Itron, Inc.

TEST REPORT FOR

Water Endpoint
Model: RIVAWA

Tested to The Following Standards:

FCC Part 15 Subpart C Section(s)

15.247
(FHSS 902-928 MHz)

Report No.: 99218-10

Date of issue: May 9, 2017

ACCREDITED
Testing Certificates:
803.01, 803.02, 803.05, 803.06

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 EMC 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:

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2111 N. Molter Road
Liberty Lake, WA 99019

Representative: Jay Holcomb
Customer Reference Number: 108830

REPORT PREPARED BY:

Dianne Dudley
CKC Laboratories, Inc.
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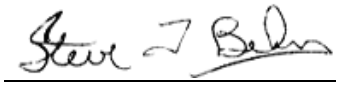
Mariposa, CA 95338

Project Number: 99218

DATE OF EQUIPMENT RECEIPT: April 25, 2017
DATE(S) OF TESTING: April 25, 2017

Report Authorization

The test data contained in this report documents the observed testing parameters pertaining to and are relevant for only the sample equipment 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	5.03.02

Site Registration & Accreditation Information

Location	CB #	TAIWAN	CANADA	FCC	JAPAN
Brea A, CA	US0060	SL2-IN-E-1146R	3082D-1	US1025	A-0147

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	NP1
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	NA2
15.207	AC Conducted Emissions	NA	NA1

NA = Not Applicable
NA1 = Not applicable because of battery operated device.
NA2 = Performed in another test report.
NP1 = Not performed because CKC was not contracted to perform the required 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
Water Endpoint	Itron, Inc.	RIVAWA	99218-cond

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:	FHSS
Operating Frequency Range:	903MHz to 926.8MHz (OOK) 902.4 to 927.6 (GFSK 150kbps) 902.2 to 927.75 (GFSK 10kpbs)
Number of Hopping Channels:	903 to 926.8 (OOK) - 120 channels. 902.4 to 927.6 (GFSK 150kbps) - 64 channels 902.2 to 927.75 (GFSK 10kpbs) - 512 channels
Modulation Type(s):	OOK and GFSK
Maximum Duty Cycle:	power level 3: 56.1mS/100mS power level 1: 12.2mS/100mS
Frequency Stability Info:	PC board antenna
Number of TX Chains:	2
Antenna Type(s) and Gain:	Integral
Beamforming Type:	NA
Antenna Connection Type:	PC board antenna
Nominal Input Voltage:	6.3Vdc Battery
Firmware / Software used for Test:	MSP 0.17.0.0, STM32 1.19.1.0

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):	4/25/2017
Configuration:	1		
Test Setup:	The equipment under test (EUT) is stand alone on the table top. The EUT is turned on and set in transmit mode. The EUT has new batteries installed. Nominal input voltage is 6.3Vdc. Freq range: 902-928 MHz Modulation: GFSK. OOK Firmware power: power level 1, 3 Firmware version: MSP 0.17.0.0, STM32 1.19.1.0 Evaluation performed at antenna port. Duty cycle: power level 3: 56.1mS/100mS, power level 1: 12.2mS/100mS Level 1: 16384bps OOK 903MHz, 910MHz, 915MHz, 926.8MHz Level 3: 10kbps GFSK 902.2MHz, 910MHz, 915MHz, 927.75MHz Level 3: 150kbps GFSK 902.4MHz, 910MHz, 915.2MHz, 927.6MHz Level 3: 16384bps OOK 903MHz, 910MHz, 915MHz, 926.8MHz Site A. Test Method: ANSI C63.10 (2013)		

Environmental Conditions			
Temperature (ºC)	23	Relative Humidity (%):	40

Test Equipment					
Asset#	**Description**	**Manufacturer**	**Model**	**Cal Date**	**Cal Due**
02672	Spectrum Analyzer	Agilent	E4446A	3/2/2017	3/2/2019
03431	Cable	Astrolab Inc.	32022-2-2909K-36TC	11/2/2015	11/2/2017
02946	Attenuator	Aeroflex/Weinschel	89-20-21	11/2/2015	11/2/2017

15.247(a)(1) 20 dB Bandwidth

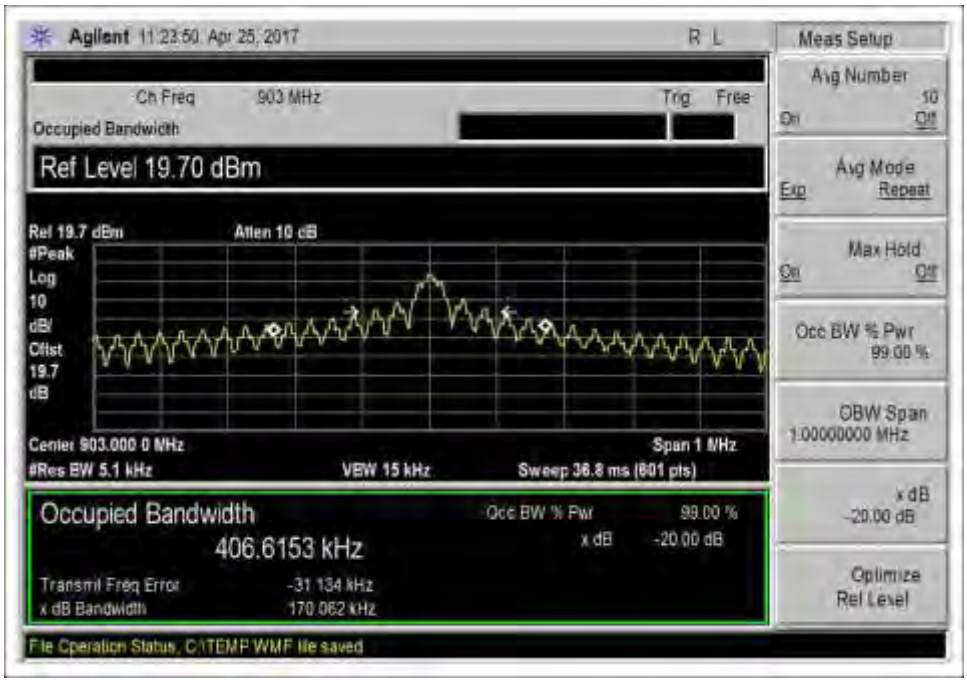
20dB Occupied Bandwidth

Test Data Summary					
Frequency (MHz)	**Antenna Port**	**Modulation**	**Measured (kHz)**	**Limit (kHz)**	**Results**
Level 1, 16384bps, OOK					
903.0	1	OOK	170.062	≤500	Pass
910.0	1	OOK	170.046	≤500	Pass
915.0	1	OOK	169.937	≤500	Pass
926.8	1	OOK	169.396		Pass
Level 3, 10kbps, GFSK					
902.2	1	GFSK	21.017	≤500	Pass
910.0	1	GFSK	20.993	≤500	Pass
915.0	1	GFSK	20.987	≤500	Pass
927.75	1	GFSK	20.962	≤500	Pass
Level 3, 150kbps, GFSK					
902.4	1	GFSK	161.431	≤500	Pass
910.0	1	GFSK	161.403	≤500	Pass
915.2	1	GFSK	161.423	≤500	Pass
927.6	1	GFSK	162.518	≤500	Pass
Level 3, 16384bps, OOK					
903.0	1	OOK	170.043	≤500	Pass
910.0	1	OOK	170.200	≤500	Pass
915.0	1	OOK	170.197	≤500	Pass
926.8	1	OOK	170.126	≤500	Pass

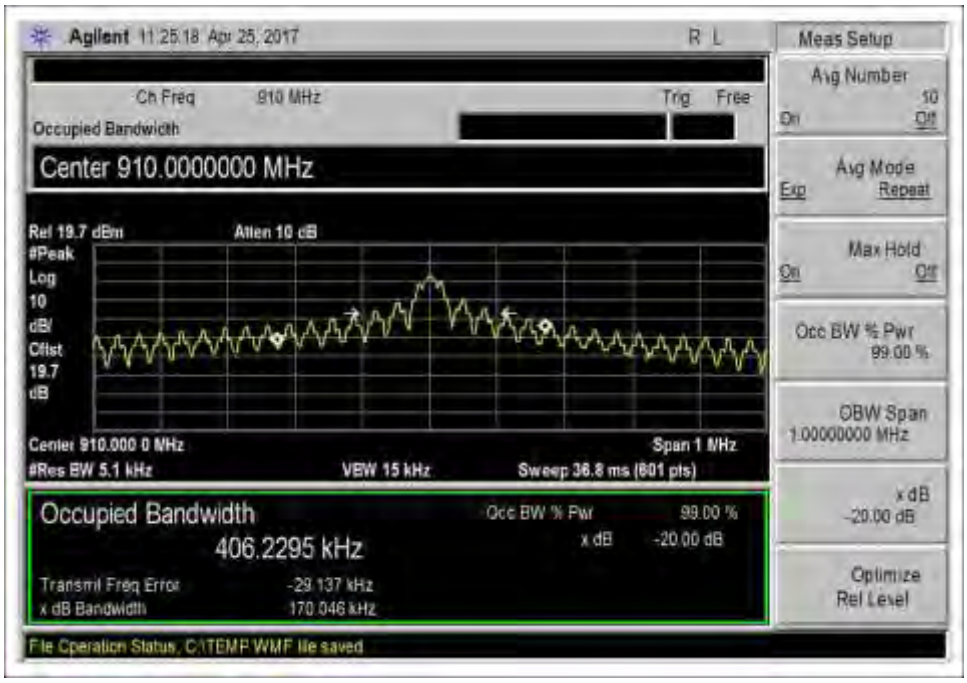
99% Occupied Bandwidth

Test Data Summary					
Frequency (MHz)	**Antenna Port**	**Modulation**	**Measured (kHz)**	**Limit (kHz)**	**Results**
Level 1, 16384bps, OOK					
903.0	1	OOK	406.6153	None	N/A
910.0	1	OOK	406.2295	None	N/A
915.0	1	OOK	409.8015	None	N/A
926.8	1	OOK	395.7981	None	N/A
Level 3, 10kbps, GFSK					
902.2	1	GFSK	19.9978	None	N/A
910.0	1	GFSK	19.9009	None	N/A
915.0	1	GFSK	19.9322	None	N/A
927.75	1	GFSK	19.9312	None	N/A
Level 3, 150kbps, GFSK					
902.4	1	GFSK	158.5491	None	N/A
910.0	1	GFSK	158.3725	None	N/A
915.2	1	GFSK	158.5283	None	N/A
927.6	1	GFSK	159.1770	None	N/A
Level 3, 16384bps, OOK					
903.0	1	OOK	383.5263	None	N/A
910.0	1	OOK	374.8367	None	N/A
915.0	1	OOK	375.1539	None	N/A
926.8	1	OOK	377.2882	None	N/A

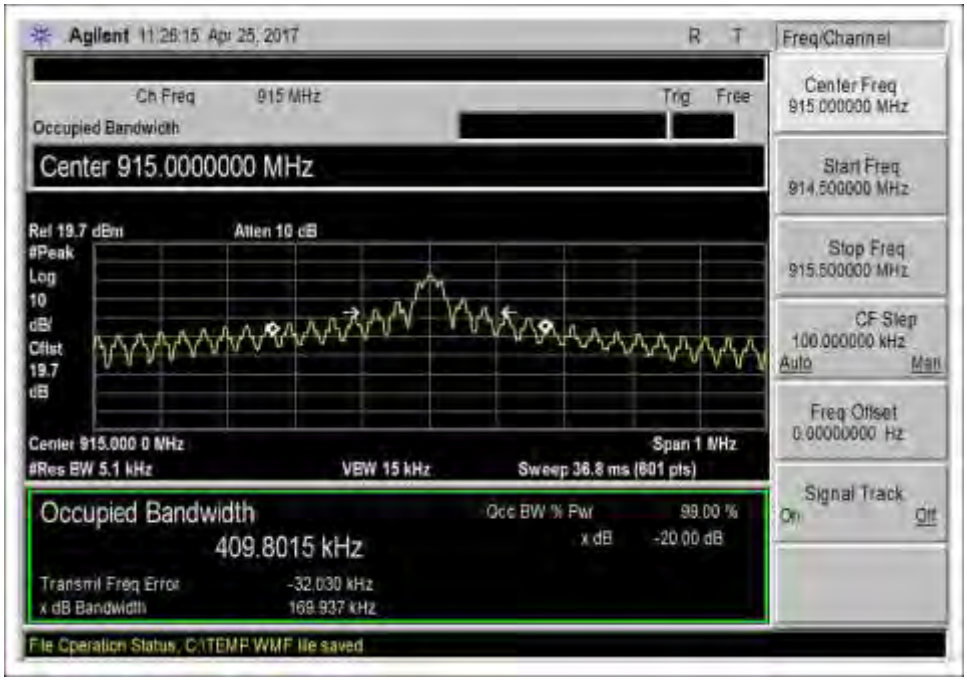
Plot(s)



