

### 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  $\geq 3 \times$  RBW
- Number of measurement points in sweep  $> 2 \times$  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:

$$\begin{aligned}\text{Total Correction Factor} &= \text{Cbl Loss (dB)} - \text{Horn Ant Gain (dBi)} + \text{Path Loss @ 4.5m (dB)} \\ &\quad + \text{EUT Ant Gain (dBi)} \\ &= 4 - 23 + 74.5 + 27 \\ &= 82.5 \text{ dB}\end{aligned}$$

EIRP =  $P_{\text{measured}}$ (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.

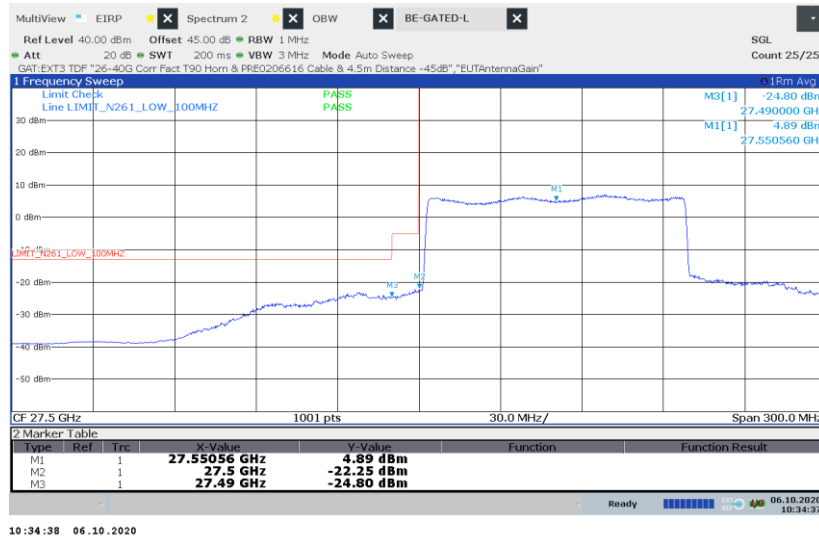
Employee IDs: 19296 & 19437

Location: Chamber 1

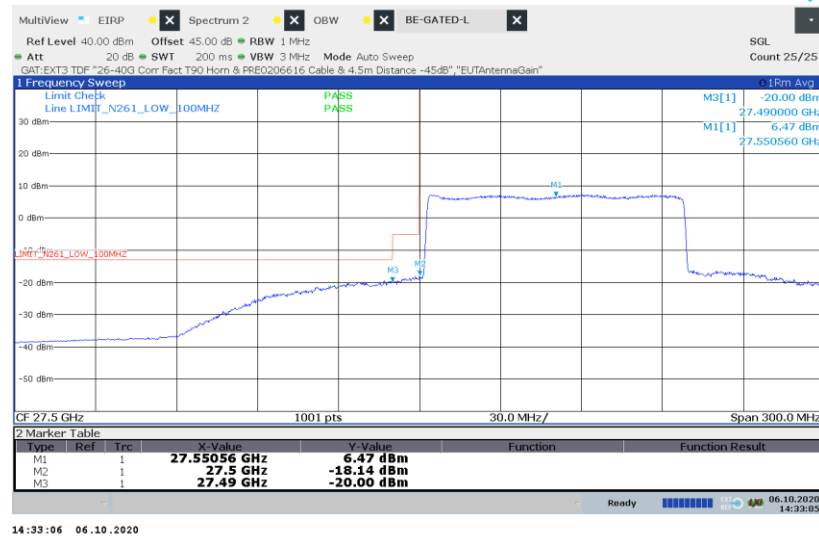
Test Date: 10/1/2020 – 10/6/2020

## 1 Carrier Configuration, Left

### Tx Main Unit - QPSK, Horizontal

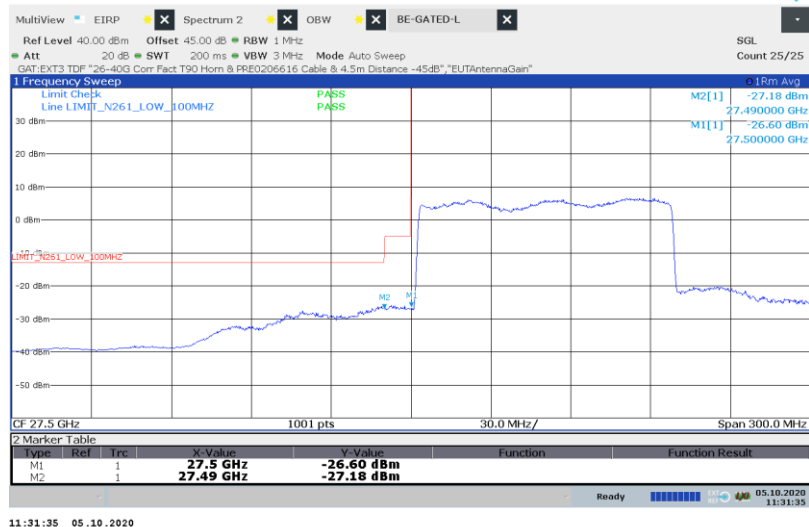


### Tx Main Unit - QPSK, Vertical

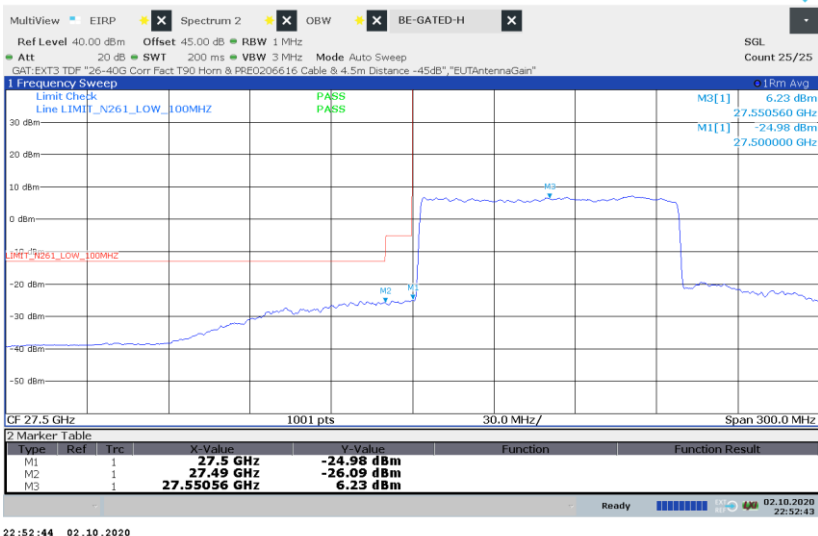


## 1 Carrier Configuration, Left

### Tx Extension Unit – 16QAM, Horizontal

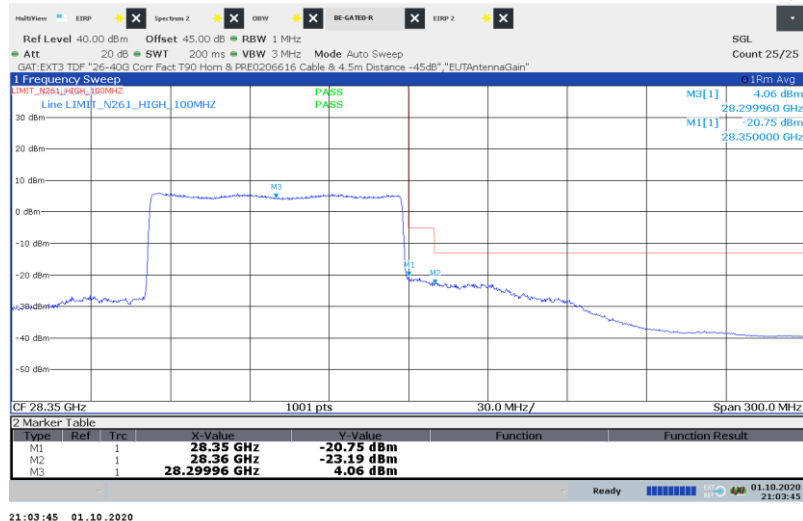


### Tx Extension Unit - 16QAM, Vertical

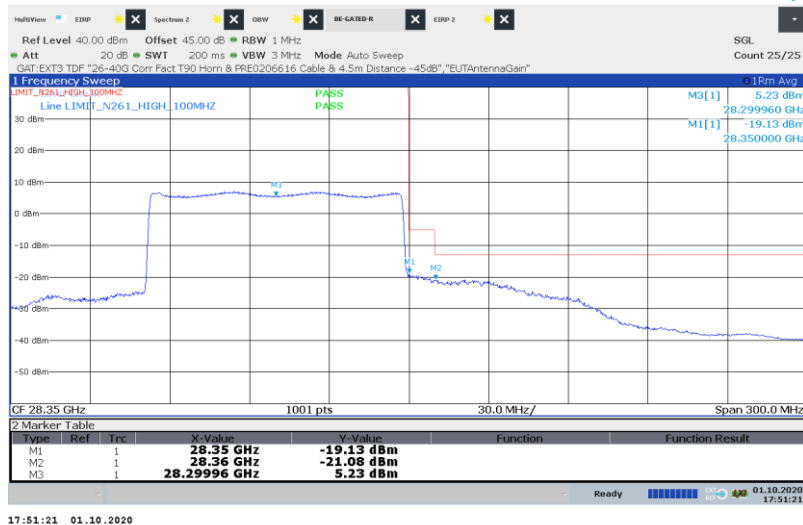


# **1 Carrier Configuration, Right**

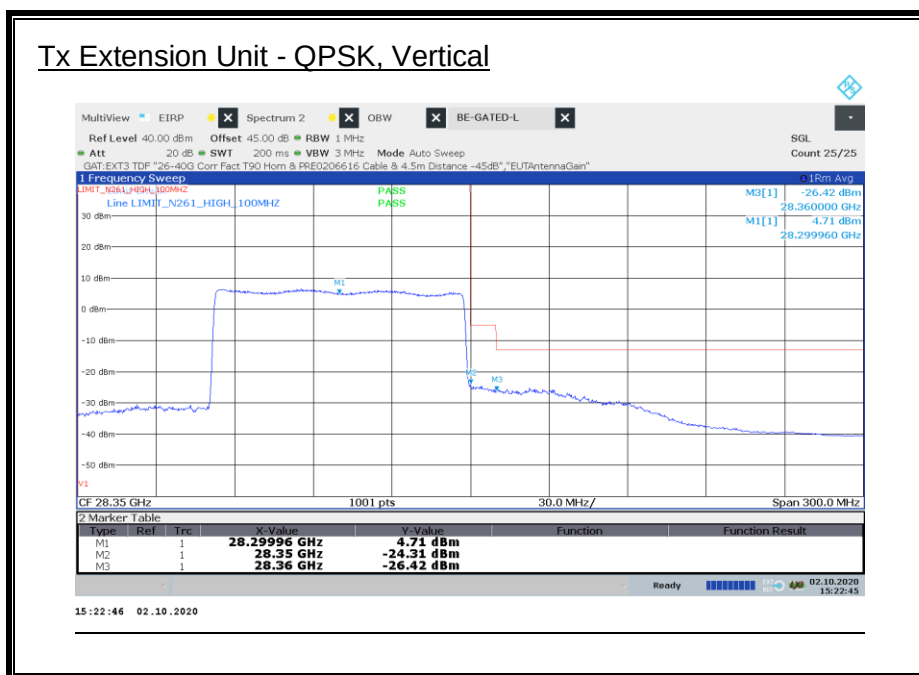
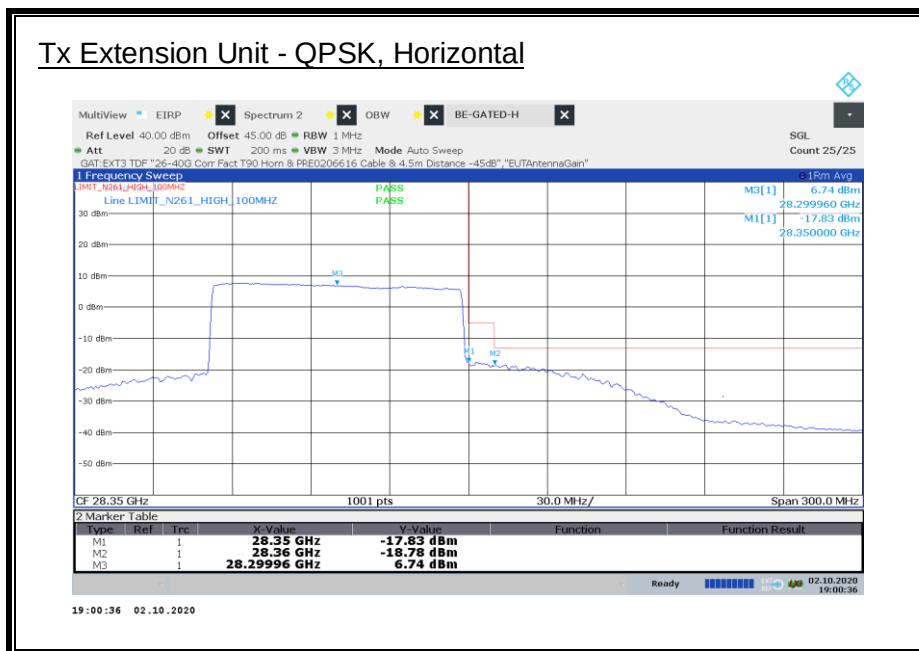
## **Tx Main Unit - QPSK, Horizontal**



