Itron, Inc.

REVISED TEST REPORT FOR 103181-34

Gas Endpoint
Model: 500GB

Tested to The Following Standards:

FCC Part 15 Subpart C Section(s)

15.247
(FHSS 902-928 MHz)

Report No.: 103181-34A

Date of issue: March 2, 2020

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

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

Test Certificate # 803.01

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Testing the Future
CKC LABORATORIES, INC.

TABLE OF CONTENTS

Administrative Information 3
- Test Report Information 3
- Revision History 3
- Report Authorization 3
- Test Facility Information 4
- Software Versions 4
- Site Registration & Accreditation Information 4
- Summary of Results 5
- Modifications During Testing 5
- Conditions During Testing 5
- Equipment Under Test 6
- General Product Information 7

FCC Part 15 Subpart C 8
- 15.247(a) Transmitter Characteristics 8
  - 15.247(a)(1)(i) 20 dB Bandwidth 8
  - 15.247(a)(1) Carrier Separation 12
  - 15.247(a)(1)(i) Number of Hopping Channels 14
  - 15.247(a)(1)(i) Time of Occupancy 23
- 15.247(b)(2) Output Power 24
- 15.247(d) RF Conducted Emissions & Band Edge 29
- 15.247(d) Radiated Emissions & Band Edge 39

Supplemental Information 62
- Measurement Uncertainty 62
- Emissions Test Details 62

ADMINISTRATIVE INFORMATION

Test Report Information

REPORT PREPARED FOR:

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

Representative: Jay Holcomb
Customer Reference Number: 191348

REPORT PREPARED BY:

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

Project Number: 103181

DATE OF EQUIPMENT RECEIPT: October 7, 2019
DATE(S) OF TESTING: October 7-31, 2019 and November 26-27, 2019

Revision History

Original: Testing of Gas Endpoint, Model: 500GB FCC Subpart C 15.247 (FHSS 902-928 MHz).
Revision A: Correction to antenna gain from 2.7dBi to 1.0dBi at power output section.

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	5.03.12

Site Registration & Accreditation Information

Location	*NIST CB #	FCC	Japan
Canyon Park, Bothell, WA	US0081	US1022	A-0136
Brea, CA	US0060	US1025	A-0136
Fremont, CA	US0082	US1023	A-0136
Mariposa, CA	US0103	US1024	A-0136

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

SUMMARY OF RESULTS

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

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

NA = Not Applicable
NA1 = Not applicable because the EUT operates on battery power.
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
No modifications were made during testing.

Modifications listed above must be incorporated into all production units.

Conditions During Testing

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

Summary of Conditions
None

EQUIPMENT UNDER TEST (EUT)

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

Configuration 1

Equipment Tested:

Device	Manufacturer	Model #	S/N
Gas Endpoint	Itron, Inc.	500GB	103181-cond

Support Equipment:

Device	Manufacturer	Model #	S/N
USB to Serial Adapter	Itron, Inc.	PCB-TEMP-0007	NA
DC Power Supply	Topward	6306D	988614
Laptop AC/DC Adapter	Dell	PA-1900-02D	NA
Laptop	Dell	Latitude E6420	8P954R1

Configuration 2

Equipment Tested:

Device	Manufacturer	Model #	S/N
Gas Endpoint	Itron, Inc.	500GB	280101435959

Support Equipment:

Device	Manufacturer	Model #	S/N
USB to Serial Adapter	Itron, Inc.	PCB-TEMP-0007	NA
Laptop AC/DC Adapter	Dell	PA-1900-02D	NA
Laptop	Dell	Latitude E6420	8P954R1

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:	902.2 – 927.75MHz, GFSK 25kbps, power level 3, 512 channels, 50kHz spacing 902.2 – 927.80MHz, GFSK,50kbps, power level 3, 129 channels, 200kHz spacing
Number of Hopping Channels:	512 (25kbps) and 129 (50kbps)
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):	25kbps GFSK, 50kbps GFSK
Maximum Duty Cycle:	100%
Number of TX Chains:	1
Antenna Type(s) and Gain:	PCB Trace, 1.0dBi
Beamforming Type:	NA
Antenna Connection Type:	Integral (External connector provided to facilitate testing)
Nominal Input Voltage:	6Vdc battery
Firmware / Software used for Test:	App Version: 5.0.4.0, CSL version: 16.0.5.0 Hardware Rev: 5

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):	10/7-22/2019
Configuration:	1		
Test Setup:	The EUT is placed on test bench. The serial port is connected to a support laptop via serial to USB adapter. The laptop is running software Command Line Interface Tool to turn on TX. The EUT is powered from 6Vdc power supply to simulate fresh battery. Frequency of measurement: 902.2 to 927.8MHz RBW=1kHz, 3kHz, 4.7kHz, 10kHz, 20kHz VBW=3kHz, 9.1kHz, 15kHz, 30kHz, 62kHz		

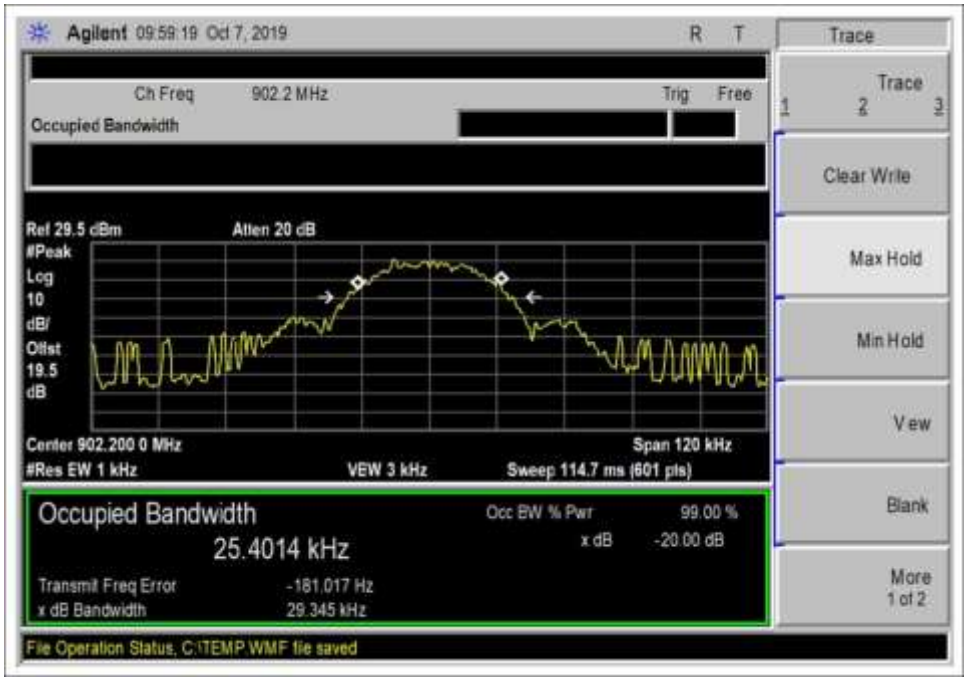
Environmental Conditions			
Temperature (ºC)	25.4	Relative Humidity (%):	30

Test Equipment					
Asset#	Description	Manufacturer	Model	Cal Date	Cal Due
02672	Spectrum Analyzer	Agilent	E4446A	3/13/2019	3/13/2021
03431	Attenuator	Aeroflex/Weinschel	89-20-21	12/19/2017	12/19/2019
P07243	Cable	H&S	32022-29094K-29094K-24TC	7/5/2018	7/5/2020

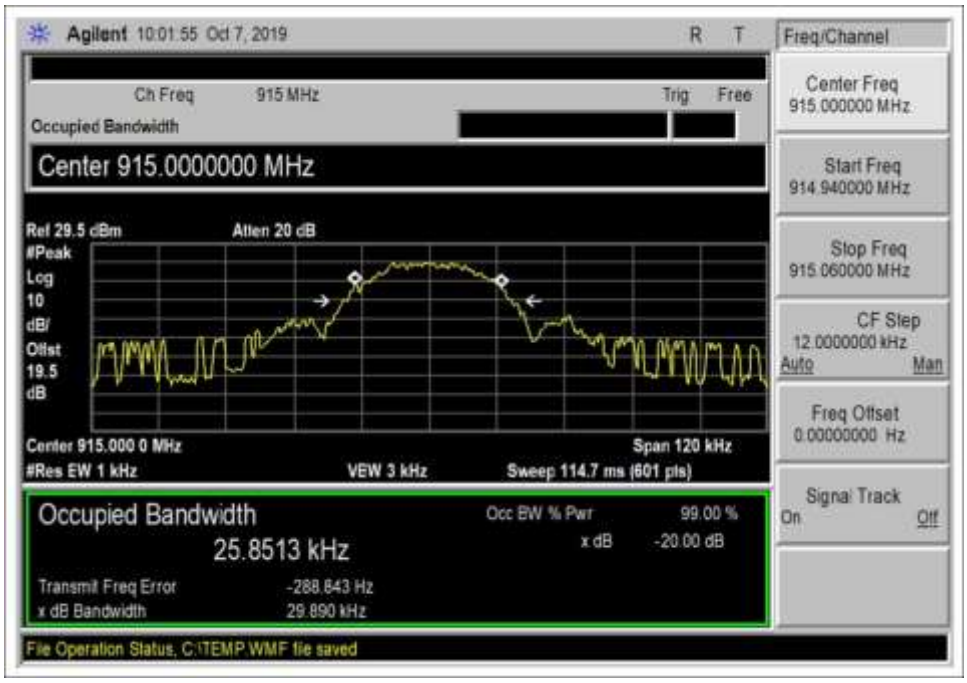
15.247(a)(1)(i) 20 dB Bandwidth

Test Data Summary					
Frequency (MHz)	Antenna Port	Modulation	Measured (kHz)	Limit (kHz)	Results
902.2	1	25kbps GFSK Level 3	29.345	≤500	Pass
915.0	1	25kbps GFSK Level 3	29.890	≤500	Pass
927.75	1	25kbps GFSK Level 3	29.795	≤500	Pass
902.2	1	50kbps GFSK Level 3	101.462	≤500	Pass
915.0	1	50kbps GFSK Level 3	101.958	≤500	Pass
927.8	1	50kbps GFSK Level 3	103.954	≤500	Pass

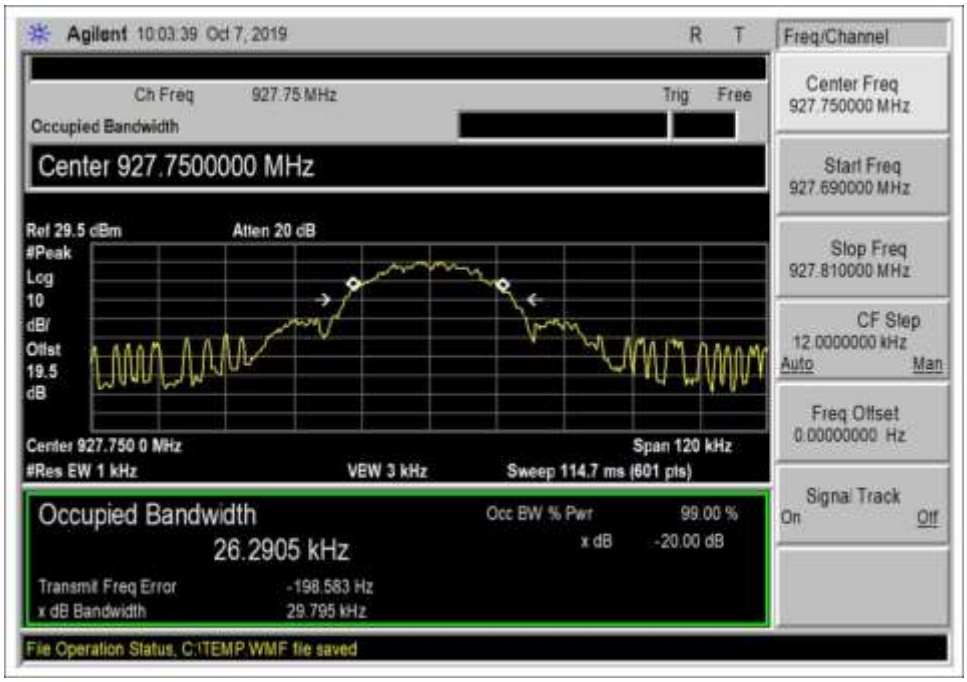
Plot(s)



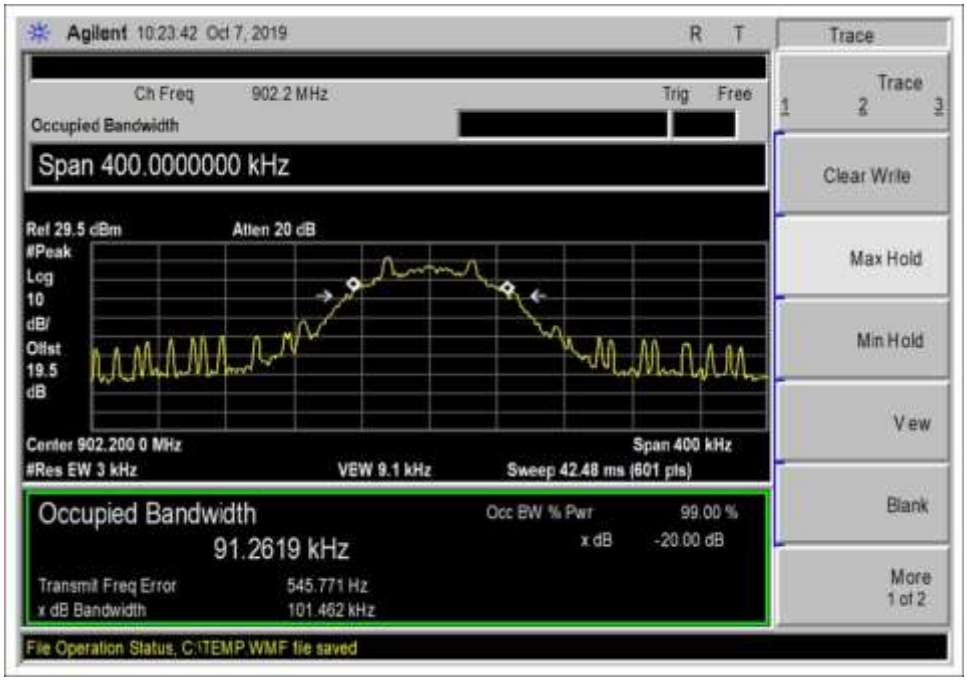
Low Channel, 25kbps



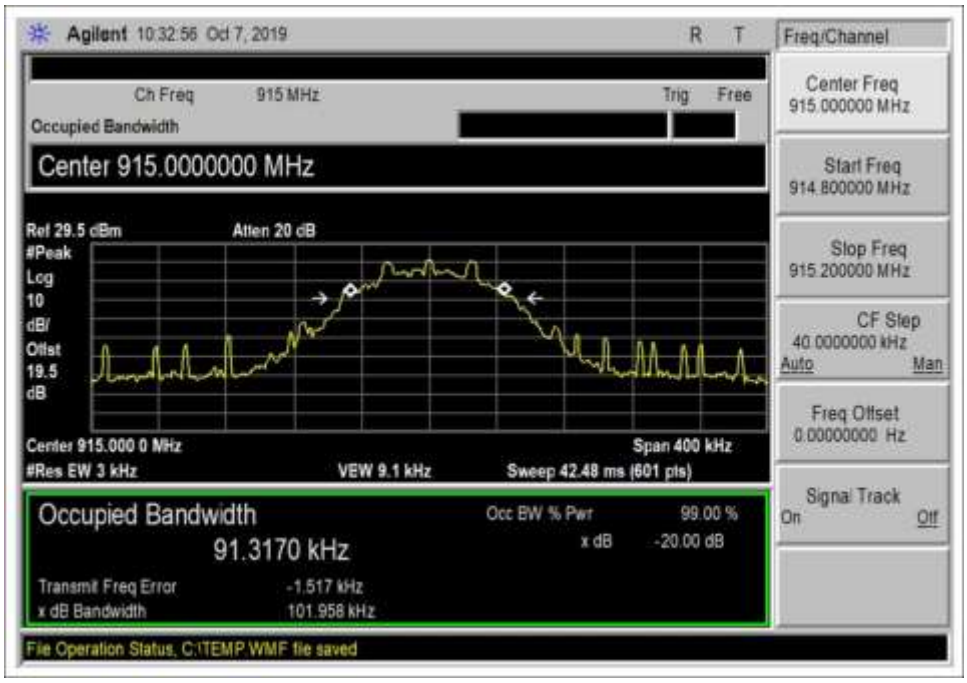
Middle Channel, 25kbps



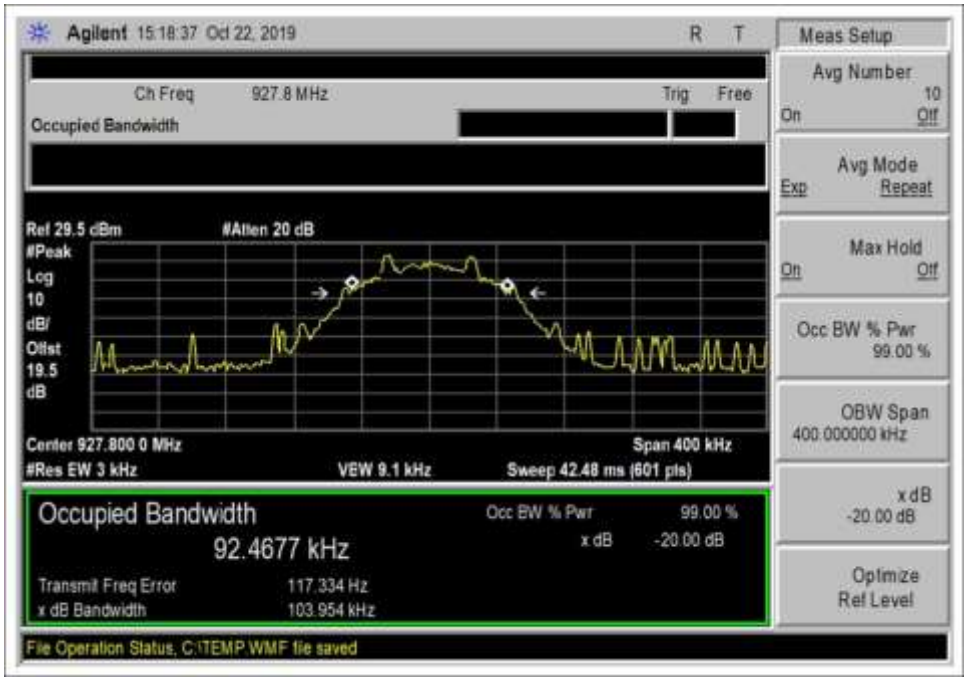
High Channel, 25kbps



Low Channel, 50kbps



Middle Channel, 50kbps

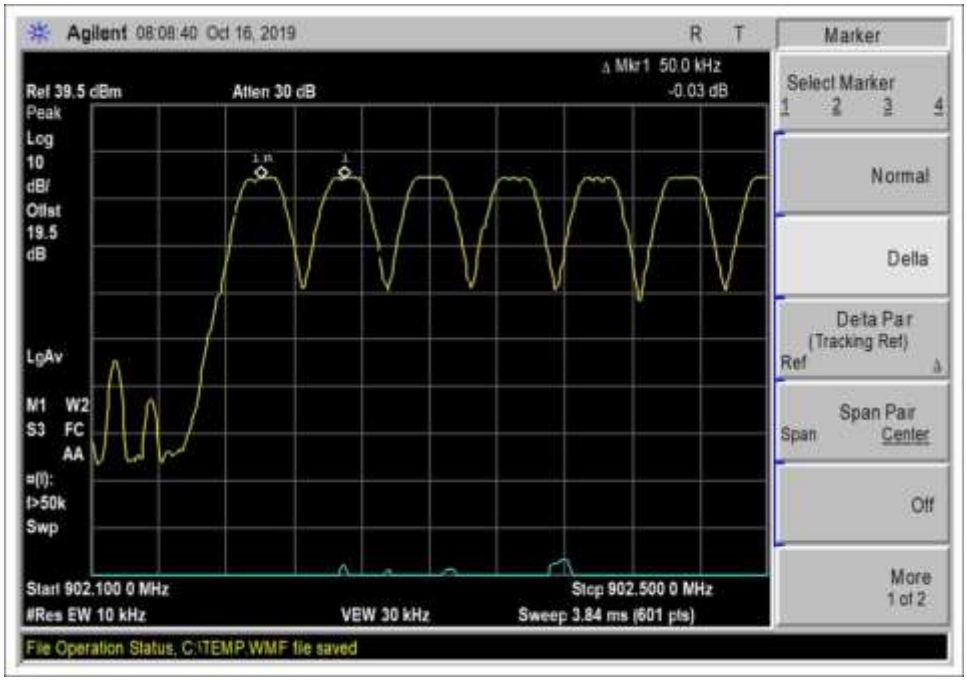


High Channel, 50kbps

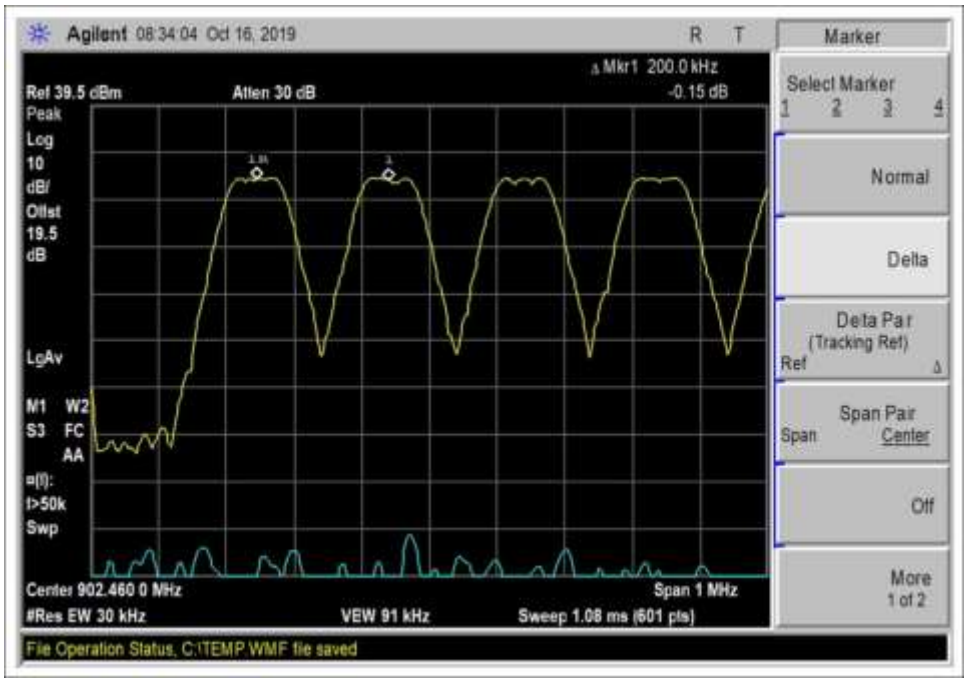
15.247(a)(1) Carrier Separation

Test Data Summary					
Limit applied: 20dB bandwidth of the hopping channel.					
Antenna Port	**Operational Mode**	**Modulation**	**Measured (kHz)**	**Limit (kHz)**	**Results**
1	Hopping	25kbps GFSK Level 3	50	>29.890	Pass
1	Hopping	50kbps GFSK Level 3	200	>103.954	Pass

