

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

(HYBRID 902-928MHz Hybrid)

Report No.: 104621-16

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:

Ittron, 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, 2020

January 21, 22 and 25, 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.

A handwritten signature in black ink that reads "Steve Behm". The signature is written in a cursive style and is positioned above a horizontal line.

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 (Hybrid 902-928MHz)

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

NA = Not Applicable

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

NP= CKC Laboratories was not contracted to perform test. See manufacturer Declaration in Average Time of Occupancy Section.

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
MOD 1 = Power setting changed from 0x00C00D7 to 0x00C0070 for OOK LV3 and to 0x00C0040 for GFSK LV3.

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:	Proprietary Low power and FHSS
Operating Frequency Range:	902.4 – 927.6MHz, 400kHz steps, 64 channels, 300kbps GFSK LV2 Hybrid
Number of Hopping Channels:	64 (GFSK)
Receiver Bandwidth and Synchronization:	The manufacturer declares the receiver input bandwidth matches the transmit channel bandwidth and shifts frequencies in synchronization with the transmitter.
Modulation Type(s):	300kbps GFSK
Maximum Duty Cycle:	45%
Number of TX Chains:	1
Antenna Type(s) and Gain:	PCB Trace/1.1dBi
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

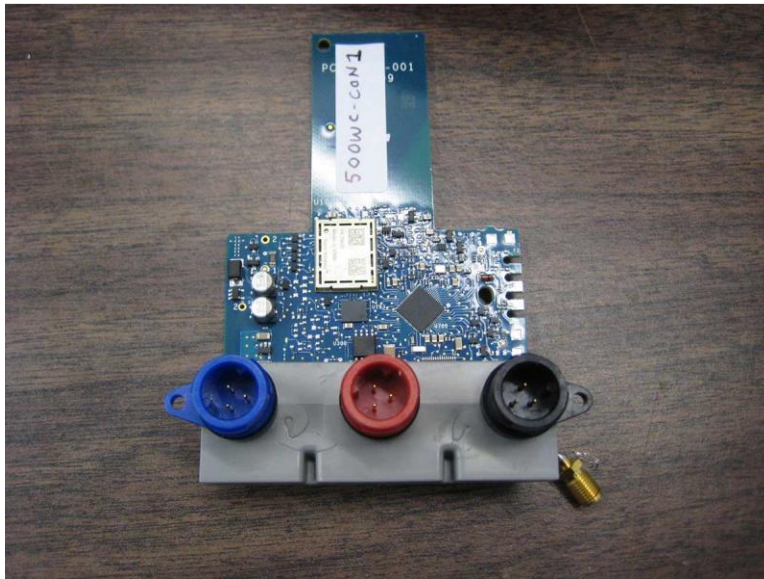
EUT and Accessory Photo(s)



GRMTC0



WPITC0



WPITC0 - Conducted



WRMTC0

Support Equipment Photo(s)



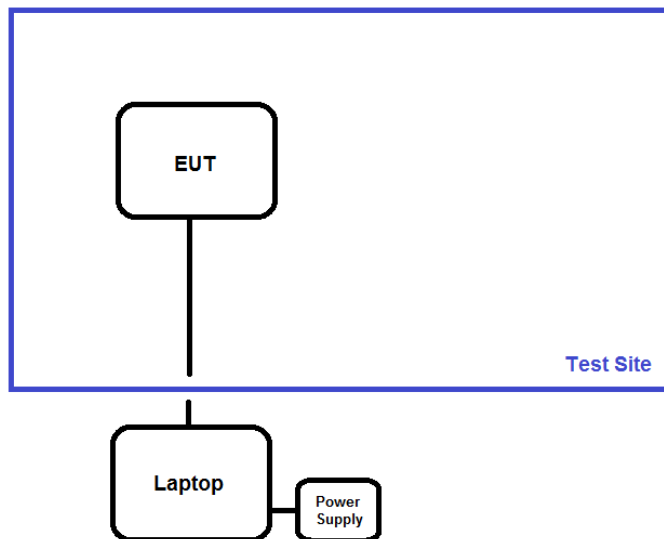
12V PSU



Laptop and Laptop PSU

Block Diagram of Test Setup(s)

Test Setup Block Diagram



FCC Part 15 Subpart C

15.247(a) Transmitter Characteristics

Test Setup/Conditions			
Test Location:	Brea Lab A	Test Engineer:	Don Nguyen
Test Method:	ANSI C63.10 (2013)	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/ modes 902.4 – 927.6MHz, 400kHz steps, 64 channels, 300kbps GFSK LV2 Tested frequency range: 902.4-927.6MHz		

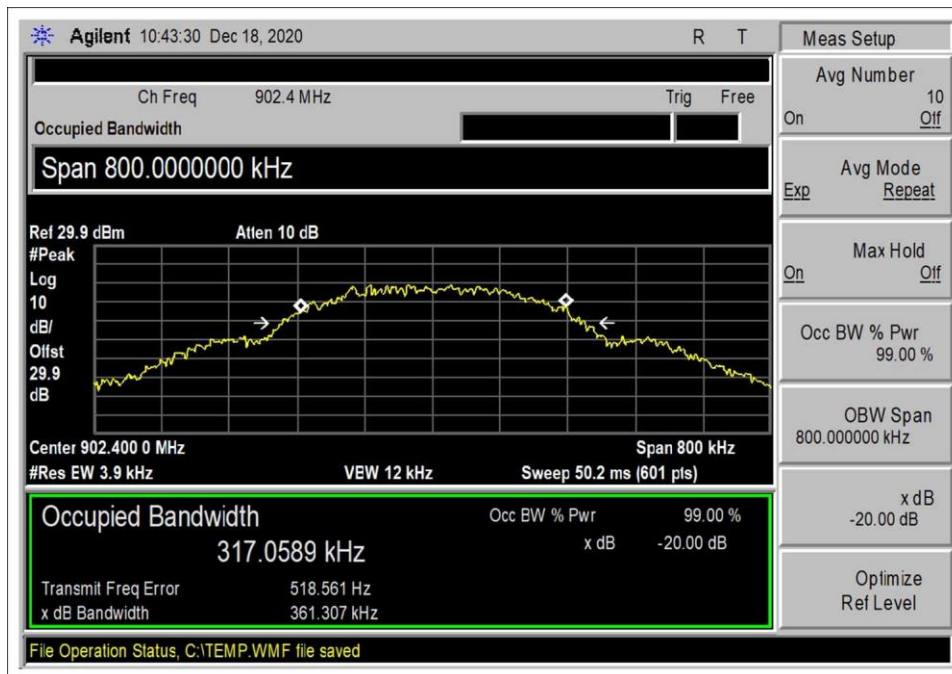
Environmental Conditions			
Temperature (°C)	18.6	Relative Humidity (%):	45

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

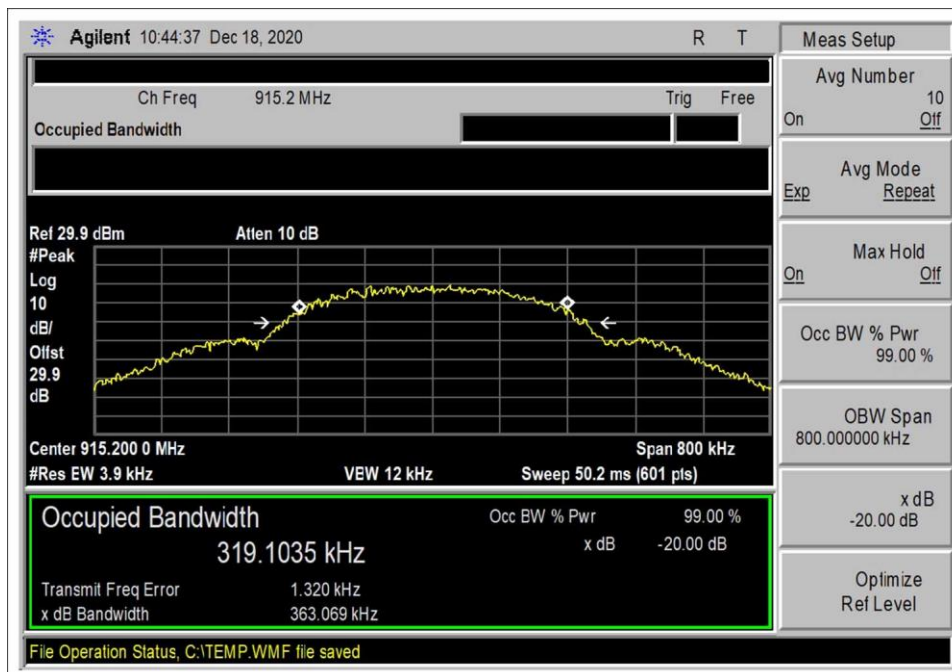
15.247(a)(1)(i) 20 dB Bandwidth

Test Data Summary					
Frequency (MHz)	Antenna Port	Modulation	Measured (kHz)	Limit (kHz)	Results
902.4	1	300k GFSK LV2	361.307	≤500	Pass
915.2	1	300k GFSK LV2	363.069	≤500	Pass
927.6	1	300k GFSK LV2	365.474	≤500	Pass

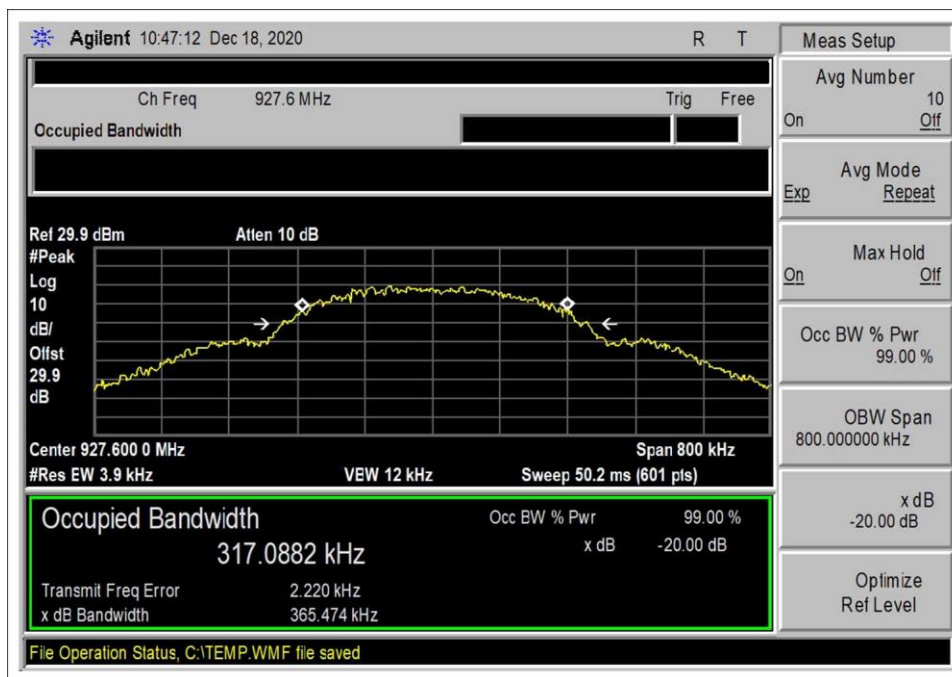
Plot(s)



Low Channel



Middle Channel

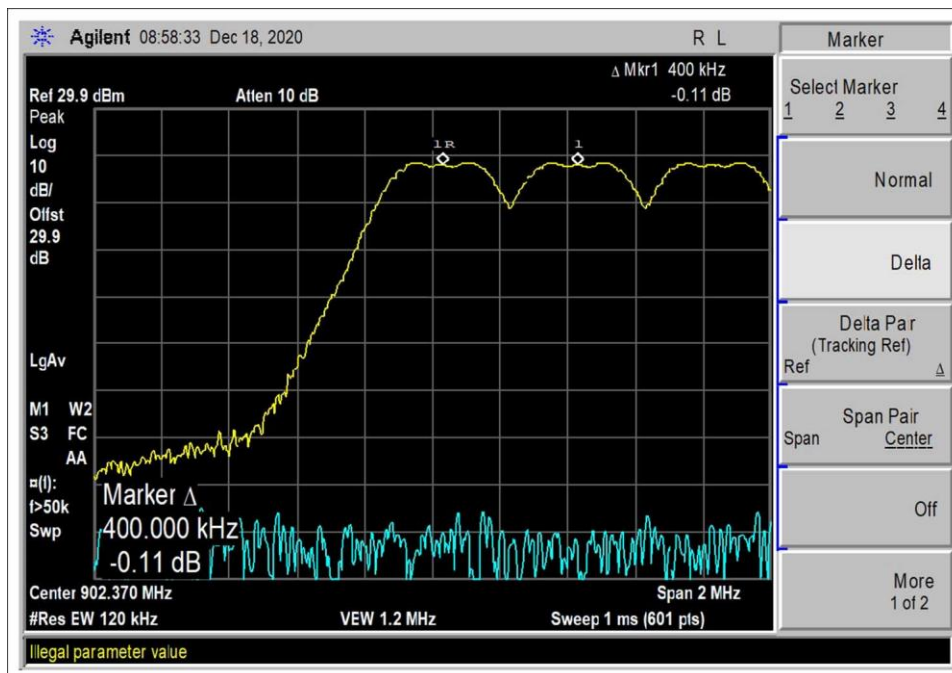


High Channel

15.247(a)(1) Carrier Separation

Test Data Summary				
Limit applied: 20dB bandwidth of the hopping channel.				
Antenna Port	Operational Mode	Measured (kHz)	Limit (kHz)	Results
1	300k GFSK LV2	400	>365.474	Pass

Plot(s)

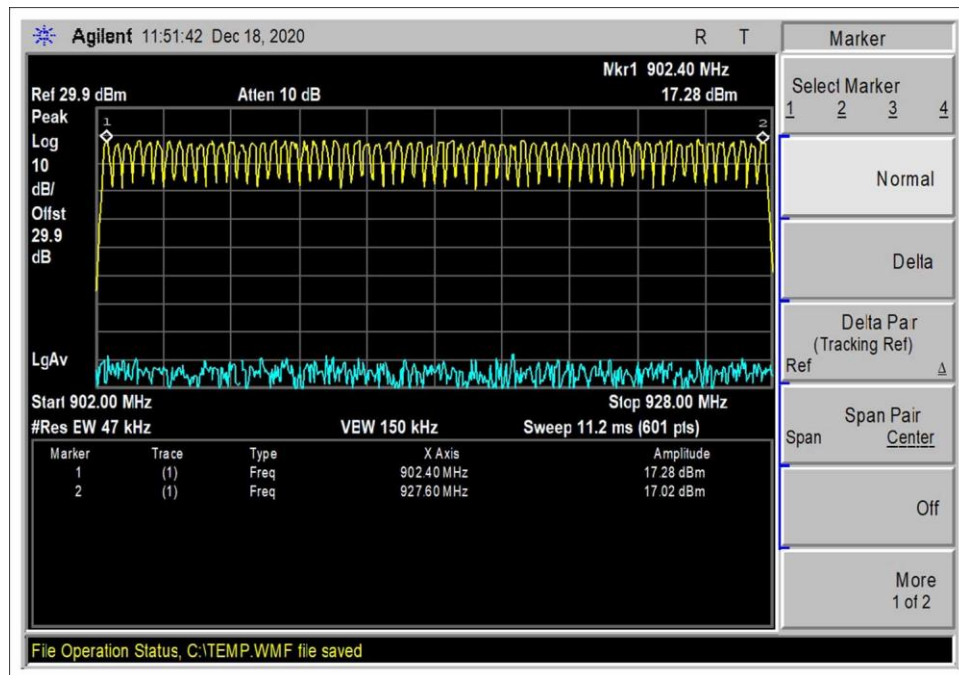


15.247(a)(1)(i) Number of Hopping Channels

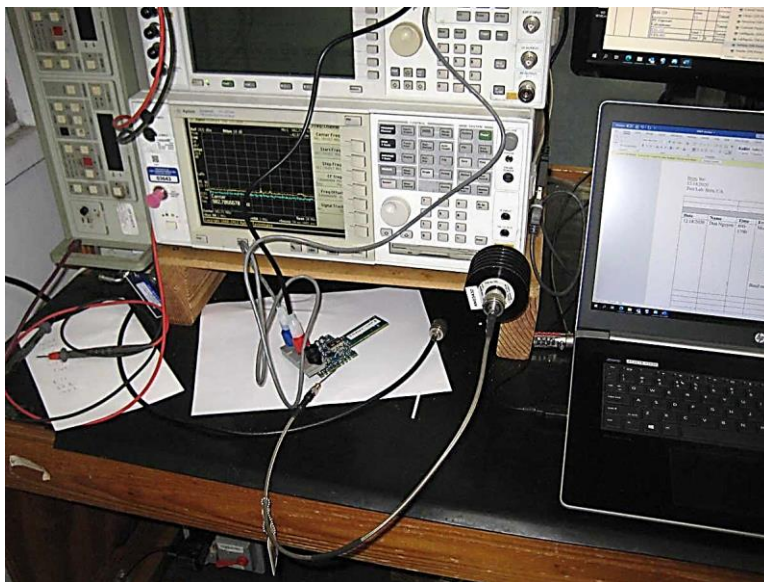
Test Data Summary				
$\text{Limit} = \begin{cases} 50 \text{ Channels} & 20 \text{ dB BW} < 250\text{kHz} \\ 25 \text{ Channels} & 20 \text{ dB BW} \geq 250\text{kHz} \end{cases}$				
Antenna Port	Operational Mode	Measured (Channels)	Limit (Channels)	Results
1	300k GFSK LV2	64	≥ 25	Pass

Note: Hybrid mode uses minimum 3 out of 64 channels.

Plot(s)



Test Setup Photo(s)



15.247(b)(2) Output Power

Test Setup/Conditions			
Test Location:	Brea Lab A	Test Engineer:	Don Nguyen
Test Method:	ANSI C63.10 (2013)	Test Date(s):	1/21/2021
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/ mode 902.4 – 927.6MHz, 400kHz steps, 64 channels, 300kbps GFSK LV2 Tested frequency range: 902.4-927.6MHz RBW=1MHz, VBW=3MHz Modification 1 was in place during testing.		

