



F2 Labs
16740 Peters Road
Middlefield, Ohio 44062
United States of America
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CERTIFICATION TEST REPORT

Manufacturer: Structured Mining Systems, Inc.
d.b.a. Cervis Inc.
170 Thorn Hill Road
Warrendale, Pennsylvania 15086
United States of America

Applicant: Same As Above

Product: Module

Model: MRF450

FCC ID: LOBMRF450

Testing Commenced: Sept. 23, 2013

Testing Ended: Oct. 7, 2013

Summary of Test Results: Page 5

Standards:

- ❖ **FEDERAL REGISTER CFR 47, PART 15 – RADIO FREQUENCY DEVICES**
 - Part 15 Subpart C, Section 15.231 - Periodic operation in the band 40.66–40.70 MHz and above 70 MHz
 - Part 15 Subpart C, Section 15.209 - Radiated emissions limits; general requirements
 - Part 15 Subpart C, Section 15.35 - Measurement detector functions and bandwidths
- ❖ **ANSI C63.4 2009 – American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz**



Order Number: F2LQ5719

Client: Cervis Inc.

Model: MRF450

Evaluation Conducted by:

Ken Littell, EMC Tech. Mgr.

Report Reviewed by:

Wendy Fuster, President

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1 ADMINISTRATIVE INFORMATION

1.1 Measurement Location:

F2 Labs in Middlefield, Ohio. Site description and attenuation data are on file with the FCC's Sampling and Measurement Branch at the FCC Laboratory in Columbia, MD.

1.2 Measurement Procedure:

All measurements were performed according to the 2003 version of ANSI C63.4 and recommended FCC procedure of measurement of DTS operating under Section 15.231. A list of the measurement equipment can be found in Section 6.

1.3 Uncertainty Budget:

Radiated Emission

- Combined Uncertainty (+ or -) 2.24 dB
- Expanded Uncertainty (+ or -) 4.48 dB

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

1.4 Document History

Document Number	Description	Issue Date	Approved By
F2LQ5719-01E	First Issue	Dec. 3, 2013	W. Fuster
F2LQ5719-01E Rev. 1	Retest of field strength emissions and replacement of test data, Section 8	Mar. 9, 2014	W. Fuster



2 SUMMARY OF TEST RESULTS

Standard(s)	Results
CFR 47 Part 15.231(a)(1)	Complies
CFR 47 Part 15.231(b) / Part 15.209	Complies
CFR 47 Part 15.231(b)(3)(c)	Complies
CFR 47 Part 15.35	Complies

Modifications Made to the Equipment
None



4 ENGINEERING STATEMENT

This report has been prepared on behalf of Cervis Inc. to provide documentation for the testing described herein. This equipment has been tested and found to comply with Part 15.231 of the FCC Rules using ANSI C63.4 2009 standards. The test results found in this test report relate only to the items tested.



5 EUT INFORMATION AND DATA

5.1 Equipment Under Test:

Product: Module

Model: MRF450

Serial No.: N/A

FCC ID: LOBMRF450

5.2 Trade Name:

Structured Mining Systems, Inc. d.b.a. Cervis Inc.

5.3 Power Supply:

Battery Powered

5.4 Applicable Rules:

CFR 47, Part 15.231, subpart C

5.5 Equipment Category:

Module

5.6 Antenna:

0dBi Omni, Vertically polarized

5.7 Accessories:

N/A

5.8 Test Item Condition:

The equipment to be tested was received in good condition.

5.9 Testing Algorithm:

The EUT was configured to permit frequency changes from low-mid-upper transmission channel. For all tests, in a semi-anechoic chamber and on the OATS, the EUT was equipped with a 0dBi Omni antenna.

**6 LIST OF MEASUREMENT INSTRUMENTATION**

Equipment Type	Asset Number	Manufacturer	Model	Serial Number	Calibration Due Date
Shield Room	0175	Ray Proof	N/A	11645	Oct. 28, 2014
Temp/Hum. Recorder	CL137	Extech	RH520	CH16992	Apr. 17, 2014
OATS-3m	CL017	Compliance Labs	N/A	001	Nov. 30, 2013
Spectrum Analyzer	CL147	Agilent	E7402A	MY45101241	Oct. 24, 2014
Spectrum Analyzer	CL138	Agilent Technologies	E4407B	US41192779	Oct. 29, 2014
Receiver	CL151	Rohde & Schwarz	ESU40	100319	Oct. 30, 2014
Antenna 1-Chamber	0142	ETS/EMCO	3142B	9811-1330	Verified
Antenna 2-OATS	0105	Sunol Sciences	JB1	A101101	May 7, 2015
Pre-Amplifier	0139	Hewlett Packard	83006A	3104A00500	Feb. 20, 2014
Active 18" Loop Antenna	CL082	A.H. Systems, Inc.	SAS-562B	241	Sept. 6, 2014
Antenna, Horn	CL098	Emco	3115	9809-5580	Nov. 30, 2013
Cable: 0.3m Low Loss	CL116	A.H. Systems, Inc.	SAC-26G-0.3	206	Mar. 1, 2014
Cable: 0.3m Low Loss	CL117	A.H. Systems, Inc.	SAC-26G-3	207	Nov. 30, 2013
Coaxial Cable	CL139	Thermax	M17/128-RG400	JB (Brown)	Feb. 2, 2014
Coaxial Cable	CL140	Thermax	M17/128-RG400	JC (Brown)	Feb. 2, 2014



7 FCC PART 15.231(a)(1)

7.1 Requirements:

A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter with not more than 5 seconds of being released.

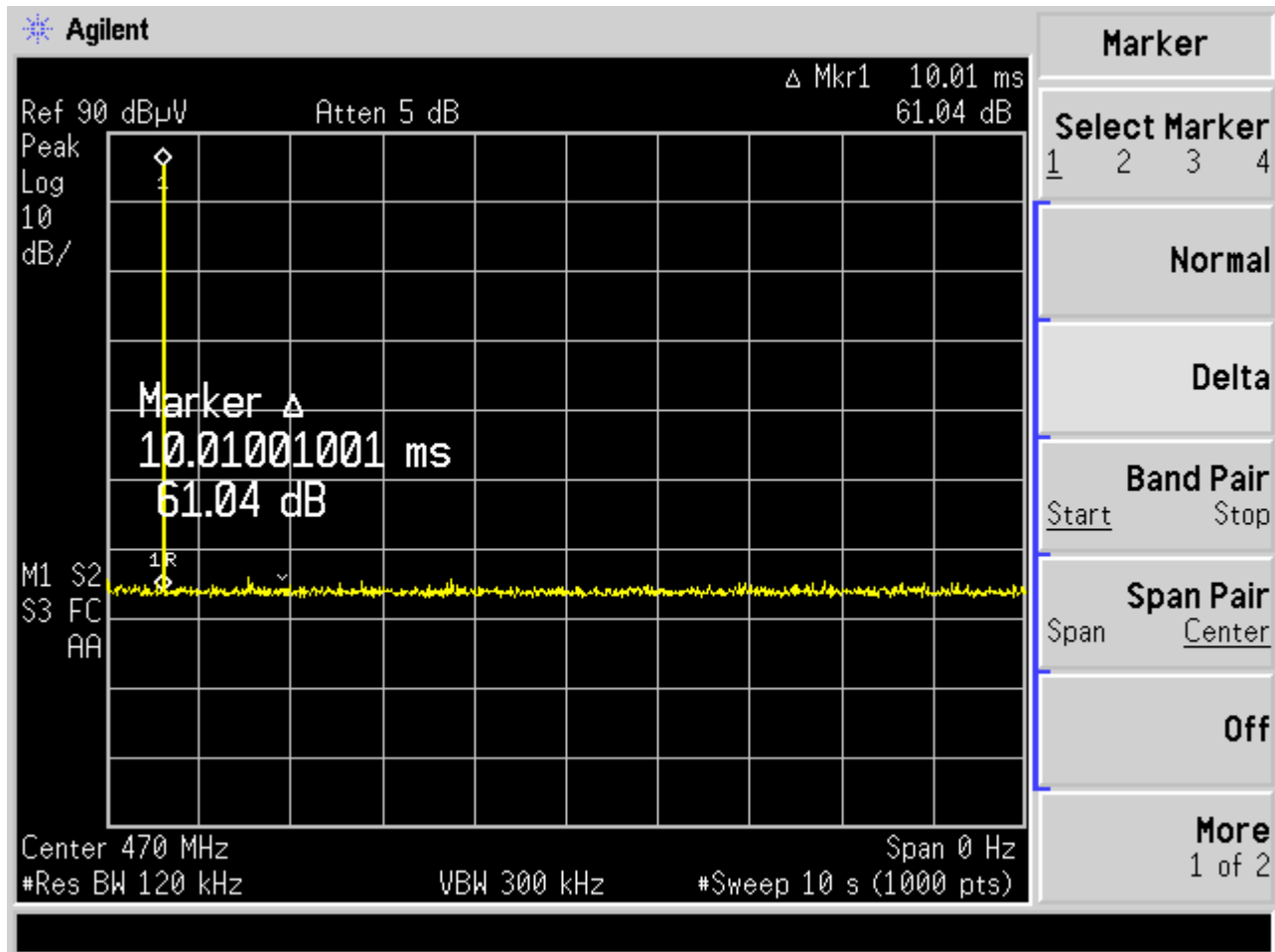


7.2 Test Data

Test Date:	Sept. 23, 2013	Test Engineer:	K. Littell
Standards:	CFR 47 Part 15.231(a)(1);	Air Temperature:	21.1°C
		Relative Humidity:	47%

High Channel

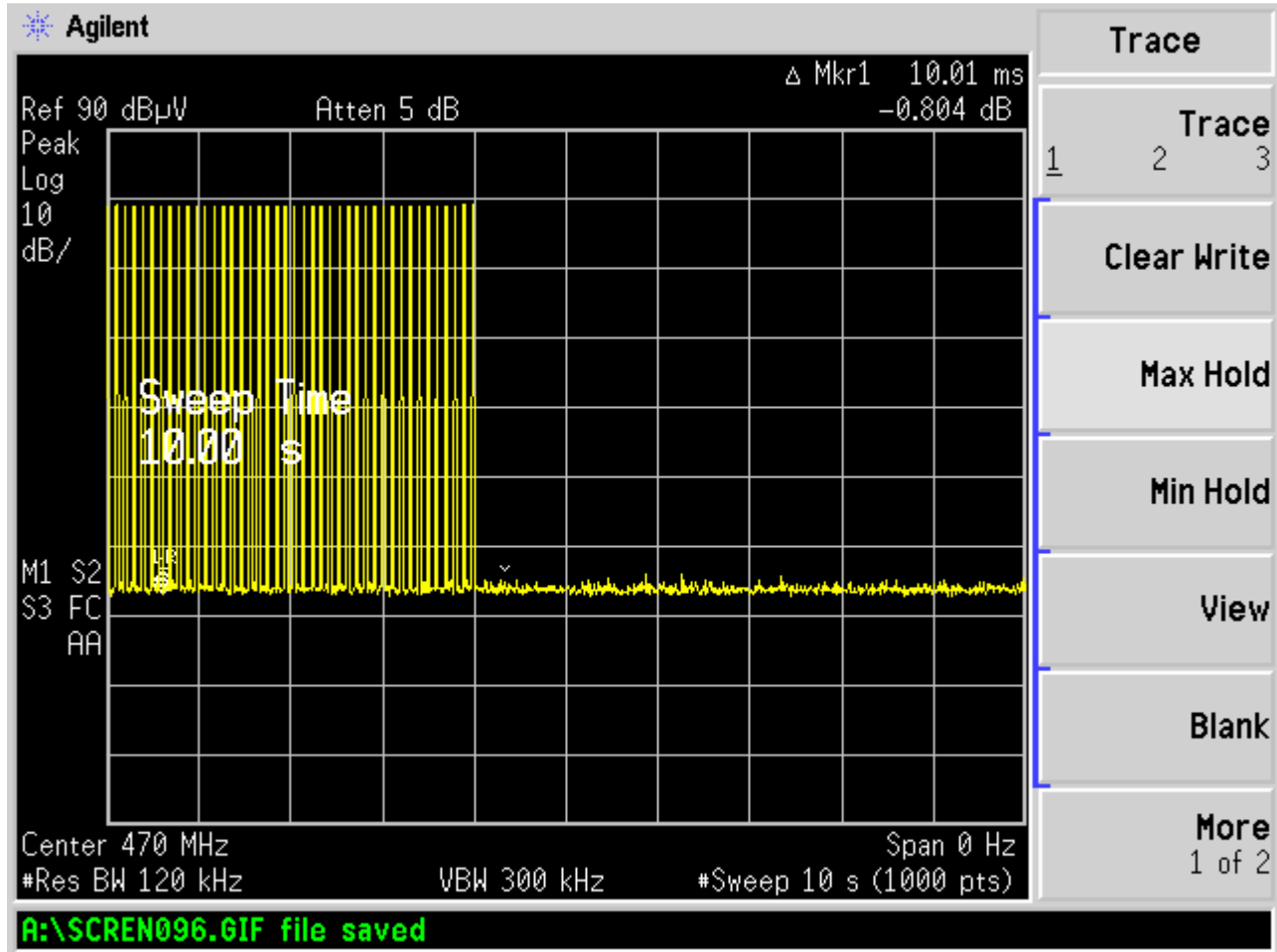
The following plot is of a single press and release of the manual push button, showing that the transmission ceased prior to 5 seconds of release.





