

TEST REPORT

ACCORDING TO: FCC 47CFR part 15 subpart C §15.247 (DTS),
RSS-247 Issue 3:2023, RSS-Gen Issue 5

FOR:

ST Engineering Telematics Wireless Ltd

Sienna MX1

Model: SMX1CS

FCC ID: NTASMX1CS

IC: 4732A-SMX1CS

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

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Address: 26 Hamelaha street, POB 1911, Holon 5811801, Israel
Telephone: +972 3557 5700
Fax: +972 3557 5703
E-mail: itsikk@tlmw.com
Contact name: Mr. Itsik Kanner

2 Equipment under test attributes

Product name: Sienna MX1
Product type: Transceiver
Model(s): SMX1CS
Serial number: 8250100917050
Hardware version: Rev B
Software release: Fc10
Receipt date 24-Jun-24

3 Manufacturer information

Manufacturer name: ST Engineering Telematics Wireless Ltd
Address: 26 Hamelaha street, POB 1911, Holon 5811801, Israel
Telephone: +972 3557 5700
Fax: +972 3557 5703
E-Mail: itsikk@tlmw.com
Contact name: Mr. Itsik Kanner

4 Test details

Project ID: 55429
Location: Hermon Laboratories Ltd. 66 HaTachana str., P.O. Box 23, Binyamina 3055001, Israel
Test started: 08-Dec-24
Test completed: 24-Feb-25
Test specification(s): FCC 47CFR part 15 subpart C §15.247 (DTS),
RSS-247 Issue 3:2023, RSS-Gen Issue 5



5 Tests summary

Test	Status
Transmitter characteristics	
FCC section 15.247(a)2 / RSS-247 section 5.2(a), 6 dB bandwidth	Pass
FCC section 15.247(b)3/ RSS-247 section 5.4(d), Peak output power	Pass
FCC section 15.247(i) / RSS-102 section 2.5.2, RF exposure	Pass, the exhibit to the application of certification is provided
FCC section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions	Pass
FCC section 15.247(e) / RSS-247 section 5.2(b), Peak power density	Pass
FCC section 15.247(d)/ RSS-247 section 5.5, Emissions at band edges	Pass
FCC section 15.203 / RSS-Gen section 6.8, Antenna requirement	Pass
FCC section 15.207(a) / RSS-Gen section 8.8, Conducted emission	Not required

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

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

	Name and Title	Date	Signature
Tested by:	Mr. M. Filobodchenko, test engineer, EMC & Radio Mr. S. Sugatov, test engineer, EMC & Radio	08-Dec-24 – 25-Feb-25	 
Reviewed by:	Mrs. S. Peysahov Sheynin, certification engineer, EMC & Radio	25-Mar-24 – 16-Apr-25	
Approved by:	Mr. M. Nikishin, group leader, EMC & Radio	08-May-25	



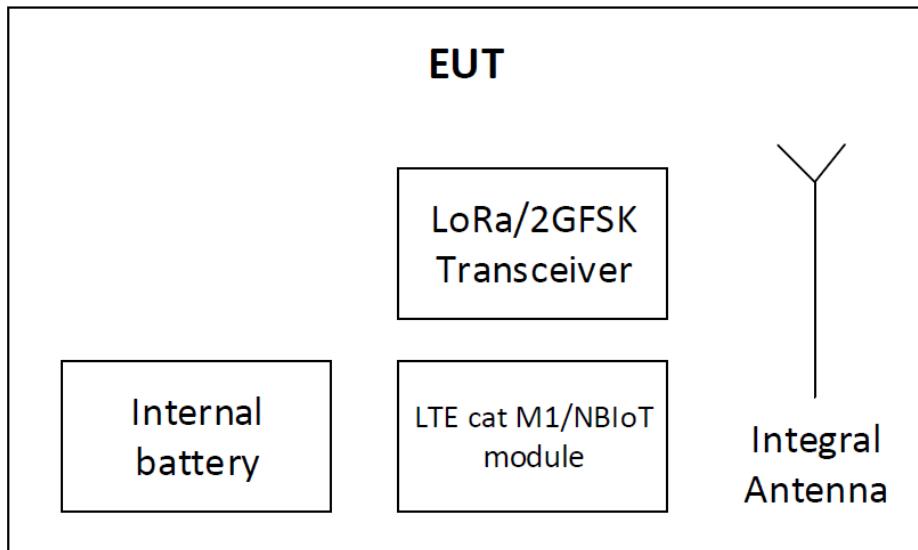
6 EUT description

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

6.1 General information

The EUT Sienna MX1 is a Meter Interface Unit that sends the water meter readings to the water management software either via cellular network or using LoRa/2GFSK modulation, to a mobile drive-by data collector. The Sienna MX1 is wired to a water meter encoder and collects the water meter data. The EUT consists of LoRa/2GFSK transceiver. The EUT is powered by 3.6V battery.

6.2 Test configuration



6.3 Changes made in EUT

No changes were implemented in the EUT during the testing.



6.4 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 range		902-928 MHz								
Operating frequency range		903 – 927 MHz								
Maximum rated output power		At transmitter 50 Ω RF output connector			19.21 dBm (LoRa) 13.27 dBm (2GFSK)					
		Peak output power								
Is transmitter output power variable?		X	No							
		Yes		continuous variable						
				stepped variable with stepsize						
				minimum RF power	dB					
				maximum RF power	dBm					
Antenna connection										
unique coupling	standard connector		X	integral	X with temporary RF connector without temporary RF connector					
Antenna/s technical characteristics										
Type	Manufacturer		Model number		Gain					
Printed	NA		NA		0 dBi					
Type of modulation										
LoRa, 2GFSK										
Modulating test signal (baseband)										
PRBS										
Transmitter power source										
X	Battery	Nominal rated voltage	3.6 VDC	Battery type	Lithium size D					
	DC	Nominal rated voltage								
	AC mains	Nominal rated voltage		Frequency						



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Test specification:	Section 15.247(a)2/ RSS-247 section 5.2(a), 6 dB bandwidth		
Test procedure:	ANSI C63.10 section 11.8.1		
Test mode:	Compliance	Verdict:	PASS
Date(s):	08-Dec-24		
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1003 hPa	Power: 3.6 VDC
Remarks:			

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

7.1 Minimum 6 dB bandwidth at LoRa modulation

7.1.1 General

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

Table 7.1.1 6 dB bandwidth limits

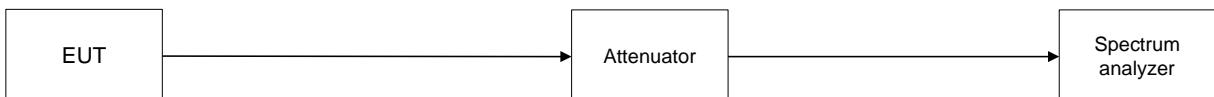
Assigned frequency, MHz	Modulation envelope reference points*, dBc	Minimum bandwidth, kHz
902.0 – 928.0	6.0	500.0

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

7.1.2 Test procedure

- 7.1.2.1 The EUT was set up as shown in Figure 7.1.1, energized and its proper operation was checked.
- 7.1.2.2 The EUT was set to transmit modulated carrier.
- 7.1.2.3 The transmitter minimum 6 dB bandwidth was measured with spectrum analyzer as frequency delta between reference points on modulation envelope and provided in Table 7.1.2 and associated plot.

Figure 7.1.1 6 dB bandwidth test setup





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Report ID: TELRAD_FCC.55429_DTS_LoRa_2GFSK.docx

Date of Issue: 8-May-25

Test specification: Section 15.247(a)2/ RSS-247 section 5.2(a), 6 dB bandwidth					
Test procedure: ANSI C63.10 section 11.8.1					
Test mode: Compliance				Verdict:	PASS
Date(s): 08-Dec-24					
Temperature: 24 °C	Relative Humidity: 42 %		Air Pressure: 1003 hPa	Power: 3.6 VDC	
Remarks:					

Table 7.1.2 6 dB bandwidth test results

ASSIGNED FREQUENCY BAND: 902 - 928 MHz
DETECTOR USED: Peak
SWEEP MODE: Single
SWEEP TIME: Auto
RESOLUTION BANDWIDTH: 100 kHz
VIDEO BANDWIDTH: 300 kHz
MODULATION: LORA
BIT RATE: 1.5 kbps

Carrier frequency, MHz	6 dB bandwidth, kHz	99%, kHz	Limit, kHz	Margin, kHz	Verdict
Low frequency					
903.00	630.24	669.83	500.00	130.24	Pass
Mid frequency					
915.00	634.74	672.53	500.00	134.74	Pass
High frequency					
927.00	633.24	669.23	500.00	133.24	Pass

Reference numbers of test equipment used

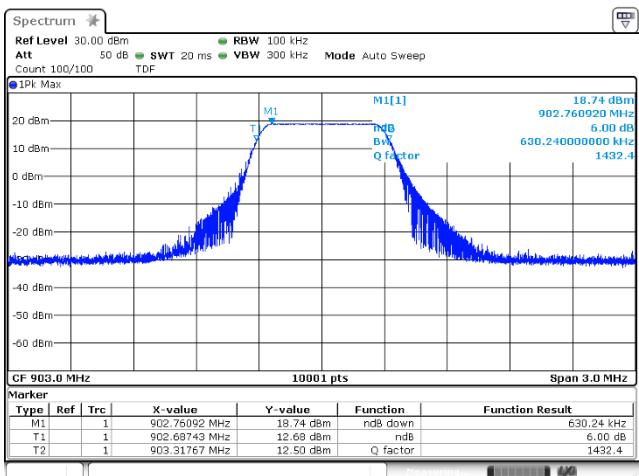
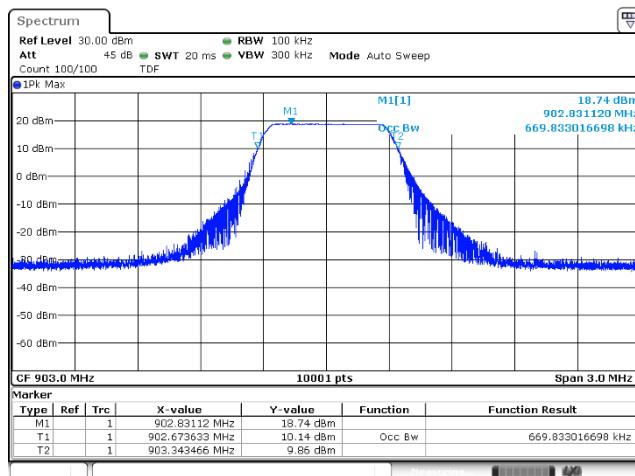
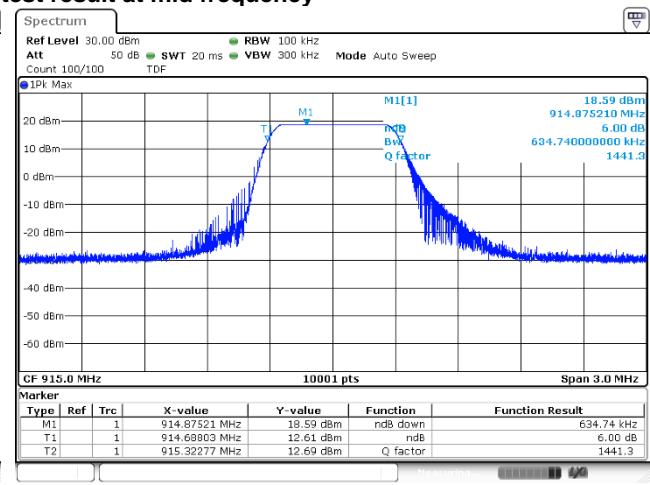
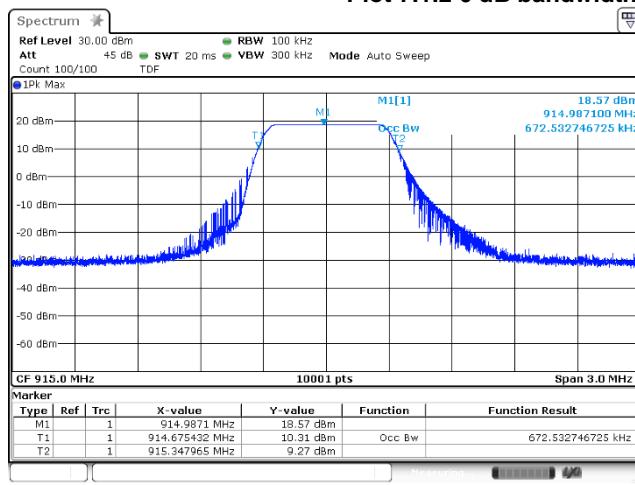
HL 4355	HL 5611	HL 5644						
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Full description is given in Appendix A.



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Test specification: Section 15.247(a)2/ RSS-247 section 5.2(a), 6 dB bandwidth			
Test procedure: ANSI C63.10 section 11.8.1			
Test mode: Compliance			Verdict: PASS
Date(s): 08-Dec-24			
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1003 hPa	Power: 3.6 VDC
Remarks:			

Plot 7.1.1 6 dB bandwidth test result at low frequency**Plot 7.1.2 6 dB bandwidth test result at mid frequency**



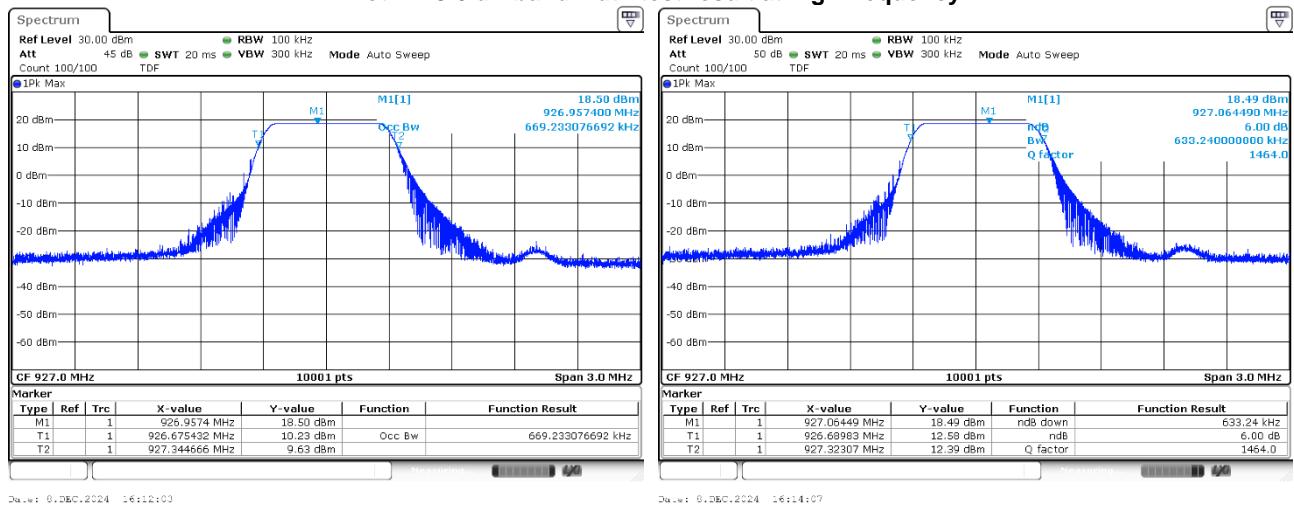
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Report ID: TELRAD_FCC.55429_DTS_LoRa_2GFSK.docx

Date of Issue: 8-May-25

Test specification: Section 15.247(a)2/ RSS-247 section 5.2(a), 6 dB bandwidth			
Test procedure:	ANSI C63.10 section 11.8.1		
Test mode:	Compliance		
Date(s):	08-Dec-24		
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1003 hPa	Power: 3.6 VDC
Remarks:			

Plot 7.1.3 6 dB bandwidth test result at high frequency





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Test specification:	Section 15.247(a)2 / RSS-247 section 5.2(a), 6 dB bandwidth		
Test procedure:	ANSI C63.10 section 11.8.1		
Test mode:	Compliance	Verdict:	PASS
Date(s):	08-Dec-24		
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1003 hPa	Power: 3.6 VDC
Remarks:			

7.2 Minimum 6 dB bandwidth at 2GFSK modulation

7.2.1 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 7.2.1 6 dB bandwidth limits

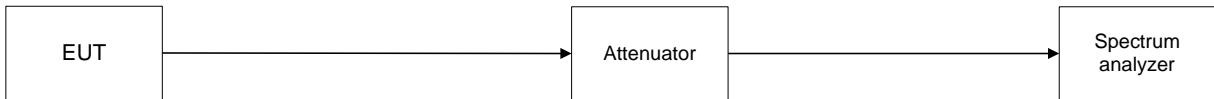
Assigned frequency, MHz	Modulation envelope reference points*, dBc	Minimum bandwidth, kHz
902.0 – 928.0	6.0	500.0

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

7.2.2 Test procedure

- 7.2.2.1 The EUT was set up as shown in Figure 7.1.1, energized and its proper operation was checked.
- 7.2.2.2 The EUT was set to transmit modulated carrier.
- 7.2.2.3 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 7.2.1 6 dB bandwidth test setup





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Test specification:	Section 15.247(a)2 / RSS-247 section 5.2(a), 6 dB bandwidth		
Test procedure:	ANSI C63.10 section 11.8.1		
Test mode:	Compliance	Verdict:	
Date(s):	08-Dec-24	PASS	
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1003 hPa	Power: 3.6 VDC
Remarks:			

Table 7.2.2 6 dB bandwidth test results

ASSIGNED FREQUENCY BAND: 902 - 928 MHz
 DETECTOR USED: Peak
 SWEEP MODE: Single
 SWEEP TIME: Auto
 RESOLUTION BANDWIDTH: 100 kHz
 VIDEO BANDWIDTH: 300 kHz
 MODULATION ENVELOPE REFERENCE 6.0 dBc
 POINTS:
 MODULATION: 2GFSK
 BIT RATE: 50 kbps

Carrier frequency, MHz	6 dB bandwidth, kHz	99%, kHz	Limit, kHz	Margin, kHz	Verdict
<u>Low frequency</u>					
903.00	741.23	771.22	500.00	241.23	Pass
<u>Mid frequency</u>					
915.00	741.23	771.52	500.00	241.23	Pass
<u>High frequency</u>					
927.00	741.53	771.22	500.00	241.53	Pass

Reference numbers of test equipment used

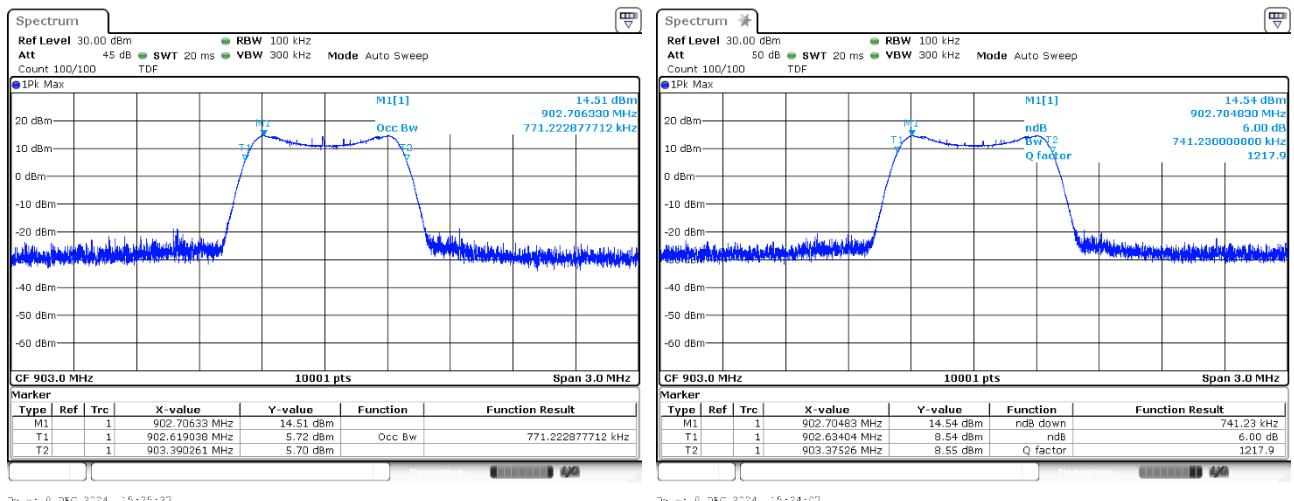
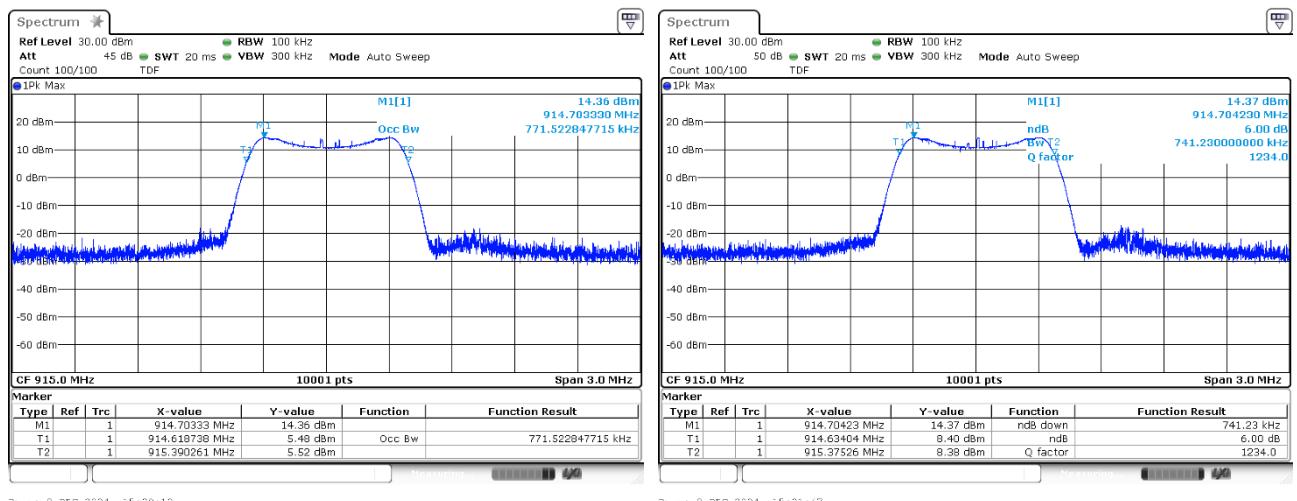
HL 4355	HL 5611	HL 5644					
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Full description is given in Appendix A.



