

Itron, Inc.

TEST REPORT FOR

500GR

Model: ERG-7000-501*

*(See Appendix A for Manufacturer's Declaration)

Tested to The Following Standards:

FCC Part 15 Subpart C Section(s)

15.247

(FHSS 902-928MHz)

Report No.: 107737-4

Date of issue: March 30, 2023



Test Certificate # 803.01

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

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

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ADMINISTRATIVE INFORMATION

Test Report Information

REPORT PREPARED FOR:

Itron, Inc.
2401 N, State Street
Waseca, MN 56093

Representative: Dan Bomsta
Customer Reference Number: 271751

DATE OF EQUIPMENT RECEIPT:

DATE(S) OF TESTING:

REPORT PREPARED BY:

Lisa Bevington
CKC Laboratories, Inc.
5046 Sierra Pines Drive
Mariposa, CA 95338

Project Number: 107737

February 1, 2023

February 1, 13, 16, & 18, 2023

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

Software Versions

CKC Laboratories Proprietary Software	Version
EMITest Emissions	5.03.20

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 (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 = 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 Under Test:

Device	Manufacturer	Model #	S/N
500GR	Itron, Inc.	ERG-7000-501	112322-500GR-cond

Support Equipment:

Device	Manufacturer	Model #	S/N
Laptop	HP	14-dq1033cl	5CD941CCWS
Laptop PSU	HP	TPN-CA14	WHGRE0AVKCR55T
Adapter Board	Itron, Inc.	None	None

Configuration 2

Equipment Under Test:

Device	Manufacturer	Model #	S/N
500GR	Itron, Inc.	ERG-7000-501	112922-500GR-rad

Support Equipment:

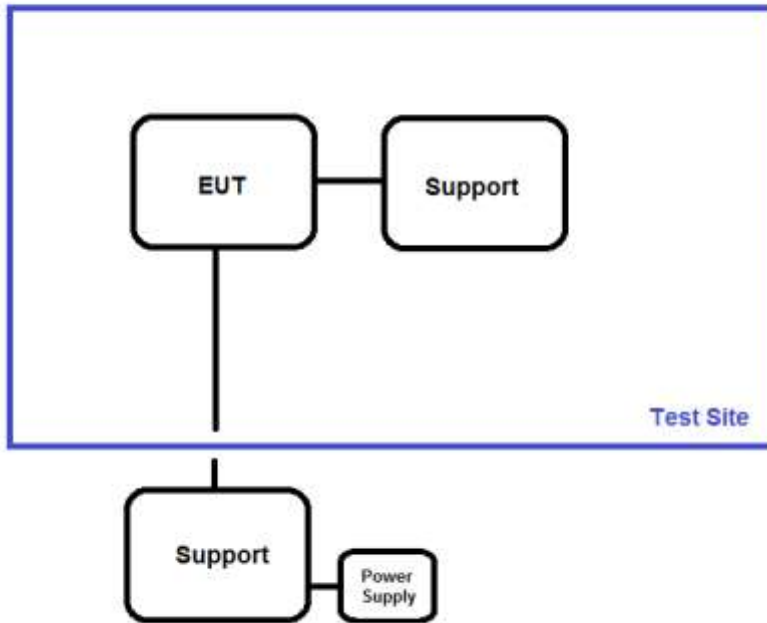
Device	Manufacturer	Model #	S/N
Laptop	HP	14-dq1033cl	5CD941CCWS
Laptop PSU	HP	TPN-CA14	WHGRE0AVKCR55T
Adapter Board	Itron, Inc.	None	None

General Product Information:

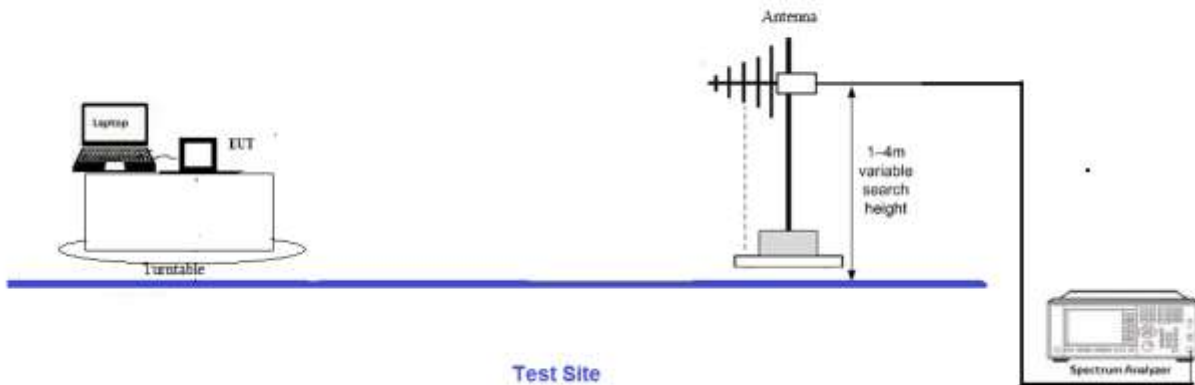
Product Information	Manufacturer-Provided Details
Equipment Type:	Stand-Alone Equipment
Type of Wideband System:	FHSS
Operating Frequency Range:	902.4-927.6
Number of Hopping Channels:	64
Receiver Bandwidth and Synchronization:	The manufacturer declares the receiver input bandwidth matches the transmit channel bandwidth and shifts frequencies in synchronization with the transmitter.
Modulation Type(s):	GFSK 150kbps
Maximum Duty Cycle:	Tested at 100%
Number of TX Chains:	1
Antenna Type(s) and Gain:	Meander / 2.7 dBi
Beamforming Type:	NA
Antenna Connection Type:	Integral (External connector provided to facilitate testing)
Nominal Input Voltage:	Battery (6VDC)
Firmware / Software used for Test:	CLI Tool App Version: 8.0.2.0, CSL Version 9.1.5.0 Hardware Rev. 5
The validity of results is dependent on the stated product details, the accuracy of which the manufacturer assumes full responsibility.	

Block Diagram of Test Setup(s)

Test Setup Block Diagram



Radiated test setup



FCC Part 15 Subpart C

15.247(a) Transmitter Characteristics

Test Setup/Conditions			
Test Location:	Bothell Lab C3	Test Engineer:	M. Harrison
Test Method:	ANSI C63.10 (2013)	Test Date(s):	2/13/2023
Configuration:	1		
Test Setup:	EUT is setup for conducted measurements. It is directly connected to the analyzer via cable and attenuator.		

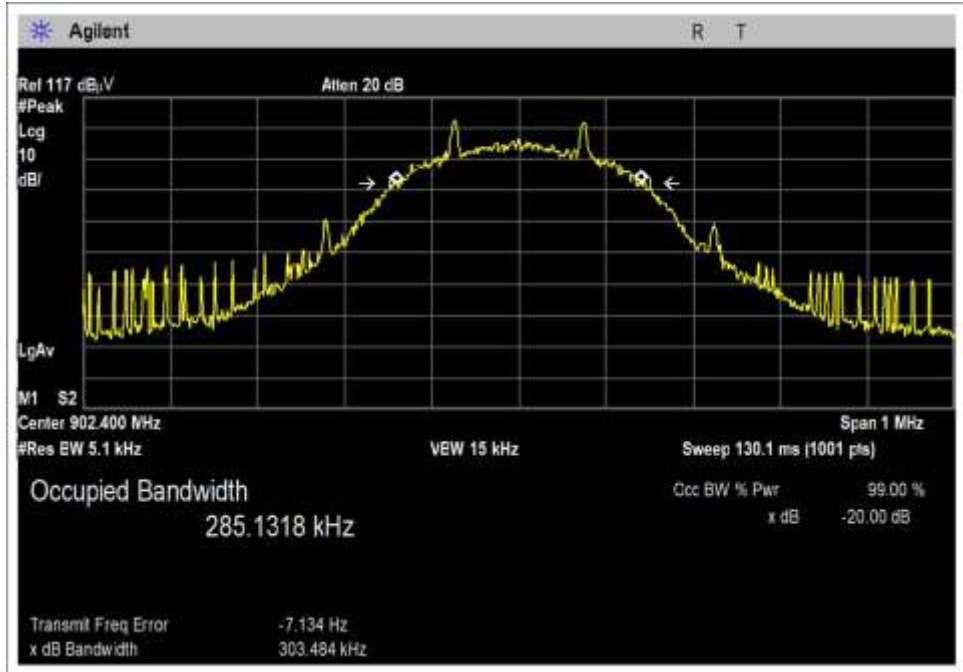
Environmental Conditions			
Temperature (°C)	20	Relative Humidity (%):	42

