8.3. BAND EDGE EMISSIONS

RULE PART(S)

FCC: §2.1051 (Radiated with Antenna), §2.1053 (Cabinet Radiated), §30.203

LIMITS

30.203 (a) - The conductive power or the total radiated power of any emission outside a licensee's frequency block shall be −13 dBm/MHz or lower. However, in the bands immediately outside and adjacent to the licensee's frequency block, having a bandwidth equal to 10 percent of the channel bandwidth, the conductive power or the total radiated power of any emission shall be −5 dBm/MHz or lower.

TEST PROCEDURE

- RBW = 1 MHz
- VBW ≥ 3 x RBW
- Number of measurement points in sweep > 2 x span / RBW
- Sweep time = auto-couple
- Detector = RMS, Gated
- Trace mode = Average

KDB 842590 D01 Upper Microwave Flexible Use Service v01 Section 4.2
ANSI C63.26-2015 Clause 5.2, Clause 5.5, Clause 6.4, and Annex C.5.2

Band Edge measurements were measured as EIRP for direct comparison to the 30.203 TRP limit to demonstrate compliance.

Band Edge measurements were performed at 4.5 m test distance.

EIRP of BE emission was calculated using the equations on ANSI C63.26-2015 Annex C.5.2. The total correction factors from the receive horn antenna gain ranging 26 – 40 GHz, cable loss and far-field path loss @ 4.5 m and the EUT antenna gain were calculated using equations C.8 and C.9, and pre-loaded into spectrum analyzer.

Sample calculation of EIRP:

Total Correction Factor = Cbl Loss (dB) – Horn Ant Gain (dBi) + Path Loss @ 4.5m (dB)
+ EUT Ant Gain (dBi)
= 4 - 23 + 74.5 + 27
= 82.5 dB

EIRP = $P_{measured}$(dBm), where Total Correction Factor preloaded.

In order to properly display of signal level on the plots, the pre-loaded correction factors were intentional lowered by 45 dB and an offset factor of 45 dB was applied on spectrum analyzer to compensate the true correction factors across 26 - 40 GHz frequency range.

Radiated power levels are investigated while the receive horn antenna was rotated through all angles to determine the worst case polarization/positioning.

RESULTS

See the following pages.