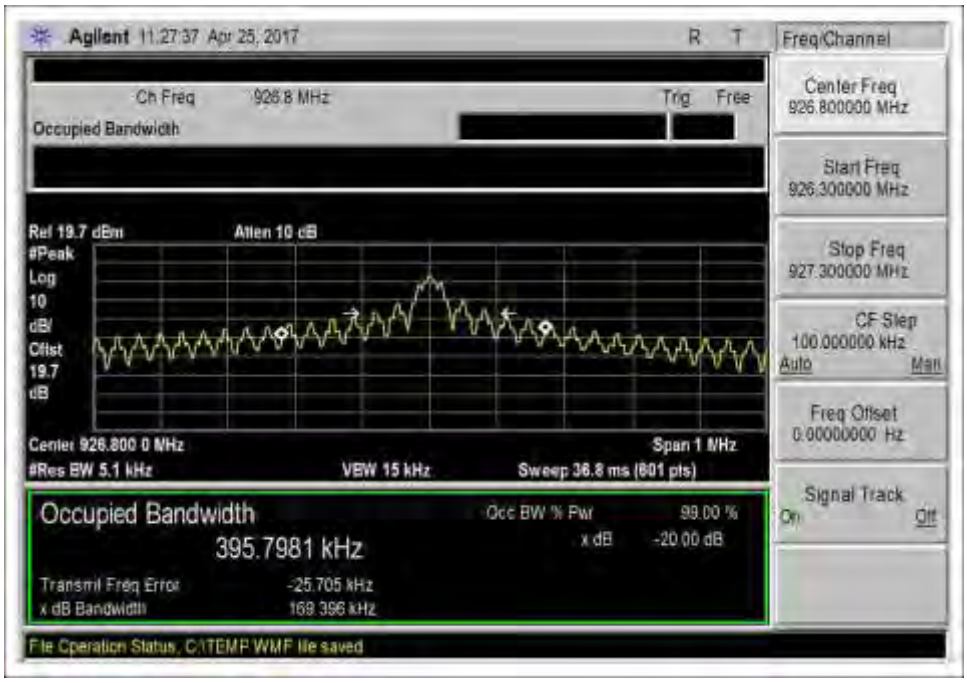
lv1 16384bps OOK 903



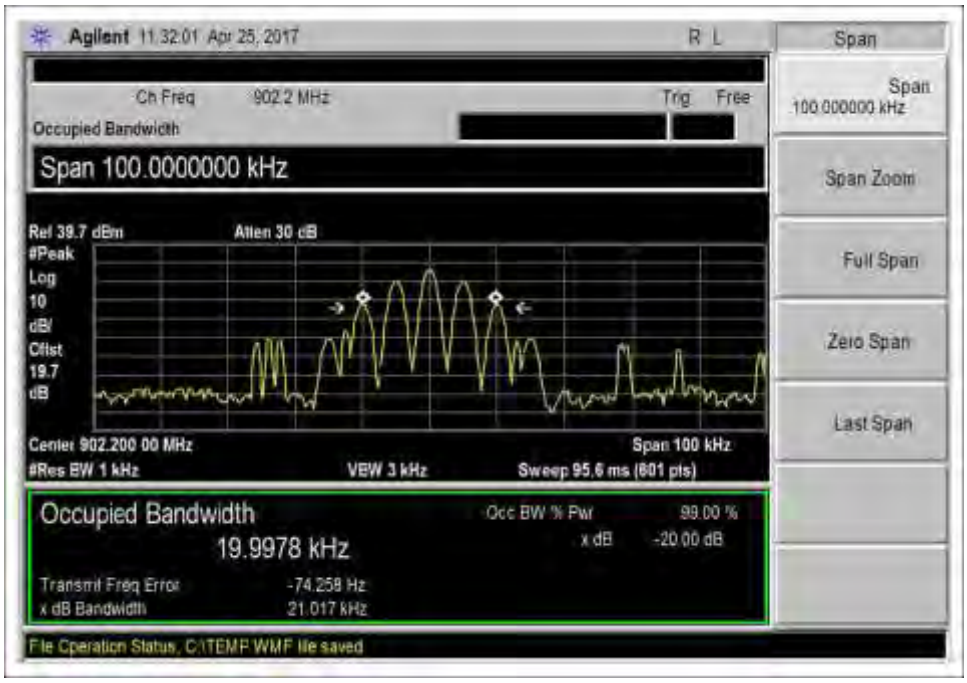
lv1 16384bps OOK 910



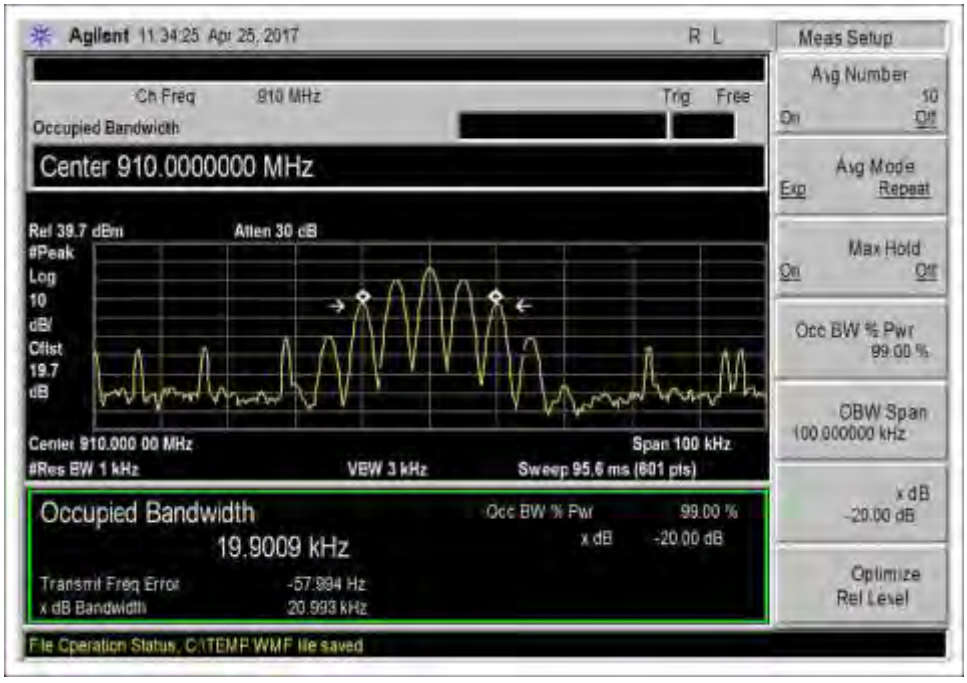
lv1 16384bps OOK 915



lv1 16384bps OOK 926.8



lv3 10kbps GFSK 902.2



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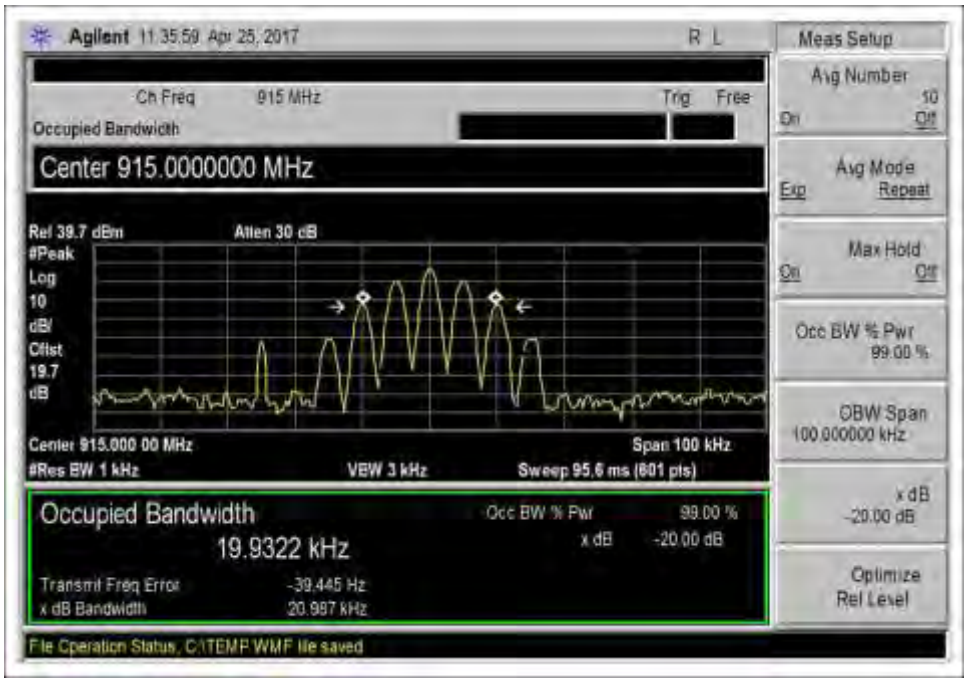
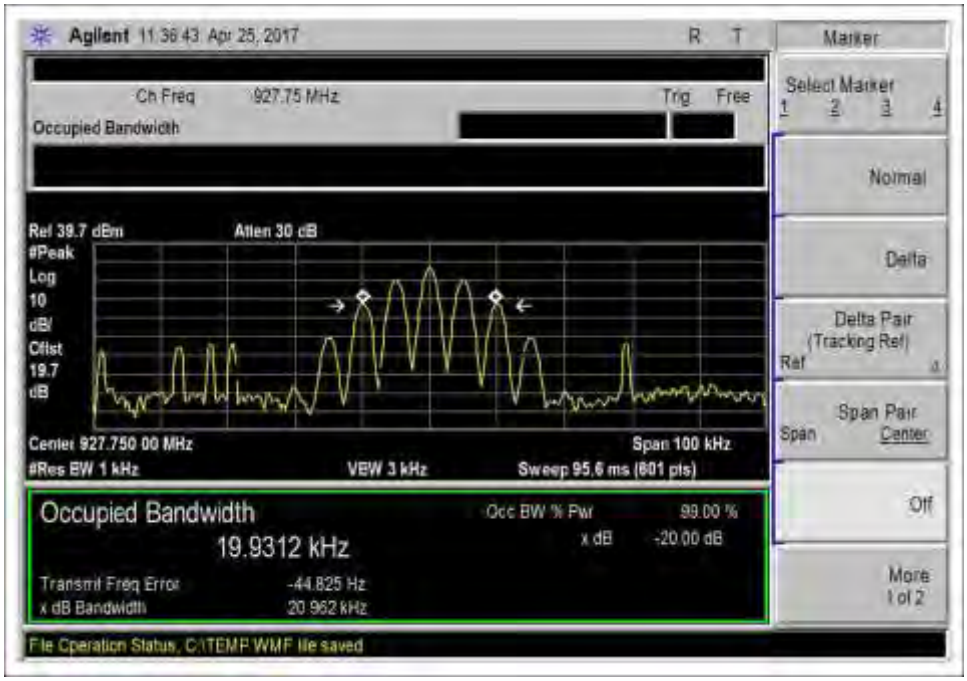
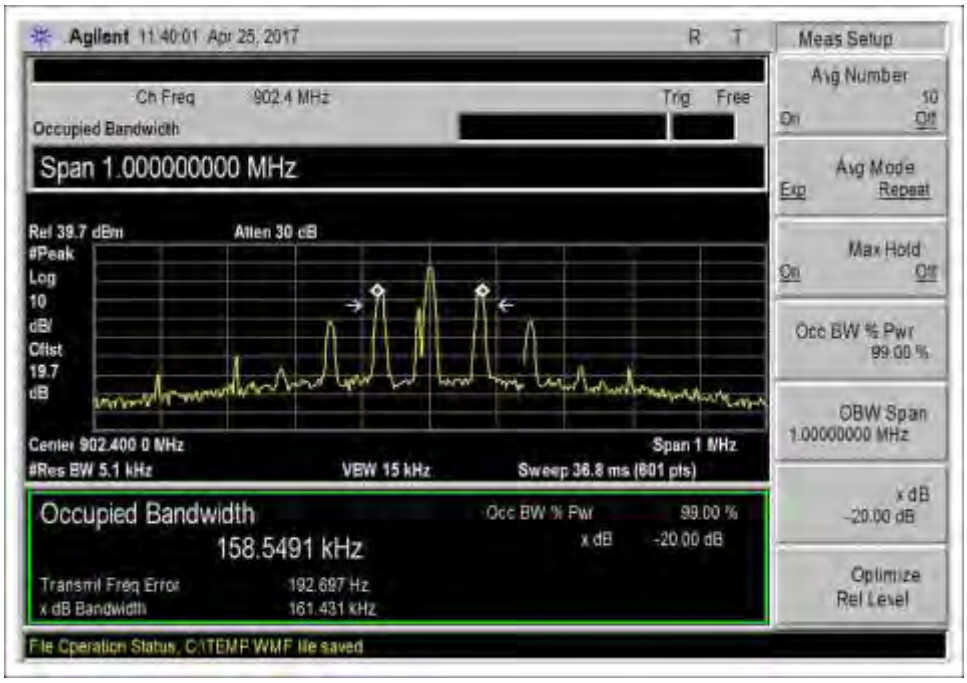