Test Equipment					
Asset#	Description	Manufacturer	Model	Cal Date	Cal Due
P05503	Attenuator	Narda	766-10	6/8/2021	6/8/2023
P05353	Cable	Andrews	Heliac	2/23/2022	2/23/2024
03807	Spectrum Analyzer	Agilent	E4440A	10/6/2022	10/6/2024

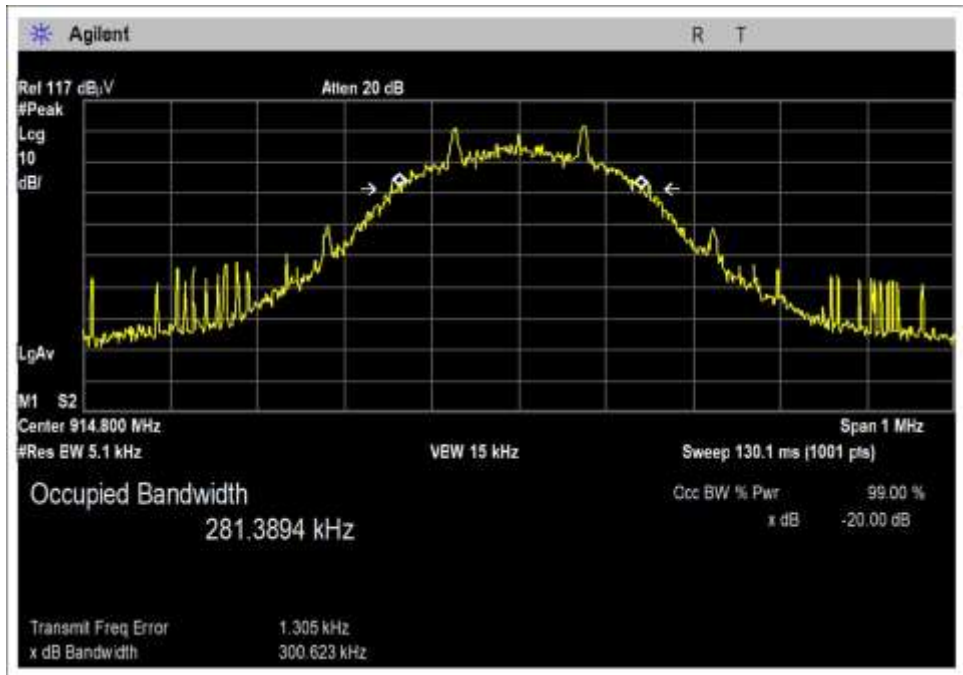
15.247(a)(1)(i) 20 dB Bandwidth

Test Data Summary					
Frequency (MHz)	Antenna Port	Modulation	Measured (kHz)	Limit (kHz)	Results
902.4	1	GFSK	303.5	≤500	Pass
914.8	1	GFSK	300.6	≤500	Pass
927.6	1	GFSK	306.9	≤500	Pass

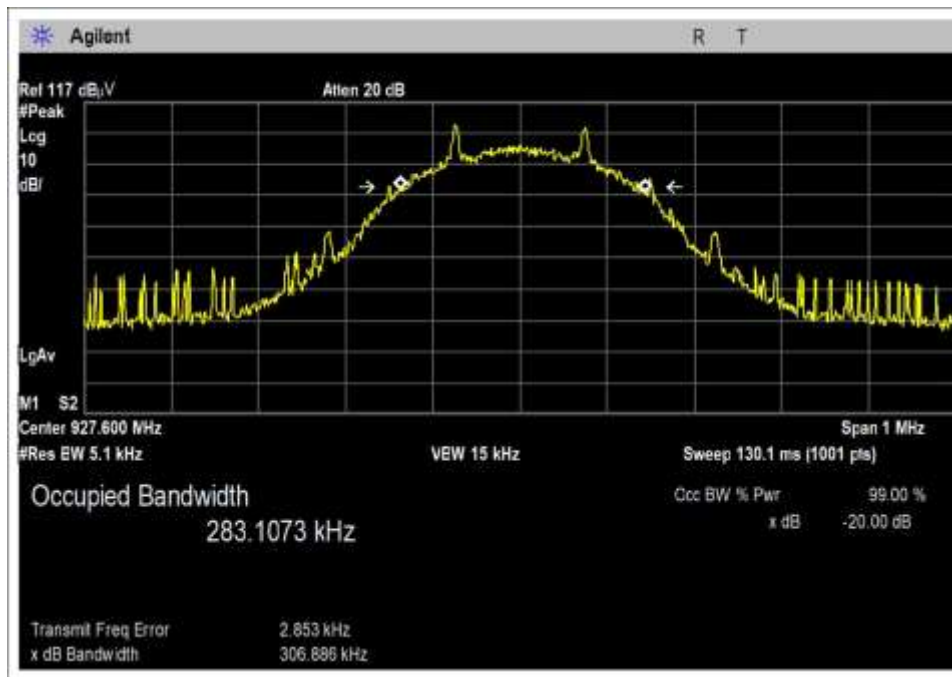
Plot(s)



Low Channel



Middle Channel

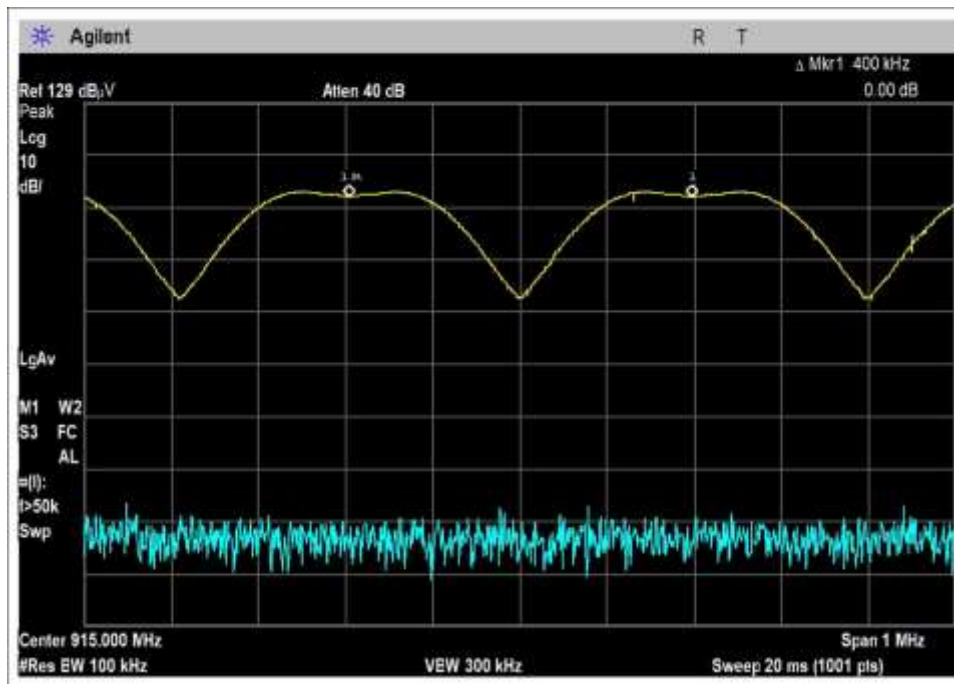


High Channel

15.247(a)(1) Carrier Separation

Test Data Summary				
Limit applied: 20dB bandwidth of the hopping channel.				
Antenna Port	Operationa Mode	Measured (kHz)	Limit (kHz)	Results
1	Hopping	400	>306.9	Pass

