# RADIO TEST REPORT

Report No: STS2209045W01

Issued for

BTECH (BaoFeng Tech)

702 N Industrial Ave Arlington South Dakota United States 57212

| | |
|---|---|
| **Product Name:** | Two way radio |
| **Brand Name:** | BTECH |
| **Model Name:** | MURS-V2 |
| **Series Model:** | N/A |
| **FCC ID:** | 2AGND-MURS-V2 |
| **Test Standard:** | FCC Part 95 |



Shenzhen STS Test Services Co., Ltd.
A 1/F, Building B, Zhuoke Science Park, No.190 Chongqing Road, HepingShequ,
Fuyong Sub-District, Bao'an District, Shenzhen, Guang Dong, China
TEL: +86-755 3688 6288 FAX: +86-755 3688 6277 E-mail:sts@stsapp.com

# TEST REPORT CERTIFICATION

| | |
|---|---|
| Applicant's Name..... : | BTECH (BaoFeng Tech) |
| Address..... : | 702 N Industrial Ave Arlington South Dakota United States 57212 |
| Manufacturer's Name..... : | BTECH (BaoFeng Tech) |
| Address..... : | 702 N Industrial Ave Arlington South Dakota United States 57212 |
| Product Description | |
| Product Name..... : | Two way radio |
| Brand Name..... : | BTECH |
| Model Name ..... : | MURS-V2 |
| Series Model..... : | N/A |
| **Test Standards** ..... : | FCC Part 95 |
| Test Procedure..... : | TIA 603-E |

This device described above has been tested by STS, the test results show that the equipment under test (EUT) is in compliance with the FCC requirements. And it is applicable only to the tested sample identified in the report.
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| | |
|---|---|
| Date of Test..... : | |
| Date of receipt of test item..... : | 09 Sept. 2022 |
| Date of performance of tests ..... : | 09 Sept. 2022 ~ 06 Jan. 2023 |
| Date of Issue..... : | 06 Jan. 2023 |
| Test Result..... : | **Pass** |

Testing Engineer : Chris chen
(Chris chen)

Technical Manager : Sean She
(Sean she)

Authorized Signatory : Bovey Yang
(Bovey Yang)

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APPROVAL

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## Revision History

| Rev. | Issue Date | Report NO. | Effect Page | Contents |
|---|---|---|---|---|
| 00 | 06 Jan. 2023 | STS2209045W01 | ALL | Initial Issue |
| | | | | |

## 1. SUMMARY OF TEST RESULTS

Test procedures according to the technical standards:

| FCC Part 95 | | | |
|---|---|---|---|
| Standard Section | Test Item | Judgment | Remark |
| FCC Part 95.2779 | MURS unwanted emissions limits | PASS | -- |
| FCC Part 95.2767 | MURS transmitting power | PASS | -- |
| FCC Part 95.2773 | MURS authorized bandwidths | PASS | -- |
| FCC Part 95.2779 | Emission mask | PASS | -- |
| FCC Part 95.2765 | MURS frequency accuracy | PASS | -- |
| FCC Part 95.2771 | MURS emission types | PASS | -- |
| FCC Part 95.2775 | MURS audio filter | PASS | -- |

NOTE: (1) “N/A” denotes test is not applicable in this Test Report.

(2) All tests are according to TIA 603-E.

## 1.1 TEST FACTORY

SHENZHEN STS TEST SERVICES CO., LTD
Add. : A 1/F, Building B, Zhuoke Science Park, No.190 Chongqing Road, HepingShequ, Fuyong Sub-District, Bao'an District, Shenzhen, Guang Dong, China
FCC test Firm Registration Number: 625569
IC test Firm Registration Number: 12108A
A2LA Certificate No.: 4338.01

## 1.2 MEASUREMENT UNCERTAINTY

The reported uncertainty of measurement **y** ± **U**, where expended uncertainty **U** is based on a standard uncertainty multiplied by a coverage factor of **k=2**, providing a level of confidence of approximately **95** %.

| No. | Item | Uncertainty |
|---|---|---|
| 1 | RF output power, conducted | ±0.87Db |
| 2 | Unwanted Emissions, conducted | ±2.895Db |
| 3 | All emissions, radiated 9K-30MHz | ±3.80Db |
| 4 | All emissions, radiated 30M-1GHz | ±4.09Db |
| 5 | All emissions, radiated 1G-6GHz | ±4.92Db |
| 6 | All emissions, radiated>6G | ±5.49Db |
| 7 | Conducted Emission (9KHz-30MHz) | ±2.73Db |

## 2. GENERAL INFORMATION

2.1 GENERAL DESCRIPTION OF THE EUT

| | | |
|---|---|---|
| Product Name | Two way radio | |
| Brand Name | BTECH | |
| Model Name | MURS-V2 | |
| Series Model | N/A | |
| Model Difference | N/A | |
| Operation Frequency Range: | 151.820MHz-154.600MHz<br>Please refer to the note 3 | |
| Antenna Type | Dipole | |
| Antenna Gain | 1.8dBi | |
| Modulation Type | MURS | F3E |
| Emission types | MURS | 16K2F3E |
| Adapter | Input:100-240V~ 50/60Hz 0.25A<br>Output: DC 10V 0.5A | |
| Charger | Input: DC 10V 0.5A<br>Output: DC 8.4V 0.5A | |
| Battery | Rated Voltage: 7.4V<br>Charge Limit Voltage:8.4V<br>Capacity: 1800mAh | |
| Hardware version number | 220428 | |
| Software version number | V22.8.23 | |
| Connecting I/O Port(s) | Please refer to the note 1 | |

Note:

1. For a more detailed features description, please refer to the manufacturer's specifications or the User Manual.
2. The antenna information refer the manufacturer provide report, applicable only to the tested sample identified in the report. Due to the incorrect antenna information, a series of problems such as the accuracy of the test results will be borne by the customer.
3. Channel List

| Channel | Frequency(MHz) | Channel | Frequency(MHz) | Channel | Frequency(MHz) |
|---|---|---|---|---|---|
| 1 | 151.82 | 3 | 151.94 | 5 | 154.60 |
| 2 | 151.88 | 4 | 154.57 | / | / |

Test channel:

| Channel | Frequency(MHz) | Low Power | High Power | Narrowband | Wideband |
|---|---|---|---|---|---|
| 2 | 151.88 | Support | Support | Support | Not Support |
| 5 | 154.60 | Support | Support | Support | Support |

## 2.2 DESCRIPTION OF THE TEST MODES

To investigate the maximum EMI emission characteristics generates from EUT, the test system was pre-scanning tested base on the consideration of following EUT operation mode or test configuration mode which possible have effect on EMI emission level. Each of these EUT operation mode(s) or test configuration mode(s) mentioned above was evaluated respectively.

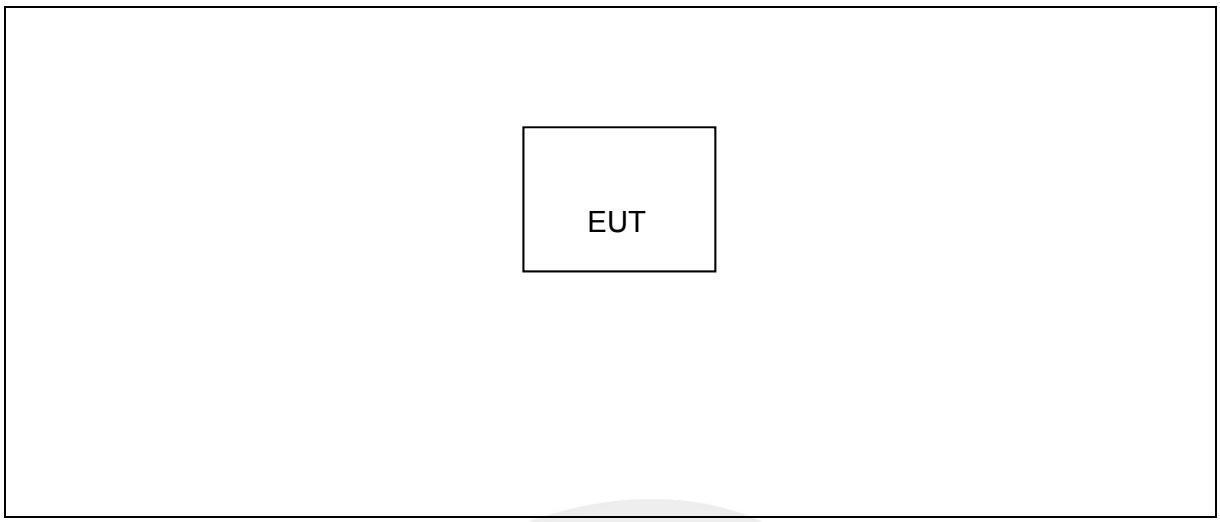
| Pretest Mode | Description |
|---|---|
| Mode 1 | MURS CH2 Low Power TX Mode |
| Mode 2 | MURS CH2 High Power TX Mode |
| Mode 3 | MURS CH5 Low Power TX Mode |
| Mode 4 | MURS CH5 High Power TX Mode |

| **For Radiated Emission/Conducted Emission** | |
|---|---|
| Final Test Mode | Description |
| Mode 1 | MURS CH2 Low Power TX Mode |
| Mode 2 | MURS CH2 High Power TX Mode |
| Mode 3 | MURS CH5 Low Power TX Mode |
| Mode 4 | MURS CH5 High Power TX Mode |

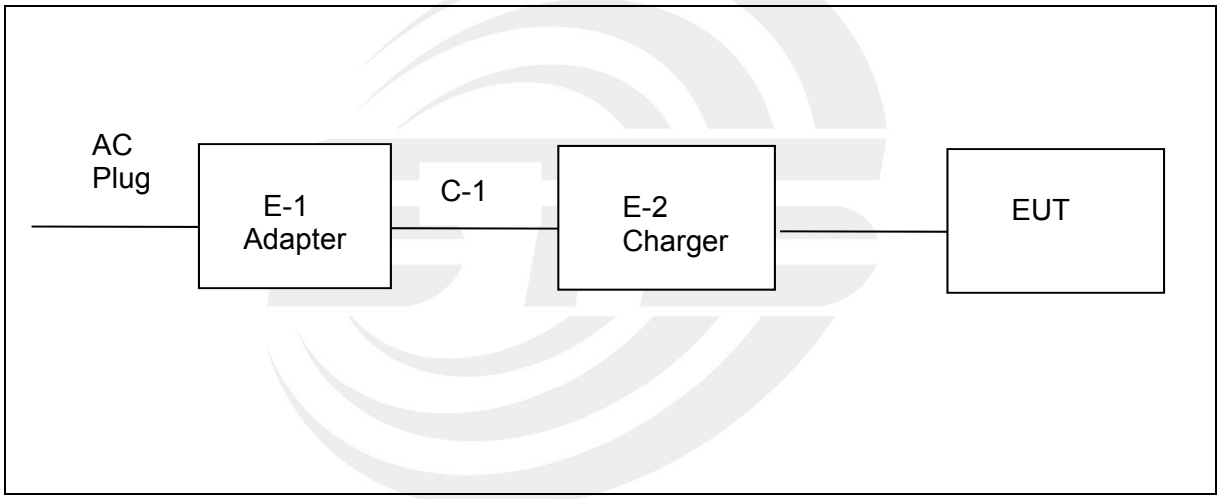
Note: Wideband and Narrowband all has been tested, the worst case is Wideband, only shown the worst case in this report.

## 2.3 BLOCK DIAGRAM SHOWING THE CONFIGURATION OF SYSTEM TESTED

Radiated Spurious Emission Test




Conducted Emission Test



## 2.4 DESCRIPTION OF NECESSARY ACCESSORIES AND SUPPORT UNITS

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

Necessary accessories

| Item | Equipment | Mfr/Brand | Model/Type No. | Length | Note |
|---|---|---|---|---|---|
| E-1 | Adapter | BTECH | 480-10050-E.S | N/A | N/A |
| E-2 | Charger | BTECH | CH-8 | N/A | N/A |
| C-1 | USB Cable | N/A | N/A | 110cm | NO |
| | | | | | |

Support units

| Item | Equipment | Mfr/Brand | Model/Type No. | Length | Note |
|---|---|---|---|---|---|
| N/A | N/A | N/A | N/A | N/A | N/A |
| | | | | | |
| | | | | | |
| | | | | | |

Note:

(1) For detachable type I/O cable should be specified the length in cm in『Length』column.

## 2.5 EQUIPMENTS LIST

| RF Radiation Test Equipment | | | | | |
|---|---|---|---|---|---|
| Kind of Equipment | Manufacturer | Type No. | Serial No. | Last Calibration | Calibrated Until |
| Temperature & Humidity | SW-108 | SuWei | N/A | 2022.03.02 | 2023.03.01 |
| Wireless Communications Test Set | R&S | CMW 500 | 117239 | 2022.03.01 | 2023.02.28 |
| Pre-Amplifier(0.1M-3GHz) | EM | EM330 | 060665 | 2022.07.04 | 2023.07.03 |
| Pre-Amplifier (1G-18GHz) | SKET | LNPA-01018G-45 | SK2018080901 | 2022.09.29 | 2023.09.28 |
| Positioning Controller | MF | MF-7802 | MF-780208587 | N/A | N/A |
| Signal Analyzer | R&S | FSV 40-N | 101823 | 2022.09.29 | 2023.09.28 |
| Switch Control Box | N/A | N/A | N/A | N/A | N/A |
| Filter Box | BALUN Technology | SU319E | BL-SZ1530051 | N/A | N/A |
| Video Controller | SKET | FCS C-3 | N/A | N/A | N/A |
| Bilog Antenna | TESEQ | CBL6111D | 34678 | 2022.09.30 | 2024.09.29 |
| Horn Antenna | SCHWARZBECK | BBHA 9120D | 02014 | 2021.10.11 | 2023.10.10 |
| Antenna Mast | MF | MFA-440H | N/A | N/A | N/A |
| Turn Table | MF | N/A | N/A | N/A | N/A |
| AC Power Source | APC | KDF-11010G | F214050035 | N/A | N/A |
| DC Power Supply | Zhaoxin | RXN 605D | 20R605D11010081 | N/A | N/A |
| Test SW | EMC Test Software | 15.2.0.339 | | | |
| RF Connected Test Equipment | | | | | |
| Kind of Equipment | Manufacturer | Type No. | Serial No. | Last Calibration | Calibrated Until |
| Temperature & Humidity | SW-108 | SuWei | N/A | 2022.03.02 | 2023.03.01 |
| Universal Radio communication tester | R&S | CMU200 | 111058 | 2022.09.28 | 2023.09.27 |
| Signal Generator | Agilent | N5182A | MY46240556 | 2022.09.28 | 2023.09.27 |
| Signal Analyzer | Agilent | N9020A | MY52440124 | 2022.03.01 | 2023.02.28 |
| Intercom comprehensive tester | HP | 8920A | 348A05658 | 2022.03.01 | 2023.02.28 |
| Temperature & Humidity Test Chamber | Safety test | AG80L | 171200018 | 2022.03.01 | 2023.02.28 |

| | | | | | |
|---|---|---|---|---|---|
| Programmable Power Supply | Agilent | E3642A | MY40002025 | 2022.09.29 | 2023.09.28 |
| Attenuator | HP | 8494B | DC-18G | 2022.03.02 | 2023.03.01 |
| AC Power Source | APC | KDF-11010G | F214050035 | N/A | N/A |

## 3. FIELD STRENGTHS AND RADIATED SPURIOUS EMISSION

3.1 RADIATED EMISSION LIMITS

a) For transmitting equipment in the MURS shall comply with the following table:

| Channel center frequencies (MHz) | Paragraphs |
|---|---|
| 151.820, 151.880 and 151.940 | (1), (2). |
| 154.570 & 154.600, with audio filter | (3), (4), (7). |
| 154.570 & 154.600, without audio filter | (5), (6), (7). |

(1) Each MURS transmitter type that transmits F3E or G3E emissions on 154.570 MHz or 154.600 MHz and incorporates an audio filter satisfying the requirements of § 95.2775 in its design may comply with the less stringent unwanted emissions attenuation requirements set forth in paragraphs (b)(3), (4), and (7) of this section.

