TIMCO ENGINEERING, Inc.

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# FCC PART 90

# TEST REPORT

| | |
|---|---|
| APPLICANT | NEPTUNE TECHNOLOGY GROUP INC. |
| | 1600 ALABAMA HIGHWAY 229 |
| | TALLASSEE AL 36078 USA |
| FCC ID | P2SR450 |
| MODEL NUMBER | R450 |
| PRODUCT DESCRIPTION | METER READING TRANSMITTER |
| DATE SAMPLE RECEIVED | 9/27/2006 |
| DATE TESTED | 9/27/2006 |
| TESTED BY | MARIO DE ARANZETA |
| APPROVED BY | MARIO DE ARANZETA |
| TIMCO REPORT NO. | 2746AUT6TestReport.doc |
| TOTAL PAGES | 22 |
| TEST RESULTS | ☒ PASS ☐ FAIL |



ACCREDITED
**Certificate # 0955-01**

# TABLE OF CONTENTS

**STATEMENT OF COMPLIANCE**

This equipment has been tested in accordance with the standards identified in the referenced test report. To the best of my knowledge and belief, these tests were performed using the measurement procedures described in this report and demonstrate that the equipment complies with the appropriate standards. No modifications were made to the equipment during testing in order to demonstrate compliance with these standards.

I attest that the necessary measurements were made by me or under my supervision, at Timco Engineering, Inc. located at 849 N.W. State Road 45, Newberry, Florida 32669 USA.

ACCREDITED
Certificate # 0955-01

**Authorized by:** Mario de Aranzeta

**Signature:** <*Mario de Aranzeta*>

**Function:** Engineer

**Date:** 10/30/2006

## GENERAL INFORMATION

## DUT SPECIFICATIONS

| The test results relate only to the items tested. | |
|---|---|
| **DUT Description** | TRANSMITTER |
| **FCC ID** | P2SR450 |
| **Model Number** | R450 |
| **Operating Frequency** | 450-470 MHz |
| **No. of Channels** | Single |
| **Type of Emission** | F1D |
| **Modulation** | Gaussian filtered FSK |
| **DUT Power Source** | ☐ 110–120Vac/50– 60Hz |
| | ☐ DC Power |
| | ☒ Battery Operated Exclusively |
| **Test Item** | ☐ Prototype |
| | ☒ Pre-Production |
| | ☐ Production |
| **Type of Equipment** | ☒ Fixed |
| | ☐ Mobile |
| | ☐ Portable |
| **Antenna** | Loaded PCB |
| **Antenna Connector** | 75 ohm F |
| **Test Condition** | Lab Temperature - 26°C Humidity – 50% |
| **Modifications to DUT** | None |
| **Test Description** | DUT was placed in continuous transmit mode of operation. |
| **Test Standards** | TIA 603, FCC CFR 47 Part 90 |

**TEST EQUIPMENT LIST**

| Device | Manufacturer | Model | Serial Number | Cal/Char Date | Due Date |
|---|---|---|---|---|---|
| Analyzer Tan Tower Spectrum Analyzer | HP | 8566B Opt 462 | 3138A07786 3144A20661 | CAL 12/7/05 | 12/7/07 |
| Analyzer Tan Tower RF Preselector | HP | 85685A | 3221A01400 | CAL 12/7/05 | 12/7/07 |
| Analyzer Tan Tower Quasi-Peak Adapter | HP | 85650A | 3303A01690 | CAL 12/8/05 | 12/8/07 |
| Analyzer Tan Tower Preamplifier | HP | 8449B-H02 | 3008A00372 | CAL 12/8/05 | 12/8/07 |
| Antenna: Biconnical | Electro-Metrics | BIA-25 | 1171 | CAL 4/29/05 | 4/29/07 |
| Antenna: Double-Ridged Horn | Electro-Metrics | RGA-180 | 2319 | CAL 12/29/04 | 12/29/06 |
| LISN | Electro-Metrics | ANS-25/2 | 2604 | CAL 10/5/06 | 10/5/08 |

**TEST PROCEDURE**

**Power Line Conducted Interference:** The procedure used was TIA 603 using a 50uH LISN. Both lines were observed with the DUT 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 standard C63.4-2003 using an Agilent spectrum receiver with preselector. 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.

