



F2 Labs
16740 Peters Road
Middlefield, Ohio 44062
United States of America
www.f2labs.com

CERTIFICATION TEST REPORT

Manufacturing Addresses: Protran Technology
52 Paterson Avenue, Suite 4
Newton, New Jersey 07680 USA

Harsco Rail
2401 Edmund Road
West Columbia, South Carolina 29171 USA

Applicant: Harsco Rail
2401 Edmund Road
West Columbia, South Carolina 29171 USA

Product Name: Ranging Module

Product Description: Module with a ranging radio to be used in distance monitoring and reporting systems.

Model: Swarm Bee

FCC ID: 2AEO5PT-000320

Testing Commenced: July 20, 2015

Testing Ended: July 22, 2015

Summary of Test Results: In Compliance, with Modifications

The EUT complies with the EMC requirements when manufactured identically as the unit tested in this report, including any required modifications. Any changes to the design or build of this unit subsequent to this testing may deem it non-compliant.

Standards:

- ❖ FCC Part 15 Subpart C, Section 15.247
- ❖ FCC Part 15, Subpart C, Section 15.207
- ❖ FCC Part 15, Subpart C, Section 15.209



Evaluation Conducted by:

Joe Knepper, EMC Proj. Eng.

Report Reviewed by:

Ken Littell, EMC Tech. Mgr.

F2 Labs
26501 Ridge Road
Damascus, MD 20872
Ph 301.253.4500
Fax 301.253.5179

F2 Labs
16740 Peters Road
Middlefield, OH 44062
Ph 440.632.5541
Fax 440.632.5542

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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 ANSI C63.4 and recommended FCC procedure of measurement of DTS operating under Section 15.247 and in KDB558074. 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
F2LQ7230B-01E	First Issue	Aug. 5, 2015	K. Littell



2 SUMMARY OF TEST RESULTS

Test Name	Standard(s)	Results
-6dB Occupied Bandwidth	CFR 47 Part 15.247(a)(2) / KDB558074	Complies
Conducted Output Power	CFR 47 Part 15.247(b)(3) / KDB558074	Complies
Conducted Spurious Emissions	CFR 47 Part 15.247(d) / Part 15.209 / KDB558074	Complies
Radiated Spurious Emission with 12dBi Whip Antenna	CFR 47 Part 15.247(d) / Part 15.209 / KDB558074	Complies
Radiated Spurious Emission with 15dBi Whip Antenna	CFR 47 Part 15.247(d) / Part 15.209 / KDB558074	Complies
Radiated Spurious Emission with 18Bi Integral Antenna	CFR 47 Part 15.247(d) / Part 15.209 / KDB558074	Complies, with Modifications*
Peak Power Spectral Density	CFR 47 Part 15.247(e) / KDB558074	Complies
Voltage Variations	CFR 47 Part 15.31 / KDB558074	Complies
Conducted Emissions	CFR 47 Part 15.207(a)	Complies

Modifications Made to the Equipment
*Output power changed only for 18dBi Whip Antenna to Output Power setting 52 (from 63).



3 TABLES OF MEASURED RESULTS

Test	2.44GHz
Conducted Output Power for use with 12 or 15dBi Whip Antennas	119.7mW (20.78dBm)
Conducted Output Power Limit when using the 12dBi whip antenna	.251W (24dBm)
Conducted Output Power Limit when using the 15dBi whip antenna	.126W (21dBm)
E.I.R.P. with 12dBi Whip Antenna	1.897W (32.78dBm)
E.I.R.P. with 15dBi Whip Antenna	3.784W (35.78dBm)
Conducted Output Power when used with 18dBi Whip Antenna	0.058W* (17.67dBm)
Conducted Output Power Limit, 18dBi Whip Antenna	0.063 Watt, (18dBm)
E.I.R.P. with 18dBi Whip Antenna	3.689W (35.67dBm)
E.I.R.P. Limit	4 Watts, (36.02dBm)
Peak Power Spectral Density	-20.96 dBm
Peak Power Spectral Density Limit	8 dBm
-6dB Occupied bandwidth	57.21MHz
-6dB Occupied Bandwidth Limit	≥ 500KHz

**Results with modifications noted in Section 2 of this Test Report.*



FCC PART 15.31 – VOLTAGE VARIATIONS

Test	Full Output (dBm)	Power (mW)	Limit
When used with 15dBi Whip Antenna @100V	20.53dBm	113mW	.126W (21dBm)
When used with 15dBi Whip Antenna @ 140V	20.46dBm	111.2mW	.126W (21dBm)
When used with 12dBi Whip Antenna @100V	20.53dBm	113mW	.251W (24dBm)
When used with 12dBi Whip Antenna @ 140V	20.46dBm	111.2mW	.251W (24dBm)
When used with 18dBi Whip Antenna @100V	17.34dBm	54.2mW	63mW (18dBm)
When used with 18dBi Whip Antenna @ 140V	17.29dBm	53.6mW	63mW (18dBm)



4 ENGINEERING STATEMENT

This report has been prepared on behalf of Harsco Rail to provide documentation for the testing described herein. This equipment has been tested and found to comply with Part 15.247 of the FCC Rules using ANSI C63.4 and KDB558074 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: Ranging Module
Model: Swarm Bee
Serial No.: 33344713373731333B0045000
FCC ID: 2AEO5PT-000320

5.2 Trade Name:

Harsco Rail

5.3 Power Supply:

AC/DC Adapter – Lenovo 42T5276

5.4 Applicable Rules:

CFR 47, Part 15.247, subpart C

5.5 Equipment Category:

Radio Transmitter-DTS

5.6 Antenna:

12dBi Whip, 15dBi Whip, 18dBi Whip

5.7 Accessories:

N/A

5.8 Test Item Condition:

The equipment to be tested was received in good condition.

5.9 Testing Algorithm:

EUT was set up in a normal operating manner, powered at 120V, 60 Hz. EUT transmitted at 2.44GHz with one channel. The highest emissions were recorded in the data tables.



6 LIST OF MEASUREMENT INSTRUMENTATION

Equipment Type	Asset Number	Manufacturer	Model	Serial Number	Calibration Due Date
Shielded Chamber	CL166	AlbatrossProjects	B83117-DF435-T261	US140023	Jan. 1, 2016
Shield Room	0175	Ray Proof	N/A	11645	Verified
Receiver	CL151	Rohde & Schwarz	ESU40	100319	Nov. 12, 2015
Antenna 1-Chamber	0142	ETS/EMCO	3142B	9811-1330	Verified
Antenna, JB3 Combination	CL175	Sunol Sciences	JB3	A030315	Mar. 12, 2016
Horn Antenna	CL098	Emco	3115	9809-5580	Dec. 3, 2015
Horn, Antenna	CL114	A.H. Systems	SAS-572	237	Oct. 16, 2016
Pre-Amplifier	CL153	Agilent	83006-69007	MY39500791	May 6, 2016
Pre-Amplifier	CL136	Hewlett Packard	8447E	1937A01894	Apr. 1, 2016
Software:	Tile Version 1.0		Software Verified: July 20, 2015		
Software:	EMC 32, Version 5.20.2		Software Verified: July 20, 2015		



7 FCC PART 15.247(a)(2) – OCCUPIED BANDWIDTH

7.1 Requirements:

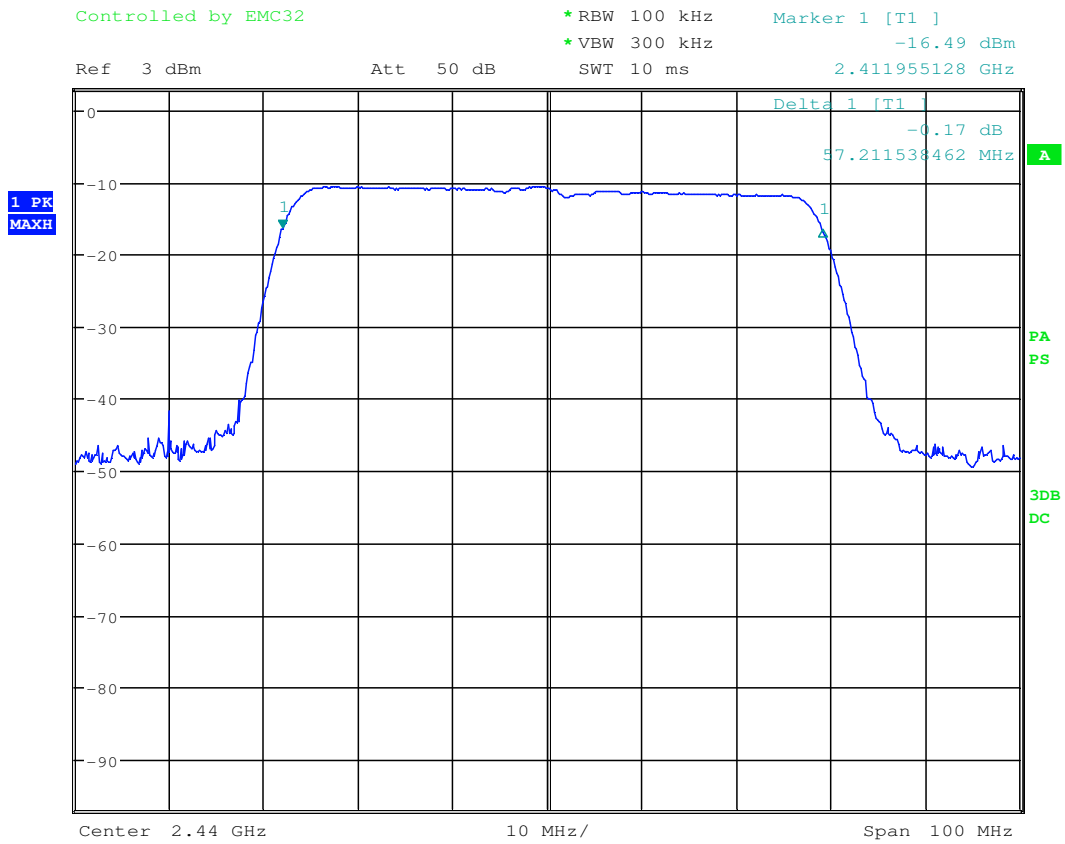
The 6dB bandwidth shall be greater than 500 kHz.

Bandwidth measurements were made at the one (2.44 GHz) frequency with the resolution Bandwidth set at 100 kHz (video bandwidth set at 300 kHz) while the span was set at 100 MHz. The bandwidth was measured using the analyzer's marker function.



7.2 Occupied Bandwidth Test Data

Test Date:	July 21, 2015	Test Engineer:	J. Knepper
Standards:	CFR 47 Part 15.247(a)(2); KDB558074	Air Temperature:	21.7°C
		Relative Humidity:	49%



Date: 21.JUL.2015 10:26:49



8 FCC PART 15.247(b)(3) – CONDUCTED OUTPUT POWER

The EUT antenna port was fitted with an SMA connector and directly connected to the input of the receiver. The peak power output was measured.

8.1 Requirements:

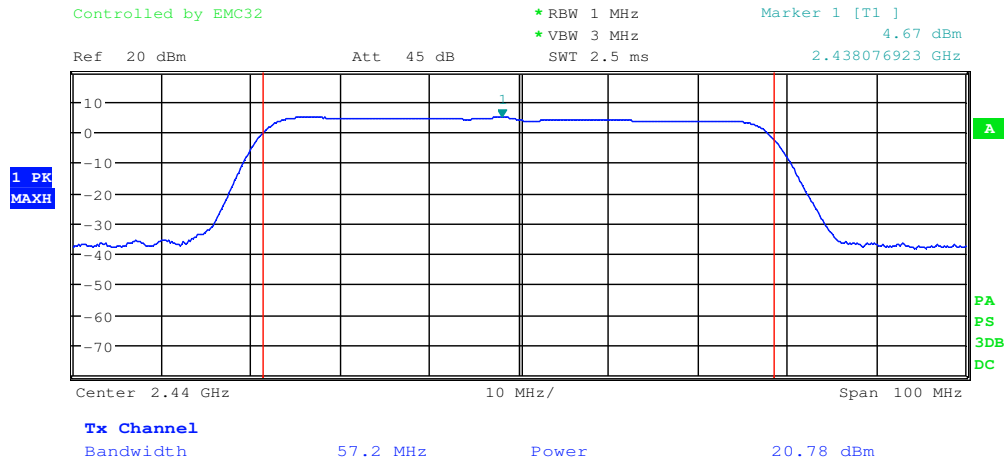
The peak power output shall be 1 watt (30 dBm) or less when using an antenna with a gain of less than 6dBi. For antennas having a gain of more than 6dBi, the limit is reduced by 1dB for every dB the antenna gain is over 6dBi.



8.2 Conducted Output Power Test Data

Test Date:	July 21, 2015	Test Engineer:	J. Knepper
Standards:	CFR 47 Part 15.247(b)(3); KDB558074	Air Temperature:	21.9°C
		Relative Humidity:	42%

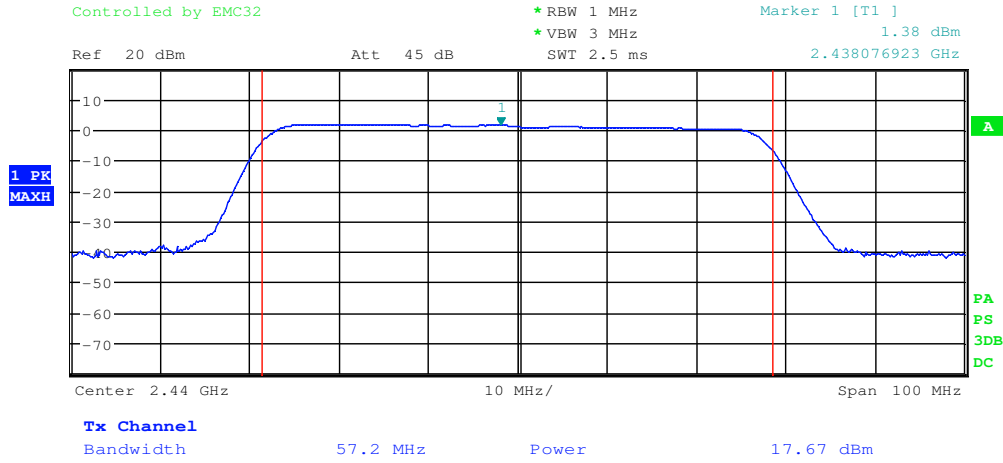
12/15dBi Whip Antennas



Date: 21.JUL.2015 10:34:55



18dBi Whip Antenna



Date: 21.JUL.2015 10:37:38



9 FCC Part 15.247(c) – CONDUCTED SPURIOUS EMISSIONS

The following tests were performed to demonstrate compliance.

RF Antenna Conducted Test

The EUT antenna port was fitted with an SMA connector and directly connected to the input of the spectrum analyzer.

9.1 Requirements:

All Spurious Emissions must be at least 20dB down from the highest emission level measured within the authorized band up through the tenth harmonic.

