

TEST REPORT

ACCORDING TO: FCC CFR 47 Part 90, subpart I, and RSS-119 Issue 12:2015

FOR:

ST Engineering Telematics Wireless Ltd

Galaxy Base Station

Model: Galaxy Base Station V1

FCC ID: NTA2WBS2

IC: 4732A-2WBS2

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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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: Galaxy Base Station
Product type: Transceiver
Model(s): Galaxy Base Station V1
Serial number: 2430004
Hardware version: Rev B
Software release: 2WBST-RV1B-101124-SW-V500
Receipt date 21-Nov-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: 55848
Location: Hermon Laboratories Ltd. 66 HaTachana str., P.O. Box 23, Binyamina 3055001, Israel
Test started: 02-Feb-25
Test completed: 17-Feb-25
Test specification(s): FCC part 90, subpart I; RSS-119 issue 12

5 Tests summary

Test	Status
Transmitter characteristics	
FCC Section 90.261(b) / RSS-119 Section 5.4, Maximum output power	Pass
FCC Section 90.209 / RSS-119 Section 5.5, Occupied bandwidth	Pass
FCC Section 90.210 (e) / RSS-119 Section 5.8.4, Emission mask	Pass
FCC Section 90.210 (e) / RSS-119 Section 5.8.4, Radiated spurious emissions	Pass
FCC Section 90.210 (e) / RSS-119 Section 5.8.4, Conducted spurious emissions	Pass
FCC Section 90.213 / RSS-119 Section 5.3, Frequency stability	Pass
FCC Section 90.214 / RSS-119 Section 5.9, Transient frequency behaviour	Pass

This test report supersedes the previously issued test report identified by Doc ID: TELRAD_FCC.55848

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	02-Feb-25 – 17-Feb-25	 
Reviewed by:	Mrs. S. Peysahov Sheynin, certification engineer, EMC & Radio	30-Mar-24 – 11-Apr-25	
Approved by:	Mr. M. Nikishin, group leader, EMC & Radio	25-May-25	

6 EUT description

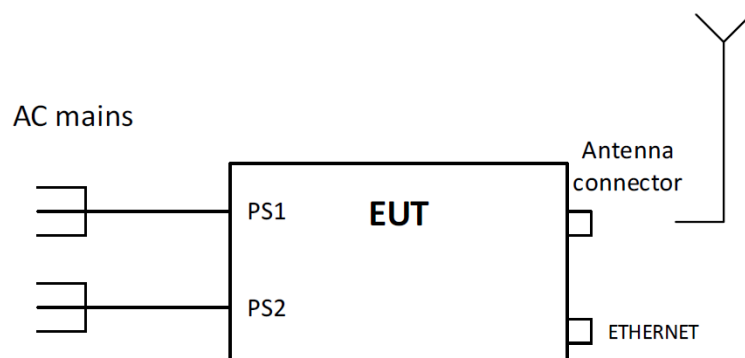
Note: The following data in this clause is provided by the customer and represents his sole responsibility

6.1 General information

The EUT is a Base Station of an automatic meter reading system which operates in 450-470 MHz band. The EUT uses 4GFSK modulation and operates on 6.25KHz channel bandwidth.

The EUT is powered by AC via PS1 and PS2 internal power supplies.

6.2 Test configuration



6.3 Changes made in EUT

No changes were implemented in the EUT during testing.

6.4 Transmitter characteristics

Type of equipment					
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			
X	fixed	Always at a distance more than 2 m from all people			
	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		450- 470 MHz			
Maximum output power		At transmitter 50 Ω RF output connector			42.97 dBm
		Effective radiated power			
Is transmitter output power variable?		No			
		X	Yes	continuous variable	
				stepped variable with stepsize	
				0.5 dB	
				minimum RF power	33 dBm
maximum RF power	43 dBm				
Antenna connection					
unique coupling	X	standard connector	integral	with temporary RF connector without temporary RF connector	
Antenna/s technical characteristics					
Type	Manufacturer	Model number	Gain		
External	Kenbotong	TQJ-450A3L	2dBi		
External	Huber-Suhner	853266	8.5dBi		
External	Amphenol	4220.09-445-T6	10dBi		
Transmitter aggregate data rate/s		4.8 kbps			
Type of modulation		4GFSK			
Modulating test signal (baseband)		PRBS			
Transmitter power source					
	Battery	Nominal rated voltage	VDC	Battery type	
	DC	Nominal rated voltage	VDC		
X	AC mains	Nominal rated voltage	120 VAC	Frequency	60 Hz
Common power source for transmitter and receiver			X	yes	no



Test specification:		Section 90.261 (b) / RSS-119 Section 5.4, Maximum output power	
Test procedure:		47 CFR, Section 2.1046; TIA/EIA-603-A, Section 2.2.1	
Test mode:		Verdict: PASS	
Date(s):			
02-Feb-25			
Temperature: 45 °C	Relative Humidity: 21 %	Air Pressure: 1022 hPa	Power: 120 VAC
Remarks:			

7 Transmitter tests according to 47CFR part 90 and RSS-119 requirements

7.1 Peak output power test

7.1.1 General

This test was performed to measure the peak output power at RF antenna connector. Specification test limits are given in Table 7.1.1. The test results are provided in Table 7.1.2 and the associated plots.

Table 7.1.1 Peak output power limits

Assigned frequency range, MHz	Maximum peak output power	
	W	dBm
450-470	20	43

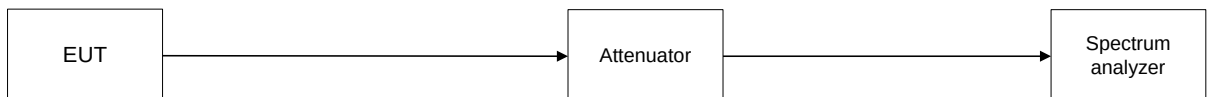
7.1.2 Test procedure

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

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

7.1.2.3 The peak output power was measured with spectrum analyzer as provided in Table 7.1.2 and associated plots.

Figure 7.1.1 Peak output power test setup





Test specification:		Section 90.261 (b) / RSS-119 Section 5.4, Maximum output power	
Test procedure:		47 CFR, Section 2.1046; TIA/EIA-603-A, Section 2.2.1	
Test mode:		Verdict: PASS	
Date(s):			
02-Feb-25			
Temperature: 45 °C	Relative Humidity: 21 %	Air Pressure: 1022 hPa	Power: 120 VAC
Remarks:			

Table 7.1.2 Peak output power test results

OPERATING FREQUENCY RANGE: 450-470 MHz
 DETECTOR USED: Peak
 RESOLUTION BANDWIDTH: 100 kHz
 VIDEO BANDWIDTH: 300 kHz
 MODULATION: 4GFSK
 BIT RATE: 4.8 kbps
 ANTENNA GAIN: 2 dBi

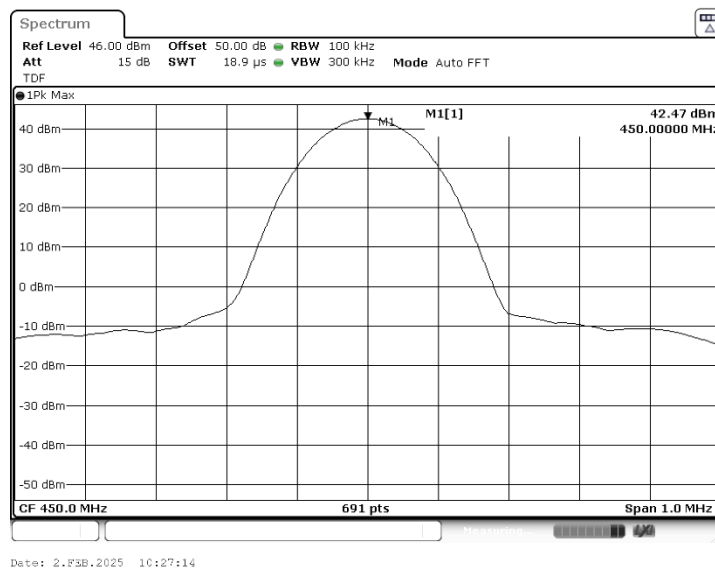
Carrier frequency, MHz	Spectrum analyzer reading, dBm	External attenuation, dB	Cable loss, dB	RF output power, dBm	Limit, dBm	Margin, dB	Verdict
450	42.47	Included	Included	42.47	43.00	-0.53	Pass
460	42.97	Included	Included	42.97	43.00	-0.03	Pass
470	42.73	Included	Included	42.73	43.00	-0.27	Pass

Reference numbers of test equipment used

HL 4355	HL 5588	HL 5626					
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Full description is given in Appendix A.

Plot 7.1.1 Peak output power test results at low frequency

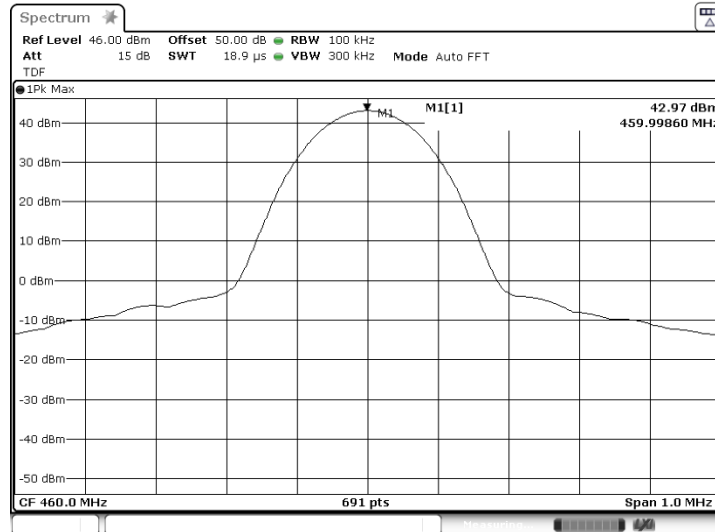




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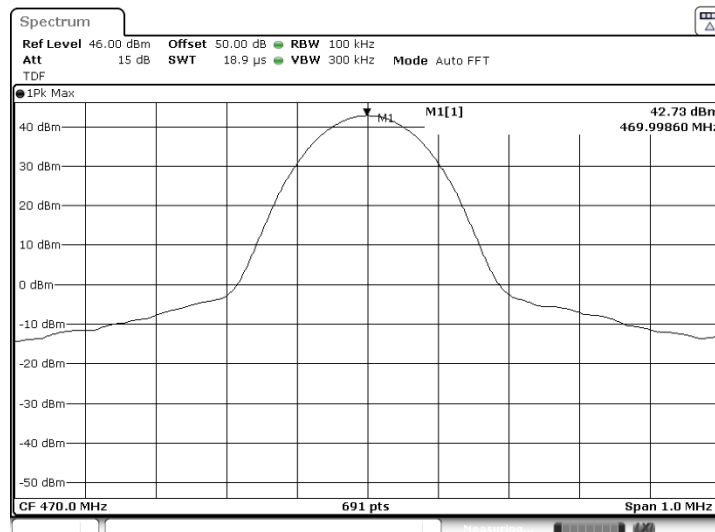
Test specification: Section 90.261 (b) / RSS-119 Section 5.4, Maximum output power			
Test procedure: 47 CFR, Section 2.1046; TIA/EIA-603-A, Section 2.2.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 02-Feb-25			
Temperature: 45 °C	Relative Humidity: 21 %	Air Pressure: 1022 hPa	Power: 120 VAC
Remarks:			

Plot 7.1.2 Peak output power test results at mid frequency



Date: 2.F3B.2025 10:29:04

Plot 7.1.3 Peak output power test results at high frequency



Date: 2.F3B.2025 10:30:27



Test specification: Section 90.209 / RSS-119 Section 5.5, Occupied bandwidth			
Test procedure: 47 CFR, Section 2.1049			
Test mode: Compliance		Verdict: PASS	
Date(s): 02-Feb-25			
Temperature: 22 °C	Relative Humidity: 43 %	Air Pressure: 1022 hPa	Power: 120 VAC
Remarks:			

7.2 Occupied bandwidth test

7.2.1 General

This test was performed to measure transmitter occupied bandwidth. Specification test limits are given in Table 7.2.1. The test results are provided in Table 7.2.2 and the associated plots.

Table 7.2.1 Occupied bandwidth limits

Assigned frequency, MHz	Modulation envelope reference points*, dBc	Maximum allowed bandwidth, kHz
450-470	26	6

* - Modulation envelope reference points are provided in terms of attenuation below the unmodulated carrier.

7.2.2 Test procedure

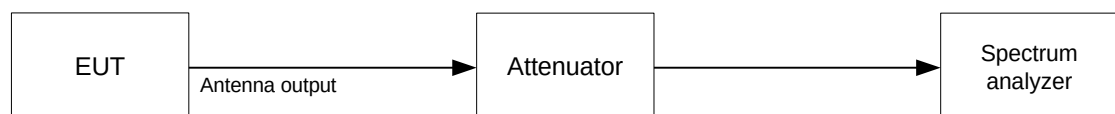
7.2.2.1 The EUT was set up as shown in Figure 7.2.1, energized and its proper operation was checked.

7.2.2.2 The EUT was set to transmit the unmodulated carrier and the reference peak power level was measured.

7.2.2.3 The EUT was set to transmit the normally modulated carrier.

7.2.2.4 The transmitter occupied bandwidth was measured with spectrum analyzer as a frequency delta between the reference points on modulation envelope and provided in Table 7.2.2 and the associated plots.

