849 NW STATE ROAD 45
NEWBERRY, FL 32669 USA
PH: 888.472.2424 OR 352.472.5500
FAX: 352.472.2030
EMAIL: INFO@TIMCOENGR.COM
HTTP://WWW.TIMCOENGR.COM

FCC PART 90
TEST REPORT

APPLICANT	KOOS TECHNICAL SERVICES
	1025 GREENWOOD BLVD SUITE 391 LAKE MARY FLORIDA 32746
FCC ID	ZBG-ATRVHF-1
MODEL NUMBER	ATR-US-VHF-100
PRODUCT DESCRIPTION	TELEMETRY RADIO
DATE SAMPLE RECEIVED	12/19/2012
DATE TESTED	12/31/2012
TESTED BY	Joe Scoglio
APPROVED BY	Mario R. de Aranzeta
TIMCO REPORT NO.	328UT13TestReport.doc
TEST RESULTS	☒ PASS ☐ FAIL

ACCREDITED
Certificate # 0955-01

TABLE OF CONTENTS

GENERAL REMARKS

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

The test results relate only to the items tested.

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.

Testing Certificate # 0955-01

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:

Joe Scoglio
Project Manager/Testing Tech.

Date: 12/31/12

GENERAL INFORMATION
DUT Specification

DUT Description	TELEMETRY RADIO
FCC ID	ZBG-ATRVHF-1
Model Number	ATR-US-VHF-100
Serial Number	N/A
Operating Frequency	150-174 MHz
Test Frequencies	150.0 MHz, 162.0 MHz, 174.0 MHz
DUT 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 26°C with a relative humidity of 50%.
Modification to the DUT	None
Test Exercise	The DUT was placed in continuous transmit mode.
Applicable Standards	ANSI/TIA 603-C:2004, FCC CFR 47 Part 90, IC RSS-119, RSS-GEN
Test Facility	Timco Engineering Inc. at 849 NW State Road 45 Newberry, FL 32669 USA.

TEST PROCEDURES

Power Line Conducted Interference: The procedure used was ANSI/TIA 603-C:2004 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/TIA 603-C:2004 using an Agilent spectrum receiver with pre-selector. 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 micro volt at the output of the antenna.

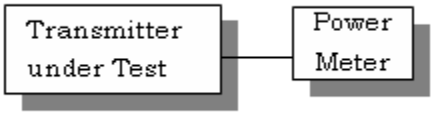
RF POWER OUTPUT

Rule Part No.: FCC Part 2.1046(a), IC RSS-119 4.1 and 5.4, RSS-GEN 4.8

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: HIGH – 4.6 Watt
LOW - .009 Watt

SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED)

Rule Part No.: FCC Part 2.1051(a), RSS-GEN 7.1.4

Requirements: 12.5 kHz CH spacing– 50+10log(4.6) = 56.6
6.25 kHz CH spacing - 55+10log(4.6) = 61.6

Method of Measurement: The carrier was modulated 100% using a 2500 Hz tone. The spectrum was scanned from 0.4 to at least the 10th harmonic of the fundamental. The measurements were made in accordance with standard ANSI/TIA 603-C:2004.

Test Data:

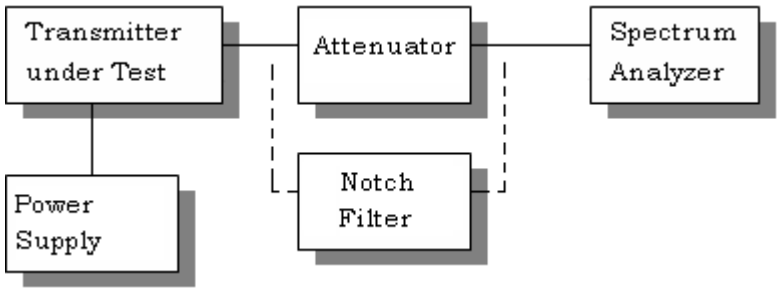
TF HIGH POWER	EF	dB below carrier		TF LOW POWER	EF	dB below carrier
150	150	0		150	150	0
	300	89.3			300	90.4
	450	77.7			450	103
	600	90.9			600	100.4
	750	95.9			750	96
	900	94.2			900	87
	1050	103.7			1050	102.4
	1200	81.4			1200	95.3
	1350	98.7			1350	99.9
	1500	85.8			1500	98.5

TF HIGH POWER	EF	dB below carrier		TF LOW POWER	EF	dB below carrier
162	162	0		162	162	0
	324	99.3			324	100.9
	468	96.9			468	102.1
	648	98.1			648	102.8
	810	98.1			810	102.7
	972	96.8			972	86.1
	1134	96			1134	102.3
	1296	89.5			1296	98.4
	1458	93.8			1458	98.7
	1620	101.6			1620	98.5

TEST DATA CONTD.

