TIMCO ENGINEERING, Inc.
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FCC

UHF PORTABLE PART 90

TEST REPORT

APPLICANT	CATTRON-THEIMEG INCORPORATED
	58 W. SHENANGO STREET SHARPSVILLE PA 16150-1198 USA
FCC ID	CN27954391072
MODEL NUMBER	79543+91072 TRX
PRODUCT DESCRIPTION	450 MHz RF MODULE
STANDARD APPLIED	CFR 47 Part 90
DATE SAMPLE RECEIVED	10/27/2014
DATE TESTED	11/4/2014
REPORT ISSUE DATE	11/6/2014
TESTED BY	Sid Sanders
APPROVED BY	Cory Leverett
TIMCO REPORT NO.	1934AUT14TestReport.docx
TEST RESULTS	☒ PASS ☐ FAIL

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GENERAL REMARKS

The attached report shall not be reproduced except in full without the written permission of Timco Engineering Inc.

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:

Engineering Project Manager

Date: 11/6/2014

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Applicant: CATTRON THEIMIG INCORPORATED
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Report: \\TIMCO-FILESRV\CUS_2014\C\CATTRON\1934AUT14\1934AUT14TESTREPORT REV 1.DOCX

GENERAL INFORMATION

EUT Specification

EUT Description	450 MHz RF MODULE
FCC ID	CN27954391072
Model Number	79543+91072 TRX
Operating Frequency Range	450-470MHz
Test Frequencies	450, 456, 470MHz
Type of Emission	7K60F1D, 7K60F1E 7K60F1W, 7K60FXE, 7K60FXD
Modulation	2FSK, 3FSK, PRBS-9
EUT Power Source	☒ 110–120Vac/50– 60Hz
	☐ DC Power 12V
	☐ Battery Operated Exclusively
Test Item	☐ Prototype
	☒ Pre-Production
	☐ Production
Type of Equipment	☐ Fixed
	☒ Mobile
	☐ Portable
Test Conditions	The temperature was 24-26ºC with a relative humidity of 50-65%.
Revision History to the EUT	None
Test Exercise	The EUT was placed in mode to transmit for 30 seconds.
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
Part 2.1033(c)(8), Part 2.1046(a), Part 90	RF Power Output	PASS
Part 2.1033(c) (4) Part 2.1047(a)(6)	Modulation Characteristics	PASS
2.1049(c), 90.210(b), 90.210 (c) 90.210(d), 90.210(e)	Emission Mask and Occupied Bandwidths	PASS
2.1051(a)	Antenna Conducted Emissions	PASS
2.1053, Part 90	Field Strength Spurious Emissions	PASS
Part 2.1055, Part 90.213	Frequency Stability	PASS
Part 90.214	Transient Frequency Behaviour	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

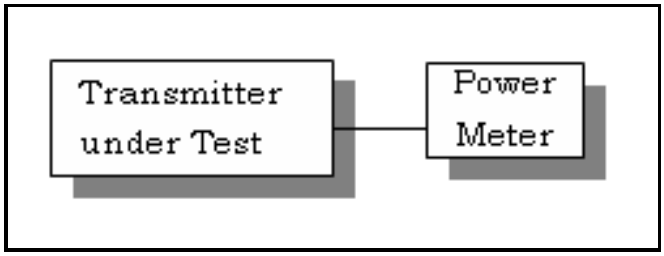
Rule Part No.: Part 2.1046(a), Part 90

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 IS fixed at 2.0W.

OUTPUT POWER:

	RF POWER (W)	
Tuned Frequency (MHz)	dBm	Watts
450.000	33.04	2.0
460.000	33.01	2.0
470.000	33.02	2.0

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

FOR HIGH POWER SETTING INPUT POWER: (13.6V)(0.260A) = 3.6Watts

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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 DIGITAL MODULATION

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

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.

Test data: NOT APPLICABLE

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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 + 10log(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 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.

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OCCUPIED BANDWIDTH

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:

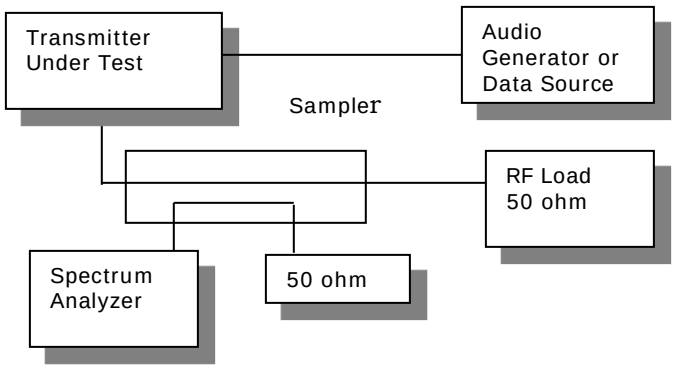
(1) On any frequency from the center of the authorized bandwidth f0 to 3.0 kHz removed from f0: Zero dB.

(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.

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

Test Setup Diagram:

