



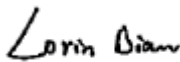
## FCC PART 22 AND PART 90 TEST REPORT

For

### Hytera Communications Corporation Limited

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

**FCC ID: YAMBD35XU1**

|                                           |                                                                                                                                                                                                |
|-------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Report Type:</b><br>Original Report    | <b>Product Name:</b><br>Digital Portable Radio                                                                                                                                                 |
| <b>Test Engineer:</b> <u>Lorin Bian</u>   |                                                                                                            |
| <b>Report Number:</b> <u>RDG161008005</u> |                                                                                                                                                                                                |
| <b>Report Date:</b> <u>2016-11-10</u>     |                                                                                                                                                                                                |
| <b>Reviewed By:</b> <u>Henry Ding</u>     |                                                                                                            |
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## GENERAL INFORMATION

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

The **Hytera Communications Corporation Limited**'s product, model: **BD352 U(1) (FCC ID: YAMBD35XU1)** (the "EUT") in this report is a **Digital Portable Radio**, which was measured approximately: 10.8 cm (H) x 4.95 cm (W) x 2.7 cm (H), rated input voltage: DC4.35V Li-ion battery or DC5V charging from adapter.

Adapter Information:

P/N: PS1031

MODEL: HKA00505010-XA

INPUT: AC 100-240V, 50/60Hz, 0.2A

OUTPUT: DC 5V, 1.0A

*Note: The series product, model BD352 U(1), BD355 U(1), BD356 U(1), BD358 U(1) are electrically identical, the difference between them is just the model name, we selected BD352 U(1) for fully testing, the details were explained in the declaration letter.*

*\*All measurement and test data in this report was gathered from final production sample, serial number: 161008005 (assigned by the BACL, Chengdu). It may have deviation from any other sample. The EUT supplied by the applicant was received on 2016-10-11, and EUT conformed to test requirement.*

### Objective

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

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

No related submittal(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 90 – PRIVATE LAND MOBILE RADIO SERVICES

Applicable Standards: TIA-603-D.

The uncertainty of any RF tests which use conducted method measurement is  $\pm 3.17$  dB, the uncertainty of any radiation on emissions measurement is:

30M~200MHz:  $\pm 4.7$  dB;  
200M~1GHz:  $\pm 6.0$  dB;  
1G-6GHz:  $\pm 5.13$  dB;  
6G~25GHz:  $\pm 5.47$  dB;

And the uncertainty will not be taken into consideration for all test data recorded in the report.

## Test Facility

The test site used by BACL to collect test data is located in the 5040, HuiLongWan Plaza, No. 1, ShaWan Road, JinNiu District, ChengDu, China

Test site at BACL has been fully described in reports submitted to the Federal Communication Commission (FCC). The details of these reports have been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on April 24, 2015. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2014.

The Federal Communications Commission has the reports on file and is listed under FCC Registration No.: 560332. The test site has been approved by the FCC for public use and is listed in the FCC Public Access Link (PAL) database.

## SYSTEM TEST CONFIGURATION

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### Description of Test Configuration

The system was configured for testing in a test mode.

### EUT Specification:

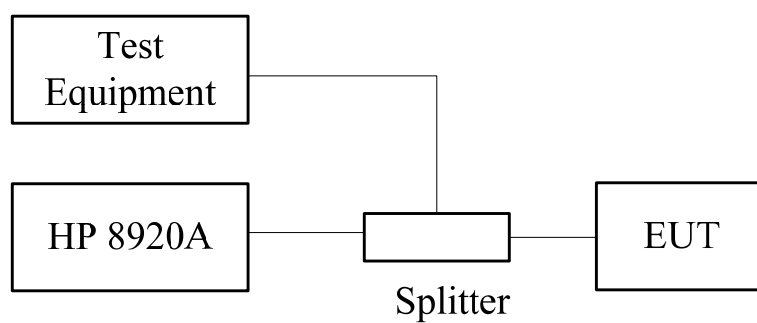
|                          |                     |
|--------------------------|---------------------|
| Operating Frequency Band | 400-470MHz          |
| Modulation Mode          | FM/4FSK             |
| Channel Spacing          | 12.5 kHz            |
| Rated Output Power       | High: 2W<br>Low: 1W |

### Support Equipment List and Details

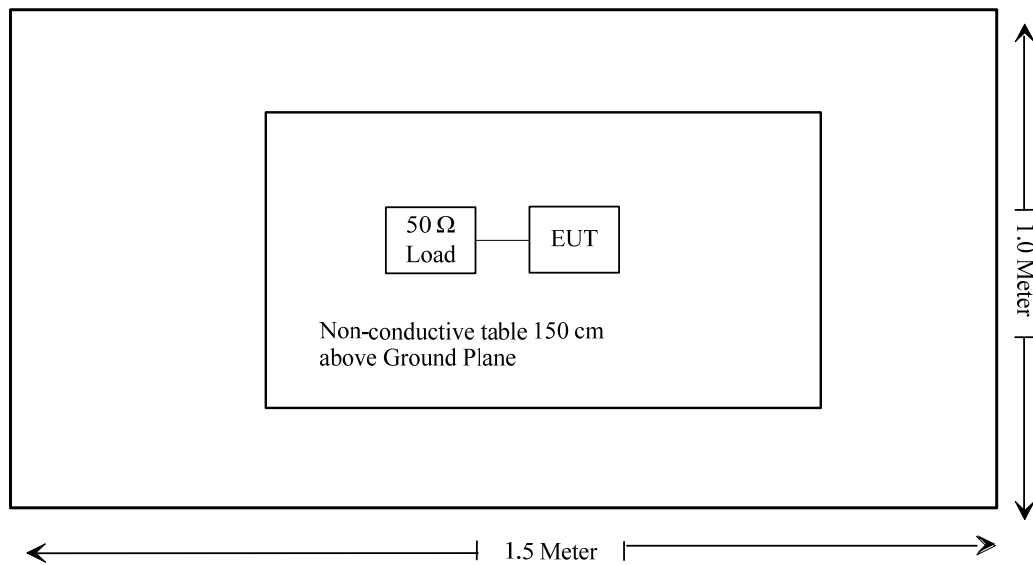
| Manufacturer | Description                     | Model | Serial Number |
|--------------|---------------------------------|-------|---------------|
| N/A          | Terminal Load<br>(50 $\Omega$ ) | N/A   | N/A           |
| HP           | RF Communications Test Set      | 8920A | 00 247        |
| N/A          | Splitter                        | N/A   | N/A           |

### Block Diagram of Test Setup

Conducted:



Radiated:



## **SUMMARY OF TEST RESULTS**

---

| <b>FCC Rules</b>                                 | <b>Description of Test</b>            | <b>Results</b> |
|--------------------------------------------------|---------------------------------------|----------------|
| §1.1310 and §2.1093                              | RF Exposure                           | Compliant      |
| §2.1046;<br>§ 22.727;§90.205                     | RF Output Power                       | Compliant      |
| §2.1047;§90.207                                  | Modulation Characteristic             | Compliant      |
| §2.1049;§22.357;§ 2<br>2.731;§90.209;<br>§90.210 | Occupied Bandwidth & Emission Mask    | Compliant      |
| §2.1051;<br>§22.861;§90.210                      | Spurious Emission at Antenna Terminal | Compliant      |
| §2.1053;<br>§22.861;§90.210                      | Spurious Radiated Emissions           | Compliant      |
| §2.1055; §<br>22.355;§90.213                     | Frequency Stability                   | Compliant      |
| §90.214                                          | Transient Frequency Behavior          | Compliant      |

## **FCC §1.1310 & §2.1093 - RF EXPOSURE**

---

### **Applicable Standard**

FCC§1.1310 and §2.1093.

### **Test Result**

Compliant, please refer to the SAR report: RDG161008005-20A.

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

### Applicable Standard

FCC §2.1046, § 22.727 and §90.205.

### Test Procedure

Conducted RF Output Power:

TIA-603-D section 2.2.1

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

Spectrum Analyzer setting:

| RBW     | VBW     |
|---------|---------|
| 100 kHz | 300 kHz |

### Test Equipment List and Details

| Manufacturer    | Description     | Model No. | Serial No. | Calibration Date | Calibration Due Date |
|-----------------|-----------------|-----------|------------|------------------|----------------------|
| Rohde & Schwarz | Signal Analyzer | FSIQ26    | 831929/005 | 2016-09-21       | 2017-09-20           |
| N/A             | RF Attenuator   | 20dB      | N/A        | Each Time        | /                    |

\* **Statement of Traceability:** BACL (Chengdu) attested that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

### Test Data

#### Environmental Conditions

|                    |           |
|--------------------|-----------|
| Temperature:       | 28.2 °C   |
| Relative Humidity: | 50 %      |
| ATM Pressure:      | 101.2 kPa |

*The testing was performed by Lorin Bian on 2016-11-03.*

Test Result: Compliant. Please refer to following tables.

FCC Part 90:

| Modulation | Channel Spacing (kHz) | f <sub>c</sub> (MHz) | Conducted Output Power (W) |      | Note               |
|------------|-----------------------|----------------------|----------------------------|------|--------------------|
|            |                       |                      | High                       | Low  |                    |
| FM         | 12.5                  | 400.0125             | 2.03                       | 1.06 | Not for FCC Review |
|            |                       | 453.2125             | 2.02                       | 1.06 | /                  |
|            |                       | 469.9875             | 2.03                       | 1.05 | /                  |
| 4FSK       |                       | 400.0125             | 2.03                       | 1.06 | Not for FCC Review |
|            |                       | 453.2125             | 2.05                       | 1.08 | /                  |
|            |                       | 469.9875             | 2.04                       | 1.07 | /                  |

FCC Part 22:

| Modulation | Channel Spacing (kHz) | f <sub>c</sub> (MHz) | Conducted Output Power (W) |      | Note |
|------------|-----------------------|----------------------|----------------------------|------|------|
|            |                       |                      | High                       | Low  |      |
| FM         | 12.5                  | 454.0125             | 2.02                       | 1.06 | /    |
| 4FSK       |                       | 454.0125             | 2.05                       | 1.08 | /    |

Note: The rated high power is 2W (33 dBm) and low power is 1W (30 dBm).

## FCC §2.1047 & §90.207 - MODULATION CHARACTERISTIC

### Applicable Standard

FCC§2.1047 & §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 Equipment List and Details

| Manufacturer | Description                | Model No. | Serial No. | Calibration Date | Calibration Due Date |
|--------------|----------------------------|-----------|------------|------------------|----------------------|
| HP           | RF Communications Test Set | 8920A     | 00 247     | 2016-08-10       | 2017-08-10           |
| N/A          | RF Attenuator              | 20dB      | N/A        | Each Time        | /                    |

\* **Statement of Traceability:** BACL (Chengdu) attested that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

### Test Data

#### Environmental Conditions

|                    |           |
|--------------------|-----------|
| Temperature:       | 28.2 °C   |
| Relative Humidity: | 50 %      |
| ATM Pressure:      | 101.2 kPa |

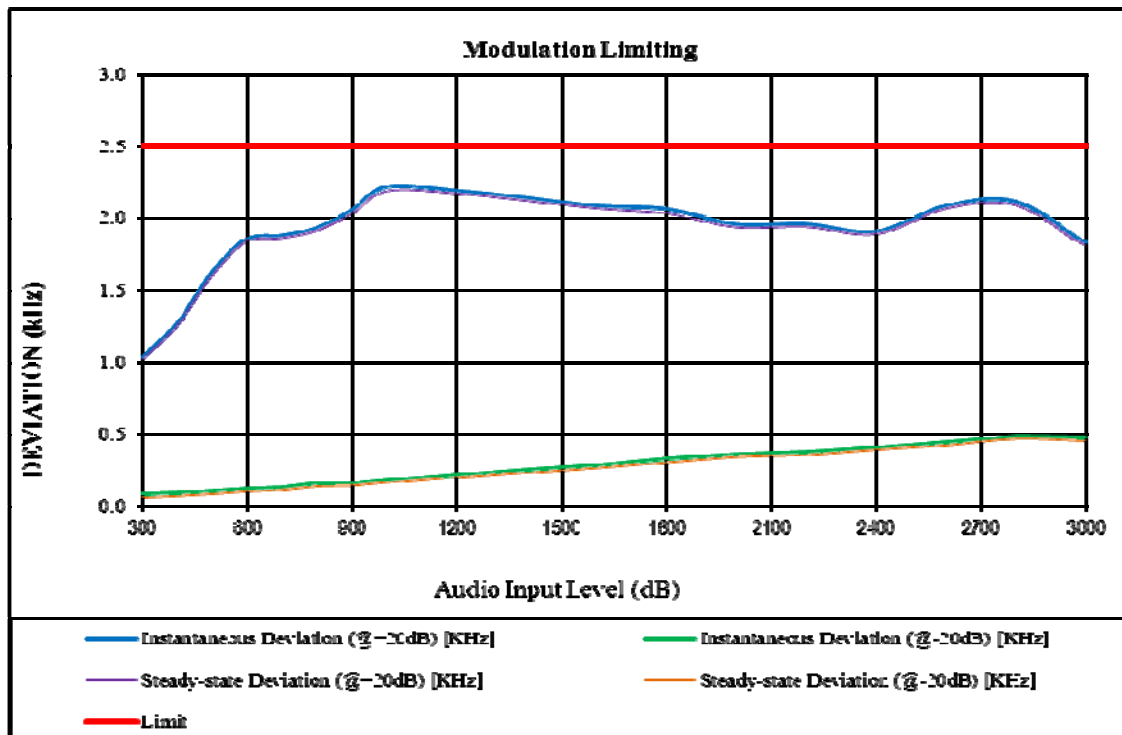
*The testing was performed by Lorin Bian on 2016-11-03.*