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Test specification:	Section 15.247(a)2 / RSS-247 section 5.2(a), 6 dB bandwidth		
Test procedure:	ANSI C63.10 section 11.8.1		
Test mode:	Compliance	Verdict: PASS	
Date(s):	08-Dec-24		
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1003 hPa	Power: 3.6 VDC
Remarks:			

Plot 7.2.1 6 dB bandwidth test result at low frequency**Plot 7.2.2 6 dB bandwidth test result at mid frequency**



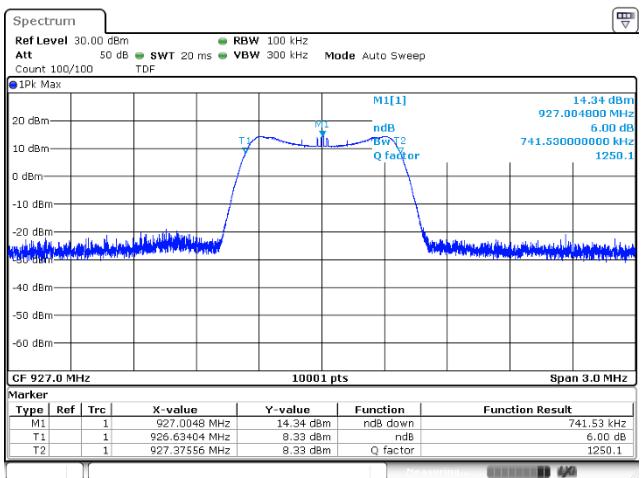
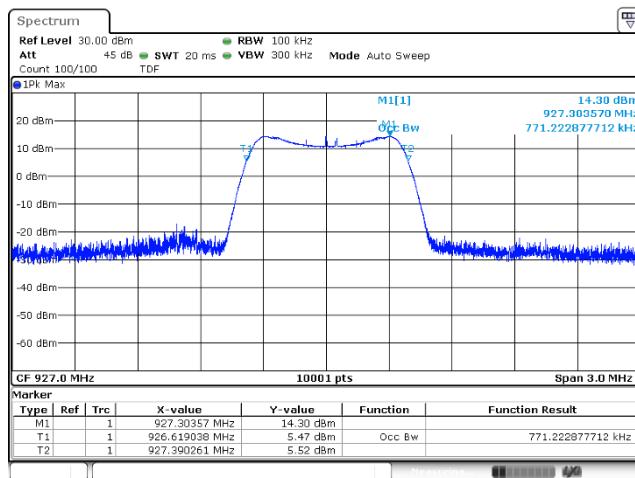
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Date of Issue: 8-May-25

Test specification:	Section 15.247(a)2 / RSS-247 section 5.2(a), 6 dB bandwidth		
Test procedure:	ANSI C63.10 section 11.8.1		
Test mode:	Compliance	Verdict: PASS	
Date(s):	08-Dec-24		
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1003 hPa	Power: 3.6 VDC
Remarks:			

Plot 7.2.3 6 dB bandwidth test result at high frequency





HERMON LABORATORIES

Report ID: TELRAD_FCC.55429_DTS_LoRa_2GFSK.docx

Date of Issue: 8-May-25

Test specification: Section 15.247(b)3/ RSS-247 section 5.4(d), Peak output power			
Test procedure: ANSI C63.10 sections 11.9.2.2.4			
Test mode: Compliance		Verdict: PASS	
Date(s): 14-Jan-25			
Temperature: 23 °C	Relative Humidity: 47 %	Air Pressure: 1018 hPa	Power: 3.6 VDC
Remarks:			

7.3 Peak output power at LoRa modulation

7.3.1 General

This test was performed to measure the maximum peak output power at the transmitter RF antenna connector. Specification test limits are given in Table 7.3.1.

Table 7.3.1 Peak output power limits

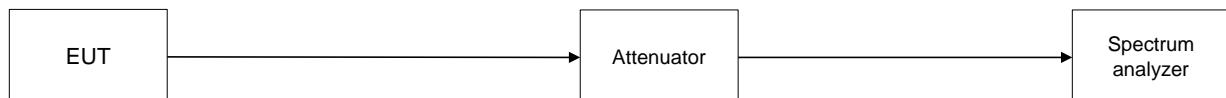
Assigned frequency range, MHz	Maximum antenna gain, dBi	Peak output power*	
		W	dBm
902.0 – 928.0	6.0	1.0	30.0

*- 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 the amount in dB that the directional gain of antenna exceeds 6 dBi.

7.3.2 Test procedure

- 7.3.2.1 The EUT was set up as shown in Figure 7.3.1, energized and its proper operation was checked.
- 7.3.2.2 The EUT was adjusted to produce maximum available for end user RF output power.
- 7.3.2.3 The duty cycle of the transmitter output signal was measured and recorded.
- 7.3.2.1 The frequency span of spectrum analyzer was set greater than the OBW of the transmitter at least 1.5 times. The maximum output power was measured using a power average (RMS) detector with resolution bandwidth set 1% to 5% of the OBW, $VBW \geq [3 \times RBW]$. The trace average at least 100 traces was performed.
- 7.3.2.2 Compute power by integrating the spectrum across the OBW of the signal using the instrument's band power measurement function with band limits set equal to the OBW band edges.
- 7.3.2.3 The duty cycle correction factor was added to the measured power to compute the average power during the actual transmission times.

Figure 7.3.1 Peak output power test setup





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Test specification: Section 15.247(b)3/ RSS-247 section 5.4(d), Peak output power			
Test procedure: ANSI C63.10 sections 11.9.2.2.4			
Test mode: Compliance			Verdict: PASS
Date(s): 14-Jan-25			
Temperature: 23 °C	Relative Humidity: 47 %	Air Pressure: 1018 hPa	Power: 3.6 VDC
Remarks:			

Table 7.3.2 Peak output power test results

ASSIGNED FREQUENCY: 902-928 MHz
 MODULATION: LoRa 500 kHz
 DETECTOR USED: Average
 EUT 20 dB BANDWIDTH: 634.74 kHz
 RESOLUTION BANDWIDTH: 1000 kHz
 VIDEO BANDWIDTH: 3000 kHz
 BIT RATE: 1.5 kbps

Carrier frequency, MHz	Spectrum analyzer reading, dBm	External attenuation, dB	DC factor, dB	Peak output power**, dBm	Limit, dBm	Margin*, dB	Verdict
903.0	16.65	Included	2.56	19.21	30.00	-10.79	Pass
915.0	16.49	Included	2.56	19.05	30.00	-10.95	Pass
927.0	16.17	Included	2.56	18.73	30.00	-11.27	Pass

* - Margin = Peak output power – specification limit.

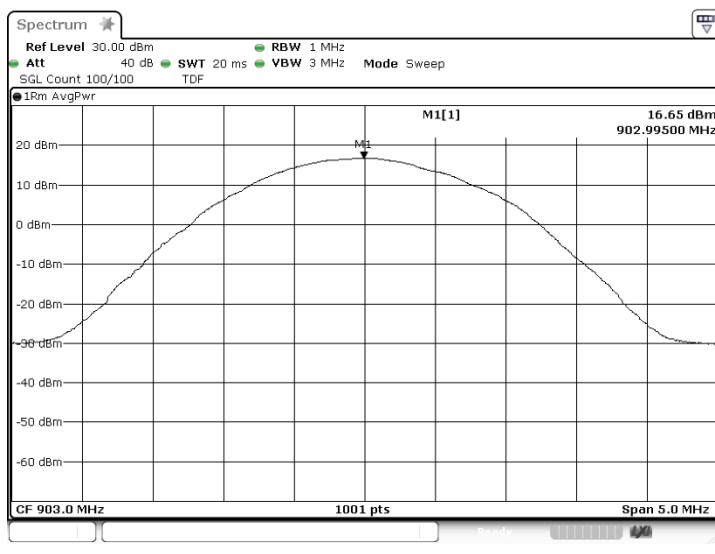
** - Peak output power = SA reading + DC factor, where

$$\text{DC Factor} = 10^{\log(1/(T_{\text{on}} / (T_{\text{on}} + T_{\text{off}})))} = 2.559 \text{ dB}$$

Reference numbers of test equipment used

HL 3230	HL 3440	HL 4135	HL 4355	HL 5642	HL 5933	HL 7523	
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Full description is given in Appendix A.

Plot 7.3.1 Average output power at low frequency



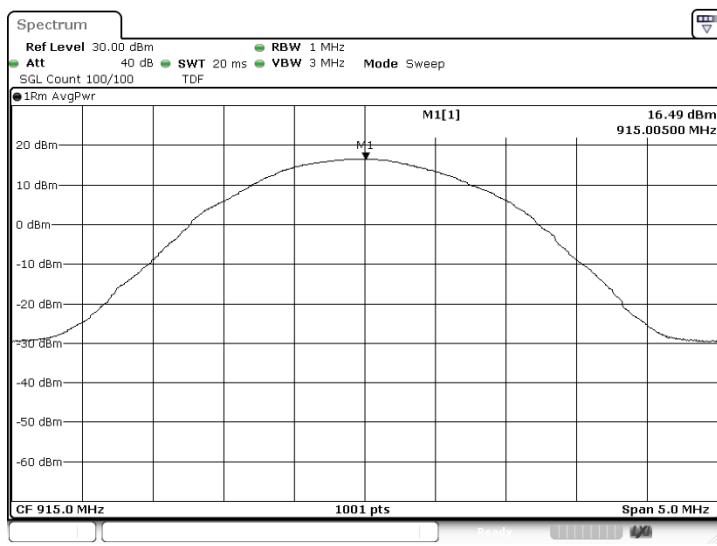
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Date of Issue: 8-May-25

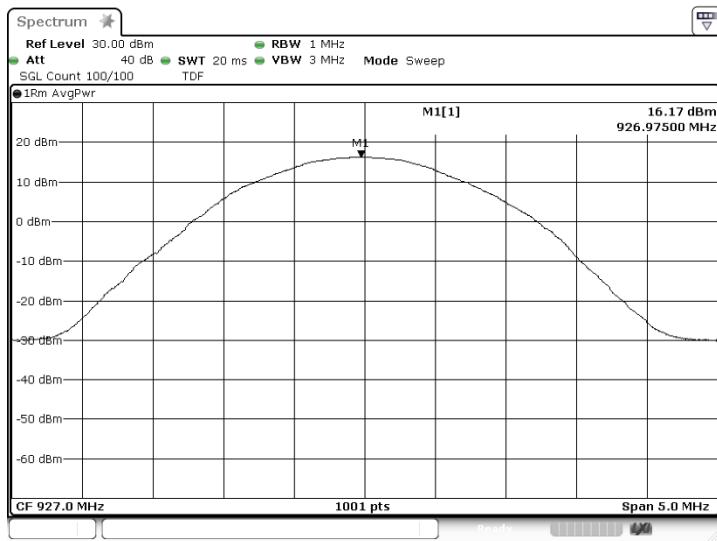
Test specification: Section 15.247(b)3/ RSS-247 section 5.4(d), Peak output power			
Test procedure: ANSI C63.10 sections 11.9.2.2.4			
Test mode: Compliance		Verdict: PASS	
Date(s): 14-Jan-25			
Temperature: 23 °C	Relative Humidity: 47 %	Air Pressure: 1018 hPa	Power: 3.6 VDC
Remarks:			

Plot 7.3.2 Average output power at mid frequency



Date: 14.JAN.2025 10:50:55

Plot 7.3.3 Average output power at high frequency



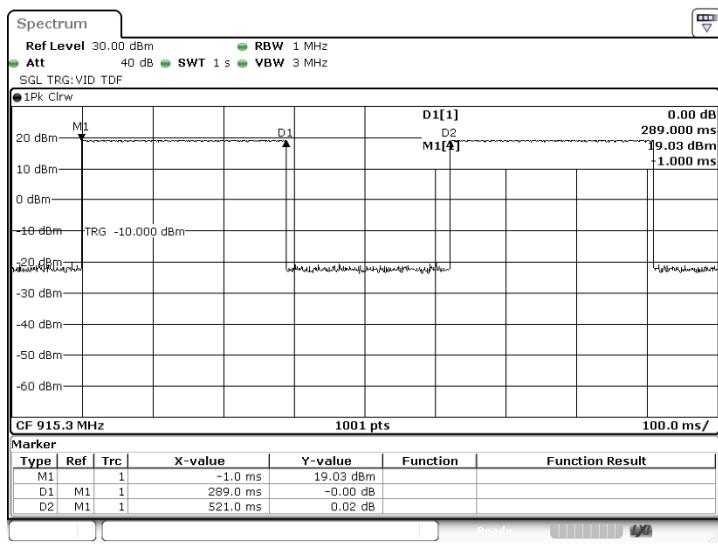
Date: 14.JAN.2025 11:39:46



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Test specification:	Section 15.247(b)3/ RSS-247 section 5.4(d), Peak output power		
Test procedure:	ANSI C63.10 sections 11.9.2.2.4		
Test mode:	Compliance		
Date(s):	14-Jan-25		
Temperature: 23 °C	Relative Humidity: 47 %	Air Pressure: 1018 hPa	Power: 3.6 VDC
Remarks:			

Plot 7.3.4 Transmission pulse duration and period





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Report ID: TELRAD_FCC.55429_DTS_LoRa_2GFSK.docx

Date of Issue: 8-May-25

Test specification: Section 15.247(b)3/ RSS-247 section 5.4(d), Peak output power			
Test procedure: ANSI C63.10 sections 11.9.2.2.4			
Test mode: Compliance		Verdict: PASS	
Date(s): 10-Feb-25			
Temperature: 24 °C	Relative Humidity: 45 %	Air Pressure: 1016 hPa	Power: 3.6 VDC
Remarks:			

7.4 Peak output power at 2GFSK modulation

7.4.1 General

This test was performed to measure the maximum peak output power at the transmitter RF antenna connector. Specification test limits are given in Table 7.3.1.

Table 7.4.1 Peak output power limits

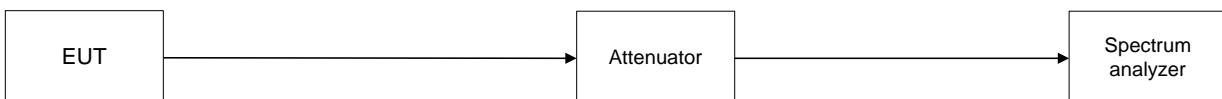
Assigned frequency range, MHz	Maximum antenna gain, dBi	Peak output power*	
		W	dBm
902.0 – 928.0	6.0	1.0	30.0

*- 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 the amount in dB that the directional gain of antenna exceeds 6 dBi.

7.4.2 Test procedure

- 7.4.2.1 The EUT was set up as shown in Figure 7.3.1, energized and its proper operation was checked.
- 7.4.2.2 The EUT was adjusted to produce maximum available for end user RF output power.
- 7.4.2.3 The duty cycle of the transmitter output signal was measured and recorded.
- 7.4.2.4 The frequency span of spectrum analyzer was set greater than the OBW of the transmitter at least 1.5 times. The maximum output power was measured using a power average (RMS) detector with resolution bandwidth set 1% to 5% of the OBW, $VBW \geq [3 \times RBW]$. The trace average at least 100 traces was performed.
- 7.4.2.5 Compute power by integrating the spectrum across the OBW of the signal using the instrument's band power measurement function with band limits set equal to the OBW band edges.
- 7.4.2.6 The duty cycle correction factor was added to the measured power to compute the average power during the actual transmission times.

Figure 7.4.1 Peak output power test setup





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Report ID: TELRAD_FCC.55429_DTS_LoRa_2GFSK.docx

Date of Issue: 8-May-25

Test specification: Section 15.247(b)3/ RSS-247 section 5.4(d), Peak output power	
Test procedure: ANSI C63.10 sections 11.9.2.2.4	
Test mode: Compliance	Verdict: PASS
Date(s): 10-Feb-25	
Temperature: 24 °C	Relative Humidity: 45 %
	Air Pressure: 1016 hPa
	Power: 3.6 VDC
Remarks:	

Table 7.4.2 Peak output power test results

ASSIGNED FREQUENCY: 902-928 MHz
 MODULATION: 2GFSK 500 kHz
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum
 DETECTOR USED: Average
 EUT 20 dB BANDWIDTH: 741.53 kHz
 RESOLUTION BANDWIDTH: 30 kHz
 VIDEO BANDWIDTH: 100 kHz
 BIT RATE: 50 kbps

Carrier frequency, MHz	Spectrum analyzer reading, dBm	External attenuation, dB	DC factor, dB	Peak output power**, dBm	Limit, dBm	Margin*, dB	Verdict
903.0	0.401	Included	12.31	12.71	30.00	-17.29	Pass
915.0	0.963	Included	12.31	13.27	30.00	-16.73	Pass
927.0	0.396	Included	12.31	12.71	30.00	-17.29	Pass

* - Margin = Peak output power – specification limit.

** - Peak output power = SA reading + DC factor, where

$$\text{DC Factor} = 10^{\ast} \log (1 / (\text{Txon} / (\text{Txon} + \text{Txoff}))) = 12.31 \text{dB}$$

Reference numbers of test equipment used

HL 3230	HL 3440	HL 5376	HL 5636	HL 5933	HL 7546		
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Full description is given in Appendix A.

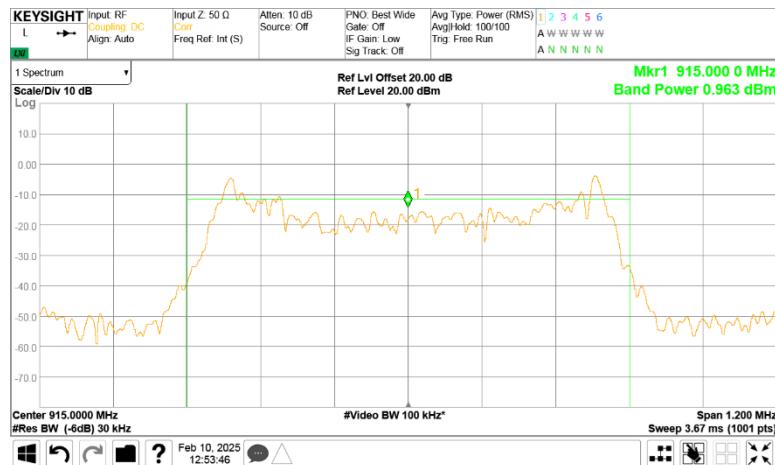
Plot 7.4.1 Average output power at low frequency



HERMON LABORATORIES

Test specification: Section 15.247(b)3/ RSS-247 section 5.4(d), Peak output power			
Test procedure: ANSI C63.10 sections 11.9.2.2.4			
Test mode: Compliance			
Date(s): 10-Feb-25			Verdict: PASS
Temperature: 24 °C	Relative Humidity: 45 %	Air Pressure: 1016 hPa	Power: 3.6 VDC
Remarks:			

Plot 7.4.2 Average output power at mid frequency



Plot 7.4.3 Average output power at high frequency

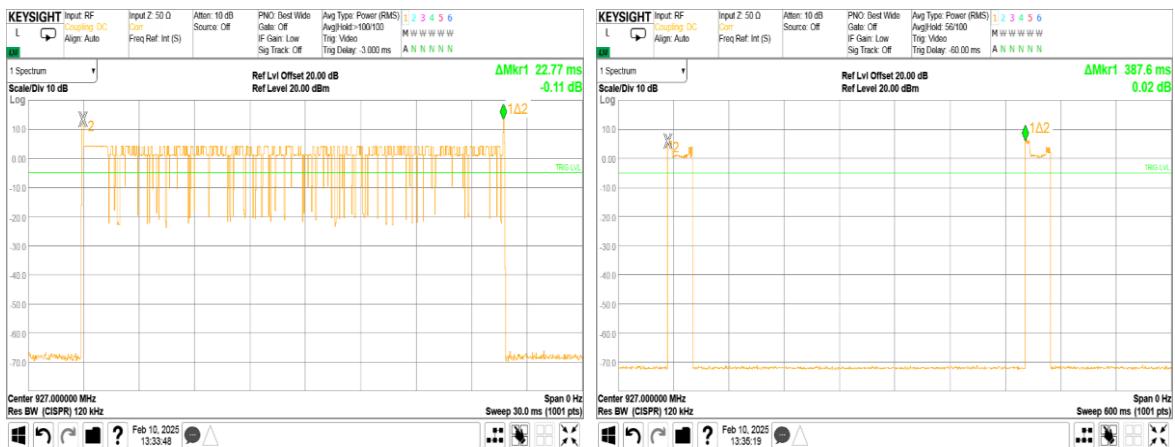




HERMON LABORATORIES

Test specification: Section 15.247(b)3/ RSS-247 section 5.4(d), Peak output power			
Test procedure: ANSI C63.10 sections 11.9.2.2.4			
Test mode: Compliance			Verdict: PASS
Date(s): 10-Feb-25			
Temperature: 24 °C	Relative Humidity: 45 %	Air Pressure: 1016 hPa	Power: 3.6 VDC
Remarks:			

Plot 7.4.4 Transmission pulse duration and period





HERMON LABORATORIES

Test specification:	Section 15.247(e), / RSS-247 section 5.2(b), Peak power density		
Test procedure:	ANSI C63.10 section 11.10.5		
Test mode:	Compliance		
Date(s):	14-Jan-25		
Temperature: 23 °C	Relative Humidity: 47 %	Air Pressure: 1016 hPa	Power: 3.6 VDC
Remarks:			

7.5 Peak spectral power density at LoRa modulation

7.5.1 General

This test was performed to measure the peak spectral power density at the transmitter RF antenna connector. 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
902 - 928	3.0	8.0

7.5.2 Test procedure

- 7.5.2.1 The EUT was set up as shown in Figure 7.5.1, energized and its proper operation was checked.
- 7.5.2.2 The EUT was adjusted to produce maximum available to end user RF output power.
- 7.5.2.3 The frequency span of spectrum analyzer was set 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.
- 7.5.2.4 The average detector with power averaging mode was used over a minimum of 100 traces. The peak marker function was used to determine the maximum power spectral density. To compute the average PSD during the actual transmission time the average factor was added to the measured values of PSD and the results provided in Table 7.5.2 and associated plots.

Figure 7.5.1 Peak spectral power density test setup





HERMON LABORATORIES

Test specification: Section 15.247(e), / RSS-247 section 5.2(b), Peak power density	
Test procedure:	ANSI C63.10 section 11.10.5
Test mode:	Compliance
Date(s):	14-Jan-25
Temperature: 23 °C	Relative Humidity: 47 %
	Air Pressure: 1016 hPa
	Power: 3.6 VDC
Remarks:	

Table 7.5.2 Peak spectral power density test results

ASSIGNED FREQUENCY: 902 – 928 MHz
 MODULATION: LoRa 500 kHz
 BIT RATE: 1.5 kbps
 DETECTOR USED: Average
 RESOLUTION BANDWIDTH: 3 kHz
 VIDEO BANDWIDTH: 30 kHz

Carrier frequency, MHz	Spectrum analyzer reading, dBm	External attenuation, dB	DC factor, dB	Peak power density, dBm / 3 kHz**	Limit, dBm	Margin*, dB	Verdict
903.0	-0.12	Included	2.56	2.44	8.0	-5.56	Pass
915.0	-0.44	Included	2.56	2.12	8.0	-5.88	Pass
927.0	-0.45	Included	2.56	2.11	8.0	-5.89	Pass

* - Margin = Peak power density – specification limit.