Employee IDs: 19296 & 19437
Location: Chamber 1
Test Date: 10/1/2020 – 10/6/2020

1 Carrier Configuration, Left

Tx Main Unit - QPSK, Horizontal

Tx Main Unit - QPSK, Vertical

1 Carrier Configuration, Left

Tx Extension Unit – 16QAM, Horizontal

Tx Extension Unit - 16QAM, Vertical

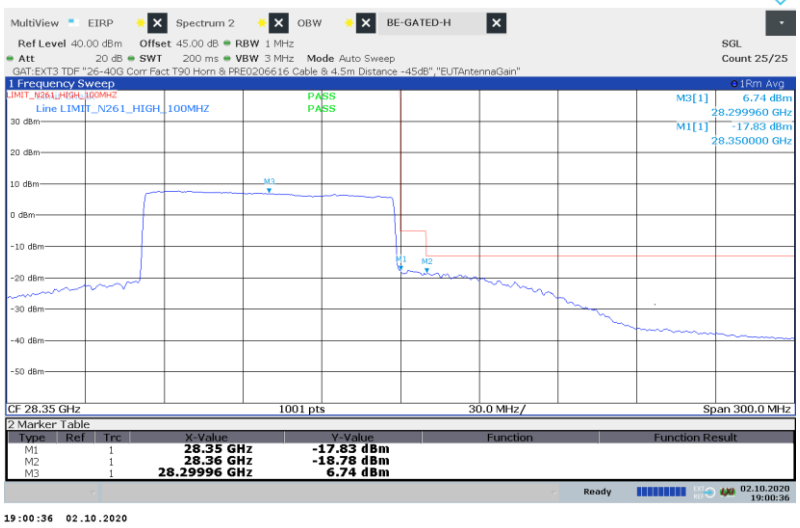
1 Carrier Configuration, Right

Tx Main Unit - QPSK, Horizontal

Tx Main Unit - QPSK, Vertical

1 Carrier Configuration, Right

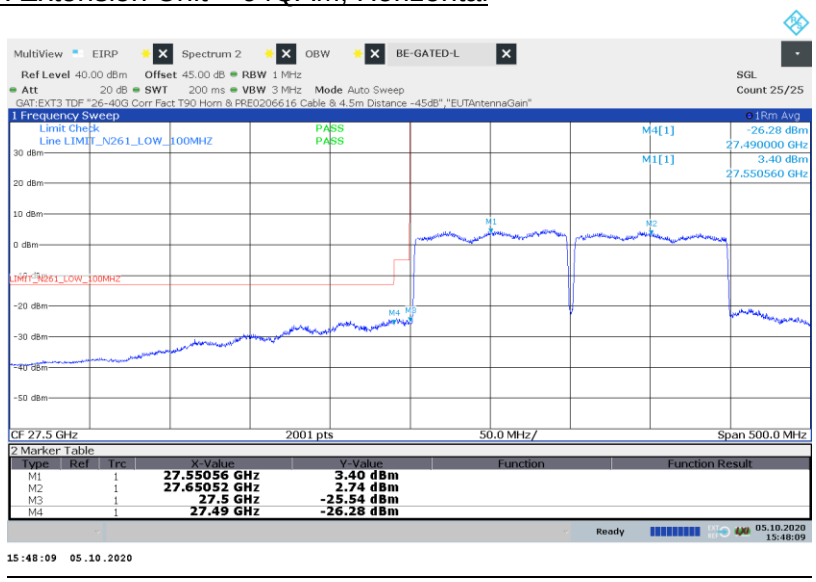
Tx Extension Unit - QPSK, Horizontal



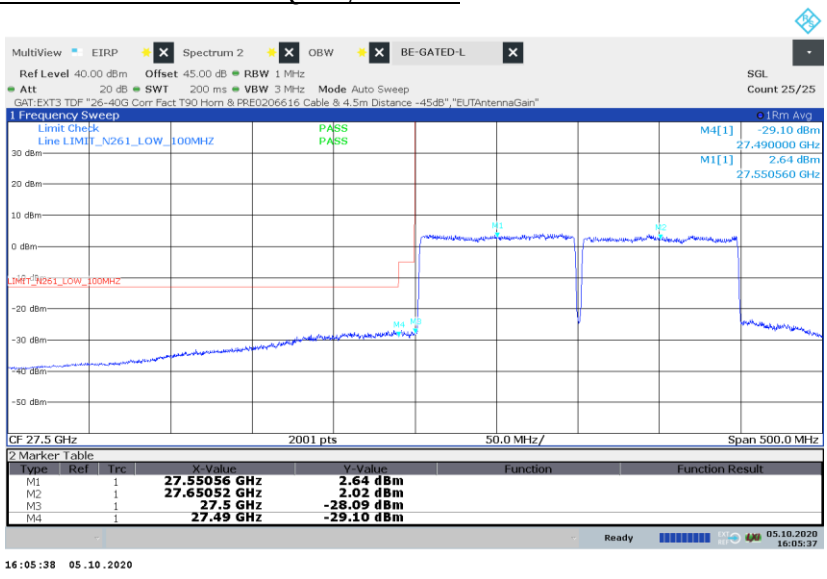
Tx Extension Unit - QPSK, Vertical

2 Carrier Configuration, Left

Tx Extension Unit – 64QAM, Horizontal

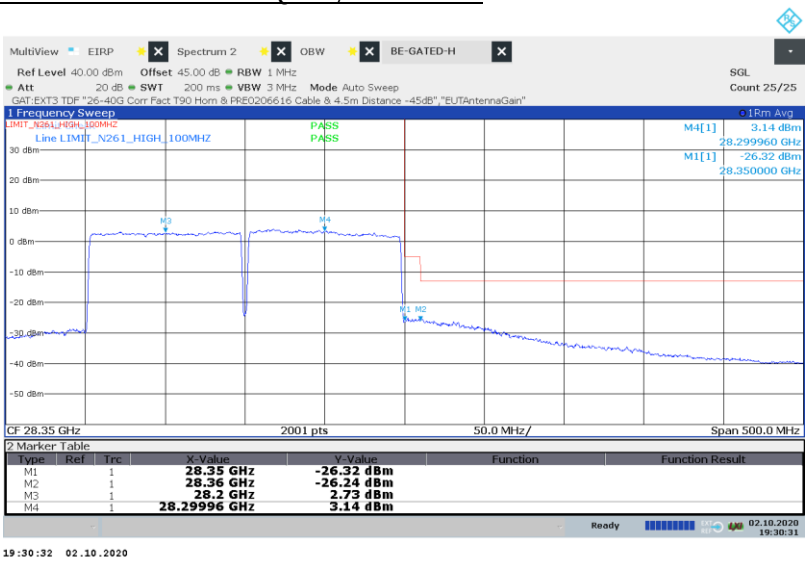


Tx Extension Unit – 64QAM, Vertical

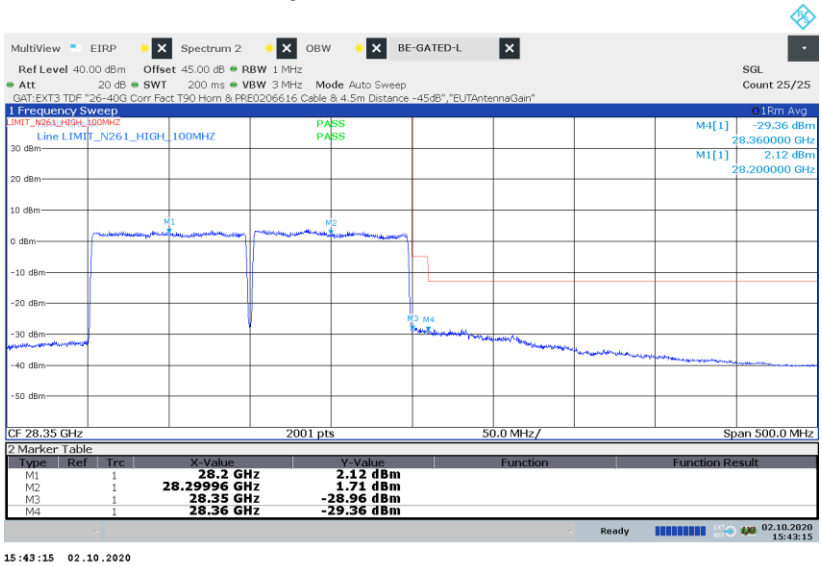


2 Carrier Configuration, Right

Tx Extension Unit – 16QAM, Horizontal



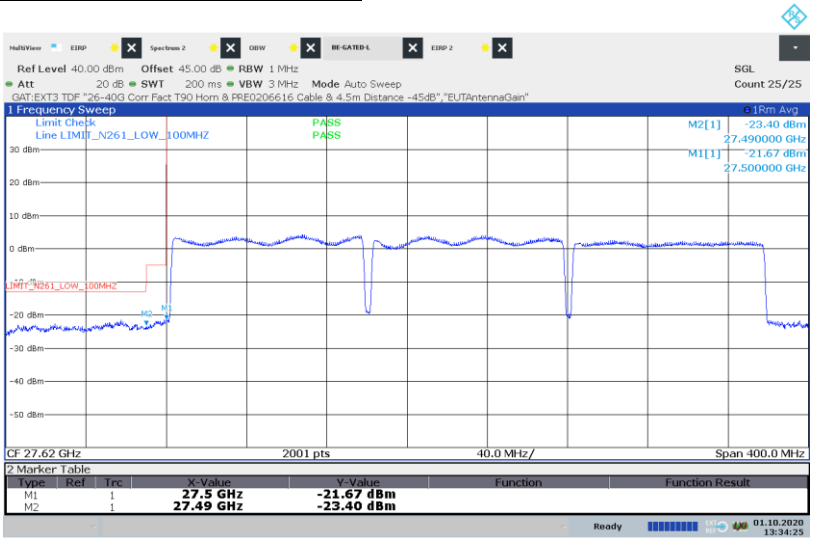
Tx Extension Unit – 16QAM, Vertical



3 Carrier Configuration, Left

Tx Main Unit - QPSK, Horizontal

Tx Main Unit - QPSK, Vertical



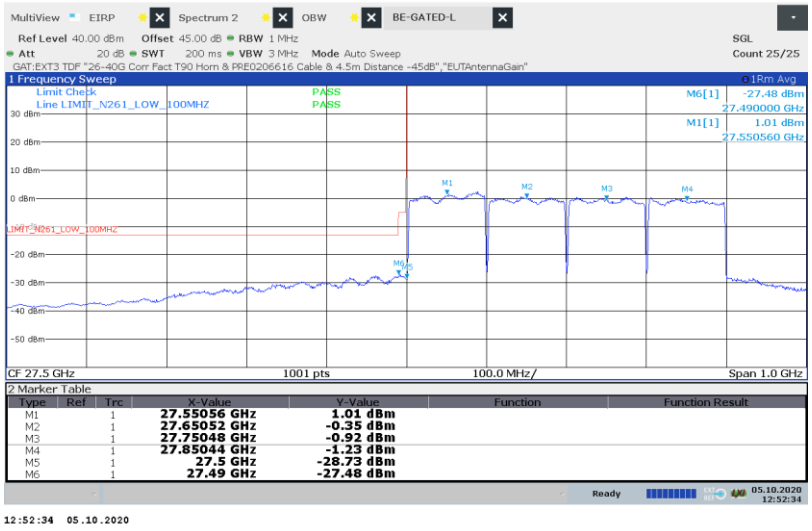
3 Carrier Configuration, Right

Tx Main Unit – 16QAM, Horizontal

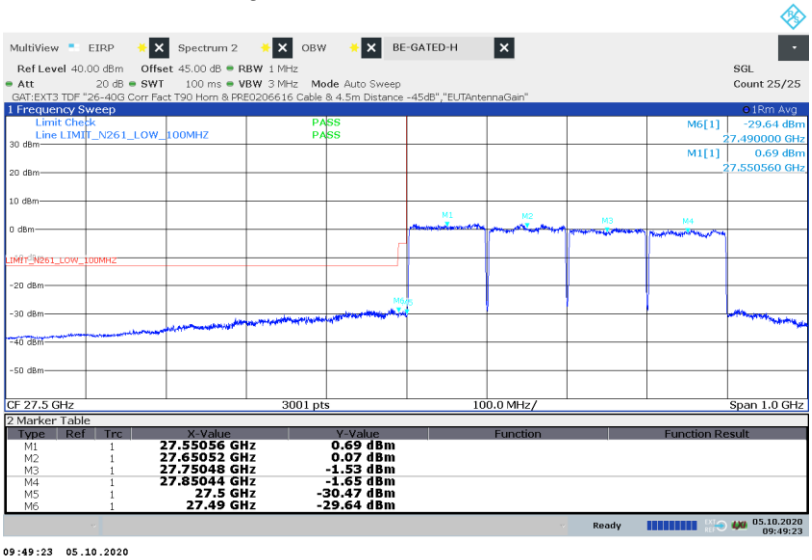
Tx Main Unit – 16QAM, Vertical

4 Carrier Configuration, Left

Tx Extension Unit – QPSK, Horizontal



Tx Extension Unit – QPSK, Vertical



4 Carrier Configuration, Right

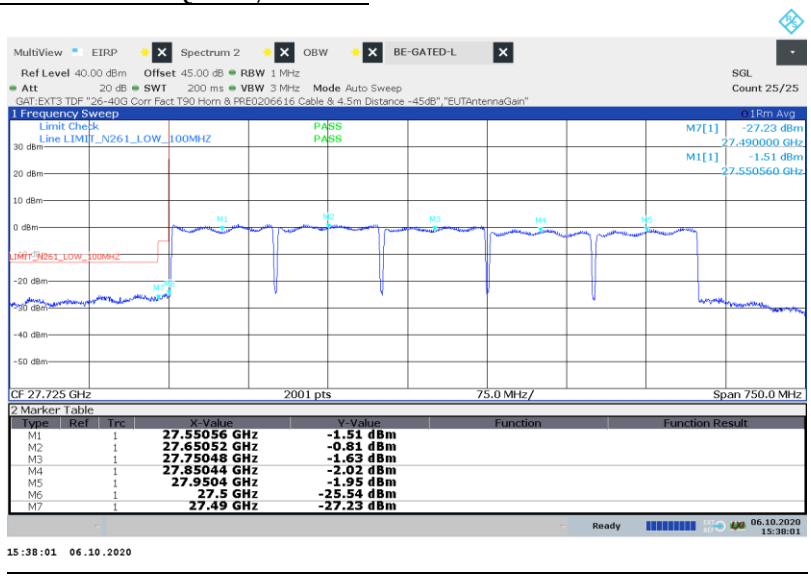
Tx Extension Unit – 16QAM, Horizontal

Tx Extension Unit – 16QAM, Vertical

5 Carrier Configuration, Left

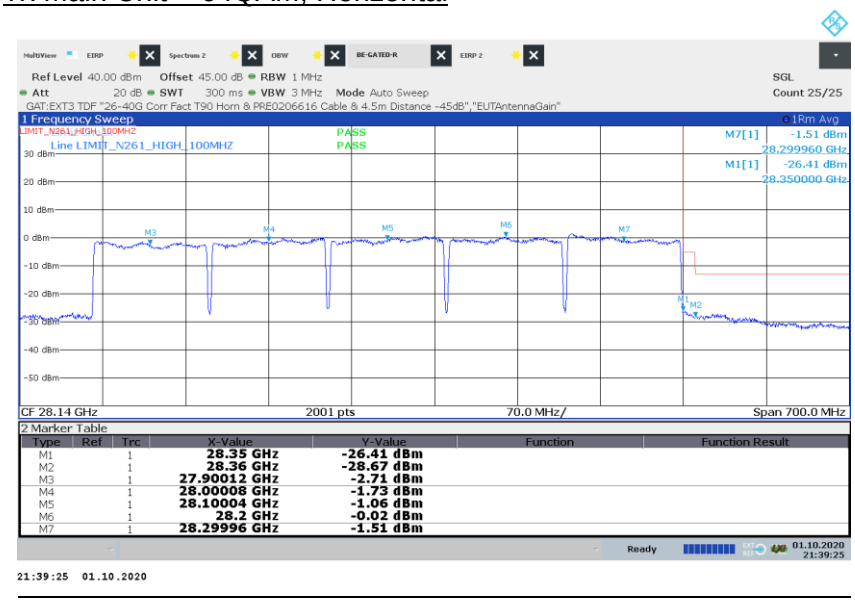
Tx Main Unit – QPSK, Horizontal

Tx Main Unit – QPSK, Vertical

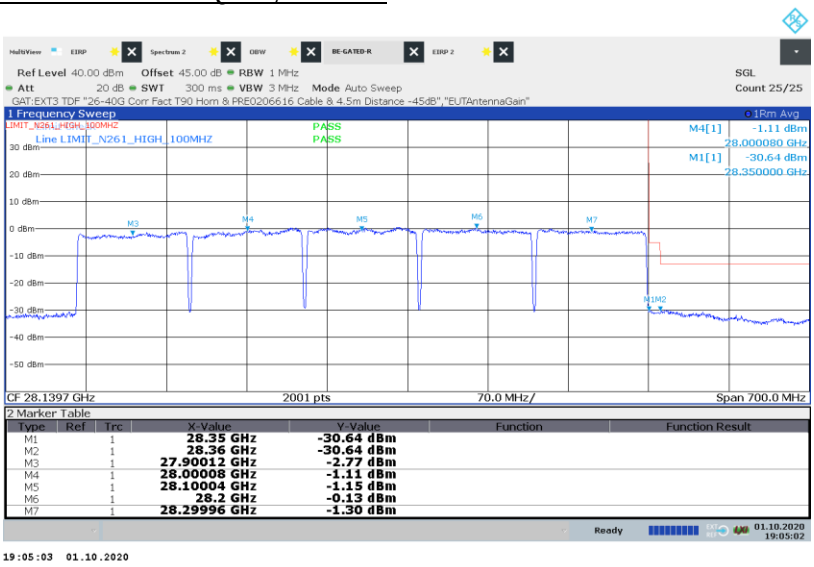


5 Carrier Configuration, Right

Tx Main Unit – 64QAM, Horizontal



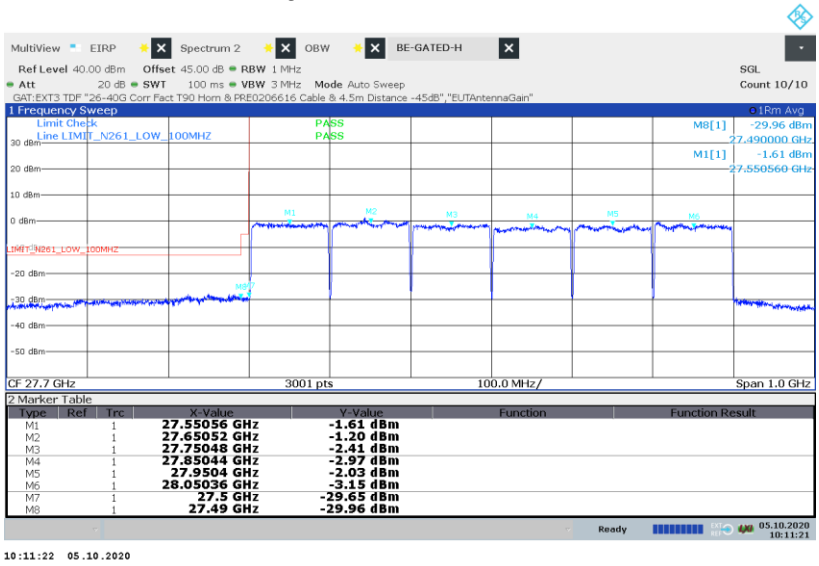
Tx Main Unit – 64QAM, Vertical



6 Carrier Configuration, Left

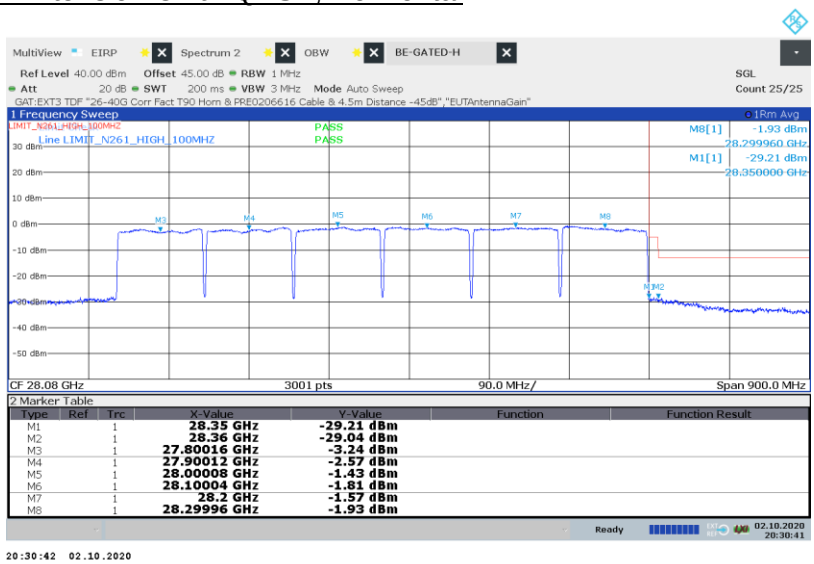
Tx Extension Unit – 64QAM, Horizontal

Tx Extension Unit – 64QAM, Vertical

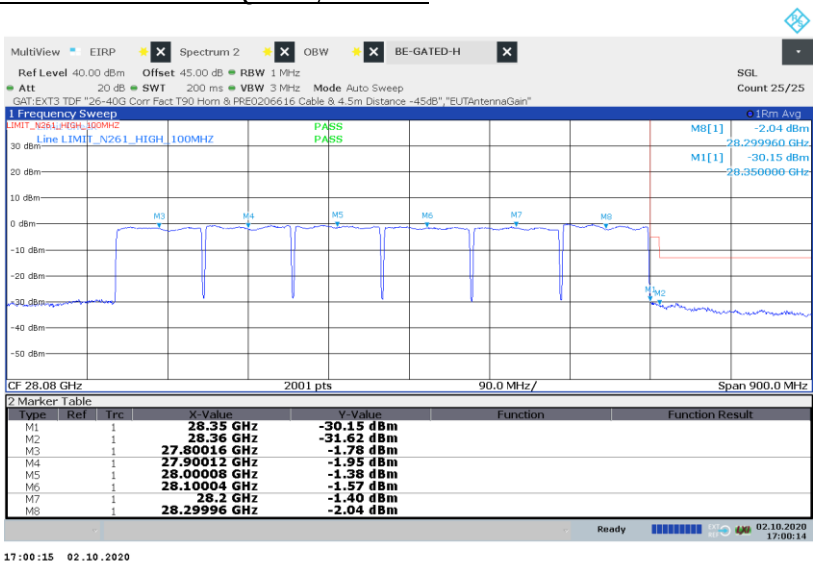


6 Carrier Configuration, Right

Tx Extension Unit - QPSK, Horizontal

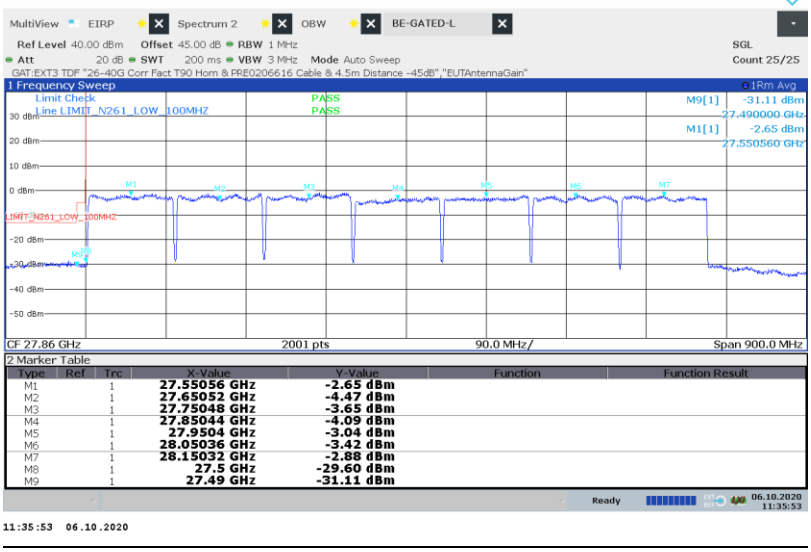


Tx Extension Unit - QPSK, Vertical



7 Carrier Configuration, Left

