HERMON LABORATORIES

ELECTRICAL TESTING
0839.01

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TEST REPORT

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

FOR:

ST Engineering Telematics Wireless Ltd.
Sonata Allegro
Models: SONATA4-AL-P, SONATA4-AL-B
FCC ID: NTASONATA4
IC: 4732A-SONATA4

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1 Applicant information

Client name:	ST Engineering Telematics Wireless Ltd
Address:	26 Harokmim st., Azrieli D-9, Holon 5885849, 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:	Sonata Allegro
Product type:	Transceiver
Model(s):	SONATA4-AL-P SONATA4-AL-B
Serial number:	14519536
Hardware version:	REV B
Software release:	UT730107
Receipt date	23-Nov-25

3 Manufacturer information

Manufacturer name:	ST Engineering Telematics Wireless Ltd
Address:	26 Harokmim st., Azrieli D-9, Holon 5885849, Israel
Telephone:	+972 3557 5700
Fax:	+972 3557 5703
E-Mail:	itsikk@tlmw.com
Contact name:	Mr. Itsik Kanner

4 Test details

Project ID:	173031
Location:	Hermon Laboratories Ltd. P.O. Box 23, Binyamina 3055001, Israel
Test started:	23-Mar-26
Test completed:	14-Apr-26
Test specification(s):	FCC 47 CFR Part 90, RSS-119 Issue 12:2015

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 90.213 / RSS-119 Section 5.3, Frequency stability	Pass
FCC Section 90.214 / RSS-119 Section 5.9, Transient frequency behaviour	Pass
Unintentional emissions	
FCC Part 15, Section 107 / ICES-003, Section 6.1 class B, Conducted emission at AC power port	Not required
FCC Part 15, Section 109 / RSS-Gen, Section 7.3 / ICES-003, Section 6.2 class B, Radiated emission	Pass

* According to manufacturer's declaration provided in Appendix G the possible variants of SONATA4-AL-P and SONATA4-AL-B fully identical and the only difference is a material that the pipe is made of. Therefore, only the relevant tests were performed for models SONATA4-AL-P and SONATA4-AL-B. All other tests were performed only for model delivering the worst ERP.

This test report supersedes the previously issued test report identified by Doc ID: STERAD_FCC.173031_Rev1

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. S. Sugatov, test engineer, EMC & Radio	23-Mar-26 – 14-Apr-26	
Reviewed by:	Mrs. S. Peysahov Sheynin, certification engineer, EMC & Radio	20-May-26 – 02-Jul-26	
Approved by:	Mr. M. Nikishin, group leader, EMC & Radio	02-Jul-26	

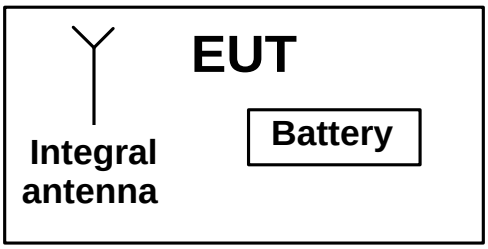
6 EUT description

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 Water Meter, operating in 450-470 MHz band. The EUT is powered by 3.6 V battery.

6.2 Test configuration



6.3 Changes made in EUT

No changes were implemented in the EUT during testing.

6.4 Transmitter characteristics

Type of equipment	
X	Stand-alone (Equipment with or without its own control provisions)
	Combined equipment (Equipment where the radio part is fully integrated within another type of equipment)
	Plug-in card (Equipment intended for a variety of host systems)

Intended use		**Condition of use**
	fixed	Always at a distance more than 2 m from all people
X	mobile	Always at a distance more than 20 cm from all people
	portable	May operate at a distance closer than 20 cm to human body

Assigned frequency ranges	450- 470 MHz

Maximum rated output power	At transmitter 50 Ω RF output connector	33.24 dBm

Is transmitter output power variable?	X	No			
		Yes		continuous variable	
				stepped variable with stepsize	dB
			minimum RF power		dBm
			maximum RF power		dBm

Antenna connection					
X	unique coupling	standard connector	integral	X	with temporary RF connector
					without temporary RF connector

Antenna/s technical characteristics			
Type	Manufacturer	Model number	Gain
Integral	Arad Technologies	Sonata ant	+1.5 dBi

Transmitter aggregate data rate/s	4.8 kbps
Type of modulation	4GFSK
Modulating test signal (baseband)	PRBS

Transmitter power source					
X	Battery	**Nominal rated voltage**	3.6 VDC	Battery type	Lithium
	DC	**Nominal rated voltage**			
	AC mains	**Nominal rated voltage**		Frequency	

Test specification:	Section 90.205 / RSS-119 Section 5.4, Maximum output power		
Test procedure:	47 CFR, Section 2.1046; TIA/EIA-603-E, Section 2.2.1		
Test mode:	Compliance	Verdict:	PASS
Date(s):	24-Mar-26		
Temperature: 26 ºC	Relative Humidity: 54 %	Air Pressure: 1008 hPa	Power: 3.6 VDC
Remarks:			

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

7.1 Effective radiated power of carrier at SONATA4-AL-B

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.

Table 7.1.1 Effective radiated power limit

Assigned frequency range, MHz	ERP	
	W	dBm
According to FCC part 90.205		
450.0 – 470.0	2	33.00
According to RSS-119		
450.0 – 470.0	60	47.78

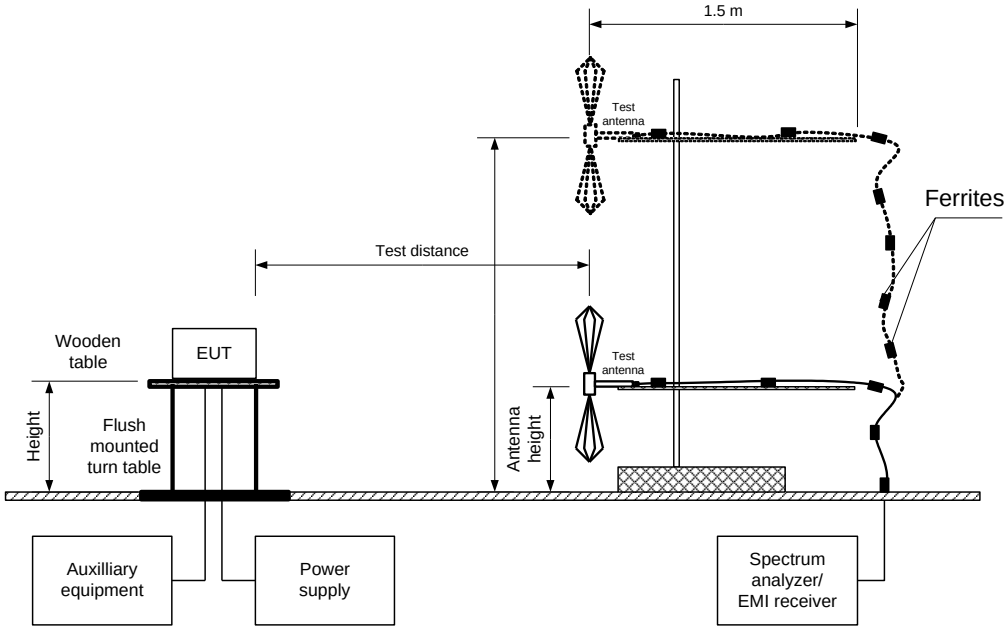
7.1.2 Test procedure

7.1.2.1 The EUT was set up as shown in Figure 7.1.1, energized and the performance check was conducted.

7.1.2.2 The field strength of the EUT carrier frequency was measured with antenna connected to spectrum analyzer/ EMI receiver. To find maximum radiation the turntable was rotated 360, the measuring antenna height was swept throughout the range, specified in Table 7.1.2 and Table 7.1.2, in both vertical and horizontal polarizations.

7.1.2.3 The worst test results (the lowest margins) were recorded in Table 7.1.2 and Table 7.1.3 and shown in the associated plots.

Figure 7.1.1 Setup for carrier field strength measurements



Test specification:	Section 90.205 / RSS-119 Section 5.4, Maximum output power		
Test procedure:	47 CFR, Section 2.1046; TIA/EIA-603-E, Section 2.2.1		
Test mode:	Compliance	Verdict:	PASS
Date(s):	24-Mar-26		
Temperature: 26 ºC	Relative Humidity: 54 %	Air Pressure: 1008 hPa	Power: 3.6 VDC
Remarks:			

Table 7.1.2 Effective radiated power according to FCC requirements

ASSIGNED FREQUENCY RANGE: 450 - 470 MHz
TEST SITE: SAC
TEST DISTANCE: 3 m
EUT HEIGHT: 0.8 m
TEST ANTENNA HEIGHTS RANGE: 1.0 – 4.0 m
DETECTOR USED: Peak
RESOLUTION BANDWIDTH: 100KHz
VIDEO BANDWIDTH: 300KHz
MODULATION: 4GFSK
TRANSMITTER OUTPUT POWER SETTINGS: Maximum

Frequency, MHz	Field strength, dB(µV/m)	Antenna polarization	Antenna height, m	Azimuth, degrees	EUT antenna gain, dBi	ERP, dBm***	Peak output power (conducted), dBm*	ERP Limit, dBm	Margin, dB**	Verdict
450.0125	129.45	Vertical	1.15	50	1.5	32.05	32.70	33	-0.95	Pass
460.0000	129.65	Vertical	1.15	50	1.5	32.25	32.90	33	-0.75	Pass
469.9875	129.99	Vertical	1.15	50	1.5	32.59	33.24	33	-0.41	Pass

Table 7.1.3 Effective radiated power according to RSS-119 requirement

ASSIGNED FREQUENCY RANGE: 450 - 470 MHz
TEST SITE: SAC
TEST DISTANCE: 3 m
EUT HEIGHT: 0.8 m
TEST ANTENNA HEIGHTS RANGE: 1.0 – 4.0 m
DETECTOR USED: Peak
RESOLUTION BANDWIDTH: 100KHz
VIDEO BANDWIDTH: 300KHz
MODULATION: 4GFSK
TRANSMITTER OUTPUT POWER SETTINGS: Maximum

Frequency, MHz	Field strength, dB(µV/m)	Antenna polarization	Antenna height, m	Azimuth, degrees	EUT antenna gain, dBi	ERP, dBm***	Peak output power (conducted), dBm*	ERP Limit, dBm	Margin, dB**	Verdict
450.0125	129.45	Vertical	1.15	50	1.5	32.05	32.75	47.78	-15.73	Pass
460.0000	129.65	Vertical	1.15	50	1.5	32.25	32.95	47.78	-15.53	Pass
469.9875	129.99	Vertical	1.15	50	1.5	32.59	33.29	47.78	-15.19	Pass

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

******- Margin = ERP – specification ERP limit.
*** ERP=Field strength in dB(µV/m) – 97.4 dB

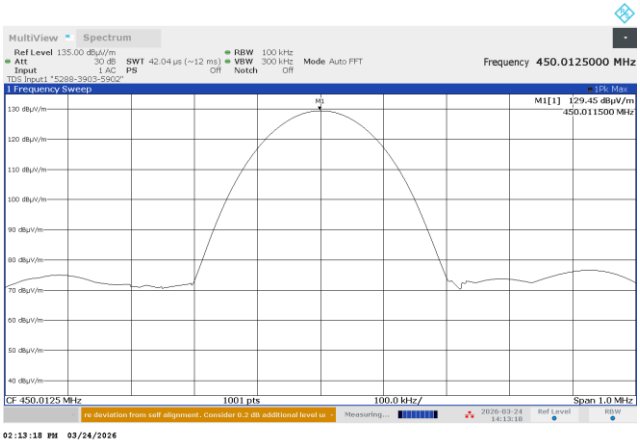
Reference numbers of test equipment used

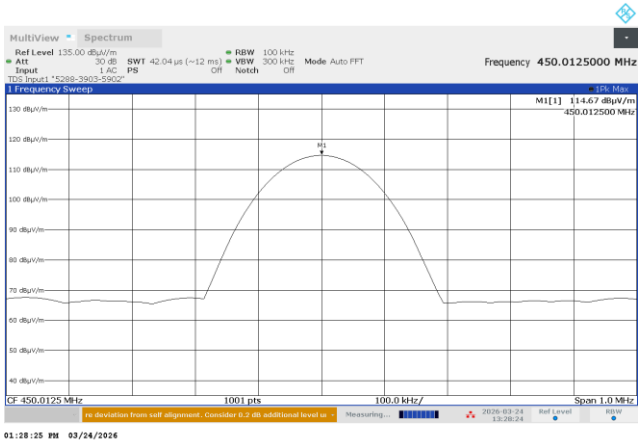
HL 6209	HL 5588	HL 3440	HL 5596				

Full description is given in Appendix A.

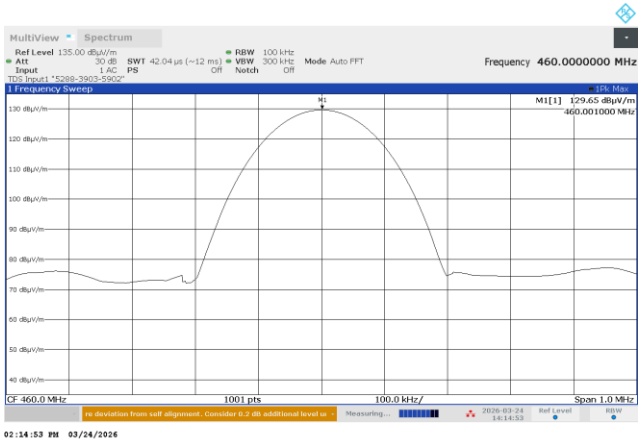
Test specification:	Section 90.205 / RSS-119 Section 5.4, Maximum output power		
Test procedure:	47 CFR, Section 2.1046; TIA/EIA-603-E, Section 2.2.1		
Test mode:	Compliance	Verdict:	PASS
Date(s):	24-Mar-26		
Temperature: 26 ºC	Relative Humidity: 54 %	Air Pressure: 1008 hPa	Power: 3.6 VDC
Remarks:			

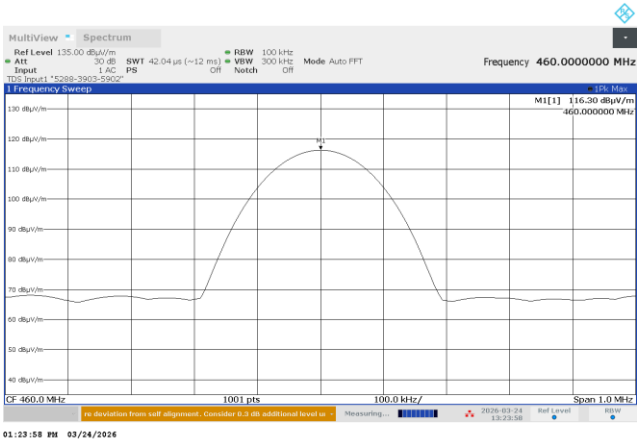
Plot 7.1.1 Transmitter carrier field strength test results at low frequency





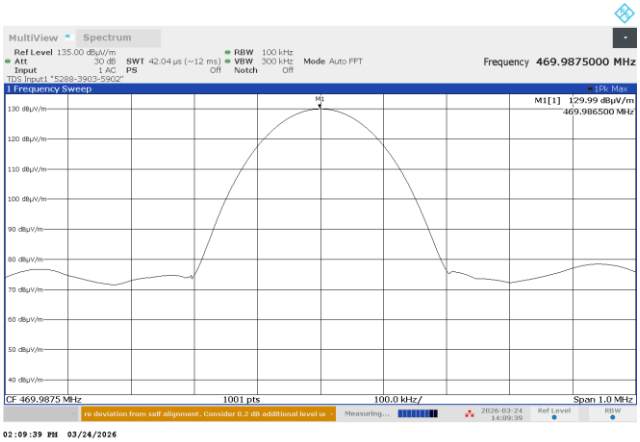
Plot 7.1.2 Transmitter carrier field strength test results at mid frequency

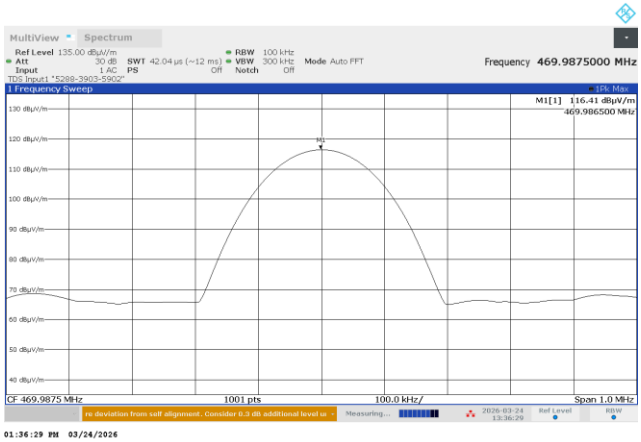




Test specification:	Section 90.205 / RSS-119 Section 5.4, Maximum output power		
Test procedure:	47 CFR, Section 2.1046; TIA/EIA-603-E, Section 2.2.1		
Test mode:	Compliance	Verdict:	PASS
Date(s):	24-Mar-26		
Temperature: 26 ºC	Relative Humidity: 54 %	Air Pressure: 1008 hPa	Power: 3.6 VDC
Remarks:			

Plot 7.1.3 Transmitter carrier field strength test results at high frequency





Test specification:	Section 90.205 / RSS-119 Section 5.4, Maximum output power		
Test procedure:	47 CFR, Section 2.1046; TIA/EIA-603-E, Section 2.2.1		
Test mode:	Compliance	Verdict:	PASS
Date(s):	24-Mar-26		
Temperature: 26 ºC	Relative Humidity: 54 %	Air Pressure: 1008 hPa	Power: 3.6 VDC
Remarks:			

7.2 Effective radiated power of carrier at SONATA4-AL-P

7.2.1 General

This test was performed to measure the peak output power at RF antenna connector. Specification test limits are given in Table 7.2.1.

Table 7.2.1 Effective radiated power limit

Assigned frequency range, MHz	ERP	
	W	dBm
According to FCC part 90.205		
450.0 – 470.0	2	33.00
According to RSS-119		
450.0 – 470.0	60	47.78

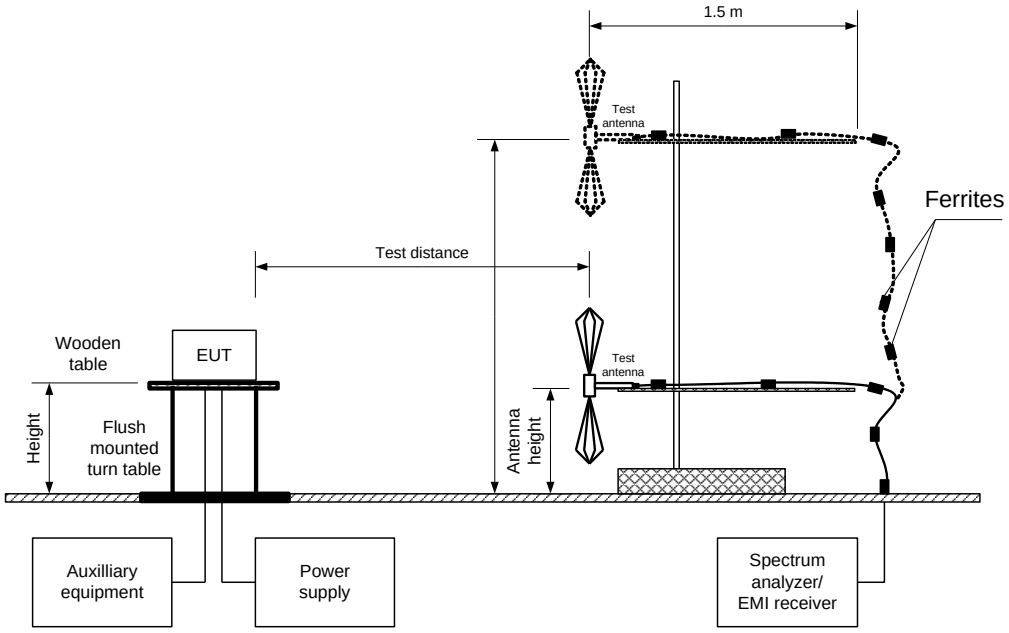
7.2.2 Test procedure

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

7.2.2.2 The field strength of the EUT carrier frequency was measured with antenna connected to spectrum analyzer/ EMI receiver. To find maximum radiation the turntable was rotated 360, the measuring antenna height was swept throughout the range, specified in Table 7.2.2 and Table 7.2.3, in both vertical and horizontal polarizations.

