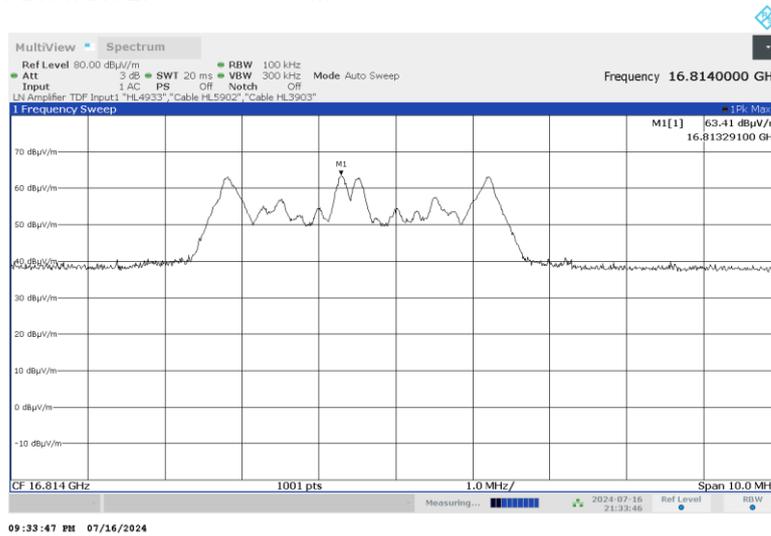


HERMON LABORATORIES

Test specification: Section 15.247(d), Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 16-Jul-24 - 17-Jul-24			
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1000 hPa	Power: 9 VDC
Remarks:			

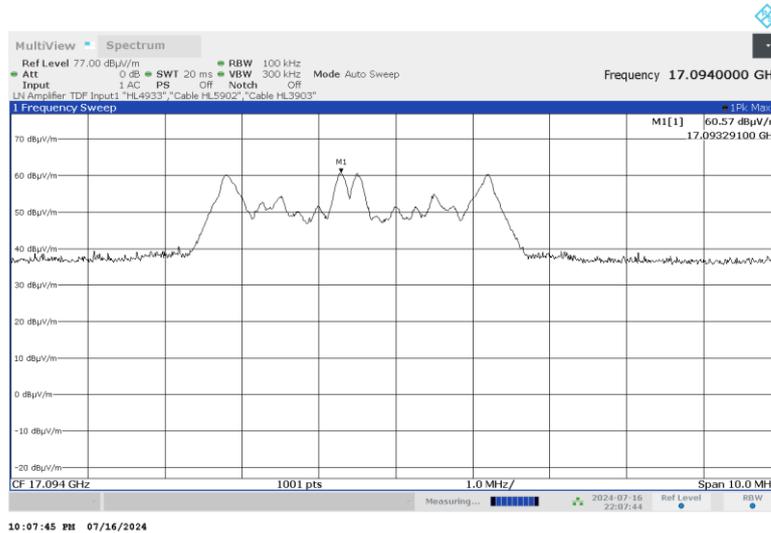
Plot 7.3.28 Radiated emission measurements at the seventh harmonic of low carrier frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m



Plot 7.3.29 Radiated emission measurements at the seventh harmonic of mid carrier frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m



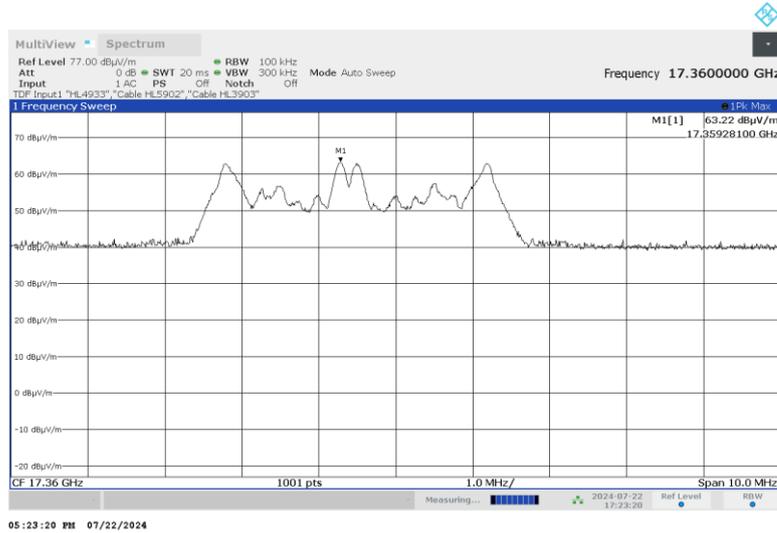


HERMON LABORATORIES

Test specification: Section 15.247(d), Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 16-Jul-24 - 17-Jul-24			
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1000 hPa	Power: 9 VDC
Remarks:			

Plot 7.3.30 Radiated emission measurements at the seventh harmonic of high carrier frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m