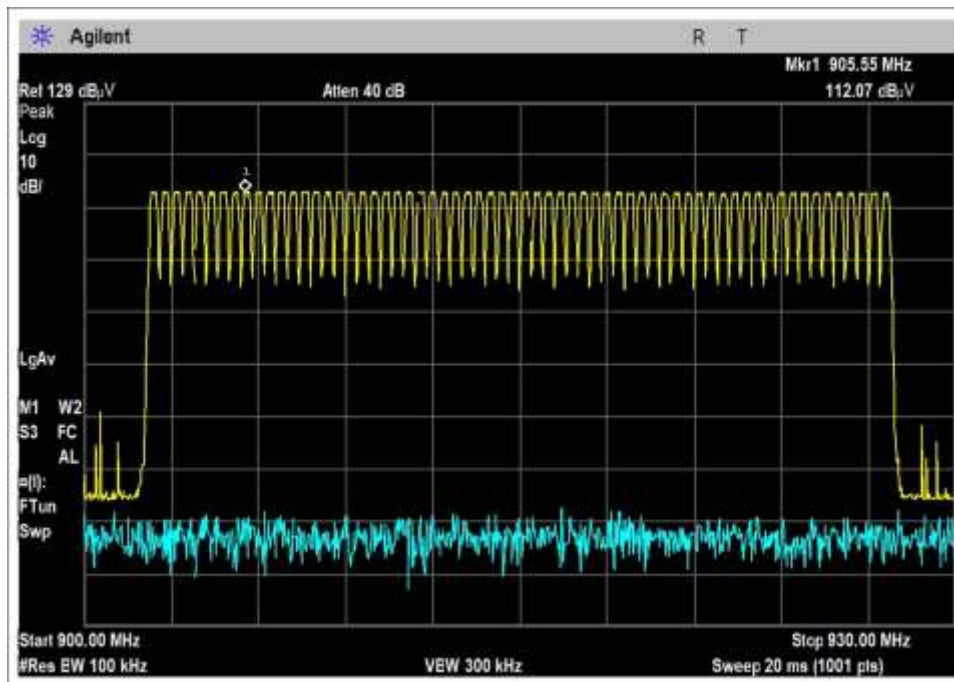
Plot(s)



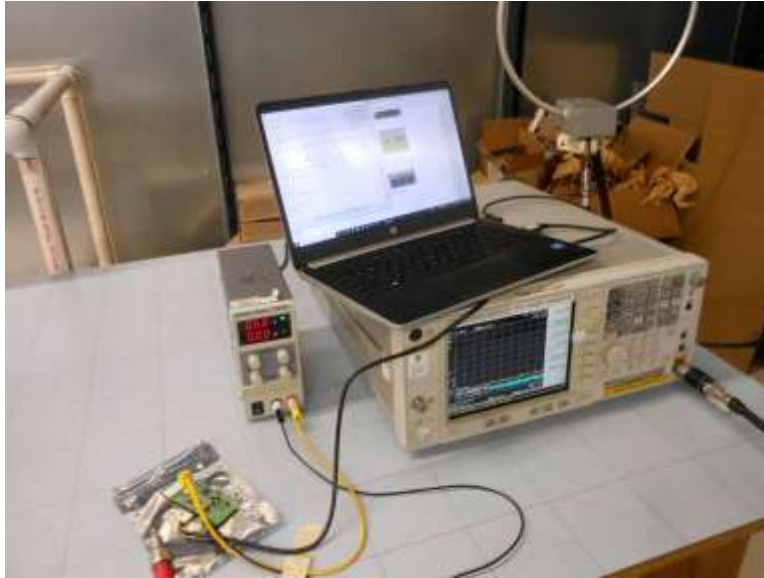
15.247(a)(1)(i) Number of Hopping Channels

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

Plot(s)



Test Setup Photo(s)



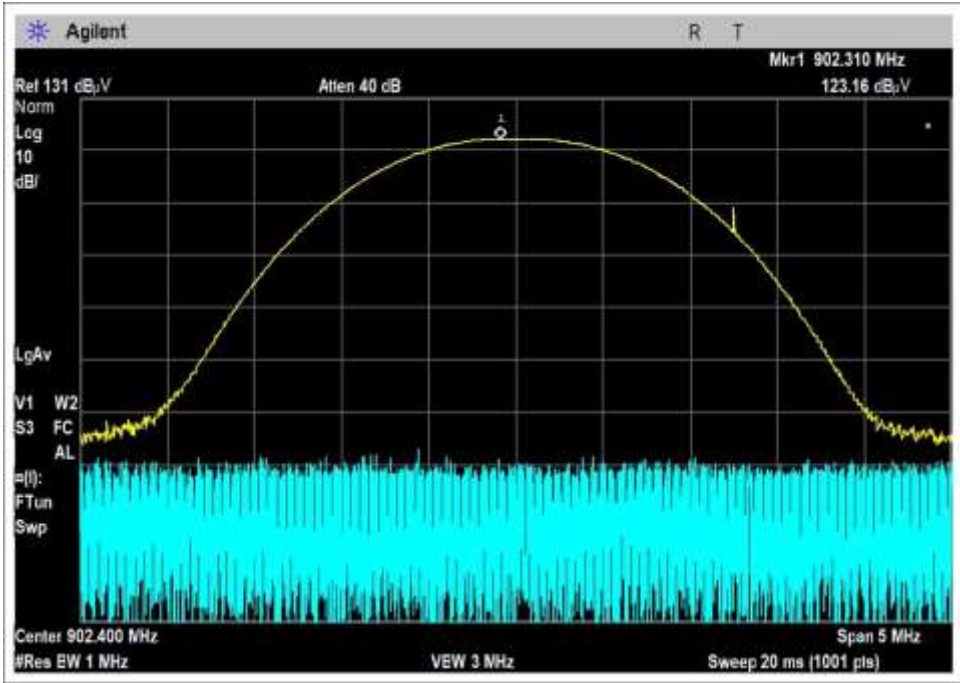
15.247(b)(2) Output Power

Test Data Summary - RF Conducted Measurement

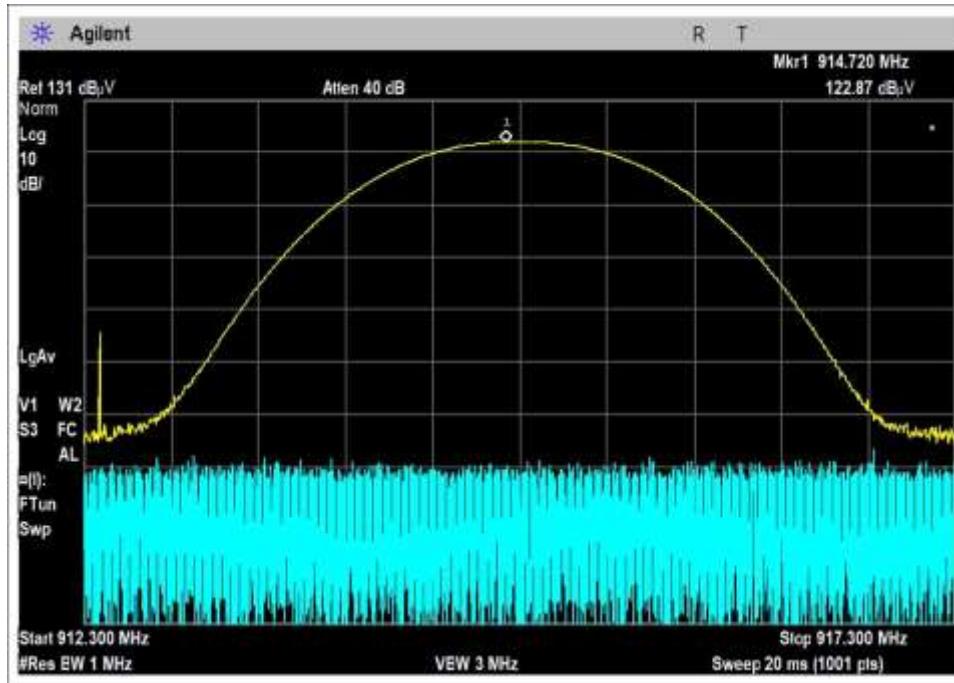
Limit = $\begin{cases} 30\text{dBm Conducted}/36\text{dBm EIRP} & | \geq 50 \text{ Channels} \\ 24\text{dBm Conducted}/30\text{dBm EIRP} & | < 50 \text{ Channels (min 25)} \end{cases}$