7.2.2.3 The worst test results (the lowest margins) were recorded in Table 7.2.2 and Table 7.2.3 and shown in the associated plots.

Figure 7.2.1 Setup for carrier field strength measurements



Test specification:	Section 90.205 / RSS-119 Section 5.4, Maximum output power		
Test procedure:	47 CFR, Section 2.1046; TIA/EIA-603-E, Section 2.2.1		
Test mode:	Compliance	Verdict:	PASS
Date(s):	24-Mar-26		
Temperature: 26 ºC	Relative Humidity: 54 %	Air Pressure: 1008 hPa	Power: 3.6 VDC
Remarks:			

Table 7.2.2 Effective radiated power according to FCC requirements

ASSIGNED FREQUENCY RANGE: 450 - 470 MHz
TEST SITE: SAC
TEST DISTANCE: 3 m
EUT HEIGHT: 0.8 m
TEST ANTENNA HEIGHTS RANGE: 1.0 – 4.0 m
DETECTOR USED: Peak
Resolution bandwidth 100 kHz
VIDEO BANDWIDTH: 300 kHz
MODULATION: 4GFSK
TRANSMITTER OUTPUT POWER SETTINGS: Maximum

Frequency, MHz	Field strength, dB(µV/m)	Antenna polarization	Antenna height, m	Azimuth, degrees	EUT antenna gain, dBi	ERP, dBm***	Peak output power (conducted), dBm*	ERP Limit, dBm	Margin dB**	Verdict
450.0125	128.09	Vertical	1.10	37	1.5	30.69	31.34	33	-2.31	Pass
460.0000	128.64	Vertical	1.10	50	1.5	31.24	31.89	33	-1.76	Pass
469.9875	129.78	Vertical	1.01	50	1.5	32.38	33.03	33	-0.62	Pass

Table 7.2.3 Effective radiated power according to RSS-119 requirement

ASSIGNED FREQUENCY RANGE: 450 - 470 MHz
TEST SITE: SAC
TEST DISTANCE: 3 m
EUT HEIGHT: 0.8 m
TEST ANTENNA HEIGHTS RANGE: 1.0 – 4.0 m
DETECTOR USED: Peak
Resolution bandwidth 100KHz
VIDEO BANDWIDTH: 300KHz
MODULATION: 4GFSK
TRANSMITTER OUTPUT POWER SETTINGS: Maximum

Frequency, MHz	Field strength, dB(µV/m)	Antenna polarization	Antenna height, m	Azimuth, degrees	EUT antenna gain, dBi	ERP, dBm***	Peak output power (conducted), dBm*	ERP Limit, dBm	Margin, dB**	Verdict
450.0125	128.09	Vertical	1.15	50	1.5	30.69	31.34	47.78	-17.09	Pass
460.0000	128.64	Vertical	1.15	50	1.5	31.24	31.89	47.78	-16.54	Pass
469.9875	129.78	Vertical	1.15	50	1.5	32.38	33.03	47.78	-15.40	Pass

*****- Peak output power in *dBm = Field strength in dB(µV/m) - Transmitter antenna gain in dBi – 95.2 dB*

******- Margin = ERP – specification ERP limit.
*** ERP=Field strength in dB(µV/m) – 97.4 dB

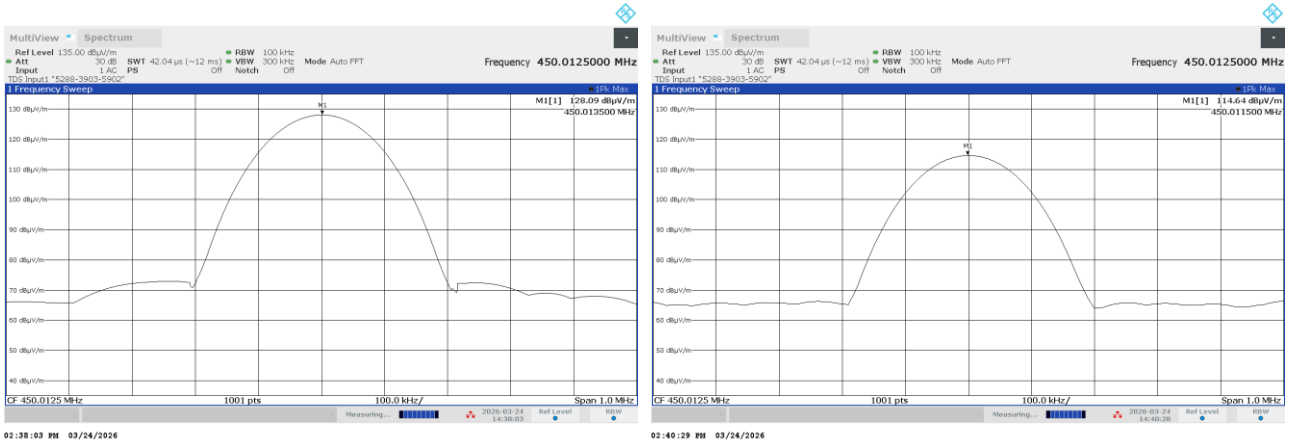
Reference numbers of test equipment used

HL 6209	HL 5588	HL 3440	HL 5596				

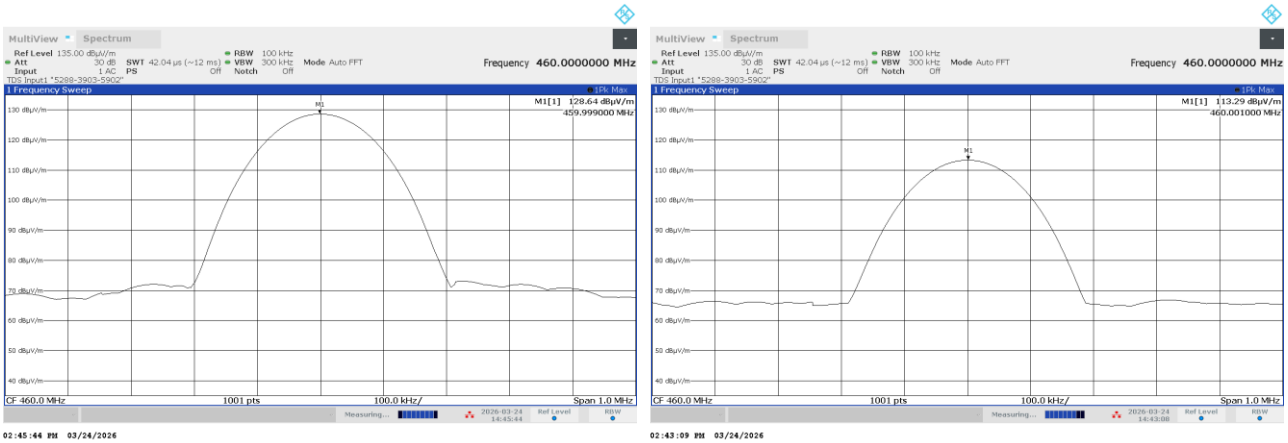
Full description is given in Appendix A.

Test specification:	Section 90.205 / RSS-119 Section 5.4, Maximum output power		
Test procedure:	47 CFR, Section 2.1046; TIA/EIA-603-E, Section 2.2.1		
Test mode:	Compliance	Verdict:	PASS
Date(s):	24-Mar-26		
Temperature: 26 ºC	Relative Humidity: 54 %	Air Pressure: 1008 hPa	Power: 3.6 VDC
Remarks:			

Plot 7.2.1 Transmitter carrier field strength test results at low frequency

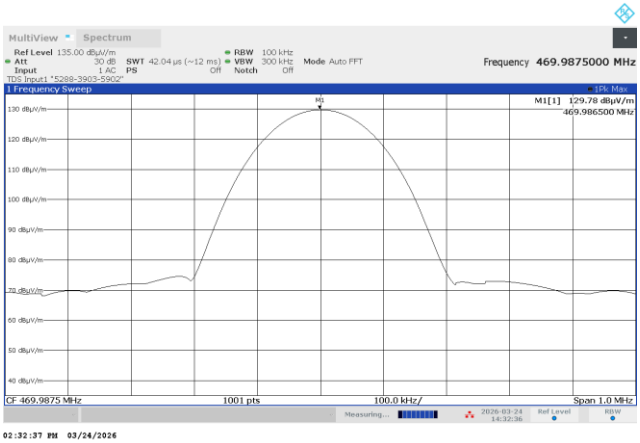


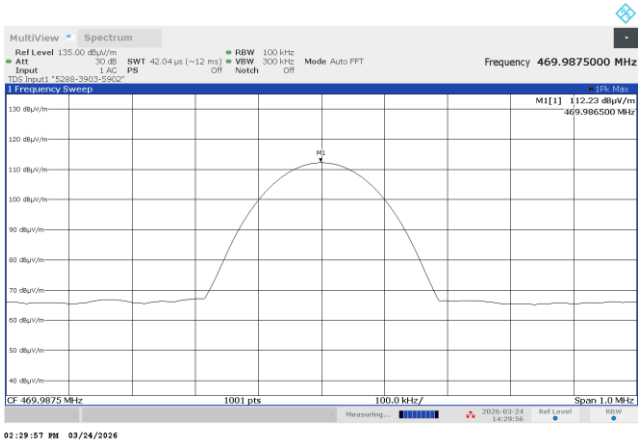
Plot 7.2.2 Transmitter carrier field strength test results at mid frequency



Test specification:	Section 90.205 / RSS-119 Section 5.4, Maximum output power		
Test procedure:	47 CFR, Section 2.1046; TIA/EIA-603-E, Section 2.2.1		
Test mode:	Compliance	Verdict:	PASS
Date(s):	24-Mar-26		
Temperature: 26 ºC	Relative Humidity: 54 %	Air Pressure: 1008 hPa	Power: 3.6 VDC
Remarks:			

Plot 7.2.3 Transmitter carrier field strength test results at high frequency





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):	26-Mar-26		
Temperature: 25 ºC	Relative Humidity: 48 %	Air Pressure: 1005 hPa	Power: 3.6 VDC
Remarks:			

7.3 Occupied bandwidth test

7.3.1 General

This test was performed to measure transmitter occupied bandwidth. Specification test limits are given in Table 7.3.1, Table 7.3.2.

Table 7.3.1 Occupied bandwidth limits according to FCC requirements

Assigned frequency, MHz	Modulation envelope reference points*, dBc	Maximum allowed bandwidth, kHz
450.0 – 470.0	26	6.0

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

Table 7.3.2 Occupied bandwidth limits according to RSS-119 requirements

Assigned frequency, MHz	Modulation envelope reference points, %	Maximum allowed bandwidth, kHz
450.0 – 470.0	99	6.0

7.3.2 Test procedure

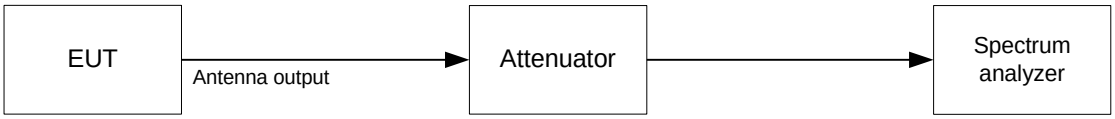
7.3.2.1 The EUT was set up as shown in Figure 7.3.1, energized and its proper operation was checked.

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

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

7.3.2.4 The transmitter occupied bandwidth was measured with spectrum analyzer as a frequency delta between the reference points on modulation envelope and provided in Table 7.3.3 and the associated plots.

Figure 7.3.1 Occupied bandwidth test setup



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):	26-Mar-26		
Temperature: 25 ºC	**Relative Humidity:** 48 %	**Air Pressure:** 1005 hPa	**Power:** 3.6 VDC
Remarks:			

Table 7.3.3 Occupied bandwidth test results

DETECTOR USED:	Peak hold
RESOLUTION BANDWIDTH:	100 Hz
VIDEO BANDWIDTH:	1 kHz
EUT POWER:	110V 60Hz
MODULATION:	4GFSK
MODULATING SIGNAL:	ID code
BIT RATE:	4.8 kbps

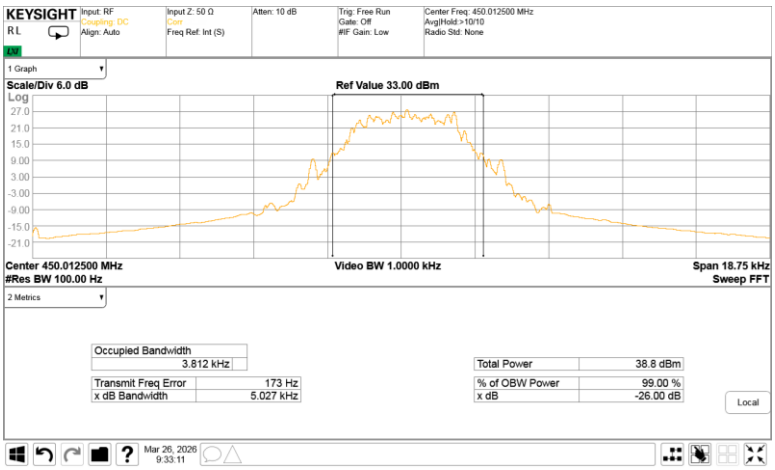
Carrier frequency, MHz	Occupied bandwidth, kHz	Limit, kHz	Margin, kHz	Verdict
MODULATION ENVELOPE REFERENCE POINTS: 99%				
450.0125	3.812	6.000	-2.188	Pass
460.0000	3.836	6.000	-2.164	Pass
469.9875	3.827	6.000	-2.173	Pass
MODULATION ENVELOPE REFERENCE POINTS: 26 dBc				
450.0125	5.027	6.000	-0.973	Pass
460.0000	5.026	6.000	-0.974	Pass
469.9875	5.085	6.000	-0.915	Pass

Reference numbers of test equipment used

HL 3766	HL 4355	HL 5637					

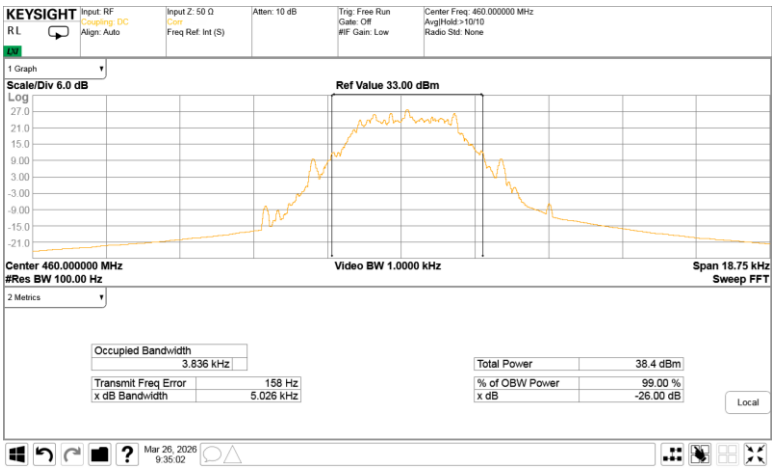
Full description is given in Appendix A.

Plot 7.3.1 Occupied bandwidth test result at low frequency

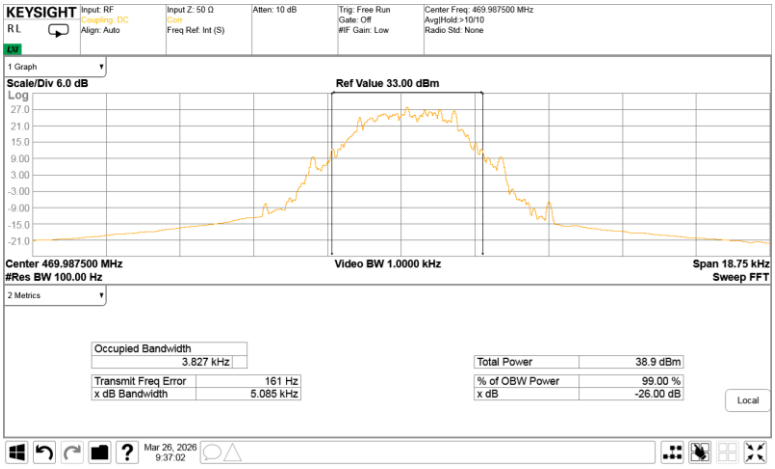


Test specification:	Section 90.209 / RSS-119 Section 5.5, Occupied bandwidth		
Test procedure:	47 CFR, Section 2.1049		
Test mode:	Compliance	Verdict:	PASS
Date(s):	26-Mar-26		
Temperature: 25 ºC	Relative Humidity: 48 %	Air Pressure: 1005 hPa	Power: 3.6 VDC
Remarks:			

Plot 7.3.2 Occupied bandwidth test result at mid frequency



Plot 7.3.3 Occupied bandwidth test result at high frequency



Test specification:	Section 90.210 / RSS-119 Section 5.8.4, Emission mask		
Test procedure:	47 CFR, Sections 2.1051, 2.1047 and 90.210(e); TIA/EIA-603-E, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date(s):	26-Mar-26		
Temperature: 26 ºC	Relative Humidity: 54 %	Air Pressure: 1008 hPa	Power: 3.6 VDC
Remarks:			

7.4 Emission mask test

7.4.1 General

This test was performed to measure emission mask at RF antenna connector. Specification test limits are given in Table 7.4.1.

