TEST REPORT

Testing laboratory:

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Test Report Number: SKT-RFC-230001

Date of issue: January 31, 2023

Applicant:	**Intellian Technologies, Inc.** 18-7, Jinwisandan-ro, Jinwi-myeon (Chungho-ri) Pyeongtaek-si, Gyeonggi-do, 17709 Korea
Manufacturer:	**Intellian Technologies, Inc.** 18-7, Jinwisandan-ro, Jinwi-myeon (Chungho-ri) Pyeongtaek-si, Gyeonggi-do, 17709 Korea
Product:	OW70L
Model:	PS-OW70P
FCC ID:	XXZ-INTOW70L
Project number:	SKTEU22-1253
EUT received:	September 21, 2022
Applied standards:	ANSI C63.26-2015 ANSI C63.4-2014 and ANSI C63.4a-2017
Rule parts:	FCC 47 CFR Part 2, Part 25
Equipment Class:	**TNB: Licensed Non-Broadcast Station Transmitter**
Remarks to the standards:	None

The above equipment has been tested by SK Tech Co., Ltd., and found compliance with the requirements set forth in the technical standards mentioned above. The results of testing in this report apply only to the product or system, which was tested.

Changwon Yang / **Testing Engineer**

Jongsoo Yoon / **Technical Manager**

Revision History of Test Report

Rev.	Revisions	Effect page	Approved by	Date
-	Initial issue	All	Jongsoo Yoon	Jan. 31, 2023

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1 Summary of test results

Requirement	FCC, CFR 47 Section	Result
RF power output / Power limits / Off-Axis EIRP Spectral Density	§2.1046, 25.204(a), 25.218	Meets the requirements
Occupied bandwidth	§2.1049	Meets the requirements
Spurious emissions at antenna terminals (conducted emissions)	§2.1051, 25.202(f)	Meets the requirements
Field strength of spurious radiation (radiated emissions)	§2.1053, 25.202(f)	Meets the requirements
Transmitter frequency stability / Frequency tolerances	§2.1055, 25.202(d)	Meets the requirements

Note: -

2 Description of equipment under test (EUT)

Product:	OW70L
Model:	PS-OW70P
Serial number:	None (prototype)
Hardware version:	prototype
Software version:	prototype

Model differences:

Model name	Difference	Tested (checked)
PS-OW70P	fully tested model that was provided by the applicant.	☒

Technical data:

Transmit frequency	TX: 14.0 GHz to 14.5 GHz RX: 10.7 GHz to 12.7 GHz
Nominal EIRP	33.6 dBW / 19.8 MHz (single carrier) 36.6 dBW / 39.6 MHz (dual carrier)
Nominal antenna gain	39.0 dBi
Authorized bandwidth	19.8 MHz / 39.6 MHz
Number of channels	Single carrier (Bandwidth 19.8 MHz): 24 Dual carrier (Bandwidth 39.6 MHz): 20
Type of modulation	TX: QPSK, 8PSK, 16QAM RX: QPSK, 8PSK, 16APSK
Type of radio transmission:	FDMA
Transmitter output power (conducted)	24.6 dBm (average power; single carrier) 27.6 dBm (average power; dual carrier)
Transmitter output power (radiated)	63.6 dBm (2290.9 W) (single carrier) 66.6 dBm (4570.9 W) (dual carrier) (calculated value with antenna gain)
Maximum occupied bandwidth	17.2 MHz / 37.3 MHz
Emission designator	17M2G7W, 37M3G7W, 17M2D7W, 37M3D7W
Antenna type	Parabolic antenna
Power source	AC 100 V to 240 V (DC 56 V for Customer Network Exchange)
Operation temperature range	-25 °C to +55 °C

Note:

I/O port	Type	Q'ty	Remark
EUT, Primary Antenna Unit			
Power & Data connector	F-type Connector (for Power + Data)	1	
RX	N-type Connector (for Rx + Power)	1	
TX	N-type Connector	1	
ETH	RJ-45 (for Ethernet)	1	
SIG	RJ-45 (for Control Signal)	1	
EUT, Secondary Antenna Unit			
MNT	RJ-45	1	
RX	N-type Connector (for Rx + Power)	1	
TX	N-type Connector	1	
ETH	RJ-45 (for Ethernet)	1	
SIG	RJ-45 (for Control Signal)	1	
EUT, Customer Network Exchange (CNX)			
LAN1	RJ-45 (To access to OneWeb services)	1	
SAT	F-type Connector (for Power + Data)	1	
POWER	6 Contact Power Plug	1	

Modification of EUT during the compliance testing: none

3 Test and measurement conditions

3.1. Operating modes

Operating modes of the sample:

<table>
<tr><th>No.</th><th>Description</th></tr>
<tr><td>-</td><td>Normal operating mode: the product can support the following channel plan.
<table>
<tr><th rowspan="2">Channel number</th><th rowspan="2">Carriers</th><th rowspan="2">Input IF Frequency (MHz)</th><th rowspan="2">LO (GHz)</th><th colspan="2">RF Output Frequency (MHz)</th></tr>
<tr><th>Bandwidth 19.8 MHz</th><th>Bandwidth 39.6 MHz</th></tr>
<tr><td rowspan="6">1</td><td>1</td><td>4 063.0</td><td rowspan="6">9.950</td><td>14 013.0</td><td>14 022.9</td></tr>
<tr><td>2</td><td>4 082.8</td><td>14 032.8</td><td>14 042.7</td></tr>
<tr><td>3</td><td>4 102.6</td><td>14 052.6</td><td>14 062.5</td></tr>
<tr><td>4</td><td>4 122.4</td><td>14 072.4</td><td>14 082.3</td></tr>
<tr><td>5</td><td>4 142.2</td><td>14 092.2</td><td>14 102.1</td></tr>
<tr><td>6</td><td>4 162.0</td><td>14 112.0</td><td>-</td></tr>
<tr><td rowspan="6">2</td><td>1</td><td>4 063.0</td><td rowspan="6">10.075</td><td>14 138.0</td><td>14 147.9</td></tr>
<tr><td>2</td><td>4 082.8</td><td>14 157.8</td><td>14 167.7</td></tr>
<tr><td>3</td><td>4 102.6</td><td>14 177.6</td><td>14 187.5</td></tr>
<tr><td>4</td><td>4 122.4</td><td>14 197.4</td><td>14 207.3</td></tr>
<tr><td>5</td><td>4 142.2</td><td>14 217.2</td><td>14 227.1</td></tr>
<tr><td>6</td><td>4 162.0</td><td>14 237.0</td><td>-</td></tr>
<tr><td rowspan="6">3</td><td>1</td><td>4 063.0</td><td rowspan="6">10.200</td><td>14 263.0</td><td>14 272.9</td></tr>
<tr><td>2</td><td>4 082.8</td><td>14 282.8</td><td>14 292.7</td></tr>
<tr><td>3</td><td>4 102.6</td><td>14 302.6</td><td>14 312.5</td></tr>
<tr><td>4</td><td>4 122.4</td><td>14 322.4</td><td>14 332.3</td></tr>
<tr><td>5</td><td>4 142.2</td><td>14 342.2</td><td>14 352.1</td></tr>
<tr><td>6</td><td>4 162.0</td><td>14 362.0</td><td>-</td></tr>
<tr><td rowspan="6">4</td><td>1</td><td>4 063.0</td><td rowspan="6">10.325</td><td>14 388.0</td><td>14 397.9</td></tr>
<tr><td>2</td><td>4 082.8</td><td>14 407.8</td><td>14 417.7</td></tr>
<tr><td>3</td><td>4 102.6</td><td>14 427.6</td><td>14 437.5</td></tr>
<tr><td>4</td><td>4 122.4</td><td>14 447.4</td><td>14 457.3</td></tr>
<tr><td>5</td><td>4 142.2</td><td>14 467.2</td><td>14 477.1</td></tr>
<tr><td>6</td><td>4 162.0</td><td>14 487.0</td><td>-</td></tr>
</table></td></tr>
</table>

Operating modes used for the Test:

No.	Operating mode
1	(a) The EUT was operated in the special Test mode, continuously transmitting the modulated RF signals without an off-time interval. The tests were performed regardless of the burst duration. (b) The tests were performed for each Bandwidth and Modulation at the following frequencies: TX single carrier (19.8 MHz BW) fLOW 14.013 GHz Channel number 1 + Carrier 1 fMID 14.263 GHz Channel number 3 + Carrier 1 fHIGH 14.487 GHz Channel number 4 + Carrier 6 TX dual carrier (39.6 MHz BW) fLOW 14.022 9 GHz Channel number 1 + Carrier (1+2) fMID 14.272 9 GHz Channel number 3 + Carrier (1+2) fHIGH 14.477 1 GHz Channel number 4 + Carrier (5+6)
2	CW carrier activated for the measurement of frequency stability

3.2. Description of support units (accessory equipment)

The following support units or accessories were used to form a representative test configuration during the tests.

#	Equipment	Manufacturer	Model No.	Serial No.
1	Notebook	HP	HSN-I26C	-
2	Notebook	HP	CHR0M1A15H	00081000DP
3	AC Adapter for #1	HP	TPN-AA00	-
4	AC Adapter for #2	HP	PPP012C-S	-

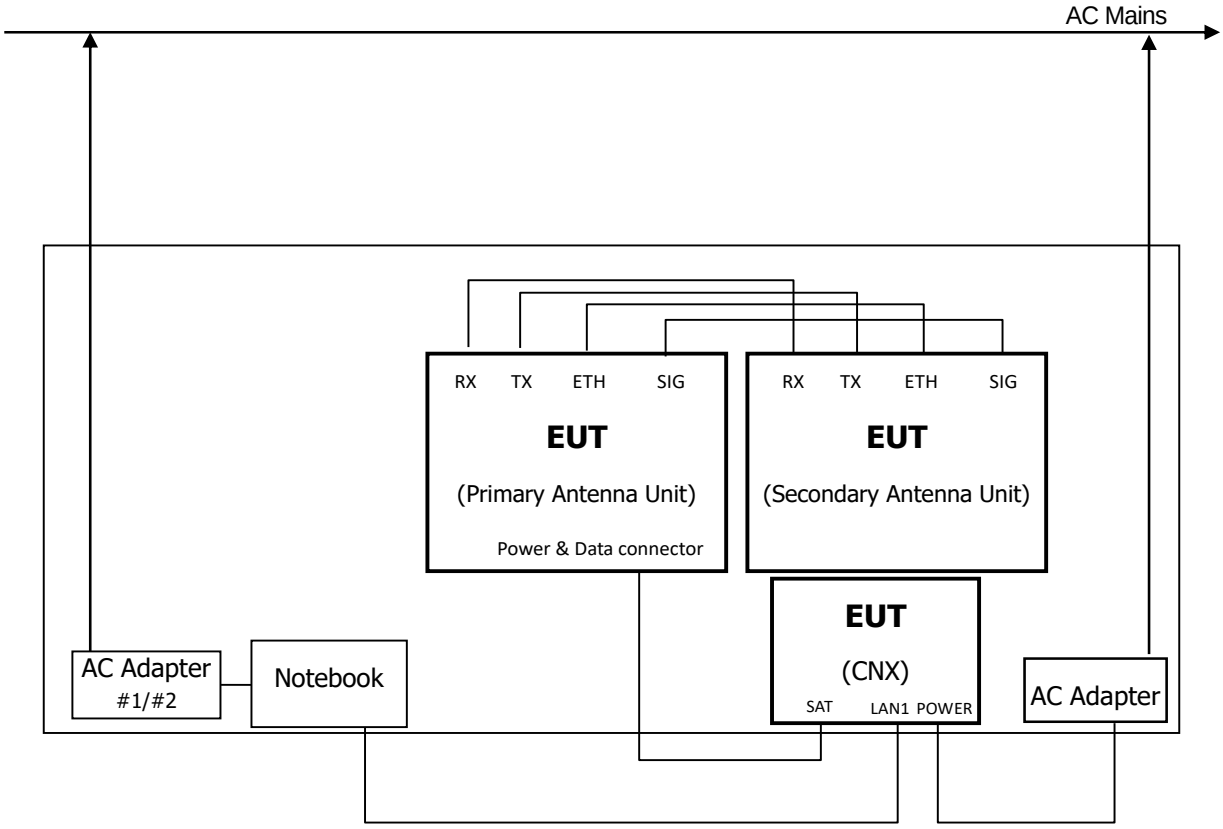
3.3. Interconnection and I/O cables

The following support units or accessories were used to form a representative test configuration during the tests.

#	Start		End		Cable	
	Name	I/O port	Name	I/O port	length (m)	shielded (Y/N)
1	EUT (Primary Antenna Unit)	(OMT and Feeder removed)	Dummy load	-	-	-
2	EUT (Primary Antenna Unit)	RX	EUT (Secondary Antenna Unit)	RX	5.0	Y
3	EUT (Primary Antenna Unit)	TX	EUT (Secondary Antenna Unit)	TX	5.0	Y
4	EUT (Primary Antenna Unit)	ETH	EUT (Secondary Antenna Unit)	ETH	5.0	Y
5	EUT (Primary Antenna Unit)	SIG	EUT (Secondary Antenna Unit)	SIG	5.0	Y
6	EUT (Primary Antenna Unit)	Power & DATA	EUT (CNX)	SAT	30.0	Y
7	EUT (CNX)	Power	AC adapter	DC output	1.2	N
8	AC Adapter	AC Input	AC Mains	AC Mains	1.5	N
9	EUT (CNX)	LAN1	Notebook	LAN	2.0	N
10	Notebook	DC Input	AC adapter #1/#2	DC output	1.7	N
11	AC Adapter #1/#2	AC Input	AC Mains	AC Mains	1.5	N

Note: *All the operating conditions including the cable connection were selected by the applicant.*

3.4. Test configuration (arrangement of EUT)



3.5. Test date

Date Tested	January 9, 2023 - January 29, 2023

4 Facilities and accreditations

4.1. Facilities

All of the measurements described in this report were performed at SK Tech Co., Ltd.

Site I: 88, Geulgaeul-ro, 81beon-gil, Wabu-eup, Namyangju-si, Gyeonggi-do, Korea
Site II: 124-8, Geulgaeul-ro, Wabu-eup, Namyangju-si, Gyeonggi-do, Korea

The sites are constructed in conformance with the requirements of ANSI C63.4 and CISPR 16-1-4. The sites comply with the Normalized Site Attenuation requirements given in ANSI C63.4, and site VSWR requirements specified in CISPR 16-1-4. The FAR used for the radiated spurious emissions fulfills the NSA requirements specified in ETSI TS 102 321 V1.1.1 (2004-05) and ETSI TR 102 273-2 V1.2.1 (2001-12). The measuring apparatus and ancillary equipment conform to CISPR 16-1 series.

4.2. Accreditations

The laboratory has been also notified to FCC and ISED by RRA as a Conformity Assessment Body, and designated to perform compliance testing on equipment subject to Certification under Parts 15, 18, 22, 24, 25, 27, 74, 90, 95, 97 and 101 of the FCC Rules, and RSS-GEN, RSS-170, RSS-210, RSS-247, RSS-248, and RSS-102 (RF Exp.)[MEAS].

Designation No.	KR0007
Company Number (IC)	5429A

4.3. List of test and measurement instruments

4.3.1 Instruments for the conducted measurements

No	Description	Model	Manufacturer	Serial No.	Cal. due	Use
1	Spectrum Analyzer	FSW67	Rohde&Schwarz	101371	2023.05.17	☒
2	Directional Coupler	17132-20	FLANN MICROWAVE	197960	2023.07.26	☒
3	Pre-amplifier (1 GHz - 18 GHz)	MLA-0118-J01-40	TSJ	14879	2023.05.09	☐
4	Pre-amplifier (18 GHz - 40 GHz)	MLA-1840-A01-50	TSJ	2610050	2023.05.17	☒
5	Pre-amplifier (40 GHz - 60 GHz)	MLA-4060-J02	TSJ	2Z00027	2023.05.17	☒
6	Harmonic mixer (60 GHz – 75 GHz)	FS-Z75	Rohde & Schwarz	102063	2023.07.25	☒
7	Termination	22101-250-CH10	FLANN MICROWAVE	275202	2023.07.26	☒
8	RF cable assembly (2 m)	MWX221	JUNKOSHA	2201S176	2023.08.24	☒
9	RF cable assembly (0.5 m)	ST40-01-9A40	SENSORVIEW	9	2023.03.14	☒
10	RF cable assembly (1 m)	SCW-VWVW012-F1	ERAVANT	15-1	2023.03.14	☒
11	RF cable assembly (0.3 m)	SCW-VWVW012-F1	ERAVANT	16-1	2023.03.14	☒
12	RF cable assembly (2 m)	ST40-01-9A40	SENSORVIEW	a-1	2023.03.14	☒
13	Temperature Chamber	SR-1006	YOJOGAWA	S5F204076	2024.01.16	☒
14	Multimeter	17B+	FLUKE	32700017WS	2023.02.07	☒
15	Digital Thermo-Hygrometer	608-H1	Testo	41383411	2023.05.20	☒

4.3.2 Instruments for the radiated measurements

No	Description	Model	Manufacturer	Serial No.	Cal. due	Use
1	EMI Test Receiver	ESR 26	Rohde&Schwarz	101441	2024.12.19	☒
2	Spectrum Analyzer	FSW67	Rohde&Schwarz	101371	2023.05.17	☒
3	Vector Signal Generator	SMBV100B	Rohde&Schwarz	101179	2023.05.10	☐
4	Signal Generator	SMB100A	Rohde&Schwarz	180704	2023.02.07	☐
5	Loop Antenna (9 kHz - 30 MHz)	HFH2-Z2E	Rohde&Schwarz	100883	2023.12.16	☒
6	BiLog broadband Antenna (30 MHz - 1 GHz)	VULB9168	Schwarzbeck	9168-230	2024.03.11	☒
7	Horn Antenna (1 GHz - 18 GHz)	3117	ETS Lindgren	00205960	2024.06.07	☒
8	Horn Antenna (1 GHz - 18 GHz)	BBHA 9120D	Schwarzbeck	9120D-816	2024.04.26	☐
9	Horn Antenna (6.5 GHz - 18 GHz)	LB-65180-20-C-SF	A-INFO	2110054000021	2024.01.22	☐
10	Horn Antenna (18 GHz - 26.5 GHz)	20240-20	Flann microwave	273364	2023.12.08	☐
11	Horn Antenna (18 GHz - 26.5 GHz)	20240-20	Flann microwave	273363	2023.11.23	☒
12	Horn Antenna (26.5 GHz - 40 GHz)	22240-20	Flann microwave	274186	2023.12.10	☐
13	Horn Antenna (26.5 GHz - 40 GHz)	22240-20	Flann microwave	274185	2023.11.23	☒
14	Horn Antenna (40 GHz - 60 GHz)	24240-20	Flann microwave	275175	2023.12.10	☒
15	Horn Antenna (60 GHz - 75 GHz)	25240-20	Flann microwave	273466	2023.12.10	☒
16	Pre-amplifier (30 MHz - 1 GHz)	MLA-10K01-B01-27	TSJ	2005350	2023.05.11	☒
17	Pre-amplifier (1 GHz - 18 GHz)	MLA-0118-J01-40	TSJ	14879	2023.05.09	☒
18	Pre-amplifier (18 GHz - 40 GHz)	MLA-1840-A01-50	TSJ	2610050	2023.05.17	☒
19	Pre-amplifier (40 GHz - 60 GHz)	MLA-4060-J02	TSJ	2Z00027	2023.05.17	☒
20	Harmonic mixer (60 GHz – 75 GHz)	FS-Z75	Rohde & Schwarz	102063	2023.07.25	☒
21	Termination	22101-250-CH10	FLANN MICROWAVE	275202	2023.07.26	☒
22	Multimeter	17B+	FLUKE	32700017WS	2023.02.07	☒
23	Digital Thermo-Hygrometer	608-H1	Testo	41383411	2023.05.20	☒

Radiated emission measurement software (30 MHz to 1 GHz): TEPTO-DV/RE_Version: 3.1.0044
Radiated spurious emission measurement software (above 1 GHz): TEPTO-DV/RSE_Version: 31.02.0034

5 Test and measurements

5.1. RF Power Output / Power limits / Off-axis EIRP spectral density

5.1.1 Regulation

FCC, CFR 47 Section

According to 2.1046, Measurements required: RF power output:

(a) For transmitters other than single sideband, independent sideband and controlled carrier radiotelephone, power output shall be measured at the RF output terminals when the transmitter is adjusted in accordance with the tune-up procedure to give the values of current and voltage on the circuit elements specified in According to 2.1033(c)(8). The electrical characteristics of the radio frequency load attached to the output terminals when this test is made shall be stated.

(b) For single sideband, independent sideband, and single channel, controlled carrier radiotelephone transmitters, the procedure specified in paragraph (a) of this section shall be employed and, in addition, the transmitter shall be modulated during the test as specified and as applicable in According to 2.1046 (b) (1-5). In all tests, the input level of the modulating signal shall be such as to develop rated peak envelope power or carrier power, as appropriate, for the transmitter.

(c) For measurements conducted pursuant to paragraphs (a) and (b) of this section, all calculations and methods used by the applicant for determining carrier power or peak envelope power, as appropriate, on the basis of measured power in the radio frequency load attached to the transmitter output terminals shall be shown. Under the test conditions specified, no components of the emission spectrum shall exceed the limits specified in the applicable rule parts as necessary for meeting occupied bandwidth or emission limitations.

According to 25.204, Power limits for earth stations

(a) In bands shared coequally with terrestrial radio communication services, the equivalent isotropically radiated power transmitted in any direction towards the horizon by an earth station, other than an ESV, operating in frequency bands between 1 and 15 GHz, shall not exceed the following limits except as provided for in paragraph (c) of this section:

+40 dBW in any 4 kHz band for $\theta \leq 0°$

+40 + 3θ dBW in any 4 kHz band for $0° < \theta \leq 5°$

where θ is the angle of elevation of the horizon viewed from the center of radiation of the antenna of the earth station and measured in degrees as positive above the horizontal plane and negative below it.

(c) For angles of elevation of the horizon greater than 5° there shall be no restriction as to the equivalent isotropically radiated power transmitted by an earth station towards the horizon.

According to 25.218, Off-axis EIRP density envelopes for FSS earth stations transmitting in certain frequency bands

(f) Digital earth station operation in the conventional Ku-band.

(1) For co-polarized transmissions in the plane tangent to the GSO arc:

$15-25\log_{10}\theta$	dBW/4 kHz	for $1.5° \leq \theta \leq 7°$
-6	dBW/4 kHz	for $7° < \theta \leq 9.2°$
$18-25\log_{10}\theta$	dBW/4 kHz	for $9.2° < \theta \leq 19.1°$
-14	dBW/4 kHz	for $19.1° < \theta \leq 180°$

Where θ is as defined in paragraph (c)(1) of this section. The EIRP density levels specified for $\theta > 7°$ may be exceeded by up to 3 dB in up to 10% of the range of theta (θ) angles from ±7-180°, and by up to 6 dB in the region of main reflector spillover energy.

(2) For co-polarized transmissions in the plane perpendicular to the GSO arc, as defined in § 25.103:

$18-25\log_{10}\theta$	dBW/4 kHz	for 3° ≤ θ ≤ 19.1°
-14	dBW/4 kHz	for 19.1° < θ ≤ 180°

Where θ is as defined in paragraph (c)(1) of this section. These EIRP density levels may be exceeded by up to 6 dB in the region of main reflector spillover energy and in up to 10% of the range of θ angles not included in that region, on each side of the line from the earth station to the target satellite.

(3) For cross-polarized transmissions in the plane tangent to the GSO arc and in the plane perpendicular to the GSO arc:

$5-25\log_{10}\theta$	dBW/4 kHz	for 1.5° ≤ θ ≤ 7°

Where θ is as defined in paragraph (c)(1) of this section.

NOTE: subtracting the antenna gain values specified in §25.209 Earth station antenna performance standards from these limits, the maximum conducted Off-axis density limit is -14 dBW/4kHz.

5.1.2 Test Procedure

The RF output power were measured with the following setting according to Subclause 5.2.4.2, 5.2.4.3 and/or 5.2.4.4 of ANSI C63.26-2015.

Procedure for measuring average power with an average power meter:
An average power meter can always be used to perform the measurement when the EUT can be configured to transmit continuously. If the EUT cannot be configured to transmit continuously (i.e., burst duty cycle < 98%), the measurement should be measured during the active transmission bursts if the gating parameters can be adjusted, otherwise the duty cycle correction should be considered.

Procedure for measuring average power of a narrowband signal with spectrum analyzer:

(a) Set span to 2 × to 3 × the OBW.
(b) Set RBW ≥ OBW.
(c) Set VBW ≥ 3 × RBW.
(d) Set number of measurement points in sweep ≥ 2 × span / RBW.
(e) Sweep time:
  (1) Set ≥ auto-couple, and enable trace averaging, or
  (2) Set ≥ [10 × (number of points in sweep) × (transmission symbol period)] and enable a single sweep (automation-compatible) measurement. The sweep time should never be faster than the auto-coupled sweep time.
(f) Detector = power averaging (rms).
(g) If the EUT can be configured to transmit continuously, then set the trigger to free run.
(h) Trace average at least 100 traces in power averaging (i.e., rms) mode if sweep is set to auto-couple. (To accurately determine the average power over multiple transmit symbols, it can be necessary to increase the number of traces to be averaged above 100 or, if using a manually configured sweep time, increase the sweep time.)
(i) Use the peak marker function to determine the maximum amplitude level.

Procedure for measuring average power of a broadband signal with spectrum analyzer:

(a) Set span to 2 × to 3 × the OBW.
(b) Set RBW = 1% to 5% of the OBW.
(c) Set VBW ≥ 3 × RBW.
(d) Set number of measurement points in sweep ≥ 2 × span / RBW.
(e) Sweep time:
  (1) Set = auto-couple, or
  (2) Set ≥ [10 × (number of points in sweep) × (transmission period)] for single sweep (automation-compatible) measurement. Transmission period is the on and off time of the transmitter.
(f) Detector = power averaging (rms).
(g) If the EUT can be configured to transmit continuously, then set the trigger to free run.
(h) If the EUT cannot be configured to transmit continuously, then use a sweep trigger with the level set to enable triggering only on full power bursts and configure the EUT to transmit at full power for the entire duration of each sweep. Verify that the sweep time is less than or equal to the transmission burst duration. Time gating can also be used under similar constraints (i.e., configured such that measurement data is collected only during active full-power transmissions).
(i) Trace average at least 100 traces in power averaging (rms) mode if sweep is set to auto-couple. To accurately determine the average power over multiple symbols, it can be necessary to increase the number of traces to be averaged above 100 or, if using a manually configured sweep time, increase the sweep time.
(j) Compute the power by integrating the spectrum across the OBW of the signal using the instrument's band or channel power measurement function, with the band/channel limits set equal to the OBW band edges. If the instrument does not have a band or channel power function, then sum the spectrum levels (in linear power units) at intervals equal to the RBW extending across the entire OBW of the spectrum.

Procedure for RF power output in any 4 kHz band:
The average power spectral density was measured according to Subclause 5.2.4.5 of ANSI C63.26-2015. The same test procedure for the measurements of Spurious Emissions at Antenna Terminals (Out-of-band emissions measurements) was used.

NOTE: As shown in the Figure 3, during the measurements, the insertion loss (Waveguide coupler, RF cable assembly) was included in the spectrum analyzer as the TDF, and bandwidth correction factor (1.25 dB) were applied as the Offset.

Procedure for Off-axis EIRP spectral density in any 4 kHz band:
The average power spectral density was measured according to Subclause 5.2.4.5 of ANSI C63.26-2015. The same test procedure for the measurements of Spurious Emissions at Antenna Terminals (Out-of-band emissions measurements) was used, except for subtracting the antenna gain.

NOTE : As shown in the Figure 4, during the measurements, the insertion loss (Waveguide coupler, RF cable assembly) was included in the spectrum analyzer as the TDF, and the bandwidth correction factor (1.25 dB) were applied as the Offset which the antenna gain was set to zero.

5.1.3 Result: PASS

Table 1: Measured values of RF Power Output

Bandwidth (carrier)	Modulation	Antenna power [dBm] (NOTE 1)			EIRP [dBm] (NOTE 2)		
		f_{LOW}	f_{MID}	f_{HIGH}	f_{LOW}	f_{MID}	f_{HIGH}
19.8 MHz (single carrier)	QPSK	24.6	24.6	24.6	63.6	63.6	63.6
	8PSK	24.6	24.6	24.6	63.6	63.6	63.6
	16QAM	24.6	24.6	24.6	63.6	63.6	63.6
39.6 MHz (dual carrier)	QPSK	27.6	27.6	27.6	66.6	66.6	66.6
	8PSK	27.6	27.6	27.6	66.6	66.6	66.6
	16QAM	27.6	27.6	27.6	66.6	66.6	66.6

NOTE 1: As shown in the Figure 1, during the measurements, the insertion loss (Waveguide coupler, RF cable assembly) was included in the spectrum analyzer as the TDF.

NOTE 2: Transmitter radiated output power including the antenna gain (39.0 dBi).

Table 2: Measured values of RF Power Output (measured with Spectrum Analyzer in any 4 kHz band)

Bandwidth (carrier)	Modulation	Measured data [dBm] (NOTE 1)			EIRP [dBm] (NOTE 2)			LIMIT [dBm]
		f_{LOW}	f_{MID}	f_{HIGH}	f_{LOW}	f_{MID}	f_{HIGH}	
19.8 MHz (single carrier)	QPSK	-1.8	-2.1	-2.0	37.2	37.0	37.0	70.0
	8PSK	-1.8	-2.0	-1.9	37.2	37.0	37.1	70.0
	16QAM	-1.7	-2.0	-2.0	37.3	37.0	37.0	70.0
39.6 MHz (dual carrier)	QPSK	-1.9	-2.1	-2.1	37.1	36.9	36.9	70.0
	8PSK	-2.0	-2.1	-2.0	37.0	36.9	37.0	70.0
	16QAM	-2.0	-2.1	-2.1	37.0	36.9	36.9	70.0

NOTE 1: The values were obtained from the Figure 3.

NOTE 2: Transmitter radiated output power including the antenna gain (39.0 dBi).

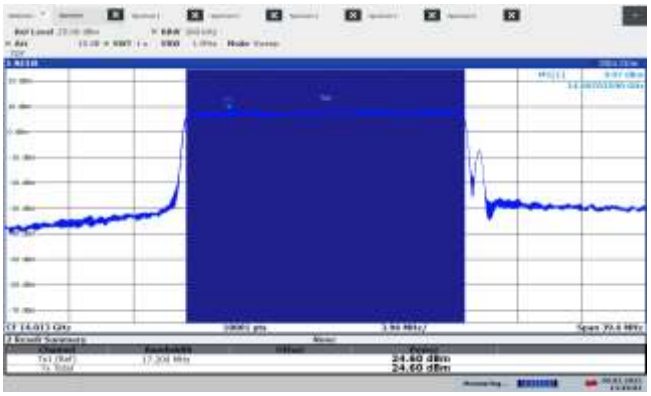
Table 3: Measured values of Off-axis EIRP spectral density

Bandwidth (carrier)	Modulation	EIRP [dBm] (NOTE)			LIMIT [dBm]
		f_{LOW}	f_{MID}	f_{HIGH}	
19.8 MHz (single carrier)	QPSK	-1.9	-2.0	-2.0	16.0
	8PSK	-1.8	-2.1	-1.9	16.0
	16QAM	-1.8	-2.0	-2.0	16.0
39.6 MHz (dual carrier)	QPSK	-2.0	-2.1	-2.1	16.0
	8PSK	-2.0	-2.2	-2.0	16.0
	16QAM	-1.9	-2.2	-2.1	16.0

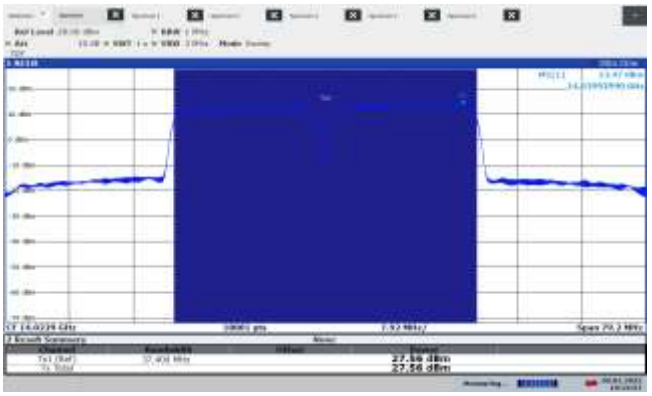
NOTE: The values were obtained from the Figure 4.

Figure 1. Plot of RF Power Output

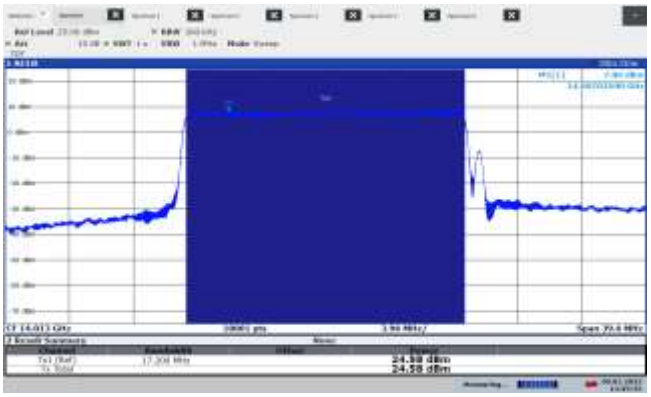
RF Power output for each Bandwidth and Modulation



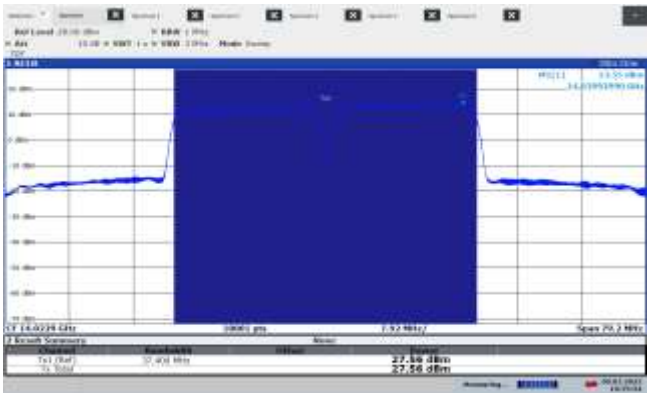
f_{LOW} (19.8 MHz, QPSK)



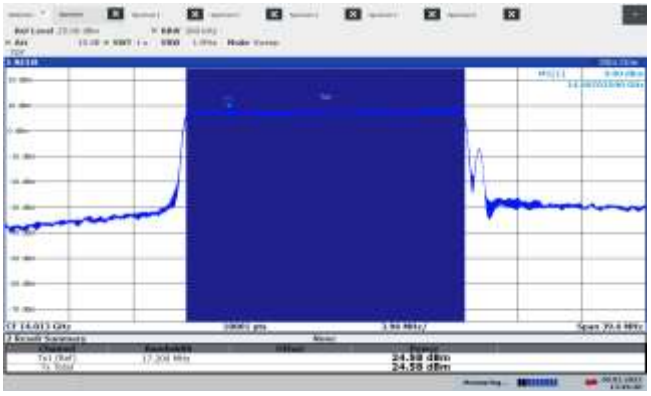
f_{LOW} (39.6 MHz, QPSK)



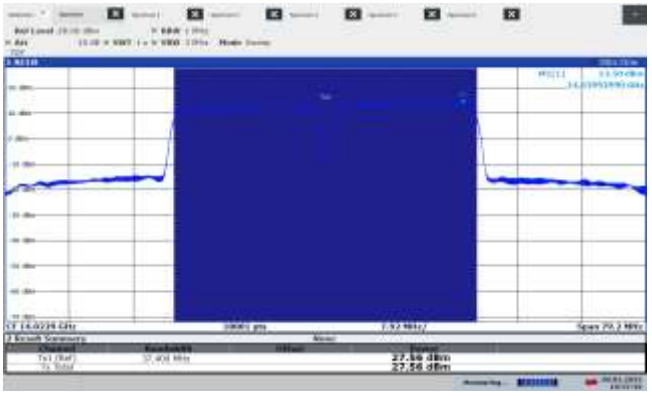
f_{LOW} (19.8 MHz, 8PSK)



f_{LOW} (39.6 MHz, 8PSK)

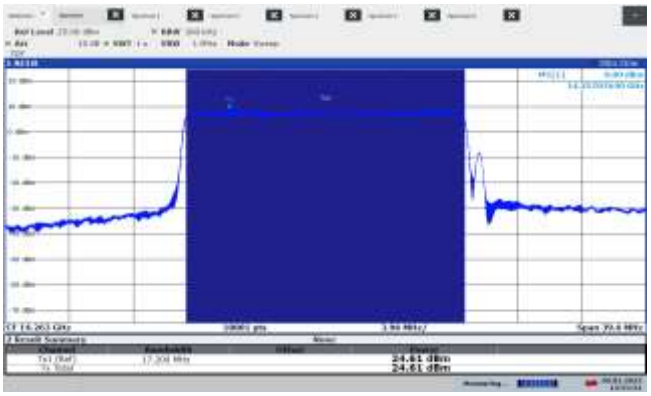


f_{LOW} (19.8 MHz, 16QAM)

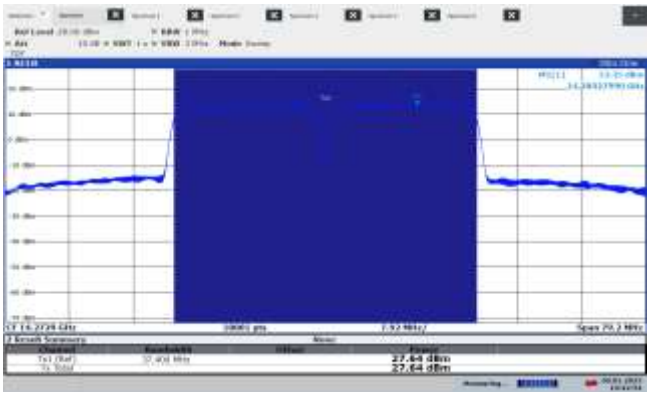


f_{LOW} (39.6 MHz, 16QAM)

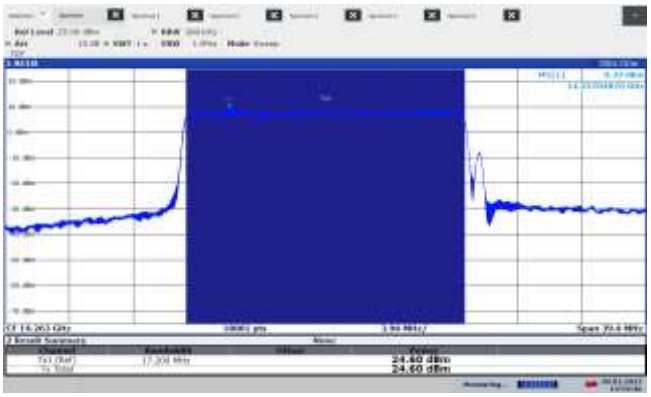
RF Power output for each Bandwidth and Modulation



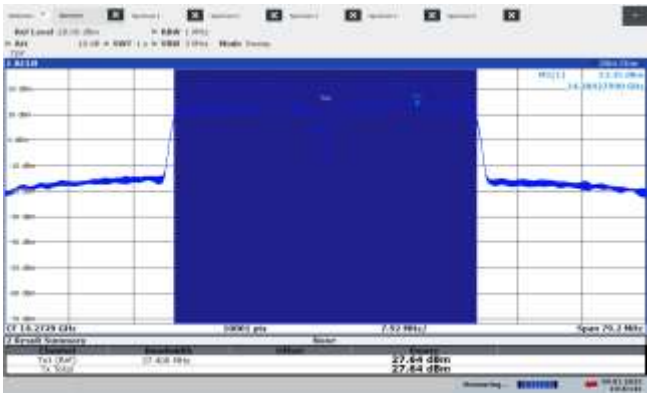
f_{MID} (19.8 MHz, QPSK)



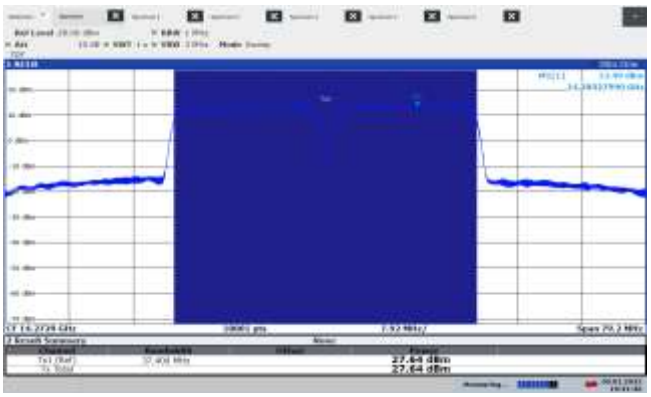
f_{MID} (39.6 MHz, QPSK)



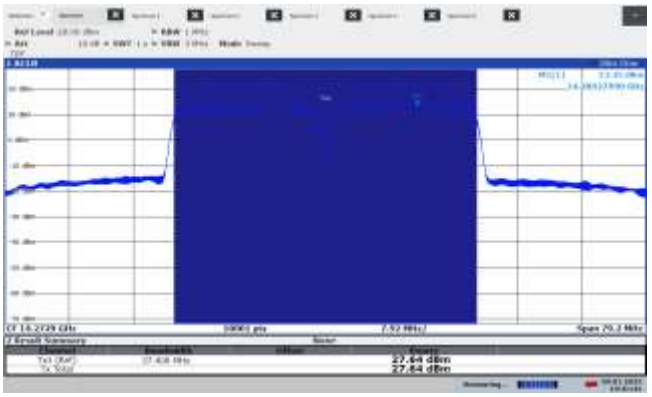
f_{MID} (19.8 MHz, 8PSK)



f_{MID} (39.6 MHz, 8PSK)

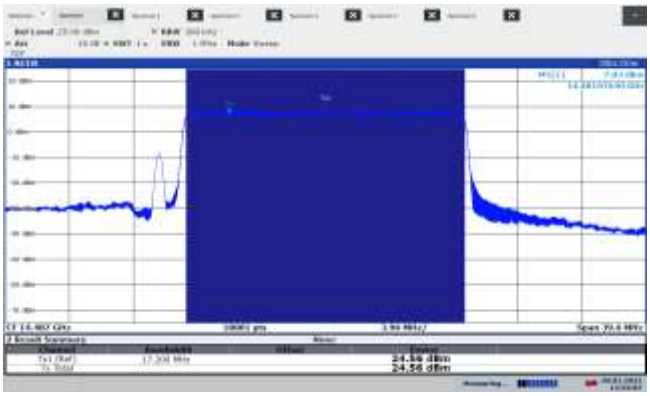


f_{MID} (19.8 MHz, 16QAM)

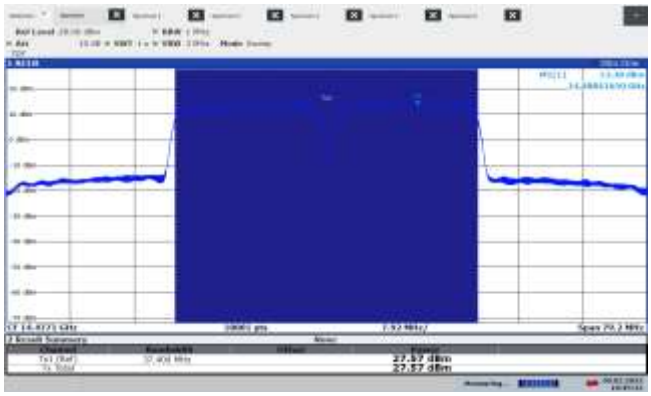


f_{MID} (39.6 MHz, 16QAM)

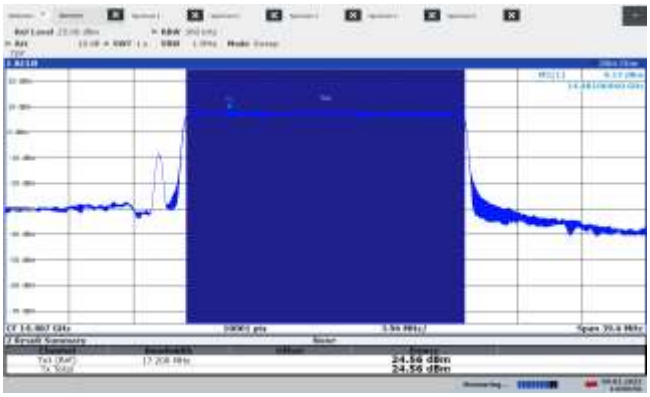
RF Power output for each Bandwidth and Modulation



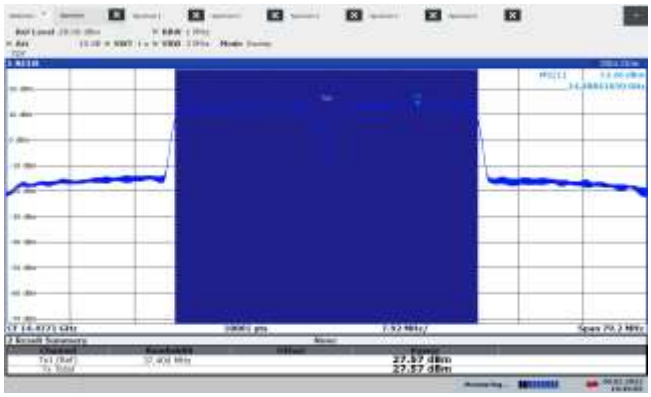
f_{HIGH} (19.8 MHz, QPSK)



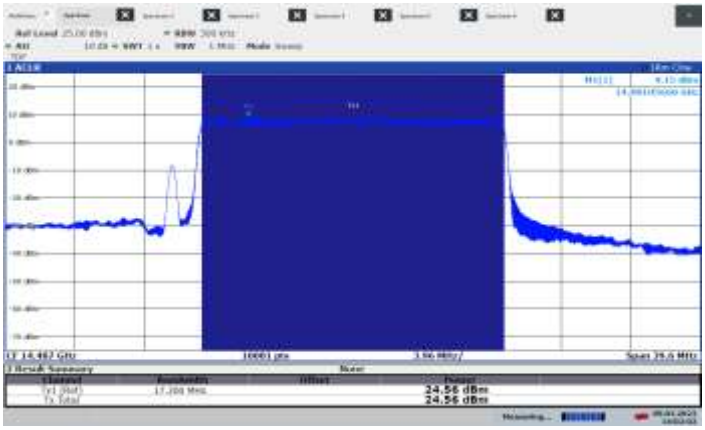
f_{HIGH} (39.6 MHz, QPSK)



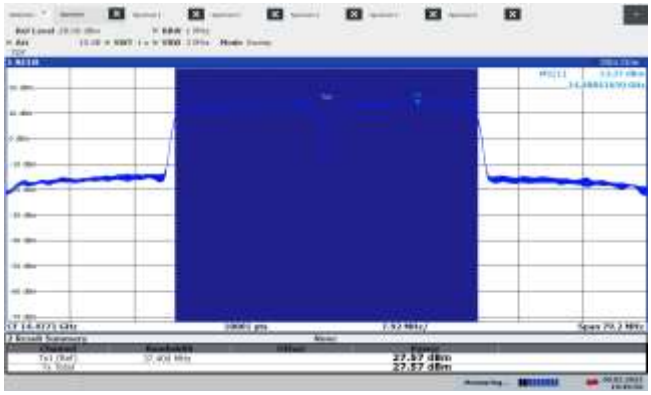
f_{HIGH} (19.8 MHz, 8PSK)



f_{HIGH} (39.6 MHz, 8PSK)



f_{HIGH} (19.8 MHz, 16QAM)



f_{HIGH} (39.6 MHz, 16QAM)

5.2. Occupied Bandwidth

5.2.1 Regulation

FCC, CFR 47 Section

According to 2.1049, Measurements required: Occupied bandwidth: The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured under the specified conditions of 2.1049 (a) through (i) as applicable.

