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ELECTRICAL TESTING
1633.01

TEST REPORT

ACCORDING TO:

FCC 47 CFR part 15, subpart C §15.247

FCC 47 CFR Part 15, Subpart B, ANSI C63.4:2014

FOR:

Scio Solutions Ltd.

SCiO-Mini 2.0

Model: SCCM2A

FCC ID: 2BLF2-SCM005

Revision table

Revision	Description	Affected pages	Date	Approval
–	New release	All	16.02.2025	Michael

Table of contents

List of tables

List of figures

List of photographs

List of plots

1 Applicant information

Client name:	Scio Solutions Ltd.
Address:	6 Hanagar St., Hod Hasharon 4527703, Israel
Telephone:	054-4595460
E-mail:	uk@scionir.com
Contact name:	Uri Kinrot

2 Equipment under test attributes

Product name:	SCiO-Mini 2.0
Model(s):	SCCM2A
Serial number:	N/A (prototype)
Hardware version:	7.0
Software release:	250 (DSP firmware release); 127 (BLE FW release)
Condition of equipment:	New
Receipt date:	15-Sep-24

3 Manufacturer information

Client name:	Scio Solutions Ltd.
Address:	6 Hanagar St., Hod Hasharon 4527703, Israel
Telephone:	054-4595460
E-mail:	uk@scionir.com
Contact name:	Uri Kinrot

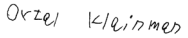
4 Test details

Project ID:	54896
Location:	Hermon Laboratories Ltd. HaSivim 43, Petach Tikva, Israel
Test started:	15-Sep-24
Test completed:	26-Nov-24
Test specification(s):	FCC 47 CFR part 15 subpart C §15.247, FCC 47 CFR Part 15, Subpart B, ANSI C63.4:2014

5 Tests summary

Test	Status
Transmitter tests according to 47CFR part 15 subpart C requirements	
Section 15.247(a)2, 6 dB bandwidth	Pass
Section 15.247(d), Radiated spurious emissions	Pass
Section 15.247(b)3, Peak output power	Pass
Section 15.247(d), Band edge emissions	Pass
Section 15.247(d), Peak power density	Pass
Section 15.207(a), Conducted emission	Pass
Emission tests according to 47CFR part 15 subpart B requirements	
FCC 47 CFR, Section 15.107 / ICES-003, Class B, AC power lines conducted emissions	Pass
FCC 47 CFR, Section 15.109 / ICES-003, Class B, Radiated emissions	Pass

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
Testing performed by:	Orit Klainman, Test Engineer, EMC and Radio	15.09.2024-26.11.2024	
Test report prepared by:	Bina Talkar, Technical Writer, EMC and Radio	10.12.2024	
Test report reviewed by:	Michael Gudovsky, Team Leader, EMC and Radio	16.02.2025	
Test report approved by:	Michael Nikishin, Head of Department, EMC and Radio	16.02.2025	

6 General information

6.1 EUT details

Note: Details in §6.1 below are provided by the customer and represent his sole responsibility.

6.1.1 Description

The SCiO Mini 2 is a palm-sized Near-Infrared (NIR) spectrometer intended for non-destructive material analysis for laboratory and field use and suitable for use by operator's hand.
The SCiO Mini 2 is used in one of two configurations, different only in the optical shade used.
Plastic shade: the user directs the device such that the shade is very close to the sample or touches the sample.
Silicone shade: the flexible shade encases the sample (for example, corn on the cob) such that ambient light is blocked by the shade.
To measure the sample characteristics, an illumination source (a 1.25W incandescent bulb) located inside the device illuminates the sample through the transparent glass window. A proprietary spectrometer located in the device behind another glass window receives some of the light reflected from the sample, and measures the spectral distribution of the reflected illumination. The characteristics of the intensity and spectral distribution received by the spectrometer is analyzed partly by a DSP inside the device and partly using mobile phone application and web services. The mobile phone and the device are connected using Bluetooth Low Energy (BLE) wireless connection.

Product environment: suitable for indoor and outdoor operation. Pollution Degree 3, IP53. Suitable for use in relative humidity 10%-90%, + 3to + 40 °C.

Supplied power: the device is powered by a rechargeable 900mAh Polymer Li-ion battery that can be charged at any time (also during operation) using a USB-C cable connected to its only port (USB-C port)

6.1.2 Mechanical characteristics

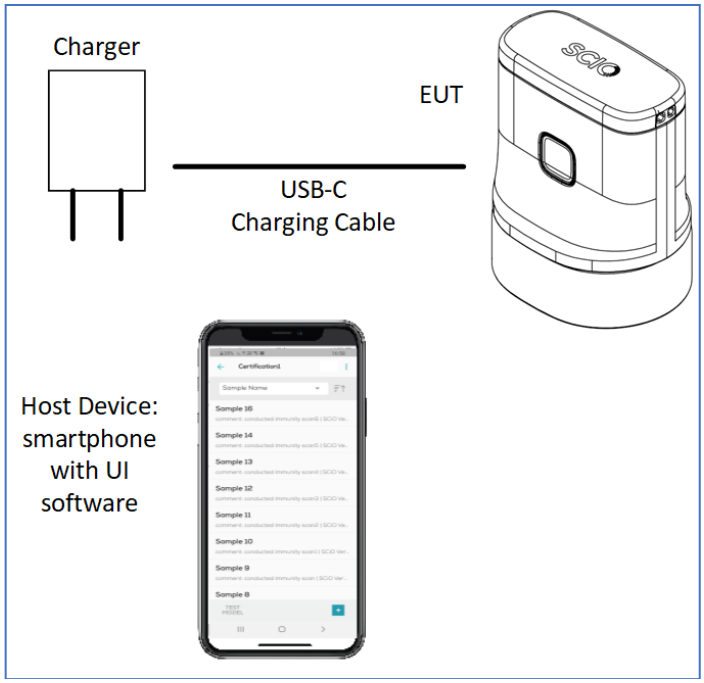
Configuration with plastic shade:

The Equipment Under Test (EUT) measures (H) 61 mm by (W) 60 mm by (D) 49 mm.
The Equipment Under Test (EUT) weighs 93 grams

Configuration with silicone shade:

The Equipment Under Test (EUT) measures (H) 73 mm by (W) 60 mm by (D) 49 mm.
The Equipment Under Test (EUT) weighs 93 grams

6.1.3 EUT configuration



6.1.4 Power supply

Type	Min	Nominal	Max
Voltage (V)	4.2	5	5.5
Current (A)	0	0.5	0.9
Frequency (Hz)	DC	DC	DC

6.1.5 EUT Modules

Description	Manufacturer	Model or P/N	Hardware rev.	Serial number
SCiO mini 2	SCIO SOLUTIONS LTD	SCCM2A	7.0	N/A (prototype)

6.1.6 Ports and lines

Port type	Port description	Conn. from	Conn. to	Qty.	Cable type	Cable length	Indoor / outdoor
USB	USB-C	EXTERNAL CHARGE CABLE	INTERNAL CIRCUITS	1	USB3.0	0.5 or 1m	**Indoor / outdoor**

6.1.7 EUT Options/configurations

Mode	Description	Configuration
Power Off	Shutoff	3s press on button from power on modes
Not Connected	Power is on, before BLE connection with host is established	1s press on button from power off mode
Connected, Standby	Connection with host is established, waiting for scan command from host or button	Use host SW interface to connect to EUT BLE
Connected, Active	Scan command from host or button was received	Use host SW to configure scan conditions

6.1.8 Auxiliary equipment

Description	Manufacturer	Model number	Serial number
smartphone	Samsung	S21	N/A

6.1.9 Operating frequencies

Frequency [MHz]	Location
Scan operating frequency	1/8 Hz
Bluetooth operating frequency	2402-2480MHz

Test specification:	Section 15.247(a)2, 6 dB bandwidth		
Test procedure:	Section 15.247(a)2		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	15-Sep-24 - 16-Sep-24		
Temperature: 24.6 ºC	Air Pressure: 1010 hPa	Relative Humidity: 46 %	Power Supply: 5 VDC
Remarks:			

7 Test Methods and Procedures

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

8.1 Minimum 6 dB bandwidth

8.1.1 General

This test was performed to measure 6 dB bandwidth of the EUT carrier frequency. Specification test limits are given in Table 8.1.1.

Table 8.1.1 6 dB bandwidth limits

Assigned frequency, MHz	Modulation envelope reference points*, dBc	Minimum bandwidth, kHz
902.0 – 928.0	6.0	500.0
2400.0 – 2483.5		
5725.0 – 5850.0		

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

8.1.2 Test procedure

8.1.2.1 The EUT was set up as shown in Figure 8.1.1, energized and its proper operation was checked.

8.1.2.2 The EUT was set to transmit modulated carrier.

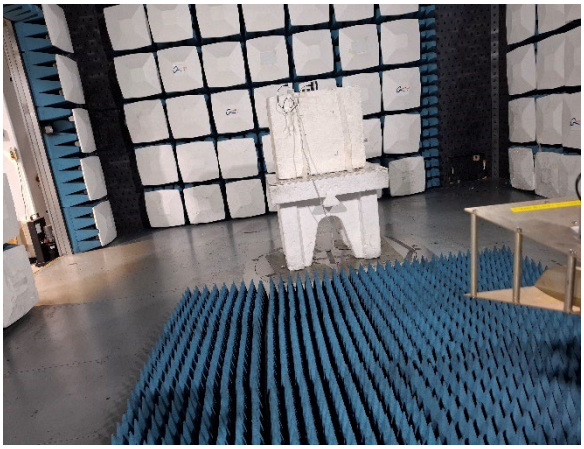
8.1.2.3 The transmitter minimum 6 dB bandwidth was measured with spectrum analyzer as frequency delta between reference points on modulation envelope and provided in Table 8.1.2 and associated plot.

Figure 8.1.1 6 dB bandwidth test setup

Test specification:	Section 15.247(a)2, 6 dB bandwidth		
Test procedure:	Section 15.247(a)2		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	15-Sep-24 - 16-Sep-24		
Temperature: 24.6 ºC	Air Pressure: 1010 hPa	Relative Humidity: 46 %	Power Supply: 5 VDC
Remarks:			

Photograph 8.1.1 6 dB bandwidth test setup

Vertical



Horizontal

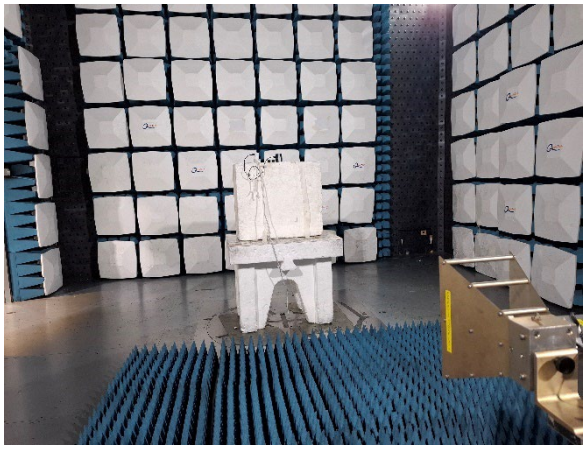


Table 8.1.2 6 dB bandwidth test results

ASSIGNED FREQUENCY BAND:	2400-2483.5 MHz
DETECTOR USED:	Peak
SWEEP MODE:	Single
SWEEP TIME:	Auto
RESOLUTION BANDWIDTH:	100 kHz
VIDEO BANDWIDTH:	300 kHz
MODULATION ENVELOPE REFERENCE POINTS:	6.0 dBc
MODULATION:	GFSK
BIT RATE:	1 Mbps

Carrier frequency, MHz	99% bandwidth, MHz	6 dB bandwidth, kHz	Limit, kHz	Margin, kHz	Verdict
Low frequency					
2402	1.0853	698.3	500	198.3	Pass
Mid frequency					
2440	1.0913	677.4	500	177.4	Pass
High frequency					
2480	1.0809	650.9	500	150.9	Pass

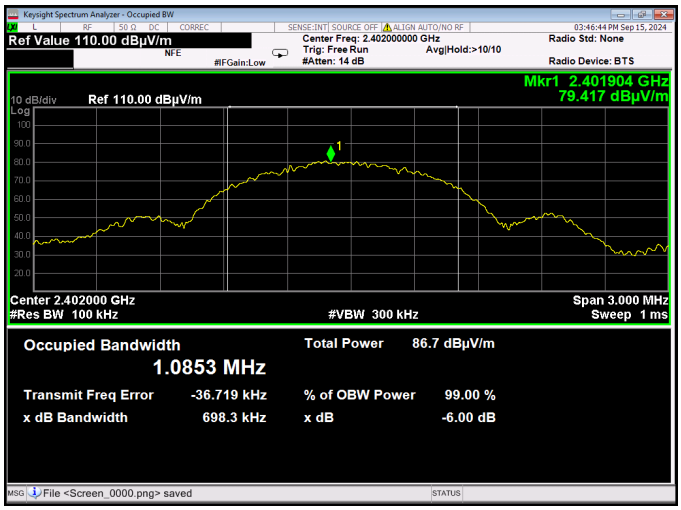
Reference numbers of test equipment used

HL 5102	HL 6208	HL 6240	HL 6574	HL 8120			

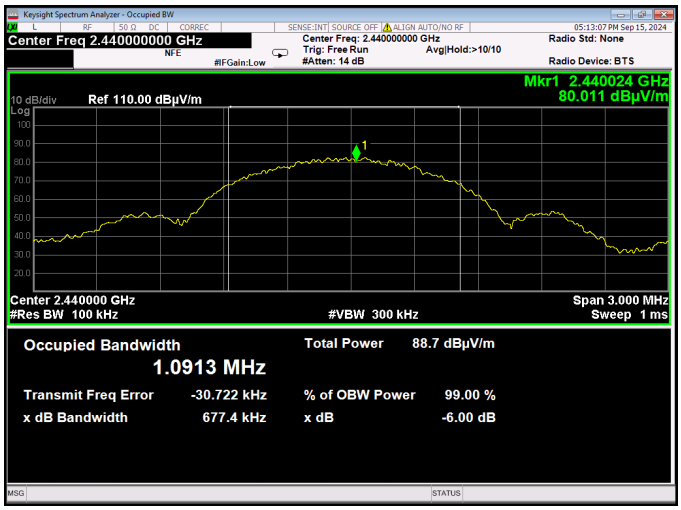
Full description is given in Appendix A.