Frequency (MHz)	Modulation	Ant. Type / Gain (dBi)	Measured (dBm)	Limit (dBm)	Results
902.4	GFSK	Meander / 2.7	26.5	≤30	Pass
914.8	GFSK	Meander / 2.7	26.2	≤30	Pass
927.6	GFSK	Meander / 2.7	26.2	≤30	Pass

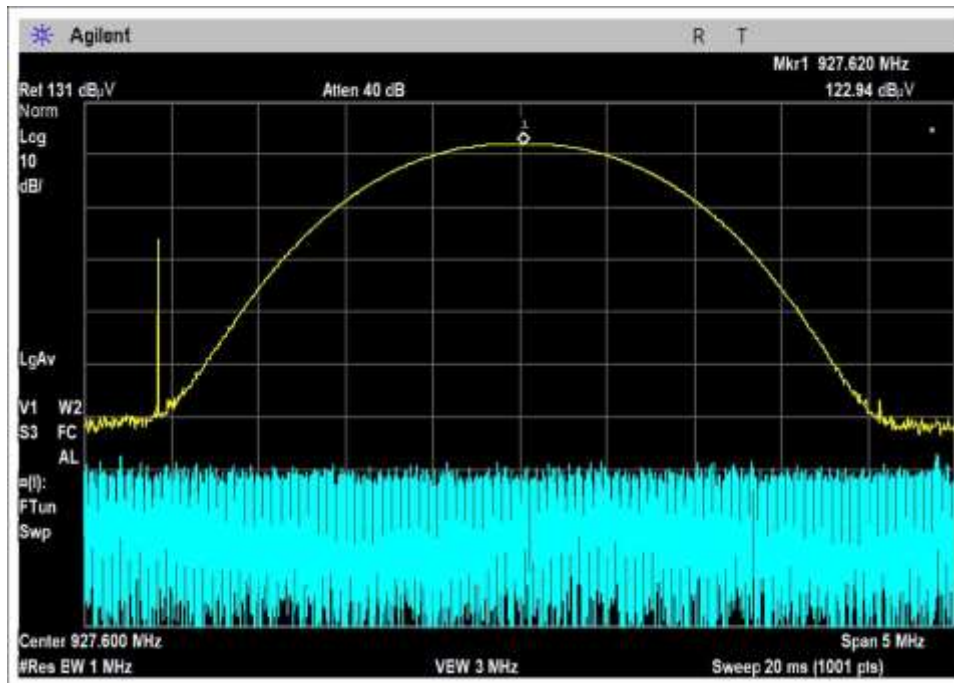
Plots



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 #: **107737** Date: 2/13/2023
 Test Type: **Conducted Emissions** Time: 13:13:17
 Tested By: Matt Harrison Sequence#: 25
 Software: EMITest 5.03.20 6VDC

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

Test Environment Conditions:
 Temperature: 18.6°C
 Pressure: 100.9 kPa
 Humidity: 40%

 Frequency Range: Fundamental
 Frequency tested: 902.4, 914.8, 927.6
 Firmware power setting: Level 3
 EUT Firmware:
 Protocol /MCS/Modulation: GFSK 150kbps

 Test Method: ANSI C63.10: 2013
 Test Mode: Transmitting
 Test Setup: EUT is setup for conducted measurement. It is directly connected to the Analyzer via cable and attenuator
 Modifications Added: None

Ittron, Inc. WO#: 107737 Sequence#: 25 Date: 2/13/2023
 15.247(b) Power Output (902-928 MHz FHSS >50 Channels) Test Lead: 6VDC RF Port



— Readings
 1 - 15.247(b) Power Output (902-928 MHz FHSS >50 Channels)
 × Peak Readings
 Software Version: 5.03.20

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	ANP05503	Attenuator	766-10	6/8/2021	6/8/2023
T2	ANP05353	Cable	Heliac	2/23/2022	2/23/2024
	AN02872	Spectrum Analyzer	E4440A	11/29/2021	11/29/2023

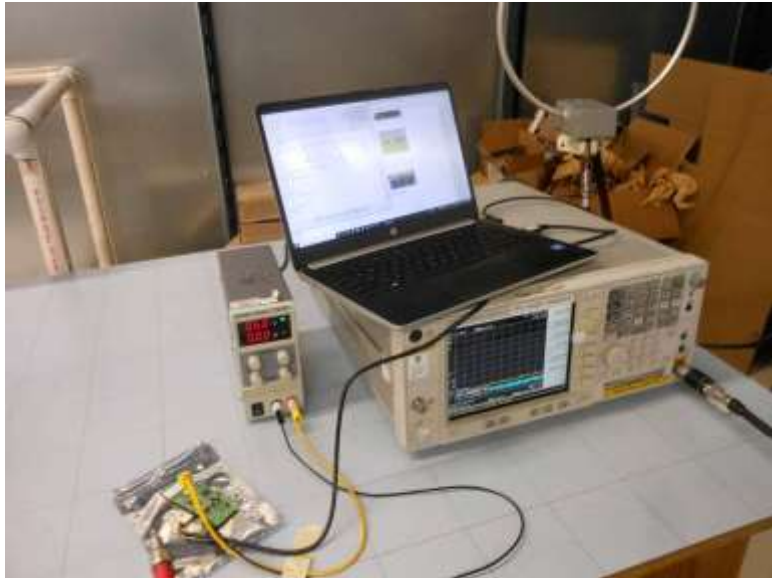
Measurement Data:

Reading listed by frequency.

Test Lead: RF Port

#	Freq MHz	Rdng dBµV	T1 dB	T2 dB	dB	dB	Dist Table	Corr dBµV	Spec dBµV	Margin dB	Polar Ant
1	902.310M	123.2	+10.1	+0.2			+0.0	133.5	137.0	-3.5	RF Po
2	914.720M	122.9	+10.1	+0.2			+0.0	133.2	137.0	-3.8	RF Po
3	927.620M	122.9	+10.1	+0.2			+0.0	133.2	137.0	-3.8	RF Po

Test Setup Photo(s)



15.247(d) RF Conducted Emissions

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) Conducted Spurious Emissions**
 Work Order #: **107737** Date: 2/13/2023
 Test Type: **Conducted Emissions** Time: 14:04:46
 Tested By: Matt Harrison Sequence#: 29
 Software: EMITest 5.03.20 6VDC

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

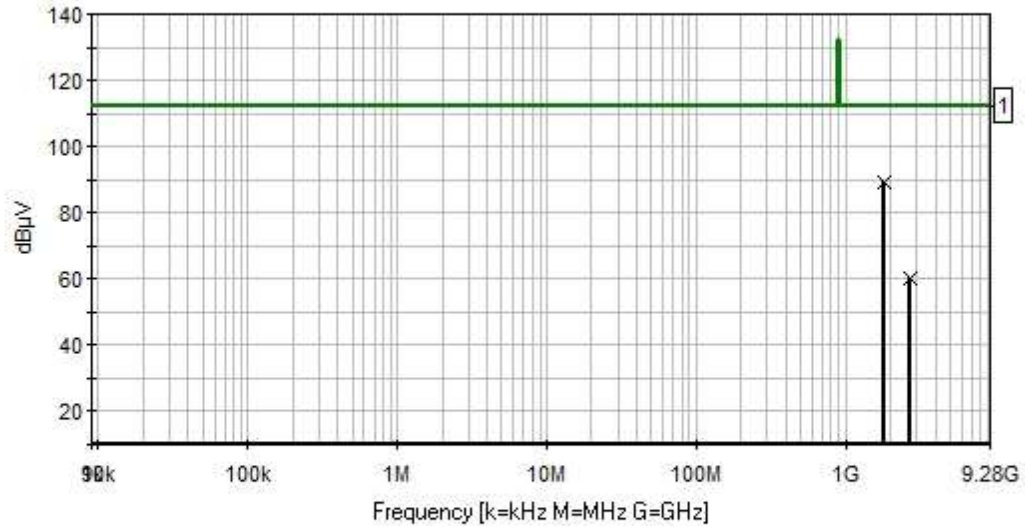
Test Conditions / Notes:

Test Environment Conditions:
 Temperature: 18.6°C
 Pressure: 100.9 kPa
 Humidity: 40%

Frequency Range: 30M-10GHz
 Frequency tested: 914.8 (Low, Middle, and High channels were investigated, and worst case is represented)
 Firmware power setting: Level 3
 EUT Firmware:
 Protocol /MCS/Modulation: GFSK, 150kbps

Test Method: ANSI C63.10: 2013
 Test Mode: Transmitting
 Test Setup: EUT is setup for conducted measurement. It is directly connected to the Analyzer via cable and attenuator
 Modifications Added: None

Iron, Inc. WO#: 107737 Sequence#: 29 Date: 2/13/2023
 15.247(d) Conducted Spurious Emissions Test Lead: 6VDC RF Port



— Readings
 — 1 - 15.247(d) Conducted Spurious Emissions
 × Peak Readings
 Software Version: 5.03.20

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	ANP05503	Attenuator	766-10	6/8/2021	6/8/2023
T2	ANP05353	Cable	Heliac	2/23/2022	2/23/2024
	AN02872	Spectrum Analyzer	E4440A	11/29/2021	11/29/2023

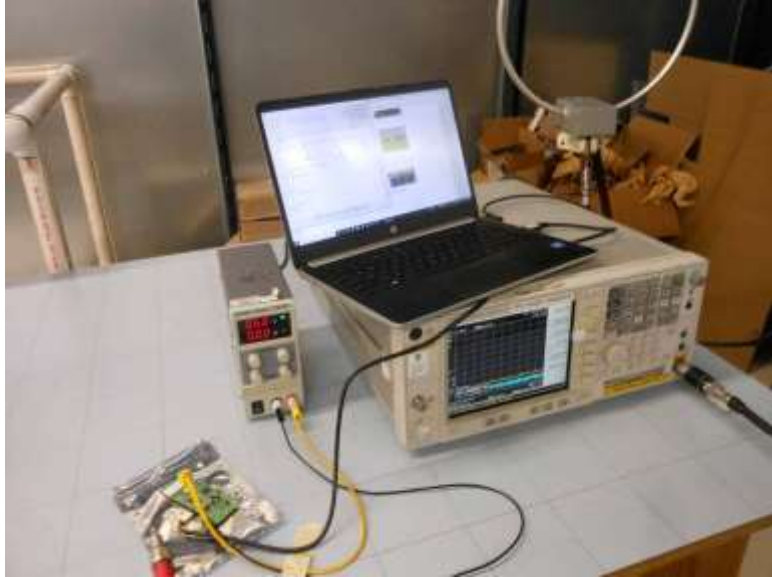
Measurement Data:

Reading listed by order taken.

Test Lead: RF Port

#	Freq MHz	Rdng dBµV	T1 dB	T2 dB	dB	dB	Dist Table	Corr dBµV	Spec dBµV	Margin dB	Polar Ant
1	1829.754M	78.7	+10.2	+0.3			+0.0	89.2	112.3	-23.1	RF Po
2	2744.602M	49.5	+10.2	+0.4			+0.0	60.1	112.3	-52.2	RF Po

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 #: **107737** Date: 2/18/2023
 Test Type: **Radiated Scan** Time: 10:11:25
 Tested By: Matt Harrison Sequence#: 37
 Software: EMITest 5.03.20

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 2			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 2			

Test Conditions / Notes:

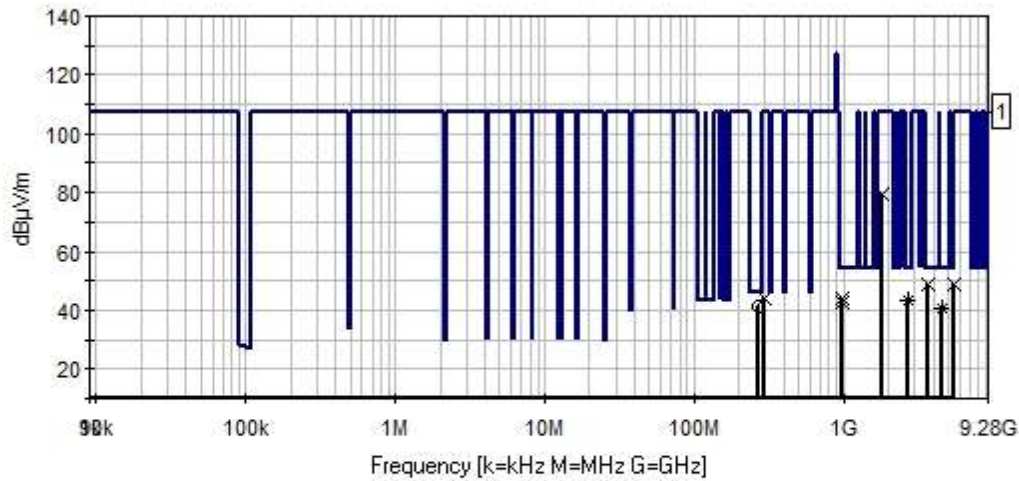
Test Environment Conditions:
 Temperature: 18.6°C
 Pressure: 100.9 kPa
 Humidity: 40%

Frequency Range: 9k-10GHz
 Frequency tested: 914.8 (Low, Middle, and High channels were investigated, and worst case is represented)
 Firmware power setting: Level 3
 EUT Firmware:
 Protocol /MCS/Modulation: GFSK 150kbps

Test Method: ANSI C63.10: 2013
 Test Mode: Transmitting
 Test Setup: EUT is setup in a tabletop configuration. It is 80cm high for below 1GHz and 150cm above 1GHz, on a Styrofoam table.
 Modifications Added: None

Notes:
 No emissions found within 20dB of the limit below 30MHz.

Iron, Inc. WO#: 107737 Sequence#: 37 Date: 2/18/2023
 15.247(d) / 15.209 Radiated Spurious Emissions Test Distance: 3 Meters Horiz



— Readings
 — 1 - 15.247(d) / 15.209 Radiated Spurious Emissions
 × Peak Readings
 ○ QP Readings
 * Average Readings
 Software Version: 5.03.20

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN03628	Biconilog Antenna	3142E	6/3/2021	6/3/2023
T2	ANP05360	Cable	RG214	2/4/2022	2/4/2024
T3	ANP06540	Cable	Heliacx	1/17/2022	1/17/2024
	AN02872	Spectrum Analyzer	E4440A	11/29/2021	11/29/2023
T4	ANP05333	Cable	Heliacx	3/14/2022	3/14/2024
T5	AN02307	Preamp	8447D	1/6/2022	1/6/2024
	AN00052	Loop Antenna	6502	5/11/2022	5/11/2024
	AN03540	Preamp	83017A	5/14/2021	5/14/2023
	AN02374ANSI	Horn Antenna	RGA-60	5/25/2021	5/25/2023
	ANP07505	Cable	CLU40-KMKM-02.00F	1/24/2023	1/24/2025
	AN03170	High Pass Filter	HM1155-11SS	9/16/2021	9/16/2023