(2) Each MURS transmitter type that transmits on 154.570 MHz or 154.600 MHz, but does not incorporate an audio filter satisfying the requirements of § 95.2775 in its design, must comply with the unwanted emissions attenuation requirements set forth in paragraphs (b)(5) through (7) of this section.

b) The power of unwanted emissions must be attenuated below the transmitter output power in Watts (P) by at least:

(1) 7.27($f_d$−2.88 kHz) dB on any frequency removed from the channel center frequency by a displacement frequency ($f_d$ in kHz) that is more than 5.625 kHz, but not more than 12.5 kHz.

(2) 50 + 10 log (P) dB or 70 dB, whichever is the lesser attenuation, on any frequency removed from the channel center frequency by more than 12.5 kHz.

(3) 25 dB on any frequency removed from the channel center frequency by more than 10 kHz, but not more than 20 kHz.

(4) 35 dB on any frequency removed from the channel center frequency by more than 20 kHz, but not more than 50 kHz.

(5) 83 log ($f_d$ ÷ 5) dB on any frequency removed from the center of the authorized bandwidth by a displacement frequency ($f_d$ in kHz) that is more than 5 kHz, but not more than 10 kHz.

(6) 29 log ($f_d^2$ ÷ 11) dB or 50 dB, whichever is the lesser attenuation on any frequency removed from the channel center frequency by a displacement frequency ($f_d$ in kHz) that is more than 10 kHz, but not more than 50 kHz.

(7) 43 + 10 log(P) dB on any frequency removed from the channel center frequency by more than 50 kHz.

43 + 10 log (Pwatts)

Calculation: Limit (dBm) =EL-43-10log10 (TP)

Notes: EL is the emission level of the Output Power expressed in dBm,

In this application, the EL is P( dBm).

Limit (dBm) = P( dBm)-43-10 log (Pwatts) = -13 dBm

| Frequencies (MHz) | Field Strength (micorvolts/meter) | Measurement Distance (meters) |
|---|---|---|
| 0.009~0.490 | 2400/F(KHz) | 300 |
| 0.490~1.705 | 24000/F(KHz) | 30 |
| 1.705~30.0 | 30 | 30 |
| 30~88 | 100 | 3 |
| 88~216 | 150 | 3 |
| 216~960 | 200 | 3 |
| Above 960 | 500 | 3 |

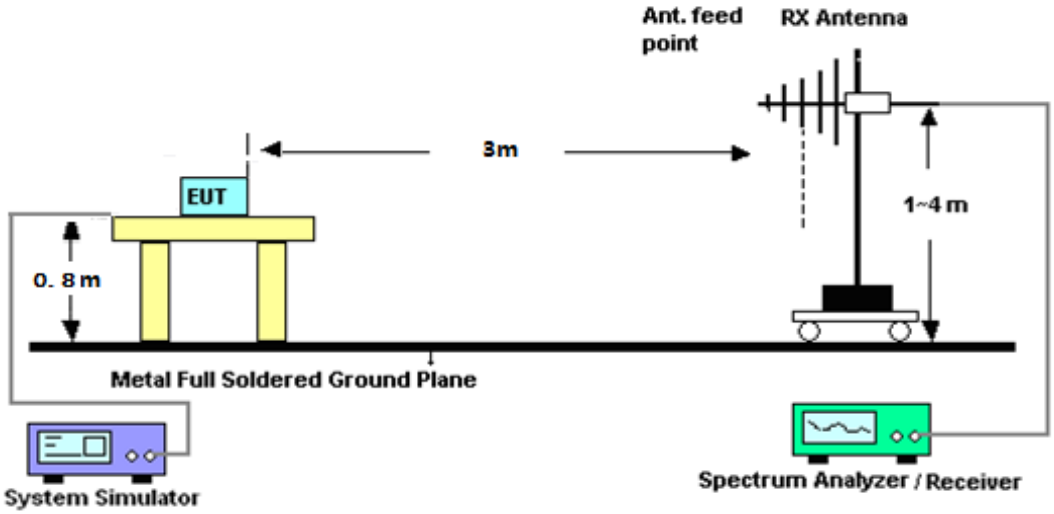
| Spectrum Parameter | Setting |
|---|---|
| Detector | Peak |
| Attenuation | Auto |
| Start Frequency | 30 MHz |
| Stop Frequency | 10th carrier harmonic |

3.2 TEST PROCEDURE

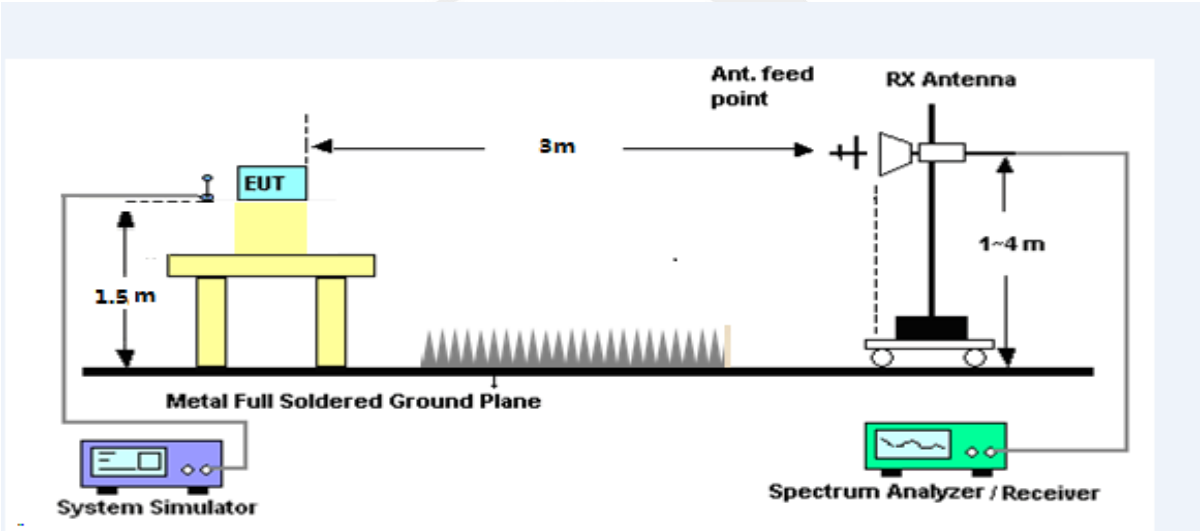
1. EUT was placed on a 1.5 meter high non-conductive stand at a 3 meter test distance from the receive antenna. A receiving antenna was placed on the antenna mast 3 meters from the EUT for emission measurements. The height of receiving antenna is 1. 0 m. Detected emissions were maximized at each frequency by rotating the EUT through 360° and adjusting the receiving antenna polarization. The radiated emission measurements of all transmit frequencies in three channels were measured with peak detector.
2. A log-periodic antenna or double-ridged waveguide horn antenna shall be substituted in place of the EUT. The log-periodic antenna will be driven by a signal generator and the level will be adjusted till the same power value on the spectrum analyzer or receiver. The level of the spurious emissions can be calculated through the level of the signal generator, cable loss, the gain of the substitution antenna and the reading of the spectrum analyzer or receiver.
3. The EUT is then put into continuously transmitting mode at its maximum power level during the test.Set Test Receiver or Spectrum RBW=1MHz,VBW=3MHz for above 1GHz and BW=100kHz,VBW=300kHz for 30MHz to 1GHz, And the maximum value of the receiver should be recorded as (Pr).
4. The EUT shall be replaced by a substitution antenna. In the chamber, an substitution antenna for the frequency band of interest is placed at the reference point of the chamber. An RF Signal source for the frequency band of interest is connected to the substitution antenna with a cable that has been constructed to not interfere with the radiation pattern of the antenna. A power ($P_{Mea}$) is applied to the input of thesubstitution antenna, and adjust the level of the signal generator output until the value of the receiver reach the previously recorded (Pr). The power of signal source ($P_{Mea}$) is recorded. The test should be performed by rotating the test item and adjusting the receiving antenna polarization.
5. A amplifier should be connected to the Signal Source output port. And the cable should be connect between the Amplifier and the Substitution Antenna. The cable loss (Pcl) ,the Substitution Antenna Gain (Ga) and the Amplifier Gain (PAg) should be recorded after test. The measurement results are obtained as described below:
   Power(EIRP)=$P_{Mea}$- $P_{Ag}$ - $P_{cl}$ + $G_a$
   We used signal generator which signal level can up to 33dBm,so we not used power Amplifier for substituation test; The measurement results are amend as described below:
   Power(EIRP)=$P_{Mea}$- $P_{cl}$ +$G_a$
6. This value is EIRP since the measurement is calibrated using an antenna of known gain (2.15 dBi) and known input power
7. ERP can be calculated from EIRP by subtracting the gain of the dipole, ERP = EIRP-2.15dBi

3.3 TEST SETUP

For radiated test from 30MHz to 1GHz




For radiated test from above 1GHz

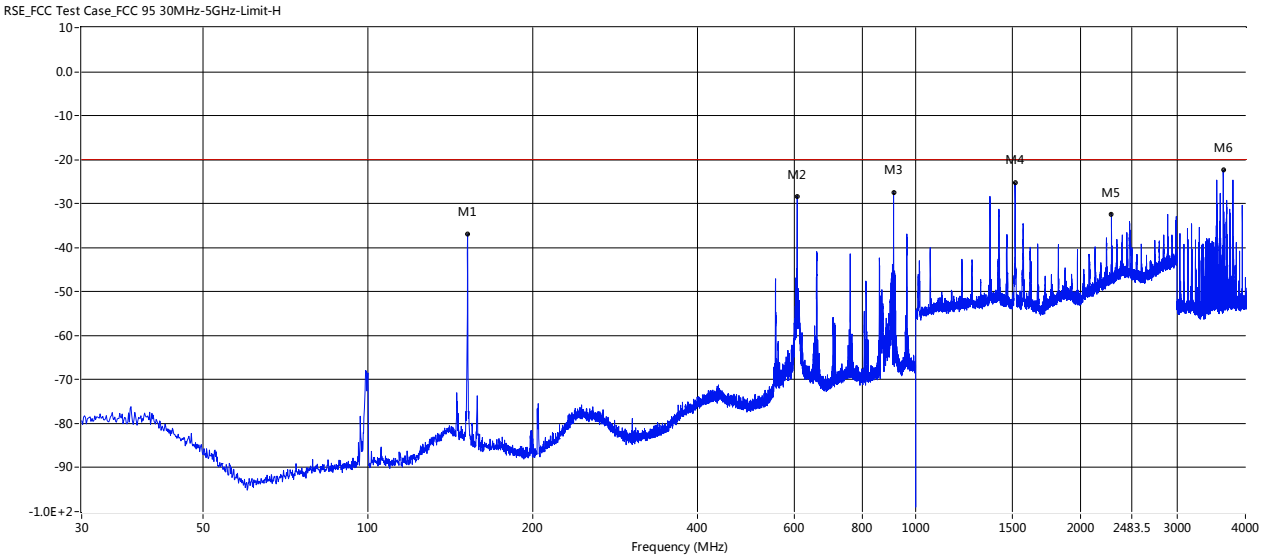



3.4 EUT OPERATING CONDITIONS

The EUT was configured for testing in a typical fashion (as a customer would normally use it). The EUT has been programmed to continuously transmit during test. This operating condition was tested and used to collect the included data.