Table 7.4.1 Emission mask limits

Frequency displacement from carrier	Attenuation below carrier, dBc
Emission mask E (Channel bandwidth 6.25 kHz, authorized bandwidth 6.0 kHz)	
0 – 3 kHz	0
3 – 4.6 kHz	30 + 16.67(f_d** - 3 kHz) or55+10logP(W) whichever is the lesser
More than 4.6 kHz	55+10logP(W) or 57 whichever is the lesser (RSS119) 55+10logP(W) or 65 whichever is the lesser (FCC210)

* - linearly increase with frequency
** - displacement frequency

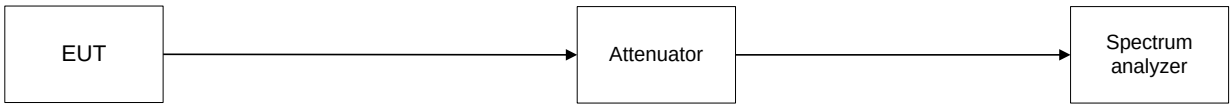
7.4.2 Test procedure

7.4.2.1 The EUT was set up as shown in Figure 7.4.1, energized and its proper operation was checked.

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

7.4.2.3 The test results are provided in Table 7.4.2 and the associated plots.

Figure 7.4.1 Emission mask test setup



Test specification:	**Section 90.210 / RSS-119 Section 5.8.4, Emission mask**		
Test procedure:	47 CFR, Sections 2.1051, 2.1047 and 90.210(e); TIA/EIA-603-E, Section 2.2.13		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	26-Mar-26		
Temperature: 26 ºC	**Relative Humidity:** 54 %	**Air Pressure:** 1008 hPa	**Power:** 3.6 VDC
Remarks:			

Table 7.4.2 Emission mask test results

Carrier frequency, MHz	Limit	Verdict
450.0125	Emission mask E	Pass
460.0000		
459.9875		

Reference numbers of test equipment used

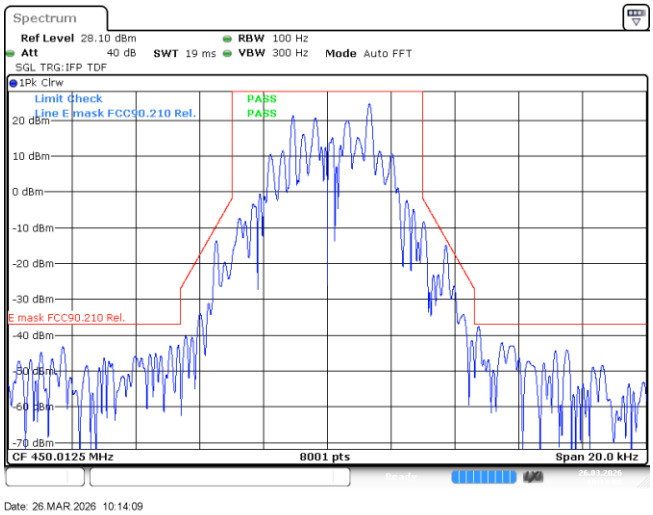
HL 3766	HL 4355	HL 5409					

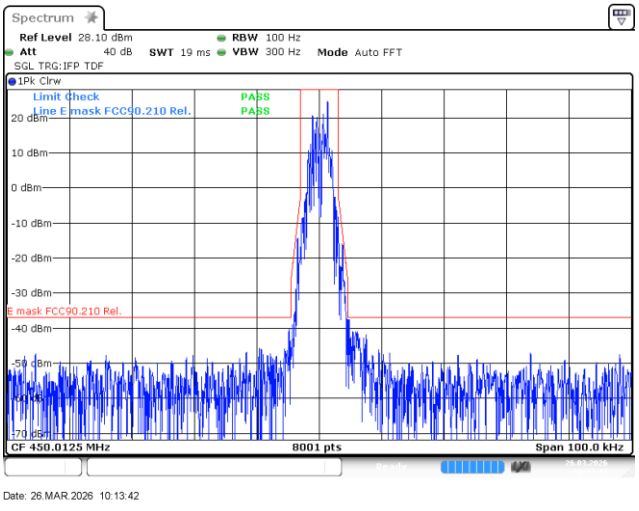
Full description is given in Appendix A.

Test specification:	Section 90.210 / RSS-119 Section 5.8.4, Emission mask		
Test procedure:	47 CFR, Sections 2.1051, 2.1047 and 90.210(e); TIA/EIA-603-E, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date(s):	26-Mar-26		
Temperature: 26 ºC	Relative Humidity: 54 %	Air Pressure: 1008 hPa	Power: 3.6 VDC
Remarks:			

Plot 7.4.1 Emission mask test results at low carrier frequency, FCC part 90.210(e)

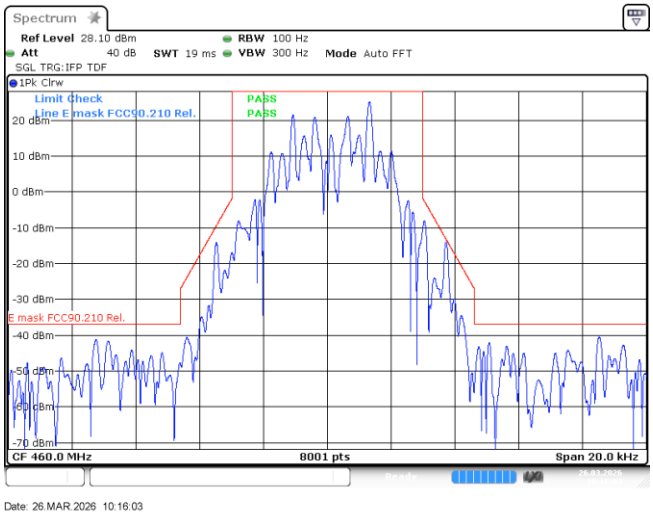
OPERATING FREQUENCY RANGE: 450 – 470 MHz
DETECTOR USED: Peak
MODULATION: 4GFSK
MODULATING SIGNAL: PRBS
TRANSMITTER OUTPUT POWER SETTINGS: Maximum

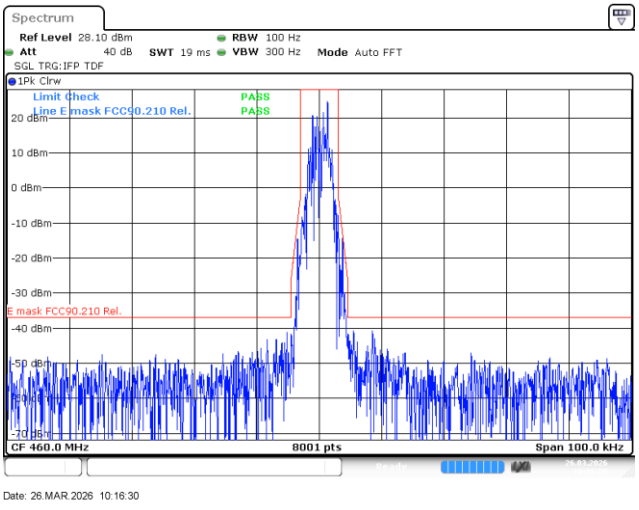




Plot 7.4.2 Emission mask test results at mid carrier frequency, FCC part 90.210(e)

OPERATING FREQUENCY RANGE: 450 – 470 MHz
DETECTOR USED: Peak
MODULATION: 4GFSK
MODULATING SIGNAL: PRBS
TRANSMITTER OUTPUT POWER SETTINGS: Maximum

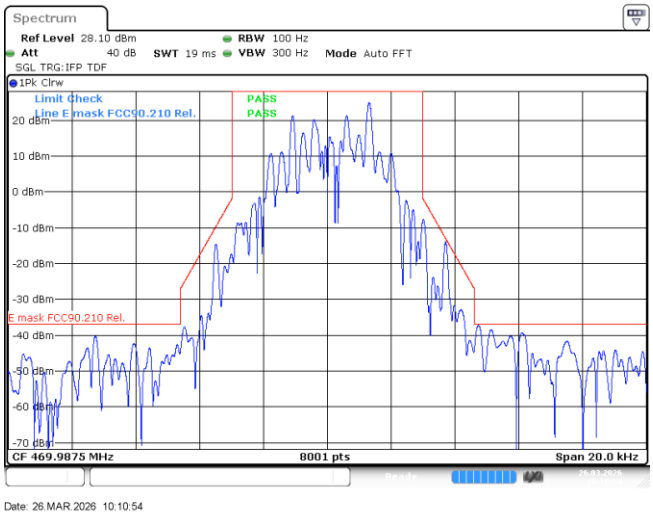


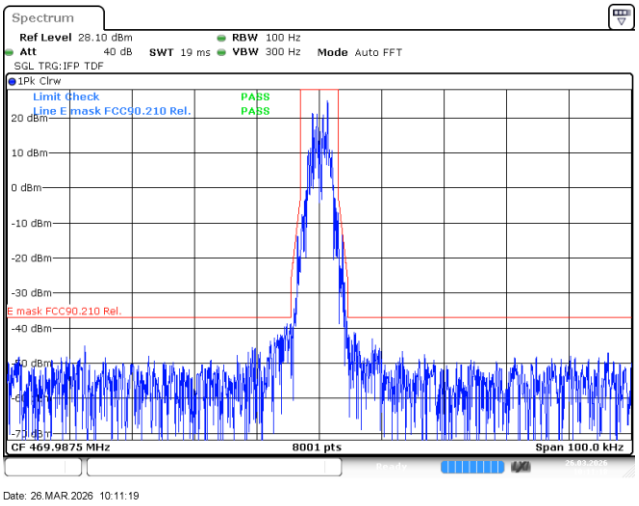


Test specification:	Section 90.210 / RSS-119 Section 5.8.4, Emission mask		
Test procedure:	47 CFR, Sections 2.1051, 2.1047 and 90.210(e); TIA/EIA-603-E, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date(s):	26-Mar-26		
Temperature: 26 ºC	Relative Humidity: 54 %	Air Pressure: 1008 hPa	Power: 3.6 VDC
Remarks:			

Plot 7.4.3 Emission mask test results at high carrier frequency, FCC part 90.210(e)

OPERATING FREQUENCY RANGE: 450 – 470 MHz
DETECTOR USED: Peak
MODULATION: 4GFSK
MODULATING SIGNAL: PRBS
TRANSMITTER OUTPUT POWER SETTINGS: Maximum

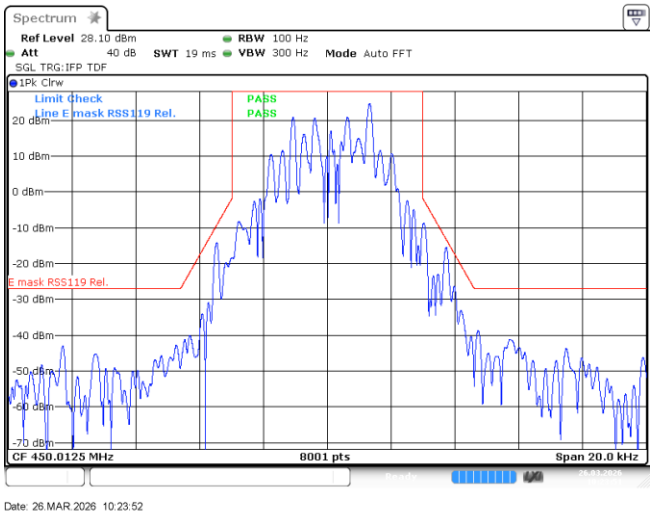


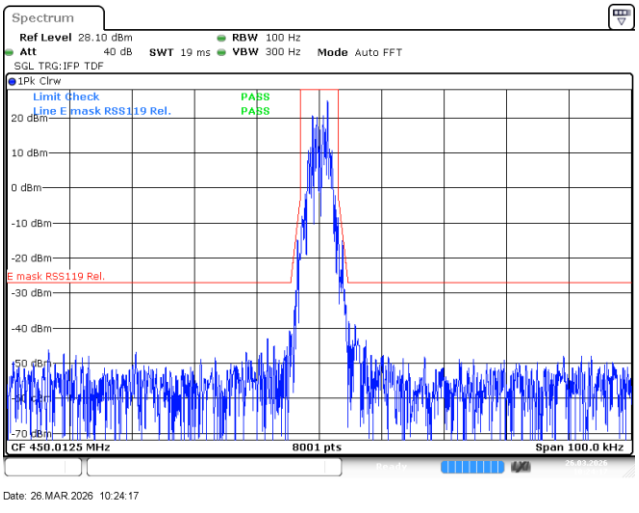


Test specification:	Section 90.210 / RSS-119 Section 5.8.4, Emission mask		
Test procedure:	47 CFR, Sections 2.1051, 2.1047 and 90.210(e); TIA/EIA-603-E, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date(s):	26-Mar-26		
Temperature: 26 ºC	Relative Humidity: 54 %	Air Pressure: 1008 hPa	Power: 3.6 VDC
Remarks:			

Plot 7.4.4 Emission mask test results at low carrier frequency, RSS-119

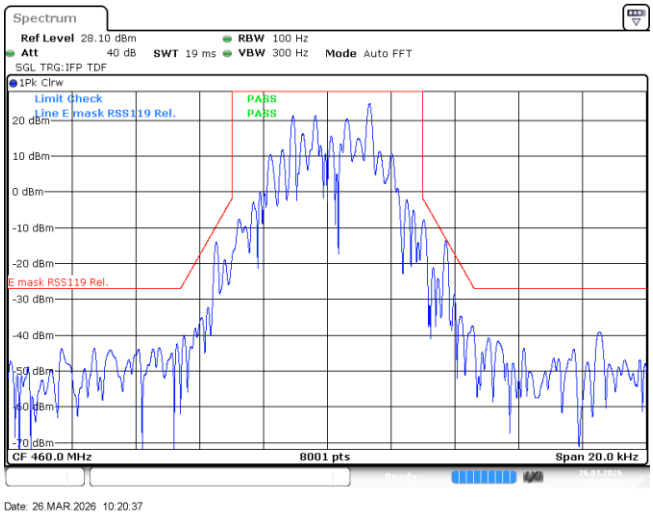
OPERATING FREQUENCY RANGE: 450 – 470 MHz
DETECTOR USED: Peak
MODULATION: 4GFSK
MODULATING SIGNAL: PRBS
TRANSMITTER OUTPUT POWER SETTINGS: Maximum

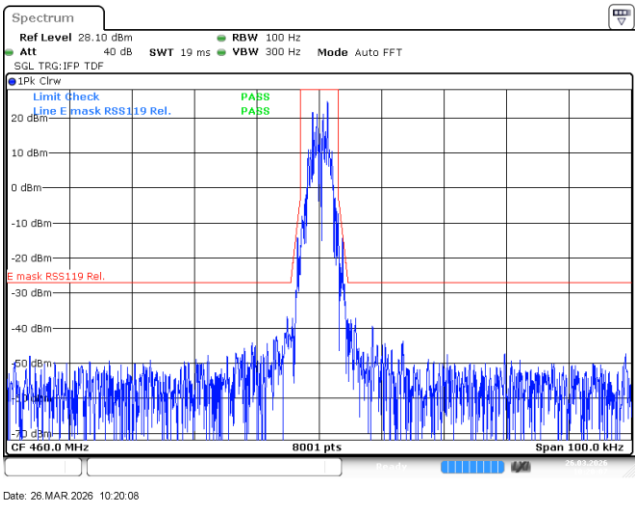




Plot 7.4.5 Emission mask test results at mid carrier frequency, RSS-119

OPERATING FREQUENCY RANGE: 450 – 470 MHz
DETECTOR USED: Peak
MODULATION: 4GFSK
MODULATING SIGNAL: PRBS
TRANSMITTER OUTPUT POWER SETTINGS: Maximum

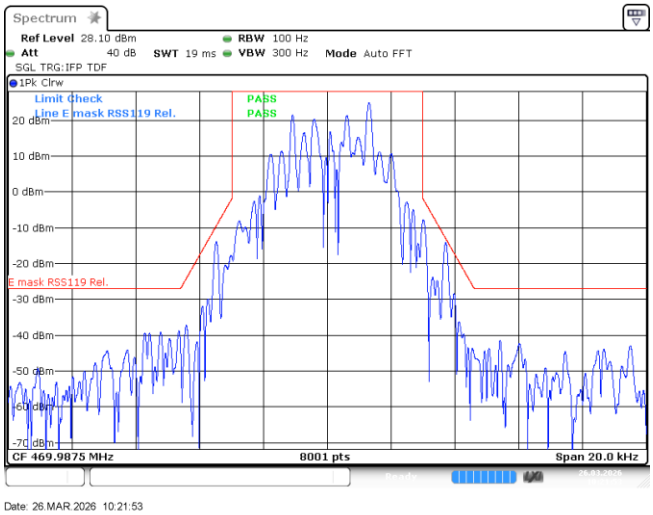


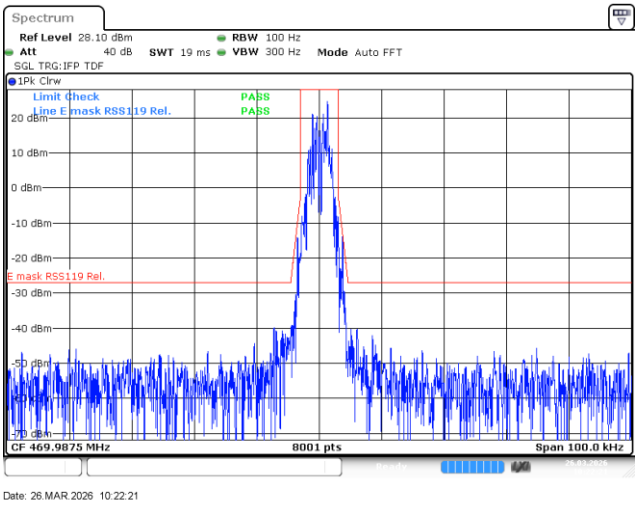


Test specification:	**Section 90.210 / RSS-119 Section 5.8.4, Emission mask**		
Test procedure:	47 CFR, Sections 2.1051, 2.1047 and 90.210(e); TIA/EIA-603-E, Section 2.2.13		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	26-Mar-26		
Temperature: 26 ºC	**Relative Humidity:** 54 %	**Air Pressure:** 1008 hPa	**Power:** 3.6 VDC
Remarks:			

Plot 7.4.6 Emission mask test results at high carrier frequency, RSS-119

OPERATING FREQUENCY RANGE: 450 – 470 MHz
DETECTOR USED: Peak
MODULATION: 4GFSK
MODULATING SIGNAL: PRBS
TRANSMITTER OUTPUT POWER SETTINGS: Maximum





Test specification:	**Section 90.210 / RSS-119 Section 5.8.4, Radiated spurious emissions**		
Test procedure:	47 CFR, Sections 2.1053; TIA/EIA-603-E, Section 2.2.12		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	24-Mar-26 – 25-Mar-26		
Temperature: 26 ºC	**Relative Humidity:** 54 %	**Air Pressure:** 1008 hPa	**Power:** 3.6 VDC
Remarks:			

7.5 Radiated spurious emission measurements for Bronze pipe

7.5.1 General

This test was performed to measure radiated spurious emissions from the EUT. Specification test limits are given in Table 7.5.1.

Table 7.5.1 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×P×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

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

7.5.2.1 The EUT was set up as shown in Figure 7.5.1, energized and the performance check was conducted.

7.5.2.2 The specified frequency range was investigated with antenna connected to spectrum analyzer. To find maximum radiation the turntable was rotated 360^0 and the measuring antenna was rotated around its vertical axis.

7.5.2.3 The worst test results (the lowest margins) were recorded in Table 7.5.2 and shown in the associated plots.

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

7.5.3.1 The EUT was set up as shown in Figure 7.5.2, energized and the performance check was conducted.

7.5.3.2 The specified frequency range was investigated with antenna connected to spectrum analyzer. To find maximum radiation the turntable was rotated 360^0 and the measuring antenna height was swept from 1 to 4 m in both, vertical and horizontal, polarizations.