Measurement Data: Reading listed by order taken. Test Distance: 3 Meters

#	Freq MHz	Rdng dB μ V	T1 T5 dB	T2 dB	T3 dB	T4 dB	Dist Table	Corr dB μ V/m	Spec dB μ V/m	Margin dB	Polar Ant
1	270.289M	53.9	+19.3 -27.0	+1.1	+0.2	+0.9	+0.0	48.4	46.0	+2.4	Horiz
2	270.289M QP	46.7	+19.3 -27.0	+1.1	+0.2	+0.9	+0.0	41.2	46.0	-4.8	Horiz
3	293.189M	50.3	+18.1 -27.0	+1.2	+0.2	+1.0	+0.0	43.8	107.4	-63.6	Horiz
4	979.450M	36.4	+30.2 -27.2	+2.5	+0.3	+1.6	+0.0	43.8	54.0	-10.2	Horiz
5	992.770M	35.3	+29.9 -27.1	+2.5	+0.3	+1.6	+0.0	42.5	54.0	-11.5	Horiz
6	1829.445M	77.1	+0.0 +0.0	+0.0	+0.4	+2.3	+0.0	79.8	107.4	-27.6	Horiz
7	2744.400M	53.5	+0.0 +0.0	+0.0	+0.5	+2.8	+0.0	56.8	54.0	+2.8	Horiz
8	2744.400M Ave	39.8	+0.0 +0.0	+0.0	+0.5	+2.8	+0.0	43.1	54.0	-10.9	Horiz
9	3659.250M	44.7	+0.0 +0.0	+0.0	+0.6	+3.5	+0.0	48.8	54.0	-5.2	Horiz
10	4574.000M	48.0	+0.0 +0.0	+0.0	+0.6	+4.2	+0.0	52.8	54.0	-1.2	Horiz
11	4574.000M Ave	35.9	+0.0 +0.0	+0.0	+0.6	+4.2	+0.0	40.7	54.0	-13.3	Horiz
12	5489.110M	43.9	+0.0 +0.0	+0.0	+0.8	+4.1	+0.0	48.8	107.4	-58.6	Horiz

Band Edge

Band Edge Summary

Operating Mode: Single Channel (Low and High)

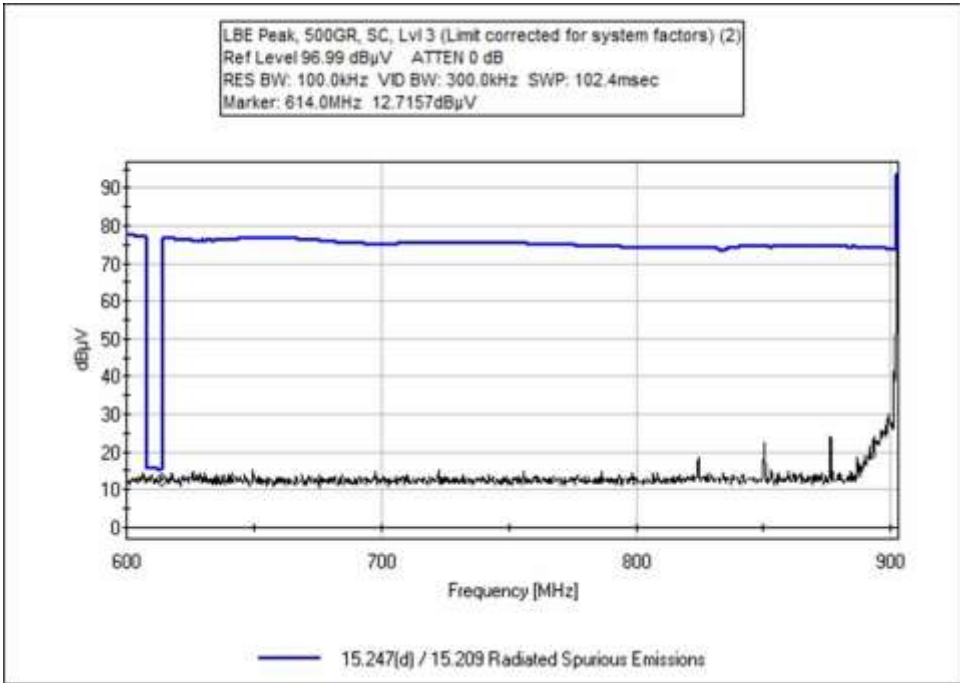
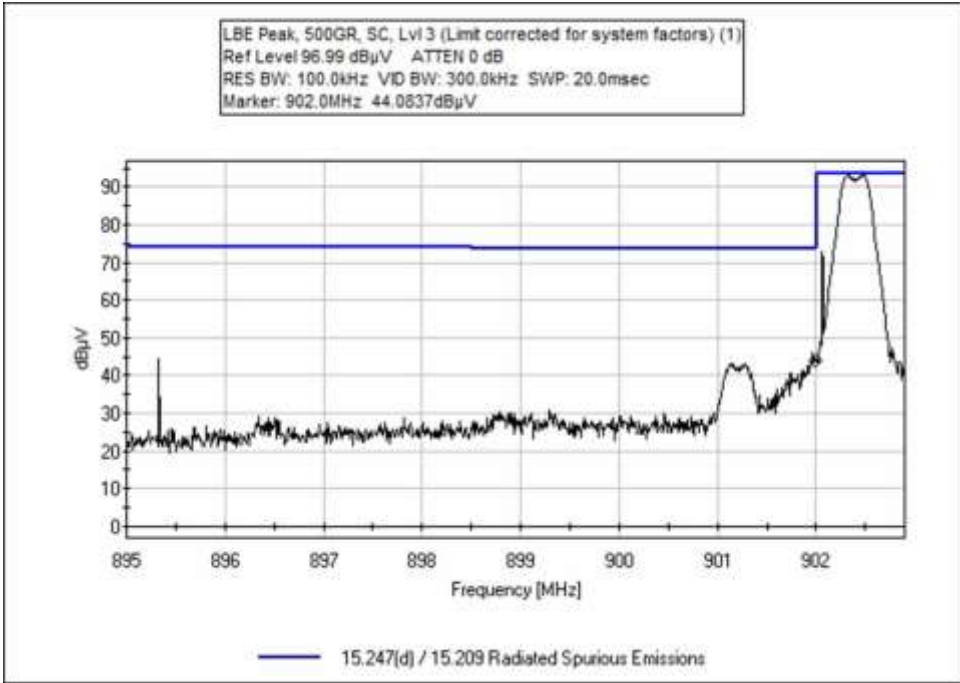
Frequency (MHz)	Modulation	Ant. Type	Field Strength (dBuV/m @3m)	Limit (dBuV/m @3m)	Results
614	GFSK	Meander	39.9	<46	Pass
902	GFSK	Meander	77.8	<107.4	Pass
928	GFSK	Meander	83.0	<107.4	Pass
960	GFSK	Meander	47.0	<54	Pass