Figure 7.2.1 Occupied bandwidth test setup





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Test specification:		Section 90.209 / RSS-119 Section 5.5, Occupied bandwidth	
Test procedure:		47 CFR, Section 2.1049	
Test mode:		Verdict: PASS	
Date(s):			
02-Feb-25			
Temperature: 22 °C	Relative Humidity: 43 %	Air Pressure: 1022 hPa	Power: 120 VAC
Remarks:			

Table 7.2.2 Occupied bandwidth test results

DETECTOR USED: Peak hold
RESOLUTION BANDWIDTH: 300 Hz
VIDEO BANDWIDTH: 3 kHz
MODULATION ENVELOPE REFERENCE POINTS: 26 dBc
MODULATION: 4GFSK
BIT RATE: 4.8 kbps

MODULATION ENVELOPE REFERENCE POINTS 26 dBc

Carrier frequency, MHz	Occupied bandwidth, kHz	Limit, kHz	Margin, kHz	Verdict
450	5.297	6.0	-0.703	Pass
460	5.297	6.0	-0.703	Pass
470	5.297	6.0	-0.703	Pass

MODULATION ENVELOPE REFERENCE POINTS 99% power

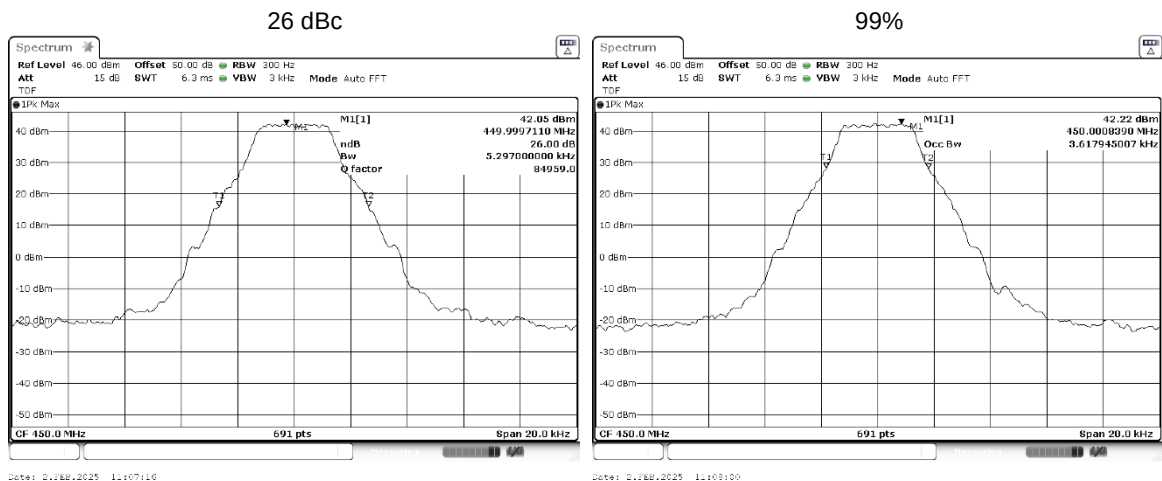
Carrier frequency, MHz	Occupied bandwidth, kHz	Limit, kHz	Margin, kHz	Verdict
450	3.618	3.7	-0.082	Pass
460	3.618	3.7	-0.082	Pass
470	3.618	3.7	-0.082	Pass

Reference numbers of test equipment used

HL 4355	HL 5588	HL 5626	HL 5933				
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Full description is given in Appendix A.

Plot 7.2.1 Occupied bandwidth test result at low frequency

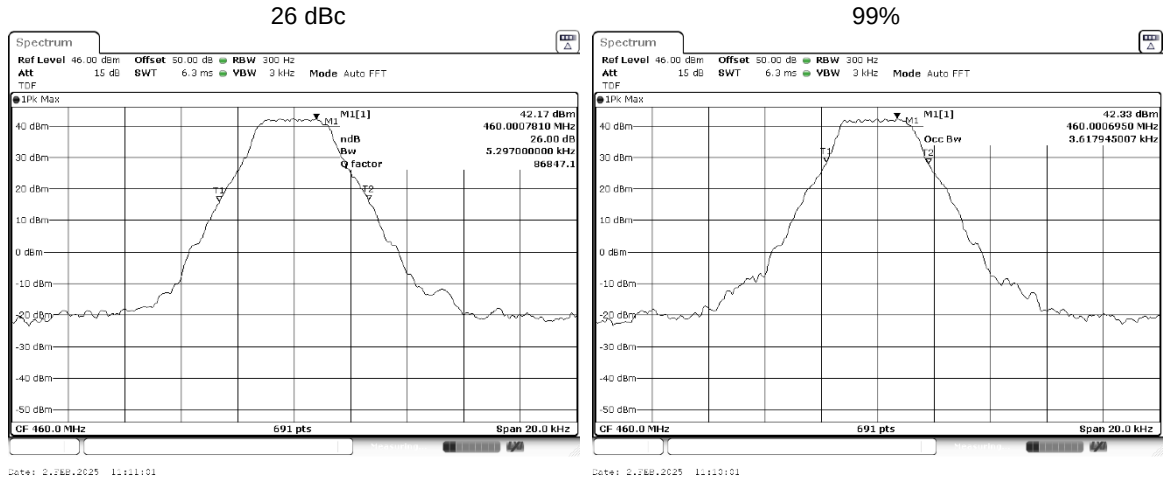




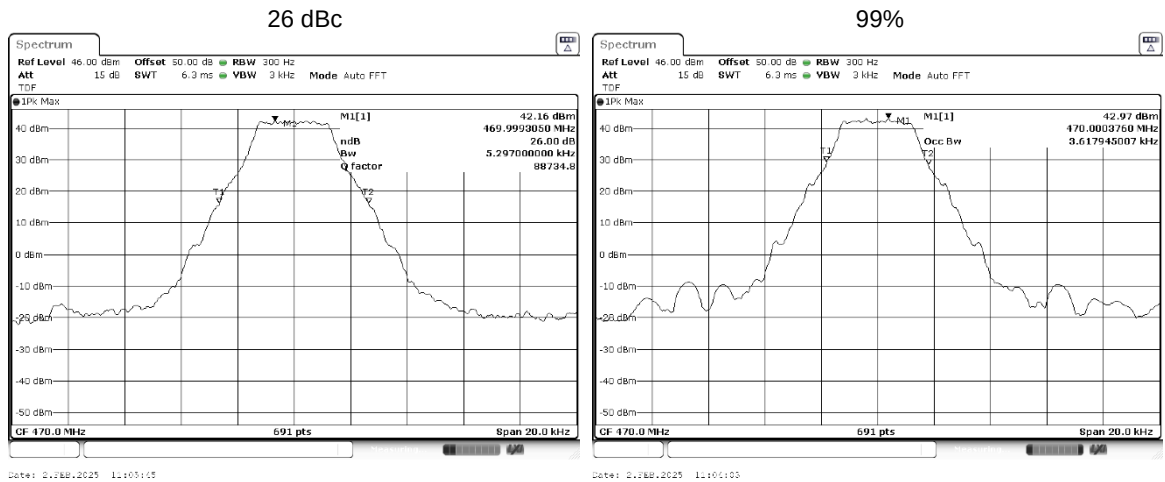
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Test specification: Section 90.209 / RSS-119 Section 5.5, Occupied bandwidth			
Test procedure: 47 CFR, Section 2.1049			
Test mode: Compliance		Verdict: PASS	
Date(s): 02-Feb-25			
Temperature: 22 °C	Relative Humidity: 43 %	Air Pressure: 1022 hPa	Power: 120 VAC
Remarks:			

Plot 7.2.2 Occupied bandwidth test result at mid frequency



Plot 7.2.3 Occupied bandwidth test result at high frequency





Test specification: Section 90.210 (e) / RSS-119 Section 5.8.4, Emission mask			
Test procedure: 47 CFR, Sections 2.1051, 2.1047 and 90.210(m); TIA/EIA-603-A, Section 2.2.13			
Test mode: Compliance		Verdict: PASS	
Date(s): 02-Feb-25			
Temperature: 23 °C	Relative Humidity: 35 %	Air Pressure: 1020 hPa	Power: 120 VAC
Remarks:			

7.3 Emission mask test

7.3.1 General

This test was performed to measure emission mask at RF antenna connector. Specification test limits are given in Table 7.3.1. The test results are provided in the associated plots.

Table 7.3.1 Emission mask limits

Frequency displacement from carrier	Attenuation below carrier, dBc
Emission mask E (Channel bandwidth 6.25 kHz, authorized bandwidth 6 kHz)	
0 – 3.0 kHz	0
3.0 – 4.6 kHz	30 +16.67 (fd -3kHz)
More than 4.6 kHz	65

* - linearly increase with frequency

** - emission mask includes carrier modulation envelope within ± 250 % of the authorized bandwidth; the frequency range removed beyond ± 250 % of the authorized bandwidth from carrier was investigated as spurious emission

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 emission mask was measured with spectrum analyzer as provided in the associated plots.

Figure 7.3.1 Emission mask test setup

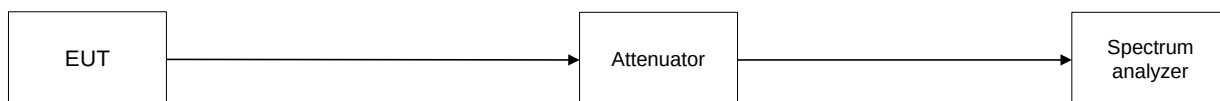


Table 7.3.2 Emission mask test results

Carrier frequency, MHz	Limit	Verdict
450	Emission mask E	Pass
460		
470		

Reference numbers of test equipment used

HL 4355	HL 5588	HL 5626	HL 5933				
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Full description is given in Appendix A.

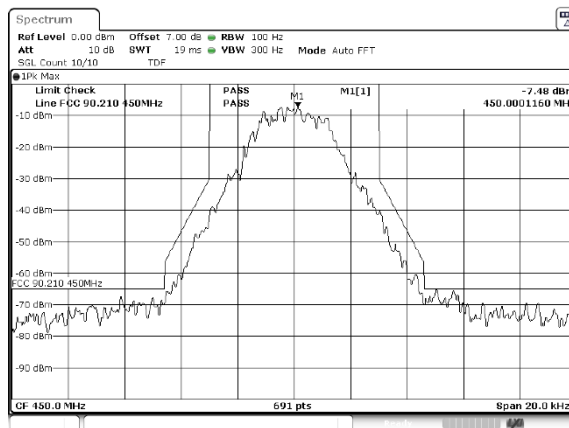
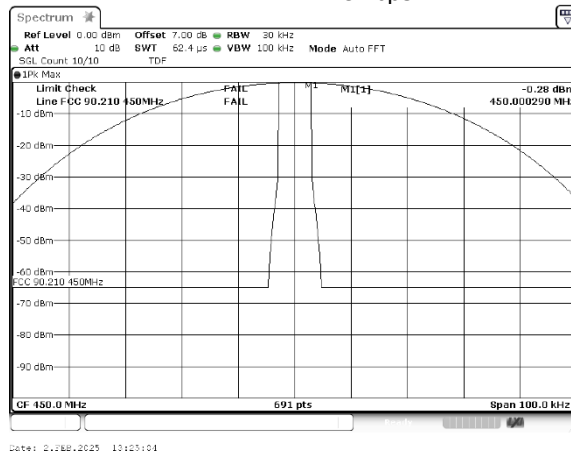


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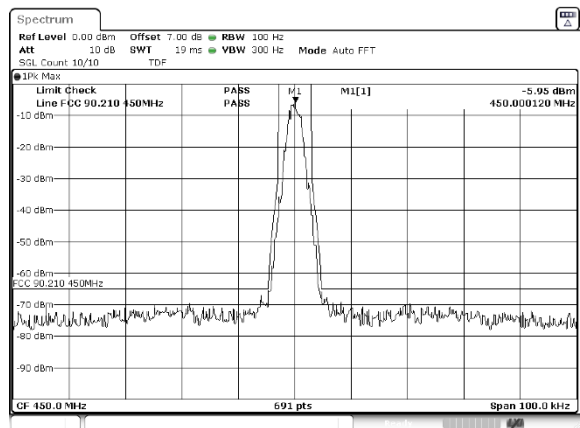
Test specification: Section 90.210 (e) / RSS-119 Section 5.8.4, Emission mask			
Test procedure: 47 CFR, Sections 2.1051, 2.1047 and 90.210(m); TIA/EIA-603-A, Section 2.2.13			
Test mode: Compliance		Verdict: PASS	
Date(s): 02-Feb-25			
Temperature: 23 °C	Relative Humidity: 35 %	Air Pressure: 1020 hPa	Power: 120 VAC
Remarks:			

Plot 7.3.1 Emission mask test results at low carrier frequency

OPERATING FREQUENCY RANGE: 450-470 MHz
DETECTOR USED: Peak
MODULATION: 4GFSK
BIT RATE: 4.8 kbps



Date: 2/28/2025 12:01:04



Date: 2/28/2025 12:02:05



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Test specification: Section 90.210 (e) / RSS-119 Section 5.8.4, Emission mask			
Test procedure: 47 CFR, Sections 2.1051, 2.1047 and 90.210(m); TIA/EIA-603-A, Section 2.2.13			
Test mode: Compliance		Verdict: PASS	
Date(s): 02-Feb-25			
Temperature: 23 °C	Relative Humidity: 35 %	Air Pressure: 1020 hPa	Power: 120 VAC
Remarks:			

Plot 7.3.2 Emission mask test results at mid carrier frequency

OPERATING FREQUENCY RANGE:

450-470 MHz

DETECTOR USED:

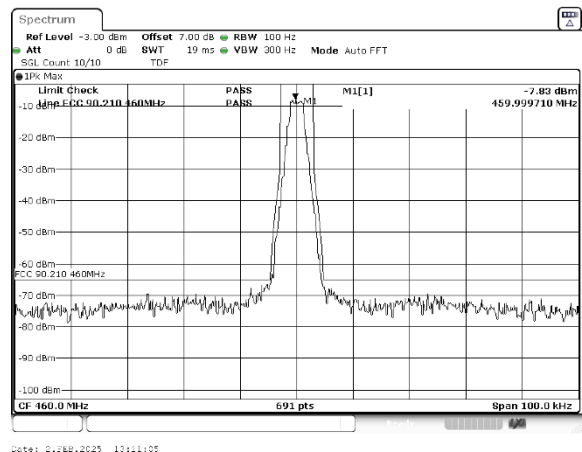
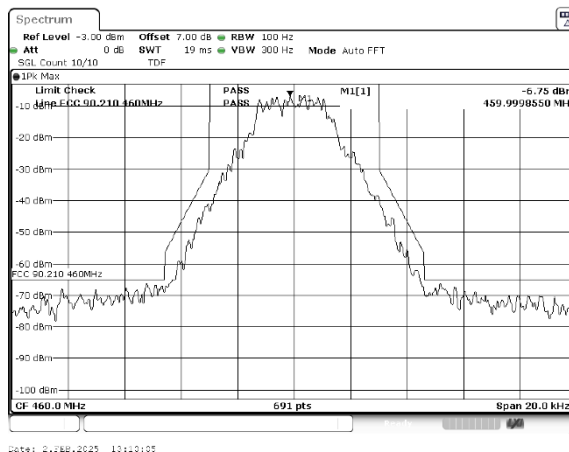
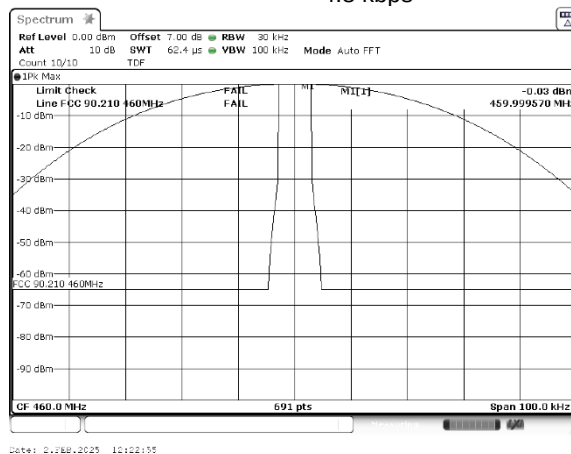
Peak

MODULATION:

4GFSK

BIT RATE:

4.8 kbps





Test specification: Section 90.210 (e) / RSS-119 Section 5.8.4, Radiated spurious emissions			
Test procedure: 47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-A, Section 2.2.12			
Test mode: Compliance		Verdict: PASS	
Date(s): 17-Feb-25			
Temperature: 23 °C	Relative Humidity: 59 %	Air Pressure: 1012230 hPa	Power: 120 VAC
Remarks:			

7.4 Radiated spurious emission measurements

7.4.1 General

This test was performed to measure radiated spurious emissions from the EUT. Specification test limits are given in Table 7.4.1.