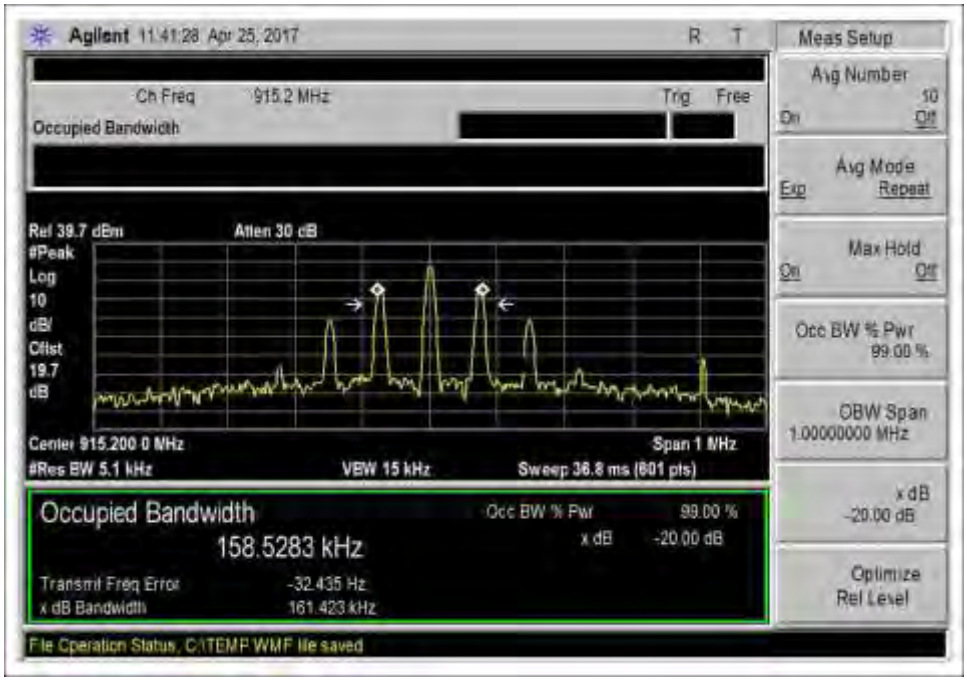
lv3 10kbps GFSK 915



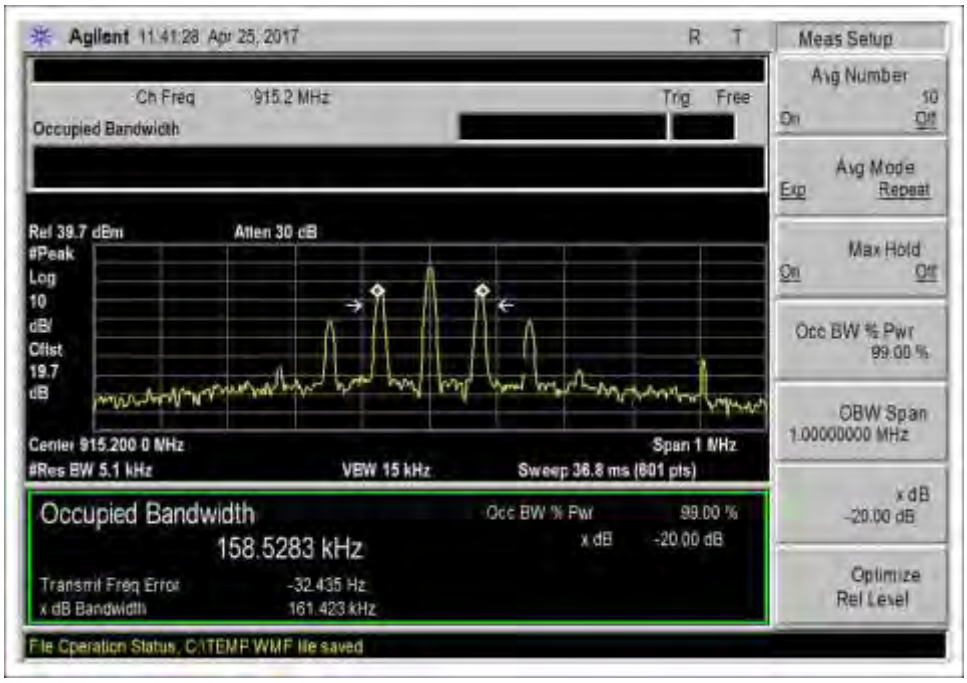
lv3 10kbps GFSK 927.75



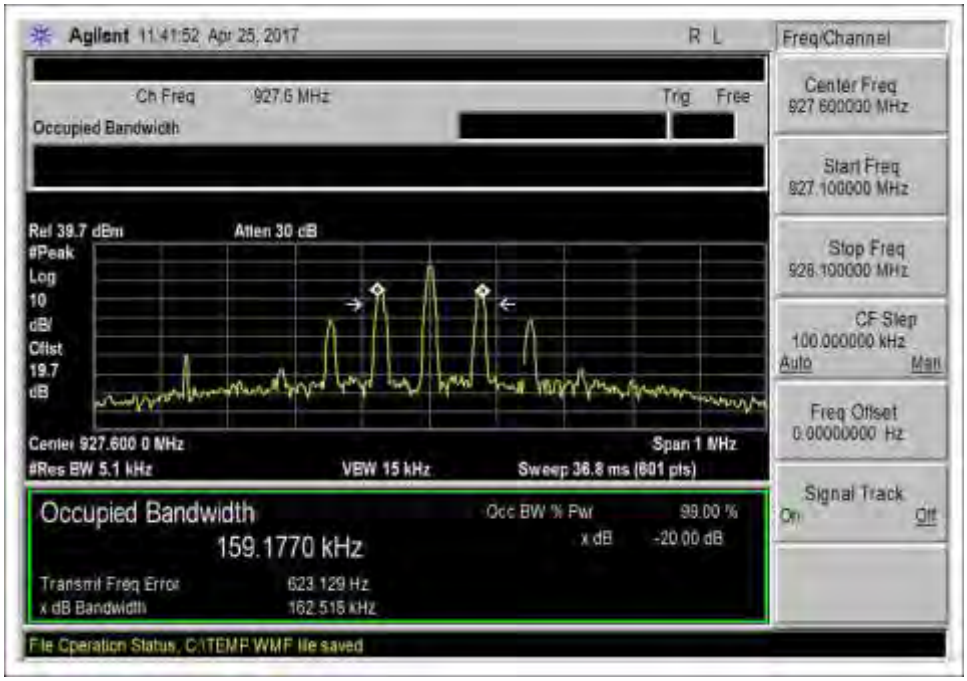
lv3 150kbps GFSK 902.4



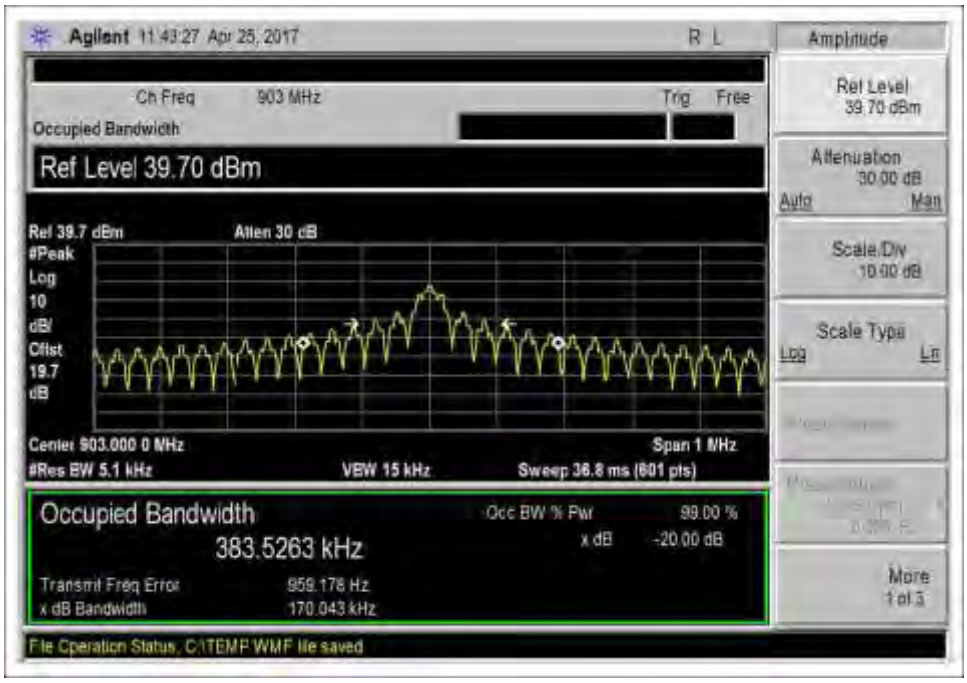
lv3 150kbps GFSK 910



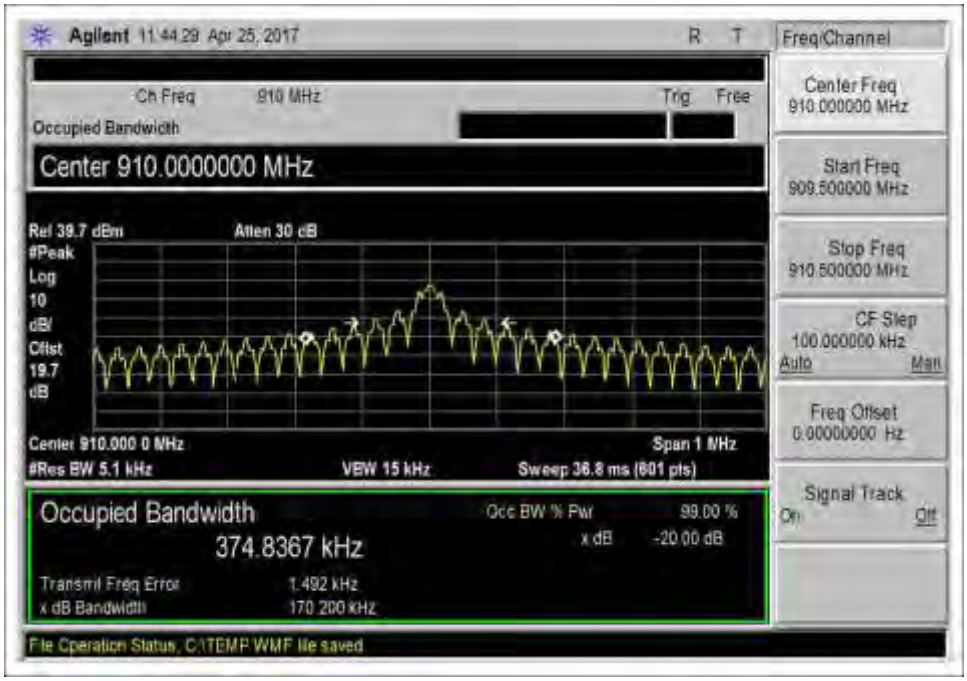
lv3 150kbps GFSK 915.2



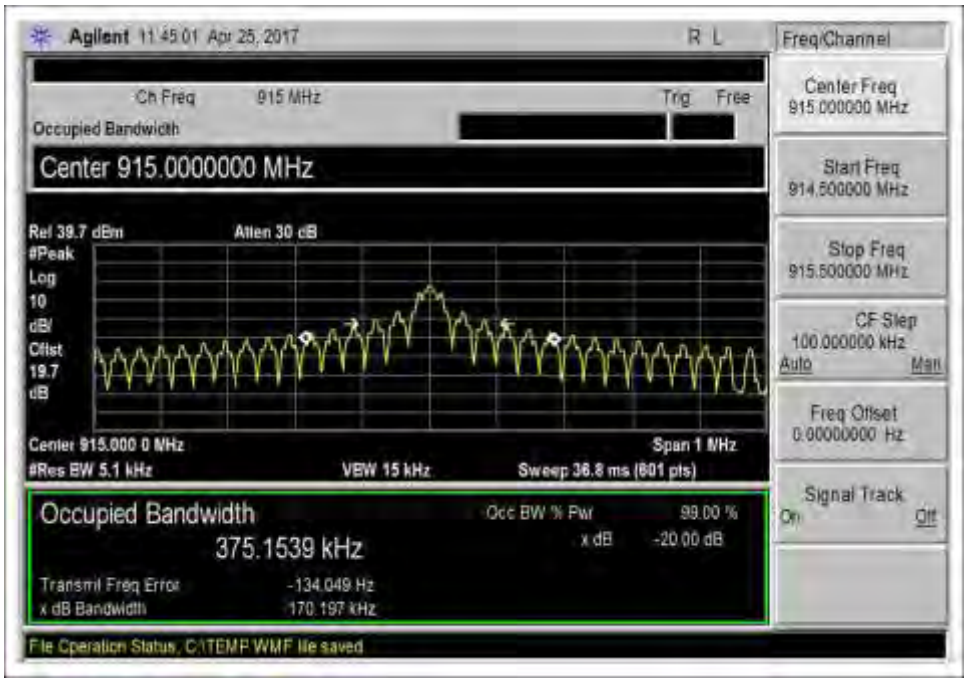
lv3 150kbps GFSK 927.6



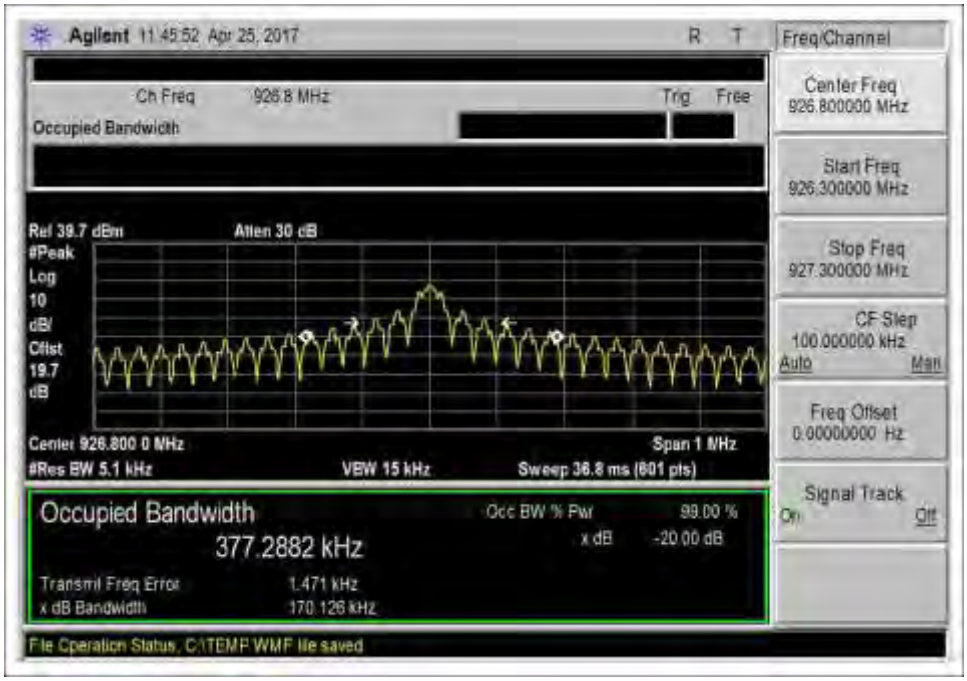
lv3 16384bps OOK 903



lv3 16384bps OOK 910



lv3 16384bps OOK 915

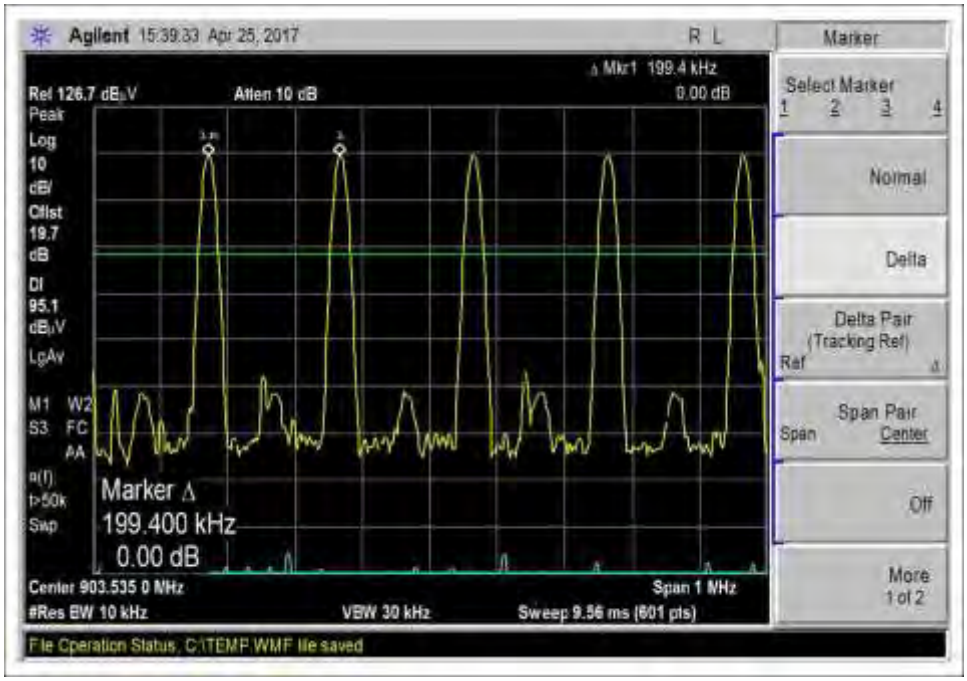


lv3 16384bps OOK 926.8

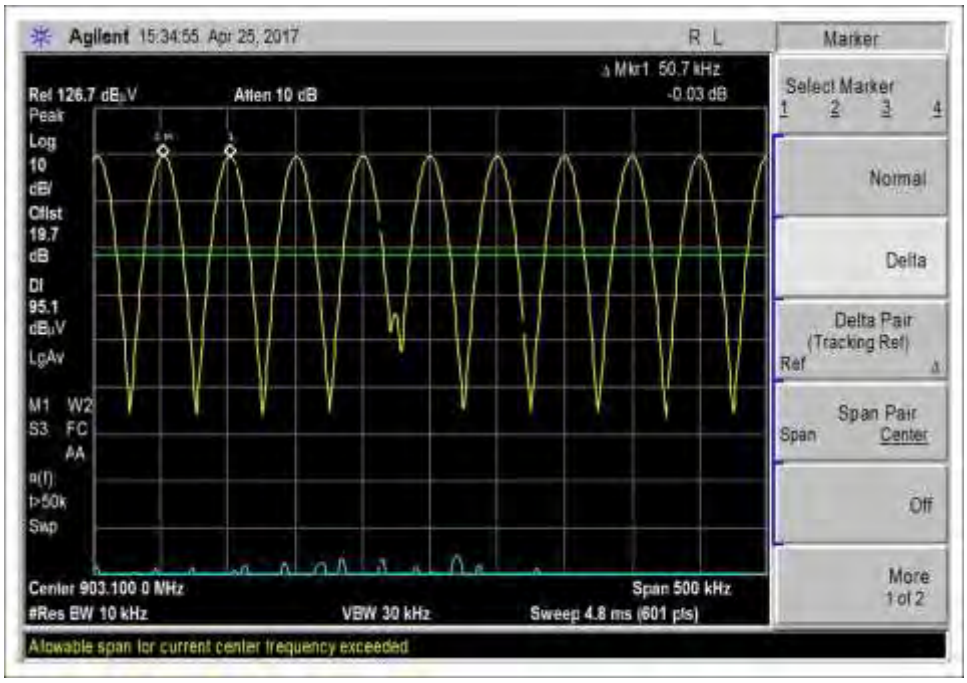
15.247(a)(1) Carrier Separation

Test Data Summary					
Limit applied: 20dB bandwidth of the hopping channel.					
Antenna Port	**Operational Mode**	**Modulation**	**Measured (kHz)**	**Limit (kHz)**	**Results**
1	CW AM	OOK 16384bps	199.4	≥ 170.235	Pass
1	CW FM10	GFSK 10kbps	50.7	≥25.000	Pass
1	CW FM150	GFSK 150kbps	397.0	≥162.518	Pass

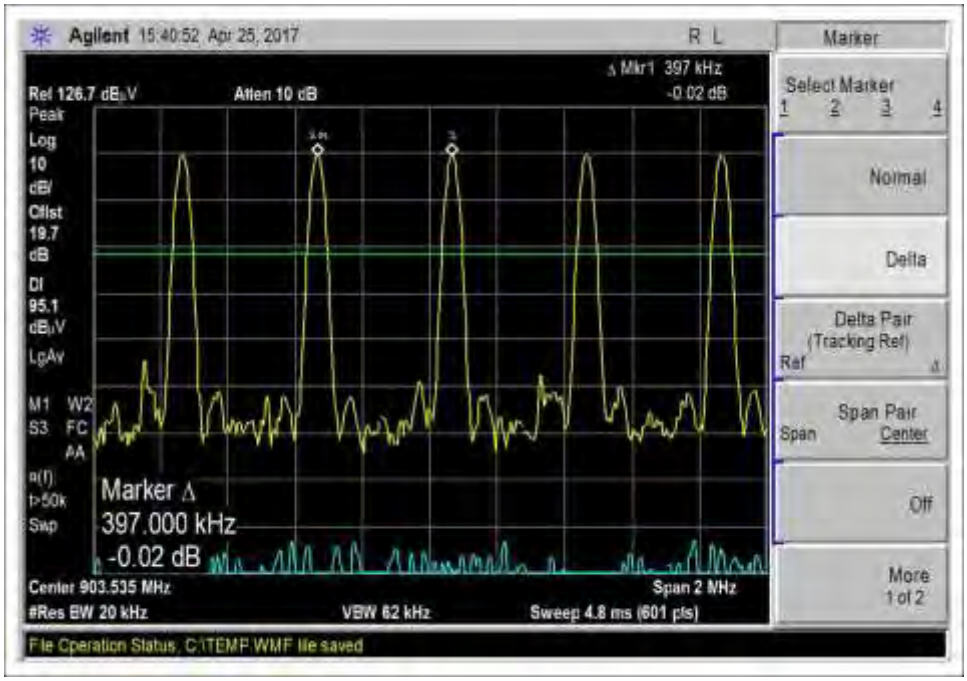
Plot(s)



CW AM



CW FM10



CW FM150

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

Test Data Summary					
$Limit = \begin{cases} 50\ Channels \mid 20\ dB\ BW < 250kHz \\ 25\ Channels \mid 20\ dB\ BW \geq 250kHz \end{cases}$					
Antenna Port	**Operational Mode**	**Modulation**	**Measured (Channels)**	**Limit (Channels)**	**Results**
1	CW AM	OOK 16384bps	120	≥50	Pass
1	CW FM10	GFSK 10kbps	512	≥50	Pass
1	CW FM150	GFSK 150kbps	64	≥50	Pass

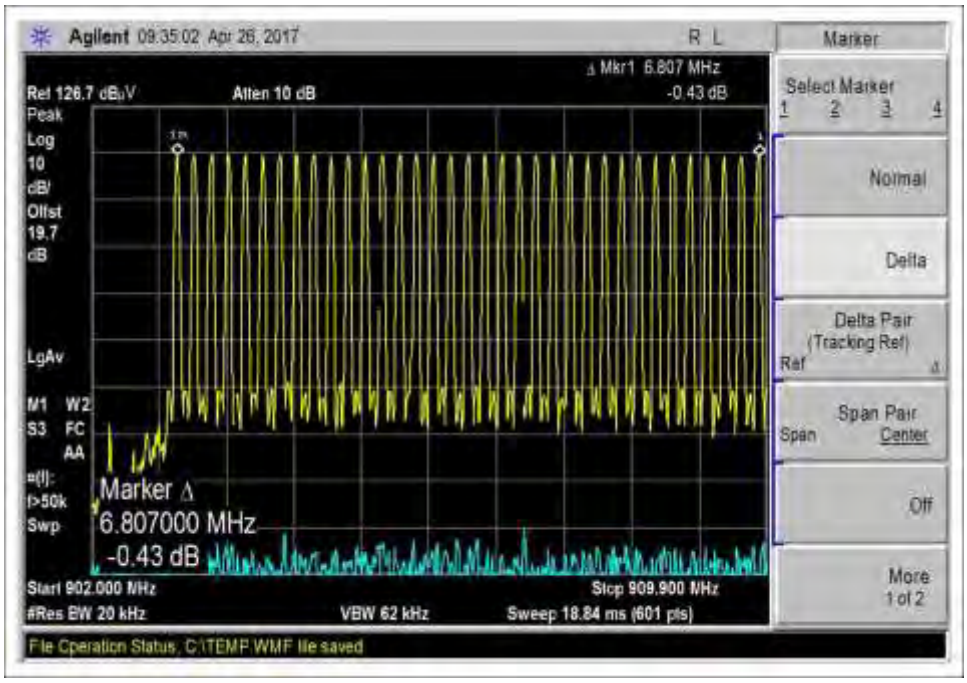
Note: For GFSK 10kbps modulation mode, only the lowest, middle and highest 32 channels are shown, for a total of 96 channels. The equation to get to all 512 channels:

CHANNEL EQUATION: FC = (C-1) * S) +F1
VARIABLES:
C=Channel Number (real numbers from 1 to 512)
S=Channel Spacing (0.05 MHZ)
F1=Channel 1 Frequency (902.2 MHZ)
FC=Channel C Frequency (MHZ)