Plot(s)



25kbps

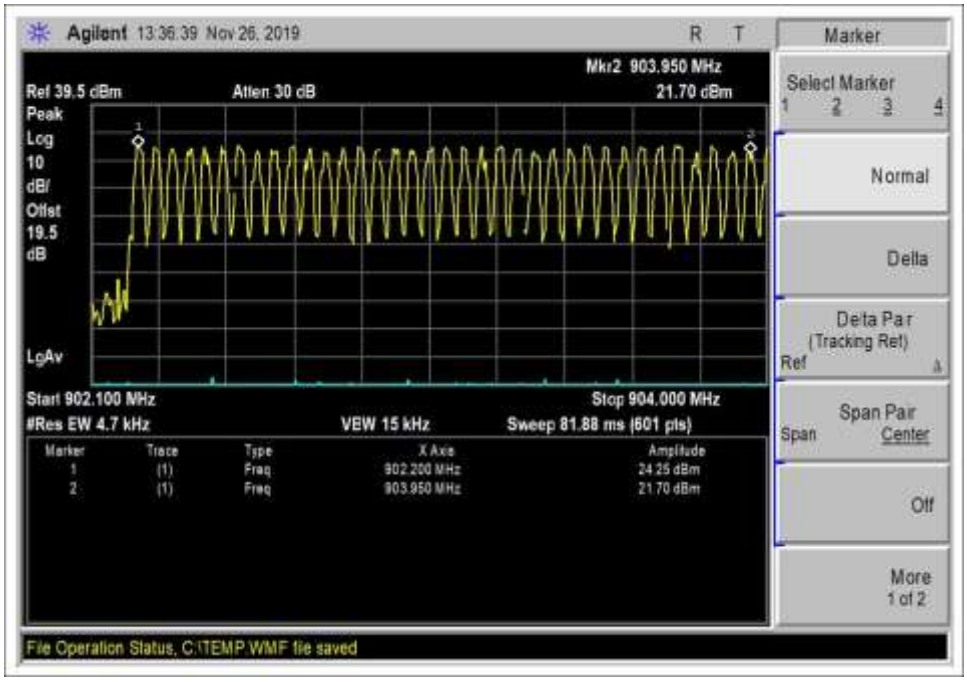

Agilent 08:34:04 Oct 16, 2019
R T
Marker
Δ Mkr1 200.0 kHz
-0.15 dB
Ref 39.5 dBm
Atten 30 dB
Peak
Log
10
dB/
Offst
19.5
dB
LgAv
M1 W2
S3 FC
AA
Swp
Center 902.460 0 MHz
Span 1 MHz
#Res EW 30 kHz
VEW 91 kHz
Sweep 1.08 ms (601 pts)
Select Marker
1 2 3 4
Normal
Delta
Delta Pair
(Tracking Ref)
Ref
Span Pair
Span
Center
Off
More
1 of 2
File Operation Status, C:\TEMP.WMF file saved

50kbps

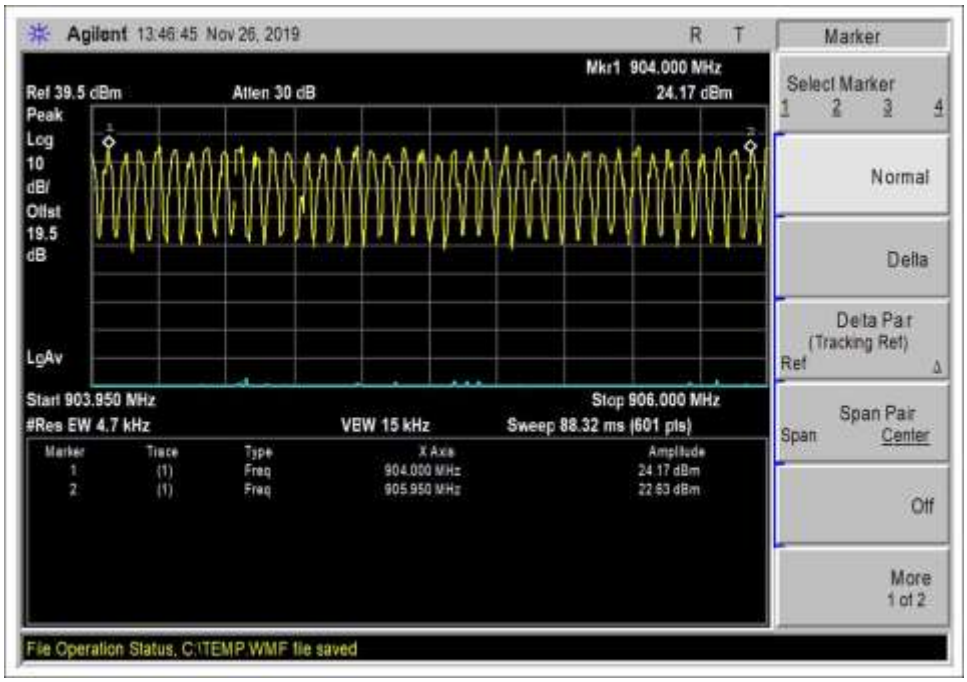
15.247(a)(1)(i) Number of Hopping Channels

Test Data Summary					
$Limit = \begin{cases} 50\ Channels\ \lvert 20\ dB\ BW < 250kHz \\ 25\ Channels\ \lvert 20\ dB\ BW \geq 250kHz \end{cases}$					
Antenna Port	**Operational Mode**	**Modulation**	**Measured (Channels)**	**Limit (Channels)**	**Results**
1	Hopping	25kbps GFSK Level 3	512	≥50	Pass
1	Hopping	50kbps GFSK Level 3	129	≥50	Pass

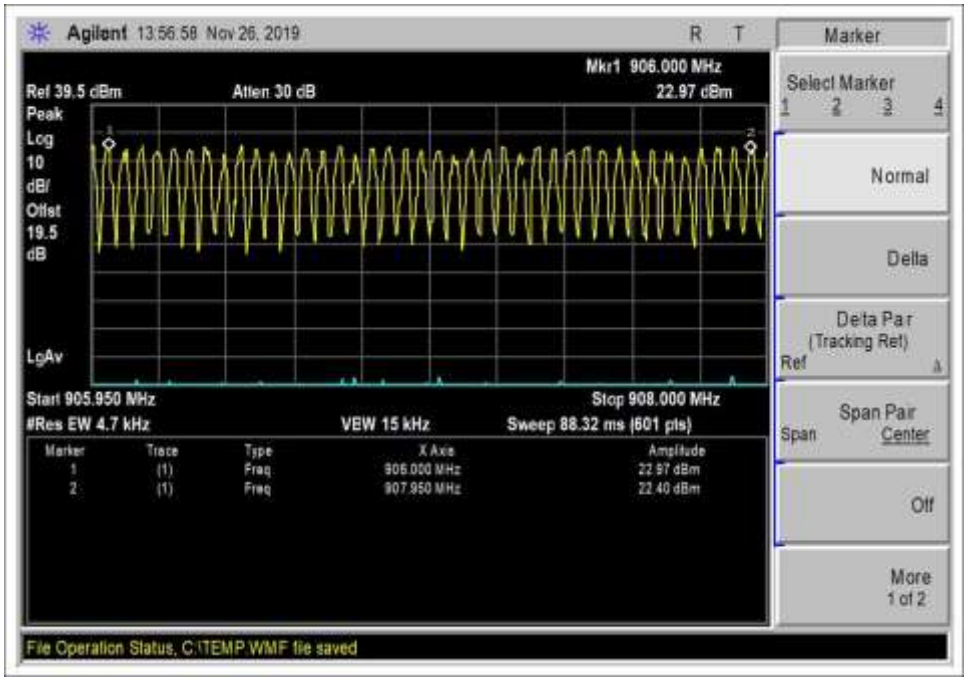
Plot(s)