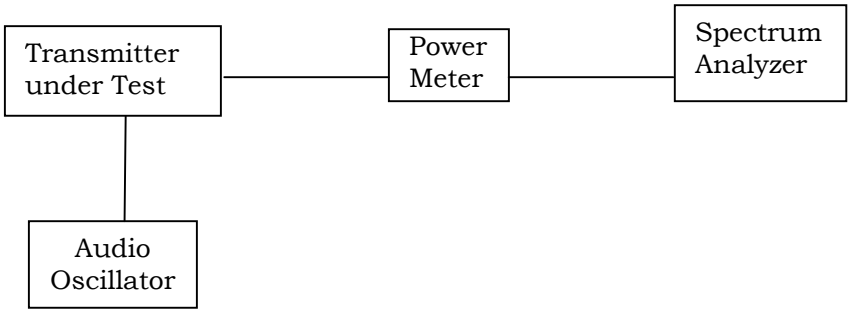
**RF POWER OUTPUT**

**Rule Part No.:** Part 2.1046(a), Part 90.210

**Test Requirements:**

**Method of Measurement:** RF power is measured by connecting a 50-ohm, resistive wattmeter to the RF output connector. With a nominal battery voltage, and the transmitter properly adjusted the RF output measures:

**Test Setup Diagram:**




**Test Data:**

OUTPUT POWER: 1 Watt

**Part 2.1033 (C)(8) DC Input into the final amplifer**

DC Voltage: 3.6 Vdc DC Current: 0.9A
DC Power: 3.24 Watts

**MODULATION CHARACTERISTICS**

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

**Test Requirements:**

**Method of Measurement:**

*Audio frequency response*

Data radio. Not applicable.

**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.

Data Radio. Not applicable.

**AUDIO INPUT VERSUS MODULATION**

**Part 2.1047(a)** For equipment employing modulation limiting. A curve or family of curves showing the percentage of modulation versus the modulating input voltage shall be submitted. For devices employing phase a or frequency modulation deviation versus input voltage is required.

Data radio: The deviation is fixed in software and not changeable by the user.

**OTHER MODULATION CHARACTERISTICS**

**Part 2.1033(c)**
**Part 2.1033(c) (4)** Type of Emission: 11K2F1D
**Part 90.209**
**Part 90.207** Bn = 2M + 2DK
M = B/2 = 7200/2
D = 2000
K=1
Bn = 2(3600)+2(2000) = 11.2k

**OCCUPIED BANDWIDTH (PART 2.1049):**

**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 + 10log(P)dB.

**Part 90.210(c) 12.5kHz 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 un-modulated 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 than10 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(fd2/11)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.

**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 f0 to 5.625 kHz removed from f0: Zero dB.

(2) On any frequency from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 5.625 kHz but no more than 12.5 kHz: At least 7.27 (fd - 2.88 kHz) dB.

(3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 12.5 kHz: At least 50 + 10log(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 f0 to 3.0 kHz removed from f0: Zero dB.

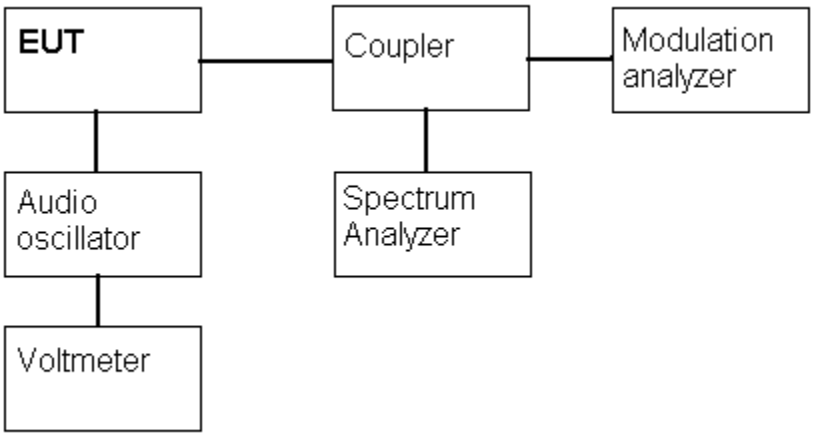
(2) On any frequency from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 3.0 kHz but no more than 4.6 kHz: At least 30 + 16.67(fd – 3.0 kHz) or 55 + 10 Log(P) or 65, whichever us the lesser attenuation.

(3) On any frequency removed from the center of the authorized bandwidth by more than 4.6kHz: At least 55 + 10log(P) dB or 65 dB, whichever is the lesser attenuation.