7.5.3.3 The worst test results (the lowest margins) were recorded in Table 7.5.2 and shown in the associated plots.

Test specification:	Section 90.210 / RSS-119 Section 5.8.4, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053; TIA/EIA-603-E, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date(s):	24-Mar-26 – 25-Mar-26		
Temperature: 26 ºC	Relative Humidity: 54 %	Air Pressure: 1008 hPa	Power: 3.6 VDC
Remarks:			

Figure 7.5.1 Setup for spurious emission field strength measurements in 9 kHz to 30 MHz band

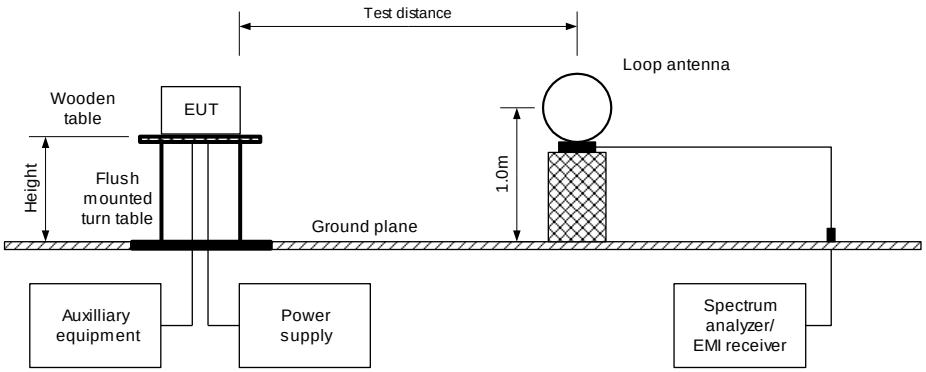
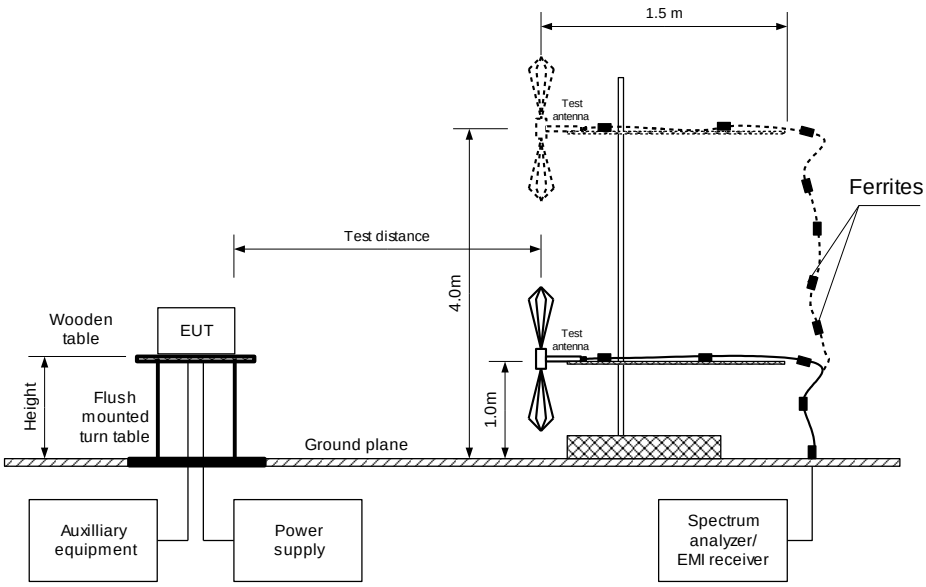


Figure 7.5.2 Setup for spurious emission field strength measurements above 30 MHz



Test specification:	**Section 90.210 / RSS-119 Section 5.8.4, Radiated spurious emissions**		
Test procedure:	47 CFR, Sections 2.1053; TIA/EIA-603-E, Section 2.2.12		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	24-Mar-26 – 25-Mar-26		
Temperature: 26 ºC	**Relative Humidity:** 54 %	**Air Pressure:** 1008 hPa	**Power:** 3.6 VDC
Remarks:			

Table 7.5.2 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	Verdict
Low carrier frequency 450.0125 MHz								
1350.00575	44.17	72.4	-28.23	1000	Horizontal	1.65	-53	Pass
1800.08000	60.42	72.4	-11.98	1000	Vertical	1.50	125	Pass
2250.05200	58.19	72.4	-14.21	1000	Horizontal	1.50	-140	Pass
4950.11120	58.94	72.4	-13.46	1000	Horizontal	1.50	47	Pass
Mid carrier frequency 460.0000 MHz								
1380.03500	49.13	72.4	-23.27	1000	Horizontal	1.65	-53	Pass
1840.05000	52.88	72.4	-19.32	1000	Horizontal	1.55	-153	Pass
2299.98000	56.21	72.4	-16.19	1000	Vertical	1.50	-114	Pass
High carrier frequency 469.9875 MHz								
1410.05740	47.88	72.4	-24.52	1000	Vertical	1.50	-110	Pass
1879.95500	56.22	72.4	-16.18	1000	Vertical	1.50	110	Pass
2349.86260	49.67	72.4	-22.73	1000	Vertical	1.50	-114	Pass

*****- Margin = Field strength of spurious – calculated field strength limit.
******- EUT front panel refers to 0 degrees position of turntable.

Table 7.5.3 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
All emissions found more than 10 dB below the limit.											Pass

*****- Margin = Spurious emission – specification limit.

Reference numbers of test equipment used

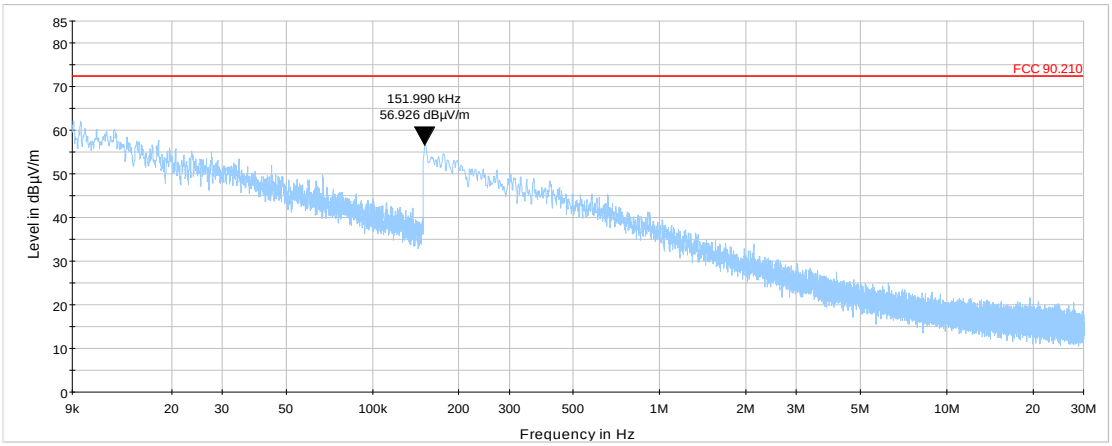
HL 0446	HL 3903	HL 4338	HL 5673	HL 5288	HL 5902	HL 7585	HL1565
HL 4933	HL 5942						

Full description is given in Appendix A.

Test specification:	Section 90.210 / RSS-119 Section 5.8.4, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053; TIA/EIA-603-E, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date(s):	24-Mar-26 – 25-Mar-26		
Temperature: 26 ºC	Relative Humidity: 54 %	Air Pressure: 1008 hPa	Power: 3.6 VDC
Remarks:			

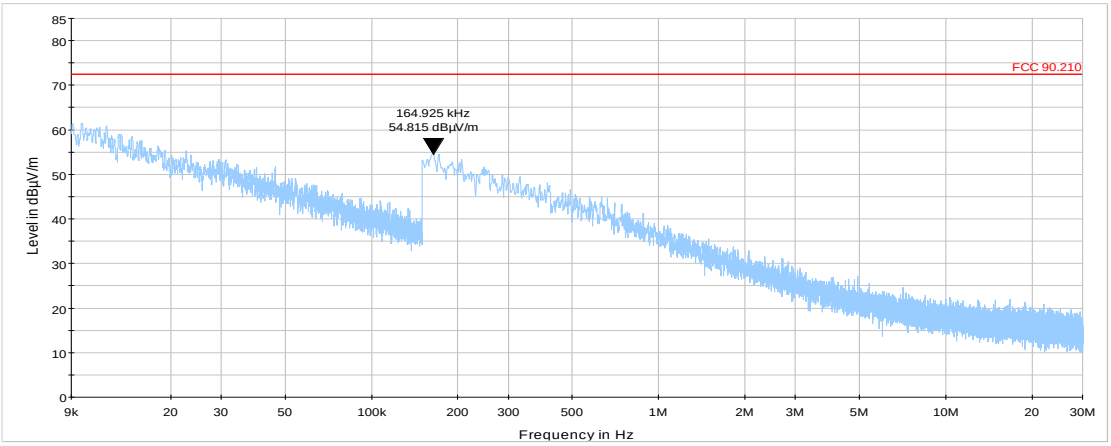
Plot 7.5.1 Radiated emission measurements in 9 kHz- 30 MHz range at low frequency

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



Plot 7.5.2 Radiated emission measurements in 9 kHz- 30 MHz range at mid frequency

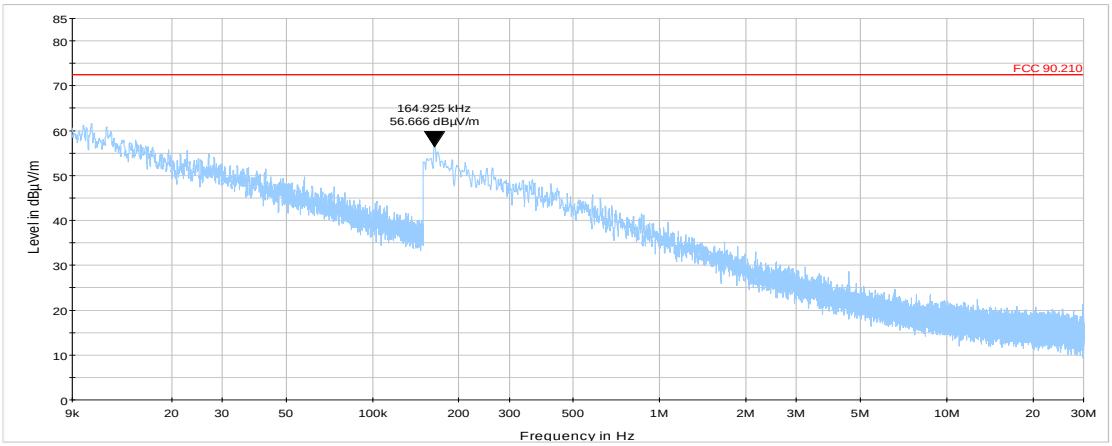
TEST SITE: Semi anechoic chamber
ANTENNA POLARIZATION: Vertical and Horizontal
TEST DISTANCE: 3 m



Test specification:	Section 90.210 / RSS-119 Section 5.8.4, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053; TIA/EIA-603-E, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date(s):	24-Mar-26 – 25-Mar-26		
Temperature: 26 ºC	Relative Humidity: 54 %	Air Pressure: 1008 hPa	Power: 3.6 VDC
Remarks:			

Plot 7.5.3 Radiated emission measurements in 9 kHz- 30 MHz range at high frequency

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

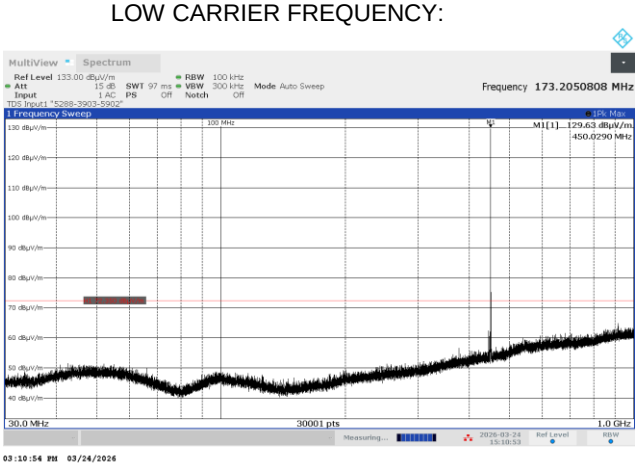


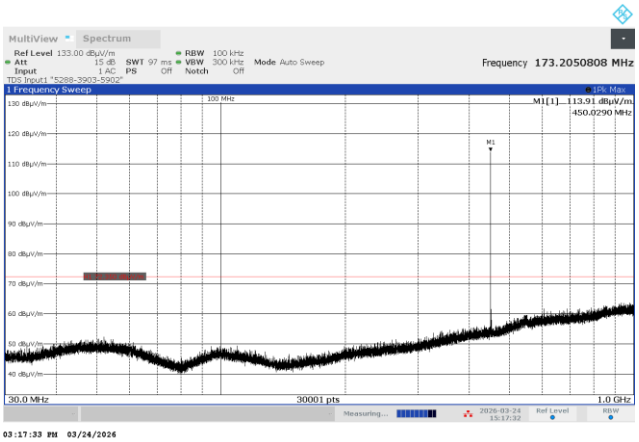
Test specification:	**Section 90.210 / RSS-119 Section 5.8.4, Radiated spurious emissions**		
Test procedure:	47 CFR, Sections 2.1053; TIA/EIA-603-E, Section 2.2.12		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	24-Mar-26 – 25-Mar-26		
Temperature: 26 ºC	**Relative Humidity:** 54 %	**Air Pressure:** 1008 hPa	**Power:** 3.6 VDC
Remarks:			

Plot 7.5.4 Radiated emission measurements in 30 - 1000 MHz range

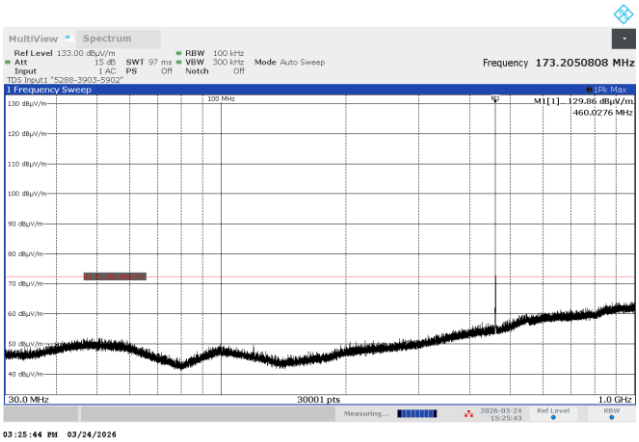
TEST SITE: Semi anechoic chamber
ANTENNA POLARIZATION: Vertical and Horizontal
TEST DISTANCE: 3 m

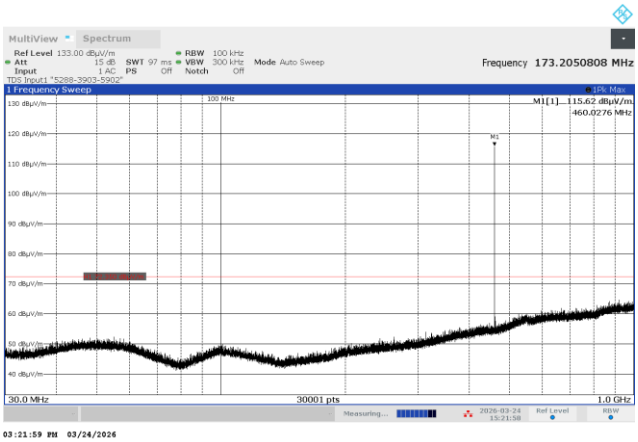
LOW CARRIER FREQUENCY: 450.0125 MHz





MID CARRIER FREQUENCY: 460 MHz



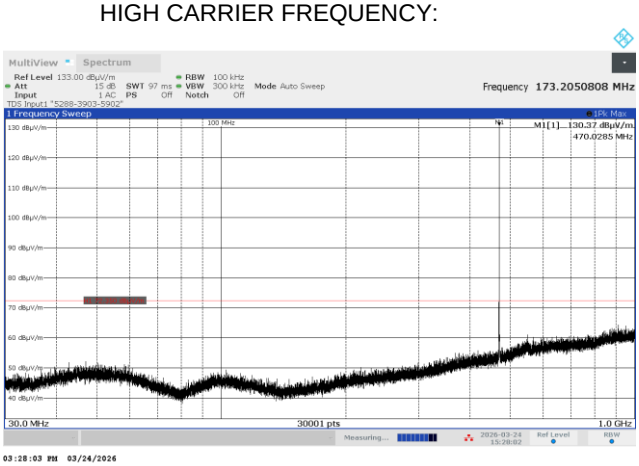


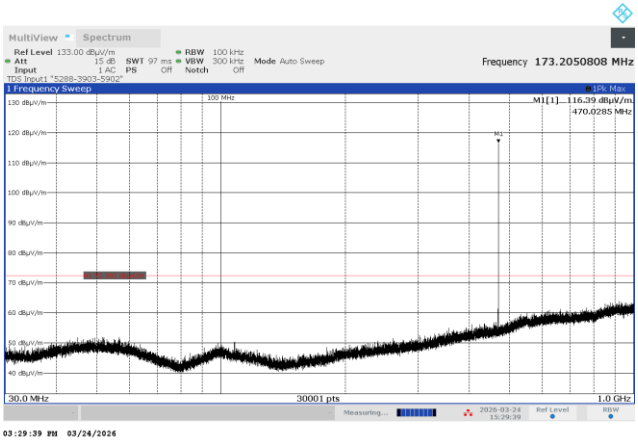
Test specification:	**Section 90.210 / RSS-119 Section 5.8.4, Radiated spurious emissions**		
Test procedure:	47 CFR, Sections 2.1053; TIA/EIA-603-E, Section 2.2.12		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	24-Mar-26 – 25-Mar-26		
Temperature: 26 ºC	**Relative Humidity:** 54 %	**Air Pressure:** 1008 hPa	**Power:** 3.6 VDC
Remarks:			

Plot 7.5.5 Radiated emission measurements in 30 - 1000 MHz range

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

HIGH CARRIER FREQUENCY: 469.9875 MHz



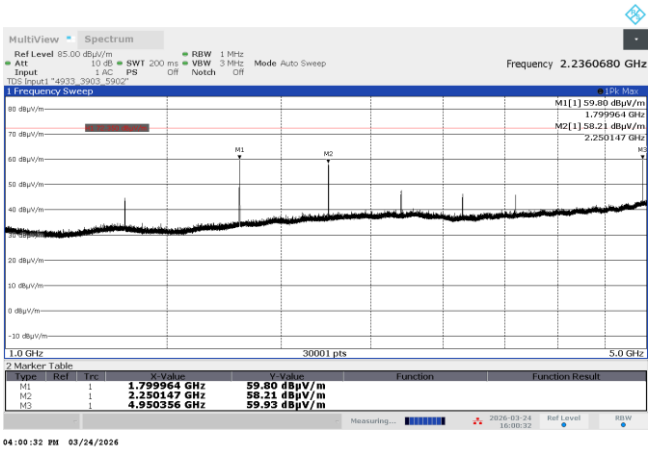


Test specification:	Section 90.210 / RSS-119 Section 5.8.4, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053; TIA/EIA-603-E, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date(s):	24-Mar-26 – 25-Mar-26		
Temperature: 26 ºC	Relative Humidity: 54 %	Air Pressure: 1008 hPa	Power: 3.6 VDC
Remarks:			

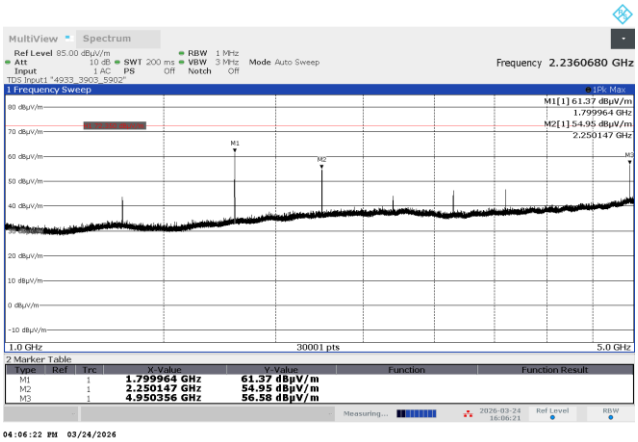
Plot 7.5.6 Radiated emission measurements in 1000 – 5000 MHz range at low carrier frequency

