MOTOROLA SOLUTIONS

CERTIFICATE 2518.08

MS ISO/IEC 17025
TESTING
SAMM NO. 0825

**MOTOROLA PENANG ADV. COMM. LABORATORY**
**Motorola Solutions Malaysia SDN BHD,**
**Plot 2A, Medan Bayan Lepas,**
**Mukim 12 S.W.D, 11900 Bayan Lepas,**
**Penang, Malaysia.**

**FCC/ISED TEST REPORT**
**Report Revision : Rev.A**

| | | |
|---|---|---|
| **Date/s Tested** | : | 9-DEC-2020 - 15-DEC-2020 |
| **Report Issue Date** | : | 4-JAN-2021 |
| **Manufacturer** | : | Motorola Solutions Malaysia SDN BHD |
| **Manufacturer Address** | : | Plot 2A, Medan Bayan Lepas, Mukim 12 SWD, 11900 Bayan Lepas, Penang, Malaysia |
| **Requestor** | : | Mohamad Shafiq Hanif Bin Ab Wahid |
| **Product Type** | : | Mobile |
| **Product Version (PMN)** | : | XPR 5550e |
| **Model Number (HVIN)** | : | AAM28QPN9RA1AN (PMUE3649C) (IC MODEL: PMUE3649CBMNAA) |
| **Frequency Band** | : | 403-470MHz |
| **Max RF Output Power** | : | 48 Watts |
| **Applicant Name** | : | Motorola Solutions Inc |
| **Applicant Address** | : | 8000 West Sunrise Boulevard, Fort Lauderdale, Florida 33322 |
| **ISED Registrations** | : | MY0001 |
| **FCC Registrations** | : | 461337 |
| **Firmware Version (FVIN)** | : | R02.20.02.0002 |

**The equipment was tested accordance to the requirement listed below:**

| | |
|---|---|
| **(LMR )** | |
| **FCC 47 CFR Part 2 / 22 / 74 / 90** | **PASS** |
| **ISED RSS- Gen Issue 5 / 119 Issue 12** | |



Prepared By:

**Putri Nur Sarah Sofia**
**Test Personnel**

Approved Signatory:

**Vincent Foong Chuen Kit**
**Responsible Engineer**

# Table of Contents

**Report Revision History**

| Revision History | Description | Date | Originator |
|---|---|---|---|
| Rev. A | Initial Report | 22-DEC-2020 | Putri Nur Sarah Sofia |

## 1.0 General Information

### EUT Description:

| | |
|---|---|
| **Technologies** | Land Mobile Radio (LMR) |
| **Modulation Type** | Analog, 4FSK |

The EUT contains following accessory devices and data cable:

| Item | Brand | Model or P/N |
|---|---|---|
| POWER CABLE TO BATTERY, 6M (20 FT.), 20 AMP (1- 45W) | MOTOROLA | HKN4192B |
| 13 WATT EXTERNAL SPEAKER | MOTOROLA | RSN4002A |
| IMPRES 4-WAY NAVIGATION KEYPAD MICROPHONE WITH ENHANCED AUDIO | MOTOROLA | RMN5127C |

**General Description of Applied Standards**
The EUT is a RF Product. According to the specifications of the manufacturer, the EUT is to comply with the requirements of the following standards:

**ANSI C63.4-2014**
**ANSI C63.26-2015**

No modifications were done to the UUT to facilitate the tests in this report.

**Deviation from standard**
Not applicable as no deviation from standard test method

**GOB board**
Test is performed with option board activated in EUT.

**Selection of test modes**
Some reports may contain a limited number of test points/modes, in which case all channels and modulations were evaluated and the worst case performance is presented in the report

## 2.0 Summary of Test Results

| FCC General Rules Part (47CFR) | ISED General Rules Part | Test Item | Result | Remarks | Serial number tested |
|---|---|---|---|---|---|
| 2.1046, 22.565, 74.461, 74.534 | RSS-119 | RF Power Output | Pass | | 511TWX2292 |
| 2.1055, 90.213, 22.355 | RSS-119 | Frequency Stability | Pass | | 511TWX2292 |
| 2.1047, 74.463 | RSS-119 | Audio Frequency Response | Pass | | 511TWX2292 |
| 2.1047, 74.463 | RSS-119 | Audio Low Pass Filter Response | Pass | | 511TWX2292 |
| 2.1047, 74.463 | RSS-119 | Modulation limiting | Pass | | 511TWX2292 |
| 74.462(c ), 90.210, 22.359(b) | RSS-119 | Occupied Bandwidth | Pass | 16K0F3E- 14.9994KHz<br>11K0F3E- 9.8346KHz<br>7K60F1D/FXD- 7.5681KHz<br>7K60F1E/FXE- 7.1050KHz<br>7K60F1W- 7.3364KHz | 511TWX2292 |
| 2.1051, 22.359 (a), (b) | RSS-119 | Band Edge Conducted Spurious Emission | Pass | | 511TWX2292 |
| 90.214 | RSS-119 | Transient Frequency Behavior | Pass | | 511TWX2292 |
| - | - | Adjacent Channel Power | NA | | |
| 2.1051, 22.359, 90.210 74.462(c) | RSS-119 | Conducted Spurious Emissions | Pass | Highest spur - 29.71dBm | 511TWX2292 |
| 2.1051, 22.359, 74.462(c) | RSS-119 | Radiated Spurious Emission | Pass | Highest spur- 44.39dBm | 511TWX2291 |
| - | - | Effective Radiated Power (ERP) | NA | | |

## 3.0 Measurement Uncertainty

| Measurement | Frequency | Expended Uncertainty (k=1.96) (±) |
|---|---|---|
| AC Power Line Conducted Spurious Emission | 150KHz ~ 30MHz | 3.43 dB |
| Radiated Emissions up to 1 GHz | 30MHz ~ 200MHz | 4.25 dB |
| | 200MHz ~ 1000MHz | 4.25 dB |
| Radiated Emissions above 1 GHz | 1GHz ~ 18GHz | 4.94 dB |
| | 18GHz ~ 25GHz | 4.94 dB |
| Conducted Spurious Emissions | 9kHz ~ 12.75GHz | 2.82 dB |
| Frequency Stability | 9kHz ~ 12.75GHz | 0.0085 ppm |
| Audio Frequency Response / Low Pass Filter Response | 300Hz – 20kHz | 4.09 % |
| Modulation Limiting | 300Hz – 3kHz | 1.15 % |
| Occupied Bandwidth | 9kHz ~ 12.75GHz | 2.82 dB |
| Band Edge Conducted Spurious Emission | 9kHz ~ 12.75GHz | 2.82 dB |
| Transient Frequency Behavior | 9kHz ~ 12.75GHz | 5.4 ms |
| Adjacent Channel Power | 9kHz ~ 12.75GHz | 2.82 dB |

## 4.0 Equipment List

### FCC Analog ATE#1: (SW version: 2.4.6 & FCC_Frequency Stability 1.0.3 rev.)

| Description | Model | Serial Number | Calibration Date | Calibration Due Date |
|---|---|---|---|---|
| CHAMBER | SH-641 | 92009188 | 06-Mar-20 | 06-Mar-21 |
| DSA Dynamic Signal Analyzer | 35670A | MY42507095 | 19-Jun-20 | 19-Jun-21 |
| ANALYZER AUDIO | 8903B | 3514A15797 | 29-Oct-20 | 29-Oct-21 |
| POWER METER | E4416A | MY45102699 | 26-Jun-20 | 26-Jun-21 |
| POWER SENSOR | E9301B | MY41498918 | 12-Aug-20 | 12-Aug-21 |
| POWER SUPPLY | 6031A | 3325A02771 | 13-Mar-20 | 13-Mar-21 |
| SIGNAL GENERATOR | 2042 | 119718/063 | 24-Jun-20 | 24-Jun-21 |
| ANALYZER MODULATION | 8901B | 3122A03662 | 08-Jul-20 | 08-Jul-21 |
| N to N RF Cable # 1 | M17/128-RG400 | NA | NA | NA |
| BNC to N RF Cable # 1 | RG 58 | NA | NA | NA |
| BNC to BNC RF Cable # 1 | RG 58 | NA | NA | NA |
| BNC to BNC RF Cable # 2 | RG 58 | NA | NA | NA |
| BNC to BNC RF Cable # 3 | RG 58 | NA | NA | NA |
| BNC to BNC RF Cable # 4 | RG 58 | NA | NA | NA |
| BNC to BNC RF Cable # 5 | RG 58 | NA | NA | NA |
| BNC to BNC RF Cable # 6 | RG 58 | NA | NA | NA |
| BNC to BNC RF Cable # 7 | RG 58 | NA | NA | NA |
| N to SMA RF Cable # 1 | RG 58 | NA | NA | NA |
| N to SMA RF Cable # 2 | RG 58 | NA | NA | NA |
| N to SMA RF Cable # 3 | RG 58 | NA | NA | NA |
| Aeroflex Attenuator 30dB | 49-30-34-LIM | NA | NA | NA |

### FCC Transient ATE #1: (SW version: FCC Transient ATE_R1.1.3)

| Description | Model | Serial Number | Calibration Date | Calibration Due Date |
|---|---|---|---|---|
| SWITCH CONTROL UNIT | 3488A | 2719A36210 | CNR | CNR |
| ATTENUATOR / SWITCH DRIVER | 11713A | 2508A10141 | CNR | CNR |
| POWER METER | E4416A | GB41293866 | 26-Feb-19 | 26-Feb-21 |
| POWER SUPPLY | 6032A | MY41002067 | 22-Feb-20 | 22-Feb-21 |
| SIGNAL GENERATOR | 8657A | 3250A05137 | 19-Jun-20 | 19-Jun-21 |
| STEP ATTENUATOR | 8494G | MY42143006 | 12-Jun-20 | 12-Jun-21 |
| STEP ATTENUATOR | 8496G | MY42143012 | 13-Jun-20 | 13-Jun-21 |
| OSCILLOSCOPE | MSO8104A | MY45002372 | 26-Jun-20 | 26-Jun-21 |
| ANALYZER MODULATION | 8901B | 3438A05093 | 23-Jun-20 | 23-Jun-21 |
| ANALYZER AUDIO | 8903B | 3011A12671 | 11-Mar-20 | 11-Mar-21 |
| ANALYZER AUDIO | 8903B | 3011A08952 | 29-Jul-20 | 29-Jul-21 |
| SPECTRUM ANAYLYZER | E4440A | MY46181974 | 2-Aug-20 | 2-Aug-21 |

| | | | | |
|---|---|---|---|---|
| N to N RF Cable # 1 | SF126/11N/11N | NA | NA | NA |
| N to N RF Cable # 2 | M17/128-RG400 | NA | NA | NA |
| N to N RF Cable # 3 | M17/128-RG400 | NA | NA | NA |
| N to N RF Cable # 4 | M17/128-RG400 | NA | NA | NA |
| N to N RF Cable # 5 | M17/128-RG400 | NA | NA | NA |
| N to N RF Cable # 6 | M17/128-RG400 | NA | NA | NA |
| N to N RF Cable # 7 | M17/128-RG400 | NA | NA | NA |
| N to N RF Cable # 8 | M17/128-RG400 | NA | NA | NA |
| N to N RF Cable # 9 | M17/128-RG400 | NA | NA | NA |
| BNC to BNC RF Cable # 1 | RG 58 | NA | NA | NA |
| BNC to BNC RF Cable # 2 | RG 58 | NA | NA | NA |
| BNC to BNC RF Cable # 3 | RG 58 | NA | NA | NA |
| BNC to BNC RF Cable # 4 | RG 58 | NA | NA | NA |
| BNC to BNC RF Cable # 5 | RG 58 | NA | NA | NA |
| BNC to BNC RF Cable # 6 | RG 58 | NA | NA | NA |
| BNC to N RF Cable # 1 | RG 58 | NA | NA | NA |
| Aeroflex Attenuator 10dB | 49-10-43-LIM | NA | NA | NA |
| Aeroflex Attenuator 10dB | 33-10-34-LIM | NA | NA | NA |
| SWITCH CONTROL UNIT | 3488A | 2719A36210 | CNR | CNR |

## CONDUCTED SPUR EMISSION ATE # 1 (SW version: Conducted Spur ATE_rev 1.23.03)

| Description | Model | Serial Number | Calibration Date | Calibration Due Date |
|---|---|---|---|---|
| SWITCH CONTROL UNIT | 3488A | 2719A32735 | CNR | CNR |
| ANALYZER SPECTRUM | E4440A | MY46185415 | 10-Jan-20 | 10-Jan-22 |
| POWER SUPPLY | 6031A | 3543A03489 | 05-Jun-20 | 05-Jun-21 |
| HIGH PASS FILTER SWITCH BOX | - | CS001 | 2-Jul-20 | 2-Jul-21 |
| N to N RF Cable # 1 | SF126/11N/11N | NA | NA | NA |
| N to N RF Cable # 2 | SF126/11N/11N | NA | NA | NA |
| BNC to BNC RF Cable # 1 | RG 58 | NA | NA | NA |
| Aeroflex Attenuator 30dB | 49-30-43-LIM | NA | NA | NA |
| Aeroflex Attenuator 10dB | 33-10-34-LIM | NA | NA | NA |

### EMC Chamber 1

| DESCRIPTION | MODEL | SERIAL NUMBER | CALIBRATION DATE | CALIBRATION DUE DATE |
|---|---|---|---|---|
| DRG HORN FREQ. | SAS-571 | 720 | 21-Mar-19 | 21-Mar-21 |
| DRG HORN FREQ. | SAS-571 | 1143 | 14-Feb-19 | 14-Feb-21 |
| POWER SUPPLY | 6032A | 2615A01178 | 21-May-20 | 21-May-21 |

| | | | | |
|---|---|---|---|---|
| SIGNAL GENERATOR | SMB 100A | 181117 | 8-Nov-18 | 8-Nov-21 |
| EMI TEST RECEIVER | ESW44 | 101731 | 3-Dec-19 | 3-Feb-21 |
| EMI TEST RECEIVER | ESIB26 | 100017 | 19-Jul-19 | 19-Jan-21 |
| 5m SEMI-ANECHOIC CHAMBER | S800-HX | J2308 | No Cal. Req'd | No Cal. Req'd |
| BILOG ANTENNA | CBL6112B | 2964 | 23-Apr-19 | 23-Apr-21 |
| BILOG ANTENNA | CBL6112B | 2950 | 8-Jul-19 | 8-Jul-21 |
| DATA LOGGER | SDL500 | A.016776 | 4-Jun-20 | 4-Jun-21 |
| SYSTEM CONTROLLER | SC104V | 050806-1 | CNR | CNR |
| TURNTABLE FLUSH MOUNT 2M | FM2011 | NA | CNR | CNR |
| ANTENNA POSITIONING TOWER | TLT2 | NA | CNR | CNR |
| BROAD-BAND HORN ANTENNA | BBHA9170 | BBHA9170255 | 27-Jan-20 | 27-Jan-21 |
| 18 - 40GHz PREAMPLIFIER | MITEQ Hi GAIN SUCOFLEX | 001 | CNR | CNR |
| PREAMPLIFIER | PAM-0118 | 269 | 24-May-19 | 24-May-22 |
| LOOP ANTENNA | 6502 | 00203479 | 21-Jan-20 | 21-Jan-21 |
| TEST SOFTWARE | EMC_FCC_IC_BLUETOOTH_RE_TEST | | | |
| VERSION | EMC_FCC_RE_v1.6.2 | | | |

# 5.0 Test Condition

## 5.1. Transmitter Test Conditions

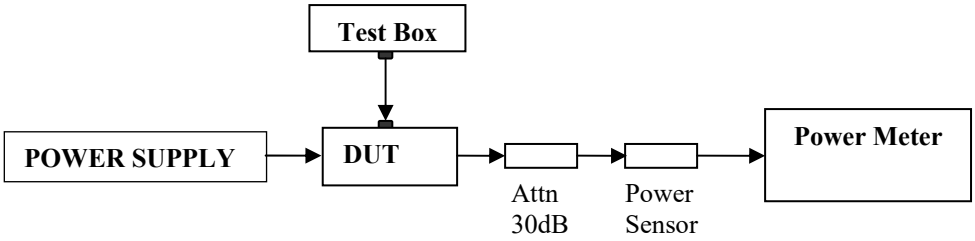
| Test Item, (Channel Spacing) | Power (W) | Modulation | Test Frequency (MHz) | Tested By | Environmental conditions |
|---|---|---|---|---|---|
| RF Output Power | Low & Max | Analog | 403.0125, 406.2, 450.025, 459.125, 467.775, 469.9875 | Putri | 23.4°C, 50%RH |
| Frequency Stability | Max | Analog | 467.775 | Putri | 25.1°C, 54.3%RH, 60.3°C, 50%RH, -30.1°C, 51.2%RH |
| Audio Frequency Response (12.5kHz / 25kHz) | Max | Analog | 467.775, 459.125 | Putri | 23.4°C, 50%RH |
| Audio Low Pass Filter Response (12.5kHz / 25kHz) | Max | Analog | 467.775, 459.125 | Putri | 23.4°C, 50%RH |
| Modulation limiting (12.5kHz / 25kHz) | Max | Analog | 467.775, 459.125 | Putri | 23.4°C, 50%RH |
| Occupied Bandwidth (12.5kHz / 20kHz / 25kHz) | Max | Analog, 4FSK | 406.2, 450.025, 467.775, 469.9875, 459.125 | Putri | 23.4°C, 50%RH |
| Band Edge Conducted Spurious Emissions (Part 22) (12.5kHz / 20kHz / 25kHz) | Low / Max | Analog, 4FSK | 459.025, 459.65, 473.0125, 479.2875 | Putri | 23.4°C, 50%RH |
| Transient Frequency Behavior *(UHF & VHF Band)* (12.5kHz / 25kHz) | Max | Analog | 467.775 | Putri | 23.4°C, 50%RH |
| Adjacent Channel Power *(700MHz Band)* (12.5kHz / 25kHz) | Max | NA | NA | | |
| Conducted Spurious Emissions- (12.5kHz / 25kHz) | Low / Max | Analog, 4FSK | 403.0125, 406.2, 450.025, 459.125, 467.775, 469.9875 | Putri | 23.4°C, 50%RH |
| Radiated Spurious Emission (12.5kHz / 25kHz) | Low / Max | Analog, 4FSK | 403.0125, 406.2, 450.025, 459.125, 467.775, 469.9875 | Nazrin, Fendi, Qawiman | 22.5 °C, 64%RH |
| GNSS (EIRP for 1559 - 1610MHz) (12.5kHz / 25kHz) | Max | NA | NA | | |
| Effective Radiated Power (ERP) (12.5kHz / 25kHz) | Max | NA | NA | | |

**NA → Not Applicable**

# 6.0 Transmitter Test Parameters

## 6.1. RF Output Power

### 6.1.1. Test Setup



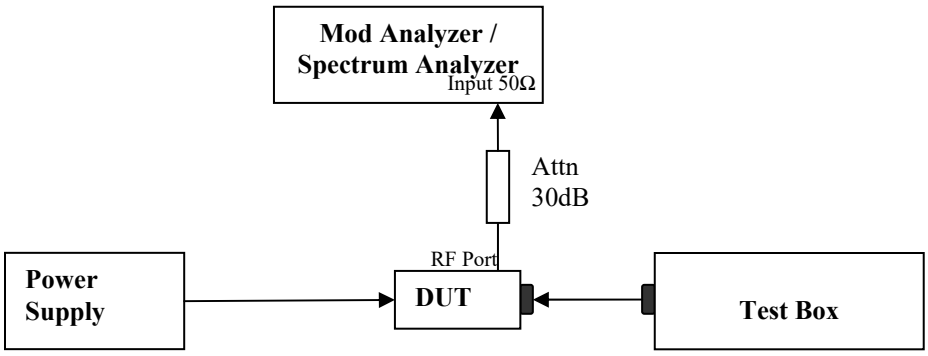

1) The DUT transmitter connected to Power Meter using the 30 dB attenuator and power sensor with above setup.
2) Path loss for the measurement included.
3) All the measurement was done at low, mid, high frequency for each band.
4) Record the power into the test report.