5.2.2 Test Procedure

The Occupied bandwidth (99 %) were measured with the following setting according to subclause 5.4.4 of ANSI C63.26.

(a) Set the spectrum analyzer to be entered in OBW measurement.
(b) The spectrum analyzer center frequency was set to the nominal EUT channel center frequency.
(c) The span range for the spectrum analyzer should be wide enough to see sufficient roll off of the signal to make the measurement.
(d) The RBW should be in the range of 1% to 5% of the anticipated OBW, and the VBW should be set ≥ 3 × RBW.
(e) Set spectrum analyzer detection mode to peak, and the trace mode to max hold.

5.2.3 Result: PASS

Table 4: Measured values of Occupied Bandwidth

Bandwidth (carrier)	Modulation	Occupied bandwidth [MHz]		
		f_{LOW}	f_{MID}	f_{HIGH}
19.8 MHz (single carrier)	QPSK	17.2	17.2	17.2
	8PSK	17.2	17.2	17.2
	16QAM	17.2	17.2	17.2
39.6 MHz (dual carrier)	QPSK	37.3	37.3	37.3
	8PSK	37.3	37.3	37.3
	16QAM	37.3	37.3	37.3

Figure 2. Plot of Occupied Bandwidth

Occupied bandwidth for each Bandwidth and Modulation

f_{LOW} (19.8 MHz, QPSK)

f_{LOW} (39.6 MHz, QPSK)

f_{LOW} (19.8 MHz, 8PSK)

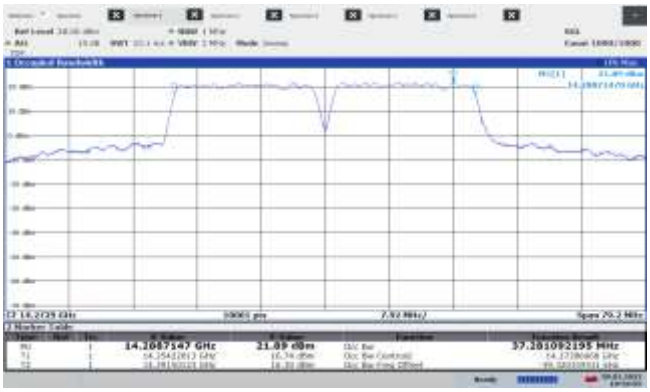
f_{LOW} (39.6 MHz, 8PSK)

f_{LOW} (19.8 MHz, 16QAM)

f_{LOW} (39.6 MHz, 16QAM)

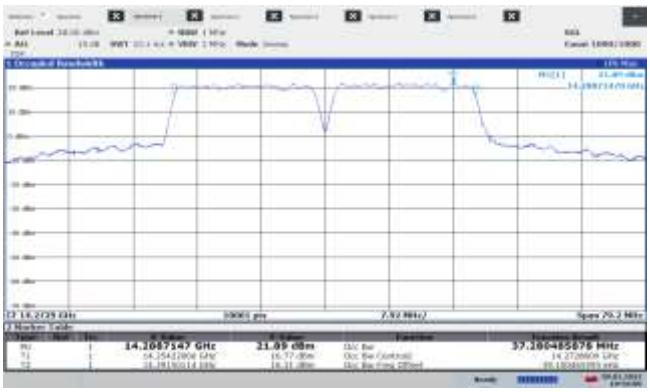
Occupied bandwidth for each Bandwidth and Modulation

f_{MID} (19.8 MHz, QPSK)



f_{MID} (39.6 MHz, QPSK)

f_{MID} (19.8 MHz, 8PSK)



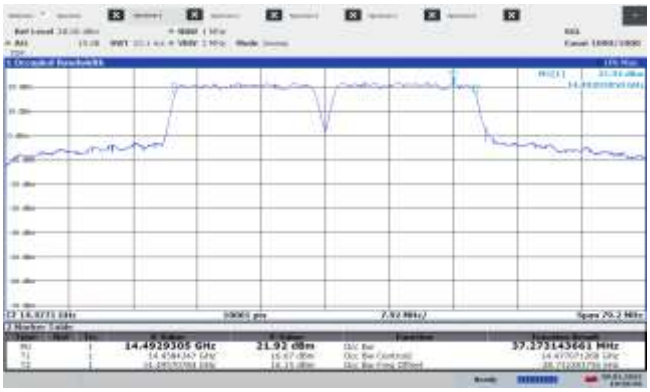
f_{MID} (39.6 MHz, 8PSK)

f_{MID} (19.8 MHz, 16QAM)

f_{MID} (39.6 MHz, 16QAM)

Occupied bandwidth for each Bandwidth and Modulation

f_{HIGH} (19.8 MHz, QPSK)



f_{HIGH} (39.6 MHz, QPSK)

f_{HIGH} (19.8 MHz, 8PSK)

f_{HIGH} (39.6 MHz, 8PSK)

f_{HIGH} (19.8 MHz, 16QAM)

f_{HIGH} (39.6 MHz, 16QAM)

5.3. Spurious Emissions at Antenna Terminals (conducted emissions)

5.3.1 Regulation

FCC, CFR 47 Section

According to 2.1051, Measurements required: Spurious emissions at antenna terminals: The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in 2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

According to 25.202(f), Emission limitations. Except for SDARS terrestrial repeaters and as provided for in paragraph (i), the mean power of emissions shall be attenuated below the mean output power of the transmitter in accordance with the schedule set forth in paragraphs (f)(1) through (f)(4) of this section. The out-of-band emissions of SDARS terrestrial repeaters shall be attenuated in accordance with the schedule set forth in paragraph (h) of this section.

(1) In any 4 kHz band, the center frequency of which is removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: 25 dB;

(2) In any 4 kHz band, the center frequency of which is removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth: 35 dB;

(3) In any 4 kHz band, the center frequency of which is removed from the assigned frequency by more than 250 percent of the authorized bandwidth: An amount equal to 43 dB plus 10 times the logarithm (to the base 10) of the transmitter power in watts;

(4) In any event, when an emission outside of the authorized bandwidth causes harmful interference, the Commission may, at its discretion, require greater attenuation than specified in paragraphs (f) (1), (2) and (3) of this section.

5.3.2 Test Procedure

The Spurious Emissions at Antenna Terminals were measured with the following setting according to subclause 5.7.3 and 5.7.4 of ANSI C63.26.

Connect the EUT antenna output port to the spectrum analyzer via an appropriate RF cable. Insert external attenuation as necessary and adjust the spectrum analyzer settings to account for the corresponding insertion loss. The unwanted emission limit was expressed in terms of "average" power. The use of "Max Hold" will not result in a true average power measurement. Instead, the proper trace mode for performing an average measurement was the "trace average" mode. Alternatively, a single sweep measurement could be used with the sweep speed set such that a relatively long dwell was realized in each trace bucket (typically at least 1 ms per trace point).

Out-of-band emissions measurements:

(a) Set the spectrum analyzer center frequency to the block, band, or channel edge frequency.

(b) Set the span wide enough to capture the fundamental emission closest to the authorized block or band edge, and to include all modulation products that spill into the immediately adjacent frequency band. In some cases, it may be possible to set the center frequency and span so as to encompass the

fundamental emission and the unwanted out-of-band (band-edge) emissions on either side of the authorized block, band, or channel. This could be accomplished with a single (slow) sweep, if adequate overload protection and sufficient dynamic range could be maintained.

(c) Set the number of points in sweep ≥ 2 × span / RBW.

(d) Sweep time should be auto for peak detection. For rms detection the sweep time should be set as follows:

(1) If the device could be configured to transmit continuously, set the (sweep time) > (number of points in sweep) × (symbol period) (e.g., by a factor of 10 × symbol period × number of points). Increasing the sweep time (i.e., slowing the sweep speed) will allow for averaging over multiple symbols.

(2) If the device could not transmit continuously, a gated sweep should be used when possible, set the sweep time > (number of points in sweep) × (symbol period) but the sweep time should always be maintained at a value that was less than or equal to the minimum transmission time.

(3) If the device could not be configured to transmit continuously and a free running sweep must be used, set the sweep time so that the averaging was performed over multiple on/off cycles by setting the sweep time > (number of points in sweep) × (transmitter period) (i.e., the transmit on-time + the off-time). The spectrum analyzer readings should subsequently be corrected by [10 log (1/duty cycle)]. This assumes that the transmission period and duty cycle was relatively constant (duty cycle variation ≤ ±2%).

(4) If the device could not be configured to transmit continuously and a free-running sweep must be used, and if the transmissions exhibit a non-constant duty cycle (duty cycle variations > ±2%), set the sweep time so that the averaging was performed over the on-period by setting the sweep time > (symbol period) × (number of points), while also maintaining the sweep time < (transmitter on-time). The trace mode should be set to max hold, since not every display point will be averaged only over just the on-time. Thus, multiple sweeps (e.g., 100) in maximum hold are necessary to ensure that the maximum power was measured.

Conducted spurious emissions measurements:

(a) Set the spectrum analyzer start frequency to the lowest frequency generated by the EUT, without going below 9 kHz, and the stop frequency to the lower frequency covered by the out-of-band emissions measurements. [remark: the measurements were performed from the waveguide cutoff frequency]

(b) When using an average power (rms) detector, ensure that the number of points in the sweep ≥ 2 × (span / RBW). This may require that the measurement range defined by the start and stop frequencies be subdivided, depending on the spectrum analyzer capabilities. This requirement does not apply to peak-detected power measurements. When average power was specified by the applicable regulation, a peak-detector could be utilized for preliminary measurements to accommodate wider frequency spans. Any emissions found in the preliminary measurement to exceed the applicable limit(s) should be further examined using a power averaging (rms) detector with the minimum number of measurement points as defined above.

(c) The sweep time should be set to auto-couple for performing peak-detector measurements. For measurements that use a power averaging (rms) detector, the sweep time should be set as described for out-of-band emissions measurements.

(d) Identify and measure the highest spurious emission levels in each frequency range. It was not necessary to re-measure the out-of-band emissions as a part of this test. Record the frequencies and amplitudes corresponding to the measured emissions and capture the data plots.

(e) Repeat step (b) through step (d) for the upper spurious emission frequency range if not already

captured by a wide span measurement.

(f) Compare the results with the corresponding limit in the applicable regulation.

Calculation of bandwidth correction factor 5.7.2 of ANSI C63.26:

If the measurement bandwidth used to perform the measurement is less than the reference bandwidth, the following scaling is applied: 10 × log [(reference bandwidth) / (resolution or measurement bandwidth)]

For example, the reference bandwidth is specified as 4 kHz and the RBW 3 kHz is used during the measurement, the bandwidth correction factor = 10 × log (4 kHz / 3 kHz) = 1.25 [dB]

NOTE 1: As shown in the Figure 3, during the Out-of-band emission measurements, the insertion loss (Waveguide coupler, RF cable assembly) was included in the spectrum analyzer as the TDF and bandwidth correction factor (1.25 dB) were applied as the Offset.

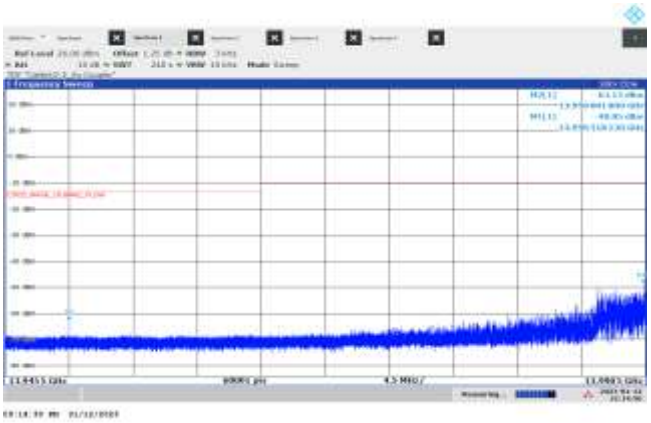
NOTE 2: As shown in the Figure 4, during the Off-axis EIRP spectral measurements, the insertion loss (Waveguide coupler, RF cable assembly) was included in the spectrum analyzer as the TDF, and the bandwidth correction factor (1.25 dB) were applied as the Offset.

NOTE 3: As shown in the Figure 5, during the spurious emission measurements, the peak detector was used with RBW 100 kHz for the preliminary measurements. The insertion loss (Waveguide coupler, Preamplifier, RF cable assembly) was included in the spectrum analyzer as the TDF.

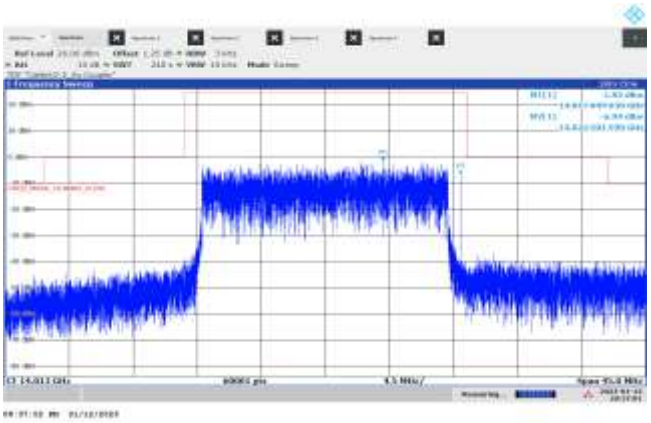
5.3.3 Result: **PASS**

Figure 3. Plot of Out-of-band Emissions (conducted emissions measurements)

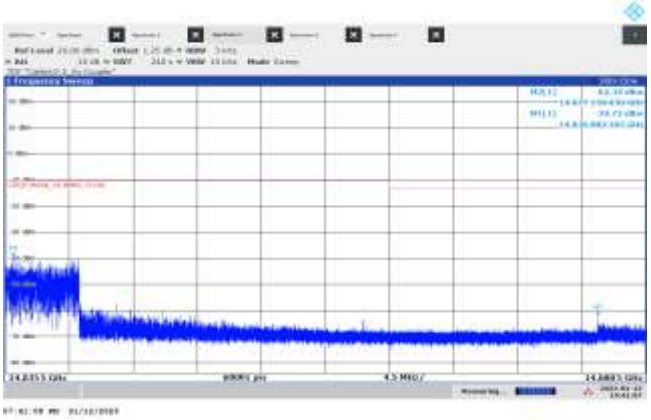
Out-of-band emissions (OOBE) and Band-edge measurements for each Bandwidth and Modulation



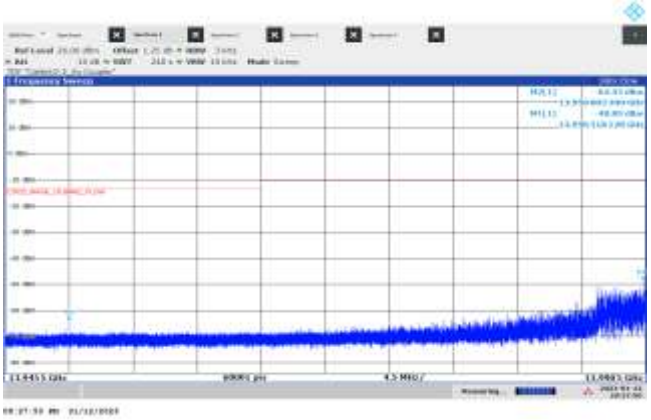
f_{LOW} (19.8 MHz, QPSK)(1)



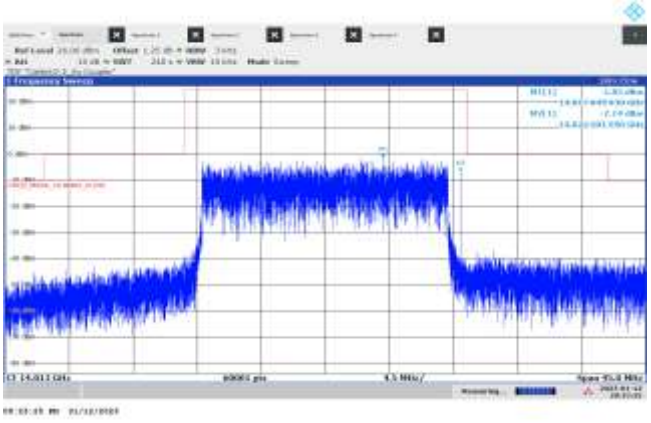
f_{LOW} (19.8 MHz, QPSK)(2)



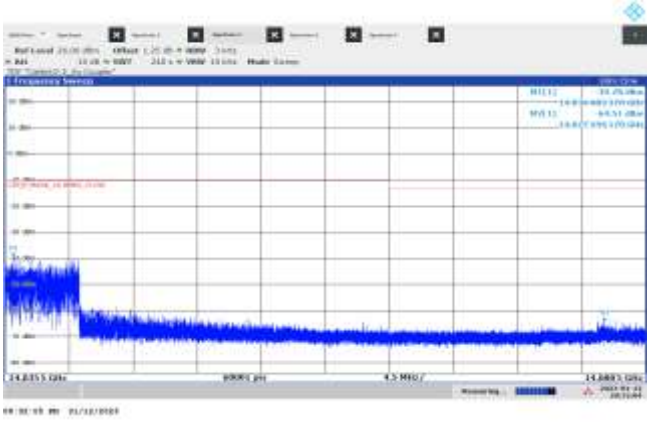
f_{LOW} (19.8 MHz, QPSK)(3)



f_{LOW} (19.8 MHz, 8PSK)(1)

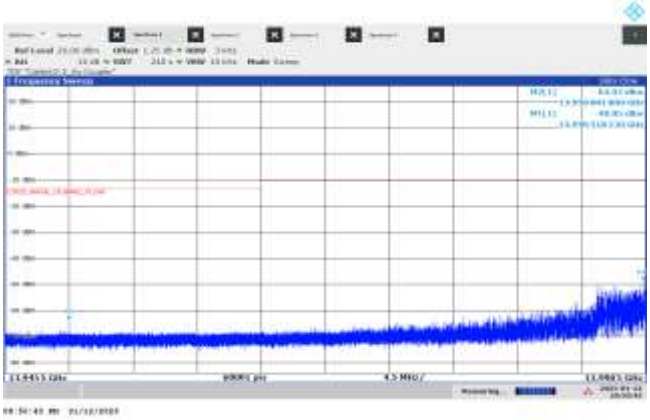


f_{LOW} (19.8 MHz, 8PSK)(2)

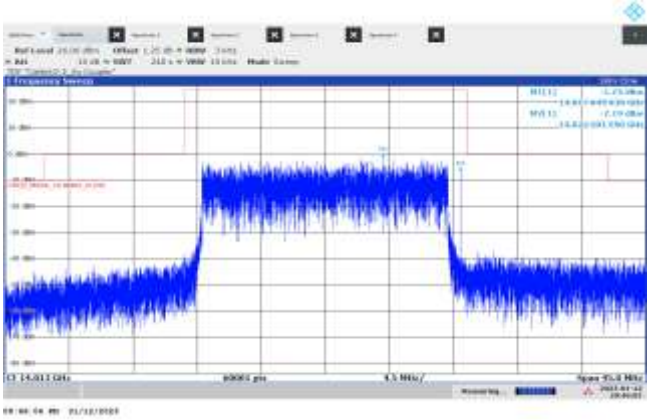


f_{LOW} (19.8 MHz, 8PSK)(3)

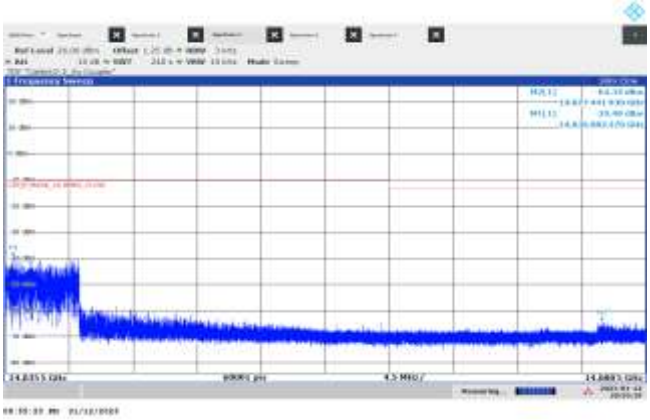
Out-of-band emissions (OOBE) and Band-edge measurements for each Bandwidth and Modulation



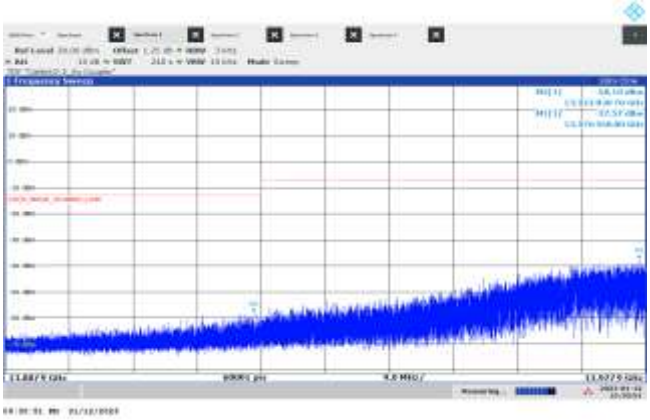
f_{LOW} (19.8 MHz, 16QAM)(1)



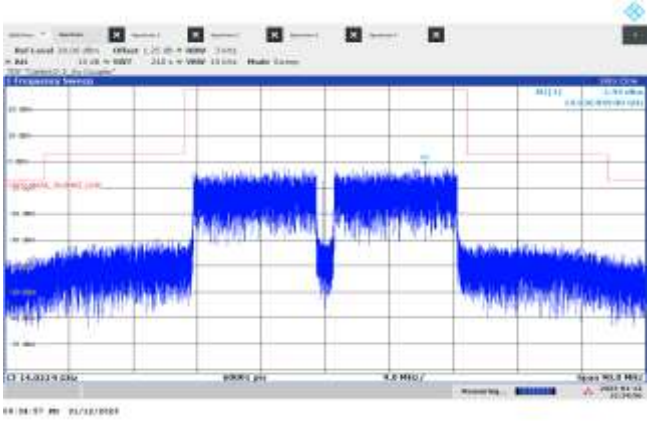
f_{LOW} (19.8 MHz, 16QAM)(2)



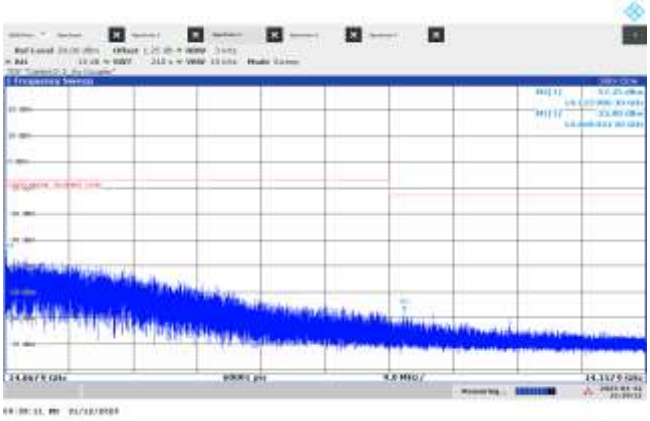
f_{LOW} (19.8 MHz, 16QAM)(3)



f_{LOW} (39.6 MHz, QPSK)(1)

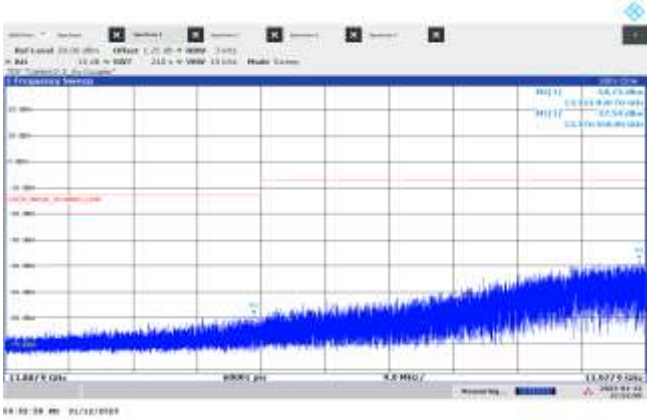


f_{LOW} (39.6 MHz, QPSK)(2)

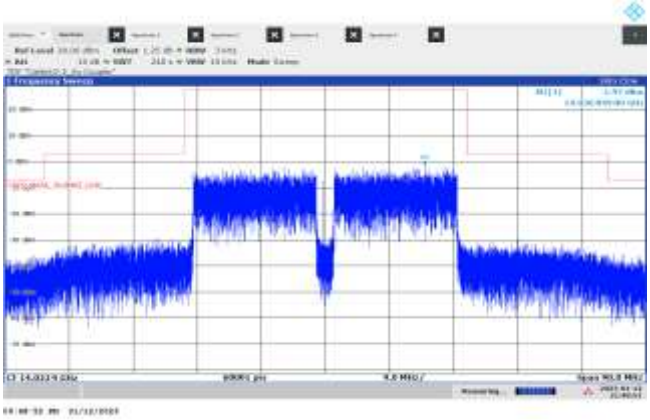


f_{LOW} (39.6 MHz, QPSK)(3)

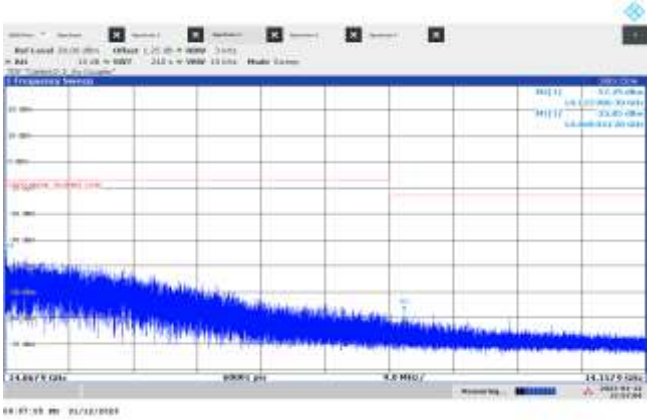
Out-of-band emissions (OOBE) and Band-edge measurements for each Bandwidth and Modulation



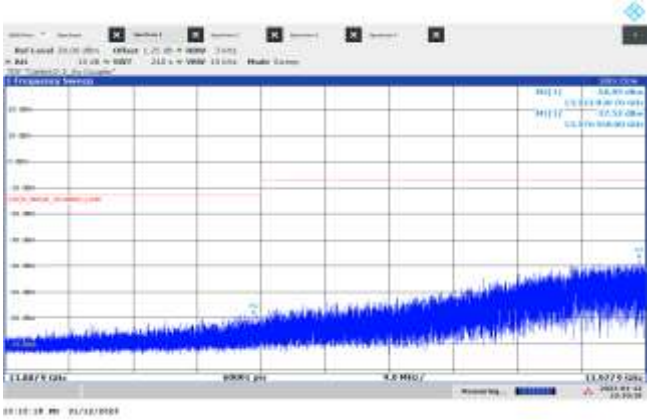
f_{LOW} (39.6 MHz, 8PSK)(1)



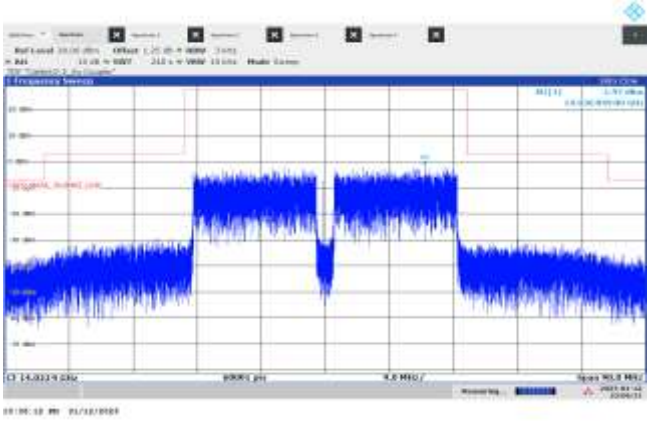
f_{LOW} (39.6 MHz, 8PSK)(2)



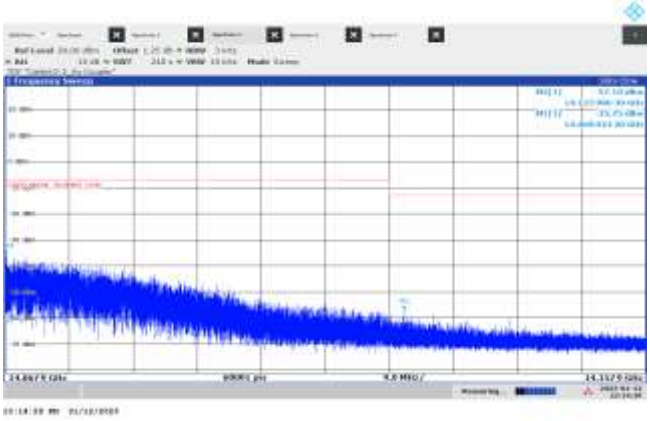
f_{LOW} (39.6 MHz, 8PSK)(3)



f_{LOW} (39.6 MHz, 16QAM)(1)

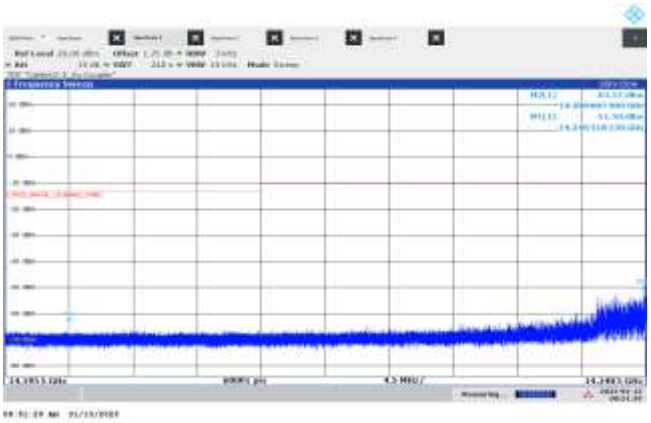


f_{LOW} (39.6 MHz, 16QAM)(2)

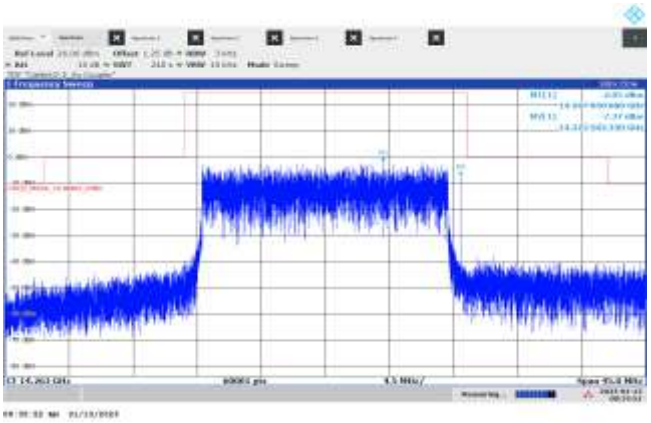


f_{LOW} (39.6 MHz, 16QAM)(3)

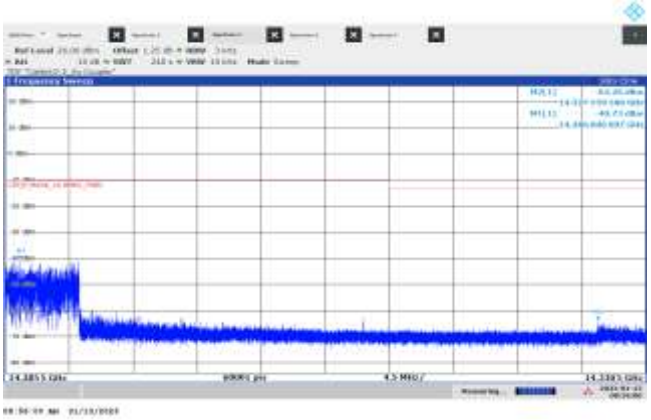
Out-of-band emissions (OOBE) and Band-edge measurements for each Bandwidth and Modulation



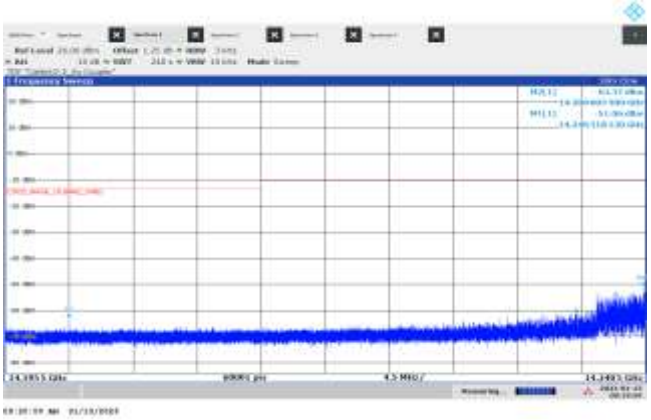
f_{MID} (19.8 MHz, QPSK)(1)



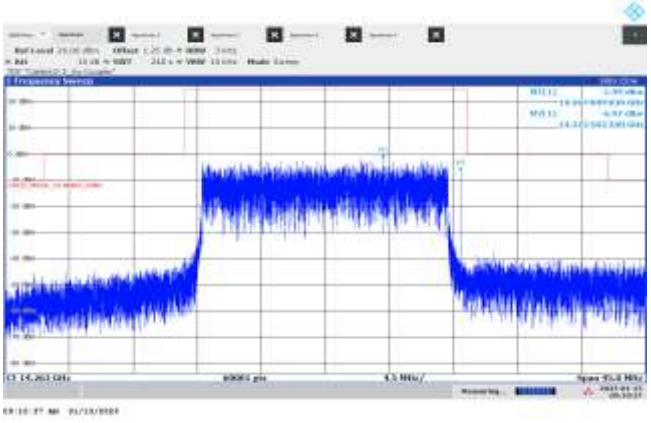
f_{MID} (19.8 MHz, QPSK)(2)



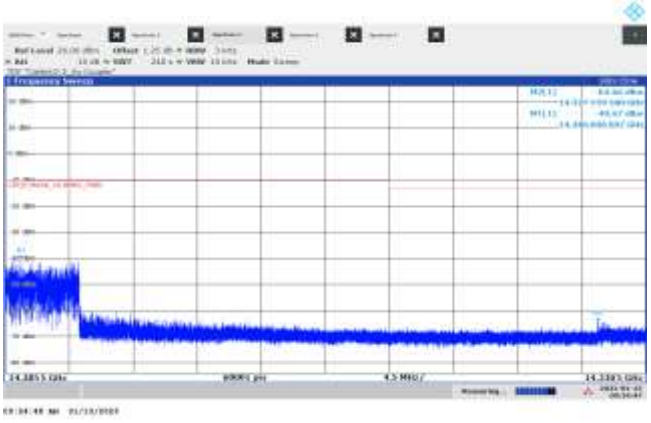
f_{MID} (19.8 MHz, QPSK)(3)



f_{MID} (19.8 MHz, 8PSK)(1)

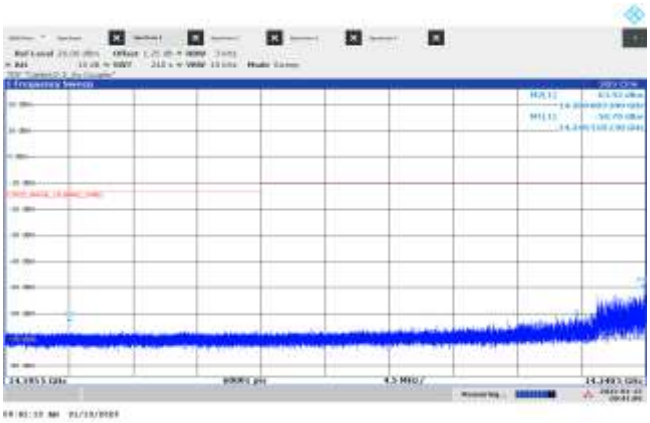


f_{MID} (19.8 MHz, 8PSK)(2)

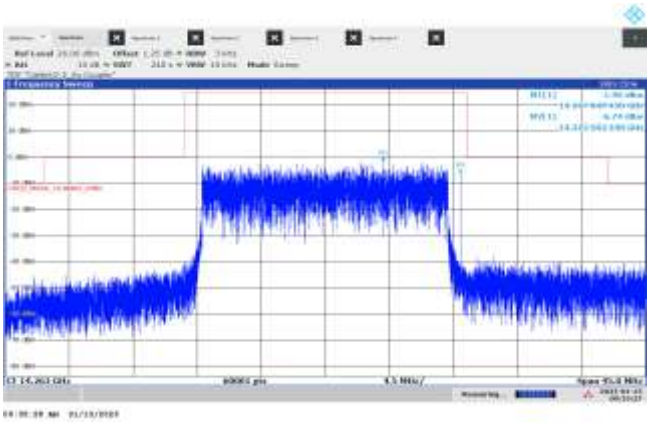


f_{MID} (19.8 MHz, 8PSK)(3)

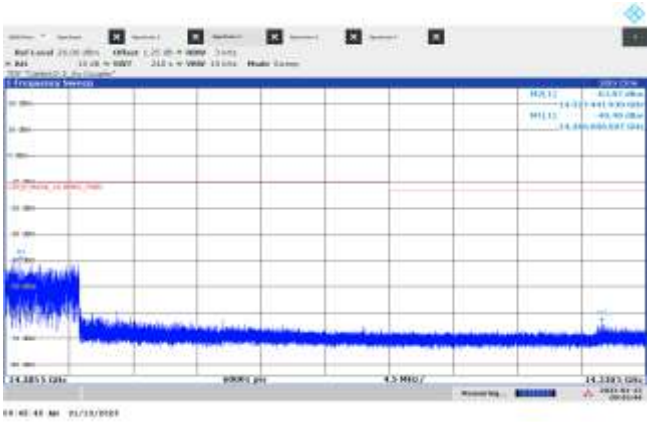
Out-of-band emissions (OOBE) and Band-edge measurements for each Bandwidth and Modulation



