

Itron, Inc.

TEST REPORT FOR

OpenWay Gas Remote Disconnect*

Model: OWGRD*

(*See Appendix A for Manufacturer Declaration)

Tested to The Following Standards:

FCC Part 15 Subpart C Section(s)

15.207 & 15.249

Report No.: 100666-23

Date of issue: October 9, 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 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.

Test Certificate # 803.02

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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: 155869

REPORT PREPARED BY:

Terri Rayle
CKC Laboratories, Inc.
5046 Sierra Pines Drive
Mariposa, CA 95338

Project Number: 100666

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

August 6, 2018
August 6-13, 2018

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.



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	5.03.11

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	NP
15.249(a)	Field Strength of Fundamental	NA	Pass
15.249(a)	Radiated Emissions and Band Edge	NA	Pass
15.207	AC Conducted Emissions	NA	NA1

NA = Not Applicable

NA1 = Not applicable because the EUT is battery powered.

NP = CKC Laboratories was not contracted to perform test. Evaluation for PCII/ Reassessment

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

None

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

Equipment Tested:

Device	Manufacturer	Model #	S/N
OpenWay Gas Remote Disconnect.	Itron, Inc.	OWGRD	091502005248

Support Equipment:

Device	Manufacturer	Model #	S/N
Laptop	Dell	E6410	CFGY2A00CET

General Product Information:

Product Information	Manufacturer-Provided Details
Equipment Type:	Stand-Alone Equipment
Type of Wideband System:	Part 15 Low Power Transceiver, Rx Verified
Operating Frequency Range:	908 to 923.8MHz (OOK)
Number of Hopping Channels:	NA
Modulation Type(s):	OOK
Maximum Duty Cycle:	Power level 0 for OOK is 100%
Number of TX Chains:	1
Antenna Type(s) and Gain:	2 dBi (vertical) and 1.4 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:	CLI_Test_STM32_ALL_500GRD_Rev2_3_0_0.hex

FCC Part 15 Subpart C

15.249(a) Field Strength of Fundamental

Test Data Summary - Voltage Variations

This equipment is battery powered and manufacturer declares the equipment cannot operate while charging. Power output tests were performed using a fresh new battery.

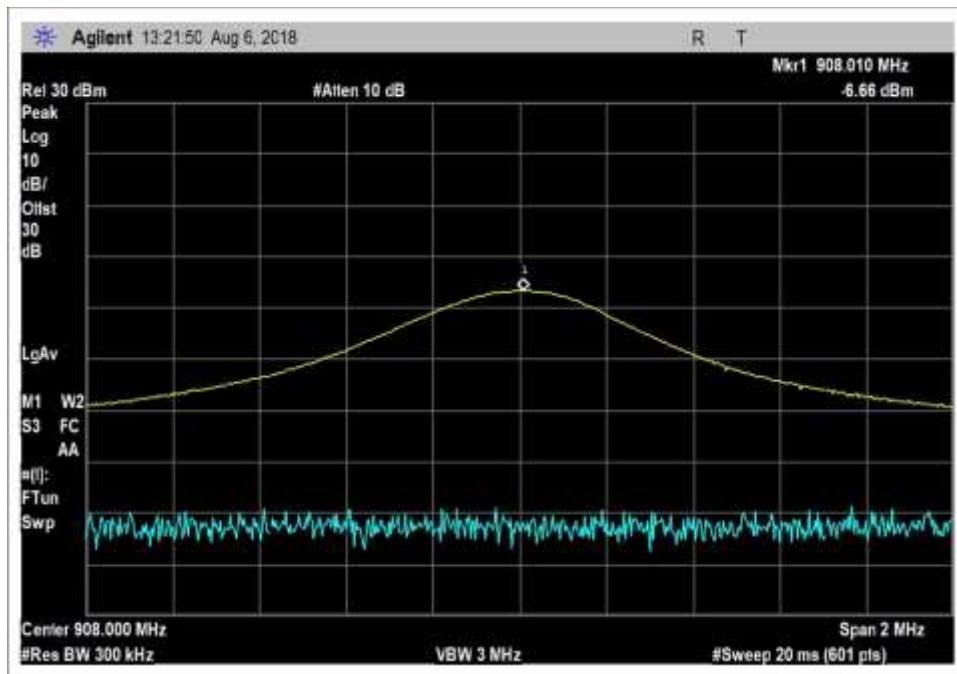
Test Data Summary – Radiated Field Strength Measurement

Frequency (MHz)	Modulation	Ant. Type	Measured (dBuV/m @ 3m)	Limit (dBuV/m @ 3m)	Results
908.0	OOK	Integral	90.5	≤94	Pass
915.0	OOK	Integral	90.5	≤94	Pass
923.8	OOK	Integral	90.1	≤94	Pass

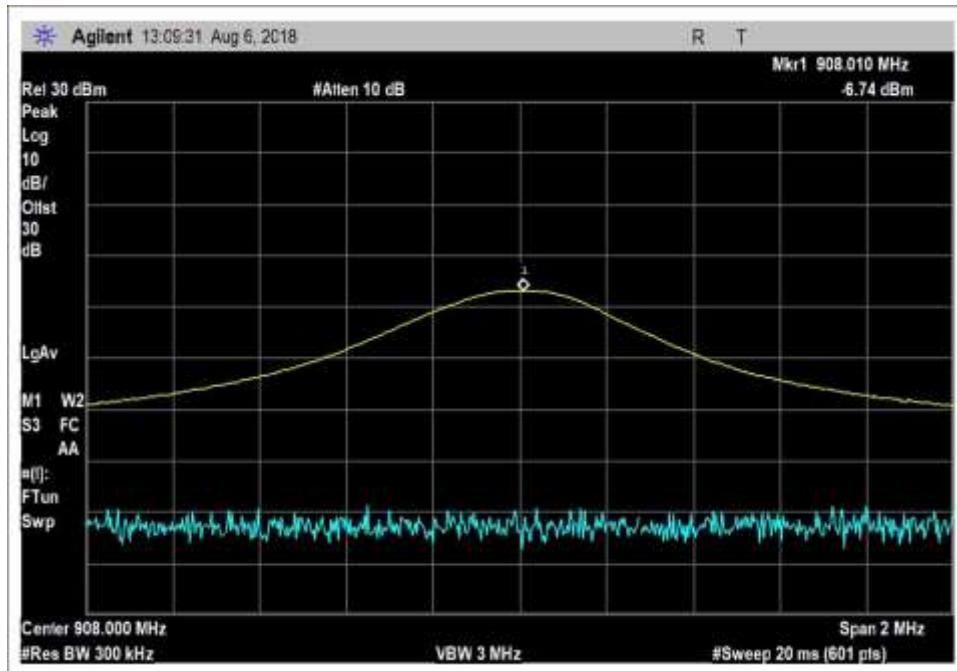
Worst case. Vertical antenna port.