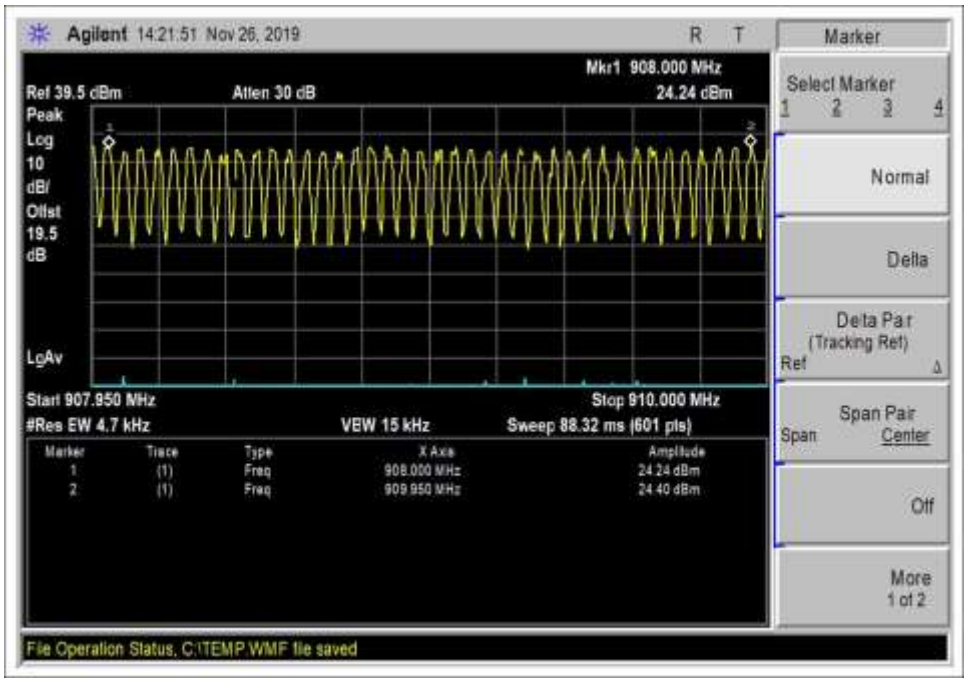
50kHz spacing_25k_902.2 to 903.95MHz



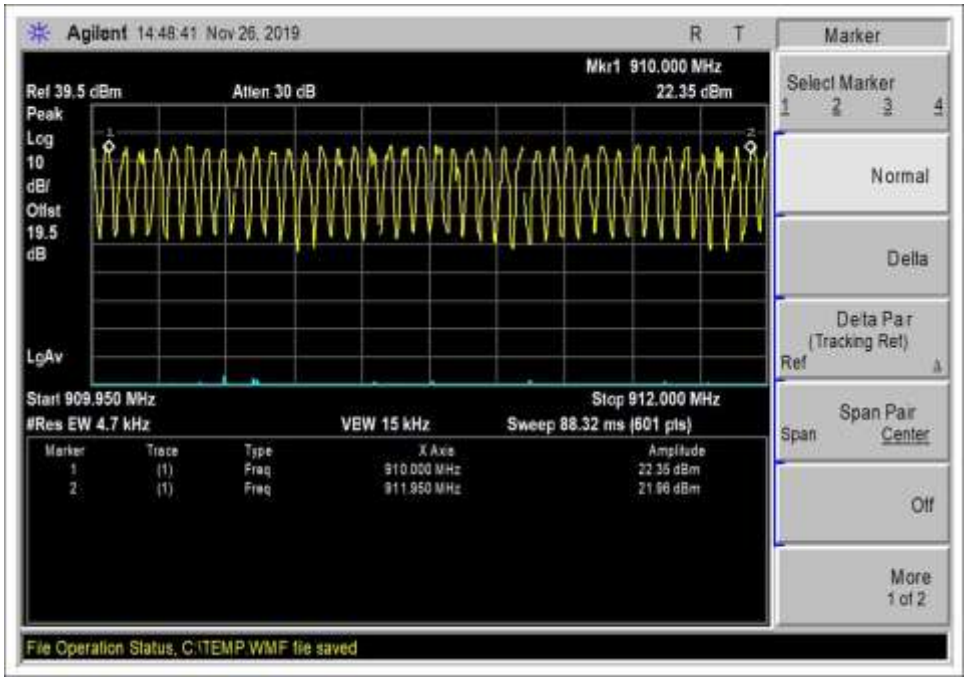
50kHz spacing_25k_904 to 905.95MHz



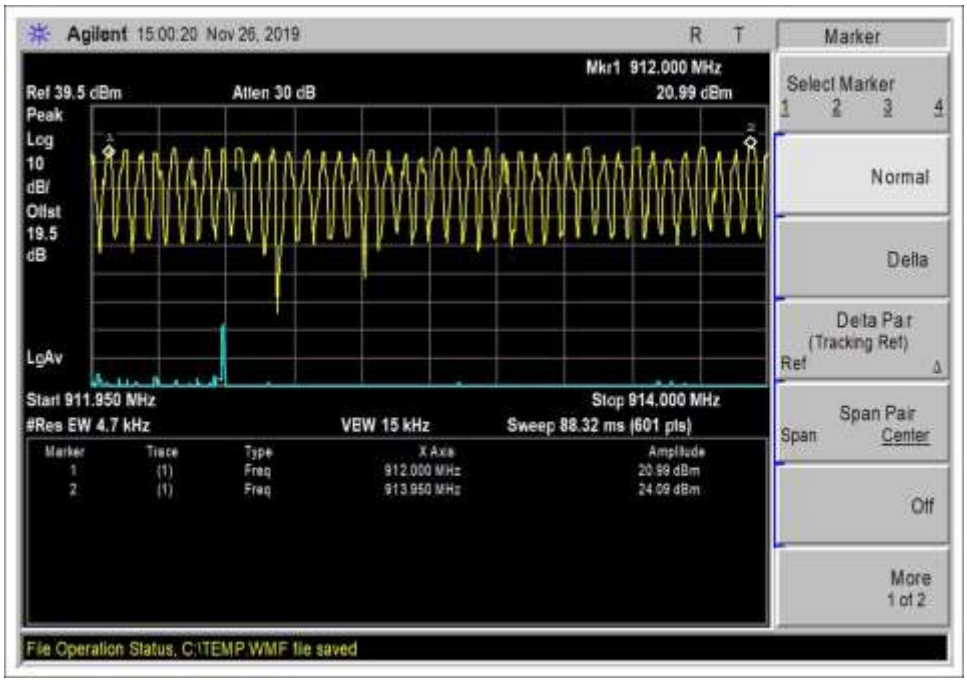
50kHz spacing_25k_906 to 907.95MHz



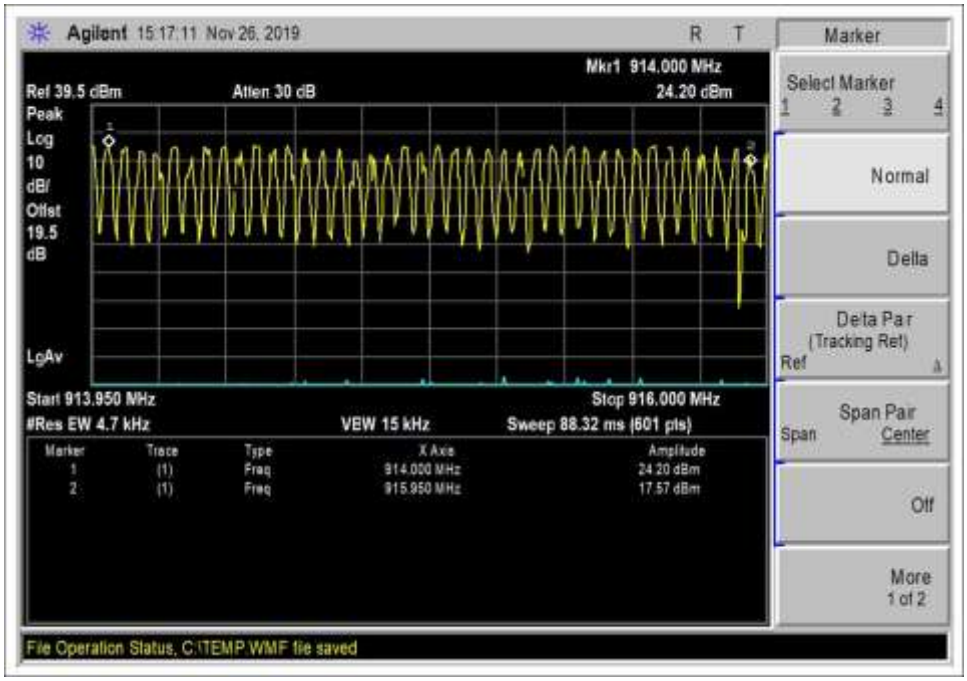
50kHz spacing_25k_908 to 909.95MHz



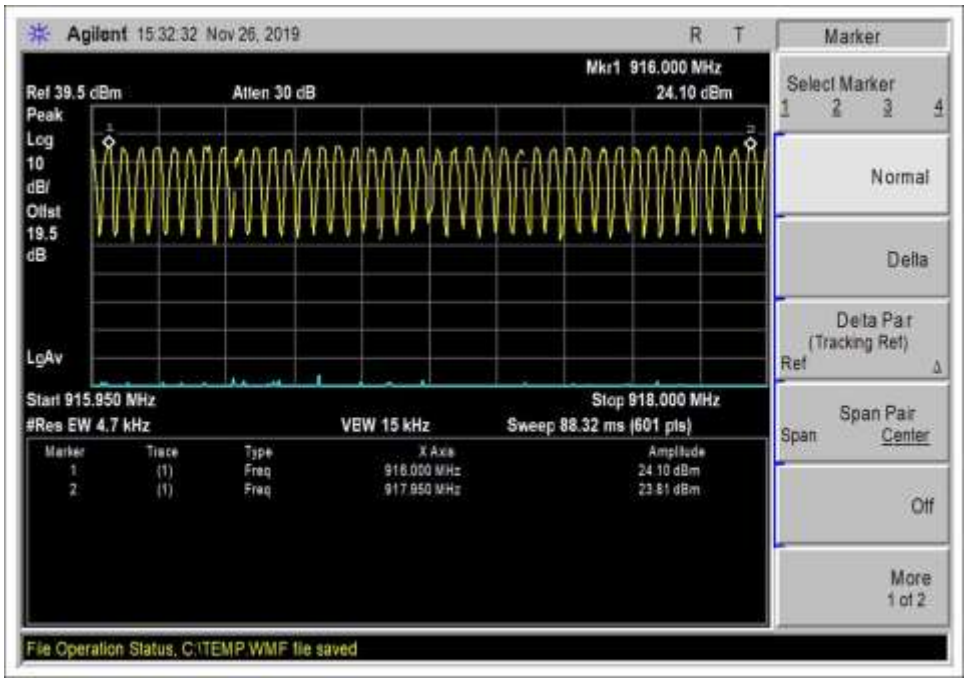
50kHz spacing_25k_910 to 911.95MHz



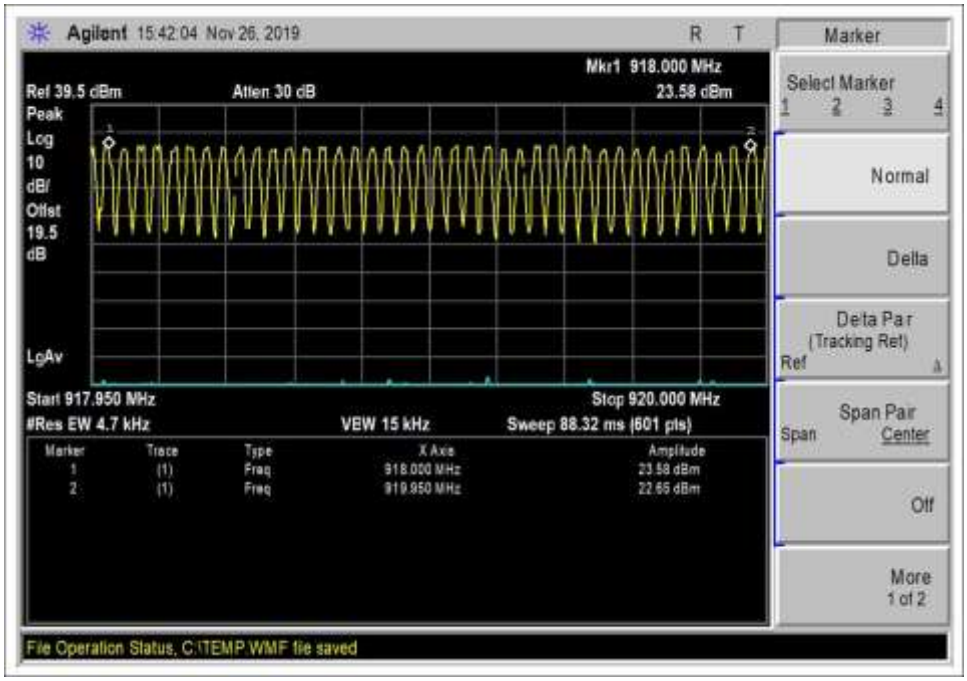
50kHz spacing_25k_912 to 913.95MHz



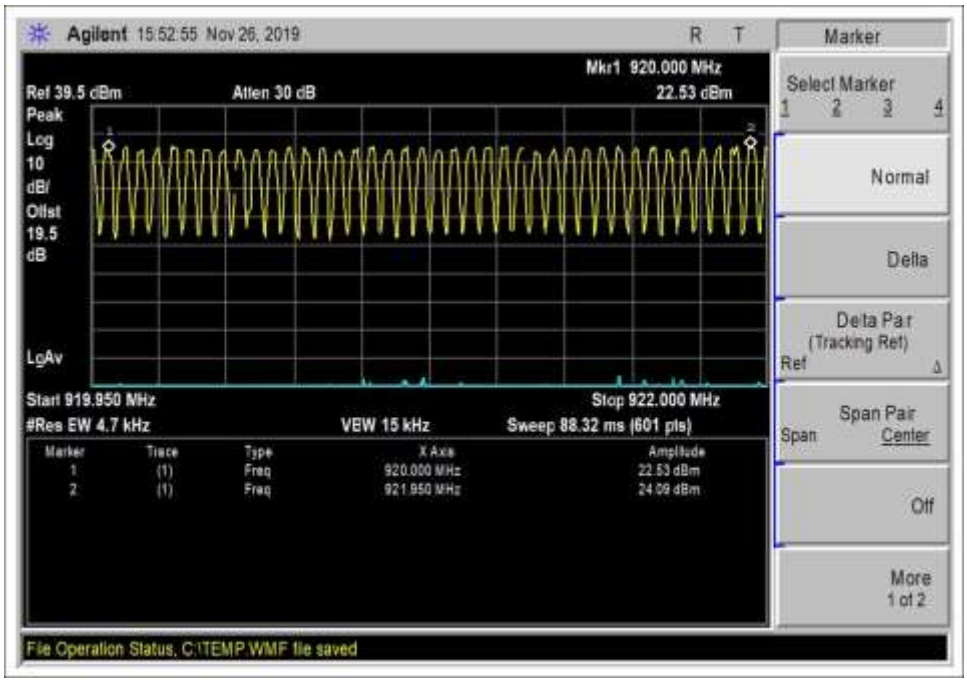
50kHz spacing_25k_914 to 915.95MHz



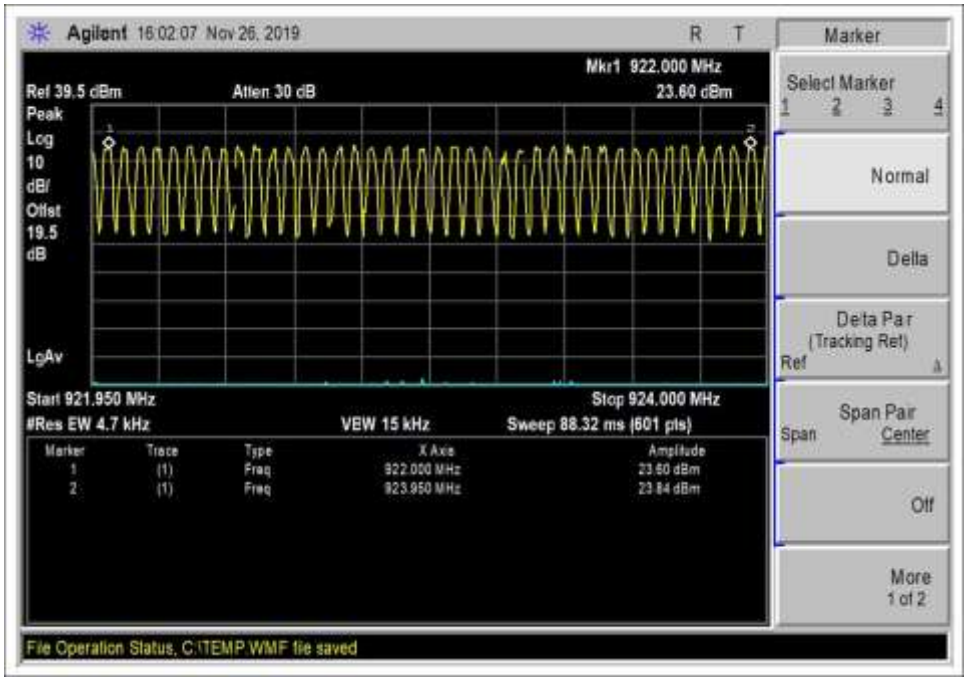
50kHz spacing_25k_916 to 917.95MHz



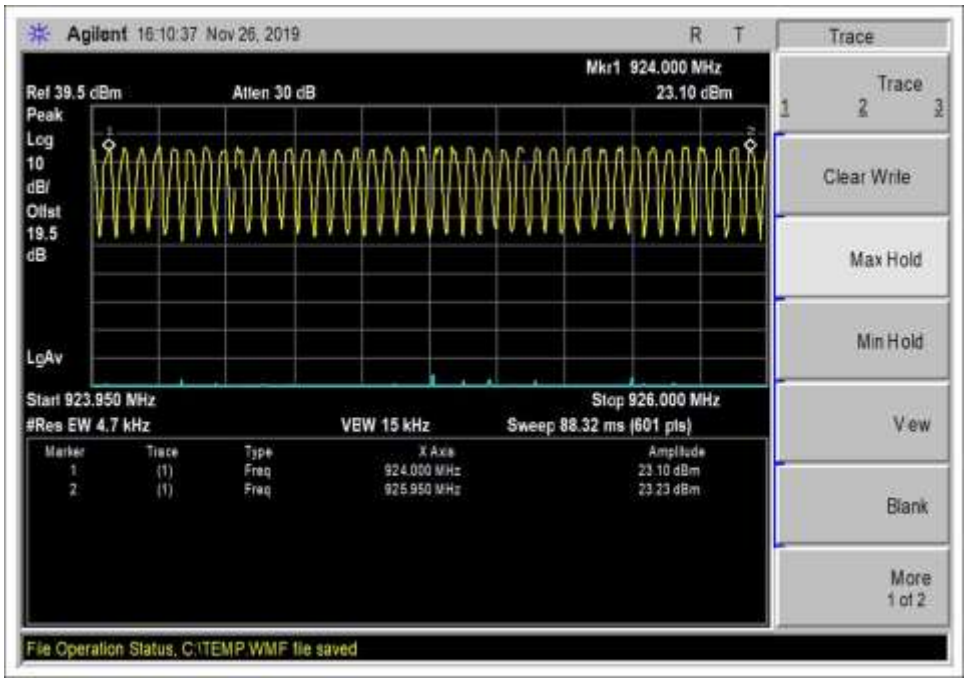
50kHz spacing_25k_918 to 919.95MHz



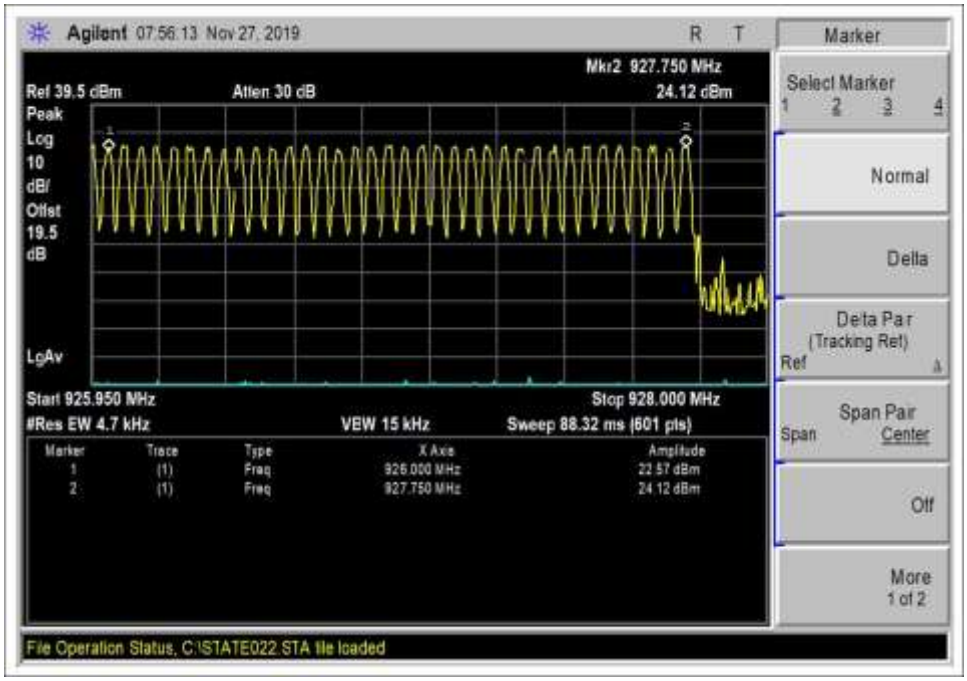
50kHz spacing_25k_920 to 921.95MHz



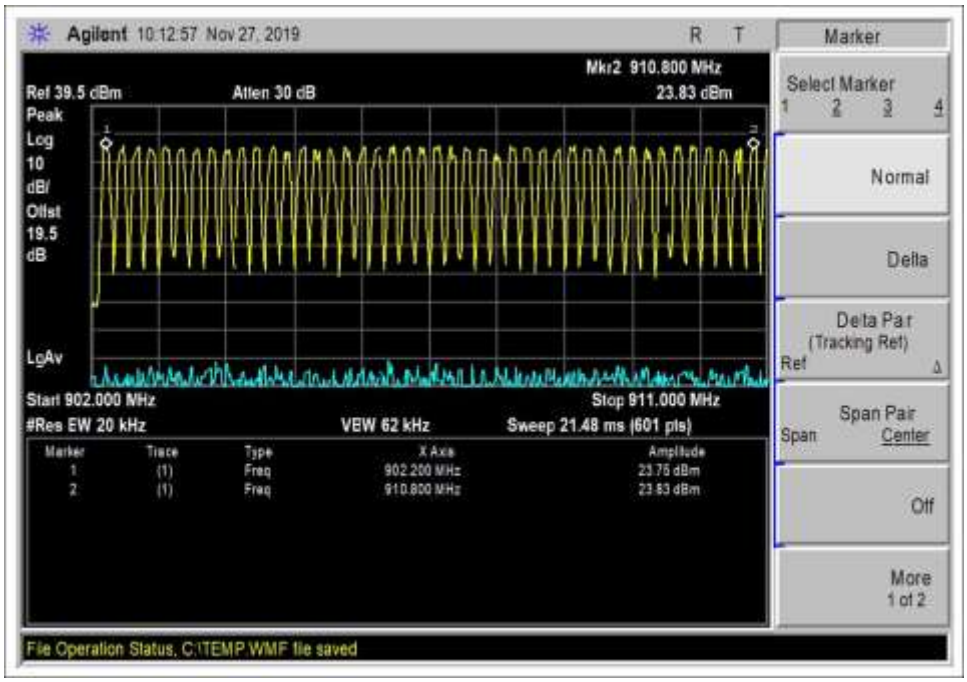
50kHz spacing_25k_922 to 923.95MHz



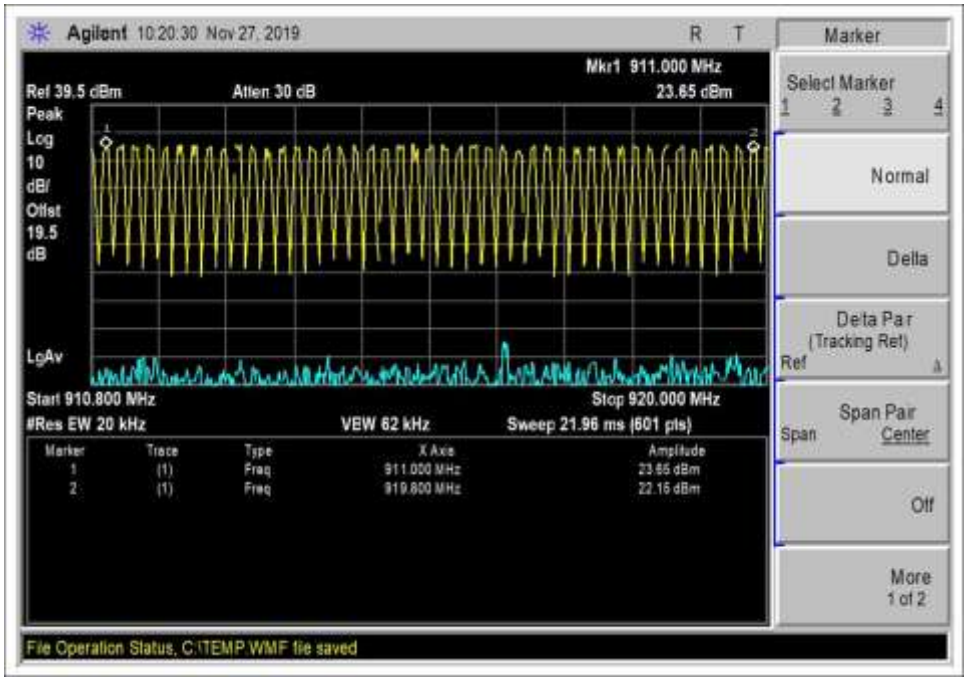
50kHz spacing_25k_924 to 925.95MHz



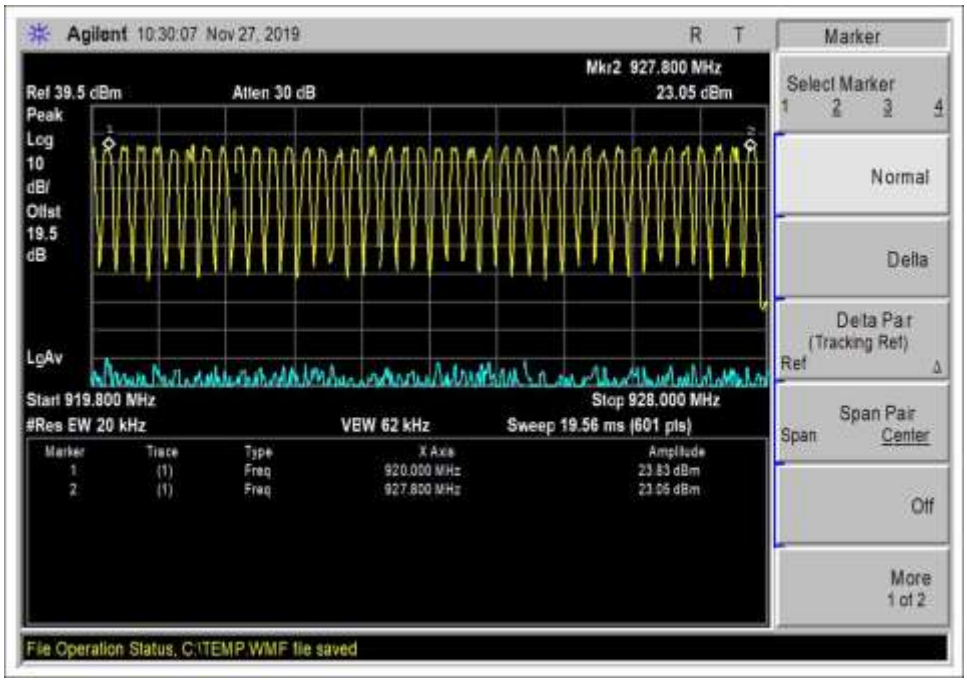
50kHz spacing_25k_926 to 927.75MHz



200kHz spacing_50k_902.2 to 910.8MHz

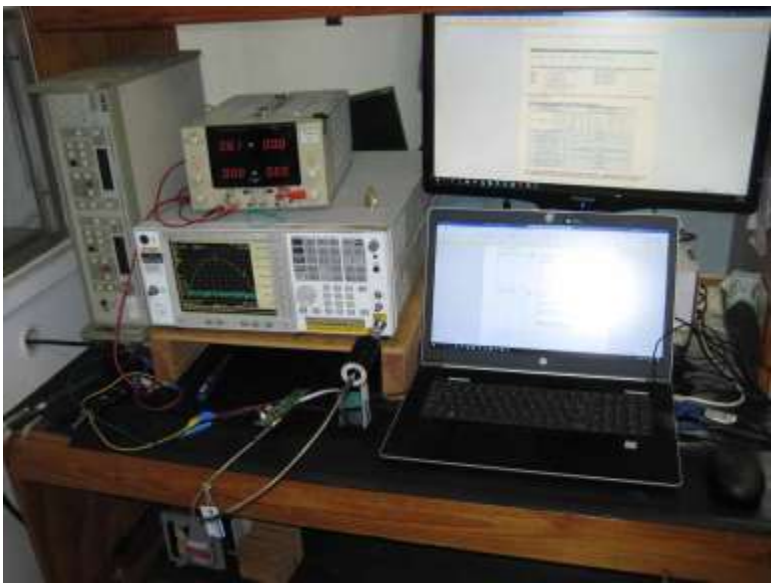


200kHz spacing_50k_911 to 919.8MHz



200kHz spacing_50k_920 to 927.8MHz

Test Setup Photo(s)



15.247(a)(1)(i) 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 399.9 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.

Itron Inc. 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.

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):	10/22/2019
Configuration:	1		
Test Setup:	The EUT is placed on test bench. The serial port is connected to a support laptop via serial to USB adapter. The laptop is running software Command Line Interface Tool to turn on TX. The EUT is powered from 6Vdc power supply to simulate fresh battery. Frequency of measurement: 902.2 to 927.8MHz RBW=100kHz, 200kHz VBW=300kHz, 620kHz		

Environmental Conditions			
Temperature (ºC)	25.6	Relative Humidity (%):	30

Test Equipment					
Asset#	**Description**	**Manufacturer**	**Model**	**Cal Date**	**Cal Due**
02672	Spectrum Analyzer	Agilent	E4446A	3/13/2019	3/13/2021
03431	Attenuator	Aeroflex/Weinschel	89-20-21	12/19/2017	12/19/2019
P07243	Cable	H&S	32022-29094K-29094K-24TC	7/5/2018	7/5/2020

Test Data Summary - Voltage Variations

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

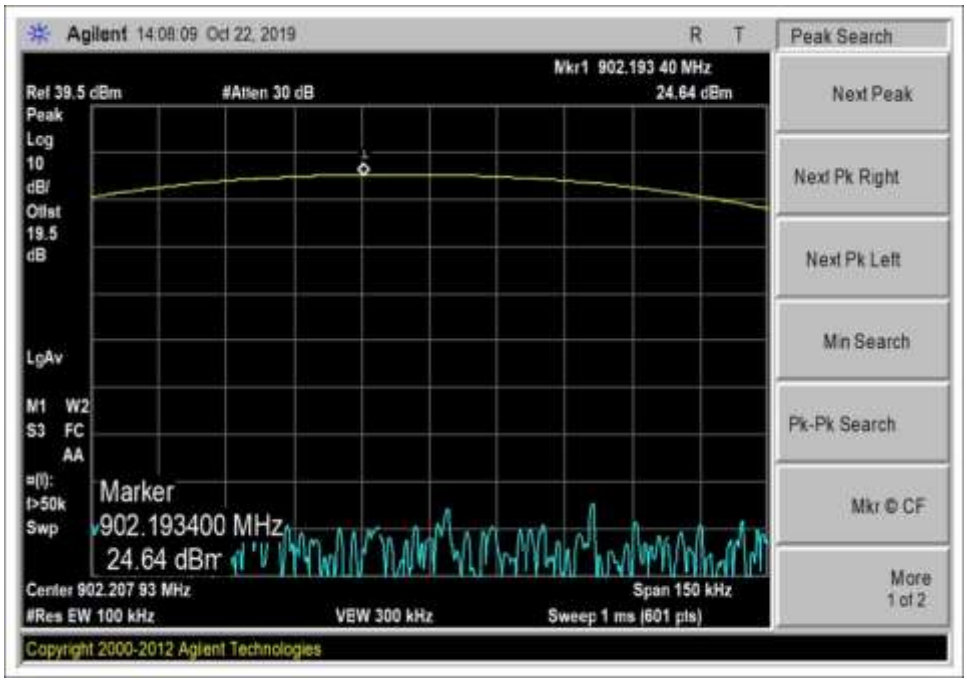
Parameter Definitions:

Measurements performed at input voltage according to manufacturer specification.