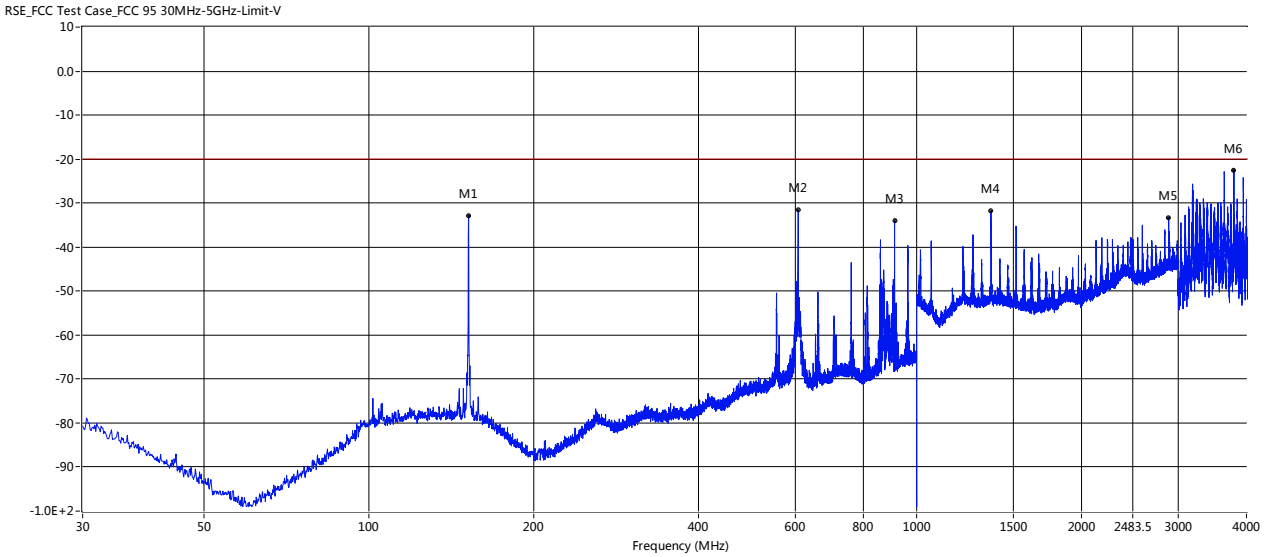
3.5 TEST RESULT

| Temperature: | 23.4 ℃ | Relative Humidity: | 60% |
|---|---|---|---|
| Test Mode: | Mode 1 | Phase : | Horizontal |



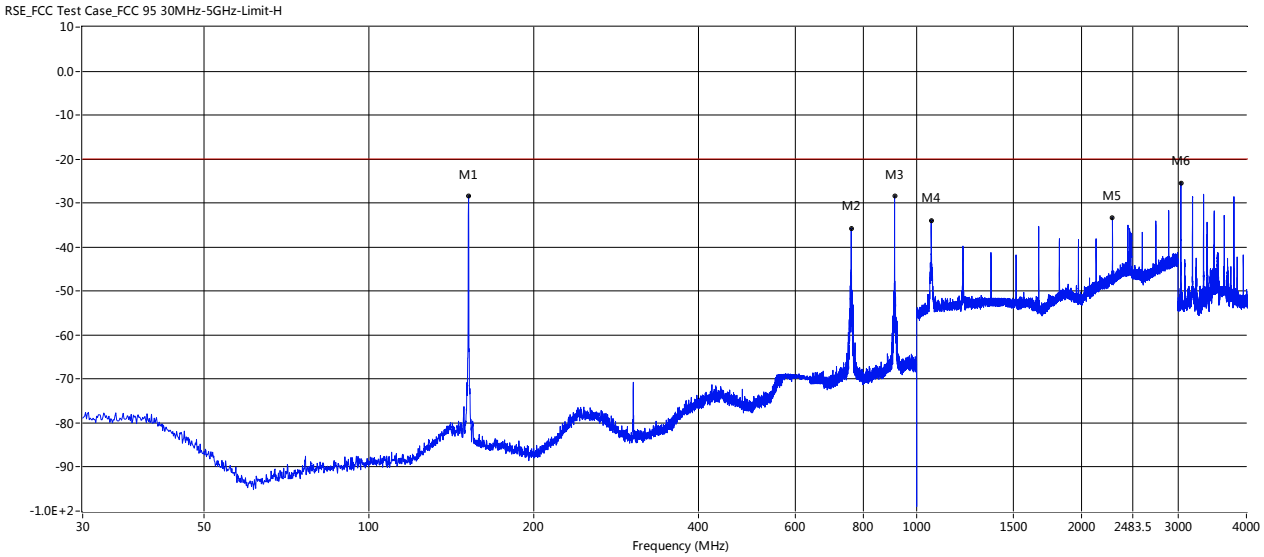

| Frequency (MHz) | Result (dBm) | Factor (dB) | PK Limit (dBm) | Over Limit (dB) | Table (o) | ANT | EUT | Verdict |
|---|---|---|---|---|---|---|---|---|
| 151.977 | -36.92 | -6.72 | -20.0 | -16.92 | 315.40 | Horizontal | Vertical | Pass |
| 607.514 | -28.35 | 6.49 | -20.0 | -8.35 | 31.00 | Horizontal | Vertical | Pass |
| 911.366 | -27.44 | 9.26 | -20.0 | -7.44 | 22.00 | Horizontal | Vertical | Pass |
| 1519.000 | -25.32 | 12.69 | -20.0 | -5.32 | 195.90 | Horizontal | Vertical | Pass |
| 2278.500 | -32.42 | 17.57 | -20.0 | -12.42 | 175.20 | Horizontal | Vertical | Pass |
| 3645.250 | -22.43 | 3.32 | -20.0 | -2.43 | 360.00 | Horizontal | Vertical | Pass |

| Temperature: | 23.4 ℃ | Relative Humidity: | 60% |
|---|---|---|---|
| Test Mode: | Mode 1 | Phase: | Vertical |



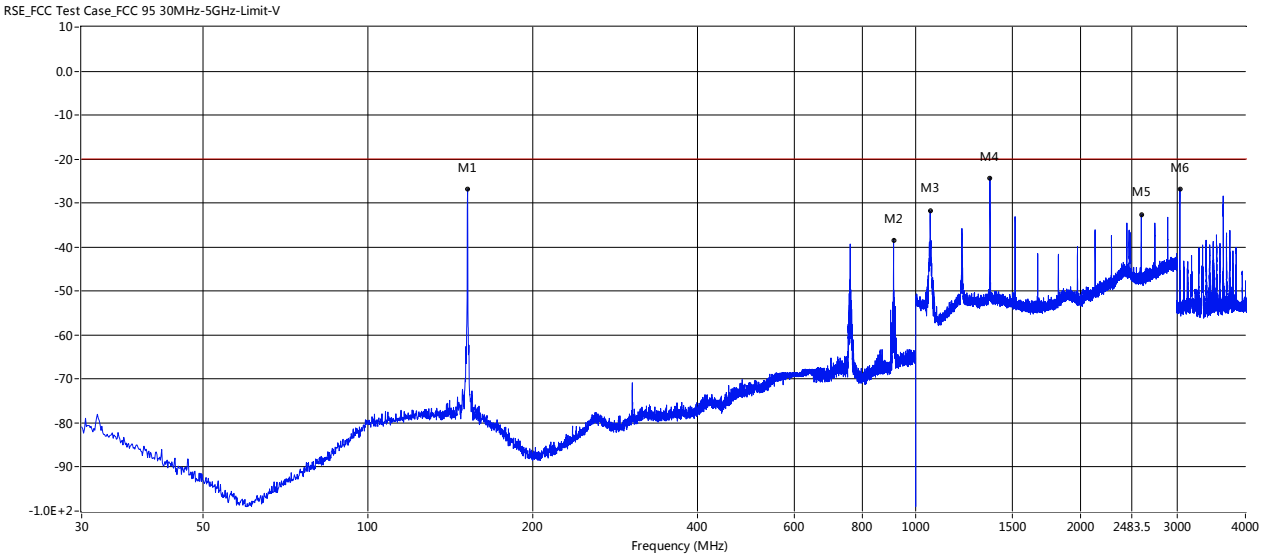

| Frequency (MHz) | Result (dBm) | Factor (dB) | PK Limit (dBm) | Over Limit (dB) | Table (o) | ANT | EUT | Verdict |
|---|---|---|---|---|---|---|---|---|
| 151.977 | -32.83 | -1.68 | -20.0 | -12.83 | 0.80 | Vertical | Vertical | Pass |
| 607.514 | -31.61 | 4.97 | -20.0 | -11.61 | 116.70 | Vertical | Vertical | Pass |
| 911.366 | -33.95 | 8.62 | -20.0 | -13.95 | 63.00 | Vertical | Vertical | Pass |
| 1367.000 | -31.85 | 13.55 | -20.0 | -11.85 | 169.90 | Vertical | Vertical | Pass |
| 2886.000 | -33.22 | 20.18 | -20.0 | -13.22 | 233.30 | Vertical | Vertical | Pass |
| 3797.000 | -22.59 | 2.85 | -20.0 | -2.59 | 180.10 | Vertical | Vertical | Pass |

| Temperature: | 23.4 ℃ | Relative Humidity: | 60% |
|---|---|---|---|
| Test Mode: | Mode 2 | Phase : | Horizontal |



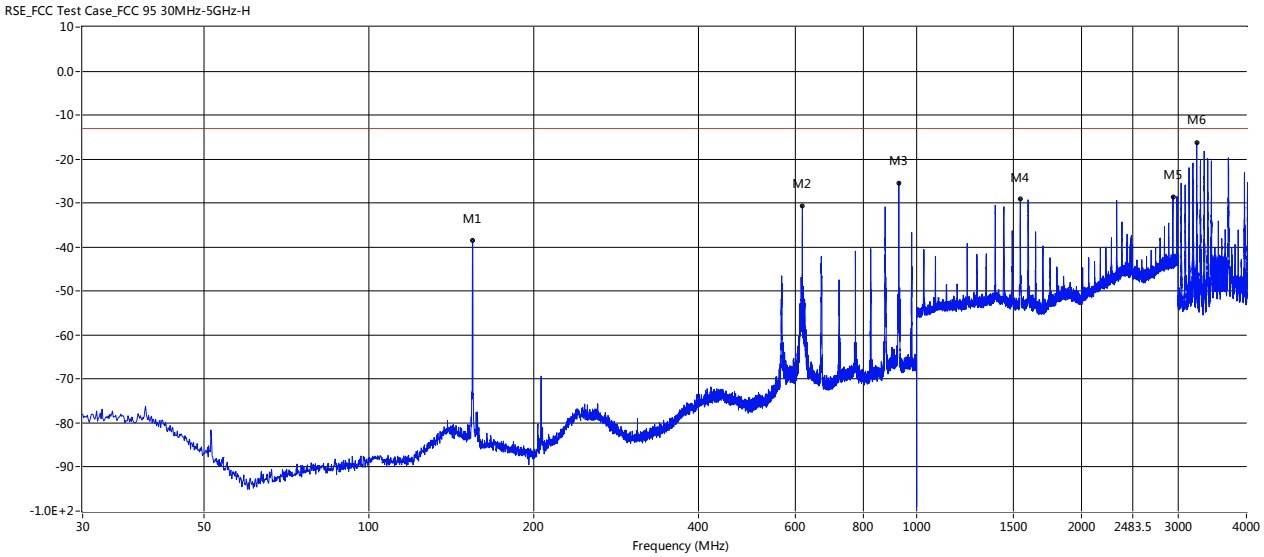

| Frequency (MHz) | Result (dBm) | Factor (dB) | PK Limit (dBm) | Over Limit (dB) | Table (o) | ANT | EUT | Verdict |
|---|---|---|---|---|---|---|---|---|
| 151.977 | -28.30 | -6.72 | -20.0 | -8.30 | 319.40 | Horizontal | Vertical | Pass |
| 759.440 | -35.74 | 7.26 | -20.0 | -15.74 | 319.40 | Horizontal | Vertical | Pass |
| 911.366 | -28.44 | 9.26 | -20.0 | -8.44 | 20.50 | Horizontal | Vertical | Pass |
| 1063.250 | -33.91 | 11.40 | -20.0 | -13.91 | 111.90 | Horizontal | Vertical | Pass |
| 2278.500 | -33.29 | 17.57 | -20.0 | -13.29 | 171.80 | Horizontal | Vertical | Pass |
| 3037.750 | -25.37 | 2.66 | -20.0 | -5.37 | 240.70 | Horizontal | Vertical | Pass |

| Temperature: | 23.4 ℃ | Relative Humidity: | 60% |
|---|---|---|---|
| Test Mode: | Mode 2 | Phase: | Vertical |



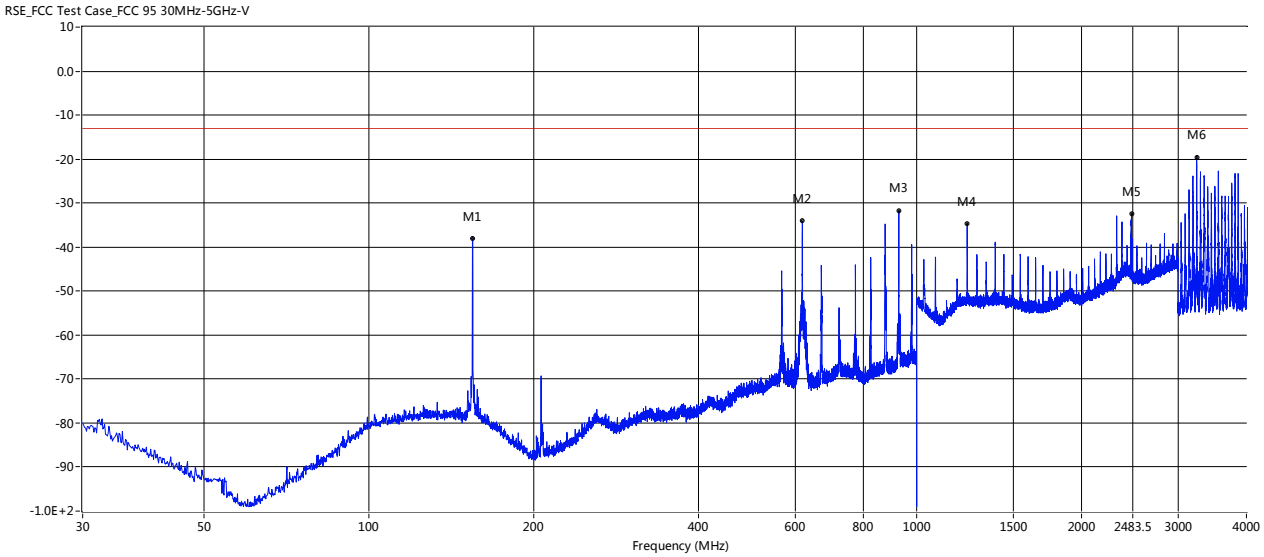

| Frequency (MHz) | Result (dBm) | Factor (dB) | PK Limit (dBm) | Over Limit (dB) | Table (o) | ANT | EUT | Verdict |
|---|---|---|---|---|---|---|---|---|
| 151.977 | -26.86 | -1.68 | -20.0 | -6.86 | 1.00 | Vertical | Vertical | Pass |
| 911.366 | -38.40 | 8.62 | -20.0 | -18.40 | 4.50 | Vertical | Vertical | Pass |
| 1063.000 | -33.54 | 10.32 | -20.0 | -13.54 | 173.00 | Vertical | Vertical | Pass |
| 1367.000 | -24.39 | 13.55 | -20.0 | -4.39 | 184.80 | Vertical | Vertical | Pass |
| 2582.000 | -32.58 | 17.68 | -20.0 | -12.58 | 178.90 | Vertical | Vertical | Pass |
| 3037.750 | -26.79 | 1.91 | -20.0 | -6.79 | 170.90 | Vertical | Vertical | Pass |

| Temperature: | 23.4 ℃ | Relative Humidity: | 60% |
|---|---|---|---|
| Test Mode: | Mode 3 | Phase : | Horizontal |