Table 7.4.1 Radiated spurious emission test limits

Frequency, MHz	Attenuation below carrier, dBc	ERP of spurious, dBm	Equivalent field strength limit @ 3m, dB(μV/m)***
0.009 – 10th harmonic*	55+10logP**	-25	72.4

* - Excluding the in band emission within ± 250 % of the authorized bandwidth from the carrier

** - P is transmitter output power in Watts

*** - Equivalent field strength limit was calculated from maximum allowed ERP of spurious as follows:
 $E = \sqrt{30 \times P \times 1.64} / r$, where P is ERP in Watts, 1.64 is numeric gain of ideal dipole and r is antenna to EUT distance in meters

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

7.4.2.1 The EUT was set up as shown in Figure 7.4.1, energized and the performance check was conducted.

7.4.2.2 The specified frequency range was investigated with antenna connected to spectrum analyzer. To find maximum radiation the turntable was rotated 360° and the measuring antenna was rotated around its vertical axis.

7.4.2.3 The worst test results (the lowest margins) were recorded in Table 7.4.2 and shown in the associated plots.

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

7.4.3.1 The EUT was set up as shown in Figure 7.4.2, energized and the performance check was conducted.

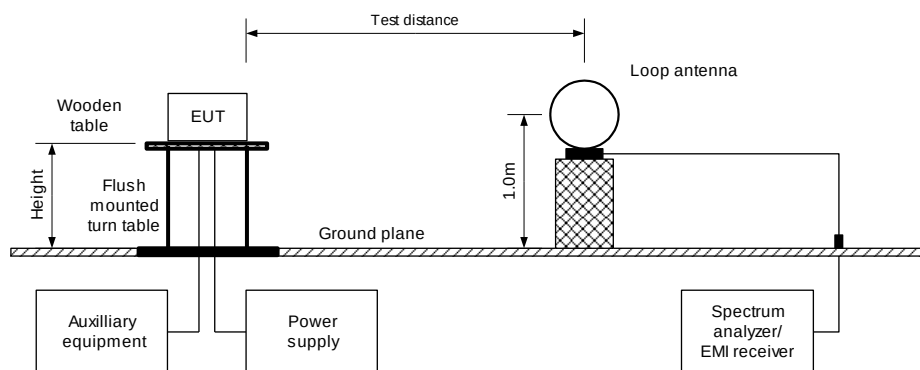
7.4.3.2 The specified frequency range was investigated with antenna connected to spectrum analyzer. To find maximum radiation the turntable was rotated 360° and the measuring antenna height was swept from 1 to 4 m in both, vertical and horizontal, polarizations.

7.4.3.3 The worst test results (the lowest margins) were recorded in Table 7.4.2 and shown in the associated plots.



Test specification: Section 90.210 (e) / RSS-119 Section 5.8.4, Radiated spurious emissions			
Test procedure: 47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-A, Section 2.2.12			
Test mode: Compliance		Verdict: PASS	
Date(s): 17-Feb-25			
Temperature: 23 °C	Relative Humidity: 59 %	Air Pressure: 1012230 hPa	Power: 120 VAC
Remarks:			

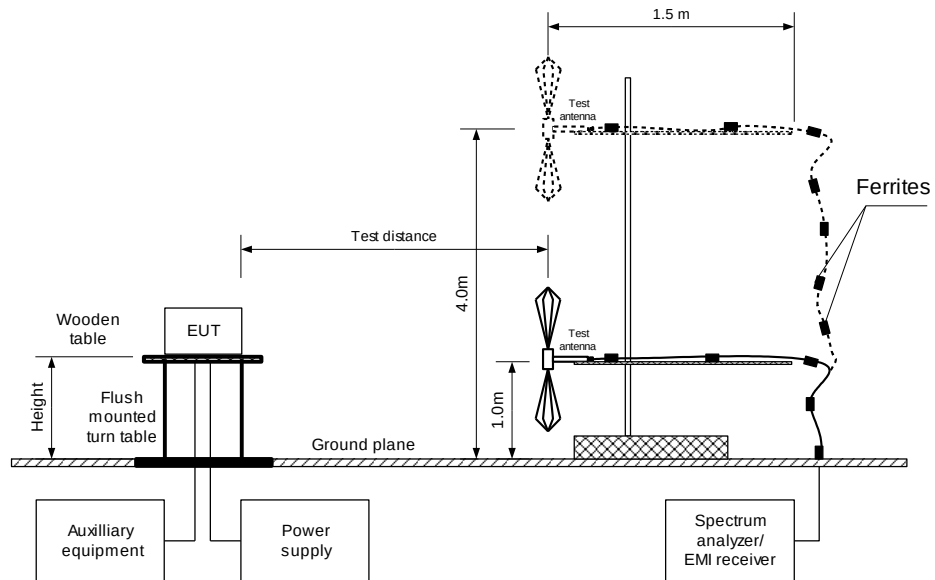
Figure 7.4.1 Setup for spurious emission field strength measurements in 9 kHz to 30 MHz band





Test specification: Section 90.210 (e) / RSS-119 Section 5.8.4, Radiated spurious emissions			
Test procedure: 47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-A, Section 2.2.12			
Test mode: Compliance		Verdict: PASS	
Date(s): 17-Feb-25			
Temperature: 23 °C	Relative Humidity: 59 %	Air Pressure: 1012230 hPa	Power: 120 VAC
Remarks:			

Figure 7.4.2 Setup for spurious emission field strength measurements above 30 MHz





Test specification: Section 90.210 (e) / RSS-119 Section 5.8.4, Radiated spurious emissions			
Test procedure: 47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-A, Section 2.2.12			
Test mode: Compliance		Verdict: PASS	
Date(s): 17-Feb-25			
Temperature: 23 °C	Relative Humidity: 59 %	Air Pressure: 1012230 hPa	Power: 120 VAC
Remarks:			

Table 7.4.2 Spurious emission field strength test results

ASSIGNED FREQUENCY RANGE: 450 - 470 MHz
 TEST DISTANCE: 3 m
 TEST SITE: Semi anechoic chamber
 INVESTIGATED FREQUENCY RANGE: 0.009 – 5000 MHz
 DETECTOR USED: Peak
 VIDEO BANDWIDTH: > Resolution bandwidth
 TEST ANTENNA TYPE: Active loop (9 kHz – 30 MHz)
 Biconilog (30 MHz – 1000 MHz)
 Double ridged guide (above 1000 MHz)
 MODULATION: 4GFSK
 BIT RATE: 4.8 kbps

Frequency, MHz	Field strength, dB(μV/m)	Limit, dB(μV/m)	Margin, dB*	RBW, kHz	Antenna polarization	Antenna height, m	Turn-table position**, degrees
Low carrier frequency 450 MHz							
3760	46.9	72.4	-25.5	1000	Horizontal	1.6	-120
Mid carrier frequency 460MHz							
1380	42.8	72.4	-29.6	1000	Horizontal	1.9	-90
4140	43.5	72.4	-28.9	1000	Horizontal	1.9	-90
High carrier frequency 470MHz							
3760	48.1	72.4	-24.3	1000	Horizontal	1.6	-120

*- Margin = Field strength of spurious – calculated field strength limit.

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

Table 7.4.3 Substitution ERP of spurious test results

ASSIGNED FREQUENCY RANGE: 450 -470 MHz
 TEST SITE: Semi anechoic chamber
 TEST DISTANCE: 3 m
 DETECTOR USED: Peak
 VIDEO BANDWIDTH: > Resolution bandwidth
 SUBSTITUTION ANTENNA TYPE: Tunable dipole (30 MHz – 1000 MHz)
 Double ridged guide (above 1000 MHz)

Frequency, MHz	Field strength, dB(μV/m)	RBW, kHz	Antenna polarization	RF generator output, dBm	Ant gain, dBd	Cable loss, dB	ERP, dBm	Attenuation below carrier, dBc	Limit, dBc	Margin, dB*	Verdict
At least 20 dB bellow the specified limit											Pass

*- Margin = Spurious emission – specification limit.

Reference numbers of test equipment used

HL 5288	HL 4933	HL 3903	HL 5902	HL 7585	HI 1915		
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Full description is given in Appendix A.



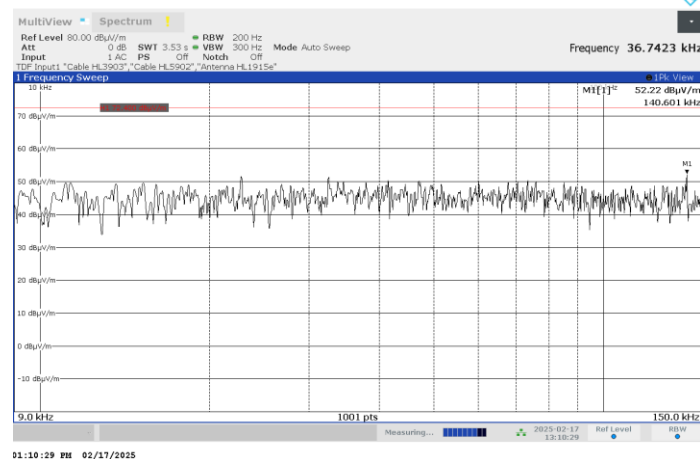
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Test specification: Section 90.210 (e) / RSS-119 Section 5.8.4, Radiated spurious emissions			
Test procedure: 47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-A, Section 2.2.12			
Test mode: Compliance		Verdict: PASS	
Date(s): 17-Feb-25			
Temperature: 23 °C	Relative Humidity: 59 %	Air Pressure: 1012230 hPa	Power: 120 VAC
Remarks:			

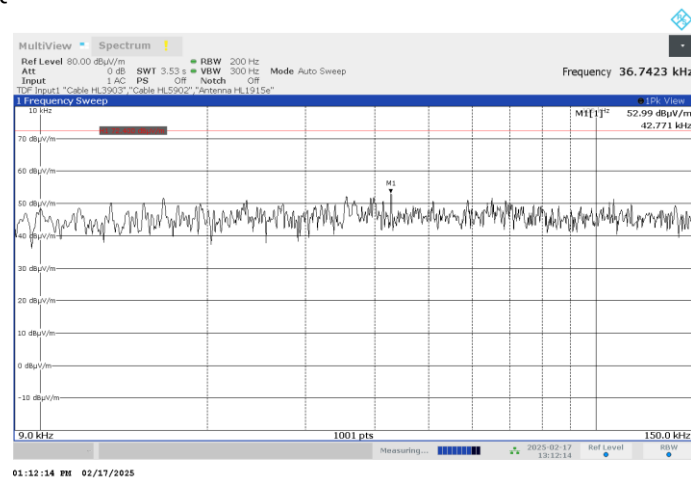
Plot 7.4.1 Radiated emission measurements in 9 kHz - 150 kHz range

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m

CARRIER FREQUENCY: Low



CARRIER FREQUENCY: Mid



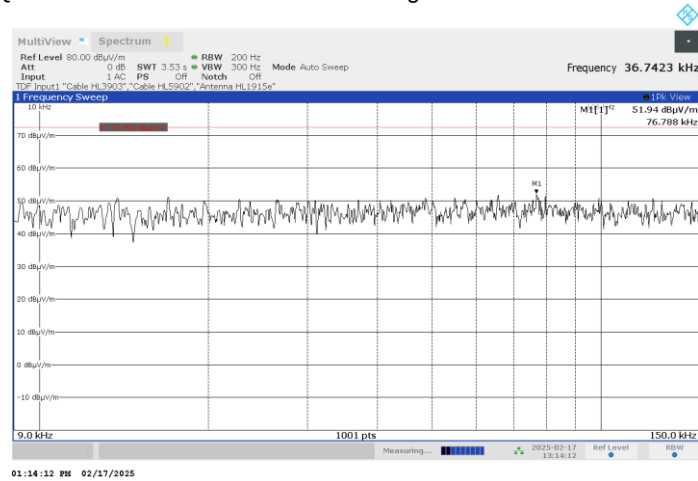


HERMON LABORATORIES

Test specification:		Section 90.210 (e) / RSS-119 Section 5.8.4, Radiated spurious emissions			
Test procedure:		47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-A, Section 2.2.12			
Test mode:		Compliance		Verdict: PASS	
Date(s):		17-Feb-25			
Temperature: 23 °C	Relative Humidity: 59 %		Air Pressure: 1012230 hPa		Power: 120 VAC
Remarks:					

CARRIER FREQUENCY:

High





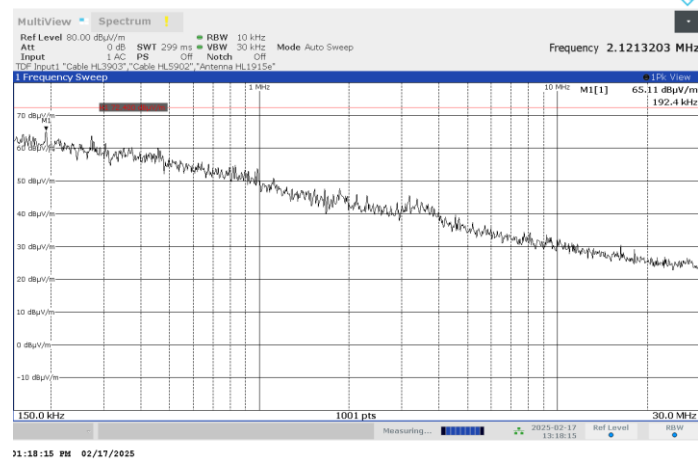
HERMON LABORATORIES

Test specification: Section 90.210 (e) / RSS-119 Section 5.8.4, Radiated spurious emissions			
Test procedure: 47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-A, Section 2.2.12			
Test mode: Compliance		Verdict: PASS	
Date(s): 17-Feb-25			
Temperature: 23 °C	Relative Humidity: 59 %	Air Pressure: 1012230 hPa	Power: 120 VAC
Remarks:			

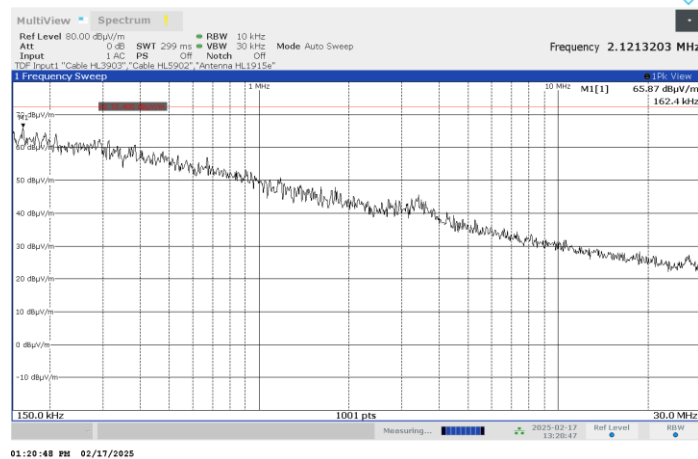
Plot 7.4.2 Radiated emission measurements in 150 kHz - 30 MHz range

