# FCC PART 22, 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: YAMBD51XVHF

| Report Type: | Product Type: |
|---|---|
| Original Report | Digital Portable Radio |

| | |
|---|---|
| **Report Number:** | RDG161124002-00A |
| **Report Date:** | 2016-12-29 |
| **Reviewed By:** | Oscar Ye<br>Engineer |
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**Note**: This test report is prepared for the customer shown above and for the equipment described herein. It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp.

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# GENERAL INFORMATION

## Product Description for Equipment under Test (EUT)

The *Hytera Communications Corporation Limited*'s product, model number: *BD512 VHF (FCC ID: YAMBD51XVHF)* or the "EUT" in this report was a *Digital Portable Radio*which was measured approximately: 12.2 cm (L) x 6.0 cm (W) x 3.6 cm (H) and the charger was measured approximately: 7.6 cm (L) * 7.6 cm (W) * 4.6 cm (H), rated input voltage: DC 7.2V rechargeable Li-ion battery or DC 12.0 V from adapter.

Adapter Information:
Model: HKA01212010-XQ
Input: AC 100-240V, 50/60 Hz, 0.5A
Output: DC 12V, 1.0A

*Notes: For the product, series model BD512 VHF and BD515 VHF, BD516 VHF, BD518 VHF have the same appearance, PCB and Material, the difference among them is just the model number. BD512 VHF were selected for fully testing, the detailed differences between them were explained and stated in the attached product similarity declaration letter by the applicant.*

** All measurement and test data in this report was gathered from production sample serial number: 161124002 (Assigned by BACL, Kunshan). The EUT supplied by the applicant was received on 2016-11-24.*

## 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 Communication Commissions rules.

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

No related submissions.

## 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 90 – Private Land Mobile Radio Service

Applicable Standards: TIA 603-D and ANSI C63.4-2014.

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

## Measurement Uncertainty

| Item | | Uncertainty |
|---|---|---|
| RF Output Power<br>Modulation Characteristic<br>Occupied Bandwidth & Emission Mask<br>Spurious Emission at Antenna Terminal<br>Frequency Stability<br>Transient Frequency Behavior | | ±0.9dB |
| Radiated emission | 30MHz~1GHz | ±5.91dB |
| | Above 1G | ±4.92dB |
| Temperature | | ±1.0℃ |
| Humidity | | ±6% |

## Test Facility

The test site used by Bay Area Compliance Laboratories Corp. (Kunshan) to collect test data is located on the No.248 Chenghu Road, Kunshan, Jiangsu province, China.

Test site at Bay Area Compliance Laboratories Corp. (Kunshan) 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 November 06, 2014. 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.: 815570. 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

## 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.

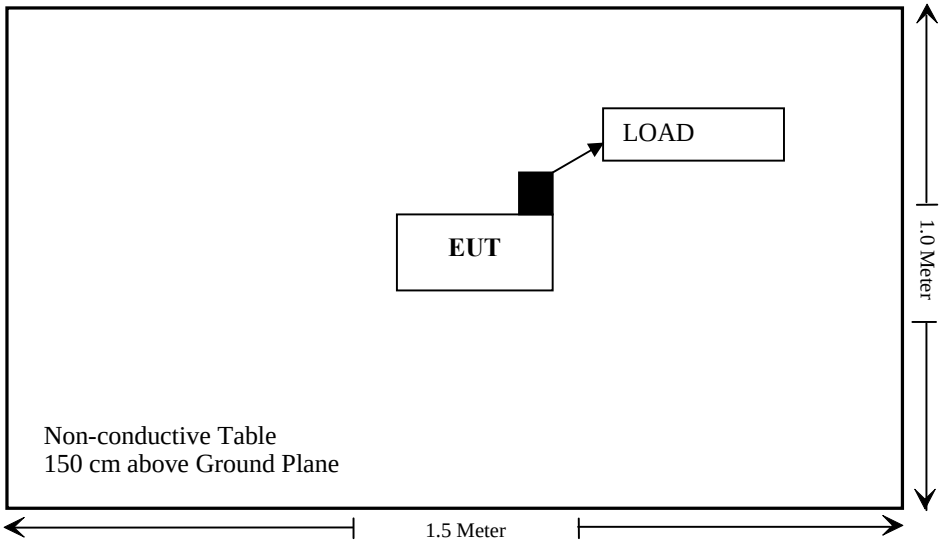
## Equipment Modifications

No modification was made to the EUT tested.

## Support Equipment List and Details

| Manufacturer | Description | Model | Serial Number |
|---|---|---|---|
| N/A | 50 ohm Load | N/A | N/A |

## Block Diagram of Test Setup



# SUMMARY OF TEST RESULTS

| FCC Rules | Description of Test | Results |
|---|---|---|
| §1.1307(b), §2.1093 | RF Exposure | Compliance |
| §2.1046; § 22.565; §90.205 | RF Output Power | Compliance |
| §2.1047; §90.207 | Modulation Characteristic | Compliance |
| §2.1049;§22.359; §90.210 | Occupied Bandwidth & Emission Mask | Compliance |
| §2.1051; §22.359;§90.210 | Spurious Emission at Antenna Terminal | Compliance |
| §2.1053; 359;§90.210 | Spurious Radiated Emissions | Compliance |
| §2.1055; § 22.355;§90.213 | Frequency Stability | Compliance |
| §90.214 | Transient Frequency Behavior | Compliance |

# TEST EQUIPMENT LIST

| Manufacturer | Description | Model | Serial Number | Calibration Date | Calibration Due Date |
|---|---|---|---|---|---|
| **Radiated Emission Test** | | | | | |
| Sonoma Instrunent | Amplifier | 330 | 171377 | 2015-12-12 | 2016-12-12 |
| Rohde & Schwarz | EMI Test Receiver | ESCI | 100195 | 2016-11-25 | 2017-11-25 |
| Sunol Sciences | Broadband Antenna | JB3 | A090314-2 | 2016-01-09 | 2019-01-08 |
| Sunol Sciences | Broadband Antenna | JB3 | A090314-1 | 2016-01-09 | 2019-01-08 |
| Narda | Pre-amplifier | AFS42-00101800 | 2001270 | 2016-09-08 | 2017-09-08 |
| EMCO | Horn Antenna | 3116 | 9510-2384 | 2015-11-07 | 2018-11-06 |
| Rohde & Schwarz | Signal Analyzer | FSIQ26 | 100048 | 2016-11-25 | 2017-11-25 |
| ETS | Horn Antenna | 3115 | 6229 | 2016-01-11 | 2017-01-10 |
| ETS | Horn Antenna | 3115 | 9311-4159 | 2016-01-11 | 2017-01-10 |
| R&S | Auto test Software | EMC32 | V 09.10.0 | NCR | NCR |
| haojintech | Coaxial Cable | Cable-1 | 001 | 2015-12-12 | 2016-12-12 |
| haojintech | Coaxial Cable | Cable-2 | 002 | 2015-12-12 | 2016-12-12 |
| haojintech | Coaxial Cable | Cable-3 | 003 | 2015-12-12 | 2016-12-12 |
| MICRO-COAX | Coaxial Cable | Cable-4 | 004 | 2015-12-12 | 2016-12-12 |
| MICRO-COAX | Coaxial Cable | Cable-5 | 005 | 2015-12-12 | 2016-12-12 |
| MICRO-COAX | Coaxial Cable | Cable-7 | 007 | 2015-12-12 | 2016-12-12 |
| HP | Signal Generator | 8341B | 2624A00116 | 2016-08-29 | 2017-08-29 |
| **RF Conducted test** | | | | | |
| BACL | TS 8997 Cable-01 | T-KS-EMC086 | T-KS-EMC086 | 2015-12-10 | 2016-12-09 |
| BACL | TS 8997 Cable-01 | T-KS-EMC086 | T-KS-EMC086 | 2016-12-10 | 2017-12-09 |
| BACL | RF cable | KS-LAB-012 | KS-LAB-012 | 2015-12-16 | 2016-12-15 |
| Rohde & Schwarz | Signal Analyzer | FSIQ26 | 836131/009 | 2016-09-21 | 2017-09-21 |
| HEWLETT PACKARD | RF Communications Test SET | 8920A | 3438A05201 | 2016-09-21 | 2017-09-21 |
| HONOVA | Power Splitter | ZFRSC-14-S+ | 019411452 | 2016-06-12 | 2017-06-12 |
| N/A | 30dB Attenuator | 100W 30dB | N/A | 2016-06-18 | 2017-06-18 |

*** Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Kunshan) 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) & §2.1093 - RF EXPOSURE

## Applicable Standard

According to FCC §1.1307(b) and §2.1093, protable device operates Part 90 should be subjected to rountine environmental evaluation for RF exposure prior or equipment authorization or use.

**Result:** Compliance.

Please refer to SAR Report Number: RDG161124002-20A.

# FCC §2.1046 & § 22.565 & §90.205 - RF OUTPUT POWER

## Applicable Standard

FCC §2.1046, § 22.565 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 ℃ |
| **Relative Humidity:** | 51 % |
| **ATM Pressure:** | 101.0 kPa |

*The testing was performed by Alisa Gao on 2016-12-01.*

*Test Mode: Transmitting*

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

| Mode | Frequency Spacing (kHz) | Frequency (MHz) | Power level | Output (dBm) | Output Power (W) | Note |
|---|---|---|---|---|---|---|
| Analog | 12.5 | 136.025 | High | 37.12 | 5.15 | For Federal |
| | | | Low | 30.51 | 1.12 | |
| | | 151.85 | High | 37.04 | 5.06 | For Part 22&90 |
| | | | Low | 30.09 | 1.02 | |
| | | 155.7525 | High | 37.07 | 5.09 | For Part 90 |
| | | | Low | 30.07 | 1.02 | |
| | | 161.61 | High | 37.04 | 5.06 | For Part 22&90 |
| | | | Low | 30.01 | 1.00 | |
| | | 173.97 | High | 37.06 | 5.08 | For Federal |
| | | | Low | 30.25 | 1.06 | |
| Digital | 12.5 | 136.025 | High | 37.11 | 5.14 | For Federal |
| | | | Low | 30.47 | 1.11 | |
| | | 151.85 | High | 37.08 | 5.11 | For Part 22&90 |
| | | | Low | 30.06 | 1.01 | |
| | | 155.7525 | High | 37.09 | 5.12 | For Part 90 |
| | | | Low | 30.04 | 1.01 | |
| | | 161.61 | High | 37.02 | 5.04 | For Part 22&90 |
| | | | Low | 30.04 | 1.01 | |
| | | 173.97 | High | 37.09 | 5.12 | For Federal |
| | | | Low | 30.27 | 1.06 | |

Note: The high rated power is 5.0W.
The low rated power is 1.0W.

# FCC §2.1047 & §90.207 - MODULATION CHARACTERISTIC

## Applicable Standard

FCC§2.1047 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-603D 2.2.3

## Test Data

### Environmental Conditions

| | |
|---|---|
| **Temperature:** | 26 ℃ |
| **Relative Humidity:** | 52 % |
| **ATM Pressure:** | 101.0 kPa |

*The testing was performed by Alisa Gao on 2016-12-02.*

*Test Mode: Transmitting*

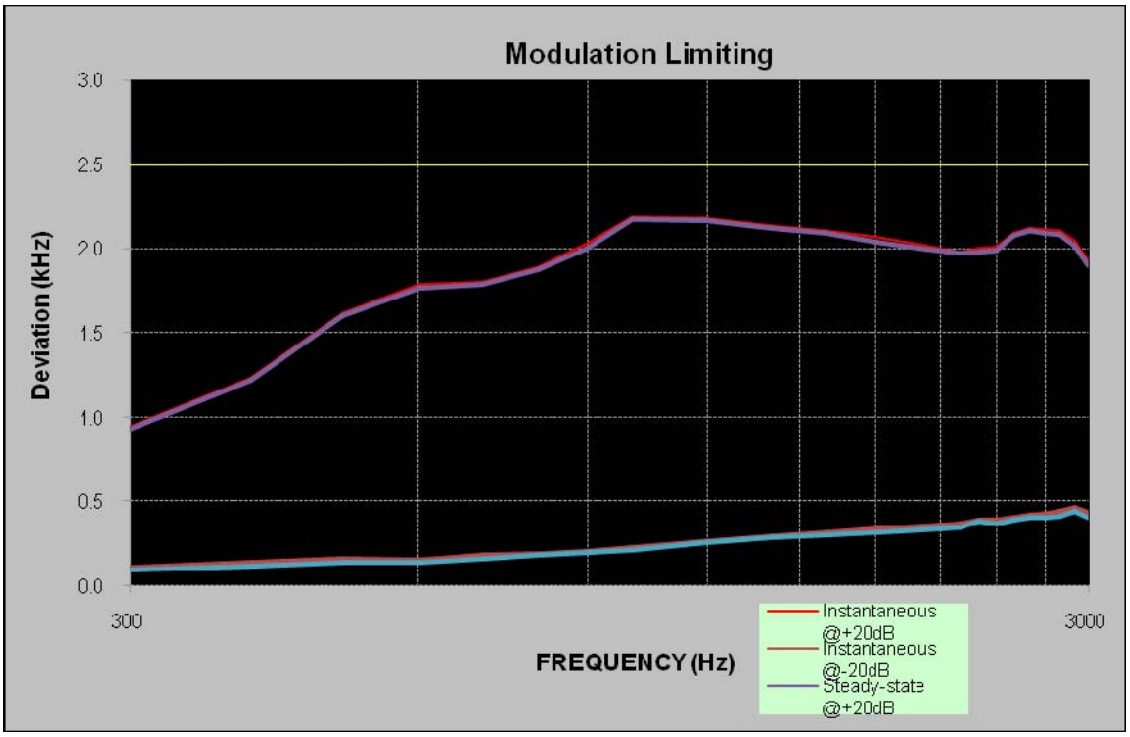
**Result:** Compliance.