Plots

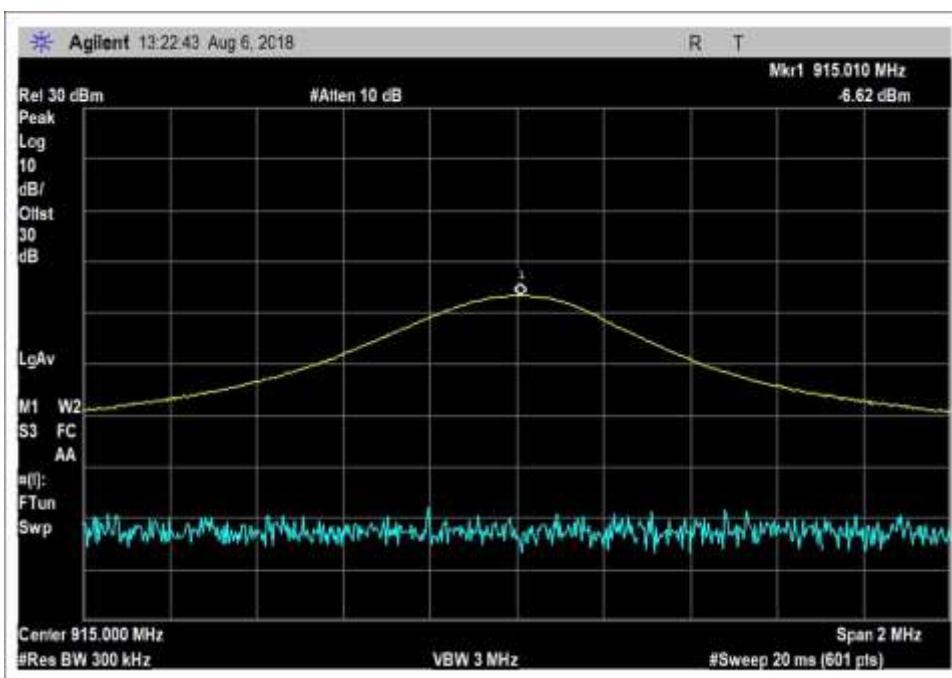
This measurement is for reference only. Reported RF output is radiated field strength measurement.



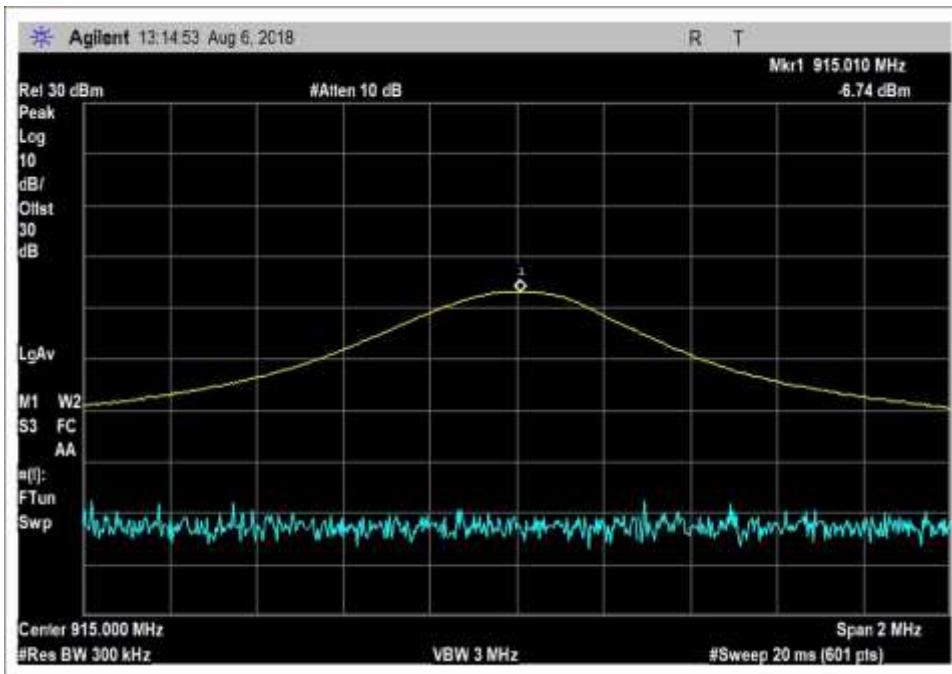
15.249_Cond_power_OOK Power 0, Horizontal 908MHz