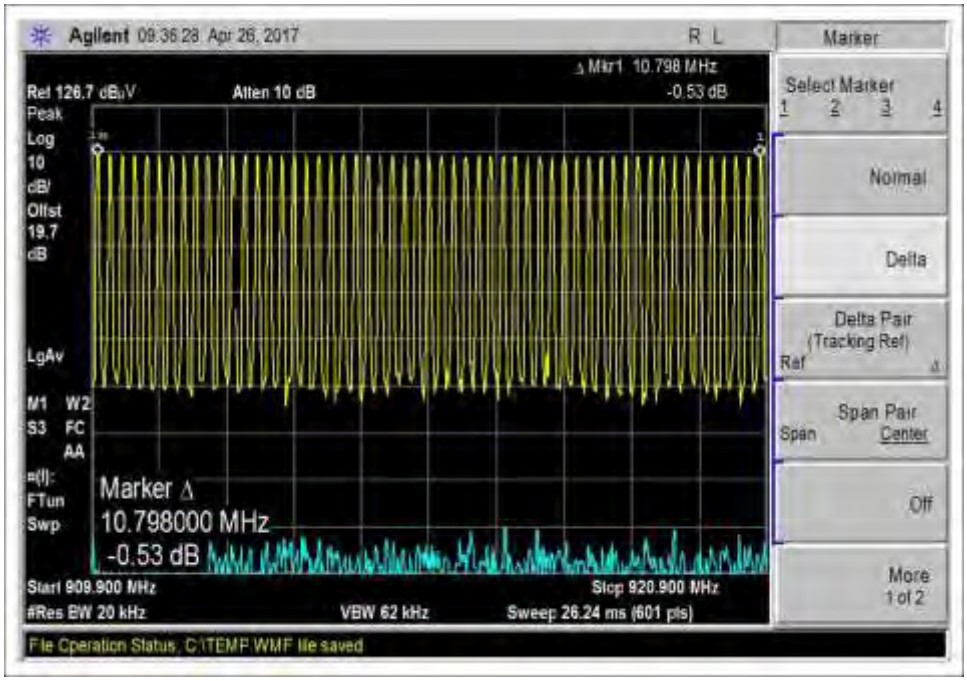
CALCULATIONS:
Channel 1 = ((1-1) X 0.05 MHZ) +902.2 MHZ = 902.2 MHZ
Channel 32 = ((32-1) X 0.05 MHZ) +902.2 MHZ = 903.75 MHZ

Plot(s)

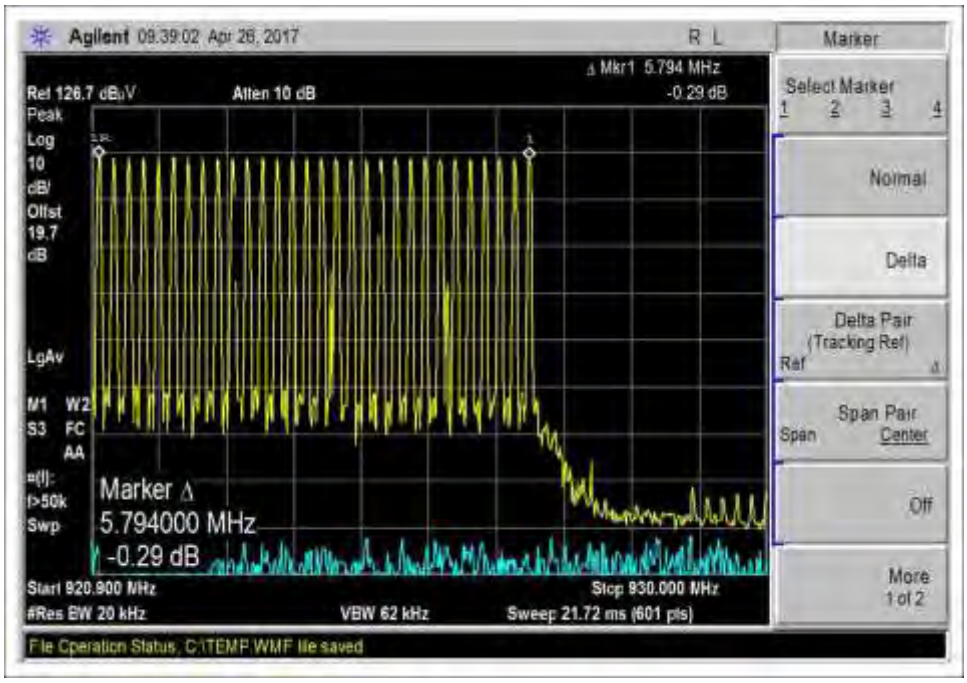
CW AM



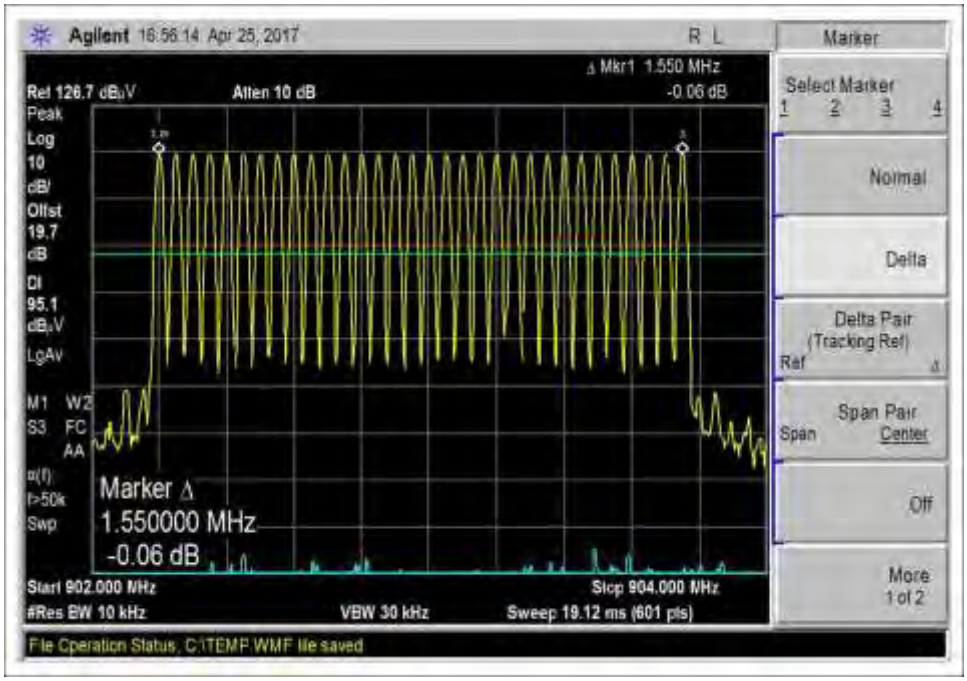
CW AM 902-909.9MHz



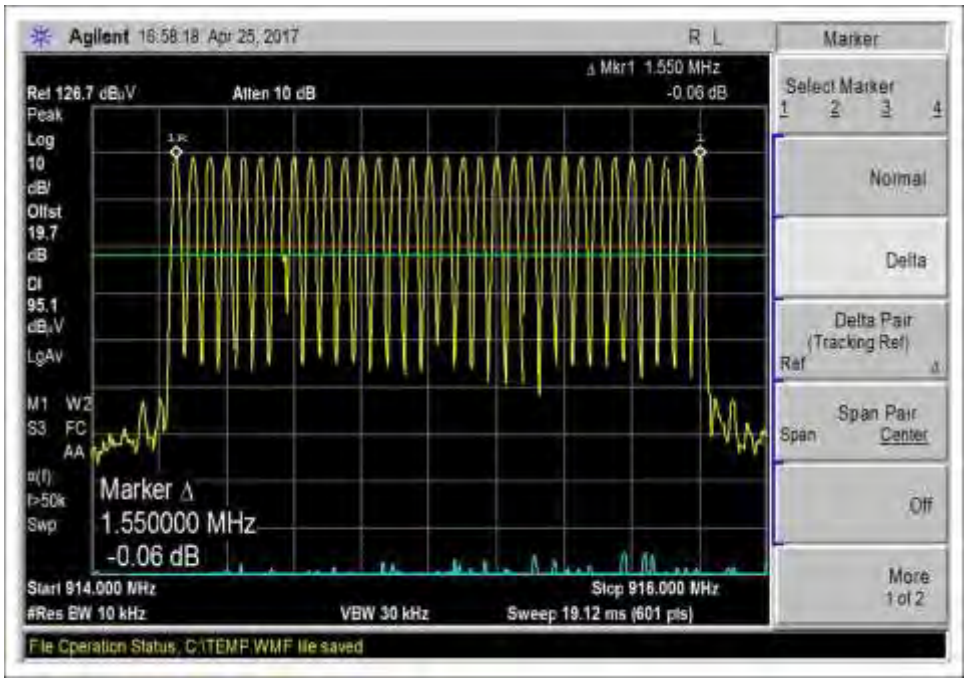
CW AM 909.9-920.9MHz



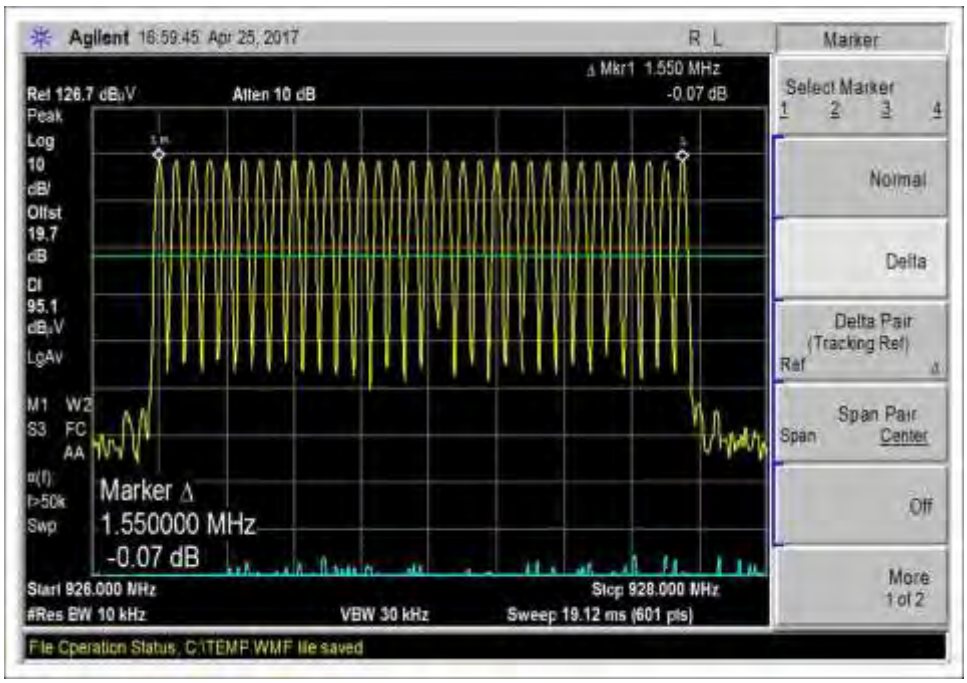
CW AM 920.9-930MHz



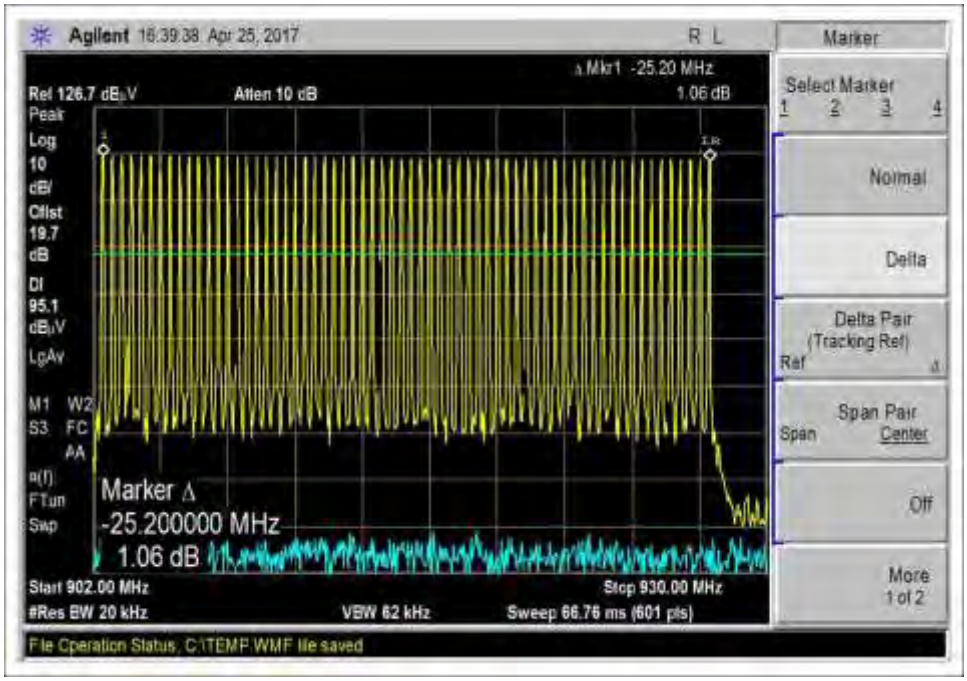
CW FM10, Low Channel



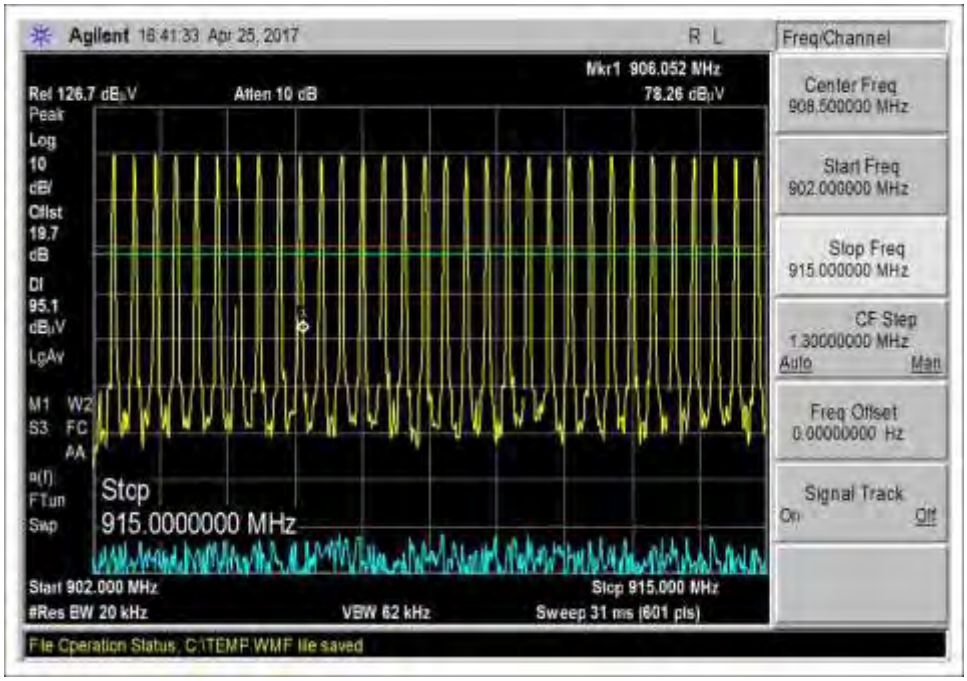
CW FM10, Middle Channel



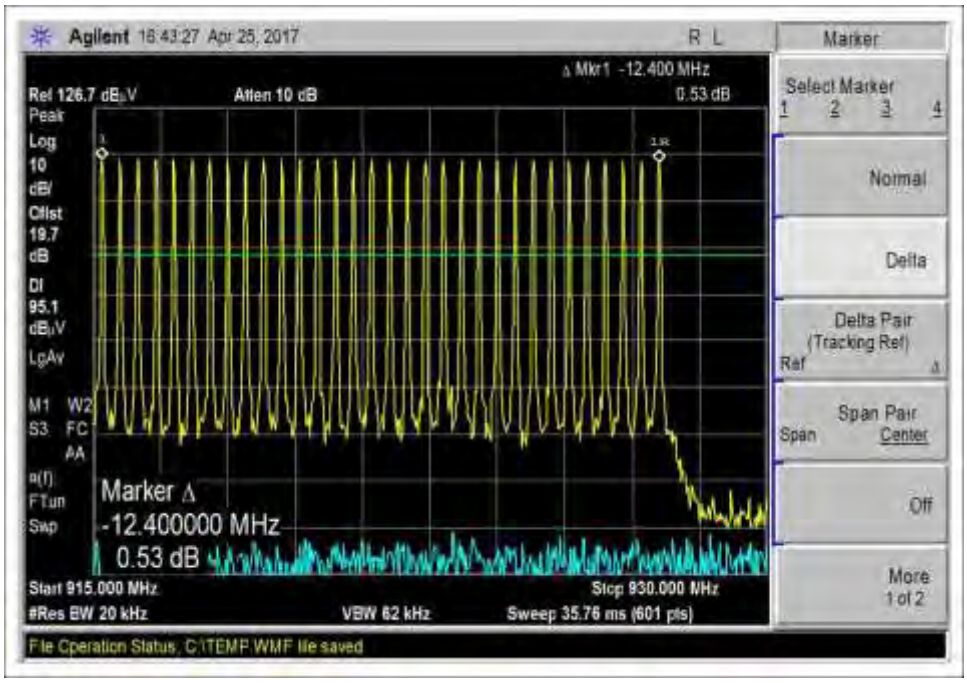
CW FM10, High Channel



CW FM150

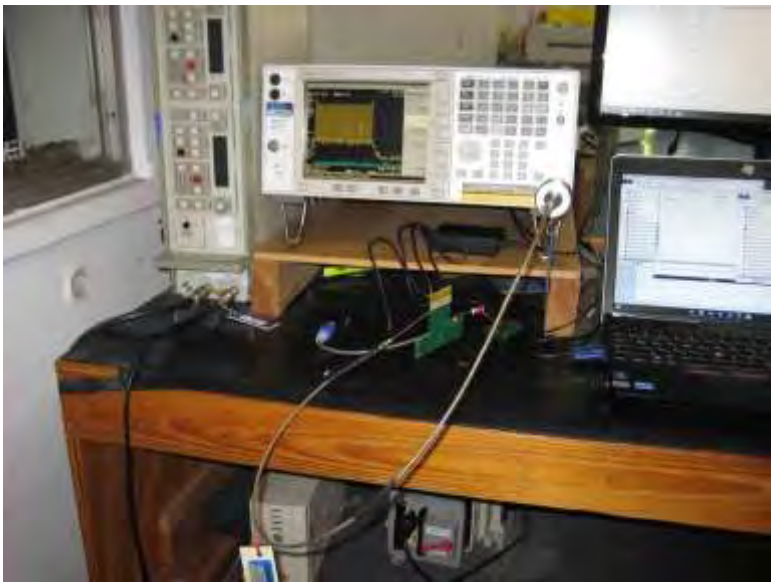


CW FM150_902-915MHz



CW FM150_915-930MHz

Test Setup Photo(s)