**Test procedure:** TIA/EIA-603 para 2.2.11.

Test procedure diagram

**OCCUPIED BANDWIDTH MEASUREMENT**



## OCCUPIED BANDWIDTH

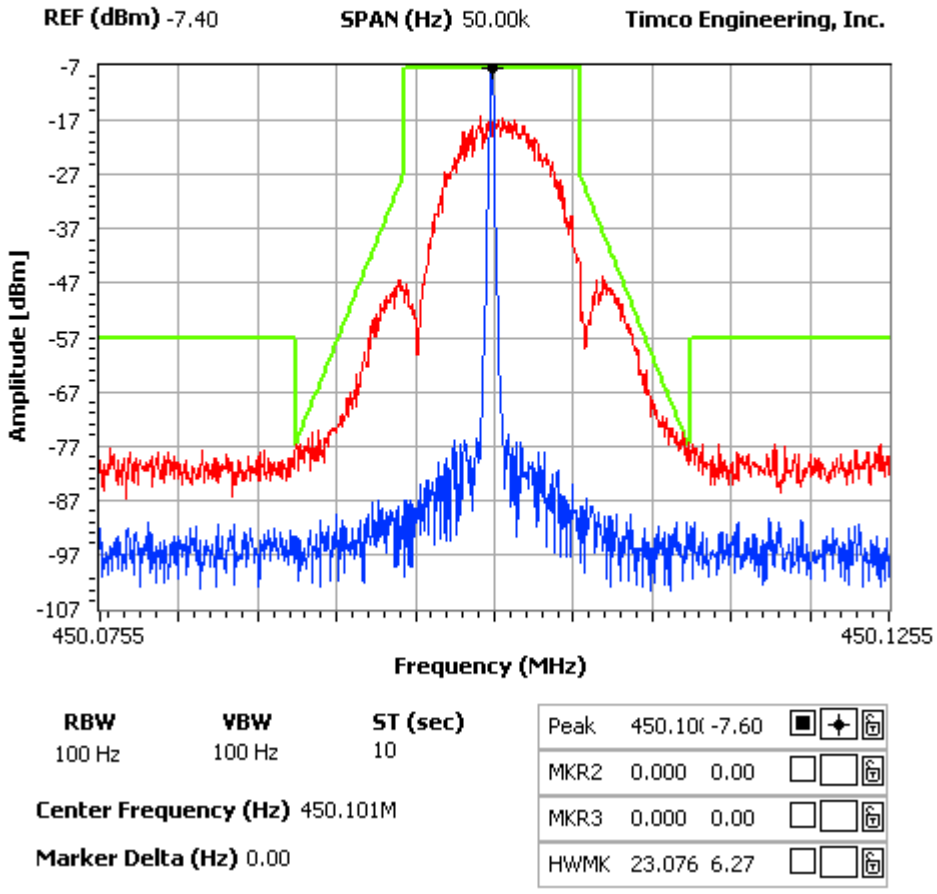
### Part 90.210(c) 12.5 kHz Channel Spacing