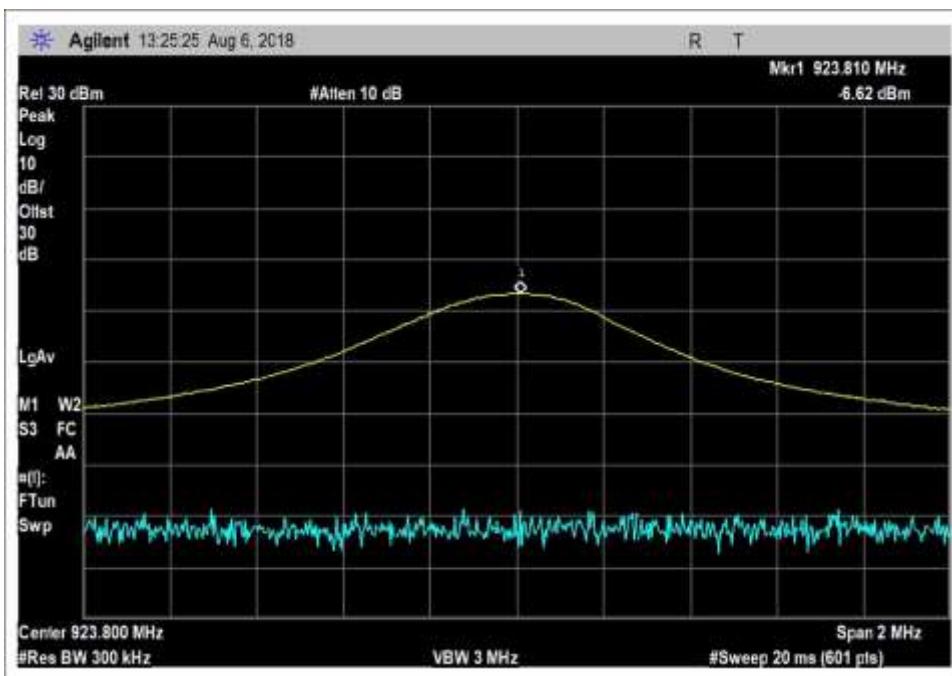
15.249_Cond_power_OOK Power 0, Vertical 908MHz



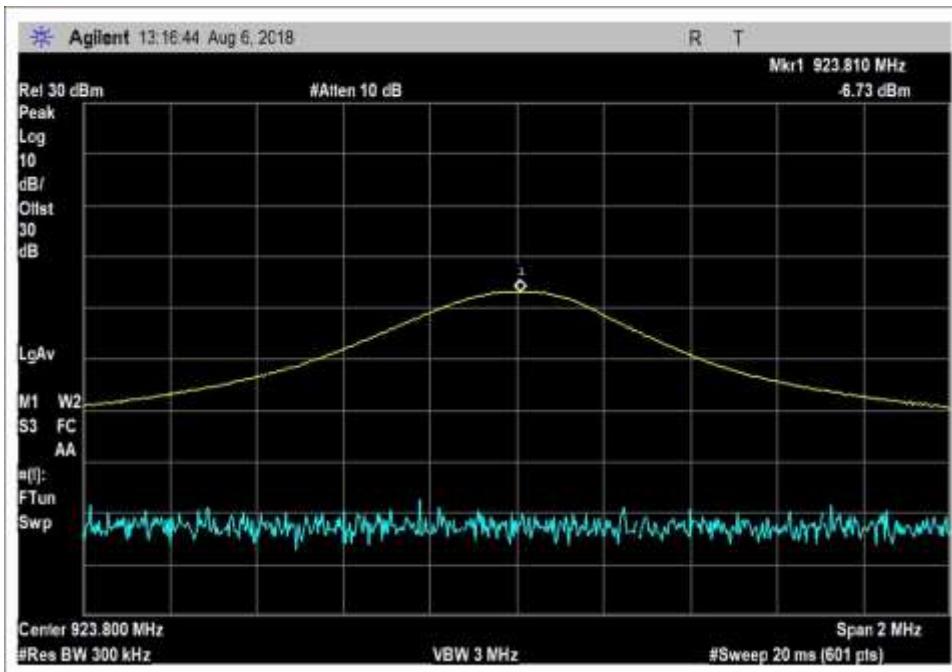
15.249_Cond_power_OOK Power 0, Horizontal 915MHz



15.249_Cond_power_OOK Power 0, Vertical 915MHz



15.249_Cond_power_OOK Power 0, Horizontal 923MHz



15.249_Cond_power_OOK Power 0, Vertical 923MHz

Test Setup / Conditions / Data

Test Location: CKC Laboratories, Inc. • 110 N. Olinda Place • Brea, CA 92821 • 714 993 6112
 Customer: **Itron, Inc.**
 Specification: **15.249 Carrier and Spurious Emissions (902-928 MHz Transmitter)**
 Work Order #: **100666** Date: 8/6/2018
 Test Type: **Radiated Scan** Time: 15:08:18
 Tested By: E. Wong Sequence#: 2
 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: CLI_Test_STM32_ALL_500GRD_Rev2_3_0_0_0.hex