*Test Result: Compliant. Please refer to following table and plots.*

# MODULATION LIMITING

Carrier Frequency: 453.2125 MHz, Channel Spacing = 12.5 kHz

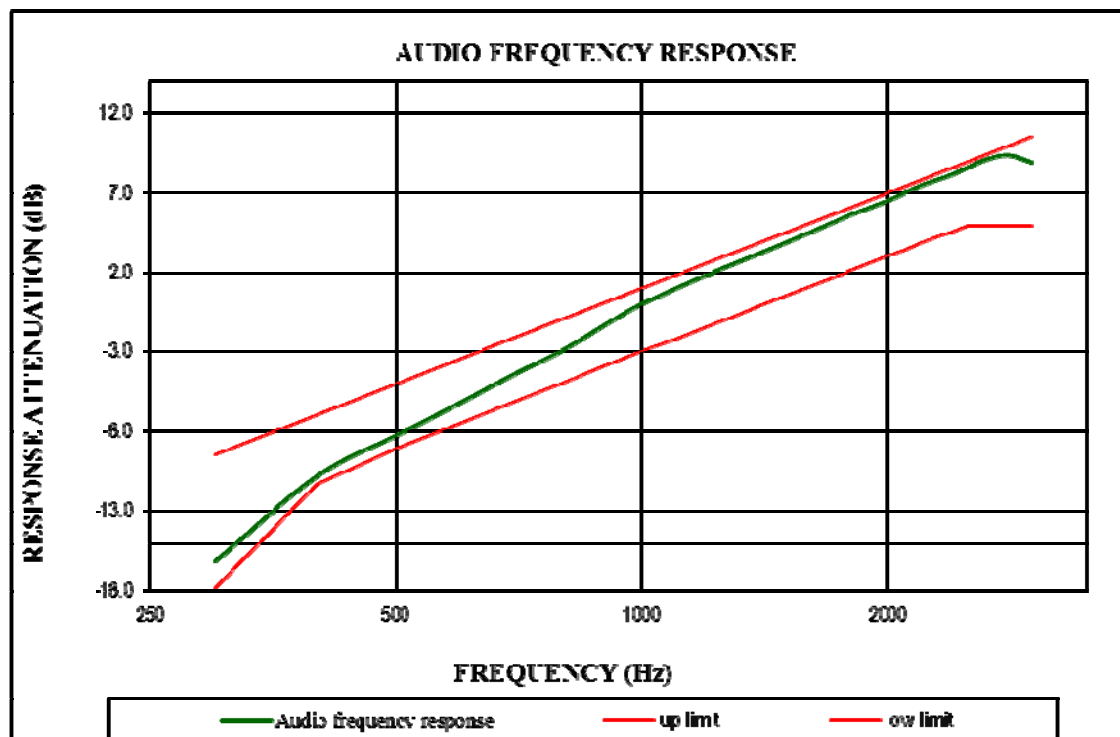
| Audio Frequency<br>(Hz) | Instantaneous                  |                                | Steady-state                   |                                | Limit<br>[kHz] |
|-------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|----------------|
|                         | Deviation<br>(@+20dB)<br>[kHz] | Deviation<br>(@-20dB)<br>[kHz] | Deviation<br>(@+20dB)<br>[kHz] | Deviation<br>(@-20dB)<br>[kHz] |                |
| 300                     | 1.031                          | 0.081                          | 1.014                          | 0.059                          | 2.5            |
| 400                     | 1.273                          | 0.088                          | 1.256                          | 0.069                          | 2.5            |
| 500                     | 1.627                          | 0.101                          | 1.605                          | 0.083                          | 2.5            |
| 600                     | 1.855                          | 0.122                          | 1.838                          | 0.099                          | 2.5            |
| 700                     | 1.881                          | 0.131                          | 1.864                          | 0.111                          | 2.5            |
| 800                     | 1.935                          | 0.155                          | 1.916                          | 0.136                          | 2.5            |
| 900                     | 2.056                          | 0.161                          | 2.032                          | 0.142                          | 2.5            |
| 1000                    | 2.215                          | 0.184                          | 2.185                          | 0.163                          | 2.5            |
| 1200                    | 2.186                          | 0.221                          | 2.168                          | 0.202                          | 2.5            |
| 1400                    | 2.138                          | 0.258                          | 2.119                          | 0.236                          | 2.5            |
| 1600                    | 2.083                          | 0.288                          | 2.066                          | 0.269                          | 2.5            |
| 1800                    | 2.062                          | 0.332                          | 2.031                          | 0.308                          | 2.5            |
| 2000                    | 1.957                          | 0.365                          | 1.939                          | 0.346                          | 2.5            |
| 2200                    | 1.959                          | 0.381                          | 1.942                          | 0.361                          | 2.5            |
| 2400                    | 1.909                          | 0.414                          | 1.891                          | 0.396                          | 2.5            |
| 2600                    | 2.083                          | 0.447                          | 2.065                          | 0.428                          | 2.5            |
| 2800                    | 2.112                          | 0.491                          | 2.087                          | 0.471                          | 2.5            |
| 3000                    | 1.827                          | 0.477                          | 1.804                          | 0.459                          | 2.5            |



### Audio Frequency Response

Carrier Frequency: 453.2125 MHz, Channel Spacing = 12.5 kHz

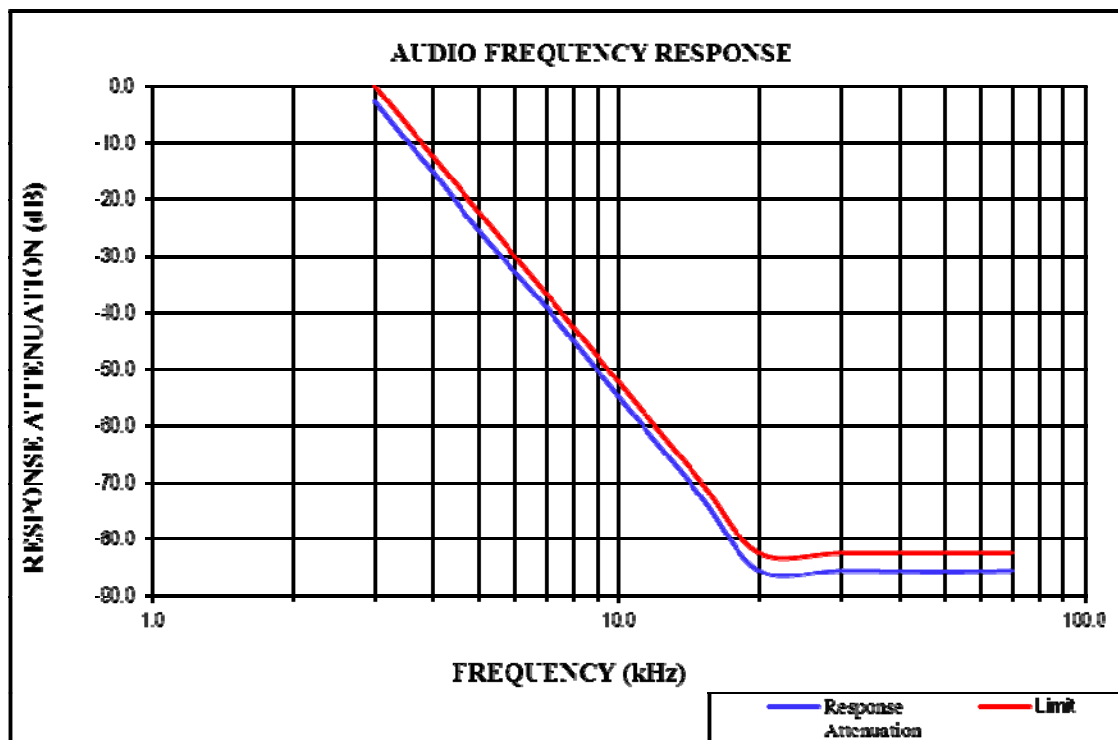
| Audio Frequency | Response Attenuation |
|-----------------|----------------------|
| Hz              | dB                   |
| 300             | -16.14               |
| 400             | -10.79               |
| 500             | -8.24                |
| 600             | -6.17                |
| 700             | -4.36                |
| 800             | -2.91                |
| 900             | -1.33                |
| 1000            | 0.00                 |
| 1200            | 1.82                 |
| 1400            | 3.23                 |
| 1600            | 4.47                 |
| 1800            | 5.62                 |
| 2000            | 6.51                 |
| 2200            | 7.48                 |
| 2400            | 8.15                 |
| 2600            | 8.96                 |
| 2800            | 9.35                 |
| 3000            | 8.91                 |



### Audio Frequency Low Pass Filter Response

Carrier Frequency: 453.2125 MHz, Channel Spacing = 12.5 kHz, high power level

| Audio Frequency | Response Attenuation | Limit |
|-----------------|----------------------|-------|
| kHz             | dB                   | dB    |
| 3.0             | -2.8                 | 0.0   |
| 3.5             | -9.6                 | -6.7  |
| 4.0             | -15.2                | -12.5 |
| 5.0             | -25.5                | -22.2 |
| 7.0             | -39.2                | -36.8 |
| 10.0            | -54.9                | -52.3 |
| 15.0            | -72.5                | -69.9 |
| 20.0            | -85.6                | -82.5 |
| 30.0            | -85.6                | -82.5 |
| 50.0            | -85.7                | -82.5 |
| 70.0            | -85.6                | -82.5 |



## FCC §2.1049& §22.357 & § 22.731 &§90.209 & §90.210 – OCCUPIED BANDWIDTH & EMISSION MASK

### Applicable Standard

FCC §2.1049, §22.357, § 22.731, §90.209 and §90.210

Applicable Emission Masks

| Frequency band (MHz) | Mask for equipment with audio low pass filter | Mask for equipment without audio low pass filter |
|----------------------|-----------------------------------------------|--------------------------------------------------|
| Below 25             | A or B                                        | A or C                                           |
| 25-50                | B                                             | C                                                |
| 72-76                | B                                             | C                                                |
| 150-174              | B, D, or E                                    | C, D or E                                        |
| 150 paging only      | B                                             | C                                                |
| 220-222              | F                                             | F                                                |
| 421-512              | B, D, or E                                    | C, D, or E                                       |
| 450 paging only      | B                                             | G                                                |
| 806-809/851-854      | B                                             | H                                                |
| 809-824/854-869      | B                                             | G                                                |
| 896-901/935-940      | I                                             | J                                                |
| 902-928              | K                                             | K                                                |
| 929-930              | B                                             | G                                                |
| 4940-4990 MHz        | L or M                                        | L or M                                           |
| 5850-5925            |                                               |                                                  |
| All other bands      | B                                             | C                                                |

**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) On any frequency from the center of the authorized bandwidth  $f_0$  to 5.625 kHz removed from  $f_0$ : Zero dB.

(2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency ( $f_d$  in kHz) of more than 5.625 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.

(4) The reference level for showing compliance with the emission mask shall be established using a resolution bandwidth sufficiently wide (usually two or three times the channel bandwidth) to capture the true peak emission of the equipment under test. In order to show compliance with the emission mask up to and including 50 kHz removed from the edge of the authorized bandwidth, adjust the resolution bandwidth to 100 Hz with the measuring instrument in a peak hold mode. A sufficient number of sweeps must be measured to insure that the emission profile is developed. If video filtering is used, its bandwidth must not be less than the instrument resolution bandwidth. For emissions beyond 50 kHz from the edge of the authorized bandwidth, see paragraph (o) of this section. If it can be shown that use of the above instrumentation settings do not accurately represent the true interference potential of the equipment under test, an alternate procedure may be used provided prior Commission approval is obtained.

#### §22.357 Emission types.

Any authorized station in the Public Mobile Services may transmit emissions of any type(s) that comply with the applicable emission rule, i.e. §22.359, §22.861 or §22.917

#### §22.731 Emission limitations.

Upon application for multichannel operation, the FCC may authorize emission bandwidths wider than those specified in §22.357, provided that spectrum utilization is equal to or better than that achieved by single channel operation.

### Test Equipment List and Details

| Manufacturer    | Description     | Model No. | Serial No. | Calibration Date | Calibration Due Date |
|-----------------|-----------------|-----------|------------|------------------|----------------------|
| Rohde & Schwarz | Signal Analyzer | FSIQ26    | 831929/005 | 2016-09-21       | 2017-09-20           |
| N/A             | RF Attenuator   | 20dB      | N/A        | Each Time        | /                    |

\* **Statement of Traceability:** BACL (Chengdu) attested that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

### Test Procedure

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

### Test Data

#### Environmental Conditions

|                           |                 |
|---------------------------|-----------------|
| <b>Temperature:</b>       | 27.6~28.2 °C    |
| <b>Relative Humidity:</b> | 30~50 %         |
| <b>ATM Pressure:</b>      | 101.2~101.5 kPa |

*The testing was performed by Lorin Bian from 2016-11-02 to 2016-11-03.*

Test Result: Compliant. Please refer to the following tables and plots.

