



FCC PART 22, 74, 80 and 90

## TEST REPORT

For

### Hytera Communications Corporation Limited

Hytera Tower, Hi-Tech Industrial Park North, 9108# Beihuan Road, Nanshan District, Shenzhen, 518057 China

**FCC ID: YAMRD98XSIU2**

|  |   |
|--|---|
| <b>Report Type:</b><br>Original Report | <b>Product Type:</b><br>Digital Repeater  |
| <b>Report Number:</b>                  | RDG171207019-00A  |
| <b>Report Date:</b>                    | 2018-03-12  |
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## GENERAL INFORMATION

### Product Description for Equipment under Test (EUT)

The *Hytera Communications Corporation Limited's* product, model number: *RD982Si U(2)* (FCC ID: *YAMRD98XSIU2*) in this report is a *Digital Repeater*, which was measured approximately: 48.2 cm (L) x 36.8 cm (W) x 9.9 cm (H), rated input voltage: DC 13.6 V.

| Type                      | Parameter          |         |
|---------------------------|--------------------|---------|
| Frequency Range(MHz)      | 450-512            |         |
| Rated Output power(Watts) | 50 (High) / 5(Low) |         |
| Modulation                | FM/4FSK            |         |
| Channel Spacing(kHz)      | FM                 | 12.5/25 |
|                           | 4FSK               | 12.5    |

*Notes: This series products model: RD985Si U(2), RD986Si U(2), RD988Si U(2) and RD982Si U(2) are identical schematics, and only are different for model number. Model RD982Si U(2) was selected for fully testing, the detailed information can be referred to the declaration which was stated and guaranteed by the applicant.*

*\* All measurement and test data in this report was gathered from production sample serial number: 171207019 (Assigned by BAACL, Shenzhen). The EUT supplied by the applicant was received on 2017-12-07.*

### Objective

This test report is prepared on behalf of *Hytera Communications Corporation Limited* in accordance with Part 2, and Part 22,74,80,90 of the Federal Communication Commissions rules.

### Related Submittal(s)/Grant(s)

No Related Submittal(s)/Grant(s).

### Test Methodology

All tests and measurements indicated in this document were performed in accordance with the Code of federal Regulations Title 47 Part 2, Sub-part J as well as the following individual parts:

- Part 22 – Public Mobile Service
- Part 74 – Experimental Radio, Auxiliary, Special Broadcast and other Program Distributonal Service
- Part 80 – Stantions in the Maritme Service
- Part 90 – Private Land Mobile Radio Service

Applicable Standards: TIA 603-D.

All emissions measurement was performed at Bay Area Compliance Laboratories Corp. (Shenzhen). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

**Measurement Uncertainty**

| Parameter                    | uncertainty |
|------------------------------|-------------|
| Occupied Channel Bandwidth   | ±5%         |
| RF output power, conducted   | ±1.5dB      |
| Unwanted Emission, conducted | ±1.5dB      |
| All emissions, radiated      | ±4.88dB     |
| Temperature                  | ±1 °        |
| Supply voltages              | ±0.4%       |

**Test Facility**

The Test site used by Bay Area Compliance Laboratories Corp. (Shenzhen) to collect test data is located on the 6/F., West Wing, Third Phase of Wanli Industrial Building, Shihua Road, Futian Free Trade Zone, Shenzhen, Guangdong, China.

The test site has been approved by the FCC under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No. : 382179, the FCC Designation No. : CN5001.

The test site has been registered with ISED Canada under ISED Canada Registration Number 3062B.

## SYSTEM TEST CONFIGURATION

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### Description of Test Configuration

The system was configured for testing in a test mode which has been done in the factory.

### EUT Exercise Software

No exercise software was used.

### Special Accessories

No special accessory was used.

### Equipment Modifications

No modification was made to the EUT tested.

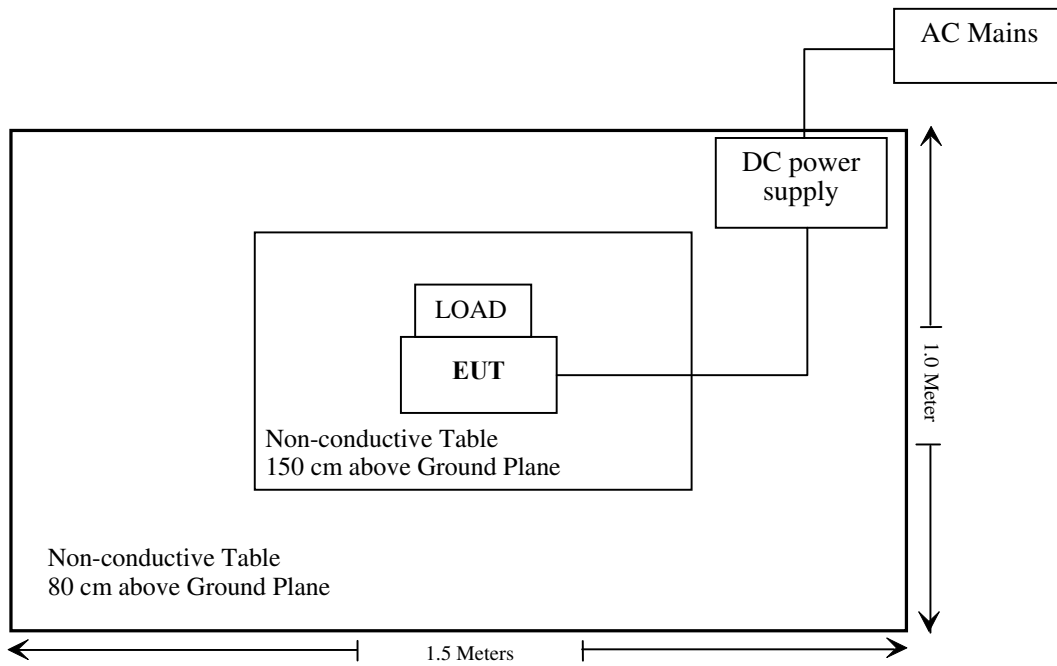
### Support Equipment List and Details

| Manufacturer | Description     | Model      | Serial Number |
|--------------|-----------------|------------|---------------|
| N/A          | Load            | 100W/50 □  | N/A           |
| TDK-Lambda   | DC power supply | Z60-14-L-C | N/A           |

### External I/O Cable

| Cable Description | Length (m) | From Port       | To  |
|-------------------|------------|-----------------|-----|
| DC Power Cable    | 3.0        | DC power supply | EUT |

**Block Diagram of Test Setup**



**SUMMARY OF TEST RESULTS**

| <b>FCC Rules</b>   | <b>Description of Test</b>            | <b>Results</b> |
|--|---------------------------------------|----------------|
| §1.1307(b), §2.1091  | Maximum Permissible exposure (MPE)    | Compliance     |
| §2.1046; § 22.727;<br>§74.461; § 80.215;<br>§90.205                          | RF Output Power                       | Compliance     |
| §2.1047  | Modulation Characteristic             | Compliance     |
| §2.1049;§22.357;§ 22.731;<br>§74.462; § 80.205;<br>§ 80.207;§90.209; §90.210 | Occupied Bandwidth & Emission Mask    | Compliance     |
| §2.1051; §22.861; §74.462;<br>§ 80.211;§90.210                               | Spurious Emission at Antenna Terminal | Compliance     |
| §2.1053; §22.861;<br>§74.462; § 80.211;§90.210                               | Spurious Radiated Emissions           | Compliance     |
| §2.1055; § 22.355;<br>§74.464; § 80.209;§90.213                              | Frequency Stability                   | Compliance     |
| §90.214  | Transient Frequency Behavior          | Compliance     |



**TEST EQUIPMENT LIST**

| Manufacturer                  | Description                    | Model                 | Serial Number          | Calibration Date | Calibration Due Date |
|-------------------------------|--------------------------------|-----------------------|------------------------|------------------|----------------------|
| <b>Radiated Emission Test</b> |                                |                       |                        |                  |                      |
| Sunol Sciences                | Horn Antenna                   | DRH-118               | A052604                | 2017-12-29       | 2020-12-28           |
| Rohde & Schwarz               | Signal Generator               | FSIQ26                | 8386001028             | 2017-04-24       | 2018-04-24           |
| Sunol Sciences                | Bi-log Antenna                 | JB1                   | A040904-2              | 2017-12-17       | 2020-12-17           |
| Mini                          | Pre-amplifier                  | ZVA-183-S+            | 5969001149             | 2017-02-14       | 2018-02-14           |
| HP                            | Amplifier                      | HP8447E               | 1937A01046             | 2017-11-19       | 2018-05-21           |
| Anritsu                       | Signal Generator               | 68369B                | 004114                 | 2017-12-05       | 2018-12-05           |
| Rohde & Schwarz               | EMI Test Receiver              | ESCI                  | 101120                 | 2017-12-07       | 2018-12-07           |
| COM POWER                     | Dipole Antenna                 | AD-100                | 041000                 | NCR              | NCR                  |
| A.H. System                   | Horn Antenna                   | SAS-200/571           | 135                    | 2015-08-18       | 2018-08-17           |
| Ducommun technologies         | RF Cable                       | UFA210A-1-4724-30050U | MFR64369<br>223410-001 | 2017-11-19       | 2018-05-21           |
| Ducommun technologies         | RF Cable                       | 104PEA                | 218124002              | 2017-11-19       | 2018-05-21           |
| Ducommun technologies         | RF Cable                       | RG-214                | 1                      | 2017-11-19       | 2018-05-21           |
| Ducommun technologies         | RF Cable                       | RG-214                | 2                      | 2017-11-22       | 2018-05-22           |
| <b>RF Conducted Test</b>      |                                |                       |                        |                  |                      |
| Rohde & Schwarz               | Signal Analyzer                | FSW13                 | 103533                 | 2017-06-15       | 2018-06-14           |
| ESPEC                         | Temperature & Humidity Chamber | EL-10KA               | 09107726               | 2017-11-22       | 2018-11-22           |
| Long Wei                      | DC Power Supply                | TPR-6420D             | 398363                 | NCR              | NCR                  |
| Rohde & Schwarz               | Vector Signal Generator        | SMW200A               | 102522                 | 2017-06-15       | 2018-06-14           |
| BEW                           | Coaxial Attenuator             | TS300-6-40            | N/A                    | 2017-06-15       | 2018-06-14           |
| MICABLE                       | RF Cable                       | D02                   | N/A                    | 2017-06-15       | 2018-06-14           |

\* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Shenzhen) attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

**FCC §1.1307 (b) (1) & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)**

**Applicable Standard**

According to subpart 1.1307 (b)(1), 2.1091 systems operating under the provisions of this section shall be operated in a manner that ensures the public is not exposed to RF energy level in excess of the communication guidelines.

**Limits for Occupational/Controlled Exposure**

| Limits for occupational/Controlled Exposure |                               |                               |                                     |                          |
|---|-------------------------------|-------------------------------|-------------------------------------|--------------------------|
| Frequency Range (MHz)                       | Electric Field Strength (V/m) | Magnetic Field Strength (A/m) | Power Density (mW/cm <sup>2</sup> ) | Averaging Time (Minutes) |
| 0.3-1.34                                    | 614                           | 1.63                          | *(100)                              | 6                        |
| 1.34-30                                     | 1842/f                        | 4.89/f                        | *(900/f <sup>2</sup> )              | 6                        |
| 30-300                                      | 61.4                          | 0.163                         | 1.0                                 | 6                        |
| 300-1500                                    | /                             | /                             | f/300                               | 6                        |
| 1500-100,000                                | /                             | /                             | 5.0                                 | 6                        |

f = frequency in MHz

\* = Plane-wave equivalent power density

**Result**

**Calculated Formulary:**

Predication of MPE limit at a given distance

$$S = \frac{PG}{4\pi R^2}$$

S = power density (in appropriate units, e.g. mW/cm<sup>2</sup>)

P = power input to the antenna (in appropriate units, e.g., mW).

G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain.

R = distance to the center of radiation of the antenna (appropriate units, e.g., cm)

| Frequency (MHz) | Antenna Gain |           | Max average output power (mW) | Evaluation Distance (cm) | Power Density (mW/cm <sup>2</sup> ) | MPE Limit (mW/cm <sup>2</sup> ) |
|-----------------|--------------|-----------|-------------------------------|--------------------------|-------------------------------------|---------------------------------|
|                 | (dBi)        | (numeric) |                               |                          |                                     |                                 |
| 450-512         | 5.5          | 3.55      | 28117                         | 80                       | 1.24                                | 1.50                            |

Note: Max tune-up output power is 47.5dBm (56234 mW), the duty cycle is 50%. So the average power is 28117 mW.

To maintain compliance with the FCC’s RF exposure guidelines, place the equipment at least 80cm from nearby persons.

**Result: Compliance**

## FCC §2.1046 & § 22.727 & §74.461 & §80.215 & §90.205 - RF OUTPUT POWER

### Applicable Standard

FCC §2.1046, § 22.727, §74.461, § 80.215 and §90.205

### Test Procedure

Conducted RF Output Power:

The RF output of the transmitter was connected to the input of the spectrum analyzer through sufficient attenuation.

Spectrum Analyzer Setting:

|         |           |
|---------|-----------|
| R B/W   | Video B/W |
| 100 kHz | 300 kHz   |

### Test Data

#### Environmental Conditions

|                    |           |
|--------------------|-----------|
| Temperature:       | 25 °C     |
| Relative Humidity: | 56 %      |
| ATM Pressure:      | 101.0 kPa |

The testing was performed by Dylan Li on 2017-12-19.

Test Mode: Transmitting

**Test Result:** Compliance. Please refer to following table.

| Modulation | Channel Separation (kHz) | Frequency (MHz) | Power Level | Output Power (dBm) | Output Power (W) | Remark         |
|------------|--------------------------|-----------------|-------------|--------------------|------------------|----------------|
| Analog     | 12.5                     | 450.0125        | High        | 47.20              | 52.48            | For Part 74/90 |
|            |                          |                 | Low         | 37.26              | 5.32             |                |
|            | 12.5                     | 453.2125        | High        | 47.19              | 52.36            | For Part 74/90 |
|            |                          |                 | Low         | 37.28              | 5.35             |                |
|            | 12.5                     | 454.5           | High        | 47.19              | 52.36            | For Part 22    |
|            |                          |                 | Low         | 37.28              | 5.35             |                |
|            | 12.5                     | 511.9875        | High        | 47.19              | 52.36            | For Part 22/90 |
|            |                          |                 | Low         | 37.24              | 5.30             |                |

| Modulation | Channel Separation (kHz) | Frequency (MHz) | Power Level | Output Power (dBm) | Output Power (W) | Remark         |
|------------|--------------------------|-----------------|-------------|--------------------|------------------|----------------|
| Analog     | 25                       | 450.0125        | High        | 47.21              | 52.60            | For Part 74    |
|            |                          |                 | Low         | 37.22              | 5.27             |                |
|            | 25                       | 454.5           | High        | 47.14              | 51.76            | For Part 22/80 |
|            |                          |                 | Low         | 37.24              | 5.30             |                |
|            | 25                       | 465.0125        | High        | 47.24              | 52.97            | For Part 80    |
|            |                          |                 | Low         | 37.29              | 5.36             |                |
| 25         | 511.9875                 | High            | 47.21       | 52.60              | For Part 22      |                |
|            |                          | Low             | 37.25       | 5.31               |                  |                |

| Modulation | Channel Separation (kHz) | Frequency (MHz) | Power Level | Output Power (dBm) | Output Power (W) | Remark         |
|------------|--------------------------|-----------------|-------------|--------------------|------------------|----------------|
| Digital    | 12.5                     | 450.0125        | High        | 47.24              | 52.97            | For Part 74/90 |
|            |                          |                 | Low         | 37.27              | 5.33             |                |
|            | 12.5                     | 453.2125        | High        | 47.18              | 52.24            | For Part 74/90 |
|            |                          |                 | Low         | 37.28              | 5.35             |                |
|            | 12.5                     | 454.5           | High        | 47.24              | 52.97            | For Part 22    |
|            |                          |                 | Low         | 37.27              | 5.33             |                |
| 12.5       | 511.9875                 | High            | 47.25       | 53.09              | For Part 22/90   |                |
|            |                          | Low             | 37.22       | 5.27               |                  |                |

Note: The high rated power is 50W, limit is 40-60W  
 The low rated power is 5W, limit is 4-6W

## **FCC §2.1047 - MODULATION CHARACTERISTIC**

### **Applicable Standard**

FCC§2.1047, §74.463, §80.213 and §90.207:

- (a) Equipment which utilizes voice modulated communication shall show the frequency response of the audio modulating circuit over a range of 100 to 5000 Hz. for equipment which is required to have a low pass filter, the frequency response of the filter, or all of the circuitry installed between the modulation limited and the modulated stage shall be supplied.
- (b) Equipment which employs modulation limiting, a curve showing the percentage of modulation versus the modulation input voltage shall be supplied.