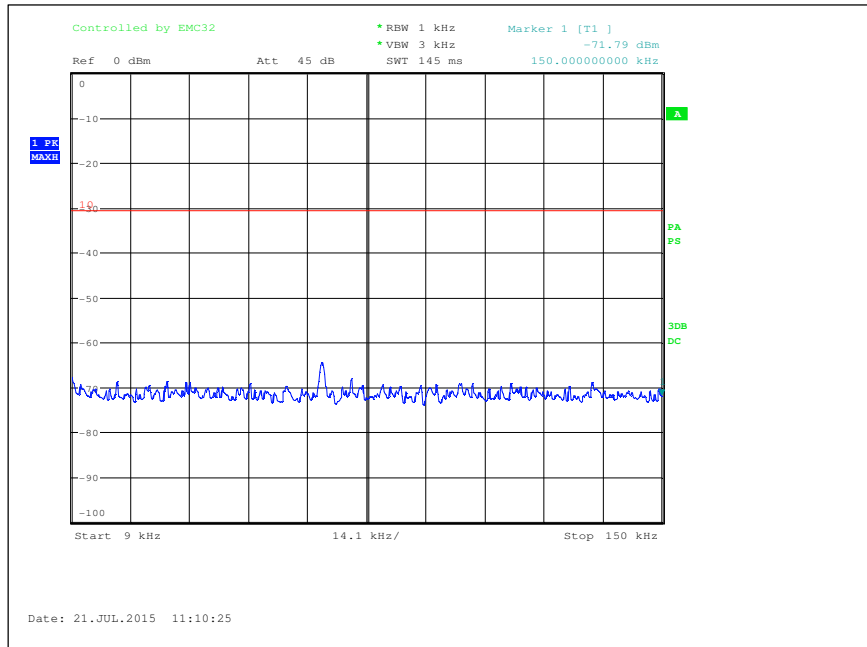
Spurious emissions measurements were made with the appropriate spectrum analyzer impulse bandwidth. Additionally, 20dB down points were measured for the channel to verify band edge compliance.



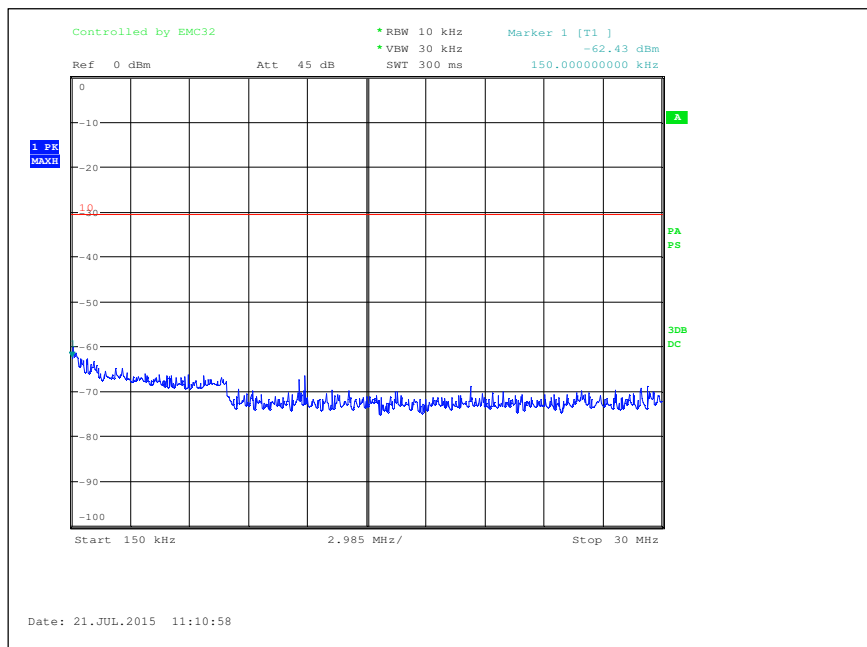
9.2 Test Data – Conducted Spurious Emissions

Test Date:	July 21, 2015	Test Engineer:	J. Knepper
Standards:	CFR 47 Part 15.247(d) / Part 15.209; KDB558074	Air Temperature:	21.9°C
		Relative Humidity:	49%

9kHz to 150kHz

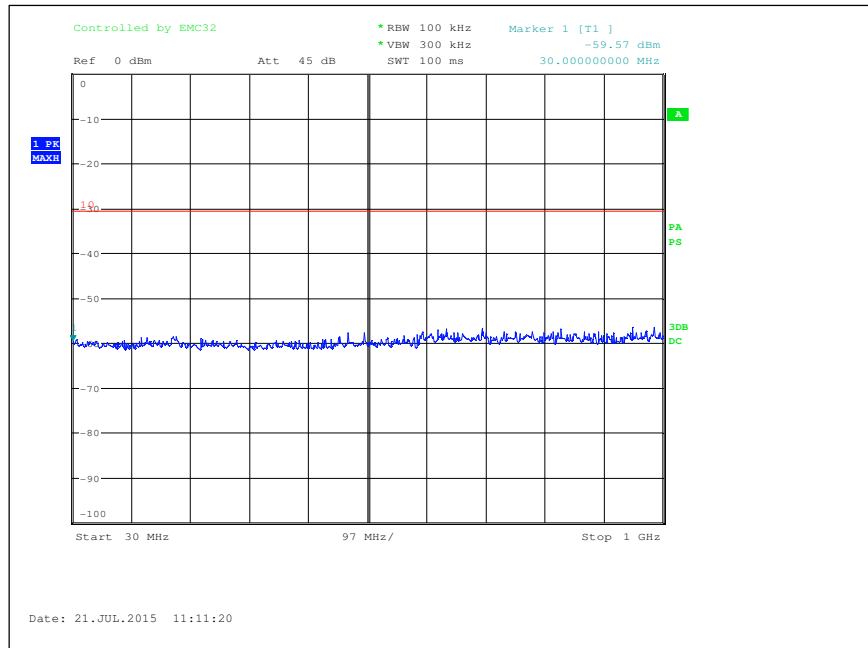


150kHz to 30 MHz

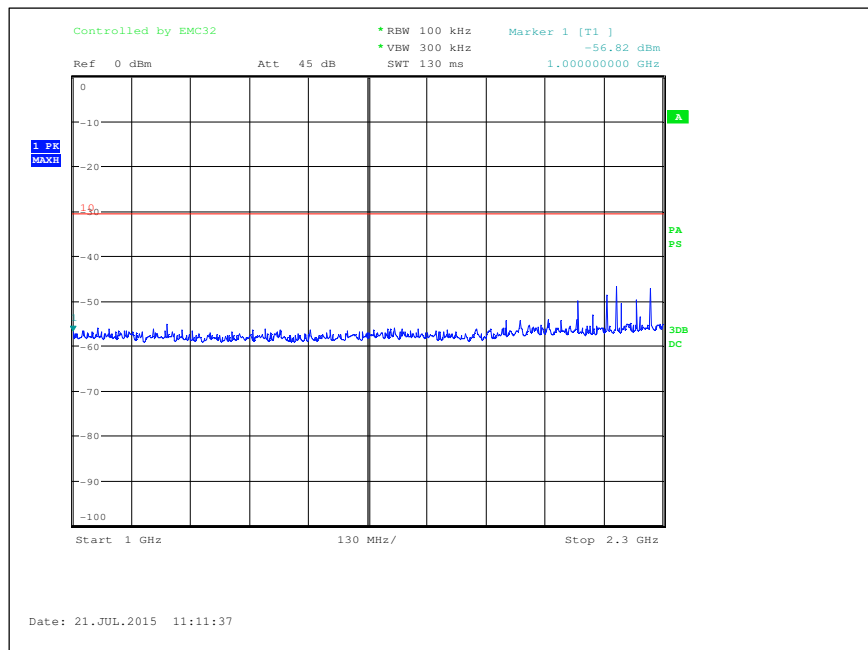




30 MHz to 1 GHz

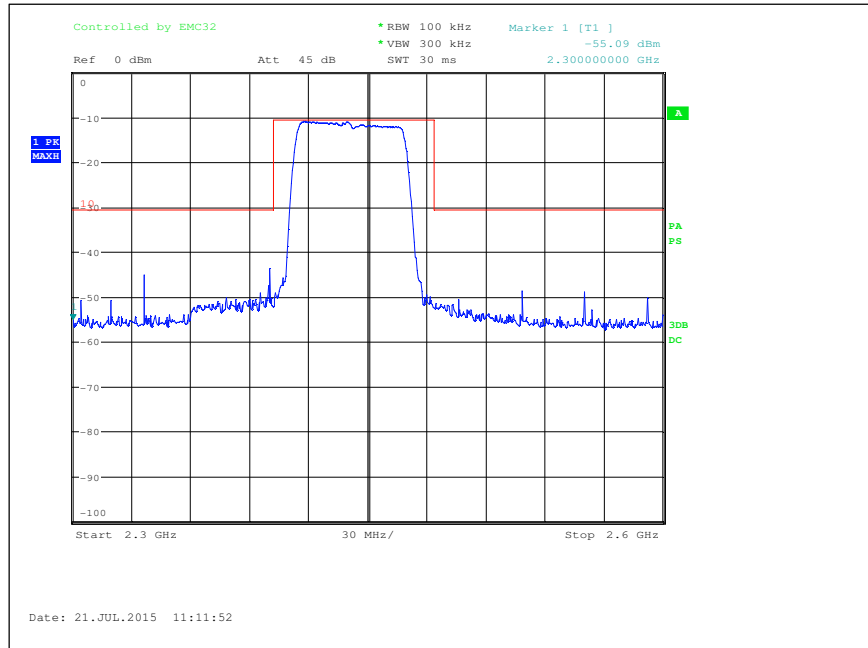


1 GHz to 2.3 GHz

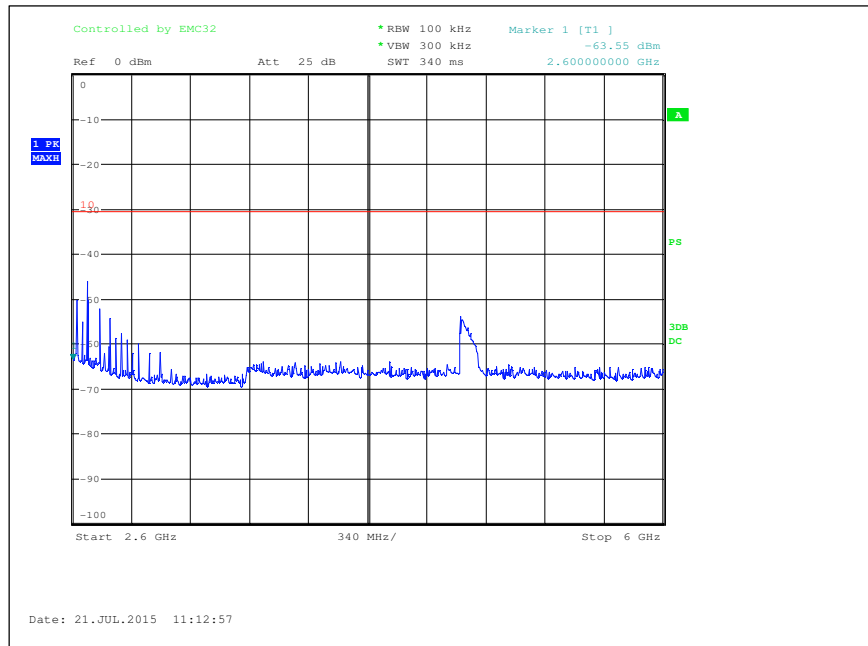




2.3 GHz to 2.6 GHz

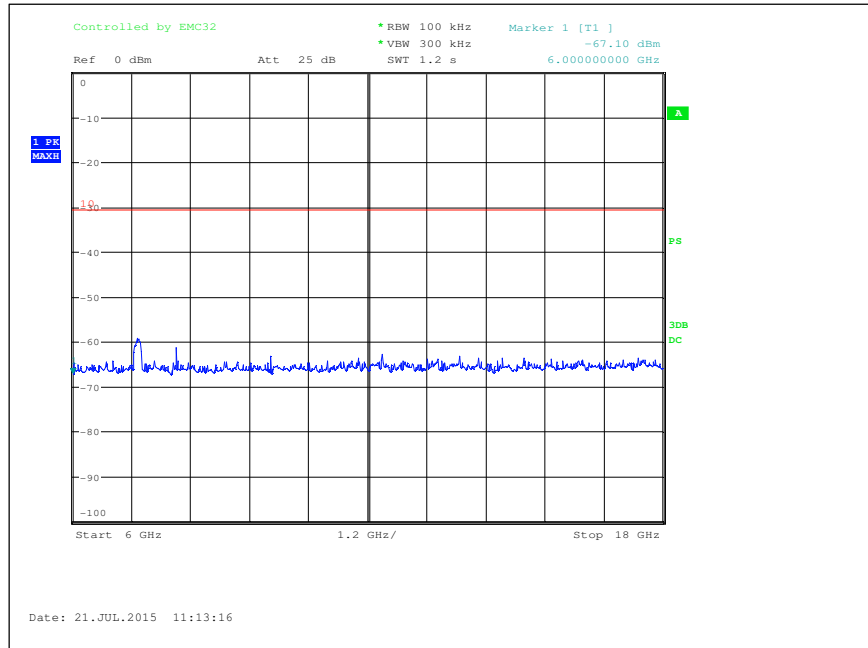


2.6 GHz to 6 GHz

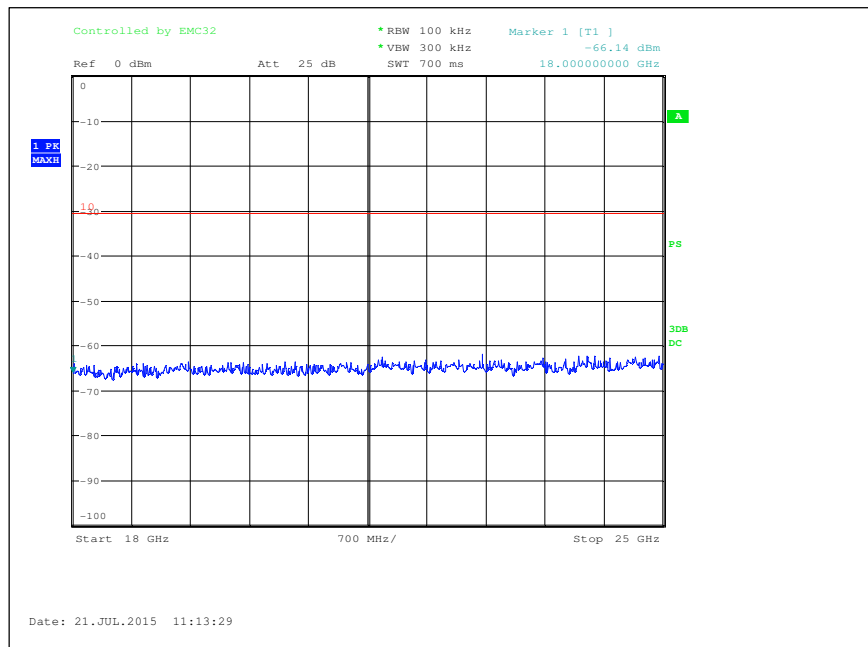




6 GHz to 18 GHz



18 GHz to 25 GHz





10 RADIATED SPURIOUS EMISSIONS

The EUT antenna port was fitted with its 12/15/18 Whip antennas. Radiated emissions were measured on the Open Area Test Site (OATS). All emissions generated that fall in the restricted bands per FCC Part 15.205 were examined.

10.1 Requirements:

All emissions that fall in the restricted bands defined in FCC Part 15.205 shall not exceed the maximum field strength listed in FCC Part 15.209(a).



10.2 Radiated Spurious Emission Test Data

Test Date(s):	July 20-22, 2015	Test Engineer:	J. Knepper
Standards:	CFR 47 Part 15.247(d); Part 15.209 / KDB558074	Air Temperature:	20.3°C
		Relative Humidity:	48%

Notes: Plots are peak, max hold prescan data included only to determine what frequencies to investigate and measure. The EUT was initially placed in a semi-anechoic chamber, and rotated in all three orthogonal positions to maximize the emissions. Characterization measurements were then performed to determine at which frequencies significant emissions occurred. These graphs are shown below.

