



FCC CFR 47 Part 22 E Test Report

| | |
|-----------------------------|--|
| APPLICANT | STANDARD COMMUNICATIONS PTY.LTD. |
| ADDRESS | PO BOX 96 WINSTON HILLS NSW 2153 AUSTRALIA |
| FCC ID | TXJCM60V25 |
| MODEL NUMBER | CM60-V25B |
| PRODUCT DESCRIPTION | VHF TRANSCEIVER |
| DATE SAMPLE RECEIVED | 4/9/2018 |
| FINAL TEST DATE | 4/16/2018 |
| TESTED BY | Franklin Rose |
| APPROVED BY | Tim Royer |
| TEST RESULTS | <input checked="" type="checkbox"/> PASS <input type="checkbox"/> FAIL |

| Report Number | Report Version | Description | Issue Date |
|------------------------------|----------------|------------------|------------|
| 477CUT18 PT22_TestReport_ | Rev1 | Initial Issue | 04/16/2018 |
| 477CUT18 PT22_TestReport_ | Rev2 | Clerical Updates | 05/30/2018 |

THE ATTACHED REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL WITHOUT THE WRITTEN APPROVAL OF TIMCO ENGINEERING, INC.



TABLE OF CONTENTS

| | |
|--|----|
| GENERAL REMARKS | 2 |
| GENERAL INFORMATION | 3 |
| RESULTS SUMMARY | 4 |
| RF POWER OUTPUT | 5 |
| PART 2.1033 (c)(8) DC INPUT INTO FINAL AMPLIFIER..... | 5 |
| MODULATION CHARACTERISTICS | 6 |
| 11K2F3E (NARROWBAND ANALOG FM VOICE) BANDWIDTH | 6 |
| 8K57F1E/F1D (C4FM VOICE/DATA) BANDWIDTH | 6 |
| AUDIO FREQUENCY RESPONSE & LOW PASS FILTER | 7 |
| Test Data: 12.5 kHz FM Audio Frequency Response & Low Pass Filter..... | 7 |
| MODULATION LIMITING | 8 |
| Test Data: 12.5 kHz FM Modulation Limiting..... | 8 |
| OCCUPIED BANDWIDTH | 9 |
| TEST DATA: 11K2F3E (NARROWBAND ANALOG FM VOICE)..... | 10 |
| TEST DATA: 8K57F1E/F1D (C4FM VOICE/DATA) | 11 |
| SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED)..... | 12 |
| SPURIOUS EMISSIONS - NARROWBAND FM (12.5 kHz) | 13 |
| Test Data: 150.8075 MHz | 13 |
| Test Data: 152.8475 MHz | 14 |
| Test Data: 157.4575 MHz | 15 |
| Test Data: 161.7675 MHz | 16 |
| SPURIOUS EMISSIONS – P25 PHASE I C4FM (12.5 kHz) | 17 |
| Test Data: 150.8075 MHz | 17 |
| Test Data: 152.8475 MHz | 18 |
| Test Data: 157.4575 MHz | 19 |
| Test Data: 161.7675 MHz | 20 |
| FIELD STRENGTH OF SPURIOUS EMISSIONS | 21 |
| TEST DATA: 150.8075 MHz | 23 |
| TEST DATA: 152.8475 MHz | 24 |
| TEST DATA: 157.4575 MHz | 25 |
| TEST DATA: 161.7675 MHz | 26 |
| FREQUENCY STABILITY | 27 |
| STATEMENT OF MEASUREMENT UNCERTAINTY | 29 |
| EMC EQUIPMENT LIST | 30 |

GENERAL REMARKS

Summary

The device under test does:

- Fulfill the general approval requirements as identified in this test report and was selected by the customer.
- Not fulfill the general approval requirements as identified in this test report

Attestations

This equipment has been tested in accordance with the standards identified in this test report. To the best of my knowledge and belief, these tests were performed using the measurement procedures described in this report.

All instrumentation and accessories used to test products for compliance to the indicated standards are calibrated regularly in accordance with ISO 17025 requirements.

I attest that the necessary measurements were made at:

Timco Engineering Inc.
849 NW State Road 45
Newberry, FL 32669
Designation #: US1070

Tested by:



| | |
|-----------------------|---|
| Name and Title | Franklin Rose, Project Manager / EMC Testing Technician |
| Date | 04/26/2018 |

Reviewed and Approved by:



| | |
|-----------------------|---|
| Name and Title | Tim Royer, Project Manager / EMC Testing Engineer |
| Date | 04/26/2018 |

GENERAL INFORMATION

EUT Specification

| | |
|--------------------------------|---|
| EUT Description | VHF TRANSCEIVER |
| FCC ID | TXJCM60V25 |
| Model Number | CM60-V25B |
| Operating Frequency | Band 1: 150.8 – 152.855 Band 2: 157.45 – 161.775 MHz |
| Test Frequencies | Band 1: 150.8075, 152.8475 MHz Band 2: 157.4575, 161.7675 MHz |
| Type of Emission | 11K2F3E (Narrowband Analog FM Voice), 8K57F1E (P25 Phase I C4FM Voice), 8K57F1D (P25 Phase I C4FM Data) |
| Modulation | FM |
| EUT Power Source | <input type="checkbox"/> 110–120Vac/50– 60Hz |
| | <input checked="" type="checkbox"/> DC Power (13.8 V) |
| | <input type="checkbox"/> Battery Operated Exclusively |
| Test Item | <input type="checkbox"/> Prototype |
| | <input checked="" type="checkbox"/> Pre-Production |
| | <input type="checkbox"/> Production |
| Type of Equipment | <input type="checkbox"/> Fixed |
| | <input checked="" type="checkbox"/> Mobile |
| | <input type="checkbox"/> Portable |
| Antenna Connector | BNC |
| Test Conditions | The temperature was 26°C Relative humidity of 50%. |
| Modification to the EUT | No Modification to EUT. |
| Test Exercise | The EUT was placed in continuous transmit and was operated in “Test Mode” for digital emissions tests. |
| Applicable Standards | ANSI/TIA 603-E:2016, ANSI C63.26, FCC CFR 47 Part 2, Part 22, using FCC CFR 47 Part 90 for reference |
| Test Facility | Timco Engineering Inc. at 849 NW State Road 45 Newberry, FL 32669 USA. Designation #: US1070 |

RESULTS SUMMARY

| Rule Part No. | Test Item | Results |
|--|---|-------------|
| 2.1046(a), 22.535(a),(b), 22.565(f), 22.593 | RF Power Output | PASS |
| Part 2.1033(c)(4) | Modulation Characteristics | PASS |
| 2.1047(a) | Audio Frequency Response and Low Filter | PASS |
| 2.1047(b) | Modulation Limiting | PASS |
| 2.1049 (c) | Occupied Bandwidth | PASS |
| 2.1051(a), 22.359(a) | Spurious Emissions at Antenna Terminals | PASS |
| 2.1053(a), 22.359(a) | Field Strength of Spurious Emissions | PASS |
| 2.1055(a)(2), 22.355 | Frequency Stability < 5 ppm | PASS |

RF POWER OUTPUT

FCC Rule Parts: FCC Part 2.1046(a), 22.535(a),(b), 22.565(f), 22.593

The effective radiated power (ERP) of transmitters operating on the channels listed in §22.531 must not exceed the limits in this section.

(a) *Maximum ERP.* The ERP must not exceed the applicable limits in this paragraph under any circumstances.

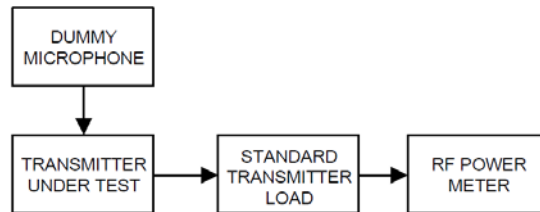
| Frequency range (MHz) | Maximum ERP (Watts) |
|-----------------------|---------------------|
| 152-159 | 1400 |

(b) *Basic power limit.* Except as provided in paragraph (d) of this section, the ERP of transmitters on the VHF channels must not exceed 500 Watts.

The effective radiated power of fixed stations operating on the channels listed in §22.591 must not exceed 150 Watts. The equivalent isotropically radiated power of existing fixed microwave stations (2110-2130 and 2160-2180 MHz) licensed under this part (pursuant to former rules) must not exceed the applicable limits set forth in §101.113 of this chapter.

(f) *Mobile transmitters.* The transmitter output power of mobile transmitters must not exceed 60 watts.