** - Peak power density = SA reading + DC factor, where
 $DC\ Factor = 10 \log(1/(Txon / (Txon+Txoff))) = 2.559\ dB$

Reference numbers of test equipment used

HL 3230	HL 3440	HL 4135	HL 4355	HL 5642	HL 7523		
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Full description is given in Appendix A.



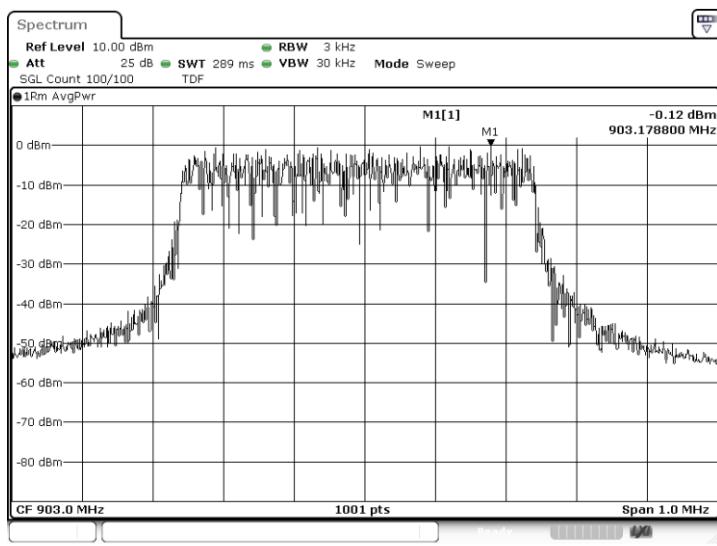
HERMON LABORATORIES

Report ID: TELRAD_FCC.55429_DTS_LoRa_2GFSK.docx

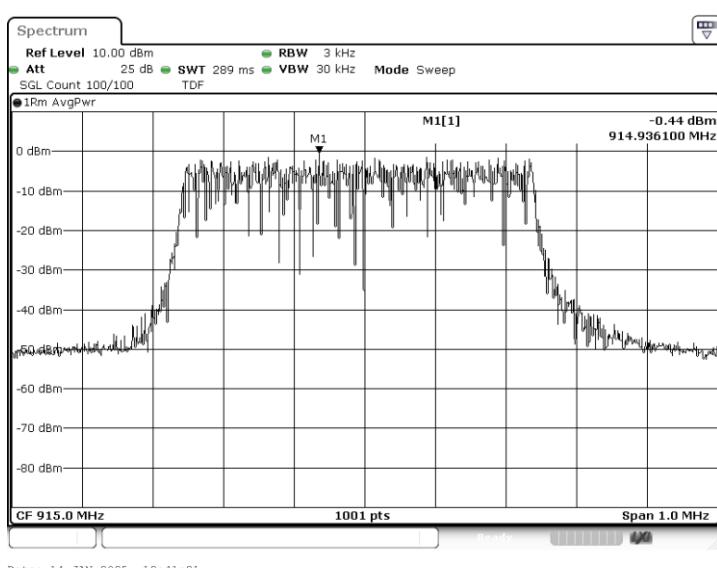
Date of Issue: 8-May-25

Test specification: Section 15.247(e), / RSS-247 section 5.2(b), Peak power density			
Test procedure: ANSI C63.10 section 11.10.5			
Test mode: Compliance		Verdict: PASS	
Date(s): 14-Jan-25			
Temperature: 23 °C	Relative Humidity: 47 %	Air Pressure: 1016 hPa	Power: 3.6 VDC
Remarks:			

Plot 7.5.1 Average spectral power density at low frequency



Plot 7.5.2 Average spectral power density at mid frequency

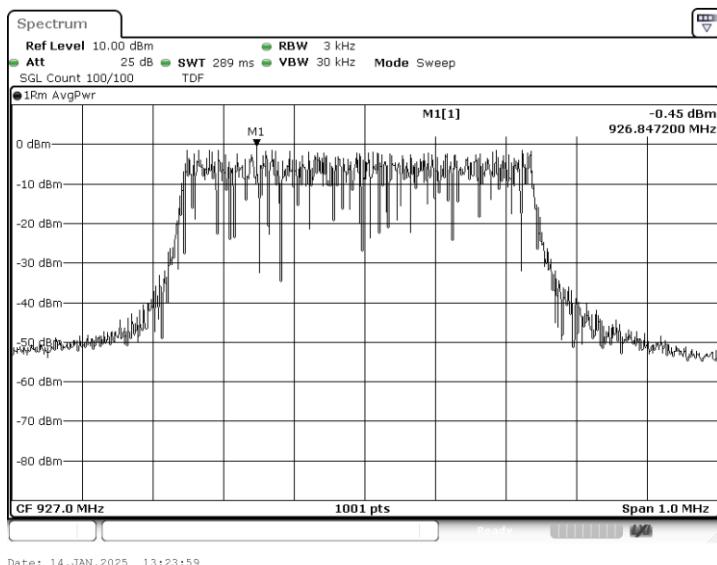




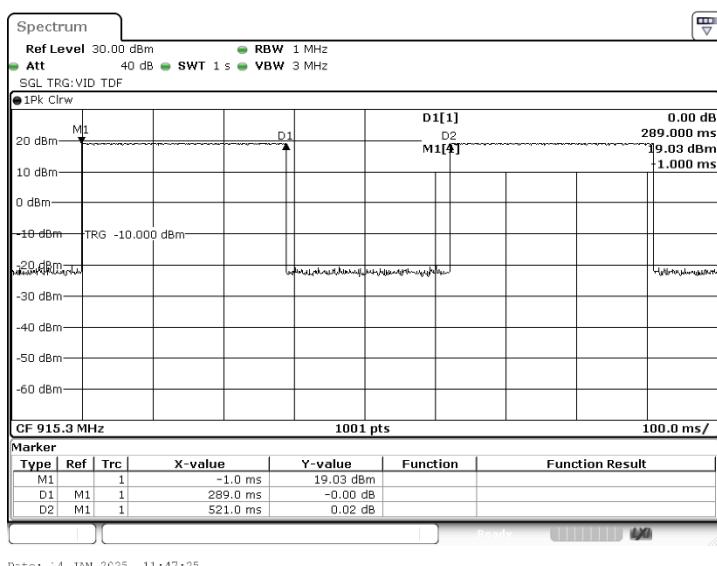
HERMON LABORATORIES

Test specification: Section 15.247(e), / RSS-247 section 5.2(b), Peak power density			
Test procedure: ANSI C63.10 section 11.10.5			
Test mode: Compliance		Verdict: PASS	
Date(s): 14-Jan-25			
Temperature: 23 °C	Relative Humidity: 47 %	Air Pressure: 1016 hPa	Power: 3.6 VDC
Remarks:			

Plot 7.5.3 Average spectral power density at high frequency



Plot 7.5.4 Transmission pulse duration and period





HERMON LABORATORIES

Test specification:	Section 15.247(e), / RSS-247 section 5.2(b), Peak power density		
Test procedure:	ANSI C63.10 section 11.10.5		
Test mode:	Compliance		
Date(s):	09-Jan-25		
Temperature: 23 °C	Relative Humidity: 47 %	Air Pressure: 1014 hPa	Power: 3.6 VDC
Remarks:			

7.6 Peak spectral power density at 2GFSK modulation

7.6.1 General

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

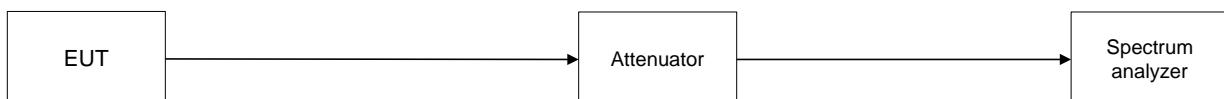
Table 7.6.1 Peak spectral power density limits

Assigned frequency range, MHz	Measurement bandwidth, kHz	Peak spectral power density, dBm
902 - 928	3.0	8.0

7.6.2 Test procedure

- 7.6.2.1 The EUT was set up as shown in Figure 7.5.1, energized and its proper operation was checked.
- 7.6.2.2 The EUT was adjusted to produce maximum available to end user RF output power.
- 7.6.2.3 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.
- 7.6.2.4 The average detector with power averaging mode was used over a minimum of 100 traces. The peak marker function was used to determine the maximum power spectral density. To compute the average PSD during the actual transmission time the average factor was added to the measured values of PSD and the results provided in Table 7.6.2 and associated plots.

Figure 7.6.1 Peak spectral power density test setup





HERMON LABORATORIES

Report ID: TELRAD_FCC.55429_DTS_LoRa_2GFSK.docx

Date of Issue: 8-May-25

Test specification: Section 15.247(e), / RSS-247 section 5.2(b), Peak power density	
Test procedure:	ANSI C63.10 section 11.10.5
Test mode:	Compliance
Date(s):	09-Jan-25
Temperature: 23 °C	Relative Humidity: 47 %
	Air Pressure: 1014 hPa
	Power: 3.6 VDC
Remarks:	

Table 7.6.2 Peak spectral power density test results

ASSIGNED FREQUENCY: 902 - 928 MHz
 MODULATION: 2GFSK
 MODULATING SIGNAL: PRBS
 BIT RATE: 50 kbps
 DETECTOR USED: Peak
 RESOLUTION BANDWIDTH: 3 kHz
 VIDEO BANDWIDTH: 30 kHz

Carrier frequency, MHz	Spectrum analyzer reading, dBm	External attenuation, dB	DC factor, dB	Peak power density, dBm / 3 kHz**	Limit, dBm	Margin*, dB	Verdict
903	-7.95	included	12.31	4.36	8.0	-3.64	Pass
915	-6.91	included	12.31	5.40	8.0	-2.60	Pass
927	-8.69	included	12.31	3.62	8.0	-4.38	Pass

* - Margin = Peak power density – specification limit.

** - Peak power density = SA reading + DC factor, where
DC Factor = $10 \log(1/(Txon / (Txon+Txoff))) = 12.31 \text{ dB}$ **Reference numbers of test equipment used**

HL 3230	HL 3440	HL 5376	HL 5636	HL 5933	HL 7546		
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Full description is given in Appendix A.



HERMON LABORATORIES

Test specification: Section 15.247(e), / RSS-247 section 5.2(b), Peak power density			
Test procedure: ANSI C63.10 section 11.10.5			
Test mode: Compliance			Verdict: PASS
Date(s): 09-Jan-25			
Temperature: 23 °C	Relative Humidity: 47 %	Air Pressure: 1014 hPa	Power: 3.6 VDC
Remarks:			

Plot 7.6.1 Average spectral power density at low frequency



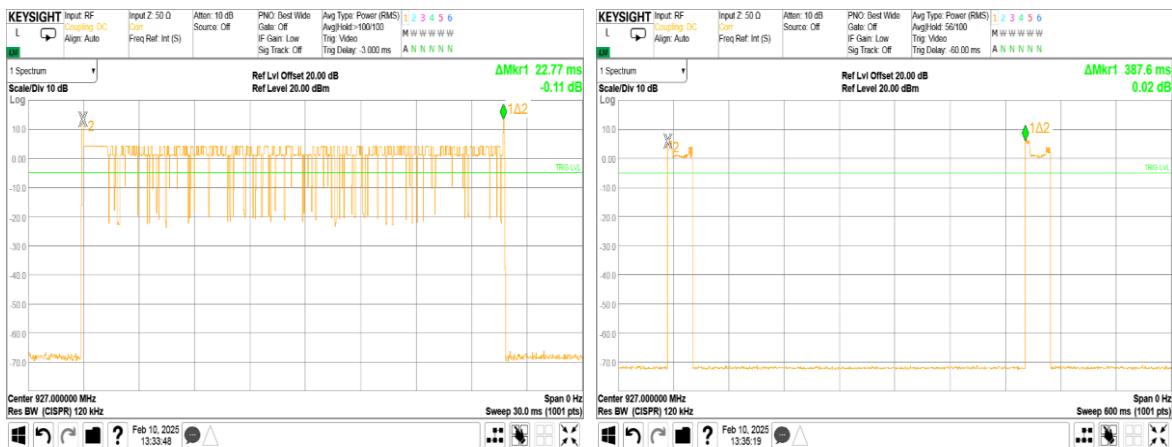
Plot 7.6.2 Average spectral power density at mid frequency





HERMON LABORATORIES

Test specification: Section 15.247(e), / RSS-247 section 5.2(b), Peak power density			
Test procedure: ANSI C63.10 section 11.10.5			
Test mode: Compliance			Verdict: PASS
Date(s): 09-Jan-25			
Temperature: 23 °C	Relative Humidity: 47 %	Air Pressure: 1014 hPa	Power: 3.6 VDC
Remarks:			

Plot 7.6.3 Average spectral power density at high frequency**Plot 7.6.4 Transmission pulse duration and period**



HERMON LABORATORIES

Report ID: TELRAD_FCC.55429_DTS_LoRa_2GFSK.docx

Date of Issue: 8-May-25

Test specification: Section 15.247(d) / RSS-247 section 5.5, Band edge emissions			
Test procedure: ANSI C63.10 section 11.13.2			
Test mode: Compliance		Verdict: PASS	
Date(s): 14-Jan-25		Air Pressure: 1016 hPa	Power: 3.6 VDC
Temperature: 23 °C Relative Humidity: 47 %			
Remarks:			

7.7 Band edge emissions at RF antenna connector at LoRa modulation

7.7.1 General

This test was performed to measure band edge emissions at RF antenna connector. Specification test limits are given in Table 7.7.1.

Table 7.7.1 Band edge emission limits

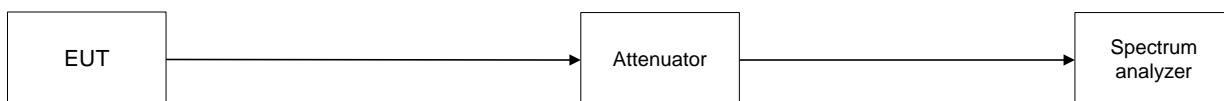
Output power	Assigned frequency, MHz	Attenuation below carrier*, dBc	Field strength at 3 m within restricted bands, dB(µV/m)	
			Peak	Average
Peak	902.0 – 928.0	20.0	74.0	54.0
Averaged over a time interval	902.0 – 928.0	30.0	74.0	54.0

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

7.7.2 Test procedure

- 7.7.2.1 The EUT was set up as shown in Figure 7.7.1, energized normally modulated at the maximum data rate and its proper operation was checked.
- 7.7.2.2 The EUT was adjusted to produce maximum available to end user RF output power at the lowest carrier frequency.
- 7.7.2.3 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.
- 7.7.2.4 The spectrum analyzer was set in max hold mode and allowed trace to stabilize. The highest emission level within the authorized band was measured.
- 7.7.2.5 The maximum band edge emission and modulation product outside of the band were measured as provided in Table 7.7.2 and associated plots and referenced to the highest emission level measured within the authorized band.
- 7.7.2.6 The above procedure was repeated with the EUT adjusted to produce maximum RF output power at the highest carrier frequency.
- 7.7.2.7 The above procedure was repeated with the frequency hopping function enabled.

Figure 7.7.1 Band edge emission test setup





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Test specification:		Section 15.247(d) / RSS-247 section 5.5, Band edge emissions		
Test procedure:		ANSI C63.10 section 11.13.2		
Test mode:	Compliance			Verdict: PASS
Date(s):	14-Jan-25			
Temperature: 23 °C	Relative Humidity: 47 %	Air Pressure: 1016 hPa	Power: 3.6 VDC	
Remarks:				

Table 7.7.2 Band edge emission test results

ASSIGNED FREQUENCY RANGE: 902.0 -928.0MHz
DETECTOR USED: Average
MODULATION: LoRa
BIT RATE: 1.5 kbps
TRANSMITTER OUTPUT POWER SETTINGS: Maximum
RESOLUTION BANDWIDTH: 100 kHz
VIDEO BANDWIDTH: ≥ RBW

Frequency, MHz	Band edge emission, dBm	Emission at carrier, dBm	Attenuation below carrier, dBc	Limit, dBc	Margin, dB*	Verdict
Low carrier - Peak power						
902.00	-28.23	18.94	47.17	30.0	-17.17	Pass
High carrier - Peak power						
928.00	-22.56	18.70	41.26	30.0	-11.26	Pass

*- Margin = Attenuation below carrier – specification limit.

Reference numbers of test equipment used

HL 3230	HL 3440	HL 4135	HL 4355	HL 5642	HL 5933	HL 7523	
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Full description is given in Appendix A.



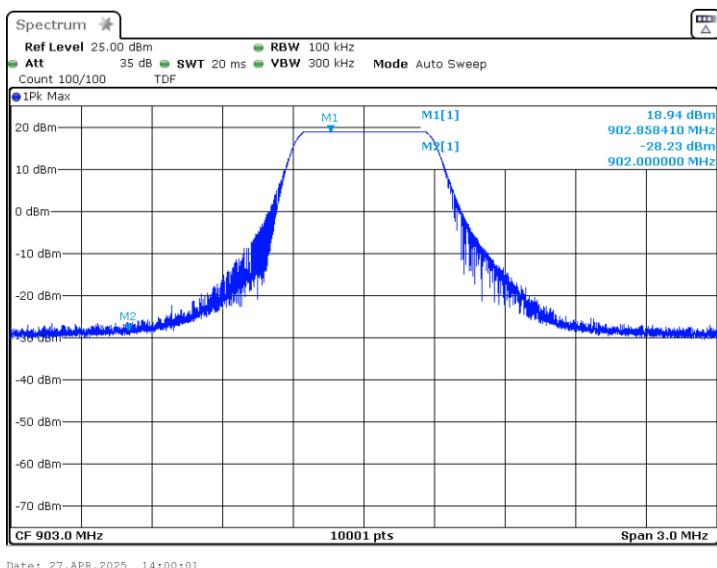
HERMON LABORATORIES

Report ID: TELRAD_FCC.55429_DTS_LoRa_2GFSK.docx

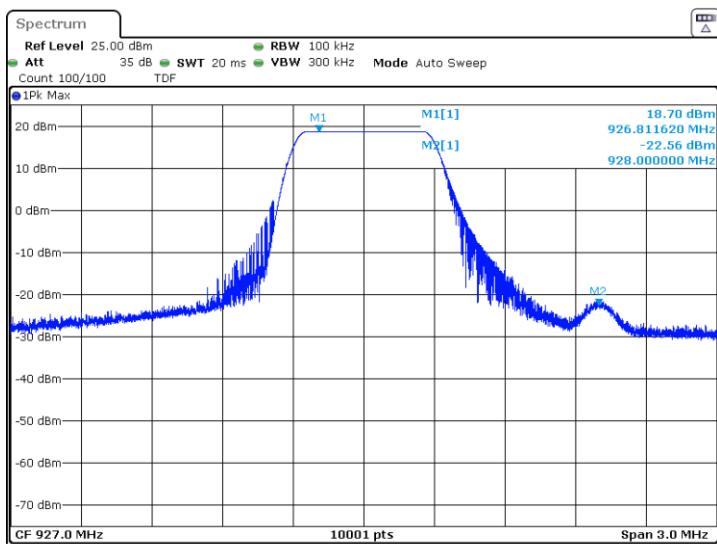
Date of Issue: 8-May-25

Test specification: Section 15.247(d) / RSS-247 section 5.5, Band edge emissions			
Test procedure:	ANSI C63.10 section 11.13.2		
Test mode:	Compliance		
Date(s):	14-Jan-25		
Temperature: 23 °C	Relative Humidity: 47 %	Air Pressure: 1016 hPa	Power: 3.6 VDC
Remarks:			

Plot 7.7.1 The highest band edge emission at low carrier frequency



Plot 7.7.2 The highest band edge emission at high carrier frequency





HERMON LABORATORIES

Report ID: TELRAD_FCC.55429_DTS_LoRa_2GFSK.docx

Date of Issue: 8-May-25

Test specification: Section 15.247(d) / RSS-247 section 5.5, Band edge emissions			
Test procedure: ANSI C63.10 section 11.13.2			
Test mode: Compliance		Verdict: PASS	
Date(s): 09-Jan-25			
Temperature: 23 °C	Relative Humidity: 47 %	Air Pressure: 1014 hPa	Power: 3.6 VDC
Remarks:			

7.8 Band edge emissions at RF antenna connector at 2GFSK modulation

7.8.1 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 7.8.1.

Table 7.8.1 Band edge emission limits

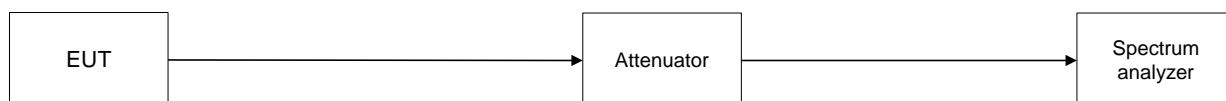
Output power	Assigned frequency, MHz	Attenuation below carrier*, dBc	Field strength at 3 m within restricted bands, dB(µV/m)	
			Peak	Average
Peak	902.0 – 928.0	20.0	74.0	54.0
Averaged over a time interval	902.0 – 928.0	30.0	74.0	54.0

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

7.8.2 Test procedure

- 7.8.2.1 The EUT was set up as shown in Figure 7.8.1, energized normally modulated at the maximum data rate and its proper operation was checked.
- 7.8.2.2 The EUT was adjusted to produce maximum available to end user RF output power at the lowest carrier frequency.
- 7.8.2.3 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.
- 7.8.2.4 The spectrum analyzer was set in max hold mode and allowed trace to stabilize. The highest emission level within the authorized band was measured.
- 7.8.2.5 The maximum band edge emission and modulation product outside of the band were measured as provided in Table 7.8.2 and associated plots and referenced to the highest emission level measured within the authorized band.
- 7.8.2.6 The above procedure was repeated with the EUT adjusted to produce maximum RF output power at the highest carrier frequency.
- 7.8.2.7 The above procedure was repeated with the frequency hopping function enabled.

Figure 7.8.1 Band edge emission test setup





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Test specification:		Section 15.247(d) / RSS-247 section 5.5, Band edge emissions		
Test procedure:		ANSI C63.10 section 11.13.2		
Test mode:	Compliance		Verdict:	PASS
Date(s):	09-Jan-25			
Temperature: 23 °C	Relative Humidity: 47 %	Air Pressure: 1014 hPa	Power: 3.6 VDC	
Remarks:				

Table 7.8.2 Band edge emission test results

ASSIGNED FREQUENCY RANGE: 902.0 -928.0MHz
DETECTOR USED: Average
MODULATION: 2GFSK
BIT RATE: 50 kbps
TRANSMITTER OUTPUT POWER SETTINGS: Maximum
RESOLUTION BANDWIDTH: 100 kHz
VIDEO BANDWIDTH: ≥ RBW

Frequency, MHz	Band edge emission, dBm	Emission at carrier, dBm	Attenuation below carrier, dBc	Limit, dBc	Margin, dB*	Verdict
Low carrier - Peak power						
902.704	-24.19	13.31	37.50	30.0	-7.50	Pass
High carrier - Peak power						
928.00	-17.46	13.73	31.19	30.0	-1.19	Pass

*- Margin = Attenuation below carrier – specification limit.