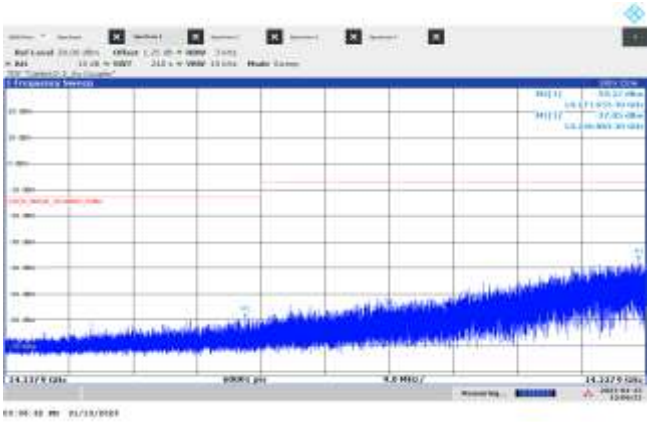
f_{MID} (19.8 MHz, 16QAM)(1)



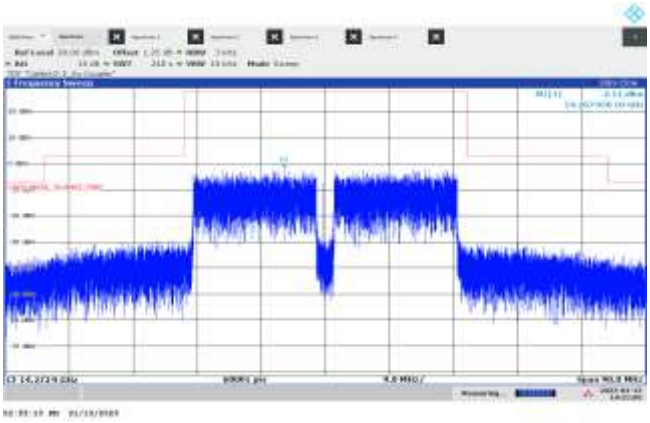
f_{MID} (19.8 MHz, 16QAM)(2)



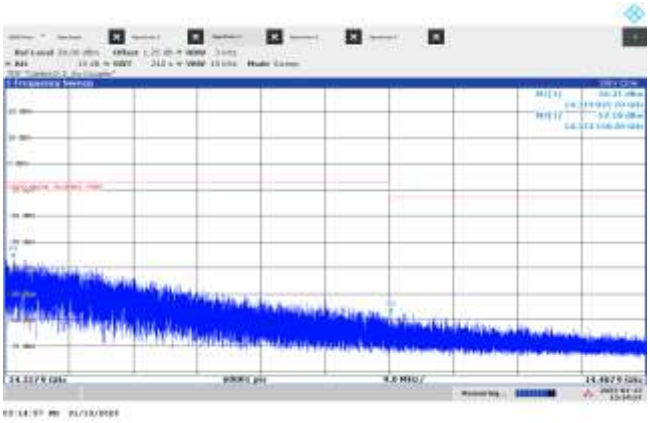
f_{MID} (19.8 MHz, 16QAM)(3)



f_{MID} (39.6 MHz, QPSK)(1)

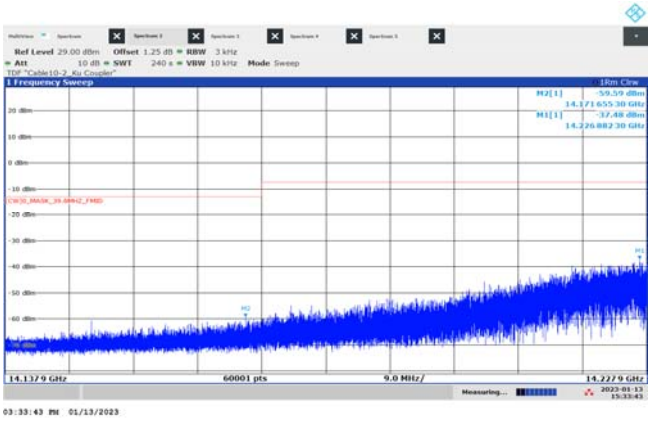


f_{MID} (39.6 MHz, QPSK)(2)

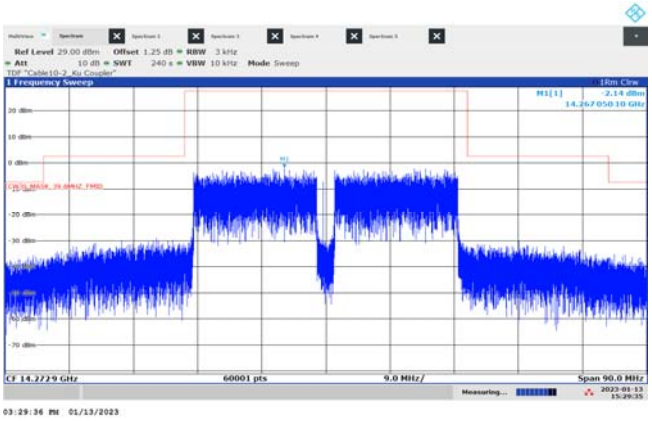


f_{MID} (39.6 MHz, QPSK)(3)

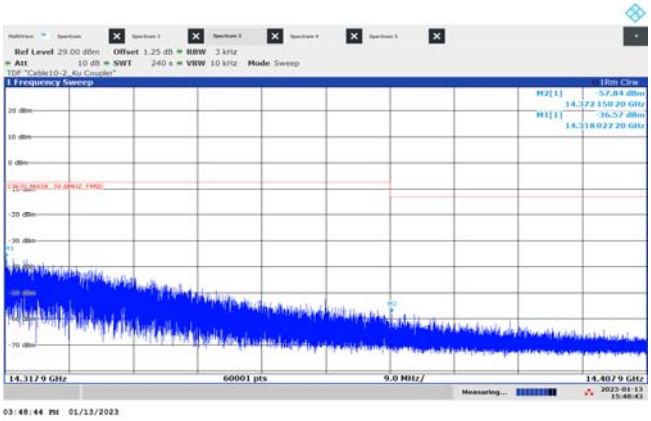
Out-of-band emissions (OOBE) and Band-edge measurements for each Bandwidth and Modulation



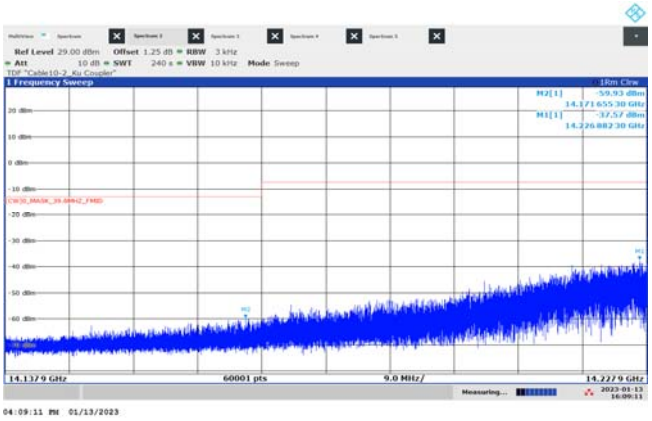
f_{MID} (39.6 MHz, 8PSK)(1)



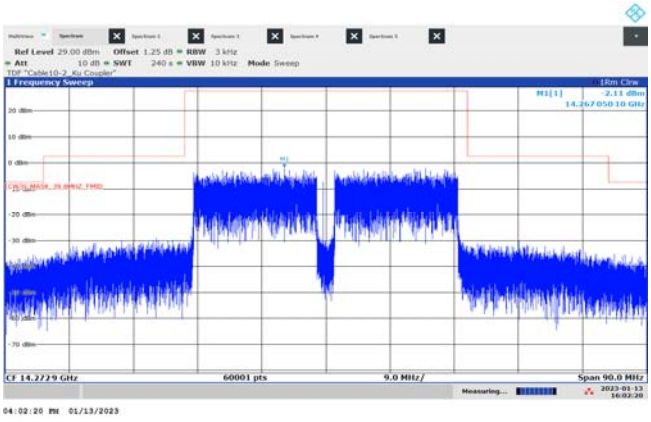
f_{MID} (39.6 MHz, 8PSK)(2)



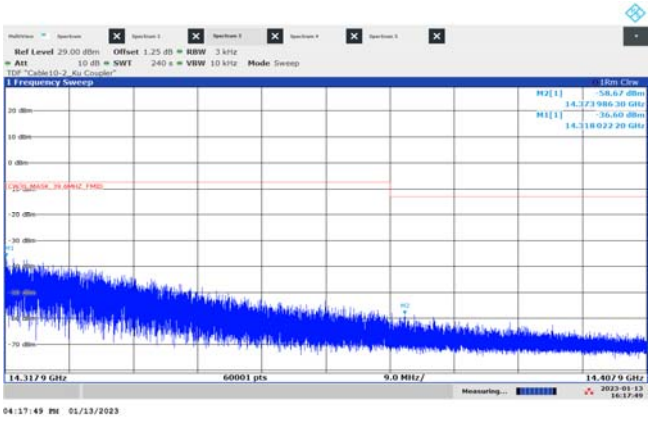
f_{MID} (39.6 MHz, 8PSK)(3)



f_{MID} (39.6 MHz, 16QAM)(1)

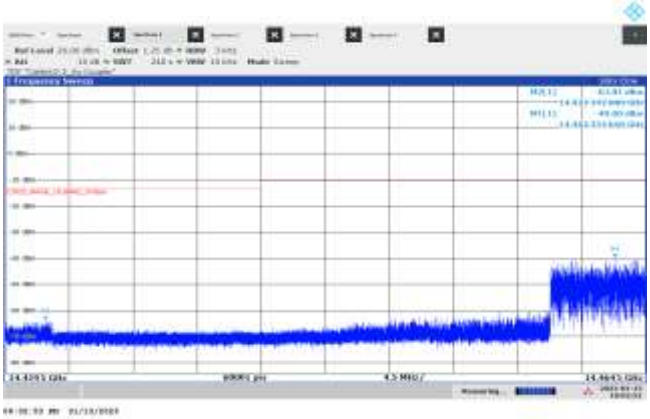


f_{MID} (39.6 MHz, 16QAM)(2)

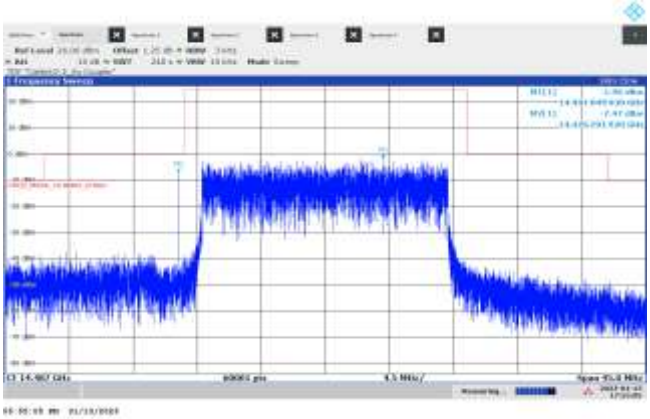


f_{MID} (39.6 MHz, 16QAM)(3)

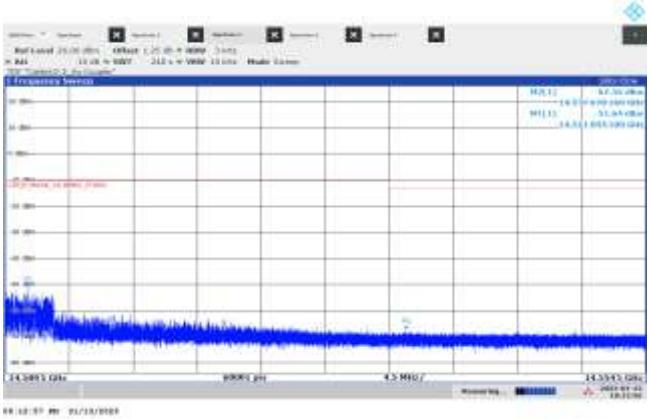
Out-of-band emissions (OOBE) and Band-edge measurements for each Bandwidth and Modulation



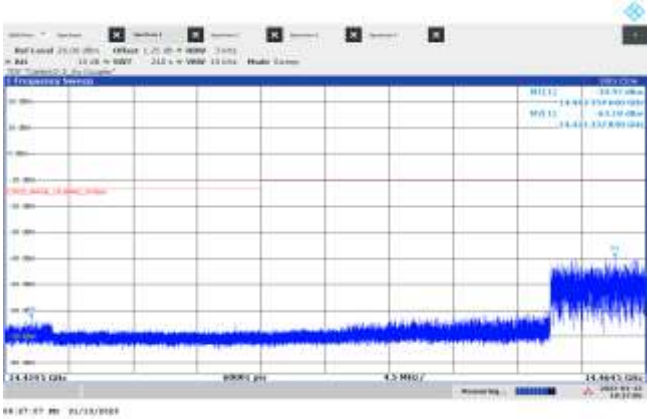
f_{HIGH} (19.8 MHz, QPSK)(1)



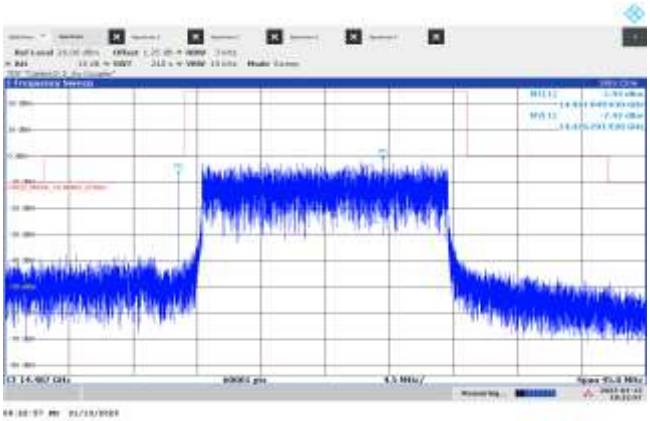
f_{HIGH} (19.8 MHz, QPSK)(2)



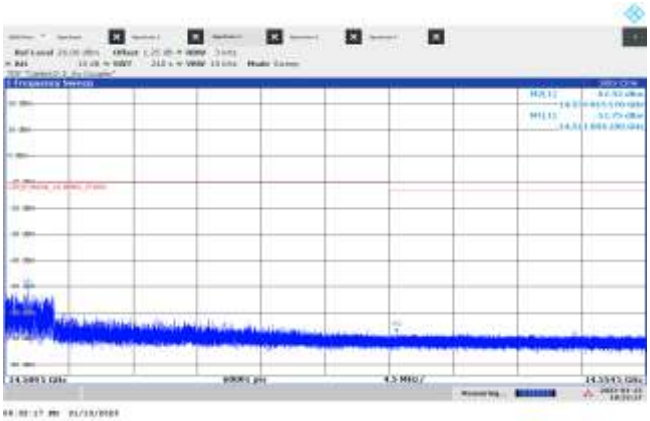
f_{HIGH} (19.8 MHz, QPSK)(3)



f_{HIGH} (19.8 MHz, 8PSK)(1)

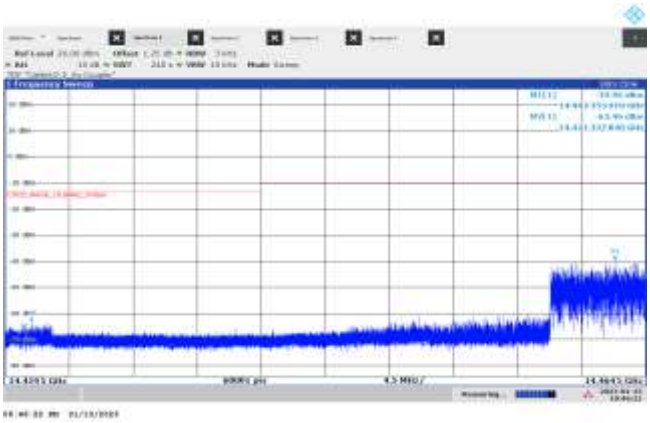


f_{HIGH} (19.8 MHz, 8PSK)(2)

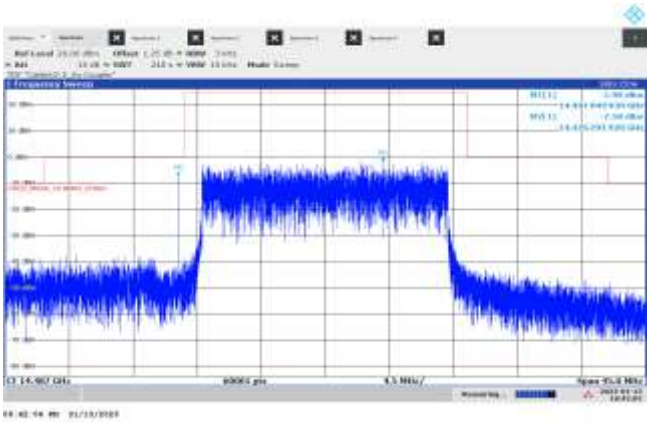


f_{HIGH} (19.8 MHz, 8PSK)(3)

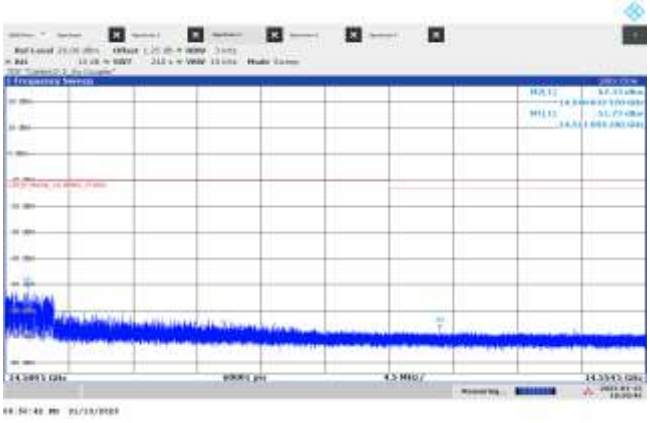
Out-of-band emissions (OOBE) and Band-edge measurements for each Bandwidth and Modulation



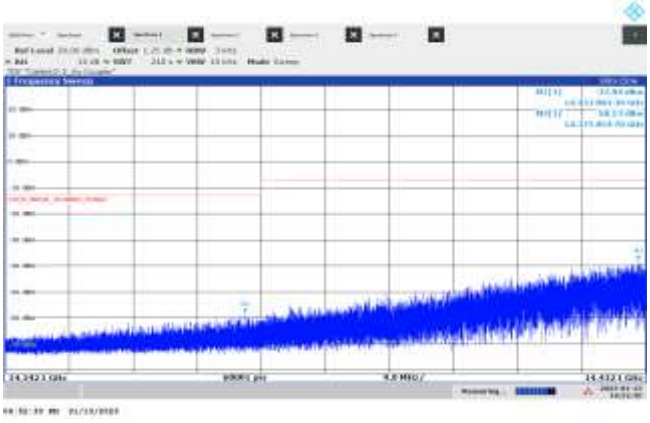
f_{HIGH} (19.8 MHz, 16QAM)(1)



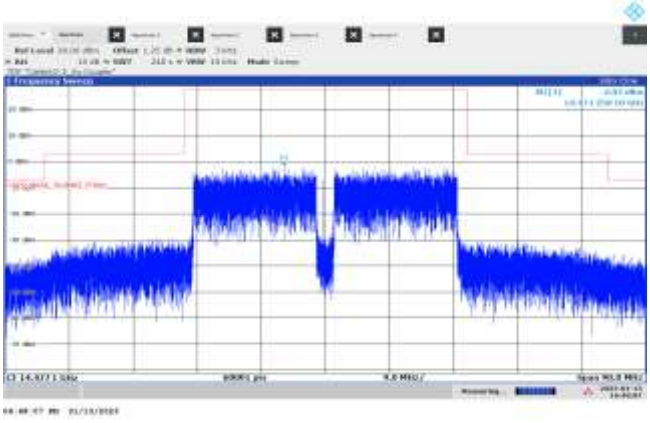
f_{HIGH} (19.8 MHz, 16QAM)(2)



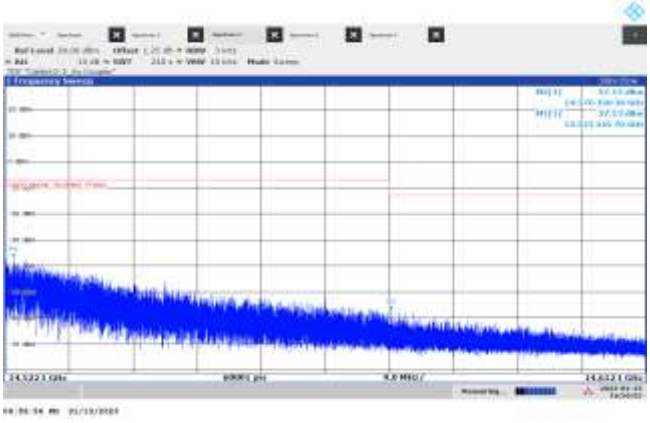
f_{HIGH} (19.8 MHz, 16QAM)(3)



f_{HIGH} (39.6 MHz, QPSK)(1)

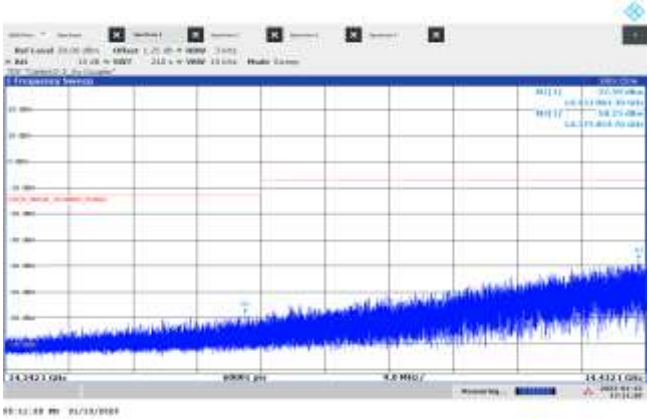


f_{HIGH} (39.6 MHz, QPSK)(2)

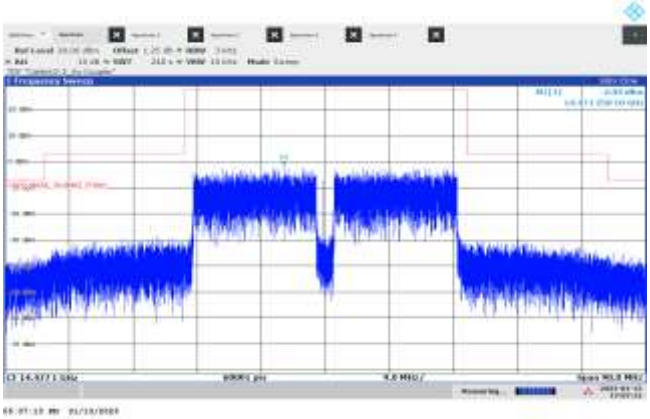


f_{HIGH} (39.6 MHz, QPSK)(3)

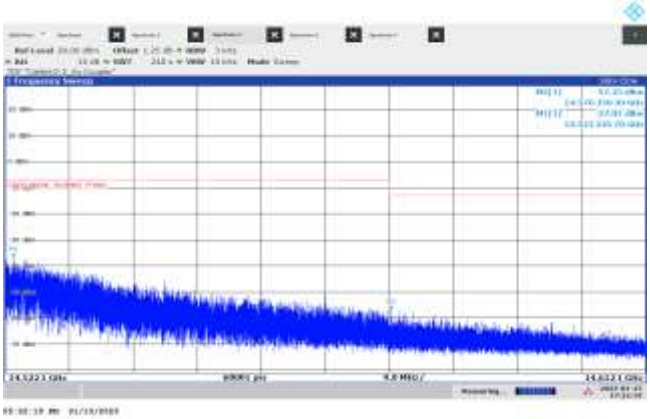
Out-of-band emissions (OOBE) and Band-edge measurements for each Bandwidth and Modulation



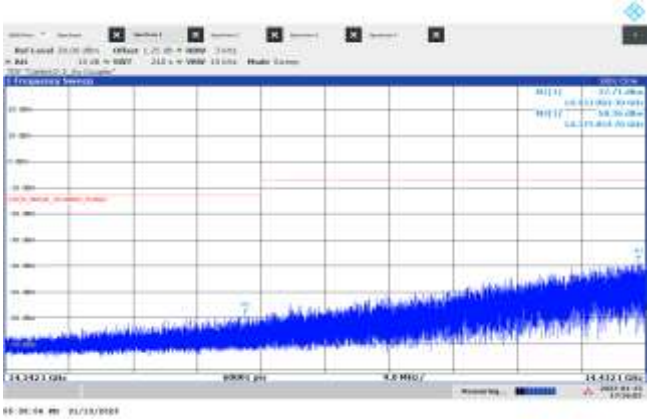
f_{HIGH} (39.6 MHz, 8PSK)(1)



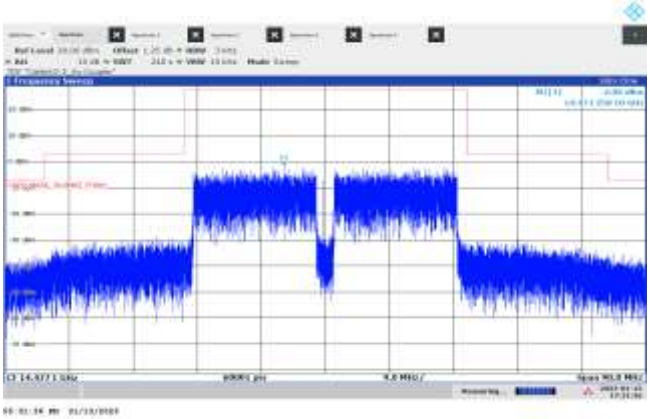
f_{HIGH} (39.6 MHz, 8PSK)(2)



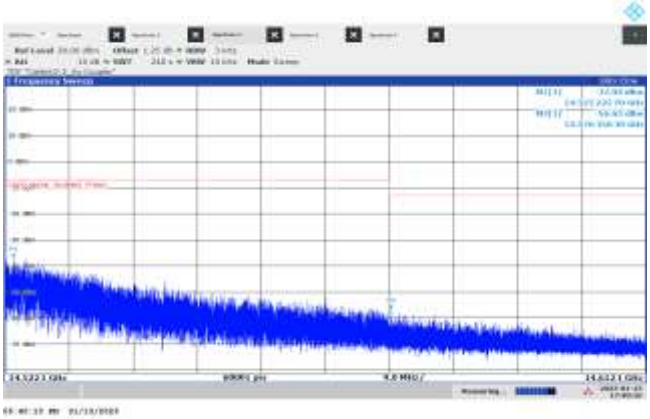
f_{HIGH} (39.6 MHz, 8PSK)(3)



f_{HIGH} (39.6 MHz, 16QAM)(1)



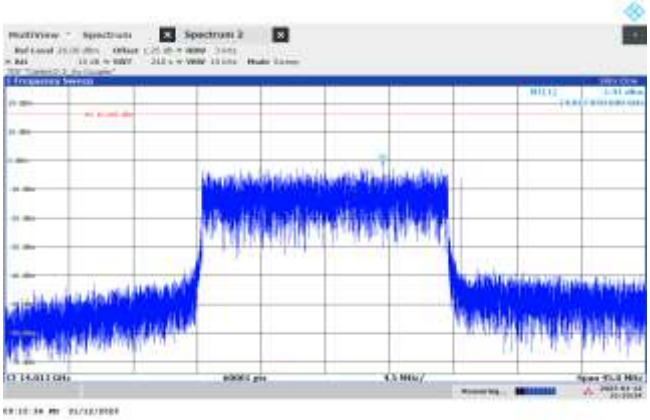
f_{HIGH} (39.6 MHz, 16QAM)(2)



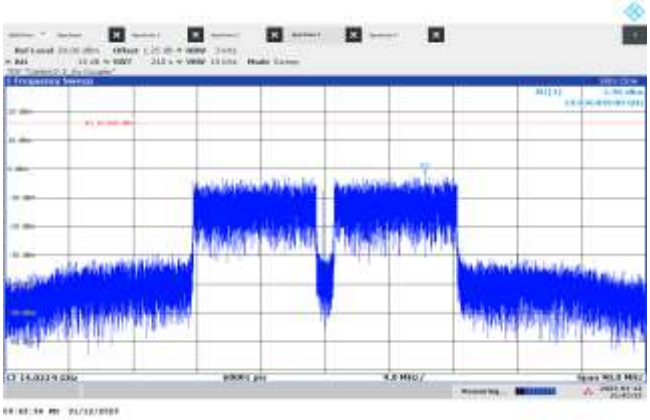
f_{HIGH} (39.6 MHz, 16QAM)(3)

Figure 4. Plot of Off-axis EIRP Spectral density (conducted emissions measurements)

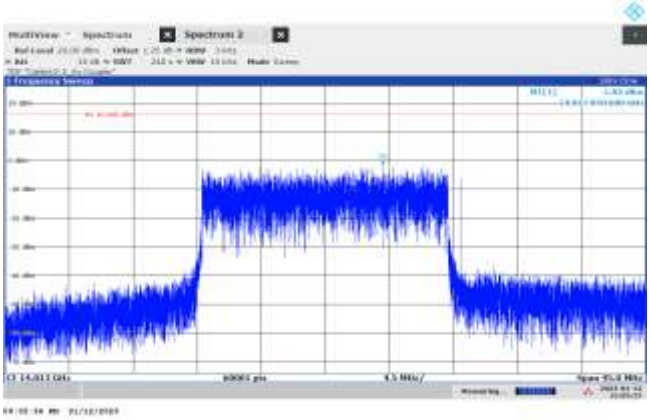
Off-axis EIRP spectral density for each Bandwidth and Modulation



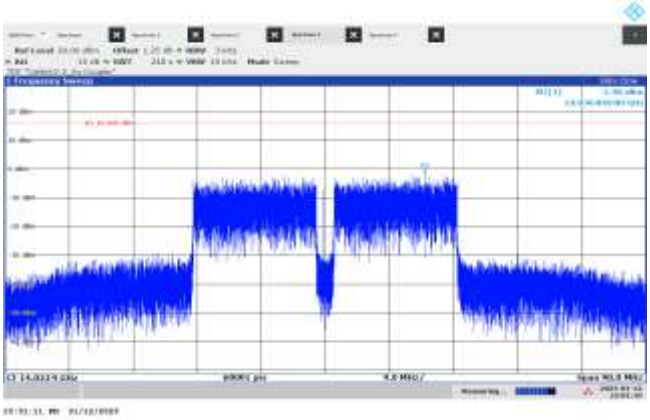
f_{LOW} (19.8 MHz, QPSK)



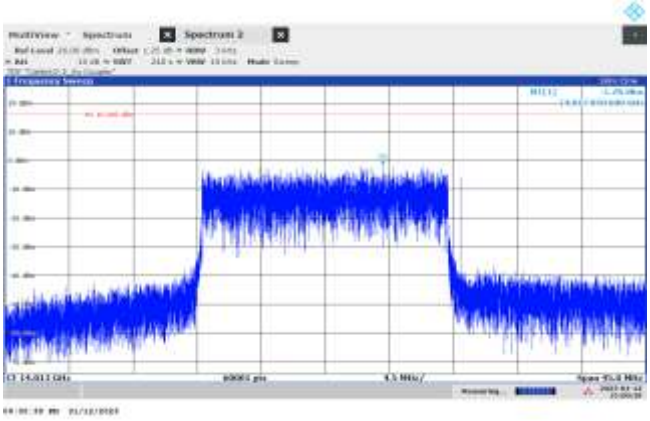
f_{LOW} (39.6 MHz, QPSK)



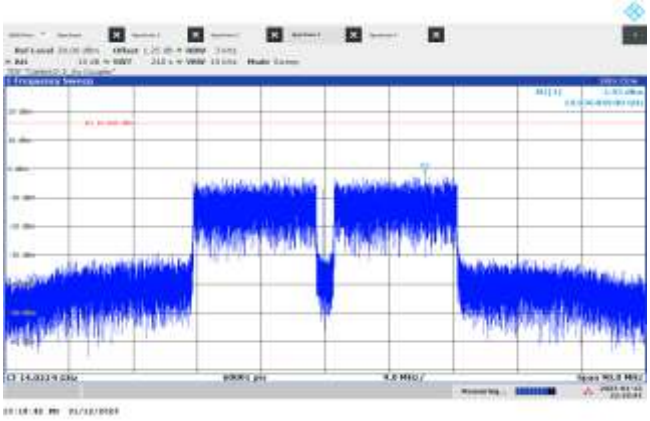
f_{LOW} (19.8 MHz, 8PSK)



f_{LOW} (39.6 MHz, 8PSK)

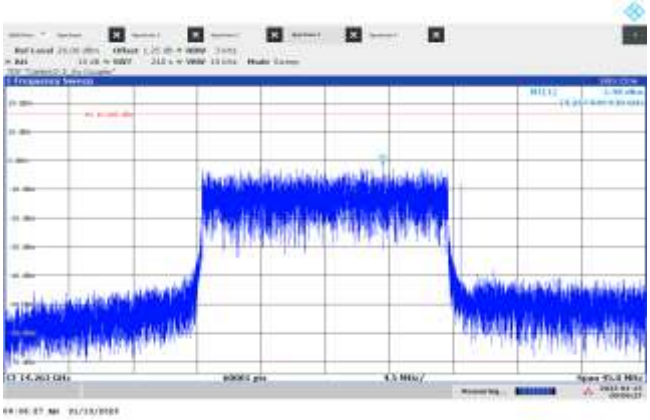


f_{LOW} (19.8 MHz, 16QAM)

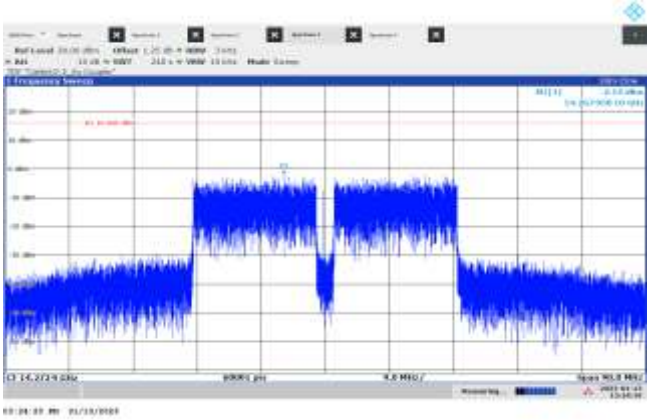


f_{LOW} (39.6 MHz, 16QAM)

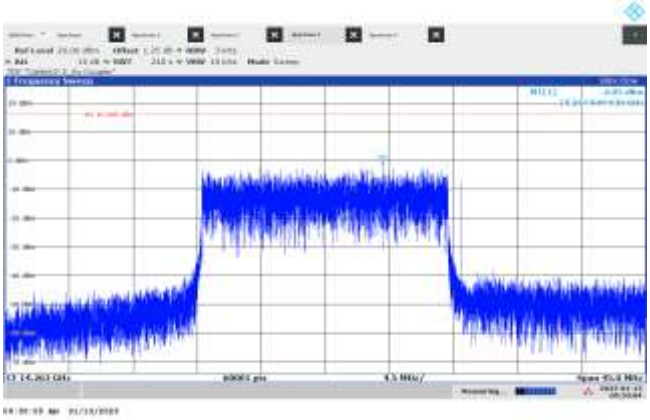
Off-axis EIRP spectral density for each Bandwidth and Modulation



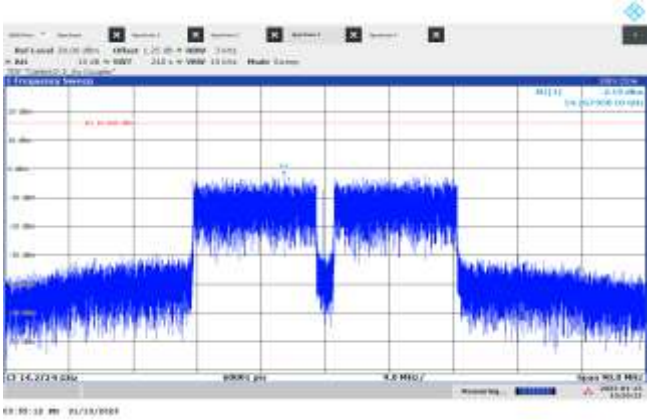
f_{MID} (19.8 MHz, QPSK)



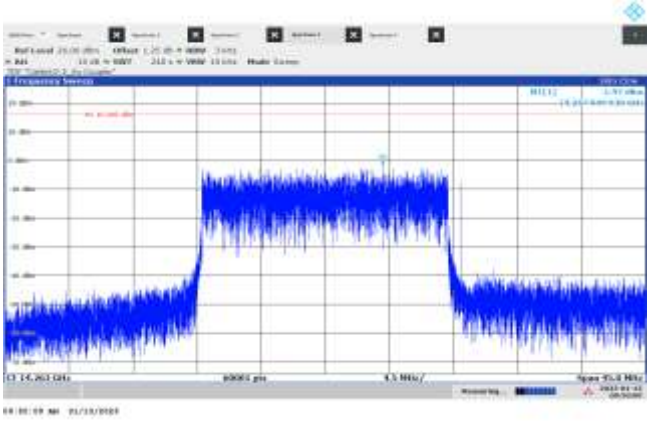
f_{MID} (39.6 MHz, QPSK)



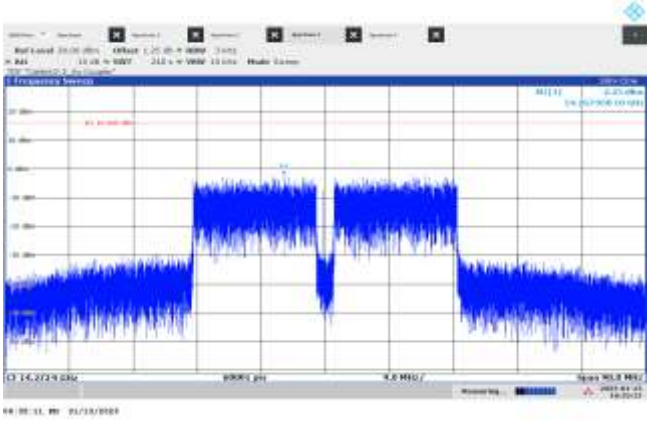
f_{MID} (19.8 MHz, 8PSK)



f_{MID} (39.6 MHz, 8PSK)

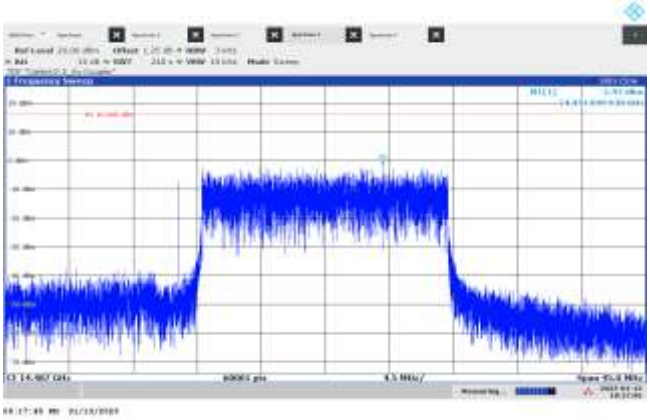


f_{MID} (19.8 MHz, 16QAM)

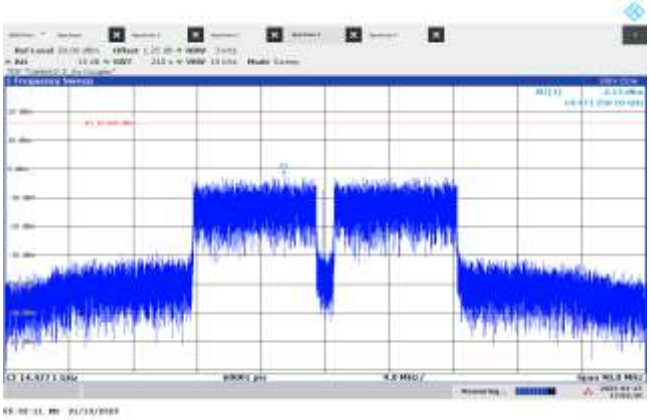


f_{MID} (39.6 MHz, 16QAM)

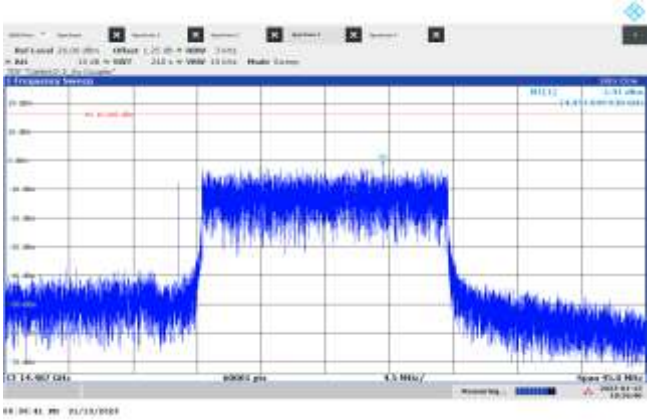
Off-axis EIRP spectral density for each Bandwidth and Modulation



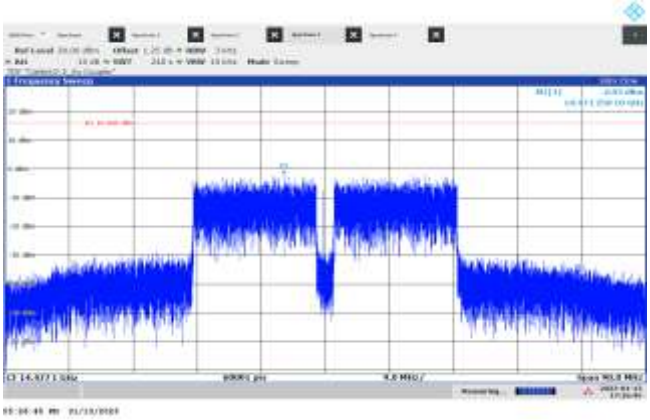
f_{HIGH} (19.8 MHz, QPSK)



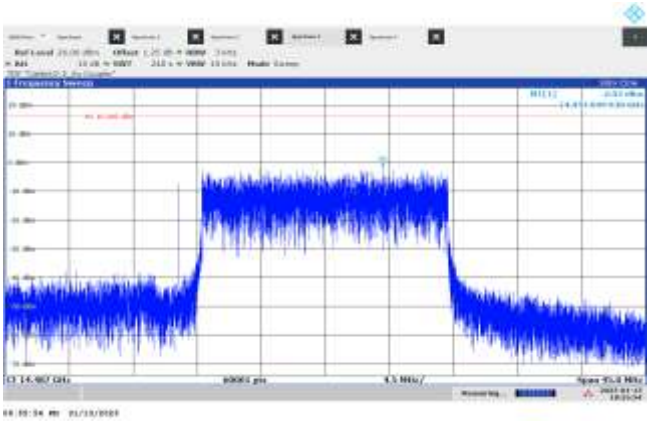
f_{HIGH} (39.6 MHz, QPSK)



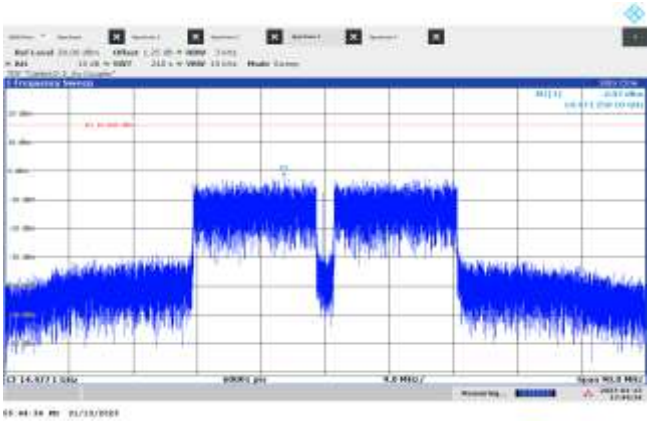
f_{HIGH} (19.8 MHz, 8PSK)



f_{HIGH} (39.6 MHz, 8PSK)



f_{HIGH} (19.8 MHz, 16QAM)



f_{HIGH} (39.6 MHz, 16QAM)

Table 5: Spurious Emissions at Antenna Terminals (conducted emissions)

Transmitting frequency (Bandwidth, Modulation)	Frequency (MHz)	Measured Values (dBm)	Limit (dBm)	Margin (dB)
Transmitting at f_{LOW}				
(19.8 MHz, QPSK)	13 990.318 130	-48.9	-13.0	35.9
(19.8 MHz, 8PSK)	13 990.318 128	-48.9	-13.0	35.9
(19.8 MHz, 16QAM)	13 990.318 130	-48.9	-13.0	35.9
(39.6 MHz, QPSK)	13 976.958 800	-37.6	-13.0	24.6
(39.6 MHz, 8PSK)	13 976.958 800	-37.5	-13.0	24.5
(39.6 MHz, 16QAM)	13 976.958 800	-37.5	-13.0	24.5
Transmitting at f_{MID}				
(19.8 MHz, QPSK)	14 200.003 300	-63.6	-13.0	50.6
(19.8 MHz, 8PSK)	14 200.003 300	-63.4	-13.0	50.4
(19.8 MHz, 16QAM)	14 327.441 930	-63.9	-13.0	50.9
(39.6 MHz, QPSK)	14 372.150 200	-57.2	-13.0	44.2
(39.6 MHz, 8PSK)	14 372.150 200	-57.8	-13.0	44.8
(39.6 MHz, 16QAM)	14 373.986 300	-58.7	-13.0	45.7
Transmitting at f_{HIGH}				
(19.8 MHz, QPSK)	14 537.678 160	-67.6	-13.0	54.6
(19.8 MHz, 8PSK)	14 537.015 170	-67.9	-13.0	54.9
(19.8 MHz, 16QAM)	14 540.032 370	-67.3	-13.0	54.3
(39.6 MHz, QPSK)	14 576.350 300	-57.2	-13.0	44.2
(39.6 MHz, 8PSK)	14 576.350 300	-57.2	-13.0	44.2
(39.6 MHz, 16QAM)	14 576.350 300	-56.6	-13.0	43.6

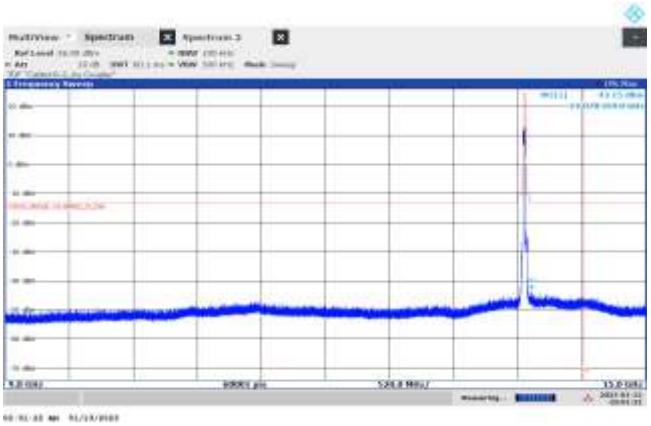
Note: *1) Margin = EIRP - Actual*

Remark: the measured values in the above table were obtained in Figure 3.

