



# Test report

REP015157-1TRFWL

Date of issue: September 26, 2023

Applicant:

MatrixSpace Inc

Product:

High performance millimeter-wave radar

Model:

MS01100

Variant(s):

N/A


FCC ID:

2BAC9MS0110001

Specifications:

- ◆ FCC CFR 47 Part 87  
Aviation Services
- ◆ FCC CFR 47 Part 2  
Frequency Allocations and Radio Treaty Matters, General Rules and Regulations

#### Lab and test locations

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FCC Site Number	Test Firm Registration Number: 392943; Designation Number: US5058
ISED Test Site	2040B-3
Tested by	Chenhao Ma, Wireless test technician
Reviewed by	James Cunningham, EMC/WL Manager
Review date	September 26, 2023
Reviewer signature	

#### Limits of responsibility

Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.

This test report has been completed in accordance with the requirements of ISO/IEC 17025. All results contain in this report are within Nemko USA's ISO/IEC 17025 accreditation.

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## Section 1 Report summary

### 1.1 Test specifications

FCC CFR 47 Part 2	Frequency Allocations and Radio Treaty Matters General Rules and Regulations
FCC CFR 47 Part 87	Aviation Services

### 1.2 Test methods

ANSI C63.26-2015	American National Standard of Procedures for Compliance Testing of Transmitters Used in Licensed Radio Services
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### 1.3 Exclusions

None.

### 1.4 Statement of compliance

Testing was performed against all relevant requirements of the test standard(s).

A range of supported sample/chirp windows were evaluated. Full testing was performed on the worst-case with respect to transmitter output power. For this test the worst case is 16.67µs with 43MHz authorized Bandwidth

Results obtained indicate that the product under test complies in full with the tested requirements.

The test results relate only to the item(s) tested.

See "Section 2 Summary of test results" for full details.

### 1.5 Test report revision history

**Table 1.5-1:** Test report revision history

Revision #	Issue Date	Details of changes made to test report
REP015157-1TRFEMC	September 26, 2023	Original report issued

## Section 2 Summary of test results

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### 2.1 FCC Part 2 and Part 87 test results

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Part	Test description	Verdict
§2.1049 and Part 87.135 (a)	Bandwidth of emission	Pass
§2.1046 (a) and §87.131	Power and emissions	Pass
§87.139 (a)	Emission limitations	Pass
§2.1055 and §87.133 (a)	Frequency stability	Pass
§2.1051 and §87.139 (a)	Spurious emissions at antenna port	Not applicable <sup>1</sup>
§2.1053 and §87.139 (a)	Emission limitations	Pass

<sup>1</sup>Note: Conducted port not available, except for frequency stability test where a special arrangement was configured.

## Section 3 Equipment under test (EUT) details

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### 3.1 Disclaimer

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This section contains information provided by the applicant and has been utilized to support the test plan. Inaccurate information provided by the applicant can affect the validity of the results within this test report. Nemko accepts no responsibility for the information contained within this section and the impact it may have on the test plan and resulting measurements.

### 3.2 Sample information

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Receipt date	28-Aug-23
Nemko sample ID number	REP015157

### 3.3 Testing period

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Test start date	28-Aug-23
Test end date	01-Sep-23

### 3.4 Applicant

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Company name	MatrixSpace Inc
Address	141 South Bedford Drive
City	Burlington
State	MA
Postal/Zip code	01803
Country	United States

### 3.5 Manufacturer

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Company name	MatrixSpace Inc
Address	141 South Bedford Drive
City	Burlington
State	MA
Postal/Zip code	01803
Country	United States

### 3.6 EUT information

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Product name	High performance millimeter-wave radar
Model	MS01100
Variant(s)	N/A
Serial number	DS88
Part number	MS01100
Power requirements	5VDC
Description/theory of operation	Security and Surveillance Radar
Software details	N/A
Operating band	24.45-24.65GHz
Operational frequencies	24.49GHz 24.55GHz 24.61GHz
Antenna type	Non-detachable phased array
Antenna gain (declared)	17 dBi

### 3.7 EUT exercise and monitoring details

#### EUT description of the methods used to exercise the EUT and all relevant ports:

- The EUT was configured via an USB 3.0 interface via ssh Linux terminal window configuration. During the testing, the EUT was set into radar mode to transmit a number of multiple chirps in various representative processing intervals, or radar “frames”, at a configurable rate, and transmitted via the integral antenna on Low, Mid and High channels at maximum power. The USB3.0 data interface was configured to its maximum UL/DL data rate of ~ 8 GBps, utilizing the Iperf test tool

#### EUT setup/configuration rationale:

- The 1024 sample, 16.67us windowed continuous chirp configuration was configured to produce the highest amplitude emissions relative to the FCC limit and represent normal operation by the end user. The antenna steering azimuth was set to 0 degrees antenna (boresight) which is the worst-case test configuration.
- The type and construction of cables used in the measurement set-up were consistent with normal or typical use. Cables with mitigation features (for example, screening, tighter/more twists per length, ferrite beads) have been noted below:
  - The following deviations were made: None
- The EUT was setup in a manner that was consistent with its typical arrangement and use. The measurement arrangement of the EUT, local ancillary equipment and associated cabling was representative of normal practice. Any deviations from typical arrangements have been noted below:
  - The following deviations were: None

### 3.8 EUT setup details

**Table 3.8-1: EUT sub assemblies**

Description	Brand name	Model/Part number	Serial number	Rev.
N/A	N/A	N/A	N/A	N/A

**Table 3.8-2: EUT interface ports**

Description	Qty.
USB 3.0 port	1
10 MHz Reference SMA port	1
1PPS sync SMA port	1

**Table 3.8-3: Support equipment**

Description	Brand name	Model/Part number	Serial number	Rev.
10 MHz Reference	Baofeng Disciplined Reference Oscillator	BG7TBL	027	2020-06-10
AC/DC ADAPTER 5V 40W	GlobTek, Inc.	GTM96600-4005-T3	various	L2

**Table 3.8-4: Inter-connection cables**

Cable description	From	To	Length (m)
USB 3.0 interface cable	Test PC	UUT / USB3.0 port	1
10 MHz reference cable	10MHz lab reference	UUT 10 MHz reference port.	1

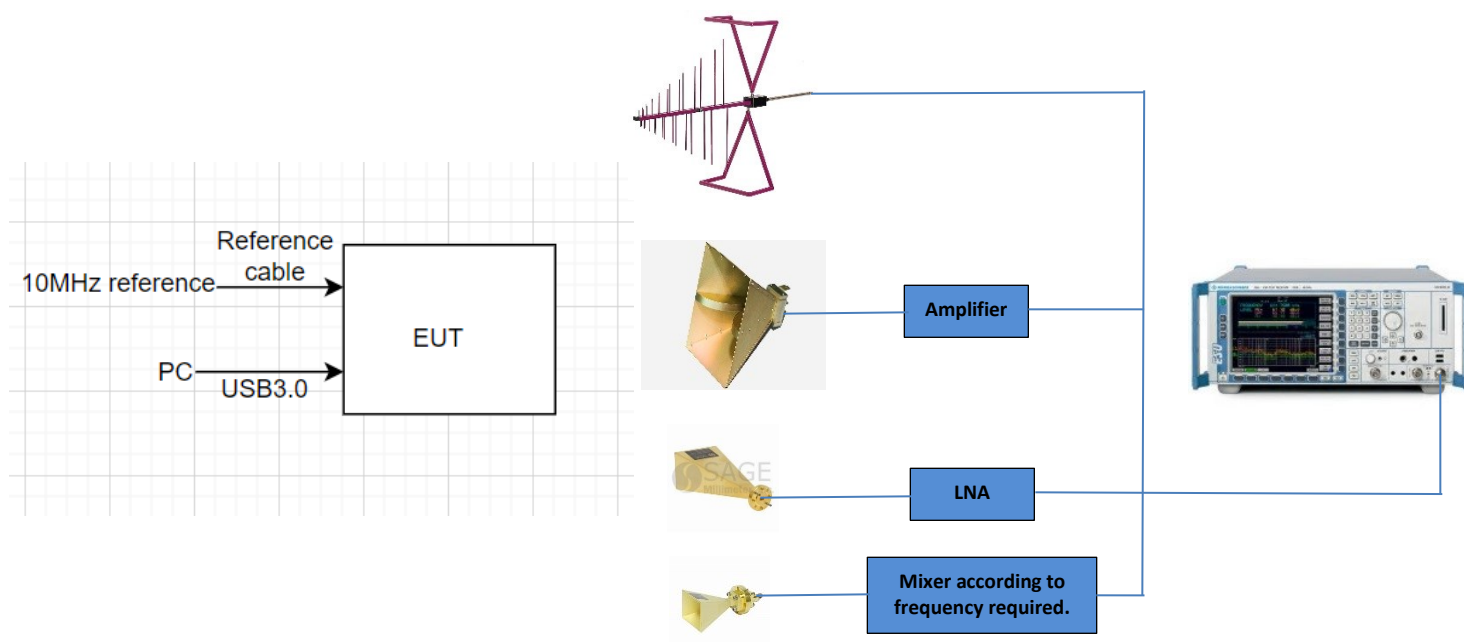


Figure 3.8-1: Test setup diagram

## Section 4 Engineering considerations

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### 4.1 Modifications incorporated in the EUT

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None.

### 4.2 Technical judgement

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None.

### 4.3 Deviations from laboratory test procedures

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None.

## Section 5 Test conditions

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### 5.1 Atmospheric conditions

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Temperature	15–30 °C
Relative humidity	20–75 %
Air pressure	86–106 kPa

When it is impracticable to carry out tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests shall be recorded and stated.

### 5.2 Power supply range

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The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of the present document, the nominal voltage shall be the declared voltage (5 VDC), or any of the declared voltages  $\pm 5\%$ , for which the equipment was designed.

## Section 6 Measurement uncertainty

### 6.1 Uncertainty of measurement

Nemko USA Inc. has calculated measurement uncertainty and is documented in EMC/MUC/001 "Uncertainty in EMC measurements." Measurement uncertainty was calculated using the methods described in CISPR 16-4-2 Specification for radio disturbance and immunity measuring apparatus and methods – Part 4-2: Uncertainties, statistics, and limit modelling – Measurement instrumentation uncertainty. The expression of Uncertainty in EMC testing. Measurement uncertainty calculations assume a coverage factor of K=2 with 95% certainty.

**Table 6.1-1: Measurement uncertainty calculations**

Measurement		$U_{\text{cispr}}$ dB	$U_{\text{lab}}$ dB
Conducted disturbance at AC mains and other port power using a V-AMN	9 kHz to 150 kHz	3.8	2.9
	150 kHz to 30 MHz	3.4	2.3
Conducted disturbance at telecommunication port using AAN	150 kHz to 30 MHz	5.0	4.3
Conducted disturbance at telecommunication port using CVP	150 kHz to 30 MHz	3.9	2.9
Conducted disturbance at telecommunication port using CP	150 kHz to 30 MHz	2.9	1.4
Conducted disturbance at telecommunication port using CP and CVP	150 kHz to 30 MHz	4.0	3.1
Radiated disturbance (electric field strength in a SAC)	30 MHz to 1 GHz	6.3	5.5
Radiated disturbance (electric field strength in a FAR)	1 GHz to 6 GHz	5.2	4.7
Radiated disturbance (electric field strength in a FAR)	6 GHz to 18 GHz	5.5	5.0

- Notes:
- Compliance assessment:
    - If  $U_{\text{lab}}$  is less than or equal to  $U_{\text{cispr}}$  then:
      - compliance is deemed to occur if no measured disturbance level exceeds the disturbance limit;
      - non-compliance is deemed to occur if any measured disturbance level exceeds the disturbance limit
    - If  $U_{\text{lab}}$  is greater than  $U_{\text{cispr}}$  then:
      - compliance is deemed to occur if no measured disturbance level, increased by  $(U_{\text{lab}} - U_{\text{cispr}})$ , exceeds the disturbance limit;
      - non-compliance is deemed to occur if any measured disturbance level, increased by  $(U_{\text{lab}} - U_{\text{cispr}})$ , exceeds the disturbance limit

V-AMN: V type artificial mains network  
 AAN: Asymmetric artificial network  
 CP: Current probe  
 CVP: Capacitive voltage probe  
 SAC: Semi-anechoic chamber  
 FAR: Fully anechoic room

## Section 7 Test equipment

### 7.1 Test equipment list

**Table 7.1-1: Test equipment list**

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
Signal & Spectrum Analyzer 10Hz to 30 GHz	Rohde & Schwarz	FSV3030	E1321	1 year	Sep-30-2023
Antenna Horn	EMCO	3115	1033	2 years	Nov-02-2024
EMC Test Receiver	Rohde & Schwarz	ESU 40	E1121	1 year	Aug-23-2024
Antenna, Bilog	Schaffner-Chase	CBL6111C	1480	1 year	Feb-21-2024
Antenna, Horn	ETS-Lingren	3117-PA	E1160	1 year	Feb-13-2024
Standard Gain Horn Antenna	Eravant	SAZ-2410-42-S1	E1013	1 year	Nov-22-2023
Standard Gain Horn Antenna	Eravant	SAZ-2410-2-S1	EW108	1 year	Nov-22-2023
Low Noise Amplifier	Sage Millimeter	SBL-1834034030-KFKF-SI	E1228	VOU	VOU
Antenna, Horn	Sage Millimeter	SAR-2309-19-S2	E1144	NCR	NCR
Mixer	Rohde & Schwarz	FS-Z60	E1138	VOU	VOU
Antenna, Horn	Sage Millimeter	SAR-2408-15-S2	E1152	NCR	NCR
Mixer	Rohde & Schwarz	FS-Z75	E1149	VOU	VOU
Antenna, Horn	Sage Millimeter	SAR-2507-10-S2	E1146	NCR	NCR
Mixer	Rohde & Schwarz	FS-Z110	E1154	VOU	VOU
Environmental chamber	Cincinnati Sub-Zero	ZPH-32-2-2-H/ACa	S1179	1 year	Aug-23-2024

Notes: N/A – not applicable  
NCR – no calibration required  
VOU – verify on use

**Table 7.1-2: Test software details**

Manufacturer of Software	Details
Rohde & Schwarz	EMC 32 V10.60.15

Notes: None

## Section 8 Testing data

### 8.1 Bandwidth of emission (99%)

#### 8.1.1 References and limits

- FCC 47 CFR Part 87: §87.135

- Test method: ANSI C63.26-2014 (5.4.4)

(a) Occupied bandwidth is the width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to 0.5 percent of the total mean power of a given emission.

(b) The authorized bandwidth is the maximum occupied bandwidth authorized to be used by a station.

(c) The necessary bandwidth for a given class of emission is the width of the frequency band which is just sufficient to ensure the transmission of information at the rate and with the quality required under specified conditions.

#### 8.1.2 Test summary

Verdict	Pass		
Test date	August 28, 2023; August 29, 2023; August 30, 2023	Temperature	19°C; 20°C; 18°C
Test engineer	Chenhao Ma, Wireless Test Technician	Air pressure	1003mbar; 1005mbar; 1006mbar
Test location	<input type="checkbox"/> Wireless bench <input checked="" type="checkbox"/> Other: 3M Chamber	Relative humidity	58%; 59%; 56%

#### 8.1.3 Notes

Testing was performed with the transmitter operating on a fixed channel at full power.

Frequency	Bandwidth declared
24.49 GHz	43MHz
24.55 GHz	43MHz
24.61 GHz	43MHz

Note 1: These bandwidths are declared only as reference, the real number is shown in table 8.1-2 of this section.

**Table 8.1-1: Pulse description table.**

Testing was done at 3 meters with the antenna and turntable fixed. A maximization of the signal was done to define the position of the max power:

Antenna height: 161 cm Turntable: 2 Degrees

#### 8.1.4 Setup details

EUT power input during test	5 VDC via AC/DC adaptor
EUT setup configuration	<input type="checkbox"/> Table-top <input type="checkbox"/> Floor standing <input checked="" type="checkbox"/> Other: Tripod mounted (1.5 m)

Receiver settings:

Resolution bandwidth	Approximately 1-5 % of the emission bandwidth
Video bandwidth	Approximately 3 x resolution bandwidth
Detector mode	Peak
Trace mode	Max Hold
Measurement time	Long enough for trace to stabilize

8.1.5 Test data

Frequency	Bandwidth declared	Result
24.49 GHz	43MHz	38.172MHz
24.55 GHz	43MHz	38.125 MHz
24.61 GHz	43MHz	38.132MHz

Table 8.1-2: 99% OBW results.

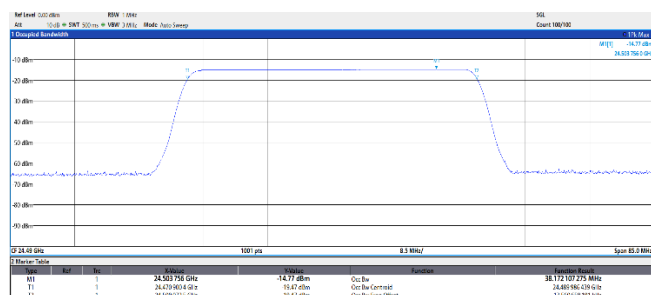


Figure 8.1-1: 99% OBW Low channel: 24.49 GHz 16.67μs with 43MHz authorized Bandwidth

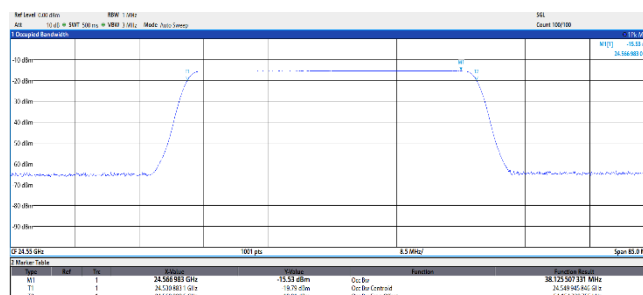


Figure 8.1-2: 99% OBW Middle channel: 24.55 GHz 16.67μs with 43MHz authorized Bandwidth

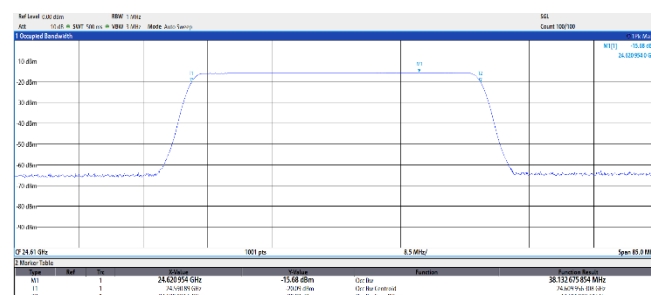


Figure 8.1-3: 99% OBW High channel: 24.61 GHz 16.67μs with 43MHz authorized Bandwidth

## 8.2 Bandwidth of emission (26 dB)

### 8.2.1 References and limits

- Test method: ANSI C63.26-2014 (5.4.3)

### 8.2.2 Test summary

Verdict	Pass		
Test date	August 28, 2023; August 29, 2023; August 30, 2023	Temperature	19°C; 20°C; 18°C;
Test engineer	Chenhao Ma, Wireless Test Technician	Air pressure	1003mbar; 1005mbar; 1006mbar
Test location	<input type="checkbox"/> Wireless bench <input checked="" type="checkbox"/> Other: 3M Chamber	Relative humidity	58%; 59%; 56%

### 8.2.3 Notes

Testing was performed with the transmitter operating on a fixed channel at full power following the cases shown on table 8.1-1 from section 8.1.3 of this document.

