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FCC

VHF PORTABLE PART 90

TEST REPORT

| | |
|-----------------------------|--|
| APPLICANT | CATTRON-THEIMEG INCORPORATED |
| | 58 W. SHENANGO STREET SHARPSVILLE PA 16150-1198 USA |
| FCC ID | CN279546-91071 |
| MODEL NUMBER | 79546+91071 TRX |
| PRODUCT DESCRIPTION | 220 MHz RF MODULE |
| STANDARD APPLIED | CFR 47 Part 90 |
| DATE SAMPLE RECEIVED | 10/27/2014 |
| DATE TESTED | 12/4/2014 |
| REPORT ISSUE DATE | 12/4/2014 |
| TESTED BY | Sid Sanders |
| APPROVED BY | Cory Leverett |
| TIMCO REPORT NO. | 1935AUT14TestReport.docx |
| TEST RESULTS | <input checked="" type="checkbox"/> PASS <input type="checkbox"/> FAIL |

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

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GENERAL REMARKS

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Summary

The device under test does:

- fulfill the general approval requirements as identified in this test report
- 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: 2005 requirements.

I attest that the necessary measurements were made, under my supervision, at:

Timco Engineering Inc.
849 NW State Road 45
Newberry, FL 32669

Authorized Signatory Name:

A handwritten signature in black ink is overlaid on a circular blue ink stamp. The stamp contains the text 'TMC ENGINEERING INC.' around the perimeter and 'FCC ID: 2AB2A' in the center. The signature appears to be 'Colas'.

Engineering Project Manager

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GENERAL INFORMATION

EUT Specification

| | |
|------------------------------------|---|
| EUT Description | 220 MHz RF MODULE |
| FCC ID | CN279546-91071 |
| Model Number | 79546+91071 TRX |
| Frequency Range | 216-222 MHz |
| Test Frequencies | 216.5, 220, 221.5 MHz |
| No. of Channels | 216-222 MHz |
| Type of Emission | 7K60F1D, |
| Modulation | FM |
| EUT Power Source | <input type="checkbox"/> 110–120Vac/50– 60Hz |
| | <input checked="" type="checkbox"/> DC Power 12V |
| | <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 |
| Test Conditions | The temperature was 24-26°C with a relative humidity of 50- 65%. |
| Revision History to the EUT | None |
| Test Exercise | The EUT was placed in continuous transmit mode. |
| Applicable Standards | ANSI/TIA 603-C:2004, FCC CFR 47 Part 90 |
| Test Facility | Timco Engineering Inc. 849 NW State Road 45 Newberry, FL 32669 USA. |

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TEST REPORT SUMMARY

| Rule Part No. | Scope of Work | Status Pass/Fail/NA |
|--|--|------------------------|
| <u>Part 2.1033(c)(8),</u> <u>Part 2.1046(a), Part 90</u> | RF Power Output | PASS |
| <u>Part 2.1033(c) (4)</u> <u>Part 2.1047(a)(6)</u> | Modulation Characteristics | PASS |
| <u>2.1049(c),</u> <u>90.210(b), 90.210 (c)</u> <u>90.210(d), 90.210(e)</u> | Emission Mask and Occupied Bandwidths | PASS |
| <u>2.1051(a)</u> | Antenna Conducted Emissions | PASS |
| <u>2.1053, Part 90</u> | Field Strength Spurious Emissions | PASS |
| <u>Part 2.1055, Part 90.213</u> | Frequency Stability | PASS |

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TEST PROCEDURE

Power Line Conducted Interference: The procedure used was ANSI/TIA 603-D:2010, using a 50uH LISN. Both lines were observed with the EUT transmitting. The bandwidth of the spectrum analyzer was 10 kHz with an appropriate sweep speed.

Bandwidth 20 dB: The measurements were made with the spectrum analyzer's resolution bandwidth (RBW) = 1 MHz and the video bandwidth (VBW) = 3 MHz and the span set as shown on plot.

Power Output: The RF power output was measured at the antenna feed point using a peak power meter.

Antenna Conducted Emissions: The RBW = 100 kHz, VBW = 300 kHz and the span set to 10.0 MHz and the spectrum was scanned from 30 MHz to the 10th harmonic of the fundamental. Above 1 GHz the resolution bandwidth was 1 MHz and the VBW = 3 MHz and the span to 50 MHz.