High Channel, cont'd

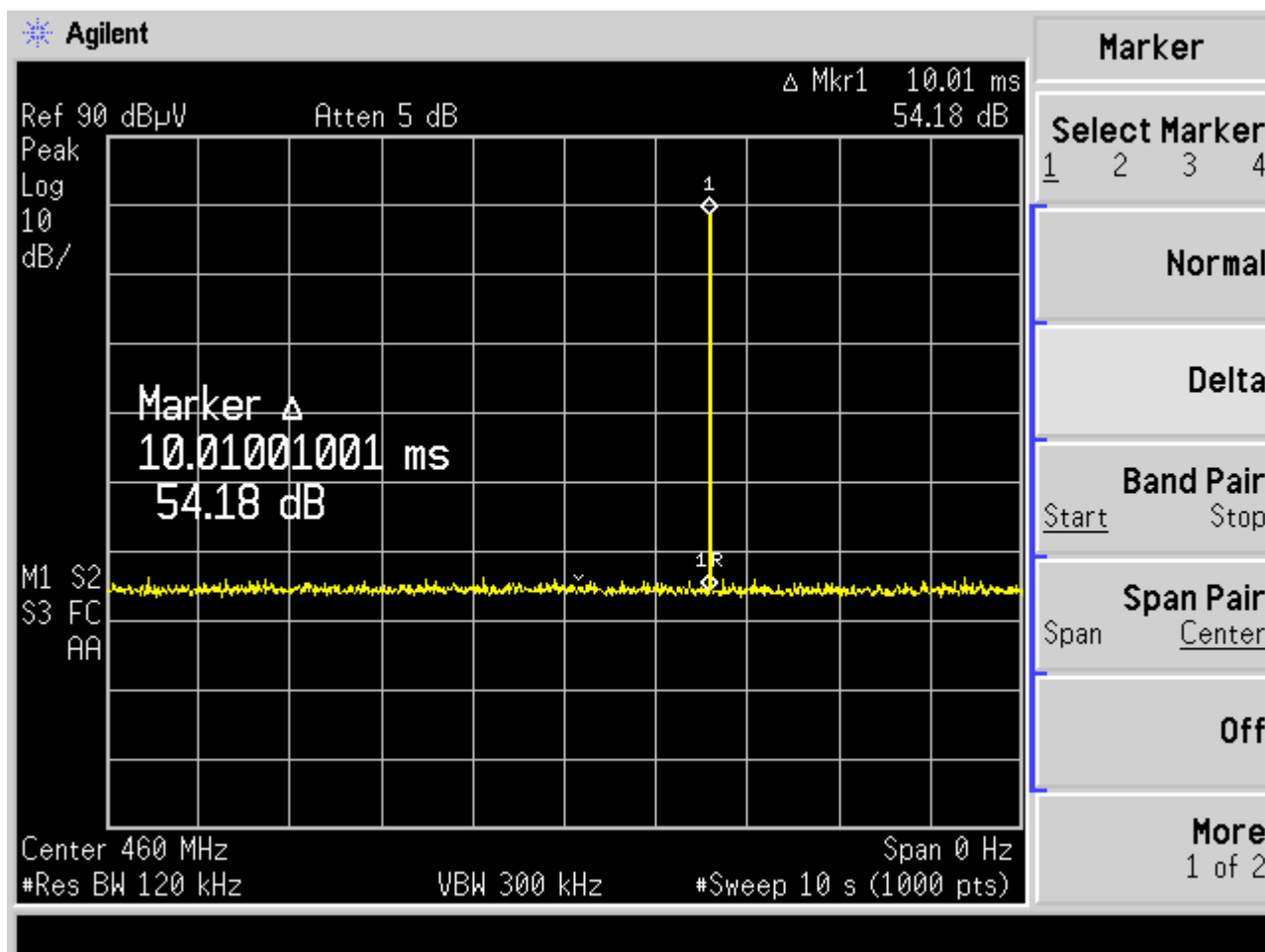
The following plot is of a press and hold for four seconds then release of the manual push button. This is to show that the transmission ceased in less than 5 seconds of release.





Mid Channel

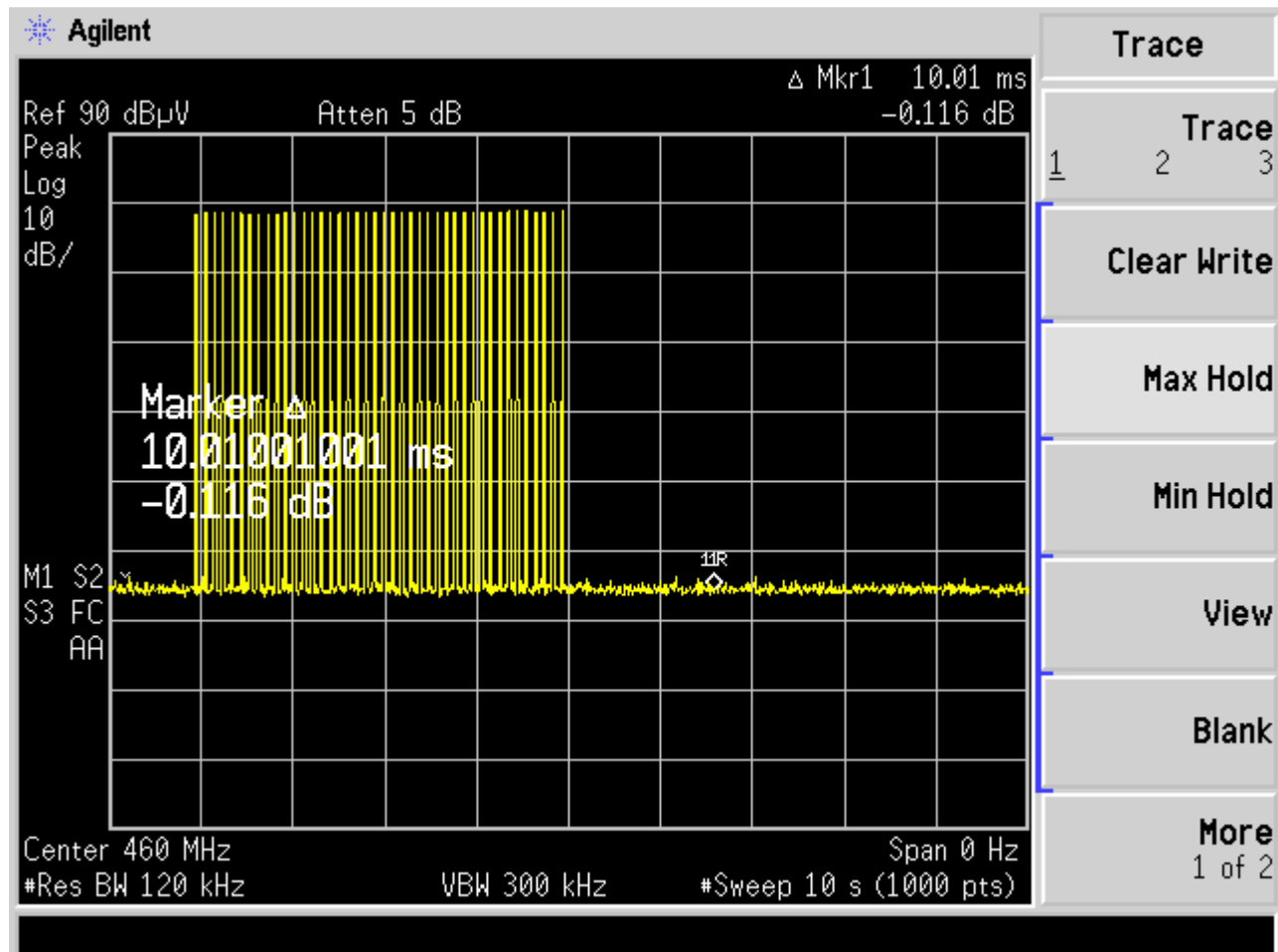
The following plot is of a single press and release of the manual push button, showing that the transmission ceased prior to 5 seconds of release.





Mid Channel, cont'd

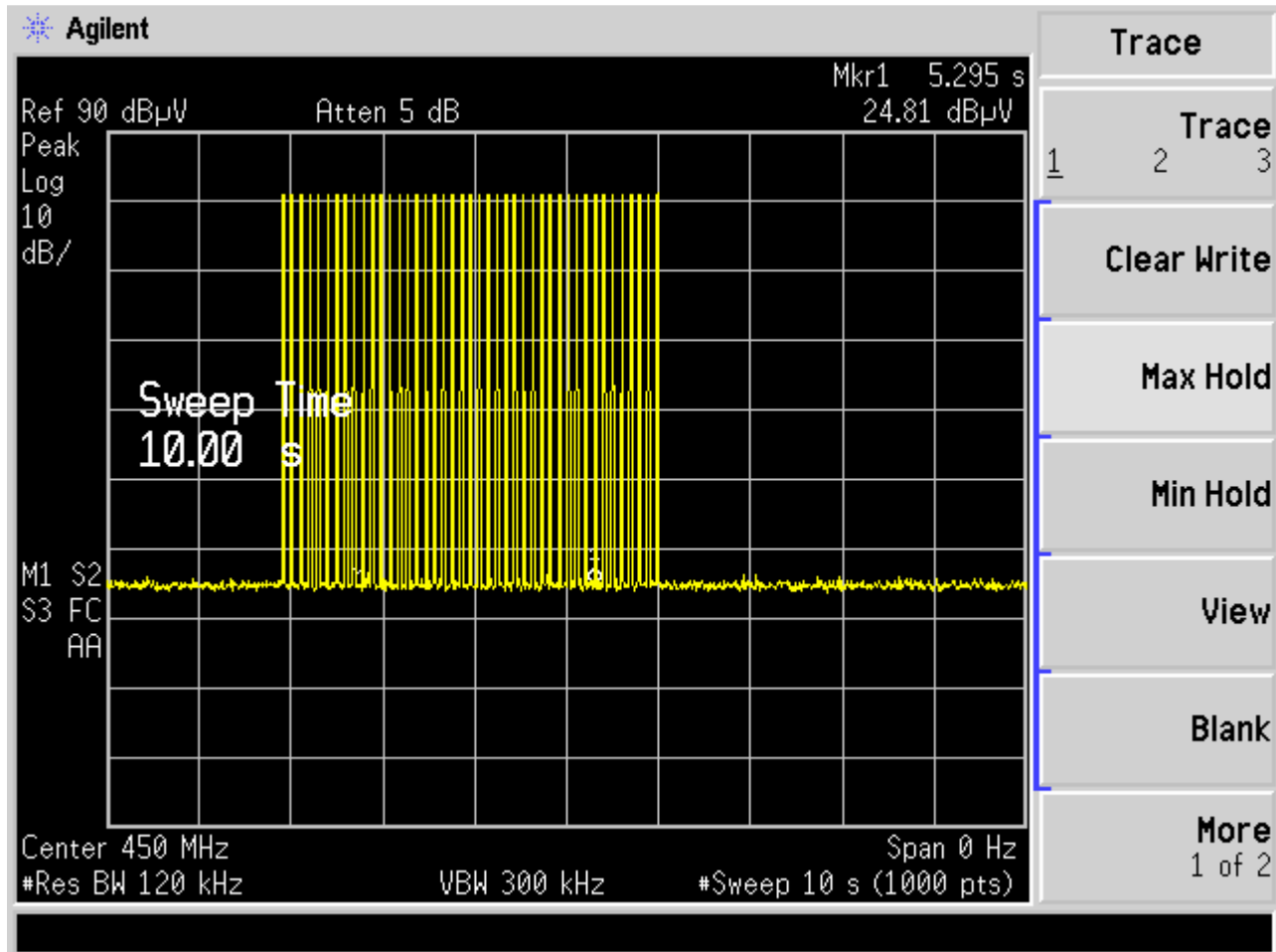
The following plot is of a press and hold for four seconds then release of the manual push button. This is to show that the transmission ceased in less than 5 seconds of release.





Low Channel

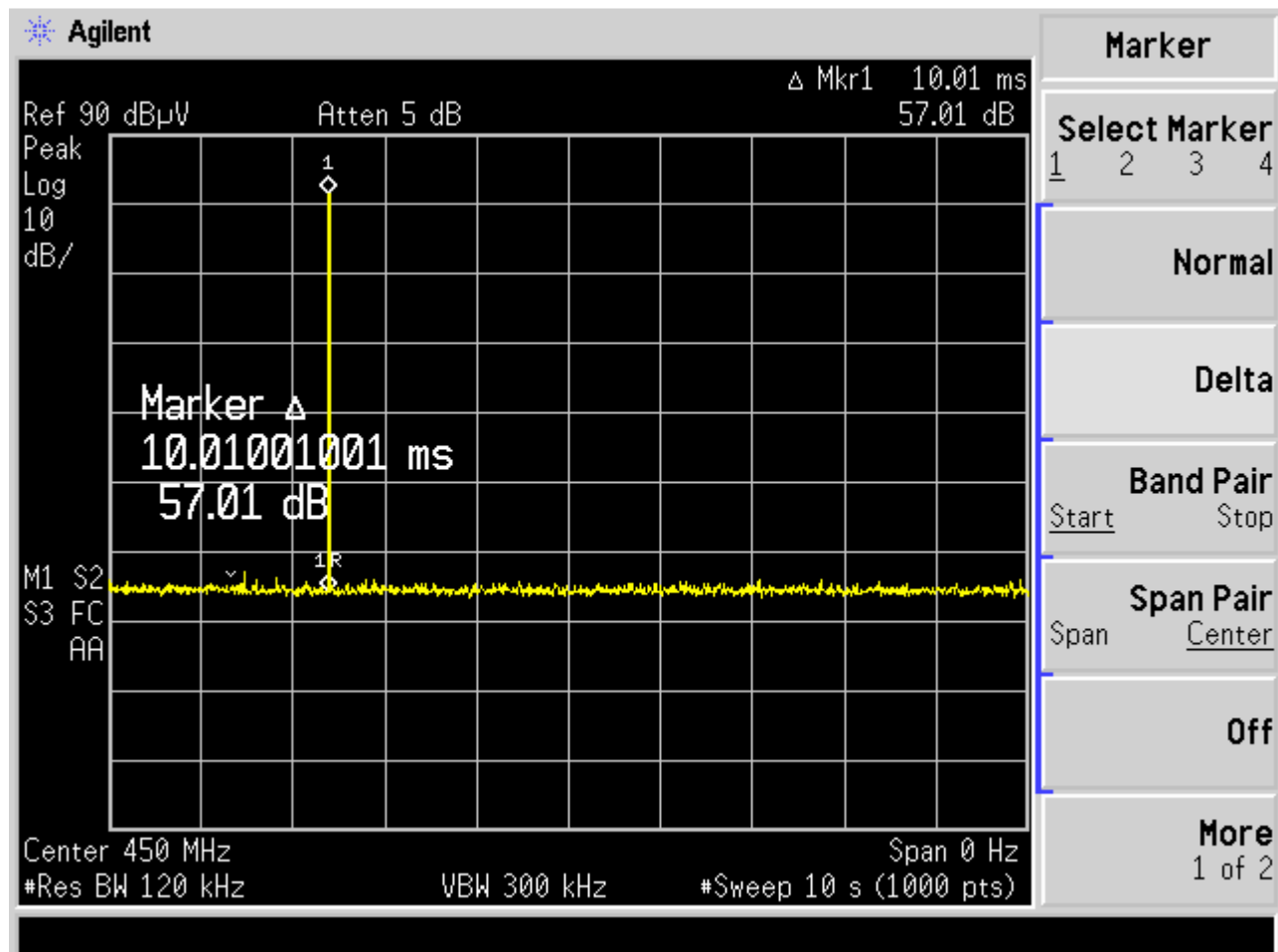
The following plot is of a press and hold for four seconds then release of the manual push button. This is to show that the transmission ceased in less than 5 seconds of release.