## **Tx Main Unit - QPSK, Vertical**

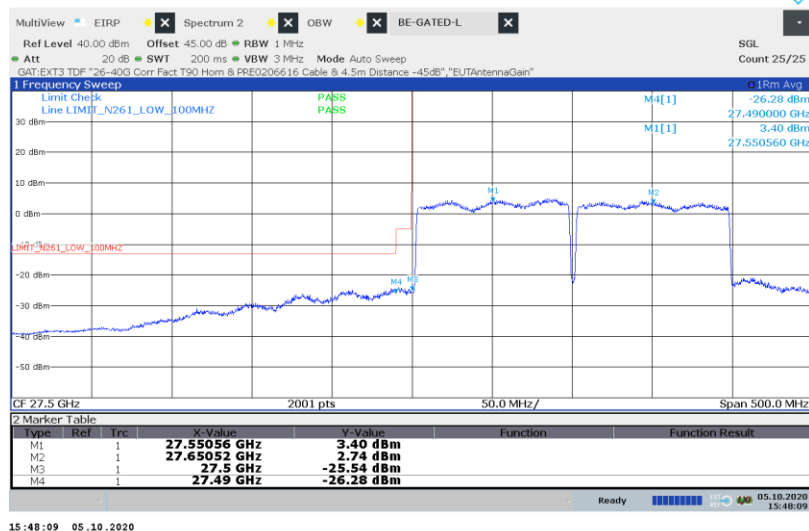


## 1 Carrier Configuration, Right



## 2 Carrier Configuration, Left

### Tx Extension Unit – 64QAM, Horizontal

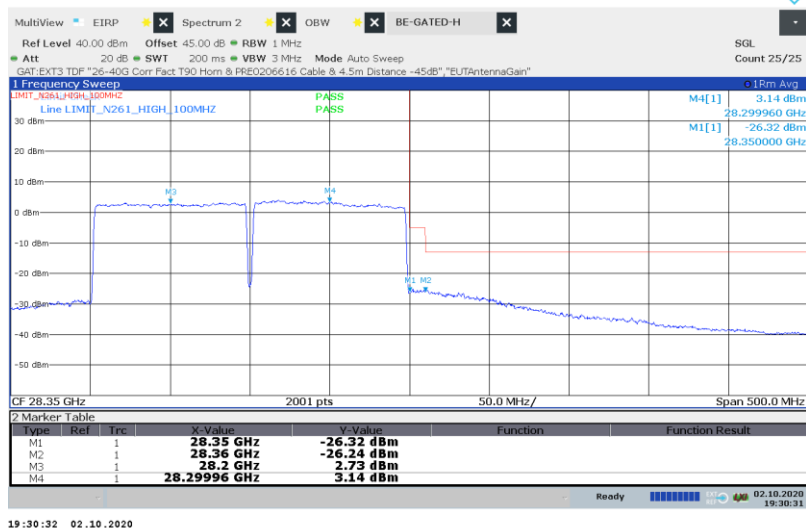


### Tx Extension Unit – 64QAM, Vertical

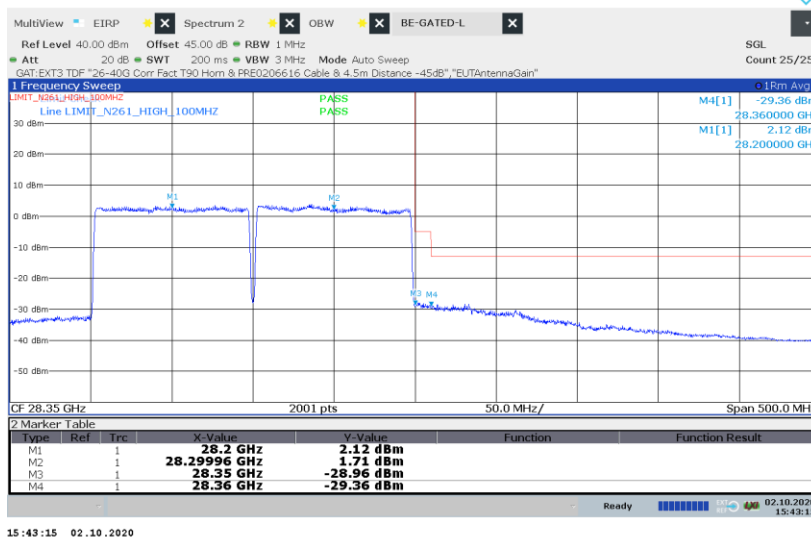


## 2 Carrier Configuration, Right

### Tx Extension Unit – 16QAM, Horizontal

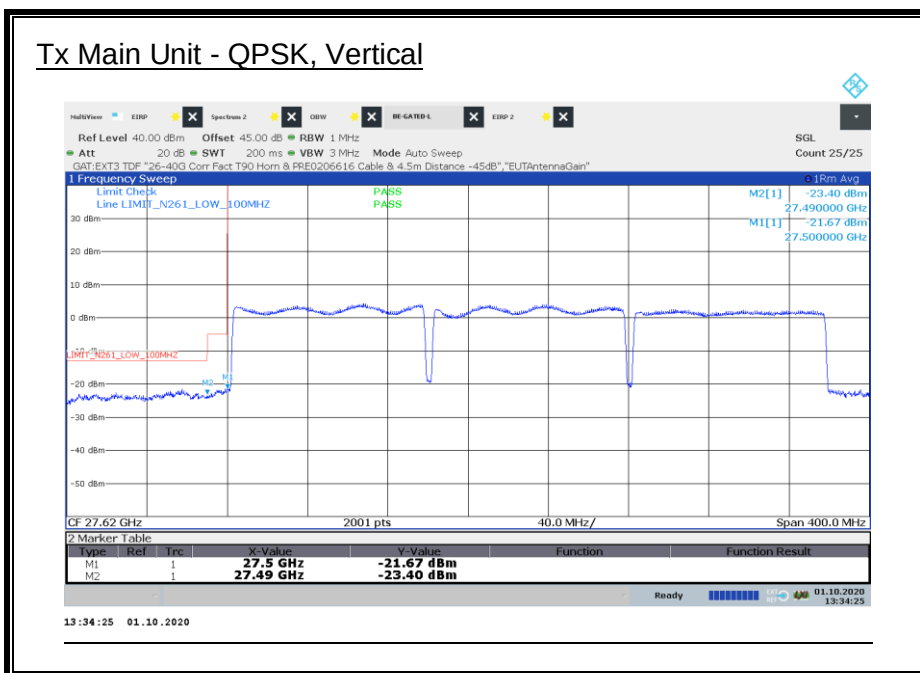
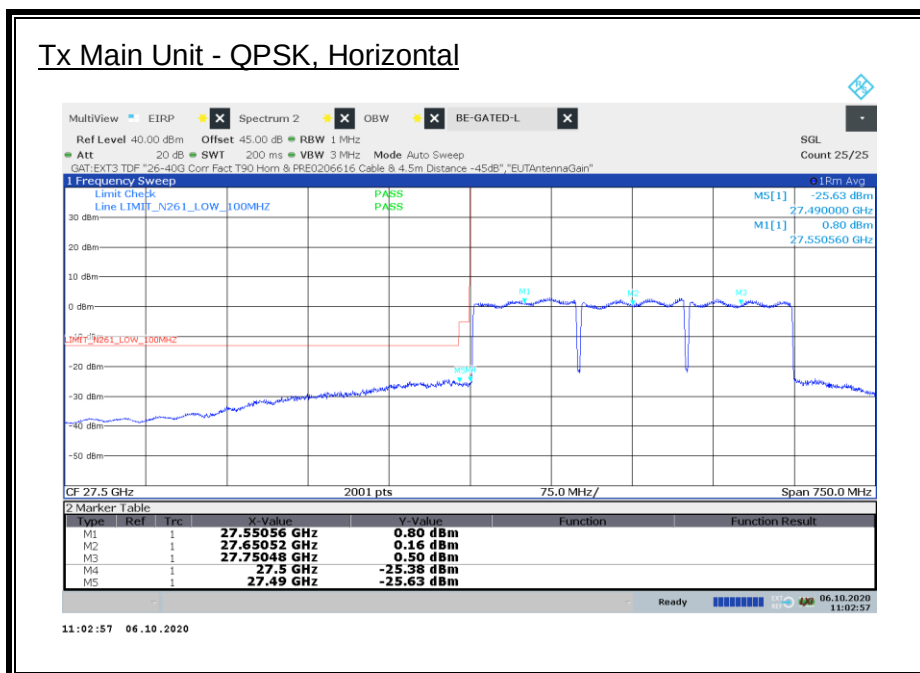