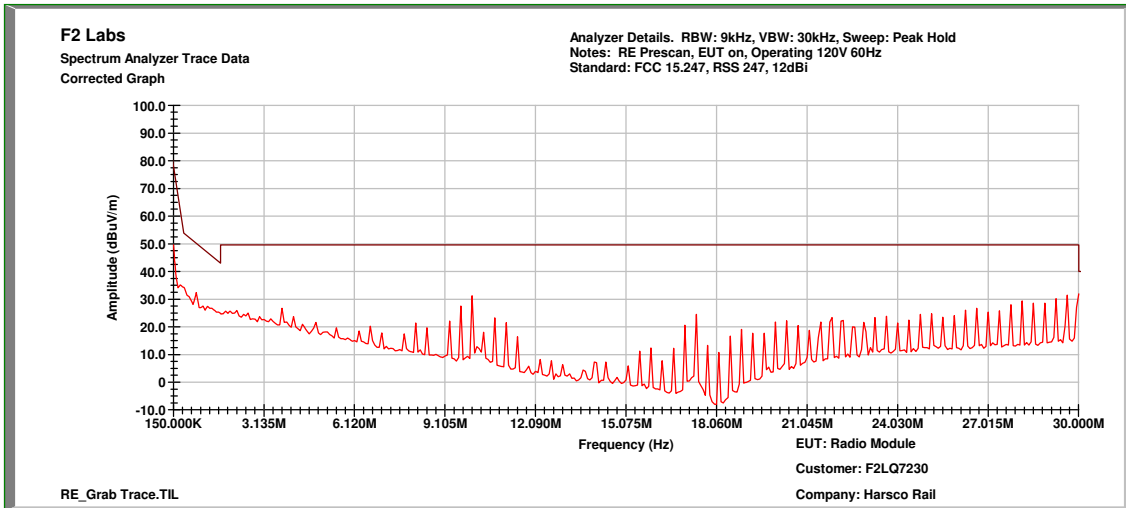
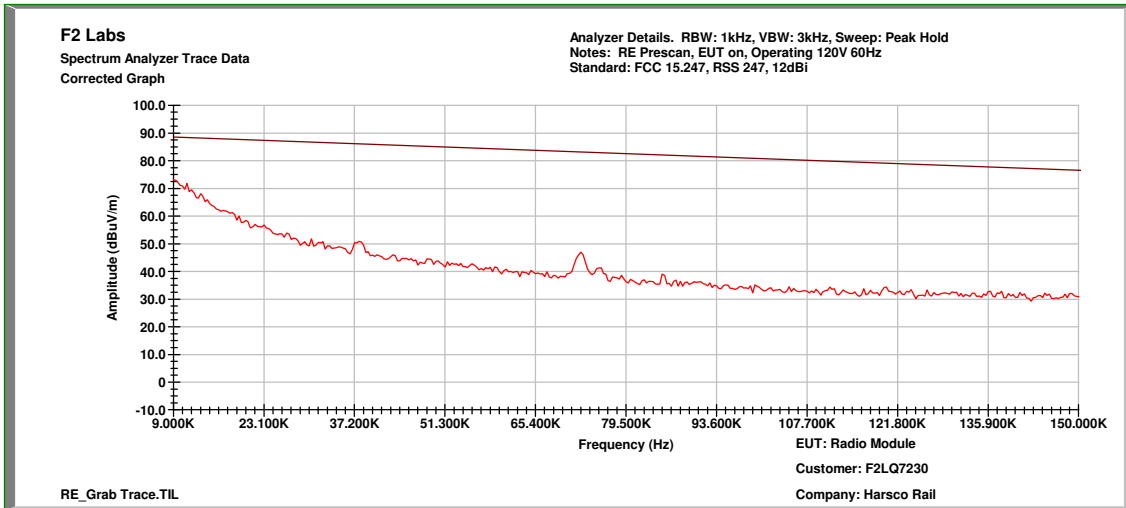
The equipment was fully exercised with all cabling attached to the EUT and was positioned on the OATS for maximum emissions. While the equipment was energized, the receiving antenna was scanned from 1.0 meter to 4.0 meters in both vertical and horizontal polarities while the turntable was adjusted 360 degrees to determine the maximum field strength. The tables of measured results can be found below.

Some of the frequencies did not change with the EUT on or off. At those frequencies, the test distance was shortened to 1 meter and still no emissions from the EUT were visible or over the ambient or limit.

In the following plots, the black line indicates ambient noise and the red line indicates the measurement with the EUT on. Emissions to be found by the EUT were measured and listed in tables. The plots are for reference only and the limit lines are not actual limit lines but merely a guide.

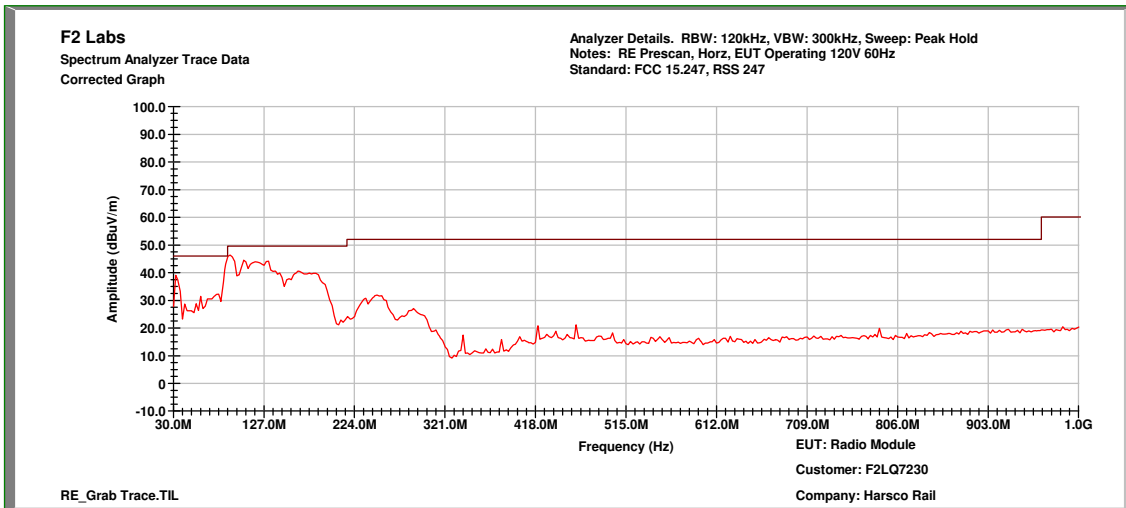
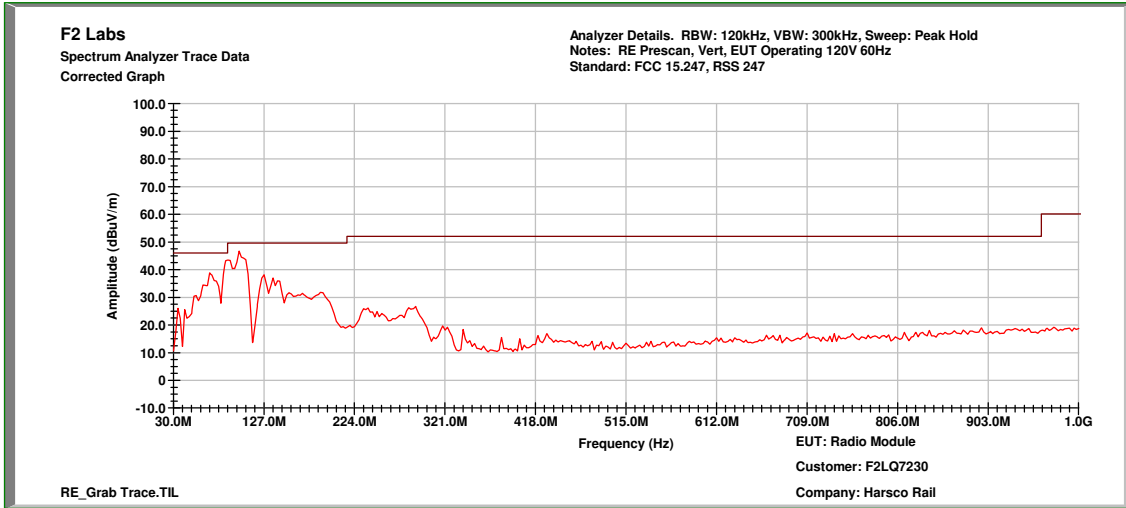


Radiated Spurious Emission with 12dBi Whip Antenna



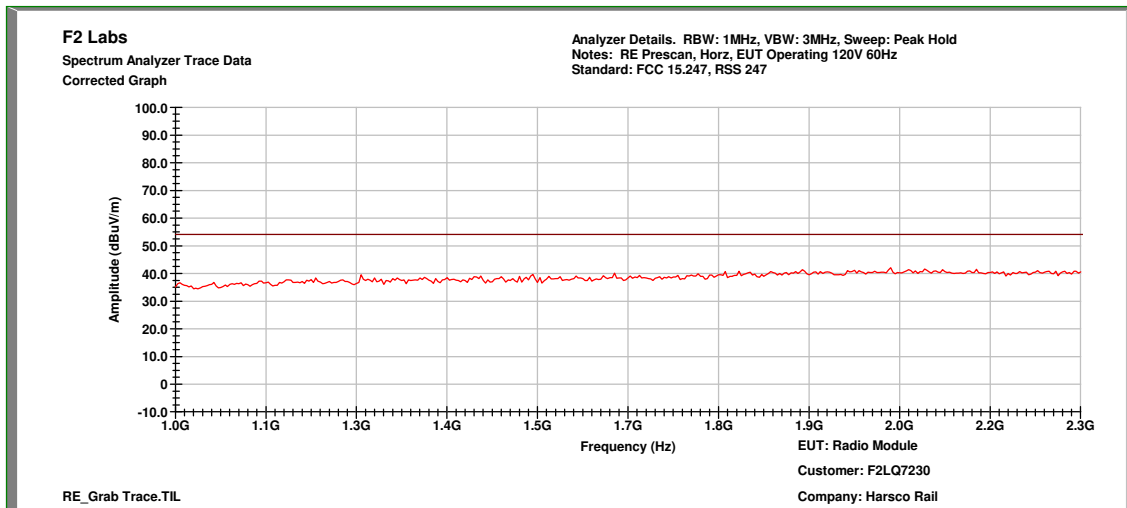
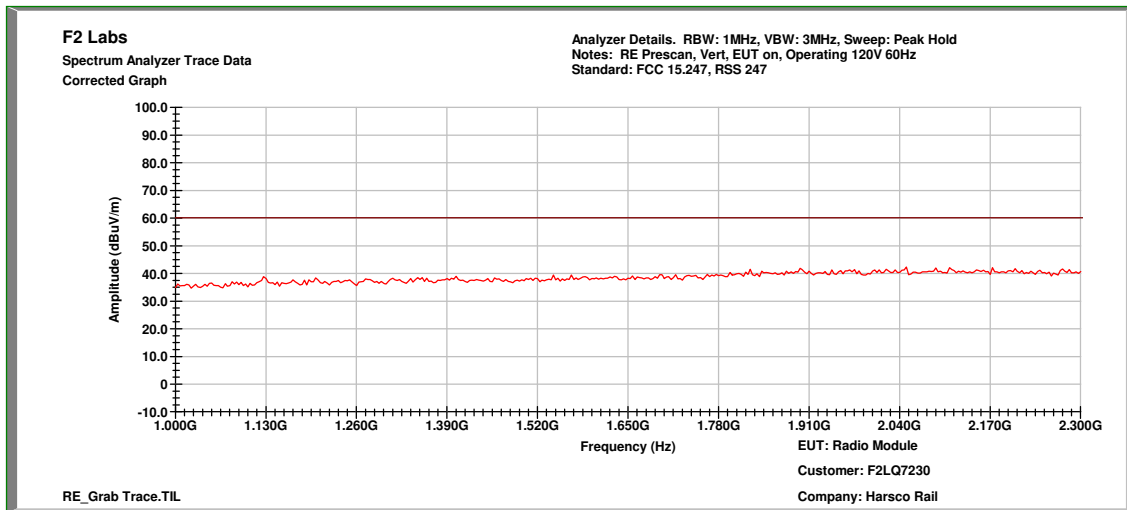


Radiated Spurious Emission with 12dBi Whip Antenna, cont'd



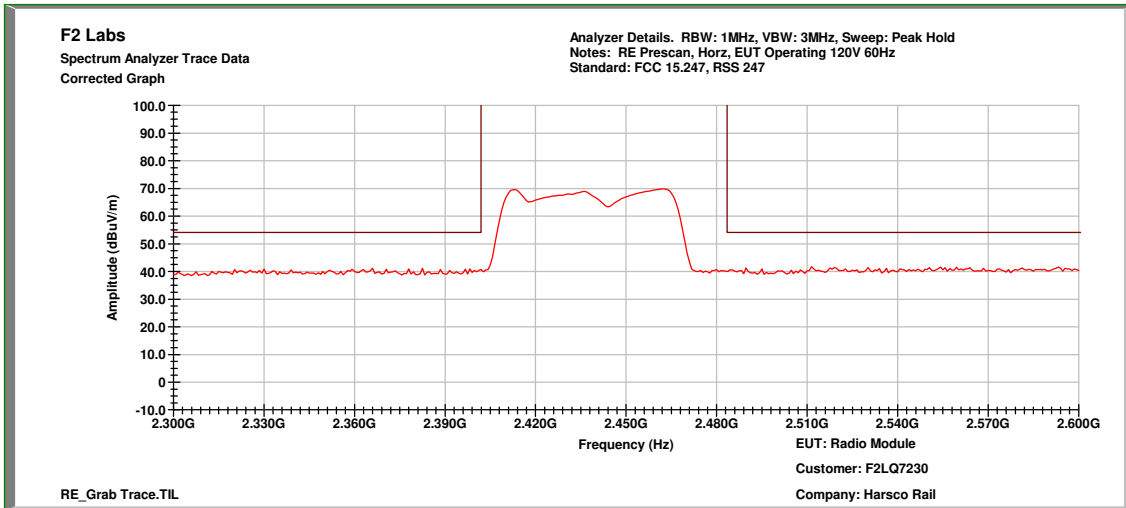
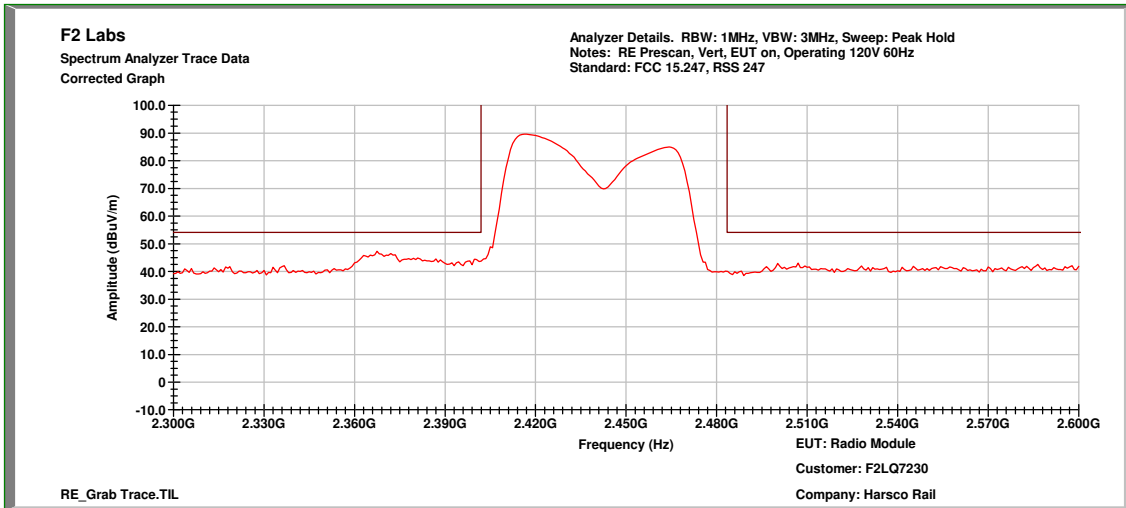