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m

CARRIER FREQUENCY: Low



CARRIER FREQUENCY: Mid



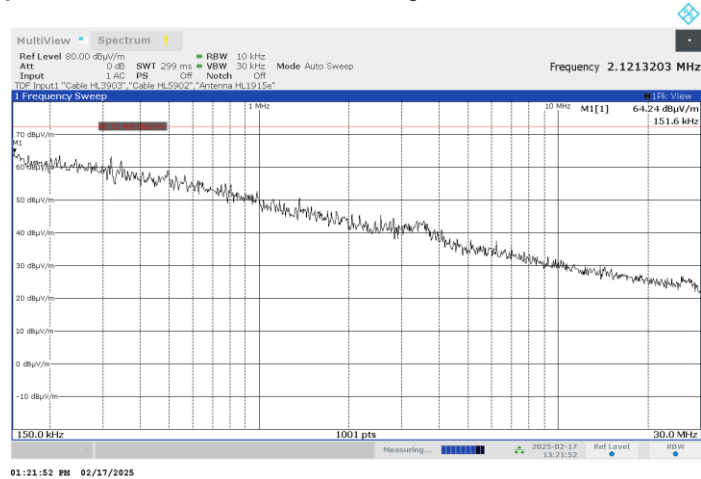


HERMON LABORATORIES

Test specification: Section 90.210 (e) / RSS-119 Section 5.8.4, Radiated spurious emissions			
Test procedure: 47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-A, Section 2.2.12			
Test mode: Compliance		Verdict: PASS	
Date(s): 17-Feb-25			
Temperature: 23 °C	Relative Humidity: 59 %	Air Pressure: 1012230 hPa	Power: 120 VAC
Remarks:			

CARRIER FREQUENCY:

High



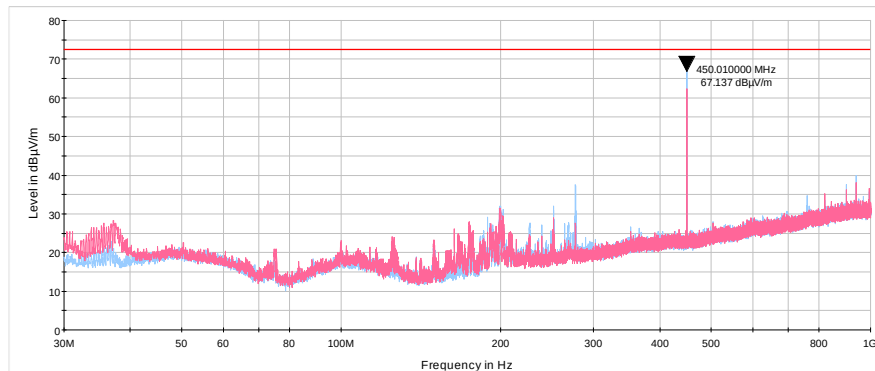


HERMON LABORATORIES

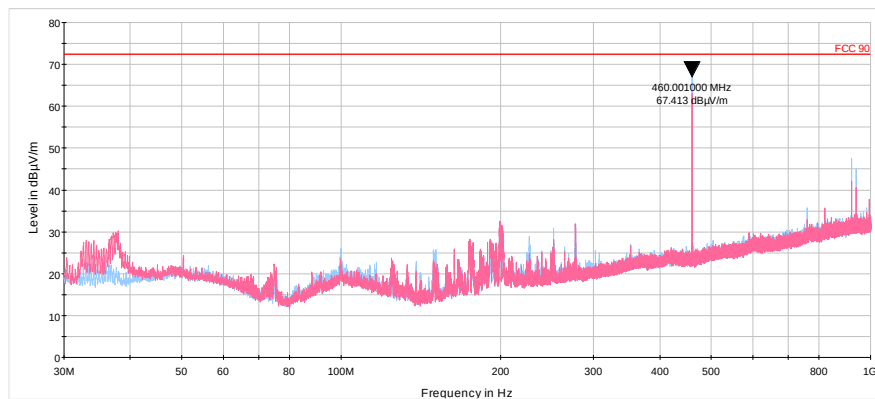
Test specification: Section 90.210 (e) / RSS-119 Section 5.8.4, Radiated spurious emissions			
Test procedure: 47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-A, Section 2.2.12			
Test mode: Compliance		Verdict: PASS	
Date(s): 17-Feb-25			
Temperature: 23 °C	Relative Humidity: 59 %	Air Pressure: 1012230 hPa	Power: 120 VAC
Remarks:			

Plot 7.4.3 Radiated emission measurements in 30 - 1000 MHz range

TEST SITE: Semi anechoic chamber
CARRIER FREQUENCY: Low (450 MHz)
ANTENNA POLARIZATION: Vertical and Horizontal
TEST DISTANCE: 3 m



TEST SITE: Semi anechoic chamber
CARRIER FREQUENCY: Mid (460 MHz)
ANTENNA POLARIZATION: Vertical and Horizontal
TEST DISTANCE: 3 m

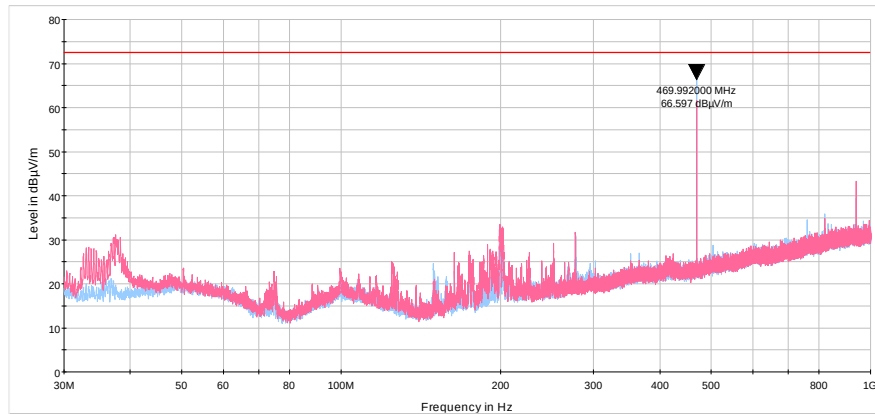




HERMON LABORATORIES

Test specification: Section 90.210 (e) / RSS-119 Section 5.8.4, Radiated spurious emissions			
Test procedure: 47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-A, Section 2.2.12			
Test mode: Compliance		Verdict: PASS	
Date(s): 17-Feb-25			
Temperature: 23 °C	Relative Humidity: 59 %	Air Pressure: 1012230 hPa	Power: 120 VAC
Remarks:			

TEST SITE:	Semi anechoic chamber
CARRIER FREQUENCY:	High (470 MHz)
ANTENNA POLARIZATION:	Vertical and Horizontal
TEST DISTANCE:	3 m





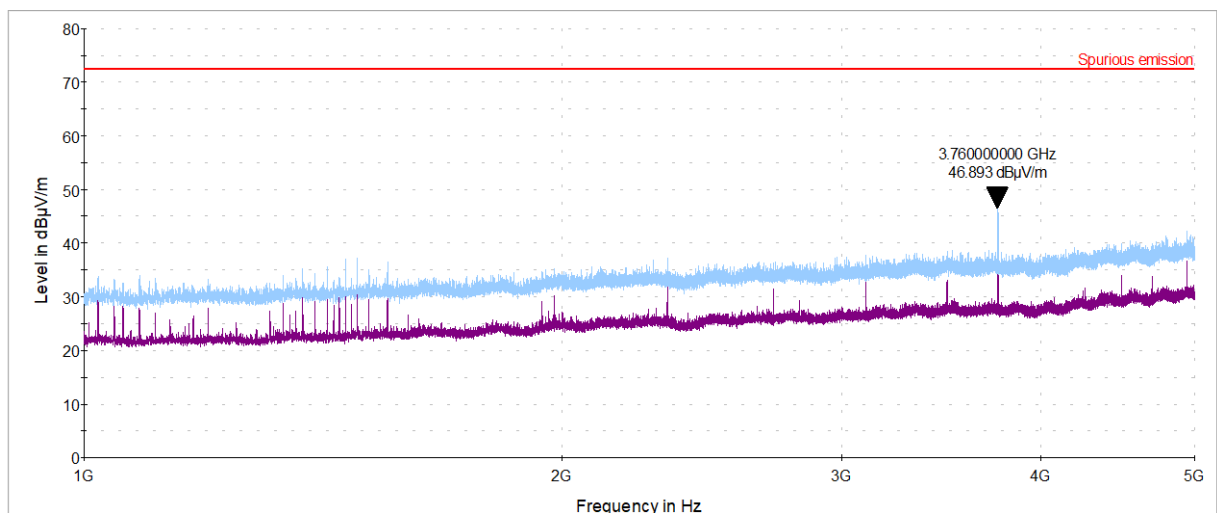
HERMON LABORATORIES

Test specification: Section 90.210 (e) / RSS-119 Section 5.8.4, Radiated spurious emissions			
Test procedure: 47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-A, Section 2.2.12			
Test mode: Compliance		Verdict: PASS	
Date(s): 17-Feb-25			
Temperature: 23 °C	Relative Humidity: 59 %	Air Pressure: 1012230 hPa	Power: 120 VAC
Remarks:			

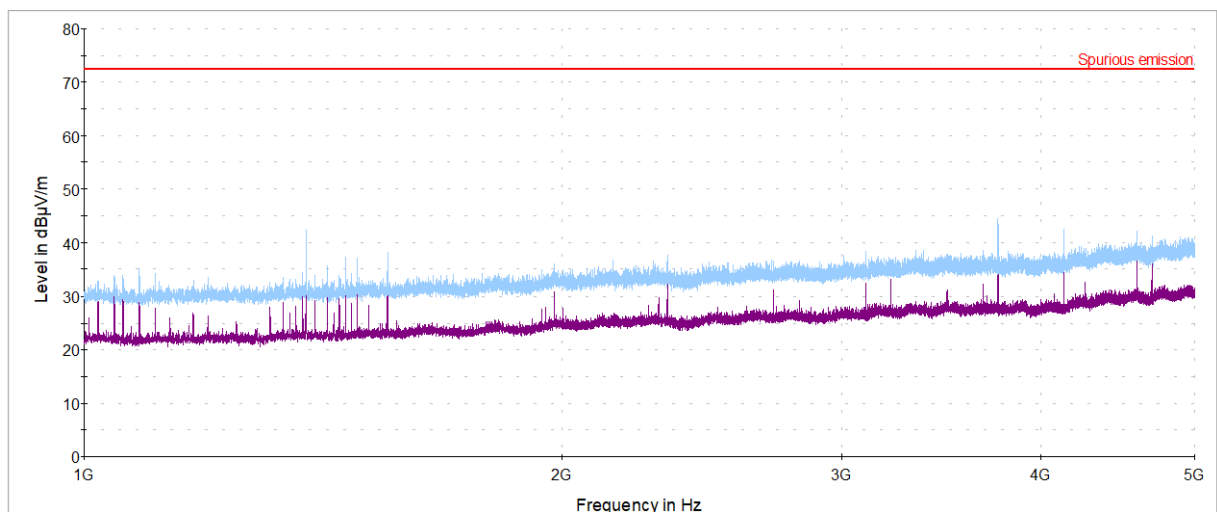
Plot 7.4.4 Radiated emission measurements in 1000 – 5000 MHz range

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

LOW CARRIER FREQUENCY: 450 MHz



MID CARRIER FREQUENCY: 460 MHz



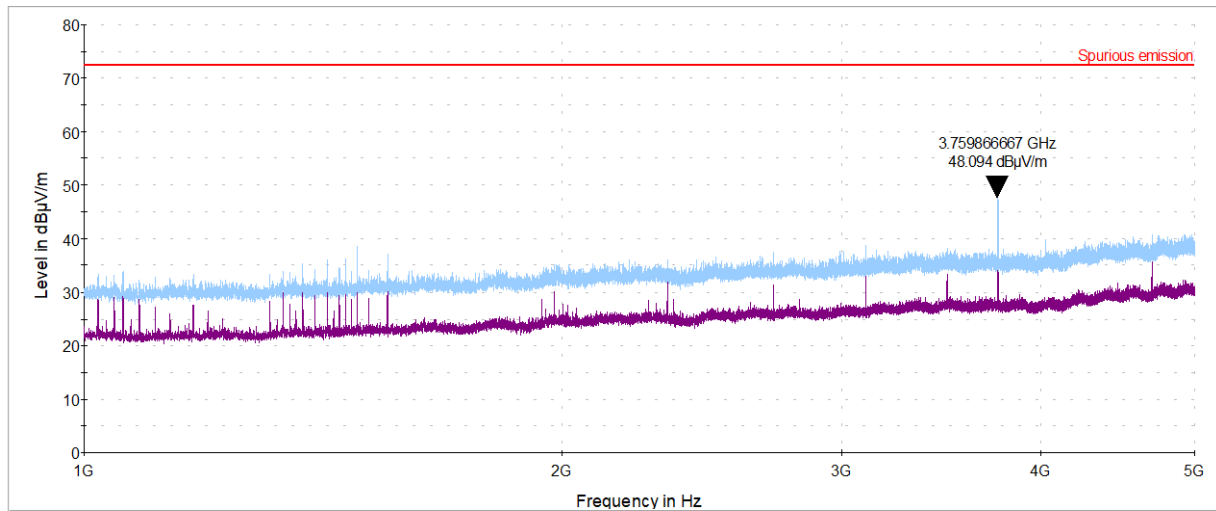


HERMON LABORATORIES

Test specification: Section 90.210 (e) / RSS-119 Section 5.8.4, Radiated spurious emissions			
Test procedure: 47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-A, Section 2.2.12			
Test mode: Compliance		Verdict: PASS	
Date(s): 17-Feb-25			
Temperature: 23 °C	Relative Humidity: 59 %	Air Pressure: 1012230 hPa	Power: 120 VAC
Remarks:			

HIGH CARRIER FREQUENCY:

470 MHz





Test specification: Section 90.210 (e) / RSS-119 Section 5.8.4, Conducted spurious emissions			
Test procedure: 47 CFR, Sections 2.1051 and 90.210(m); TIA/EIA-603-A, Section 2.2.13			
Test mode: Compliance		Verdict: PASS	
Date(s): 05-Feb-25 - 02-Feb-25			
Temperature: 23 °C	Relative Humidity: 35 %	Air Pressure: 1020 hPa	Power: 120 VAC
Remarks:			

7.5 Spurious emissions at RF antenna connector test

7.5.1 General

This test was performed to measure spurious emissions at RF antenna connector. Specification test limits are given in Table 7.5.1.

