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FCC PART 90
&
IC RSS 119
UHF MOBILE TEST REPORT

APPLICANT	LAIRD CONTROLS NORTH AMERICA INC.
	655 N. RIVER ROAD NW SUITE A WARREN OH 44483-2254 USA
FCC ID	CN278970
IC	1007A-78970
MODEL NUMBER	78970 TRX
PRODUCT DESCRIPTION	ADL 450 MHZ 2PCA-7897-X001
DATE SAMPLE RECEIVED	6/13/2017
DATE TESTED	6/26/17
TESTED BY	Tim Royer
APPROVED BY	Sid Sanders
TEST RESULTS	☒ PASS ☐ FAIL

Report Number	Version Number	Description	Issue Date
1063AUT17TestReport	Rev1	Initial Issue	6/30/2017
	Rev2	Revised SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED), Removed ACP	7/21/2017
	Rev3	Updated Occupied Bandwidth	8/3/2017
	Rev4	Updated Test Exercise section	8/8/2017
	Rev 5	Correction on Emission Designator – Page 3	10/5/2017

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

Date: 6/26/2017

Reviewed and approved by: _____
Name and Title: Sid Sanders, Engineer

Date: 7/18/2017

GENERAL INFORMATION

EUT Specification

EUT Description	ADL 450 MHZ 2PCA-7897-X001
FCC ID	CN278970
IC	1007A-78970
Model Number	78970 TRX
Operating Frequency	450-470MHz
Test Frequencies	450,460 & 470 MHz
Type of Emission	8K05F1D
Modulation	GFSK
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% & 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 either the Excaliber, MKU or 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	Pass

RF POWER OUTPUT

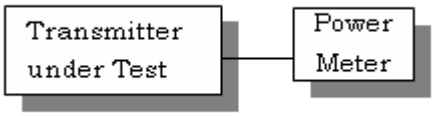
Rule Part No.: Part 2.1046(a), Part 90, RSS-119

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:

	RF POWER (W)	
Tuned Frequency (MHz)	HI	LOW
450.05	0.017	0.001
460.05	0.016	0.001
469.95	0.017	0.001

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

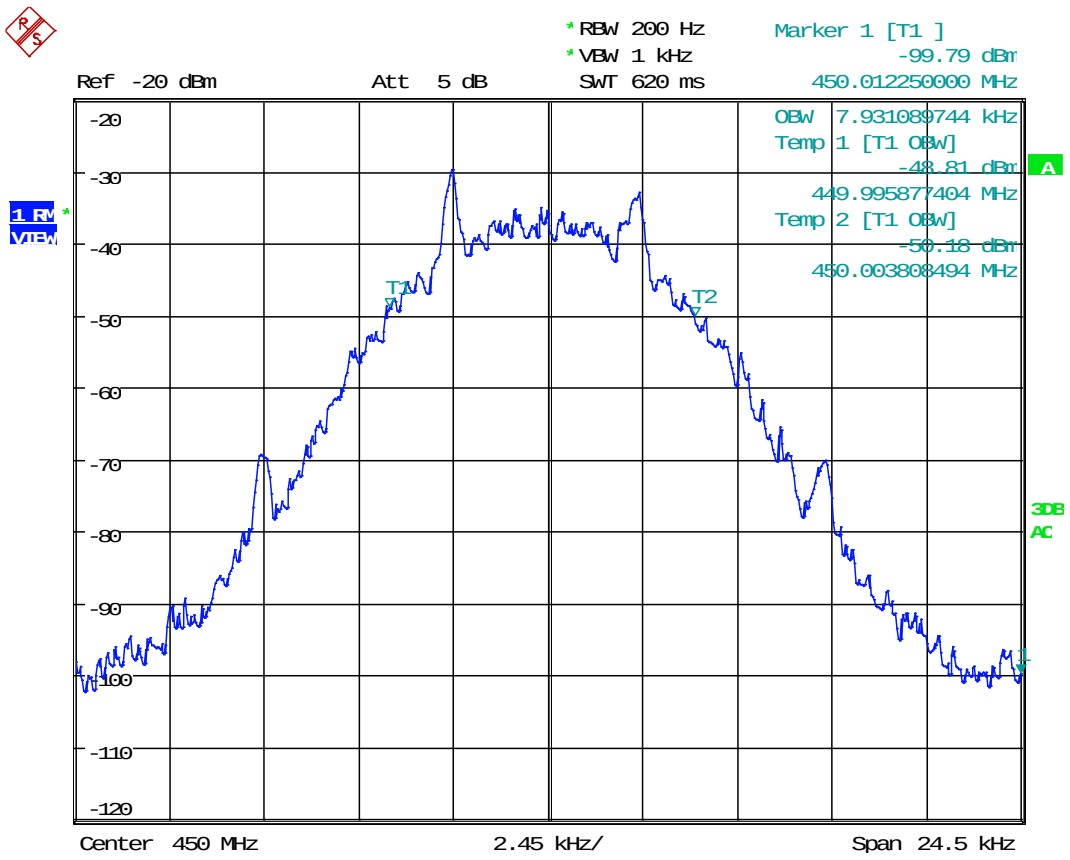
FOR LOW POWER SETTING INPUT POWER: (3.2V) (21.92mA) = 0.07 Watts
FOR HIGH POWER SETTING INPUT POWER: (3.2V) (40mA) = 0.128Watts

