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FCC PART 90
&
IC RSS 119
UHF MOBILE TEST REPORT

APPLICANT	NEPTUNE TECHNOLOGY GROUP INC.
	1600 ALABAMA HIGHWAY 229 TALLASSEE AL 36078 USA
FCC ID	P2SR450DC
IC	4171B-R450DC
MODEL NUMBER	R450DC
PRODUCT DESCRIPTION	DATA COLLECTOR
DATE SAMPLE RECEIVED	10/31/2017
DATE TESTED	10/31/2017
TESTED BY	Tim Royer
APPROVED BY	Sid Sanders
TEST RESULTS	☒ PASS ☐ FAIL

Report Number	Version Number	Description	Issue Date
1895AUT17Test Report	Rev1	Initial Issue	11/10/2017
	Rev2	Revised Report	12/20/2017
	Rev 3	Administrative Updates	1/11/2018

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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

Sr. EMC Engineer
EMC-003838-NE

Date: 11/8/2017

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

Date: 11/16/2017

GENERAL INFORMATION

EUT Specification

EUT Description	DATA COLLECTOR
FCC ID	P2SR450DC
IC	4171B-450DC
Model Number	R450DC
Operating Frequency	450-470MHz
Test Frequencies	451.125, 457.875 & 463.375 MHz
Type of Emission	Digital
Modulation	GMSK
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 EUT was operated in a normal mode.
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.**

RF EXPOSURE INFORMATION: 47CFR 2.1093

The requirements for this equipment are covered in the included SAR measurements report.

RF POWER OUTPUT

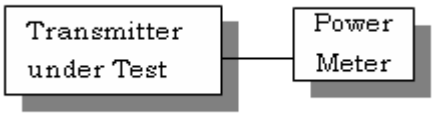
Rule Part No.: Part 2.1046(a), Part 90, RSS-119

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	
Tuned Frequency (MHz)	W	dBm
451.125	10.05	40.02
457.875	10.3	40.13
463.375	9.93	39.97

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

FOR HIGH POWER SETTING INPUT POWER: (13.8V) (6.95A) = 95.91Watts

MODULATION CHARACTERISTICS

Rule Part: Part 2.1033(c), Part 2.1033(c) (4), Part 90.209, Part 90.207

Rule Part Industry Canada:

Type of Emission: 11K2F1D

Type of Emission: 11K2F1D

Bn = 2(M/2) + 2DK
M = 9600
D = 800
K=1
Bn = 2(9600/2) +2(800) = 11.2k

OCCUPIED BANDWIDTH

Part 2.1049(c) EMISSION BANDWIDTH:

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

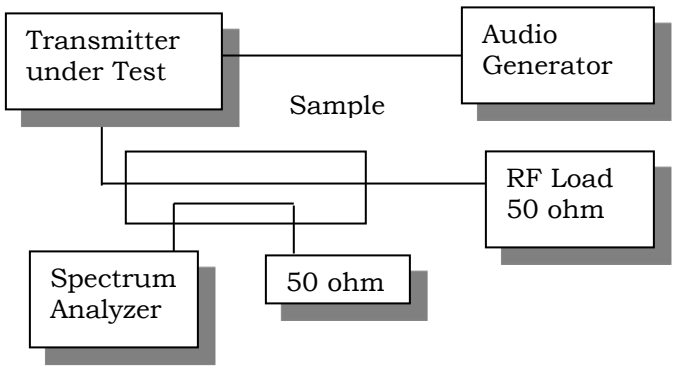
For transmitters designed to operate with a 12.5 kHz channel bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

(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.

Test Setup Diagram:



Test Data: See the plots below

OCCUPIED BANDWIDTH

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

450 - 470 MHz BAND

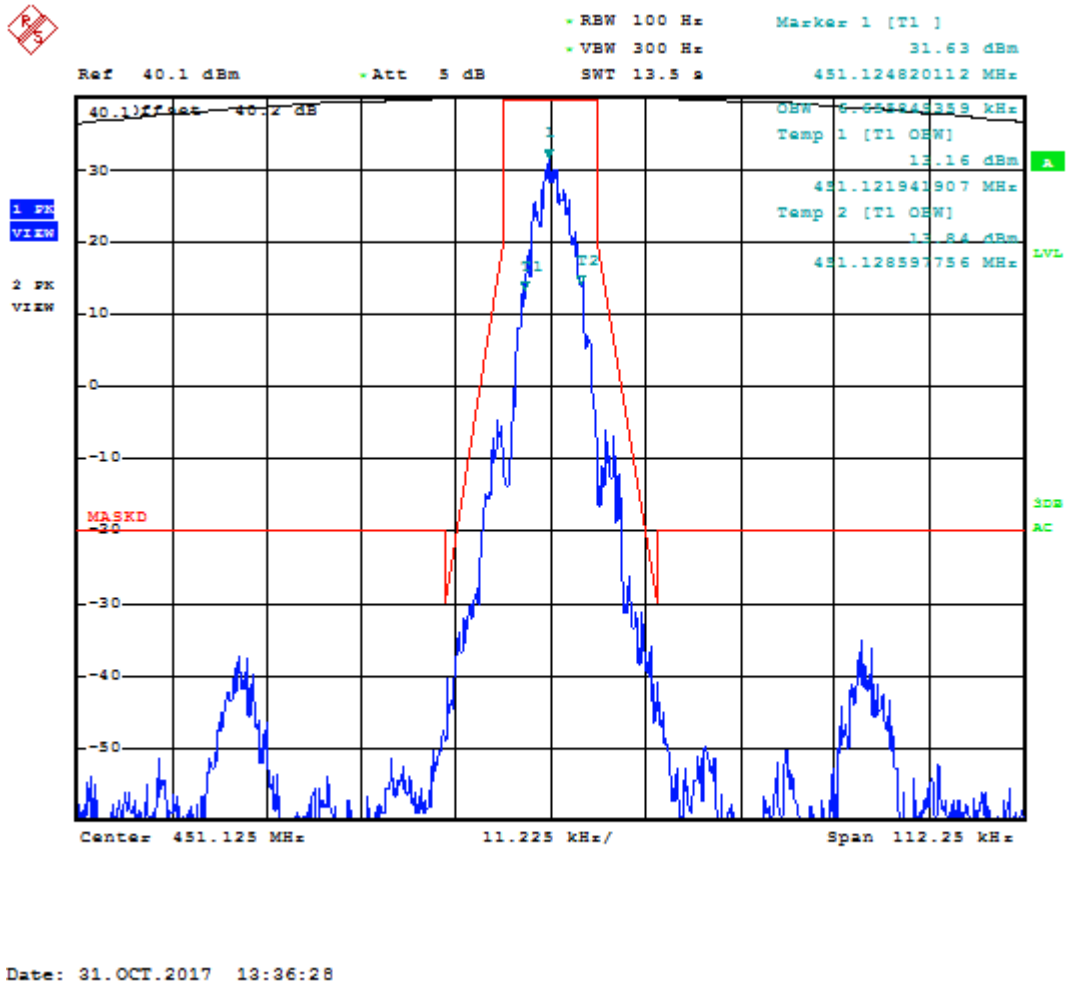


Figure 1: Occupied bandwidth – 12.5 kHz DIGITAL

OCCUPIED BANDWIDTH

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