### 6.1.2. Test Result

| Temperature | 25˚C | | | | |
|---|---|---|---|---|---|
| Voltage (V) | 13.6V | | | | |
| Frequency (MHz) | Low Power (W) | Current (A) | Max Power (W) | Current (A) | Remark |
| 403.01250 | 24.80 | 5.82 | 47.70 | 8.04 | Not for FCC review |
| 406.20000 | 24.80 | 5.70 | 47.50 | 7.86 | |
| 450.02500 | 24.90 | 6.18 | 47.60 | 8.85 | |
| 459.12500 | 24.90 | 6.36 | 47.20 | 8.85 | |
| 467.77500 | 24.80 | 6.27 | 47.60 | 8.86 | |
| 469.98750 | 24.80 | 6.21 | 47.10 | 8.61 | |

## 6.2. Frequency Stability

### 6.2.1. Test Setup



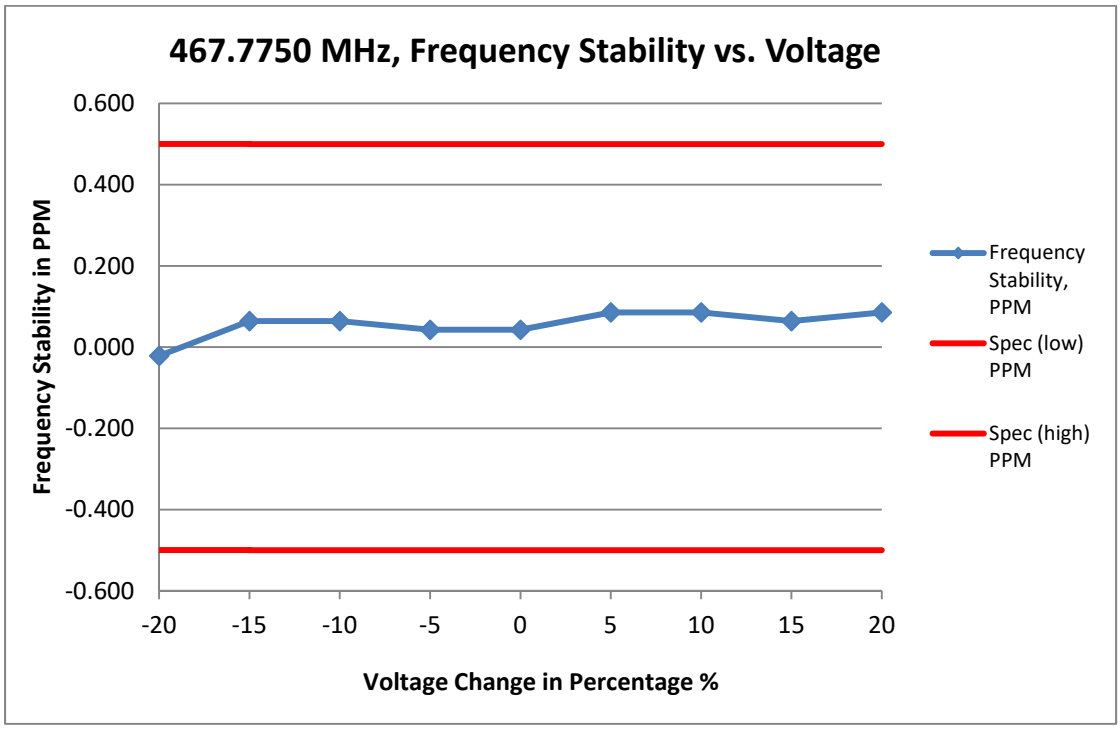

1) The DUT transmitter output port was connected to Modulation / Spectrum Analyzer.
2) Path loss for the measurement included.
3) Transmit the DUT and record the freq in $MCF_{MHz}$.
4) Test in 2 conditions:
   - Temperature: The frequency of the transmitter was measured from -30°C to 50°C.
   - Supply Voltage:
     -Mobile: The frequency of the transmitter was measured from 85% to 115% of the nominal operating input voltage.
     -Portable: The frequency of the transmitter was measured from nominal ± x % as specified by the manufacturer

5) Calculate the ppm frequency error by the following:

$$ppm\ error = \left(\frac{MCF_{MHz}}{ACF_{MHz}} - 1\right) * 10^6$$

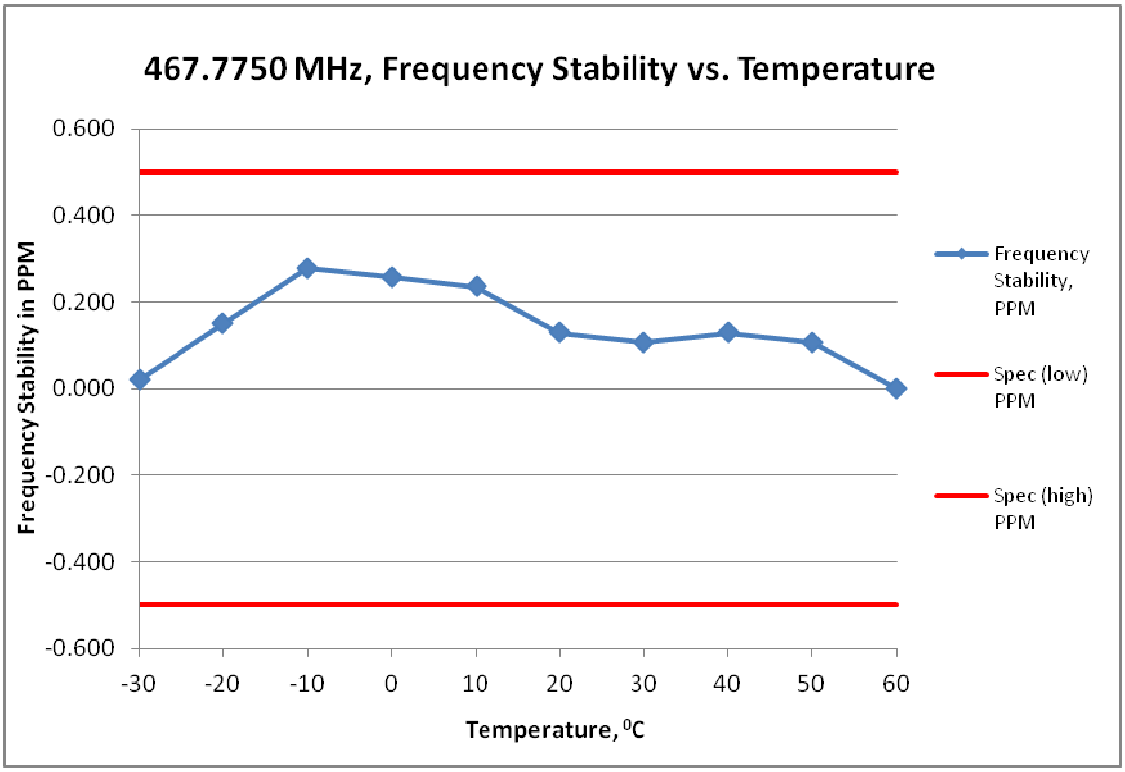
Where: $MCF_{MHz}$ is the Measured Carrier Frequency in MHz
$ACF_{MHz}$ is the Assigned Carrier Frequency in MHz

### 6.2.2. Test Result




(i) Frequency Stability VS Voltage

| Frequency / Channel Spacing | 467.7750 MHz / 12.5 kHz | | | | |
|---|---|---|---|---|---|
| Temperature, $^{0}$C | 25 | | | | |
| Voltage % | Voltage, V | Frequency, MHz | Frequency Stability, PPM | Spec (low) PPM | Spec (high) PPM |
| -20 | 9.000 | 467.774990 | -0.021 | -0.500 | 0.500 |
| -15 | 11.560 | 467.775030 | 0.064 | -0.500 | 0.500 |
| -10 | 12.240 | 467.775030 | 0.064 | -0.500 | 0.500 |
| -5 | 12.920 | 467.775020 | 0.043 | -0.500 | 0.500 |
| 0 | 13.600 | 467.775020 | 0.043 | -0.500 | 0.500 |
| 5 | 14.280 | 467.775040 | 0.086 | -0.500 | 0.500 |
| 10 | 14.960 | 467.775040 | 0.086 | -0.500 | 0.500 |
| 15 | 15.640 | 467.775030 | 0.064 | -0.500 | 0.500 |
| 20 | 16.320 | 467.775040 | 0.086 | -0.500 | 0.500 |




(ii) Frequency Stability VS temperature

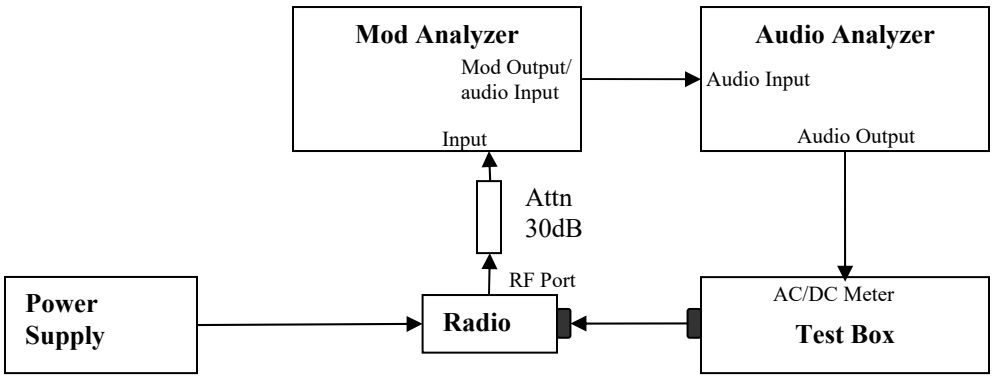
| Frequency / Channel Spacing | 467.7750 MHz / 12.5 kHz | | | |
|---|---|---|---|---|
| Voltage, V | 13.6 | | | |
| Temperature, °C | Frequency, MHz | Frequency Stability, PPM | Spec (low) PPM | Spec (high) PPM |
| -30 | 467.775010 | 0.021 | -0.500 | 0.500 |
| -20 | 467.775070 | 0.150 | -0.500 | 0.500 |
| -10 | 467.775130 | 0.278 | -0.500 | 0.500 |
| 0 | 467.775120 | 0.257 | -0.500 | 0.500 |
| 10 | 467.775110 | 0.235 | -0.500 | 0.500 |
| 20 | 467.775060 | 0.128 | -0.500 | 0.500 |
| 30 | 467.775050 | 0.107 | -0.500 | 0.500 |
| 40 | 467.775060 | 0.128 | -0.500 | 0.500 |
| 50 | 467.775050 | 0.107 | -0.500 | 0.500 |
| 60 | 467.775000 | 0.000 | -0.500 | 0.500 |

### 6.2.3. Test Limit

As per manufacturer declared spec +/- 0.5ppm

## 6.3. Audio Frequency Response

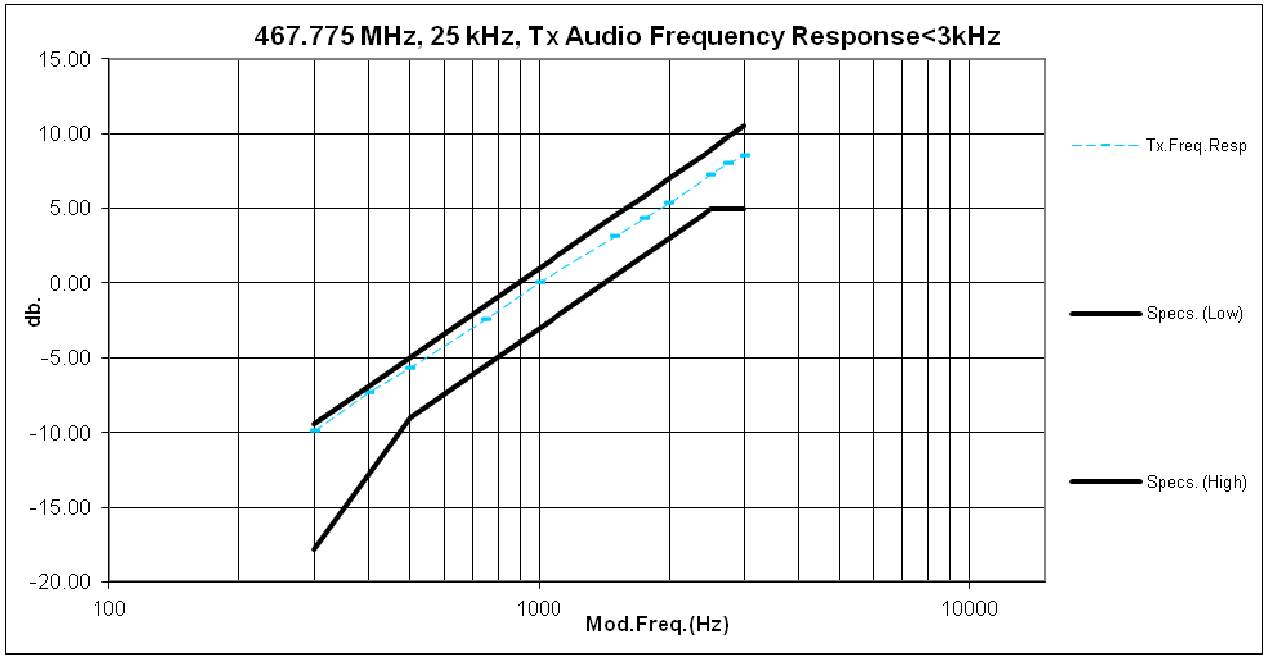
### 6.3.1. Test Setup

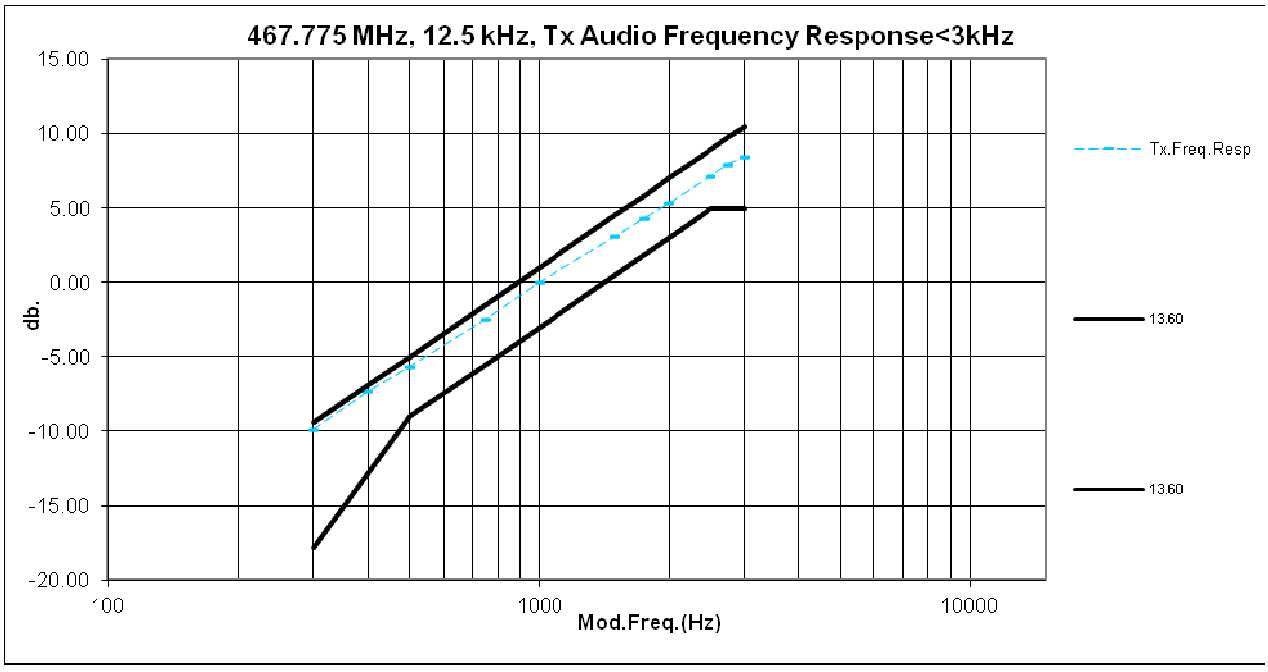



1) The DUT transmitter output port was connected to Modulation Analyzer.
2) Path loss for the measurement included.
3) Set the audio bandwidth filter to 15 kHz and 50 kHz.
4) Transmit the radio and set the audio analyzer to 1 kHz audio frequency and 20% of the Full rated system deviation.
5) On audio analyzer, set the rated level as reference to zero.
6) Vary the audio frequency from 300 Hz to 3 kHz. Record the change in dB on the audio analyzer.