Radiation Interference: The test procedure used was ANSI/TIA 603-D:2010, using an Rohde & Schwarz – EMI test receiver. The bandwidth (RBW) of the spectrum receiver was 100 kHz up to 1 GHz and 1 MHz above 1 GHz with an appropriate sweep speed. The VBW above 1 GHz was 3 MHz. The analyzer was calibrated in dB above a microvolt at the output of the antenna.

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RF POWER OUTPUT

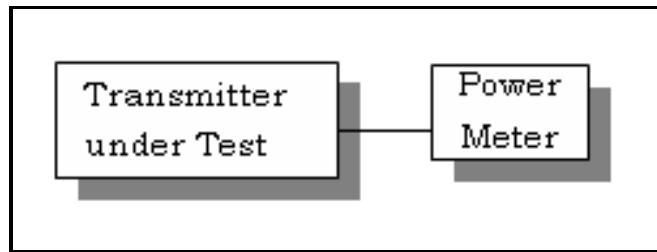
Rule Part No.: Part 2.1046(a), Part 90

Test Requirements: Manufacturer's Specification

Method of Measurement: RF power is measured by using a 50-ohm, resistive wattmeter to the RF output connector. With a nominal battery voltage (if battery operated), or a properly adjusted power supply (if not battery operated), and the transmitter properly adjusted the RF output measures:

For the device with a fixed or integral antenna, the RF power is measured as ERP. The substitution method was used. The RF output measures:

Test Setup Diagram:



Test Data: RF power of the EUT can be set at 1.5watts.

OUTPUT POWER:

| Tuned Frequency (MHz) | RF POWER (W) | |
|-----------------------|--------------|-----|
| | dBm | W |
| 216.5 | 31.8 | 1.5 |
| 217.0 | 31.4 | 1.5 |
| 220.0 | 31.4 | 1.4 |
| 222.0 | 31.8 | 1.5 |

Part 2.1033 (C)(8) DC Input into the final amplifier

FOR DC POWER SETTING INPUT POWER: (13.6V)(.147A) = 7.2Watts

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MODULATION CHARACTERISTICS

Rule Part No.: Part 2.1047(a)(b)

Test Requirements:

Method of Measurement:

Part 2.1033(c)

Part 90.209

Part 90.207

Part 2.1033(c) (4) Type of Emission: 7K60F1D, 7K60F1E, 7K60F1W, 7K60FXE, 7K60FXD

Audio frequency response

The audio frequency response was measured in accordance with ANSI/TIA 603-D: 2010. A curve or equivalent data showing the frequency response of the audio modulating circuit over a range of 100 – 5000Hz shall be submitted. The audio frequency response curve is shown below.

NOT APPLICABLE NO AUDIO.

VOICE MODULATED COMMUNICATION EQUIPMENT

Part 2.1047(a): For equipment required to have an audio low-pass filter, a curve showing the frequency response of the filter, or of all the circuitry installed between the modulation limiter and the modulated stage shall be submitted.

NOT APPLICABLE NO AUDIO.

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MODULATION CHARACTERISTICS

AUDIO INPUT VERSUS MODULATION

Rule Part No.: Part 2.1047(b) & 90

Test Requirements:

Method of Measurement: **Modulation cannot exceed 100%**, The audio input level needed for a particular percentage of modulation was measured in accordance with ANSI/TIA 603-D: 2010. The audio input curves versus modulation are shown below. Curves are provided for audio input frequencies of 300, 1000, and 3000 Hz.

NOT APPLICABLE NO AUDIO.

OCCUPIED BANDWIDTH

Part 2.1049(c) EMISSION BANDWIDTH:

Part 90.210(b) 25kHz Channel Spacing

Data in the plots show that on any frequency removed from the assigned frequency by more than 50%, but not more than 100%: At least 25dB. On any frequency removed from the assigned frequency by more than 100%, but not more than 250%: At least 35 dB. On any frequency removed from the assigned frequency by more than 250%, of the authorized bandwidth: At least $43 + 10\log(P)$ dB.

