

# Ittron, Inc.

## TEST REPORT FOR

**Mobile Collection Device, MC4  
Model: DCU53104C**

### Tested to The Following Standards:

**FCC Part 15 Subpart C Section(s)**

**15.207 & 15.247  
(FHSS 902-928 MHz)**

**Report No.: 104623-11**

**Date of issue: January 12, 2021**



**Test Certificate # 803.01**

This test report bears the accreditation symbol indicating that the testing performed herein meets the test and reporting requirements of ISO/IEC 17025 under the applicable scope of testing for CKC Laboratories, Inc.

We strive to create long-term, trust based relationships by providing sound, adaptive, customer first testing services. We embrace each of our customers' unique EMC challenges, not as an interruption to set processes, but rather as the reason we are in business.

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## ADMINISTRATIVE INFORMATION

### Test Report Information

**REPORT PREPARED FOR:**

Ittron, Inc.  
2111 N. Molter Road  
Liberty Lake, WA 99019

Representative: Jay Holcomb  
Customer Reference Number: 226650

**DATE OF EQUIPMENT RECEIPT:****DATE(S) OF TESTING:****REPORT PREPARED BY:**

Kim Romero  
CKC Laboratories, Inc.  
5046 Sierra Pines Drive  
Mariposa, CA 95338

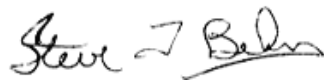
Project Number: 104623

December 2, 2020

December 2, 9, 14, and 16, 2020

### Report Authorization

The test data contained in this report documents the observed testing parameters pertaining to and are relevant for only the equipment provided by the client, tested in the agreed upon operational mode(s) and configuration(s) as identified herein. Compliance assessment remains the client's responsibility. This report may not be used to claim product endorsement by A2LA or any government agencies. This test report has been authorized for release under quality control from CKC Laboratories, Inc.

A handwritten signature in black ink that reads "Steve Behm".

**Steve Behm**  
**Director of Quality Assurance & Engineering Services**  
**CKC Laboratories, Inc.**

## Test Facility Information



Our laboratories are configured to effectively test a wide variety of product types. CKC utilizes first class test equipment, anechoic chambers, data acquisition and information services to create accurate, repeatable and affordable test results.

TEST LOCATION(S):  
CKC Laboratories, Inc.  
110 Olinda Place  
Brea, CA 92823

## Software Versions

CKC Laboratories Proprietary Software	Version
EMITest Emissions	5.03.19

## Site Registration & Accreditation Information

Location	*NIST CB #	FCC	Canada	Japan
Canyon Park, Bothell, WA	US0103	US1024	3082C	A-0136
Brea, CA	US0103	US1024	3082D	A-0136
Fremont, CA	US0103	US1024	3082B	A-0136
Mariposa, CA	US0103	US1024	3082A	A-0136

\*CKC's list of NIST designated countries can be found at: <https://standards.gov/cabs/designations.html>

## SUMMARY OF RESULTS

### Standard / Specification: FCC Part 15 Subpart C - 15.247 (FHSS 902-928MHz)

Test Procedure	Description	Modifications	Results
15.247(a)(1)(i)	Occupied Bandwidth	NA	NP
15.247(a)(1)	Carrier Separation	NA	NP
15.247(a)(1)(i)	Number of Hopping Channels	NA	NP
15.247(a)(1)(i)	Average Time of Occupancy	NA	NP
15.247(b)(2)	Output Power	NA	Pass
15.247(d)	RF Conducted Emissions & Band Edge	NA	NP
15.247(d)	Radiated Spurious Emissions	NA	Pass
15.247(d)	Band Edge (Radiated)	NA	NP
15.207	AC Conducted Emissions	NA	NA1

NA = Not Applicable

NA1 = Not applicable because the EUT is connected to 12V car battery and shall not be connected to public utility AC power line.

NP = Not performed because CKC Laboratories was not contracted to perform testing.

#### ISO/IEC 17025 Decision Rule

The declaration of pass or fail herein is based upon assessment to the specification(s) listed above, including where applicable, assessment of measurement uncertainties. For performance related tests, equipment was monitored for specified criteria identified in that section of testing.

## Modifications During Testing

This list is a summary of the modifications made to the equipment during testing.

#### Summary of Conditions

No modifications were made during testing.

Modifications listed above must be incorporated into all production units.

## Conditions During Testing

This list is a summary of the conditions noted to the equipment during testing.

#### Summary of Conditions

The manufacturer declares that MC4Pro (with optional receivers) is the worst case of MC4Core (without optional receivers)

## EQUIPMENT UNDER TEST (EUT)

During testing, numerous configurations may have been utilized. The configurations listed below support compliance to the standard(s) listed in the Summary of Results section.

### Configuration 1 (MC4Pro+tablet)

#### Equipment Tested:

Device	Manufacturer	Model #	S/N
Receiver Antenna	PCTEL	SUB-0275-001/H	S15180005
Automobile Adapter	Lind Electronics, Inc.	PA1555-2155 FB	NA
Tablet	Panasonic	FZ-G1	NA
5dBi Antenna	PCTEL	Generic	NA
Mobile Collection Device, MC4	Ittron, Inc.	DCU53104C	74007941

#### Support Equipment:

Device	Manufacturer	Model #	S/N
Power Supply	Extech Instruments	382225	P99250026

### Configuration 2 (MC4Pro+laptop)

#### Equipment Tested:

Device	Manufacturer	Model #	S/N
Receiver Antenna	PCTEL	SUB-0275-001/H	S15180005
Power Supply	Panasonic	CF-AA5713A M3	5713AM314Z14641A
Laptop	Panasonic	CF-VEK33	T1126Z
5dBi Antenna	PCTEL	Generic	NA
Mobile Collection Device, MC4	Ittron, Inc.	DCU53104C	74007941

#### Support Equipment:

Device	Manufacturer	Model #	S/N
Power Supply	Extech Instruments	382225	P99250026

## General Product Information:

Product Information	Manufacturer-Provided Details
Equipment Type:	Stand-Alone Equipment
Type of Wideband System:	FHSS
Operating Frequency Range:	908-924MHz
Number of Hopping Channels:	81
Receiver Bandwidth and Synchronization:	The manufacturer declares the receiver input bandwidth matches the transmit channel bandwidth and shifts frequencies in synchronization with the transmitter.
Modulation Type(s):	12.5kbps FM
Maximum Duty Cycle:	45mS
Number of TX Chains:	1
Antenna Type(s) and Gain:	External / 5dbi
Beamforming Type:	NA
Antenna Connection Type:	External Connector
Nominal Input Voltage:	13.8Vdc from car battery / 5Vdc charger
Firmware / Software used for Test:	Arm Version: 7.66.00.01 DSP Version: 5.70.00.00 FPGA Version: 3.02 PSoC Version: 3.01 MC3 SuperRaptor Test ver.4.0.3.5