**Analog Modulation:**

## MODULATION LIMITING

Carrier Frequency: 155.7525MHz, Channel Separation=12.5 kHz

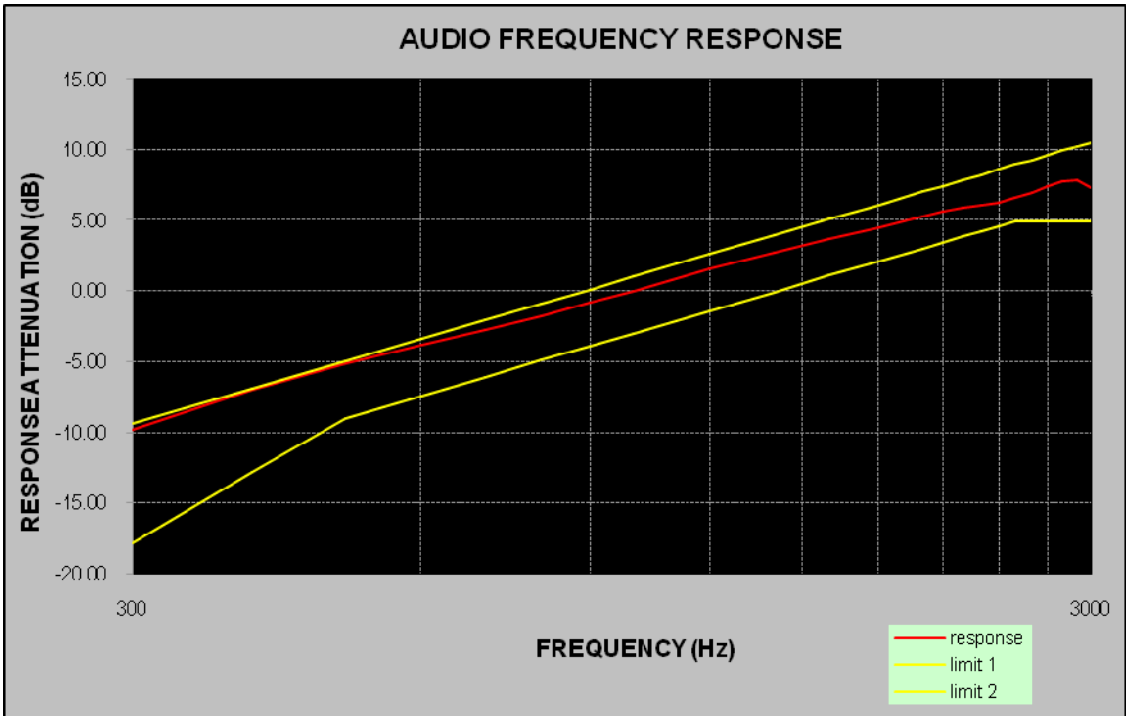
| Audio Frequency (Hz) | Instantaneous | | Steady-state | | FCC Limit [kHz] |
|---|---|---|---|---|---|
| | DEVIATION (@+20dB) [kHz] | DEVIATION (@-20dB) [kHz] | DEVIATION (@+20dB) [kHz] | DEVIATION (@-20dB) [kHz] | |
| 300 | 0.946 | 0.114 | 0.931 | 0.098 | 2.500 |
| 400 | 1.237 | 0.139 | 1.218 | 0.118 | 2.500 |
| 500 | 1.619 | 0.161 | 1.602 | 0.142 | 2.500 |
| 600 | 1.788 | 0.156 | 1.765 | 0.137 | 2.500 |
| 700 | 1.804 | 0.183 | 1.789 | 0.165 | 2.500 |
| 800 | 1.894 | 0.195 | 1.880 | 0.184 | 2.500 |
| 900 | 2.030 | 0.210 | 2.005 | 0.196 | 2.500 |
| 1000 | 2.191 | 0.232 | 2.176 | 0.211 | 2.500 |
| 1200 | 2.182 | 0.267 | 2.163 | 0.257 | 2.500 |
| 1400 | 2.136 | 0.293 | 2.118 | 0.288 | 2.500 |
| 1600 | 2.104 | 0.317 | 2.089 | 0.305 | 2.500 |
| 1800 | 2.066 | 0.340 | 2.041 | 0.319 | 2.500 |
| 2000 | 2.027 | 0.354 | 2.002 | 0.335 | 2.500 |
| 2100 | 2.006 | 0.362 | 1.987 | 0.341 | 2.500 |
| 2200 | 1.983 | 0.369 | 1.975 | 0.348 | 2.500 |
| 2300 | 2.003 | 0.395 | 1.983 | 0.383 | 2.500 |
| 2400 | 2.010 | 0.389 | 1.989 | 0.372 | 2.500 |
| 2500 | 2.092 | 0.404 | 2.076 | 0.395 | 2.500 |
| 2600 | 2.119 | 0.422 | 2.104 | 0.406 | 2.500 |
| 2700 | 2.112 | 0.430 | 2.095 | 0.409 | 2.500 |
| 2800 | 2.103 | 0.442 | 2.086 | 0.416 | 2.500 |
| 2900 | 2.045 | 0.468 | 2.018 | 0.441 | 2.500 |
| 3000 | 1.926 | 0.435 | 1.903 | 0.407 | 2.500 |


Modulation Limiting
Deviation (kHz)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
300
3000
FREQUENCY (Hz)
Instantaneous @+20dB
Instantaneous @-20dB
Steady-state @+20dB

**Audio Frequency Response**

Carrier Frequency: 155.7525 MHz, Channel Separation=12.5 kHz

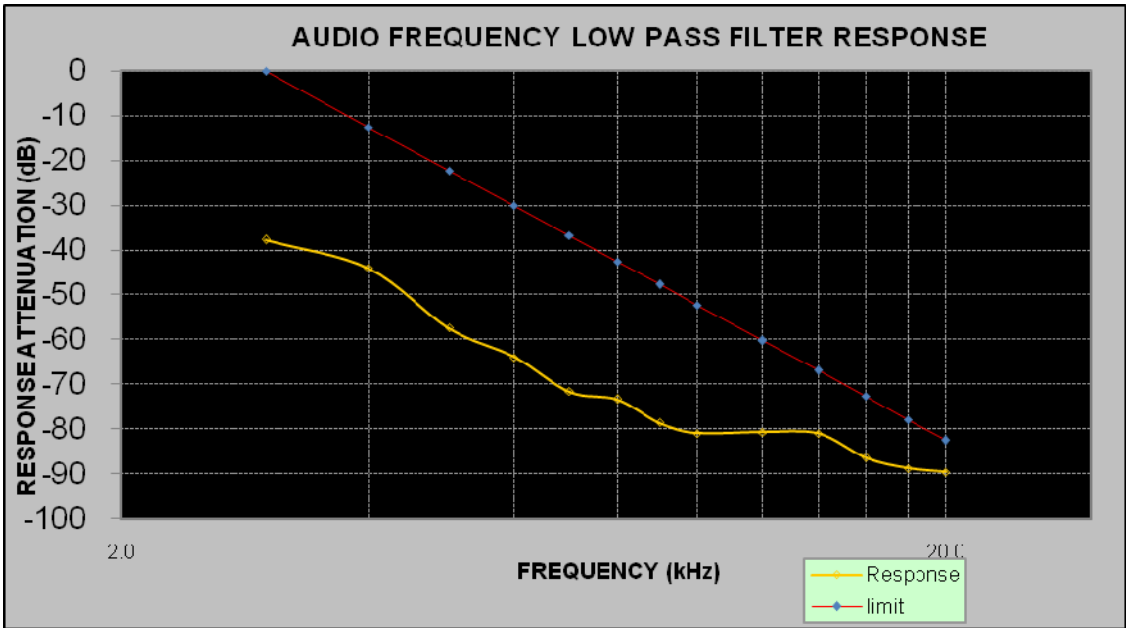
| Audio Frequency (Hz) | Response Attenuation (dB) |
|---|---|
| 300 | -9.84 |
| 400 | -7.01 |
| 500 | -5.19 |
| 600 | -3.88 |
| 700 | -2.78 |
| 800 | -1.83 |
| 900 | -0.82 |
| 1000 | 0.00 |
| 1200 | 1.55 |
| 1400 | 2.73 |
| 1600 | 3.71 |
| 1800 | 4.51 |
| 2000 | 5.27 |
| 2100 | 5.61 |
| 2200 | 5.86 |
| 2300 | 6.06 |
| 2400 | 6.27 |
| 2500 | 6.57 |
| 2600 | 6.96 |
| 2700 | 7.40 |
| 2800 | 7.71 |
| 2900 | 7.83 |
| 3000 | 7.33 |


AUDIO FREQUENCY RESPONSE
15.00
10.00
5.00
0.00
-5.00
-10.00
-15.00
-20.00
RESPONSEATTENUATION (dB)
300
3000
FREQUENCY (Hz)
response
limit 1
limit 2

**Audio frequency lows pass filter response**

Carrier Frequency: 155.7525 MHz, Channel Separation=12.5 kHz

| Audio Frequency (kHz) | Response Attenuation (dB) | Limit (dB) |
|---|---|---|
| 1.0 | 0.0 | / |
| 3.0 | -37.7 | 0.0 |
| 4.0 | -44.0 | -12.5 |
| 5.0 | -57.4 | -22.2 |
| 6.0 | -63.9 | -30.1 |
| 7.0 | -71.6 | -36.8 |
| 8.0 | -73.3 | -42.6 |
| 9.0 | -78.5 | -47.7 |
| 10.0 | -80.9 | -52.3 |
| 12.0 | -80.7 | -60.2 |
| 14.0 | -81.0 | -66.9 |
| 16.0 | -86.4 | -72.7 |
| 18.0 | -88.7 | -77.8 |
| 20.0 | -89.6 | -82.5 |



# FCC §2.1049 & §22.359 & §90.210 – OCCUPIED BANDWIDTH & EMISSION MASK

## Applicable Standard

FCC §2.1049, §22.359 and §90.210

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 $f_0$, 0dB.

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 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: At least 50 + 10 log (P) dB or 70 dB, whichever is the lesser attenuation.

## Test Procedure

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

The resolution bandwidth of the spectrum analyzer was set at 100 Hz and the spectrum was recorded in the frequency band ±50 kHz from the carrier frequency.

