



中认信通
CHINA CERTIFICATION ICT CO., LTD (DONGGUAN)



TEST REPORT

Applicant: Northfield Telecommunications, Inc. d/b/a
Advanced Wireless Communications

Address: 20809 Kensington Blvd, Lakeville, Minnesota, United States 55044

FCC ID: Q9SAWRDRP9050S

Product Name: Digital Repeater

Model Number: AWR-DRP9050S

Standard(s): 47 CFR Part 2
47 CFR Part 90
ANSI C63.26-2015
ANSI/TIA 603-E-2016

The above equipment has been tested and found compliance with the requirement of the relative standards by China Certification ICT Co., Ltd (Dongguan)

Report Number: CR21110034-00B

Date Of Issue: 2022-03-07

Reviewed By: Sun Zhong

Sun Zhong

Title: Manager

Test Laboratory: China Certification ICT Co., Ltd (Dongguan)

No. 113, Pingkang Road, Dalang Town, Dongguan,
Guangdong, China
Tel: +86-769-82016888

Test Facility

The Test site used by China Certification ICT Co., Ltd (Dongguan) to collect test data is located on the No. 113, Pingkang Road, Dalang Town, Dongguan, Guangdong, China.

The lab has been recognized as the FCC accredited lab under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No. : 442868, the FCC Designation No. : CN1314.

The lab has been recognized by Innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements, the CAB identifier: CN0123.

Declarations

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1. GENERAL INFORMATION

1.1 Product Description for Equipment under Test (EUT)

| | |
|--|--|
| EUT Name: | Digital Repeater |
| EUT Model: | AWR-DRP9050S |
| Operation Frequency: | 400-470 MHz |
| Modulation Type: | FM, 4FSK |
| Channel Spacing: | 12.5 kHz |
| Rated Output Power: (Conducted) | High Power Level: 50W Low Power Level: 5W |
| Rated Input Voltage: | AC 100~240V |
| Serial Number: | CR21110034-RF |
| EUT Received Date: | 2021.12.15 |
| EUT Received Status: | Good |

Antenna Information Detail ▲:

| Antenna Manufacturer | Antenna Type | input impedance (Ohm) | Antenna Gain /Frequency Range |
|----------------------|--------------|--------------------------|----------------------------------|
| HUAHONG | Whip | 50 | 5.0 dBi/400-470MHz |

Accessory Information:

| Accessory Description | Manufacturer | Model | Parameters |
|-----------------------|--------------|-------|------------|
| / | / | / | / |

Test Frequency Detail:

Per C63.26-2015, section 5.1, the lowest frequency, middle frequency, and highest frequency was performed the test as below:

| Modulation/ Channel Bandwidth | Test Channel | Frequency (MHz) | Rule Part |
|-------------------------------------|--------------|--------------------|-------------|
| FM 12.5kHz | Lowest | 400.0125 | For Federal |
| | Middle | 453.2125 | For Part 90 |
| | Highest | 469.9875 | For Part 90 |
| 4FSK 12.5kHz | Lowest | 400.0125 | For Federal |
| | Middle | 453.2125 | For Part 90 |
| | Highest | 469.9875 | For Part 90 |

1.2 Description of Test Configuration

1.2.1 EUT Operation Condition:

| | |
|---------------------------------|--|
| EUT Operation Mode: | The system was configured for testing in Engineering Mode, which was provided by the manufacturer. |
| Equipment Modifications: | No |
| EUT Exercise Software: | No |

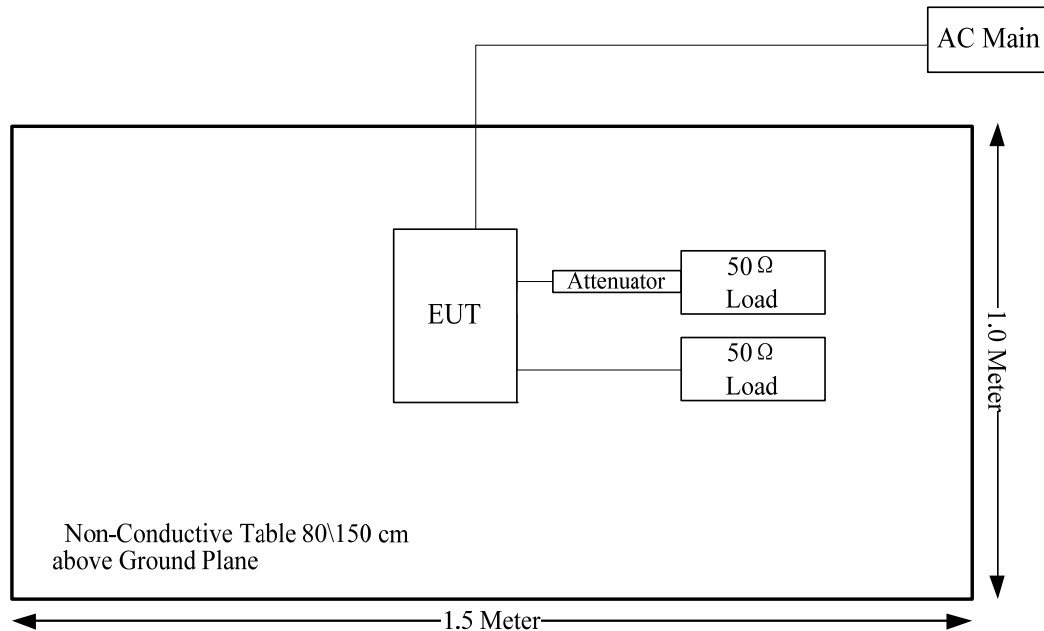
1.2.2 Support Equipment List and Details

| Manufacturer | Description | Model | Serial Number |
|-----------------|--------------------|------------|---------------|
| WEINSCHTEL Corp | Load | 50ohm | 50ohm Load-1 |
| WEINSCHTEL Corp | Load | 50ohm | 50ohm Load-2 |
| BEW | Coaxial Attenuator | TS300-6-40 | 213311 |

1.2.3 Support Cable List and Details

| Cable Description | Shielding Type | Ferrite Core | Length (m) | From Port | To |
|-------------------|----------------|--------------|------------|-----------|-----------------|
| RF Cable*2 | Yes | No | 0.2 | EUT | Load/Attenuator |

1.2.4 Block Diagram of Test Setup



1.3 Measurement Uncertainty

Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty. The extended uncertainty given in this report is obtained by combining the standard uncertainty times the coverage factor K with the 95% confidence interval.

| Parameter | Measurement Uncertainty |
|-----------------------------------|---|
| Occupied Channel Bandwidth | ±5 % |
| RF output power, conducted | ±0.61dB |
| Power Spectral Density, conducted | ±0.61 dB |
| Unwanted Emissions, radiated | 30M~200MHz: 4.15 dB,200M~1GHz: 5.61 dB,1G~6GHz: 5.14 dB, 6G~18GHz: 5.93 dB,18G~26.5G:5.47 dB,26.5G~40G:5.63 dB |
| Unwanted Emissions, conducted | ±1.26 dB |
| Temperature | ±1 °C |
| Humidity | ±5% |
| DC and low frequency voltages | ±0.4% |
| Duty Cycle | 1% |

2. SUMMARY OF TEST RESULTS

| Standard/Rule(s) | Description of Test | Results |
|------------------------------|---------------------------------------|-----------|
| §2.1055; §90.213 | Frequency Stability | Compliant |
| §2.1046; §90.205 | RF Output Power | Compliant |
| §2.1049; §90.209; §90.210 | Occupied Bandwidth & Emission Mask | Compliant |
| §2.1051; §90.210 | Spurious Emission at Antenna Terminal | Compliant |
| §2.1053; §90.210 | Spurious Radiated Emissions | Compliant |
| §90.214 | Transient Frequency Behavior | Compliant |
| §2.1047 | Modulation Characteristic | Compliant |

3. REQUIREMENTS AND TEST PROCEDURES

3.1 Transmitter Frequency Stability

3.1.1 Applicable Standard

FCC §90.213

In the 150-174 MHz band, fixed and base stations with a 12.5 kHz channel bandwidth must have a frequency stability of 2.5 ppm. Fixed and base stations with a 6.25 kHz channel bandwidth must have a frequency stability of 1.0 ppm.

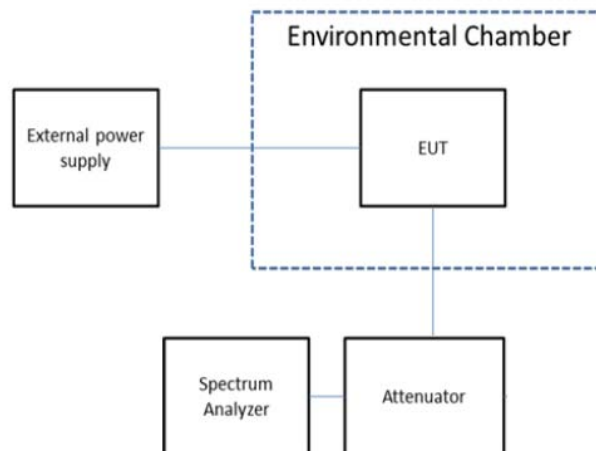
In the 421-512 MHz band, mobile stations designed to operate with a 12.5 kHz channel bandwidth must have a frequency stability of 2.5 ppm. Mobile stations designed to operate with a 6.25 kHz channel bandwidth must have a frequency stability of 1.0 ppm.

3.1.2 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.

3.1.3 EUT Setup Block Diagram



3.2 Transmitter Output Power

3.2.1 Applicable Standard

FCC §90.205

(h) 450-470 MHz.

(1) The maximum allowable station effective radiated power (ERP) is dependent upon the station's antenna HAAT and required service area and will be authorized in accordance with table 2.

Applicants requesting an ERP in excess of that listed in table 2 must submit an engineering analysis based upon generally accepted engineering practices and standards that includes coverage contours to demonstrate that the requested station parameters will not produce coverage in excess of that which the applicant requires.

(2) Applications for stations where special circumstances exist that make it necessary to deviate from the ERP and antenna heights in Table 2 will be submitted to the frequency coordinator accompanied by a technical analysis, based upon generally accepted engineering practices and standards, that demonstrates that the requested station parameters will not produce a signal strength in excess of 39 dBu at any point along the edge of the requested service area. The coordinator may then recommend any ERP appropriate to meet this condition.

(3) An applicant for a station with a service area radius greater than 32 km (20 mi) must justify the requested service area radius, which may be authorized only in accordance with table 2, note 4. For base stations with service areas greater than 80 km, all operations 80 km or less from the base station will be on a primary basis and all operations outside of 80 km from the base station will be on a secondary basis and will be entitled to no protection from primary operations.

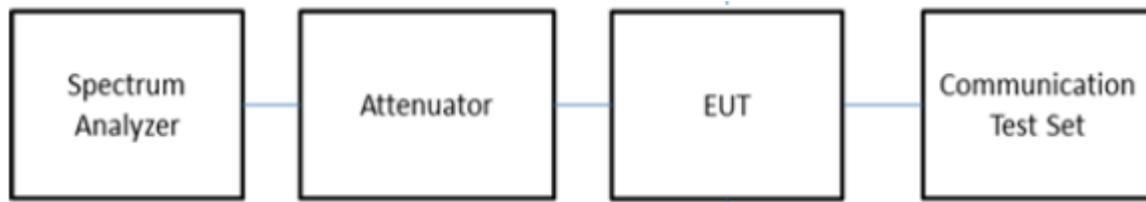
3.2.2 Test Procedure

Before performing this measurement, the power of the EUT shall be set or controlled to the maximum rating of the range for which equipment certification or verification is sought.

Except where otherwise specified, tests shall be performed at the ambient temperature, at the manufacturer's rated supply voltage, and with the transmitter modulating signal representative (i.e. typical) of those encountered in a real system operation.

The spectrum analyzer shall be configured with a resolution bandwidth that encompasses the entire occupied bandwidth (see section 6.7) of the EUT. If the spectrum analyzer's largest available resolution bandwidth is smaller than the occupied bandwidth of the EUT, it is permitted to use a narrower resolution bandwidth plus numerical integration, in linear power terms, over the occupied bandwidth of the transmitter in order to measure its output power, except when the emission is a wideband noise-like signal and being measured for peak power. For transmitters with constant envelope modulation, RF output power and field strength measurements performed on the fundamental frequency can be carried out with an unmodulated carrier. The method used shall be described in the test report.

3.2.3 EUT Setup Block Diagram



Note: the Insertion loss 40.2dB was offset into the Spectrum.

3.3 Occupied Bandwidth & Emission Mask

3.3.1 Applicable Standard

FCC §90.209

(a) Each authorization issued to a station licensed under this part will show an emission designator representing the class of emission authorized. The designator will be prefixed by a specified necessary bandwidth. This number does not necessarily indicate the bandwidth occupied by the emission at any instant. In those cases where §2.202 of this chapter does not provide a formula for the computation of necessary bandwidth, the occupied bandwidth, as defined in part 2 of this chapter, may be used in lieu of the necessary bandwidth.

(b) (5) Unless specified elsewhere, channel spacings and bandwidths that will be authorized in the following frequency bands are given in the following table: STANDARD CHANNEL SPACING/BANDWIDTH

FCC §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) On any frequency from the center of the authorized bandwidth f_0 to 5.625 kHz removed from f_0 : Zero dB.
- (2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 5.625 kHz but no more than 12.5 kHz: At least $7.27(f_d - 2.88 \text{ kHz})$ dB.
- (3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 12.5 kHz: At least $50 + 10 \log(P)$ dB or 70 dB, whichever is the lesser attenuation.
- (4) The reference level for showing compliance with the emission mask shall be established using a resolution bandwidth sufficiently wide (usually two or three times the channel bandwidth) to capture the true peak emission of the equipment under test. In order to show compliance with the emission mask up to and including 50 kHz removed from the edge of the authorized bandwidth, adjust the resolution bandwidth to 100 Hz with the measuring instrument in a peak hold mode. A sufficient number of sweeps must be measured to insure that the emission profile is developed. If video filtering is used, its bandwidth must not be less than the instrument resolution bandwidth. For emissions beyond 50 kHz from the edge of the authorized bandwidth, see paragraph (o) of this section. If it can be shown that use of the above instrumentation settings do not accurately represent the true interference potential of the equipment under test, an alternate procedure may be used provided prior Commission approval is obtained.

3.3.2 Test Procedure

The occupied bandwidth or the “99% emission bandwidth” is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total

transmitted power of the fundamental transmitted emission is contained. The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs.

In some cases, the “x dB bandwidth” is required, which is defined as the frequency range between two points, one at the lowest frequency below and one at the highest frequency above the carrier frequency, at which the maximum power level of the transmitted emission is attenuated x dB below the maximum in-band power level of the modulated signal, where the two points are on the outskirts of the in-band emission.