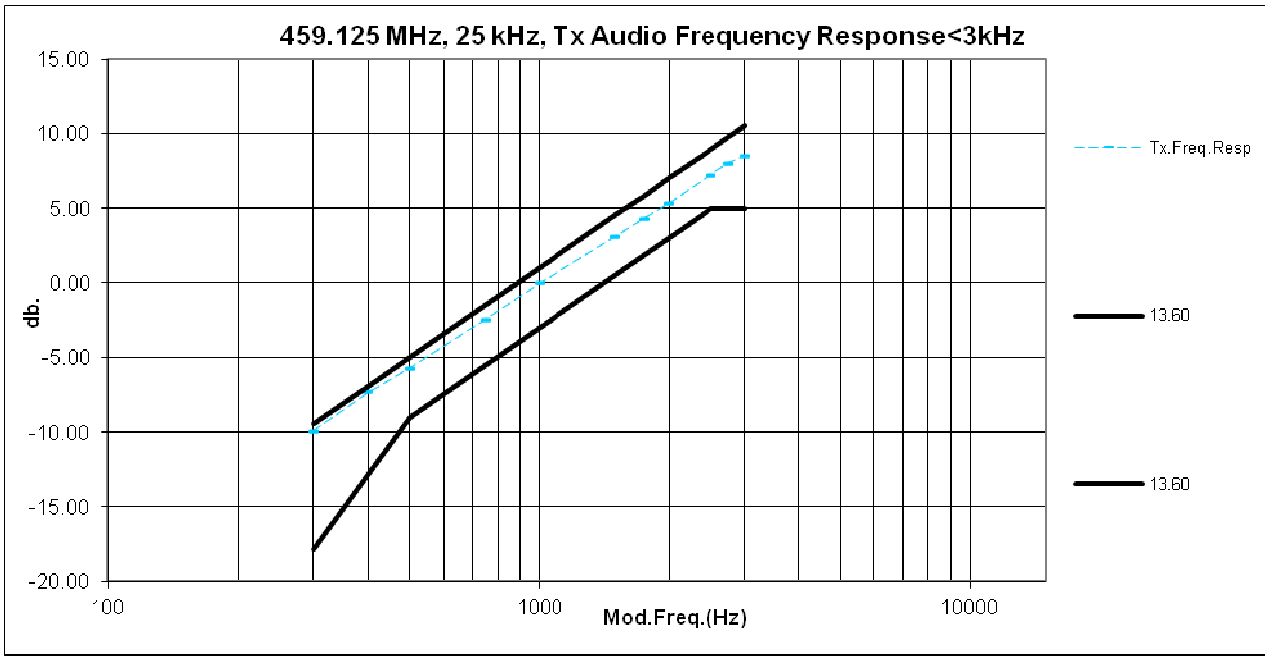
### 6.3.2. Test Result

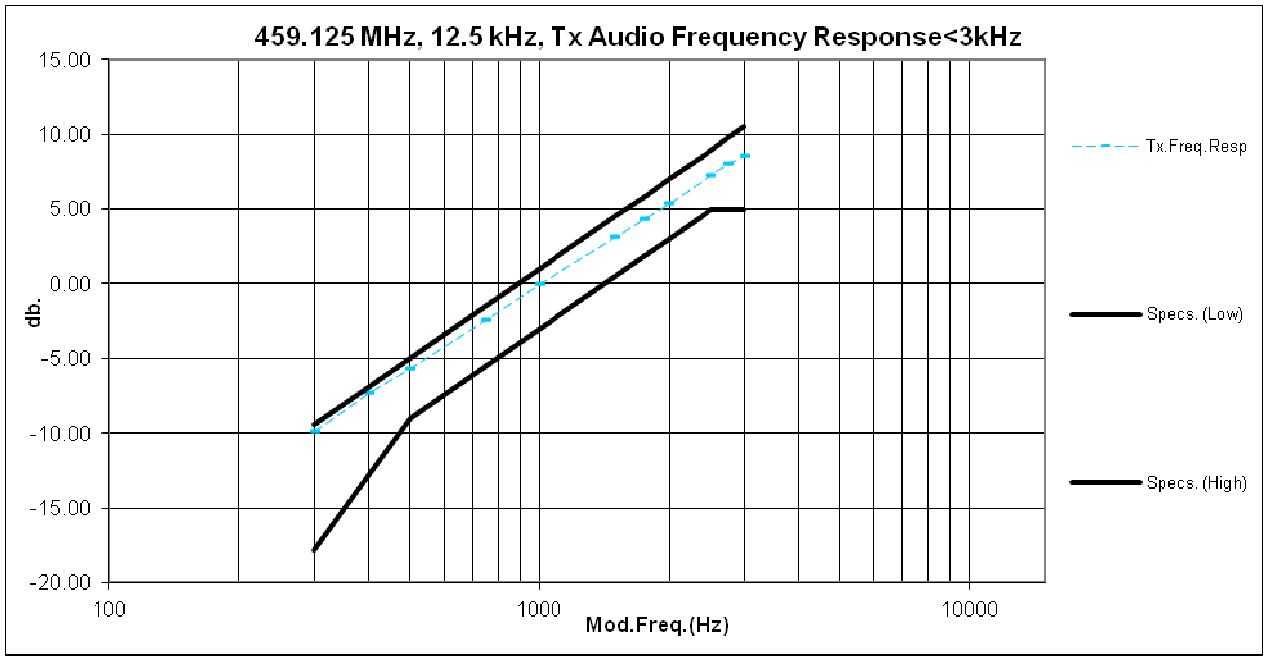
Not for FCC review



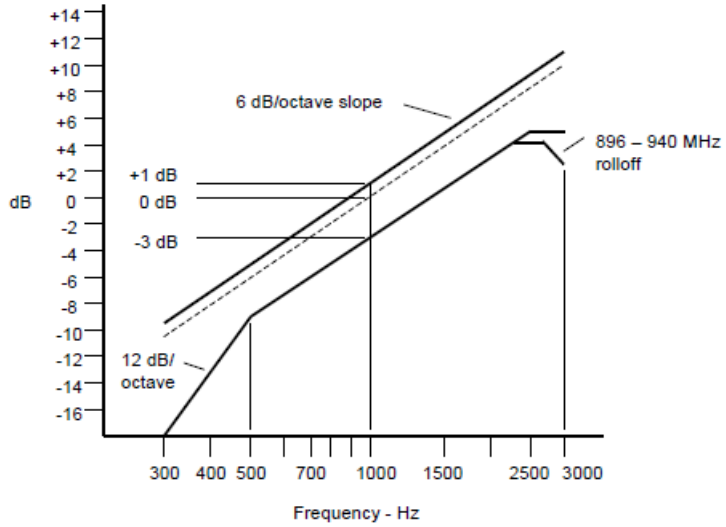



Not for FCC review



### 6.3.3. Test Limit

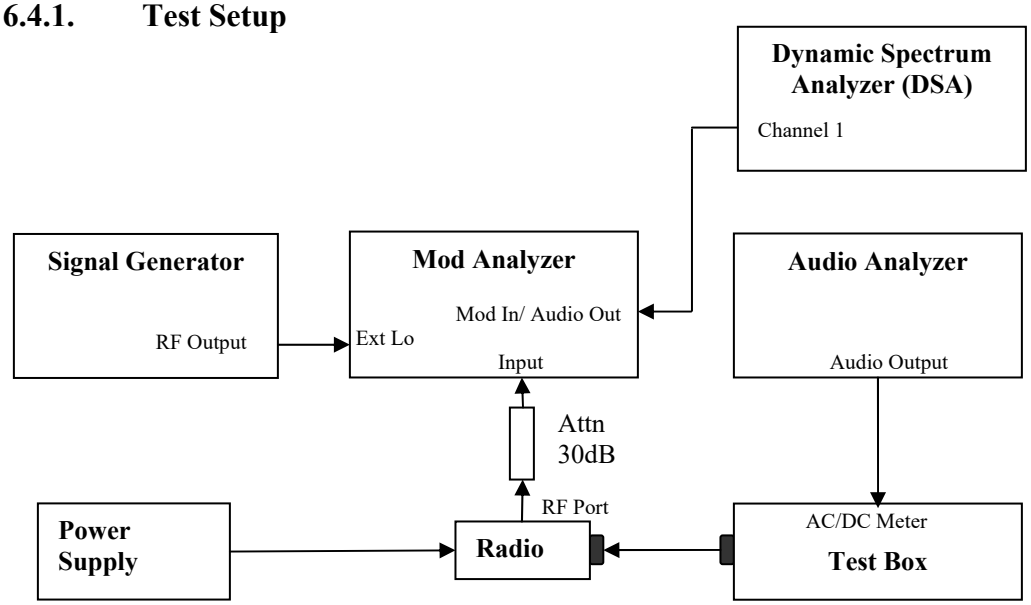



Note:

- *There are additional 6 dB per octave attenuation is allowed from 2.5KHz to 3KHz in equipment 25MHz to 869MHz radio.*
- *Additional 6 dB per octave attenuation is allowed from 2.3KHz to 2.7KHz & additional 12 dB per octave attenuation is allowed from 2.7KHz to 3KHz in equipment 896MHz to 940MHz radio.*

## 6.4. Audio Low Pass Filter Response

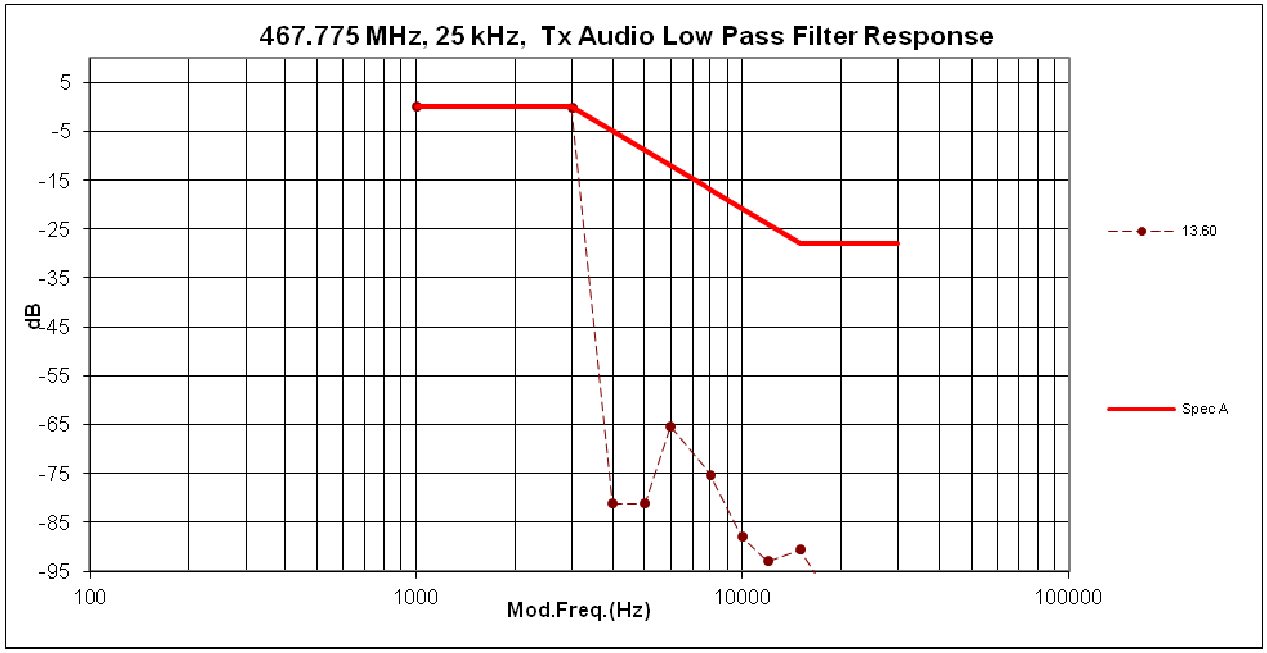
### 6.4.1. Test Setup

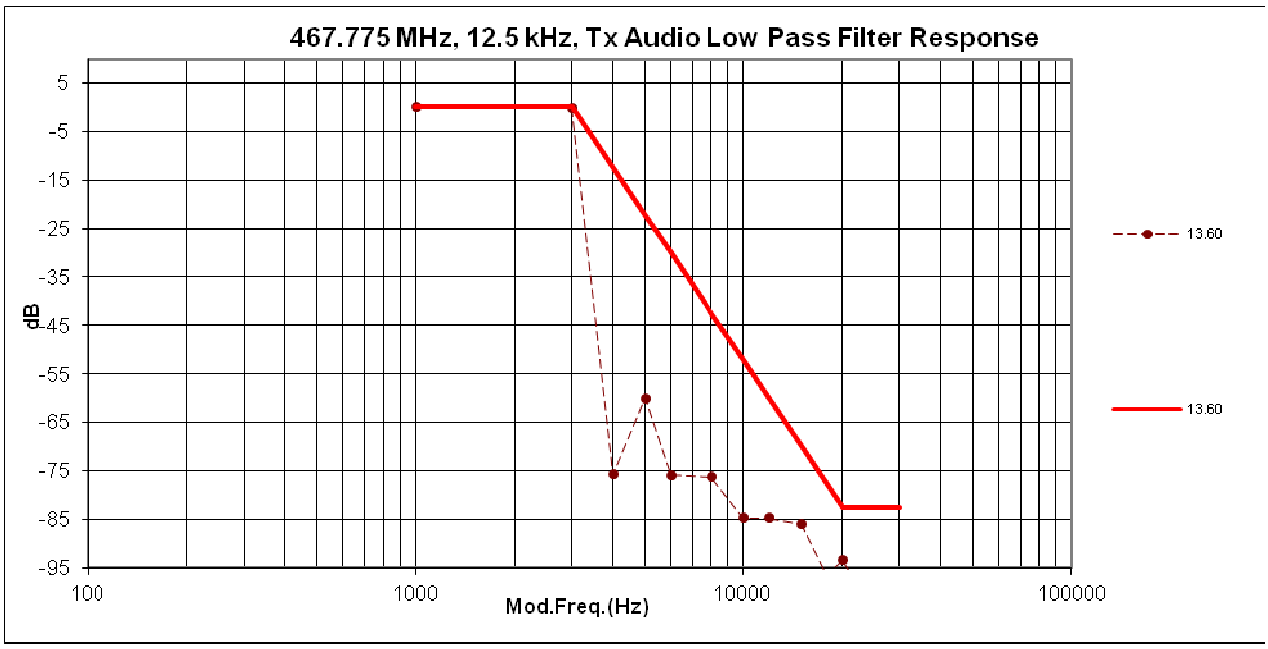



1) The DUT transmitter output port was connected to Modulation Analyzer.
2) Path loss for the measurement included.
3) Press 23.1SPCL on modulation analyzer to enable the external LO from Sigen.
4) Set the Sigen frequency to Fc + 1.5 MHz, RF output level to 0dBm without modulation.
5) Transmit the radio and set the audio analyzer to 1 kHz audio frequency and 60% of the Full rated system deviation.
6) Up the amplitude by 20dB.
7) On DSA, get the reference point to 0dB.
8) Vary the frequency on audio analyzer from 3 kHz to 20 kHz, record the audio tone from DSA.