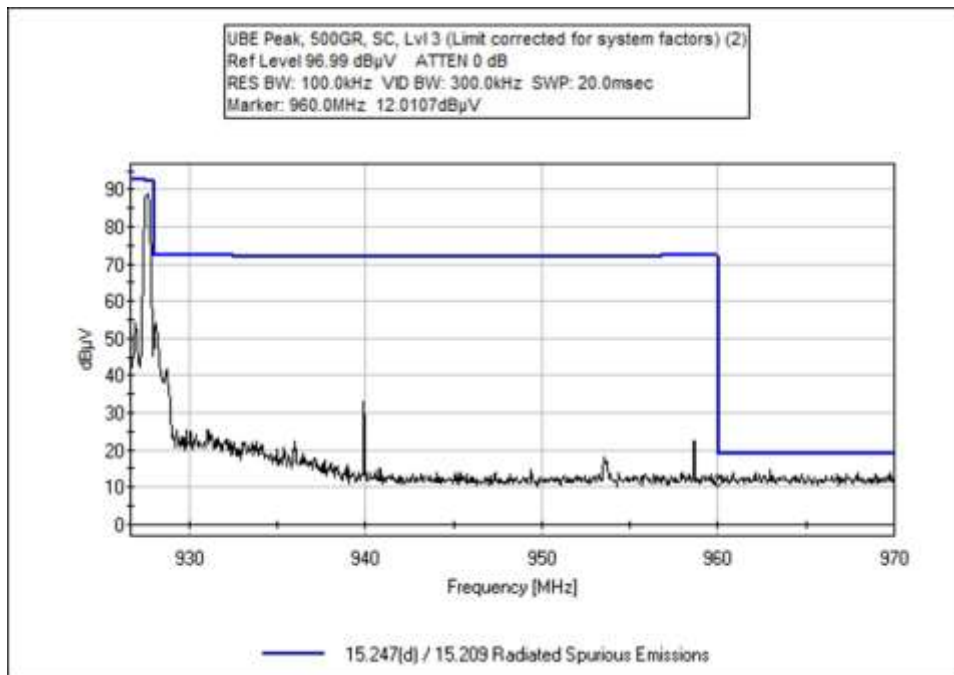
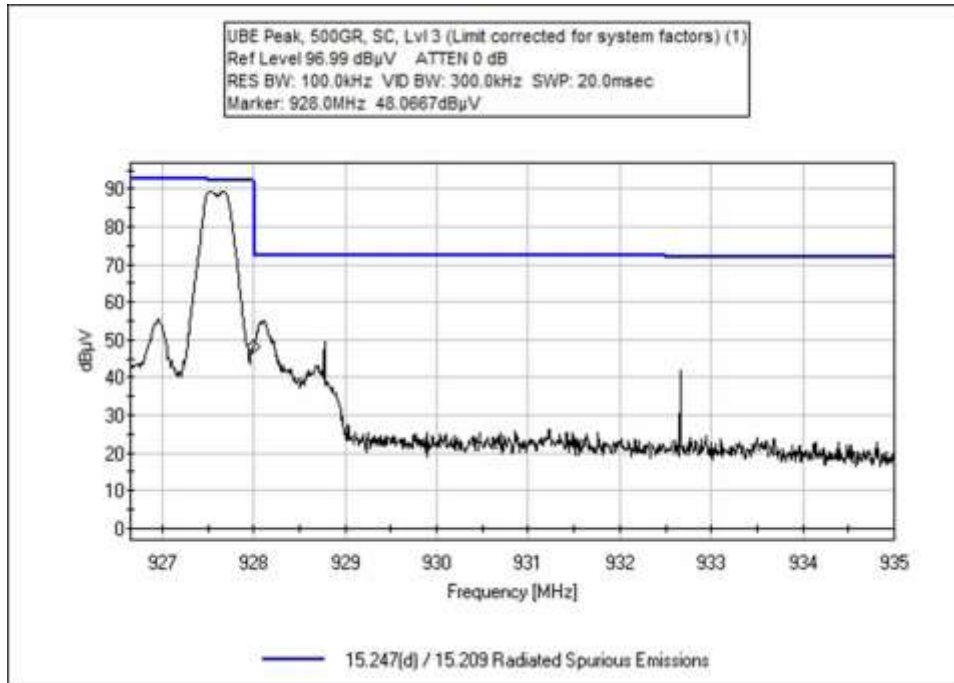
Band Edge Summary

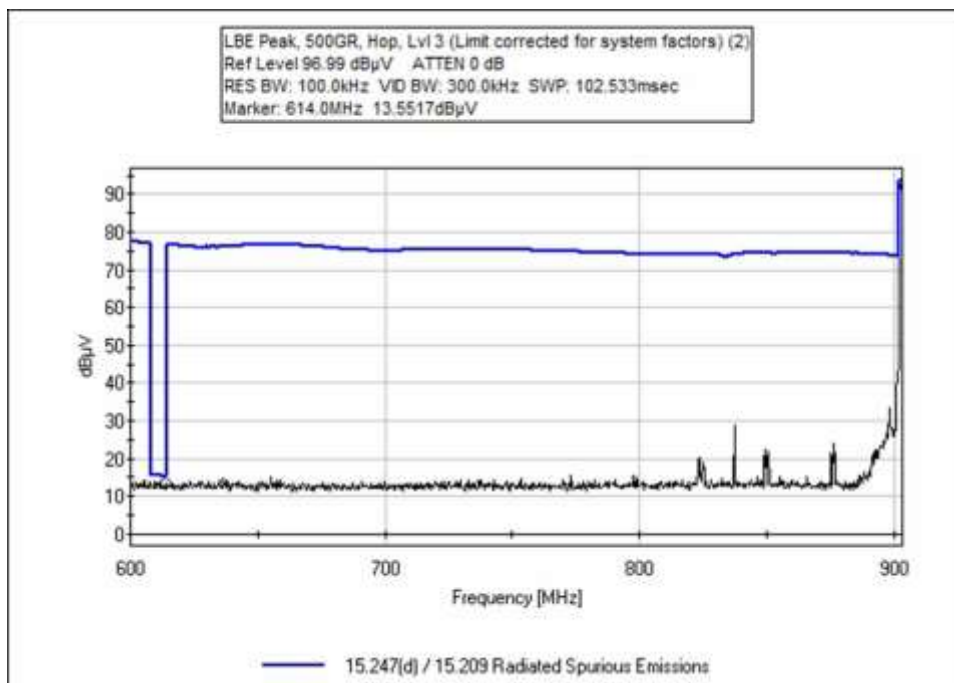
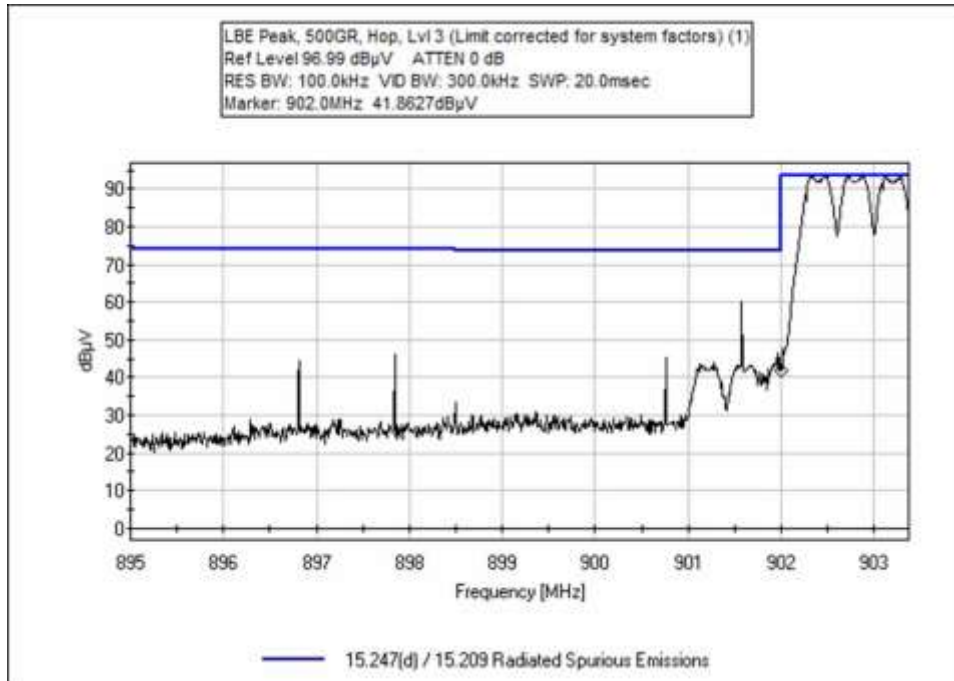
Operating Mode: Hopping