Low Channel, cont'd

The following plot is of a single press and release of the manual push button, showing that the transmission ceased prior to 5 seconds of release.





8 FCC PART 15.231(b)

8.1 Requirements:

Field strength of emissions, fundamental and spurious using average detector and a peak limit of 20dB was added above the average limit per 15.35(b).

Limits for fundamental frequency 260 MHz to 470 MHz is : 3750 to 12,500 $\mu\text{V/m}$.

Limits for spurious emissions were those specified in 15.209.

While the equipment was energized, the receiving antenna was scanned from 1.0 meter to 4.0 meters in both vertical and horizontal polarities while the turntable was adjusted 360 degrees to determine the maximum field strength.

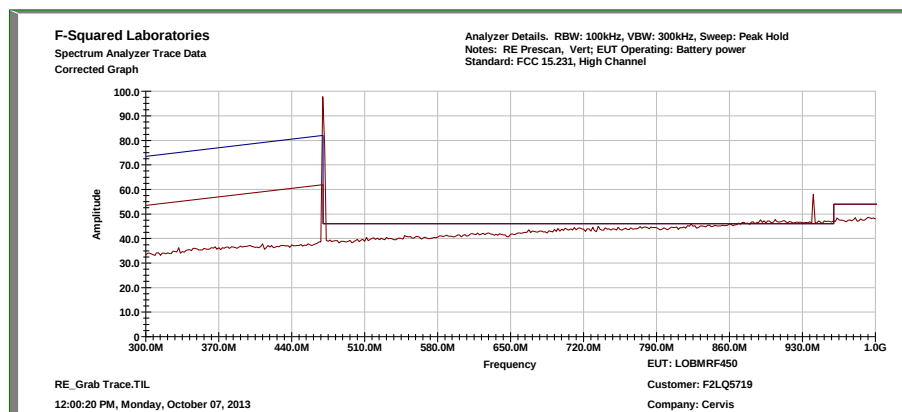
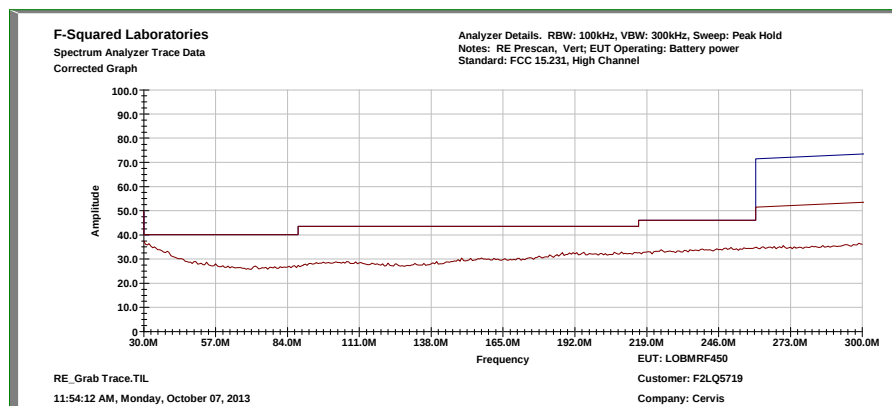
The equipment was fully exercised with all cabling attached to the EUT and was positioned for maximum emissions. The EUT antenna was positioned flat against the plastic tabletop and it was verified, by placing a foam support between the table and the antenna, that the table had no effect on the emissions at these frequency ranges.



8.2 Test Data

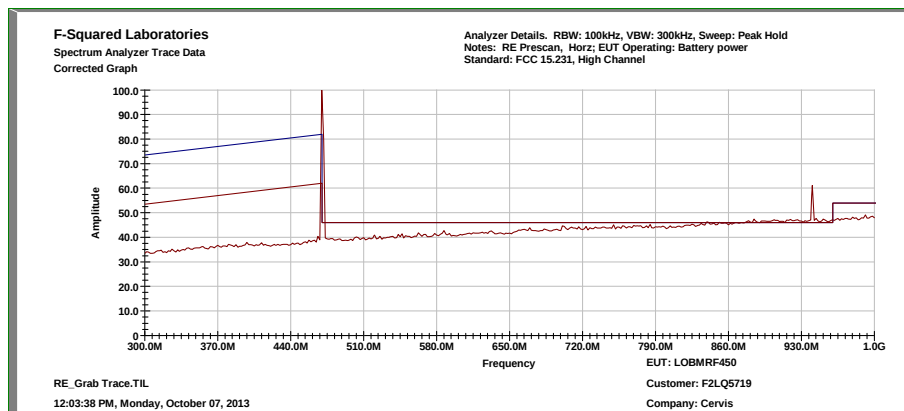
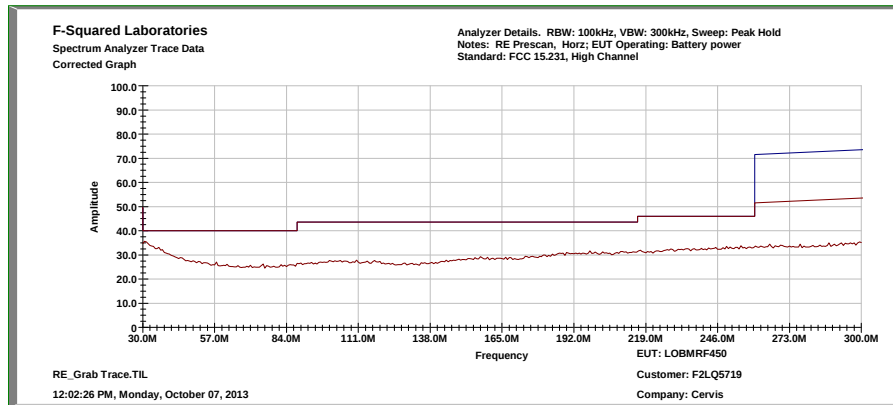
Test Date:	Oct. 7, 2013	Test Engineer:	K. Littell
Standards:	CFR 47 Part 15.231(b); 15.209; C63.4:2009, Section 13.7	Air Temperature:	21.3°C
		Relative Humidity:	47%

High Channel





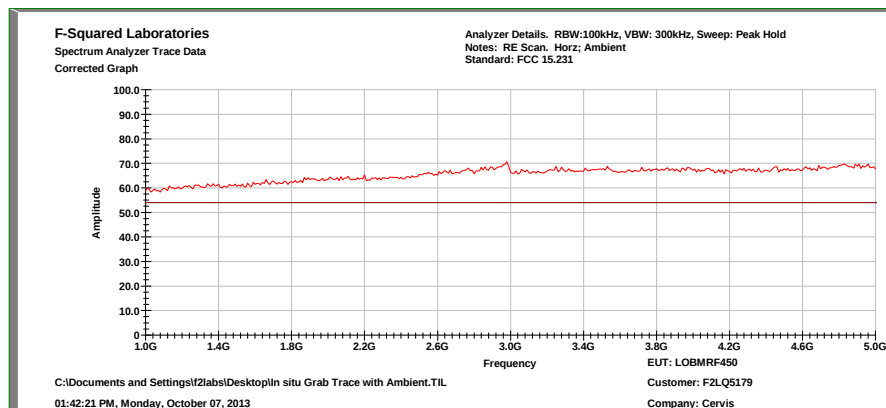
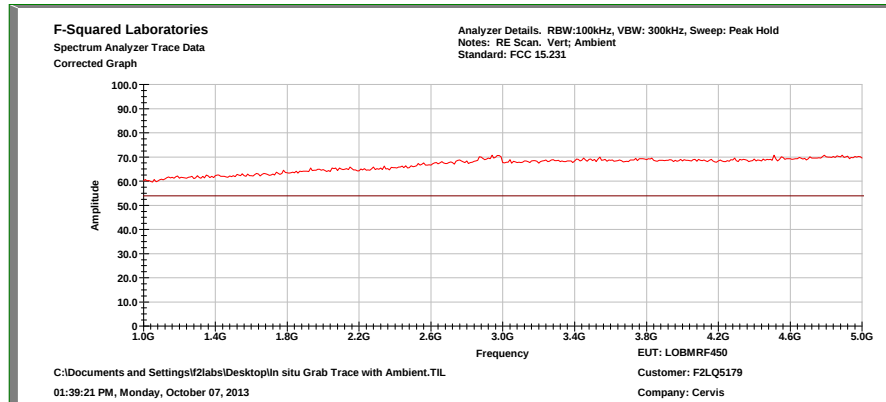
High Channel, cont'd





High Channel, cont'd

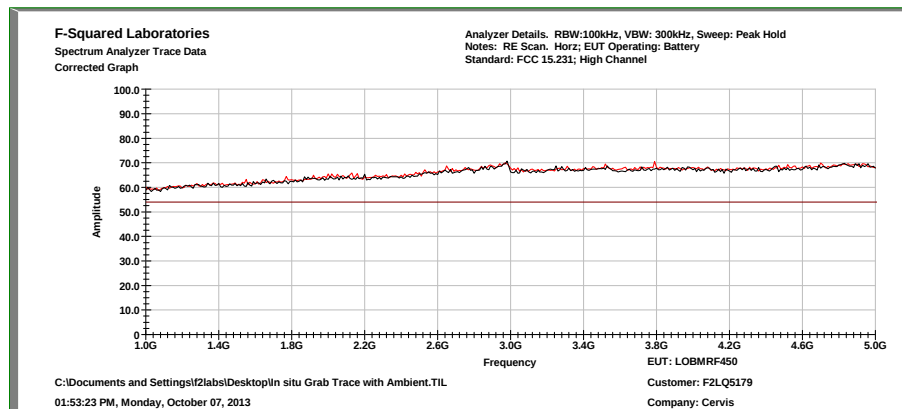
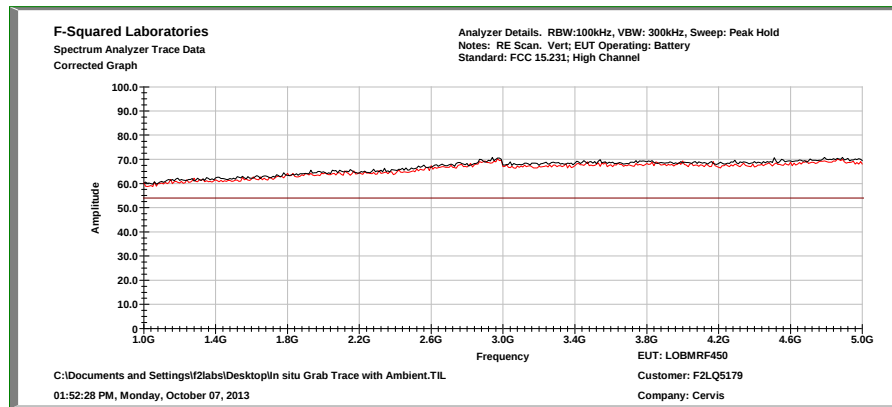
NOTE: The following plots are of the ambient noise floor measurement with the EUT off.





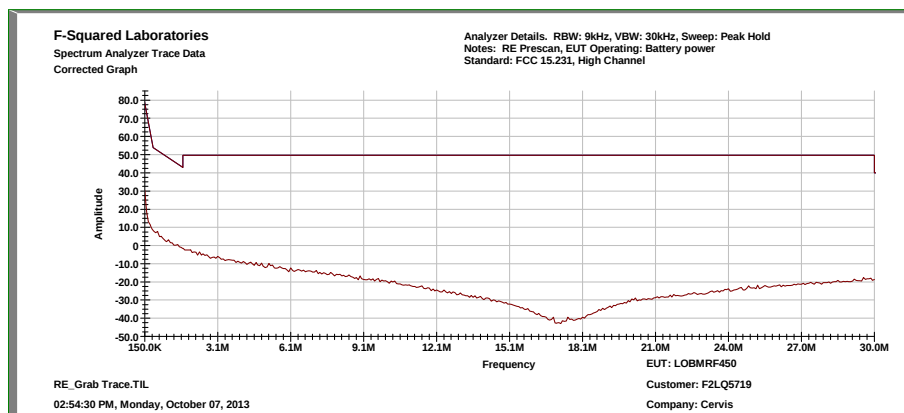
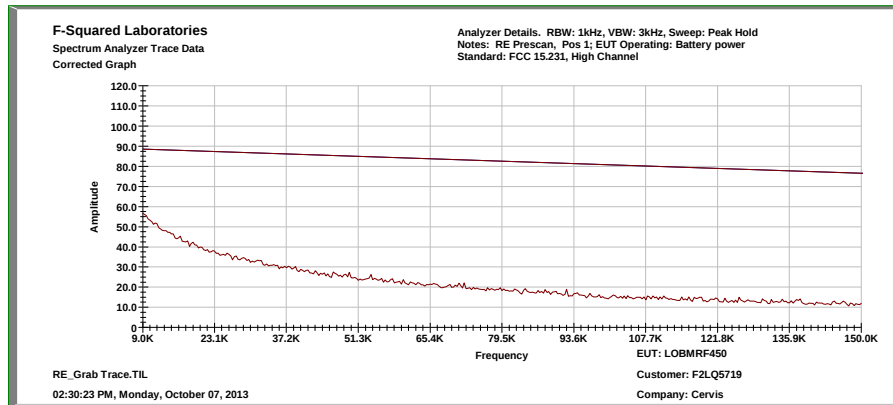
High Channel, cont'd

NOTE: The following plots are of the ambient noise floor measurement in black and the measurement with the EUT on in red, showing that there were no measurable emissions above the noise floor.