FCC Part 90:

| Modulation Mode | Channel Spacing | f <sub>c</sub> | 26 dB Bandwidth | 99% Occupied Bandwidth | Power Level |
|-----------------|-----------------|----------------|-----------------|------------------------|-------------|
|                 |                 | MHz            | kHz             | kHz                    |             |
| FM              | 12.5 kHz        | 453.2125       | 10.30           | 9.92                   | High        |
|                 |                 |                | 10.30           | 9.92                   | Low         |
| 4FSK            | 12.5 kHz        |                | 9.40            | 7.21                   | High        |
|                 |                 |                | 9.40            | 7.32                   | Low         |

FCC Part 22:

| Modulation Mode | Channel Spacing | f <sub>c</sub> | 26 dB Bandwidth | 99% Occupied Bandwidth | Power Level |
|-----------------|-----------------|----------------|-----------------|------------------------|-------------|
|                 |                 | MHz            | kHz             | kHz                    |             |
| FM              | 12.5 kHz        | 454.0125       | 10.30           | 9.92                   | High        |
|                 |                 |                | 10.30           | 9.92                   | Low         |
| 4FSK            |                 |                | 9.31            | 7.21                   | High        |
|                 |                 |                | 9.31            | 7.42                   | Low         |

Note: Emission bandwidth was based on calculation method instead of measurement.

Emission Designator

Per CFR 47 §2.201& §2.202, BW = 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

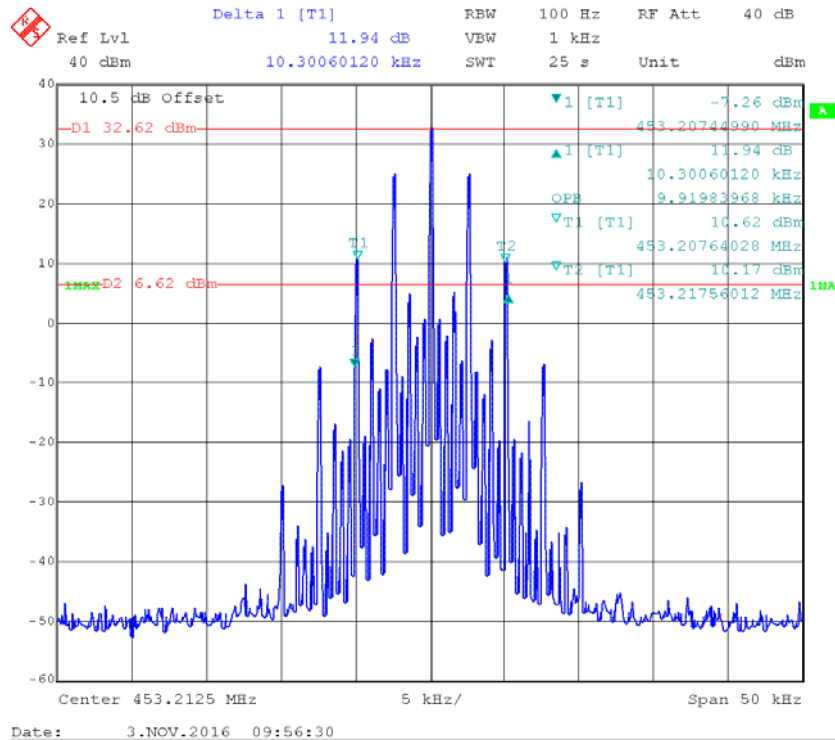
The 99% energy rule (title 47CFR 2.1049) was used for digital mode. It basically states that 99% of the modulation energy falls within X kHz, in this case, 7.60 kHz. The emission mask was obtained from 47CFR 90.210(d).

F1D and F1E portion of the designator indicates digital information.

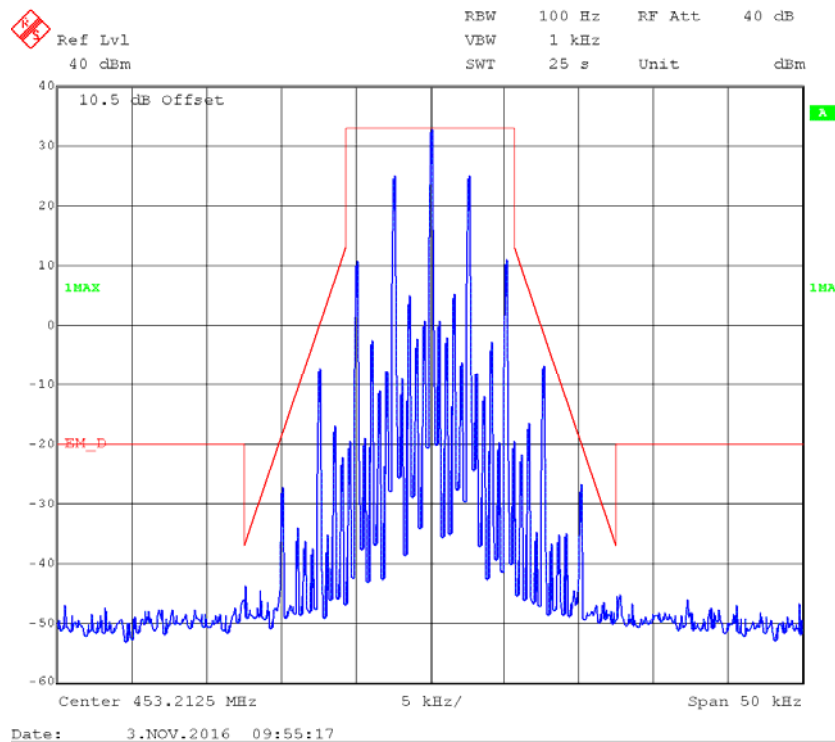
Therefore, the entire designator for 12.5 kHz channel spacing digital mode is 7K60F1D and 7K60F1E.

Part 90:

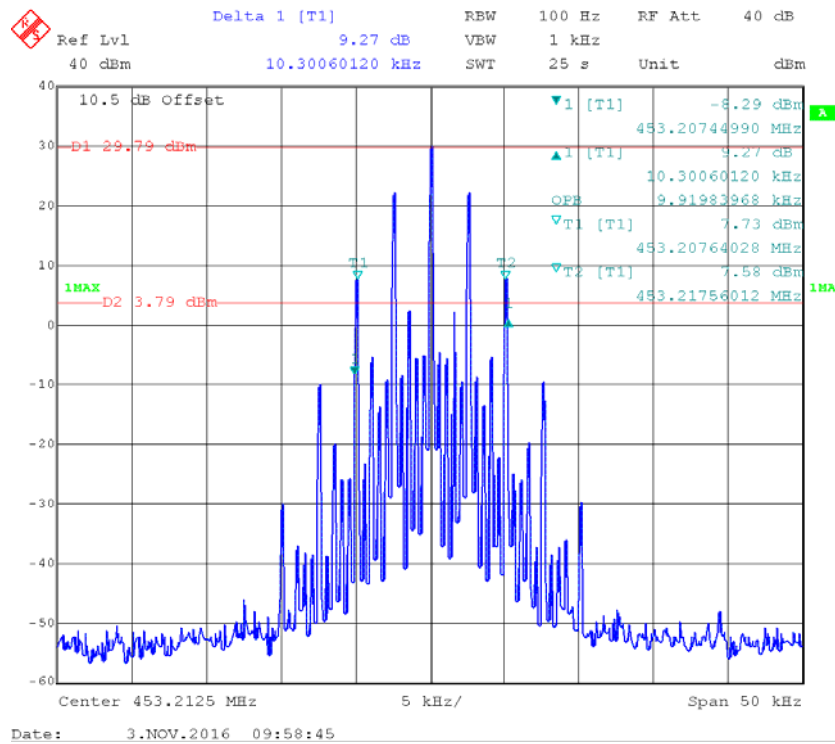
### Occupied Bandwidth – FM, 453.2125 MHz, High Power Level



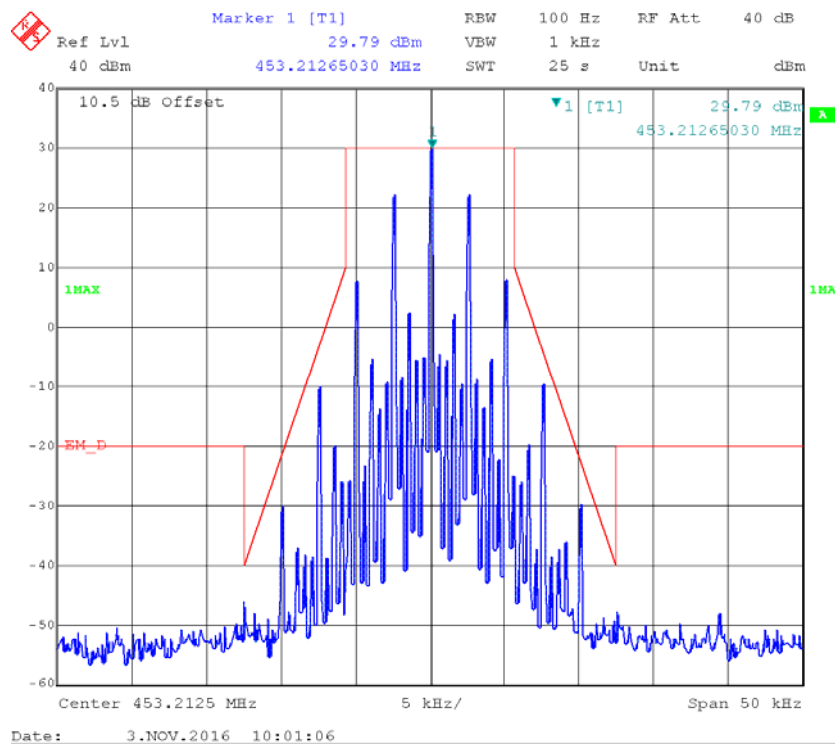
### Emission Mask - Type D



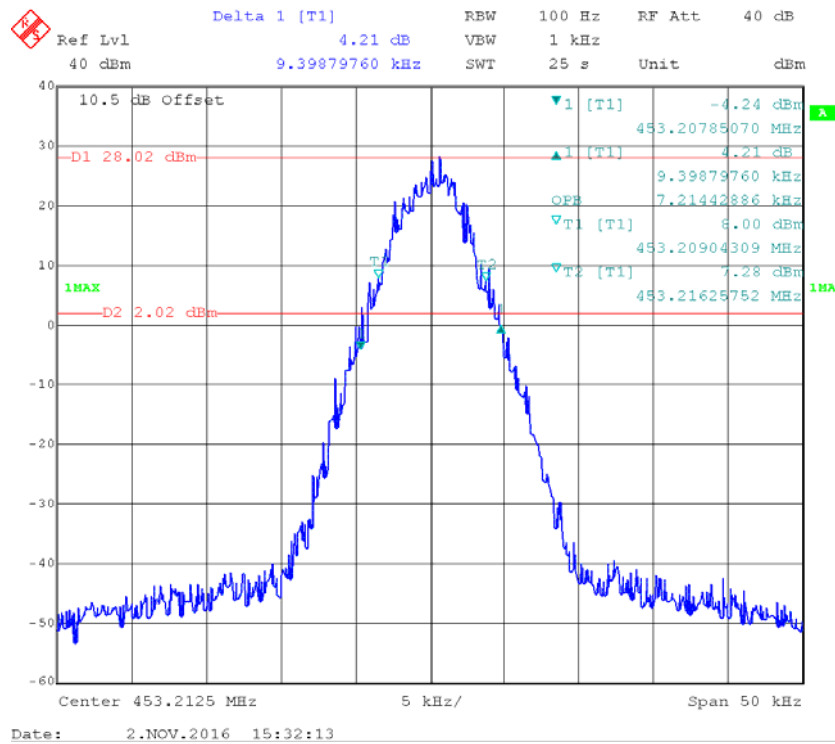
## Occupied Bandwidth – FM, 453.2125 MHz, Low Power Level