Part 90.210(c) 25 kHz Channel Spacing Not Equipped with a Low Pass Filter

For transmitters that are not equipped with an audio low pass filter pursuant to S90.211 (b), the power of any emission must be attenuated below the unmodulated carrier output power as follows; (1) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 5 kHz but not more than 10 kHz: At least $83 \log(fd/5)$ dB; (2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 10 kHz, but not more than 250% of the authorized bandwidth: At least $29 \log(fd/11)$ dB or 50 dB, whichever is the lesser attenuation; (3) On any frequency removed from the center of the authorized bandwidth by more than 250% of the authorized bandwidth: At least $43 + 10 \log(Po)$ dB.

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MODULATION CHARACTERISTICS

Part 90.210(d) Emission Mask D - 12.5 kHz channel BW 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 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 $7.27 + 10\log(f_d - 5.625)$ 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.

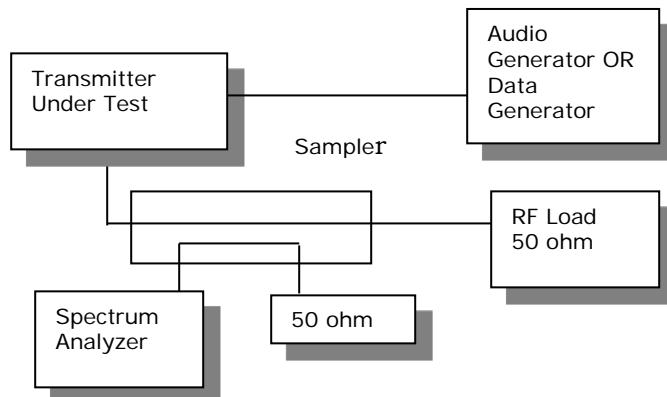
Part 90.210(e) Emission Mask E – 6.25 kHz channel BW equipment.

For transmitters designed to operate with a 6.25 kHz 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 3.0 kHz removed from f_0 : Zero dB.
- (2) On any frequency from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 3.0 kHz but no more than 4.6 kHz: At least $30 + 16.67(f_d - 3.0)$ dB or $55 + 10\log(P)$ or 65, whichever is the lesser attenuation.
- (3) On any frequency removed from the center of the authorized bandwidth by more than 4.6 kHz: At least $55 + 10\log(P)$ dB or 65 dB, whichever is the lesser attenuation.

Method of Measurement: ANSI/TIA 603-D: 2010

Test Setup Diagram:



Test Data: See the plots below

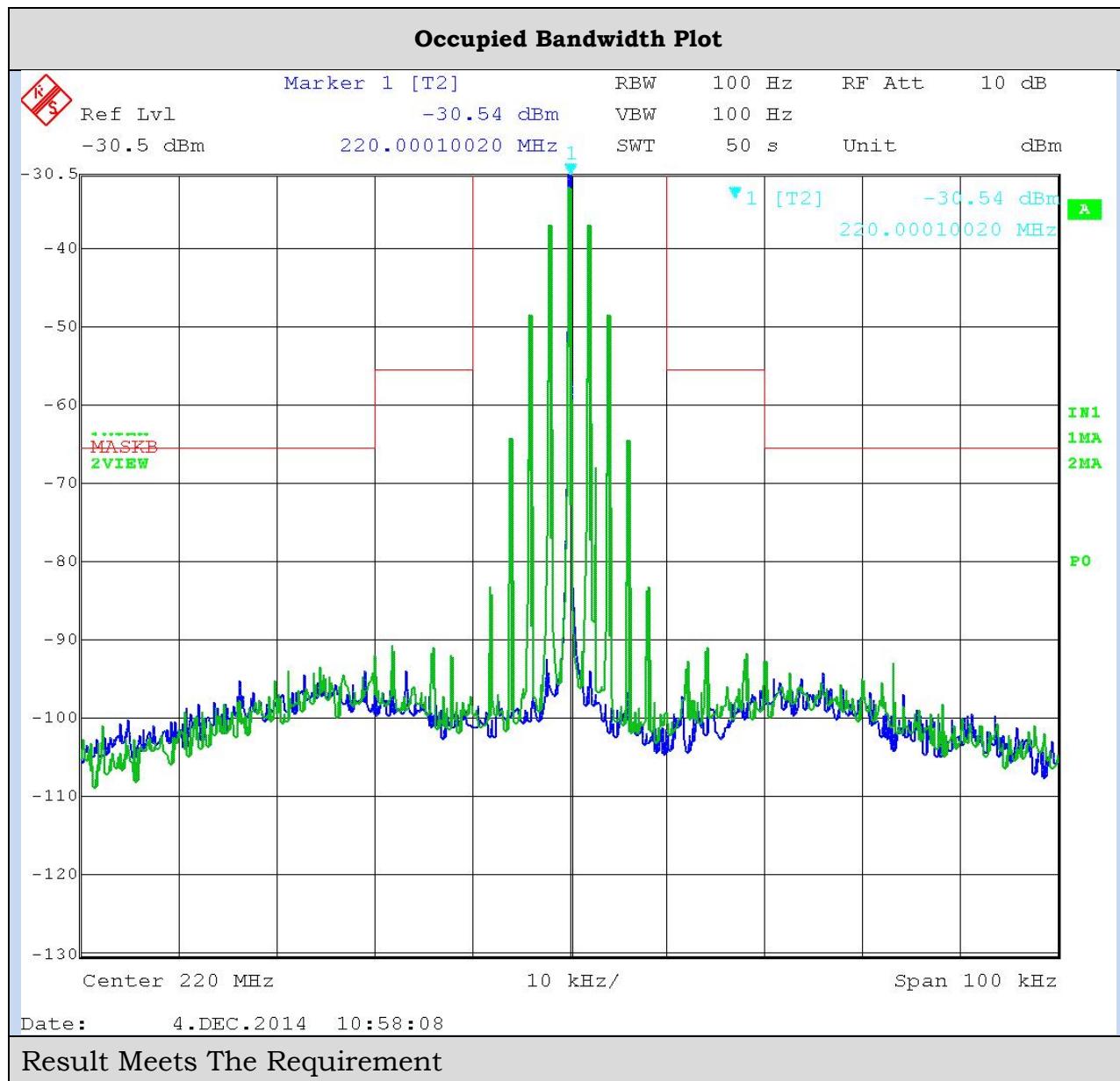
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OCCUPIED BANDWIDTH PLOTS: 3FSK