### Part 90.210(d) Emission Mask D - 12.5 kHz channel

**NOTES:**

NEPTUNE TECHNOLOGY GROUP INC.
OCCUPIED BANDWIDTH PLOT

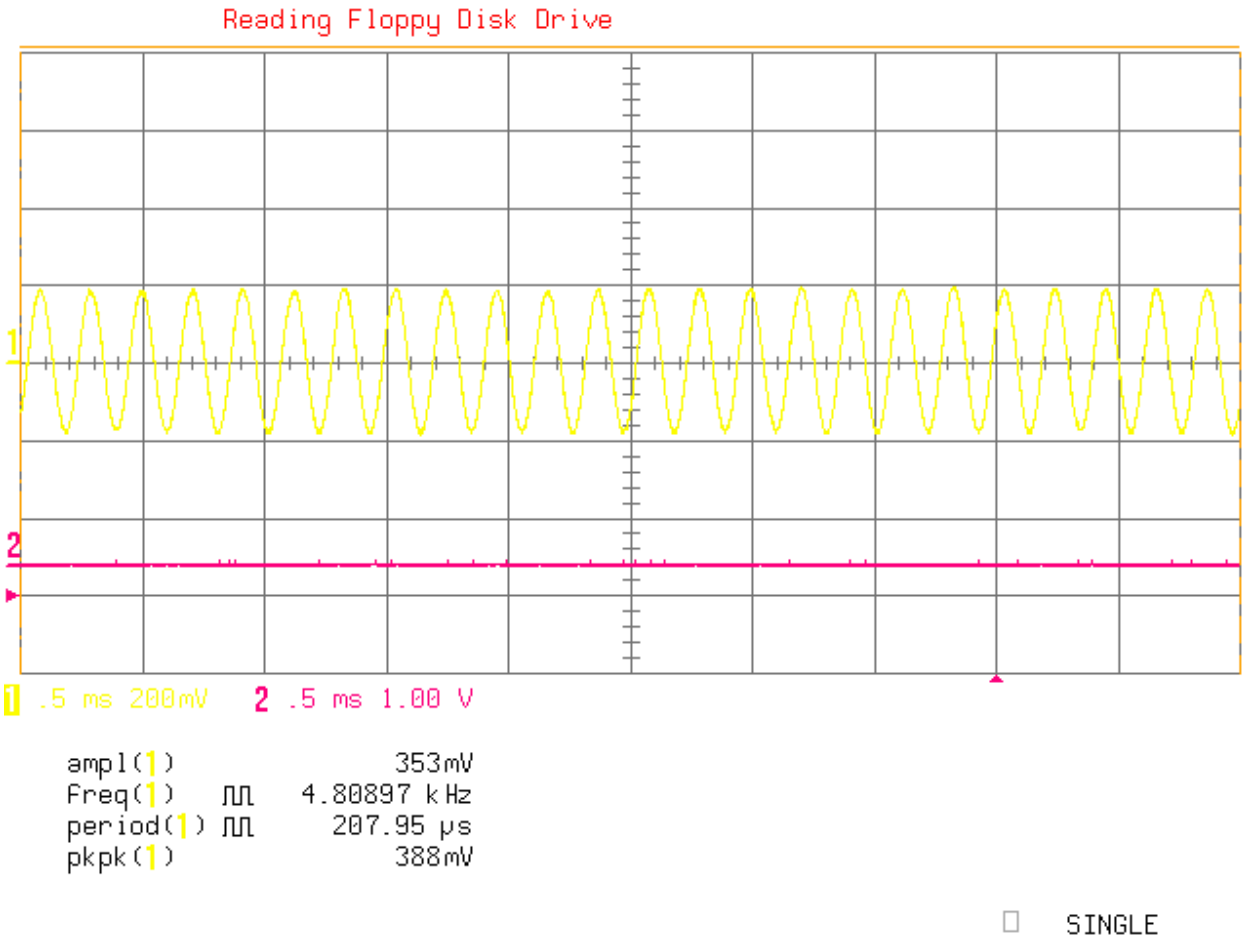
**FCC 90.210 Mask D**



**SPECTRAL EFFICIENCY**

Part 90.203 (j)(8)(9)(10)

The plot below shows the demodulated output when the radio is modulated with a 9600 baud data stream.



**SPURIOUS EMISSIONS AT ANTENNA TERMINALS** (CONDUCTED)

**Rule Part No.:** Part 2.1051(a)

**Requirements:** 12.5 kHz channel spacing

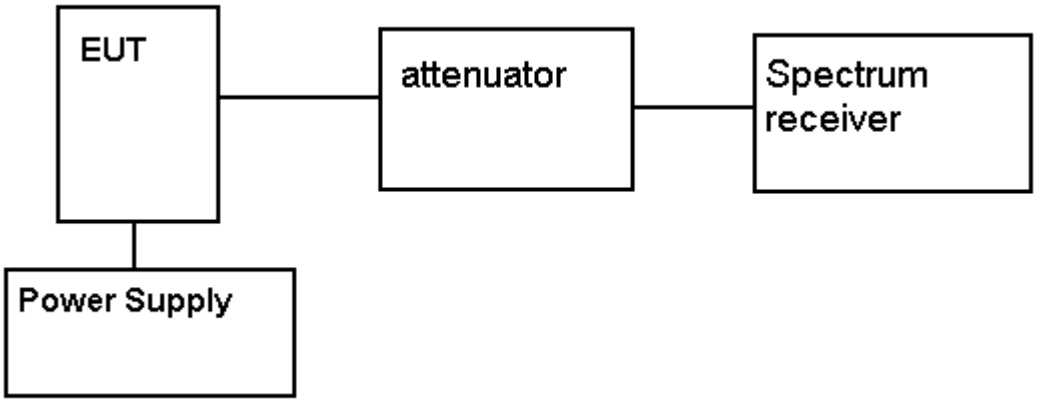
**Method of Measurement:** The spectrum was scanned from 0.4 to at least the 10th harmonic of the fundamental. The measurements were made in accordance with standard TIA/EIA-603.