Testing was done at 3 meters with the antenna and turntable fixed. A maximization of the signal was done to define the position of the max power:  
Antenna heigh: 161 cm Turntable: 2 Degrees

### 8.2.4 Setup details

EUT power input during test	5 VDC via AC/DC adaptor
EUT setup configuration	<input type="checkbox"/> Table-top <input type="checkbox"/> Floor standing <input checked="" type="checkbox"/> Other: Tripod mounted (1.61 m)

Receiver settings:

Resolution bandwidth	Approximately 1-5 % of the emission bandwidth
Video bandwidth	Approximately 3 x resolution bandwidth
Detector mode	Peak
Trace mode	Max Hold
Measurement time	Long enough for trace to stabilize

## 8.2.5 Test data

Frequency	Bandwidth
24.49 GHz	42.03MHz
24.55 GHz	42.03MHz
24.61 GHz	42.03MHz

Table 8.2-1: 26 dB OBW results.

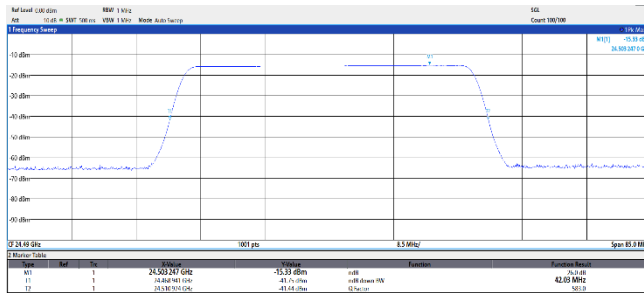


Figure 8.2-1: 26 dB OBW Low channel: 24.49 GHz 16.67  $\mu$ s with 43MHz authorized Bandwidth

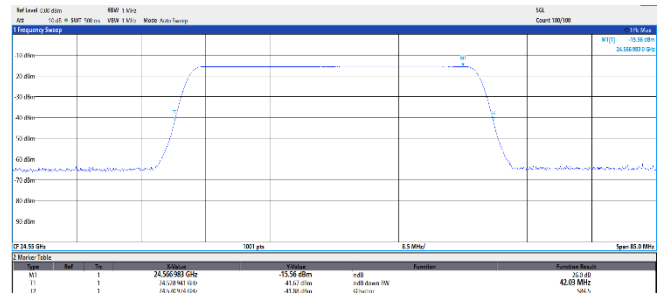


Figure 8.2-2: 26 dB OBW Middle channel: 24.55 GHz 16.67  $\mu$ s with 43MHz authorized Bandwidth

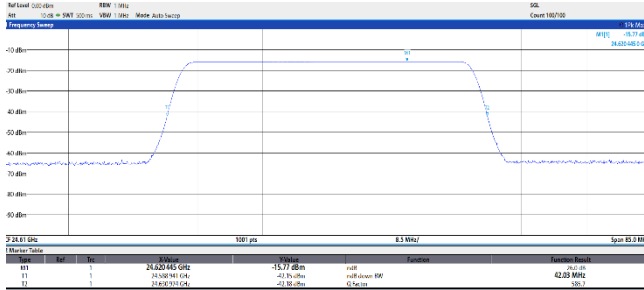


Figure 8.2-3: 26 dB OBW High channel: 24.61 GHz 16.67  $\mu$ s with 43MHz authorized Bandwidth

## 8.3 Power and emissions

### 8.3.1 References and limits

- FCC 47 CFR Part 87: §87.131
- Test method: ANSI C63.26-2014 (5.2.4.4.2)

The following table lists authorized emissions and maximum power. Power must be determined by direct measurement.

Class of station	Frequency band/frequency	Authorized emission(s) <sup>7</sup>	Maximum power <sup>1</sup>
(Radionavigation)	Various <sup>7</sup>	Various <sup>7</sup>	Various. <sup>7</sup>

<sup>7</sup> Frequency, emission, and maximum power will be determined by appropriate standards during the certification process.

### 8.3.2 Test summary

Verdict	Pass		
Test date	August 28, 2023; August 29, 2023	Temperature	19°C; 20°C
Test engineer	Chenhao Ma, Wireless Test Technician	Air pressure	1003mbar; 1005mbar
Test location	<input type="checkbox"/> Wireless bench <input checked="" type="checkbox"/> Other: 3M Chamber	Relative humidity	58%; 59%

### 8.3.3 Notes

Testing was performed with the transmitter operating on a fixed channel at full power following the cases shown on table 8.1-1 from section 8.1.3 of this document. All correction factors corresponding cables losses, receiving antenna gain, and air path losses were compensated to get the real EIRP value of the product. Both polarizations were evaluated, horizontal and vertical (linear polarization per client declaration) and only the worst case (max power) was taken for the testing purposes: horizontal polarization. The duty cycle correction factor was added according to each frequency channel tested. Table 8.3-1 shows the constant duty cycle corresponding to each case.

The equation to calculate the total correction factor corresponding to each frequency tested is given by the following expression as well as the table with the corresponding duty cycle to each case:

$$E.I.R.P = P_r - G_r - 20 \log_{10} \left( \frac{\lambda}{4\pi d} \right)$$

Adding cable losses and duty cycle correction factors (absolute values):

$$E.I.R.P = P_r - G_r - 20 \log_{10} \left( \frac{\lambda}{4\pi d} \right) + L_{cable} + 10 \log_{10} \left( \frac{1}{Duty\ cycle} \right)$$

Where:

$P_r$  = Power received in the spectrum analyzer

$\lambda$  = Wavelength of the signal

$L_{cable}$  = Losses corresponding to interconnexion cables

$d$  = Measuring distance (3 meters)

$G_r$  = Receiving antenna gain

DC = Duty cycle declared

Example:

$$E.I.R.P = P_r - 17 - 20 \log_{10} \left( \frac{299792458}{24550000000 \cdot 4\pi(3)} \right) + 11.804 + 10 \log_{10} \left( \frac{1}{1} \right)$$

$$E.I.R.P = P_r - 17 - (-69.786) + 11.804 + 0 = P_r + 64.59 \text{ (offset)}$$

For this test, the total compensation is: 64.59dBm

### 8.3.3 Notes, continued

Frequency	Constant duty cycle
24.49 GHz	100%
24.55 GHz	100%
24.61 GHz	100%

**Table 8.3-1: Duty cycle table.**

Testing was done at 3 meters with the antenna and turntable fixed. A maximization of the signal was done to define the position of the max power:  
Antenna height: 161 cm Turntable: 2 Degrees

### 8.3.4 Setup details

EUT power input during test	5 VDC via AC/DC adaptor
EUT setup configuration	<input type="checkbox"/> Table-top <input type="checkbox"/> Floor standing <input checked="" type="checkbox"/> Other: Tripod mounted (1.5 m)

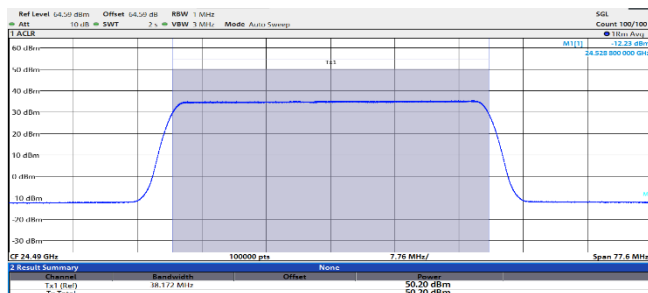
Receiver settings:

Resolution bandwidth	Approximately 1-5 % of the emission bandwidth
Video bandwidth	Approximately 3 x resolution bandwidth
Detector mode	RMS
Trace mode	Average (at least 100 traces)
Measurement points	≥ (2xspan)/RBW
Span	2 times or 3 times the 99% OBW

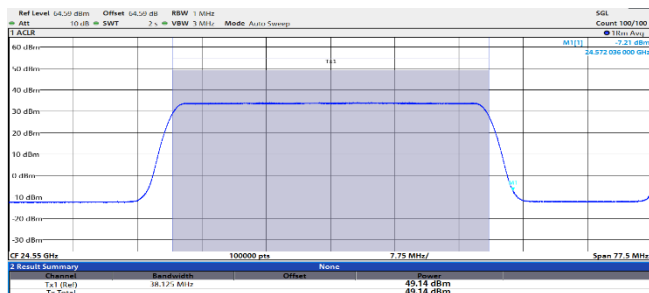
### 8.3.5 Test data

Frequency	Declared power	Antenna gain	Measured Power (EIRP)
24.49 GHz	49 dBm	17 dBi	50.20 dBm
24.55 GHz	49 dBm	17 dBi	49.14 dBm
24.61 GHz	49 dBm	17 dBi	49.53 dBm

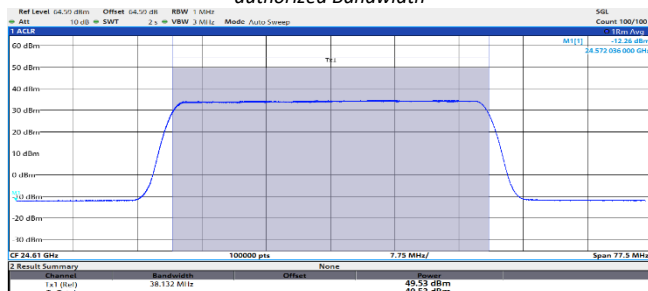
**Table 8.3-2: Power results (EIRP)**



**Figure 8.3-1: EIRP Power, Low channel: 24.49 GHz 16.67 μs with 43MHz authorized Bandwidth**



**Figure 8.3-2: EIRP Power, Middle channel: 24.55 GHz 16.67 μs with 43MHz authorized Bandwidth**



**Figure 8.3-3: EIRP Power, High channel: 24.61 GHz 16.67 μs with 43MHz authorized Bandwidth**

## 8.4 Emission limitations

### 8.4.1 References and limits

- FCC 47 CFR Part 87: §87.139
- Test method: ANSI C63.26-2014 (5.5)

(a) Except for ELTs and when using single sideband (R3E, H3E, J3E), or frequency modulation (F9) or digital modulation (F9Y) for telemetry or telecommand in the 1435–1525 MHz, 2345–2395 MHz, or 5091–5150 MHz band or digital modulation (G7D) for differential GPS, the mean power of any emissions must be attenuated below the mean power of the transmitter (pY) as follows:

(1) When the frequency is removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth the attenuation must be at least 25 dB;

(2) When the frequency is removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth the attenuation must be at least 35 dB.

(3) When the frequency is removed from the assigned frequency by more than 250 percent of the authorized bandwidth the attenuation for aircraft station transmitters must be at least 40 dB; and the attenuation for aeronautical station transmitters must be at least 43 + 10 log<sub>10</sub> pY dB.

### 8.4.2 Test summary

Verdict	Pass		
Test date	August 31, 2023; August 30, 2023	Temperature	19°C; 20°C
Test engineer	Chenhao Ma, Wireless Test Technician	Air pressure	1003mbar, 1005mbar
Test location	<input type="checkbox"/> Wireless bench <input checked="" type="checkbox"/> Other: 3M Chamber	Relative humidity	58%; 59%

### 8.4.3 Notes

Testing was performed with the transmitter operating on a fixed channel at full power following the cases shown on table 8.1-1 from section 8.1.3 of this document. The width of the mask was defined according to the authorized bandwidth widest.

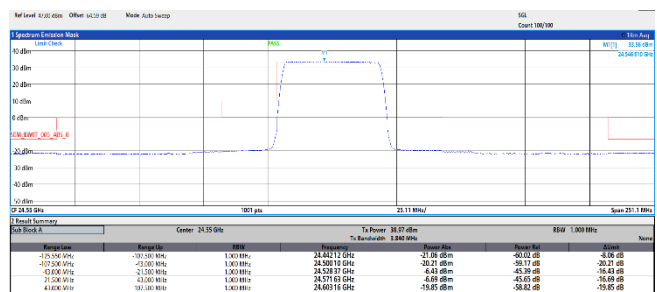
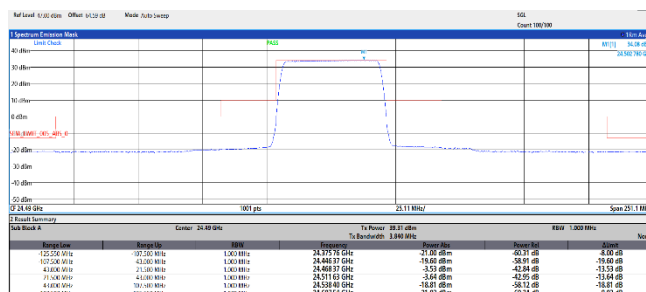
### 8.4.4 Setup details

EUT power input during test	5 VDC via AC/DC adaptor
EUT setup configuration	<input type="checkbox"/> Table-top <input type="checkbox"/> Floor standing <input checked="" type="checkbox"/> Other: Tripod mounted (1.61 m)

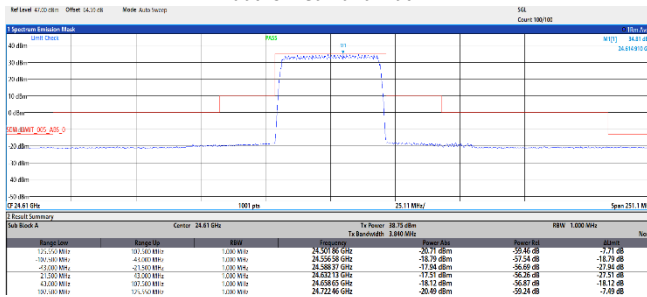
Receiver settings:

Resolution bandwidth	Approximately 1-5 % of the emission bandwidth
Video bandwidth	Approximately 3 x resolution bandwidth
Detector mode	RMS
Trace mode	Average (at least 100 traces)
Span	Enough to see the spectrum under investigation

### 8.4.5 Test data



**Figure 8.4-1: Emission mask, Low channel: 24.49 GHz, 16.67  $\mu$ s with 43MHz authorized Bandwidth**



**Figure 8.4-2: Emission mask, Middle channel: 24.55 GHz, 16.67  $\mu$ s with 43MHz authorized Bandwidth**

**Figure 8.4-3: Emission mask, High channel: 24.61 GHz, 16.67  $\mu$ s with 43MHz authorized Bandwidth**

Range Low	Range Up	Power	Power Mask	Power Ref	Mask
1.250 MHz	10.000 MHz	1.000 MHz	24.5018 GHz	-20.11 dBm	-20.11 dB
10.000 MHz	40.000 MHz	1.000 MHz	24.5068 GHz	-18.79 dBm	-18.79 dB
40.000 MHz	75.000 MHz	1.000 MHz	24.5087 GHz	-17.84 dBm	-17.84 dB
75.000 MHz	100.000 MHz	1.000 MHz	24.5093 GHz	-16.13 dBm	-16.13 dB
100.000 MHz	150.000 MHz	1.000 MHz	24.5228 GHz	-20.89 dBm	-20.89 dB

## 8.5 Transmitter spurious emissions

### 8.5.1 References and limits

- FCC 47 CFR Part 87: §87.139
- Test method: ANSI C63.4 (5.5)

(a) Except for ELTs and when using single sideband (R3E, H3E, J3E), or frequency modulation (F9) or digital modulation (F9Y) for telemetry or telecommand in the 1435–1525 MHz, 2345–2395 MHz, or 5091–5150 MHz band or digital modulation (G7D) for differential GPS, the mean power of any emissions must be attenuated below the mean power of the transmitter (pY) as follows:

(3) When the frequency is removed from the assigned frequency by more than 250 percent of the authorized bandwidth the attenuation for aircraft station transmitters must be at least 40 dB; and the attenuation for aeronautical station transmitters must be at least 43 + 10 log<sub>10</sub> pY dB.

- FCC 47 CFR Part 2: §2.1057

(a) In all of the measurements set forth in §§ 2.1051 and 2.1053, the spectrum shall be investigated from the lowest radio frequency signal generated in the equipment, without going below 9 kHz, up to at least the frequency shown below:

(2) If the equipment operates at or above 10 GHz and below 30 GHz: to the fifth harmonic of the highest fundamental frequency or to 100 GHz, whichever is lower.

### 8.5.2 Test summary

Verdict	Pass		
Test date	August 29, 2023; August 30, 2023	Temperature	20°C; 18°C
Test engineer	Chenhao Ma, Wireless Test Technician	Air pressure	1002mbar; 1001mbar
Test location	<input type="checkbox"/> Wireless bench <input checked="" type="checkbox"/> Other: 3M Chamber	Relative humidity	59%; 56%

### 8.5.3 Notes

Testing was performed with the transmitter operating on a fixed channel at full power.

#### 8.5.4 Setup details

EUT power input during test	5 VDC via AC/DC adaptor
EUT setup configuration	<input checked="" type="checkbox"/> Table-top (Above 1 GHz: 1.5m) <input type="checkbox"/> Floor standing <input checked="" type="checkbox"/> Other: Tripod mounted (Below 1 GHz: 80 cm)
Antenna height variation	1–4 m
Turn table position	0–360°
Measurement details	A preview measurement was generated with receiver in continuous scan or sweep mode while the EUT was rotated, and antenna adjusted to maximize radiated emission. Emissions detected within 6 dB or above limit were re-measured with the appropriate detector against the correlating limit and recorded as the final measurement.