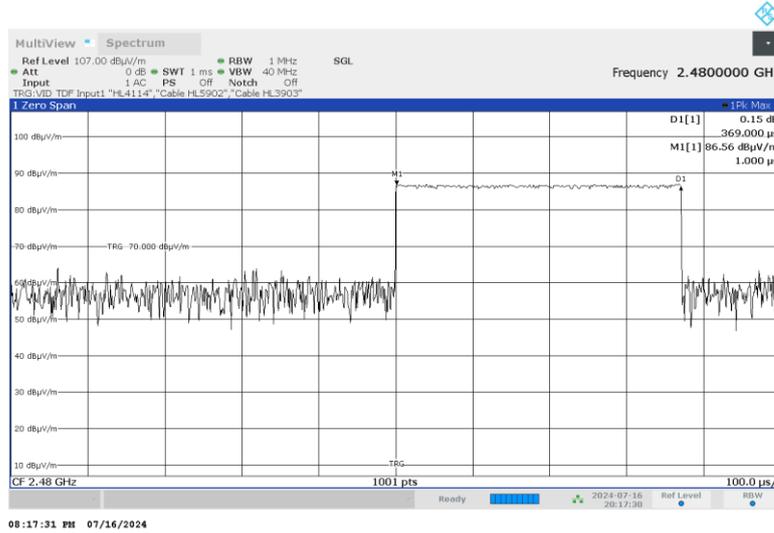




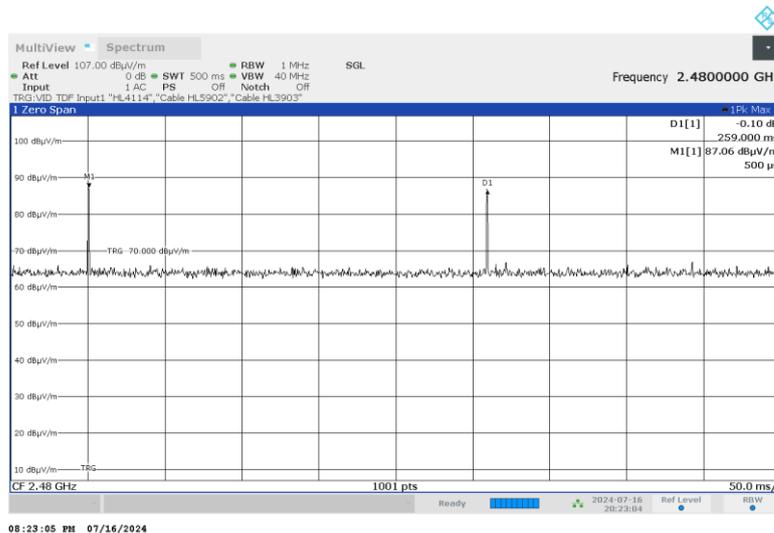
HERMON LABORATORIES

Test specification: Section 15.247(d), Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 16-Jul-24 - 17-Jul-24			
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1000 hPa	Power: 9 VDC
Remarks:			

Plot 7.3.31 Transmission pulse duration



Plot 7.3.32 Transmission pulse period





Test specification: Section 15.247(d), Band edge emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 02-Jun-24			
Temperature: 23 °C	Relative Humidity: 45 %	Air Pressure: 1006 hPa	Power: 9.0 VDC
Remarks:			

7.4 Band edge radiated emissions

7.4.1 General

This test was performed to measure emissions, radiated from the EUT at the assigned frequency band edges. Specification test limits are given in Table 7.4.1.

Table 7.4.1 Band edge emission limits

Output power	Assigned frequency, MHz	Attenuation below carrier*, dBc	Field strength at 3 m within restricted bands, dB(µV/m)	
			Peak	Average
Peak	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.

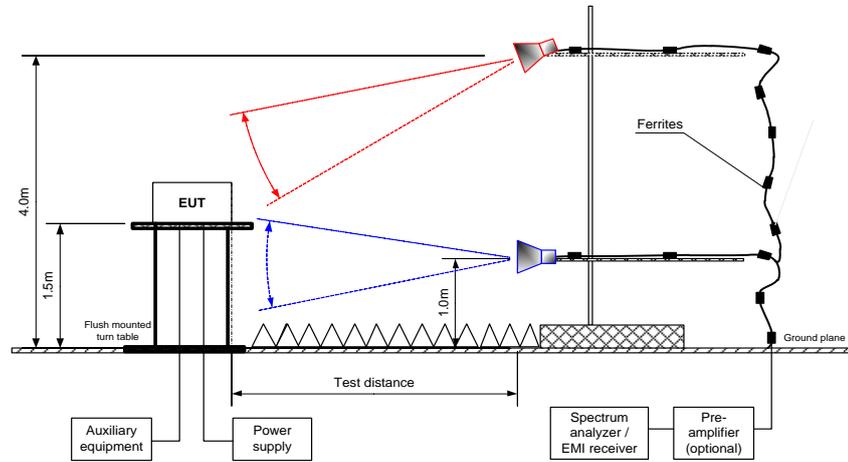
7.4.2 Test procedure

- 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), Band edge emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 02-Jun-24			
Temperature: 23 °C	Relative Humidity: 45 %	Air Pressure: 1006 hPa	Power: 9.0 VDC
Remarks:			

Figure 7.4.1 Band edge emission test setup





Test specification: Section 15.247(d), Band edge emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 02-Jun-24			
Temperature: 23 °C	Relative Humidity: 45 %	Air Pressure: 1006 hPa	Power: 9.0 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, dB(μV/m)	Emission at carrier, dB(μV/m)	Attenuation below carrier, dBc	Limit, dBc	Margin, dB*	Verdict
2400.000	41.89	93.52	51.63	20.0	31.63	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**	
2483.50	46.50	74.0	-27.50	N/A	54.0	-7.50	Pass

Reference numbers of test equipment used

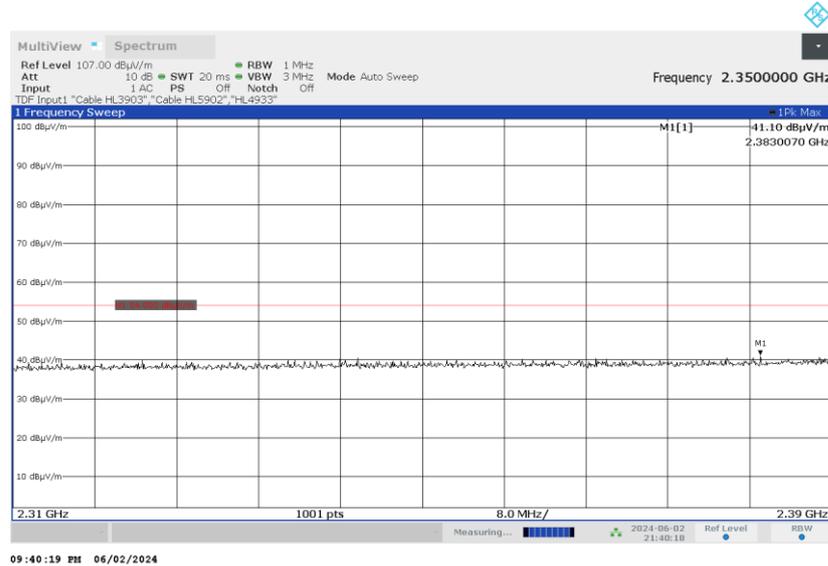
HL 3903	HL 4933	HL 5902	HL 7585	HL 4015			
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Full description is given in Appendix A.