**EUT and Accessory Photo(s)**



MC4Pro



Laptop and Power Adapter





Tablet



### Tablet Power Adapter



Antennas

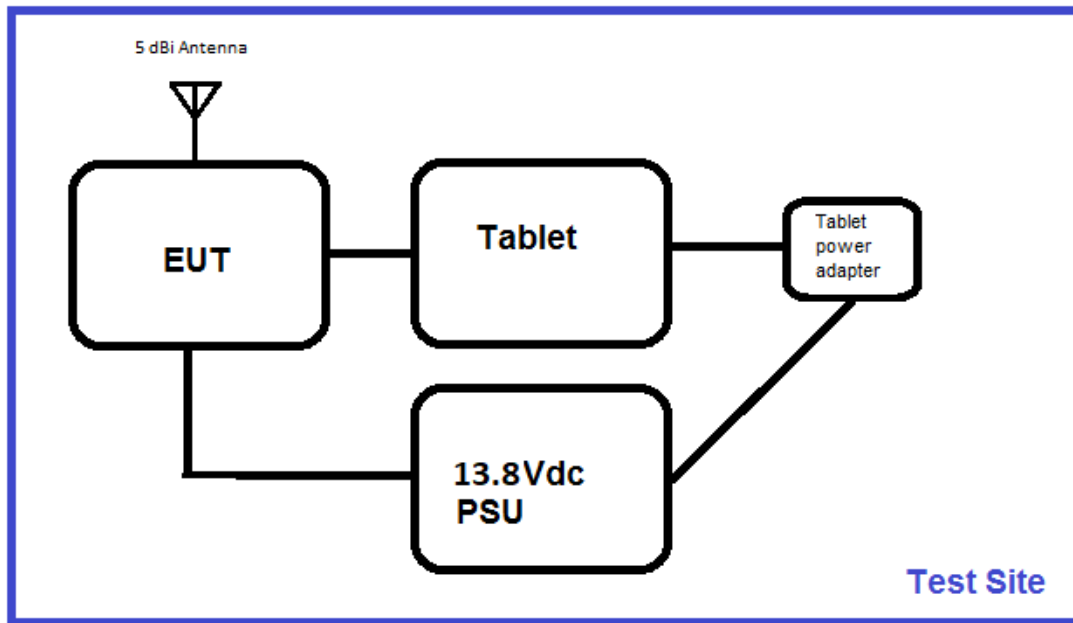
**Support Equipment Photo(s)**



12V Power Supply

Block Diagram of Test Setup(s)

## Test Setup Block Diagram



## FCC Part 15 Subpart C

### 15.247(b)(2) Output Power

Test Setup/Conditions			
Test Location:	Brea Lab A	Test Engineer:	Don Nguyen
Test Method:	ANSI C63.10 (2013)	Test Date(s):	12/2/2020
Configuration:	1		
Test Setup:	<p>The EUT is placed on test bench. Input voltage is 13.8Vdc from external power supply. USB port is connected to a touchscreen tablet. The computer is sending command to the EUT using software MC3 SuperRaptor Test ver.4.0.3.5 The EUT is set to continuously transmit.</p> <p>Operating frequency: 908-924MHz Frequency of measurement: 902-928MHz RBW=300kHz VBW=910kHz</p> <p>Note: Power output is verified for c2pc.</p>		

Environmental Conditions			
Temperature (°C)	25	Relative Humidity (%):	30

Test Equipment					
Asset #	Description	Manufacturer	Model	Cal Date	Cal Due
03643	Spectrum Analyzer	Agilent	E4440A	5/20/2020	5/20/2022
03432	Attenuator	Aeroflex/Weinschel	90-30-34	10/22/2019	10/22/2021
P07246	Cable	H&S	32022-29094K-29094K-24TC	5/29/2020	5/29/2022

Test Data Summary - Voltage Variations					
Frequency (MHz)	Modulation	V <sub>Minimum</sub> (dBm)	V <sub>Nominal</sub> (dBm)	V <sub>Maximum</sub> (dBm)	Max Deviation from V <sub>Nominal</sub> (dB)
908	12.5kbps FM	NA	29.40	NA	NA
916	12.5kbps FM	NA	29.78	NA	NA
924	12.5kbps FM	NA	29.46	NA	NA

Test performed using operational mode with the highest output power, representing worst case.

NA: This equipment is battery powered. Power output tests were performed using an external power supply to simulate a fresh battery.

### Parameter Definitions:

Measurements performed at input voltage  $V_{\text{Nominal}} \pm 15\%$ .

Parameter	Value
$V_{\text{Nominal}}$ :	13.8
$V_{\text{Minimum}}$ :	NA
$V_{\text{Maximum}}$ :	NA

NA: This equipment is battery powered. Power output tests were performed using an external power supply to simulate a fresh battery.

### Test Data Summary - Voltage Variations

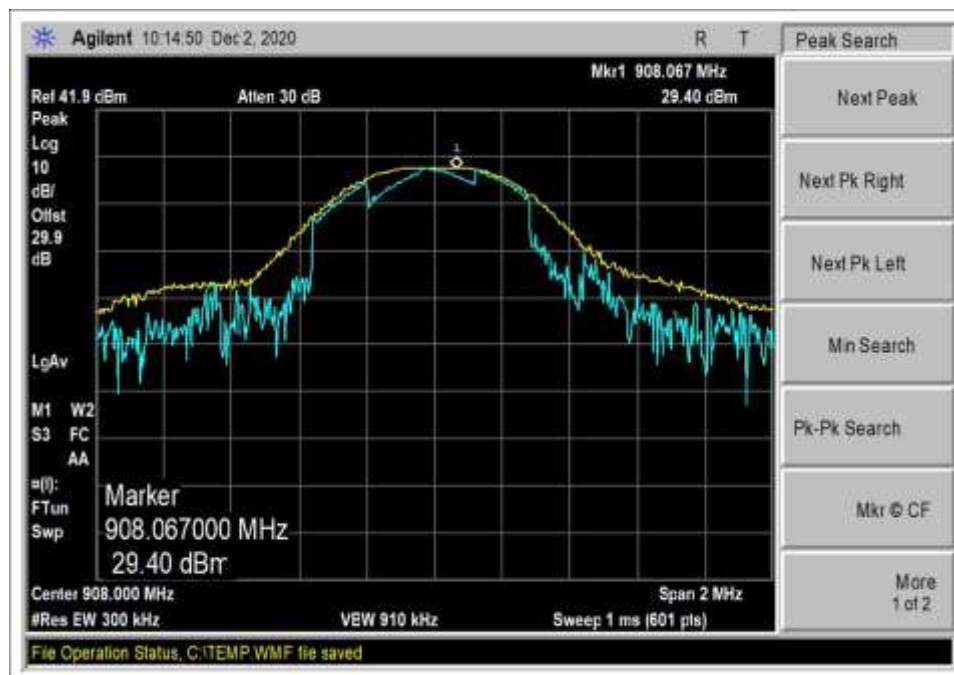
This equipment is battery powered. Power output tests were performed using an external power supply to simulate a fresh battery.