15.247(b)(1) Output Power

Test Setup/Conditions			
Test Location:	Brea Lab A	Test Engineer:	Don Nguyen
Test Method:	ANSI C63.10 (2013)	Test Date(s):	4/25/2017
Configuration:	1		
Test Setup:	The equipment under test (EUT) is stand alone on the table top. The EUT is turned on and set in transmit mode. The EUT has new batteries installed. Nominal input voltage is 6.3Vdc. Freq range: 902-928 MHz Modulation: GFSK. OOK Firmware power: power level 1, 3 Firmware version: MSP 0.17.0.0, STM32 1.19.1.0 Evaluation performed at antenna port. Duty cycle: power level 3: 56.1mS/100mS, power level 1: 12.2mS/100mS Level 1: 16384bps OOK 903MHz, 910MHz, 915MHz, 926.8MHz Level 3: 10kbps GFSK 902.2MHz, 910MHz, 915MHz, 927.75MHz Level 3: 150kbps GFSK 902.4MHz, 910MHz, 915.2MHz, 927.6MHz Level 3: 16384bps OOK 903MHz, 910MHz, 915MHz, 926.8MHz Site A. Test Method: ANSI C63.10 (2013)		

Environmental Conditions			
Temperature (ºC)	23	Relative Humidity (%):	46

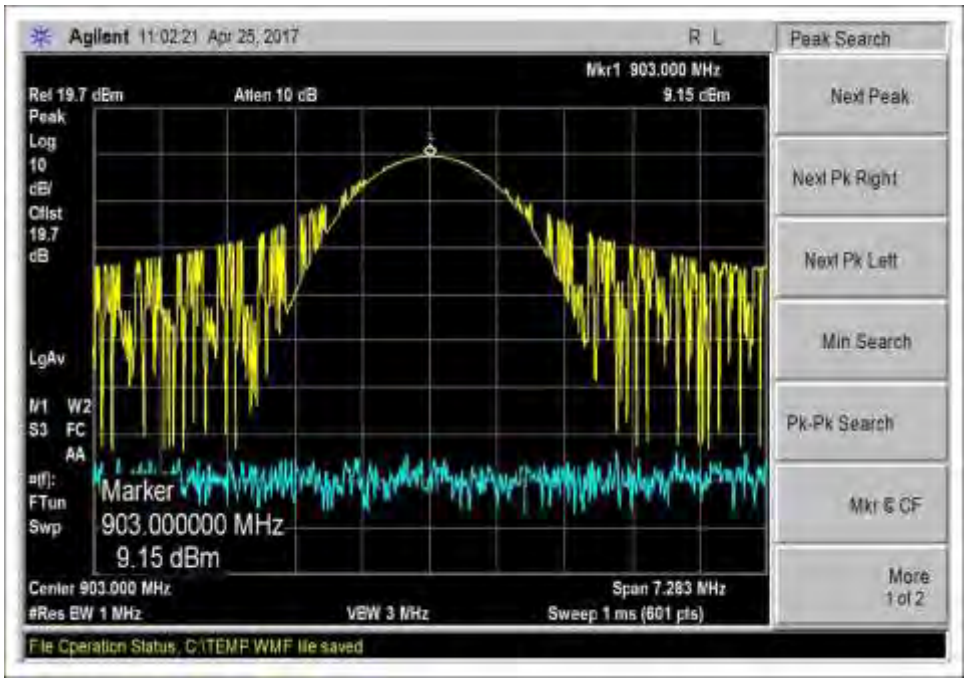
Test Equipment					
Asset#	**Description**	**Manufacturer**	**Model**	**Cal Date**	**Cal Due**
02672	Spectrum Analyzer	Agilent	E4446A	3/2/2017	3/2/2019
03431	Cable	Astrolab Inc.	32022-2-2909K-36TC	11/2/2015	11/2/2017
02946	Attenuator	Aeroflex/Weinschel	89-20-21	11/2/2015	11/2/2017

Test Data Summary - Voltage Variations

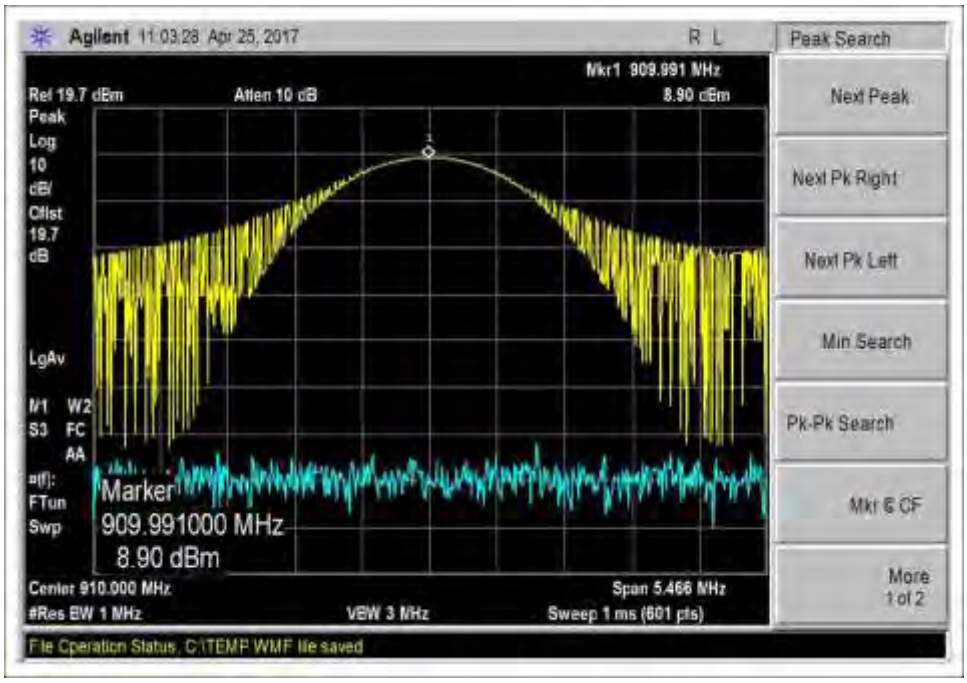
Power output tests were performed using a fresh battery.

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)	**Ant. Type / Gain (dBi)**	**Modulation**	**Measured (dBm)**	**Limit (dBm)**	**Results**
Level 1, 16384bps, OOK					
903.0		OOK	9.15	≤ 30	Pass
910.0		OOK	8.90	≤ 30	Pass
915.0		OOK	8.70	≤ 30	Pass
926.8		OOK	8.20	≤ 30	Pass
Level 3, 10kbps, GFSK					
902.2		GFSK	27.63	≤ 30	Pass
910.0		GFSK	27.66	≤ 30	Pass
915.0		GFSK	27.64	≤ 30	Pass
927.75		GFSK	27.62	≤ 30	Pass
Level 3, 150kbps, GFSK					
902.4		GFSK	27.59	≤ 30	Pass
910.0		GFSK	27.62	≤ 30	Pass
915.2		GFSK	27.63	≤ 30	Pass
927.6		GFSK	27.61	≤ 30	Pass
Level 3, 16384bps, OOK					
903.0		OOK	22.83	≤ 30	Pass
910.0		OOK	22.97	≤ 30	Pass
915.0		OOK	23.02	≤ 30	Pass
926.8		OOK	23.05	≤ 30	Pass

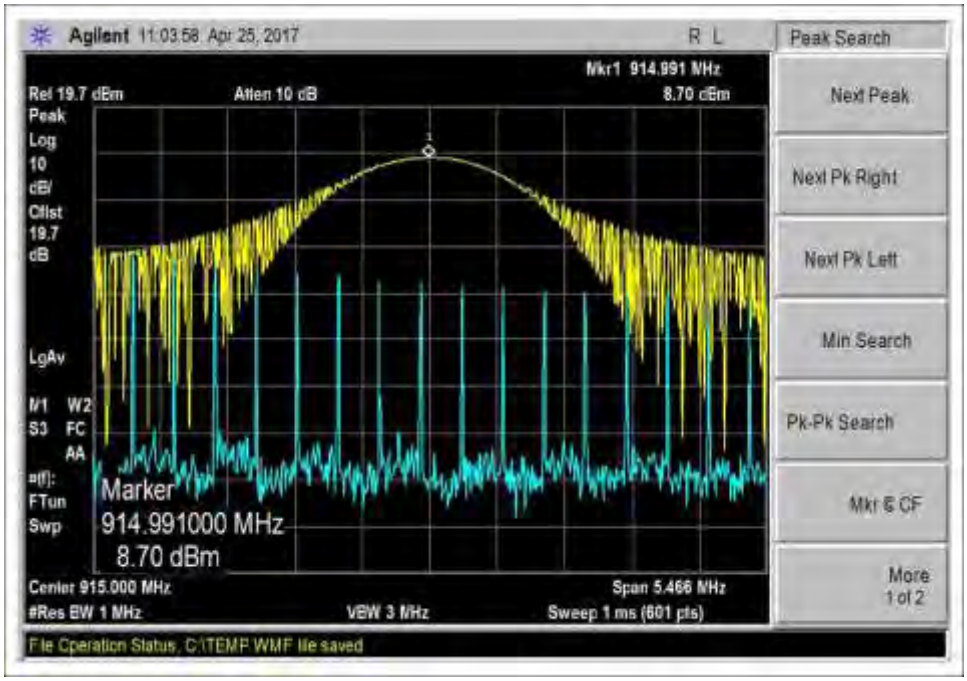
Plot(s)