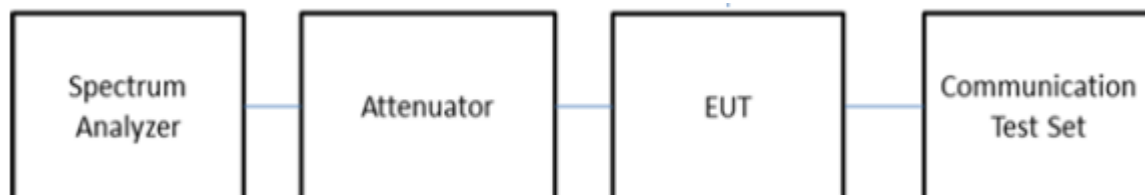
The following conditions shall be observed for measuring the occupied bandwidth and x dB bandwidth:

- The transmitter shall be operated at its maximum carrier power measured under normal test conditions.
- The span of the spectrum analyzer shall be set large enough to capture all products of the modulation process, including the emission skirts, around the carrier frequency, but small enough to avoid having other emissions (e.g. on adjacent channels) within the span.
- The detector of the spectrum analyzer shall be set to “Sample”. However, a peak, or peak hold, may be used in place of the sampling detector since this usually produces a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold (or “Max Hold”) may be necessary to determine the occupied / x dB bandwidth if the device is not transmitting continuously.
- The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the actual occupied / x dB bandwidth and the video bandwidth (VBW) shall not be smaller than three times the RBW value. Video averaging is not permitted.

Note: It may be necessary to repeat the measurement a few times until the RBW and VBW are in compliance with the above requirement.

For the 99% emission bandwidth, the trace data points are recovered and directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached, and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded. The difference between the two recorded frequencies is the occupied bandwidth (or the 99% emission bandwidth).

3.3.3 EUT Setup Block Diagram



Note: the Insertion loss 30.2dB was offset into the Spectrum.

3.4 Transmitter Unwanted Emissions(Conducted)

3.4.1 Applicable Standard

FCC §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:

- (5) On any frequency from the center of the authorized bandwidth f_0 to 5.625 kHz removed from f_0 : Zero dB.
- (6) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 5.625 kHz but no more than 12.5 kHz: At least $7.27(f_d - 2.88 \text{ kHz})$ dB.
- (7) 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.
- (8) The reference level for showing compliance with the emission mask shall be established using a resolution bandwidth sufficiently wide (usually two or three times the channel bandwidth) to capture the true peak emission of the equipment under test. In order to show compliance with the emission mask up to and including 50 kHz removed from the edge of the authorized bandwidth, adjust the resolution bandwidth to 100 Hz with the measuring instrument in a peak hold mode. A sufficient number of sweeps must be measured to insure that the emission profile is developed. If video filtering is used, its bandwidth must not be less than the instrument resolution bandwidth. For emissions beyond 50 kHz from the edge of the authorized bandwidth, see paragraph (o) of this section. If it can be shown that use of the above instrumentation settings do not accurately represent the true interference potential of the equipment under test, an alternate procedure may be used provided prior Commission approval is obtained.

3.4.2 Test Procedure

In order to show compliance with the emission mask up to and including 50 kHz removed from the edge of the authorized bandwidth, adjust the resolution bandwidth to 100 Hz with the measuring instrument in a peak mode. For emissions beyond 50 kHz from the edge of the authorized bandwidth, the resolution bandwidth shall be 100 kHz for frequencies at or below 1 GHz, and 1 MHz for frequencies above 1 GHz. However, for emission mask F, at a displacement frequency of less than 3.75 kHz, the resolution bandwidth shall be 30 Hz.

In measuring unwanted emissions, the spectrum shall be investigated from 30 MHz or the lowest radio frequency signal generated or used in the equipment, whichever is lower, without going below 9 kHz, up to at least the applicable frequency given below:

- (a) If the equipment operates below 10 GHz: to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.
- (b) If the equipment operates at or above 10 GHz and below 30 GHz: to the fifth harmonic of the

highest fundamental frequency or to 100 GHz, whichever is lower.

(c) If the equipment operates at or above 30 GHz: to the fifth harmonic of the highest fundamental frequency or to 200 GHz, whichever is lower, unless specified otherwise in the applicable RSS.

(d) If the equipment contains a digital device that is exclusively used for enabling the operation of the radio apparatus: the spectrum shall be investigated according to the conditions specified in paragraphs (a) through (c) of this section or the range applicable to the digital device, as shown in table 2, whichever is the higher frequency range of investigation.

Table 2 – Frequency range for radiated measurement for equipment with a digital device

| Highest frequency generated, operated or used in the equipment (MHz) | Upper frequency limit of measurement range (MHz) |
|--|---|
| < 1.705 | 30 |
| 1.705-108 | 1000 |
| 108-500 | 2000 |
| 500-1000 | 5000 |
| > 1000 | 5 th harmonic of the highest frequency or 40 GHz, whichever is lower |

It is not necessary to report the amplitude of spurious emissions attenuated more than 20 dB below the permissible value

3.4.3 EUT Setup Block Diagram



Note: the Insertion loss 30.2dB was offset into the Spectrum.

3.5 Transmitter Unwanted Emissions(Radiated)

3.5.1 Applicable Standard

FCC §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:

- (9) On any frequency from the center of the authorized bandwidth f_0 to 5.625 kHz removed from f_0 : Zero dB.
- (10) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 5.625 kHz but no more than 12.5 kHz: At least $7.27(f_d - 2.88 \text{ kHz})$ dB.
- (11) 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.
- (12) The reference level for showing compliance with the emission mask shall be established using a resolution bandwidth sufficiently wide (usually two or three times the channel bandwidth) to capture the true peak emission of the equipment under test. In order to show compliance with the emission mask up to and including 50 kHz removed from the edge of the authorized bandwidth, adjust the resolution bandwidth to 100 Hz with the measuring instrument in a peak hold mode. A sufficient number of sweeps must be measured to insure that the emission profile is developed. If video filtering is used, its bandwidth must not be less than the instrument resolution bandwidth. For emissions beyond 50 kHz from the edge of the authorized bandwidth, see paragraph (o) of this section. If it can be shown that use of the above instrumentation settings do not accurately represent the true interference potential of the equipment under test, an alternate procedure may be used provided prior Commission approval is obtained.

3.5.2 Test Procedure

In measuring unwanted emissions, the spectrum shall be investigated from 30 MHz or the lowest radio frequency signal generated or used in the equipment, whichever is lower, without going below 9 kHz, up to at least the applicable frequency given below:

- (a) If the equipment operates below 10 GHz: to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.
- (b) If the equipment operates at or above 10 GHz and below 30 GHz: to the fifth harmonic of the highest fundamental frequency or to 100 GHz, whichever is lower.
- (c) If the equipment operates at or above 30 GHz: to the fifth harmonic of the highest fundamental frequency or to 200 GHz, whichever is lower, unless specified otherwise in the applicable RSS.
- (d) If the equipment contains a digital device that is exclusively used for enabling the operation of the radio apparatus: the spectrum shall be investigated according to the conditions specified in paragraphs

(a) through (c) of this section or the range applicable to the digital device, as shown in table 2, whichever is the higher frequency range of investigation.

Table 2 – Frequency range for radiated measurement for equipment with a digital device

| Highest frequency generated, operated or used in the equipment (MHz) | Upper frequency limit of measurement range (MHz) |
|--|---|
| < 1.705 | 30 |
| 1.705-108 | 1000 |
| 108-500 | 2000 |
| 500-1000 | 5000 |
| > 1000 | 5 th harmonic of the highest frequency or 40 GHz, whichever is lower |

It is not necessary to report the amplitude of spurious emissions attenuated more than 20 dB below the permissible value

3.6 Transient Frequency Behavior

3.6.1 Applicable Standard

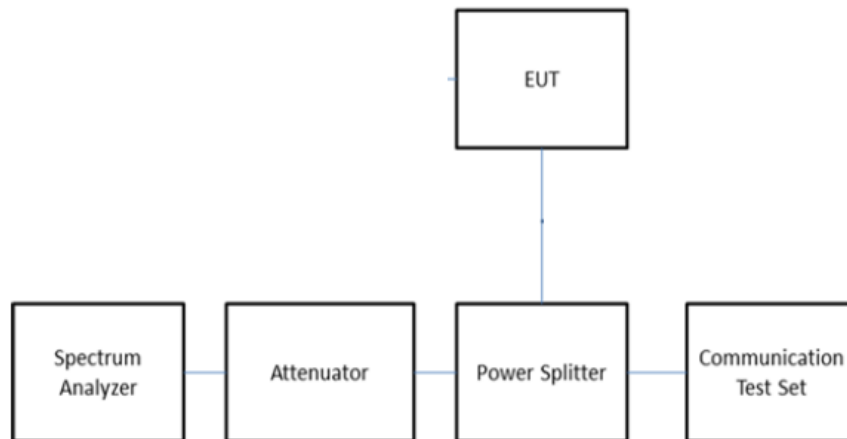
FCC §90.214

Transmitters designed to operate in the 150-174 MHz and 421-512 MHz frequency bands must maintain transient frequencies within the maximum frequency difference limits during the time intervals indicated:

| Time intervals ^{1 2} | Maximum frequency difference ³ | All equipment | |
|---|---|----------------|----------------|
| | | 150 to 174 MHz | 421 to 512 MHz |
| Transient Frequency Behavior for Equipment Designed to Operate on 12.5 kHz Channels | | | |
| t_1 ⁴ | ± 12.5 kHz | 5.0 ms | 10.0 ms |
| t_2 | ± 6.25 kHz | 20.0 ms | 25.0 ms |
| t_3 ⁴ | ± 12.5 kHz | 5.0 ms | 10.0 ms |

3.6.2 Test Procedure

TIA-603-E Clause 2.2.19



- a) Connect the equipment as illustrated.
- b) Connect the output of the standard transmitter load to the RF power meter. Supply sufficient attenuation via the RF attenuator to provide a level that is approximately 40 dB below the maximum allowable input to the modulation domain analyzer.
- c) Unkey the transmitter.
- d) Disconnect the RF power meter and connect the modulation domain analyzer in its place. Set the envelope trigger of the modulation domain analyzer to the minimum level that will trigger when the transmitter is keyed.
- e) Reduce the attenuation of the RF attenuator so that the input to the modulation domain analyzer is increased by 30 dB when the transmitter is keyed.
- f) Set the modulation domain analyzer to trigger on the rising edge of the waveform in order to capture a single-shot turn-on of the transmitter signal.
- g) Adjust the display of the modulation domain analyzer for proper viewing of the transmitter transient behavior. Set the timebase reference to the left for observing the transmitter turn-on transient.
- h) Key the transmitter.
- i) Observe the stored display of the modulation domain analyzer. The signal trace shall be maintained within the allowable limits during the periods t_1 and t_2 , and shall also remain within

limits following t_2 .

- j) Adjust the modulation domain analyzer to trigger on the falling edge of the transmitter waveform in order to capture a single-shot turn-off transient of the transmitter signal.
- k) Adjust the display of the modulation domain analyzer for proper viewing of the transmitter transient behavior. Set the timebase reference to the right for observing the transmitter turn-off transient.
- l) Unkey the transmitter.
- m) Observe the stored display of the modulation domain analyzer. The signal trace shall be maintained within the allowable limits during the period t_3 .

3.7 Modulation characteristics.

3.7.1 Applicable Standard

FCC §2.1047

- (a) Voice modulated communication equipment. A curve or equivalent data showing the frequency response of the audio modulating circuit over a range of 100 to 5000 Hz shall be submitted. For equipment required to have an audio low-pass filter, a curve showing the frequency response of the filter, or of all circuitry installed between the modulation limiter and the modulated stage shall be submitted.
- (b) Equipment which employs modulation limiting. A curve or family of curves showing the percentage of modulation versus the modulation input voltage shall be supplied. The information submitted shall be sufficient to show modulation limiting capability throughout the range of modulating frequencies and input modulating signal levels employed.
- (c) Single sideband and independent sideband radiotelephone transmitters which employ a device or circuit to limit peak envelope power. A curve showing the peak envelope power output versus the modulation input voltage shall be supplied. The modulating signals shall be the same in frequency as specified in paragraph (c) of §2.1049 for the occupied bandwidth tests.
- (d) Other types of equipment. A curve or equivalent data which shows that the equipment will meet the modulation requirements of the rules under which the equipment is to be licensed.

3.7.2 Test Procedure

C63.26-2015, Clause 5.3.2 Modulation limiting test methodology

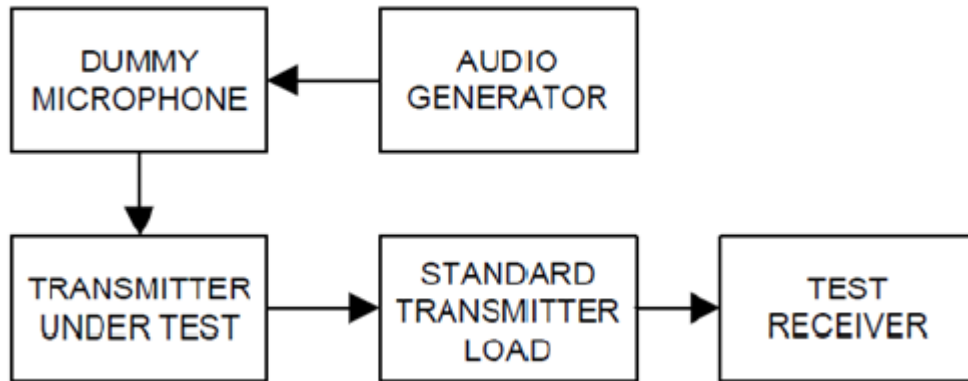
Modulation limiting is the ability of a transmitter circuit to limit the transmitter from producing deviations in excess of a rated system deviation.

- a) Connect the equipment as illustrated in Figure 1.
- b) Adjust the transmitter per the manufacturer's procedure for full rated system deviation.
- c) Set the test receiver to measure peak positive deviation. Set the audio bandwidth for ≤ 0.25 Hz to ≥ 15000 Hz. Turn the de-emphasis function off.
- d) Apply a 1000 Hz modulating signal to the transmitter from the audio frequency generator, and adjust the level to obtain 60% of full rated system deviation. This is the 0 dB reference level.
- e) Increase the level from the audio generator by 20 dB in 5 dB increments recording the deviation as measured from the test receiver in each step. Verify that the audio level used to make the OBW measurement is included in the sweep.
- f) Repeat for step e) at 300 Hz, 2500 Hz and 3000 Hz at a minimum using the 0 dB reference level obtained in step d).
- g) Set the test receiver to measure peak negative deviation and repeat step d) through step f).
- h) The values recorded in step f) and step g) are the modulation limiting.
- i) Plot the data set as a percentage of deviation relative to the 0 dB reference point versus input voltage.