#### Receiver settings (below 1 GHz):

Resolution bandwidth	120 kHz
Video bandwidth	300 kHz
Detector mode	Peak (preview measurements) Quasi-peak (final measurements)
Trace mode	Max Hold
Measurement time	5000 ms (final measurements)

#### Receiver settings (from 1 -40 GHz):

Resolution bandwidth	1 MHz
Video bandwidth	3 MHz
Detector mode	Peak (preview measurements) Peak and average (final measurements)
Trace mode	Max Hold
Measurement time	5000 ms (final measurements)

#### Spectrum analyzer settings (above 40 GHz):

Resolution bandwidth	1 MHz
Video bandwidth	3 MHz
Detector mode	Average
Trace mode	Max Hold

8.5.5 Test data

Full Spectrum

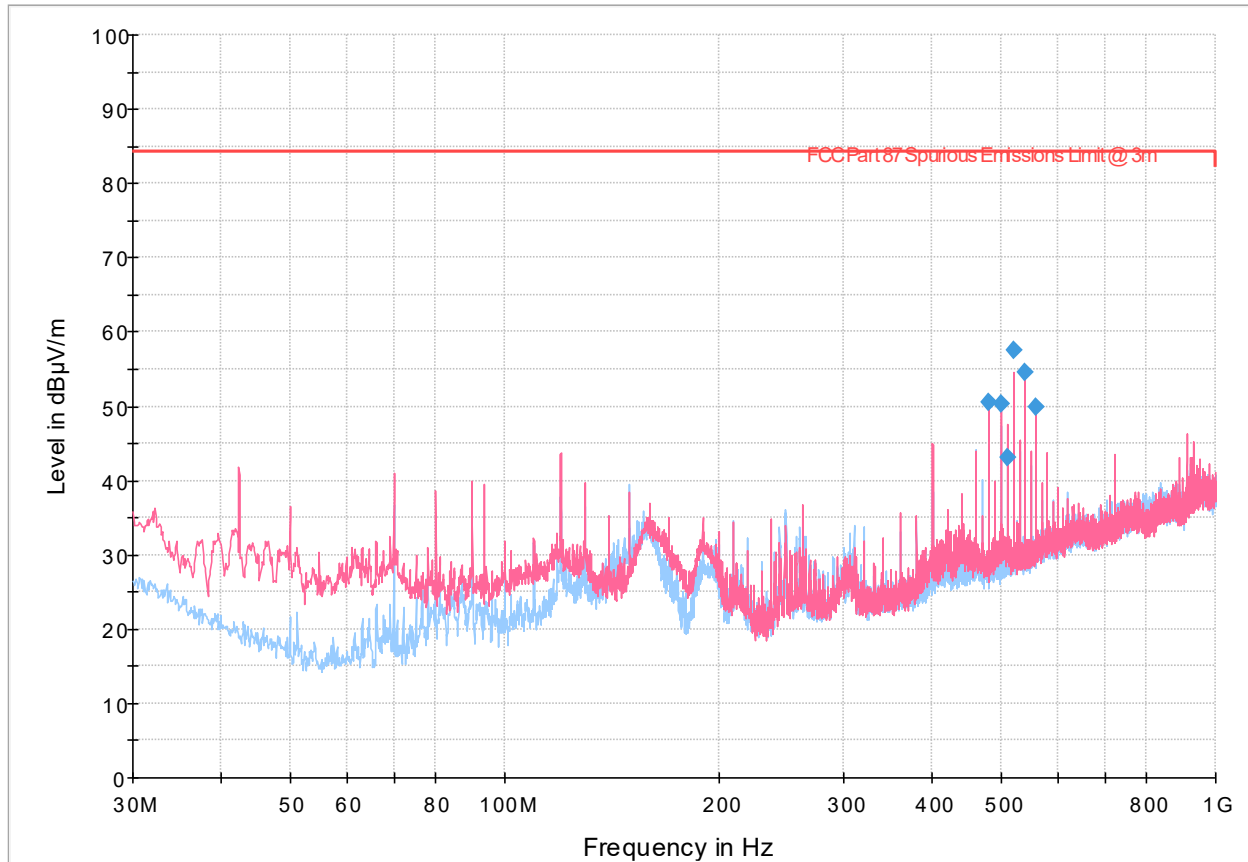


Figure 8.5-1: Radiated emissions spectral plot (30 MHz - 1 GHz) 24.49GHz low channel with 43MHz authorized Bandwidth

Table 8.5-1: Radiated emissions results

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
479.983000	50.50	84.38	33.88	5000.0	120.000	100.0	V	212.0	26.2
500.005000	50.31	84.38	34.07	5000.0	120.000	100.0	V	216.0	26.6
510.013000	43.06	84.38	41.32	5000.0	120.000	104.0	V	323.0	26.8
520.004000	57.46	84.38	26.92	5000.0	120.000	164.0	V	234.0	27.3
539.986000	54.50	84.38	29.88	5000.0	120.000	100.0	V	244.0	28.2
560.008000	49.98	84.38	34.40	5000.0	120.000	100.0	V	356.0	28.8

Notes:

<sup>1</sup> Field strength (dB V/m) = receiver/spectrum analyzer value (dB V) + correction factor (dB)

<sup>2</sup> Correction factors = antenna factor ACF (dB) + cable loss (dB)

<sup>3</sup> Emissions that were continuously present for a minimum of 1 second and occurred more than once for every 15 seconds observation period were considered valid emissions. The maximum value of valid emissions has been recorded.

Full Spectrum

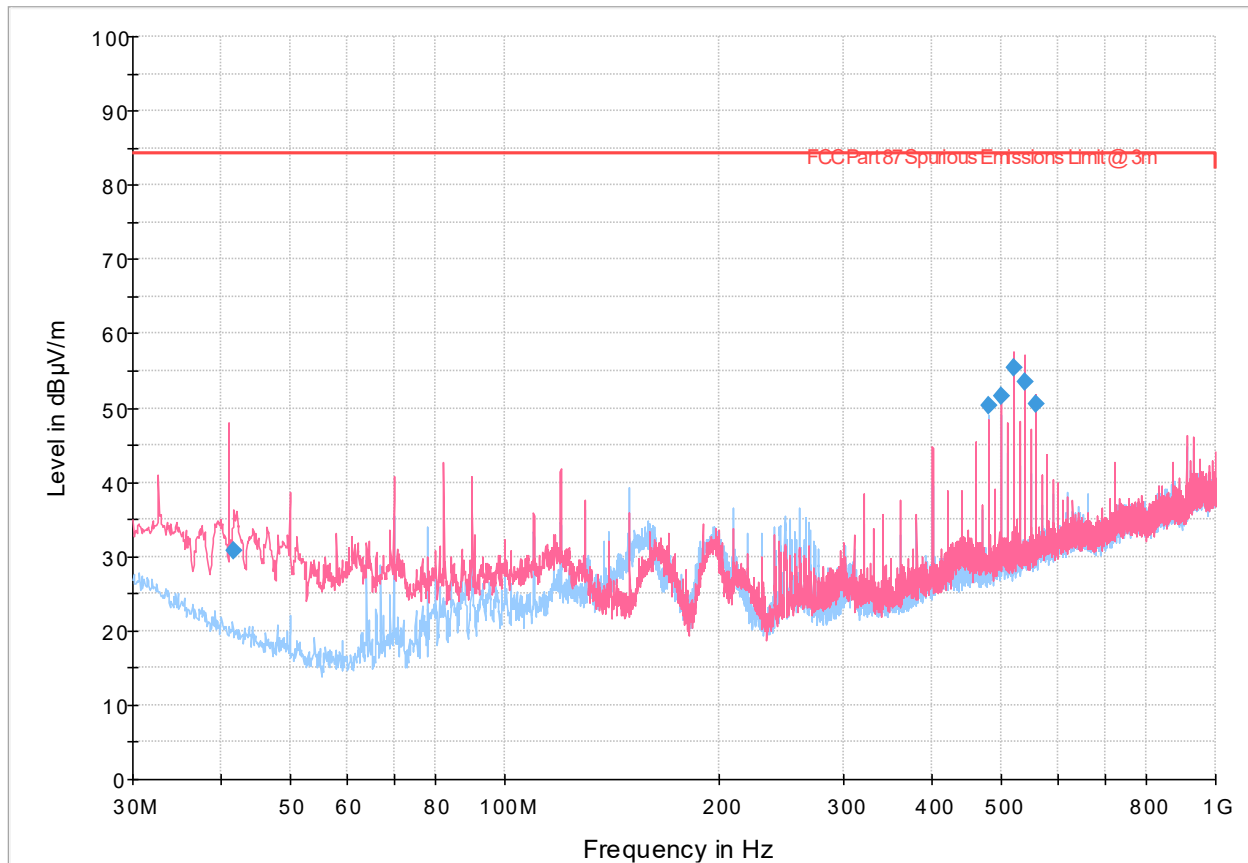


Figure 8.5-2: Radiated emissions spectral plot (30 MHz - 1 GHz) 24.55GHz middle channel with 43MHz authorized Bandwidth

Table 8.5-2: Radiated emissions results

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
41.641000	30.89	84.38	53.49	5000.0	120.000	107.0	V	278.0	18.2
479.983000	50.23	84.38	34.15	5000.0	120.000	146.0	H	145.0	26.2
500.005000	51.52	84.38	32.86	5000.0	120.000	100.0	V	204.0	26.6
520.004000	55.37	84.38	29.01	5000.0	120.000	100.0	V	206.0	27.3
539.986000	53.55	84.38	30.83	5000.0	120.000	127.0	V	218.0	28.2
560.008000	50.60	84.38	33.78	5000.0	120.000	118.0	V	236.0	28.8

Notes: <sup>1</sup> Field strength (dB V/m) = receiver/spectrum analyzer value (dB V) + correction factor (dB)  
<sup>2</sup> Correction factors = antenna factor ACF (dB) + cable loss (dB)  
<sup>3</sup> Emissions that were continuously present for a minimum of 1 second and occurred more than once for every 15 seconds observation period were considered valid emissions. The maximum value of valid emissions has been recorded.

Full Spectrum

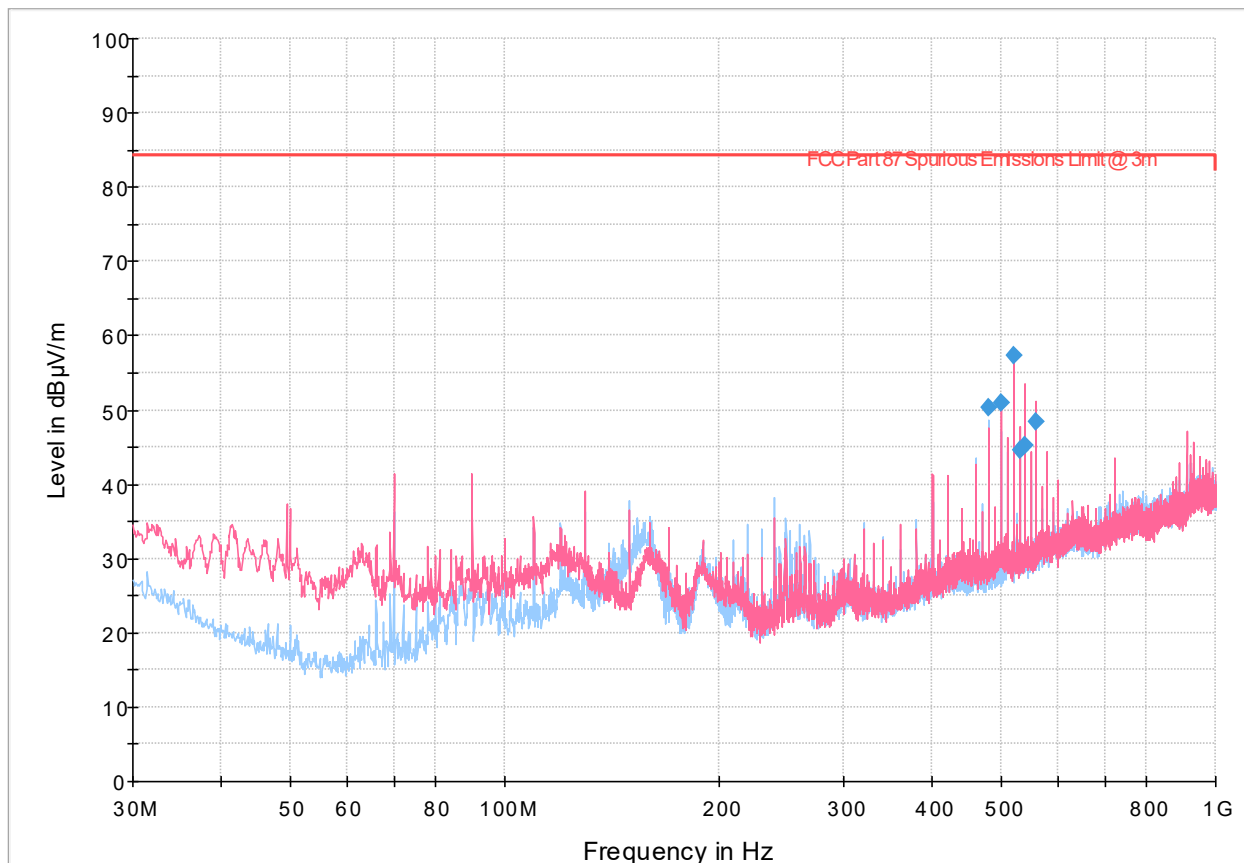


Figure 8.5-3: Radiated emissions spectral plot (30 MHz - 1 GHz) 24.61GHz High channel with 43MHz authorized Bandwidth

Table 8.5-3: Radiated emissions results

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
479.983000	50.31	84.38	34.07	5000.0	120.000	150.0	H	148.0	26.2
500.005000	51.00	84.38	33.38	5000.0	120.000	100.0	V	225.0	26.6
520.004000	57.26	84.38	27.12	5000.0	120.000	100.0	V	330.0	27.3
529.995000	44.58	84.38	39.80	5000.0	120.000	100.0	V	0.0	27.7
539.986000	45.16	84.38	39.22	5000.0	120.000	131.0	V	0.0	28.2
560.008000	48.47	84.38	35.91	5000.0	120.000	124.0	V	230.0	28.8

Notes: <sup>1</sup> Field strength (dB V/m) = receiver/spectrum analyzer value (dB V) + correction factor (dB)  
<sup>2</sup> Correction factors = antenna factor ACF (dB) + cable loss (dB)  
<sup>3</sup> Emissions that were continuously present for a minimum of 1 second and occurred more than once for every 15 seconds observation period were considered valid emissions. The maximum value of valid emissions has been recorded.

Full Spectrum

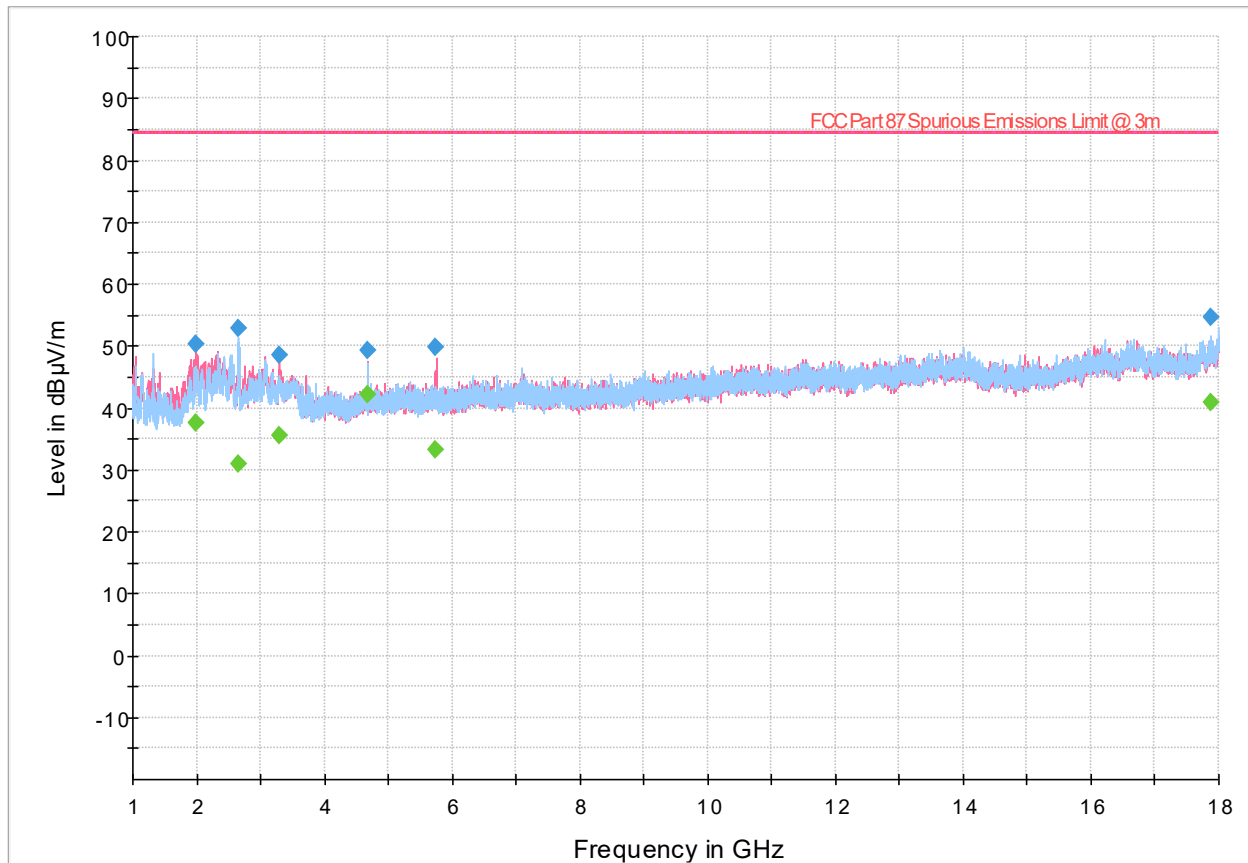


Figure 8.5-4: Radiated emissions spectral plot (1 GHz - 18 GHz) 24.49GHz Low channel with 43MHz authorized Bandwidth

Table 8.5-4: Radiated emissions results

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1986.050000	---	37.58	84.40	46.82	5000.0	1000.000	112.0	V	278.0	-6.8
1986.050000	50.37	---	84.40	34.03	5000.0	1000.000	112.0	V	278.0	-6.8
2665.050000	52.74	---	84.40	31.66	5000.0	1000.000	170.0	H	123.0	-4.6
2665.050000	---	31.03	84.40	53.37	5000.0	1000.000	170.0	H	123.0	-4.6
3287.500000	---	35.54	84.40	48.86	5000.0	1000.000	126.0	V	86.0	-2.9
3287.500000	48.49	---	84.40	35.91	5000.0	1000.000	126.0	V	86.0	-2.9
4684.900000	---	42.10	84.40	42.30	5000.0	1000.000	183.0	V	32.0	0.5
4684.900000	49.32	---	84.40	35.08	5000.0	1000.000	183.0	V	32.0	0.5
5746.600000	---	33.27	84.40	51.13	5000.0	1000.000	186.0	V	0.0	1.7
5746.600000	49.86	---	84.40	34.54	5000.0	1000.000	186.0	V	0.0	1.7
17877.650000	54.62	---	84.40	29.78	5000.0	1000.000	248.0	V	58.0	18.6
17877.650000	---	40.86	84.40	43.54	5000.0	1000.000	248.0	V	58.0	18.6

Notes: <sup>1</sup> Field strength (dB V/m) = receiver/spectrum analyzer value (dB V) + correction factor (dB)

<sup>2</sup> Correction factors = antenna factor ACF (dB) + cable loss (dB)

<sup>3</sup> Emissions that were continuously present for a minimum of 1 second and occurred more than once for every 15 seconds observation period were considered valid emissions. The maximum value of valid emissions has been recorded.