Method of Measurement: TIA-603-E, 2.2.1



Test Data: Power Measurement Table

| Peak Power Output | | | | | | |
|-------------------|-------|-------|------------------------------|------------|-----------|---------|
| Tx Power Level | dBm | Watts | Max Rated Antenna Gain (dBi) | EIRP (dBm) | ERP (dBm) | ERP (W) |
| High | 43.81 | 24.04 | 5.15 | 48.96 | 46.81 | 47.97 |
| Med | 39.84 | 9.64 | 5.15 | 44.99 | 42.84 | 19.23 |
| Low | 30.02 | 1.00 | 5.15 | 35.17 | 33.02 | 2.00 |

Part 2.1033 (c)(8) DC Input into Final Amplifier

INPUT POWER: (13.8 V) (6.0 A) = **82.8 Watts**

Result: Meets Requirements

MODULATION CHARACTERISTICS

FCC Rule Parts: Part 2.1033(c)(4)

11K2F3E (Narrowband Analog FM Voice) Bandwidth

$$B_n = 2M + 2Dk$$
$$B_n = (2 \times 3) + (2 \times 2.5) = 11.0 \text{ kHz}$$

Where:

f_m = modulating frequency, kHz
 f_d = deviation, kHz
k = constant (= 1)

Necessary Bandwidth for 11K2F3E = **11.0 kHz**

90. 209(b)(5) Authorized Bandwidth for 11K2F3E = **11.25 kHz**

8K57F1E/F1D (C4FM Voice/Data) Bandwidth

Necessary Bandwidth for 8K57F1E/F1D (99% Occupied Bandwidth) = **8.57 kHz**

90. 209(b)(5) Authorized Bandwidth for 8K57F1E/F1D = **11.25 kHz**

Result: Meets Requirements

AUDIO FREQUENCY RESPONSE & LOW PASS FILTER

Rule Part No.: 2.1047(a)

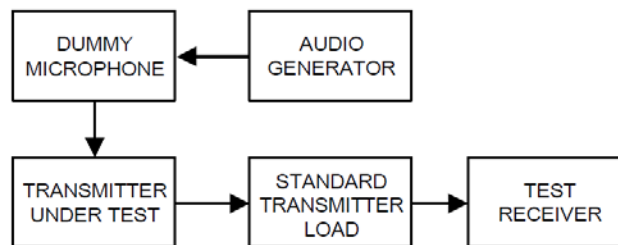
Requirements:

(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.

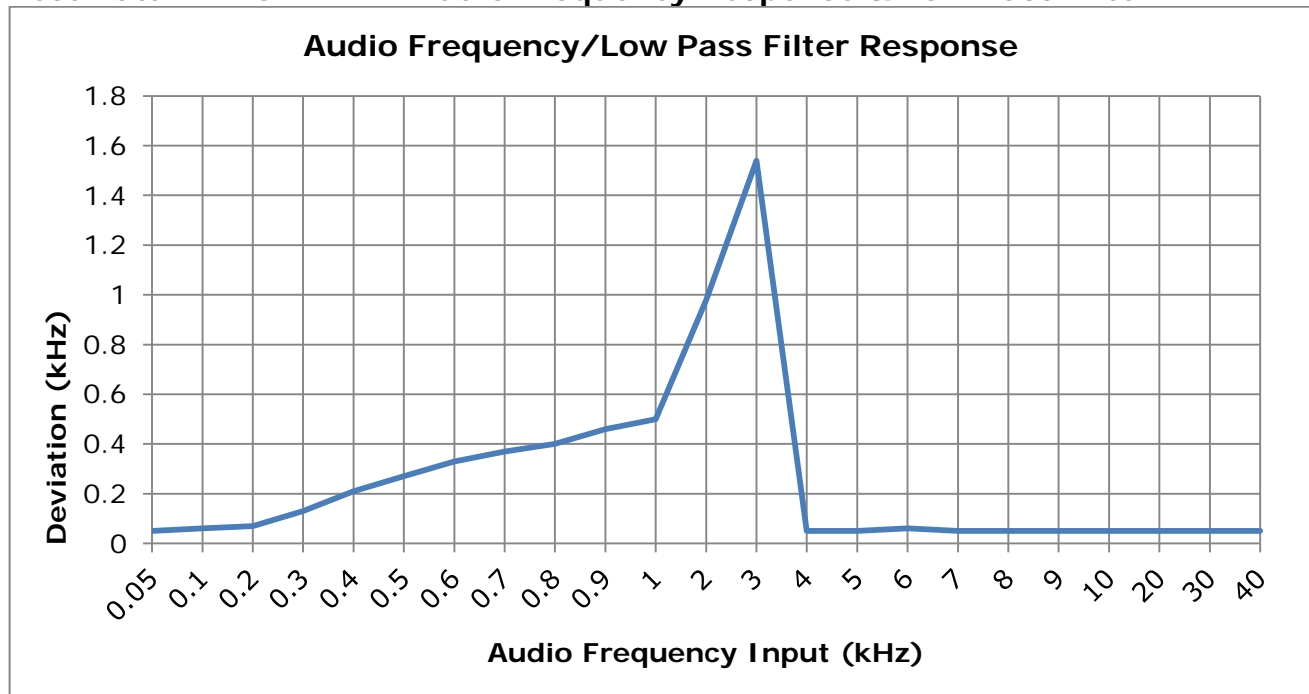
Test Procedure: TIA 603-E, 2.2.6.2.2, 2.2.15 (Using the Test Setup from section 2.2.6)

Note: The Low Pass Filter is digital, and has no "input" or "output" as found in the method of measurement, above. Testing has been altered accordingly to show the operation of the filter.

Note: Testing deviates from TIA 603-E 2.2.6.2.2 and 2.2.15. The Audio Frequency Response and Low Pass Filter Response plot data has been taken simultaneously using the Modulation Meter reading of Deviation (kHz), satisfying the requirements above.



Test Data: 12.5 kHz FM Audio Frequency Response & Low Pass Filter



MODULATION LIMITING

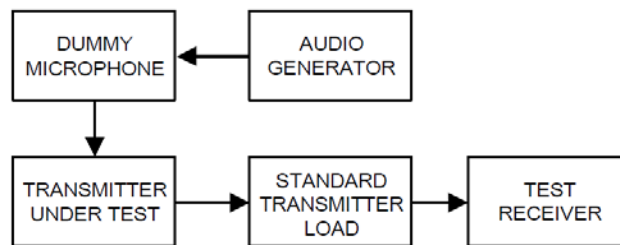
Rule Part No.: 2.1047(b)

Requirements:

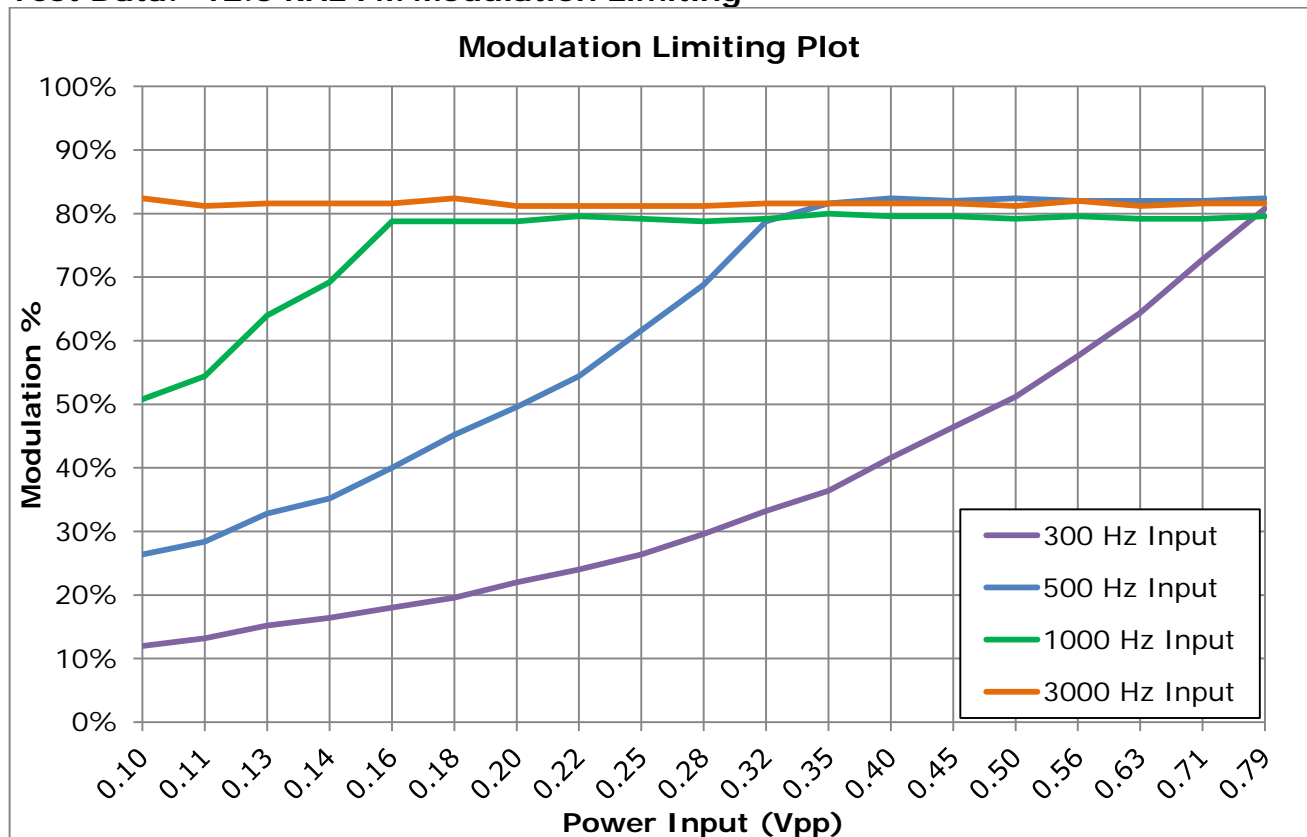
(b) *Equipment which employs modulation limiting.* A curve or family of curves showing the percentage of modulation versus the modulation input voltage shall be supplied. The information submitted shall be sufficient to show modulation limiting capability throughout the range of modulating frequencies and input modulating signal levels employed.