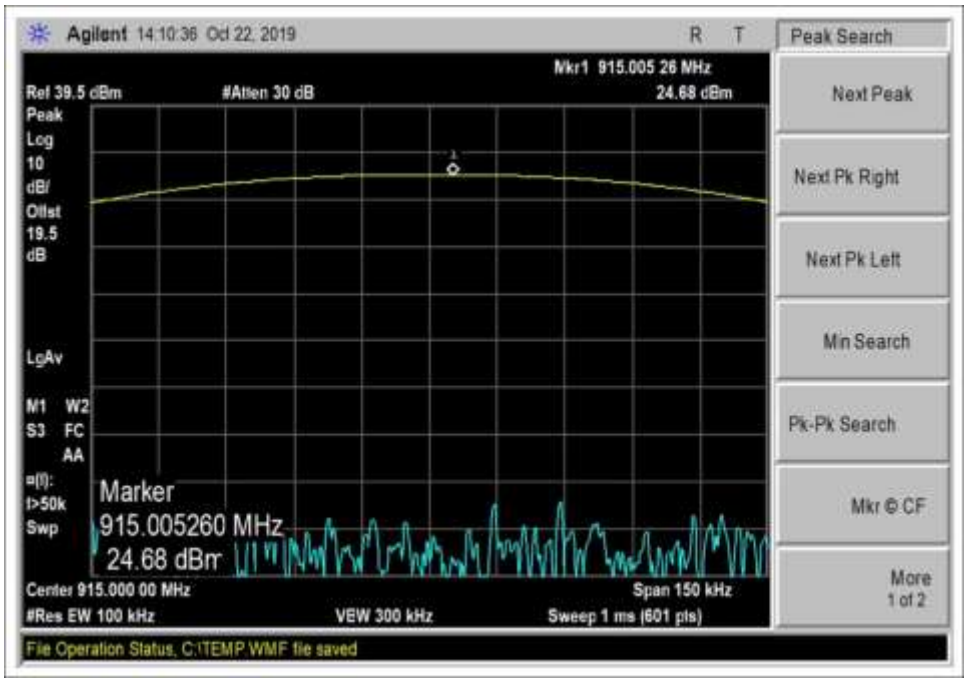
Parameter	Value
$V_{Nominal}$:	6Vdc
$V_{Minimum}$:	6Vdc
$V_{Maximum}$:	6Vdc

Test Data Summary - RF Conducted Measurement					
$Limit = \begin{cases} 30dBm\ Conducted/36dBm\ EIRP \mid \geq 50\ Channels \\ 24dBm\ Conducted/30dBm\ EIRP \mid < 50\ Channels\ (\min 25) \end{cases}$					
Frequency (MHz)	**Modulation**	**Ant. Type / Gain (dBi)**	**Measured (dBm)**	**Limit (dBm)**	**Results**
902.2	25kbps GFSK LV3	PCB Trace, 1.0dBi	24.64	≤30	Pass
915.0	25kbps GFSK LV3	PCB Trace, 1.0dBi	24.68	≤30	Pass
927.75	25kbps GFSK LV3	PCB Trace, 1.0dBi	24.66	≤30	Pass
902.2	50kbps GFSK LV3	PCB Trace, 1.0dBi	24.67	≤30	Pass
915.0	50kbps GFSK LV3	PCB Trace, 1.0dBi	24.71	≤30	Pass
927.8	50kbps GFSK LV3	PCB Trace, 1.0dBi	24.71	≤30	Pass

Plots

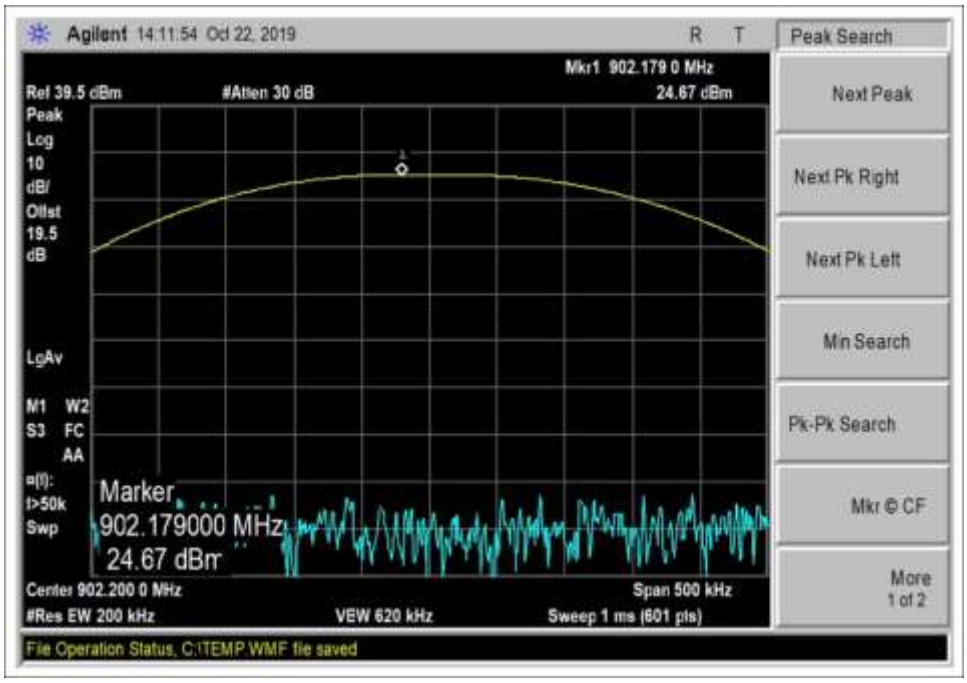


Low Channel, 25kbps

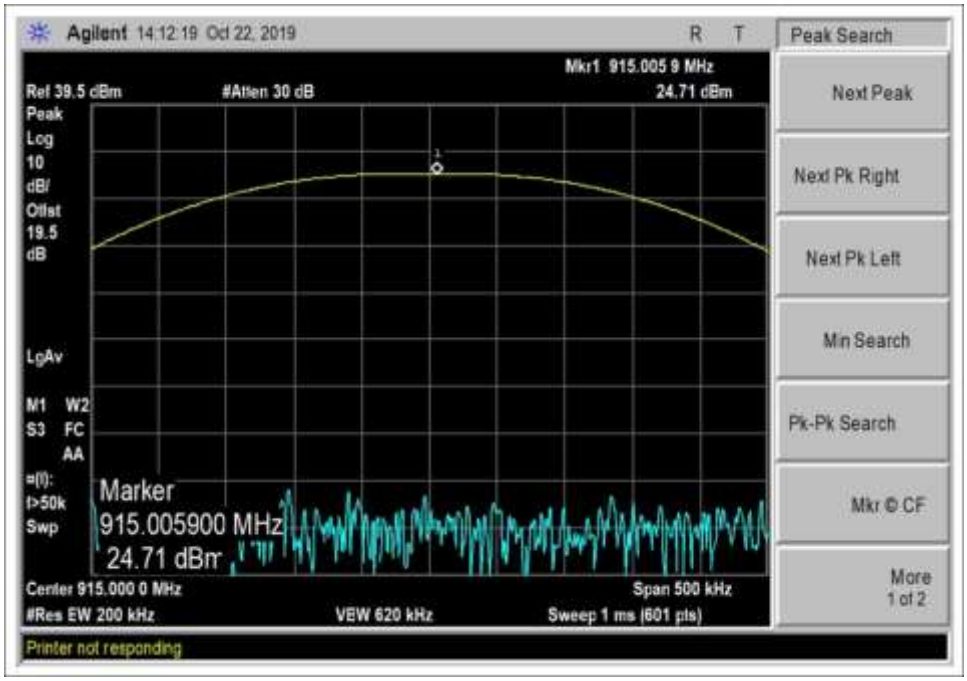


Middle Channel, 25kbps

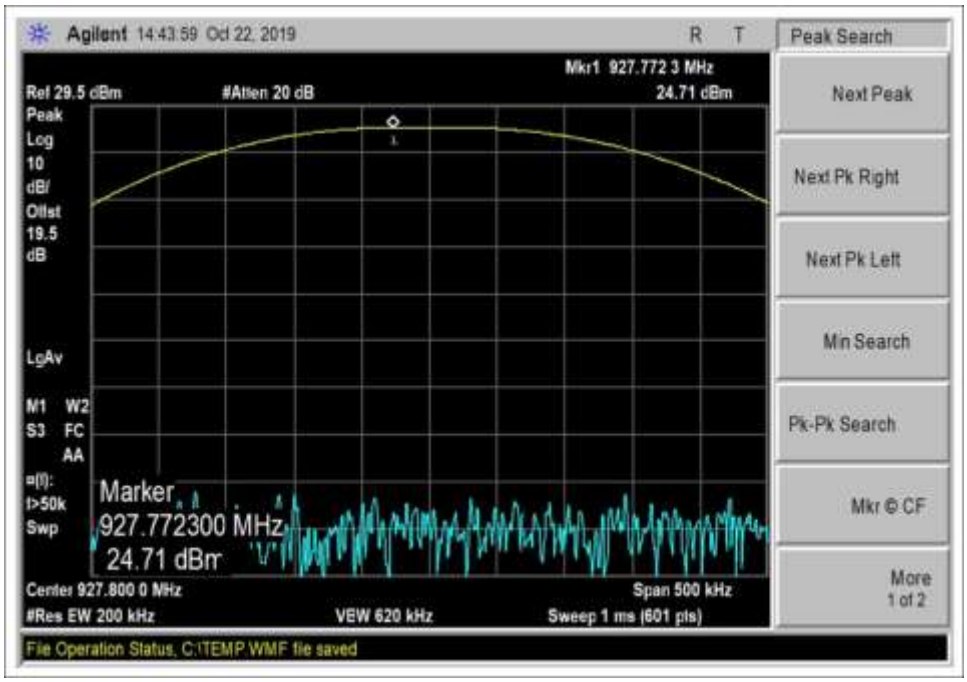
High Channel, 25kbps



Low Channel, 50kbps

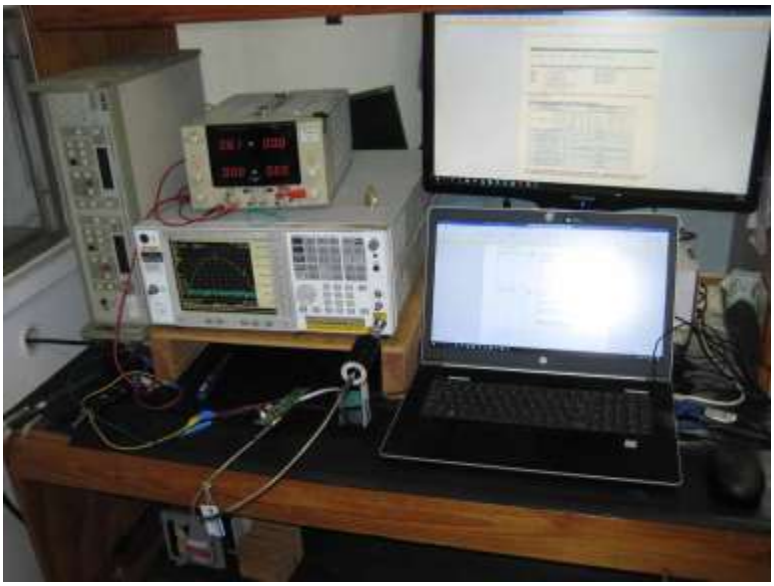


Middle Channel, 50kbps



High Channel, 50kbps

Test Setup Photo(s)



15.247(d) RF Conducted Emissions & Band Edge

Test Setup / Conditions / Data

Test Location:	CKC Laboratories, Inc. • 110 N. Olinda Place • Brea, CA 92823 • 714-993-6112		
Customer:	**Itron, Inc.**		
Specification:	**15.247(d) Conducted Spurious Emissions**		
Work Order #:	**103181**	Date:	10/8/2019
Test Type:	**Conducted Emissions**	Time:	10:09:05
Tested By:	Don Nguyen	Sequence#:	0
Software:	EMITest 5.03.12		6.0Vdc

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

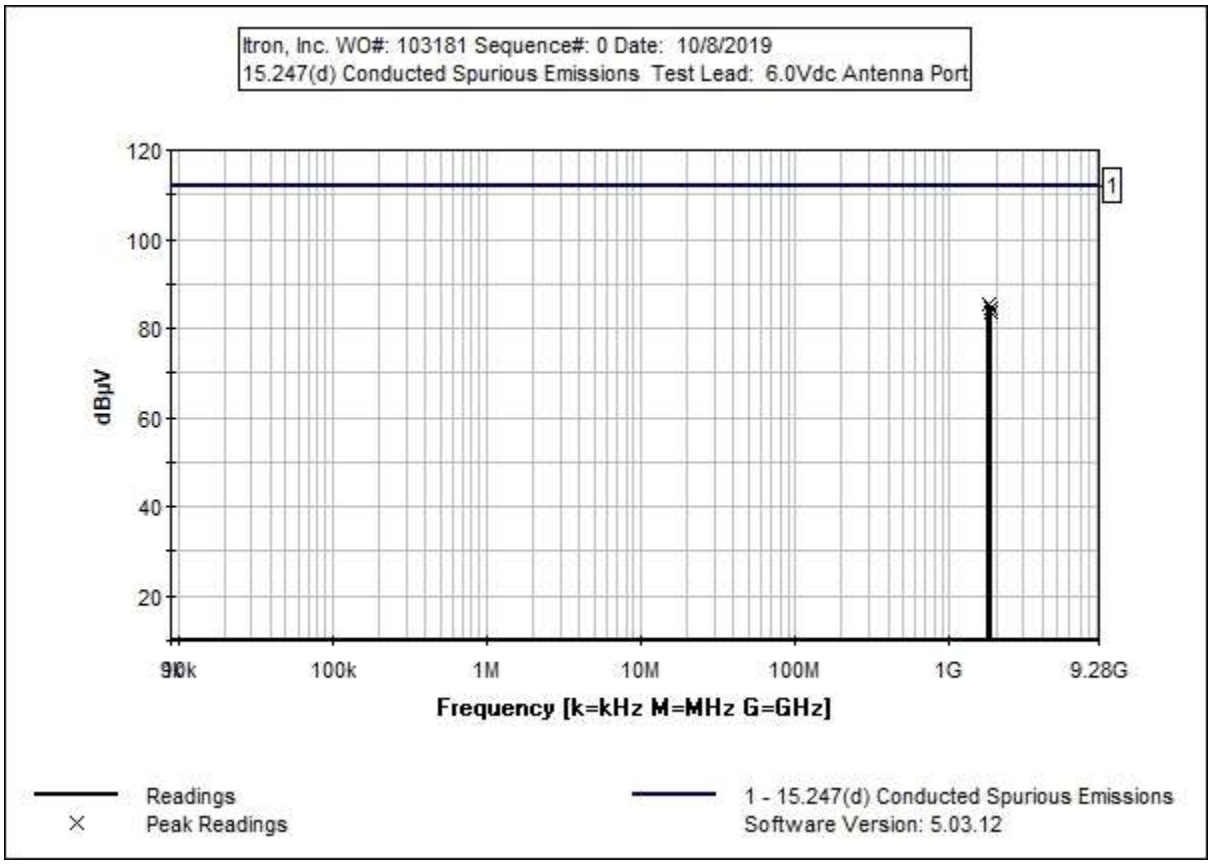
Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

The EUT is placed on test bench. The serial port is connected to a support laptop via serial to USB adapter.
The laptop is running software Command Line Interface Tool to turn on TX.
The EUT is powered from 6Vdc power supply to simulate fresh battery.
Modulation: 25kbps GFSK Level 3

Frequency of measurement: 9kHz-9280MHz
RBW=100kHz, VBW=300kHz

Test Location: Brea Lab A
Temperature (ºC): 25.6
Relative Humidity (%): 30
Test Method: ANSI C63.10 (2013)



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02672	Spectrum Analyzer	E4446A	3/13/2019	3/13/2021
T1	AN03431	Attenuator	89-20-21	12/19/2017	12/19/2019
T2	ANP07243	Cable	32022-29094K-29094K-24TC	7/5/2018	7/5/2020

Measurement Data: Reading listed by margin. Test Lead: Antenna Port

#	Freq MHz	Rdng dBµV	T1 dB	T2 dB	dB	dB	Dist Table	Corr dBµV	Spec dBµV	Margin dB	Polar Ant
1	1804.400M	65.9	+19.3	+0.2			+0.0	85.4	111.7	-26.3	Anten
2	1830.000M	64.8	+19.3	+0.2			+0.0	84.3	111.7	-27.4	Anten
3	1855.500M	64.0	+19.3	+0.2			+0.0	83.5	111.7	-28.2	Anten

Test Location:	CKC Laboratories, Inc. • 110 N. Olinda Place • Brea, CA 92823 • 714-993-6112		
Customer:	**Itron, Inc.**		
Specification:	**15.247(d) Conducted Spurious Emissions**		
Work Order #:	**103181**	Date:	10/8/2019
Test Type:	**Conducted Emissions**	Time:	10:15:53
Tested By:	Don Nguyen	Sequence#:	1
Software:	EMITest 5.03.12		6.0Vdc

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

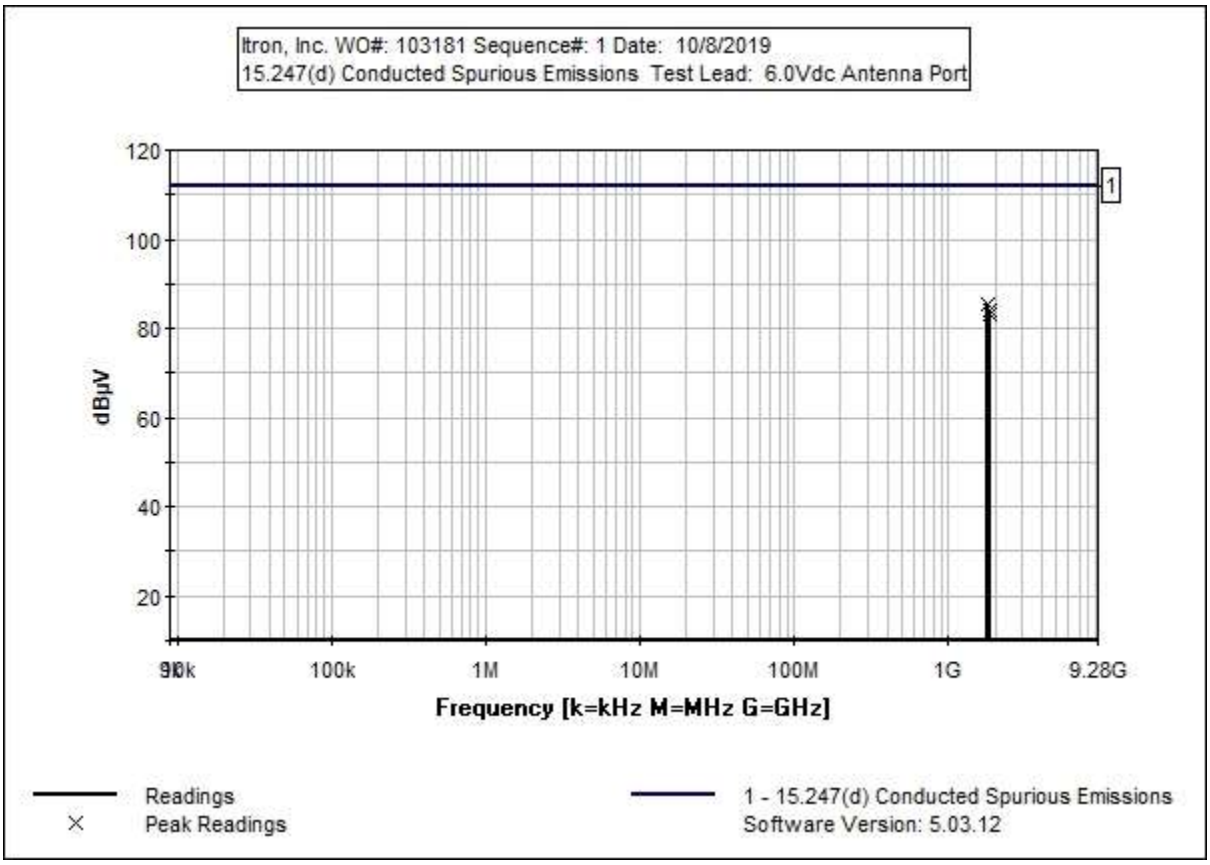
Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