### Test Data Summary - RF Conducted Measurement

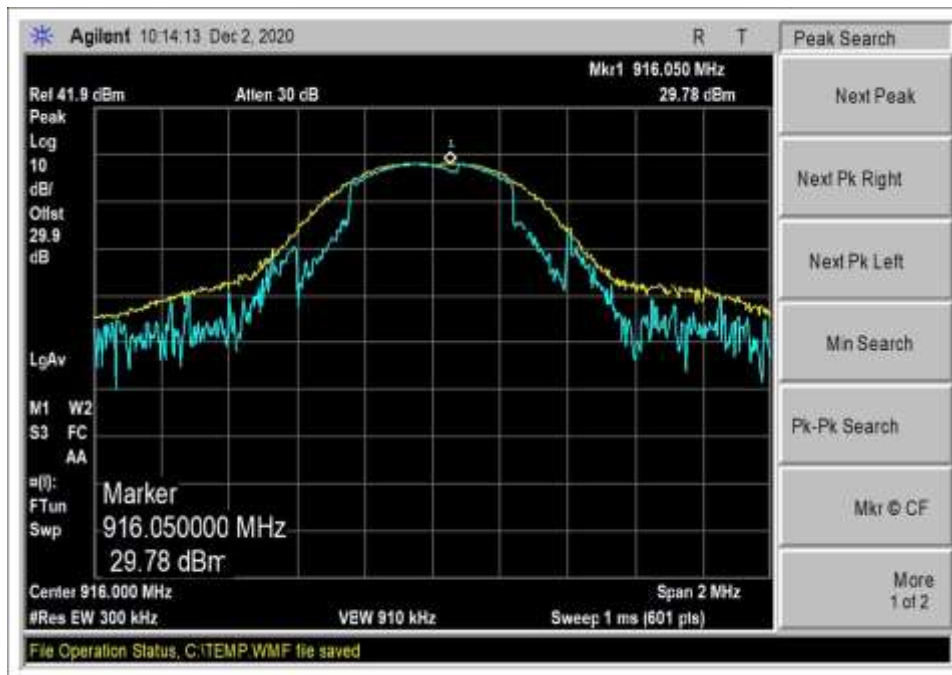
$$\text{Limit} = \begin{cases} 30\text{dBm Conducted}/36\text{dBm EIRP} & | \geq 50 \text{ Channels} \\ 24\text{dBm Conducted}/30\text{dBm EIRP} & | < 50 \text{ Channels (min 25)} \end{cases}$$

Frequency (MHz)	Modulation	Ant. Type / Gain (dBi)	Measured (dBm)	Limit (dBm)	Results
908	12.5kbps FM	5	29.40	$\leq 30$	Pass
916	12.5kbps FM	5	29.78	$\leq 30$	Pass
924	12.5kbps FM	5	29.46	$\leq 30$	Pass

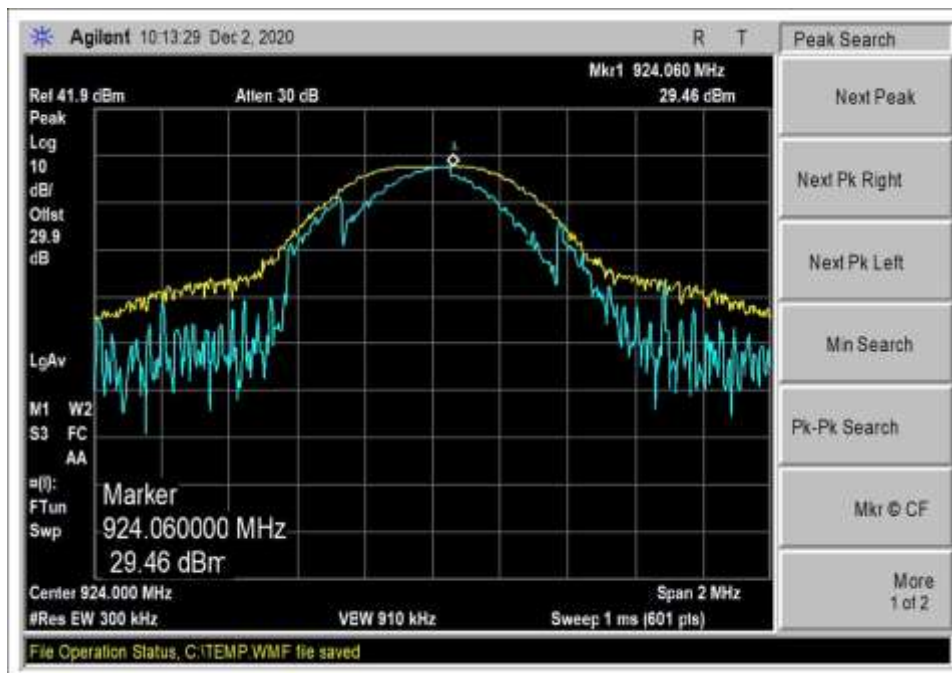
### Plots



Low Channel, Power



Middle Channel, Power



High Channel, Power

Test Setup Photo(s)





## 15.247(d) Radiated Spurious Emissions

### Test Setup / Conditions / Data

Test Location: CKC Laboratories Inc. • 110 N. Olinda Pl. • Brea, CA 92823 • 714-993-6112  
 Customer: **Itron, Inc.**  
 Specification: **15.247(d) / 15.209 Radiated Spurious Emissions**  
 Work Order #: **104623** Date: 12/9/2020  
 Test Type: **Maximized Emissions** Time: 11:54:14  
 Tested By: Don Nguyen Sequence#: 2  
 Software: EMITest 5.03.19

#### Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

#### Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

#### Test Conditions / Notes:

The EUT is placed on turn table. Input voltage is 13.8Vdc from external power supply. GPS, L/R receiver, and main antenna ports are connected to an external antenna. USB port is connected to a touchscreen computer. The computer is sending command to the EUT using software MC3 SuperRaptor Test ver.4.0.3.5. The EUT is set into transmitter mode. The EUT is rotated in three orthogonal orientation. Data represents the worst case orientation. The antenna of the EUT is mounted to a 52" diameter aluminum plate to represent a vehicle roof. The aluminum plate is supported by foam blocks. The EUT is directly below the plate, on the test table.

Operating Frequency: 908-924MHz  
 Frequency of Measurement: 9k-9280MHz  
 9kHz to 150kHz RBW=0.2kHz, VBW=0.6kHz  
 150kHz to 30MHz RBW=9kHz, VBW=27kHz  
 30-1000MHz, RBW=120kHz, VBW=360kHz  
 1000-9280MHz, RBW=1MHz, VBW=3MHz

#### Test Environment Conditions:

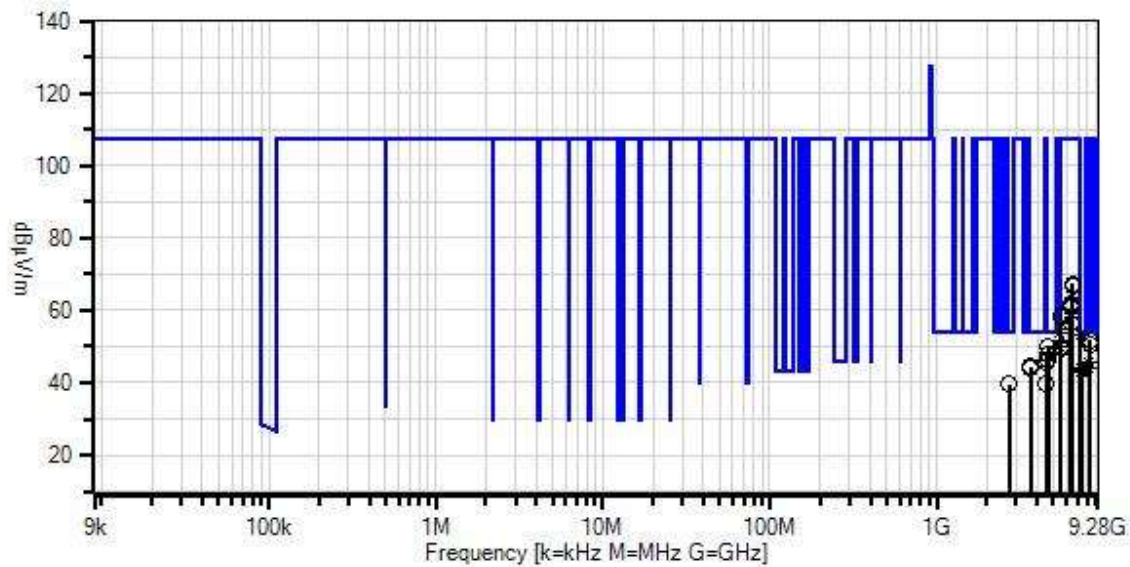
Temperature: 24°C  
 Relative Humidity: 22%  
 Site A

Duty correction factor is applied to RSM readings above 1GHz per KDB 558074 clause 9.b  
 Correction factor =  $20\log(44.67\text{ms}/100\text{ms}) = -7.0\text{dB}$

Note: Per manufacturer, installation manual shall state that a minimum of 12" of separation between the omni TX antenna and receiver antennas is required and the receiver antenna side-lookers are to be mounted "parallel" to the omni TX antenna.