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 = 7.9kHz



Date: 3.AUG.2017 14:53:31

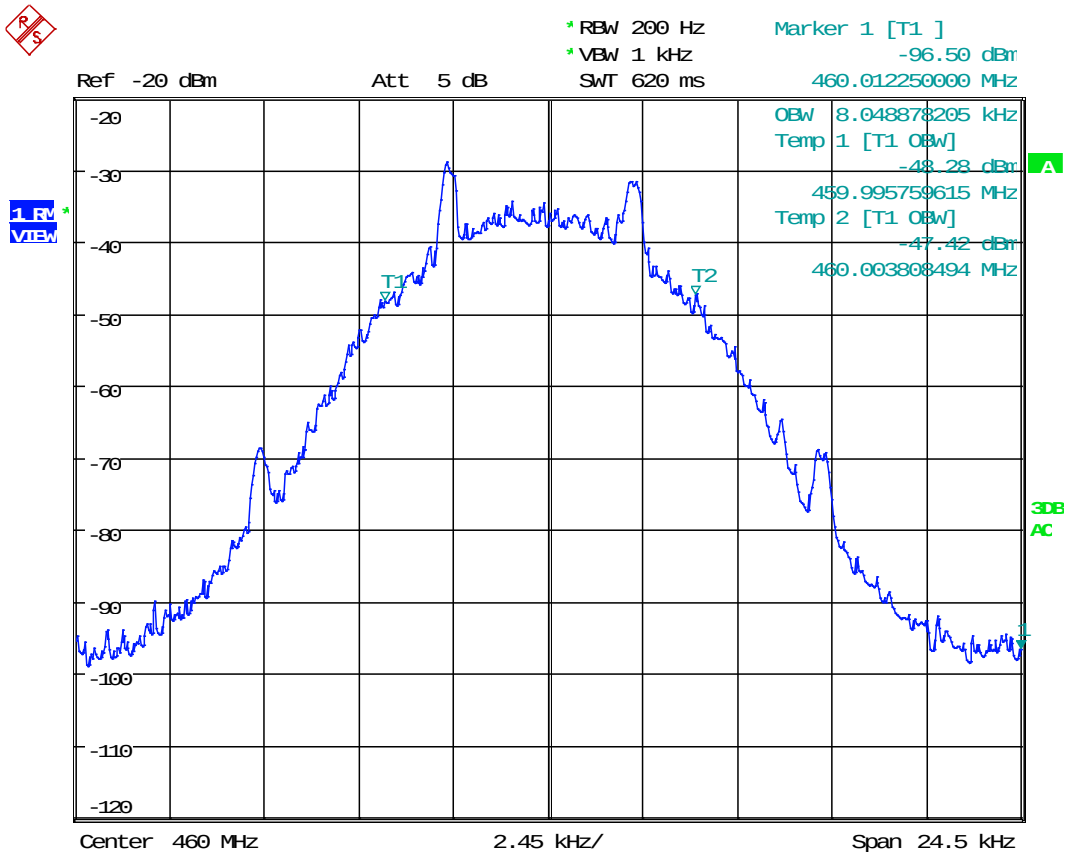
Results Meet Requirements

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 = 8kHz



Date: 3.AUG.2017 14:52:35

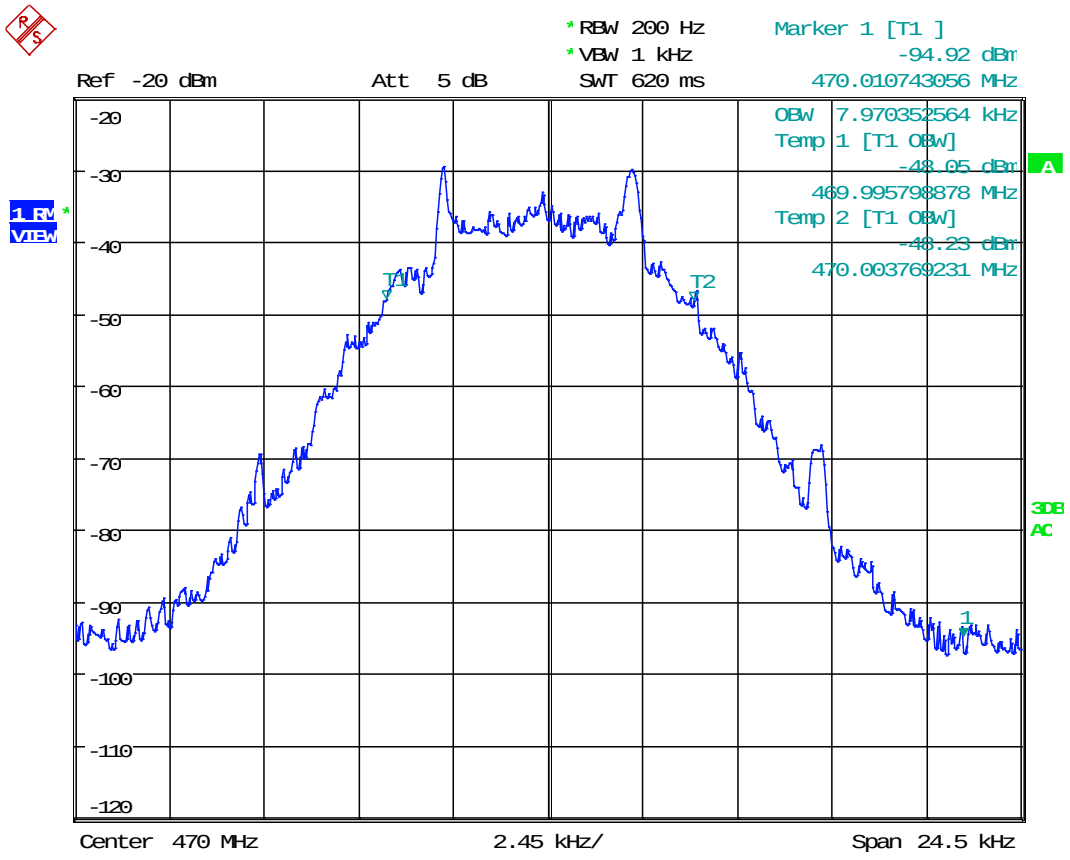
Results Meet Requirements

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 =7.9kHz



Date: 3.AUG.2017 14:51:30

Results Meet Requirements

OCCUPIED BANDWIDTH

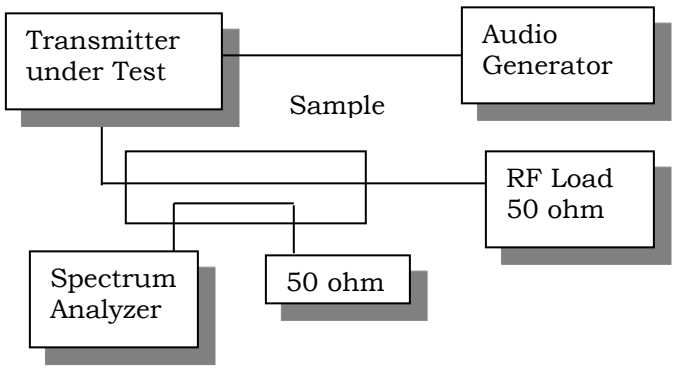
Part 2.1049(c) EMISSION BANDWIDTH:
Part 90.210(d) Emission Mask D - 12.5 kHz channel BW equipment.
IC RSS 119