C63.26-2015, Clause 5.3.3.2 Audio frequency response test methodology—Constant Input

- a) Connect the equipment as illustrated in Figure 3.
- b) Set the test receiver to measure peak positive deviation. Set the audio bandwidth for ≤ 50 Hz to ≥ 15000 Hz. Turn the de-emphasis function off.
- c) Adjust the transmitter per the manufacturer's procedure for full rated system deviation.
- d) Apply a 1000 Hz tone and adjust the audio frequency generator to produce 20% of the rated system deviation.
- e) Set the test receiver to measure rms deviation and record the deviation reading as DEVREF.
- f) Set the audio frequency generator to the desired test frequency between 300 Hz and 3000 Hz.

3.7.3 EUT Setup Block Diagram



4. Test DATA AND RESULTS

4.1 Transmitter Frequency Stability

| | | | |
|----------------|---------------|--------------|--------------|
| Serial Number: | CR21110034-RF | Test Date: | 2022-02-26 |
| Test Site: | RF | Test Mode: | Transmitting |
| Tester: | Rinka Li | Test Result: | Pass |

Environmental Conditions:

| | | | | | |
|----------------------|----|------------------------------|----|------------------------|-------|
| Temperature: (°C) | 26 | Relative Humidity: (%) | 51 | ATM Pressure: (kPa) | 101.8 |
|----------------------|----|------------------------------|----|------------------------|-------|

Test Equipment List and Details:

| Manufacturer | Description | Model | Serial Number | Calibration Date | Calibration Due Date |
|--------------|------------------------|----------|---------------|------------------|----------------------|
| zhuoxiang | Coaxial Cable | SMA-178 | 211002 | Each time | N/A |
| YINSAIGE | Coaxial Cable | SS402 | SJ0100003 | Each time | N/A |
| Weinschel | Coaxial Attenuators | 53-20-34 | LN751 | Each time | N/A |
| R&S | Signal Analyzer | FSIQ26 | 831929/006 | 2021-07-15 | 2022-07-14 |
| BACL | TEMP&HUMI Test Chamber | BTH-150 | 30026 | 2021-07-22 | 2022-07-21 |
| UNI-T | Multimeter | UT39A+ | C210582554 | 2021-09-30 | 2022-09-29 |

* Statement of Traceability: China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Data:

| Un-modulation, 12.5kHz, $f_c = 453.2125$ MHz, | | | | |
|---|-----------------|-------------|-----------------|-------|
| Temperature | Voltage | Measured | Frequency Error | Limit |
| °C | V _{AC} | MHz | ppm | ppm |
| -30 | 120 | 453.2127716 | 0.60 | 1.5 |
| -20 | | 453.2127716 | 0.60 | |
| -10 | | 453.2127717 | 0.60 | |
| 0 | | 453.2127711 | 0.60 | |
| 10 | | 453.2127756 | 0.61 | |
| 20 | | 453.2127717 | 0.60 | |
| 30 | | 453.2127714 | 0.60 | |
| 40 | | 453.2127717 | 0.60 | |
| 50 | | 453.2127752 | 0.61 | |
| 20 | | 138 | 453.2127723 | |
| 20 | 102 | 453.2127775 | 0.61 | |

4.2 Transmitter Output Power

| | | | |
|----------------|---------------|--------------|--------------|
| Serial Number: | CR21110034-RF | Test Date: | 2022-01-04 |
| Test Site: | RF | Test Mode: | Transmitting |
| Tester: | Rinka Li | Test Result: | Pass |

Environmental Conditions:

| | | | | | |
|----------------------|----|------------------------------|----|----------------------|-------|
| Temperature: (°C) | 26 | Relative Humidity: (%) | 51 | Temperature: (°C) | 101.8 |
|----------------------|----|------------------------------|----|----------------------|-------|

Test Equipment List and Details:

| Manufacturer | Description | Model | Serial Number | Calibration Date | Calibration Due Date |
|--------------|----------------------------|----------|---------------|------------------|----------------------|
| R&S | Spectrum Analyzer | FSU26 | 200256 | 2021-07-22 | 2022-07-21 |
| zhuoxiang | Coaxial Cable | SMA-178 | 211002 | Each time | N/A |
| Weinschel | Coaxial Attenuators | 53-20-34 | LN751 | Each time | N/A |
| Weinschel | Coaxial Attenuators | 53-20-34 | LN765 | Each time | N/A |
| HP | RF Communications Test Set | 8920A | 3438A05209 | 2021-07-22 | 2022-07-21 |

* Statement of Traceability: China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Data:

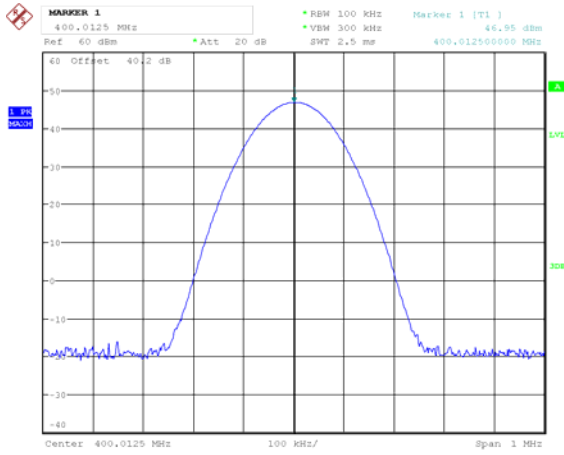
| Channel Separation | Test Modulation | Test Channel | Test Frequency (MHz) | Conducted Output Power (dBm) | | Limit (dBm) | |
|--------------------|-----------------|--------------|----------------------|------------------------------|-----------------|------------------|-----------------|
| | | | | High Power Level | Low Power Level | High Power Level | Low Power Level |
| 12.5kHz | FM | Low | 400.0125 | 46.95 | 36.87 | 47.78 | 37.78 |
| | | Middle | 453.2125 | 46.77 | 36.74 | 47.78 | 37.78 |
| | | High | 469.9875 | 47.04 | 37.03 | 47.78 | 37.78 |
| | 4FSK | Low | 400.0125 | 46.95 | 36.85 | 47.78 | 37.78 |
| | | Middle | 453.2125 | 46.78 | 36.81 | 47.78 | 37.78 |
| | | High | 469.9875 | 47.02 | 37.05 | 47.78 | 37.78 |

Note: The high rated power level is 50W(47dBm), and low rated power level is 5W(37dBm).

The output power shall not exceed by more than 20 percent the manufacturer's rated output power for the particular transmitter specifically listed on the authorization.

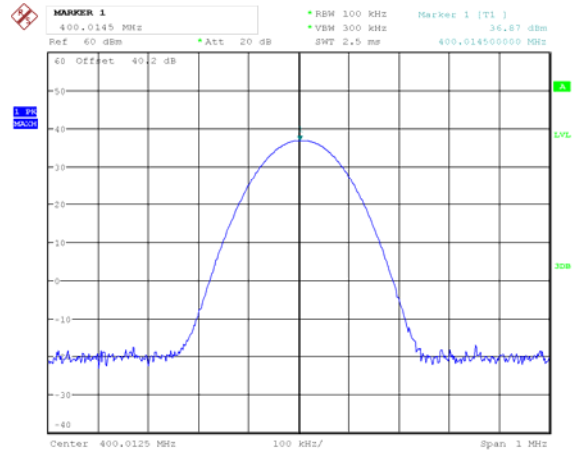
FM, 12.5kHz:

Low Channel, 400.0125 MHz High Power



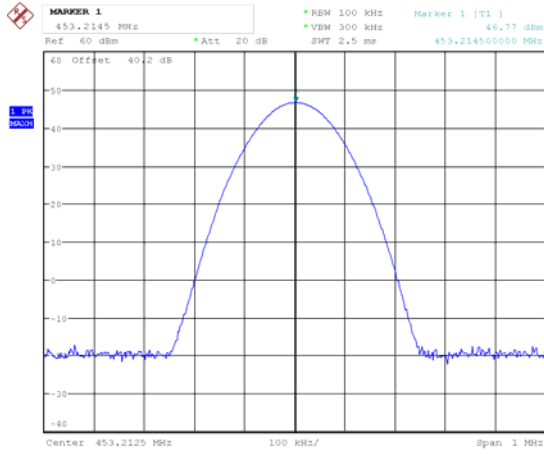
Date: 4.JAN.2022 11:16:01

Low Channel, 400.0125 MHz Low Power



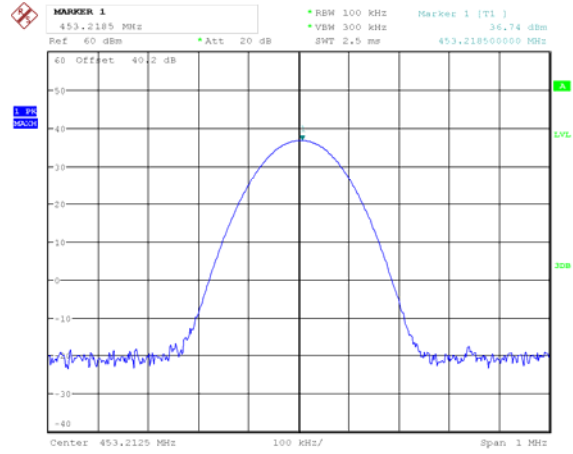
Date: 4.JAN.2022 11:16:55

Part 90, Middle Channel, 453.2125 MHz High Power



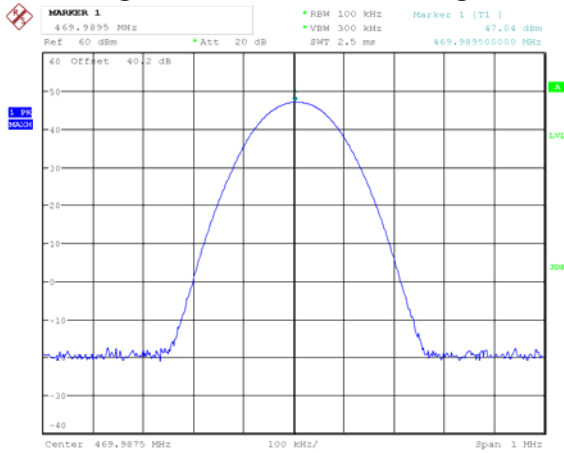
Date: 4.JAN.2022 11:17:30

Part 90, Middle Channel, 453.2125 MHz Low Power



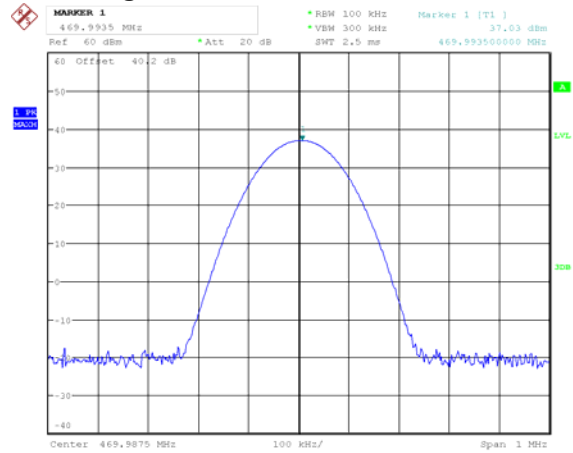
Date: 4.JAN.2022 11:18:15

High Channel, 469.9875MHz High Power



Date: 4.JAN.2022 11:18:44

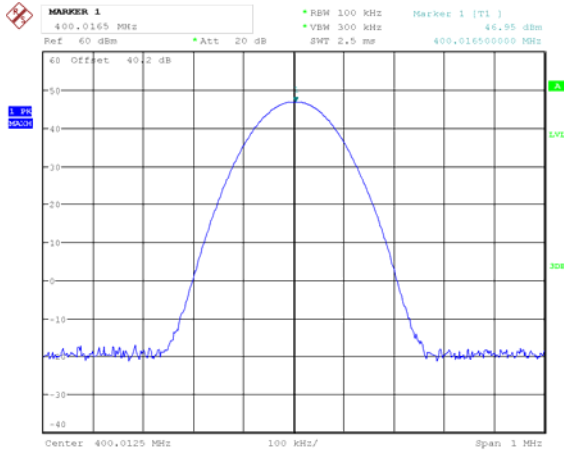
High Channel, 469.9875 MHz Low Power



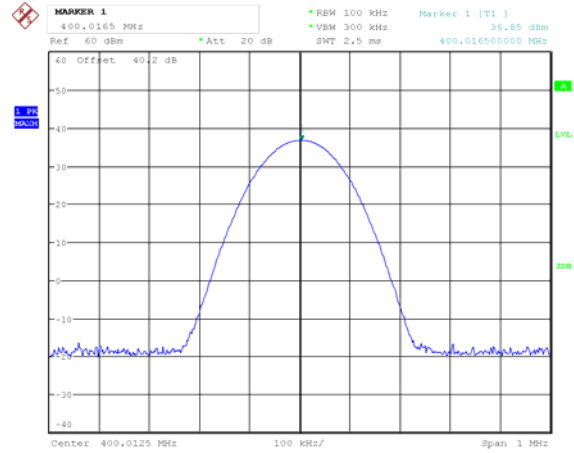
Date: 4.JAN.2022 11:19:03

4FSK, 12.5kHz:

Low Channel, 400.0125 MHz High Power



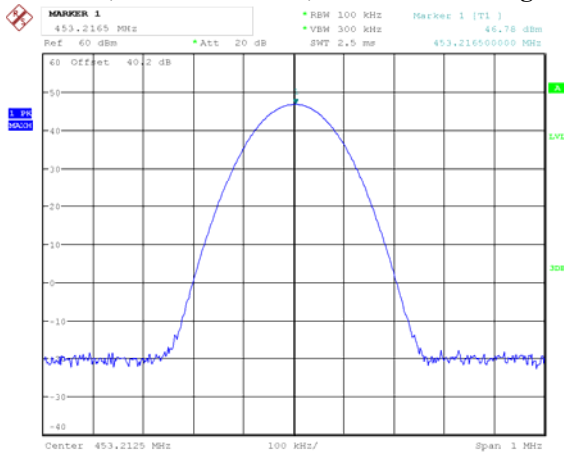
Low Channel, 400.0125 MHz Low Power



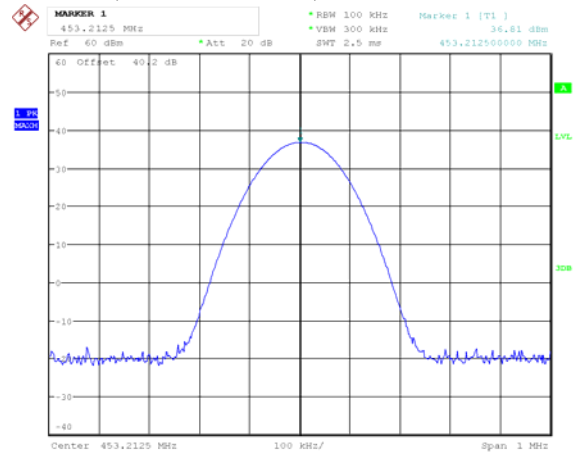
Date: 4.JAN.2022 11:02:07

Date: 4.JAN.2022 11:03:19

Part 90, Middle Channel, 453.2125 MHz High Power



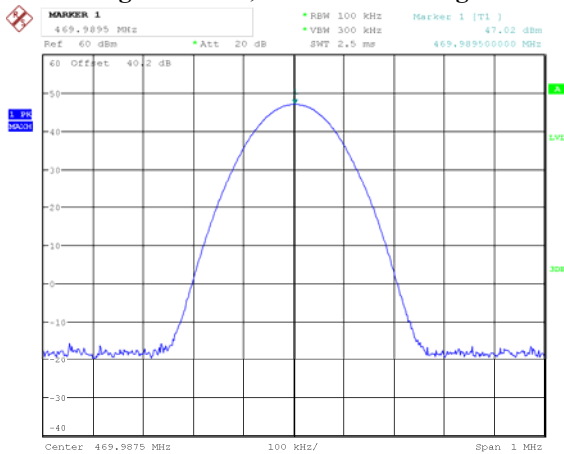
Part 90, Middle Channel, 453.2125 MHz Low Power