Test specification:	Section 15.247(a)2, 6 dB bandwidth		
Test procedure:	Section 15.247(a)2		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	15-Sep-24 - 16-Sep-24		
Temperature: 24.6 ºC	Air Pressure: 1010 hPa	Relative Humidity: 46 %	Power Supply: 5 VDC
Remarks:			

Plot 8.1.1 6 dB bandwidth test result at low frequency

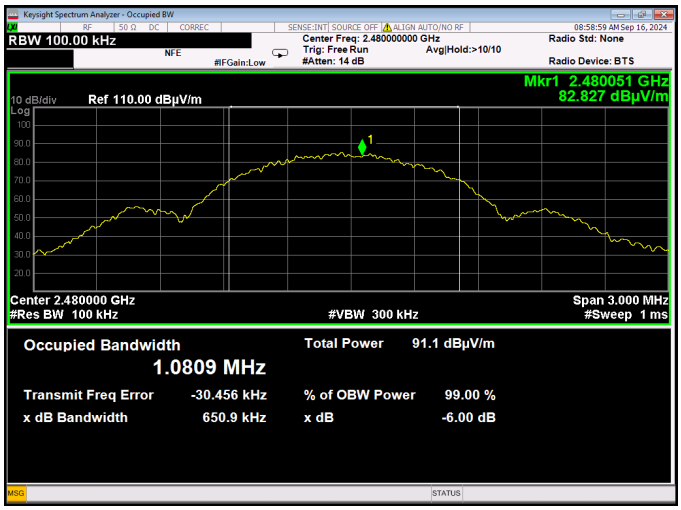


Plot 8.1.2 6 dB bandwidth test result at mid frequency



Test specification:	Section 15.247(a)2, 6 dB bandwidth		
Test procedure:	Section 15.247(a)2		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	15-Sep-24 - 16-Sep-24		
Temperature: 24.6 ºC	Air Pressure: 1010 hPa	Relative Humidity: 46 %	Power Supply: 5 VDC
Remarks:			

Plot 8.1.3 6 dB bandwidth test result at high frequency



Test specification:	Section 15.247(d), Radiated spurious emissions		
Test procedure:	Section 15.247(c) / ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	23-Sep-24 - 25-Sep-24		
Temperature: 22.6 ºC	Air Pressure: 1011 hPa	Relative Humidity: 43 %	Power Supply: 5 VDC
Remarks:			

8.2 Field strength of spurious emissions

8.2.1 General

This test was performed to measure field strength of spurious emissions from the EUT. Specification test limits are given in Table 8.2.1.

Table 8.2.1 Radiated spurious emissions limits

Frequency, MHz	Field strength at 3 m within restricted bands, dB(μV/m)*			Attenuation of field strength of spurious versus carrier outside restricted bands, dBc***
	Peak	Quasi Peak	Average	
0.009 – 0.090	148.5 – 128.5	NA	128.5 – 108.5**	20.0
0.090 – 0.110	NA	108.5 – 106.8**	NA	
0.110 – 0.490	126.8 – 113.8	NA	106.8 – 93.8**	
0.490 – 1.705	NA	73.8 – 63.0**	NA	
1.705 – 30.0*		69.5		
30 – 88		40.0		
88 – 216		43.5		
216 – 960		46.0		
960 - 1000		54.0		
1000 – 10thharmonic	74.0	NA	54.0	

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

$$Lim_{S2} = Lim_{S1} + 40 \log (S_1/S_2),$$

where S_1 and S_2 – standard defined and test distance respectively in meters.
**- The limit decreases linearly with the logarithm of frequency.
*** - The field strength limits applied from the lowest radio frequency generated in the device, without going below 9 kHz up to the tenth harmonic of the highest fundamental frequency.

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

8.2.2.1 The EUT was set up as shown in Figure 8.2.1, energized and the performance check was conducted.

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

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

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

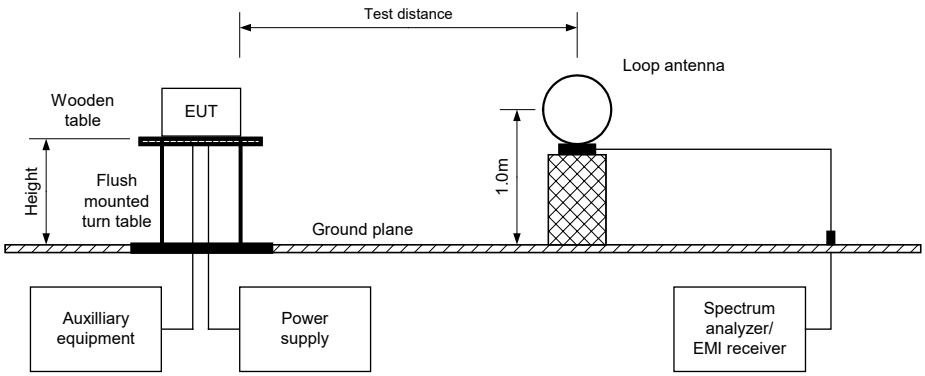
8.2.3.1 The EUT was set up as shown in Figure 8.2.2, Figure 8.2.3, energized and the performance check was conducted.

8.2.3.2 The specified frequency range was investigated with antenna connected to spectrum analyzer/ EMI receiver. To find maximum radiation the turntable was rotated 360^0, the measuring antenna height was changed from 1 to 4 m, its polarization was switched from vertical to horizontal.

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

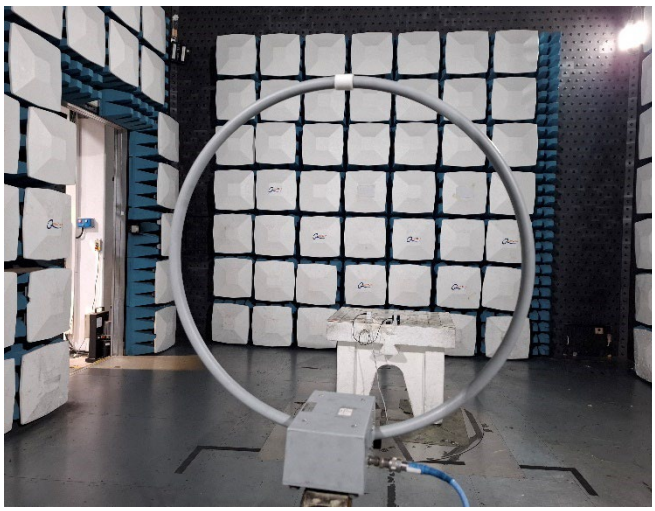
Test specification:	Section 15.247(d), Radiated spurious emissions		
Test procedure:	Section 15.247(c) / ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	23-Sep-24 - 25-Sep-24		
Temperature: 22.6 ºC	Air Pressure: 1011 hPa	Relative Humidity: 43 %	Power Supply: 5 VDC
Remarks:			

Figure 8.2.1 Setup for spurious emission field strength measurements below 30 MHz

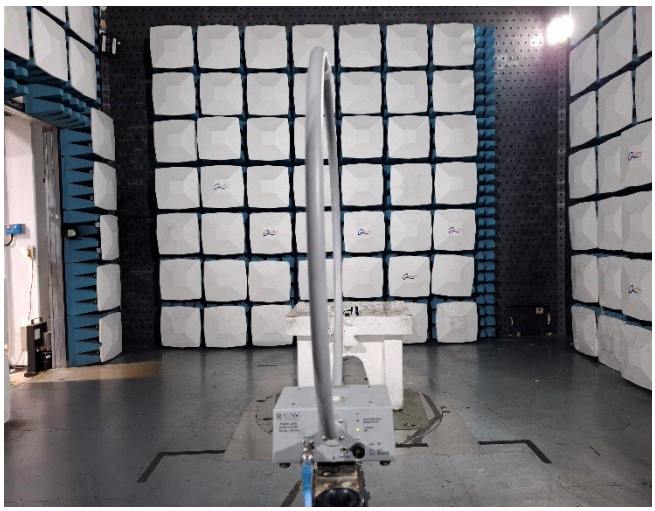


Photograph 8.2.1 Setup for spurious emission field strength measurements below 30 MHz

Coaxial



Vertical coplanar



Test specification:	Section 15.247(d), Radiated spurious emissions		
Test procedure:	Section 15.247(c) / ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	23-Sep-24 - 25-Sep-24		
Temperature: 22.6 ºC	Air Pressure: 1011 hPa	Relative Humidity: 43 %	Power Supply: 5 VDC
Remarks:			

Figure 8.2.2 Setup for spurious emission field strength measurements in 30 – 1000 MHz

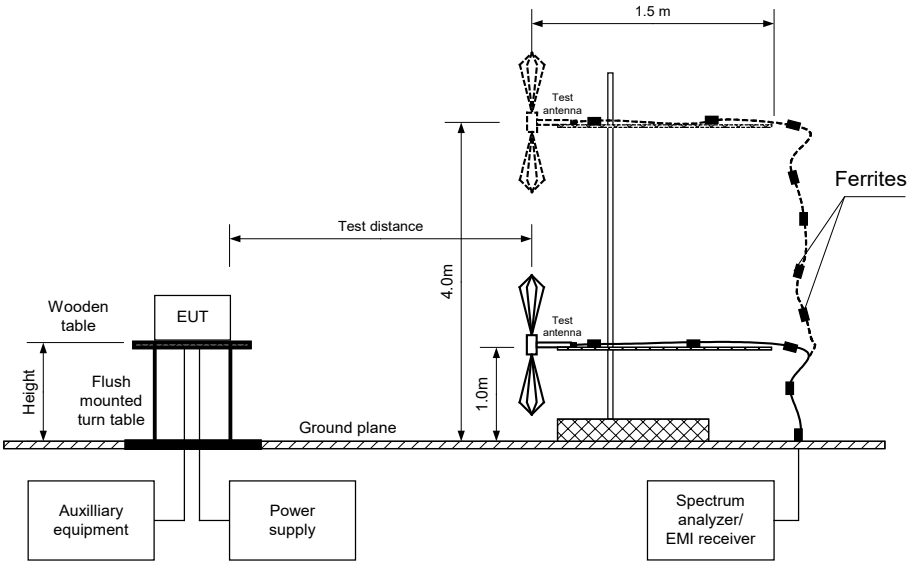
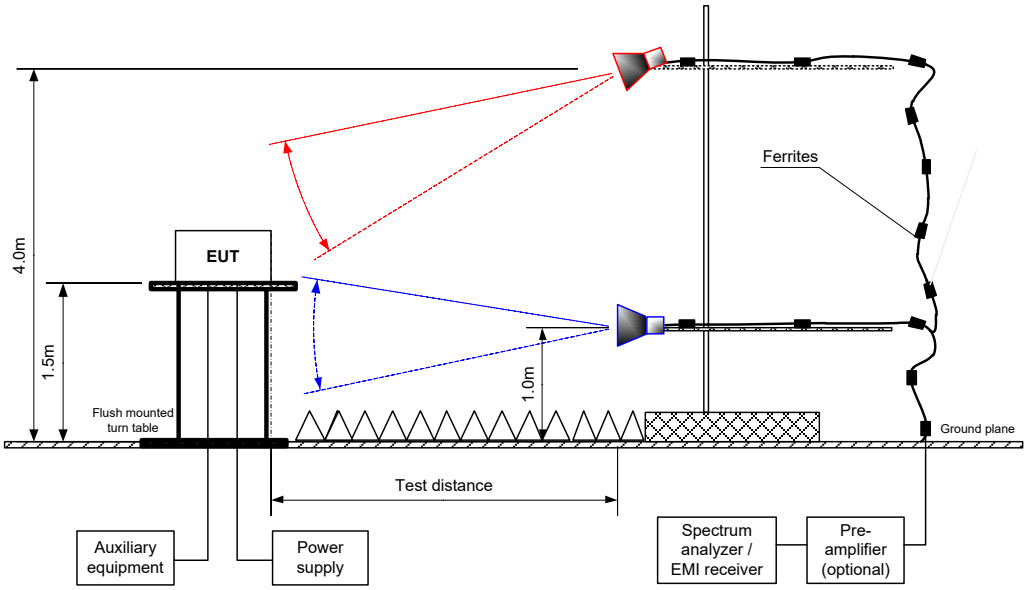