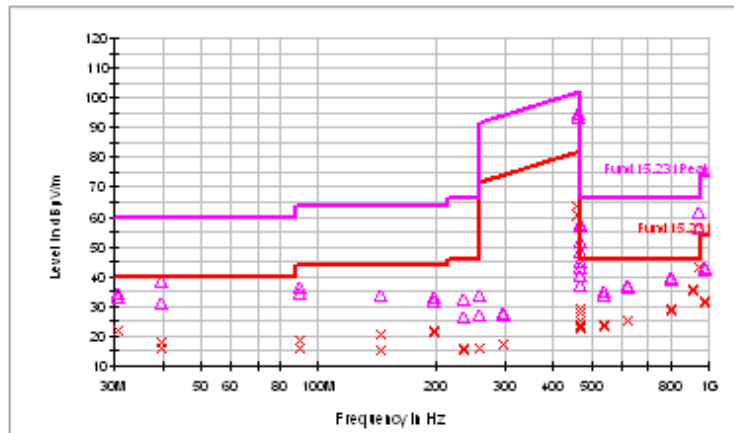
High Channel, cont'd





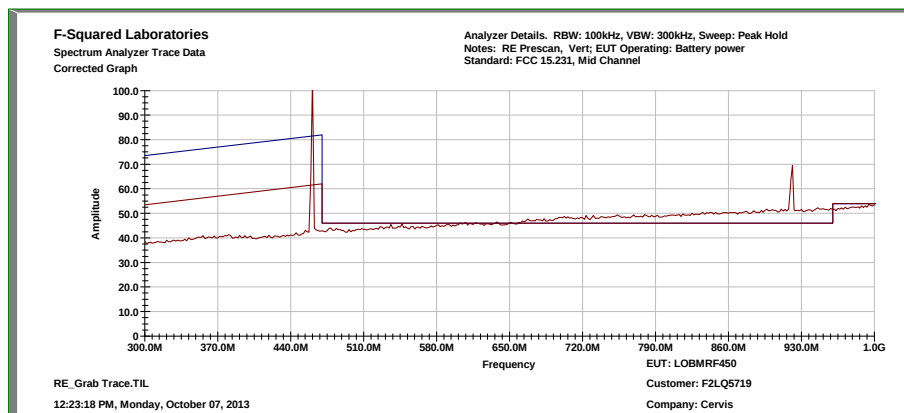
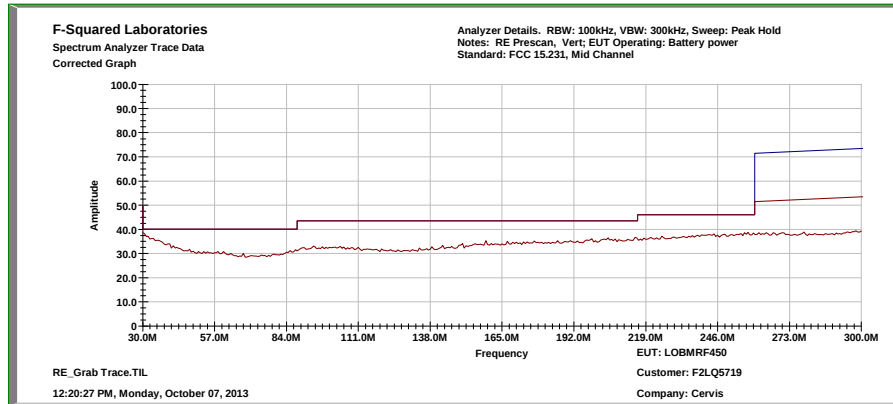
High Channel

Frequency (MHz)	MaxPeak (dBμV/m)	MaxPeak (dBμV/m) Limit	Average (dBμV/m)	Average (dBμV/m) w/DCCF	Average (dBμV/m) Limit	Bandwidth (kHz)	Polarity	Corr. (dB)
30.620000	34.7	60.0	22.0	2.0	40.0	120.000	H	22.1
30.620000	33.2	60.0	21.9	1.9	40.0	120.000	V	20.7
39.480000	38.5	60.0	15.9	-4.1	40.0	120.000	H	15.3
39.480000	31.2	60.0	18.3	-1.7	40.0	120.000	V	14.0
89.410000	36.5	63.5	15.9	-4.1	43.5	120.000	V	10.4
89.410000	34.4	63.5	18.4	-1.6	43.5	120.000	H	9.4
143.980000	33.9	63.5	15.1	-4.9	43.5	120.000	H	14.9
143.980000	33.7	63.5	20.8	0.8	43.5	120.000	V	15.0
197.480000	33.3	63.5	21.8	1.8	43.5	120.000	V	15.5
197.480000	31.7	63.5	21.1	1.1	43.5	120.000	H	15.8
236.380000	32.6	66.0	15.7	-4.3	46.0	120.000	H	15.0
236.380000	26.4	66.0	15.1	-4.9	46.0	120.000	V	15.0
257.480000	33.9	66.0	15.6	-4.4	46.0	120.000	H	15.6
257.480000	27.2	66.0	15.9	-4.1	46.0	120.000	V	15.8
298.670000	27.2	94.6	17.0	-3.0	74.6	120.000	V	16.8
298.670000	28.0	94.6	17.3	-2.7	74.6	120.000	H	17.3
469.610000	40.6	101.9	23.4	3.4	81.9	120.000	V	21.5
469.670000	45.4	101.9	23.7	3.7	81.9	120.000	V	21.5
469.670000	57.5	101.9	29.0	9.0	81.9	120.000	H	21.9
469.670000	51.5	101.9	25.5	5.5	81.9	120.000	V	21.5
470.000000	96.4	101.9	61.7	41.7	81.9	120.000	V	21.5
470.000000	94.7	101.9	66.3	46.3	81.9	120.000	H	21.5
470.300000	56.9	66.0	27.9	7.9	46.0	120.000	H	21.9
470.310000	48.6	66.0	24.0	4.0	46.0	120.000	V	21.5
470.590000	37.0	66.0	22.9	2.9	46.0	120.000	V	21.6
470.610000	43.4	66.0	25.2	5.2	46.0	120.000	H	21.9
536.730000	33.7	66.0	23.2	3.2	46.0	120.000	V	22.7
536.730000	35.2	66.0	23.7	3.7	46.0	120.000	H	23.2
621.490000	37.3	66.0	25.4	5.4	46.0	120.000	V	24.5
621.490000	36.6	66.0	25.5	5.5	46.0	120.000	H	24.6
804.100000	39.2	66.0	28.4	8.4	46.0	120.000	V	27.2
804.100000	40.1	66.0	29.0	9.0	46.0	120.000	H	27.8
940.000000	52.0	66.0	34.4	14.4	46.0	120.000	H	29.5
940.000000	49.7	66.0	33.7	13.7	46.0	120.000	V	29.0
975.830000	42.5	73.9	31.4	11.4	53.9	120.000	V	29.5
977.250000	43.2	73.9	31.9	11.9	59.9	120.000	H	30.0



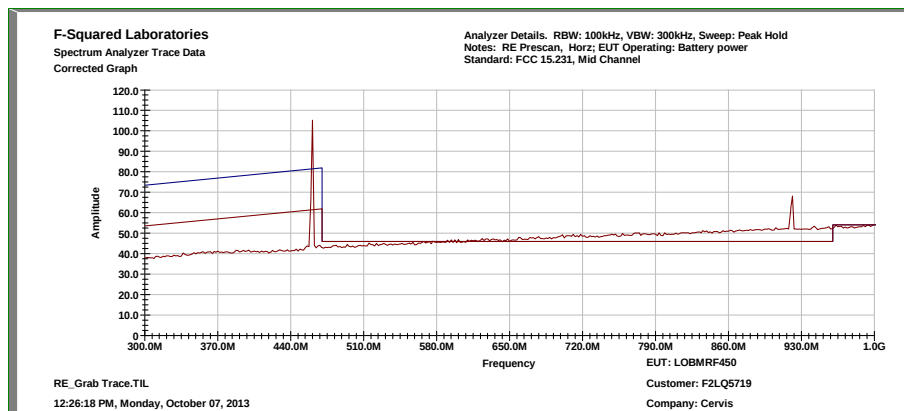
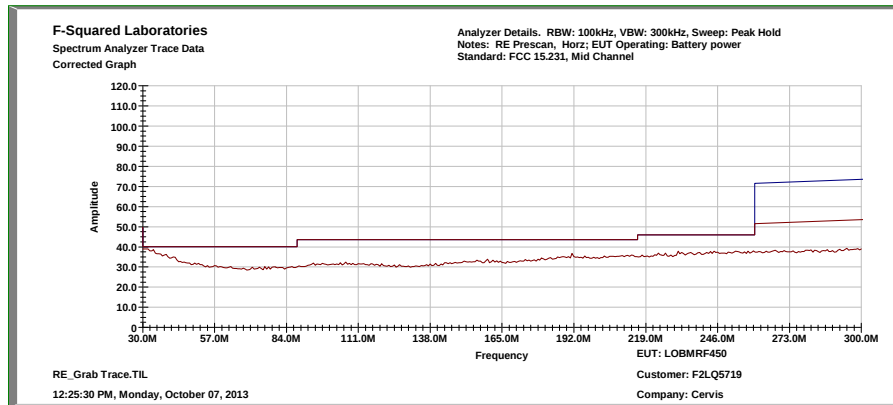


Mid Channel





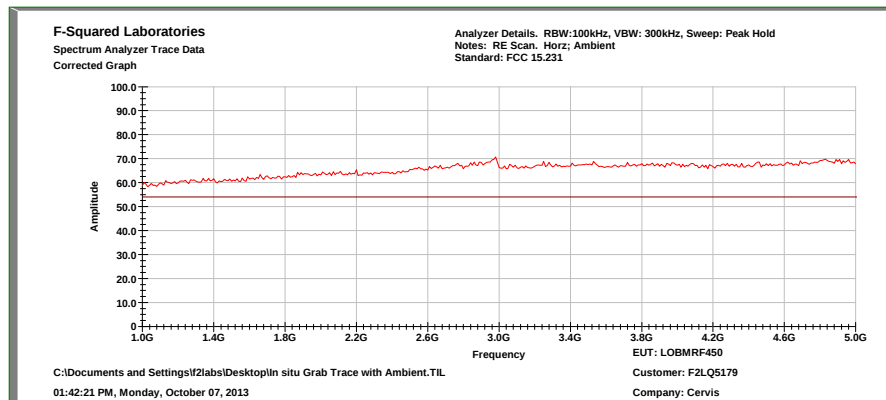
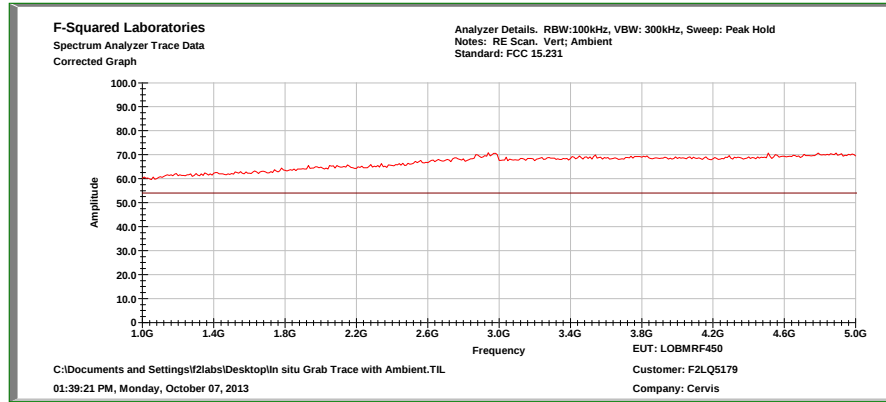
Mid Channel, cont'd





Mid Channel, cont'd

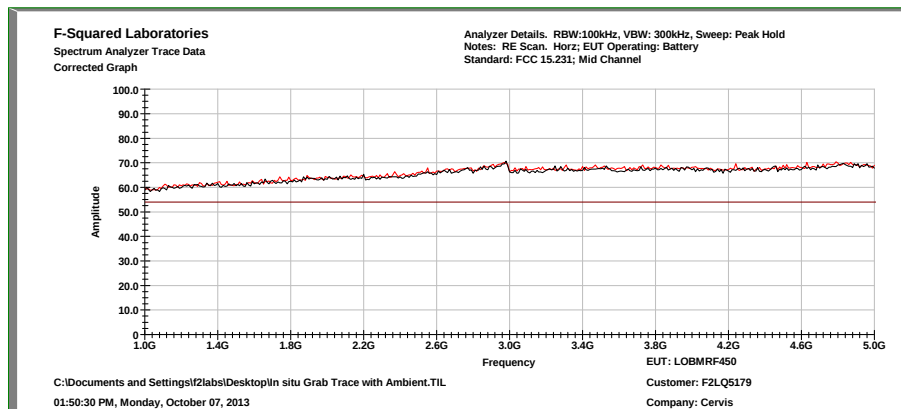
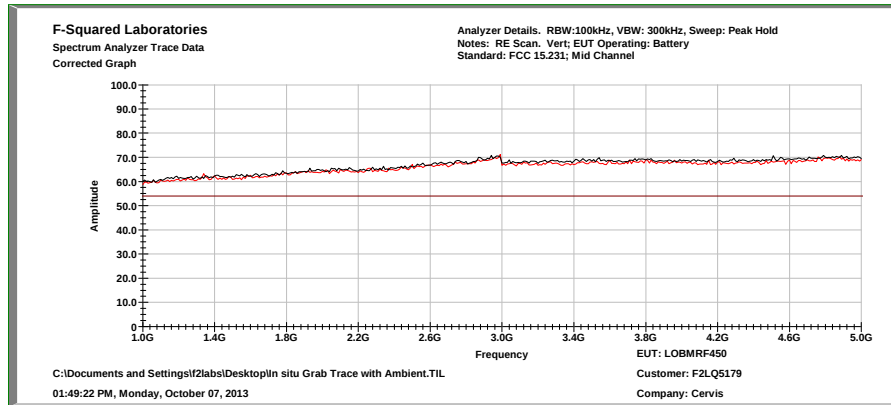
NOTE: The following plots are of the ambient noise floor measurement with the EUT off.