Itron, Inc. WO#: 104623 Sequence#: 2 Date: 12/9/2020  
15.247(d) / 15.209 Radiated Spurious Emissions Test Distance: 3 Meters Horiz



— Readings  
× QP Readings  
▼ Ambient  
○ Peak Readings  
\* Average Readings  
Software Version: 5.03.19  
1 - 15.247(d) / 15.209 Radiated Spurious Emissions

#### Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN00314	Loop Antenna	6502	4/13/2020	4/13/2022
	AN00309	Preamp	8447D	12/24/2019	12/24/2021
	ANP05281	Attenuator	1B	4/7/2020	4/7/2022
	ANP05050	Cable	RG223/U	12/24/2018	12/24/2020
	ANP01911	Cable-Amplitude +15C to +45C (dB)	RG214/U	1/2/2020	1/2/2022
	AN01993	Biconilog Antenna	CBL6111C	6/11/2019	6/11/2021
	ANDuty Cycle Correction Factor	Test Data Adjustment		2/19/2020	2/19/2022
T1	AN03643	Spectrum Analyzer	E4440A	5/20/2020	5/20/2022
T2	AN00786	Preamp	83017A	5/20/2020	5/20/2022
T3	AN00849	Horn Antenna	3115	3/17/2020	3/17/2022
T4	ANP06360	Cable	L1-PNMMN-48	8/8/2019	8/8/2021
T5	ANP07246	Cable	32022-29094K- 29094K-24TC	5/29/2020	5/29/2022
T6	AN03169	High Pass Filter	HM1155-11SS	5/8/2019	5/8/2021

**Measurement Data:**

Reading listed by margin.

Test Distance: 3 Meters

#	Freq MHz	Rdng dBμV	T1 T5 dB	T2 T6 dB	T3 dB	T4 dB	Dist Table	Corr dBμV/m	Spec dBμV/m	Margin dB	Polar Ant
1	5448.300M Ave	57.9	+0.0 +0.7	-37.2 +0.2	+34.1	+5.1	+0.0	53.8	54.0	-0.2	Horiz
^	5448.300M	59.4	+0.0 +0.7	-37.2 +0.2	+34.1	+5.1	+0.0	62.3	54.0	+8.3	Horiz
^	5448.300M	57.9	+0.0 +0.7	-37.2 +0.2	+34.1	+5.1	+0.0	60.8	54.0 RMS	+6.8	Horiz
4	7263.592M Ave	54.5	+0.0 +0.8	-37.2 +0.2	+36.0	+6.1	+0.0	53.4	54.0	-0.6	Vert
^	7263.592M	56.1	+0.0 +0.8	-37.2 +0.2	+36.0	+6.1	+0.0	62.0	54.0	+8.0	Vert
^	7263.592M	54.5	+0.0 +0.8	-37.2 +0.2	+36.0	+6.1	+0.0	60.4	54.0 RMS	+6.4	Vert
7	7263.617M Ave	54.4	+0.0 +0.8	-37.2 +0.2	+36.0	+6.1	+0.0	53.3	54.0	-0.7	Horiz
^	7263.617M	55.7	+0.0 +0.8	-37.2 +0.2	+36.0	+6.1	+0.0	61.6	54.0	+7.6	Horiz
^	7263.617M	54.4	+0.0 +0.8	-37.2 +0.2	+36.0	+6.1	+0.0	60.3	54.0 RMS	+6.3	Horiz
10	8244.450M	44.3	+0.0 +0.9	-37.2 +0.3	+36.9	+6.5	+0.0	51.7	54.0	-2.3	Vert
11	8316.433M	42.8	+0.0 +0.9	-37.2 +0.4	+37.0	+6.5	+0.0	50.4	54.0	-3.6	Vert
12	5448.400M Ave	54.2	+0.0 +0.7	-37.2 +0.2	+34.1	+5.1	+0.0	50.1	54.0	-3.9	Vert
^	5448.400M	55.7	+0.0 +0.7	-37.2 +0.2	+34.1	+5.1	+0.0	58.6	54.0	+4.6	Vert
^	5448.400M	54.2	+0.0 +0.7	-37.2 +0.2	+34.1	+5.1	+0.0	57.1	54.0 RMS	+3.1	Vert
15	4619.817M	49.4	+0.0 +0.6	-37.4 +0.2	+32.7	+4.5	+0.0	50.0	54.0	-4.0	Vert
16	4580.133M	47.5	+0.0 +0.6	-37.4 +0.2	+32.6	+4.5	+0.0	48.0	54.0	-6.0	Vert
17	4619.850M	45.5	+0.0 +0.6	-37.4 +0.2	+32.7	+4.5	+0.0	46.1	54.0	-7.9	Horiz
18	4579.850M	45.5	+0.0 +0.6	-37.4 +0.2	+32.6	+4.5	+0.0	46.0	54.0	-8.0	Horiz
19	4539.767M	45.3	+0.0 +0.6	-37.4 +0.2	+32.6	+4.5	+0.0	45.8	54.0	-8.2	Horiz
20	8172.517M Ave	45.4	+0.0 +0.9	-37.2 +0.3	+36.8	+6.4	+0.0	45.6	54.0	-8.4	Vert
^	8172.517M	48.5	+0.0 +0.9	-37.2 +0.3	+36.8	+6.4	+0.0	55.7	54.0	+1.7	Vert
^	8172.517M	45.4	+0.0 +0.9	-37.2 +0.3	+36.8	+6.4	+0.0	52.6	54.0 RMS	-1.4	Vert
23	3664.017M	45.6	+0.0 +0.7	-38.1 +0.2	+32.0	+4.0	+0.0	44.4	54.0	-9.6	Horiz

