

# Itron, Inc.

## TEST REPORT FOR

**500C**

**Models: WPITC0, WRMTC0 and GRMTC0**

### Tested to The Following Standards:

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

**15.247**

**(DTS 2400-2483.5 MHz)**

**Report No.: 104621-17**

**Date of issue: February 9, 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:**

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

Representative: Jay Holcomb  
Customer Reference Number: 223674

**DATE OF EQUIPMENT RECEIPT:**

**DATE(S) OF TESTING:**

**REPORT PREPARED BY:**

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

Project Number: 104621

December 18, 2020

December 18 and 21, 2020

January 8 and 11, 2021

### 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	5.03.19

## 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 (DTS)

Test Procedure	Description	Modifications	Results
15.247(a)(2)	6dB Bandwidth	NA	PASS
15.247(b)(3)	Output Power	NA	PASS
15.247(d)	RF Conducted Emissions & Band Edge	NA	PASS
15.247(d)	Radiated Emissions & Band Edge	NA	PASS
15.247(e)	Power Spectral Density	NA	PASS
15.207	AC Conducted Emissions	NA	NA1

NA = Not Applicable

NA1 = Not applicable, the manufacturer declares the EUT is battery operated.

#### 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 (GAS REMOTE)

**Equipment Tested:**

Device	Manufacturer	Model #	S/N
500C	Itron, Inc.	GRMTC0	RAD1

**Support Equipment:**

Device	Manufacturer	Model #	S/N
Laptop	Dell	Latitude E6420	8P954R1
Laptop Power Supply	Dell	ADP-65JB	None

### Configuration 2 (WATER REMOTE)

**Equipment Tested:**

Device	Manufacturer	Model #	S/N
500C	Itron, Inc.	WRMTC0	RAD1

**Support Equipment:**

Device	Manufacturer	Model #	S/N
Laptop	Dell	Latitude E6420	8P954R1
Laptop Power Supply	Dell	ADP-65JB	None

### Configuration 3 (PIT)

**Equipment Tested:**

Device	Manufacturer	Model #	S/N
500C	Itron, Inc.	WPITC0	RAD1

**Support Equipment:**

Device	Manufacturer	Model #	S/N
Laptop	Dell	Latitude E6420	8P954R1
Laptop Power Supply	Dell	ADP-65JB	None

### Configuration 4 (WPITC0 Conducted)

**Equipment Tested:**

Device	Manufacturer	Model #	S/N
500C	Itron, Inc.	WPITC0	CON1

**Support Equipment:**

Device	Manufacturer	Model #	S/N
Power Supply	Extech Instruments	382225	P99250026
Laptop	Dell	Latitude E6420	8P954R1
Laptop Power Supply	Dell	ADP-65JB	None

### General Product Information:

Product Information	Manufacturer-Provided Details
Equipment Type:	Stand-Alone Equipment
Type of Wideband System:	BLE
Operating Frequency Range:	2402-2480MHz
Modulation Type(s):	GFSK
Maximum Duty Cycle:	12.5%
Number of TX Chains:	1
Antenna Type(s) and Gain:	PCB Trace/ 2.0 dBi
Beamforming Type:	NA
Antenna Connection Type:	Integral (External connector provided to facilitate testing)
Nominal Input Voltage:	3.6Vdc battery
Firmware / Software used for Test:	App Version: 0.0.25.0, CSL version: 8.1.3.0 Hardware Rev: 9

### EUT and Accessory Photo(s)

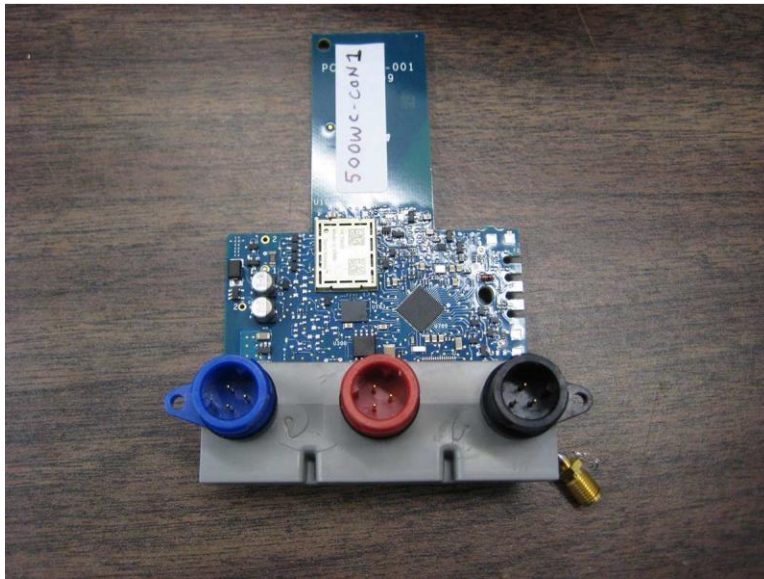


GRMTC0





WPITCO



WPITCO - Conducted





WRMTC0

**Support Equipment Photo(s)**



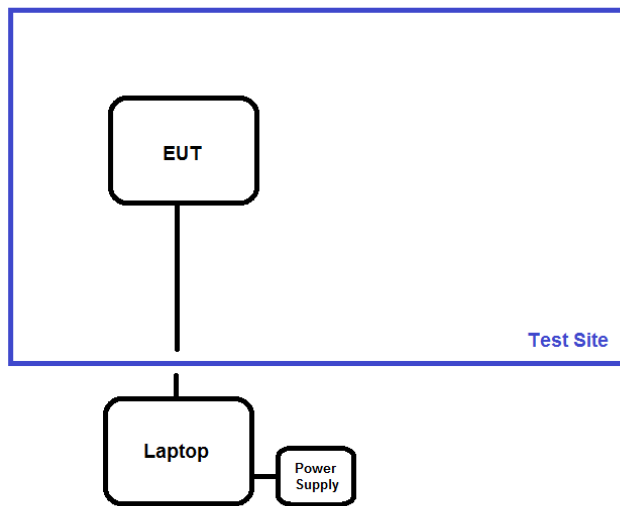
12V PSU



Laptop and Laptop PSU

**Block Diagram of Test Setup(s)**

**Test Setup Block Diagram**



## FCC Part 15 Subpart C

### 15.247(a)(2) 6dB Bandwidth

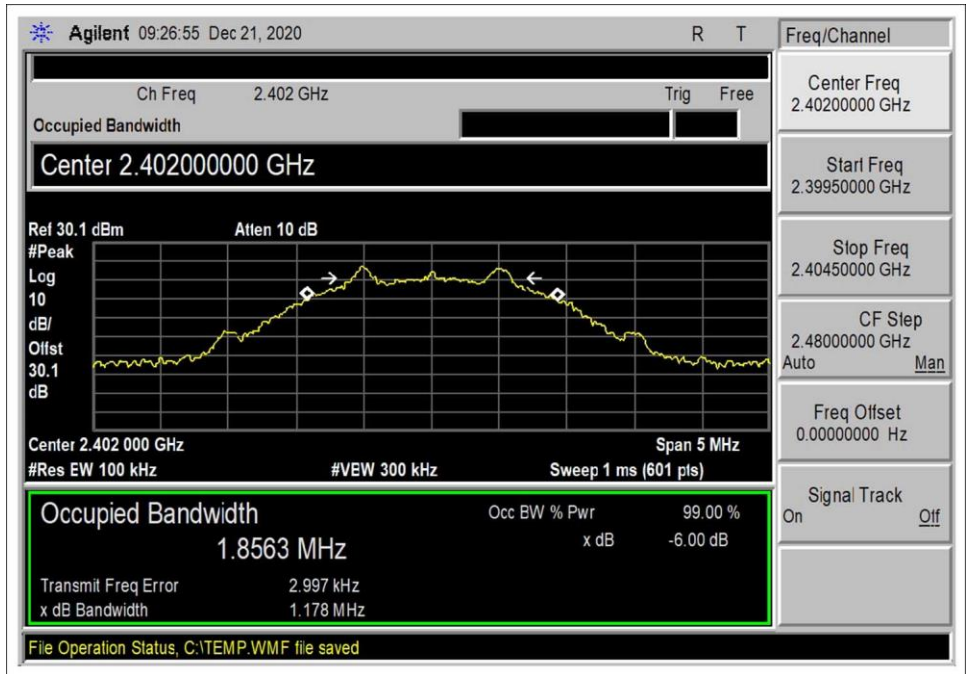
Test Setup/Conditions			
Test Location:	Brea Lab A	Test Engineer:	Don Nguyen
Test Method:	ANSI C63.10 (2013), KDB 558074 v05r02: 04/02/2019	Test Date(s):	12/18/2020
Configuration:	4		
Test Setup:	The EUT is placed on test bench and powered from 3.6Vdc power supply (to simulate fresh battery). The EUT is connected to a support laptop running CLI Tool ver.2.0.1.24. Operating frequency range: 2402-2480MHz Tested frequency range: 2402-2480MHz RBW=100kHz, VBW=300kHz Note: Three EUTs have the same internal hardware. Conducted data measured on one EUT represents for all three EUTs.		

Environmental Conditions			
Temperature (°C)	18.6	Relative Humidity (%):	45

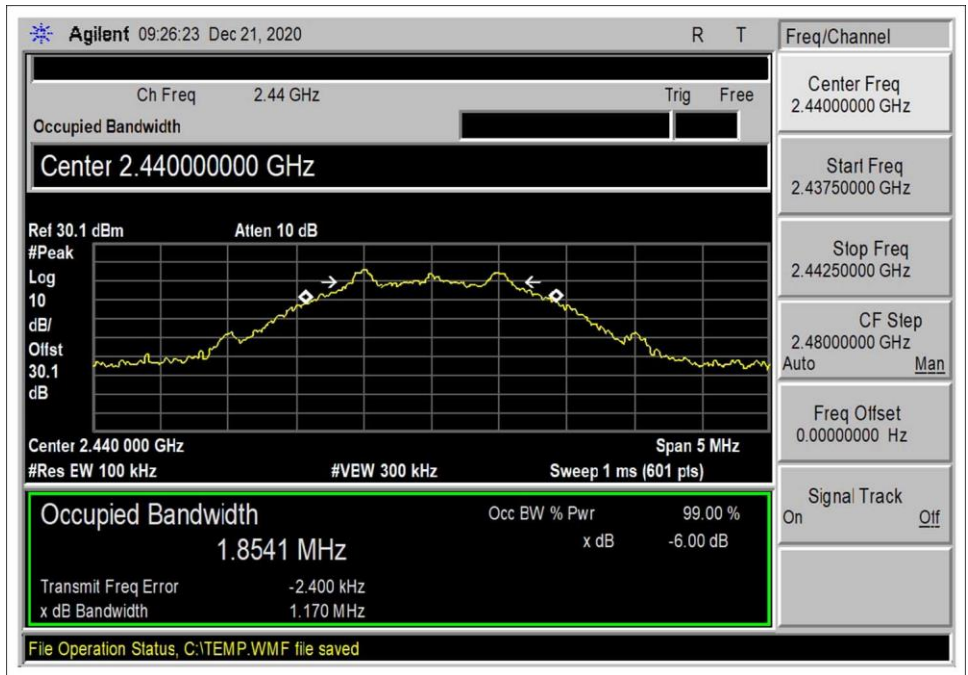
Test Equipment					
Asset#	Description	Manufacturer	Model	Cal Date	Cal Due
03643	Spectrum Analyzer	Agilent	E4440A	5/20/2020	5/20/2022
03432	Attenuator	Aeroflex/Weinschel	90-30-34	10/22/2019	10/22/2021
P07246	Cable	H&S	32022-29094K-29094K-24TC	5/29/2020	5/29/2022

Test Data Summary					
Frequency (MHz)	Antenna Port	Modulation	Measured (kHz)	Limit (kHz)	Results
2402	1	GFSK	1178	≥500	Pass
2440	1	GFSK	1170	≥500	Pass
2480	1	GFSK	1169	≥500	Pass