### Tx Extension Unit – 16QAM, Vertical



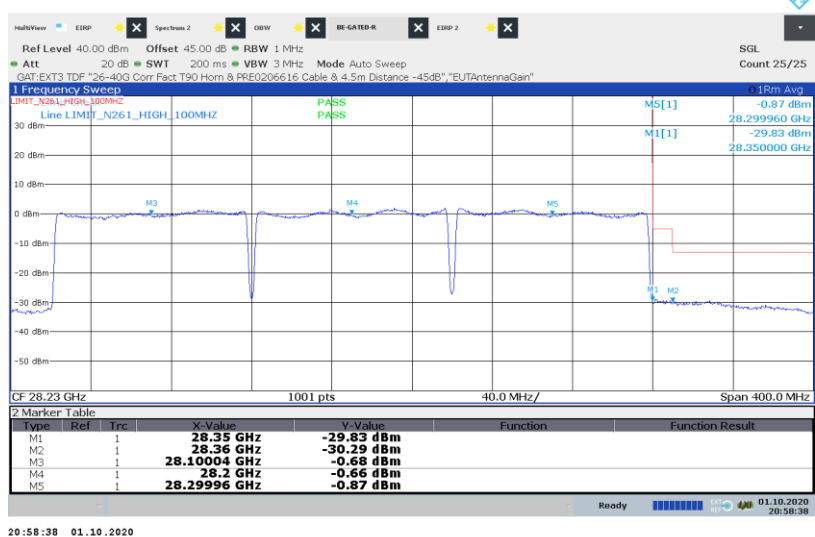


### 3 Carrier Configuration, Left



### 3 Carrier Configuration, Right

#### Tx Main Unit – 16QAM, Horizontal



#### Tx Main Unit – 16QAM, Vertical

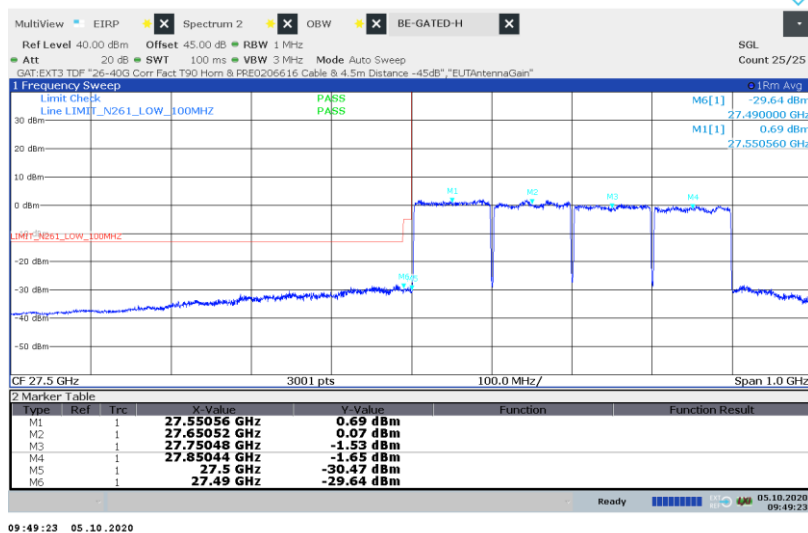


#### 4 Carrier Configuration, Left

##### Tx Extension Unit – QPSK, Horizontal



##### Tx Extension Unit – QPSK, Vertical



#### 4 Carrier Configuration, Right

##### Tx Extension Unit – 16QAM, Horizontal

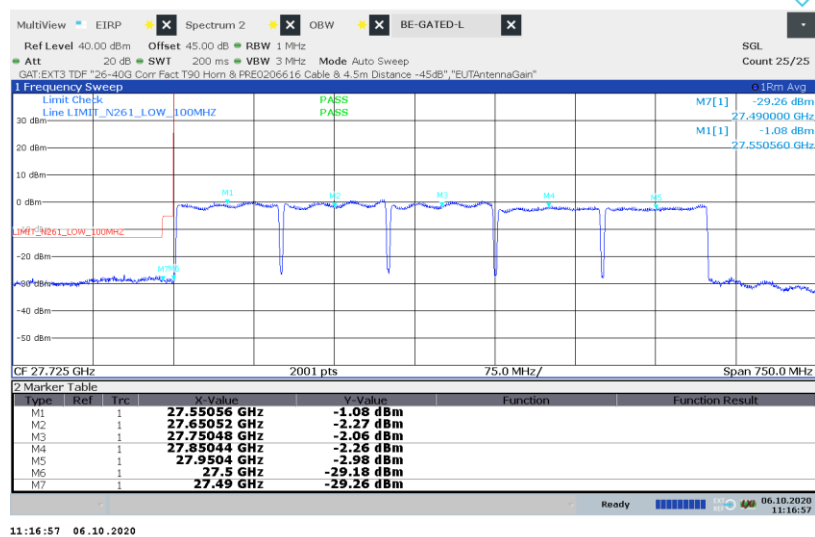


##### Tx Extension Unit – 16QAM, Vertical

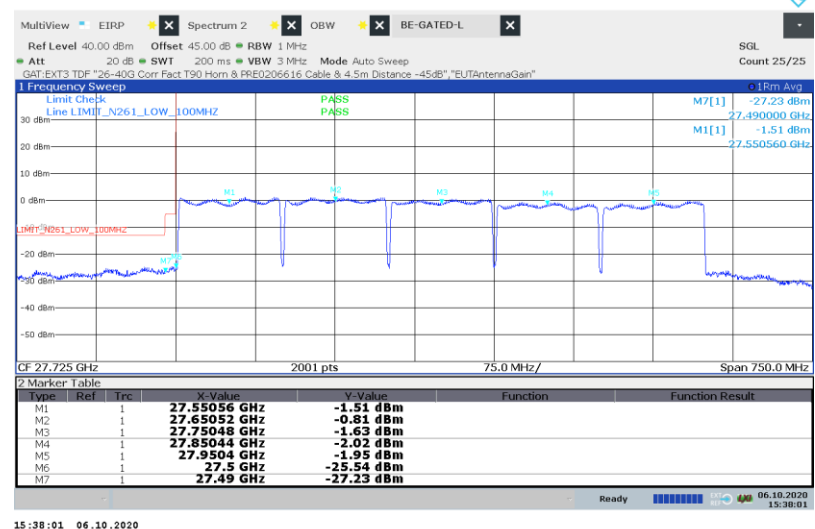


## 5 Carrier Configuration, Left

### Tx Main Unit – QPSK, Horizontal

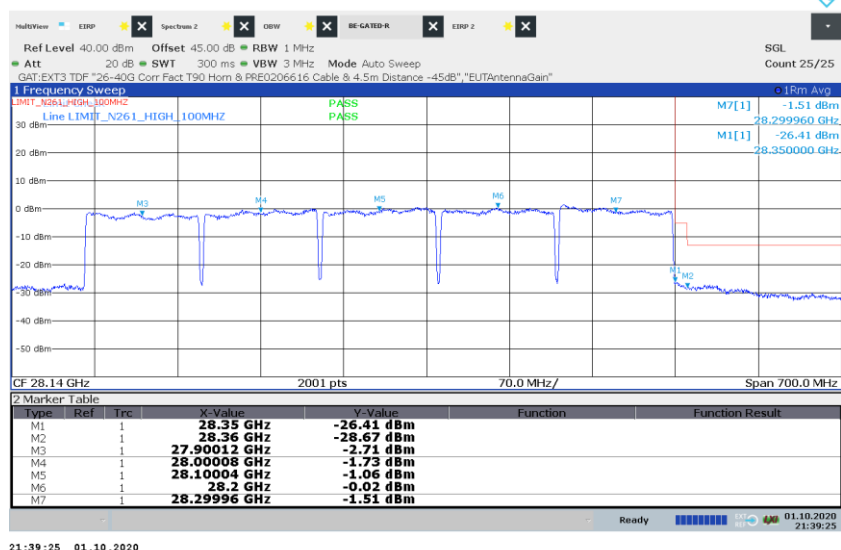


### Tx Main Unit – QPSK, Vertical

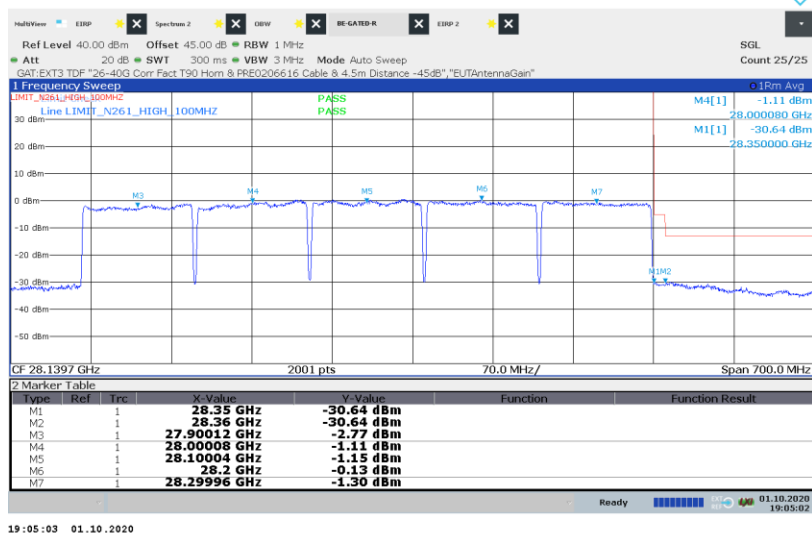


## 5 Carrier Configuration, Right

### Tx Main Unit – 64QAM, Horizontal

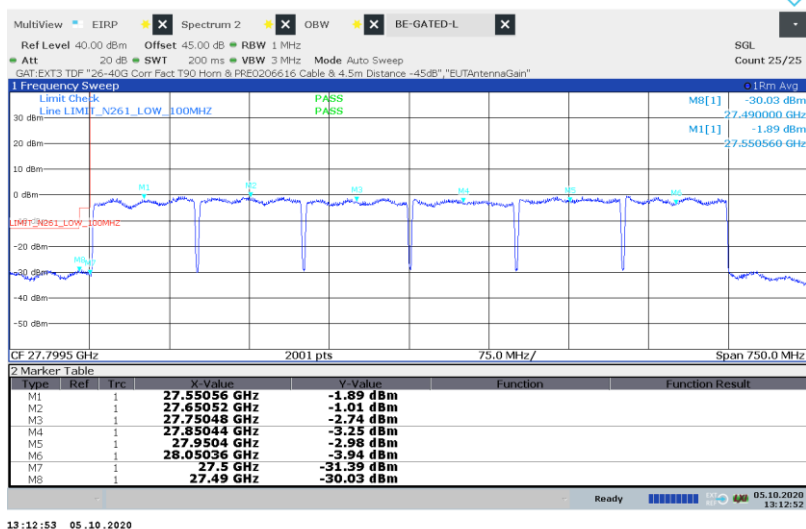


### Tx Main Unit – 64QAM, Vertical

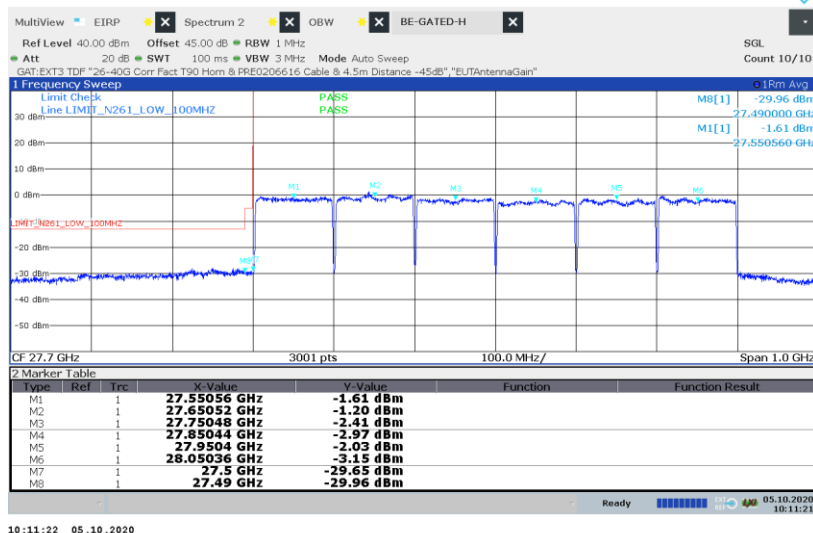


## 6 Carrier Configuration, Left

### Tx Extension Unit – 64QAM, Horizontal

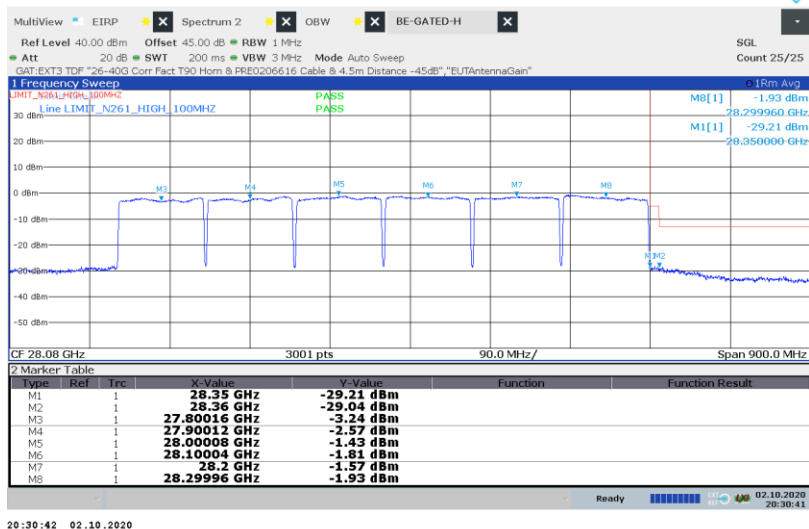


### Tx Extension Unit – 64QAM, Vertical

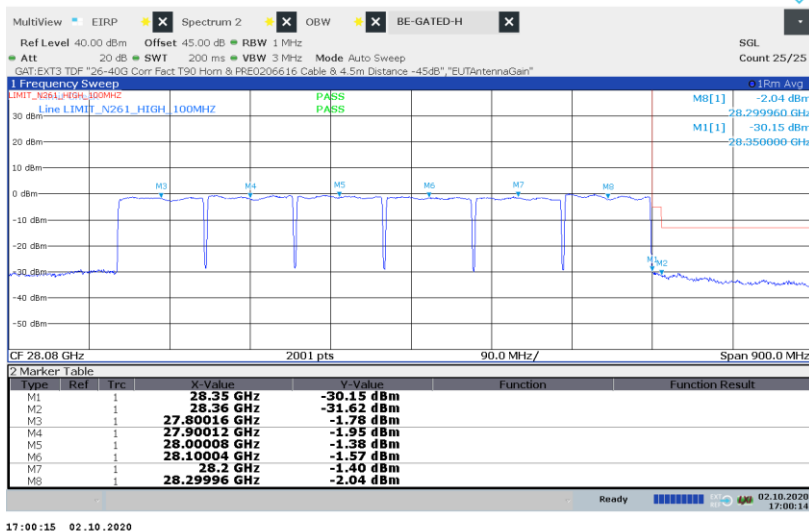