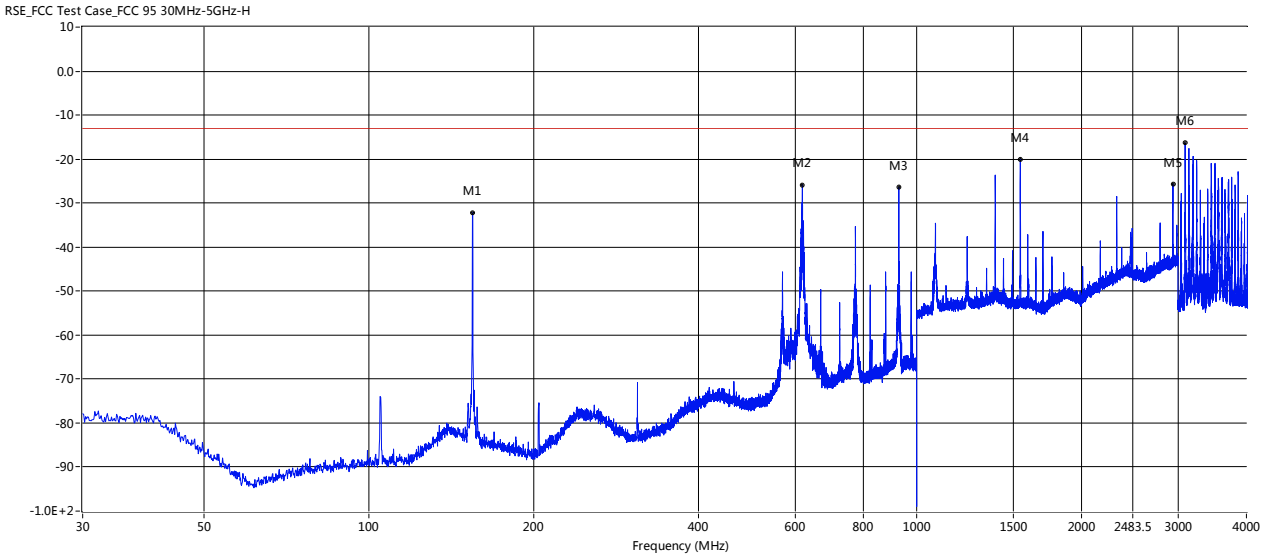

| Frequency (MHz) | Result (dBm) | Factor (dB) | PK Limit (dBm) | Over Limit (dB) | Table (o) | ANT | EUT | Verdict |
|---|---|---|---|---|---|---|---|---|
| 154.645 | -38.57 | -7.24 | -13.0 | -25.57 | 321.30 | Horizontal | Vertical | Pass |
| 618.426 | -30.71 | 7.18 | -13.0 | -17.71 | 222.50 | Horizontal | Vertical | Pass |
| 927.735 | -25.36 | 9.05 | -13.0 | -12.36 | 357.10 | Horizontal | Vertical | Pass |
| 1546.000 | -29.04 | 12.73 | -13.0 | -16.04 | 284.60 | Horizontal | Vertical | Pass |
| 2938.000 | -28.51 | 20.90 | -13.0 | -15.51 | 215.10 | Horizontal | Vertical | Pass |
| 3246.750 | -16.16 | 2.81 | -13.0 | -3.16 | 186.10 | Horizontal | Vertical | Pass |

| Temperature: | 23.4 ℃ | Relative Humidity: | 60% |
|---|---|---|---|
| Test Mode: | Mode 3 | Phase: | Vertical |



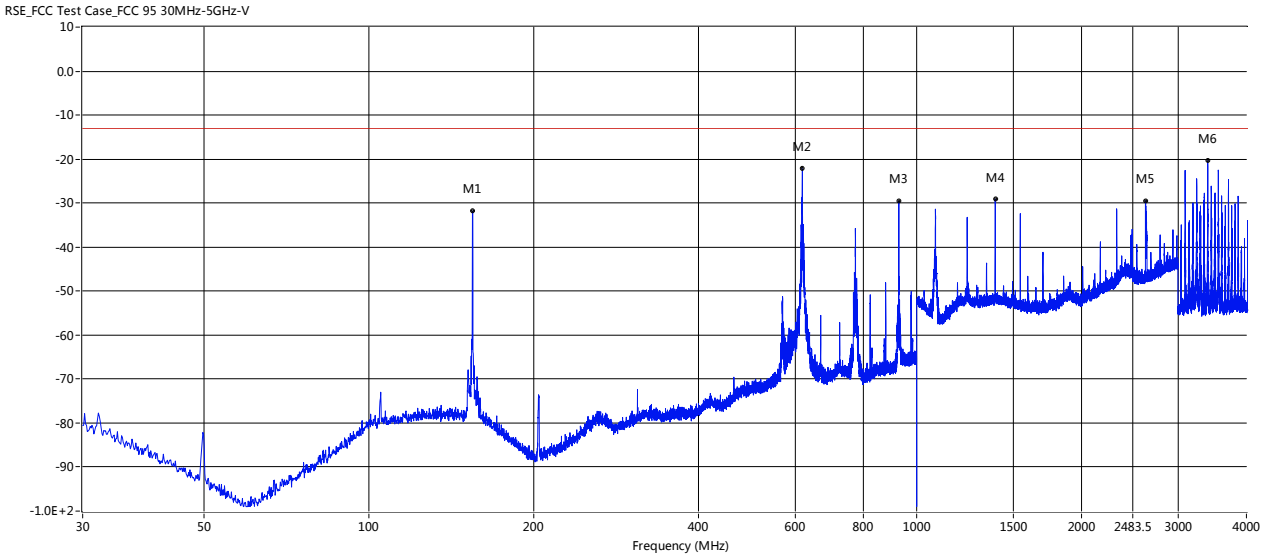

| Frequency (MHz) | Result (dBm) | Factor (dB) | PK Limit (dBm) | Over Limit (dB) | Table (o) | ANT | EUT | Verdict |
|---|---|---|---|---|---|---|---|---|
| 154.645 | -38.08 | -1.80 | -13.0 | -25.08 | 0.90 | Vertical | Vertical | Pass |
| 618.426 | -34.09 | 5.35 | -13.0 | -21.09 | 0.20 | Vertical | Vertical | Pass |
| 927.735 | -31.70 | 9.42 | -13.0 | -18.70 | 262.00 | Vertical | Vertical | Pass |
| 1237.000 | -34.67 | 13.51 | -13.0 | -21.67 | 241.60 | Vertical | Vertical | Pass |
| 2467.500 | -32.48 | 18.61 | -13.0 | -19.48 | 23.90 | Vertical | Vertical | Pass |
| 3246.750 | -19.56 | 2.01 | -13.0 | -6.56 | 204.60 | Vertical | Vertical | Pass |

| Temperature: | 23.4 ℃ | Relative Humidity: | 60% |
|---|---|---|---|
| Test Mode: | Mode 4 | Phase : | Horizontal |




| Frequency (MHz) | Result (dBm) | Factor (dB) | PK Limit (dBm) | Over Limit (dB) | Table (o) | ANT | EUT | Verdict |
|---|---|---|---|---|---|---|---|---|
| 154.524 | -32.27 | -7.21 | -13.0 | -19.27 | 325.30 | Horizontal | Vertical | Pass |
| 618.426 | -25.84 | 7.18 | -13.0 | -12.84 | 139.70 | Horizontal | Vertical | Pass |
| 927.735 | -26.39 | 9.05 | -13.0 | -13.39 | 41.50 | Horizontal | Vertical | Pass |
| 1546.000 | -20.05 | 12.73 | -13.0 | -7.05 | 274.00 | Horizontal | Vertical | Pass |
| 2937.750 | -25.69 | 20.90 | -13.0 | -12.69 | 235.10 | Horizontal | Vertical | Pass |
| 3092.000 | -16.32 | 2.83 | -13.0 | -3.32 | 213.20 | Horizontal | Vertical | Pass |

| Temperature: | 23.4 ℃ | Relative Humidity: | 60% |
|---|---|---|---|
| Test Mode: | Mode 4 | Phase: | Vertical |




| Frequency (MHz) | Result (dBm) | Factor (dB) | PK Limit (dBm) | Over Limit (dB) | Table (o) | ANT | EUT | Verdict |
|---|---|---|---|---|---|---|---|---|
| 154.645 | -31.81 | -1.80 | -13.0 | -18.81 | 0.30 | Vertical | Vertical | Pass |
| 618.426 | -22.20 | 5.35 | -13.0 | -9.20 | 0.00 | Vertical | Vertical | Pass |
| 927.735 | -29.54 | 9.42 | -13.0 | -16.54 | 145.00 | Vertical | Vertical | Pass |
| 1391.500 | -29.08 | 13.76 | -13.0 | -16.08 | 167.80 | Vertical | Vertical | Pass |
| 2618.250 | -29.54 | 17.83 | -13.0 | -16.54 | 337.10 | Vertical | Vertical | Pass |
| 3401.500 | -20.37 | 1.58 | -13.0 | -7.37 | 202.40 | Vertical | Vertical | Pass |

## 4. SPURIOUS EMISSION ON ANTENNA PORT

4.1 LIMIT

a) For transmitting equipment in the MURS shall comply with the following table:

| Channel center frequencies (MHz) | Paragraphs |
|---|---|
| 151.820, 151.880 and 151.940 | (1), (2). |
| 154.570 & 154.600, with audio filter | (3), (4), (7). |
| 154.570 & 154.600, without audio filter | (5), (6), (7). |

(1) Each MURS transmitter type that transmits F3E or G3E emissions on 154.570 MHz or 154.600 MHz and incorporates an audio filter satisfying the requirements of § 95.2775 in its design may comply with the less stringent unwanted emissions attenuation requirements set forth in paragraphs (b)(3), (4), and (7) of this section.

(2) Each MURS transmitter type that transmits on 154.570 MHz or 154.600 MHz, but does not incorporate an audio filter satisfying the requirements of § 95.2775 in its design, must comply with the unwanted emissions attenuation requirements set forth in paragraphs (b)(5) through (7) of this section.

b) The power of unwanted emissions must be attenuated below the transmitter output power in Watts (P) by at least:

(1) 7.27($f_d$−2.88 kHz) dB on any frequency removed from the channel center frequency by a displacement frequency ($f_d$ in kHz) that is more than 5.625 kHz, but not more than 12.5 kHz.

(2) 50 + 10 log (P) dB or 70 dB, whichever is the lesser attenuation, on any frequency removed from the channel center frequency by more than 12.5 kHz.

(3) 25 dB on any frequency removed from the channel center frequency by more than 10 kHz, but not more than 20 kHz.

(4) 35 dB on any frequency removed from the channel center frequency by more than 20 kHz, but not more than 50 kHz.

(5) 83 log ($f_d$ ÷ 5) dB on any frequency removed from the center of the authorized bandwidth by a displacement frequency ($f_d$ in kHz) that is more than 5 kHz, but not more than 10 kHz.

(6) 29 log ($f_d^2$ ÷ 11) dB or 50 dB, whichever is the lesser attenuation on any frequency removed from the channel center frequency by a displacement frequency ($f_d$ in kHz) that is more than 10 kHz, but not more than 50 kHz.

(7) 43 + 10 log(P) dB on any frequency removed from the channel center frequency by more than 50 kHz.

43 + 10 log (Pwatts)

Calculation: Limit (dBm) =EL-43-10log10 (TP)

Notes: EL is the emission level of the Output Power expressed in dBm,

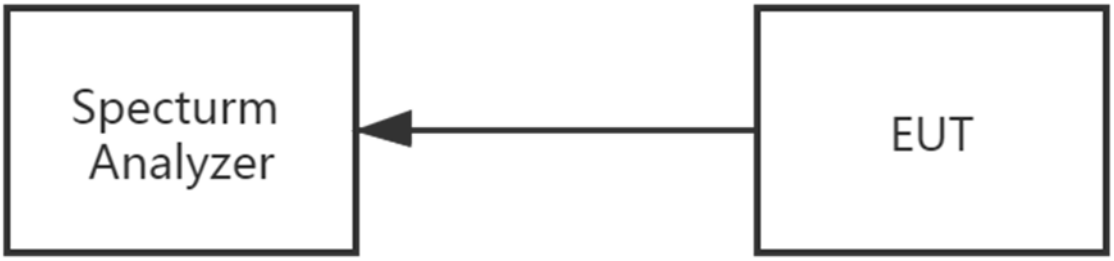
In this application, the EL is P( dBm).

Limit (dBm) = P( dBm)-43-10 log (Pwatts) = -13 dBm

4.2 TEST PROCEDURE

1. The EUT was connected to the spectrum analyzer through sufficent attenuation.
2. Sufficient scans were taken to show any out of band emission up to 10th. Harmonic for the lower and the highest frequency range.
3. Set EUT as digital data mode.
4. Set RBW 30kHz, VBW 100 kHz in the frequency band 30MHz to 1GHz,while set RBW=1MHz. VBW=3MHz from the 1GHz to 10th Harmonic.