Test specification: Section 15.247(d), Band edge emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 02-Jun-24			
Temperature: 23 °C	Relative Humidity: 45 %	Air Pressure: 1006 hPa	Power: 9.0 VDC
Remarks:			

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



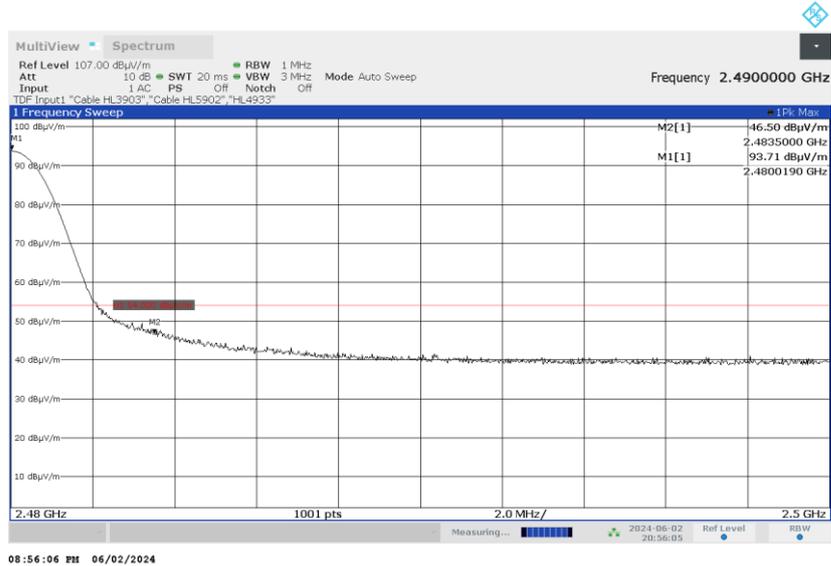
Plot 7.4.2 The highest emission level outside restricted band at low carrier frequency





Test specification: Section 15.247(d), Band edge emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 02-Jun-24			
Temperature: 23 °C	Relative Humidity: 45 %	Air Pressure: 1006 hPa	Power: 9.0 VDC
Remarks:			

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





Test specification: Section 15.247(e), Maximum power spectral density			
Test procedure: ANSI C63.10 section 11.10.2			
Test mode: Compliance		Verdict: PASS	
Date(s): 22-Jul-24			
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1000 hPa	Power: 9 VDC
Remarks:			

7.5 Peak spectral power density

7.5.1 General

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

Table 7.5.1 Peak spectral power density limits

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

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

7.5.2 Test procedure for field strength measurements

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

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

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

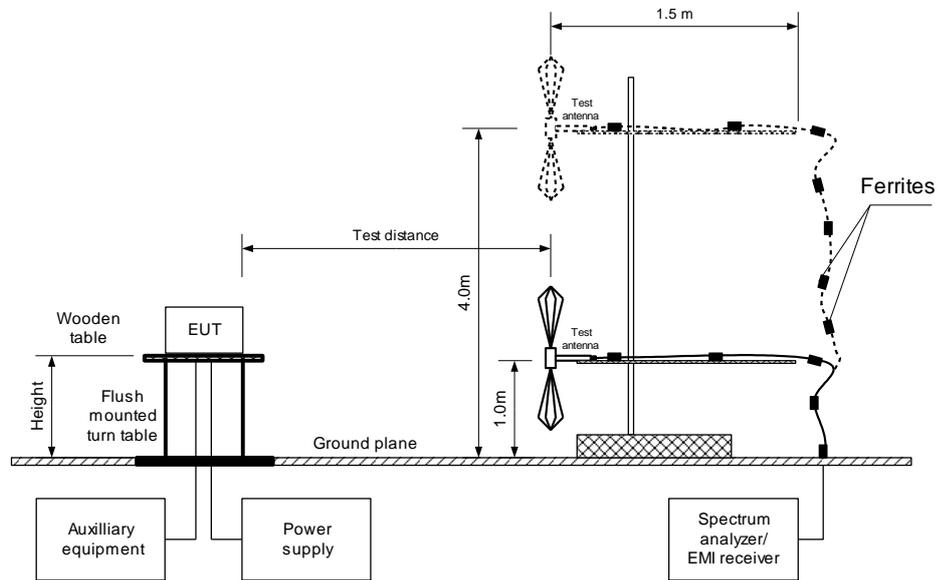
7.5.2.4 The frequency span of spectrum analyzer was set to capture the entire 6 dB band of the transmitter, in peak hold mode with resolution bandwidth set to 3.0 kHz, video bandwidth wider than resolution bandwidth, auto sweep time and sufficient number of sweeps was allowed for trace stabilization. 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), Maximum power spectral density			
Test procedure: ANSI C63.10 section 11.10.2			
Test mode: Compliance		Verdict: PASS	
Date(s): 22-Jul-24			
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1000 hPa	Power: 9 VDC
Remarks:			