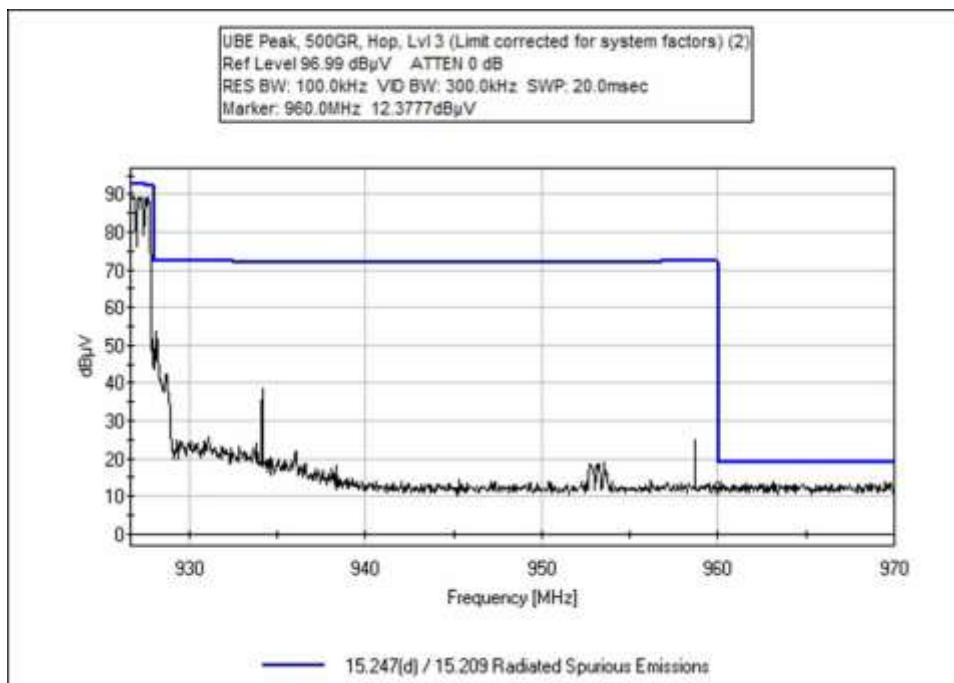
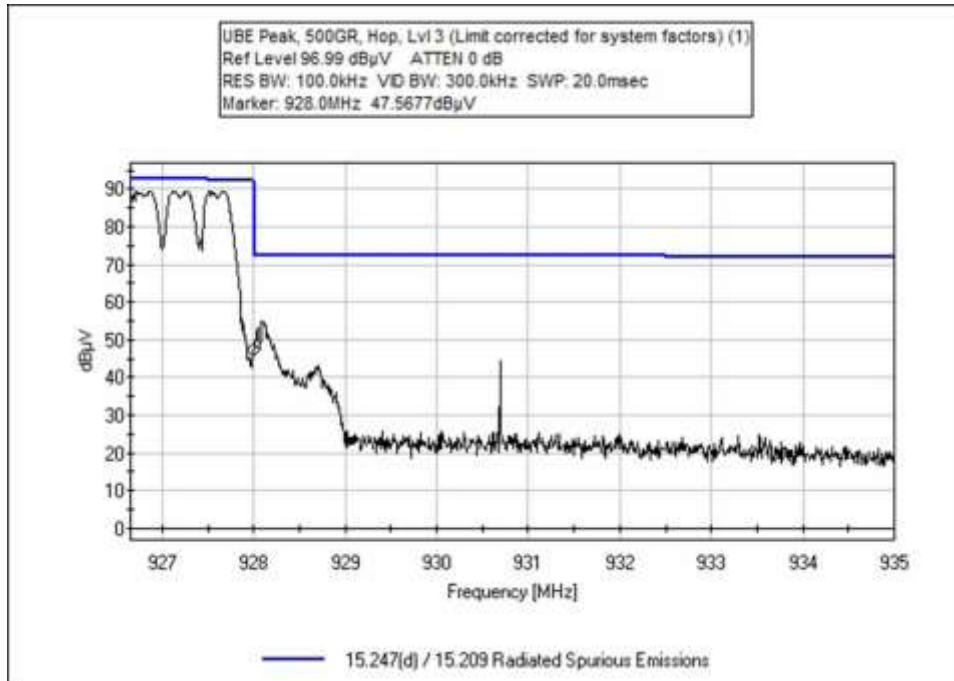
Frequency (MHz)	Modulation	Ant. Type	Field Strength (dBuV/m @3m)	Limit (dBuV/m @3m)	Results
614	GFSK	Meander	39.9	<46	Pass
902	GFSK	Meander	75.6	<107.4	Pass
928	GFSK	Meander	82.5	<107.4	Pass
960	GFSK	Meander	47.4	<54	Pass

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 #: **107737** Date: 2/10/2023
 Test Type: **Radiated Scan** Time: 10:36:39
 Tested By: Matt Harrison Sequence#: 13
 Software: EMITest 5.03.20

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 2			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 2			

Test Conditions / Notes:

Test Environment Conditions:
 Temperature: 18.6°C
 Pressure: 100.9 kPa
 Humidity: 40%

Frequency Range: 600-970 MHz
 Frequency tested: 902.4, 927.6
 Firmware power setting: Level 3
 EUT Firmware:
 Protocol /MCS/Modulation: GFSK 150kbps

Test Method: ANSI C63.10: 2013
 Test Mode: Transmitting
 Test Setup: EUT is setup in a tabletop configuration. It is 80cm high on a Styrofoam table.
 Modifications Added: None

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN03628	Biconilog Antenna	3142E	6/3/2021	6/3/2023
T2	ANP05360	Cable	RG214	2/4/2022	2/4/2024
T3	ANP06540	Cable	Heliac	1/17/2022	1/17/2024
T4	AN02872	Spectrum Analyzer	E4440A	11/29/2021	11/29/2023
T5	ANP05333	Cable	Heliac	3/14/2022	3/14/2024

Measurement Data: Reading listed by order taken. Test Distance: 3 Meters

#	Freq	Rdng	T1	T2	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dB μ V	T5				Table	dB μ V/m	dB μ V/m	dB	Ant
1	902.000M	44.1	+29.6 +1.5	+2.3	+0.3	+0.0	+0.0	77.8	107.4 SC	-29.6	Vert
2	614.000M	12.7	+27.2 +1.3	+1.9	+0.3	+0.0	+0.0	43.4	46.0 SC	-2.6	Vert
3	614.000M QP	9.2	+27.2 +1.3	+1.9	+0.3	+0.0	+0.0	39.9	46.0 SC	-6.1	Vert
4	902.000M	41.9	+29.6 +1.5	+2.3	+0.3	+0.0	+0.0	75.6	107.4 Hop	-31.8	Vert
5	614.000M	13.6	+27.2 +1.3	+1.9	+0.3	+0.0	+0.0	44.3	46.0 Hop	-1.7	Vert
6	614.000M QP	9.2	+27.2 +1.3	+1.9	+0.3	+0.0	+0.0	39.9	46.0 Hop	-6.1	Vert
7	928.000M	47.6	+30.6 +1.6	+2.4	+0.3	+0.0	+0.0	82.5	107.4 Hop	-24.9	Vert
8	960.000M	12.4	+30.7 +1.6	+2.4	+0.3	+0.0	+0.0	47.4	54.0 Hop	-6.6	Vert
9	928.000M	48.1	+30.6 +1.6	+2.4	+0.3	+0.0	+0.0	83.0	107.4 SC	-24.4	Vert
10	960.000M	12.0	+30.7 +1.6	+2.4	+0.3	+0.0	+0.0	47.0	54.0 SC	-7.0	Vert

Test Setup Photo(s)



Below 1GHz; 500GR



Below 1GHz, C4, View 1



Below 1GHz, C4, View 2



Above 1GHz, C4, View 1



Above 1GHz, C4, View 2

Appendix A: Manufacturer Declaration

The following Model has been tested by CKC Laboratories:

Model: ERG-7000-501

The manufacturer declares that the following additional models are identical electrically or any differences between them do not affect their EMC characteristics, and therefore meets the level of testing equivalent to the tested model.

Device	Manufacturer	Model #
500GR	Itron, Inc.	ERG-7000-502
500GR	Itron, Inc.	ERG-7000-503
500GR	Itron, Inc.	ERG-7000-505

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.