

Ittron, Inc.

TEST REPORT FOR

Gas Endpoint
Model: Intelis-Gas

Tested to The Following Standards:

FCC Part 15 Subpart C Section(s)

15.247
(HYBRID 902-928 MHz)

Report No.: 105334-6

Date of issue: May 4, 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: 235535

DATE OF EQUIPMENT RECEIPT:**DATE(S) OF TESTING:****REPORT PREPARED BY:**

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

Project Number: 105334

April 12, 2021

April 12-13 and 22, 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".

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.
22116 23rd Drive S.E.,
Canyon Park, Bothell, WA 98021

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	NP
15.247(a)(1)(i)	Number of Hopping Channels	NA	NP
15.247(a)(1)(i)	Average Time of Occupancy	NA	NA1
15.247 (f)	Hybrid Systems Time of Occupancy	NA	NP
15.247 (f)	Hybrid Systems Power Spectral Density	NA	Pass
15.247(b)(2)	Output Power	NA	Pass
15.247(d)	RF Conducted Emissions & Band Edge	NA	NA2
15.247(d)	Radiated Emissions & Band Edge	NA	Pass
15.207	AC Conducted Emissions	NA	NA3

NA = Not Applicable

NA1 = The time of occupancy test is covered under the Hybrid Systems section 5.3 (a).

NA2 = The manufacturer declares the EUT has an integral antenna (temporary antenna port provided for power and OBW measurements only per manufacturer).

NA3 = The manufacturer declares the EUT is battery powered.

NP = CKC Laboratories was not contracted to perform test.

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.	Intelis-Gas	105334-cond

Support Equipment:

Device	Manufacturer	Model #	S/N
Power Supply	Maxtra	MA-305D	P07354
Laptop	HP	14-dq1033cl	NA
AC Adapter (for Laptop)	HP	L25296-002	NA
USB Hub	Insignia	NS-PCH5420	NA
USB Interface Board	Itron, Inc.	PCB-TEMP-0007 Rev3	NA

Configuration 2

Equipment Tested:

Device	Manufacturer	Model #	S/N
Gas Endpoint	Itron, Inc.	Intelis-Gas	105334-rad

Support Equipment:

Device	Manufacturer	Model #	S/N
None			

General Product Information:

Product Information	Manufacturer-Provided Details
Equipment Type:	Stand-Alone Equipment
Type of Wideband System:	Proprietary Hybrid FHSS
Operating Frequency Range:	902.4 to 927.6MHz
Number of Hopping Channels:	Up to 64
Modulation Type(s):	GFSK
Maximum Duty Cycle:	100% tested as worst case
Number of TX Chains:	2 Note: no simultaneous transmission, there is a different Tx chain routing for power level 0/1 compared to 2/3 which are contained within other reports
Antenna Type(s) and Gain:	Internal Trace, 3.0dBi
Beamforming Type:	NA
Antenna Connection Type:	Integral (External connector provided to facilitate testing)
Nominal Input Voltage:	6.0VDC battery
Firmware / Software used for Test:	CLI Tool (2.0.1.24) App Version 7.0.16.0 CSL Version 8.1.11.0

EUT Photo(s)



Configuration 1



Configuration 2

Support Equipment Photo(s)

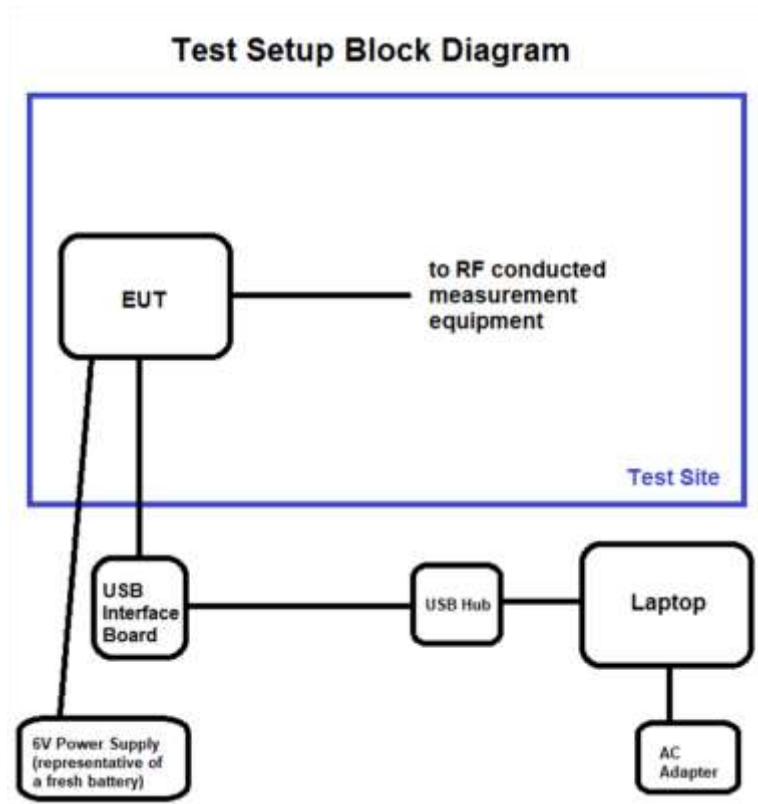


Laptop, Hub and Interface

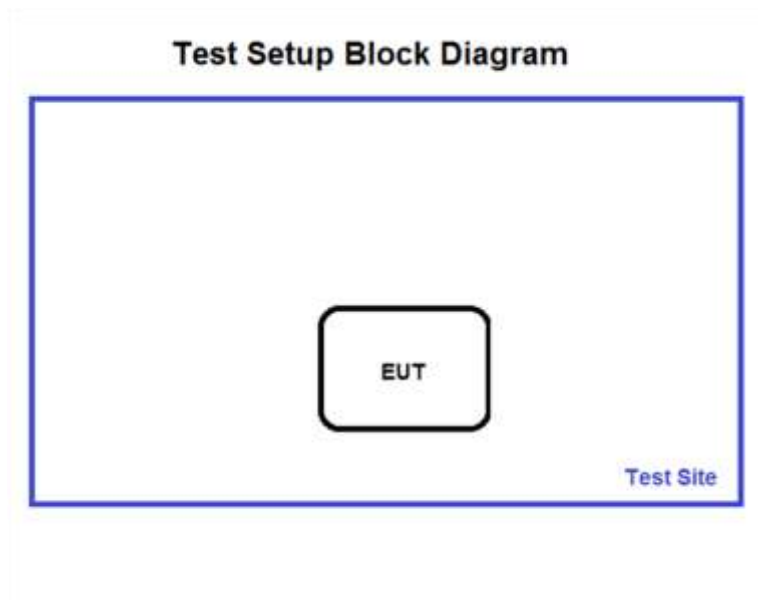


Power Supply

Block Diagram of Test Setup(s)



Configuration 1



Configuration 2

FCC Part 15 Subpart C

15.247(a) Transmitter Characteristics

Test Setup/Conditions			
Test Location:	Bothell Lab Bench	Test Engineer:	M. Atkinson
Test Method:	ANSI C63.10 (2013)	Test Date(s):	4/12/2021
Configuration:	1		
Test Setup:	EUT has temporary antenna connector attached. EUT directly connected to spectrum analyzer through appropriate cables and attenuators. EUT is continuously transmitting with modulation.		
Note:	For this Hybrid mode there is no requirement to meet the FHSS or DTS bandwidth limit. However, the system must pass the DTS PSD limit of 8dBm in any 3kHz band. Both 6dB and 20dB bandwidth measured for informational purposes.		

Environmental Conditions			
Temperature (°C)	22	Relative Humidity (%):	32

Test Equipment					
Asset#	Description	Manufacturer	Model	Cal Date	Cal Due
02871	Spectrum Analyzer	Agilent	E4440A	3/12/2020	3/12/2022
P07227	Attenuator	Pasternack	PE7004-6	10/2/2019	10/2/2021
P05748	Attenuator	Pasternack	PE7004-20	3/4/2020	3/4/2022
P06008	Cable	Andrew	Helix	2/1/2021	2/1/2023

15.247(a)(1) 20 dB Bandwidth

20dB Occupied Bandwidth

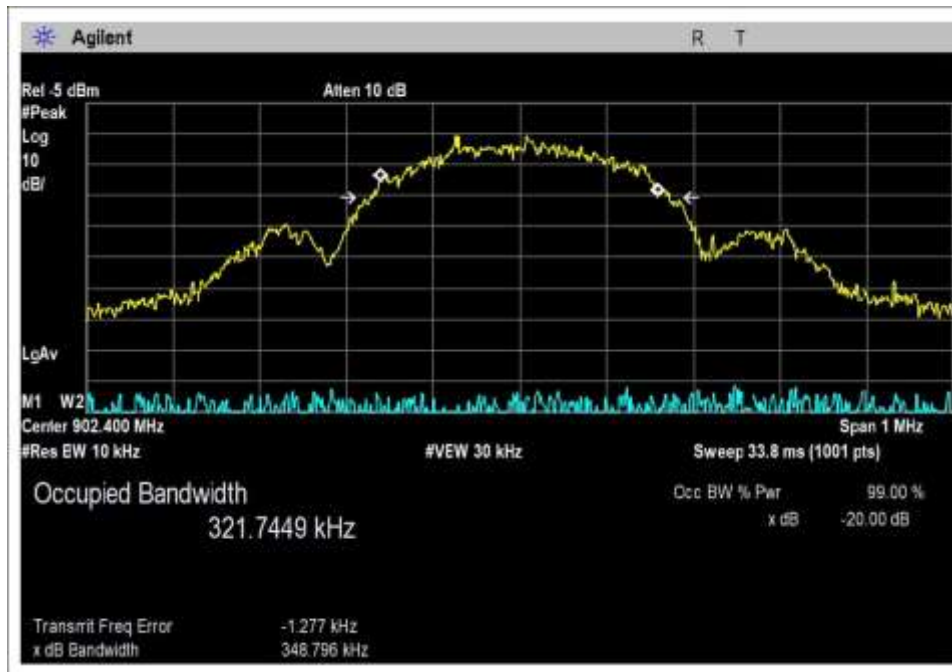
Test Data Summary					
Frequency (MHz)	Antenna Port	Modulation	Measured (kHz)	Limit (kHz)	Results
902.4	1	GFSK 300kbps PL2	348.796	See Note above in test section table.	NA
915.6	1	GFSK 300kbps PL2	353.465		
927.6	1	GFSK 300kbps PL2	353.476		