Table 7.5.1 Spurious emission limits

Frequency, MHz	Attenuation below carrier, dBc	ERP of spurious, dBm
0.009 – 10th harmonic*	65 (mask E)	-22.0

* - spurious emission limits do not apply to the in band emission within ± 250 % of the authorized bandwidth from the carrier; investigated in course of emission mask testing

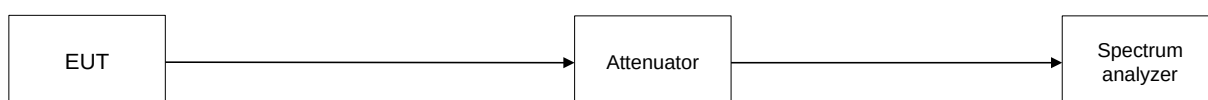
7.5.2 Rest procedure

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 for end user RF output power.

7.5.2.3 The spurious emission was measured with spectrum analyzer as provided in Table 7.5.2 and associated plots.

Figure 7.5.1 Spurious emission test setup





Test specification: Section 90.210 (e) / RSS-119 Section 5.8.4, Conducted spurious emissions			
Test procedure: 47 CFR, Sections 2.1051 and 90.210(m); TIA/EIA-603-A, Section 2.2.13			
Test mode: Compliance		Verdict: PASS	
Date(s): 05-Feb-25 - 02-Feb-25			
Temperature: 23 °C	Relative Humidity: 35 %	Air Pressure: 1020 hPa	Power: 120 VAC
Remarks:			

Table 7.5.2 Spurious emission test results

ASSIGNED FREQUENCY RANGE: 450-470 MHz
 INVESTIGATED FREQUENCY RANGE: 0.009 – 5000 MHz
 DETECTOR USED: Peak
 VIDEO BANDWIDTH: ≥ Resolution bandwidth
 MODULATION: 4GFSK
 BIT RATE: 4.8 kbps

Frequency, MHz	SA reading, dBm	Attenuator, dB	Cable loss, dB	RBW, kHz	Spurious emission, dBm	Attenuation below carrier, dBc	Limit, dBc	Margin, dB*	Verdict
Low carrier frequency 450 MHz									
294.620	-41.86	Included	Included	100	-41.86	84.33	65	19.33	Pass
434.392	-32.83	Included	Included	100	-32.83	75.30	65	10.30	Pass
449.950	-27.94	Included	Included	100	-27.94	70.41	65	5.41	Pass
450.050	-29.82	Included	Included	100	-29.82	72.29	65	7.29	Pass
469.920	-26.43	Included	Included	100	-26.43	68.90	65	3.90	Pass
900.140	-34.60	Included	Included	100	-34.60	77.07	65	12.07	Pass
1350.020	-46.10	Included	Included	1000	-46.10	88.57	65	23.57	Pass
Mid carrier frequency 460 MHz									
373.730	-40.63	Included	Included	100	-40.63	83.60	65	18.60	Pass
423.135	-36.38	Included	Included	100	-36.38	79.35	65	14.35	Pass
446.819	-31.36	Included	Included	100	-31.36	74.33	65	9.33	Pass
459.950	-30.43	Included	Included	100	-30.43	73.40	65	8.40	Pass
460.060	-29.88	Included	Included	100	-29.88	72.85	65	7.85	Pass
475.680	-34.63	Included	Included	100	-34.63	77.60	65	12.60	Pass
501.320	-38.45	Included	Included	100	-38.45	81.42	65	16.42	Pass
919.830	-36.44	Included	Included	100	-36.44	79.41	65	14.41	Pass
1379.920	-39.82	Included	Included	1000	-39.82	82.79	65	17.79	Pass
High carrier frequency 470 MHz									
291.730	-41.29	Included	Included	100	-41.29	84.02	65	19.02	Pass
449.942	-26.98	Included	Included	100	-26.98	69.71	65	4.71	Pass
452.009	-30.31	Included	Included	100	-30.31	73.04	65	8.04	Pass
459.980	-27.65	Included	Included	100	-27.65	70.38	65	5.38	Pass
469.950	-28.95	Included	Included	100	-28.95	71.68	65	6.68	Pass
470.050	-28.57	Included	Included	100	-28.57	71.30	65	6.30	Pass
483.170	-34.52	Included	Included	100	-34.52	77.25	65	12.25	Pass
940.090	-37.00	Included	Included	100	-37.00	79.73	65	14.73	Pass
1408.100	-32.25	Included	Included	1000	-32.25	74.98	65	9.98	Pass

*- Margin = Spurious emission – specification limit.

Reference numbers of test equipment used

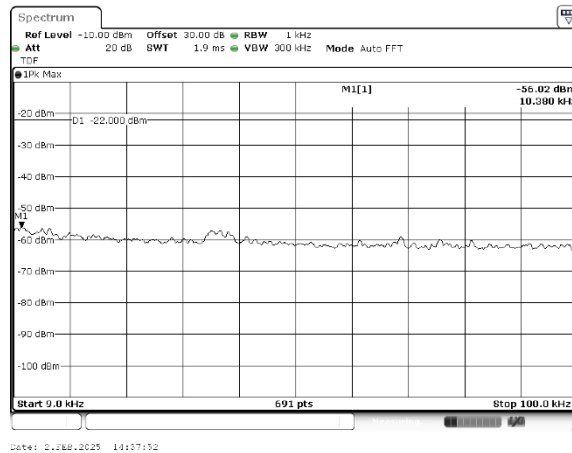
HL 3339	HL 3818	HL 3901	HL 4355	HL 5588	HL 5626		
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Full description is given in Appendix A.

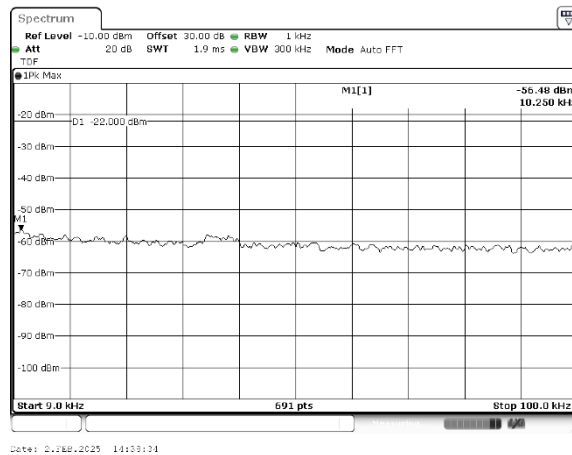


Test specification: Section 90.210 (e) / RSS-119 Section 5.8.4, Conducted spurious emissions			
Test procedure: 47 CFR, Sections 2.1051 and 90.210(m); TIA/EIA-603-A, Section 2.2.13			
Test mode: Compliance		Verdict: PASS	
Date(s): 05-Feb-25 - 02-Feb-25			
Temperature: 23 °C	Relative Humidity: 35 %	Air Pressure: 1020 hPa	Power: 120 VAC
Remarks:			

Plot 7.5.1 Spurious emission measurements in 9 - 100 kHz range at low carrier frequency



Plot 7.5.2 Spurious emission measurements in 9 - 100 kHz range at mid carrier frequency

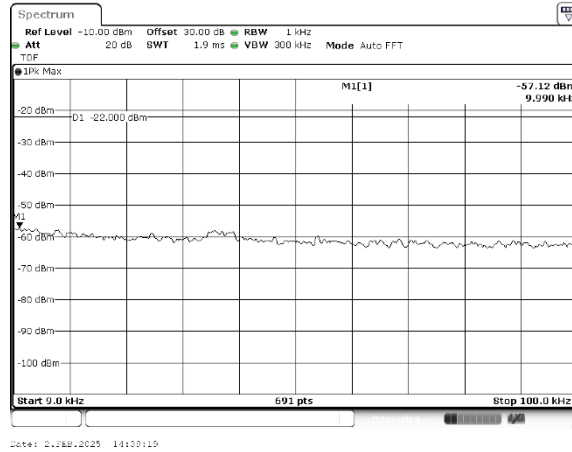




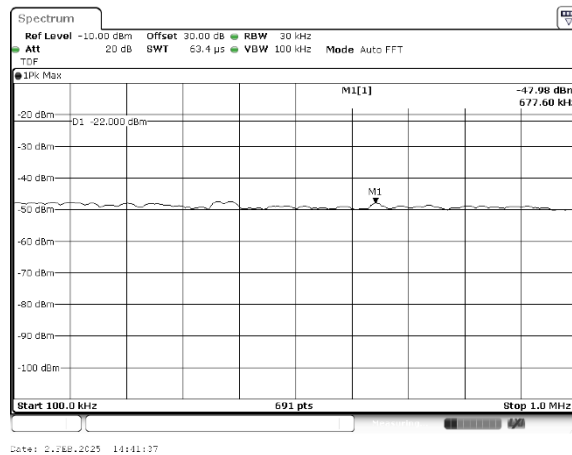
HERMON LABORATORIES

Test specification: Section 90.210 (e) / RSS-119 Section 5.8.4, Conducted spurious emissions			
Test procedure: 47 CFR, Sections 2.1051 and 90.210(m); TIA/EIA-603-A, Section 2.2.13			
Test mode: Compliance		Verdict: PASS	
Date(s): 05-Feb-25 - 02-Feb-25			
Temperature: 23 °C	Relative Humidity: 35 %	Air Pressure: 1020 hPa	Power: 120 VAC
Remarks:			

Plot 7.5.3 Spurious emission measurements in 9 - 100 kHz range at high carrier frequency



Plot 7.5.4 Spurious emission measurements in 0.10 - 1.0 MHz range at low carrier frequency

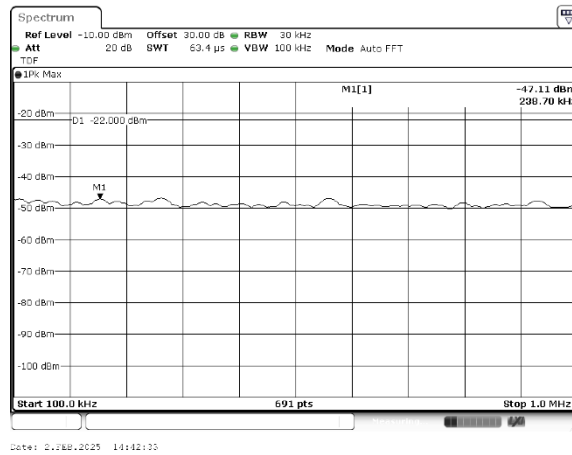




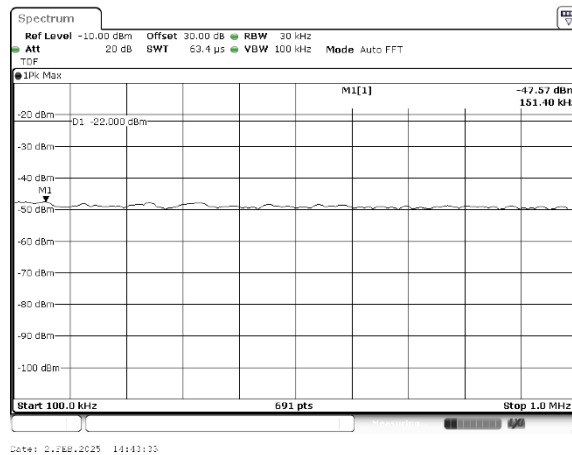
HERMON LABORATORIES

Test specification:		Section 90.210 (e) / RSS-119 Section 5.8.4, Conducted spurious emissions	
Test procedure:		47 CFR, Sections 2.1051 and 90.210(m); TIA/EIA-603-A, Section 2.2.13	
Test mode:		Verdict: PASS	
Date(s):			
05-Feb-25 - 02-Feb-25			
Temperature: 23 °C	Relative Humidity: 35 %	Air Pressure: 1020 hPa	Power: 120 VAC
Remarks:			

Plot 7.5.5 Spurious emission measurements in 0.10 - 1.0 MHz range at mid carrier frequency



Plot 7.5.6 Spurious emission measurements in 0.10 – 1.0 MHz range at high carrier frequency

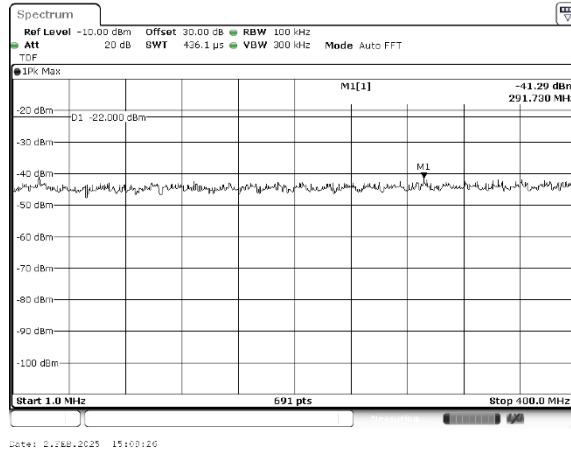




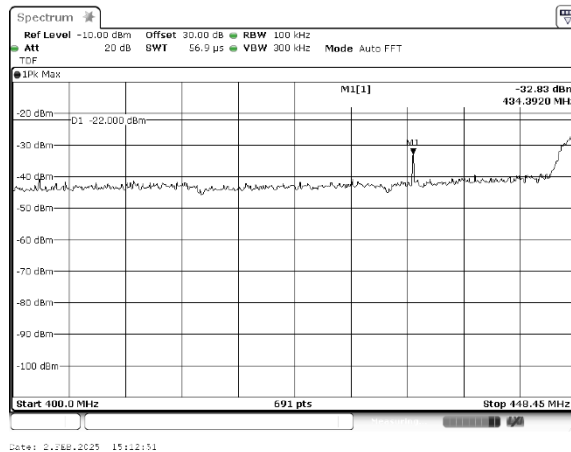
HERMON LABORATORIES

Test specification: Section 90.210 (e) / RSS-119 Section 5.8.4, Conducted spurious emissions			
Test procedure: 47 CFR, Sections 2.1051 and 90.210(m); TIA/EIA-603-A, Section 2.2.13			
Test mode: Compliance		Verdict: PASS	
Date(s): 05-Feb-25 - 02-Feb-25			
Temperature: 23 °C	Relative Humidity: 35 %	Air Pressure: 1020 hPa	Power: 120 VAC
Remarks:			

Plot 7.5.9 Spurious emission measurements in 1.0 - 400 MHz range at high carrier frequency



Plot 7.5.10 Spurious emission measurements in 400-448.45 MHz range at low carrier frequency

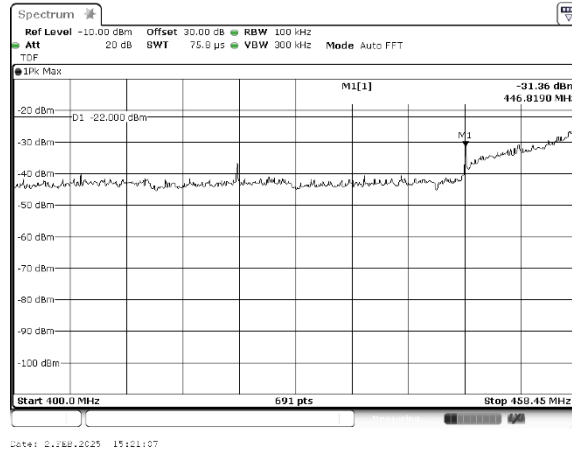




HERMON LABORATORIES

Test specification: Section 90.210 (e) / RSS-119 Section 5.8.4, Conducted spurious emissions			
Test procedure: 47 CFR, Sections 2.1051 and 90.210(m); TIA/EIA-603-A, Section 2.2.13			
Test mode: Compliance		Verdict: PASS	
Date(s): 05-Feb-25 - 02-Feb-25			
Temperature: 23 °C	Relative Humidity: 35 %	Air Pressure: 1020 hPa	Power: 120 VAC
Remarks:			

