TIMCO ENGINEERING, Inc.

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FCC PART 90 & IC RSS 119
UHF MOBILE TEST REPORT

APPLICANT	CATTRON NORTH AMERICA INC.
ADDRESS	655 N. RIVER ROAD NW SUITE A WARREN, OH 44483-2254 USA
FCC ID	CN289693
IC	1007A-89693
MODEL NUMBER	89693 TRX
PRODUCT DESCRIPTION	LRMII TRANSCEIVER MODULE
DATE SAMPLE RECEIVED	2/28/2019
DATE TESTED	03/12/18
TESTED BY	Tim Royer
APPROVED BY	Franklin Rose
TEST RESULTS	☒ PASS ☐ FAIL

Report Number	Version Number	Description	Issue Date
461UT19_TestReport	Rev2	Initial Issue	03/12/2019
461UT19_TestReport	Rev3	Made correction on report signature	04/11/2019

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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 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
Tested by:

Sr. EMC Engineer
EMC-003838-NE

Name and Title: Tim Royer, Project Manager/Testing Engineer

Date: 03/12/2018

Reviewed and approved by:

Name and Title: Franklin Rose, Project Manager/EMC Specialist

Date: 03/19/2019

GENERAL INFORMATION

EUT Specification

EUT Description	LRMII TRANSCEIVER MODULE
FCC ID	CN289693
IC	1007A-89693
Model Number	89693 TRX
Operating Frequency	450-470MHz
Test Frequencies	450,460 & 470 MHz
Type of Emission	8K12F1D/ F1W/ F1X
Modulation	FSK
EUT Power Source	☐ 110–120Vac/50– 60Hz
	☒ DC Power 5V
	☐ 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% & Barometric Pressure: 1019 – 1022 mb
Modification to the EUT	None
Test Exercise	The RF Module (EUT) was operated in a normal mode while connected to a test jig during testing.
Applicable Standards	ANSI/TIA 603-D:2010, FCC CFR 47 Part 90, & IC RSS 119 i12 2015
Test Facility	Timco Engineering Inc. at 849 NW State Road 45 Newberry, FL 32669 USA.

TEST RESULTS SUMMARY

Test Description	FCC RULE PART NO.	RESULT
Modulation Characteristics	2.1047(a)(b)	**Pass**
RF Power Output	2.1046(a), 90.205, IC RSS 119	**Pass**
Occupied Bandwidth	2.1049(c)(h), 90.210, IC RSS 119	**Pass**
Spurious Emissions at Antenna Terminal	2.1051(a), 90.210(b)(g)(h), 90.691, 90.543(c)	**Pass**
Field Strength of Spurious Radiation	2.1053, 90.210, IC RSS 119	**Pass**
FIELD STRENGTH OF SPURIOUS RADIATION EMISSIONS	Part 2.1053, 90.210, 90.543(c)(f)	**Pass**
FREQUENCY STABILITY	Part 2.1055, Part 90.213, IC RSS 119	**Pass**
TRANSIENT FREQUENCY RESPONSE	90.214, IC RSS 119	**N/A**

RF POWER OUTPUT

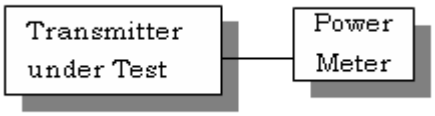
Rule Part No.: Part 2.1046(a), Part 90, RSS-119

Requirements: For IC the power output must be within ±1.0dB of the manufacturer's rating.

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:

Tuned Frequency	RF Power (High)		RF Power (Low)	
MHz	dBm	W	dBm	W
450	18.36	0.069	0.85	0.0012
460	18.09	0.064	0.99	0.0012
470	17.84	0.061	1.09	0.0012