6dB Occupied Bandwidth (required for PSD measurement for Hybrid System)

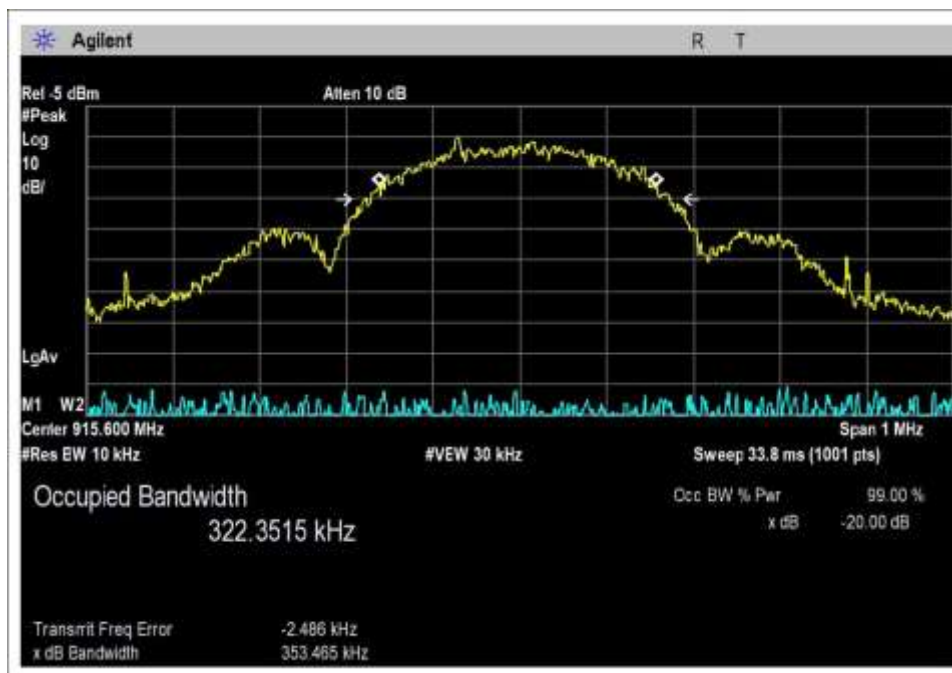
Test Data Summary					
Frequency (MHz)	Antenna Port	Modulation	Measured (kHz)	Limit (kHz)	Results
902.4	1	GFSK 300kbps PL2	296.780	See Note above in test section table.	NA
915.6	1	GFSK 300kbps PL2	296.796		
927.6	1	GFSK 300kbps PL2	295.774		

Plot(s)