Test Procedure: TIA 603-E, 2.2.3

Note: The test method alone is not sufficient to meet the standard of FCC Pt. 2.1047(b). Deviation (kHz), as recorded from test equipment, has been converted into percentage as required above.



Test Data: 12.5 kHz FM Modulation Limiting



OCCUPIED BANDWIDTH

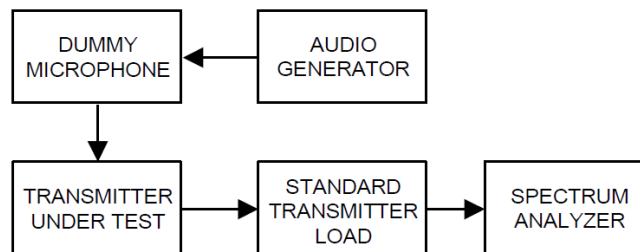
FCC Rule Parts: 2.1049 (c)

(c) Radiotelephone transmitters equipped with a device to limit modulation or peak envelope power shall be modulated as follows. For single sideband and independent sideband transmitters, the input level of the modulating signal shall be 10 dB greater than that necessary to produce rated peak envelope power.

(1) Other than single sideband or independent sideband transmitters—when modulated by a 2500 Hz tone at an input level 16 dB greater than that necessary to produce 50 percent modulation. The input level shall be established at the frequency of maximum response of the audio modulating circuit.

Method of Measurement: ANSI C63.26, 5.4.4 (using Test Setup from TIA 603-E 2.2.11, below)

Note: The receiver's automatic 99% Occupied Bandwidth function was used. The function is identical in operation to ANSI C63.26, 5.4.4, Step e).

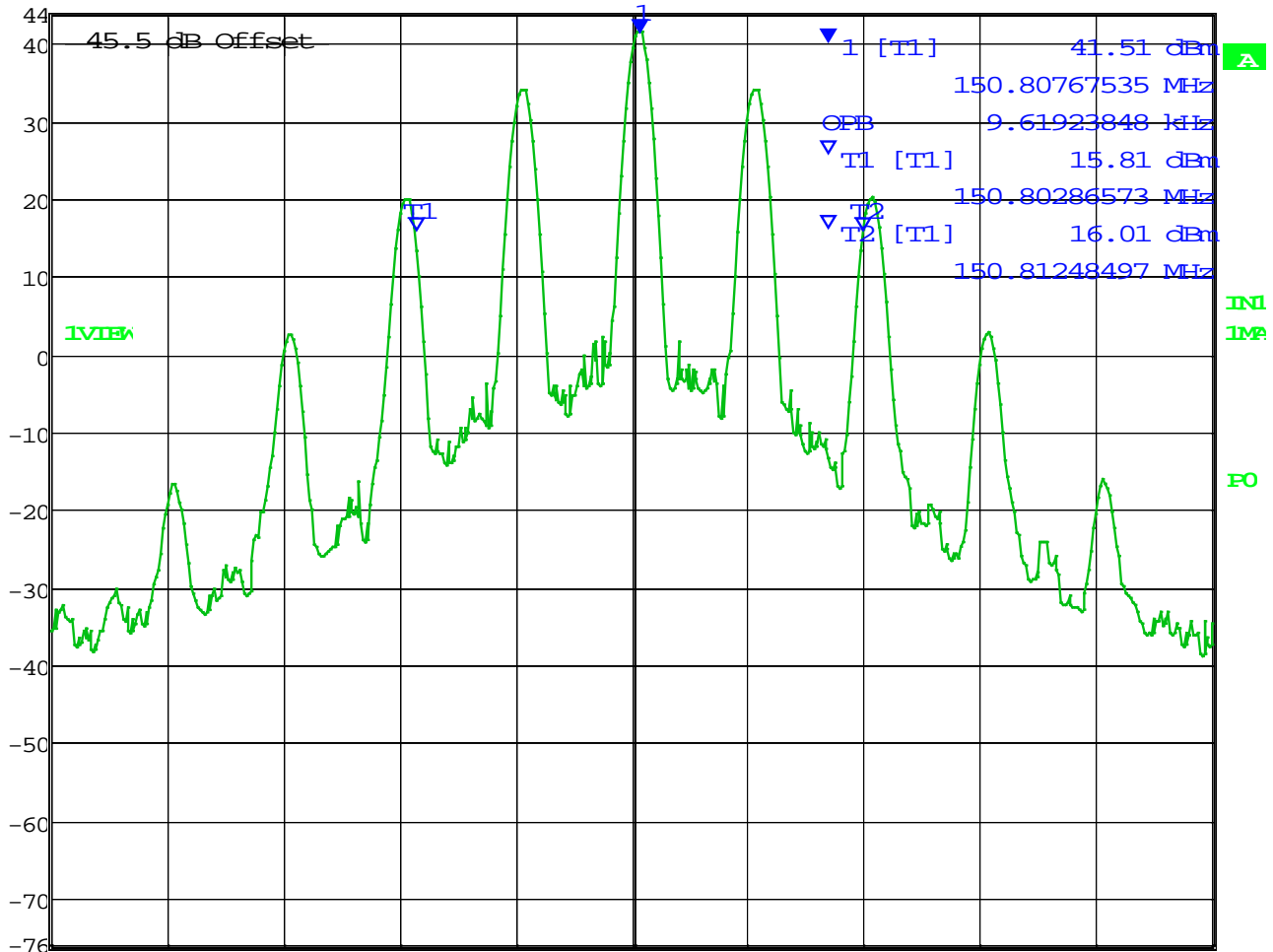


OCCUPIED BANDWIDTH 99%

Test Data: 11K2F3E (Narrowband Analog FM Voice)



| | | | | | | | |
|---------|--------|---------------|------------------|-----|--------|--------|-------|
| Ref Lvl | 44 dBm | Marker 1 [T1] | 41.51 dBm | RBW | 300 Hz | RF Att | 20 dB |
| | | | 150.80767535 MHz | VBW | 3 kHz | | |
| | | | | SWT | 1.4 s | Unit | dBm |