TF HIGH POWER	EF	dB below carrier		TF LOW POWER	EF	dB below carrier
174	174	0		174	174	0
	348	86.4			348	99.3
	522	89.7			522	101.1
	696	88.9			696	103.1
	870	103			870	101.7
	1044	96.6			1044	92.2
	1218	73.4			1218	100.1
	1392	91.5			1392	96.4
	1566	106.8			1566	100.2
	1740	87.9			1740	101.6

Method of Measuring Conducted Spurious Emissions



METHOD OF MEASUREMENT: The procedure used was ANSI/TIA 603-C:2004. The measurements were made at TIMCO ENGINEERING INC. 849 N.W. State Road 45, Newberry, Florida 32669.

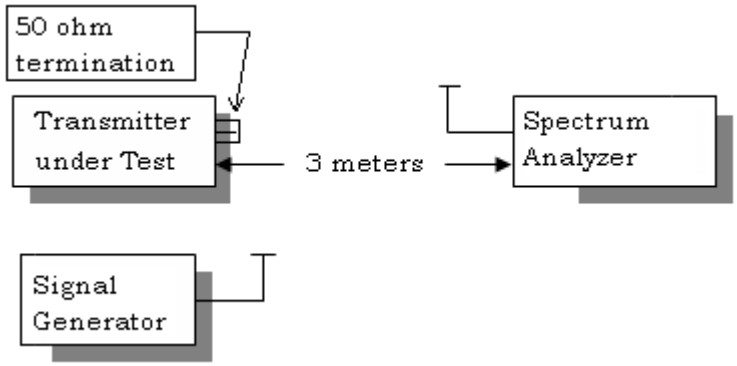
FIELD STRENGTH OF SPURIOUS EMISSIONS

Rule Parts. No.: FCC Part 2.1053, RSS-GEN 4.9

Requirements: 12.5 kHz CH spacing– 50+10log(4.6) = 56.6
6.25 kHz CH spacing - 55+10log(4.6) = 61.6

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-C:2004 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

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
150.00	V	0
300.00	H	84.2
450.00	V	76.3
600.00	H	81.8
750.00	H	99.9
900.00	H	92.6
1050.00	H	91.8
1200.00	H	90.6

Low Power

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
150.00	V	0
300.00	H	74.1
450.00	V	72.9
600.00	H	79.2
750.00	H	76.9
900.00	H	72.1
1050.00	H	65.6

High Power

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
162.00	V	0
324.00	H	84.2
486.00	V	76.4
648.00	H	82.0
810.00	H	99.6
972.00	H	92.7
1134.00	H	91.9
1296.00	H	90.7

Low Power

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
162.00	V	0
324.00	H	72.1
486.00	V	71.8
648.00	H	77.7
810.00	H	75.0
972.00	H	70.3

TEST DATA CONTD.

HIGH POWER

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
174.00	V	0
348.00	H	84.0
522.00	V	75.6
696.00	H	79.6
870.00	V	95.2
1044.00	H	92.4
1218.00	H	91.2
1392.00	H	91.0

LOW POWER

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
174.00	V	0
348.00	V	73.1
522.00	V	71.9
696.00	V	74.1
870.00	H	72.9
1044.00	H	69.5

FREQUENCY STABILITY

Rule Parts. No.: FCC Part 2.1055, Part 90.213, RSS-119 5.3, RSS-GEN 7.2.4

Requirements: Temperature range requirements: -30 to +50° C.
Voltage Variation +, -15%
±1.5 PPM

Method of Measurements: ANSI/TIA 603-C:2004

Test Data:

Assigned Frequency (Ref. Frequency) (MHz)		
Temperature (°C)	**Frequency (MHz)**	**Frequency Stability (PPM)**
-30	162.00101	1.05
-20	162.001030	1.17
-10	162.00103	1.17
0	162.000990	0.93
+10	162.000960	0.74
+20	162.0009	0.37
+30	162.00079	-0.31
+40	162.00066	-1.11
+50	162.00065	-1.17

Assigned Frequency (Ref. Frequency) (MHz)		
% Battery (%)	**Frequency (MHz)**	**Frequency Stability (PPM)**
-15%	162.00085	0.06
	162.000840	
+15%	162.00085	0.06

TRANSIENT FREQUENCY BEHAVIOR

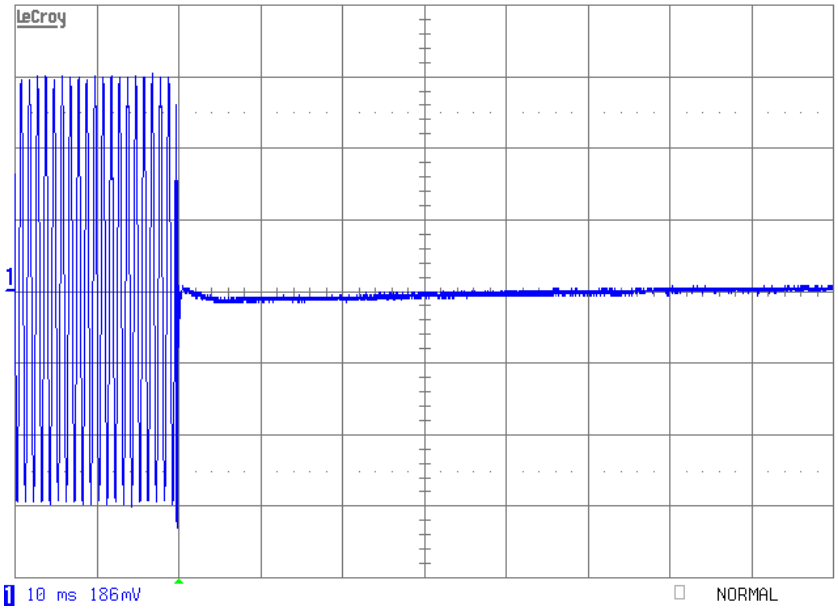
FCC Part 2.1055(a)(1)
FCC Part 90.214, IC RSS-119 5.8