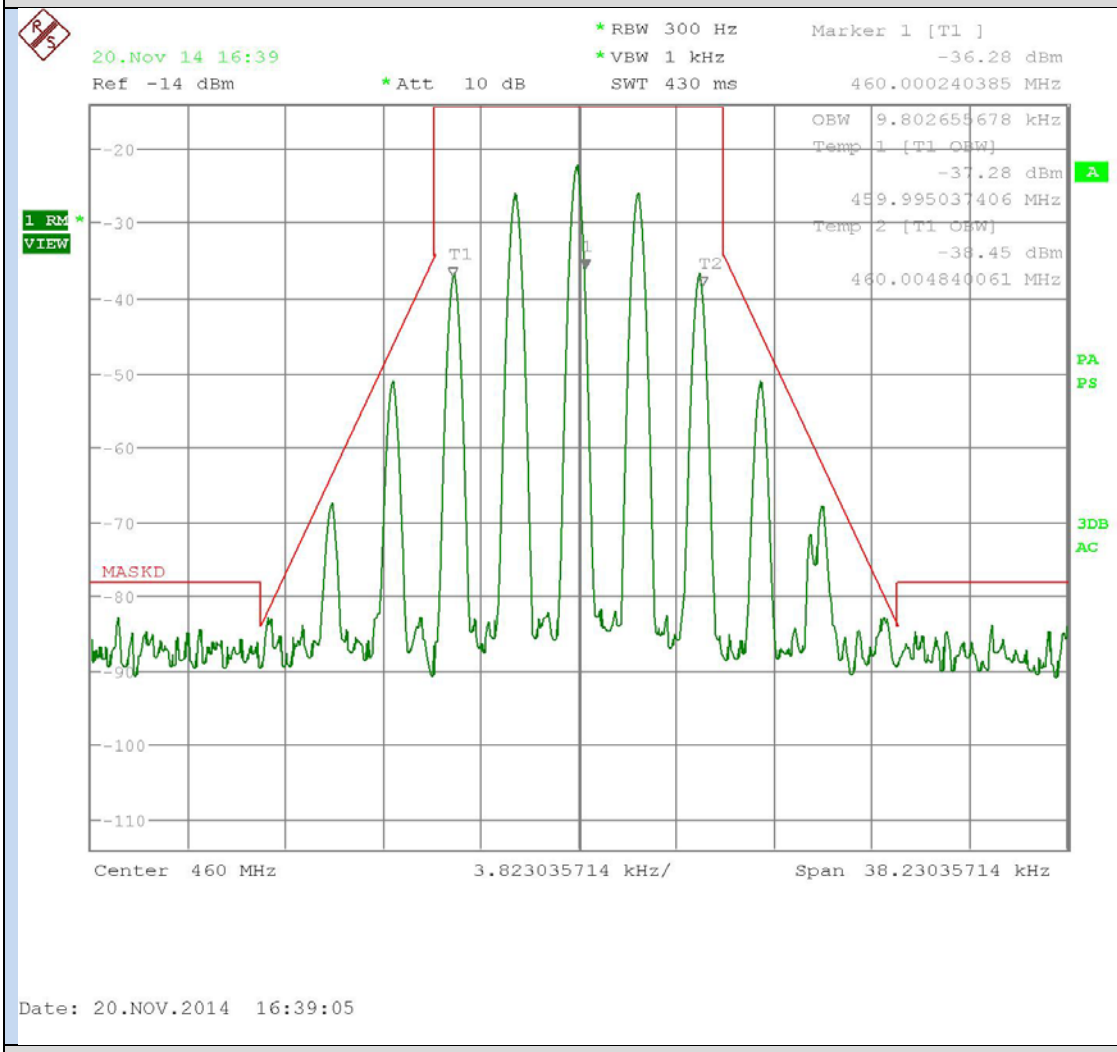


Test Data: See the plots below

OCCUPIED BANDWIDTH PLOTS: 3FSK

Part 90.210(D) Emission Mask D - 12.5 Khz Channel Bandwidth – 3FSK Contineous 101010101010….@ 9.6kbps

Occupied Bandwidth Plot



Result Meets The Requirement

Results: 99% Bandwidth = 9.9kHz

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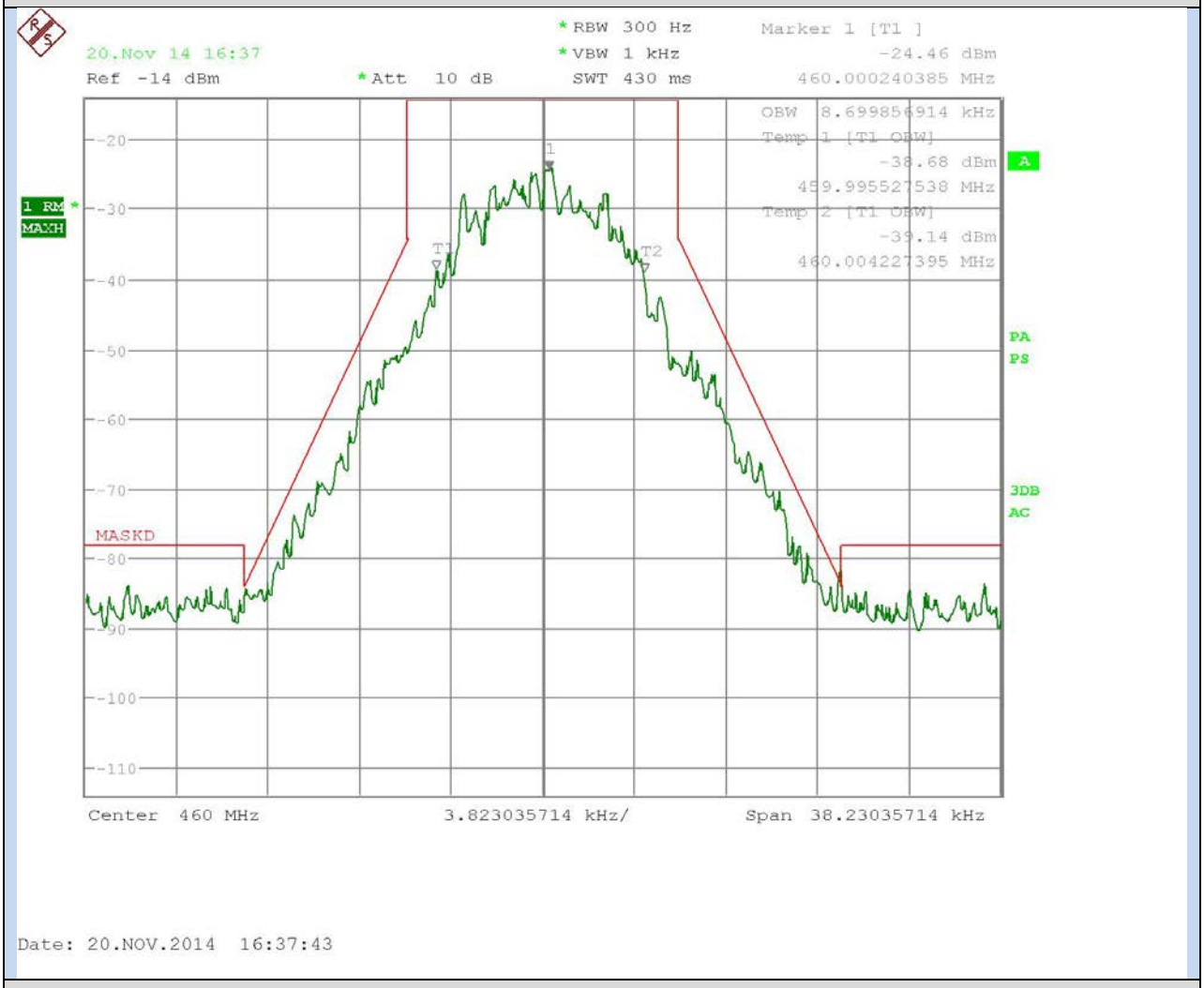
OCCUPIED BANDWIDTH PLOTS: PRBS

Part 90.210(D) Emission Mask D - 12.5 kHz Channel Bandwidth - PRBS

Occupied Bandwidth Plot



Result Meets The Requirement

Results: 99% BW = 8.69kHz.