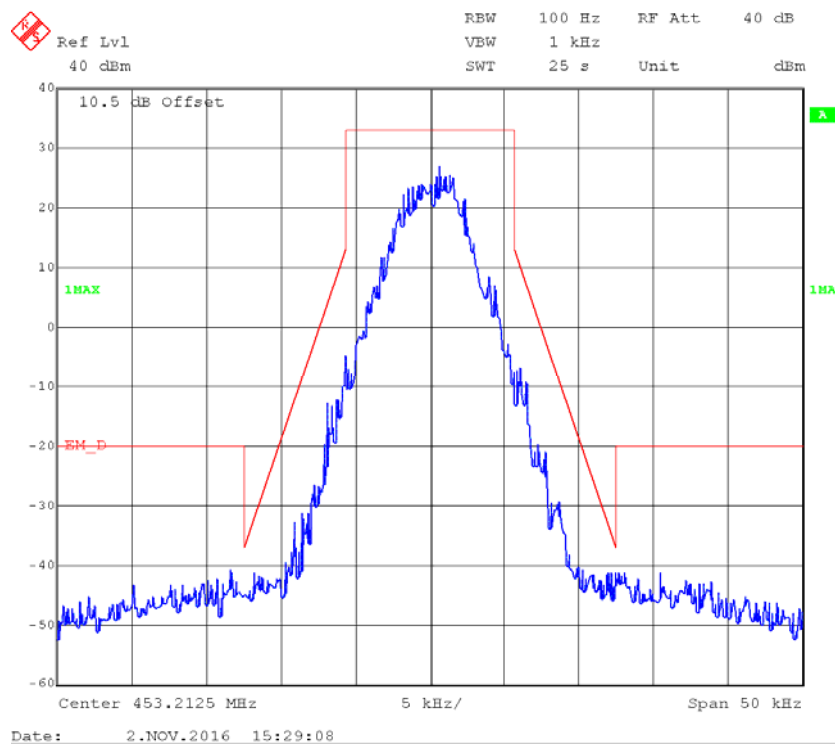
## Emission Mask - Type D



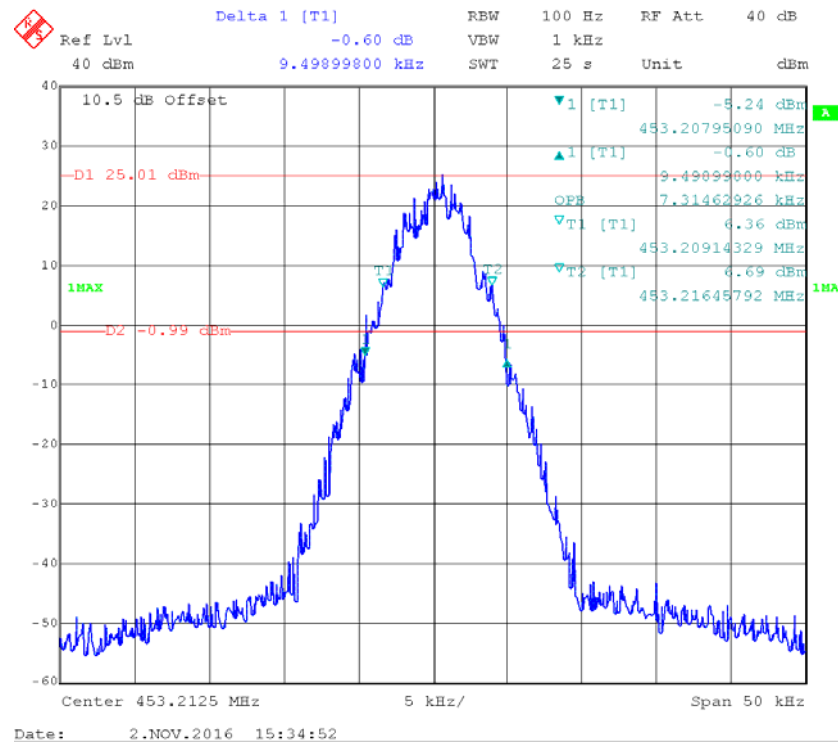
# Occupied Bandwidth – 4FSK, 453.2125 MHz, High Power Level



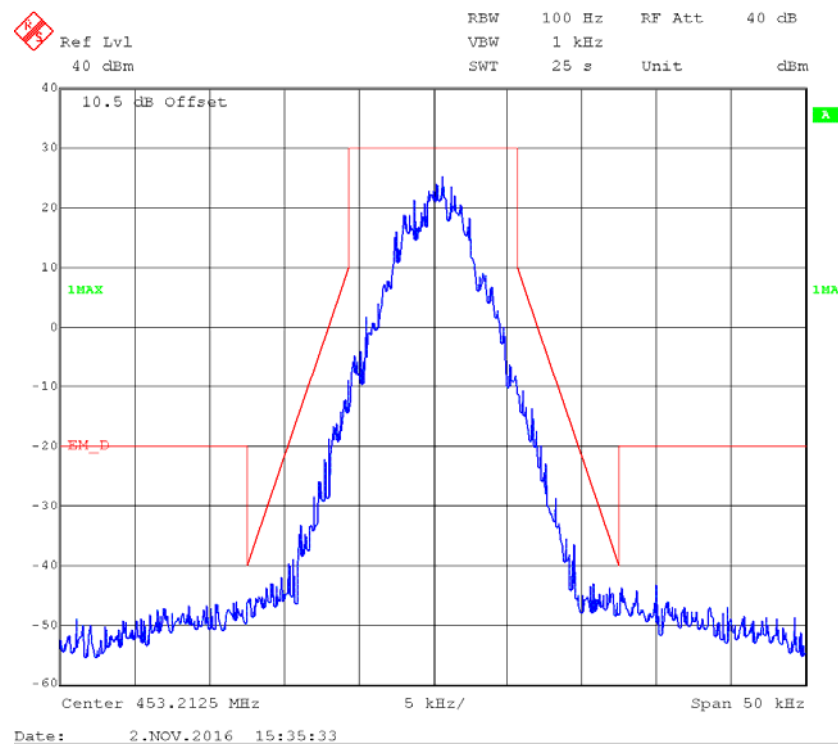
## Emission Mask - Type D



## Occupied Bandwidth – 4FSK, 453.2125 MHz, Low Power Level

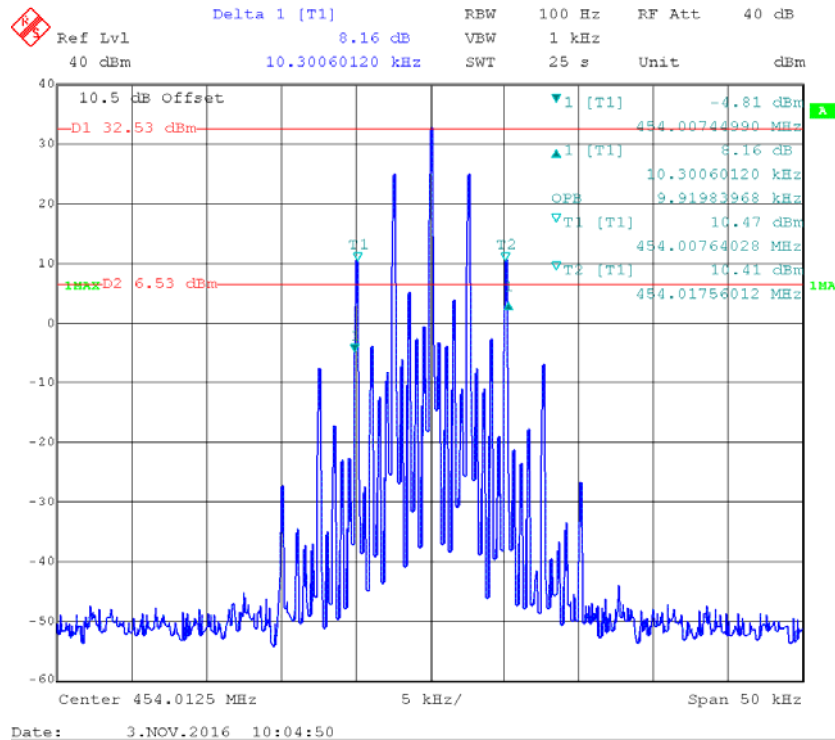


## Emission Mask - Type D

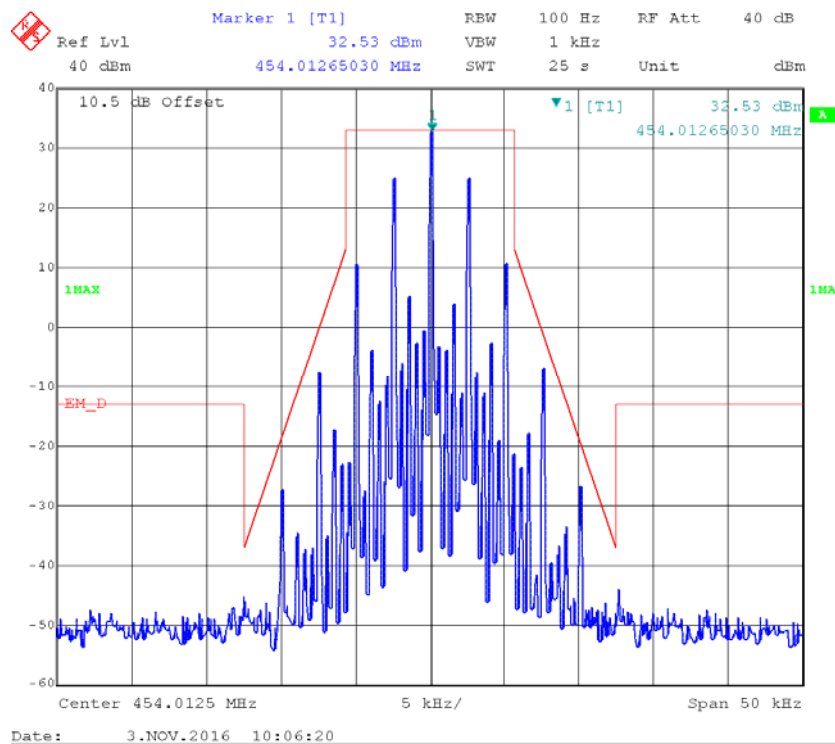


Part 22:

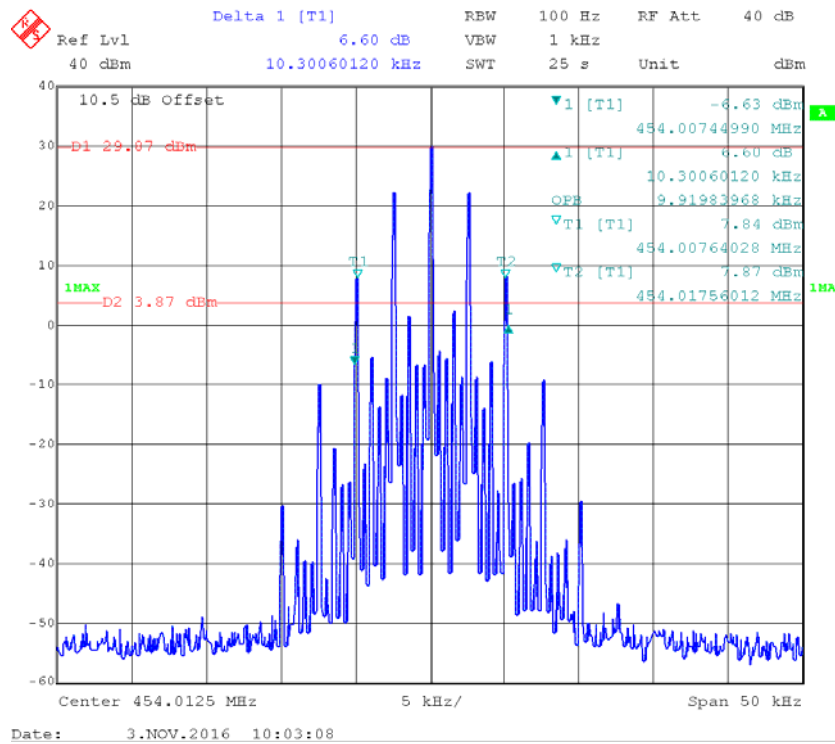
### Occupied Bandwidth – FM, 454.0125 MHz, High Power Level



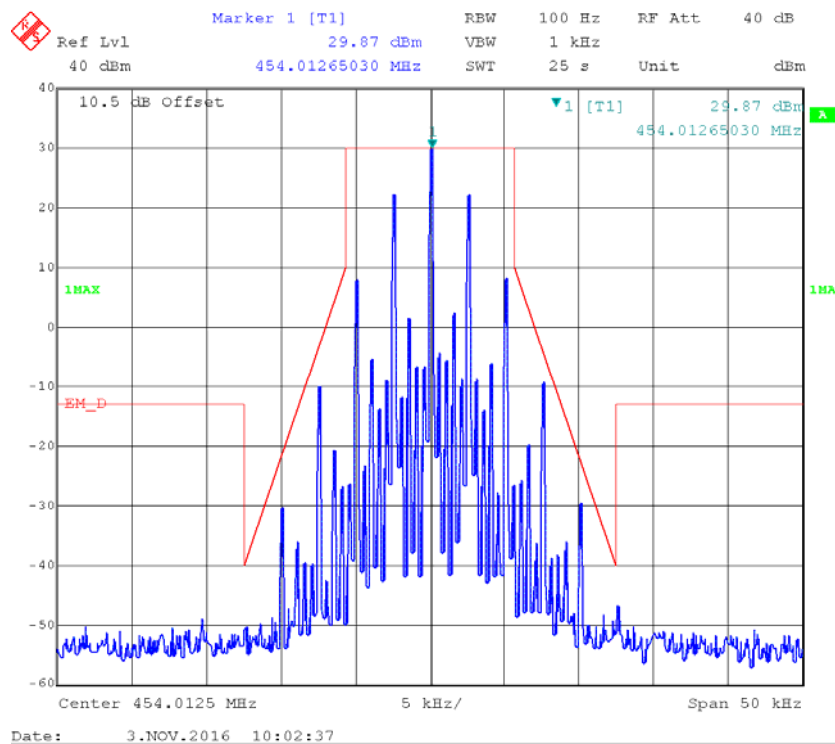
### Emission Mask - Type D



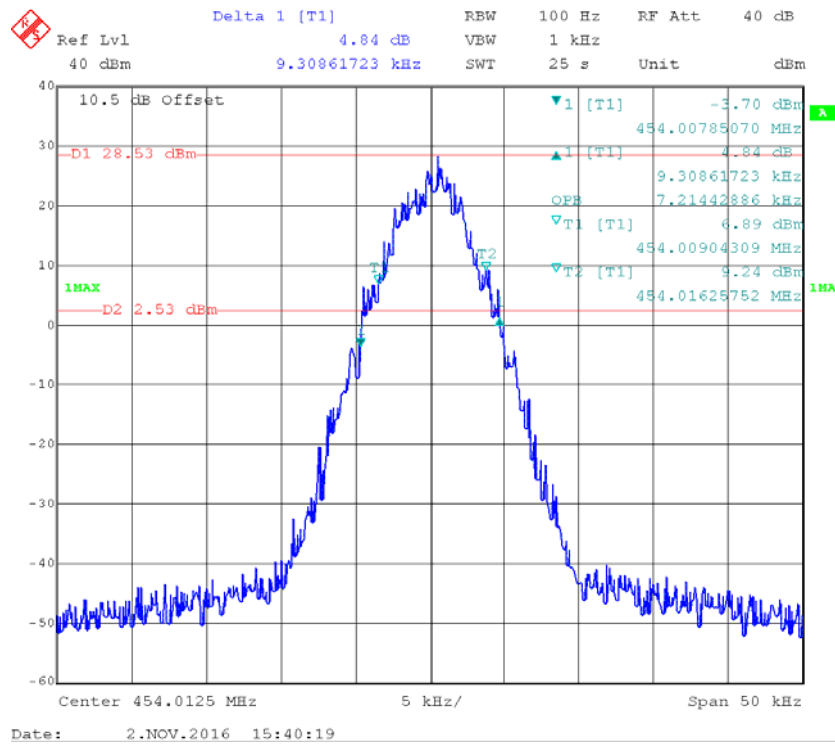
# Occupied Bandwidth – FM, 454.0125 MHz, Low Power Level