## Test Data

### Environmental Conditions

| | |
|---|---|
| **Temperature:** | 24.5 ℃ |
| **Relative Humidity:** | 50 % |
| **ATM Pressure:** | 101.0 kPa |

*The testing was performed by Alisa Gao on 2016-12-15.*

| Modulation | Frequency (MHz) | Channel space (kHz) | Power Level | 99% Occupied Bandwidth (kHz) | 26 dB Emissions Bandwidth (kHz) |
|---|---|---|---|---|---|
| Analog | 151.85 | 12.5 | High | 5.29 | 10.34 |
| | | | Low | 5.29 | 10.34 |
| | 155.7525 | 12.5 | High | 5.29 | 10.34 |
| | | | Low | 5.29 | 10.34 |
| | 161.61 | 12.5 | High | 5.29 | 10.34 |
| | | | Low | 5.29 | 10.34 |
| Digital | 151.85 | 12.5 | High | 6.73 | 9.02 |
| | | | Low | 6.85 | 9.74 |
| | 155.7525 | 12.5 | High | 6.73 | 9.50 |
| | | | Low | 7.09 | 9.50 |
| | 161.61 | 12.5 | High | 6.97 | 9.26 |
| | | | Low | 6.97 | 9.50 |

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

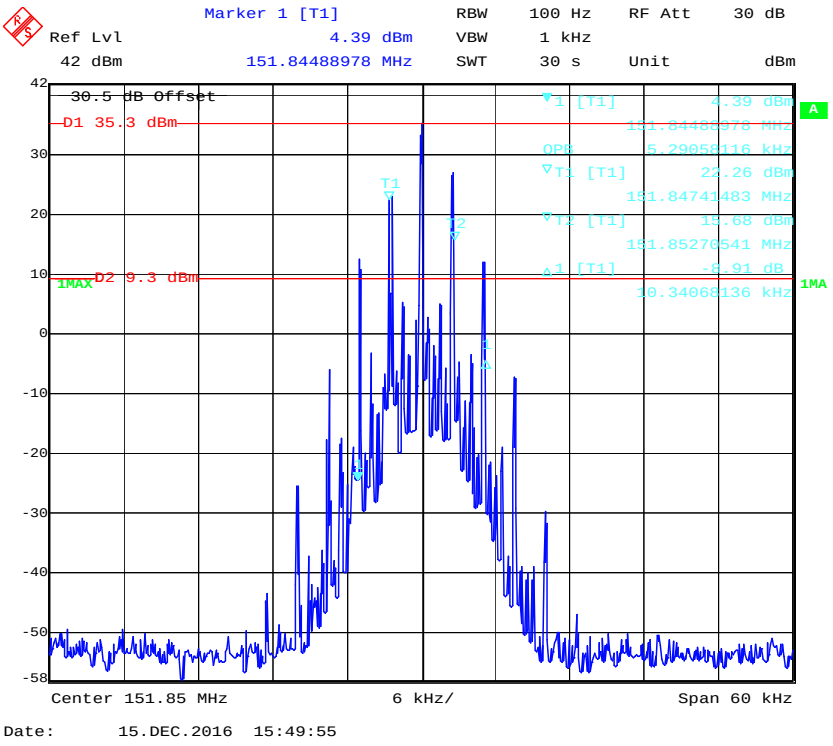
Emission Designator Per CFR 47 §2.201& §2.202&, $B_n = 2M + 2D$

**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 kHz + 2.5 kHz) = 11 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.

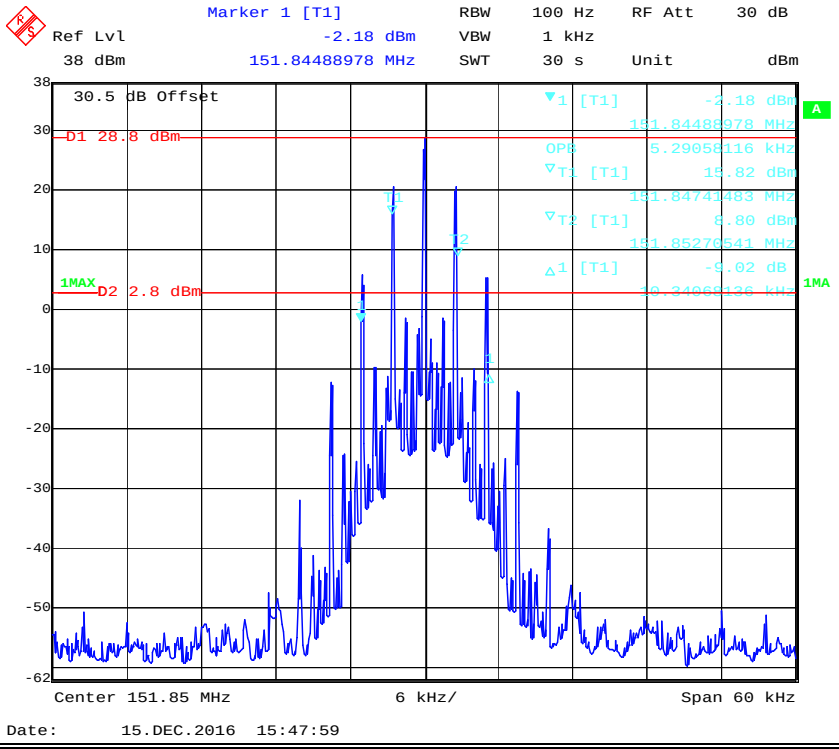
For Digital Mode (Channel Spacing: 12.5 kHz)
Emission Designator 7K60F1D and 7K60F1E
The 99% energy rule (title 47CFR 2.1049) was used for digital mode. It basically states that 99% of the modulation energy falls within X kHz, in this case, 7.09 kHz. The emission mask was obtained from 47CFR 90.210(d).
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:**

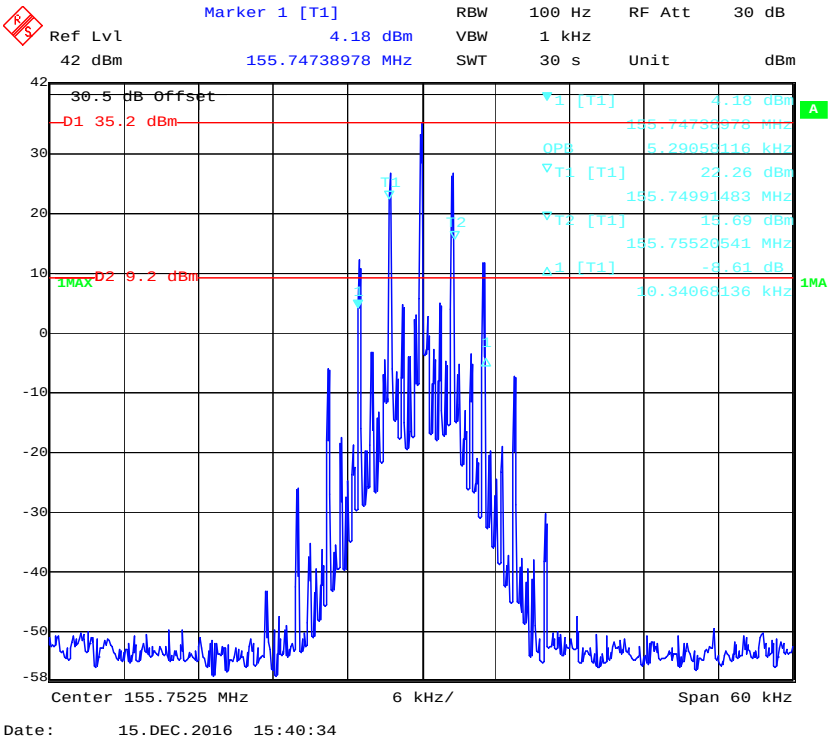
**Frequency 151.85 MHz: 99% Occupied & 26 dB Bandwidth, High Power**



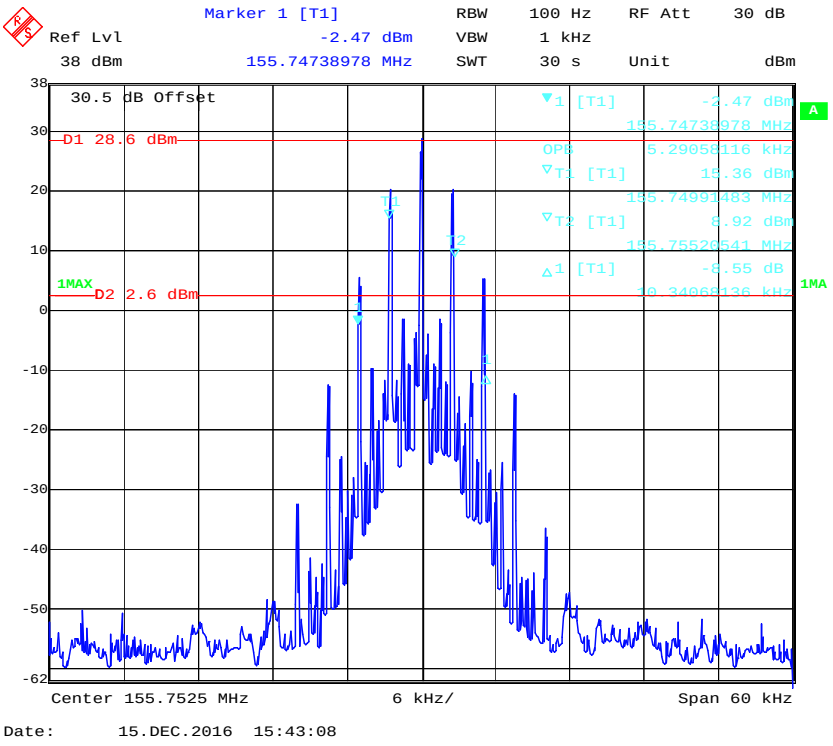

**Frequency 151.85 MHz: 99% Occupied & 26 dB Bandwidth, Low Power**



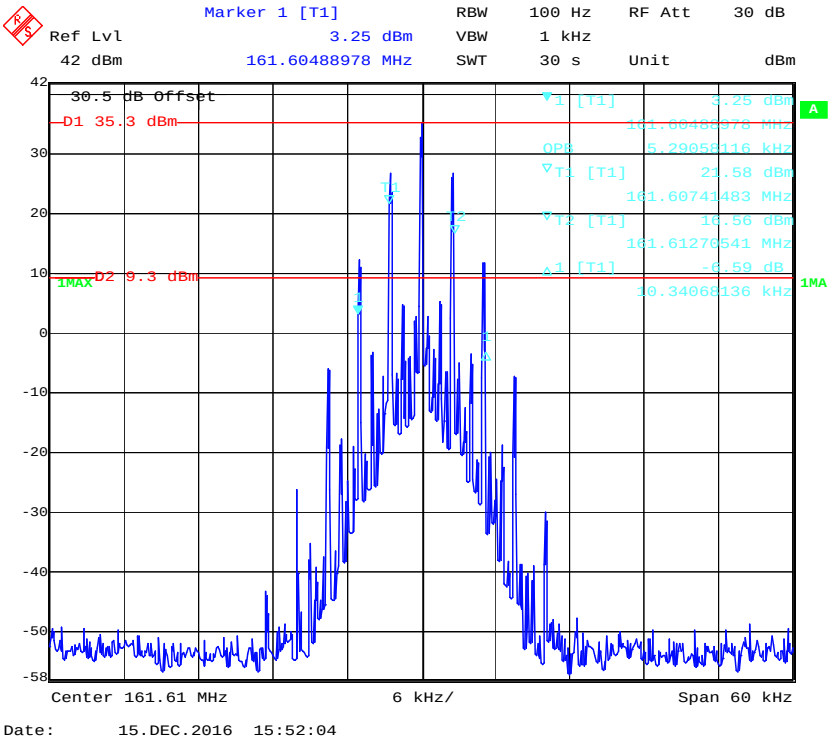
**Frequency 155.7525 MHz: 99% Occupied & 26 dB Bandwidth, High Power**