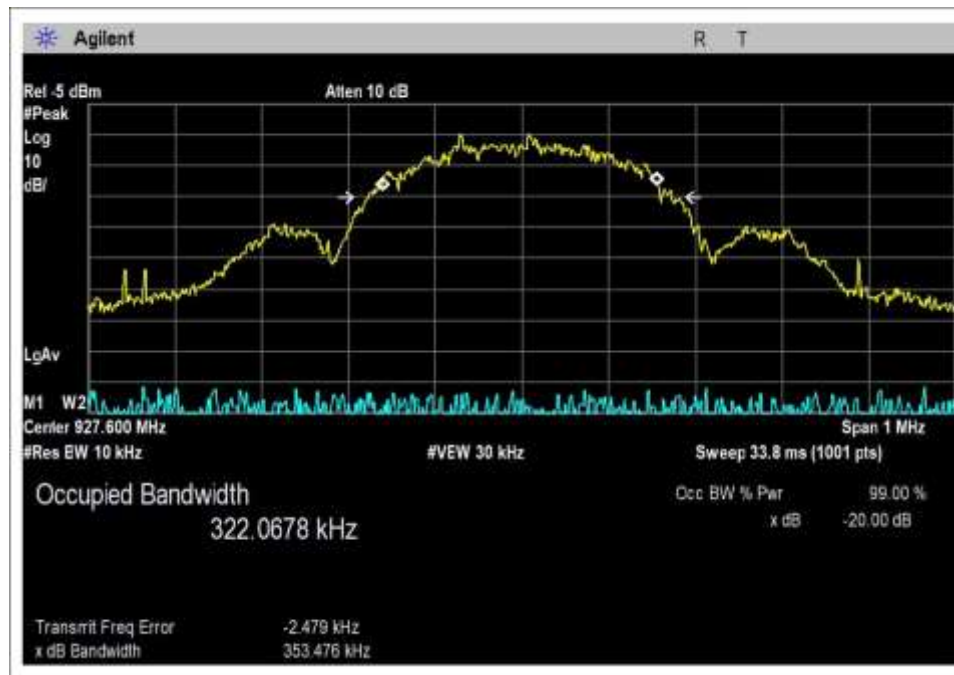
20dB Occupied Bandwidth



Low Channel

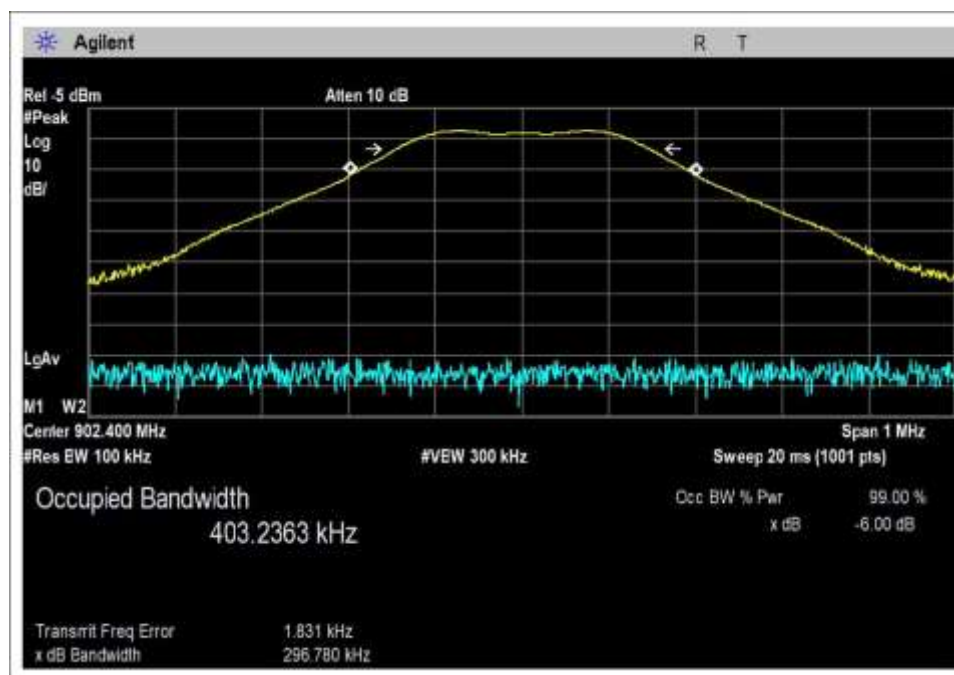


Middle Channel

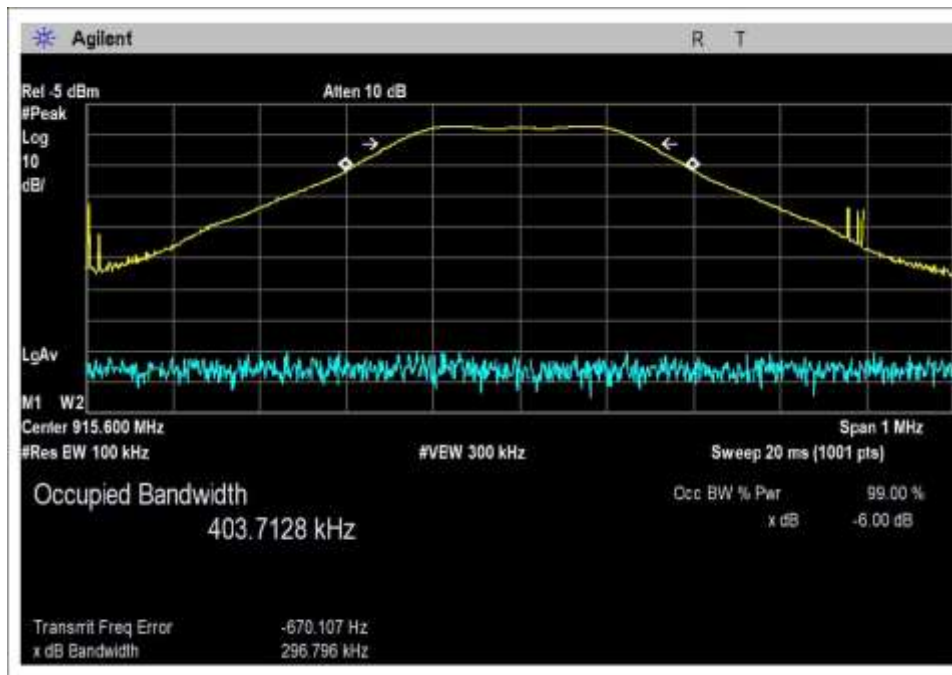


High Channel

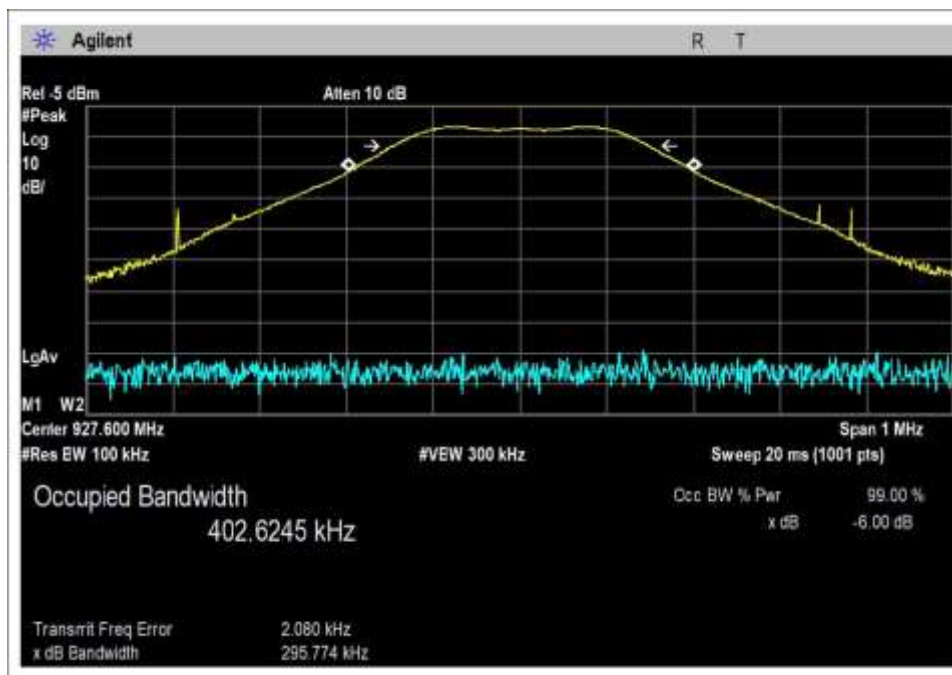
6dB Occupied Bandwidth



Low Channel



Middle Channel



High Channel

Test Setup Photo(s)



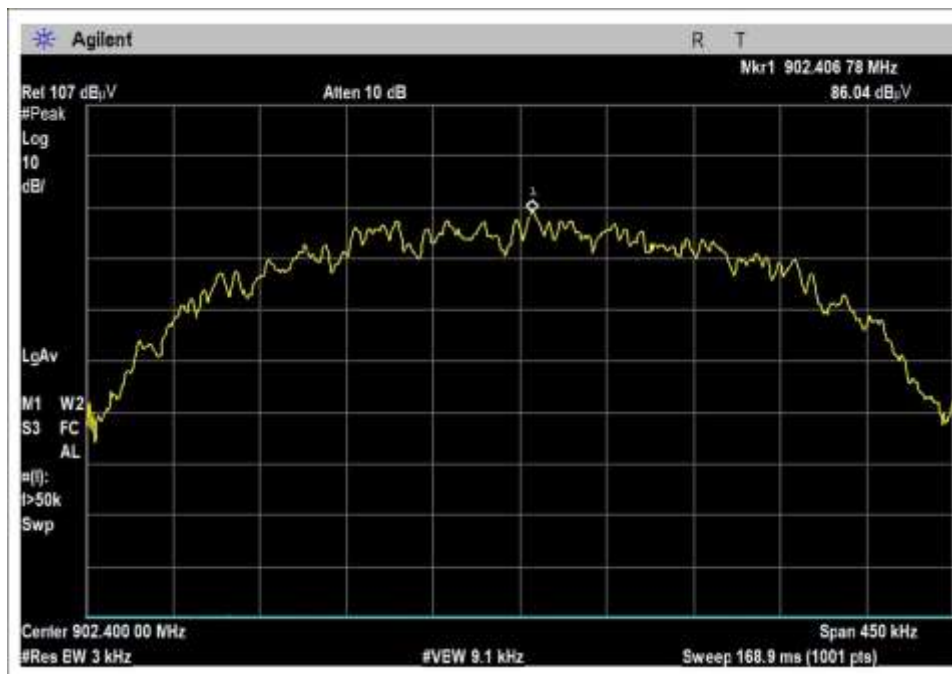
15.247(f) Hybrid Systems Power Spectral Density

Test Data Summary - RF Conducted Measurement

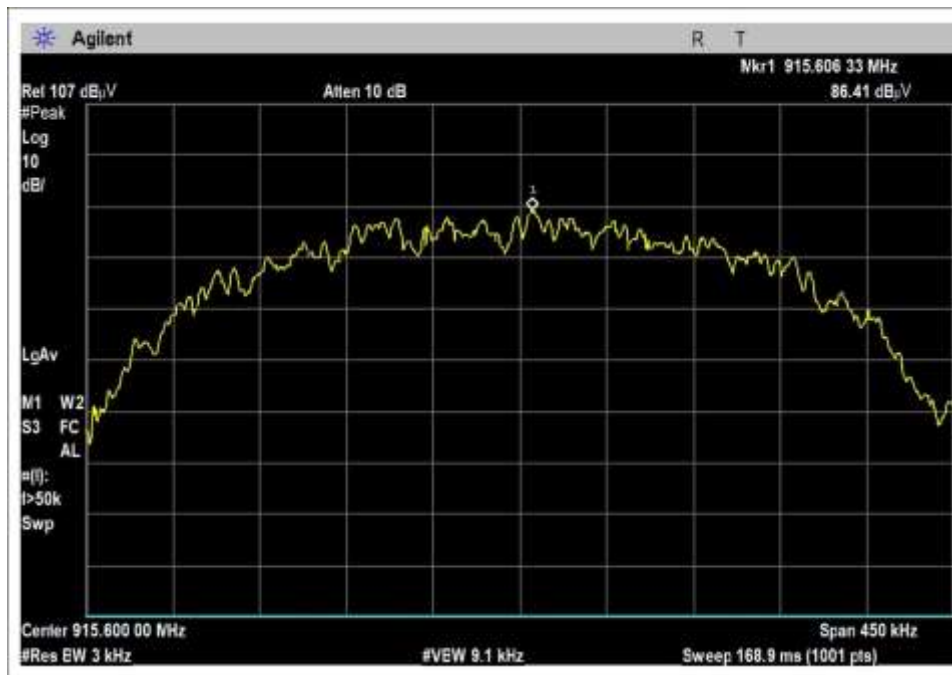
Measurement Method: PKPSD

Frequency (MHz)	Modulation	Measured (dBm/3kHz)	Limit (dBm/3kHz)	Results
902.4	GFSK 300kbps PL2	5.5	≤8	Pass
915.6	GFSK 300kbps PL2	5.9	≤8	Pass
927.6	GFSK 300kbps PL2	6.3	≤8	Pass

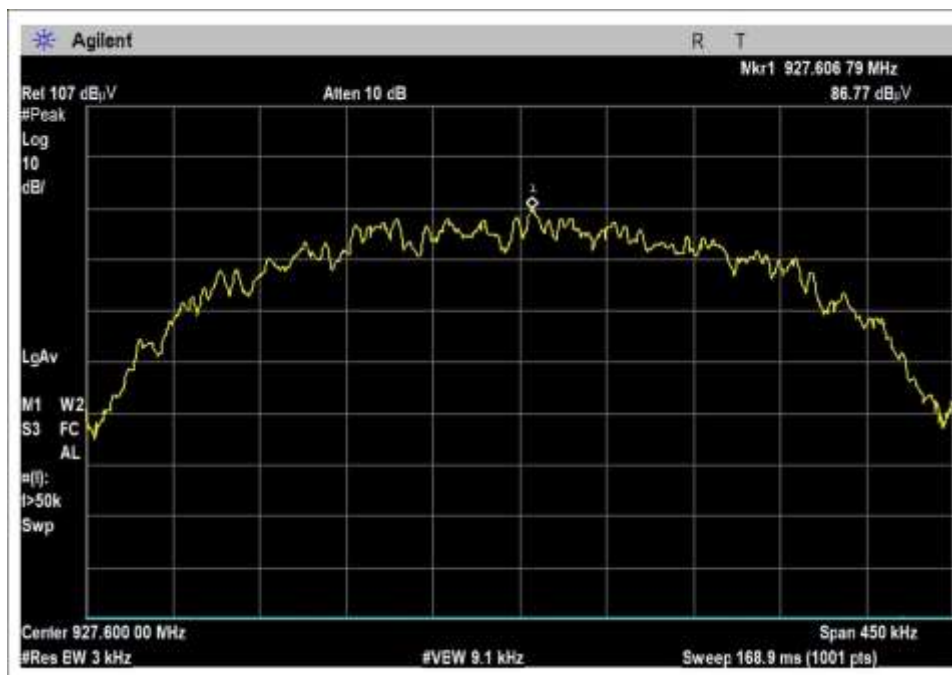
Plot(s)