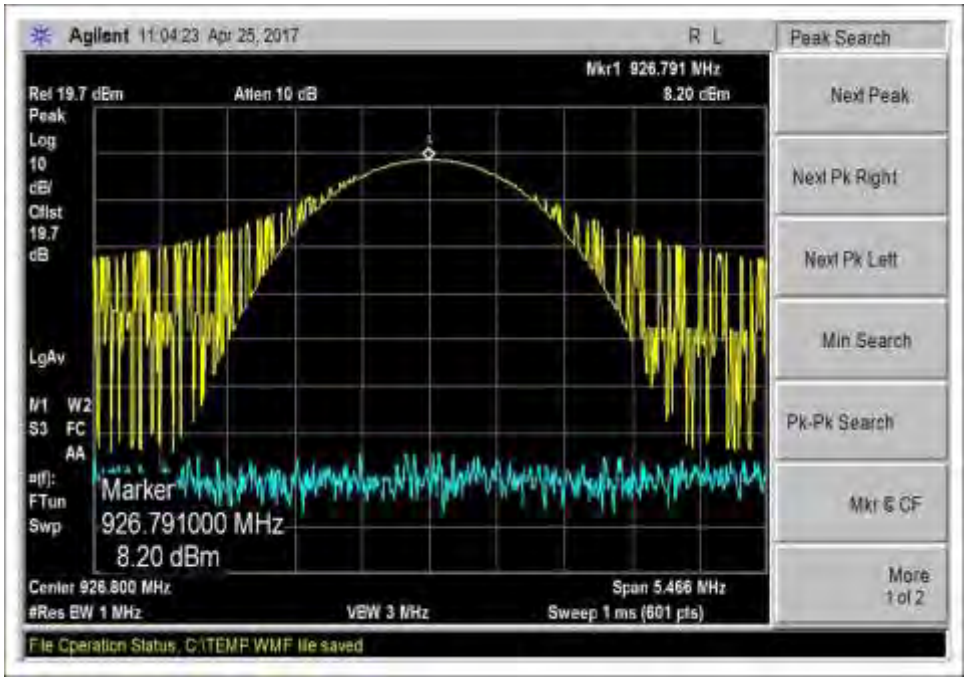
lv1 16384bps OOK 903



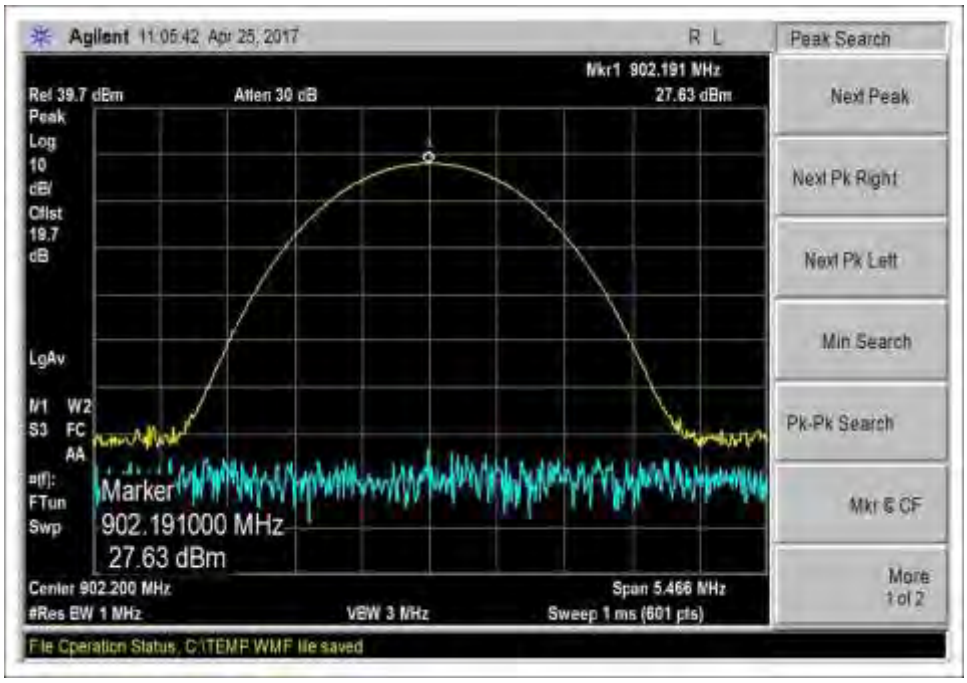
lv1 16384bps OOK 910



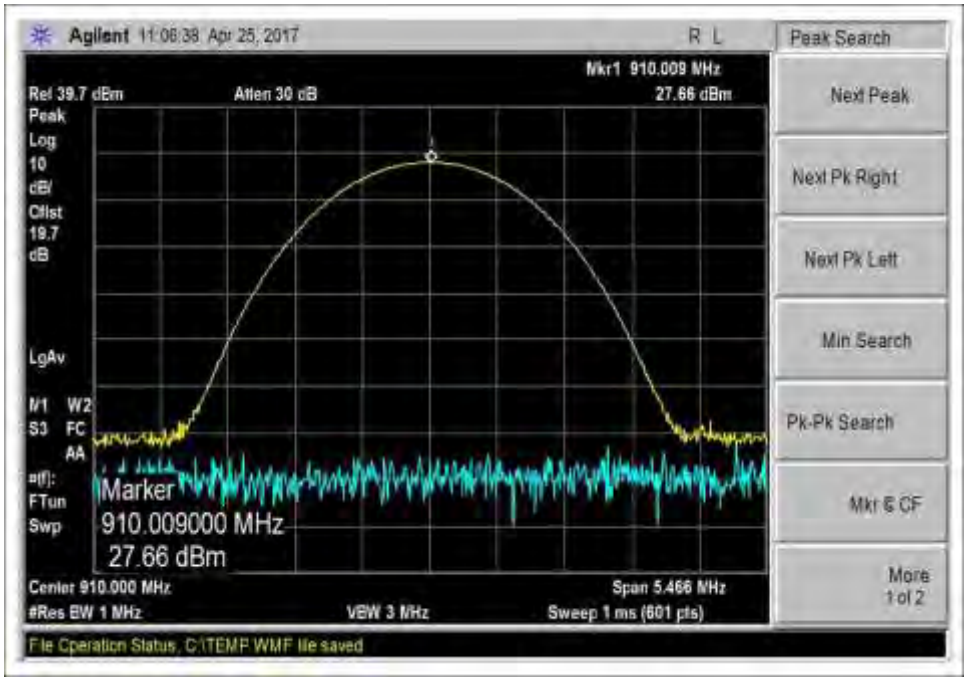
lv1 16384bps OOK 915



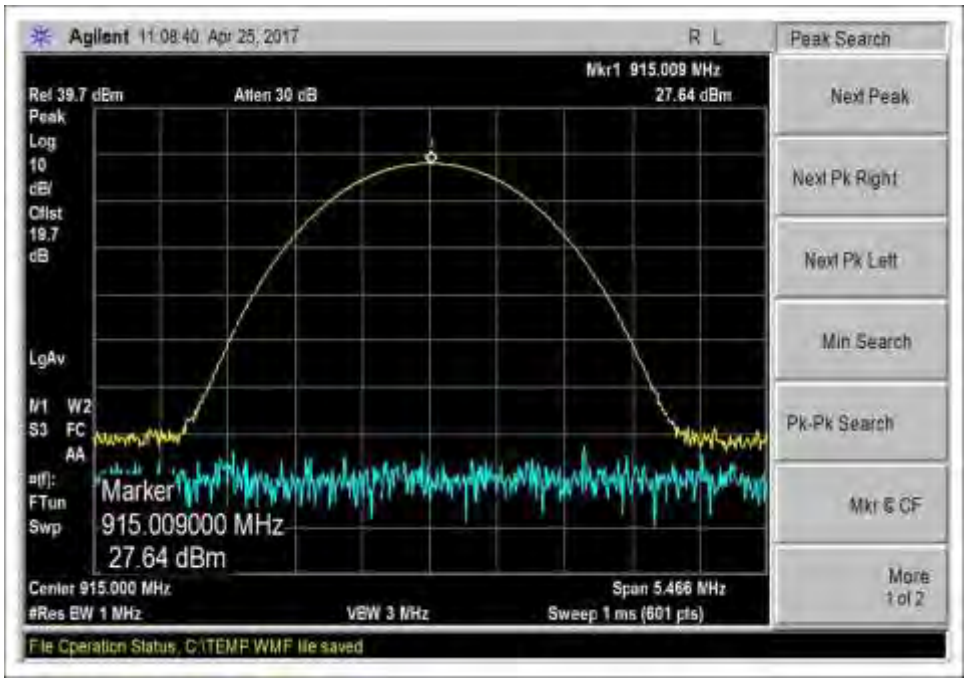
lv1 16384bps OOK 926.8



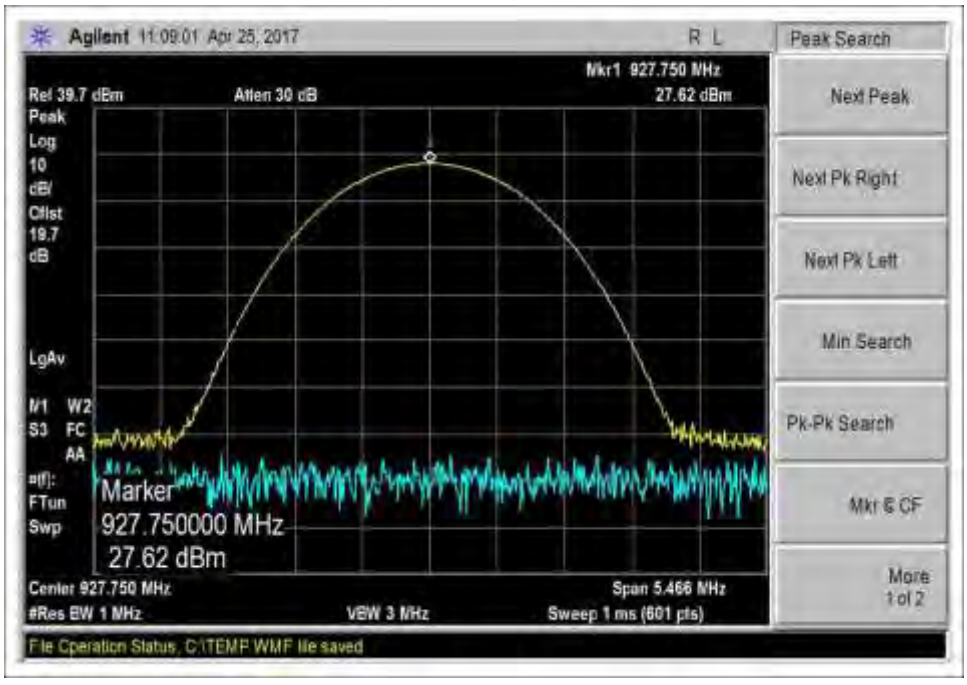
lv3 10kbps GFSK 902.2



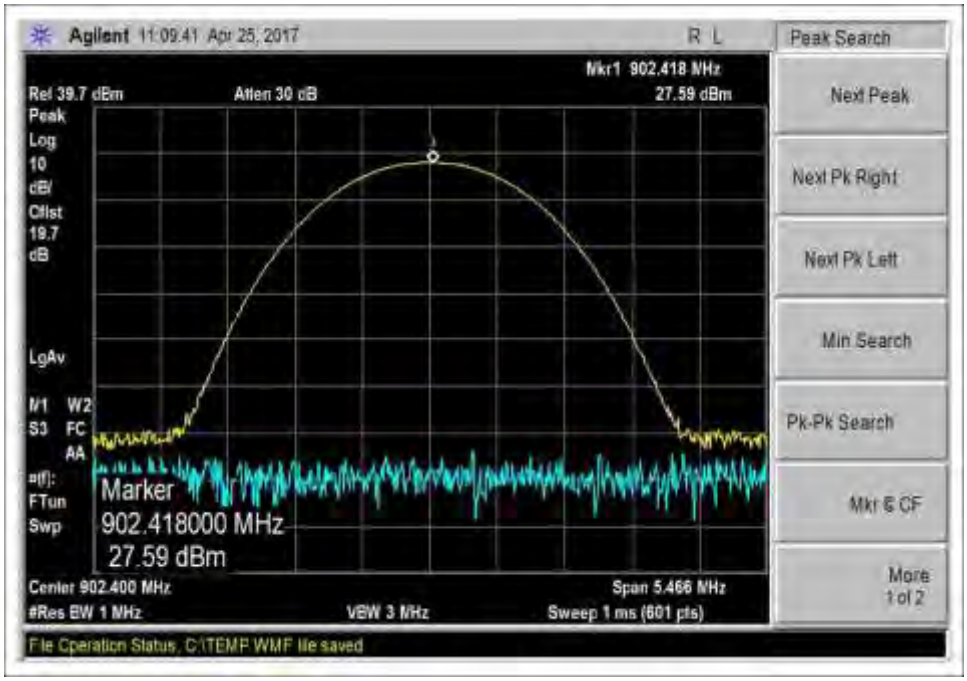
lv3 10kbps GFSK 910



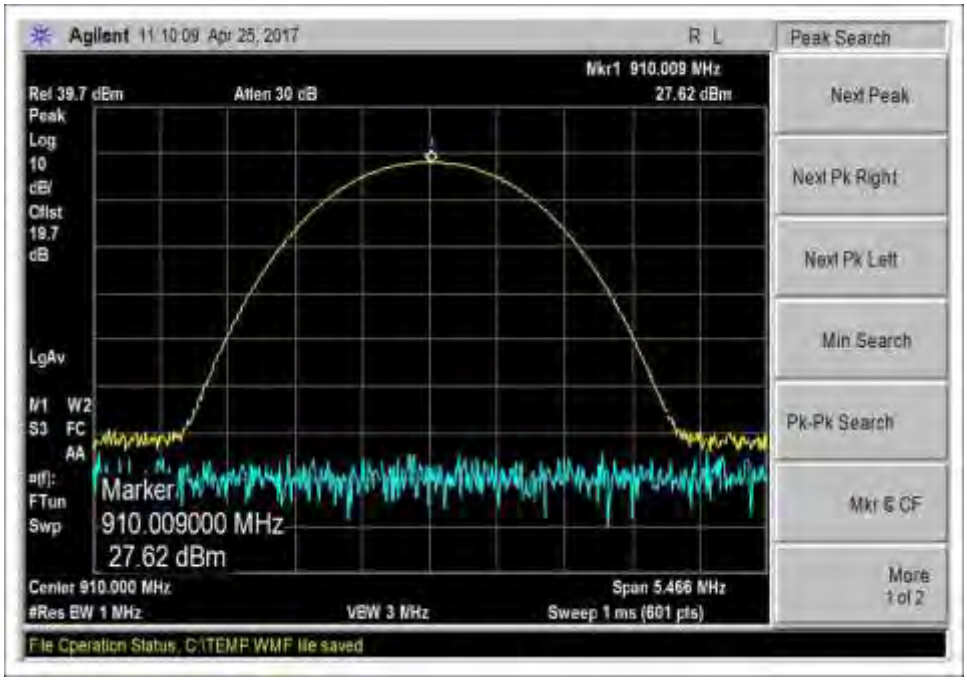
lv3 10kbps GFSK 915



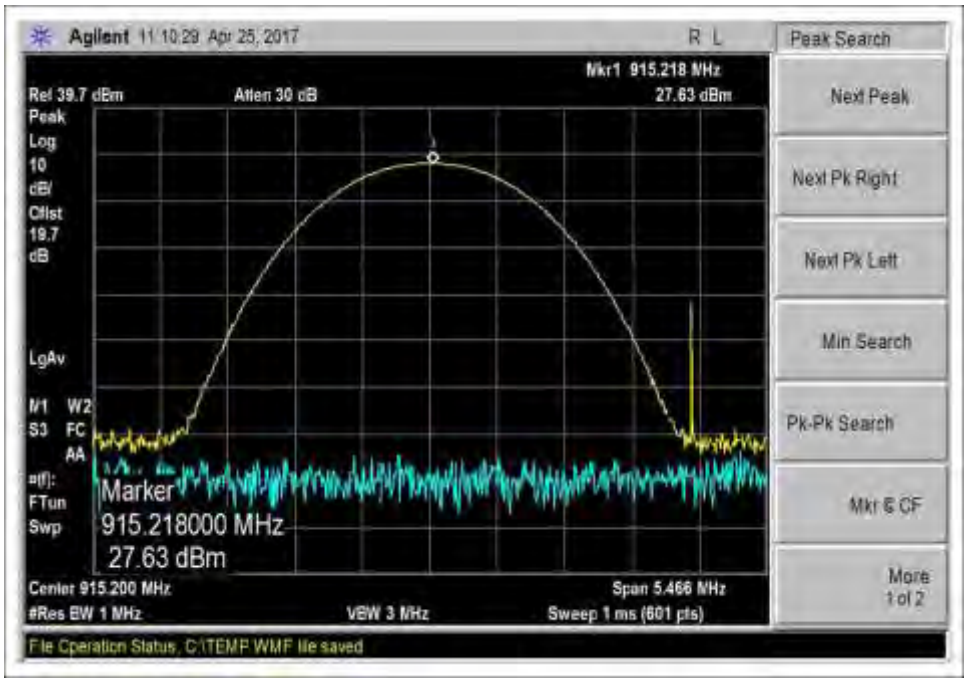
lv3 10kbps GFSK 927.75



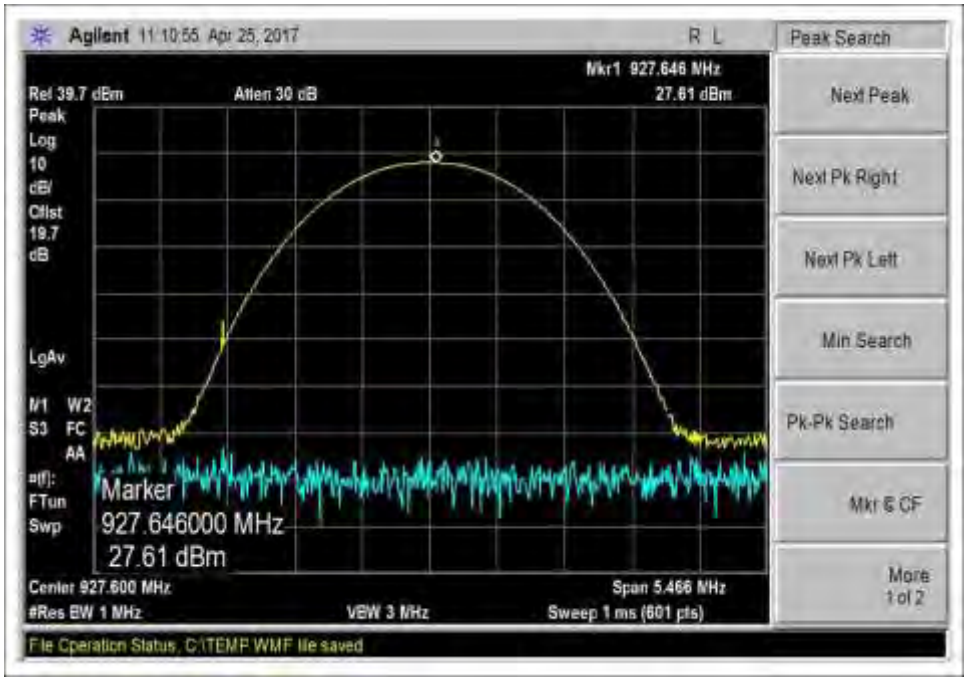
lv3 150kbps GFSK 902.4



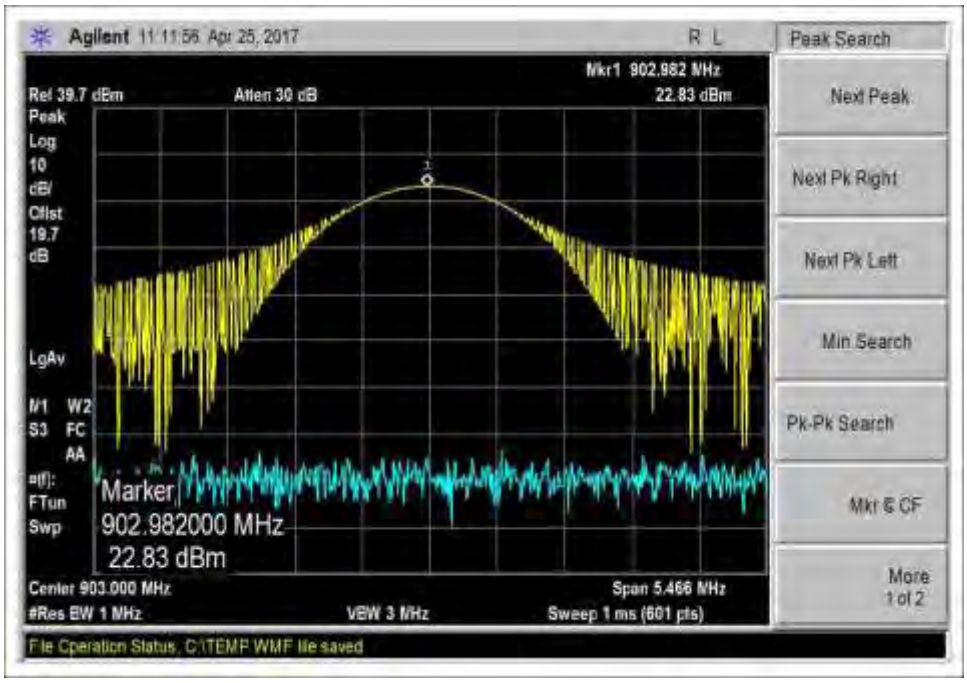
lv3 150kbps GFSK 910



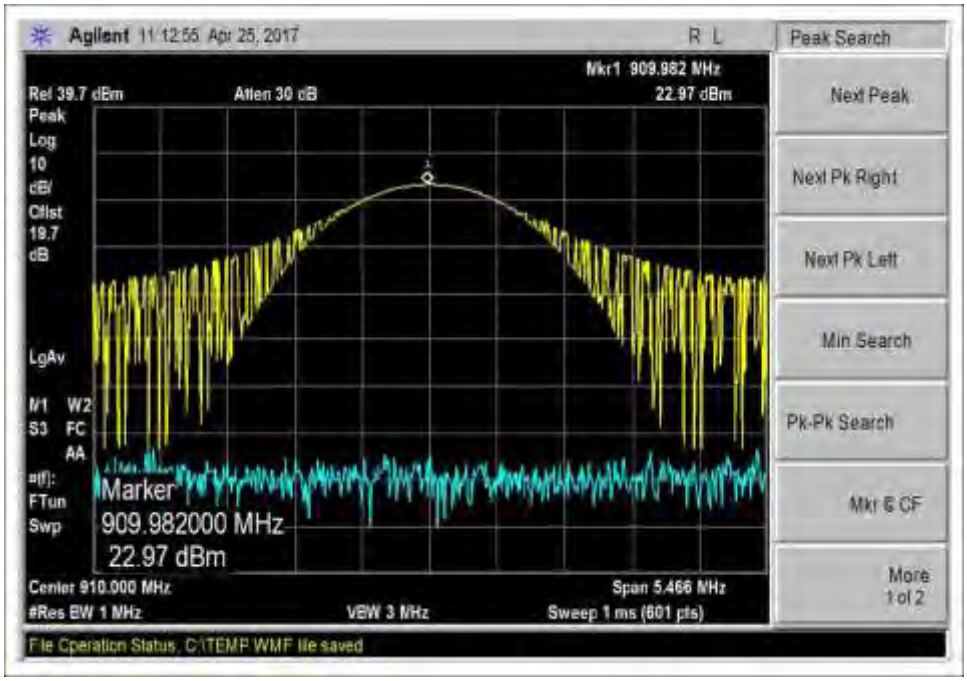
lv3 150kbps GFSK 915.2



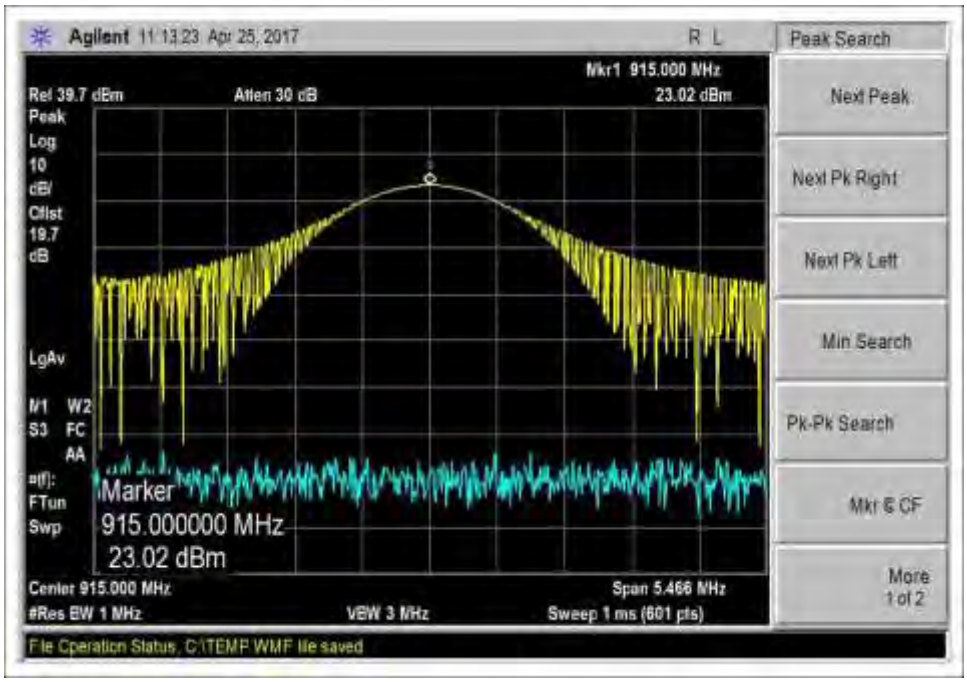
lv3 150kbps GFSK 927.6



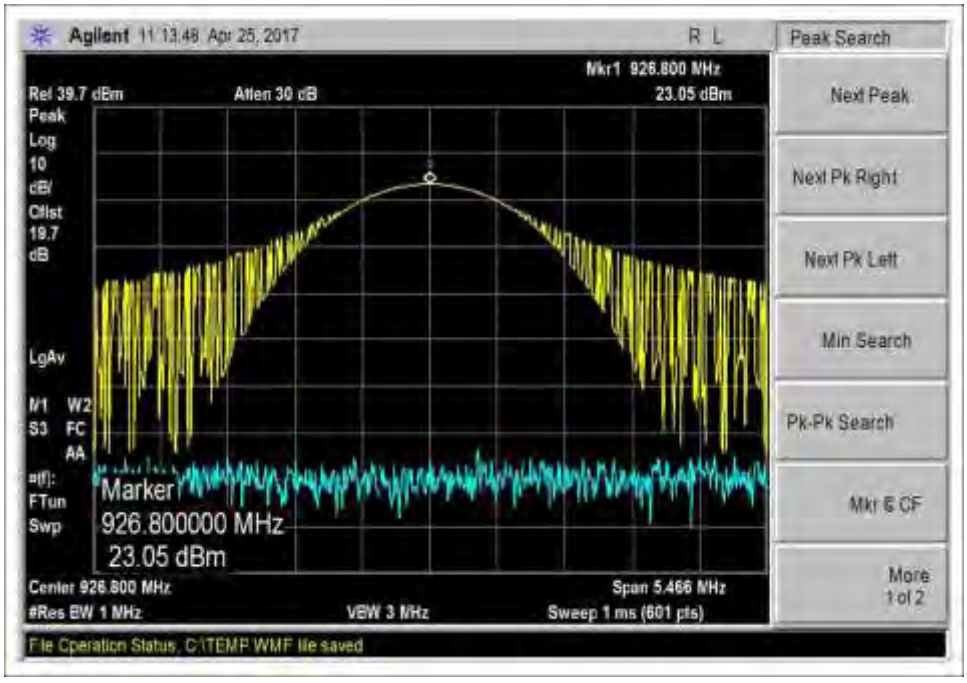
lv3 16384bps OOK 903



lv3 16384bps OOK 910



lv3 16384bps OOK 915



lv3 16384bps OOK 926.8

15.247(d) RF Conducted Emissions & Band Edge

See data sheets for test setup and test equipment.

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 #:	**99218**	Date:	4/25/2017
Test Type:	**Conducted Emissions**	Time:	13:35:27
Tested By:	Don Nguyen	Sequence#:	2
Software:	EMITest 5.03.02		110V 60Hz

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

The equipment under test (EUT) is stand alone on the table top. The EUT is turned on and set in transmit mode. The EUT has new batteries installed. Nominal input voltage is 6.3Vdc.

Freq range: 902-928 MHz
Modulation: GFSK. OOK
Firmware power: power level 1, 3
Firmware version: MSP 0.17.0.0, STM32 1.19.1.0
Evaluation performed at antenna port.
Duty cycle: power level 3: 56.1mS/100mS, power level 1: 12.2mS/100mS

Level 1: 16384bps	OOK	903MHz, 910MHz, 915MHz, 926.8MHz
Level 3: 10kbps	GFSK	902.2MHz, 910MHz, 915MHz, 927.75MHz
Level 3: 150kbps	GFSK	902.4MHz, 910MHz, 915.2MHz, 927.6MHz
Level 3: 16384bps	OOK	903MHz, 910MHz, 915MHz, 926.8MHz

Frequency range of measurement = 9 kHz- 10GHz.
9 kHz - 10000 MHz; RBW=100kHz, VBW=100kHz.
Test environment conditions Temperature: 24°C, Humidity: 40%, Pressure: 100.1kPa.

Site A. Test Method: ANSI C63.10 (2013)

No emission within 20dB of the limit was detected.

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02672	Spectrum Analyzer	E4446A	3/2/2017	3/2/2019
	AN03431	Attenuator	89-20-21	11/2/2015	11/2/2017
	AN02946	Cable	32022-2-2909K-36TC	11/2/2015	11/2/2017

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

#	Freq	Rdng					Dist	Corr	Spec	Margin	Polar
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV	dBµV	dB	Ant

Band Edge

Band Edge Summary				
Limit applied: Max Power/100kHz - 20dB.				
Frequency (MHz)	**Modulation**	**Measured (dBm)**	**Limit (dBm)**	**Results**
Level 1, 16384bps, OOK				
902	GFSK	-22.6	< -10.85	Pass
928	GFSK	-25.8	< -10.85	Pass
Level 3, 10kbps, GFSK				
902	OOK	-8.3	< 7.66	Pass
928	OOK	-18.9	< 7.66	Pass
Level 3, 150kbps, GFSK				
902	GFSK	-27.3	< 7.63	Pass
928	GFSK	-27.3	< 7.63	Pass
Level 3, 16384bps, OOK				
902	OOK	-9.5	< 3.05	Pass
928	OOK	-11.0	< 3.05	Pass

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 #:	**99218**	Date:	4/25/2017
Test Type:	**Conducted Emissions**	Time:	13:35:27
Tested By:	Don Nguyen	Sequence#:	2
Software:	EMITest 5.03.02		110V 60Hz

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

The equipment under test (EUT) is stand alone on the table top. The EUT is turned on and set in transmit mode. The EUT has new batteries installed. Nominal input voltage is 6.3Vdc.

Freq range: 902-928 MHz
Modulation: GFSK. OOK
Firmware power: power level 1, 3
Firmware version: MSP 0.17.0.0, STM32 1.19.1.0
Evaluation performed at antenna port.
Duty cycle: power level 3: 56.1mS/100mS, power level 1: 12.2mS/100mS

Level 1: 16384bps	OOK	903MHz, 910MHz, 915MHz, 926.8MHz
Level 3: 10kbps	GFSK	902.2MHz, 910MHz, 915MHz, 927.75MHz
Level 3: 150kbps	GFSK	902.4MHz, 910MHz, 915.2MHz, 927.6MHz
Level 3: 16384bps	OOK	903MHz, 910MHz, 915MHz, 926.8MHz

Frequency range of measurement = 9 kHz- 10GHz.
9 kHz - 10000 MHz; RBW=100kHz, VBW=100kHz.
Test environment conditions Temperature: 24°C, Humidity: 40%, Pressure: 100.1kPa.

Site A. Test Method: ANSI C63.10 (2013)

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02672	Spectrum Analyzer	E4446A	3/2/2017	3/2/2019
T1	AN03431	Attenuator	89-20-21	11/2/2015	11/2/2017
T2	AN02946	Cable	32022-2-2909K-36TC	11/2/2015	11/2/2017

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	902.000M	32.6	+19.3	+0.4			+0.0	52.3	79.0	-26.7	Anten
2	928.000M	24.0	+19.3	+0.4			+0.0	43.7	79.0	-35.3	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 #:	**99218**	Date:	4/25/2017
Test Type:	**Conducted Emissions**	Time:	13:46:05
Tested By:	Don Nguyen	Sequence#:	2
Software:	EMITest 5.03.02		110V 60Hz

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

The equipment under test (EUT) is stand alone on the table top. The EUT is turned on and set in transmit mode. The EUT has new batteries installed. Nominal input voltage is 6.3Vdc.

Freq range: 902-928 MHz
Modulation: GFSK. OOK