Reference numbers of test equipment used

HL 3230	HL 3440	HL 5376	HL 5636	HL 5933	HL 7546		
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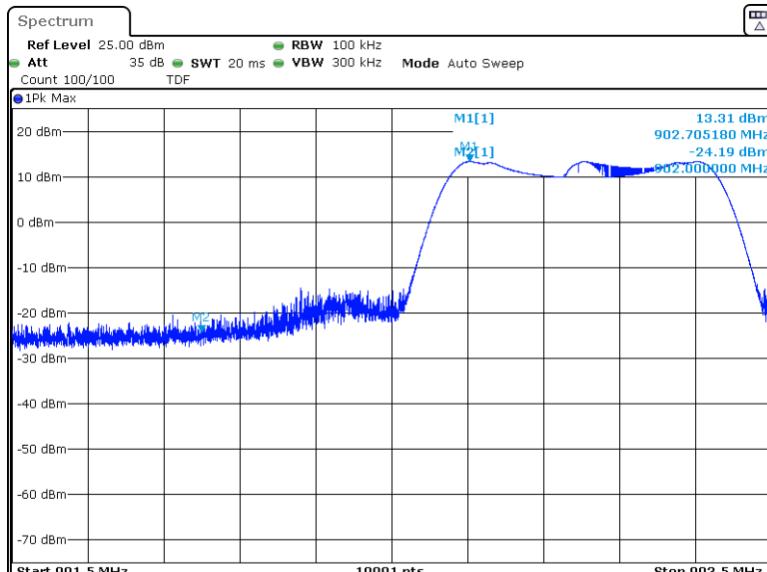
Full description is given in Appendix A.



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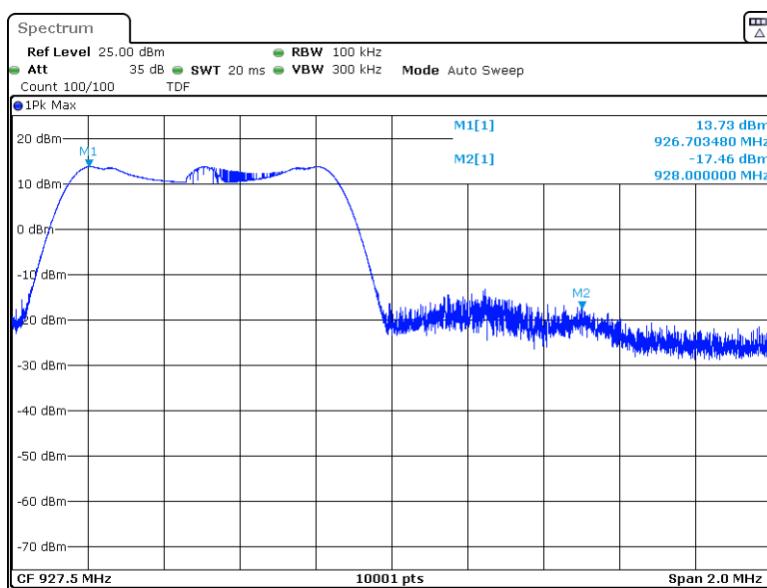
Test specification: Section 15.247(d) / RSS-247 section 5.5, Band edge emissions			
Test procedure:	ANSI C63.10 section 11.13.2		
Test mode:	Compliance		
Date(s):	09-Jan-25		
Temperature: 23 °C	Relative Humidity: 47 %	Air Pressure: 1014 hPa	Power: 3.6 VDC
Remarks:			

Plot 7.8.1 The highest band edge emission at low carrier frequency



Date: 27.APR.2025 14:42:31

Plot 7.8.2 The highest band edge emission at high carrier frequency



Date: 27.APR.2025 15:02:04



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Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure:	ANSI C63.10 section 11.12.1		
Test mode:	Compliance		
Date(s):	22-Dec-24 - 26-Dec-24		
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1006 hPa	Power: 3.6 VDC
Remarks:			

7.9 Field strength of spurious emissions at LoRa modulation

7.9.1 General

This test was performed to measure field strength of spurious emissions from the EUT. Specification test limits are given in Table 7.9.1.

Table 7.9.1 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**	30.0	
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**			
1.705 – 30.0*		69.5			
30 – 88	NA	40.0	NA		
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:

$$L_{mS2} = L_{mS1} + 40 \log \left(\frac{S_1}{S_2} \right)$$

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.

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

7.9.2.1 The EUT was set up as shown in Figure 7.9.1, energized and the performance check was conducted.

7.9.2.2 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.

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

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

7.9.3.1 The EUT was set up as shown in Figure 7.9.2, Figure 7.9.3, energized and the performance check was conducted.

7.9.3.2 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.

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



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Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 22-Dec-24 - 26-Dec-24			
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1006 hPa	Power: 3.6 VDC
Remarks:			

Figure 7.9.1 Setup for spurious emission field strength measurements below 30 MHz

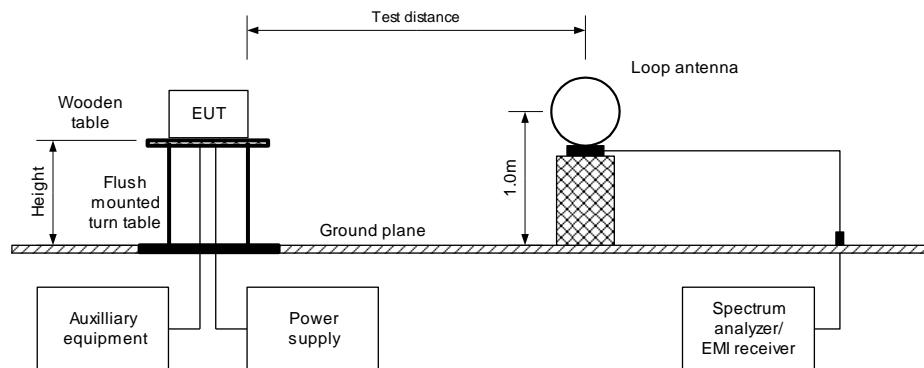
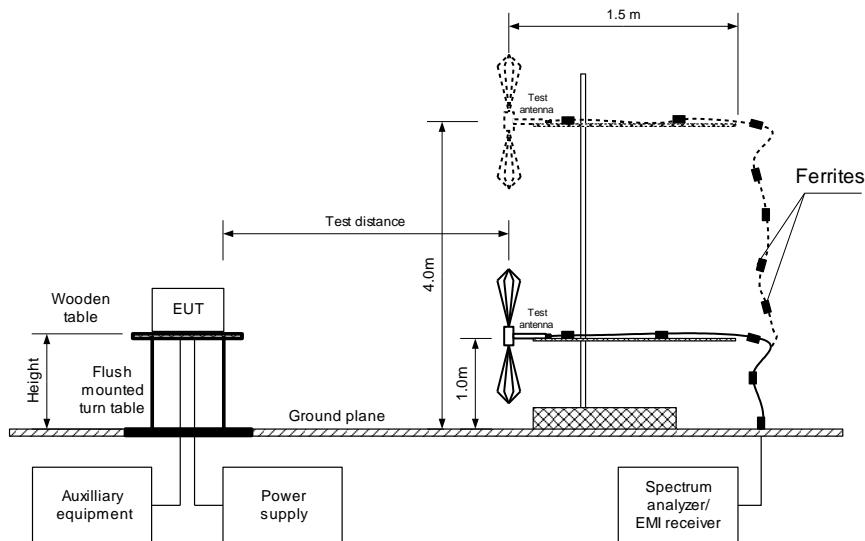


Figure 7.9.2 Setup for spurious emission field strength measurements in 30 -1000 MHz

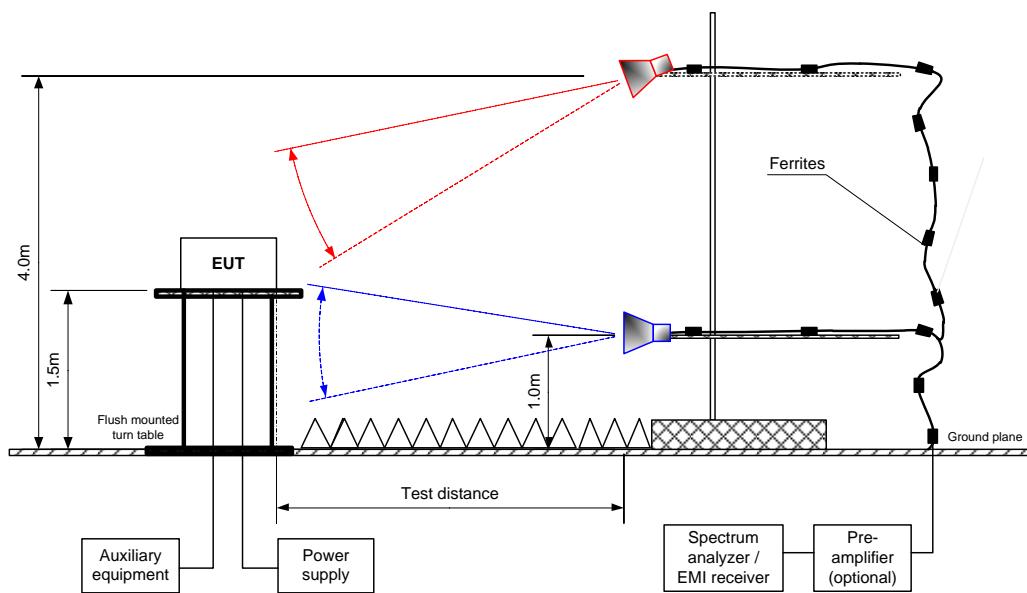




HERMON LABORATORIES

Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 22-Dec-24 - 26-Dec-24			
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1006 hPa	Power: 3.6 VDC
Remarks:			

Figure 7.9.3 Setup for spurious emission field strength measurements above 1000 MHz





Test specification:	Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions		
Test procedure:	ANSI C63.10 section 11.12.1		
Test mode:	Compliance	Verdict:	PASS
Date(s):	22-Dec-24 - 26-Dec-24		
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1006 hPa	Power: 3.6 VDC
Remarks:			

Table 7.9.2 Field strength of emissions outside restricted bands

ASSIGNED FREQUENCY:	902 - 928 MHz
INVESTIGATED FREQUENCY RANGE:	0.009 - 9500 MHz
TEST DISTANCE:	3 m
MODULATION:	LoRa (500 kHz)
BIT RATE:	1.5 kbps
TRANSMITTER OUTPUT POWER:	19.21 dBm at low carrier frequency 19.05 dBm at mid carrier frequency 18.73 dBm at high carrier frequency
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)

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

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



HERMON LABORATORIES

Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure:	ANSI C63.10 section 11.12.1		
Test mode:	Compliance		
Date(s):	22-Dec-24 - 26-Dec-24		
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1006 hPa	Power: 3.6 VDC
Remarks:			

Table 7.9.3 Field strength of spurious emissions above 1 GHz within restricted bands

ASSIGNED FREQUENCY: 902 - 928 MHz
 INVESTIGATED FREQUENCY RANGE: 1000 - 9500 MHz
 TEST DISTANCE: 3 m
 MODULATION: LoRa (500 kHz)
 BIT RATE: 1.5 kbps
 TRANSMITTER OUTPUT POWER: 19.21 dBm at low carrier frequency
 19.05 dBm at mid carrier frequency
 18.73 dBm at high carrier frequency
 DETECTOR USED: Peak
 RESOLUTION BANDWIDTH: 1000 kHz
 TEST ANTENNA TYPE: Double ridged guide

Frequency, MHz	Antenna Polarization	Height, m	Azimuth, degrees*	Peak field strength			Average field strength			Verdict
				Measured, dB(µV/m)	Limit, dB(µV/m)	Margin, dB**	Measured, dB(µV/m)	Calculated, dB(µV/m)	Limit, dB(µV/m)	
Low carrier frequency										
2709	V	1.0	10	48.62	74	-25.38	48.62	NA	54	-5.38
3612	V	2.1	10	55.38	74	-18.62	49.67***	NA	54	-5.32
4515	V	1.0	5	50.83	74	-23.17	50.83	NA	54	-3.17
5418	V	1.0	-30	51.93	74	-22.07	51.93	NA	54	-2.07
Mid carrier frequency										
2745	V	1.0	0	49.21	74	-24.79	49.21	NA	54	-4.79
3660	V	1.6	10	56.55	74	-17.45	50.44***	NA	54	-4.55
4575	V	1.1	15	51.19	74	-22.81	51.19	NA	54	-2.81
High carrier frequency										
2781	V	1.0	10	53.92	74	-20.08	53.92	NA	54	-0.08
3708	V	1.6	10	56.68	74	-17.32	52.04***	NA	54	-2.95
4634	V	1.0	10	50.52	74	-23.48	50.52	NA	54	-3.48

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

**- Margin = Measured field strength - specification limit.

***- Average field strength = SA reading + DC factor, where

$$\text{DC Factor} = 10^{\log_{10}(1/(T_{xon} + T_{xon+Txoff}))} = 2.559 \text{ dB}$$

Table 7.9.4 Average factor calculation

Transmission pulse		Transmission burst		Transmission train duration, ms	Average factor, dB
Duration, ms	Period, ms	Duration, ms	Period, ms		
NA	NA	NA	NA	NA	NA

*- Average factor was calculated as follows

for pulse train shorter than 100 ms:

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

for pulse train longer than 100 ms:

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



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Report ID: TELRAD_FCC.55429_DTS_LoRa_2GFSK.docx

Date of Issue: 8-May-25

Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 22-Dec-24 - 26-Dec-24			
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1006 hPa	Power: 3.6 VDC
Remarks:			

Table 7.9.5 Field strength of spurious emissions below 1 GHz within restricted bands

ASSIGNED FREQUENCY:	902 - 928 MHz
INVESTIGATED FREQUENCY RANGE:	0.009 – 1000 MHz
TEST DISTANCE:	3 m
MODULATION:	LoRa (500 kHz)
BIT RATE:	1.5 kbps
TRANSMITTER OUTPUT POWER:	19.21 dBm at low carrier frequency 19.05 dBm at mid carrier frequency 18.73 dBm at high carrier frequency
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			
Low carrier frequency											
No emissions were found							Pass				
Mid carrier frequency											
No emissions were found							Pass				
High carrier frequency											
No emissions were found							Pass				

*- Margin = Measured emission - specification limit.

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



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Report ID: TELRAD_FCC.55429_DTS_LoRa_2GFSK.docx

Date of Issue: 8-May-25

Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions					
Test procedure: ANSI C63.10 section 11.12.1					
Test mode: Compliance				Verdict:	PASS
Date(s): 22-Dec-24 - 26-Dec-24					
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1006 hPa		Power: 3.6 VDC	
Remarks:					

Table 7.9.6 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	
8.362 - 8.366	37.5 - 38.25	322 - 335.4	2483.5 - 2500	9300 - 9500	Above 38.6

Table 7.9.7 Restricted bands according to RSS-Gen

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

Reference numbers of test equipment used

HL 1915	HL 3903	HL 4114	HL 5288	HL 5902	HL 7585	HL 0446	
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Full description is given in Appendix A.

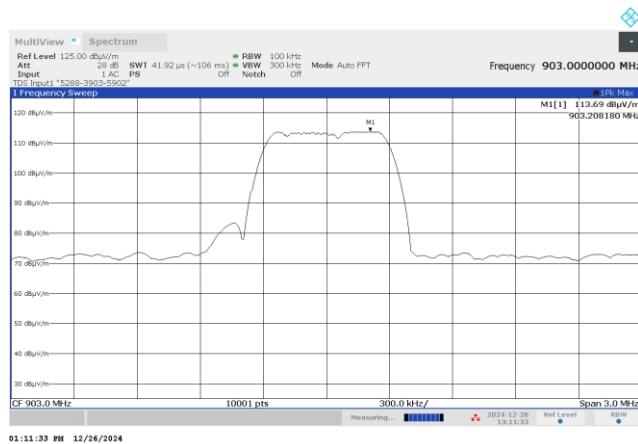


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Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure:	ANSI C63.10 section 11.12.1		
Test mode:	Compliance		
Date(s):	22-Dec-24 - 26-Dec-24		
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1006 hPa	Power: 3.6 VDC
Remarks:			

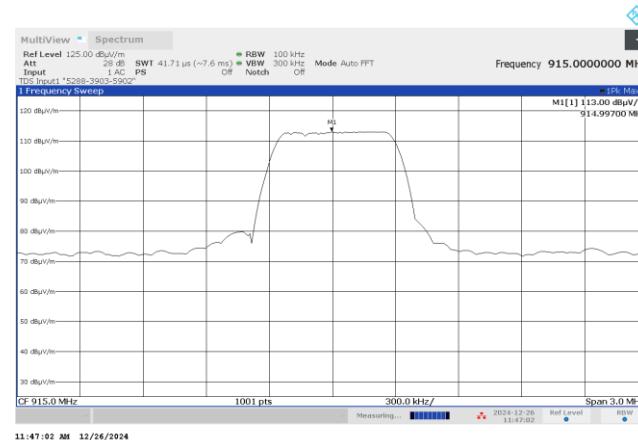
Plot 7.9.1 Radiated emission measurements at the low carrier frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m



Plot 7.9.2 Radiated emission measurements at the mid carrier frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m



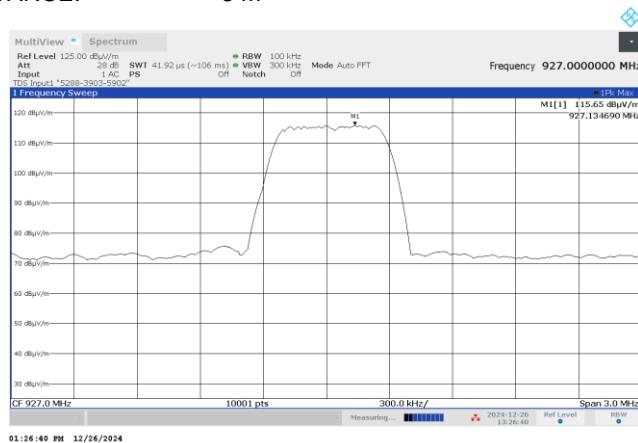


HERMON LABORATORIES

Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure:	ANSI C63.10 section 11.12.1		
Test mode:	Compliance		
Date(s):	22-Dec-24 - 26-Dec-24		
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1006 hPa	Power: 3.6 VDC
Remarks:			

Plot 7.9.3 Radiated emission measurements at the high carrier frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m



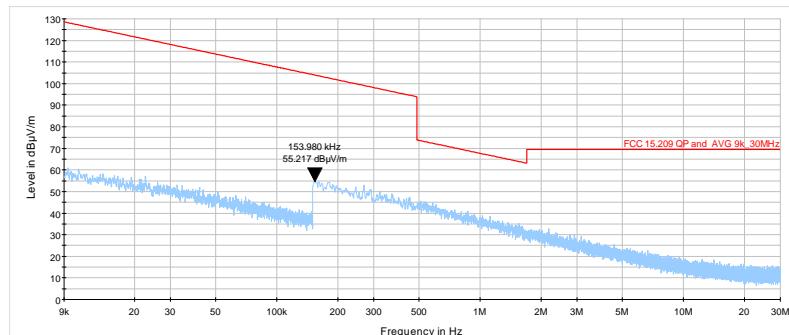


HERMON LABORATORIES

Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance			Verdict: PASS
Date(s): 22-Dec-24 - 26-Dec-24			
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1006 hPa	Power: 3.6 VDC
Remarks:			

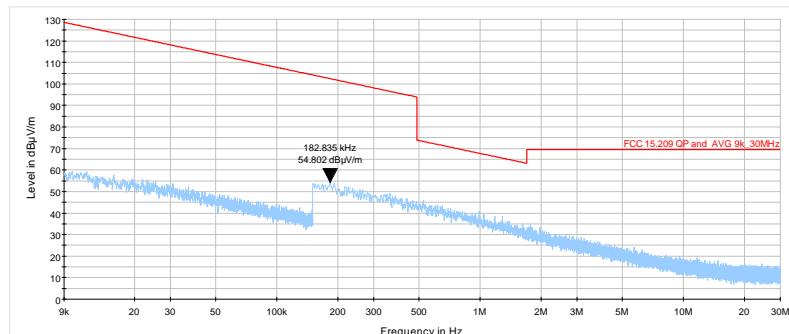
Plot 7.9.4 Radiated emission measurements from 9 kHz to 30 MHz at the low carrier frequency

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



Plot 7.9.5 Radiated emission measurements from 9 kHz to 30 MHz at the mid carrier frequency

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



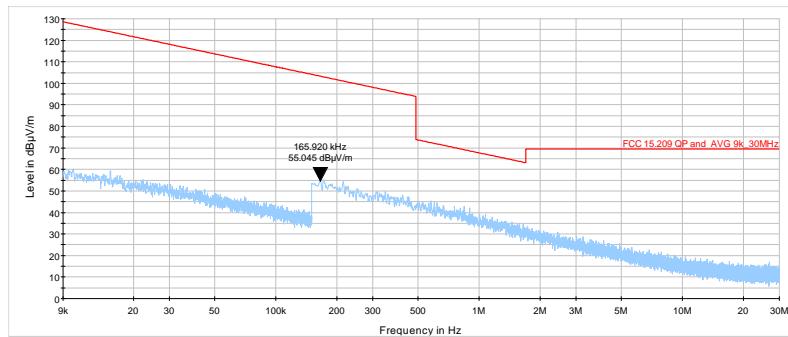


HERMON LABORATORIES

Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure:	ANSI C63.10 section 11.12.1		
Test mode:	Compliance		
Date(s):	22-Dec-24 - 26-Dec-24		
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1006 hPa	Power: 3.6 VDC
Remarks:			

Plot 7.9.6 Radiated emission measurements from 9 kHz to 30 MHz at the high carrier frequency

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



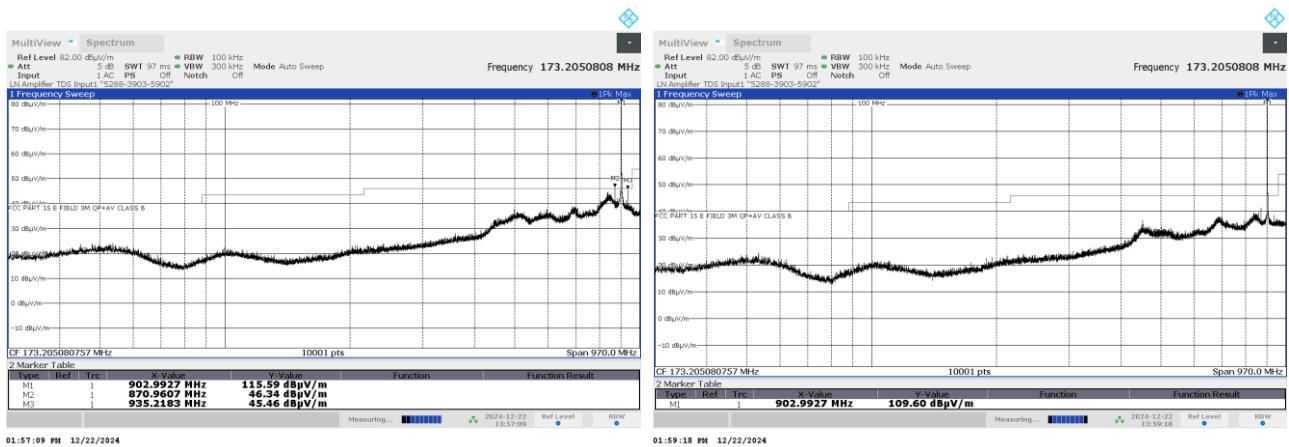


HERMON LABORATORIES

Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure:	ANSI C63.10 section 11.12.1		
Test mode:	Compliance		
Date(s):	22-Dec-24 - 26-Dec-24		
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1006 hPa	Power: 3.6 VDC
Remarks:			