Environmental Conditions			
Temperature (°C)	24	Relative Humidity (%):	34

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 _{Nominal} :	3.6Vdc
V _{Minimum} :	3.6Vdc
V _{Maximum} :	3.6Vdc

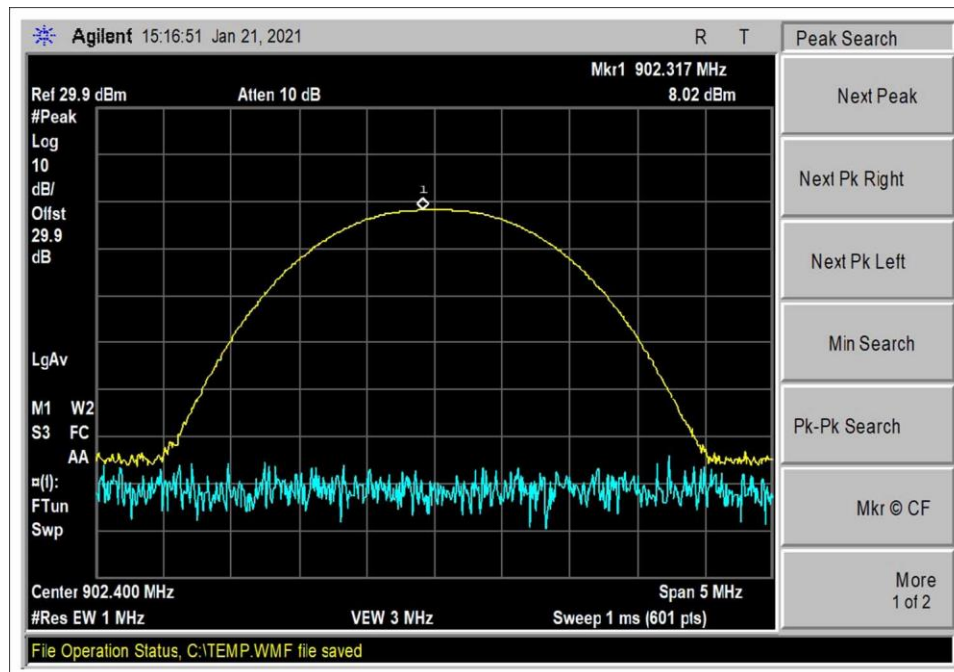
Test Data Summary - Voltage Variations

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

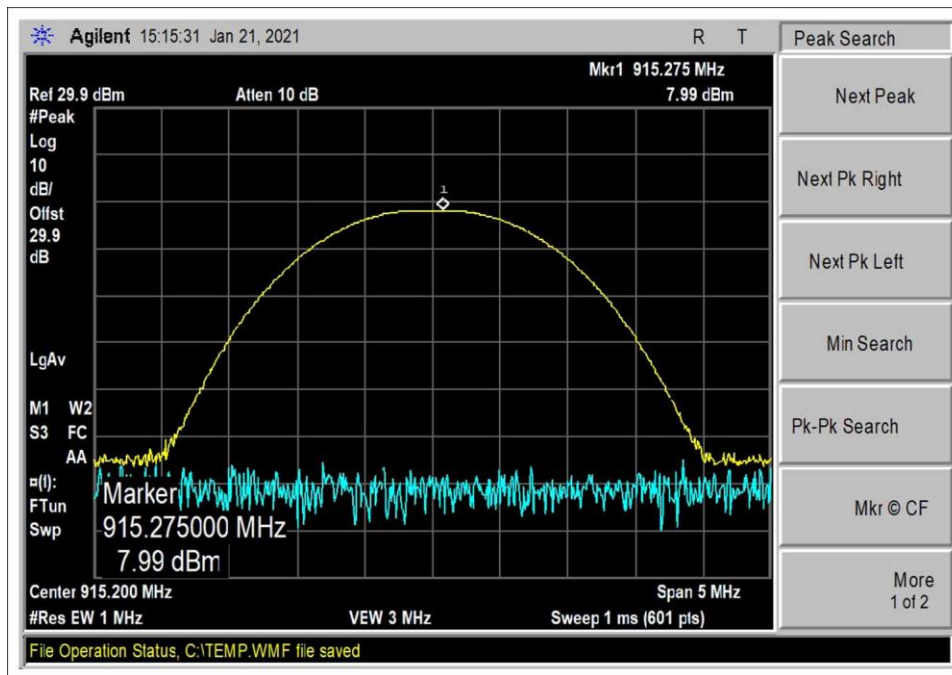
Test Data Summary - RF Conducted Measurement

$\text{Limit} = \begin{cases} 30\text{dBm Conducted}/36\text{dBm EIRP} & \geq 50 \text{ Channels} \\ 24\text{dBm Conducted}/30\text{dBm EIRP} & < 50 \text{ Channels (min 25)} \end{cases}$					
Frequency (MHz)	Modulation	Ant. Type / Gain (dBi)	Measured (dBm)	Limit (dBm)	Results
902.4	300k GFSK LV2	PCB Trace	8.02	≤ 30	Pass
915.2	300k GFSK LV2	PCB Trace	7.99	≤ 30	Pass
927.6	300k GFSK LV2	PCB Trace	7.96	≤ 30	Pass

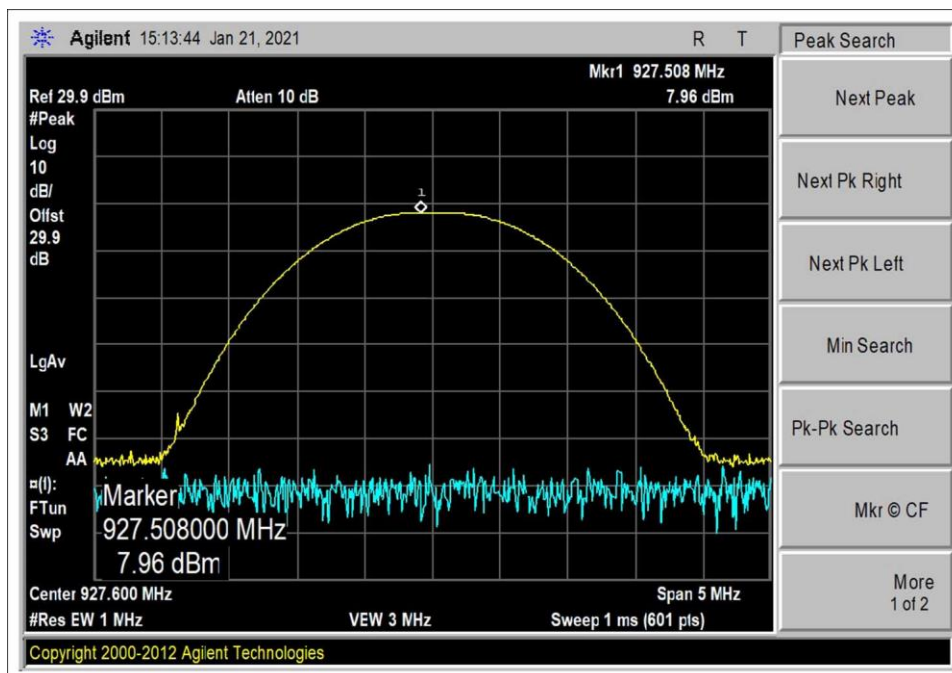
Plots



Low Channel

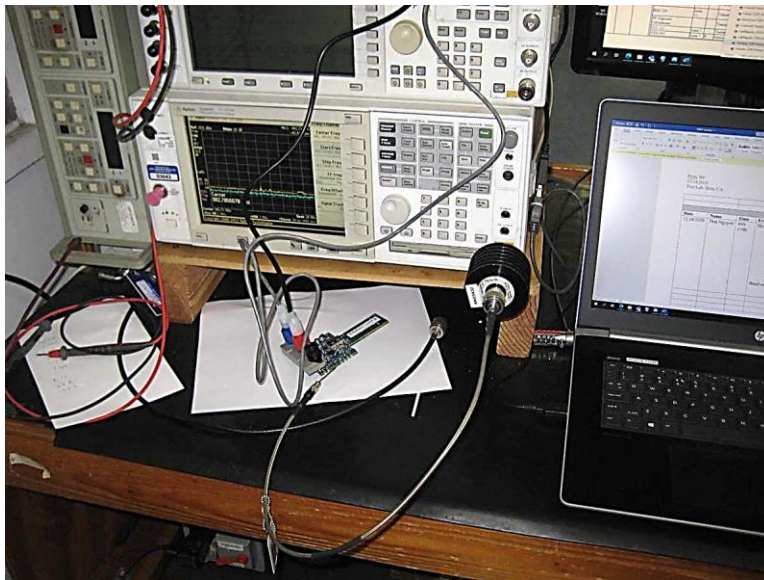


Middle Channel



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: 1/22/2021
 Test Type: **Conducted Emissions** Time: 08:11:45
 Tested By: Don Nguyen Sequence#: 3
 Software: EMITest 5.03.19

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 4			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 4			

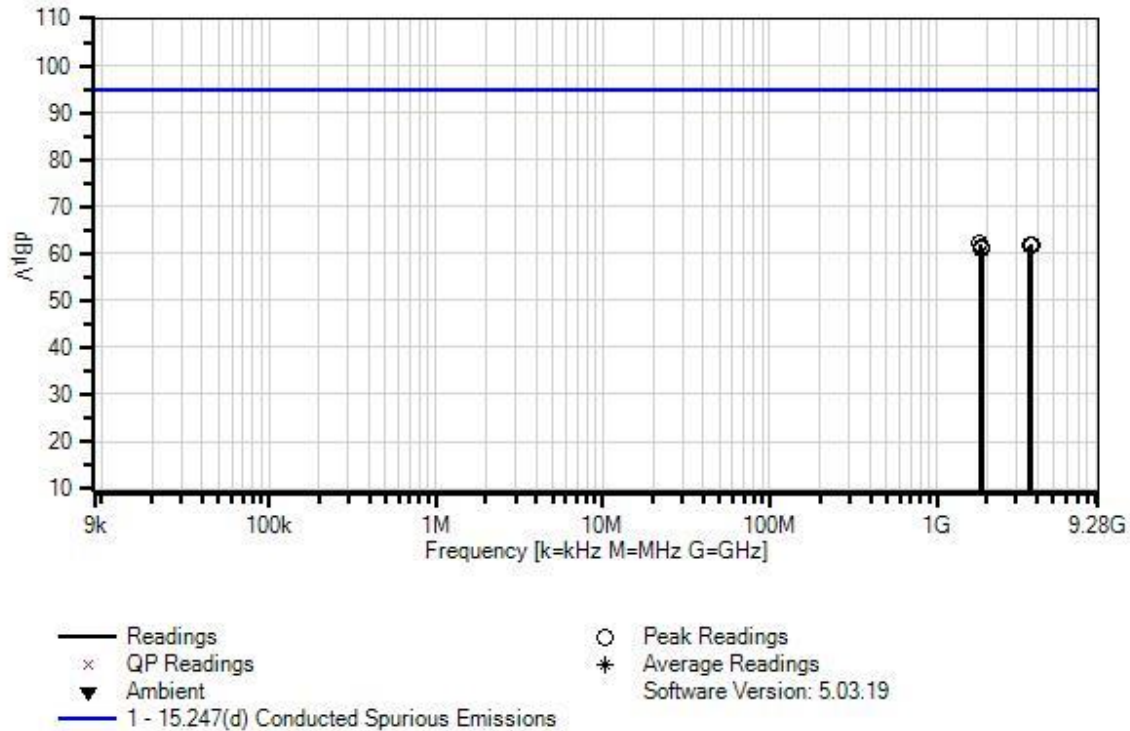
Test Conditions / Notes:

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
 902.4 - 927.6MHz, 400kHz steps, 64 channels, 300kbps **GFSK LV2/LV3**
 Frequency of measurement: 9kHz-9.28GHz
 RBW=100kHz, VBW=300kHz

 Test Method: ANSI C63.10 (2013)
 Temperature (°C): 24
 Relative Humidity (%): 34

 Modification 1 was in place during testing.

Itron, Inc. W/O#: 104621 Sequence#: 3 Date: 1/22/2021
15.247(d) Conducted Spurious Emissions Test Distance: None Antenna Port



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN03432	Attenuator	90-30-34	10/22/2019	10/22/2021
T2	ANP07246	Cable	32022-29094K-29094K-24TC	5/29/2020	5/29/2022
	AN02869	Spectrum Analyzer	E4440A	8/3/2020	8/3/2021

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	1804.644M	32.2	+29.6	+0.4			+0.0	62.2	95.0	-32.8	Anten
2	3710.100M	31.4	+29.8	+0.7			+0.0	61.9	95.0	-33.1	Anten
3	3609.913M	31.4	+29.7	+0.6			+0.0	61.7	95.0	-33.3	Anten
4	3661.113M	31.1	+29.8	+0.7			+0.0	61.6	95.0	-33.4	Anten
5	1830.553M	31.4	+29.6	+0.4			+0.0	61.4	95.0	-33.6	Anten
6	1855.053M	31.0	+29.6	+0.4			+0.0	61.0	95.0	-34.0	Anten

Band Edge

Band Edge Summary

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

Operating Mode: Single Channel (Low and High)

Frequency (MHz)	Modulation	Measured (dBm)	Limit (dBm)	Results
902	300k GFSK LV2	-32.68	<-11.98	Pass
928	300k GFSK LV2	-35.66	<-11.98	Pass

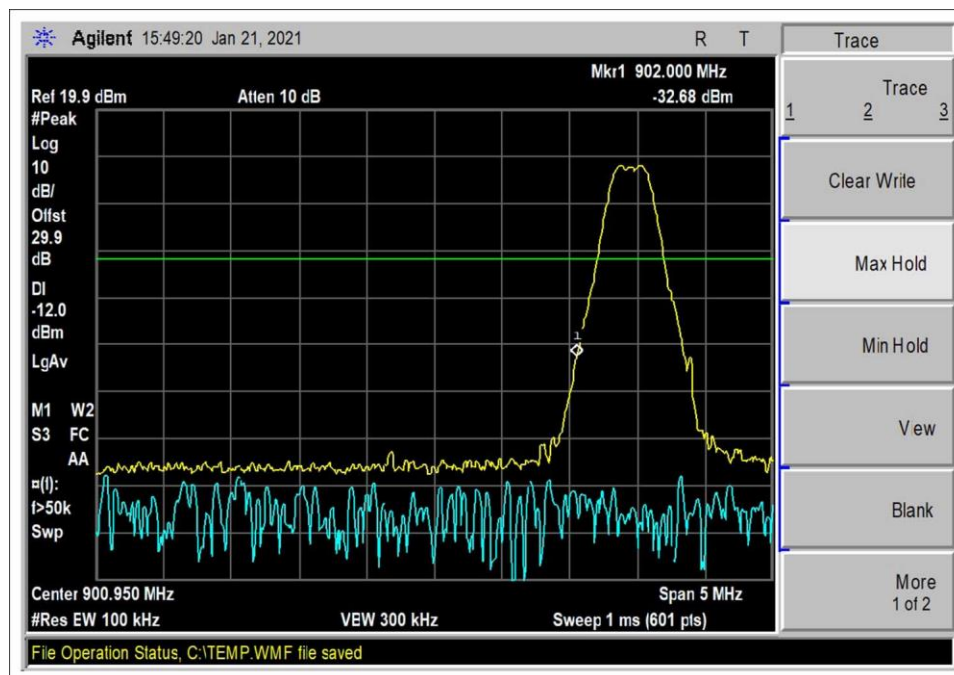
Band Edge Summary

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

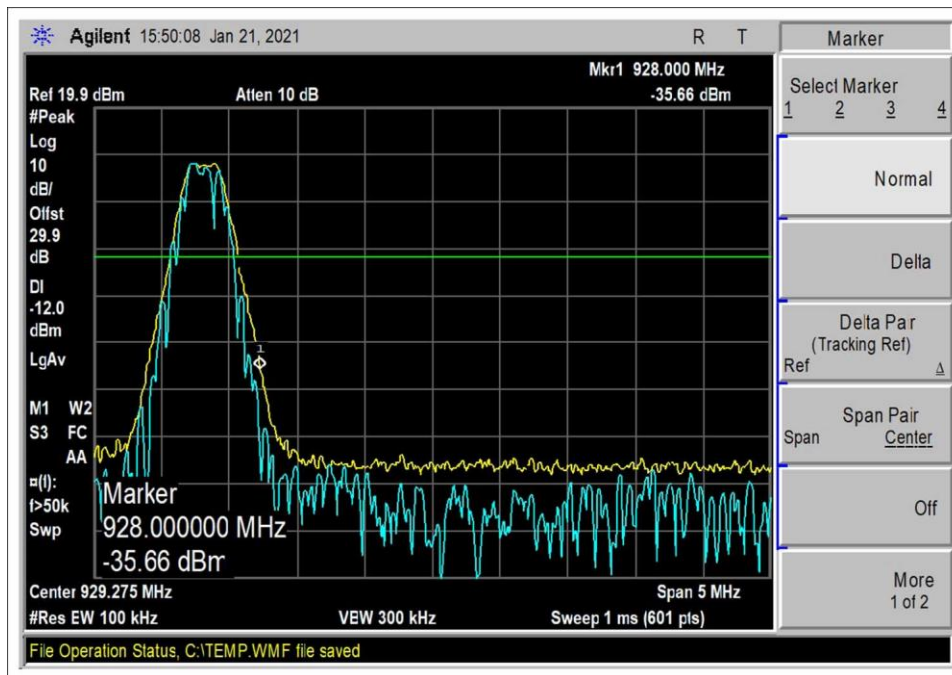
Operating Mode: Hopping

Frequency (MHz)	Modulation	Measured (dBm)	Limit (dBm)	Results
902	300k GFSK LV2	-32.76	<-11.98	Pass
928	300k GFSK LV2	-34.92	<-11.98	Pass