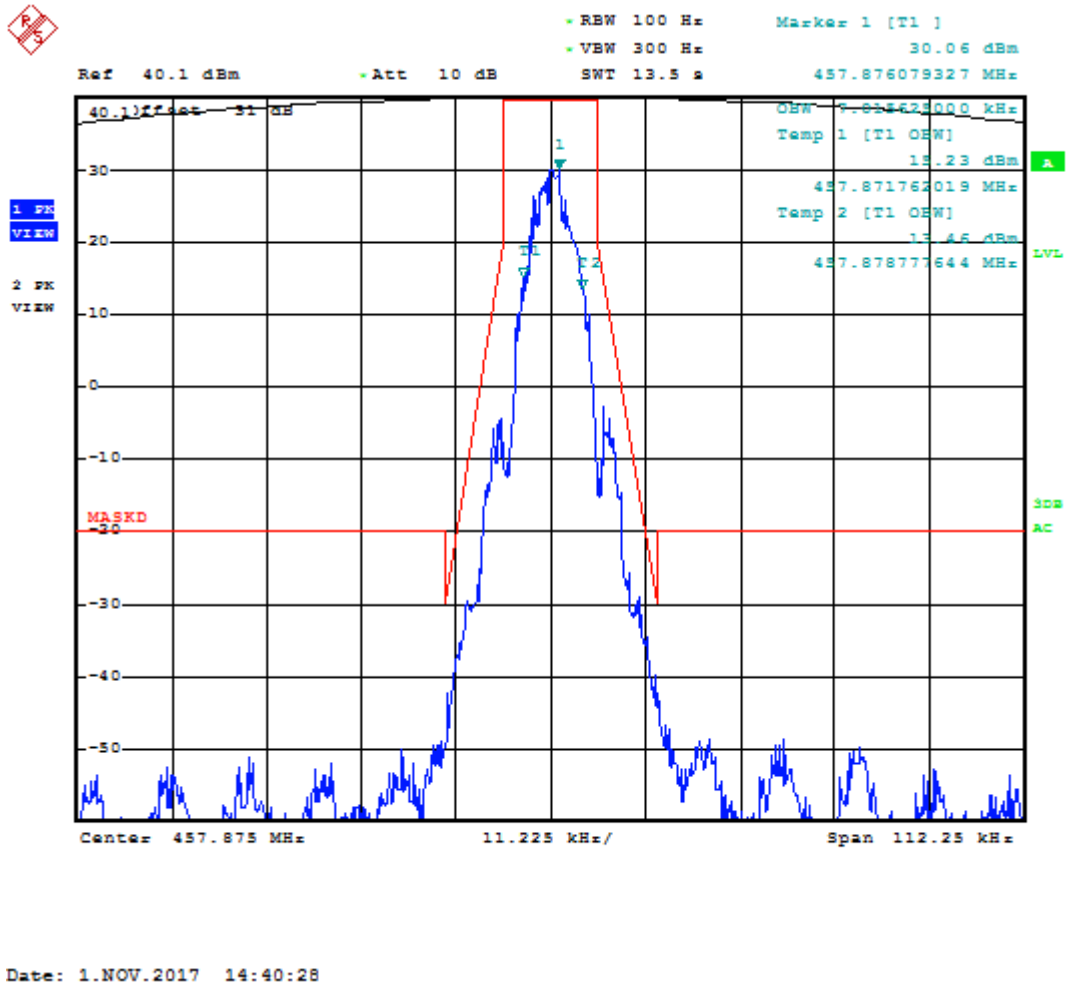


Figure 2: Occupied bandwidth – 12.5 kHz DIGITAL

OCCUPIED BANDWIDTH

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

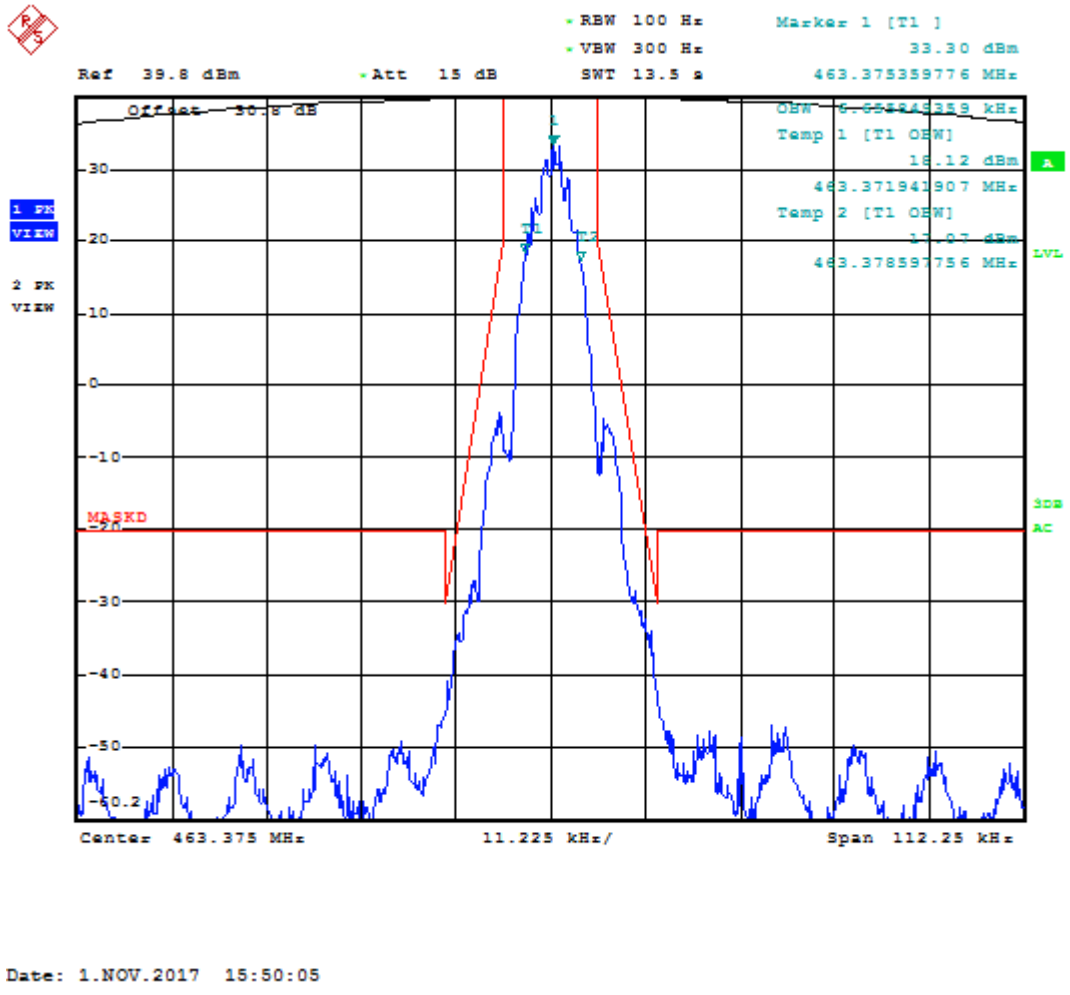
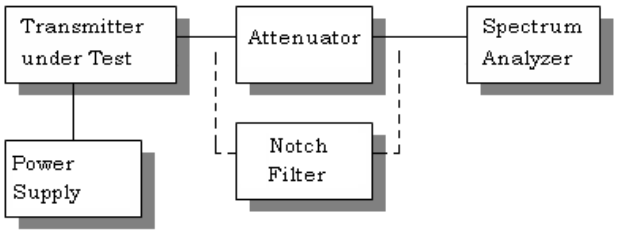