Radiated Spurious Emission with 12dBi Whip Antenna, cont'd



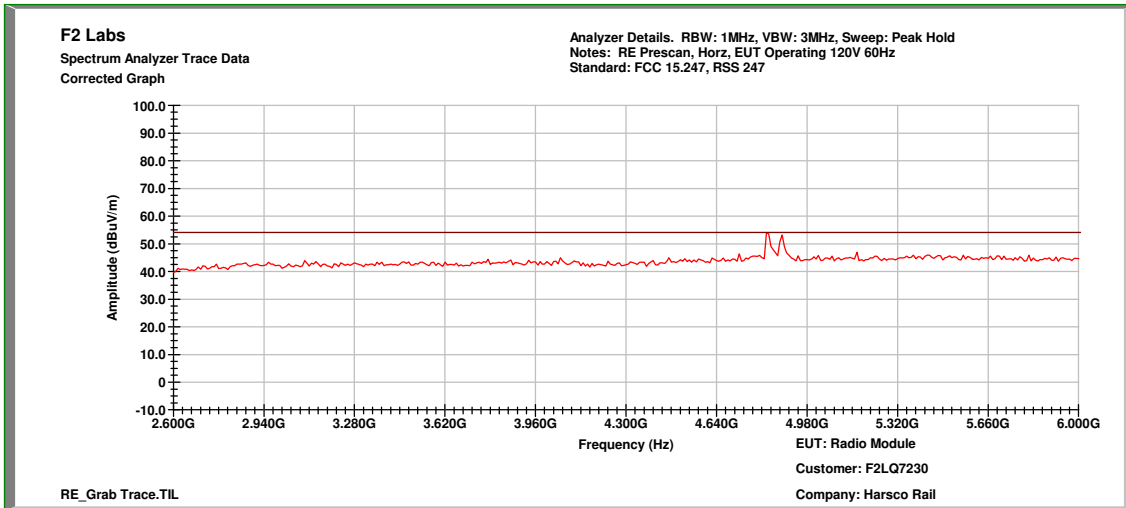
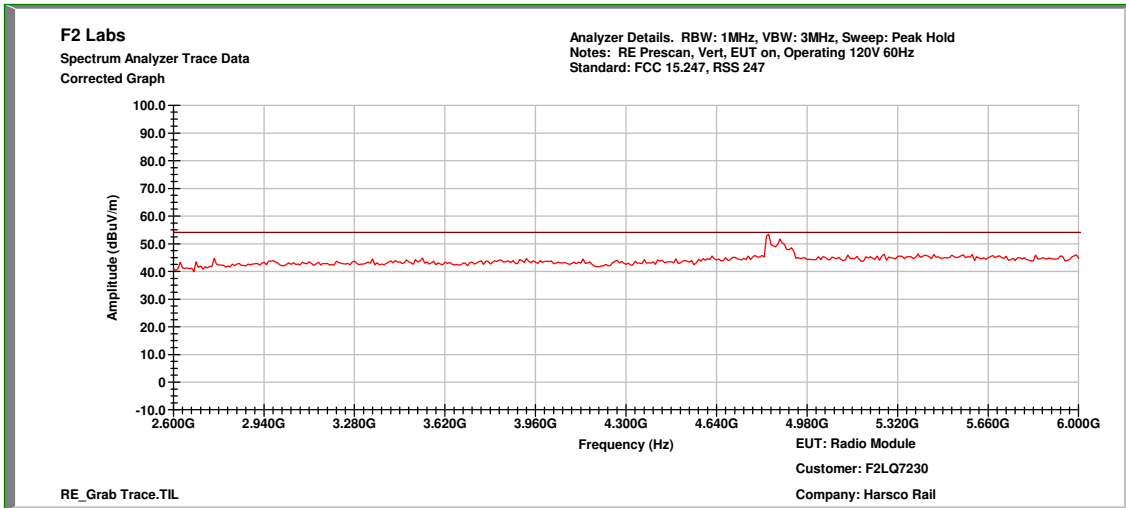


Radiated Spurious Emission with 12dBi Whip Antenna, cont'd



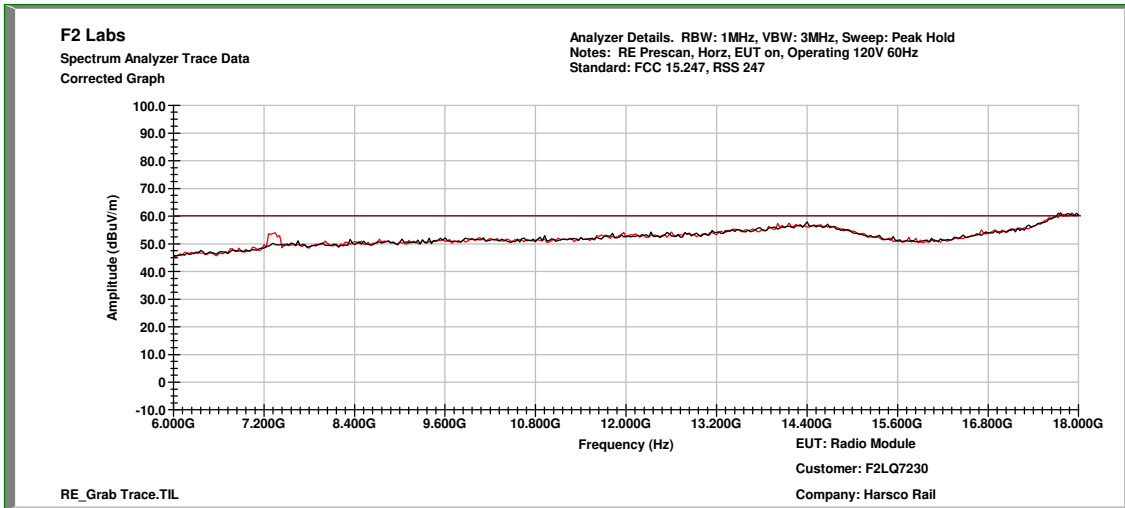
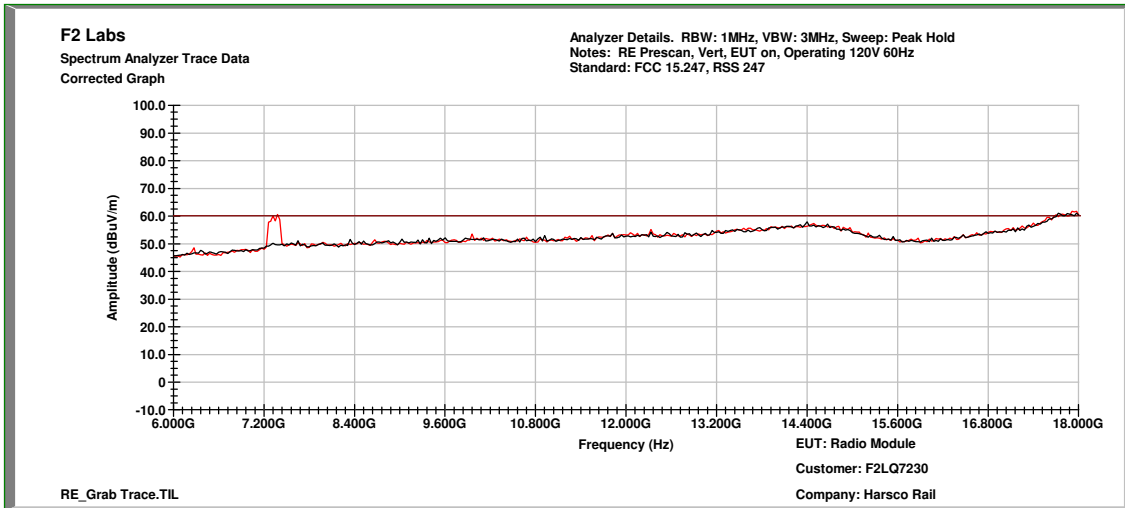


Radiated Spurious Emission with 12dBi Whip Antenna, cont'd



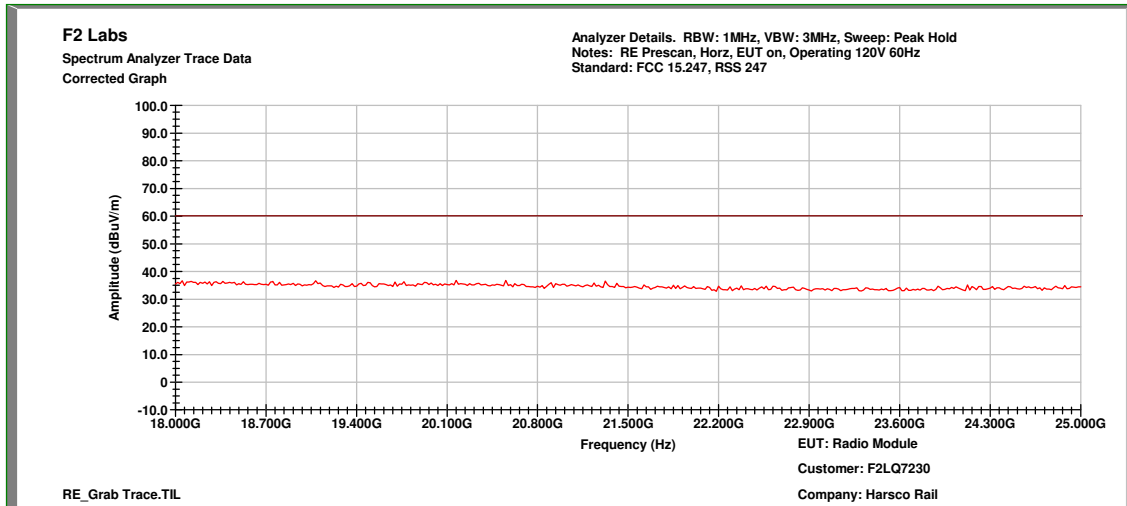
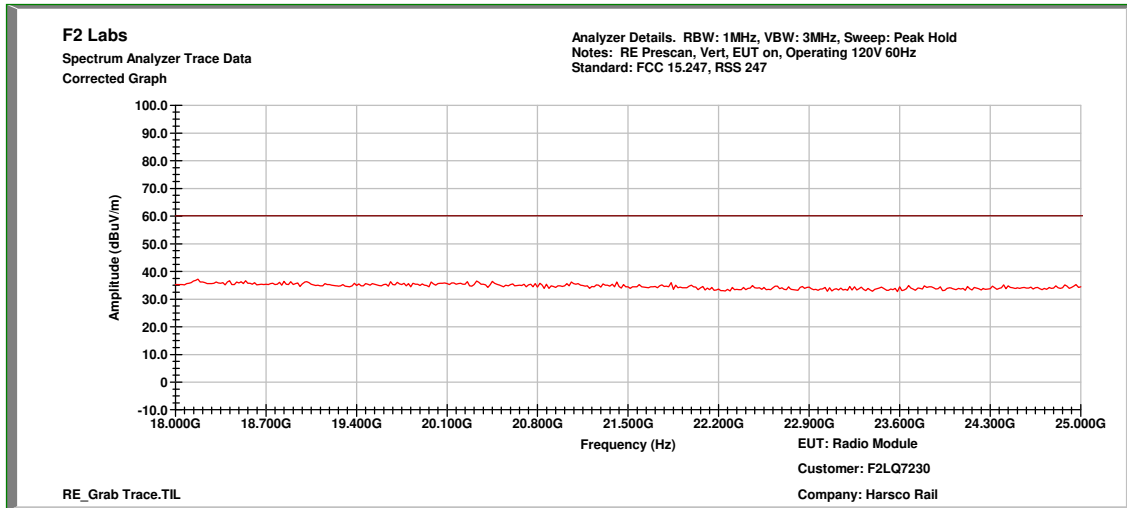


Radiated Spurious Emission with 12dBi Whip Antenna, cont'd





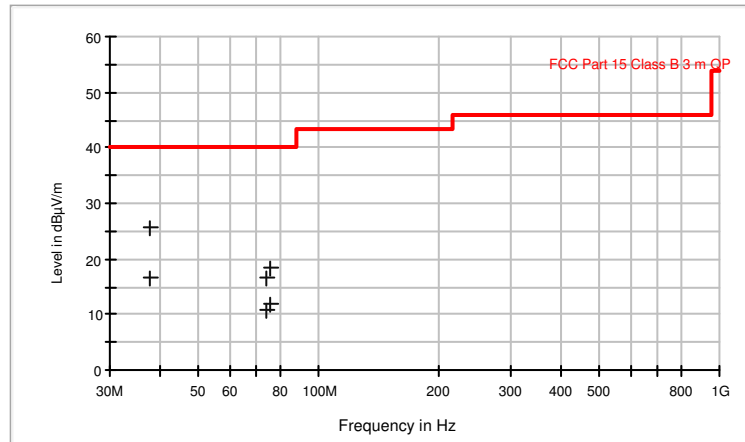
Radiated Spurious Emission with 12dBi Whip Antenna, cont'd





12dBi Antenna, 30 MHz to 1 GHz, QuasiPeak

Frequency (MHz)	Antenna Polarization	Reading (dBμV)	Cable Loss & Antenna Factor (dB)	Emission (dBμV/m)	Limit (dBμV/m)	Margin (dB)
37.728000	V	10.1	15.7	25.80	40.0	-14.2
37.728000	H	-0.5	17.1	16.60	40.0	-23.4
73.958000	V	7.8	8.9	16.70	40.0	-23.3
73.958000	H	1.1	9.9	11.00	40.0	-29.0
75.066000	V	9.8	8.8	18.60	40.0	-21.4
75.066000	H	2.0	9.8	11.80	40.0	-28.2



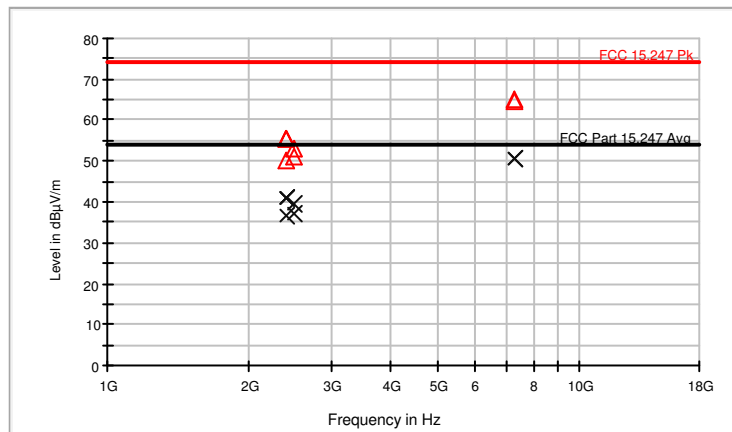


12dBi Antenna, 1 GHz to 18 GHz, MaxPeak

Frequency (MHz)	Antenna Polarization	Reading (dBμV)	Cable Loss & Antenna Factor (dB)	Emission (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2390.000000	V	44.3	11.2	55.50	74.0	-18.5
2390.000000	V	44.3	11.2	55.50	74.0	-18.5
2390.000000	V	44.3	11.2	55.50	74.0	-18.5
2390.000000	H	38.8	11.2	50.00	74.0	-24.0
2483.500000	V	41.3	11.5	52.80	74.0	-21.2
2483.500000	H	39.5	11.5	51.00	74.0	-23.0
7320.000000	H	41.3	23.2	64.50	74.0	-9.5
7320.000000	V	41.8	23.2	65.00	74.0	-9.0