Antenna type: Integral

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: 29°C

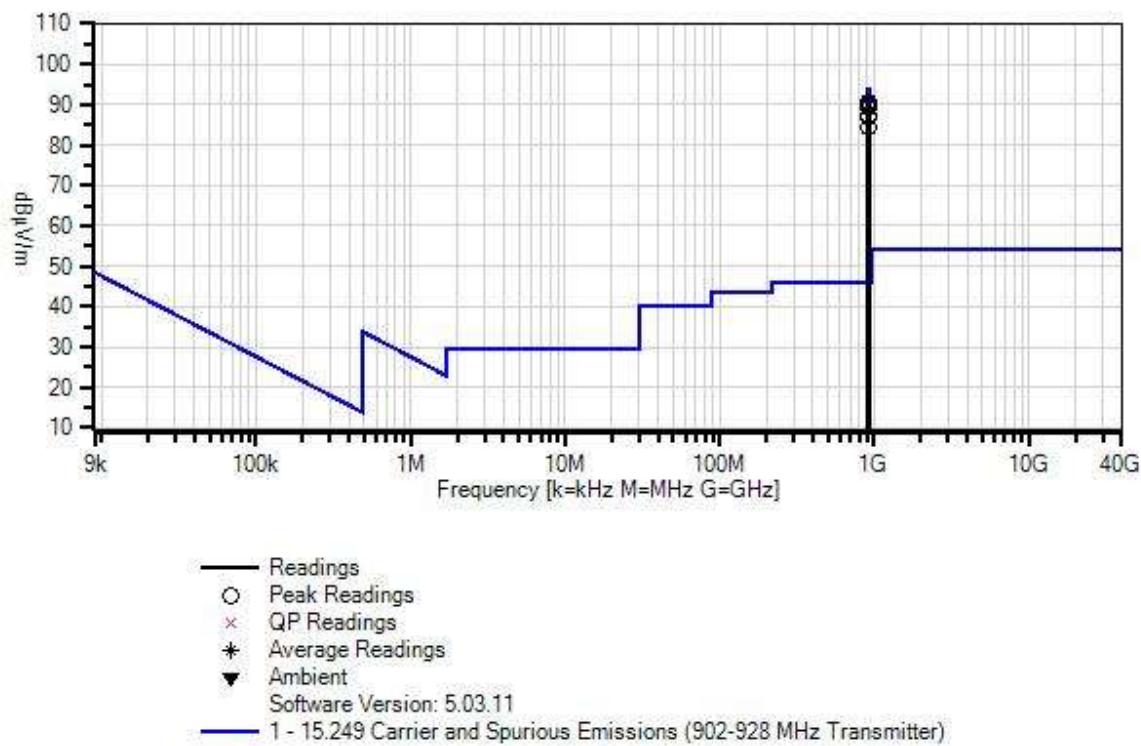
Relative Humidity: 41%

Pressure: 100kPa

Site A

Test Method: ANSI C63.10 (2013)

Itron, Inc. WO#: 100666 Sequence#: 2 Date: 8/6/2018
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	AN01995	Biconilog Antenna	CBL6111C	4/23/2018	4/23/2020
T3	ANP05275	Attenuator	1W	4/5/2018	4/5/2020
T4	ANP05198	Cable-Amplitude +15C to +45C (dB)	8268	12/7/2016	12/7/2018
T5	AN00309	Preamp	8447D	2/19/2018	2/19/2020
T6	ANP05050	Cable	RG223/U	1/20/2017	1/20/2019

Measurement Data:

Reading listed by margin.

Test Distance: 3 Meters

#	Freq	Rdng	T1	T2	T3	T4	Dist	Corr	Spec	Margin	Polar
			T5	T6			Table	dB μ V/m	dB μ V/m		
	MHz	dB μ V	dB	dB	dB	dB				dB	Ant
1	915.000M	82.1	+0.0	+23.0	+6.1	+6.0	+0.0	90.5	94.0	-3.5	Vert
			-27.2	+0.5							vert ant port
2	908.000M	82.3	+0.0	+22.9	+6.1	+5.9	+0.0	90.5	94.0	-3.5	Vert
			-27.2	+0.5							vert ant port
3	923.800M	81.5	+0.0	+23.2	+6.1	+6.0	+0.0	90.1	94.0	-3.9	Vert
			-27.2	+0.5							vert ant port
4	915.000M	81.6	+0.0	+23.0	+6.1	+6.0	+0.0	90.0	94.0	-4.0	Horiz
			-27.2	+0.5							horiz ant port
5	908.000M	81.5	+0.0	+22.9	+6.1	+5.9	+0.0	89.7	94.0	-4.3	Horiz
			-27.2	+0.5							horiz ant port
6	908.000M	81.2	+0.0	+22.9	+6.1	+5.9	+0.0	89.4	94.0	-4.6	Horiz
			-27.2	+0.5							vert ant port
7	923.800M	80.6	+0.0	+23.2	+6.1	+6.0	+0.0	89.2	94.0	-4.8	Horiz
			-27.2	+0.5							horiz ant port
8	915.000M	79.1	+0.0	+23.0	+6.1	+6.0	+0.0	87.5	94.0	-6.5	Horiz
			-27.2	+0.5							vert ant port
9	923.800M	78.1	+0.0	+23.2	+6.1	+6.0	+0.0	86.7	94.0	-7.3	Horiz
			-27.2	+0.5							vert ant port
10	915.000M	76.0	+0.0	+23.0	+6.1	+6.0	+0.0	84.4	94.0	-9.6	Vert
			-27.2	+0.5							horiz ant port
11	923.800M	75.8	+0.0	+23.2	+6.1	+6.0	+0.0	84.4	94.0	-9.6	Vert
			-27.2	+0.5							horiz ant port
12	908.000M	76.1	+0.0	+22.9	+6.1	+5.9	+0.0	84.3	94.0	-9.7	Vert
			-27.2	+0.5							horiz ant port

Test Setup Photos



Horizontal Pipe



Horizontal Pipe



Vertical Pipe



Vertical Pipe

15.249(a) Radiated Emissions and Band Edge

Test Setup / Conditions / Data

Test Location: CKC Laboratories, Inc. • 110 N. Olinda Place • Brea, CA 92821 • 714 993 6112
 Customer: **Itron, Inc.**
 Specification: **15.249 Carrier and Spurious Emissions (902-928 MHz Transmitter)**
 Work Order #: **100666** Date: 8/13/2018
 Test Type: **Maximized Emissions** Time: 13:32:56
 Tested By: Don Nguyen Sequence#: 4
 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: CLI_Test_STM32_ALL_500GRD_Rev2_3_0_0_0.hex
 Antenna type: Integral

Frequencies tested: 908.0MHz, 915.0MHz, 923.8MHz
 Frequency range of measurement = 9kHz to 10000MHz.
 9k-150kHz, RBW=200Hz, VBW=600Hz.
 150k-30MHz, RBW=9kHz, VBW=27kHz.
 30M-1000MHz, RBW=120kHz, VBW=360kHz
 1000-10000MHz, RBW=1MHz, VBW=3MHz

Test environment conditions:

Temperature: 26°C

Relative Humidity: 57%

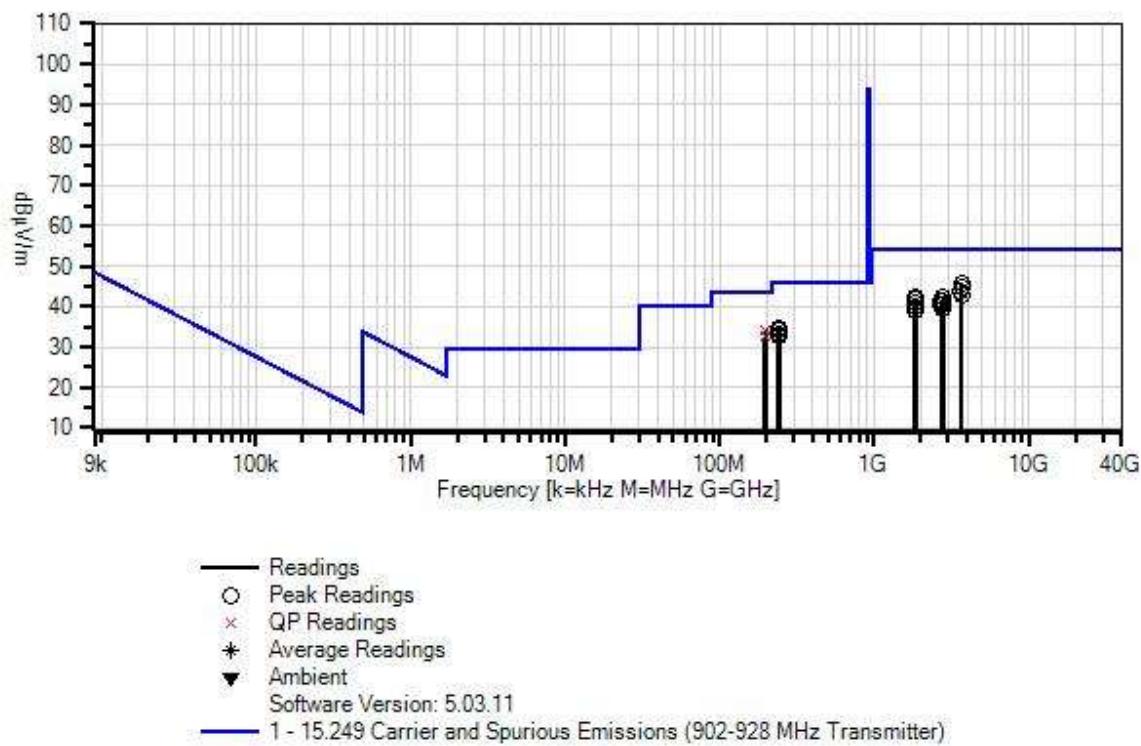
Pressure: 100kPa

Site A

Test Method: ANSI C63.10 (2013)

The evaluation is for PCII/ Reassessment. Worst case emission profile.

Itron, Inc. WO#: 100666 Sequence#: 4 Date: 8/13/2018
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
	AN00314	Loop Antenna	6502	5/13/2018	5/13/2020
T1	AN01995	Biconilog Antenna	CBL6111C	4/23/2018	4/23/2020
T2	ANP05275	Attenuator	1W	4/5/2018	4/5/2020
T3	ANP05198	Cable-Amplitude +15C to +45C (dB)	8268	12/7/2016	12/7/2018
T4	AN00309	Preamp	8447D	2/19/2018	2/19/2020
T5	ANP05050	Cable	RG223/U	1/20/2017	1/20/2019
	AN02672	Spectrum Analyzer	E4446A	3/2/2017	3/2/2019
T6	AN00786	Preamp	83017A	5/12/2018	5/12/2020
T7	AN00849	Horn Antenna	3115	3/14/2018	3/14/2020
T8	AN02946	Cable	32022-2-2909K- 36TC	12/12/2017	12/12/2019
T9	AN03169	High Pass Filter	HM1155-11SS	6/15/2017	6/15/2019
T10	ANP07139	Cable	ANDL1- PNMNM-48	3/1/2017	3/1/2019

Measurement Data:

Reading listed by margin.

Test Distance: 3 Meters

#	Freq	Rdng	T1	T2	T3	T4	Dist	Corr	Spec	Margin	Polar
			T5	T6	T7	T8					
			T9	T10							
	MHz	dB μ V	dB	dB	dB	dB	Table	dB μ V/m	dB μ V/m	dB	Ant
1	3660.000M	46.4	+0.0	+0.0	+0.0	+0.0	+0.0	45.5	54.0	-8.5	Horiz
			+0.0	-38.3	+31.6	+1.8					
			+0.2	+3.8							
2	198.250M	44.6	+9.1	+6.0	+2.4	-28.0	+0.0	34.3	43.5	-9.2	Horiz
	QP		+0.2	+0.0	+0.0	+0.0					
			+0.0	+0.0							
^	198.250M	50.5	+9.1	+6.0	+2.4	-28.0	+0.0	40.2	43.5	-3.3	Horiz
			+0.2	+0.0	+0.0	+0.0					
			+0.0	+0.0							
4	3660.000M	45.5	+0.0	+0.0	+0.0	+0.0	+0.0	44.6	54.0	-9.4	Vert
			+0.0	-38.3	+31.6	+1.8					
			+0.2	+3.8							
5	3632.000M	45.0	+0.0	+0.0	+0.0	+0.0	+0.0	43.8	54.0	-10.2	Vert
			+0.0	-38.3	+31.3	+1.8					
			+0.2	+3.8							
6	196.550M	42.9	+9.1	+6.0	+2.4	-28.0	+0.0	32.6	43.5	-10.9	Horiz
	QP		+0.2	+0.0	+0.0	+0.0					
			+0.0	+0.0							
^	196.550M	50.7	+9.1	+6.0	+2.4	-28.0	+0.0	40.4	43.5	-3.1	Horiz
			+0.2	+0.0	+0.0	+0.0					
			+0.0	+0.0							
8	3695.200M	43.6	+0.0	+0.0	+0.0	+0.0	+0.0	42.9	54.0	-11.1	Vert
			+0.0	-38.3	+31.8	+1.8					
			+0.2	+3.8							
9	241.490M	41.3	+12.3	+6.0	+2.7	-28.0	+0.0	34.5	46.0	-11.5	Horiz
			+0.2	+0.0	+0.0	+0.0					
			+0.0	+0.0							