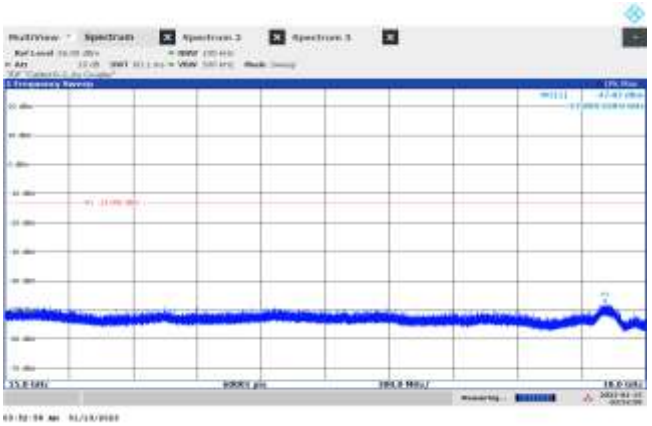
Figure 5. Plot of Spurious Emissions at Antenna Terminals (conducted emissions measurements)

Conducted spurious emission measurements for each Bandwidth and Modulation

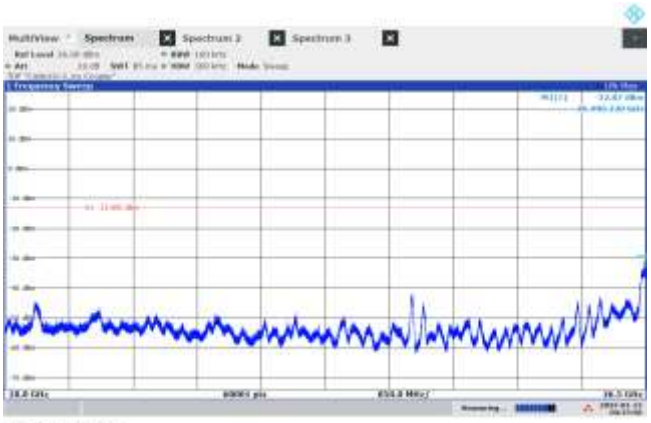
f_{LOW} (19.8 MHz, QPSK)



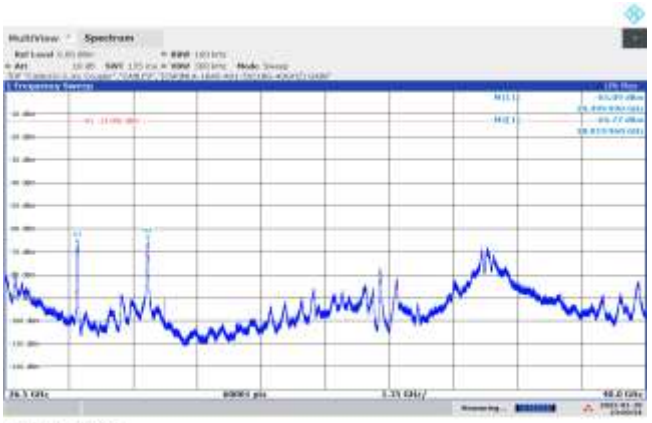
9.8 GHz to 15 GHz



15 GHz to 18 GHz



18 GHz to 26.5 GHz



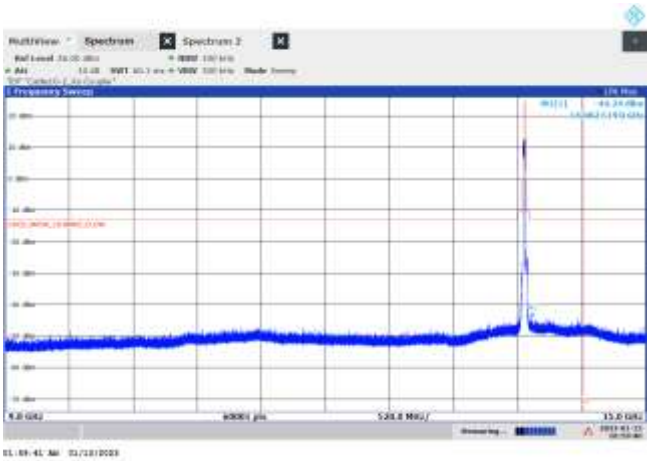
26.5 GHz to 40 GHz

40 GHz to 60 GHz

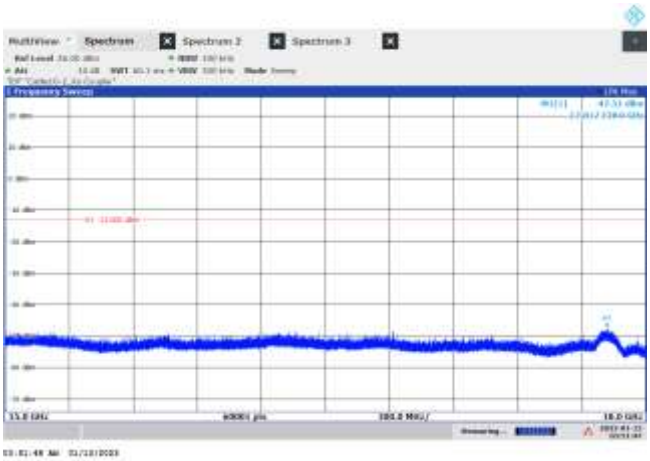
60 GHz to 75 GHz

Conducted spurious emission measurements for each Bandwidth and Modulation

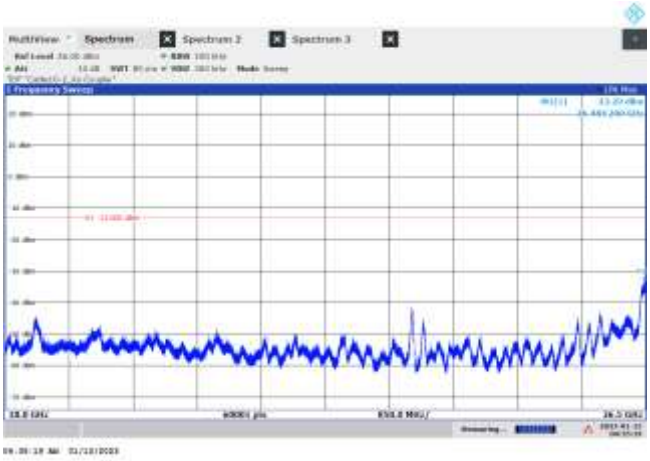
f_{LOW} (19.8 MHz, 8PSK)



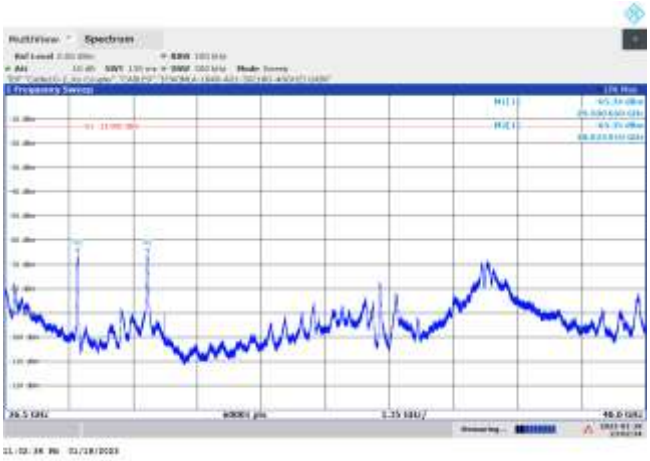
9.8 GHz to 15 GHz



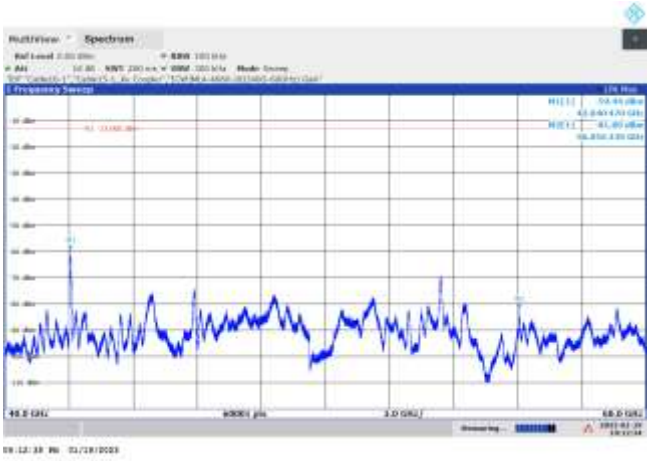
15 GHz to 18 GHz



18 GHz to 26.5 GHz



26.5 GHz to 40 GHz

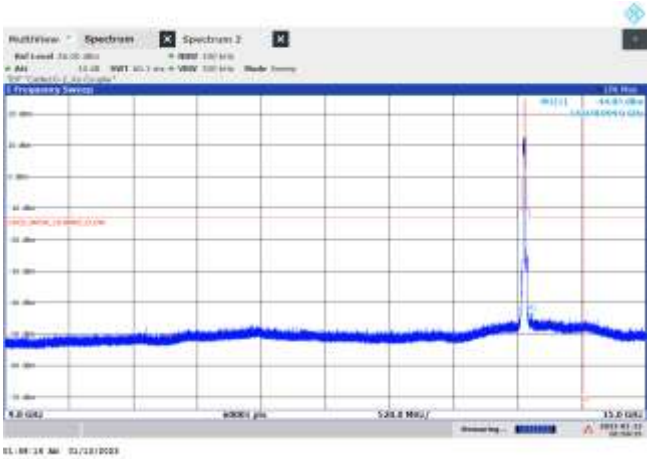


40 GHz to 60 GHz

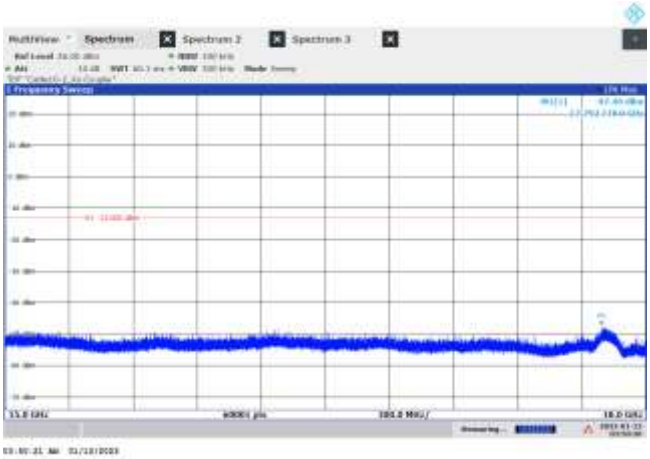
60 GHz to 75 GHz

Conducted spurious emission measurements for each Bandwidth and Modulation

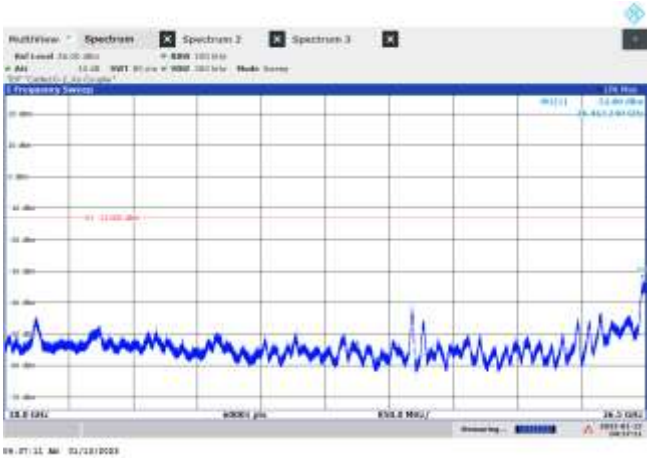
f_{LOW} (19.8 MHz, 16QAM)



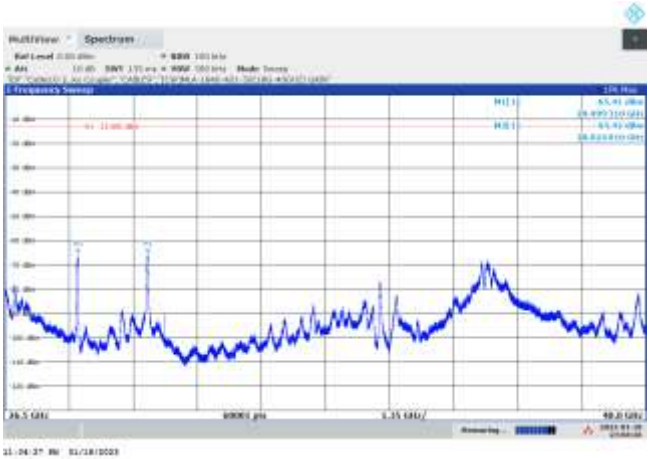
9.8 GHz to 15 GHz



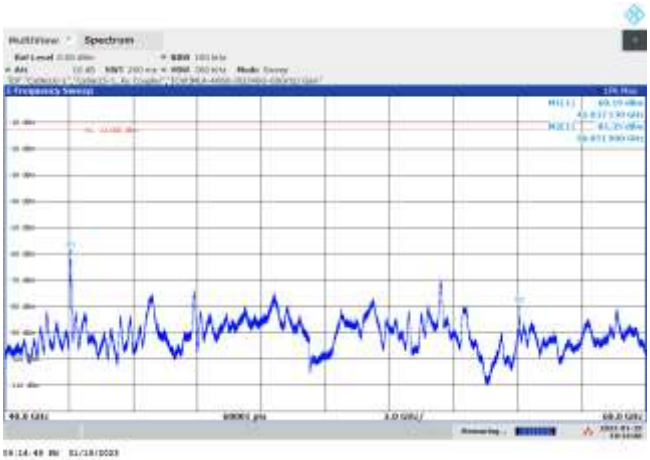
15 GHz to 18 GHz



18 GHz to 26.5 GHz



26.5 GHz to 40 GHz

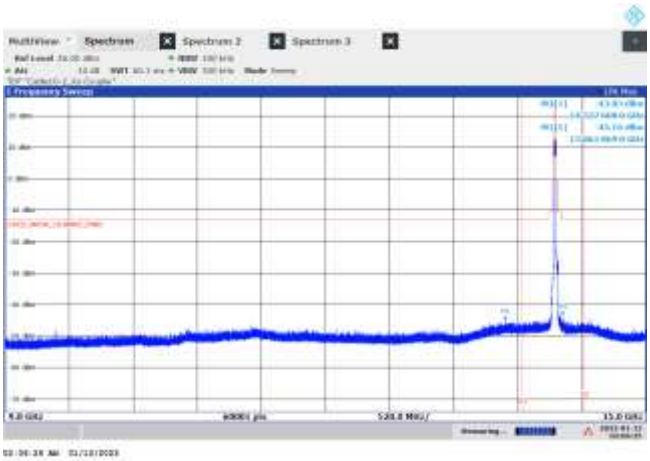


40 GHz to 60 GHz

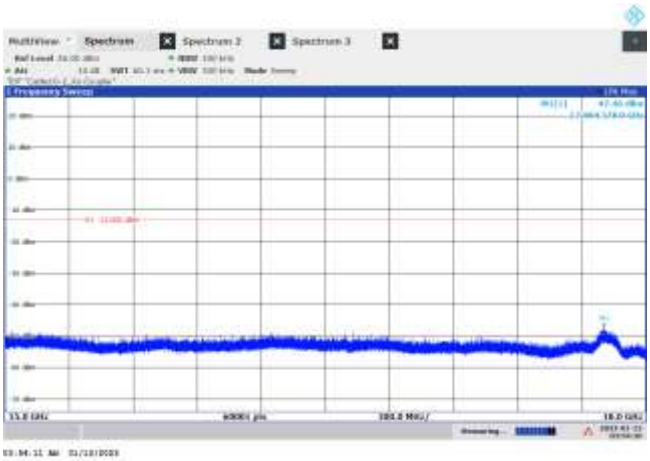
60 GHz to 75 GHz

Conducted spurious emission measurements for each Bandwidth and Modulation

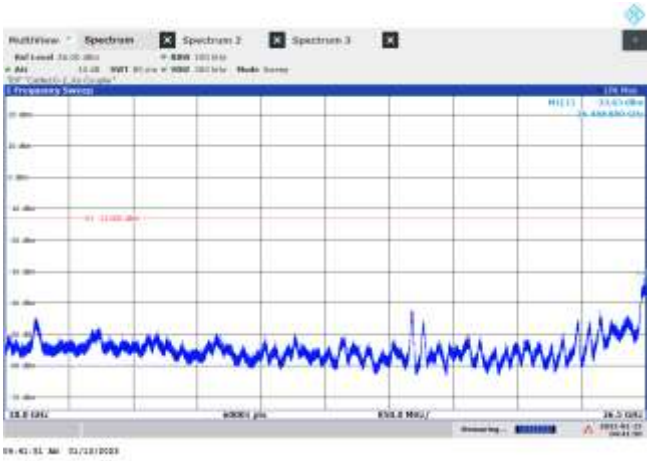
f_{MID} (19.8 MHz, QPSK)



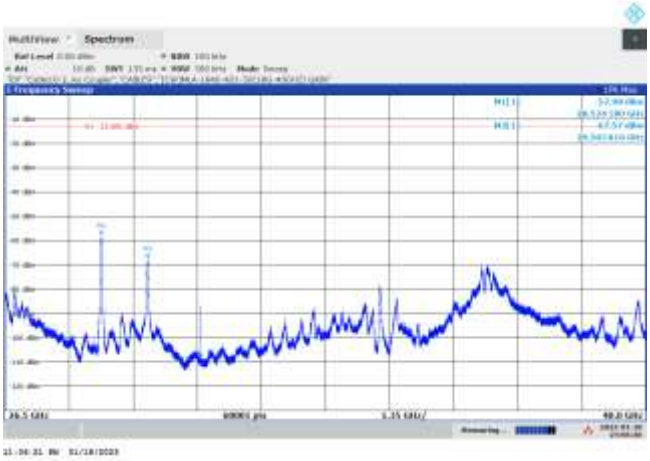
9.8 GHz to 15 GHz



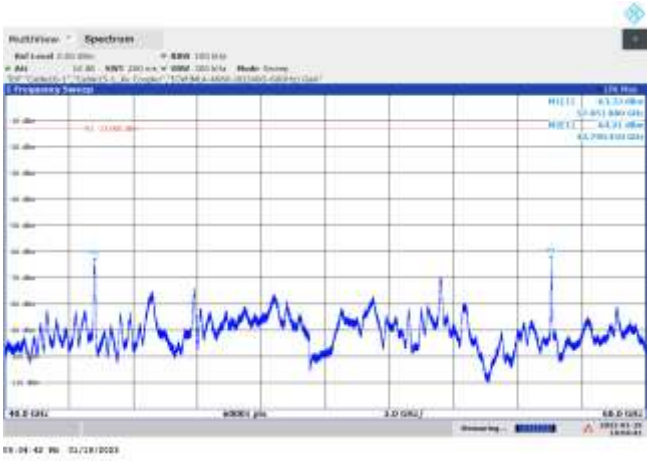
15 GHz to 18 GHz



18 GHz to 26.5 GHz



26.5 GHz to 40 GHz

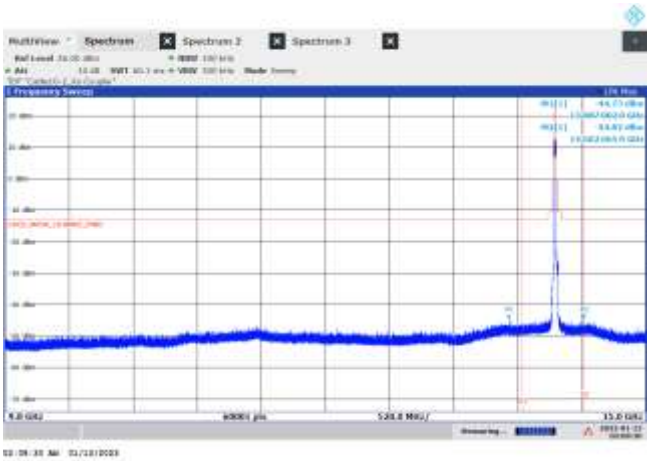


40 GHz to 60 GHz

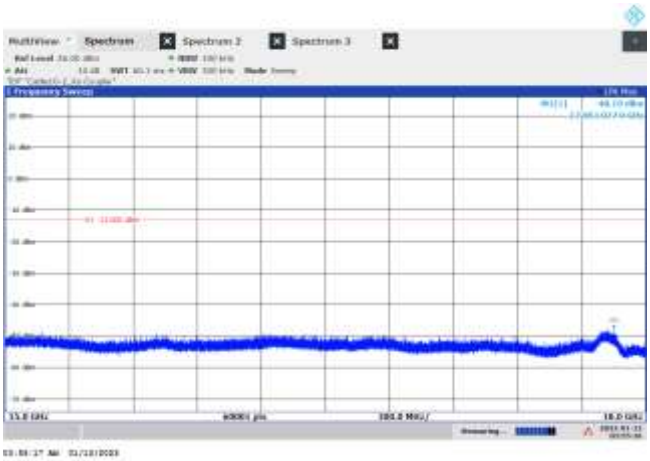
60 GHz to 75 GHz

Conducted spurious emission measurements for each Bandwidth and Modulation

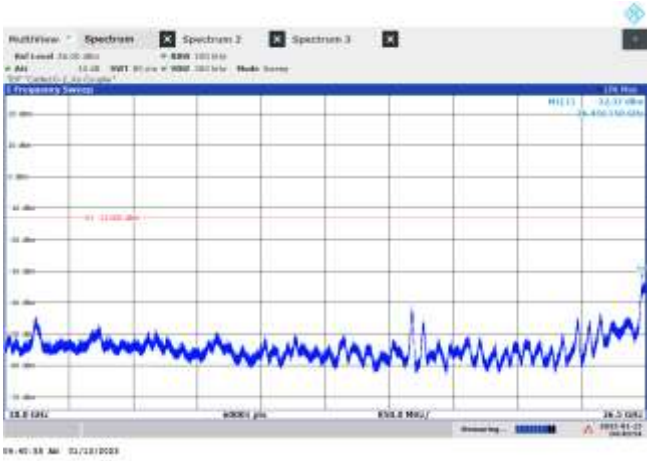
f_{MID} (19.8 MHz, 8PSK)



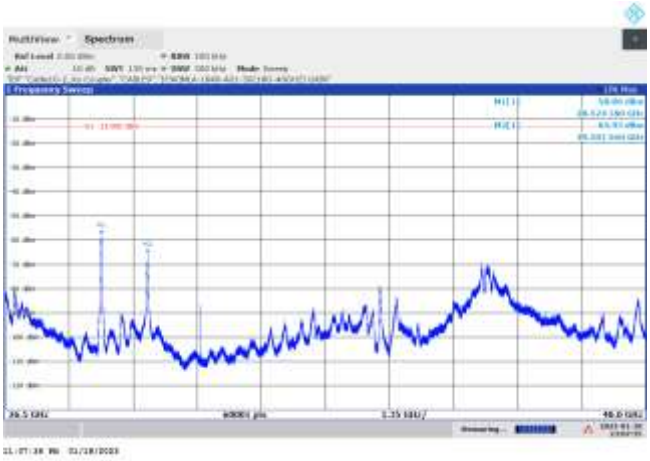
9.8 GHz to 15 GHz



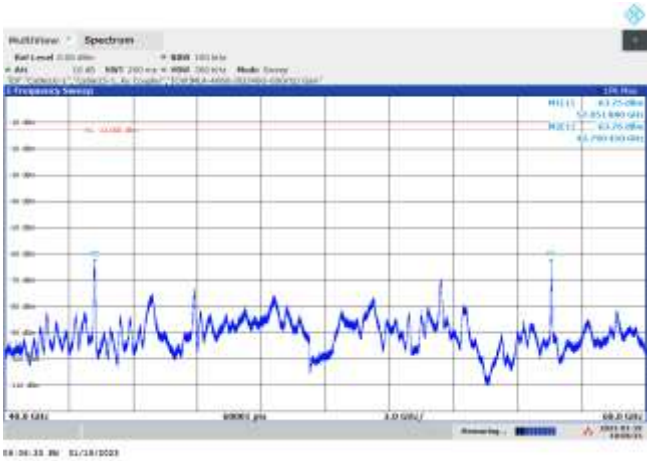
15 GHz to 18 GHz



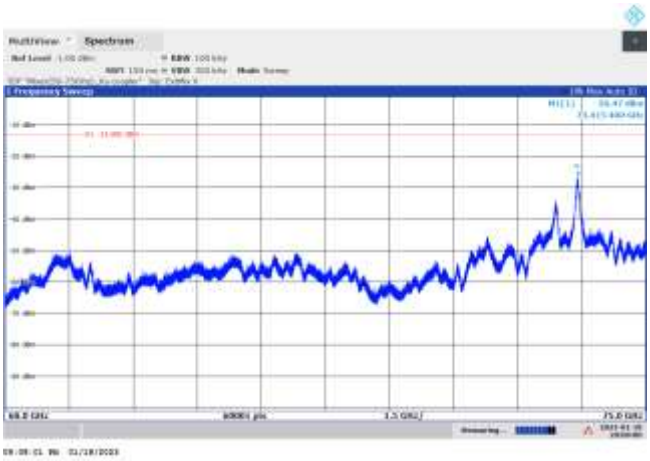
18 GHz to 26.5 GHz



26.5 GHz to 40 GHz



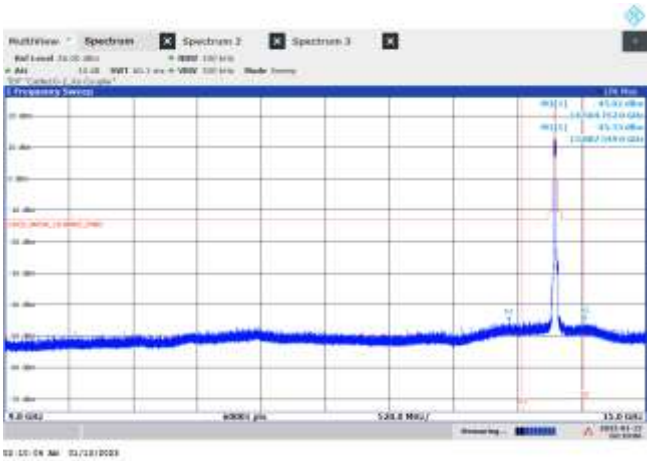
40 GHz to 60 GHz



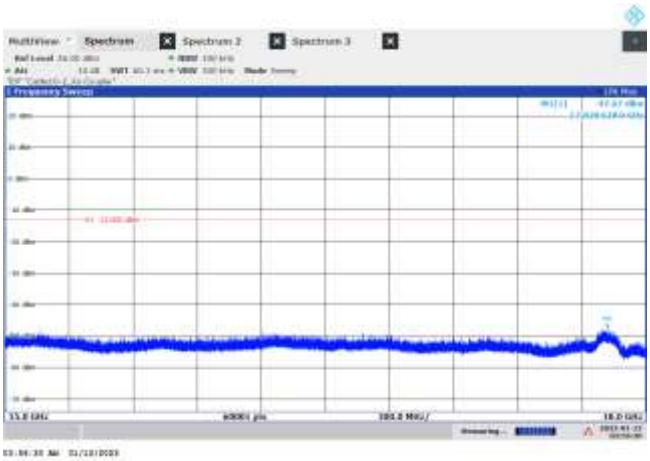
60 GHz to 75 GHz

Conducted spurious emission measurements for each Bandwidth and Modulation

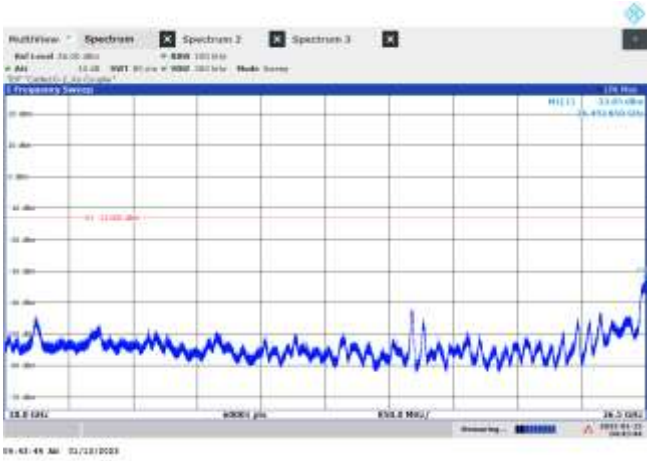
f_{MID} (19.8 MHz, 16QAM)



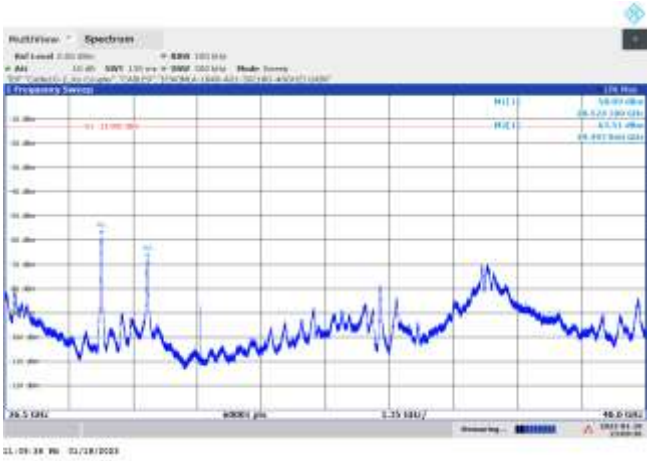
9.8 GHz to 15 GHz



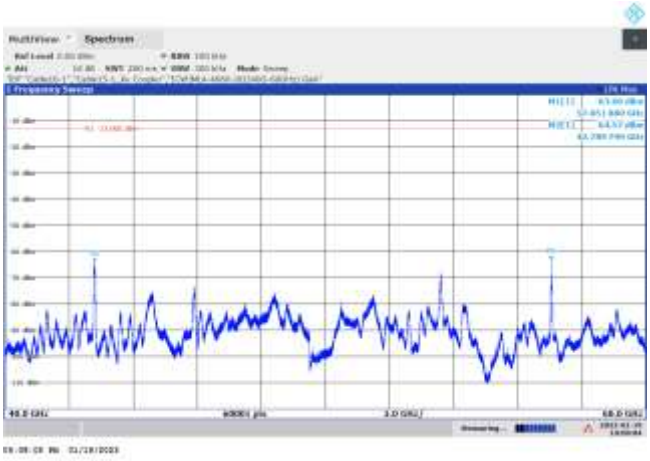
15 GHz to 18 GHz



18 GHz to 26.5 GHz



26.5 GHz to 40 GHz

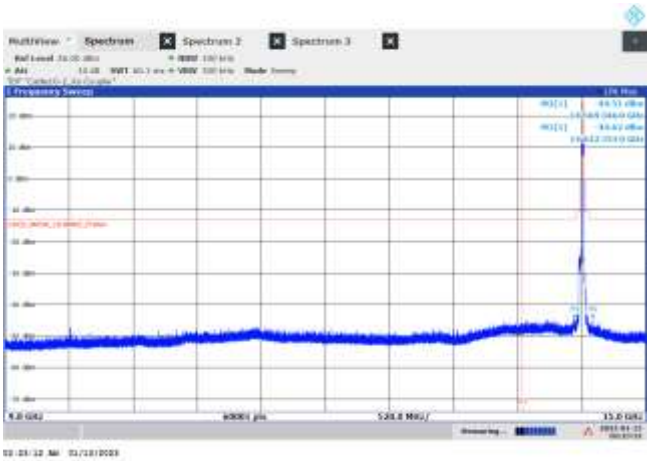


40 GHz to 60 GHz

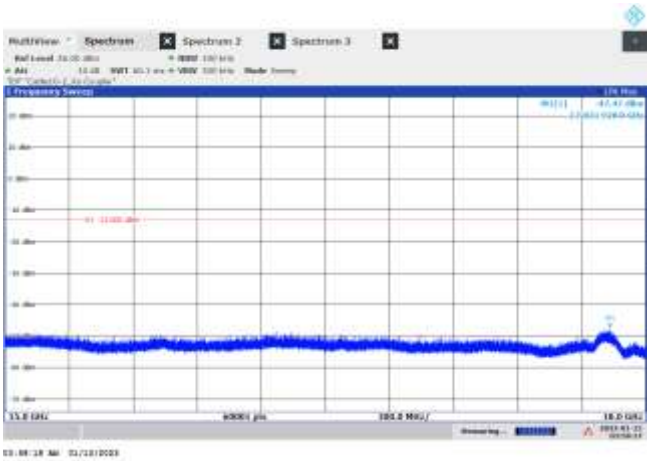
60 GHz to 75 GHz

Conducted spurious emission measurements for each Bandwidth and Modulation

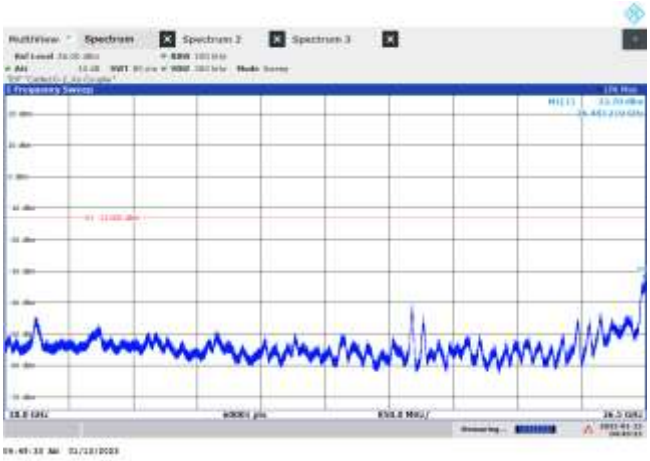
f_{HIGH} (19.8 MHz, QPSK)



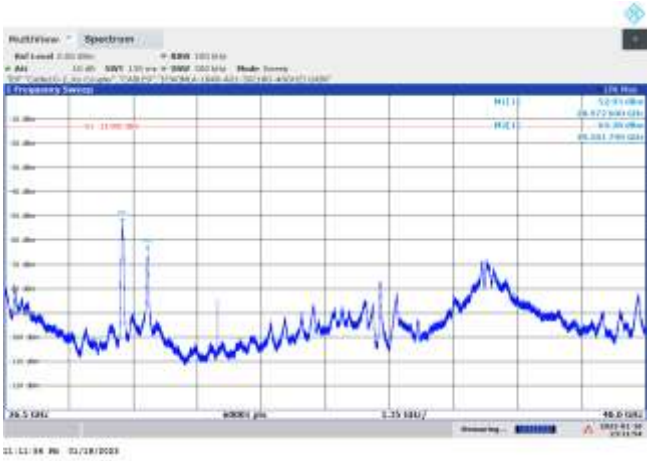
9.8 GHz to 15 GHz



15 GHz to 18 GHz



18 GHz to 26.5 GHz



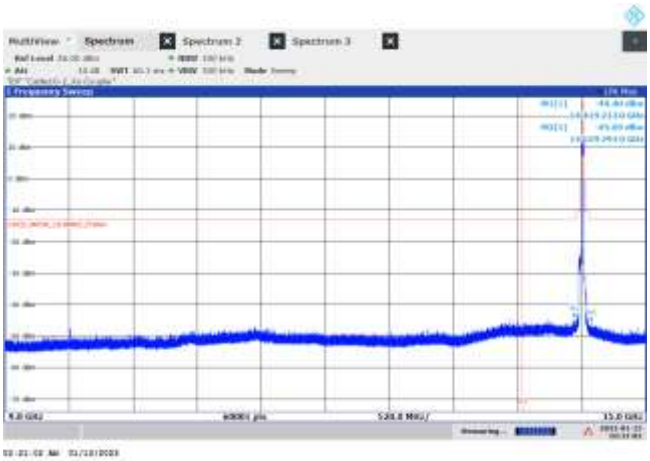
26.5 GHz to 40 GHz

40 GHz to 60 GHz

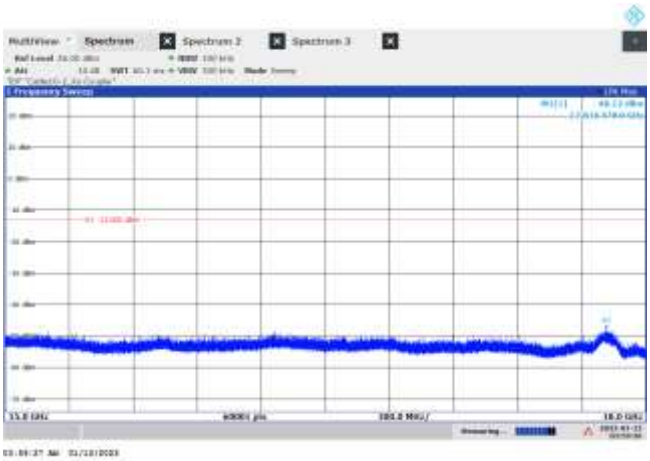
60 GHz to 75 GHz

Conducted spurious emission measurements for each Bandwidth and Modulation

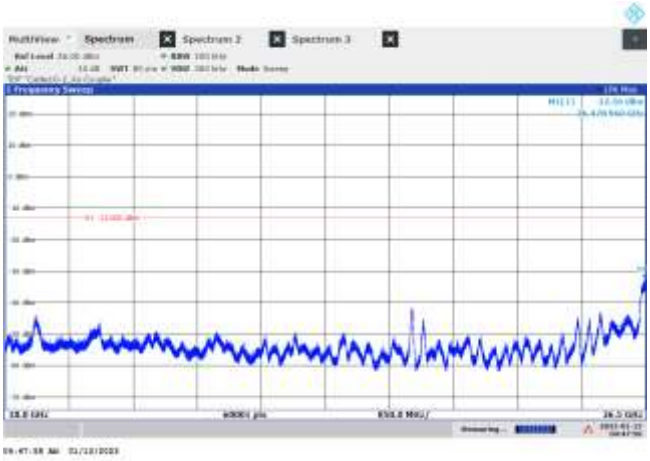
f_{HIGH} (19.8 MHz, 8PSK)