Low Channel



Middle Channel



High Channel

Test Setup / Conditions / Data

Test Location: CKC Laboratories • 22116 23rd Drive SE, Suite A • Bothell, WA 98021 • 1-800-500-4EMC (4362)
 Customer: **Itron, Inc.**
 Specification: **15.247(f) Peak Power Spectral Density for Hybrid Systems (902-928 MHz DTS)**
 Work Order #: **105334** Date: 4/13/2021
 Test Type: **Conducted Emissions** Time: 14:09:01
 Tested By: Michael Atkinson Sequence#: 4
 Software: EMITest 5.03.19 6VDC (representative of fresh battery)

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

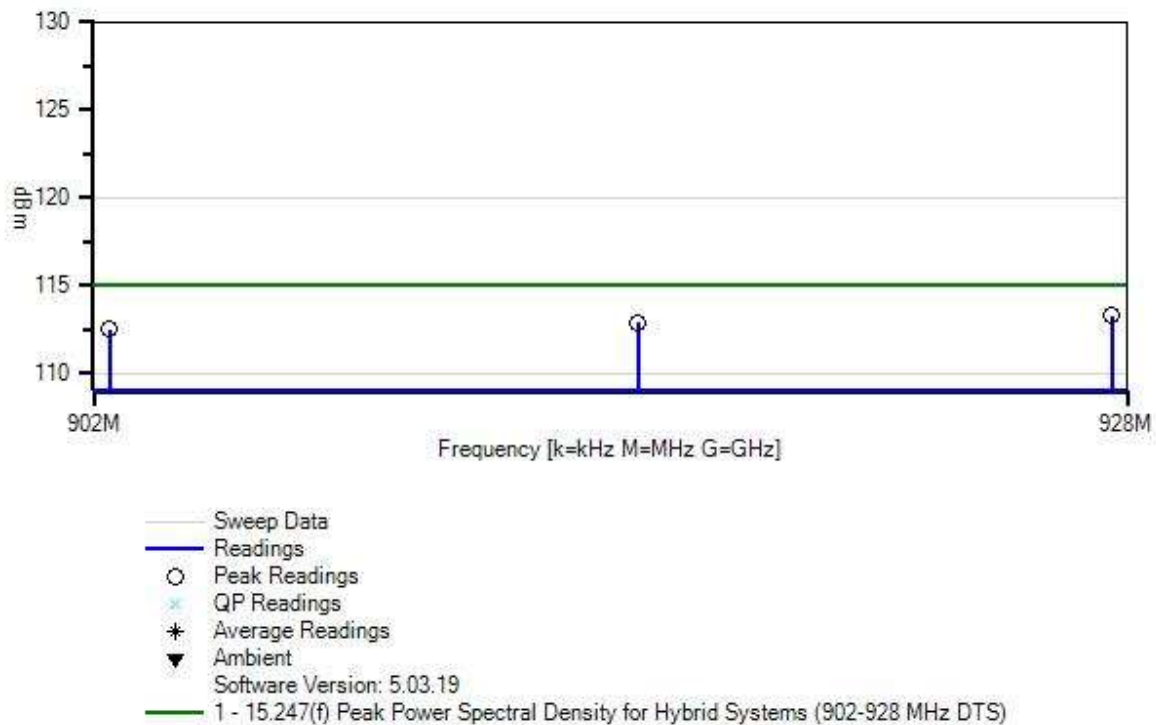
Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

Test Location: Bothell Lab Bench Test Method: ANSI C63.10 (2013) Temperature (°C): 21 Relative Humidity (%): 33 EUT has temporary antenna connector attached. EUT directly connected to spectrum analyzer through appropriate cables and attenuators. EUT is continuously transmitting with modulation.

Itron, Inc. WD#: 105334 Sequence#: 4 Date: 4/13/2021
15.247(f) Peak Power Spectral Density for Hybrid Systems (902-928 MHz DTS) Test Lead: 6VDC (representative of fresh battery) RF Port



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02871	Spectrum Analyzer	E4440A	3/12/2020	3/12/2022
T1	ANP07227	Attenuator	PE7004-6	10/2/2019	10/2/2021
T2	ANP05748	Attenuator	PE7004-20	3/4/2020	3/4/2022
T3	ANP06008	Cable	Helix	2/1/2021	2/1/2023

Measurement Data:

Reading listed by margin.

Test Lead: RF Port

#	Freq MHz	Rdng dBμV	T1 dB	T2 dB	T3 dB	dB	Dist Table	Corr dBm	Spec dBm	Margin dB	Polar Ant
1	927.607M	86.8	+5.9	+20.0	+0.6		+0.0	113.3	115.0	-1.7	RF Po
2	915.606M	86.4	+5.9	+20.0	+0.6		+0.0	112.9	115.0	-2.1	RF Po
3	902.407M	86.0	+5.9	+20.0	+0.6		+0.0	112.5	115.0	-2.5	RF Po

Test Setup Photo(s)



15.247(b)(2) Output Power

Test Data Summary - Voltage Variations

This equipment is battery powered. Power output tests were performed at 6VDC with a temporary power supply connection to represent a fresh battery.

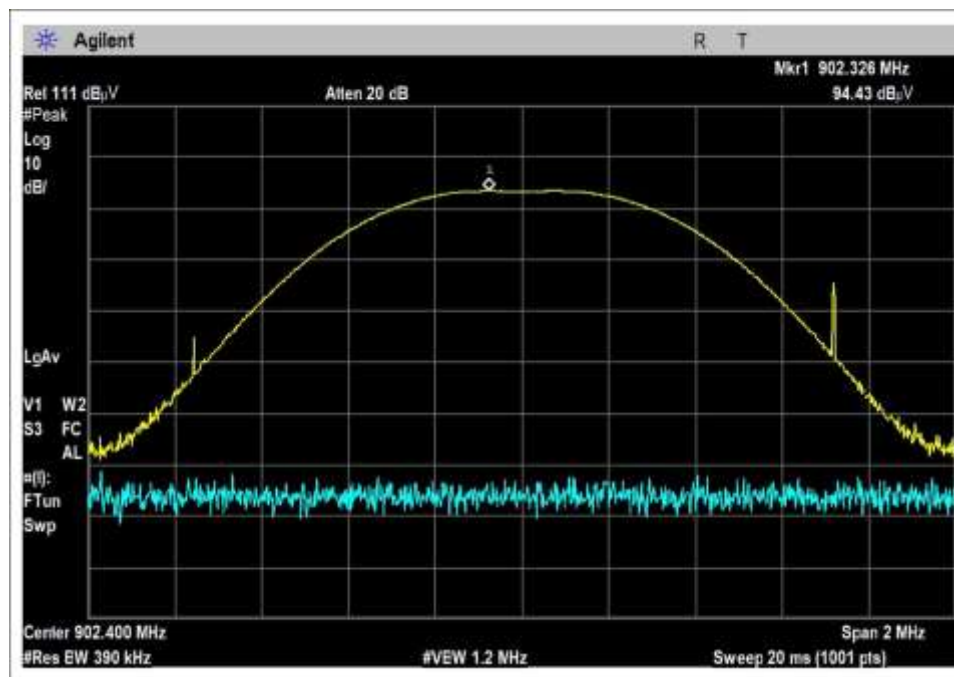
Test Data Summary - RF Conducted Measurement

Limit = 30dBm Conducted/36dBm EIRP

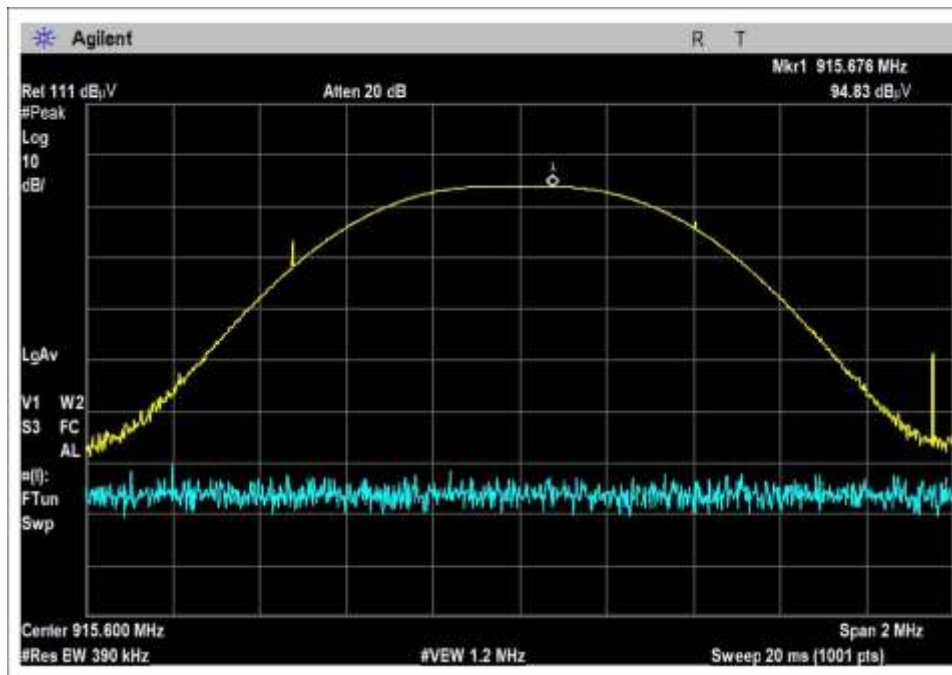
Frequency (MHz)	Modulation	Ant. Type / Gain (dBi)	Measured (dBm)	Limit (dBm)	Results
902.4	GFSK 300kbps PL2	Trace, 3.0 dBi	13.9	≤30	Pass
915.6	GFSK 300kbps PL2	Trace, 3.0 dBi	14.3	≤30	Pass
927.6	GFSK 300kbps PL2	Trace, 3.0 dBi	14.6	≤30	Pass

For this Hybrid Mode there is no minimum number of hopping channels required for the 1 Watt (30dBm) limit.