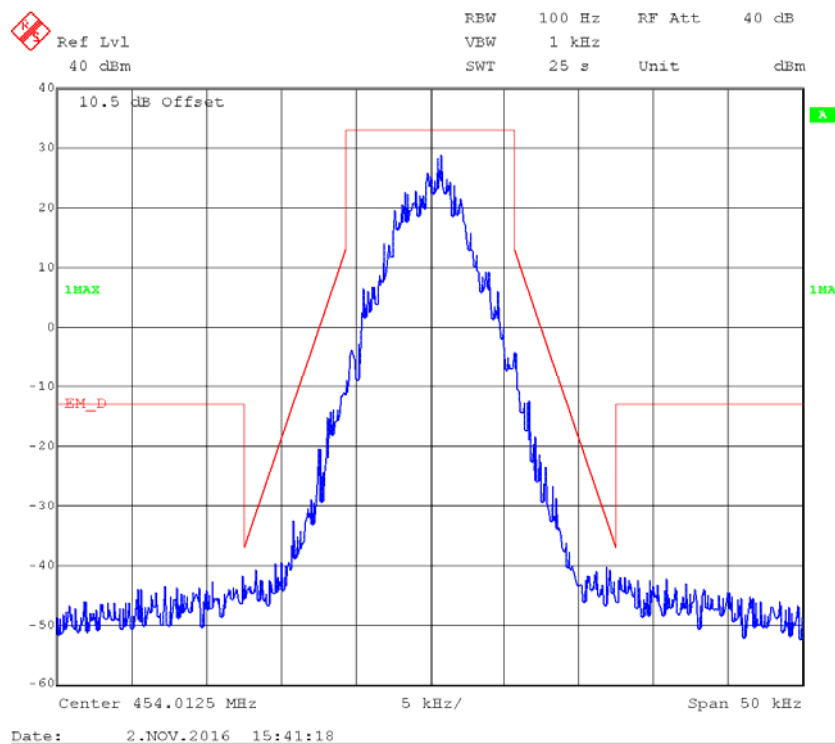
## Emission Mask - Type D



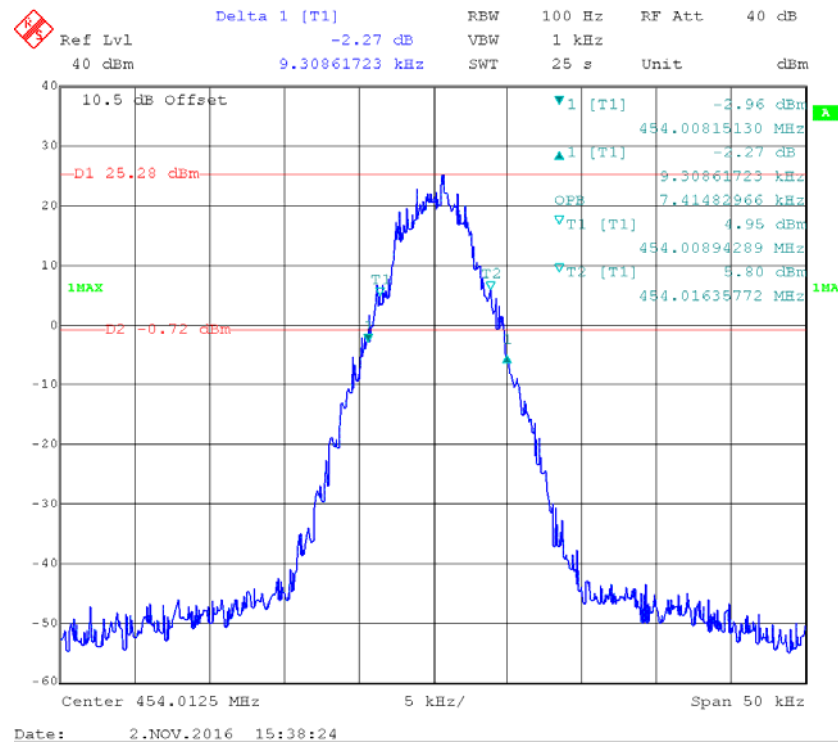
## Occupied Bandwidth – 4FSK, 454.0125 MHz, High Power Level



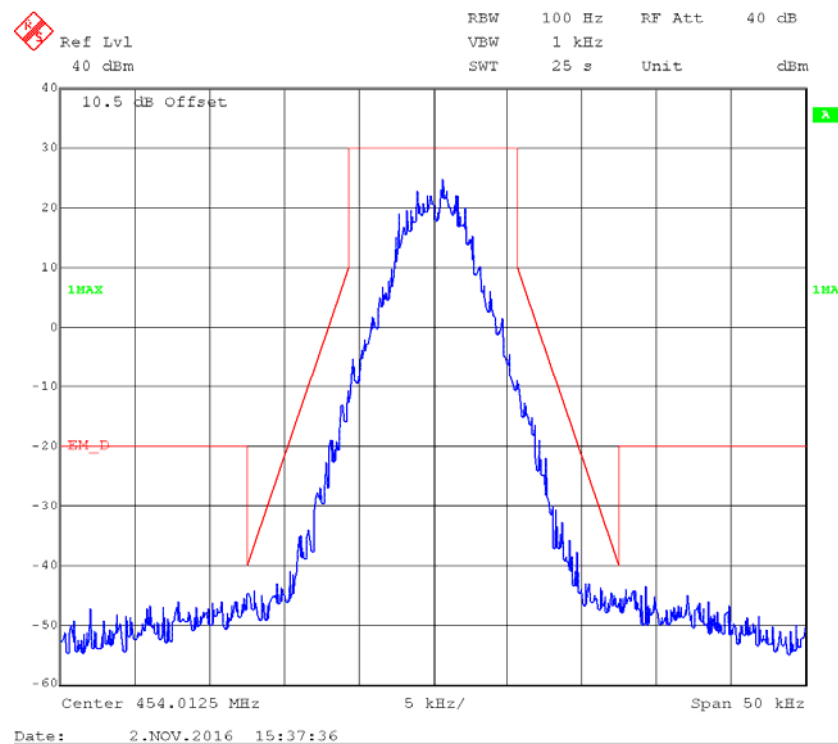
## Emission Mask - Type D



## Occupied Bandwidth – 4FSK, 454.0125 MHz, Low Power Level



## Emission Mask - Type D



## FCC §2.1051& §22.861 & §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) On any frequency from the center of the authorized bandwidth  $f_0$  to 5.625 kHz removed from  $f_0$ : Zero dB.

(2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency ( $f_d$  in kHz) of more than 5.625 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.

(4) The reference level for showing compliance with the emission mask shall be established using a resolution bandwidth sufficiently wide (usually two or three times the channel bandwidth) to capture the true peak emission of the equipment under test. In order to show compliance with the emission mask up to and including 50 kHz removed from the edge of the authorized bandwidth, adjust the resolution bandwidth to 100 Hz with the measuring instrument in a peak hold mode. A sufficient number of sweeps must be measured to insure that the emission profile is developed. If video filtering is used, its bandwidth must not be less than the instrument resolution bandwidth. For emissions beyond 50 kHz from the edge of the authorized bandwidth, see paragraph (o) of this section. If it can be shown that use of the above instrumentation settings do not accurately represent the true interference potential of the equipment under test, an alternate procedure may be used provided prior Commission approval is obtained.

§22.861 Emission limitations.

(a) Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least  $43 + 10 \log(P)$  dB.

### Test Equipment List and Details

| Manufacturer    | Description     | Model No. | Serial No. | Calibration Date | Calibration Due Date |
|-----------------|-----------------|-----------|------------|------------------|----------------------|
| Rohde & Schwarz | Signal Analyzer | FSIQ26    | 831929/005 | 2016-09-21       | 2017-09-20           |
| N/A             | RF Attenuator   | 20dB      | N/A        | Each Time        | /                    |

\* **Statement of Traceability:** BACL (Chengdu) attested that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

## Test Procedure

Adjust the spectrum analyzer for the following settings:

- 1) Resolution Bandwidth = 100 kHz for spurious emissions below 1 GHz, and 1 MHz for spurious emissions above 1 GHz.
- 2) Video Bandwidth  $\geq 3$  times the resolution bandwidth.
- 3) Sweep Speed  $\leq 2000$  Hz per second.
- 4) Detector Mode = peak.

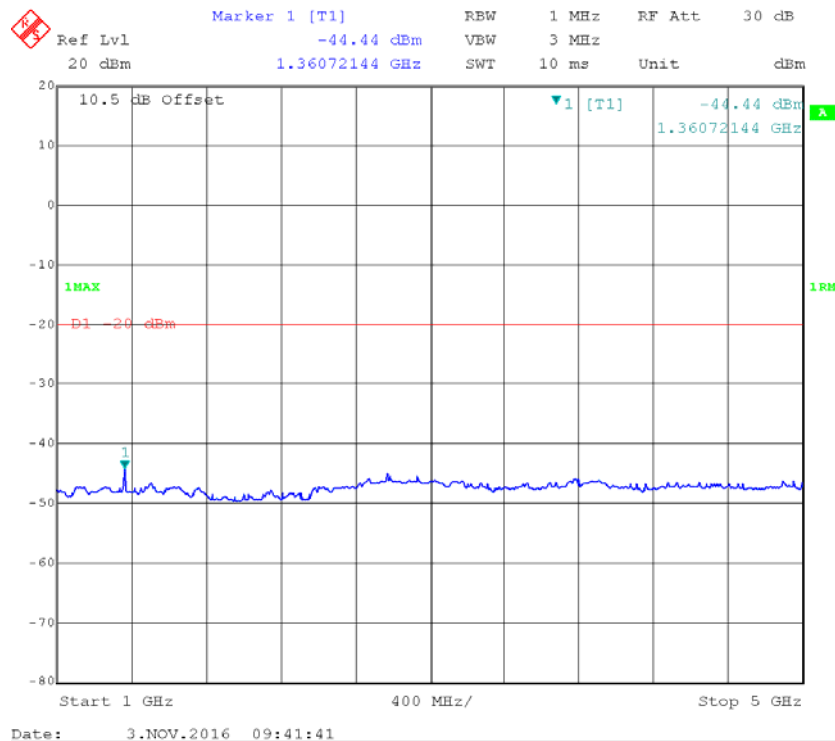
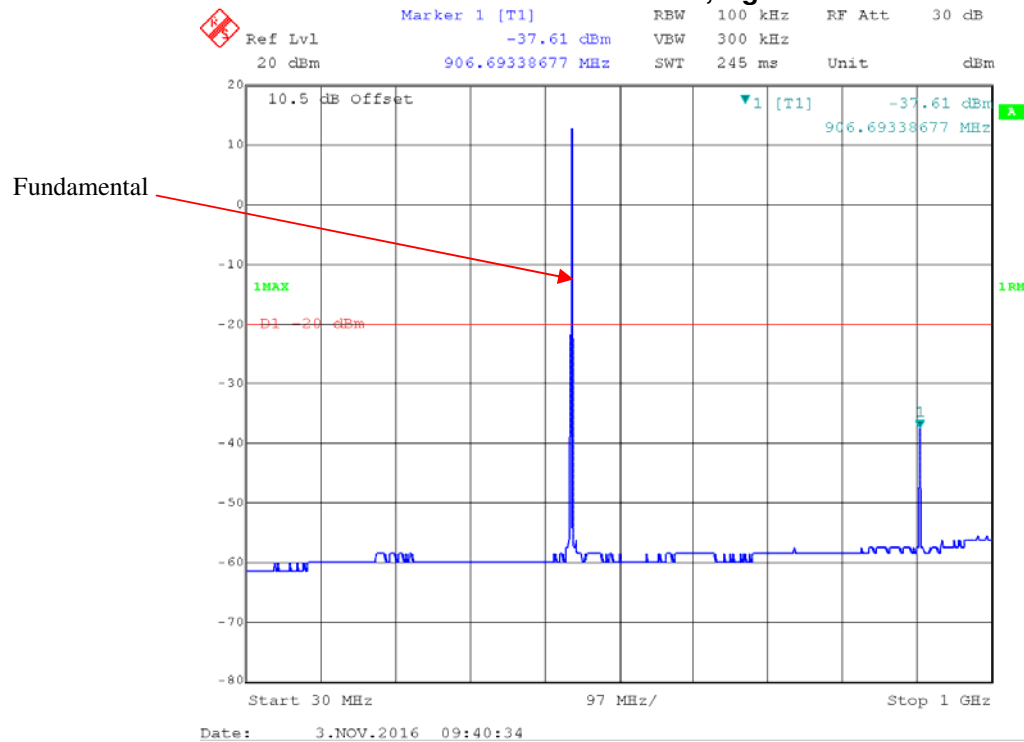
## Test Data