Center 150.8075 MHz 2.5 kHz/ Span 25 kHz

Date: 1.JAN.1997 05:13:13

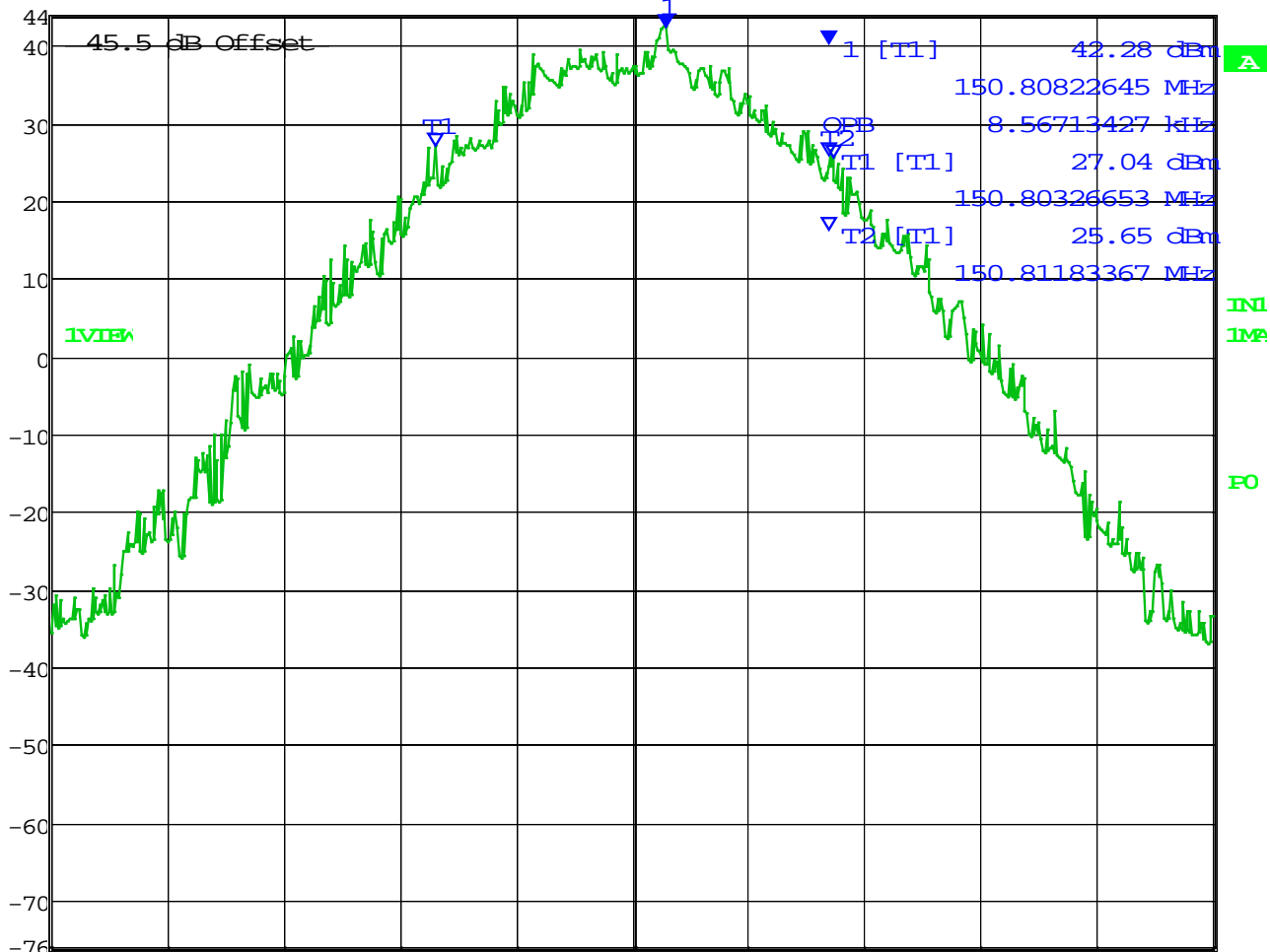
99% OBW = 9.62 kHz

OCCUPIED BANDWIDTH 99%

Test Data: 8K57F1E/F1D (C4FM Voice/Data)



| | | | | | | | |
|---------|--------|---------------|------------------|-----|--------|--------|-------|
| Ref Lvl | 44 dBm | Marker 1 [T1] | 42.28 dBm | RBW | 300 Hz | RF Att | 20 dB |
| | | | 150.80822645 MHz | VBW | 3 kHz | | |
| | | | | SWT | 1.4 s | Unit | dBm |



Center 150.8075 MHz 2.5 kHz/ Span 25 kHz

Date: 1.JAN.1997 05:16:20

99% OBW = 8.57 kHz

Result: Meets Requirements

SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED)

FCC Rule Parts: 2.1051(a), 22.359(a)

Requirements:

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

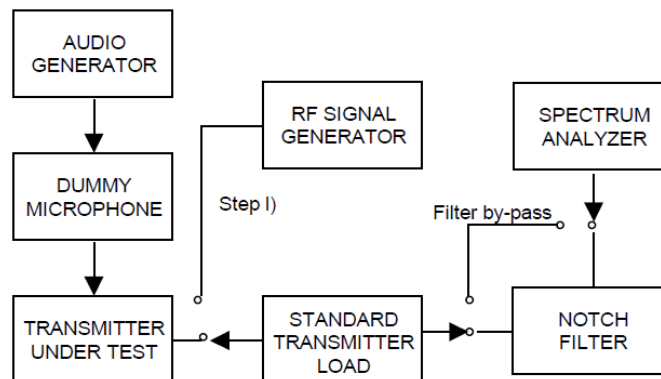
The limit below conforms to FCC CFR 47 Part 90.210(d)(3) and in all cases is more strict than that set forth in this rulepart. Please refer below:

FCC Rule Parts: 90.210(d)(3)

(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.

Method of Measurement: ANSI/TIA-603-E

Test Procedure: TIA 603-E, 2.2.13



SPURIOUS EMISSIONS - NARROWBAND FM (12.5 kHz)

Test Data: 150.8075 MHz

| Spurious Conducted Emissions, Narrowband FM (12.5 kHz), Mask D Limit (≥250% Authorized BW) | High Power | | Med Power | | Low Power | |
|--|-------------|--------------|-------------|--------------|-------------|--------------|
| | dBm | 43.81 | dBm | 39.84 | dBm | 30.02 |
| | Watts | 24.04 | Watts | 9.64 | Watts | 1.00 |
| | Limit (dBm) | -20 | Limit (dBm) | -20 | Limit (dBm) | -20 |
| Frequency (MHz) | Peak (dBm) | Margin (dB) | Peak (dBm) | Margin (dB) | Peak (dBm) | Margin (dB) |
| Fundamental 150.8075 | 43.81 | 0.00 | 39.84 | 0.00 | 30.02 | 0.00 |
| 2nd Harmonic 301.6150 | -40.53 | 20.53 | -39.19 | 19.19 | -43.36 | 23.36 |
| 3rd Harmonic 452.4225 | -37.84 | 17.84 | -43.06 | 23.06 | -50.10 | 30.10 |
| 4th Harmonic 603.2300 | -31.41 | 11.41 | -36.63 | 16.63 | -47.49 | 27.49 |
| 5th Harmonic 754.0375 | -45.32 | 25.32 | -44.78 | 24.78 | -48.48 | 28.48 |
| 6th Harmonic 904.8450 | -32.21 | 12.21 | -42.93 | 22.93 | -49.72 | 29.72 |
| 7th Harmonic 1055.6525 | -58.96 | 38.96 | -58.54 | 38.54 | -55.03 | 35.03 |
| 8th Harmonic 1206.4600 | -53.35 | 33.35 | -55.31 | 35.31 | -54.41 | 34.41 |
| 9th Harmonic 1357.2675 | -57.88 | 37.88 | -57.09 | 37.09 | -56.64 | 36.64 |
| 10th Harmonic * 1508.0750 | -60.21 | 40.21 | -59.64 | 39.64 | -60.00 | 40.00 |

* Indicates Noise Floor of Measurement

SPURIOUS EMISSIONS AT ANTENNA TERMINALS

Test Data: 152.8475 MHz

| Spurious Conducted Emissions, Narrowband FM (12.5 kHz), Mask D Limit (≥250% Authorized BW) | High Power | | Med Power | | Low Power | |
|--|-------------|--------------|-------------|--------------|-------------|--------------|
| | dBm | 43.81 | dBm | 39.84 | dBm | 30.02 |
| | Watts | 24.04 | Watts | 9.64 | Watts | 1.00 |
| | Limit (dBm) | -20 | Limit (dBm) | -20 | Limit (dBm) | -20 |
| Frequency (MHz) | Peak (dBm) | Margin (dB) | Peak (dBm) | Margin (dB) | Peak (dBm) | Margin (dB) |
| Fundamental 152.8475 | 43.81 | 0.00 | 39.84 | 0.00 | 30.02 | 0.00 |
| 2nd Harmonic 305.6950 | -42.20 | 22.20 | -38.66 | 18.66 | -43.66 | 23.66 |
| 3rd Harmonic 458.5425 | -39.84 | 19.84 | -40.94 | 20.94 | -49.82 | 29.82 |
| 4th Harmonic 611.3900 | -29.30 | 9.30 | -36.29 | 16.29 | -46.81 | 26.81 |
| 5th Harmonic 764.2375 | -41.56 | 21.56 | -45.66 | 25.66 | -51.48 | 31.48 |
| 6th Harmonic 917.0850 | -31.95 | 11.95 | -40.35 | 20.35 | -51.26 | 31.26 |
| 7th Harmonic * 1069.9325 | -59.77 | 39.77 | -58.18 | 38.18 | -55.12 | 35.12 |
| 8th Harmonic 1222.7800 | -53.45 | 33.45 | -56.12 | 36.12 | -55.12 | 35.12 |
| 9th Harmonic 1375.6275 | -58.34 | 38.34 | -58.60 | 38.60 | -58.73 | 38.73 |
| 10th Harmonic * 1528.4750 | -60.09 | 40.09 | -59.88 | 39.88 | -60.45 | 40.45 |