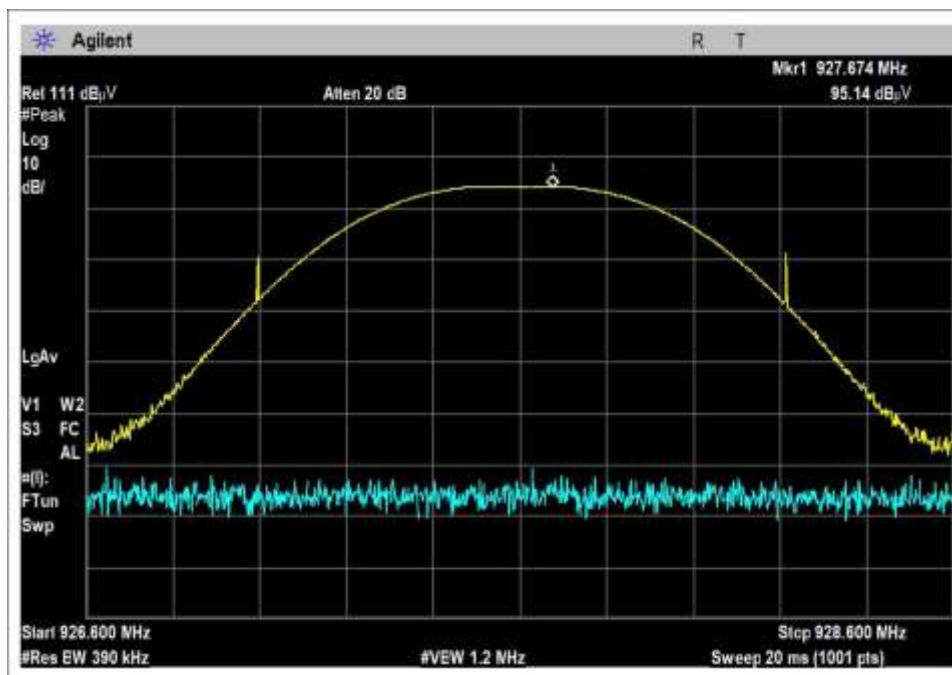
Plots



Low Channel



Middle Channel



High Channel

Test Setup / Conditions / Data

Test Location: CKC Laboratories • 22116 23rd Drive SE, Suite A • Bothell, WA 98021 • 1-800-500-4EMC (4362)
 Customer: **Itron, Inc.**
 Specification: **15.247(b) Power Output (902-928 MHz FHSS >50 Channels)**
 Work Order #: **105334** Date: 4/13/2021
 Test Type: **Conducted Emissions** Time: 12:06:25
 Tested By: Michael Atkinson Sequence#: 3
 Software: EMITest 5.03.19 6VDC (representative of fresh battery)

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

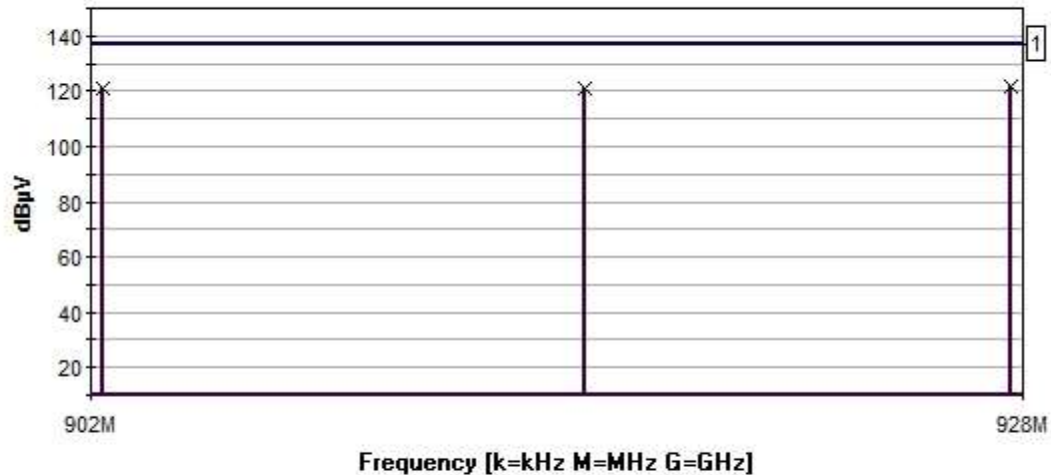
Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

Test Location: Bothell Lab Bench Test Method: ANSI C63.10 (2013) Temperature (°C): 22 Relative Humidity (%): 32 EUT has temporary antenna connector attached. EUT directly connected to spectrum analyzer through appropriate cables and attenuators. EUT is continuously transmitting with modulation.

Ittron, Inc. WO#: 105334 Sequence#: 3 Date: 4/13/2021
15.247(b) Power Output (902-928 MHz FHSS >50 Channels) Test Lead: 6VDC (representative of fresh battery) RF Port



— Sweep Data
— 1 - 15.247(b) Power Output (902-928 MHz FHSS >50 Channels)
— Measure List
— Readings
× Peak Readings
Software Version: 5.03.19

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02871	Spectrum Analyzer	E4440A	3/12/2020	3/12/2022
T1	ANP07227	Attenuator	PE7004-6	10/2/2019	10/2/2021
T2	ANP05748	Attenuator	PE7004-20	3/4/2020	3/4/2022
T3	ANP06008	Cable	Helix	2/1/2021	2/1/2023

Measurement Data:

Reading listed by margin.

Test Lead: RF Port

#	Freq MHz	Rdng dBμV	T1 dB	T2 dB	T3 dB	Dist dB	Table	Corr dBμV	Spec dBμV	Margin dB	Polar Ant
1	927.674M	95.1	+5.9	+20.0	+0.6		+0.0	121.6	137.0	-15.4	RF Po
									GFSK 300k P2		
2	915.676M	94.8	+5.9	+20.0	+0.6		+0.0	121.3	137.0	-15.7	RF Po
									GFSK 300k P2		
3	902.326M	94.4	+5.9	+20.0	+0.6		+0.0	120.9	137.0	-16.1	RF Po
									GFSK 300k P2		

Test Setup Photo(s)



15.247(d) Radiated Emissions & Band Edge

Test Setup / Conditions / Data

Test Location: CKC Laboratories • 22116 23rd Drive SE, Suite A • Bothell, WA 98021 • 1-800-500-4EMC (4362)
 Customer: **Itron, Inc.**
 Specification: **15.247(d) / 15.209 Radiated Spurious Emissions**
 Work Order #: **105334** Date: 4/22/2021
 Test Type: **Radiated Scan** Time: 15:18:55
 Tested By: Michael Atkinson Sequence#: 6
 Software: EMITest 5.03.19

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 2			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 2			

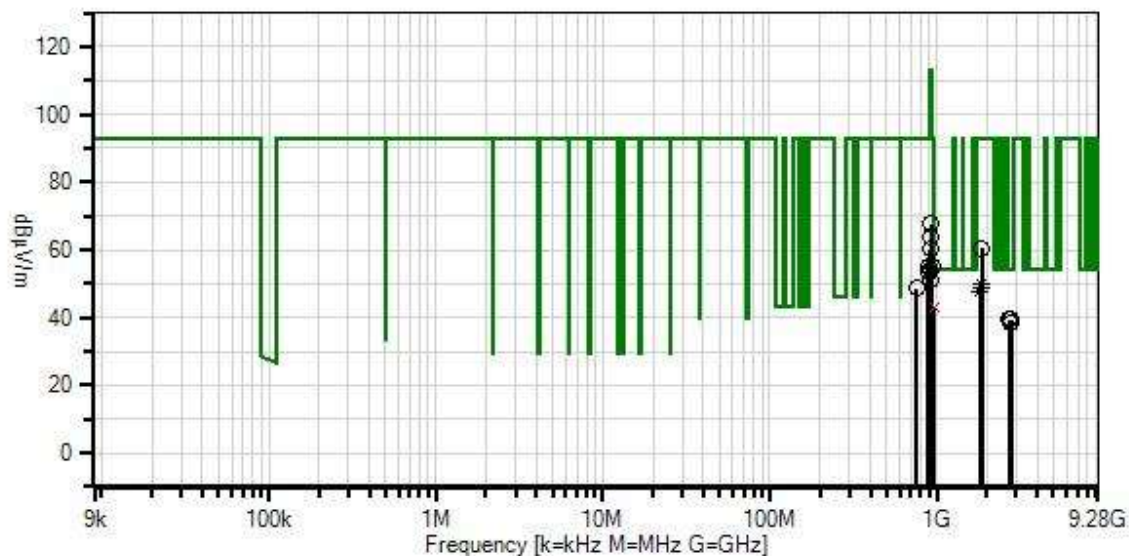
Test Conditions / Notes:

Frequency: 9kHz to 10GHz

Test Location: Bothell Lab Bench
 Test Method: ANSI C63.10 (2013)
 Temperature (°C): 22
 Relative Humidity (%): 30

Setup: EUT is continuously transmitting with modulation on lab selected channel.
 EUT is battery powered with a fresh battery installed.
 Horizontal and Vertical polarities investigated above 30MHz, worst case reported.
 3 x orthogonal axes investigated below 30MHz, worst case reported.