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

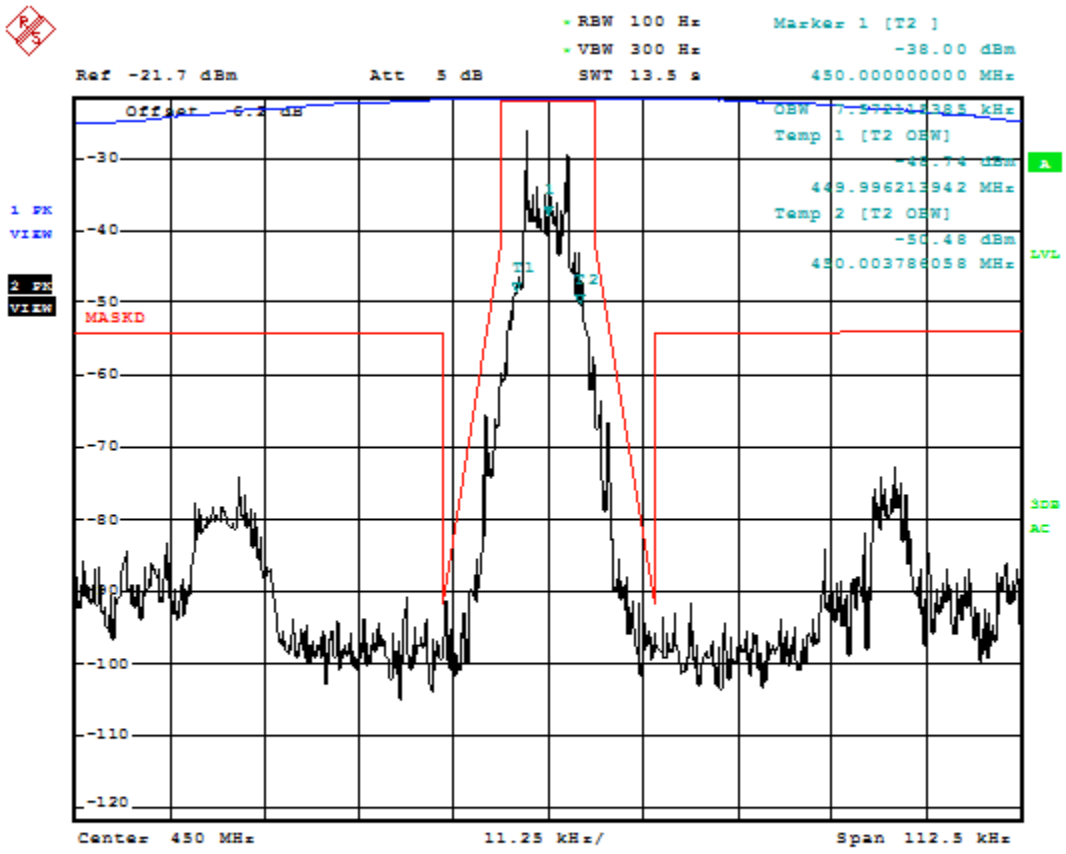


Figure 1: Occupied bandwidth 450MHz

Results Meet Requirements

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

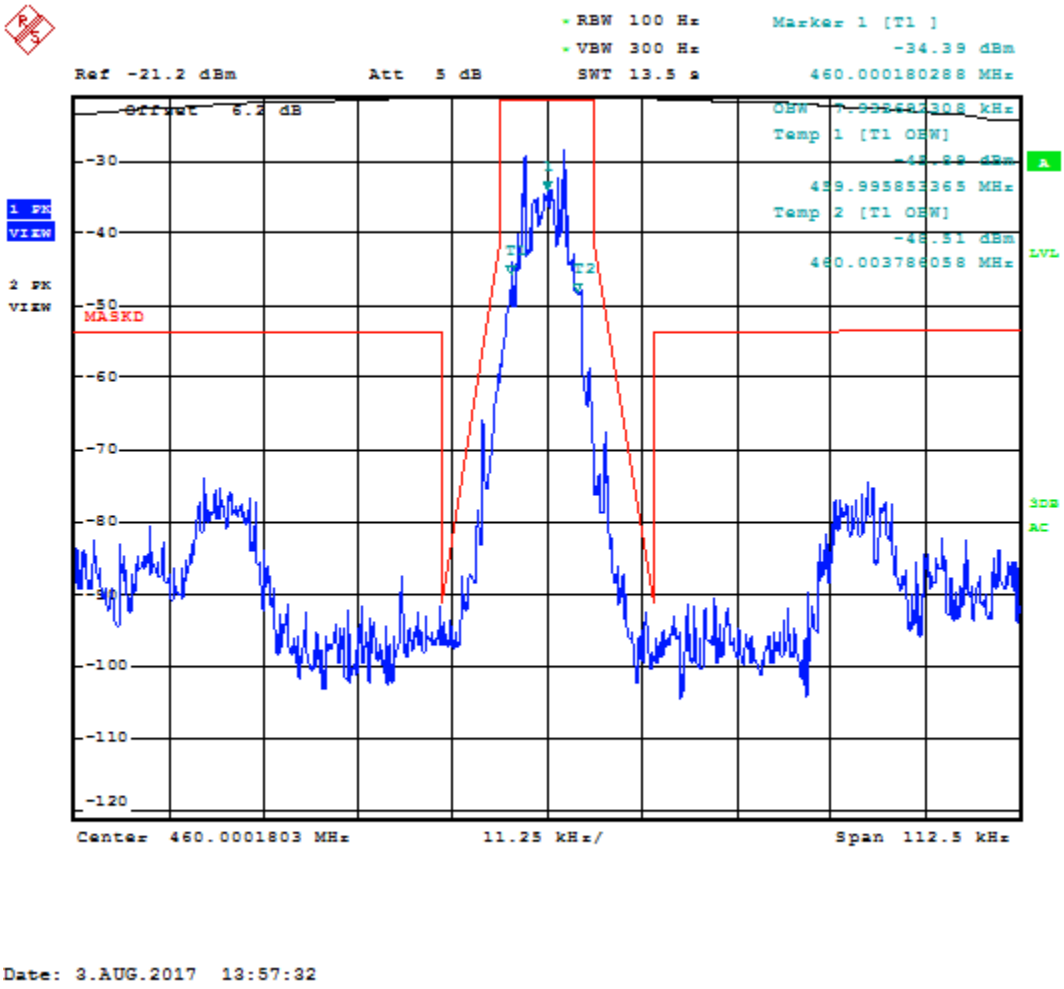


Figure 2: Occupied bandwidth 460MHz

Results Meet Requirements

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

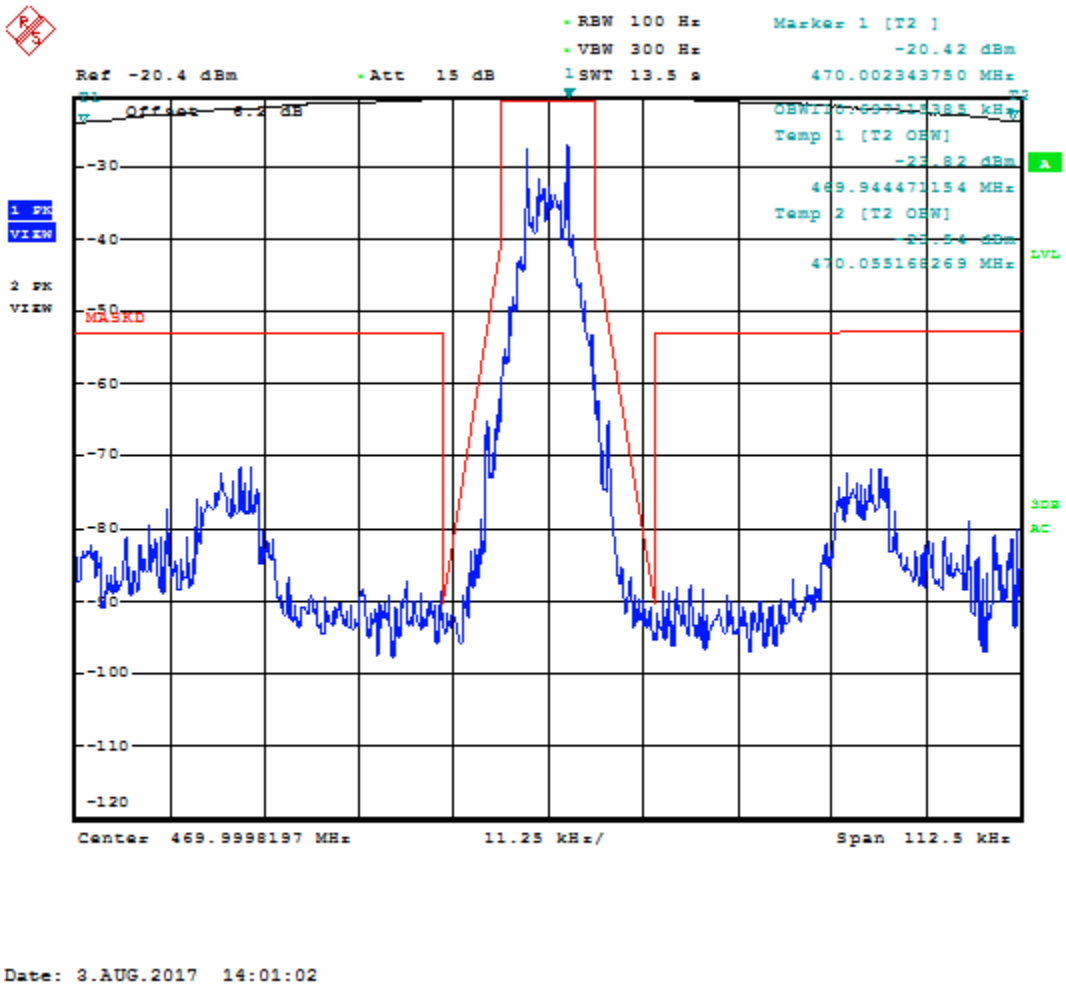


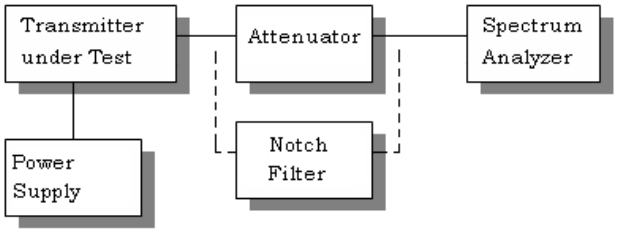
Figure 3: Occupied bandwidth 470MHz

Results Meet Requirements

SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED)

Rule Part No.: Part 2.1051(a)

Method of Measuring Conducted Spurious Emissions