Part 90.210(D) Emission Mask D - 12.5 KHz Channel Bandwidth - DIGITAL



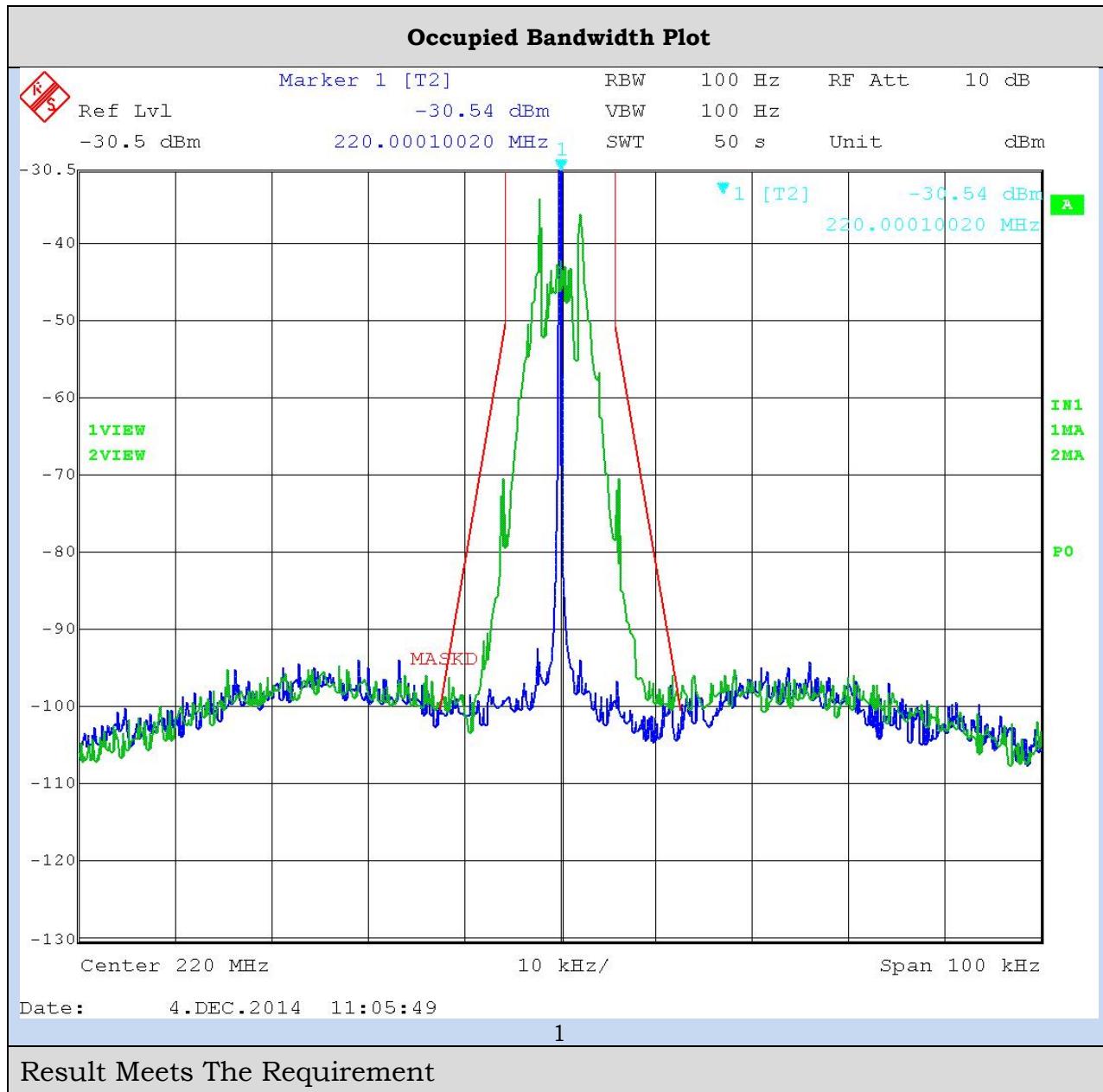
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Part 90.210(D) Emission Mask D - 12.5 KHz Channel Bandwidth - DIGITAL