### **Test Procedure**

Test Method: TIA/EIA-603 2.2.3

### **Test Data**

#### **Environmental Conditions**

|                           |           |
|---------------------------|-----------|
| <b>Temperature:</b>       | 25 °C     |
| <b>Relative Humidity:</b> | 56 %      |
| <b>ATM Pressure:</b>      | 101.0 kPa |

*The testing was performed by Dylan Li on 2017-12-30.*

*Test Mode: Transmitting*

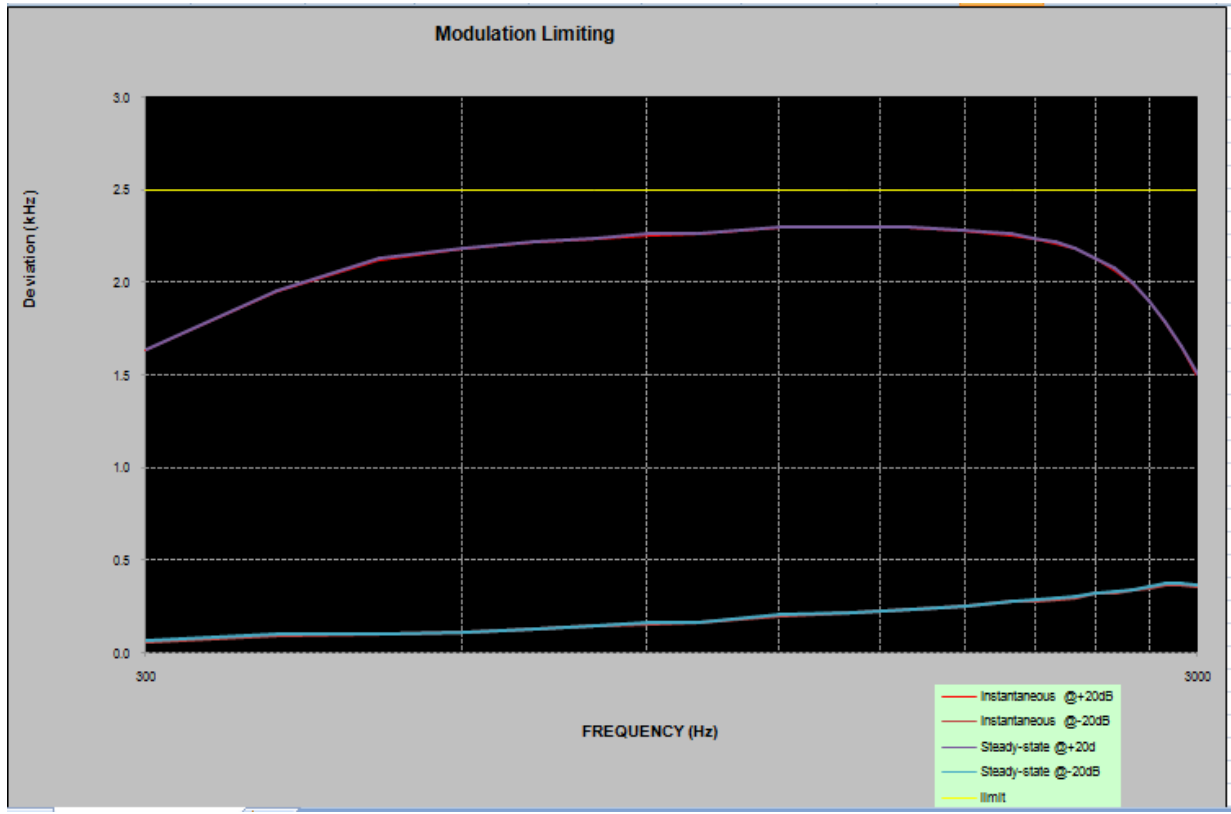
**Result:** Compliance.

**Analog Modulation:**

**MODULATION LIMITING**

Carrier Frequency: 453.2125 MHz, Channel Separation=12.5 kHz

| Audio Frequency<br>(Hz) | Instantaneous                  |                                | Steady-state                   |                                | FCC Limit<br>[kHz] |
|-------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------|
|                         | DEVIATION<br>(@+20dB)<br>[kHz] | DEVIATION<br>(@-20dB)<br>[kHz] | DEVIATION<br>(@+20dB)<br>[kHz] | DEVIATION<br>(@-20dB)<br>[kHz] |                    |
| 300                     | 1.633                          | 0.063                          | 1.638                          | 0.066                          | 2.5                |
| 400                     | 1.954                          | 0.098                          | 1.959                          | 0.101                          | 2.5                |
| 500                     | 2.122                          | 0.101                          | 2.130                          | 0.104                          | 2.5                |
| 600                     | 2.179                          | 0.112                          | 2.187                          | 0.115                          | 2.5                |
| 700                     | 2.216                          | 0.130                          | 2.223                          | 0.133                          | 2.5                |
| 800                     | 2.233                          | 0.144                          | 2.239                          | 0.148                          | 2.5                |
| 900                     | 2.256                          | 0.159                          | 2.262                          | 0.162                          | 2.5                |
| 1000                    | 2.261                          | 0.165                          | 2.268                          | 0.169                          | 2.5                |
| 1200                    | 2.298                          | 0.203                          | 2.302                          | 0.206                          | 2.5                |
| 1400                    | 2.296                          | 0.219                          | 2.305                          | 0.221                          | 2.5                |
| 1600                    | 2.293                          | 0.236                          | 2.301                          | 0.239                          | 2.5                |
| 1800                    | 2.278                          | 0.252                          | 2.287                          | 0.257                          | 2.5                |
| 2000                    | 2.256                          | 0.276                          | 2.263                          | 0.281                          | 2.5                |
| 2100                    | 2.236                          | 0.282                          | 2.241                          | 0.286                          | 2.5                |
| 2200                    | 2.210                          | 0.291                          | 2.219                          | 0.297                          | 2.5                |
| 2300                    | 2.178                          | 0.301                          | 2.189                          | 0.304                          | 2.5                |
| 2400                    | 2.126                          | 0.321                          | 2.134                          | 0.326                          | 2.5                |
| 2500                    | 2.068                          | 0.328                          | 2.077                          | 0.335                          | 2.5                |
| 2600                    | 1.997                          | 0.341                          | 2.005                          | 0.346                          | 2.5                |
| 2700                    | 1.898                          | 0.353                          | 1.907                          | 0.357                          | 2.5                |
| 2800                    | 1.777                          | 0.370                          | 1.786                          | 0.375                          | 2.5                |
| 2900                    | 1.646                          | 0.369                          | 1.654                          | 0.378                          | 2.5                |
| 3000                    | 1.494                          | 0.359                          | 1.503                          | 0.366                          | 2.5                |

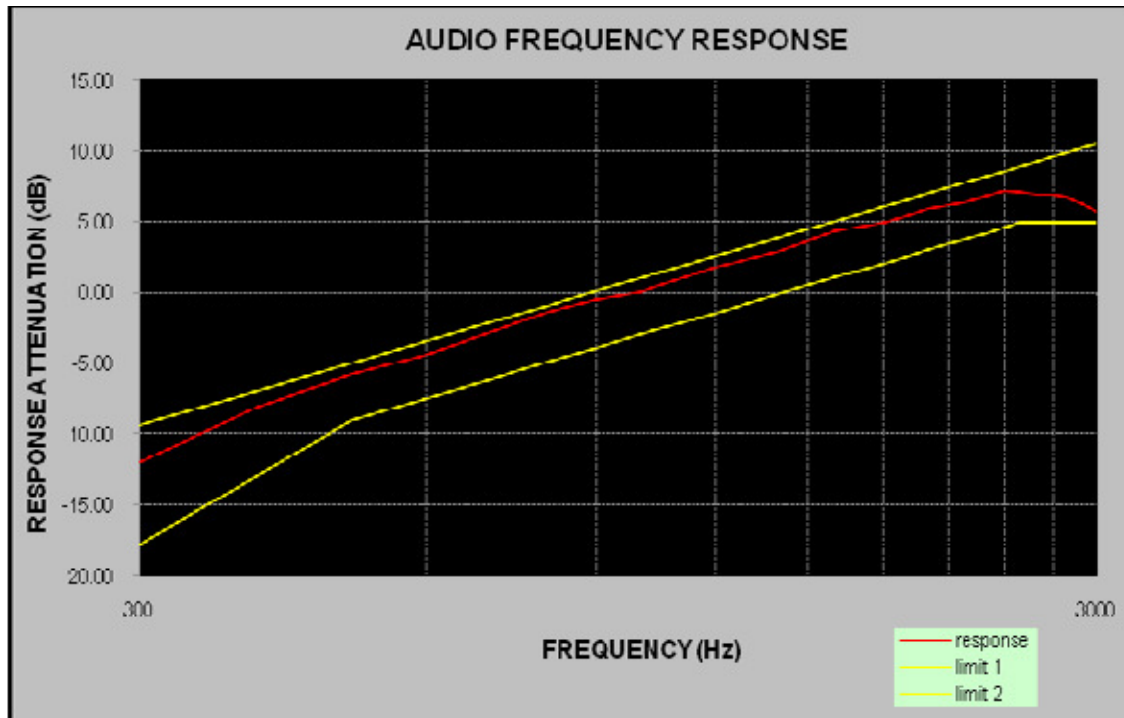


**Audio Frequency Response**

Carrier Frequency: 453.2125 MHz, Channel Separation=12.5 kHz

| <b>Audio Frequency (Hz)</b> | <b>Response Attenuation (dB)</b> |
|-----------------------------|----------------------------------|
| 300                         | -12.04                           |
| 400                         | -8.05                            |
| 500                         | -5.81                            |
| 600                         | -4.35                            |
| 700                         | -2.81                            |
| 800                         | -1.41                            |
| 900                         | -0.54                            |
| 1000                        | 0.00                             |
| 1200                        | 1.80                             |
| 1400                        | 2.93                             |
| 1600                        | 4.35                             |
| 1800                        | 4.95                             |
| 2000                        | 5.94                             |
| 2100                        | 6.23                             |
| 2200                        | 6.48                             |
| 2300                        | 6.85                             |
| 2400                        | 7.14                             |
| 2500                        | 7.11                             |
| 2600                        | 6.88                             |
| 2700                        | 6.86                             |
| 2800                        | 6.72                             |
| 2900                        | 6.26                             |
| 3000                        | 5.78                             |

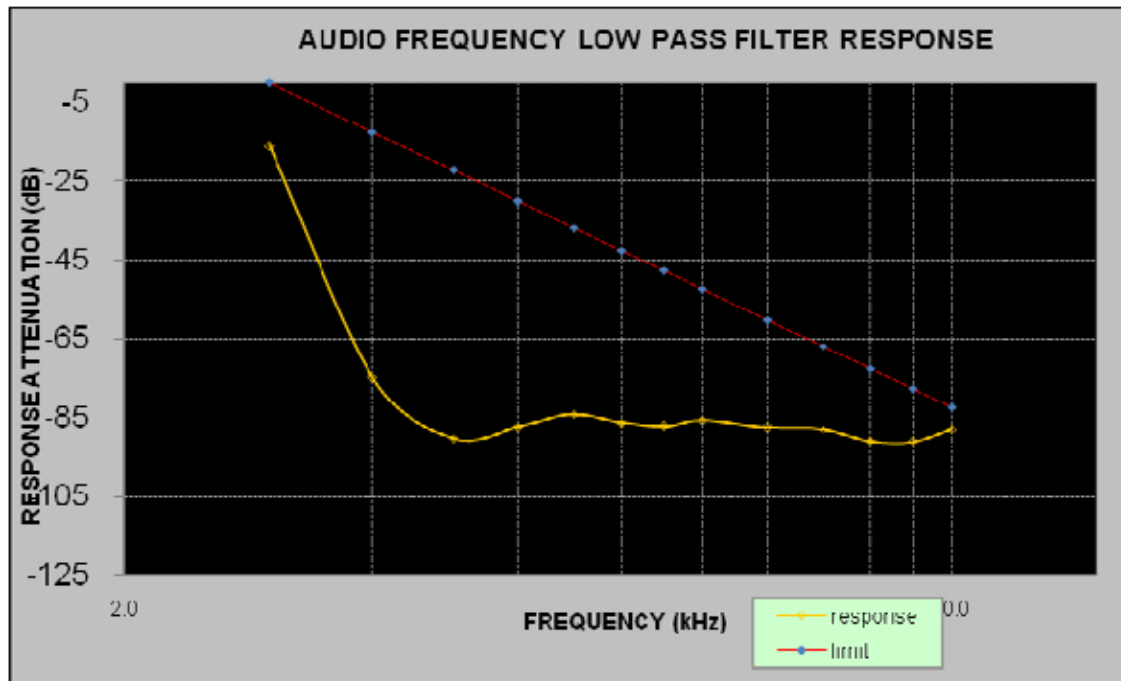




**Audio frequency lows pass filter response**

Carrier Frequency: 453.2125 MHz, Channel Separation=12.5 kHz

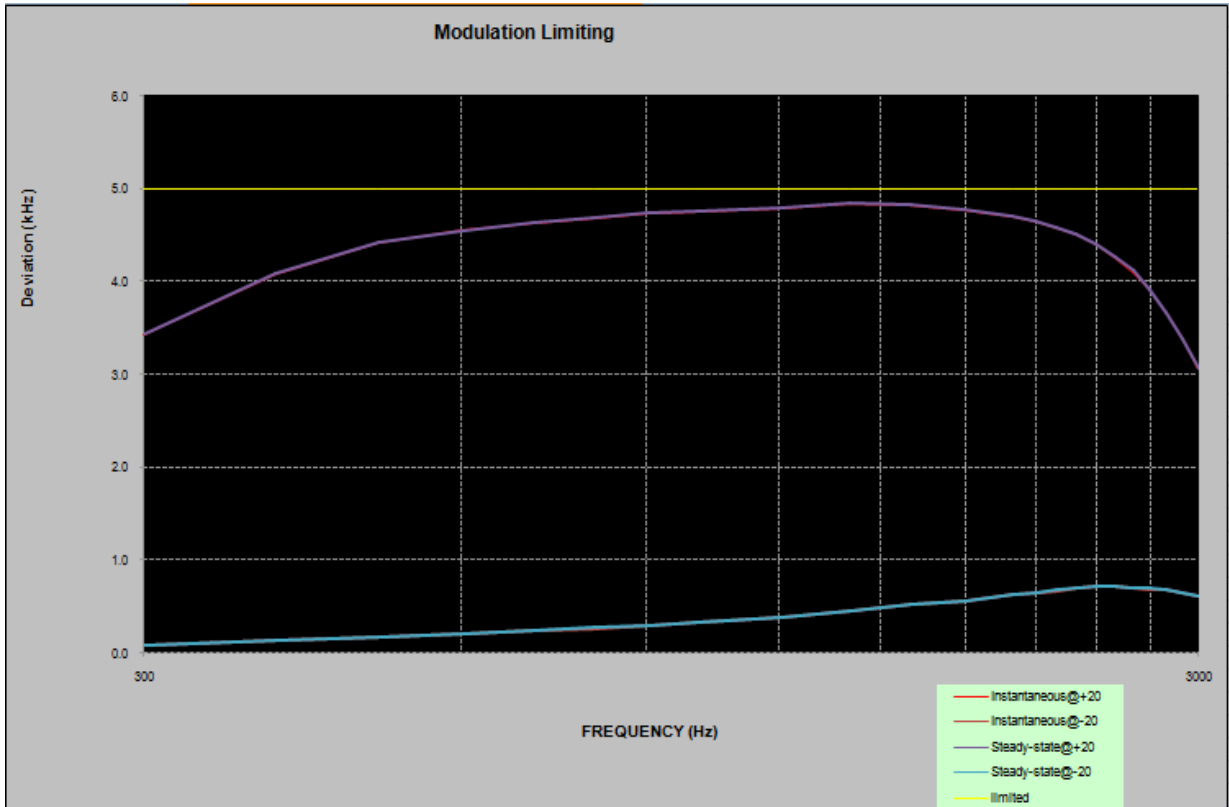
| Audio Frequency (kHz) | Response Attenuation (dB) | Limit (dB) |
|-----------------------|---------------------------|------------|
| 1.0                   | 0.0                       | /          |
| 3.0                   | -16.00                    | 0.0        |
| 4.0                   | -74.90                    | -12.5      |
| 5.0                   | -90.20                    | -22.2      |
| 6.0                   | -87.40                    | -30.1      |
| 7.0                   | -84.20                    | -36.8      |
| 8.0                   | -86.40                    | -42.6      |
| 9.0                   | -87.30                    | -47.7      |
| 10.0                  | -85.80                    | -52.3      |
| 12.0                  | -87.60                    | -60.2      |
| 14.0                  | -88.00                    | -66.9      |
| 16.0                  | -91.00                    | -72.7      |
| 18.0                  | -91.10                    | -77.8      |
| 20.0                  | -88.00                    | -82.5      |



**MODULATION LIMITING**

Carrier Frequency: 465.0125 MHz, Channel Separation=25 kHz

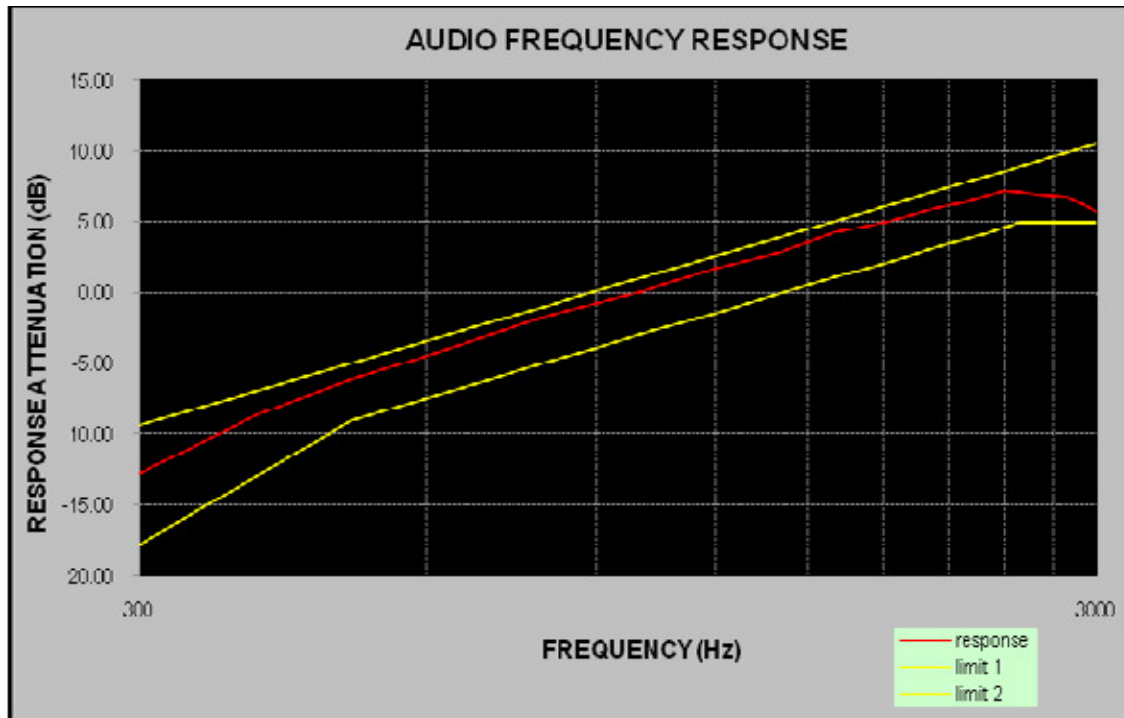
| Audio Frequency<br>(Hz) | Instantaneous                  |                                | Steady-state                   |                                | FCC Limit<br>[kHz] |
|-------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------|
|                         | DEVIATION<br>(@+20dB)<br>[kHz] | DEVIATION<br>(@-20dB)<br>[kHz] | DEVIATION<br>(@+20dB)<br>[kHz] | DEVIATION<br>(@-20dB)<br>[kHz] |                    |
| 300                     | 3.431                          | 0.086                          | 3.435                          | 0.089                          | 5                  |
| 400                     | 4.084                          | 0.131                          | 4.089                          | 0.134                          | 5                  |
| 500                     | 4.416                          | 0.166                          | 4.425                          | 0.169                          | 5                  |
| 600                     | 4.549                          | 0.205                          | 4.556                          | 0.207                          | 5                  |
| 700                     | 4.623                          | 0.238                          | 4.631                          | 0.243                          | 5                  |
| 800                     | 4.683                          | 0.269                          | 4.695                          | 0.274                          | 5                  |
| 900                     | 4.729                          | 0.297                          | 4.738                          | 0.303                          | 5                  |
| 1000                    | 4.750                          | 0.325                          | 4.763                          | 0.331                          | 5                  |
| 1200                    | 4.783                          | 0.388                          | 4.795                          | 0.391                          | 5                  |
| 1400                    | 4.833                          | 0.447                          | 4.841                          | 0.452                          | 5                  |
| 1600                    | 4.815                          | 0.528                          | 4.826                          | 0.532                          | 5                  |
| 1800                    | 4.765                          | 0.561                          | 4.774                          | 0.565                          | 5                  |
| 2000                    | 4.696                          | 0.623                          | 4.708                          | 0.627                          | 5                  |
| 2100                    | 4.646                          | 0.646                          | 4.653                          | 0.651                          | 5                  |
| 2200                    | 4.577                          | 0.673                          | 4.585                          | 0.679                          | 5                  |
| 2300                    | 4.502                          | 0.697                          | 4.513                          | 0.705                          | 5                  |
| 2400                    | 4.397                          | 0.714                          | 4.411                          | 0.721                          | 5                  |
| 2500                    | 4.263                          | 0.715                          | 4.275                          | 0.725                          | 5                  |
| 2600                    | 4.098                          | 0.696                          | 4.121                          | 0.704                          | 5                  |
| 2700                    | 3.903                          | 0.691                          | 3.915                          | 0.698                          | 5                  |
| 2800                    | 3.653                          | 0.683                          | 3.661                          | 0.687                          | 5                  |
| 2900                    | 3.368                          | 0.648                          | 3.377                          | 0.654                          | 5                  |
| 3000                    | 3.052                          | 0.609                          | 3.059                          | 0.622                          | 5                  |