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

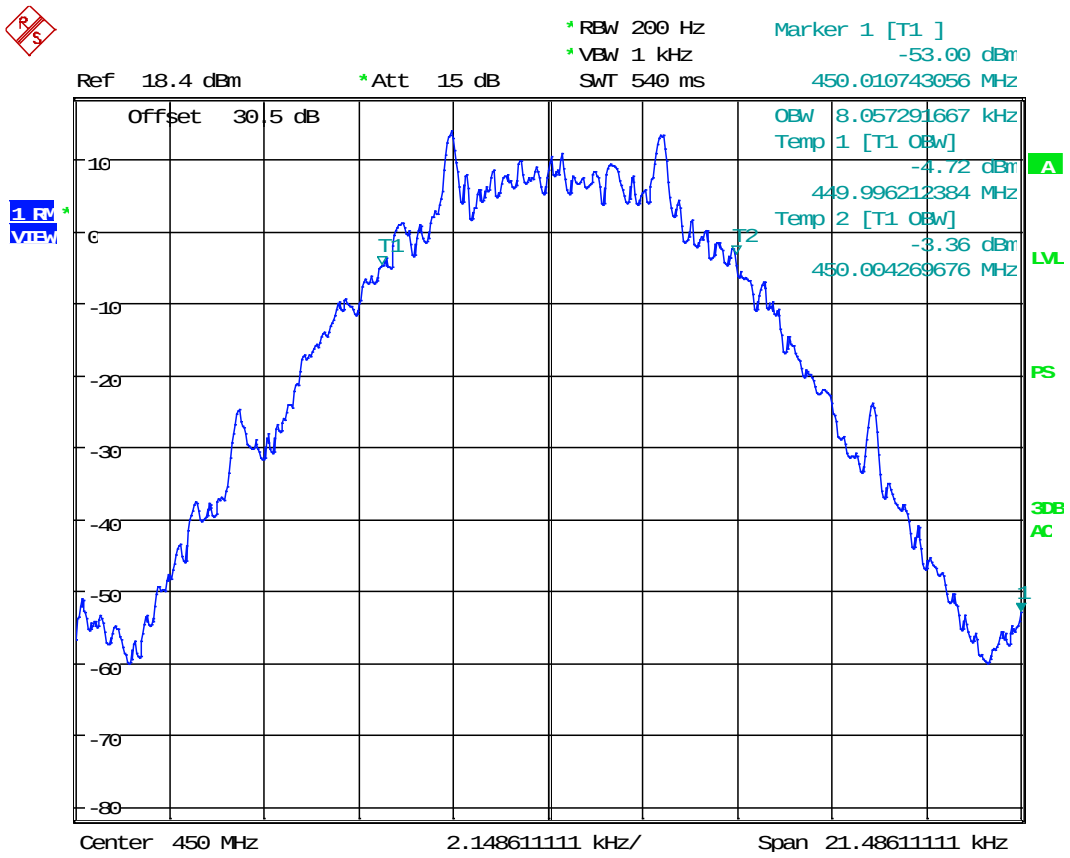
INPUT POWER: (5V) (40mA) = 0.2 Watts

MODULATION CHARACTERISTICS

Requirements: Part 2.1033(c), 2.1033(c) (4), 2.1047(a) (b), 90.209, 90.207, IC RSS 119

TEST FREQ. 450 MHz

99% dB OCC BW = 8.05kHz



Date: 12.MAR.2019 14:54:00

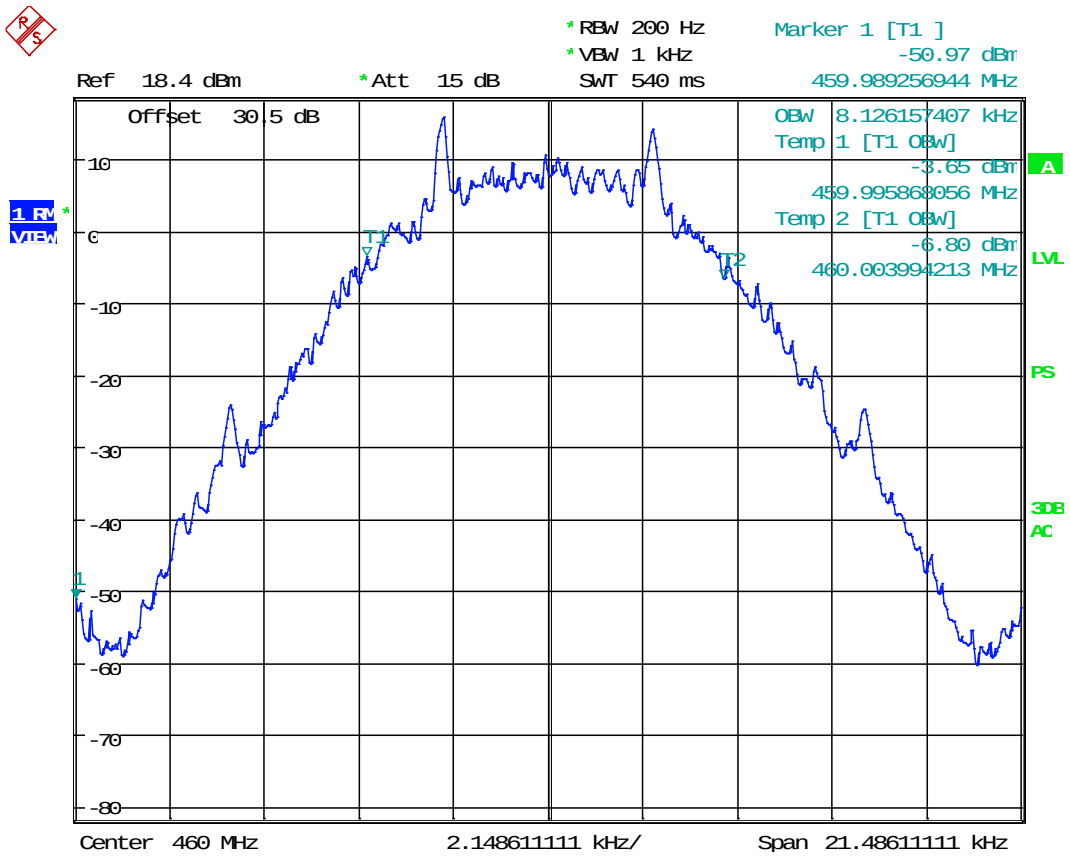
Results Meet Requirements

MODULATION CHARACTERISTICS

Requirements: Part 2.1033(c), 2.1033(c) (4), 2.1047(a) (b), 90.209, 90.207, IC RSS 119

