

# Itron, Inc.

## TEST REPORT FOR

**OpenWay Gas Remote Disconnect**  
**Model: OWRGRD**

**Tested to The Following Standards:**

**FCC Part 15 Subpart C Section 15.249**

**Report No.: 100666-8**

**Date of issue: January 23, 2018**



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 EMC 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.

## TABLE OF CONTENTS

Administrative Information .....	3
Test Report Information .....	3
Report Authorization .....	3
Test Facility Information .....	4
Software Versions .....	4
Site Registration & Accreditation Information .....	4
Summary of Results .....	5
Modifications During Testing .....	5
Conditions During Testing .....	5
Equipment Under Test .....	6
General Product Information .....	7
FCC Part 15 Subpart C .....	8
15.215(c) Occupied Bandwidth (20dB BW) .....	8
15.249(a) Field Strength of Fundamental .....	11
15.249(a) Radiated Emissions and Band Edge .....	15
Supplemental Information .....	26
Measurement Uncertainty .....	26
Emissions Test Details .....	26

## ADMINISTRATIVE INFORMATION

### Test Report Information

**REPORT PREPARED FOR:**

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

**REPORT PREPARED BY:**

Dianne Dudley  
CKC Laboratories, Inc.  
5046 Sierra Pines Drive  
Mariposa, CA 95338

Representative: Jay Holcomb  
Customer Reference Number: 137056

Project Number: 100666

**DATE OF EQUIPMENT RECEIPT:**  
**DATE(S) OF TESTING:**

December 7, 2017  
December 7-8, 2017

### Report Authorization

The test data contained in this report documents the observed testing parameters pertaining to and are relevant for only the sample equipment 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.



*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 North Olinda Place  
Brea, CA 92823

## Software Versions

CKC Laboratories Proprietary Software	Version
EMITest Emissions	5.03.11

## Site Registration & Accreditation Information

Location	NIST CB #	TAIWAN	CANADA	FCC	JAPAN
Brea A, CA	US0060	SL2-IN-E-1146R	3082D-1	US1025	A-0147

## SUMMARY OF RESULTS

### Standard / Specification: FCC Part 15 Subpart C - 15.249

Test Procedure	Description	Modifications	Results
15.215(c)	Occupied Bandwidth	NA	Pass
15.249(a)	Field Strength of Fundamental	NA	Pass
15.249(a)	Field Strength of Spurious Emissions	NA	Pass

NA = Not Applicable

### 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

None

## EQUIPMENT UNDER TEST (EUT)

CKC Laboratories tested Model: **OWGRD**

Since the time of testing, the manufacturer has chosen to update the model name to:

**Model: OWRGRD** Any difference between the names does not affect their EMC characteristics and therefore meets the level of testing equivalent to the tested model.

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

***Equipment Tested:***

Device	Manufacturer	Model #	S/N
OpenWay Gas Remote Disconnect	Itron, Inc.	OWRGRD	NA

***Support Equipment:***

Device	Manufacturer	Model #	S/N
Laptop	Dell	E6410	CFGY2A00CET

## General Product Information:

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Product Information	Manufacturer-Provided Details
Equipment Type:	Stand-Alone Equipment
Type of Wideband System:	Low Power Transceiver, Rx Verified
Operating Frequency Range:	908 to 923.8MHz (OOK)
Number of Hopping Channels:	1 at a time
Modulation Type(s):	OOK
Maximum Duty Cycle:	100%
Number of TX Chains:	2
Antenna Type(s) and Gain:	2 – 2.3 dBi (vertical) and 0.1 dBi (horizontal)
Beamforming Type:	NA
Antenna Connection Type:	Integral (External connector provided to facilitate testing)
Nominal Input Voltage:	6.0V DC – battery
Firmware / Software used for Test:	2.0.10.0