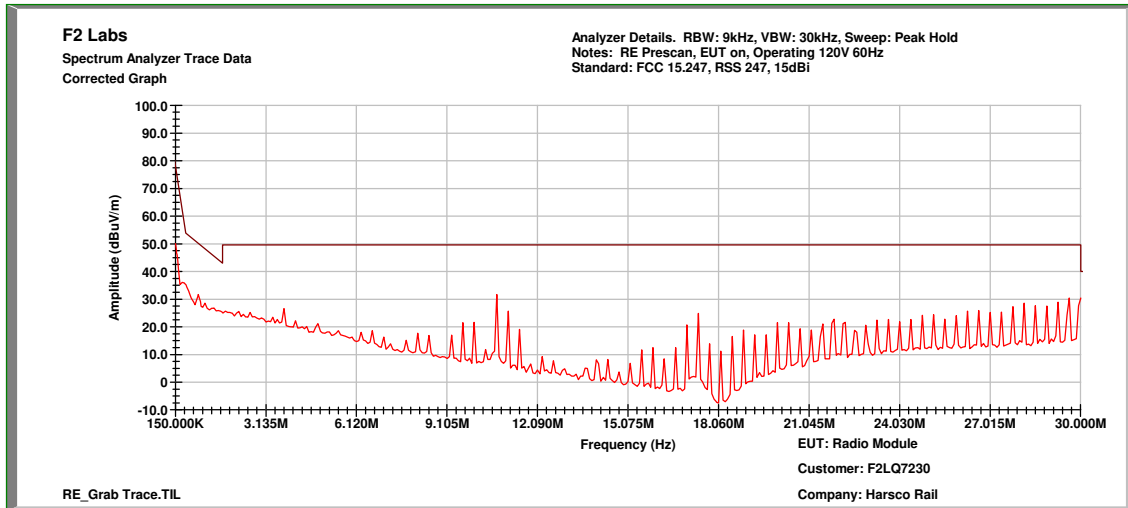
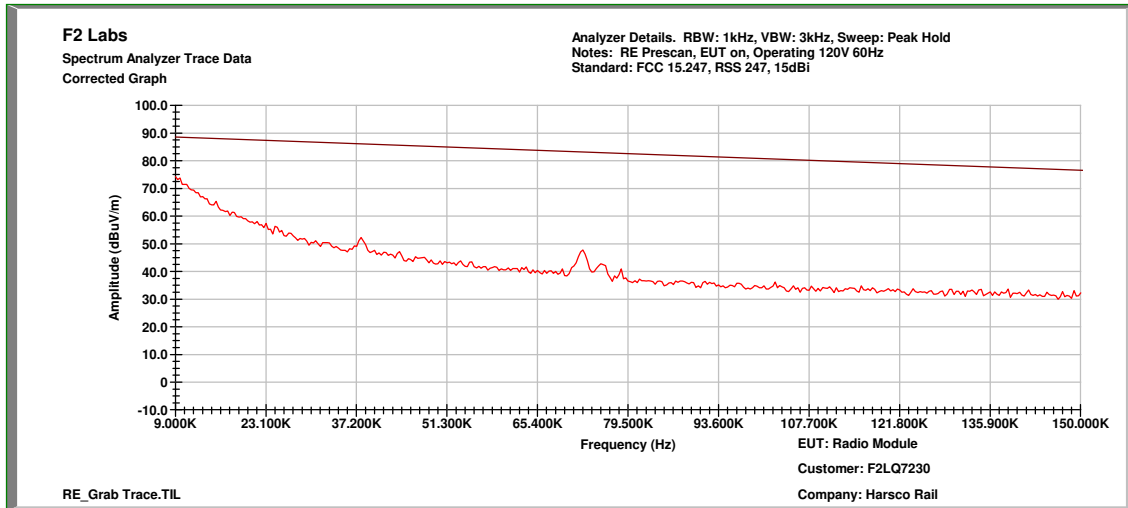
12dBi Antenna, 1 GHz to 18 GHz, Average

Frequency (MHz)	Antenna Polarization	Reading (dBμV)	Cable Loss & Antenna Factor (dB)	Emission (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2390.000000	V	29.9	11.2	41.10	54.0	-12.9
2390.000000	V	29.9	11.2	41.10	54.0	-12.9
2390.000000	V	29.9	11.2	41.10	54.0	-12.9
2390.000000	H	25.3	11.2	36.50	54.0	-17.5
2483.500000	V	27.8	11.5	39.30	54.0	-14.7
2483.500000	H	25.4	11.5	36.90	54.0	-17.1
7320.000000	H	27.5	23.2	50.70	54.0	-3.3
7320.000000	V	27.5	23.2	50.70	54.0	-3.3



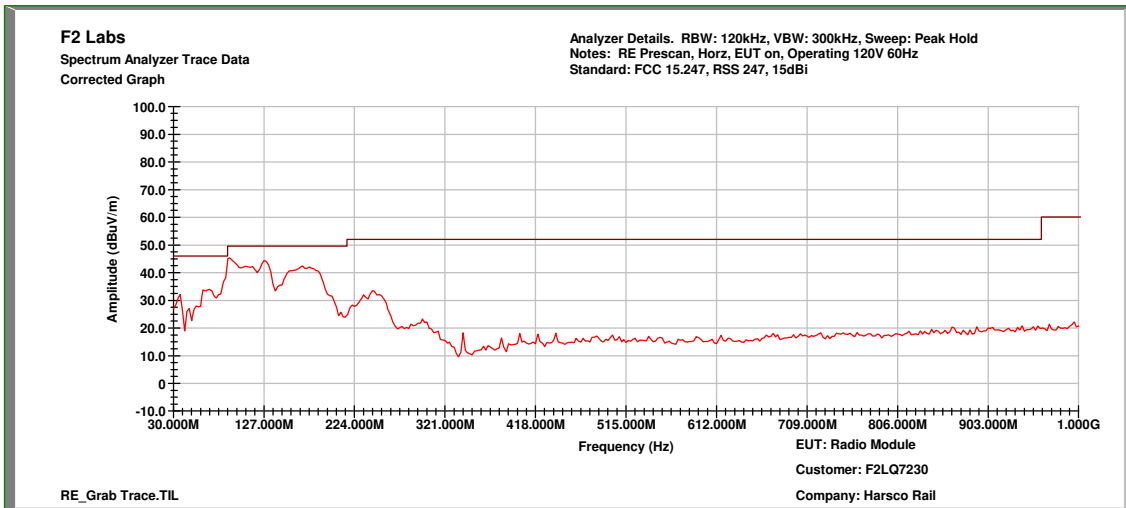
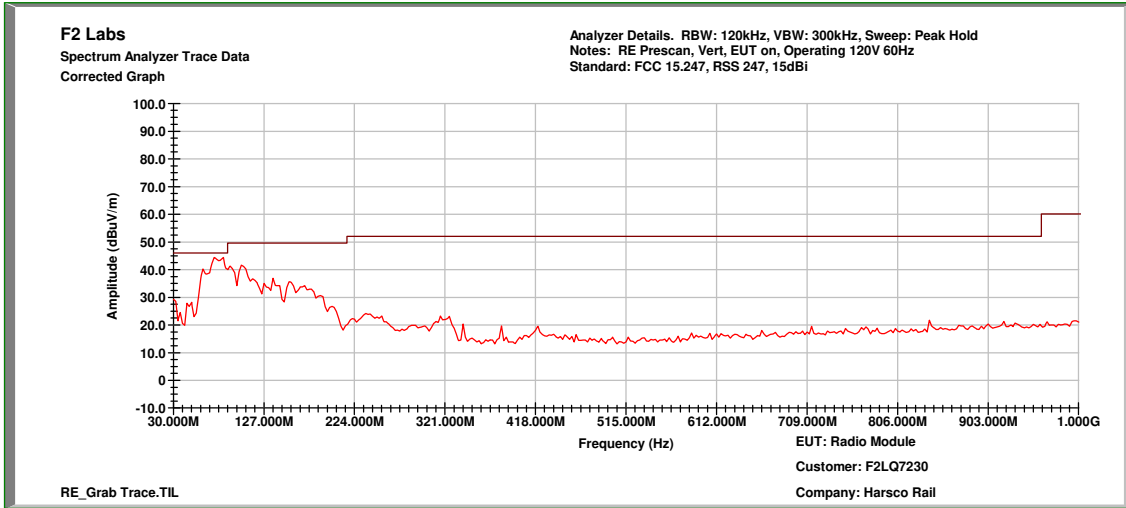


Radiated Spurious Emission with 15dBi Whip Antenna



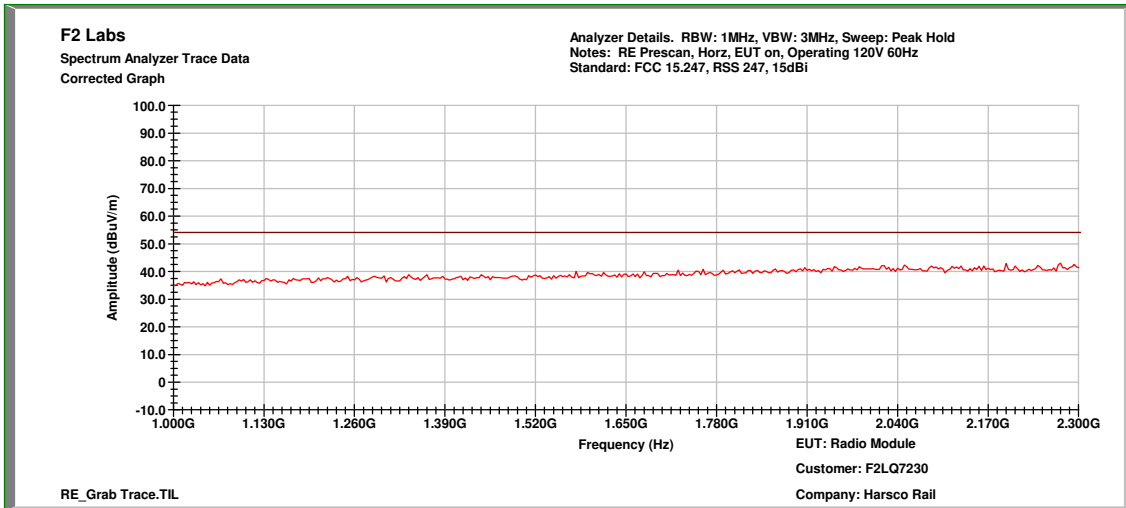
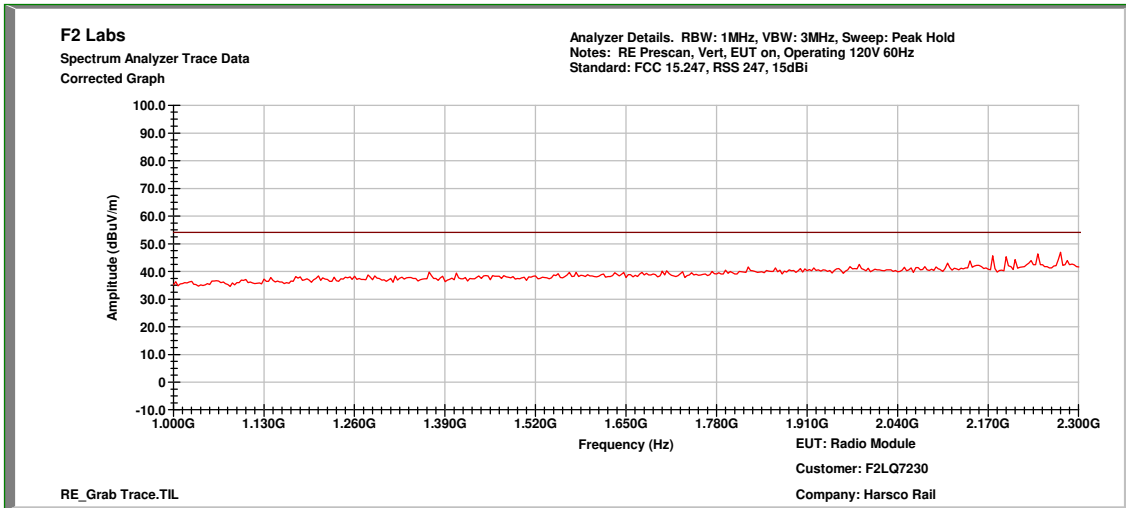


Radiated Spurious Emission with 15dBi Whip Antenna, cont'd



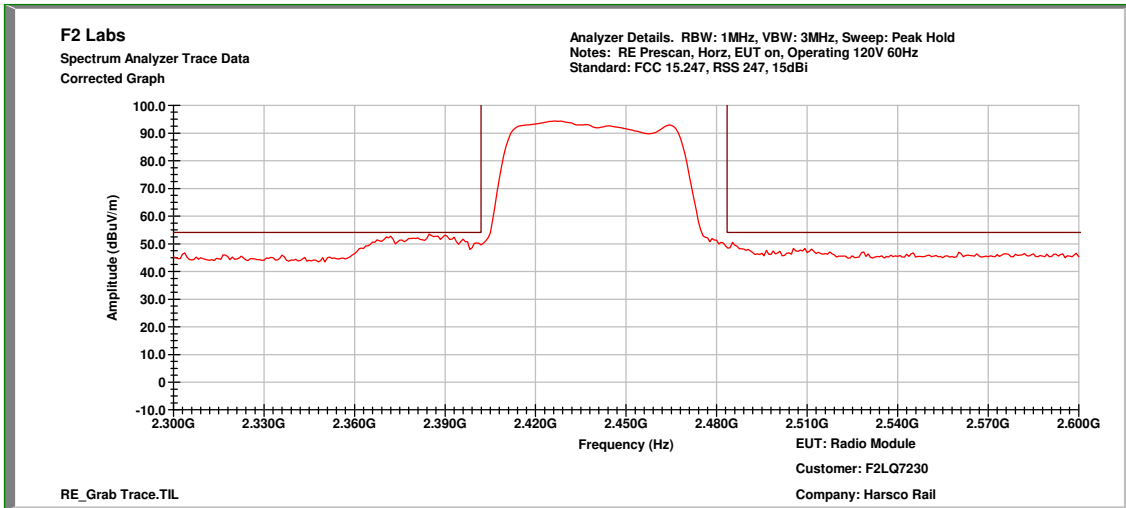
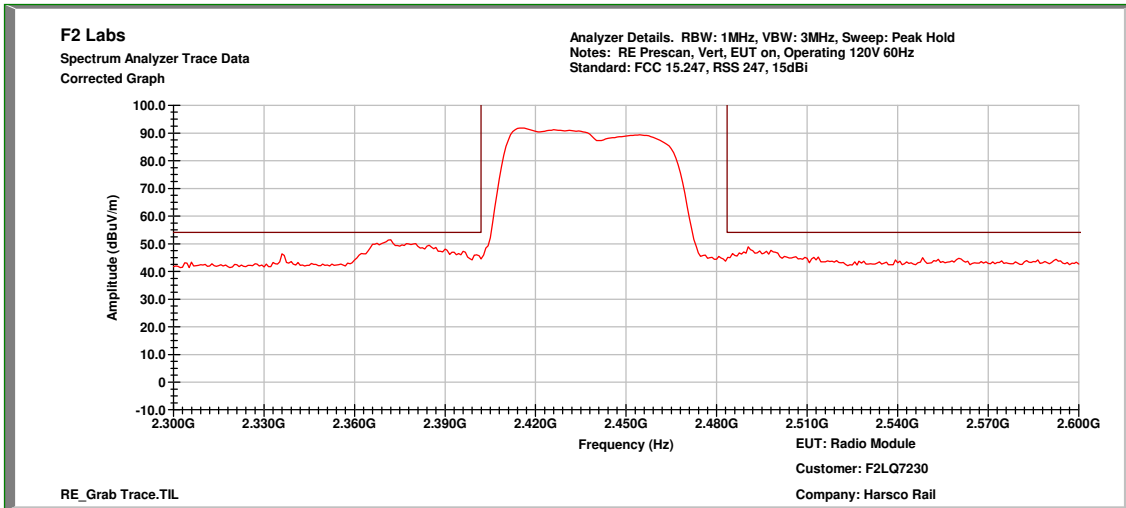