TEST FREQ. 460 MHz

99% dB OCC BW =8.12kHz



Date: 12.MAR.2019 14:53:11

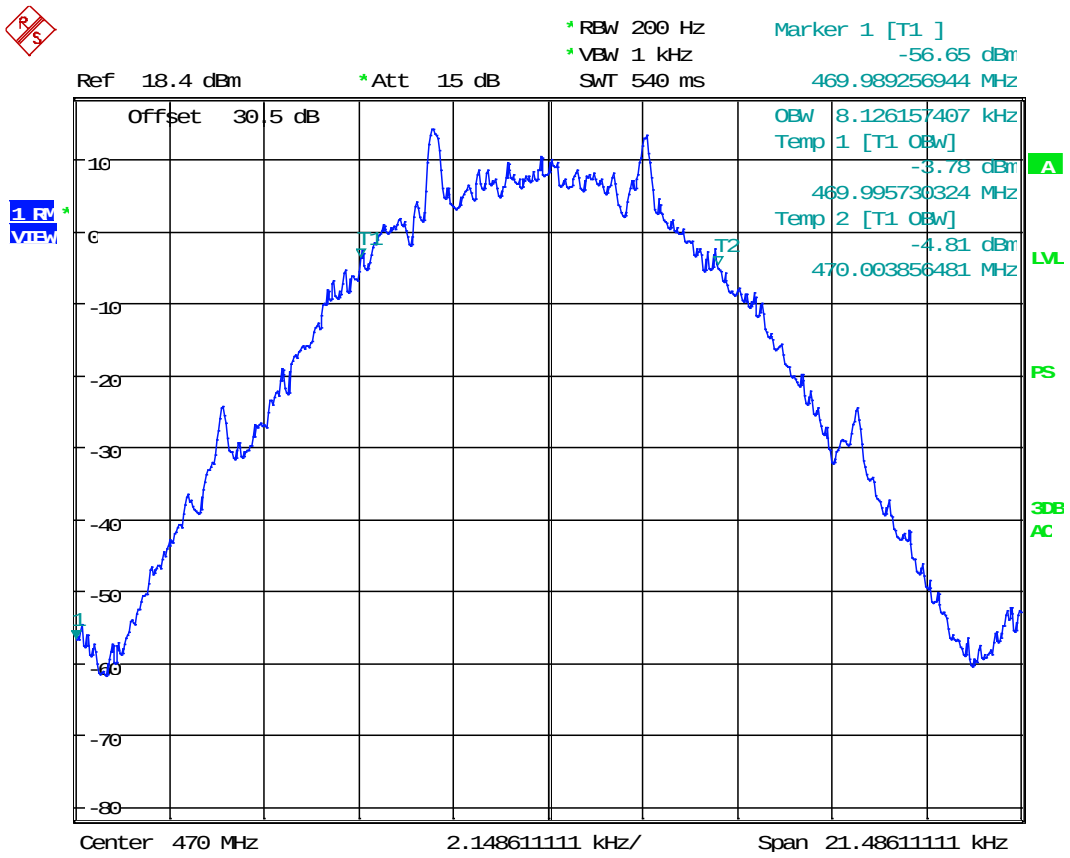
Results Meet Requirements

MODULATION CHARACTERISTICS

Requirements: Part 2.1033(c), 2.1033(c) (4), 2.1047(a) (b), 90.209, 90.207, IC RSS 119

TEST FREQ. 470 MHz

99% dB OCC BW =8.12kHz



Date: 12.MAR.2019 14:54:59

Results Meet Requirements

OCCUPIED BANDWIDTH

Requirements: Part 2.1049(c), Part 90.210(d), IC RSS 119

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:

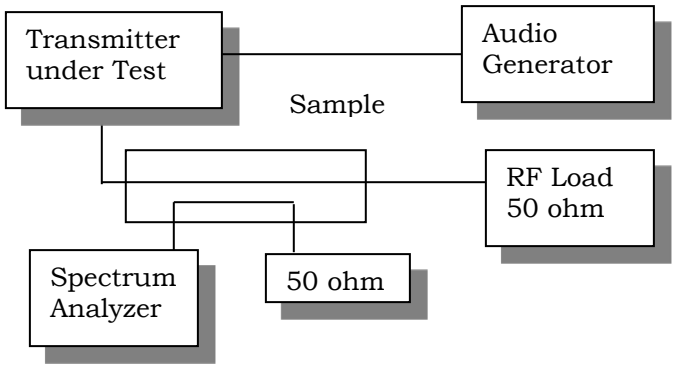
(1) On any frequency from the center of the authorized bandwidth f0 to 5.625 kHz removed from f0: Zero dB.

(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.

Method of Measurement: Was in accordance with test procedures detailed in the standard list above.

Test Setup Diagram:



Test Data: See the plots below

Results Meet Requirements

OCCUPIED BANDWIDTH

Part 90.210(c) Emission Mask D – 12.5 kHz channel

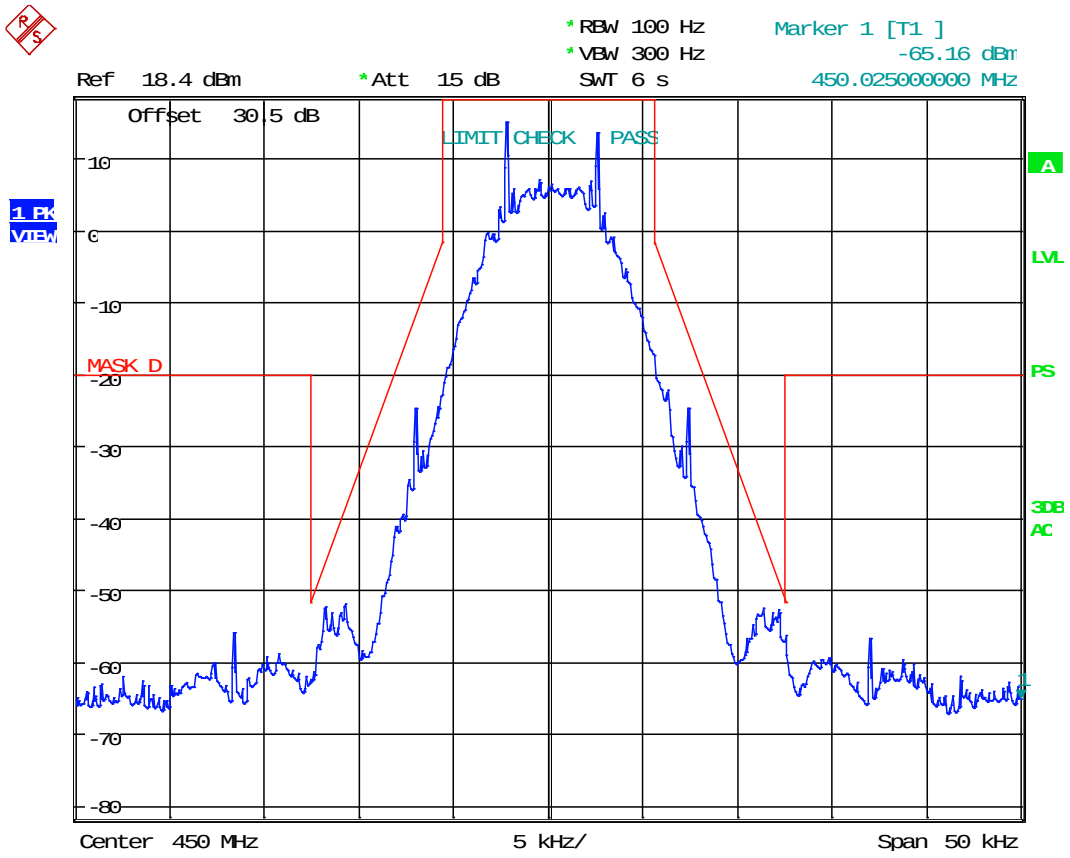
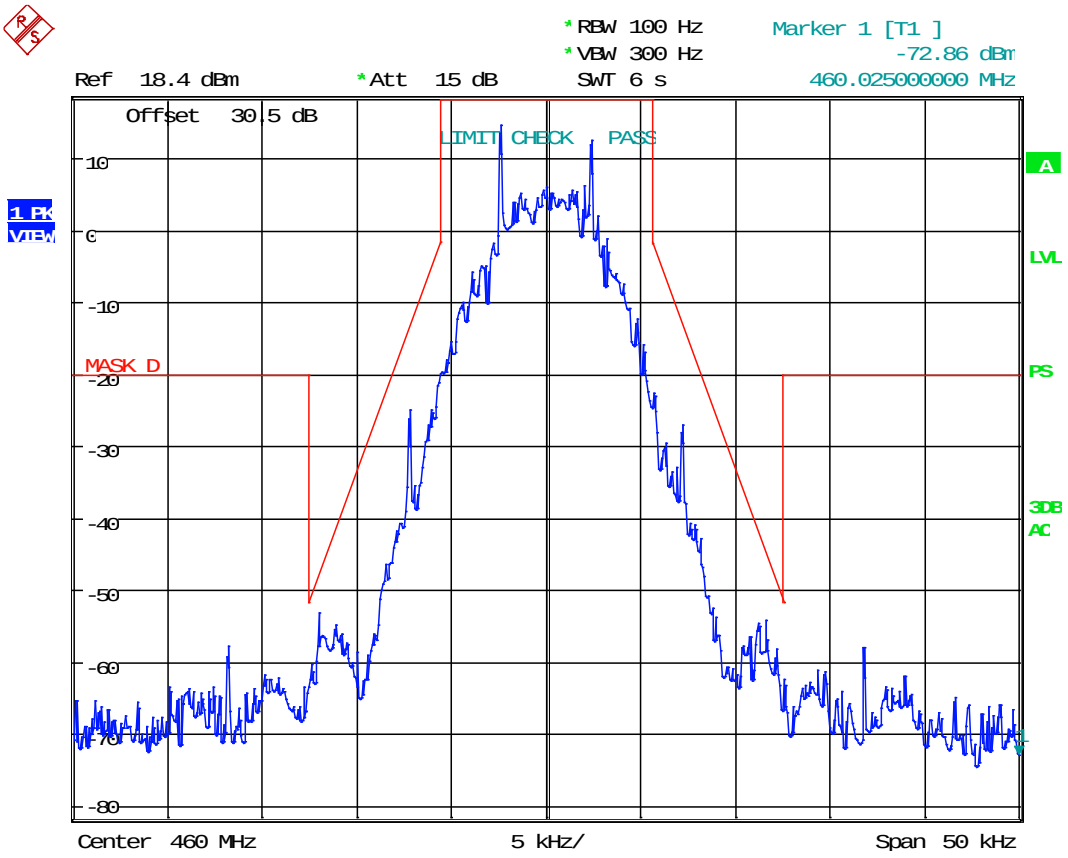