Requirements:

25 kHz Channel Spacing = 43+10log (p) =dBc

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

Test Data: 450.05 MHz

	dBm	Watts	Limit
Power Output	12.36	0.017	25.30
	Frequency	dBc	Margin
	450	0	
	900	70.31	45.01
	1350	53.31	28.01
	1800	69.16	43.86
	2250	36.65	11.35
	2700	43.85	18.55
	3150	28.86	3.56
	3600	49.21	23.91
	4050	32.87	7.57
	4500	51.87	26.57

Results Meet Requirements

SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED)

Test Data: 460 MHz

	dBm	Watts	Limit
Power Output	12.21	0.017	25.30
	Frequency	dBc	Margin
	460	0	
	920	56.63	31.33
	1380	36.76	11.46
	1840	58.83	33.53
	2300	46.01	20.71
	2760	50.54	25.24
	3220	37.46	12.16
	3680	37.15	11.85
	4140	38.68	13.38
	4600	51.9	26.60

Results Meet Requirements

SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED)

Test Data: 470 MHz

	dBm	Watts	Limit
Power Output	12.31	0.017	25.30
	Frequency	dBc	Margin
	470	0	
	940	66.67	41.37
	1410	48.81	23.51
	1880	61.81	36.51
	2350	36.76	11.46
	2820	36.38	11.08
	3290	33.2	7.90
	3760	39.1	13.80
	4230	34.79	9.49
	4700	59.2	33.90

Results Meet Requirements

FIELD STRENGTH OF SPURIOUS RADIATION EMISSIONS

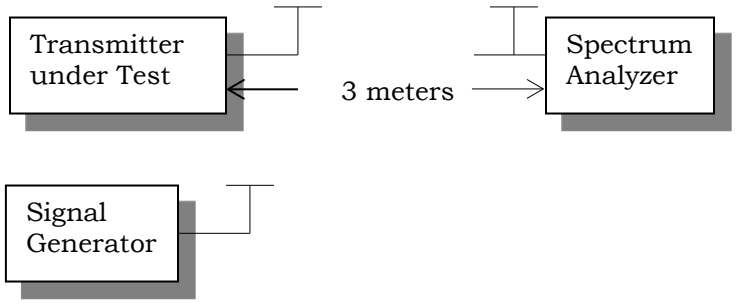
Rule Parts. No.: Part 2.1053, 90.210, 90.543(c)(f), IC RSS 119

Requirements:

25 kHz Channel Spacing = 43+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