10	2771.400M	46.6	+0.0	+0.0	+0.0	+0.0	+0.0	42.4	54.0	-11.6	Vert
			+0.0	-38.6	+29.5	+1.4					
			+0.2	+3.3							
11	237.500M	41.4	+12.0	+6.0	+2.7	-28.0	+0.0	34.3	46.0	-11.7	Vert
			+0.2	+0.0	+0.0	+0.0					
			+0.0	+0.0							
12	1847.600M	50.0	+0.0	+0.0	+0.0	+0.0	+0.0	42.2	54.0	-11.8	Vert
			+0.0	-38.9	+27.2	+1.1					
			+0.3	+2.5							
13	1816.000M	50.0	+0.0	+0.0	+0.0	+0.0	+0.0	42.1	54.0	-11.9	Vert
			+0.0	-38.9	+27.1	+1.1					
			+0.3	+2.5							
14	2724.000M	46.1	+0.0	+0.0	+0.0	+0.0	+0.0	41.5	54.0	-12.5	Horiz
			+0.0	-38.6	+29.2	+1.4					
			+0.2	+3.2							
15	2745.000M	45.8	+0.0	+0.0	+0.0	+0.0	+0.0	41.4	54.0	-12.6	Vert
			+0.0	-38.6	+29.4	+1.4					
			+0.2	+3.2							
16	237.490M	40.4	+12.0	+6.0	+2.7	-28.0	+0.0	33.3	46.0	-12.7	Horiz
			+0.2	+0.0	+0.0	+0.0					
			+0.0	+0.0							
17	1830.000M	49.0	+0.0	+0.0	+0.0	+0.0	+0.0	41.1	54.0	-12.9	Horiz
			+0.0	-38.9	+27.1	+1.1					
			+0.3	+2.5							
18	242.250M	39.5	+12.4	+6.0	+2.7	-28.0	+0.0	32.8	46.0	-13.2	Vert
			+0.2	+0.0	+0.0	+0.0					
			+0.0	+0.0							
19	2745.000M	45.0	+0.0	+0.0	+0.0	+0.0	+0.0	40.6	54.0	-13.4	Horiz
			+0.0	-38.6	+29.4	+1.4					
			+0.2	+3.2							
20	2724.000M	45.0	+0.0	+0.0	+0.0	+0.0	+0.0	40.4	54.0	-13.6	Vert
			+0.0	-38.6	+29.2	+1.4					
			+0.2	+3.2							
21	1816.000M	47.7	+0.0	+0.0	+0.0	+0.0	+0.0	39.8	54.0	-14.2	Horiz
			+0.0	-38.9	+27.1	+1.1					
			+0.3	+2.5							
22	2771.400M	43.8	+0.0	+0.0	+0.0	+0.0	+0.0	39.6	54.0	-14.4	Horiz
			+0.0	-38.6	+29.5	+1.4					
			+0.2	+3.3							
23	1830.000M	47.1	+0.0	+0.0	+0.0	+0.0	+0.0	39.2	54.0	-14.8	Vert
			+0.0	-38.9	+27.1	+1.1					
			+0.3	+2.5							
24	1847.600M	46.8	+0.0	+0.0	+0.0	+0.0	+0.0	39.0	54.0	-15.0	Horiz
			+0.0	-38.9	+27.2	+1.1					
			+0.3	+2.5							