* Indicates Noise Floor of Measurement

SPURIOUS EMISSIONS AT ANTENNA TERMINALS

Test Data: 157.4575 MHz

| Spurious Conducted Emissions, Narrowband FM (12.5 kHz), Mask D Limit ($\geq 250\%$ Authorized BW) | High Power | | Med Power | | Low Power | |
|--|-------------|--------------|-------------|--------------|-------------|--------------|
| | dBm | 43.81 | dBm | 39.84 | dBm | 30.02 |
| | Watts | 24.04 | Watts | 9.64 | Watts | 1.00 |
| | Limit (dBm) | -20 | Limit (dBm) | -20 | Limit (dBm) | -20 |
| Frequency (MHz) | Peak (dBm) | Margin (dB) | Peak (dBm) | Margin (dB) | Peak (dBm) | Margin (dB) |
| Fundamental 157.4575 | 43.81 | 0.00 | 39.84 | 0.00 | 30.02 | 0.00 |
| 2nd Harmonic 314.9150 | -43.72 | 23.72 | -39.44 | 19.44 | -45.41 | 25.41 |
| 3rd Harmonic 472.3725 | -39.72 | 19.72 | -38.80 | 18.80 | -48.03 | 28.03 |
| 4th Harmonic 629.8300 | -31.34 | 11.34 | -32.66 | 12.66 | -43.59 | 23.59 |
| 5th Harmonic 787.2875 | -35.66 | 15.66 | -44.23 | 24.23 | -42.28 | 22.28 |
| 6th Harmonic 944.7450 | -28.52 | 8.52 | -35.56 | 15.56 | -52.85 | 32.85 |
| 7th Harmonic 1102.2025 | -53.33 | 33.33 | -56.73 | 36.73 | -55.99 | 35.99 |
| 8th Harmonic 1259.6600 | -55.10 | 35.10 | -57.43 | 37.43 | -55.58 | 35.58 |
| 9th Harmonic 1417.1175 | -57.49 | 37.49 | -60.48 | 40.48 | -60.54 | 40.54 |
| 10th Harmonic * 1574.5750 | -59.05 | 39.05 | -58.61 | 38.61 | -59.74 | 39.74 |

* Indicates Noise Floor of Measurement

SPURIOUS EMISSIONS AT ANTENNA TERMINALS

Test Data: 161.7675 MHz

| Spurious Conducted Emissions, Narrowband FM (12.5 kHz), Mask D Limit (≥250% Authorized BW) | High Power | | Med Power | | Low Power | |
|--|-------------|--------------|-------------|--------------|-------------|--------------|
| | dBm | 43.81 | dBm | 39.84 | dBm | 30.02 |
| | Watts | 24.04 | Watts | 9.64 | Watts | 1.00 |
| | Limit (dBm) | -20 | Limit (dBm) | -20 | Limit (dBm) | -20 |
| Frequency (MHz) | Peak (dBm) | Margin (dB) | Peak (dBm) | Margin (dB) | Peak (dBm) | Margin (dB) |
| Fundamental 161.7675 | 43.81 | 0.00 | 39.84 | 0.00 | 30.02 | 0.00 |
| 2nd Harmonic 323.5350 | -42.88 | 22.88 | -42.40 | 22.40 | -48.49 | 28.49 |
| 3rd Harmonic 485.3025 | -37.12 | 17.12 | -45.16 | 25.16 | -45.05 | 25.05 |
| 4th Harmonic 647.0700 | -44.27 | 24.27 | -32.69 | 12.69 | -41.25 | 21.25 |
| 5th Harmonic 808.8375 | -34.34 | 14.34 | -48.83 | 28.83 | -59.62 | 39.62 |
| 6th Harmonic 970.6050 | -38.21 | 18.21 | -37.34 | 17.34 | -60.38 | 40.38 |
| 7th Harmonic 1132.3725 | -50.47 | 30.47 | -55.38 | 35.38 | -56.91 | 36.91 |
| 8th Harmonic 1294.1400 | -59.61 | 39.61 | -59.30 | 39.30 | -59.02 | 39.02 |
| 9th Harmonic 1455.9075 | -56.68 | 36.68 | -59.03 | 39.03 | -58.75 | 38.75 |
| 10th Harmonic * 1617.6750 | -59.75 | 39.75 | -58.69 | 38.69 | -58.41 | 38.41 |

* Indicates Noise Floor of Measurement

SPURIOUS EMISSIONS AT ANTENNA TERMINALS

SPURIOUS EMISSIONS – P25 Phase I C4FM (12.5 kHz)

Test Data: 150.8075 MHz

| Spurious Conducted Emissions, C4FM (12.5 kHz), Mask D Limit ($\geq 250\%$ Authorized BW) | | High Power | | Med Power | | Low Power | |
|---|-------------|-------------|--------------|-------------|--------------|-------------|--------------|
| | | dBm | 43.81 | dBm | 39.84 | dBm | 30.02 |
| | | Watts | 24.04 | Watts | 9.64 | Watts | 1.00 |
| | | Limit (dBm) | -20 | Limit (dBm) | -20 | Limit (dBm) | -20 |
| Frequency (MHz) | | Peak (dBm) | Margin (dB) | Peak (dBm) | Margin (dB) | Peak (dBm) | Margin (dB) |
| Fundamental | 150.8075 | 43.81 | 0.00 | 39.84 | 0.00 | 30.02 | 0.00 |
| 2nd Harmonic | 301.6150 | -40.54 | 20.54 | -39.48 | 19.48 | -43.82 | 23.82 |
| 3rd Harmonic | 452.4225 | -36.70 | 16.70 | -43.92 | 23.92 | -52.32 | 32.32 |
| 4th Harmonic | 603.2300 | -30.73 | 10.73 | -36.10 | 16.10 | -47.09 | 27.09 |
| 5th Harmonic | 754.0375 | -44.30 | 24.30 | -45.26 | 25.26 | -50.86 | 30.86 |
| 6th Harmonic | 904.8450 | -32.05 | 12.05 | -43.23 | 23.23 | -49.28 | 29.28 |
| 7th Harmonic | 1055.6525 | -59.35 | 39.35 | -58.23 | 38.23 | -54.06 | 34.06 |
| 8th Harmonic | 1206.4600 | -52.31 | 32.31 | -54.48 | 34.48 | -54.34 | 34.34 |
| 9th Harmonic | 1357.2675 | -57.84 | 37.84 | -57.29 | 37.29 | -57.29 | 37.29 |
| 10th Harmonic | * 1508.0750 | -59.50 | 39.50 | -59.70 | 39.70 | -58.88 | 38.88 |

* Indicates Noise Floor of Measurement

SPURIOUS EMISSIONS AT ANTENNA TERMINALS

Test Data: 152.8475 MHz

| Spurious Conducted Emissions, C4FM (12.5 kHz), Mask D Limit ($\geq 250\%$ Authorized BW) | High Power | | Med Power | | Low Power | |
|---|-------------|--------------|-------------|--------------|-------------|--------------|
| | dBm | 43.81 | dBm | 39.84 | dBm | 30.02 |
| | Watts | 24.04 | Watts | 9.64 | Watts | 1.00 |
| | Limit (dBm) | -20 | Limit (dBm) | -20 | Limit (dBm) | -20 |
| Frequency (MHz) | Peak (dBm) | Margin (dB) | Peak (dBm) | Margin (dB) | Peak (dBm) | Margin (dB) |
| Fundamental 152.8475 | 43.81 | 0.00 | 39.84 | 0.00 | 30.02 | 0.00 |
| 2nd Harmonic 305.6950 | -41.65 | 21.65 | -38.67 | 18.67 | -43.98 | 23.98 |
| 3rd Harmonic 458.5425 | -37.09 | 17.09 | -41.28 | 21.28 | -50.68 | 30.68 |
| 4th Harmonic 611.3900 | -30.13 | 10.13 | -36.42 | 16.42 | -46.96 | 26.96 |
| 5th Harmonic 764.2375 | -41.16 | 21.16 | -46.50 | 26.50 | -51.24 | 31.24 |
| 6th Harmonic 917.0850 | -31.90 | 11.90 | -39.84 | 19.84 | -51.63 | 31.63 |
| 7th Harmonic 1069.9325 | -58.88 | 38.88 | -57.62 | 37.62 | -55.12 | 35.12 |
| 8th Harmonic 1222.7800 | -54.85 | 34.85 | -56.20 | 36.20 | -54.56 | 34.56 |
| 9th Harmonic 1375.6275 | -58.74 | 38.74 | -56.65 | 36.65 | -56.21 | 36.21 |
| 10th Harmonic * 1528.4750 | -59.46 | 39.46 | -58.88 | 38.88 | -59.46 | 39.46 |