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

Vertical



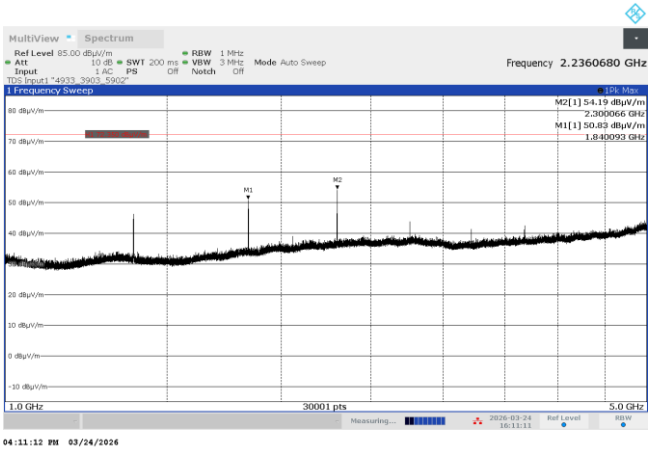
Horizontal

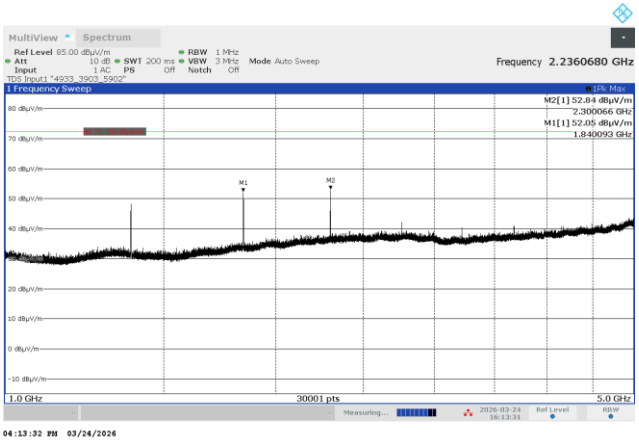


Plot 7.5.7 Radiated emission measurements in 1000 – 5000 MHz range at mid carrier frequency

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

Horizontal

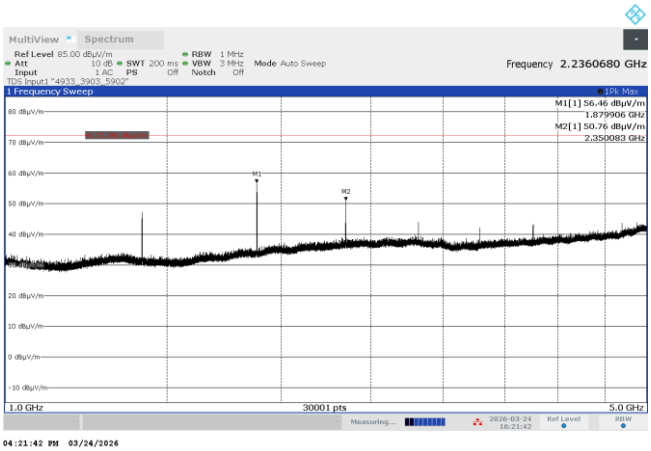


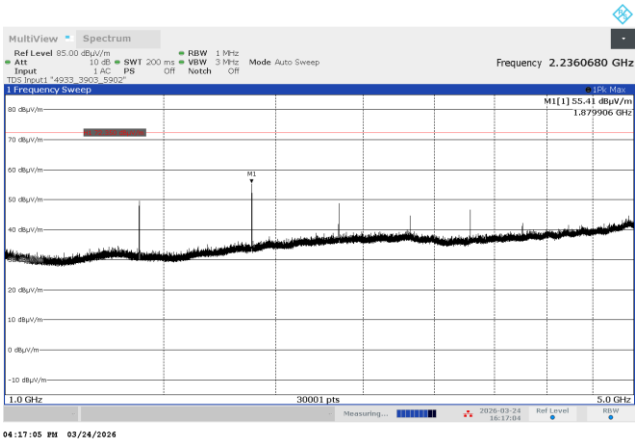


Test specification:	**Section 90.210 / RSS-119 Section 5.8.4, Radiated spurious emissions**		
Test procedure:	47 CFR, Sections 2.1053; TIA/EIA-603-E, Section 2.2.12		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	24-Mar-26 – 25-Mar-26		
Temperature: 26 ºC	**Relative Humidity:** 54 %	**Air Pressure:** 1008 hPa	**Power:** 3.6 VDC
Remarks:			

Plot 7.5.8 Radiated emission measurements in 1000 – 5000 MHz range at high carrier frequency

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



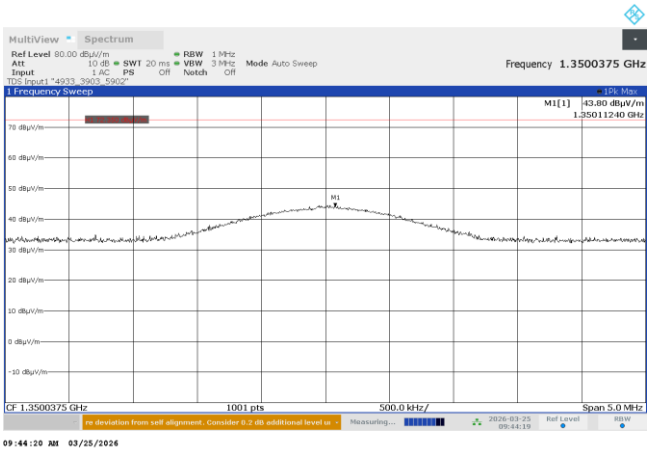


Test specification:	**Section 90.210 / RSS-119 Section 5.8.4, Radiated spurious emissions**		
Test procedure:	47 CFR, Sections 2.1053; TIA/EIA-603-E, Section 2.2.12		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	24-Mar-26 – 25-Mar-26		
Temperature: 26 ºC	**Relative Humidity:** 54 %	**Air Pressure:** 1008 hPa	**Power:** 3.6 VDC
Remarks:			

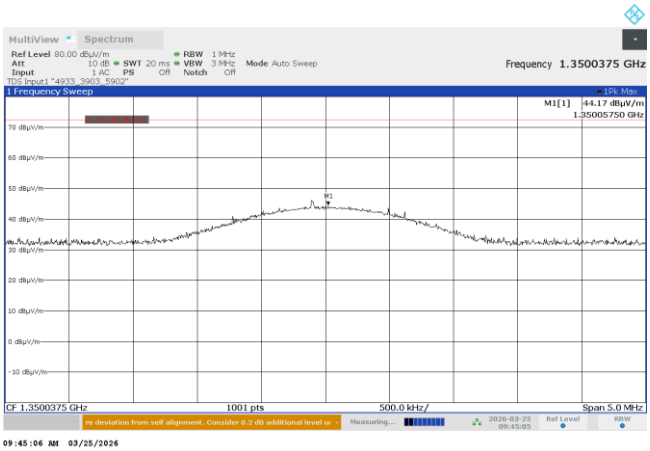
Plot 7.5.9 Radiated emission measurements at the 3rd harmonics at low carrier frequency

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

Vertical



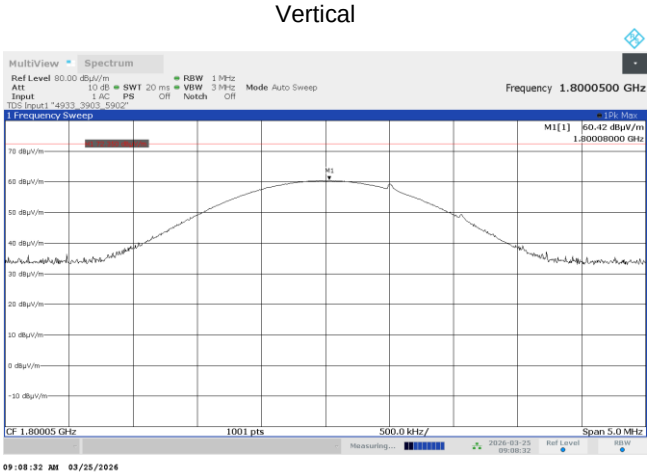
Horizontal



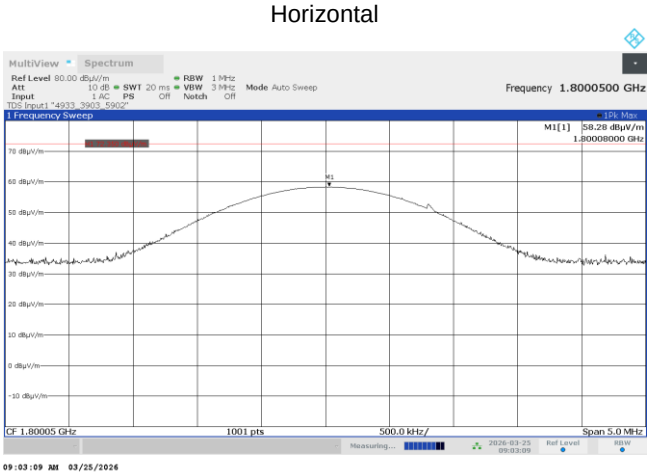
Plot 7.5.10 Radiated emission measurements at the 4th harmonics at low carrier frequency

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

Vertical



Horizontal

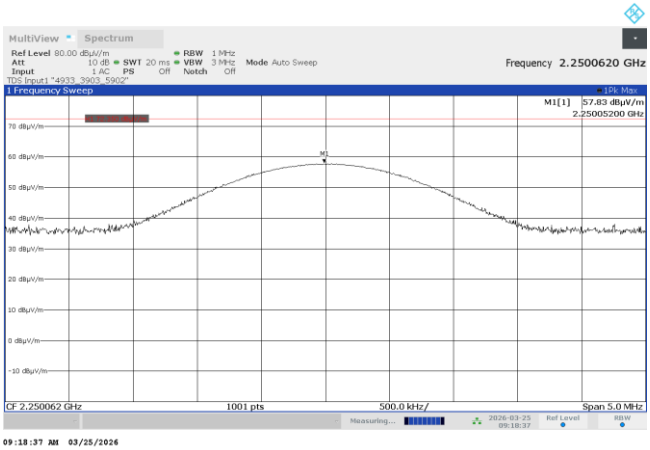


Test specification:	**Section 90.210 / RSS-119 Section 5.8.4, Radiated spurious emissions**		
Test procedure:	47 CFR, Sections 2.1053; TIA/EIA-603-E, Section 2.2.12		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	24-Mar-26 – 25-Mar-26		
Temperature: 26 ºC	**Relative Humidity:** 54 %	**Air Pressure:** 1008 hPa	**Power:** 3.6 VDC
Remarks:			

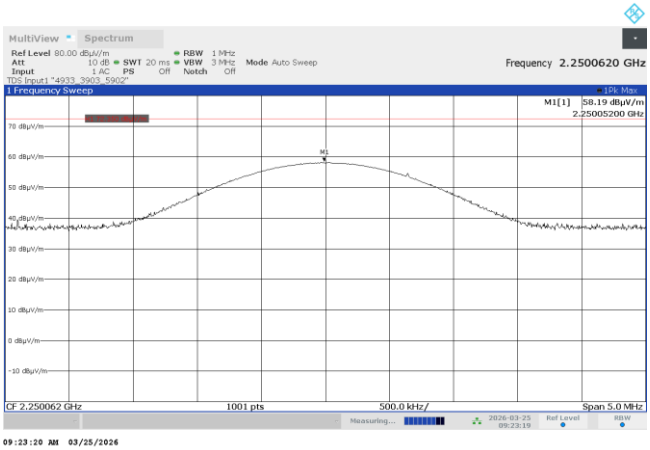
Plot 7.5.11 Radiated emission measurements at the 5th harmonics at low carrier frequency

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

Vertical



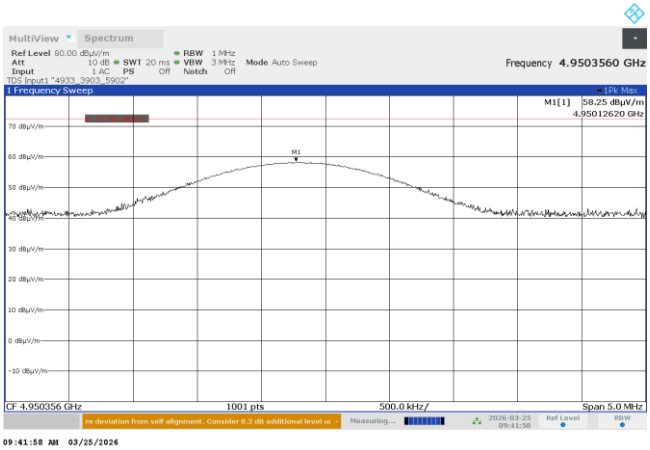
Horizontal



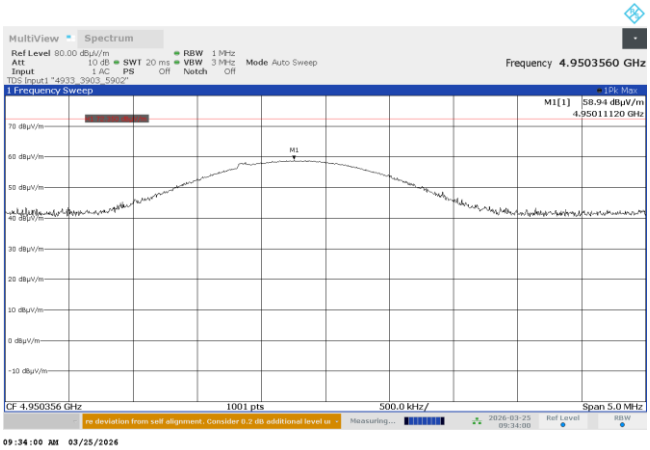
Plot 7.5.12 Radiated emission measurements at the 11th harmonics at low carrier frequency

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

Vertical



Horizontal

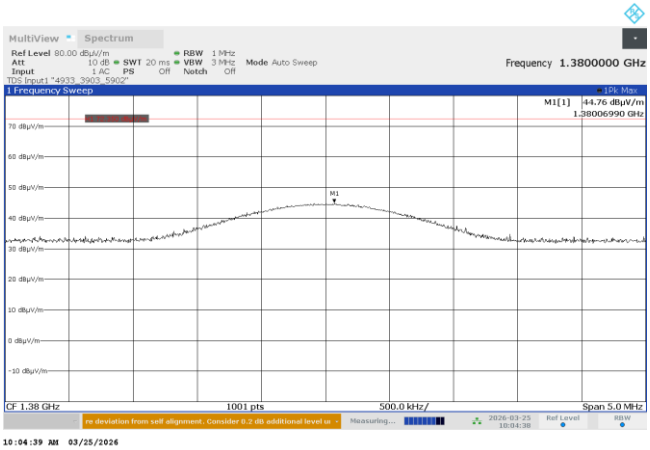


Test specification:	Section 90.210 / RSS-119 Section 5.8.4, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053; TIA/EIA-603-E, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date(s):	24-Mar-26 – 25-Mar-26		
Temperature: 26 ºC	Relative Humidity: 54 %	Air Pressure: 1008 hPa	Power: 3.6 VDC
Remarks:			

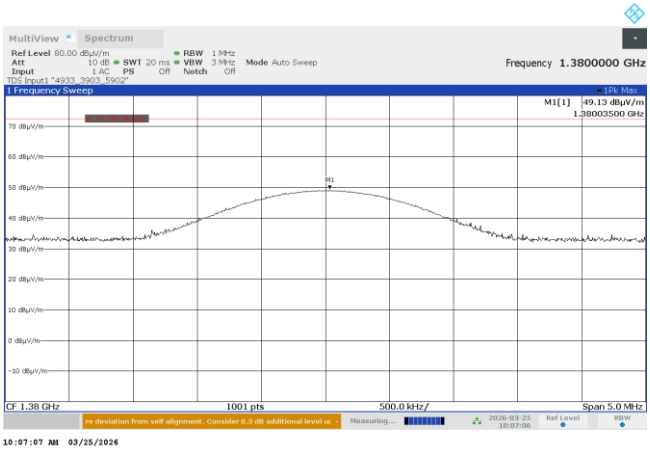
Plot 7.5.13 Radiated emission measurements at the 3rd harmonics at mid frequency

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

Vertical



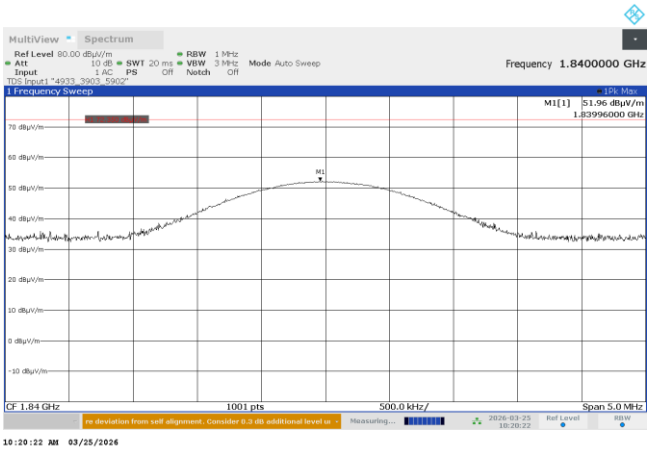
Horizontal



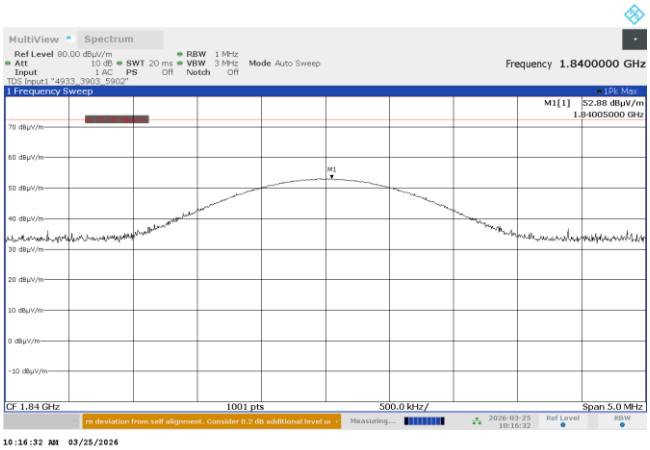
Plot 7.5.14 Radiated emission measurements at the 4th harmonics at mid frequency