Radiated Spurious Emission with 15dBi Whip Antenna, cont'd



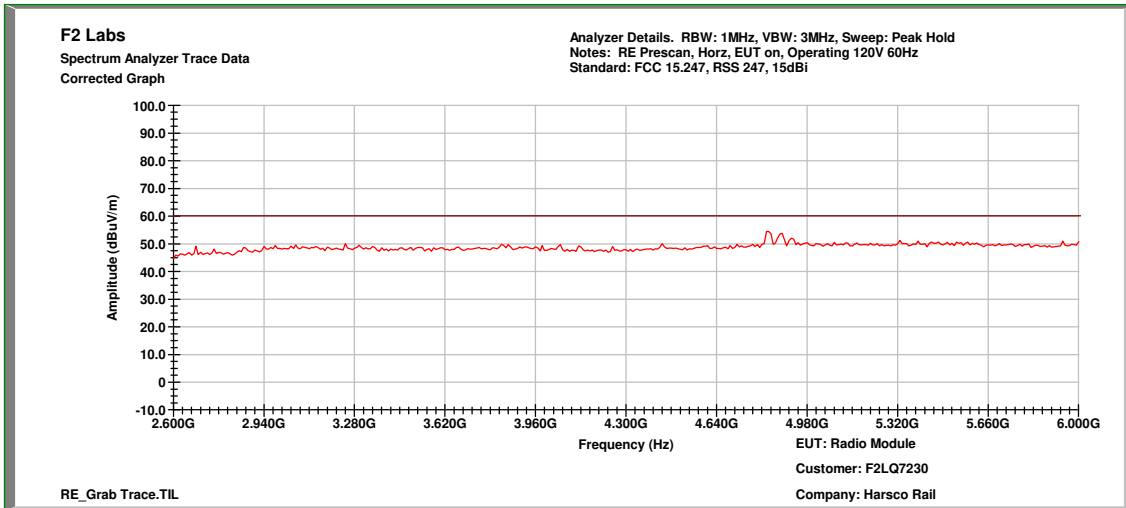
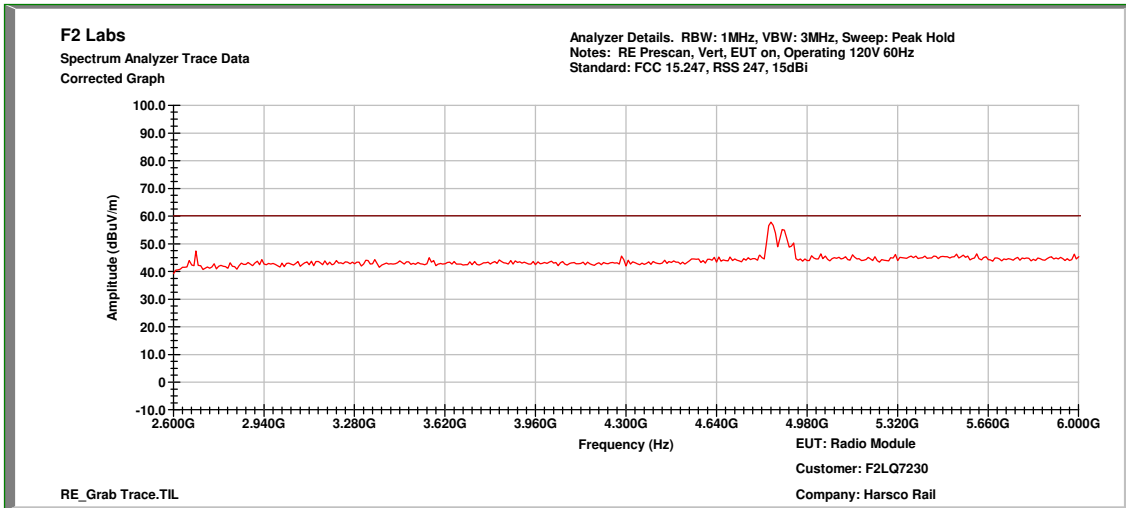


Radiated Spurious Emission with 15dBi Whip Antenna, cont'd



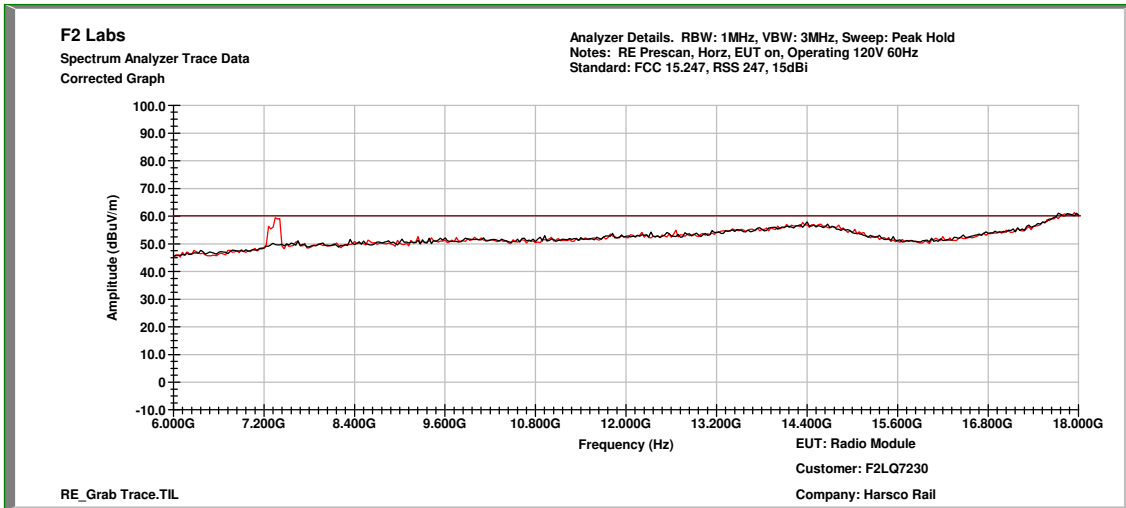
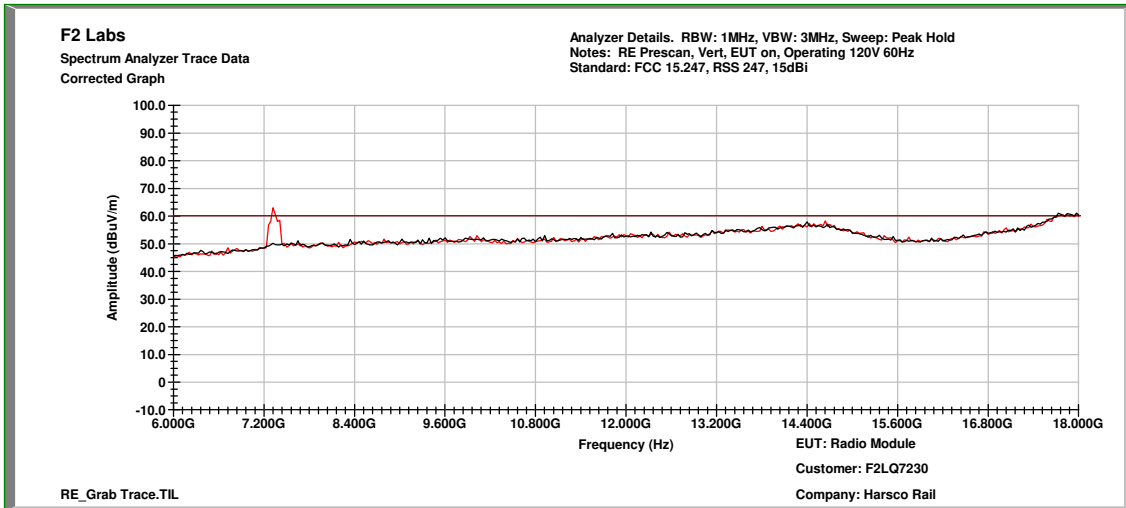


Radiated Spurious Emission with 15dBi Whip Antenna, cont'd



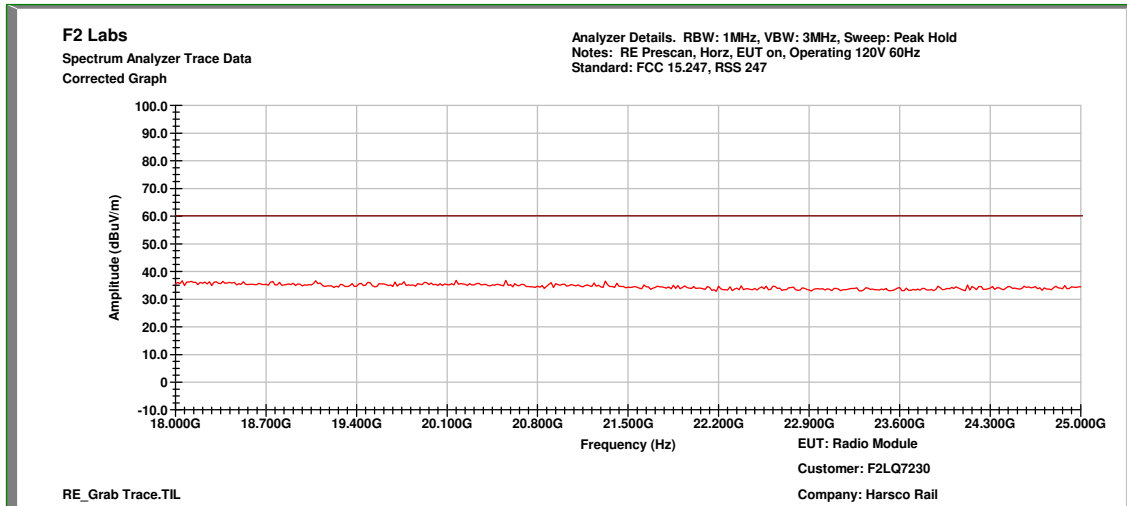
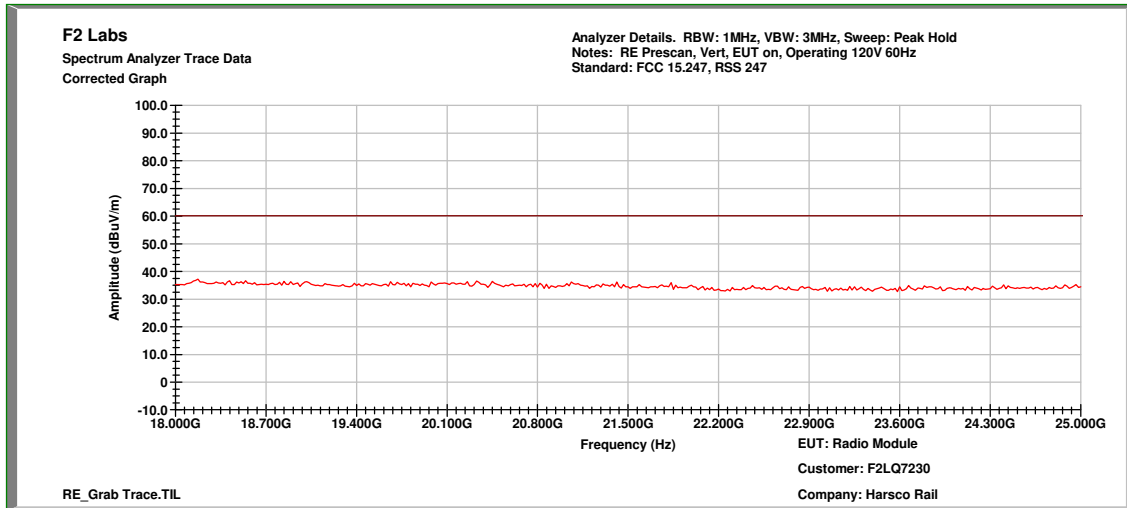


Radiated Spurious Emission with 15dBi Whip Antenna, cont'd





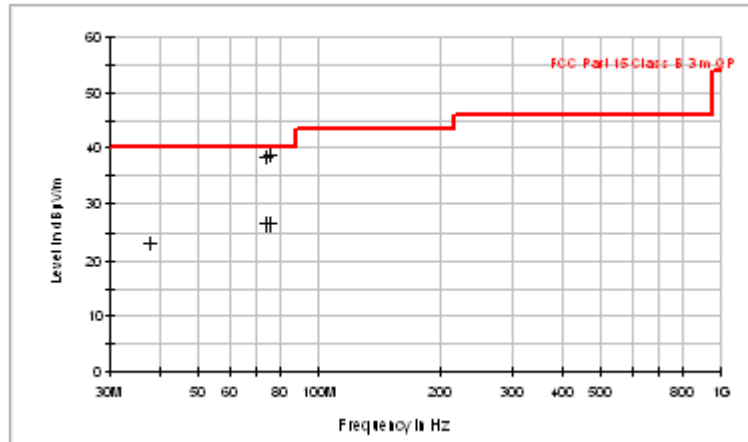
Radiated Spurious Emission with 15dBi Whip Antenna, cont'd





15dBi Antenna, 30 MHz to 1 GHz, QuasiPeak

Frequency (MHz)	Antenna Polarization	Reading (dBμV)	Cable Loss & Antenna Factor (dB)	Emission (dBμV/m)	Limit (dBμV/m)	Margin (dB)
37.732000	V	7.3	15.7	23.00	40.0	-17.0
37.732000	H	7.4	15.7	23.10	40.0	-16.9
74.000000	V	29.3	8.9	38.20	40.0	-1.8
74.000000	H	17.6	8.9	26.50	40.0	-13.5
75.110000	V	30.0	8.8	38.80	40.0	-1.2
75.110000	H	17.4	8.8	26.20	40.0	-13.8



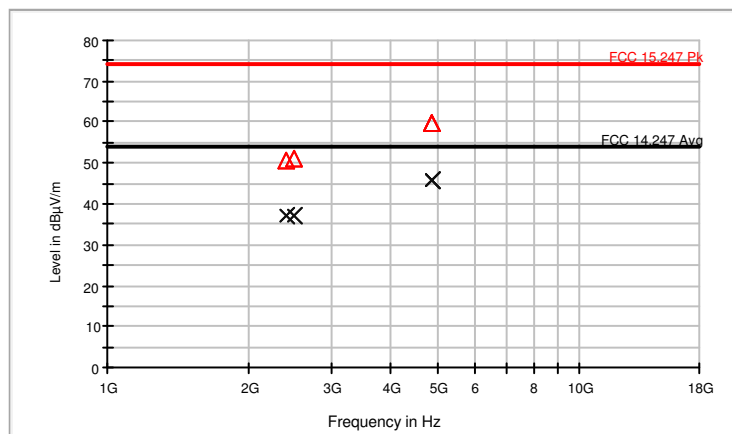


15dBi Antenna, 1 GHz to 18 GHz, MaxPeak

Frequency (MHz)	Antenna Polarization	Reading (dBμV)	Cable Loss & Antenna Factor (dB)	Emission (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2390.000000	H	39.5	11.2	50.70	74.0	-23.3
2390.000000	V	39.2	11.2	50.40	74.0	-23.6
2483.500000	H	39.5	11.5	51.00	74.0	-23.0
2483.500000	V	39.5	11.5	51.00	74.0	-23.0
4880.000000	H	41.9	17.9	59.80	74.0	-14.2
4880.000000	H	41.9	17.9	59.80	74.0	-14.2
4880.000000	V	41.7	17.9	59.60	74.0	-14.4
4880.000000	H	41.9	17.9	59.80	74.0	-14.2