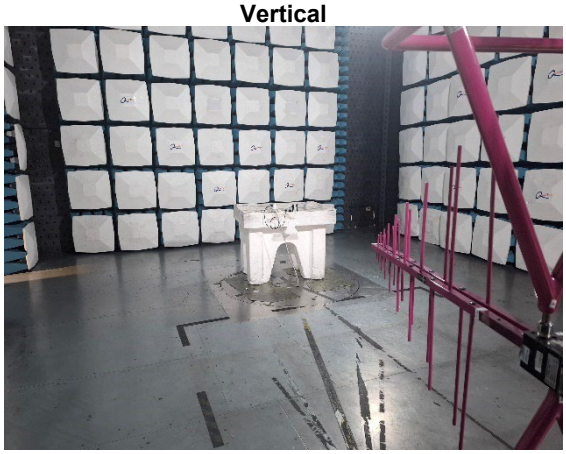
Figure 8.2.3 Setup for spurious emission field strength measurements above1000 MHz



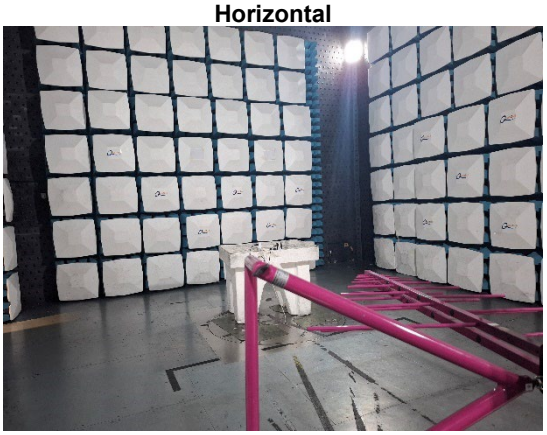
Test specification:	Section 15.247(d), Radiated spurious emissions		
Test procedure:	Section 15.247(c) / ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	23-Sep-24 - 25-Sep-24		
Temperature: 22.6 ºC	Air Pressure: 1011 hPa	Relative Humidity: 43 %	Power Supply: 5 VDC
Remarks:			

Photograph 8.2.2 Setup for spurious emission field strength measurements from 30 to 1000 MHz

Vertical

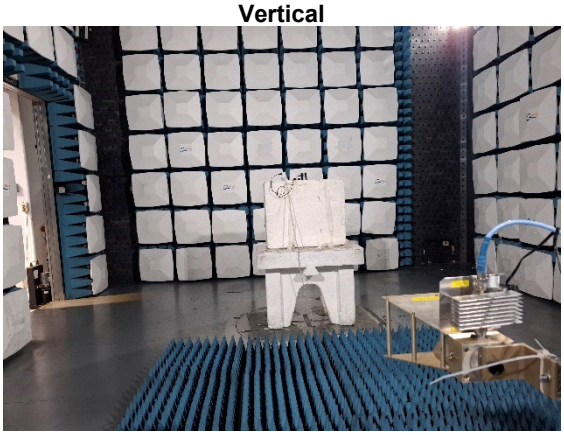


Horizontal

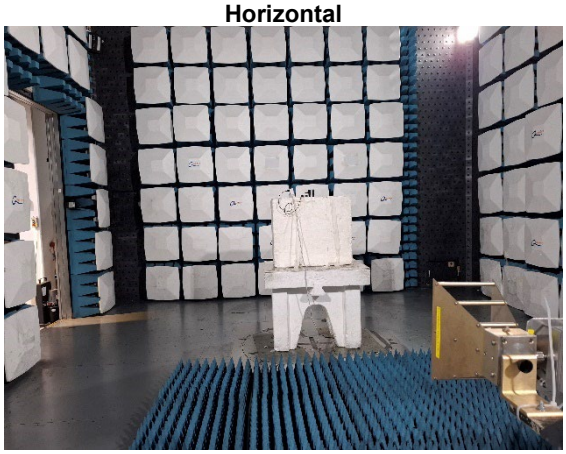


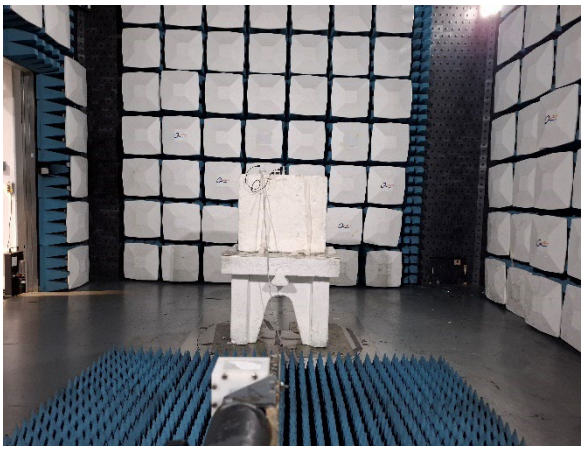
Photograph 8.2.3 Setup for spurious emission field strength measurements above 1000 MHz

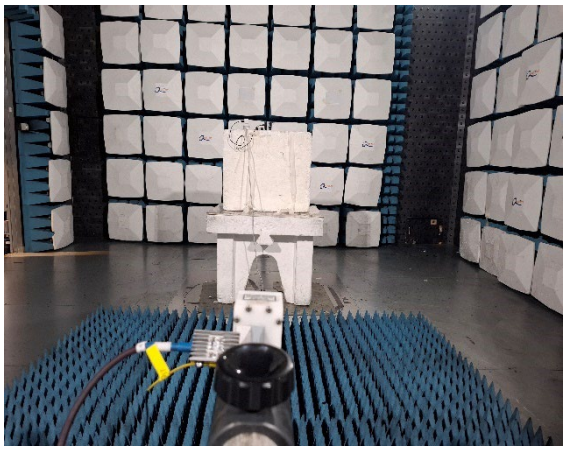
Vertical



Horizontal







Test specification:	Section 15.247(d), Radiated spurious emissions		
Test procedure:	Section 15.247(c) / ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	23-Sep-24 - 25-Sep-24		
Temperature: 22.6 ºC	Air Pressure: 1011 hPa	Relative Humidity: 43 %	Power Supply: 5 VDC
Remarks:			

Table 8.2.2 Field strength of emissions outside restricted bands

ASSIGNED FREQUENCY: 2400-2483.5 MHz
INVESTIGATED FREQUENCY RANGE: 0.009 - 265000 MHz
TEST DISTANCE: 3 m
MODULATION: GFSK
BIT RATE: 1 Mbps
DUTY CYCLE: 100 %
TRANSMITTER OUTPUT POWER SETTINGS: Maximum
DETECTOR USED: Peak
RESOLUTION BANDWIDTH: 100 kHz
VIDEO BANDWIDTH: 300 kHz
TEST ANTENNA TYPE: Active loop (9 kHz – 30 MHz)
Biconilog (30 MHz – 1000 MHz)
Double ridged guide (above 1000 MHz)

Frequency, MHz	Field strength of spurious, dB(µV/m)	Antenna polarization	Antenna height, m	Azimuth, degrees*	Field strength of carrier, dB(µV/m)	Attenuation below carrier, dBc	Limit, dBc	Margin, dB**	Verdict
Low carrier frequency 2402MHz									
599.951	40.018	V	1.01	28	87.612	-47.594	20.0	-27.594	Pass
32.542	33.07	H	1.88	62	81.417	-48.347		-28.347	
539.988	41.86	H	1.75	0		-39.557		-19.557	
556.625	34.58	H	1.96	360		-46.837		-26.837	
599.981	43.07	H	1.55	157		-38.347		-18.347	
845.671	37.33	H	3.67	14		-44.087		-24.087	
Mid carrier frequency 2440 MHz									
39.469	40.685	V	2.20	360	88.796	-48.111	20.0	-28.111	Pass
39.488	35.23	H	3.97	162	82.273	-47.043		-27.043	
239.991	34.35	H	1.31	238		-47.923		-27.923	
539.992	42.06	H	1.75	360		-40.213		-20.213	
599.997	42.75	H	1.56	163		-39.523		-19.523	
957.000	37.28	H	2.89	301		-44.993		-24.993	
High carrier frequency 2480 MHz									
38.782	40.313	V	2.40	0	90.772	-50.459	20.0	-30.459	Pass
32.030	35.59	H	3.80	0	84.566	-48.976		-28.976	
39.606	34.17	H	239	342		-50.396		-30.396	
539.985	38.64	H	209	157		-45.926		-25.926	
600.002	40.22	H	159	0		-44.346		-24.346	
932.304	38.60	H	101	114		-45.966		-25.966	

*- EUT front panel refers to 0 degrees position of turntable.
**- Margin = Attenuation below carrier – specification limit.

Test specification:	Section 15.247(d), Radiated spurious emissions		
Test procedure:	Section 15.247(c) / ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	23-Sep-24 - 25-Sep-24		
Temperature: 22.6 ºC	Air Pressure: 1011 hPa	Relative Humidity: 43 %	Power Supply: 5 VDC
Remarks:			

Table 8.2.3 Field strength of spurious emissions above 1 GHz within restricted bands

ASSIGNED FREQUENCY: 2400-2483.5 MHz
INVESTIGATED FREQUENCY RANGE: 1000 - 26500 MHz
TEST DISTANCE: 3 m
MODULATION: GFSK
BIT RATE: 1 Mbps
DUTY CYCLE: 100 %
TRANSMITTER OUTPUT POWER SETTINGS: Maximum
DETECTOR USED: Peak
RESOLUTION BANDWIDTH: 1000 kHz
TEST ANTENNA TYPE: Double ridged guide

Frequency, MHz	Antenna		Azimuth, degrees*	Peak field strength(VBW=3 MHz)			Average field strength(VBW=1 Hz)				Verdict
	Polarization	Height, m		Measured, dB(μV/m)	Limit, dB(μV/m)	Margin, dB**	Measured, dB(μV/m)	Calculated, dB(μV/m)	Limit, dB(μV/m)	Margin, dB***	
Low carrier frequency 2402 MHz											
4805.947	V	1.95	14	51.54	74.00	-22.46	47.18	NA	54.00	-6.82	Pass
10825.631	V	1.10	95	50.53	74.00	-23.47	37.50	NA	54.00	-16.50	
4805.984	H	1.00	103	52.09	74.00	-21.91	47.71	NA	54.00	-6.29	
12018.213	H	3.86	107	50.74	74.00	-23.26	37.84	NA	54.00	-16.16	
Mid carrier frequency 2440 MHz											
4881.862	V	1.84	355	52.73	74.00	-21.27	48.26	NA	54.00	-5.74	Pass
10798.920	V	1.01	0	50.64	74.00	-23.36	37.42	NA	54.00	-16.58	
4881.918	H	1.00	97	52.47	74.00	-21.53	48.47	NA	54.00	-5.53	
12438.586	H	3.73	42	50.55	74.00	-23.45	37.48	NA	54.00	-16.52	
High carrier frequency 2480 MHz											
4957.899	V	1.92	350	51.90	74.00	-22.10	48.07	NA	54.00	-5.93	Pass
11668.924	V	1.01	7	51.77	74.00	-22.23	37.72	NA	54.00	-16.28	
4957.873	H	1.02	125	50.58	74.00	-23.42	46.03	NA	54.00	-7.97	
11738.603	H	3.76	355	50.75	74.00	-23.25	37.81	NA	54.00	-16.19	

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

Test specification:	Section 15.247(d), Radiated spurious emissions		
Test procedure:	Section 15.247(c) / ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	23-Sep-24 - 25-Sep-24		
Temperature: 22.6 ºC	Air Pressure: 1011 hPa	Relative Humidity: 43 %	Power Supply: 5 VDC
Remarks:			