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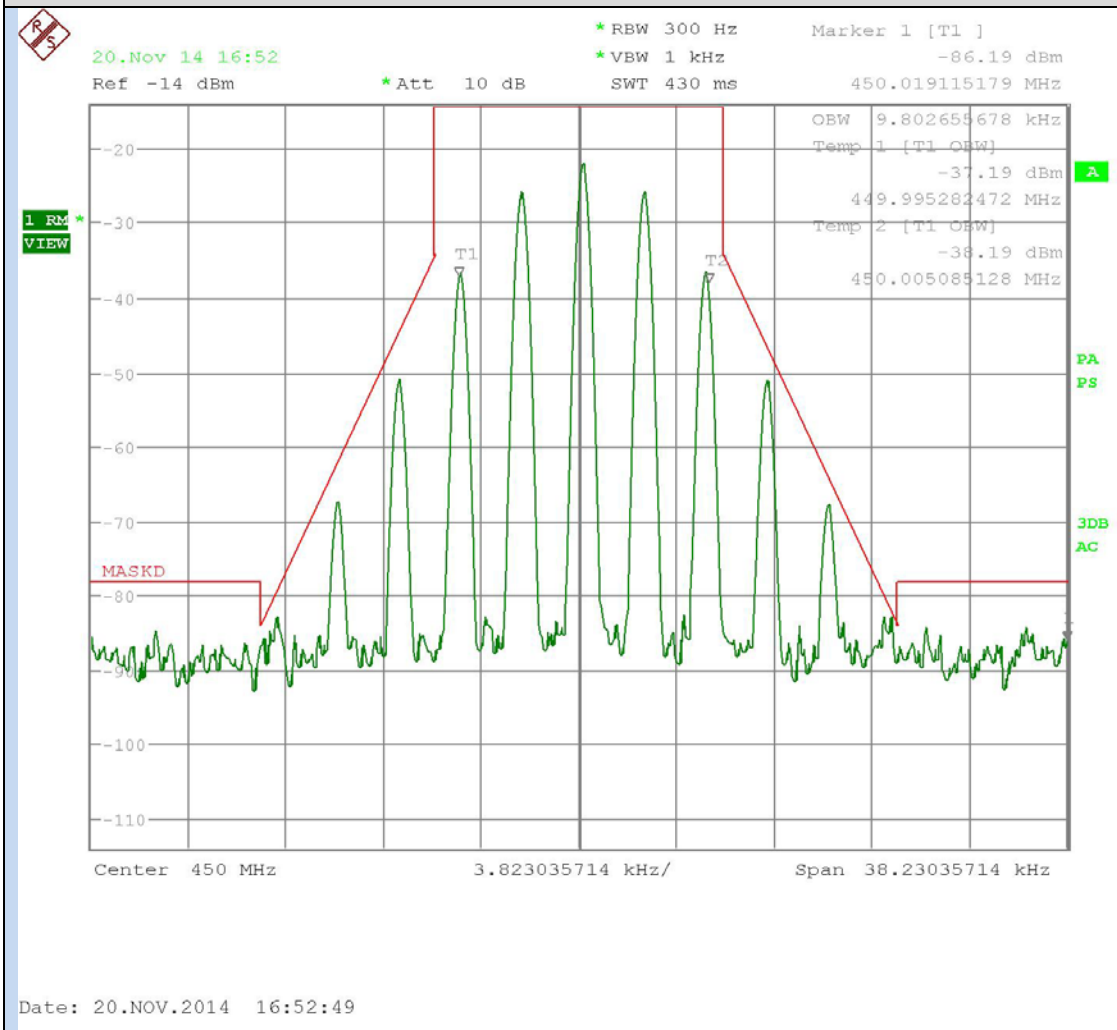
OCCUPIED BANDWIDTH PLOTS: 99% 450 MHz 3FSK