Full Spectrum

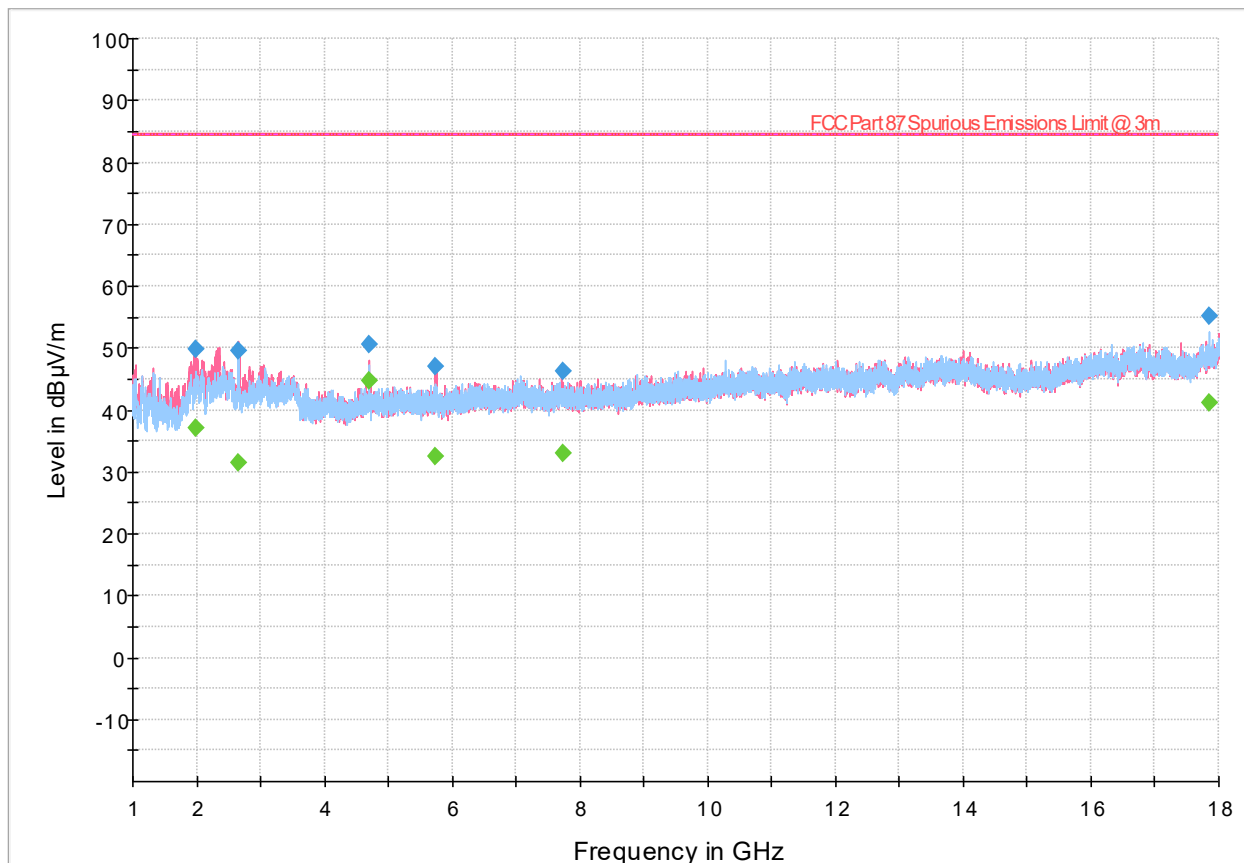


Figure 8.5-5: Radiated emissions spectral plot (1 GHz - 18 GHz) 24.55GHz Middle channel with 43MHz authorized Bandwidth

Table 8.5-5: Radiated emissions results

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1982.900000	49.69	---	84.40	34.71	5000.0	1000.000	106.0	V	0.0	-6.7
1982.900000	---	37.15	84.40	47.25	5000.0	1000.000	106.0	V	0.0	-6.7
2656.050000	---	31.52	84.40	52.88	5000.0	1000.000	119.0	V	62.0	-4.6
2656.050000	49.67	---	84.40	34.73	5000.0	1000.000	119.0	V	62.0	-4.6
4700.200000	50.66	---	84.40	33.74	5000.0	1000.000	219.0	V	302.0	0.4
4700.200000	---	44.77	84.40	39.63	5000.0	1000.000	219.0	V	302.0	0.4
5745.450000	46.92	---	84.40	37.48	5000.0	1000.000	162.0	V	100.0	1.7
5745.450000	---	32.40	84.40	52.00	5000.0	1000.000	162.0	V	100.0	1.7
7725.900000	---	33.08	84.40	51.32	5000.0	1000.000	256.0	V	262.0	4.1
7725.900000	46.16	---	84.40	38.24	5000.0	1000.000	256.0	V	262.0	4.1
17849.800000	55.13	---	84.40	29.27	5000.0	1000.000	283.0	H	35.0	18.2
17849.800000	---	41.13	84.40	43.27	5000.0	1000.000	283.0	H	35.0	18.2

Notes: <sup>1</sup> Field strength (dB V/m) = receiver/spectrum analyzer value (dB V) + correction factor (dB)

<sup>2</sup> Correction factors = antenna factor ACF (dB) + cable loss (dB)

<sup>3</sup> Emissions that were continuously present for a minimum of 1 second and occurred more than once for every 15 seconds observation period were considered valid emissions. The maximum value of valid emissions has been recorded.

Full Spectrum

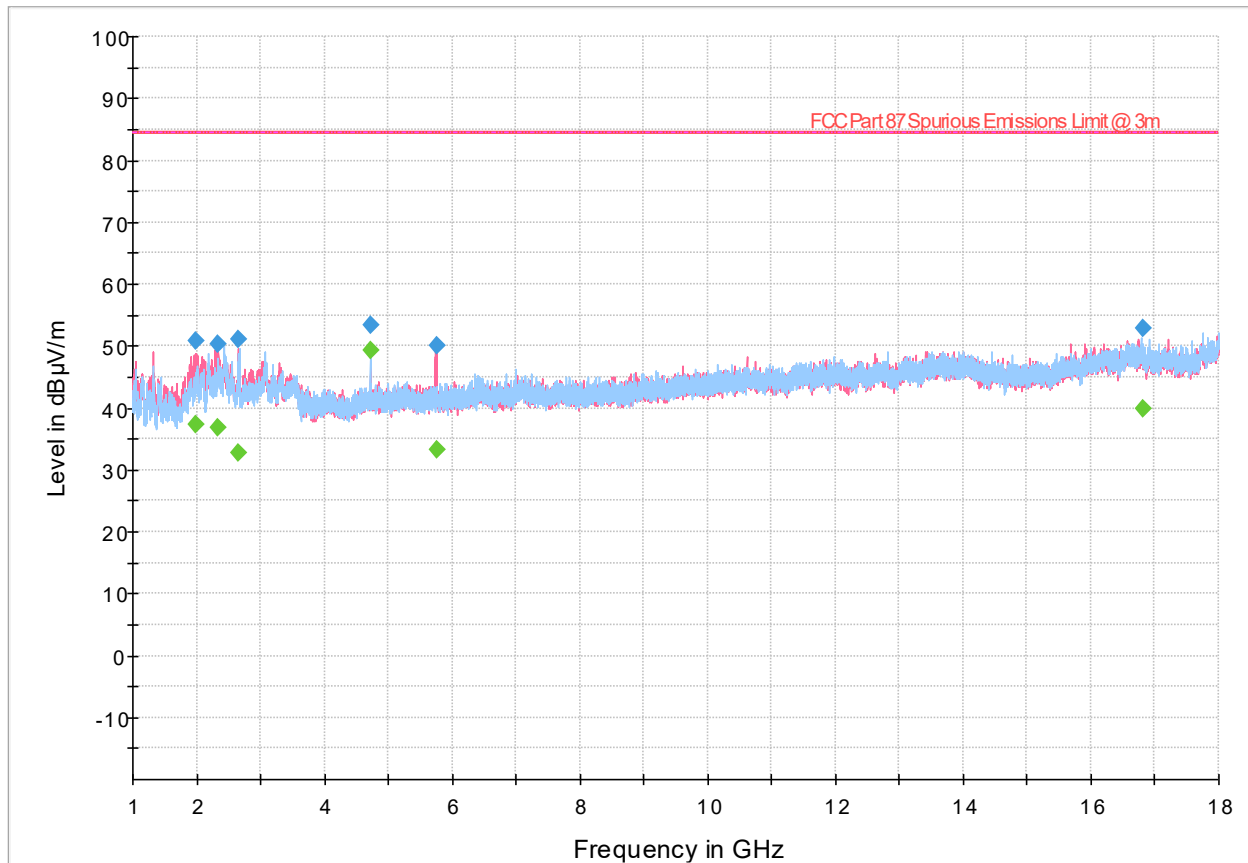


Figure 8.5-6: Radiated emissions spectral plot (1 GHz - 18 GHz) 24.61GHz High channel with 43MHz authorized Bandwidth

Table 8.5-6: Radiated emissions results

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1976.750000	50.80	---	84.40	33.60	5000.0	1000.000	98.0	V	-1.0	-6.6
1976.750000	---	37.28	84.40	47.12	5000.0	1000.000	98.0	V	-1.0	-6.6
2343.500000	50.27	---	84.40	34.13	5000.0	1000.000	112.0	V	60.0	-5.8
2343.500000	---	36.86	84.40	47.54	5000.0	1000.000	112.0	V	60.0	-5.8
2656.300000	51.06	---	84.40	33.34	5000.0	1000.000	106.0	V	112.0	-4.6
2656.300000	---	32.63	84.40	51.77	5000.0	1000.000	106.0	V	112.0	-4.6
4715.100000	53.28	---	84.40	31.12	5000.0	1000.000	98.0	H	10.0	0.4
4715.100000	---	49.33	84.40	35.07	5000.0	1000.000	98.0	H	10.0	0.4
5754.950000	---	33.30	84.40	51.10	5000.0	1000.000	194.0	V	0.0	1.8
5754.950000	50.03	---	84.40	34.37	5000.0	1000.000	194.0	V	0.0	1.8
16812.700000	---	39.85	84.40	44.55	5000.0	1000.000	350.0	H	268.0	16.6
16812.700000	52.93	---	84.40	31.47	5000.0	1000.000	350.0	H	268.0	16.6

Notes: <sup>1</sup> Field strength (dB V/m) = receiver/spectrum analyzer value (dB V) + correction factor (dB)

<sup>2</sup> Correction factors = antenna factor ACF (dB) + cable loss (dB)

<sup>3</sup> Emissions that were continuously present for a minimum of 1 second and occurred more than once for every 15 seconds observation period were considered valid emissions. The maximum value of valid emissions has been recorded.

Full Spectrum

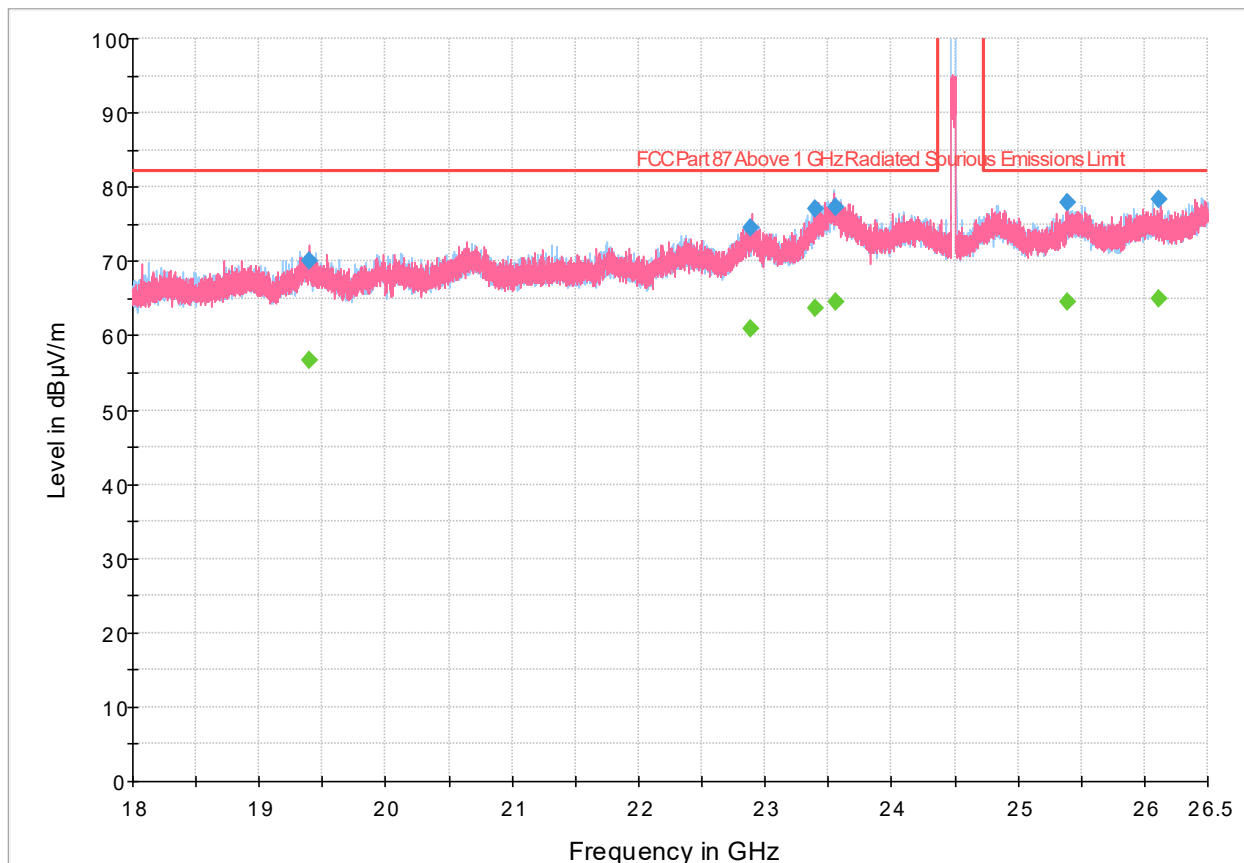


Figure 8.5-7: Radiated emissions spectral plot (18 GHz - 26.5 GHz) 24.49GHz Low channel with 43MHz authorized Bandwidth

Table 8.5-7: Radiated emissions results

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
19396.818750	69.96	---	82.23	12.27	5000.0	1000.000	137.0	V	304.0	55.8
19396.818750	---	56.78	---	---	5000.0	1000.000	137.0	V	304.0	55.8
22886.956250	74.52	---	82.23	7.71	5000.0	1000.000	222.0	V	0.0	59.2
22886.956250	---	60.96	---	---	5000.0	1000.000	222.0	V	0.0	59.2
23398.893750	---	63.60	---	---	5000.0	1000.000	124.0	V	312.0	61.9
23398.893750	77.02	---	82.23	5.21	5000.0	1000.000	124.0	V	312.0	61.9
23558.306250	77.37	---	82.23	4.86	5000.0	1000.000	304.0	H	331.0	63.2
23558.306250	---	64.51	---	---	5000.0	1000.000	304.0	H	331.0	63.2
25392.668750	77.82	---	82.23	4.41	5000.0	1000.000	397.0	V	136.0	60.8
25392.668750	---	64.58	---	---	5000.0	1000.000	397.0	V	136.0	60.8
26116.418750	---	64.91	---	---	5000.0	1000.000	370.0	H	298.0	61.6
26116.418750	78.41	---	82.23	3.82	5000.0	1000.000	370.0	H	298.0	61.6

Notes: <sup>1</sup> Field strength (dB V/m) = receiver/spectrum analyzer value (dB V) + correction factor (dB)

<sup>2</sup> Correction factors = antenna factor ACF (dB) + cable loss (dB)

<sup>3</sup> Emissions that were continuously present for a minimum of 1 second and occurred more than once for every 15 seconds observation period were considered valid emissions. The maximum value of valid emissions has been recorded.

Full Spectrum

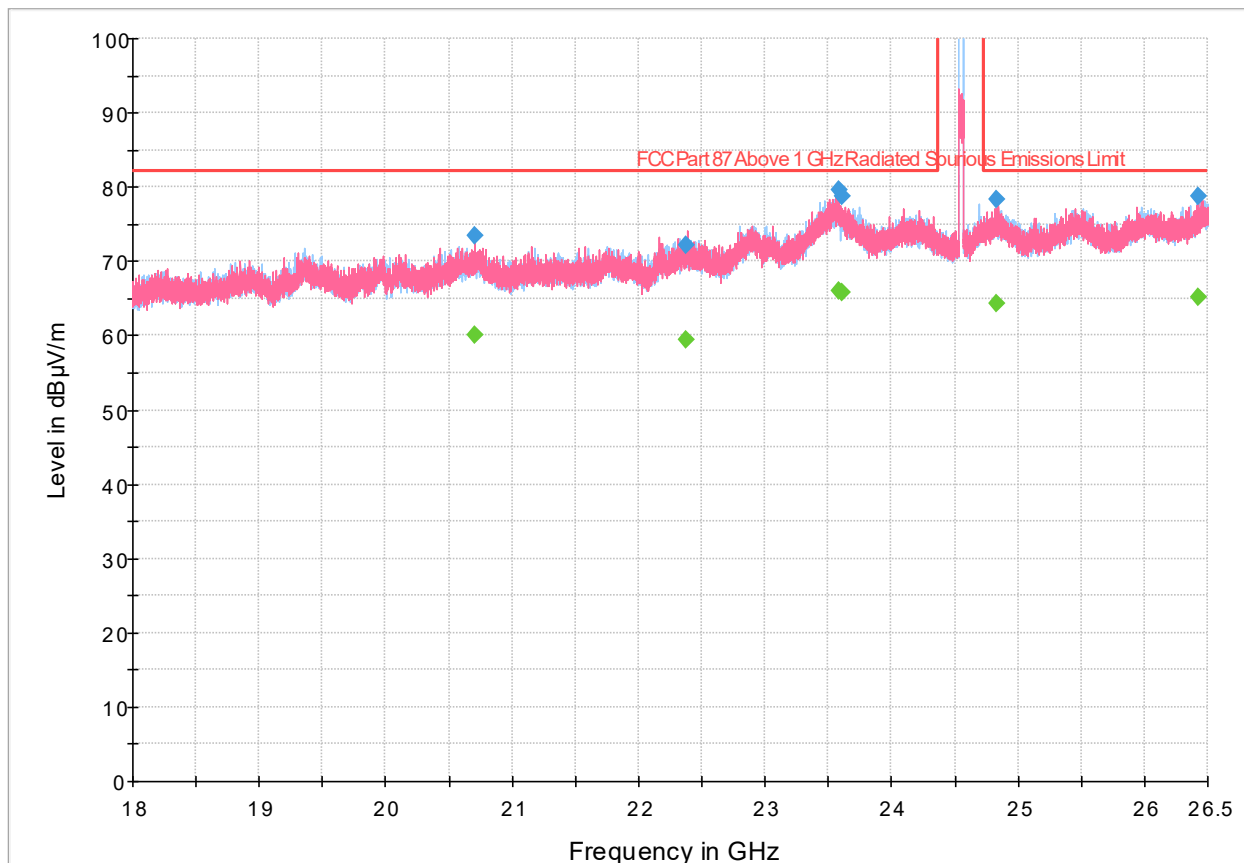


Figure 8.5-8: Radiated emissions spectral plot (18 GHz - 26.5 GHz) 24.55GHz Middle channel with 43MHz authorized Bandwidth

Table 8.5-8: Radiated emissions results

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
20708.750000	73.55	---	82.23	8.68	5000.0	1000.000	191.0	V	0.0	58.2
20708.750000	---	59.98	---	---	5000.0	1000.000	191.0	V	0.0	58.2
22380.625000	---	59.49	---	---	5000.0	1000.000	261.0	V	146.0	57.6
22380.625000	72.29	---	82.23	9.94	5000.0	1000.000	261.0	V	146.0	57.6
23577.843750	---	65.96	---	---	5000.0	1000.000	198.0	V	180.0	63.3
23577.843750	79.69	---	82.23	2.54	5000.0	1000.000	198.0	V	180.0	63.3
23603.575000	---	65.79	---	---	5000.0	1000.000	162.0	V	163.0	63.1
23603.575000	78.80	---	82.23	3.43	5000.0	1000.000	162.0	V	163.0	63.1
24829.668750	78.28	---	82.23	3.95	5000.0	1000.000	332.0	V	354.0	60.9
24829.668750	---	64.42	---	---	5000.0	1000.000	332.0	V	354.0	60.9
26430.043750	---	65.17	---	---	5000.0	1000.000	357.0	H	89.0	62.5
26430.043750	78.77	---	82.23	3.46	5000.0	1000.000	357.0	H	89.0	62.5

Notes: <sup>1</sup> Field strength (dB V/m) = receiver/spectrum analyzer value (dB V) + correction factor (dB)

<sup>2</sup> Correction factors = antenna factor ACF (dB) + cable loss (dB)

<sup>3</sup> Emissions that were continuously present for a minimum of 1 second and occurred more than once for every 15 seconds observation period were considered valid emissions. The maximum value of valid emissions has been recorded.