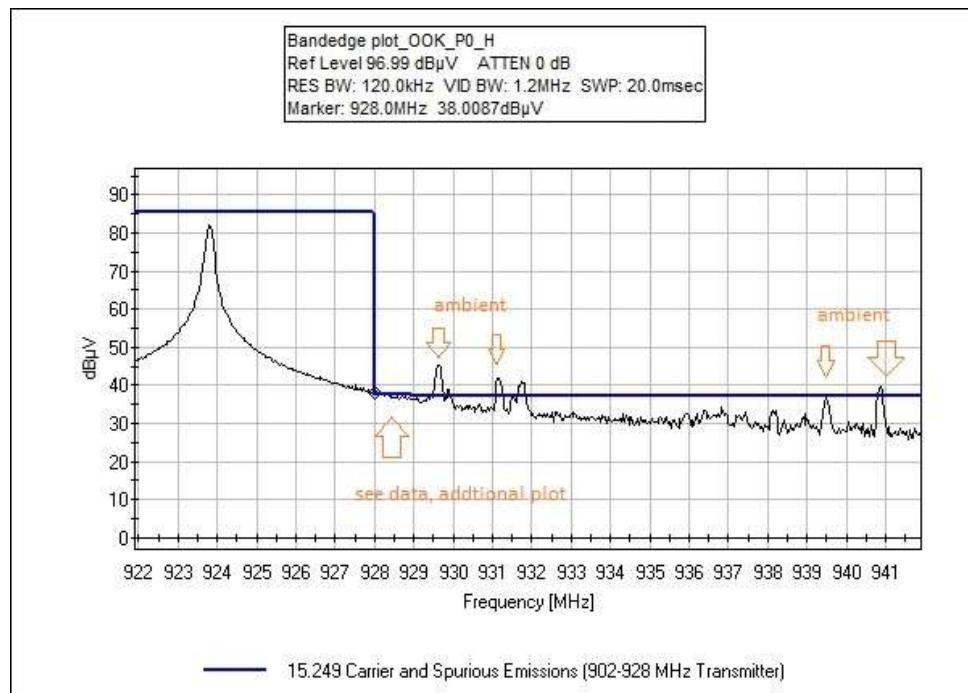
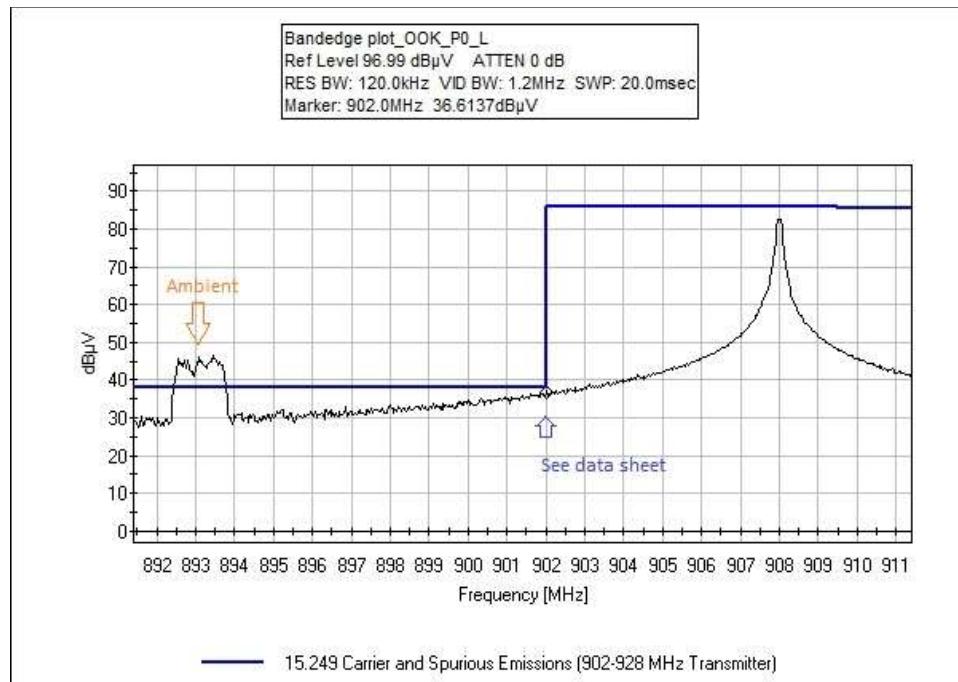
Band Edge

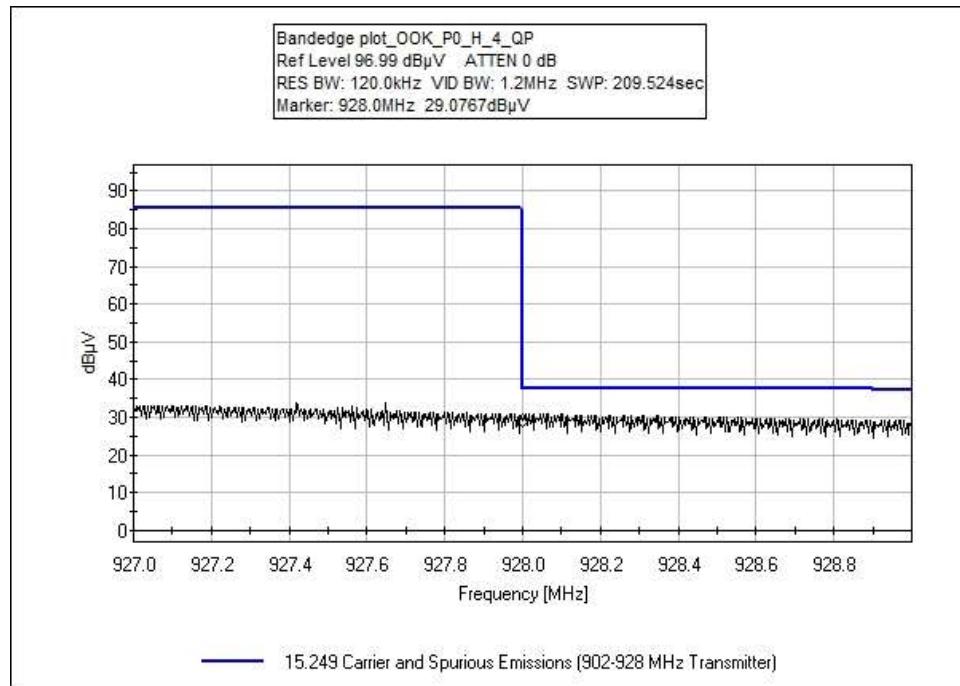
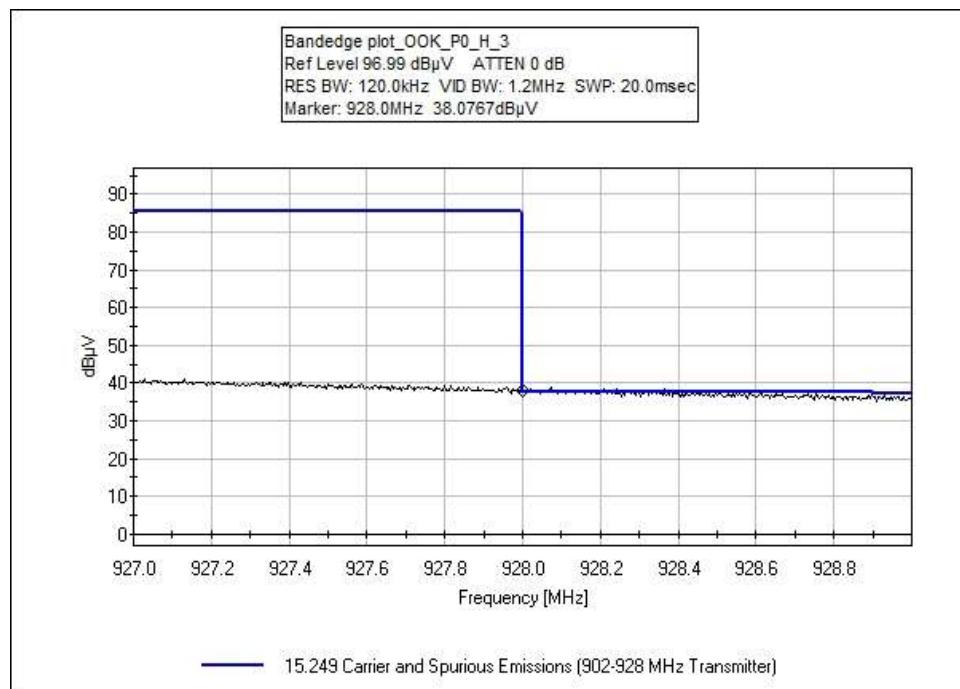
Band Edge Summary