Figure 2: Occupied bandwidth – 12.5 kHz DIGITAL

SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED)

Rule Part No.: Part 2.1051(a)

Method of Measuring Conducted Spurious Emissions



Requirements:

12.5 kHz Channel Spacing = 50+10log (40) =60dBc

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 test procedures detailed in the standard list above.

Test Data: 451.125 MHz

Power Output	dBm	Watts	Limit (dBc)
	40	10.00	60

Frequency		dBc	Margin
(fundamental)	451.125	0.00	0.00
	902.250	101.08	41.08
	1353.375	79.08	19.08
*	1804.500	98.70	38.70
*	2255.625	92.15	32.15
	2706.750	98.70	38.70
*	3157.875	98.70	38.70
*	3609.000	98.70	38.70
*	4060.125	98.70	38.70
*	4511.250	98.70	38.70

* Indicates Noise Floor

SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED)

Test Data: 457.875 MHz

Power Output	dBm	Watts	Limit (dBc)
	40	10.00	60

Frequency		dBc	Margin
(fundamental)	457.875	0.00	0.00
	915.750	91.33	31.33
	1373.625	74.47	14.47
*	1831.500	99.57	39.57
	2289.375	96.70	36.70
	2747.250	100.30	40.30
*	3205.125	100.30	40.30
*	3663.000	100.30	40.30
*	4120.875	100.30	40.30
*	4578.750	100.30	40.30

* Indicates Noise Floor

SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED)

Test Data: 463.375 MHz

Power Output	dBm	Watts	Limit (dBc)
	40	10.00	60

Frequency		dBc	Margin
(fundamental)	463.375	0.00	0.00
	926.750	90.49	30.49
	1390.125	73.51	13.51
	1853.500	99.55	39.55
	2316.875	103.56	43.56
*	2780.250	103.56	43.56
*	3243.625	103.56	43.56
*	3707.000	103.56	43.56
*	4170.375	103.56	43.56
*	4633.750	103.56	43.56

* Indicates Noise Floor

FIELD STRENGTH OF SPURIOUS RADIATION EMISSIONS

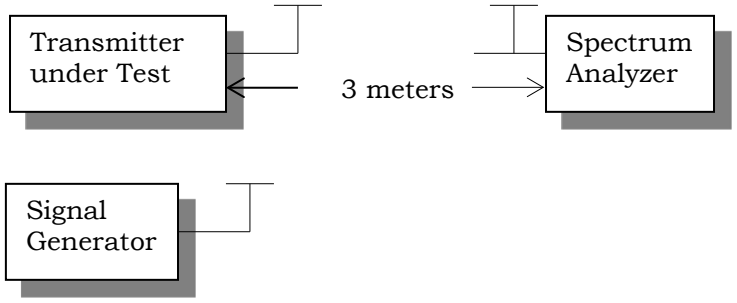
Rule Parts. No.: Part 2.1053

Requirements:

12.5 kHz Channel Spacing = 50+10log (10) =60dBc

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: 451.1 MHz

Power Output	dBm		Watts	Limit (dBc)
	40		10.00	60

Tuned Freq MHz	Emission Frequency MHz	Antenna Polarity	erp (dBmW)	Margin dBc
451.1	902.3	V	-46.57	26.57
451.1	1353.4	V	-48.16	28.16
451.1	1804.5	H	-47.65	27.65
451.1	2255.6	V	-49.69	29.69
451.1	2706.8	V	-44.33	24.33
451.1	3157.9	H	-41.87	21.87
451.1	3609.0	H	-52.03	32.03
451.1	4060.1	H	-50.19	30.19
451.1	4511.3	V	-54.89	34.89

FIELD STRENGTH OF SPURIOUS RADIATION EMISSIONS

Rule Parts. No.: Part 2.1053

Test Data: 457.875 MHz

Power Output	dBm		Watts	Limit (dBc)
	40.13		10.30	60.13
Tuned Freq MHz	Emission Frequency MHz	Antenna Polarity	erp (dBmW)	Margin dBc
457.88	915.75	H	-42.65	22.65
457.88	1373.63	V	-53.55	33.55
457.88	1831.50	H	-44.67	24.67
457.88	2289.38	H	-54.91	34.91
457.88	2747.25	H	-47.36	27.36
457.88	3205.13	V	-50.43	30.43
457.88	3663.00	H	-49.33	29.33
457.88	4120.88	V	-50.92	30.92
457.88	4578.75	V	-50.31	30.31

FIELD STRENGTH OF SPURIOUS RADIATION EMISSIONS

Rule Parts. No.: Part 2.1053

Test Data: 463.375 MHz

Power Output	dBm		Watts	Limit (dBc)
	39.97		9.93	59.97
Tuned Freq MHz	Emission Frequency MHz	Antenna Polarity	erp (dBmW)	Margin dBc
463.38	926.75	H	-54.66	34.66
463.38	1390.13	H	-55.27	35.27
463.38	1853.50	V	-46.64	26.64
463.38	2316.88	H	-48.88	28.88
463.38	2780.25	V	-47.40	27.40
463.38	3243.63	V	-46.36	26.36
463.38	3707.00	V	-47.37	27.37
463.38	4170.38	H	-48.92	28.92
463.38	4633.75	H	-44.89	24.89

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: 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)	452.075287		
-30°C	452.075287	0	0.000
-20°C	452.075226	-61	-0.135
-10°C	452.075378	91	0.201
0°C	452.075287	0	0.000
10°C	452.075226	-61	-0.135
20°C	452.075287	0	0.000
30°C	452.075287	0	0.000
40°C	452.075226	-61	-0.135
50°C	452.075378	91	0.201
Battery Voltage	**Frequency**	**Hz**	**PPM**
-15%	452.075287	0	0.000
15%	452.075287	0	0.000

***NOTE: Frequency Stability data from the same band is taken from the previous testing of the identical EUT, FCC ID MMA914100B, taken February 20th, 2007.**

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	
Adjacent channel power	±1.47dB	(1)
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
Coaxial Cable - BMBM-0065-01 Black DC-2G	Belden		BMBM-0065-01	07/18/16	07/18/18
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
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	11/28/17
Antenna: Double-Ridged Horn/ETS Horn 2	ETS-Lindgren	3117	00041534	03/01/17	03/01/19
Software: Field Strength Program	Timco	N/A	Version 4.10.7.0	NA	NA
Antenna: Active Loop	ETS-Lindgren	6502	00062529	11/18/15	11/18/17
EMI Test Receiver R & S ESU 40 Chamber	Rohde & Schwarz	ESU 40	100320	04/01/16	04/01/18
Attenuator N 30dB 500W DC-2.5G	Bird	8325	1761	10/31/17	10/31/19
Non Radiating 50 OHM Load	Sierra Elec	160B-600X	1038	09/13/16	09/13/18
Attenuator N 20dB 2W DC-13G	Narda	777C	36124	05/24/17	05/23/19
Bore-sight Antenna Positioning Tower	Sunol Sciences	TLT2	N/A	N/A	N/A

*EMI RECEIVER SOFTWARE VERSION

The receiver firmware used was version 4.43 Service Pack 3

END OF TEST REPORT