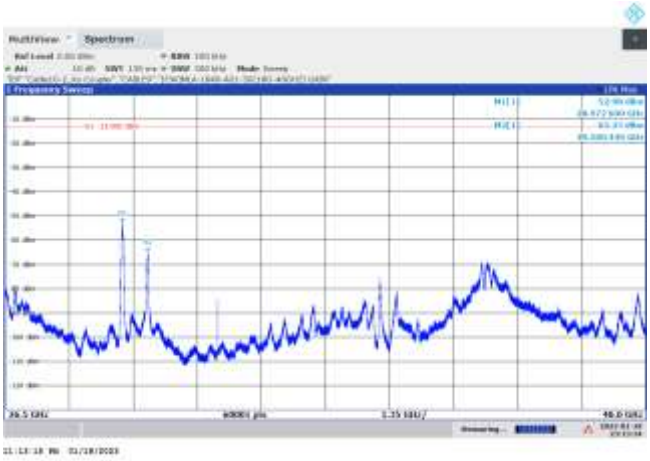
9.8 GHz to 15 GHz



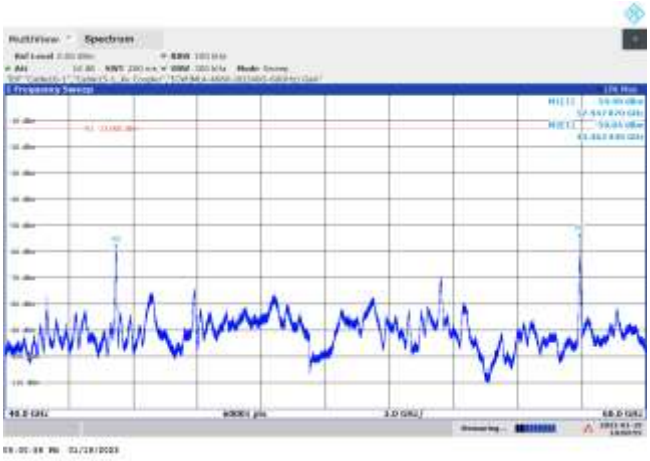
15 GHz to 18 GHz



18 GHz to 26.5 GHz



26.5 GHz to 40 GHz

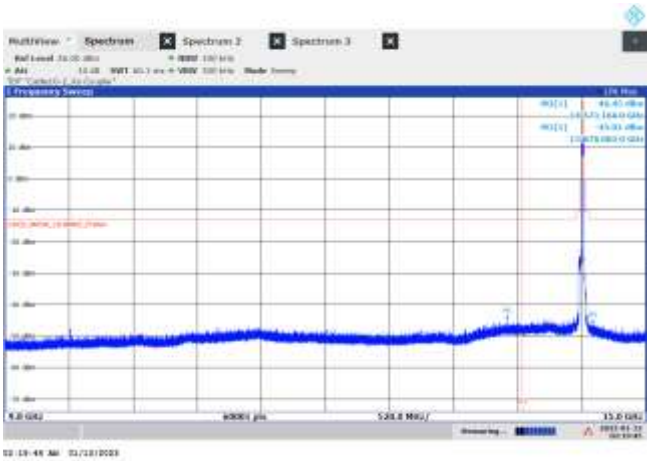


40 GHz to 60 GHz

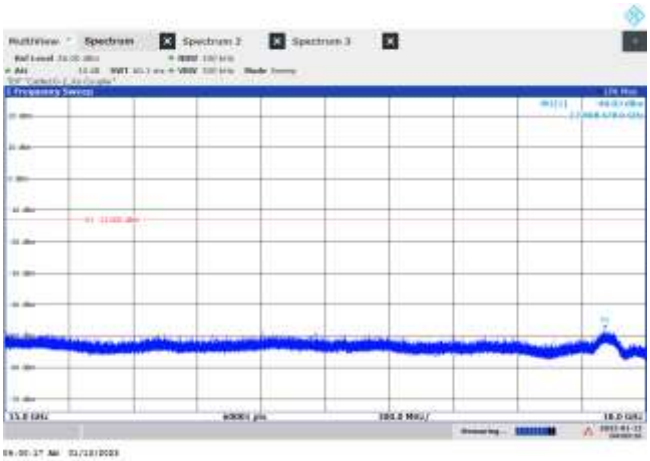
60 GHz to 75 GHz

Conducted spurious emission measurements for each Bandwidth and Modulation

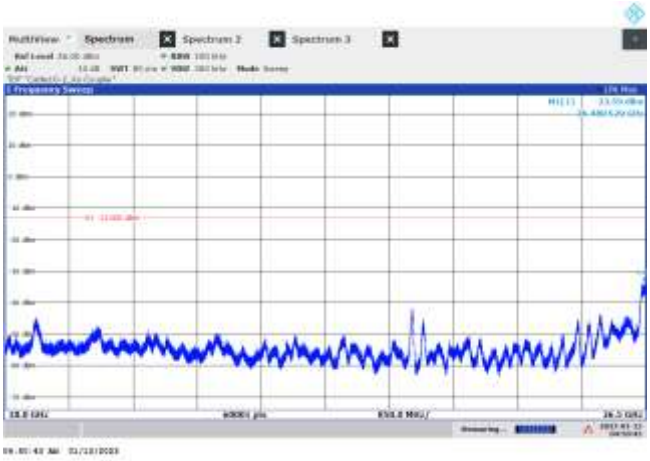
f_{HIGH} (19.8 MHz, 16QAM)



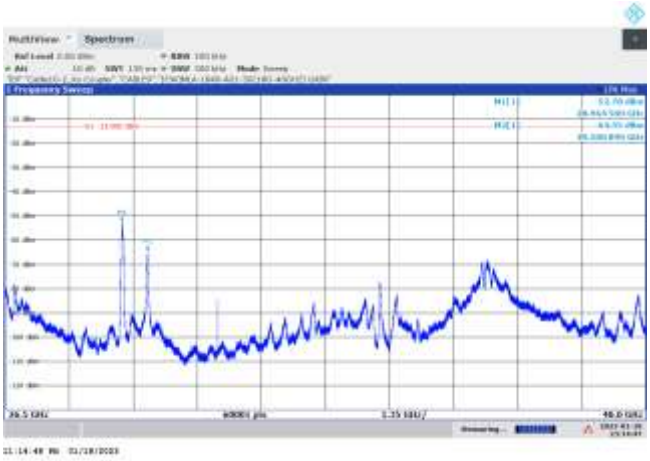
9.8 GHz to 15 GHz



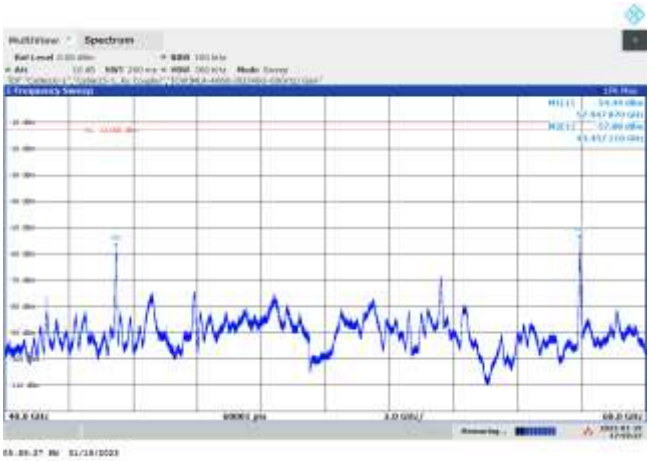
15 GHz to 18 GHz



18 GHz to 26.5 GHz



26.5 GHz to 40 GHz

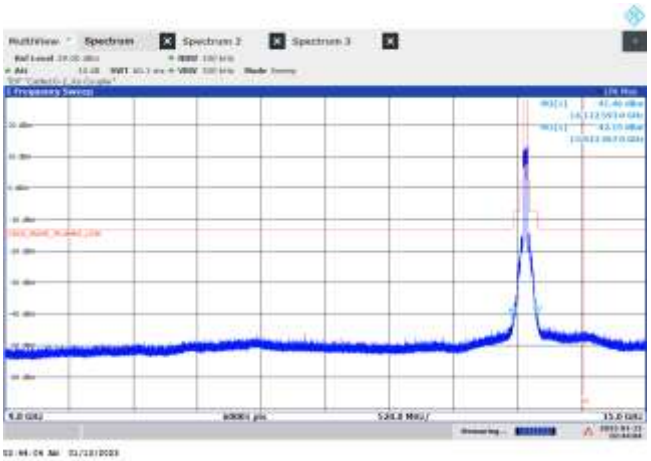


40 GHz to 60 GHz

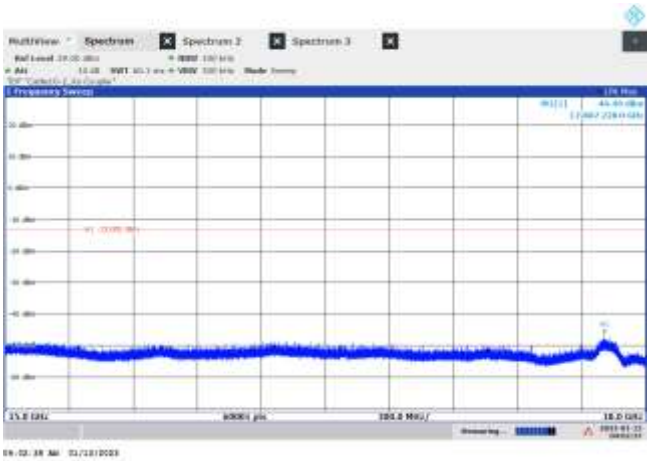
60 GHz to 75 GHz

Conducted spurious emission measurements for each Bandwidth and Modulation

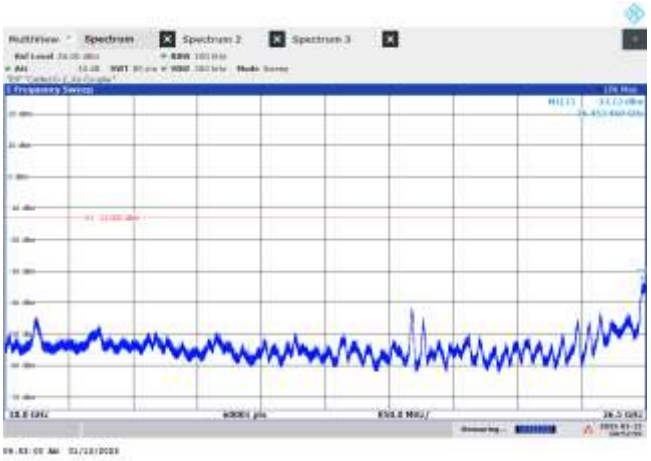
f_{LOW} (39.6 MHz, QPSK)



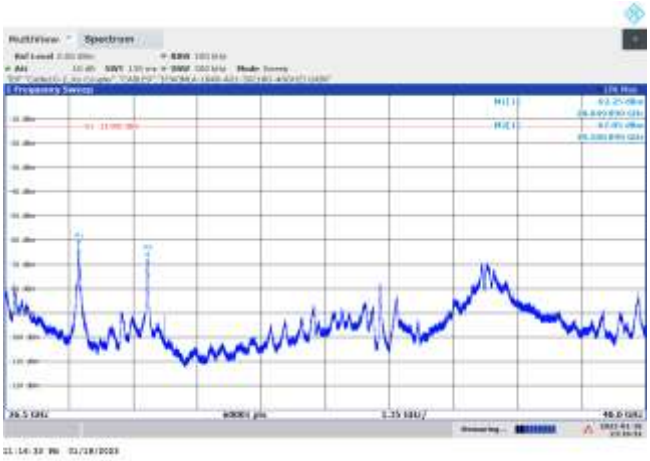
9.8 GHz to 15 GHz



15 GHz to 18 GHz



18 GHz to 26.5 GHz



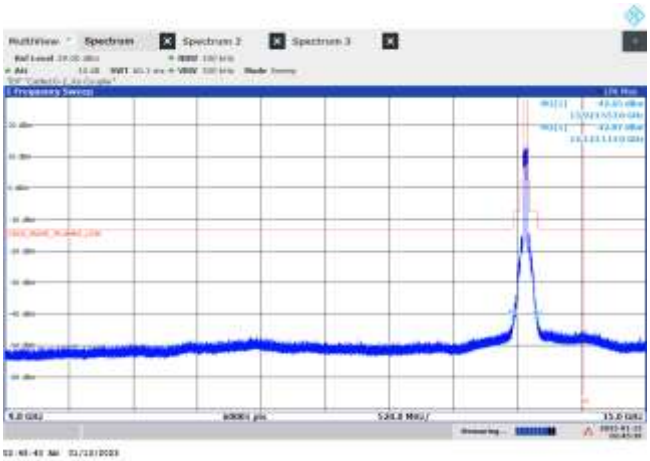
26.5 GHz to 40 GHz

40 GHz to 60 GHz

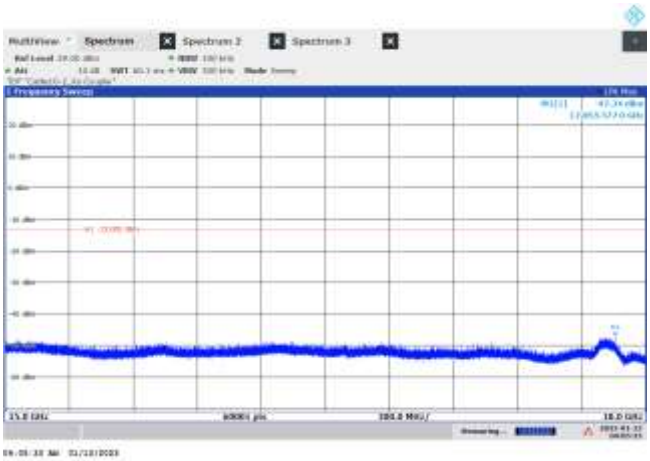
60 GHz to 75 GHz

Conducted spurious emission measurements for each Bandwidth and Modulation

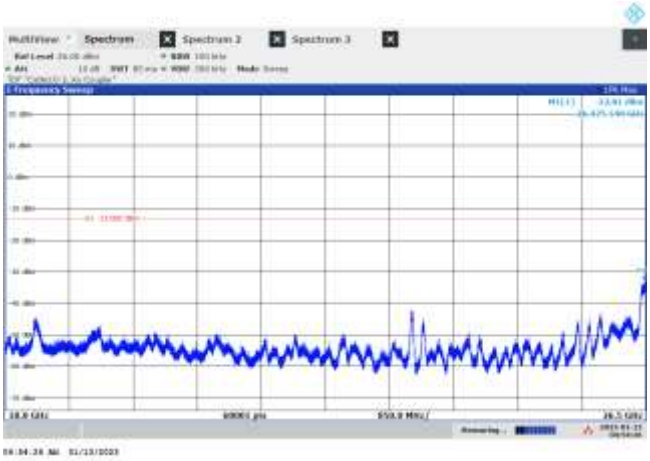
f_{LOW} (39.6 MHz, 8PSK)



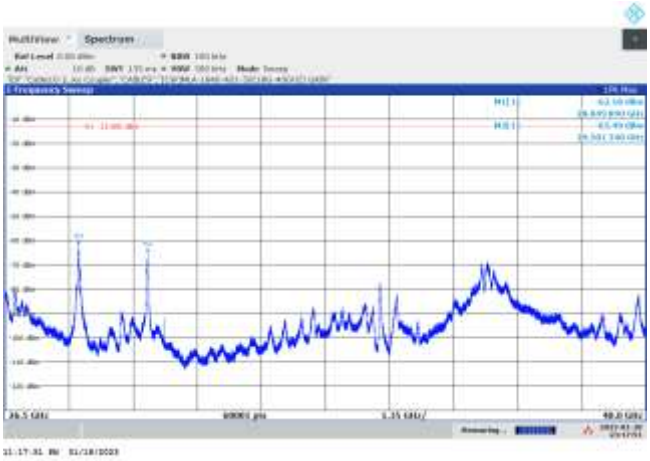
9.8 GHz to 15 GHz



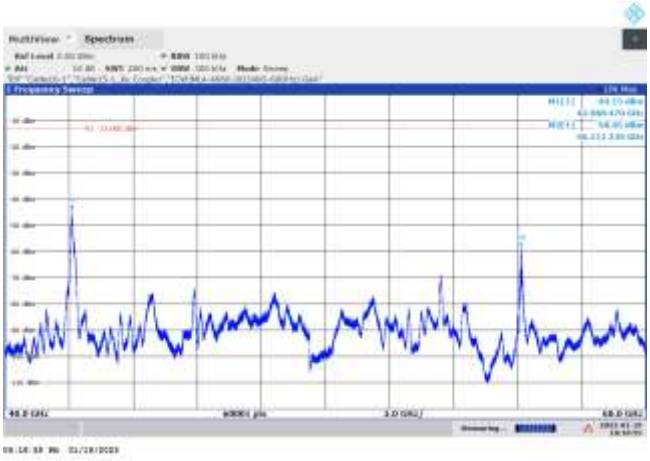
15 GHz to 18 GHz



18 GHz to 26.5 GHz



26.5 GHz to 40 GHz

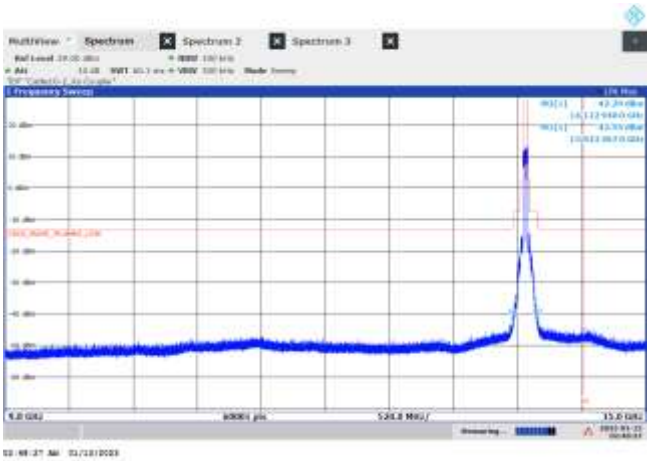


40 GHz to 60 GHz

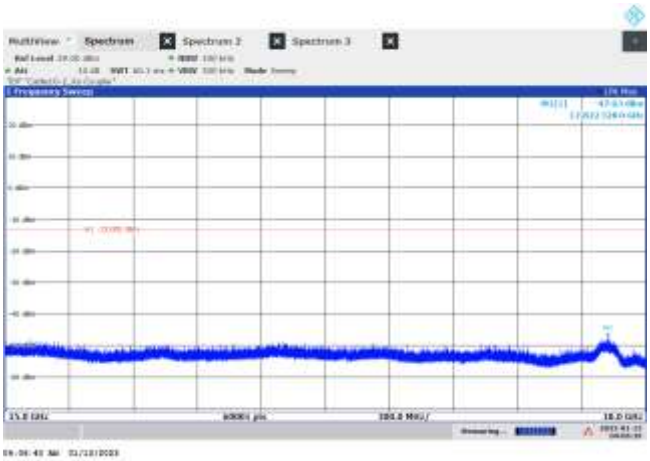
60 GHz to 75 GHz

Conducted spurious emission measurements for each Bandwidth and Modulation

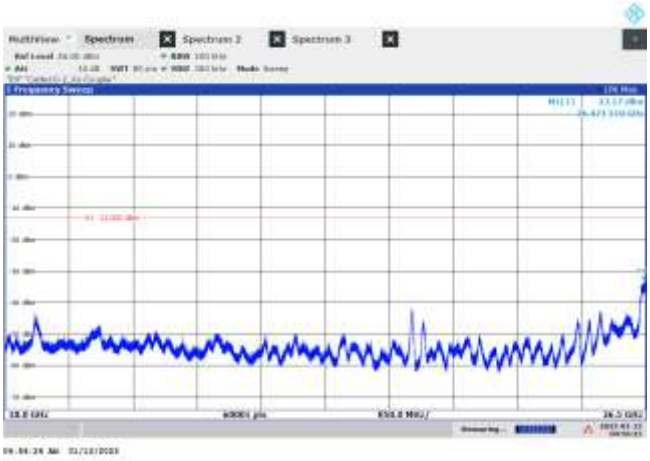
f_{Low} (39.6 MHz, 16QAM)



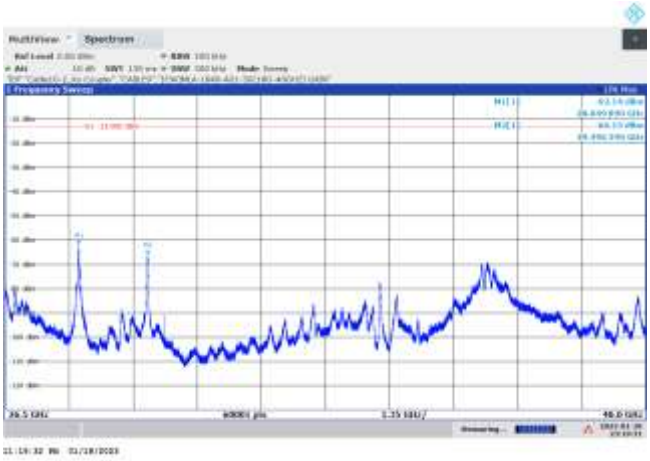
9.8 GHz to 15 GHz



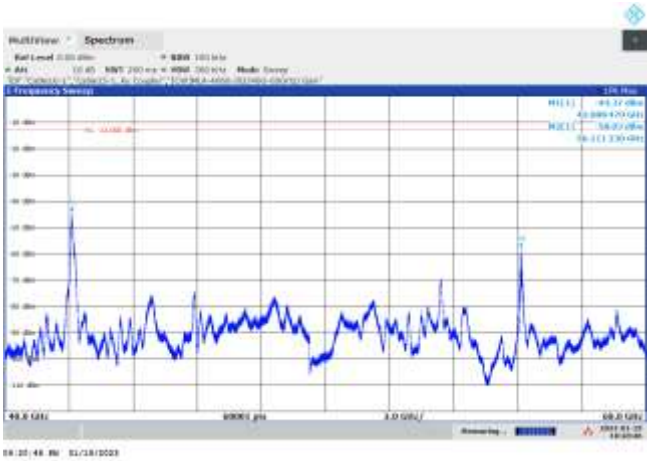
15 GHz to 18 GHz



18 GHz to 26.5 GHz



26.5 GHz to 40 GHz

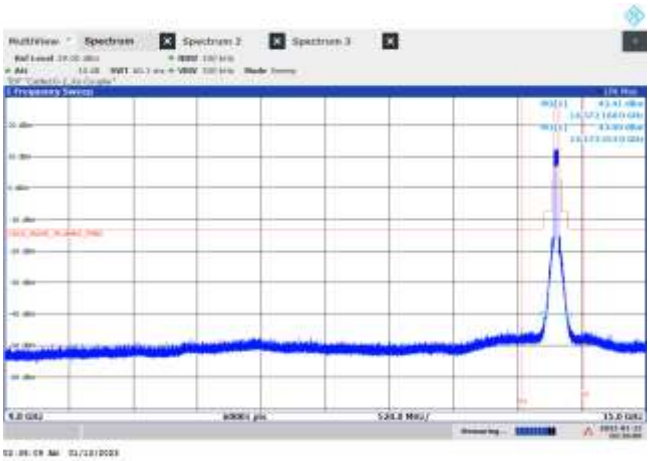


40 GHz to 60 GHz

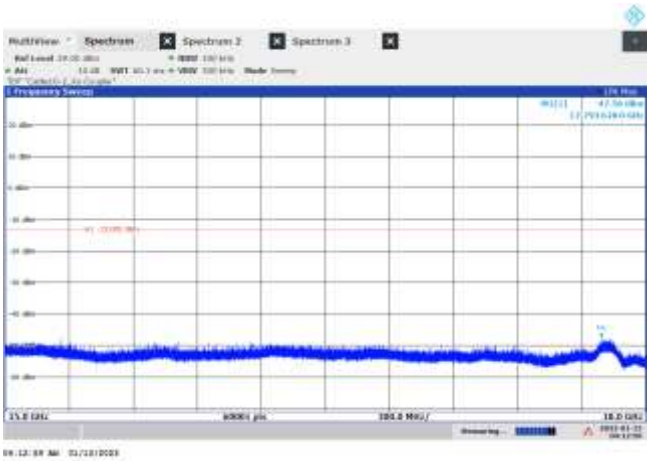
60 GHz to 75 GHz

Conducted spurious emission measurements for each Bandwidth and Modulation

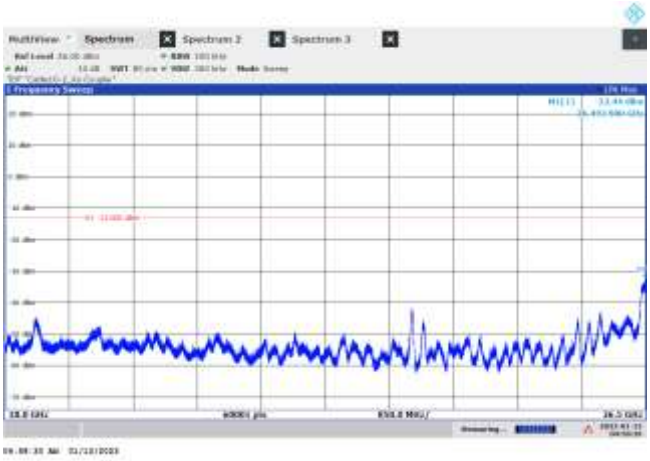
f_{MID} (39.6 MHz, QPSK)



9.8 GHz to 15 GHz

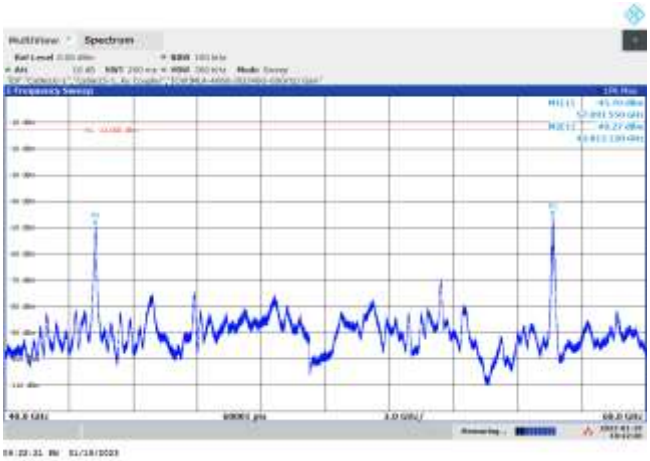


15 GHz to 18 GHz



18 GHz to 26.5 GHz

26.5 GHz to 40 GHz

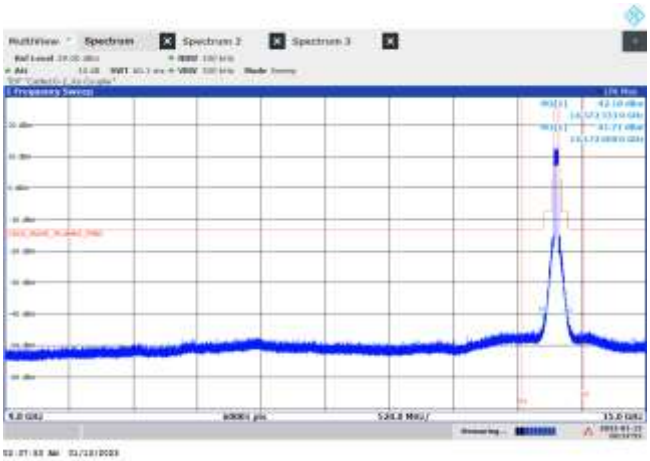


40 GHz to 60 GHz

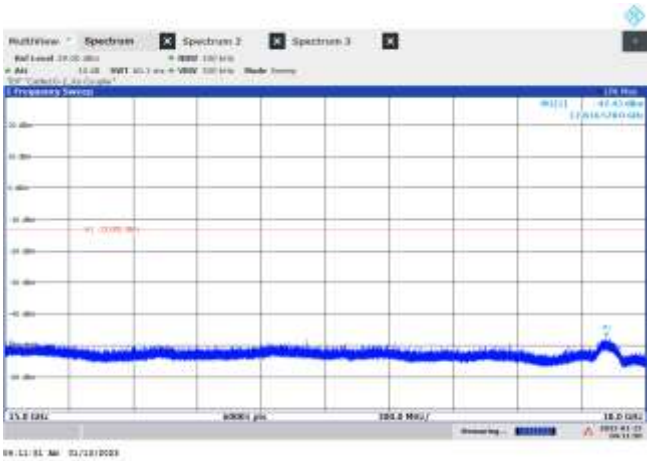
60 GHz to 75 GHz

Conducted spurious emission measurements for each Bandwidth and Modulation

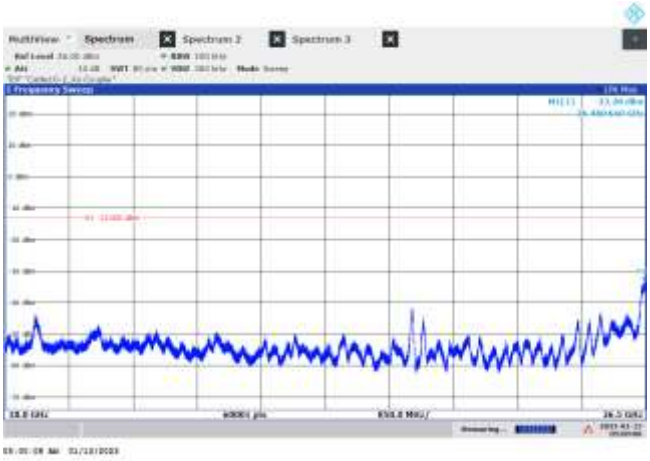
f_{MID} (39.6 MHz, 8PSK)



9.8 GHz to 15 GHz

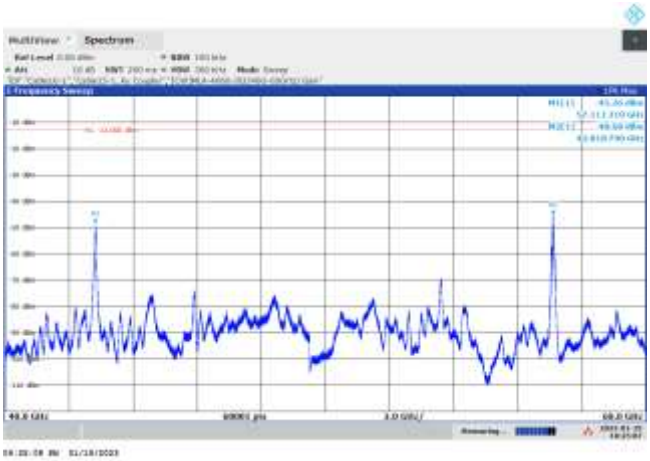


15 GHz to 18 GHz



18 GHz to 26.5 GHz

26.5 GHz to 40 GHz

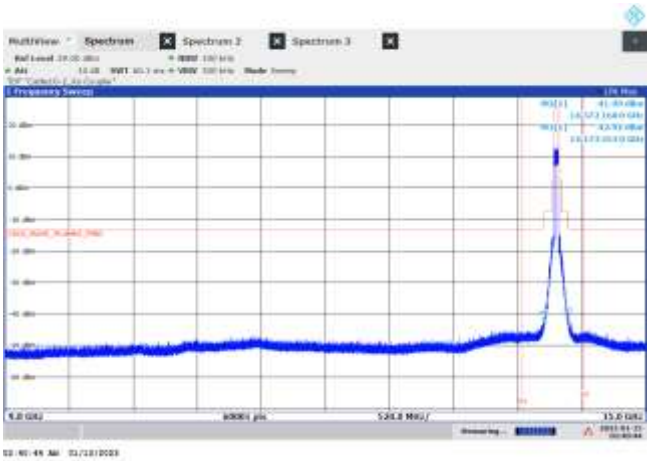


40 GHz to 60 GHz

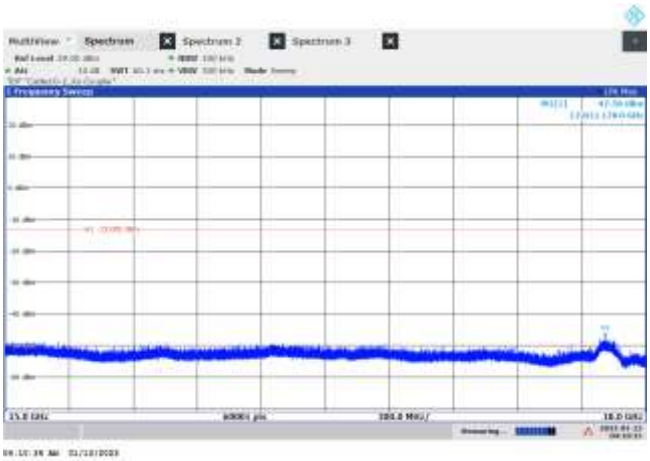
60 GHz to 75 GHz

Conducted spurious emission measurements for each Bandwidth and Modulation

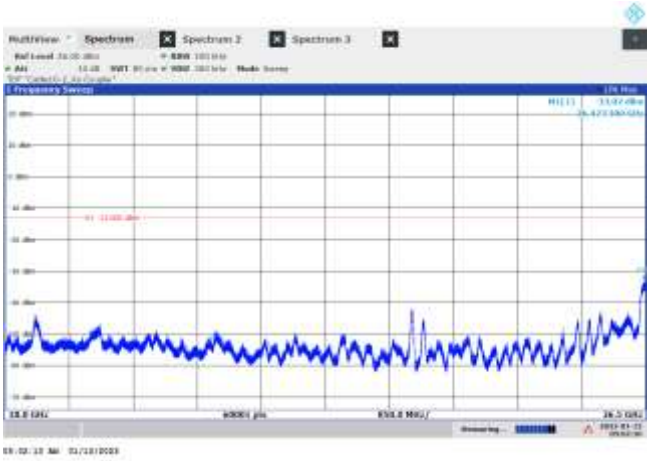
f_{MID} (39.6 MHz, 16QAM)



9.8 GHz to 15 GHz



15 GHz to 18 GHz



18 GHz to 26.5 GHz

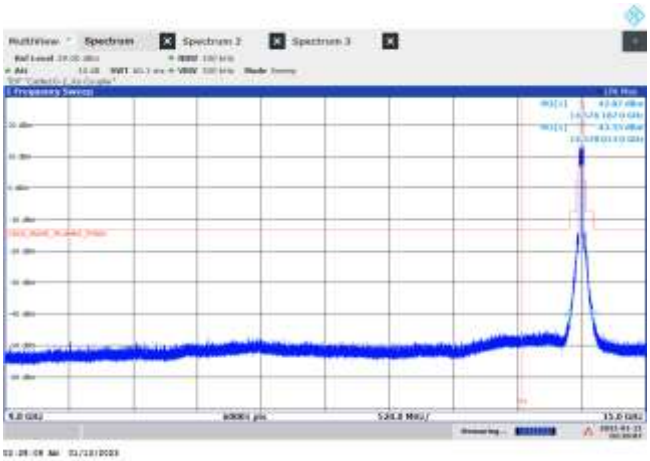
26.5 GHz to 40 GHz

40 GHz to 60 GHz

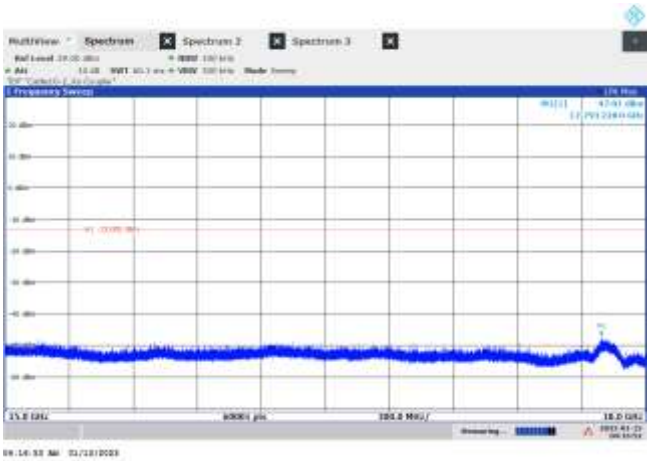
60 GHz to 75 GHz

Conducted spurious emission measurements for each Bandwidth and Modulation

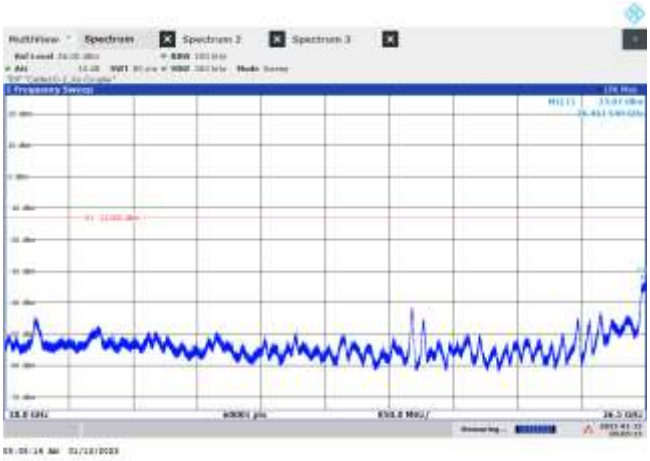
f_{HIGH} (39.6 MHz, QPSK)



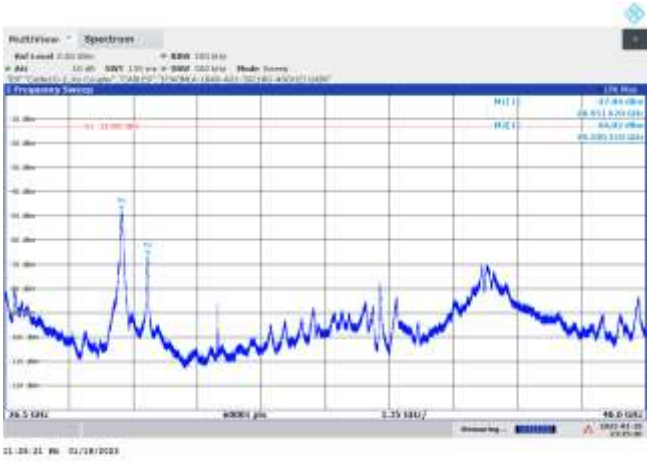
9.8 GHz to 15 GHz



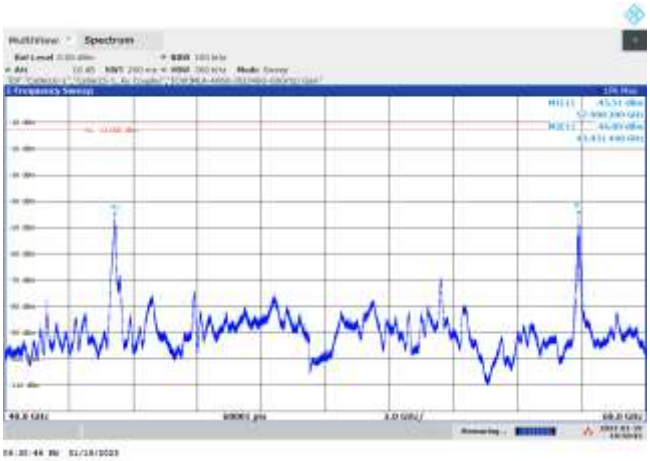
15 GHz to 18 GHz



18 GHz to 26.5 GHz



26.5 GHz to 40 GHz

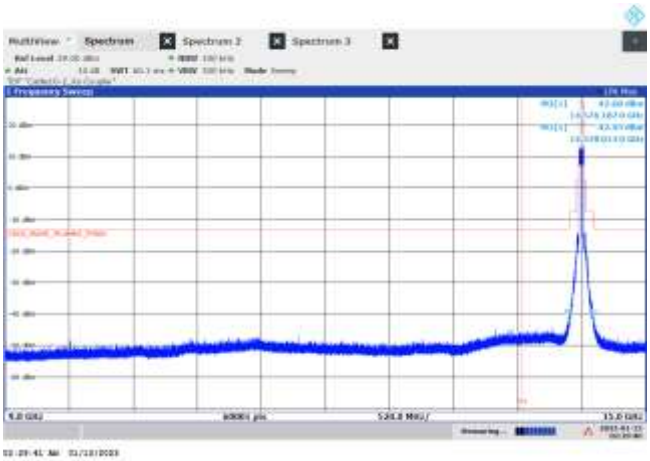


40 GHz to 60 GHz

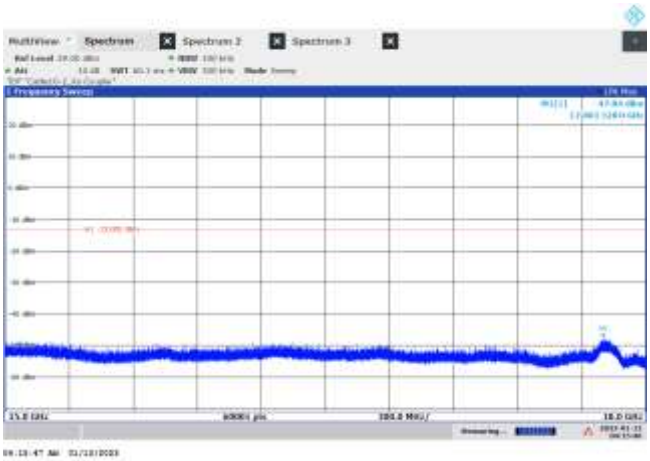
60 GHz to 75 GHz

Conducted spurious emission measurements for each Bandwidth and Modulation

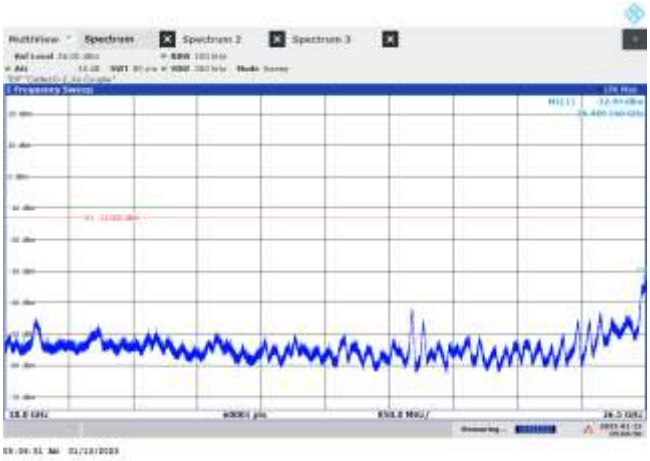
f_{HIGH} (39.6 MHz, 8PSK)