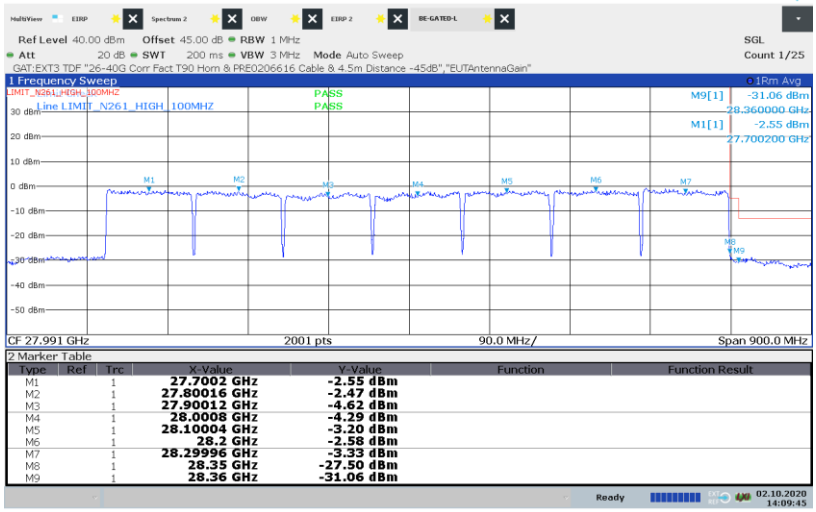
Tx Main Unit – QPSK, Horizontal



Tx Main Unit – QPSK, Vertical

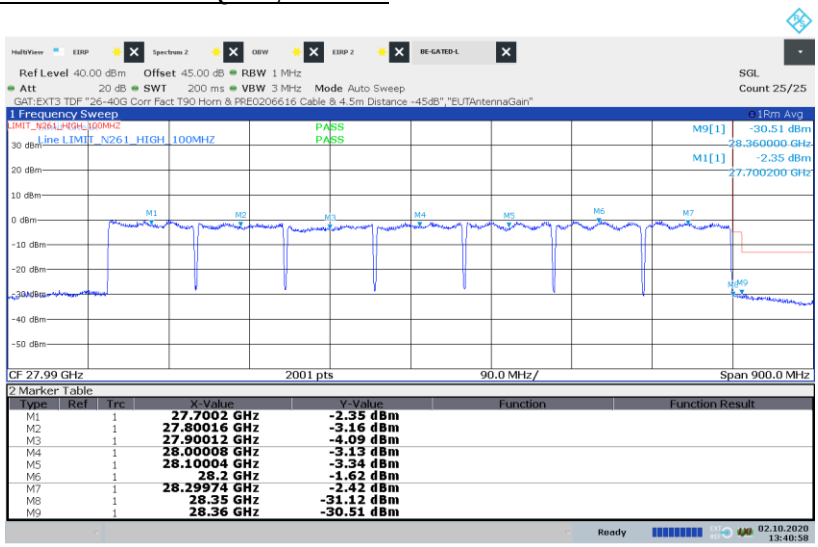
7 Carrier Configuration, Right

Tx Main Unit – 64QAM, Horizontal



14:09:46 02.10.2020

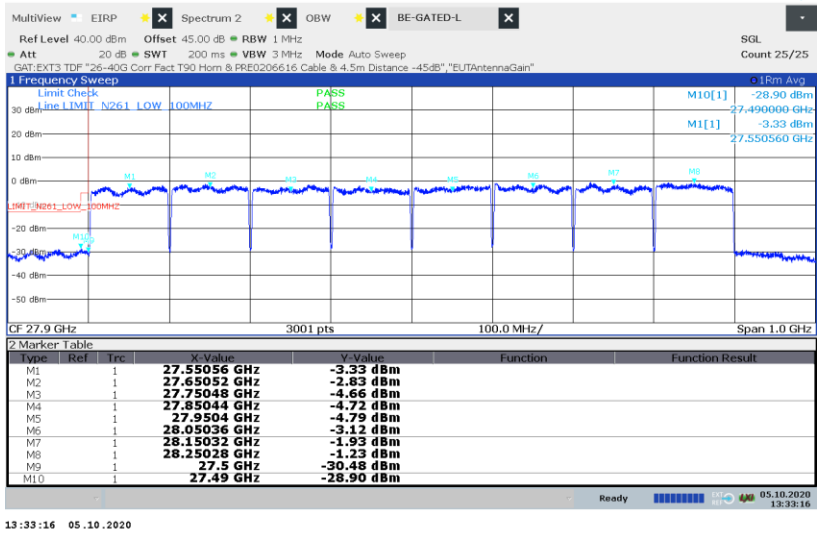
Tx Main Unit – 64QAM, Vertical



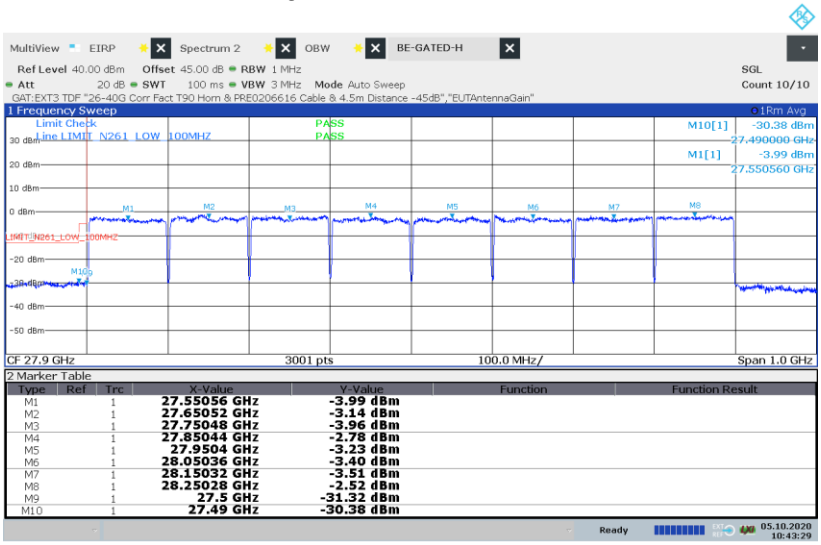
13:40:58 02.10.2020

8 Carrier Configuration, Left

Tx Extension Unit – 16QAM, Horizontal

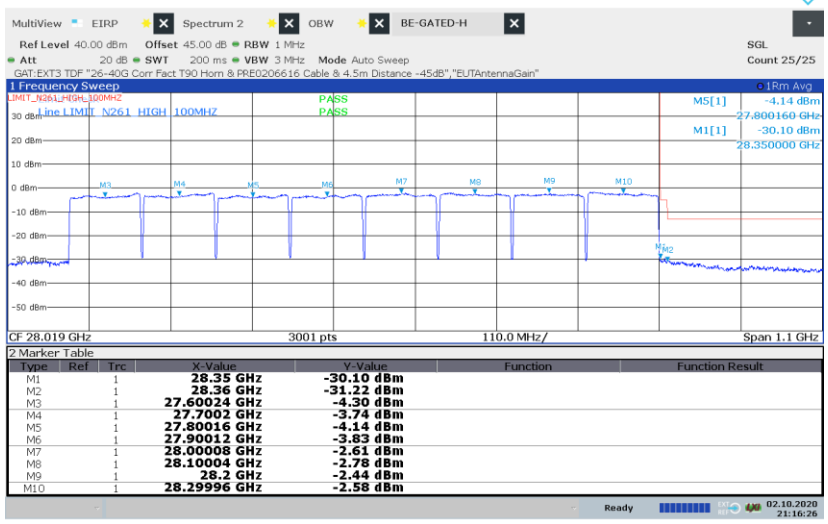


Tx Extension Unit – 16QAM, Vertical

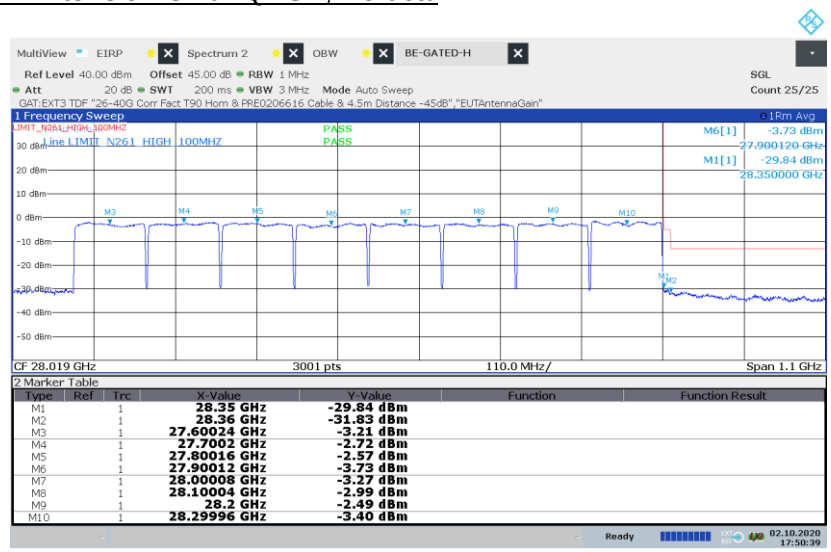


8 Carrier Configuration, Right

Tx Extension Unit - QPSK, Horizontal



Tx Extension Unit - QPSK, Vertical



8.4. SPURIOUS EMISSIONS

LIMIT RULE PART(S)

FCC: §2.1051 (Radiated with Antenna), §2.1053 (Cabinet Radiated), §30.203

LIMIT

30.203 - (a) The conductive power or the total radiated power of any emission outside a licensee's frequency block shall be −13 dBm/MHz or lower.

TEST PROCEDURE

KDB 842590 D01 Upper Microwave Flexible Use Service v01 Section 4.4.2 and Section 4.4.3. ANSI C63.26-2015 Clause 5.5.4 and Annex C.5.2.

All radiated spurious emissions were measured as EIRP to compare with the §30.203 TRP limits to demonstrate compliance.

RSE was investigated from 30 MHz – 100 GHz on n261 band.

Plots below 18 GHz are corrected field strength levels, measured at 3 meter test distance. The average EIRP reported below is calculated per section 5.2.7 of ANSI C63.26-2015 which states: EIRP (dBm) = E (dBµV/m) + 20log(D) − 104.8; where D is the measurement distance (in the far field region) in m. The field strength E is calculated E (dBµV/m) = Spectrum Analyzer Level (dBm) + Antenna Factor (dB/m) + Cable Loss (dB) + 107. All appropriate Antenna Factor and Cable Loss have been applied in the spectrum analyzer for each measurement. Thus, the limit of -13 dBm/MHz is equal to 82.2 dBµV/m @ 3m.

RSEs above 18 GHz were measured at the appropriate far field distances listed on Section 5 on this report (FAR-FIELD DISTANCE AND MEASUREMENT DISTANCE). Then, the EIRP of RSE was calculated using the equations on ANSI C63.26-2015 Annex C.5.2, as described on Sections 8.2 and 8.3.