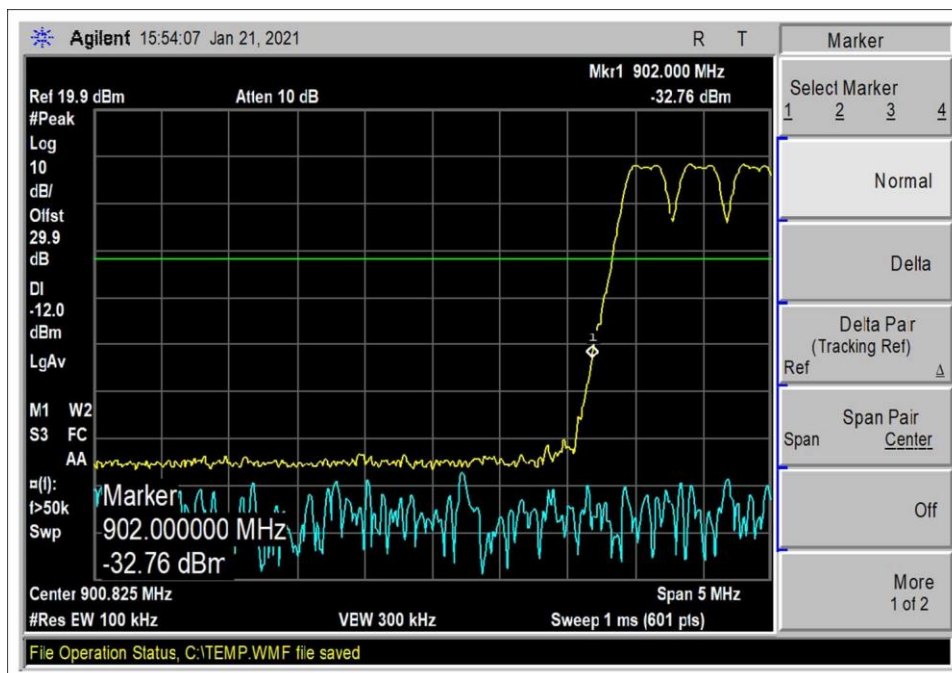
Band Edge Plots



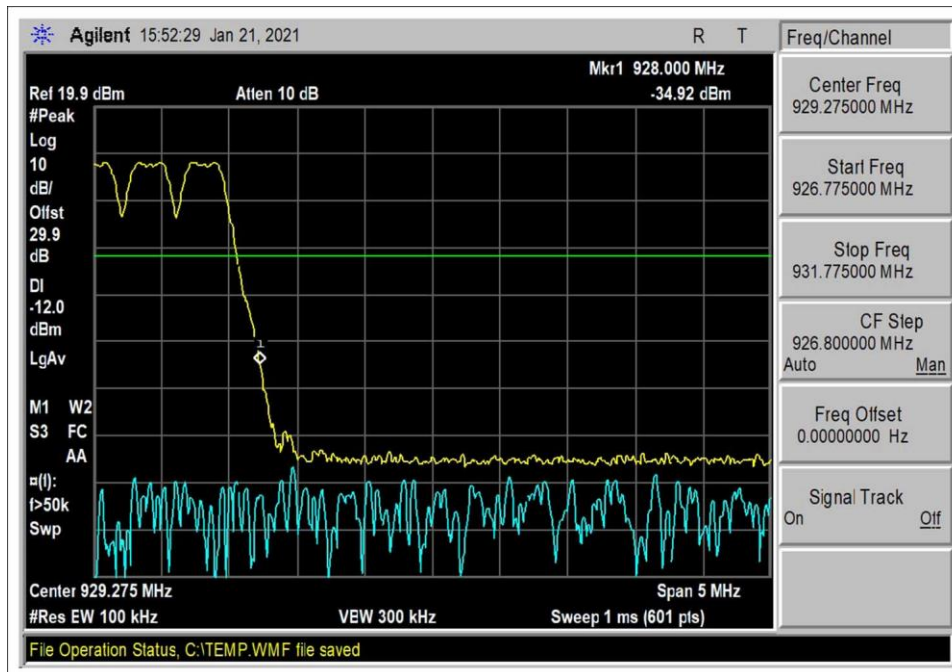
GFSK LV2_3 Low Channel



GFSK LV2_3 High Channel

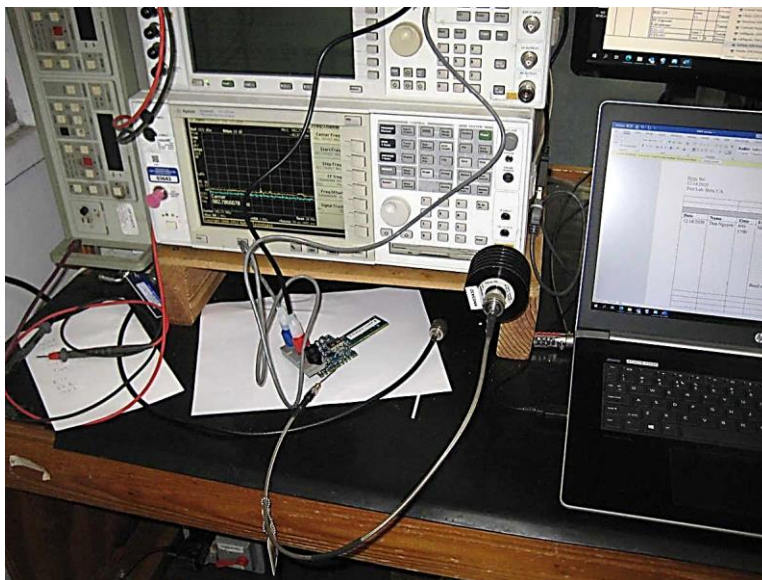


GFSK LV2_3 Low Channel, Hopping



GFSK LV2_3 High Channel, Hopping

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: 1/22/2021
 Test Type: **Radiated Emissions** Time: 12:45:05
 Tested By: Don Nguyen Sequence#: 15
 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

902.4 - 927.6MHz, 400kHz steps, 64 channels, 300k **GFSK LV2/LV3**

Frequency of measurement: 9k-9280MHz

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

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

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

1000-9280MHz, RBW=1MHz, VBW=3MHz

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

Note: The manufacturer declares the worst case duty cycle is 45ms per 100ms. Duty cycle correction factor= $20\log(45\text{ms}/100\text{ms}) = -6.9\text{dB}$. Average readings in restricted band are calculated from peak readings with duty cycle correction factor.

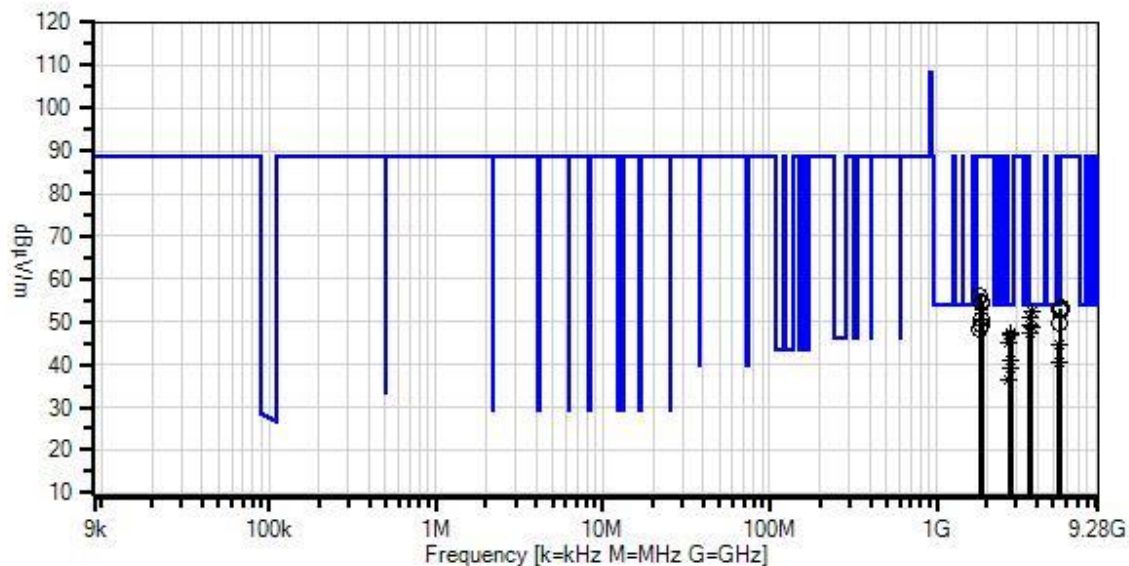
Test Method: ANSI C63.10 (2013)

Temperature (°C): 24

Relative Humidity (%): 30

Modification 1 was in place during testing.

Itron, Inc. WO#: 104621 Sequence#: 15 Date: 1/22/2021
15.247(d) / 15.209 Radiated Spurious Emissions Test Distance: 3 Meters Horiz



— Readings
× QP Readings
▼ Ambient
○ Peak Readings
* Average Readings
Software Version: 5.03.19

1 - 15.247(d) / 15.209 Radiated Spurious Emissions

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN00314	Loop Antenna	6502	4/13/2020	4/13/2022
	ANP01911	Cable-Amplitude +15C to +45C (dB)	RG214/U	1/2/2020	1/2/2022
	ANP05281	Attenuator	1B	4/7/2020	4/7/2022
	AN01993	Biconilog Antenna	CBL6111C	6/11/2019	6/11/2021
T1	AN00786	Preamp	83017A	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	ANP07246	Cable	32022-29094K- 29094K-24TC	5/29/2020	5/29/2022
T5	AN03169	High Pass Filter	HM1155-11SS	5/8/2019	5/8/2021
T6	AN02869	Spectrum Analyzer	E4440A	8/3/2020	8/3/2021
T7	ANDCCF	Duty Cycle Correction Factor		1/1/2021	1/1/2025

Measurement Data:

Reading listed by margin.

Test Distance: 3 Meters

#	Freq MHz	Rdng dBμV	T1 T5 dB	T2 T6 dB	T3 T7 dB	T4 dB	Dist Table	Corr dBμV/m	Spec dBμV/m	Margin dB	Polar Ant
1	3710.592M Ave	60.3	-38.1 +0.2	+32.2 +0.0	+4.0 -7.0	+0.7	+0.0	52.3	54.0	-1.7	Vert
^	3710.592M	60.3	-38.1 +0.2	+32.2 +0.0	+4.0 +0.0	+0.7	+0.0	59.3	54.0	+5.3	Vert
3	3661.092M Ave	59.3	-38.1 +0.2	+32.0 +0.0	+4.0 -7.0	+0.7	+0.0	51.1	54.0	-2.9	Vert
^	3661.092M	59.3	-38.1 +0.2	+32.0 +0.0	+4.0 +0.0	+0.7	+0.0	58.1	54.0	+4.1	Vert
5	3660.567M Ave	57.3	-38.1 +0.2	+32.0 +0.0	+4.0 -7.0	+0.7	+0.0	49.1	54.0	-4.9	Horiz
^	3660.567M	57.3	-38.1 +0.2	+32.0 +0.0	+4.0 +0.0	+0.7	+0.0	56.1	54.0	+2.1	Horiz
7	3609.558M Ave	57.7	-38.1 +0.1	+31.8 +0.0	+4.0 -7.0	+0.6	+0.0	49.1	54.0	-4.9	Vert
^	3609.558M	57.7	-38.1 +0.1	+31.8 +0.0	+4.0 +0.0	+0.6	+0.0	56.1	54.0	+2.1	Vert
9	3710.183M Ave	56.9	-38.1 +0.2	+32.2 +0.0	+4.0 -7.0	+0.7	+0.0	48.9	54.0	-5.1	Horiz
^	3710.183M	56.9	-38.1 +0.2	+32.2 +0.0	+4.0 +0.0	+0.7	+0.0	55.9	54.0	+1.9	Horiz
11	2783.100M Ave	59.1	-38.5 +0.2	+29.8 +0.0	+3.5 -7.0	+0.4	+0.0	47.5	54.0	-6.5	Vert
^	2783.100M	59.1	-38.5 +0.2	+29.8 +0.0	+3.5 +0.0	+0.4	+0.0	54.5	54.0	+0.5	Vert
13	3609.883M Ave	56.1	-38.1 +0.1	+31.8 +0.0	+4.0 -7.0	+0.6	+0.0	47.5	54.0	-6.5	Horiz
^	3609.883M	56.1	-38.1 +0.1	+31.8 +0.0	+4.0 +0.0	+0.6	+0.0	54.5	54.0	+0.5	Horiz
15	2745.317M Ave	58.7	-38.5 +0.2	+29.7 +0.0	+3.4 -7.0	+0.4	+0.0	46.9	54.0	-7.1	Vert
^	2745.317M	58.7	-38.5 +0.2	+29.7 +0.0	+3.4 +0.0	+0.4	+0.0	53.9	54.0	-0.1	Vert
17	2707.192M Ave	57.1	-38.5 +0.2	+29.5 +0.0	+3.4 -7.0	+0.4	+0.0	45.1	54.0	-8.9	Vert
^	2707.192M	57.1	-38.5 +0.2	+29.5 +0.0	+3.4 +0.0	+0.4	+0.0	52.1	54.0	-1.9	Vert
19	5414.750M Ave	48.7	-37.2 +0.2	+34.0 +0.0	+5.1 -7.0	+0.7	+0.0	44.5	54.0	-9.5	Horiz
^	5414.750M	48.7	-37.2 +0.2	+34.0 +0.0	+5.1 +0.0	+0.7	+0.0	51.5	54.0	-2.5	Horiz
21	2782.442M Ave	52.4	-38.5 +0.2	+29.8 +0.0	+3.5 -7.0	+0.4	+0.0	40.8	54.0	-13.2	Horiz
^	2782.442M	52.4	-38.5 +0.2	+29.8 +0.0	+3.5 +0.0	+0.4	+0.0	47.8	54.0	-6.2	Horiz

23	5414.500M Ave	44.9	-37.2 +0.2	+34.0 +0.0	+5.1 -7.0	+0.7	+0.0	40.7	54.0	-13.3	Vert
^	5414.500M	44.9	-37.2 +0.2	+34.0 +0.0	+5.1 +0.0	+0.7	+0.0	47.7	54.0	-6.3	Vert
25	2745.992M Ave	50.9	-38.5 +0.2	+29.7 +0.0	+3.4 -7.0	+0.4	+0.0	39.1	54.0	-14.9	Horiz
^	2745.992M	50.9	-38.5 +0.2	+29.7 +0.0	+3.4 +0.0	+0.4	+0.0	46.1	54.0	-7.9	Horiz
27	2707.400M Ave	48.4	-38.5 +0.2	+29.5 +0.0	+3.4 -7.0	+0.4	+0.0	36.4	54.0	-17.6	Horiz
^	2707.400M	48.4	-38.5 +0.2	+29.5 +0.0	+3.4 +0.0	+0.4	+0.0	43.4	54.0	-10.6	Horiz
29	1804.983M	65.0	-38.8 +0.2	+26.7 +0.0	+2.8 +0.0	+0.4	+0.0	56.3	88.5	-32.2	Vert
30	1830.417M	63.2	-38.8 +0.2	+26.9 +0.0	+2.8 +0.0	+0.4	+0.0	54.7	88.5	-33.8	Vert
31	1855.175M	62.6	-38.8 +0.2	+27.0 +0.0	+2.9 +0.0	+0.4	+0.0	54.3	88.5	-34.2	Vert
32	5565.850M	50.5	-37.3 +0.2	+34.1 +0.0	+5.1 +0.0	+0.7	+0.0	53.3	88.5	-35.2	Horiz
33	5565.858M	50.0	-37.3 +0.2	+34.1 +0.0	+5.1 +0.0	+0.7	+0.0	52.8	88.5	-35.7	Vert
34	5490.900M	49.8	-37.2 +0.2	+34.1 +0.0	+5.1 +0.0	+0.7	+0.0	52.7	88.5	-35.8	Horiz
35	1854.942M	58.7	-38.8 +0.2	+27.0 +0.0	+2.9 +0.0	+0.4	+0.0	50.4	88.5	-38.1	Horiz
36	5491.083M	46.7	-37.2 +0.2	+34.1 +0.0	+5.1 +0.0	+0.7	+0.0	49.6	88.5	-38.9	Vert
37	1830.308M	57.9	-38.8 +0.2	+26.9 +0.0	+2.8 +0.0	+0.4	+0.0	49.4	88.5	-39.1	Horiz
38	1804.917M	57.0	-38.8 +0.2	+26.7 +0.0	+2.8 +0.0	+0.4	+0.0	48.3	88.5	-40.2	Horiz

Test Location: CKC Laboratories Inc. • 110 N. Olinda Pl. • Brea, CA 92823 • 714-993-6112
 Customer: **Itron, Inc.**
 Specification: **15.247(d) / 15.209 Radiated Spurious Emissions**
 Work Order #: **104621** Date: 1/22/2021
 Test Type: **Radiated Emissions** Time: 10:20:37
 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:

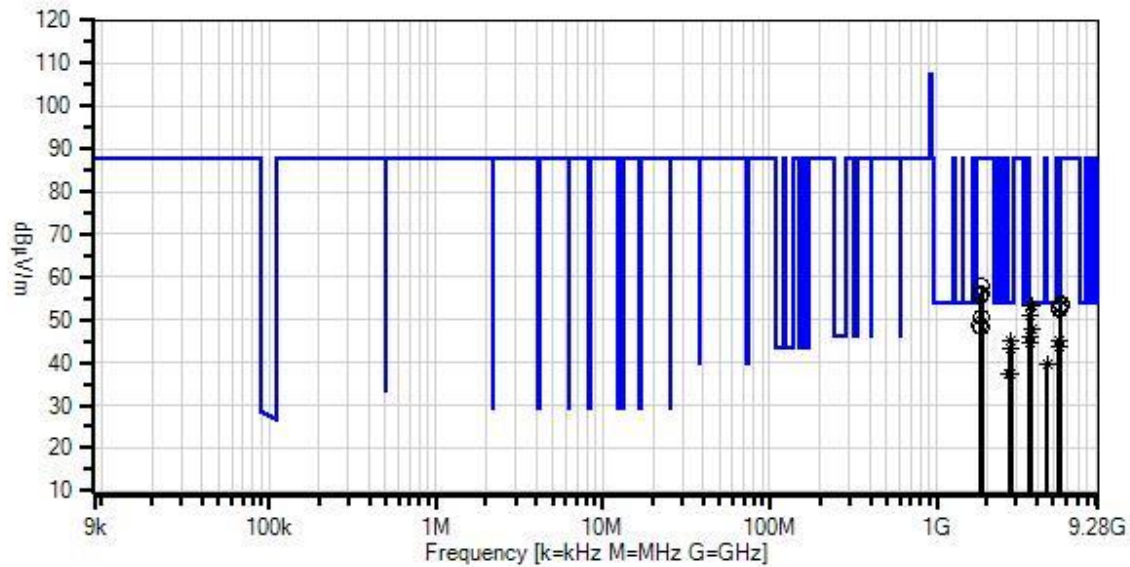
The EUT is placed on Styrofoam platform and powered from 3.6V fresh battery. The EUT is connected to a remote located laptop running CLI Tool ver.2.0.1.24.
 EUT has fixed orientation per manufacture's specification.
 Operating frequency range/ mode
 902.4 - 927.6MHz, 400kHz steps, 64 channels, 300k **GFSK LV2/LV3**
 Frequency of measurement: 9k-9280MHz
 9kHz to 150kHz RBW=0.2kHz, VBW=0.6kHz
 150kHz to 30MHz RBW=9kHz, VBW=27kHz
 30-1000MHz, RBW=120kHz, VBW=360kHz
 1000-9280MHz, RBW=1MHz, VBW=3MHz
 -20dBc limit, RBW=100kHz, VBW=300kHz

Note: The manufacturer declares the worst case duty cycle is 45ms per 100ms. Duty cycle correction factor=
 $20\log(45\text{ms}/100\text{ms}) = -6.9\text{dB}$ Average readings in restricted band are calculated from peak readings with duty
 cycle correction factor.

Test Method: ANSI C63.10 (2013)
 Temperature (°C): 24
 Relative Humidity (%): 30

Modification 1 was in place during testing.