Figure 7.5.1 Setup for carrier field strength measurements





Test specification: Section 15.247(e), Maximum power spectral density			
Test procedure: ANSI C63.10 section 11.10.2			
Test mode: Compliance		Verdict: PASS	
Date(s): 22-Jul-24			
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1000 hPa	Power: 9 VDC
Remarks:			

Table 7.5.2 Field strength measurement of peak spectral power density

ASSIGNED FREQUENCY: 2400 – 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: 10 kHz
TEST ANTENNA TYPE: Horn
MODULATION: GFSK
BIT RATE: 1 Mbps
TRANSMITTER OUTPUT POWER SETTINGS: Maximum

Frequency, MHz	Field strength, dB(μV/m)	EUT antenna gain, dBi	Limit, dB(μV/m)	Margin, dB*	Antenna polarization	Antenna height, m	Turn-table position**, degrees
2402	81.51	2.3	103.2	-23.99	V	1.35	180
2442	80.16	2.3	103.2	-25.34	V	1.38	-180
2480	80.55	2.3	103.2	-24.95	V	1.13	-140

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

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

Reference numbers of test equipment used

HL 3903	HL 4933	HL 5902	HL 7585				
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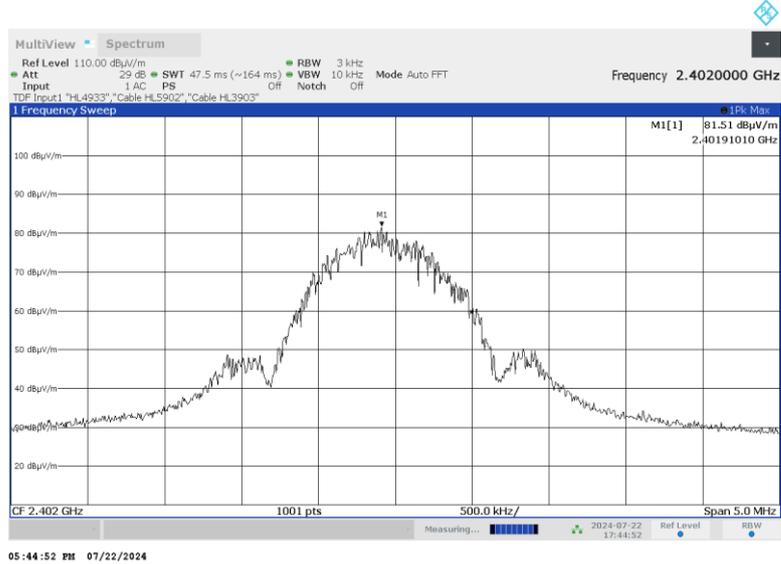
Full description is given in Appendix A.



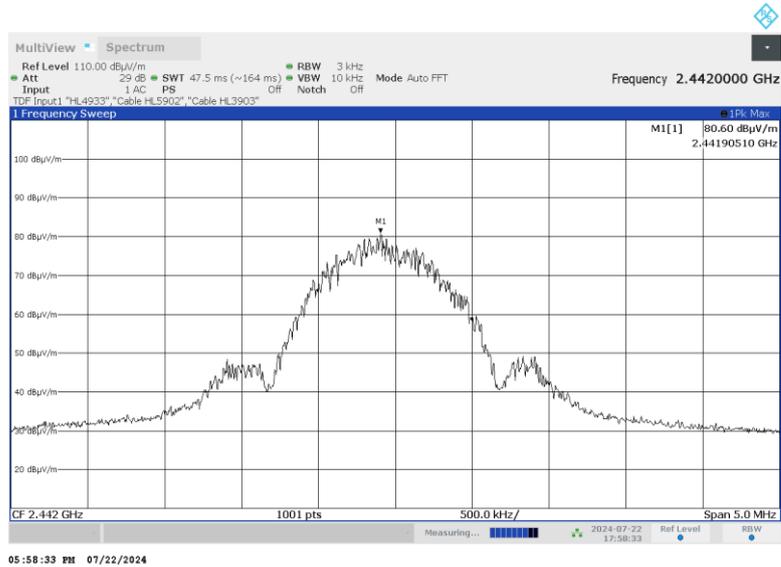
HERMON LABORATORIES

Test specification: Section 15.247(e), Maximum power spectral density			
Test procedure: ANSI C63.10 section 11.10.2			
Test mode: Compliance		Verdict: PASS	
Date(s): 22-Jul-24			
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1000 hPa	Power: 9 VDC
Remarks:			

Plot 7.5.1 Peak spectral power density at low frequency



Plot 7.5.2 Peak spectral power density at mid frequency

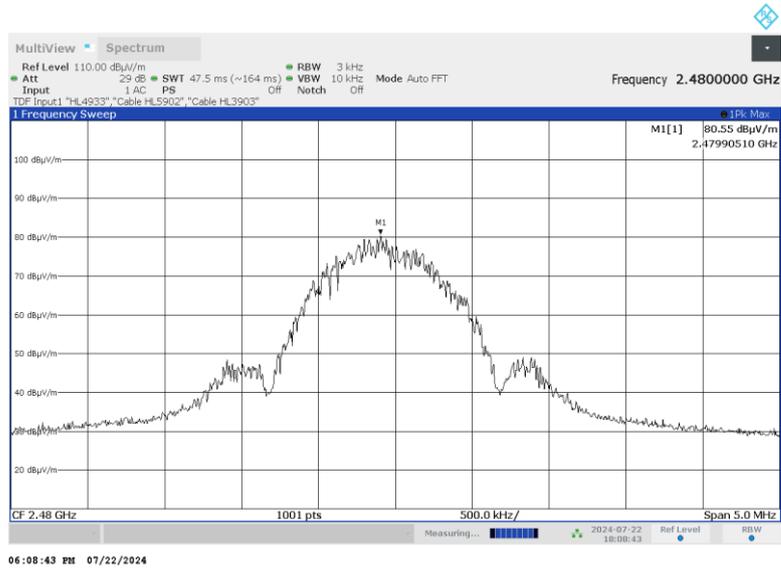




HERMON LABORATORIES

Test specification: Section 15.247(e), Maximum power spectral density			
Test procedure: ANSI C63.10 section 11.10.2			
Test mode: Compliance		Verdict: PASS	
Date(s): 22-Jul-24			
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1000 hPa	Power: 9 VDC
Remarks:			