24	8171.483M	44.0	+0.0	-37.2	+36.8	+6.4	+0.0	44.2	54.0	-9.8	Horiz
	Ave		+0.9	+0.3							
^	8171.483M	47.4	+0.0	-37.2	+36.8	+6.4	+0.0	54.6	54.0	+0.6	Horiz
			+0.9	+0.3							
^	8171.483M	44.0	+0.0	-37.2	+36.8	+6.4	+0.0	51.2	54.0	-2.8	Horiz
			+0.9	+0.3				RMS			
27	3663.833M	45.4	+0.0	-38.1	+32.0	+4.0	+0.0	44.2	54.0	-9.8	Vert
			+0.7	+0.2							
28	7328.450M	45.1	+0.0	-37.3	+36.2	+6.1	+0.0	44.1	54.0	-9.9	Vert
	Ave		+0.8	+0.2							
^	7328.450M	49.2	+0.0	-37.3	+36.2	+6.1	+0.0	55.2	54.0	+1.2	Vert
			+0.8	+0.2							
^	7328.450M	45.1	+0.0	-37.3	+36.2	+6.1	+0.0	51.1	54.0	-2.9	Vert
			+0.8	+0.2				RMS			
31	7392.250M	44.1	+0.0	-37.3	+36.3	+6.1	+0.0	43.3	54.0	-10.7	Vert
	Ave		+0.9	+0.2							
^	7392.250M	47.0	+0.0	-37.3	+36.3	+6.1	+0.0	53.2	54.0	-0.8	Vert
			+0.9	+0.2							
^	7392.250M	44.1	+0.0	-37.3	+36.3	+6.1	+0.0	50.3	54.0	-3.7	Vert
			+0.9	+0.2				RMS			
34	7328.450M	44.0	+0.0	-37.3	+36.2	+6.1	+0.0	43.0	54.0	-11.0	Horiz
	Ave		+0.8	+0.2							
^	7328.450M	48.0	+0.0	-37.3	+36.2	+6.1	+0.0	54.0	54.0	+0.0	Horiz
			+0.8	+0.2							
^	7328.450M	44.0	+0.0	-37.3	+36.2	+6.1	+0.0	50.0	54.0	-4.0	Horiz
			+0.8	+0.2				RMS			
37	7391.600M	43.6	+0.0	-37.3	+36.3	+6.1	+0.0	42.8	54.0	-11.2	Horiz
	Ave		+0.9	+0.2							
^	7391.600M	47.3	+0.0	-37.3	+36.3	+6.1	+0.0	53.5	54.0	-0.5	Horiz
			+0.9	+0.2							
^	7391.600M	43.6	+0.0	-37.3	+36.3	+6.1	+0.0	49.8	54.0	-4.2	Horiz
			+0.9	+0.2				RMS			
40	4539.733M	39.1	+0.0	-37.4	+32.6	+4.5	+0.0	39.6	54.0	-14.4	Vert
			+0.6	+0.2							
41	2723.808M	44.5	+0.0	-38.5	+29.6	+3.4	+0.0	39.6	54.0	-14.4	Vert
			+0.4	+0.2							
42	6468.283M	63.5	+0.0	-37.2	+34.4	+5.8	+0.0	67.4	107.2	-39.8	Horiz
			+0.7	+0.2							
43	6468.383M	62.9	+0.0	-37.2	+34.4	+5.8	+0.0	66.8	107.2	-40.4	Vert
			+0.7	+0.2							
44	6411.500M	57.8	+0.0	-37.1	+34.4	+5.8	+0.0	61.8	107.2	-45.4	Vert
			+0.7	+0.2							
45	6412.450M	57.3	+0.0	-37.1	+34.4	+5.8	+0.0	61.3	107.2	-45.9	Horiz
			+0.7	+0.2							
46	6356.350M	56.5	+0.0	-37.1	+34.4	+5.7	+0.0	60.5	107.2	-46.7	Horiz
			+0.8	+0.2							

47	5496.083M	55.8	+0.0 +0.7	-37.2 +0.2	+34.1	+5.1	+0.0	58.7	107.2	-48.5	Vert
48	5496.400M	55.2	+0.0 +0.7	-37.2 +0.2	+34.1	+5.1	+0.0	58.1	107.2	-49.1	Horiz
49	6356.192M	52.7	+0.0 +0.8	-37.1 +0.2	+34.4	+5.7	+0.0	56.7	107.2	-50.5	Vert
50	5543.817M	47.2	+0.0 +0.7	-37.3 +0.2	+34.1	+5.1	+0.0	50.0	107.2	-57.2	Vert
51	5543.633M	46.7	+0.0 +0.7	-37.3 +0.2	+34.1	+5.1	+0.0	49.5	107.2	-57.7	Horiz

Test Location: CKC Laboratories Inc. • 110 N. Olinda Pl. • Brea, CA 92823 • 714-993-6112  
 Customer: **Itron, Inc.**  
 Specification: **15.247(d) / 15.209 Radiated Spurious Emissions**  
 Work Order #: **104623** Date: 12/14/2020  
 Test Type: **Maximized Emissions** Time: 14:47:29  
 Tested By: Don Nguyen Sequence#: 3  
 Software: EMITest 5.03.19

***Equipment Tested:***

Device	Manufacturer	Model #	S/N
Configuration 2			

***Support Equipment:***

Device	Manufacturer	Model #	S/N
Configuration 2			

***Test Conditions / Notes:***

The EUT is placed on turn table. Input voltage is 13.8Vdc from external power supply. GPS, L/R receiver, and main antenna ports are connected to external antennas. USB port is connected to a touchscreen computer. The computer is sending command to the EUT using software MC3 SuperRaptor Test ver.4.0.3.5. The EUT is set into transmitter mode. The EUT is rotated in three orthogonal orientation. Data represents the worst case orientation. The antenna of the EUT is mounted to a 52" diameter aluminum plate to represent a vehicle roof. The aluminum plate is supported by foam blocks. The EUT is directly below the plate, on the test table.

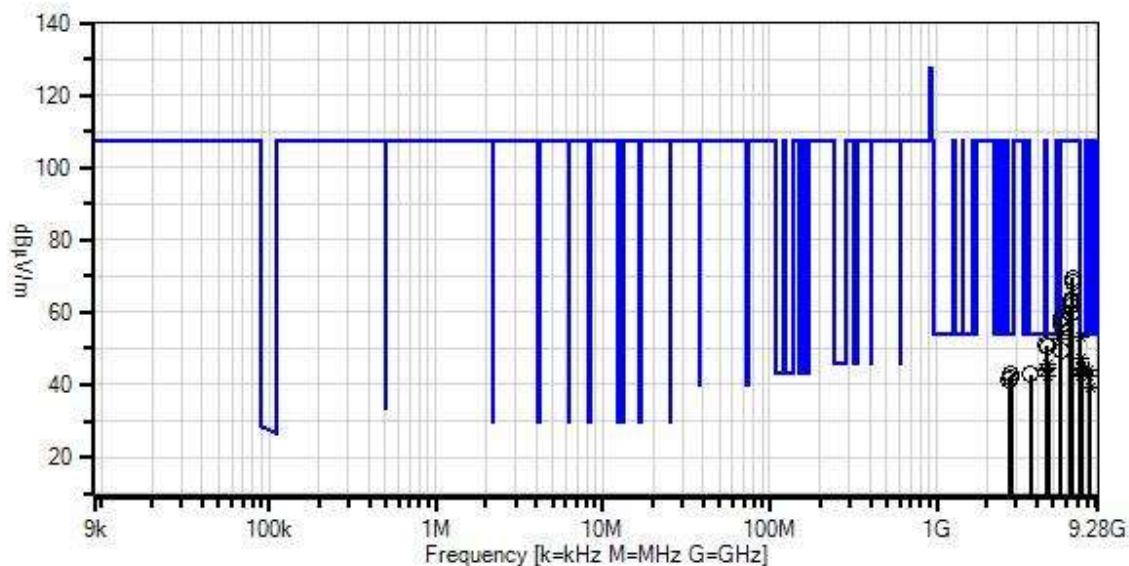
Operating Frequency: 908-924MHz  
 Frequency of Measurement: 9k-9280MHz  
 9kHz to 150kHz RBW=0.2kHz, VBW=0.6kHz  
 150kHz to 30MHz RBW=9kHz, VBW=27kHz  
 30-1000MHz, RBW=120kHz, VBW=360kHz  
 1000-9280MHz, RBW=1MHz, VBW=3MHz

Test Environment Conditions:  
 Temperature: 24°C  
 Relative Humidity: 22%  
 Site A

Duty correction factor is applied to RSM readings above 1GHz per KDB 558074 clause 9.b  
 Correction factor =  $20\log(44.67\text{ms}/100\text{ms}) = -7.0\text{dB}$

Note: Per manufacturer, installation manual shall state that a minimum of 12" of separation between the omni TX antenna and receiver antennas is required and the receiver antenna side-lookers are to be mounted "parallel" to the omni TX antenna.