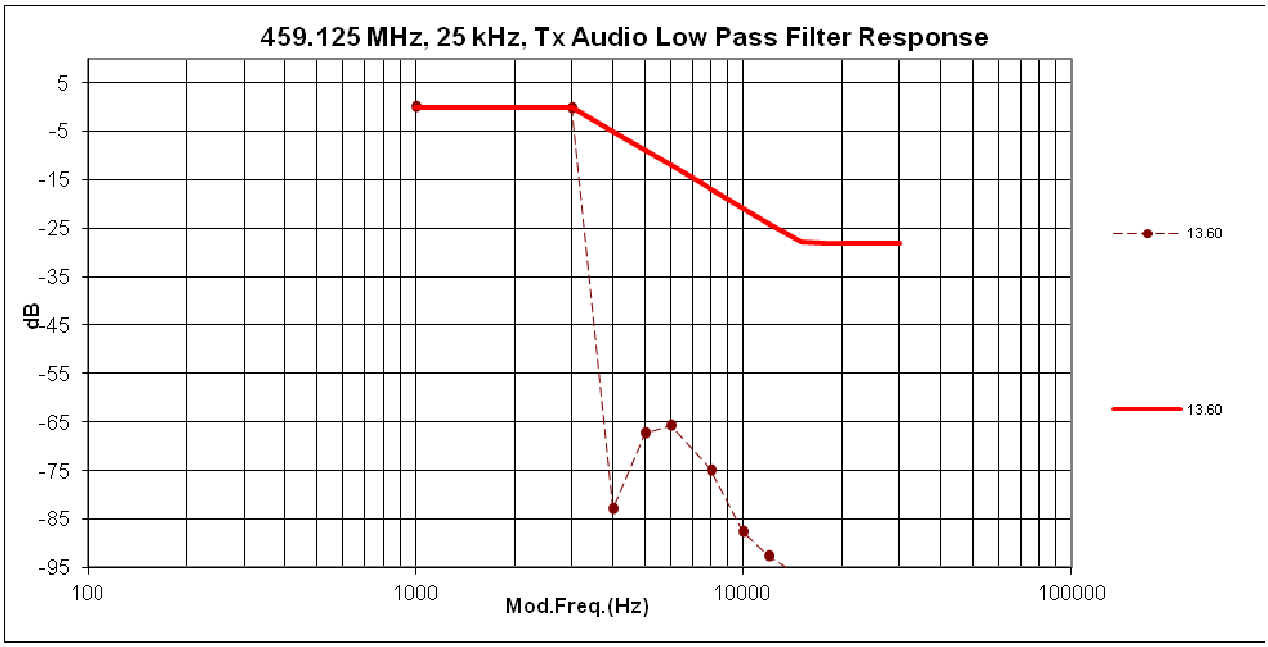
### 6.4.2. Test Result

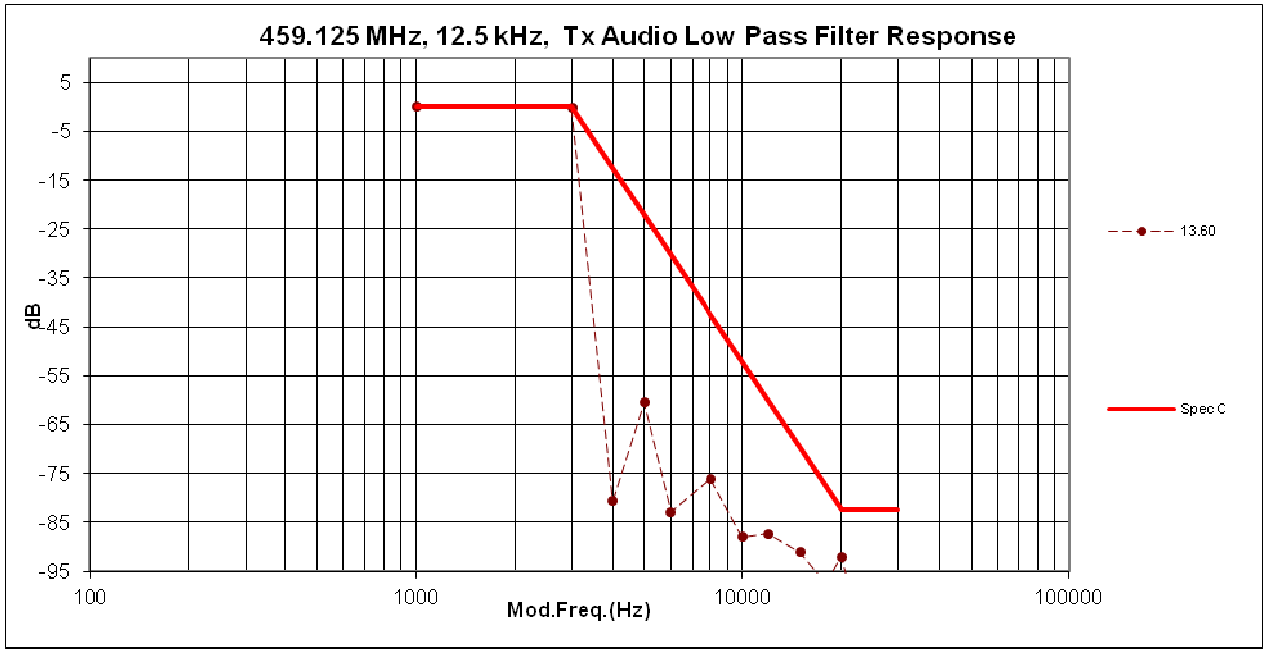
Not for FCC review



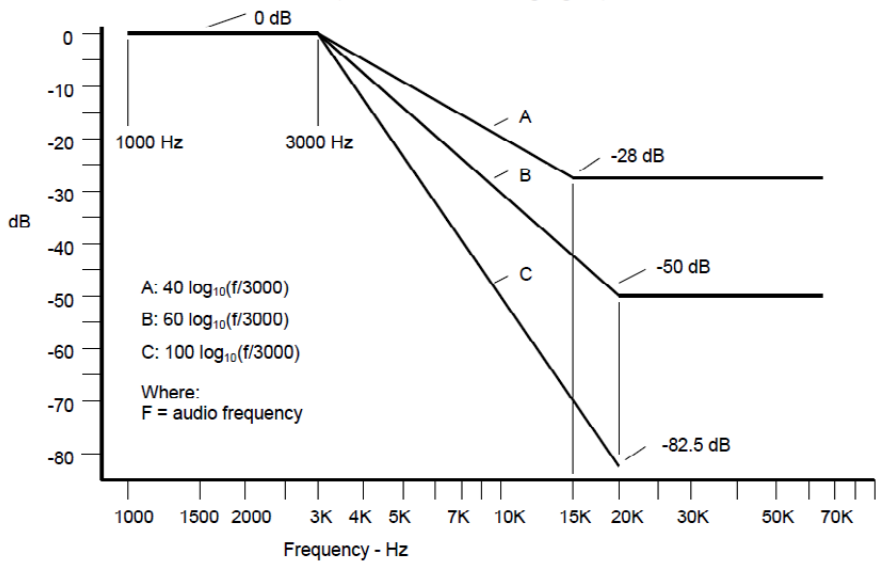



Not for FCC review



### 6.4.3. Test Limit




For audio frequencies above 3000 Hz, the audio response of the post limiter low-pass filter shall meet or exceed the following requirements:

a) For equipment operating on 20, 25 or 30 kHz channel bandwidth in the 25 MHz to 174 MHz range:

At frequencies from 3000 Hz through 15,000 Hz the attenuation shall be greater than the attenuation at 1000 Hz by at least: $40 \log_{10}(f / 3000)$ dB

where: $f$ is the audio frequency in Hz.

At frequencies above 15,000 Hz, the attenuation shall be greater than the attenuation at 1000 Hz, by at least: 28 dB.

b) For equipment operating with 25 kHz bandwidth channels between 406 and 512 MHz through 896 MHz, and between 929 MHz through 930 MHz:

At frequencies from 3000 Hz through 20,000 Hz, the attenuation shall be greater than the attenuation at 1000 Hz by at least: $60 \log_{10}(f / 3000)$ dB

where: $f$ is the audio frequency in Hz.

At frequencies above 20,000 Hz the attenuation shall be greater than the attenuation at 1000 Hz by at least: 50 dB.

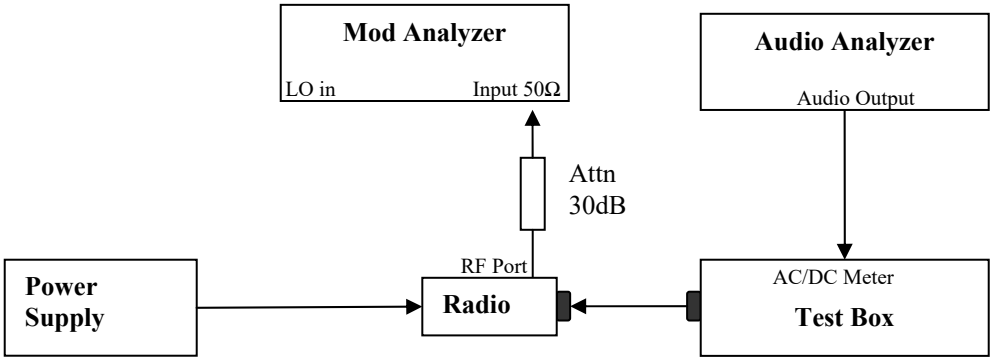
c) For equipment operating on channels between 896 MHz through 901 MHz, between 935 MHz through 940 MHz, and 12.5 or 15 kHz spaced channels in the frequency range 138-174 MHz and 406-512 MHz.

At frequencies from 3000 Hz through 20,000 Hz the attenuation shall be greater than the attenuation at 1000 Hz by at least: $100 \log_{10}(f / 3000)$ dB

where: $f$ is the audio frequency in Hz.

## 6.5. Modulation Limiting

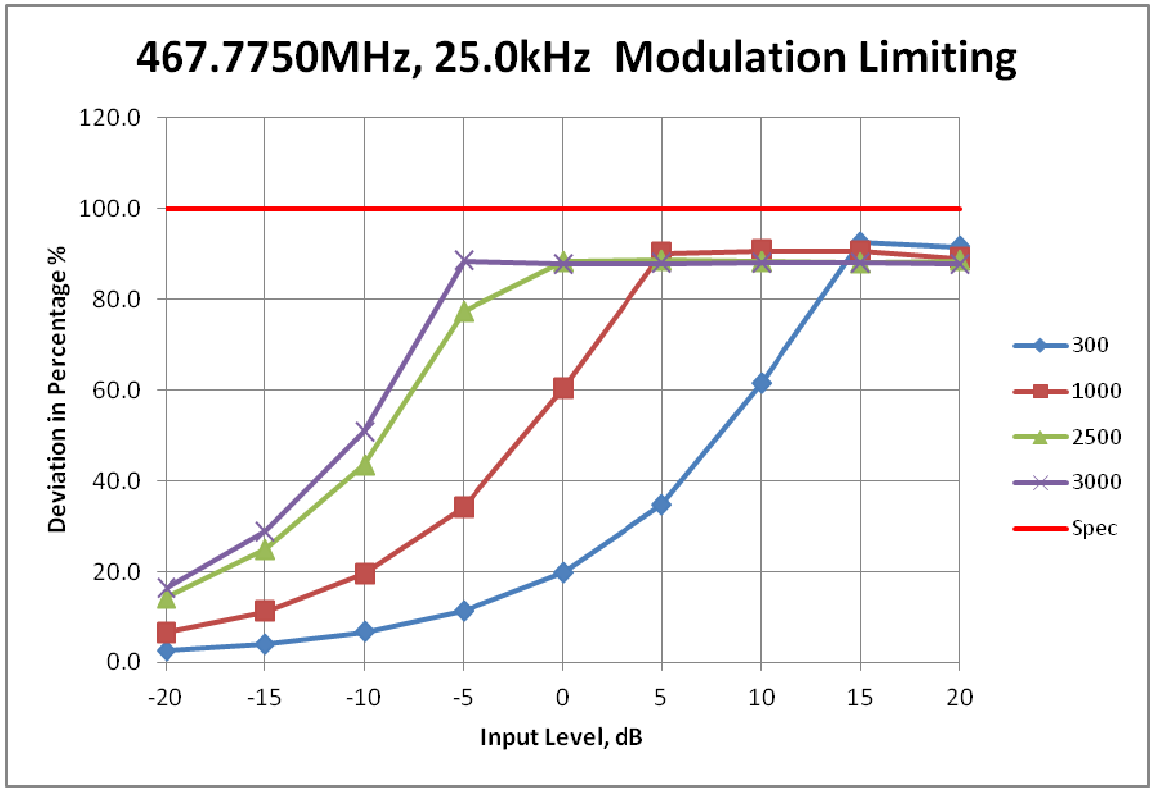
### 6.5.1. Test Setup

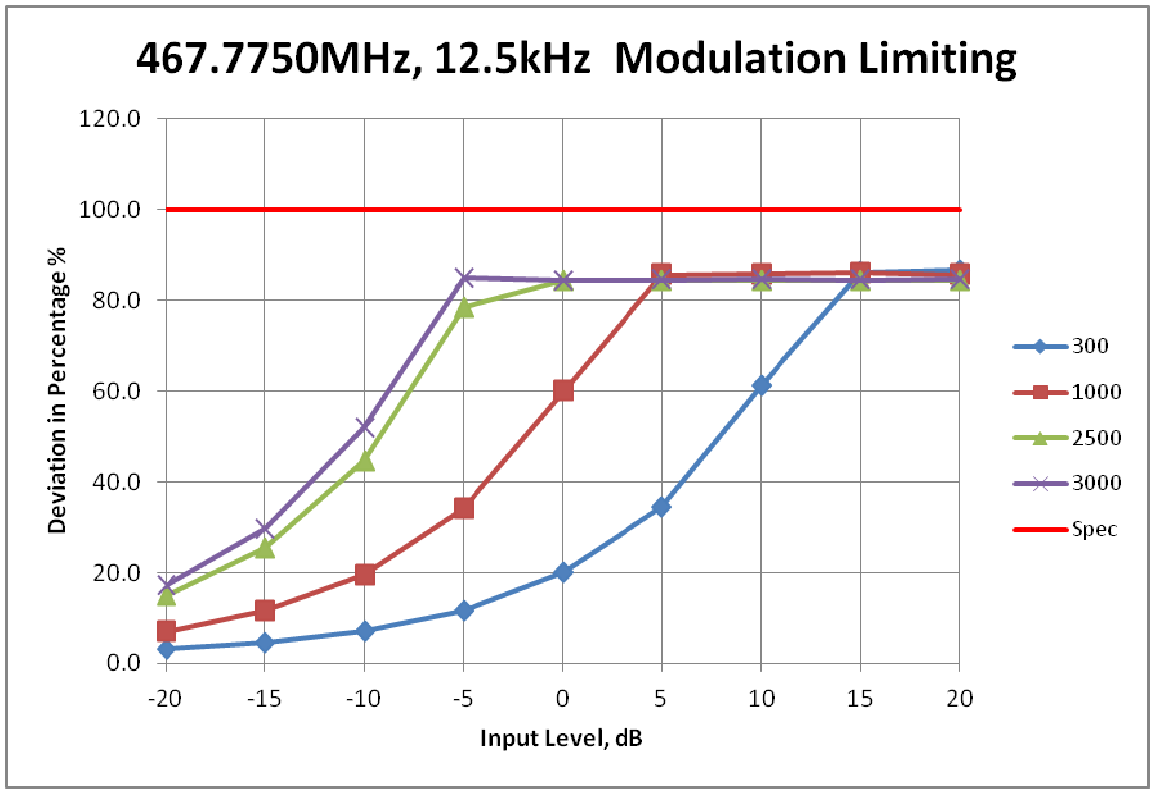


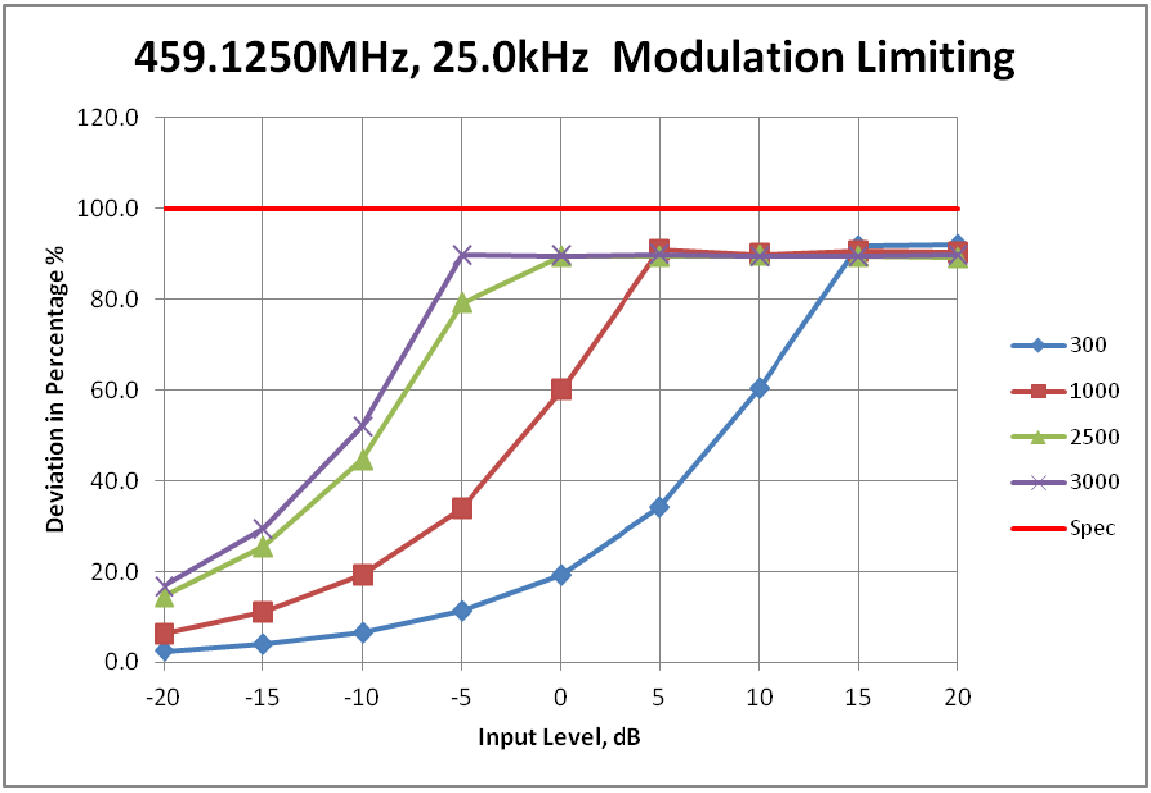

1) The DUT transmitter output port was connected to Modulation Analyzer.
2) Path loss for the measurement included.
3) Set the audio bandwidth filter to 15 kHz.
4) Transmit the radio and set the audio analyzer to 1 kHz audio frequency and 60% of the Full rated system deviation.
5) Record the frequency deviation as 0dB input level at 1kHz audio frequency.
6) Repeat the step and record the frequency deviation from -20 dB to 20dB by 5 dB increments and different audio freq 300 Hz, 2.5 kHz and 3 kHz.