### Environmental Conditions

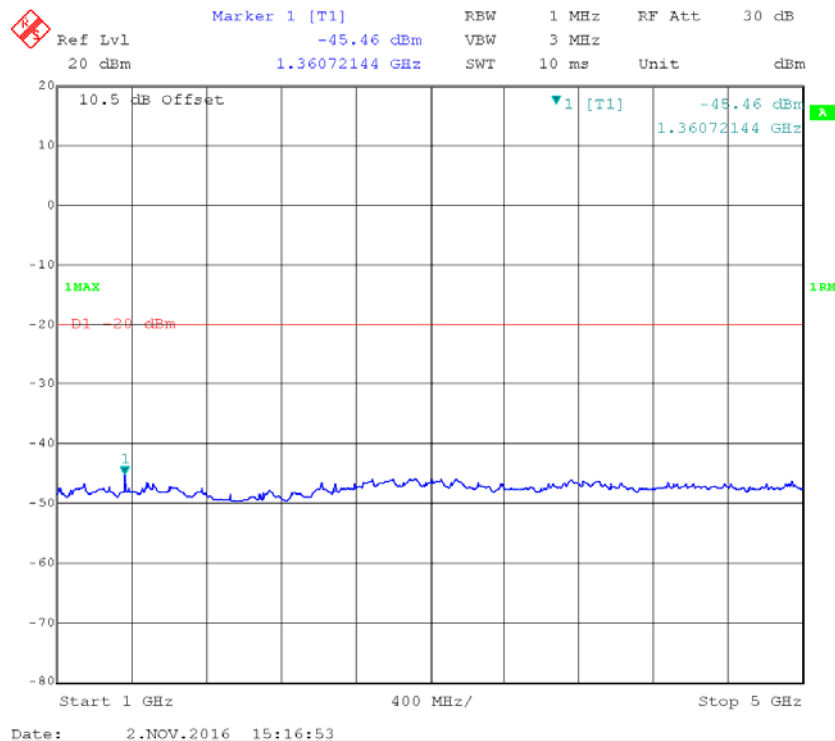
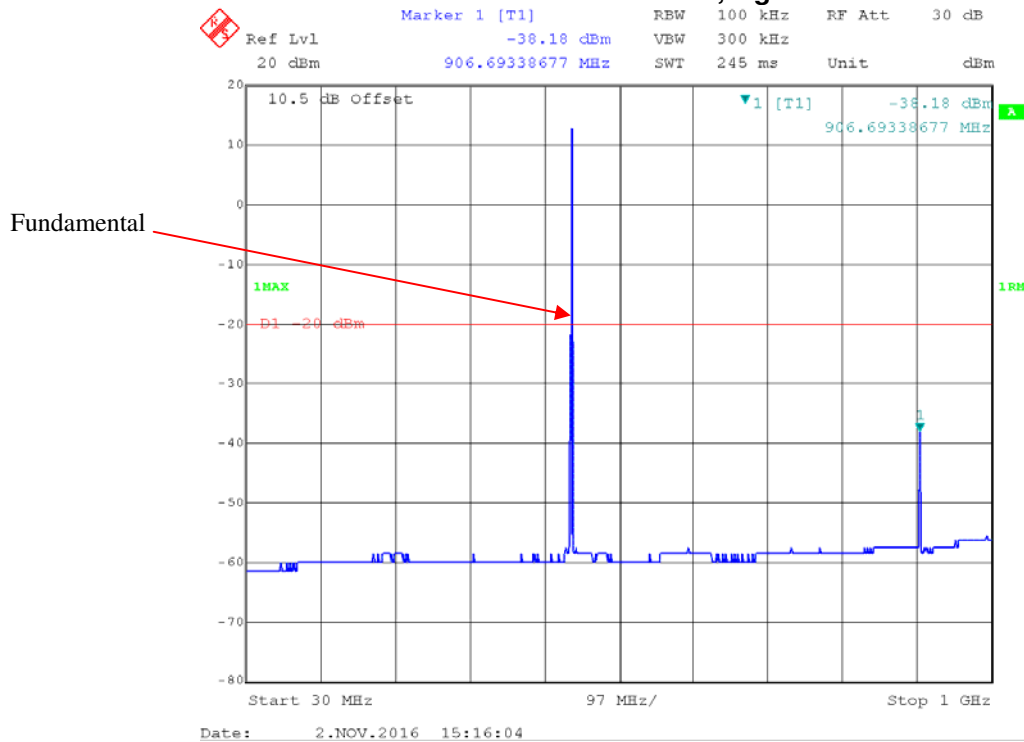
|                           |                 |
|---------------------------|-----------------|
| <b>Temperature:</b>       | 27.6~28.2 °C    |
| <b>Relative Humidity:</b> | 30~50 %         |
| <b>ATM Pressure:</b>      | 101.2~101.5 kPa |

*The testing was performed by Lorin Bian from 2016-11-02 to 2016-11-03.*

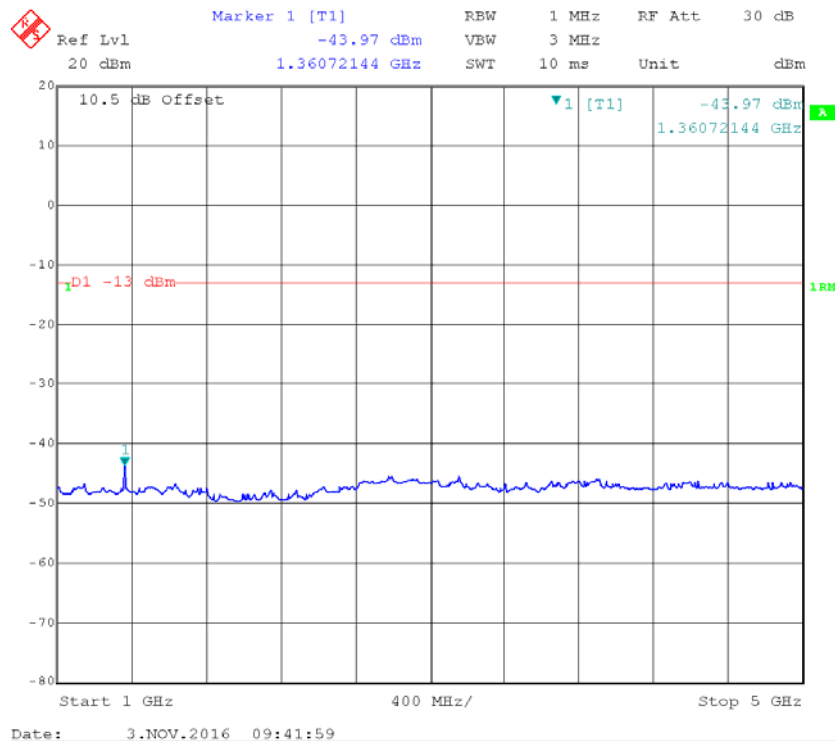
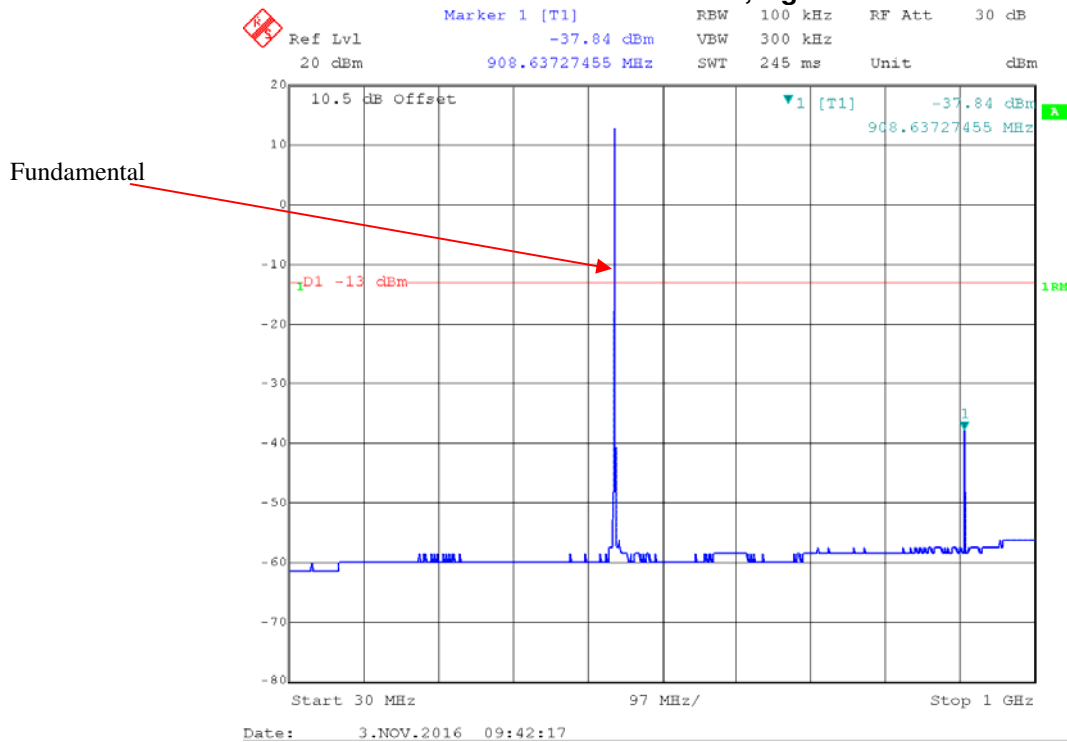
**FCC PART 90**  
**453.2125 MHz – FM Mode, High Power**



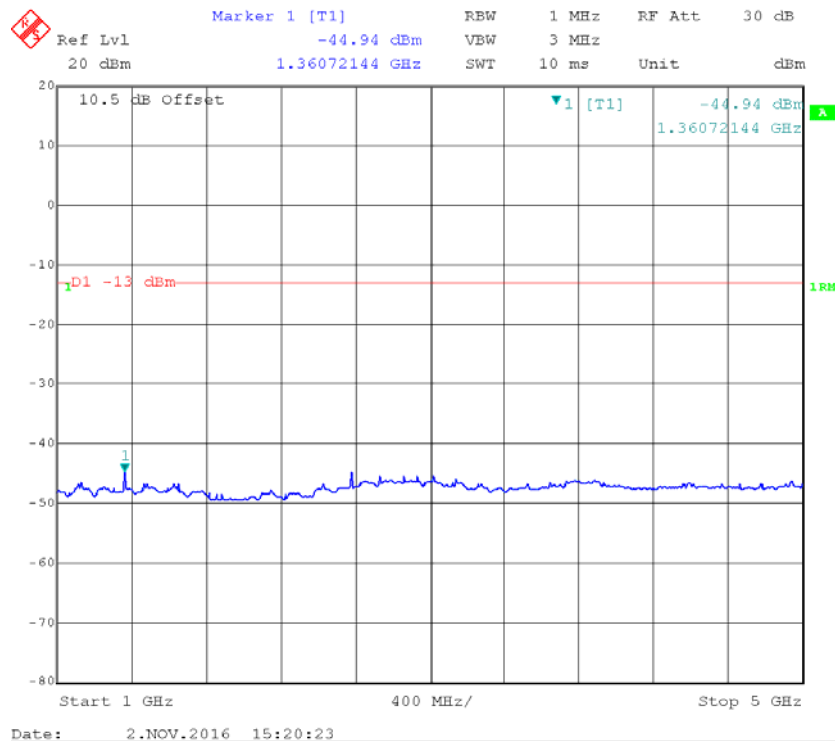
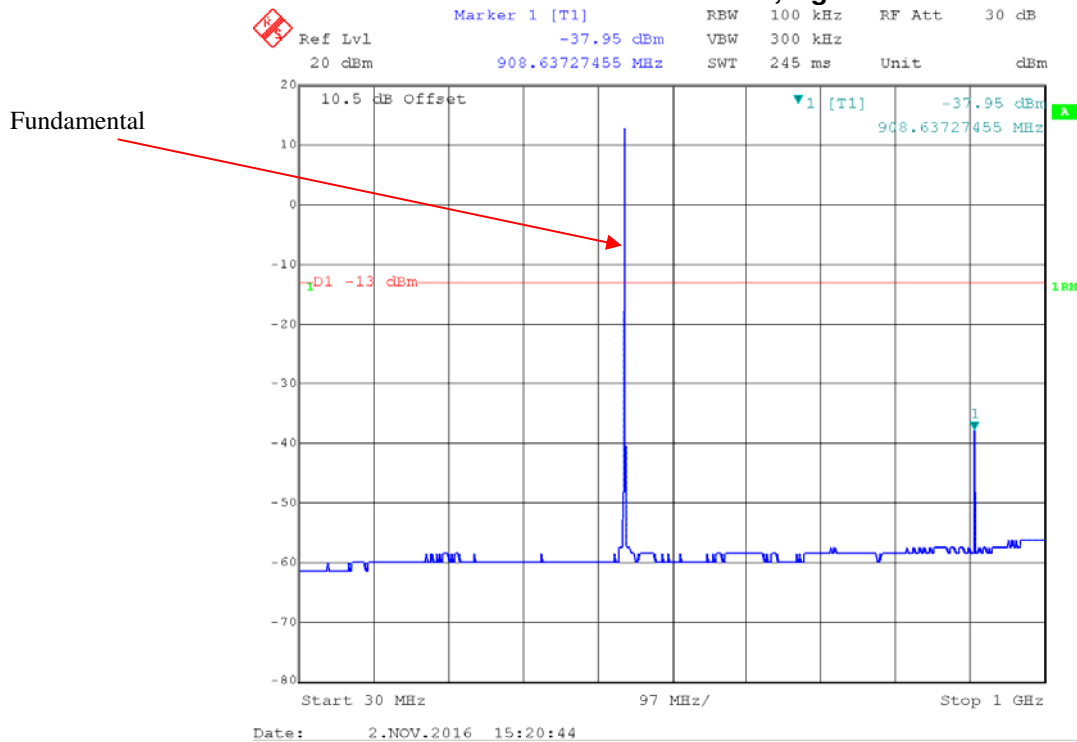
**FCC PART 90**  
**453.2125 MHz –4FSK Mode,High Power**