**FCC Limit:** 50+10log(1) = 50 dB

**Test Data:**

| TF | EF | dB below carrier |
|---|---|---|
| 450 | 450 | 0 |
| | 900 | 65 |
| | 1350 | 87.2 |
| | 1800 | 81.6 |
| | 2250 | 75.24 |
| | | |
| 460 | 460 | 0 |
| | 920 | 65 |
| | 1380 | 90.7 |
| | 1840 | 90.9 |
| | 2300 | 74.7 |
| | | |
| 470 | 470 | 0 |
| | 940 | 63.4 |
| | 1410 | 91.6 |
| | 1880 | 96.1 |
| | 2350 | 99.1 |

**Method of Measuring Conducted Spurious Emissions**




**METHOD OF MEASUREMENT:** The procedure used was TIA/EIA-603 STANDARD without any exceptions. The measurements were made at TIMCO ENGINEERING INC. 849 N.W. State Road 45, Newberry, Florida 32669.

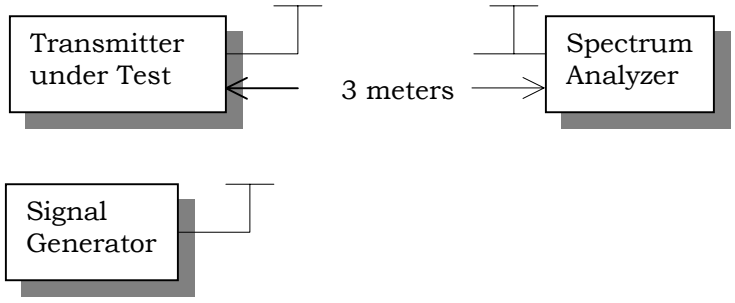
**FIELD STRENGTH OF SPURIOUS EMISSIONS**

**Rule Parts. No.:** Part 2.1053

**Requirements:** 50+10log(1) = 50 dB

**Method of Measurements:** The spectrum was scanned from 30 MHz to at least the tenth harmonic of the fundamental. This test was conducted per TIA/EIA standard 603 using the substitution method.

**Test Setup Diagram:**



**Test Data:**

| Emission Frequency MHz | Ant. Polarity | dB Below Carrier (dBc) |
|---|---|---|
| 450.00 | 0 | 0.00 |
| 900.00 | V | 83.95 |
| 1350.00 | V | 80.67 |
| 1800.00 | H | 73.31 |
| 2250.00 | V | 83.73 |
| 2700.00 | V | 86.54 |
| 3150.00 | V | 82.36 |
| 3600.00 | H | 82.13 |

| Emission Frequency MHz | Ant. Polarity | dB Below Carrier (dBc) |
|---|---|---|
| 460.00 | 0 | 0.00 |
| 920.00 | H | 73.19 |
| 1380.00 | H | 78.86 |
| 1840.00 | V | 72.39 |
| 2300.00 | H | 61.69 |
| 2760.00 | V | 83.20 |
| 3220.00 | V | 78.51 |
| 3680.00 | V | 81.83 |
| 4140.00 | H | 91.57 |

| Emission Frequency MHz | Ant. Polarity | dB Below Carrier (dBc) |
|---|---|---|
| 470.00 | 0 | 0.00 |
| 940.00 | V | 82.63 |
| 1410.00 | V | 81.74 |
| 1880.00 | V | 72.86 |
| 2350.00 | H | 88.66 |
| 2820.00 | V | 85.36 |
| 3760.00 | V | 80.03 |
| 4230.00 | V | 80.18 |