Itron, Inc. WO#: 105334 Sequence#: 6 Date: 4/22/2021
15.247(d) / 15.209 Radiated Spurious Emissions Test Distance: 3 Meters Vert



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02871	Spectrum Analyzer	E4440A	3/12/2020	3/12/2022
T1	ANP06540	Cable	Heliac	8/23/2019	8/23/2021
T2	ANP06515	Cable	Heliac	7/1/2020	7/1/2022
T3	AN00052	Loop Antenna	6502	5/4/2020	5/4/2022
T4	AN03170	High Pass Filter	HM1155-11SS	10/23/2019	10/23/2021
T5	AN03540	Preamplifier	83017A	5/13/2019	5/13/2021
T6	ANP07505	Cable	CLU40-KMKM-02.00F	1/26/2021	1/26/2023
T7	AN01467	Horn Antenna-ANSI C63.5 Calibration	3115	7/5/2019	7/5/2021
T8	ANP05305	Cable	ETSI-50T	9/6/2019	9/6/2021
T9	ANP05360	Cable	RG214	2/3/2020	2/3/2022
T10	ANP06123	Attenuator	18N-6	4/2/2021	4/2/2023
T11	AN03628	Biconilog Antenna	3142E	6/11/2019	6/11/2021

Measurement Data:

Reading listed by margin.

Test Distance: 3 Meters

#	Freq	Rdng	T1 T5 T9	T2 T6 T10	T3 T7 T11	T4 T8	Dist	Corr	Spec	Margin	Polar
	MHz	dBμV	dB	dB	dB	dB	Table	dBμV/m	dBμV/m	dB	Ant
1	967.600M QP	8.2	+0.4 +0.0 +2.2	+0.0 +0.0 +5.8	+0.0 +0.0 +24.7	+0.0 +1.5	+0.0	42.8	54.0	-11.2	Vert
^	967.600M	15.2	+0.4 +0.0 +2.2	+0.0 +0.0 +5.8	+0.0 +0.0 +24.7	+0.0 +1.5	+0.0	49.8	54.0	-4.2	Vert
3	2707.400M	40.8	+0.7 -34.1 +0.0	+2.9 +0.3 +0.0	+0.0 +28.3 +0.0	+0.4 +0.0	+0.0	39.3	54.0 902.4	-14.7	Vert
4	2782.990M	40.6	+0.7 -34.1 +0.0	+2.9 +0.3 +0.0	+0.0 +28.5 +0.0	+0.4 +0.0	+0.0	39.3	54.0 927.6	-14.7	Vert
5	2746.950M	39.7	+0.7 -34.1 +0.0	+2.9 +0.3 +0.0	+0.0 +28.4 +0.0	+0.4 +0.0	+0.0	38.3	54.0 915.6	-15.7	Vert
6	930.800M	33.4	+0.4 +0.0 +2.2	+0.0 +0.0 +5.8	+0.0 +0.0 +24.2	+0.0 +1.5	+0.0	67.5	93.0	-25.5	Horiz
7	1855.390M	65.1	+0.5 -34.7 +0.0	+2.4 +0.3 +0.0	+0.0 +26.6 +0.0	+0.4 +0.0	+0.0	60.6	93.0 927.6	-32.4	Vert
8	890.200M	21.9	+0.3 +0.0 +2.1	+0.0 +0.0 +5.8	+0.0 +0.0 +23.8	+0.0 +1.4	+0.0	55.3	93.0	-37.7	Vert
9	944.200M	20.8	+0.4 +0.0 +2.2	+0.0 +0.0 +5.8	+0.0 +0.0 +24.4	+0.0 +1.5	+0.0	55.1	93.0	-37.9	Vert
10	890.600M	20.0	+0.3 +0.0 +2.1	+0.0 +0.0 +5.8	+0.0 +0.0 +23.8	+0.0 +1.4	+0.0	53.4	93.0	-39.6	Horiz
11	1855.180M Ave	54.8	+0.5 -34.7 +0.0	+2.4 +0.3 +0.0	+0.0 +26.5 +0.0	+0.4 +0.0	+0.0	50.2	93.0 927.6	-42.8	Vert
12	1831.309M Ave	53.8	+0.5 -34.8 +0.0	+2.4 +0.3 +0.0	+0.0 +26.3 +0.0	+0.4 +0.0	+0.0	48.9	93.0 915.6	-44.1	Vert
^	1831.350M	64.1	+0.5 -34.8 +0.0	+2.4 +0.3 +0.0	+0.0 +26.3 +0.0	+0.4 +0.0	+0.0	59.2	93.0 915.6	-33.8	Vert
14	754.570M	16.1	+0.3 +0.0 +1.8	+0.0 +0.0 +5.8	+0.0 +0.0 +23.3	+0.0 +1.3	+0.0	48.6	93.0	-44.4	Vert

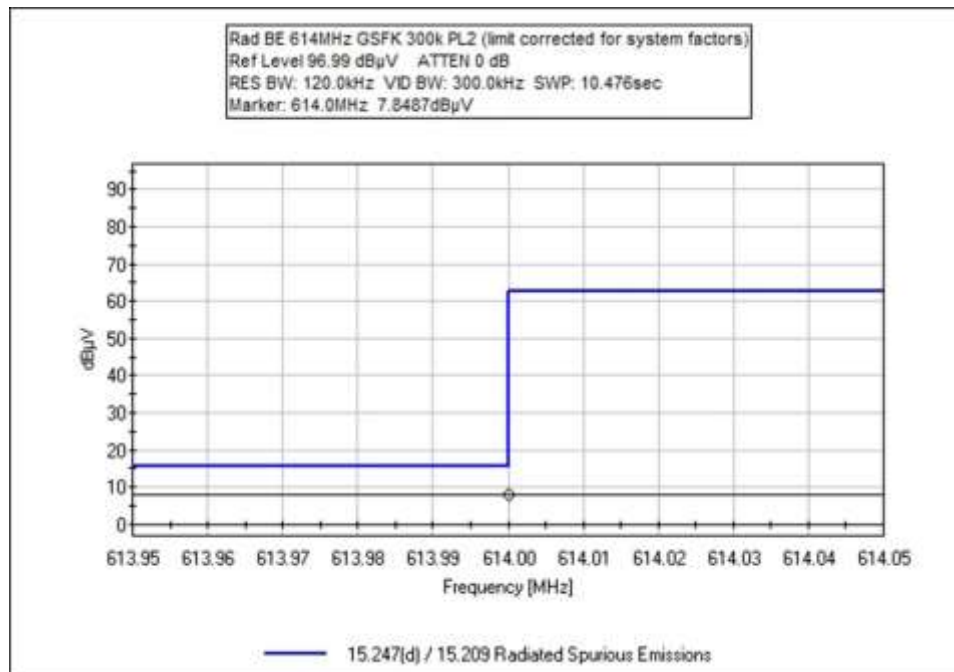
15	1804.918M Ave	52.4	+0.5 -34.8 +0.0	+2.3 +0.3 +0.0	+0.0 +26.1 +0.0	+0.5 +0.0	+0.0	47.3	93.0 902.4	-45.7	Vert
^	1805.000M	62.8	+0.5 -34.8 +0.0	+2.3 +0.3 +0.0	+0.0 +26.1 +0.0	+0.5 +0.0	+0.0	57.7	93.0 902.4	-35.3	Vert
17	925.000M	29.5	+0.4 +0.0 +2.2	+0.0 +0.0 +5.8	+0.0 +0.0 +24.1	+0.0 +1.5	+0.0	63.5	113.0	-49.5	Vert
18	911.000M	26.4	+0.4 +0.0 +2.1	+0.0 +0.0 +5.8	+0.0 +0.0 +23.9	+0.0 +1.5	+0.0	60.1	113.0	-52.9	Vert
19	917.200M	17.4	+0.4 +0.0 +2.1	+0.0 +0.0 +5.8	+0.0 +0.0 +24.0	+0.0 +1.5	+0.0	51.2	113.0	-61.8	Horiz
20	5.669M	19.7	+0.0 +0.0 +0.0	+0.1 +0.0 +0.0	+9.3 +0.0 +0.0	+0.0 +0.0	-40.0	-10.9	93.0	-103.9	Para