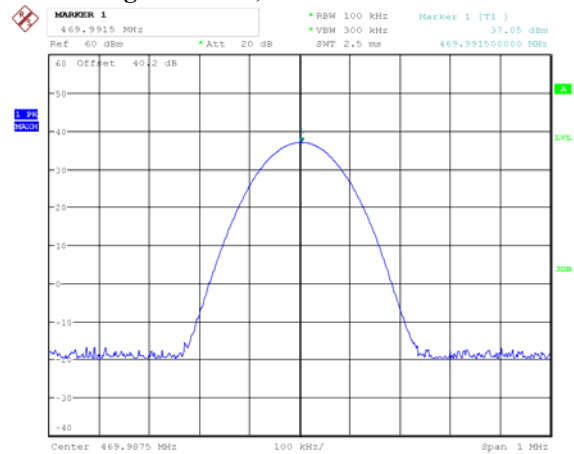
Date: 4.JAN.2022 11:03:54

Date: 4.JAN.2022 11:04:22

High Channel, 469.9875MHz High Power



High Channel, 469.9875 MHz Low Power



Date: 4.JAN.2022 11:05:54

Date: 4.JAN.2022 11:06:44

4.3 Occupied Bandwidth & Emission Mask

| | | | |
|----------------|---------------|--------------|-----------------------|
| Serial Number: | CR21110034-RF | Test Date: | 2022-02-25~2022-02-26 |
| Test Site: | RF | Test Mode: | Transmitting |
| Tester: | Rinka Li | Test Result: | Pass |

Environmental Conditions:

| | | | | | |
|----------------------|----|------------------------------|----|----------------------|-------|
| Temperature: (°C) | 26 | Relative Humidity: (%) | 51 | Temperature: (°C) | 101.8 |
|----------------------|----|------------------------------|----|----------------------|-------|

Test Equipment List and Details:

| Manufacturer | Description | Model | Serial Number | Calibration Date | Calibration Due Date |
|--------------|----------------------------|---------------|---------------|------------------|----------------------|
| R&S | Signal Analyzer | FSIQ26 | 831929/006 | 2021-07-22 | 2022-07-21 |
| zhuoxiang | Coaxial Cable | SMA-178 | 211002 | Each time | N/A |
| Weinschel | Coaxial Attenuators | 53-20-34 | LN751 | Each time | N/A |
| eastsheep | Coaxial Attenuator | 2W-SMA-JK-18G | 21060301 | Each time | N/A |
| HP | RF Communications Test Set | 8920A | 3438A05209 | 2021-07-22 | 2022-07-21 |

** Statement of Traceability: China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).*

Test Data:

| Test Mode | Test Channel | Test Frequency (MHz) | High Power Level | | Low Power Level | |
|-----------------|--------------|----------------------|------------------------------|-------------------------------|------------------------------|-------------------------------|
| | | | 99% Occupied Bandwidth (kHz) | 26dB Emission Bandwidth (kHz) | 99% Occupied Bandwidth (kHz) | 26dB Emission Bandwidth (kHz) |
| FM 12.5kHz | Low | 400.0125 | 5.17 | 10.34 | 5.17 | 10.34 |
| | Middle | 453.2125 | 5.29 | 10.34 | 5.29 | 10.34 |
| | High | 469.9875 | 5.29 | 10.34 | 5.29 | 10.34 |
| 4FSK 12.5kHz | Low | 400.0125 | 7.21 | 9.26 | 7.21 | 9.38 |
| | Middle | 453.2125 | 7.33 | 9.50 | 7.33 | 9.98 |
| | High | 469.9875 | 7.70 | 9.86 | 7.70 | 9.86 |

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

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

For FM Mode (Channel Spacing: 12.5 kHz)

Emission Designator: 11K0F3E

In this case, the maximum modulating frequency is 3.0 kHz with a 2.5 kHz deviation.

$BW = 2(M+D) = 2*(3.0 \text{ kHz} + 2.5 \text{ kHz}) = 11 \text{ kHz} = 11K0$

F3E portion of the designator represents an FM voice transmission

Therefore, the entire designator for 12.5 kHz channel spacing FM mode is 11K0F3E.

For Digital Mode (Channel Spacing: 12.5 kHz)

Emission Designator: 7K60F1D and 7K60F1E

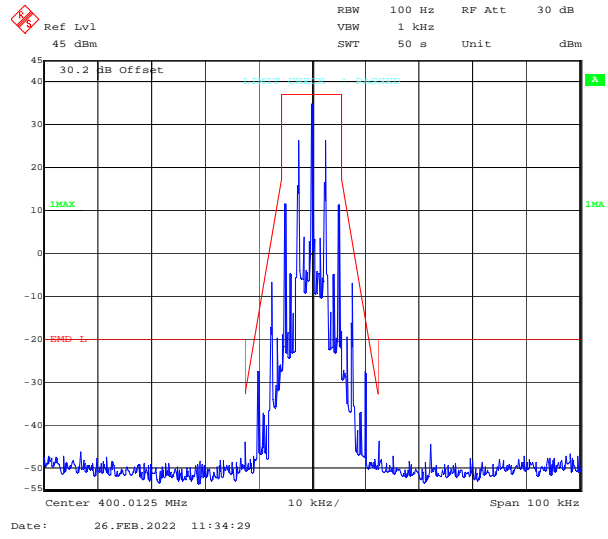
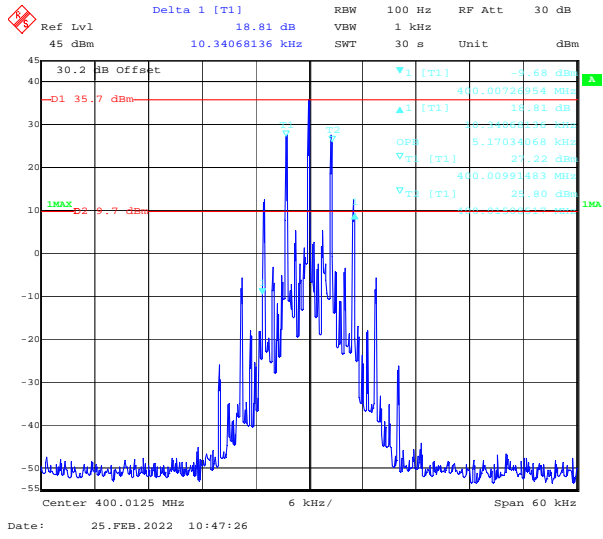
The 99% energy rule (title 47CFR 2.1049) was used for digital mode. It basically states that 99% of the modulation energy falls within X kHz, in this case, 7.60 kHz. The emission mask was obtained from 47CFR 90.210(d).

F1D and F1E portion of the designator indicates digital information.

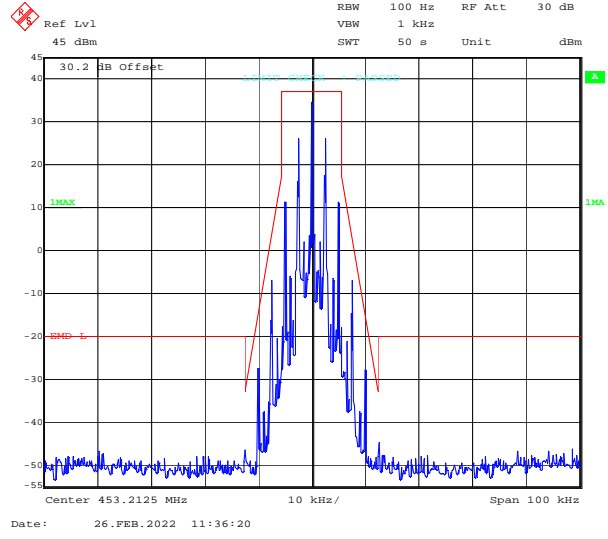
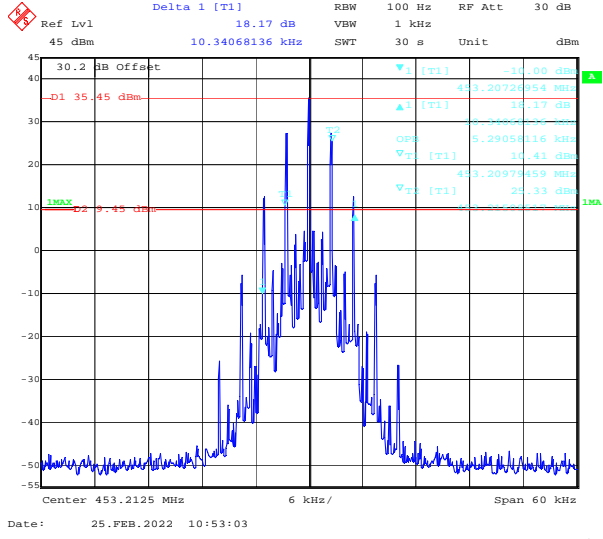
Therefore, the entire designator for 12.5 kHz channel spacing digital mode is 7K60F1D and 7K60F1E.

FM, 12.5kHz, Low Power:

Low Channel

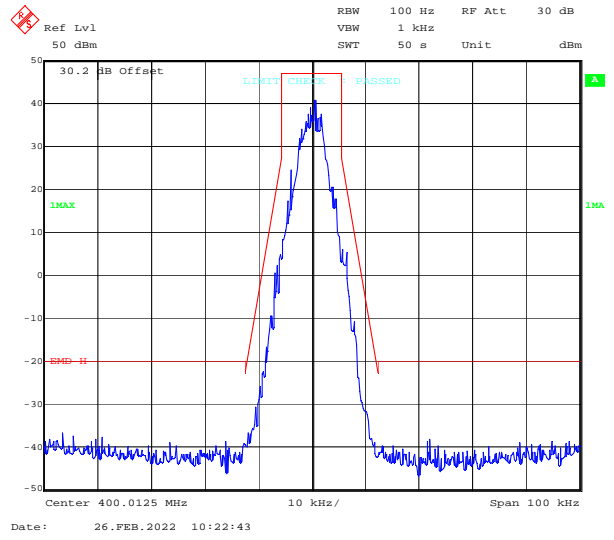
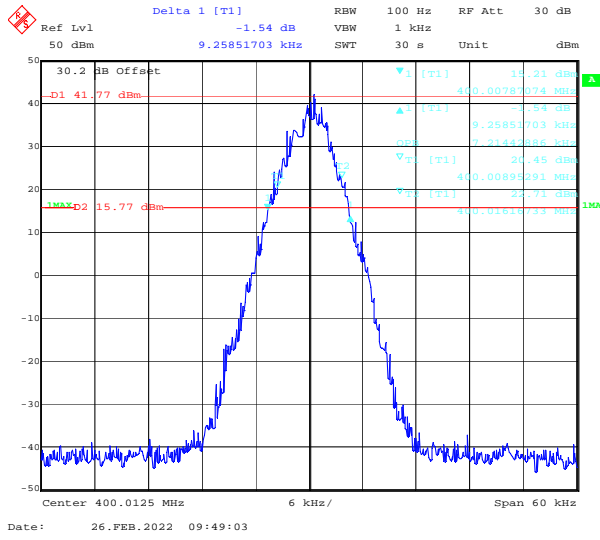


Middle Channel

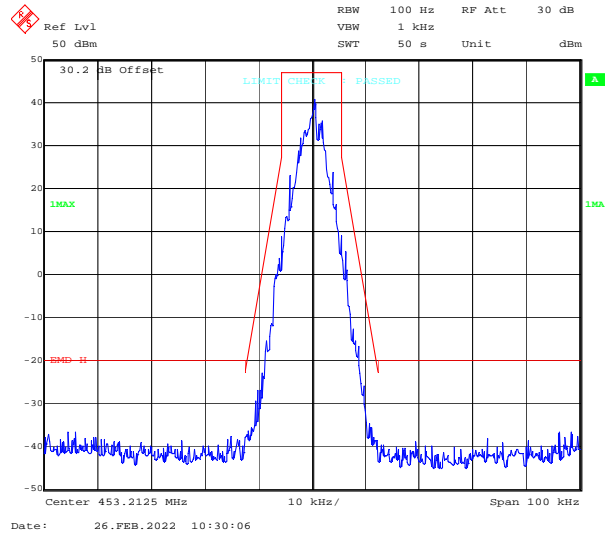
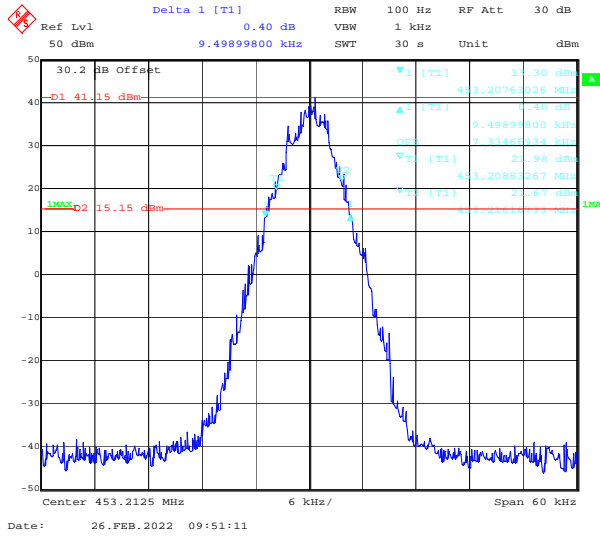


4FSK, 12.5kHz, High Power:

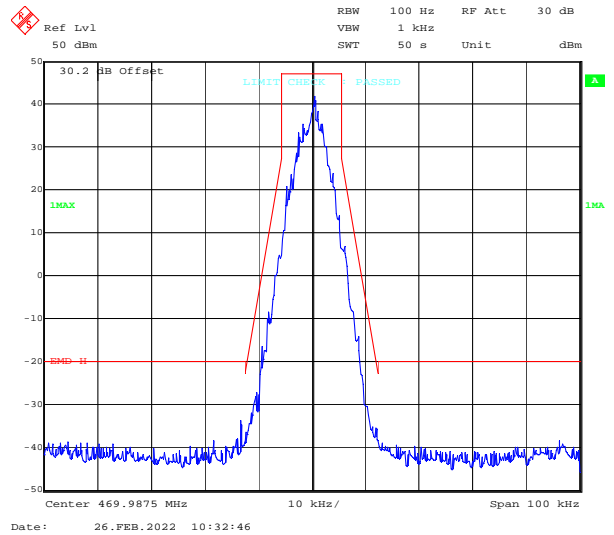
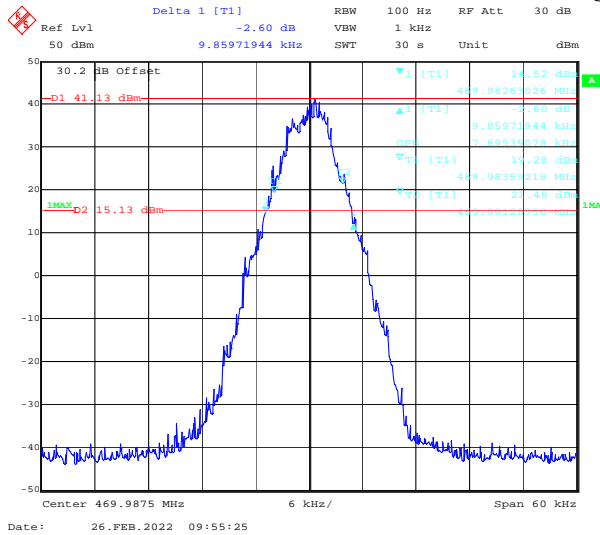
Low Channel



Middle Channel

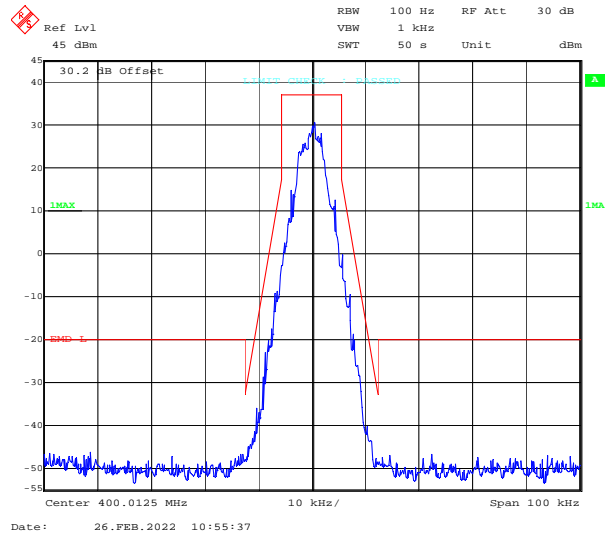
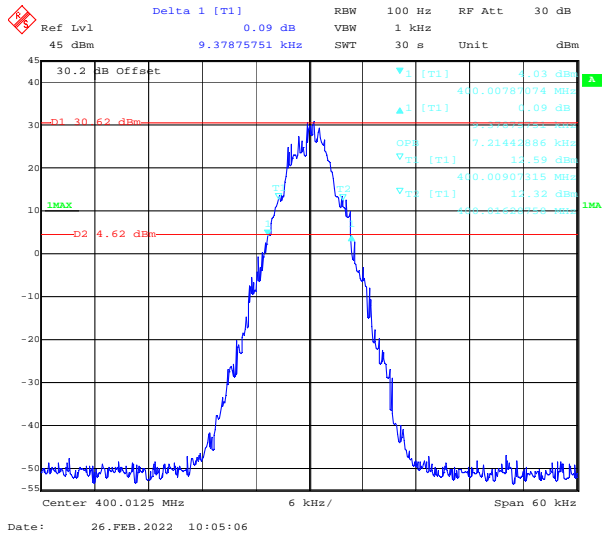


High Channel

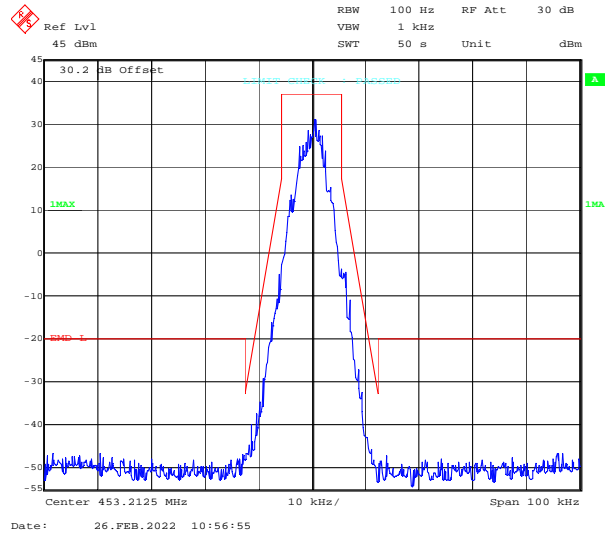
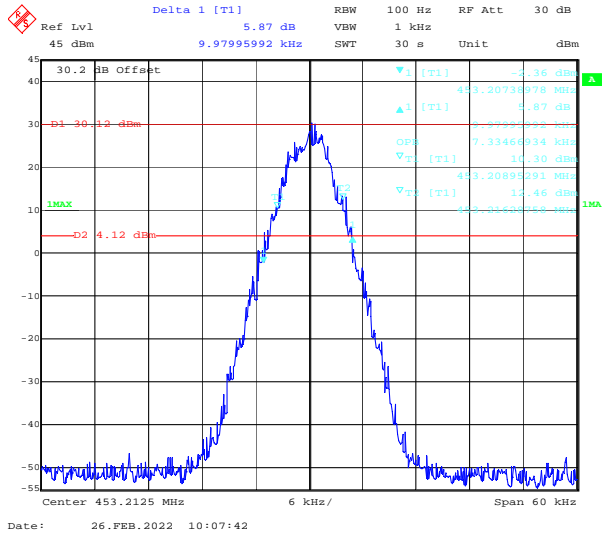


4FSK, 12.5kHz, Low Power:

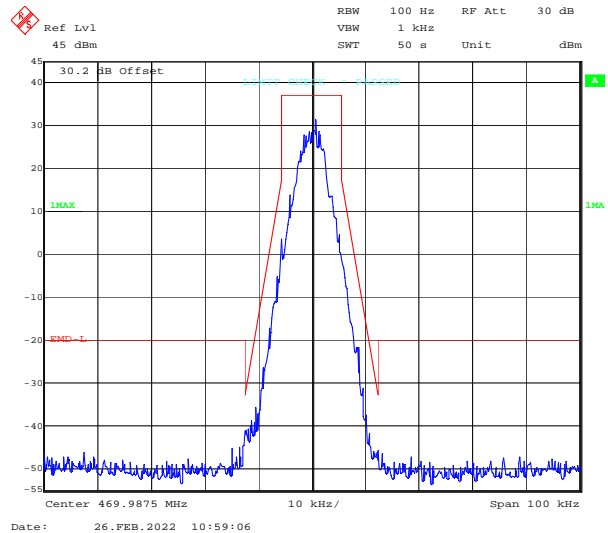
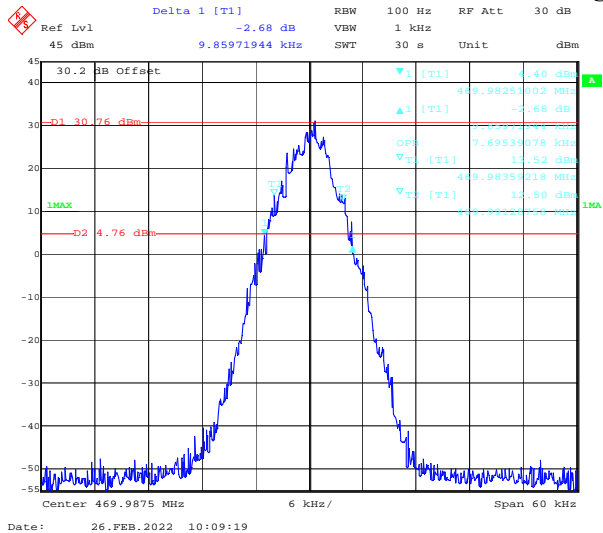
Low Channel



Middle Channel



High Channel



4.4 Transmitter Unwanted Emissions (Conducted)

| | | | |
|----------------|---------------|--------------|--------------|
| Serial Number: | CR21110034-RF | Test Date: | 2022-02-26 |
| Test Site: | RF | Test Mode: | Transmitting |
| Tester: | Rinka Li | Test Result: | Pass |

Environmental Conditions:

| | | | | | |
|----------------------|----|------------------------------|----|----------------------|-------|
| Temperature: (°C) | 26 | Relative Humidity: (%) | 51 | Temperature: (°C) | 101.8 |
|----------------------|----|------------------------------|----|----------------------|-------|

Test Equipment List and Details:

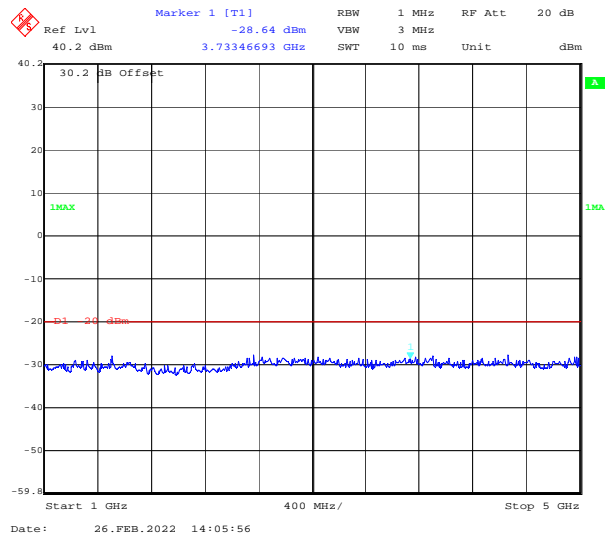
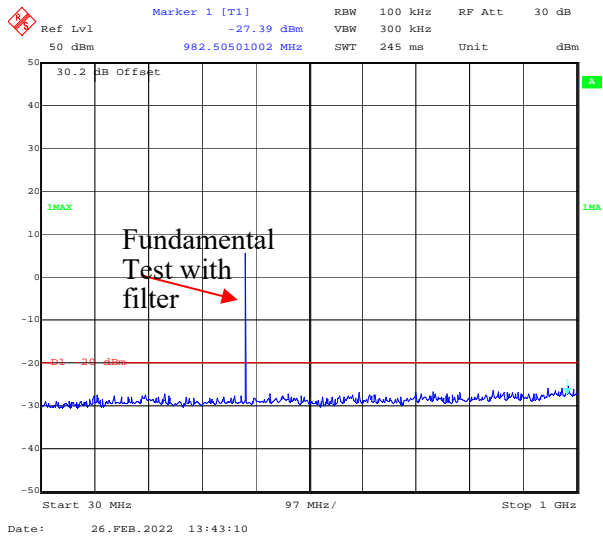
| Manufacturer | Description | Model | Serial Number | Calibration Date | Calibration Due Date |
|--------------|----------------------------|-------------------|---------------|------------------|----------------------|
| R&S | Spectrum Analyzer | FSU26 | 200256 | 2021-07-22 | 2022-07-21 |
| zhuoxiang | Coaxial Cable | SMA-178 | 211002 | Each time | N/A |
| Weinschel | Coaxial Attenuators | 53-20-34 | LN751 | Each time | N/A |
| eastsheep | Coaxial Attenuator | 2W-SMA-JK-18G | 21060301 | Each time | N/A |
| HP | RF Communications Test Set | 8920A | 3438A05209 | 2021-07-22 | 2022-07-21 |
| E-Microwave | Band Rejector Filter | OBF-ZP-400-470-NF | OE01201051 | 2022-01-23 | 2023-01-22 |

* Statement of Traceability: China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

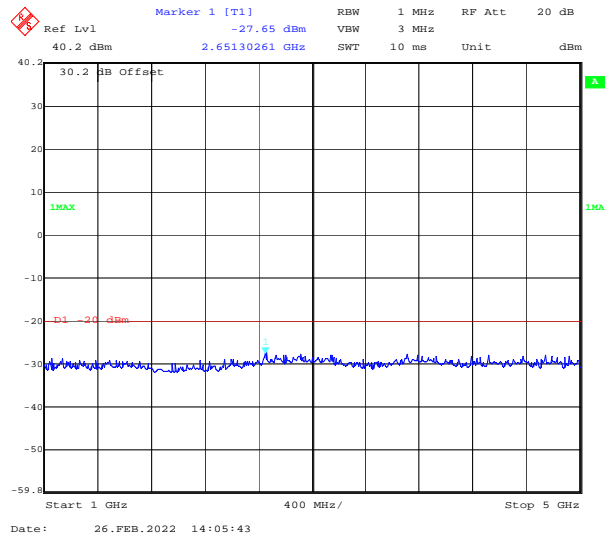
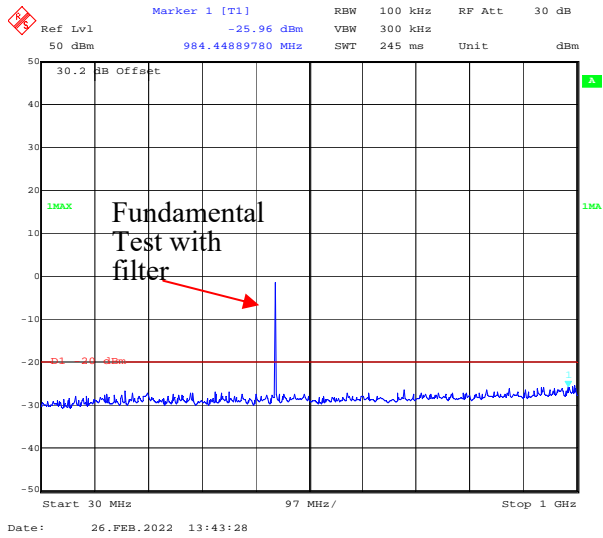
Test Data:

FM, 12.5kHz:

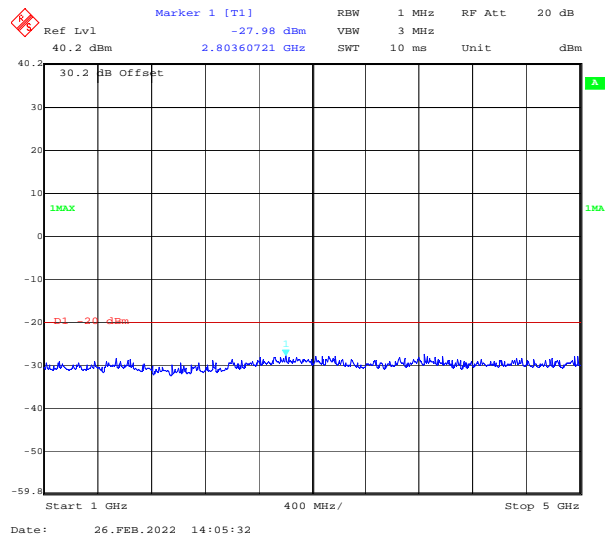
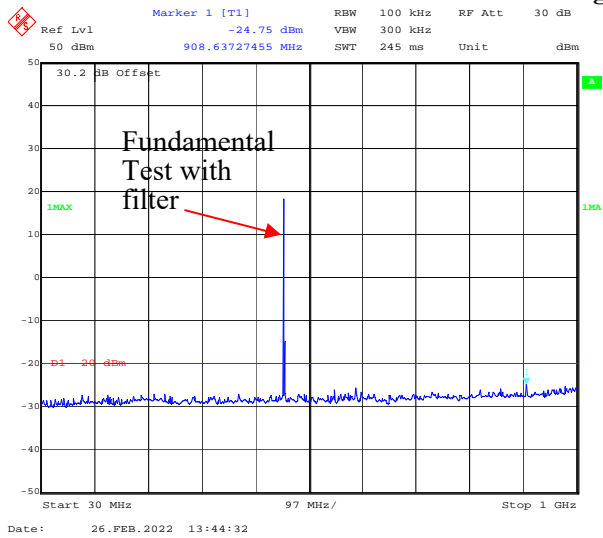
Low Channel



Middle Channel

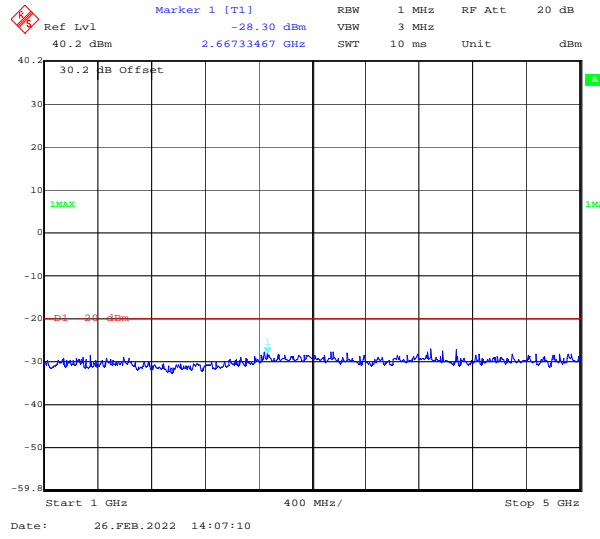
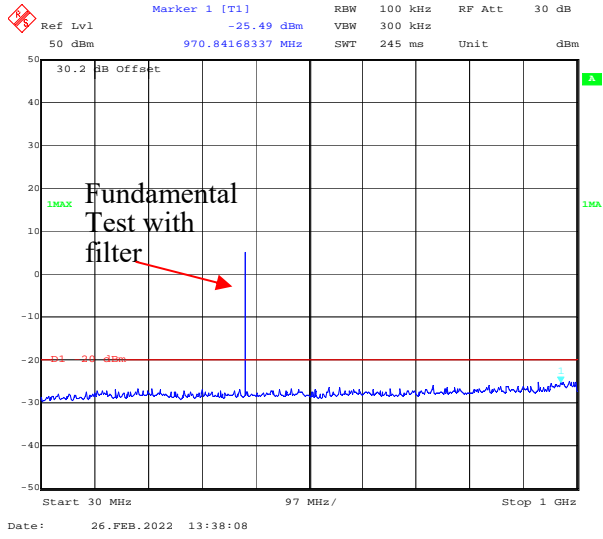


High Channel

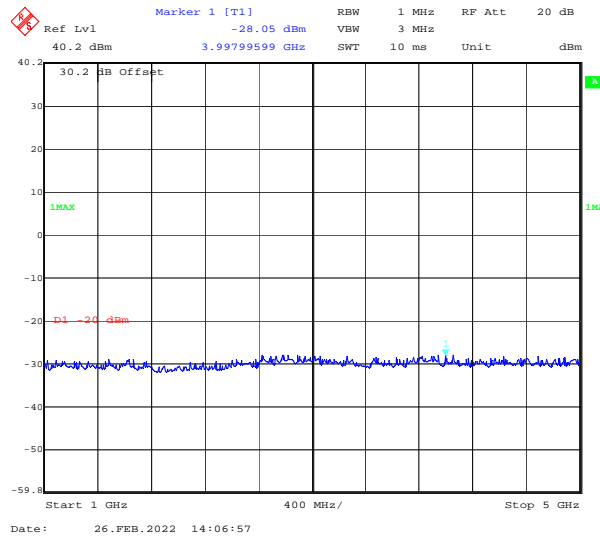
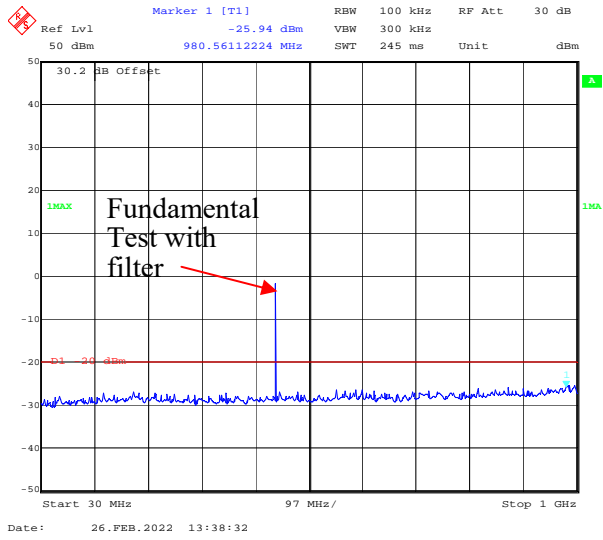


4FSK, 12.5kHz:

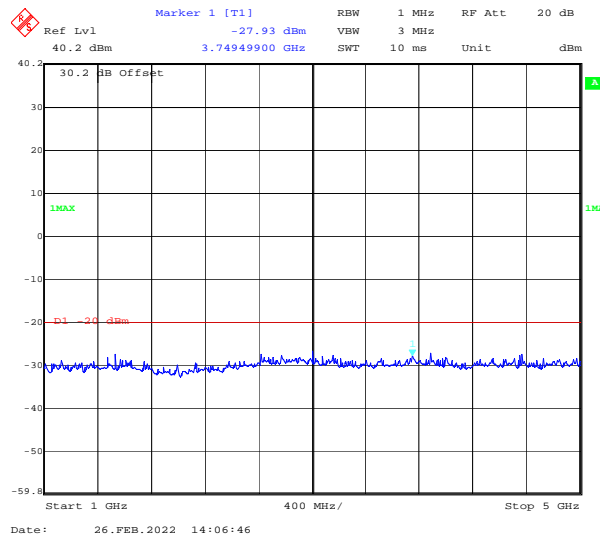
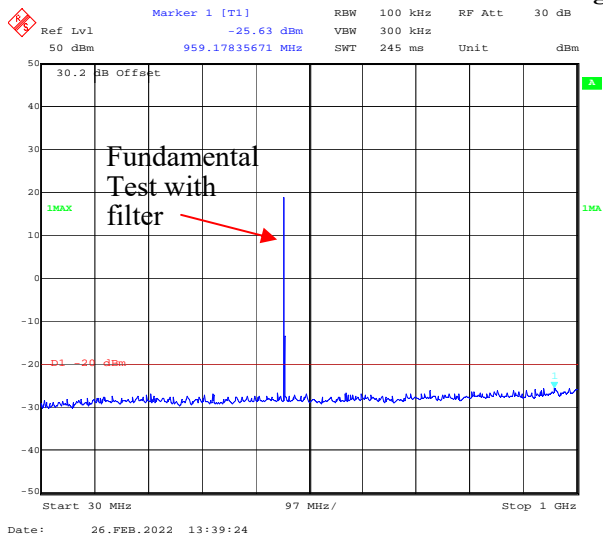
Low Channel



Middle Channel



High Channel



4.5 Transient Frequency Behavior

| | | | |
|----------------|---------------|--------------|--------------|
| Serial Number: | CR21110034-RF | Test Date: | 2022-01-28 |
| Test Site: | RF | Test Mode: | Transmitting |
| Tester: | Rinka Li | Test Result: | Pass |

Environmental Conditions:

| | | | | | |
|----------------------|----|------------------------------|----|----------------------|-------|
| Temperature: (°C) | 26 | Relative Humidity: (%) | 51 | Temperature: (°C) | 101.8 |
|----------------------|----|------------------------------|----|----------------------|-------|

Test Equipment List and Details:

| Manufacturer | Description | Model | Serial Number | Calibration Date | Calibration Due Date |
|--------------|----------------------------|---------------|---------------|------------------|----------------------|
| R&S | Signal Analyzer | FSIQ26 | 831929/006 | 2021-07-22 | 2022-07-21 |
| zhuoxiang | Coaxial Cable | SMA-178 | 211002 | Each time | N/A |
| YINSAIGE | Coaxial Cable | SS402 | SJ0100003 | Each time | N/A |
| Weinschel | Coaxial Attenuators | 53-20-34 | LN751 | Each time | N/A |
| eastsheep | Coaxial Attenuator | 2W-SMA-JK-18G | 21060301 | Each time | N/A |
| HP | RF Communications Test Set | 8920A | 3438A05209 | 2021-07-22 | 2022-07-21 |
| Weinschel | Power splitter | 1515 | RA915 | Each time | N/A |

* Statement of Traceability: China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

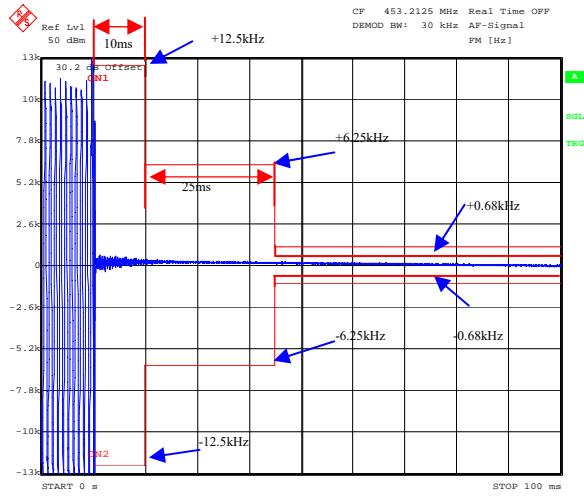
Test Data:

| Channel Spacing (kHz) | Transient Period (ms) | Transient Frequency | Result |
|-----------------------|-----------------------|---------------------|--------|
| 12.5 | 10(t ₁) | ±12.5 kHz | Pass |
| | 25(t ₂) | ±6.25 kHz | |
| | 10(t ₃) | ±12.5 kHz | |

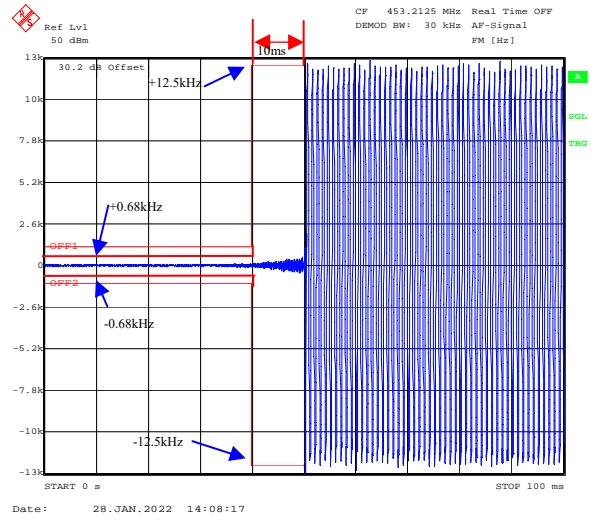
Note: During the time from the end of t₂ to the beginning of t₃, the frequency difference must not exceed the limits specified in 90.213:

For 453.2125 MHz 12.5kHz mode, limit is: 453.2125 MHz* 1.5ppm = 0.680 kHz

Tune ON



Tune OFF



4.6 Modulation Characteristic

| | | | |
|----------------|---------------|--------------|--------------|
| Serial Number: | CR21110034-RF | Test Date: | 2022-02-26 |
| Test Site: | RF | Test Mode: | Transmitting |
| Tester: | Rinka Li | Test Result: | Pass |

Environmental Conditions:

| | | | | | |
|----------------------|----|------------------------------|----|----------------------|-------|
| Temperature: (°C) | 26 | Relative Humidity: (%) | 51 | Temperature: (°C) | 101.8 |
|----------------------|----|------------------------------|----|----------------------|-------|

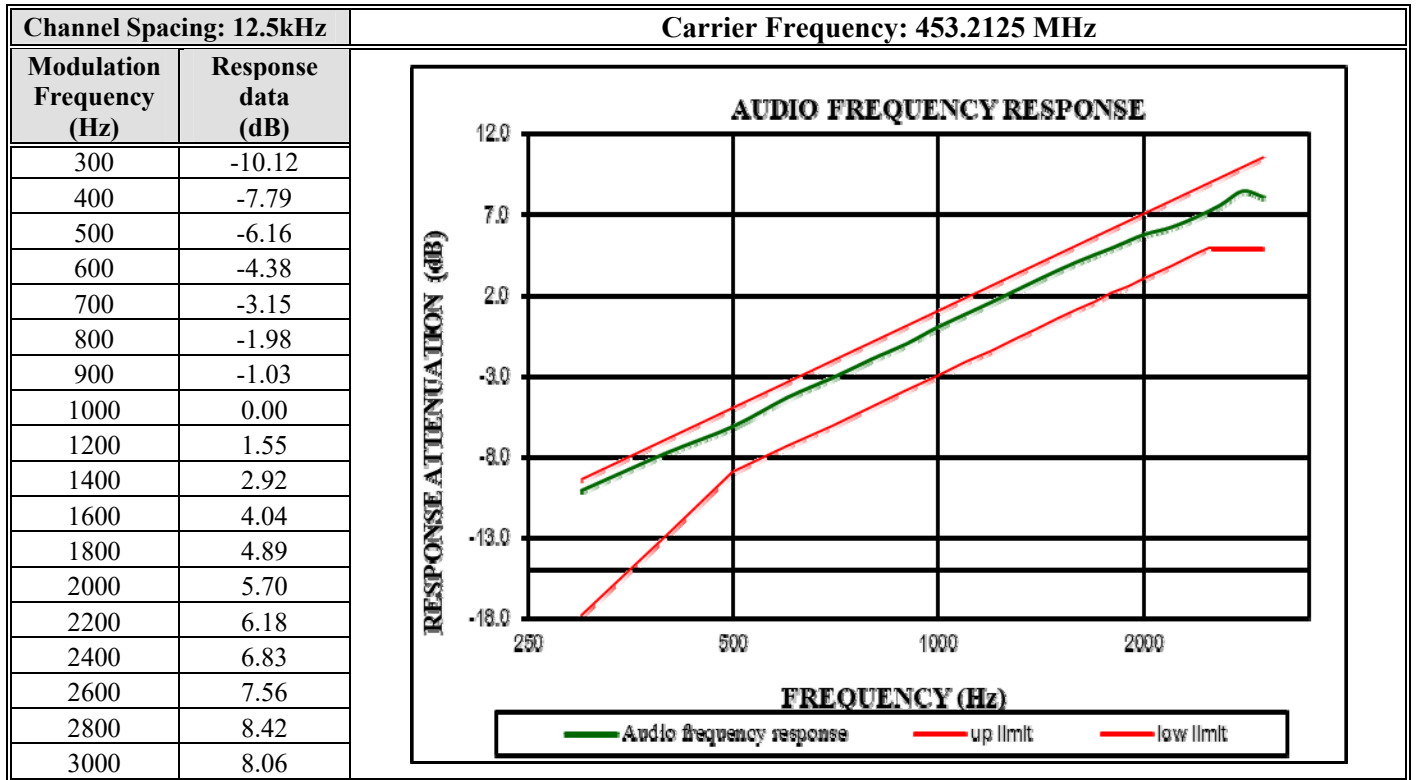
Test Equipment List and Details:

| Manufacturer | Description | Model | Serial Number | Calibration Date | Calibration Due Date |
|--------------|----------------------------|---------------|---------------|------------------|----------------------|
| zhuoxiang | Coaxial Cable | SMA-178 | 211002 | Each time | N/A |
| YINSAIGE | Coaxial Cable | SS402 | SJ0100003 | Each time | N/A |
| Weinschel | Coaxial Attenuators | 53-20-34 | LN751 | Each time | N/A |
| eastsheep | Coaxial Attenuator | 2W-SMA-JK-18G | 21060301 | Each time | N/A |
| HP | RF Communications Test Set | 8920A | 3438A05209 | 2021-07-22 | 2022-07-21 |