**Audio Frequency Response**

Carrier Frequency: 465.0125 MHz, Channel Separation=25 kHz

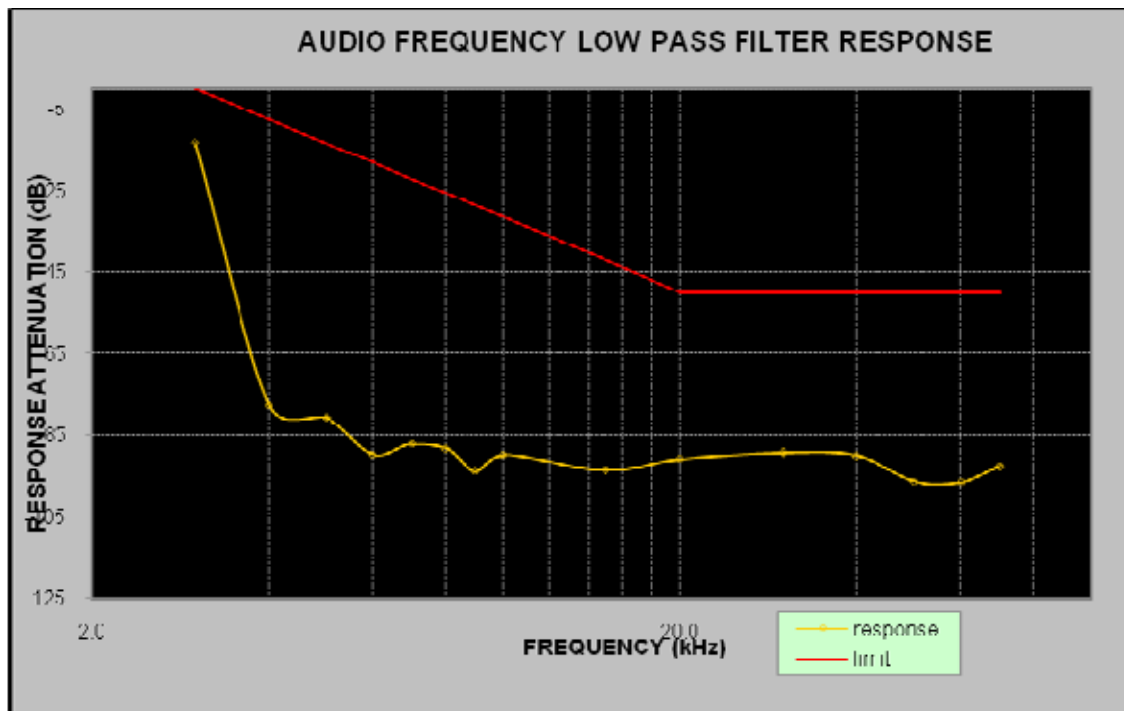
| <b>Audio Frequency (Hz)</b> | <b>Response Attenuation (dB)</b> |
|-----------------------------|----------------------------------|
| 300                         | -12.80                           |
| 400                         | -8.61                            |
| 500                         | -6.14                            |
| 600                         | -4.48                            |
| 700                         | -2.95                            |
| 800                         | -1.68                            |
| 900                         | -0.80                            |
| 1000                        | 0.00                             |
| 1200                        | 1.68                             |
| 1400                        | 2.89                             |
| 1600                        | 4.29                             |
| 1800                        | 4.93                             |
| 2000                        | 5.88                             |
| 2100                        | 6.21                             |
| 2200                        | 6.42                             |
| 2300                        | 6.82                             |
| 2400                        | 7.15                             |
| 2500                        | 7.08                             |
| 2600                        | 6.86                             |
| 2700                        | 6.82                             |
| 2800                        | 6.72                             |
| 2900                        | 6.29                             |
| 3000                        | 5.79                             |



**Audio frequency lows pass filter response**

Carrier Frequency: 465.0125 MHz, Channel Separation=25 kHz

| Audio Frequency (kHz) | Response Attenuation (dB) | Limit (dB) |
|-----------------------|---------------------------|------------|
| 1.0                   | 0.0                       | /          |
| 3.0                   | -13.20                    | 0.0        |
| 4.0                   | -77.70                    | -7.5       |
| 5.0                   | -80.60                    | -13.3      |
| 6.0                   | -89.80                    | -18.1      |
| 7.0                   | -87.10                    | -22.1      |
| 8.0                   | -88.20                    | -25.6      |
| 9.0                   | -93.90                    | -28.6      |
| 10.0                  | -89.90                    | -31.4      |
| 15.0                  | -93.60                    | -41.9      |
| 20.0                  | -90.80                    | -50.0      |
| 30.0                  | -89.40                    | -50.0      |
| 40.0                  | -90.10                    | -50.0      |
| 50.0                  | -96.50                    | -50.0      |
| 60.0                  | -96.70                    | -50.0      |
| 70.0                  | -92.60                    | -50.0      |



**FCC §2.1049 & §22.357 & § 22.731 & §74.462 & § 80.205 & § 80.207 & §90.209 & §90.210 – OCCUPIED BANDWIDTH & EMISSION MASK****Applicable Standard**

FCC §2.1049, §22.357, § 22.731, §74.462, § 80.205, § 80.207, §90.209 and §90.210

**Test Procedure**

The test was performed in according to ANSI/TIA-603-D Section 2.2.11.2.

**Test Data****Environmental Conditions**

|                           |                 |
|---------------------------|-----------------|
| <b>Temperature:</b>       | 24~25 °C        |
| <b>Relative Humidity:</b> | 50~56 %         |
| <b>ATM Pressure:</b>      | 100.9~101.0 kPa |

*The testing was performed by Dylan Li from 2018-01-01 to 2018-03-10.*



| Modulation | Channel Separation (kHz) | Frequency (MHz) | Power Level | 99% Occupied Bandwidth (kHz) | 26 dB Emissions Bandwidth (kHz) | Note           |
|------------|--------------------------|-----------------|-------------|------------------------------|---------------------------------|----------------|
| Analog     | 12.5                     | 453.2125        | High        | 9.94                         | 10.34                           | For Part 74/90 |
|            | 12.5                     |                 | Low         | 9.94                         | 10.34                           |                |
|            | 12.5                     | 454.5           | High        | 9.94                         | 10.26                           | For Part 22    |
|            | 12.5                     |                 | Low         | 9.94                         | 10.26                           |                |
| Digital    | 12.5                     | 453.2125        | High        | 7.53                         | 9.29                            | For Part 74/90 |
|            | 12.5                     |                 | Low         | 7.53                         | 9.78                            |                |
|            | 12.5                     | 454.5           | High        | 7.61                         | 8.89                            | For Part 22    |
|            | 12.5                     |                 | Low         | 7.85                         | 9.78                            |                |

*Emission designator is base on calculation instead of measurement  
Emission Designator Per CFR 47 §2.201& §2.202&,  $B_n = 2M + 2D$*

**For FM Mode (Channel Spacing: 12.5 kHz)**

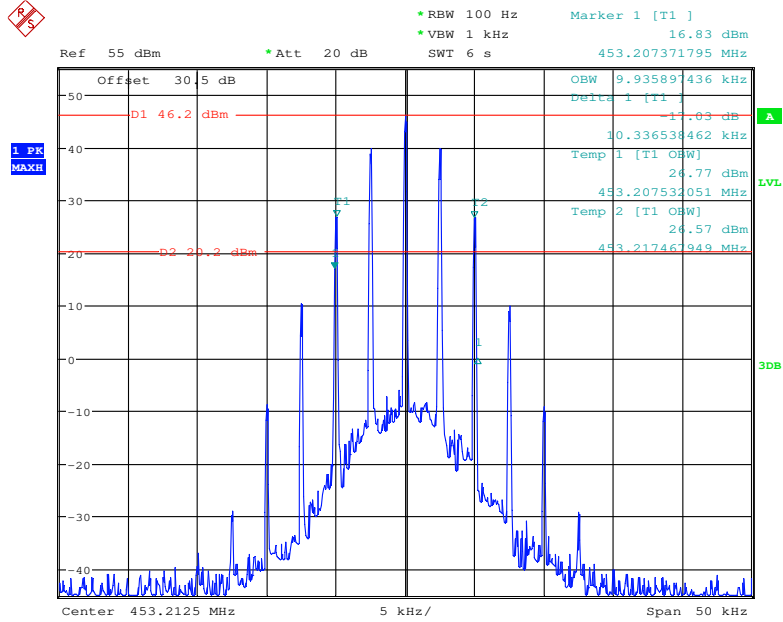
*Emission Designator 11K0F3E In this case, the maximum modulating frequency is 3.0 kHz with a 2.5 kHz deviation.  $BW = 2(M+D) = 2*(3.0 \text{ kHz} + 2.5 \text{ kHz}) = 11 \text{ kHz}$  □ 11K0  
F3E portion of the designator represents an FM voice transmission Therefore, the entire designator for 12.5 kHz channel spacing FM mode is 11K0F3E.*

**For Digital Mode (Channel Spacing: 12.5 kHz)**

*Emission Designator 7K60F1D and 7K60F1E  
The 99% energy rule (title 47CFR 2.1049) was used for digital mode. It basically states that 99% of the modulation energy falls within X kHz, in this case, 7.85 kHz. The emission mask was obtained from 47CFR 90.210(d).  
F1D and F1E portion of the designator indicates digital information.  
Therefore, the entire designator for 12.5 kHz channel spacing digital mode is 7K60F1D and 7K60F1E.*

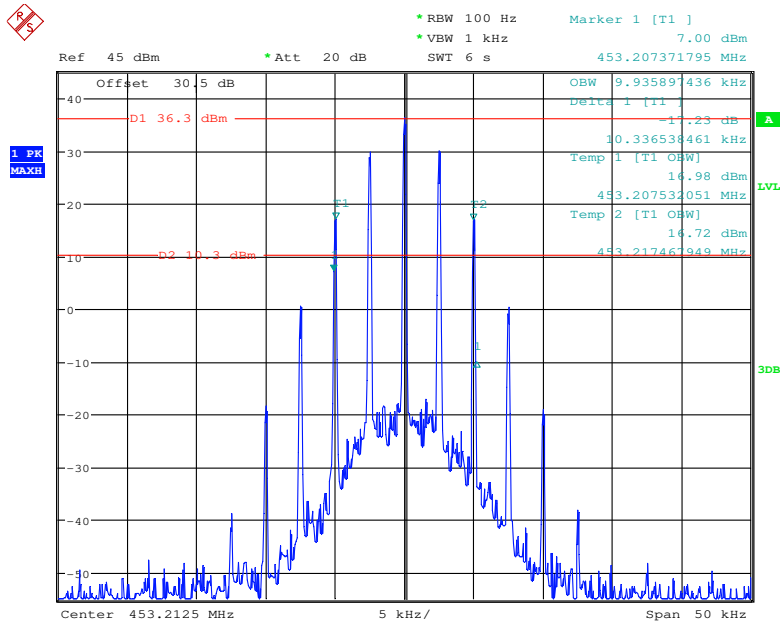
Analog Modulation:

Frequency 453.2125 MHz: 99% Occupied & 26 dB Bandwidth, High Power



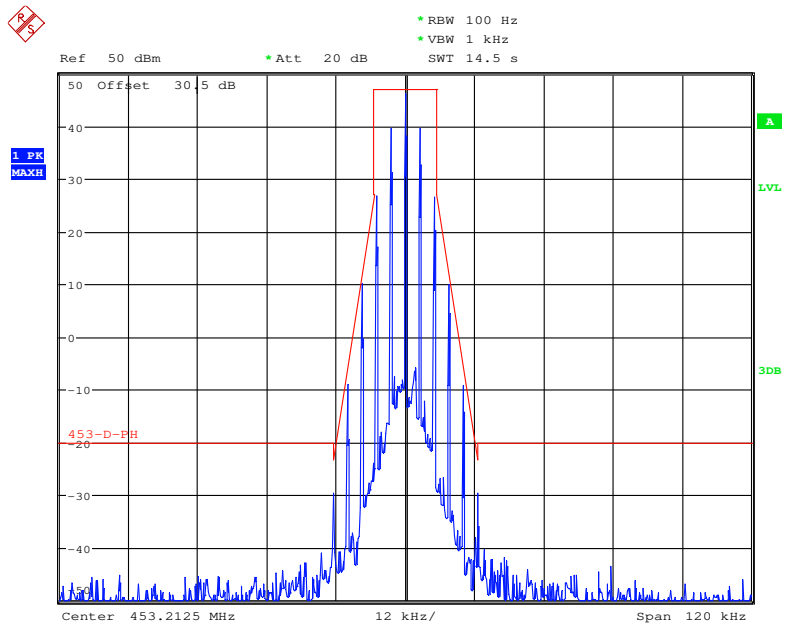
Date: 1.JAN.2018 19:21:35

Frequency 453.2125 MHz: 99% Occupied & 26 dB Bandwidth, Low Power



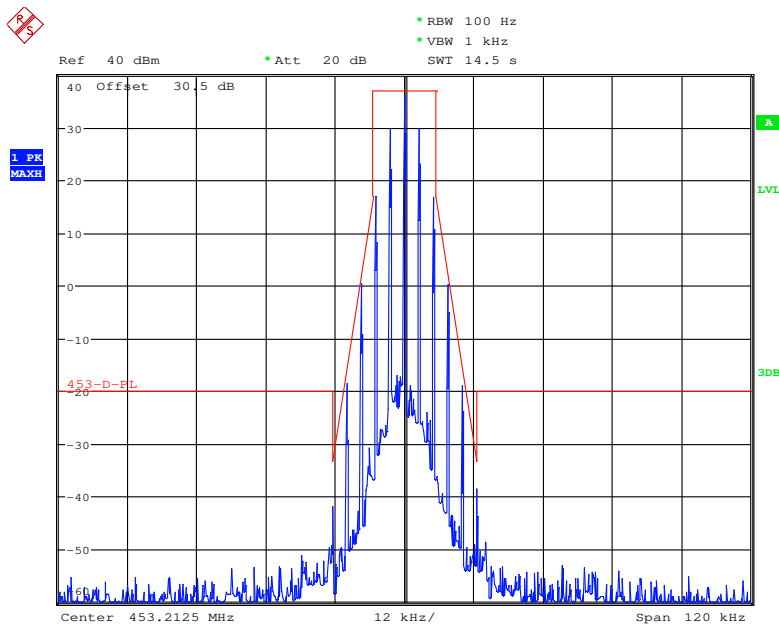
Date: 1.JAN.2018 19:20:38

### Frequency 453.2125 MHz: Emission Mask D, High Power



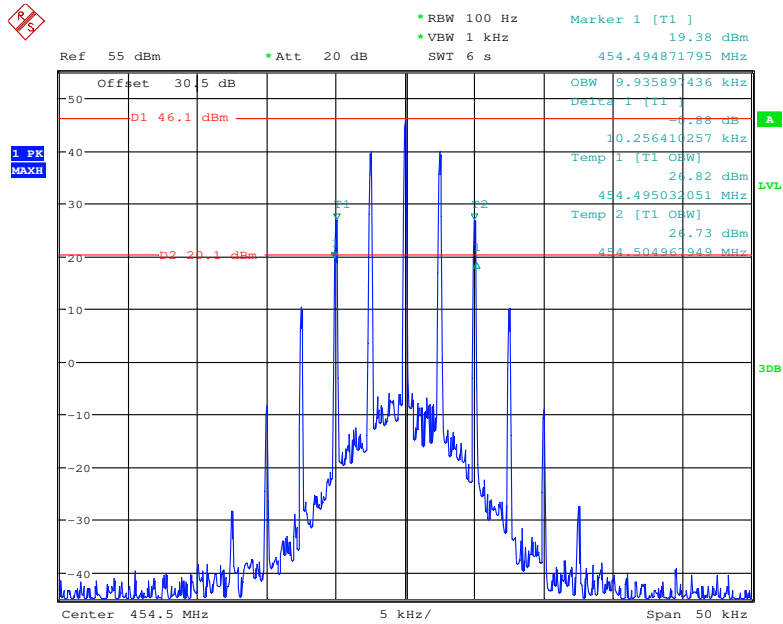
Date: 1.JAN.2018 18:52:06

### Frequency 453.2125 MHz: Emission Mask D, Low Power



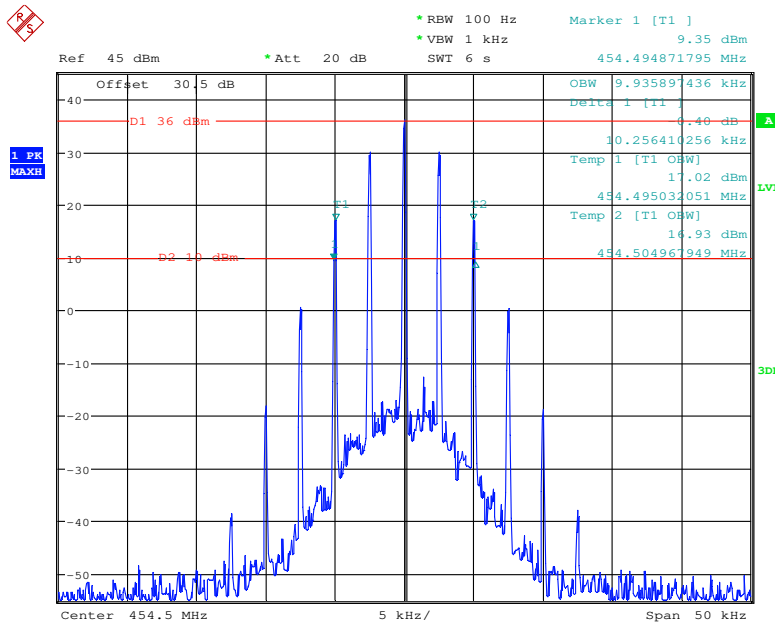
Date: 1.JAN.2018 18:49:43

**Frequency 454.5 MHz: 99% Occupied & 26 dB Bandwidth, High Power**



Date: 1.JAN.2018 19:18:30

**Frequency 454.5 MHz: 99% Occupied & 26 dB Bandwidth, Low Power**

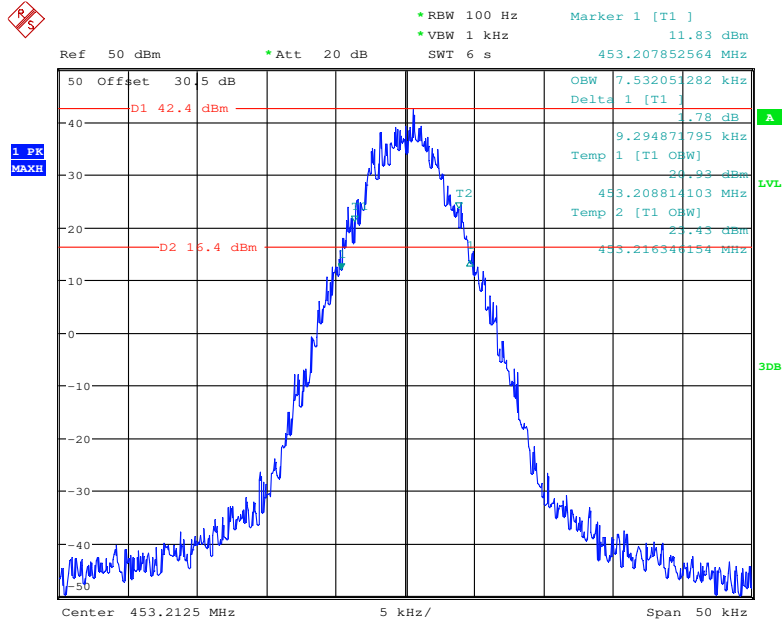


Date: 1.JAN.2018 19:19:18



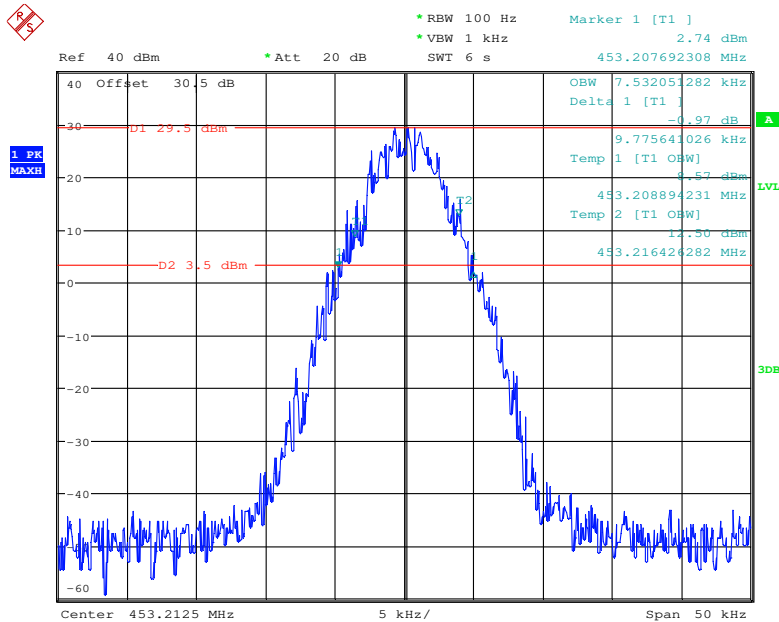
**Digital Modulation:**

**Frequency 453.2125 MHz: 99% Occupied & 26 dB Bandwidth, High Power**



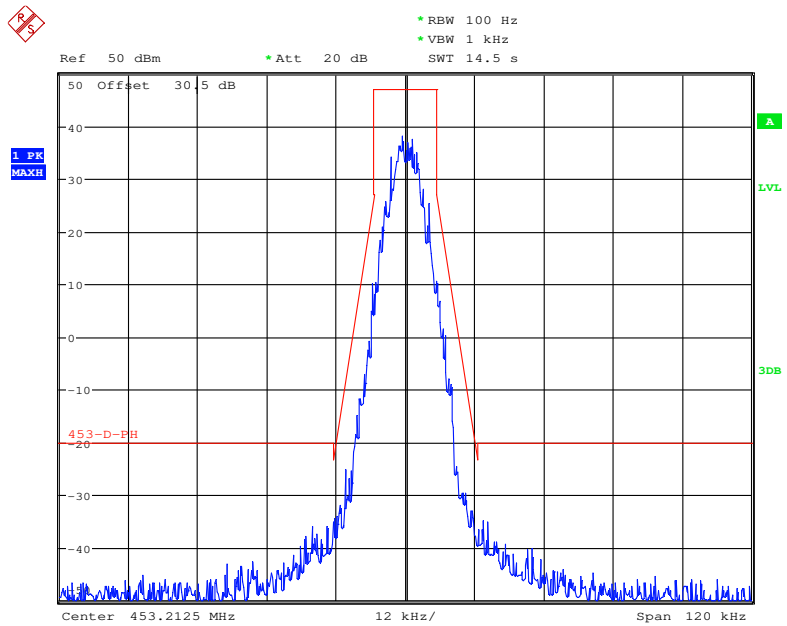
Date: 1.JAN.2018 20:47:33

**Frequency 453.2125 MHz: 99% Occupied & 26 dB Bandwidth, Low Power**



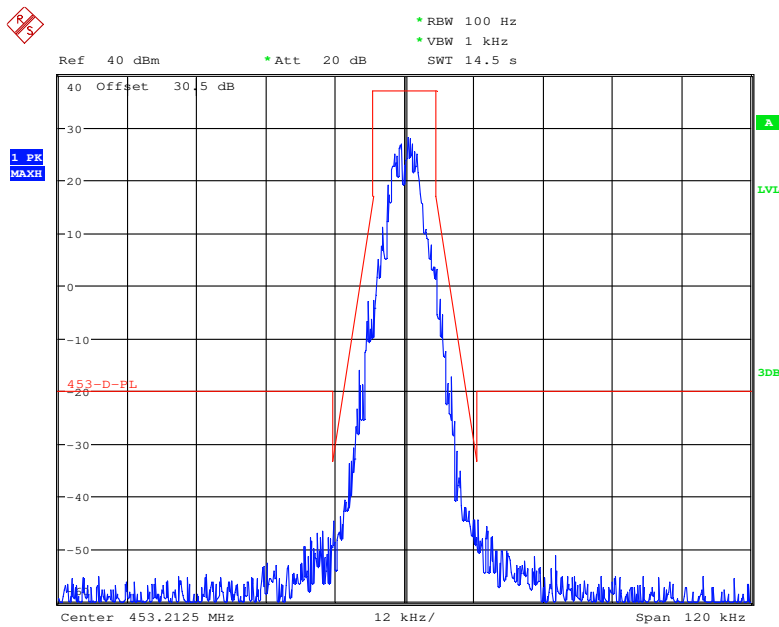
Date: 1.JAN.2018 20:46:29

### Frequency 453.2125 MHz: Emission Mask D, High Power



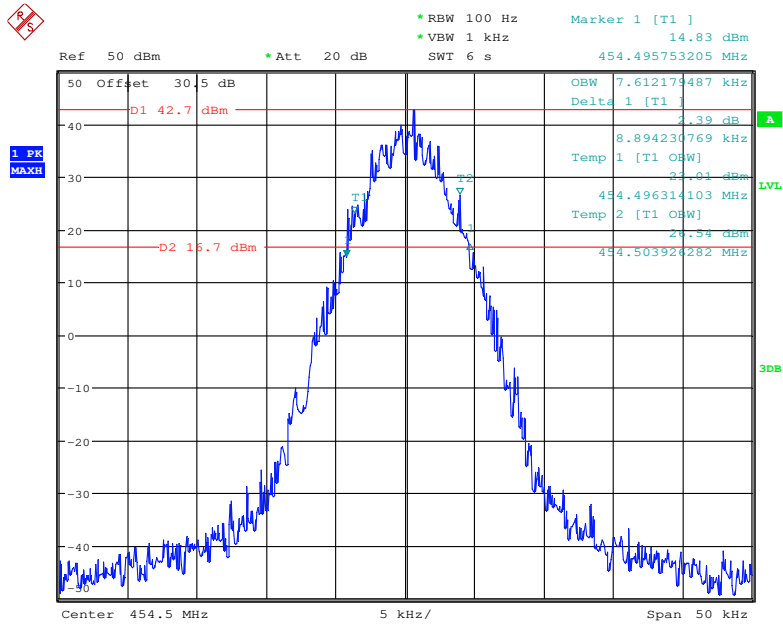
Date: 1.JAN.2018 21:02:00

### Frequency 453.2125 MHz: Emission Mask D, Low Power



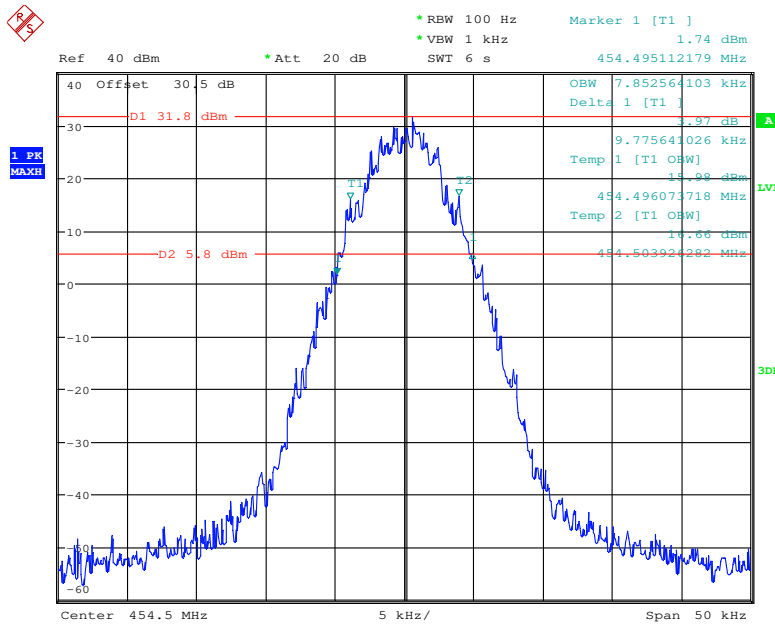
Date: 1.JAN.2018 21:00:57

**Frequency 454.5 MHz: 99% Occupied & 26 dB Bandwidth, High Power**



Date: 1.JAN.2018 20:48:27

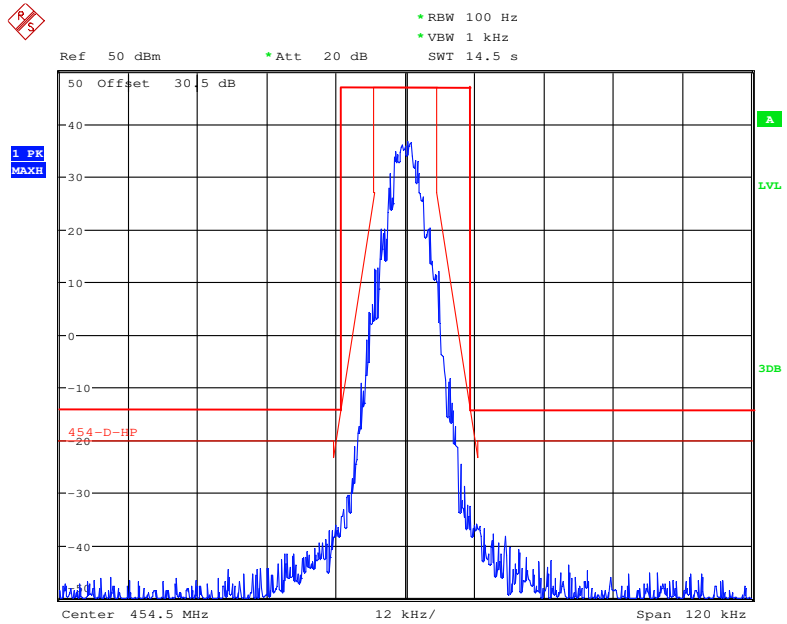
**Frequency 454.5 MHz: 99% Occupied & 26 dB Bandwidth, Low Power**



Date: 1.JAN.2018 20:50:04

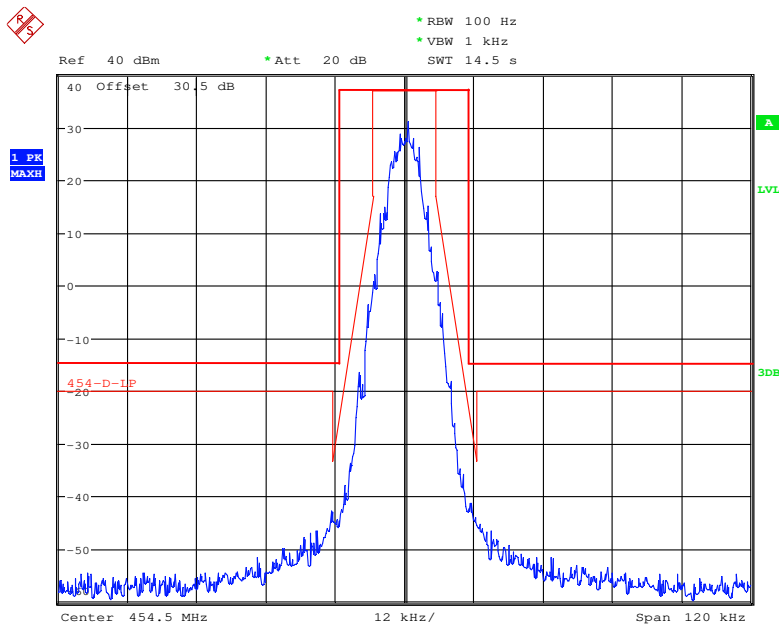


### Frequency 454.5 MHz: Emission Mask, High Power, FCC part 22.359



Date: 1.JAN.2018 20:59:11

### Frequency 454.5 MHz: Emission Mask, Low Power, FCC part 22.359



Date: 15.JAN.2018 22:30:33

| Modulation | Channel Separation (kHz) | Frequency (MHz) | Power Level | 99% Occupied Bandwidth (kHz) | 26 dB Emissions Bandwidth (kHz) | Note        |
|------------|--------------------------|-----------------|-------------|------------------------------|---------------------------------|-------------|
| Analog     | 25                       | 454.5           | High        | 15.06                        | 15.71                           | For Part 22 |
|            | 25                       |                 | Low         | 15.06                        | 15.71                           |             |
|            | 25                       | 465.0125        | High        | 15.06                        | 15.71                           | For Part 80 |
|            | 25                       |                 | Low         | 15.06                        | 15.71                           |             |
|            | 25                       | 450.0125        | High        | 15.06                        | 15.71                           | For Part 74 |
|            | 25                       |                 | Low         | 15.06                        | 15.71                           |             |

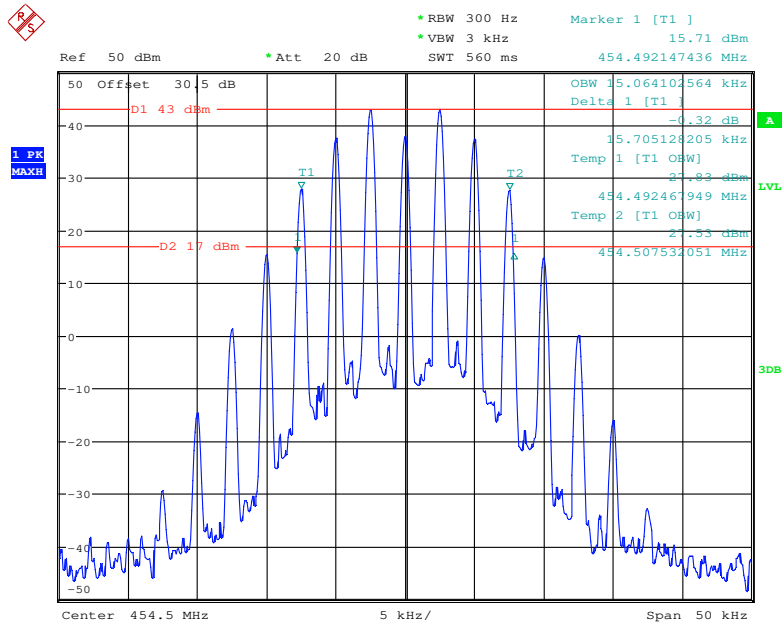
*Emission designator is base on calculation instead of measurement  
 Emission Designator Per CFR 47 §2.201 & §2.202,  $B_n = 2M + 2D$*