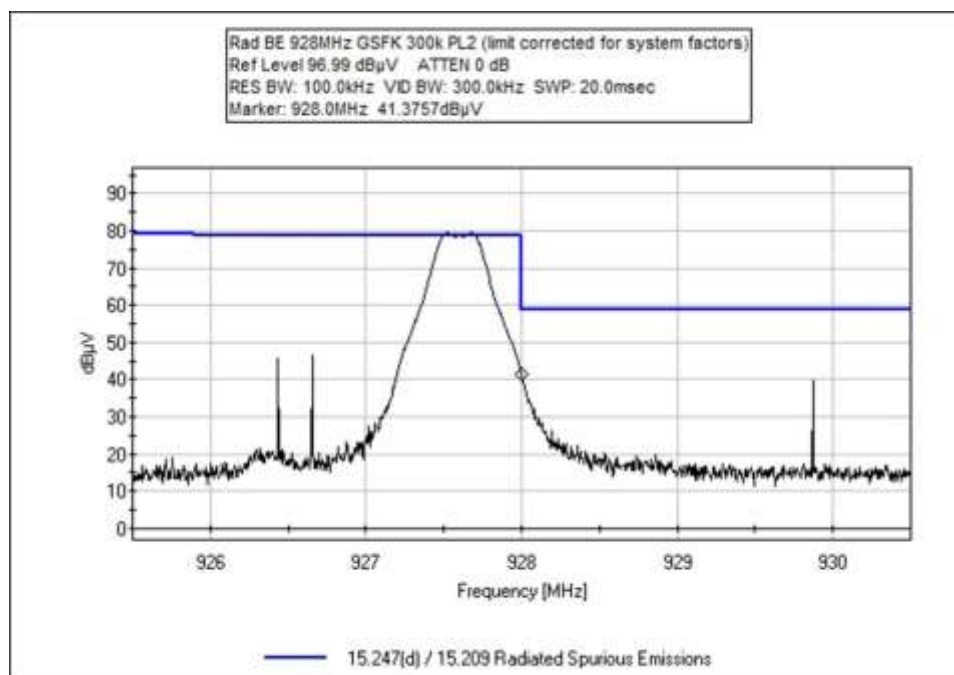
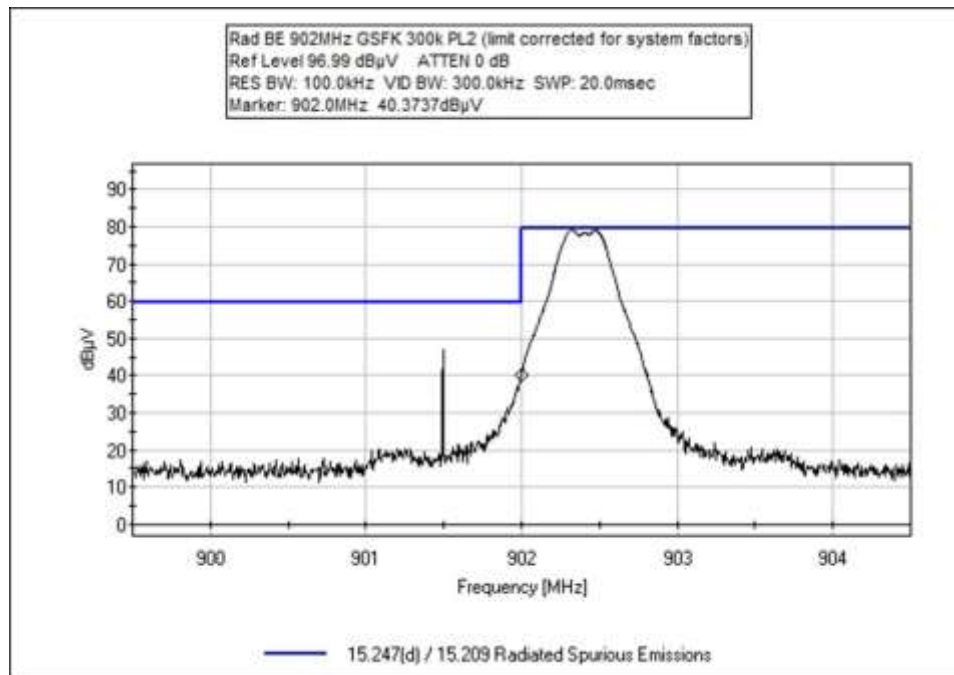
Band Edge

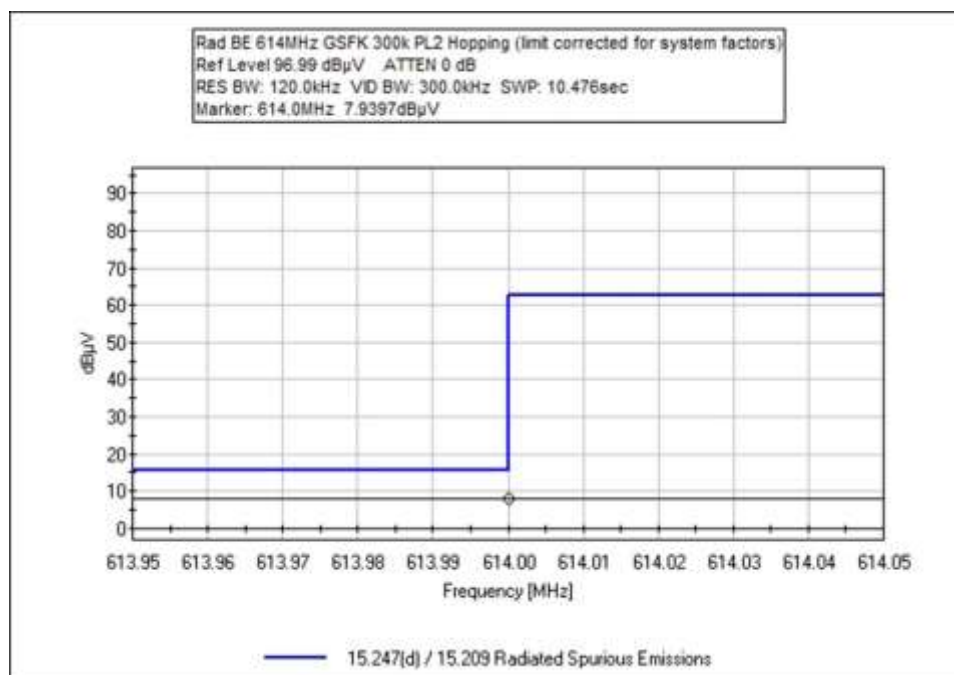
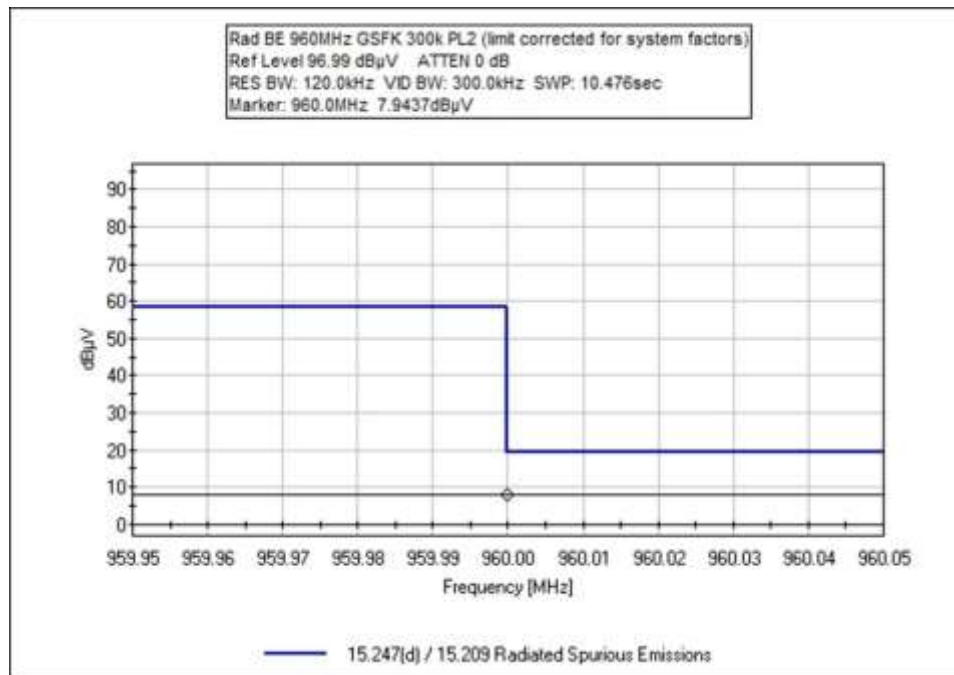
Band Edge Summary