Frequency (MHz)	Modulation	Ant. Type	Field Strength (dBuV/m @3m)	Limit (dBuV/m @3m)	Results
902	OOK	Integral	36.6*	<46	Pass
928	OOK	Integral	38.3*	<46	Pass

*Quasi Peak

Band Edge Plots





Test Setup / Conditions / Data

Test Location: CKC Laboratories, Inc. • 110 N. Olinda Place • Brea, CA 92821 • 714 993 6112
 Customer: **Itron, Inc.**
 Specification: **15.249 Carrier and Spurious Emissions (902-928 MHz Transmitter)**
 Work Order #: **100666** Date: 8/7/2018
 Test Type: **Radiated Scan** Time: 09:35:56
 Tested By: E. Wong 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

Modulation: OOK. Firmware power: power level 0

EUT firmware: CLI_Test_STM32_ALL_500GRD_Rev2_3_0_0_0.hex

Antenna type: Integral

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: 29°C

Relative Humidity: 41%

Pressure: 100kPa

Site A

Test Method: ANSI C63.10 (2013)

The evaluation is for PCII/ Reassessment. Worst case emission profile, Vertical pipe.

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02672	Spectrum Analyzer	E4446A	3/2/2017	3/2/2019
T1	AN01995	Biconilog Antenna	CBL6111C	4/23/2018	4/23/2020
T2	ANP05275	Attenuator	1W	4/5/2018	4/5/2020
T3	ANP05198	Cable-Amplitude +15C to +45C (dB)	8268	12/7/2016	12/7/2018
T4	AN00309	Preamp	8447D	2/19/2018	2/19/2020
T5	ANP05050	Cable	RG223/U	1/20/2017	1/20/2019

Measurement Data:

Reading listed by margin.

Test Distance: 3 Meters

#	Freq	Rdng	T1	T2	T3	T4	Dist	Corr	Spec	Margin	Polar
			T5				Table	dB μ V/m	dB μ V/m		
	MHz	dB μ V	dB	dB	dB	dB					Ant
1	928.000M	29.8	+23.2	+6.1	+6.0	-27.3	+0.0	38.3	46.0	-7.7	Vert
	QP		+0.5						bandedge H		
^	928.000M	38.0	+23.2	+6.1	+6.0	-27.3	+0.0	46.5	46.0	+0.5	Vert
			+0.5						bandedge H		
3	902.000M	28.5	+22.8	+6.1	+5.9	-27.2	+0.0	36.6	46.0	-9.4	Vert
	QP		+0.5						bandedge L		
^	902.000M	36.4	+22.8	+6.1	+5.9	-27.2	+0.0	44.5	46.0	-1.5	Vert
			+0.5						bandedge L		

Test Setup Photos



9kHz – 1GHz, Horizontal Pipe



9kHz – 1GHz, Horizontal Pipe



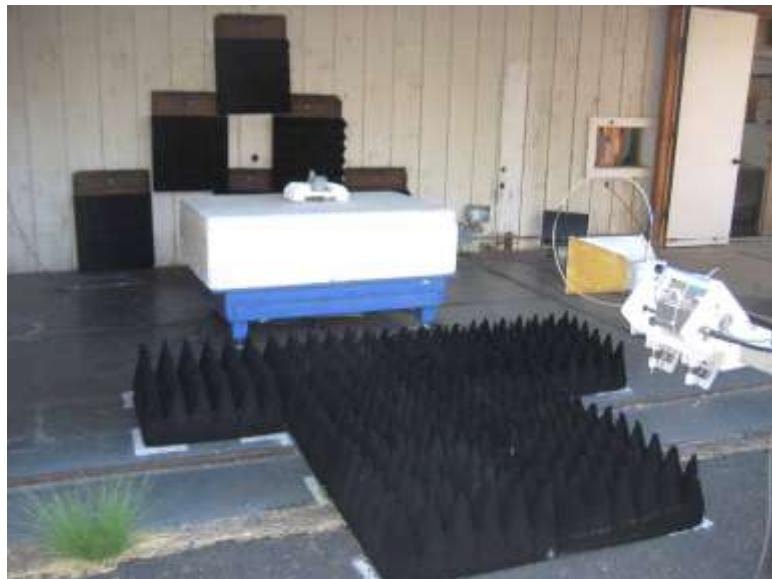
9kHz – 1GHz, Vertical Pipe



9kHz – 1GHz, Vertical Pipe



1 – 10GHz, Cone placement



1 – 10GHz, Cone placement

Appendix A: Manufacturer Declaration

The following device and model has been tested by CKC Laboratories:

Device: OpenWay Gas Remote Disconnect

Model: OWGRD

Since the time of testing, the manufacturer has chosen to use the following device and model name in its place. The manufacturer declares that any differences between the names does not affect their EMC characteristics and therefore meets the level of testing equivalent to the tested device and model name:

Device: OpenWay Riva Gas Remote Disconnect

Model: OWRGRD

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