**For FM Mode (Channel Spacing: 25 kHz)**

*Emission Designator 16K0F3E In this case, the maximum modulating frequency is 5.0 kHz with a 3 kHz deviation.  $BW = 2(M+D) = 2*(5\text{ kHz} + 3\text{ kHz}) = 16\text{ kHz}$   $\square$  16K0  
 F3E portion of the designator represents an FM voice transmission Therefore, the entire designator for 25 kHz channel spacing FM mode is 16K0F3E.*

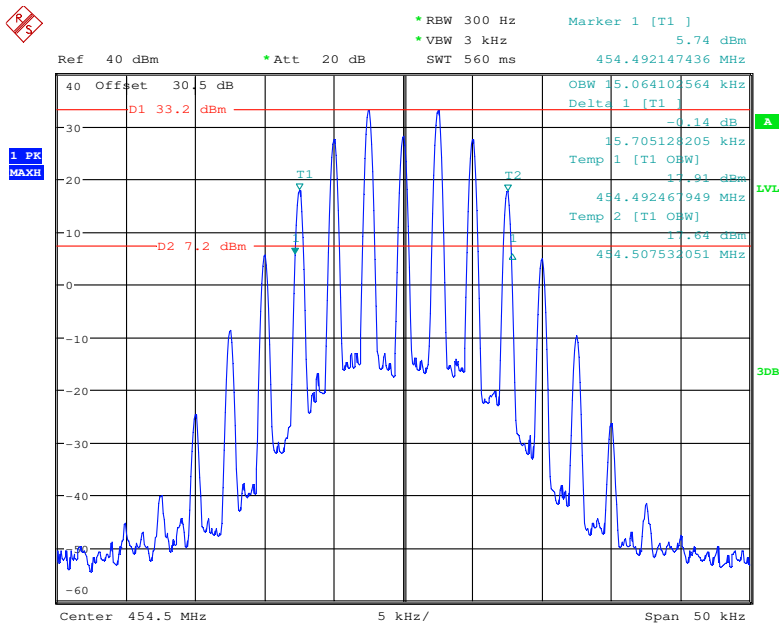
Analog Modulation

Frequency 454.5 MHz: 99% Occupied & 26 dB Bandwidth, High Power



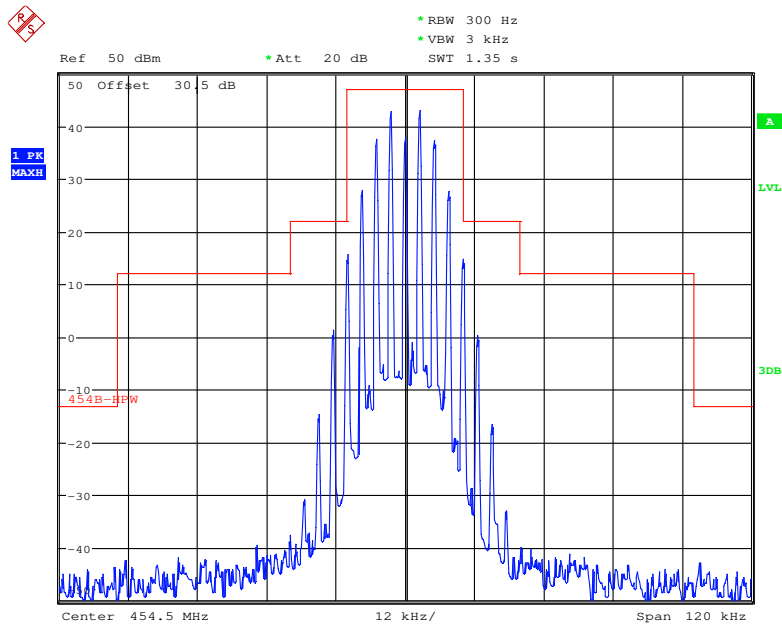
Date: 1.JAN.2018 19:12:38

Frequency 454.5 MHz: 99% Occupied & 26 dB Bandwidth, Low Power



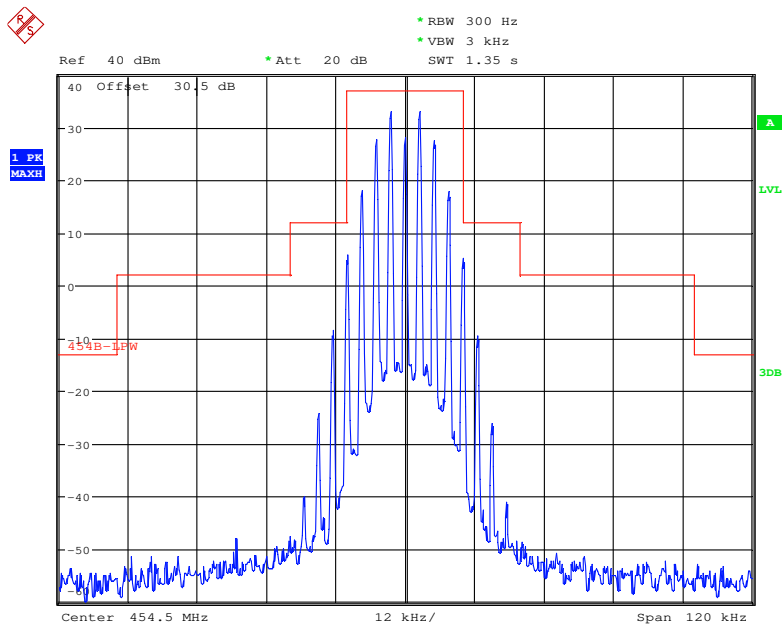
Date: 1.JAN.2018 19:11:36

### Frequency 454.5 MHz: Emission Mask B, High Power



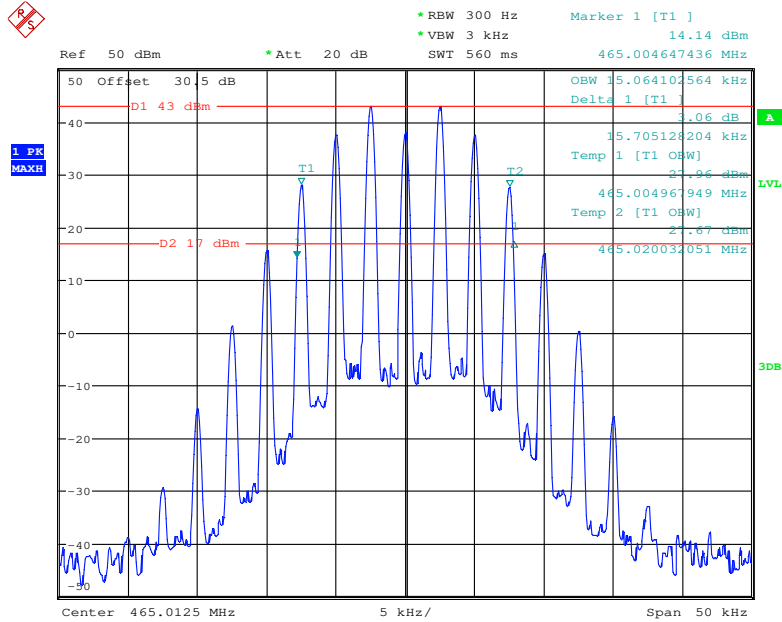
Date: 1.JAN.2018 19:02:30

### Frequency 454.5 MHz: Emission Mask B, Low Power



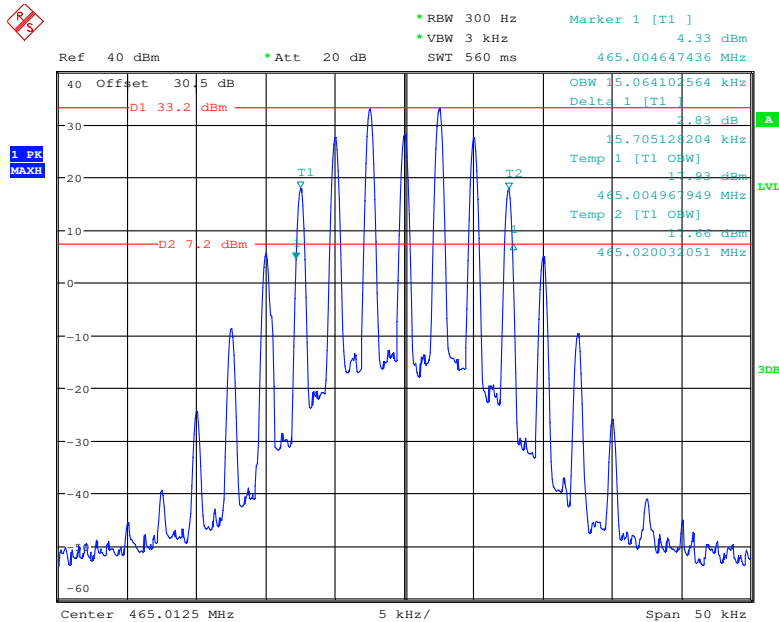
Date: 1.JAN.2018 19:03:03

**Frequency 465.0125 MHz: 99% Occupied & 26 dB Bandwidth, High Power**



Date: 1.JAN.2018 19:10:04

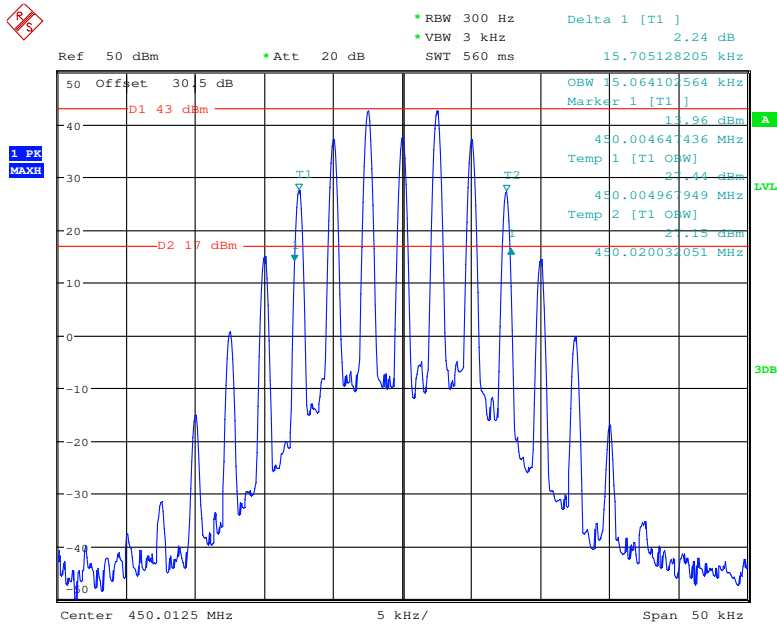
**Frequency 465.0125 MHz: 99% Occupied & 26 dB Bandwidth, Low Power**



Date: 1.JAN.2018 19:10:47

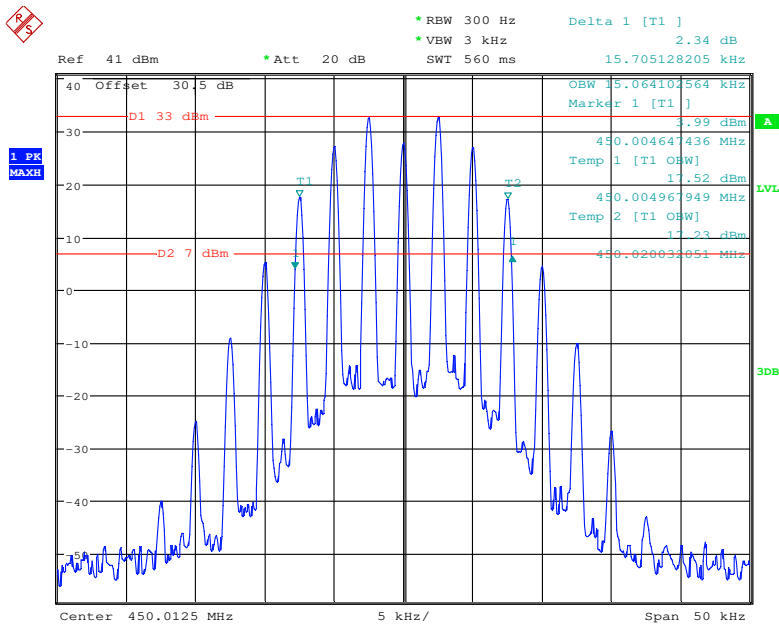


**Frequency 450.0125 MHz: 99% Occupied & 26 dB Bandwidth, High Power**



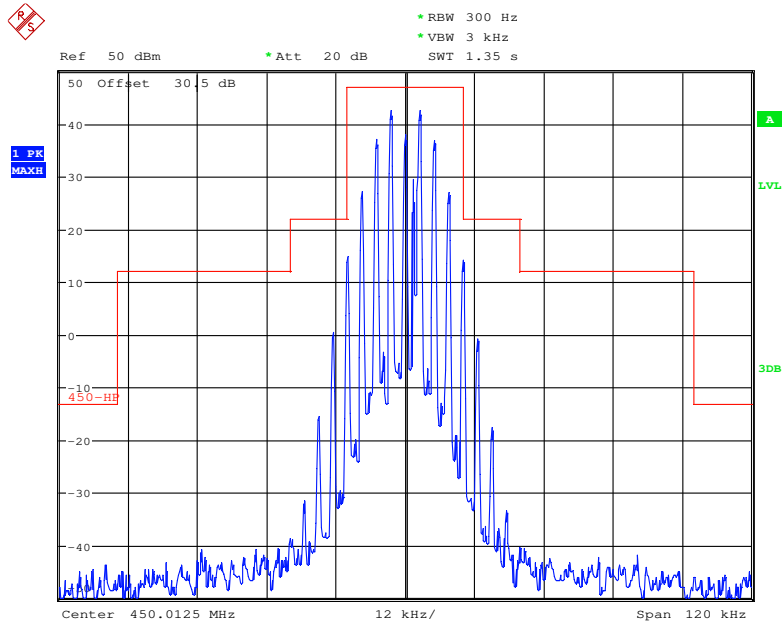
Date: 10.MAR.2018 17:27:33

**Frequency 450.0125MHz: 99% Occupied & 26 dB Bandwidth, Low Power**



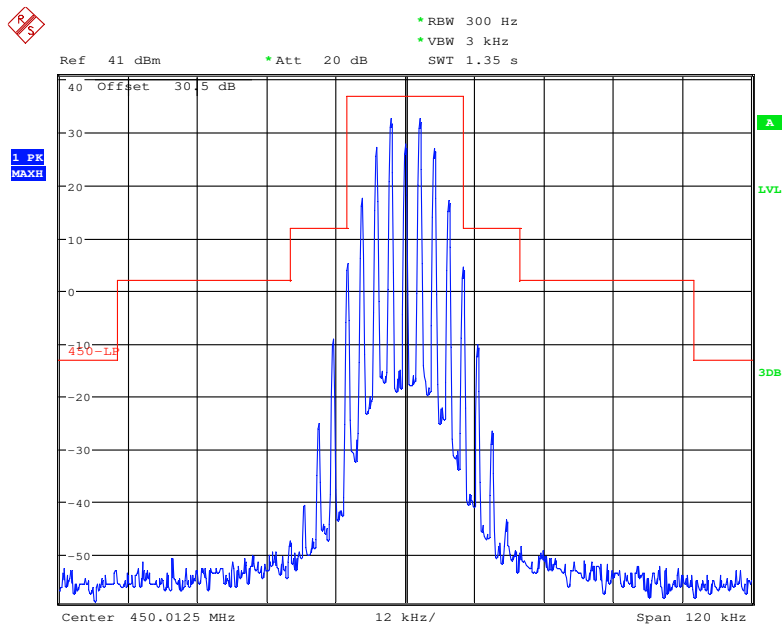
Date: 10.MAR.2018 17:30:08

### Frequency 450.0125 MHz: Emission Mask B, High Power



Date: 10.MAR.2018 17:43:04

### Frequency 450.0125 MHz: Emission Mask B, Low Power



Date: 10.MAR.2018 17:45:31



## FCC §2.1051 & §22.861 & §74.462 & § 80.211 & §90.210 - SPURIOUS EMISSIONS AT ANTENNA TERMINALS

### Applicable Standard

Emission Mask D—12.5 kHz channel bandwidth equipment. For transmitters designed to operate with a 12.5 kHz channel bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

- 1) For any frequency removed from the center of the authorized bandwidth  $f_0$  to 5.625 kHz removed from  $f_0$ , 0 dB.
- 2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency ( $f_d$  in kHz) of more than 5.626 kHz but no more than 12.5 kHz, at least  $7.27 (f_d - 2.88 \text{ kHz})$  dB.
- 3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency ( $f_d$  in kHz) of more than 12.5 kHz: At least  $50 + 10 \log (P)$  dB or 70 dB, whichever is the lesser attenuation.

Emission Mask B—25 kHz channel bandwidth equipment. For transmitters designed to operate with a 25 kHz channel bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

- 1) On any frequency removed from the assigned frequency by more than 50 percent, but not more than 100 percent of the authorized bandwidth: At least 25 dB.
- 2) On any frequency removed from the assigned frequency by more than 100 percent, but not more than 250 percent of the authorized bandwidth: At least 35 dB.
- 3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least  $43 + 10 \log (P)$  dB.

### Test Procedure

The RF output of the EUT was connected to a spectrum analyzer through appropriate attenuation. The resolution bandwidth of the spectrum analyzer was set at 100kHz for below 1GHz, and 1MHz for above 1GHz. Sufficient scans were taken to show any out of band emissions up to 10<sup>th</sup> harmonic.