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:

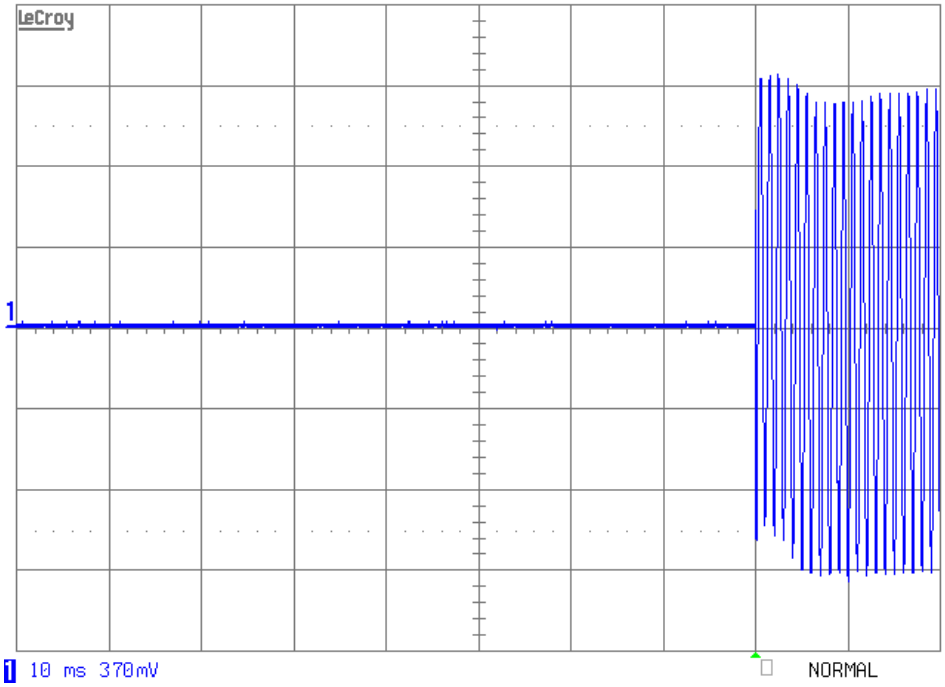
Time Intervals	Maximum frequency difference	All Equipment	
		150-174 MHz	421-512 MHz
Transient Frequency Behavior for Equipment Designed to Operate on 25 kHz Channels			
t_1[4]	±25.0 kHz	5.0 ms	10.0 ms
t_2	±12.5 kHz	20.0 ms	25.0 ms
t_3[4]	±25.0 kHz	5.0 ms	10.0 ms
Transient Frequency Behavior for Equipment 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