Part 90.210(D) Emission Mask D - 12.5 kHz Channel Bandwidth -

Occupied Bandwidth Plot



Result Meets The Requirement

Results: 99% Bandwidth = 9.8kHz

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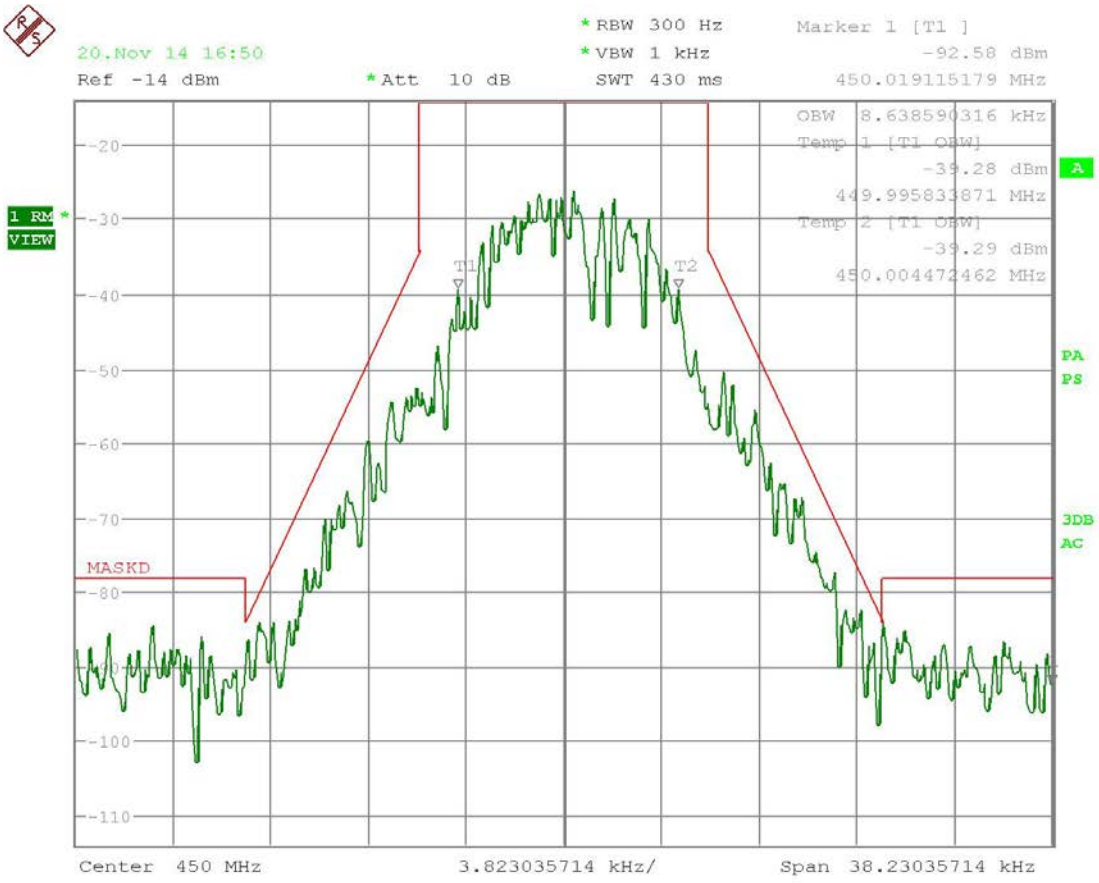
OCCUPIED BANDWIDTH PLOTS: 99% DIGITAL 450MHz