**FREQUENCY STABILITY**

**Rule Parts. No.:** Part 2.1055, Part 90.213

**Requirements:** Temperature range requirements: -30 to +50° C.
Voltage variation +, -15%
Mobile – 1.5 ppm fixed

**Method of Measurements:** TIA/EIA 603.

**Test Data:**

| **Reference. Frequency (MHz)** | | 450.098722 |
|---|---|---|
| **Temperature (ºC)** | **Frequency (MHz)** | **Frequency Stability (PPM)** |
| -30 | 450.098194 | -1.17 |
| -20 | 450.098304 | -0.93 |
| -10 | 450.098420 | -0.67 |
| 0 | 450.098552 | -0.38 |
| +10 | 450.098688 | -0.08 |
| +20 | 450.098722 | 0.00 |
| +30 | 450.098680 | -0.09 |
| +40 | 450.098530 | -0.43 |
| +50 | 450.098567 | -0.34 |

| | | |
|---|---|---|
| **% Battery** | **Frequency (MHz)** | **Frequency Stability (PPM)** |
| -15% | 450.098740 | 0.04 |
| 0 | | |
| +15% | 450.098738 | 0.04 |

**TRANSIENT FREQUENCY RESPONSE**

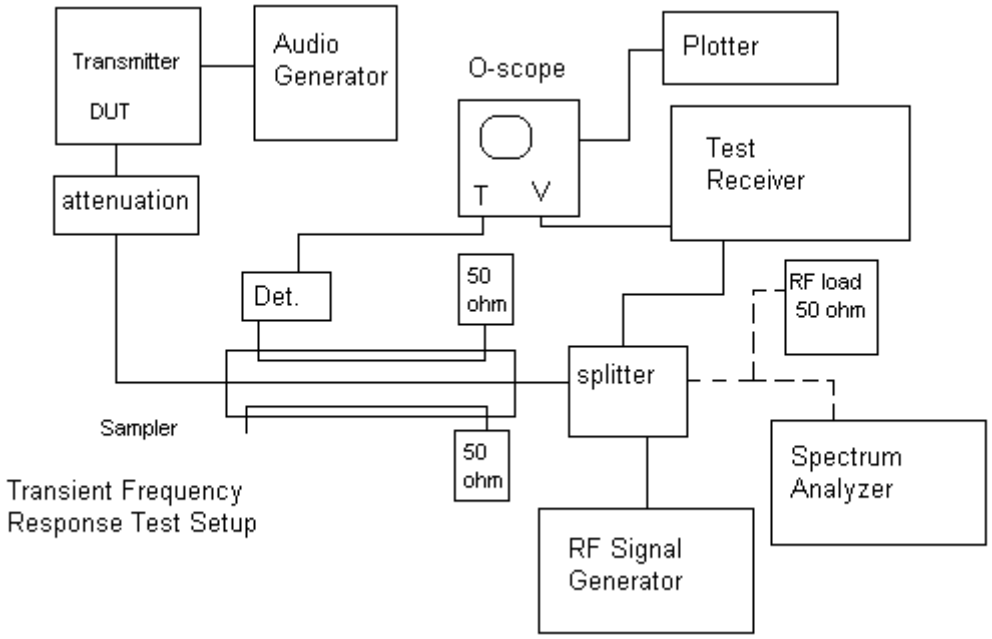
**Part 90.214**

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

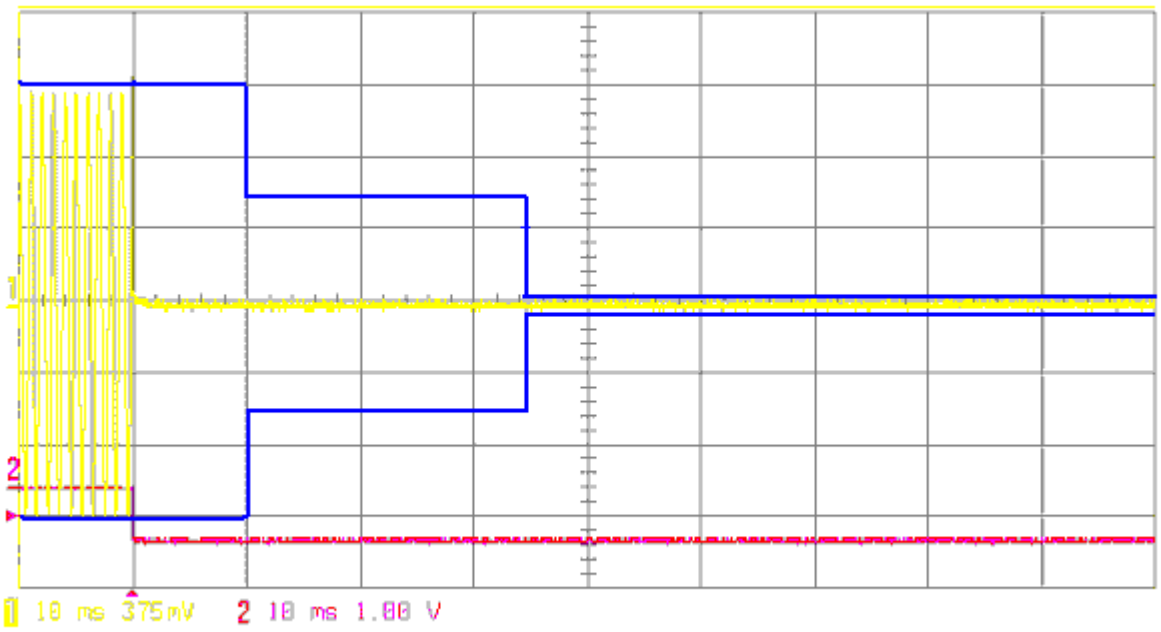
| Time Intervals | Maximum frequency difference | All equipment | |
|---|---|---|---|
| | | 150-174 MHz | 421-512 MHz |
| Transient frequency behavior for equipment designed to operate on 25 kHz channels | | | |