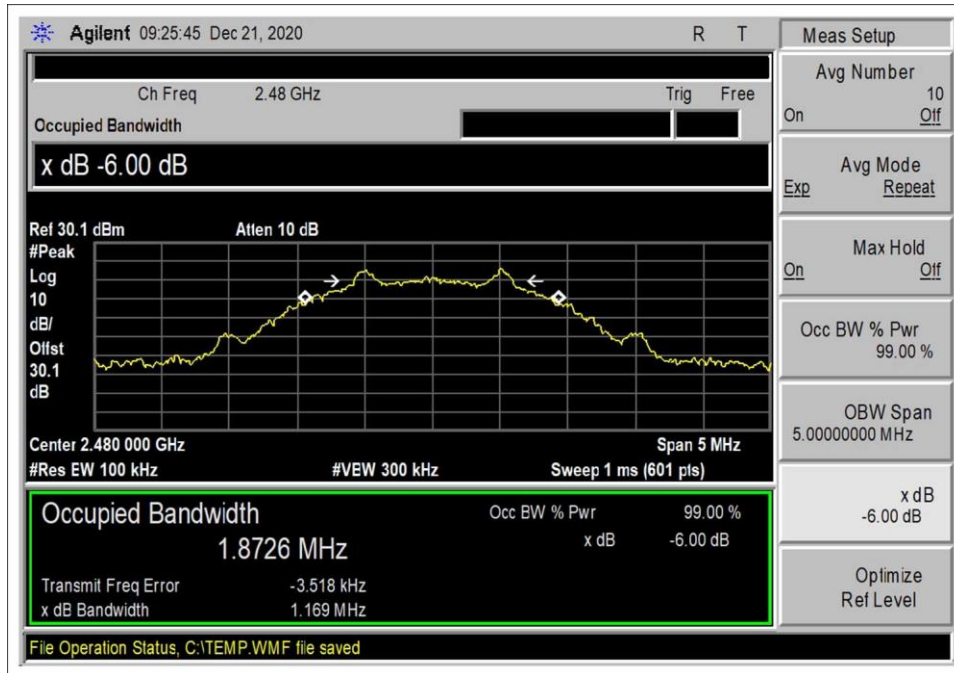
**Plot(s)**



Low Channel

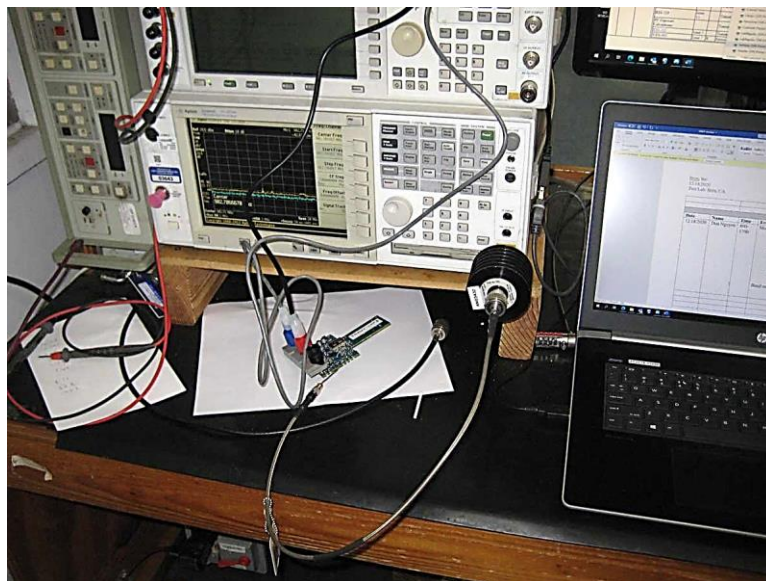


Middle Channel



High Channel

**Test Setup Photo(s)**





## 15.247(b)(3) Output Power

Test Setup / Conditions			
Test Location:	Brea Lab A	Test Engineer:	Don Nguyen
Test Method:	ANSI C63.10 (2013), KDB 558074 v05r02: 04/02/2019	Test Date(s):	12/18/2020
Configuration:	4		
Test Setup:	The EUT is placed on test bench and powered from 3.6Vdc power supply (to simulate fresh battery). The EUT is connected to a support laptop running CLI Tool ver.2.0.1.24. Operating frequency range: 2402-2480MHz Tested frequency range: 2402-2480MHz RBW=2MHz, VBW=6MHz  Note: Three EUTs have the same internal hardware. Conducted data measured on one EUT represents for all three EUTs.		

Environmental Conditions			
Temperature (°C)	23.1	Relative Humidity (%):	25

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

### Parameter Definitions:

Measurements performed at input voltage according to manufacturer specification.

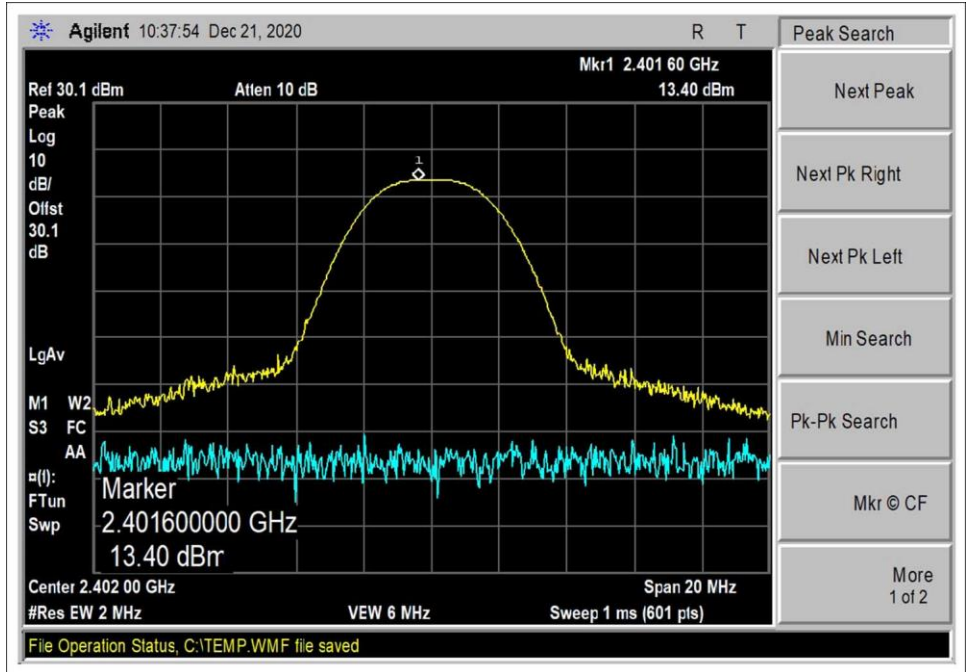
Parameter	Value
V <sub>Nominal</sub> :	3.6Vdc
V <sub>Minimum</sub> :	3.6Vdc
V <sub>Maximum</sub> :	3.6Vdc

### Test Data Summary - Voltage Variations

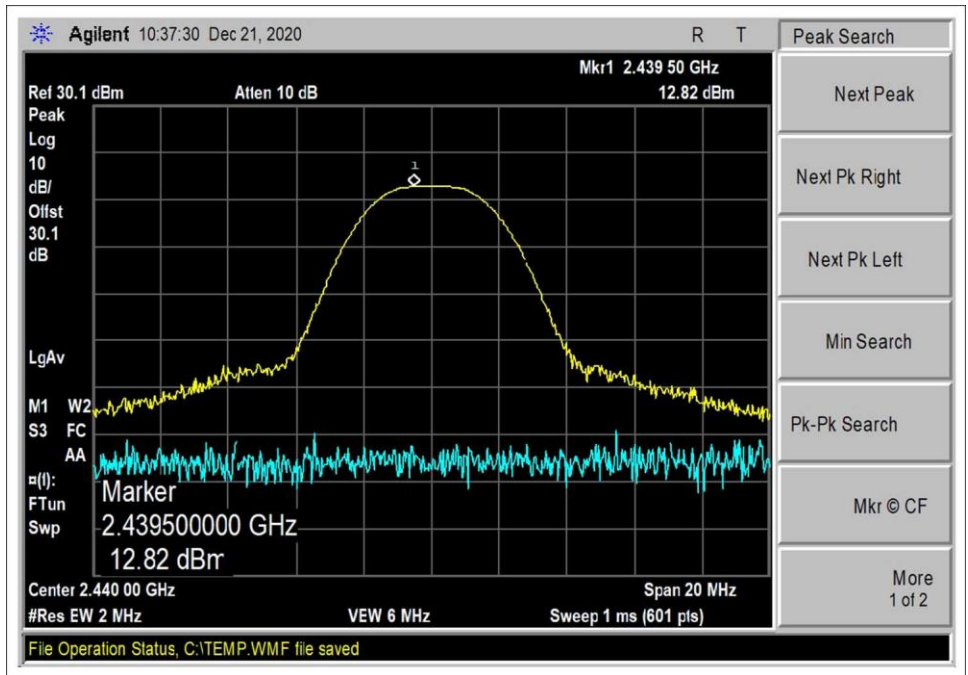
This equipment is battery powered. Power output tests were performed using an external power supply simulating fresh battery.

Test Data Summary - RF Conducted Measurement					
Measurement Option: RBW > DTS Bandwidth					
Frequency (MHz)	Modulation	Ant. Type / Gain (dBi)	Measured (dBm)	Limit (dBm)	Results
2402	GFSK	PCB Trace/ 2.0	13.40	≤30	Pass
2440	GFSK	PCB Trace/ 2.0	12.82	≤30	Pass
2480	GFSK	PCB Trace/ 2.0	12.07	≤30	Pass

## Plots

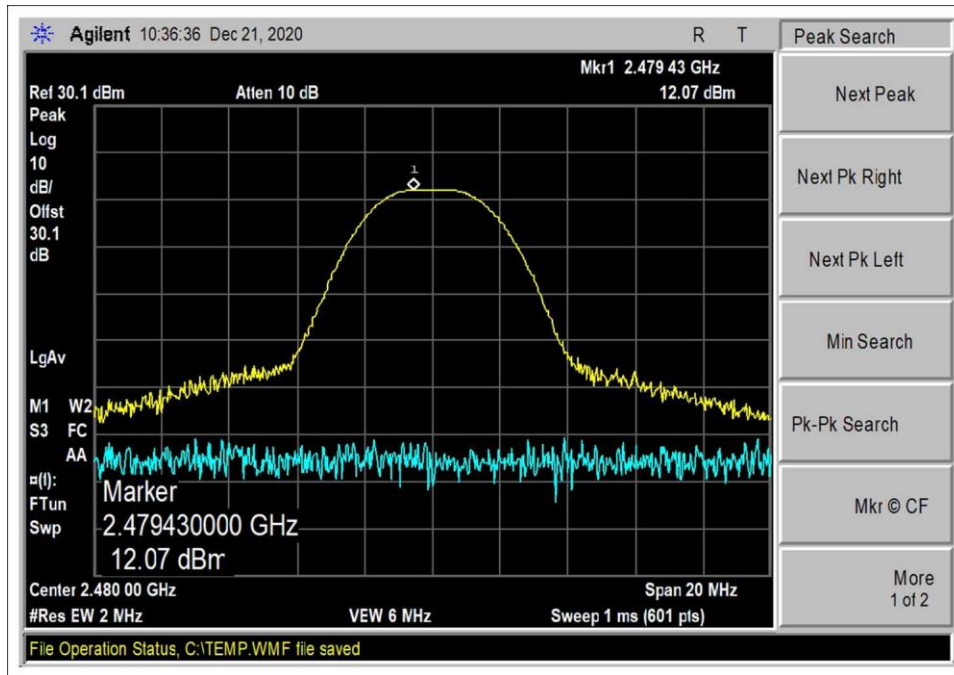


Low Channel



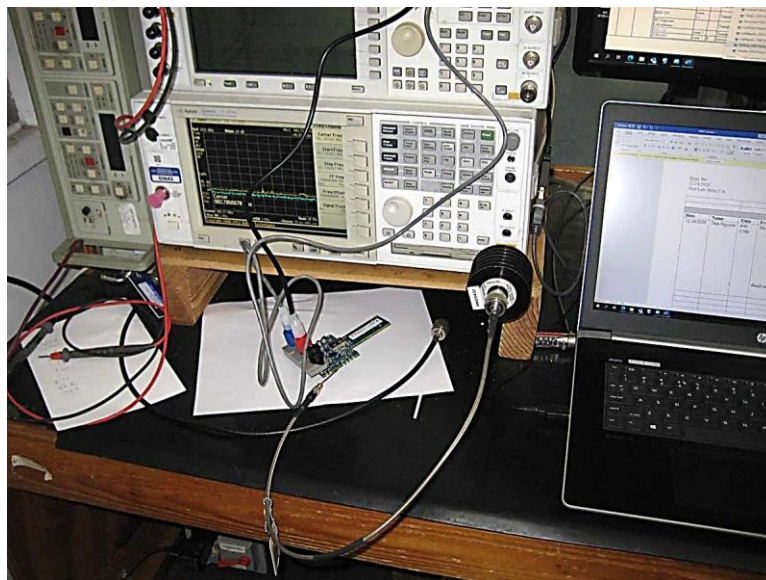
Middle Channel





High Channel

**Test Setup Photo(s)**



## 15.247(d) RF Conducted Emissions & Band Edge

### 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) Conducted Spurious Emissions**  
 Work Order #: **104621** Date: 12/21/2020  
 Test Type: **Conducted Emissions** Time: 10:53:01  
 Tested By: Don Nguyen Sequence#: 5  
 Software: EMITest 5.03.19

***Equipment Tested:***

Device	Manufacturer	Model #	S/N
Configuration 4			

***Support Equipment:***

Device	Manufacturer	Model #	S/N
Configuration 4			

***Test Conditions / Notes:***

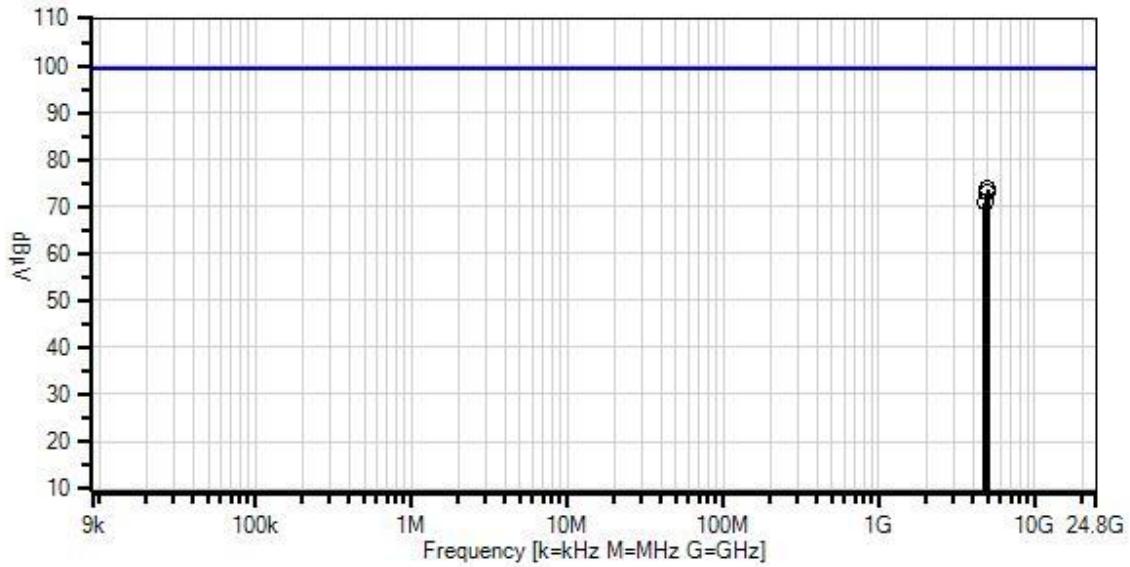
The EUT is placed on test bench and powered from 3.6Vdc power supply (to simulate fresh battery). The EUT is connected to a support laptop running CLI Tool ver.2.0.1.24.