Ittron, Inc. WO#: 104621 Sequence#: 10 Date: 1/22/2021
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

1 - 15.247(d) / 15.209 Radiated Spurious Emissions

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN00314	Loop Antenna	6502	4/13/2020	4/13/2022
	ANP01911	Cable-Amplitude +15C to +45C (dB)	RG214/U	1/2/2020	1/2/2022
	ANP05281	Attenuator	1B	4/7/2020	4/7/2022
	AN01993	Biconilog Antenna	CBL6111C	6/11/2019	6/11/2021
T1	AN00786	Preamp	83017A	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	ANP07246	Cable	32022-29094K- 29094K-24TC	5/29/2020	5/29/2022
T5	AN03169	High Pass Filter	HM1155-11SS	5/8/2019	5/8/2021
	AN02869	Spectrum Analyzer	E4440A	8/3/2020	8/3/2021
T6	ANDCCF	Duty Cycle Correction Factor		1/1/2021	1/1/2025

Measurement Data:

Reading listed by margin.

Test Distance: 3 Meters

#	Freq MHz	Rdng dBμV	T1 T5 dB	T2 T6 dB	T3 dB	T4 dB	Dist Table	Corr dBμV/m	Spec dBμV/m	Margin dB	Polar Ant
1	3661.067M Ave	61.7	-38.1 +0.2	+32.0 -7.0	+4.0	+0.7	+0.0	53.5	54.0	-0.5	Vert
^	3661.067M	61.7	-38.1 +0.2	+32.0 +0.0	+4.0	+0.7	+0.0	60.5	54.0	+6.5	Vert
3	3710.617M Ave	61.1	-38.1 +0.2	+32.2 -7.0	+4.0	+0.7	+0.0	53.1	54.0	-0.9	Vert
^	3710.617M	61.1	-38.1 +0.2	+32.2 +0.0	+4.0	+0.7	+0.0	60.1	54.0	+6.1	Vert
5	3609.833M Ave	59.6	-38.1 +0.1	+31.8 -7.0	+4.0	+0.6	+0.0	51.0	54.0	-3.0	Vert
^	3609.833M	59.6	-38.1 +0.1	+31.8 +0.0	+4.0	+0.6	+0.0	58.0	54.0	+4.0	Vert
7	3710.067M Ave	56.0	-38.1 +0.2	+32.2 -7.0	+4.0	+0.7	+0.0	48.0	54.0	-6.0	Horiz
^	3710.067M	56.0	-38.1 +0.2	+32.2 +0.0	+4.0	+0.7	+0.0	55.0	54.0	+1.0	Horiz
9	3660.400M Ave	54.0	-38.1 +0.2	+32.0 -7.0	+4.0	+0.7	+0.0	45.8	54.0	-8.2	Horiz
^	3660.400M	54.0	-38.1 +0.2	+32.0 +0.0	+4.0	+0.7	+0.0	52.8	54.0	-1.2	Horiz
11	2782.733M Ave	56.6	-38.5 +0.2	+29.8 -7.0	+3.5	+0.4	+0.0	45.0	54.0	-9.0	Vert
^	2782.733M	56.6	-38.5 +0.2	+29.8 +0.0	+3.5	+0.4	+0.0	52.0	54.0	-2.0	Vert
13	5413.750M Ave	49.1	-37.2 +0.2	+34.0 -7.0	+5.1	+0.7	+0.0	44.9	54.0	-9.1	Horiz
^	5413.750M	49.1	-37.2 +0.2	+34.0 +0.0	+5.1	+0.7	+0.0	51.9	54.0	-2.1	Horiz
15	3609.933M Ave	53.3	-38.1 +0.1	+31.8 -7.0	+4.0	+0.6	+0.0	44.7	54.0	-9.3	Horiz
^	3609.933M	53.3	-38.1 +0.1	+31.8 +0.0	+4.0	+0.6	+0.0	51.7	54.0	-2.3	Horiz
17	5414.483M Ave	47.8	-37.2 +0.2	+34.0 -7.0	+5.1	+0.7	+0.0	43.6	54.0	-10.4	Vert
^	5414.483M	47.8	-37.2 +0.2	+34.0 +0.0	+5.1	+0.7	+0.0	50.6	54.0	-3.4	Vert
19	2745.750M Ave	55.1	-38.5 +0.2	+29.7 -7.0	+3.4	+0.4	+0.0	43.3	54.0	-10.7	Vert
^	2745.750M	55.1	-38.5 +0.2	+29.7 +0.0	+3.4	+0.4	+0.0	50.3	54.0	-3.7	Vert
21	4576.167M Ave	46.0	-37.4 +0.2	+32.6 -7.0	+4.5	+0.6	+0.0	39.5	54.0	-14.5	Vert
^	4576.167M	46.0	-37.4 +0.2	+32.6 +0.0	+4.5	+0.6	+0.0	46.5	54.0	-7.5	Vert

23	2782.750M Ave	49.0	-38.5 +0.2	+29.8 -7.0	+3.5	+0.4	+0.0	37.4	54.0	-16.6	Horiz
^	2782.750M	49.0	-38.5 +0.2	+29.8 +0.0	+3.5	+0.4	+0.0	44.4	54.0	-9.6	Horiz
25	2707.250M Ave	49.3	-38.5 +0.2	+29.5 -7.0	+3.4	+0.4	+0.0	37.3	54.0	-16.7	Vert
^	2707.250M	49.3	-38.5 +0.2	+29.5 +0.0	+3.4	+0.4	+0.0	44.3	54.0	-9.7	Vert
27	2745.750M Ave	49.0	-38.5 +0.2	+29.7 -7.0	+3.4	+0.4	+0.0	37.2	54.0	-16.8	Horiz
^	2745.750M	49.0	-38.5 +0.2	+29.7 +0.0	+3.4	+0.4	+0.0	44.2	54.0	-9.8	Horiz
29	1855.000M	66.2	-38.8 +0.2	+27.0 +0.0	+2.9	+0.4	+0.0	57.9	87.6	-29.7	Vert
30	1830.350M	64.5	-38.8 +0.2	+26.9 +0.0	+2.8	+0.4	+0.0	56.0	87.6	-31.6	Vert
31	1804.850M	64.1	-38.8 +0.2	+26.7 +0.0	+2.8	+0.4	+0.0	55.4	87.6	-32.2	Vert
32	5565.200M	50.8	-37.3 +0.2	+34.1 +0.0	+5.1	+0.7	+0.0	53.6	87.6	-34.0	Vert
33	5565.883M	50.4	-37.3 +0.2	+34.1 +0.0	+5.1	+0.7	+0.0	53.2	87.6	-34.4	Horiz
34	5491.283M	50.2	-37.2 +0.2	+34.1 +0.0	+5.1	+0.7	+0.0	53.1	87.6	-34.5	Vert
35	5491.450M	49.3	-37.2 +0.2	+34.1 +0.0	+5.1	+0.7	+0.0	52.2	87.6	-35.4	Horiz
36	1830.417M	59.0	-38.8 +0.2	+26.9 +0.0	+2.8	+0.4	+0.0	50.5	87.6	-37.1	Horiz
37	1805.000M	57.6	-38.8 +0.2	+26.7 +0.0	+2.8	+0.4	+0.0	48.9	87.6	-38.7	Horiz
38	1855.383M	56.5	-38.8 +0.2	+27.0 +0.0	+2.9	+0.4	+0.0	48.2	87.6	-39.4	Horiz

Test Location: CKC Laboratories Inc. • 110 N. Olinda Pl. • Brea, CA 92823 • 714-993-6112
 Customer: **Itron, Inc.**
 Specification: **15.247(d) / 15.209 Radiated Spurious Emissions**
 Work Order #: **104621** Date: 1/22/2021
 Test Type: **Radiated Emissions** Time: 13:23:43
 Tested By: Don Nguyen Sequence#: 12
 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:

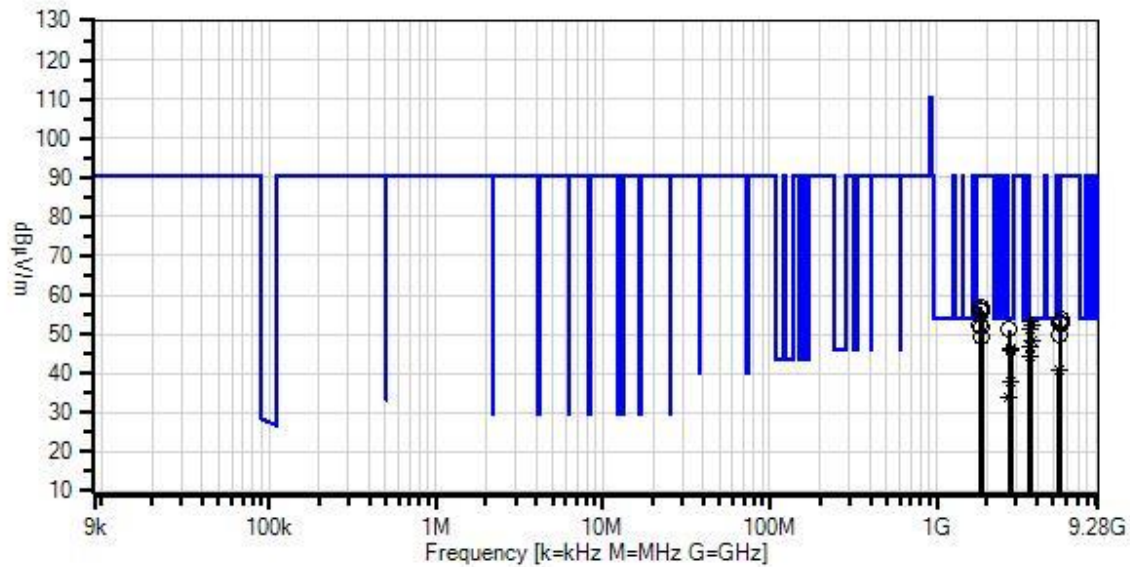
The EUT is placed on Styrofoam platform and powered from 3.6V fresh battery. The EUT is connected to a remote located laptop running CLI Tool ver.2.0.1.24.
 EUT has fixed orientation per manufacture's specification.
 Operating frequency range/ mode
 902.4 - 927.6MHz, 400kHz steps, 64 channels, 300k **GFSK LV2/LV3**
 Frequency of measurement: 9k-9280MHz
 9kHz to 150kHz RBW=0.2kHz, VBW=0.6kHz
 150kHz to 30MHz RBW=9kHz, VBW=27kHz
 30-1000MHz, RBW=120kHz, VBW=360kHz
 1000-9280MHz, RBW=1MHz, VBW=3MHz
 -20dBc limit, RBW=100kHz, VBW=300kHz

Note: The manufacturer declares the worst case duty cycle is 45ms per 100ms. Duty cycle correction factor=
 $20\log(45\text{ms}/100\text{ms}) = -6.9\text{dB}$. Average readings in restricted band are calculated from peak readings with duty
 cycle correction factor.

Test Method: ANSI C63.10 (2013)
 Temperature (°C): 24
 Relative Humidity (%): 30

Modification 1 was in place during testing.

Ittron, Inc. WO#: 104621 Sequence#: 12 Date: 1/22/2021
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
	ANP01911	Cable-Amplitude +15C to +45C (dB)	RG214/U	1/2/2020	1/2/2022
	ANP05281	Attenuator	1B	4/7/2020	4/7/2022
	AN01993	Biconilog Antenna	CBL6111C	6/11/2019	6/11/2021
	AN03643	Spectrum Analyzer	E4440A	5/20/2020	5/20/2022
T1	AN00786	Preamplifier	83017A	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	ANP07246	Cable	32022-29094K- 29094K-24TC	5/29/2020	5/29/2022
T5	AN03169	High Pass Filter	HM1155-11SS	5/8/2019	5/8/2021
T6	ANDCCF	Duty Cycle Correction Factor		1/1/2021	1/1/2025

Measurement Data:

Reading listed by margin.

Test Distance: 3 Meters

#	Freq MHz	Rdng dBμV	T1 T5 dB	T2 T6 dB	T3 dB	T4 dB	Dist Table	Corr dBμV/m	Spec dBμV/m	Margin dB	Polar Ant
1	3660.517M Ave	61.3	-38.1 +0.2	+32.0 -7.0	+4.0	+0.7	+0.0	53.1	54.0	-0.9	Vert
^	3660.517M	61.3	-38.1 +0.2	+32.0 +0.0	+4.0	+0.7	+0.0	60.1	54.0	+6.1	Vert
3	3710.733M Ave	60.2	-38.1 +0.2	+32.2 -7.0	+4.0	+0.7	+0.0	52.2	54.0	-1.8	Vert
^	3710.733M	60.2	-38.1 +0.2	+32.2 +0.0	+4.0	+0.7	+0.0	59.2	54.0	+5.2	Vert
5	2707.450M	56.3	-38.5 +0.2	+29.5 +0.0	+3.4	+0.4	+0.0	51.3	54.0	-2.7	Vert
6	2707.450M	56.3	-38.5 +0.2	+29.5 +0.0	+3.4	+0.4	+0.0	51.3	54.0	-2.7	Vert
7	3609.467M Ave	59.8	-38.1 +0.1	+31.8 -7.0	+4.0	+0.6	+0.0	51.2	54.0	-2.8	Vert
^	3609.467M	59.8	-38.1 +0.1	+31.8 +0.0	+4.0	+0.6	+0.0	58.2	54.0	+4.2	Vert
9	3710.200M Ave	56.4	-38.1 +0.2	+32.2 -7.0	+4.0	+0.7	+0.0	48.4	54.0	-5.6	Horiz
^	3710.200M	56.4	-38.1 +0.2	+32.2 +0.0	+4.0	+0.7	+0.0	55.4	54.0	+1.4	Horiz
11	3660.750M Ave	54.8	-38.1 +0.2	+32.0 -7.0	+4.0	+0.7	+0.0	46.6	54.0	-7.4	Horiz
^	3660.750M	54.8	-38.1 +0.2	+32.0 +0.0	+4.0	+0.7	+0.0	53.6	54.0	-0.4	Horiz
13	2783.017M Ave	58.1	-38.5 +0.2	+29.8 -7.0	+3.5	+0.4	+0.0	46.5	54.0	-7.5	Vert
^	2783.017M	58.1	-38.5 +0.2	+29.8 +0.0	+3.5	+0.4	+0.0	53.5	54.0	-0.5	Vert
15	2745.533M Ave	57.6	-38.5 +0.2	+29.7 -7.0	+3.4	+0.4	+0.0	45.8	54.0	-8.2	Vert
^	2745.533M	57.6	-38.5 +0.2	+29.7 +0.0	+3.4	+0.4	+0.0	52.8	54.0	-1.2	Vert
17	3609.300M Ave	52.9	-38.1 +0.1	+31.8 -7.0	+4.0	+0.6	+0.0	44.3	54.0	-9.7	Horiz
^	3609.300M	52.9	-38.1 +0.1	+31.8 +0.0	+4.0	+0.6	+0.0	51.3	54.0	-2.7	Horiz
19	5414.267M Ave	45.3	-37.2 +0.2	+34.0 -7.0	+5.1	+0.7	+0.0	41.1	54.0	-12.9	Vert
^	5414.267M	45.3	-37.2 +0.2	+34.0 +0.0	+5.1	+0.7	+0.0	48.1	54.0	-5.9	Vert
21	2783.083M Ave	49.5	-38.5 +0.2	+29.8 -7.0	+3.5	+0.4	+0.0	37.9	54.0	-16.1	Horiz
^	2783.083M	49.5	-38.5 +0.2	+29.8 +0.0	+3.5	+0.4	+0.0	44.9	54.0	-9.1	Horiz

23	2745.467M	49.6	-38.5	+29.7	+3.4	+0.4	+0.0	37.8	54.0	-16.2	Horiz
	Ave		+0.2	-7.0							
^	2745.467M	49.6	-38.5	+29.7	+3.4	+0.4	+0.0	44.8	54.0	-9.2	Horiz
			+0.2	+0.0							
25	2707.183M	46.0	-38.5	+29.5	+3.4	+0.4	+0.0	34.0	54.0	-20.0	Horiz
	Ave		+0.2	-7.0							
^	2707.183M	46.0	-38.5	+29.5	+3.4	+0.4	+0.0	41.0	54.0	-13.0	Horiz
			+0.2	+0.0							
27	1830.750M	65.5	-38.8	+26.9	+2.8	+0.4	+0.0	57.0	90.5	-33.5	Vert
			+0.2	+0.0							
28	1804.667M	64.9	-38.8	+26.7	+2.8	+0.4	+0.0	56.2	90.5	-34.3	Vert
			+0.2	+0.0							
29	1855.300M	64.2	-38.8	+27.0	+2.9	+0.4	+0.0	55.9	90.5	-34.6	Vert
			+0.2	+0.0							
30	5564.883M	50.8	-37.3	+34.1	+5.1	+0.7	+0.0	53.6	90.5	-36.9	Vert
			+0.2	+0.0							
31	5566.117M	50.1	-37.3	+34.1	+5.1	+0.7	+0.0	52.9	90.5	-37.6	Horiz
			+0.2	+0.0							
32	5490.650M	49.8	-37.2	+34.1	+5.1	+0.7	+0.0	52.7	90.5	-37.8	Vert
			+0.2	+0.0							
33	1804.783M	60.9	-38.8	+26.7	+2.8	+0.4	+0.0	52.2	90.5	-38.3	Horiz
			+0.2	+0.0							
34	1855.117M	60.0	-38.8	+27.0	+2.9	+0.4	+0.0	51.7	90.5	-38.8	Horiz
			+0.2	+0.0							
35	5490.883M	46.8	-37.2	+34.1	+5.1	+0.7	+0.0	49.7	90.5	-40.8	Horiz
			+0.2	+0.0							
36	1830.383M	57.7	-38.8	+26.9	+2.8	+0.4	+0.0	49.2	90.5	-41.3	Horiz
			+0.2	+0.0							

Band Edge

Band Edge Summary GAS REMOTE-Configuration 1

Operating Mode: Single Channel (Low and High)

Frequency (MHz)	Modulation	Ant. Type	Field Strength (dBuV/m @3m)	Limit (dBuV/m @3m)	Results
614	GFSK LV2	PCB Trace	41.1	<46	Pass
902	GFSK LV2	PCB Trace	67.8	<88.5	Pass
928	GFSK LV2	PCB Trace	66.8	<88.5	Pass
960	GFSK LV2	PCB Trace	49.3	<54	Pass

Band Edge Summary GAS REMOTE-Configuration 1

Operating Mode: Hopping

Frequency (MHz)	Modulation	Ant. Type	Field Strength (dBuV/m @3m)	Limit (dBuV/m @3m)	Results
614	GFSK LV2	PCB Trace	41.8	<46	Pass
902	GFSK LV2	PCB Trace	66.2	<88.5	Pass
928	GFSK LV2	PCB Trace	66.3	<88.5	Pass
960	GFSK LV2	PCB Trace	47.5	<54	Pass

Band Edge Summary WATER REMOTE Configuration 2

Operating Mode: Single Channel (Low and High)

Frequency (MHz)	Modulation	Ant. Type	Field Strength (dBuV/m @3m)	Limit (dBuV/m @3m)	Results
614	GFSK LV2	PCB Trace	43.2	<46	Pass
902	GFSK LV2	PCB Trace	66.3	<87.6	Pass
928	GFSK LV2	PCB Trace	69.8	<87.6	Pass
960	GFSK LV2	PCB Trace	48.1	<54	Pass