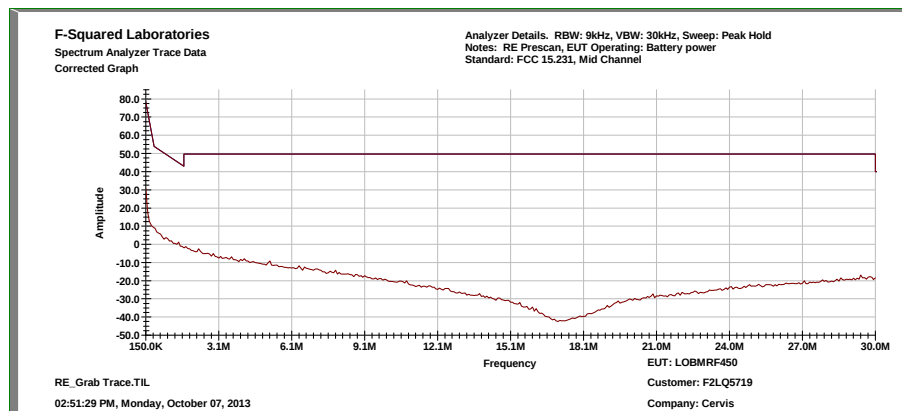
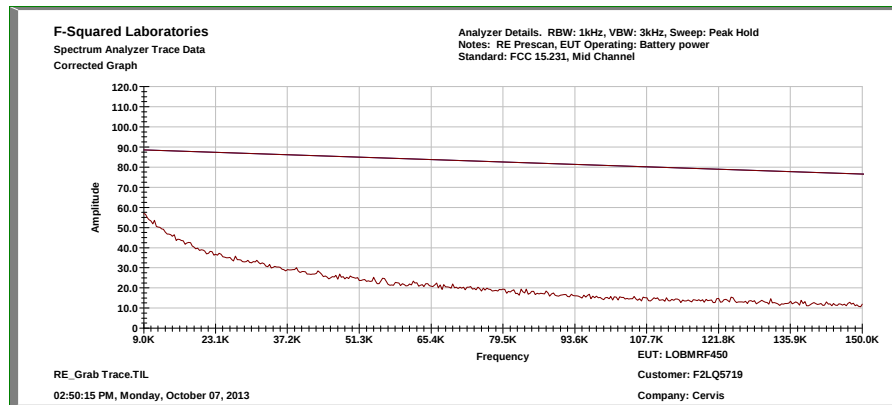
Mid Channel, cont'd

NOTE: The following plots are of the ambient noise floor measurement in black and the measurement with the EUT on in red, showing that there were no measurable emissions above the noise floor.





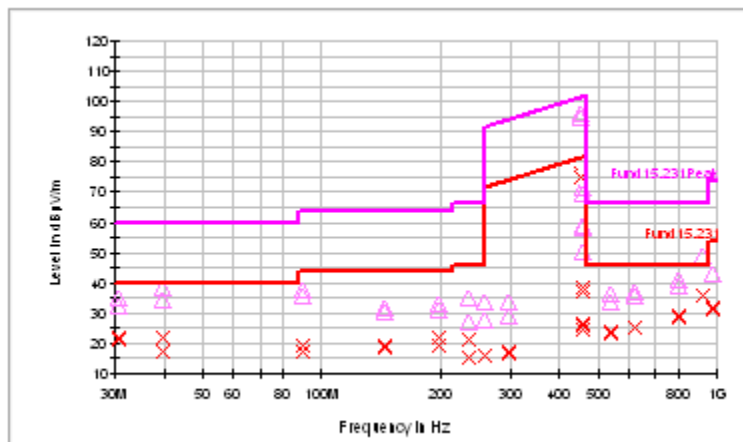
Mid Channel, cont'd





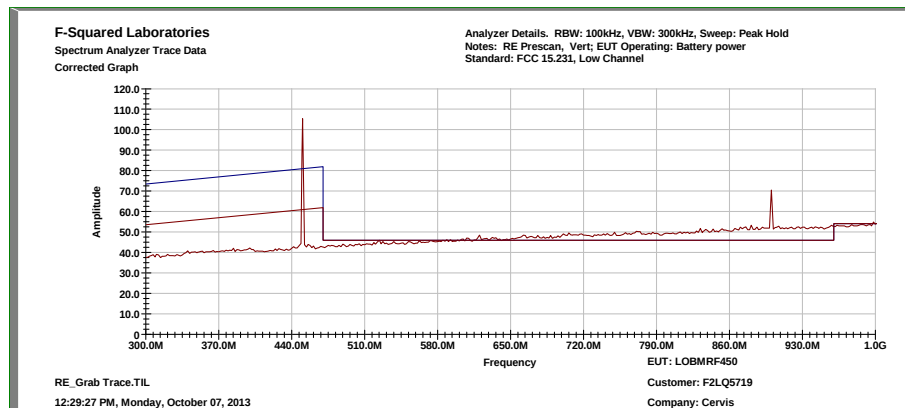
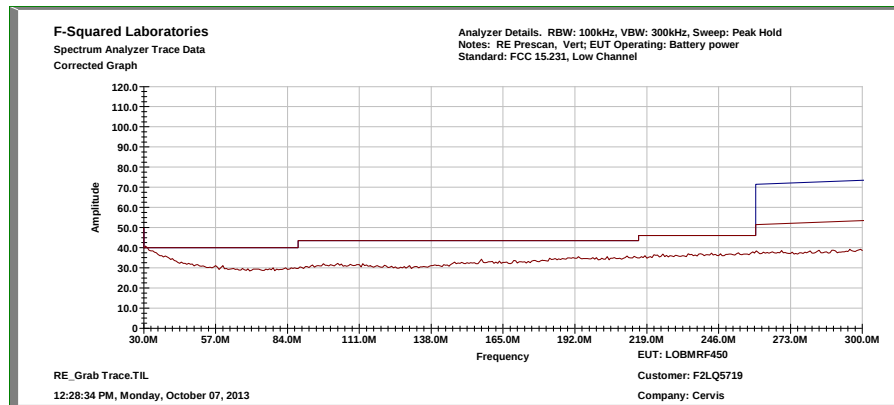
Mid Channel

Frequency (MHz)	MaxPeak (dBµV/m)	MaxPeak (dBµV/m) Limit	Average (dBµV/m)	Average (dBµV/m) w/DCCF	Average (dBµV/m) Limit	Bandwidth (kHz)	Polarity	Corr. (dB)
30.620000	32.8	60.0	21.4	1.4	40.0	120.000	V	20.7
30.620000	35.4	60.0	22.0	2	40.0	120.000	H	22.1
39.480000	34.7	60.0	17.1	-2.9	40.0	120.000	V	14.0
39.480000	38.5	60.0	22.0	2	40.0	120.000	H	15.3
89.410000	37.6	63.5	17.0	-3	43.5	120.000	V	10.4
89.410000	35.5	63.5	19.3	-0.7	43.5	120.000	H	9.4
143.980000	30.3	63.5	18.9	-1.1	43.5	120.000	V	15.0
143.980000	31.9	63.5	19.4	-0.6	43.5	120.000	H	14.9
197.480000	31.0	63.5	19.2	-0.8	43.5	120.000	V	15.5
197.480000	33.3	63.5	21.7	1.7	43.5	120.000	H	15.8
236.380000	35.5	66.0	21.2	1.2	46.0	120.000	H	15.0
236.380000	26.9	66.0	15.4	-4.6	46.0	120.000	V	15.0
257.480000	27.8	66.0	15.8	-4.2	46.0	120.000	V	15.8
257.480000	34.1	66.0	15.7	-4.3	46.0	120.000	H	15.6
298.670000	34.2	94.6	17.5	-2.5	74.6	120.000	H	17.3
298.670000	29.0	94.6	16.8	-3.2	74.6	120.000	V	16.8
459.720000	43.7	101.6	24.5	4.5	81.6	120.000	V	20.9
459.790000	50.4	101.6	26.1	6.1	81.6	120.000	V	20.9
459.790000	57.3	101.6	37.0	17	81.6	120.000	H	21.2
460.000000	95.2	101.6	66.2	46.2	81.6	120.000	H	21.2
460.000000	94.9	101.6	63.8	43.8	81.6	120.000	V	20.9
460.200000	63.1	101.6	38.2	18.2	81.6	120.000	H	21.3
460.210000	50.5	101.7	26.3	6.3	81.7	120.000	V	21.0
460.280000	46.8	101.7	24.6	4.6	81.7	120.000	V	21.0
536.730000	36.4	66.0	23.8	3.8	46.0	120.000	H	23.2
536.730000	33.9	66.0	23.2	3.2	46.0	120.000	V	22.7
621.490000	37.3	66.0	25.5	5.5	46.0	120.000	H	24.6
621.490000	35.8	66.0	25.3	5.3	46.0	120.000	V	24.5
804.100000	39.4	66.0	28.8	8.8	46.0	120.000	H	27.8
804.100000	41.0	66.0	28.3	8.3	46.0	120.000	V	27.2
804.100000	40.8	66.0	29.0	9	46.0	120.000	H	27.8
920.000000	49.1	66.0	36.0	16	46.0	120.000	H	29.1
975.830000	43.3	73.9	31.7	11.7	53.9	120.000	H	29.9
975.830000	43.3	73.9	31.4	11.4	59.9	120.000	V	29.5



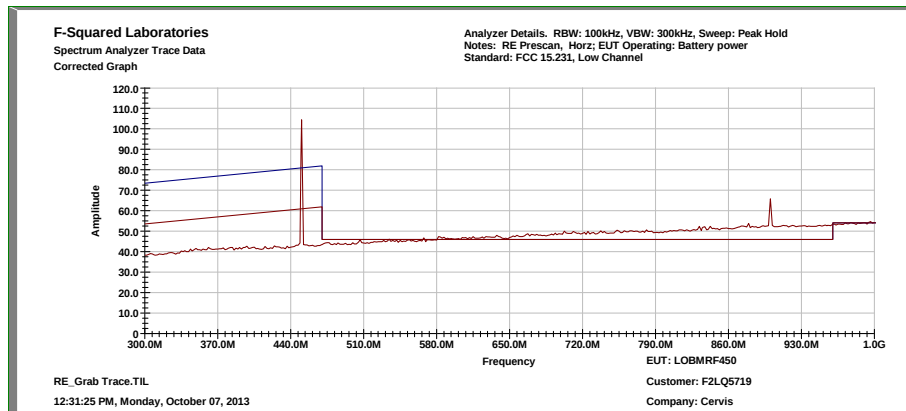
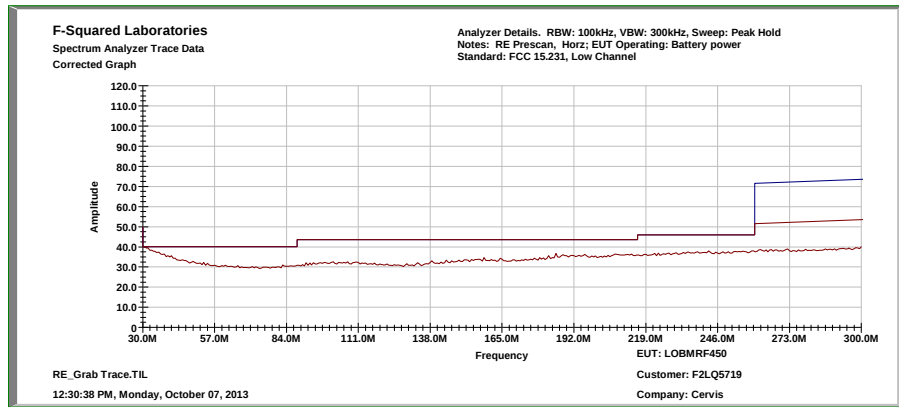


Low Channel





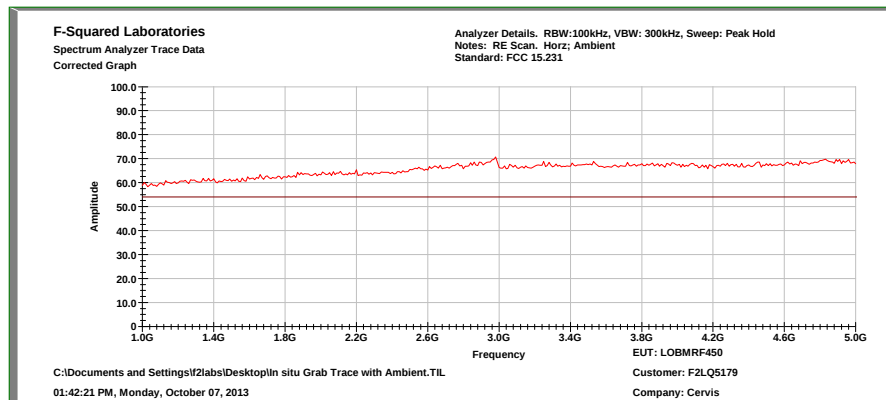
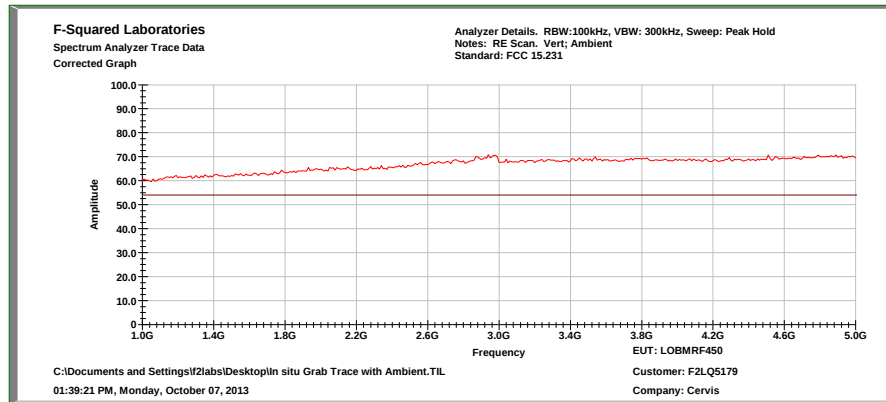
Low Channel, cont'd