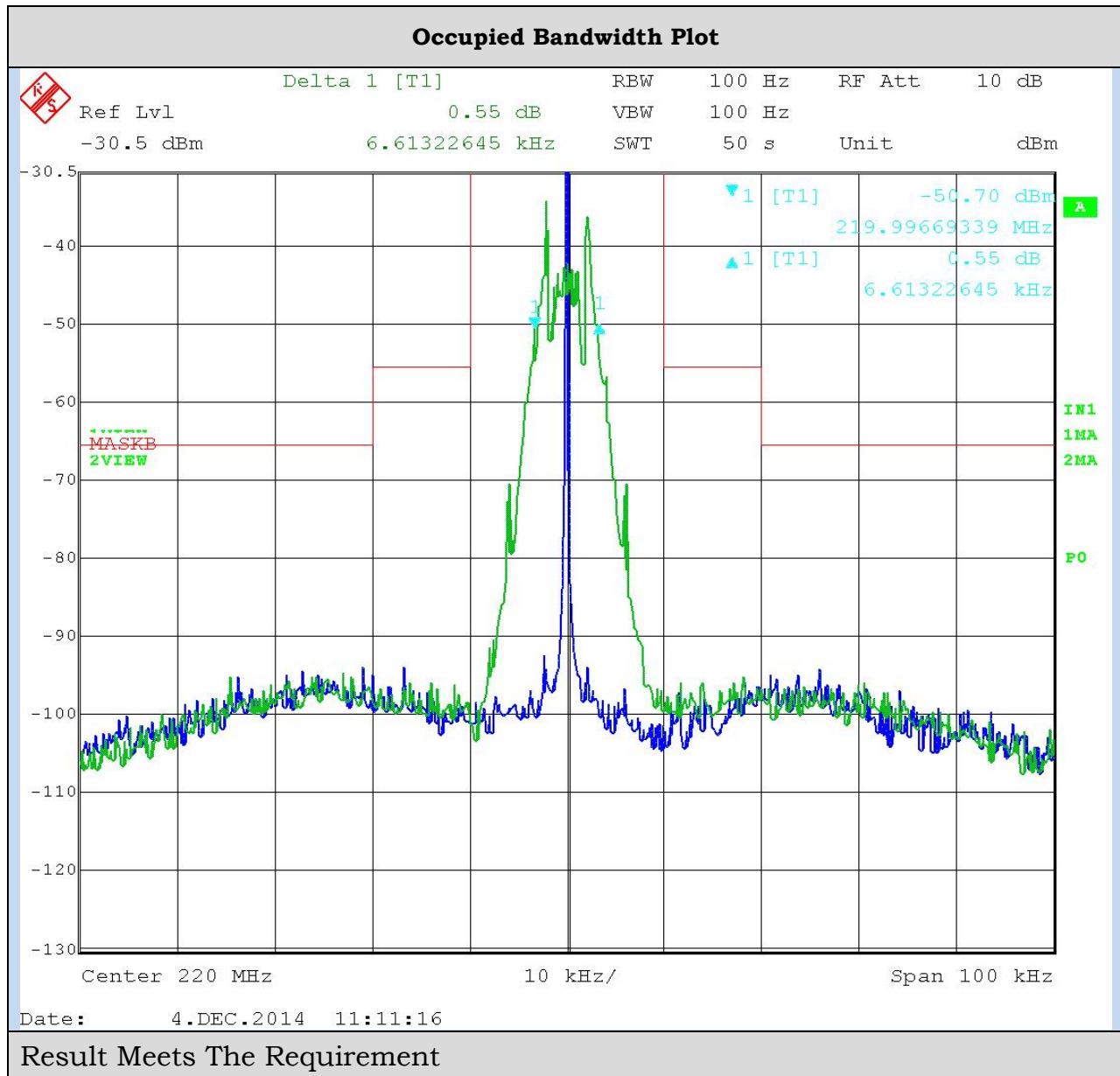


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Part 90.210(D) Emission Mask – 20dB Bandwidth -

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SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED)

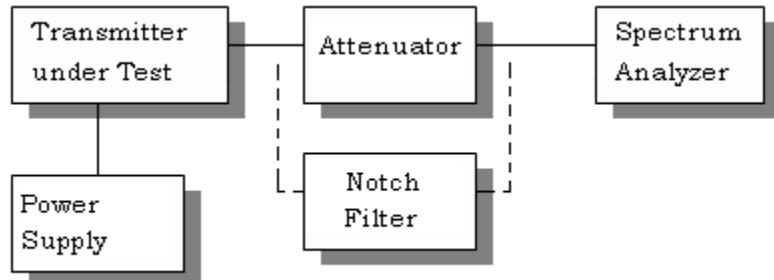
Rule Part No.: Part 2.1051(a)

Requirements:

12.5 kHz Channel Spacing = $50 + 10 \log (1.5) = 51.7 \text{ dBc}$ (low power)

Method of Measurement: The carrier was modulated 100% using a 2500 Hz tone. The spectrum was scanned from the lowest frequency generated to at least the 10th harmonic of the fundamental. The measurements were made in accordance with standard ANSI/TIA 603-D: 2010.

Method of Measuring Conducted Spurious Emissions



Test Data: High Power Low end of Band

| | dBm | dBm | Watts |
|--------------|-----------|--------|-------|
| Power Output | | | 1.5 |
| | | | |
| | Frequency | dBm | dBc |
| | 216.5 | 31.4 | 0 |
| | 433 | -96.2 | 69.2 |
| | 649.5 | -93.8 | 66.8 |
| | 866 | -90.3 | 63.3 |
| | 1082.5 | -87.54 | 60.54 |
| | 1299 | -89.5 | 62.5 |
| | 1515.5 | -89.1 | 62.1 |
| | 1732 | -87.9 | 60.9 |
| | 1948.5 | -87.5 | 60.5 |
| | 2165 | -87.9 | 60.9 |
| | | | |

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SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED)

Test Data: High Power Middle of Band

| | dBm | dBm | Watts |
|--------------|-----------|--------|-------|
| Power Output | 33 | 1.5 | |
| | | | |
| | Frequency | dBm | dBc |
| | 220 | 31.4 | 0 |
| | 440 | -91.8 | 64.8 |
| | 660 | -95.7 | 68.7 |
| | 880 | -93.1 | 66.1 |
| | 1100 | -87.54 | 60.54 |
| | 1320 | -89.14 | 62.14 |
| | 1540 | -88.9 | 61.9 |
| | 1760 | -89.3 | 62.3 |
| | 1980 | -86.9 | 59.9 |
| | 2200 | -87.1 | 60.1 |
| | | | |