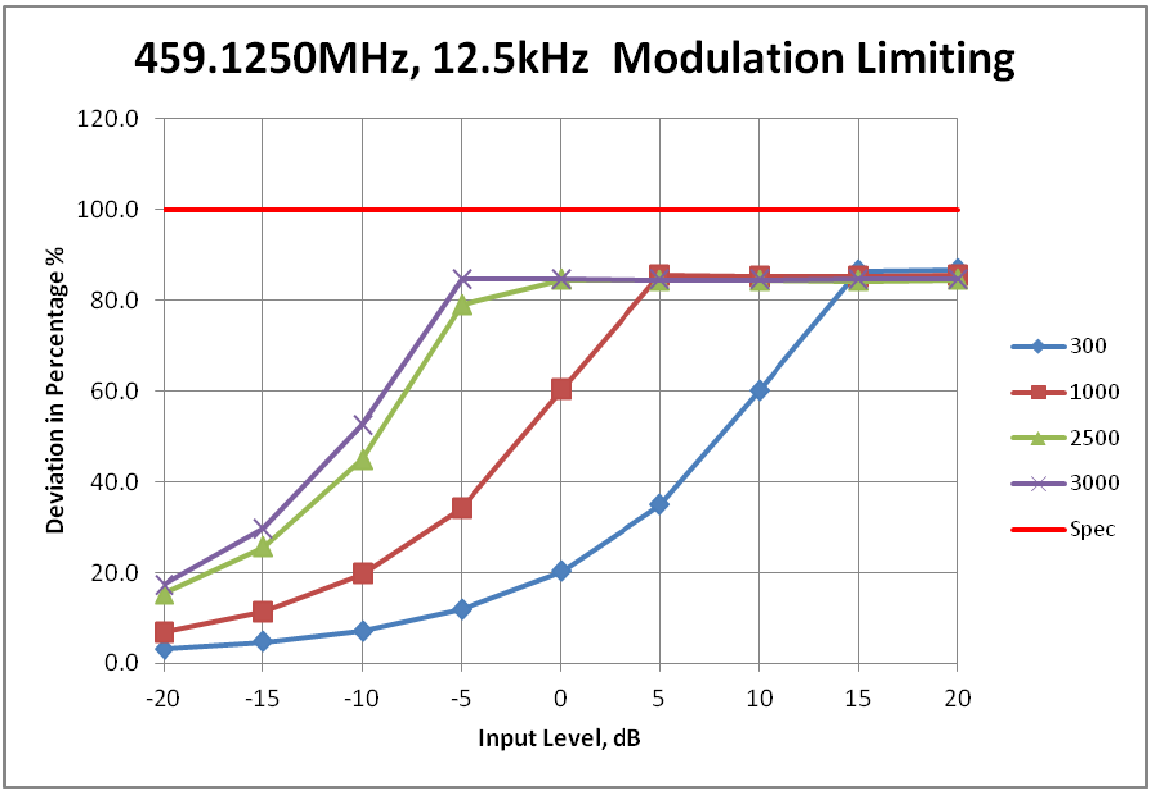
### 6.5.2. Test Result

Not for FCC review





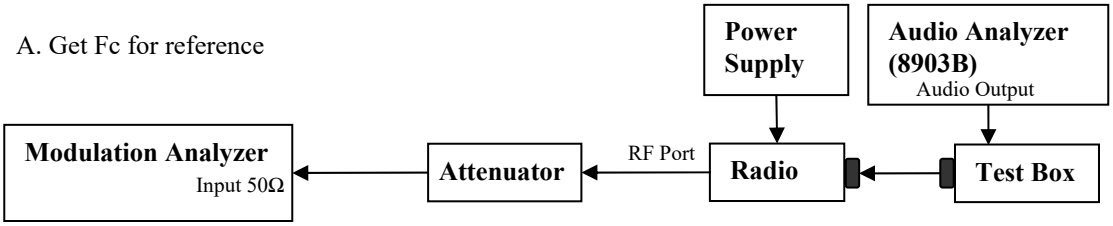

### 6.5.3. Test Limit

Modulation Limiting shall not exceed 100 percent.

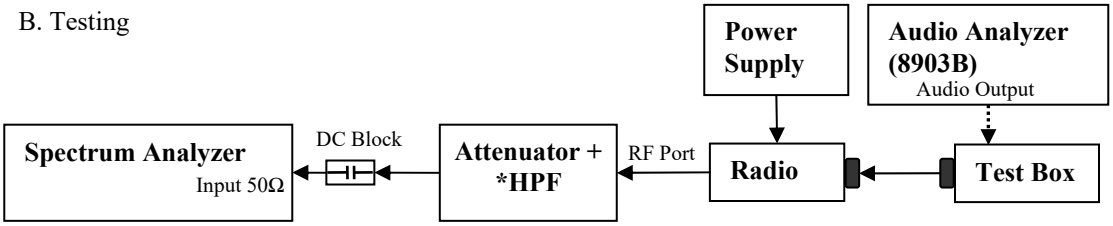
## 6.6. Occupied Bandwidth

### 6.6.1. Test Setup (Analog)

A. Get Fc for reference




B. Testing




1) The DUT transmitter output port was connected to Modulation Analyzer.
2) Set the audio bandwidth filter to 15 kHz low pass filter and 50 kHz high pass filter.
3) Transmit the radio and set the audio analyzer to 2.5 kHz audio frequency and 50% of the rated deviation. Up the amplitude by 16 dB. Dekey the DUT.
4) Path loss for the measurement included.
5) Select the Occupied Bandwidth measurement for 99% Emissions Bandwidth Measurement.
6) Key in the Fc and Resolution Bandwidth (1 ~ 5 % of emission designator).
7) Transmit the DUT and record the occupied Bandwidth frequency.
8) Preset the spectrum analyzer for sideband spectrum measurement.
9) Set the span and Resolution Bandwidth (according to FCC/ ISED standard).
10) Save the screen shot as modulated signal
11) Remove the audio tone from audio analyzer to capture unmodulated signal.

* Only HPF added for Mask 80.211 measurement with attenuator.

### 6.6.2. Test Result (Analog)

BANDWIDTH CALCULATIONS:

Carson's Rule for FM modulation is utilized to compute the bandwidth shown in the FCC emission designator.
Carson's Rule is: BW = 2 * (M + D) where: BW = Bandwidth
M= Maximum modulating frequency
D = Deviation

Standard Audio Modulation (25 kHz Channelization, Analog Voice):
Emission Designator 16K0F3E

In this case, the maximum modulating frequency is 3 kHz with a 5 kHz deviation.

BW = 2(M+D) = 2*(3 kHz + 5 kHz) = 16 kHz =➔ 16K0
F3E portion of the designator indicates voice.

Therefore, the entire designator for 25 kHz channelization analog voice is 16K0F3E

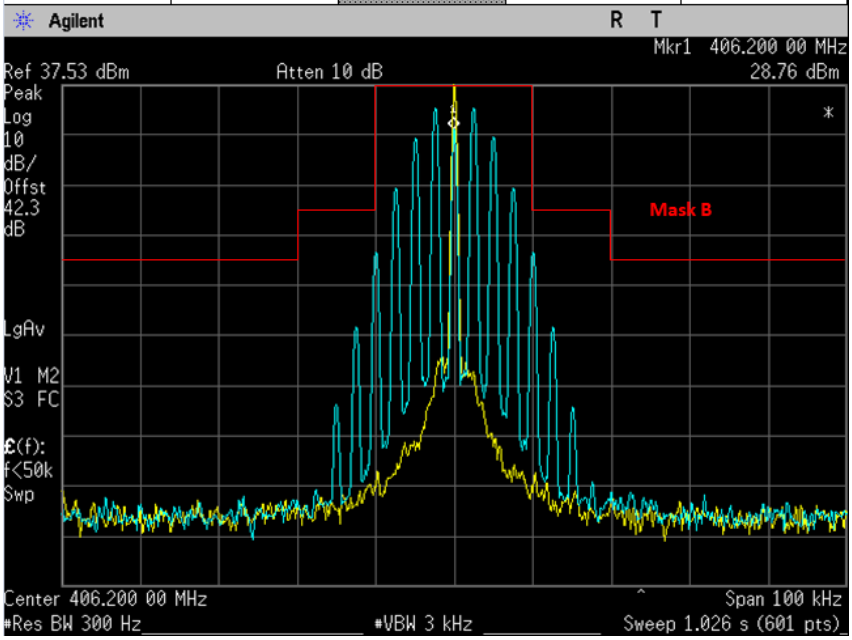
Standard Audio Modulation (12.5 kHz Channelization, Analog Voice):
Emission Designator 11K0F3E

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 indicates voice.

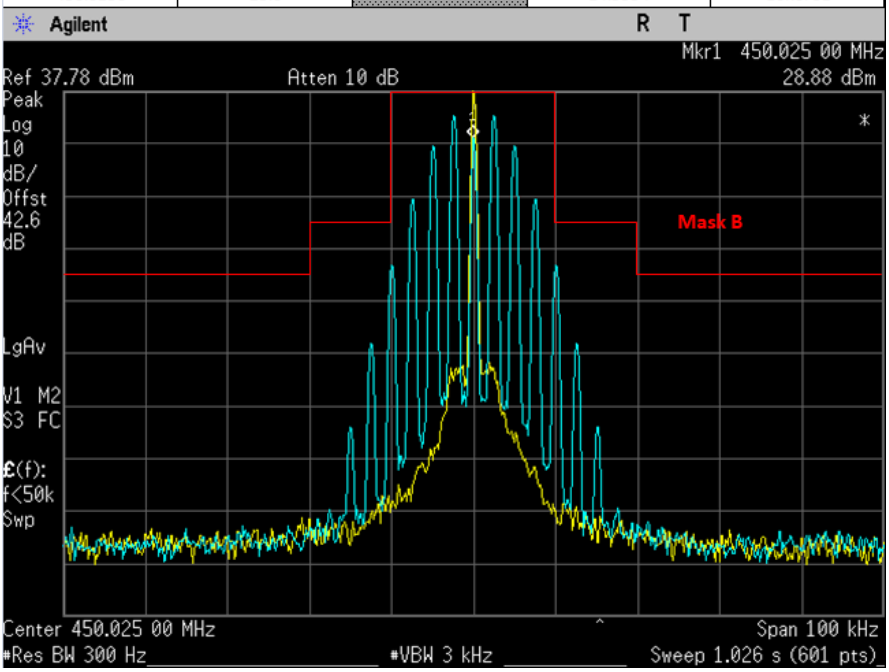
Therefore, the entire designator for 12.5 kHz channelization analog voice is 11K0F3E.

| Modulation | | | Rules Part | |
|---|---|---|---|---|
| Analog Voice | | | RSS 119 | |
| Channel Frequency (MHz) | Channel Spacing (kHz) | | 99% OCB (kHz) | Emission Designator |
| 406.2000 | 25.0 | | 14.9885 | 16K0F3E |



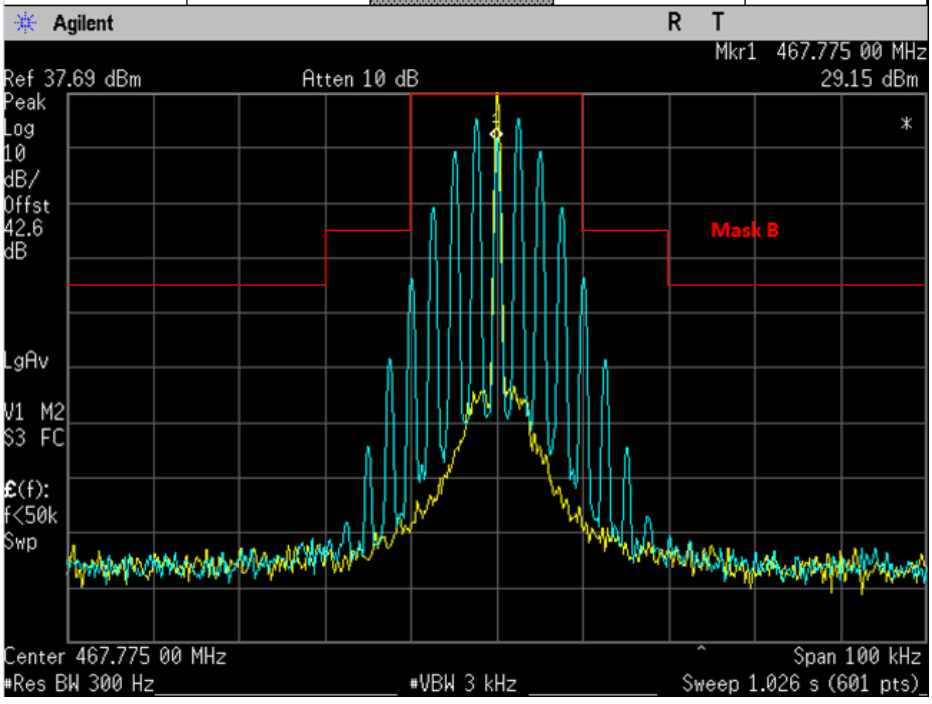

**Not for FCC review**

| Modulation | | | Rules Part | |
|---|---|---|---|---|
| Analog Voice | | | 74.462(c ) / RSS 119 | |
| Channel Frequency (MHz) | Channel Spacing (kHz) | | 99% OCB (kHz) | Emission Designator |
| 450.0250 | 25.0 | | 14.9994 | 16K0F3E |



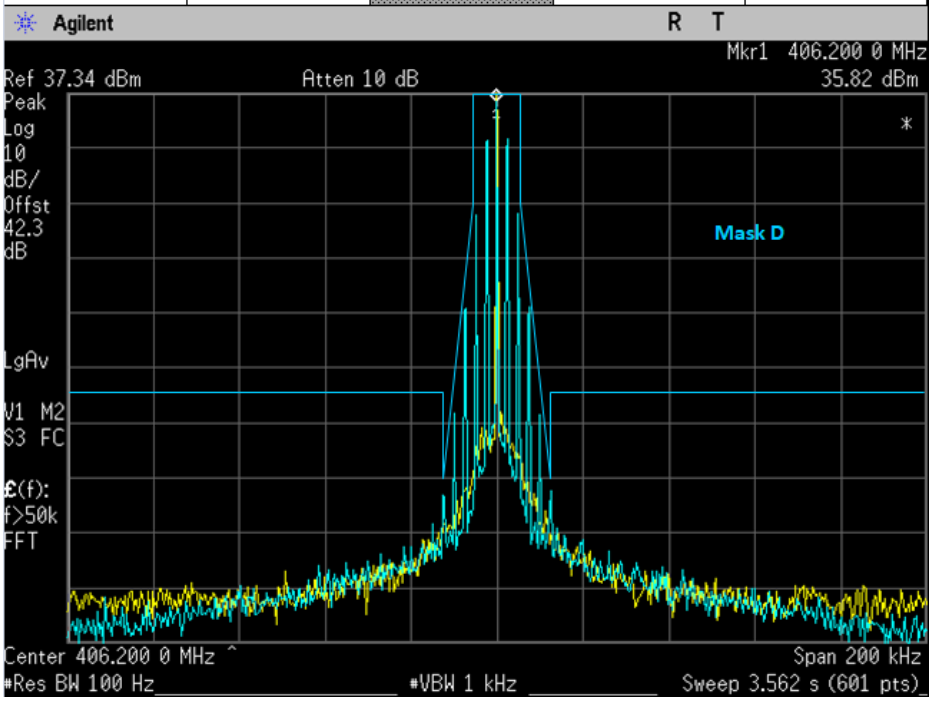

**For Part 74**

| Modulation | | | Rules Part | |
|---|---|---|---|---|
| Analog Voice | | | 80.211(f) / RSS 119 | |
| Channel Frequency (MHz) | Channel Spacing (kHz) | | 99% OCB (kHz) | Emission Designator |
| 467.7750 | 25.0 | | 14.9701 | 16K0F3E |

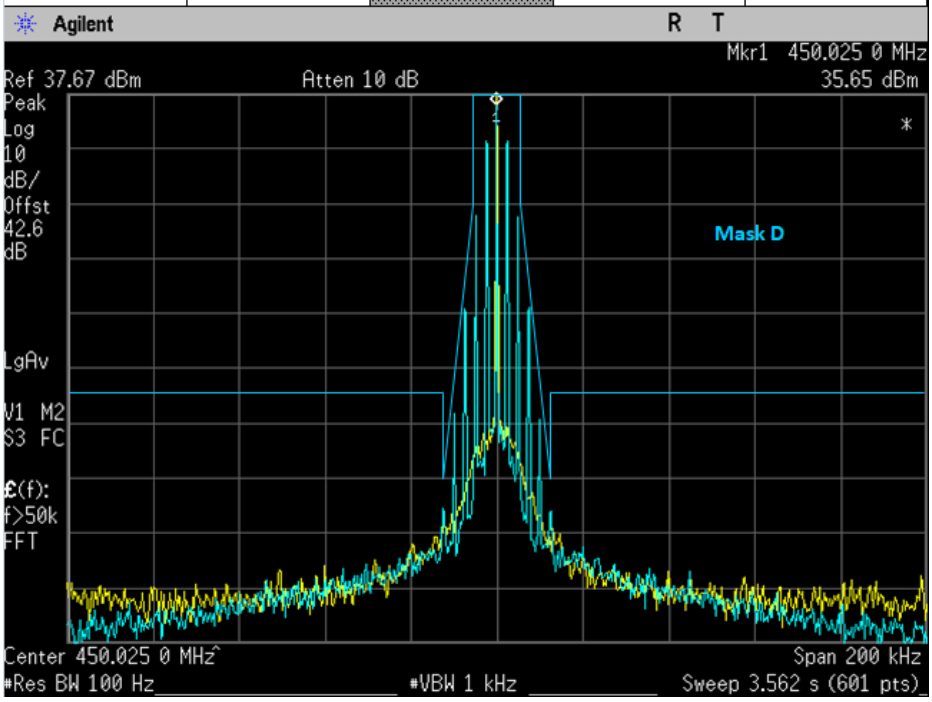



**For Part 80 (NOT FOR FCC REVIEW)**

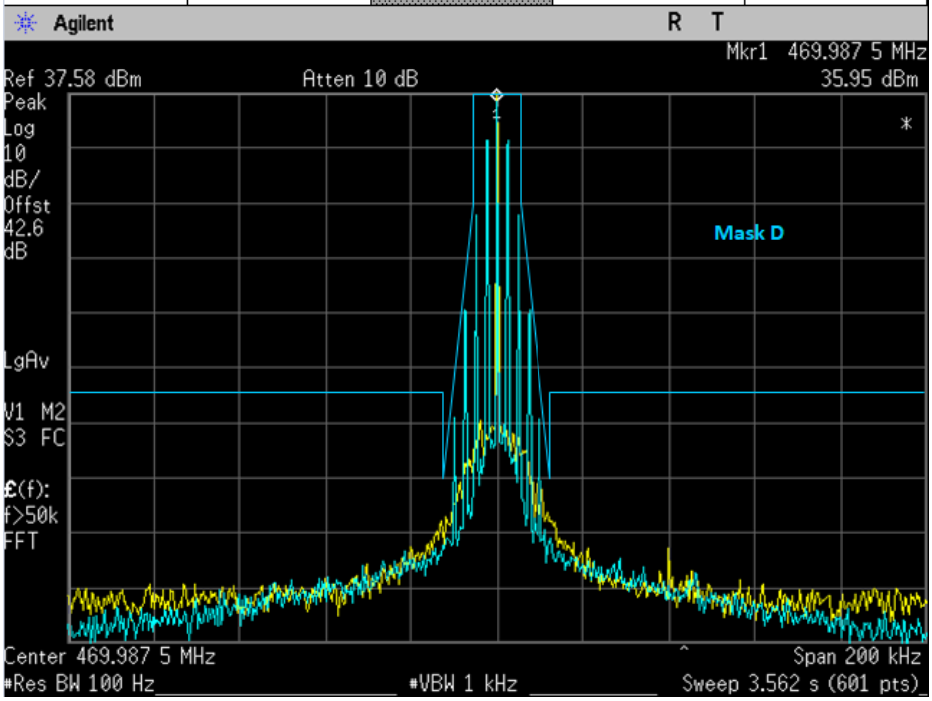
| Modulation | | | Rules Part | |
|---|---|---|---|---|
| Analog Voice | | | 90.210 / RSS 119 | |
| **Channel Frequency (MHz)** | **Channel Spacing (kHz)** | | **99% OCB (kHz)** | **Emission Designator** |
| 406.2000 | 12.5 | | 9.8061 | 11K0F3E |