The EUT is placed on test bench. The serial port is connected to a support laptop via serial to USB adapter.
The laptop is running software Command Line Interface Tool to turn on TX.
The EUT is powered from 6Vdc power supply to simulate fresh battery.
Modulation: 50kbps GFSK Level 3

Frequency of measurement: 9kHz-9280MHz
RBW=100kHz, VBW=300kHz

Test Location: Brea Lab A
Temperature (ºC): 25.6
Relative Humidity (%): 30
Test Method: ANSI C63.10 (2013)



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN02672	Spectrum Analyzer	E4446A	3/13/2019	3/13/2021
T2	AN03431	Attenuator	89-20-21	12/19/2017	12/19/2019
T3	ANP07243	Cable	32022-29094K-29094K-24TC	7/5/2018	7/5/2020

Measurement Data: Reading listed by margin. Test Lead: Antenna Port

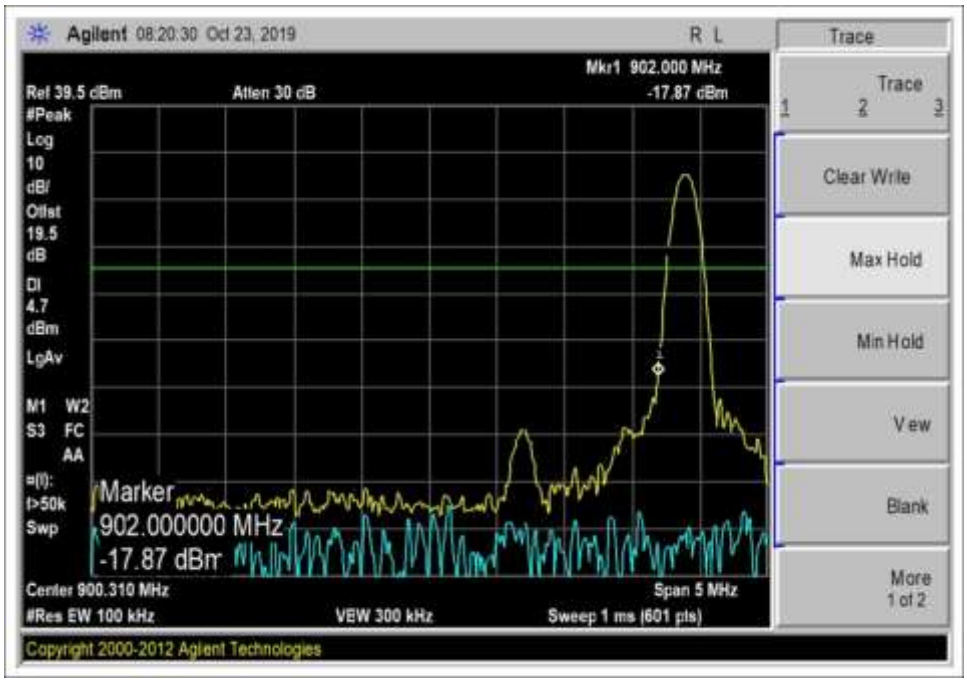
#	Freq MHz	Rdng dBµV	T1 dB	T2 dB	T3 dB	dB	Dist Table	Corr dBµV	Spec dBµV	Margin dB	Polar Ant
1	1804.400M	65.7	+0.0	+19.3	+0.2		+0.0	85.2	111.7	-26.5	Anten
2	1830.000M	64.6	+0.0	+19.3	+0.2		+0.0	84.1	111.7	-27.6	Anten
3	1855.600M	63.9	+0.0	+19.3	+0.2		+0.0	83.4	111.7	-28.3	Anten

Band Edge

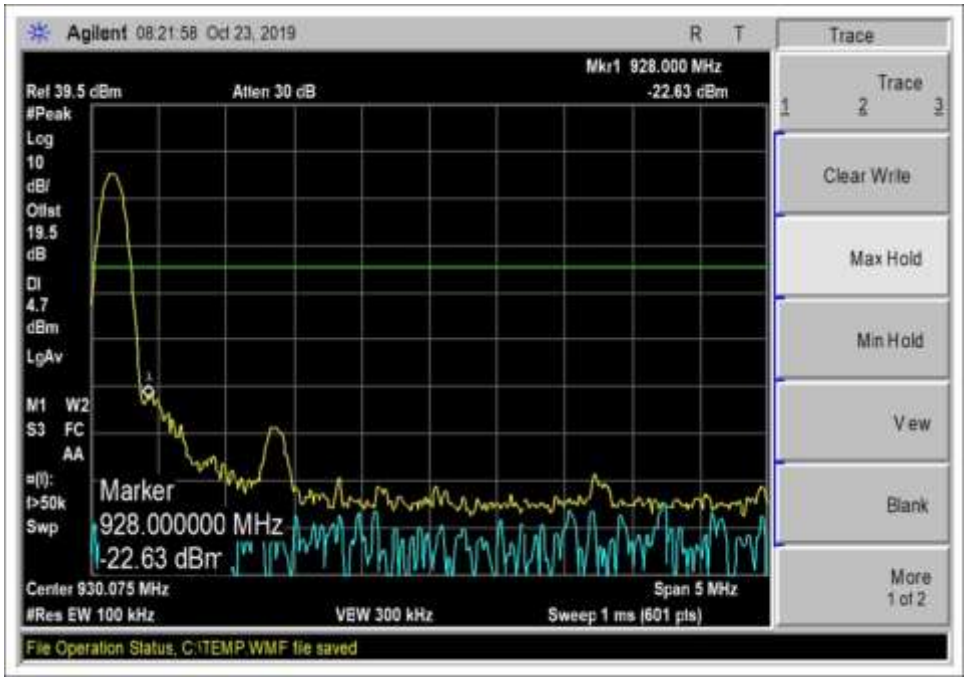
Band Edge Summary				
Limit applied: Max Power/100kHz - 20dB. Operating Mode: Single Channel (Low and High)				
Frequency (MHz)	**Modulation**	**Measured (dBm)**	**Limit (dBm)**	**Results**
902	25kbps GFSK Level 3	-17.87	<4.68	Pass
928	25kbps GFSK Level 3	-22.63	<4.68	Pass
902	50kbps GFSK Level 3	-10.17	<4.71	Pass
928	50kbps GFSK Level 3	-16.64	<4.71	Pass

Band Edge Summary				
Limit applied: Max Power/100kHz - 20dB. Operating Mode: Hopping				
Frequency (MHz)	**Modulation**	**Measured (dBm)**	**Limit (dBm)**	**Results**
902	25kbps GFSK Level 3	-18.14	<4.68	Pass
928	25kbps GFSK Level 3	-27.95	<4.68	Pass
902	50kbps GFSK Level 3	-11.27	<4.71	Pass
928	50kbps GFSK Level 3	-15.97	<4.71	Pass

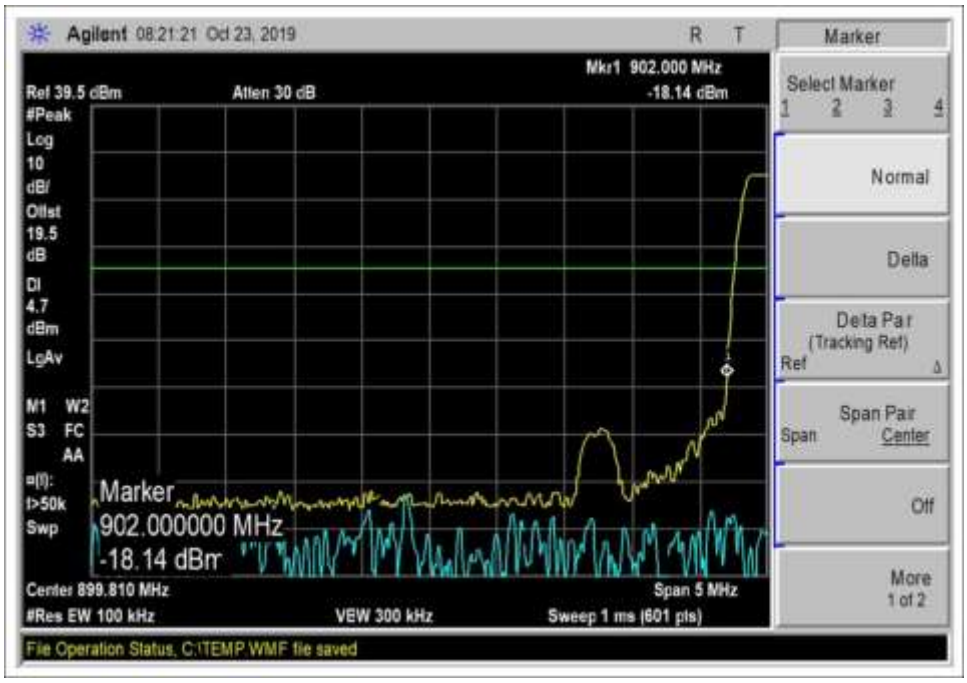
Band Edge Plots



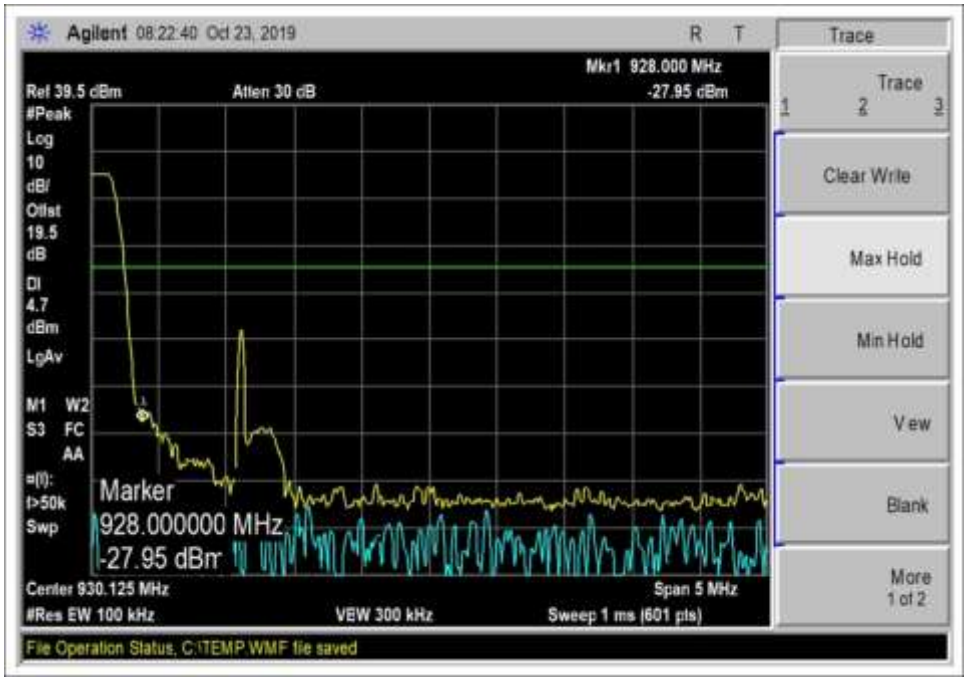
Low Channel, 25kbps



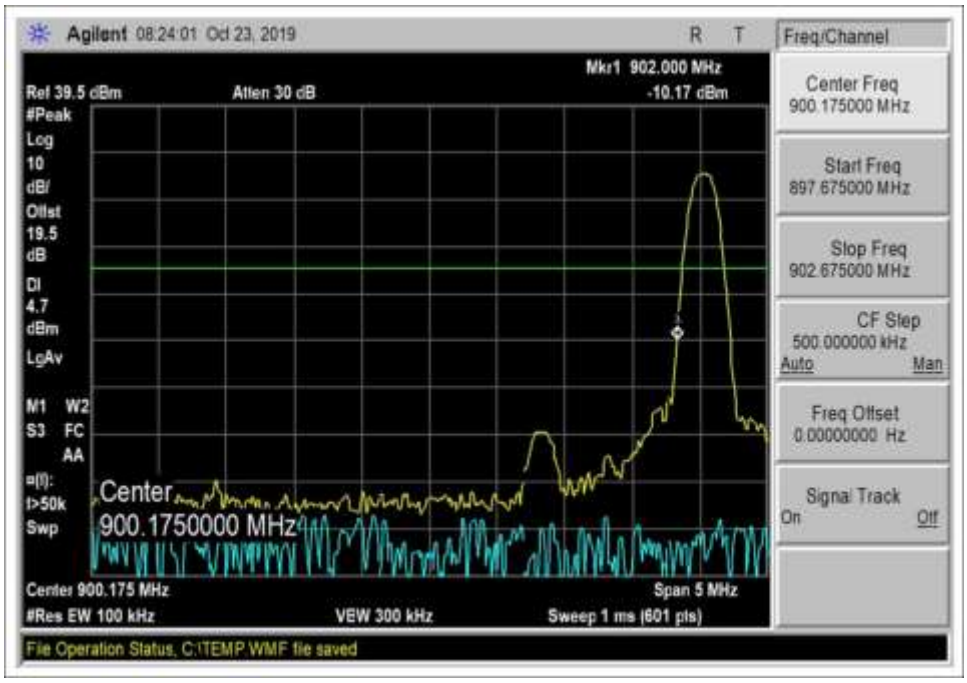
High Channel, 25kbps



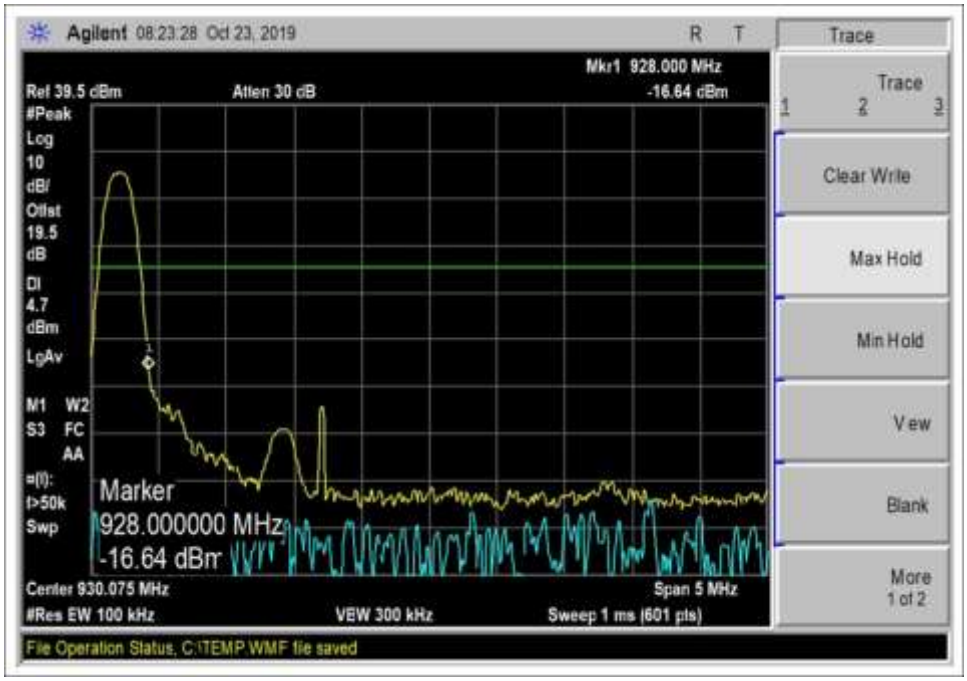
Low Channel Hopping, 25kbps



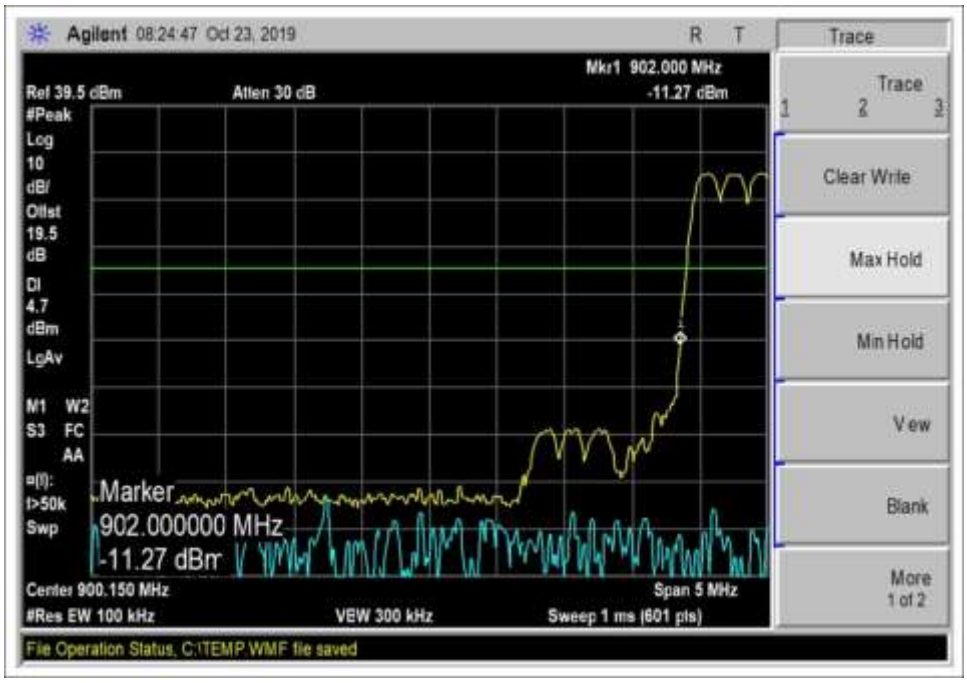
High Channel Hopping, 25kbps



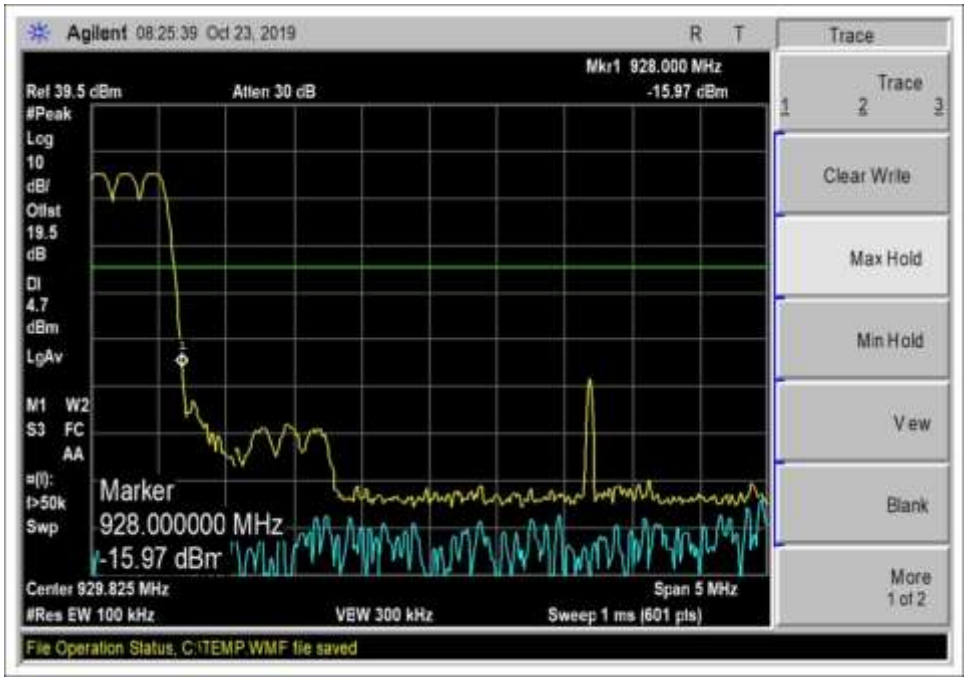
Low Channel, 50kbps



High Channel, 50kbps

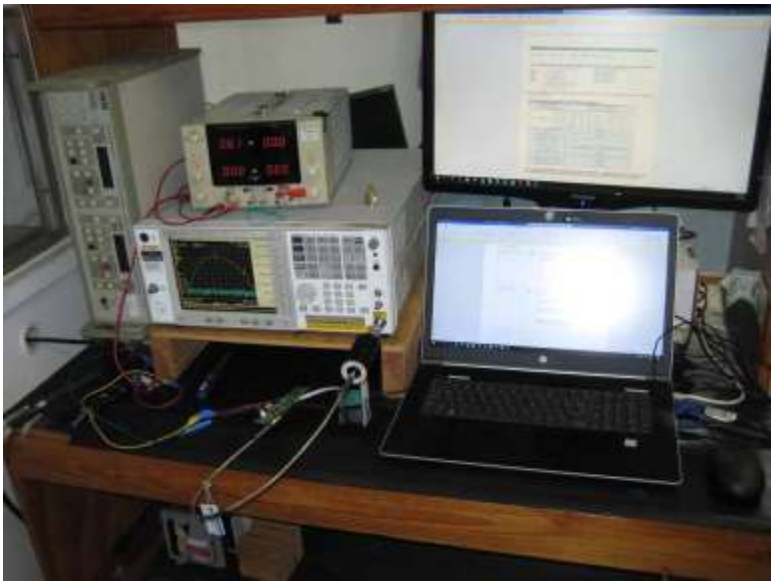


Low Channel Hopping, 50kbps



High Channel Hopping, 50kbps

Test Setup Photo(s)