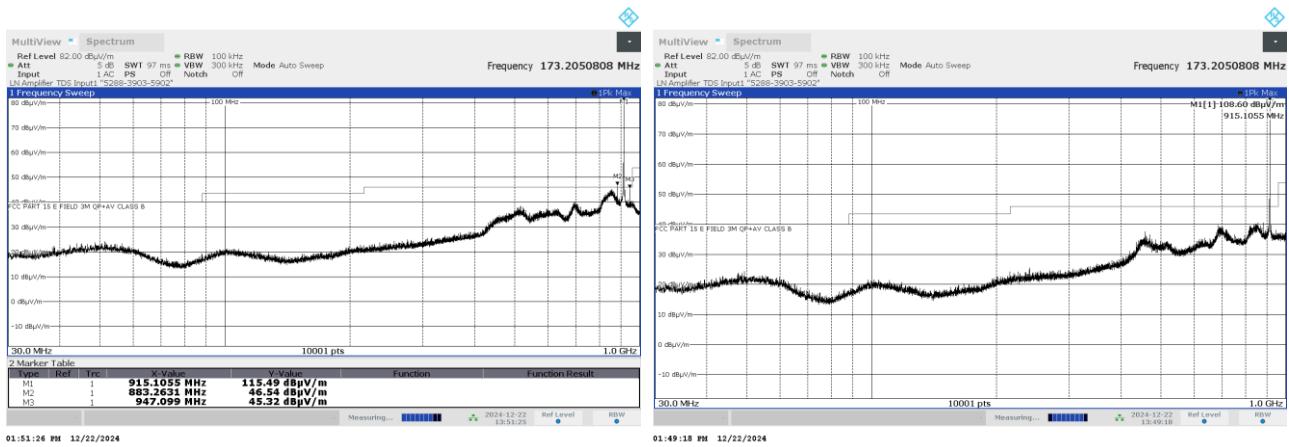
Plot 7.9.7 Radiated emission measurements from 30 to 1000 MHz at the low carrier frequency

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



Plot 7.9.8 Radiated emission measurements from 30 to 1000 MHz at the mid carrier frequency

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



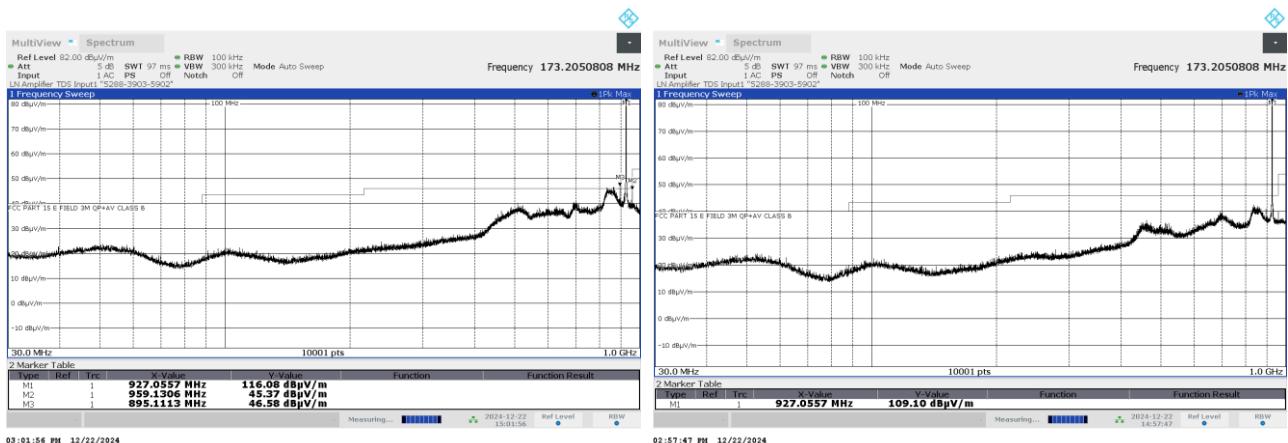


HERMON LABORATORIES

Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure:	ANSI C63.10 section 11.12.1		
Test mode:	Compliance		
Date(s):	22-Dec-24 - 26-Dec-24		
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1006 hPa	Power: 3.6 VDC
Remarks:			

Plot 7.9.9 Radiated emission measurements from 30 to 1000 MHz at the high carrier frequency

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



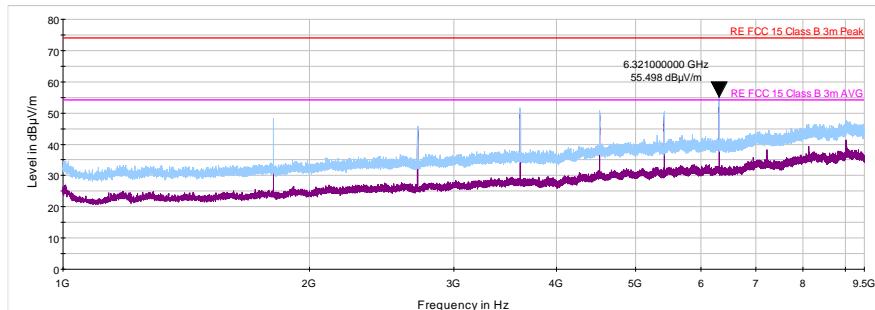


HERMON LABORATORIES

Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance			Verdict: PASS
Date(s): 22-Dec-24 - 26-Dec-24			
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1006 hPa	Power: 3.6 VDC
Remarks:			

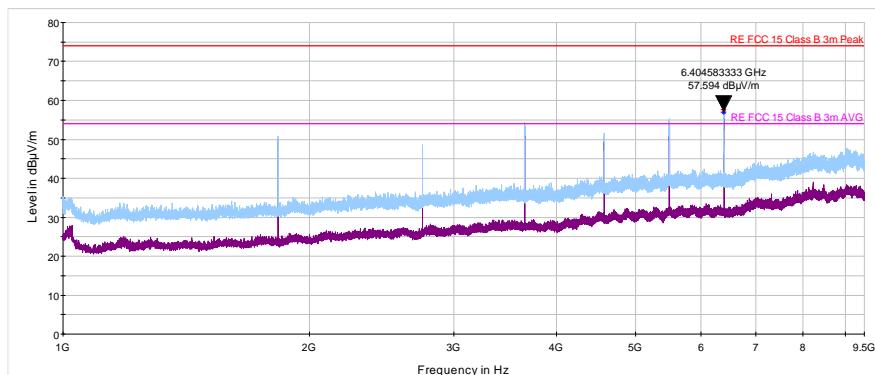
Plot 7.9.10 Radiated emission measurements from 1000 to 9500 MHz at the low carrier frequency

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



Plot 7.9.11 Radiated emission measurements from 1000 to 9500 MHz at the mid carrier frequency

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



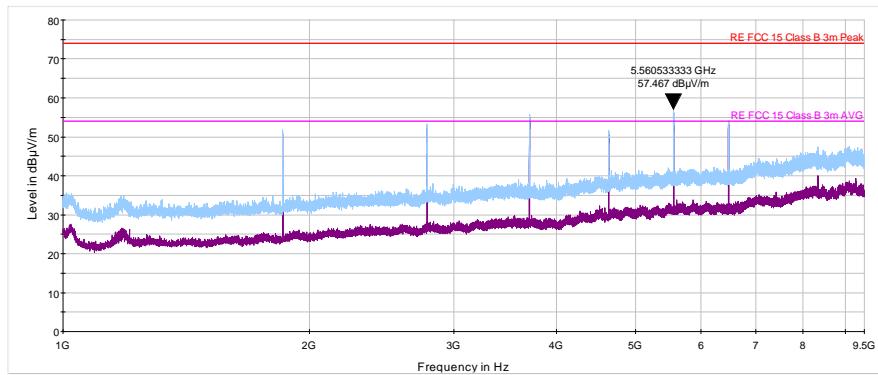


HERMON LABORATORIES

Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure:	ANSI C63.10 section 11.12.1		
Test mode:	Compliance		
Date(s):	22-Dec-24 - 26-Dec-24		
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1006 hPa	Power: 3.6 VDC
Remarks:			

Plot 7.9.12 Radiated emission measurements from 1000 to 9500 MHz at the high carrier frequency

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





HERMON LABORATORIES

Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure:	ANSI C63.10 section 11.12.1		
Test mode:	Compliance		
Date(s):	22-Dec-24 - 26-Dec-24		
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1006 hPa	Power: 3.6 VDC
Remarks:			

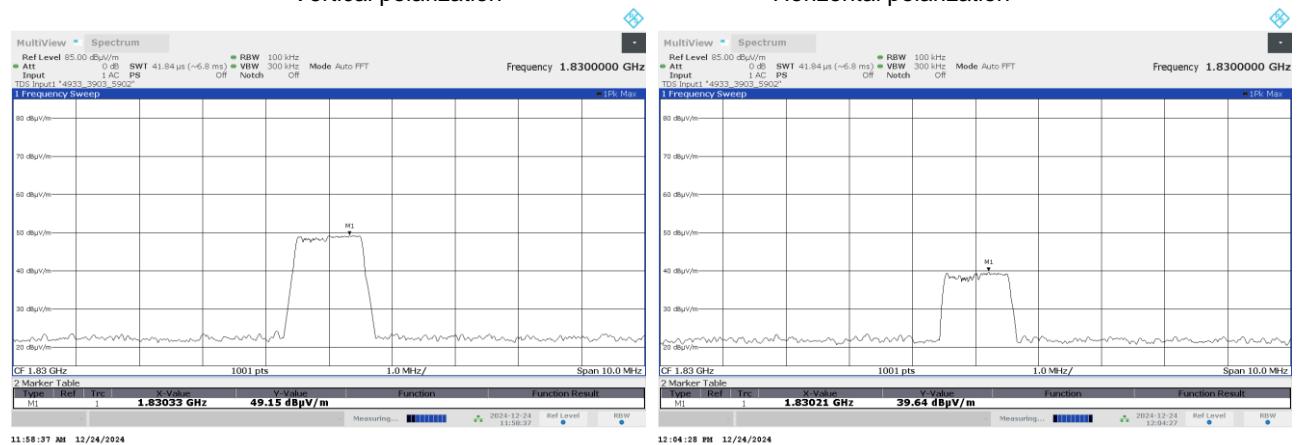
Plot 7.9.13 Radiated emission measurements at the second harmonic of mid carrier frequency

TEST SITE:
TEST DISTANCE:

Vertical polarization

Semi anechoic chamber
3 m

Horizontal polarization



11:58:37 AM 12/24/2024

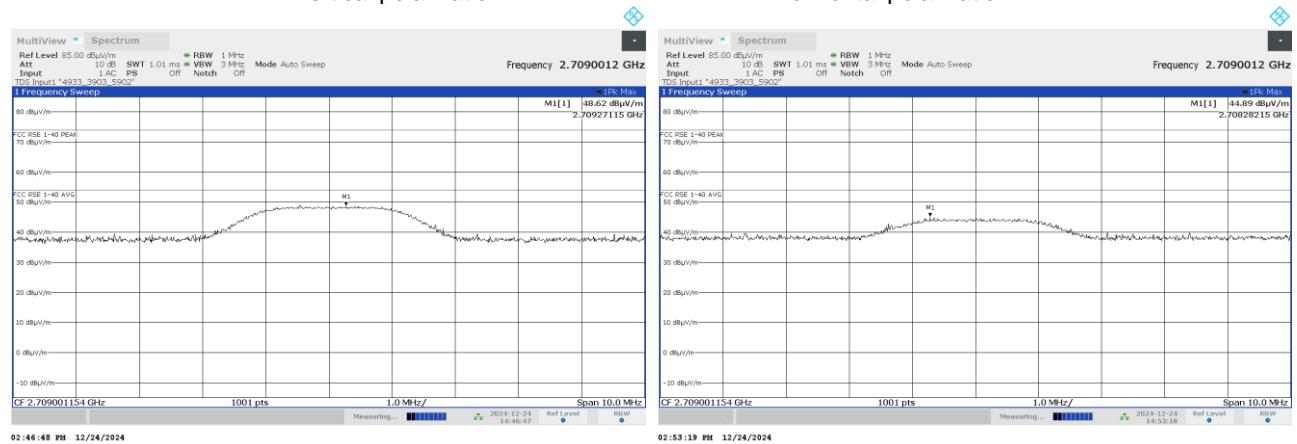
12:04:28 PM 12/24/2024

Plot 7.9.14 Radiated emission measurements at the third harmonic of low carrier frequency

TEST SITE:
TEST DISTANCE:Semi anechoic chamber
3 m

Vertical polarization

Horizontal polarization



02:46:48 PM 12/24/2024

02:53:19 PM 12/24/2024



HERMON LABORATORIES

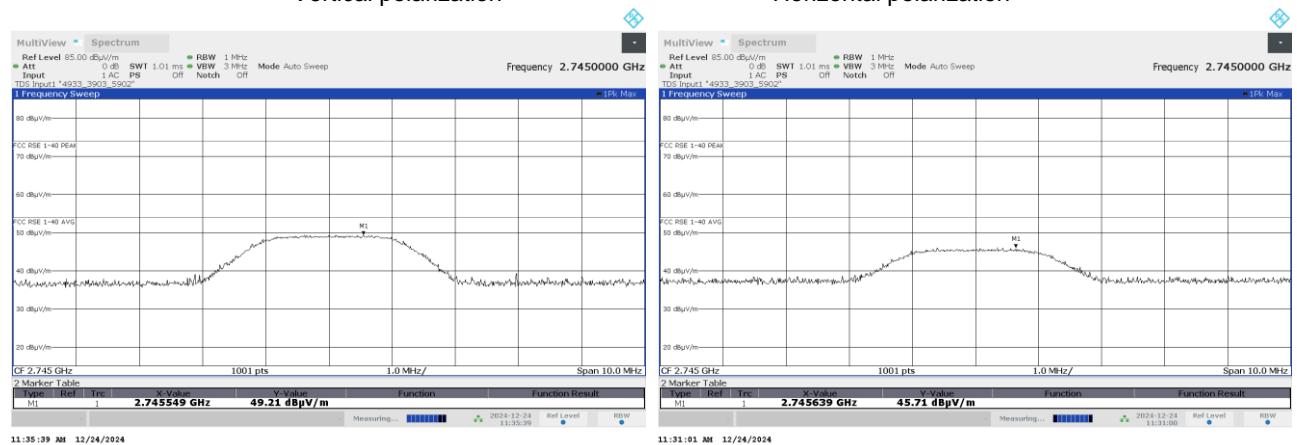
Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure:	ANSI C63.10 section 11.12.1		
Test mode:	Compliance		
Date(s):	22-Dec-24 - 26-Dec-24		
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1006 hPa	Power: 3.6 VDC
Remarks:			

Plot 7.9.15 Radiated emission measurements at the third harmonic of mid carrier frequency

TEST SITE:
TEST DISTANCE:Semi anechoic chamber
3 m

Vertical polarization

Horizontal polarization



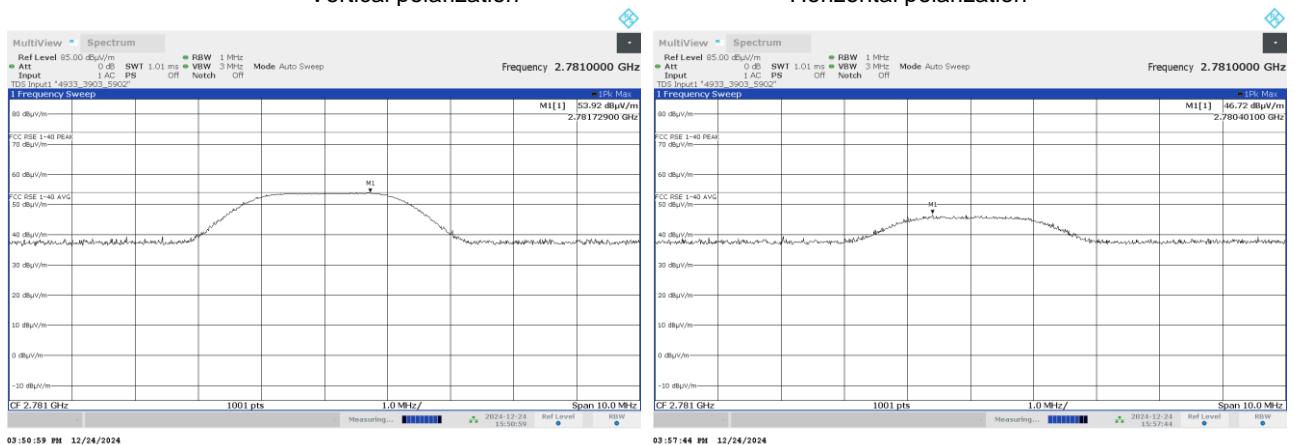
11:35:39 AM 12/24/2024

Plot 7.9.16 Radiated emission measurements at the third harmonic of high carrier frequency

TEST SITE:
TEST DISTANCE:Semi anechoic chamber
3 m

Vertical polarization

Horizontal polarization



03:50:59 PM 12/24/2024

03:57:44 PM 12/24/2024



HERMON LABORATORIES

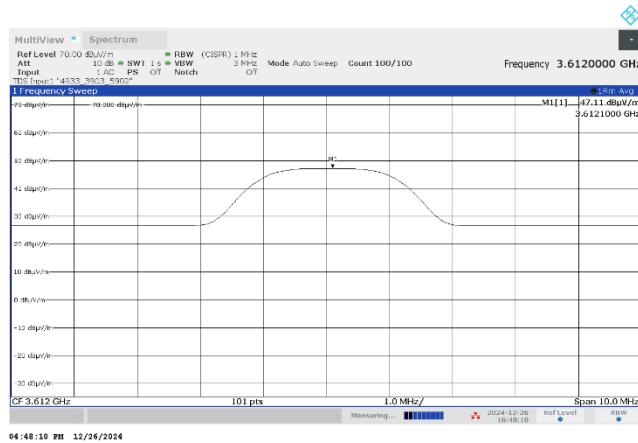
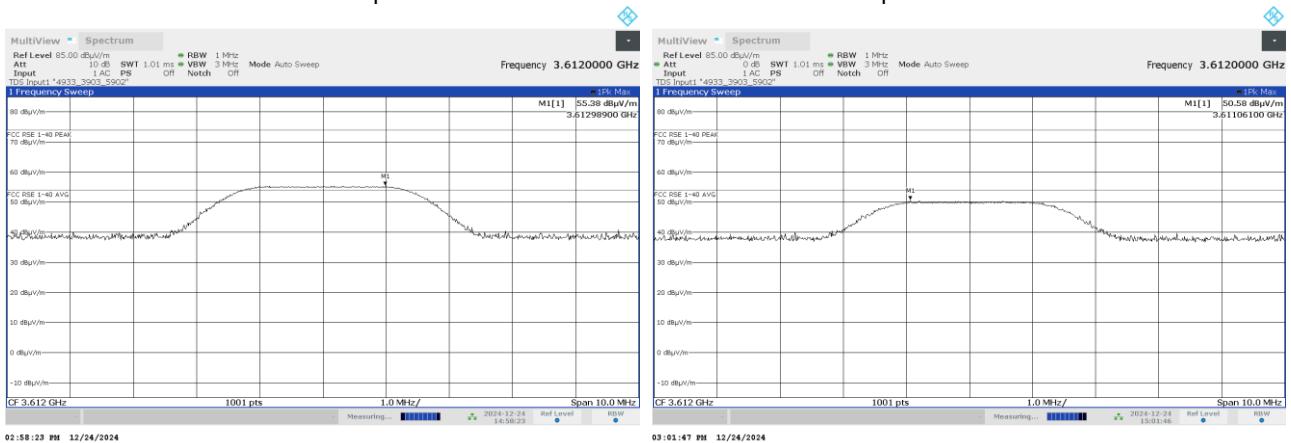
Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure:	ANSI C63.10 section 11.12.1		
Test mode:	Compliance		
Date(s):	22-Dec-24 - 26-Dec-24		
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1006 hPa	Power: 3.6 VDC
Remarks:			

Plot 7.9.17 Radiated emission measurements at the fourth harmonic of low carrier frequency

TEST SITE:
TEST DISTANCE:Semi anechoic chamber
3 m

Vertical polarization

Horizontal polarization





HERMON LABORATORIES

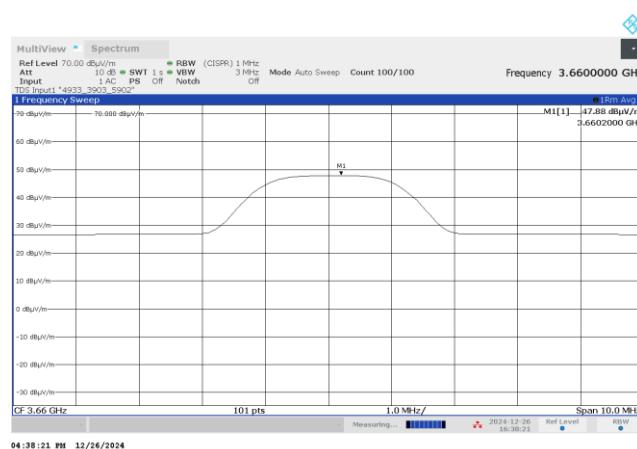
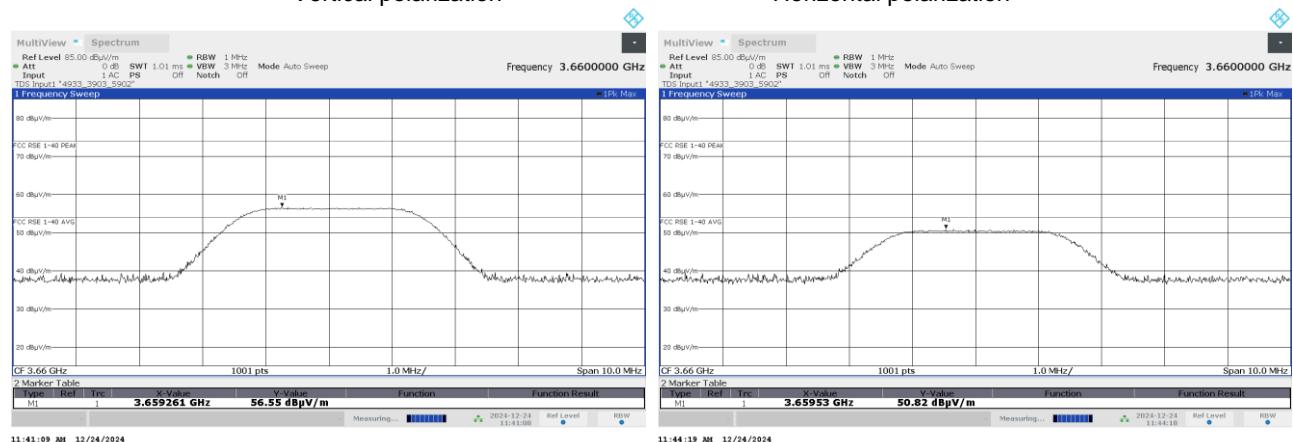
Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure:	ANSI C63.10 section 11.12.1		
Test mode:	Compliance		
Date(s):	22-Dec-24 - 26-Dec-24		
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1006 hPa	Power: 3.6 VDC
Remarks:			