Operating frequency range/ modes  
2402-2480MHz, BLE

Frequency of measurement: 9kHz-24800MHz  
RBW=100kHz, VBW=300kHz

Test Method: ANSI C63.10 (2013), KDB 558074 v05r02: 04/02/2019  
 Temperature (°C): 23.1  
 Relative Humidity (%): 25

Ittron, Inc. W/O#: 104621 Sequence#: 5 Date: 12/21/2020  
15.247(d) Conducted Spurious Emissions Test Distance: None Antenna Port



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

**Test Equipment:**

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	ANP07246	Cable	32022-29094K-29094K-24TC	5/29/2020	5/29/2022
T2	AN03643	Spectrum Analyzer	E4440A	5/20/2020	5/20/2022

**Measurement Data:**

Reading listed by margin.

Test Distance: None

#	Freq MHz	Rdng dBμV	T1 dB	T2 dB	dB	dB	Dist Table	Corr dBμV	Spec dBμV	Margin dB	Polar Ant
1	4959.017M	73.1	+0.6	+0.0			+0.0	73.7	99.6	-25.9	Anten
2	4879.017M	72.3	+0.6	+0.0			+0.0	72.9	99.6	-26.7	Anten
3	4803.017M	70.1	+0.7	+0.0			+0.0	70.8	99.6	-28.8	Anten

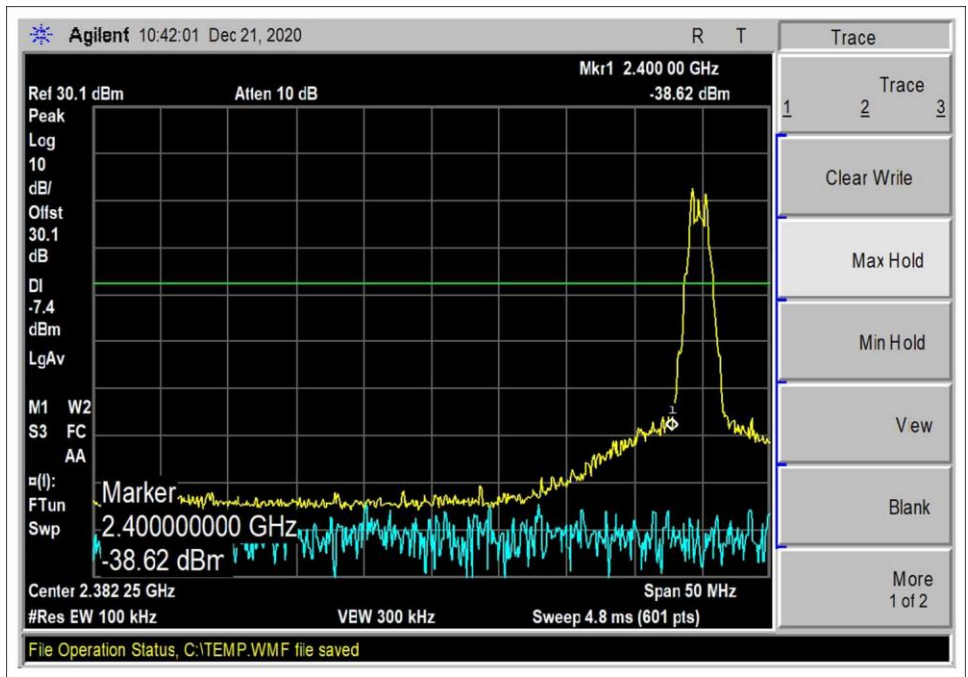
## Band Edge

### Band Edge Summary

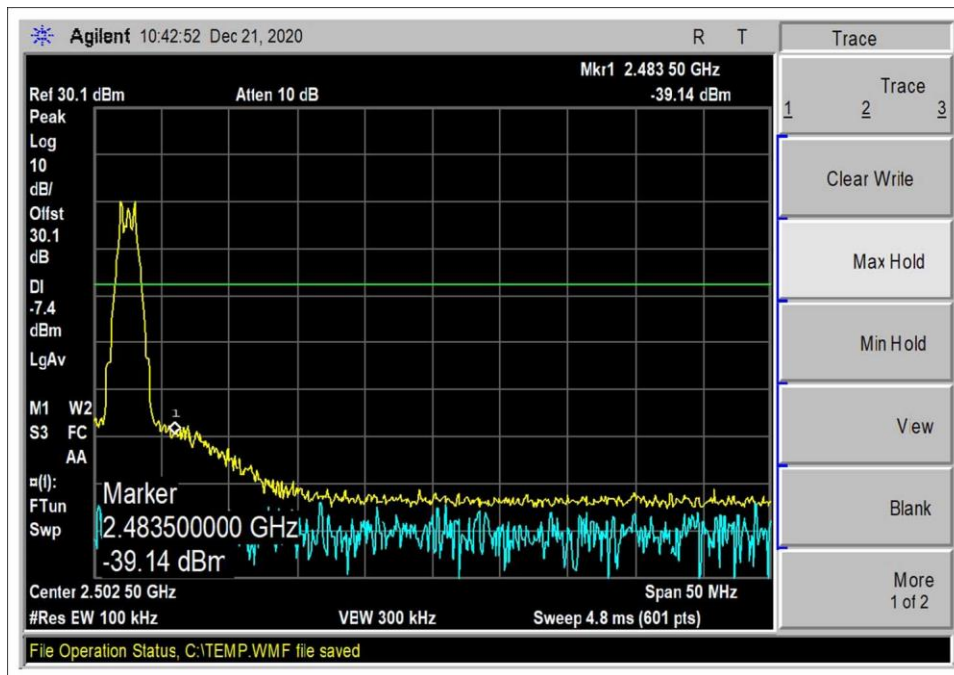
Limit applied: Max Power/100kHz - 20dB.

Frequency (MHz)	Modulation	Measured (dBm)	Limit (dBm)	Results
2400.0	GFSK	-38.62	<-7.4	Pass
2483.5	GFSK	-39.14	<-7.4	Pass

### Band Edge Plots

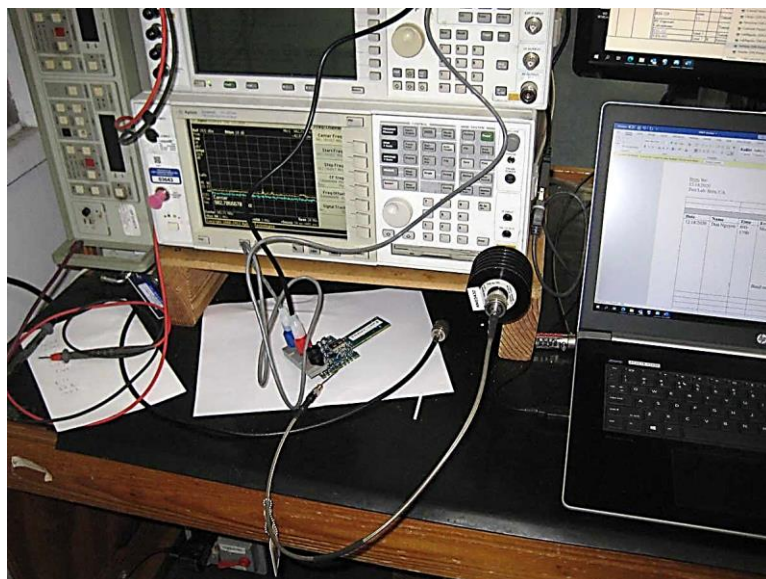


Low Channel



High Channel

**Test Setup Photo(s)**



## 15.247(d) Radiated Emissions & Band Edge

### 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 #: **104621** Date: 1/8/2021  
 Test Type: **Maximized Emissions** Time: 09:38:45  
 Tested By: Don Nguyen Sequence#: 12  
 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 Styrofoam platform and powered from 3.6V fresh battery. The EUT is connected to a remote located laptop running CLI Tool ver.2.0.1.24.

EUT has fixed orientation per manufacture's specification.

Operating frequency range/ mode

2402-2480MHz, BLE

Frequency of measurement: 9k-24835MHz

9kHz to 150kHz RBW=0.2kHz, VBW=0.6kHz

150kHz to 30MHz RBW=9kHz, VBW=27kHz

30-1000MHz, RBW=120kHz, VBW=360kHz

1000-24835MHz, RBW=1MHz, VBW=3MHz

-20dBc limit, RBW=100kHz, VBW=300kHz

Note: The manufacturer declares the worst case duty cycle is 12.5ms per 100ms. Duty cycle correction factor= $20\log(12.5/100) = -18.06$  dB. Average readings in restricted band are calculated from peak readings with duty cycle correction factor.

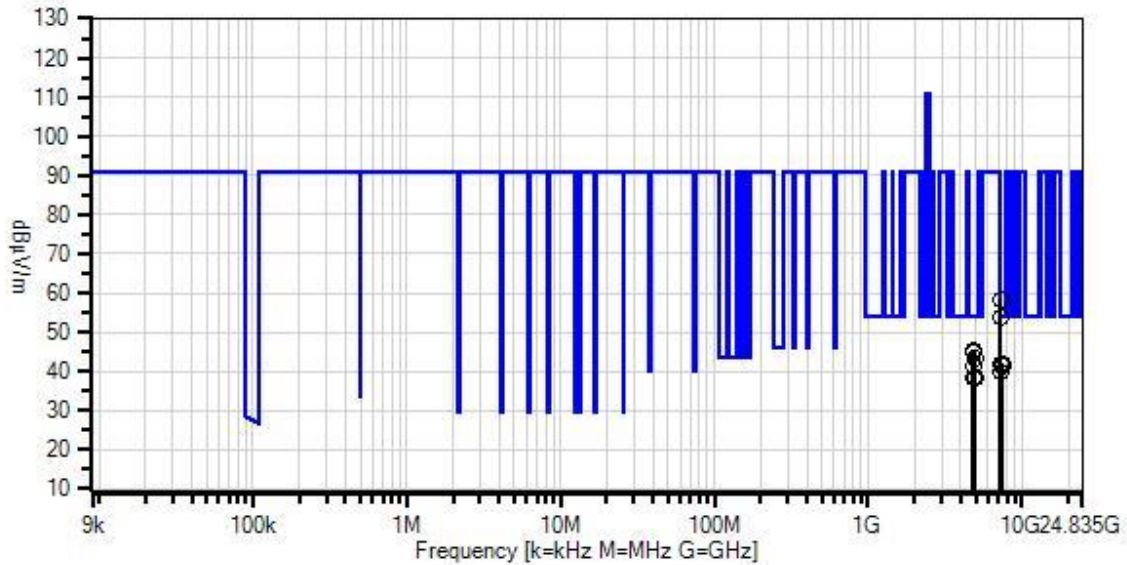
Test Method: ANSI C63.10 (2013), KDB 558074 v05r02: 04/02/2019

Temperature (°C): 22

Relative Humidity (%): 47



Itron, Inc. WO#: 104621 Sequence#: 12 Date: 1/8/2021  
 15.247(d) / 15.209 Radiated Spurious Emissions Test Distance: 3 Meters Horiz



— 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
	ANP05050	Cable	RG223/U	12/14/2020	12/14/2022
	ANP05198	Cable-Amplitude +15C to +45C (dB)	8268	12/21/2020	12/21/2022
	AN00309	Preamp	8447D	12/24/2019	12/24/2021
	ANP05281	Attenuator	1B	4/7/2020	4/7/2022
	AN02869	Spectrum Analyzer	E4440A	8/3/2020	8/3/2021
T1	AN00849	Horn Antenna	3115	3/17/2020	3/17/2022
T2	ANP06360	Cable	L1-PNMNM-48	8/8/2019	8/8/2021
T3	AN00786	Preamp	83017A	5/20/2020	5/20/2022
T4	ANP07246	Cable	32022-29094K- 29094K-24TC	5/29/2020	5/29/2022
T5	AN03385	High Pass Filter	11SH10- 3000/T10000- O/O	5/13/2019	5/13/2021
T6	ANDCCF	Duty Cycle Correction Factor		1/7/2021	1/7/2031
	AN01413	Horn Antenna	84125-80008	10/19/2020	10/19/2022
	AN03367	Horn Antenna	62-GH-62-25.	8/1/2019	8/1/2021



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

#	Freq MHz	Rdng dB $\mu$ V	T1 T5 dB	T2 T6 dB	T3 dB	T4 dB	Dist Table	Corr dB $\mu$ V/m	Spec dB $\mu$ V/m	Margin dB	Polar Ant
1	4805.033M	62.6	+33.0 +0.3	+4.5 -18.1	-37.6	+0.7	+0.0	45.4	54.0	-8.6	Vert
2	4879.083M	62.2	+33.2 +0.3	+4.5 -18.1	-37.6	+0.6	+0.0	45.1	54.0	-8.9	Vert
3	4959.000M	60.4	+33.4 +0.4	+4.5 -18.1	-37.6	+0.6	+0.0	43.6	54.0	-10.4	Vert
4	7441.450M	53.4	+36.5 +0.2	+6.1 -18.1	-37.2	+0.9	+0.0	41.8	54.0	-12.2	Vert
5	7321.283M	53.8	+36.2 +0.2	+6.1 -18.1	-37.3	+0.8	+0.0	41.7	54.0	-12.3	Vert
6	4802.800M	58.6	+33.0 +0.3	+4.5 -18.1	-37.6	+0.7	+0.0	41.4	54.0	-12.6	Horiz
7	7441.650M	52.8	+36.5 +0.2	+6.1 -18.1	-37.2	+0.9	+0.0	41.2	54.0	-12.8	Horiz
8	7321.567M	52.2	+36.2 +0.2	+6.1 -18.1	-37.3	+0.8	+0.0	40.1	54.0	-13.9	Horiz
9	4881.250M	55.7	+33.2 +0.3	+4.5 -18.1	-37.6	+0.6	+0.0	38.6	54.0	-15.4	Horiz
10	4958.867M	55.3	+33.4 +0.4	+4.5 -18.1	-37.6	+0.6	+0.0	38.5	54.0	-15.5	Horiz
11	7204.383M	52.4	+35.9 +0.2	+6.1 +0.0	-37.1	+0.8	+0.0	58.3	90.9	-32.6	Horiz
12	7207.333M	48.0	+35.9 +0.2	+6.1 +0.0	-37.1	+0.8	+0.0	53.9	90.9	-37.0	Vert