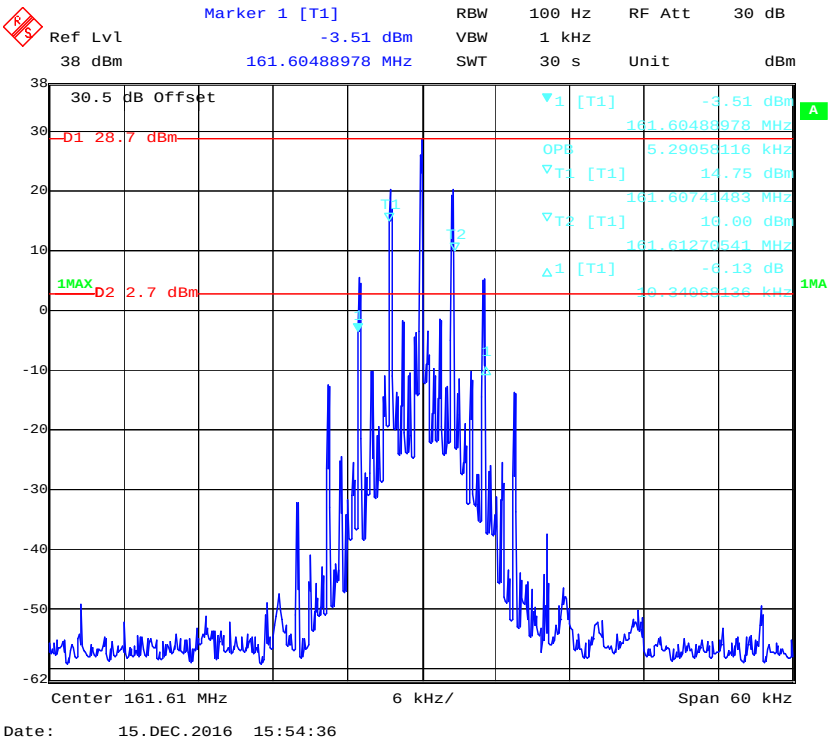

**Frequency 155.7525 MHz: 99% Occupied & 26 dB Bandwidth, Low Power**



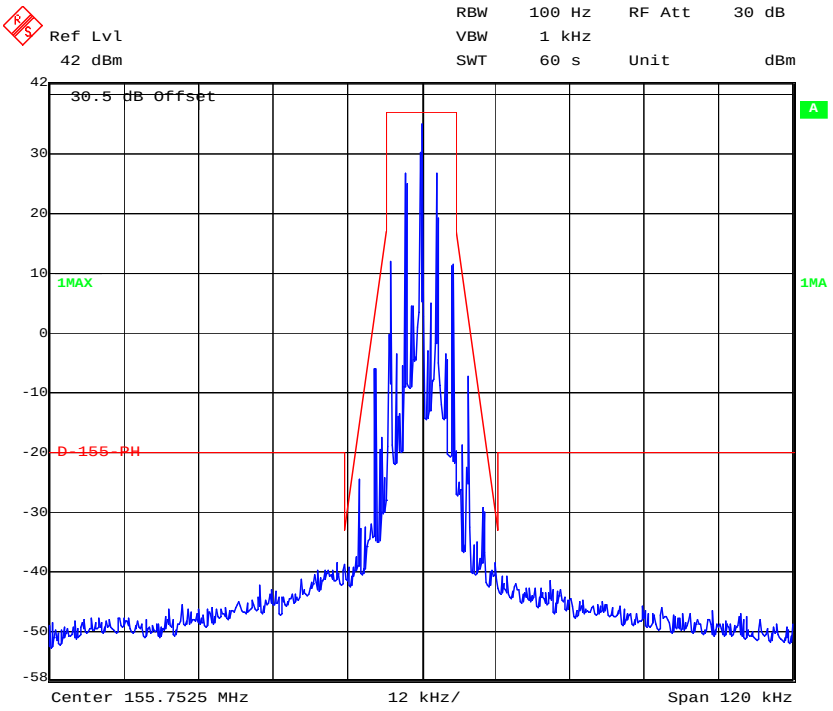
**Frequency 161.61 MHz: 99% Occupied & 26 dB Bandwidth, High Power**



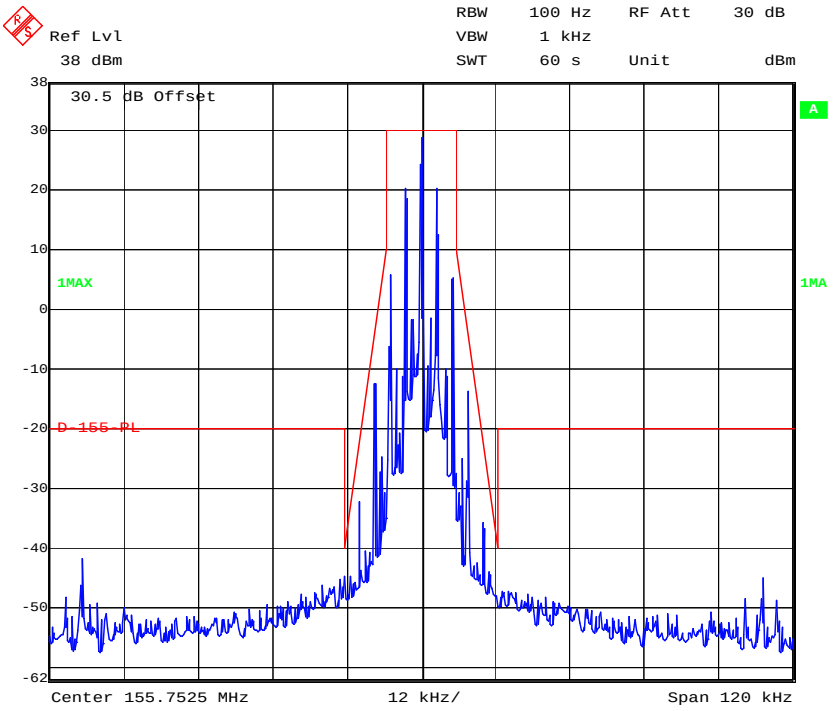

**Frequency 161.61 MHz: 99% Occupied & 26 dB Bandwidth, Low Power**



## Frequency 155.7525 MHz: Emission Mask, High Power

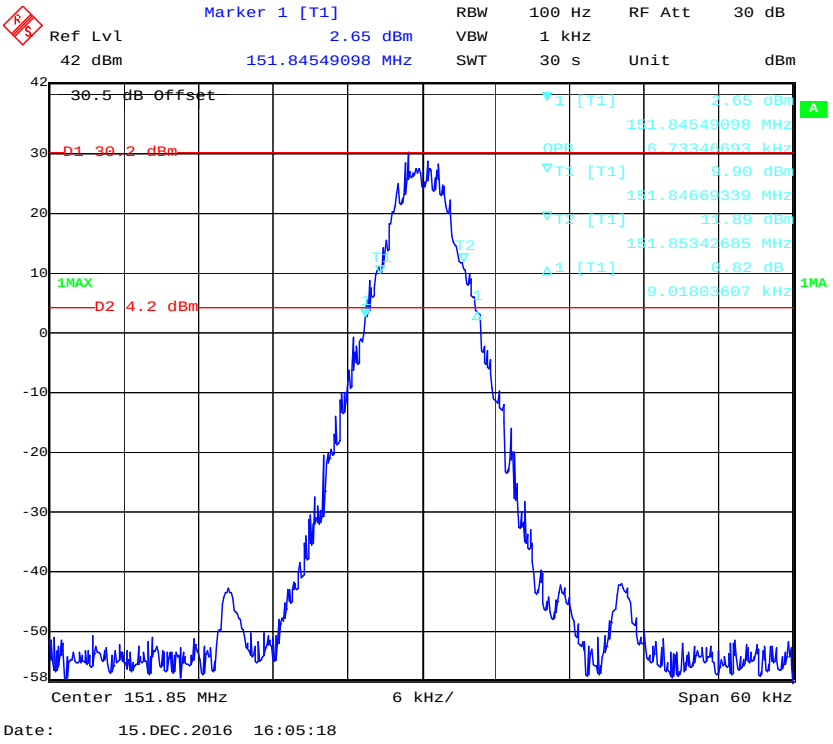



## Frequency 155.7525 MHz: Emission Mask, Low Power

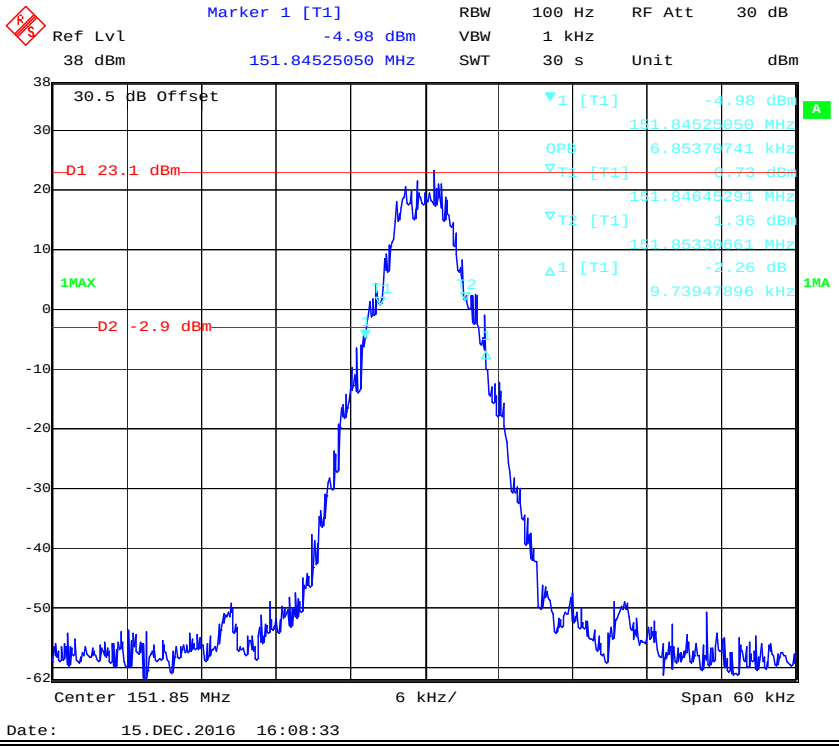


**Digital Modulation:**

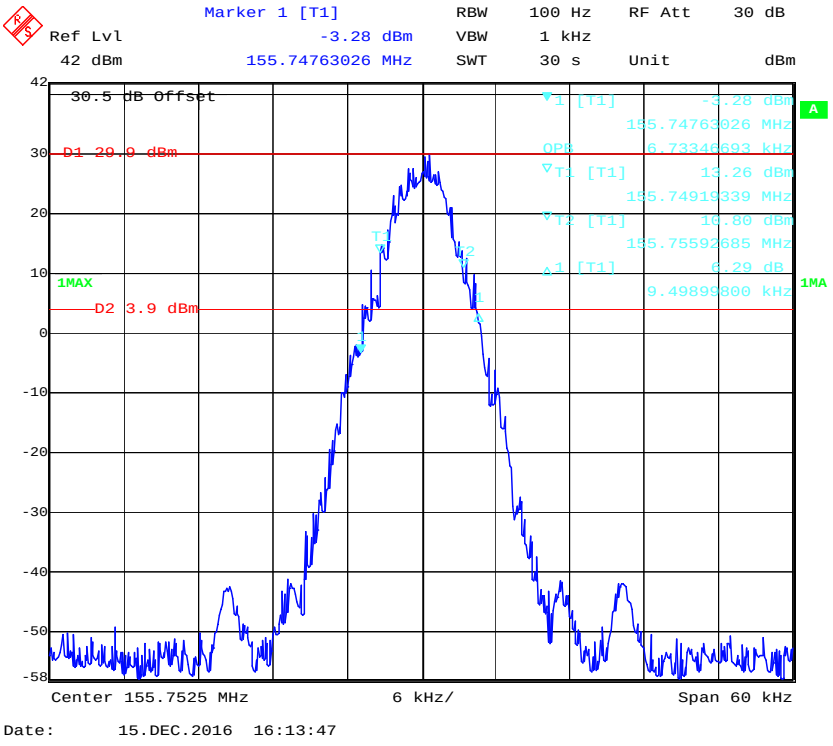
**Frequency 151.85 MHz: 99% Occupied & 26 dB Bandwidth, High Power**