Plot 7.5.3 Peak spectral power density at high frequency





Test specification: Section 15.203, Antenna requirement			
Test procedure: Visual inspection			
Test mode: Compliance		Verdict: PASS	
Date(s): 22-Jul-24			
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1000 hPa	Power: 9 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	



Test specification: FCC 47 CFR, Section 15.109, Class B, Radiated emissions			
Test procedure: ANSI C63.4, Section 8.3			
Test mode: Compliance		Verdict:	
Date(s): 23-May-24			
Temperature: 26 °C	Relative Humidity: 40 %	Air Pressure: 1008 hPa	Power: 9 VDC
Remarks:			

8 Emissions tests according to FCC 47CFR part 15 subpart B

8.1 Radiated emission measurements

8.1.1 General

This test was performed to measure radiated emissions from the EUT enclosure. The 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
FCC 47 CFR, Section 15.109				
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 a test distance other than specified was calculated using the inverse linear distance extrapolation factor as follows: $Lim_{S_2} = Lim_{S_1} + 20 \log(S_1/S_2)$, where S_1 and S_2 – the standard defined and the test distance respectively in meters.

8.1.2 Test procedure for measurements in semi-anechoic chamber

8.1.2.1 30 – 1000 MHz range. The EUT was set up as shown in Figure 8.1.1 and the associated photograph/s, energized and the EUT performance was checked.

8.1.2.2 The measurements were performed in the anechoic chamber at 3 m test distance. The specified frequency range was investigated with the antenna connected to the EMI receiver. To find the highest emission the turntable was rotated 360° and the measuring antenna height was swept from 1 to 4 m in both, vertical and horizontal polarizations. The EUT cables position was varied to maximize emission.

8.1.2.3 1000 – 40000 MHz range. The EUT was set up as shown in Figure 8.1.2 and the associated photograph/s, energized and the EUT performance was checked.

8.1.2.4 The measurements were performed in the semi anechoic chamber at 3 m test distance. The specified frequency range was investigated with the antenna connected to the EMI receiver. To find the highest emission the turntable was rotated 360° and the measuring antenna height was swept from 1 to 4 m in both, vertical and horizontal polarizations. In order to stay within the 3 dB beamwidth while keeping the antenna height scanned from 1 to 4 m, a few sweeps with different antenna angles over the entire height were performed.

8.1.2.5 The worst test results with respect to the limits were recorded in Table 8.1.2 and shown in the associated plots.



Test specification: FCC 47 CFR, Section 15.109, Class B, Radiated emissions			
Test procedure: ANSI C63.4, Section 8.3			
Test mode: Compliance		Verdict:	
Date(s): 23-May-24			
Temperature: 26 °C	Relative Humidity: 40 %	Air Pressure: 1008 hPa	Power: 9 VDC
Remarks:			

Figure 8.1.1 Setup for radiated emission measurements in anechoic chamber in 30 – 1000 MHz range, table-top EUT

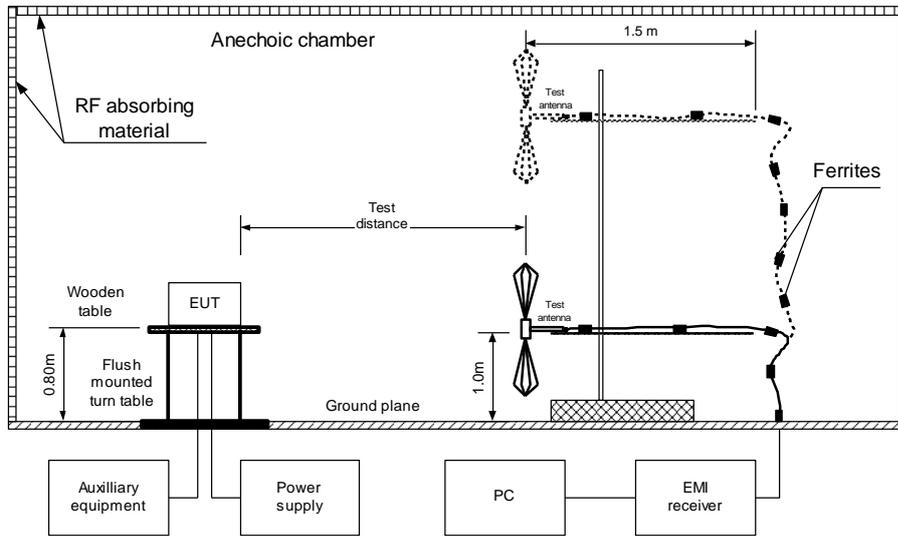
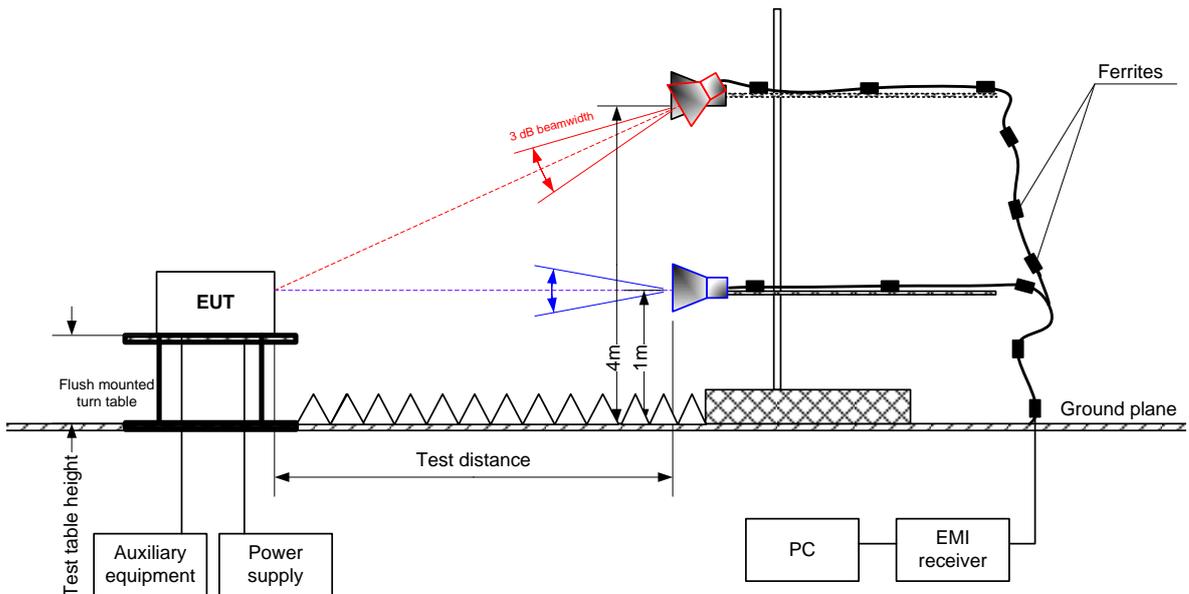