## FCC Part 15 Subpart C

### 15.215(c) Occupied Bandwidth (20dB BW)

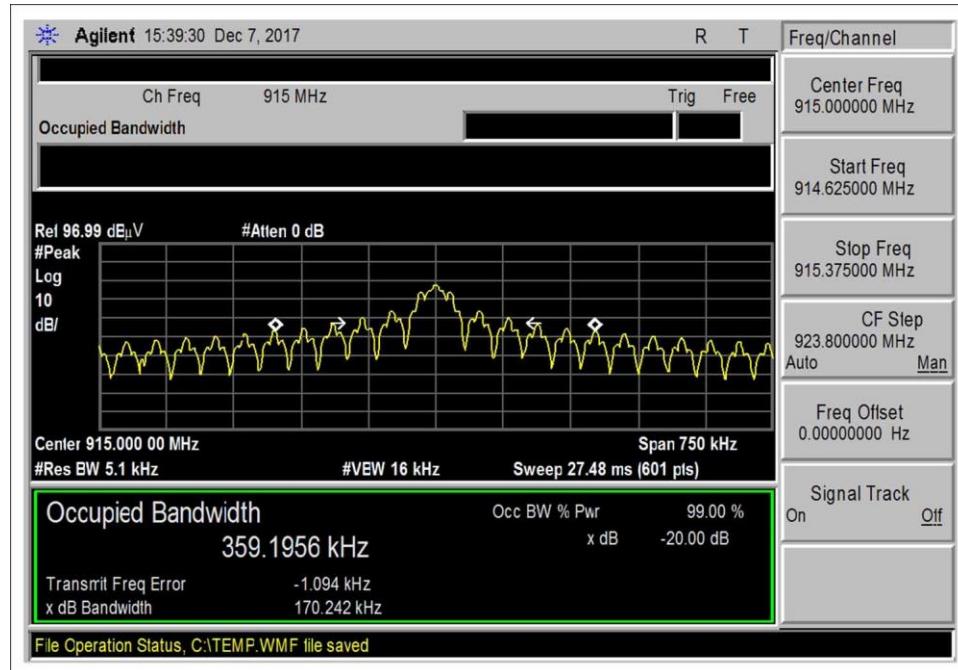
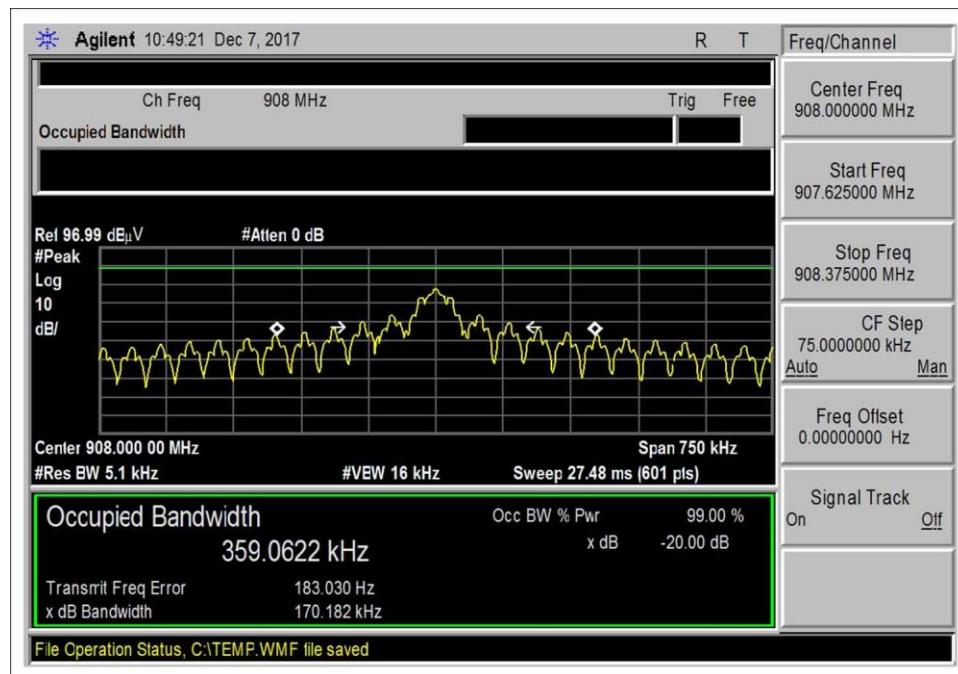
Test Setup/Conditions			
Test Location:	Brea Lab A	Test Engineer:	S. Yamamoto
Test Method:	ANSI C63.10 (2013)	Test Date(s):	12/7/2017
Configuration:	1		
Test Setup:	The equipment under test (EUT) is placed on the tabletop. The output of the EUT is connected to the spectrum analyzer using a coaxial cable and attenuator. The EUT is transmitting at its rated output power.		

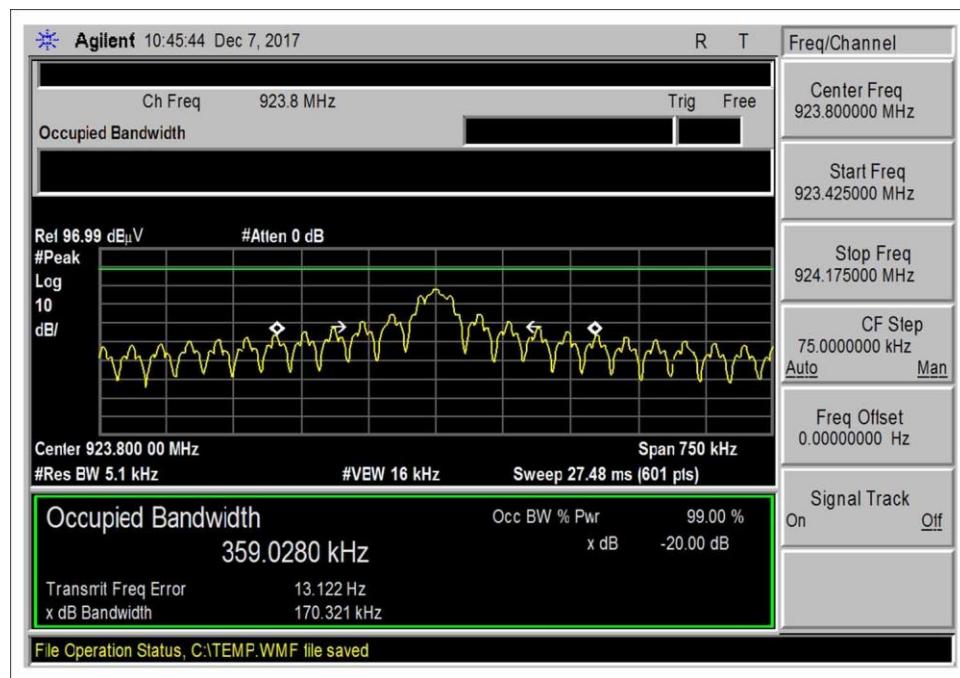
Environmental Conditions			
Temperature (°C)	22	Relative Humidity (%):	35

Test Equipment					
Asset#	Description	Manufacturer	Model	Cal Date	Cal Due
02672	Spectrum Analyzer	Agilent	E4446A	3/2/2017	3/2/2019
03432	Attenuator	Aeroflex/Weinsche I	90-30-34	10/27/2017	10/27/2019
P06664	Cable	Gore	PHASEFLEX FJR01N01036.0	4/5/2016	4/5/2018

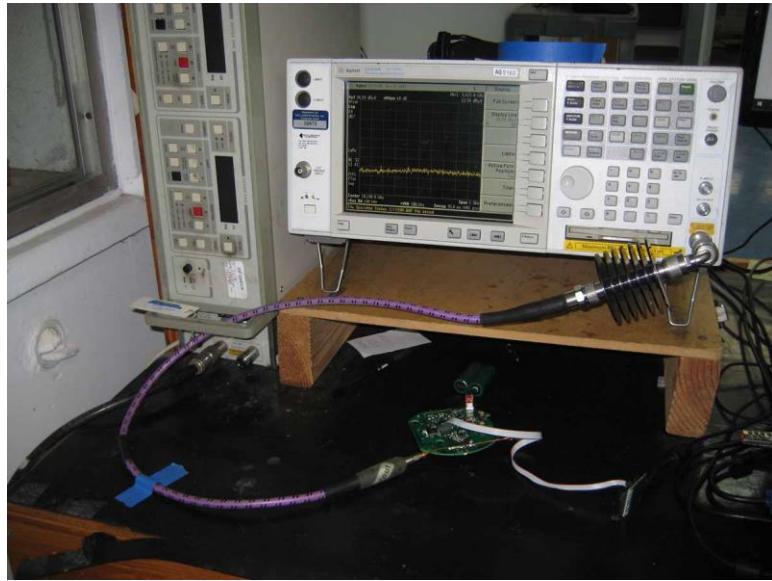
Test Data Summary					
Frequency (MHz)	Antenna Port	Modulation	Measured (kHz)	Limit (kHz)	Results
908	V	OOK	170.2	None	NA
915	V	OOK	170.2	None	NA
923.8	V	OOK	170.3	None	NA