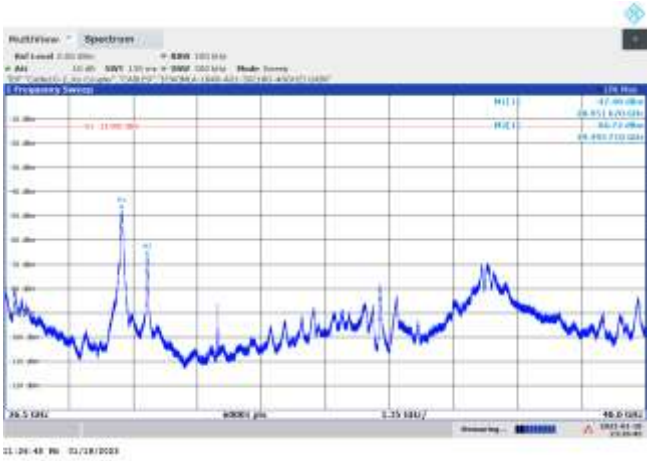
9.8 GHz to 15 GHz



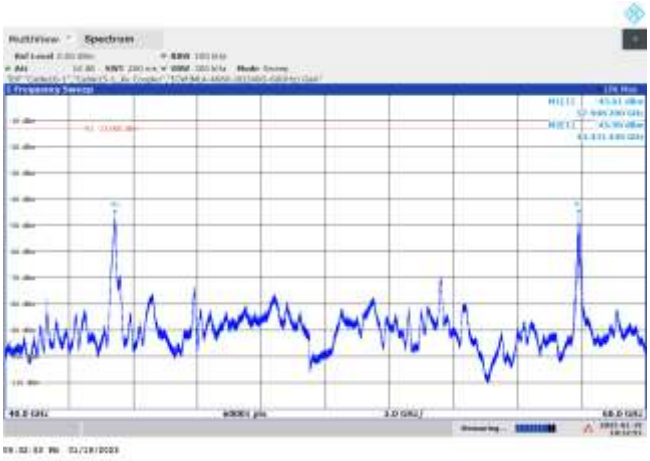
15 GHz to 18 GHz



18 GHz to 26.5 GHz



26.5 GHz to 40 GHz

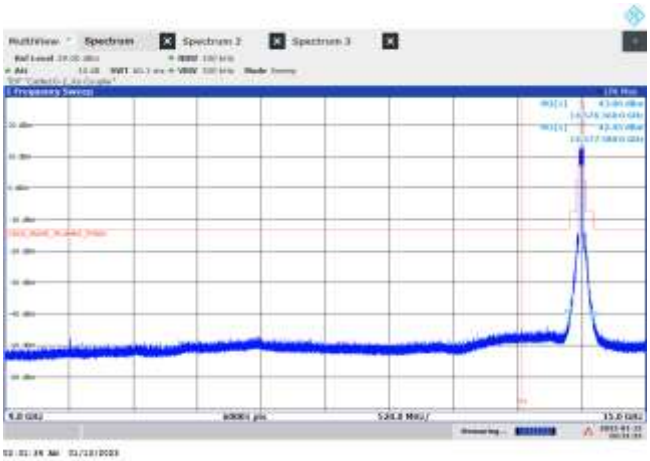


40 GHz to 60 GHz

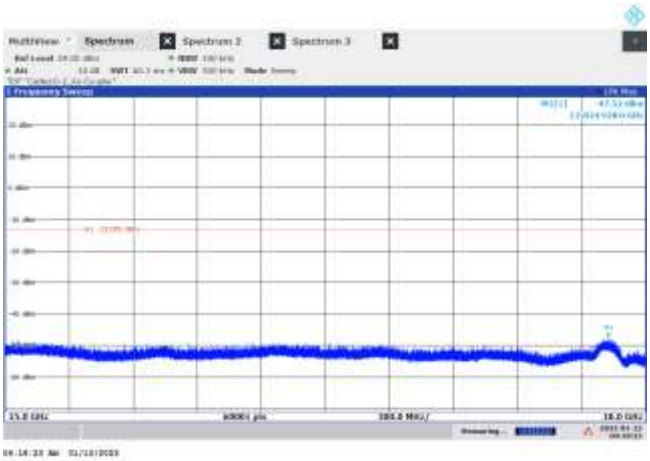
60 GHz to 75 GHz

Conducted spurious emission measurements for each Bandwidth and Modulation

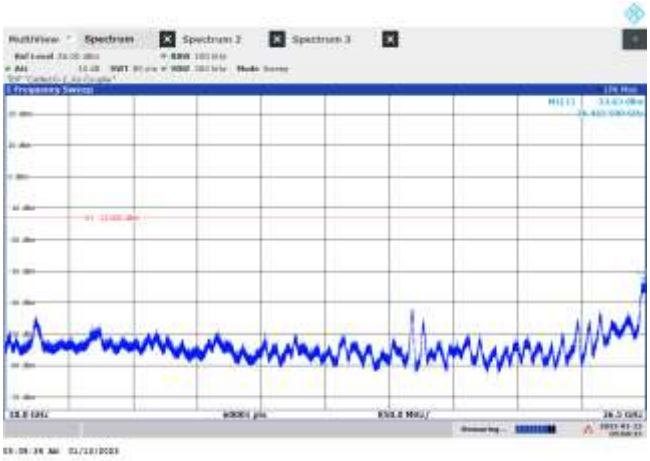
f_{HIGH} (39.6 MHz, 16QAM)



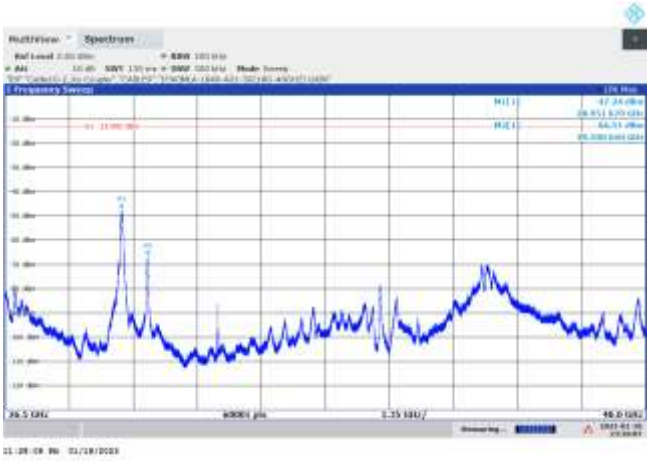
9.8 GHz to 15 GHz



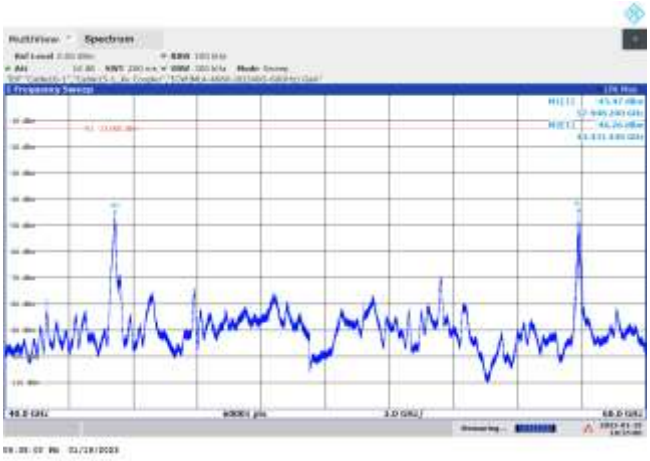
15 GHz to 18 GHz



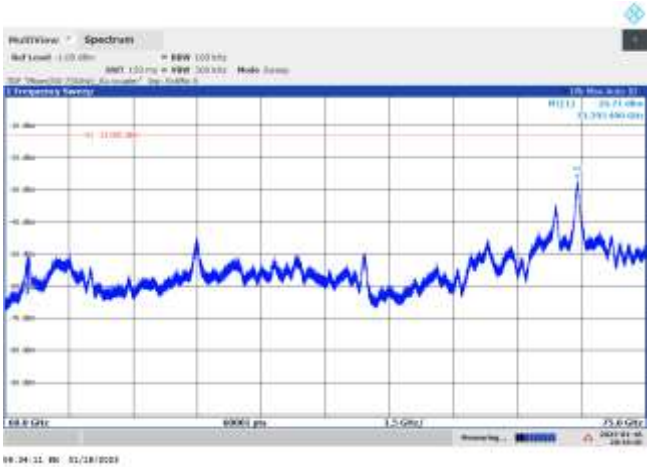
18 GHz to 26.5 GHz



26.5 GHz to 40 GHz



40 GHz to 60 GHz



60 GHz to 75 GHz

5.4. Field Strength of Spurious Radiation (radiated emissions)

5.4.1 Regulation

FCC, CFR 47 Section

According to 2.1053(a), Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the magnitude of each harmonic and other spurious emission. For this test, single sideband, independent sideband, and controlled carrier transmitters shall be modulated under the conditions specified in paragraph (c) of 2.1049, as appropriate. For equipment operating on frequencies below 890 MHz, an open field test is normally required with the measuring instrument antenna located in the far-field at all test frequencies. In the event it is either impractical or impossible to make open field measurements (e.g. a broadcast transmitter installed in a building) measurements will be accepted of the equipment as installed. Such measurements must be accompanied by a description of the site where the measurements were made showing the location of any possible source of reflections which might distort the field strength measurements. Information submitted shall include the relative radiated power of each spurious emission with reference to the rated power output of the transmitter, assuming all emissions are radiated from half-wave dipole antennas.

According to 2.1053(b), The measurements specified in paragraph (a) of this section shall be made for the following equipment:

(1) Those in which the spurious emissions are required to be 60 dB or more below the mean power of the transmitter.
(2) All equipment operating on frequencies higher than 25 MHz.
(3) All equipment where the antenna is an integral part of and attached directly to the transmitter.
(4) Other types of equipment as required, when deemed necessary by the Commission.

According to 25.202(f), Emission limitations. Except for SDARS terrestrial repeaters and as provided for in paragraph (i), the mean power of emissions shall be attenuated below the mean output power of the transmitter in accordance with the schedule set forth in paragraphs (f)(1) through (f)(4) of this section. The out-of-band emissions of SDARS terrestrial repeaters shall be attenuated in accordance with the schedule set forth in paragraph (h) of this section.

(1) In any 4 kHz band, the center frequency of which is removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: 25 dB;
(2) In any 4 kHz band, the center frequency of which is removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth: 35 dB;
(3) In any 4 kHz band, the center frequency of which is removed from the assigned frequency by more than 250 percent of the authorized bandwidth: An amount equal to 43 dB plus 10 times the logarithm (to the base 10) of the transmitter power in watts;
(4) In any event, when an emission outside of the authorized bandwidth causes harmful interference, the Commission may, at its discretion, require greater attenuation than specified in paragraphs (f) (1), (2) and (3) of this section.

ISED, RSS section

RSS-170, 5.4.3.1. Mobile Earth Stations in All Frequency Bands

The average power of unwanted emissions shall be attenuated below the average output power, P (dBW), of the transmitter, as specified below:

(1) 25 dB in any 4 kHz band, the centre frequency of which is offset from the channel frequency by more

than 50%, up to and including 100% of the occupied bandwidth or necessary bandwidth, whichever is greater;

(2) 35 dB in any 4 kHz band, the centre frequency of which is offset from the channel frequency by more than 100%, up to and including 250% of the occupied bandwidth or necessary bandwidth, whichever is greater; and

(3) 43 + 10 log p (watts) in any 4 kHz band, the centre frequency of which is offset from the channel frequency by more than 250% of the occupied bandwidth or necessary bandwidth, whichever is greater.

5.4.2 Test Procedure

The field strength of radiated spurious measurements was made in accordance with the procedures of subclause 5.5 of ANSI C63.26

The radiated emission measurements were performed inside the chamber.

(a) The EUT was placed on the support at the height of 80 cm (below 1 GHz) or 1.5 m (above 1 GHz).

(b) The EUT's RF ports were terminated by the 50 ohm load.

(c) The EUT was tested using both modulations and at the low, mid, and high channels.

(d) The EUT was rotated about 360° and the receiving antenna scanned from 1 to 4m in order to capture the maximum emission.

(e) The measurements were made with the receive antenna in both horizontal and vertical polarizations.

(f) If the EUT was designed to be installed in one of two distinct orientations, the tests should be performed in both orientations. If the EUT could be operated in one of multiple orientations (e.g., handheld, portable, or modular devices), the tests should be performed in a minimum of three orientations.

(g) The harmonic emissions up to the 5th or 100 GHz, whichever was the lesser, were investigated.

(h) The plots were corrected for the cable loss, antenna factor, and distance correction.

For the measurement frequency below 1 GHz, the field strength was measured and then mathematically corrected to an E.I.R.P., according to 5.2.7 of ANSI C63.26.

(a) E (dBμV/m) = Measured amplitude level (dBμV) + Cable Loss (dB) + Antenna Factor (dB/m).

(b) E (dBμV/m) = Measured amplitude level (dBm) + 107 + Cable Loss (dB) + Antenna Factor (dB/m).

(c) E (dBμV/m) = EIRP (dBm) - 20log(D) + 104.8; where D is the measurement distance in m.

(d) EIRP (dBm) = E (dBμV/m) + 20log(D) - 104.8; where D is the measurement distance in m.

For the measurement frequency above 1 GHz, the EIRP was directly determined by using the basic free-space propagation path loss according to the C.5.2 of ANSI C63.26. The radiated measurements using substitution techniques were performed if the emissions exceeded (or approached to) the specified limits.

NOTE 1: During the preliminary measurements, the EUT was operated with the bandwidth ((19.8 MHz, 16QAM) and (39.6 MHz, 16QAM)) with highest power density in 4 kHz during the preliminary measurements as the worst-case. The peak detector was used with the appropriate measurement bandwidth (RBW) as 1 kHz (from 9 kHz to 150 kHz), 10 kHz (from 150 kHz to 30 MHz), 100 kHz (from 30 MHz to 1 GHz), and 1 MHz (from 1 GHz to 75 GHz).

NOTE 2: For the final measurements, any emissions found in the preliminary measurements were further examined by using the RMS detector with RBW 3 kHz and corrected to the reference bandwidth of 4 kHz.

5.4.3 Result: PASS

Table 6: Field Strength of Spurious Radiation (radiated emissions from 9 kHz to 30 MHz)

Test set-up:	Refer to the test configuration and photographs of the test setup.
	Test site: SAC
	Antenna distance: ☐ 10 m ☒ 3 m
	Rx antenna height: 1 m
	frequency range: 9 kHz to 30 MHz
	reference bandwidth: 4 kHz (with RMS dectector)
Operating mode:	#1 (19.8 MHz, 16QAM)

(The chart below shows the highest readings taken from the final data.)

Frequency (MHz)	Pol. (V/H)	Reading (dBμV)	AMP (dB)	AF (dB/m)	CL (dB)	CB (dB)	FS (dBμV/m)	EIRP (dBm)	Limit (dBm)	Margin (dB)
Transmitting at f_{LOW}										
0.016	V	40.1	0.0	20.9	0.1	1.3	62.4	-32.9	-13.0	19.9
0.016	H	42.9	0.0	20.9	0.1	1.3	65.2	-30.1	-13.0	17.1
Transmitting at f_{MID}										
0.016	V	39.6	0.0	20.9	0.1	1.3	61.9	-33.4	-13.0	20.4
0.016	H	42.4	0.0	20.9	0.1	1.3	64.7	-30.6	-13.0	17.6
Transmitting at f_{HIGH}										
0.016	V	39.8	0.0	20.9	0.1	1.3	62.1	-33.2	-13.0	20.2
0.016	H	43.2	0.0	20.9	0.1	1.3	65.5	-29.8	-13.0	16.8

Note: *1) V/H: Vertical / Horizontal polarization*
2) AMP, AF, CL: pre-amplifier gain, antenna factor, cable loss
3) CB: bandwidth correction factor (1.3 dB, when RBW 3 kHz was used)
4) FS: field strength, FS = Reading - AMP + AF + CL + CB
5) EIRP = FS + 20log(D) - 104.8; i.e. EIRP (-13 dBm) is corresponded to FS (82.2 dBμV/m) (where D = 3 m)
6) Margin = Limit - EIRP

Test set-up:	Refer to the test configuration and photographs of the test setup.	
	Test site:	SAC
	Antenna distance:	☐ 10 m ☒ 3 m
	Rx antenna height:	1 m
	frequency range:	9 kHz to 30 MHz
	reference bandwidth:	4 kHz (with RMS dectector)
Operating mode:	#1 (39.6 MHz, 16QAM)	

(The chart below shows the highest readings taken from the final data. The other emission levels were very low against the limit.)

Frequency (MHz)	Pol. (V/H)	Reading (dBμV)	AMP (dB)	AF (dB/m)	CL (dB)	CB (dB)	FS (dBμV/m)	EIRP (dBm)	Limit (dBm)	Margin (dB)
Transmitting at f_{LOW}										
0.016	V	35.7	0.0	20.9	0.1	1.3	58.0	-37.3	-13.0	24.3
0.016	H	44.6	0.0	20.9	0.1	1.3	66.9	-28.4	-13.0	15.4
Transmitting at f_{MID}										
0.016	V	35.7	0.0	20.9	0.1	1.3	58.0	-37.3	-13.0	24.3
0.016	H	44.5	0.0	20.9	0.1	1.3	66.8	-28.5	-13.0	15.5
Transmitting at f_{HIGH}										
0.016	V	35.5	0.0	20.9	0.1	1.3	57.8	-37.5	-13.0	24.5
0.016	H	44.7	0.0	20.9	0.1	1.3	67.0	-28.3	-13.0	15.3

Note: *1) V/H: Vertical / Horizontal polarization*
2) AMP, AF, CL: pre-amplifier gain, antenna factor, cable loss
3) CB: bandwidth correction factor (1.3 dB, when RBW 3 kHz was used)
4) FS: field strength, FS = Reading - AMP + AF + CL + CB
5) EIRP = FS + 20log(D) - 104.8; i.e. EIRP (-13 dBm) is corresponded to FS (82.2 dBμV/m) (where D = 3 m)
6) Margin = Limit - EIRP

Table 7: Field Strength of Spurious Radiation (radiated emissions from 30 MHz to 1 GHz)

Test set-up:	Refer to the test configuration and photographs of the test setup. Test site: SAC Antenna distance: ☐ 10 m ☒ 3 m Rx antenna height: 1 m to 4 m frequency range: 30 MHz to 1 GHz reference bandwidth: 4 kHz (with RMS dectector)
Operating mode:	#1 (19.8 MHz, 16QAM)

Frequency (MHz)	Pol. (V/H)	Height (m)	Reading (dBμV)	AMP (dB)	AF (dB/m)	CL (dB)	FS (dBμV/m)	EIRP (dBm)	Limit (dBm)	Margin (dB)
Transmitting at f_{LOW}										
250.006	H	1.00	52.4	29.6	17.6	1.7	42.1	-53.2	-13.0	40.2
250.006	V	2.00	52.8	29.6	17.6	1.7	42.5	-52.8	-13.0	39.8
275.032	H	1.00	48.0	29.8	18.5	1.7	38.4	-56.9	-13.0	43.9
275.032	V	2.00	51.9	29.8	18.5	1.7	42.3	-53.0	-13.0	40.0
525.014	V	1.00	44.8	30.5	24.1	2.3	40.7	-54.6	-13.0	41.6
Transmitting at f_{MID}										
250.004	H	1.00	51.5	29.6	17.6	1.7	41.2	-54.1	-13.0	41.1
250.004	V	2.00	53.8	29.6	17.6	1.7	43.5	-51.8	-13.0	38.8
275.020	H	1.00	48.2	29.8	18.5	1.7	38.6	-56.7	-13.0	43.7
275.020	V	2.00	51.9	29.8	18.5	1.7	42.3	-53.0	-13.0	40.0
375.036	V	1.00	48.3	30.4	20.9	2.0	40.8	-54.5	-13.0	41.5
525.022	V	1.00	45.0	30.5	24.1	2.3	40.9	-54.4	-13.0	41.4
Transmitting at f_{HIGH}										
250.026	H	1.00	52.1	29.6	17.6	1.7	41.8	-53.5	-13.0	40.5
250.026	V	2.00	53.4	29.6	17.6	1.7	43.1	-52.2	-13.0	39.2
275.029	V	2.00	50.0	29.8	18.5	1.7	40.4	-54.9	-13.0	41.9
324.977	V	1.00	48.4	30.1	19.9	1.9	40.1	-55.2	-13.0	42.2
525.020	V	1.00	44.8	30.5	24.1	2.3	40.7	-54.6	-13.0	41.6
750.035	H	1.00	41.5	31.8	27.7	2.8	40.2	-55.1	-13.0	42.1

Note: *1) V/H: Vertical / Horizontal polarization*
2) AMP, AF, CL: pre-amplifier gain, antenna factor, cable loss
3) FS: field strength, FS = Reading - AMP + AF + CL
4) EIRP = FS + 20log(D) - 104.8; i.e. EIRP (-13 dBm) is corresponded to FS (82.2 dBμV/m) (where D = 3 m)
5) Margin = Limit - EIRP

Remark: the measured EIRP in the above table were obtained from the preliminary measurements (peak data) by using the Peak detector with RBW 100 kHz. The final measurements (RMS detector with RBW 3 kHz, and adding the bandwidth correction factor) were not performed because the emissions were very low against the limit.

Test set-up:	Refer to the test configuration and photographs of the test setup.
	Test site: SAC
	Antenna distance: ☐ 10 m ☒ 3 m
	Rx antenna height: 1 m to 4 m
	frequency range: 30 MHz to 1 GHz
	reference bandwidth: 4 kHz (with RMS dectector)
Operating mode:	#1 (39.6 MHz, 16QAM)

Frequency (MHz)	Pol. (V/H)	Height (m)	Reading (dBμV)	AMP (dB)	AF (dB/m)	CL (dB)	FS (dBμV/m)	EIRP (dBm)	Limit (dBm)	Margin (dB)
Transmitting at f_{LOW}										
158.288	V	1.00	49.9	29.6	18.7	1.3	40.3	-55.0	-13.0	42.0
249.987	H	1.00	52.1	29.6	17.6	1.7	41.8	-53.5	-13.0	40.5
249.987	V	2.00	53.4	29.6	17.6	1.7	43.1	-52.2	-13.0	39.2
275.011	H	1.00	47.6	29.8	18.5	1.7	38.0	-57.3	-13.0	44.3
275.011	V	2.00	50.1	29.8	18.5	1.7	40.5	-54.8	-13.0	41.8
524.990	V	1.00	45.6	30.5	24.1	2.3	41.5	-53.8	-13.0	40.8
Transmitting at f_{MID}										
250.007	H	1.00	52.7	29.6	17.6	1.7	42.4	-52.9	-13.0	39.9
250.007	V	1.00	53.1	29.6	17.6	1.7	42.8	-52.5	-13.0	39.5
274.987	H	1.00	47.2	29.8	18.5	1.7	37.6	-57.7	-13.0	44.7
274.987	V	2.00	50.2	29.8	18.5	1.7	40.6	-54.7	-13.0	41.7
525.006	H	2.00	40.2	30.5	24.1	2.3	36.1	-59.2	-13.0	46.2
525.006	V	1.00	44.9	30.5	24.1	2.3	40.8	-54.5	-13.0	41.5
Transmitting at f_{HIGH}										
250.003	H	1.00	52.9	29.6	17.6	1.7	42.6	-52.7	-13.0	39.7
250.003	V	2.00	53.4	29.6	17.6	1.7	43.1	-52.2	-13.0	39.2
324.996	V	1.00	49.0	30.1	19.9	1.9	40.7	-54.6	-13.0	41.6
524.992	V	1.00	45.7	30.5	24.1	2.3	41.6	-53.7	-13.0	40.7
750.040	H	1.00	40.8	31.8	27.7	2.8	39.5	-55.8	-13.0	42.8

Note: *1) V/H: Vertical / Horizontal polarization*
2) AMP, AF, CL: pre-amplifier gain, antenna factor, cable loss
3) FS: field strength, FS = Reading - AMP + AF + CL
4) EIRP = FS + 20log(D) - 104.8; i.e. EIRP (-13 dBm) is corresponded to FS (82.2 dBμV/m) (where D = 3 m)
5) Margin = Limit - EIRP

Remark: the measured EIRP in the above table were obtained from the preliminary measurements (peak data) by using the Peak detector with RBW 100 kHz. The final measurements (RMS detector with RBW 3 kHz, and adding the bandwidth correction factor) were not performed because the emissions were very low against the limit.

Table 8: Field Strength of Spurious Radiation (radiated emissions from 1 GHz to 75 GHz)

Test set-up:	Refer to the test configuration and photographs of the test setup. Test site: FAR Antenna distance: ☒ 3 m ☒ 1 m (only for above 60 GHz) Rx antenna height: 1 m to 4 m frequency range: 1 GHz to 18 GHz; 18 GHz to 26.5 GHz; 26.5 GHz to 40 GHz; 40 GHz to 60 GHz; 60 GHz to 75 GHz reference bandwidth: 4 kHz (with RMS dectector)
Operating mode:	#1 (19.8 MHz, 16QAM)

Frequency (MHz)	Pol. (V/H)	Reading (dBm)	PL (dB)	AG (dBi)	CL (dB)	AMP (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
Transmitting at f_{LOW}									
9 600.30	H	-56.20	61.63	13.10	11.72	45.83	-41.78	-13.00	28.78
19 199.78	H	-39.40	67.65	18.80	17.01	59.90	-33.44	-13.00	20.44
20 399.97	H	-43.60	68.18	19.30	17.45	60.78	-38.05	-13.00	25.05
9 600.30	V	-52.20	61.63	13.10	11.72	45.83	-37.78	-13.00	24.78
19 200.20	V	-41.50	67.65	18.80	17.01	59.90	-35.54	-13.00	22.54
20 399.97	V	-42.50	68.18	19.30	17.45	60.78	-36.95	-13.00	23.95
Transmitting at f_{MID}									
9 600.30	H	-56.10	61.63	13.10	11.72	45.83	-41.68	-13.00	28.68
19 199.78	H	-39.50	67.65	18.80	17.01	59.90	-33.54	-13.00	20.54
20 399.97	H	-42.80	68.18	19.30	17.45	60.78	-37.25	-13.00	24.25
9 600.30	V	-52.70	61.63	13.10	11.72	45.83	-38.28	-13.00	25.28
19 199.78	V	-41.80	67.65	18.80	17.01	59.90	-35.84	-13.00	22.84
20 399.97	V	-42.70	68.18	19.30	17.45	60.78	-37.15	-13.00	24.15
Transmitting at f_{HIGH}									
9 600.30	H	-56.5	61.63	13.10	11.72	45.83	-42.08	-13.00	29.08
19 199.78	H	-39.5	67.65	18.80	17.01	59.90	-33.54	-13.00	20.54
20 399.97	H	-44.1	68.18	19.30	17.45	60.78	-38.55	-13.00	25.55
20 650.30	H	-47.9	68.28	19.30	17.46	60.95	-42.41	-13.00	29.41
48 326.00	H	-47.9	75.67	19.83	7.45	52.51	-37.12	-13.00	24.12
9 600.30	V	-52.9	61.63	13.10	11.72	45.83	-38.48	-13.00	25.48
19 199.78	V	-42.3	67.65	18.80	17.01	59.90	-36.34	-13.00	23.34
20 399.97	V	-42.6	68.18	19.30	17.45	60.78	-37.05	-13.00	24.05
48 326.00	V	-48.5	75.67	19.83	7.45	52.51	-37.72	-13.00	24.72

Note: *1) V/H: Vertical / Horizontal polarization*
2) PL, AG, CL, AMP: free space Path Loss, Antenna Gain, Cable Loss and Gain of pre-amplifier
3) EIRP = Reading + PL - AG + CL - AMP
4) Margin = Limit - EIRP

Remark: the measured EIRP in the above table were obtained from the preliminary measurements (peak data) by using the Peak detector with RBW 1 MHz. The final measurements (RMS detector with RBW 3 kHz, and adding the bandwidth correction factor) were not performed because the emissions were very low against the limit.

Test set-up:	Refer to the test configuration and photographs of the test setup.
	Test site: FAR
	Antenna distance: ☒ 3 m ☒ 1 m (only for above 60 GHz)
	Rx antenna height: 1 m to 4 m
	frequency range: 1 GHz to 18 GHz; 18 GHz to 26.5 GHz; 26.5 GHz to 40 GHz; 40 GHz to 60 GHz; 60 GHz to 75 GHz
	reference bandwidth: 4 kHz (with RMS dectector)
Operating mode:	#1 (39.6 MHz, 16QAM)

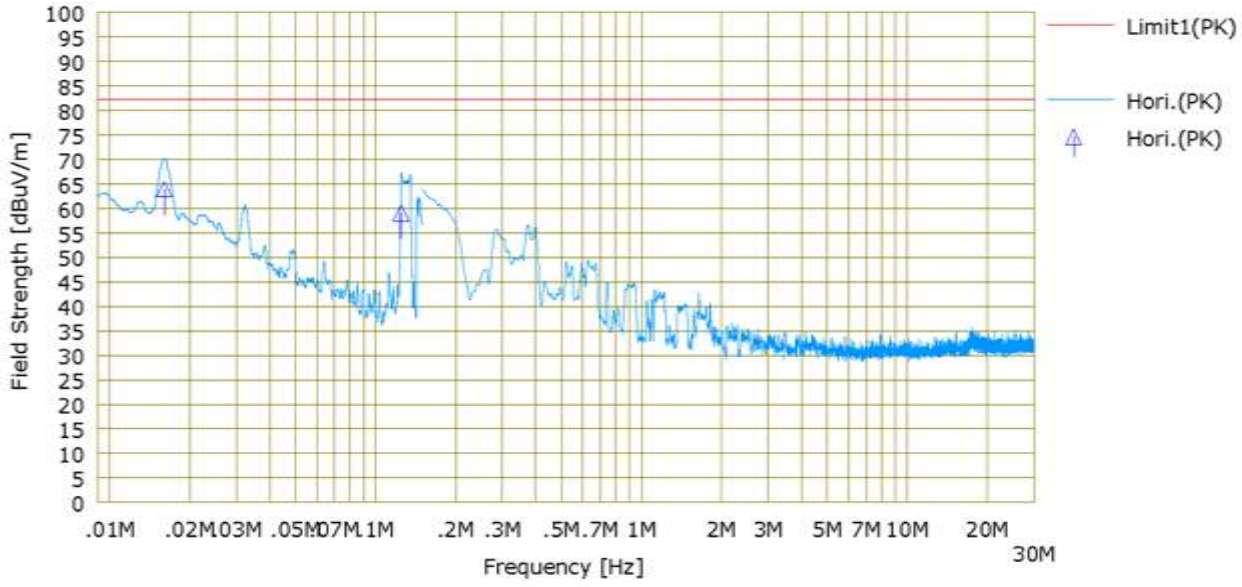
Frequency (MHz)	Pol. (V/H)	Reading (dBm)	PL (dB)	AG (dBi)	CL (dB)	AMP (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
Transmitting at f_{LOW}									
9 600.30	H	-55.80	61.63	13.10	11.72	45.83	-41.38	-13.00	28.38
19 199.78	H	-38.70	67.65	18.80	17.01	59.90	-32.74	-13.00	19.74
20 399.97	H	-44.00	68.18	19.30	17.45	60.78	-38.45	-13.00	25.45
9 600.30	V	-52.80	61.63	13.10	11.72	45.83	-38.38	-13.00	25.38
19 199.78	V	-41.60	67.65	18.80	17.01	59.90	-35.64	-13.00	22.64
20 399.97	V	-43.30	68.18	19.30	17.45	60.78	-37.75	-13.00	24.75
Transmitting at fMID									
9 600.30	H	-56.20	61.63	13.10	11.72	45.83	-41.78	-13.00	28.78
19 199.78	H	-39.10	67.65	18.80	17.01	59.90	-33.14	-13.00	20.14
20 399.97	H	-42.00	68.18	19.30	17.45	60.78	-36.45	-13.00	23.45
9 600.30	V	-52.70	61.63	13.10	11.72	45.83	-38.28	-13.00	25.28
19 200.20	V	-42.40	67.65	18.80	17.01	59.90	-36.44	-13.00	23.44
20 399.97	V	-42.80	68.18	19.30	17.45	60.78	-37.25	-13.00	24.25
Transmitting at fHIGH									
9 600.30	H	-57.00	61.63	13.10	11.72	45.83	-42.58	-13.00	29.58
19 199.78	H	-39.30	67.65	18.80	17.01	59.90	-33.34	-13.00	20.34
20 399.97	H	-43.70	68.18	19.30	17.45	60.78	-38.15	-13.00	25.15
9 600.30	V	-52.50	61.63	13.10	11.72	45.83	-38.08	-13.00	25.08
19 200.20	V	-41.70	67.65	18.80	17.01	59.90	-35.74	-13.00	22.74
20 399.97	V	-43.20	68.18	19.30	17.45	60.78	-37.65	-13.00	24.65

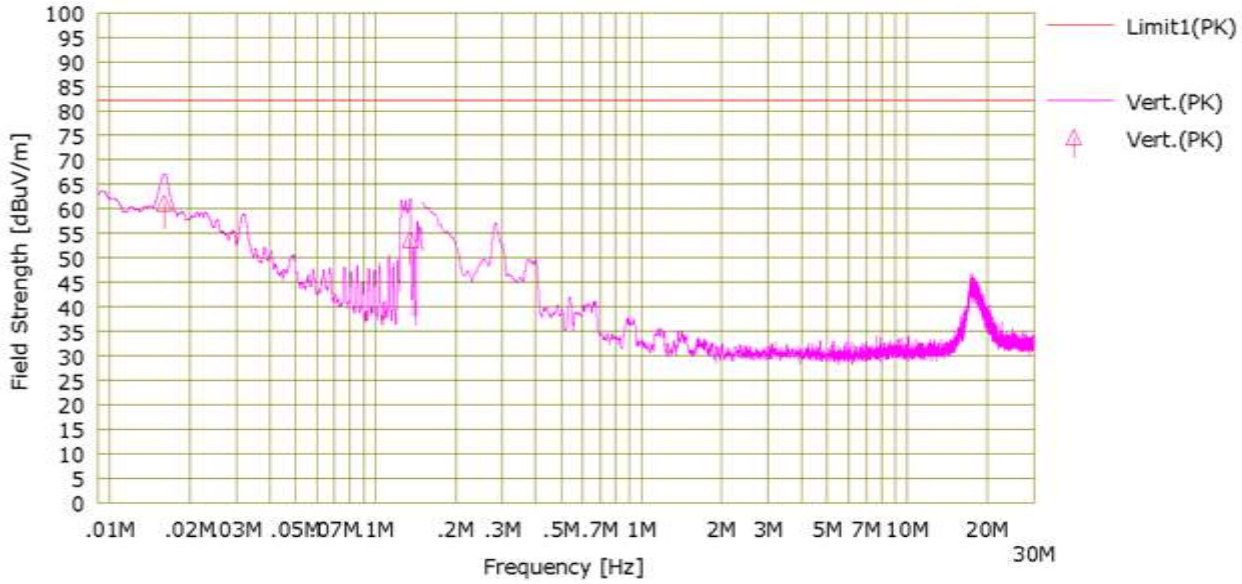
Note: *1) V/H: Vertical / Horizontal polarization*
2) PL, AG, CL, AMP: free space Path Loss, Antenna Gain, Cable Loss and Gain of pre-amplifier
3) EIRP = Reading + PL - AG + CL - AMP
4) Margin = Limit - EIRP

Remark: the measured EIRP in the above table were obtained from the preliminary measurements (peak data) by using the Peak detector with RBW 1 MHz. The final measurements (RMS detector with RBW 3 kHz, and adding the bandwidth correction factor) were not performed because the emissions were very low against the limit.

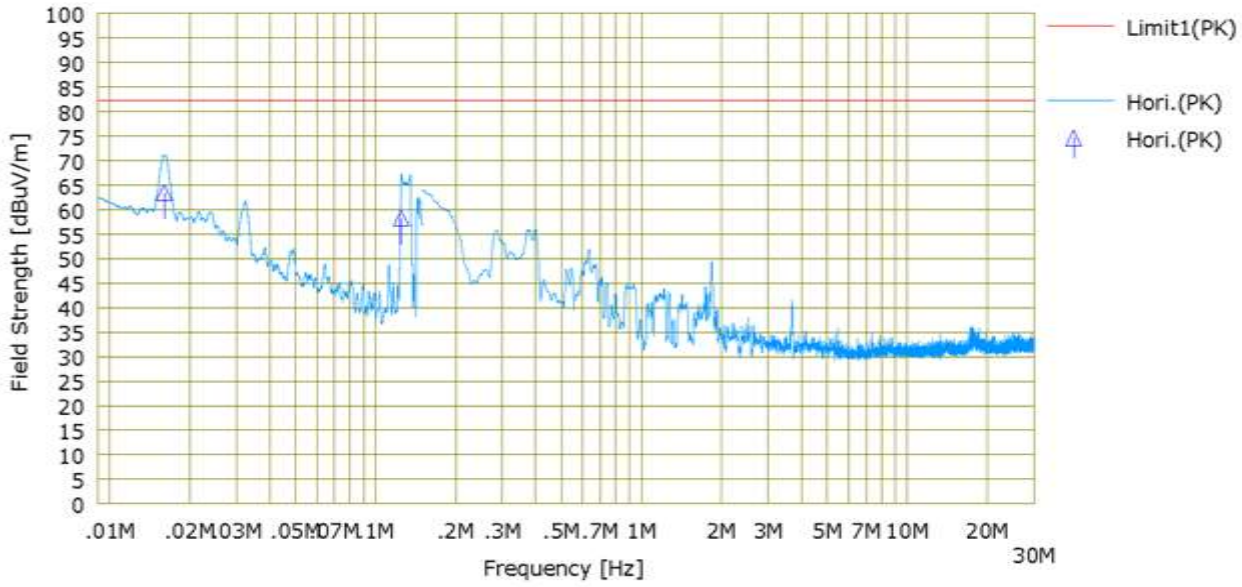
Figure 6. Plot of Field Strength of Spurious Radiation (radiated emissions from 9 kHz to 30 MHz)

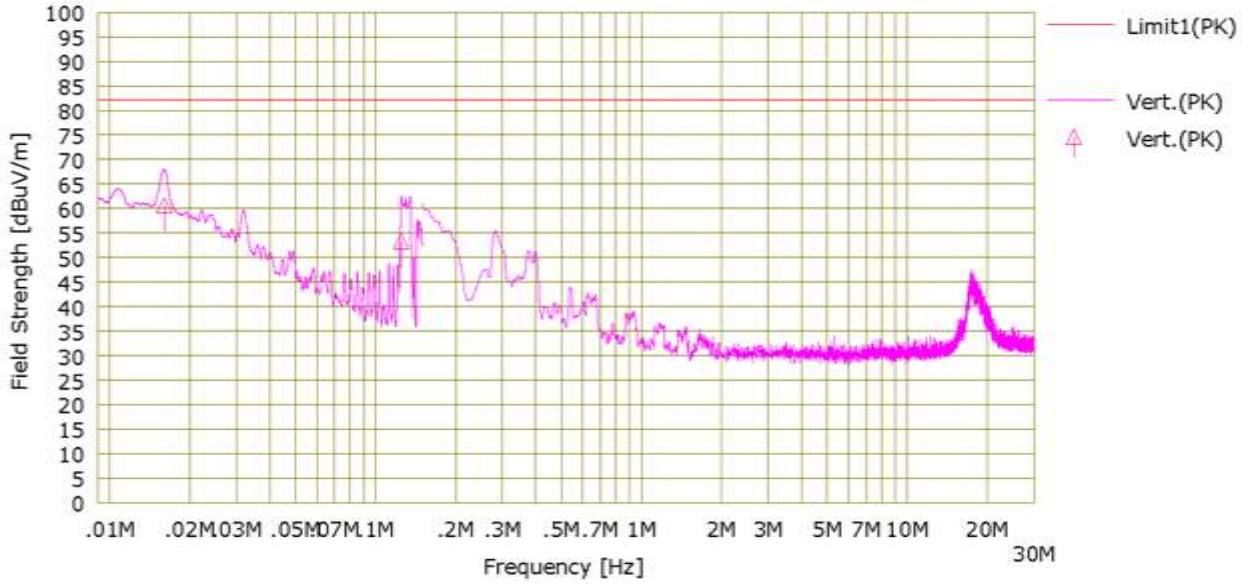
transmitting at f_{LOW} (19.8 MHz, 16QAM)