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 #: **104621** Date: 1/8/2021  
 Test Type: **Maximized Emissions** Time: 08:34:19  
 Tested By: Don Nguyen Sequence#: 10  
 Software: EMITest 5.03.19

***Equipment Tested:***

Device	Manufacturer	Model #	S/N
Configuration 2			

***Support Equipment:***

Device	Manufacturer	Model #	S/N
Configuration 2			

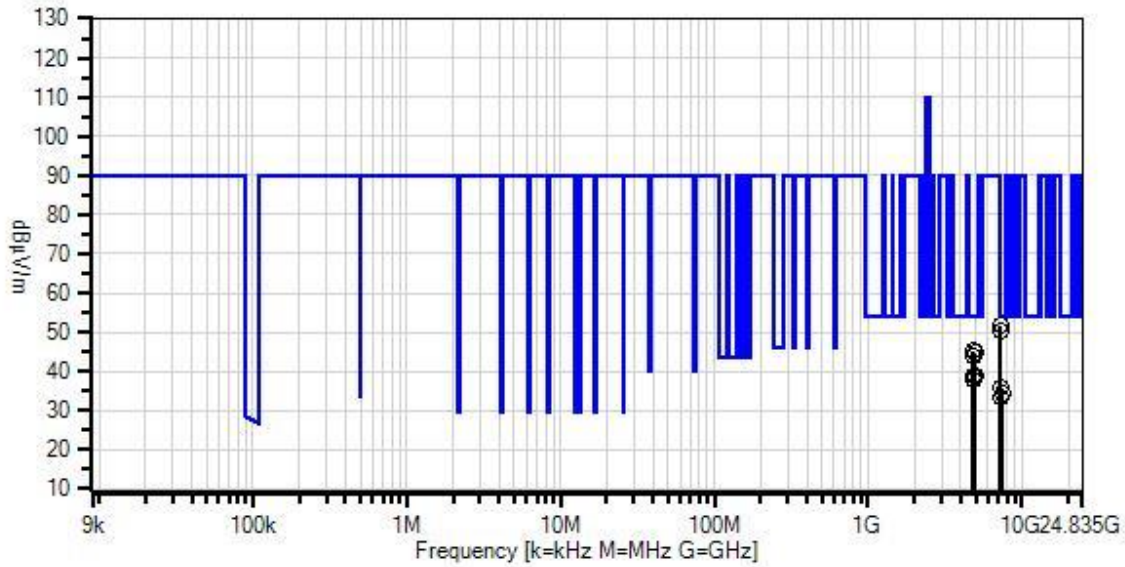
***Test Conditions / Notes:***

The EUT is placed on Styrofoam platform and powered from 3.6V fresh battery. The EUT is connected to a remote located laptop running CLI Tool ver.2.0.1.24.  
 EUT has fixed orientation per manufacture's specification.  
 Operating frequency range/ mode  
 2402-2480MHz, BLE  
 Frequency of measurement: 9k-24835MHz  
 9kHz to 150kHz RBW=0.2kHz, VBW=0.6kHz  
 150kHz to 30MHz RBW=9kHz, VBW=27kHz  
 30-1000MHz, RBW=120kHz, VBW=360kHz  
 1000-24835MHz, RBW=1MHz, VBW=3MHz  
 -20dBc limit, RBW=100kHz, VBW=300kHz

Note: The manufacturer declares the worst case duty cycle is 12.5ms per 100ms. Duty cycle correction factor= $20\log(12.5/100) = -18.06$  dB. Average readings in restricted band are calculated from peak readings with duty cycle correction factor.

Test Method: ANSI C63.10 (2013), KDB 558074 v05r02: 04/02/2019  
 Temperature (°C): 22  
 Relative Humidity (%): 47

Itron, Inc. WO#: 104621 Sequence#: 10 Date: 1/8/2021  
 15.247(d) / 15.209 Radiated Spurious Emissions Test Distance: 3 Meters Horiz



- 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
	ANP05050	Cable	RG223/U	12/14/2020	12/14/2022
	ANP05198	Cable-Amplitude +15C to +45C (dB)	8268	12/21/2020	12/21/2022
	AN00309	Preamp	8447D	12/24/2019	12/24/2021
	ANP05281	Attenuator	1B	4/7/2020	4/7/2022
	AN02869	Spectrum Analyzer	E4440A	8/3/2020	8/3/2021
T1	AN00849	Horn Antenna	3115	3/17/2020	3/17/2022
T2	ANP06360	Cable	L1-PNMNM-48	8/8/2019	8/8/2021
T3	AN00786	Preamp	83017A	5/20/2020	5/20/2022
T4	ANP07246	Cable	32022-29094K- 29094K-24TC	5/29/2020	5/29/2022
T5	AN03385	High Pass Filter	11SH10- 3000/T10000- O/O	5/13/2019	5/13/2021
T6	ANDCCF	Duty Cycle Correction Factor		1/7/2021	1/7/2031
	AN01413	Horn Antenna	84125-80008	10/19/2020	10/19/2022
	AN03367	Horn Antenna	62-GH-62-25.	8/1/2019	8/1/2021

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

#	Freq MHz	Rdng dB $\mu$ V	T1 T5 dB	T2 T6 dB	T3 dB	T4 dB	Dist Table	Corr dB $\mu$ V/m	Spec dB $\mu$ V/m	Margin dB	Polar Ant
1	4805.087M	62.3	+33.0 +0.3	+4.5 -18.1	-37.6	+0.7	+0.0	45.1	54.0	-8.9	Vert
2	4958.967M	61.4	+33.4 +0.4	+4.5 -18.1	-37.6	+0.6	+0.0	44.6	54.0	-9.4	Vert
3	4881.117M	61.1	+33.2 +0.3	+4.5 -18.1	-37.6	+0.6	+0.0	44.0	54.0	-10.0	Vert
4	4960.900M	55.9	+33.4 +0.4	+4.5 -18.1	-37.6	+0.6	+0.0	39.1	54.0	-14.9	Horiz
5	4802.933M	56.0	+33.0 +0.3	+4.5 -18.1	-37.6	+0.7	+0.0	38.8	54.0	-15.2	Horiz
6	4881.117M	55.2	+33.2 +0.3	+4.5 -18.1	-37.6	+0.6	+0.0	38.1	54.0	-15.9	Horiz
7	7321.600M	47.9	+36.2 +0.2	+6.1 -18.1	-37.3	+0.8	+0.0	35.8	54.0	-18.2	Horiz
8	7438.567M	46.1	+36.5 +0.2	+6.1 -18.1	-37.2	+0.9	+0.0	34.5	54.0	-19.5	Horiz
9	7318.550M	45.4	+36.2 +0.2	+6.1 -18.1	-37.3	+0.8	+0.0	33.3	54.0	-20.7	Vert
10	7204.567M	45.7	+35.9 +0.2	+6.1 +0.0	-37.1	+0.8	+0.0	51.6	89.8	-38.2	Horiz
11	7207.453M	44.4	+35.9 +0.2	+6.1 +0.0	-37.1	+0.8	+0.0	50.3	89.8	-39.5	Vert

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 #: **104621** Date: 1/8/2021  
 Test Type: **Maximized Emissions** Time: 09:04:58  
 Tested By: Don Nguyen Sequence#: 11  
 Software: EMITest 5.03.19

***Equipment Tested:***

Device	Manufacturer	Model #	S/N
Configuration 3			

***Support Equipment:***

Device	Manufacturer	Model #	S/N
Configuration 3			

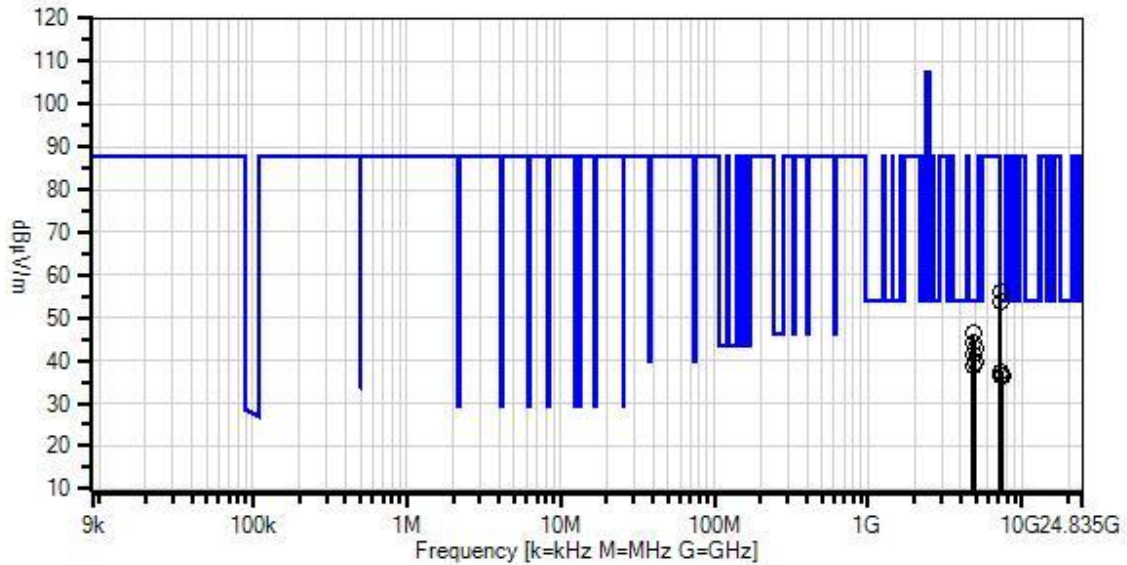
***Test Conditions / Notes:***

The EUT is placed on Styrofoam platform and powered from 3.6V fresh battery. The EUT is connected to a remote located laptop running CLI Tool ver.2.0.1.24.  
 EUT has fixed orientation per manufacture's specification.  
 Operating frequency range/ mode  
 2402-2480MHz, BLE  
 Frequency of measurement: 9k-24835MHz  
 9kHz to 150kHz RBW=0.2kHz, VBW=0.6kHz  
 150kHz to 30MHz RBW=9kHz, VBW=27kHz  
 30-1000MHz, RBW=120kHz, VBW=360kHz  
 1000-24835MHz, RBW=1MHz, VBW=3MHz  
 -20dBc limit, RBW=100kHz, VBW=300kHz

Note: The manufacturer declares the worst case duty cycle is 12.5ms per 100ms. Duty cycle correction factor= $20\log(12.5/100) = -18.06$  dB. Average readings in restricted band are calculated from peak readings with duty cycle correction factor.

Test Method: ANSI C63.10 (2013), KDB 558074 v05r02: 04/02/2019  
 Temperature (°C): 22  
 Relative Humidity (%): 47

Itron, Inc. WO#: 104621 Sequence#: 11 Date: 1/8/2021  
 15.247(d) / 15.209 Radiated Spurious Emissions Test Distance: 3 Meters Vert



— Readings  
 × QP Readings  
 ▼ Ambient  
 ○ 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
	ANP05050	Cable	RG223/U	12/14/2020	12/14/2022
	ANP05198	Cable-Amplitude +15C to +45C (dB)	8268	12/21/2020	12/21/2022
	AN00309	Preamp	8447D	12/24/2019	12/24/2021
	ANP05281	Attenuator	1B	4/7/2020	4/7/2022
	AN02869	Spectrum Analyzer	E4440A	8/3/2020	8/3/2021
T1	AN00849	Horn Antenna	3115	3/17/2020	3/17/2022
T2	ANP06360	Cable	L1-PNMNM-48	8/8/2019	8/8/2021
T3	AN00786	Preamp	83017A	5/20/2020	5/20/2022
T4	ANP07246	Cable	32022-29094K- 29094K-24TC	5/29/2020	5/29/2022
T5	AN03385	High Pass Filter	11SH10- 3000/T10000- O/O	5/13/2019	5/13/2021
T6	ANDCCF	Duty Cycle Correction Factor		1/7/2021	1/7/2031
	AN01413	Horn Antenna	84125-80008	10/19/2020	10/19/2022
	AN03367	Horn Antenna	62-GH-62-25.	8/1/2019	8/1/2021

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

#	Freq MHz	Rdng dB $\mu$ V	T1 T5 dB	T2 T6 dB	T3 dB	T4 dB	Dist Table	Corr dB $\mu$ V/m	Spec dB $\mu$ V/m	Margin dB	Polar Ant
1	4805.050M	63.5	+33.0 +0.3	+4.5 -18.1	-37.6	+0.7	+0.0	46.3	54.0	-7.7	Vert
2	4878.950M	61.5	+33.2 +0.3	+4.5 -18.1	-37.6	+0.6	+0.0	44.4	54.0	-9.6	Vert
3	4961.117M	59.5	+33.4 +0.4	+4.5 -18.1	-37.6	+0.6	+0.0	42.7	54.0	-11.3	Vert
4	4802.900M	58.5	+33.0 +0.3	+4.5 -18.1	-37.6	+0.7	+0.0	41.3	54.0	-12.7	Horiz
5	4959.000M	56.3	+33.4 +0.4	+4.5 -18.1	-37.6	+0.6	+0.0	39.5	54.0	-14.5	Horiz
6	4879.033M	56.0	+33.2 +0.3	+4.5 -18.1	-37.6	+0.6	+0.0	38.9	54.0	-15.1	Horiz
7	7321.467M	49.5	+36.2 +0.2	+6.1 -18.1	-37.3	+0.8	+0.0	37.4	54.0	-16.6	Horiz
8	7438.567M	48.1	+36.5 +0.2	+6.1 -18.1	-37.2	+0.9	+0.0	36.5	54.0	-17.5	Horiz
9	7321.833M	48.5	+36.2 +0.2	+6.1 -18.1	-37.3	+0.8	+0.0	36.4	54.0	-17.6	Vert
10	7438.767M	47.8	+36.5 +0.2	+6.1 -18.1	-37.2	+0.9	+0.0	36.2	54.0	-17.8	Vert
11	7204.583M	49.9	+35.9 +0.2	+6.1 +0.0	-37.1	+0.8	+0.0	55.8	87.6	-31.8	Horiz
12	7207.333M	48.0	+35.9 +0.2	+6.1 +0.0	-37.1	+0.8	+0.0	53.9	87.6	-33.7	Vert