Plot 7.9.18 Radiated emission measurements at the fourth harmonic of mid carrier frequency

TEST SITE:
TEST DISTANCE:Semi anechoic chamber
3 m

Vertical polarization

Horizontal polarization





HERMON LABORATORIES

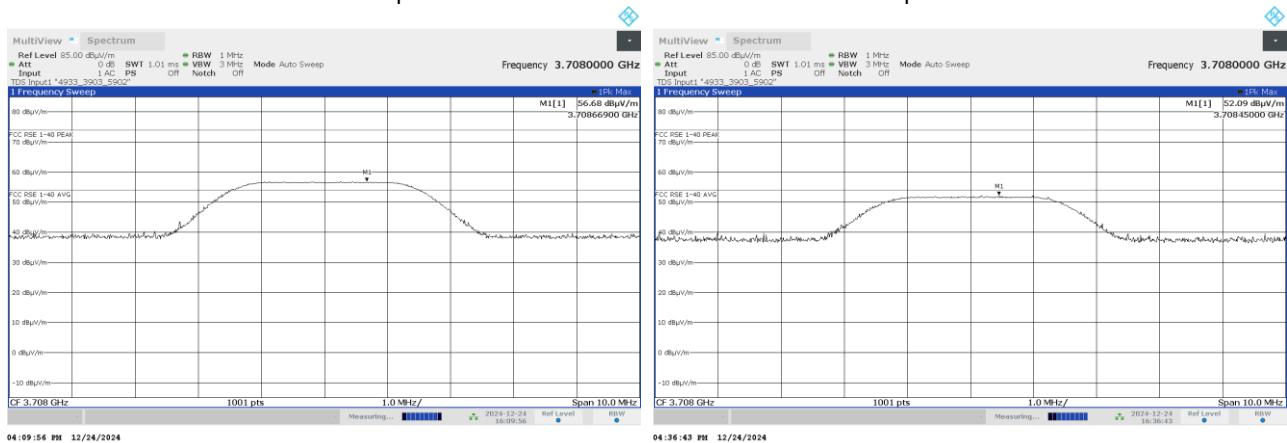
Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure:	ANSI C63.10 section 11.12.1		
Test mode:	Compliance		
Date(s):	22-Dec-24 - 26-Dec-24		
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1006 hPa	Power: 3.6 VDC
Remarks:			

Plot 7.9.19 Radiated emission measurements at the fourth harmonic of high carrier frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m

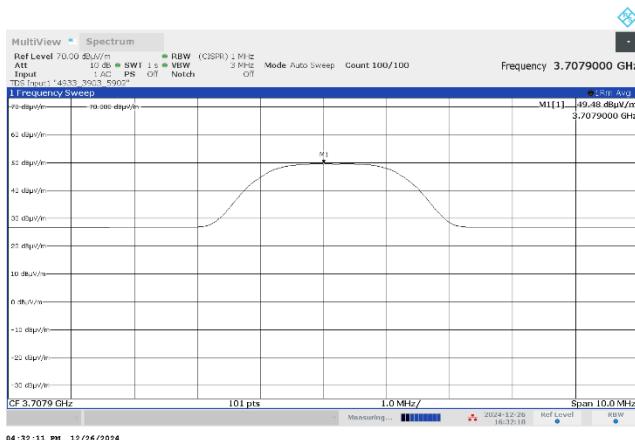
Vertical polarization

Horizontal polarization



04:09:56 PM 12/24/2024

04:36:43 PM 12/24/2024



04:32:11 PM 12/26/2024



HERMON LABORATORIES

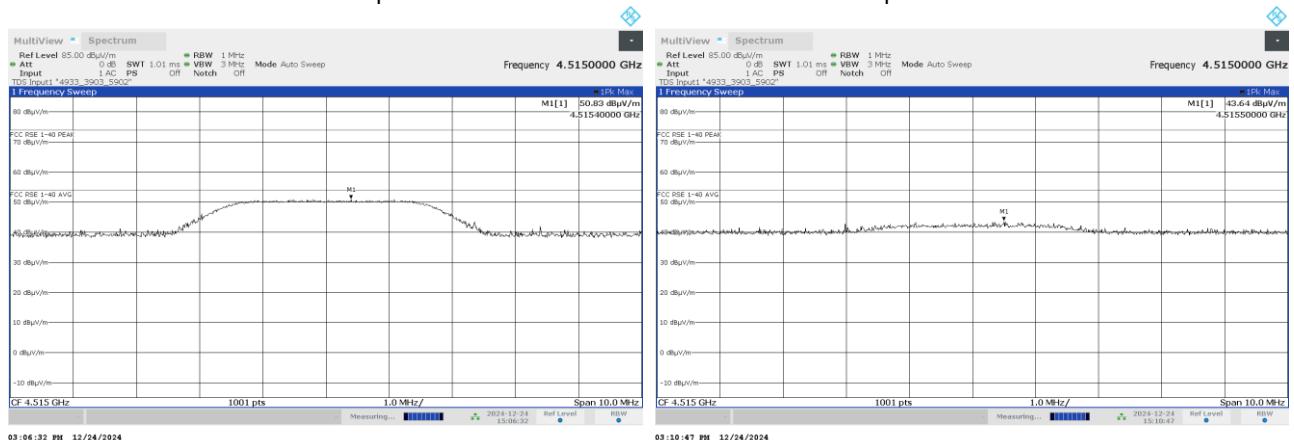
Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure:	ANSI C63.10 section 11.12.1		
Test mode:	Compliance		
Date(s):	22-Dec-24 - 26-Dec-24		
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1006 hPa	Power: 3.6 VDC
Remarks:			

Plot 7.9.20 Radiated emission measurements at the fifth harmonic of low carrier frequency

TEST SITE:
TEST DISTANCE:Semi anechoic chamber
3 m

Vertical polarization

Horizontal polarization

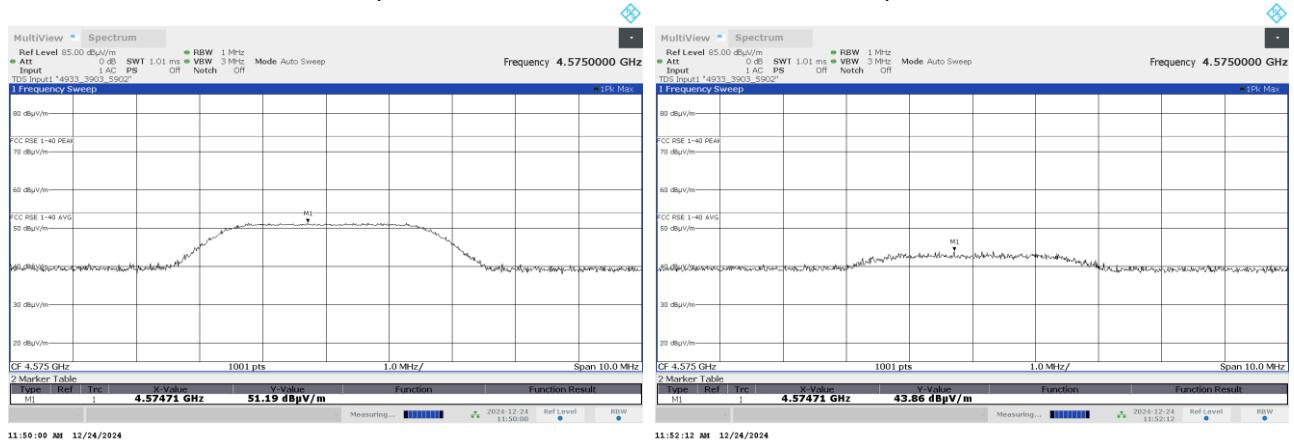


Plot 7.9.21 Radiated emission measurements at the fifth harmonic of mid carrier frequency

TEST SITE:
TEST DISTANCE:Semi anechoic chamber
3 m

Vertical polarization

Horizontal polarization





HERMON LABORATORIES

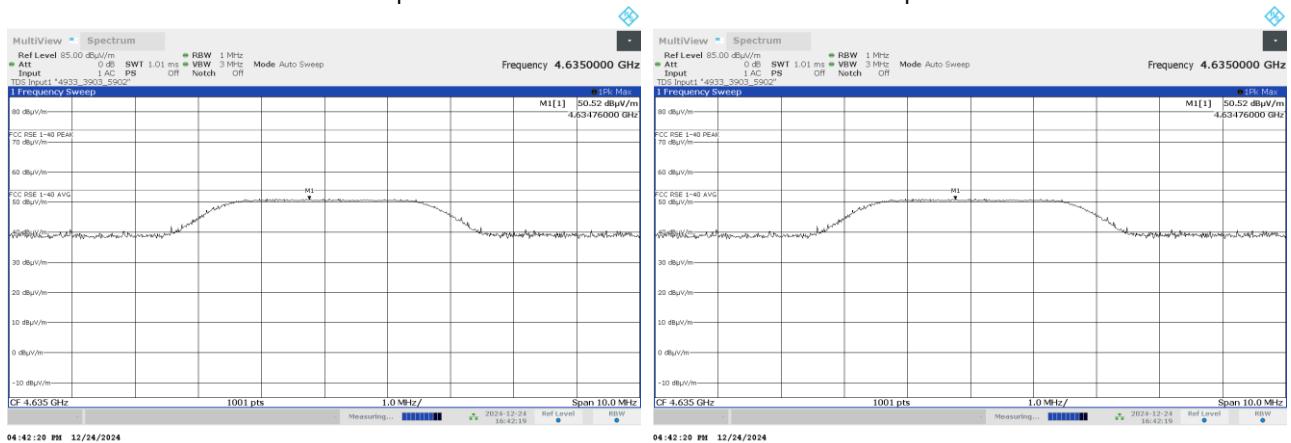
Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure:	ANSI C63.10 section 11.12.1		
Test mode:	Compliance		
Date(s):	22-Dec-24 - 26-Dec-24		
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1006 hPa	Power: 3.6 VDC
Remarks:			

Plot 7.9.22 Radiated emission measurements at the fifth harmonic of high carrier frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m

Vertical polarization

Horizontal polarization

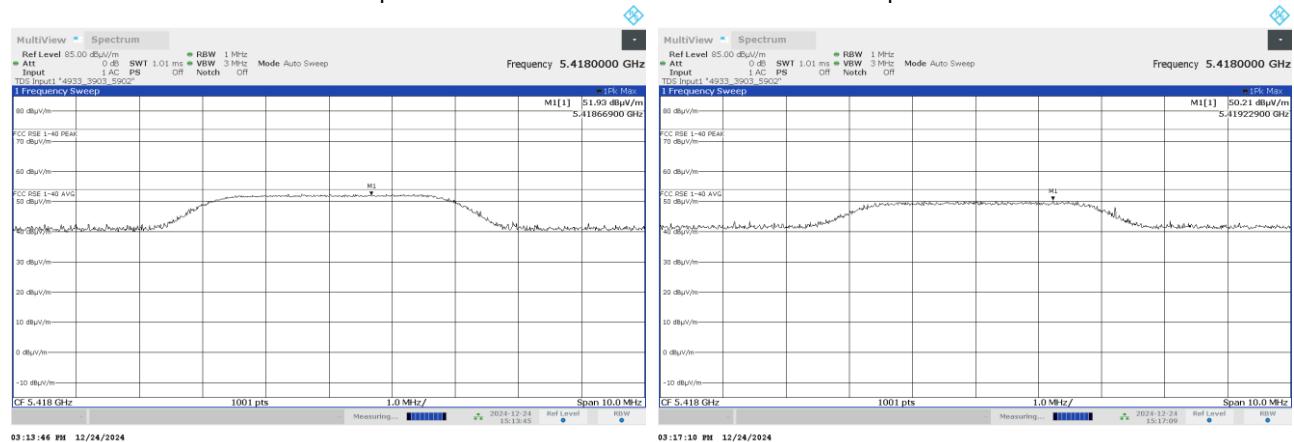


Plot 7.9.23 Radiated emission measurements at the sixth harmonic of low carrier frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m

Vertical polarization

Horizontal polarization





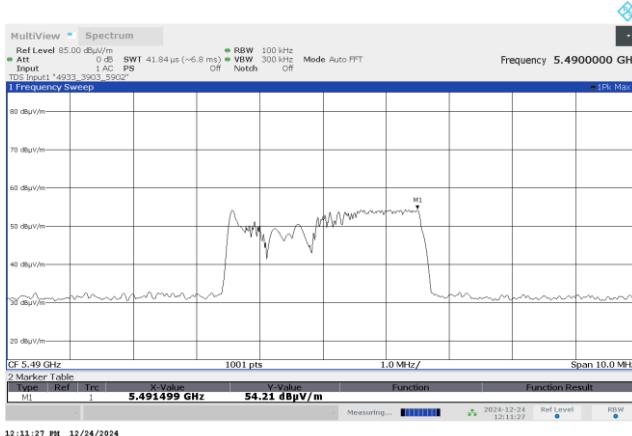
HERMON LABORATORIES

Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure:	ANSI C63.10 section 11.12.1		
Test mode:	Compliance		
Date(s):	22-Dec-24 - 26-Dec-24		
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1006 hPa	Power: 3.6 VDC
Remarks:			

Plot 7.9.24 Radiated emission measurements at the sixth harmonic of mid carrier frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m

Vertical polarization



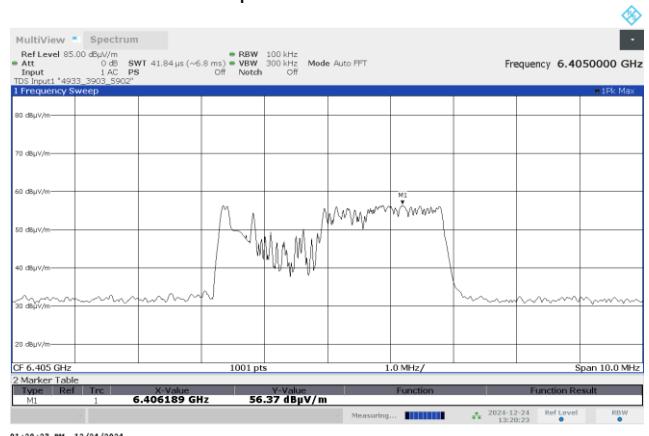
Horizontal polarization



Plot 7.9.25 Radiated emission measurements at the seventh harmonic of mid carrier frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
Vertical polarization

Horizontal polarization





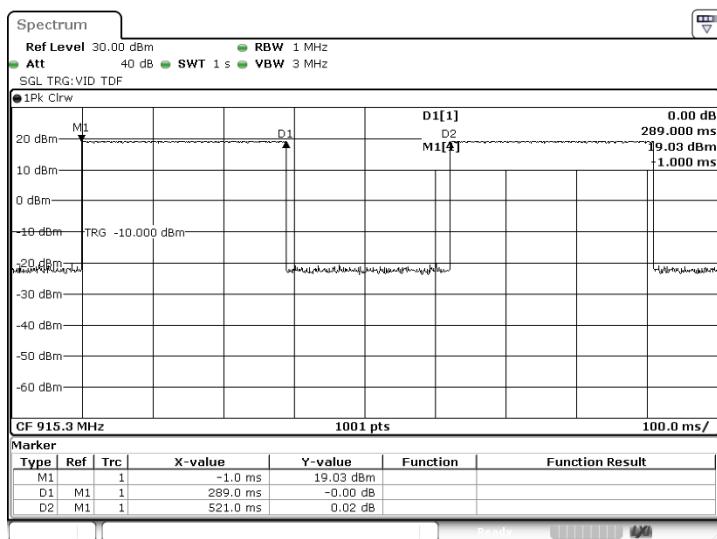
HERMON LABORATORIES

Report ID: TELRAD_FCC.55429_DTS_LoRa_2GFSK.docx

Date of Issue: 8-May-25

Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure:	ANSI C63.10 section 11.12.1		
Test mode:	Compliance		
Date(s):	22-Dec-24 - 26-Dec-24		
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1006 hPa	Power: 3.6 VDC
Remarks:			

Plot 7.9.26 Transmission pulse duration and period





HERMON LABORATORIES

Report ID: TELRAD_FCC.55429_DTS_LoRa_2GFSK.docx

Date of Issue: 8-May-25

Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance			Verdict: PASS
Date(s): 02-Feb-25 - 24-Feb-25			
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1019 hPa	Power: 3.6 VDC
Remarks:			

7.10 Field strength of spurious emissions at 2GFSK modulation

7.10.1 General

This test was performed to measure field strength of spurious emissions from the EUT. Specification test limits are given in Table 7.10.1.

Table 7.10.1 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**	30.0
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**		
1.705 – 30.0*		69.5		
30 – 88	NA	40.0	NA	
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:

$$L_{mS2} = L_{mS1} + 40 \log \left(\frac{S_1}{S_2} \right)$$

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.

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

7.10.2.1 The EUT was set up as shown in Figure 7.10.1, energized and the performance check was conducted.

7.10.2.2 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.

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

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

7.10.3.1 The EUT was set up as shown in Figure 7.10.2, Figure 7.10.3, energized and the performance check was conducted.

7.10.3.2 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.

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



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Report ID: TELRAD_FCC.55429_DTS_LoRa_2GFSK.docx

Date of Issue: 8-May-25

Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure:	ANSI C63.10 section 11.12.1		
Test mode:	Compliance		
Date(s):	02-Feb-25 - 24-Feb-25		
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1019 hPa	Power: 3.6 VDC
Remarks:			

Figure 7.10.1 Setup for spurious emission field strength measurements below 30 MHz

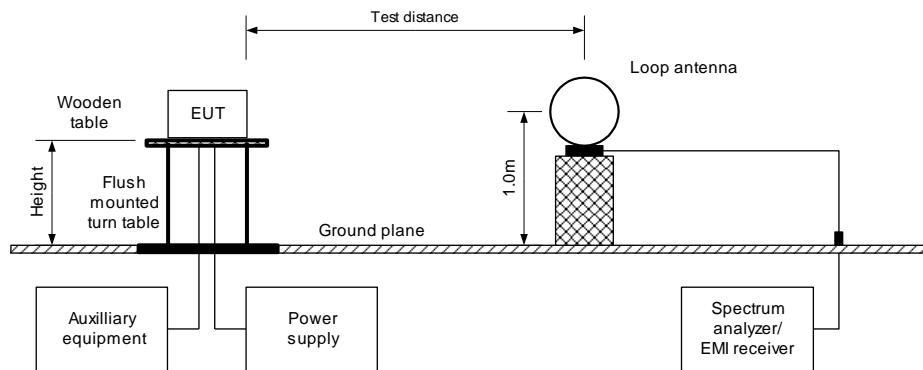
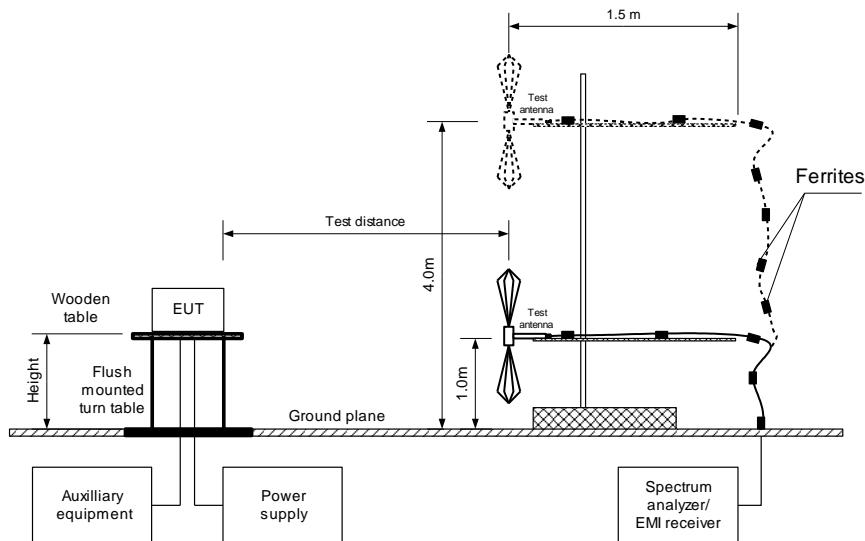


Figure 7.10.2 Setup for spurious emission field strength measurements in 30 -1000 MHz





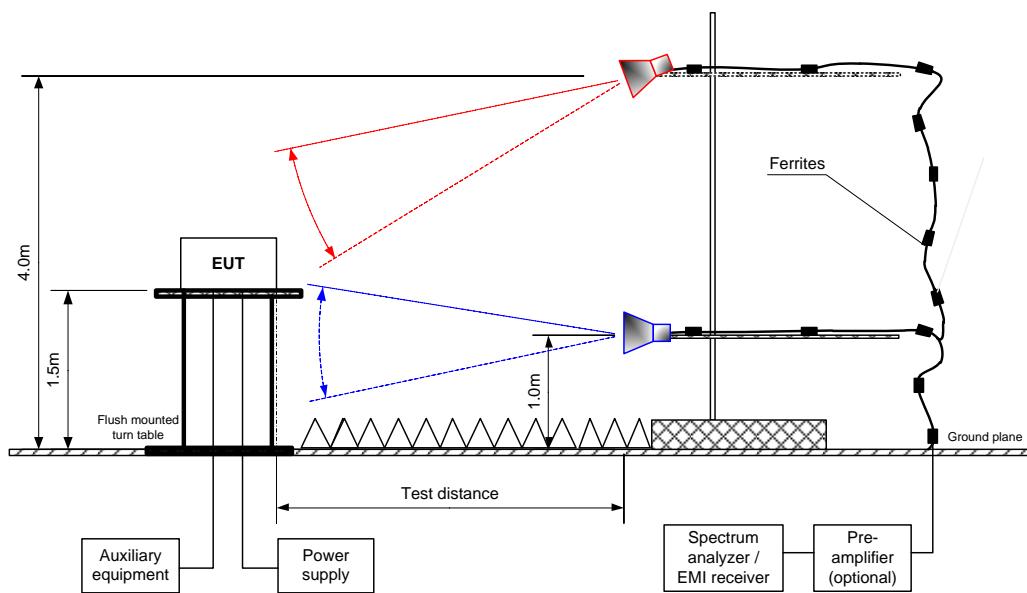
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Report ID: TELRAD_FCC.55429_DTS_LoRa_2GFSK.docx