Part 90.210(D) Emission Mask D - 12.5 kHz Channel Bandwidth - PRBS

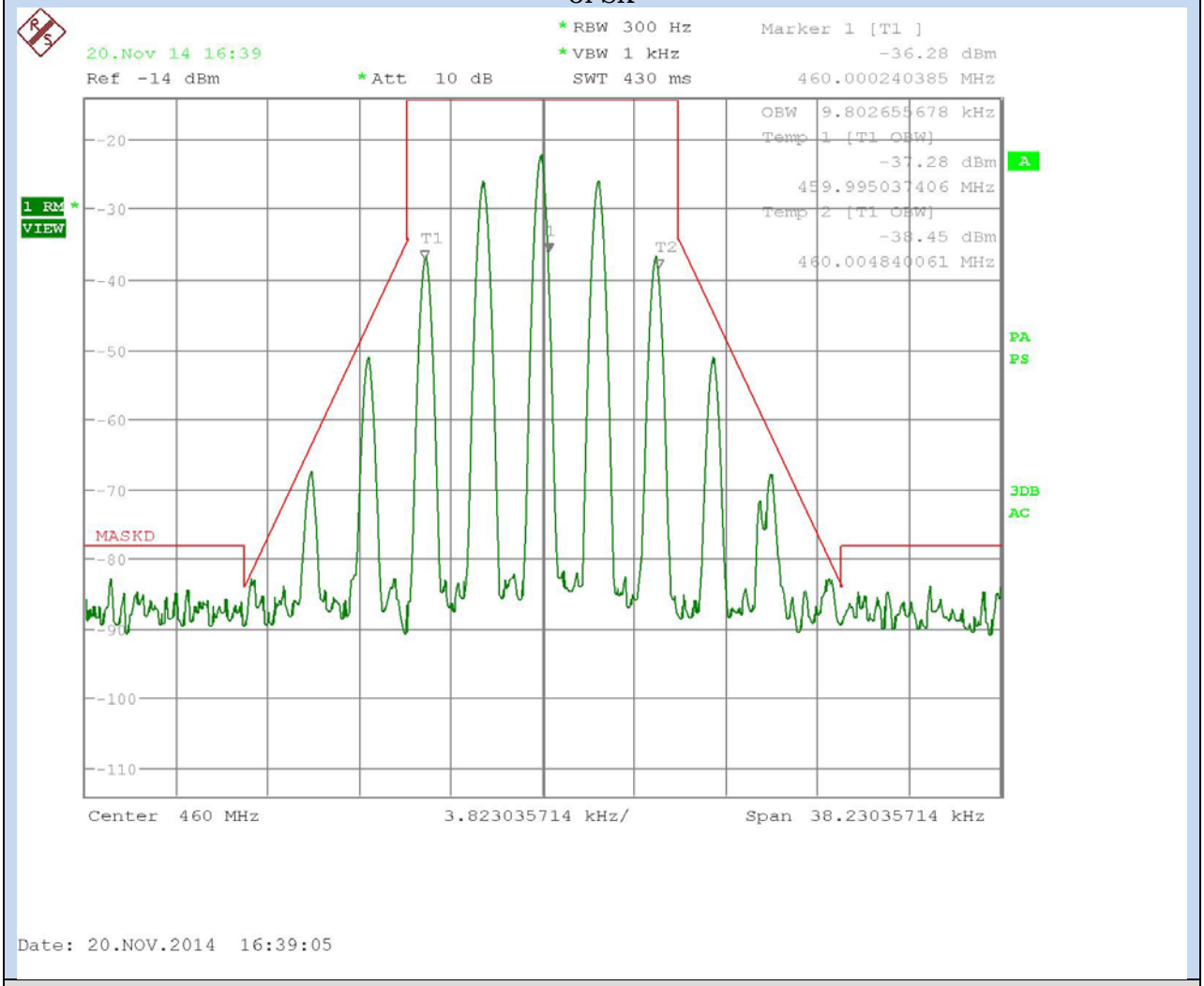


Date: 20.NOV.2014 16:50:07

Results: 99% Bandwidth = 8.63kHz

OCCUPIED BANDWIDTH PLOTS: 99% 460

Part 90.210(D) Emission Mask D - 12.5 kHz Channel Bandwidth – 3FSK99%

Occupied Bandwidth Plot
3FSK

Result Meets The Requirement

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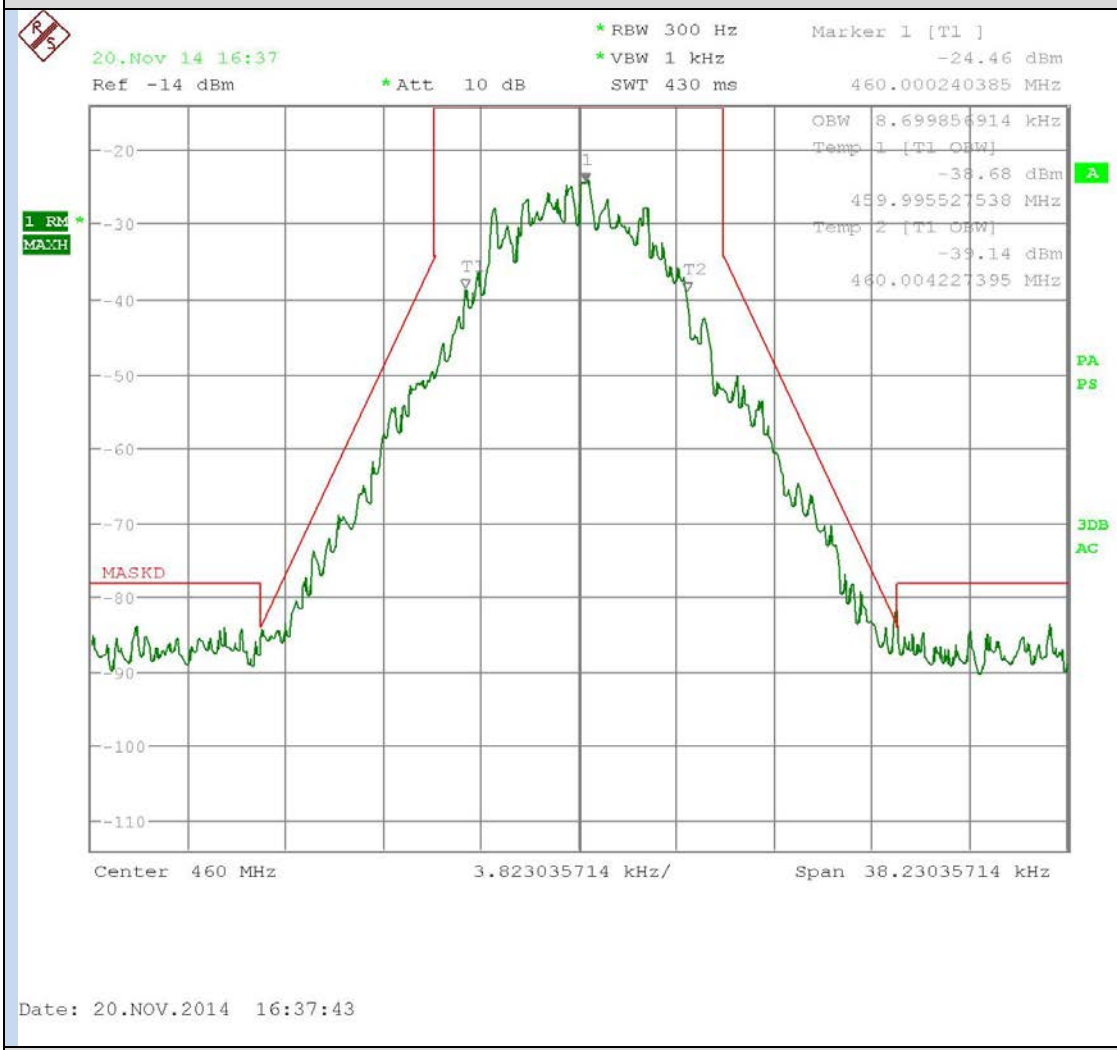
OCCUPIED BANDWIDTH PLOTS: 99% DIGITAL 460

Part 90.210(D) Emission Mask D - 12.5 kHz Channel Bandwidth - PRBS

Occupied Bandwidth Plot



Result Meets The Requirement

Results: 99% Bandwidth = 8.63kHz

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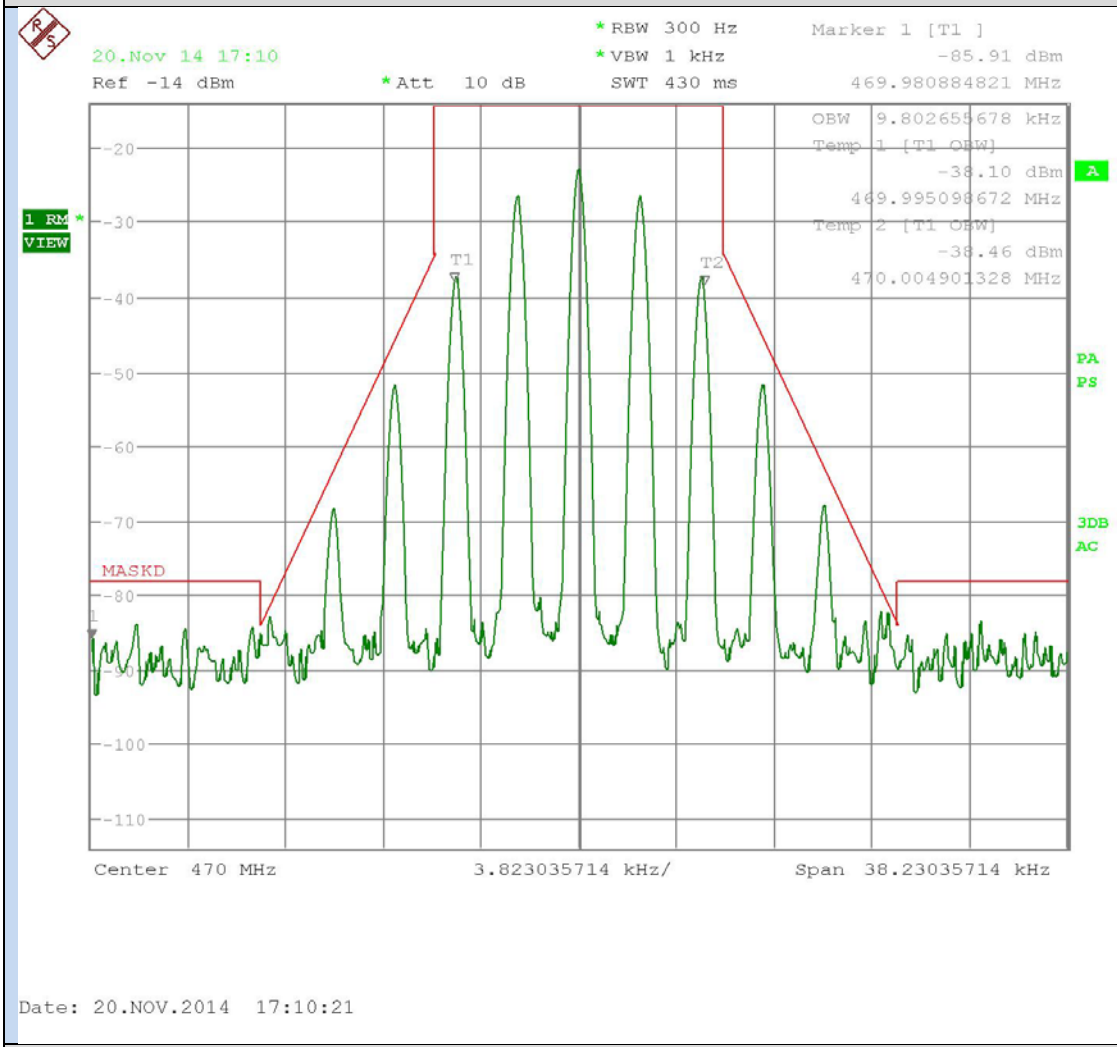
OCCUPIED BANDWIDTH PLOTS: 99% DIGITAL 470 3FSK