## Plot(s)





### Test Setup Photo(s)



## 15.249(a) Field Strength of Fundamental

Test Data Summary – Radiated Field Strength Measurement					
Frequency (MHz)	Modulation	Ant. Type	Measured (dBuV/m @ 3m)	Limit (dBuV/m @ 3m)	Results
923.8	OOK	Integral	90.1	≤94	Pass
908.0	OOK	Integral	88.7	≤94	Pass
915.0	OOK	Integral	89.1	≤94	Pass

## Test Setup / Conditions / Data

Test Location: CKC Laboratories, Inc • 110 N. Olinda Place • Brea, CA 92823 • 714-993-6112  
 Customer: **Itron, Inc**  
 Specification: **15.249 Carrier and Spurious Emissions (902-928 MHz Transmitter)**  
 Work Order #: **100666** Date: 12/7/2017  
 Test Type: **Maximized Emissions** Time: 16:21:31  
 Tested By: S. Yamamoto Sequence#: 1  
 Software: EMITest 5.03.11

### *Equipment Tested:*

Device	Manufacturer	Model #	S/N
Configuration 1			

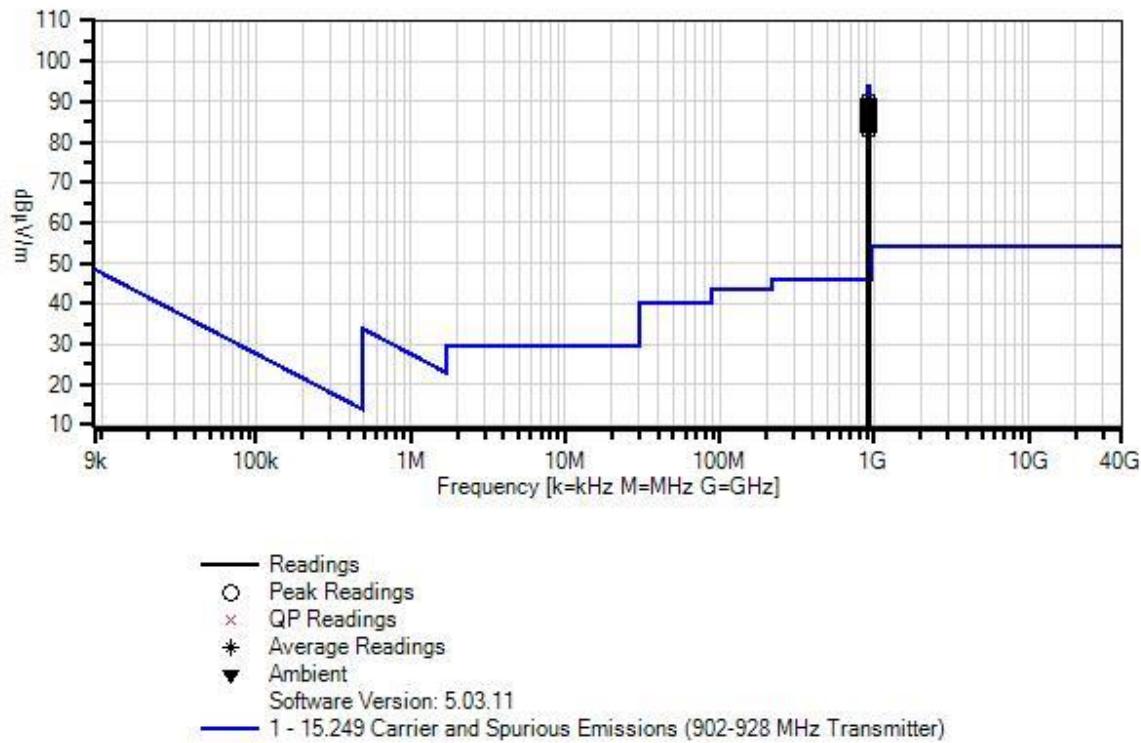
### *Support Equipment:*

Device	Manufacturer	Model #	S/N
Configuration 1			

### *Test Conditions / Notes:*

The equipment under test (EUT) is placed stand alone on the Styrofoam table top. The EUT is turned on and placed in a continuous transmit mode. The EUT has fresh batteries installed. Nominal input voltage is 6.0Vdc.  
 The EUT is tested in orientations specified by the manufacturer: vertical pipe and horizontal pipe.  
 Operating frequency: 908.0-923.8MHz  
 Modulation: OOK. Firmware power: power level 0  
 EUT firmware 2.0.10.0  
 Antenna type integral  
 Antenna gain 2.3 dBi (vertical) and 0.1 dBi (horizontal)  
 Frequencies tested: 908.0MHz, 915.0MHz, 923.8MHz  
 Frequency range of measurement = 908.0-923.8MHz. RBW=120 kHz, VBW=360 kHz  
 Test environment conditions: Temperature: 20°C, Relative Humidity: 30%, 101kPa, Site A  
 Test Method: ANSI C63.10 (2013)

Itron, Inc WO#: 100666 Sequence#: 1 Date: 12/7/2017  
15.249 Carrier and Spurious Emissions (902-928 MHz Transmitter) Test Distance: 3 Meters Vert



**Test Equipment:**

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN02672	Spectrum Analyzer	E4446A	3/2/2017	3/2/2019
T2	ANP05050	Cable	RG223/U	1/20/2017	1/20/2019
T3	AN00309	Preamp	8447D	3/14/2016	3/14/2018
T4	ANP05198	Cable-Amplitude +15C to +45C (dB)	8268	12/7/2016	12/7/2018
T5	ANP05275	Attenuator	1W	5/5/2016	5/5/2018
T6	AN01995	Biconilog Antenna	CBL6111C	5/10/2016	5/10/2018

**Measurement Data:**

Reading listed by margin.