## 6 Carrier Configuration, Right

### Tx Extension Unit - QPSK, Horizontal



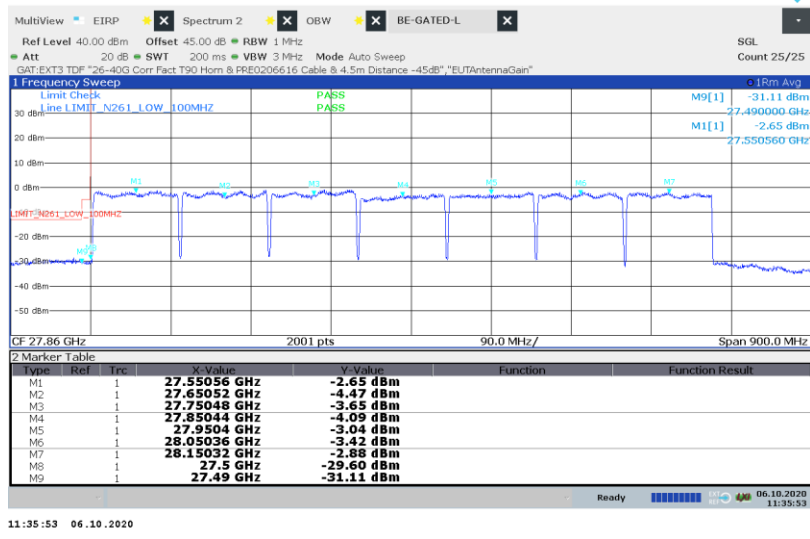
### Tx Extension Unit - QPSK, Vertical





## 7 Carrier Configuration, Left

### Tx Main Unit – QPSK, Horizontal

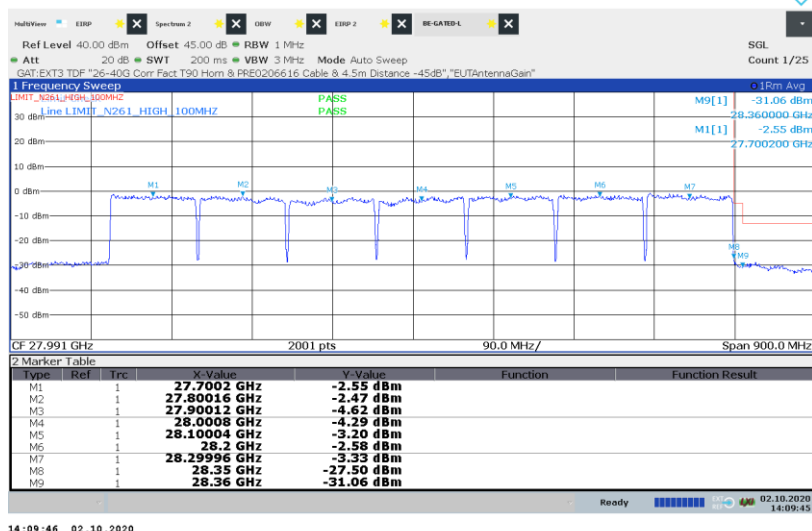


### Tx Main Unit – QPSK, Vertical

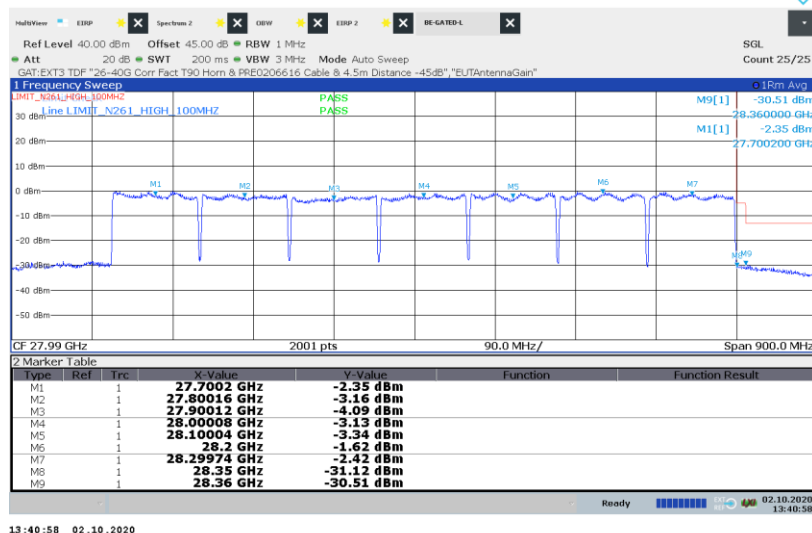


## 7 Carrier Configuration, Right

### Tx Main Unit – 64QAM, Horizontal

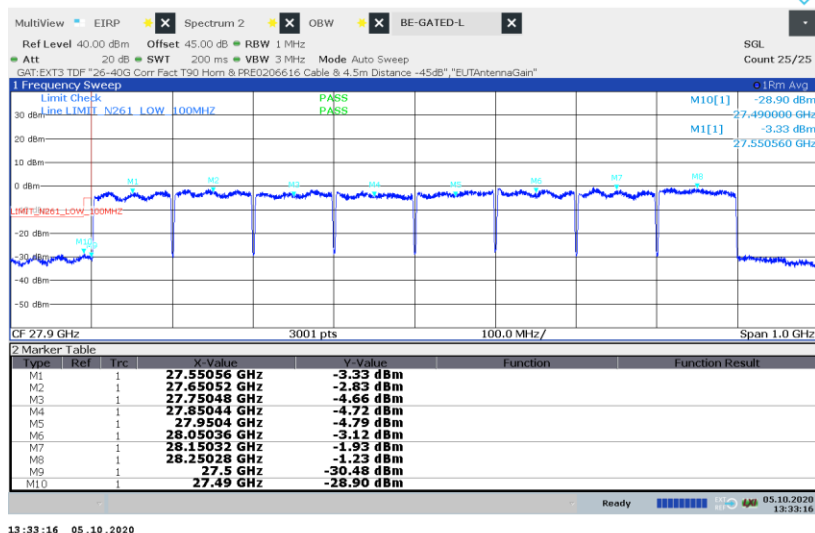


### Tx Main Unit – 64QAM, Vertical

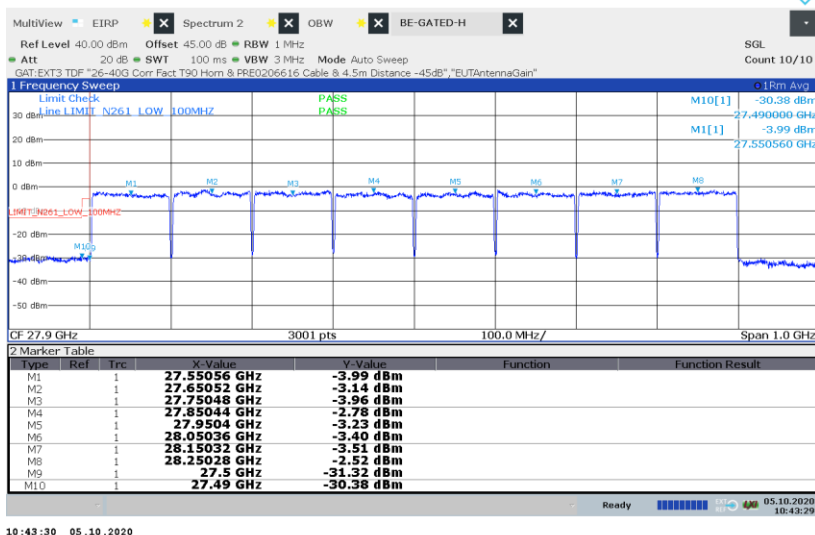


## 8 Carrier Configuration, Left

### Tx Extension Unit – 16QAM, Horizontal

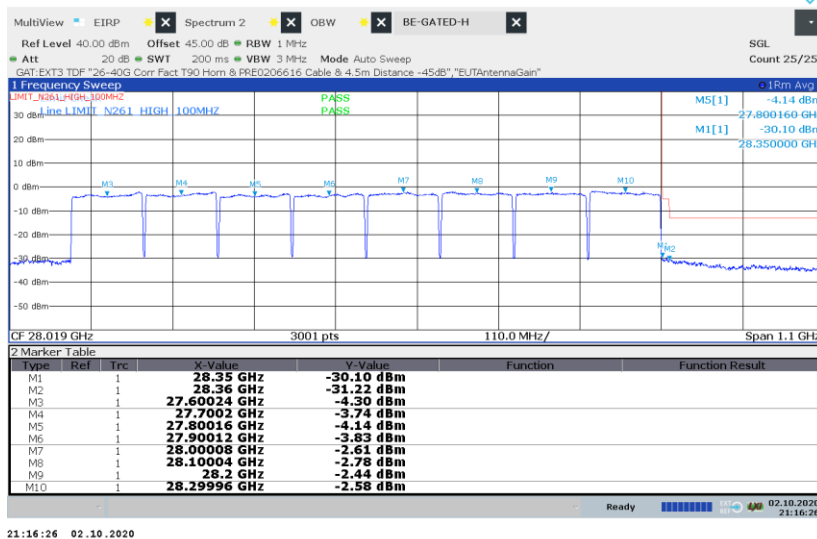


### Tx Extension Unit – 16QAM, Vertical

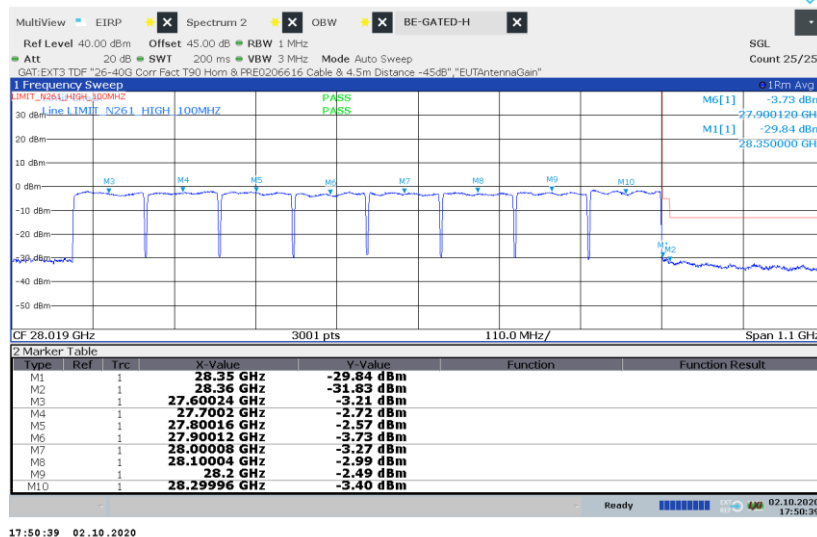


## 8 Carrier Configuration, Right

### 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:  $EIRP (dBm) = E (dB\mu V/m) + 20\log(D) - 104.8$ ; where D is the measurement distance (in the far field region) in m. The field strength E is calculated  $E (dB\mu V/m) = \text{Spectrum Analyzer Level (dBm)} + \text{Antenna Factor (dB/m)} + \text{Cable Loss (dB)} + 107$ . 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:**

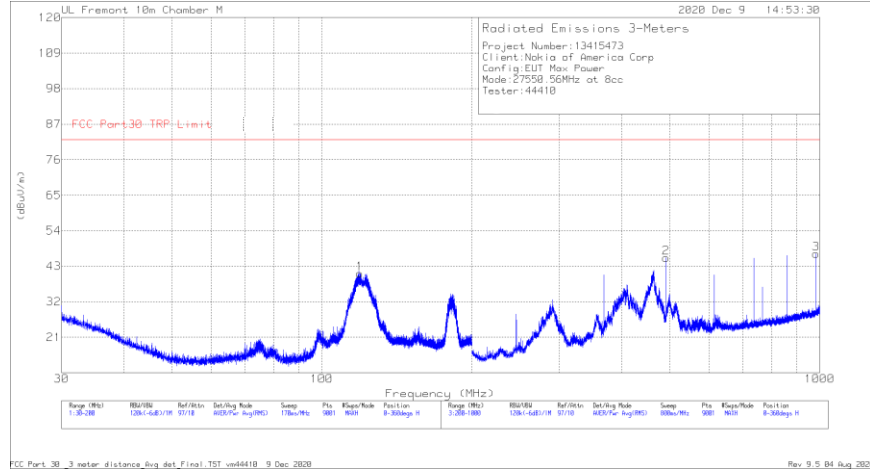
RSE below 18 GHz :  
Employee ID: 44410  
Location: Chamber M  
Test Date: 12/9/2020