15.247(d) Radiated Emissions & Band Edge

Test Setup / Conditions / Data

Test Location:	CKC Laboratories, Inc. • 110 N. Olinda Place • Brea, CA 92823 • 714-993-6112		
Customer:	**Itron, Inc.**		
Specification:	**15.247(d) / 15.209 Radiated Spurious Emissions**		
Work Order #:	**103181**	Date:	10/29/2019
Test Type:	**Maximized Emissions**	Time:	10:53:53
Tested By:	Don Nguyen	Sequence#:	27
Software:	EMITest 5.03.12		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 2			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 2			

Test Conditions / Notes:

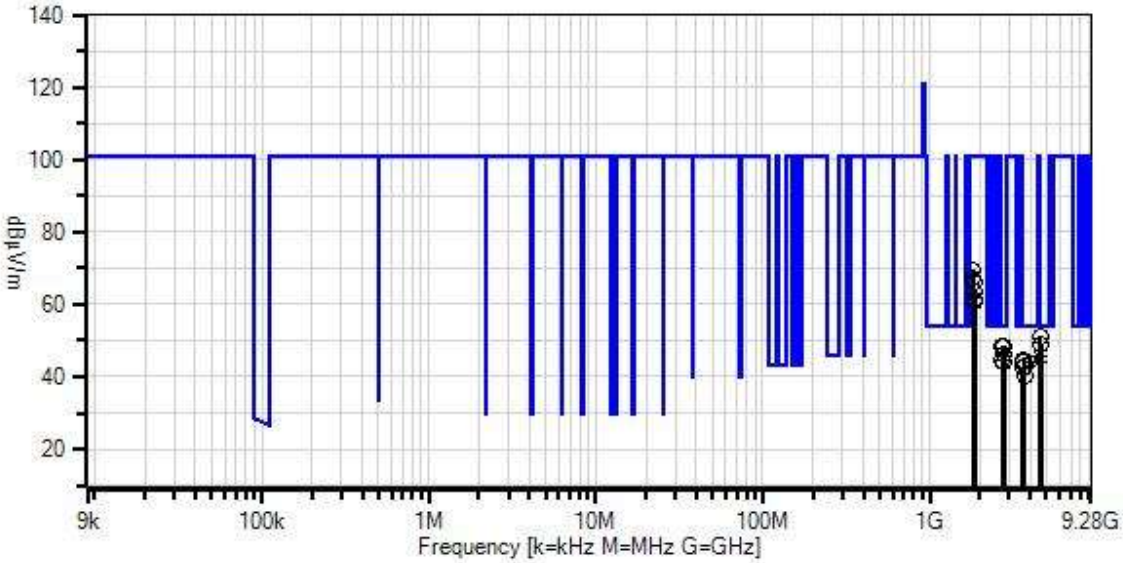
The EUT is placed on Styrofoam platform. The serial port is connected to a support laptop via serial to USB adapter. The laptop is running software Command Line Interface Tool to turn on TX.
The EUT is powered from fresh battery 6.0Vdc.
Manufacturer declares that the EUT has fixed installation orientation.
Modulation: 25kbps GFSK Level 3

Frequency of measurement: 9kHz-9280MHz
9 kHz -150 kHz;RBW=200 Hz,VBW=600 Hz;
150 kHz-30 MHz;RBW=9 kHz,VBW=27 kHz;
30 MHz-1000 MHz;RBW=120 kHz,VBW=360 kHz,
1000 MHz-9280MHz;RBW=1 MHz,VBW=3 MHz.
RBW=100kHz, VBW=300kHz (-20dbc limit)

Site A
Test Method: ANSI C63.10 (2013)
Temperature (ºC): 23.7
Relative Humidity (%): 31.1

Note: no emission detected under 1GHz.

Itron, Inc. WO#: 103181 Sequence#: 27 Date: 10/29/2019
15.247(d) / 15.209 Radiated Spurious Emissions Test Distance: 3 Meters Vert



Readings
QP Readings
Ambient
1 - 15.247(d) / 15.209 Radiated Spurious Emissions
Peak Readings
Average Readings
Software Version: 5.03.12

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN00314	Loop Antenna	6502	5/13/2018	5/13/2020
	AN01995	Biconilog Antenna	CBL6111C	4/23/2018	4/23/2020
	ANP05275	Attenuator	1W	4/5/2018	4/5/2020
	ANP05198	Cable-Amplitude +15C to +45C (dB)	8268	12/4/2018	12/4/2020
T1	AN02672	Spectrum Analyzer	E4446A	3/13/2019	3/13/2021
T2	AN00786	Preamp	83017A	5/12/2018	5/12/2020
T3	AN00849	Horn Antenna	3115	3/14/2018	3/14/2020
T4	ANP07139	Cable	ANDL1-PNMNM-48	3/4/2019	3/4/2021
T5	ANP07244	Cable	32022-29094K-29094K-24TC	7/5/2018	7/5/2020
T6	AN03169	High Pass Filter	HM1155-11SS	5/8/2019	5/8/2021
	AN00309	Preamp	8447D	2/19/2018	2/19/2020
	ANP05050	Cable	RG223/U	12/24/2018	12/24/2020

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	4575.000M	50.6	+0.0 +0.7	-37.8 +0.2	+33.0	+4.6	+0.0	51.3	54.0	-2.7	Horiz
2	4575.000M	50.2	+0.0 +0.7	-37.8 +0.2	+33.0	+4.6	+0.0	50.9	54.0	-3.1	Vert
3	4638.750M	48.3	+0.0 +0.6	-37.7 +0.2	+32.8	+4.7	+0.0	48.9	54.0	-5.1	Horiz
4	4638.750M	48.3	+0.0 +0.6	-37.7 +0.2	+32.8	+4.7	+0.0	48.9	54.0	-5.1	Vert
5	2706.600M	53.9	+0.0 +0.4	-38.6 +0.2	+29.1	+3.4	+0.0	48.4	54.0	-5.6	Vert
6	2745.000M	53.6	+0.0 +0.4	-38.6 +0.2	+29.4	+3.4	+0.0	48.4	54.0	-5.6	Horiz
7	2783.250M	53.3	+0.0 +0.4	-38.6 +0.2	+29.5	+3.5	+0.0	48.3	54.0	-5.7	Vert
8	2783.250M	51.0	+0.0 +0.4	-38.6 +0.2	+29.5	+3.5	+0.0	46.0	54.0	-8.0	Horiz
9	4511.000M Ave	45.1	+0.0 +0.7	-37.8 +0.2	+32.9	+4.5	+0.0	45.6	54.0	-8.4	Vert
^	4511.000M	52.1	+0.0 +0.7	-37.8 +0.2	+32.9	+4.5	+0.0	52.6	54.0	-1.4	Vert
11	3660.000M	46.3	+0.0 +0.5	-38.3 +0.2	+31.6	+4.1	+0.0	44.4	54.0	-9.6	Vert
12	2706.658M	49.9	+0.0 +0.4	-38.6 +0.2	+29.1	+3.4	+0.0	44.4	54.0	-9.6	Horiz
13	4511.100M Ave	43.6	+0.0 +0.7	-37.8 +0.2	+32.9	+4.5	+0.0	44.1	54.0	-9.9	Horiz
^	4511.100M	51.6	+0.0 +0.7	-37.8 +0.2	+32.9	+4.5	+0.0	52.1	54.0	-1.9	Horiz

15	2745.000M	49.2	+0.0 +0.4	-38.6 +0.2	+29.4	+3.4	+0.0	44.0	54.0	-10.0	Vert
16	3660.000M	45.8	+0.0 +0.5	-38.3 +0.2	+31.6	+4.1	+0.0	43.9	54.0	-10.1	Horiz
17	3711.000M	44.8	+0.0 +0.5	-38.3 +0.2	+31.9	+4.1	+0.0	43.2	54.0	-10.8	Horiz
18	3608.800M	45.1	+0.0 +0.6	-38.4 +0.1	+31.1	+4.1	+0.0	42.6	54.0	-11.4	Vert
19	3608.908M	45.0	+0.0 +0.6	-38.4 +0.1	+31.1	+4.1	+0.0	42.5	54.0	-11.5	Horiz
20	3711.000M	42.0	+0.0 +0.5	-38.3 +0.2	+31.9	+4.1	+0.0	40.4	54.0	-13.6	Vert
21	1804.400M	78.4	+0.0 +0.2	-38.9 +0.2	+27.0	+2.6	+0.0	69.5	100.9	-31.4	Vert
22	1804.400M	76.0	+0.0 +0.2	-38.9 +0.2	+27.0	+2.6	+0.0	67.1	100.9	-33.8	Horiz
23	1830.000M	74.8	+0.0 +0.2	-38.9 +0.2	+27.1	+2.6	+0.0	66.0	100.9	-34.9	Vert
24	1855.500M	72.0	+0.0 +0.2	-38.9 +0.2	+27.3	+2.7	+0.0	63.5	100.9	-37.4	Horiz
25	1830.000M	70.0	+0.0 +0.2	-38.9 +0.2	+27.1	+2.6	+0.0	61.2	100.9	-39.7	Horiz
26	1855.500M	69.2	+0.0 +0.2	-38.9 +0.2	+27.3	+2.7	+0.0	60.7	100.9	-40.2	Vert

Test Location:	CKC Laboratories, Inc. • 110 N. Olinda Place • Brea, CA 92823 • 714-993-6112		
Customer:	**Itron, Inc.**		
Specification:	**15.247(d) / 15.209 Radiated Spurious Emissions**		
Work Order #:	**103181**	Date:	10/29/2019
Test Type:	**Maximized Emissions**	Time:	13:16:17
Tested By:	Don Nguyen	Sequence#:	28
Software:	EMITest 5.03.12		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 2			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 2			

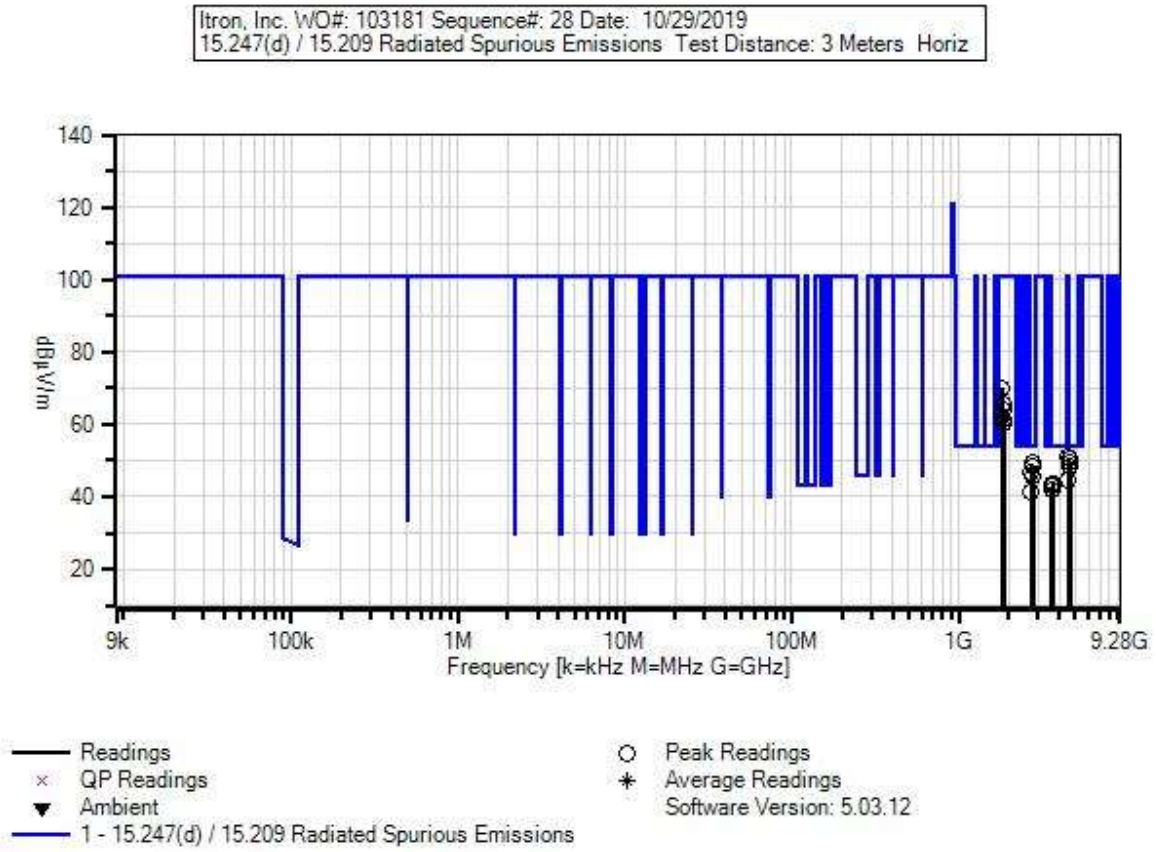
Test Conditions / Notes:

The EUT is placed on Styrofoam platform. The serial port is connected to a support laptop via serial to USB adapter. The laptop is running software Command Line Interface Tool to turn on TX.
The EUT is powered from fresh battery 6.0Vdc.
Manufacturer declares that the EUT has fixed installation orientation.
Modulation: 50kbps GFSK Level 3

Frequency of measurement: 9kHz-9280MHz
9 kHz -150 kHz;RBW=200 Hz,VBW=600 Hz;
150 kHz-30 MHz;RBW=9 kHz,VBW=27 kHz;
30 MHz-1000 MHz;RBW=120 kHz,VBW=360 kHz,
1000 MHz-9280MHz;RBW=1 MHz,VBW=3 MHz.
RBW=100kHz, VBW=300kHz (-20dbc limit)

Site A
Test Method: ANSI C63.10 (2013)
Temperature (ºC): 23.7
Relative Humidity (%): 31.1

Note: no emission detected under 1GHz.


Itron, Inc. WO#: 103181 Sequence#: 28 Date: 10/29/2019
15.247(d) / 15.209 Radiated Spurious Emissions Test Distance: 3 Meters Horiz
140
120
100
80
60
40
20
dBµV/m
9k
100k
1M
10M
100M
1G
9.28G
Frequency [k=kHz M=MHz G=GHz]
Readings
QP Readings
Ambient
1 - 15.247(d) / 15.209 Radiated Spurious Emissions
Peak Readings
Average Readings
Software Version: 5.03.12

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN00314	Loop Antenna	6502	5/13/2018	5/13/2020
	AN01995	Biconilog Antenna	CBL6111C	4/23/2018	4/23/2020
	ANP05275	Attenuator	1W	4/5/2018	4/5/2020
	ANP05198	Cable-Amplitude +15C to +45C (dB)	8268	12/4/2018	12/4/2020
	AN02672	Spectrum Analyzer	E4446A	3/13/2019	3/13/2021
T1	AN00786	Preamp	83017A	5/12/2018	5/12/2020
T2	AN00849	Horn Antenna	3115	3/14/2018	3/14/2020
T3	ANP07139	Cable	ANDL1-PNMNM-48	3/4/2019	3/4/2021
T4	ANP07244	Cable	32022-29094K-29094K-24TC	7/5/2018	7/5/2020
T5	AN03169	High Pass Filter	HM1155-11SS	5/8/2019	5/8/2021
	AN00309	Preamp	8447D	2/19/2018	2/19/2020
	ANP05050	Cable	RG223/U	12/24/2018	12/24/2020

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

#	Freq MHz	Rdng dBµV	T1 T5 dB	T2 dB	T3 dB	T4 dB	Dist Table	Corr dBµV/m	Spec dBµV/m	Margin dB	Polar Ant
1	4511.000M	50.5	-37.8 +0.2	+32.9	+4.5	+0.7	+0.0	51.0	54.0	-3.0	Horiz
2	4575.000M	49.8	-37.8 +0.2	+33.0	+4.6	+0.7	+0.0	50.5	54.0	-3.5	Vert
3	4575.000M	49.7	-37.8 +0.2	+33.0	+4.6	+0.7	+0.0	50.4	54.0	-3.6	Horiz
4	4639.000M	49.0	-37.7 +0.2	+32.8	+4.7	+0.6	+0.0	49.6	54.0	-4.4	Horiz
5	2745.000M	54.5	-38.6 +0.2	+29.4	+3.4	+0.4	+0.0	49.3	54.0	-4.7	Vert
6	4639.000M	47.7	-37.7 +0.2	+32.8	+4.7	+0.6	+0.0	48.3	54.0	-5.7	Vert
7	2745.000M	53.4	-38.6 +0.2	+29.4	+3.4	+0.4	+0.0	48.2	54.0	-5.8	Horiz
8	2783.400M	53.1	-38.6 +0.2	+29.5	+3.5	+0.4	+0.0	48.1	54.0	-5.9	Vert
9	2706.600M	52.3	-38.6 +0.2	+29.1	+3.4	+0.4	+0.0	46.8	54.0	-7.2	Vert
10	2783.400M	50.7	-38.6 +0.2	+29.5	+3.5	+0.4	+0.0	45.7	54.0	-8.3	Horiz
11	4511.000M	44.3	-37.8 +0.2	+32.9	+4.5	+0.7	+0.0	44.8	54.0	-9.2	Vert
12	3711.200M	45.3	-38.3 +0.2	+31.9	+4.1	+0.5	+0.0	43.7	54.0	-10.3	Vert
13	3711.200M	45.2	-38.3 +0.2	+31.9	+4.1	+0.5	+0.0	43.6	54.0	-10.4	Horiz
14	3660.000M	45.2	-38.3 +0.2	+31.6	+4.1	+0.5	+0.0	43.3	54.0	-10.7	Vert

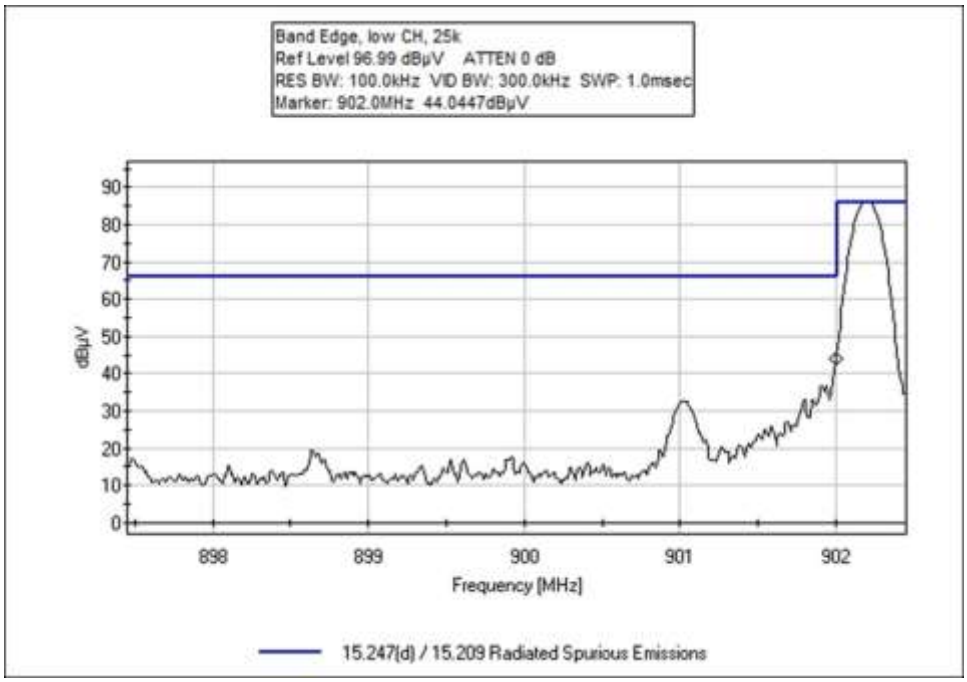
15	3660.000M	45.1	-38.3 +0.2	+31.6	+4.1	+0.5	+0.0	43.2	54.0	-10.8	Horiz
16	3608.800M	45.4	-38.4 +0.1	+31.1	+4.1	+0.6	+0.0	42.9	54.0	-11.1	Vert
17	3608.800M	44.6	-38.4 +0.1	+31.1	+4.1	+0.6	+0.0	42.1	54.0	-11.9	Horiz
18	2706.600M	47.1	-38.6 +0.2	+29.1	+3.4	+0.4	+0.0	41.6	54.0	-12.4	Horiz
19	1804.400M	78.9	-38.9 +0.2	+27.0	+2.6	+0.2	+0.0	70.0	100.9	-30.9	Vert
20	1830.000M	74.5	-38.9 +0.2	+27.1	+2.6	+0.2	+0.0	65.7	100.9	-35.2	Vert
21	1855.600M	72.3	-38.9 +0.2	+27.3	+2.7	+0.2	+0.0	63.8	100.9	-37.1	Horiz
22	1804.400M	71.4	-38.9 +0.2	+27.0	+2.6	+0.2	+0.0	62.5	100.9	-38.4	Horiz
23	1830.000M	69.9	-38.9 +0.2	+27.1	+2.6	+0.2	+0.0	61.1	100.9	-39.8	Horiz
24	1855.600M	68.5	-38.9 +0.2	+27.3	+2.7	+0.2	+0.0	60.0	100.9	-40.9	Vert