| $t_1$[4] | ±25.0 kHz | 5.0 ms | 10.0 ms |
| $t_2$ | ±12.5 kHz | 20.0 ms | 25.0 ms |
| $t_3$[4] | ±25.0 kHz | 5.0 ms | 10.0 ms |
| 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 |
| Transient frequency behavior for equipment designed to operate on 6.25 kHz channels | | | |
| $t_1$[4] | ±6.25 kHz | 5.0 ms | 10.0 ms |
| $t_2$ | ±3.125 kHz | 20.0 ms | 25.0 ms |
| $t_3$[4] | ±6.25 kHz | 5.0 ms | 10.0 ms |

**TEST PROCEDURE:** TIA/EIA TS603 Paragraph 2.2.19, the levels were set as follows;

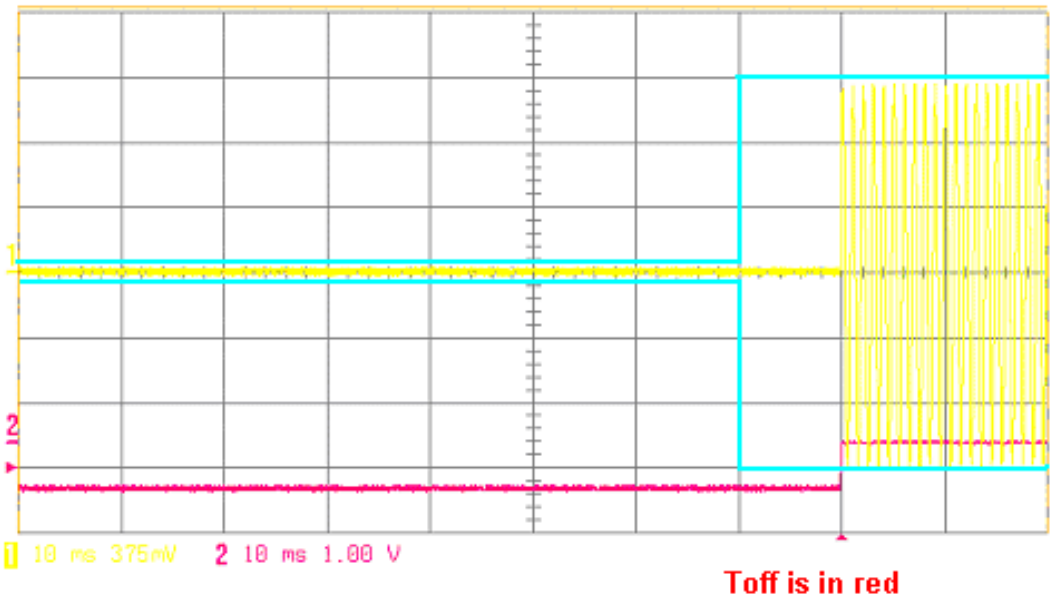
1. Using the variable attenuator the transmitter level was set to 40 dB below the test receivers maximum input level, then the transmitter was turned off.
2. With the transmitter off the signal generator was set 20dB below the level of the transmitter in the above step, this level will be maintained with the signal generator through-out the test.
3. Reduce the attenuation between the transmitter and the RF detector by 30 dB.
4. With the levels set as above the transient frequency behavior was observed & recorded.



Transient Frequency Response Test Setup




Ton is in red




Toff is in red