### Test Data

#### Environmental Conditions

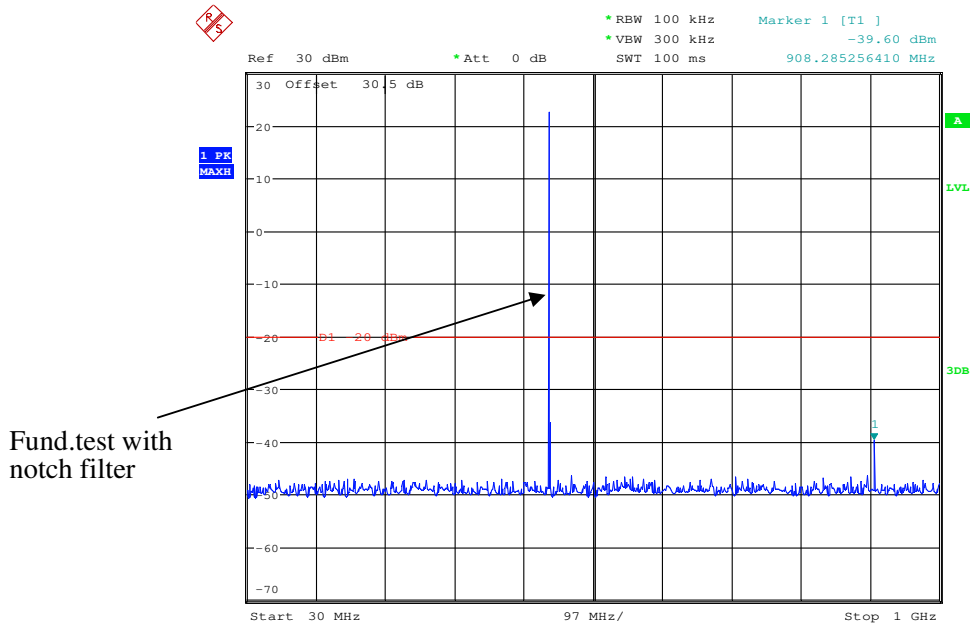
|                    |           |
|--------------------|-----------|
| Temperature:       | 24 °C     |
| Relative Humidity: | 50 %      |
| ATM Pressure:      | 101.0 kPa |

*The testing was performed by Dylan Li from 2017-12-19 to 2018-03-10.*

*Test Mode: Transmitting, please refer to the following plots.*

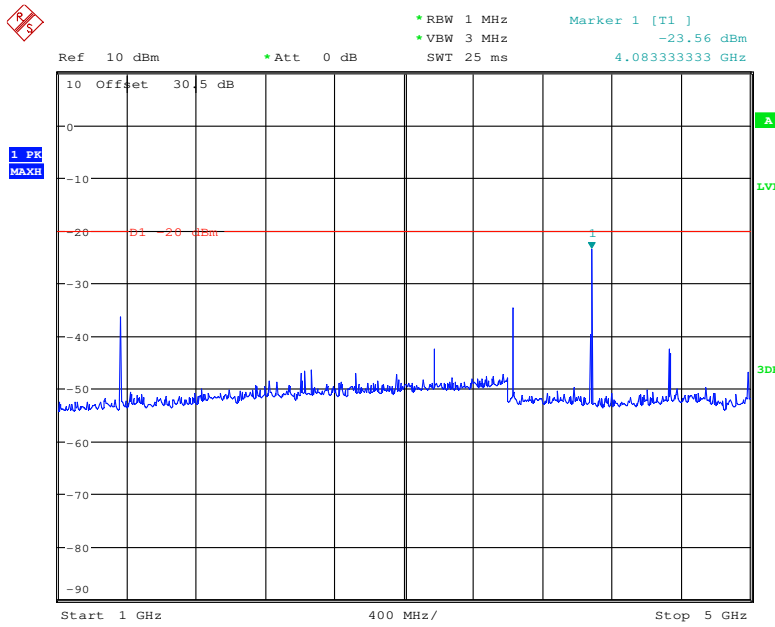
*Note: All test was performed under the high power.*