* Indicates Noise Floor of Measurement

SPURIOUS EMISSIONS AT ANTENNA TERMINALS

Test Data: 157.4575 MHz

| Spurious Conducted Emissions, C4FM (12.5 kHz), Mask D Limit ($\geq 250\%$ Authorized BW) | High Power | | Med Power | | Low Power | |
|---|-------------|--------------|-------------|--------------|-------------|--------------|
| | dBm | 43.81 | dBm | 39.84 | dBm | 30.02 |
| | Watts | 24.04 | Watts | 9.64 | Watts | 1.00 |
| | Limit (dBm) | -20 | Limit (dBm) | -20 | Limit (dBm) | -20 |
| Frequency (MHz) | Peak (dBm) | Margin (dB) | Peak (dBm) | Margin (dB) | Peak (dBm) | Margin (dB) |
| Fundamental 157.4575 | 43.81 | 0.00 | 39.84 | 0.00 | 30.02 | 0.00 |
| 2nd Harmonic 314.9150 | -43.17 | 23.17 | -39.67 | 19.67 | -45.99 | 25.99 |
| 3rd Harmonic 472.3725 | -35.94 | 15.94 | -42.03 | 22.03 | -49.17 | 29.17 |
| 4th Harmonic 629.8300 | -31.92 | 11.92 | -33.99 | 13.99 | -43.69 | 23.69 |
| 5th Harmonic 787.2875 | -35.66 | 15.66 | -54.79 | 34.79 | -54.62 | 34.62 |
| 6th Harmonic 944.7450 | -28.44 | 8.44 | -35.55 | 15.55 | -52.01 | 32.01 |
| 7th Harmonic 1102.2025 | -52.80 | 32.80 | -55.12 | 35.12 | -56.99 | 36.99 |
| 8th Harmonic 1259.6600 | -54.60 | 34.60 | -56.53 | 36.53 | -56.13 | 36.13 |
| 9th Harmonic 1417.1175 | -57.39 | 37.39 | -60.48 | 40.48 | -59.83 | 39.83 |
| 10th Harmonic * 1574.5750 | -59.51 | 39.51 | -60.14 | 40.14 | -59.49 | 39.49 |

* Indicates Noise Floor of Measurement

SPURIOUS EMISSIONS AT ANTENNA TERMINALS

Test Data: 161.7675 MHz

| Spurious Conducted Emissions, C4FM (12.5 kHz), Mask D Limit ($\geq 250\%$ Authorized BW) | High Power | | Med Power | | Low Power | |
|---|-------------|--------------|-------------|--------------|-------------|--------------|
| | dBm | 43.81 | dBm | 39.84 | dBm | 30.02 |
| | Watts | 24.04 | Watts | 9.64 | Watts | 1.00 |
| | Limit (dBm) | -20 | Limit (dBm) | -20 | Limit (dBm) | -20 |
| Frequency (MHz) | Peak (dBm) | Margin (dB) | Peak (dBm) | Margin (dB) | Peak (dBm) | Margin (dB) |
| Fundamental 161.7675 | 43.81 | 0.00 | 39.84 | 0.00 | 30.02 | 0.00 |
| 2nd Harmonic 323.5350 | -41.89 | 21.89 | -41.46 | 21.46 | -47.93 | 27.93 |
| 3rd Harmonic 485.3025 | -33.46 | 13.46 | -41.41 | 21.41 | -43.21 | 23.21 |
| 4th Harmonic 647.0700 | -45.66 | 25.66 | -33.19 | 13.19 | -40.84 | 20.84 |
| 5th Harmonic 808.8375 | -35.22 | 15.22 | -49.59 | 29.59 | -59.39 | 39.39 |
| 6th Harmonic 970.6050 | -38.94 | 18.94 | -37.20 | 17.20 | -59.57 | 39.57 |
| 7th Harmonic 1132.3725 | -50.41 | 30.41 | -56.93 | 36.93 | -58.13 | 38.13 |
| 8th Harmonic * 1294.1400 | -59.91 | 39.91 | -59.21 | 39.21 | -59.72 | 39.72 |
| 9th Harmonic 1455.9075 | -56.07 | 36.07 | -58.94 | 38.94 | -59.45 | 39.45 |
| 10th Harmonic * 1617.6750 | -59.30 | 39.30 | -58.60 | 38.60 | -59.11 | 39.11 |

* Indicates Noise Floor of Measurement

FIELD STRENGTH OF SPURIOUS EMISSIONS

FCC Rule Parts: FCC Part 2.1053(a), 22.359(a)

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

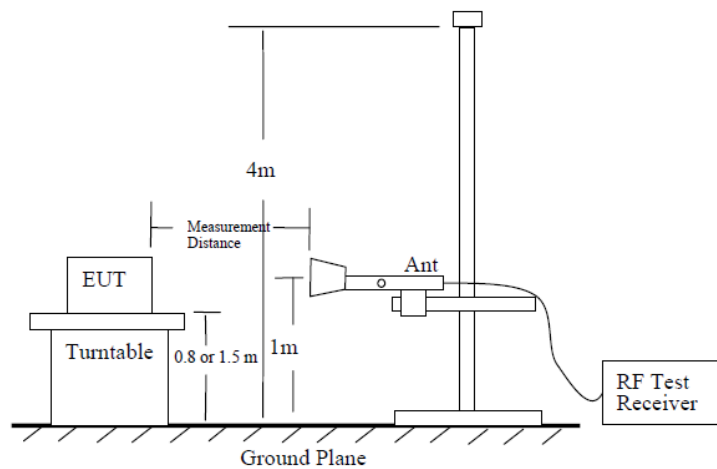
The limit below conforms to FCC CFR 47 Part 90.210(d)(3) and in all cases is more strict than that set forth in this rulepart. Please refer below:

FCC Rule Parts: 90.210(d)(3)

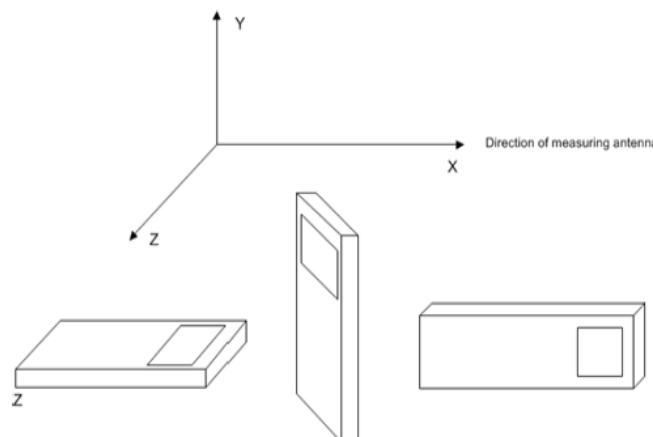
(3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 12.5 kHz: At least $50 + 10 \log (P)$ dB or 70 dB, whichever is the lesser attenuation.

Method of Measurement: ANSI C63.26, 5.5.4

Test Site Setup:



EUT Orientation(s):





Note: The tabulated data shows the results of the radiated field strength emissions test. The spectrum was scanned from the lowest frequency generated internally to at least the tenth harmonic of the fundamental. This test was conducted in accordance with the standard listed above using the substitution method. Measurements were made at the test site of TIMCO ENGINEERING, INC. located at 849 NW State Road 45, Newberry, FL 32669. The measurements below represent the worst case of all the frequencies tested.

Note: The six (6) highest emissions or more of each worst-case operational modes of the EUT are represented below. Emissions 20 dB below the limit are not required to be reported.

FIELD STRENGTH OF SPURIOUS EMISSIONS

Test Data: 150.8075 MHz

Low Power

| Power Output | | Limit | | |
|----------------|------------------------|------------------|----------------|-------------|
| dBm | Watts | dBc | dBm | |
| 30.02 | 1.00 | 50.02 | -20.00 | |
| Tuned Freq MHz | Emission Frequency MHz | Antenna Polarity | ERP (dBm) | Margin (dB) |
| 150.81 | 603.23 | V | -44.188 | 24.19 |
| 150.81 | 603.23 | H | -43.218 | 23.22 |

Medium Power

| Power Output | | Limit | | |
|----------------|------------------------|------------------|----------------|-------------|
| dBm | Watts | dBc | dBm | |
| 39.84 | 9.64 | 59.84 | -20.00 | |
| Tuned Freq MHz | Emission Frequency MHz | Antenna Polarity | ERP (dBm) | Margin (dB) |
| 150.81 | 603.23 | H | -33.278 | 13.28 |
| 150.81 | 603.23 | V | -32.348 | 12.35 |
| 150.81 | 904.84 | V | -36.972 | 16.97 |
| 150.81 | 904.84 | H | -35.912 | 15.91 |