Band Edge Summary WATER-REMOTE Configuration 2

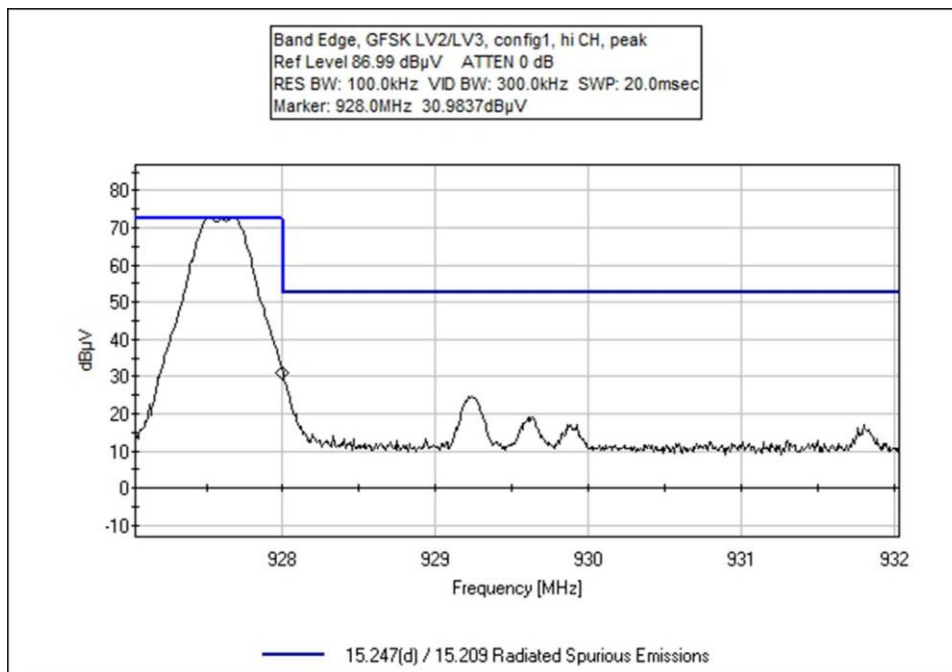
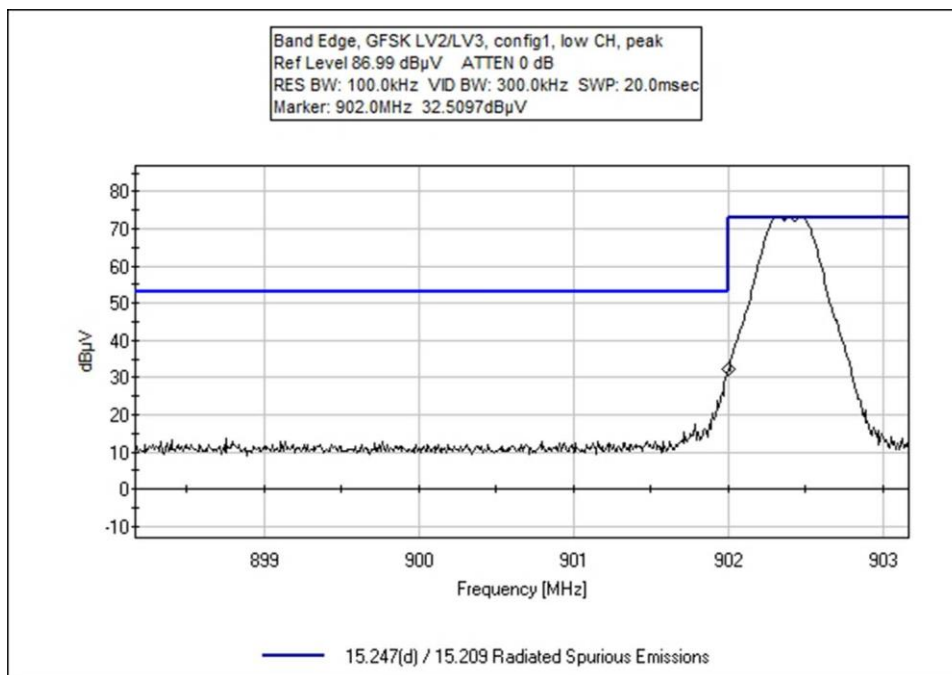
Operating Mode: Hopping

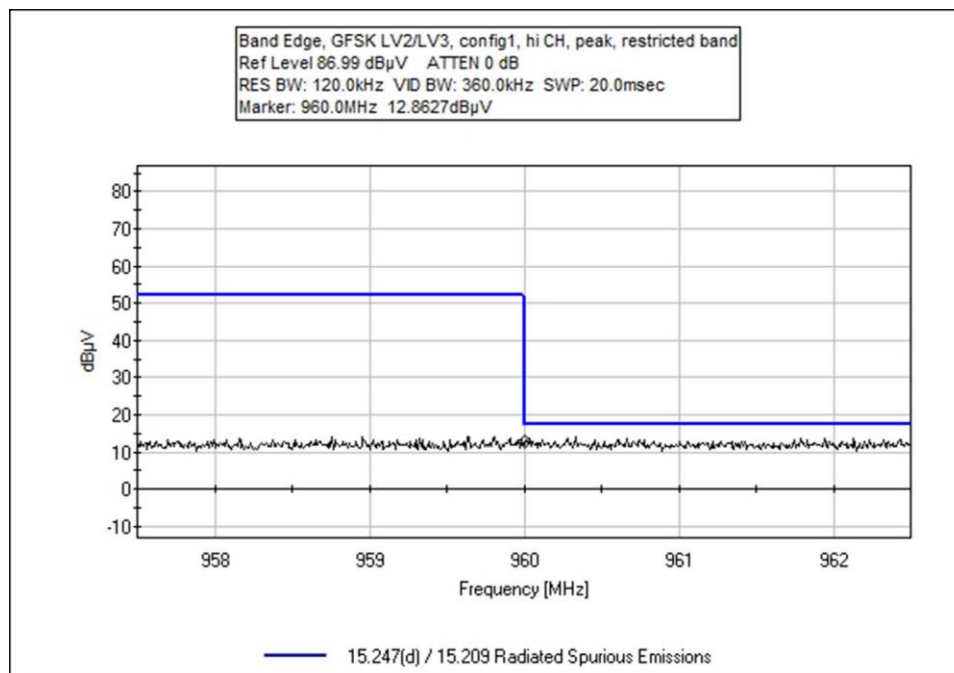
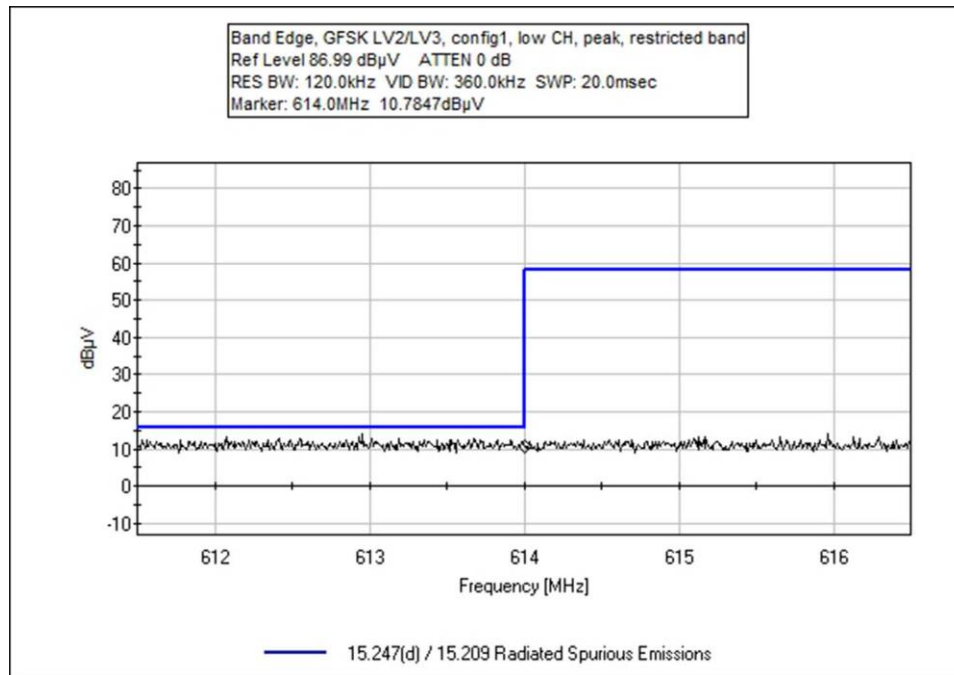
Frequency (MHz)	Modulation	Ant. Type	Field Strength (dBuV/m @3m)	Limit (dBuV/m @3m)	Results
614	GFSK LV2	PCB Trace	43.2	<46	Pass
902	GFSK LV2	PCB Trace	65.4	<87.6	Pass
928	GFSK LV2	PCB Trace	69.6	<87.6	Pass
960	GFSK LV2	PCB Trace	47.6	<54	Pass

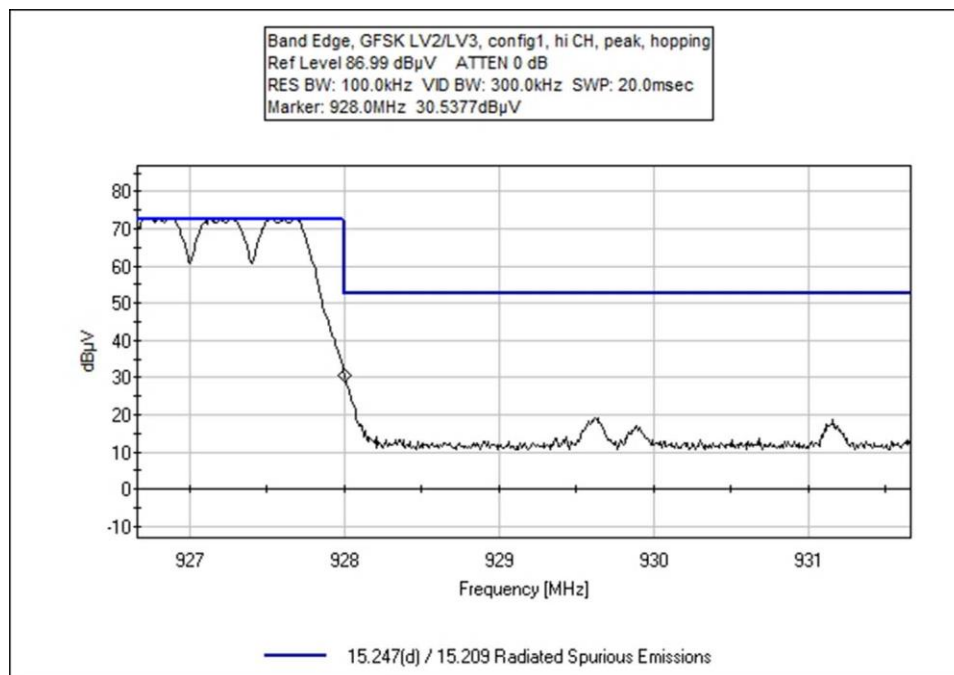
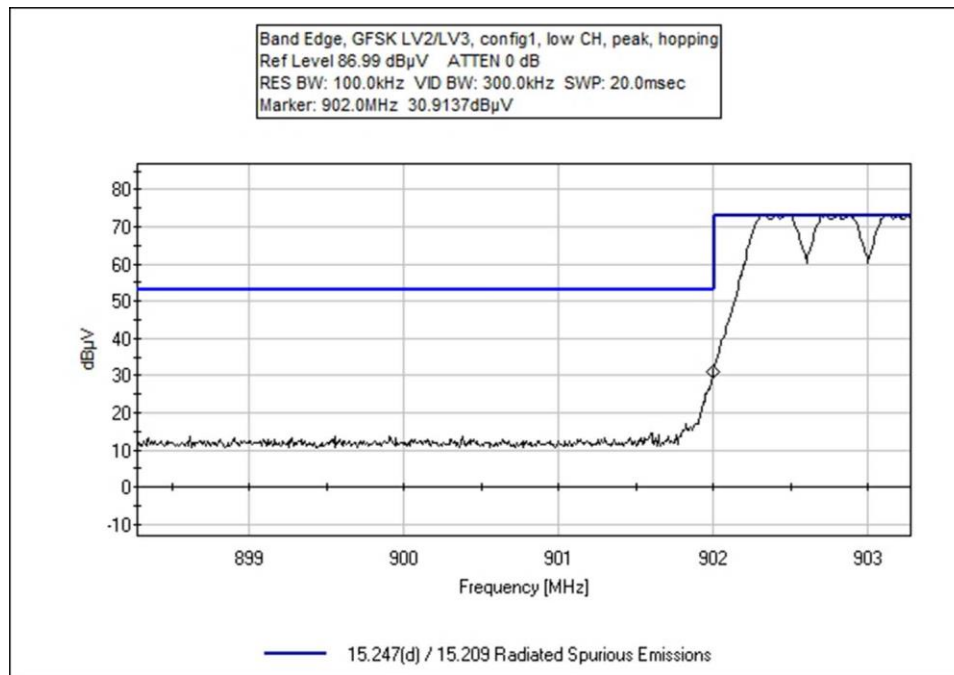
Band Edge Summary PIT-Configuration 3					
Operating Mode: Single Channel (Low and High)					
Frequency (MHz)	Modulation	Ant. Type	Field Strength (dBuV/m @3m)	Limit (dBuV/m @3m)	Results
614	GFSK LV2	PCB Trace	41.2	<46	Pass
902	GFSK LV2	PCB Trace	68.7	<90.5	Pass
928	GFSK LV2	PCB Trace	69.7	<90.5	Pass
960	GFSK LV2	PCB Trace	48.3	<54	Pass

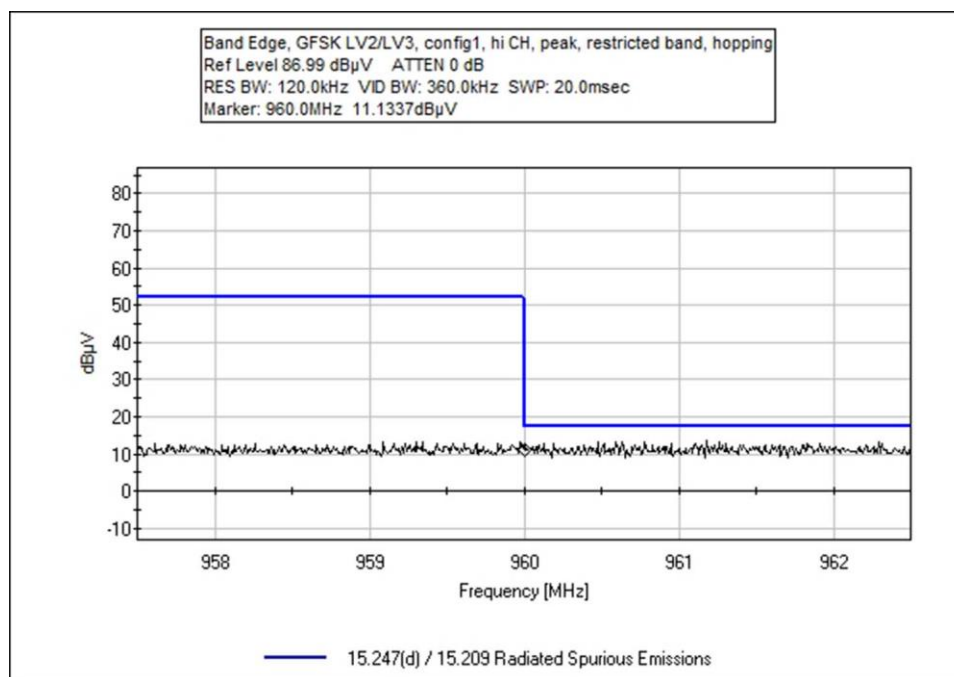
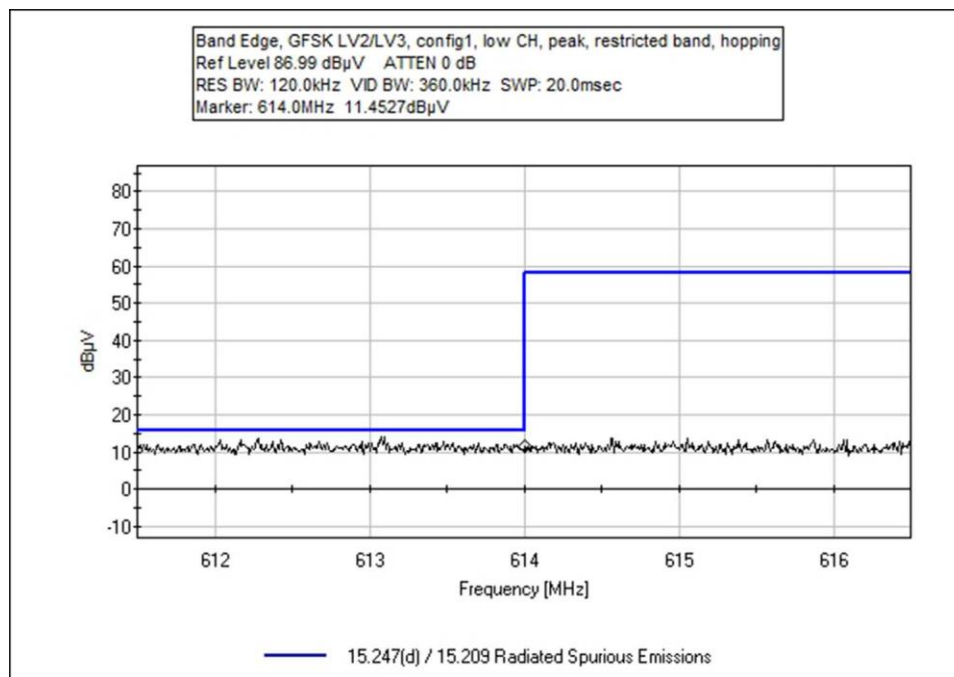
Band Edge Summary PIT-Configuration 3					
Operating Mode: Hopping					
Frequency (MHz)	Modulation	Ant. Type	Field Strength (dBuV/m @3m)	Limit (dBuV/m @3m)	Results
614	GFSK LV2	PCB Trace	40.9	<46	Pass
902	GFSK LV2	PCB Trace	68.1	<90.5	Pass
928	GFSK LV2	PCB Trace	70.0	<90.5	Pass
960	GFSK LV2	PCB Trace	47.2	<54	Pass