Ittron, Inc. WO#: 104623 Sequence#: 3 Date: 12/14/2020  
15.247(d) / 15.209 Radiated Spurious Emissions Test Distance: 3 Meters Vert



— Readings  
 × QP Readings  
 ▼ Ambient  
 — 1 - 15.247(d) / 15.209 Radiated Spurious Emissions

○ Peak Readings  
 \* Average Readings  
 Software Version: 5.03.19

#### Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN00314	Loop Antenna	6502	4/13/2020	4/13/2022
	AN00309	Preamp	8447D	12/24/2019	12/24/2021
	ANP05281	Attenuator	1B	4/7/2020	4/7/2022
	ANP05050	Cable	RG223/U	12/24/2018	12/24/2020
	ANP01911	Cable-Amplitude +15C to +45C (dB)	RG214/U	1/2/2020	1/2/2022
	AN01993	Biconilog Antenna	CBL6111C	6/11/2019	6/11/2021
T1	ANDuty Cycle Correction Factor	Test Data Adjustment		2/19/2020	2/19/2022
T2	AN03643	Spectrum Analyzer	E4440A	5/20/2020	5/20/2022
T3	AN00786	Preamp	83017A	5/20/2020	5/20/2022
T4	AN00849	Horn Antenna	3115	3/17/2020	3/17/2022
T5	ANP06360	Cable	L1-PNMMN-48	8/8/2019	8/8/2021
T6	ANP07246	Cable	32022-29094K- 29094K-24TC	5/29/2020	5/29/2022
T7	AN03169	High Pass Filter	HM1155-11SS	5/8/2019	5/8/2021

**Measurement Data:**

Reading listed by margin.

Test Distance: 3 Meters

#	Freq MHz	Rdng dBμV	T1 T5 dB	T2 T6 dB	T3 T7 dB	T4 dB	Dist Table	Corr dBμV/m	Spec dBμV/m	Margin dB	Polar Ant
1	5448.350M	58.0	-7.0	+0.0	-37.2	+34.1	+0.0	53.9	54.0	-0.1	Horiz
	Ave		+5.1	+0.7	+0.2						
^	5448.350M	59.1	+0.0	+0.0	-37.2	+34.1	+0.0	62.0	54.0	+8.0	Horiz
			+5.1	+0.7	+0.2						
^	5448.350M	58.0	+0.0	+0.0	-37.2	+34.1	+0.0	60.9	54.0	+6.9	Horiz
			+5.1	+0.7	+0.2			RMS			
4	7263.517M	54.3	-7.0	+0.0	-37.2	+36.0	+0.0	53.2	54.0	-0.8	Horiz
	Ave		+6.1	+0.8	+0.2						
^	7263.517M	55.9	+0.0	+0.0	-37.2	+36.0	+0.0	61.8	54.0	+7.8	Horiz
			+6.1	+0.8	+0.2						
^	7263.517M	54.3	+0.0	+0.0	-37.2	+36.0	+0.0	60.2	54.0	+6.2	Horiz
			+6.1	+0.8	+0.2			RMS			
7	5448.283M	56.6	-7.0	+0.0	-37.2	+34.1	+0.0	52.5	54.0	-1.5	Vert
	Ave		+5.1	+0.7	+0.2						
^	5448.283M	57.6	+0.0	+0.0	-37.2	+34.1	+0.0	60.5	54.0	+6.5	Vert
			+5.1	+0.7	+0.2						
^	5448.283M	56.6	+0.0	+0.0	-37.2	+34.1	+0.0	59.5	54.0	+5.5	Vert
			+5.1	+0.7	+0.2			RMS			
10	4539.783M	50.5	+0.0	+0.0	-37.4	+32.6	+0.0	51.0	54.0	-3.0	Vert
			+4.5	+0.6	+0.2						
11	4580.117M	49.8	+0.0	+0.0	-37.4	+32.6	+0.0	50.3	54.0	-3.7	Vert
			+4.5	+0.6	+0.2						
12	7264.350M	48.2	-7.0	+0.0	-37.2	+36.0	+0.0	47.1	54.0	-6.9	Vert
	Ave		+6.1	+0.8	+0.2						
^	7264.350M	50.6	+0.0	+0.0	-37.2	+36.0	+0.0	56.5	54.0	+2.5	Vert
			+6.1	+0.8	+0.2						
^	7264.350M	48.2	+0.0	+0.0	-37.2	+36.0	+0.0	54.1	54.0	+0.1	Vert
			+6.1	+0.8	+0.2			RMS			
15	4580.200M	52.4	-7.0	+0.0	-37.4	+32.6	+0.0	45.9	54.0	-8.1	Horiz
	Ave		+4.5	+0.6	+0.2						
^	4580.200M	54.0	+0.0	+0.0	-37.4	+32.6	+0.0	54.5	54.0	+0.5	Horiz
			+4.5	+0.6	+0.2						
^	4580.200M	52.4	+0.0	+0.0	-37.4	+32.6	+0.0	52.9	54.0	-1.1	Horiz
			+4.5	+0.6	+0.2			RMS			
18	4619.750M	50.9	-7.0	+0.0	-37.4	+32.7	+0.0	44.5	54.0	-9.5	Vert
	Ave		+4.5	+0.6	+0.2						
^	4619.750M	52.9	+0.0	+0.0	-37.4	+32.7	+0.0	53.5	54.0	-0.5	Vert
			+4.5	+0.6	+0.2						
^	4619.750M	50.9	+0.0	+0.0	-37.4	+32.7	+0.0	51.5	54.0	-2.5	Vert
			+4.5	+0.6	+0.2			RMS			
21	7328.450M	45.5	-7.0	+0.0	-37.3	+36.2	+0.0	44.5	54.0	-9.5	Vert
	Ave		+6.1	+0.8	+0.2						
^	7328.450M	48.5	+0.0	+0.0	-37.3	+36.2	+0.0	54.5	54.0	+0.5	Vert
			+6.1	+0.8	+0.2						
^	7328.450M	45.5	+0.0	+0.0	-37.3	+36.2	+0.0	51.5	54.0	-2.5	Vert
			+6.1	+0.8	+0.2			RMS			