RSEs from 18 – 50 GHz were measured using a spectrum analyzer or EMI receiver with an internal preamplifier when applicable. Emissions above 50 GHz were measured using a harmonic mixer with spectrum analyzer, while an external LNA was used when applicable.

RSEs of 30 – 1000 MHz and 1 – 100 GHz were performed at 0.8 meter and 1.5 meters height, respectively.

All RSEs were investigated on the Main Unit with full design of circuitry to represent the worst case of RSE. The RSE investigation included 1 carrier configuration on left, center and right channels, also the 8 carrier configuration on left channel, with QPSK modulation. The worst case RSE at each frequency range is included in this report.

In addition, the 2 carrier configurations on left, center and right channels were verified for IMD product at the near upper and lower band edge regions. The test data for the worst case IMD emission is reported.

The EUT employs 20 – 40 GHz antenna arrays, the EUT antenna gain was preloaded to spectrum analyzer as the offset to the RSE measurement, ranging from 20 – 40 GHz frequency range.

RESULTS

See the following pages.

TESTED BY:

RSE below 18 GHz :
Employee ID: 44410
Location: Chamber M
Test Date: 12/9/2020

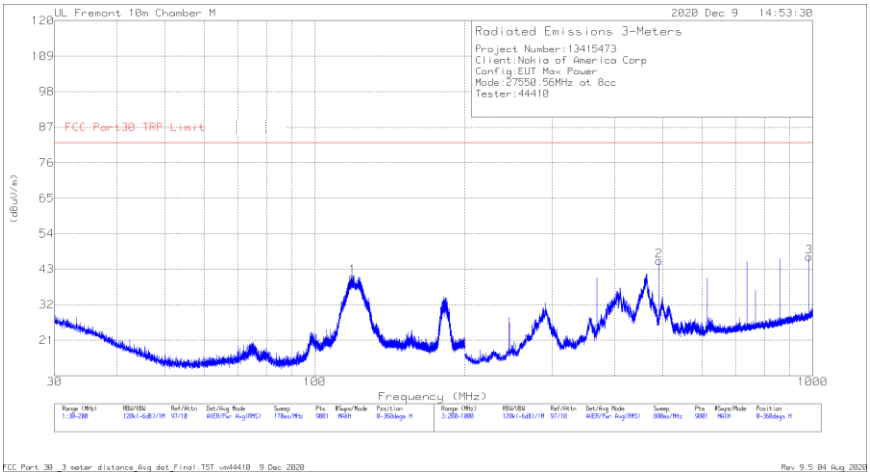
RSE above 18 GHz:
Employee IDs: 19296 & 19437
Location: Chamber 1
Test Date: 10/22/2020 – 1/13/2021

8.4.1. RADIATED EMISSIONS, 30 MHz - 1 GHz

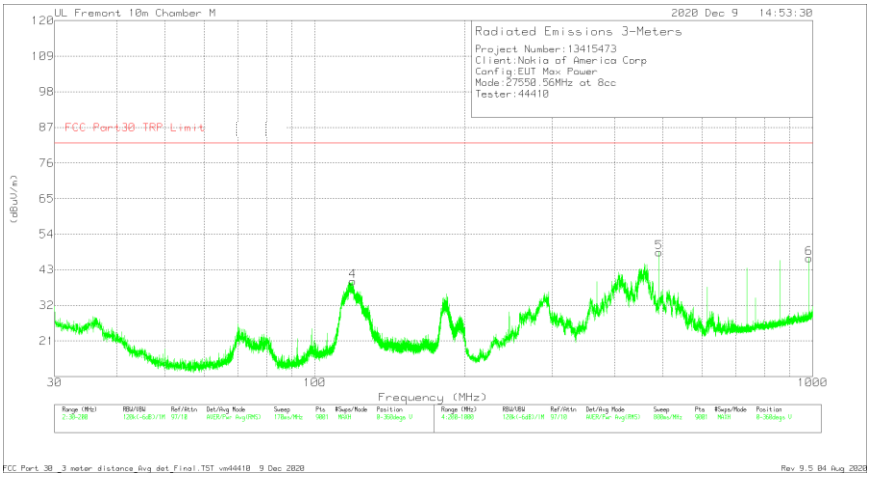
8 Carrier Configuration, Left

Tx Main Unit – QPSK

Horizontal



Vertical



Trace Markers

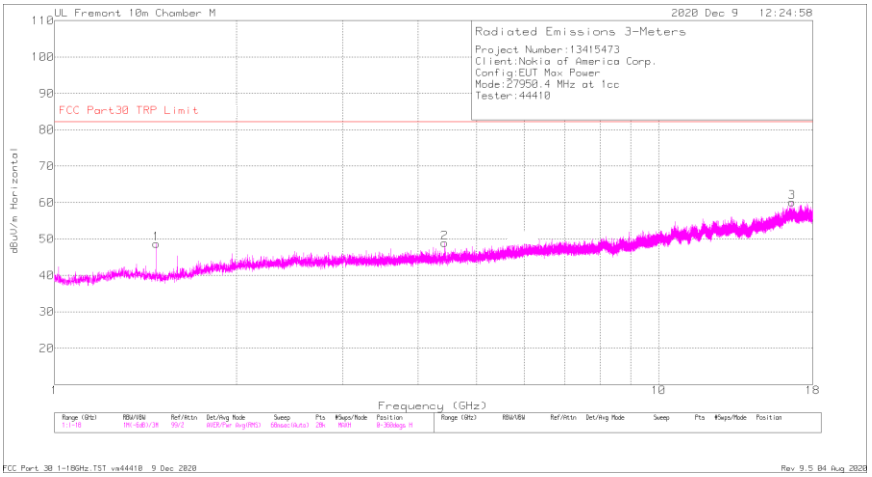
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Hybrid PRE0181574	Amp/Cbl (dB)	correction RBW 120k to 1 MHz	Corrected Reading (dBuV/m)	FCC Part30 TRP Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	119.2505	41.16	RMS	19.6	-28.3	8.3	40.76	82.2	-41.44	0-360	100	H
4	119.1939	39.93	RMS	19.6	-28.3	8.3	39.53	82.2	-42.67	0-360	94	V
2	491.467	41.06	RMS	23.5	-27.3	8.3	45.56	82.2	-36.64	0-360	99	H
3	983.1121	33.37	RMS	29	-23.8	8.3	46.87	82.2	-35.33	0-360	99	H
5	491.467	43.88	RMS	23.5	-27.3	8.3	48.38	82.2	-33.82	0-360	99	V
6	983.1121	33.1	RMS	29	-23.8	8.3	46.6	82.2	-35.6	0-360	99	V