Date of Issue: 8-May-25

Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 02-Feb-25 - 24-Feb-25			
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1019 hPa	Power: 3.6 VDC
Remarks:			

Figure 7.10.3 Setup for spurious emission field strength measurements above 1000 MHz





Test specification:	Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions		
Test procedure:	ANSI C63.10 section 11.12.1		
Test mode:	Compliance	Verdict:	PASS
Date(s):	02-Feb-25 - 24-Feb-25		
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1019 hPa	Power: 3.6 VDC
Remarks:			

Table 7.10.2 Field strength of emissions outside restricted bands

ASSIGNED FREQUENCY:	902 - 928 MHz
INVESTIGATED FREQUENCY RANGE:	0.009 – 9500 MHz
TEST DISTANCE:	3 m
MODULATION:	2GFSK
BIT RATE:	50 kbps
TRANSMITTER OUTPUT POWER:	12.71 dBm at low carrier frequency 13.27 dBm at mid carrier frequency 12.71 dBm at high carrier frequency
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)

Basic rugged grade (above 1000 m.s.l.)									
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									
813.492	44.55	Vertical	1.00	180	110.20	65.65	30.0	35.65	Pass
698.158	37.16	Vertical	1.00	50		73.04		43.04	
1806.420	39.33	Horizontal	1.00	60		70.87		40.87	
6318.820	46.71	Horizontal	1.00	110		63.49		33.49	
Mid carrier frequency									
467.672	35.00	Vertical	1.00	75	111.03	75.03	30.0	45.03	Pass
828.946	48.66	Vertical	1.00	120		61.37		31.37	
1830.000	46.02	Vertical	1.00	180		64.01		34.01	
5492.000	46.67	Vertical	1.00	90		63.36		33.36	
6402.900	52.84	Vertical	1.00	80		57.19		27.19	
High carrier frequency									
469.747	37.62	Vertical	1.00	130	110.52	72.90	30.0	42.90	Pass
838.888	49.39	Vertical	1.00	180		61.13		31.13	
1854.420	44.53	Vertical	1.00	90		65.99		35.99	
5560.230	48.10	Vertical	1.00	60		62.42		32.42	
6487.110	42.77	Vertical	1.00	60		67.75		37.75	

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

**- Margin = Attenuation below carrier – specification limit



Test specification:	Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions		
Test procedure:	ANSI C63.10 section 11.12.1		
Test mode:	Compliance	Verdict:	PASS
Date(s):	02-Feb-25 - 24-Feb-25		
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1019 hPa	Power: 3.6 VDC
Remarks:			

Table 7.10.3 Field strength of spurious emissions above 1 GHz within restricted bands

ASSIGNED FREQUENCY:	902 - 928 MHz
INVESTIGATED FREQUENCY RANGE:	1000 - 9500 MHz
TEST DISTANCE:	3 m
MODULATION:	2-GFSK
BIT RATE:	50 kbps
TRANSMITTER OUTPUT POWER:	12.71 dBm at low carrier frequency 13.27 dBm at mid carrier frequency 12.71 dBm at high carrier frequency
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										No emissions were found	Pass	
Mid carrier frequency										No emissions were found	Pass	
2745.000	Vertical	1.00	-175	44.07	74.00	-29.93	44.07	NA	54.00	-9.93	Pass	
3660.093	Vertical	1.00	-5	46.11	74.00	-27.89	46.11	NA	54.00	-7.89		
4573.541	Vertical	1.00	0	46.22	74.00	-27.78	46.22	NA	54.00	-7.78		
High carrier frequency										No emissions were found	Pass	

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

**- Margin = Measured field strength - specification limit.

Table 7.10.4 Average factor calculation

Transmission pulse		Transmission burst		Transmission train duration, ms	Average factor, dB
Duration, ms	Period, ms	Duration, ms	Period, ms		
27.6	387.0	N/A	N/A	N/A	-11.181

*- 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:

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



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Report ID: TELRAD_FCC.55429_DTS_LoRa_2GFSK.docx

Date of Issue: 8-May-25

Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure:	ANSI C63.10 section 11.12.1		
Test mode:	Compliance		
Date(s):	02-Feb-25 - 24-Feb-25		
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1019 hPa	Power: 3.6 VDC
Remarks:			

Table 7.10.5 Field strength of spurious emissions below 1 GHz within restricted bands

ASSIGNED FREQUENCY:	902 - 928 MHz
INVESTIGATED FREQUENCY RANGE:	0.009 – 1000 MHz
TEST DISTANCE:	3 m
MODULATION:	2 GFSK
BIT RATE:	50 kbps
TRANSMITTER OUTPUT POWER:	12.71 dBm at low carrier frequency 13.27 dBm at mid carrier frequency 12.71 dBm at high carrier frequency
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
Low carrier frequency		Measured emission, dB(µV/m)			Limit, dB(µV/m)	Margin, dB*		
		No emissions were found					Pass	
Mid carrier frequency		No emissions were found					Pass	
High carrier frequency		No emissions were found					Pass	

*- Margin = Measured emission - specification limit.

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



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Report ID: TELRAD_FCC.55429_DTS_LoRa_2GFSK.docx

Date of Issue: 8-May-25

Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions					
Test procedure: ANSI C63.10 section 11.12.1					
Test mode: Compliance				Verdict:	PASS
Date(s): 02-Feb-25 - 24-Feb-25					
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1019 hPa		Power: 3.6 VDC	
Remarks:					

Table 7.10.6 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	
8.362 - 8.366	37.5 - 38.25	322 - 335.4	2483.5 - 2500	9300 - 9500	Above 38.6

Table 7.10.7 Restricted bands according to RSS-Gen

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

Reference numbers of test equipment used

HL 1915	HL 3903	HL 4114	HL 5288	HL 5902	HL 7585	HL0446	
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Full description is given in Appendix A.

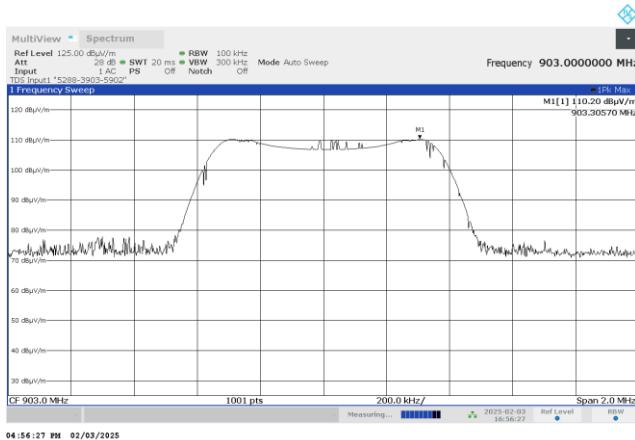


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Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure:	ANSI C63.10 section 11.12.1		
Test mode:	Compliance		
Date(s):	02-Feb-25 - 24-Feb-25		
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1019 hPa	Power: 3.6 VDC
Remarks:			

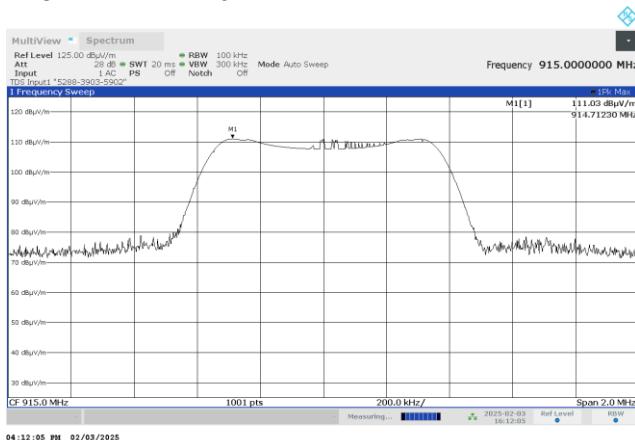
Plot 7.10.1 Radiated emission measurements at the low carrier frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m



Plot 7.10.2 Radiated emission measurements at the mid carrier frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m



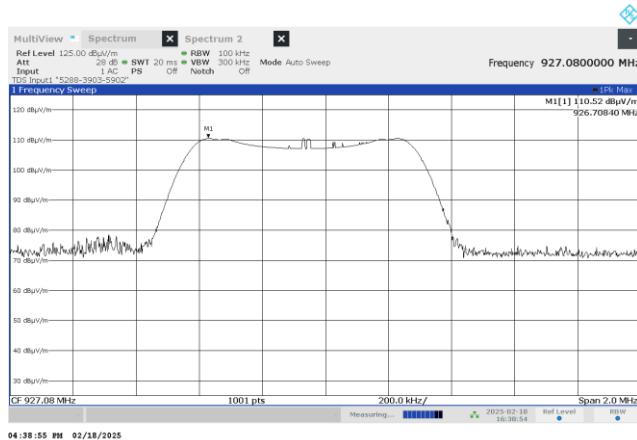


HERMON LABORATORIES

Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure:	ANSI C63.10 section 11.12.1		
Test mode:	Compliance		
Date(s):	02-Feb-25 - 24-Feb-25		
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1019 hPa	Power: 3.6 VDC
Remarks:			

Plot 7.10.3 Radiated emission measurements at the high carrier frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m



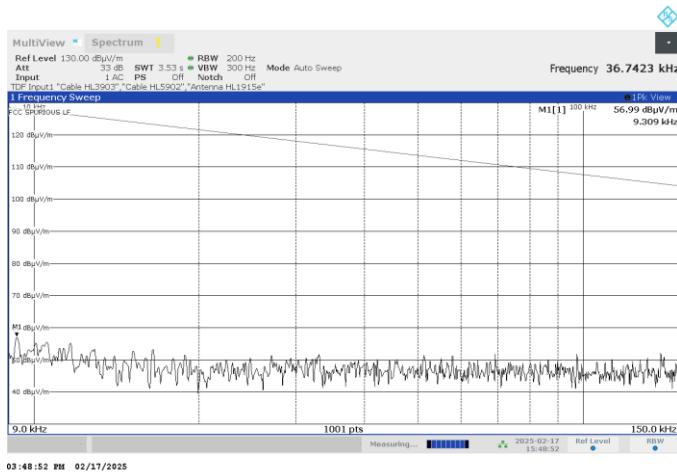


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Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure:	ANSI C63.10 section 11.12.1		
Test mode:	Compliance		
Date(s):	02-Feb-25 - 24-Feb-25		
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1019 hPa	Power: 3.6 VDC
Remarks:			

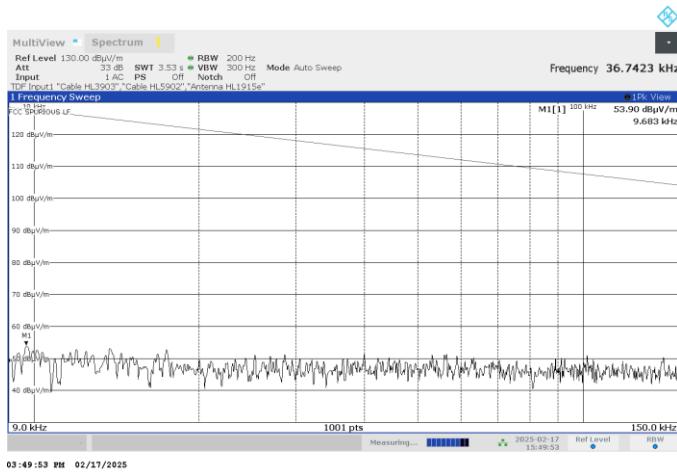
Plot 7.10.4 Radiated emission measurements from 9 kHz to 150 kHz at the low carrier frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m



Plot 7.10.5 Radiated emission measurements from 9 kHz to 150 kHz at the mid carrier frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m





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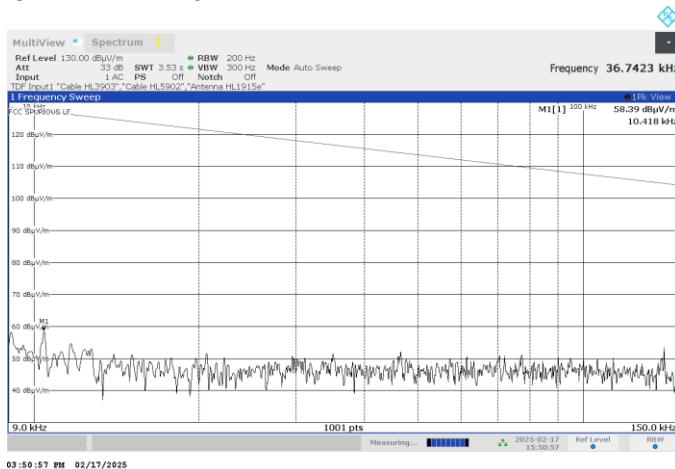
Report ID: TELRAD_FCC.55429_DTS_LoRa_2GFSK.docx

Date of Issue: 8-May-25

Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure:	ANSI C63.10 section 11.12.1		
Test mode:	Compliance		
Date(s):	02-Feb-25 - 24-Feb-25		
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1019 hPa	Power: 3.6 VDC
Remarks:			

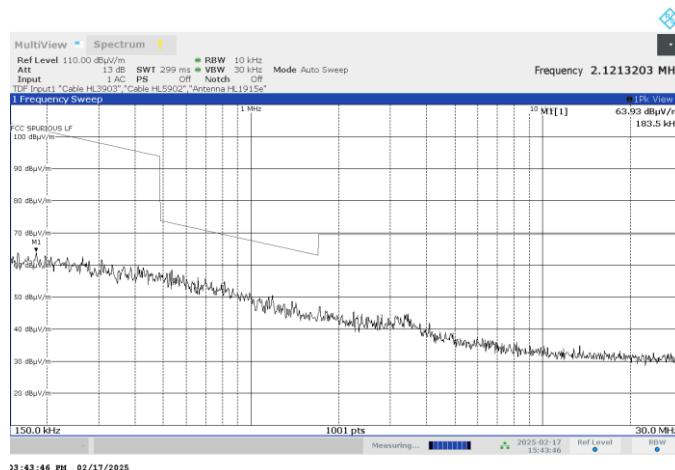
Plot 7.10.6 Radiated emission measurements from 9 kHz to 150 kHz at the high carrier frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m



Plot 7.10.7 Radiated emission measurements from 150 kHz to 30 MHz at the low carrier frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m



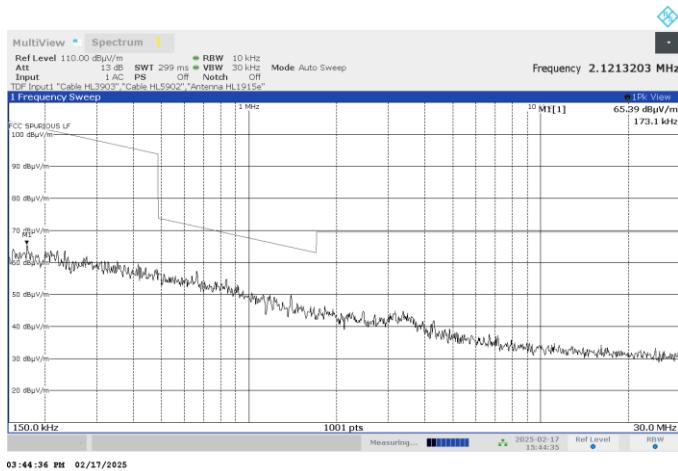


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Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure:	ANSI C63.10 section 11.12.1		
Test mode:	Compliance		
Date(s):	02-Feb-25 - 24-Feb-25		
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1019 hPa	Power: 3.6 VDC
Remarks:			

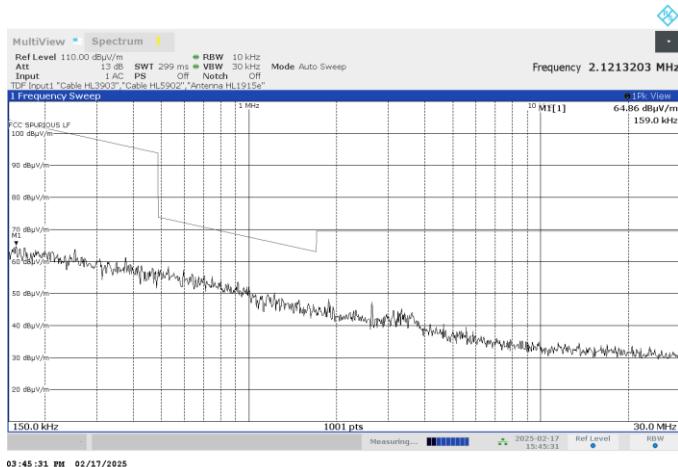
Plot 7.10.8 Radiated emission measurements from 150 kHz to 30 MHz at the mid carrier frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m



Plot 7.10.9 Radiated emission measurements from 150 kHz to 30 MHz at the high carrier frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m



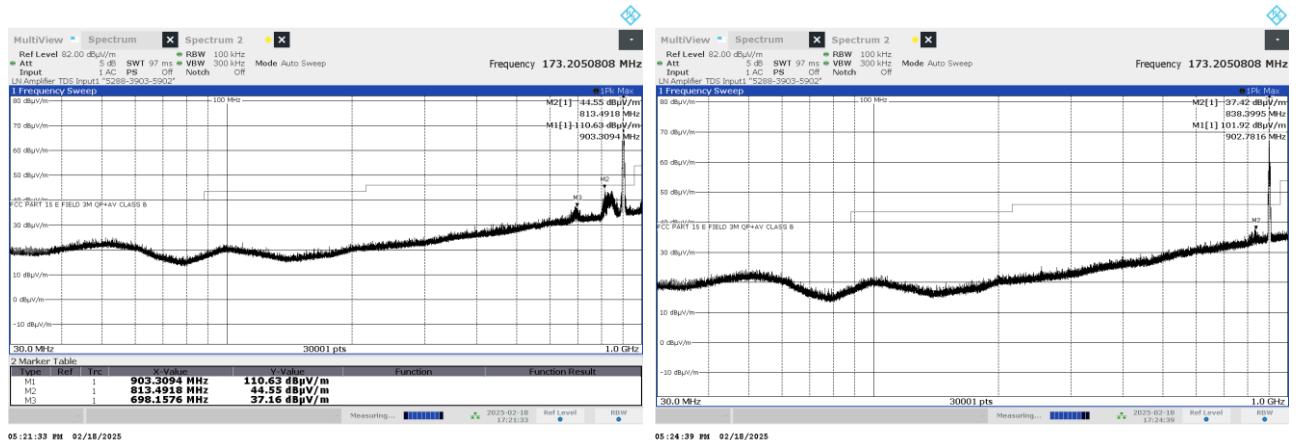


HERMON LABORATORIES

Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure:	ANSI C63.10 section 11.12.1		
Test mode:	Compliance		
Date(s):	02-Feb-25 - 24-Feb-25		
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1019 hPa	Power: 3.6 VDC
Remarks:			

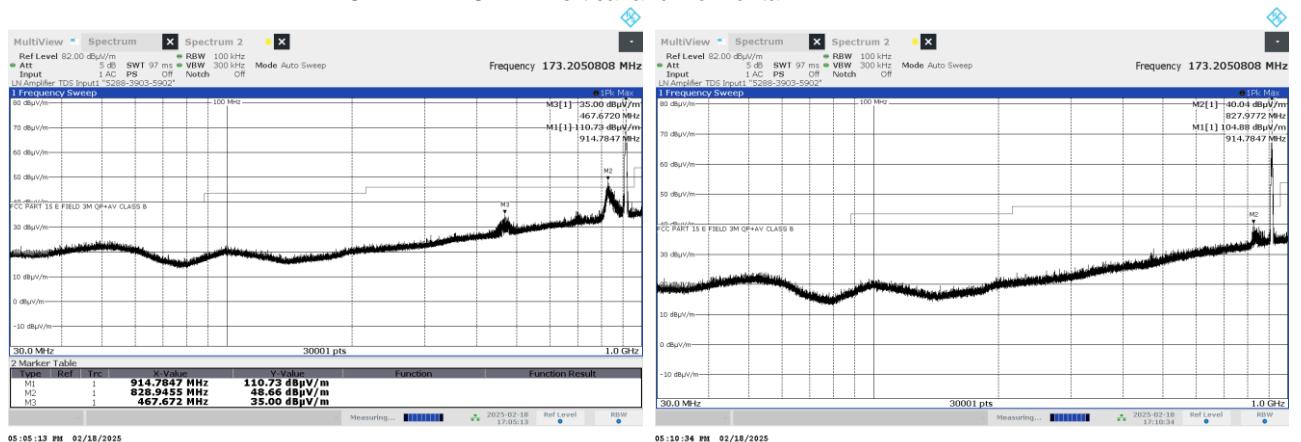
Plot 7.10.10 Radiated emission measurements from 30 to 1000 MHz at the low carrier frequency

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



Plot 7.10.11 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



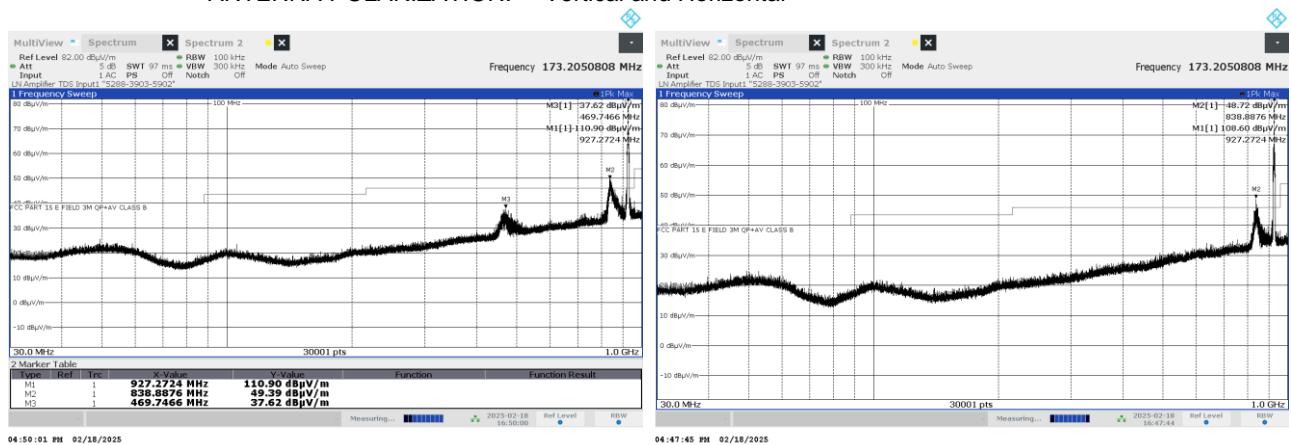


HERMON LABORATORIES

Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure:	ANSI C63.10 section 11.12.1		
Test mode:	Compliance		
Date(s):	02-Feb-25 - 24-Feb-25		
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1019 hPa	Power: 3.6 VDC
Remarks:			