Figure 1: Occupied bandwidth 450MHz

Results Meet Requirements

OCCUPIED BANDWIDTH

Part 90.210(b) Emission Mask D – 12.5 kHz channel



Date: 12.MAR.2019 14:28:43

Figure 2: Occupied bandwidth 460MHz

Results Meet Requirements

OCCUPIED BANDWIDTH

Part 90.210(b) Emission Mask D – 12.5 kHz channel

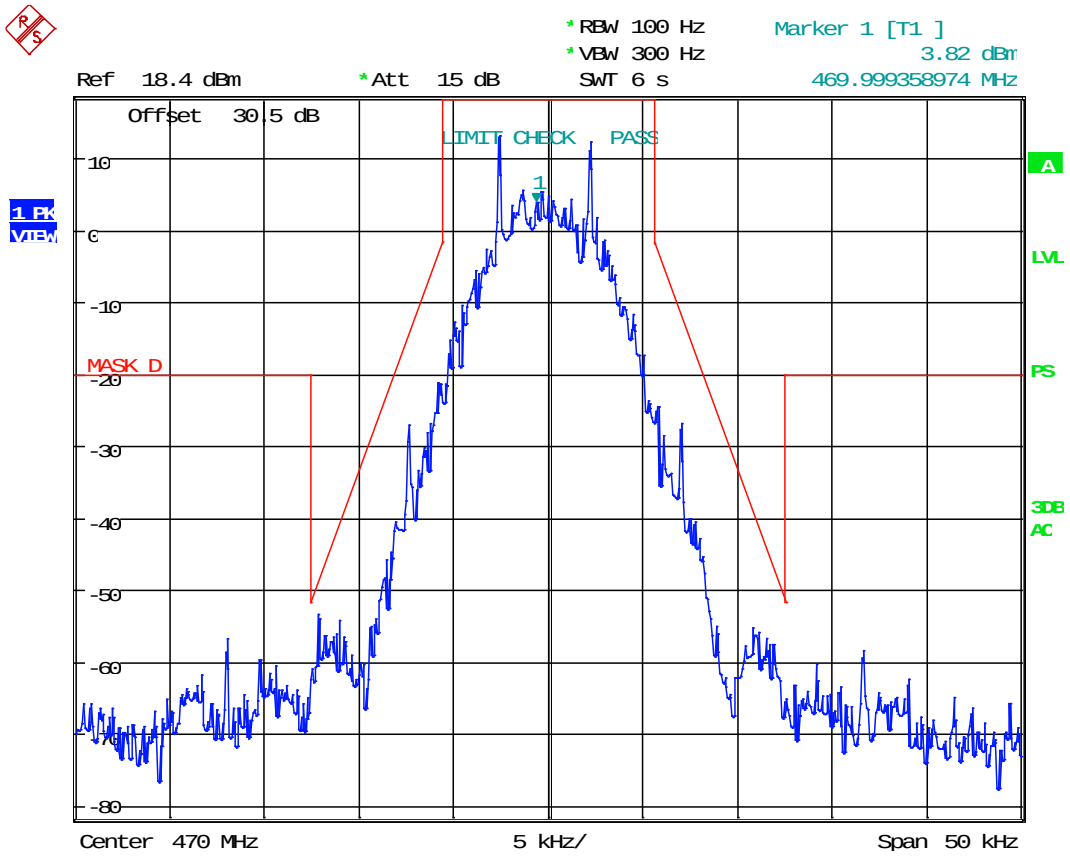


Figure 3: Occupied bandwidth 470MHz

Results Meet Requirements

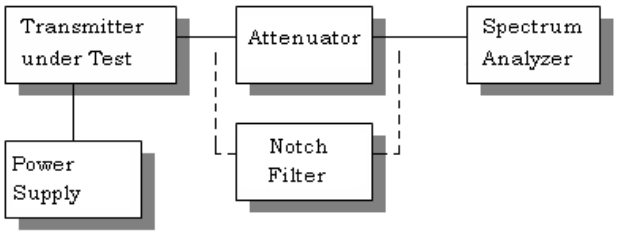
SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED)

Rule Part No.: Part 2.1051(a)

Requirements: 12.5 kHz Channel Spacing = 50+10log (p) =dBc

Method of Measurement: The EUT was transmitting in a normal operational mode

Test Setup:



Test Data: 450.05 MHz

Spurious Conducted Emissions, Narrowband FM (12.5 kHz), Mask D Limit (≥250% Authorized BW)		High Power		Low Power	
		dBm	18.09	dBm	0.85
		Watts	0.06	Watts	0.00
		Limit (dBm)	-20	Limit (dBm)	-20
Frequency (MHz)		**Peak (dBm)**	**Margin (dB)**	**Peak (dBm)**	**Margin (dB)**
Fundamental	450.0000	18.09	0.00	0.85	0.00
2nd Harmonic	900.0000	-56.84	**36.84**	-25.70	**5.70**
3rd Harmonic	1350.0000	-50.03	**30.03**	-55.95	**35.95**
4th Harmonic	1800.0000	-57.55	**37.55**	-67.91	**47.91**
5th Harmonic	2250.0000	-51.39	**31.39 ***	-61.33	**41.33**
6th Harmonic	2700.0000	-45.92	**25.92**	-67.29	**47.29**
7th Harmonic	3150.0000	-48.17	**28.17 ***	-72.93	**52.93 ***
8th Harmonic	3600.0000	-48.17	**28.17 ***	-72.93	**52.93 ***
9th Harmonic	4050.0000	-48.17	**28.17 ***	-72.93	**52.93 ***
10th Harmonic	4500.0000	-48.17	**28.17 ***	-72.93	**52.93 ***

* Indicates Noise Floor of Measurement

Results Meet Requirements

SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED)