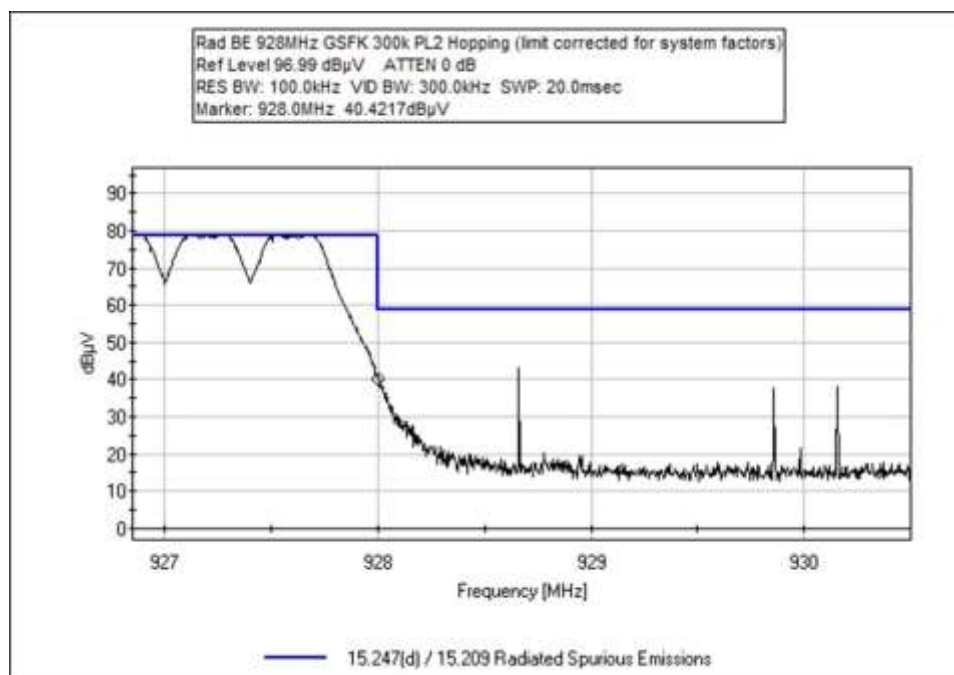
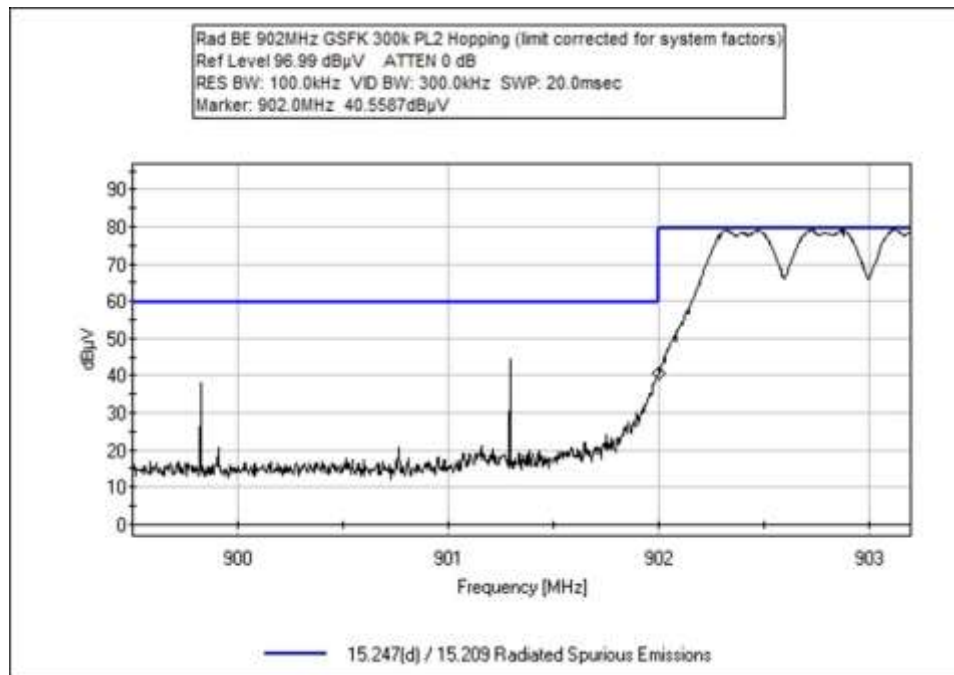
Frequency (MHz)	Modulation	Ant. Type	Field Strength (dBuV/m @3m)	Limit (dBuV/m @3m)	Results
614	GFSK 300kbps PL2	Trace	38.0	<46	Pass
902			73.8	<93	Pass
928			75.5	<93	Pass
960			42.4	<54	Pass
614	GFSK 300kbps PL2 - Hopping	Trace	38.1	<46	Pass
902			74.0	<93	Pass
928			74.5	<93	Pass
960			42.5	<54	Pass

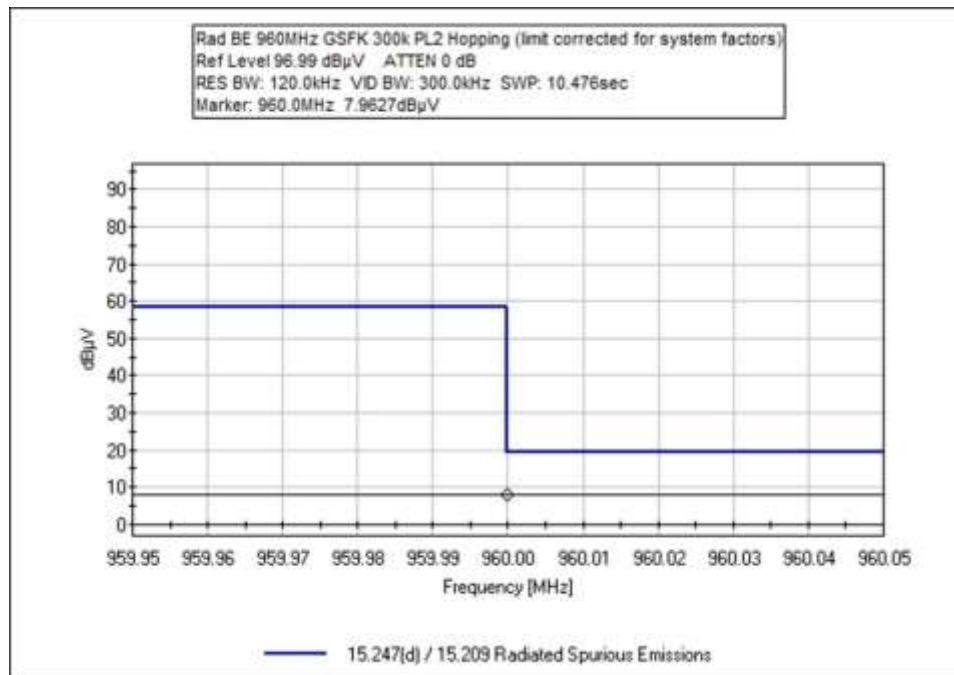
Band Edge Plots











Test Setup / Conditions / Data

Test Location: CKC Laboratories • 22116 23rd Drive SE, Suite A • Bothell, WA 98021 • 1-800-500-4EMC (4362)
 Customer: **Itron, Inc.**
 Specification: **15.247(d) / 15.209 Radiated Spurious Emissions**
 Work Order #: **105334** Date: 4/22/2021
 Test Type: **Radiated Scan** Time: 09:12:54
 Tested By: Michael Atkinson Sequence#: 6
 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:

Horizontal and Vertical polarities investigated, worst case reported.

Note:

For Hybrid GFSK 300kbps PL2 has 113dbuV/m @3m fundamental measured with 100kbps

Test Location: Bothell Lab Bench
 Test Method: ANSI C63.10 (2013)
 Temperature (°C): 22
 Relative Humidity (%): 32

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02871	Spectrum Analyzer	E4440A	3/12/2020	3/12/2022
T1	ANP06540	Cable	Heliac	8/23/2019	8/23/2021
T2	ANP05305	Cable	ETSI-50T	9/6/2019	9/6/2021
T3	ANP05360	Cable	RG214	2/3/2020	2/3/2022
T4	ANP06123	Attenuator	18N-6	4/2/2021	4/2/2023
T5	AN03628	Biconilog Antenna	3142E	6/11/2019	6/11/2021

Measurement Data:

Reading listed by margin.

Test Distance: 3 Meters

#	Freq	Rdng	T1 T5	T2	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dB μ V	dB	dB	dB	dB	Table	dB μ V/m	dB μ V/m	dB	Ant
1	614.000M QP	7.9	+0.3 +21.2	+1.2	+1.7	+5.8	+0.0	38.1	46.0 GFSK 300k PL2 hop	-7.9	Vert
2	614.000M QP	7.8	+0.3 +21.2	+1.2	+1.7	+5.8	+0.0	38.0	46.0 GFSK 300k PL2	-8.0	Vert
3	960.000M QP	8.0	+0.4 +24.6	+1.5	+2.2	+5.8	+0.0	42.5	54.0 GFSK 300k PL2 hop	-11.5	Vert
4	960.000M QP	7.9	+0.4 +24.6	+1.5	+2.2	+5.8	+0.0	42.4	54.0 GFSK 300k PL2	-11.6	Vert
5	928.000M	41.4	+0.4 +24.2	+1.5	+2.2	+5.8	+0.0	75.5	93.0 GFSK 300k PL2	-17.5	Vert
6	928.000M	40.4	+0.4 +24.2	+1.5	+2.2	+5.8	+0.0	74.5	93.0 GFSK 300k PL2 hop	-18.5	Vert
7	902.000M	40.6	+0.3 +23.8	+1.4	+2.1	+5.8	+0.0	74.0	93.0 GFSK 300k PL2 hop	-19.0	Vert
8	902.000M	40.4	+0.3 +23.8	+1.4	+2.1	+5.8	+0.0	73.8	93.0 GFSK 300k PL2	-19.2	Vert

Test Setup Photo(s)



Below 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 $\text{dB}\mu\text{V}/\text{m}$, 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.