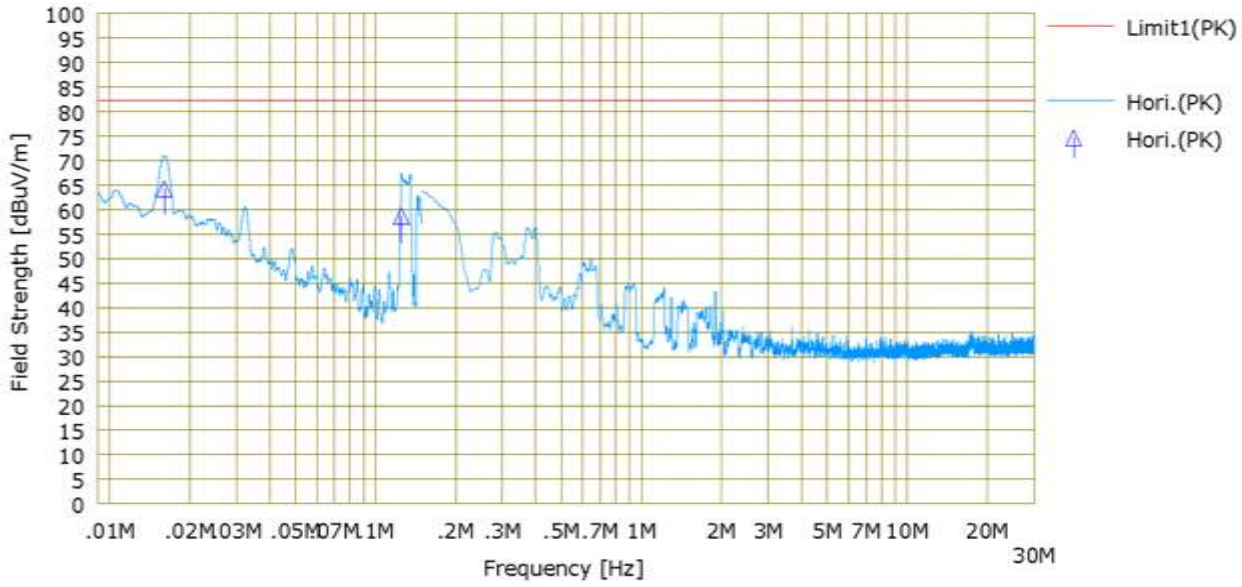


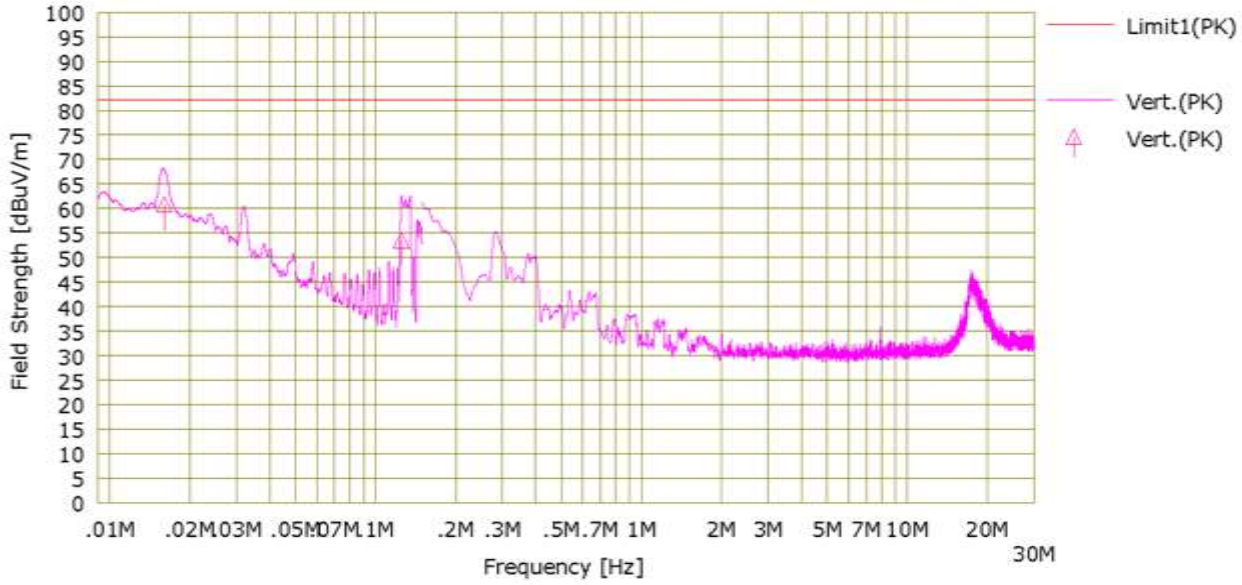
transmitting at f_{MID} (19.8 MHz, 16QAM)



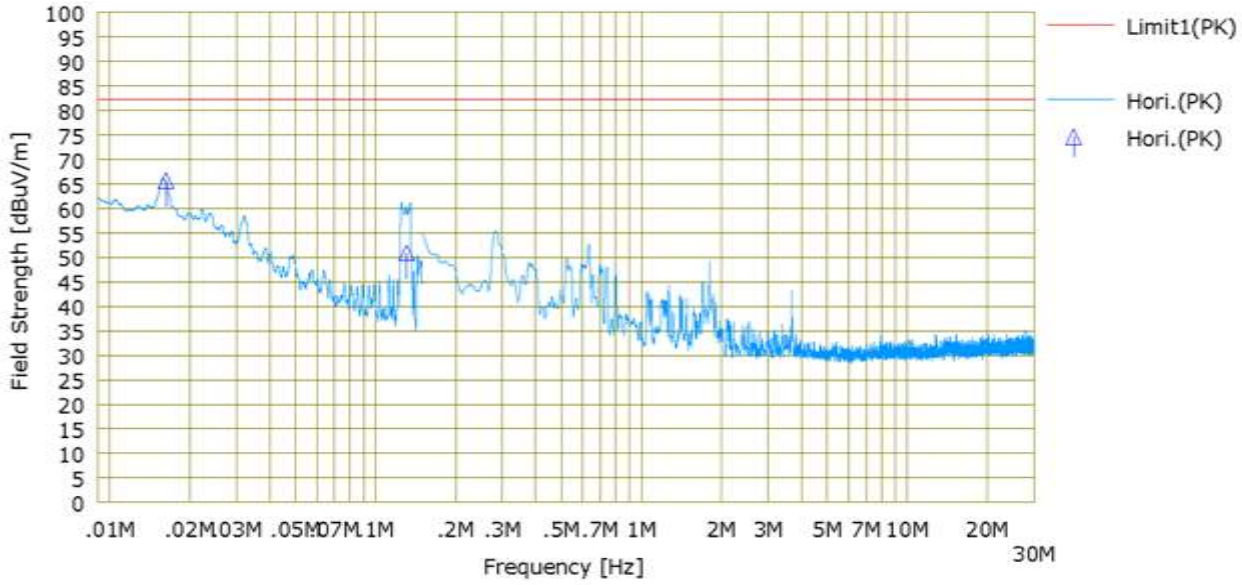


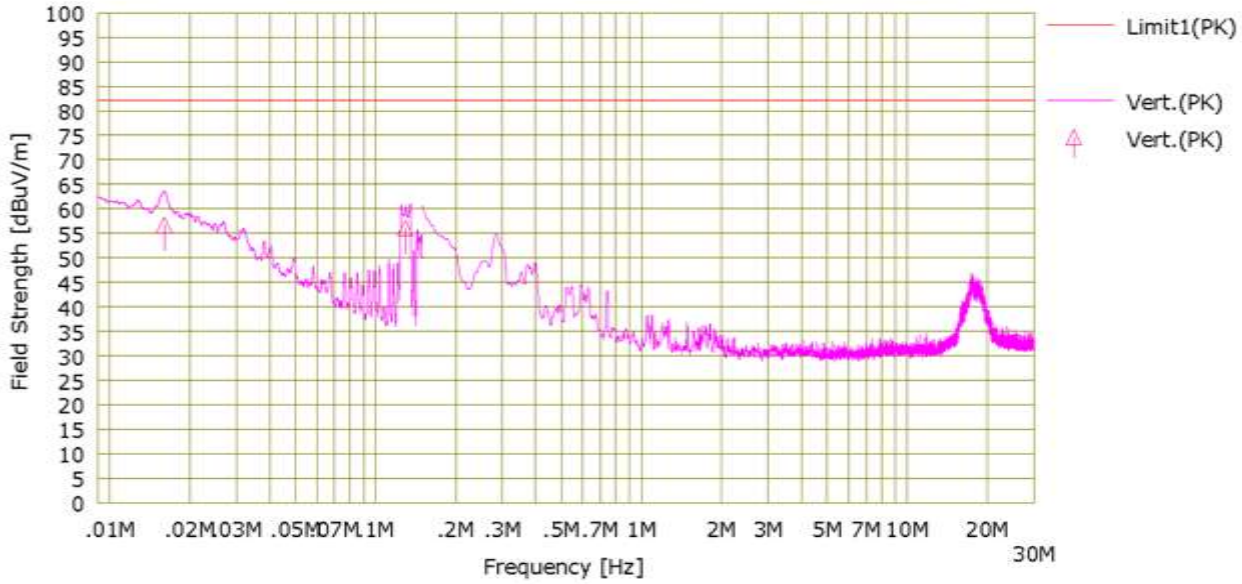
transmitting at f_{HIGH} (19.8 MHz, 16QAM)



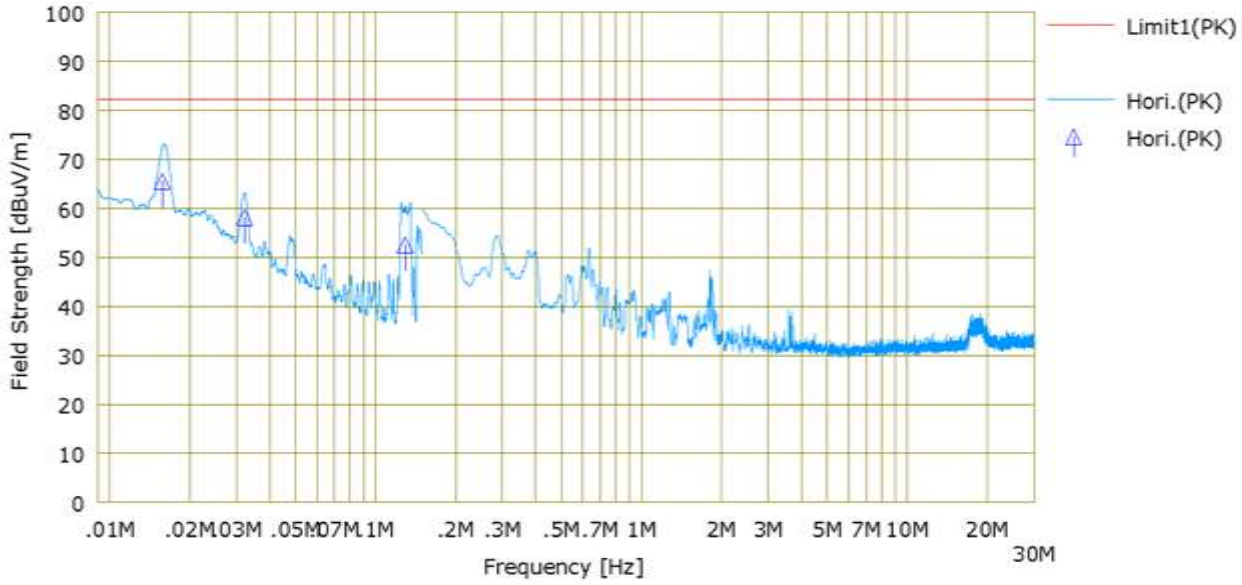


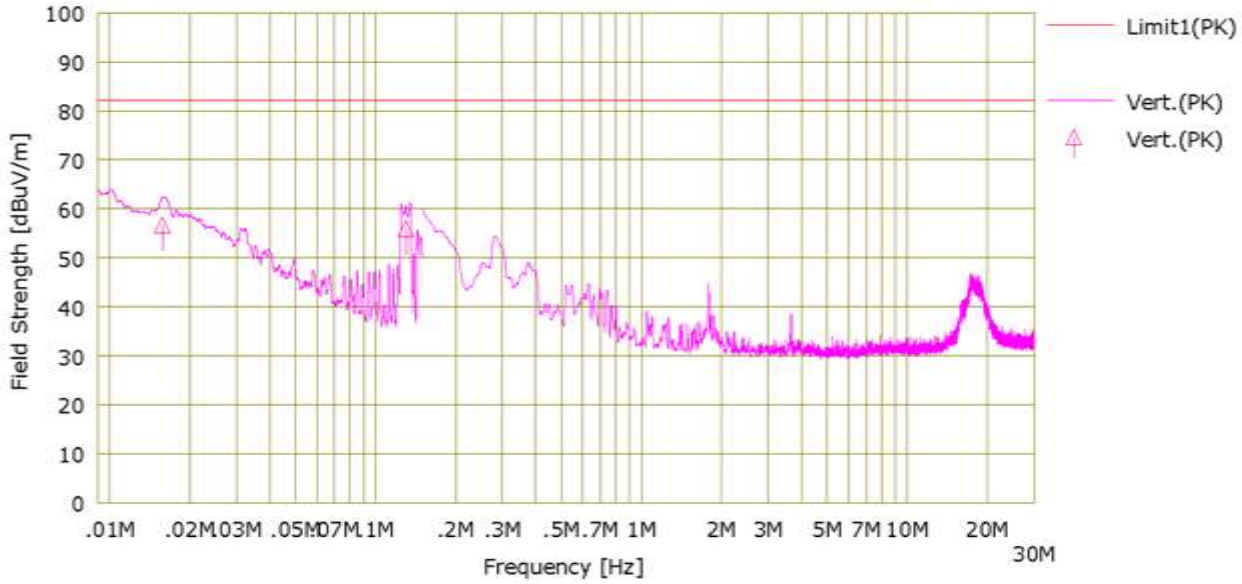
transmitting at f_{LOW} (39.6 MHz, 16QAM)



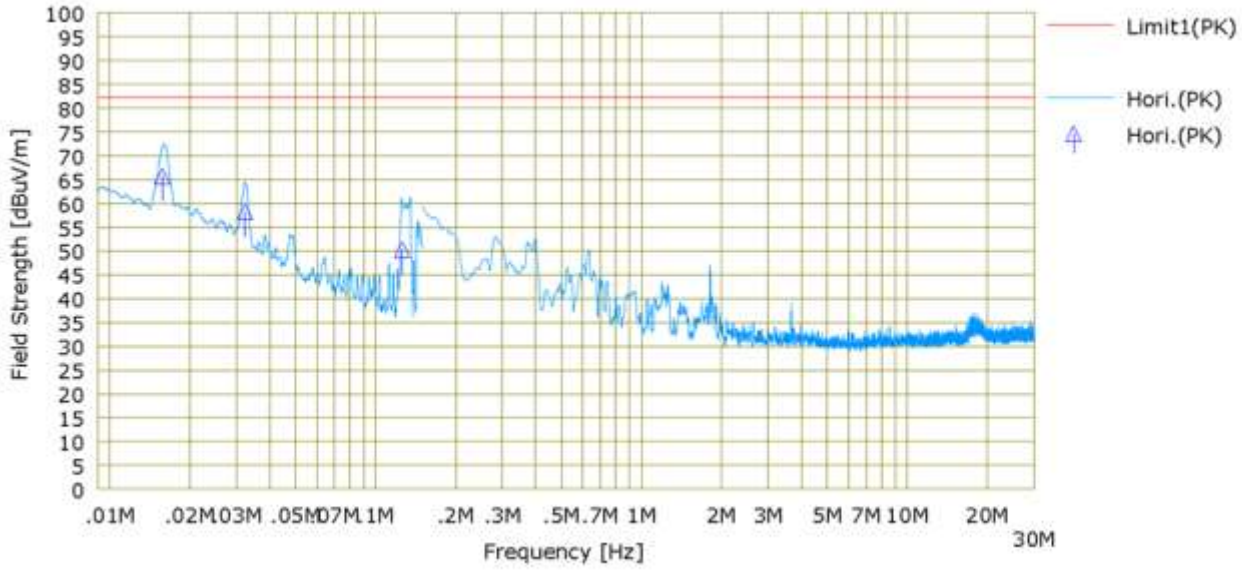


transmitting at f_{MID} (39.6 MHz, 16QAM)





transmitting at f_{HIGH} (39.6 MHz, 16QAM)



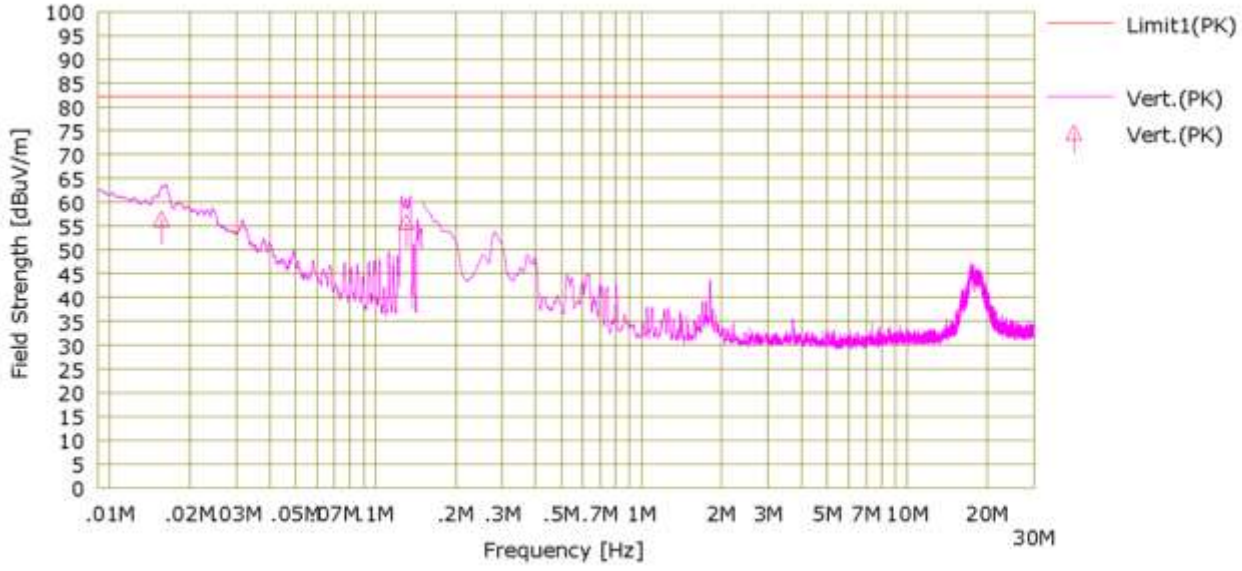
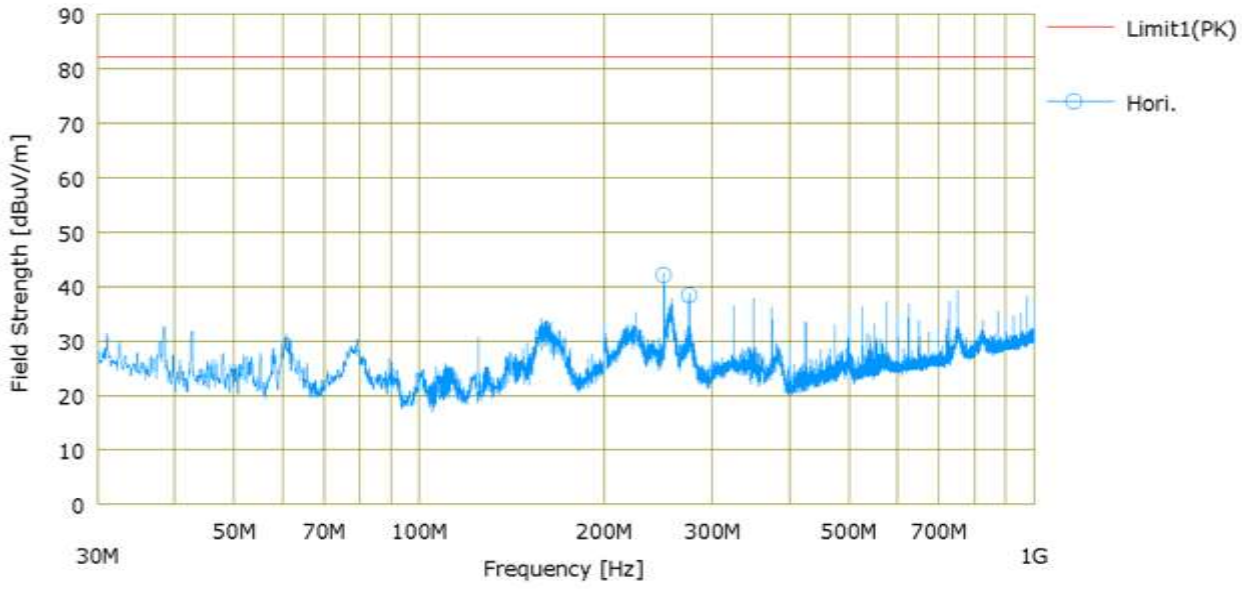
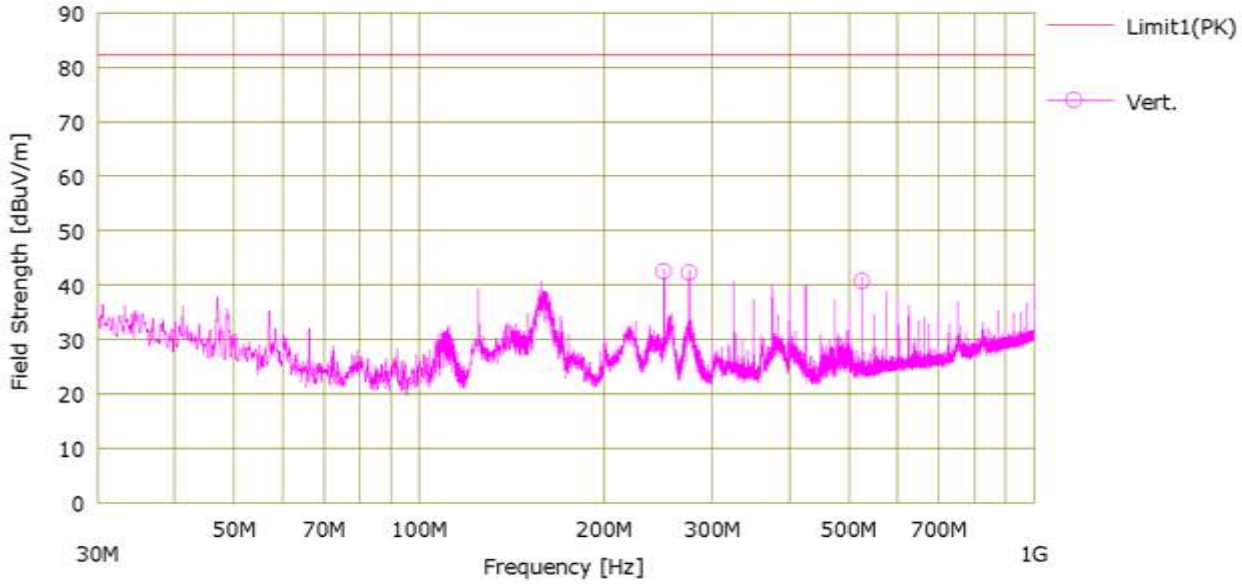


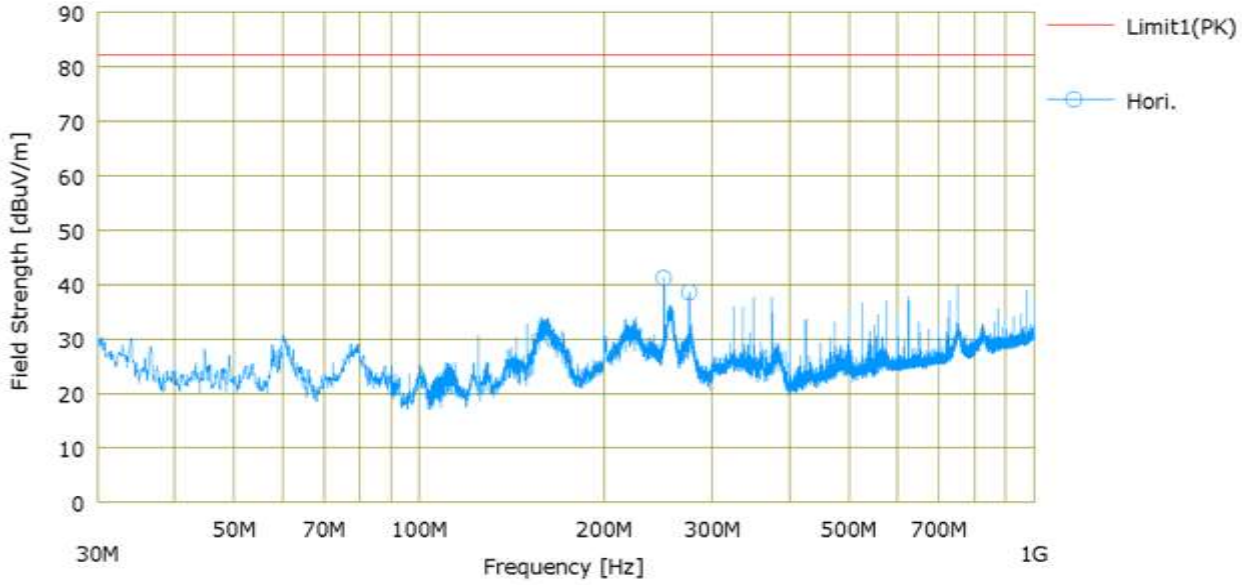
Figure 7. Plot of Field Strength of Spurious Radiation (radiated emissions from 30 MHz to 1 GHz)

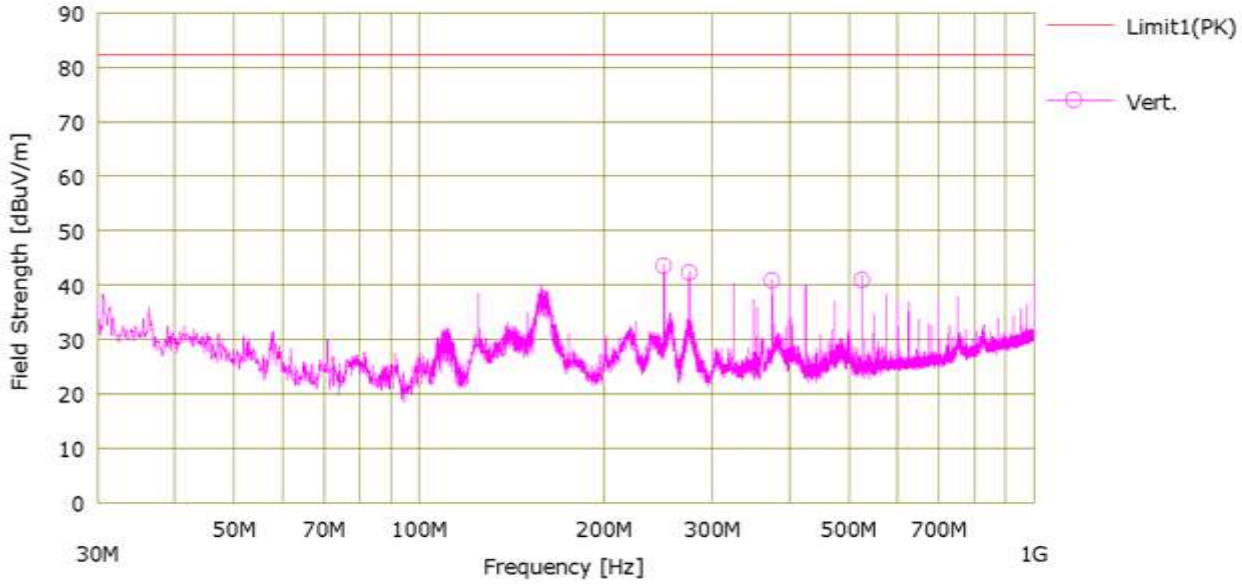
transmitting at f_{LOW} (19.8 MHz, 16QAM)



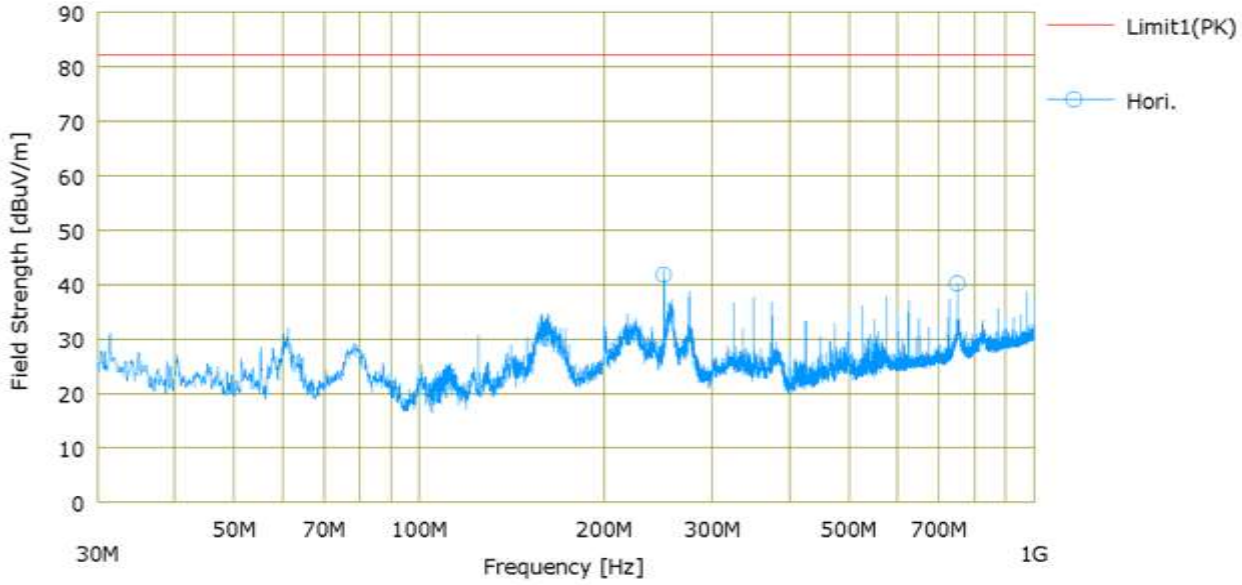


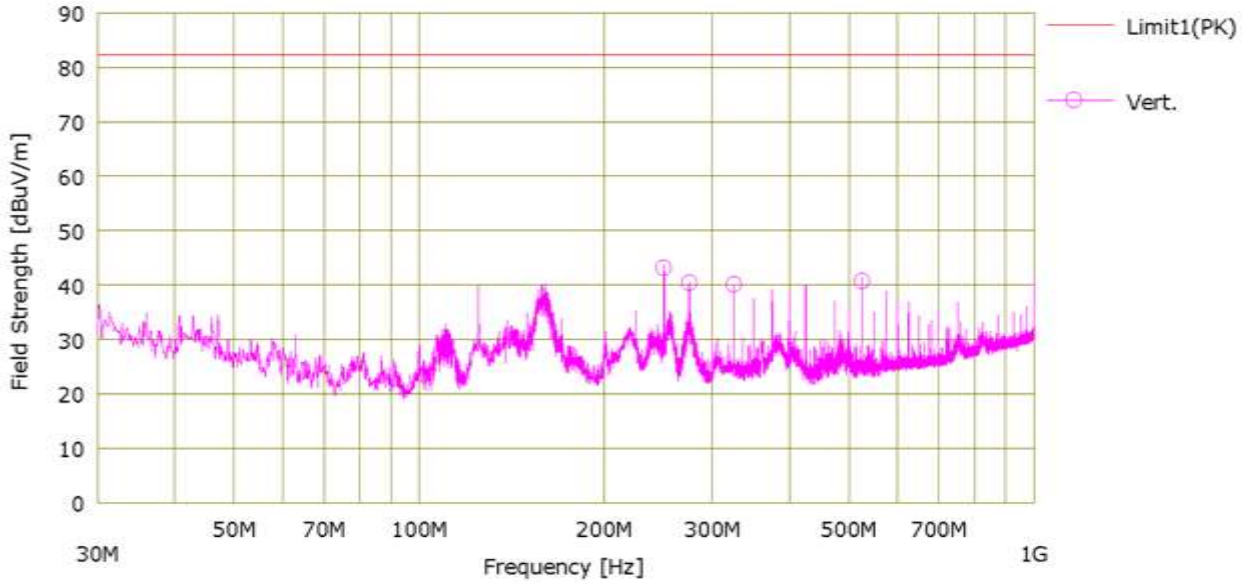
transmitting at f_{MID} (19.8 MHz, 16QAM)



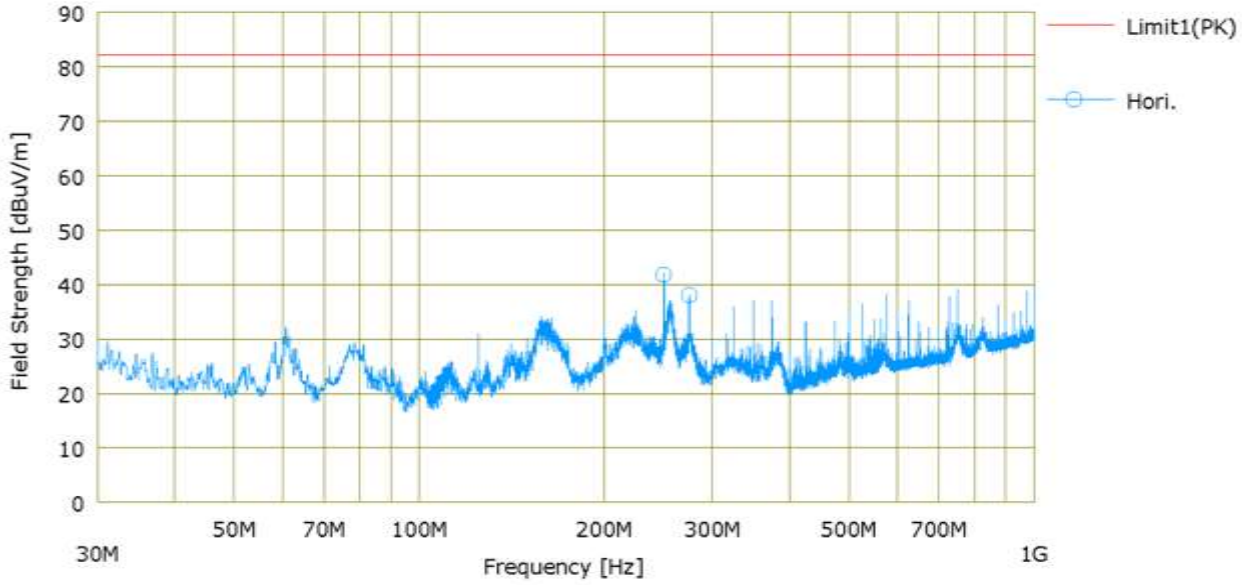


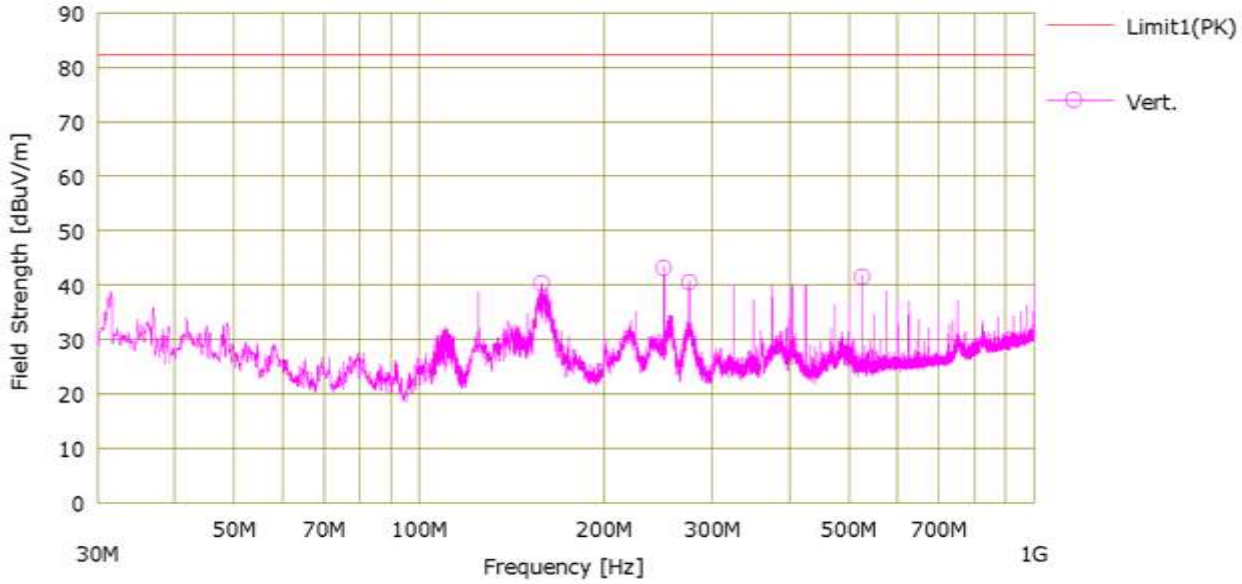
transmitting at f_{HIGH} (19.8 MHz, 16QAM)



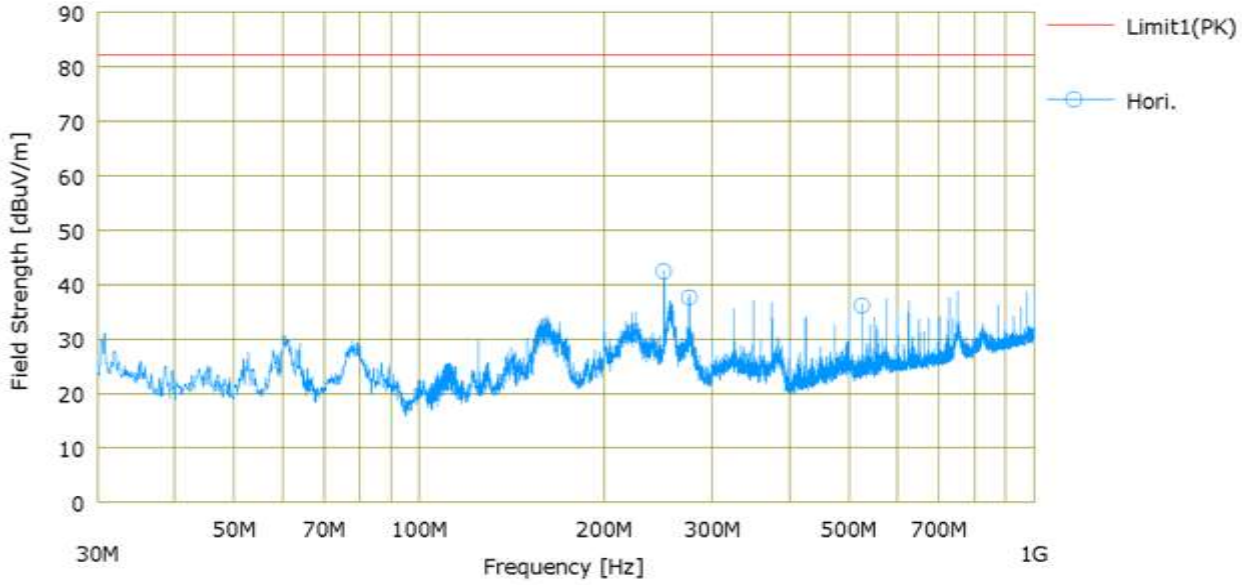


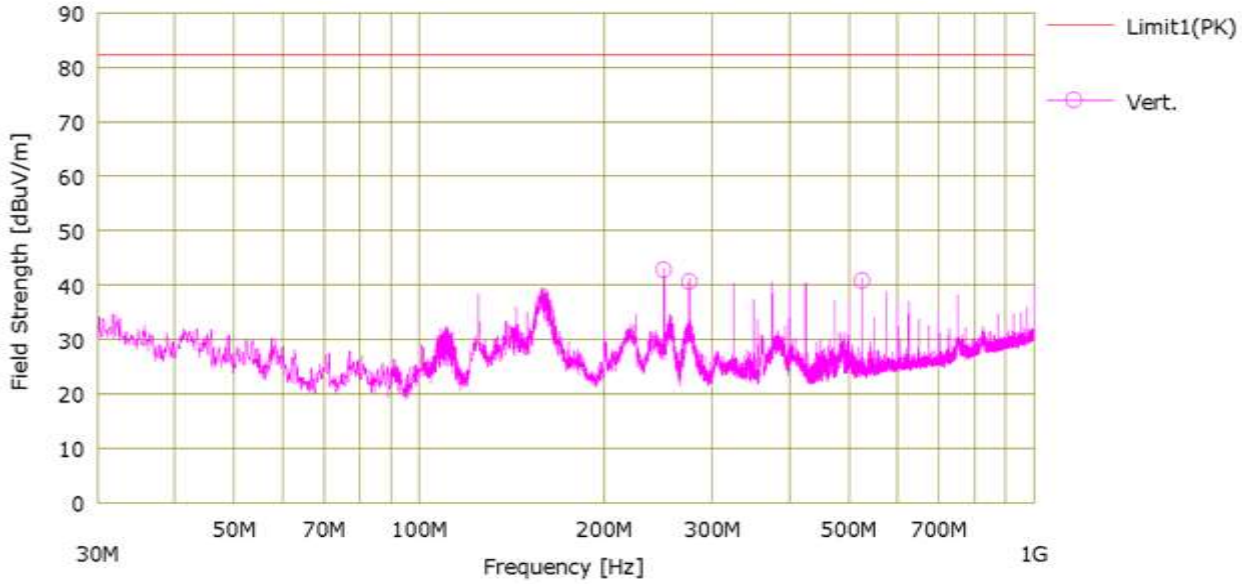
transmitting at f_{LOW} (39.6 MHz, 16QAM)



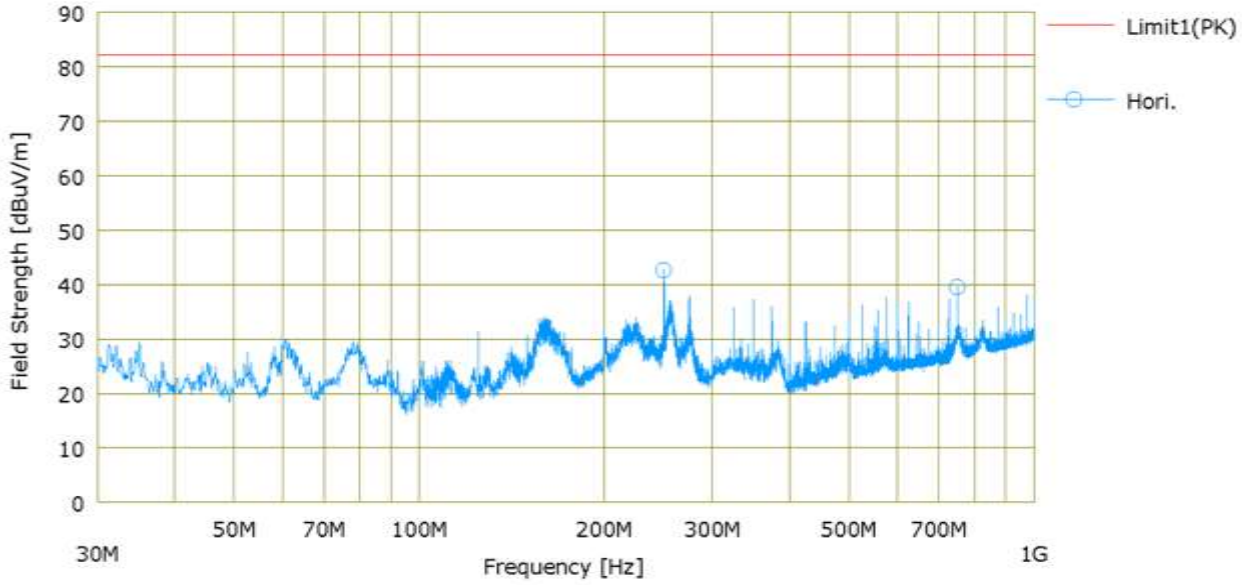


transmitting at f_{MID} (39.6 MHz, 16QAM)





transmitting at f_{HIGH} (39.6 MHz, 16QAM)