## Band Edge

### Band Edge Summary-Configuration 1

Frequency (MHz)	Modulation	Ant. Type	Field Strength (dBuV/m @3m)	Limit (dBuV/m @3m)	Results
2390.0	GFSK	PCB Trace	40.8*	<54	Pass
2400.0	GFSK	PCB Trace	64.0	<90.9	Pass
2483.5	GFSK	PCB Trace	51.3*	<54	Pass

### Band Edge Summary-Configuration 2

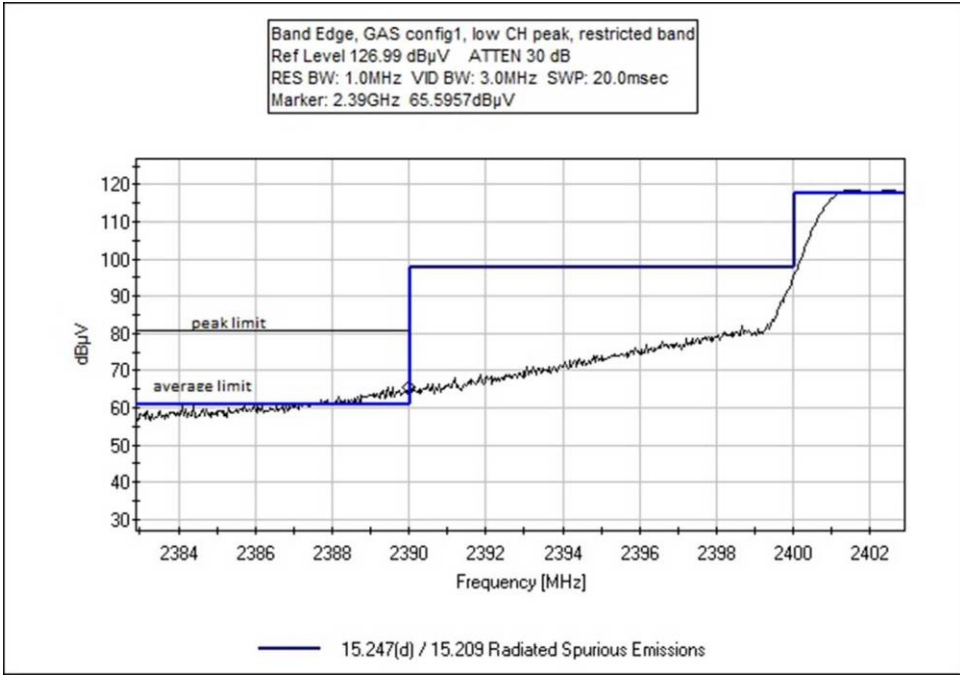
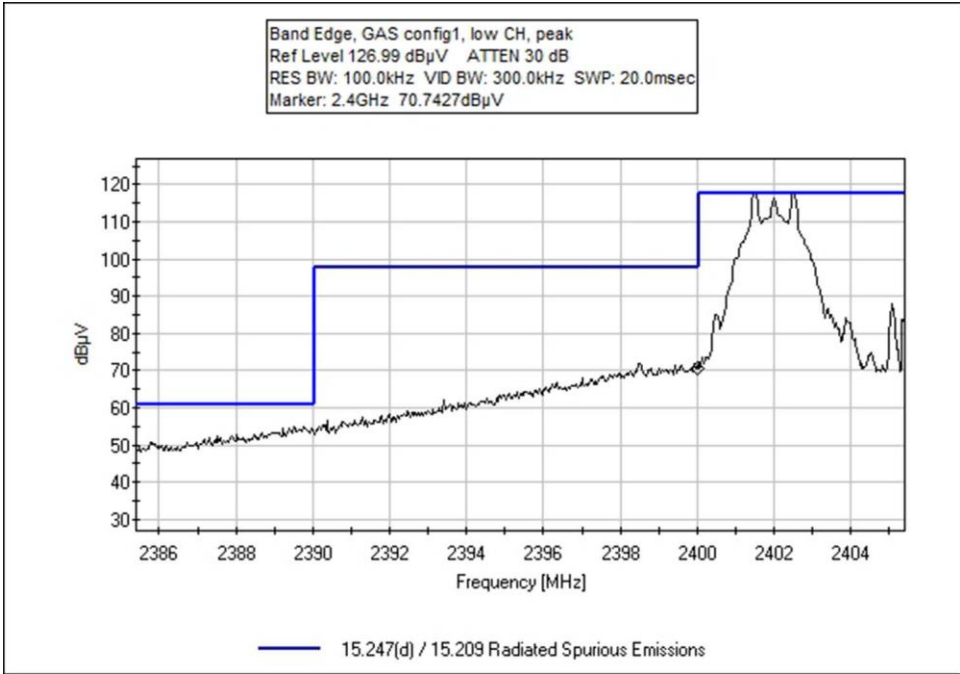
Frequency (MHz)	Modulation	Ant. Type	Field Strength (dBuV/m @3m)	Limit (dBuV/m @3m)	Results
2390.0	GFSK	PCB Trace	37.3*	<54	Pass
2400.0	GFSK	PCB Trace	61.4	<89.8	Pass
2483.5	GFSK	PCB Trace	51.8*	<54	Pass

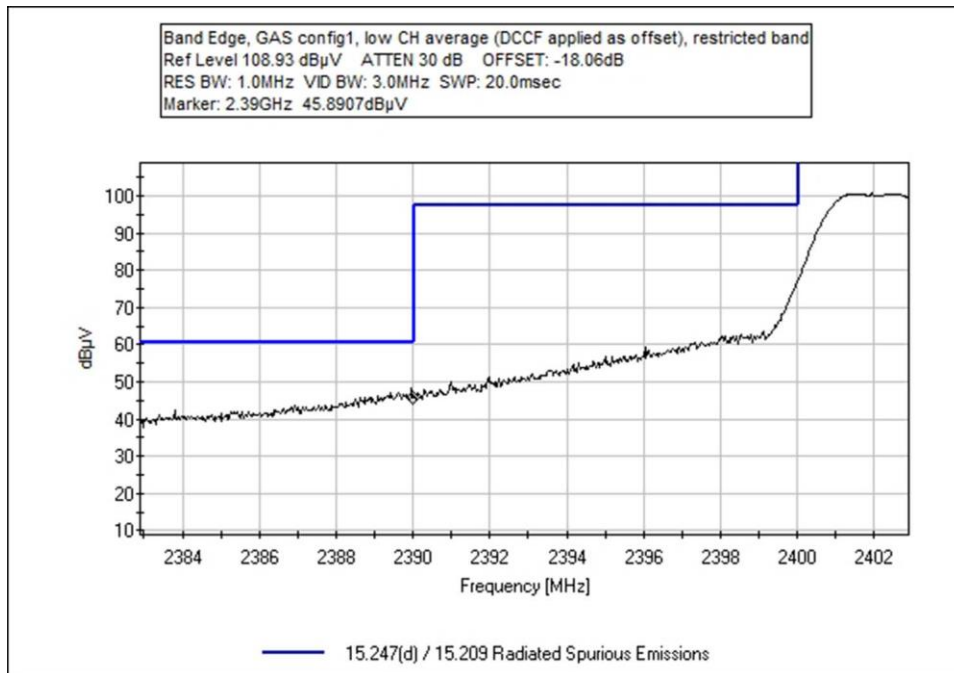
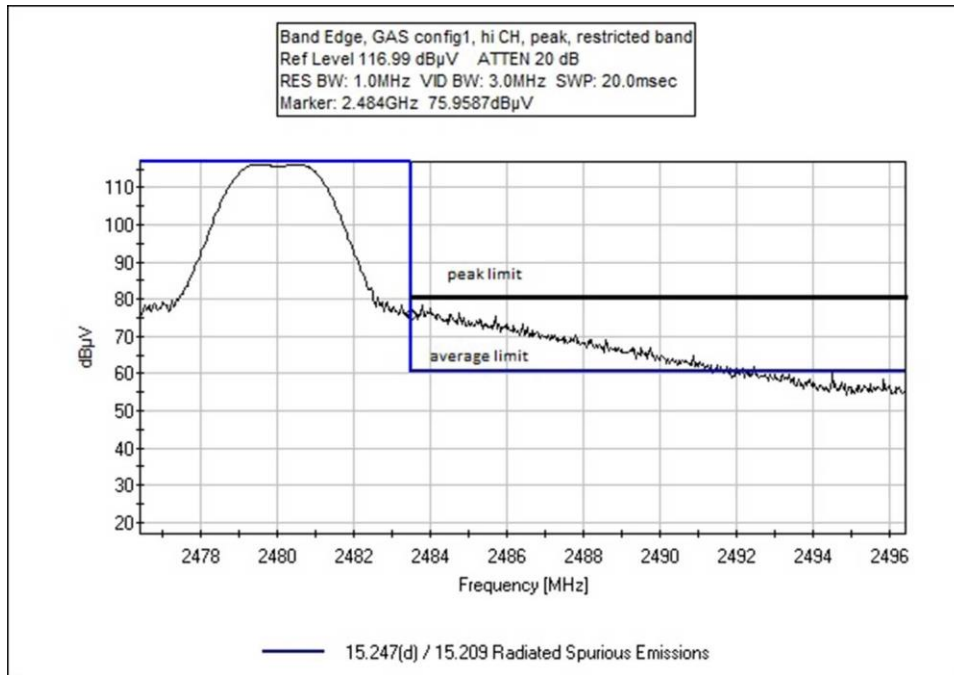
### Band Edge Summary-Configuration 3

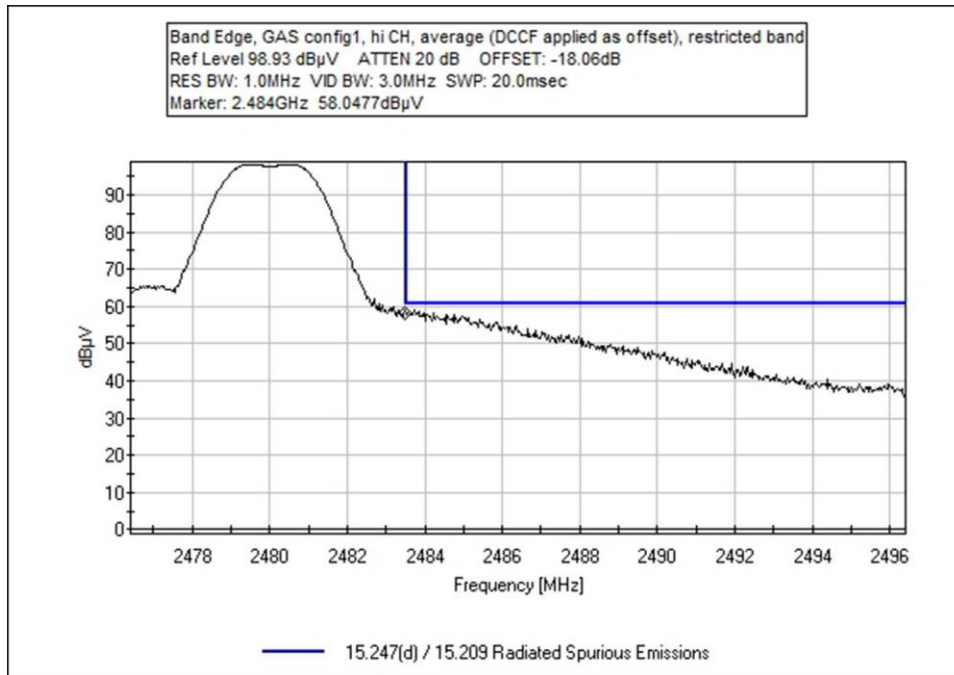
Frequency (MHz)	Modulation	Ant. Type	Field Strength (dBuV/m @3m)	Limit (dBuV/m @3m)	Results
2390.0	GFSK	PCB Trace	34.0*	<54	Pass
2400.0	GFSK	PCB Trace	56.0	<87.6	Pass
2483.5	GFSK	PCB Trace	51.2*	<54	Pass