Test Distance: 3 Meters

#	Freq MHz	Rdng dB $\mu$ V	T1 dB	T2 dB	T3 dB	T4 dB	Dist Table	Corr dB $\mu$ V/m	Spec dB $\mu$ V/m	Margin dB	Polar
1	923.800M	81.2	+0.0 +6.0	+0.5 +23.7	-27.3	+6.0	+0.0	90.1	94.0	-3.9	Vert
2	915.000M	80.4	+0.0 +6.0	+0.5 +23.5	-27.3	+6.0	+0.0	89.1	94.0	-4.9	Vert
3	908.000M	80.2	+0.0 +6.0	+0.5 +23.4	-27.3	+5.9	+0.0	88.7	94.0	-5.3	Vert
4	915.000M	79.7	+0.0 +6.0	+0.5 +23.5	-27.3	+6.0	+0.0	88.4	94.0	-5.6	Horiz
5	915.000M	79.0	+0.0 +6.0	+0.5 +23.5	-27.3	+6.0	+0.0	87.7	94.0	-6.3	Horiz
6	908.000M	78.3	+0.0 +6.0	+0.5 +23.4	-27.3	+5.9	+0.0	86.8	94.0	-7.2	Horiz
7	915.000M	77.8	+0.0 +6.0	+0.5 +23.5	-27.3	+6.0	+0.0	86.5	94.0	-7.5	Horiz
8	923.800M	76.5	+0.0 +6.0	+0.5 +23.7	-27.3	+6.0	+0.0	85.4	94.0	-8.6	Horiz
9	908.000M	76.6	+0.0 +6.0	+0.5 +23.4	-27.3	+5.9	+0.0	85.1	94.0	-8.9	Horiz
10	923.800M	75.3	+0.0 +6.0	+0.5 +23.7	-27.3	+6.0	+0.0	84.2	94.0	-9.8	Horiz
11	915.000M	75.5	+0.0 +6.0	+0.5 +23.5	-27.3	+6.0	+0.0	84.2	94.0	-9.8	Vert
12	923.800M	74.9	+0.0 +6.0	+0.5 +23.7	-27.3	+6.0	+0.0	83.8	94.0	-10.2	Vert
13	908.000M	74.3	+0.0 +6.0	+0.5 +23.4	-27.3	+5.9	+0.0	82.8	94.0	-11.2	Vert

**Test Setup Photo(s)**



## 15.249(a) Radiated Emissions and Band Edge

See data sheets for test setup and test equipment.

### Test Setup / Conditions / Data

Test Location: CKC Laboratories, Inc • 110 N. Olinda Place • Brea, CA 92823 • 714-993-6112  
 Customer: **Itron, Inc**  
 Specification: **15.249 Carrier and Spurious Emissions (902-928 MHz Transmitter)**  
 Work Order #: **100666** Date: 12/8/2017  
 Test Type: **Maximized Emissions** Time: 09:06:17  
 Tested By: S. Yamamoto Sequence#: 3  
 Software: EMITest 5.03.11

*Equipment Tested:*

Device	Manufacturer	Model #	S/N
Configuration 1			

*Support Equipment:*

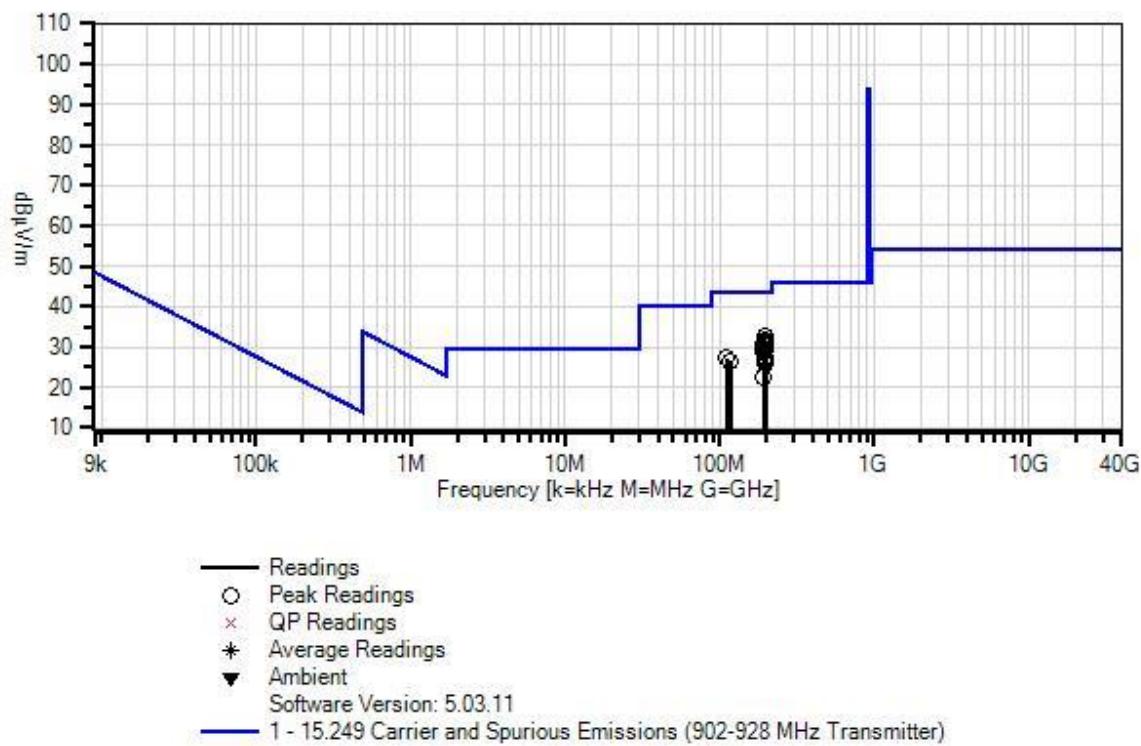
Device	Manufacturer	Model #	S/N
Configuration 1			