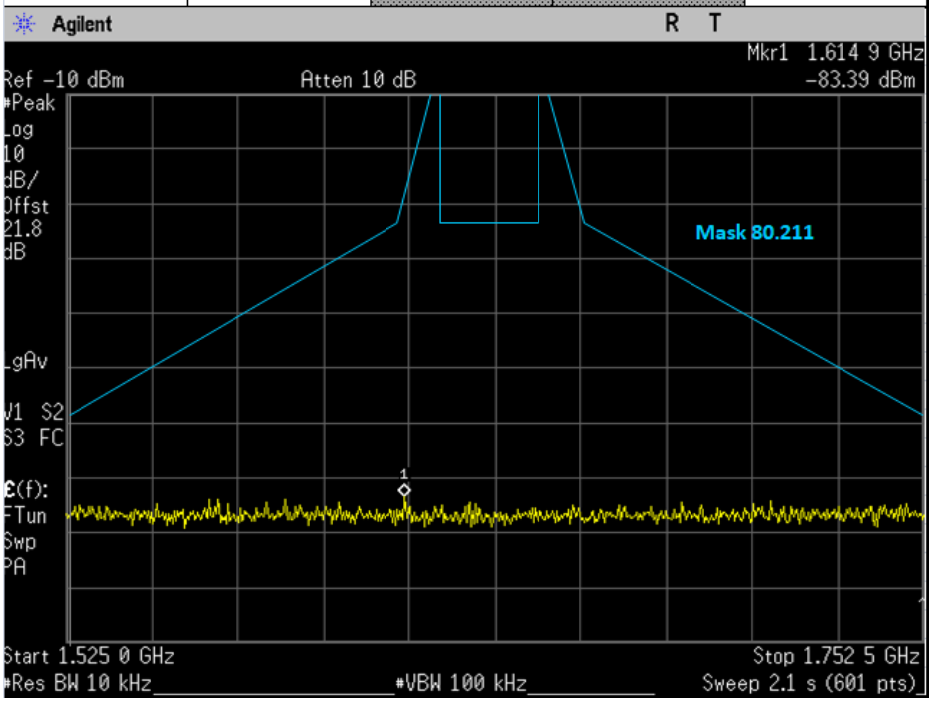

| Modulation | | | Rules Part | |
|---|---|---|---|---|
| Analog Voice | | | 90.210 / 74.462(c ) | |
| **Channel Frequency (MHz)** | **Channel Spacing (kHz)** | | **99% OCB (kHz)** | **Emission Designator** |
| 450.0250 | 12.5 | | 9.8346 | 11K0F3E |



| Modulation | Rules Part | | | |
|---|---|---|---|---|
| Analog Voice | 90.210 | | | |
| **Channel Frequency (MHz)** | **Channel Spacing (kHz)** | | **99% OCB (kHz)** | **Emission Designator** |
| 469.9875 | 12.5 | | 9.8097 | 11K0F3E |

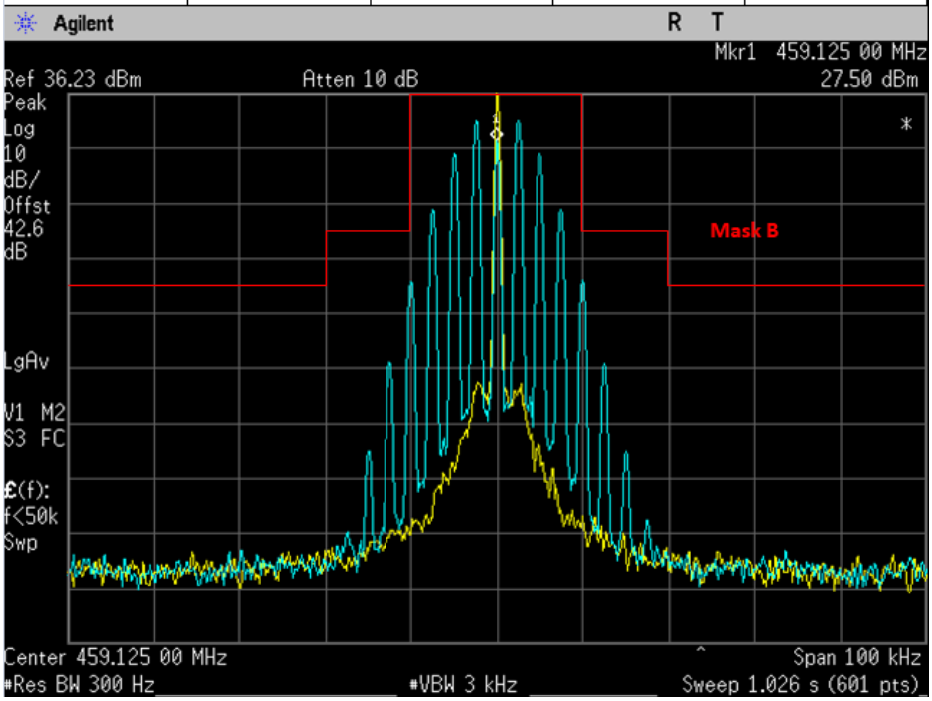



| Modulation | Rules Part | | | |
|---|---|---|---|---|
| Analog Voice | 80.211(c ) | | | |
| **Channel Frequency (MHz)** | **Channel Spacing (kHz)** | | | **Emission Designator** |
| 467.7750 | 25.0 | | | 16K0F3E |

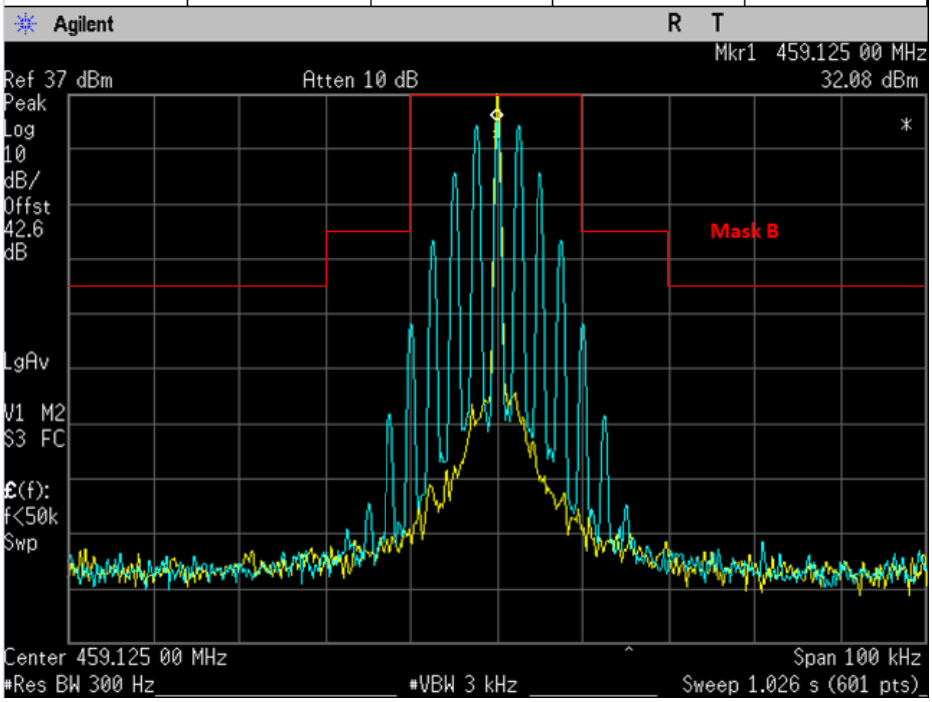



**(NOT FOR FCC REVIEW)**

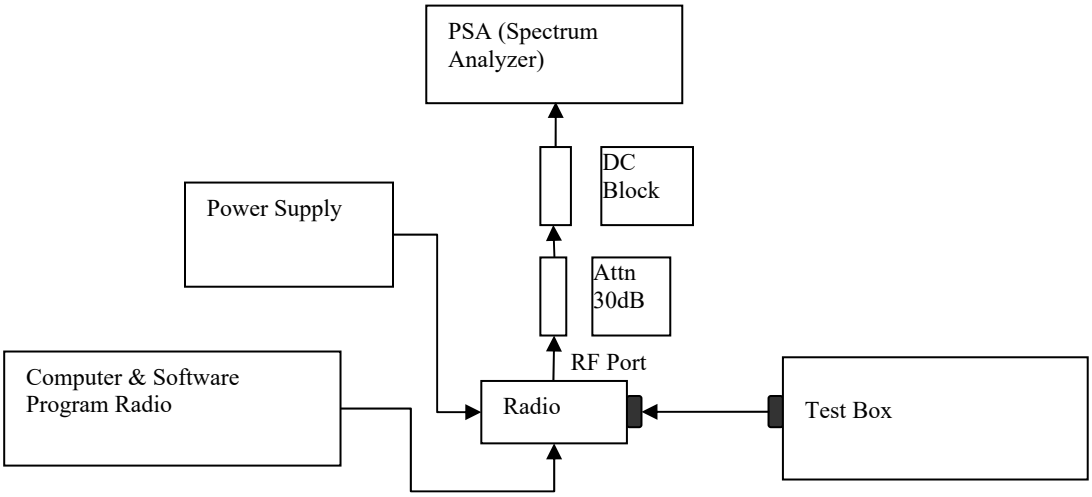
| Modulation | Rules Part | | | |
|---|---|---|---|---|
| Analog Voice | 22.359(b) | | | |
| **Channel Frequency (MHz)** | **Channel Spacing (kHz)** | **-26 dB Point (kHz)** | **99% OCB (kHz)** | **Emission Designator** |
| 459.1250 | 25.0 | 15.5370 | 14.9388 | 16K0F3E |




| Modulation | Rules Part | | | |
|---|---|---|---|---|
| Analog Voice | 22.359(b) | | | |
| **Channel Frequency (MHz)** | **Channel Spacing (kHz)** | **-26 dB Point (kHz)** | **99% OCB (kHz)** | **Emission Designator** |
| 459.1250 | 20.0 | 15.3681 | 10.3563 | 16K0F3E |



### 6.6.3. Test Setup (Digital)




1) Program and set radio to operate in desire test frequency and digital mode with modulation. (*4FSK, C4FM or other digital modulation form).
2) Path loss for the measurement included.
3) Select the Occupied Bandwidth measurement for 99% Emissions Bandwidth Measurement.
4) Key in the Fc and Resolution Bandwidth (1 ~ 5 % of emission designator).
5) Transmit the DUT and record the occupied Bandwidth frequency.
6) Preset the spectrum analyzer for modulation emission spectrum measurement.
7) Set the span and Resolution Bandwidth (according to FCC/ ISED standard).
8) Capture the screen shot as modulated signal.

*Note:

- For Digital Modulation, 12.5 kHz Data F1D & FXD would be the same. Therefore only measurements with F1D modulation shown below.
- For Digital Modulation, 12.5 kHz Data F1E & FXE would be the same. Therefore only measurements with F1E modulation shown below.

### 6.6.4. Test Result (Digital)

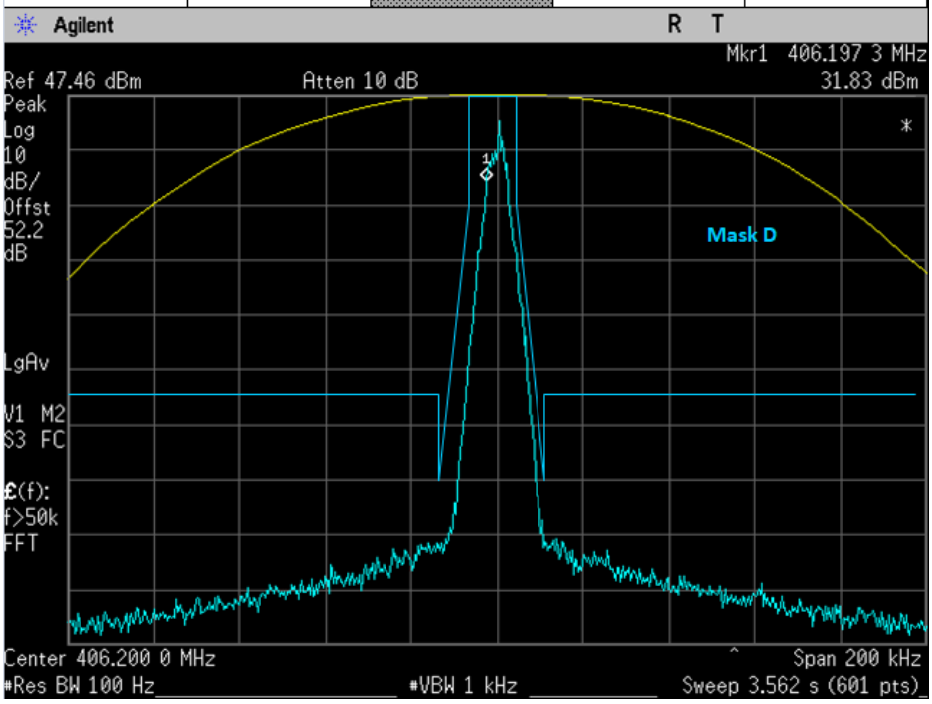
Digital (12.5 kHz Channelization, Digital Data/Voice/Data+Voice):
Emission Designator 8K10F1D/E/W

*The 99% energy rule (title 47CFR 2.989) was used for digital mode and is more accurate than Carson's rule. It basically states that 99% of the modulation energy falls within X kHz, in this case, 7.60 kHz Measurements were performed in accordance with TIA/EIA TSB102.CAAB Section 2.2.5.2. The emission mask was obtained from 47CFR 90.210(d).*

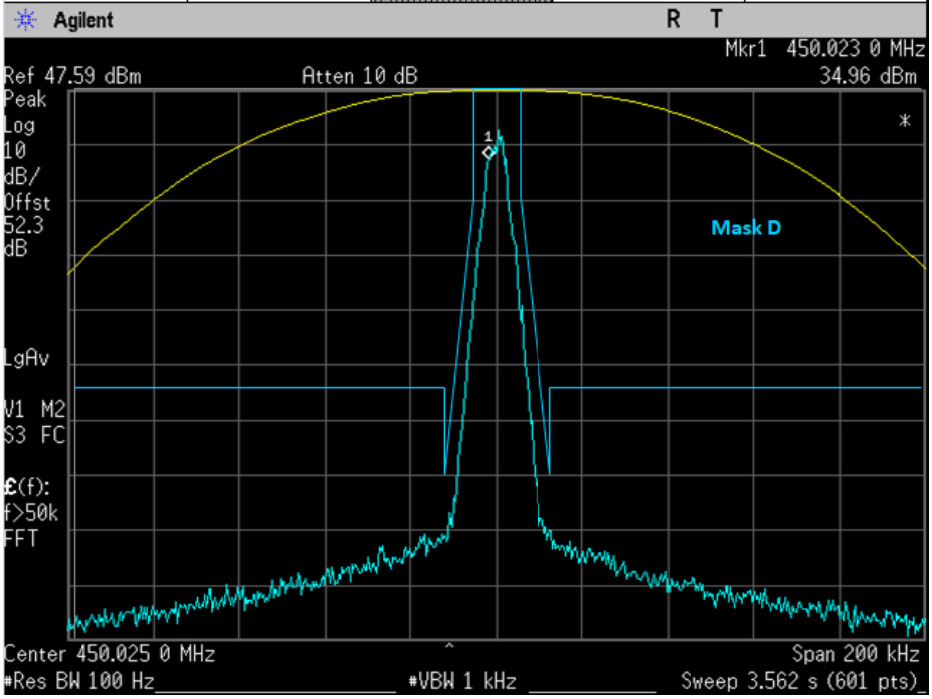
F1D/E/W portion of the designator indicates digital data/voice/data+voice respectively

Therefore, the entire designator for 12.5 kHz channelization digital data is 7K60F1D/E/W

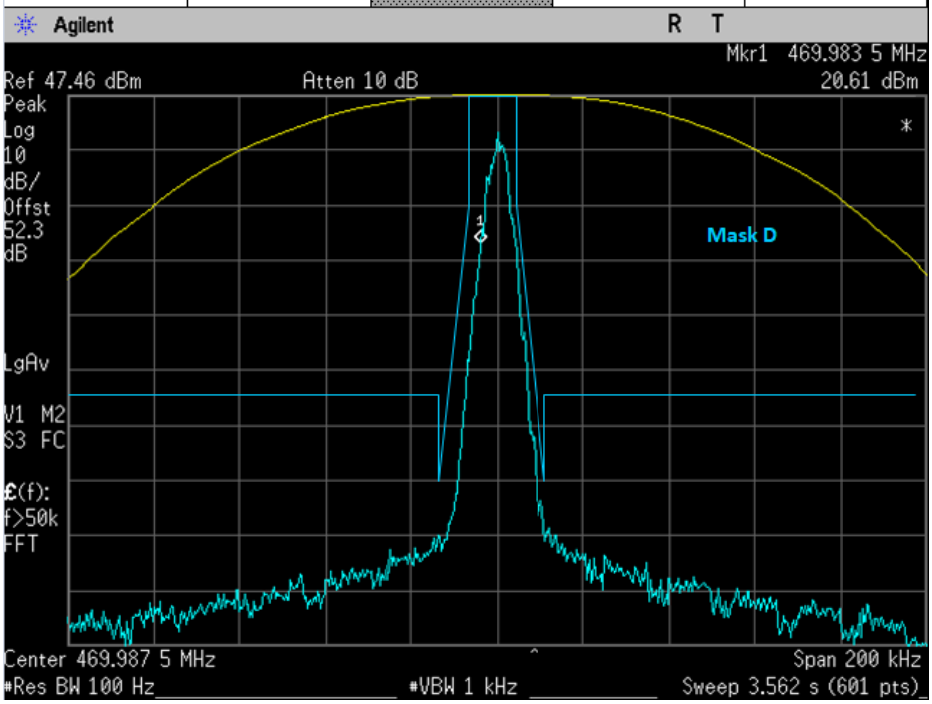
| Modulation | | | Rules Part | |
|---|---|---|---|---|
| 4FSK Data | | | 90.210 / RSS 119 | |
| **Channel Frequency (MHz)** | **Channel Spacing (kHz)** | | **99% OCB (kHz)** | **Emission Designator** |
| 406.2000 | 12.5 | | 7.4491 | 7K60F1D |