Test Data: High Power High End of Band

| | dBm | dBm | Watts |
|--------------|-----------|--------|-------|
| Power Output | 33.1 | 1.5 | |
| | | | |
| | frequency | dBm | dBc |
| | 222 | 31.4 | 0 |
| | 444 | -94.7 | 67.7 |
| | 666 | -95.2 | 68.2 |
| | 888 | -91.5 | 64.5 |
| | 1110 | -87.87 | 60.87 |
| | 1332 | -89.64 | 62.64 |
| | 1554 | -89.05 | 62.05 |
| | 1776 | -89.26 | 62.26 |
| | 1998 | -89.2 | 62.2 |
| | 2220 | -87.75 | 60.75 |
| | | | |

Results: Meets Requirements

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FIELD STRENGTH OF SPURIOUS EMISSIONS

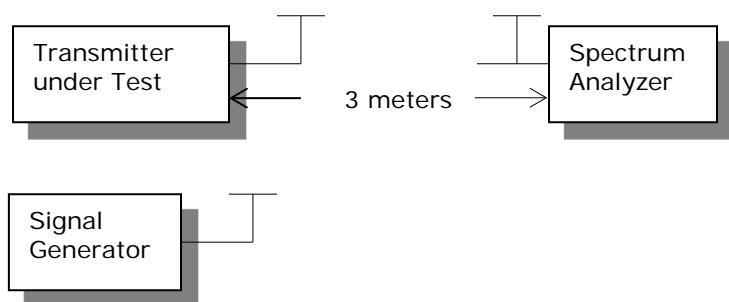
Rule Parts. No.: Part 2.1053

Requirements:

$$12.5\text{kHz} \text{ Channel Spacing} = 50 + 10\log(\text{OP}) = 51.7 \text{ dBc}$$

METHOD OF MEASUREMENT: The tabulated data shows the results of the radiated field strength emissions test. The spectrum was scanned from 30 MHz to at least the tenth harmonic of the fundamental. This test was conducted per ANSI/TIA 603-D: 2010 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.

Test Setup Diagram:



Test Data:

HIGH POWER: Low End of the Band

| Emission Frequency (MHz) | Power Mode | ERP Power Output (dBm) | ERP Power Output (Watts) | FCC Requirement dB | Bandwidth - BW - kHz |
|--------------------------|------------|------------------------|--------------------------|--------------------|----------------------|
| 217.00 | Hi | 31.80 | 1.51 | 51.80 | 12.50 |

| Emission Frequency (MHz) | Ant. Polarity | Below Carrier (dBc) | Margin |
|--------------------------|---------------|---------------------|--------|
| 434.00 | V | 56.84 | 5.04 |
| 651.00 | V | 71.38 | 19.58 |
| 868.00 | H | 77.74 | 25.94 |
| 1,085.00 | H | 74.77 | 22.97 |
| 1,302.00 | H | 101.64 | 49.84 |
| 1,519.00 | H | 103.65 | 51.85 |
| 1,736.00 | H | 99.67 | 47.87 |
| 1,953.00 | H | 98.81 | 47.01 |
| 2,170.00 | H | 100.25 | 48.45 |

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FIELD STRENGTH OF SPURIOUS EMISSIONS

LOW POWER: Middle of the Band

| Emission Frequency (MHz) | Power Mode | ERP Power Output (dBm) | ERP Power Output (Watts) | FCC Requirement dB | Bandwidth - BW - kHz |
|--------------------------|------------|------------------------|--------------------------|--------------------|----------------------|
| 220.00 | Hi | 31.80 | 1.51 | 51.80 | 12.50 |

| Emission Frequency (MHz) | Ant. Polarity | Below Carrier (dBc) | Margin |
|--------------------------|---------------|---------------------|--------|
| 440.00 | H | 57.90 | 6.10 |
| 660.00 | H | 68.99 | 17.19 |
| 880.00 | V | 74.26 | 22.46 |
| 1,100.00 | V | 74.33 | 22.53 |
| 1,320.00 | H | 101.85 | 50.05 |
| 1,540.00 | H | 103.27 | 51.47 |
| 1,760.00 | H | 99.39 | 47.59 |
| 1,980.00 | H | 98.72 | 46.92 |
| 2,200.00 | H | 100.31 | 48.51 |