\*Average readings are calculated from peak readings + DCCF

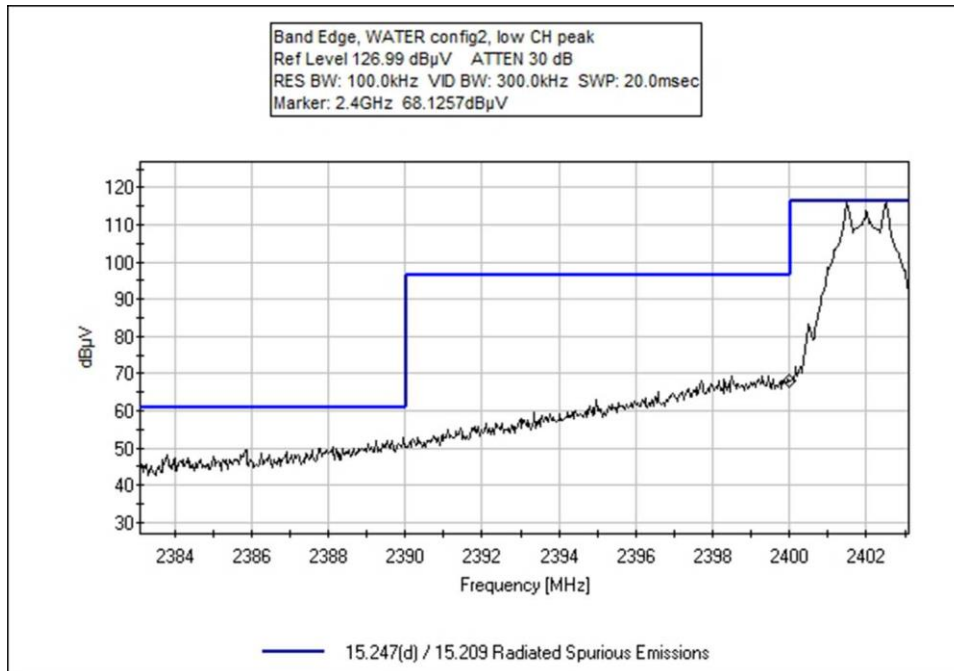
**Band Edge Plots, Configuration 1**

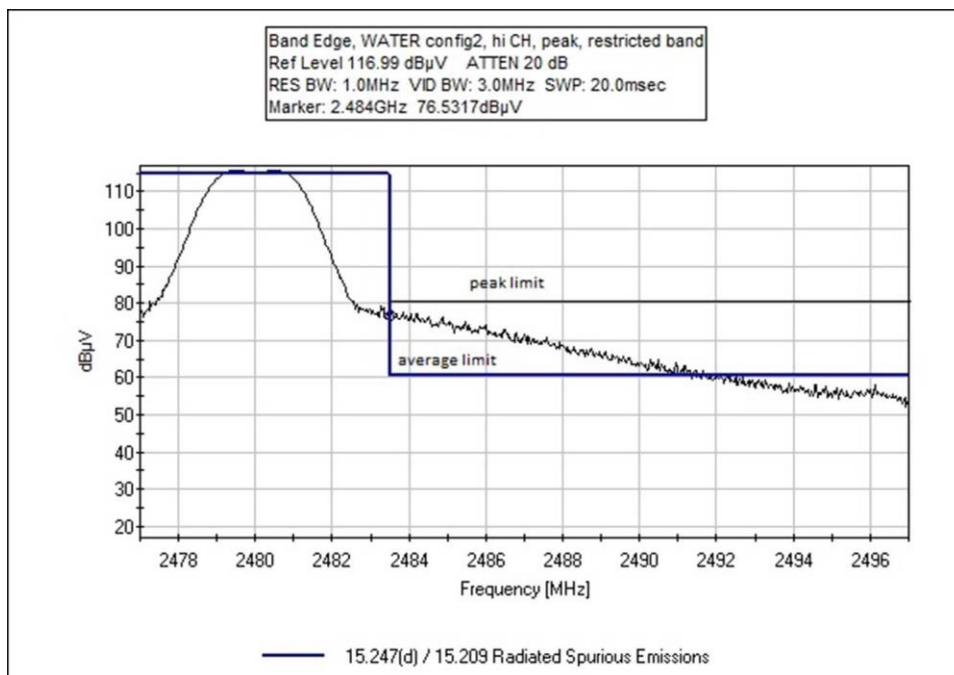
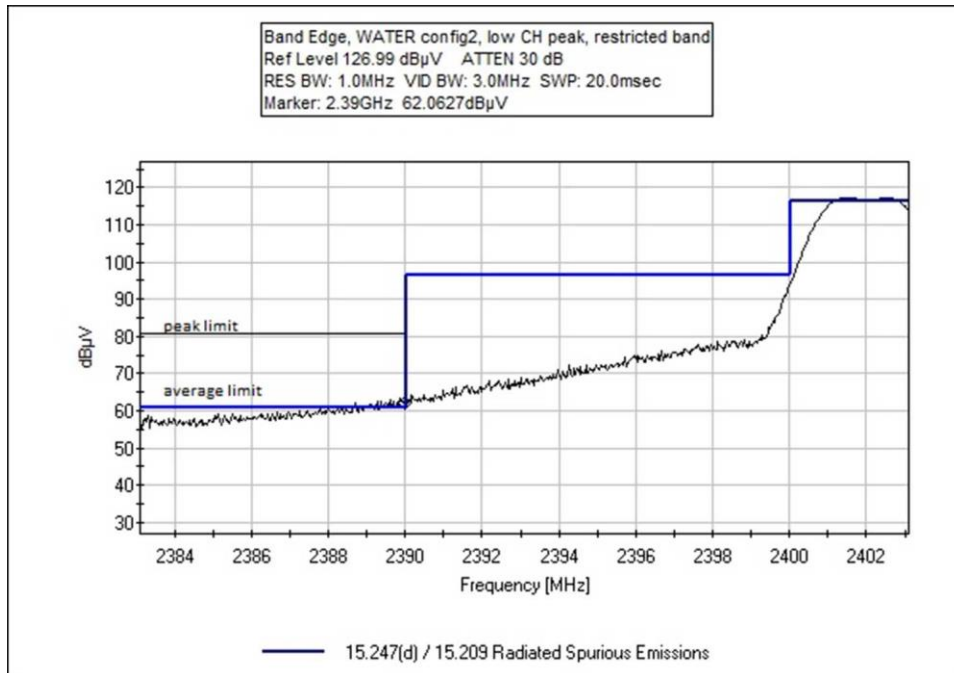


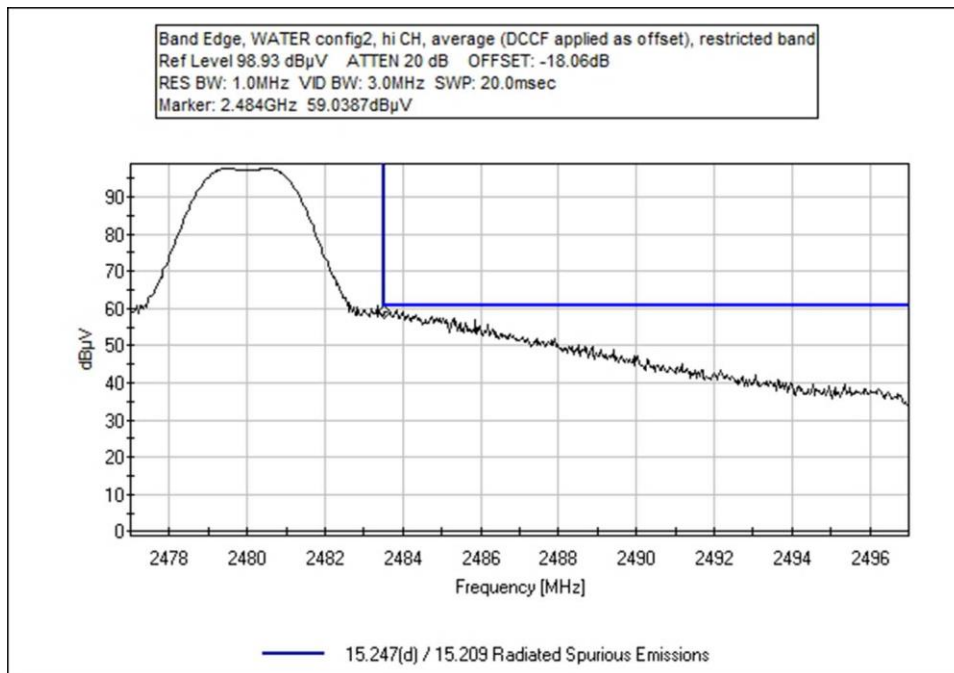
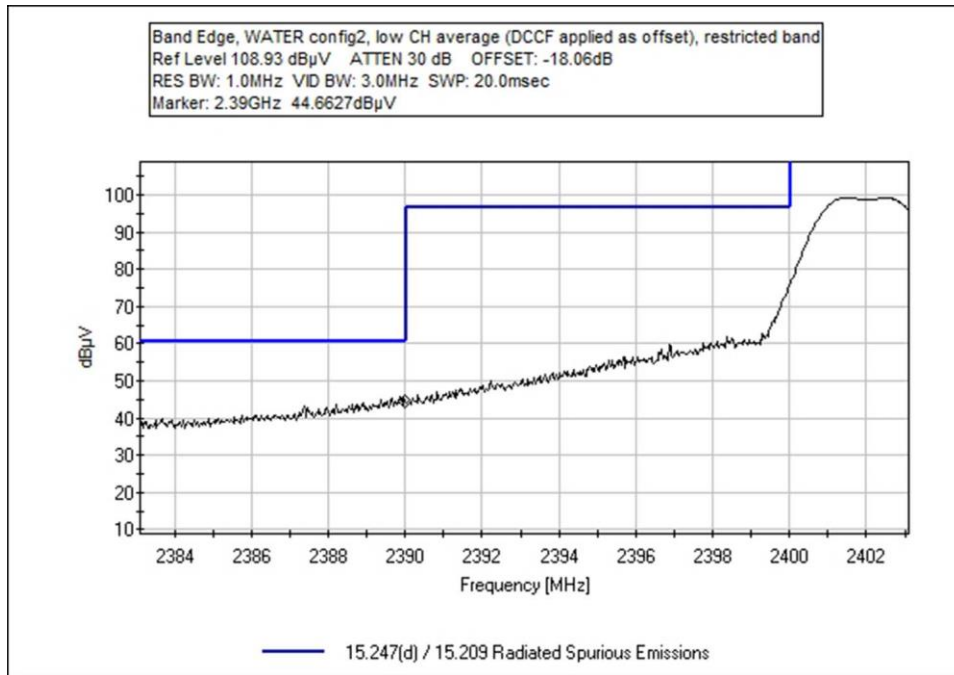




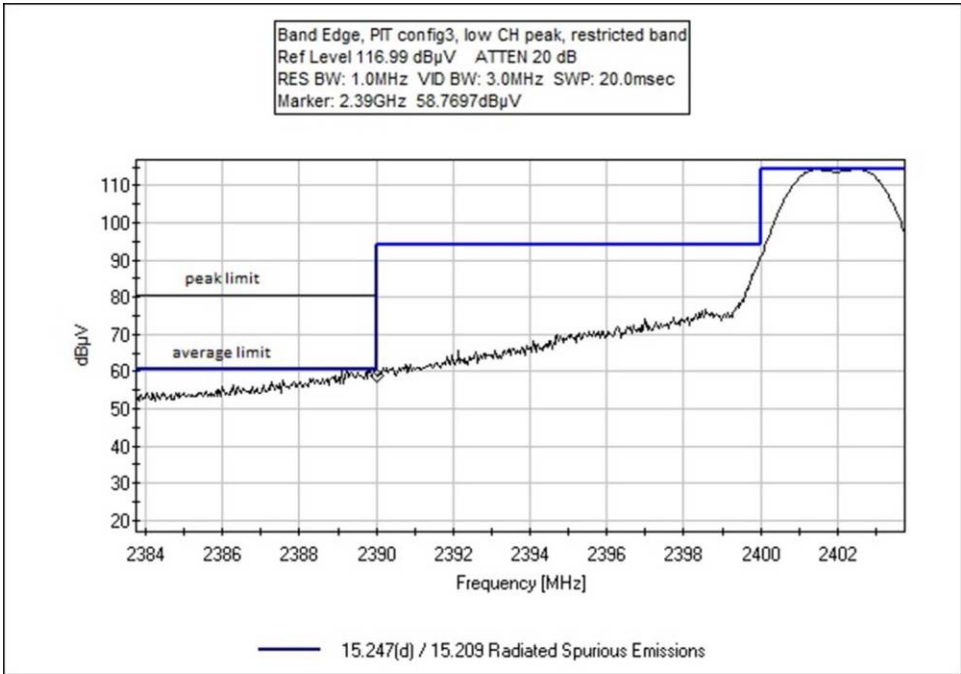
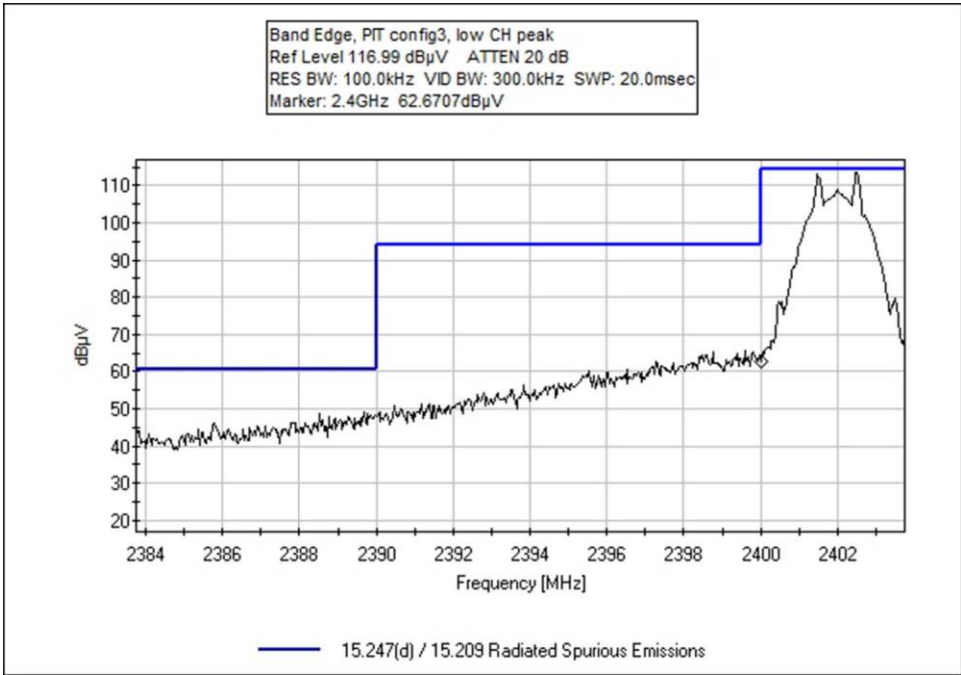
**Band Edge Plots, Configuration 2**