Plot 7.10.12 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



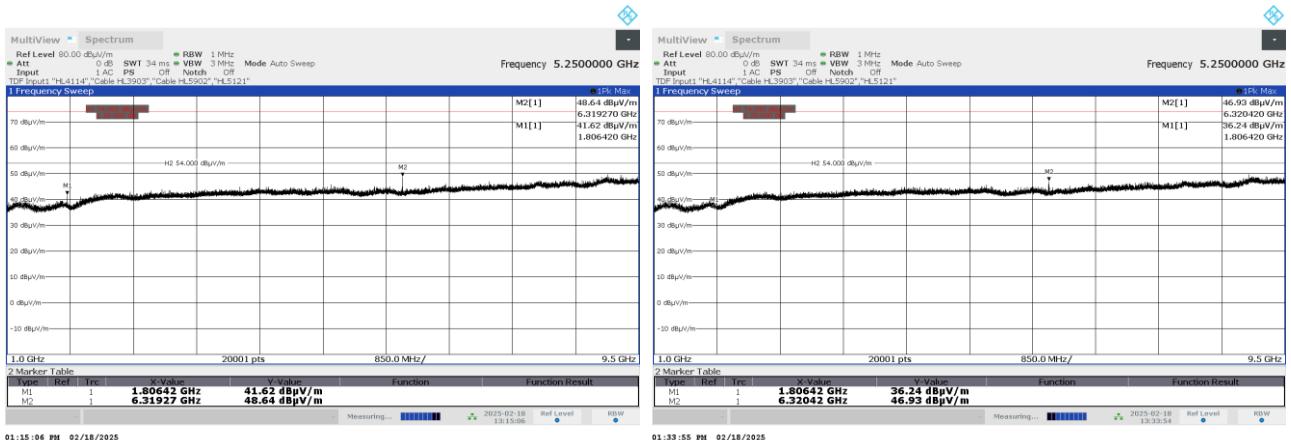


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Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure:	ANSI C63.10 section 11.12.1		
Test mode:	Compliance		
Date(s):	02-Feb-25 - 24-Feb-25		
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1019 hPa	Power: 3.6 VDC
Remarks:			

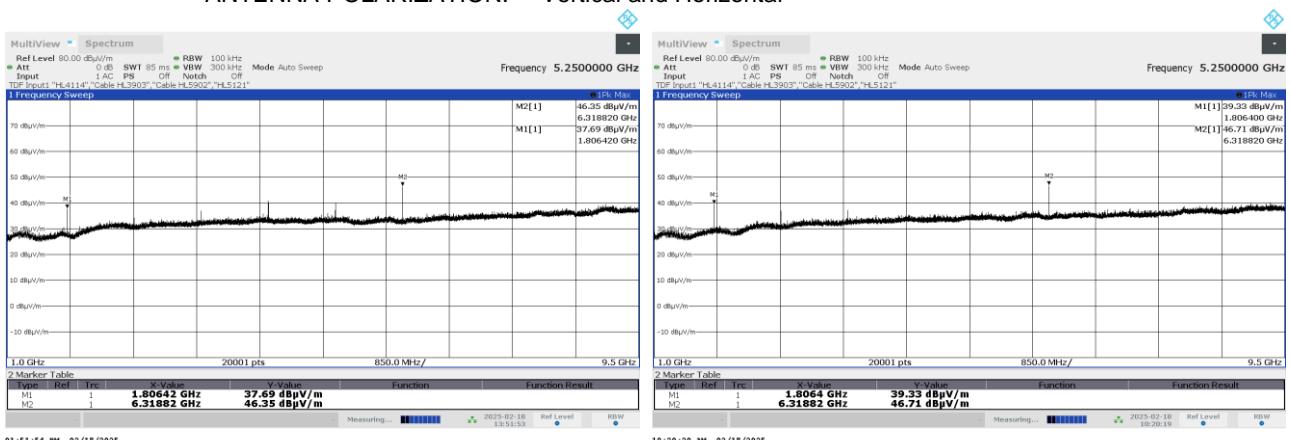
Plot 7.10.13 Radiated emission measurements from 1000 to 9500 MHz at the low carrier frequency

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



Plot 7.10.14 Radiated emission measurements from 1000 to 9500 MHz at the low carrier frequency (100 kHz RBW – Out of restricted band emissions)

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





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Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure:	ANSI C63.10 section 11.12.1		
Test mode:	Compliance		
Date(s):	02-Feb-25 - 24-Feb-25		
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1019 hPa	Power: 3.6 VDC
Remarks:			

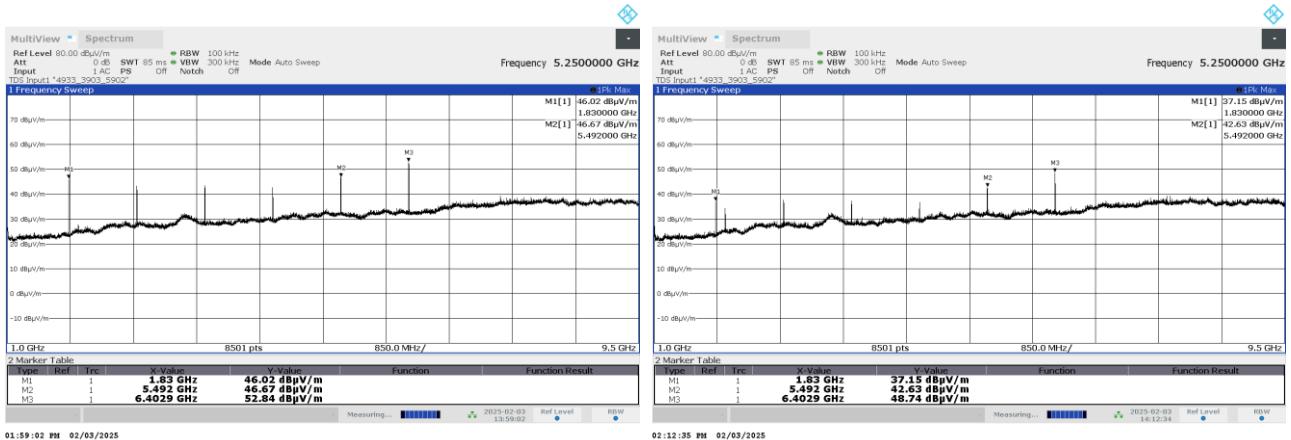
Plot 7.10.15 Radiated emission measurements from 1000 to 9500 MHz at the mid carrier frequency

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



Plot 7.10.16 Radiated emission measurements from 1000 to 9500 MHz at the mid carrier frequency (100 kHz RBW – Out of restricted band emissions)

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





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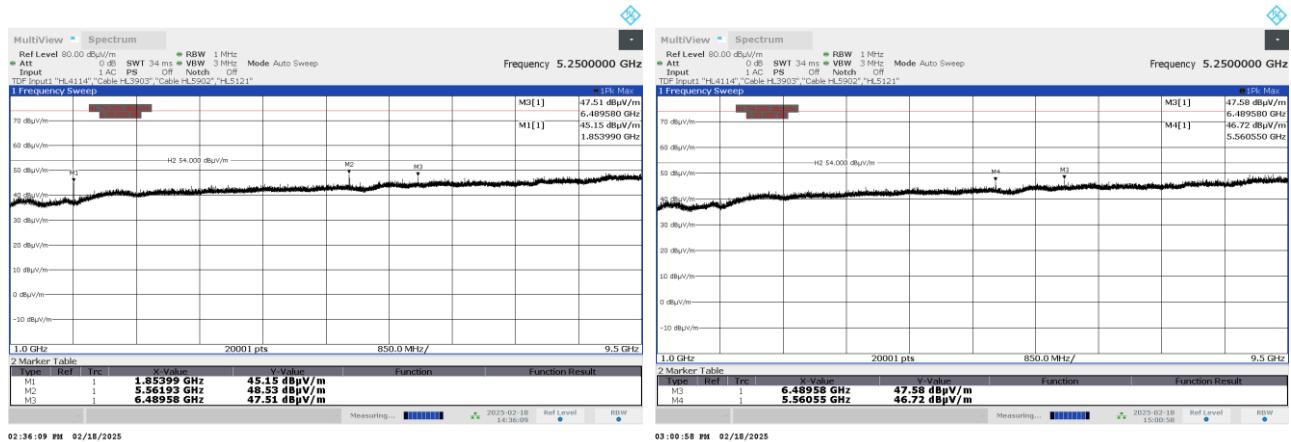
Report ID: TELRAD_FCC.55429_DTS_LoRa_2GFSK.docx

Date of Issue: 8-May-25

Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions				
Test procedure: ANSI C63.10 section 11.12.1				
Test mode: Compliance			Verdict: PASS	
Date(s): 02-Feb-25 - 24-Feb-25				
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1019 hPa	Power: 3.6 VDC	
Remarks:				

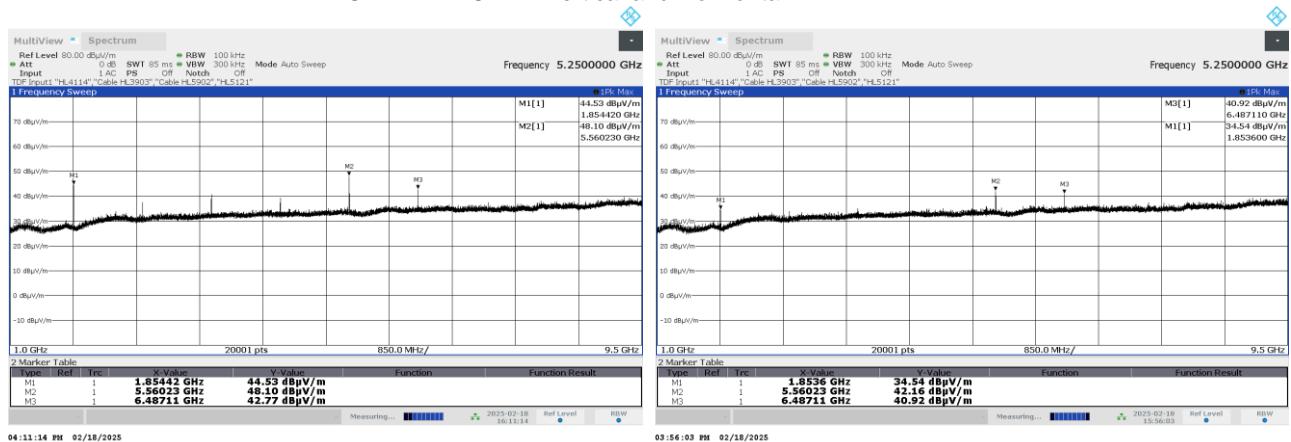
Plot 7.10.17 Radiated emission measurements from 1000 to 9500 MHz at the high carrier frequency

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



Plot 7.10.18 Radiated emission measurements from 1000 to 9500 MHz at the high carrier frequency (100 kHz RBW – Out of restricted band emissions)

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



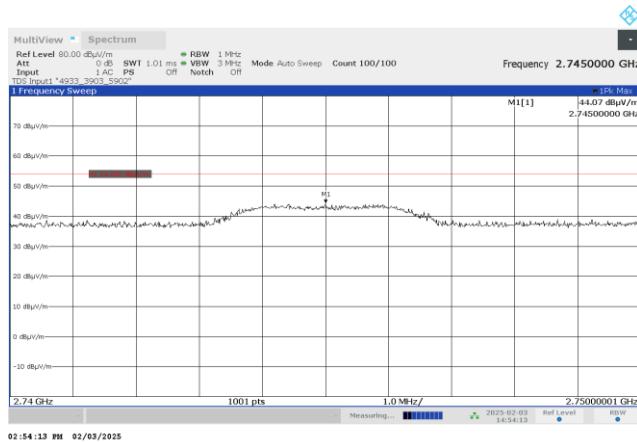


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Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure:	ANSI C63.10 section 11.12.1		
Test mode:	Compliance		
Date(s):	02-Feb-25 - 24-Feb-25		
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1019 hPa	Power: 3.6 VDC
Remarks:			

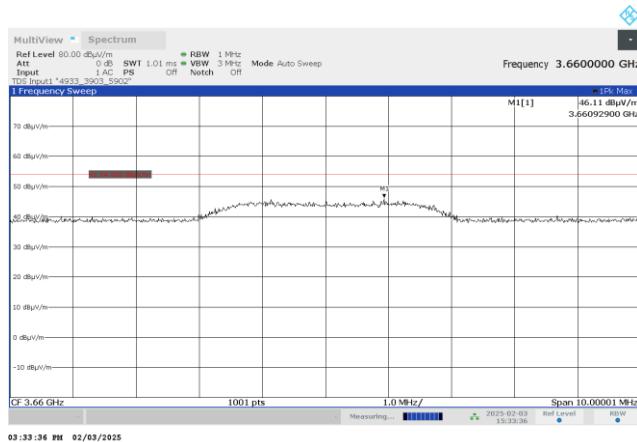
Plot 7.10.19 Radiated emission measurements at the third harmonic of mid carrier frequency

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



Plot 7.10.20 Radiated emission measurements at the fourth harmonic of mid carrier frequency

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



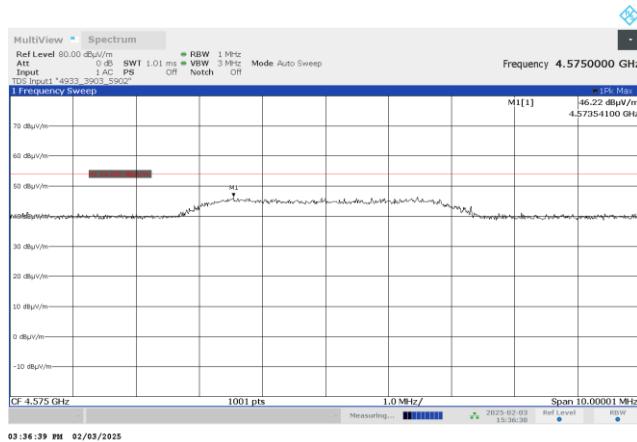


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Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure:	ANSI C63.10 section 11.12.1		
Test mode:	Compliance		
Date(s):	02-Feb-25 - 24-Feb-25		
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1019 hPa	Power: 3.6 VDC
Remarks:			

Plot 7.10.21 Radiated emission measurements at the fifth harmonic of mid carrier frequency

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

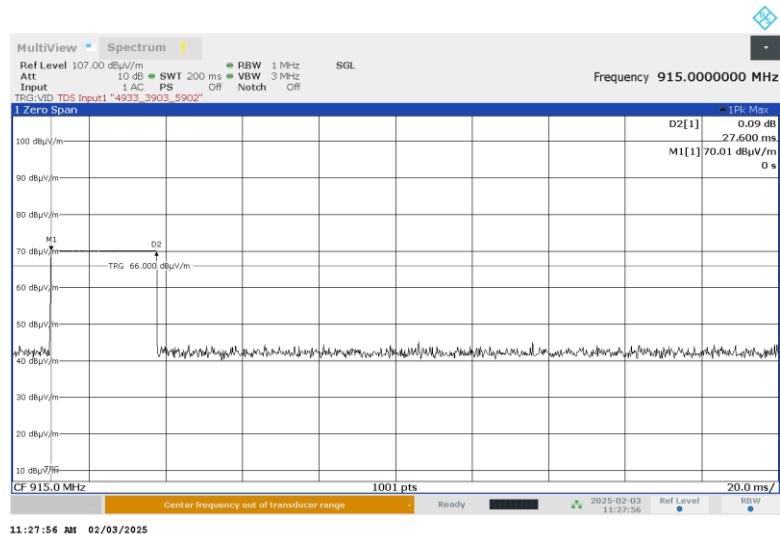




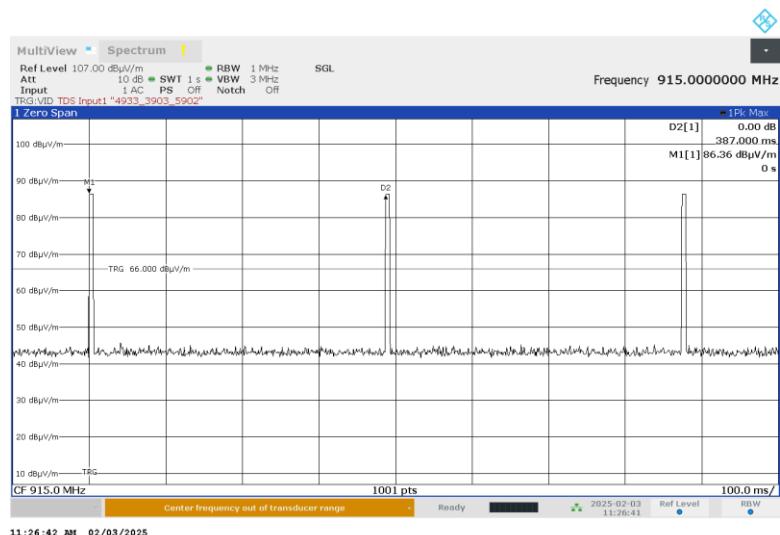
HERMON LABORATORIES

Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure:	ANSI C63.10 section 11.12.1		
Test mode:	Compliance		
Date(s):	02-Feb-25 - 24-Feb-25		
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1019 hPa	Power: 3.6 VDC
Remarks:			

Plot 7.10.22 Transmission pulse duration



Plot 7.10.23 Transmission pulse period





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Test specification:	Section 15.203 / RSS-Gen section 6.8, Antenna requirement		
Test procedure:	Visual inspection		
Test mode:	Compliance	Verdict:	PASS
Date(s):	10-Feb-25		
Temperature: 23 °C	Relative Humidity: 45 %	Air Pressure: 1016 hPa	Power: 3.6 VDC
Remarks:			

7.11 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 7.11.1.

Table 7.11.1 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	



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8 APPENDIX A Test equipment and ancillaries used for tests

HL No	Description	Manufacturer	Model	Ser. No.	Last Cal./Check	Due Cal./Check
1915	Antenna, Loop, Active Receiving, 1 kHz - 30 MHz	EMC Test Systems	6507	1457	29-Feb-24	28-Feb-25
3230	Multimeter	Fluke	115C	94173028	14-Aug-24	14-Aug-25
3440	Precision Fixed Attenuator, 50 Ohm, 5 W, 20 dB, DC to 18 GHz	Mini-Circuits	BW-S20W5+	NA	05-Aug-24	05-Aug-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
4114	Antenna, Double-Ridged Waveguide Horn, 1 to 18 GHz	ETS Lindgren	3117	00123515	27-Oct-24	27-Oct-25
4135	Shield Box	TESCOM CO., LTD	TC-5916A	5916A000 136	20-May-24	20-May-25
4355	Signal and Spectrum Analyzer, 9 kHz to 7 GHz	Rohde & Schwarz	FSV 7	101630	19-Jun-24	19-Jun-25
5288	Trilog Antenna, 25 MHz - 8 GHz, 100W	Frankonia	ALX-8000E	00809	24-Mar-22	24-Mar-25
5376	EXA Signal Analyzer, 10 Hz - 32 GHz	Keysight Technologies	N9010B	MY574704 04	06-Jan-25	06-Jan-26
5611	Precision Fixed Attenuator, 50 Ohm, 5 W, 10 dB, DC to 18 GHz	Mini Circuits	BW-S10W5+	NA	11-Mar-24	11-Mar-25
5636	Cable, 50 Ohm, DC to 18 GHz, 1.8 m, SMA/SMA	Mini Circuits	CBL-6FT-SMSM+	NA	17-Nov-24	17-Nov-25
5642	Cable, 50 Ohm, DC to 18 GHz, 1.8 m, SMA/SMA	Mini Circuits	CBL-6FT-SMSM+	NA	29-Jul-24	29-Jul-25
5644	Cable, 50 Ohm, DC to 18 GHz, 1.8 m, SMA/SMA	Mini Circuits	CBL-6FT-SMSM+	NA	06-May-24	06-May-25
5902	RF cable, 18 GHz, 6.0m, N-type	Huber-Suhner	SF126EA/11N/11N/6000	NA	17-Nov-24	17-Nov-25
5933	Thermometer Hygrometer , (0 to +50) deg., (20-95) % RH	Kkmoon	Dyimore	NA	15-May-24	15-May-25
7523	Programmable DC Power Supplies, 48VDC/38A	TDK-Lambda Ltd	GEN40-38	LOC-823A277-0004	13-Mar-24	13-Mar-25
7546	Power supply 60VDC/12.5A	Agilent Technologies	N5747A	US25F676 2C	29-May-24	29-May-25
7585	EMI Test Receiver, 1 Hz to 44 GHz	Rohde & Schwarz	ESW44	103130	24-Sep-24	24-Sep-25



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9 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.



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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.



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10 APPENDIX B Measurement uncertainties

Expanded uncertainty at 95% confidence in Hermon Labs EMC measurements

Test description	Expanded uncertainty
Conducted carrier power at RF antenna connector	Below 12.4 GHz: ± 1.7 dB 12.4 GHz to 40 GHz: ± 2.3 dB
Conducted emissions at RF antenna connector	9 kHz to 2.9 GHz: ± 2.6 dB 2.9 GHz to 6.46 GHz: ± 3.5 dB 6.46 GHz to 13.2 GHz: ± 4.3 dB 13.2 GHz to 22.0 GHz: ± 5.0 dB 22.0 GHz to 26.8 GHz: ± 5.5 dB 26.8 GHz to 40.0 GHz: ± 4.8 dB
Occupied bandwidth	± 8.0 %
Duty cycle, timing (Tx ON / OFF) and average factor measurements	± 1.0 %
Conducted emissions with LISN	9 kHz to 150 kHz: ± 3.9 dB 150 kHz to 30 MHz: ± 3.8 dB
Radiated emissions at 3 m measuring distance Horizontal polarization	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
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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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 are R-10808 for OATS, R-1082 for anechoic chamber, 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

Specification references

FCC 47CFR part 15: 2023

Radio Frequency Devices

ANSI C63.10: 2013

American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

RSS-247 Issue 3: 2023

Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence- Exempt Local Area Network (LE-LAN) Devices

RSS-Gen Issue 5
with_amendment_1_2: 2021

General Requirements and Information for the Certification of Radiocommunication Equipment



HERMON LABORATORIES

13 APPENDIX E Abbreviations and acronyms

A	ampere
AC	alternating current
AM	amplitude modulation
AVRG	average (detector)
BB	broad band
cm	centimeter
dB	decibel
dBm	decibel referred to one milliwatt
dB(µV)	decibel referred to one microvolt
dB(µV/m)	decibel referred to one microvolt per meter
dB(µA)	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
µs	microsecond
NA	not applicable
NB	narrow band
OATS	open area test site
Ω	Ohm
QP	quasi-peak
RE	radiated emission
RF	radio frequency
rms	root mean square
Rx	receive
s	second
T	temperature
Tx	transmit
V	volt

END OF DOCUMENT