High Power

| Power Output | | Limit | | |
|----------------|------------------------|------------------|----------------|-------------|
| dBm | Watts | dBc | dBm | |
| 43.81 | 24.04 | 63.81 | -20.00 | |
| Tuned Freq MHz | Emission Frequency MHz | Antenna Polarity | ERP (dBm) | Margin (dB) |
| 150.81 | 904.84 | H | -27.452 | 7.45 |
| 150.81 | 904.84 | V | -28.232 | 8.23 |
| 150.81 | 754.04 | H | -40.273 | 20.27 |
| 150.81 | 603.23 | H | -27.948 | 7.95 |
| 150.81 | 603.23 | V | -26.928 | 6.93 |

FIELD STRENGTH OF SPURIOUS EMISSIONS

Test Data: 152.8475 MHz

Low Power

| Power Output | | Limit | | |
|----------------|------------------------|------------------|----------------|-------------|
| dBm | Watts | dBc | dBm | |
| 30.02 | 1.00 | 50.02 | -20.00 | |
| Tuned Freq MHz | Emission Frequency MHz | Antenna Polarity | ERP (dBm) | Margin (dB) |
| 152.85 | 611.39 | H | -39.016 | 19.02 |
| 152.85 | 611.39 | V | -35.866 | 15.87 |
| 152.85 | 917.09 | H | -40.306 | 20.31 |
| 152.85 | 917.09 | V | -37.096 | 17.10 |

Medium Power

| Power Output | | Limit | | |
|----------------|------------------------|------------------|----------------|-------------|
| dBm | Watts | dBc | dBm | |
| 39.84 | 9.64 | 59.84 | -20.00 | |
| Tuned Freq MHz | Emission Frequency MHz | Antenna Polarity | ERP (dBm) | Margin (dB) |
| 152.85 | 611.39 | H | -27.346 | 7.35 |
| 152.85 | 611.39 | V | -24.036 | 4.04 |
| 152.85 | 917.09 | H | -30.336 | 10.34 |
| 152.85 | 917.09 | V | -27.016 | 7.02 |

High Power

| Power Output | | Limit | | |
|----------------|------------------------|------------------|----------------|-------------|
| dBm | Watts | dBc | dBm | |
| 43.81 | 24.04 | 63.81 | -20.00 | |
| Tuned Freq MHz | Emission Frequency MHz | Antenna Polarity | ERP (dBm) | Margin (dB) |
| 150.81 | 904.84 | H | -27.452 | 7.45 |
| 150.81 | 904.84 | V | -28.232 | 8.23 |
| 150.81 | 754.04 | H | -40.273 | 20.27 |
| 150.81 | 603.23 | H | -27.948 | 7.95 |
| 150.81 | 603.23 | V | -26.928 | 6.93 |

FIELD STRENGTH OF SPURIOUS EMISSIONS

Test Data: 157.4575 MHz

Low Power

| Power Output | | Limit | | |
|----------------|------------------------|------------------|-----------|-------------|
| dBm | Watts | dBc | dBm | |
| 30.02 | 1.00 | 50.02 | -20.00 | |
| Tuned Freq MHz | Emission Frequency MHz | Antenna Polarity | ERP (dBm) | Margin (dB) |
| 157.45 | 629.77 | H | -41.808 | 21.81 |
| 157.45 | 629.77 | V | -40.428 | 20.43 |

Medium Power

| Power Output | | Limit | | |
|----------------|------------------------|------------------|-----------|-------------|
| dBm | Watts | dBc | dBm | |
| 39.84 | 9.64 | 59.84 | -20.00 | |
| Tuned Freq MHz | Emission Frequency MHz | Antenna Polarity | ERP (dBm) | Margin (dB) |
| 157.45 | 629.83 | V | -21.918 | 1.92 |
| 157.45 | 629.83 | H | -26.928 | 6.93 |
| 157.45 | 944.74 | V | -21.278 | 1.28 |
| 157.45 | 944.74 | H | -23.988 | 3.99 |

High Power

| Power Output | | Limit | | |
|----------------|------------------------|------------------|-----------|-------------|
| dBm | Watts | dBc | dBm | |
| 43.81 | 24.04 | 63.81 | -20.00 | |
| Tuned Freq MHz | Emission Frequency MHz | Antenna Polarity | ERP (dBm) | Margin (dB) |
| 157.46 | 629.83 | V | -22.718 | 2.72 |
| 157.46 | 629.83 | H | -24.308 | 4.31 |
| 157.46 | 787.29 | V | -30.860 | 10.86 |
| 157.46 | 787.29 | H | -26.920 | 6.92 |
| 157.46 | 944.74 | V | -21.298 | 1.30 |
| 157.46 | 944.74 | H | -21.848 | 1.85 |

FIELD STRENGTH OF SPURIOUS EMISSIONS

Test Data: 161.7675 MHz

Low Power

| Power Output | | Limit | | |
|----------------|------------------------|------------------|-----------|-------------|
| dBm | Watts | dBc | dBm | |
| 30.02 | 1.00 | 50.02 | -20.00 | |
| Tuned Freq MHz | Emission Frequency MHz | Antenna Polarity | ERP (dBm) | Margin (dB) |
| 161.77 | 647.07 | H | -39.387 | 19.39 |
| 161.77 | 647.07 | V | -41.267 | 21.27 |

Medium Power

| Power Output | | Limit | | |
|----------------|------------------------|------------------|-----------|-------------|
| dBm | Watts | dBc | dBm | |
| 39.84 | 9.64 | 59.84 | -20.00 | |
| Tuned Freq MHz | Emission Frequency MHz | Antenna Polarity | ERP (dBm) | Margin (dB) |
| 161.77 | 647.07 | H | -29.767 | 9.77 |
| 161.77 | 647.07 | V | -29.907 | 9.91 |
| 161.77 | 970.60 | V | -26.745 | 6.74 |
| 161.77 | 970.60 | H | -26.945 | 6.94 |

High Power

| Power Output | | Limit | | |
|----------------|------------------------|------------------|-----------|-------------|
| dBm | Watts | dBc | dBm | |
| 43.81 | 24.04 | 63.81 | -20.00 | |
| Tuned Freq MHz | Emission Frequency MHz | Antenna Polarity | ERP (dBm) | Margin (dB) |
| 161.77 | 970.60 | V | -24.205 | 4.20 |
| 161.77 | 970.60 | H | -24.405 | 4.40 |
| 161.77 | 808.84 | H | -31.712 | 11.71 |
| 161.77 | 808.84 | V | -31.942 | 11.94 |
| 161.77 | 647.07 | V | -39.227 | 19.23 |
| 161.77 | 647.07 | H | -35.827 | 15.83 |