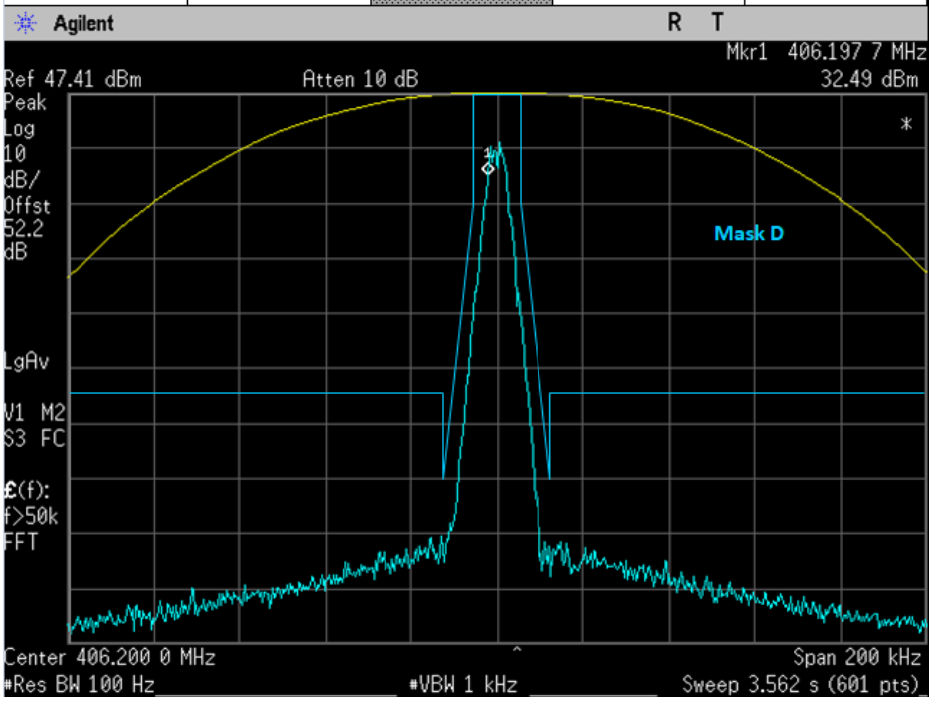
| Modulation | | | Rules Part | |
|---|---|---|---|---|
| 4FSK Data | | | 90.210 / 74.462(c ) | |
| **Channel Frequency (MHz)** | **Channel Spacing (kHz)** | | **99% OCB (kHz)** | **Emission Designator** |
| 450.0250 | 12.5 | | 7.4999 | 7K60F1D |



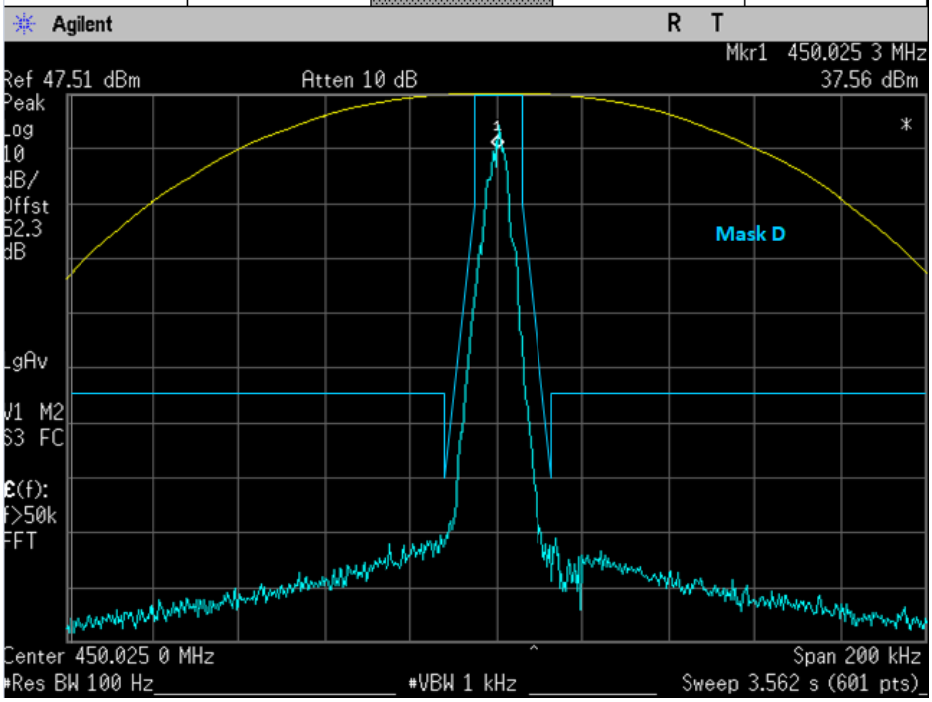

| Modulation | | | Rules Part | |
|---|---|---|---|---|
| 4FSK Data | | | 90.210 | |
| **Channel Frequency (MHz)** | **Channel Spacing (kHz)** | | **99% OCB (kHz)** | **Emission Designator** |
| 469.9875 | 12.5 | | 7.5681 | 7K60F1D |



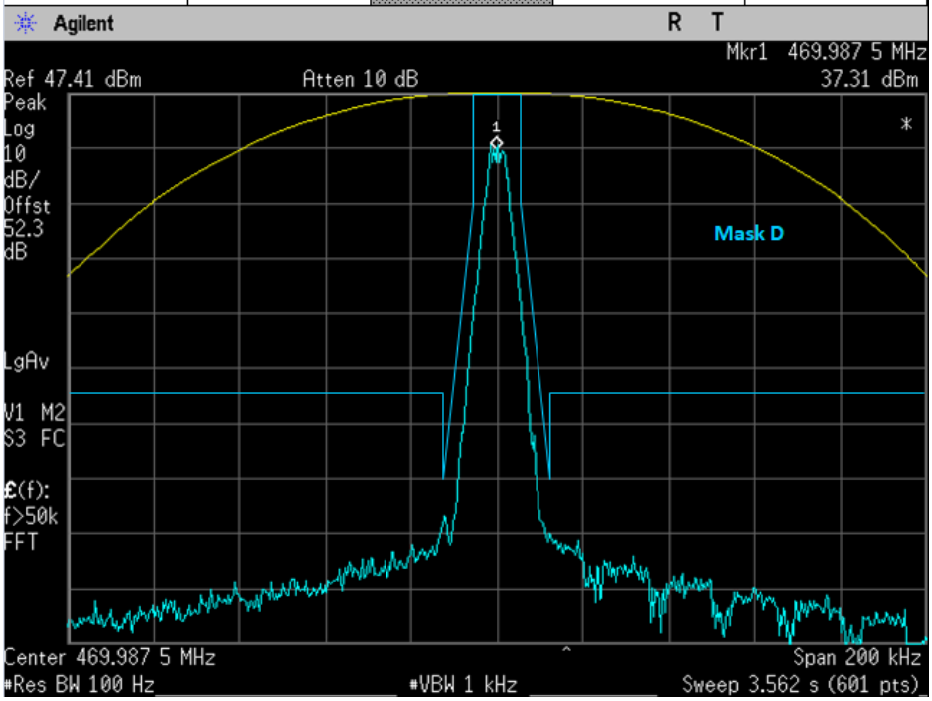
| Modulation | | | Rules Part | |
|---|---|---|---|---|
| 4FSK Voice | | | 90.210 / RSS 119 | |
| **Channel Frequency (MHz)** | **Channel Spacing (kHz)** | | **99% OCB (kHz)** | **Emission Designator** |
| 406.2000 | 12.5 | | 6.8228 | 7K60F1E |



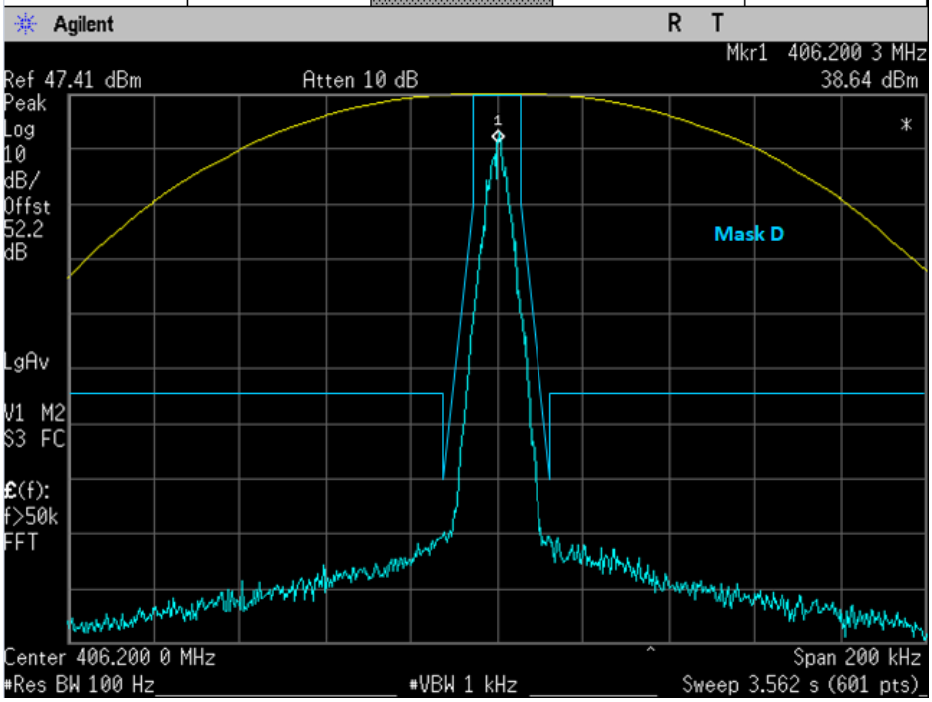

| Modulation | | | Rules Part | |
|---|---|---|---|---|
| 4FSK Voice | | | 90.210 / 74.462(c ) | |
| **Channel Frequency (MHz)** | **Channel Spacing (kHz)** | | **99% OCB (kHz)** | **Emission Designator** |
| 450.0250 | 12.5 | | 6.8032 | 7K60F1E |



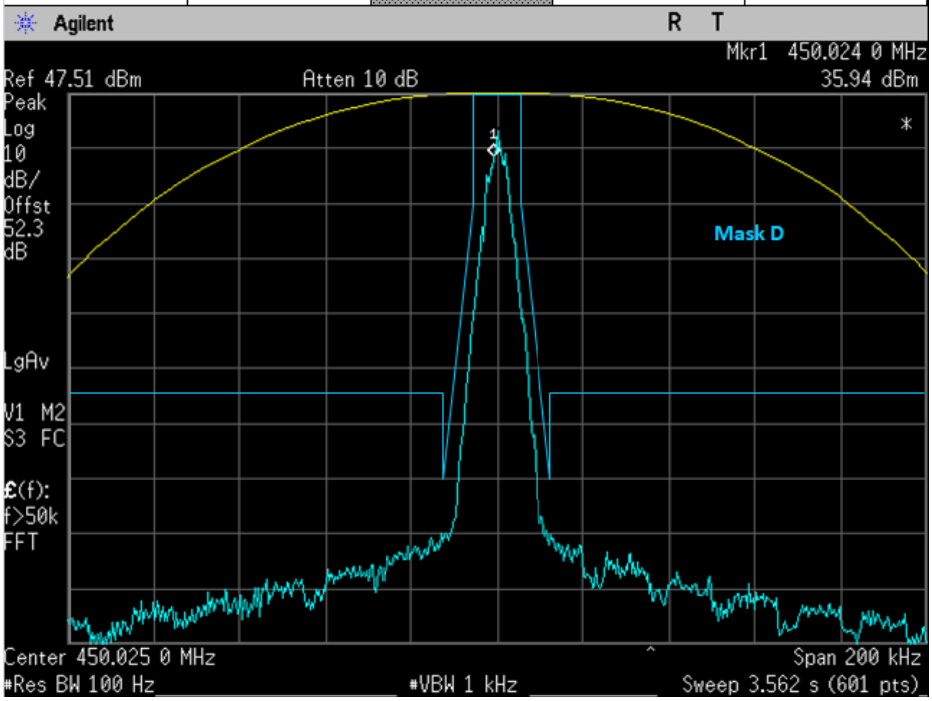
| Modulation | | | Rules Part | |
|---|---|---|---|---|
| 4FSK Voice | | | 90.210 | |
| **Channel Frequency (MHz)** | **Channel Spacing (kHz)** | | **99% OCB (kHz)** | **Emission Designator** |
| 469.9875 | 12.5 | | 7.0397 | 7K60F1E |



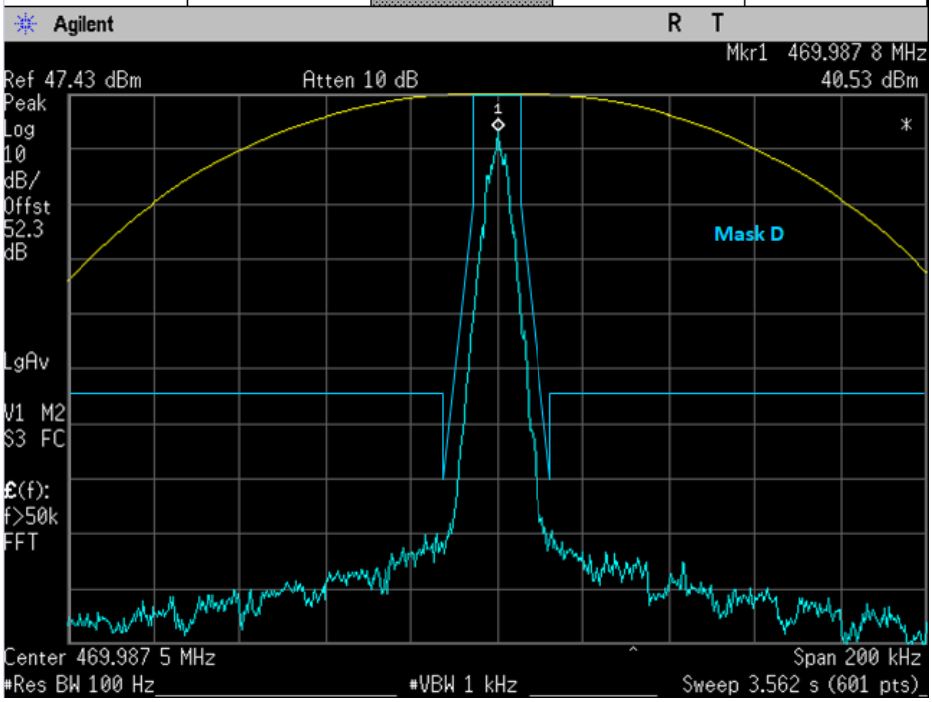

| Modulation | | | Rules Part | |
|---|---|---|---|---|
| 4FSK Data+Voice | | | 90.210 / RSS 119 | |
| **Channel Frequency (MHz)** | **Channel Spacing (kHz)** | | **99% OCB (kHz)** | **Emission Designator** |
| 406.2000 | 12.5 | | 7.3510 | 7K60F1W |



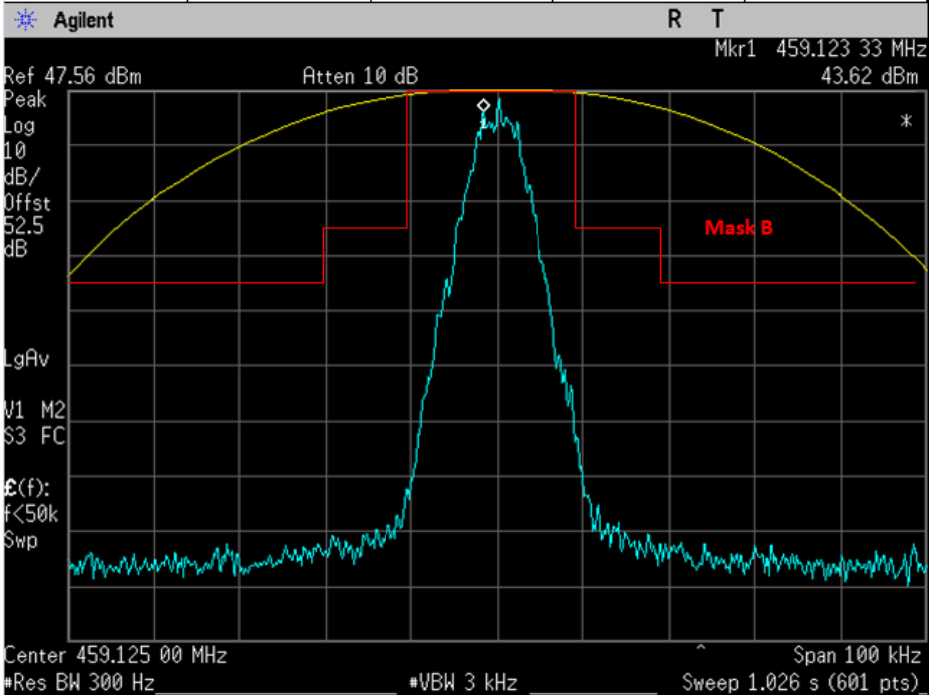
| Modulation | | | Rules Part | |
|---|---|---|---|---|
| 4FSK Data+Voice | | | 90.210 / 74.462(c ) | |
| **Channel Frequency (MHz)** | **Channel Spacing (kHz)** | | **99% OCB (kHz)** | **Emission Designator** |
| 450.0250 | 12.5 | | 7.1585 | 7K60F1W |