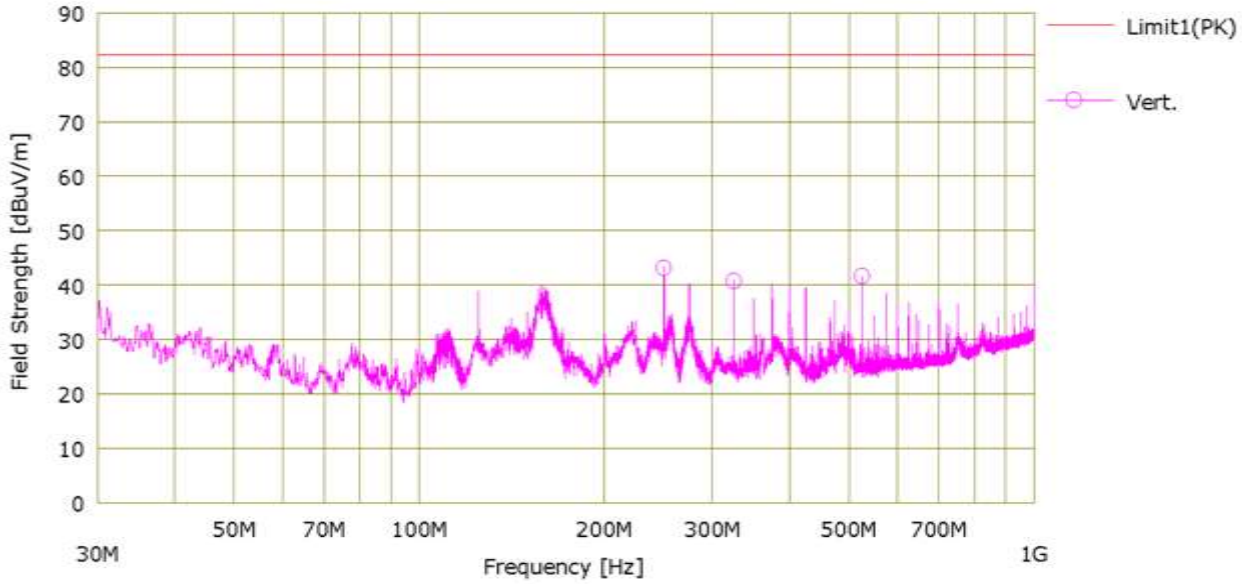
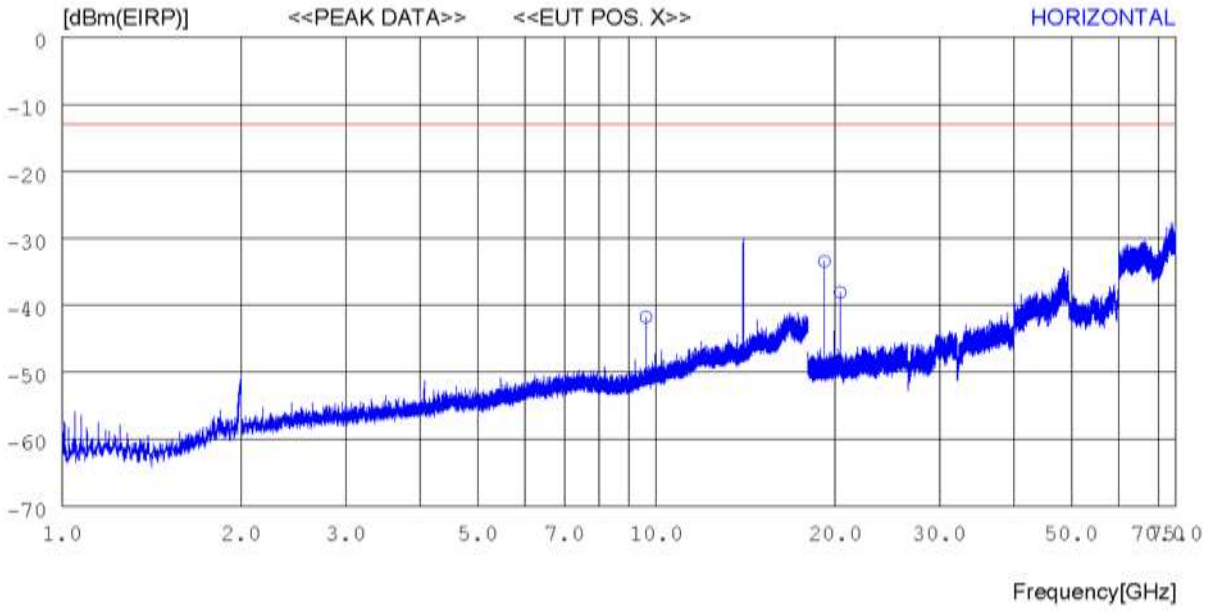
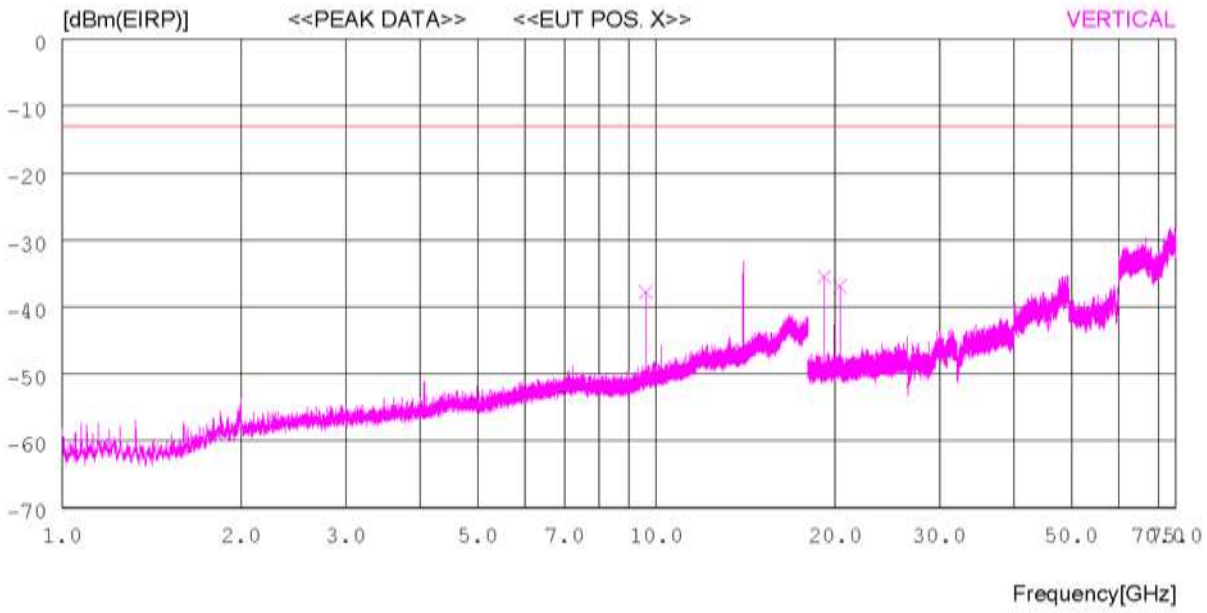


Figure 8. Plot of Field Strength of Spurious Radiation (radiated emissions from 1 GHz to 75 GHz)

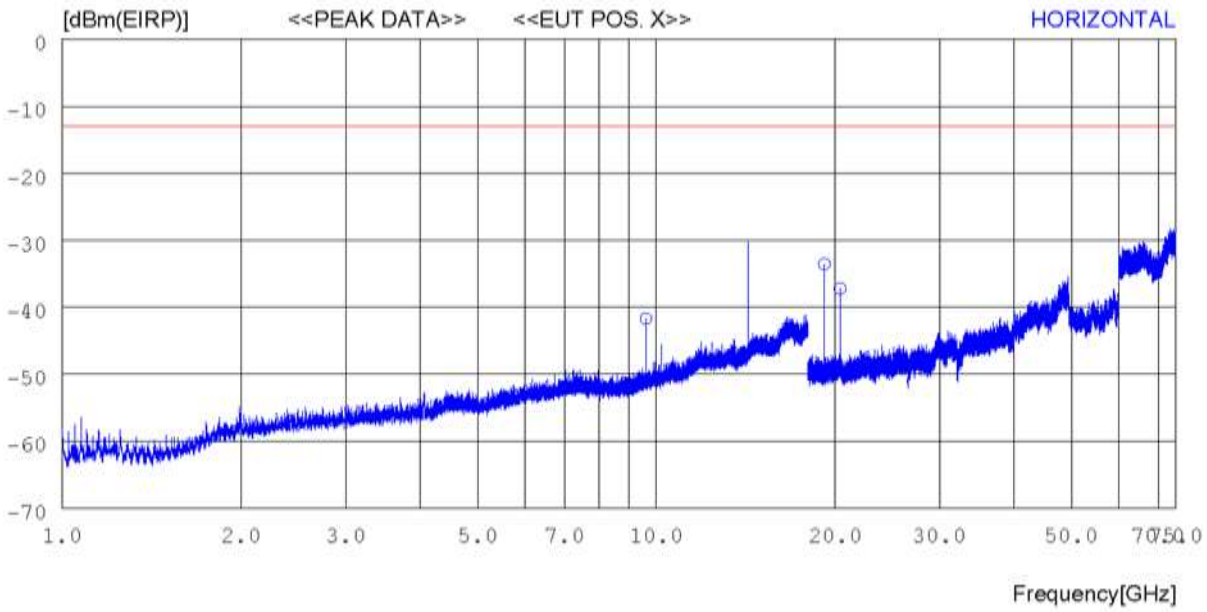
transmitting at f_{LOW} (19.8 MHz, 16QAM)

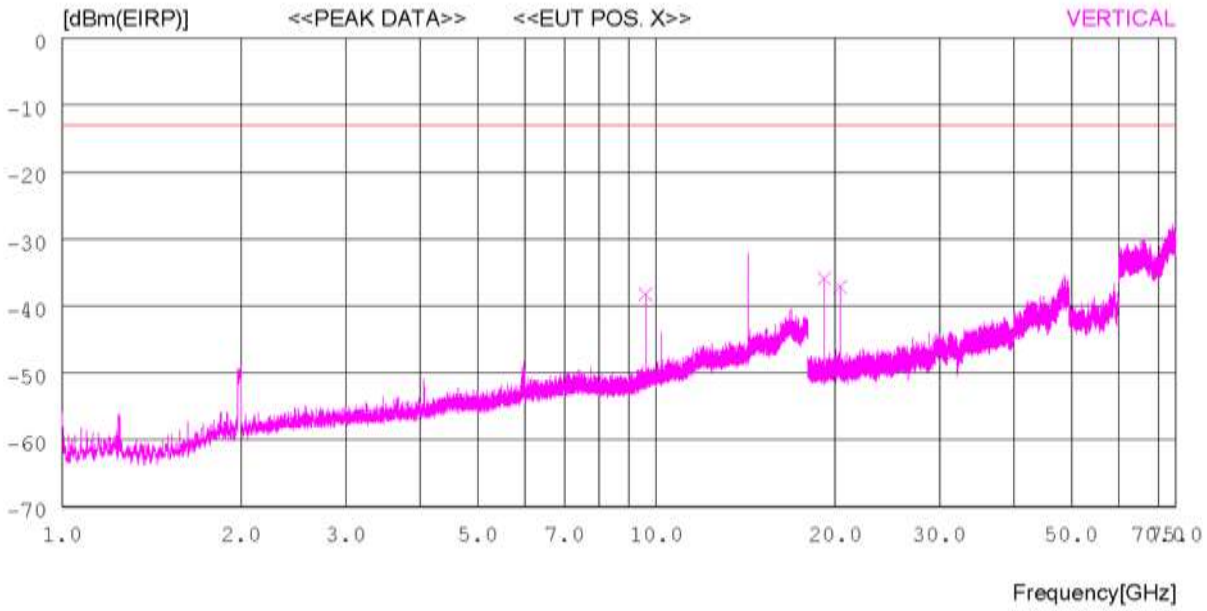




remark: the emissions in the fundamental frequency were not subject to the limits; although the antennas were terminated by the dummy loads, the fundamental transmitting signal was leaked and detected and therefore these emissions were ignored.

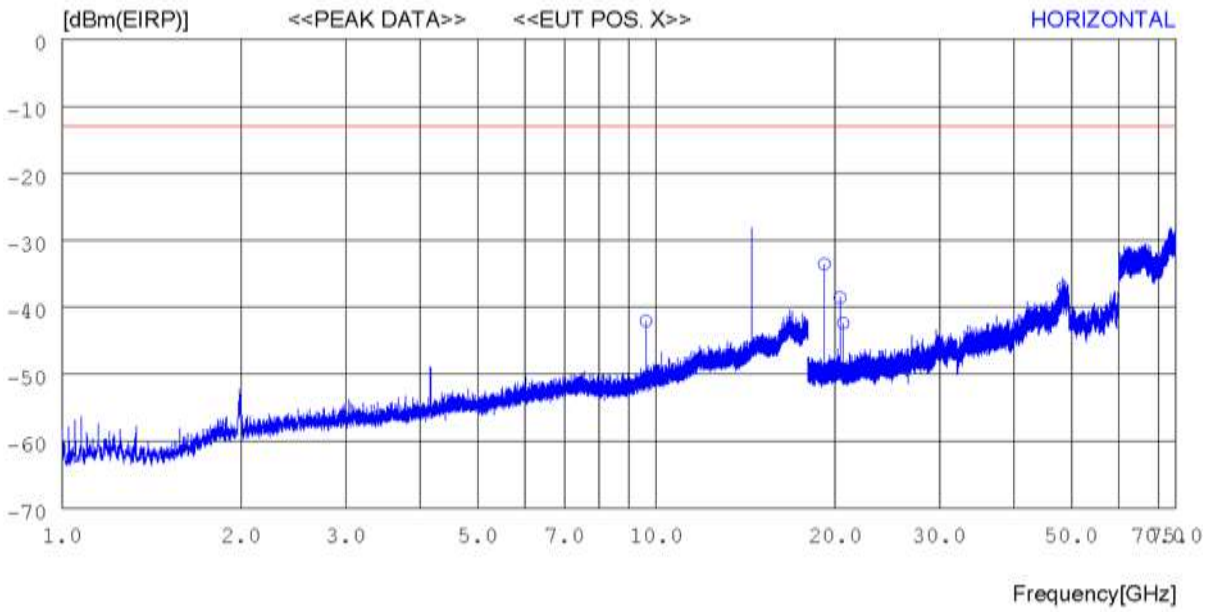
transmitting at f_{MID} (19.8 MHz, 16QAM)

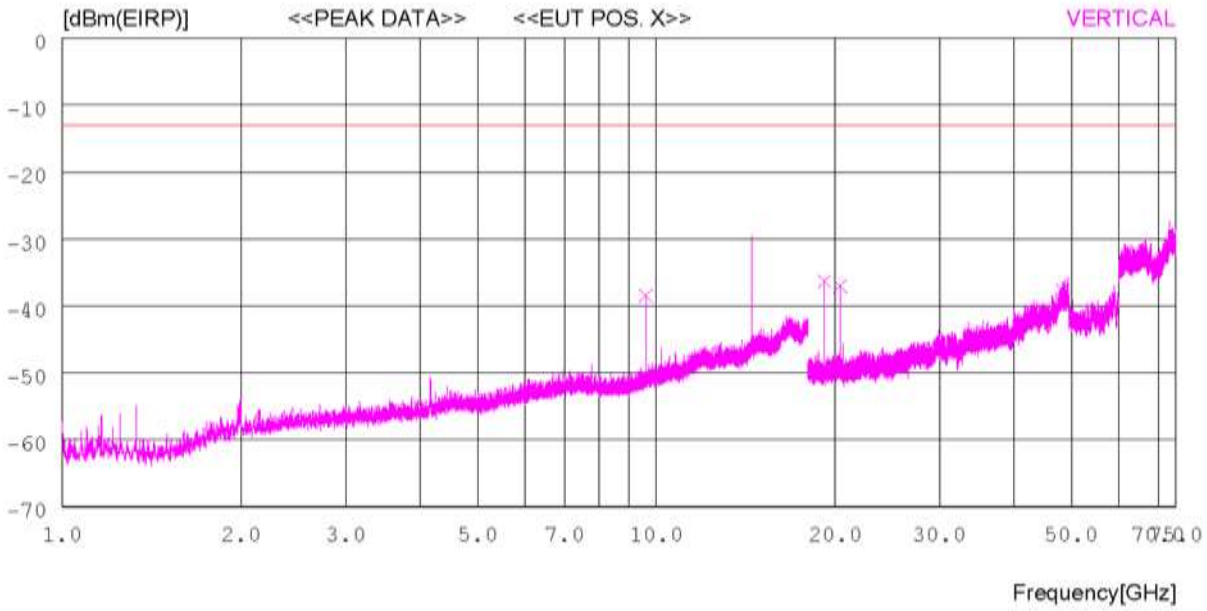




remark: the emissions in the fundamental frequency were not subject to the limits; although the antennas were terminated by the dummy loads, the fundamental transmitting signal was leaked and detected and therefore these emissions were ignored.

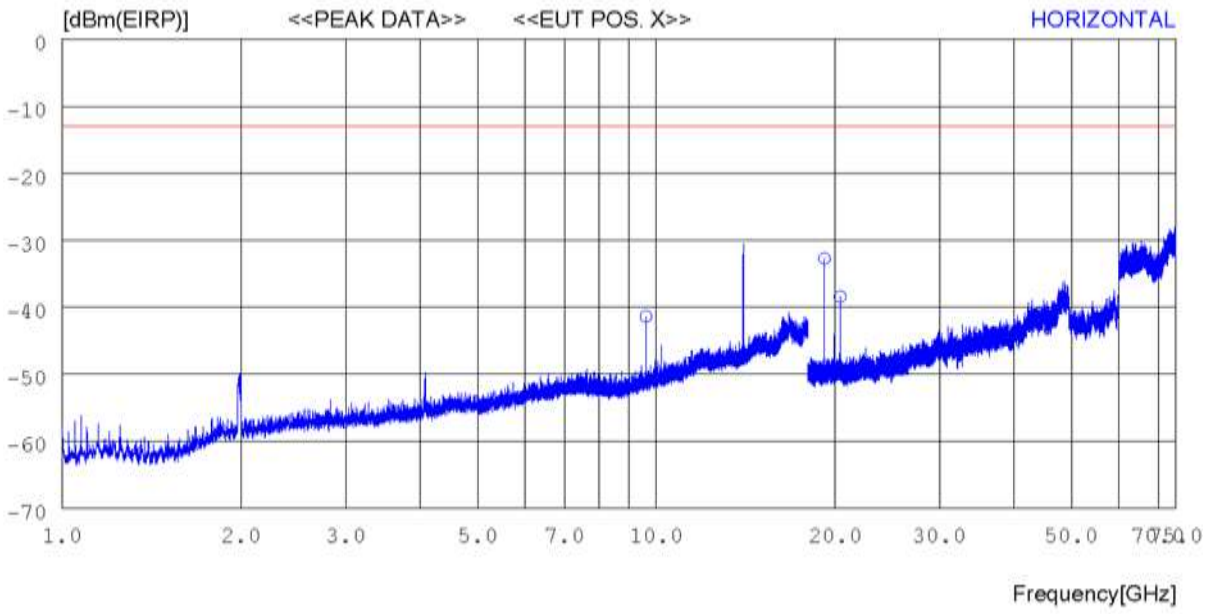
transmitting at f_{HIGH} (19.8 MHz, 16QAM)

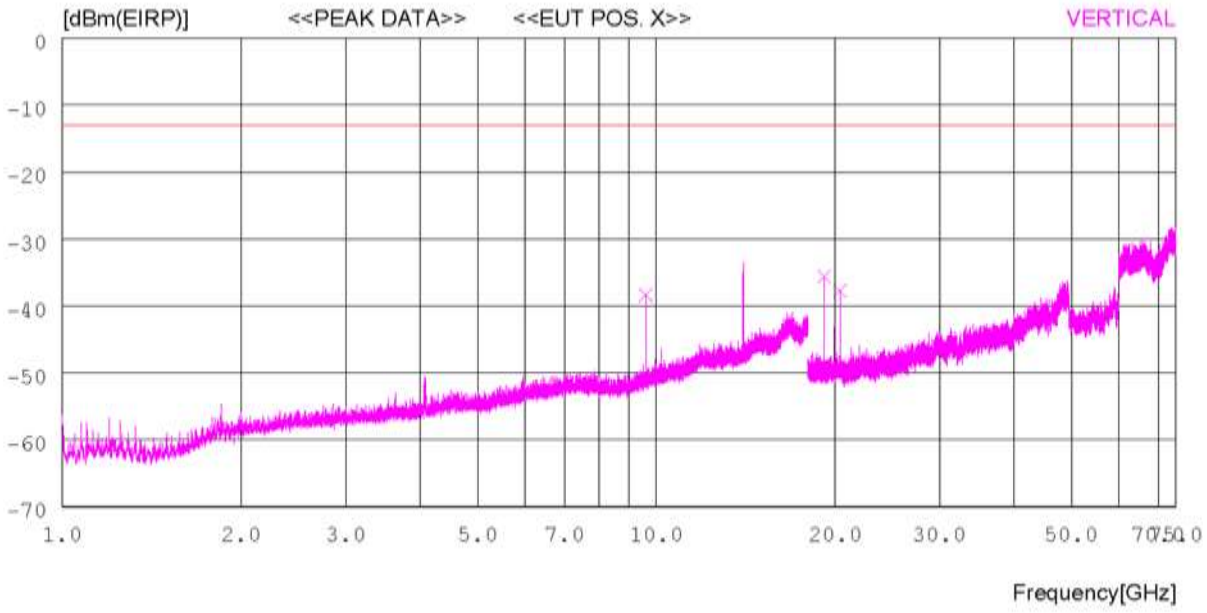




remark: the emissions in the fundamental frequency were not subject to the limits; although the antennas were terminated by the dummy loads, the fundamental transmitting signal was leaked and detected and therefore these emissions were ignored.

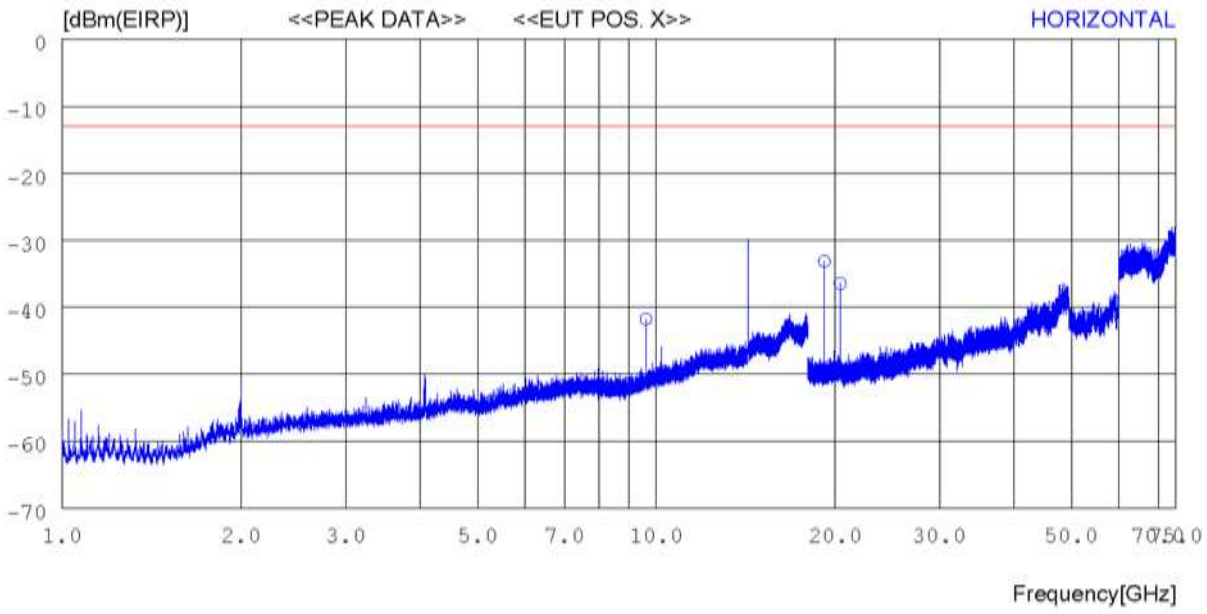
transmitting at f_{LOW} (39.6 MHz, 16QAM)

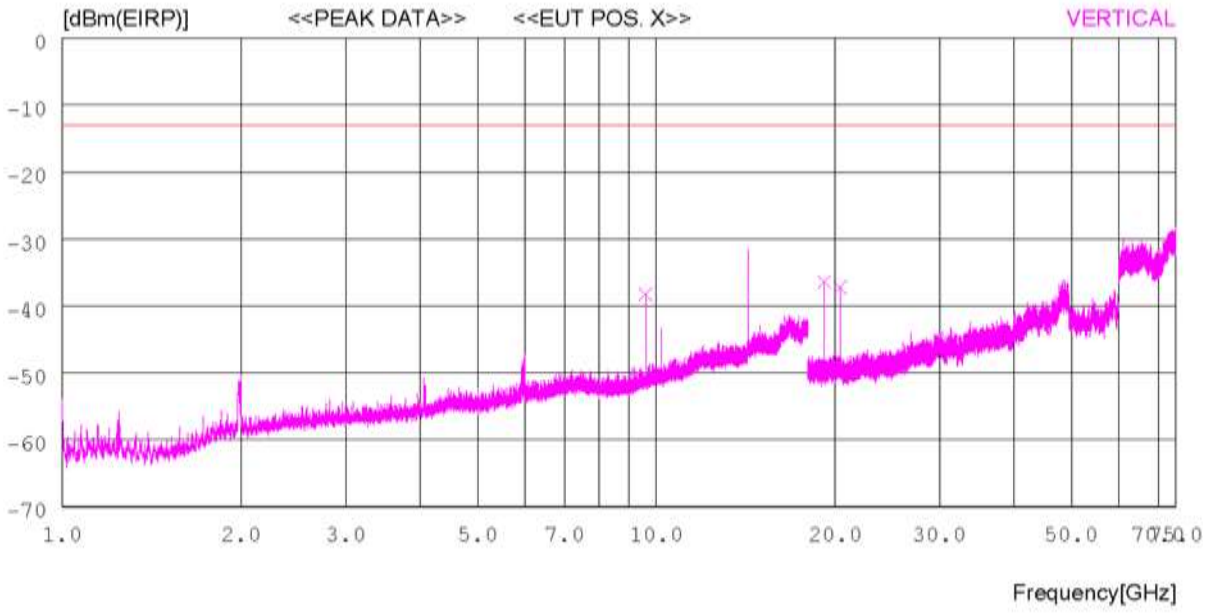




remark: the emissions in the fundamental frequency were not subject to the limits; although the antennas were terminated by the dummy loads, the fundamental transmitting signal was leaked and detected and therefore these emissions were ignored.

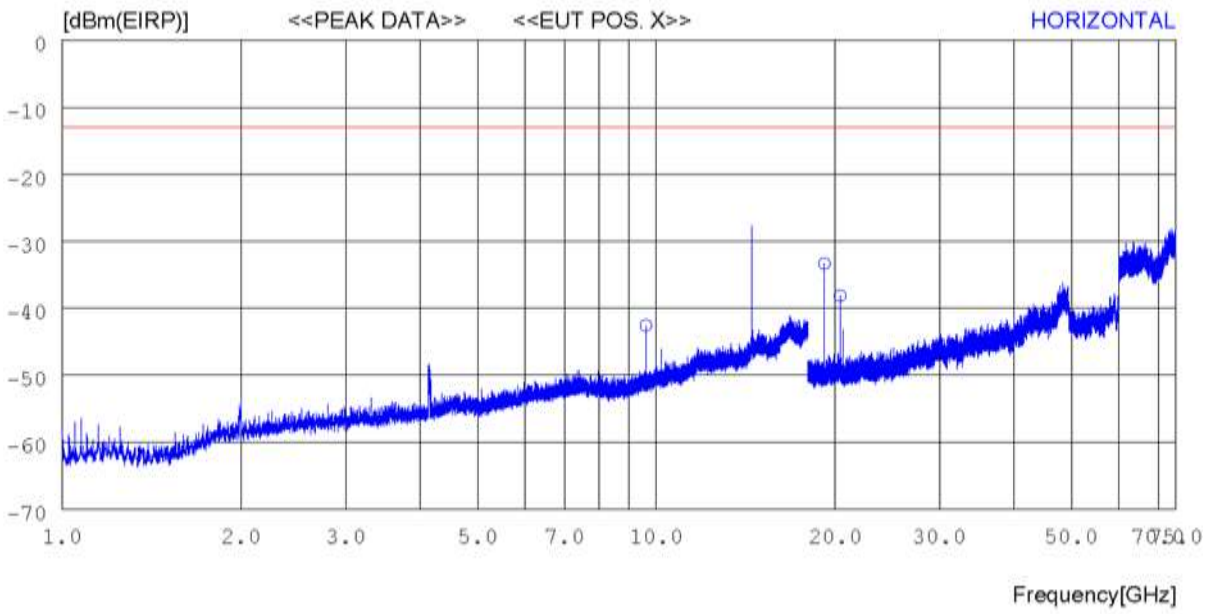
transmitting at f_{MID} (39.6 MHz, 16QAM)

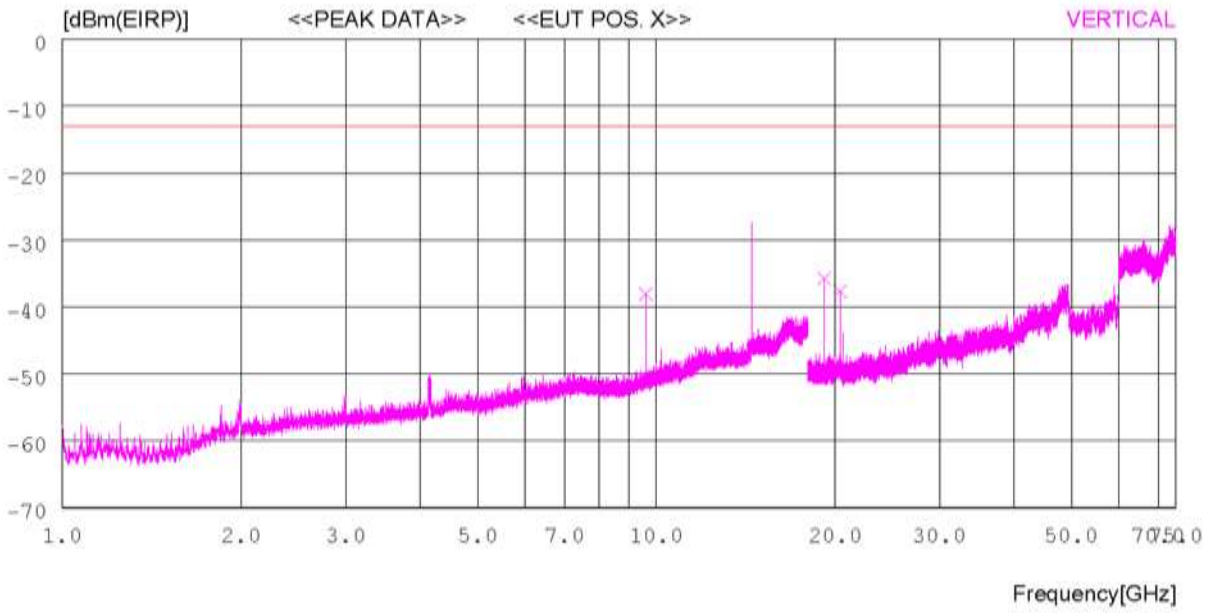




remark: the emissions in the fundamental frequency were not subject to the limits; although the antennas were terminated by the dummy loads, the fundamental transmitting signal was leaked and detected and therefore these emissions were ignored.

transmitting at f_{HIGH} (39.6 MHz, 16QAM)





remark: the emissions in the fundamental frequency were not subject to the limits; although the antennas were terminated by the dummy loads, the fundamental transmitting signal was leaked and detected and therefore these emissions were ignored.

5.5. Transmitter Frequency Stability

5.5.1 Regulation

FCC, CFR 47 Section

According to 2.1055,

(a) The frequency stability shall be measured with variation of ambient temperature as follows:

(1) From -30° to + 50° centigrade for all equipment except that specified in paragraphs (a) (2) and (3) of this section.

(2) From -20° to + 50° centigrade for equipment to be licensed for use in the Maritime Services under part 80 of this chapter, except for Class A, B, and S Emergency Position Indicating Radio beacons (EPIRBS), and equipment to be licensed for use above 952 MHz at operational fixed stations in all services, stations in the Local Television Transmission Service and Point-to-Point Microwave Radio Service under part 21 of this chapter, equipment licensed for use aboard aircraft in the Aviation Services under part 87 of this chapter, and equipment authorized for use in the Family Radio Service under part 95 of this chapter.

(3) From 0° to + 50° centigrade for equipment to be licensed for use in the Radio Broadcast Services under part 73 of this chapter.

(b) Frequency measurements shall be made at the extremes of the specified temperature range and at intervals of not more than 10° centigrade through the range. A period of time sufficient to stabilize all of the components of the oscillator circuit at each temperature level shall be allowed prior to frequency measurement. The short term transient effects on the frequency of the transmitter due to keying (except for broadcast transmitters) and any heating element cycling normally occurring at each ambient temperature level also shall be shown. Only the portion or portions of the transmitter containing the frequency determining and stabilizing circuitry need be subjected to the temperature variation test.

(c) In addition to all other requirements of this section, the following information is required for equipment incorporating heater type crystal oscillators to be used in mobile stations, for which type acceptance is first requested after March 25, 1974, except for battery powered, hand carried, portable equipment having less than 3 watts mean output power.

(1) Measurement data showing variation in transmitter output frequency from a cold start and the elapsed time necessary for the frequency to stabilize within the applicable tolerance. Tests shall be made after temperature stabilization at each of the ambient temperature levels; the lower temperature limit, 0° centigrade and + 30° centigrade with no primary power applied.

(2) Beginning at each temperature level specified in paragraph (c)(1) of this section, the frequency shall be measured within one minute after application of primary power to the transmitter and at intervals of no more than one minute thereafter until ten minutes have elapsed or until sufficient measurements are obtained to indicate clearly that the frequency has stabilized within the applicable tolerance, whichever time period is greater. During each test, the ambient temperature shall not be allowed to rise more than 10° centigrade above the respective beginning ambient temperature level.

(3) The elapsed time necessary for the frequency to stabilize within the applicable tolerance from each beginning ambient temperature level as determined from the tests specified in this paragraph shall be specified in the instruction book for the transmitter furnished to the user.

(4) When it is impracticable to subject the complete transmitter to this test because of its physical dimensions or power rating, only its frequency determining and stabilizing portions need be tested.

(d) The frequency stability shall be measured with variation of primary supply voltage as follows:

(1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.

(2) For hand carried, battery powered equipment, reduce primary supply voltage to the battery operating end point which shall be specified by the manufacturer.

(3) The supply voltage shall be measured at the input to the cable normally provided with the equipment, or at the power supply terminals if cables are not normally provided. Effects on frequency of transmitter keying (except for broadcast transmitters) and any heating element cycling at the nominal supply voltage and at each extreme also shall be shown.

(e) When deemed necessary, the Commission may require tests of frequency stability under conditions in addition to those specifically set out in paragraphs (a), (b), (c), and (d) of this section. (For example measurements showing the effect of proximity to large metal objects, or of various types of antennas, may be required for portable equipment.)

According to 25.202(d), Frequency tolerance, Earth stations. The carrier frequency of each earth station transmitter authorized in these services shall be maintained within 0.001 percent of the reference frequency.

5.5.2 Test Procedure

The frequency stability was measured with the following setting according to subclause 5.6.3 of ANSI C63.26.

Frequency stability versus environmental temperature:

(a) Supply the EUT with nominal voltage.

(b) Turn on the EUT and tune it to the center frequency of the operating band.

(c) Turn the EUT off and place it inside an environmental temperature chamber. For devices that are normally operated continuously, the EUT may be energized while inside the test chamber. For devices that have oscillator heaters, energize only the heater circuit while the EUT was inside the chamber.

(d) RF output was connected to the frequency counter or spectrum analyzer via feed through attenuators.

(e) Set the temperature control on the chamber to the highest specified EUT operating temperature and allow the temperature inside the chamber to stabilize at the set temperature before starting frequency measurements.

(f) While maintaining a constant temperature inside the environmental chamber, turn on the EUT and record the operating frequency at startup and two, five, and ten minutes after the EUT was energized.

(g) After all measurements have been made at the highest specified temperature turn the EUT off.

(h) Repeat the above measurement process for the EUT with the test chamber set at the appropriate temperature.

When the frequency stability limit is stated as being sufficient such that the fundamental emissions stay within the authorized bands of operation, a reference point should be established at the applicable unwanted emissions limit using a RBW equal to the RBW required by the unwanted emissions specification of the applicable regulatory standard. These reference points measured using the lowest and highest channel of operation should be identified as f_L and f_H respectively. The worst-case frequency offset determined in the above methods should be added or subtracted from the values of f_L and f_H and the resulting frequencies must remain within the band.

Frequency Stability versus Input Voltage:

(a) These tests should be made at room temperature (20 ± 5) °C supply the EUT with nominal voltage.

(b) Couple RF output to the frequency counter or spectrum analyzer.

(c) Tune the EUT to the center frequency of the operating band and measure the frequency at startup and two, five, and ten minutes after startup.

(d) Supply it with 85 % of the nominal voltage and repeat the above procedure.

(e) Supply it with 115 % of the nominal voltage and repeat the above procedure.

(f) Repeat the frequency measurement at the low and high channel of the operating band.

5.5.3 Result: PASS

Table 9: Frequency stability (temperature variations)

Reference Frequency: 14 263 MHz

Temperature	Voltage	Measured Carrier Frequency with time elapsed			
		START UP	2 minutes	5 minutes	10 minutes
[°C]	[V_{AC}]	[MHZ]	[MHZ]	[MHZ]	[MHZ]
+50	120	14 263.001 605	14 263.001 606	14 263.001 608	14 263.001 608
+40	120	14 263.001 603	14 263.001 603	14 263.001 603	14 263.001 604
+30	120	14 263.001 604	14 263.001 604	14 263.001 604	14 263.001 603
+20	120	14 263.001 609	14 263.001 609	14 263.001 608	14 263.001 606
+10	120	14 263.001 624	14 263.001 621	14 263.001 618	14 263.001 614
0	120	14 263.001 620	14 263.001 617	14 263.001 616	14 263.001 615
-10	120	14 263.001 625	14 263.001 624	14 263.001 624	14 263.001 623
-20	120	14 263.001 630	14 263.001 630	14 263.001 629	14 263.001 628
-30	120	14 263.001 640	14 263.001 639	14 263.001 638	14 263.001 634

Reference Frequency: 14 263 MHz, LIMIT: within 0.001 % (10 ppm; within ± 142 63 Hz)

Temperature	Voltage	Frequency Tolerance							
		START UP		2 minutes		5 minutes		10 minutes	
[°C]	[V_{AC}]	Err [Hz]	Err [ppm]	Err [Hz]	Err [ppm]	Err [Hz]	Err [ppm]	Err [Hz]	Err [ppm]
+50	120	1 605	0.11	1 606	0.11	1 608	0.11	1 608	0.11
+40	120	1 603	0.11	1 603	0.11	1 603	0.11	1 604	0.11
+30	120	1 604	0.11	1 604	0.11	1 604	0.11	1 603	0.11
+20	120	1 609	0.11	1 609	0.11	1 608	0.11	1 606	0.11
+10	120	1 624	0.11	1 621	0.11	1 618	0.11	1 614	0.11
0	120	1 620	0.11	1 617	0.11	1 616	0.11	1 615	0.11
-10	120	1 625	0.11	1 624	0.11	1 624	0.11	1 622	0.11
-20	120	1 630	0.11	1 630	0.11	1 629	0.11	1 628	0.11
-30	120	1 640	0.12	1 638	0.11	1 638	0.11	1 634	0.11

Err [Hz] = 10^6 × (Measured frequency [MHz] - Reference Frequency [MHz])

Err [ppm] = 10^6 × (Measured frequency [MHz] - Reference Frequency [MHz]) / Reference frequency [MHz]

NOTE: For testing purpose EUT's modulation was deactivated, and the CW carrier was activated.

Table 10: Frequency stability (voltage variations)

Reference Frequency [MHz]	Voltage [V_{AC}]	Measured Carrier Frequency with time elapsed			
		START UP [MHZ]	2 minutes [MHZ]	5 minutes [MHZ]	10 minutes [MHZ]
14 013	85 %	14 013.001 536	14 013.001 537	14 013.001 536	14 013.001 537
	100 %	14 013.001 541	14 013.001 541	14 013.001 541	14 013.001 541
	115 %	14 013.001 537	14 013.001 538	14 013.001 537	14 013.001 538
14 263	85 %	14 263.001 576	14 263.001 577	14 263.001 576	14 263.001 575
	100 %	14 263.001 580	14 263.001 580	14 263.001 579	14 263.001577
	115 %	14 263.001 577	14 263.001 576	14 263.001 576	14 263.001 576
14 487	85 %	14 487.001 611	14 487.001 612	14 487.001 611	14 487.001 611
	100 %	14 487.001 610	14 487.001 610	14 487.001 610	14 487.001 610
	115 %	14 487.001 610	14 487.001 610	14 487.001 610	14 487.001 608

Reference Frequency [MHz]	Voltage [V_{AC}]	Frequency Tolerance (LIMIT: within 0.001 %;10 ppm)							
		START UP		2 minutes		5 minutes		10 minutes	
		Err [Hz]	Err [ppm]	Err [Hz]	Err [ppm]	Err [Hz]	Err [ppm]	Err [Hz]	Err [ppm]
14 013	85 %	1 536	0.11	1 537	0.11	1 536	0.11	1 537	0.11
	100 %	1 541	0.11	1 541	0.11	1 541	0.11	1 540	0.11
	115 %	1 537	0.11	1 538	0.11	1 537	0.11	1 538	0.11
14 263	85 %	1 576	0.11	1 577	0.11	1 576	0.11	1 575	0.11
	100 %	1 580	0.11	1 580	0.11	1 579	0.11	1 577	0.11
	115 %	1 577	0.11	1 576	0.11	1 576	0.11	1 576	0.11
14 487	85 %	1 611	0.11	1 612	0.11	1 611	0.11	1 611	0.11
	100 %	1 610	0.11	1 610	0.11	1 610	0.11	1 610	0.11
	115 %	1 610	0.11	1 610	0.11	1 609	0.11	1 608	0.11

Err [Hz] = 10^6 × (Measured frequency [MHz] - Reference Frequency [MHz])

Err [ppm] = 10^6 × (Measured frequency [MHz] - Reference Frequency [MHz]) / Reference frequency [MHz]

NOTE: For testing purpose EUT's modulation was deactivated, and the CW carrier was activated.