*Test Conditions / Notes:*

The equipment under test (EUT) is placed stand alone on the Styrofoam table top. The EUT is turned on and placed in a continuous transmit mode. The EUT has fresh batteries installed. Nominal input voltage is 6.0Vdc.  
 The EUT is tested in orientations specified by the manufacturer: vertical pipe and horizontal pipe  
 Operating frequency: 908.0-923.8MHz  
 Tested frequencies: 908, 915, 923.8MHz  
 Modulation: OOK. Firmware power: power level 0  
 EUT firmware 2.0.10.0  
 Antenna type integral  
 Antenna gain 2.3 dBi (vertical) and 0.1 dBi (horizontal)  
 Frequency range of measurement = 9kHz to 10000MHz. 9kHz to 150kHz, RBW=200Hz; 150kHz to 30MHz, RBW=9kHz; 30MHz to 1000MHz, RBW=120kHz; 1GHz to 10GHz, RBW=1 MHz

Test environment conditions: Temperature: 20°C, Relative Humidity 32%, 101kPa, Site A  
 Test Method: ANSI C63.10 (2013)

Itron, Inc WO#: 100666 Sequence#: 3 Date: 12/8/2017  
15.249 Carrier and Spurious Emissions (902-928 MHz Transmitter) Test Distance: 3 Meters Horiz



**Test Equipment:**

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN02672	Spectrum Analyzer	E4446A	3/2/2017	3/2/2019
T2	ANP05050	Cable	RG223/U	1/20/2017	1/20/2019
T3	AN00309	Preamp	8447D	3/14/2016	3/14/2018
T4	ANP05198	Cable-Amplitude +15C to +45C (dB)	8268	12/7/2016	12/7/2018
T5	ANP05275	Attenuator	1W	5/5/2016	5/5/2018
T6	AN01995	Biconilog Antenna	CBL6111C	5/10/2016	5/10/2018
	AN00314	Loop Antenna	6502	5/20/2016	5/20/2018

**Measurement Data:** Reading listed by margin. Test Distance: 3 Meters

#	Freq	Rdng	T1 T5	T2 T6	T3	T4	Dist	Corr	Spec	Margin	Polar
			MHz	dB $\mu$ V	dB	dB	Table	dB $\mu$ V/m	dB $\mu$ V/m	dB	Ant
1	194.894M	42.9	+0.0 +6.0	+0.2 +9.1	-28.0	+2.4	+0.0	32.6	43.5	-10.9	Vert
2	194.731M	42.8	+0.0 +6.0	+0.2 +9.1	-28.0	+2.4	+0.0	32.5	43.5	-11.0	Horiz
3	194.435M	42.0	+0.0 +6.0	+0.2 +9.1	-28.0	+2.4	+0.0	31.7	43.5	-11.8	Vert
4	196.385M	41.8	+0.0 +6.0	+0.2 +9.1	-28.0	+2.4	+0.0	31.5	43.5	-12.0	Horiz
5	194.024M	41.7	+0.0 +6.0	+0.2 +9.1	-28.0	+2.4	+0.0	31.4	43.5	-12.1	Horiz
6	195.240M	41.2	+0.0 +6.0	+0.2 +9.1	-28.0	+2.4	+0.0	30.9	43.5	-12.6	Horiz
7	192.505M	40.9	+0.0 +6.0	+0.2 +9.1	-28.0	+2.4	+0.0	30.6	43.5	-12.9	Vert
8	192.451M	40.0	+0.0 +6.0	+0.2 +9.1	-28.0	+2.4	+0.0	29.7	43.5	-13.8	Horiz
9	198.122M	39.4	+0.0 +6.0	+0.2 +9.1	-28.0	+2.4	+0.0	29.1	43.5	-14.4	Vert
10	191.804M	39.0	+0.0 +6.0	+0.2 +9.1	-28.0	+2.4	+0.0	28.7	43.5	-14.8	Vert
11	110.900M	36.6	+0.0 +6.0	+0.1 +11.0	-28.1	+1.7	+0.0	27.3	43.5	-16.2	Vert
12	196.879M	37.5	+0.0 +6.0	+0.2 +9.1	-28.0	+2.4	+0.0	27.2	43.5	-16.3	Horiz
13	196.595M	37.0	+0.0 +6.0	+0.2 +9.1	-28.0	+2.4	+0.0	26.7	43.5	-16.8	Horiz
14	116.770M	35.3	+0.0 +6.0	+0.1 +11.4	-28.1	+1.8	+0.0	26.5	43.5	-17.0	Vert
15	194.115M	36.5	+0.0 +6.0	+0.2 +9.1	-28.0	+2.4	+0.0	26.2	43.5	-17.3	Horiz
16	196.376M	36.4	+0.0 +6.0	+0.2 +9.1	-28.0	+2.4	+0.0	26.1	43.5	-17.4	Vert
17	192.834M	32.9	+0.0 +6.0	+0.2 +9.1	-28.0	+2.4	+0.0	22.6	43.5	-20.9	Vert

Customer: **Itron, Inc**  
 Specification: **15.249 Carrier and Spurious Emissions (902-928 MHz Transmitter)**  
 Work Order #: **100666** Date: **12/7/2017**  
 Test Type: **Maximized Emissions** Time: **15:10:52**  
 Tested By: **S. Yamamoto** Sequence#: **2**  
 Software: **EMITest 5.03.11**