Full Spectrum

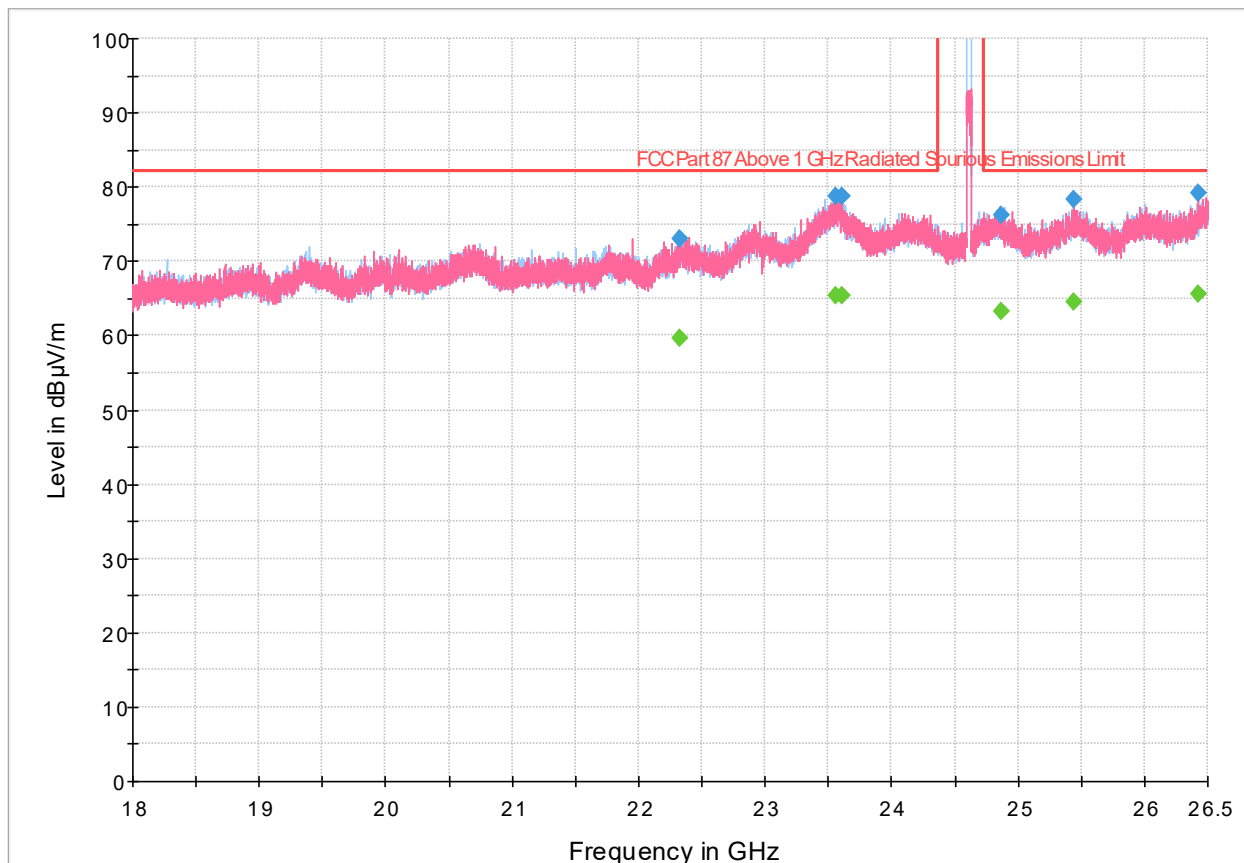


Figure 8.5-9: Radiated emissions spectral plot (18 GHz - 26.5 GHz) 24.61GHz High channel with 43MHz authorized Bandwidth

Table 8.5-9: Radiated emissions results

Frequency (MHz)	MaxPeak (dBμV/m)	CAverage (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
22324.081250	73.08	---	82.23	9.15	5000.0	1000.000	387.0	V	90.0	57.7
22324.081250	---	59.71	---	---	5000.0	1000.000	387.0	V	90.0	57.7
23557.125000	---	65.41	---	---	5000.0	1000.000	172.0	H	114.0	63.2
23557.125000	78.71	---	82.23	3.52	5000.0	1000.000	172.0	H	114.0	63.2
23611.612500	---	65.45	---	---	5000.0	1000.000	149.0	V	54.0	63.1
23611.612500	78.81	---	82.23	3.42	5000.0	1000.000	149.0	V	54.0	63.1
24861.668750	---	63.28	---	---	5000.0	1000.000	256.0	H	209.0	61.0
24861.668750	76.13	---	82.23	6.10	5000.0	1000.000	256.0	H	209.0	61.0
25439.281250	---	64.60	---	---	5000.0	1000.000	340.0	V	357.0	61.1
25439.281250	78.45	---	82.23	3.78	5000.0	1000.000	340.0	V	357.0	61.1
26419.231250	79.10	---	82.23	3.13	5000.0	1000.000	277.0	V	68.0	62.5
26419.231250	---	65.52	---	---	5000.0	1000.000	277.0	V	68.0	62.5

Notes: <sup>1</sup> Field strength (dB V/m) = receiver/spectrum analyzer value (dB V) + correction factor (dB)

<sup>2</sup> Correction factors = antenna factor ACF (dB) + cable loss (dB)

<sup>3</sup> Emissions that were continuously present for a minimum of 1 second and occurred more than once for every 15 seconds observation period were considered valid emissions. The maximum value of valid emissions has been recorded.

Full Spectrum

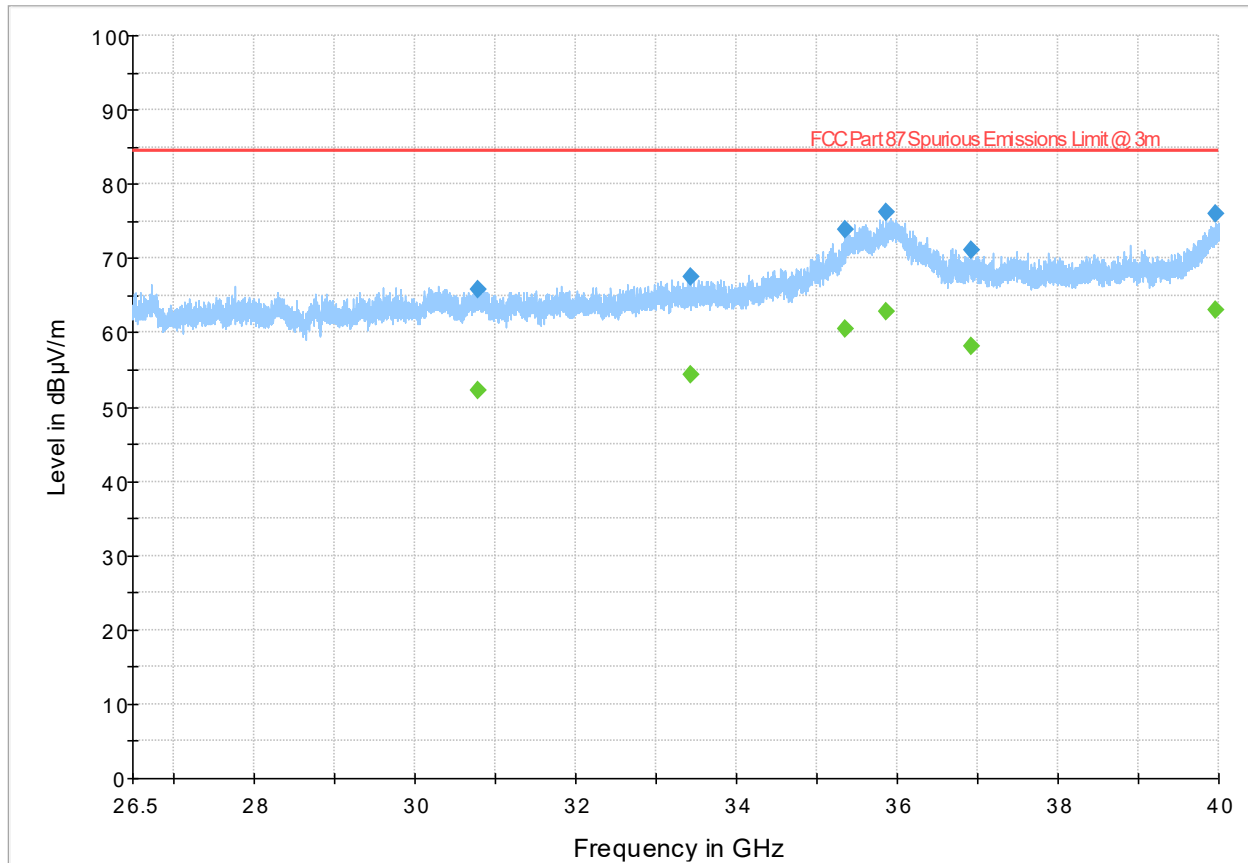


Figure 8.5-10: Radiated emissions spectral plot (26.5 GHz - 40 GHz) 24.49GHz Low channel with 43MHz authorized Bandwidth

Table 8.5-10: Radiated emissions results

Frequency (MHz)	MaxPeak (dBμV/m)	CAverage (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
30793.175000	65.86	---	84.40	18.54	5000.0	1000.000	142.0	H	189.0	48.6
30793.175000	---	52.13	---	---	5000.0	1000.000	142.0	H	189.0	48.6
33441.437500	67.42	---	84.40	16.98	5000.0	1000.000	151.0	H	174.0	48.8
33441.437500	---	54.44	---	---	5000.0	1000.000	151.0	H	174.0	48.8
35358.081250	---	60.46	---	---	5000.0	1000.000	153.0	V	38.0	54.0
35358.081250	73.96	---	84.40	10.44	5000.0	1000.000	153.0	V	38.0	54.0
35856.731250	---	62.86	---	---	5000.0	1000.000	213.0	V	224.0	56.0
35856.731250	76.13	---	84.40	8.27	5000.0	1000.000	213.0	V	224.0	56.0
36918.431250	---	58.08	---	---	5000.0	1000.000	113.0	H	300.0	51.1
36918.431250	71.15	---	84.40	13.25	5000.0	1000.000	113.0	H	300.0	51.1
39956.775000	---	63.01	---	---	5000.0	1000.000	142.0	H	226.0	53.6
39956.775000	76.10	---	84.40	8.30	5000.0	1000.000	142.0	H	226.0	53.6

Notes: <sup>1</sup> Field strength (dB V/m) = receiver/spectrum analyzer value (dB V) + correction factor (dB)

<sup>2</sup> Correction factors = antenna factor ACF (dB) + cable loss (dB)

<sup>3</sup> Emissions that were continuously present for a minimum of 1 second and occurred more than once for every 15 seconds observation period were considered valid emissions. The maximum value of valid emissions has been recorded.

Full Spectrum

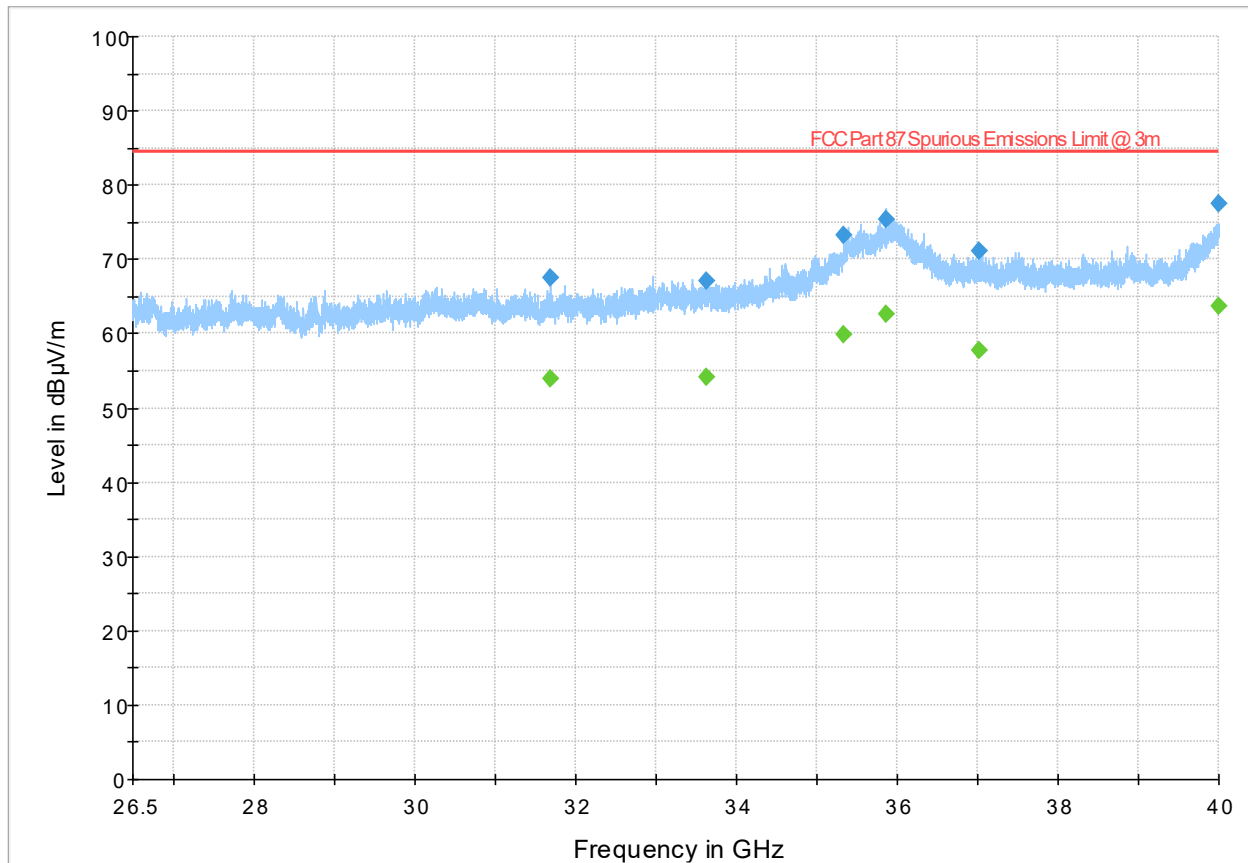


Figure 8.5-11: Radiated emissions spectral plot (26.5 GHz - 40 GHz) 24.55GHz Middle channel with 43MHz authorized Bandwidth

Table 8.5-11: Radiated emissions results

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
31684.162500	67.49	---	84.40	16.91	5000.0	1000.000	158.0	V	88.0	48.3
31684.162500	---	53.88	---	---	5000.0	1000.000	158.0	V	88.0	48.3
33638.293750	---	54.10	---	---	5000.0	1000.000	187.0	V	140.0	48.8
33638.293750	67.05	---	84.40	17.35	5000.0	1000.000	187.0	V	140.0	48.8
35336.362500	73.18	---	84.40	11.22	5000.0	1000.000	111.0	V	14.0	53.8
35336.362500	---	59.82	---	---	5000.0	1000.000	111.0	V	14.0	53.8
35865.918750	---	62.73	---	---	5000.0	1000.000	213.0	V	140.0	56.1
35865.918750	75.37	---	84.40	9.03	5000.0	1000.000	213.0	V	140.0	56.1
37016.625000	---	57.76	---	---	5000.0	1000.000	205.0	V	17.0	51.0
37016.625000	71.08	---	84.40	13.32	5000.0	1000.000	205.0	V	17.0	51.0
39995.637500	---	63.76	---	---	5000.0	1000.000	113.0	V	298.0	53.9
39995.637500	77.58	---	84.40	6.82	5000.0	1000.000	113.0	V	298.0	53.9

Notes: <sup>1</sup> Field strength (dB V/m) = receiver/spectrum analyzer value (dB V) + correction factor (dB)

<sup>2</sup> Correction factors = antenna factor ACF (dB) + cable loss (dB)

<sup>3</sup> Emissions that were continuously present for a minimum of 1 second and occurred more than once for every 15 seconds observation period were considered valid emissions. The maximum value of valid emissions has been recorded.