**Analog Modulation:  
30MHz – 1 GHz, Channel Spacing 12.5 kHz, 453.2125 MHz, For FCC part 74/90**



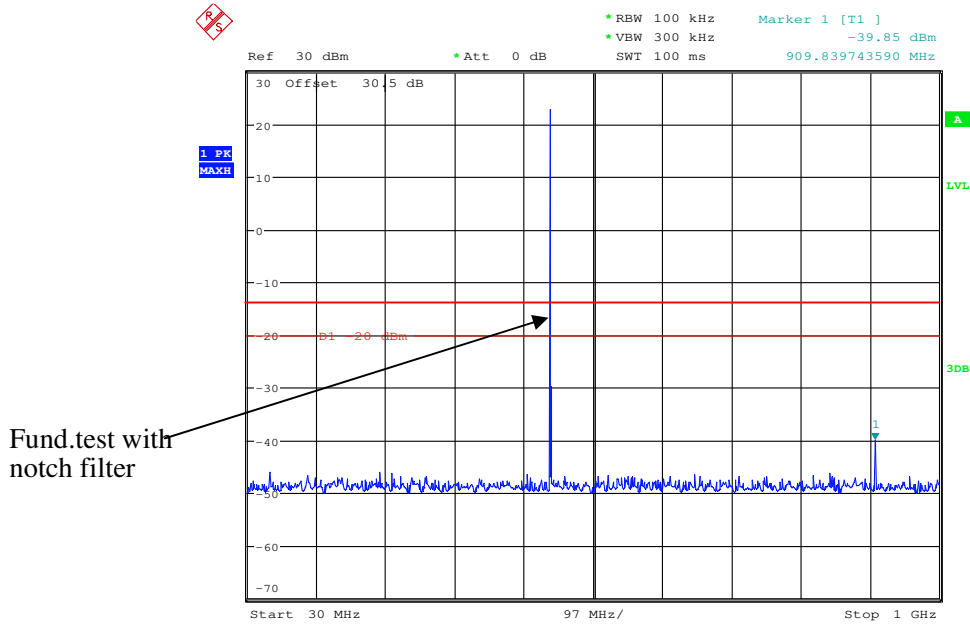
Date: 19.DEC.2017 22:20:29

**1 GHz – 5 GHz, Channel Spacing 12.5 kHz, 453.2125 MHz, For FCC part 74/90**



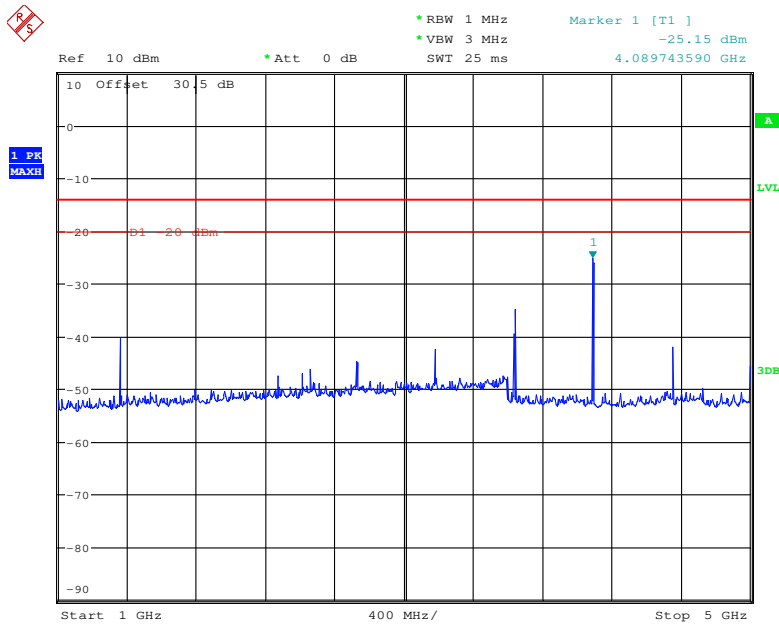
Date: 19.DEC.2017 22:25:33

### 30MHz – 1 GHz, Channel Spacing 12.5 kHz, 454.5 MHz, For FCC part 22



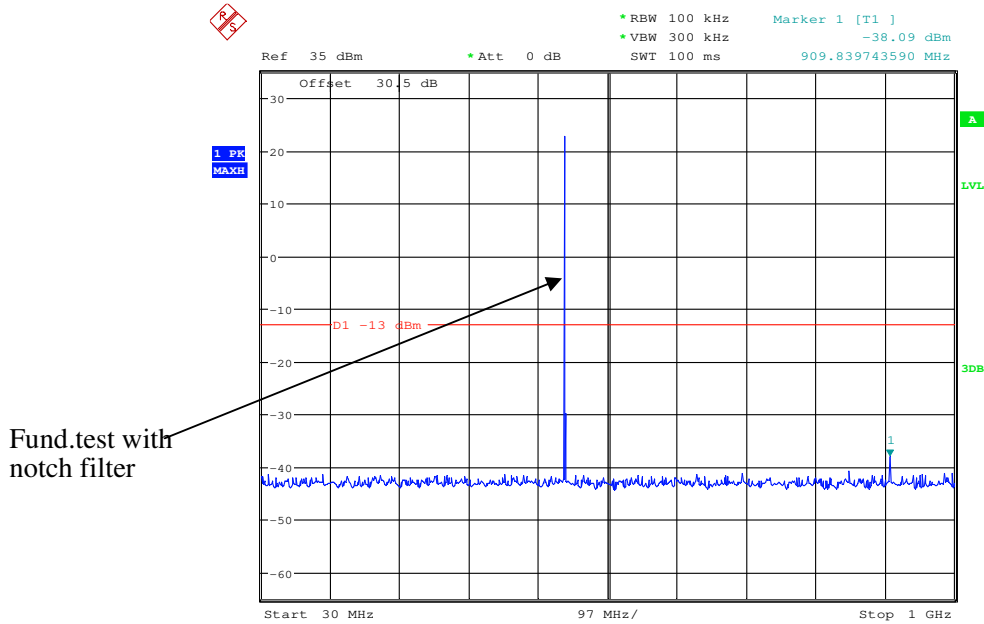
Date: 19.DEC.2017 22:20:44

### 1 GHz – 5 GHz, Channel Spacing 12.5 kHz, 454.5 MHz, For FCC part 22



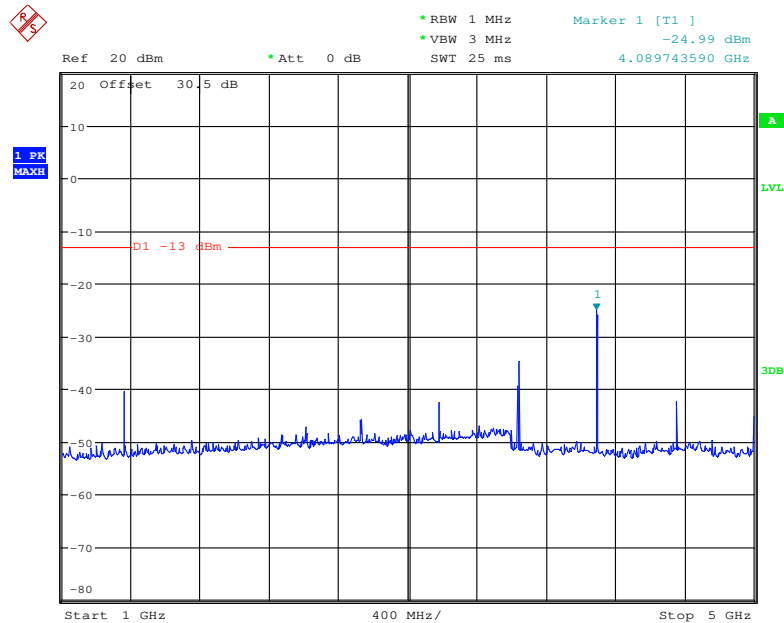
Date: 19.DEC.2017 22:25:10

30MHz – 1 GHz, Channel Spacing 25 kHz, 454.5 MHz, For FCC part 22



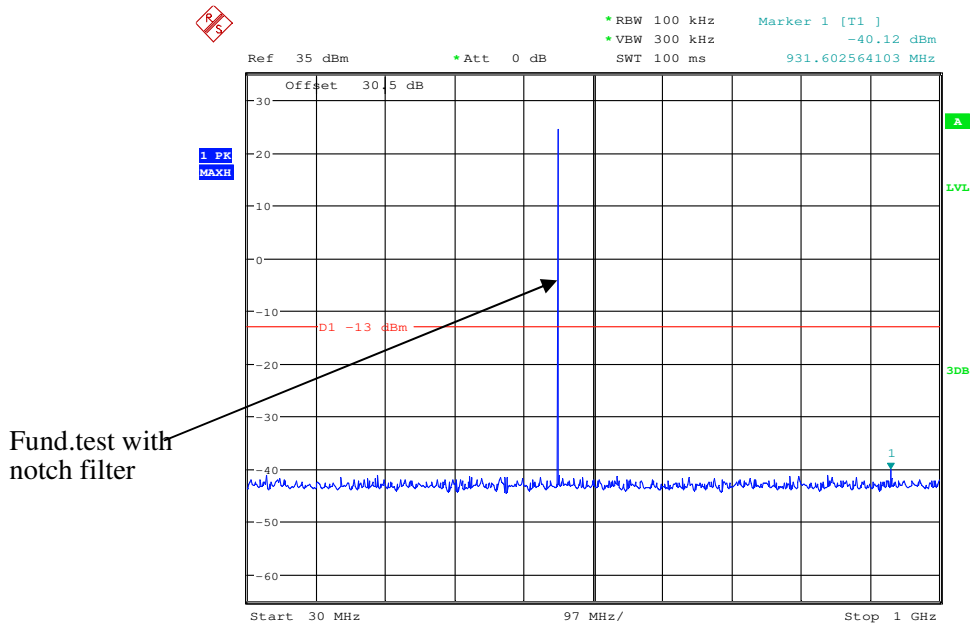
Date: 19.DEC.2017 22:22:10

1 GHz – 5 GHz, Channel Spacing 25 kHz, 454.5 MHz, For FCC part 22



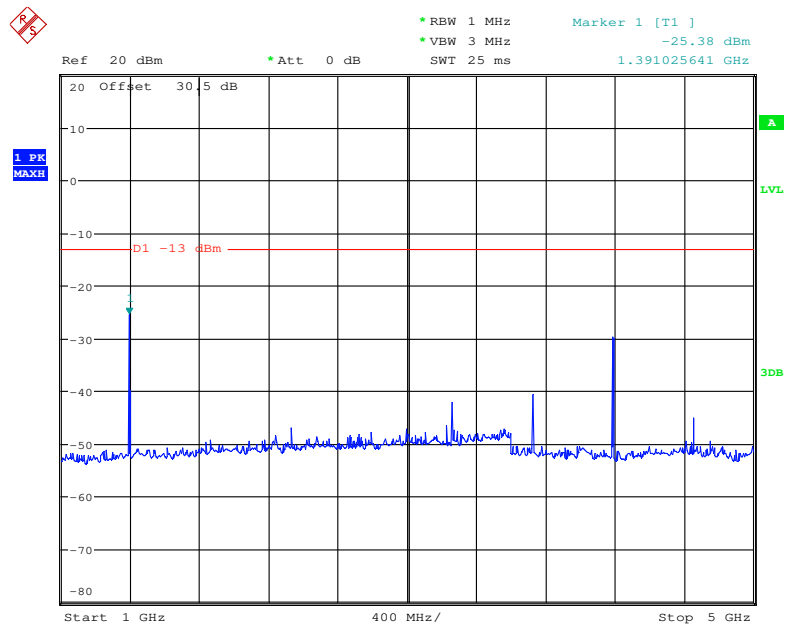
Date: 19.DEC.2017 22:23:48

30MHz – 1 GHz, Channel Spacing 25 kHz, 465.0125 MHz, For FCC part 80



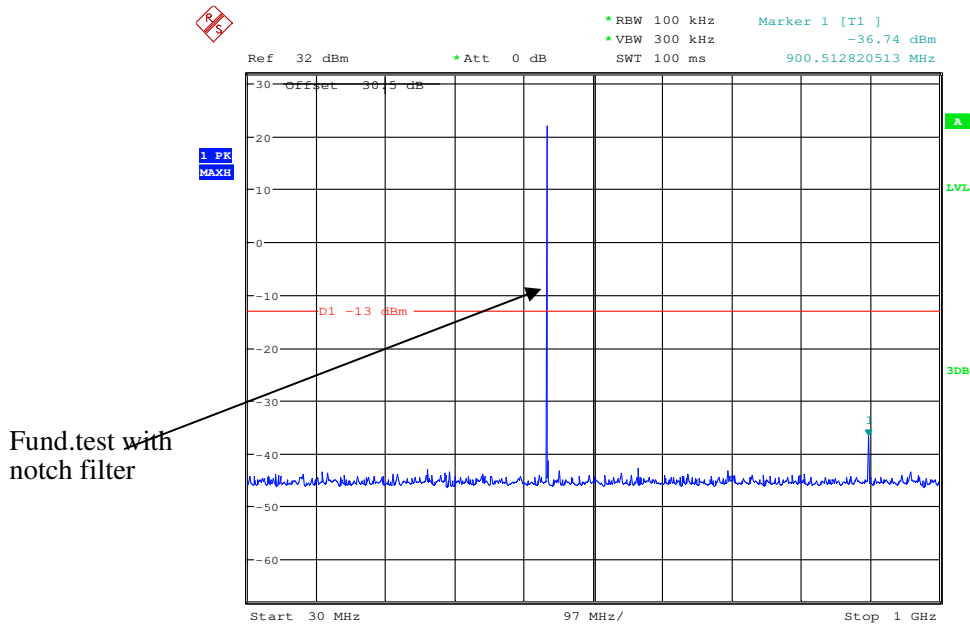
Date: 19.DEC.2017 22:22:44

1 GHz – 5 GHz, Channel Spacing 25 kHz, 465.0125 MHz, For FCC part 80



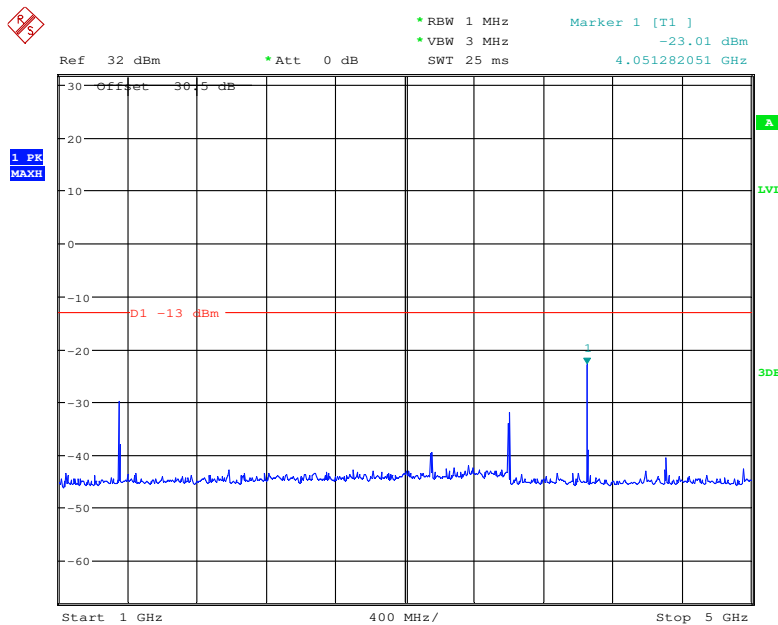
Date: 19.DEC.2017 22:23:25

### 30MHz – 1 GHz, Channel Spacing 25 kHz, 450.0125 MHz, For FCC part 74



Date: 10.MAR.2018 17:06:50

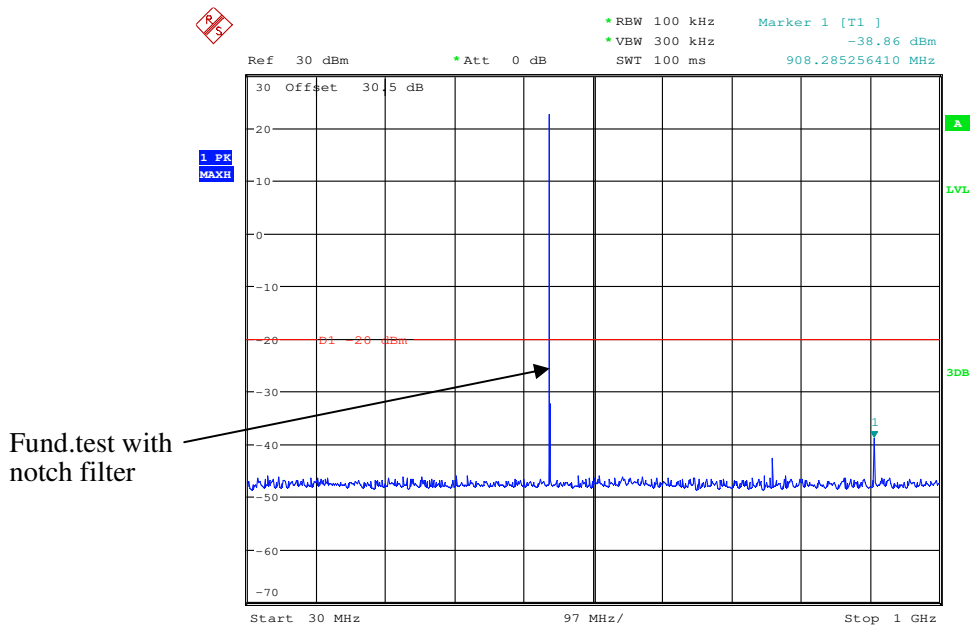
### 1 GHz – 5 GHz, Channel Spacing 25 kHz, 450.0125 MHz, For FCC part 74



Date: 10.MAR.2018 17:08:25

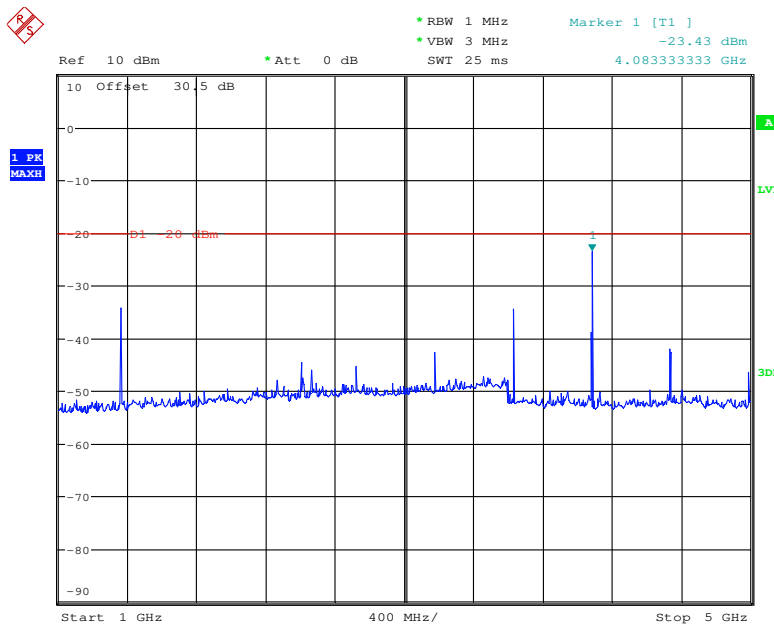
**Digital Modulation:**

**30MHz – 1 GHz, 453.2125 MHz, For FCC part 74/90**



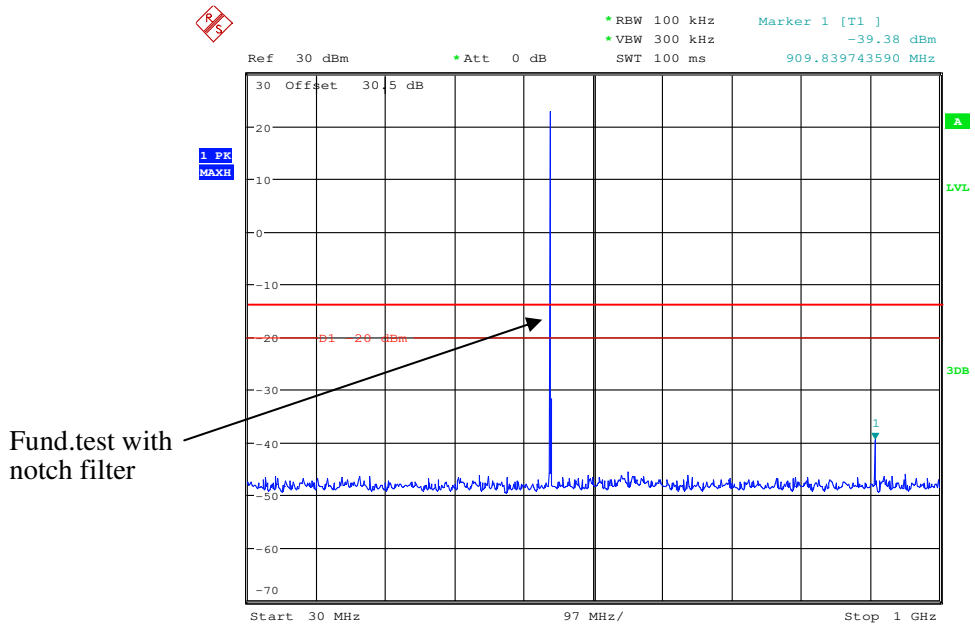
Date: 19.DEC.2017 22:15:19

**1 GHz – 5 GHz, 453.2125 MHz, For FCC part 74/90**



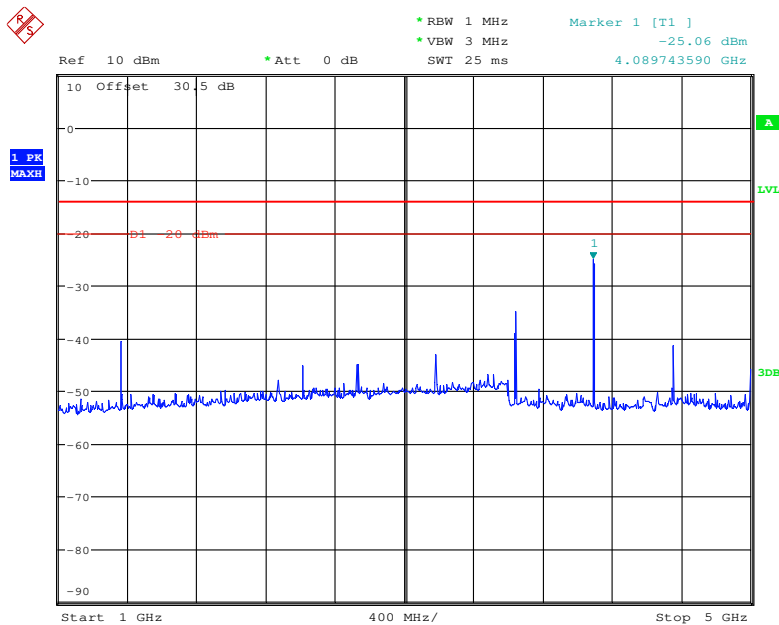
Date: 19.DEC.2017 22:27:01

### 30MHz – 1 GHz, 454.5 MHz, For FCC part 22



Date: 19.DEC.2017 22:16:43

### 1 GHz – 5 GHz, 454.5 MHz, For FCC part 22



Date: 19.DEC.2017 22:26:45



## FCC §2.1053 & §22.861 & §74.462 & § 80.211 & §90.210 - RADIATED SPURIOUS EMISSIONS

### Applicable Standard

FCC §2.1053, §22.861, §74.462, § 80.211 and §90.210

### Test Procedure

The transmitter was placed on a wooden turntable, and it was transmitting into a non-radiating load, which was also placed on the turntable.

The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from the EUT. The test was performed by placing the EUT on 3-orthogonal axis.

The frequency range up to teeth harmonic of the fundamental frequency was investigated.

Remove the EUT and replace it with substitution antenna. A signal generator was connected to the substitution antenna by a non-radiating cable. The absolute levels of the spurious emissions were measured by the substitution.

Spurious emissions in dB = 10 lg (TXpwr in Watts/0.001)-the absolute level

Spurious attenuation limit in dB = 50 + 10 Log<sub>10</sub> (power out in Watts) for EUT with a 12.5 kHz channel bandwidth.

Spurious attenuation limit in dB = 43 + 10 Log<sub>10</sub> (power out in Watts) for EUT with a 25 kHz channel bandwidth.

### Test Data

#### Environmental Conditions

|                    |           |
|--------------------|-----------|
| Temperature:       | 24 °C     |
| Relative Humidity: | 51 %      |
| ATM Pressure:      | 101.0 kPa |

*The testing was performed by Dylan Li on 2018-01-09.*

*Test Mode: Transmitting*

**30MHz - 6GHz:**

| Frequency (MHz)                                       | Receiver Reading (dBµV) | Turn Table Angle Degree | Rx Antenna |             | Substituted |                 |                   | Absolute Level (dBm) | Limit (dBm) | Margin (dB) |
|---|-------------------------|-------------------------|------------|-------------|-------------|-----------------|-------------------|----------------------|-------------|-------------|
|   |                         |                         | Height (m) | Polar (H/V) | Level (dBm) | Cable Loss (dB) | Antenna Gain (dB) |                      |             |             |
| Analog Modulation 453.2125MHz-12.5 kHz For part 74/90 |                         |                         |            |             |             |                 |                   |                      |             |             |
| 906.425   | 40.63                   | 219                     | 1.8        | H           | -55.1       | 0.70            | 0.0               | -55.80               | -20         | 35.80       |
| 906.425   | 41.18                   | 266                     | 1.7        | V           | -53.1       | 0.70            | 0.0               | -53.80               | -20         | 33.80       |
| 3625.70   | 51.46                   | 340                     | 1.2        | H           | -49.6       | 1.50            | 9.80              | -41.30               | -20         | 21.30       |
| 3625.70   | 49.36                   | 191                     | 2.3        | V           | -51.2       | 1.50            | 9.80              | -42.90               | -20         | 22.90       |
| 4078.91   | 47.55                   | 305                     | 1.5        | H           | -52.4       | 1.40            | 10.00             | -43.80               | -20         | 23.80       |
| 4078.91   | 45.28                   | 294                     | 2.3        | V           | -53.6       | 1.40            | 10.00             | -45.00               | -20         | 25.00       |
| Digital Modulation 453.0125MHz For part 74/90         |                         |                         |            |             |             |                 |                   |                      |             |             |
| 906.425   | 41.12                   | 296                     | 2.2        | H           | -54.6       | 0.70            | 0.0               | -55.30               | -20         | 35.30       |
| 906.425   | 40.39                   | 348                     | 1.7        | V           | -53.9       | 0.70            | 0.0               | -54.60               | -20         | 34.60       |
| 3625.70   | 53.68                   | 35                      | 1.2        | H           | -47.4       | 1.50            | 9.80              | -39.10               | -20         | 19.10       |
| 3625.70   | 51.47                   | 183                     | 1.8        | V           | -49.1       | 1.50            | 9.80              | -40.80               | -20         | 20.80       |
| 4078.91   | 46.58                   | 145                     | 2.4        | H           | -53.4       | 1.40            | 10.00             | -44.80               | -20         | 24.80       |
| 4078.91   | 45.33                   | 216                     | 1.5        | V           | -53.5       | 1.40            | 10.00             | -44.90               | -20         | 24.90       |
| Analog Modulation 454.5MHz-12.5 kHz For part 22       |                         |                         |            |             |             |                 |                   |                      |             |             |
| 909   | 41.25                   | 83                      | 1.4        | H           | -54.5       | 0.70            | 0.0               | -55.20               | -13         | 42.20       |
| 909   | 42.62                   | 161                     | 1.6        | V           | -51.6       | 0.70            | 0.0               | -52.30               | -13         | 39.30       |
| 3181.50   | 51.27                   | 214                     | 1.4        | H           | -47.4       | 1.60            | 9.60              | -39.40               | -13         | 26.40       |
| 3181.50   | 50.38                   | 284                     | 1.7        | V           | -48.6       | 1.60            | 9.60              | -40.60               | -13         | 27.60       |
| 3636.00   | 47.35                   | 331                     | 2.1        | H           | -53.7       | 1.50            | 9.80              | -45.40               | -13         | 32.40       |
| 3636.00   | 45.22                   | 225                     | 2.0        | V           | -55.3       | 1.50            | 9.80              | -47.00               | -13         | 34.00       |
| Digital Modulation 454.5 MHz For part 22              |                         |                         |            |             |             |                 |                   |                      |             |             |
| 909   | 39.67                   | 272                     | 1.4        | H           | -56.1       | 0.70            | 0.0               | -56.80               | -13         | 43.80       |
| 909   | 40.29                   | 233                     | 1.3        | V           | -54.0       | 0.70            | 0.0               | -54.70               | -13         | 41.70       |
| 3181.50   | 46.87                   | 267                     | 1.9        | H           | -51.8       | 1.60            | 9.60              | -43.80               | -13         | 30.80       |
| 3181.50   | 48.33                   | 334                     | 1.5        | V           | -50.6       | 1.60            | 9.60              | -42.60               | -13         | 29.60       |
| 3636.00   | 50.06                   | 101                     | 1.9        | H           | -51.0       | 1.50            | 9.80              | -42.70               | -13         | 29.70       |
| 3636.00   | 52.25                   | 16                      | 2.4        | V           | -48.3       | 1.50            | 9.80              | -40.00               | -13         | 27.00       |

| Frequency (MHz)                                   | Receiver Reading (dBµV) | Turn Table Angle Degree | Rx Antenna |             | Substituted |                 |                   | Absolute Level (dBm) | Limit (dBm) | Margin (dB) |
|---|-------------------------|-------------------------|------------|-------------|-------------|-----------------|-------------------|----------------------|-------------|-------------|
|   |                         |                         | Height (m) | Polar (H/V) | Level (dBm) | Cable Loss (dB) | Antenna Gain (dB) |                      |             |             |
| Analog Modulation 454.5 MHz-25 kHz For part 22    |                         |                         |            |             |             |                 |                   |                      |             |             |
| 909   | 41.96                   | 205                     | 2.4        | H           | -53.8       | 0.70            | 0.0               | -54.50               | -13         | 41.50       |
| 909   | 40.87                   | 1                       | 1.7        | V           | -53.4       | 0.70            | 0.0               | -54.10               | -13         | 41.10       |
| 3636.00   | 53.64                   | 12                      | 2.1        | H           | -47.4       | 1.50            | 9.80              | -39.10               | -13         | 26.10       |
| 3636.00   | 51.87                   | 125                     | 1.8        | V           | -48.7       | 1.50            | 9.80              | -40.40               | -13         | 27.40       |
| 4090.50   | 48.34                   | 266                     | 2.3        | H           | -51.6       | 1.40            | 10.00             | -43.00               | -13         | 30.00       |
| 4090.50   | 45.77                   | 286                     | 1.6        | V           | -53.1       | 1.40            | 10.00             | -44.50               | -13         | 31.50       |
| Analog Modulation 465.0125 MHz-25 kHz For part 80 |                         |                         |            |             |             |                 |                   |                      |             |             |
| 930.025   | 43.42                   | 169                     | 1.7        | H           | -50.8       | 0.74            | 0.0               | -51.54               | -13         | 38.54       |
| 930.025   | 42.91                   | 329                     | 1.1        | V           | -51.4       | 0.74            | 0.0               | -52.14               | -13         | 39.14       |
| 2790.08   | 48.35                   | 193                     | 1.4        | H           | -54.5       | 1.80            | 9.70              | -46.60               | -13         | 33.60       |
| 2790.08   | 46.27                   | 224                     | 1.6        | V           | -56.2       | 1.80            | 9.70              | -48.30               | -13         | 35.30       |
| 3255.09   | 45.11                   | 350                     | 1.3        | H           | -54.5       | 1.50            | 9.60              | -46.40               | -13         | 33.40       |
| 3255.09   | 43.24                   | 78                      | 1.7        | V           | -56.4       | 1.50            | 9.60              | -48.30               | -13         | 35.30       |
| Analog Modulation 450.0125 MHz-25 kHz For part 74 |                         |                         |            |             |             |                 |                   |                      |             |             |
| 900.03  | 41.35                   | 255                     | 2.0        | V           | -54.4       | 0.7             | 0.0               | -55.10               | -13         | 42.10       |
| 900.03  | 40.51                   | 41                      | 1.9        | H           | -53.7       | 0.7             | 0.0               | -54.40               | -13         | 41.40       |
| 2800.09   | 52.47                   | 203                     | 1.8        | H           | -51.5       | 1.80            | 9.70              | -43.60               | -13         | 30.60       |
| 2800.09   | 50.63                   | 185                     | 2.1        | V           | -53.0       | 1.80            | 9.70              | -45.10               | -13         | 32.10       |
| 3200.10   | 49.87                   | 224                     | 1.9        | H           | -49.6       | 1.60            | 9.60              | -41.60               | -13         | 28.60       |
| 3200.10   | 47.64                   | 238                     | 1.8        | V           | -52.1       | 1.60            | 9.60              | -44.10               | -13         | 31.10       |

**Note:**

Absolute Level = Substituted Level - Cable loss + Antenna Gain

Margin = Limit- Absolute Level

## FCC §2.1055 & § 22.355 & §74.464 & § 80.209 & §90.213 - FREQUENCY STABILITY

### Applicable Standard

FCC §2.1055, § 22.355, §74.464, § 80.209 and §90.213

### Test Procedure

Frequency Stability vs. Temperature: The equipment under test was connected to an external DC power supply and the RF output was connected to a frequency counter via feed-through attenuators. The EUT was placed inside the temperature chamber. The DC leads and RF output cable exited the chamber through an opening made for the purpose.