HIGH END OF BAND

| Emission Frequency (MHz) | Power Mode | ERP Power Output (dBm) | ERP Power Output (Watts) | FCC Requirement dB | Bandwidth - BW - kHz |
|--------------------------|------------|------------------------|--------------------------|--------------------|----------------------|
| 222.00 | Hi | 31.80 | 1.51 | 51.80 | 12.50 |

| Emission Frequency (MHz) | Ant. Polarity | Below Carrier (dBc) | Margin |
|--------------------------|---------------|---------------------|--------|
| 444.00 | H | 58.50 | 6.70 |
| 666.00 | V | 77.64 | 25.84 |
| 888.00 | H | 81.14 | 29.34 |
| 1,110.00 | V | 74.86 | 23.06 |
| 1,332.00 | H | 102.00 | 50.20 |
| 1,554.00 | H | 103.01 | 51.21 |
| 1,776.00 | H | 99.37 | 47.57 |
| 1,998.00 | H | 98.66 | 46.86 |
| 2,220.00 | H | 100.36 | 48.56 |

RESULTS: MEETS REQUIREMENTS

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FREQUENCY STABILITY

Rule Parts. No.: Part 2.1055, Part 90.213

Requirements: Temperature range requirements: -30 to +50° C.
Voltage Variation +, -15%
±2.5 PPM

Method of Measurements: ANSI/TIA 603-D: 2010.

Test Data:

| Temperature | Frequency MHz | PPM |
|------------------|------------------|--------|
| 25°C (reference) | 216.999715 | |
| -30°C | 216.999522 | -0.889 |
| -20°C | 216.999524 | -0.880 |
| -10°C | 216.999724 | 0.041 |
| 0°C | 216.999816 | 0.465 |
| 10°C | 216.999908 | 0.889 |
| 20°C | 217.000099 | 1.770 |
| 30°C | 217.000021 | 1.410 |
| 40°C | 217.000037 | 1.484 |
| 50°C | 217.000099 | 1.770 |
| | | |
| Battery Voltage | Frequency | PPM |
| -15% | 216.999708 | -0.032 |
| 15% | 216.99971 | -0.023 |

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EQUIPMENT LIST

| Device | Manufacturer | Model | Serial Number | Cal/Char Date | Due Date |
|---|----------------------|---------|---------------|---------------|----------|
| Antenna: Biconnical Chamber | Eaton Chamber | 94455-1 | 1057 | 06/14/13 | 06/14/15 |
| Antenna: Log-Periodic Chamber | Eaton | 96005 | 1243 | 05/31/13 | 05/31/15 |
| LISN (Primary) | Electro-Metrics | EM-7820 | 2682 | 02/26/13 | 02/26/15 |
| Temperature Chamber LARGE | Tenney Engineering | TTRC | 11717-7 | 08/19/14 | 08/19/16 |
| AC Voltmeter | HP | 400FL | 2213A14728 | 06/26/13 | 06/26/15 |
| Frequency Counter Large Chamber | HP | 5352B | 2632A00165 | 06/26/13 | 06/26/15 |
| 3-Meter Semi-Anechoic Chamber | Panashield | N/A | N/A | 12/31/13 | 12/31/15 |
| Antenna: Double-Ridged Horn/ETS Horn 1 | ETS-Lindgren Chamber | 3117 | 00035923 | 06/13/14 | 06/13/16 |
| EMI Test Receiver R & S ESIB 40 Screen Room | Rohde & Schwarz | ESIB 40 | 100274 | 08/12/14 | 08/12/16 |
| Software: Field Strength Program | Timco | N/A | Version 4.0 | 12/12/99 | 12/12/99 |
| Hygro-Thermometer | Extech | 445703 | 0602 | 06/20/13 | 06/20/15 |
| 30 dB Attenuator | Narda | 769-30 | 10267 | 03/15/13 | 03/15/15 |
| Attenuator 30dB 500W | Bird | 8325 | 1761 | 02/25/13 | 02/25/15 |

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