Low Channel, cont'd

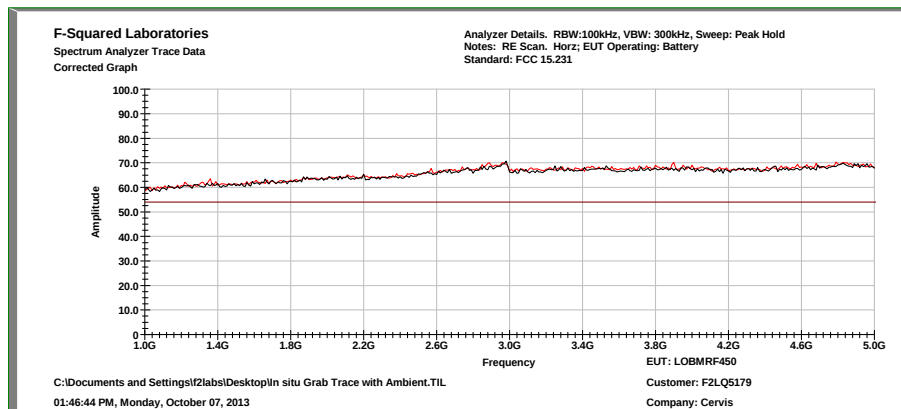
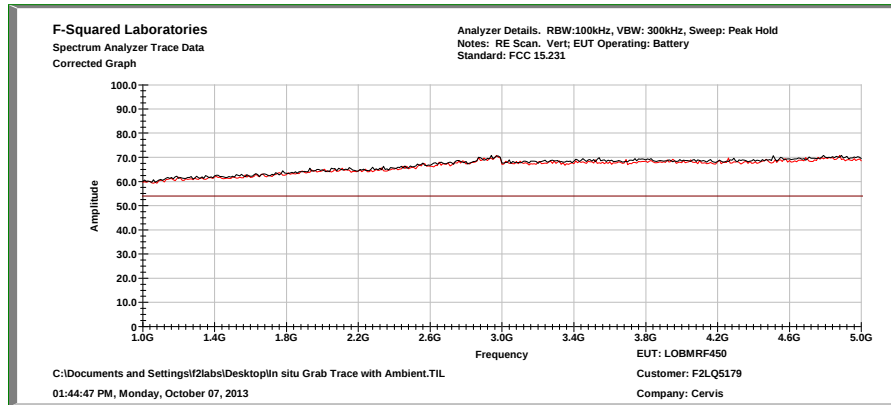
NOTE: The following plots are of the ambient noise floor measurement with the EUT off.





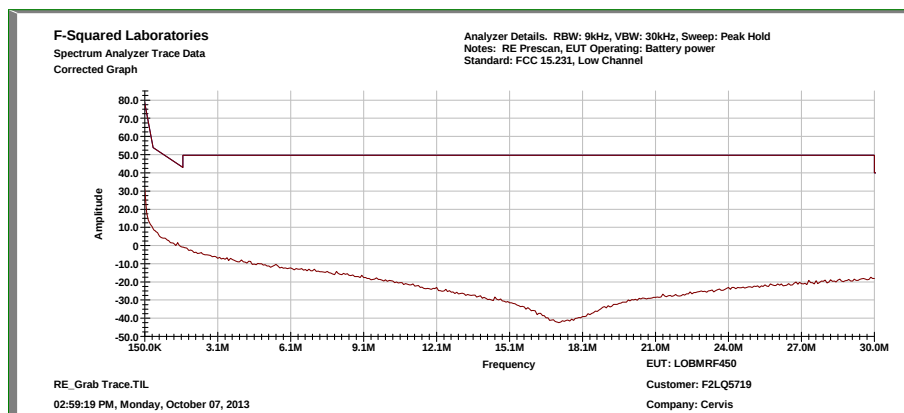
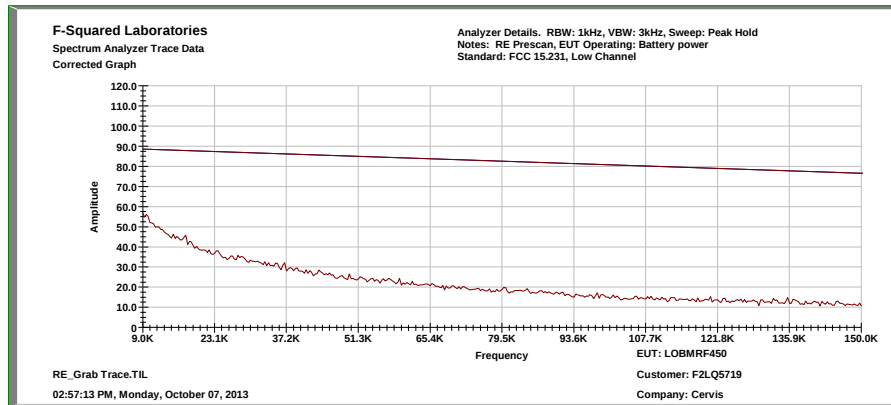
Low Channel, cont'd

NOTE: The following plots are of the ambient noise floor measurement in black and the measurement with the EUT on in red, showing that there were no measurable emissions above the noise floor.





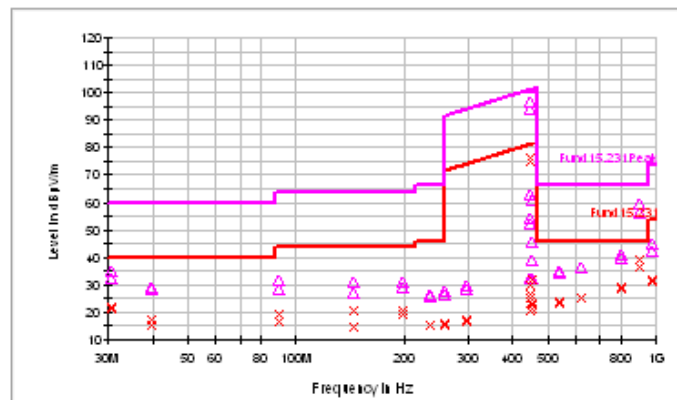
Low Channel, cont'd





Low Channel

Frequency (MHz)	MaxPeak (dBµV/m)	MaxPeak (dBµV/m) Limit	Average (dBµV/m)	Average (dBµV/m) w/DCCF	Average (dBµV/m) Limit	Bandwidth (kHz)	Polarity	Corr. (dB)
30.620000	34.9	60.0	22.2	2.2	40.0	120.000	H	22.1
30.620000	32.8	60.0	21.4	1.4	40.0	120.000	V	20.7
39.480000	28.3	60.0	15.3	-4.7	40.0	120.000	H	15.3
39.480000	29.3	60.0	17.4	-2.6	40.0	120.000	V	14.0
89.410000	28.5	63.5	16.7	-3.3	43.5	120.000	V	10.4
89.410000	31.6	63.5	19.1	-0.9	43.5	120.000	H	9.4
143.980000	31.0	63.5	20.8	0.8	43.5	120.000	V	15.0
143.980000	27.0	63.5	14.9	-5.1	43.5	120.000	H	14.9
197.480000	31.3	63.5	20.7	0.7	43.5	120.000	H	15.8
197.480000	29.3	63.5	19.0	-1	43.5	120.000	V	15.5
236.380000	25.9	66.0	15.1	-4.9	46.0	120.000	V	15.0
236.380000	26.5	66.0	15.5	-4.5	46.0	120.000	H	15.0
257.480000	27.6	66.0	15.8	-4.2	46.0	120.000	V	15.8
257.480000	26.9	66.0	15.6	-4.4	46.0	120.000	H	15.6
298.670000	29.7	94.6	17.2	-2.8	74.6	120.000	H	17.3
298.670000	28.5	94.6	16.8	-3.2	74.6	120.000	V	16.8
449.410000	44.9	101.3	26.2	6.2	81.3	120.000	H	21.1
449.410000	42.3	101.3	20.8	0.8	81.3	120.000	V	20.8
449.710000	58.1	101.3	29.8	9.8	81.3	120.000	H	21.1
449.710000	54.2	101.3	25.0	5	81.3	120.000	V	20.8
450.040000	95.9	101.3	65.9	45.9	81.3	120.000	H	21.1
450.040000	97.5	101.3	68.1	48.1	81.3	120.000	V	20.8
450.280000	51.4	101.3	31.8	11.8	81.3	120.000	H	21.1
450.280000	46.0	101.3	22.6	2.6	81.3	120.000	V	20.8
450.570000	32.6	101.4	21.0	1	81.4	120.000	V	20.8
450.570000	39.2	101.4	23.2	3.2	81.4	120.000	H	21.1
536.730000	34.3	66.0	23.7	3.7	46.0	120.000	H	23.2
536.730000	34.9	66.0	23.2	3.2	46.0	120.000	V	22.7
621.490000	36.4	66.0	25.3	5.3	46.0	120.000	V	24.5
621.490000	36.2	66.0	25.4	5.4	46.0	120.000	H	24.6
804.100000	39.9	66.0	28.9	8.9	46.0	120.000	H	27.8
804.100000	40.8	66.0	28.5	8.5	46.0	120.000	V	27.2
900.000000	49.2	66.0	38.4	18.4	46.0	120.000	V	28.5
900.000000	51.3	66.0	40.1	20.1	46.0	120.000	H	29.0
975.830000	38.8	73.9	26.0	6.0	53.9	120.000	V	29.5
977.250000	36.9	73.9	29.1	9.1	59.9	120.000	H	30.0





9 FCC Part 15.231(b)(3)(c)

9.1 Requirements:

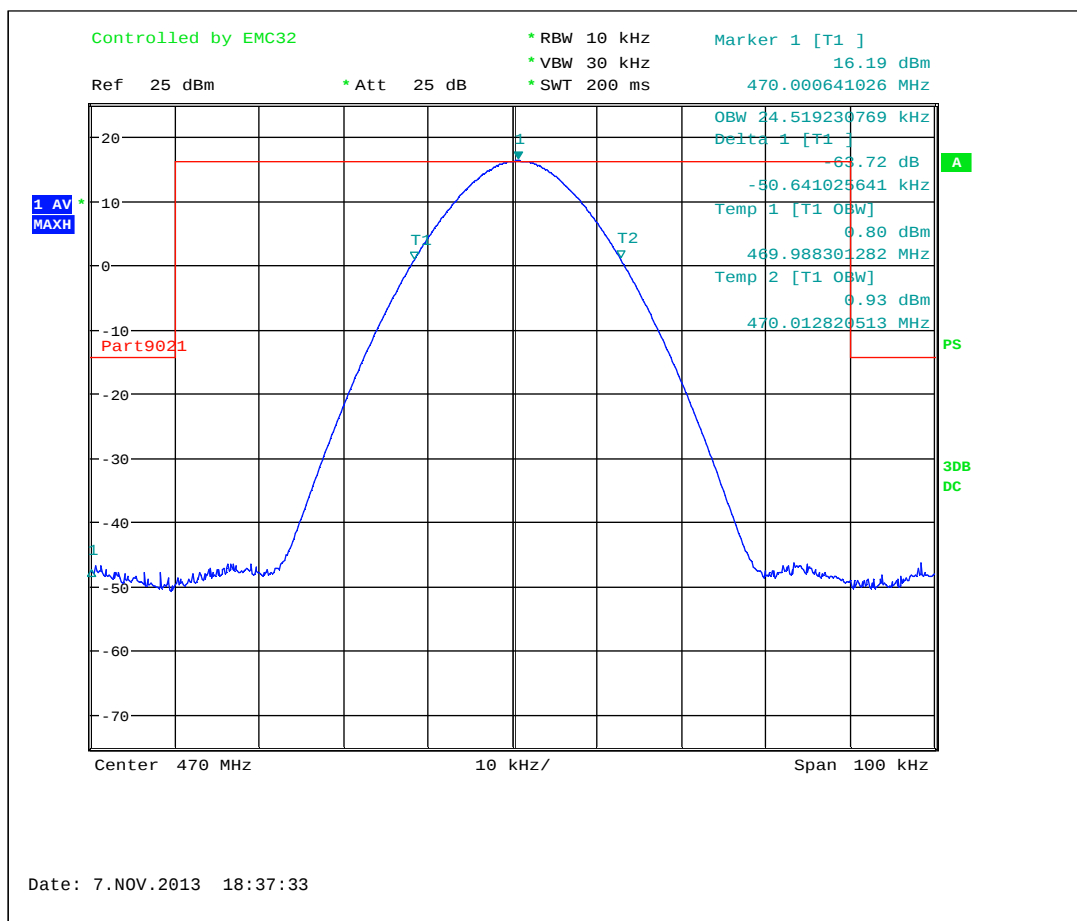
The bandwidth of the emission shall be no wider than 0.25% of the center frequency. Bandwidth is determined at the points 20dB down from the modulated carrier. 450 MHz bandwidth must be no wider than 1.1235 MHz; 460 MHz no wider than 1.15 MHz, and 470 MHz no wider than 1.175 MHz..