Band Edge Plot, Configuration 1

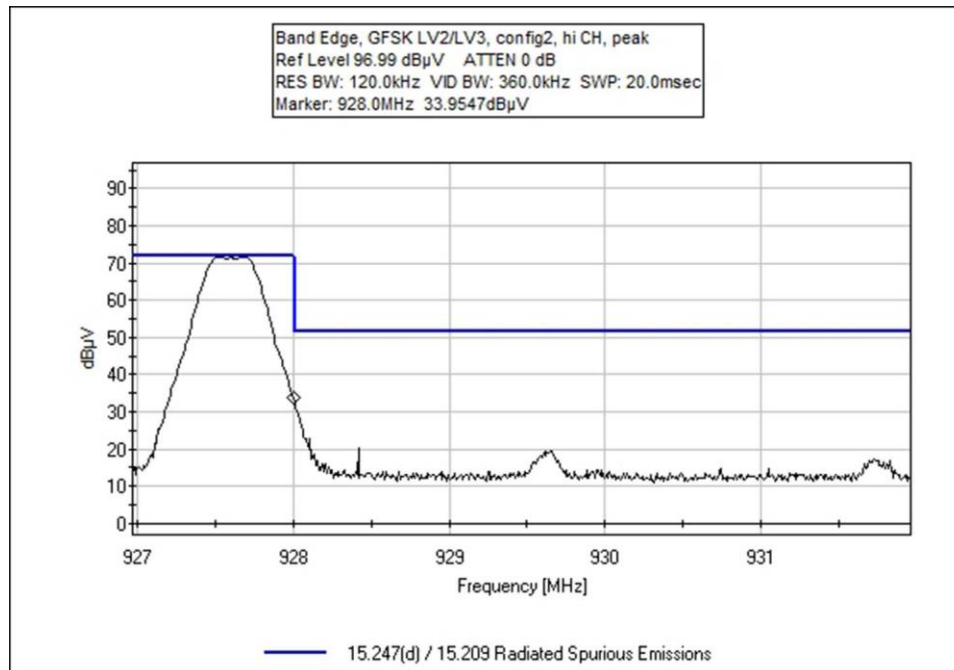
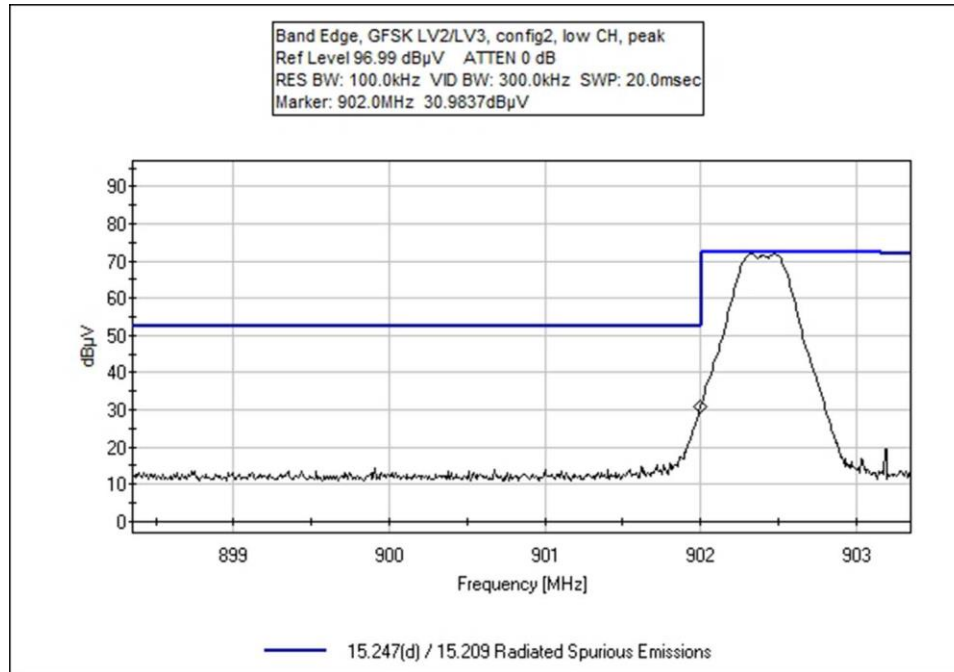


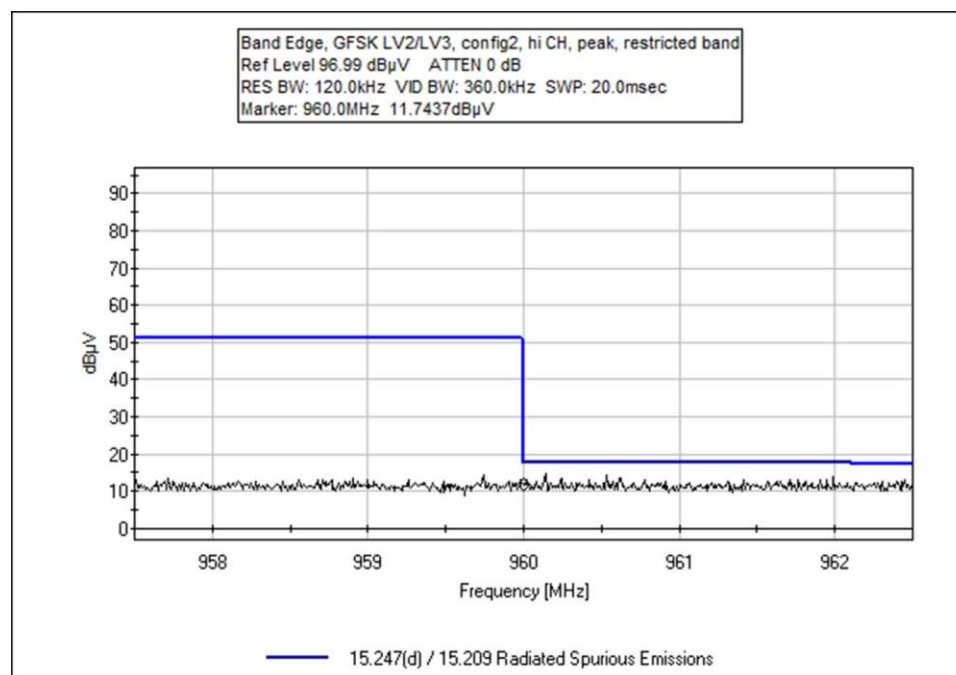
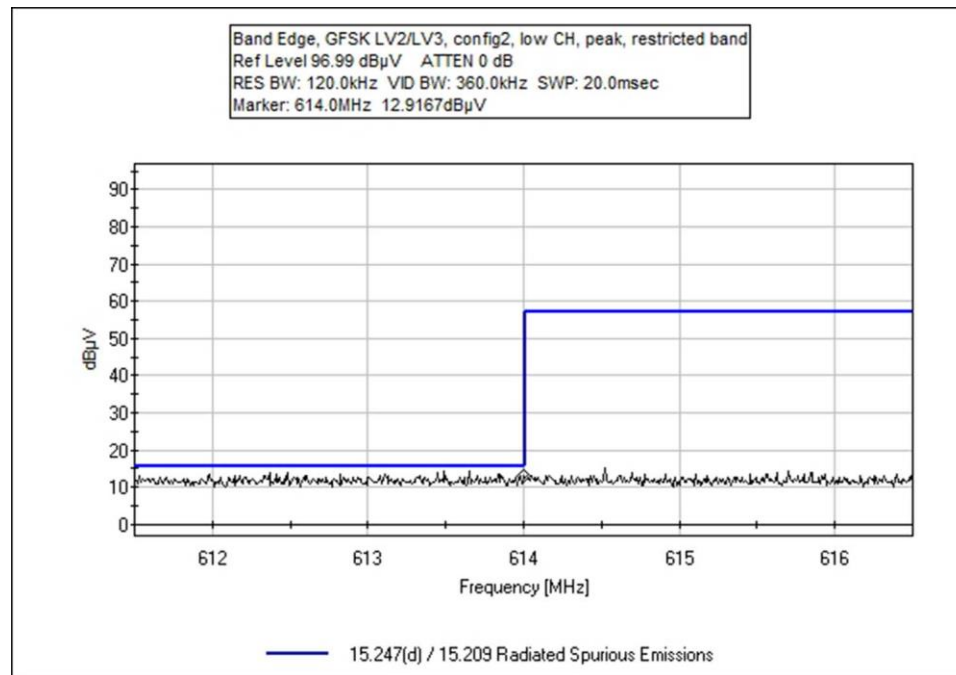


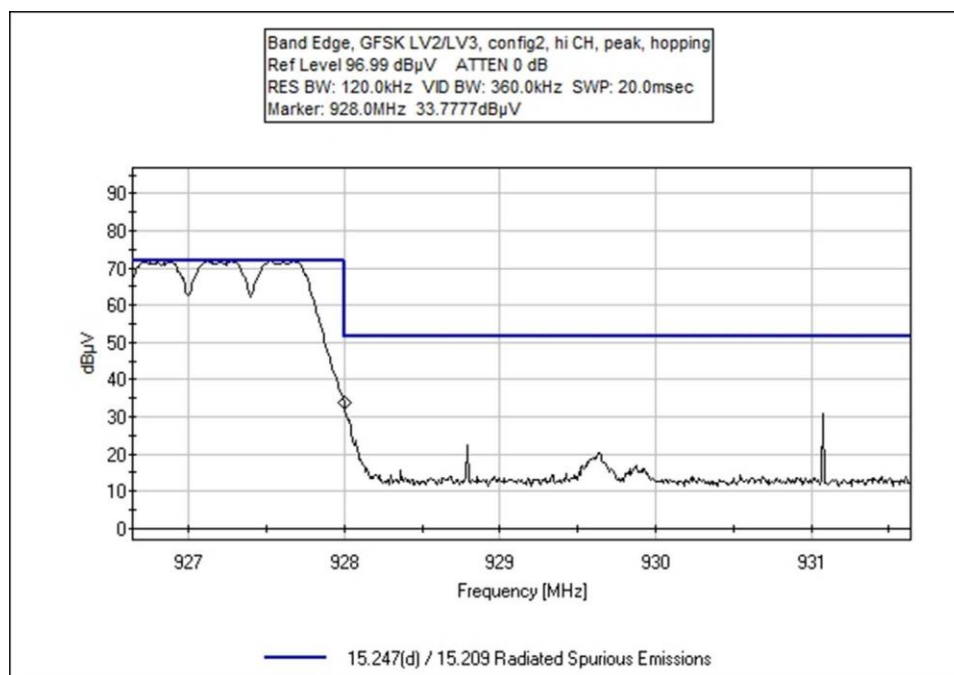
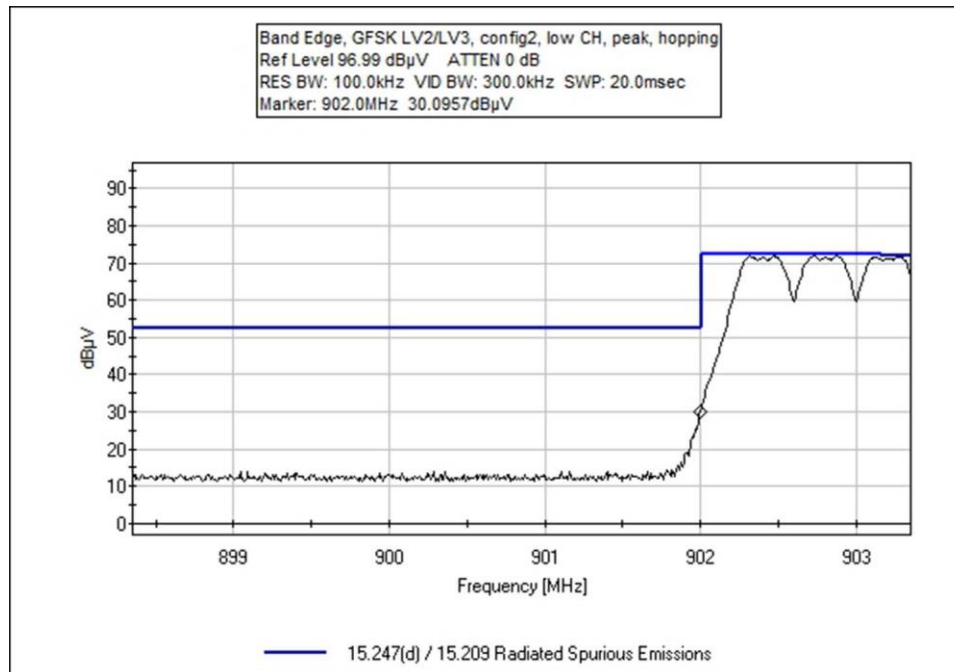


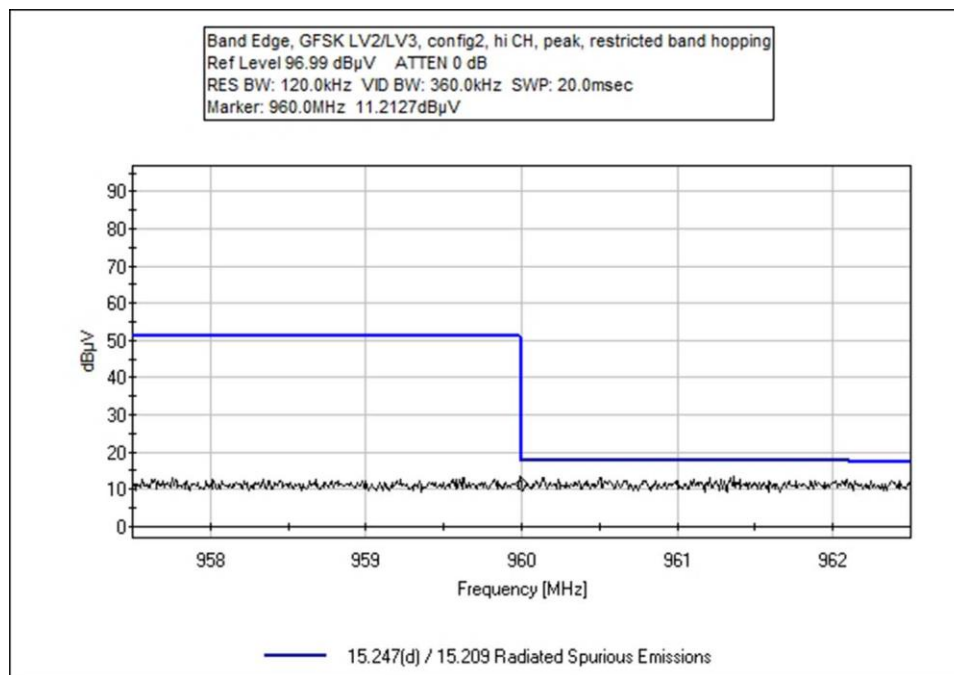
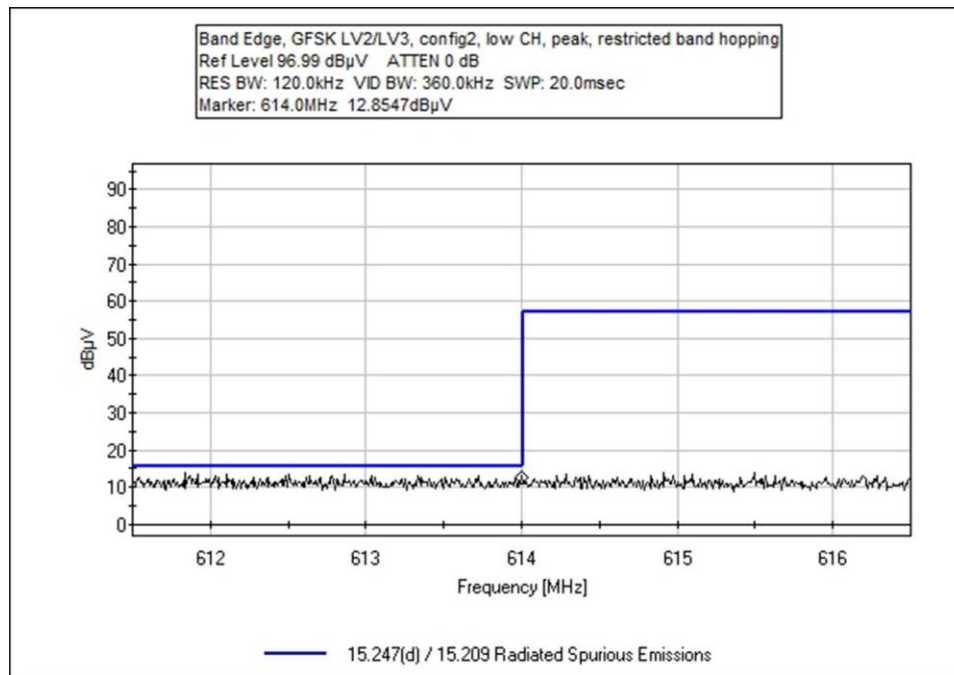


Band Edge Plot, Configuration 2

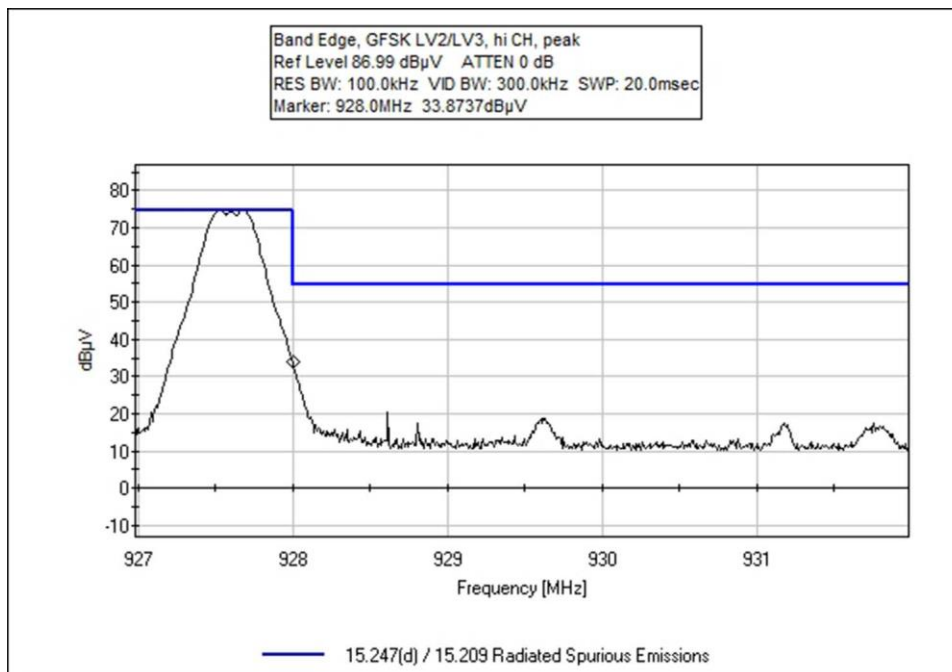
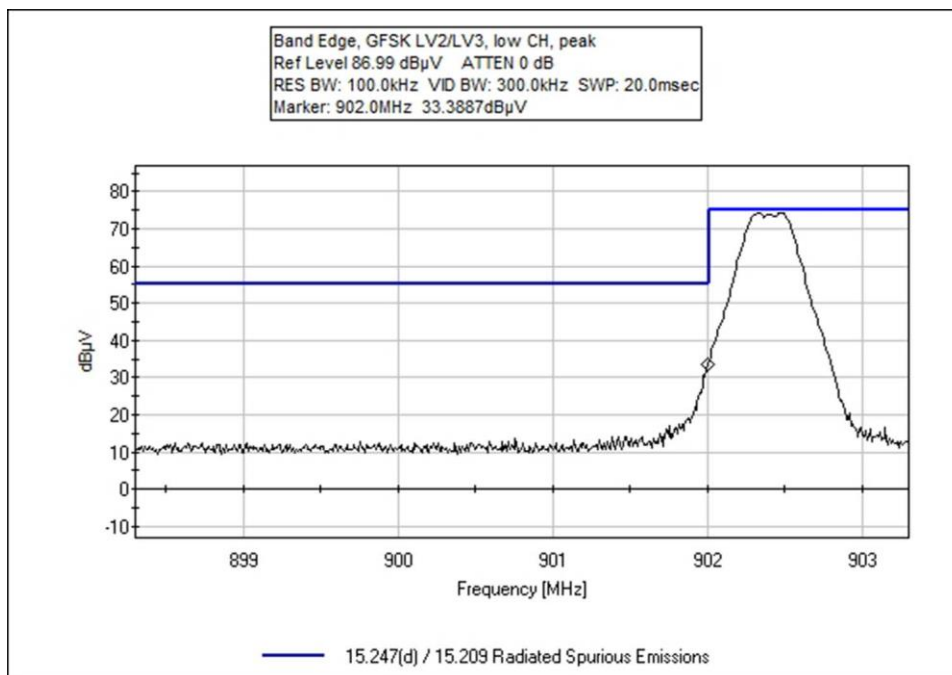