**FCC PART 22**  
**454.0125 MHz –FM Mode,High Power**



**FCC PART 22**  
**454.0125 MHz – 4FSK Mode, High Power**



## **FCC §2.1053 & §22.861 & §90.210 - RADIATED SPURIOUS EMISSIONS**

### **Applicable Standard**

FCC §2.1053 and §22.861 and §90.210

### **Test Equipment List and Details**

| <b>Manufacturer</b> | <b>Description</b>          | <b>Model</b> | <b>Serial Number</b> | <b>Calibration Date</b> | <b>Calibration Due Date</b> |
|---------------------|-----------------------------|--------------|----------------------|-------------------------|-----------------------------|
| Agilent             | Amplifier                   | 8447D        | 2944A10442           | 2015-12-02              | 2016-12-01                  |
| Rohde & Schwarz     | EMI Test Receiver           | ESCI         | 100028               | 2015-12-02              | 2016-12-01                  |
| Sunol Sciences      | Broadband Antenna           | JB3          | A101808              | 2016-04-10              | 2019-04-09                  |
| Rohde & Schwarz     | Spectrum Analyzer           | FSEM30       | 100018               | 2015-12-02              | 2016-12-01                  |
| ETS                 | Horn Antenna                | 3115         | 003-6076             | 2015-12-02              | 2016-12-01                  |
| ETS                 | Horn Antenna                | 3115         | 6751                 | 2014-06-16              | 2017-06-15                  |
| EMCO                | Adjustable Dipole Antenna   | 3121C        | 9109-258             | N/A                     | N/A                         |
| HP                  | Signal Generator            | 8648C        | 3623A04150           | 2016-5-23               | 2017-5-22                   |
| WILTRON             | SWEPT FREQUENCY SYNTHESIZER | 6737         | 213001               | 2016-5-23               | 2017-5-22                   |
| Mini-circuits       | Amplifier                   | ZVA-183-S+   | 771001215            | 2016-05-20              | 2017-05-19                  |
| EMCT                | Semi-Anechoic Chamber       | 966          | N/A                  | 2015-04-24              | 2018-04-23                  |
| N/A                 | RF Cable (below 1GHz)       | NO.1         | N/A                  | 2015-11-10              | 2016-11-09                  |
| N/A                 | RF Cable (below 1GHz)       | NO.4         | N/A                  | 2015-11-10              | 2016-11-09                  |
| N/A                 | RF Cable (above 1GHz)       | NO.2         | N/A                  | 2015-11-10              | 2016-11-09                  |

\* **Statement of Traceability:** BACL (Chengdu) attested that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

### **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.

For part 90:

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.

For part 22:

The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log (P) dB.

## Test Data

### Environmental Conditions

|                           |           |
|---------------------------|-----------|
| <b>Temperature:</b>       | 26.9 °C   |
| <b>Relative Humidity:</b> | 45 %      |
| <b>ATM Pressure:</b>      | 100.7 kPa |

*The testing was performed by Lorin Bian on 2016-10-24.*

Test Mode: Transmitting (FM mode, high power level)

| Frequency                                       | Polar | S.A. Reading | S.G. Level | Antenna Gain | Cable Loss | Absolute Level | Limit | Margin |
|-------------------------------------------------|-------|--------------|------------|--------------|------------|----------------|-------|--------|
| MHz                                             | H/V   | dBuV         | dBm        | dBd/dBi      | dB         | dBm            | dBm   | dB     |
| <b>Frequency: 453.2125 MHz, for FCC PART 90</b> |       |              |            |              |            |                |       |        |
| 906.425                                         | H     | 23.67        | -53.8      | 0.0          | 0.6        | -54.4          | -20.0 | 34.4   |
| 906.425                                         | V     | 24.41        | -48.4      | 0.0          | 0.6        | -49.0          | -20.0 | 29.0   |
| 1359.638                                        | H     | 41.03        | -61.8      | 7.2          | 0.8        | -55.4          | -20.0 | 35.4   |
| 1359.638                                        | V     | 41.82        | -60.3      | 7.2          | 0.8        | -53.9          | -20.0 | 33.9   |
| 1812.85                                         | H     | 38.17        | -62        | 8.0          | 0.9        | -54.9          | -20.0 | 34.9   |
| 1812.85                                         | V     | 36.57        | -62.8      | 8.0          | 0.9        | -55.7          | -20.0 | 35.7   |
| 2266.063                                        | H     | 35.78        | -64        | 8.5          | 1.4        | -56.9          | -20.0 | 36.9   |
| 2266.063                                        | V     | 35.1         | -61.5      | 8.5          | 1.4        | -54.4          | -20.0 | 34.4   |
| 2719.275                                        | H     | 34.9         | -64.3      | 8.8          | 1.1        | -56.6          | -20.0 | 36.6   |
| 2719.275                                        | V     | 34.57        | -63.8      | 8.8          | 1.1        | -56.1          | -20.0 | 36.1   |
| 3172.488                                        | H     | 34.14        | -62.9      | 8.7          | 1.2        | -55.4          | -20.0 | 35.4   |
| 3172.488                                        | V     | 34.06        | -63.3      | 8.7          | 1.2        | -55.8          | -20.0 | 35.8   |
| 3625.7                                          | H     | 33.31        | -62.6      | 8.8          | 1.3        | -55.1          | -20.0 | 35.1   |
| 3625.7                                          | V     | 33.37        | -62.9      | 8.8          | 1.3        | -55.4          | -20.0 | 35.4   |
| 4078.913                                        | H     | 32.93        | -62.1      | 9.0          | 1.6        | -54.7          | -20.0 | 34.7   |
| 4078.913                                        | V     | 32.62        | -62.4      | 9.0          | 1.6        | -55.0          | -20.0 | 35.0   |
| 4532.125                                        | H     | 34.12        | -61.3      | 10.2         | 1.6        | -52.7          | -20.0 | 32.7   |
| 4532.125                                        | V     | 34.03        | -61.4      | 10.2         | 1.6        | -52.8          | -20.0 | 32.8   |
| <b>Frequency: 454.0125 MHz, for FCC PART 22</b> |       |              |            |              |            |                |       |        |
| 908.025                                         | H     | 24.66        | -52.7      | 0.0          | 0.6        | -53.3          | -13.0 | 40.3   |
| 908.025                                         | V     | 22.77        | -50        | 0.0          | 0.6        | -50.6          | -13.0 | 37.6   |
| 1362.038                                        | H     | 42.7         | -60.2      | 7.2          | 0.8        | -53.8          | -13.0 | 40.8   |
| 1362.038                                        | V     | 41.05        | -61.1      | 7.2          | 0.8        | -54.7          | -13.0 | 41.7   |
| 1816.05                                         | H     | 36.71        | -63.4      | 8.0          | 0.9        | -56.3          | -13.0 | 43.3   |
| 1816.05                                         | V     | 35.88        | -63.4      | 8.0          | 0.9        | -56.3          | -13.0 | 43.3   |
| 2270.063                                        | H     | 35.47        | -64.3      | 8.5          | 1.4        | -57.2          | -13.0 | 44.2   |
| 2270.063                                        | V     | 35.2         | -61.4      | 8.5          | 1.4        | -54.3          | -13.0 | 41.3   |
| 2724.075                                        | H     | 34.34        | -64.8      | 8.8          | 1.1        | -57.1          | -13.0 | 44.1   |
| 2724.075                                        | V     | 34.73        | -63.6      | 8.8          | 1.1        | -55.9          | -13.0 | 42.9   |
| 3178.088                                        | H     | 34.1         | -62.9      | 8.7          | 1.2        | -55.4          | -13.0 | 42.4   |
| 3178.088                                        | V     | 34           | -63.3      | 8.7          | 1.2        | -55.8          | -13.0 | 42.8   |
| 3632.1                                          | H     | 33.67        | -62.2      | 8.8          | 1.3        | -54.7          | -13.0 | 41.7   |
| 3632.1                                          | V     | 33.68        | -62.5      | 8.8          | 1.3        | -55.0          | -13.0 | 42.0   |
| 4086.113                                        | H     | 32.6         | -62.5      | 9.0          | 1.6        | -55.1          | -13.0 | 42.1   |
| 4086.113                                        | V     | 32.83        | -62.3      | 9.0          | 1.6        | -54.9          | -13.0 | 41.9   |
| 4540.125                                        | H     | 33.89        | -61.5      | 10.2         | 1.6        | -52.9          | -13.0 | 39.9   |
| 4540.125                                        | V     | 33.76        | -61.7      | 10.2         | 1.6        | -53.1          | -13.0 | 40.1   |

Test Mode: Transmitting (4FSK mode, high power level)

| Frequency                                       | Polar | S.A. Reading | S.G. Level | Antenna Gain | Cable Loss | Absolute Level | Limit | Margin |
|-------------------------------------------------|-------|--------------|------------|--------------|------------|----------------|-------|--------|
| MHz                                             | H/V   | dBuV         | dBm        | dBd/dBi      | dB         | dBm            | dBm   | dB     |
| <b>Frequency: 453.2125 MHz, for FCC PART 90</b> |       |              |            |              |            |                |       |        |
| 906.425                                         | H     | 24.63        | -52.8      | 0.0          | 0.6        | -53.4          | -20.0 | 33.4   |
| 906.425                                         | V     | 24.67        | -48.1      | 0.0          | 0.6        | -48.7          | -20.0 | 28.7   |
| 1359.638                                        | H     | 38.79        | -64.1      | 7.2          | 0.8        | -57.7          | -20.0 | 37.7   |
| 1359.638                                        | V     | 41.69        | -60.5      | 7.2          | 0.8        | -54.1          | -20.0 | 34.1   |
| 1812.85                                         | H     | 36.34        | -63.8      | 8.0          | 0.9        | -56.7          | -20.0 | 36.7   |
| 1812.85                                         | V     | 36.38        | -63        | 8.0          | 0.9        | -55.9          | -20.0 | 35.9   |
| 2266.063                                        | H     | 36.42        | -63.4      | 8.5          | 1.4        | -56.3          | -20.0 | 36.3   |
| 2266.063                                        | V     | 36.12        | -60.5      | 8.5          | 1.4        | -53.4          | -20.0 | 33.4   |
| 2719.275                                        | H     | 34.66        | -64.5      | 8.8          | 1.1        | -56.8          | -20.0 | 36.8   |
| 2719.275                                        | V     | 35.37        | -63        | 8.8          | 1.1        | -55.3          | -20.0 | 35.3   |
| 3172.488                                        | H     | 34.63        | -62.4      | 8.7          | 1.2        | -54.9          | -20.0 | 34.9   |
| 3172.488                                        | V     | 34.32        | -63        | 8.7          | 1.2        | -55.5          | -20.0 | 35.5   |
| 3625.7                                          | H     | 33.79        | -62.1      | 8.8          | 1.3        | -54.6          | -20.0 | 34.6   |
| 3625.7                                          | V     | 33.66        | -62.6      | 8.8          | 1.3        | -55.1          | -20.0 | 35.1   |
| 4078.913                                        | H     | 32.63        | -62.4      | 9.0          | 1.6        | -55.0          | -20.0 | 35.0   |
| 4078.913                                        | V     | 32.91        | -62.1      | 9.0          | 1.6        | -54.7          | -20.0 | 34.7   |
| 4532.125                                        | H     | 34.12        | -61.3      | 10.2         | 1.6        | -52.7          | -20.0 | 32.7   |
| 4532.125                                        | V     | 33.98        | -61.4      | 10.2         | 1.6        | -52.8          | -20.0 | 32.8   |
| <b>Frequency: 454.0125 MHz, for FCC PART 22</b> |       |              |            |              |            |                |       |        |
| 908.025                                         | H     | 23.26        | -54.1      | 0.0          | 0.6        | -54.7          | -13.0 | 41.7   |
| 908.025                                         | V     | 23.44        | -49.3      | 0.0          | 0.6        | -49.9          | -13.0 | 36.9   |
| 1362.038                                        | H     | 37.01        | -65.9      | 7.2          | 0.8        | -59.5          | -13.0 | 46.5   |
| 1362.038                                        | V     | 41.52        | -60.6      | 7.2          | 0.8        | -54.2          | -13.0 | 41.2   |
| 1816.05                                         | H     | 36.53        | -63.6      | 8.0          | 0.9        | -56.5          | -13.0 | 43.5   |
| 1816.05                                         | V     | 36.45        | -62.8      | 8.0          | 0.9        | -55.7          | -13.0 | 42.7   |
| 2270.063                                        | H     | 35.17        | -64.6      | 8.5          | 1.4        | -57.5          | -13.0 | 44.5   |
| 2270.063                                        | V     | 35.83        | -60.8      | 8.5          | 1.4        | -53.7          | -13.0 | 40.7   |
| 2724.075                                        | H     | 35.79        | -63.4      | 8.8          | 1.1        | -55.7          | -13.0 | 42.7   |
| 2724.075                                        | V     | 35.21        | -63.1      | 8.8          | 1.1        | -55.4          | -13.0 | 42.4   |
| 3178.088                                        | H     | 35           | -62        | 8.7          | 1.2        | -54.5          | -13.0 | 41.5   |
| 3178.088                                        | V     | 36.12        | -61.2      | 8.7          | 1.2        | -53.7          | -13.0 | 40.7   |
| 3632.1                                          | H     | 33.14        | -62.7      | 8.8          | 1.3        | -55.2          | -13.0 | 42.2   |
| 3632.1                                          | V     | 33.68        | -62.5      | 8.8          | 1.3        | -55.0          | -13.0 | 42.0   |
| 4086.113                                        | H     | 32.99        | -62.1      | 9.0          | 1.6        | -54.7          | -13.0 | 41.7   |
| 4086.113                                        | V     | 32.67        | -62.4      | 9.0          | 1.6        | -55.0          | -13.0 | 42.0   |
| 4540.125                                        | H     | 33.67        | -61.8      | 10.2         | 1.6        | -53.2          | -13.0 | 40.2   |
| 4540.125                                        | V     | 34.96        | -60.5      | 10.2         | 1.6        | -51.9          | -13.0 | 38.9   |