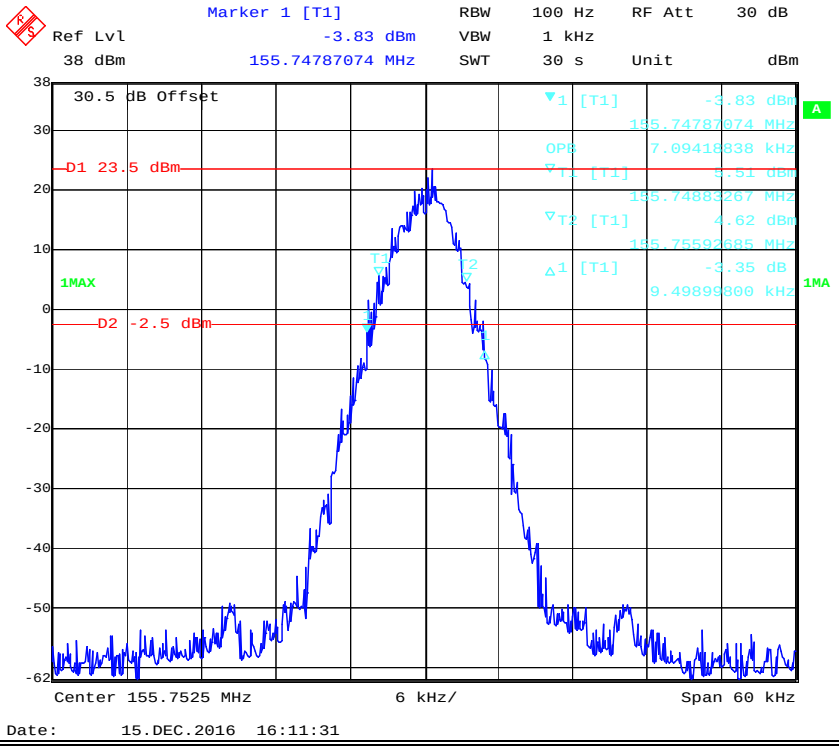

**Frequency 151.85 MHz: 99% Occupied & 26 dB Bandwidth, Low Power**



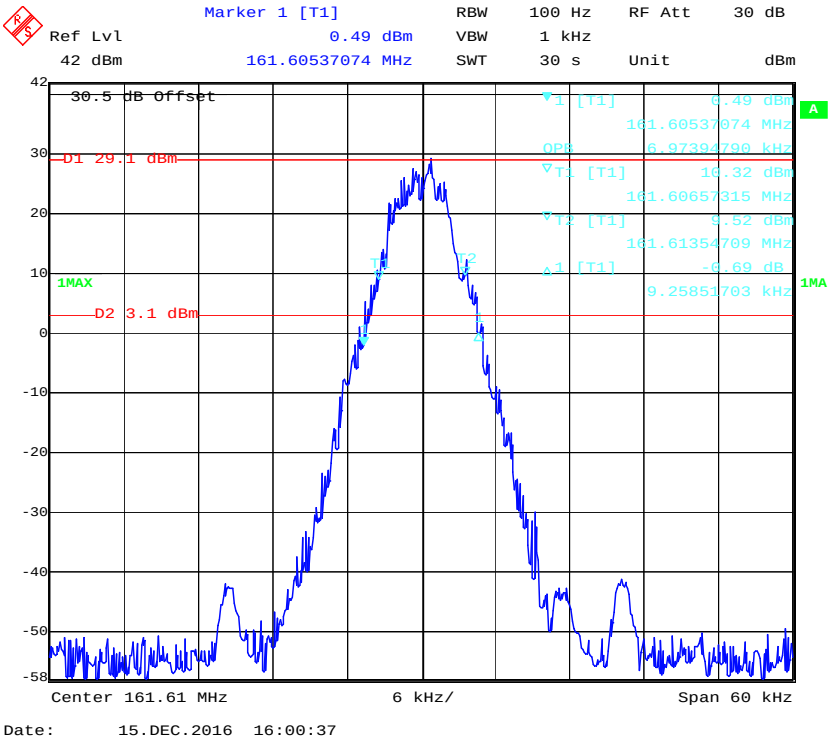
**Frequency 155.7525 MHz: 99% Occupied & 26 dB Bandwidth, High Power**



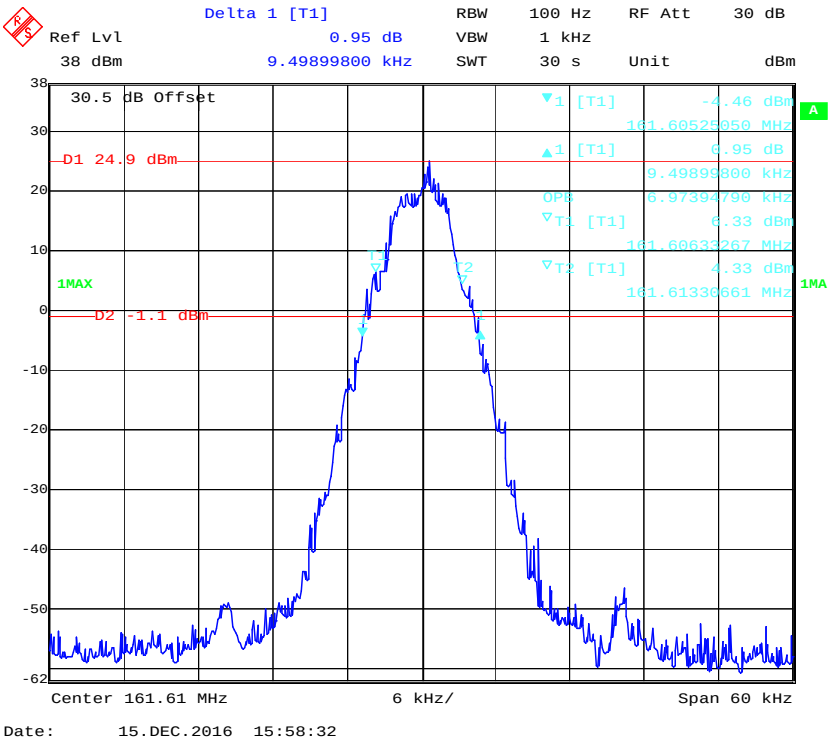

**Frequency 155.7525 MHz: 99% Occupied & 26 dB Bandwidth, Low Power**



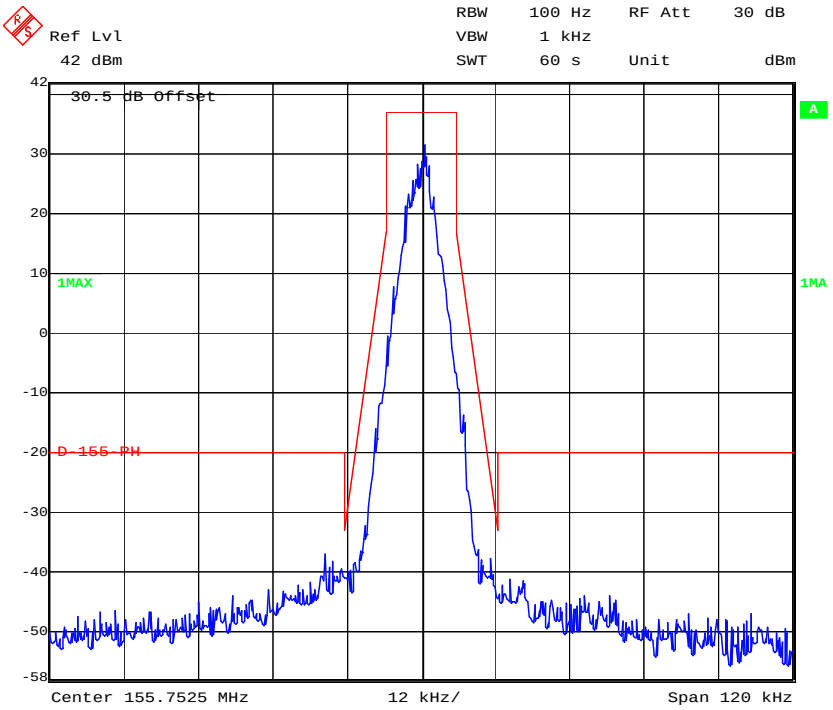
**Frequency 161.61 MHz: 99% Occupied & 26 dB Bandwidth, High Power**



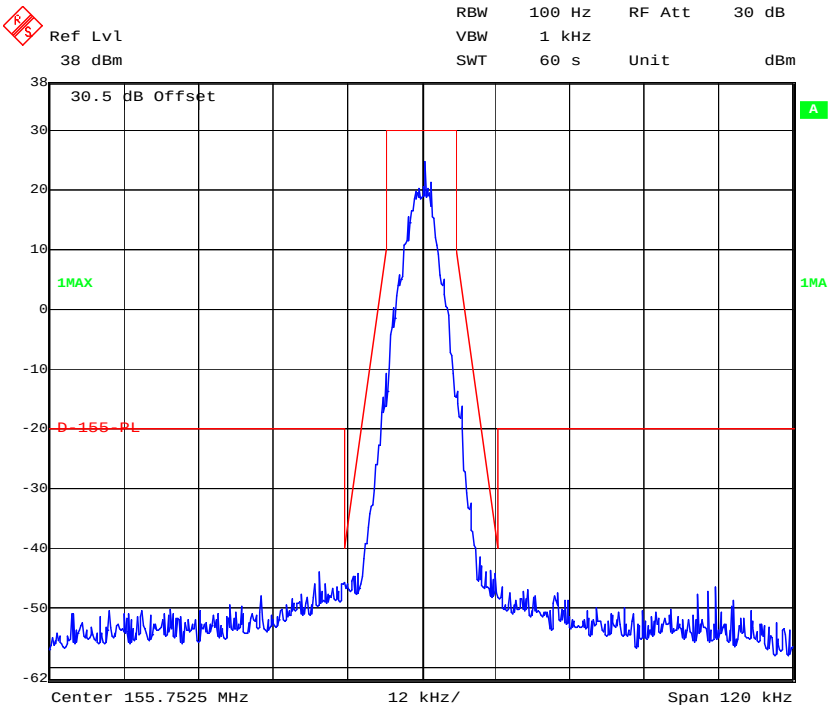

**Frequency 161.61 MHz: 99% Occupied & 26 dB Bandwidth, Low Power**



## Frequency 155.7525 MHz: Emission Mask, High Power




## Frequency 155.7525 MHz: Emission Mask, Low Power



# FCC §2.1051 & §22.359 & §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 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.

## 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$^{th}$ harmonic.

## Test Data

### Environmental Conditions

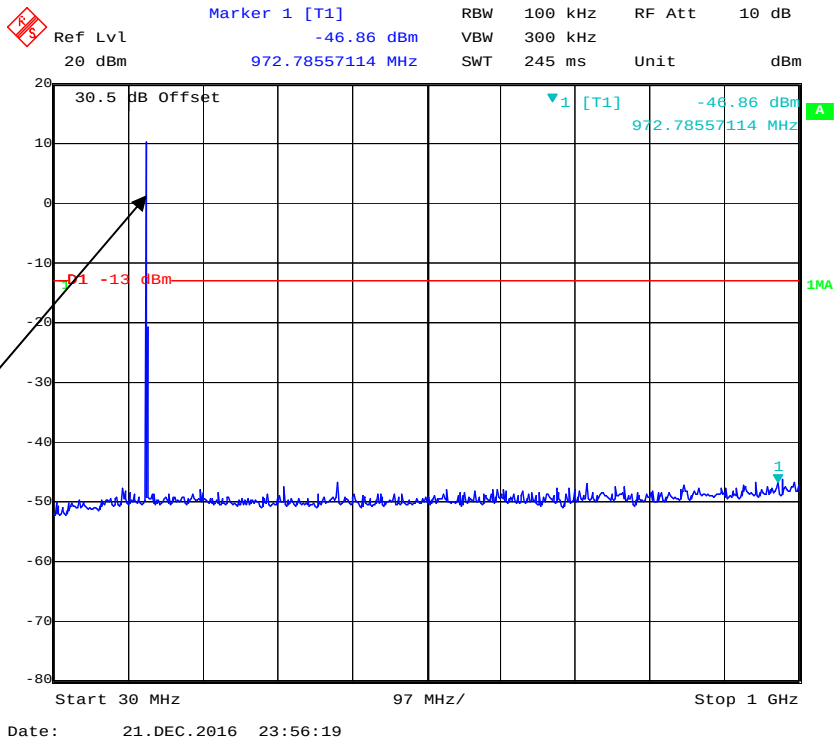
| | |
|---|---|
| **Temperature:** | 22~24.5 ℃ |
| **Relative Humidity:** | 45~50 % |
| **ATM Pressure:** | 100.0~101.0 kPa |