4.3 TEST SETUP

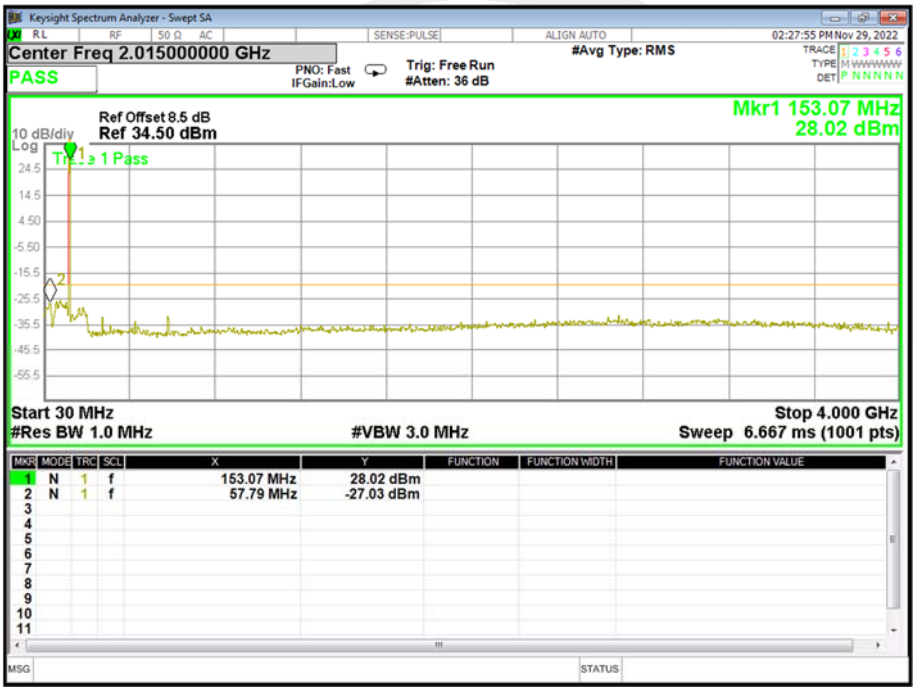



4.4 EUT OPERATION CONDITIONS

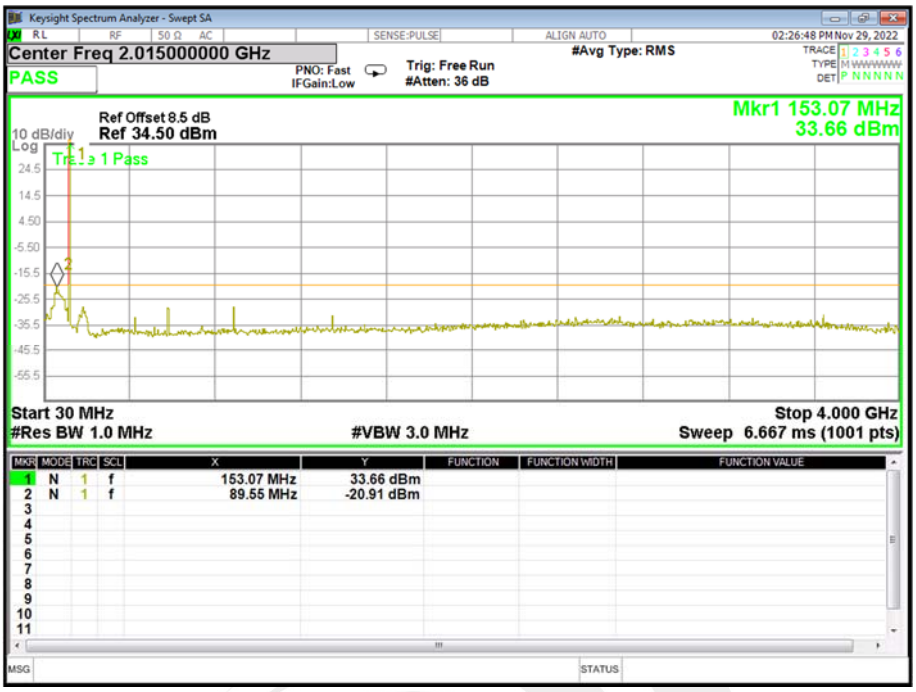
TX mode.

4.5 TEST RESULT

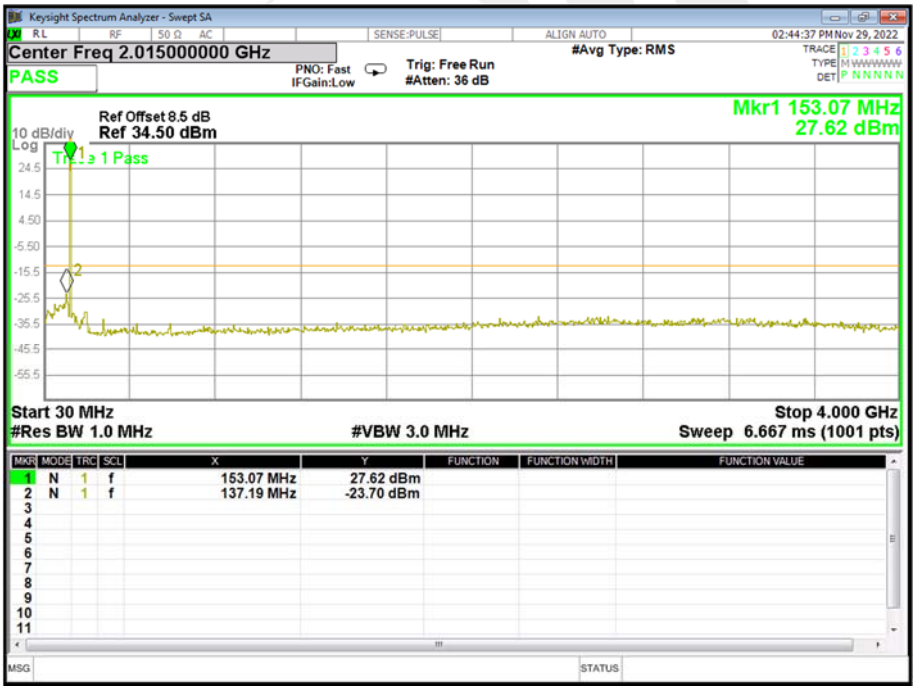
Mode 1



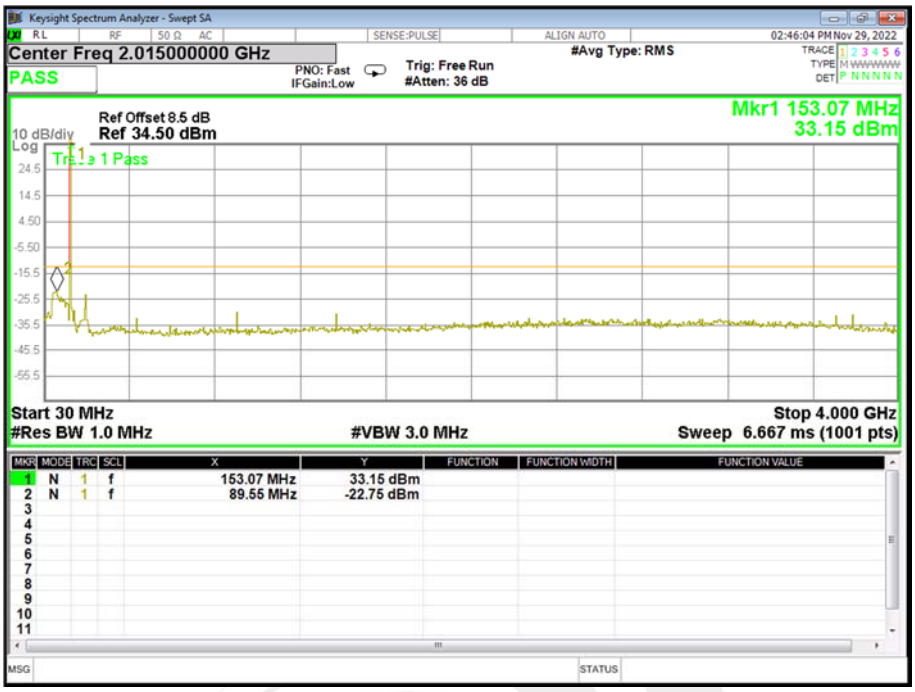
Mode 2


Keysight Spectrum Analyzer - Swept SA
Center Freq 2.015000000 GHz
PASS
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 36 dB
#Avg Type: RMS
02:26:48 PM Nov 29, 2022
Ref Offset 8.5 dB
10 dB/div
Ref 34.50 dBm
Log
Mkr1 153.07 MHz
33.66 dBm
Start 30 MHz
#Res BW 1.0 MHz
#VBW 3.0 MHz
Stop 4.000 GHz
Sweep 6.667 ms (1001 pts)
1 N 1 f 153.07 MHz 33.66 dBm
2 N 1 f 89.55 MHz -20.91 dBm

Mode 3


Keysight Spectrum Analyzer - Swept SA
Center Freq 2.015000000 GHz
PASS
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 36 dB
#Avg Type: RMS
02:44:37 PM Nov 29, 2022
Ref Offset 8.5 dB
10 dB/div
Ref 34.50 dBm
Log
Mkr1 153.07 MHz
27.62 dBm
Start 30 MHz
#Res BW 1.0 MHz
#VBW 3.0 MHz
Stop 4.000 GHz
Sweep 6.667 ms (1001 pts)
1 N 1 f 153.07 MHz 27.62 dBm
2 N 1 f 137.19 MHz -23.70 dBm

Mode 4


Keysight Spectrum Analyzer - Swept SA
Center Freq 2.015000000 GHz
PASS
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 36 dB
#Avg Type: RMS
02:46:04 PM Nov 29, 2022
Ref Offset 8.5 dB
10 dB/div
Ref 34.50 dBm
Mkr1 153.07 MHz
33.15 dBm
Trace 1 Pass
Start 30 MHz
#Res BW 1.0 MHz
#VBW 3.0 MHz
Stop 4.000 GHz
Sweep 6.667 ms (1001 pts)
1 N 1 f 153.07 MHz 33.15 dBm
2 N 1 f 89.55 MHz -22.75 dBm

## 5. TRANSMITTER OUTPUT POWER

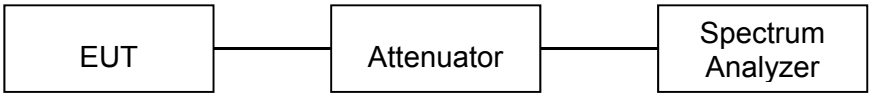
5.1 LIMIT

Each MURS transmitter type must be designed such that the transmitter power output does not exceed 2 Watts under normal operating conditions.

5.2 TEST PROCEDURE

Measurements shall be made to establish the radio frequency power delivered by the transmitter the standard output termination. The power output shall be monitored and recorded and no adjustment shall be made to the transmitter after the test has begun, except as noted bellow:
If the power output is adjustable, measurements shall be made for the highest and lowest power levels. The EUT connect to the Spectrum Analyzer through 30 dB attenuator.

5.3 TEST SETUP




5.4 TEST RESULTS

Low Power:

| Operation Mode | Test Frequency(MHz) | Bandwidth | Test Results (dBm) | Test Results (W) | Limit (W) | Result |
|---|---|---|---|---|---|---|
| MURS | 151.88 | Narrow band | 26.93 | 0.49 | 2 | Pass |
| | 154.60 | Narrow band | 27.73 | 0.59 | 2 | Pass |
| | 154.60 | Wideband | 27.77 | 0.60 | 2 | Pass |

High Power:

| Operation Mode | Test Frequency(MHz) | Bandwidth | Test Results (dBm) | Test Results (W) | Limit (W) | Result |
|---|---|---|---|---|---|---|
| MURS | 151.88 | Narrow band | 32.25 | 1.68 | 2 | Pass |
| | 154.60 | Narrow band | 31.95 | 1.57 | 2 | Pass |
| | 154.60 | Wideband | 32.17 | 1.65 | 2 | Pass |

## 6. BANDWIDTH TEST

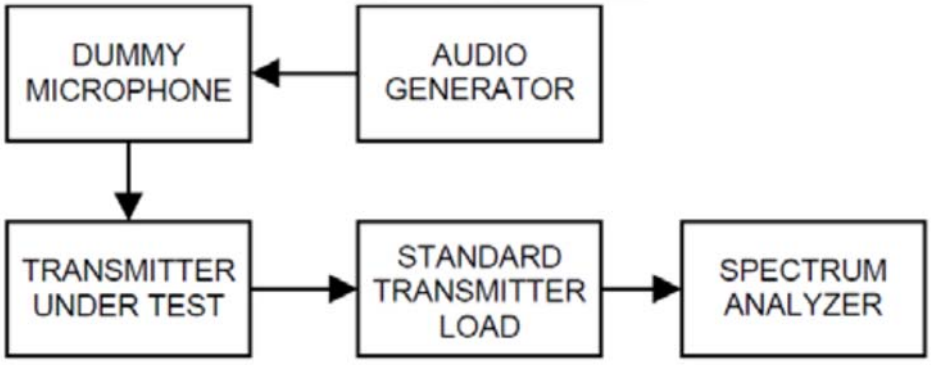
6.1 LIMIT

Each MURS transmitter type must be designed to meet the emission bandwidth limitations in this section.
(a) The occupied bandwidth of emissions transmitted on the center frequencies 151.820 MHz, 151.880 MHz, and 151.940 MHz must not exceed 11.25 kHz.
(b) The occupied bandwidth of emissions transmitted on the center frequencies 154.570 MHz and 154.600 MHz must not exceed 20.0 kHz.
(c) The occupied bandwidth of type A3E emissions must not exceed 8.0 kHz.

6.2 TEST PROCEDURE

1. The EUT was connected to the spectrum analyzer through sufficent attenuation.
2. Set EUT as digital data mode.
3. Set SPA Center Frequency=fundamental frequency, RBW=100Hz, VBW=1KHz, span =15KHz.
4. Set SPA Max hold. Mark peak, Set 99% Occupied Bandwidth.

6.3 TEST SETUP




6.4 EUT OPERATION CONDITIONS

TX mode.