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

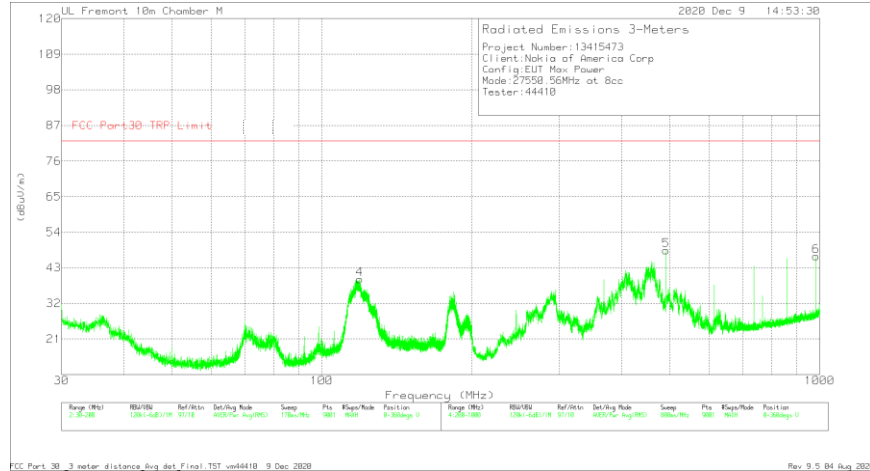
## 8.4.1. RADIATED EMISSIONS, 30 MHz - 1 GHz

### 8 Carrier Configuration, Left

#### Tx Main Unit – QPSK Horizontal



#### Vertical



### Trace Markers

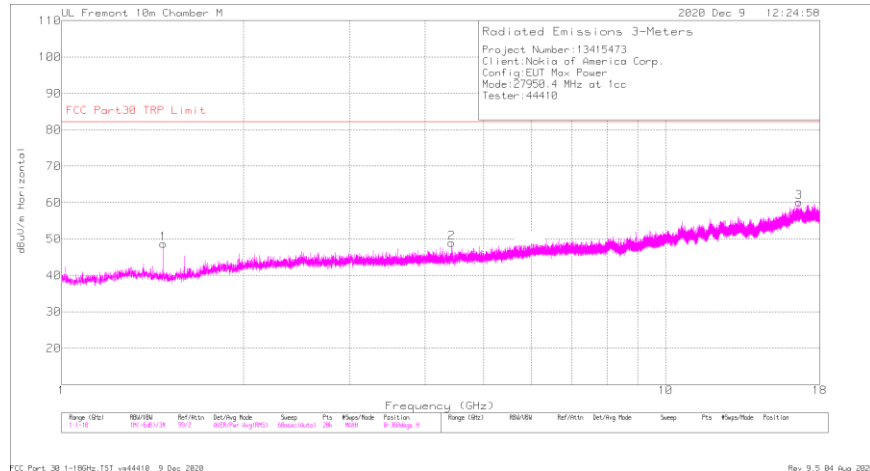
| Marker | Frequency (MHz) | Meter Reading (dBμV) | Det | Hybrid PRE0181574 | Amp/Cbl (dB) | correction RBW 120k to 1 MHz | Corrected Reading (dBμV/m) | FCC Part30 TRP Limit (dBμV/m) | Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|-----|-------------------|--------------|------------------------------|----------------------------|-------------------------------|-------------|----------------|-------------|----------|
| 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

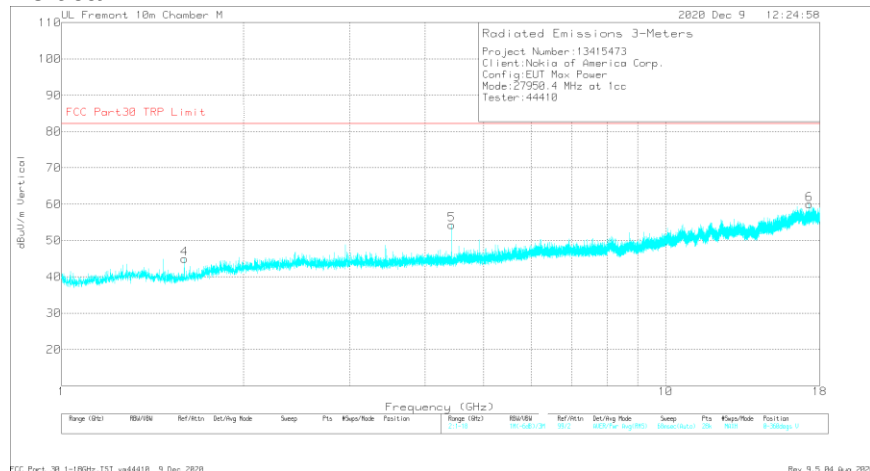
## 8.4.2. RADIATED EMISSIONS, 1 - 18 GHz

### 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/Filtr/P ad (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        |

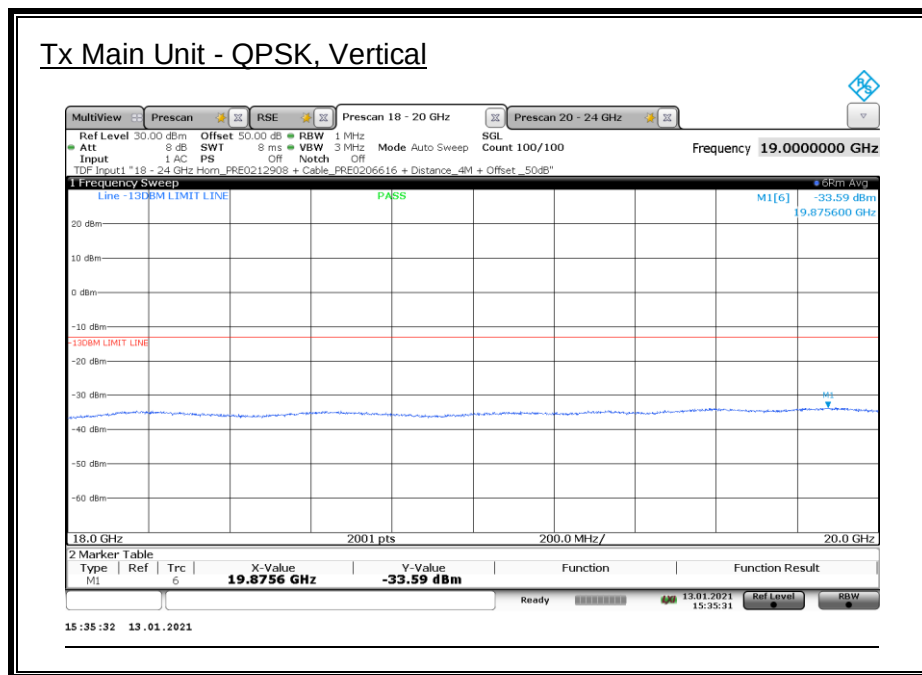
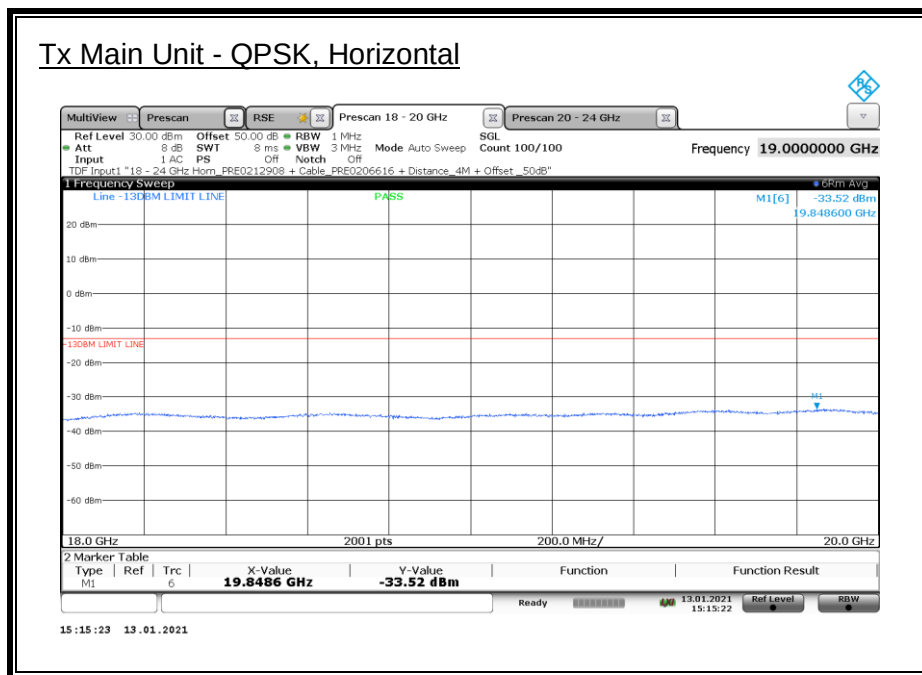
| Range 2: Vertical 1000 - 18000MHz |                 |                      |     |                |                         |                          |                               |             |                |             |          |
|-----------------------------------|-----------------|----------------------|-----|----------------|-------------------------|--------------------------|-------------------------------|-------------|----------------|-------------|----------|
| Marker                            | Frequency (GHz) | Meter Reading (dBuV) | Det | AF T345 (dB/m) | Amp/Cbl/Filtr/P ad (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

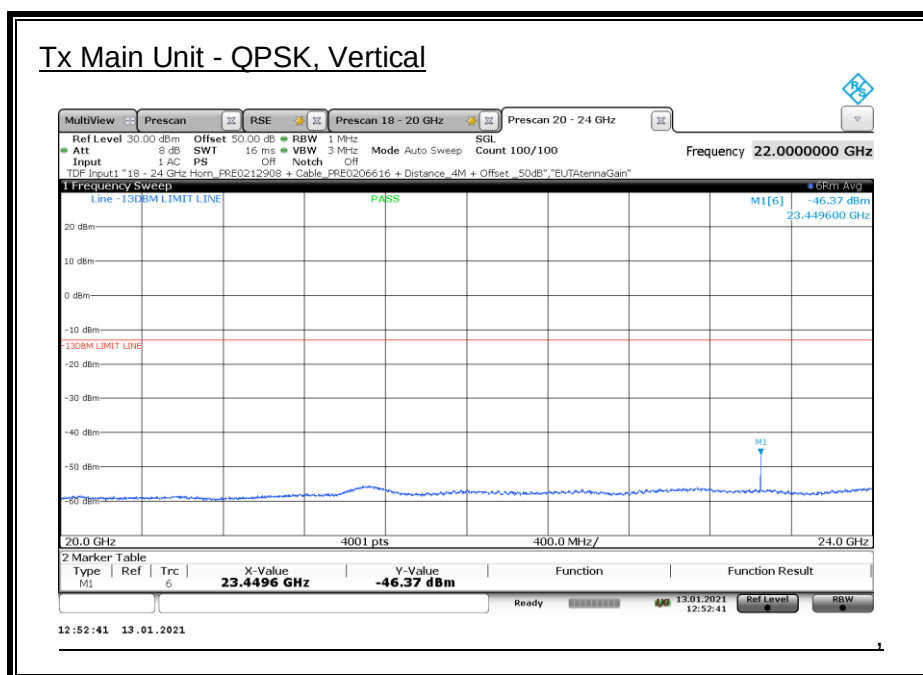
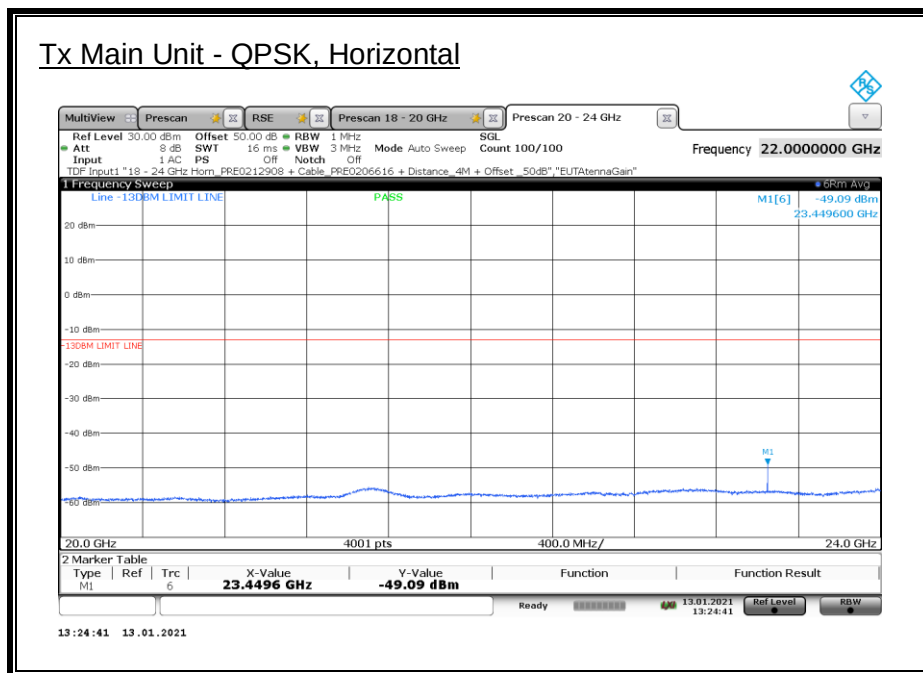
#### 1 Carrier Configuration, Left



No Emission Detected.