Table 8.2.4 Average factor calculation

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

*- Average factor was calculated as follows

for pulse train shorter than 100 ms:

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

for pulse train longer than 100 ms:

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

Table 8.2.5 Field strength of spurious emissions below 1 GHz within restricted bands

ASSIGNED FREQUENCY:	2400-2483.5 MHz
INVESTIGATED FREQUENCY RANGE:	0.009 – 1000 MHz
TEST DISTANCE:	3 m
MODULATION:	GFSK
BIT RATE:	1 Mbps
DUTY CYCLE:	100 %
TRANSMITTER OUTPUT POWER SETTINGS:	Maximum
RESOLUTION BANDWIDTH:	0.2 kHz (9 kHz – 150 kHz) 9.0 kHz (150 kHz – 30 MHz) 120 kHz (30 MHz – 1000 MHz)
VIDEO BANDWIDTH:	> Resolution bandwidth
TEST ANTENNA TYPE:	Active loop (9 kHz – 30 MHz) Biconilog (30 MHz – 1000 MHz)

Frequency, MHz	Peak emission, dB(µV/m)	Quasi-peak			Antenna polarization	Antenna height, m	Turn-table position**, degrees	Verdict
		Measured emission, dB(µV/m)	Limit, dB(µV/m)	Margin, dB*				
Low carrier frequency 2402 MHz								
240.006	33.328	30.298	46.0	-15.702	V	2.58	233	Pass
240.004	36.108	33.798	46.0	-12.202	H	1.52	233	Pass
Mid carrier frequency 2440 MHz								
240.007	36.558	33.652	46.0	-12.348	V	1.52	233	Pass
240.005	32.838	29.778	46.0	-16.222	H	2.52	202	Pass
270.100	34.111	30.36	46.0	-15.640	H	1.3	28	Pass
High carrier frequency 2480 MHz								
240.001	33.668	31.108	46.0	-14.892	V	2.58	233	Pass
240.002	35.968	33.888	46.0	-12.112	H	1.52	233	Pass

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

Test specification:	Section 15.247(d), Radiated spurious emissions		
Test procedure:	Section 15.247(c) / ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	23-Sep-24 - 25-Sep-24		
Temperature: 22.6 ºC	Air Pressure: 1011 hPa	Relative Humidity: 43 %	Power Supply: 5 VDC
Remarks:			

Table 8.2.6 Restricted bands

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

Reference numbers of test equipment used

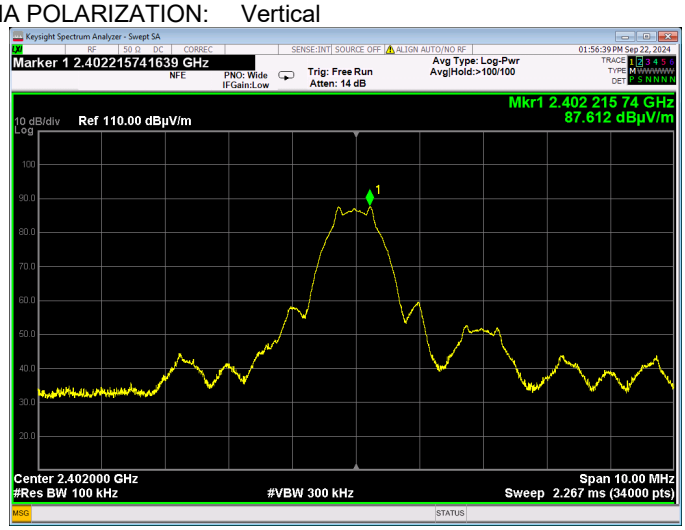
HL 5102	HL 6208	HL 6238	HL 6240	HL 6573	HL 6574	HL 6679	HL 7737
HL 8090	HL 8120						

Full description is given in Appendix A.

Test specification:	Section 15.247(d), Radiated spurious emissions		
Test procedure:	Section 15.247(c) / ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	23-Sep-24 - 25-Sep-24		
Temperature: 22.6 ºC	Air Pressure: 1011 hPa	Relative Humidity: 43 %	Power Supply: 5 VDC
Remarks:			

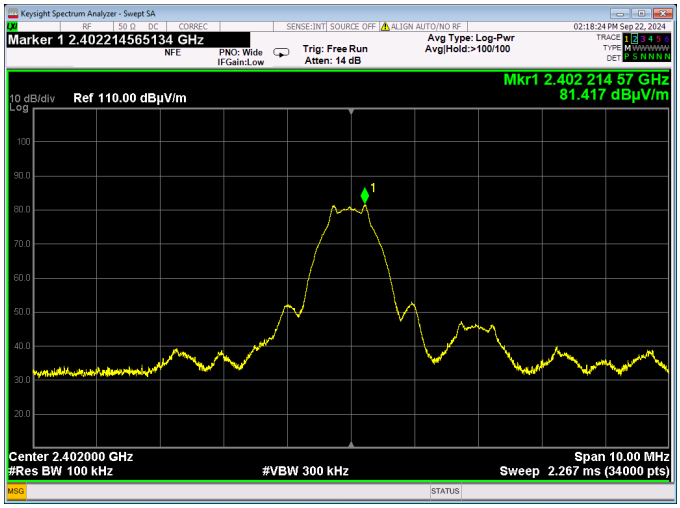
Plot 8.2.1 Radiated emission measurements at the low carrier frequency

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



Plot 8.2.2 Radiated emission measurements at the low carrier frequency

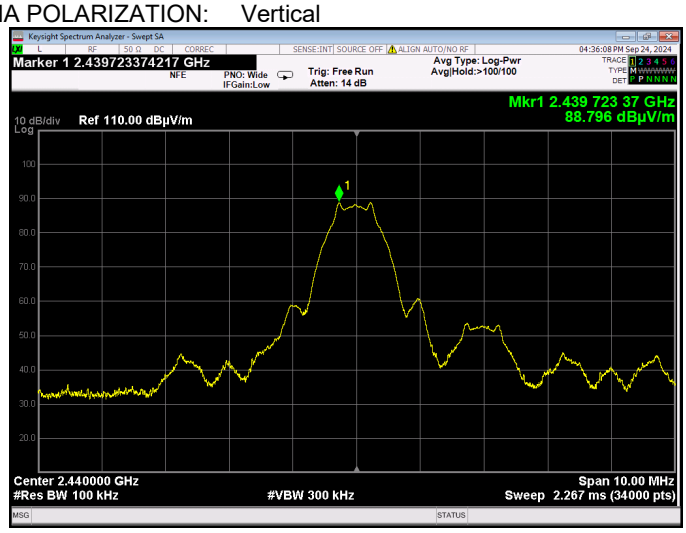
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal



Test specification:	Section 15.247(d), Radiated spurious emissions		
Test procedure:	Section 15.247(c) / ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	23-Sep-24 - 25-Sep-24		
Temperature: 22.6 ºC	Air Pressure: 1011 hPa	Relative Humidity: 43 %	Power Supply: 5 VDC
Remarks:			

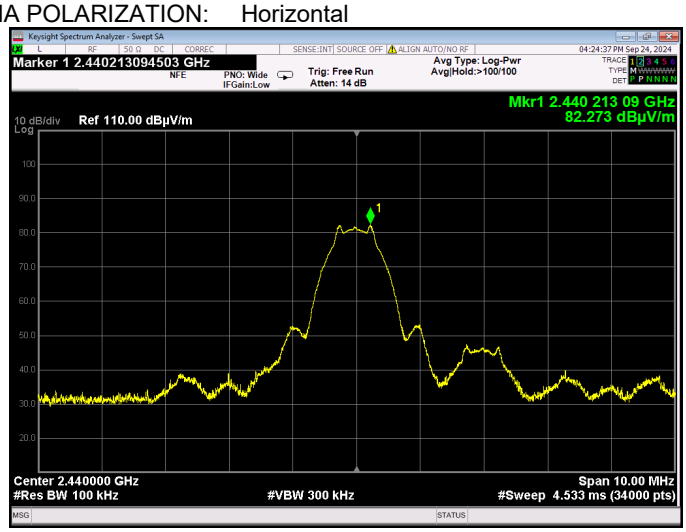
Plot 8.2.3 Radiated emission measurements at the mid carrier frequency

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



Plot 8.2.4 Radiated emission measurements at the mid carrier frequency

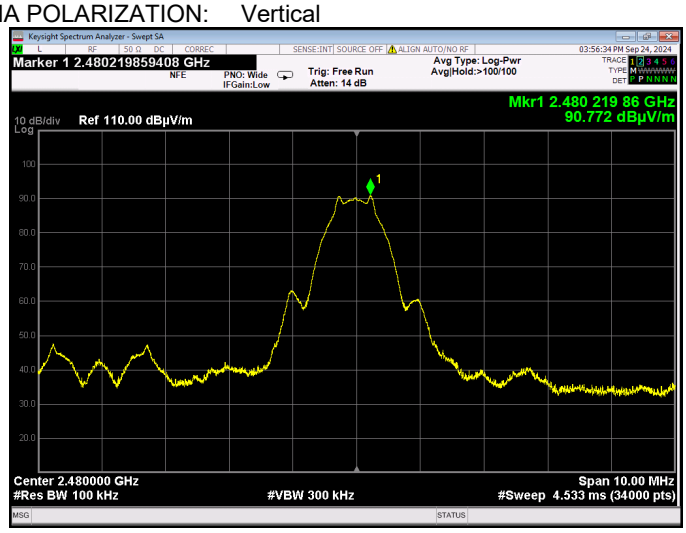
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal



Test specification:	Section 15.247(d), Radiated spurious emissions		
Test procedure:	Section 15.247(c) / ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	23-Sep-24 - 25-Sep-24		
Temperature: 22.6 ºC	Air Pressure: 1011 hPa	Relative Humidity: 43 %	Power Supply: 5 VDC
Remarks:			

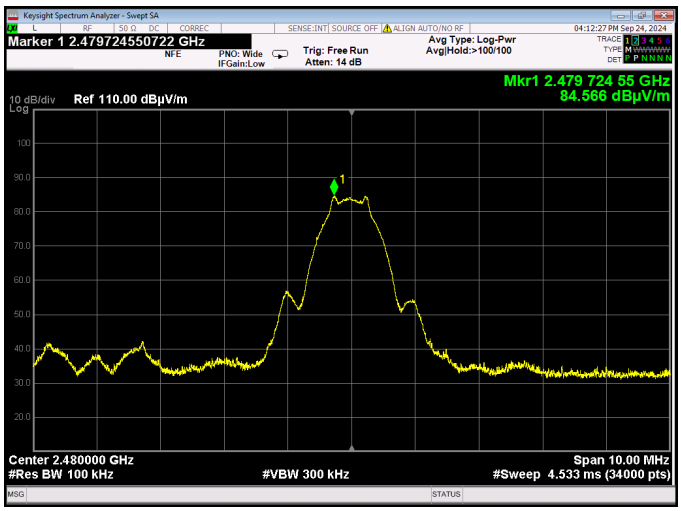
Plot 8.2.5 Radiated emission measurements at the high carrier frequency

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



Plot 8.2.6 Radiated emission measurements at the high carrier frequency

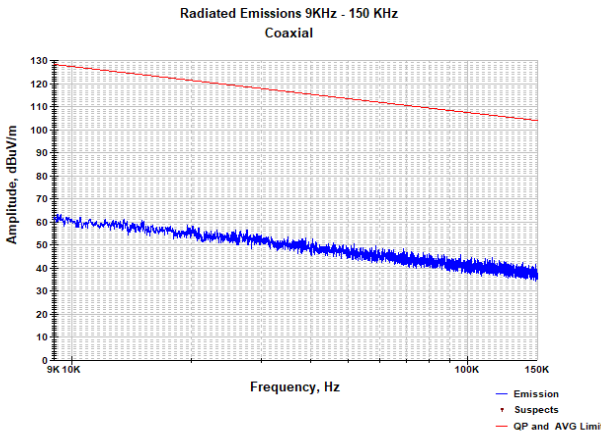
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal

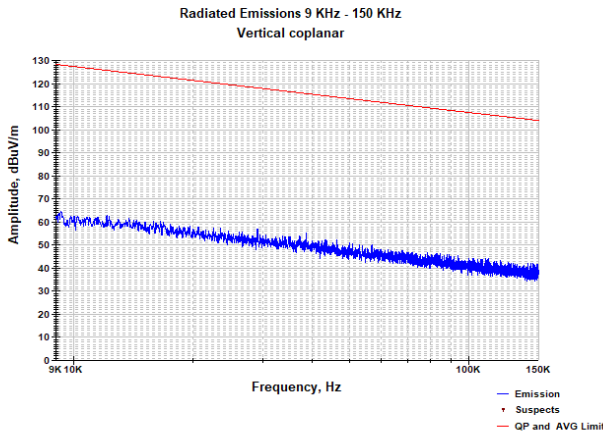


Test specification:	**Section 15.247(d), Radiated spurious emissions**		
Test procedure:	Section 15.247(c) / ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	23-Sep-24 - 25-Sep-24		
Temperature: 22.6 ºC	**Air Pressure:** 1011 hPa	**Relative Humidity:** 43 %	**Power Supply:** 5 VDC
Remarks:			

Plot 8.2.7 Radiated emission measurements from 9 to 150 kHz at the low carrier frequency

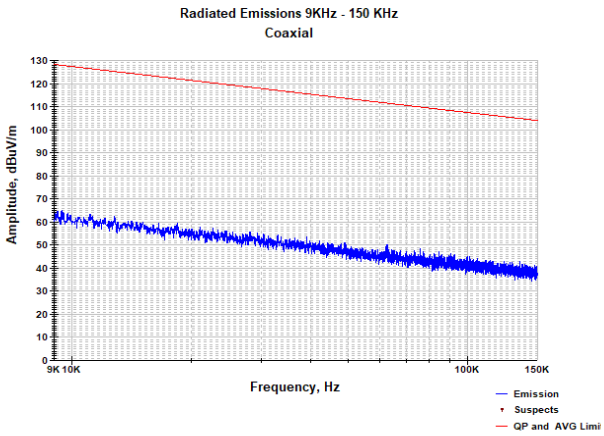
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m

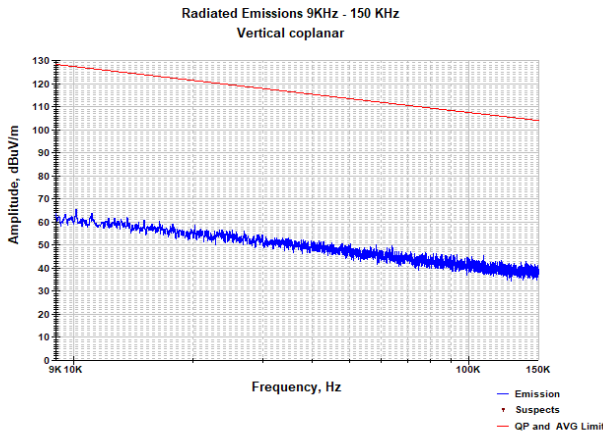




Plot 8.2.8 Radiated emission measurements from 9 to 150 kHz at the mid carrier frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m

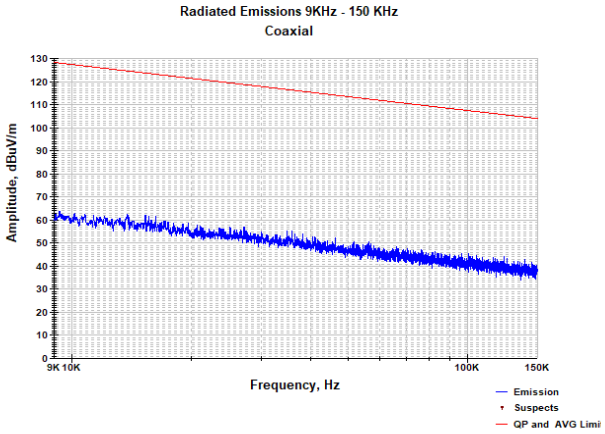


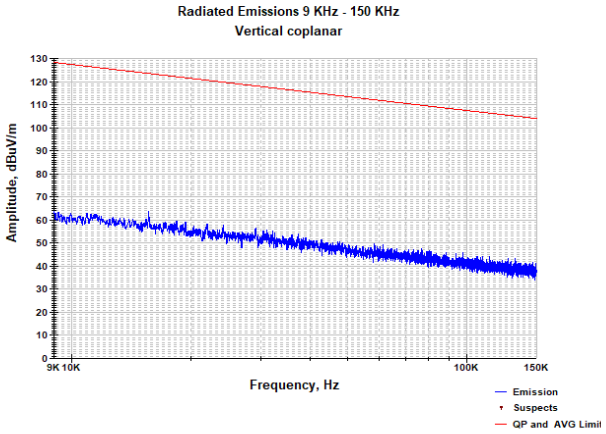


Test specification:	**Section 15.247(d), Radiated spurious emissions**		
Test procedure:	Section 15.247(c) / ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	23-Sep-24 - 25-Sep-24		
Temperature: 22.6 ºC	**Air Pressure:** 1011 hPa	**Relative Humidity:** 43 %	**Power Supply:** 5 VDC
Remarks:			

Plot 8.2.9 Radiated emission measurements from 9 to 150 kHz at the high carrier frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m

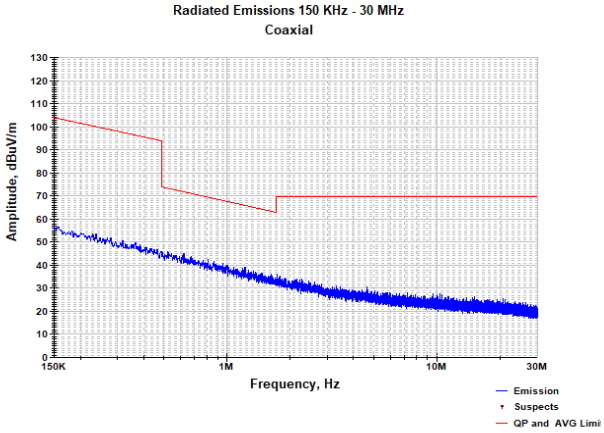


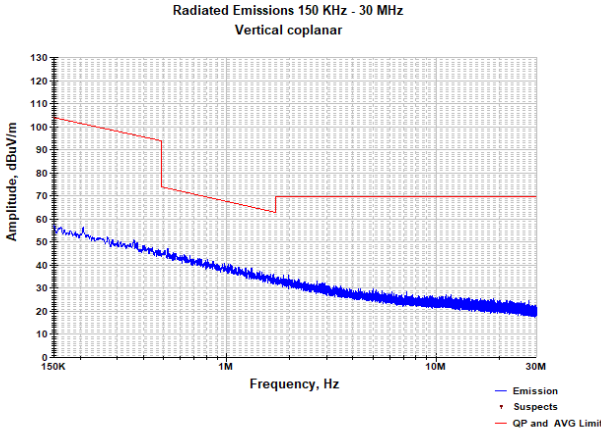


Test specification:	**Section 15.247(d), Radiated spurious emissions**		
Test procedure:	Section 15.247(c) / ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	23-Sep-24 - 25-Sep-24		
Temperature: 22.6 ºC	**Air Pressure:** 1011 hPa	**Relative Humidity:** 43 %	**Power Supply:** 5 VDC
Remarks:			

Plot 8.2.10 Radiated emission measurements from 0.15 to 30 MHz at the low carrier frequency

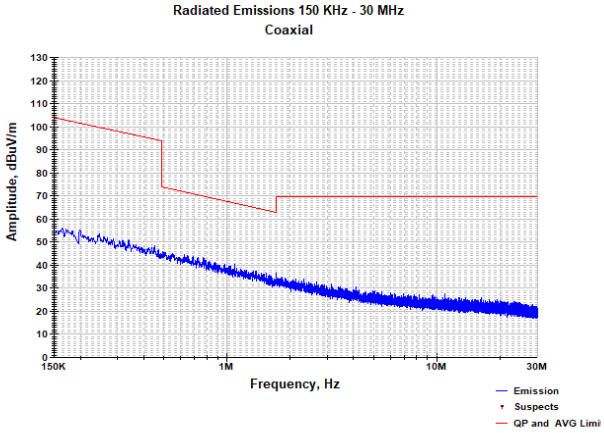
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m

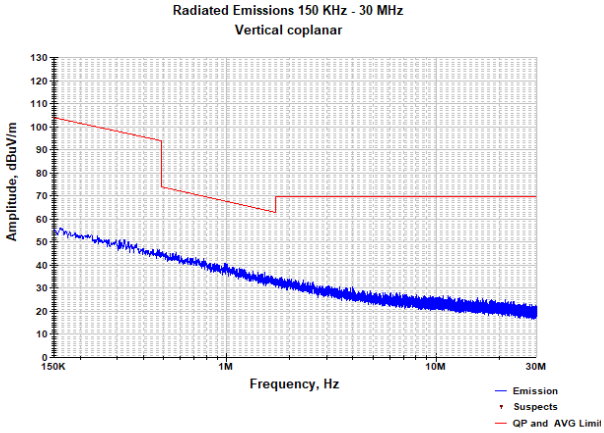




Plot 8.2.11 Radiated emission measurements from 0.15 to 30 MHz at the mid carrier frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m

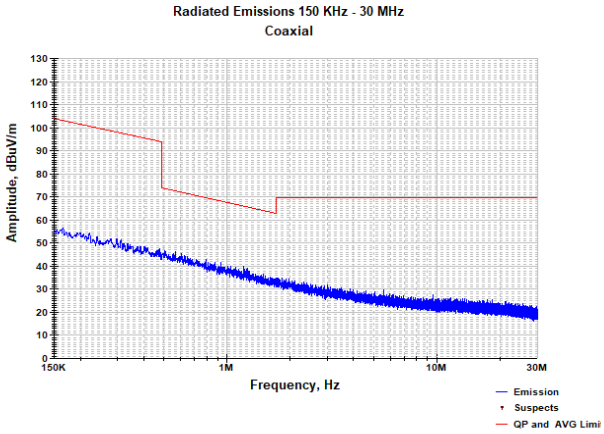


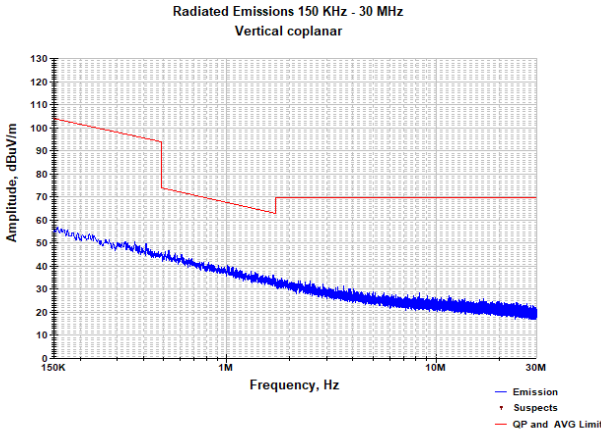


Test specification:	**Section 15.247(d), Radiated spurious emissions**		
Test procedure:	Section 15.247(c) / ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	23-Sep-24 - 25-Sep-24		
Temperature: 22.6 ºC	**Air Pressure:** 1011 hPa	**Relative Humidity:** 43 %	**Power Supply:** 5 VDC
Remarks:			

Plot 8.2.12 Radiated emission measurements from 0.15 to 30 MHz at the high carrier frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m



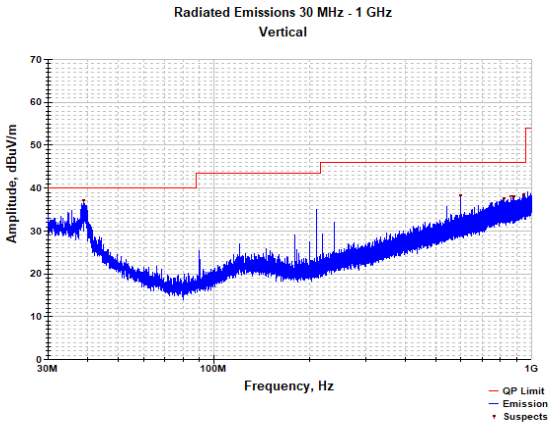


Test specification:	**Section 15.247(d), Radiated spurious emissions**		
Test procedure:	Section 15.247(c) / ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	23-Sep-24 - 25-Sep-24		
Temperature: 22.6 ºC	**Air Pressure:** 1011 hPa	**Relative Humidity:** 43 %	**Power Supply:** 5 VDC
Remarks:			

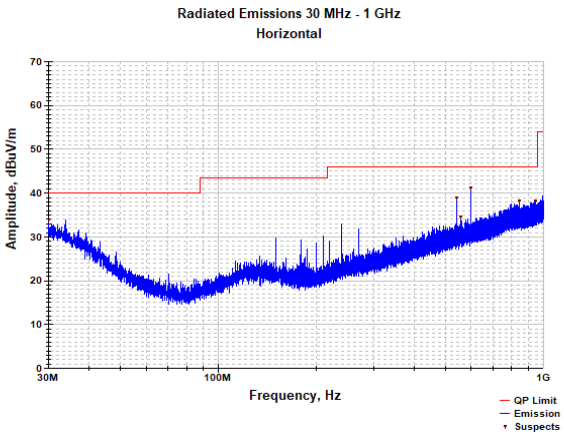
Plot 8.2.13 Radiated emission measurements from 30 to 1000 MHz at the low carrier frequency