Figure 8.1.2 Setup for radiated emission measurements in 1000 – 18000 MHz range, table-top EUT





Test specification: FCC 47 CFR, Section 15.109, Class B, Radiated emissions			
Test procedure: ANSI C63.4, Section 8.3			
Test mode: Compliance		Verdict:	
Date(s): 23-May-24			
Temperature: 26 °C	Relative Humidity: 40 %	Air Pressure: 1008 hPa	Power: 9 VDC
Remarks:			

Table 8.1.2 Radiated emission test results

EUT SET UP: TABLE-TOP
 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*				
947.474	34.02	22.67	46.0	-23.33	Vertical	2.62	-99	Pass

TEST SITE: SEMI ANECHOIC CHAMBER
 TEST DISTANCE: 3 m
 DETECTORS USED: PEAK / AVERAGE
 FREQUENCY RANGE: 1000 MHz – 18000MHz
 RESOLUTION BANDWIDTH: 1000 kHz

Frequency, MHz	Average			Antenna polarization	Antenna tilt, degrees	Antenna height, m	Turn-table position**, degrees	Verdict
	Measured emission, dB(µV/m)	Limit, dB(µV/m)	Margin, dB*					
2928.028	24.49	54.0	-29.51	Vertical	3.22	110	2928.028	Pass
2968.640	24.27	54.0	-29.73	Vertical	1.44	157	2968.640	
2983.962	24.49	54.0	-29.51	Vertical	2.90	-5	2983.962	
3474.457	25.40	54.0	-28.60	Vertical	4.00	-144	3474.457	
3704.408	25.76	54.0	-28.24	Vertical	4.00	180	3704.408	
3793.175	25.31	54.0	-28.69	Horizontal	3.08	78	3793.175	
11844.293	36.37	54.0	-17.63	Horizontal	2.48	-62	11844.293	

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

Reference numbers of test equipment used

HL 3903	HL 4015	HL 4933	HL 5085	HL 5288	HL 5902	HL 7585	
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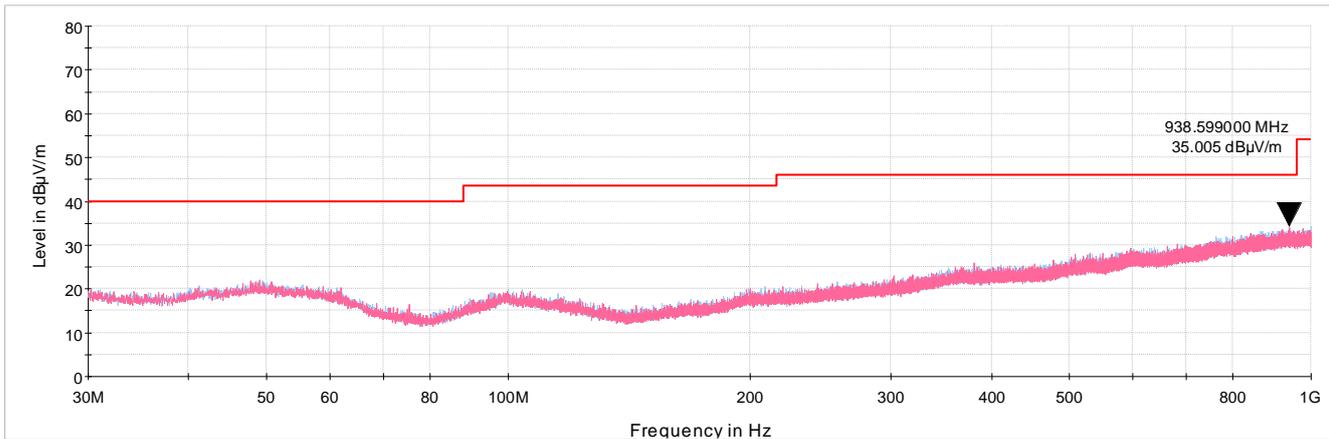
Full description is given in Appendix A.