*The testing was performed by Alisa Gao from 2016-12-15 to 2016-12-21*

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

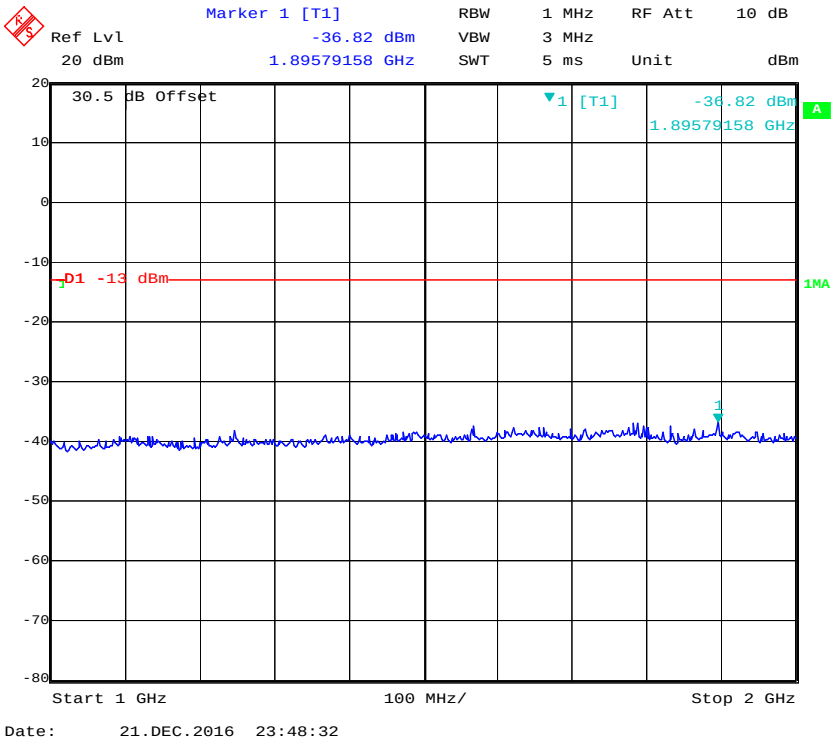
**Analog Modulation:**

**30MHz – 1 GHz, Spacing Channel 12.5 kHz, 151.85 MHz, For Part 22**

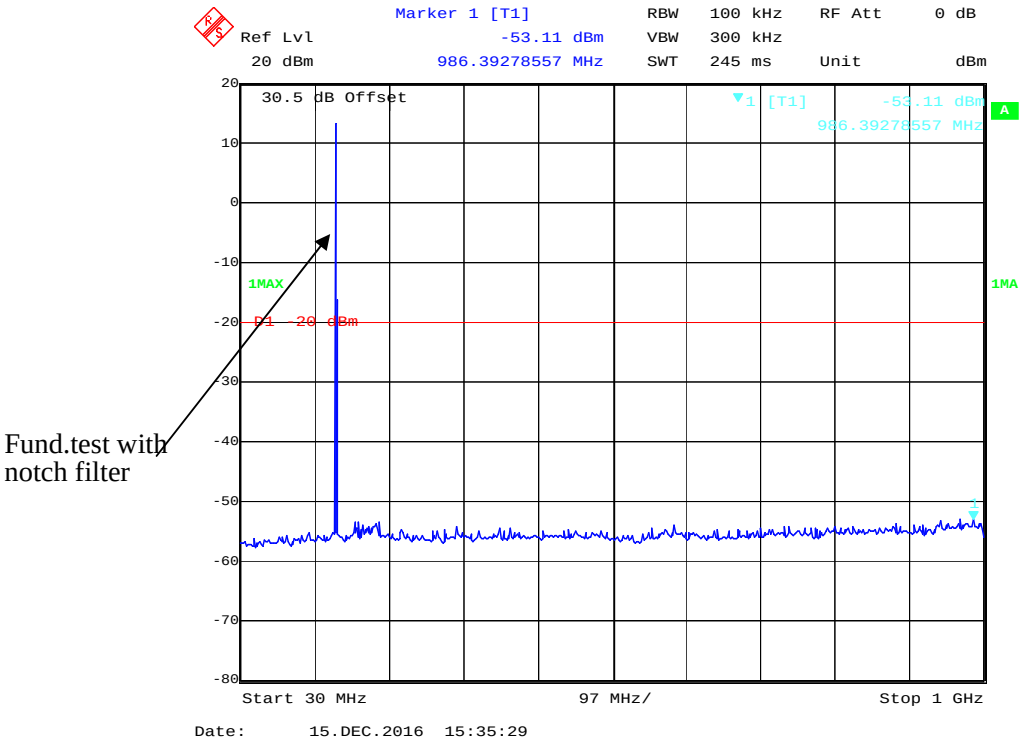



Fund.test with notch filter

**1 GHz – 2GHz, Spacing Channel 12.5 kHz, 151.85 MHz, For Part 22**

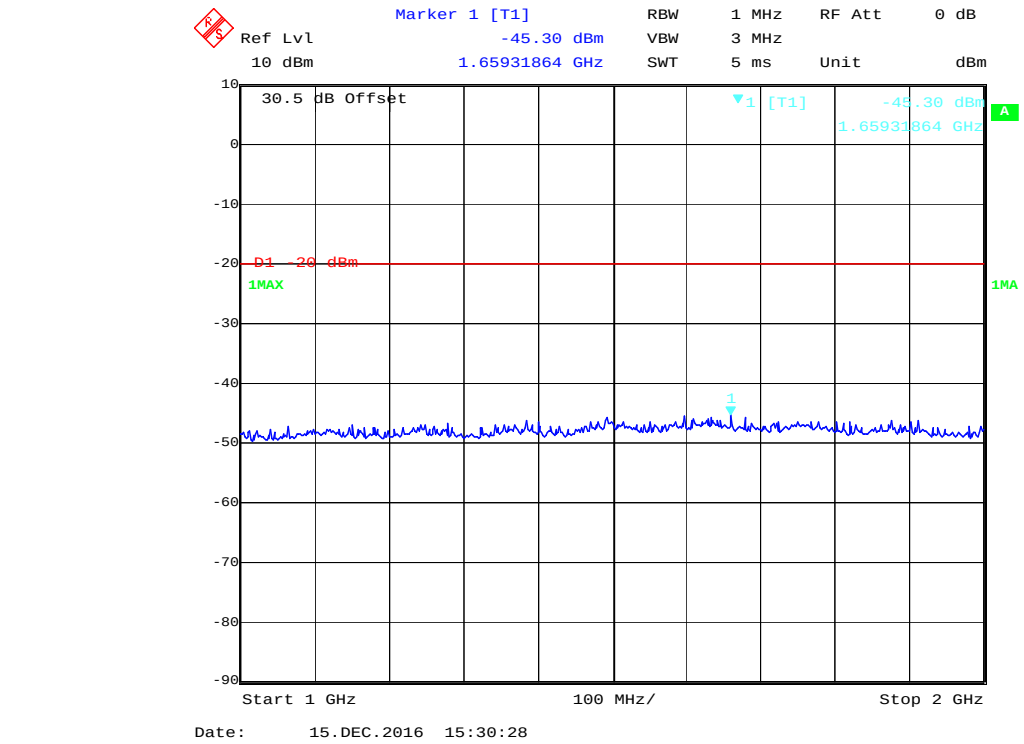


**30MHz – 1 GHz, Spacing Channel 12.5 kHz, 155.7525 MHz, For Part 90**

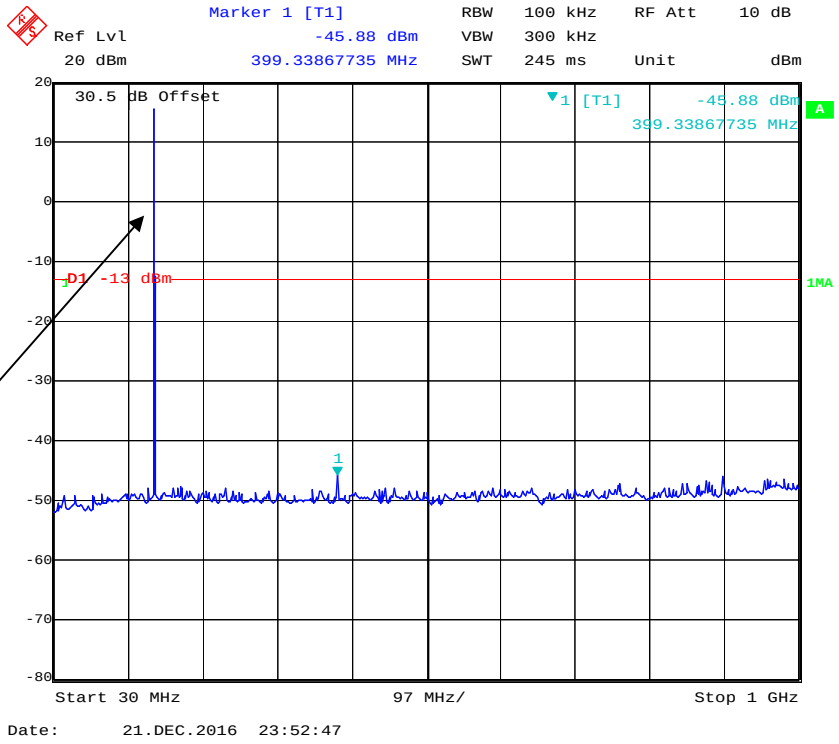



Fund.test with notch filter

**1 GHz – 2GHz, Spacing Channel 12.5 kHz, 155.7525 MHz, For Part 90**

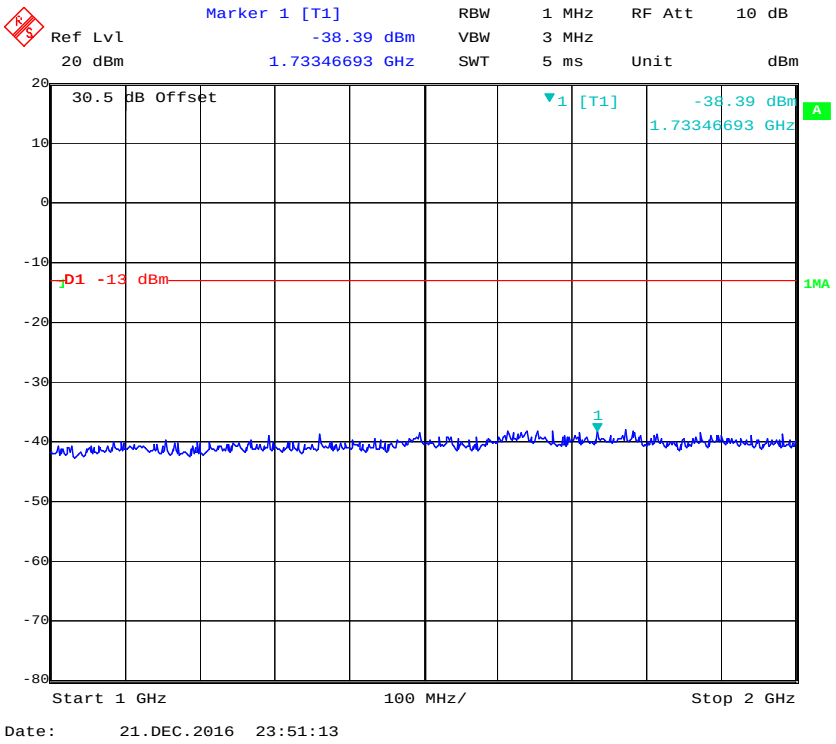


**30MHz – 1 GHz, Spacing Channel 12.5 kHz, 161.61 MHz, For Part 22**



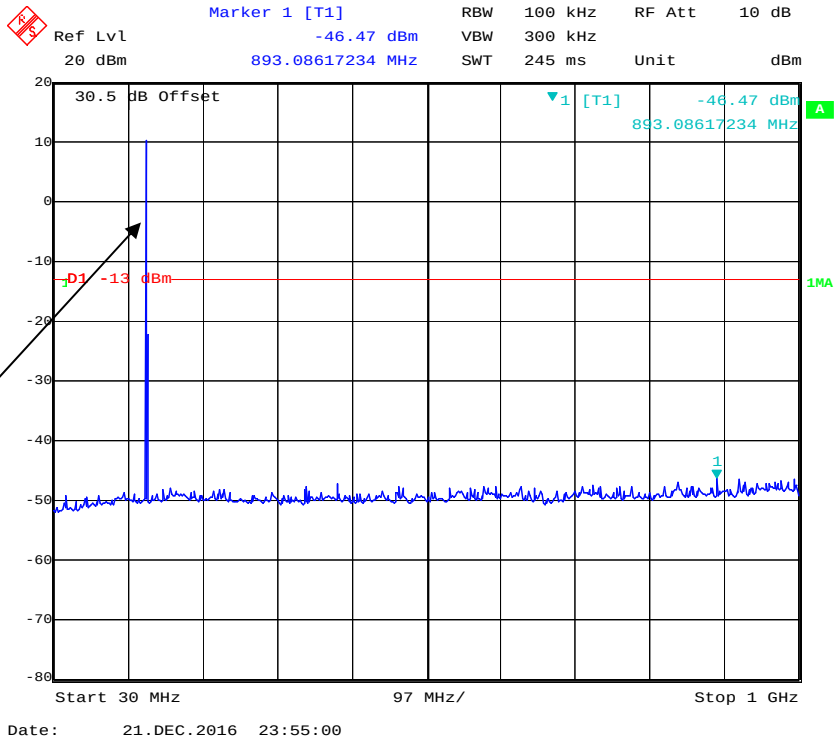

Fund.test with notch filter

**1 GHz – 2GHz, Spacing Channel 12.5 kHz, 161.61 MHz, For Part 22**



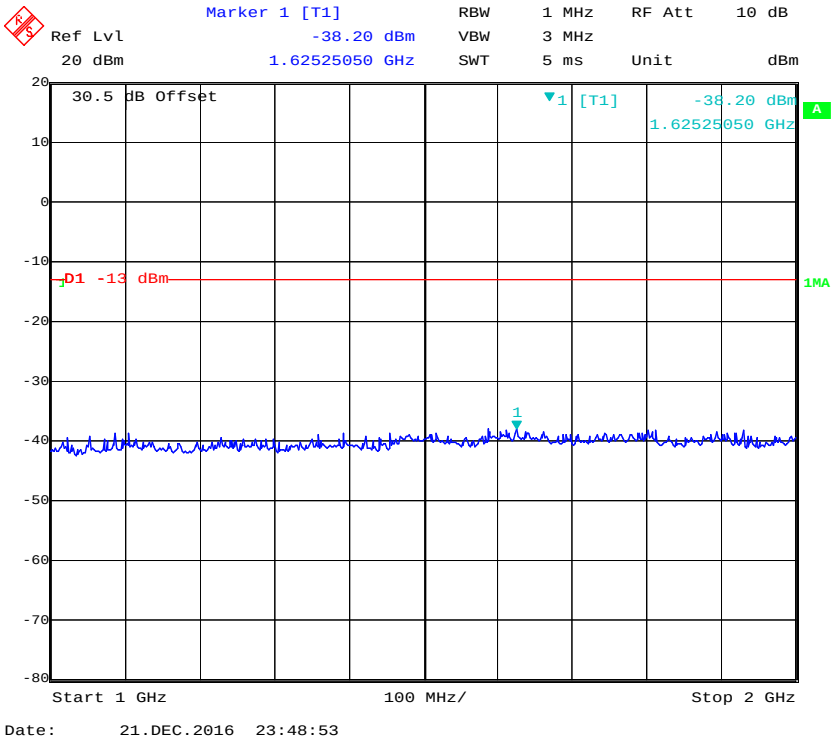