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

Vertical



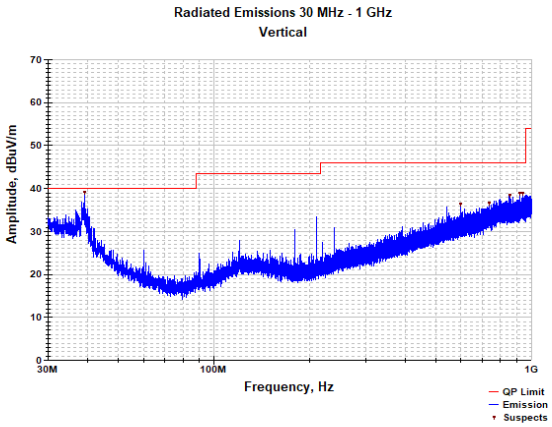
Horizontal



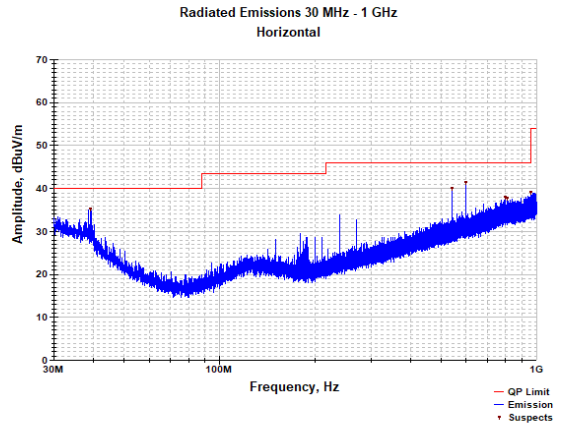
Plot 8.2.14 Radiated emission measurements from 30 to 1000 MHz at the mid carrier frequency

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

Vertical



Horizontal

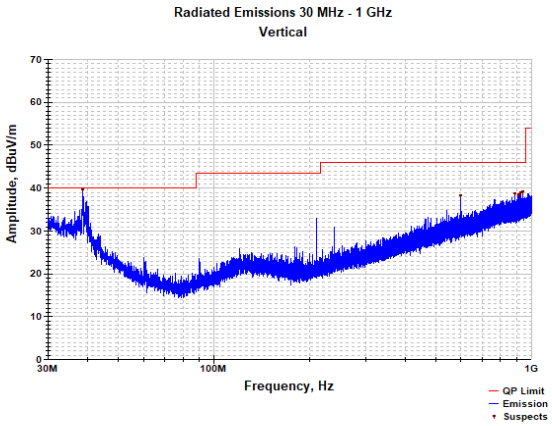


Test specification:	**Section 15.247(d), Radiated spurious emissions**		
Test procedure:	Section 15.247(c) / ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	23-Sep-24 - 25-Sep-24		
Temperature: 22.6 ºC	**Air Pressure:** 1011 hPa	**Relative Humidity:** 43 %	**Power Supply:** 5 VDC
Remarks:			

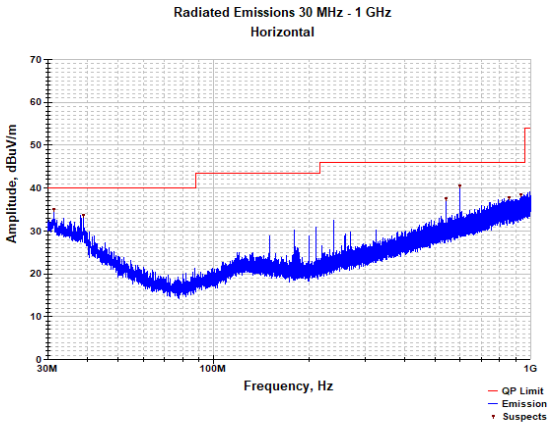
Plot 8.2.15 Radiated emission measurements from 30 to 1000 MHz at the high carrier frequency

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

Vertical



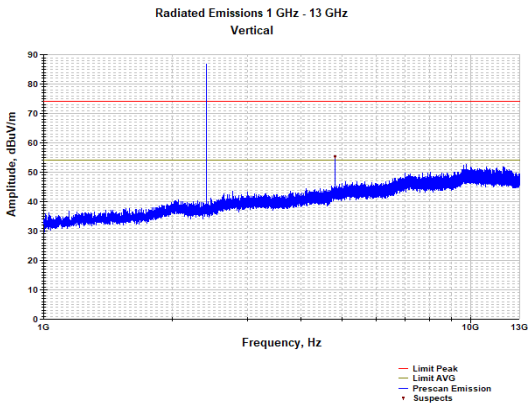
Horizontal



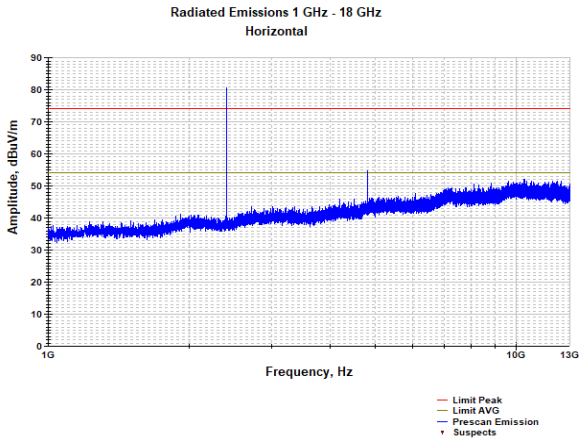
Plot 8.2.16 Radiated emission measurements from 1000 to 13000 MHz at the low carrier frequency

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

Vertical

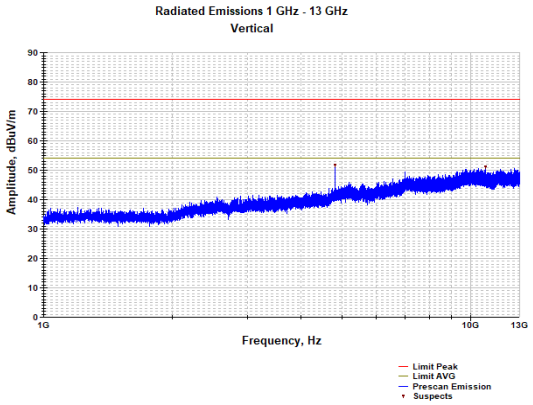


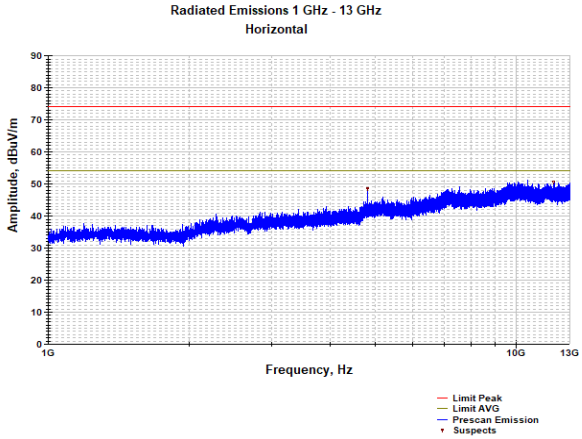
Horizontal



Test specification:	Section 15.247(d), Radiated spurious emissions		
Test procedure:	Section 15.247(c) / ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	23-Sep-24 - 25-Sep-24		
Temperature: 22.6 ºC	Air Pressure: 1011 hPa	Relative Humidity: 43 %	Power Supply: 5 VDC
Remarks:			

High pass filter (3000-18000 MHz)



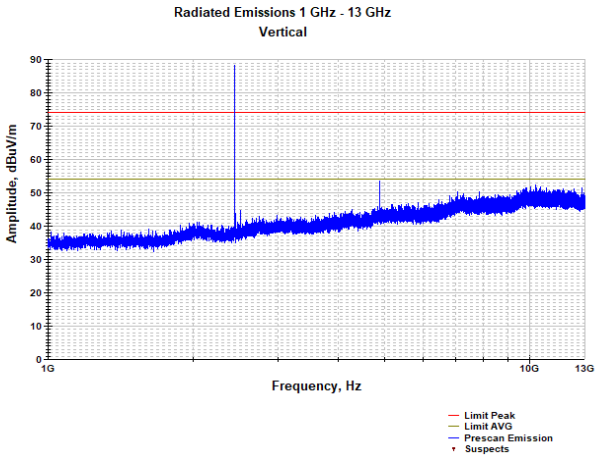


Test specification:	Section 15.247(d), Radiated spurious emissions		
Test procedure:	Section 15.247(c) / ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	23-Sep-24 - 25-Sep-24		
Temperature: 22.6 ºC	Air Pressure: 1011 hPa	Relative Humidity: 43 %	Power Supply: 5 VDC
Remarks:			

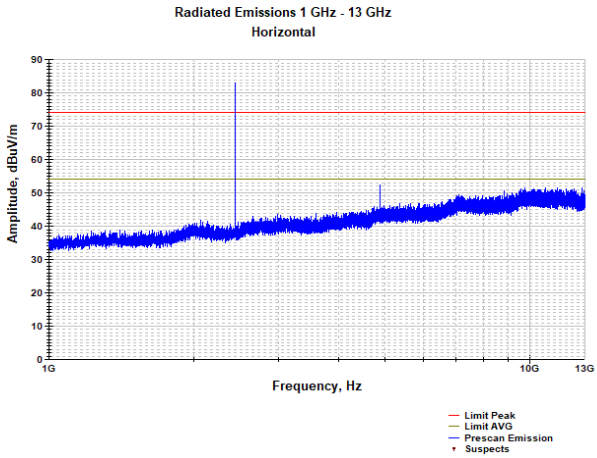
Plot 8.2.17 Radiated emission measurements from 1000 to 13000 MHz at the mid carrier frequency

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

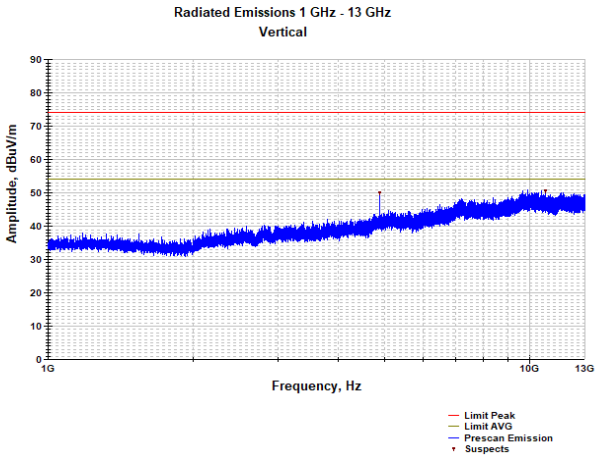
Vertical

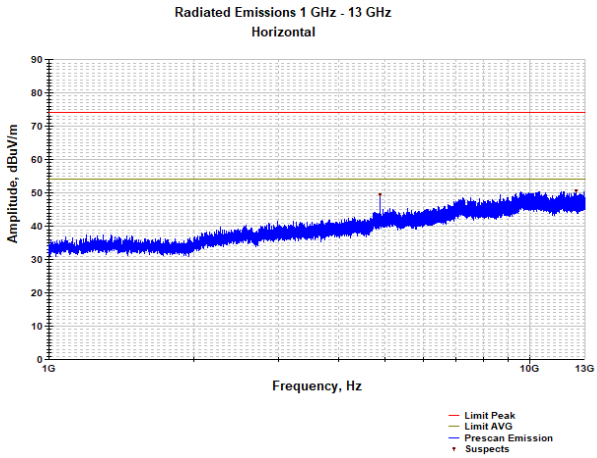


Horizontal



High pass filter (3000-18000 MHz)



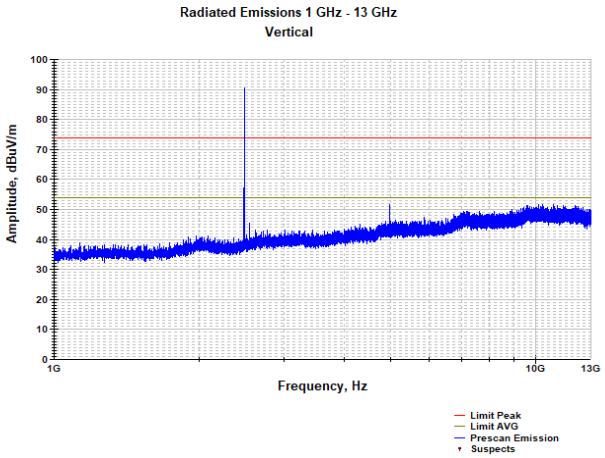


Test specification:	**Section 15.247(d), Radiated spurious emissions**		
Test procedure:	Section 15.247(c) / ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	23-Sep-24 - 25-Sep-24		
Temperature: 22.6 ºC	**Air Pressure:** 1011 hPa	**Relative Humidity:** 43 %	**Power Supply:** 5 VDC
Remarks:			