24	7392.483M Ave	45.1	-7.0 +6.1	+0.0 +0.9	-37.3 +0.2	+36.3	+0.0	44.3	54.0	-9.7	Horiz
^	7392.483M	48.5	+0.0 +6.1	+0.0 +0.9	-37.3 +0.2	+36.3	+0.0	54.7	54.0	+0.7	Horiz
^	7392.483M	45.1	+0.0 +6.1	+0.0 +0.9	-37.3 +0.2	+36.3	+0.0	51.3	54.0 RMS	-2.7	Horiz
27	4539.750M Ave	50.8	-7.0 +4.5	+0.0 +0.6	-37.4 +0.2	+32.6	+0.0	44.3	54.0	-9.7	Horiz
^	4539.750M	52.3	+0.0 +4.5	+0.0 +0.6	-37.4 +0.2	+32.6	+0.0	52.8	54.0	-1.2	Horiz
^	4539.750M	50.8	+0.0 +4.5	+0.0 +0.6	-37.4 +0.2	+32.6	+0.0	51.3	54.0 RMS	-2.7	Horiz
30	8171.508M Ave	44.1	-7.0 +6.4	+0.0 +0.9	-37.2 +0.3	+36.8	+0.0	44.3	54.0	-9.7	Vert
^	8171.508M	47.6	+0.0 +6.4	+0.0 +0.9	-37.2 +0.3	+36.8	+0.0	54.8	54.0	+0.8	Vert
^	8171.508M	44.1	+0.0 +6.4	+0.0 +0.9	-37.2 +0.3	+36.8	+0.0	51.3	54.0 RMS	-2.7	Vert
33	3664.000M	44.0	+0.0 +4.0	+0.0 +0.7	-38.1 +0.2	+32.0	+0.0	42.8	54.0	-11.2	Vert
34	2772.067M	47.4	+0.0 +3.5	+0.0 +0.4	-38.5 +0.2	+29.7	+0.0	42.7	54.0	-11.3	Vert
35	7392.383M Ave	43.5	-7.0 +6.1	+0.0 +0.9	-37.3 +0.2	+36.3	+0.0	42.7	54.0	-11.3	Vert
^	7392.383M	47.4	+0.0 +6.1	+0.0 +0.9	-37.3 +0.2	+36.3	+0.0	53.6	54.0	-0.4	Vert
^	7392.383M	43.5	+0.0 +6.1	+0.0 +0.9	-37.3 +0.2	+36.3	+0.0	49.7	54.0 RMS	-4.3	Vert
38	4620.250M Ave	48.7	-7.0 +4.5	+0.0 +0.6	-37.4 +0.2	+32.7	+0.0	42.3	54.0	-11.7	Horiz
^	4620.250M	51.0	+0.0 +4.5	+0.0 +0.6	-37.4 +0.2	+32.7	+0.0	51.6	54.0	-2.4	Horiz
^	4620.250M	48.7	+0.0 +4.5	+0.0 +0.6	-37.4 +0.2	+32.7	+0.0	49.3	54.0 RMS	-4.7	Horiz
41	7327.600M Ave	43.3	-7.0 +6.1	+0.0 +0.8	-37.3 +0.2	+36.2	+0.0	42.3	54.0	-11.7	Horiz
^	7327.600M	47.0	+0.0 +6.1	+0.0 +0.8	-37.3 +0.2	+36.2	+0.0	53.0	54.0	-1.0	Horiz
^	7327.600M	43.3	+0.0 +6.1	+0.0 +0.8	-37.3 +0.2	+36.2	+0.0	49.3	54.0 RMS	-4.7	Horiz
44	8171.517M Ave	42.0	-7.0 +6.4	+0.0 +0.9	-37.2 +0.3	+36.8	+0.0	42.2	54.0	-11.8	Horiz
^	8171.517M	46.2	+0.0 +6.4	+0.0 +0.9	-37.2 +0.3	+36.8	+0.0	53.4	54.0	-0.6	Horiz
^	8171.517M	42.0	+0.0 +6.4	+0.0 +0.9	-37.2 +0.3	+36.8	+0.0	49.2	54.0 RMS	-4.8	Horiz
47	2772.000M	46.7	+0.0 +3.5	+0.0 +0.4	-38.5 +0.2	+29.7	+0.0	42.0	54.0	-12.0	Horiz
48	2748.000M	46.8	+0.0 +3.4	+0.0 +0.4	-38.5 +0.2	+29.7	+0.0	42.0	54.0	-12.0	Vert
49	2724.050M	46.3	+0.0 +3.4	+0.0 +0.4	-38.5 +0.2	+29.6	+0.0	41.4	54.0	-12.6	Vert



50	8244.550M	38.8	-7.0	+0.0	-37.2	+36.9	+0.0	39.2	54.0	-14.8	Vert
	Ave		+6.5	+0.9	+0.3						
^	8244.550M	43.7	+0.0	+0.0	-37.2	+36.9	+0.0	51.1	54.0	-2.9	Vert
			+6.5	+0.9	+0.3						
^	8244.550M	38.8	+0.0	+0.0	-37.2	+36.9	+0.0	46.2	54.0	-7.8	Vert
			+6.5	+0.9	+0.3				RMS		
53	6467.717M	65.6	+0.0	+0.0	-37.2	+34.4	+0.0	69.5	107.2	-37.7	Horiz
			+5.8	+0.7	+0.2						
54	6467.667M	64.6	+0.0	+0.0	-37.2	+34.4	+0.0	68.5	107.2	-38.7	Vert
			+5.8	+0.7	+0.2						
55	6411.467M	59.3	+0.0	+0.0	-37.1	+34.4	+0.0	63.3	107.2	-43.9	Horiz
			+5.8	+0.7	+0.2						
56	6412.500M	58.9	+0.0	+0.0	-37.1	+34.4	+0.0	62.9	107.2	-44.3	Vert
			+5.8	+0.7	+0.2						
57	6355.833M	58.0	+0.0	+0.0	-37.1	+34.4	+0.0	62.0	107.2	-45.2	Horiz
			+5.7	+0.8	+0.2						
58	6356.467M	55.9	+0.0	+0.0	-37.1	+34.4	+0.0	59.9	107.2	-47.3	Vert
			+5.7	+0.8	+0.2						
59	5495.533M	55.5	+0.0	+0.0	-37.2	+34.1	+0.0	58.4	107.2	-48.8	Horiz
			+5.1	+0.7	+0.2						
60	5496.267M	55.2	+0.0	+0.0	-37.2	+34.1	+0.0	58.1	107.2	-49.1	Vert
			+5.1	+0.7	+0.2						
61	5543.650M	53.8	+0.0	+0.0	-37.3	+34.1	+0.0	56.6	107.2	-50.6	Vert
			+5.1	+0.7	+0.2						
62	5543.700M	46.6	+0.0	+0.0	-37.3	+34.1	+0.0	49.4	107.2	-57.8	Horiz
			+5.1	+0.7	+0.2						

### 15.35(c) Duty Cycle Correction Factor

Test Data Summary			
Antenna Port	Operational Mode	Measured On Time (mS / P <sub>obs</sub> )	Calculated DCCF (dB)
1	Hopping	44.67	-7.0

Observation Period, P<sub>obs</sub> is the duration of the pulse train or maximum 100mS

Measured results are calculated as follows:

$$On\ Time = \left( \sum_{Bursts} RF\ Burst\ On\ Time + \sum_{Control} Control\ Signal\ On\ time \right) \Big|_{P_{obs} \text{ (max 100ms)}}$$