***Equipment Tested:***

<b>Device</b>	<b>Manufacturer</b>	<b>Model #</b>	<b>S/N</b>
Configuration 1			

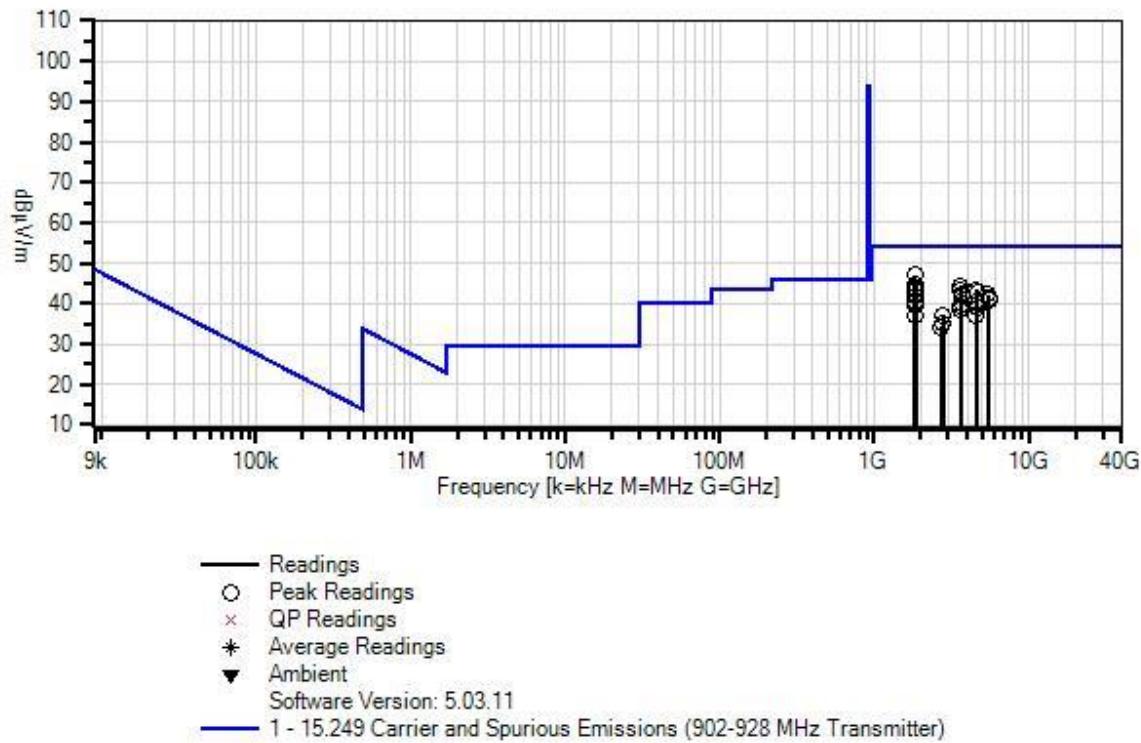
***Support Equipment:***

<b>Device</b>	<b>Manufacturer</b>	<b>Model #</b>	<b>S/N</b>
Configuration 1			

***Test Conditions / Notes:***

The equipment under test (EUT) is placed stand alone on the Styrofoam table top. The EUT is turned on and placed in a continuous transmit mode. The EUT has fresh batteries installed. Nominal input voltage is 6.0Vdc.  
 The EUT is tested in orientations specified by the manufacturer: vertical pipe and horizontal pipe  
 Operating frequency: 908.0-923.8MHz  
 Modulation: OOK. Firmware power: power level 0  
 EUT firmware 2.0.10.0  
 Antenna type integral  
 Antenna gain 2.3 dBi (vertical) and 0.1 dBi (horizontal)  
 Frequency range of measurement = 1000MHz to 10000MHz. RBW=1 MHz, VBW=3 MHz  
  
 Test environment conditions: Temperature: 20°C, Relative Humidity 30%, 101kPa, Site A  
 Test Method: ANSI C63.10 (2013)

Itron, Inc WO#: 100666 Sequence#: 2 Date: 12/7/2017  
15.249 Carrier and Spurious Emissions (902-928 MHz Transmitter) Test Distance: 3 Meters Vert



**Test Equipment:**

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02672	Spectrum Analyzer	E4446A	3/2/2017	3/2/2019
T1	ANP06661	Cable	LDF1-50	5/6/2016	5/6/2018
T2	AN00786	Preamp	83017A	5/9/2016	5/9/2018
T3	AN03169	High Pass Filter	HM1155-11SS	6/15/2017	6/15/2019
T4	ANP06977	Cable	PHASEFLEX EJR01N01036. 0	4/5/2016	4/5/2018
T5	AN00849	Horn Antenna	3115	3/4/2016	3/4/2018

**Measurement Data:** Reading listed by margin. Test Distance: 3 Meters

#	Freq MHz	Rdng dB $\mu$ V	T1 dB	T2 dB	T3 dB	T4 dB	Dist Table	Corr dB $\mu$ V/m	Spec dB $\mu$ V/m	Margin dB	Polar
1	1816.004M	57.2 +23.9	+3.6	-38.5	+0.3	+0.5	+0.0	47.0	54.0	-7.0	Vert
2	1847.593M	55.1 +24.0	+3.6	-38.5	+0.3	+0.5	+0.0	45.0	54.0	-9.0	Vert
3	3632.008M	49.3 +27.6	+4.6	-37.9	+0.2	+0.6	+0.0	44.4	54.0	-9.6	Horiz
4	1816.005M	53.8 +23.9	+3.6	-38.5	+0.3	+0.5	+0.0	43.6	54.0	-10.4	Horiz
5	1847.572M	53.6 +24.0	+3.6	-38.5	+0.3	+0.5	+0.0	43.5	54.0	-10.5	Horiz
6	4539.910M	46.0 +29.0	+5.5	-37.6	+0.1	+0.5	+0.0	43.5	54.0	-10.5	Vert
7	3631.973M	48.2 +27.6	+4.6	-37.9	+0.2	+0.6	+0.0	43.3	54.0	-10.7	Vert
8	4618.963M	44.8 +29.2	+5.6	-37.6	+0.1	+0.5	+0.0	42.6	54.0	-11.4	Vert
9	3695.135M	47.0 +27.8	+4.7	-37.9	+0.2	+0.6	+0.0	42.4	54.0	-11.6	Vert
10	3695.118M	46.9 +27.8	+4.7	-37.9	+0.2	+0.6	+0.0	42.3	54.0	-11.7	Horiz
11	5448.000M	41.2 +31.3	+6.3	-37.4	+0.1	+0.7	+0.0	42.2	54.0	-11.8	Vert
12	3695.138M	46.6 +27.8	+4.7	-37.9	+0.2	+0.6	+0.0	42.0	54.0	-12.0	Vert
13	1816.033M	52.0 +23.9	+3.6	-38.5	+0.3	+0.5	+0.0	41.8	54.0	-12.2	Horiz
14	5542.799M	40.4 +31.4	+6.4	-37.5	+0.1	+0.7	+0.0	41.5	54.0	-12.5	Vert
15	5542.772M	40.0 +31.4	+6.4	-37.5	+0.1	+0.7	+0.0	41.1	54.0	-12.9	Horiz
16	1816.048M	50.7 +23.9	+3.6	-38.5	+0.3	+0.5	+0.0	40.5	54.0	-13.5	Vert
17	4539.954M	42.9 +29.0	+5.5	-37.6	+0.1	+0.5	+0.0	40.4	54.0	-13.6	Horiz
18	4618.986M	42.2 +29.2	+5.6	-37.6	+0.1	+0.5	+0.0	40.0	54.0	-14.0	Vert