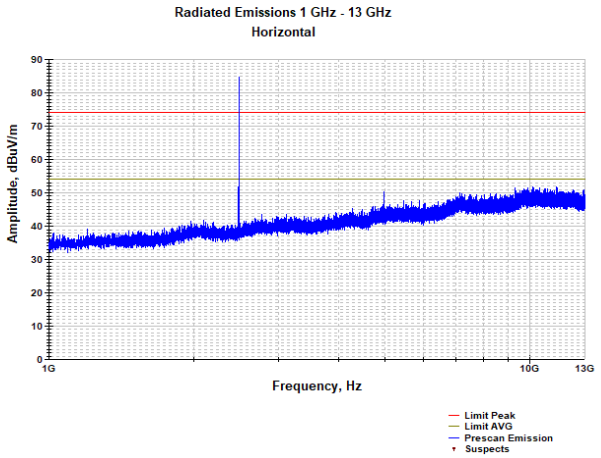
Plot 8.2.18 Radiated emission measurements from 1000 to 13000 MHz at the high carrier frequency

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

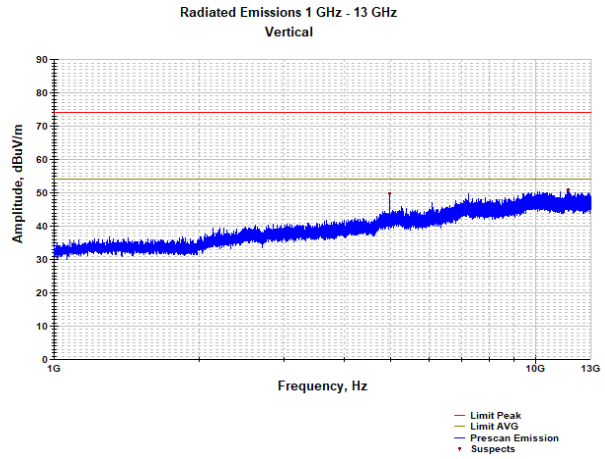
Vertical

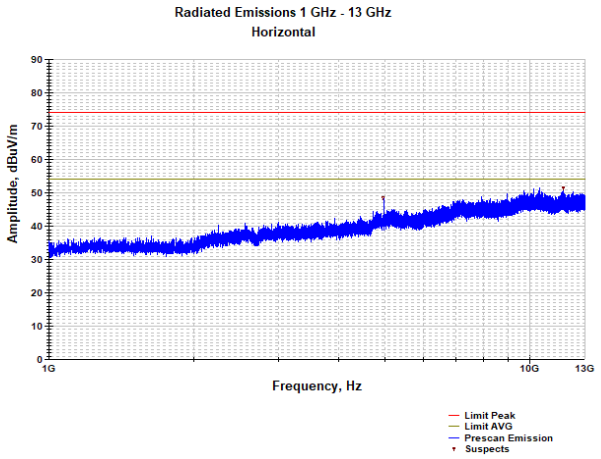


Horizontal



High pass filter (3000-18000 MHz)





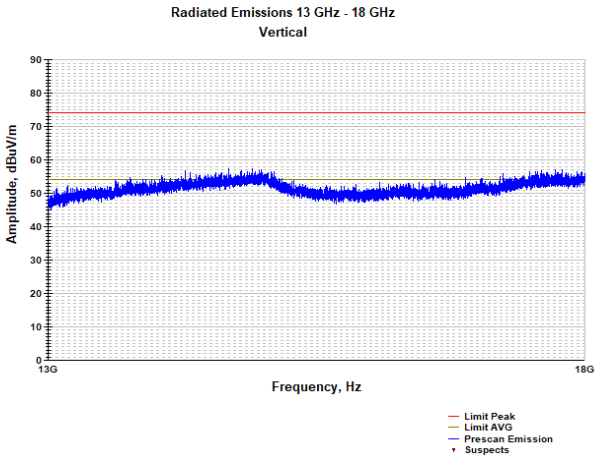
Test specification:	Section 15.247(d), Radiated spurious emissions		
Test procedure:	Section 15.247(c) / ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	23-Sep-24 - 25-Sep-24		
Temperature: 22.6 ºC	Air Pressure: 1011 hPa	Relative Humidity: 43 %	Power Supply: 5 VDC
Remarks:			

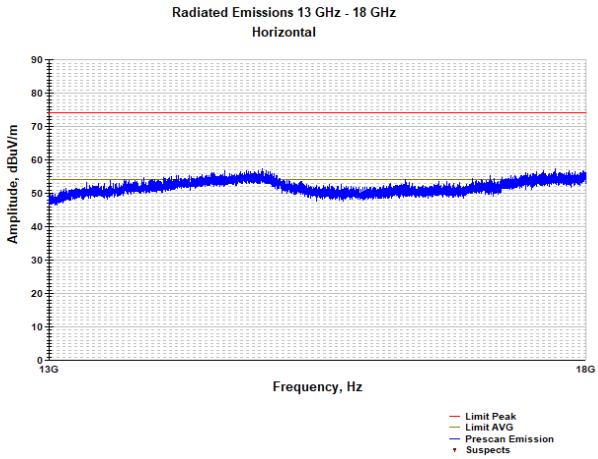
Plot 8.2.19 Radiated emission measurements from 13000 to 18000 MHz at the low carrier frequency

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

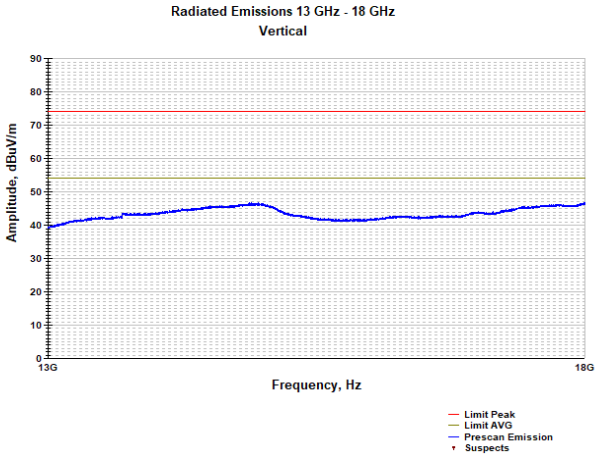
Vertical **Horizontal**

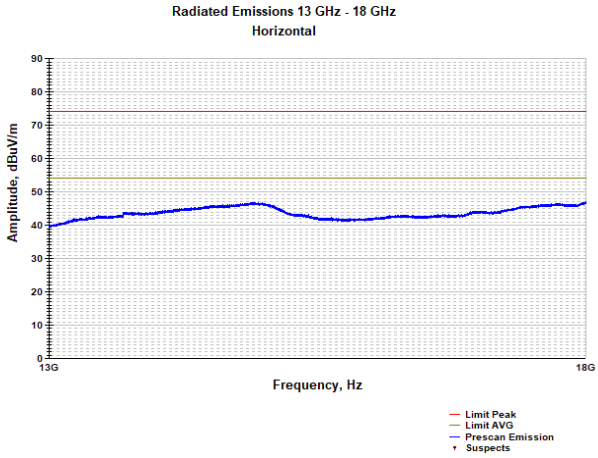
Peak (VBW=3MHz)





AVG(VBW=1KHz)





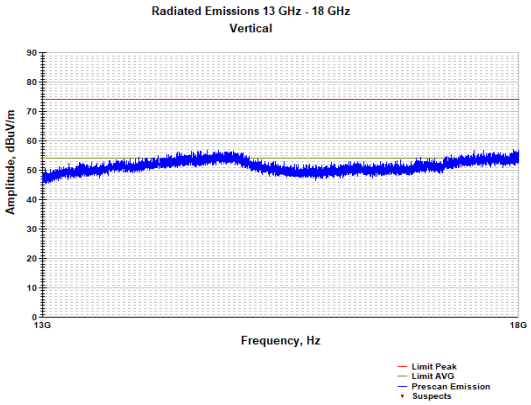
Test specification:	Section 15.247(d), Radiated spurious emissions		
Test procedure:	Section 15.247(c) / ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	23-Sep-24 - 25-Sep-24		
Temperature: 22.6 ºC	Air Pressure: 1011 hPa	Relative Humidity: 43 %	Power Supply: 5 VDC
Remarks:			

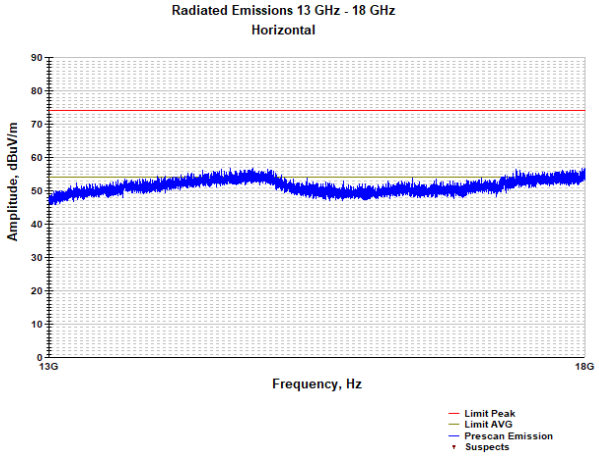
Plot 8.2.20 Radiated emission measurements from 13000 to 18000 MHz at the mid carrier frequency

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

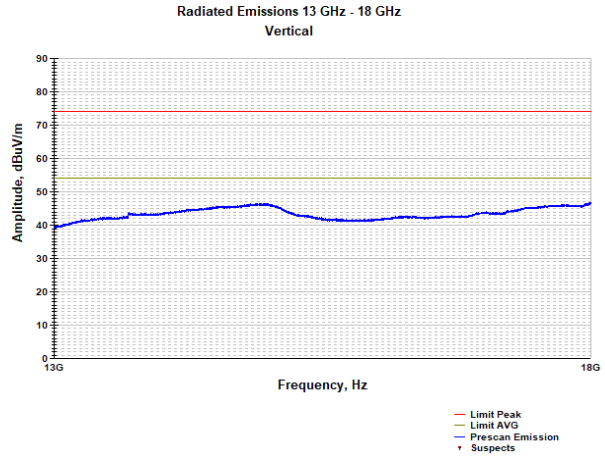
Vertical **Horizontal**

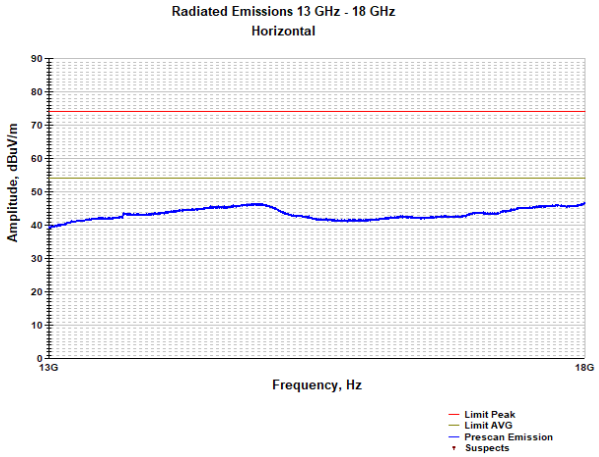
Peak (VBW=3MHz)





AVG(VBW=1KHz)





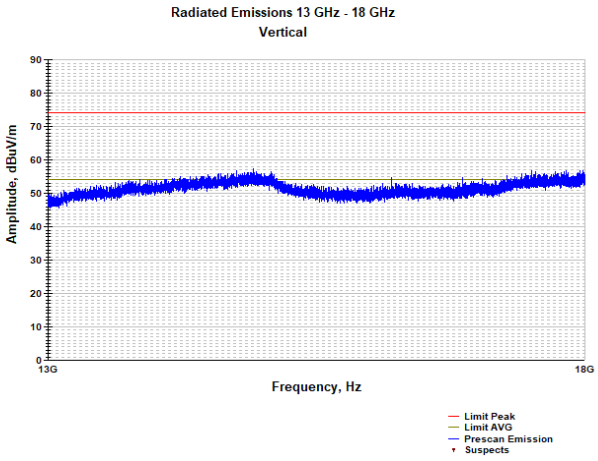
Test specification:	Section 15.247(d), Radiated spurious emissions		
Test procedure:	Section 15.247(c) / ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	23-Sep-24 - 25-Sep-24		
Temperature: 22.6 ºC	Air Pressure: 1011 hPa	Relative Humidity: 43 %	Power Supply: 5 VDC
Remarks:			