TRANSIENT FREQUENCY RESPONSE PLOTS

6.25k ON

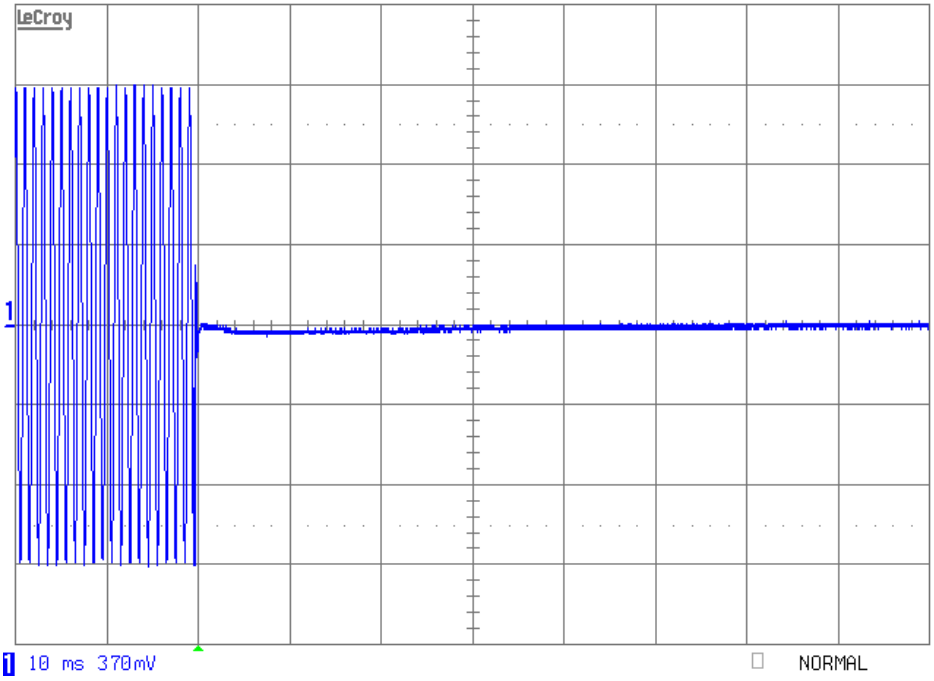


6.25k OFF

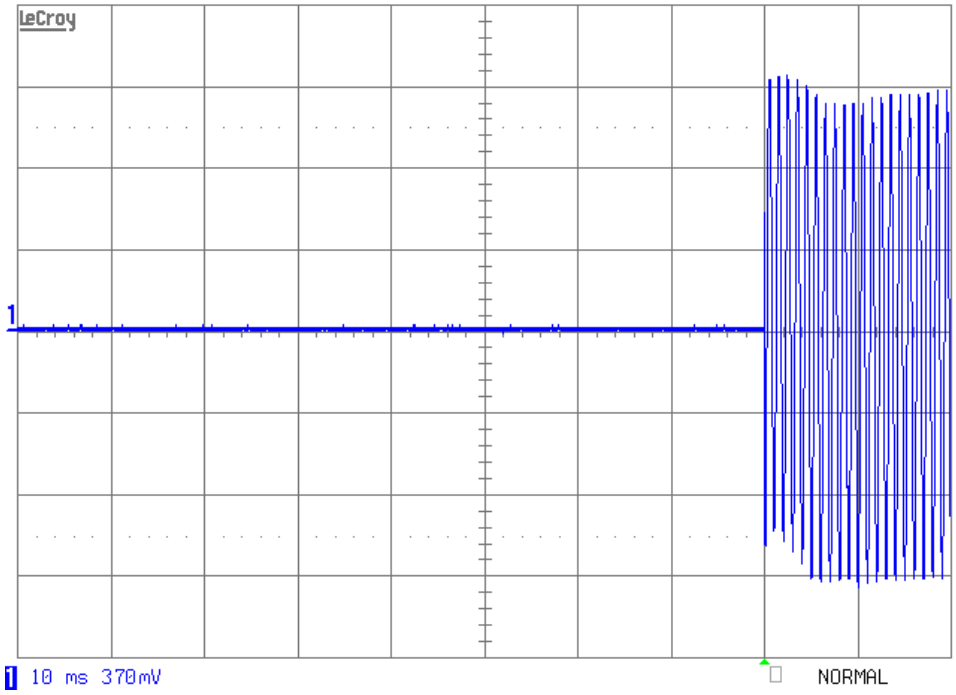

LeCroy
1
1 10 ms 370mV
NORMAL

TRANSIENT FREQUENCY RESPONSE PLOTS

12.5k ON



12.5k OFF

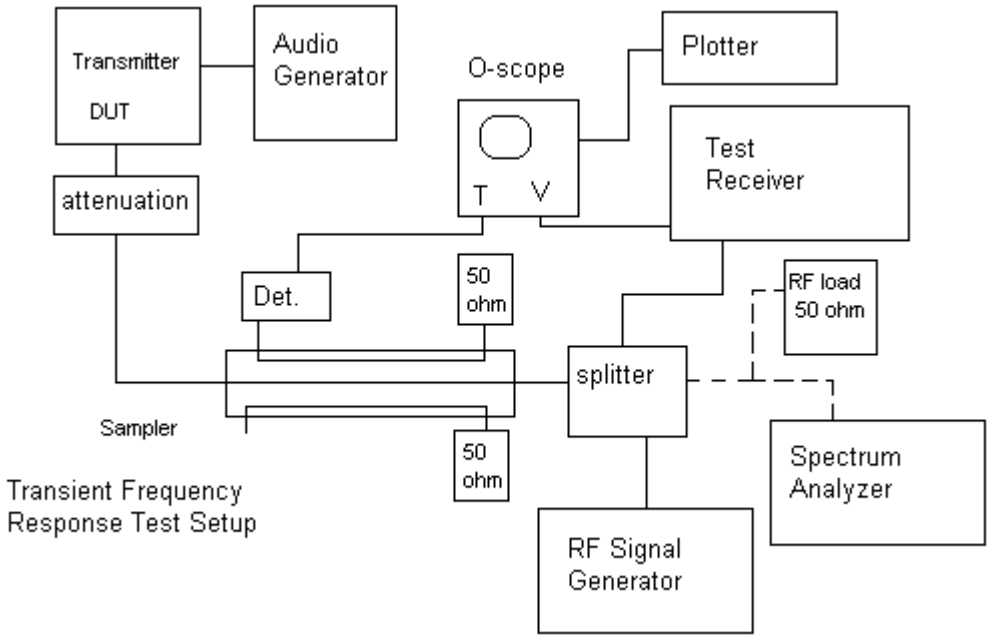

LeCroy
1
1 10 ms 370mV
NORMAL

TEST PROCEDURE: ANSI/TIA 603-C:2004 PARA 2.2.19

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. With the levels set as above the transient frequency behavior was observed & recorded.