## 6.5 TEST RESULTS

Low Power

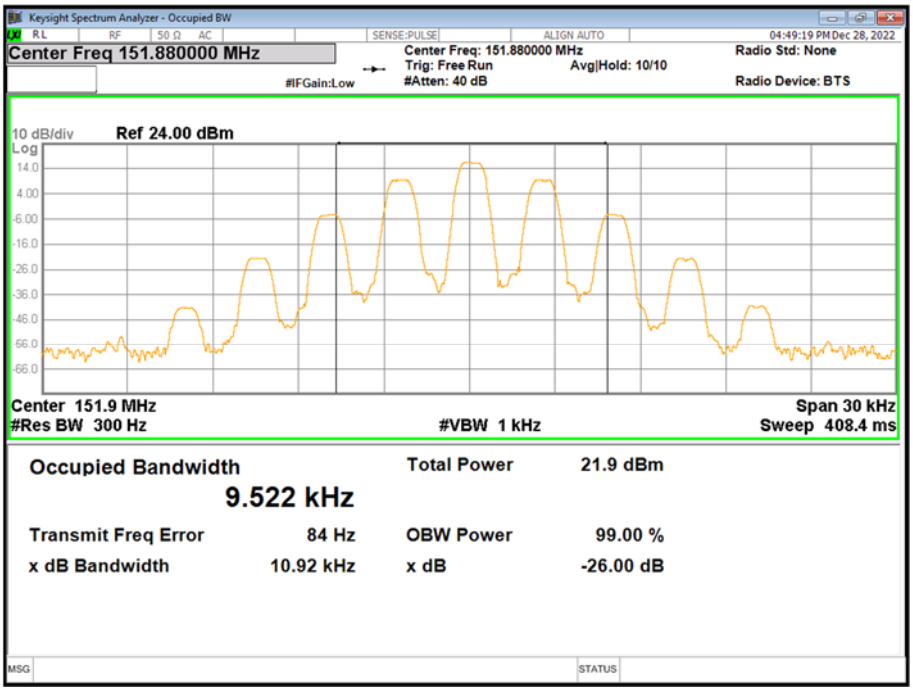
| Operation Mode | Test Frequency(MHz) | Bandwidth | 99% Occupied Bandwidth(KHz) | Limits (KHz) | Result |
|---|---|---|---|---|---|
| MURS | 151.88 | Narrow band | 9.522 | 11.25 | Pass |
| | 154.60 | Narrow band | 9.378 | 20 | Pass |
| | 154.60 | Wideband | 16.198 | 20 | Pass |

High Power

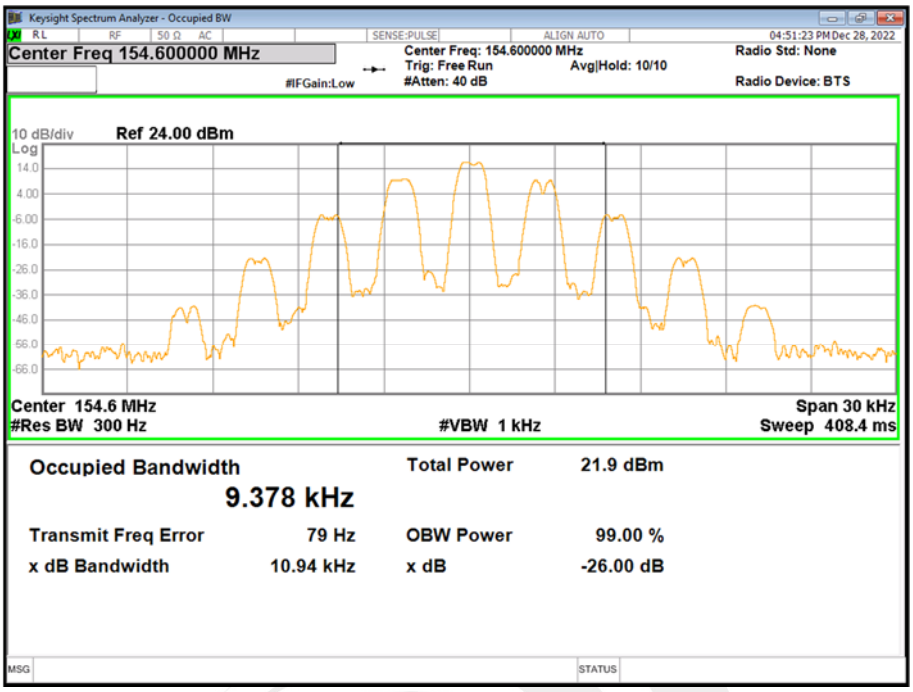
| Operation Mode | Test Frequency(MHz) | Bandwidth | 99% Occupied Bandwidth(KHz) | Limits (KHz) | Result |
|---|---|---|---|---|---|
| MURS | 151.88 | Narrow band | 9.463 | 11.25 | Pass |
| | 154.60 | Narrow band | 9.303 | 20 | Pass |
| | 154.60 | Wideband | 16.209 | 20 | Pass |

Narrow band:

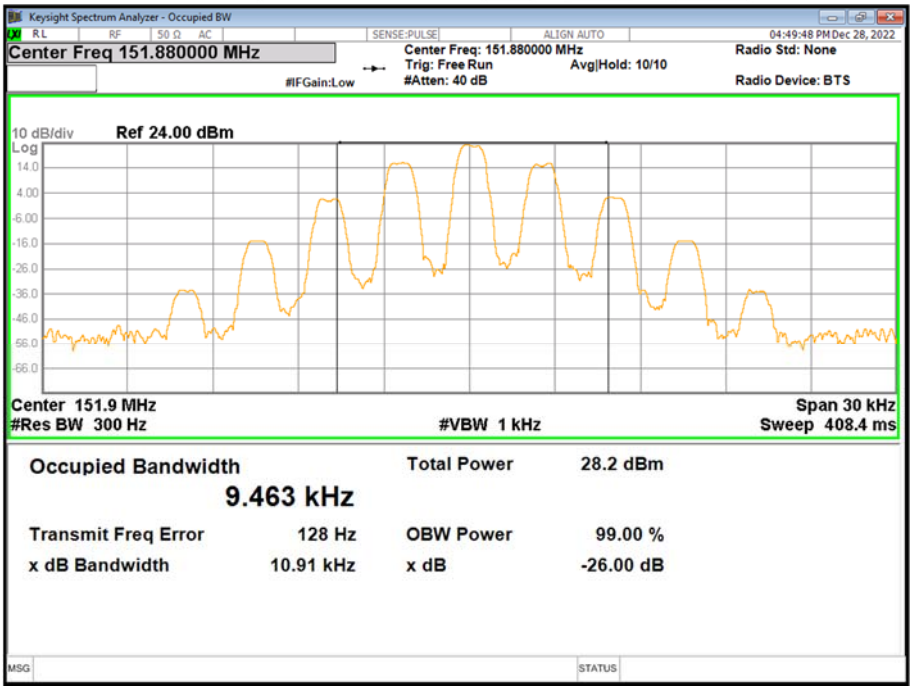
CH2_Low Power



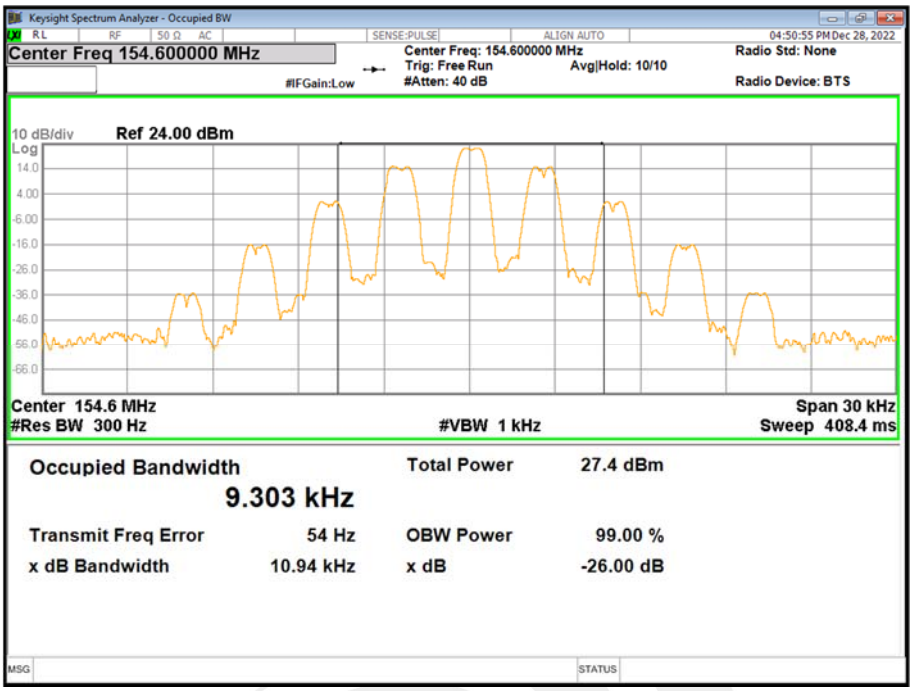
CH5_Low Power




CH2_High Power

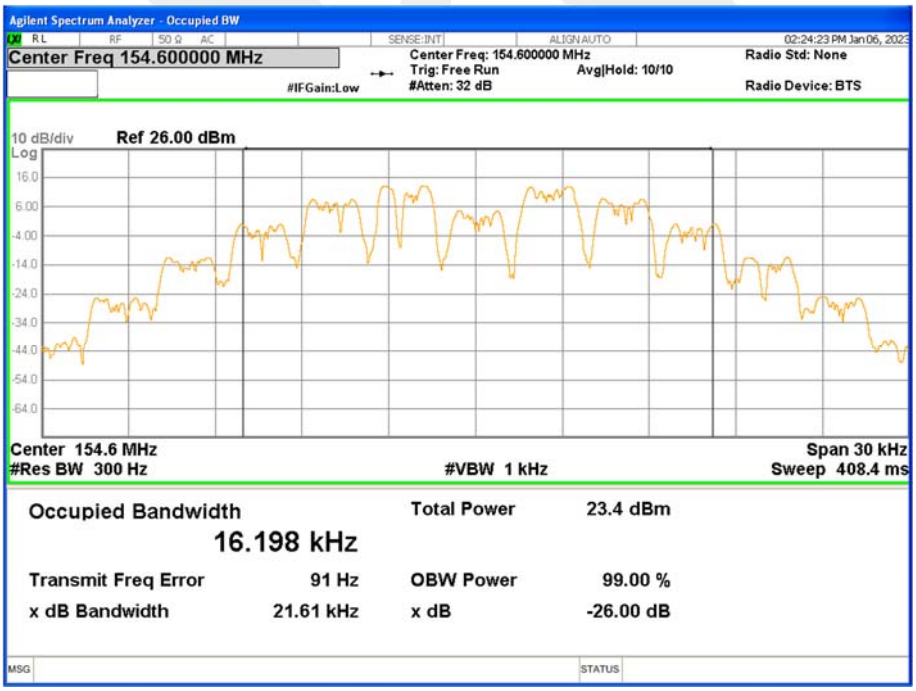


CH5_High Power

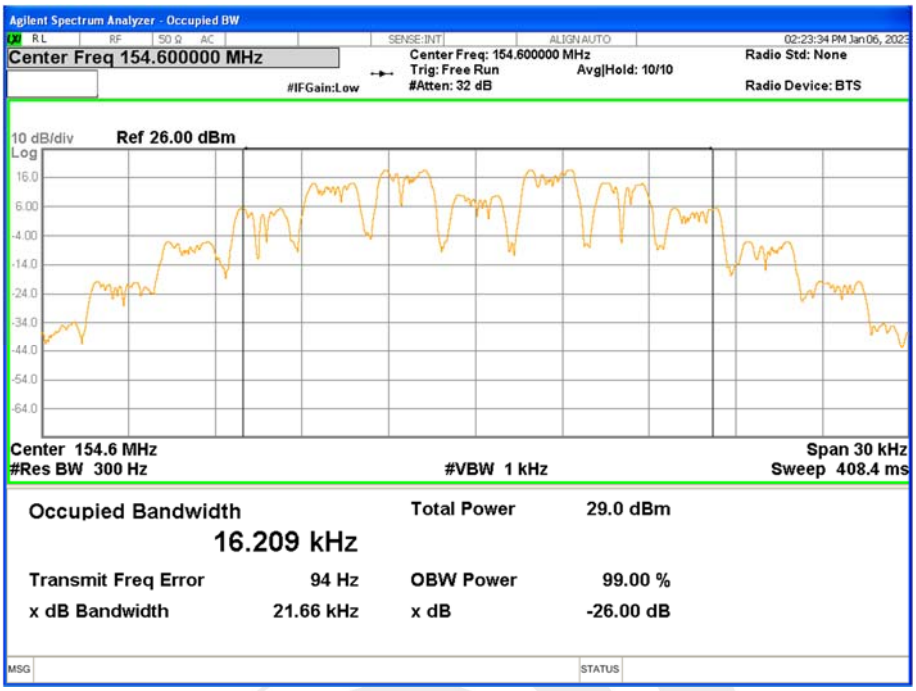



Wideband:

CH5_Low Power



CH5_High Power



## 7. EMISSION MASK

7.1 LIMIT

a) For transmitting equipment in the MURS shall comply with the following table:

| Channel center frequencies (MHz) | Paragraphs |
|---|---|
| 151.820, 151.880 and 151.940 | (1), (2). |
| 154.570 & 154.600, with audio filter | (3), (4), (7). |
| 154.570 & 154.600, without audio filter | (5), (6), (7). |

(1) Each MURS transmitter type that transmits F3E or G3E emissions on 154.570 MHz or 154.600 MHz and incorporates an audio filter satisfying the requirements of § 95.2775 in its design may comply with the less stringent unwanted emissions attenuation requirements set forth in paragraphs (b)(3), (4), and (7) of this section.

(2) Each MURS transmitter type that transmits on 154.570 MHz or 154.600 MHz, but does not incorporate an audio filter satisfying the requirements of § 95.2775 in its design, must comply with the unwanted emissions attenuation requirements set forth in paragraphs (b)(5) through (7) of this section.

b) The power of unwanted emissions must be attenuated below the transmitter output power in Watts (P) by at least:

(1) 7.27($f_d$−2.88 kHz) dB on any frequency removed from the channel center frequency by a displacement frequency ($f_d$ in kHz) that is more than 5.625 kHz, but not more than 12.5 kHz.

(2) 50 + 10 log (P) dB or 70 dB, whichever is the lesser attenuation, on any frequency removed from the channel center frequency by more than 12.5 kHz.

(3) 25 dB on any frequency removed from the channel center frequency by more than 10 kHz, but not more than 20 kHz.

(4) 35 dB on any frequency removed from the channel center frequency by more than 20 kHz, but not more than 50 kHz.

(5) 83 log ($f_d$ ÷ 5) dB on any frequency removed from the center of the authorized bandwidth by a displacement frequency ($f_d$ in kHz) that is more than 5 kHz, but not more than 10 kHz.

(6) 29 log ($f_d^2$ ÷ 11) dB or 50 dB, whichever is the lesser attenuation on any frequency removed from the channel center frequency by a displacement frequency ($f_d$ in kHz) that is more than 10 kHz, but not more than 50 kHz.

(7) 43 + 10 log(P) dB on any frequency removed from the channel center frequency by more than 50 kHz.