Test specification: FCC 47 CFR, Section 15.109, Class B, Radiated emissions			
Test procedure: ANSI C63.4, Section 8.3			
Test mode: Compliance		Verdict:	
Date(s): 23-May-24			
Temperature: 26 °C	Relative Humidity: 40 %	Air Pressure: 1008 hPa	Power: 9 VDC
Remarks:			

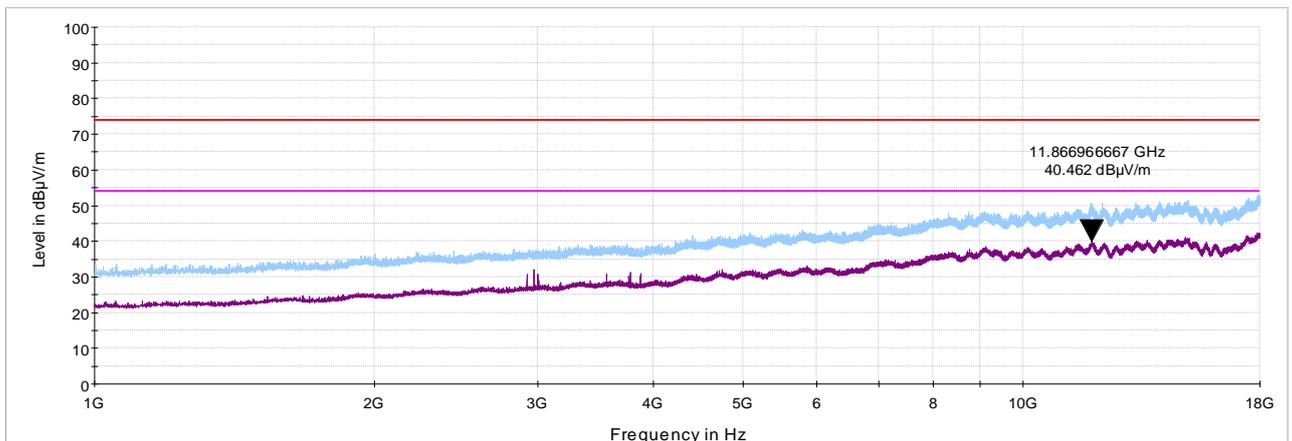
Plot 8.1.1 Radiated emission measurements in 30 - 1000 MHz range, horizontal / vertical antenna polarization

TEST SITE: Anechoic chamber
TEST DISTANCE: 3 m



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

TEST SITE: Anechoic chamber
TEST DISTANCE: 3 m



**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	29-Feb-24	28-Feb-25
3903	Microwave Cable Assembly, 40.0 GHz, 1.5 m, SMA/SMA	Huber-Suhner	SUCOFL EX 102A	1226/2A	06-May-24	06-May-25
4015	Temp. & Humidity Meter, (-50 - +70) deg, (20 - 99)% RH	Mad Electronics	HTC-1	NA	15-May-24	15-May-25
4114	Antenna, Double-Ridged Waveguide Horn, 1 to 18 GHz	ETS Lindgren	3117	00123515	08-Nov-23	08-Nov-24
4338	Reject Band Filter, 50 Ohm, 0 to 2170 and 3000 to 18000 MHz, SMA-FM / SMA-M	Micro-Tronics	BRM 50702-02	023	10-Jul-24	10-Jul-26
4933	Active Horn Antenna, 1 GHz to 18 GHz	COM-POWER CORPORATION	AHA-118	701046	20-Feb-24	20-Feb-25
4956	Active horn antenna, 18 to 40 GHz	COM-POWER CORPORATION	AHA-840	105004	03-Mar-24	03-Mar-25
5085	Attenuator, 4 dB, DC - 6 GHz, 1 W	Mini-Circuits	UNAT-4+	NA	24-Mar-22	24-Mar-25
5112	RF cable, 40 GHz, 5.5 m, K-type	Huber-Suhner	SF102EA/11SK/11SK/5500MM	502494/2EA	16-Apr-23	16-Apr-24
5288	Trilog Antenna, 25 MHz - 8 GHz, 100W	Frankonia	ALX-8000E	00809	24-Mar-22	24-Mar-25
5902	RF cable, 18 GHz, 6.0m, N-type	Huber-Suhner	SF126EA/11N/11N/6000	NA	19-Nov-23	19-Nov-24
7585	EMI Test Receiver, 1 Hz to 44 GHz	Rohde & Schwarz	ESW44	103130	21-Sep-23	21-Sep-24



10 APPENDIX B Test equipment correction factors

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

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

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

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



HL 5288: Trilog Antenna
Frankonia, model: ALX-8000E, s/n: 00809
30-1000 MHz

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

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

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

above 1000 MHz

Frequency, MHz	Antenna factor, dB/m
1000	26.9
1100	28.1
1200	28.4
1300	29.6
1400	29.1
1500	30.4
1600	30.7
1700	31.5
1800	32.3
1900	32.6
2000	32.5
2100	32.9
2200	33.5
2300	33.2
2400	33.7
2500	34.6
2600	34.7
2700	34.6
2800	35.0
2900	35.5
3000	36.2
3100	36.8
3200	36.8
3300	37.0
3400	37.5
3500	38.2

Frequency, MHz	Antenna factor, dB/m
3600	38.9
3700	39.4
3800	39.4
3900	39.6
4000	39.7
4100	39.8
4200	40.5
4300	40.9
4400	41.1
4500	41.4
4600	41.3
4700	41.6
4800	41.9
4900	42.3
5000	42.7
5100	43.0
5200	42.9
5300	43.5
5400	43.6
5500	44.3
5600	44.7
5700	45.0
5800	45.0
5900	45.3
6000	45.9