Firmware power: power level 1, 3
Firmware version: MSP 0.17.0.0, STM32 1.19.1.0
Evaluation performed at antenna port.
Duty cycle: power level 3: 56.1mS/100mS, power level 1: 12.2mS/100mS

Level 1: 16384bps	OOK	903MHz, 910MHz, 915MHz, 926.8MHz
Level 3: 10kbps	GFSK	902.2MHz, 910MHz, 915MHz, 927.75MHz
Level 3: 150kbps	GFSK	902.4MHz, 910MHz, 915.2MHz, 927.6MHz
Level 3: 16384bps	OOK	903MHz, 910MHz, 915MHz, 926.8MHz

Frequency range of measurement = 9 kHz- 10GHz.
9 kHz - 10000 MHz; RBW=100kHz, VBW=100kHz.
Test environment conditions Temperature: 24°C, Humidity: 40%, Pressure: 100.1kPa.

Site A. Test Method: ANSI C63.10 (2013)

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02672	Spectrum Analyzer	E4446A	3/2/2017	3/2/2019
T1	AN03431	Attenuator	89-20-21	11/2/2015	11/2/2017
T2	AN02946	Cable	32022-2-2909K-36TC	11/2/2015	11/2/2017

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	902.000M	64.7	+19.3	+0.4			+0.0	84.4	96.2	-11.8	Anten
2	928.000M	61.5	+19.3	+0.4			+0.0	81.2	96.2	-15.0	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 #:	**99218**	Date:	4/25/2017
Test Type:	**Conducted Emissions**	Time:	14:01:34
Tested By:	Don Nguyen	Sequence#:	5
Software:	EMITest 5.03.02		110V 60Hz

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

The equipment under test (EUT) is stand alone on the table top. The EUT is turned on and set in transmit mode. The EUT has new batteries installed. Nominal input voltage is 6.3Vdc.

Freq range: 902-928 MHz
Modulation: GFSK. OOK
Firmware power: power level 1, 3
Firmware version: MSP 0.17.0.0, STM32 1.19.1.0
Evaluation performed at antenna port.
Duty cycle: power level 3: 56.1mS/100mS, power level 1: 12.2mS/100mS

Level 1: 16384bps	OOK	903MHz, 910MHz, 915MHz, 926.8MHz
Level 3: 10kbps	GFSK	902.2MHz, 910MHz, 915MHz, 927.75MHz
Level 3: 150kbps	GFSK	902.4MHz, 910MHz, 915.2MHz, 927.6MHz
Level 3: 16384bps	OOK	903MHz, 910MHz, 915MHz, 926.8MHz

Frequency range of measurement = 9 kHz- 10GHz.
9 kHz - 10000 MHz; RBW=100kHz, VBW=100kHz.
Test environment conditions Temperature: 24°C, Humidity: 40%, Pressure: 100.1kPa.

Site A. Test Method: ANSI C63.10 (2013)

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02672	Spectrum Analyzer	E4446A	3/2/2017	3/2/2019
T1	AN03431	Attenuator	89-20-21	11/2/2015	11/2/2017
T2	AN02946	Cable	32022-2-2909K-36TC	11/2/2015	11/2/2017

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	902.000M	77.8	+19.3	+0.4			+0.0	97.5	110.1	-12.6	Anten
2	928.000M	76.3	+19.3	+0.4			+0.0	96.0	110.1	-14.1	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 #:	**99218**	Date:	4/25/2017
Test Type:	**Conducted Emissions**	Time:	13:53:14
Tested By:	Don Nguyen	Sequence#:	3
Software:	EMITest 5.03.02		110V 60Hz

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

The equipment under test (EUT) is stand alone on the table top. The EUT is turned on and set in transmit mode. The EUT has new batteries installed. Nominal input voltage is 6.3Vdc.

Freq range: 902-928 MHz
Modulation: GFSK. OOK
Firmware power: power level 1, 3
Firmware version: MSP 0.17.0.0, STM32 1.19.1.0
Evaluation performed at antenna port.
Duty cycle: power level 3: 56.1mS/100mS, power level 1: 12.2mS/100mS

Level 1: 16384bps	OOK	903MHz, 910MHz, 915MHz, 926.8MHz
Level 3: 10kbps	GFSK	902.2MHz, 910MHz, 915MHz, 927.75MHz
Level 3: 150kbps	GFSK	902.4MHz, 910MHz, 915.2MHz, 927.6MHz
Level 3: 16384bps	OOK	903MHz, 910MHz, 915MHz, 926.8MHz

Frequency range of measurement = 9 kHz- 10GHz.
9 kHz - 10000 MHz; RBW=100kHz, VBW=100kHz.
Test environment conditions Temperature: 24°C, Humidity: 40%, Pressure: 100.1kPa.

Site A. Test Method: ANSI C63.10 (2013)

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02672	Spectrum Analyzer	E4446A	3/2/2017	3/2/2019
T1	AN03431	Attenuator	89-20-21	11/2/2015	11/2/2017
T2	AN02946	Cable	32022-2-2909K-36TC	11/2/2015	11/2/2017

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	902.000M	79.0	+19.3	+0.4			+0.0	98.7	114.7	-16.0	Anten
2	928.000M	68.4	+19.3	+0.4			+0.0	88.1	114.7	-26.6	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 #:	**99218**	Date:	4/25/2017
Test Type:	**Conducted Emissions**	Time:	13:56:32
Tested By:	Don Nguyen	Sequence#:	4
Software:	EMITest 5.03.02		110V 60Hz

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

The equipment under test (EUT) is stand alone on the table top. The EUT is turned on and set in transmit mode. The EUT has new batteries installed. Nominal input voltage is 6.3Vdc.

Freq range: 902-928 MHz
Modulation: GFSK. OOK
Firmware power: power level 1, 3
Firmware version: MSP 0.17.0.0, STM32 1.19.1.0
Evaluation performed at antenna port.
Duty cycle: power level 3: 56.1mS/100mS, power level 1: 12.2mS/100mS

Level 1: 16384bps	OOK	903MHz, 910MHz, 915MHz, 926.8MHz
Level 3: 10kbps	GFSK	902.2MHz, 910MHz, 915MHz, 927.75MHz
Level 3: 150kbps	GFSK	902.4MHz, 910MHz, 915.2MHz, 927.6MHz
Level 3: 16384bps	OOK	903MHz, 910MHz, 915MHz, 926.8MHz

Frequency range of measurement = 9 kHz- 10GHz.
9 kHz - 10000 MHz; RBW=100kHz, VBW=100kHz.
Test environment conditions Temperature: 24°C, Humidity: 40%, Pressure: 100.1kPa.