43 + 10 log (Pwatts)

Calculation: Limit (dBm) =EL-43-10log10 (TP)

Notes: EL is the emission level of the Output Power expressed in dBm,

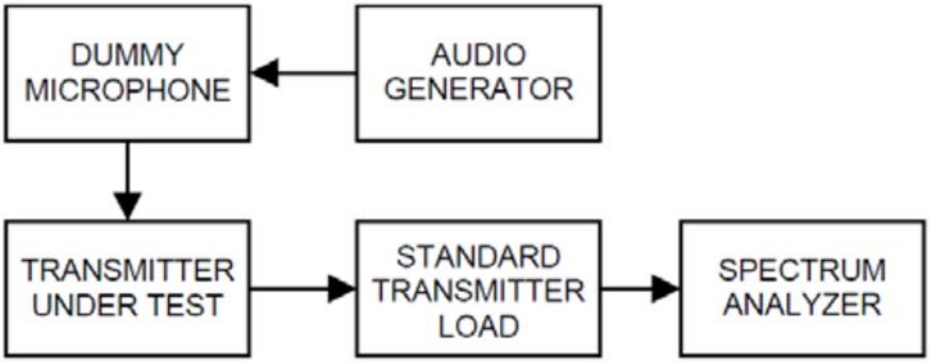
In this application, the EL is P( dBm).

Limit (dBm) = P( dBm)-43-10 log (Pwatts) = -13 dBm

7.2 TEST PROCEDURE

1. The EUT was connected to the spectrum analyzer through sufficent attenuation.
2. Set EUT as digital data mode.
3. Set SPA Center Frequency=fundamental frequency, RBW=300Hz, VBW=3KHz, span =120KHz.

7.3 TEST SETUP



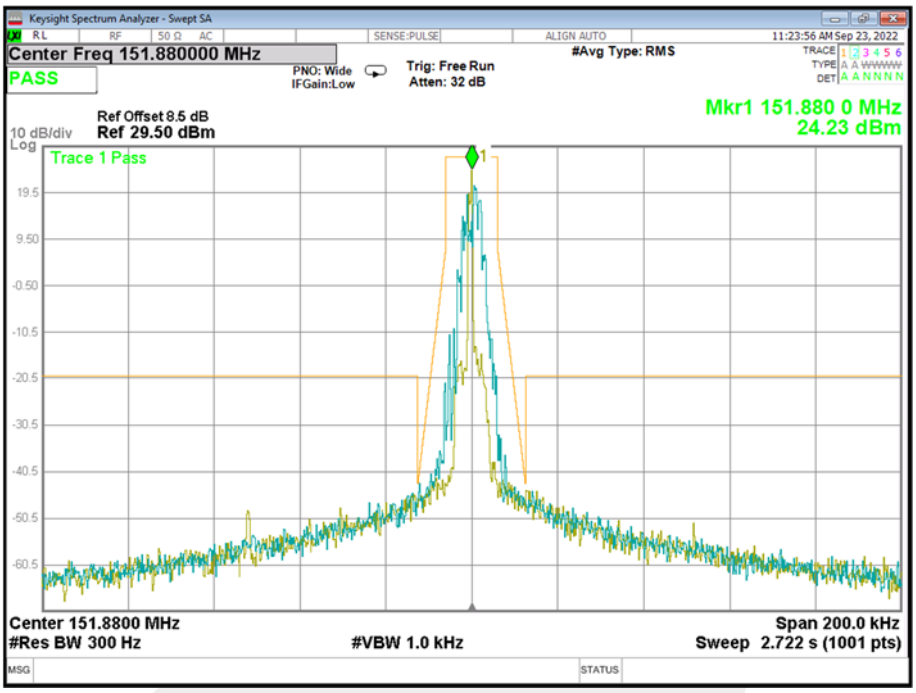

7.4 EUT OPERATION CONDITIONS

TX mode.

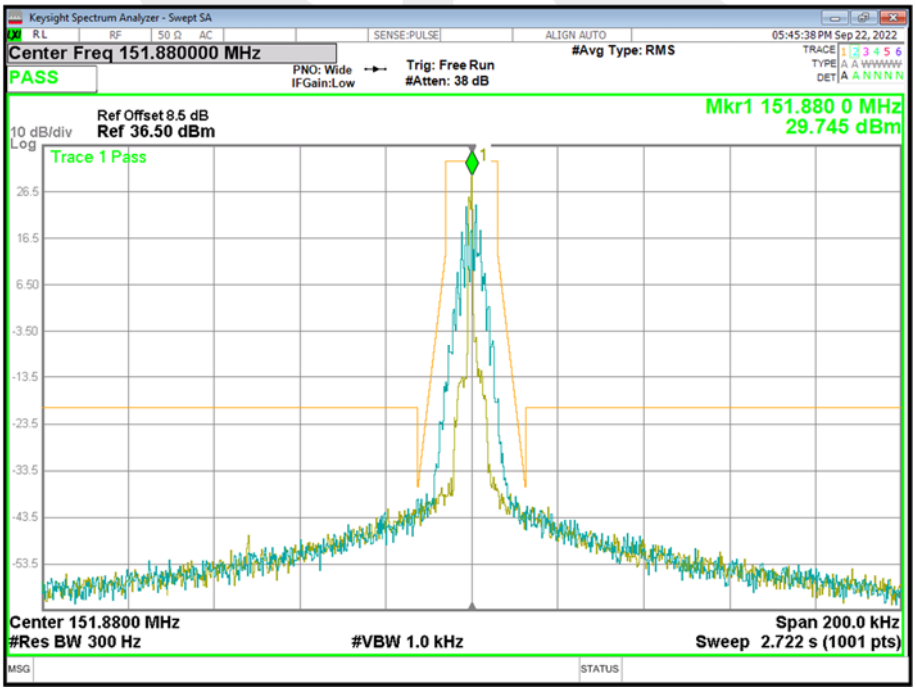
7.5 TEST RESULT

Narrow band:

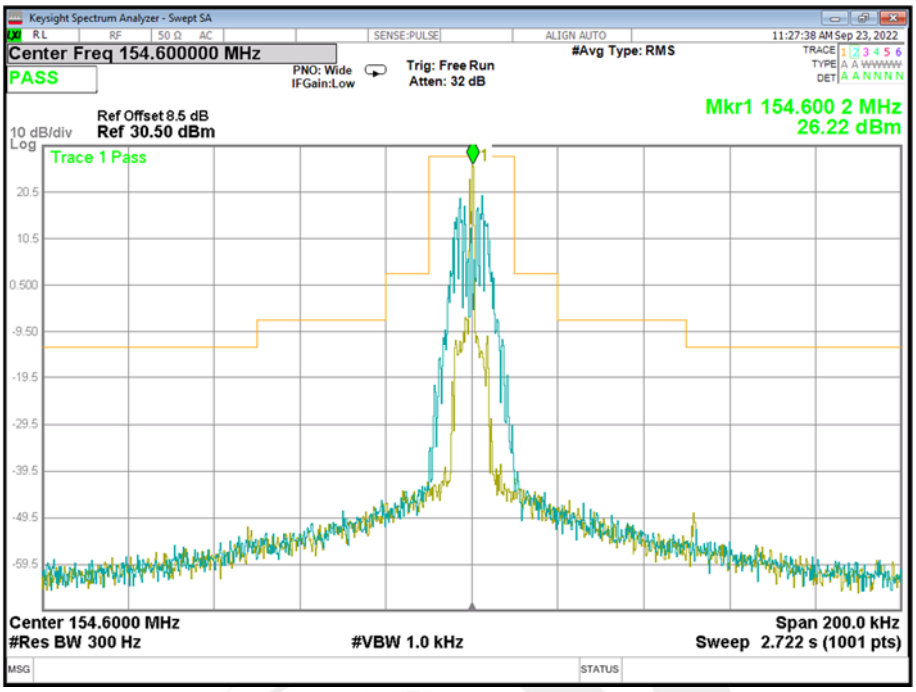
Mode 1



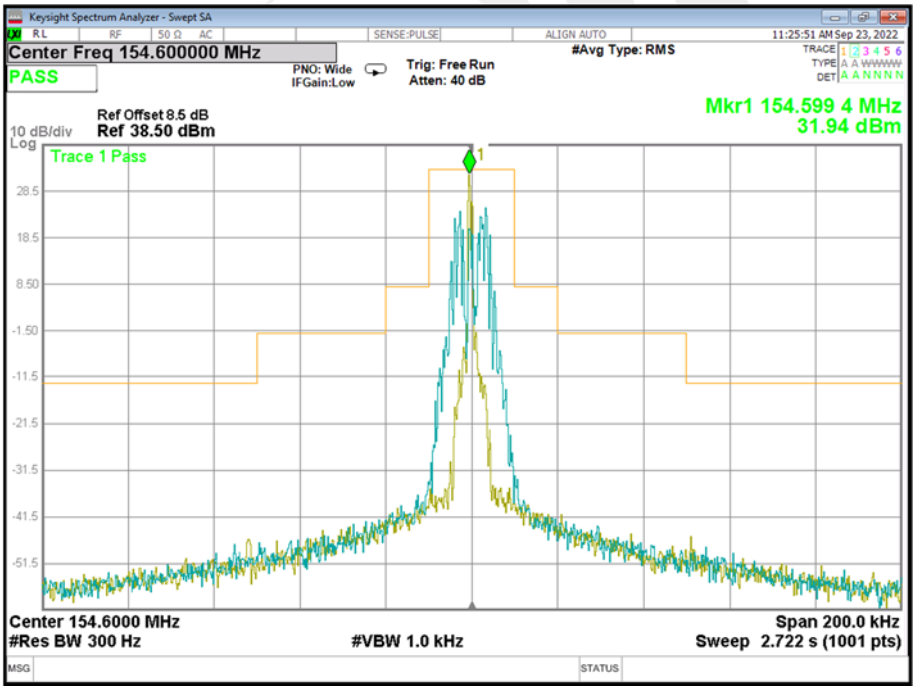

Mode 2



Mode 3

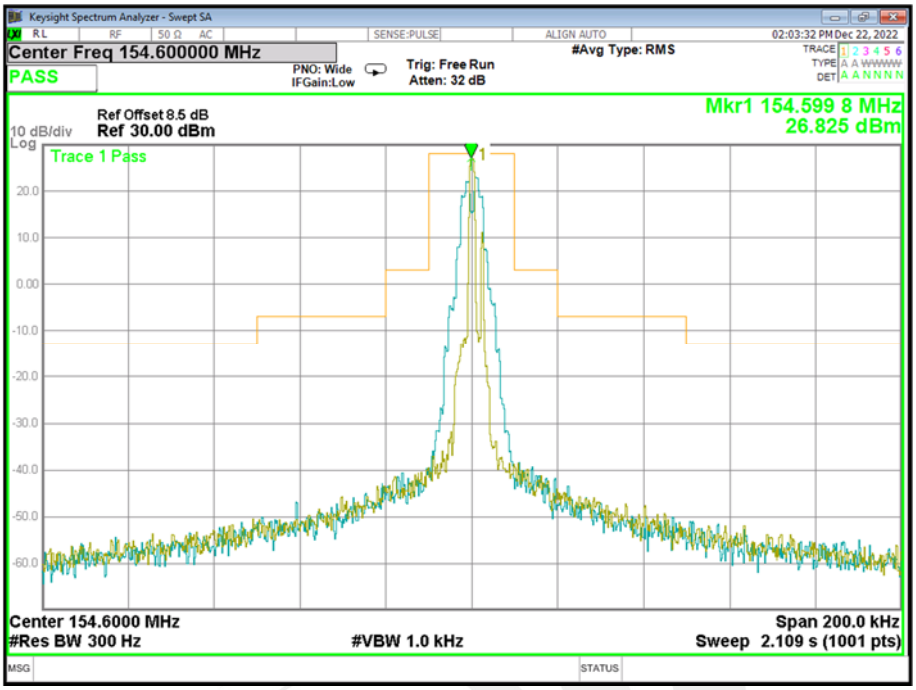

Keysight Spectrum Analyzer - Swept SA
Center Freq 154.600000 MHz
PASS
PNO: Wide
IFGain:Low
Trig: Free Run
Atten: 32 dB
#Avg Type: RMS
11:27:38 AM Sep 23, 2022
Ref Offset 8.5 dB
10 dB/div
Log
Ref 30.50 dBm
Mkr1 154.600 2 MHz
26.22 dBm
Trace 1 Pass
20.5
10.5
0.500
-9.50
-19.5
-29.5
-39.5
-49.5
-59.5
Center 154.6000 MHz
#Res BW 300 Hz
#VBW 1.0 kHz
Span 200.0 kHz
Sweep 2.722 s (1001 pts)

Mode 4

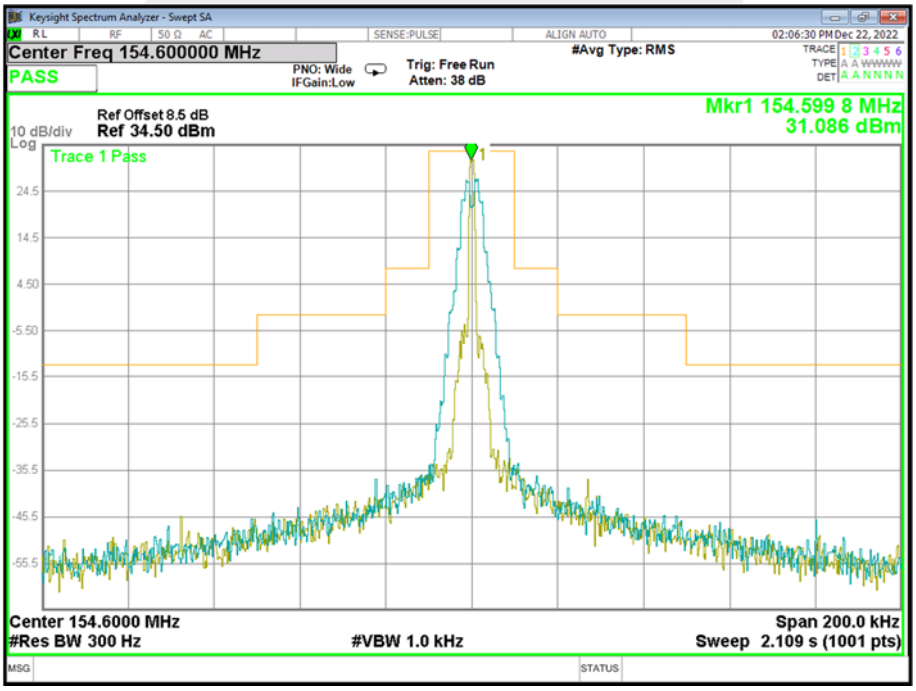

Keysight Spectrum Analyzer - Swept SA
Center Freq 154.600000 MHz
PASS
PNO: Wide
IFGain:Low
Trig: Free Run
Atten: 40 dB
#Avg Type: RMS
11:25:51 AM Sep 23, 2022
Ref Offset 8.5 dB
10 dB/div
Log
Ref 38.50 dBm
Mkr1 154.599 4 MHz
31.94 dBm
Trace 1 Pass
28.5
18.5
8.50
-1.50
-11.5
-21.5
-31.5
-41.5
-51.5
Center 154.6000 MHz
#Res BW 300 Hz
#VBW 1.0 kHz
Span 200.0 kHz
Sweep 2.722 s (1001 pts)