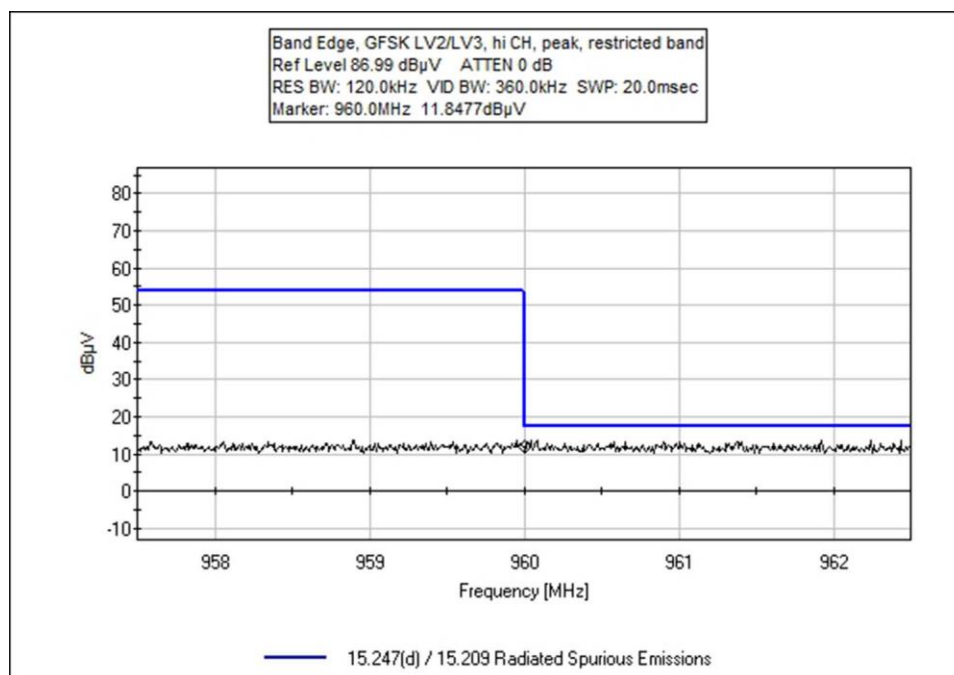
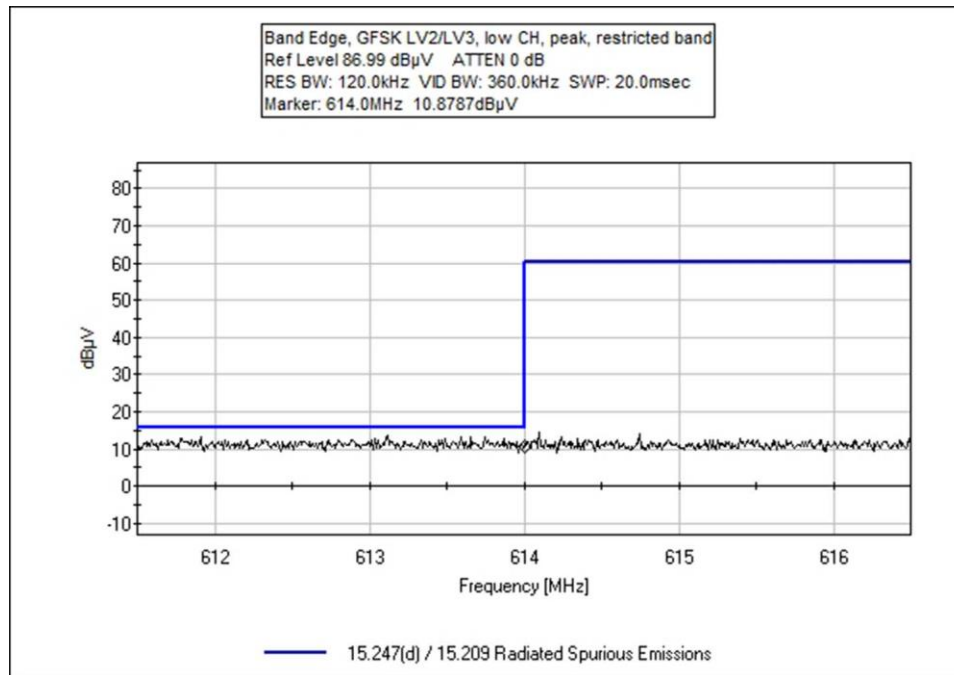


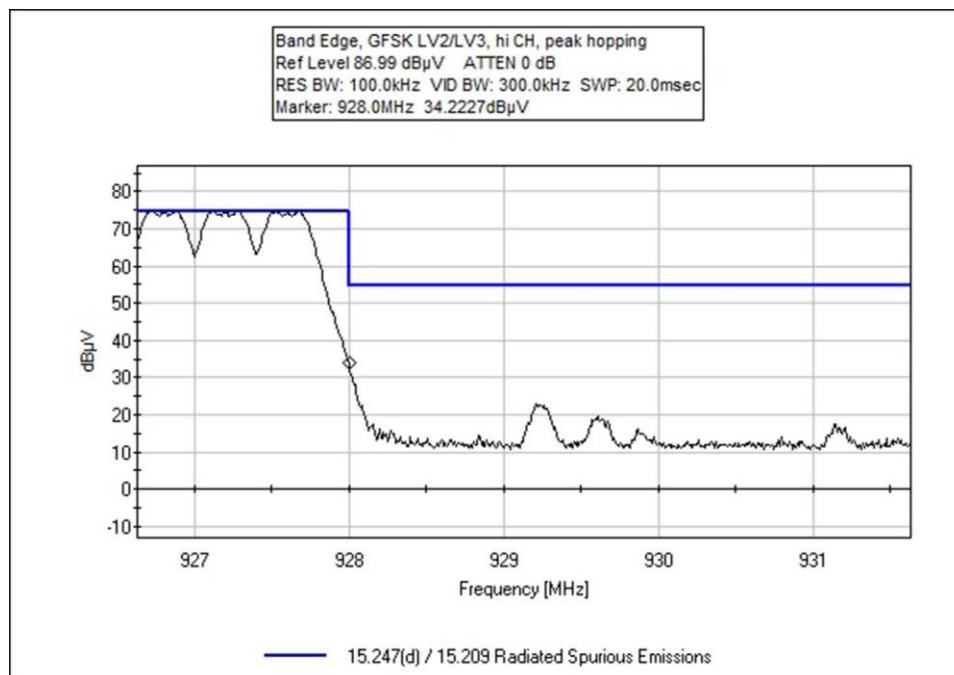
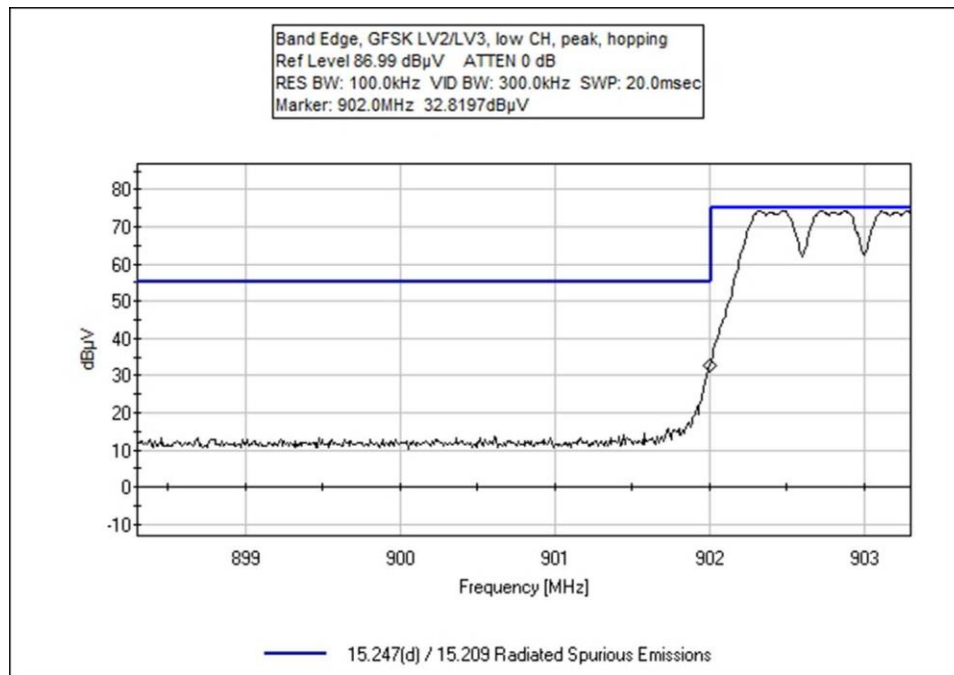


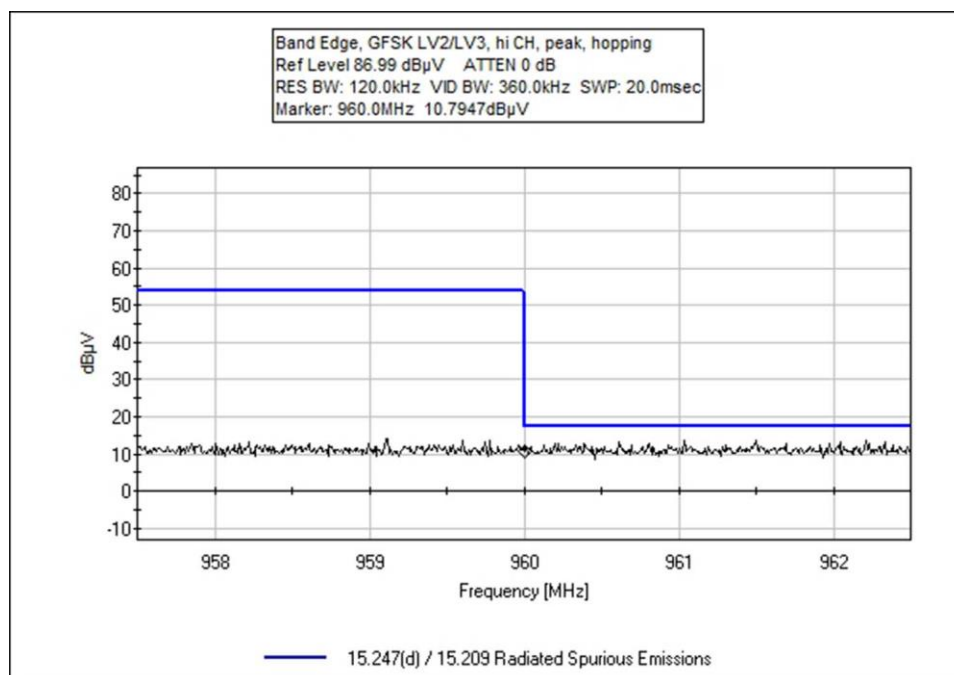
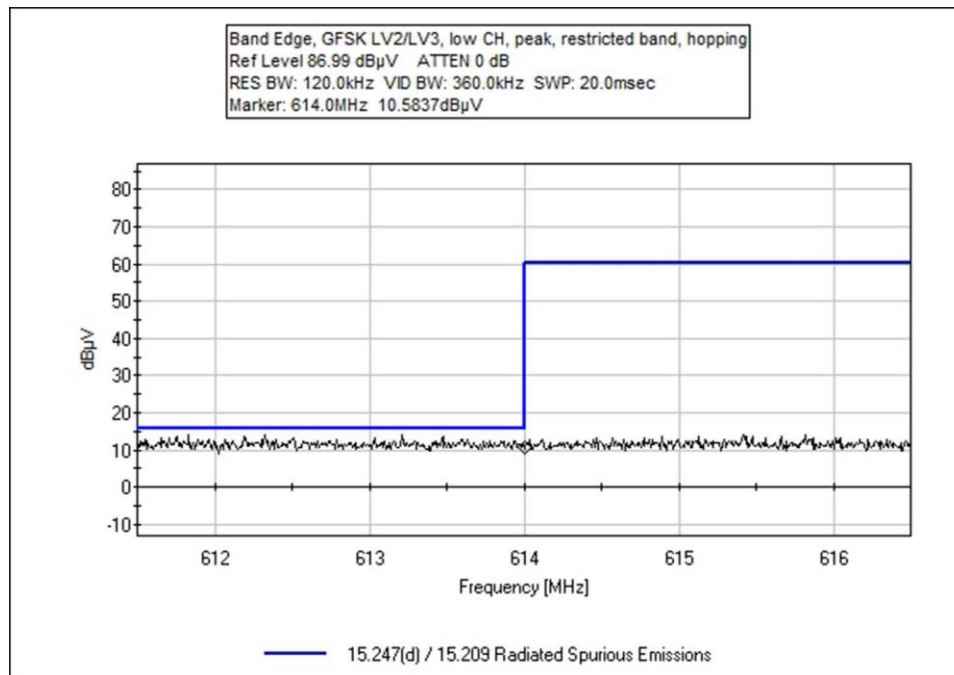


Band Edge Plot, Configuration 3









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: 1/25/2021
 Test Type: **Radiated Emissions** Time: 10:18:32
 Tested By: Don Nguyen Sequence#: 11
 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
 902.4 - 927.6MHz, 400kHz steps, 64 channels, 300kbps GFSK LV2/LV3
 Frequency of measurement: 614-960MHz
 RBW=120kHz, VBW=360kHz (restricted band)
 RBW=100kHz, VBW=300kHz (-20dBc)

 Test Method: ANSI C63.10 (2013)
 Temperature (°C): 24
 Relative Humidity (%): 30

 Modification 1 was in place during testing.

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	ANP05281	Attenuator	1B	4/7/2020	4/7/2022
T2	AN01993	Biconilog Antenna	CBL6111C	6/11/2019	6/11/2021
T3	AN02869	Spectrum Analyzer	E4440A	8/3/2020	8/3/2021
T4	ANP05198	Cable-Amplitude +15C to +45C (dB)	8268	12/21/2020	12/21/2022

Measurement Data:

Reading listed by margin.

Test Distance: 3 Meters

#	Freq MHz	Rdng dBμV	T1 dB	T2 dB	T3 dB	T4 dB	Dist Table	Corr dBμV/m	Spec dBμV/m	Margin dB	Polar Ant
1	614.000M	11.5	+5.9	+19.8	+0.0	+4.6	+0.0	41.8	46.0 hopping	-4.2	Vert
2	960.000M	12.9	+6.0	+24.4	+0.0	+6.0	+0.0	49.3	54.0	-4.7	Vert
3	614.000M	10.8	+5.9	+19.8	+0.0	+4.6	+0.0	41.1	46.0	-4.9	Vert
4	960.000M	11.1	+6.0	+24.4	+0.0	+6.0	+0.0	47.5	54.0 hopping	-6.5	Vert
5	902.000M	32.5	+6.0	+23.5	+0.0	+5.8	+0.0	67.8	88.5	-20.7	Vert
6	928.000M	31.0	+6.0	+23.9	+0.0	+5.9	+0.0	66.8	88.5	-21.7	Vert
7	928.000M	30.5	+6.0	+23.9	+0.0	+5.9	+0.0	66.3	88.5 hopping	-22.2	Vert
8	902.000M	30.9	+6.0	+23.5	+0.0	+5.8	+0.0	66.2	88.5 hopping	-22.3	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: 1/25/2021
 Test Type: **Radiated Emissions** Time: 09:55:52
 Tested By: Don Nguyen Sequence#: 5
 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
 902.4 - 927.6MHz, 400kHz steps, 64 channels, 300k GFSK LV2/LV3
 Frequency of measurement: 614-960MHz
 RBW=120kHz, VBW=360kHz (restricted band)
 RBW=100kHz, VBW=300kHz (-20dBc)

 Test Method: ANSI C63.10 (2013)
 Temperature (°C): 24
 Relative Humidity (%): 30

 Modification 1 was in place during testing.

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	ANP05281	Attenuator	1B	4/7/2020	4/7/2022
T2	AN01993	Biconilog Antenna	CBL6111C	6/11/2019	6/11/2021
T3	AN02869	Spectrum Analyzer	E4440A	8/3/2020	8/3/2021
T4	ANP05198	Cable-Amplitude +15C to +45C (dB)	8268	12/21/2020	12/21/2022

Measurement Data:

Reading listed by margin.