9.2 Test Data – OCCUPIED BANDWIDTH

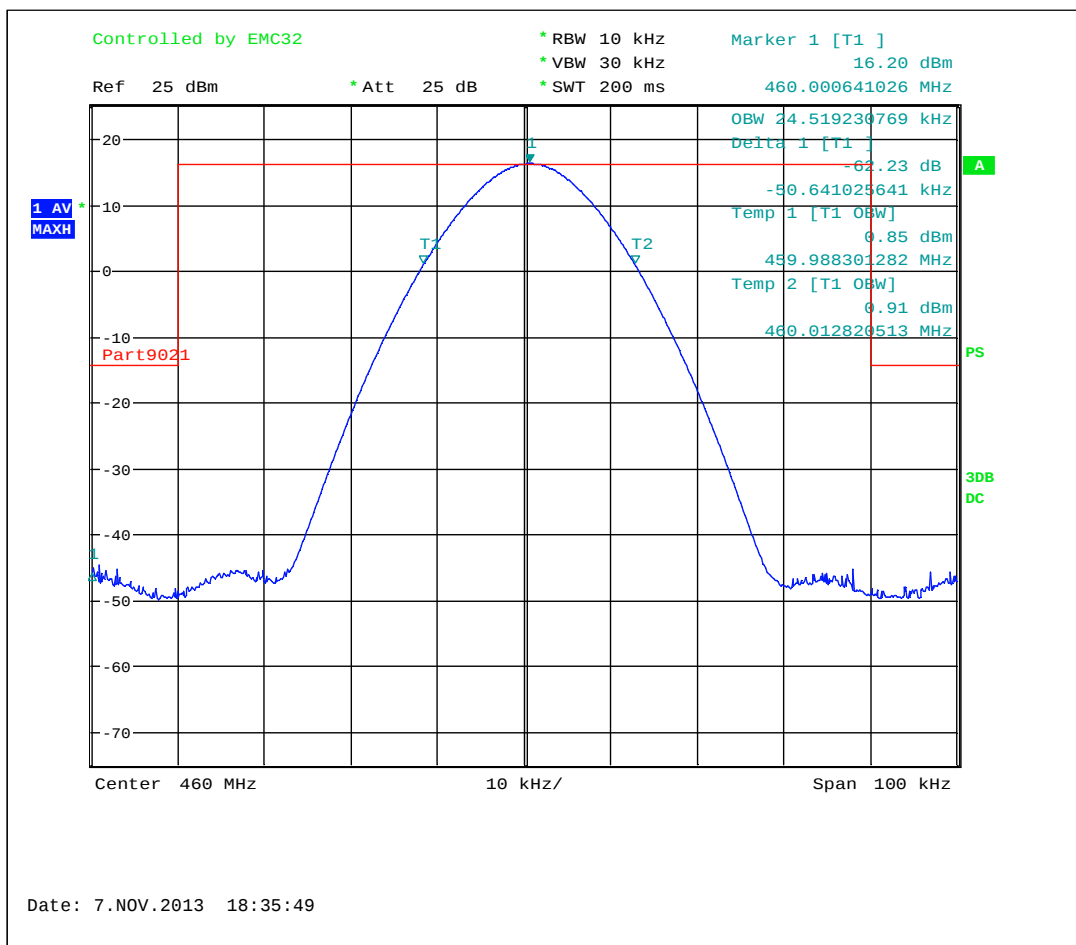
Test Date:	Sept. 27, 2013	Test Engineer:	K. Littell
Standards:	CFR 47 Part 15.231(b)(3)(c)	Air Temperature:	21.7°C
		Relative Humidity:	46%

Occupied Bandwidth, High Channel: 24.519 kHz
Occupied Bandwidth, Mid Channel: 24.5192 kHz
Occupied Bandwidth, Low Channel: 24.52 kHz

High Channel

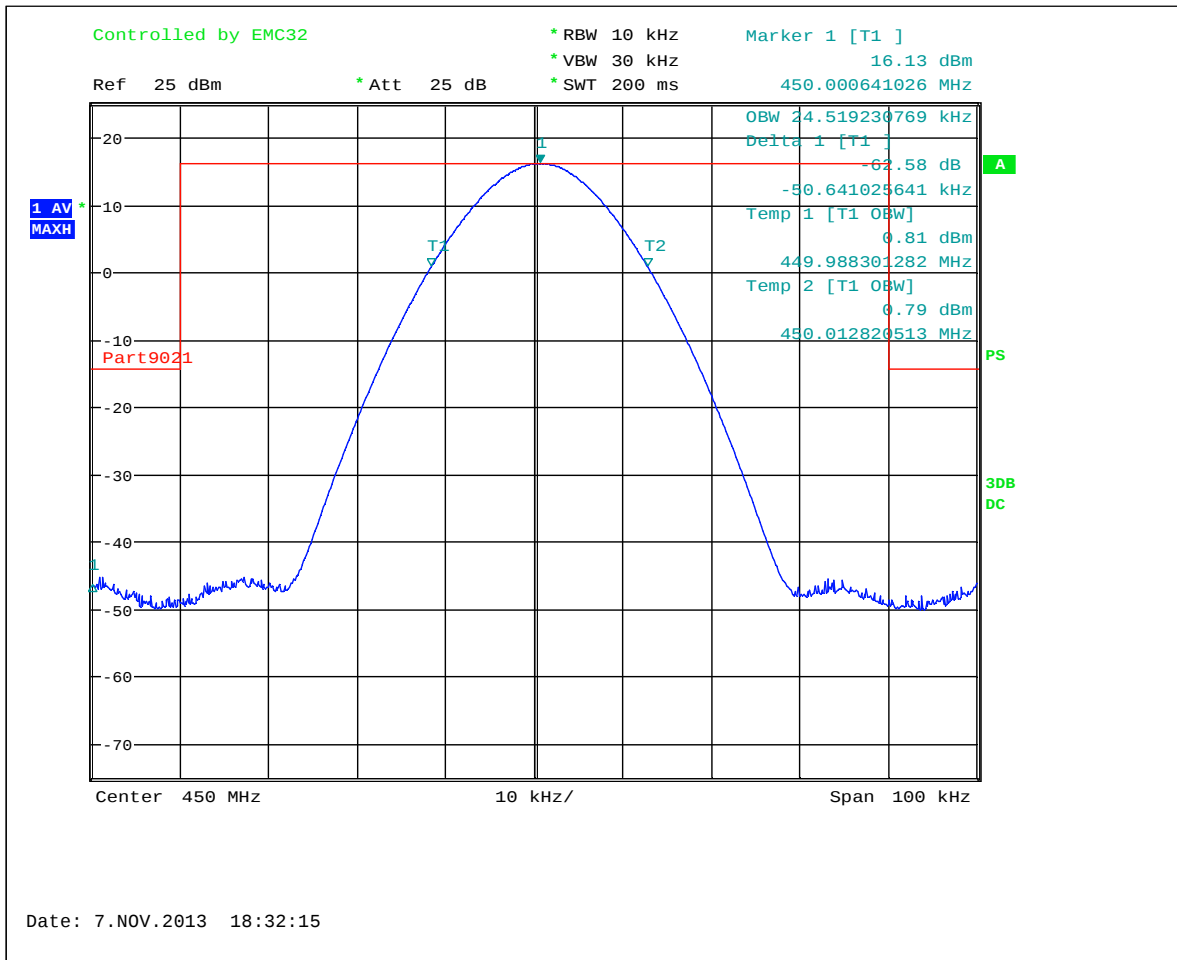


Mid Channel





Low Channel





10 15.35(c) - DUTY CYCLE

A duty cycle correction of 20dB was added to the field strength measured because the EUT has a 10% duty cycle. Transmission was on for 10mS and off for 90mS. The formula used was: $DCCF = 20\log \left[\frac{10mS}{100mS} \right] = -20$

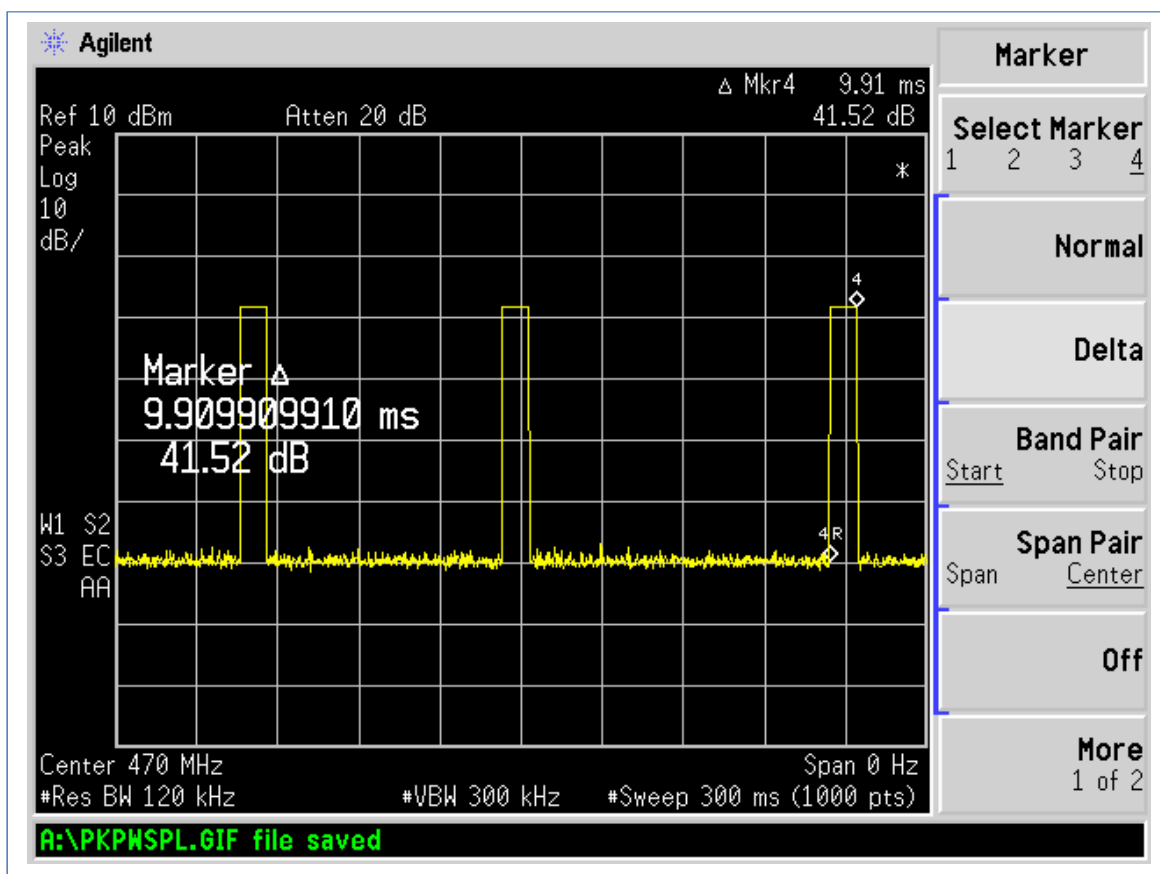


10.2 Test Data

Test Date(s):	Sept. 23, 2013	Test Engineer:	K. Littell
Standards:	CFR 47 Part 15.231	Air Temperature:	21.5°C
		Relative Humidity:	47%

High Channel

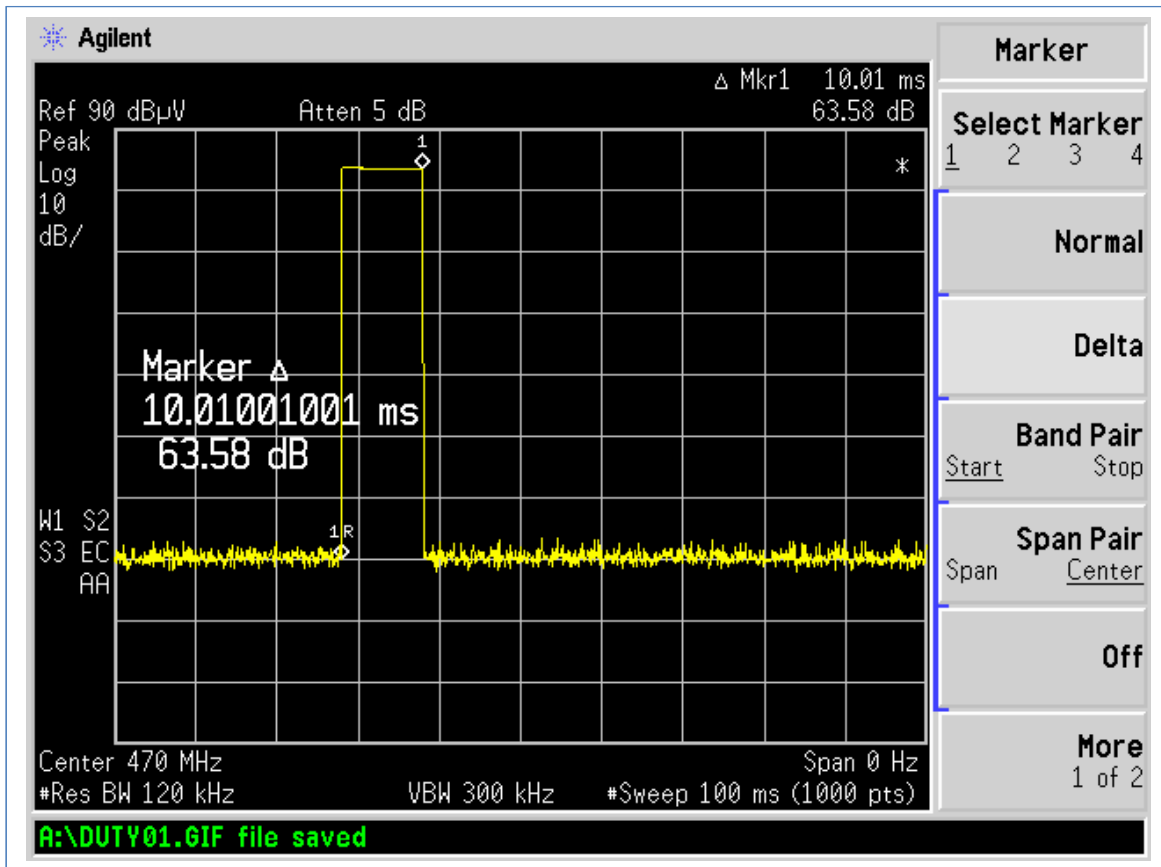
The following plot is of a single press and release of the manual push button three times, showing the Duty Cycle.