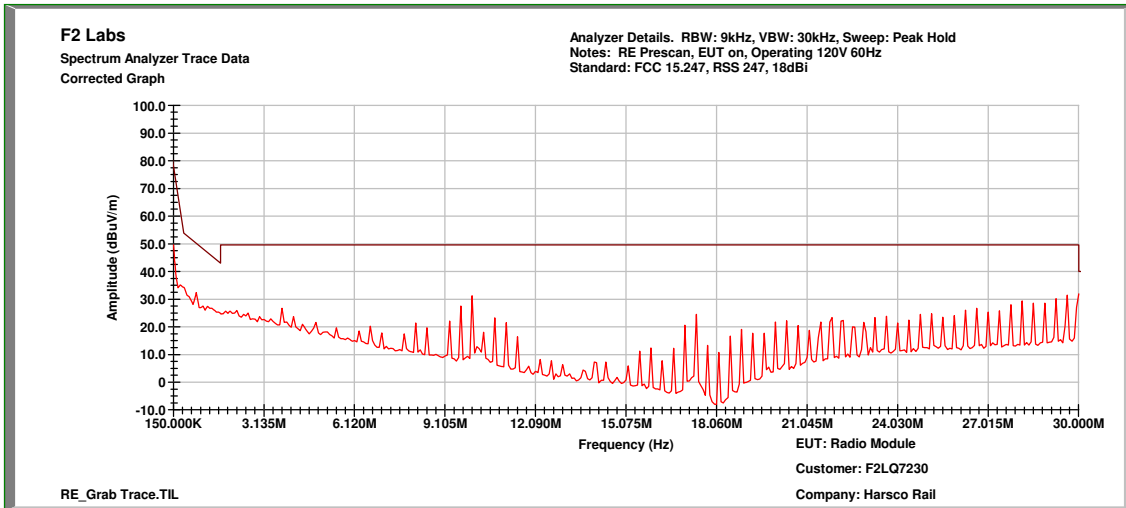
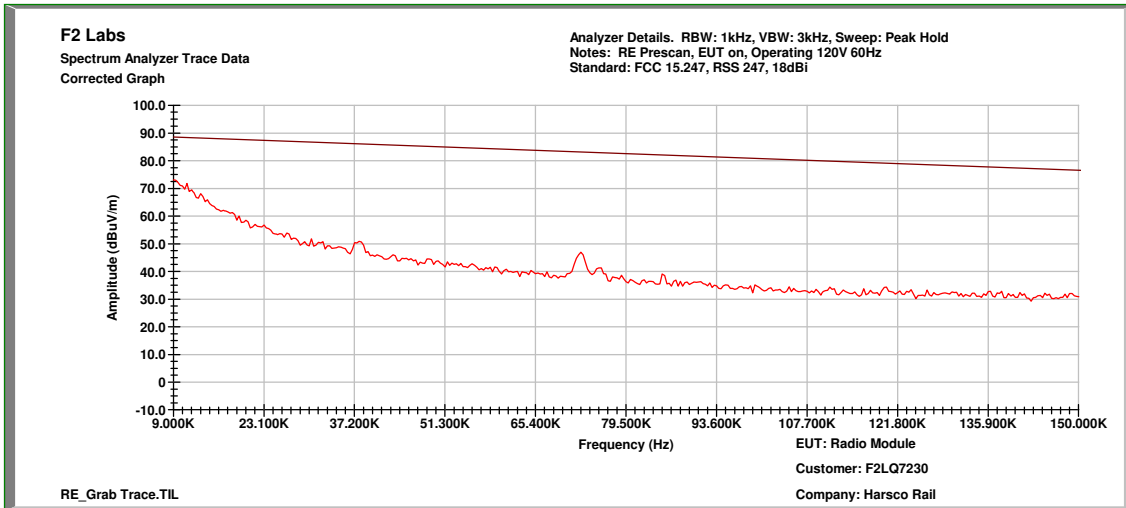
15dBi Antenna, >1 GHz to 18 GHz, Average

Frequency (MHz)	Antenna Polarization	Reading (dBμV)	Cable Loss & Antenna Factor (dB)	Emission (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2390.000000	H	26.0	11.2	37.20	54.0	-16.8
2390.000000	V	25.9	11.2	37.10	54.0	-16.9
2483.500000	H	25.7	11.5	37.20	54.0	-16.8
2483.500000	V	25.6	11.5	37.10	54.0	-16.9
4880.000000	H	28.0	17.9	45.90	54.0	-8.1
4880.000000	H	28.0	17.9	45.90	54.0	-8.1
4880.000000	V	28.0	17.9	45.90	54.0	-8.1
4880.000000	H	28.0	17.9	45.90	54.0	-8.1



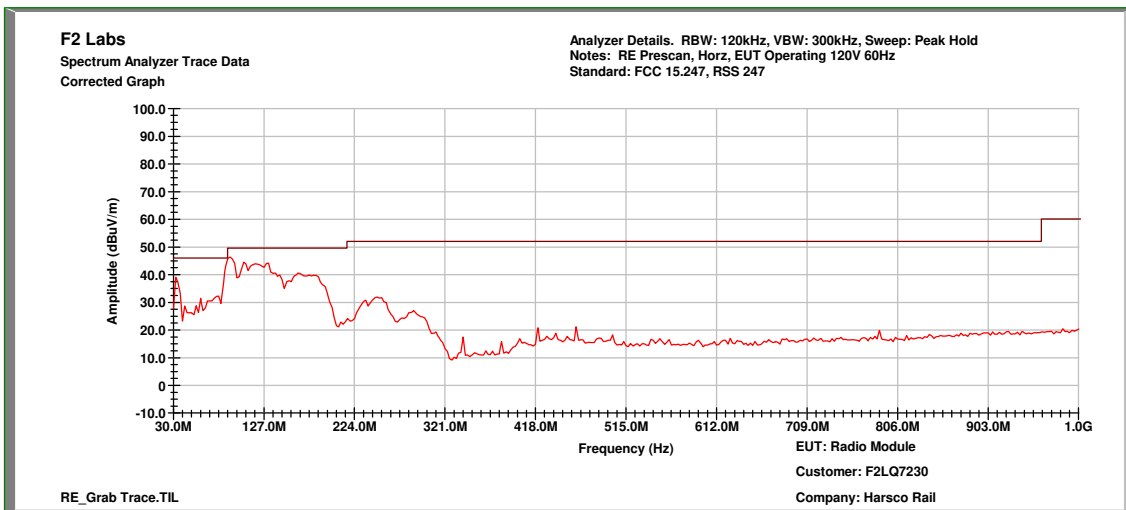
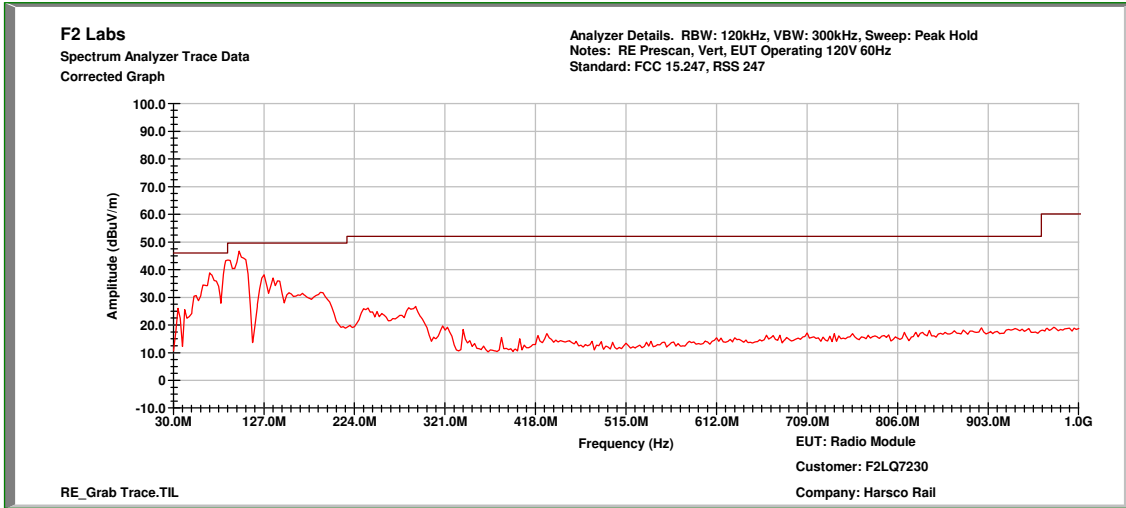


Radiated Spurious Emission with 18dBi Whip Antenna



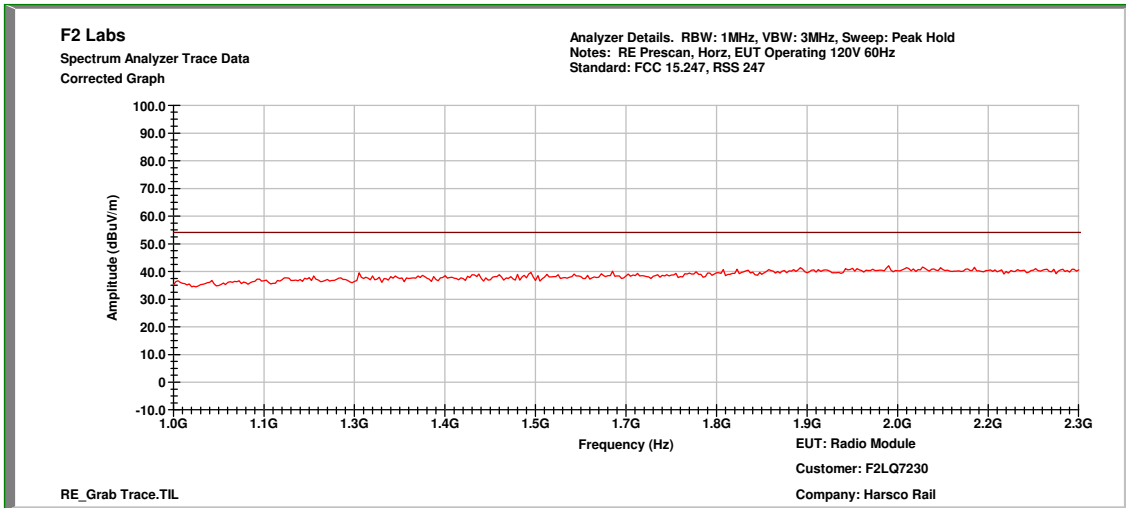
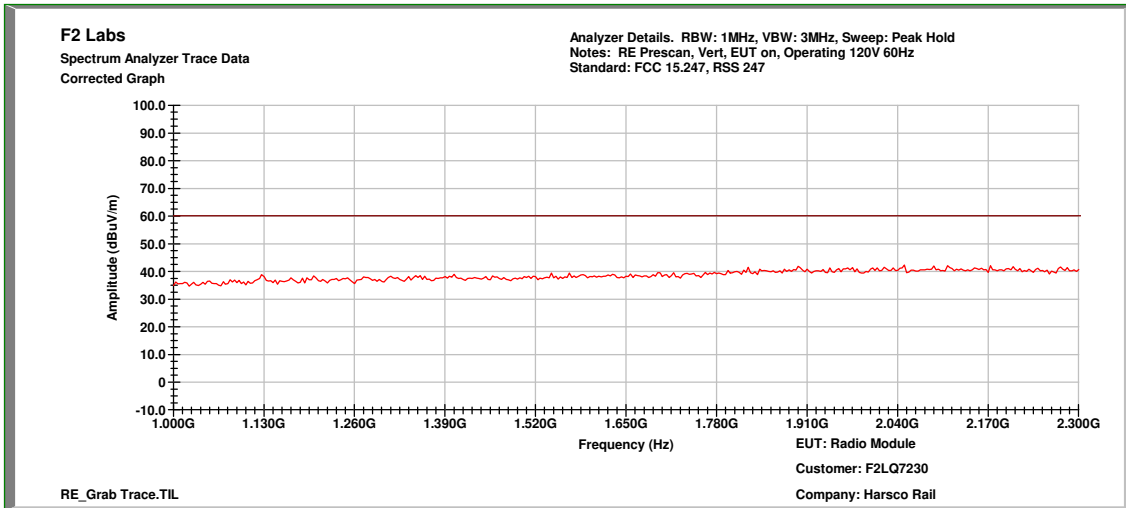


Radiated Spurious Emission with 18dBi Whip Antenna, cont'd



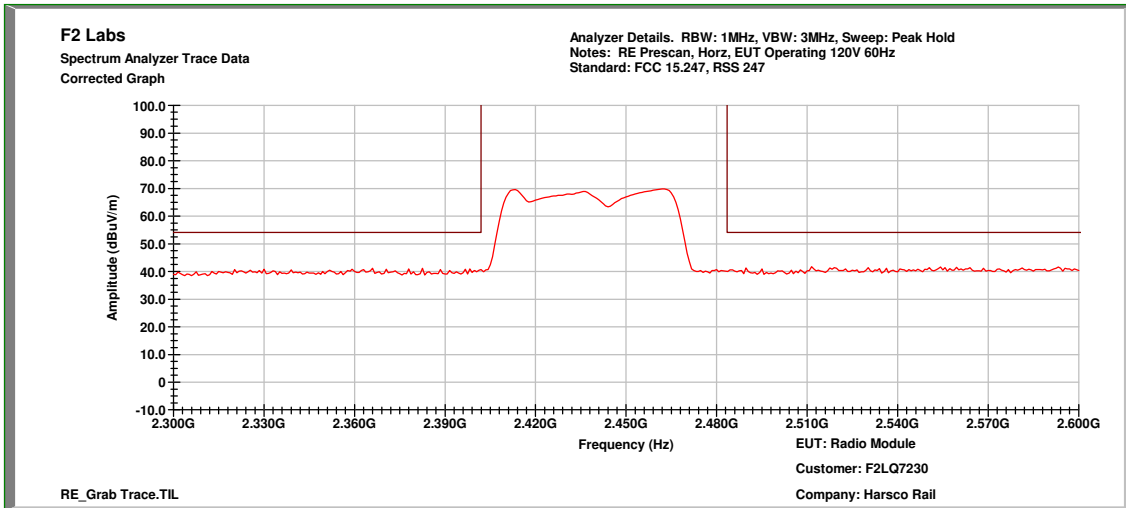
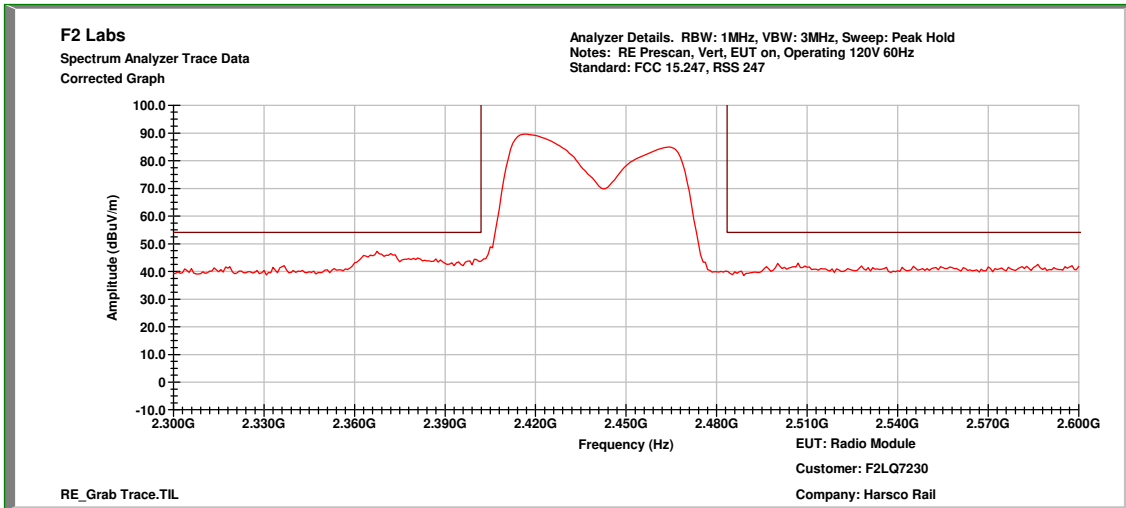