Test Distance: 3 Meters

#	Freq MHz	Rdng dBμV	T1 dB	T2 dB	T3 dB	T4 dB	Dist Table	Corr dBμV/m	Spec dBμV/m	Margin dB	Polar Ant
1	614.000M	12.9	+5.9	+19.8	+0.0	+4.6	+0.0	43.2	46.0	-2.8	Vert
2	614.000M	12.9	+5.9	+19.8	+0.0	+4.6	+0.0	43.2	46.0 hopping	-2.8	Vert
3	960.000M	11.7	+6.0	+24.4	+0.0	+6.0	+0.0	48.1	54.0	-5.9	Vert
4	960.000M	11.2	+6.0	+24.4	+0.0	+6.0	+0.0	47.6	54.0 hopping	-6.4	Vert
5	928.000M	34.0	+6.0	+23.9	+0.0	+5.9	+0.0	69.8	87.6	-17.8	Vert
6	928.000M	33.8	+6.0	+23.9	+0.0	+5.9	+0.0	69.6	87.6 hopping	-18.0	Vert
7	902.000M	31.0	+6.0	+23.5	+0.0	+5.8	+0.0	66.3	87.6	-21.3	Vert
8	902.000M	30.1	+6.0	+23.5	+0.0	+5.8	+0.0	65.4	87.6 hopping	-22.2	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: 1/25/2021
 Test Type: **Radiated Emissions** Time: 10:04:36
 Tested By: Don Nguyen Sequence#: 10
 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
 902.4 - 927.6MHz, 400kHz steps, 64 channels, 300kbps GFSK LV2/LV3
 Frequency of measurement: 614-960MHz
 RBW=120kHz, VBW=360kHz (restricted band)
 RBW=100kHz, VBW=300kHz (-20dBc)
 Test Method: ANSI C63.10 (2013)
 Temperature (°C): 24
 Relative Humidity (%): 30
 Modification 1 was in place during testing.

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	ANP05281	Attenuator	1B	4/7/2020	4/7/2022
T2	AN01993	Biconilog Antenna	CBL6111C	6/11/2019	6/11/2021
T3	AN02869	Spectrum Analyzer	E4440A	8/3/2020	8/3/2021
T4	ANP05198	Cable-Amplitude +15C to +45C (dB)	8268	12/21/2020	12/21/2022

Measurement Data:

Reading listed by margin.

Test Distance: 3 Meters

#	Freq MHz	Rdng dB μ V	T1 dB	T2 dB	T3 dB	T4 dB	Dist Table	Corr dB μ V/m	Spec dB μ V/m	Margin dB	Polar Ant
1	614.000M	10.9	+5.9	+19.8	+0.0	+4.6	+0.0	41.2	46.0	-4.8	Vert
2	614.000M	10.6	+5.9	+19.8	+0.0	+4.6	+0.0	40.9	46.0 hopping	-5.1	Vert
3	960.000M	11.9	+6.0	+24.4	+0.0	+6.0	+0.0	48.3	54.0	-5.7	Vert
4	960.000M	10.8	+6.0	+24.4	+0.0	+6.0	+0.0	47.2	54.0 hopping	-6.8	Vert
5	928.000M	34.2	+6.0	+23.9	+0.0	+5.9	+0.0	70.0	90.5 hopping	-20.5	Vert
6	928.000M	33.9	+6.0	+23.9	+0.0	+5.9	+0.0	69.7	90.5	-20.8	Vert
7	902.000M	33.4	+6.0	+23.5	+0.0	+5.8	+0.0	68.7	90.5	-21.8	Vert
8	902.000M	32.8	+6.0	+23.5	+0.0	+5.8	+0.0	68.1	90.5 hopping	-22.4	Vert

Test Setup Photo(s)



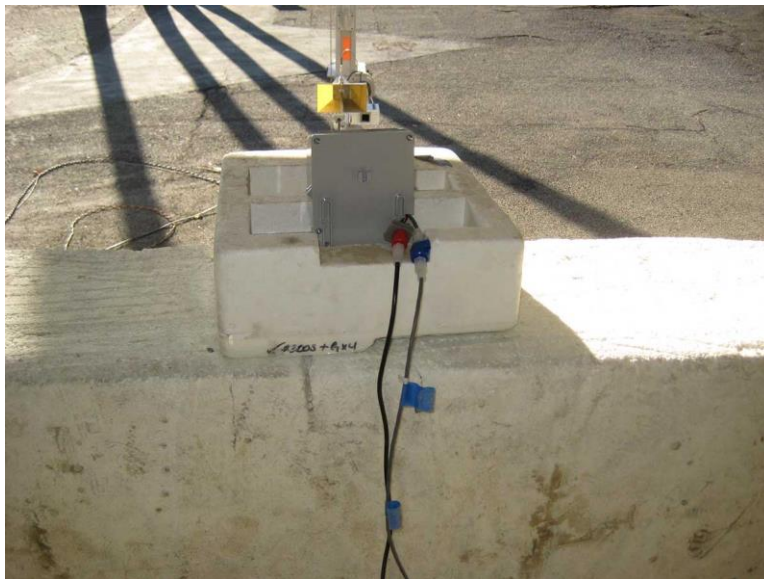
Configuration 1, Below 1GHz



Configuration 1, Below 1GHz



Configuration 1, Above 1GHz



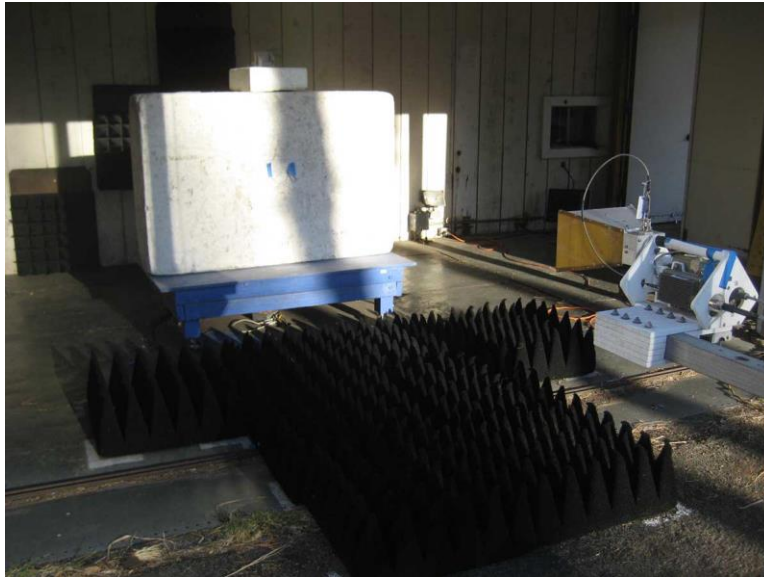
Configuration 1, Above 1GHz



Configuration 2, Below 1GHz



Configuration 2, Below 1GHz



Configuration 2, Above 1GHz



Configuration 2, Above 1GHz



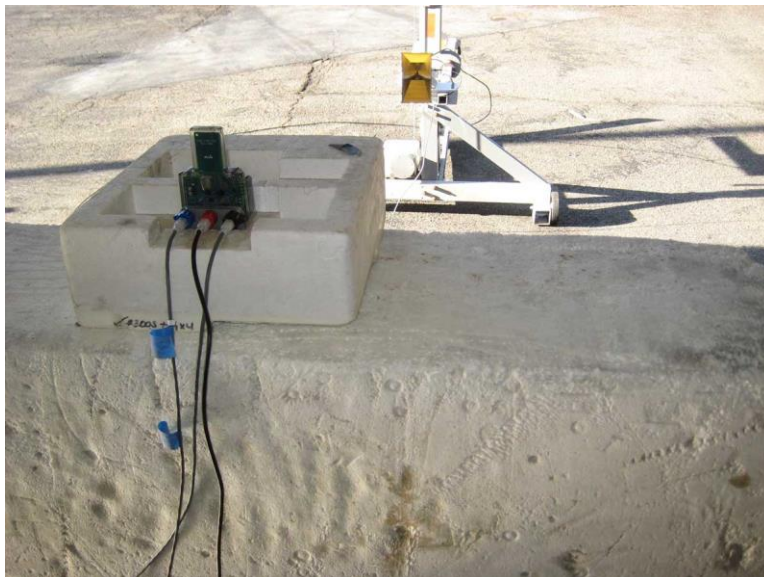
Configuration 3, Below 1GHz



Configuration 3, Below 1GHz



Configuration 3, Above 1GHz



Configuration 3, Above 1GHz

15.247(f) Power Spectral Density

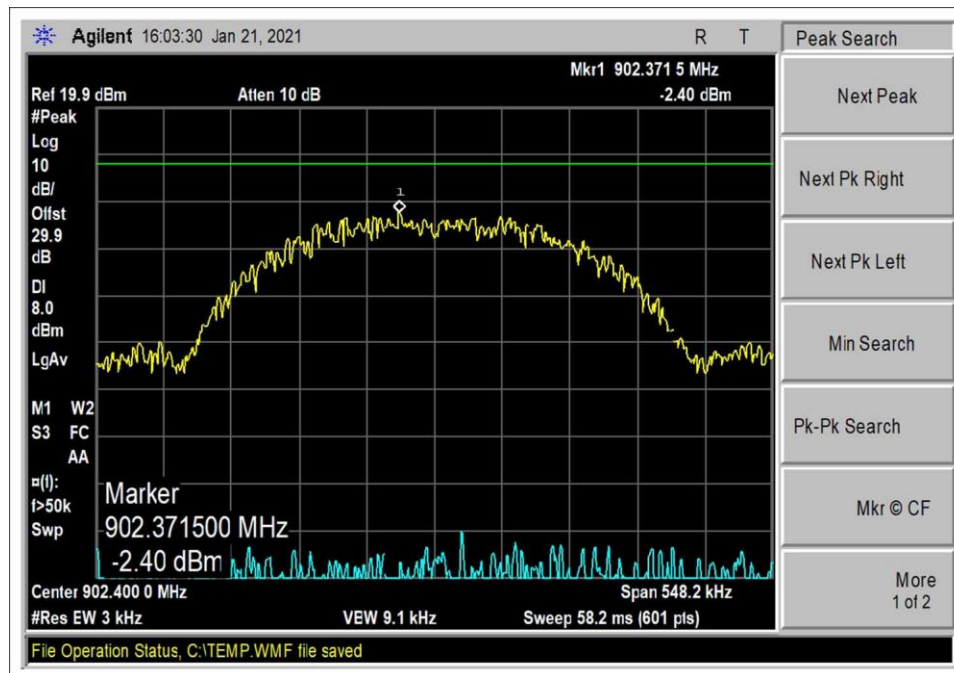
Test Setup/Conditions			
Test Location:	Brea Lab A	Test Engineer:	Don Nguyen
Test Method:	ANSI C63.10 (2013)	Test Date(s):	1/21/2021
Configuration:	4		
Test Setup:	The EUT is placed on test bench and powered from 3.6Vdc power supply (to simulate fresh battery). The EUT is connected to a support laptop running CLI Tool ver.2.0.1.24. Operating frequency range/ modes: 902.4 – 927.6MHz, 400kHz steps, 64 channels, 300kbps GFSK LV2 Tested frequency range: 902.4-927.6MHz RBW=3kHz, VBW=9.1kHz		

Environmental Conditions			
Temperature (°C)	24	Relative Humidity (%):	34

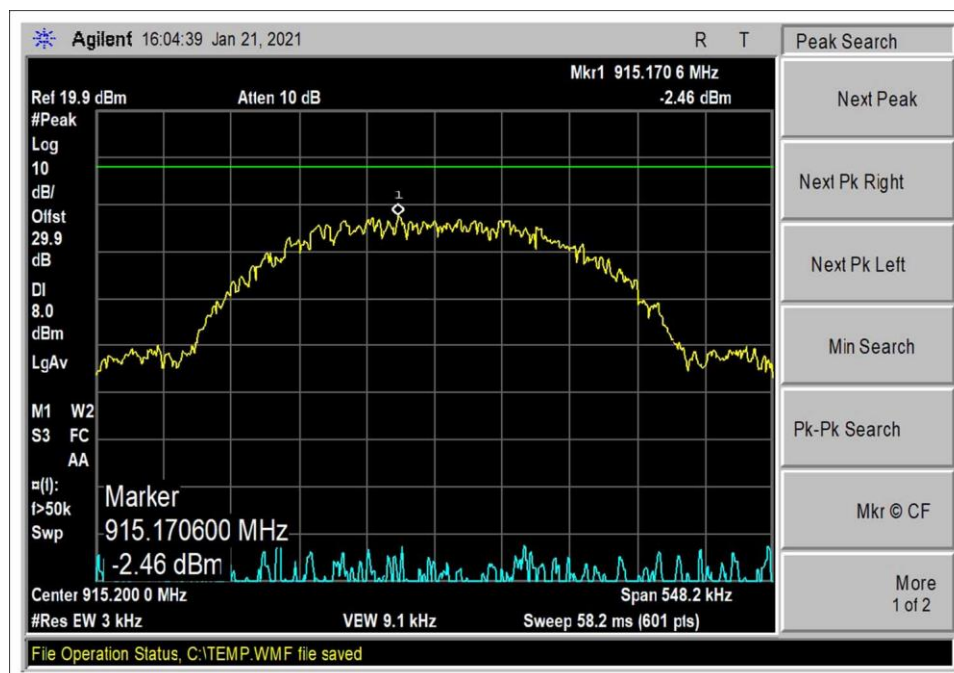
Test Equipment					
Asset#	Description	Manufacturer	Model	Cal Date	Cal Due
03643	Spectrum Analyzer	Agilent	E4440A	5/20/2020	5/20/2022
03432	Attenuator	Aeroflex/Weinschel	90-30-34	10/22/2019	10/22/2021
P07246	Cable	H&S	32022-29094K-29094K-24TC	5/29/2020	5/29/2022

Test Data Summary - RF Conducted Measurement				
Measurement Method: PKPSD				
Frequency (MHz)	Modulation	Measured (dBm/3kHz)	Limit (dBm/3kHz)	Results
902.4	300k GFSK LV2	-2.40	≤8	Pass
915.2	300k GFSK LV2	-2.46	≤8	Pass
927.6	300k GFSK LV2	-2.42	≤8	Pass

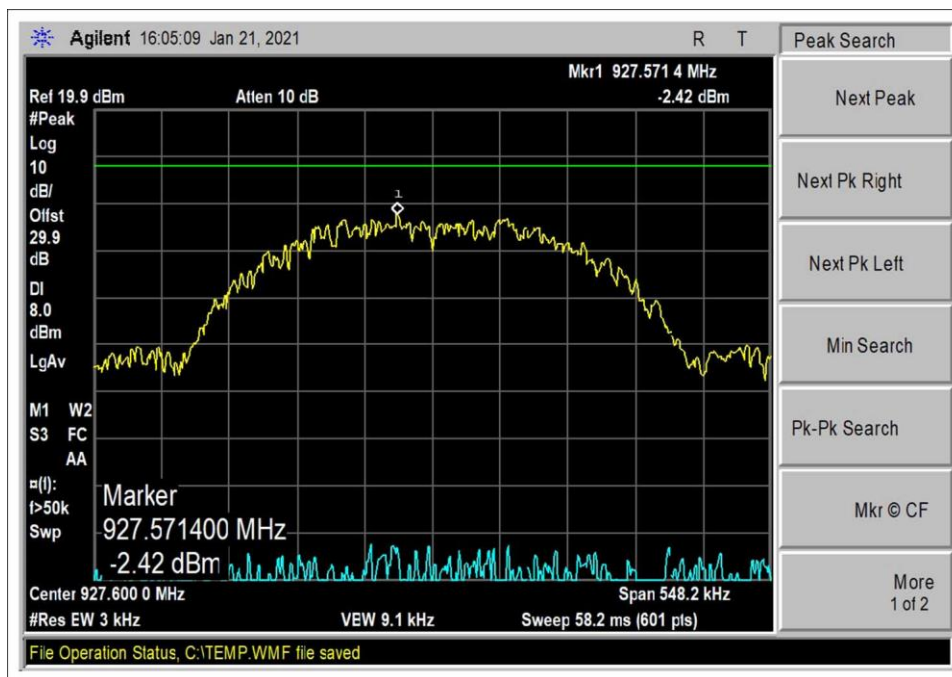
Test Data



300k GFSK LV2, Low Channel

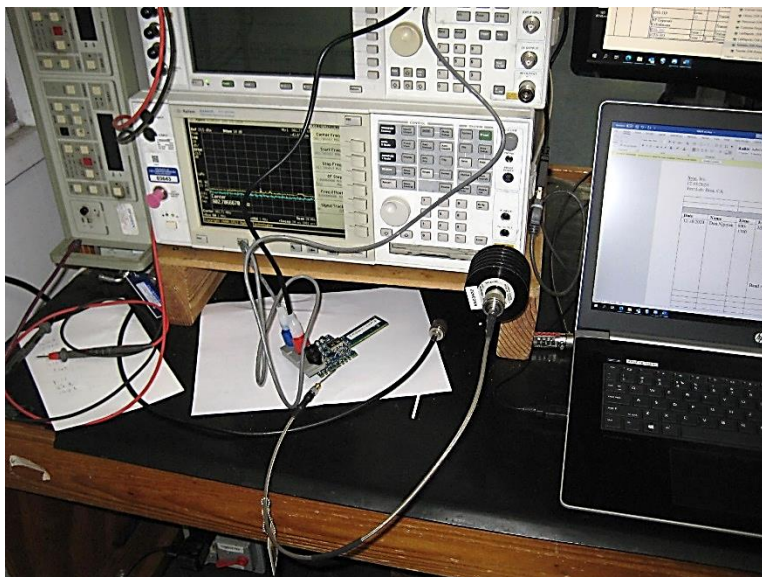


300k GFSK LV2, Middle Channel



300k GFSK LV2, High Channel

Test Setup Photo(s)



15.247(f) Time of Occupancy

CKC laboratories was not contracted to perform the testing due to the required equipment and firmware to exercise the EUT's multiple pseudo-random hopping sequences was not available and that the complexity of the different modulations and modes depend on the device to be in a fully operating network environment.

Therefore, the manufacturer declares the following:

"With the multiple modulations, modes and hop tables, the mode with the worst-case Time of Occupancy to demonstrate 400mS compliance is 399 mS in 20 seconds, since this modulation is less than 250kHz Occupied Band Width. Each session of multiple short transmissions takes place on channels out of a minimum of 50 channels in a pseudorandom sequence. The algorithm that determines the pseudo-random hop sequence ensures all active channels are used equally on the average.

Additionally, the manufacturer declares the following:

Since the 300kbps power level 2 modulation is a hybrid both DTS and DSS, we comply with the channel occupancy requirement of 400mS in 1.2 seconds (minimum of 3 channels x 400mS = 1.2 seconds).

Ittron employs hopping patterns based on pseudo-random sequence generators or pseudo-random hop tables.

The firmware uses the channels in the prescribed pseudo random order, therefore it maintains equal channel usage.

The system has receiver channel bandwidths that match the transmitter's modulation bandwidth that is enabled.

With the transmitter and receiver in synchronization within the network, transmitters switch frequencies in synchronization with the receiver.

When the transmitter needs to send a continuous or long data stream, total time of the packet transmissions is monitored to comply with dwell time requirement of 400ms in the appropriate 10s or 20s window depending on the modulation/mode enabled.

This device does not employ any hopping avoidance techniques."

SUPPLEMENTAL INFORMATION

Measurement Uncertainty

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

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

Emissions Test Details

TESTING PARAMETERS

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

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

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

CORRECTION FACTORS

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

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

TEST INSTRUMENTATION AND ANALYZER SETTINGS

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

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

SPECTRUM ANALYZER/RECEIVER DETECTOR FUNCTIONS

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

Peak

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

Quasi-Peak

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

Average

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