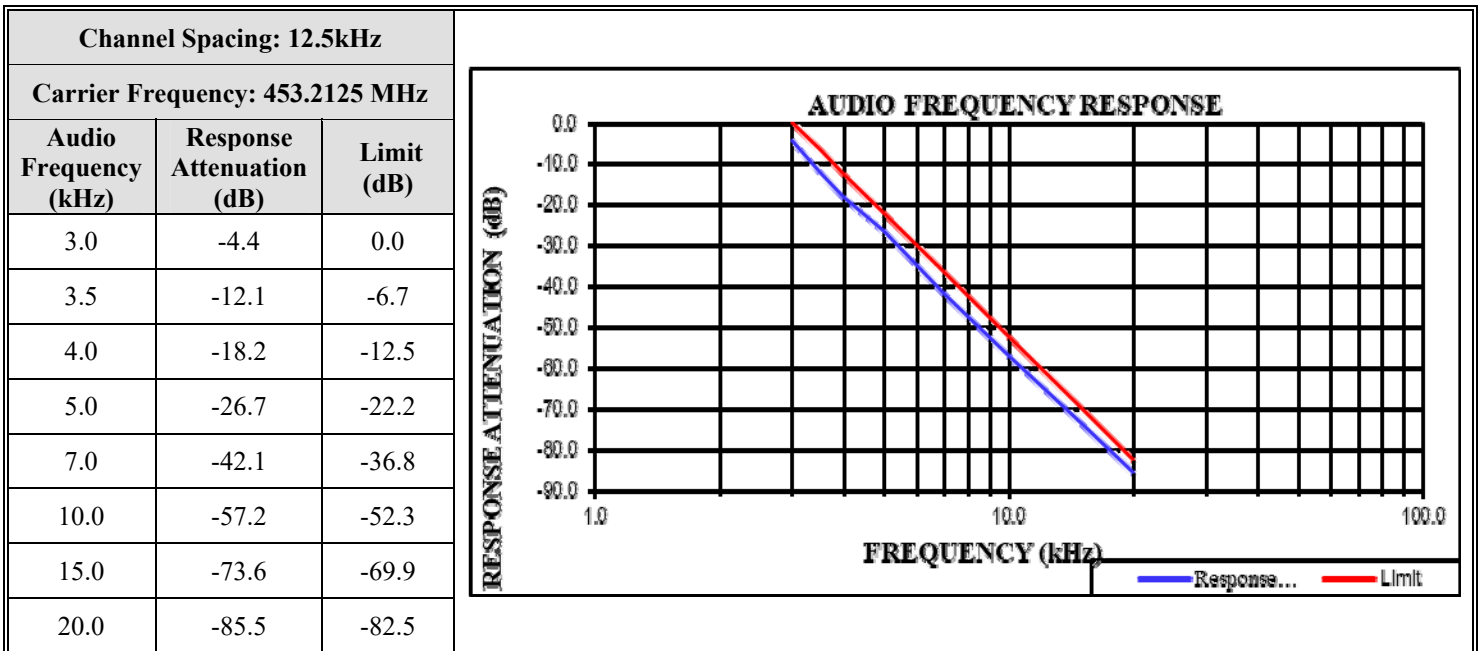
* Statement of Traceability: China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Data:

Audio Frequency Response – High Power

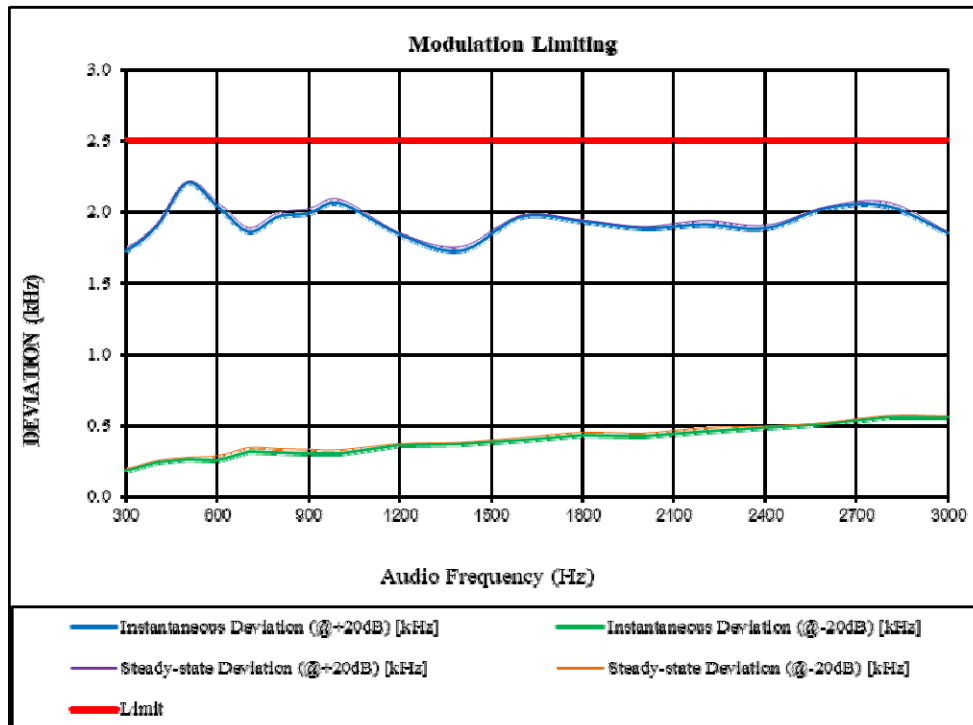


Audio Frequency Low Pass Filter Response – High Power



Modulation Limiting – High Power

| Channel Spacing: 12.5kHz | | Carrier Frequency: 453.2125 MHz | | | |
|--------------------------|--------------------------|---------------------------------|--------------------------|--------------------------|-------------|
| Audio Frequency (Hz) | Instantaneous | | Steady-state | | Limit [kHz] |
| | Deviation (@+20dB) [kHz] | Deviation (@-20dB) [kHz] | Deviation (@+20dB) [kHz] | Deviation (@-20dB) [kHz] | |
| 300 | 1.723 | 0.176 | 1.743 | 0.186 | 2.5 |
| 400 | 1.901 | 0.238 | 1.911 | 0.248 | 2.5 |
| 500 | 2.204 | 0.259 | 2.214 | 0.269 | 2.5 |
| 600 | 2.036 | 0.251 | 2.066 | 0.281 | 2.5 |
| 700 | 1.856 | 0.309 | 1.886 | 0.339 | 2.5 |
| 800 | 1.964 | 0.302 | 1.994 | 0.332 | 2.5 |
| 900 | 1.988 | 0.297 | 2.018 | 0.327 | 2.5 |
| 1000 | 2.057 | 0.294 | 2.087 | 0.324 | 2.5 |
| 1200 | 1.839 | 0.357 | 1.849 | 0.367 | 2.5 |
| 1400 | 1.728 | 0.367 | 1.758 | 0.377 | 2.5 |
| 1600 | 1.965 | 0.391 | 1.975 | 0.411 | 2.5 |
| 1800 | 1.929 | 0.428 | 1.939 | 0.448 | 2.5 |
| 2000 | 1.882 | 0.422 | 1.892 | 0.442 | 2.5 |
| 2200 | 1.906 | 0.452 | 1.936 | 0.482 | 2.5 |
| 2400 | 1.881 | 0.483 | 1.901 | 0.493 | 2.5 |
| 2600 | 2.024 | 0.507 | 2.034 | 0.517 | 2.5 |
| 2800 | 2.037 | 0.558 | 2.067 | 0.568 | 2.5 |
| 3000 | 1.847 | 0.555 | 1.857 | 0.565 | 2.5 |



4.7 Transmitter Unwanted Emissions (Radiated)

| | | | |
|----------------|-----------------------|--------------|--------------|
| Serial Number: | CR21110034-RF | Test Date: | 2021-12-23 |
| Test Site: | 966-2,966-1 | Test Mode: | Transmitting |
| Tester: | Carl Liang, Tommy Luo | Test Result: | Pass |

Environmental Conditions:

| | | | | | |
|----------------------|-----------|---------------------------|-------|------------------------|-------|
| Temperature: (°C) | 21.9~24.2 | Relative Humidity: (%) | 55~56 | ATM Pressure: (kPa) | 101.1 |
|----------------------|-----------|---------------------------|-------|------------------------|-------|

Test Equipment List and Details:

| Manufacturer | Description | Model | Serial Number | Calibration Date | Calibration Due Date |
|-----------------|---------------------------------|-----------------------|---------------|------------------|----------------------|
| Sunol Sciences | Antenna | JB6 | A082520-5 | 2020-10-19 | 2023-10-18 |
| R&S | EMI Test Receiver | ESR3 | 102724 | 2021-07-22 | 2022-07-21 |
| TIMES MICROWAVE | Coaxial Cable | LMR-600-UltraFlex | C-0470-02 | 2021-07-18 | 2022-07-17 |
| TIMES MICROWAVE | Coaxial Cable | LMR-600-UltraFlex | C-0780-01 | 2021-07-18 | 2022-07-17 |
| Sonoma | Amplifier | 310N | 186165 | 2021-07-18 | 2022-07-17 |
| EMCO | Adjustable Dipole Antenna | 3121C | 9109-756 | N/A | N/A |
| MICRO-COAX | Coaxial Cable | UFA210B-0-0720-300300 | 99G1448 | 2021-07-25 | 2022-07-24 |
| Agilent | Signal Generator | E8247C | MY43321352 | 2021-04-25 | 2022-04-24 |
| ETS-Lindgren | Horn Antenna | 3115 | 9912-5985 | 2020-10-13 | 2023-10-12 |
| R&S | Spectrum Analyzer | FSV40 | 101591 | 2021-07-22 | 2022-07-21 |
| MICRO-COAX | Coaxial Cable | UFA210A-1-1200-70U300 | 217423-008 | 2021-08-08 | 2022-08-07 |
| MICRO-COAX | Coaxial Cable | UFA210A-1-2362-300300 | 235780-001 | 2021-08-08 | 2022-08-07 |
| Mini | Pre-amplifier | ZVA-183-S+ | 5969001149 | 2021-11-10 | 2022-11-09 |
| AH | Double Ridge Guide Horn Antenna | SAS-571 | 1396 | 2021-10-18 | 2024-10-17 |
| E-Microwave | Band Rejector Filter | OBF-ZP-400-470-NF | OE01201051 | 2021-01-23 | 2022-01-22 |

* Statement of Traceability: China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Data:

30MHz - 5GHz:

| Frequency (MHz) | Polar (H/V) | Receiver Reading (dB μ V) | Substituted Method | | | Absolute Level (dBm) | Limit (dBm) | Margin (dB) |
|---------------------------------------|-------------|-------------------------------|-------------------------|------------------------|-----------------|----------------------|-------------|-------------|
| | | | Substituted Level (dBm) | Antenna Gain (dBd/dBi) | Cable Loss (dB) | | | |
| FM, Frequency: 400.0125MHz-12.5 kHz | | | | | | | | |
| 800.03 | H | 19.29 | -52.01 | 0.00 | 0.58 | -52.59 | -20.00 | 32.59 |
| 800.03 | V | 18.35 | -49.39 | 0.00 | 0.58 | -49.97 | -20.00 | 29.97 |
| 1200.04 | H | 36.71 | -66.15 | 7.66 | 0.69 | -59.18 | -20.00 | 39.18 |
| 1200.04 | V | 36.58 | -67.02 | 7.66 | 0.69 | -60.05 | -20.00 | 40.05 |
| 1600.05 | H | 35.20 | -69.17 | 8.62 | 0.83 | -61.38 | -20.00 | 41.38 |
| 1600.05 | V | 34.91 | -69.49 | 8.62 | 0.83 | -61.70 | -20.00 | 41.70 |
| 2000.06 | H | 33.64 | -68.49 | 9.10 | 0.89 | -60.28 | -20.00 | 40.28 |
| 2000.06 | V | 33.30 | -68.20 | 9.10 | 0.89 | -59.99 | -20.00 | 39.99 |
| 2400.08 | H | 33.74 | -67.31 | 9.34 | 0.98 | -58.95 | -20.00 | 38.95 |
| 2400.08 | V | 33.66 | -67.13 | 9.34 | 0.98 | -58.77 | -20.00 | 38.77 |
| 2800.09 | H | 33.81 | -66.12 | 9.88 | 1.04 | -57.28 | -20.00 | 37.28 |
| 2800.09 | V | 33.34 | -66.46 | 9.88 | 1.04 | -57.62 | -20.00 | 37.62 |
| 3200.10 | H | 33.89 | -63.23 | 10.28 | 1.11 | -54.06 | -20.00 | 34.06 |
| 3200.10 | V | 35.09 | -61.78 | 10.28 | 1.11 | -52.61 | -20.00 | 32.61 |
| 3600.11 | H | 35.67 | -61.88 | 10.50 | 1.24 | -52.62 | -20.00 | 32.62 |
| 3600.11 | V | 34.88 | -62.53 | 10.50 | 1.24 | -53.27 | -20.00 | 33.27 |
| 4000.13 | H | 35.48 | -60.28 | 10.90 | 1.29 | -50.67 | -20.00 | 30.67 |
| 4000.13 | V | 34.95 | -60.61 | 10.90 | 1.29 | -51.00 | -20.00 | 31.00 |
| 4FSK, Frequency: 400.0125MHz-12.5 kHz | | | | | | | | |
| 800.03 | H | 19.23 | -52.07 | 0.00 | 0.58 | -52.65 | -20.00 | 32.65 |
| 800.03 | V | 20.83 | -46.91 | 0.00 | 0.58 | -47.49 | -20.00 | 27.49 |
| 1200.04 | H | 36.67 | -66.19 | 7.66 | 0.69 | -59.22 | -20.00 | 39.22 |
| 1200.04 | V | 36.47 | -67.13 | 7.66 | 0.69 | -60.16 | -20.00 | 40.16 |
| 1600.05 | H | 36.15 | -68.22 | 8.62 | 0.83 | -60.43 | -20.00 | 40.43 |
| 1600.05 | V | 34.84 | -69.56 | 8.62 | 0.83 | -61.77 | -20.00 | 41.77 |
| 2000.06 | H | 34.77 | -67.36 | 9.10 | 0.89 | -59.15 | -20.00 | 39.15 |
| 2000.06 | V | 34.18 | -67.32 | 9.10 | 0.89 | -59.11 | -20.00 | 39.11 |
| 2400.08 | H | 33.94 | -67.11 | 9.34 | 0.98 | -58.75 | -20.00 | 38.75 |
| 2400.08 | V | 32.78 | -68.01 | 9.34 | 0.98 | -59.65 | -20.00 | 39.65 |
| 2800.09 | H | 33.24 | -66.69 | 9.88 | 1.04 | -57.85 | -20.00 | 37.85 |
| 2800.09 | V | 34.22 | -65.58 | 9.88 | 1.04 | -56.74 | -20.00 | 36.74 |
| 3200.10 | H | 33.95 | -63.17 | 10.28 | 1.11 | -54.00 | -20.00 | 34.00 |
| 3200.10 | V | 33.85 | -63.02 | 10.28 | 1.11 | -53.85 | -20.00 | 33.85 |
| 3600.11 | H | 35.00 | -62.55 | 10.50 | 1.24 | -53.29 | -20.00 | 33.29 |
| 3600.11 | V | 35.19 | -62.22 | 10.50 | 1.24 | -52.96 | -20.00 | 32.96 |
| 4000.13 | H | 35.35 | -60.41 | 10.90 | 1.29 | -50.80 | -20.00 | 30.80 |
| 4000.13 | V | 36.11 | -59.45 | 10.90 | 1.29 | -49.84 | -20.00 | 29.84 |

| Frequency (MHz) | Polar (H/V) | Receiver Reading (dBμV) | Substituted Method | | | Absolute Level (dBm) | Limit (dBm) | Margin (dB) |
|--------------------------------------|-------------|-------------------------|-------------------------|------------------------|-----------------|----------------------|-------------|-------------|
| | | | Substituted Level (dBm) | Antenna Gain (dBd/dBi) | Cable Loss (dB) | | | |
| FM, Frequency: 453.0125MHz-12.5 kHz | | | | | | | | |
| 906.03 | H | 18.95 | -49.67 | 0.00 | 0.55 | -50.22 | -20.00 | 30.22 |
| 906.03 | V | 19.62 | -46.39 | 0.00 | 0.55 | -46.94 | -20.00 | 26.94 |
| 1359.64 | H | 36.05 | -67.26 | 8.11 | 0.77 | -59.92 | -20.00 | 39.92 |
| 1359.64 | V | 36.12 | -67.40 | 8.11 | 0.77 | -60.06 | -20.00 | 40.06 |
| 1812.85 | H | 34.84 | -68.59 | 8.88 | 0.90 | -60.61 | -20.00 | 40.61 |
| 1812.85 | V | 35.23 | -68.32 | 8.88 | 0.90 | -60.34 | -20.00 | 40.34 |
| 2266.06 | H | 34.19 | -67.88 | 9.26 | 0.95 | -59.57 | -20.00 | 39.57 |
| 2266.06 | V | 32.53 | -69.43 | 9.26 | 0.95 | -61.12 | -20.00 | 41.12 |
| 2719.28 | H | 33.93 | -66.04 | 9.75 | 1.05 | -57.34 | -20.00 | 37.34 |
| 2719.28 | V | 32.98 | -66.93 | 9.75 | 1.05 | -58.23 | -20.00 | 38.23 |
| 3172.49 | H | 35.03 | -62.21 | 10.27 | 1.13 | -53.07 | -20.00 | 33.07 |
| 3172.49 | V | 34.33 | -62.70 | 10.27 | 1.13 | -53.56 | -20.00 | 33.56 |
| 3625.70 | H | 35.45 | -62.04 | 10.53 | 1.22 | -52.73 | -20.00 | 32.73 |
| 3625.70 | V | 35.06 | -62.32 | 10.53 | 1.22 | -53.01 | -20.00 | 33.01 |
| 4078.91 | H | 35.77 | -60.19 | 10.85 | 1.29 | -50.63 | -20.00 | 30.63 |
| 4078.91 | V | 36.04 | -59.85 | 10.85 | 1.29 | -50.29 | -20.00 | 30.29 |
| 4532.13 | H | 35.26 | -60.41 | 10.64 | 1.37 | -51.14 | -20.00 | 31.14 |
| 4532.13 | V | 35.71 | -59.73 | 10.64 | 1.37 | -50.46 | -20.00 | 30.46 |
| 4FSK, Frequency:453.0125MHz-12.5 kHz | | | | | | | | |
| 906.03 | H | 21.13 | -47.49 | 0.00 | 0.55 | -48.04 | -20.00 | 28.04 |
| 906.03 | V | 19.77 | -46.24 | 0.00 | 0.55 | -46.79 | -20.00 | 26.79 |
| 1359.64 | H | 36.78 | -66.53 | 8.11 | 0.77 | -59.19 | -20.00 | 39.19 |
| 1359.64 | V | 35.53 | -67.99 | 8.11 | 0.77 | -60.65 | -20.00 | 40.65 |
| 1812.85 | H | 34.05 | -69.38 | 8.88 | 0.90 | -61.40 | -20.00 | 41.40 |
| 1812.85 | V | 34.22 | -69.33 | 8.88 | 0.90 | -61.35 | -20.00 | 41.35 |
| 2266.06 | H | 33.62 | -68.45 | 9.26 | 0.95 | -60.14 | -20.00 | 40.14 |
| 2266.06 | V | 33.90 | -68.06 | 9.26 | 0.95 | -59.75 | -20.00 | 39.75 |
| 2719.28 | H | 33.15 | -66.82 | 9.75 | 1.05 | -58.12 | -20.00 | 38.12 |
| 2719.28 | V | 34.26 | -65.65 | 9.75 | 1.05 | -56.95 | -20.00 | 36.95 |
| 3172.49 | H | 35.07 | -62.17 | 10.27 | 1.13 | -53.03 | -20.00 | 33.03 |
| 3172.49 | V | 34.06 | -62.97 | 10.27 | 1.13 | -53.83 | -20.00 | 33.83 |
| 3625.70 | H | 34.52 | -62.97 | 10.53 | 1.22 | -53.66 | -20.00 | 33.66 |
| 3625.70 | V | 35.35 | -62.03 | 10.53 | 1.22 | -52.72 | -20.00 | 32.72 |
| 4078.91 | H | 36.12 | -59.84 | 10.85 | 1.29 | -50.28 | -20.00 | 30.28 |
| 4078.91 | V | 35.32 | -60.57 | 10.85 | 1.29 | -51.01 | -20.00 | 31.01 |
| 4532.13 | H | 35.36 | -60.31 | 10.64 | 1.37 | -51.04 | -20.00 | 31.04 |
| 4532.13 | V | 35.01 | -60.43 | 10.64 | 1.37 | -51.16 | -20.00 | 31.16 |

| Frequency (MHz) | Polar (H/V) | Receiver Reading (dBμV) | Substituted Method | | | Absolute Level (dBm) | Limit (dBm) | Margin (dB) |
|--------------------------------------|-------------|-------------------------|-------------------------|------------------------|-----------------|----------------------|-------------|-------------|
| | | | Substituted Level (dBm) | Antenna Gain (dBd/dBi) | Cable Loss (dB) | | | |
| FM, Frequency: 469.9875MHz-12.5 kHz | | | | | | | | |
| 939.98 | H | 19.63 | -48.16 | 0.00 | 0.64 | -48.80 | -20.00 | 28.80 |
| 939.98 | V | 19.84 | -45.51 | 0.00 | 0.64 | -46.15 | -20.00 | 26.15 |
| 1409.96 | H | 36.59 | -67.09 | 8.25 | 0.72 | -59.56 | -20.00 | 39.56 |
| 1409.96 | V | 36.74 | -66.99 | 8.25 | 0.72 | -59.46 | -20.00 | 39.46 |
| 1879.95 | H | 34.69 | -68.39 | 8.96 | 0.88 | -60.31 | -20.00 | 40.31 |
| 1879.95 | V | 33.95 | -68.89 | 8.96 | 0.88 | -60.81 | -20.00 | 40.81 |
| 2349.94 | H | 33.63 | -67.86 | 9.31 | 0.97 | -59.52 | -20.00 | 39.52 |
| 2349.94 | V | 32.95 | -68.30 | 9.31 | 0.97 | -59.96 | -20.00 | 39.96 |
| 2819.93 | H | 33.34 | -66.50 | 9.91 | 1.05 | -57.64 | -20.00 | 37.64 |
| 2819.93 | V | 33.05 | -66.71 | 9.91 | 1.05 | -57.85 | -20.00 | 37.85 |
| 3289.91 | H | 34.95 | -61.77 | 10.32 | 1.15 | -52.60 | -20.00 | 32.60 |
| 3289.91 | V | 35.11 | -61.36 | 10.32 | 1.15 | -52.19 | -20.00 | 32.19 |
| 3759.90 | H | 34.86 | -61.55 | 10.66 | 1.24 | -52.13 | -20.00 | 32.13 |
| 3759.90 | V | 35.64 | -60.65 | 10.66 | 1.24 | -51.23 | -20.00 | 31.23 |
| 4229.89 | H | 35.88 | -60.16 | 10.76 | 1.32 | -50.72 | -20.00 | 30.72 |
| 4229.89 | V | 36.24 | -59.74 | 10.76 | 1.32 | -50.30 | -20.00 | 30.30 |
| 4FSK, Frequency:469.9875MHz-12.5 kHz | | | | | | | | |
| 939.98 | H | 19.38 | -48.41 | 0.00 | 0.64 | -49.05 | -20.00 | 29.05 |
| 939.98 | V | 19.35 | -46.00 | 0.00 | 0.64 | -46.64 | -20.00 | 26.64 |
| 1409.96 | H | 37.51 | -66.17 | 8.25 | 0.72 | -58.64 | -20.00 | 38.64 |
| 1409.96 | V | 36.33 | -67.40 | 8.25 | 0.72 | -59.87 | -20.00 | 39.87 |
| 1879.95 | H | 34.35 | -68.73 | 8.96 | 0.88 | -60.65 | -20.00 | 40.65 |
| 1879.95 | V | 34.54 | -68.30 | 8.96 | 0.88 | -60.22 | -20.00 | 40.22 |
| 2349.94 | H | 33.18 | -68.31 | 9.31 | 0.97 | -59.97 | -20.00 | 39.97 |
| 2349.94 | V | 34.23 | -67.02 | 9.31 | 0.97 | -58.68 | -20.00 | 38.68 |
| 2819.93 | H | 33.70 | -66.14 | 9.91 | 1.05 | -57.28 | -20.00 | 37.28 |
| 2819.93 | V | 33.14 | -66.62 | 9.91 | 1.05 | -57.76 | -20.00 | 37.76 |
| 3289.91 | H | 35.82 | -60.90 | 10.32 | 1.15 | -51.73 | -20.00 | 31.73 |
| 3289.91 | V | 34.68 | -61.79 | 10.32 | 1.15 | -52.62 | -20.00 | 32.62 |
| 3759.90 | H | 35.33 | -61.08 | 10.66 | 1.24 | -51.66 | -20.00 | 31.66 |
| 3759.90 | V | 34.85 | -61.44 | 10.66 | 1.24 | -52.02 | -20.00 | 32.02 |
| 4229.89 | H | 36.15 | -59.89 | 10.76 | 1.32 | -50.45 | -20.00 | 30.45 |
| 4229.89 | V | 36.04 | -59.94 | 10.76 | 1.32 | -50.50 | -20.00 | 30.50 |

Note 1: The unit of antenna gain is dBd for frequency below 1GHz and is dBi for frequency above 1GHz.

Note 2:

Absolute Level = Substituted Level - Cable loss + Antenna Gain

Margin = Limit- Absolute Level

5. RF EXPOSURE EVALUATION

5.1 FCC Maximum Permissible Exposure (MPE)

5.1.1 Applicable Standard

According to subpart §1.1310, systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

5.1.2 Limits

Maximum Permissible Exposure (MPE) (§1.1310, §2.1091)

| Limits for Occupational/Controlled Exposure | | | | |
|---|-----------------------------------|-----------------------------------|---|--|
| Frequency Range (MHz) | Electric Field Strength (E) (V/m) | Magnetic Field Strength (H) (A/m) | Power Density (S) (mW/cm ²) | Averaging Time E , H or S (minutes) |
| 0.3- 3.0 | 614 | 1.63 | (100)* | 6 |
| 3.0 - 30 | 1842/f | 4.89/f | (900/f ²)* | 6 |
| 30-300 | 61.4 | 0.163 | 1.0 | 6 |
| 300-1500 | / | / | f/300 | 6 |
| 1500-100,000 | / | / | 5 | 6 |

f = frequency in MHz; * = Plane-wave equivalent power density;

According to §1.1310 and §2.1091 RF exposure is calculated.

5.1.3 Calculated Formulary:

Predication of MPE limit at a given distance

$S = PG/4\pi R^2$ = power density (in appropriate units, e.g. mW/cm²);

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

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

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

5.1.4 Calculated Data

| Frequency Band (MHz) | Maximum Tune-up Conducted Power (dBm) | Antenna Gain (dBi) | Evaluation Distance (cm) | Power Density (mW/cm ²) | MPE Limit (mW/cm ²) |
|----------------------|---------------------------------------|--------------------|--------------------------|-------------------------------------|---------------------------------|
| 400-470 | 47.5 | 5.0 | 110 | 1.17 | 1.33 |

Result: Compliant, The device meet MPE requirement at 110 cm distance.

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