RMS - RMS detector

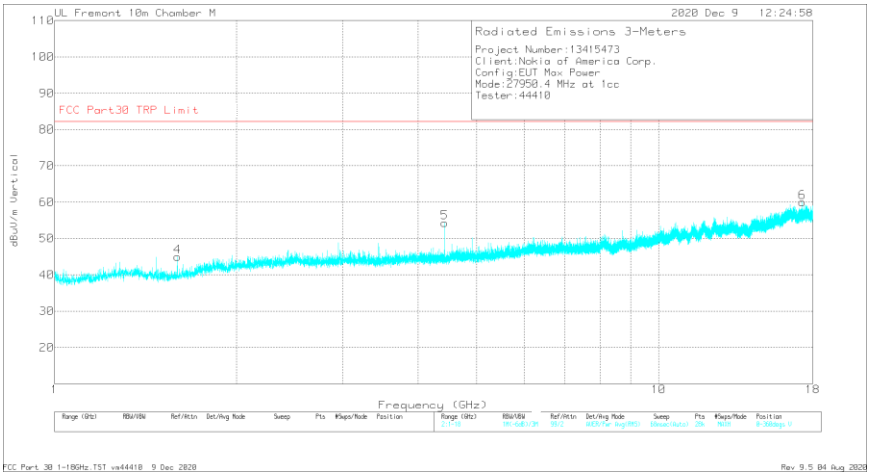
8.4.2. RADIATED EMISSIONS, 1 - 18 GHz

1 Carrier Configuration, Center

Tx Main Unit – QPSK
Horizontal



Vertical



Trace Markers

Range 1: Horizontal 1000 - 18000MHz											
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T345 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading dBuV/m	FCC Part30 TRP Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	1.47418	56.92	RMS	28.1	-36.3	48.72	82.2	-33.48	0-360	100	H
2	4.42368	47.17	RMS	33.6	-31.8	48.97	82.2	-33.23	0-360	199	H
3	16.63758	41.14	RMS	41.8	-22.8	60.14	82.2	-22.06	0-360	100	H

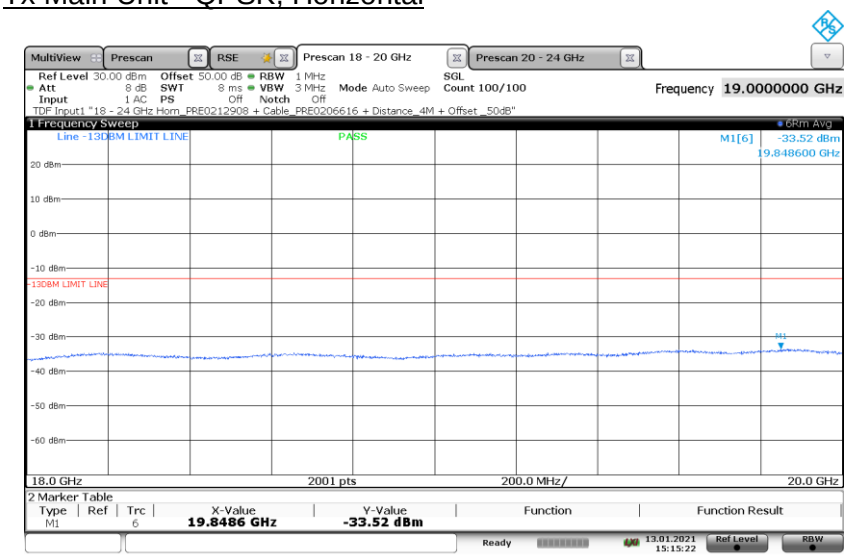
Range 2: Vertical 1000 - 18000MHz											
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T345 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading dBuV/m	FCC Part30 TRP Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
4	1.59682	52.82	RMS	28.3	-36.2	44.92	82.2	-37.28	0-360	100	V
5	4.42368	52.55	RMS	33.6	-31.8	54.35	82.2	-27.85	0-360	100	V
6	17.30483	40.66	RMS	41.3	-22	59.96	82.2	-22.24	0-360	100	V

RMS - RMS detector

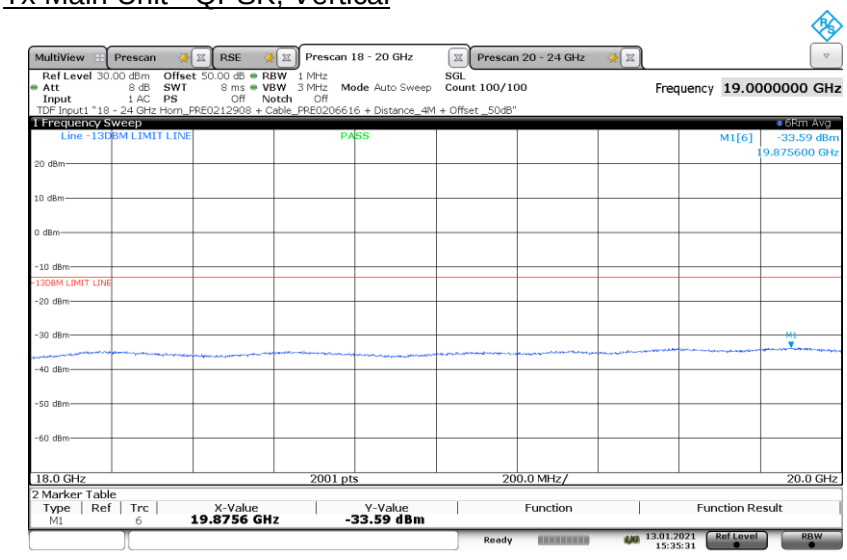
8.4.3. RADIATED EMISSIONS, 18 - 20 GHz

1 Carrier Configuration, Left

Tx Main Unit - QPSK, Horizontal



Tx Main Unit - QPSK, Vertical

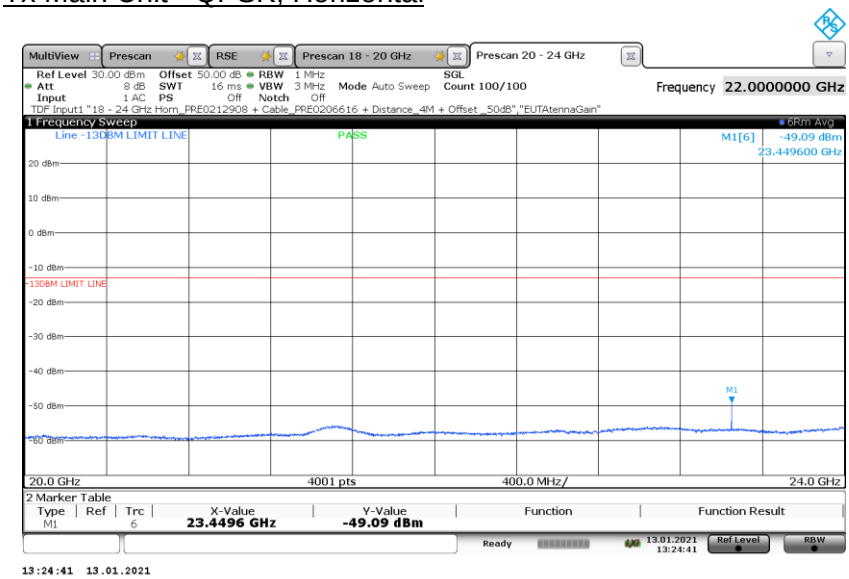


No Emission Detected.

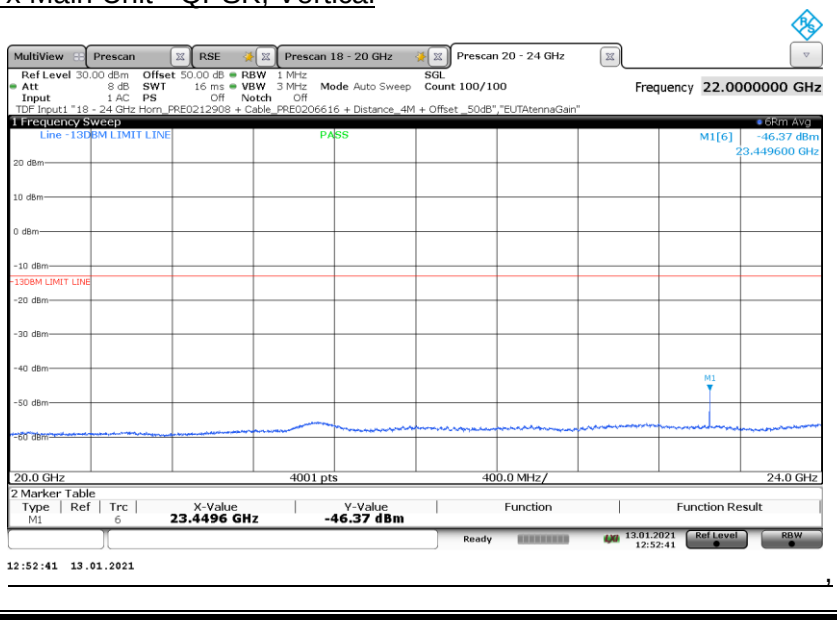
8.4.4. RADIATED EMISSIONS, 20 – 24 GHz

1 Carrier Configuration, Right

Tx Main Unit - QPSK, Horizontal



Tx Main Unit - QPSK, Vertical



Emissions detected at pre-scan. Avg EIRP was measured.