Test Data: 460 MHz

Spurious Conducted Emissions, Narrowband FM (12.5 kHz), Mask D Limit (≥250% Authorized BW)		High Power		Low Power	
		dBm	18.09	dBm	0.99
		Watts	0.06	Watts	0.00
		Limit (dBm)	-20	Limit (dBm)	-20
Frequency (MHz)		**Peak (dBm)**	**Margin (dB)**	**Peak (dBm)**	**Margin (dB)**
Fundamental	460.0000	18.09	0.00	0.99	0.00
2nd Harmonic	920.0000	-51.50	**31.50**	-31.20	**11.20**
3rd Harmonic	1380.0000	-48.38	**28.38**	-52.77	**32.77**
4th Harmonic	1840.0000	-55.50	**35.50**	-65.13	**45.13**
5th Harmonic	2300.0000	-54.11	**34.11 ***	-62.16	**42.16**
6th Harmonic	2760.0000	-45.08	**25.08**	-66.80	**46.80**
7th Harmonic	3220.0000	-49.84	**29.84 ***	-77.70	**57.7 ***
8th Harmonic	3680.0000	-49.09	**29.09**	-68.33	**48.33**
9th Harmonic	4140.0000	-49.84	**29.84 ***	-77.70	**57.7 ***
10th Harmonic	4600.0000	-49.84	**29.84 ***	-77.70	**57.7 ***

* Indicates Noise Floor of Measurement

Results Meet Requirements

SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED)

Test Data: 470 MHz

Spurious Conducted Emissions, Narrowband FM (12.5 kHz), Mask D Limit (≥250% Authorized BW)		High Power		Low Power	
		dBm	17.84	dBm	1.09
		Watts	0.06	Watts	0.00
		Limit (dBm)	-20	Limit (dBm)	-20
Frequency (MHz)		**Peak (dBm)**	**Margin (dB)**	**Peak (dBm)**	**Margin (dB)**
Fundamental	470.0000	17.84	0.00	1.09	0.00
2nd Harmonic	940.0000	-45.37	**25.37**	-45.91	**25.91**
3rd Harmonic	1410.0000	-50.67	**30.67**	-69.93	**49.93**
4th Harmonic	1880.0000	-53.84	**33.84**	-70.95	**50.95**
5th Harmonic	2350.0000	-45.94	**25.94 ***	-69.53	**49.53 ***
6th Harmonic	2820.0000	-46.82	**26.82**	-69.53	**49.53 ***
7th Harmonic	3290.0000	-30.55	**10.55**	-69.53	**49.53 ***
8th Harmonic	3760.0000	-41.67	**21.67 ***	-63.56	**43.56**
9th Harmonic	4230.0000	-41.67	**21.67 ***	-69.53	**49.53 ***
10th Harmonic	4700.0000	-41.67	**21.67 ***	-69.53	**49.53 ***

* Indicates Noise Floor of Measurement

Results Meet Requirements

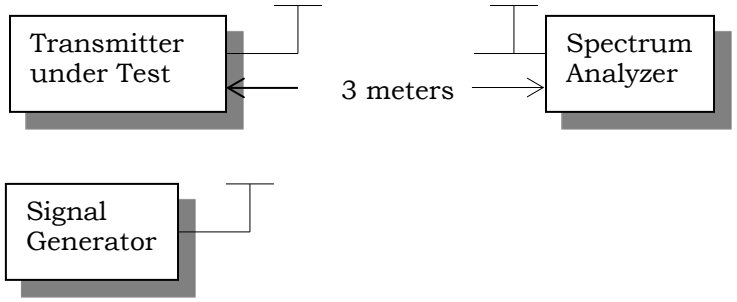
FIELD STRENGTH OF SPURIOUS RADIATION EMISSIONS

Rule Parts. No.: Part 2.1053, 90.210, 90.543(c)(f), IC RSS 119

Requirements: 12.5 kHz Channel Spacing = 50+10log (p) =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 in accordance with test procedures detailed in the standard list 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.

Test Setup Diagram:



FIELD STRENGTH OF SPURIOUS RADIATION EMISSIONS

Rule Parts. No.: Part 2.1053, 90.210

Test Data: 450MHz High Power

Tuned Frequency (MHz)	Emission Frequency (MHz)	ERP (dBm)	Margin (dB)
450	900	**-50.157**	30.16
450	900	**-50.637**	30.64
450	1350	**-49.627**	29.63
450	1350	**-50.007**	30.01
450	1800	**-46.695**	26.70
450	1800	**-50.105**	30.11
450	2250	**-49.777**	29.78
450	2250	**-50.387**	30.39
450	2700	**-49.097**	29.10
450	2700	**-49.097**	29.10
450	3150	**-48.069**	28.07
450	3150	**-48.069**	28.07
450	3600	**-47.557**	27.56
450	3600	**-47.557**	27.56
450	4050	**-47.093**	27.09
450	4050	**-47.093**	27.09
450	4500	**-46.557**	26.56
450	4500	**-46.557**	26.56