Part 90.210(D) Emission Mask D - 12.5 kHz Channel Bandwidth -

Occupied Bandwidth Plot



Result Meets The Requirement

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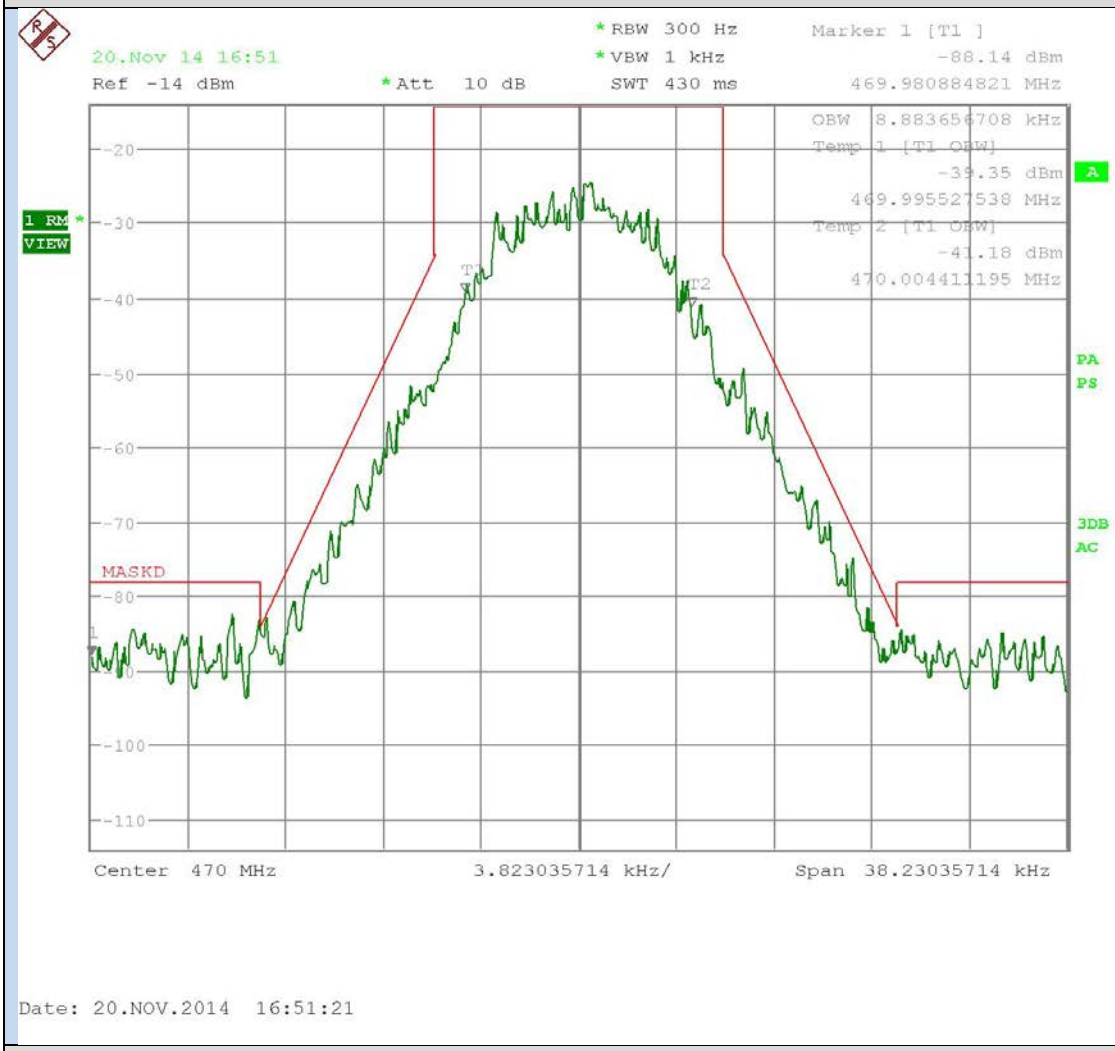
OCCUPIED BANDWIDTH PLOTS: 99% 470

Part 90.210(D) Emission Mask D - 12.5 kHz Channel Bandwidth - PRBS

Occupied Bandwidth Plot



Result Meets The Requirement

Results: 99% Bandwidth = 8.88kHz

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SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED)