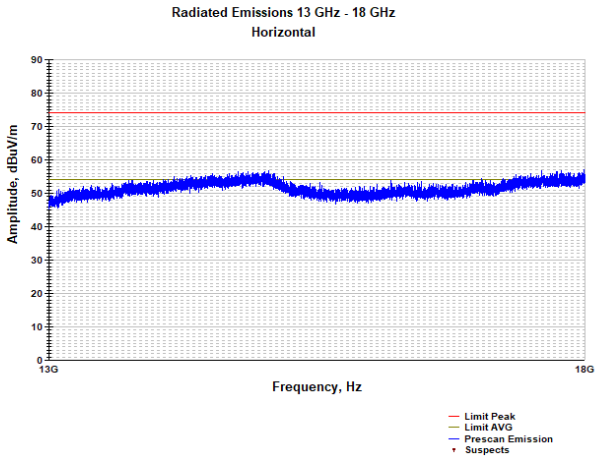
Plot 8.2.21 Radiated emission measurements from 13000 to 18000 MHz at the high carrier frequency

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

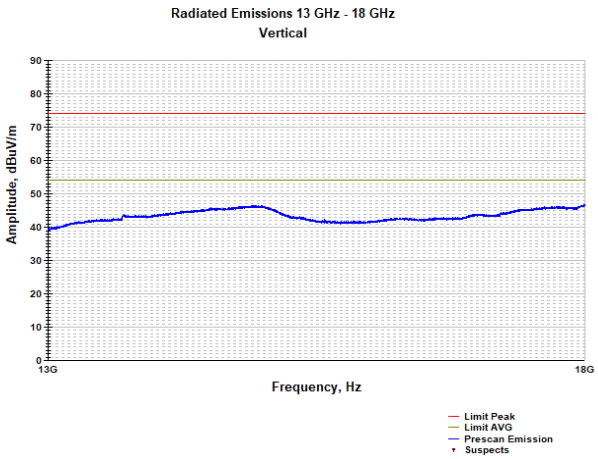
Vertical **Horizontal**

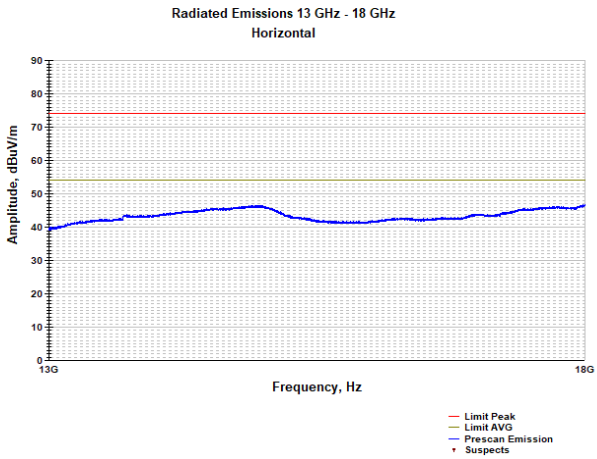
Peak (VBW=3MHz)





AVG (VBW=1KHz)



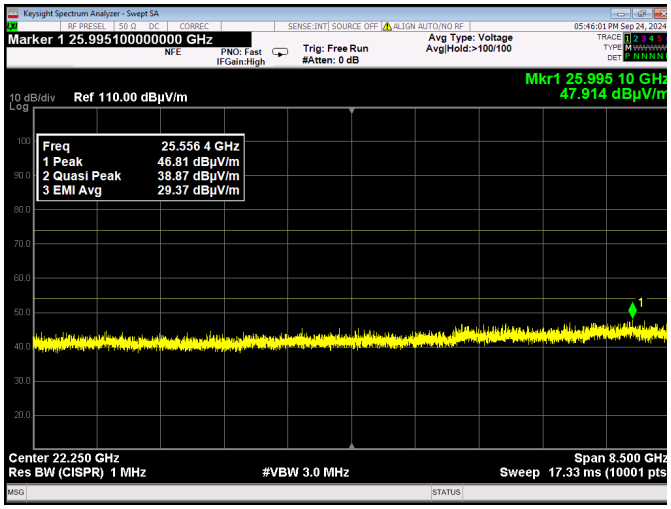


Test specification:	Section 15.247(d), Radiated spurious emissions		
Test procedure:	Section 15.247(c) / ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	23-Sep-24 - 25-Sep-24		
Temperature: 22.6 ºC	Air Pressure: 1011 hPa	Relative Humidity: 43 %	Power Supply: 5 VDC
Remarks:			

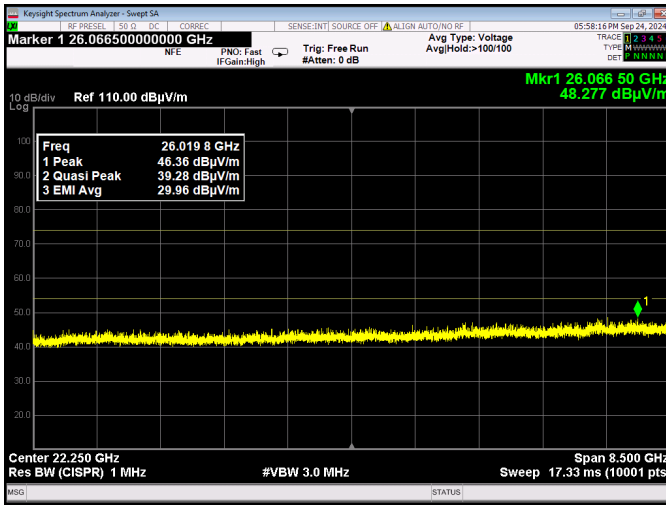
Plot 8.2.22 Radiated emission measurements from 18000 to 26500 MHz at the low carrier frequency

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

Vertical



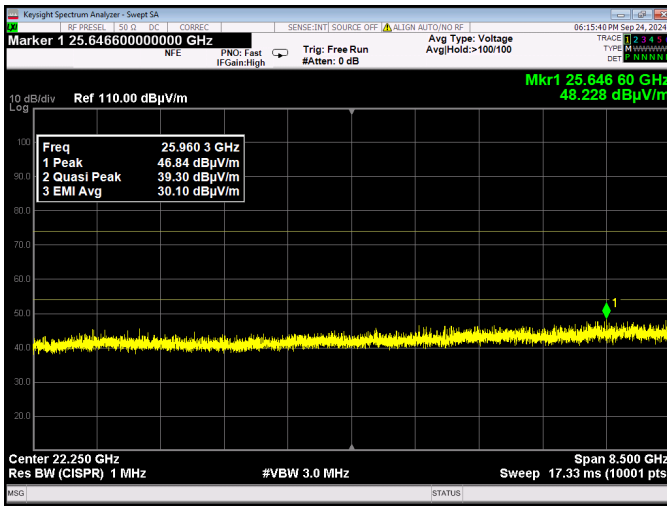
Horizontal



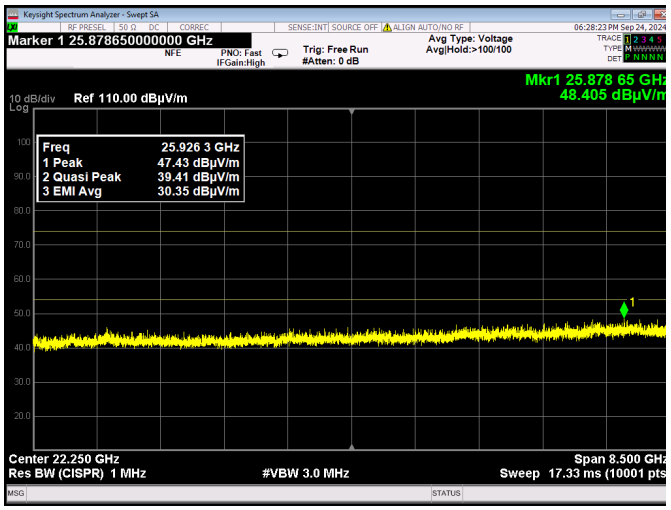
Plot 8.2.23 Radiated emission measurements from 18000 to 26500 MHz at the mid carrier frequency

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

Vertical



Horizontal

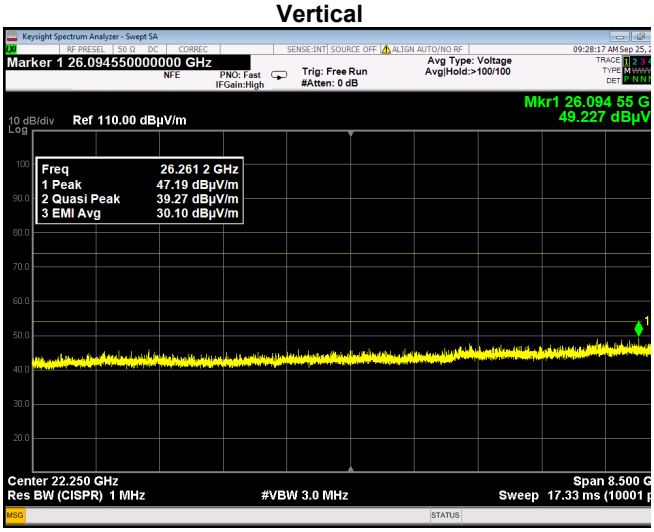


Test specification:	Section 15.247(d), Radiated spurious emissions		
Test procedure:	Section 15.247(c) / ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	23-Sep-24 - 25-Sep-24		
Temperature: 22.6 ºC	Air Pressure: 1011 hPa	Relative Humidity: 43 %	Power Supply: 5 VDC
Remarks:			

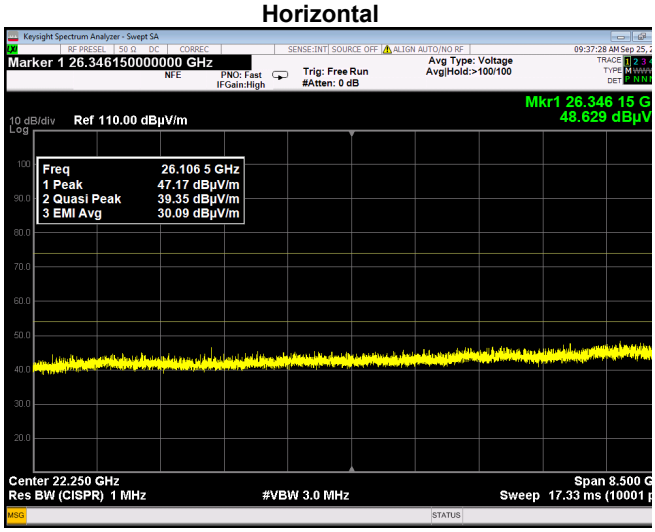
Plot 8.2.24 Radiated emission measurements from 18000 to 26500 MHz at the high carrier frequency

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

Vertical



Horizontal



Test specification:	Section 15.247(b)3, Peak output power		
Test procedure:	Section 15.247(b)		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	15-Sep-24 - 16-Sep-24		
Temperature: 24.6 ºC	Air Pressure: 1010 hPa	Relative Humidity: 46 %	Power Supply: 5 VDC
Remarks:			

8.3 Peak output power

8.3.1 General

This test was performed to measure the maximum peak output power radiated by transmitter. Specification test limits are given in Table 8.3.1.

Table 8.3.1 Peak output power limits

Assigned frequency range, MHz	Maximum antenna gain, dBi	Peak output power*		Equivalent field strength limit @ 3m, dB(μV/m)**
		W	dBm	
902.0 – 928.0	6.0	1.0	30.0	131.2
2400.0 – 2483.5				
5725.0 – 5850.0				

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

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

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

8.3.2 Test procedure

8.3.2.1 The EUT was set up as shown in Figure 8.3.1, energized and its proper operation was checked.

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

8.3.2.3 The resolution bandwidth of spectrum analyzer was set wider than 6 dB bandwidth of the EUT and the field strength of the EUT carrier frequency was measured with antenna connected to spectrum analyzer/ EMI receiver. To find maximum radiation the turntable was rotated 360^0 and the measuring antenna height was swept in both vertical and horizontal polarizations.

8.3.2.4 The maximum field strength of the EUT carrier frequency was measured as provided in Table 8.3.2 and associated plots.

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

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

where P is the peak output power in W, E is the field strength in V/m, d is the test distance and G is the transmitter numeric antenna gain over an isotropic radiator.
The above equation was converted in logarithmic units for 3 m test distance:

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

8.3.2.6 The worst test results (the lowest margins) were recorded in Table 8.3.2.