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



11 APPENDIX C Measurement uncertainties

Expanded uncertainty at 95% confidence in Hermon Labs EMC measurements

Test description	Expanded uncertainty
Conducted carrier power at RF antenna connector	Below 12.4 GHz: ± 1.7 dB 12.4 GHz to 40 GHz: ± 2.3 dB
Conducted emissions at RF antenna connector	9 kHz to 2.9 GHz: ± 2.6 dB 2.9 GHz to 6.46 GHz: ± 3.5 dB 6.46 GHz to 13.2 GHz: ± 4.3 dB 13.2 GHz to 22.0 GHz: ± 5.0 dB 22.0 GHz to 26.8 GHz: ± 5.5 dB 26.8 GHz to 40.0 GHz: ± 4.8 dB
Occupied bandwidth	± 8.0 %
Duty cycle, timing (Tx ON / OFF) and average factor measurements	± 1.0 %
Conducted emissions with LISN	9 kHz to 150 kHz: ± 3.9 dB 150 kHz to 30 MHz: ± 3.8 dB
Radiated emissions at 3 m measuring distance Horizontal polarization Vertical polarization	Biconilog antenna: ± 5.3 dB Biconical antenna: ± 5.0 dB Log periodic antenna: ± 5.3 dB Double ridged horn antenna: ± 5.3 dB Biconilog antenna: ± 6.0 dB Biconical antenna: ± 5.7 dB Log periodic antenna: ± 6.0 dB Double ridged horn antenna: ± 6.0 dB

Hermon Laboratories is accredited by A2LA for calibration according to present requirements of ISO/IEC 17025 and NCSL Z540-1. The accreditation is granted to perform calibration of parameters that are listed in the Scope of Hermon Laboratories Accreditation.

Hermon Laboratories calibrates its reference and transfer standards by calibration laboratories accredited to ISO/IEC 17025 by a mutually recognized Accreditation Body or by a recognized national metrology institute. All reference and transfer standards used in the calibration system are traceable to national or international standards.

In-house calibration of all test and measurement equipment is performed on a regular basis according to Hermon Laboratories calibration procedures, manufacturer calibration/verification procedures or procedures defined in the relevant standards. The Hermon Laboratories test and measurement equipment is calibrated within the tolerances specified by the manufacturers and/or by the relevant standards.



12 APPENDIX D Test laboratory description

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

Hermon Laboratories is recognized and accredited by the Federal Communications Commission (USA) for 1, 2, 15, 18 parts of Code of Federal Regulations 47 (CFR 47), Test Firm Registration Number is 927748, Designation Number is IL1001; registered by Industry Canada for electromagnetic emissions, file number IC 2186A-1 for OATS, certified by VCCI, Japan (the registration numbers are R-808 for OATS, R-1082 for anechoic chamber, G-869 for RE measurements above 1 GHz, C-845 for conducted emissions site and T-1606 for conducted emissions at telecommunication ports).

The laboratory is accredited by American Association for Laboratory Accreditation (USA) according to ISO/IEC 17025 for electromagnetic compatibility, product safety, telecommunications testing, environmental simulation and calibration (for exact scope please refer to Certificate No. 839.01, 839.03 and 839.04).

Address: P.O. Box 23, Binyamina 3055001, Israel.
Telephone: +972 4628 8001
Fax: +972 4628 8277
e-mail: mail@hermonlabs.com
website: www.hermonlabs.com

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

13 APPENDIX E Specification references

FCC 47CFR part 15: 2022	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
AC	alternating current
A/m	ampere per meter
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
OATS	open area test site
Ω	Ohm
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



15 APPENDIX G Manufacturer's declaration



Xsense®
Dolev Street 33, P08 54
Migdal Tefen, Israel, 2495900

Email: info@xsense.co
Website: www.xsense.co
Tel: +972-(4)-9122800

Declaration of Identity

We, the undersigned,

Company: Xsense Ltd.
Address: Dolev 33, Migdal Tefen, 2495900
Country: Israel
Telephone number: +972-(4)-9122800

Declare under our sole responsibility that the following equipment:

Brand/Item	Type/Model	Short Product Description
XSENSE RTL	XRT20229	Data logger 4G_CatM1_Quectel + BLE AAAA alkaline battery

Is electronically/electrically/mechanically identical to the following equipment (including Software/Hardware version(s)):

Brand/Item	Type/Model	Short Product Description
XSENSE RTL	XRT10010	Data logger 2G + BLE AA alkaline battery
XSENSE RTL	XRT10110	Data logger 2G + BLE AAA alkaline battery
XSENSE RTL	XRT10210	Data logger 2G + BLE AAAA alkaline battery
XSENSE RTL	XRT20010	Data logger 4G_CatM1_Telit + BLE AA alkaline battery
XSENSE RTL	XRT20110	Data logger 4G_CatM1_Telit + BLE AAA alkaline battery
XSENSE RTL	XRT20210	Data logger 4G_CatM1_Telit + BLE AAAA alkaline battery
XSENSE RTL	XRT20029	Data logger 4G_CatM1_Quectel + BLE AA alkaline battery
XSENSE RTL	XRT20129	Data logger 4G_CatM1_Quectel + BLE AAA alkaline battery
XSENSE RTL	XRT30010	Data logger 4G_Cat1_N + BLE AA alkaline battery
XSENSE RTL	XRT30110	Data logger 4G_Cat1_N + BLE AA alkaline battery
XSENSE RTL	XRT30210	Data logger 4G_Cat1_N + BLE AA alkaline battery
XSENSE RTL	XRT30029	Data logger 4G_Cat1_U + BLE AA alkaline battery
XSENSE RTL	XRT30129	Data logger 4G_Cat1_U + BLE AA alkaline battery
XSENSE RTL	XRT30229	Data logger 4G_Cat1_U + BLE AA alkaline battery

The name change was made to identify which communication technology (2G/4G) and battery are used.

The variety of batteries is due to the logger's lifetime.

Controller Name: Robert Williams

Signature:

Stamp: Xsense Ltd.

Tefen, Dolev 33, 24959 Israel
Reg. No. 51-473495-3

END OF DOCUMENT