Full Spectrum

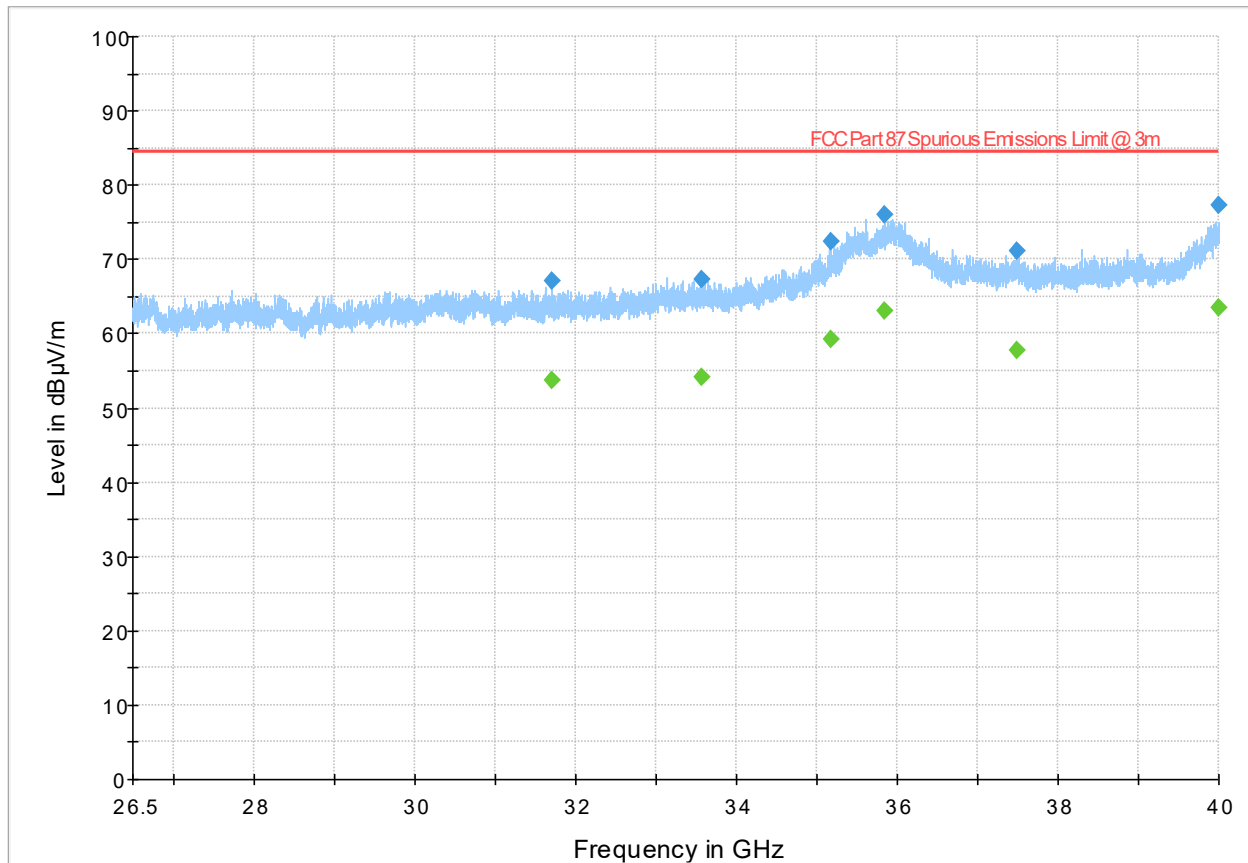


Figure 8.5-12: Radiated emissions spectral plot (26.5 GHz - 40 GHz) 24.61GHz High channel with 43MHz authorized Bandwidth

Table 8.5-12: Radiated emissions results

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
31704.012500	67.10	---	84.40	17.30	5000.0	1000.000	98.0	H	88.0	48.3
31704.012500	---	53.62	---	---	5000.0	1000.000	98.0	H	88.0	48.3
33572.918750	67.22	---	84.40	17.18	5000.0	1000.000	211.0	H	126.0	48.9
33572.918750	---	54.08	---	---	5000.0	1000.000	211.0	H	126.0	48.9
35176.843750	---	59.17	---	---	5000.0	1000.000	188.0	H	74.0	52.5
35176.843750	72.49	---	84.40	11.91	5000.0	1000.000	188.0	H	74.0	52.5
35837.943750	---	63.07	---	---	5000.0	1000.000	137.0	V	-21.0	56.0
35837.943750	76.08	---	84.40	8.32	5000.0	1000.000	137.0	V	-21.0	56.0
37488.450000	71.13	---	84.40	13.27	5000.0	1000.000	110.0	H	-1.0	50.8
37488.450000	---	57.73	---	---	5000.0	1000.000	110.0	H	-1.0	50.8
39992.262500	77.19	---	84.40	7.21	5000.0	1000.000	113.0	H	185.0	53.9
39992.262500	---	63.58	---	---	5000.0	1000.000	113.0	H	185.0	53.9

Notes: <sup>1</sup> Field strength (dB V/m) = receiver/spectrum analyzer value (dB V) + correction factor (dB)

<sup>2</sup> Correction factors = antenna factor ACF (dB) + cable loss (dB)

<sup>3</sup> Emissions that were continuously present for a minimum of 1 second and occurred more than once for every 15 seconds observation period were considered valid emissions. The maximum value of valid emissions has been recorded.

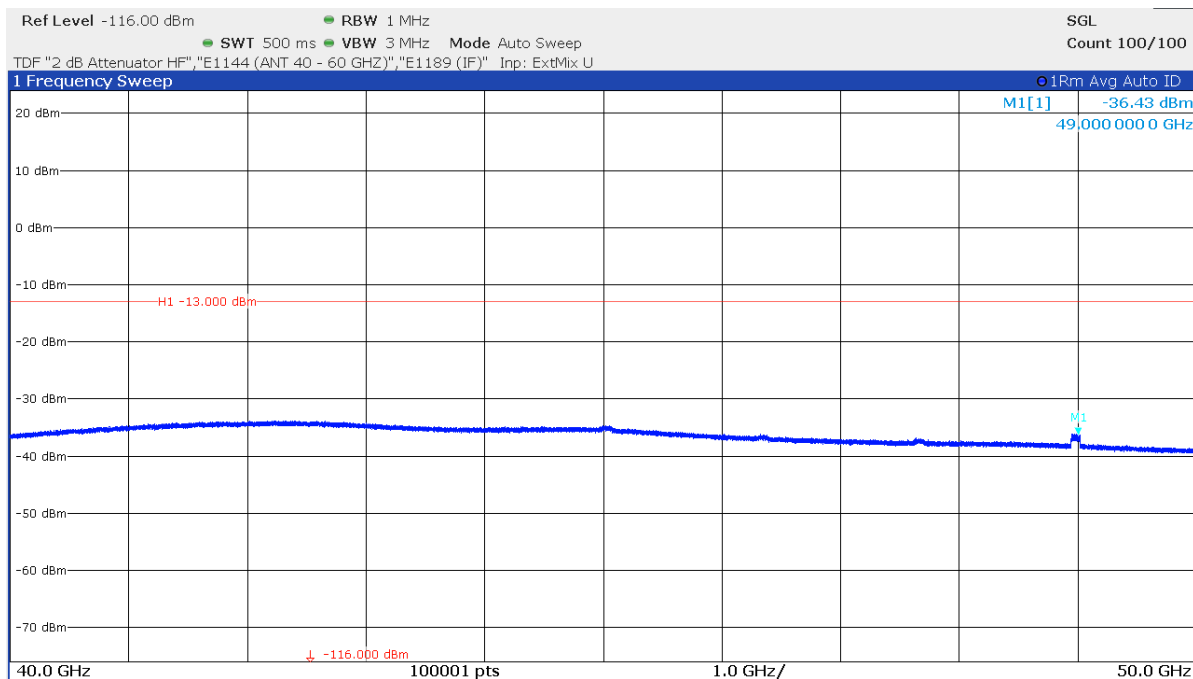


Figure 8.5-13: Unwanted emissions spurious band plot – Field strength measured, 40-50 GHz, horizontal polarization, Low channel 24.49 GHz with 43MHz authorized Bandwidth.

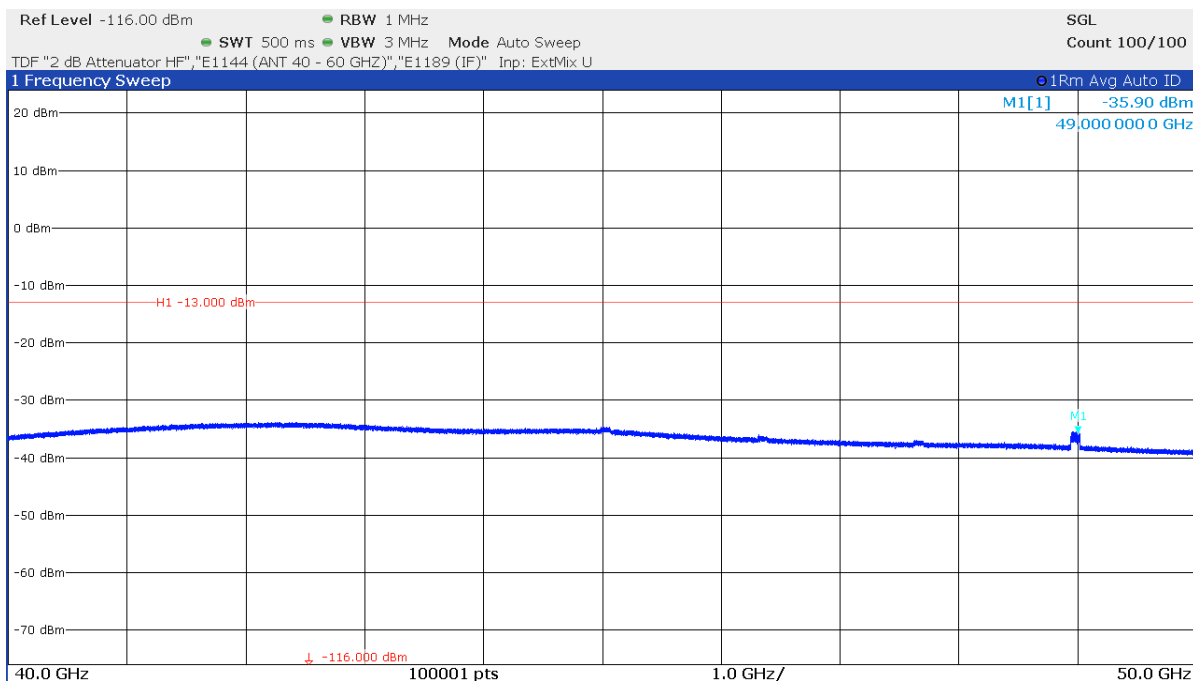


Figure 8.5-14: Unwanted emissions spurious band plot – Field strength measured, 40-50 GHz, vertical polarization, Low channel 24.49 GHz with 43MHz authorized Bandwidth.

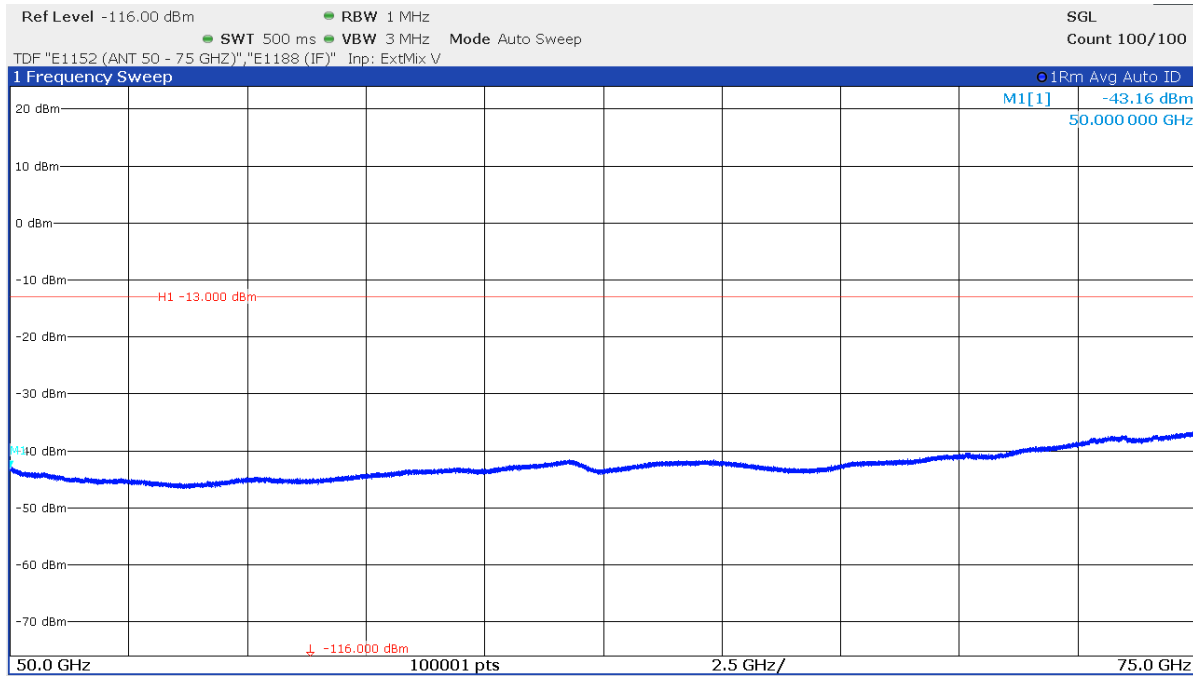


Figure 8.5-15: Unwanted emissions spurious band plot – Field strength measured 50-75 GHz, horizontal polarization, Low channel 24.49 GHz with 43MHz authorized Bandwidth.

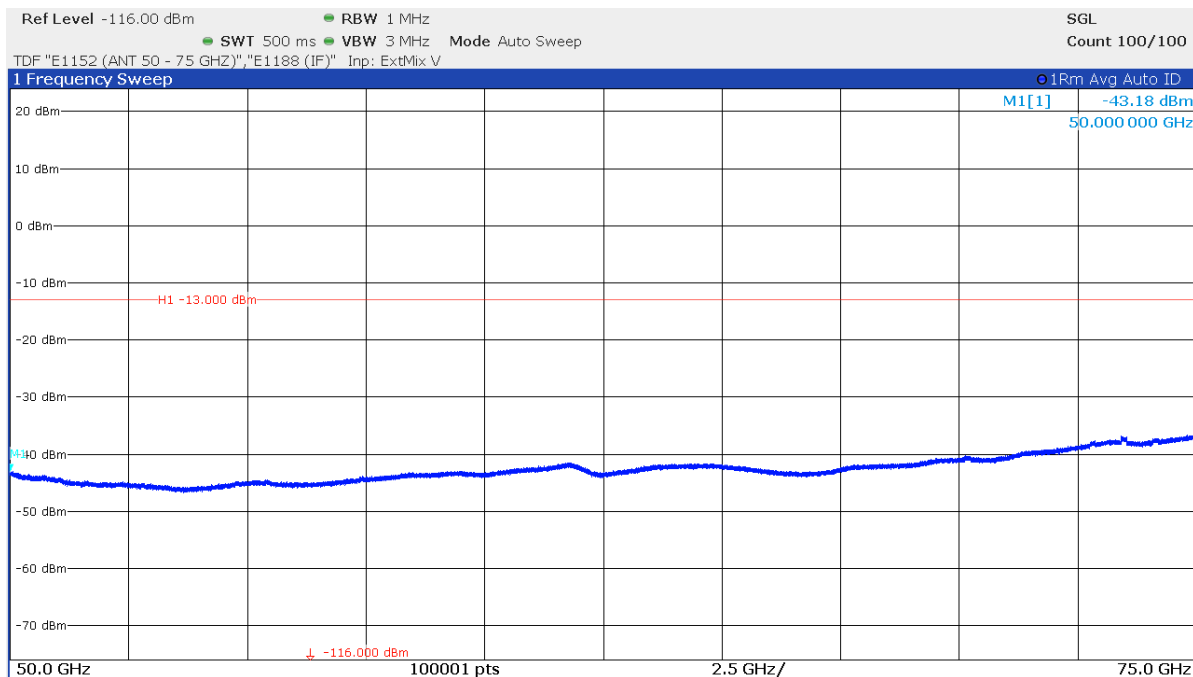


Figure 8.5-16: Unwanted emissions spurious band plot – Field strength measured 50-75 GHz, vertical polarization, Low channel 24.49 GHz with 43MHz authorized Bandwidth.

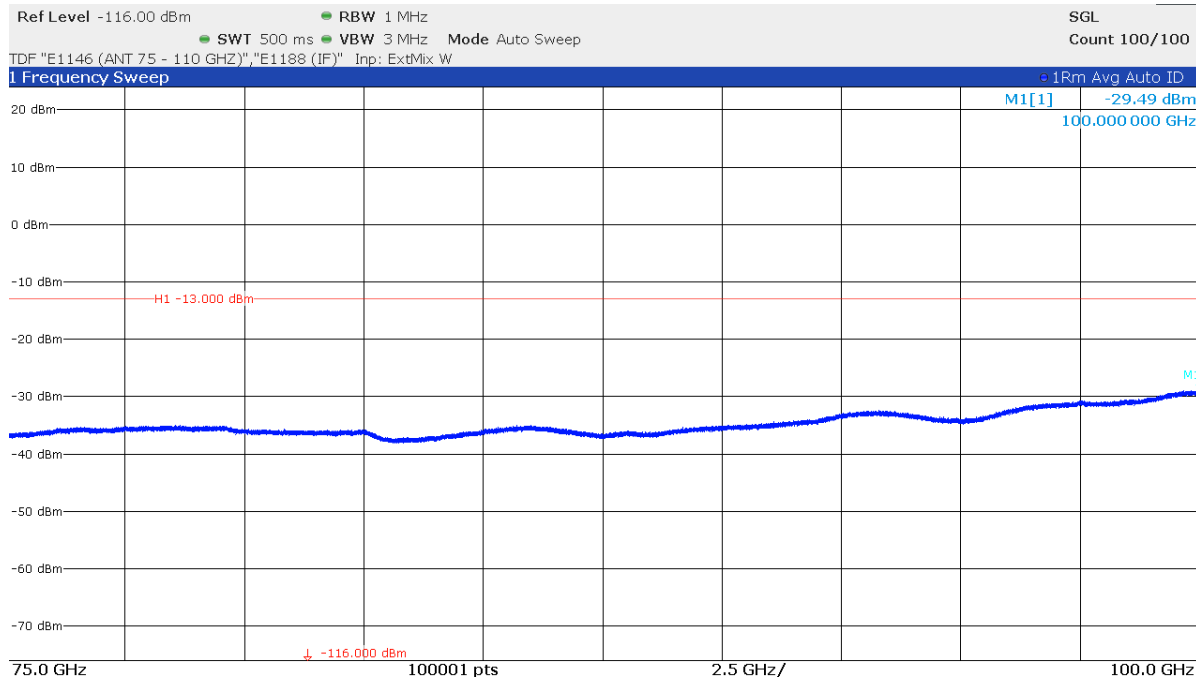


Figure 8.5-17: Unwanted emissions spurious band plot – Field strength measured 75-100 GHz, horizontal polarization, Low channel 24.49 GHz with 43MHz authorized Bandwidth.