## 8.4.4. RADIATED EMISSIONS, 20 – 24 GHz

### 1 Carrier Configuration, Right



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

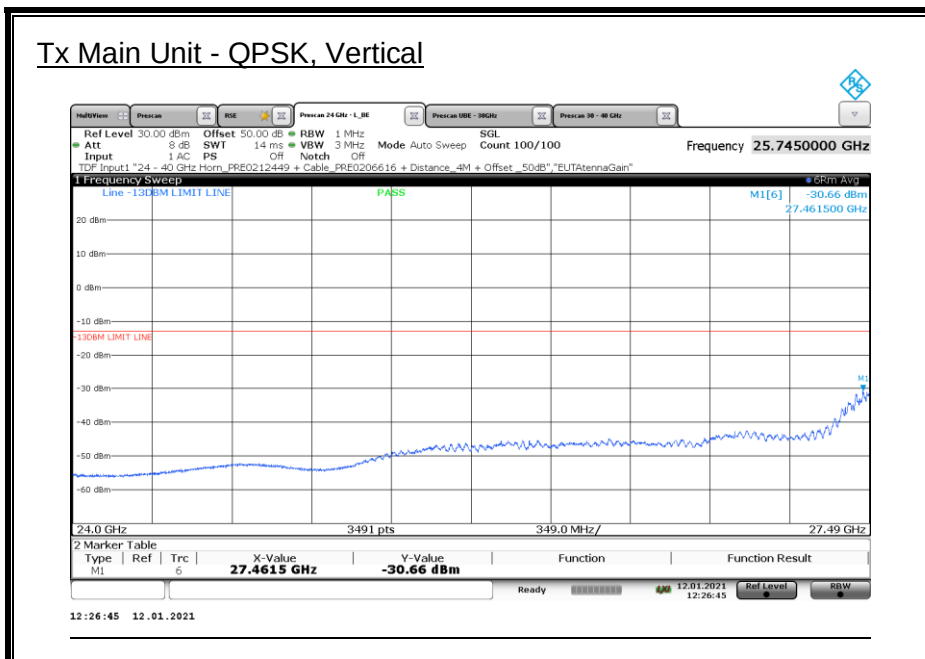
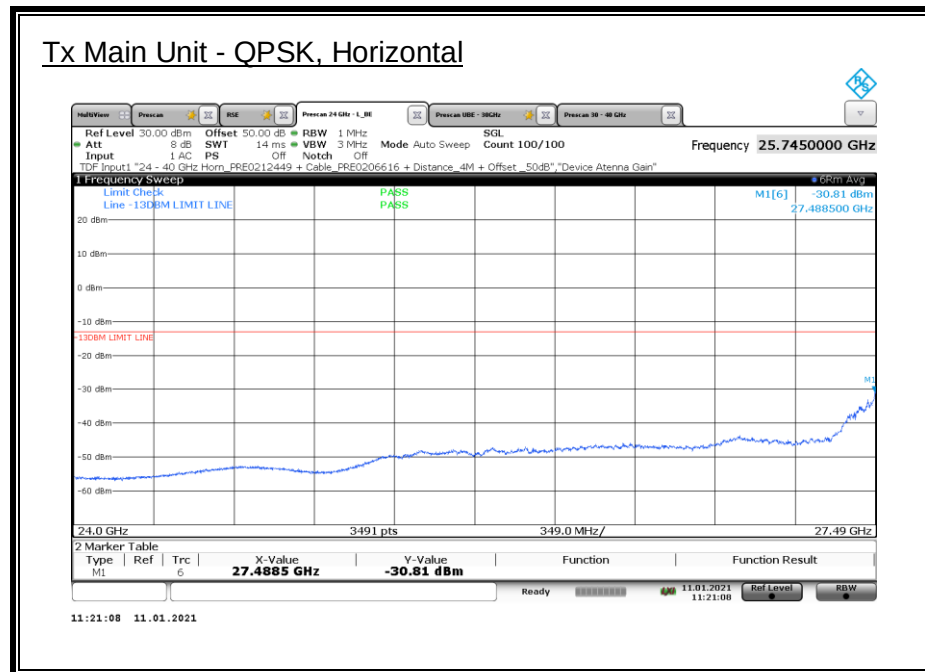
**EIRP RESULTS, 1CC**

| Channel | Freq.   | Meas.<br>Distance | Rx Ant.<br>Polarity | Corrected<br>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

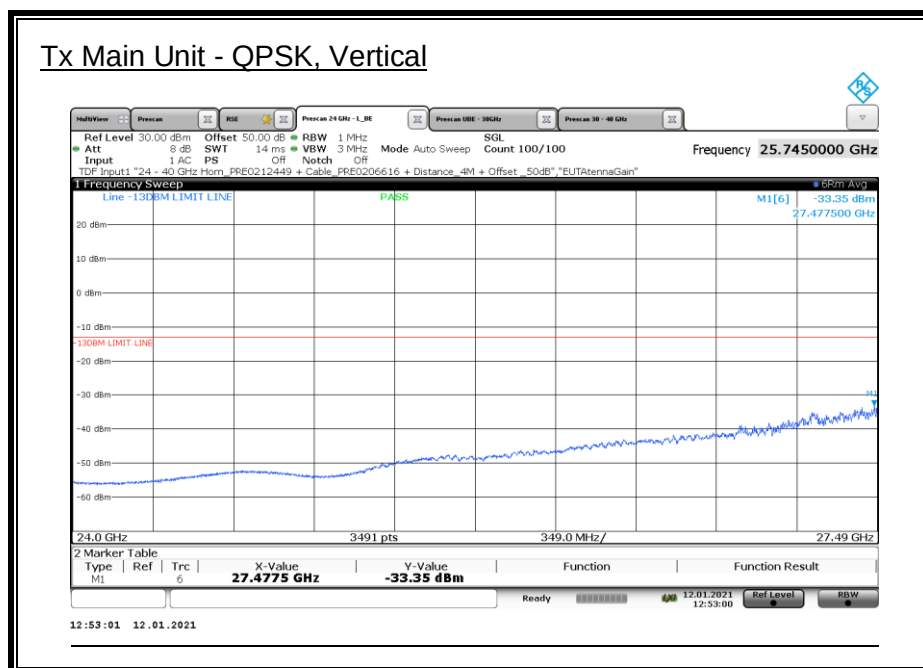
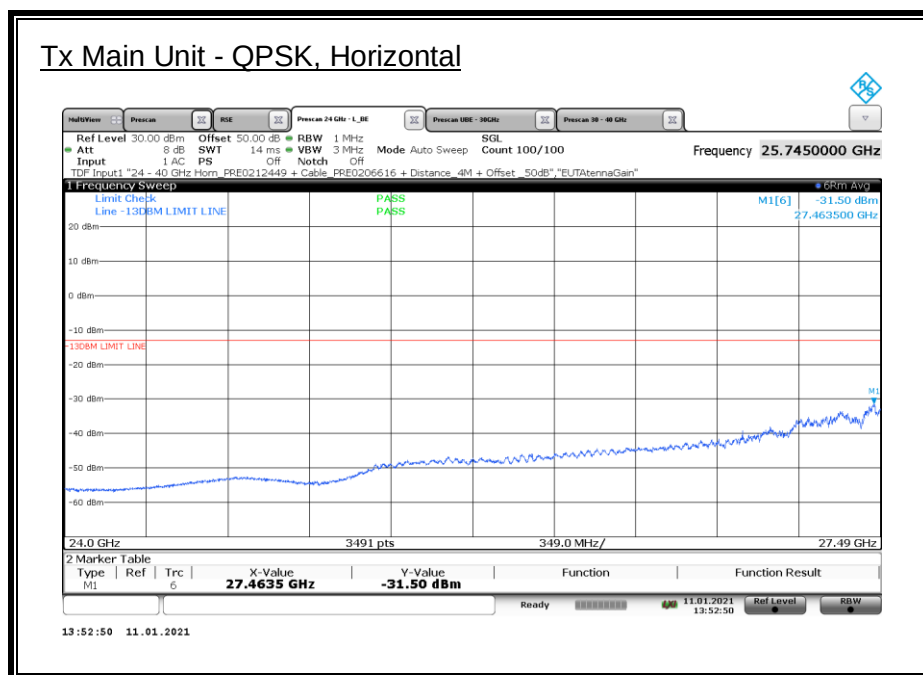
Note: 27.49 - 28.36 GHz covered by Fundamental and BE measurements.

### 2 Carrier Configuration, Left



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

## 8 Carrier Configuration, Left



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

**EIRP RESULTS, 2CC**

| Channel | Freq.    | Meas.<br>Distance | Rx Ant.<br>Polarity | Corrected<br>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  |

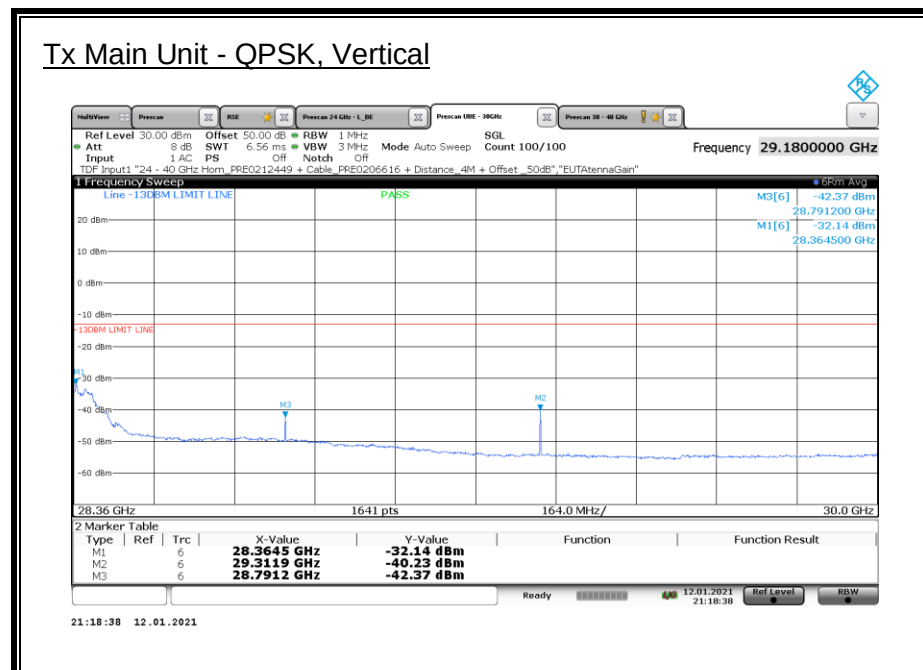
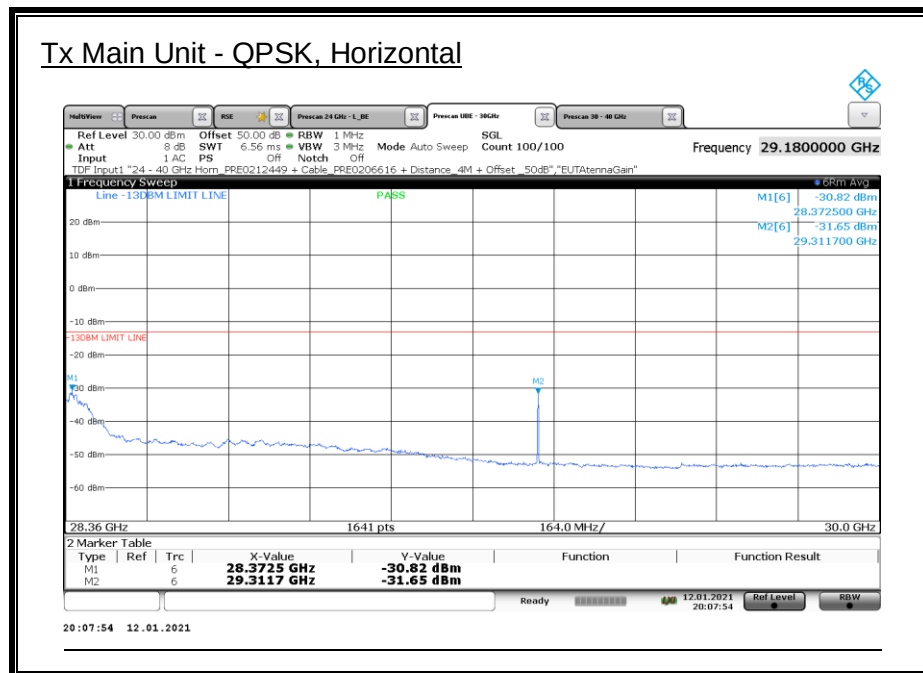
**EIRP RESULTS, 8CC**

| Channel | Freq.    | Meas.<br>Distance | Rx Ant.<br>Polarity | Corrected<br>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.