19	3695.179M	44.6	+4.7 +27.8	-37.9	+0.2	+0.6	+0.0	40.0	54.0	-14.0	Horiz
20	4619.057M	41.9	+5.6 +29.2	-37.6	+0.1	+0.5	+0.0	39.7	54.0	-14.3	Horiz
21	1847.602M	49.7	+3.6 +24.0	-38.5	+0.3	+0.5	+0.0	39.6	54.0	-14.4	Horiz
22	3632.021M	44.2	+4.6 +27.6	-37.9	+0.2	+0.6	+0.0	39.3	54.0	-14.7	Horiz
23	4619.003M	41.3	+5.6 +29.2	-37.6	+0.1	+0.5	+0.0	39.1	54.0	-14.9	Horiz
24	3632.000M	43.4	+4.6 +27.6	-37.9	+0.2	+0.6	+0.0	38.5	54.0	-15.5	Vert
25	1847.598M	47.3	+3.6 +24.0	-38.5	+0.3	+0.5	+0.0	37.2	54.0	-16.8	Vert
26	4540.000M	39.5	+5.5 +29.0	-37.6	+0.1	+0.5	+0.0	37.0	54.0	-17.0	Vert
27	2771.450M	44.2	+4.1 +26.1	-38.0	+0.2	+0.4	+0.0	37.0	54.0	-17.0	Horiz
28	2771.482M	42.1	+4.1 +26.1	-38.0	+0.2	+0.4	+0.0	34.9	54.0	-19.1	Vert
29	2724.000M	41.8	+4.1 +25.9	-38.1	+0.2	+0.4	+0.0	34.3	54.0	-19.7	Vert