Plot 7.5.11 Spurious emission measurements in 400-458.45 MHz at mid carrier frequency



Plot 7.5.12 Spurious emission measurements in 400-468.45 MHz at high carrier frequency

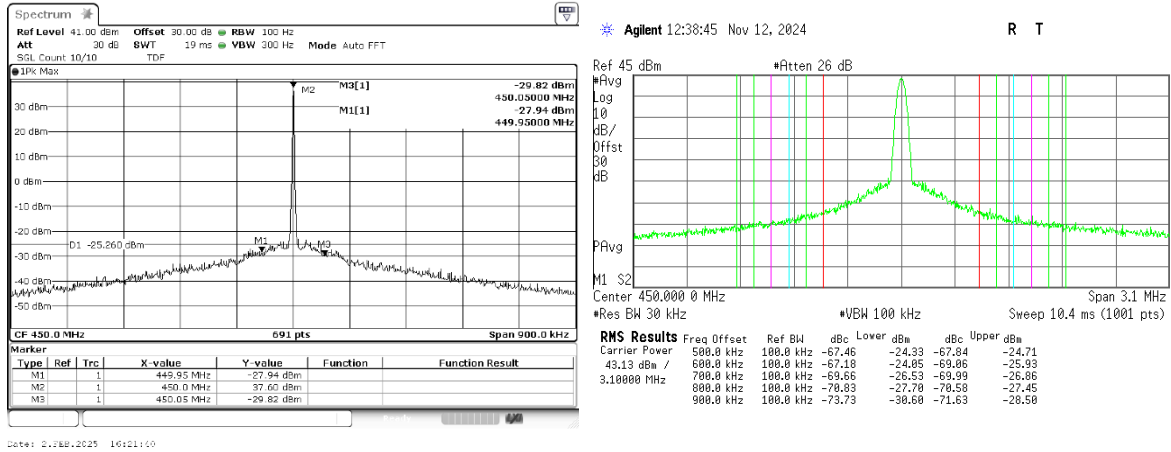




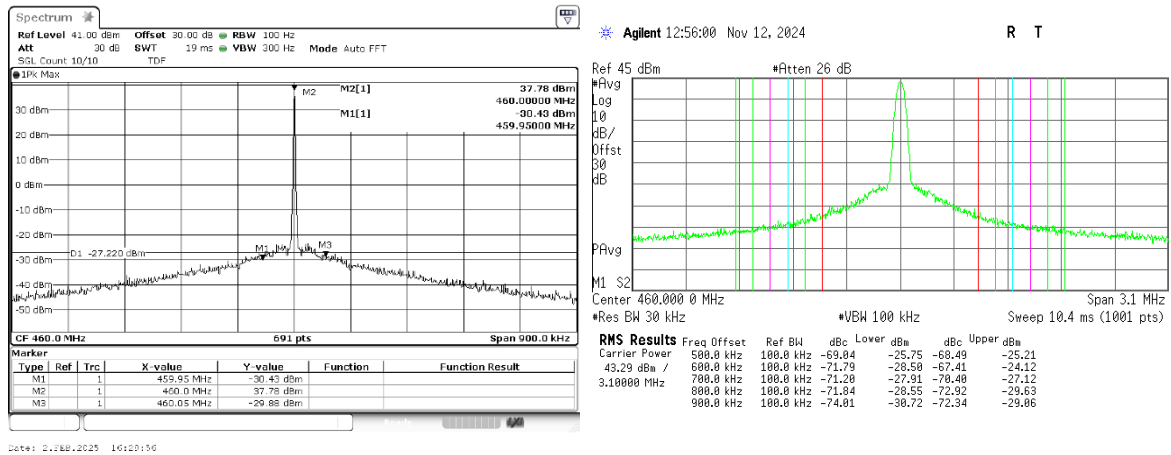
HERMON LABORATORIES

Test specification: Section 90.210 (e) / RSS-119 Section 5.8.4, Conducted spurious emissions			
Test procedure: 47 CFR, Sections 2.1051 and 90.210(m); TIA/EIA-603-A, Section 2.2.13			
Test mode: Compliance		Verdict: PASS	
Date(s): 05-Feb-25 - 02-Feb-25			
Temperature: 23 °C	Relative Humidity: 35 %	Air Pressure: 1020 hPa	Power: 120 VAC
Remarks:			

Plot 7.5.13 Spurious emission measurements in 448.45 – 451.55 MHz at low carrier frequency



Plot 7.5.14 Spurious emission measurements in 458.45 – 461.55 MHz at mid carrier frequency

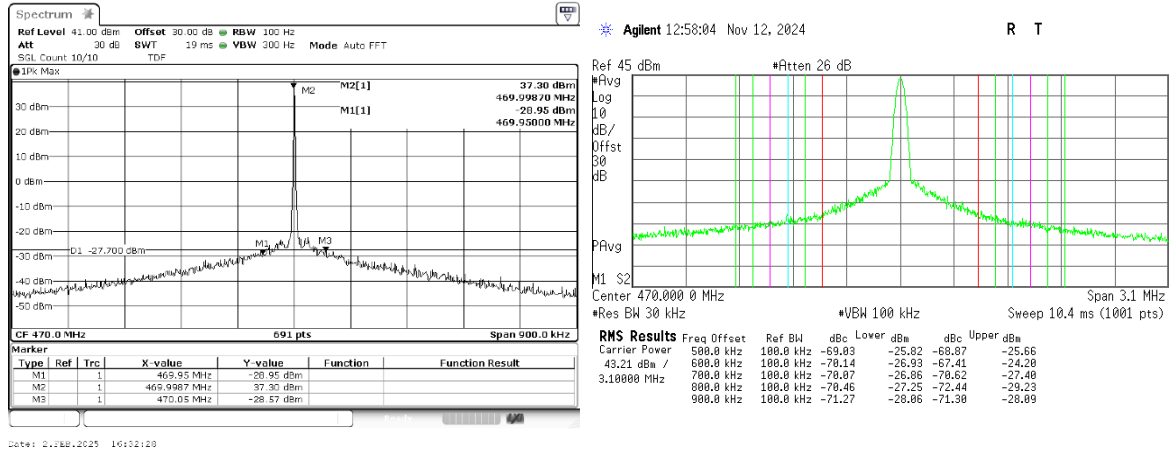




HERMON LABORATORIES

Test specification: Section 90.210 (e) / RSS-119 Section 5.8.4, Conducted spurious emissions			
Test procedure: 47 CFR, Sections 2.1051 and 90.210(m); TIA/EIA-603-A, Section 2.2.13			
Test mode: Compliance		Verdict: PASS	
Date(s): 05-Feb-25 - 02-Feb-25			
Temperature: 23 °C	Relative Humidity: 35 %	Air Pressure: 1020 hPa	Power: 120 VAC
Remarks:			

Plot 7.5.15 Spurious emission measurements in 468.45 – 471.55 MHz at high carrier frequency

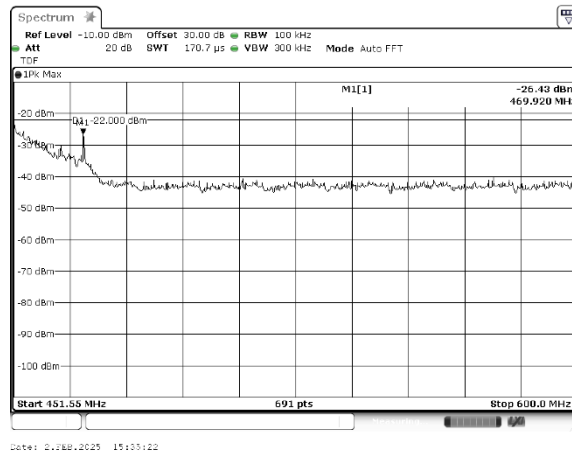




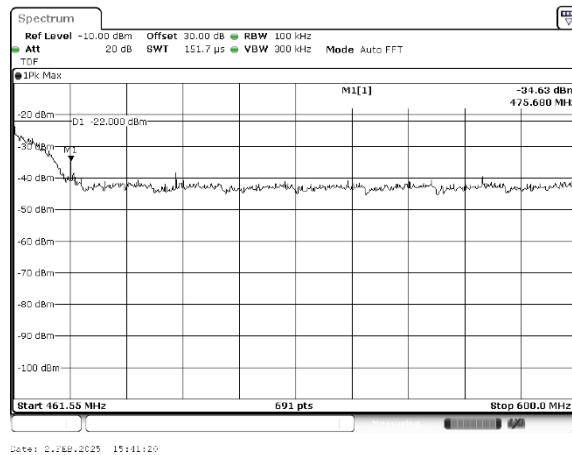
HERMON LABORATORIES

Test specification: Section 90.210 (e) / RSS-119 Section 5.8.4, Conducted spurious emissions			
Test procedure: 47 CFR, Sections 2.1051 and 90.210(m); TIA/EIA-603-A, Section 2.2.13			
Test mode: Compliance		Verdict: PASS	
Date(s): 05-Feb-25 - 02-Feb-25			
Temperature: 23 °C	Relative Humidity: 35 %	Air Pressure: 1020 hPa	Power: 120 VAC
Remarks:			

Plot 7.5.16 Conducted spurious emission measurements in 451.55 – 600 MHz of low carrier frequency



Plot 7.5.17 Conducted spurious emission measurements in 461.55 – 600 MHz of mid carrier frequency

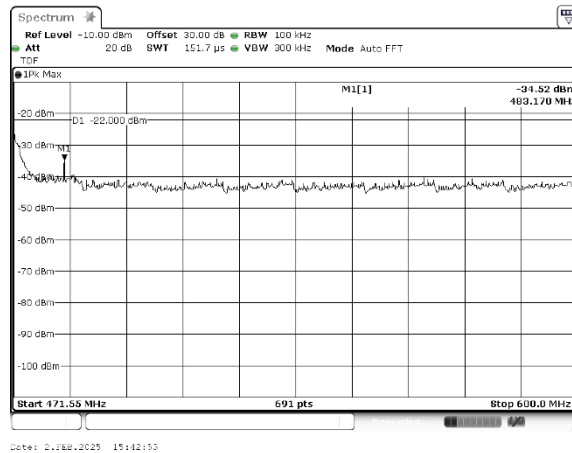




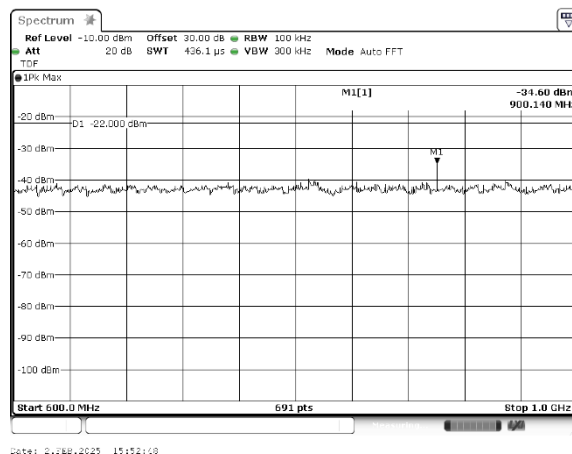
HERMON LABORATORIES

Test specification: Section 90.210 (e) / RSS-119 Section 5.8.4, Conducted spurious emissions			
Test procedure: 47 CFR, Sections 2.1051 and 90.210(m); TIA/EIA-603-A, Section 2.2.13			
Test mode: Compliance		Verdict: PASS	
Date(s): 05-Feb-25 - 02-Feb-25			
Temperature: 23 °C	Relative Humidity: 35 %	Air Pressure: 1020 hPa	Power: 120 VAC
Remarks:			

Plot 7.5.18 Conducted spurious emission measurements in 471.55 – 600 MHz of high carrier frequency



Plot 7.5.19 Conducted spurious emission measurements in 600 – 1000 MHz of low carrier frequency

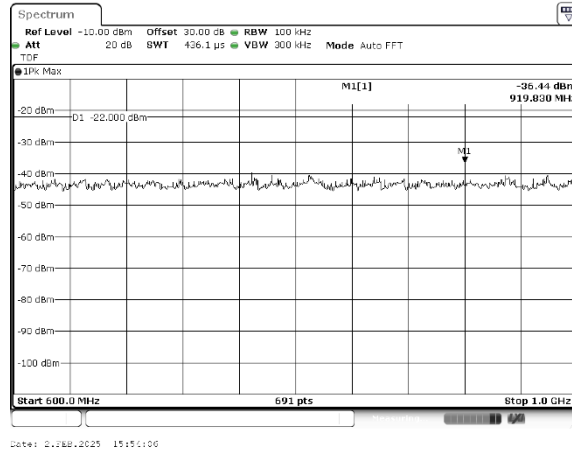




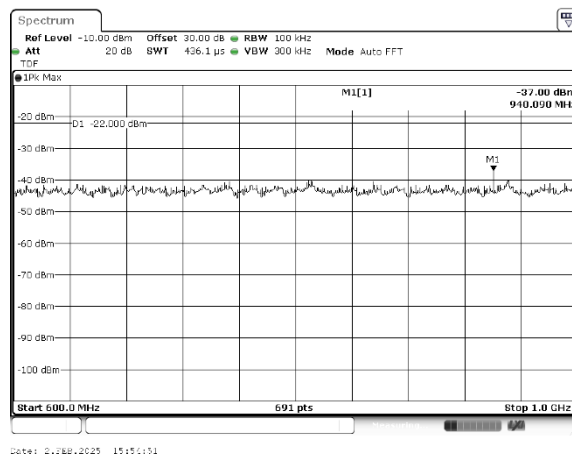
HERMON LABORATORIES

Test specification: Section 90.210 (e) / RSS-119 Section 5.8.4, Conducted spurious emissions			
Test procedure: 47 CFR, Sections 2.1051 and 90.210(m); TIA/EIA-603-A, Section 2.2.13			
Test mode: Compliance		Verdict: PASS	
Date(s): 05-Feb-25 - 02-Feb-25			
Temperature: 23 °C	Relative Humidity: 35 %	Air Pressure: 1020 hPa	Power: 120 VAC
Remarks:			

Plot 7.5.20 Conducted spurious emission measurements in 600 – 1000 MHz of mid carrier frequency



Plot 7.5.21 Conducted spurious emission measurements in 600 – 1000 MHz of high carrier frequency