Wideband:

Mode 3




Mode 4



## 8. FREQUENCY STABILITY

8.1 LIMIT

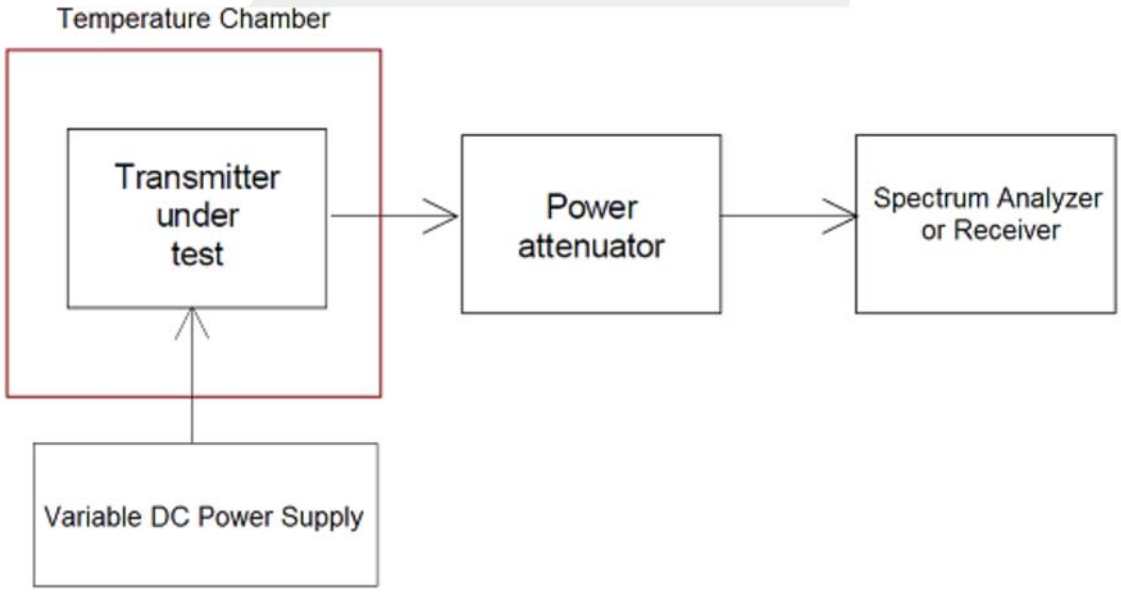
(a) MURS transmitters that operate with an emission bandwidth of 6.25 kHz or less must be designed such that the carrier frequencies remain within ±2.0 parts-per-million (ppm) of the channel center frequencies specified in § 95.2763 during normal operating conditions.

(b) MURS transmitters that operate with an emission bandwidth greater than 6.25 kHz must be designed such that the carrier frequencies remain within ±5.0 ppm of the channel center frequencies specified in § 95.2763 during normal operating conditions.

8.2 TEST PROCEDURE

1. The frequency stability shall be measured with variation of ambient temperature from -30℃ to +50℃
2. For battery powered equipment, the frequency stability shall be measured with reducing primary supply voltage to the battery operating end point, which is specified by the manufacture.
3. Vary primary supply voltage from 6.29V to 8.51V.
4. The EUT was set in the climate chamber and connected to an external DC power supply. The RF output was directly connected to Spectrum Analyzer The coupling loss of the additional cables was recorded and taken in account for all the measurements. After temperature stabilization (approx. 20 min for each stage), the frequency for the lower, the middle and the highest frequency range was recorded. For Frequency stability Vs. Voltage the EUT was connected to a DC power supply and the voltage was adjusted in the required ranges. The result was recorded

8.3 TEST SETUP




8.4 EUT OPERATION CONDITIONS

TX mode.

8.5 TEST RESULT

Note: All mode has been tested, only shown the worst case in this report.

| MURS_(151.88MHz) | | | | | | |
|---|---|---|---|---|---|---|
| Voltage | Temperature (°C) | Nominal Frequency (MHz) | Measured Frequency (MHz) | Frequency error (ppm) | Limit | Result |
| Normal Voltage | -30 | 151.880 | 151.8799 | -0.6584 | ±5ppm | Pass |
| | -20 | 151.880 | 151.8795 | -3.2921 | | |
| | -10 | 151.880 | 151.8800 | 0.0000 | | |
| | 0 | 151.880 | 151.8799 | -0.6584 | | |
| | 10 | 151.880 | 151.8797 | -1.9752 | | |
| | 20 | 151.880 | 151.8797 | -1.9752 | | |
| | 30 | 151.880 | 151.8803 | 1.9752 | | |
| | 40 | 151.880 | 151.8796 | -2.6337 | | |
| | 50 | 151.880 | 151.8802 | 1.3168 | | |
| Maximum Voltage | 20 | 151.880 | 151.8802 | 1.3168 | | |
| BEP | 20 | 151.880 | 151.8802 | 1.3168 | | |

| MURS_(154.60MHz) | | | | | | |
|---|---|---|---|---|---|---|
| Voltage | Temperature (°C) | Nominal Frequency (MHz) | Measured Frequency (MHz) | Frequency error (ppm) | Limit | Result |
| Normal Voltage | -30 | 154.600 | 154.5999 | -0.6468 | ±5ppm | Pass |
| | -20 | 154.600 | 154.5999 | -0.6468 | | |
| | -10 | 154.600 | 154.6003 | 1.9405 | | |
| | 0 | 154.600 | 154.6000 | 0.0000 | | |
| | 10 | 154.600 | 154.6002 | 1.2937 | | |
| | 20 | 154.600 | 154.6000 | 0.0000 | | |
| | 30 | 154.600 | 154.5999 | -0.6468 | | |
| | 40 | 154.600 | 154.5999 | -0.6468 | | |
| | 50 | 154.600 | 154.6002 | 1.2937 | | |
| Maximum Voltage | 20 | 154.600 | 154.6000 | 0.0000 | | |
| BEP | 20 | 154.600 | 154.6003 | 1.9405 | | |

## 9. MURS AUDIO FILTER

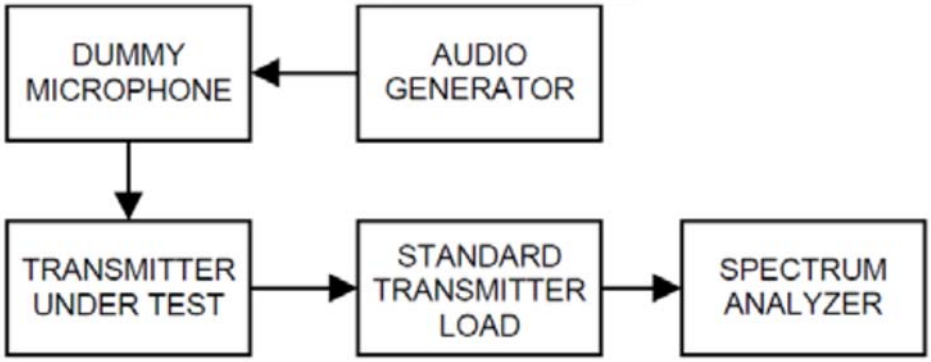
9.1 LIMIT

(a) The audio filter must be between the modulation limiter and the modulated stage of the transmitter.
(b) At any frequency (f in kHz) between 3 and 15 kHz, the filter must have an attenuation of at least 40 log (f/3) dB more than the attenuation at 1 kHz. Above 15 kHz, it must have an attenuation of at least 28 dB more than the attenuation at 1 kHz.

9.2 TEST PROCEDURE

1. Configure the EUT as shown in figure
2. Apply a 1000 Hz tone from the audio signal generator and adjust the level per manufacturer's specifications. Record the dB level of the 1000 Hz tone as $LEV_{REF}$.
3. Set the audio signal generator to the desired test frequency between 3000 Hz and the upper low pass filter limit. Record the dB level at the test frequency as $LEV_{FREQ}$
4. Calculate the audio frequency response at the test frequency as:
low pass filter response = $LEV_{FREQ}$ - $LEV_{REF}$

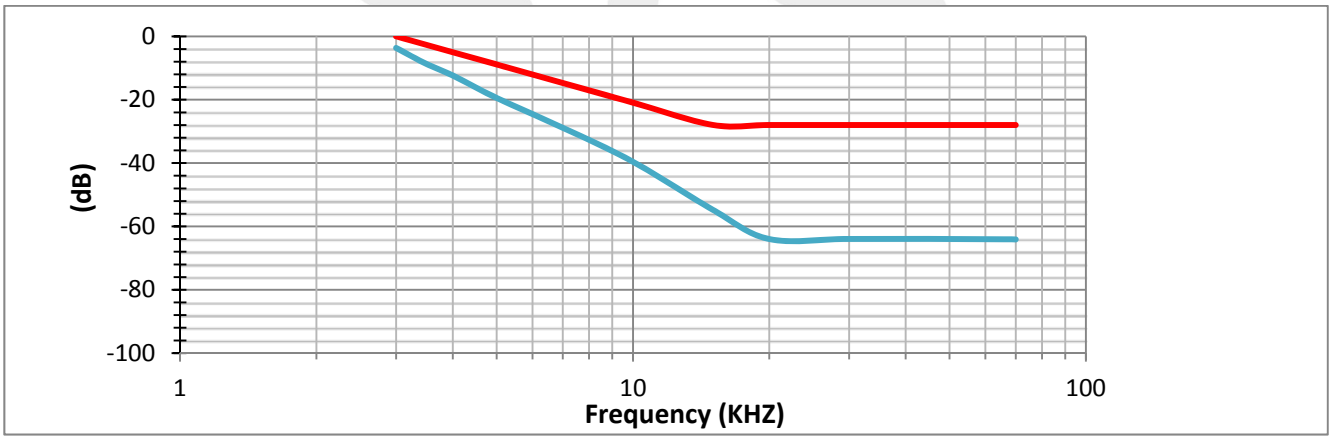
9.3 TEST SETUP



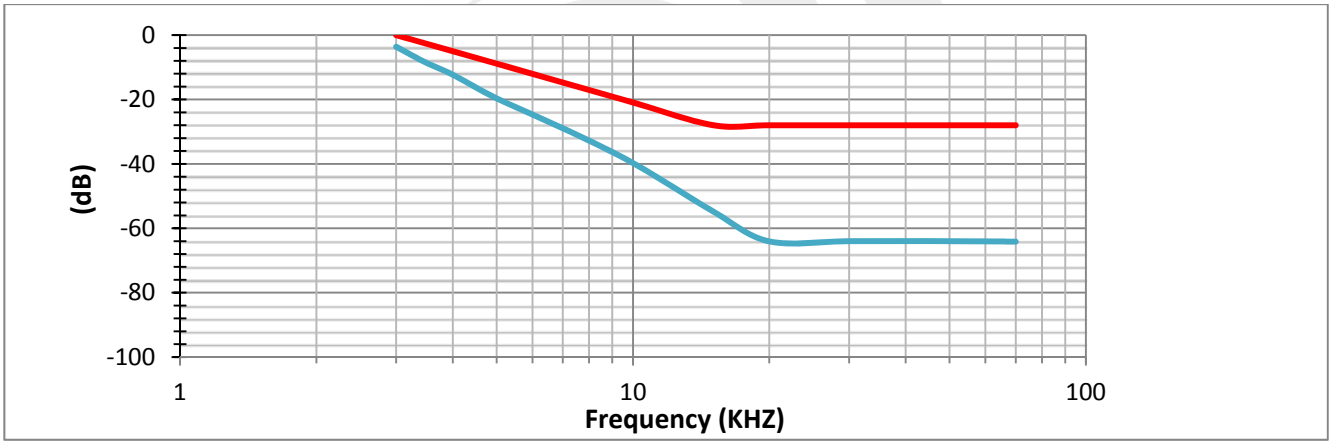
9.4 TEST RESULT

Note: All mode has been tested, only shown the worst case in this report.

| MURS_(151.88MHz) | | | |
|---|---|---|---|
| Audio Frequency(KHz) | Limit | Response Attenuation(dB) | Result |
| 3 | 0 | -3.66 | PASS |
| 3.5 | -2.68 | -8.71 | |
| 4 | -5 | -12.35 | |
| 5 | -8.87 | -19.43 | |
| 7 | -14.72 | -28.85 | |
| 10 | -20.92 | -39.58 | |
| 15 | -27.96 | -54.73 | |
| 20 | -28 | -64.00 | |
| 30 | -28 | -63.96 | |
| 50 | -28 | -63.97 | |
| 70 | -28 | -64.09 | |



| MURS_154.6MHz | | | |
|---|---|---|---|
| Audio Frequency(KHz) | Limit | Response Attenuation(dB) | Result |
| 3 | 0 | -3.61 | PASS |
| 3.5 | -2.68 | -8.62 | |
| 4 | -5 | -12.29 | |
| 5 | -8.87 | -19.64 | |
| 7 | -14.72 | -28.93 | |
| 10 | -20.92 | -39.72 | |
| 15 | -27.96 | -54.69 | |
| 20 | -28 | -64.06 | |
| 30 | -28 | -64.02 | |
| 50 | -28 | -64.00 | |
| 70 | -28 | -64.15 | |



## APPENDIX 1- PHOTOS OF TEST SETUP

Note: See test photos in setup photo document for the actual connections between Product and support equipment.

※※※※※END OF THE REPORT※※※※※