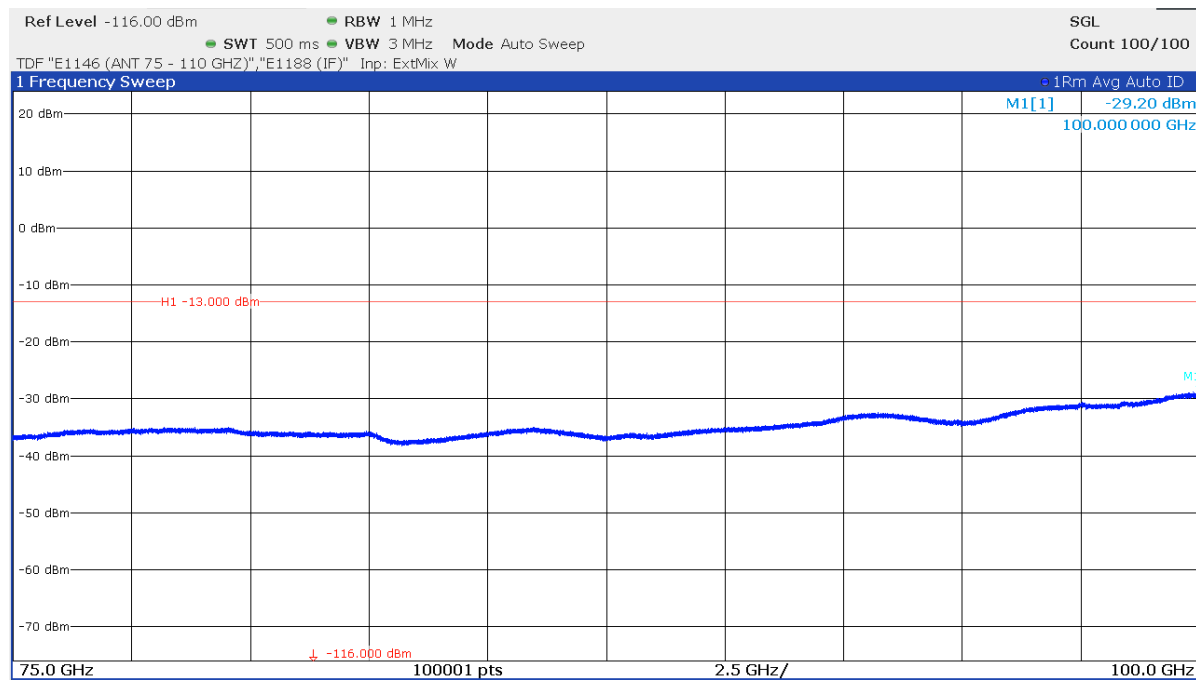


Figure 8.5-18: Unwanted emissions spurious band plot – Field strength measured 75-100 GHz, vertical polarization, Low channel 24.49 GHz with 43MHz authorized Bandwidth.

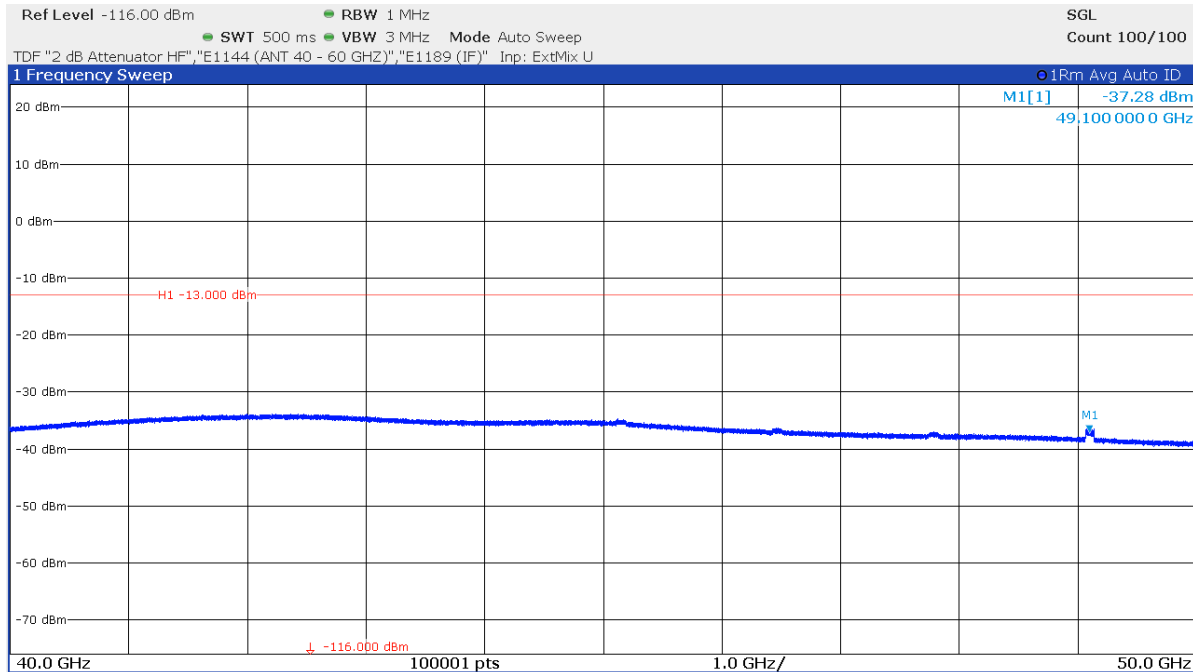


Figure 8.5-19: Unwanted emissions spurious band plot – Field strength measured, 40 -50 GHz, horizontal polarization, Middle channel 24.55 GHz with 43MHz authorized Bandwidth.

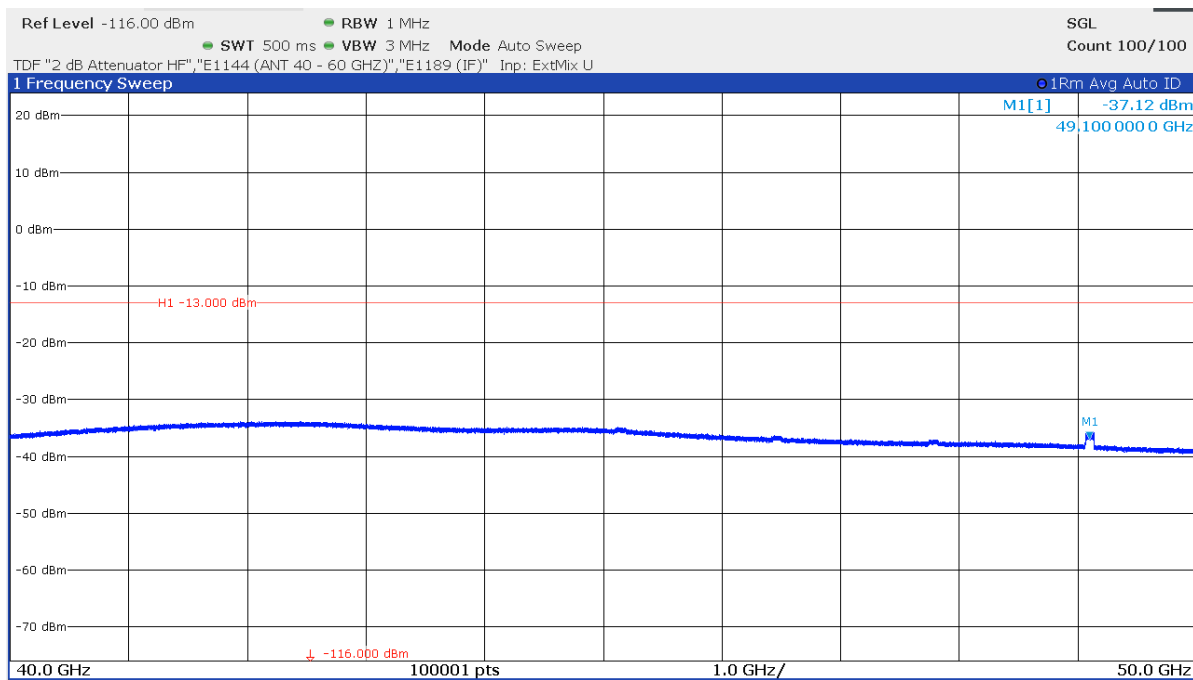


Figure 8.5-20: Unwanted emissions spurious band plot – Field strength measured, 40-50 GHz, vertical polarization, Middle channel 24.55 GHz with 43MHz authorized Bandwidth.

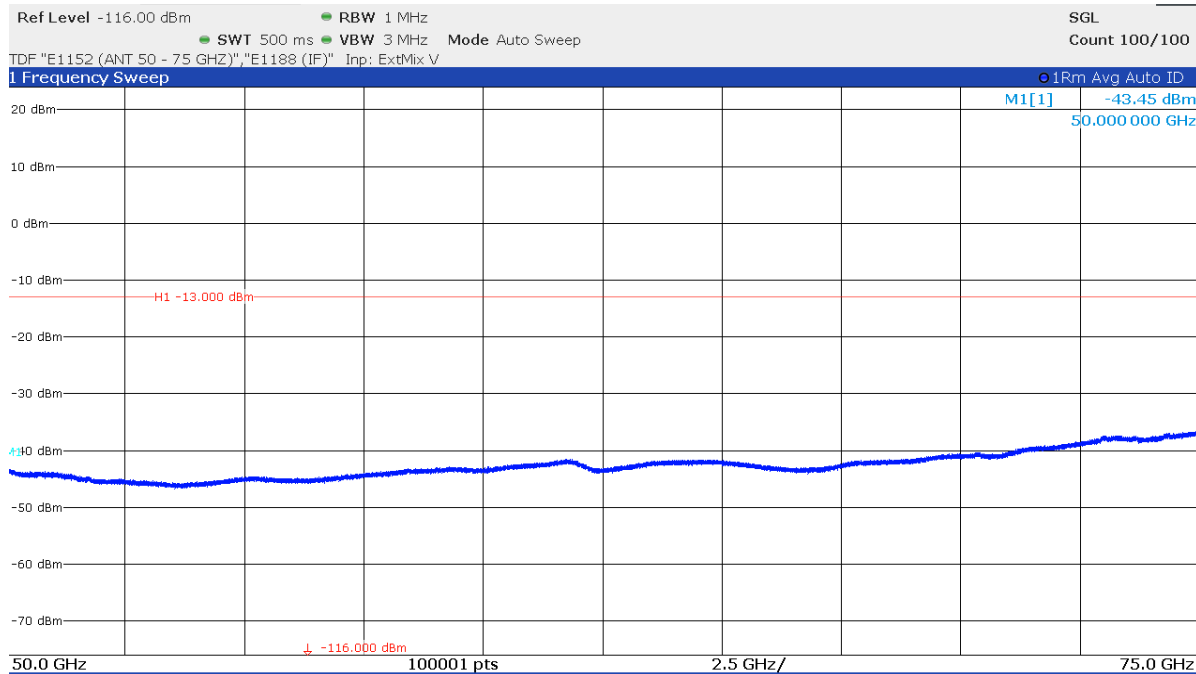


Figure 8.5-21: Unwanted emissions spurious band plot – Field strength measured 50-75 GHz, horizontal polarization, Middle channel 24.55 GHz with 43MHz authorized Bandwidth.

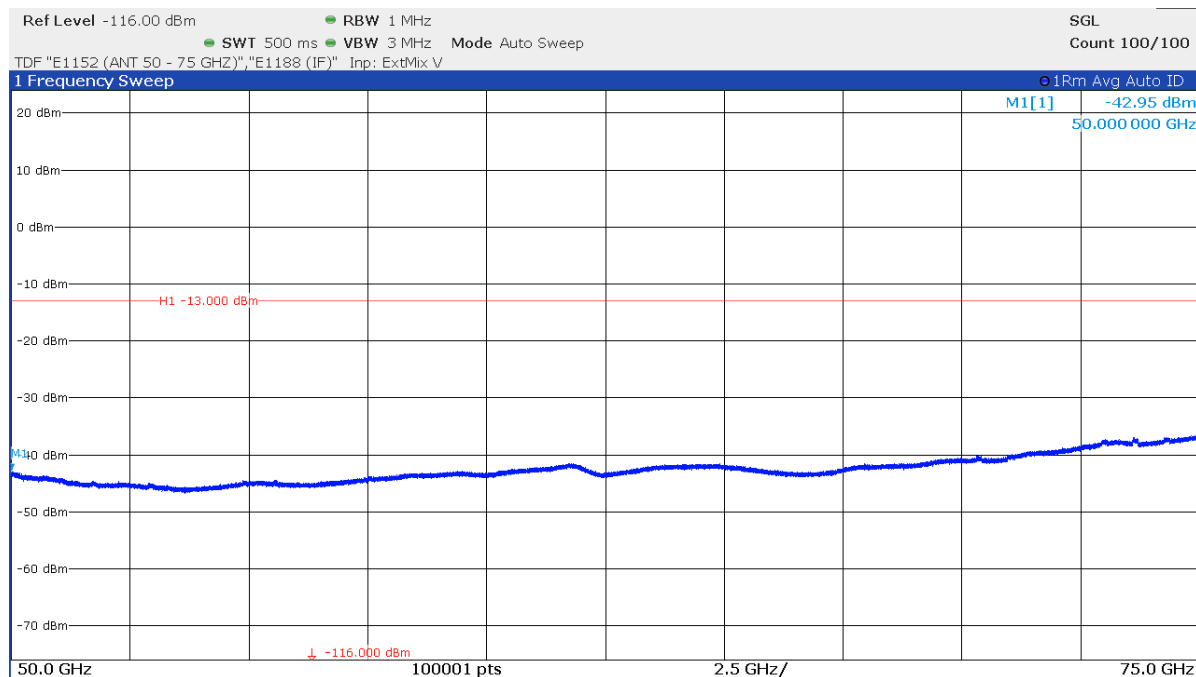


Figure 8.5-22: Unwanted emissions spurious band plot – Field strength measured 50-75 GHz, vertical polarization, Middle channel 24.55 GHz with 43MHz authorized Bandwidth.

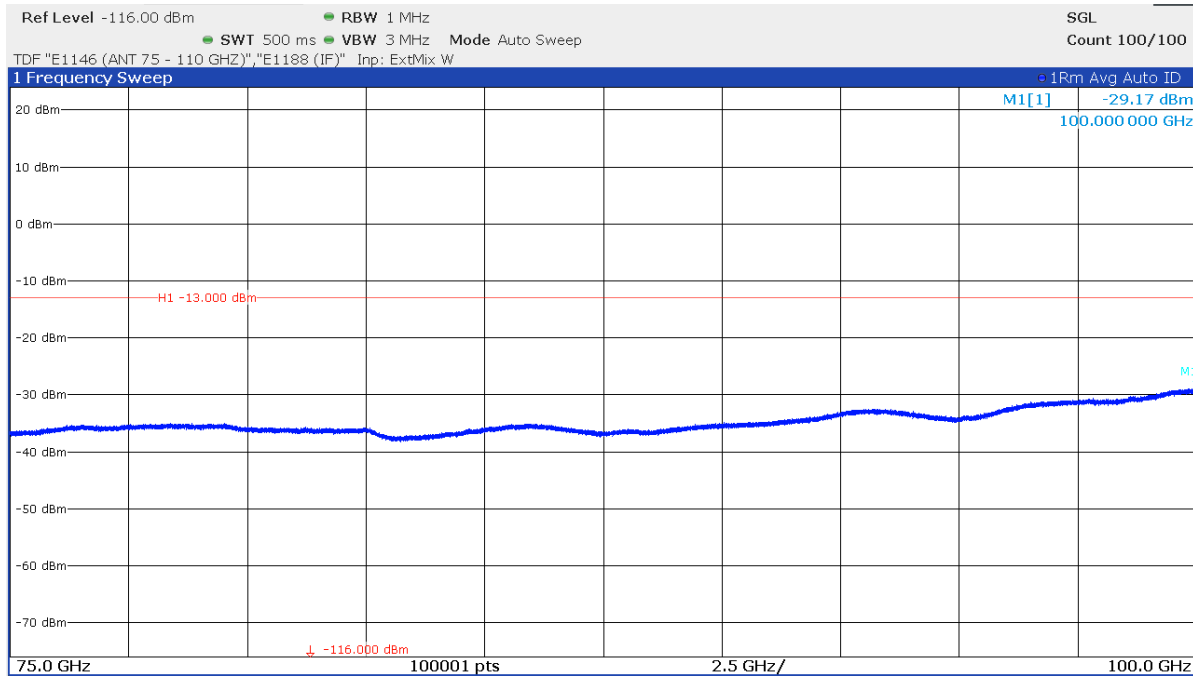


Figure 8.5-23: Unwanted emissions spurious band plot – Field strength measured 75-100 GHz, horizontal polarization, Middle channel 24.55 GHz with 43MHz authorized Bandwidth.

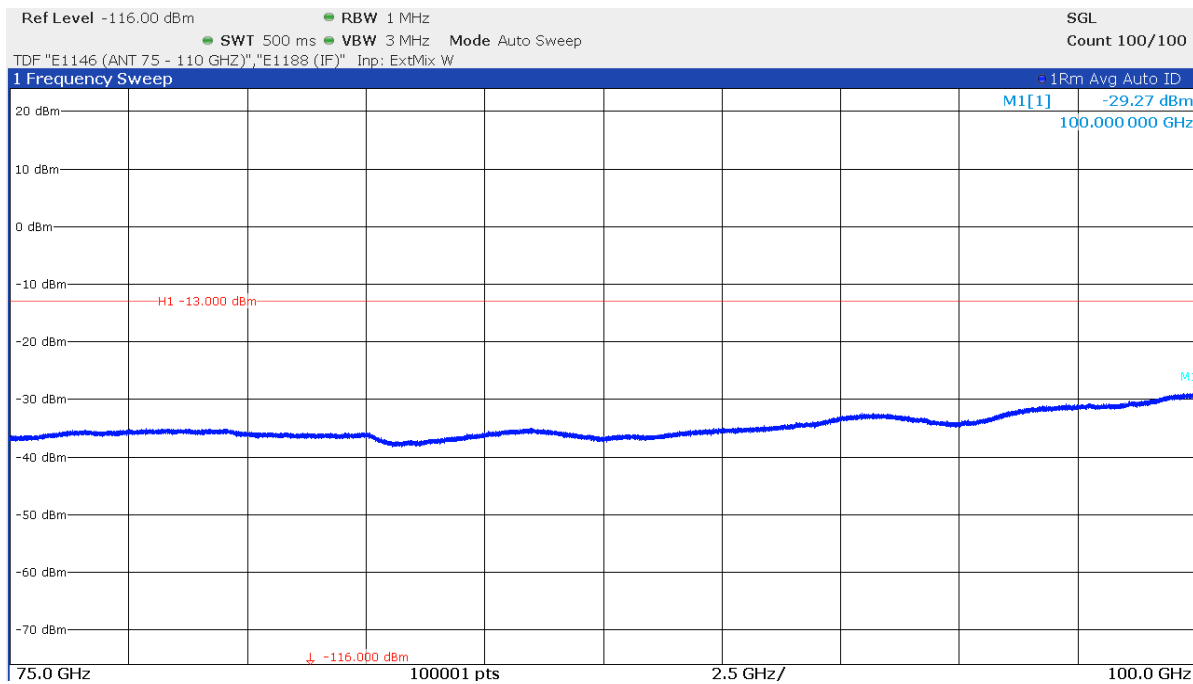


Figure 8.5-24: Unwanted emissions spurious band plot – Field strength measured 75-100 GHz, vertical polarization, Middle channel 24.55 GHz with 43MHz authorized Bandwidth.