Transient Frequency Response Test Setup

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) 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:

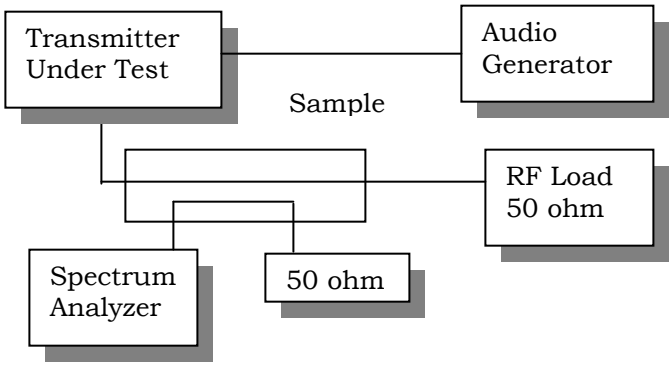
(1) On any frequency from the center of the authorized bandwidth f0 to 5.625 kHz removed from f0: Zero dB.
(2) On any frequency from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 5.625 kHz but no more than 12.5 kHz: At least 7.27 (fd - 2.88 kHz) dB.
(3) On 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.

Method of Measurement: ANSI/TIA 603-C: 2004

Test Setup Diagram:



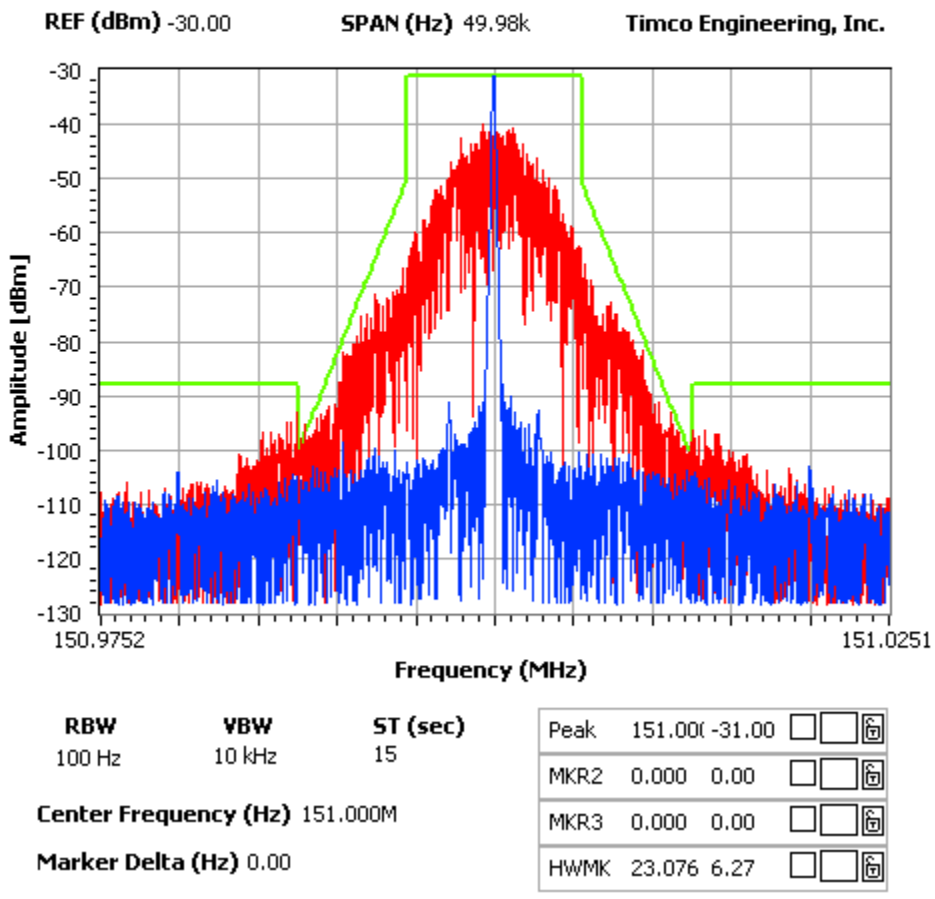
Test Data: See the plots below

OCCUPIED BANDWIDTH PLOTS

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

NOTES:

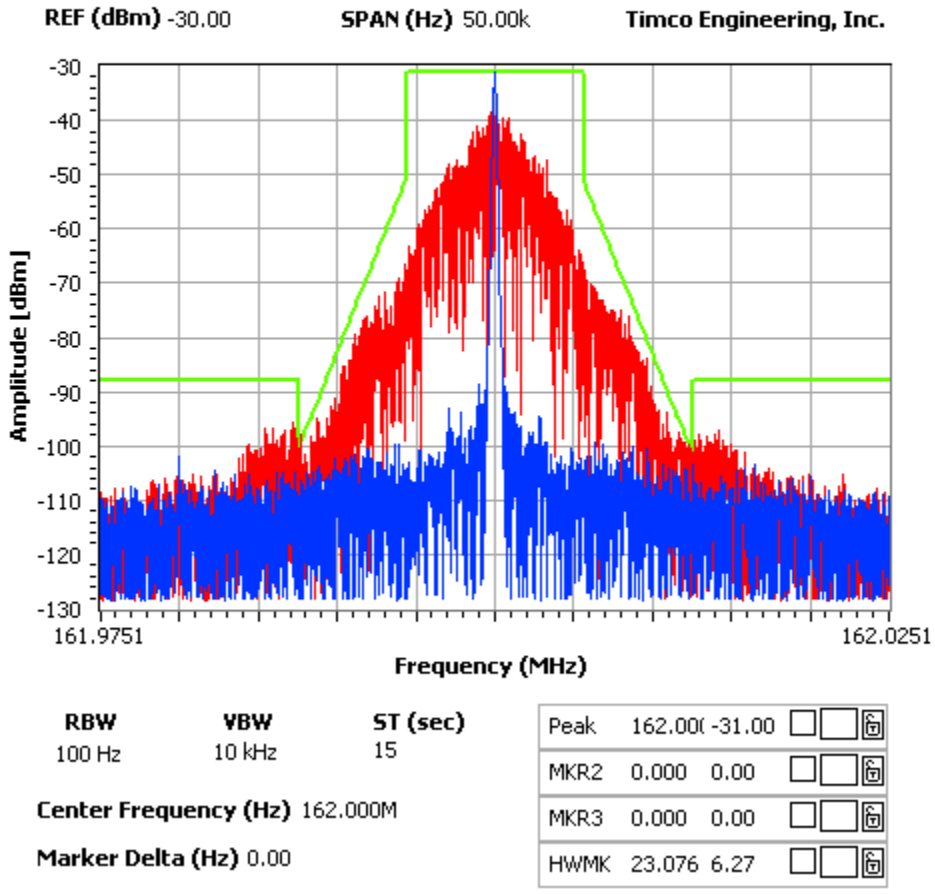
FCC 90.210 Mask D



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

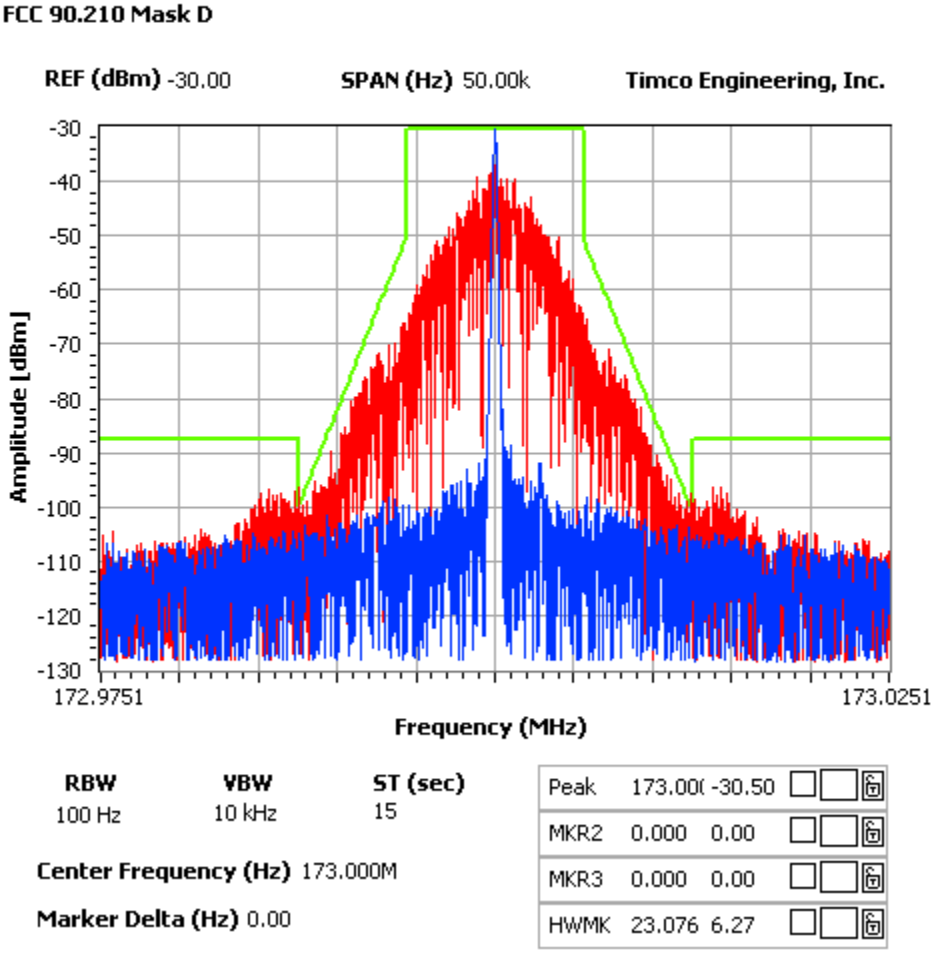
NOTES:

FCC 90.210 Mask D



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

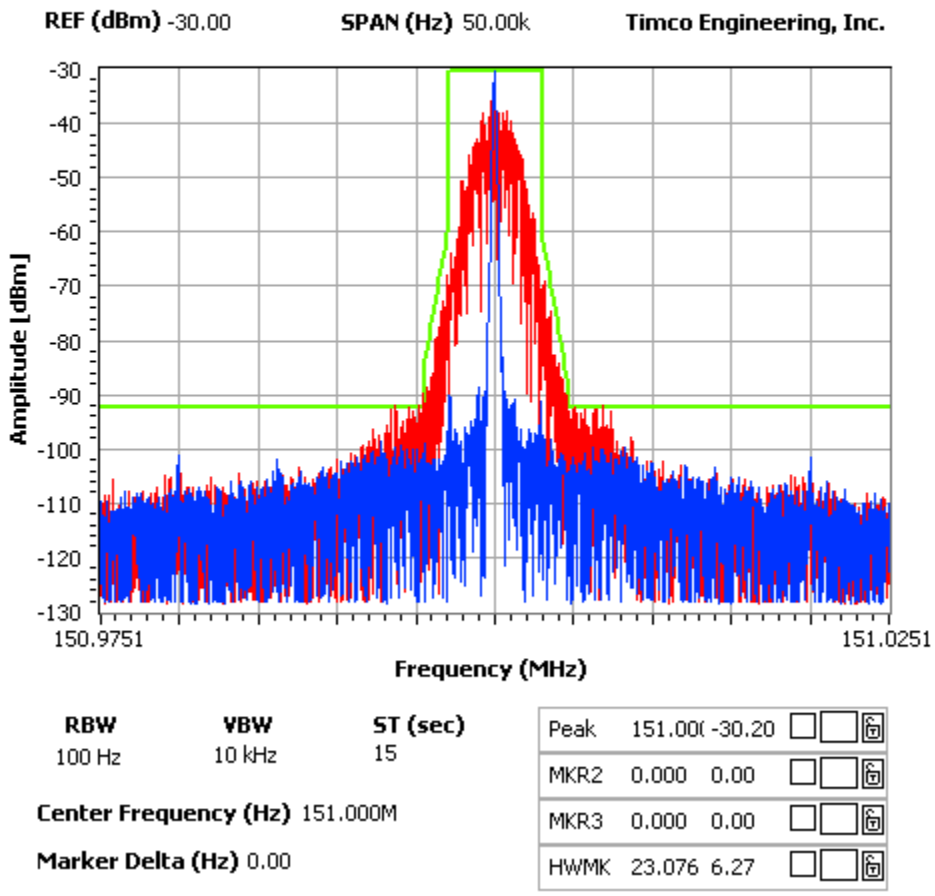
NOTES:



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

NOTES:

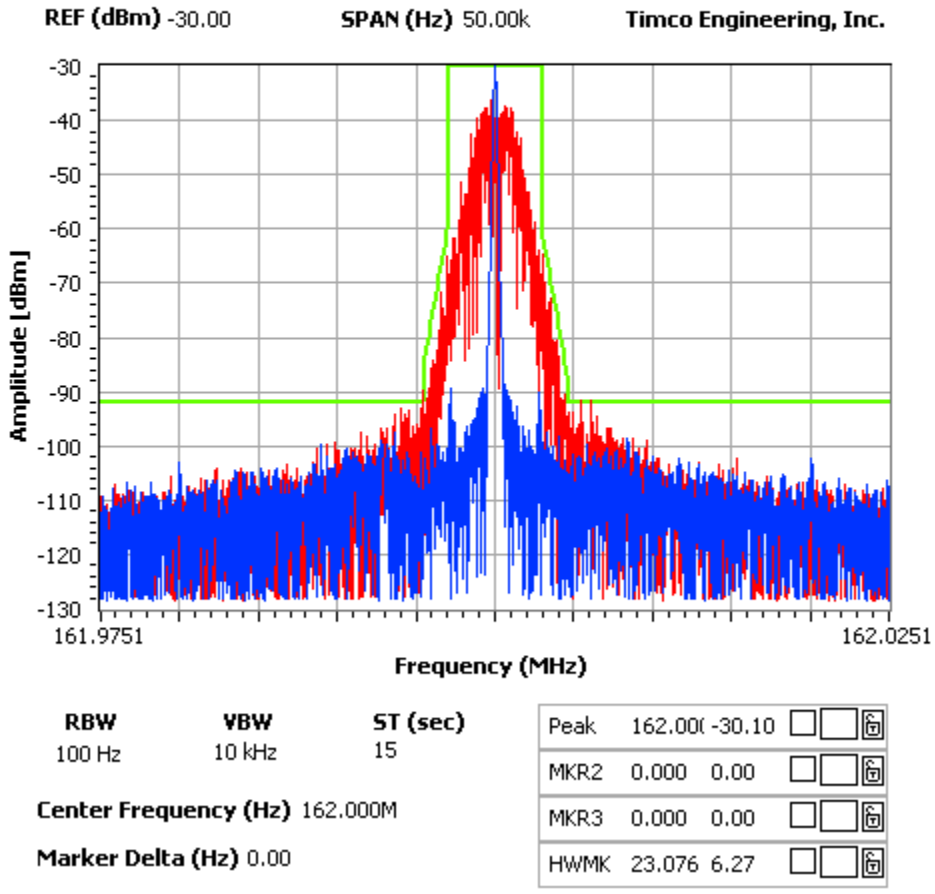
FCC 90.210 Mask E



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

NOTES:

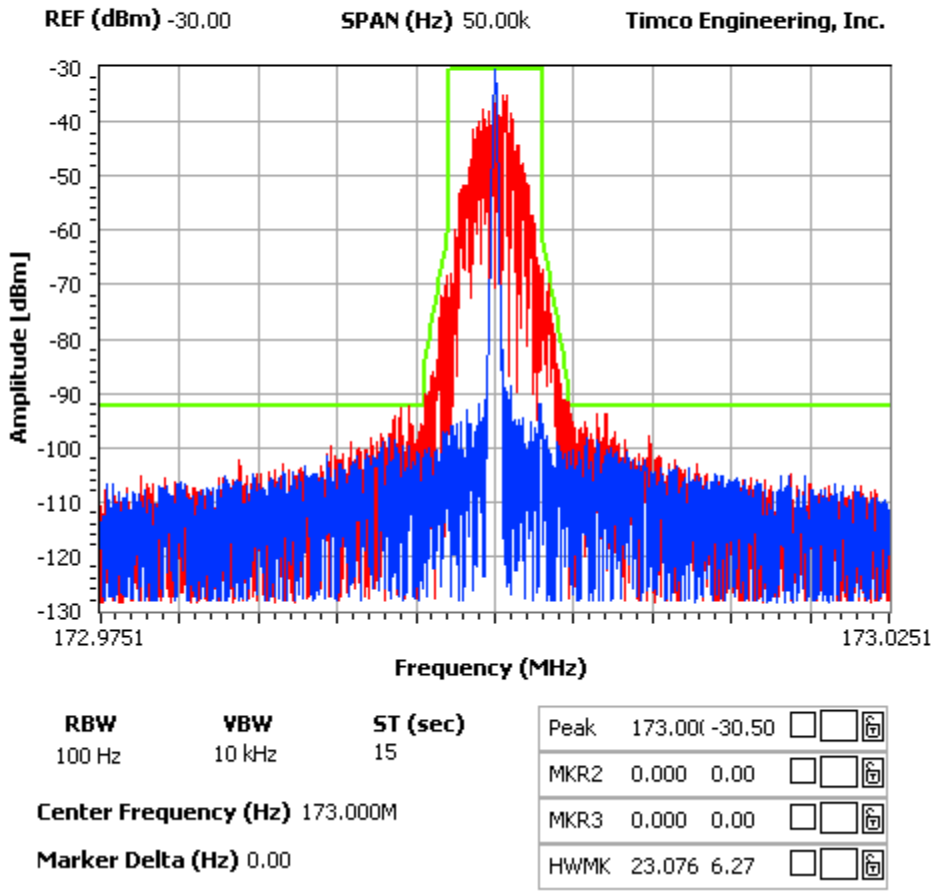
FCC 90.210 Mask E



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

NOTES:

FCC 90.210 Mask E



EMC EQUIPMENT LIST

Device	Manufacturer	Model	Serial Number	Cal/Char Date	Due Date
Analyzer Tan Tower Spectrum Analyzer	HP	8566B Opt 462	3138A07786 3144A20661	10/28/11	10/28/13
Analyzer Tan Tower Preamplifier	HP	8449B-H02	3008A00372	10/28/11	10/28/13
Antenna: Biconnical	Electro-Metrics	BIA-25	1171	06/13/12	06/13/14
Antenna: Biconnical	Eaton	94455-1	1096	05/04/11	05/04/13
Antenna: Log-Periodic	Electro-Metrics	LPA-25	1122	05/04/11	05/04/13
Antenna: Dipole Kit	Electro-Metrics	TDA-30/1-4	152	11/01/09	11/01/99
Frequency Counter	HP	5352B	2632A00165	06/22/11	06/22/13
Frequency Counter	HP	5385A	2730A03025	08/17/11	08/17/13
Signal Generator	HP	8640B	2308A21464	02/23/12	02/23/14
Hygro-Thermometer	Extech	445703	0602	06/15/11	06/15/13
Digital Multimeter	Fluke	77	35053830	09/09/11	09/09/13
Analyzer Tan Tower RF Preselector	HP	85685A	3221A01400	10/28/11	10/28/13
Antenna: Passive Loop	EMC Test Systems	EMCO 6512	9706-1211	06/14/12	06/14/14
Analyzer Tan Tower Quasi-Peak Adapter	HP	85650A	3303A01690	10/28/11	10/28/13
Temperature Chamber	Tenney Engineering	TTRC	11717-7	07/03/12	07/03/14
Frequency Counter	HP	5385A	3242A07460	06/22/11	06/22/13
3-Meter Semi-Anechoic Chamber	Panashield	N/A	N/A	12/31/11	12/31/13