Test Data: 450MHz High Power

Emission Frequency MHz	Antenna Polarity	erp (dBmW)	Margin
900.00	H	-61.9	48.9
1350.00	V	-60.2	47.3
1800.00	H	-53.7	40.8
2250.00	H	-53.6	40.7
2700.00	V	-53.5	40.6
3150.00	H	-37.6	24.7
3600.00	V	-51.9	39.0
4050.00	V	-51.8	38.9
4500.00	V	-49.7	36.8

Results Meet Requirements

FIELD STRENGTH OF SPURIOUS RADIATION EMISSIONS

Test Data: 460MHz High Power

Emission Frequency MHz	Antenna Polarity	erp (dBmW)	Margin
920.00	V	-65.09	90.39
1380.00	V	-59.11	84.41
1840.00	H	-55.49	80.79
2300.00	V	-54.55	79.85
2760.00	V	-53.25	78.55
3220.00	V	-40.06	65.37
4140.00	H	-46.24	71.55
4600.00	V	-49.27	74.57

Results Meet Requirements

FIELD STRENGTH OF SPURIOUS RADIATION EMISSIONS

Test Data: 470MHz High Power

Emission Frequency MHz	Antenna Polarity	erp (dBmW)	Margin
940.00	H	-66.09	66.11
1410.00	H	-60.38	60.40
1880.00	V	-53.90	53.92
2350.00	V	-56.15	56.17
2820.00	V	-55.28	55.29
3290.00	H	-52.42	52.44
3760.00	H	-51.15	51.17
4230.00	H	-52.67	52.69
4700.00	H	-50.74	50.76

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

Temperature	Frequency MHz	Hz	PPM
25°C (reference)	450.002344		
-30°C	450.002336	-8	-0.018
-20°C	450.002293	-51	-0.113
-10°C	450.00212	-224	-0.498
0°C	450.002128	-216	-0.480
10°C	450.002219	-125	-0.278
20°C	450.002364	20	0.044
30°C	450.002379	35	0.078
40°C	450.002313	-31	-0.069
50°C	450.002291	-53	-0.118
Battery Voltage	Frequency	Hz	PPM
-15%	450.002347	3	0.007
15%	450.003347	1003	2.229

Results Does Meet Requirements

TRANSIENT FREQUENCY RESPONSE

RULE PARTS. NO.: 90.214, IC RSS 119

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[1] [2]	Maximum frequency difference[3]	All equipment	
		150 to 174 MHz	421 to 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

[1] t_{on} is the instant when a 1 kHz test signal is completely suppressed, including any capture time due to phasing.

t_1 is the time period immediately following t_{on}.

t_2 is the time period immediately following t_1.

t_3 is the time period from the instant when the transmitter is turned off until t_{off}.

t_{off} is the instant when the 1 kHz test signal starts to rise.

[2] During the time from the end of t_2 to the beginning of t_3, the frequency difference must not exceed the limits specified in §90.213.

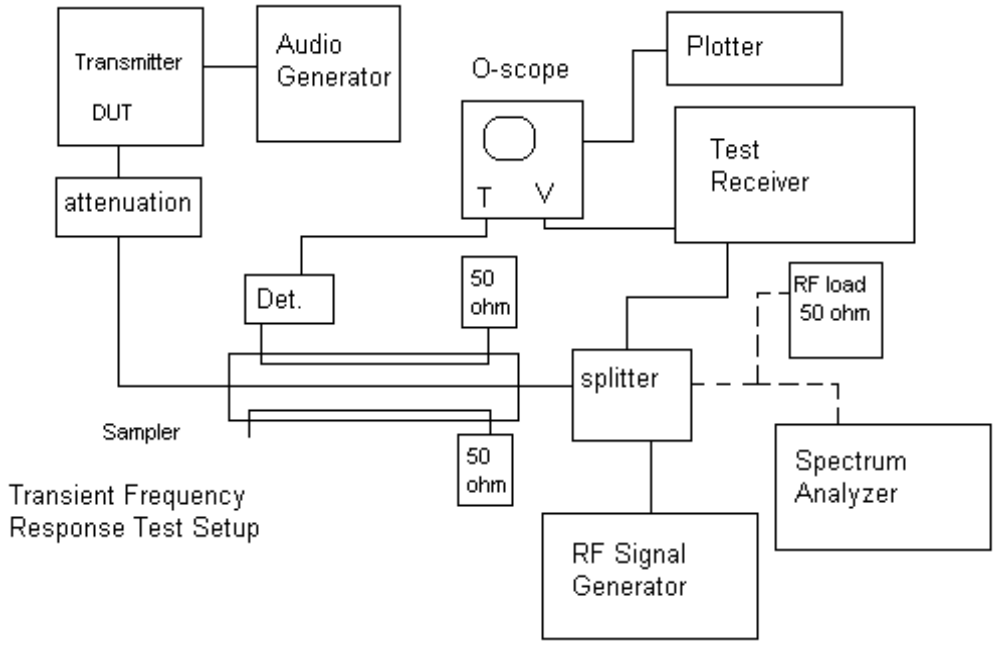
[3] Difference between the actual transmitter frequency and the assigned transmitter frequency.

[4] If the transmitter carrier output power rating is 6 watts or less, the frequency difference during this time period may exceed the maximum frequency difference for this time period.