High Channel, cont'd

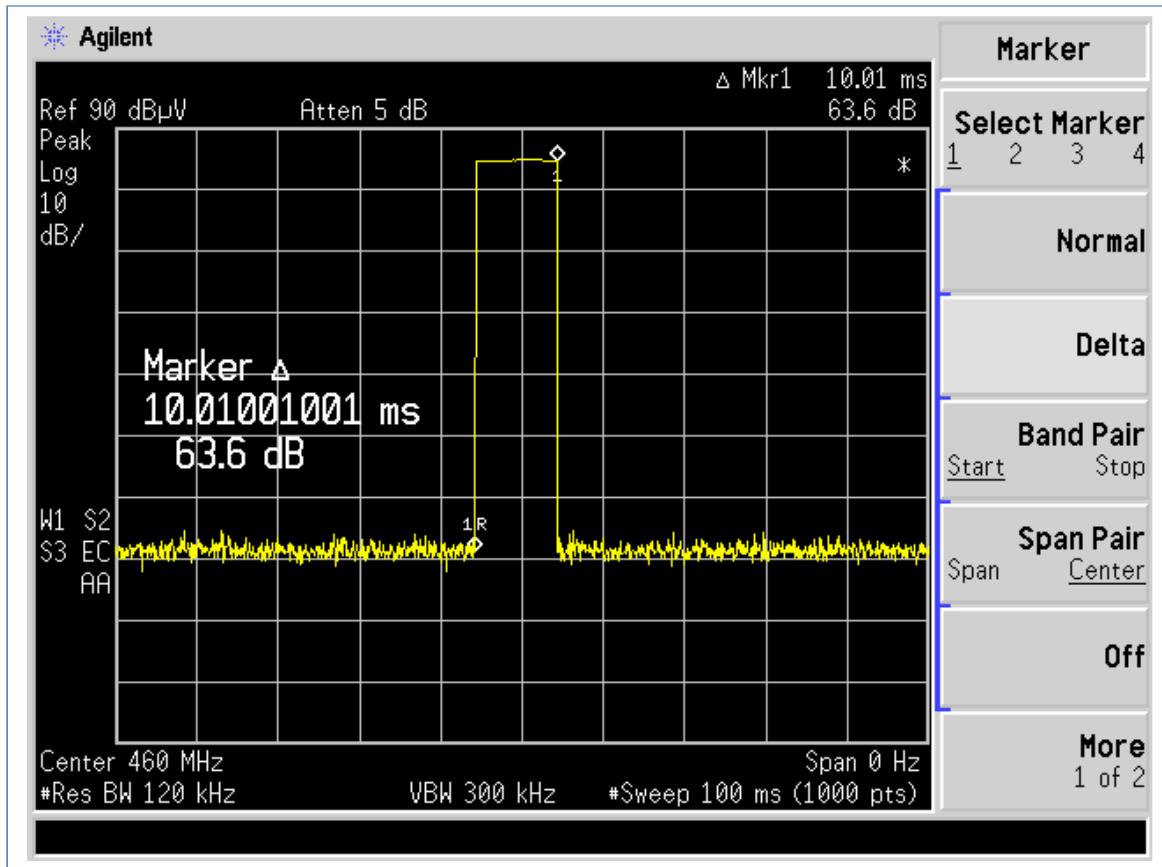
The following plot is of a single press and release of the manual push button, showing the Duty Cycle.





Mid Channel

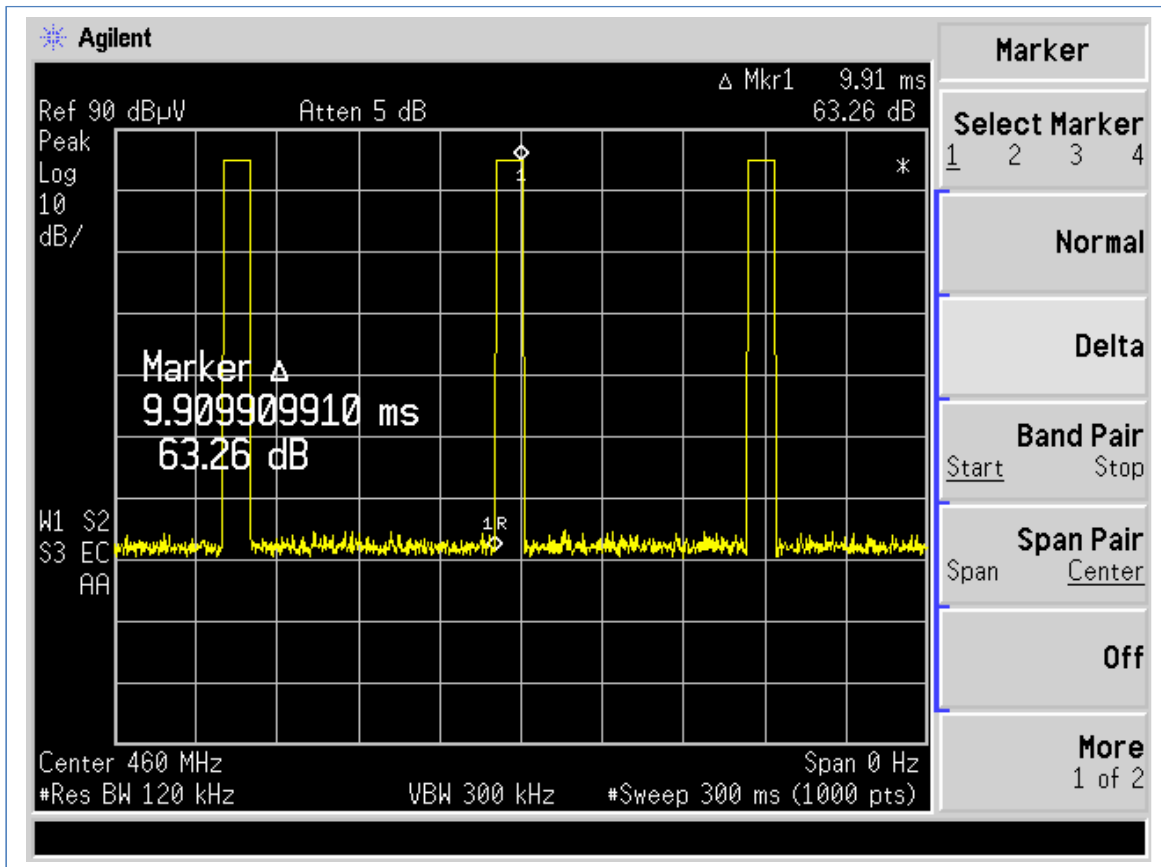
The following plot is of a single press and release of the manual push button, showing the Duty Cycle.





Mid Channel, cont'd

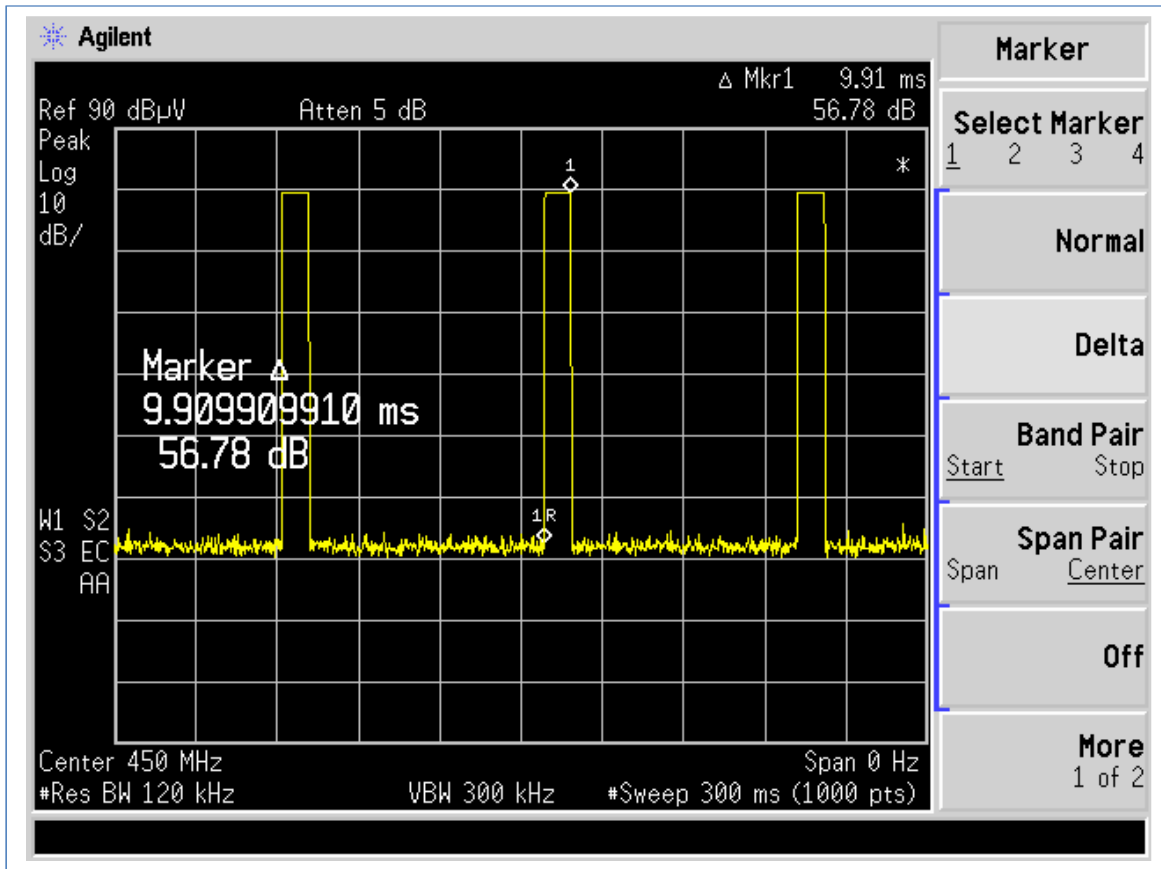
The following plot is of a single press and release of the manual push button three times, showing the Duty Cycle.





Low Channel

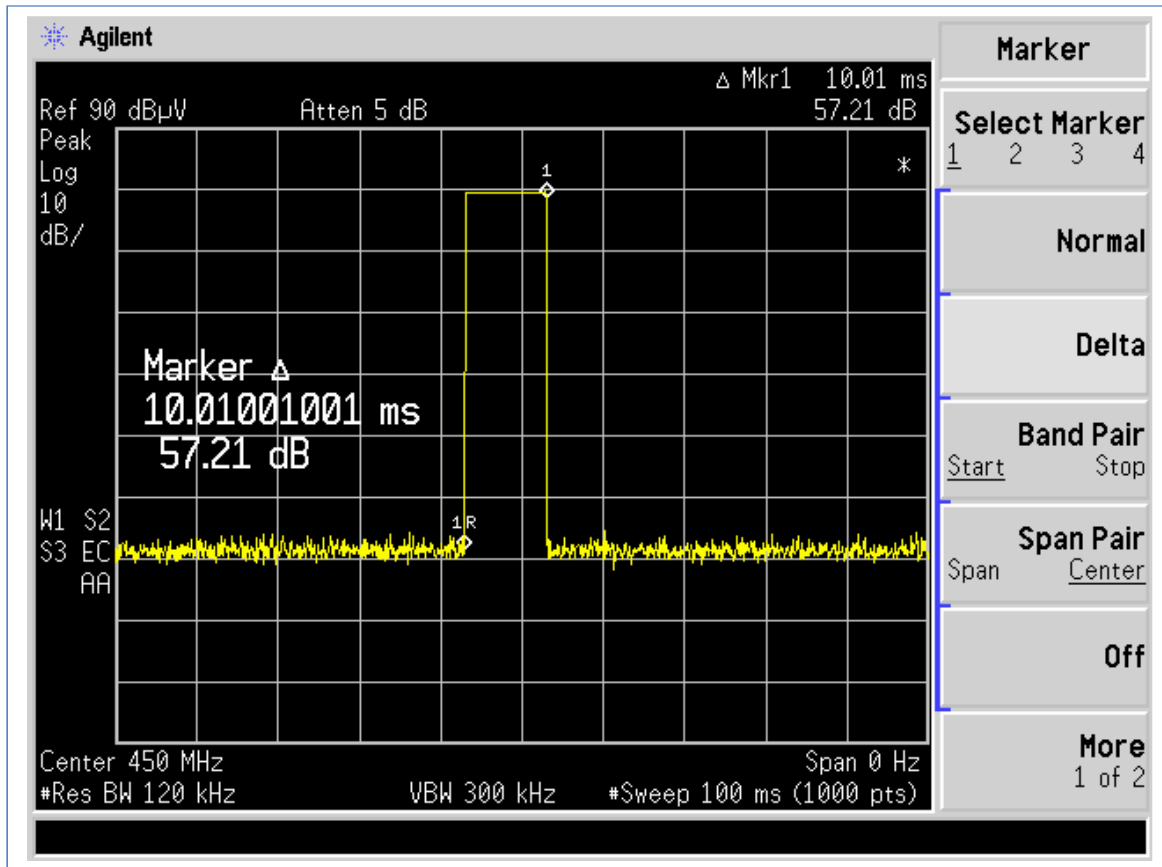
The following plot is of a single press and release of the manual push button three times, showing the Duty Cycle.





Low Channel, cont'd

The following plot is of a single press and release of the manual push button, showing the Duty Cycle.





10 PHOTOGRAPHS