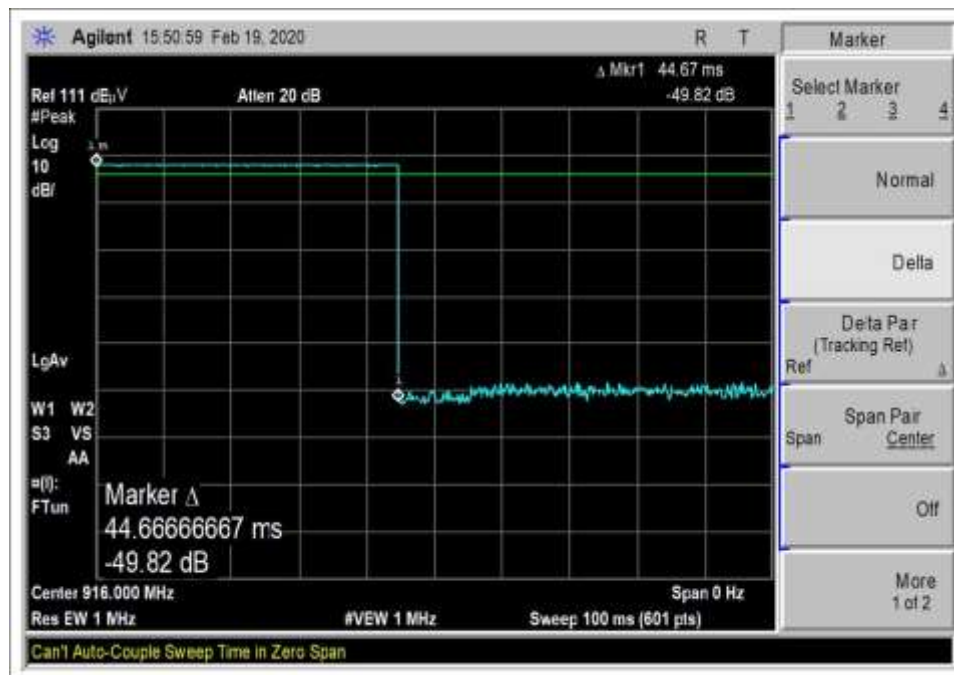
Measured Values:

Parameter	Value
Observation Period (P <sub>obs</sub> ):	100ms
Number of RF Bursts / P <sub>obs</sub> :	1
On time of RF Burst:	44.67ms
Number of Control or other signals / P <sub>obs</sub> :	0
On time of Control or other Signals:	0
Total Measured On Time:	44.67

Duty Cycle Correction Factor (DCCF) is calculated in accordance with ANSI C63.10:

$$DCCF = 20 \cdot \log \left( \frac{On\ Time}{P_{obs}} \right)$$

## Test Plot(s)



Duty Cycle 100ms

**Test Setup Photo(s)**



Below 1GHz; Configuration 1



Below 1GHz; Configuration 1



Below 1GHz; Configuration 2



Below 1GHz; Configuration 2



Above 1GHz; Configuration 1



Above 1GHz; Configuration 1



Above 1GHz; Configuration 2



Above 1GHz; Configuration 2





X Axis; Configuration 1 and 2



Y Axis; Configuration 1 and 2





Z Axis; Configuration 1 and 2

## SUPPLEMENTAL INFORMATION

### Measurement Uncertainty

Uncertainty Value	Parameter
4.73 dB	Radiated Emissions
3.34 dB	Mains Conducted Emissions
3.30 dB	Disturbance Power

Uncertainties reported are worst case for all CKC Laboratories' sites and represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of  $k=2$ . Compliance is deemed to occur provided measurements are below the specified limits.

### Emissions Test Details

#### TESTING PARAMETERS

Unless otherwise indicated, the following configuration parameters are used for equipment setup: The cables were routed consistent with the typical application by varying the configuration of the test sample. Interface cables were connected to the available ports of the test unit. The effect of varying the position of the cables was investigated to find the configuration that produced maximum emissions. Cables were of the type and length specified in the individual requirements. The length of cable that produced maximum emissions was selected.

The equipment under test (EUT) was set up in a manner that represented its normal use, as shown in the setup photographs. Any special conditions required for the EUT to operate normally are identified in the comments that accompany the emissions tables.

The emissions data was taken with a spectrum analyzer or receiver. Incorporating the applicable correction factors for distance, antenna, cable loss and amplifier gain, the data was reduced as shown in the table below. The corrected data was then compared to the applicable emission limits. Preliminary and final measurements were taken in order to ensure that all emissions from the EUT were found and maximized.

#### CORRECTION FACTORS

The basic spectrum analyzer reading was converted using correction factors as shown in the highest emissions readings in the tables. For radiated emissions in  $\text{dB}\mu\text{V}/\text{m}$ , the spectrum analyzer reading in  $\text{dB}\mu\text{V}$  was corrected by using the following formula. This reading was then compared to the applicable specification limit. Individual measurements were compared with the displayed limit value in the margin column. The margin was calculated based on subtracting the limit value from the corrected measurement value; a positive margin represents a measurement exceeding the limit, while a negative margin represents a measurement less than the limit.

SAMPLE CALCULATIONS		
	Meter reading	( $\text{dB}\mu\text{V}$ )
+	Antenna Factor	( $\text{dB}/\text{m}$ )
+	Cable Loss	( $\text{dB}$ )
-	Distance Correction	( $\text{dB}$ )
-	Preamplifier Gain	( $\text{dB}$ )
=	Corrected Reading	( $\text{dB}\mu\text{V}/\text{m}$ )

#### TEST INSTRUMENTATION AND ANALYZER SETTINGS

The test instrumentation and equipment listed were used to collect the emissions data. A spectrum analyzer or receiver was used for all measurements. Unless otherwise specified, the following table shows the measuring equipment bandwidth settings that were used in designated frequency bands. For testing emissions, an appropriate reference level and a vertical scale size of 10 dB per division were used.

MEASURING EQUIPMENT BANDWIDTH SETTINGS PER FREQUENCY RANGE			
TEST	BEGINNING FREQUENCY	ENDING FREQUENCY	BANDWIDTH SETTING
CONDUCTED EMISSIONS	150 kHz	30 MHz	9 kHz
RADIATED EMISSIONS	9 kHz	150 kHz	200 Hz
RADIATED EMISSIONS	150 kHz	30 MHz	9 kHz
RADIATED EMISSIONS	30 MHz	1000 MHz	120 kHz
RADIATED EMISSIONS	1000 MHz	>1 GHz	1 MHz

#### SPECTRUM ANALYZER/RECEIVER DETECTOR FUNCTIONS

The notes that accompany the measurements contained in the emissions tables indicate the type of detector function used to obtain the given readings. Unless otherwise noted, all readings were made in the "positive peak" detector mode. Whenever a "quasi-peak" or "average" reading was recorded, the measurement was annotated with a "QP" or an "Ave" on the appropriate rows of the data sheets. In cases where quasi-peak or average limits were employed and data exists for multiple measurement types for the same frequency then the peak measurement was retained in the report for reference, however the numbering for the affected row was removed and an arrow or caret ("^") was placed in the far left-hand column indicating that the row above takes precedence for comparison to the limit. The following paragraphs describe in more detail the detector functions and when they were used to obtain the emissions data.

##### Peak

In this mode, the spectrum analyzer or receiver recorded all emissions at their peak value as the frequency band selected was scanned. By combining this function with another feature called "peak hold," the measurement device had the ability to measure intermittent or low duty cycle transient emission peak levels. In this mode the measuring device made a slow scan across the frequency band selected and measured the peak emission value found at each frequency across the band.

##### Quasi-Peak

Quasi-peak measurements were taken using the quasi-peak detector when the true peak values exceeded or were within 2 dB of a quasi-peak specification limit. Additional QP measurements may have been taken at the discretion of the operator.

##### Average

Average measurements were taken using the average detector when the true peak values exceeded or were within 2 dB of an average specification limit. Additional average measurements may have been taken at the discretion of the operator. If the specification or test procedure requires trace averaging, then the averaging was performed using 100 samples or as required by the specification. All other average measurements are performed using video bandwidth averaging. To make these measurements, the test engineer reduces the video bandwidth on the measuring device until the modulation of the signal is filtered out. At this point the measuring device is set into the linear mode and the scan time is reduced.