After the temperature stabilized for approximately 20 minutes, the frequency output was recorded from the counter.

### Test Data

#### Environmental Conditions

|                           |           |
|---------------------------|-----------|
| <b>Temperature:</b>       | 24 °C     |
| <b>Relative Humidity:</b> | 56 %      |
| <b>ATM Pressure:</b>      | 101.0 kPa |

*The testing was performed by Dylan Li on 2018-01-10.*

*Test Mode: Transmitting*

*Note: This device is a Base station.*

For 12.5 kHz:

| <b>Analog Modulation, Reference Frequency: 453.2125 MHz, Limit: ±1.5 ppm</b> |  |  |                              |
|--|--|--|------------------------------|
| <b>Test Environment</b>  |  | <b>Frequency Measure with Time Elapsed</b> |                              |
| <b>Temperature (°C)</b>  | <b>Voltage Supplied (V<sub>DC</sub>)</b> | <b>Measured Frequency (MHz)</b>            | <b>Frequency Error (ppm)</b> |
| Frequency Stability versus Input Temperature                                 |  |  |                              |
| 50   | 13.6                                     | 453.21245                                  | -0.1103                      |
| 40   | 13.6                                     | 453.21247                                  | -0.0662                      |
| 30   | 13.6                                     | 453.21247                                  | -0.0662                      |
| 20   | 13.6                                     | 453.21242                                  | -0.1765                      |
| 10   | 13.6                                     | 453.21241                                  | -0.1986                      |
| 0  | 13.6                                     | 453.21241                                  | -0.1986                      |
| -10  | 13.6                                     | 453.21246                                  | -0.0883                      |
| -20  | 13.6                                     | 453.21246                                  | -0.0883                      |
| -30  | 13.6                                     | 453.21241                                  | -0.1986                      |
| Frequency Stability Versus Input Voltage                                     |  |  |                              |
| 20   | 11.6                                     | 453.21245                                  | -0.1103                      |

| <b>Digital Modulation, Reference Frequency: 453.2125 MHz, Limit: ±1.5 ppm</b> |  |  |                              |
|---|--|--|------------------------------|
| <b>Test Environment</b>   |  | <b>Frequency Measure with Time Elapsed</b> |                              |
| <b>Temperature (°C)</b>   | <b>Voltage Supplied (V<sub>DC</sub>)</b> | <b>Measured Frequency (MHz)</b>            | <b>Frequency Error (ppm)</b> |
| Frequency Stability versus Input Temperature                                  |  |  |                              |
| 50  | 13.6                                     | 453.21245                                  | -0.1103                      |
| 40  | 13.6                                     | 453.21244                                  | -0.1324                      |
| 30  | 13.6                                     | 453.21245                                  | -0.1103                      |
| 20  | 13.6                                     | 453.21249                                  | -0.0221                      |
| 10  | 13.6                                     | 453.21248                                  | -0.0441                      |
| 0   | 13.6                                     | 453.21250                                  | 0                            |
| -10   | 13.6                                     | 453.21246                                  | -0.0883                      |
| -20   | 13.6                                     | 453.21242                                  | -0.1765                      |
| -30   | 13.6                                     | 453.21249                                  | -0.0221                      |
| Frequency Stability Versus Input Voltage                                      |  |  |                              |
| 20  | 11.6                                     | 453.21242                                  | -0.1765                      |

| <b>Analog Modulation, Reference Frequency: 454.5 MHz, Limit: ±2.5 ppm</b> |  |  |                              |
|---|--|--|------------------------------|
| <b>Test Environment</b>   |  | <b>Frequency Measure with Time Elapsed</b> |                              |
| <b>Temperature (°C)</b>   | <b>Voltage Supplied (V<sub>DC</sub>)</b> | <b>Measured Frequency (MHz)</b>            | <b>Frequency Error (ppm)</b> |
| Frequency Stability versus Input Temperature                              |  |  |                              |
| 50  | 13.6                                     | 454.49995                                  | -0.1100                      |
| 40  | 13.6                                     | 454.49998                                  | -0.0440                      |
| 30  | 13.6                                     | 454.49994                                  | -0.1320                      |
| 20  | 13.6                                     | 454.50000                                  | -0.1760                      |
| 10  | 13.6                                     | 454.49993                                  | -0.1540                      |
| 0   | 13.6                                     | 454.49991                                  | -0.1980                      |
| -10   | 13.6                                     | 454.49994                                  | -0.1320                      |
| -20   | 13.6                                     | 454.49997                                  | -0.0660                      |
| -30   | 13.6                                     | 454.49994                                  | -0.1320                      |
| Frequency Stability versus Input Voltage                                  |  |  |                              |
| 20  | 11.6                                     | 454.49997                                  | -0.0660                      |

| <b>Digital Modulation, Reference Frequency: 454.5 MHz, Limit: ±2.5 ppm</b> |  |  |                              |
|--|--|--|------------------------------|
| <b>Test Environment</b>  |  | <b>Frequency Measure with Time Elapsed</b> |                              |
| <b>Temperature (°C)</b>  | <b>Voltage Supplied (V<sub>DC</sub>)</b> | <b>Measured Frequency (MHz)</b>            | <b>Frequency Error (ppm)</b> |
| Frequency Stability versus Input Temperature                               |  |  |                              |
| 50   | 13.6                                     | 454.49995                                  | -0.1100                      |
| 40   | 13.6                                     | 454.49999                                  | -0.0220                      |
| 30   | 13.6                                     | 454.49994                                  | -0.1320                      |
| 20   | 13.6                                     | 454.49998                                  | -0.0440                      |
| 10   | 13.6                                     | 454.49991                                  | -0.1980                      |
| 0  | 13.6                                     | 454.49992                                  | -0.1760                      |
| -10  | 13.6                                     | 454.49996                                  | -0.0880                      |
| -20  | 13.6                                     | 454.49996                                  | -0.0880                      |
| -30  | 13.6                                     | 454.49998                                  | -0.0440                      |
| Frequency Stability versus Input Voltage                                   |  |  |                              |
| 20   | 11.6                                     | 454.49999                                  | -0.0220                      |

For 25 kHz:

| <b>Analog Modulation, Reference Frequency: 453.2125 MHz, Limit: ±2.5 ppm</b> |  |  |                              |
|--|--|--|------------------------------|
| <b>Test Environment</b>  |  | <b>Frequency Measure with Time Elapsed</b> |                              |
| <b>Temperature (°C)</b>  | <b>Voltage Supplied (V<sub>DC</sub>)</b> | <b>Measured Frequency (MHz)</b>            | <b>Frequency Error (ppm)</b> |
| Frequency Stability versus Input Temperature                                 |  |  |                              |
| 50   | 13.6                                     | 453.21245                                  | -0.1103                      |
| 40   | 13.6                                     | 453.21245                                  | -0.1103                      |
| 30   | 13.6                                     | 453.21241                                  | -0.1986                      |
| 20   | 13.6                                     | 453.21248                                  | -0.0441                      |
| 10   | 13.6                                     | 453.21248                                  | -0.0441                      |
| 0  | 13.6                                     | 453.21242                                  | -0.1765                      |
| -10  | 13.6                                     | 453.21244                                  | -0.1324                      |
| -20  | 13.6                                     | 453.21247                                  | -0.0662                      |
| -30  | 13.6                                     | 453.21247                                  | -0.0662                      |
| Frequency Stability versus Input Voltage                                     |  |  |                              |
| 20   | 11.6                                     | 453.21249                                  | -0.0221                      |

| <b>Analog Modulation, Reference Frequency: 465.0125 MHz, Limit: ±5.0 ppm</b> |  |  |                              |
|--|--|--|------------------------------|
| <b>Test Environment</b>  |  | <b>Frequency Measure with Time Elapsed</b> |                              |
| <b>Temperature (°C)</b>  | <b>Voltage Supplied (V<sub>DC</sub>)</b> | <b>Measured Frequency (MHz)</b>            | <b>Frequency Error (ppm)</b> |
| Frequency Stability versus Input Temperature                                 |  |  |                              |
| 50   | 13.6                                     | 465.01245                                  | -0.1075                      |
| 40   | 13.6                                     | 465.01242                                  | -0.1720                      |
| 30   | 13.6                                     | 465.01243                                  | -0.1505                      |
| 20   | 13.6                                     | 465.01242                                  | -0.1720                      |
| 10   | 13.6                                     | 465.01247                                  | -0.0645                      |
| 0  | 13.6                                     | 465.01242                                  | -0.1720                      |
| -10  | 13.6                                     | 465.01242                                  | -0.1720                      |
| -20  | 13.6                                     | 465.01244                                  | -0.1290                      |
| -30  | 13.6                                     | 465.01243                                  | -0.1505                      |
| Frequency Stability versus Input Voltage                                     |  |  |                              |
| 20   | 11.6                                     | 465.01246                                  | -0.0860                      |

| <b>Analog Modulation, Reference Frequency: 450.0125 MHz, Limit: ±2.5 ppm</b> |  |  |                              |
|--|--|--|------------------------------|
| <b>Test Environment</b>  |  | <b>Frequency Measure with Time Elapsed</b> |                              |
| <b>Temperature (°C)</b>  | <b>Voltage Supplied (V<sub>DC</sub>)</b> | <b>Measured Frequency (MHz)</b>            | <b>Frequency Error (ppm)</b> |
| Frequency Stability versus Input Temperature                                 |  |  |                              |
| 50   | 13.6                                     | 450.01243                                  | -0.1556                      |
| 40   | 13.6                                     | 450.01240                                  | -0.2222                      |
| 30   | 13.6                                     | 450.01248                                  | -0.0444                      |
| 20   | 13.6                                     | 450.01242                                  | -0.1778                      |
| 10   | 13.6                                     | 450.01246                                  | -0.0889                      |
| 0  | 13.6                                     | 450.01241                                  | -0.2000                      |
| -10  | 13.6                                     | 450.01243                                  | -0.1556                      |
| -20  | 13.6                                     | 450.01247                                  | -0.0667                      |
| -30  | 13.6                                     | 450.01245                                  | -0.1111                      |
| Frequency Stability versus Input Voltage                                     |  |  |                              |
| 20   | 11.6                                     | 450.01247                                  | -0.0667                      |



## FCC §90.214 - TRANSIENT FREQUENCY BEHAVIOR

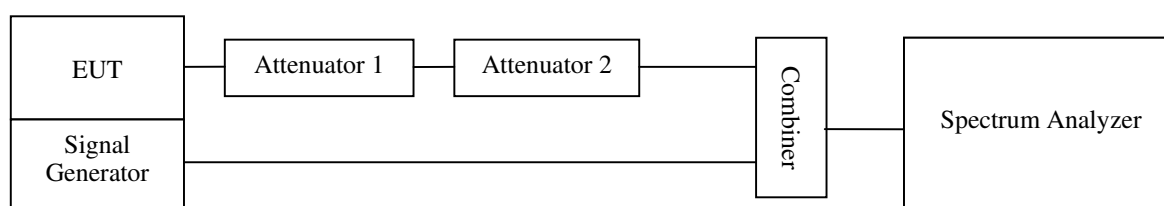
### Applicable Standard

Regulations: FCC §90.214

Test method: ANSI/TIA-603-D 2010, section 2.2.19.3

### Test Procedure

- a) Connect the EUT and test equipment as shown on the following block diagram.
- b) Set the Spectrum Analyzer to measure FM deviation, and tune the RF frequency to the transmitter assigned frequency.
- c) Set the signal generator to the assigned transmitter frequency and modulate it with a 1 kHz tone at  $\pm 12.5$  kHz deviation and set its output level to -100dBm.
- d) Turn on the transmitter.
- e) Supply sufficient attenuation via the RF attenuator to provide an input level to the Spectrum Analyzer that is 40 dB below the maximum allowed input power when the transmitter is operating at its rated power level. Note this power level on the Spectrum Analyzer as  $P_0$ .
- f) Turn off the transmitter.
- g) Adjust the RF level of the signal generator to provide RF power equal to  $P_0$ . This signal generator RF level shall be maintained throughout the rest of the measurement.
- h) Remove the attenuation 1, so the input power to the Spectrum Analyzer is increased by 30 dB when the transmitter is turned on.
- i) Adjust the vertical amplitude control of the spectrum analyzer to display the 1000 Hz at  $\pm 4$  divisions vertically centered on the display. Set trigger mode of the Spectrum Analyzer to "Video", and tune the "trigger level" on suitable level. Then set the "trigger offset" to -10ms for turn on and -15ms for turn off.
- j) Turn on the transmitter and the transient wave will be captured on the screen of Spectrum Analyzer. Observe the stored display. The instant when the 1 kHz test signal is completely suppressed is considered to be  $t_{on}$ . The trace should be maintained within the allowed divisions during the period  $t_1$  and  $t_2$ .
- k) Then turn off the transmitter, and another transient wave will be captured on the screen of Spectrum Analyzer. The trace should be maintained within the allowed divisions during the period  $t_3$ .



### Test Data

#### Environmental Conditions

|                           |           |
|---------------------------|-----------|
| <b>Temperature:</b>       | 25 °C     |
| <b>Relative Humidity:</b> | 56 %      |
| <b>ATM Pressure:</b>      | 101.0 kPa |

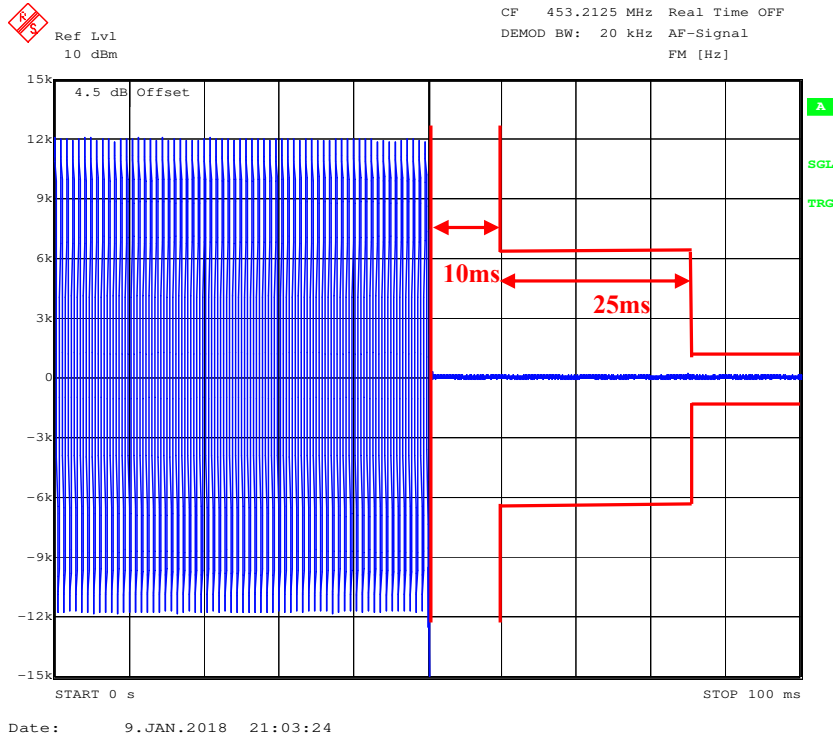
*The testing was performed by Dylan Li on 2018-01-09.*

| Channel Separation (kHz) | Transient Period (ms) | Transient Frequency | Result |
|--------------------------|-----------------------|---------------------|--------|
| 12.5                     | 10 (t1)               | <+/-12.5 kHz        | Pass   |
|                          | 25(t2)                | <+/-6.25 kHz        |        |
|                          | 10 (t3)               | <+/-12.5 kHz        |        |

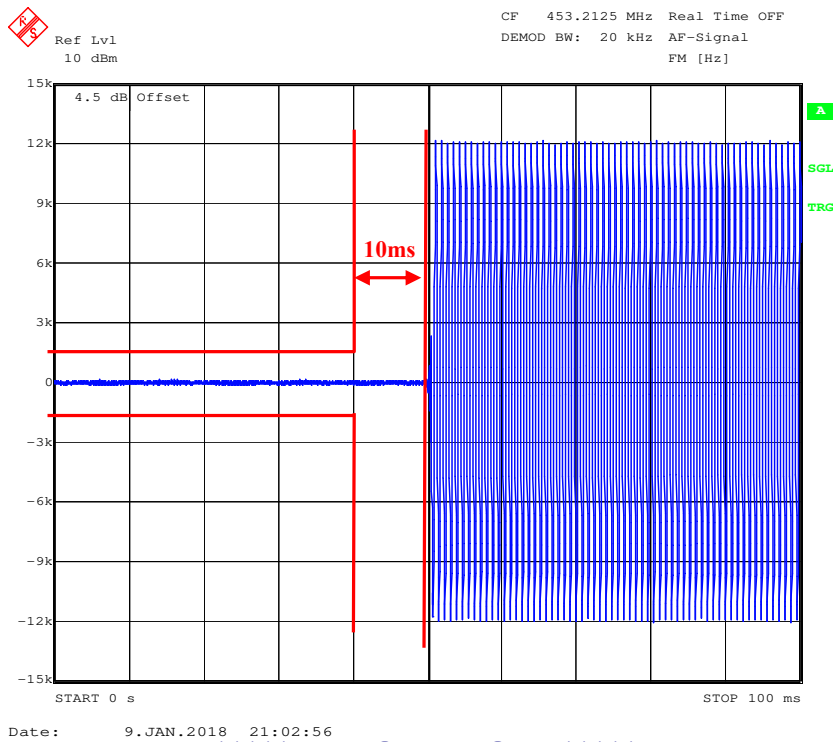
Please refer to the following plots.

Channel: 453.2125 MHz, 12.5 kHz

### Turn on



### Turn off



\*\*\*\*\* END OF REPORT \*\*\*\*\*