EIRP RESULTS, 1CC

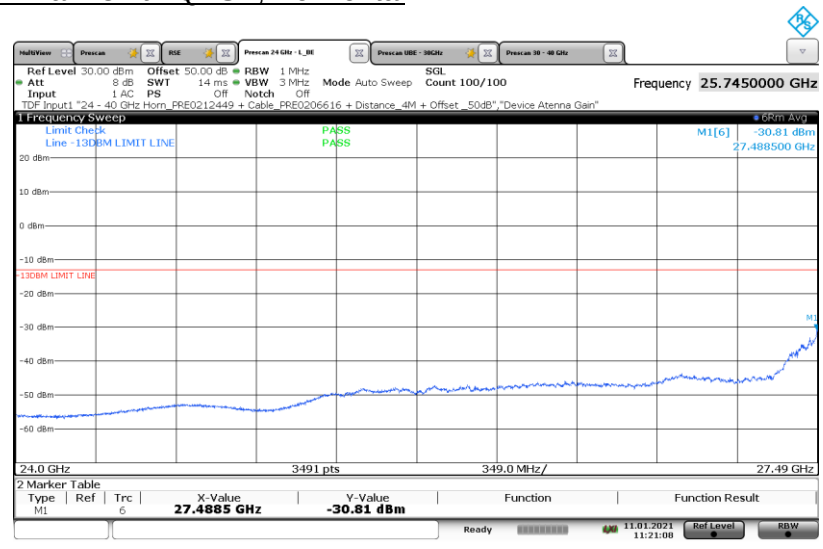
Channel	Freq.	Meas. Distance	Rx Ant. Polarity	Corrected Avg EIRP	TRP Limit	Margin
	(GHz)	(m)	H/V	(dBm)	(dBm)	(dB)
Right	23.4496	4	H	-45.21	-13	-32.21
Right	23.4496	4	V	-43.21	-13	-30.21

8.4.5. RADIATED EMISSIONS, 24 – 27.49 GHz

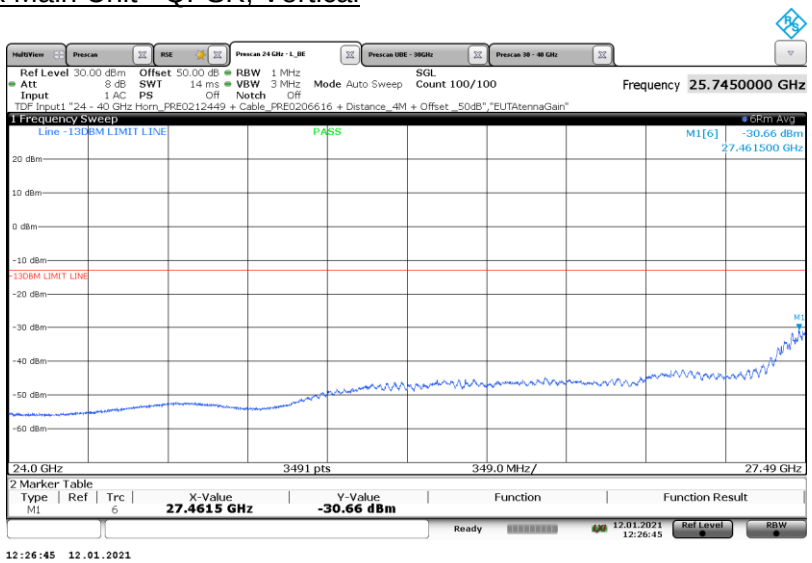
Note: 27.49 - 28.36 GHz covered by Fundamental and BE measurements.

2 Carrier Configuration, Left

Tx Main Unit - QPSK, Horizontal



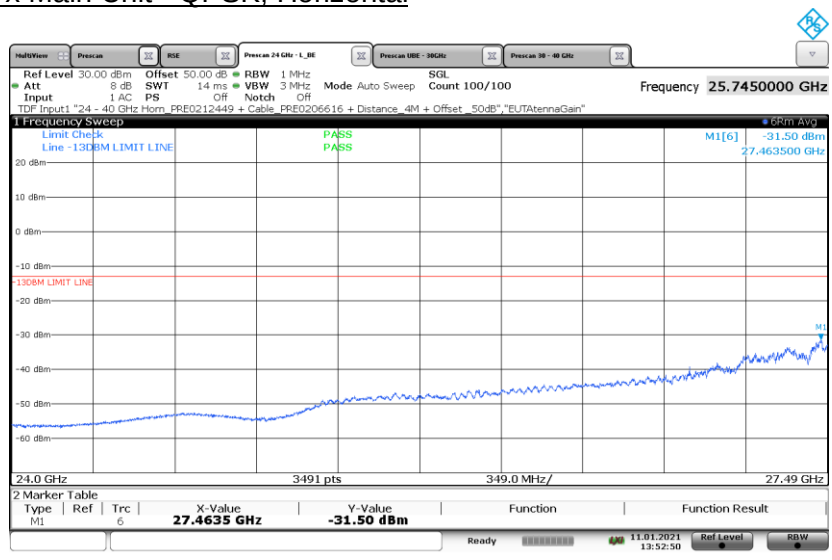
Tx Main Unit - QPSK, Vertical



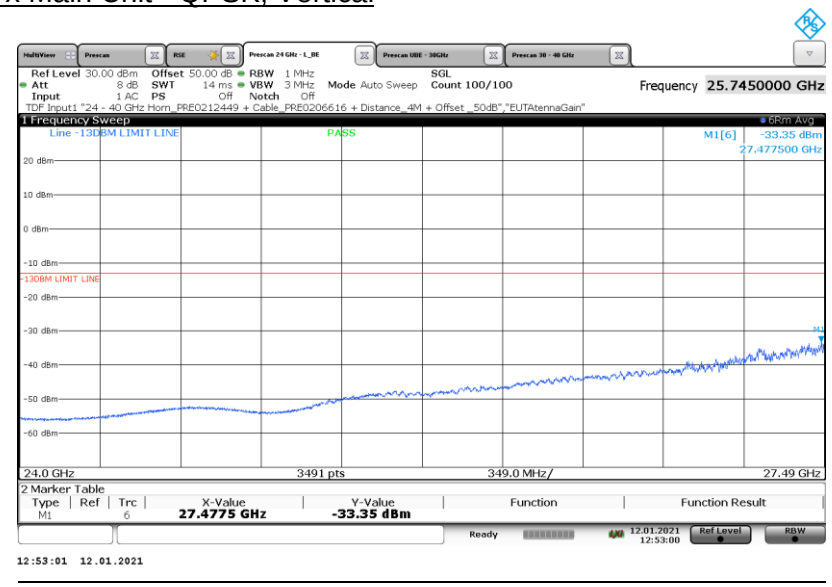
Emissions detected at pre-scan. Avg EIRP was measured.

8 Carrier Configuration, Left

Tx Main Unit - QPSK, Horizontal



Tx Main Unit - QPSK, Vertical



Emissions detected at pre-scan. Avg EIRP was measured.

EIRP RESULTS, 2CC

Channel	Freq.	Meas. Distance	Rx Ant. Polarity	Corrected Avg EIRP	TRP Limit	Margin
	(GHz)	(m)	H/V	(dBm)	(dBm)	(dB)
Left	27.48845	4	H	-19.01	-13	-6.01
Left	27.48416	4	V	-16.23	-13	-3.23

EIRP RESULTS, 8CC

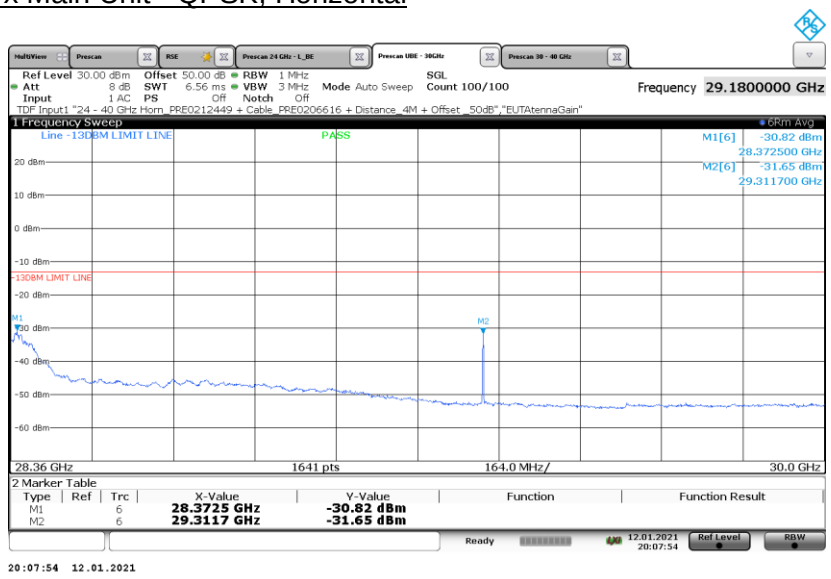
Channel	Freq.	Meas. Distance	Rx Ant. Polarity	Corrected Avg EIRP	TRP Limit	Margin
	(GHz)	(m)	H/V	(dBm)	(dBm)	(dB)
Left	27.47007	4	H	-22.19	-13	-9.19
Left	27.48376	4	V	-22.41	-13	-9.41

8.4.6. RADIATED EMISSIONS, 28.36 - 30 GHz

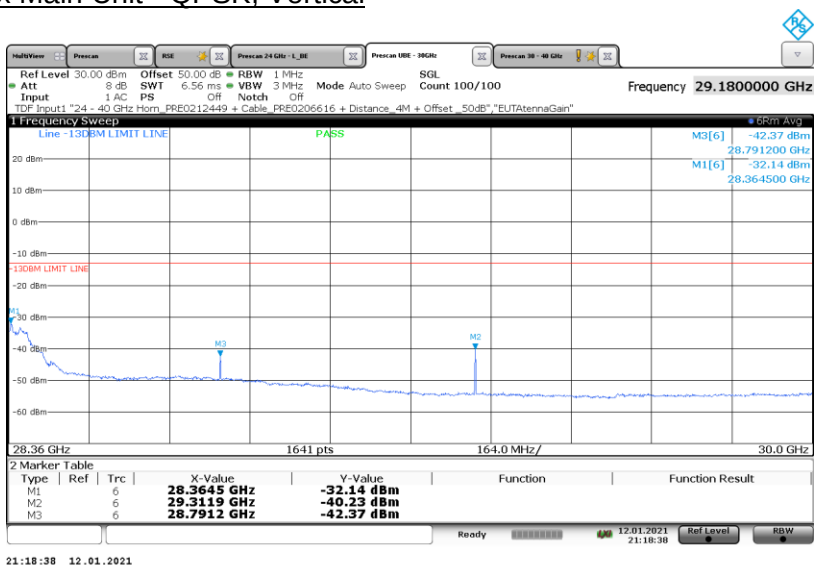
Note: 27.49 - 28.36 GHz covered by Fundamental and BE measurements.