**Note:**

- 1) The unit of Antenna Gain is dBd for frequency below 1GHz, and the unit of Antenna Gain is dBi for frequency above 1GHz.
- 2) Absolute Level = SG Level - Cable loss + Antenna Gain
- 3) Margin = Limit-Absolute Level

## **FCC §2.1055 & § 22.355 & §90.213- FREQUENCY STABILITY**

### **Applicable Standard**

FCC §2.1055, § 22.355, §90.213

### **Test Equipment List and Details**

| <b>Manufacturer</b> | <b>Description</b>            | <b>Model No.</b> | <b>Serial No.</b> | <b>Calibration Date</b> | <b>Calibration Due Date</b> |
|---------------------|-------------------------------|------------------|-------------------|-------------------------|-----------------------------|
| BACL                | High Temperature Test Chamber | BTH-150          | 30024             | 2015-12-2               | 2016-12-1                   |
| FLUKE               | Multimeter                    | 1587             | 27870099          | 2015-12-30              | 2016-12-29                  |
| Rohde & Schwarz     | Signal Analyzer               | FSIQ26           | 831929/005        | 2016-09-21              | 2017-09-20                  |
| N/A                 | RF Attenuator                 | 20dB             | N/A               | Each Time               | /                           |

\* **Statement of Traceability:** BACL (Chengdu) attested that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

### **Test Procedure**

Frequency Stability vs. Temperature: The equipment under test was connected to 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 power 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.

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

- (1) Vary primary supply voltage from 85 to 115 percent of the nominal value.
- (2) For hand carried, battery powered equipment, reduce primary supply voltage to the battery operating end point which shall be specified by the manufacturer.

## Test Data

### Environmental Conditions

|                           |           |
|---------------------------|-----------|
| <b>Temperature:</b>       | 28.2 °C   |
| <b>Relative Humidity:</b> | 50 %      |
| <b>ATM Pressure:</b>      | 101.2 kPa |

*The testing was performed by Lorin Bian on 2016-11-03.*

*Test Mode: Transmitting*

FCC PART 90:

| Reference Frequency: 453.2125 MHz, Limit: 2.5 ppm |                 |            |                 |
|---------------------------------------------------|-----------------|------------|-----------------|
| Temperature                                       | Voltage         | Measured   | Frequency Error |
| °C                                                | V <sub>DC</sub> | MHz        | ppm             |
| -30                                               | 3.8             | 453.212597 | 0.21            |
| -20                                               |                 | 453.212599 | 0.22            |
| -10                                               |                 | 453.212591 | 0.20            |
| 0                                                 |                 | 453.215980 | 7.68            |
| 10                                                |                 | 453.212592 | 0.20            |
| 20                                                |                 | 453.212595 | 0.21            |
| 30                                                |                 | 453.212601 | 0.22            |
| 40                                                |                 | 453.212607 | 0.24            |
| 50                                                |                 | 453.212609 | 0.24            |
| 60                                                |                 | 453.212613 | 0.25            |
| 20                                                | 3.5             | 453.212592 | 0.20            |
| 20                                                | 4.35            | 453.212596 | 0.21            |

FCC PART 22:

| Reference Frequency: 454.0125 MHz, Limit: 2.5 ppm |                 |            |                 |
|---------------------------------------------------|-----------------|------------|-----------------|
| Temperature                                       | Voltage         | Measured   | Frequency Error |
| °C                                                | V <sub>DC</sub> | MHz        | ppm             |
| -30                                               | 3.8             | 454.012587 | 0.19            |
| -20                                               |                 | 454.012591 | 0.20            |
| -10                                               |                 | 454.012593 | 0.20            |
| 0                                                 |                 | 454.012607 | 0.24            |
| 10                                                |                 | 454.012604 | 0.23            |
| 20                                                |                 | 454.012601 | 0.22            |
| 30                                                |                 | 454.012611 | 0.24            |
| 40                                                |                 | 454.012609 | 0.24            |
| 50                                                |                 | 454.012605 | 0.23            |
| 60                                                |                 | 454.012612 | 0.25            |
| 20                                                | 3.5             | 454.012598 | 0.22            |
| 20                                                | 4.35            | 454.012602 | 0.22            |

Note: The extreme voltage is declared by the manufacturer.

## 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 Equipment List and Details

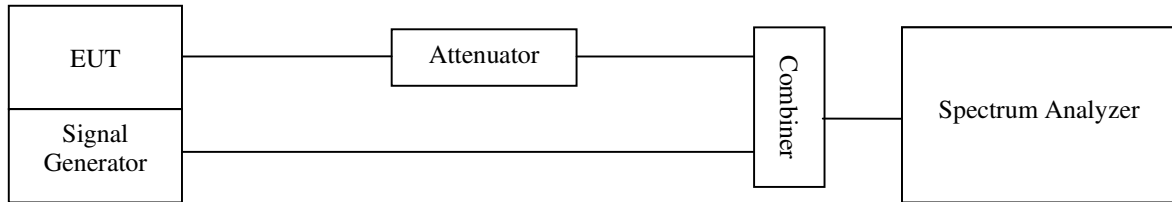
| Manufacturer    | Description     | Model No. | Serial No. | Calibration Date | Calibration Due Date |
|-----------------|-----------------|-----------|------------|------------------|----------------------|
| Rohde & Schwarz | Signal Analyzer | FSIQ26    | 831929/005 | 2016-09-21       | 2017-09-20           |
| N/A             | RF Attenuator   | 20dB      | N/A        | Each Time        | /                    |

\* **Statement of Traceability:** BACL (Chengdu) attested that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

### Test Procedure

- Connect the EUT and test equipment as shown on the following block diagram.
- Set the Spectrum Analyzer to measure FM deviation, and tune the RF frequency to the transmitter assigned frequency.
- 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.
- Turn on the transmitter.
- 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  $P_0$ .
- Turn off the transmitter.
- 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.
- Remove the attenuation 1, so the input power to the Spectrum Analyzer is increased by 30 dB when the transmitter is turned on.
- 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.
- 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

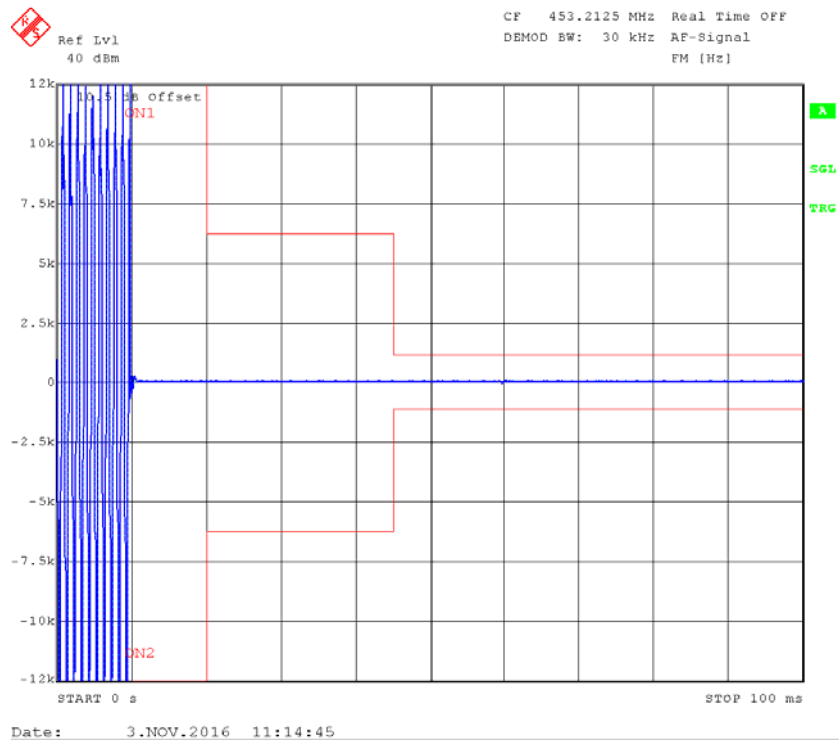
|                           |           |
|---------------------------|-----------|
| <b>Temperature:</b>       | 28.2 °C   |
| <b>Relative Humidity:</b> | 50 %      |
| <b>ATM Pressure:</b>      | 101.2 kPa |

The testing was performed by Lorin Bian on 2016-11-03.

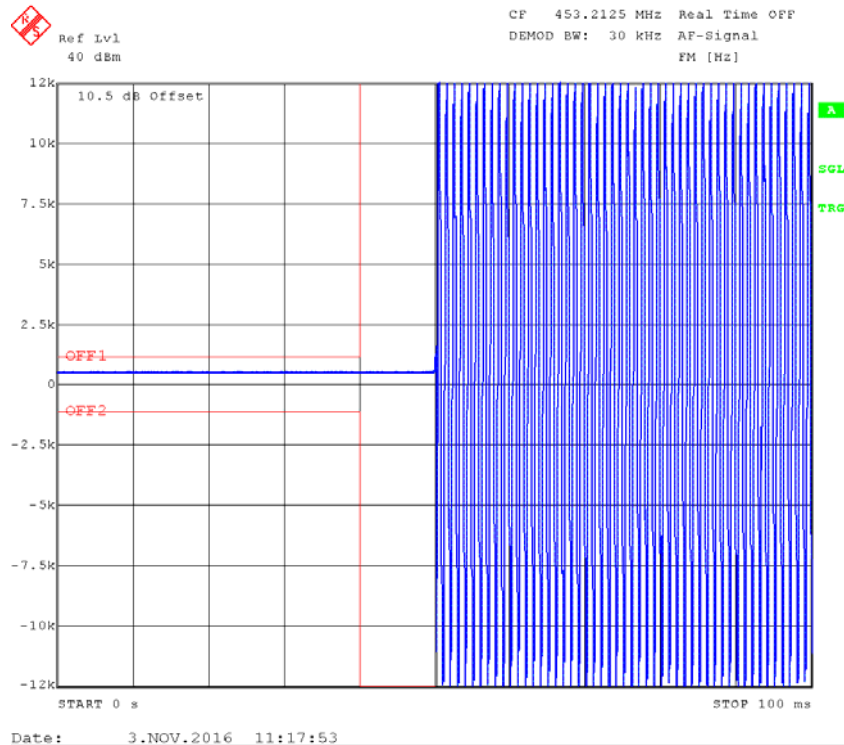
| Channel Spacing<br>(kHz) | Transient Period<br>(ms) | Maximum frequency<br>difference | Result |
|--------------------------|--------------------------|---------------------------------|--------|
| 12.5                     | $< 10(t_1)$              | $\pm 12.5$ kHz                  | Pass   |
|                          | $< 25(t_2)$              | $\pm 6.25$ kHz                  |        |
|                          | $< 10(t_3)$              | $\pm 12.5$ kHz                  |        |

Please refer to the following plots.

### Turn on – 453.2125 MHz, High power level



### Turn off – 453.2125 MHz, High power level



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