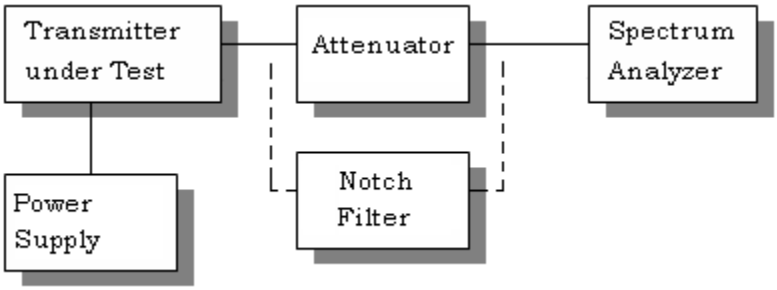
Rule Part No.: Part 2.1051(a)

Requirements:

12.5 kHz Channel Spacing = 50+10 log (2.0) = 53.0 dBc (high 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	Watts
Power Output	33	2
	Frequency	dBc
	450	0
	900	65.8
	1350	62.45
	1800	66.23
	2250	61.5
	2700	62.1
	3150	62.8
	3600	61.2
	4050	61.9
	4500	63.2

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SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED)

Test Data: High Power Middle of Band

	dBm	Watts
Power Output	33.01	2
	Frequency	dBc
	460	0
	920	55.8
	1380	61.9
	1840	59.9
	2300	60.4
	2760	60.7
	3220	61.5
	3680	62
	4140	61.4
	4600	61.8

Test Data: High Power High End of Band

	dBm	Watts
Power Output	33.02	2
	frequency	dBc
	470	0
	940	59.1
	1410	59.9
	1880	59.7
	2350	58.8
	2820	59.3
	3290	59.1
	3760	58.3
	4230	60.3
	4700	58.7

FIELD STRENGTH OF SPURIOUS EMISSIONS

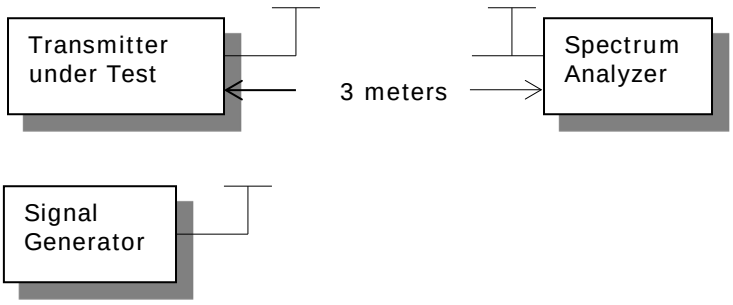
Rule Parts. No.: Part 2.1053

Requirements:

12.5kHz Channel Spacing = 50+10log(OP) = 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:



FIELD STRENGTH OF SPURIOUS EMISSIONS

Test Data:

Emission Frequency (MHz)	Power Mode	ERP Power Output (dBm)	ERP Power Output (Watts)	FCC Requirement dB	Bandwidth - BW - kHz
460.00	Hi	33.00	2.00	53.00	12.50

HIGH POWER: Middle of the Band

Emission Frequency (MHz)	Ant. Polarity	Below Carrier (dBc)	Margin
920.00	V	63.74	10.74
1,380.00	H	70.17	17.17
1,840.00	H	82.90	29.90
2,300.00	H	79.90	26.90
2,760.00	H	78.60	25.60
3,220.00	H	77.64	24.64
3,680.00	V	80.90	27.90
4,140.00	V	78.88	25.88
4,600.00	H	89.36	36.36

FREQUENCY STABILITY

Rule Parts. No.: Part 2.1055, Part 90.213

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

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

Test Data: for FCC

Temperature	Frequency MHz	PPM
25°C (reference)	459.999898	
-30°C	459.999808	-0.196
-20°C	459.999838	-0.130
-10°C	459.999956	0.126
0°C	459.999999	0.220
10°C	459.999973	0.163
20°C	459.99986	-0.083
30°C	460.000012	0.248
40°C	459.999994	0.209
50°C	459.999951	0.115
Battery Voltage	Frequency	PPM
-15%	459.999902	0.009
15%	459.999908	0.022

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TRANSIENT FREQUENCY BEHAVIOR