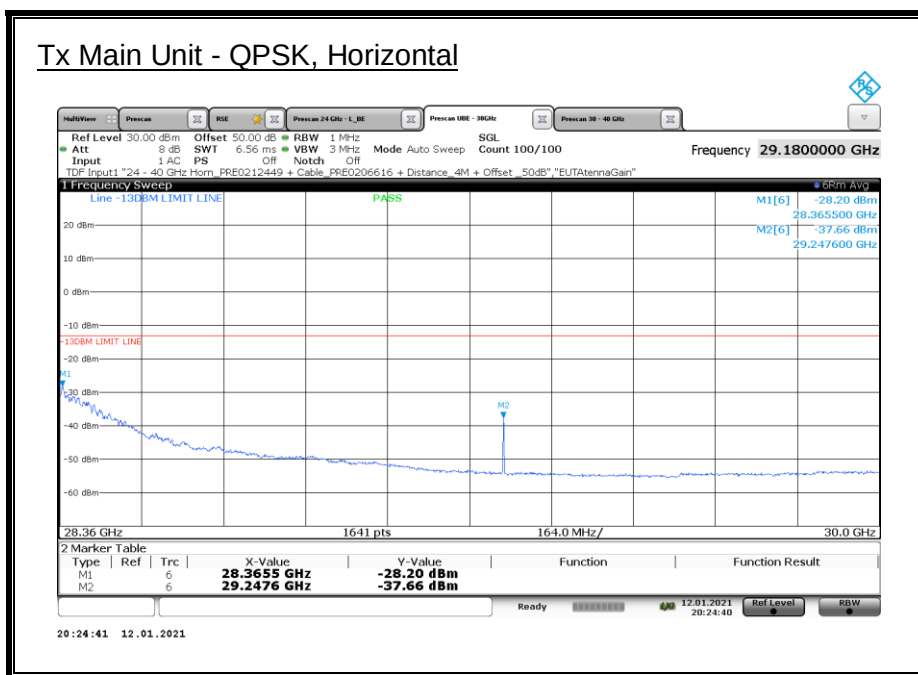
### 1 Carrier Configuration, Right



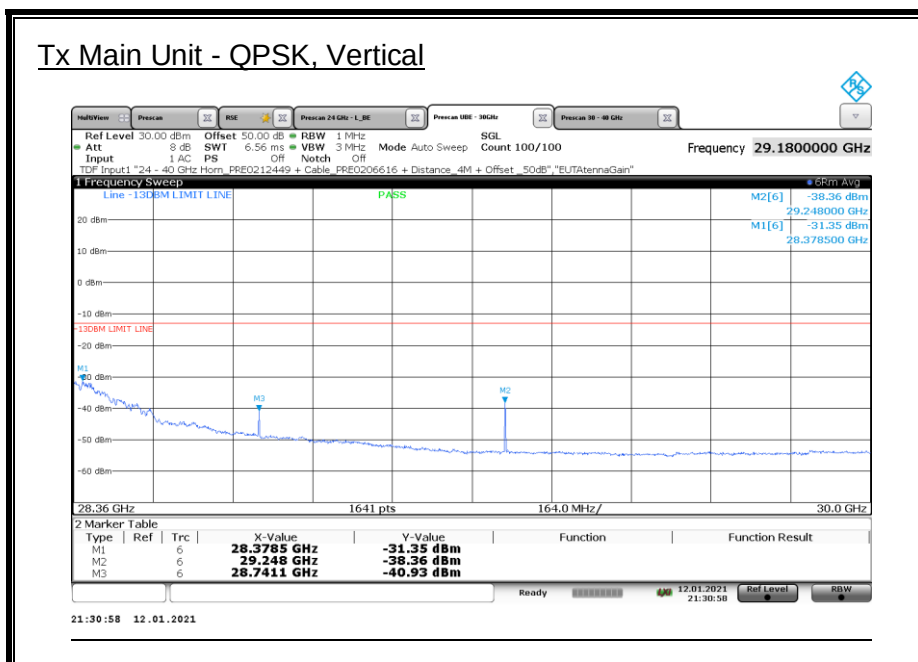
Emissions detected at pre-scan. Avg EIRP was measured.

## 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**

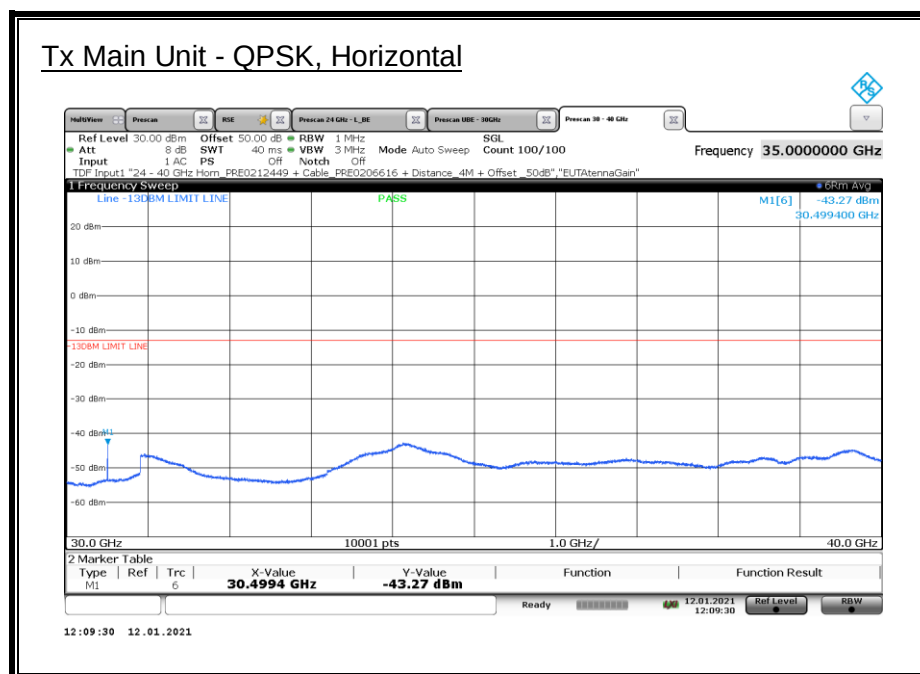
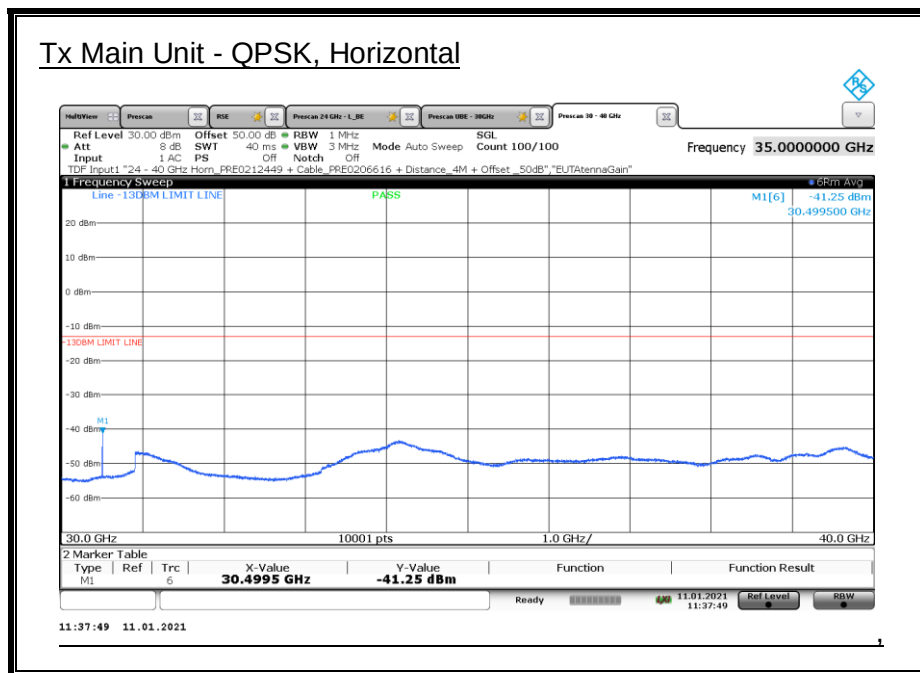
| Channel | Freq.    | Meas.<br>Distance | Rx Ant.<br>Polarity | Corrected<br>Avg EIRP | TRP Limit | Margin |
|---------|----------|-------------------|---------------------|-----------------------|-----------|--------|
|         | (GHz)    | (m)               | H/V                 | (dBm)                 | (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.<br>Distance | Rx Ant.<br>Polarity | Corrected<br>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



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

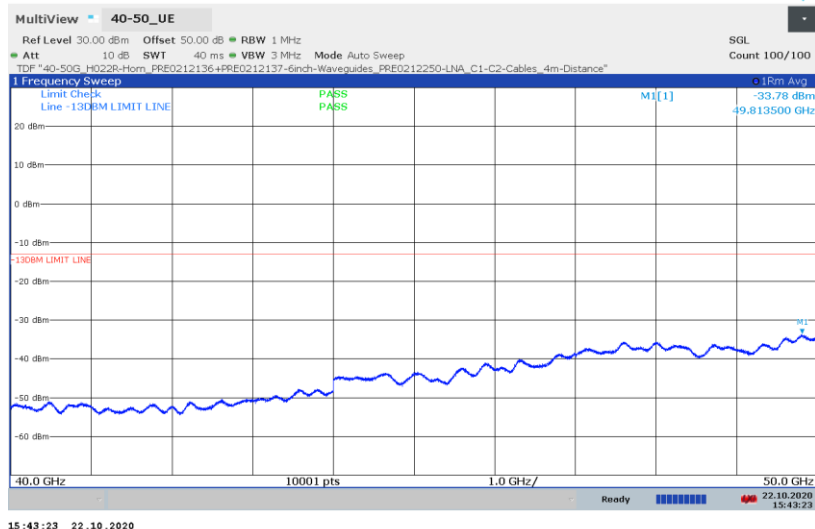
**EIRP RESULTS, 1CC**

| Channel | Freq.   | Meas.<br>Distance | Rx Ant.<br>Polarity | Corrected<br>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 |

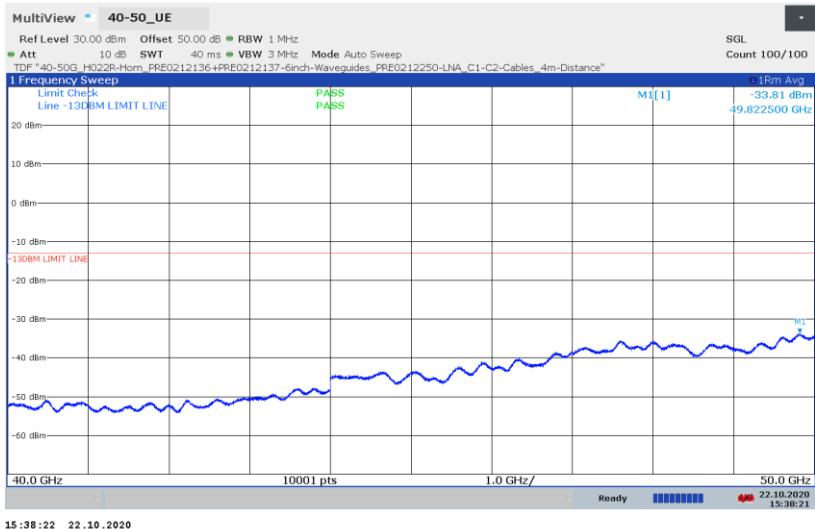
## 8.4.8. RADIATED EMISSIONS, 40 - 50 GHz