**Digital Modulation:**

**30MHz - 1 GHz, 151.85 MHz, For Part 22**

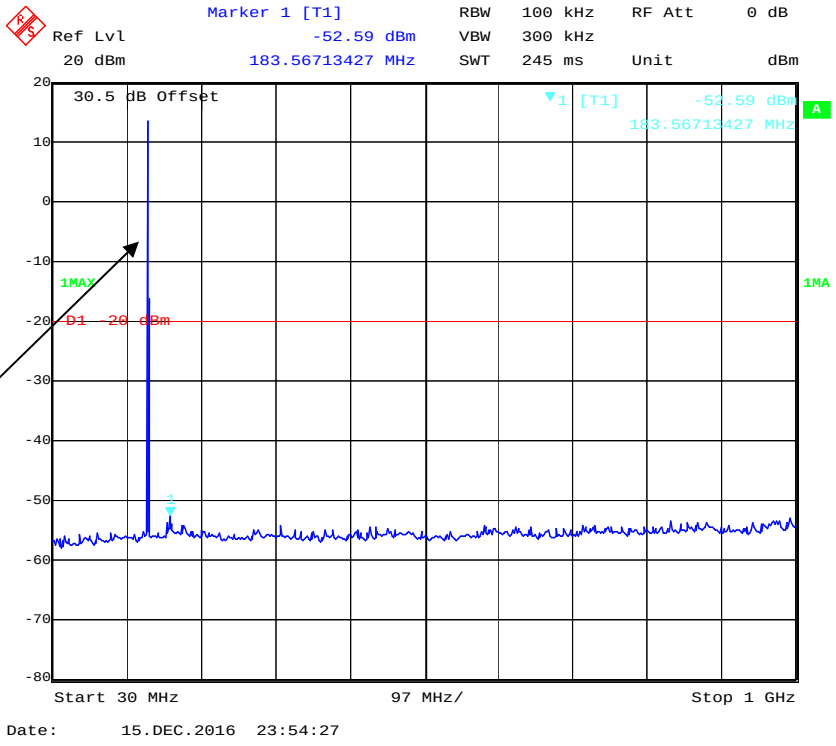



Fund.test with notch filter

**1 GHz – 2 GHz, 151.85MHz , For Part 22**

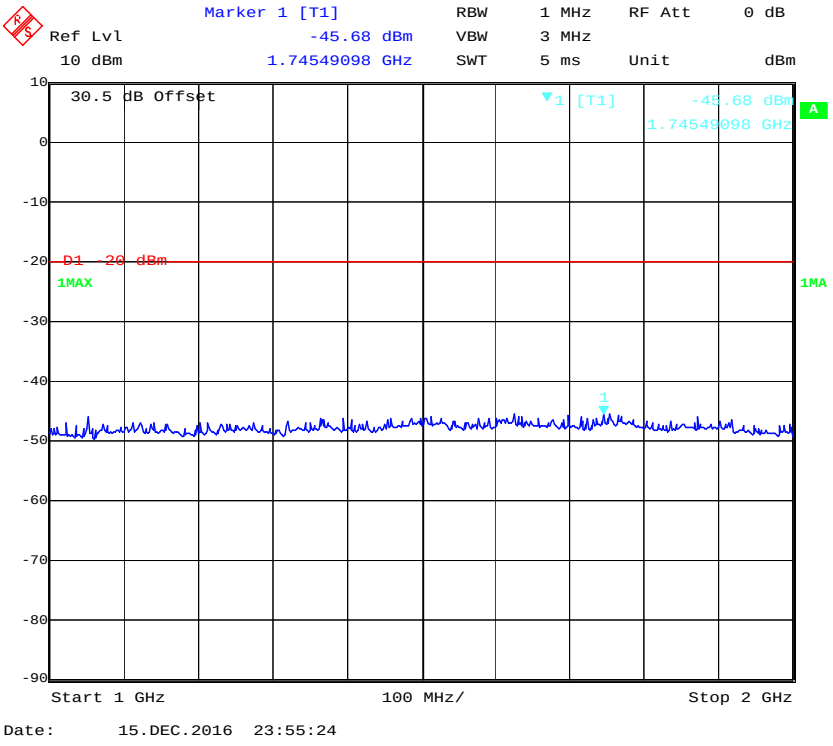


## 30MHz - 1 GHz, 155.7525MHz, For Part 90

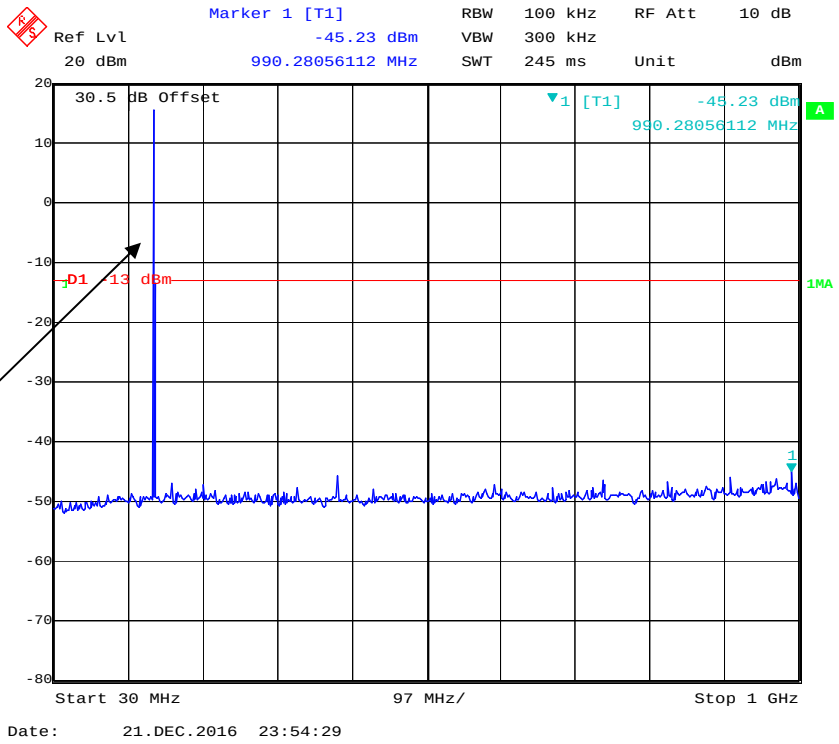



Fund.test with notch filter

## 1 GHz – 2 GHz, 155.7525MHz , For Part 90

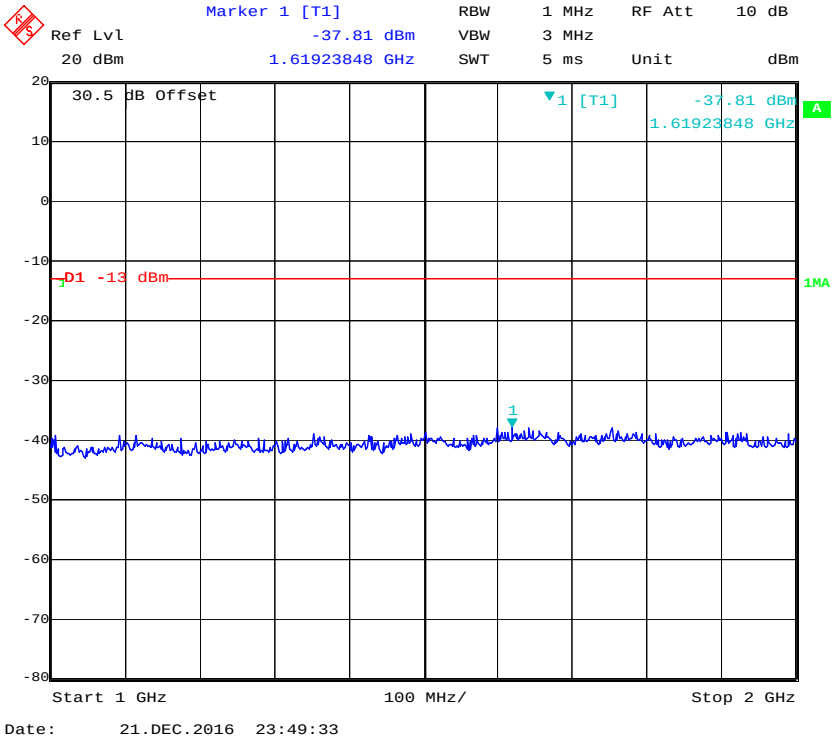


## 30MHz - 1 GHz, 161.61MHz, For Part 22




Fund.test with notch filter

## 1 GHz – 2 GHz, 161.61MHz , For Part 22



# FCC §2.1053 & §22.359 & §90.210 - RADIATED SPURIOUS EMISSIONS

## Applicable Standard

FCC §2.1053, §22.359 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 1g (TXpwr in Watts/0.001)-the absolute level

Spurious attenuation limit in dB =50+10 $Log_{10}$ (power out in Watts) for EUT with a 12.5 kHz channel bandwidth.

## Test Data

### Environmental Conditions

| | |
|---|---|
| **Temperature:** | 25 ℃ |
| **Relative Humidity:** | 50 % |
| **ATM Pressure:** | 100.0 kPa |