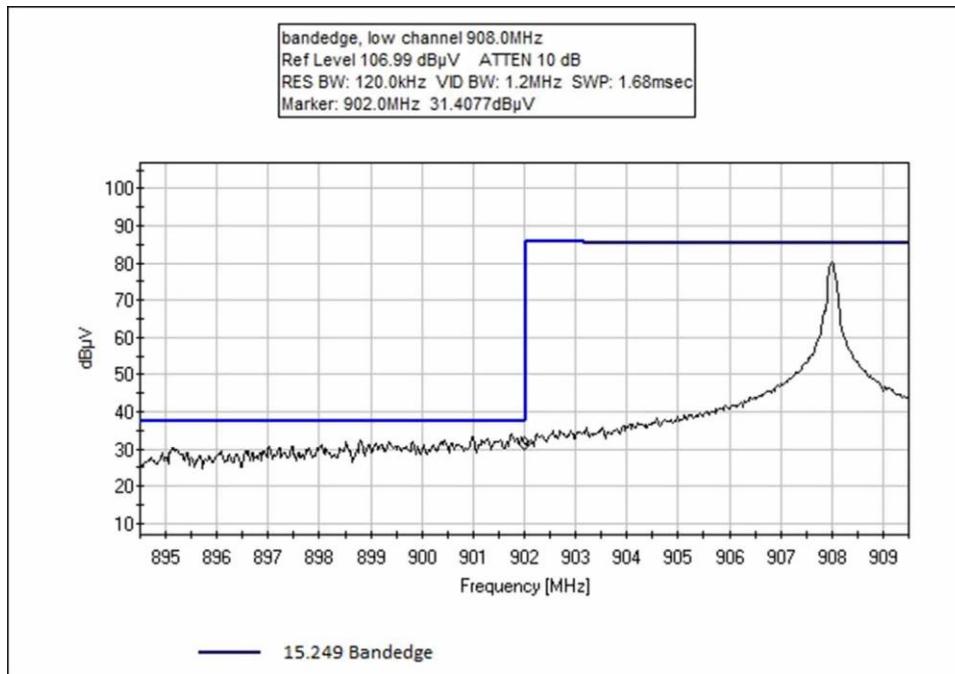
## Band Edge

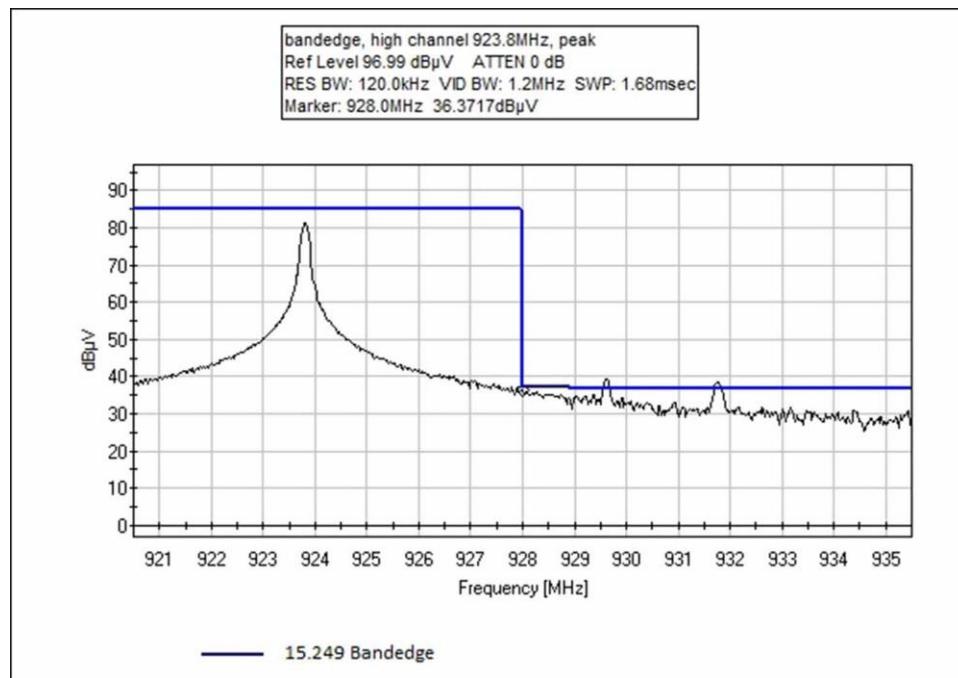
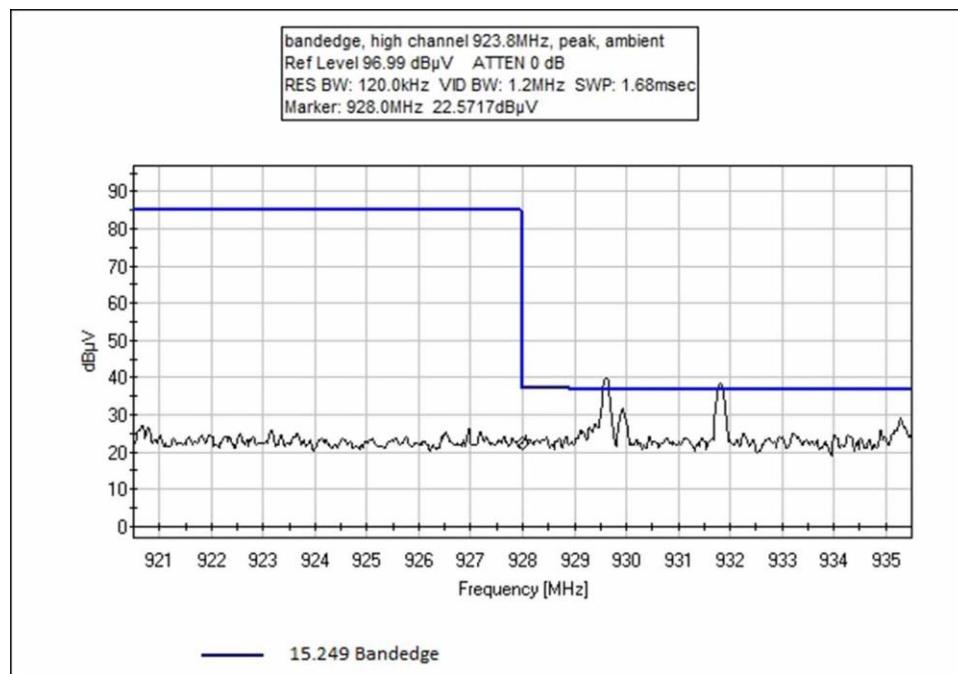
### Band Edge Summary

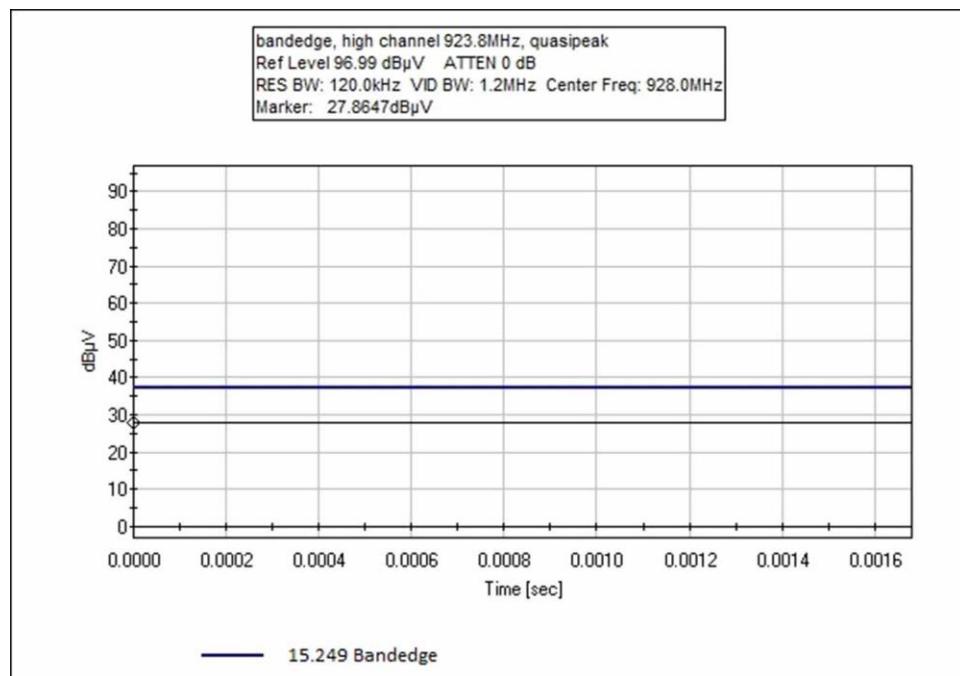
Frequency (MHz)	Modulation	Ant. Type	Field Strength (dBuV/m @3m)	Limit (dBuV/m @3m)	Results
902	OOK	Integral	39.8	<46	Pass
928	OOK	Integral	36.8	<46	Pass

Data and limit line in band edge plots do not include the transducer factors of 8.4dB at 902MHz and 8.9dB at 928MHz.

## Band Edge Plots







### Test Setup Photo(s)





Cone Placement

## 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 dB $\mu$ V/m, the spectrum analyzer reading in dB $\mu$ 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	(dB $\mu$ V)
+ Antenna Factor	(dB/m)
+ Cable Loss	(dB)
- Distance Correction	(dB)
- Preamplifier Gain	(dB)
= Corrected Reading	(dB $\mu$ V/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.