TRANSIENT FREQUENCY RESPONSE

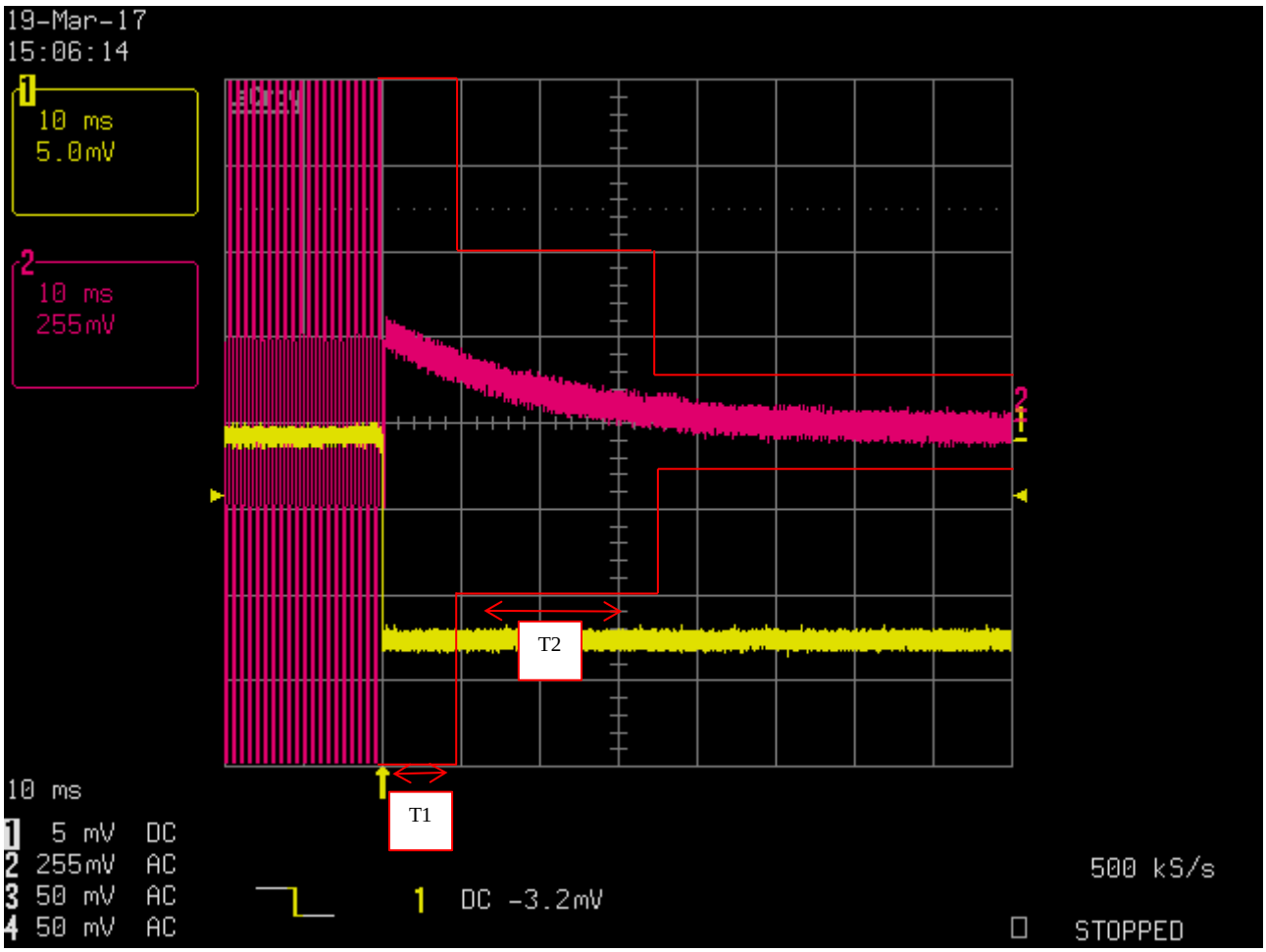
METHOD OF MEASUREMENTS: ANSI/TIA-603 § 2.2.2 Carrier Frequency Stability

TEST SETUP DIAGRAM:



Transient Frequency Response Test Setup

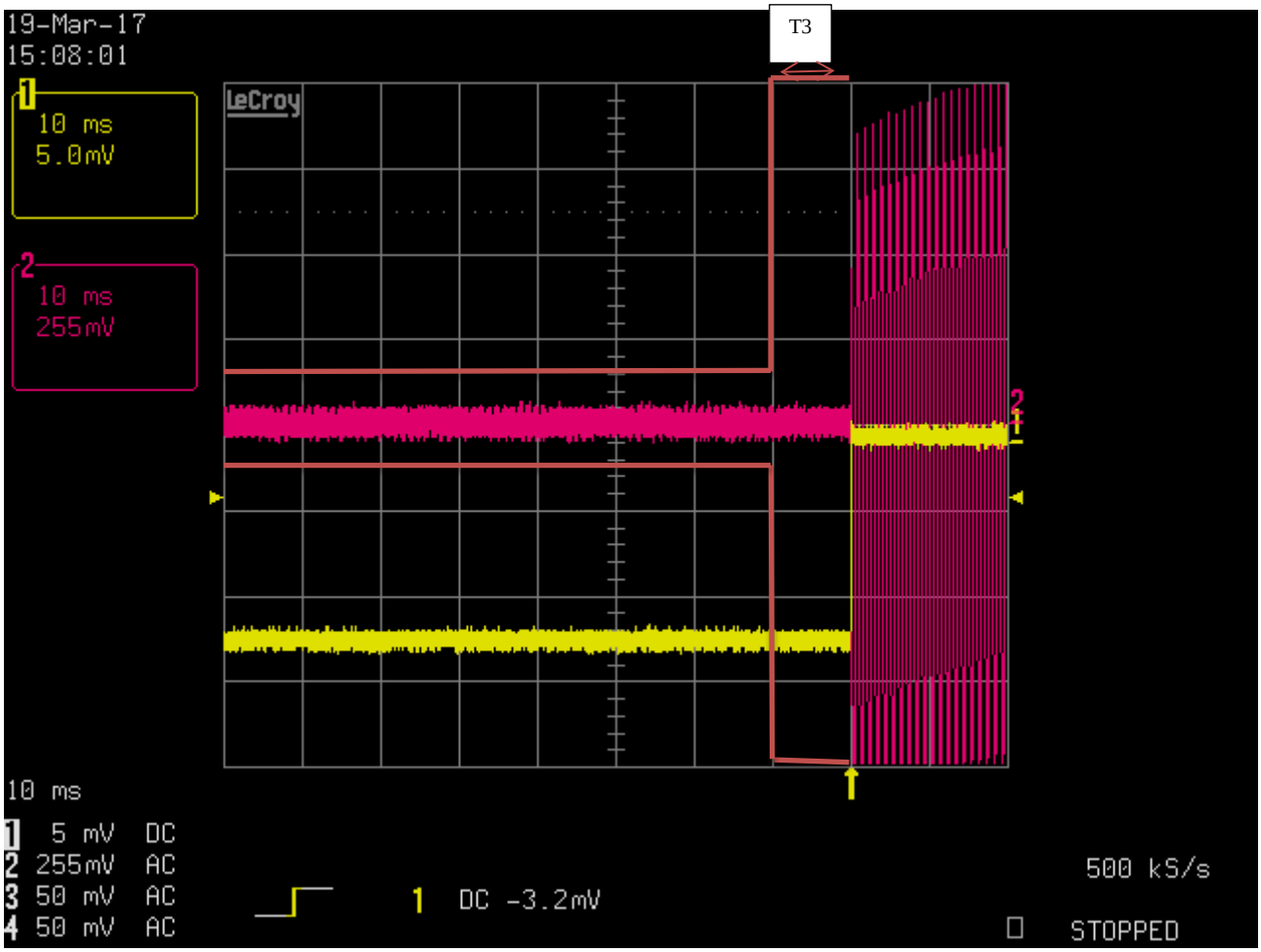
Test Data: 12.5 KHz Channel Spacing Turn On



Results meet requirements

TRANSIENT FREQUENCY RESPONSE

Test Data: 12.5 KHz Channel Spacing Turn Off



Results meet requirements

STATE OF THE MEASUREMENT UC

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
12 Volt Power Supply	Astron	RS-12A	9312779	N/A	N/A
Antenna: Log-Periodic 1122	Electro-Metrics	LPA-25	1122	07/14/15	07/14/17
Antenna: Dipole Kit 153	Electro-Metrics	TDA-30/1-4	153	N/A	N/A
Temperature Chamber LARGE	Tenney Engineering	TTRC	11717-7	09/01/16	09/01/18
Digital Multimeter	Fluke	77	35053830	10/21/15	10/21/17
Frequency Counter Large Chamber	HP	5352B	2632A00165	07/01/15	07/01/17
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	04/25/16	12/31/17
Sweep/Signal Generator	Anritsu	68369B	985112	10/28/15	10/28/17
Antenna: Double-Ridged Horn/ETS Horn 2	ETS-Lindgren Chamber	3117	00041534	03/01/17	03/01/19
Software: Field Strength Program	Timco	N/A	Version 4.10.7.0	N/A	N/A
Coaxial Cable #103 - KMKM-0180-01 Aqua	Micro-Coax	UFB142A-0-0720-200200	225363-002 (#103)	08/05/15	08/05/17
Hygro-Thermometer	Extech	445703	0602	06/30/15	06/30/17
Type K J Thermometer	Martel	303	080504494	10/26/15	10/26/17
EMI Test Receiver R & S ESU 40 Chamber	Rohde & Schwarz	ESU 40	100320	04/01/16	04/01/18
Coaxial Cable - BMBM-0155-00 Black	MIYAZAKI		BMBM-0155-00	05/24/16	05/24/18
Non Radiating 50 OHM Load	Sierra Elec	160B-600X	1038	09/13/16	09/13/18
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)	06/26/15	06/26/17
Splitter 1-1000MHz	Mini-Circuits	ZFSC-4-1-BNC+	U115700825	NA	NA
1G Ocilloscope	LeCroy	LC584AM	10605	07/07/15	07/07/17
Bi-Directional Coupler - 30MHz to 2GHz	HP	778D	1144A01731 (#46)	09/15/15	09/15/17

*EMI RECEIVER SOFTWARE VERSION

The receiver firmware used was version 4.43 Service Pack 3

END OF TEST REPORT