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

Vertical



Horizontal

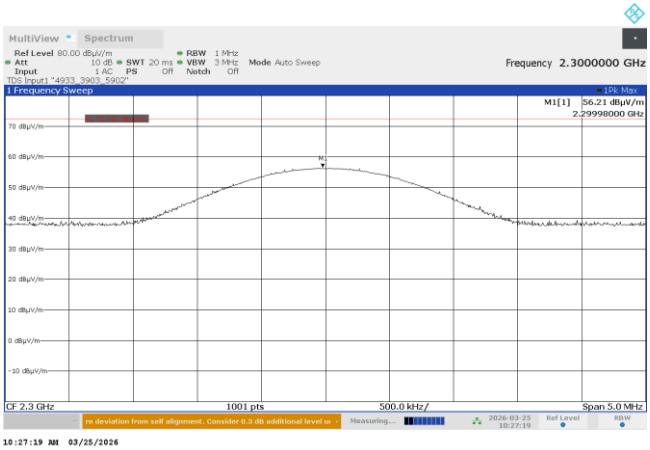


Test specification:	Section 90.210 / RSS-119 Section 5.8.4, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053; TIA/EIA-603-E, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date(s):	24-Mar-26 – 25-Mar-26		
Temperature: 26 ºC	Relative Humidity: 54 %	Air Pressure: 1008 hPa	Power: 3.6 VDC
Remarks:			

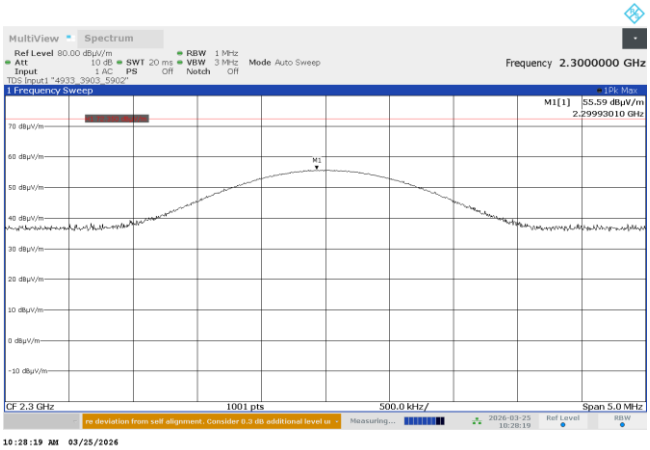
Plot 7.5.15 Radiated emission measurements at the 5th harmonics at mid frequency

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

Vertical



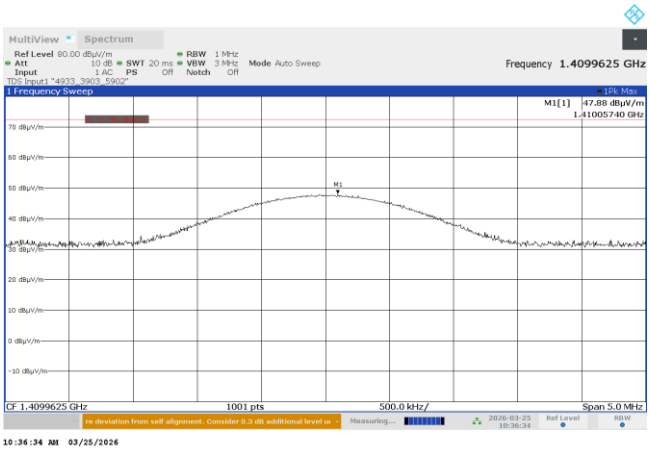
Horizontal



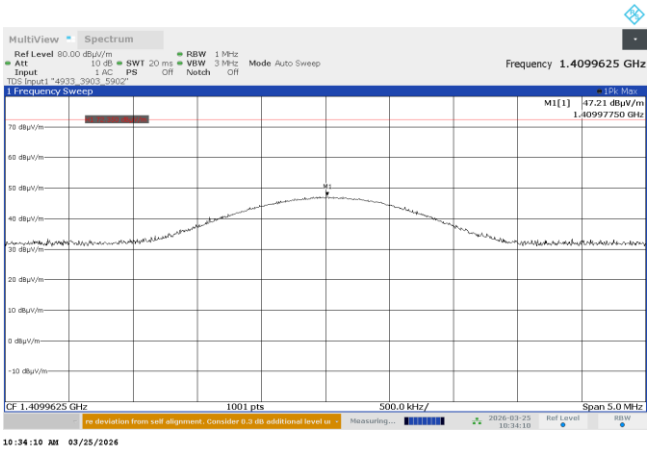
Plot 7.5.16 Radiated emission measurements at the 3rd harmonics at high carrier frequency

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

Vertical



Horizontal

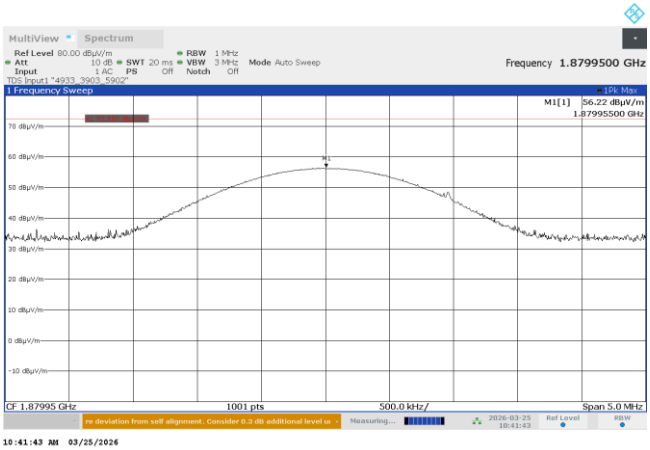


Test specification:	Section 90.210 / RSS-119 Section 5.8.4, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053; TIA/EIA-603-E, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date(s):	24-Mar-26 – 25-Mar-26		
Temperature: 26 ºC	Relative Humidity: 54 %	Air Pressure: 1008 hPa	Power: 3.6 VDC
Remarks:			

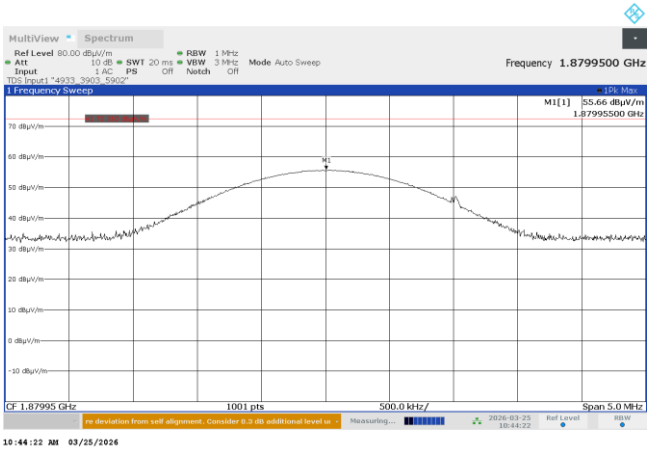
Plot 7.5.17 Radiated emission measurements at the 4th harmonics at high carrier frequency

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

Vertical



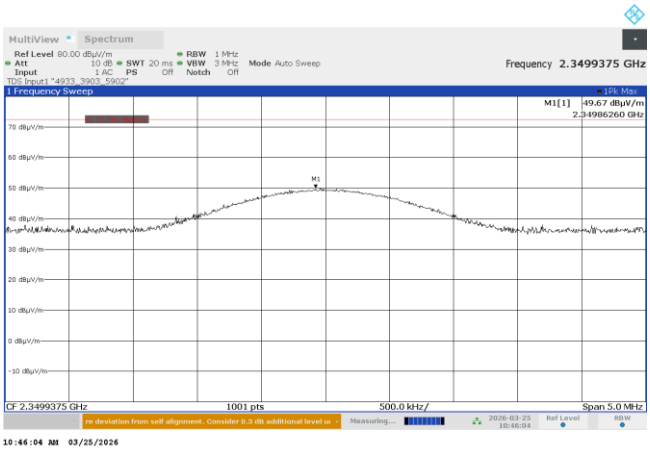
Horizontal



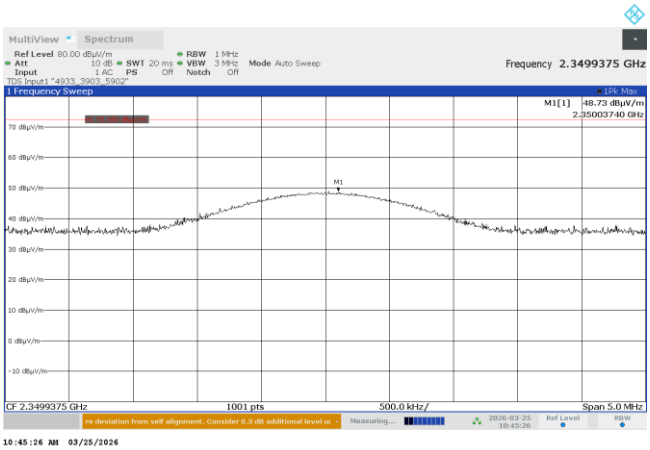
Plot 7.5.18 Radiated emission measurements at the 5th harmonics at high carrier frequency

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

Vertical



Horizontal



Test specification:	Section 90.213 / RSS-119 Section 5.3, Frequency stability		
Test procedure:	47 CFR, Section 2.1055; TIA/EIA-603-E Section 2.2.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	13-Apr-26		
Temperature: 24 ºC	Relative Humidity: 55 %	Air Pressure: 1002 hPa	Power: 3.6 VDC
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.

Table 7.6.1 Frequency stability limits

Assigned frequency, MHz	Maximum allowed frequency displacement	
	ppm	Hz
450.0031	1.0	450
460.0000		460
469.9969		470

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.

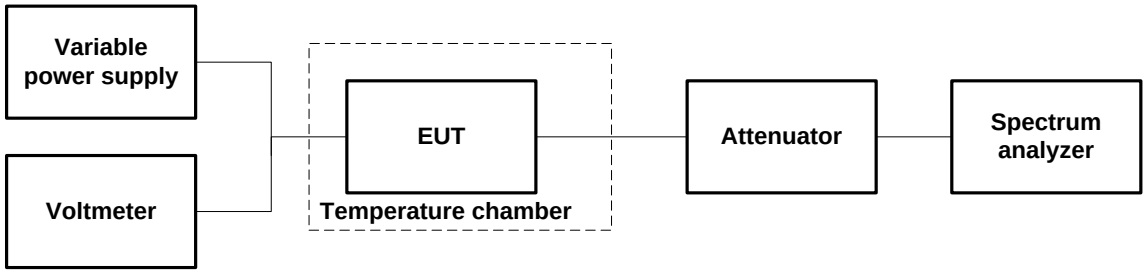
7.6.2.4 The above procedure was repeated at 0˚C and at the lowest test temperature.

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.

7.6.2.7 The test results are provided in Table 7.6.2.

Figure 7.6.1 Frequency stability test setup



Test specification:	**Section 90.213 / RSS-119 Section 5.3, Frequency stability**		
Test procedure:	47 CFR, Section 2.1055; TIA/EIA-603-E Section 2.2.2		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	13-Apr-26		
Temperature: 24 ºC	**Relative Humidity:** 55 %	**Air Pressure:** 1002 hPa	**Power:** 3.6 VDC
Remarks:			

Table 7.6.2 Frequency stability test results

OPERATING FREQUENCY: 450 – 470 MHz
NOMINAL POWER VOLTAGE: 3.6 V DC
TEMPERATURE STABILIZATION PERIOD: 20 min
POWER DURING TEMPERATURE TRANSITION: **Off**
SPECTRUM ANALYZER MODE: Counter
RESOLUTION BANDWIDTH: 10 Hz
VIDEO BANDWIDTH: 30 Hz
MODULATION: Unmodulated

T, ºC	Voltage, V	Frequency, MHz							Max frequency drift, Hz		Limit, Hz	Margin, Hz	Verdict
		Start up	1st min	2nd min	3rd min	4th min	5th min	10th min	Positive	Negative			
Low frequency 450.0125 MHz													
-30	nominal	450.012715	450.012714	450.012722	450.012725	450.012729	450.012734	450.012721	234	0		-216	Pass
-20	nominal	450.012667	NA	NA	NA	NA	NA	450.012671	171	0		-279	Pass
-10	nominal	450.012589	NA	NA	NA	NA	NA	450.012591	91	0		-359	Pass
0	nominal	450.012580	450.012579	450.012585	450.012581	450.012587	450.012584	450.012582	87	0		-363	Pass
10	nominal	450.012582	NA	NA	NA	NA	NA	450.012583	83	0		-367	Pass
20	+15%	NA	NA	NA	NA	NA	NA	NA	NA	NA	450	NA	NA
20	nominal	450.012638	NA	NA	NA	NA	NA	450.012704	204	0		-246	Pass
20	-15%	450.012659	NA	NA	NA	NA	NA	450.012612	159	0		-291	Pass
30	nominal	450.012738	450.012688	450.012677	450.012619	450.012688	450.012737	450.012667	238	0		-212	Pass
40	nominal	450.012755	NA	NA	NA	NA	NA	450.012794	294	0		-156	Pass
50	nominal	450.012842	NA	NA	NA	NA	NA	450.012838	342	0		-108	Pass
Mid frequency 460.0000MHz													
-30	nominal	460.000240	460.000251	460.000257	460.000255	460.000249	460.000249	460.000247	257	0		-203	Pass
-20	nominal	460.000248	NA	NA	NA	NA	NA	460.000248	248	0		-212	Pass
-10	nominal	460.000182	NA	NA	NA	NA	NA	460.000188	188	0		-272	Pass
0	nominal	460.000190	460.000199	460.000191	460.000199	460.000202	460.000187	460.000196	202	0		-258	Pass
10	nominal	460.000192	NA	NA	NA	NA	NA	460.000174	192	0		-268	Pass
20	+15%	NA	NA	NA	NA	NA	NA	NA	NA	NA	460	NA	NA
20	nominal	460.000212	NA	NA	NA	NA	NA	460.000214	214	0		-246	Pass
20	-15%	460.000217	NA	NA	NA	NA	NA	460.000212	217	0		-243	Pass
30	nominal	460.000216	460.000206	460.000215	460.000212	460.000207	460.000214	460.000204	216	0		-244	Pass
40	nominal	460.000248	NA	NA	NA	NA	NA	460.000253	253	0		-207	Pass
50	nominal	460.000357	NA	NA	NA	NA	NA	460.000364	364	0		-96	Pass
High frequency 469.9875 MHz													
-30	nominal	469.987743	469.987739	469.987742	469.987744	469.987743	469.987745	469.987747	247	0		-223	Pass
-20	nominal	469.987692	NA	NA	NA	NA	NA	469.987698	198	0		-272	Pass
-10	nominal	469.987617	NA	NA	NA	NA	NA	469.98762	120	0		-350	Pass
0	nominal	469.987613	469.987617	469.987612	469.987620	469.987614	469.987621	469.987624	124	0		-346	Pass
10	nominal	469.987606	NA	NA	NA	NA	NA	469.98761	110	0		-360	Pass
20	+15%	NA	NA	NA	NA	NA	NA	NA	NA	NA	470	NA	NA
20	nominal	469.987652	NA	NA	NA	NA	NA	469.987657	157	0		-313	Pass
20	-15%	469.987647	NA	NA	NA	NA	NA	469.987658	158	0		-312	Pass
30	nominal	469.987658	469.987659	469.987658	469.987658	469.987657	469.987656	469.987656	159	0		-311	Pass
40	nominal	469.987742	NA	NA	NA	NA	NA	469.987741	242	0		-228	Pass
50	nominal	469.987862	NA	NA	NA	NA	NA	469.987866	366	0		-104	Pass

* - Reference frequency

Reference numbers of test equipment used

HL 0493	HL 3766	HL 4355					

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-E, Section 2.2.19		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	13-Apr-26		
Temperature: 24 ºC	**Relative Humidity:** 55 %	**Air Pressure:** 1008 hPa	**Power:** 3.6 VDC
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.

Table 7.7.1 Transient frequency limits

Channel bandwidth, kHz	Carrier frequency tolerance, kHz	Duration, ms	Time interval*
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.

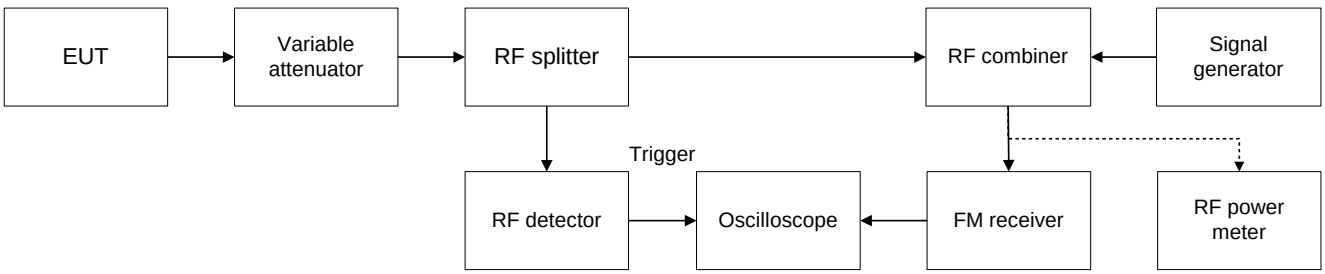
7.7.2.2 The signal generator was set to the assigned transmitter frequency modulated with 1 kHz tone at 25 kHz deviation and the output power was adjusted to provide the same as the EUT signal level at the FM receiver input as measured with power meter.

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.

7.7.2.5 The test results are provided in **Error! Reference source not found.** and the associated plots.

Figure 7.7.1 Transient frequency test setup



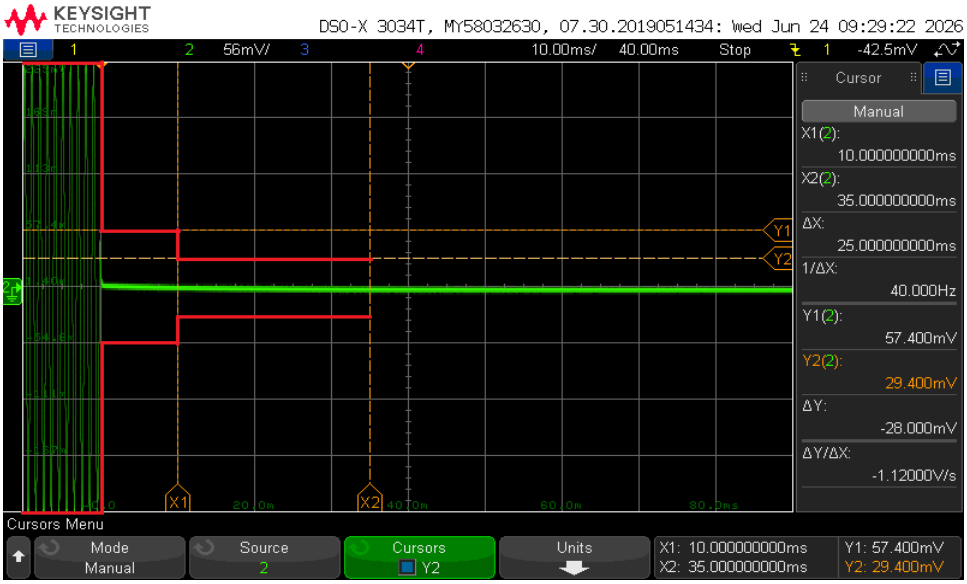
Reference numbers of test equipment used

HL 2667	HL 3433	HL 3438	HL 3442	HL 3785	HL 4413	HL 4778	HL 4938
HL 5472	HL 5971						

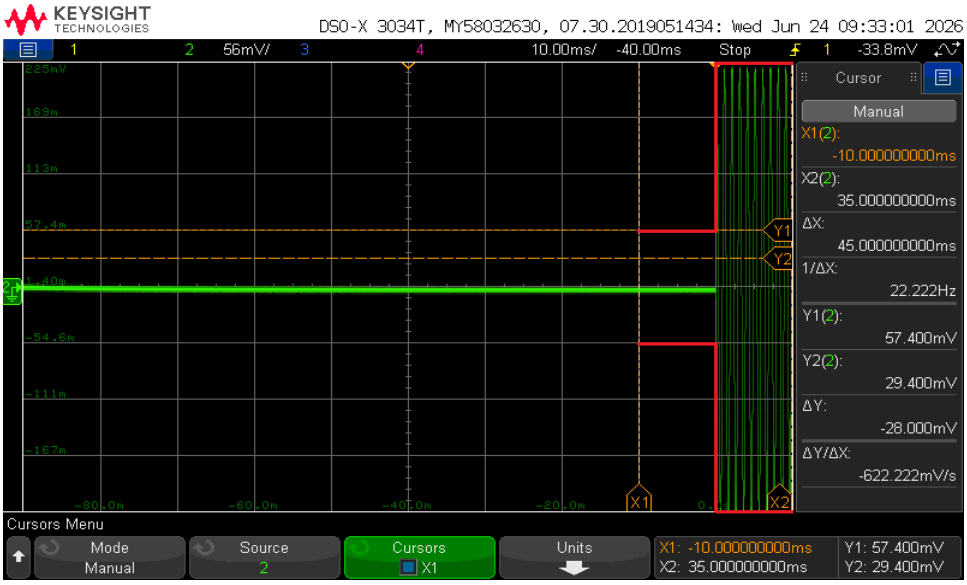
Full description is given in Appendix A.