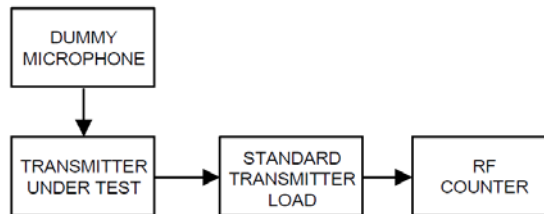
FREQUENCY STABILITY

FCC Rule Parts: FCC Part 2.1055(a)(2), 22.355

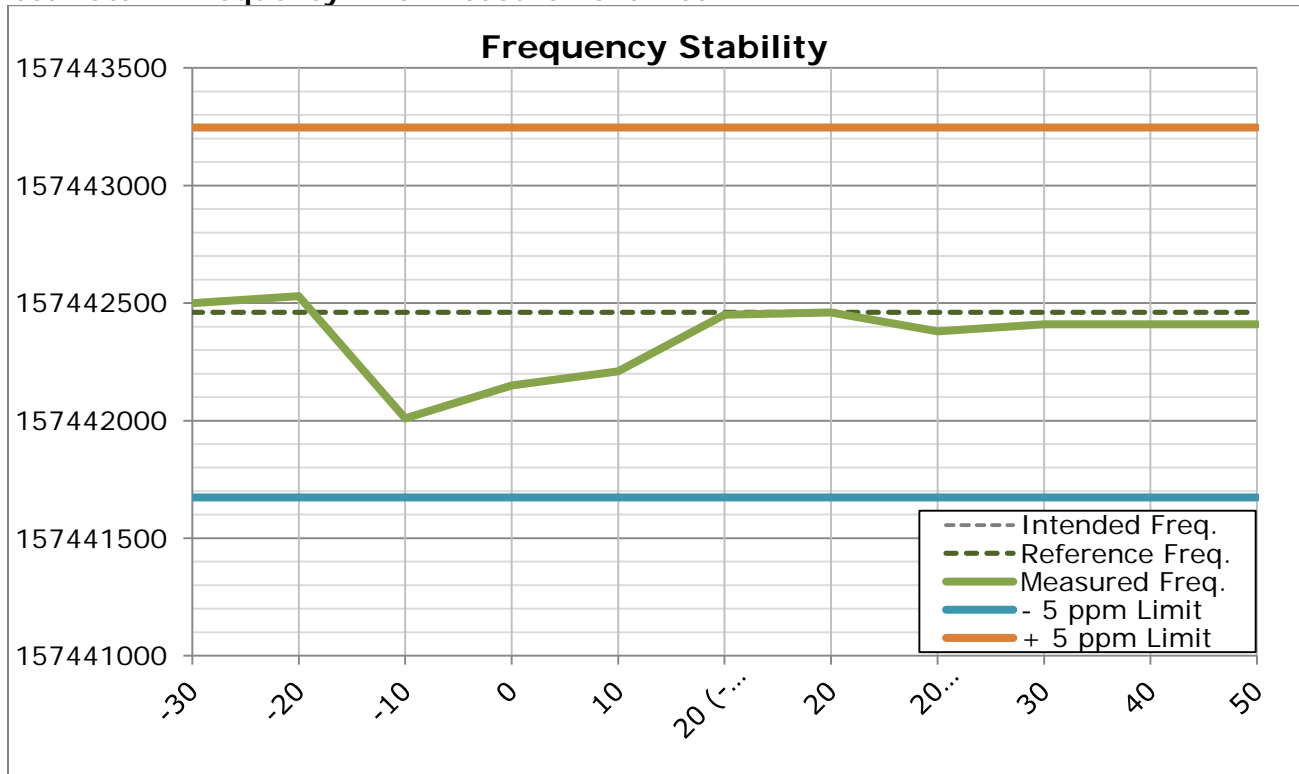
TABLE C-1—FREQUENCY TOLERANCE FOR TRANSMITTERS IN THE PUBLIC MOBILE SERVICES

| Frequency range (MHz) | Base, fixed (ppm) | Mobile >3 watts (ppm) | Mobile ≤3 watts (ppm) |
|-----------------------|-------------------|-----------------------|-----------------------|
| 50 to 450 | 5.0 | 5.0 | 50.0 |

Method of Measurements: TIA 603-E, 2.2.2



Test Data: Frequency Error Measurement Plot



FREQUENCY STABILITY

Test Data: Frequency Error Measurement Table

| Limit: | | 5 | ppm | |
|------------------|------------------------|-------------------------|-----------------------------------|----------------|
| Temperature (°C) | Supplied Voltage (VDC) | Intended Frequency (Hz) | Measured Reference Frequency (Hz) | Deviation (Hz) |
| 20°C (reference) | 13.8 | 157440000 | 157442460 | -2460 |

| @ 20°C (reference) | | | | |
|----------------------|------------------------|----------------|----------------|-------|
| Supplied Voltage (%) | Supplied Voltage (VDC) | Frequency (Hz) | Deviation (Hz) | PPM |
| -15% | 11.73 | 157442450 | 10 | 0.064 |
| 15% | 15.87 | 157442380 | 80 | 0.508 |

| Temperature (°C) | Supplied Voltage (VDC) | Frequency (Hz) | Deviation (Hz) | PPM |
|------------------|------------------------|----------------|----------------|--------|
| 50 | 13.8 | 157442410 | 50 | 0.318 |
| 40 | 13.8 | 157442410 | 50 | 0.318 |
| 30 | 13.8 | 157442410 | 50 | 0.318 |
| 20 | 13.8 | 157442460 | 0 | 0.000 |
| 10 | 13.8 | 157442210 | 250 | 1.588 |
| 0 | 13.8 | 157442150 | 310 | 1.969 |
| -10 | 13.8 | 157442010 | 450 | 2.858 |
| -20 | 13.8 | 157442530 | 70 | -0.445 |
| -30 | 13.8 | 157442500 | 40 | -0.254 |

RESULT: Meets Requirements

STATEMENT OF MEASUREMENT UNCERTAINTY

The data and results referenced in this document are true and accurate. The measurement uncertainty was calculated for all measurements listed in this test report according To CISPR 16-4 or ENTR 100-028 Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: “Uncertainty in EMC Measurements” and is documented in the Timco Engineering, Inc. quality system according to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Hereafter the best measurement capability for Timco Engineering, Inc. is reported:

| Test Items | Measurement Uncertainty | Notes |
|---|-------------------------|-------|
| RF Frequency Accuracy | ± 49.5 Hz | (1) |
| RF Conducted Power | ±0.93dB | (1) |
| Conducted spurious emission of transmitter valid up to 40GHz | ± 1.86dB | |
| Occupied Bandwidth | ± 2.65% | |
| Audio Frequency Response | ± 1.86dB | |
| Modulation limiting | ± 1.88% | |
| Radiated RF Power | ± 1.4dB | |
| Maximum frequency deviation: Within 300 Hz and 6kHz of audio freq. | ± 1.88% | |
| Within 6kHz and 25kHz of audio Freq. | ± 2.04% | |
| Rad Emissions Sub Meth up to 26.5GHz | ± 2.14dB | |
| Adjacent channel power | ± 1.47dB | (1) |
| Transient Frequency Response | ± 1.88% | |
| Temperature | ± 1.0°C | (1) |
| Humidity | ± 5.0% | |

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k=1.96$.

EMC EQUIPMENT LIST

| Device | Manufacturer | Model | Serial Number | Cal/Char Date | Due Date |
|--|--------------------|------------------------------|--|---------------|----------|
| Coaxial Cable - BMBM-0065-01 Black DC-2G | Belden | | BMBM-0065-01 | 07/18/16 | 07/18/18 |
| Antenna: Biconical 1096 | Eaton | 94455-1 | 1096 | 08/01/17 | 08/01/19 |
| Antenna: Log-Periodic 1122 | Electro-Metrics | LPA-25 | 1122 | 07/26/17 | 07/26/19 |
| Temperature Chamber LARGE | Tenney Engineering | TTRC | 11717-7 | 09/01/16 | 09/01/18 |
| Frequency Counter Small Chamber | HP | 5385A | 3242A07460 | 08/22/17 | 08/22/19 |
| Coaxial Cable - Chamber 3 cable set (backup) | Micro-Coax | Chamber 3 cable set (backup) | KMKM-0244-02 KMKM-0670-01 KFKF-0197-00 | N/A | N/A |
| CHAMBER | Panashield | 3M | N/A | 04/25/16 | 5/31/18 |
| Antenna: Double-Ridged Horn/ETS Horn 2 | ETS-Lindgren | 3117 | 00041534 | 03/01/17 | 03/01/19 |
| Software: Field Strength Program | Timco | N/A | Version 4.10.7.0 | N/A | N/A |
| Antenna: Passive Loop | EMCO | 6512 | 9706-1211 | 07/26/17 | 07/26/19 |
| Type K J Thermometer | Martel | 303 | 080504494 | 11/02/17 | 11/02/19 |
| EMI Test Receiver R & S ESIB 40 | Rohde & Schwarz | ESIB 40 | 100274 | 08/18/16 | 08/18/18 |
| EMI Test Receiver R & S ESU 40 | Rohde & Schwarz | ESU 40 | 100320 | 04/01/16 | 04/01/19 |
| Attenuator N 20dB 20W DC-12G | Narda | 768-20-SP | 155 | 07/10/17 | 07/10/19 |
| Attenuator N 20dB 20W DC-12G | Narda | 768-20-SP | 344 | 07/10/17 | 07/10/19 |
| Attenuator N 30dB 100W DC-6G | Pasternack | PE7214-30 | #109 | 05/24/17 | 05/24/19 |
| Attenuator BNC 10dB DC-2G | MiniCircuits | HAT-10+ | #54 | 07/14/17 | 07/14/19 |
| Bore-sight Antenna Positioning Tower | Sunol Sciences | TLT2 | N/A | N/A | N/A |
| Tunable Notch Filter 250-850 MHz | Eagle | TNF-200 | 250-850 MHz (#19) | 11/19/17 | 11/19/19 |
| Terminator N 20W DC-18G | Narda | 8205 | #14 | 04/06/17 | 04/06/19 |
| Attenuator BNC 6dB 50Ohm DC-2G | Mini-Circuits | HAT-6+ | #53 | 07/14/17 | 07/14/19 |
| Attenuator N 30dB 100W DC-6G | Pasternack | PE7214-30 | #109 | 05/24/17 | 05/23/19 |
| DC Power Supply | HP | 6286A | 1744A03842 | N/A | N/A |
| Modulation Analyzer | HP | 8901A | 3050A05856 | 04/13/17 | 04/13/19 |
| Function Generator | Standford | DS340 | 25200 | 02/21/18 | 02/21/20 |
| Terminator N 20W DC-18G | Narda | 8205 | #14 | 04/06/17 | 04/06/19 |

*EMI RECEIVER SOFTWARE VERSION

The receiver firmware used was version 4.43 Service Pack 3

END OF TEST REPORT