1 Carrier Configuration, Right

Tx Main Unit - QPSK, Horizontal



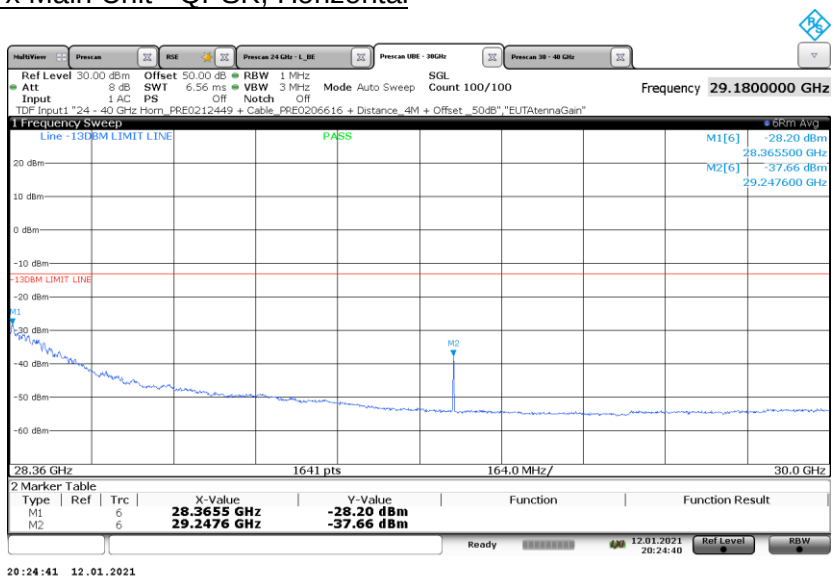
Tx Main Unit - QPSK, Vertical



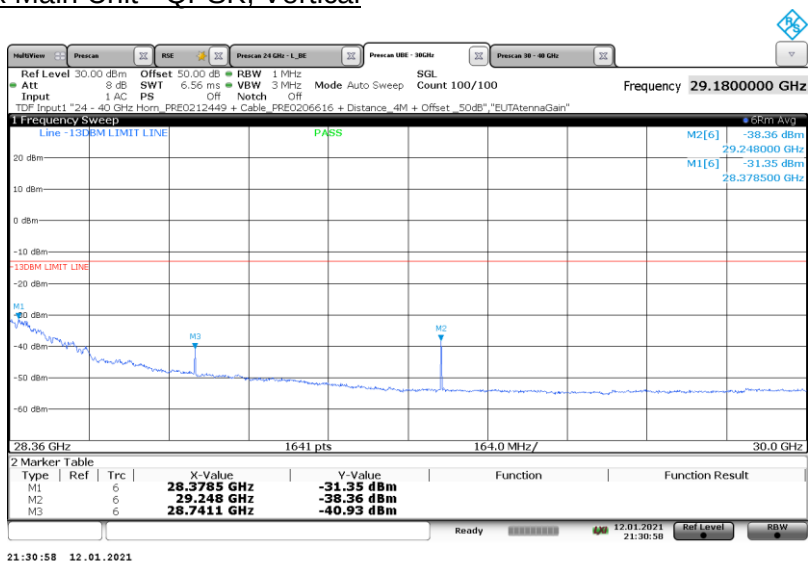
Emissions detected at pre-scan. Avg EIRP was measured.

2 Carrier Configuration, Right

Tx Main Unit - QPSK, Horizontal



Tx Main Unit - QPSK, Vertical



Emissions detected at pre-scan. Avg EIRP was measured.

EIRP RESULTS, 1CC

Channel	Freq.	Meas. Distance	Rx Ant. Polarity	Corrected Avg EIRP	TRP Limit	Margin
	(GHz)	(m)	H/V	(dBm)	(dBm)	(dB)
Right	28.36035	4	H	-23.41	-13	-10.41
Right	28.36754	4	V	-21.22	-13	-8.22
Right	29.312	4	H	-24.81	-13	-11.81
Right	29.312	4	V	-33.43	-13	-20.43

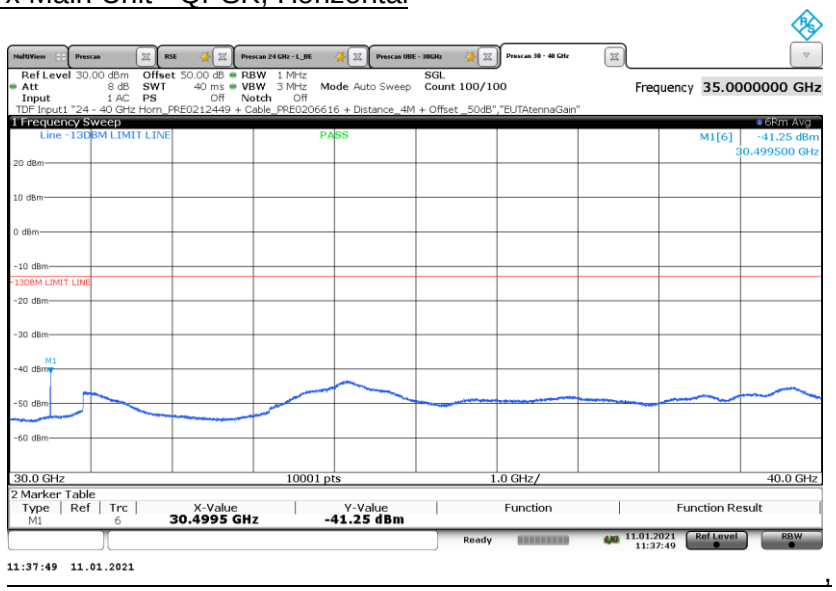
EIRP RESULTS, 2CC

Channel	Freq.	Meas. Distance	Rx Ant. Polarity	Corrected Avg EIRP	TRP Limit	Margin
	(GHz)	(m)	H/V	(dBm)	(dBm)	(dB)
Right	28.36105	4	H	-14.66	-13	-1.66
Right	28.36105	4	V	-14.32	-13	-1.32
Right	29.248	4	H	-26.10	-13	-13.10
Right	29.248	4	V	-29.09	-13	-16.09

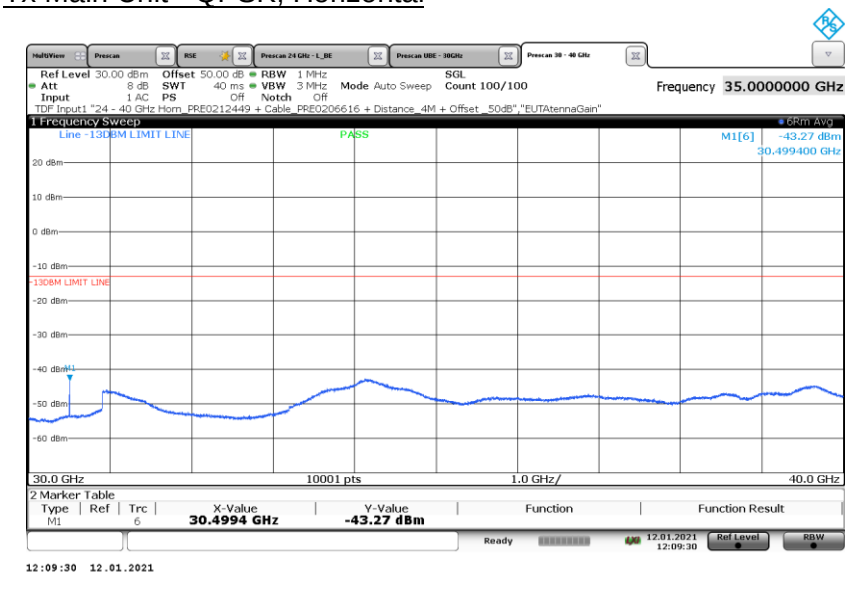
8.4.7. RADIATED EMISSIONS, 30 - 40 GHz

1 Carrier Configuration, Left

Tx Main Unit - QPSK, Horizontal



Tx Main Unit - QPSK, Horizontal



Emissions detected at pre-scan. Avg EIRP was measured.

EIRP RESULTS, 1CC

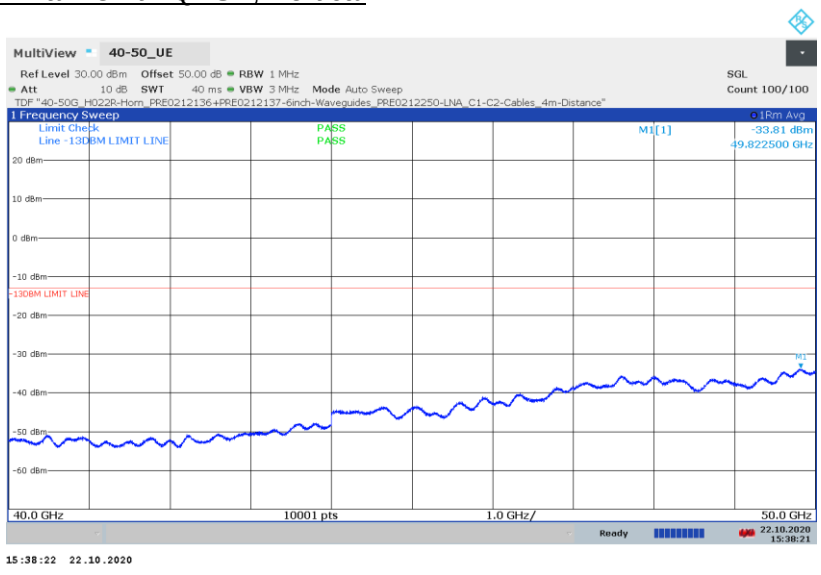
Channel	Freq.	Meas. Distance	Rx Ant. Polarity	Corrected Avg EIRP	TRP Limit	Margin
	(GHz)	(m)	H/V	(dBm)	(dBm)	(dB)
Left	30.4995	4	H	-33.42	-13	-20.42
Left	30.4995	4	V	-39.25	-13	-26.25

8.4.8. RADIATED EMISSIONS, 40 - 50 GHz

1 Carrier Configuration, Center

Tx Main Unit - QPSK, Horizontal

Tx Main Unit - QPSK, Vertical

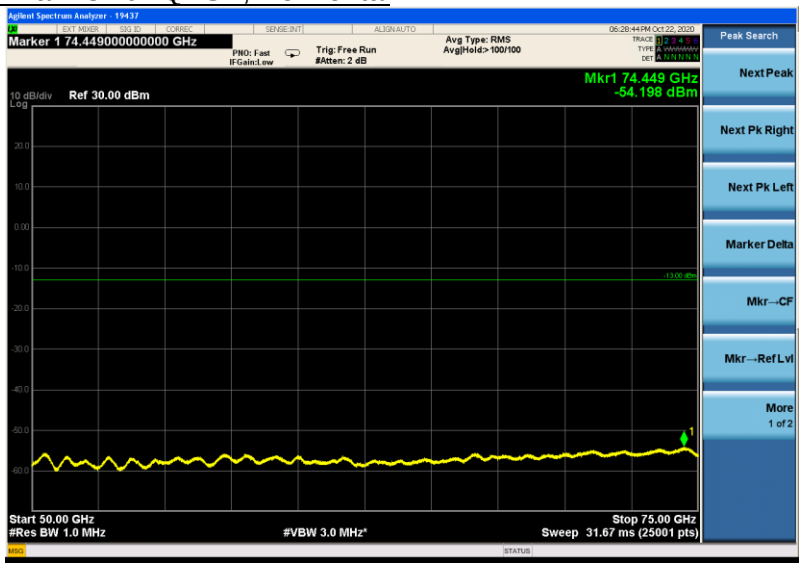


No Emission Detected.