*The testing was performed by Layne Li on 2016-12-08.*

*Test Mode: Transmitting*

**30MHz - 2GHz:**

| Frequency (MHz) | Receiver Reading (dBμV) | Turn Table Angle Degree | Rx Antenna | | Substituted | | | Absolute Level (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Height (m) | Polar (H/V) | SG Level (dBm) | Cable Loss (dB) | Antenna Gain (dB) | | | |
| Analog Modulation 151.85MHz, For Part 22 | | | | | | | | | | |
| 303.70 | 45.31 | 135 | 1.4 | H | -64.4 | 0.2 | 3.85 | -60.75 | -13 | 47.75 |
| 303.70 | 39.52 | 91 | 1.3 | V | -67.6 | 0.2 | 3.85 | -63.95 | -13 | 50.95 |
| 455.55 | 42.58 | 79 | 1.6 | H | -62.9 | 0.23 | 4.05 | -59.08 | -13 | 46.08 |
| 455.55 | 44.82 | 105 | 2.2 | V | -57.4 | 0.23 | 4.05 | -53.58 | -13 | 40.58 |
| 1518.50 | 40.49 | 233 | 2.4 | H | -63.3 | 0.35 | 8.20 | -55.45 | -13 | 42.45 |
| 1518.50 | 41.40 | 351 | 1.9 | V | -64.1 | 0.35 | 8.20 | -56.25 | -13 | 43.25 |
| Analog Modulation 155.7525MHz, For Part 90 | | | | | | | | | | |
| 311.51 | 46.11 | 342 | 1.7 | H | -63.6 | 0.2 | 3.85 | -59.95 | -20 | 39.95 |
| 311.51 | 39.72 | 237 | 1.3 | V | -67.4 | 0.2 | 3.85 | -63.75 | -20 | 43.75 |
| 467.26 | 42.68 | 38 | 1.9 | H | -62.8 | 0.23 | 4.05 | -58.98 | -20 | 38.98 |
| 467.26 | 44.42 | 46 | 1.7 | V | -57.8 | 0.23 | 4.05 | -53.98 | -20 | 33.98 |
| 1557.53 | 38.99 | 228 | 1.2 | H | -63.8 | 0.37 | 8.36 | -55.81 | -20 | 35.81 |
| 1557.53 | 39.43 | 104 | 1.7 | V | -65.2 | 0.37 | 8.36 | -57.21 | -20 | 37.21 |
| Digital Modulation 151.85MHz, For Part 22 | | | | | | | | | | |
| 303.70 | 42.41 | 327 | 1.7 | H | -67.3 | 0.2 | 3.85 | -63.65 | -13 | 50.65 |
| 303.70 | 41.92 | 358 | 1.9 | V | -65.2 | 0.2 | 3.85 | -61.55 | -13 | 48.55 |
| 455.55 | 41.98 | 200 | 1.5 | H | -63.5 | 0.23 | 4.05 | -59.68 | -13 | 46.68 |
| 455.55 | 45.22 | 142 | 1.4 | V | -57.0 | 0.23 | 4.05 | -53.18 | -13 | 40.18 |
| 1518.50 | 40.39 | 109 | 1.3 | H | -63.4 | 0.35 | 8.20 | -55.55 | -13 | 42.55 |
| 1518.50 | 41.10 | 142 | 1.7 | V | -64.4 | 0.35 | 8.20 | -56.55 | -13 | 43.55 |
| Digital Modulation 155.7525MHz, For Part 90 | | | | | | | | | | |
| 311.51 | 42.01 | 302 | 1.8 | H | -67.7 | 0.2 | 3.85 | -64.05 | -20 | 44.05 |
| 311.51 | 42.22 | 297 | 1.5 | V | -64.9 | 0.2 | 3.85 | -61.25 | -20 | 41.25 |
| 467.26 | 42.08 | 121 | 1.5 | H | -63.4 | 0.23 | 4.05 | -59.58 | -20 | 39.58 |
| 467.26 | 45.52 | 46 | 1.2 | V | -56.7 | 0.23 | 4.05 | -52.88 | -20 | 32.88 |
| 1557.53 | 39.49 | 179 | 1.2 | H | -63.3 | 0.37 | 8.36 | -55.31 | -20 | 35.31 |
| 1557.53 | 39.73 | 71 | 1.5 | V | -64.9 | 0.37 | 8.36 | -56.91 | -20 | 36.91 |

**Note:**
Absolute Level = SG Level - Cable loss + Antenna Gain
Margin = Limit- Absolute Level

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

## Applicable Standard

FCC §2.1055, § 22.355 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

| | |
|---|---|
| **Temperature:** | 25 ℃ |
| **Relative Humidity:** | 51 % |
| **ATM Pressure:** | 101.0 kPa |

*The testing was performed by Alisa Gao on 2016-12-01.*

*Test Mode: Transmitting*

**For Analog Modulation**

| Reference Frequency: 151.85 MHz, Limit: ±5.0 ppm | | | |
|---|---|---|---|
| Test Environment | | Frequency Measure with Time Elapsed | |
| Temperature (℃) | Voltage Supplied ($V_{DC}$) | Measured Frequency (MHz) | Frequency Error (ppm) |
| Frequency Stability versus Input Temperature | | | |
| 50 | 7.2 | 151.850063 | 0.296 |
| 40 | 7.2 | 151.850048 | 0.211 |
| 30 | 7.2 | 151.850055 | 0.244 |
| 20 | 7.2 | 151.850040 | 0.158 |
| 10 | 7.2 | 151.850037 | 0.119 |
| 0 | 7.2 | 151.850045 | 0.257 |
| -10 | 7.2 | 151.850051 | 0.316 |
| -20 | 7.2 | 151.850043 | 0.270 |
| -30 | 7.2 | 151.850062 | 0.356 |
| Frequency Stability versus Input Voltage | | | |
| 20 | 6.3 | 151.850042 | 0.191 |

| Reference Frequency: 155.7525 MHz, Limit: ±5.0 ppm | | | |
|---|---|---|---|
| Test Environment | | Frequency Measure with Time Elapsed | |
| Temperature (℃) | Power Supplied ($V_{DC}$) | Measured Frequency error (MHz) | Frequency Error (ppm) |
| Frequency Stability versus Input Temperature | | | |
| 50 | 7.2 | 155.752543 | 0.276 |
| 40 | 7.2 | 155.752539 | 0.250 |
| 30 | 7.2 | 155.752516 | 0.103 |
| 20 | 7.2 | 155.752508 | 0.051 |
| 10 | 7.2 | 155.752512 | 0.077 |
| 0 | 7.2 | 155.752522 | 0.141 |
| -10 | 7.2 | 155.752513 | 0.083 |
| -20 | 7.2 | 155.752530 | 0.193 |
| -30 | 7.2 | 155.752536 | 0.231 |
| Frequency Stability versus Input Voltage | | | |
| 20 | 6.3 | 155.752514 | 0.090 |

**For Digital Modulation**

| Reference Frequency: 151.85 MHz, Limit: ±5.0 ppm | | | |
|---|---|---|---|
| Test Environment | | Frequency Measure with Time Elapsed | |
| Temperature (℃) | Voltage Supplied ($V_{DC}$) | Measured Frequency (MHz) | Frequency Error (ppm) |
| Frequency Stability versus Input Temperature | | | |
| 50 | 7.2 | 151.850051 | 0.263 |
| 40 | 7.2 | 151.850050 | 0.204 |
| 30 | 7.2 | 151.850039 | 0.145 |
| 20 | 7.2 | 151.850038 | 0.105 |
| 10 | 7.2 | 151.850035 | 0.178 |
| 0 | 7.2 | 151.850049 | 0.158 |
| -10 | 7.2 | 151.850042 | 0.204 |
| -20 | 7.2 | 151.850053 | 0.263 |
| -30 | 7.2 | 151.850058 | 0.250 |
| Frequency Stability versus Input Voltage | | | |
| 20 | 6.3 | 151.850041 | 0.132 |

| Reference Frequency: 155.7525 MHz, Limit: ±5.0 ppm | | | |
|---|---|---|---|
| Test Environment | | Frequency Measure with Time Elapsed | |
| Temperature (℃) | Power Supplied ($V_{DC}$) | Measured Frequency (MHz) | Frequency Error (ppm) |
| Frequency Stability versus Input Temperature | | | |
| 50 | 7.2 | 155.752537 | 0.238 |
| 40 | 7.2 | 155.752541 | 0.263 |
| 30 | 7.2 | 155.752519 | 0.122 |
| 20 | 7.2 | 155.752515 | 0.096 |
| 10 | 7.2 | 155.752523 | 0.148 |
| 0 | 7.2 | 155.752525 | 0.161 |
| -10 | 7.2 | 155.752534 | 0.218 |
| -20 | 7.2 | 155.752526 | 0.167 |
| -30 | 7.2 | 155.752543 | 0.276 |
| Frequency Stability versus Input Voltage | | | |
| 20 | 6.3 | 155.752520 | 0.128 |

# FCC §90.214 - TRANSIENT FREQUENCY BEHAVIOR

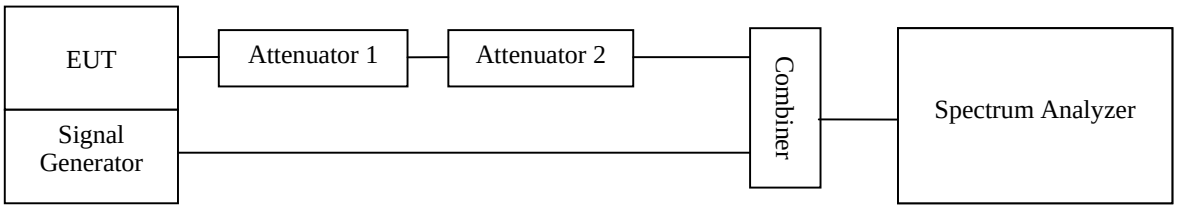
## Applicable Standard

Regulations: FCC §90.214
Test method: 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 ±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 ±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 "tiger 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

| | |
|---|---|
| **Temperature:** | 24 ℃ |
| **Relative Humidity:** | 51 % |
| **ATM Pressure:** | 101.0 kPa |

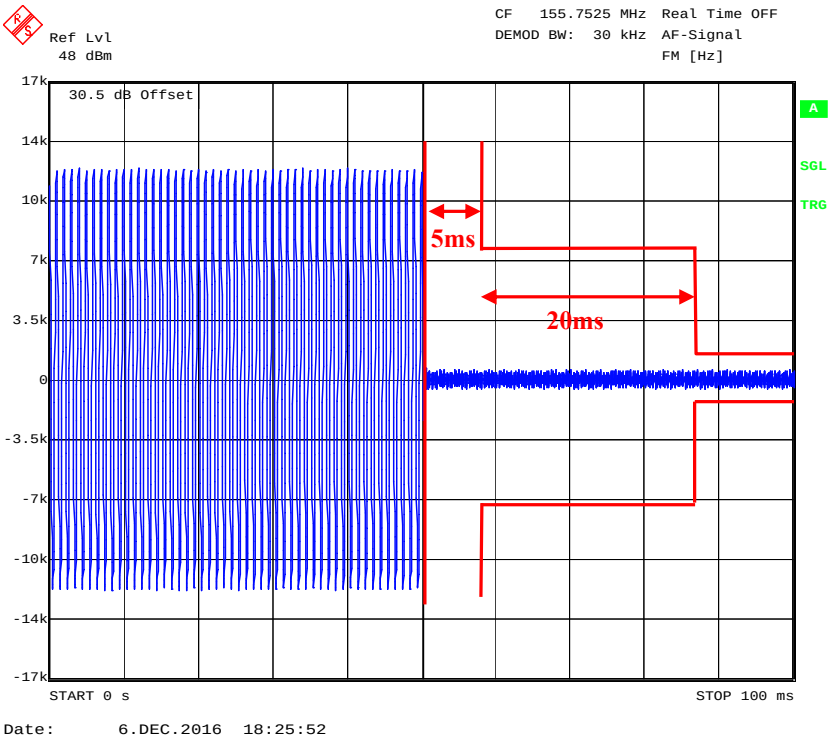
*The testing was performed by Alisa Gao on 2016-12-06.*

| Channel Separation (kHz) | Transient Period (ms) | Transient Frequency | Result |
|---|---|---|---|
| 12.5 | 5 (t1) | <+/-12.5 kHz | Pass |
| | 20(t2) | <+/-6.25 kHz | |
| | 5 (t3) | <+/-12.5 kHz | |

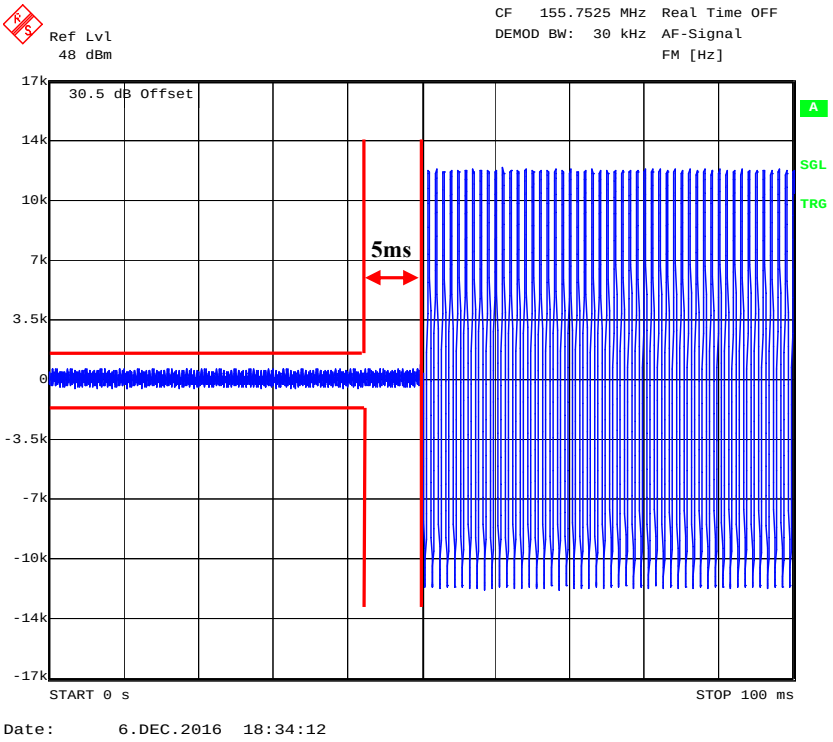
Please refer to the following plots.

**Channel Spacing 12.5 kHz**

**Turn on**



**Turn off**




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