Site A. Test Method: ANSI C63.10 (2013)

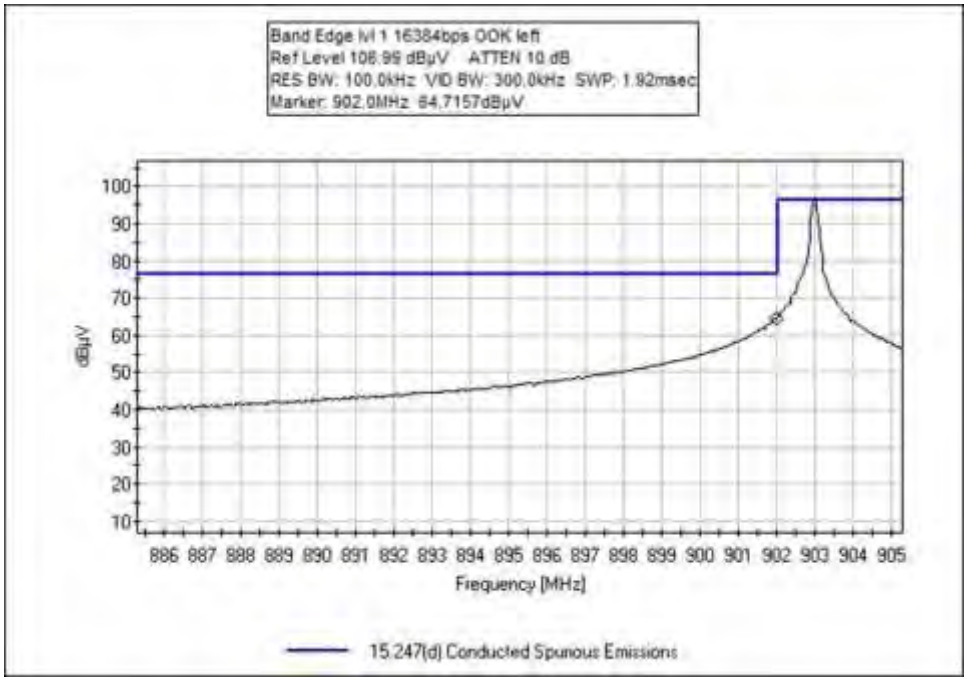
Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02672	Spectrum Analyzer	E4446A	3/2/2017	3/2/2019
T1	AN03431	Attenuator	89-20-21	11/2/2015	11/2/2017
T2	AN02946	Cable	32022-2-2909K-36TC	11/2/2015	11/2/2017

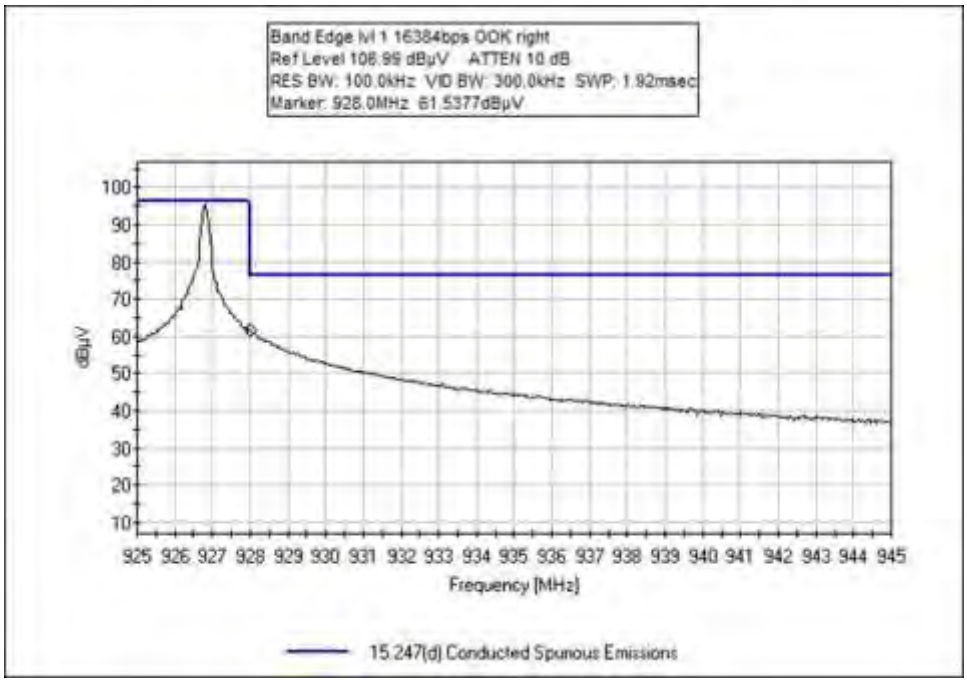
Measurement Data: Reading listed by margin. Test Lead: Antenna port

#	Freq MHz	Rdng dBµV	T1 dB	T2 dB	dB	dB	Dist Table	Corr dBµV	Spec dBµV	Margin dB	Polar Ant
1	928.000M	60.0	+19.3	+0.4			+0.0	79.7	114.6	-34.9	Anten
2	902.000M	60.0	+19.3	+0.4			+0.0	79.7	114.6	-34.9	Anten

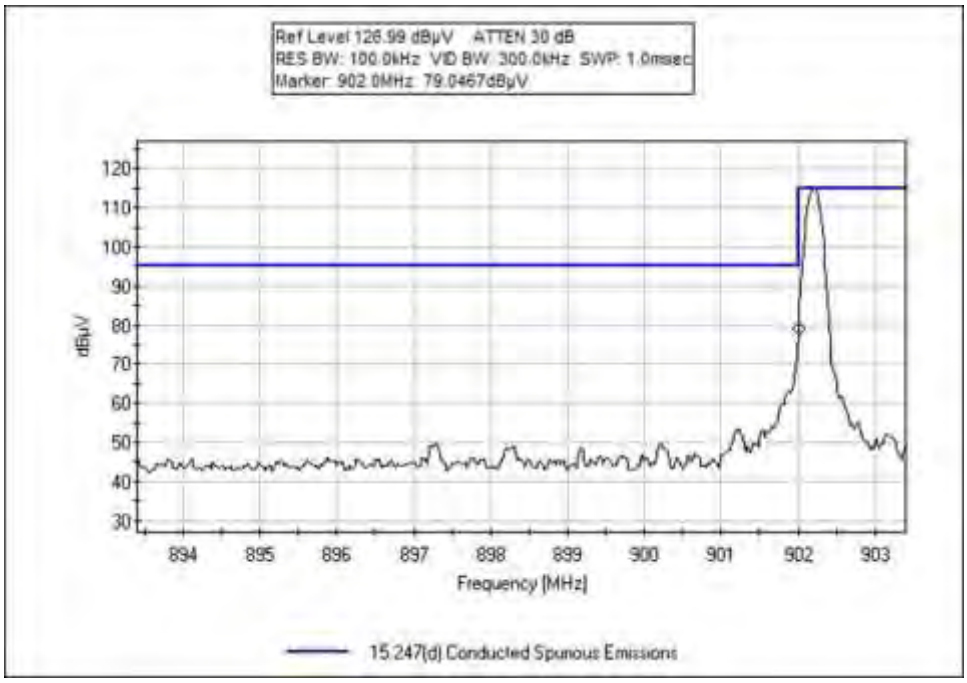
Band Edge Plots



lvl 1 16384bps OOK left



lvl 1 16384bps OOK right



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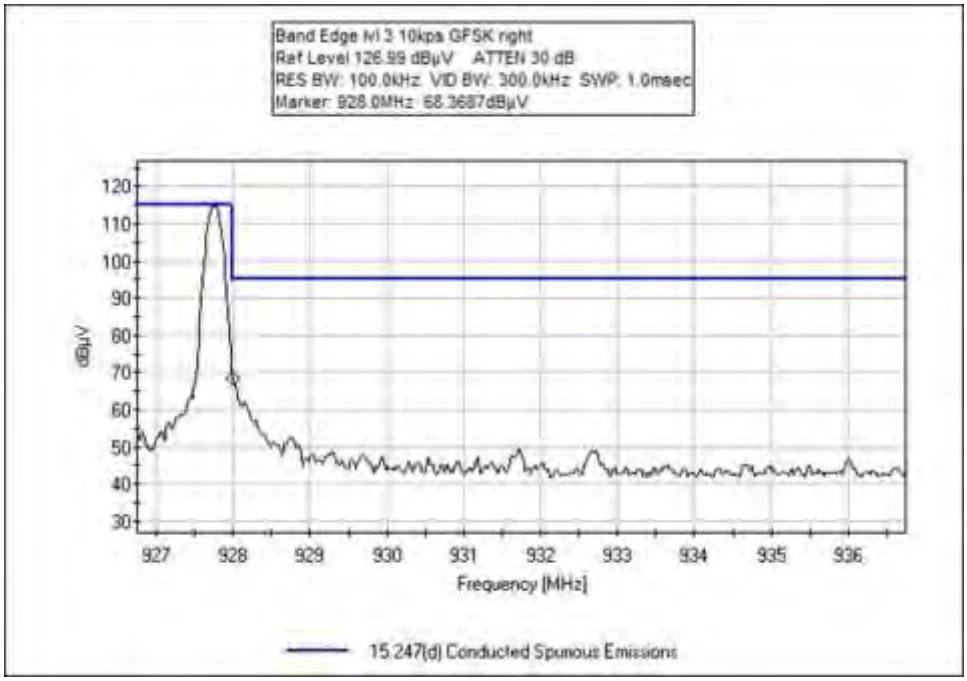

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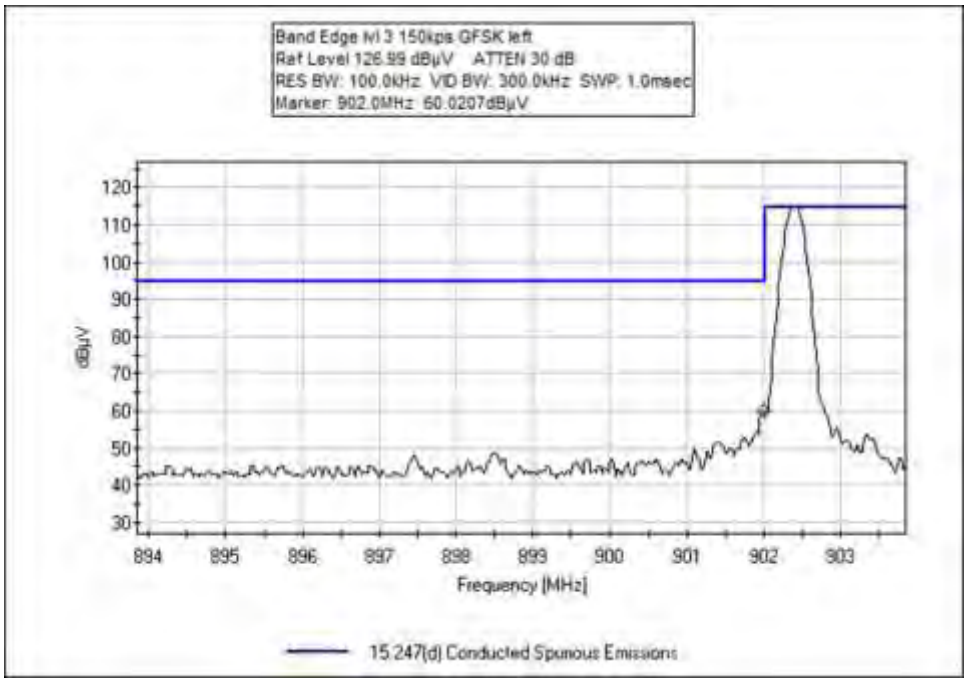

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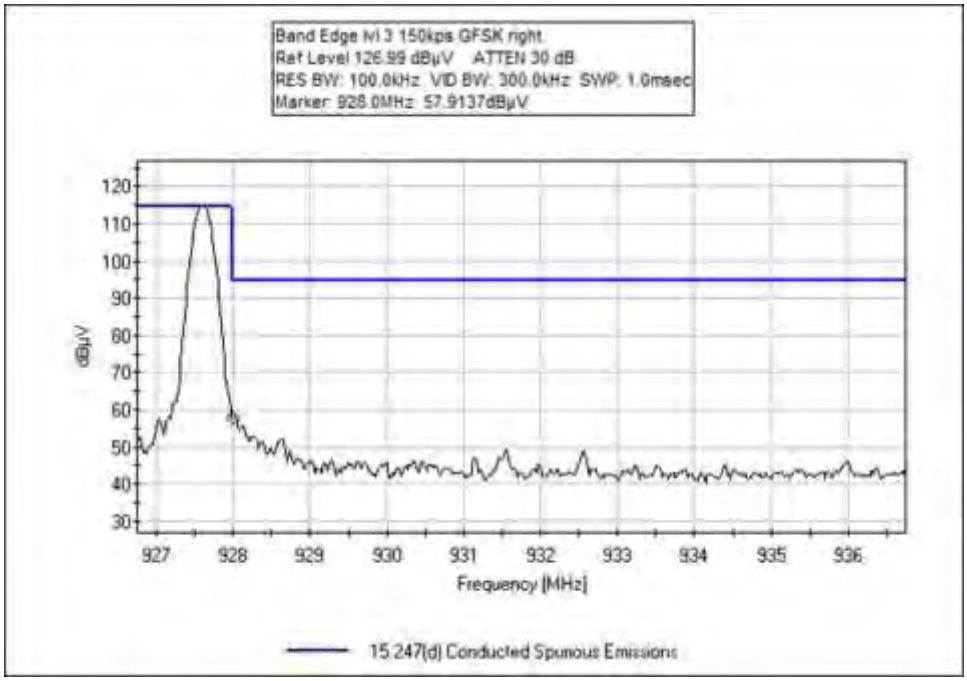

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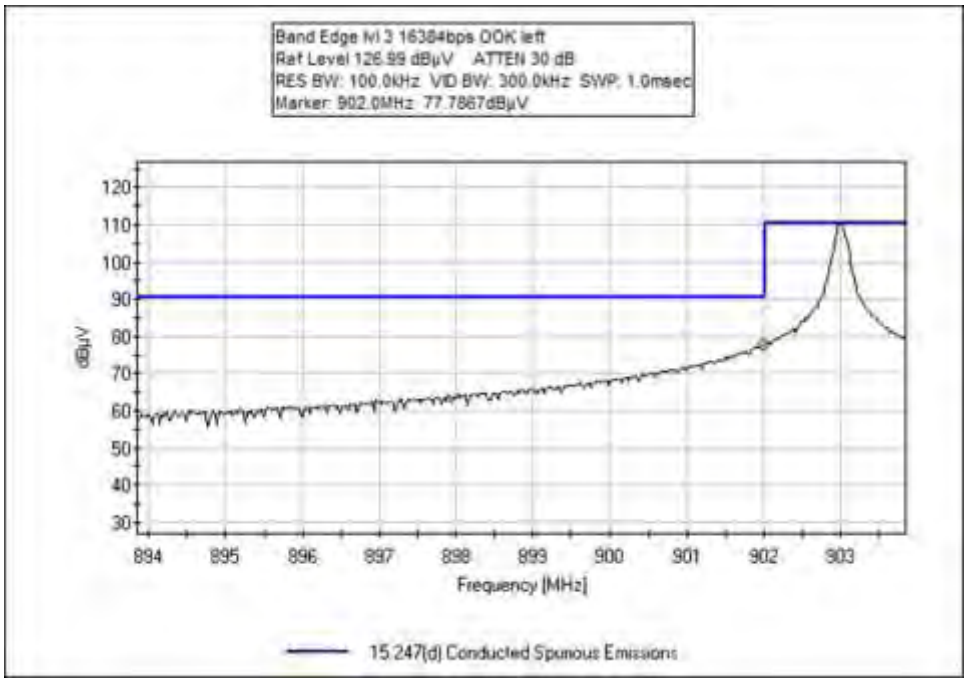

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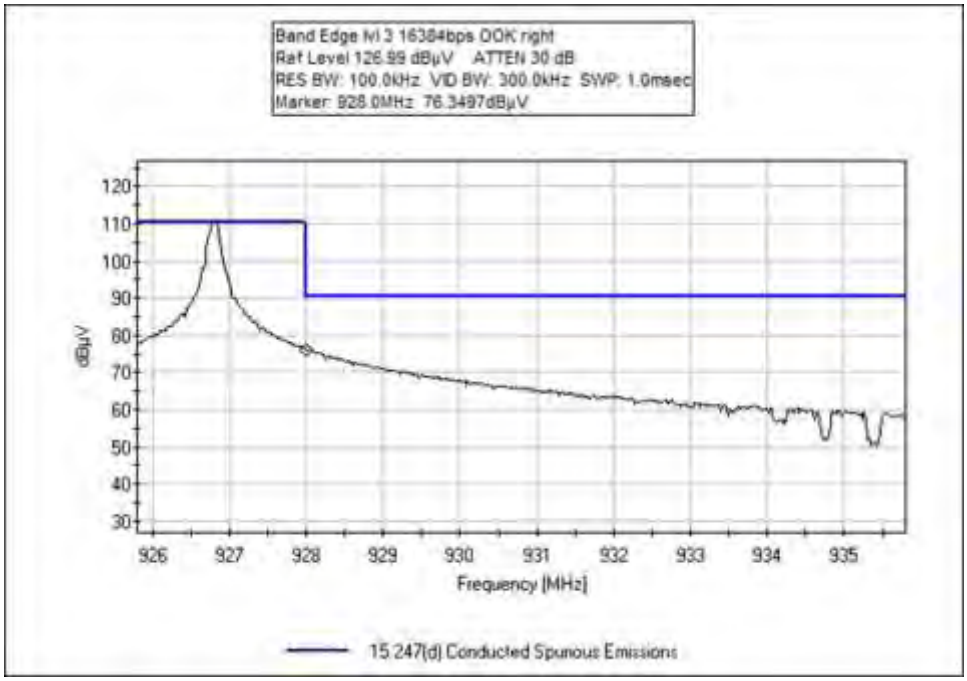

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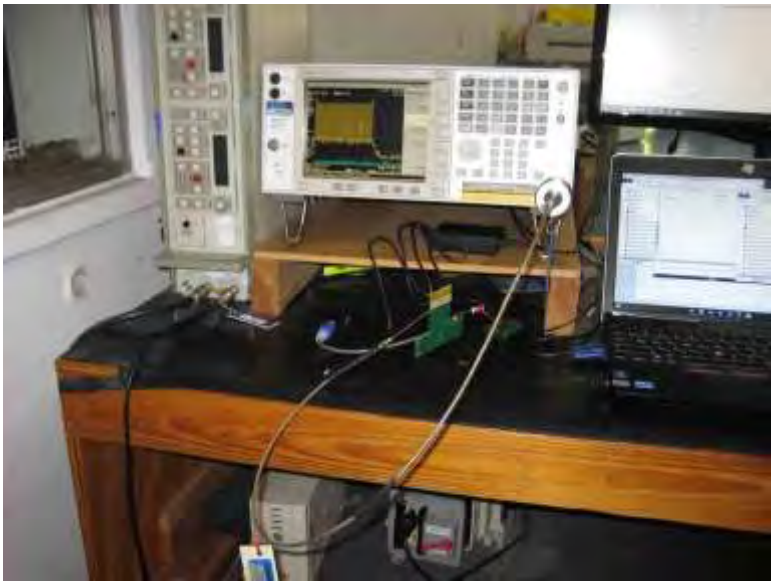
Test Setup Photo(s)



SUPPLEMENTAL INFORMATION

Measurement Uncertainty

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

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

Emissions Test Details

TESTING PARAMETERS

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

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

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

CORRECTION FACTORS

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

SAMPLE CALCULATIONS		
	Meter reading	(dBµV)
+	Antenna Factor	(dB/m)
+	Cable Loss	(dB)
-	Distance Correction	(dB)
-	Preamplifier Gain	(dB)
=	Corrected Reading	(dBµV/m)

TEST INSTRUMENTATION AND ANALYZER SETTINGS

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

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.