Part 90.214 Transient Frequency Behavior

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

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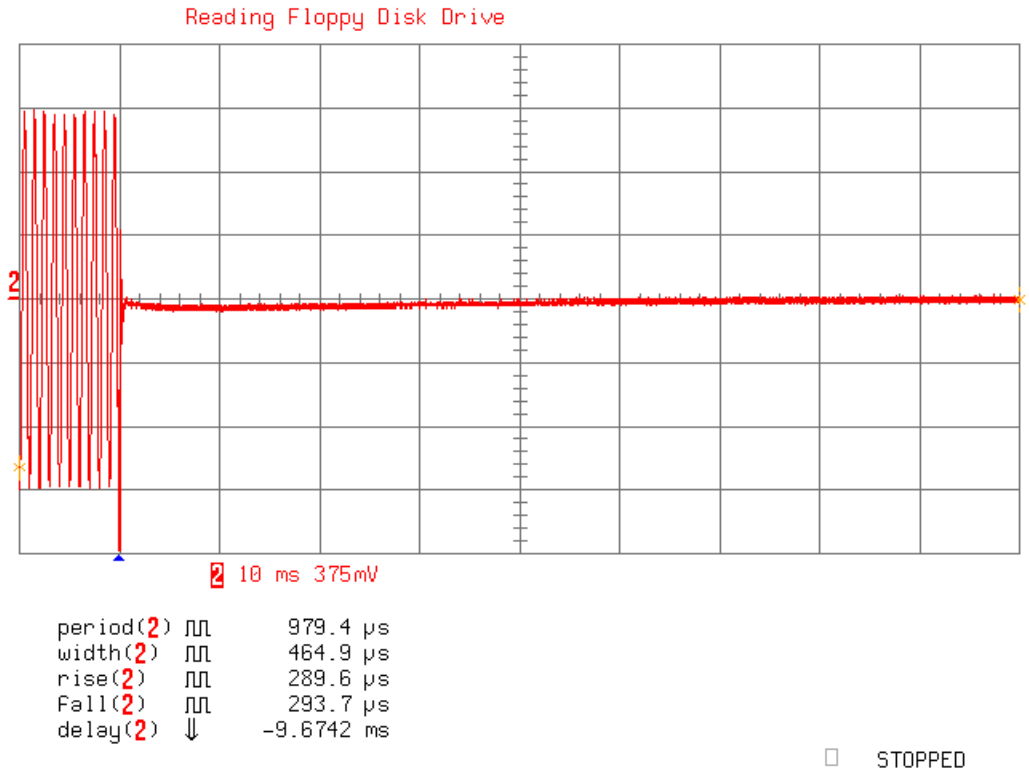
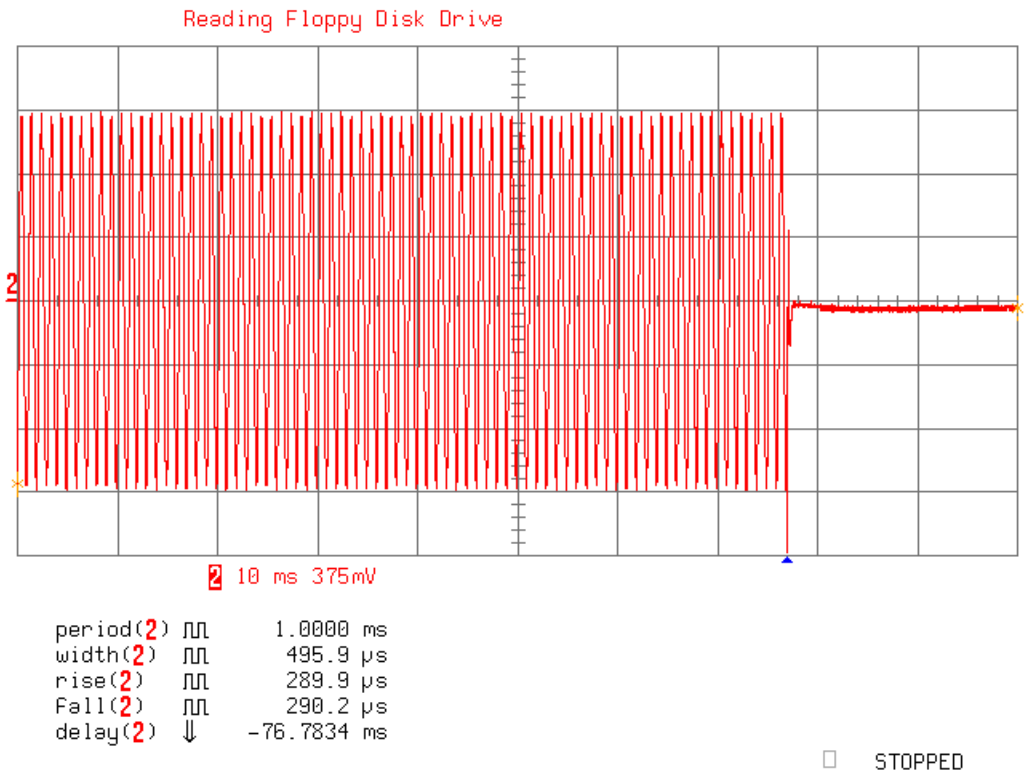
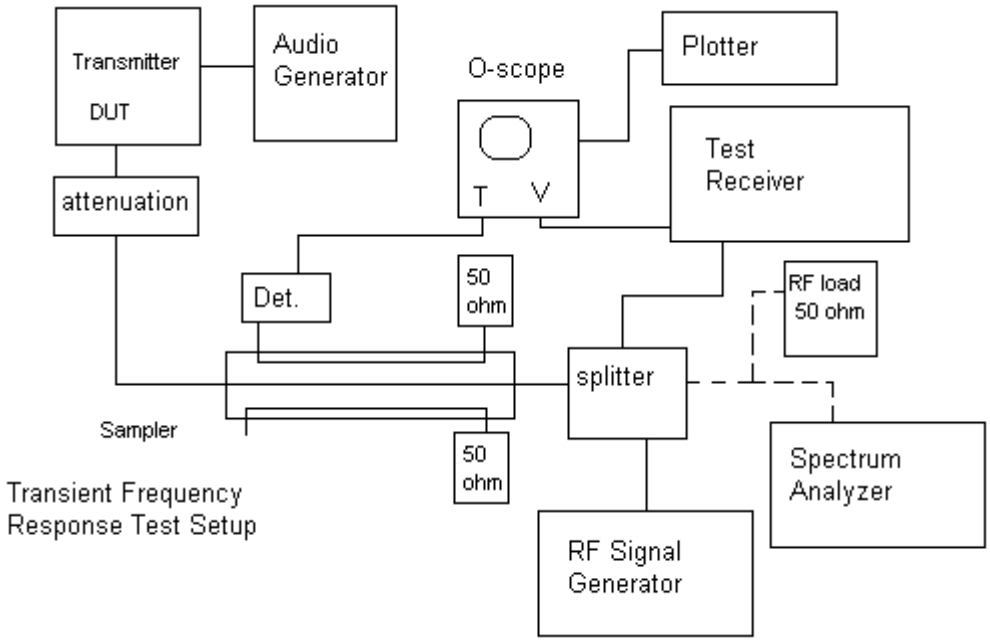
Test Data:


Reading Floppy Disk Drive
2
2 10 ms 375mV
period(2) 979.4 µs
width(2) 464.9 µs
rise(2) 289.6 µs
Fall(2) 293.7 µs
delay(2) -9.6742 ms
STOPPED


Reading Floppy Disk Drive
2
2 10 ms 375mV
period(2) 1.0000 ms
width(2) 495.9 µs
rise(2) 289.9 µs
Fall(2) 290.2 µs
delay(2) -76.7834 ms
STOPPED

TEST PROCEEDURE: ANSI/TIA 603-D:2010, 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 and recorded.



Transient Frequency Response Test Setup

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
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
Digital Multimeter	Fluke	77	35053830	08/22/13	08/22/15
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	12/12/13	12/12/15
Hygro-Thermometer	Extech	445703	0602	06/20/13	06/20/15
EMI Test Receiver R & S ESU 40 Chamber	Rohde & Schwarz	ESU 40	100320	03/11/14	03/11/16
Attenuator 30dB 500W	Bird	8325	1761	02/25/13	02/25/15

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