Results Meet Requirements

FIELD STRENGTH OF SPURIOUS RADIATION EMISSIONS

Test Data: 460MHz High Power

Tuned Frequency (MHz)	Emission Frequency (MHz)	ERP (dBm)	Margin (dB)
460	920	**-46.567**	26.57
460	920	**-53.447**	33.45
460	1380	**-51.130**	31.13
460	1380	**-52.850**	32.85
460	1840	**-42.958**	22.96
460	1840	**-46.308**	26.31
460	2300	**-51.717**	31.72
460	2300	**-51.717**	31.72
460	2760	**-51.058**	31.06
460	2760	**-51.058**	31.06
460	3220	**-49.763**	29.76
460	3220	**-49.763**	29.76
460	3680	**-49.273**	29.27
460	3680	**-49.273**	29.27
460	4140	**-49.034**	29.03
460	4140	**-49.034**	29.03
460	4600	**-47.795**	27.80
460	4600	**-47.795**	27.80

Results Meet Requirements

FIELD STRENGTH OF SPURIOUS RADIATION EMISSIONS

Test Data: 470MHz High Power

Tuned Frequency (MHz)	Emission Frequency (MHz)	ERP (dBm)	Margin (dB)
470	940	**-51.987**	31.99
470	940	**-51.237**	31.24
470	1410	**-50.344**	30.34
470	1410	**-49.554**	29.55
470	1880	**-45.101**	25.10
470	1880	**-49.491**	29.49
470	2820	**-49.206**	29.21
470	2820	**-49.206**	29.21
470	3290	**-47.852**	27.85
470	3290	**-47.852**	27.85
470	3760	**-45.215**	25.21
470	3760	**-45.215**	25.21
470	4230	**-46.845**	26.84
470	4230	**-46.845**	26.84
470	4700	**-46.365**	26.37
470	4700	**-46.365**	26.37

Results Meet Requirements

FIELD STRENGTH OF SPURIOUS RADIATION EMISSIONS

Rule Parts. No.: Part 2.1053

Test Data: 450MHz Low Power

Tuned Frequency (MHz)	Emission Frequency (MHz)	Field Strength (dBµV/m)	ERP (dBm)	Margin (dB)
450	900	42.570	**-54.807**	34.81
450	900	42.090	**-55.287**	35.29
450	1350	43.100	**-54.277**	34.28
450	1350	42.720	**-54.657**	34.66
450	1800	46.032	**-51.345**	31.35
450	1800	42.622	**-54.755**	34.76
450	2250	42.950	**-54.427**	34.43
450	2250	46.990	**-50.387**	30.39
450	2700	48.280	**-49.097**	29.10
450	2700	48.280	**-49.097**	29.10
450	3150	49.308	**-48.069**	28.07
450	3150	49.308	**-48.069**	28.07
450	3600	49.820	**-47.557**	27.56
450	3600	49.820	**-47.557**	27.56
450	4050	50.284	**-47.093**	27.09
450	4050	50.284	**-47.093**	27.09
450	4500	50.820	**-46.557**	26.56
450	4500	50.820	**-46.557**	26.56

Results Meet Requirements

FIELD STRENGTH OF SPURIOUS RADIATION EMISSIONS

Test Data: 460MHz Low Power

Tuned Frequency (MHz)	Emission Frequency (MHz)	Field Strength (dBµV/m)	ERP (dBm)	Margin (dB)
460	920	46.920	**-50.457**	30.46
460	920	40.040	**-57.337**	37.34
460	1380	42.358	**-55.020**	35.02
460	1380	40.638	**-56.740**	36.74
460	1840	50.530	**-46.848**	26.85
460	1840	47.180	**-50.198**	30.20
460	2300	45.660	**-51.717**	31.72
460	2300	45.660	**-51.717**	31.72
460	2760	46.319	**-51.058**	31.06
460	2760	46.319	**-51.058**	31.06
460	3220	47.614	**-49.763**	29.76
460	3220	47.614	**-49.763**	29.76
460	3680	48.104	**-49.273**	29.27
460	3680	48.104	**-49.273**	29.27
460	4140	48.343	**-49.034**	29.03
460	4140	48.343	**-49.034**	29.03
460	4600	49.582	**-47.795**	27.80
460	4600	49.582	**-47.795**	27.80

Results Meet Requirements

FIELD STRENGTH OF SPURIOUS RADIATION EMISSIONS

Test Data: 470MHz Low Power

Tuned Frequency (MHz)	Emission Frequency (MHz)	Field Strength (dBµV/m)	ERP (dBm)	Margin (dB)
470	940	37.970	**-59.407**	39.41
470	940	38.720	**-58.657**	38.66
470	1410	39.613	**-57.764**	37.76
470	1410	40.403	**-56.974**	36.97
470	1880	44.856	**-52.521**	32.52
470	1880	40.466	**-56.911**	36.91
470	2820	48.172	**-49.206**	29.21
470	2820	48.172	**-49.206**	29.21
470	3290	49.526	**-47.852**	27.85
470	3290	49.526	**-47.852**	27.85
470	3760	52.162	**-45.215**	25.21
470	3760	52.162	**-45.215**	25.21
470	4230	50.532	**-46.845**	26.84
470	4230	50.532	**-46.845**	26.84
470	4700	51.012	**-46.365**	26.37
470	4700	51.012	**-46.365**	26.37

Results Meet Requirements

FREQUENCY STABILITY

Rule Parts. No.: Part 2.1055, Part 90.213, IC RSS 119

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

Method of Measurements: Was in accordance with test procedures detailed in the standard list above.