8.4.9. RADIATED EMISSIONS, 50 - 75 GHz

1 Carrier Configuration, Center

Tx Main Unit - QPSK, Horizontal



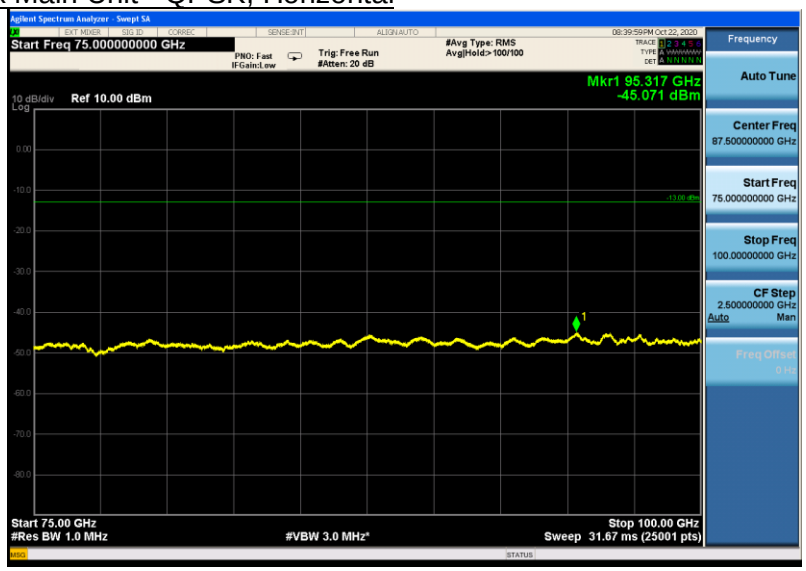
Tx Main Unit - QPSK, Vertical

No Emission Detected.

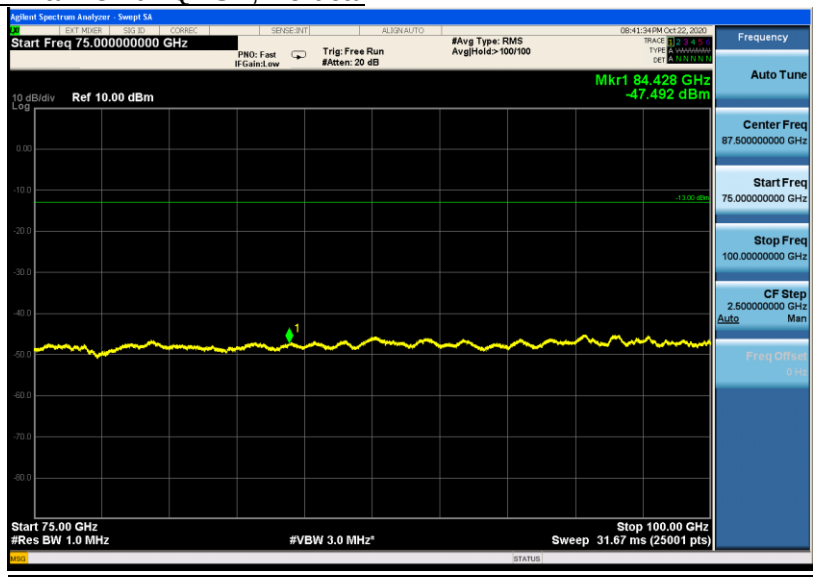
8.4.10. RADIATED EMISSIONS, 75 - 100 GHz

1 Carrier Configuration, Center

Tx Main Unit - QPSK, Horizontal



Tx Main Unit - QPSK, Vertical



No Emission Detected.

APPENDIX A

1. 50-75 GHz VDI WR15.0SAX

Virginia Diodes, Inc
979 2nd St. SE
Suite 309
Charlottesville, VA 22902
Phone: 434-297-3257
Fax: 434-297-3258

Certificate of Conformance

To: UL LLC
47173 Benicia Street
Fremont, CA 94538
United States

From: Virginia Diodes, Inc
979 2nd St. SE
Suite 309
Charlottesville, VA 22902

Packing List No: 201834 **Today's Date:** 06/02/20
Shipping Date: 06/02/20 **PO Number:** 7862016682

Quantity Shipped	Unit	Description	Order-Job Number
1	EA	VDIWR15.0SAX WR15SAX / SN: SAX 620	20141A-01

The VDI product(s) in this shipment meet(s) the guidelines for performance specifications established in accordance with the corresponding Purchase Order. Data presented in the User Guide, where applicable, has been obtained in accordance with VDI's Quality Management System. All instruments, used to obtain data, which require calibration have been calibrated with equipment traceable to the National Institute of Standards and Technology (NIST) and through NIST to the International System of Units (SI).

Authorized Signature
Virginia Diodes, Inc

Page 1 of 1

2. 75-110 GHz VDI WR10.0SAX

Virginia Diodes, Inc
979 2nd St. SE
Suite 309
Charlottesville, VA 22902
Phone: 434-297-3257
Fax: 434-297-3258

Certificate of Conformance

To: UL Verification Services Inc.
47173 Benicia Street
Fremont, CA 94538
United States

From: Virginia Diodes, Inc
979 2nd St. SE
Suite 309
Charlottesville, VA 22902

Packing List No: 201833 **Today's Date:** 06/03/20
Shipping Date: 06/02/20 **PO Number:** 7862016682

Quantity Shipped	Unit	Description	Order-Job Number
1	EA	VDIWR10.0SAX WR10SAX - Spectrum Analyzer Extension Module; SN: SAX 649.	20141C-01

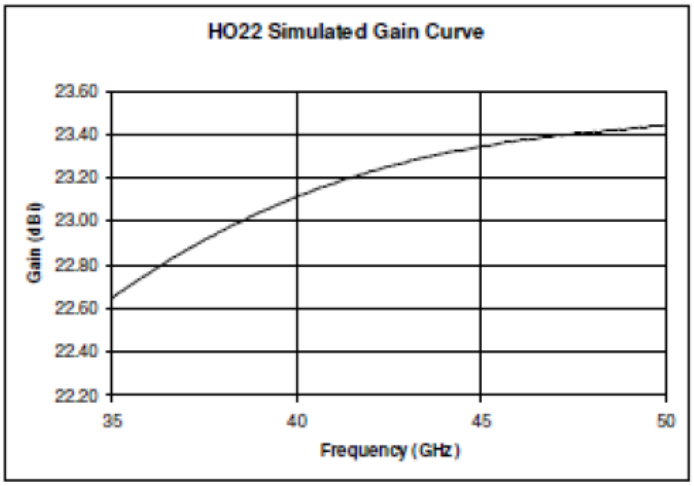
The VDI product(s) in this shipment meet(s) the guidelines for performance specifications established in accordance with the corresponding Purchase Order. Data presented in the User Guide, where applicable, has been obtained in accordance with VDI's Quality Management System. All instruments, used to obtain data, which require calibration have been calibrated with equipment traceable to the National Institute of Standards and Technology (NIST) and through NIST to the International System of Units (SI).

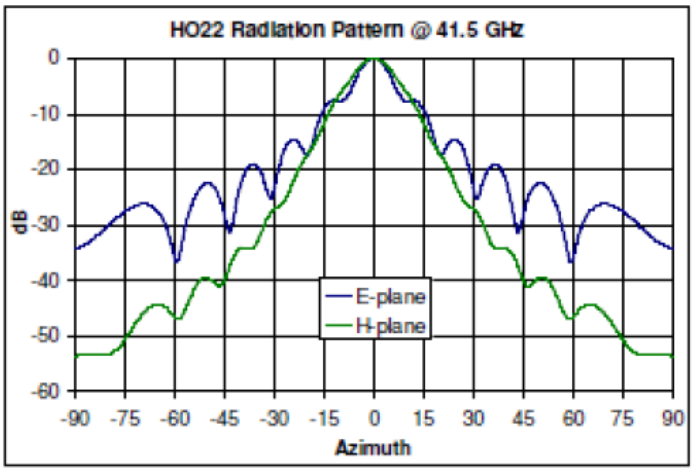
Authorized Signature
Virginia Diodes, Inc

Page 1 of 1

3. 35-50 GHz CMI HO22R HORN ANTENNA

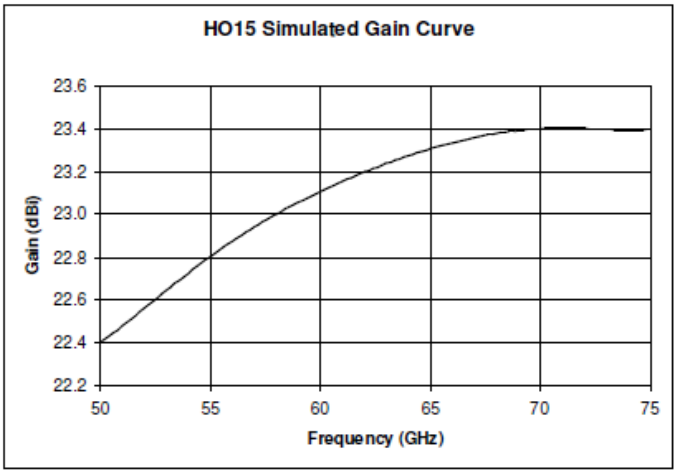
24 Boston Court
Longmont, CO 80501
303 651-0707 (P)
303 651-0706 (F)
www.custommicrowave.com

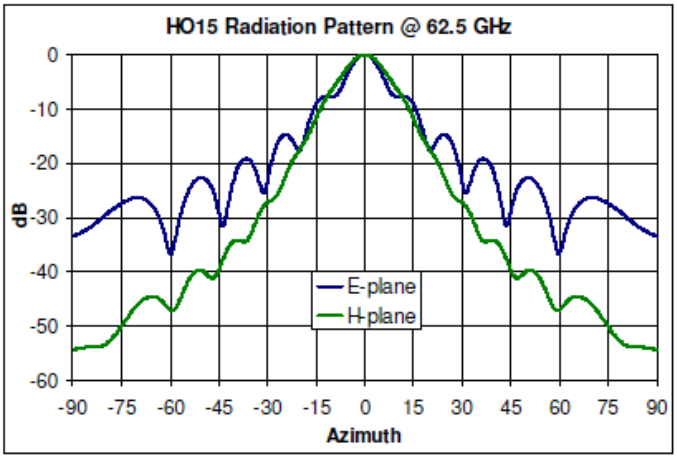




4. 50-75 GHz CMI HO15R HORN ANTENNA

custom microwave inc.
24 Boston Court
Longmont, CO 80501
303 651-0707(P)
303 651-0706(F)
www.custommicrowave.com





5. 75-110 GHz CMI HO10R HORN ANTENNA

24 Boston Court
Longmont, CO 80501
303 651-0707(P)
303 651-0706(F)
www.custommicrowave.com