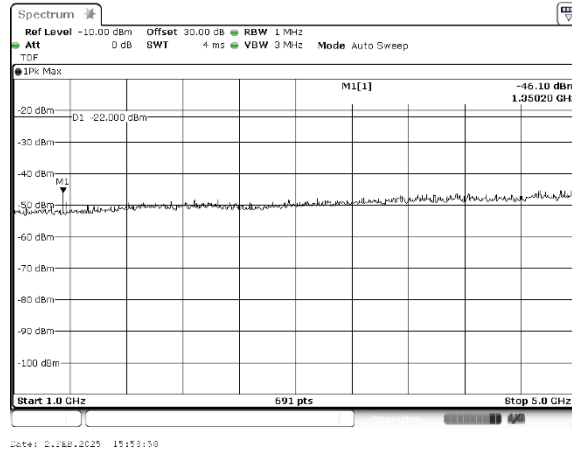




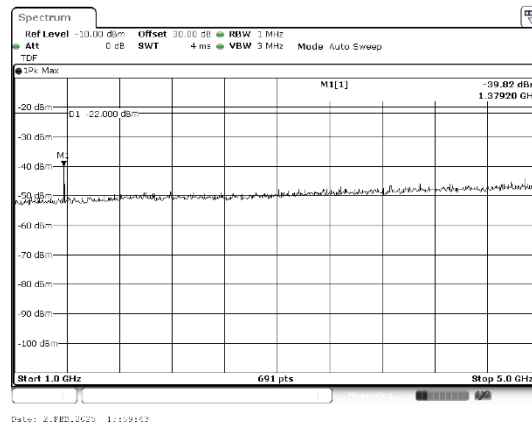
HERMON LABORATORIES

Test specification: Section 90.210 (e) / RSS-119 Section 5.8.4, Conducted spurious emissions			
Test procedure: 47 CFR, Sections 2.1051 and 90.210(m); TIA/EIA-603-A, Section 2.2.13			
Test mode: Compliance		Verdict: PASS	
Date(s): 05-Feb-25 - 02-Feb-25			
Temperature: 23 °C	Relative Humidity: 35 %	Air Pressure: 1020 hPa	Power: 120 VAC
Remarks:			

Plot 7.5.22 Conducted spurious emission measurements in 1 – 5 GHz of low carrier frequency



Plot 7.5.23 Conducted spurious emission measurements in 1 – 5 GHz of mid carrier frequency

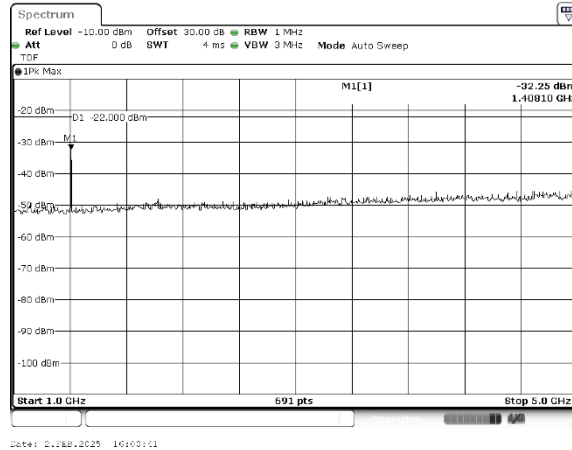




HERMON LABORATORIES

Test specification:		Section 90.210 (e) / RSS-119 Section 5.8.4, Conducted spurious emissions	
Test procedure:		47 CFR, Sections 2.1051 and 90.210(m); TIA/EIA-603-A, Section 2.2.13	
Test mode:		Verdict: PASS	
Date(s):			
05-Feb-25 - 02-Feb-25			
Temperature: 23 °C	Relative Humidity: 35 %	Air Pressure: 1020 hPa	Power: 120 VAC
Remarks:			

Plot 7.5.24 Conducted spurious emission measurements in 1 – 5 GHz of high carrier frequency





Test specification: Section 90.213 / RSS-119 Section 5.3, Frequency stability			
Test procedure: 47 CFR, Section 2.1055; TIA/EIA-603-A Section 2.2.2			
Test mode: Compliance		Verdict: PASS	
Date(s): 06-Feb-25			
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1019 hPa	Power: 120 VAC
Remarks:			

7.6 Frequency stability test

7.6.1 General

This test was performed to measure frequency stability of transmitter RF carrier. Specification test limits are given in Table 7.6.1. The test results are provided in Table 7.6.2.

Table 7.6.1 Frequency stability limits

Assigned frequency, MHz	Maximum allowed frequency displacement	
	ppm	Hz
450	0.5	225
460		230
470		235

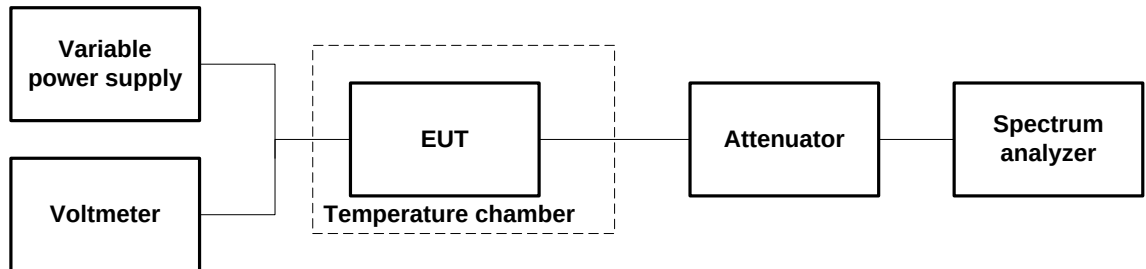
7.6.2 Test procedure

- 7.6.2.1 The EUT was set up as shown in Figure 7.6.1, energized and its proper operation was checked.
- 7.6.2.2 The EUT power was turned off. Temperature within test chamber was set to +30°C and a period of time sufficient to stabilize all of the oscillator circuit components was allowed.
- 7.6.2.3 The EUT was powered on and carrier frequency was measured at start up moment and then every minute until frequency had been stabilized or 10 minutes elapsed whichever reached the last. The EUT was powered off.
- 7.6.2.4 The above procedure was repeated at 0°C and at the lowest test temperature.
- 7.6.2.5 The EUT was powered on and carrier frequency was measured at start up moment and at the end of stabilization period at the rest of test temperatures and voltages. The EUT was powered off.
- 7.6.2.6 Frequency displacement was calculated and compared with the limit as provided in Table 7.6.2.



Test specification: Section 90.213 / RSS-119 Section 5.3, Frequency stability			
Test procedure: 47 CFR, Section 2.1055; TIA/EIA-603-A Section 2.2.2			
Test mode: Compliance		Verdict: PASS	
Date(s): 06-Feb-25			
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1019 hPa	Power: 120 VAC
Remarks:			

Figure 7.6.1 Frequency stability test setup





HERMON LABORATORIES

Test specification: Section 90.213 / RSS-119 Section 5.3, Frequency stability			
Test procedure: 47 CFR, Section 2.1055; TIA/EIA-603-A Section 2.2.2			
Test mode: Compliance		Verdict: PASS	
Date(s): 06-Feb-25			
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1019 hPa	Power: 120 VAC
Remarks:			

Table 7.6.2 Frequency stability test results

OPERATING FREQUENCY: 450-470 MHz
 NOMINAL POWER VOLTAGE: 120 VAC
 TEMPERATURE STABILIZATION PERIOD: 20 min
 POWER DURING TEMPERATURE TRANSITION: Off
 SPECTRUM ANALYZER MODE: Counter
 RESOLUTION BANDWIDTH: 10 Hz
 VIDEO BANDWIDTH: 10 Hz
 MODULATION: Unmodulated

T, °C	Voltage, V	Frequency, MHz							Max frequency drift, Hz		Limit, Hz	Margin, Hz	Verdict
		Start up	1 st min	2 nd min	3 rd min	4 th min	5 th min	10 th min	Positive	Negative			
Low frequency 450 MHz													
-30	nominal	450.000014	450.000014	450.000014	450.000014	450.000014	450.000014	450.000014	1	0	225	-224	Pass
-20	nominal	450.000014	NA	NA	NA	NA	NA	450.000014	1	0		-224	Pass
-10	nominal	450.000014	NA	NA	NA	NA	NA	450.000014	1	0		-224	Pass
0	nominal	450.000014	450.000014	450.000014	450.000014	450.000014	450.000014	450.000014	1	0		-224	Pass
10	nominal	450.000013	NA	NA	NA	NA	NA	450.000013	0	0		-225	Pass
20	+15%	450.000013	NA	NA	NA	NA	NA	450.000013	0	0		-225	Pass
20	nominal	450.000013	NA	NA	NA	NA	NA	450.000013*	0	0		-225	Pass
20	-15%	450.000013	NA	NA	NA	NA	NA	450.000013	0	0		-225	Pass
30	nominal	450.000011	450.000011	450.000012	450.000012	450.000012	450.000012	450.000012	0	1		-224	Pass
40	nominal	450.000011	NA	NA	NA	NA	NA	450.000011	0	2		-223	Pass
50	nominal	450.000001	NA	NA	NA	NA	NA	450.000010	0	3		-222	Pass
60	nominal	450.000008	NA	NA	NA	NA	NA	450.000008	0	5		-220	Pass
70	nominal	450.000009	NA	NA	NA	NA	NA	450.000006	0	7		-218	Pass
Mid frequency 460 MHz													
-30	nominal	460.000014	460.000014	460.000014	460.000014	460.000014	460.000014	460.000014	1	0	230	-229	Pass
-20	nominal	460.000014	NA	NA	NA	NA	NA	460.000014	1	0		-229	Pass
-10	nominal	460.000014	NA	NA	NA	NA	NA	460.000014	1	0		-229	Pass
0	nominal	460.000014	460.000014	460.000014	460.000014	460.000014	460.000014	460.000014	1	0		-229	Pass
10	nominal	460.000013	NA	NA	NA	NA	NA	460.000013	0	0		-230	Pass
20	+15%	460.000013	NA	NA	NA	NA	NA	460.000013	0	0		-230	Pass
20	nominal	460.000013	NA	NA	NA	NA	NA	460.000013*	0	0		-230	Pass
20	-15%	460.000013	NA	NA	NA	NA	NA	460.000013	0	0		-230	Pass
30	nominal	460.000012	460.000012	460.000012	460.000012	460.000012	460.000012	460.000012	0	1		-229	Pass
40	nominal	460.000011	NA	NA	NA	NA	NA	460.000011	0	2		-228	Pass
50	nominal	460.000011	NA	NA	NA	NA	NA	460.000010	0	3		-227	Pass
60	nominal	460.000008	NA	NA	NA	NA	NA	460.000008	0	5		-225	Pass
70	nominal	460.000008	NA	NA	NA	NA	NA	460.000007	0	6		-224	Pass



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Report ID: TELRAD_FCC.55848_Rev1.docx
Date of Issue: 25-May-25

Test specification: Section 90.213 / RSS-119 Section 5.3, Frequency stability			
Test procedure: 47 CFR, Section 2.1055; TIA/EIA-603-A Section 2.2.2			
Test mode: Compliance		Verdict: PASS	
Date(s): 06-Feb-25			
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1019 hPa	Power: 120 VAC
Remarks:			



Test specification: Section 90.213 / RSS-119 Section 5.3, Frequency stability			
Test procedure: 47 CFR, Section 2.1055; TIA/EIA-603-A Section 2.2.2			
Test mode: Compliance		Verdict: PASS	
Date(s): 06-Feb-25			
Temperature: 24 °C	Relative Humidity: 42 %	Air Pressure: 1019 hPa	Power: 120 VAC
Remarks:			

Table 7.6.3 Frequency stability test results (continuation)

OPERATING FREQUENCY: 450-470 MHz
 NOMINAL POWER VOLTAGE: 120 VAC
 TEMPERATURE STABILIZATION PERIOD: 20 min
 POWER DURING TEMPERATURE TRANSITION: Off
 SPECTRUM ANALYZER MODE: Counter
 RESOLUTION BANDWIDTH: 10 Hz
 VIDEO BANDWIDTH: 10 Hz
 MODULATION: Unmodulated

High frequency 470 MHz													
-30	nominal	470.000015	470.000015	470.000015	470.000015	470.000015	470.000015	470.000015	2	0	235	-233	Pass
-20	nominal	470.000015	NA	NA	NA	NA	NA	470.000015	2	0		-233	Pass
-10	nominal	470.000014	NA	NA	NA	NA	NA	470.000014	1	0		-234	Pass
0	nominal	470.000014	470.000014	470.000014	470.000014	470.000014	470.000014	470.000014	1	0		-234	Pass
10	nominal	470.000013	NA	NA	NA	NA	NA	470.000013	0	0		-235	Pass
20	+15%	470.000013	NA	NA	NA	NA	NA	470.000013	0	0		-235	Pass
20	nominal	470.000013	NA	NA	NA	NA	NA	470.000013*	0	0		-235	Pass
20	-15%	470.000013	NA	NA	NA	NA	NA	470.000013	0	0		-235	Pass
30	nominal	470.000012	470.000012	470.000012	470.000012	470.000012	470.000012	470.000012	0	1		-234	Pass
40	nominal	470.000011	NA	NA	NA	NA	NA	470.000011	0	2		-233	Pass
50	nominal	470.000011	NA	NA	NA	NA	NA	470.000010	0	3		-232	Pass
60	nominal	470.000008	NA	NA	NA	NA	NA	470.000008	0	5		-230	Pass
70	nominal	470.000008	NA	NA	NA	NA	NA	470.000007	0	6		-229	Pass

* - Reference frequency

Reference numbers of test equipment used

HL 3047	HL 3286	HL 3434	HL 5977				
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Full description is given in Appendix A.



Test specification: Section 90.214 / RSS-119 Section 5.9, Transient frequency behaviour			
Test procedure: TIA/EIA-603-A, Section 2.2.19			
Test mode: Compliance		Verdict: PASS	
Date(s): 05-Feb-25			
Temperature: 23 °C	Relative Humidity: 45 %	Air Pressure: 1007 hPa	Power: 120 VAC
Remarks:			

7.7 Transient frequency behaviour test

7.7.1 General

This test was performed to measure carrier frequency drift as function of time during transmitter start up and shut down. Specification test limits are given in Table 7.7.1. The test results are provided in the associated plots.

Table 7.7.1 Transient frequency limits

Channel bandwidth, kHz	Carrier frequency tolerance, kHz	Duration, ms	Time interval*
421.0 – 512.0 MHz band			
6.25	± 6.25	10.0	t_1
	± 3.125	25.0	t_2
	± 6.25	10.0	t_3

* - t_{on} is the instant when a 1 kHz test signal is completely suppressed;

t_1 is the time period immediately following t_{on} ;

t_2 is the time period immediately following t_1 ;

t_3 is the time period from the instant when the transmitter is turned off until t_{off} ;

t_{off} is the instant when the 1 kHz test signal starts to rise.

7.7.2 Test procedure

7.7.2.1 The EUT was set up as shown in Figure 7.7.1, energized and its proper operation was checked. Variable attenuator was adjusted to provide signal level approximately 40 dB below the FM receiver maximum allowed level as measured with RF power meter. The EUT was turned off.

7.7.2.2 The signal generator was set to the assigned transmitter frequency modulated with 1 kHz tone at 25 kHz deviation and the output power was adjusted to provide the same as the EUT signal level at the FM receiver input as measured with power meter.