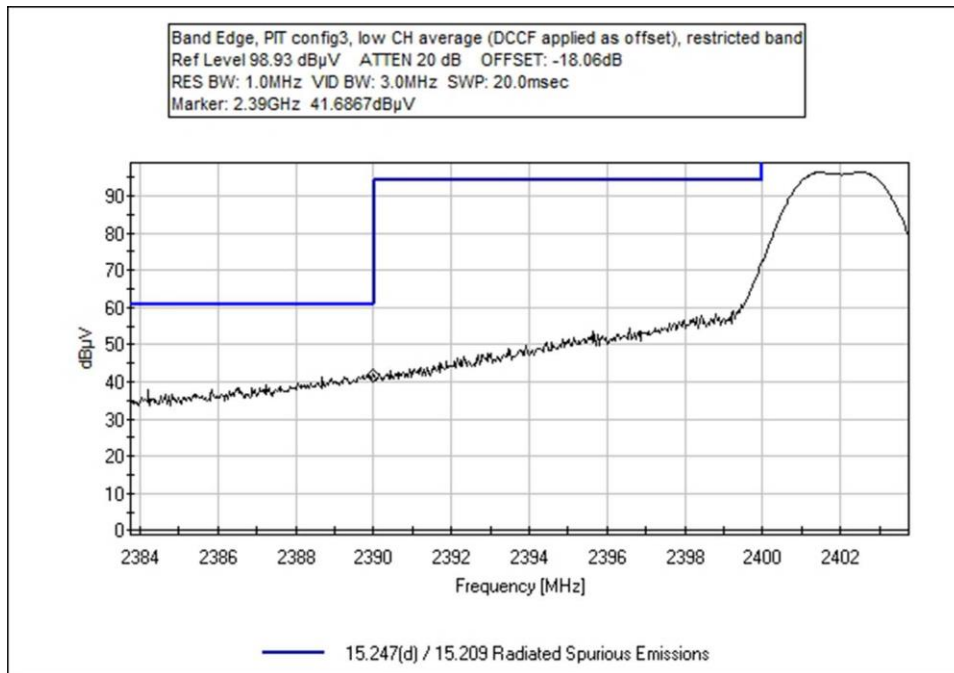
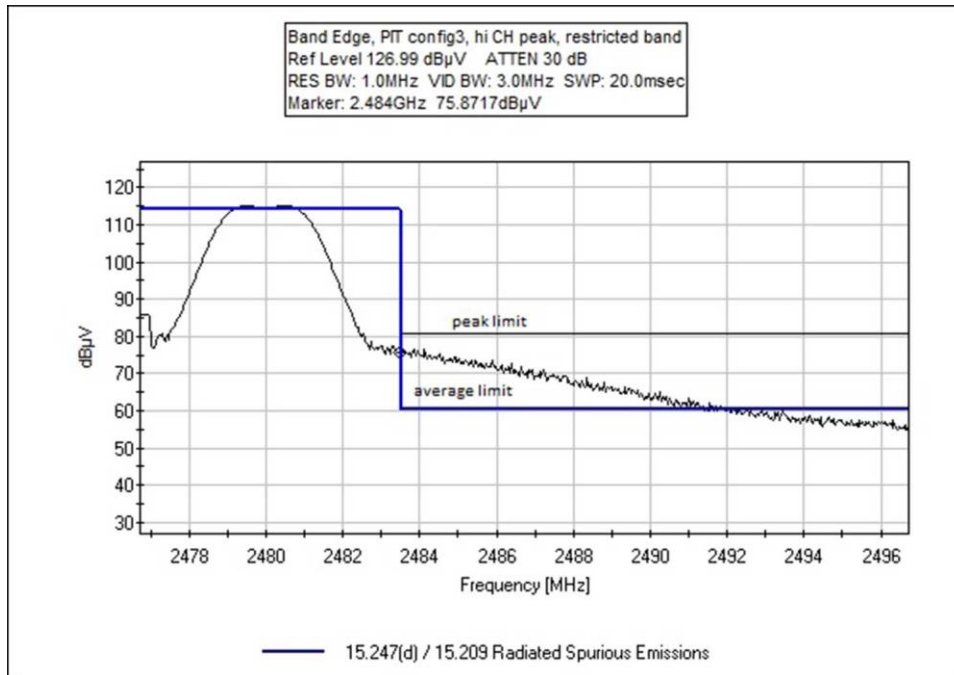


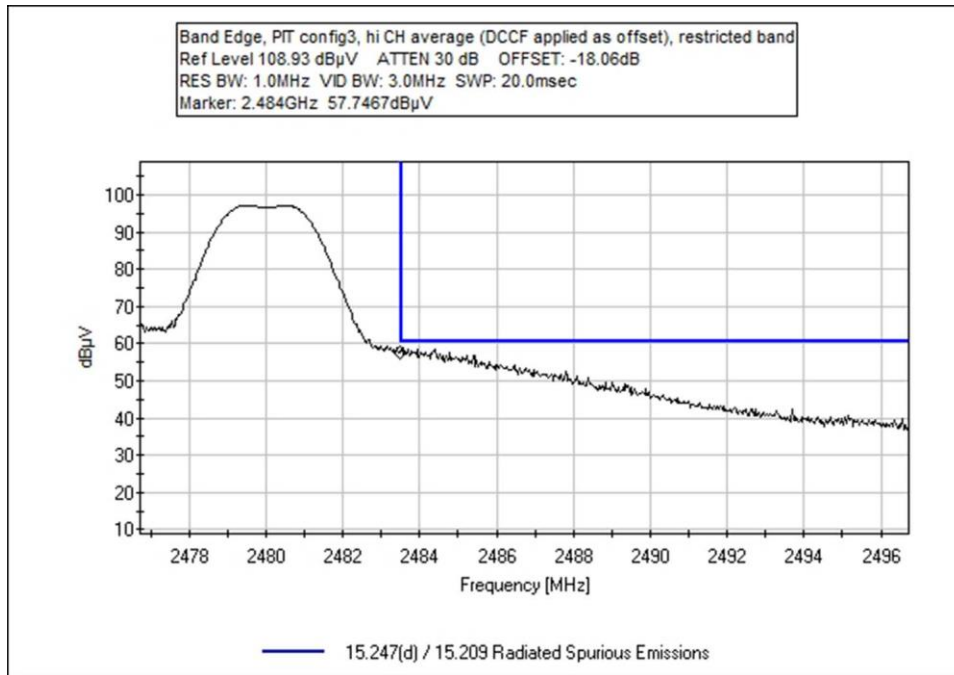


### Band Edge Plots, Configuration 3









**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 #: **104621** Date: 1/11/2021  
 Test Type: **Maximized Emissions** Time: 14:24:53  
 Tested By: Don Nguyen Sequence#: 7  
 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 Styrofoam platform and powered from 3.6V fresh battery. The EUT is connected to a remote located laptop running CLI Tool ver.2.0.1.24.  
 EUT has fixed orientation per manufacture's specification.  
 Operating frequency range/ mode  
 2402-2480MHz, BLE  
 Frequency of measurement: 2390-2483.5MHz  
 RBW=1MHz, VBW=3MHz (restricted band)  
 RBW=100kHz, VBW=300kHz (-20dBc)

Note: The manufacturer declares the worst case duty cycle is 12.5ms per 100ms. Duty cycle correction factor= $20\log(12.5/100) = -18.06$  dB. Average readings in restricted band are calculated from peak readings with duty cycle correction factor.

Test Method: ANSI C63.10 (2013), KDB 558074 v05r02: 04/02/2019  
 Temperature (°C): 22  
 Relative Humidity (%): 47

**Test Equipment:**

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN03643	Spectrum Analyzer	E4440A	5/20/2020	5/20/2022
T2	AN00849	Horn Antenna	3115	3/17/2020	3/17/2022
T3	ANP06360	Cable	L1-PNMNM-48	8/8/2019	8/8/2021
T4	AN00786	Preamp	83017A	5/20/2020	5/20/2022
T5	ANP07246	Cable	32022-29094K-29094K-24TC	5/29/2020	5/29/2022
T6	ANDCCF	Duty Cycle Correction Factor		1/7/2021	1/7/2031

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

#	Freq MHz	Rdng dB $\mu$ V	T1 T5 dB	T2 T6 dB	T3 dB	T4 dB	Dist Table	Corr dB $\mu$ V/m	Spec dB $\mu$ V/m	Margin dB	Polar Ant
1	2483.500M	76.0	+0.0 +0.4	+28.3 -18.1	+3.3	-38.6	+0.0	51.3	54.0	-2.7	Vert
^	2483.500M	76.0	+0.0 +0.4	+28.3 +0.0	+3.3	-38.6	+0.0	69.4	54.0	+15.4	Vert
3	2390.000M	65.6	+0.0 +0.4	+28.3 -18.1	+3.2	-38.6	+0.0	40.8	54.0	-13.2	Vert
^	2390.000M	65.6	+0.0 +0.4	+28.3 +0.0	+3.2	-38.6	+0.0	58.9	54.0	+4.9	Vert
5	2400.000M	70.7	+0.0 +0.4	+28.3 +0.0	+3.2	-38.6	+0.0	64.0	90.9	-26.9	Vert

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 #: **104621** Date: 1/11/2021  
 Test Type: **Maximized Emissions** Time: 14:30:13  
 Tested By: Don Nguyen Sequence#: 9  
 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 Styrofoam platform and powered from 3.6V fresh battery. The EUT is connected to a remote located laptop running CLI Tool ver.2.0.1.24.  
 EUT has fixed orientation per manufacture's specification.  
 Operating frequency range/ mode  
 2402-2480MHz, BLE  
 Frequency of measurement: 2390-2483.5MHz  
 RBW=1MHz, VBW=3MHz (restricted band)  
 RBW=100kHz, VBW=300kHz (-20dBc)

Note: The manufacturer declares the worst case duty cycle is 12.5ms per 100ms. Duty cycle correction factor= $20\log(12.5/100) = -18.06$  dB. Average readings in restricted band are calculated from peak readings with duty cycle correction factor.

Test Method: ANSI C63.10 (2013), KDB 558074 v05r02: 04/02/2019  
 Temperature (°C): 22  
 Relative Humidity (%): 47

**Test Equipment:**

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN03643	Spectrum Analyzer	E4440A	5/20/2020	5/20/2022
T2	AN00849	Horn Antenna	3115	3/17/2020	3/17/2022
T3	ANP06360	Cable	L1-PNMNM-48	8/8/2019	8/8/2021
T4	AN00786	Preamp	83017A	5/20/2020	5/20/2022
T5	ANP07246	Cable	32022-29094K-29094K-24TC	5/29/2020	5/29/2022
T6	ANDCCF	Duty Cycle Correction Factor		1/7/2021	1/7/2031

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

#	Freq MHz	Rdng dB $\mu$ V	T1 T5 dB	T2 T6 dB	T3 dB	T4 dB	Dist Table	Corr dB $\mu$ V/m	Spec dB $\mu$ V/m	Margin dB	Polar Ant
1	2483.500M	76.5	+0.0	+28.3	+3.3	-38.6	+0.0	51.8	54.0	-2.2	Vert
	Ave		+0.4	-18.1							
^	2483.500M	76.5	+0.0	+28.3	+3.3	-38.6	+0.0	69.9	54.0	+15.9	Vert
			+0.4	+0.0							
3	2390.000M	62.1	+0.0	+28.3	+3.2	-38.6	+0.0	37.3	54.0	-16.7	Vert
	Ave		+0.4	-18.1							
^	2390.000M	62.1	+0.0	+28.3	+3.2	-38.6	+0.0	55.4	54.0	+1.4	Vert
			+0.4	+0.0							
5	2400.000M	68.1	+0.0	+28.3	+3.2	-38.6	+0.0	61.4	89.8	-28.4	Vert
			+0.4	+0.0							

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 #: **104621** Date: 1/11/2021  
 Test Type: **Maximized Emissions** Time: 14:35:09  
 Tested By: Don Nguyen Sequence#: 8  
 Software: EMITest 5.03.19

**Equipment Tested:**

Device	Manufacturer	Model #	S/N
Configuration 3			

**Support Equipment:**

Device	Manufacturer	Model #	S/N
Configuration 3			

**Test Conditions / Notes:**

The EUT is placed on Styrofoam platform and powered from 3.6V fresh battery. The EUT is connected to a remote located laptop running CLI Tool ver.2.0.1.24.  
 EUT has fixed orientation per manufacture's specification.  
 Operating frequency range/ mode  
 2402-2480MHz, BLE  
 Frequency of measurement: 2390-2483.5MHz  
 RBW=1MHz, VBW=3MHz (restricted band)  
 RBW=100kHz, VBW=300kHz (-20dBc)

Note: The manufacturer declares the worst case duty cycle is 12.5ms per 100ms. Duty cycle correction factor= $20\log(12.5/100) = -18.06$  dB. Average readings in restricted band are calculated from peak readings with duty cycle correction factor.