### 1 Carrier Configuration, Center

#### Tx Main Unit - QPSK, Horizontal



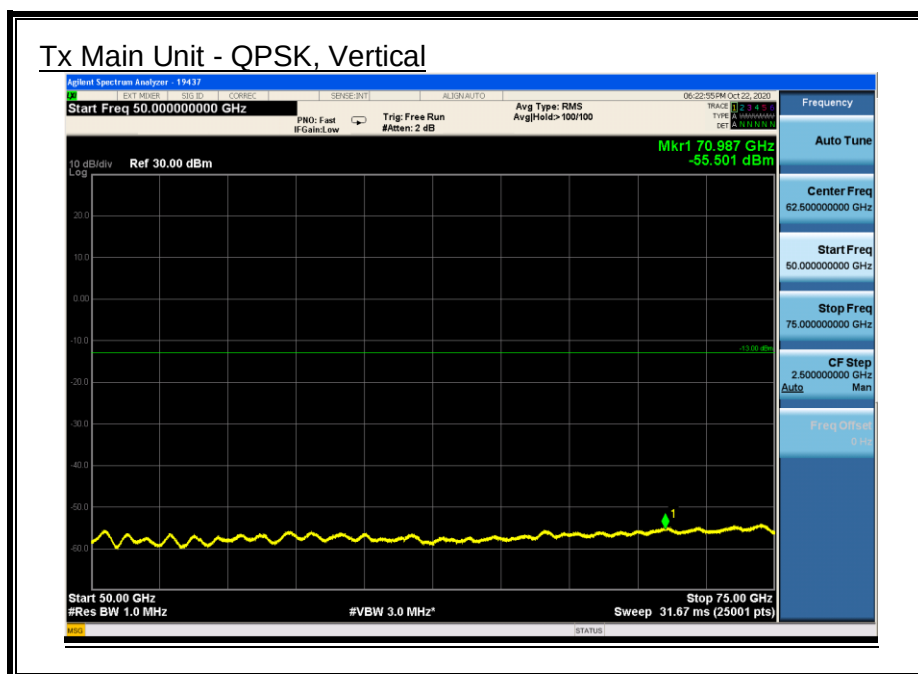
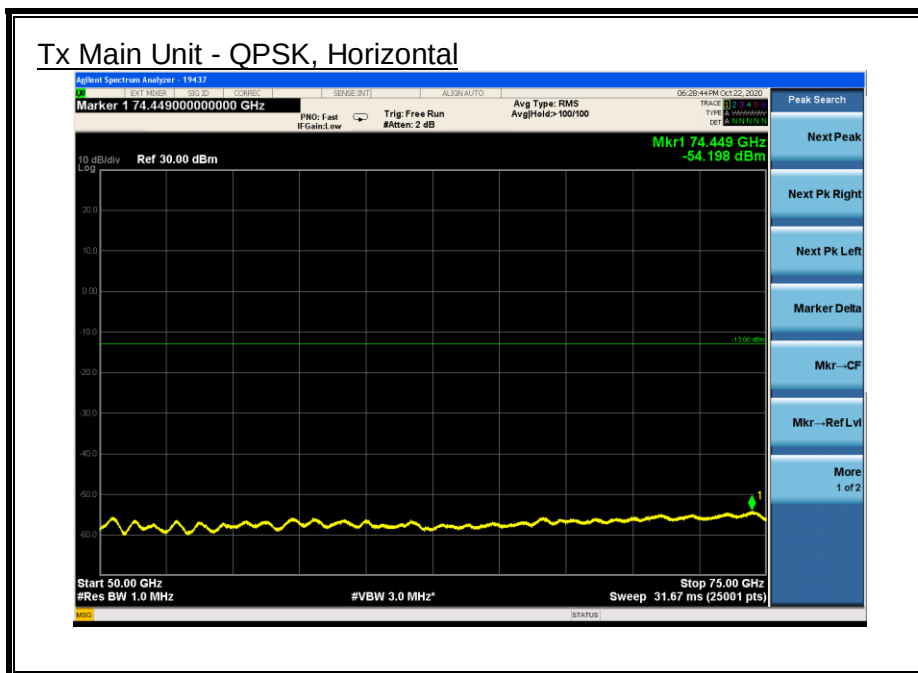
#### Tx Main Unit - QPSK, Vertical



No Emission Detected.

## 8.4.9. RADIATED EMISSIONS, 50 - 75 GHz

### 1 Carrier Configuration, Center

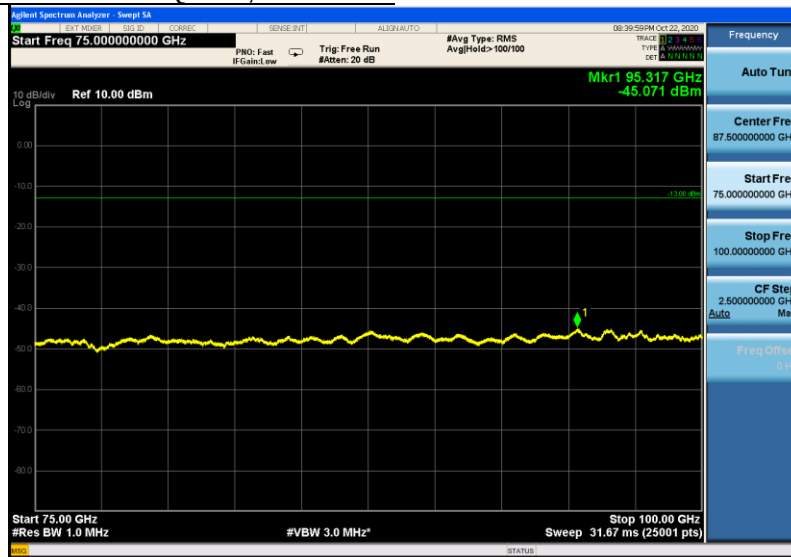


No Emission Detected.

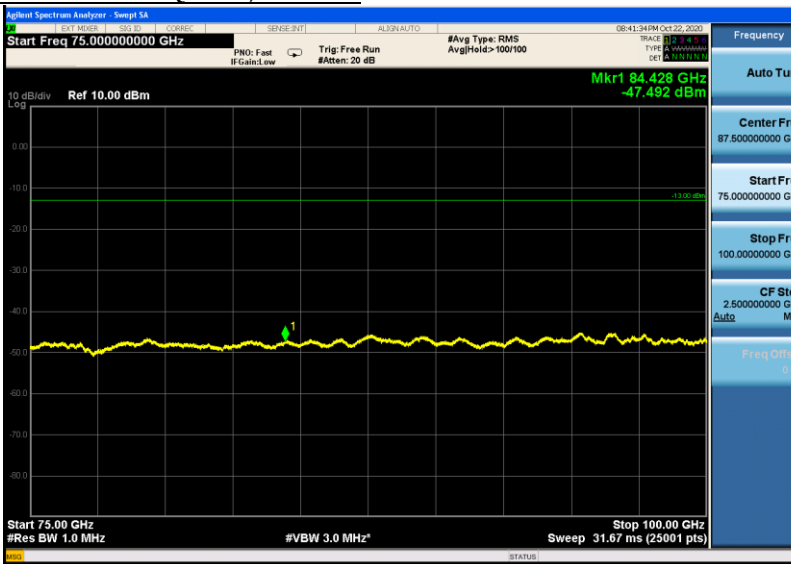
## 8.4.10. RADIATED EMISSIONS, 75 - 100 GHz

### 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  
Shipping Date: 06/02/20

Today's Date: 06/02/20  
PO Number: 7862016682

| Quantity       |             |                                       | <u>Order-Job</u> |
|----------------|-------------|---------------------------------------|------------------|
| <u>Shipped</u> | <u>Unit</u> | <u>Description</u>                    | <u>Number</u>    |
| 1              | EA          | VDIWR15.0SAX<br>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

A handwritten signature in black ink, appearing to be "HSD", is written over a horizontal line.

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  
Shipping Date: 06/02/20

Today's Date: 06/03/20  
PO Number: 7862016682

| Quantity | Shipped | Unit | Description                                                                | Order-Job<br>Number |
|----------|---------|------|----------------------------------------------------------------------------|---------------------|
| 1        |         | EA   | VDIWR10.0SAX<br>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

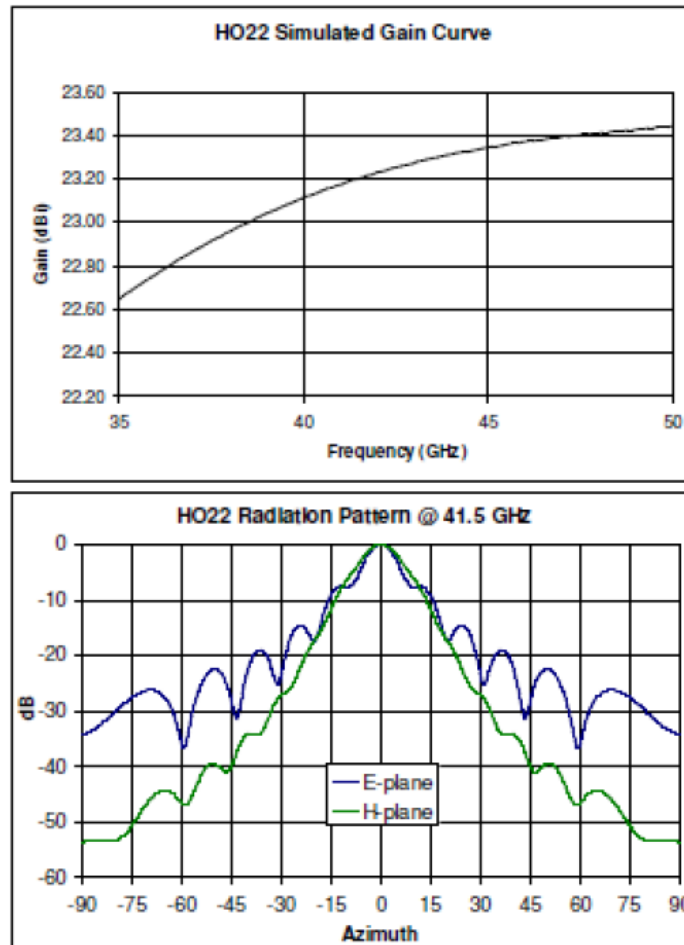
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### 3. 35-50 GHz CMI HO22R HORN ANTENNA



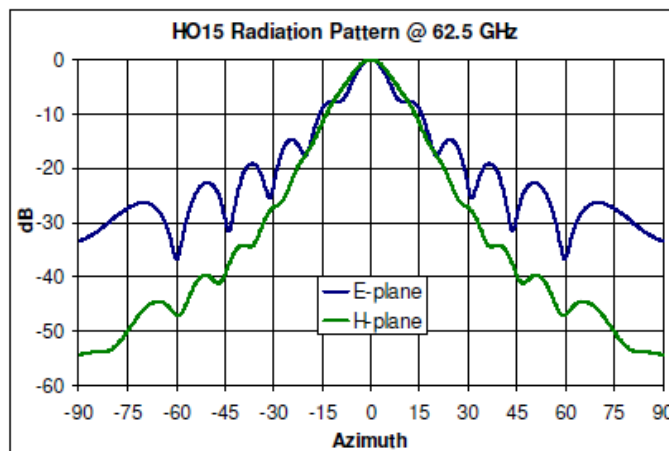
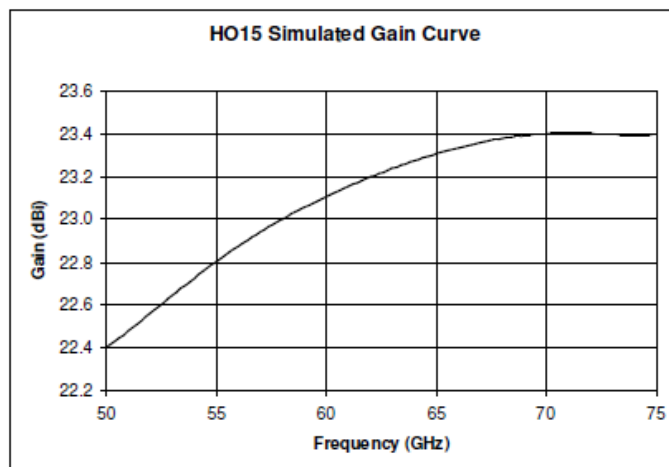
24 Boston Court  
Longmont, CO 80501  
303 651-0707 (P)  
303 651-0706 (F)  
www.custommicrowave.com



#### 4. 50-75 GHz CMI HO15R HORN ANTENNA



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