Test specification:	Section 90.214 / RSS-119 Section 5.9, Transient frequency behaviour		
Test procedure:	TIA/EIA-603-E, Section 2.2.19		
Test mode:	Compliance	Verdict:	PASS
Date(s):	13-Apr-26		
Temperature: 24 ºC	Relative Humidity: 55 %	Air Pressure: 1008 hPa	Power: 3.6 VDC
Remarks:			

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

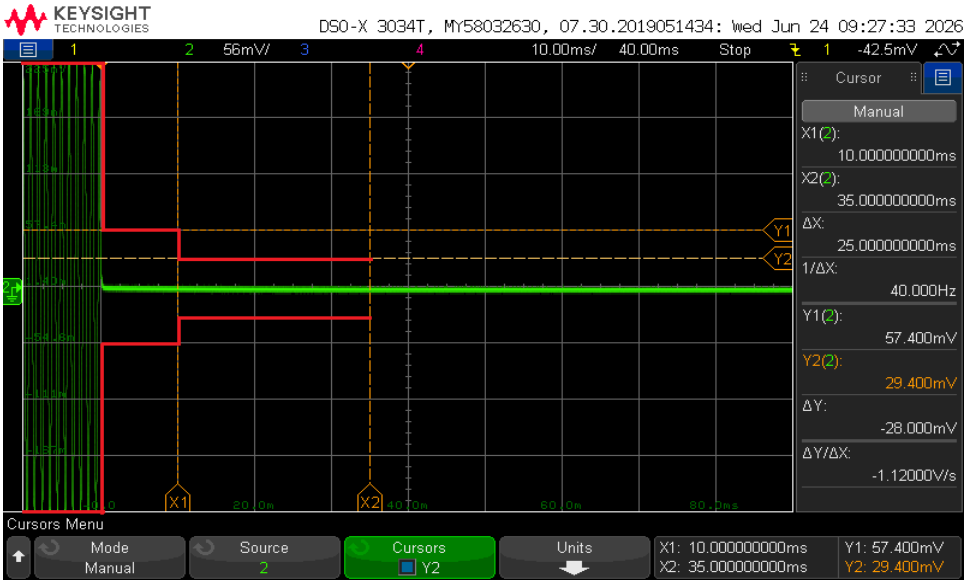


Plot 7.7.2 Transient frequency during power OFF test results at low carrier frequency

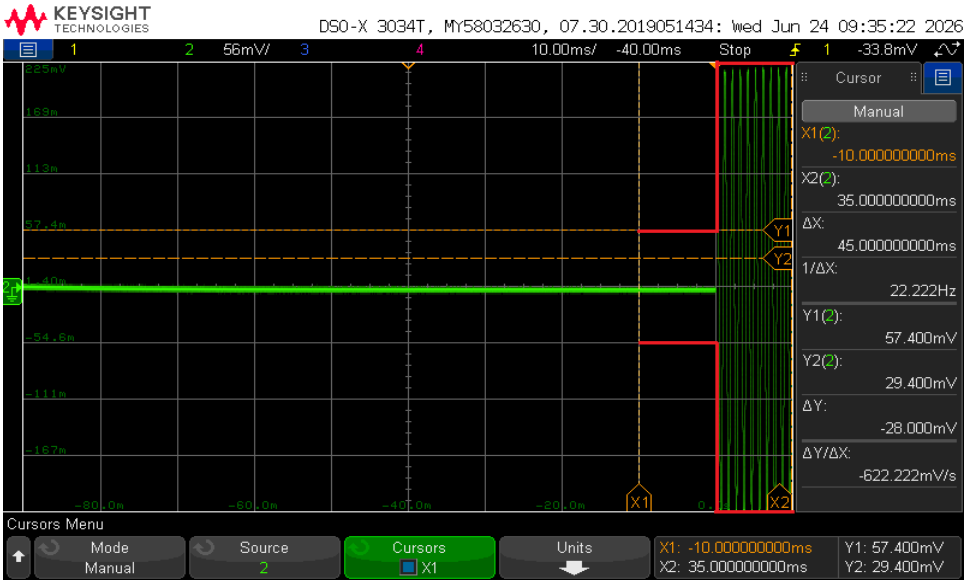


Test specification:	Section 90.214 / RSS-119 Section 5.9, Transient frequency behaviour		
Test procedure:	TIA/EIA-603-E, Section 2.2.19		
Test mode:	Compliance	Verdict:	PASS
Date(s):	13-Apr-26		
Temperature: 24 ºC	Relative Humidity: 55 %	Air Pressure: 1008 hPa	Power: 3.6 VDC
Remarks:			

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

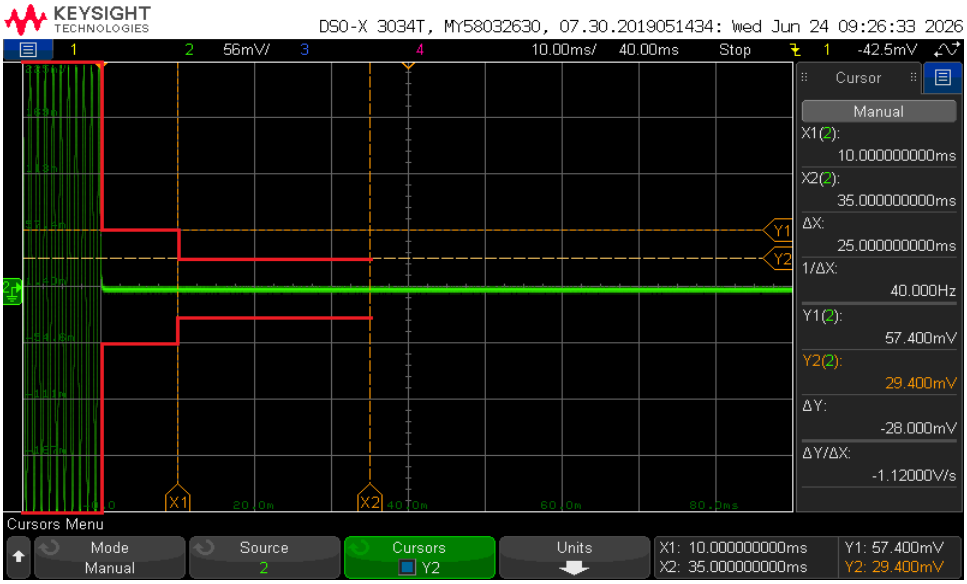


Plot 7.7.4 Transient frequency during power OFF test results at mid carrier frequency

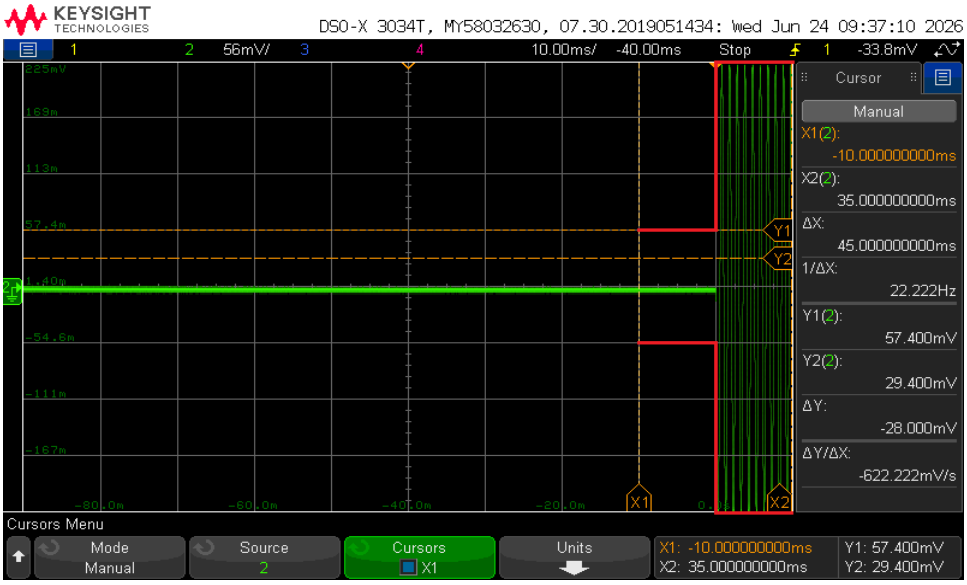


Test specification:	Section 90.214 / RSS-119 Section 5.9, Transient frequency behaviour		
Test procedure:	TIA/EIA-603-E, Section 2.2.19		
Test mode:	Compliance	Verdict:	PASS
Date(s):	13-Apr-26		
Temperature: 24 ºC	Relative Humidity: 55 %	Air Pressure: 1008 hPa	Power: 3.6 VDC
Remarks:			

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



Test specification:	ICES-003, Section 5.5 Class B, Radiated disturbance measurements		
Test procedure:	CAN/CSA-CEI/IEC CISPR 22, Section 6		
Test mode:	Compliance	Verdict:	PASS
Date(s):	13-Apr-26		
Temperature: 24 ºC	Relative Humidity: 55 %	Air Pressure: 1008 hPa	Power: 3.6 VDC
Remarks:			

8 Emissions tests according to FCC 47CFR part 15 subpart B and ICES-003 requirements

8.1 Radiated emission measurements for Bronze pipe

8.1.1 General

This test was performed to measure radiated emissions from the EUT enclosure. The specification test limits are given in Table 8.1.1.

Table 8.1.1 Radiated emission test limits

Frequency, MHz	Class B limit, dB(μV/m)			Class A limit, dB(μV/m)		
	10 m distance	3 m distance		10 m distance	3 m distance	
FCC 47 CFR, Section 15.109						
30 - 88	29.5*	40.0		39.0	49.5*	
88 - 216	33.0*	43.5		43.5	54.0*	
216 - 960	35.5*	46.0		46.4	56.9*	
Above 960	43.5*	54.0		49.5	60.0*	
ICES-003, Section 3.2.2						
30 - 88	30.0	40.0		40.0	50.0	
88 - 216	33.1	43.5		43.5	54.0	
216 - 230	35.6	46.0		46.4	56.9	
230 - 960	37.0	47.0		47.0	57.0	
960 - 1000	43.5	54.0		49.5	60.0	
1000 - 40000	---	74 (Peak)	54 (AVR)	---	80 (Peak)	60 (AVR)

* - The limit for a test distance other than specified was calculated using the inverse linear distance extrapolation factor as follows: $Lim_{S2} = Lim_{S1} + 20 \log (S_1/S_2)$,
where S_1 and S_2 – the standard defined and the test distance respectively in meters.

8.1.2 Test procedure for measurements in semi-anechoic chamber

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

8.1.2.2 The measurements were performed in the anechoic chamber at 3 m test distance. The specified frequency range was investigated with the antenna connected to the EMI receiver. To find the highest emission the turntable was rotated 360^0 and the measuring antenna height was swept from 1 to 4 m in both, vertical and horizontal polarizations. The EUT cables position was varied to maximize emission.

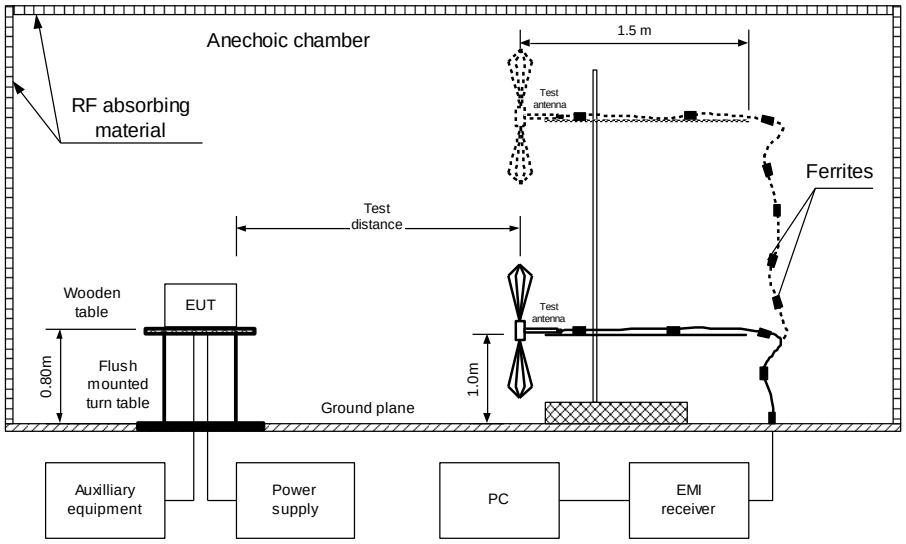
8.1.2.3 **1000 – 40000 MHz range.** The EUT was set up as shown in Figure 8.1.2 and the associated photograph/s, energized and the EUT performance was checked.

8.1.2.4 The measurements were performed in the semi anechoic chamber at 3 m test distance. The specified frequency range was investigated with the antenna connected to the EMI receiver. To find the highest emission the turntable was rotated 360^0 and the measuring antenna height was swept from 1 to 4 m in both, vertical and horizontal polarizations. In order to stay within the 3 dB beamwidth while keeping the antenna height scanned from 1 to 4 m, a few sweeps with different antenna angles over the entire height were performed.

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

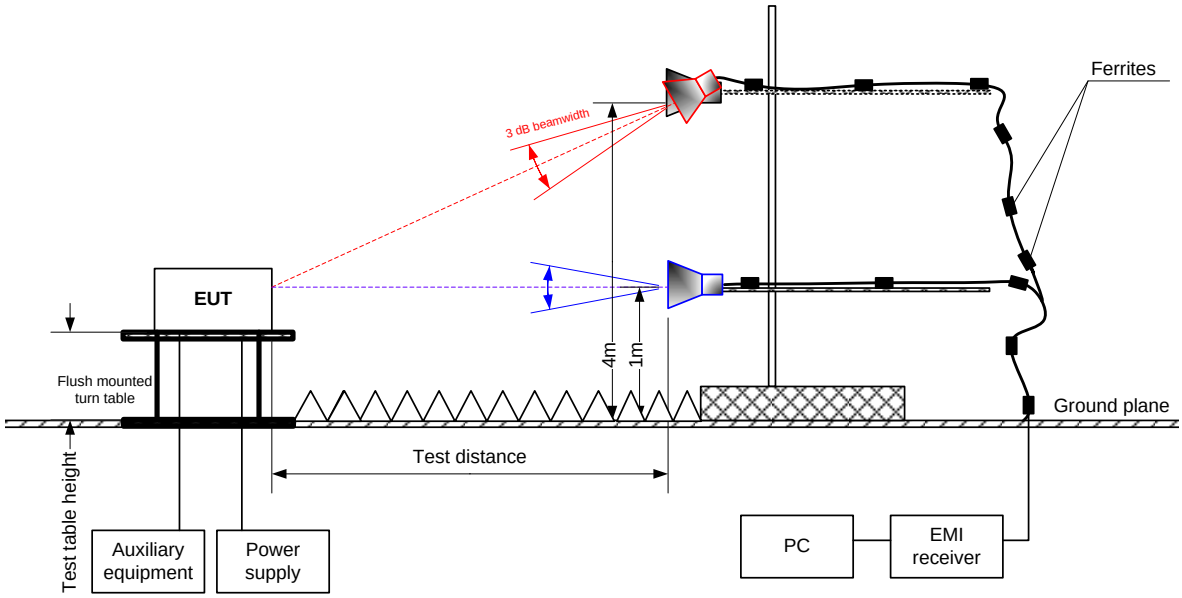
Test specification:	ICES-003, Section 5.5 Class B, Radiated disturbance measurements		
Test procedure:	CAN/CSA-CEI/IEC CISPR 22, Section 6		
Test mode:	Compliance	Verdict:	PASS
Date(s):	13-Apr-26		
Temperature: 24 ºC	Relative Humidity: 55 %	Air Pressure: 1008 hPa	Power: 3.6 VDC
Remarks:			

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



Test specification:	ICES-003, Section 5.5 Class B, Radiated disturbance measurements		
Test procedure:	CAN/CSA-CEI/IEC CISPR 22, Section 6		
Test mode:	Compliance	Verdict:	PASS
Date(s):	13-Apr-26		
Temperature: 24 ºC	Relative Humidity: 55 %	Air Pressure: 1008 hPa	Power: 3.6 VDC
Remarks:			

Figure 8.1.2 Setup for radiated emission measurements in 1000 – 40000 MHz range, table-top EUT



Test specification:	**ICES-003, Section 5.5 Class B, Radiated disturbance measurements**		
Test procedure:	CAN/CSA-CEI/IEC CISPR 22, Section 6		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	13-Apr-26		
Temperature: 24 ºC	**Relative Humidity:** 55 %	**Air Pressure:** 1008 hPa	**Power:** 3.6 VDC
Remarks:			

Table 8.1.2 Radiated emission test results

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

Frequency, MHz	Peak emission, dB(µV/m)	Quasi-peak			Antenna polarization	Antenna height, m	Turn-table position**, degrees	Verdict
		Measured emission, dB(µV/m)	Limit, dB(µV/m)	Margin, dB*				
82.960	28.86	18.86	40.00	-21.14	Vertical	1.60	-135	Pass

TEST SITE: SEMI ANECHOIC CHAMBER
TEST DISTANCE: 3 m
DETECTORS USED: PEAK / AVERAGE
FREQUENCY RANGE: 1000 MHz – 2500 MHz (15.33)
RESOLUTION BANDWIDTH: 1000 kHz

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

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

Reference numbers of test equipment used

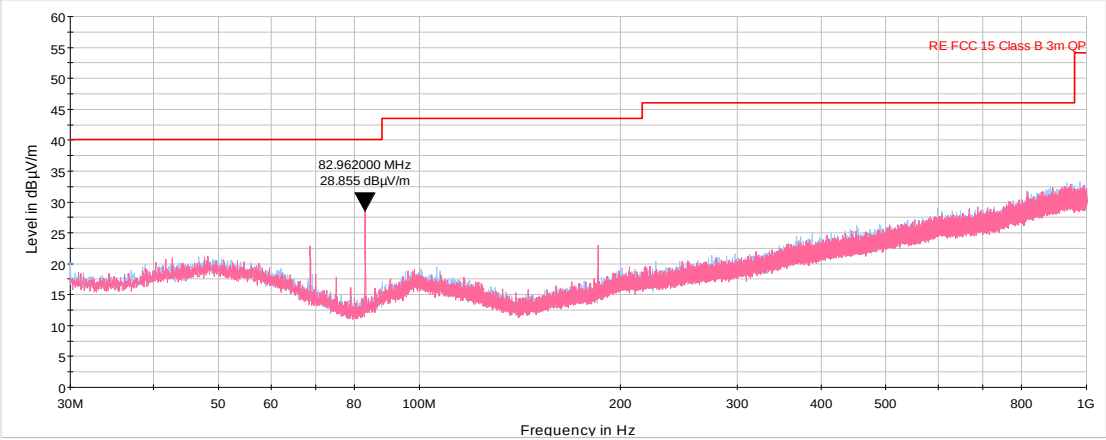
HL 0446	HL 3903	HL 4338	HL 5673	HL 5288	HL 5902	HL 7585	HL1565
HL 4933	HL 5942						

Full description is given in Appendix A.