Test Data: 450-470 MHz Band Table

450 MHz High Power (Worst-case Settings)				
		Limit:	2.5	ppm
Temperature (°C)	**Supplied Voltage (VDC)**	**Intended Frequency (Hz)**	**Measured Reference Frequency (Hz)**	**Deviation (Hz)**
20°C (reference)	5	450000000	450000130	-130

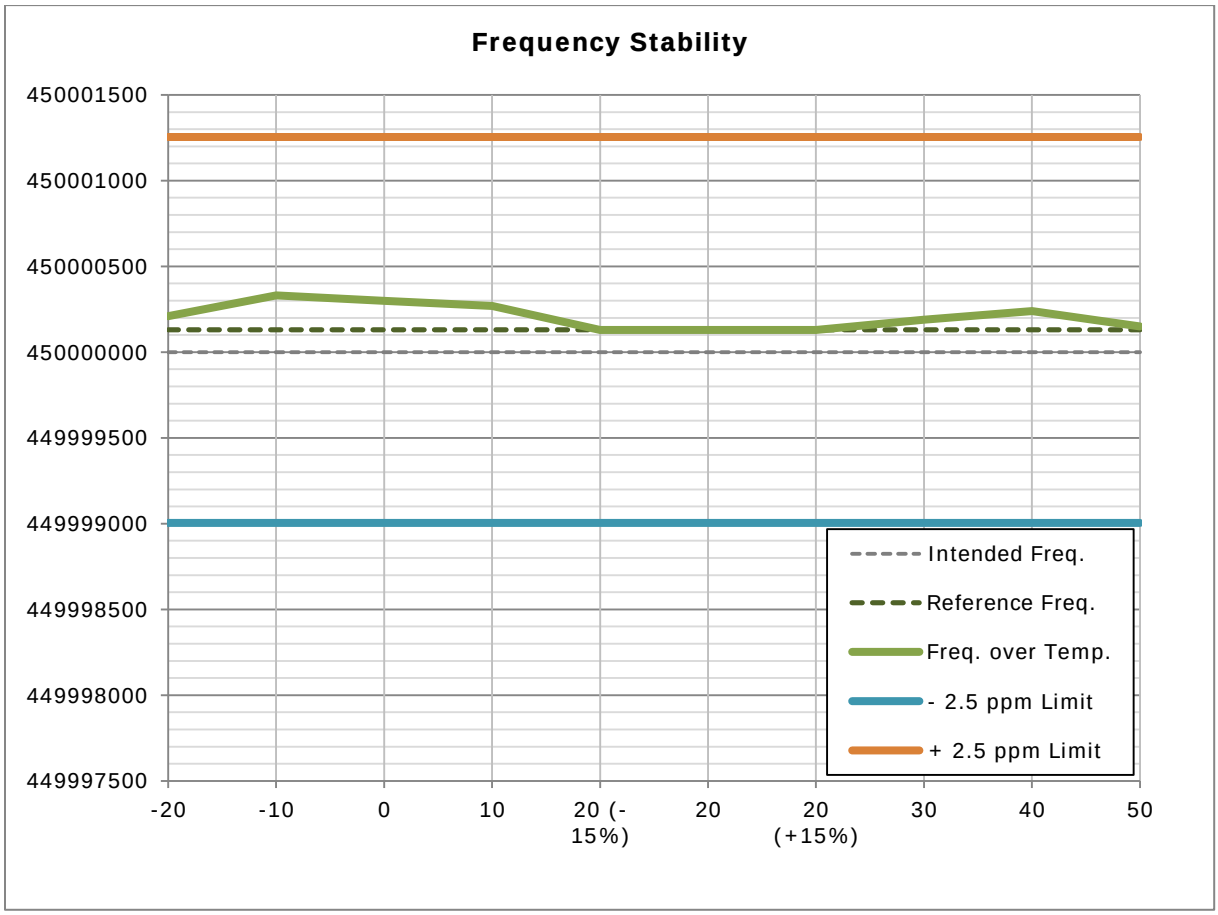
@ 20°C (reference)				
Supplied Voltage (%)	**Supplied Voltage (VDC)**	**Frequency (Hz)**	**Deviation (Hz)**	**PPM**
-15%	4.25	450000130	0	0.000
15%	5.75	450000130	0	0.000

Temperature (°C)	**Supplied Voltage (VDC)**	**Frequency (Hz)**	**Deviation (Hz)**	**PPM**
50	5	450000150	-20.00000	-0.044
40	5	450000240	-110.00000	-0.244
30	5	450000190	60.00000	-0.133
20	5	450000130	0.00000	0.000
10	5	450000270	140.00000	-0.311
0	5	450000300	170.00000	-0.378
-10	5	450000330	200.00000	-0.444
-20	5	450000210	80.00000	-0.178

Results Meet Requirements

FREQUENCY STABILITY

Test Data: 450-470 MHz Band Plot



Results Meet Requirements

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. Within 6kHz and 25kHz of audio Freq.	 ±1.88% ±2.04%	
Rad Emissions Sub Meth up to 26.5GHz	 ±2.14dB	
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.

EQUIPMENT LIST

Device	Manufacturer	Model	Serial Number	Cal/Char Date	Due Date
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	N/A	N/A
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	12/31/2017	12/31/2019
Antenna: Double-Ridged Horn/ETS Horn 2	ETS-Lindgren	3117	00041534	03/01/17	03/01/20
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	08/18/19
EMI Test Receiver R & S ESU 40	Rohde & Schwarz	ESU 40	100320	08/28/18	08/28/20
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

*EMI RECEIVER SOFTWARE VERSION

The receiver firmware used was version 4.43 Service Pack 3

END OF TEST REPORT