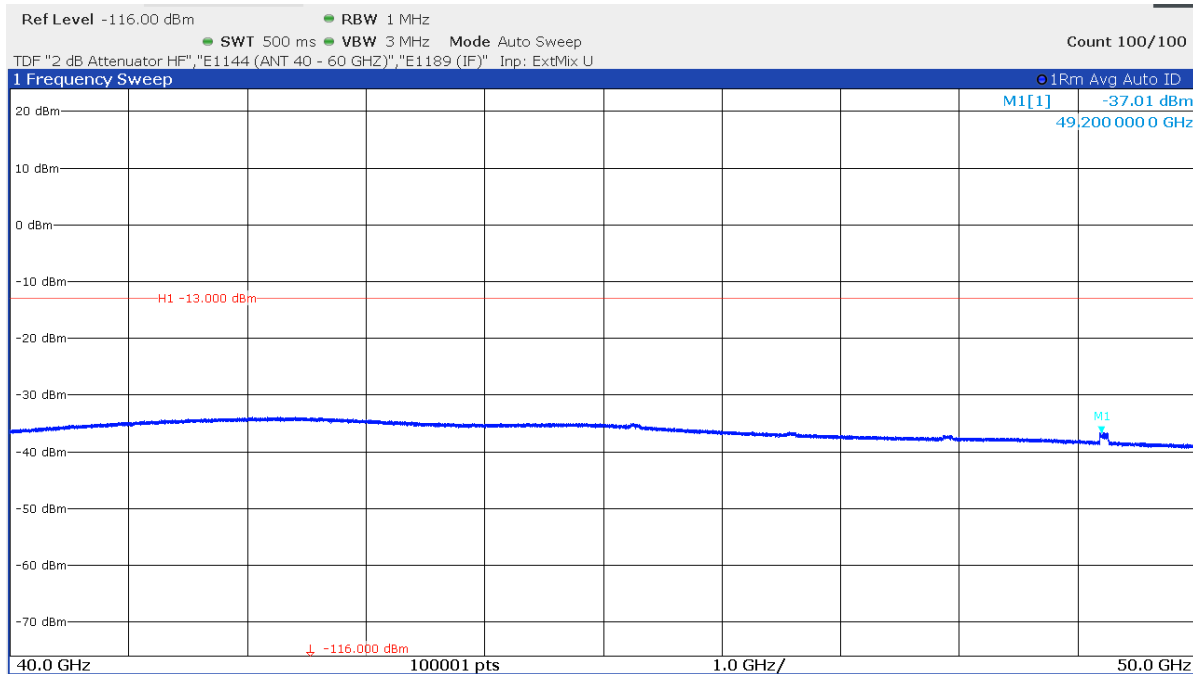


Figure 8.5-25: Unwanted emissions spurious band plot – Field strength measured, 40 -50 GHz, horizontal polarization, High channel 24.61 GHz with 43MHz authorized Bandwidth.

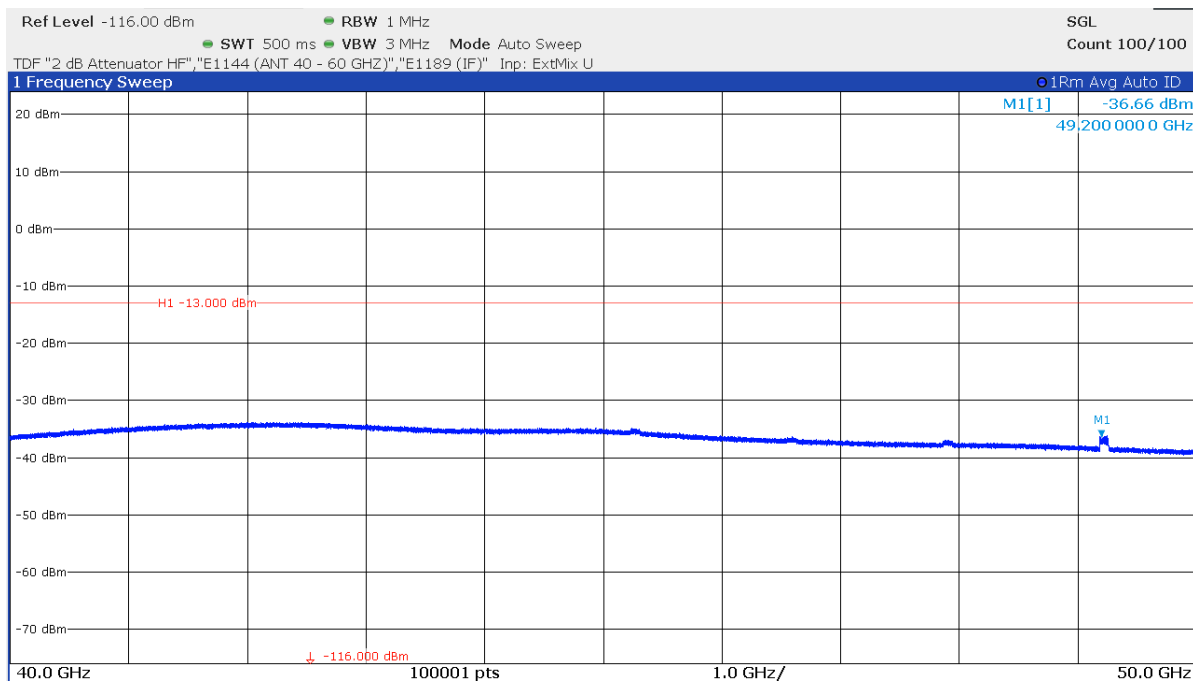


Figure 8.5-26: Unwanted emissions spurious band plot – Field strength measured, 40-50 GHz, vertical polarization, High channel 24.61 GHz with 43MHz authorized Bandwidth.

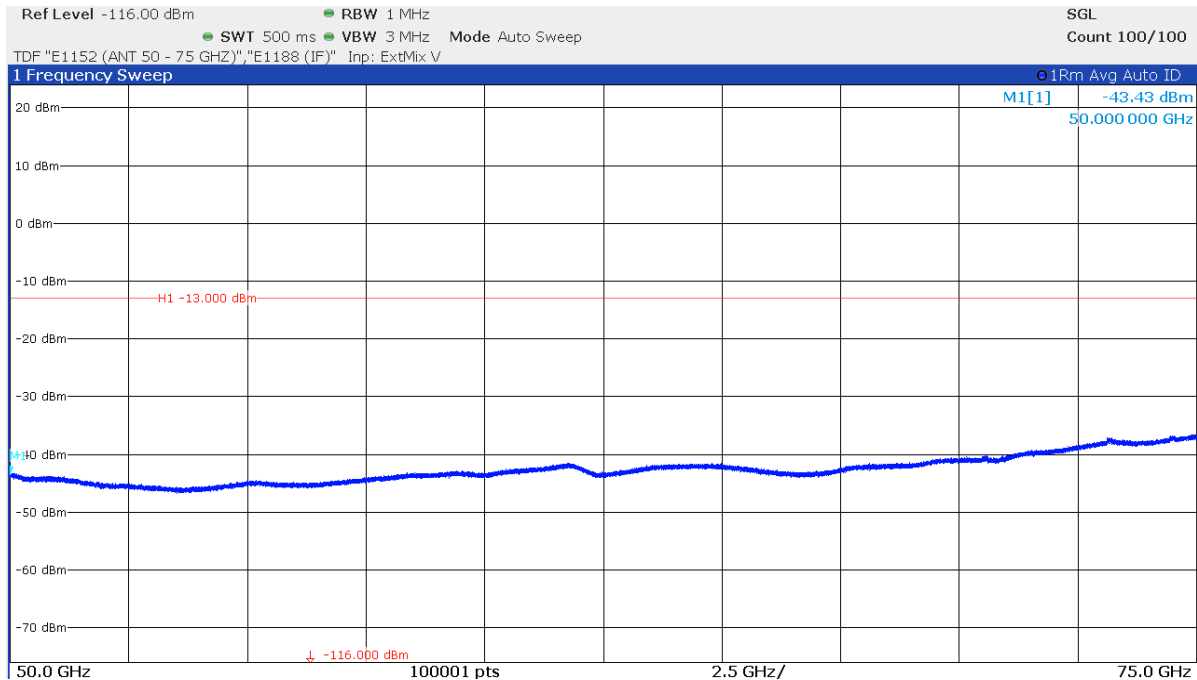


Figure 8.5-27: Unwanted emissions spurious band plot – Field strength measured 50-75 GHz, horizontal polarization, High channel 24.61 GHz with 43MHz authorized Bandwidth.

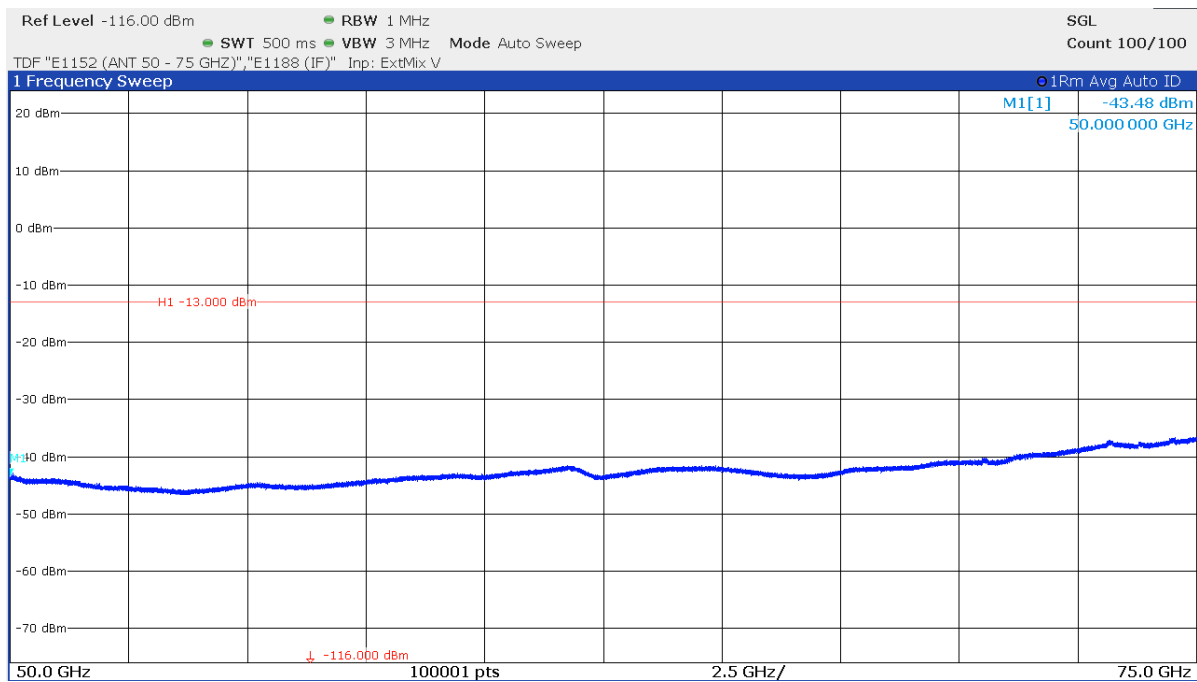


Figure 8.5-28: Unwanted emissions spurious band plot – Field strength measured 50-75 GHz, vertical polarization, High channel 24.61 GHz with 43MHz authorized Bandwidth.

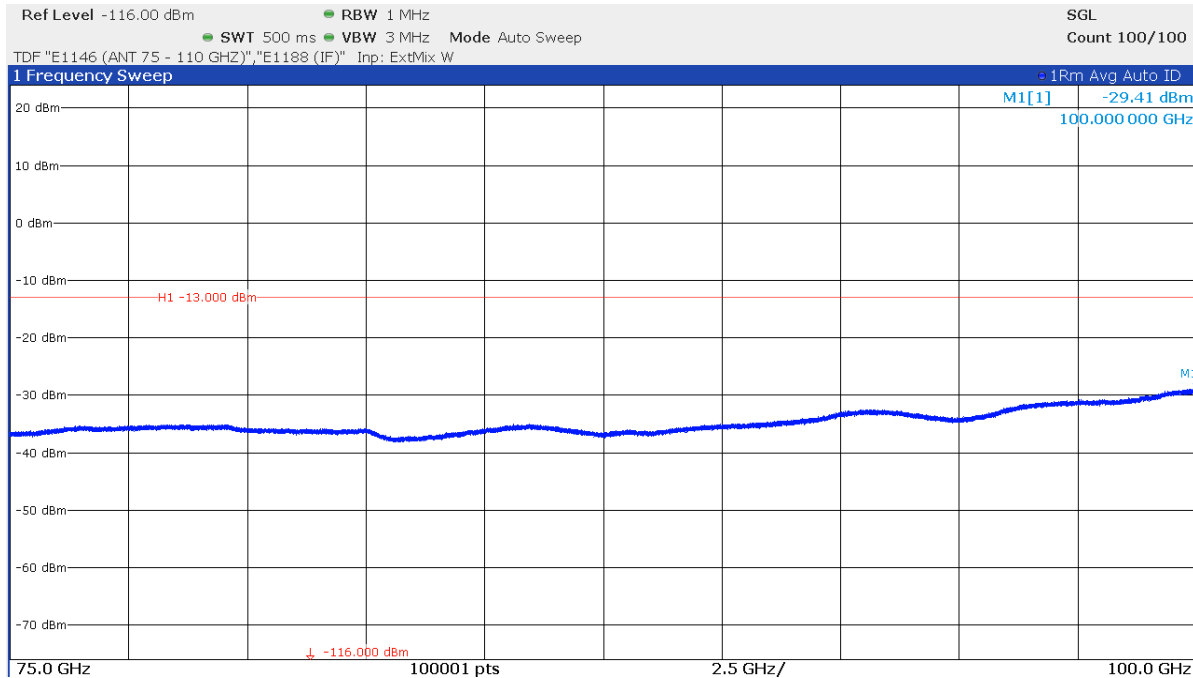


Figure 8.5-29: Unwanted emissions spurious band plot – Field strength measured 75-100 GHz, horizontal polarization, High channel 24.61 GHz with 43MHz authorized Bandwidth.

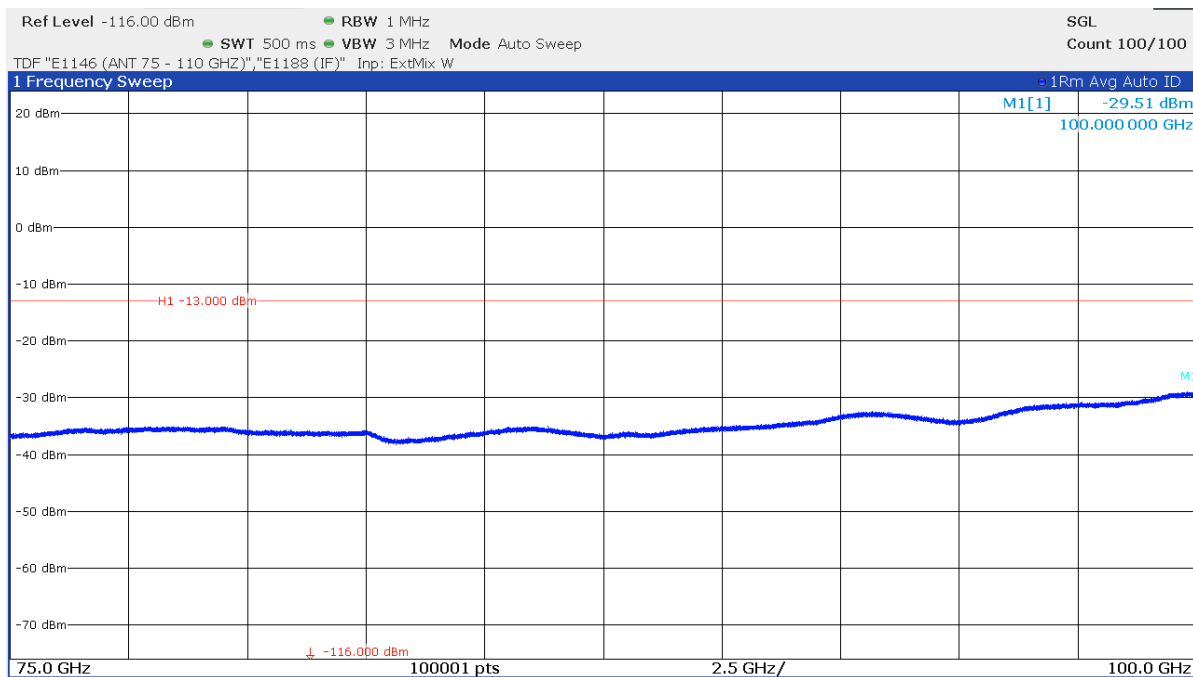


Figure 8.5-30: Unwanted emissions spurious band plot – Field strength measured 75-100 GHz, vertical polarization, High channel 24.61 GHz with 43MHz authorized Bandwidth.

## 8.6 Frequency stability

### 8.6.1 References and limits

- FCC 47 CFR Part 87: §87.133
- Test method: ANSI C63.26 (5.6.3)
  - (a) Except as provided in paragraphs (c), (d), (f), and (g) of this section, the carrier frequency of each station must be maintained within these tolerances:

Frequency band (lower limit exclusive, upper limit inclusive), and categories of stations	Tolerance <sup>1</sup>	Tolerance <sup>2</sup>
Radionavigation stations	5000	5000

### 8.6.2 Test summary

Verdict	Pass		
Test date	August 31, 2023	Temperature	20°C
Test engineer	Chenhao Ma, Wireless Test Technician	Air pressure	1007mbar
Test location	<input type="checkbox"/> Wireless bench <input type="checkbox"/> 10 m semi-anechoic chamber <input type="checkbox"/> 3 m semi-anechoic chamber <input checked="" type="checkbox"/> Other: Environmental chamber	Relative humidity	53 %

### 8.6.3 Notes

Testing was performed with the transmitter operating on a fixed channel at full power. An unmodulated signal with a frequency center in the middle channel was selected for this test (24.55 GHz).  
 For this test Radar commanded using special engineering sequence to force it to stop sweeping and go into RF CW mode at 24.55GHz mid-channel to facilitate frequency stability measurements accurately. These commands are not available to users.

### 8.6.4 Setup details

EUT power input during test	5 VDC via AC/DC adaptor
EUT setup configuration	<div><input type="checkbox"/> Table-top</div> <div><input type="checkbox"/> Floor standing</div> <div><input checked="" type="checkbox"/> Other: Mounted on a fixture provided by client</div>

Spectrum analyzer settings:

Resolution bandwidth	30 kHz
Video bandwidth	3 MHz
Detector mode	Peak
Trace mode	Max Hold

8.6.5 Test data

**Table 8.6-1:** Frequency stability results.

Voltage	Temperature	Channel frequency (Hz)	Measured frequency (Hz)	ppm	Limit (ppm)	Result
120V	-40°C	24550000000	24550000000	0	5000	Pass
120V	-30°C	24550000000	24549930000	2.851	5000	Pass
120V	-20°C	24550000000	24550170000	6.924	5000	Pass
120V	-10°C	24550000000	24550170000	6.924	5000	Pass
120V	0°C	24550000000	24549830000	6.924	5000	Pass
120V	+10°C	24550000000	24550085000	3.462	5000	Pass
120V	+20°C	24550000000	24549915000	3.462	5000	Pass
138V	+20°C	24550000000	24550000000	0	5000	Pass
102V	+20°C	24550000000	24550000000	0	5000	Pass
120V	+30°C	24550000000	24549830000	6.924	5000	Pass
120V	+40°C	24550000000	24549915000	3.462	5000	Pass
120V	+50°C	24550000000	24550000000	0	5000	Pass

End of test report