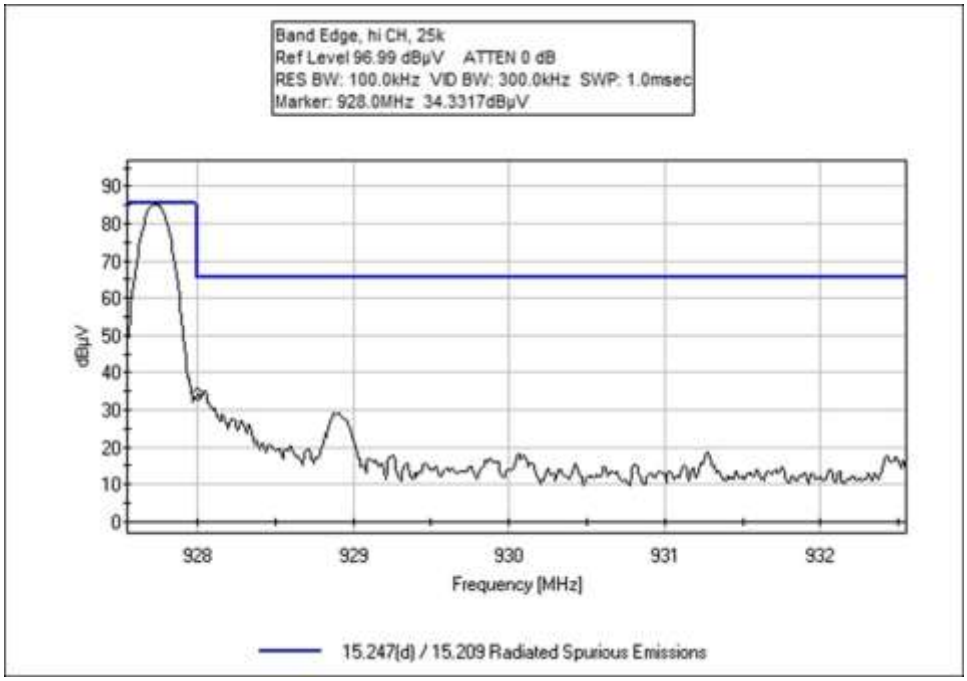
Band Edge

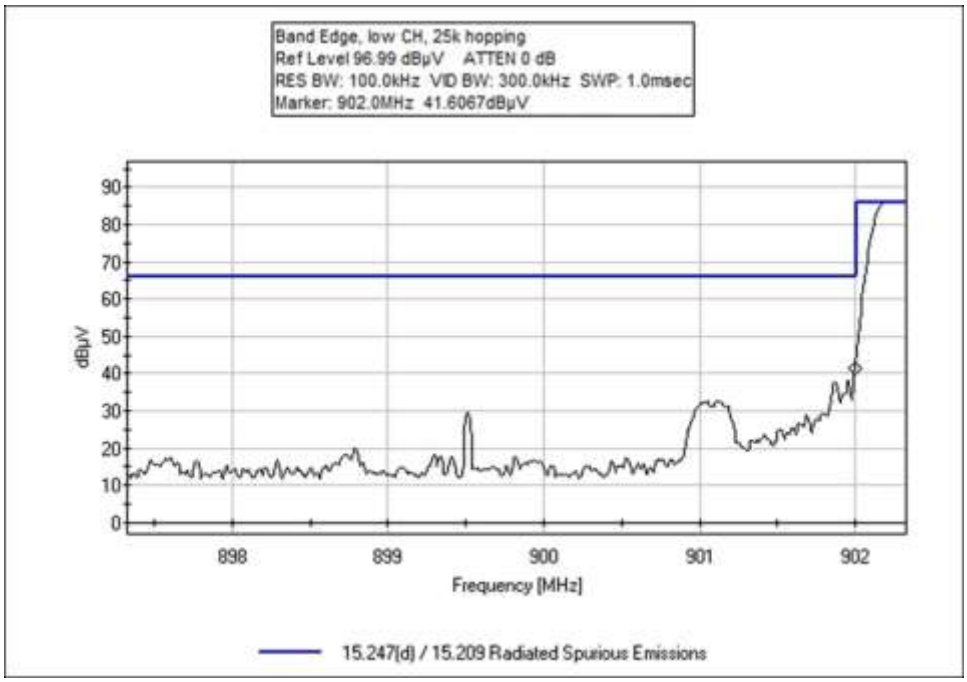
Band Edge Summary					
Operating Mode: Single Channel (Low and High)					
Frequency (MHz)	**Modulation**	**Ant. Type**	**Field Strength (dBuV/m @3m)**	**Limit (dBuV/m @3m)**	**Results**
614	25kbps GFSK Level 3	PCB Trace	40.1	<46	Pass
902	25kbps GFSK Level 3	PCB Trace	78.8	<100.9	Pass
928	25kbps GFSK Level 3	PCB Trace	69.6	<100.9	Pass
960	25kbps GFSK Level 3	PCB Trace	48.2	<54	Pass
614	50kbps GFSK Level 3	PCB Trace	40.6	<46	Pass
902	50kbps GFSK Level 3	PCB Trace	84.8	<100.9	Pass
928	50kbps GFSK Level 3	PCB Trace	80.8	<100.9	Pass
960	50kbps GFSK Level 3	PCB Trace	47.1	<54	Pass

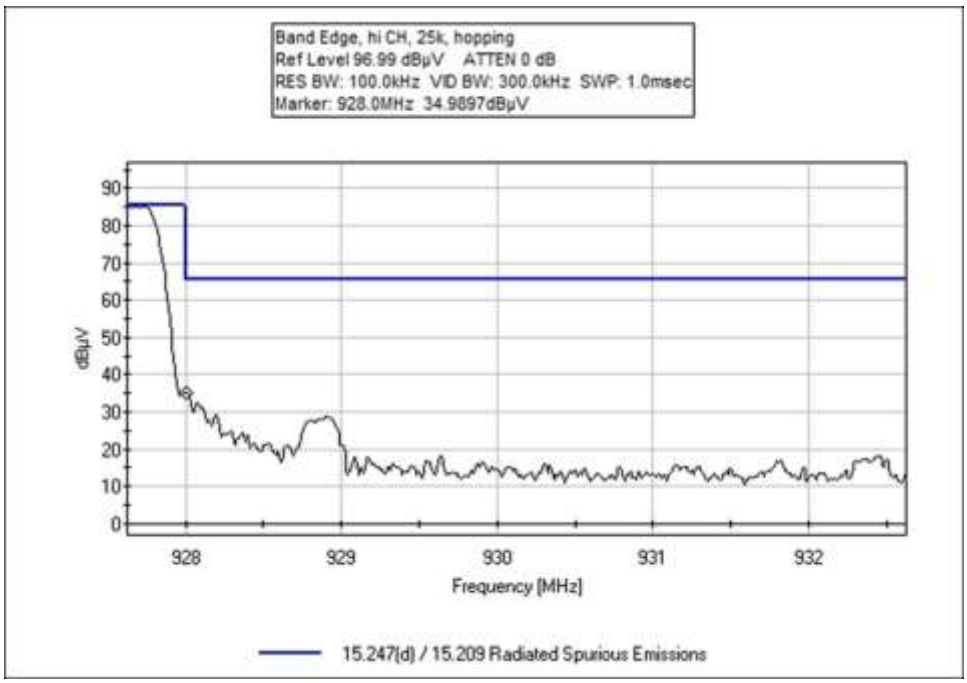
Band Edge Summary					
Operating Mode: Hopping					
Frequency (MHz)	**Modulation**	**Ant. Type**	**Field Strength (dBuV/m @3m)**	**Limit (dBuV/m @3m)**	**Results**
614	25kbps GFSK Level 3	PCB Trace	41.6	<46	Pass
902	25kbps GFSK Level 3	PCB Trace	76.4	<100.9	Pass
928	25kbps GFSK Level 3	PCB Trace	70.3	<100.9	Pass
960	25kbps GFSK Level 3	PCB Trace	48.6	<54	Pass
614	50kbps GFSK Level 3	PCB Trace	41.7	<46	Pass
902	50kbps GFSK Level 3	PCB Trace	85.9	<100.9	Pass
928	50kbps GFSK Level 3	PCB Trace	78.6	<100.9	Pass
960	50kbps GFSK Level 3	PCB Trace	48.4	<54	Pass

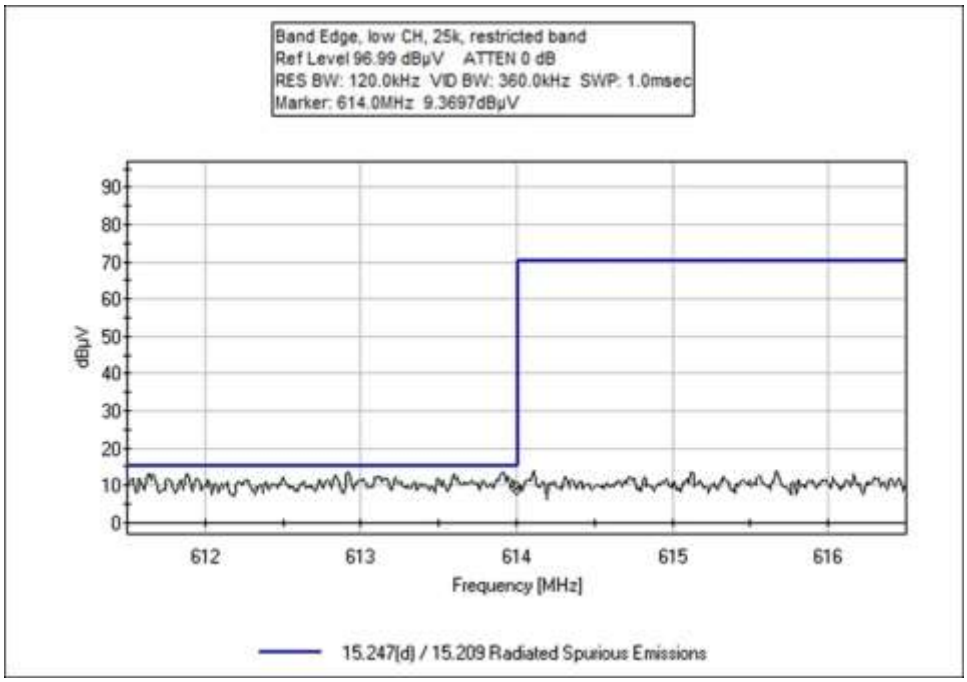
Band Edge Plots

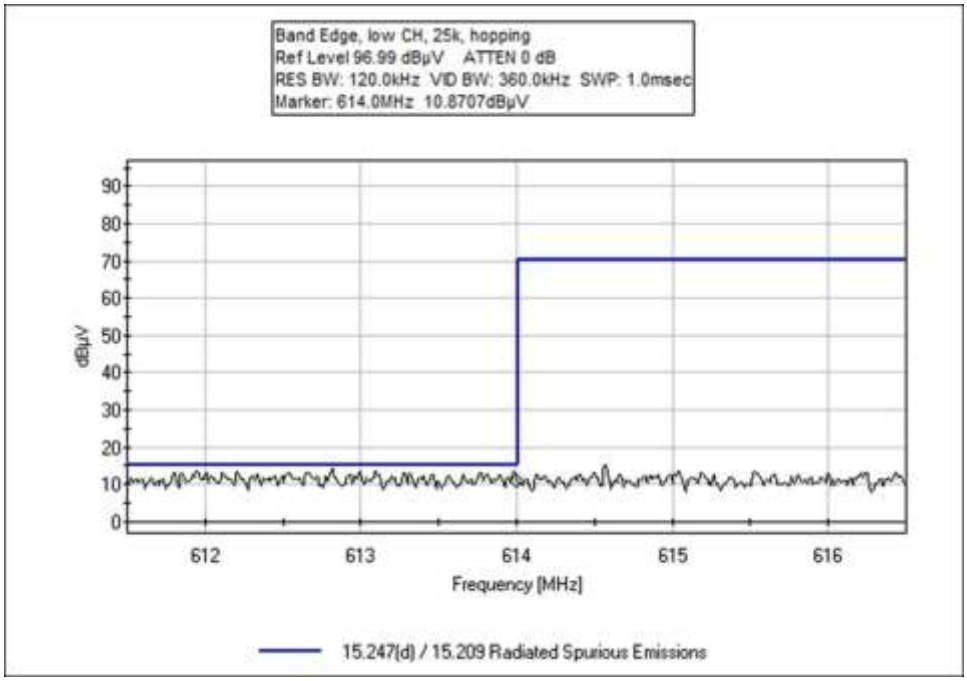


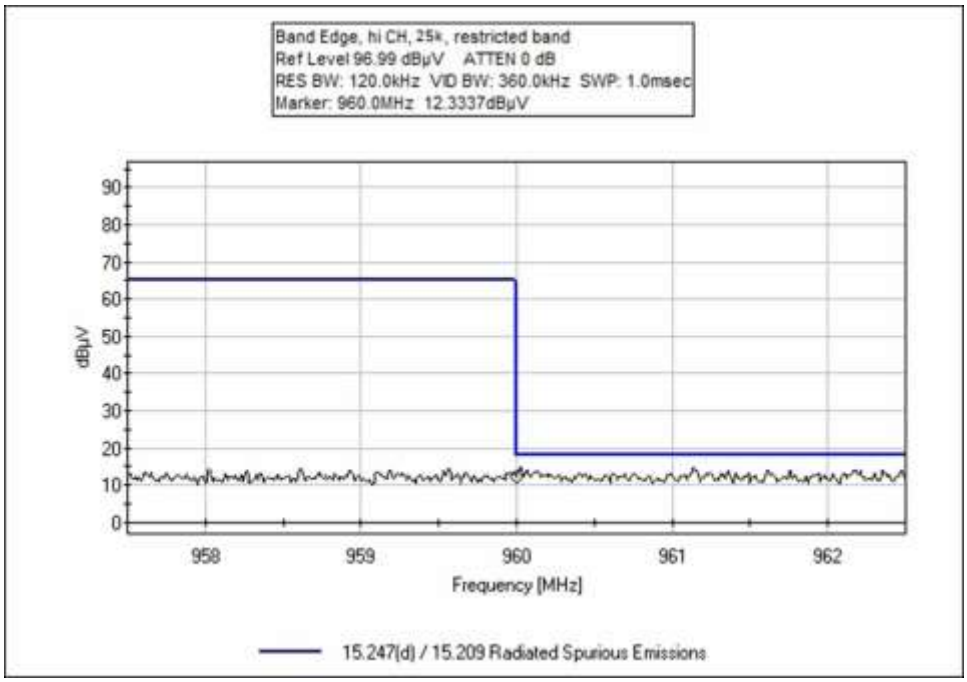


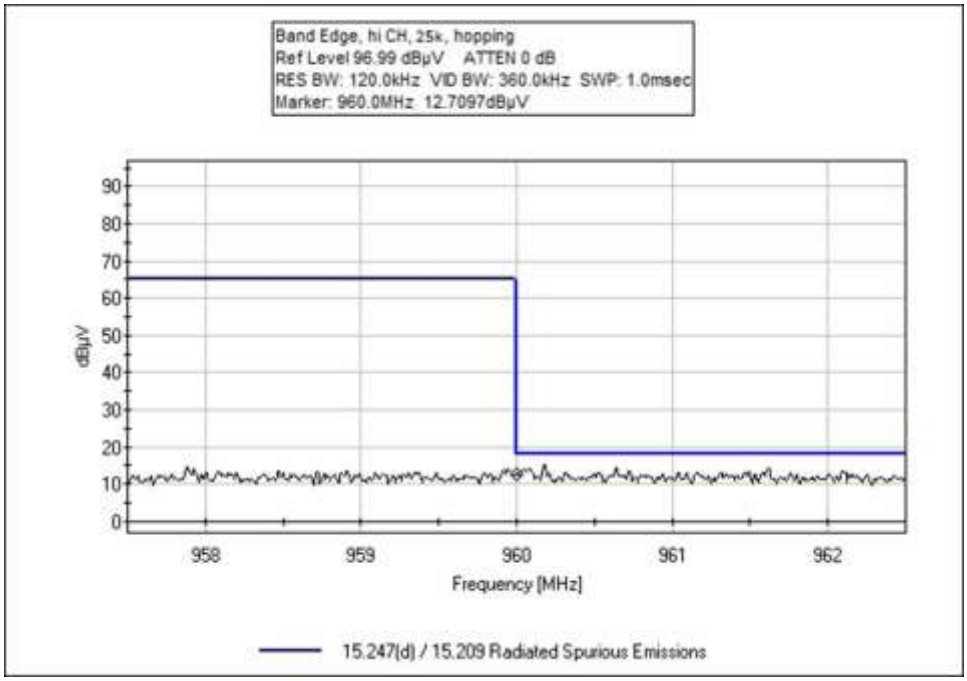

Band Edge, low CH, 25k hopping
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 100.0kHz VID BW: 300.0kHz SWP: 1.0msec
Marker: 902.0MHz 41.6067dBµV
dBµV
90
80
70
60
50
40
30
20
10
0
898
899
900
901
902
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions

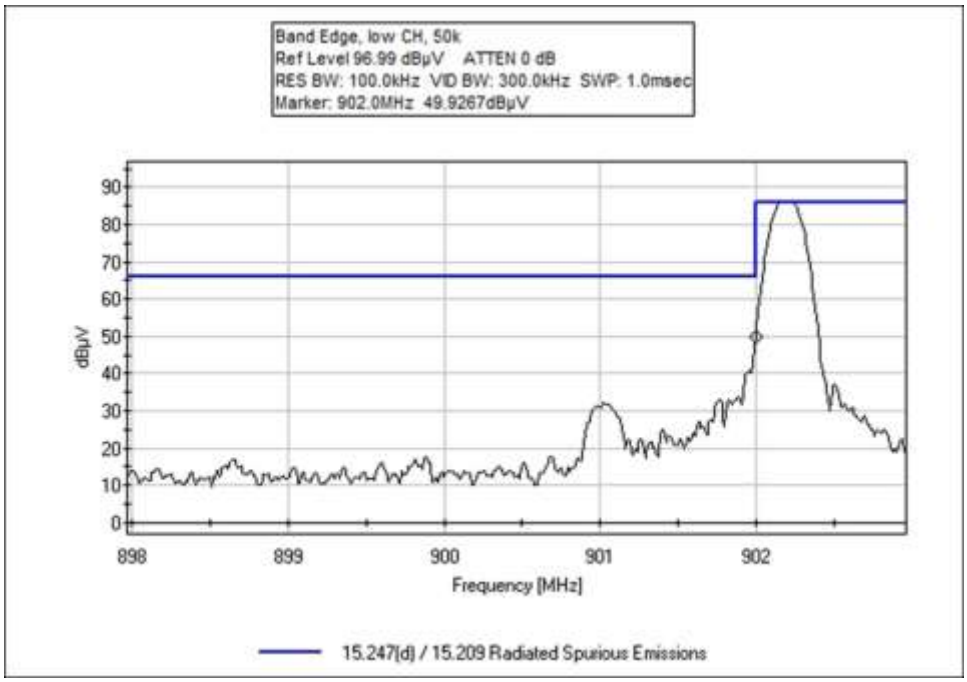

Band Edge, hi CH, 25k, hopping
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 100.0kHz VID BW: 300.0kHz SWP: 1.0msec
Marker: 928.0MHz 34.9897dBµV
dBµV
90
80
70
60
50
40
30
20
10
0
928
929
930
931
932
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions

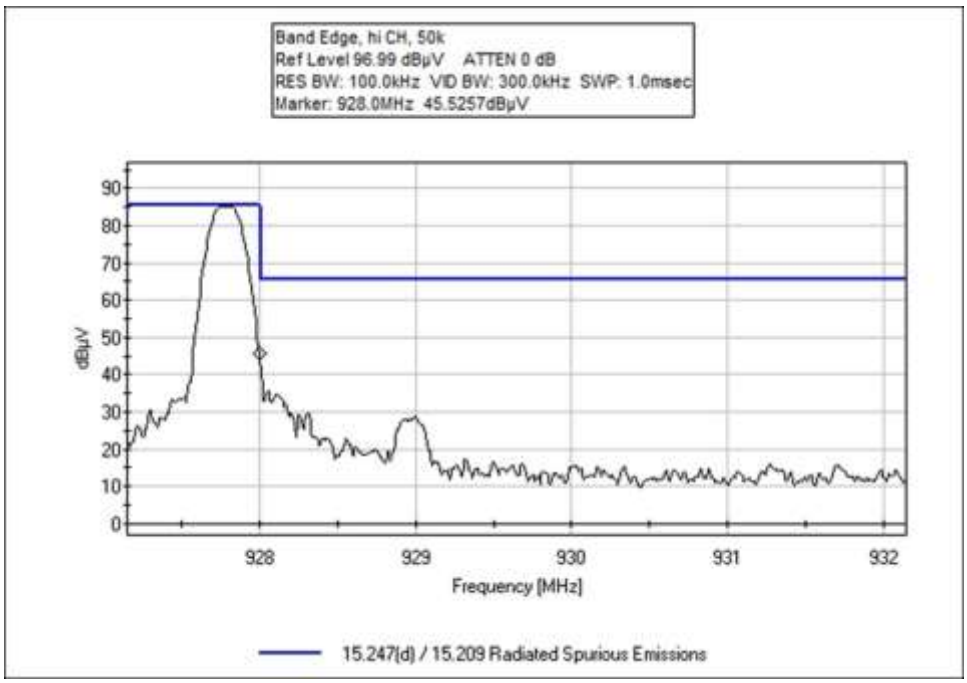

Band Edge, low CH, 25k, restricted band
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 120.0kHz VID BW: 360.0kHz SWP: 1.0msec
Marker: 614.0MHz 9.3697dBµV
dBµV
90
80
70
60
50
40
30
20
10
0
612
613
614
615
616
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions

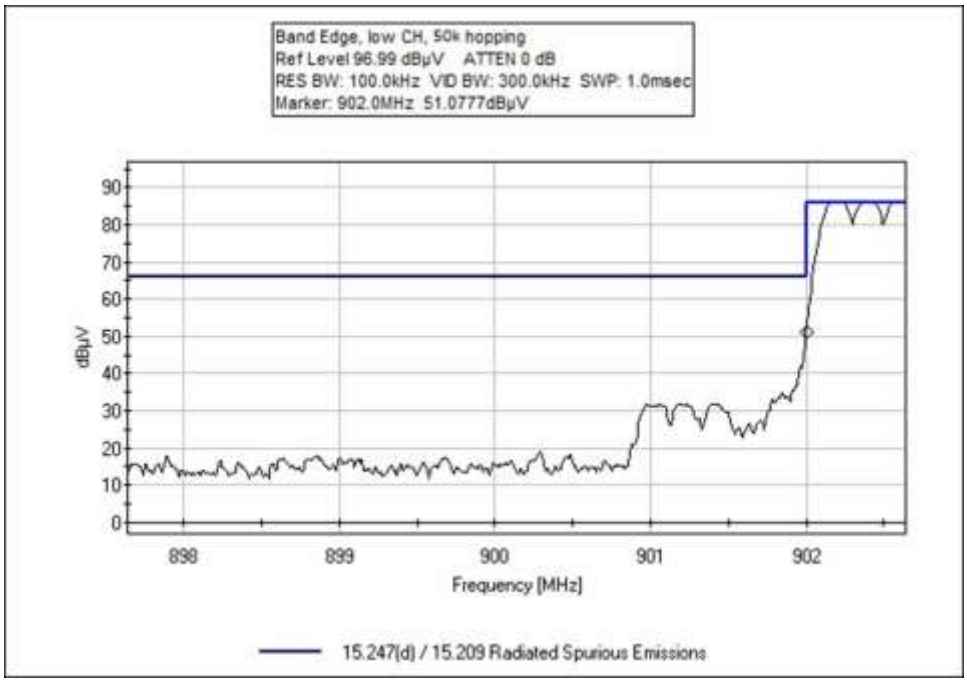

Band Edge, low CH, 25k, hopping
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 120.0kHz VID BW: 360.0kHz SWP: 1.0msec
Marker: 614.0MHz 10.8707dBµV
dBµV
90
80
70
60
50
40
30
20
10
0
612
613
614
615
616
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions

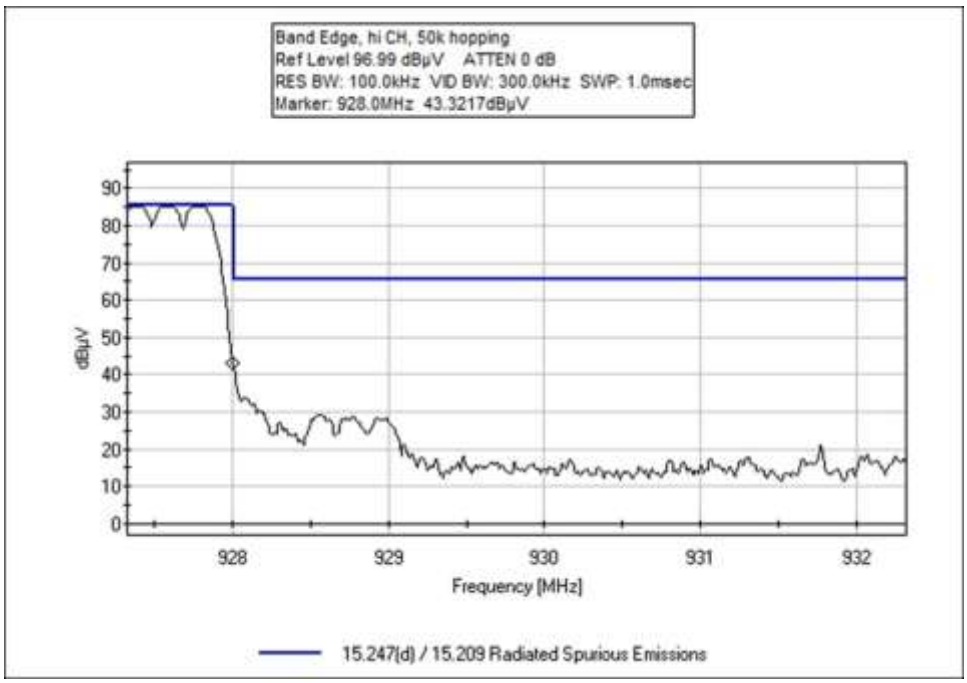

Band Edge, hi CH, 25k, restricted band
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 120.0kHz VID BW: 360.0kHz SWP: 1.0msec
Marker: 960.0MHz 12.3337dBµV
dBµV
90
80
70
60
50
40
30
20
10
0
958
959
960
961
962
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions

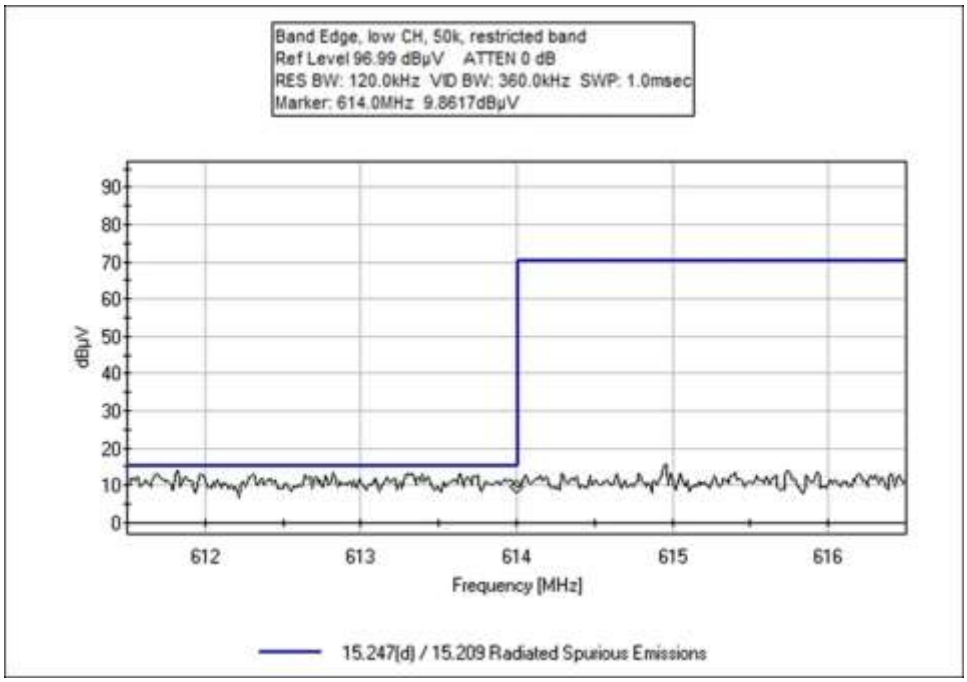

Band Edge, hi CH, 25k, hopping
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 120.0kHz VID BW: 360.0kHz SWP: 1.0msec
Marker: 960.0MHz 12.7097dBµV
dBµV
90
80
70
60
50
40
30
20
10
0
958
959
960
961
962
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions

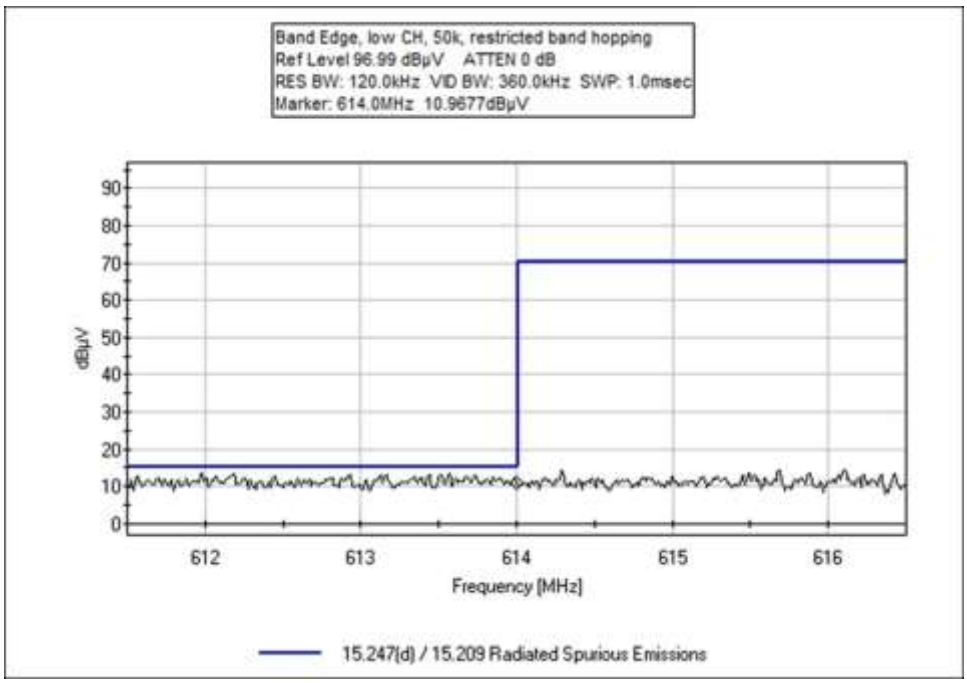

Band Edge, low CH, 50k
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 100.0kHz VID BW: 300.0kHz SWP: 1.0msec
Marker: 902.0MHz 49.9267dBµV
dBµV
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions

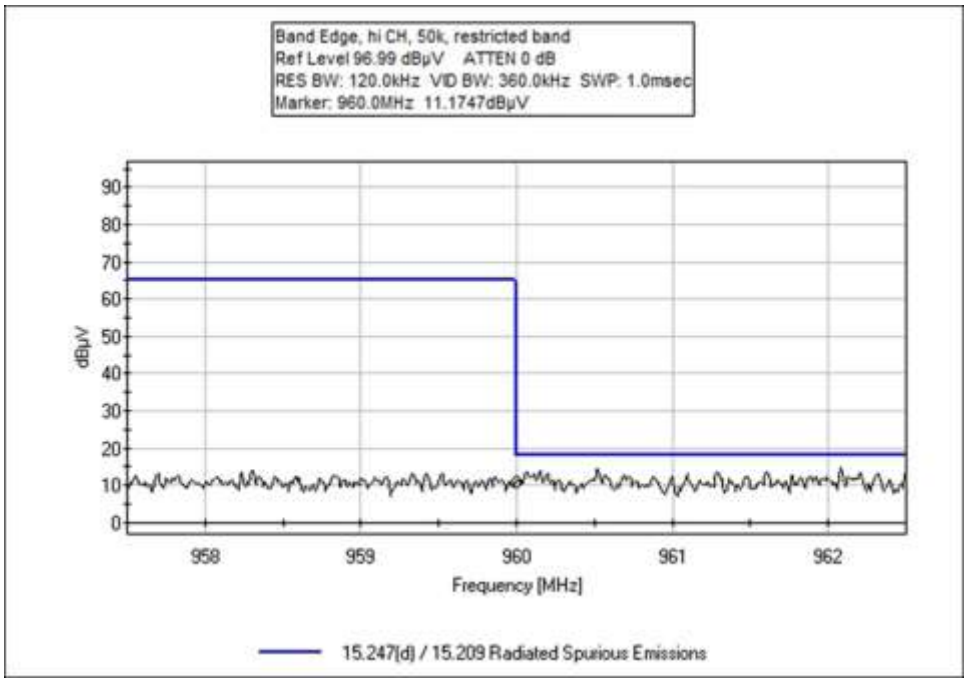

Band Edge, hi CH, 50k
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 100.0kHz VID BW: 300.0kHz SWP: 1.0msec
Marker: 928.0MHz 45.5257dBµV
dBµV
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions

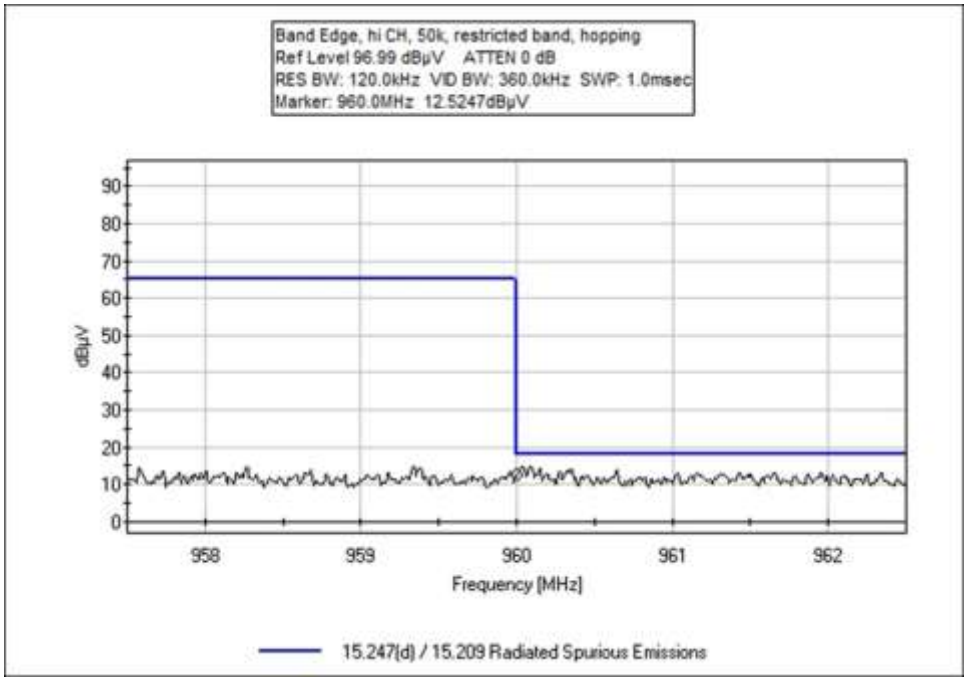

Band Edge, low CH, 50k hopping
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 100.0kHz VID BW: 300.0kHz SWP: 1.0msec
Marker: 902.0MHz 51.0777dBµV
dBµV
90
80
70
60
50
40
30
20
10
0
898
899
900
901
902
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions


Band Edge, hi CH, 50k hopping
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 100.0kHz VID BW: 300.0kHz SWP: 1.0msec
Marker: 928.0MHz 43.3217dBµV
dBµV
90
80
70
60
50
40
30
20
10
0
928
929
930
931
932
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions


Band Edge, low CH, 50k, restricted band
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 120.0kHz VID BW: 360.0kHz SWP: 1.0msec
Marker: 614.0MHz 9.8617dBµV
dBµV
90
80
70
60
50
40
30
20
10
0
612
613
614
615
616
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions


Band Edge, low CH, 50k, restricted band hopping
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 120.0kHz VID BW: 360.0kHz SWP: 1.0msec
Marker: 614.0MHz 10.9677dBµV
dBµV
90
80
70
60
50
40
30
20
10
0
612
613
614
615
616
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions


Band Edge, hi CH, 50k, restricted band
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 120.0kHz VID BW: 360.0kHz SWP: 1.0msec
Marker: 960.0MHz 11.1747dBµV
dBµV
90
80
70
60
50
40
30
20
10
0
958
959
960
961
962
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions


Band Edge, hi CH, 50k, restricted band, hopping
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 120.0kHz VID BW: 360.0kHz SWP: 1.0msec
Marker: 960.0MHz 12.5247dBµV
dBµV
90
80
70
60
50
40
30
20
10
0
958
959
960
961
962
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions

Test Setup / Conditions / Data

Test Location:	CKC Laboratories, Inc. • 110 N. Olinda Place • Brea, CA 92823 • 714-993-6112		
Customer:	**Itron, Inc.**		
Specification:	**15.247(d) / 15.209 Radiated Spurious Emissions**		
Work Order #:	**103181**	Date:	10/21/2019
Test Type:	**Maximized Emissions**	Time:	12:02:27
Tested By:	Don Nguyen	Sequence#:	4
Software:	EMITest 5.03.12		

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. The serial port is connected to a support laptop via serial to USB adapter. The laptop is running software Command Line Interface Tool to turn on TX.
The EUT is powered from fresh battery 6.0Vdc.
Modulation: 25kbps GFSK Level 3

Frequency of measurement: 614MHz-960MHz
RBW=100kHz, VBW=300kHz (-20dBc limit)
RBW=120kHz, VBW=360kHz (restricted band limit)

Site A
Test Method: ANSI C63.10 (2013)
Temperature (ºC): 23.7
Relative Humidity (%): 31.1

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN01995	Biconilog Antenna	CBL6111C	4/23/2018	4/23/2020
T2	ANP05275	Attenuator	1W	4/5/2018	4/5/2020
T3	ANP05198	Cable-Amplitude +15C to +45C (dB)	8268	12/4/2018	12/4/2020
T4	AN02672	Spectrum Analyzer	E4446A	3/13/2019	3/13/2021

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	10.9	+20.0	+6.0	+4.7	+0.0	+0.0	41.6	46.0 hopping	-4.4	Vert
2	960.000M	12.7	+23.7	+6.1	+6.1	+0.0	+0.0	48.6	54.0 hopping	-5.4	Vert
3	960.000M	12.3	+23.7	+6.1	+6.1	+0.0	+0.0	48.2	54.0	-5.8	Vert
4	614.000M	9.4	+20.0	+6.0	+4.7	+0.0	+0.0	40.1	46.0	-5.9	Vert
5	902.000M	44.0	+22.8	+6.1	+5.9	+0.0	+0.0	78.8	100.9	-22.1	Vert
6	902.000M	41.6	+22.8	+6.1	+5.9	+0.0	+0.0	76.4	100.9 hopping	-24.5	Vert
7	928.000M	35.0	+23.2	+6.1	+6.0	+0.0	+0.0	70.3	100.9 hopping	-30.6	Vert
8	928.000M	34.3	+23.2	+6.1	+6.0	+0.0	+0.0	69.6	100.9	-31.3	Vert

Test Location:	CKC Laboratories, Inc. • 110 N. Olinda Place • Brea, CA 92823 • 714-993-6112		
Customer:	**Itron, Inc.**		
Specification:	**15.247(d) / 15.209 Radiated Spurious Emissions**		
Work Order #:	**103181**	Date:	10/21/2019
Test Type:	**Maximized Emissions**	Time:	11:58:38
Tested By:	Don Nguyen	Sequence#:	5
Software:	EMITest 5.03.12		

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. The serial port is connected to a support laptop via serial to USB adapter. The laptop is running software Command Line Interface Tool to turn on TX.
The EUT is powered from fresh battery 6.0Vdc.
Modulation: 50kbps GFSK Level 3

Frequency of measurement: 614MHz-960MHz
RBW=100kHz, VBW=300kHz (-20dBc limit)
RBW=120kHz, VBW=360kHz (restricted band limit)

Site A
Test Method: ANSI C63.10 (2013)
Temperature (ºC): 23.7
Relative Humidity (%): 31.1

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN01995	Biconilog Antenna	CBL6111C	4/23/2018	4/23/2020
T2	ANP05275	Attenuator	1W	4/5/2018	4/5/2020
T3	ANP05198	Cable-Amplitude +15C to +45C (dB)	8268	12/4/2018	12/4/2020
T4	AN02672	Spectrum Analyzer	E4446A	3/13/2019	3/13/2021

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	11.0	+20.0	+6.0	+4.7	+0.0	+0.0	41.7	46.0 hopping	-4.3	Vert
2	614.000M	9.9	+20.0	+6.0	+4.7	+0.0	+0.0	40.6	46.0	-5.4	Vert
3	960.000M	12.5	+23.7	+6.1	+6.1	+0.0	+0.0	48.4	54.0 hopping	-5.6	Vert
4	960.000M	11.2	+23.7	+6.1	+6.1	+0.0	+0.0	47.1	54.0	-6.9	Vert
5	902.000M	51.1	+22.8	+6.1	+5.9	+0.0	+0.0	85.9	100.9 hopping	-15.0	Vert
6	902.000M	50.0	+22.8	+6.1	+5.9	+0.0	+0.0	84.8	100.9	-16.1	Vert
7	928.000M	45.5	+23.2	+6.1	+6.0	+0.0	+0.0	80.8	100.9	-20.1	Vert
8	928.000M	43.3	+23.2	+6.1	+6.0	+0.0	+0.0	78.6	100.9 hopping	-22.3	Vert

Test Setup Photo(s)

Below 1GHz

Below 1GHz

Above 1GHz

Above 1GHz

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.

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.