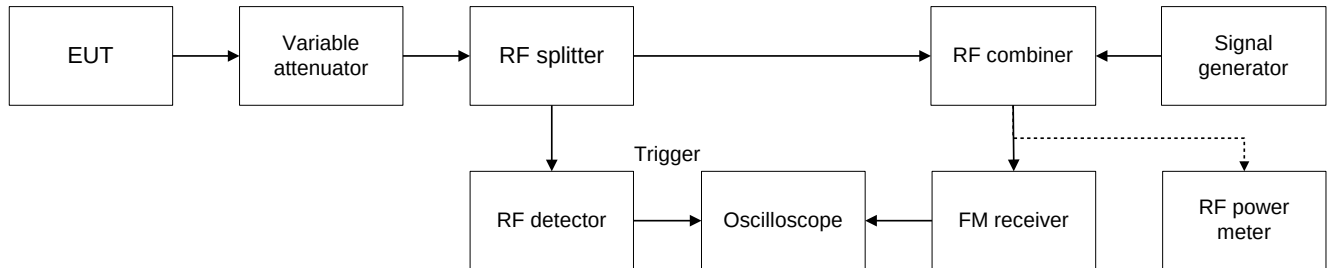
7.7.2.3 The storage oscilloscope was set to provide horizontal sweep rate 10 milliseconds per division. Amplitude control of the storage oscilloscope was adjusted to obtain 1 kHz sinusoidal signal vertically centered with ± 4 divisions amplitude.

7.7.2.4 The variable attenuator was adjusted to increase RF level supplied to splitter by 30 dB and the EUT was consequently turned on and off. Transient frequency during power switching was captured and shown in the associated plots.



Test specification: Section 90.214 / RSS-119 Section 5.9, Transient frequency behaviour			
Test procedure: TIA/EIA-603-A, Section 2.2.19			
Test mode: Compliance		Verdict: PASS	
Date(s): 05-Feb-25			
Temperature: 23 °C	Relative Humidity: 45 %	Air Pressure: 1007 hPa	Power: 120 VAC
Remarks:			

Figure 7.7.1 Transient frequency test setup





Test specification: Section 90.214 / RSS-119 Section 5.9, Transient frequency behaviour			
Test procedure: TIA/EIA-603-A, Section 2.2.19			
Test mode: Compliance		Verdict: PASS	
Date(s): 05-Feb-25			
Temperature: 23 °C	Relative Humidity: 45 %	Air Pressure: 1007 hPa	Power: 120 VAC
Remarks:			

Table 7.7.2 Transient frequency behavior test results

Carrier frequency, MHz	Time interval	Duration, ms	Frequency tolerance, kHz	Limit, kHz	Margin, kHz	Verdict
Channel bandwidth 6.25 kHz						
450	t ₁	10	4.029	± 6.25	-2.221	Pass
	t ₂	25	1.953	± 3.125	-1.172	
	t ₃	10	4.517	± 6.25	-1.733	
460	t ₁	10	3.864	± 6.25	-2.221	Pass
	t ₂	25	1.809	± 3.125	-1.172	
	t ₃	10	3.235	± 6.25	-1.733	
470	t ₁	10	5.555	± 6.25	-2.221	Pass
	t ₂	25	2.686	± 3.125	-1.172	
	t ₃	10	2.747	± 6.25	-1.733	

Reference numbers of test equipment used

HL 2016	HL 2017	HL 2227	HL 4275	HL 4366	HL 5369	HL 5376	HL 5472
HL 5645	HL 5933	HL 5971	HL 6991				

Full description is given in Appendix A.



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Test specification: Section 90.214 / RSS-119 Section 5.9, Transient frequency behaviour			
Test procedure: TIA/EIA-603-A, Section 2.2.19			
Test mode: Compliance		Verdict: PASS	
Date(s): 05-Feb-25			
Temperature: 23 °C	Relative Humidity: 45 %	Air Pressure: 1007 hPa	Power: 120 VAC
Remarks:			

Plot 7.7.1 Transient frequency during power ON test results at low carrier frequency



Plot 7.7.2 Transient frequency during power OFF test results at low carrier frequency





HERMON LABORATORIES

Test specification: Section 90.214 / RSS-119 Section 5.9, Transient frequency behaviour			
Test procedure: TIA/EIA-603-A, Section 2.2.19			
Test mode: Compliance		Verdict: PASS	
Date(s): 05-Feb-25			
Temperature: 23 °C	Relative Humidity: 45 %	Air Pressure: 1007 hPa	Power: 120 VAC
Remarks:			

Plot 7.7.3 Transient frequency during power ON test results at mid carrier frequency



Plot 7.7.4 Transient frequency during power OFF test results at mid carrier frequency

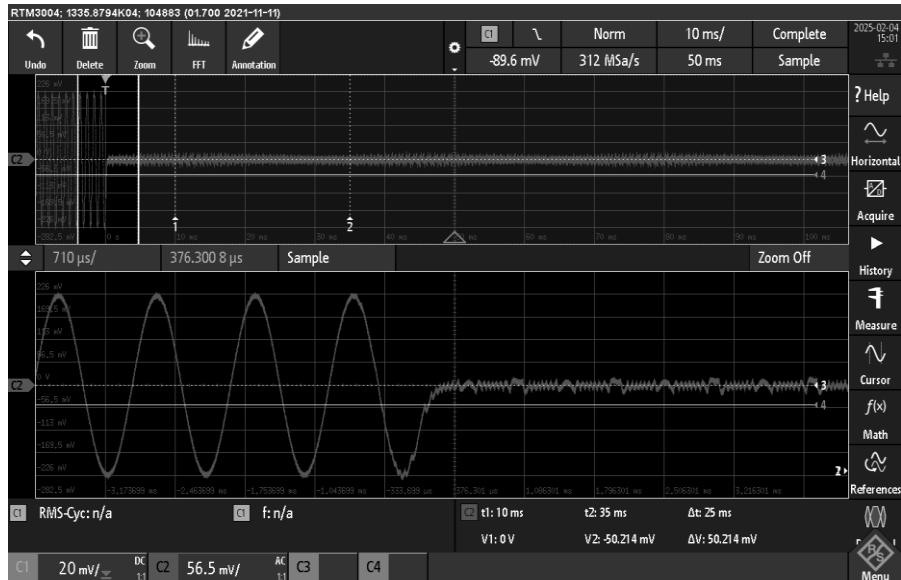




HERMON LABORATORIES

Test specification: Section 90.214 / RSS-119 Section 5.9, Transient frequency behaviour			
Test procedure: TIA/EIA-603-A, Section 2.2.19			
Test mode: Compliance		Verdict: PASS	
Date(s): 05-Feb-25			
Temperature: 23 °C	Relative Humidity: 45 %	Air Pressure: 1007 hPa	Power: 120 VAC
Remarks:			

Plot 7.7.5 Transient frequency during power ON test results at high carrier frequency



Plot 7.7.6 Transient frequency during power OFF test results at high carrier frequency



8 APPENDIX A Test equipment and ancillaries used for tests

HL No	Description	Manufacturer	Model	Ser. No.	Last Cal./ Check	Due Cal./ Check
0787	Transient Limiter 9 kHz-200 MHz	Hewlett Packard	11947A	3107A01877	12-Sep-24	12-Sep-25
1501	Cable RF, 6 m, BNC/BNC	Belden	M17/167 MIL-C-17	1501	06-May-24	06-May-25
2016	Attenuator, Manual Step, 0-9/1 dB, 0-8 GHz, 2 W	Midwest Microwave	1072	1315	12-Mar-24	12-Mar-25
2017	Attenuator, Manual Step, 0-60/10 dB, 0-8.0 GHz	Midwest Microwave	1071	2017	12-Mar-24	12-Mar-25
2227	Crystal Detector 0.01-18 GHz, 100 mW	Hewlett Packard Co	8472A	NA	08-Jan-24	08-Jan-26
3016	LISN, Two-line V-network, 9 kHz to 30 MHz, (50 uH+5 Ohm), CISPR16-1, MIL-461E	Rohde & Schwarz	ESH 3-Z5	892239/002	13-Jan-25	13-Jan-26
3047	AC Power Supply, 0 - 130 & 260v, 45 - 2000 Hz	BEHLMAN	150-C-202	5033	07-Oct-24	07-Oct-25
3286	Temperature Chamber, (-50 to +170) °C	Thermotron	EL-8-CH-1-1-CO2	21-9048	02-Dec-24	02-Dec-25
3339	High Pass Filter, 50 Ohm, 600 to 3000 MHz.	Mini-Circuits	SHP-600+	NA	22-Jun-23	22-Jun-25
3434	Test Cable , DC-18 GHz, 1.5 m, SMA - SMA	Mini-Circuits	CBL-5FT-SMSM+	25683	06-May-24	06-May-25
3818	PSA Series Spectrum Analyzer, 3 Hz- 44 GHz	Agilent Technologies	E4446A	MY48250288	18-Sep-24	18-Sep-25
3901	Microwave Cable Assembly, 40.0 GHz, 3.5 m, SMA/SMA	Huber-Suhner	SUCOFL EX 102A	1225/2A	05-May-24	05-May-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
4275	Test Cable , DC-18 GHz, 1.8 m, SMA/M - N/M	Mini-Circuits	CBL-6FT-SMNM+	70050	18-Nov-24	18-Nov-25
4355	Signal and Spectrum Analyzer, 9 kHz to 7 GHz	Rohde & Schwarz	FSV 7	101630	19-Jun-24	19-Jun-25
4366	Directional coupler, 1 GHz to 18 GHz, 10 dB, SMA Female	Tiger Micro-Electronics Institute	TGD-A1101-10	01e-JSDE805-007	02-Jun-24	02-Jun-26
4933	Active Horn Antenna, 1 GHz to 18 GHz	COM-POWER CORPORATION	AHA-118	701046	20-Feb-24	20-Feb-25
5288	Trilog Antenna, 25 MHz - 8 GHz, 100W	Frankonia	ALX-8000E	00809	24-Mar-22	24-Mar-25
5369	Digital storage oscilloscope, 350 MHz	Keysight Technologies	DSOX3034T	MY58032630	01-Oct-24	01-Oct-25
5376	EXA Signal Analyzer, 10 Hz - 32 GHz	Keysight Technologies	N9010B	MY57470404	06-Jan-25	06-Jan-26
5472	Power Splitter / Combiner 0.5-1 GHz	Mini Circuits	ZAPD-1	NA	09-Feb-23	09-Feb-25



HL No	Description	Manufacturer	Model	Ser. No.	Last Cal./ Check	Due Cal./ Check
5588	Cable, 50 Ohm, DC to 18 GHz, 1.8 m, SMA/N-type	Mini Circuits	CBL-6FT-SMNM+	NA	02-Jul-24	02-Jul-25
5626	Precision Fixed Attenuator, 50 Ohm, 5 W, 20 dB, DC to 18 GHz	Mini Circuits	BW-N20W5+	NA	05-Aug-24	05-Aug-25
5645	Cable, 50 Ohm, DC to 18 GHz, 1.8 m, SMA/SMA	Mini Circuits	CBL-6FT-SMSM+	NA	20-May-24	20-May-25
5707	EMI receiver	PMM / Narda	PMM 9010F	060WW91101	19-Jun-24	19-Jun-25
5802	Bidirectional Attenuator, 10 dB, DC-18 GHz, 5W, N-M / N-FM	Schwarzbeck mess-elektronik	DGA 9552 N	CK4522	25-Jul-22	25-Jul-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
5971	Oscilloscope, 500 MHz, digital 4 channel	Rohde & Schwarz	RTM3004	104883	05-Nov-24	05-Nov-25
5977	Attenuator 40 dB, DC to 6 GHz, 150W	Aeroflex / Weinschel	57-40-33	NR309	12-Mar-24	12-Mar-25
6991	MXG Analog Signal Generator, 100 kHz - 1GHz	Agilent Technologies	N5181A	MY49061204	06-Feb-24	06-Mar-25
7585	EMI Test Receiver, 1 Hz to 44 GHz	Rohde & Schwarz	ESW44	103130	24-Sep-24	24-Sep-25

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	Frequency, MHz	Measured antenna factor (with preamplifier), dB/m
1000	-16.1	10000	1.8
1500	-15.1	10500	1.0
2000	-10.9	11000	0.3
2500	-11.9	11500	-0.5
3000	-11.1	12000	3.1
3500	-10.6	12500	1.4
4000	-8.6	13000	-0.3
4500	-8.3	13500	-0.4
5000	-5.9	14000	2.5
5500	-5.7	14500	2.2
6000	-3.3	15000	1.9
6500	-4.0	15500	0.5
7000	-2.2	16000	2.1
7500	-1.7	16500	1.2
8000	1.1	17000	0.6
8500	-0.8	17500	3.1
9000	-1.5	18000	4.2
9500	-0.2		

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

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

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

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

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

above 1000 MHz

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

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

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

10 APPENDIX C Measurement uncertainties

Expanded uncertainty at 95% confidence in Hermon Labs EMC measurements

Test description	Expanded uncertainty
Transmitter tests	
Carrier power conducted at antenna connector	± 1.7 dB
Carrier power radiated (substitution method)	± 4.5 dB
Occupied bandwidth	$\pm 8\%$
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
Spurious emissions radiated 30 MHz – 40 GHz (substitution method)	± 4.5 dB
Frequency error	30 – 300 MHz: ± 50.5 Hz (1.68 ppm) 300 – 1000 MHz: ± 168 Hz (0.56 ppm)
Transient frequency behaviour	187 Hz $\pm 13.9\%$
Duty cycle, timing (Tx ON / OFF) and average factor measurements	$\pm 1.0\%$
Unintentional radiator tests	
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
Vertical polarization	Biconilog antenna: ± 6.0 dB Biconical antenna: ± 5.7 dB Log periodic antenna: ± 6.0 dB Double ridged horn antenna: ± 6.0 dB

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

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

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

11 APPENDIX D Test laboratory description

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

Hermon Laboratories is recognized and accredited by the Federal Communications Commission (USA) for 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 E

Specification references

FCC 47CFR part 90: 2022
FCC 47CFR part 2: 2023
ANSI/TIA/EIA-603-E:2016
RSS-119 Issue 12: 2015

Private land mobile radio services
Frequency allocations and radio treaty matters; general rules and regulations
Land Mobile FM or PM Communications Equipment Measurement and Performance Standards
Land Mobile and Fixed Equipment Operating in the Frequency Range 27.41-960 MHz

13 APPENDIX F 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(μ V)	decibel referred to one microvolt
dB(μ V/m)	decibel referred to one microvolt per meter
dB(μ A)	decibel referred to one microampere
DC	direct current
EIRP	equivalent isotropically radiated power
ERP	effective radiated power
EUT	equipment under test
F	frequency
GHz	gigahertz
GND	ground
H	height
HL	Hermon laboratories
Hz	hertz
k	kilo
kHz	kilohertz
LO	local oscillator
m	meter
MHz	megahertz
min	minute
mm	millimeter
ms	millisecond
μ s	microsecond
NA	not applicable
NB	narrow band
OATS	open area test site
Ω	Ohm
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