Test specification:	ICES-003, Section 5.5 Class B, Radiated disturbance measurements		
Test procedure:	CAN/CSA-CEI/IEC CISPR 22, Section 6		
Test mode:	Compliance	Verdict:	PASS
Date(s):	13-Apr-26		
Temperature: 24 ºC	Relative Humidity: 55 %	Air Pressure: 1008 hPa	Power: 3.6 VDC
Remarks:			

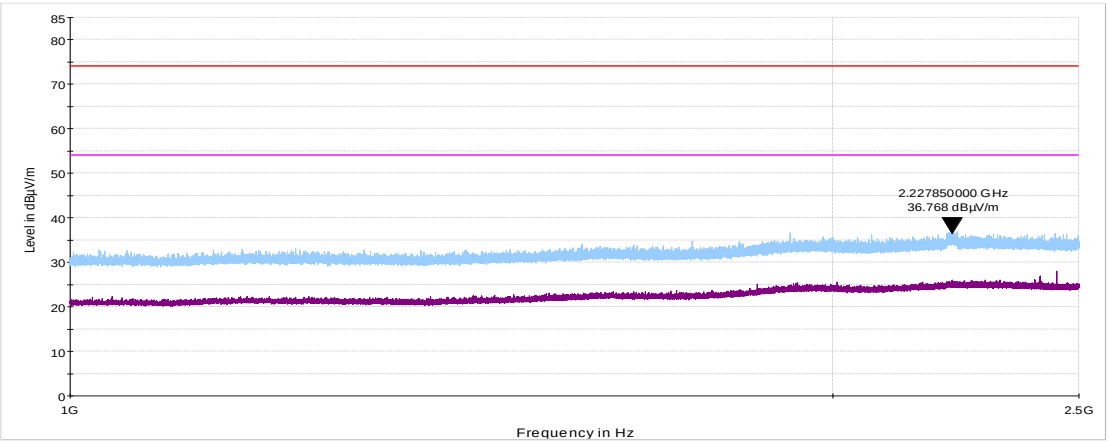
Plot 8.1.1 Radiated emission measurements in 30 - 1000 MHz range, vertical and horizontal antenna polarization

TEST SITE: Anechoic chamber
TEST DISTANCE: 3 m



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

TEST SITE: Anechoic chamber
TEST DISTANCE: 3 m



9 APPENDIX A Test equipment and ancillaries used for tests

HL No	Description	Manufacturer	Model	Ser. No.	Last Cal./ Check	Due Cal./ Check
4135	Shield Box	TESCOM CO., LTD	TC-5916A	5916A000136	18-May-25	18-May-26
5596	Precision Fixed Attenuator, 50 Ohm, 5 W, 10 dB, DC to 18000 MHz	Mini Circuits	BW-N10W5+	NA	03-Aug-25	03-Aug-26
5588	Cable, 50 Ohm, DC to 18 GHz, 1.8 m, SMA/N-type	Mini Circuits	CBL-6FT-SMNM+	NA	10-Nov-25	10-Nov-26
5626	Precision Fixed Attenuator, 50 Ohm, 5 W, 20 dB, DC to 18 GHz	Mini Circuits	BW-N20W5+	NA	03-Aug-25	03-Aug-26
3230	Multimeter	Fluke	115C	94173028	20-Aug-25	20-Aug-26
5376	EXA Signal Analyzer, 10 Hz - 32 GHz	Keysight Technologies	N9010B	MY57470404	17-Mar-25 13-Apr-26	13-Apr-26 13-Apr-27
4355	Signal and Spectrum Analyzer, 9 kHz to 7 GHz	Rohde & Schwarz	FSV 7	101630	02-Nov-25	02-Nov-26
6957	Directional Coupler, 1-2000 MHz, 15.5 dB, 50Ω	MiniCircuits	ZFDC-15-5	0 0006	11-Jul-24	11-Jul-27
446	Antenna, Loop, Active, 10 (9) kHz - 30 MHz	EMCO	6502	2857	05-Feb-26	05-Feb-27
3903	Microwave Cable Assembly, 40.0 GHz, 1.5 m, SMA/SMA	Huber-Suhner	SUCOFLEX 102A	1226/2A	10-Jun-25	10-Jun-26
4933	Active Horn Antenna, 1 GHz to 18 GHz	COM-POWER CORPORATION	AHA-118	701046	23-Feb-26	23-Feb-27
4339	High pass Filter, 50 Ohm, 1000 to 18000 MHz, SMA-FM / SMA-M	Micro-Tronics	HPM50115-02	001	05-Jun-25	05-Jun-27
5288	Trilog Antenna, 25 MHz - 8 GHz, 100W	Frankonia	ALX-8000E	00809	08-Apr-25	08-Apr-27
5902	RF cable, 18 GHz, 6.0m, N-type	Huber-Suhner	SF126EA/11N/11N/6000	NA	24-Apr-25	24-Apr-26
7585	EMI Test Receiver, 1 Hz to 44 GHz	Rohde & Schwarz	ESW44	103130	30-Sep-25	30-Sep-26
2227	Crystal Detector 0.01-18 GHz, 100 mW	Hewlett Packard Co	8472A	NA	21-Jan-26	21-Jan-28
5472	Power Splitter / Combiner 0.5-1 GHz	Mini Circuits	ZAPD-1	NA	09-Feb-25	09-Feb-27
4366	Directional coupler, 1 GHz to 18 GHz, 10 dB, SMA Female	Tiger Micro-Electronics Institute	TGD-A1101-10	01e-JSDE805-007	06-Jun-26	06-Jun-28
3433	Test Cable , DC-18 GHz, 1.5 m, SMA - SMA	Mini-Circuits	CBL-5FT-SMSM+	25679	15-May-25	15-May-26
5942	Signal Generator, 8.0 kHz to 6.0 GHz	Rohde & Schwarz	SMB-100B	102327	09-Feb-26	09-Feb-27
5971	Oscilloscope, 500 MHz, digital 4 channel	Rohde & Schwarz	RTM3004	104883	10-Nov-25	10-Nov-26
6659	Variable Attenuator 0-11dB	Hewlett Packard	8494A	3308A22659	20-Jul-25	20-Jul-26
7523	Programmable DC Power Supplies, 48VDC/38A	TDK-Lambda Ltd	GEN40-38	LOC-823A277-0004	01-Feb-26	01-Feb-27
7803	Variable attenuator DC-4GHz, 70 dB, 10dB step	Hewlett Packard	HP8495A	3308A15231	20-Jul-25	20-Jul-26

10 APPENDIX B 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	±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 ± 13.9 %
Duty cycle, timing (Tx ON / OFF) and average factor measurements	± 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 Vertical polarization	 Biconilog antenna: ± 5.3 dB Biconical antenna: ± 5.0 dB Log periodic antenna: ± 5.3 dB Double ridged horn antenna: ± 5.3 dB Biconilog antenna: ± 6.0 dB Biconical antenna: ± 5.7 dB Log periodic antenna: ± 6.0 dB Double ridged horn antenna: ± 6.0 dB

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

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

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

11 APPENDIX C Test laboratory description

Tests were performed at Hermon Laboratories Ltd., which is a fully independent, private, EMC, Radio, Safety, Environmental and Telecommunication testing facility.
Hermon Laboratories is recognized and accredited by the Federal Communications Commission (USA) for relevant parts of Code of Federal Regulations 47 (CFR 47), Test Firm Registration Number is 927748, Designation Number is IL1001; Recognized by Innovation, Science and Economic Development Canada for wireless and terminal testing (ISED), ISED #2186A, CAB identifier is IL1001; Certified by VCCI, Japan (the registration numbers for OATS are R-10808 for RE measurements below 1 GHz, G-20112 for RE measurements above 1 GHz, R-11082 for anechoic chamber for RE measurements below 1 GHz, G-10869 for RE measurements above 1 GHz, C-10845 for conducted emissions site and T-11606 for conducted emissions at telecommunication ports).
The laboratory is accredited by American Association for Laboratory Accreditation (USA) according to ISO/IEC 17025 for electromagnetic compatibility, product safety, telecommunications testing, environmental simulation and calibration (for exact scope please refer to Certificate No. 839.01, 839.03 and 839.04).

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12 APPENDIX D Specification references

FCC 47CFR part 90: 2024	Private land mobile radio services
FCC 47CFR part 2: 2024	Frequency allocations and radio treaty matters; general rules and regulations
ANSI/TIA/EIA-603-E:2016	Land Mobile FM or PM Communications Equipment Measurement and Performance Standards
RSS-119 Issue 12: 2015	Land Mobile and Fixed Equipment Equipment Operating in the Frequency Range 27.41-960 MHz
RSS-Gen Issue 5: 2021	General Requirements for Compliance of Radio Apparatus

13 APPENDIX E Test equipment correction factors

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

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

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

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

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

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

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

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

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

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

Cable loss
Test Cable, Mini-Circuits, CBL-5FT-SMSM+, SMA-SMA, 18 GHz, 1.5 m, S/N 25679
Mini-Circuits, HL 3433

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10.0	0.06	9000	2.01
100	0.17	9500	2.06
500	0.41	10000	2.05
1000	0.58	10500	2.18
1500	0.72	11000	2.26
2000	0.86	11500	2.28
2500	0.96	12000	2.43
3000	1.04	12500	2.53
3500	1.13	13000	2.52
4000	1.23	13500	2.56
4500	1.31	14000	2.60
5000	1.41	14500	2.59
5500	1.49	15000	2.67
6000	1.55	15500	2.76
6500	1.63	16000	2.86
7000	1.71	16500	2.91
7500	1.78	17000	2.95
8000	1.86	17500	3.02
8500	1.92	18000	3.07

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

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

Cable loss
RF cable, DC to 18 GHz, 1.8m, 50 Ohm, Mini-Circuits,
CBL-6FT-SMNM+, HL 4938

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
0.1	0.16	5100	2.10	10300	3.37	15500	4.59
50	0.23	5200	2.15	10400	3.39	15600	4.61
100	0.29	5300	2.16	10500	3.41	15700	4.64
200	0.38	5400	2.19	10600	3.42	15800	4.66
300	0.46	5500	2.23	10700	3.45	15900	4.71
400	0.53	5600	2.29	10800	3.49	16000	4.72
500	0.59	5700	2.27	10900	3.52	16100	4.73
600	0.64	5800	2.31	11000	3.52	16200	4.80
700	0.69	5900	2.36	11100	3.53	16300	4.83
800	0.74	6000	2.38	11200	3.59	16400	4.82
900	0.78	6100	2.41	11300	3.60	16500	4.86
1000	0.83	6200	2.44	11400	3.59	16600	4.88
1100	0.87	6300	2.49	11500	3.64	16700	4.89
1200	0.91	6400	2.51	11600	3.67	16800	4.95
1300	0.95	6500	2.54	11700	3.67	16900	4.93
1400	0.99	6600	2.58	11800	3.69	17000	4.94
1500	1.03	6700	2.61	11900	3.73	17100	4.97
1600	1.06	6800	2.63	12000	3.74	17200	5.00
1700	1.10	6900	2.66	12100	3.76	17300	5.03
1800	1.13	7000	2.70	12200	3.79	17400	5.03
1900	1.16	7100	2.73	12300	3.83	17500	5.05
2000	1.19	7200	2.76	12400	3.86	17600	5.11
2100	1.23	7300	2.77	12500	3.87	17700	5.12
2200	1.25	7400	2.80	12600	3.94	17800	5.11
2300	1.28	7500	2.83	12700	3.96	17900	5.13
2400	1.31	7600	2.85	12800	3.98	18000	4.87
2500	1.35	7700	2.85	12900	4.05		
2600	1.38	7800	2.88	13000	4.06		
2700	1.40	7900	2.90	13100	4.07		
2800	1.43	8000	2.89	13200	4.13		
2900	1.47	8100	2.92	13300	4.20		
3000	1.49	8200	2.93	13400	4.18		
3100	1.52	8300	2.94	13500	4.24		
3200	1.56	8400	2.95	13600	4.30		
3300	1.59	8500	2.99	13700	4.33		
3400	1.61	8600	2.99	13800	4.37		
3500	1.64	8700	3.01	13900	4.39		
3600	1.69	8800	3.03	14000	4.40		
3700	1.70	8900	3.07	14100	4.38		
3800	1.72	9000	3.08	14200	4.40		
3900	1.76	9100	3.09	14300	4.41		
4000	1.80	9200	3.12	14400	4.42		
4100	1.81	9300	3.15	14500	4.42		
4200	1.84	9400	3.17	14600	4.43		
4300	1.88	9500	3.18	14700	4.46		
4400	1.90	9600	3.22	14800	4.46		
4500	1.93	9700	3.24	14900	4.49		
4600	1.95	9800	3.25	15000	4.49		
4700	1.99	9900	3.27	15100	4.51		
4800	2.01	10000	3.31	15200	4.55		
4900	2.04	10100	3.34	15300	4.56		
5000	2.09	10200	3.34	15400	4.55		

Cable loss
RF Cable, Huber-Suhner, 18 GHz, 6 m,
SF118/11N(x2), S/N 500023/118
HL 5405

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
0.1	0.04	5500	2.61
50	0.24	6000	2.88
100	0.33	6500	2.92
200	0.47	7000	2.97
300	0.57	7500	3.05
400	0.66	8000	3.16
500	0.75	8500	3.28
600	0.81	9000	3.49
700	0.87	9500	3.52
800	0.93	10000	3.63
900	0.99	10500	3.73
1000	1.06	11000	3.84
1100	1.10	11500	3.97
1200	1.15	12000	4.02
1300	1.19	12500	4.13
1400	1.27	13000	4.17
1500	1.31	13500	4.28
1600	1.37	14000	4.35
1700	1.40	14500	4.56
1800	1.42	15000	4.87
1900	1.46	15500	4.76
2000	1.50	16000	4.81
2500	1.71	16500	4.87
3000	1.90	17000	5.01
3500	2.03	17500	5.05
4000	2.23	18000	5.52
4500	2.42		
5000	2.46		

Cable loss
RF Cable, Huber-Suhner, 40 GHz, 2 m, ,
SF102EA/11SK/11SK/2000MM, S/N 503973/2EA
HL 5409

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
100	0.26	20500	3.75
200	0.36	21000	3.80
300	0.45	21500	3.85
500	0.58	22000	3.90
1000	0.82	22500	3.95
1500	0.99	23000	4.00
2000	1.15	23500	4.04
2500	1.28	24000	4.09
3000	1.40	24500	4.13
3500	1.51	25000	4.19
4000	1.61	25500	4.25
4500	1.71	26000	4.30
5000	1.80	26500	4.37
5500	1.89	27000	4.45
6000	1.98	27500	4.47
6500	2.06	28000	4.45
7000	2.14	28500	4.49
7500	2.22	29000	4.57
8000	2.29	29500	4.60
8500	2.36	30000	4.59
9000	2.43	30500	4.63
9500	2.50	31000	4.68
10000	2.58	31500	4.74
10500	2.63	32000	4.81
11000	2.70	32500	4.89
11500	2.76	33000	4.89
12000	2.82	33500	4.92
12500	2.87	34000	4.94
13000	2.94	34500	4.99
13500	3.00	35000	5.07
14000	3.06	35500	5.12
14500	3.11	36000	5.14
15000	3.17	36500	5.22
15500	3.23	37000	5.28
16000	3.29	37500	5.30
16500	3.35	38000	5.39
17000	3.41	38500	5.48
17500	3.47	39000	5.44
18000	3.51	39500	5.45
18500	3.56	40000	5.51
19000	3.60		
19500	3.66		
20000	3.71		

Cable loss
RF Cable, Mini Circuits, DC to 18 GHz, 1.8 m,
CBL-6FT-SMSM+, HL 5637

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
0.1	0.02	8750	2.34
10	0.83	9000	2.35
30	0.49	9250	2.37
50	0.15	9500	2.40
100	0.21	9750	2.40
250	0.33	10000	2.43
500	0.48	10250	2.44
750	0.59	10500	2.45
1000	0.68	10750	2.48
1250	0.77	11000	2.51
1500	0.85	11250	2.55
1750	0.92	11500	2.60
2000	0.99	11750	2.64
2250	1.06	12000	2.68
2500	1.12	12250	2.73
2750	1.19	12500	2.76
3000	1.25	12750	2.80
3250	1.30	13000	2.86
3500	1.36	13250	2.88
3750	1.41	13500	2.92
4000	1.46	13750	2.96
4250	1.52	14000	2.99
4500	1.57	14250	3.03
4750	1.61	14500	3.06
5000	1.65	14750	3.07
5250	1.68	15000	3.14
5500	1.73	15250	3.16
5750	1.77	15500	3.21
6000	1.81	15750	3.26
6250	1.87	16000	3.29
6500	1.92	16250	3.34
6750	1.96	16500	3.36
7000	2.00	16750	3.37
7250	2.07	17000	3.42
7500	2.11	17250	3.42
7750	2.14	17500	3.43
8000	2.21	17750	3.42
8250	2.26	18000	3.43
8500	2.29		

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

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

14 APPENDIX F Abbreviations and acronyms

A	ampere
AC	alternating current
A/m	ampere per meter
AM	amplitude modulation
AVRG	average (detector)
cm	centimeter
dB	decibel
dBm	decibel referred to one milliwatt
dB(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
PM	pulse modulation
PS	power supply
ppm	part per million (10^{-6})
QP	quasi-peak
RE	radiated emission
RF	radio frequency
rms	root mean square
Rx	receive
s	second
T	temperature
Tx	transmit
V	volt
WB	wideband

15 APPENDIX G Manufacturer's declaration

ST Engineering

Declaration of Identity

We, the undersigned,

Company: ST Engineering Telematics Wireless Ltd.
Address: 26 Harokmim st., Azrieli D-9, Holon 5885849, Israel
Telephone number: +972 35575706

Declare under our sole responsibility that the following equipment:

Brand/Item	Model	Short Product description
Sonata Allegro	SONATA4-AL-P	A water meter operates in Allegro system at 450-470MHz

and

Brand/Item	Model	Short Product description
Sonata Allegro	SONATA4-AL-B	A water meter operates in Allegro system at 450-470MHz

are electronically identical – have the same PCB, Bill of material, and radio operational software, except the mechanical pipeline material:
Model SONATA4-AL-P has a pipeline made of polymer.
Model SONATA4-AL-B has a pipeline made of brass.

Itzhak Kanner

RF Manager, R&D
ST Engineering Telematics Wireless Ltd.

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