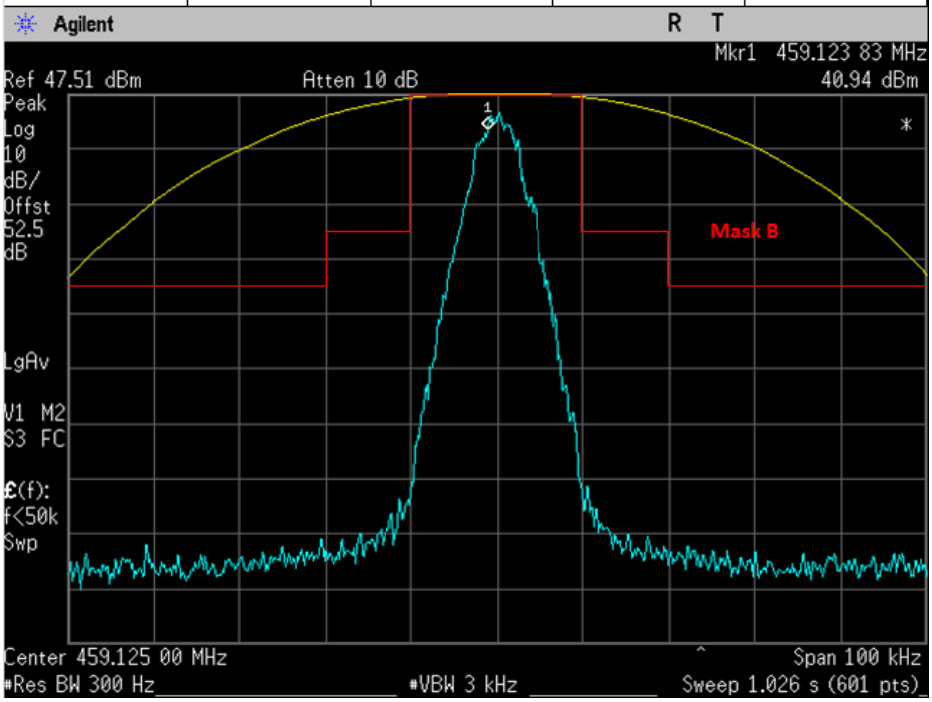

| Modulation | | | Rules Part | |
|---|---|---|---|---|
| 4FSK Data+Voice | | | 90.210 | |
| **Channel Frequency (MHz)** | **Channel Spacing (kHz)** | | **99% OCB (kHz)** | **Emission Designator** |
| 469.9875 | 12.5 | | 7.3364 | 7K60F1W |



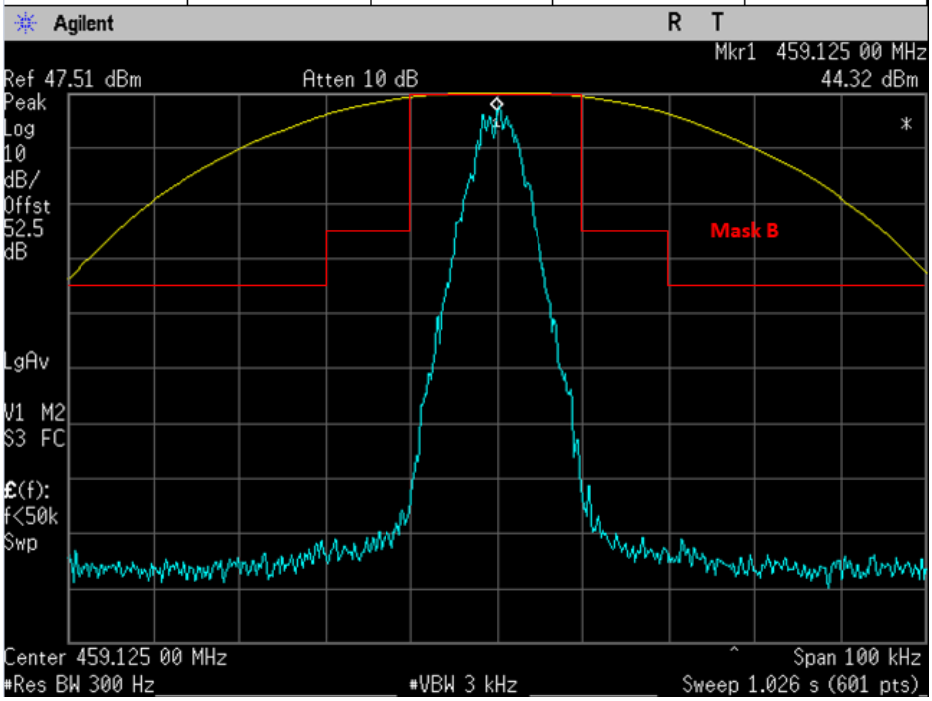
| Modulation | Rules Part | | | |
|---|---|---|---|---|
| 4FSK Data | 22.359(b) | | | |
| **Channel Frequency (MHz)** | **Channel Spacing (kHz)** | **-26 dB Point (kHz)** | **99% OCB (kHz)** | **Emission Designator** |
| 459.1250 | 12.5 | 9.1283 | 7.1114 | 7K60F1D |




| Modulation | Rules Part | | | |
|---|---|---|---|---|
| 4FSK Voice | FCC Part 22.359(b) | | | |
| **Channel Frequency (MHz)** | **Channel Spacing (kHz)** | **-26 dB Point (kHz)** | **99% OCB (kHz)** | **Emission Designator** |
| 459.1250 | 12.5 | 9.4849 | 7.1050 | 7K60F1E |



| Modulation | | Rules Part | | |
|---|---|---|---|---|
| 4FSK Data+Voice | | FCC Part 22.359(b) | | |
| **Channel Frequency (MHz)** | **Channel Spacing (kHz)** | **-26 dB Point (kHz)** | **99% OCB (kHz)** | **Emission Designator** |
| 459.1250 | 12.5 | 8.8169 | 7.1295 | 7K60F1W |



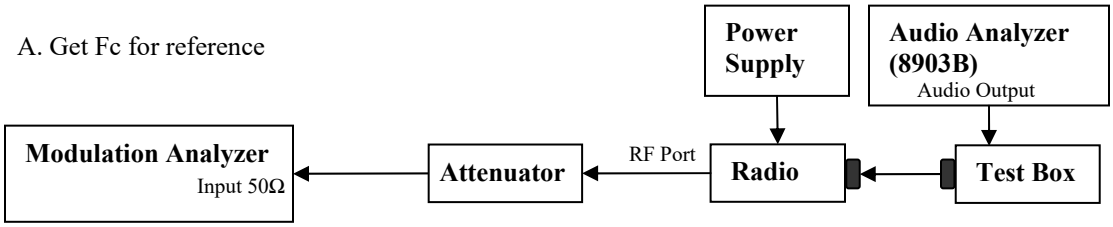

### 6.6.5. Test Limit

The 99% occupied bandwidth is the width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to a specified percentage 0.5% of the total mean transmitted power.

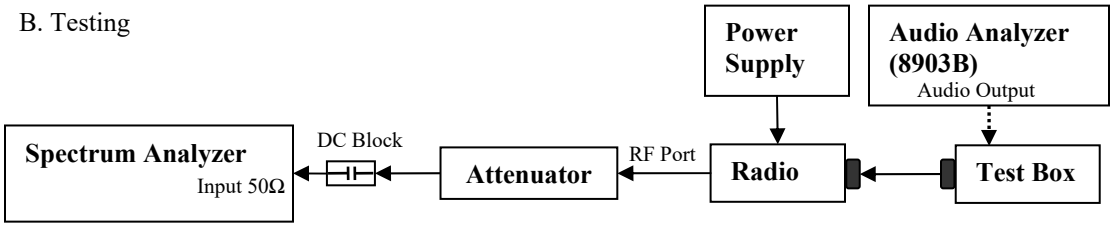
## 6.7. Band Edge Conducted Spurious Emission (Part 22)

### 6.7.1. Test Setup (Analog)

A. Get Fc for reference




B. Testing



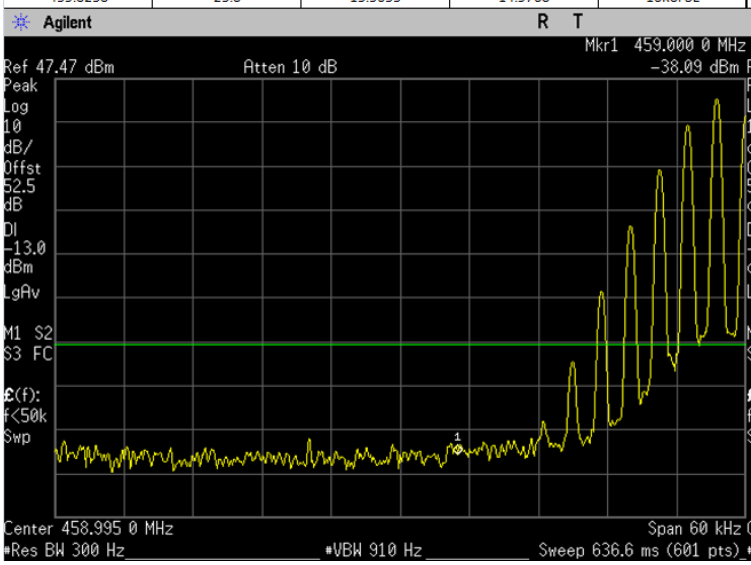

2) The DUT transmitter output port was connected to Modulation Analyzer.
3) Set the audio bandwidth filter to 15 kHz low pass filter and 50 kHz high pass filter.
4) Transmit the radio and set the audio analyzer to 2.5 kHz audio frequency and 50% of the rated deviation. Up the amplitude by 16 dB. Dekey the DUT.
5) Path loss for the measurement included.
6) Select the Occupied Bandwidth measurement for 99% and 26dB Emissions Bandwidth Measurement.
7) Key in the Fc and Resolution Bandwidth.
8) Transmit the DUT and record the occupied Bandwidth frequencies.
9) Preset the spectrum analyzer for band edge measurement.
10) The band edges of lowest and highest channels were measured.
11) Key in the Lowest and highest channel frequency, span is 60 kHz and Resolution Bandwidth is at least 1% of Emission Bandwidth.
12) Save the screen shot as modulated signal.
13) Remove the audio tone from audio analyzer to capture unmodulated signal.

*Note:
- For emission designator ending with F3E, 16K0F3E is the worst case and therefore only 16K0F3E will be shown.

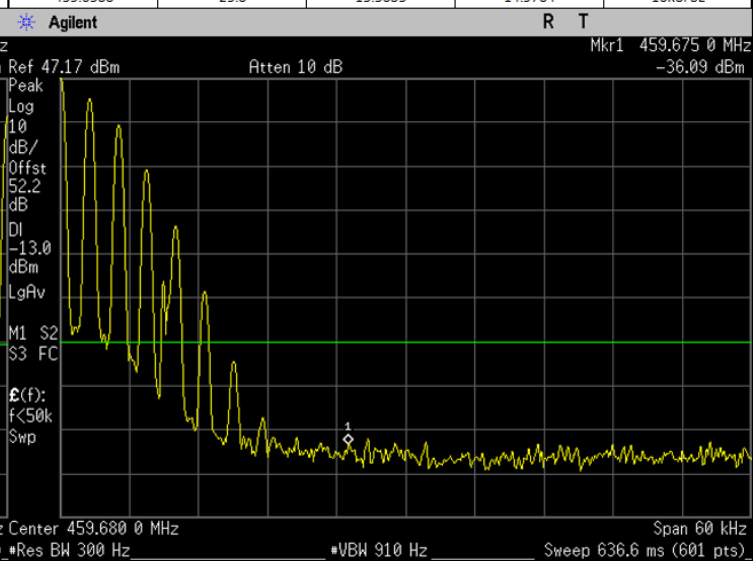
### 6.7.2. Test Result (Analog)

MAX POWER

| Modulation | Rules Part | | | |
|---|---|---|---|---|
| Analog Voice | FCC Part 22.359(b) | | | |
| **Channel Frequency** | **Channel Spacing** | **-26 dB Point (kHz)** | **99% OCB** | **Emission Designator** |
| 459.0250 | 25.0 | 15.5655 | 14.9760 | 16K0F3E |

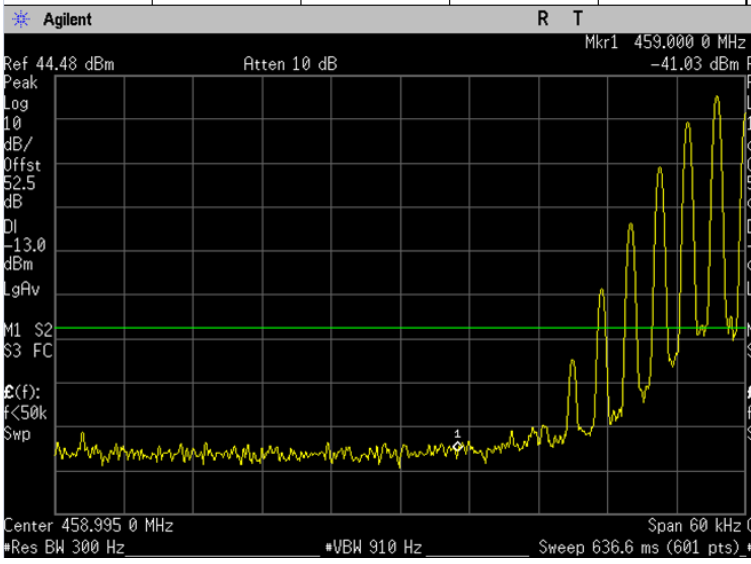



| Modulation | Rules Part | | | |
|---|---|---|---|---|
| Analog Voice | FCC Part 22.359(b) | | | |
| **Channel Frequency** | **Channel Spacing** | **-26 dB Point (kHz)** | **99% OCB** | **Emission Designator** |
| 459.6500 | 25.0 | 15.5635 | 14.9704 | 16K0F3E |

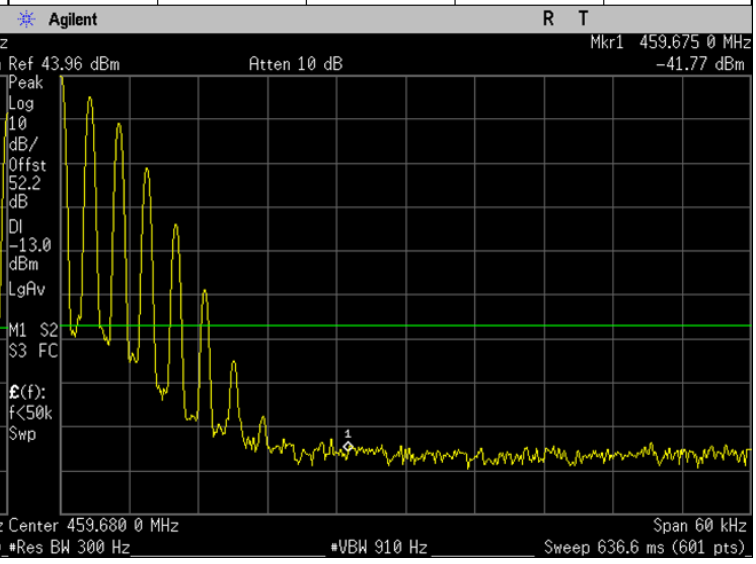



LOW POWER

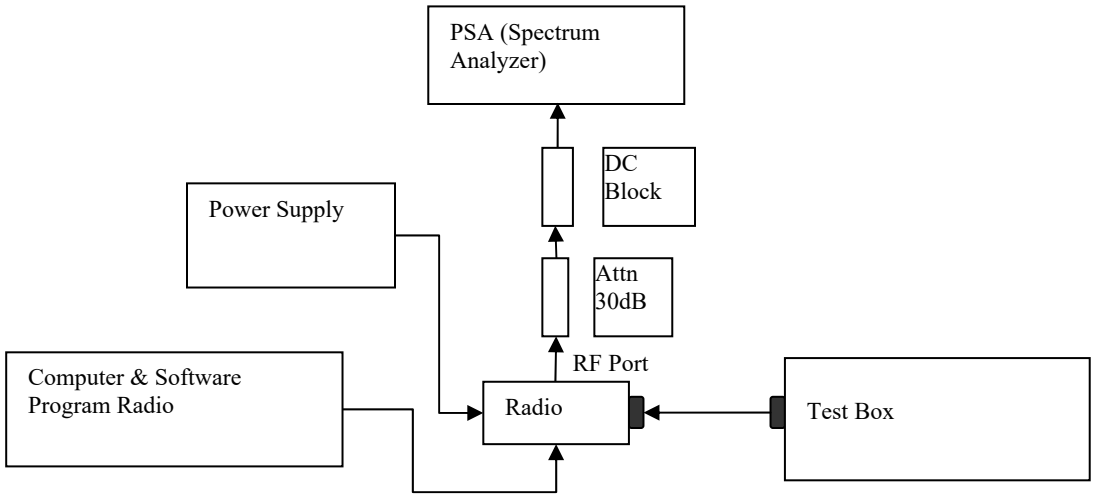
| Modulation | Rules Part | | | |
|---|---|---|---|---|
| Analog Voice | FCC Part 22.359(b) | | | |
| **Channel Frequency** | **Channel Spacing** | **-26 dB Point (kHz)** | **99% OCB** | **Emission Designator** |
| 459.0250 | 25.0 | 15.5582 | 14.9663 | 16K0F3E |




| Modulation | Rules Part | | | |
|---|---|---|---|---|
| Analog Voice | FCC Part 22.359(b) | | | |
| **Channel Frequency** | **Channel Spacing** | **-26 dB Point (kHz)** | **99% OCB** | **Emission Designator** |
| 459.6500 | 25.0 | 15.5577 | 14.9625 | 16K0F3E |



### 6.7.3. Test Setup (Digital)




1) Program and set radio to operate in desire test frequency and digital mode with modulation. (*4FSK, C4FM or other digital modulation form).
2) Path loss for the measurement included.
3) Select the Occupied Bandwidth measurement for 99% and 26dB Emissions Bandwidth Measurement.
4) Key in the Fc and Resolution Bandwidth.
5) Transmit radio record the occupied Bandwidth frequencies.
6) Preset the spectrum analyzer for band edge measurement.
7) Key in the lowest and highest channels frequency, span is 60 kHz and Resolution Bandwidth is at least 1% of Emission Bandwidth.
8) Save the screen shot.

*Note:

- For Digital Modulation, 12.5 kHz Data F1D & FXD would be the same. Therefore only measurements with F1D modulation shown below.
- For Digital Modulation, 12.5 kHz Data F1E & FXE would be the same. Therefore only measurements with F1E modulation shown below.