Test Method: ANSI C63.10 (2013), KDB 558074 v05r02: 04/02/2019  
 Temperature (°C): 22  
 Relative Humidity (%): 47

**Test Equipment:**

ID	Asset #/Serial #	Description	Model	Calibration Date	Cal Due Date
T1	AN03643	Spectrum Analyzer	E4440A	5/20/2020	5/20/2022
T2	AN00849	Horn Antenna	3115	3/17/2020	3/17/2022
T3	ANP06360	Cable	L1-PNMNM-48	8/8/2019	8/8/2021
T4	AN00786	Preamp	83017A	5/20/2020	5/20/2022
T5	ANP07246	Cable	32022-29094K-29094K-24TC	5/29/2020	5/29/2022
T6	ANDCCF	Duty Cycle Correction Factor		1/7/2021	1/7/2031

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

#	Freq MHz	Rdng dB $\mu$ V	T1 T5 dB	T2 T6 dB	T3 dB	T4 dB	Dist Table	Corr dB $\mu$ V/m	Spec dB $\mu$ V/m	Margin dB	Polar Ant
1	2483.500M	75.9	+0.0 +0.4	+28.3 -18.1	+3.3	-38.6	+0.0	51.2	54.0	-2.8	Vert
^	2483.500M	75.9	+0.0 +0.4	+28.3 +0.0	+3.3	-38.6	+0.0	69.3	54.0	+15.3	Vert
3	2390.000M	58.8	+0.0 +0.4	+28.3 -18.1	+3.2	-38.6	+0.0	34.0	54.0	-20.0	Vert
^	2390.000M	58.8	+0.0 +0.4	+28.3 +0.0	+3.2	-38.6	+0.0	52.1	54.0	-1.9	Vert
5	2400.000M	62.7	+0.0 +0.4	+28.3 +0.0	+3.2	-38.6	+0.0	56.0	87.6	-31.6	Vert



**Test Setup Photo(s)**



Configuration 1, Below 1GHz



Configuration 1, Below 1GHz



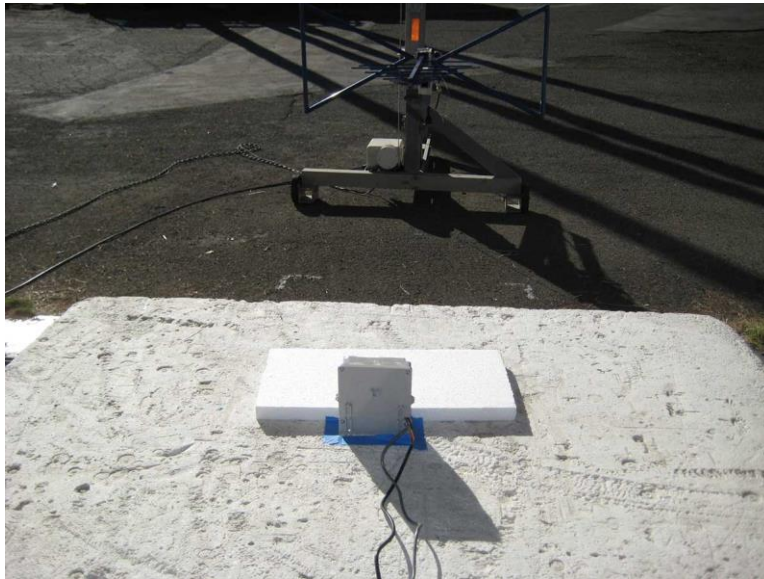
Configuration 1, Above 1GHz



Configuration 1, Above 1GHz

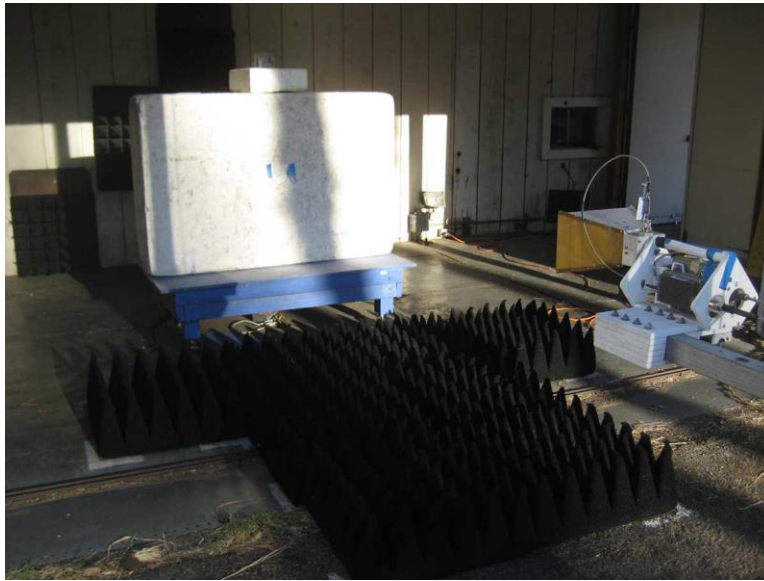


Configuration 2, Below 1GHz



Configuration 2, Below 1GHz





Configuration 2, Above 1GHz



Configuration 2, Above 1GHz



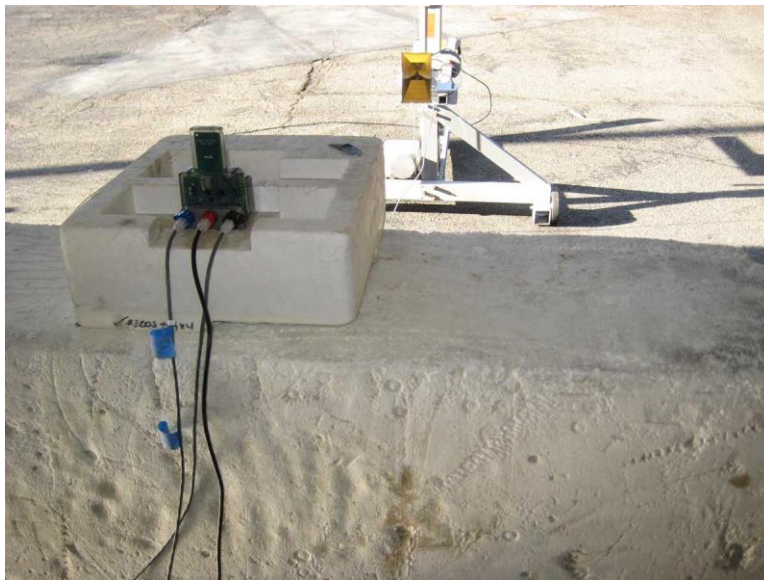
Configuration 3, Below 1GHz



Configuration 3, Below 1GHz



Configuration 3, Above 1GHz



Configuration 3, Above 1GHz

## 15.247(e) Power Spectral Density

Test Setup / Conditions / Data			
Test Location:	Brea Lab A	Test Engineer:	Don Nguyen
Test Method:	ANSI C63.10 (2013), KDB 558074 v05r02: 04/02/2019	Test Date(s):	12/21/2020
Configuration:	4		
Test Setup:	<p>The EUT is placed on test bench and powered from 3.6Vdc power supply (to simulate fresh battery). The EUT is connected to a support laptop running CLI Tool ver.2.0.1.24.</p> <p>Operating frequency range: 2402-2480MHz            Tested frequency range: 2402-2480MHz            RBW=3kHz, VBW=9.1kHz</p> <p>Note: Three EUTs have the same internal hardware. Conducted data measured on one EUT represents for all three EUTs.</p>		

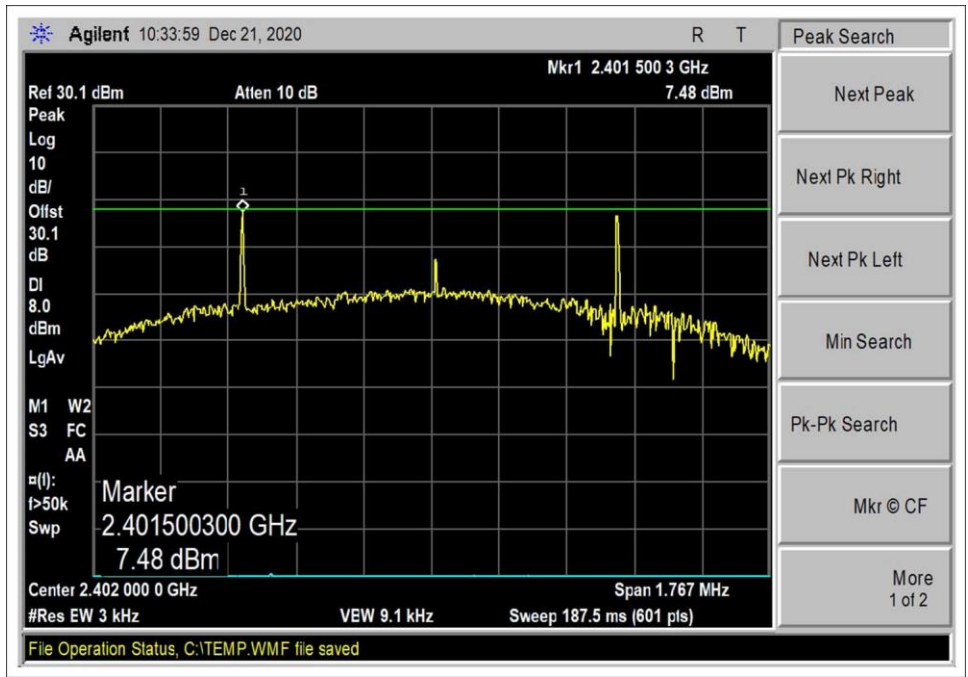
Environmental Conditions			
Temperature (°C)	23.1	Relative Humidity (%):	25

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

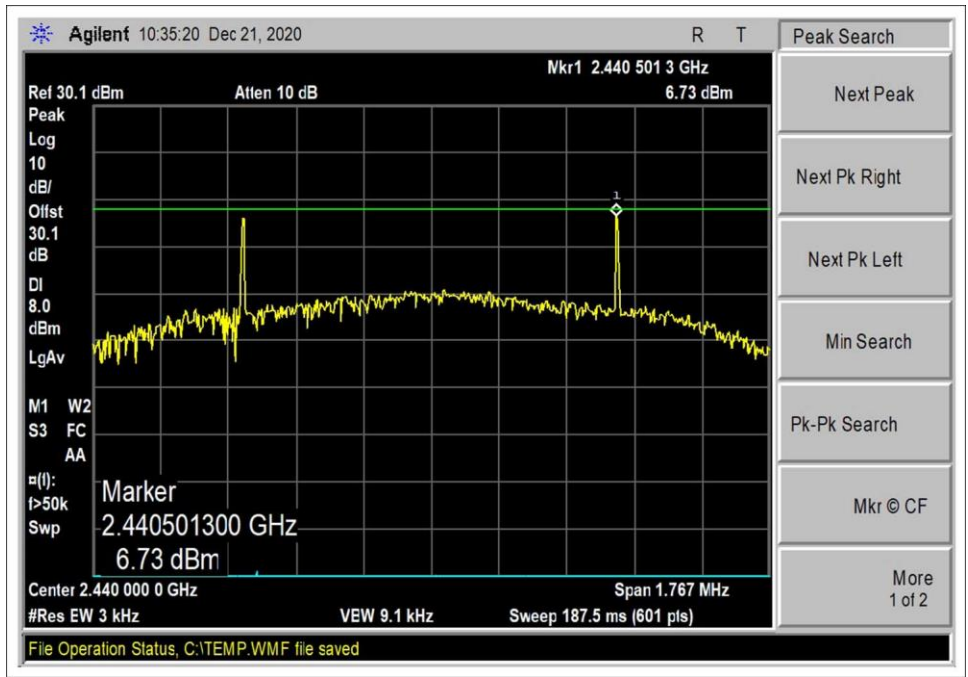
PSD Test Data Summary - RF Conducted Measurement				
Measurement Method: PKPSD				
Frequency (MHz)	Modulation	Measured (dBm/3kHz)	Limit (dBm/3kHz)	Results
2402	GFSK	7.48	≤8	Pass
2440	GFSK	6.73	≤8	Pass
2480	GFSK	6.03	≤8	Pass



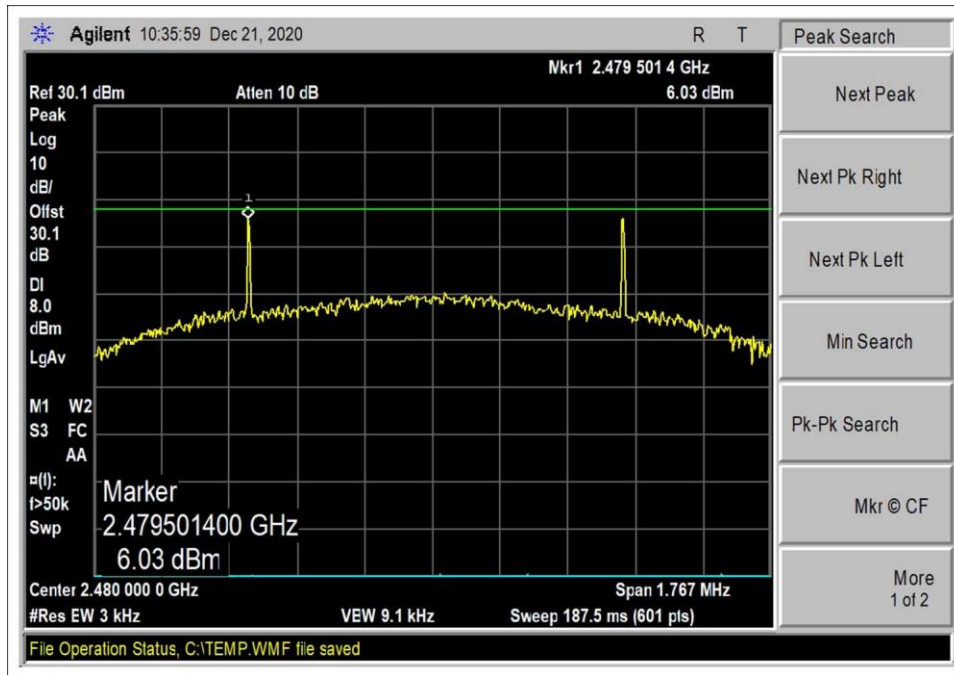
## Plots



Low Channel

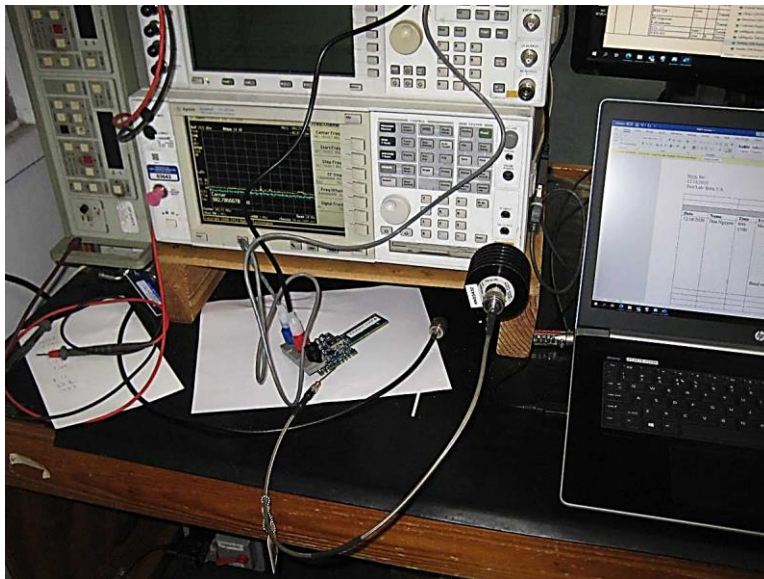


Middle Channel



High Channel

Test Setup Photo(s)



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

<b>MEASURING EQUIPMENT BANDWIDTH SETTINGS PER FREQUENCY RANGE</b>			
<b>TEST</b>	<b>BEGINNING FREQUENCY</b>	<b>ENDING FREQUENCY</b>	<b>BANDWIDTH SETTING</b>
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.