Radiated Spurious Emission with 18dBi Whip Antenna, cont'd



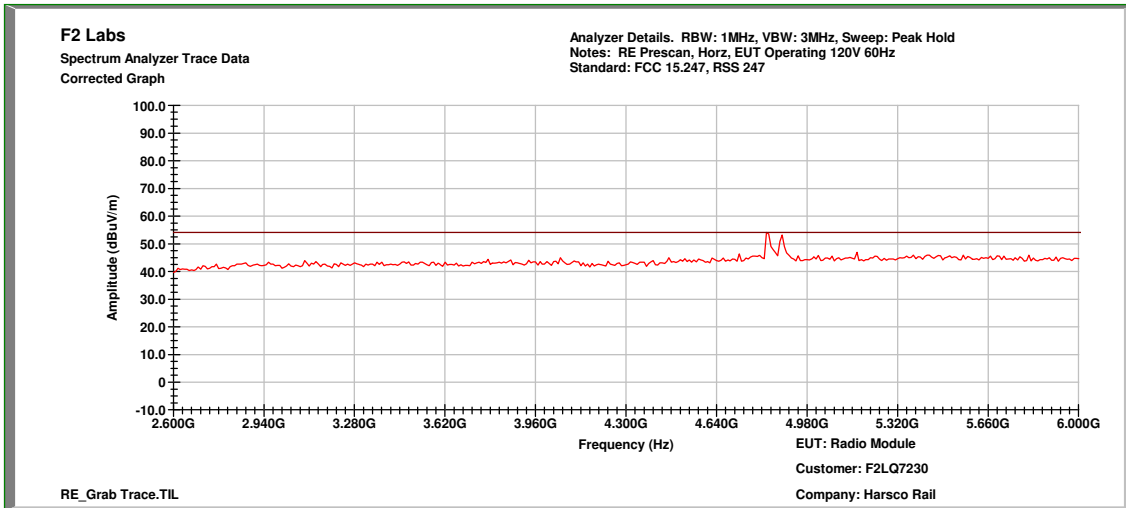
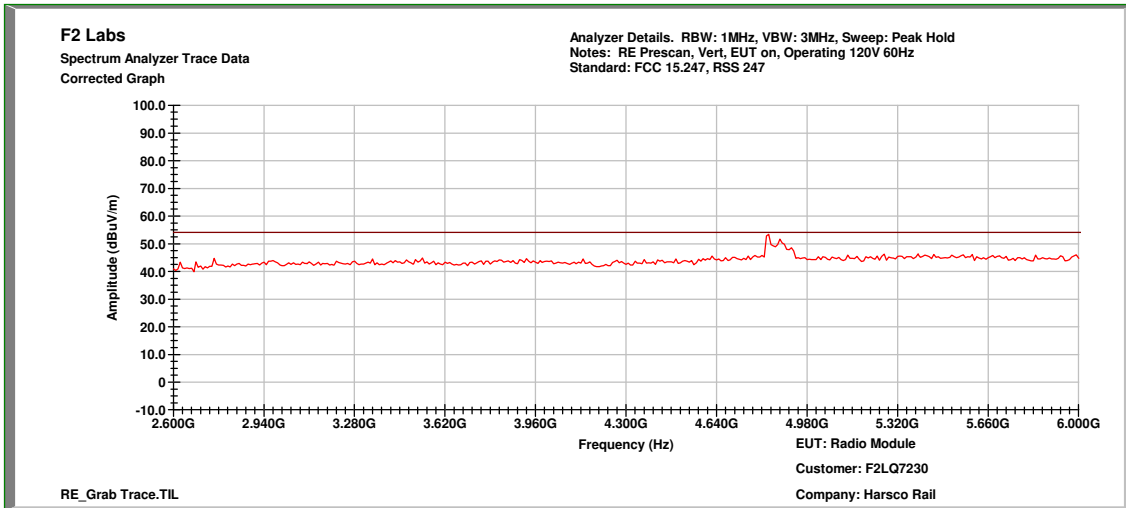


Radiated Spurious Emission with 18dBi Whip Antenna, cont'd



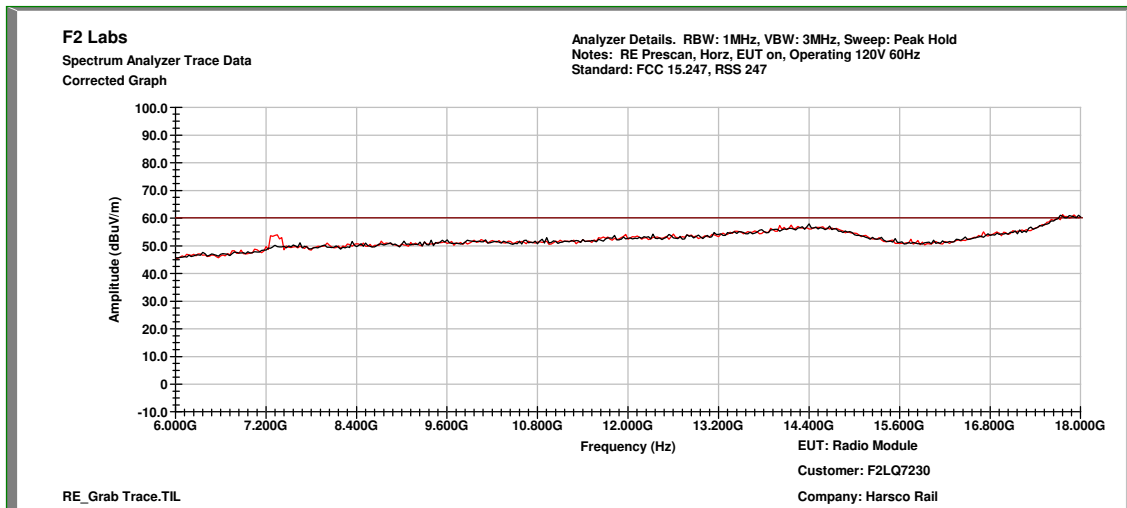
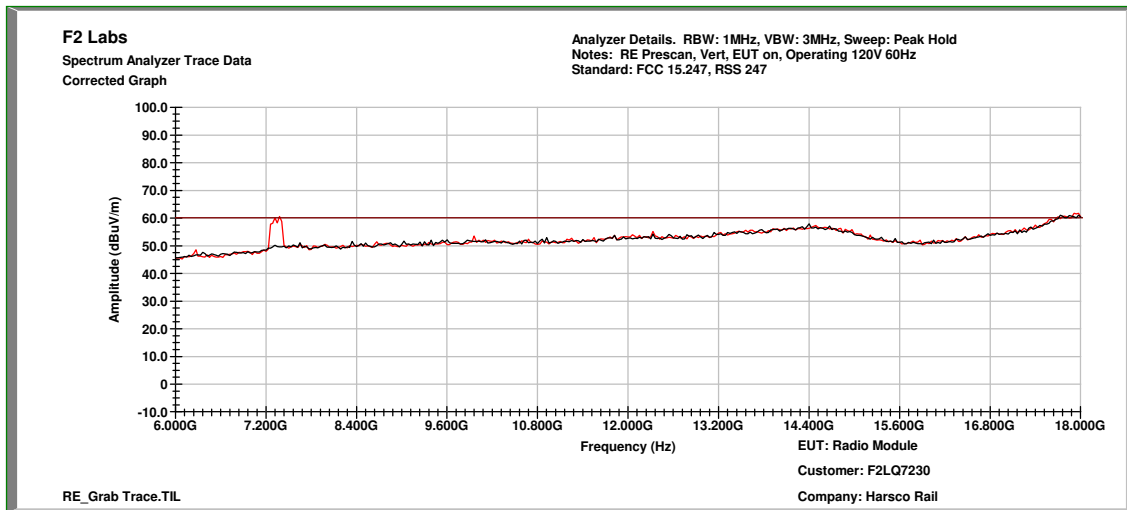


Radiated Spurious Emission with 18dBi Whip Antenna, cont'd



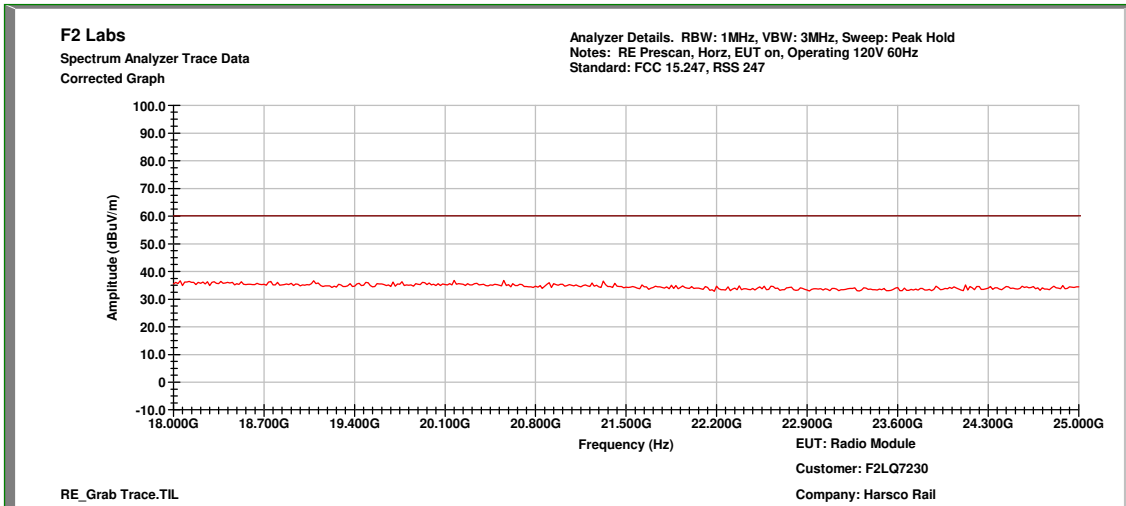
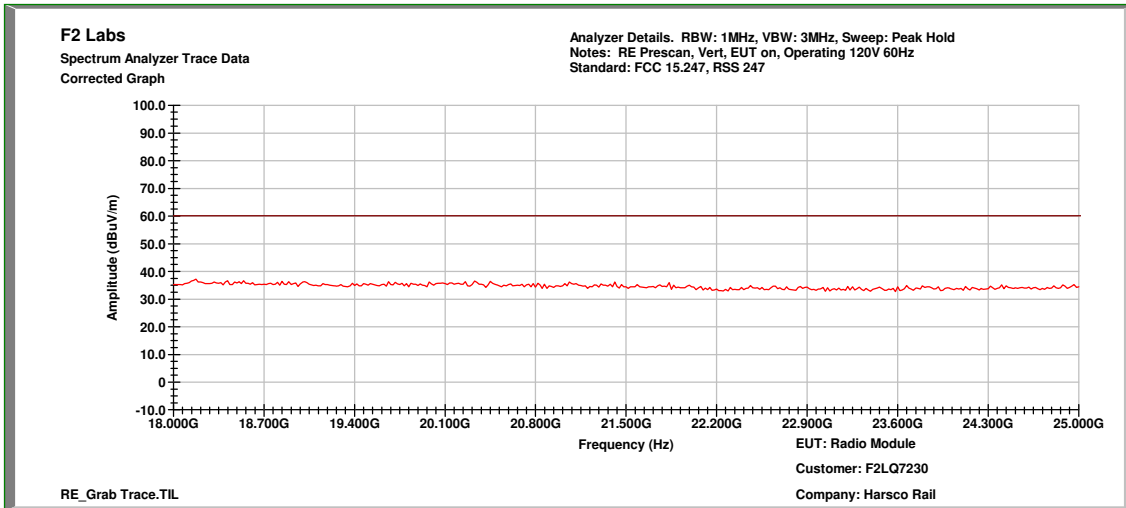


Radiated Spurious Emission with 18dBi Whip Antenna, cont'd





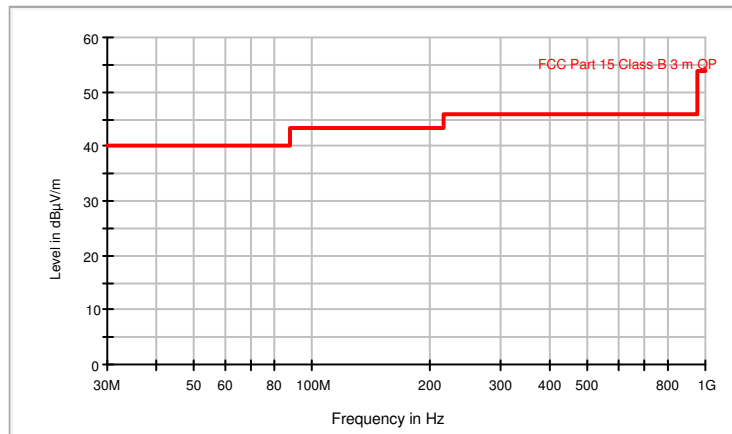
Radiated Spurious Emission with 18dBi Whip Antenna, cont'd





18dBi Antenna, 30 MHz to 1 GHz, QuasiPeak

Frequency (MHz)	Antenna Polarization	Reading (dB μ V)	Cable Loss & Antenna Factor (dB)	Emission (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
37.500000	V	13.9	15.8	29.70	40.0	-10.3
38.000000	H	-2.2	16.9	14.70	40.0	-25.3
74.000000	V	17.6	9.9	27.50	40.0	-12.5
75.000000	H	21.4	8.8	30.20	40.0	-9.8
120.000000	V	13.8	16.1	29.90	43.5	-13.6
128.164000	H	14.1	16.7	30.80	43.5	-12.7
136.312000	H	12.7	15.7	28.40	43.5	-15.1
150.000000	H	0.8	15.0	15.80	43.5	-27.7



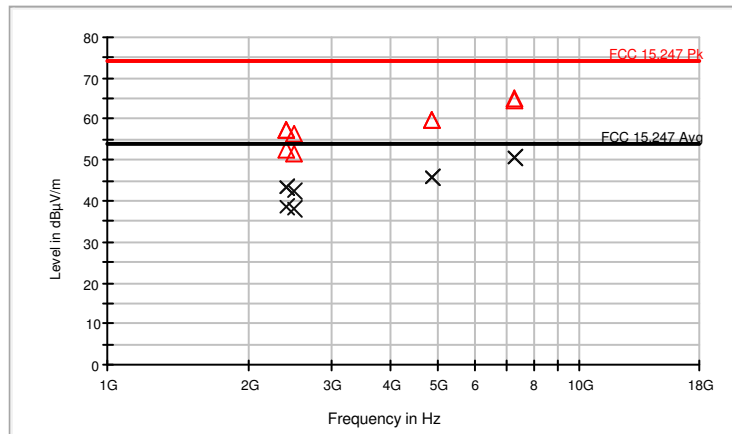


18dBi Antenna, 1 GHz to 18 GHz, MaxPeak

Frequency (MHz)	Antenna Polarization	Reading (dBμV)	Cable Loss & Antenna Factor (dB)	Emission (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2390.000000	V	46.1	11.2	57.30	74.0	-16.7
2390.000000	V	46.1	11.2	57.30	74.0	-16.7
2390.000000	H	41.2	11.2	52.40	74.0	-21.6
2483.500000	V	44.9	11.5	56.40	74.0	-17.6
2483.500000	H	40.0	11.5	51.50	74.0	-22.5
4880.000000	V	41.8	17.9	59.70	74.0	-14.3
4880.000000	H	41.7	17.9	59.60	74.0	-14.4
7320.000000	H	41.8	23.2	65.00	74.0	-9.0
7320.000000	V	41.6	23.2	64.80	74.0	-9.2

18dBi Antenna, >1 GHz to 18 GHz, Average

Frequency (MHz)	Antenna Polarization	Reading (dBμV)	Cable Loss & Antenna Factor (dB)	Emission (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2390.000000	V	32.2	11.2	43.40	54.0	-10.6
2390.000000	V	32.3	11.2	43.50	54.0	-10.5
2390.000000	H	27.4	11.2	38.60	54.0	-15.4
2483.500000	V	30.9	11.5	42.40	54.0	-11.6
2483.500000	H	26.7	11.5	38.20	54.0	-15.8
4880.000000	V	28.1	17.9	46.00	54.0	-8.0
4880.000000	H	28.0	17.9	45.90	54.0	-8.1
7320.000000	H	27.5	23.2	50.70	54.0	-3.3
7320.000000	V	27.5	23.2	50.70	54.0	-3.3





11 FCC PART 15.247 – PEAK POWER SPECTRAL DENSITY (PSD)

Peak power spectral density measurements were performed.

11.1 Requirements:

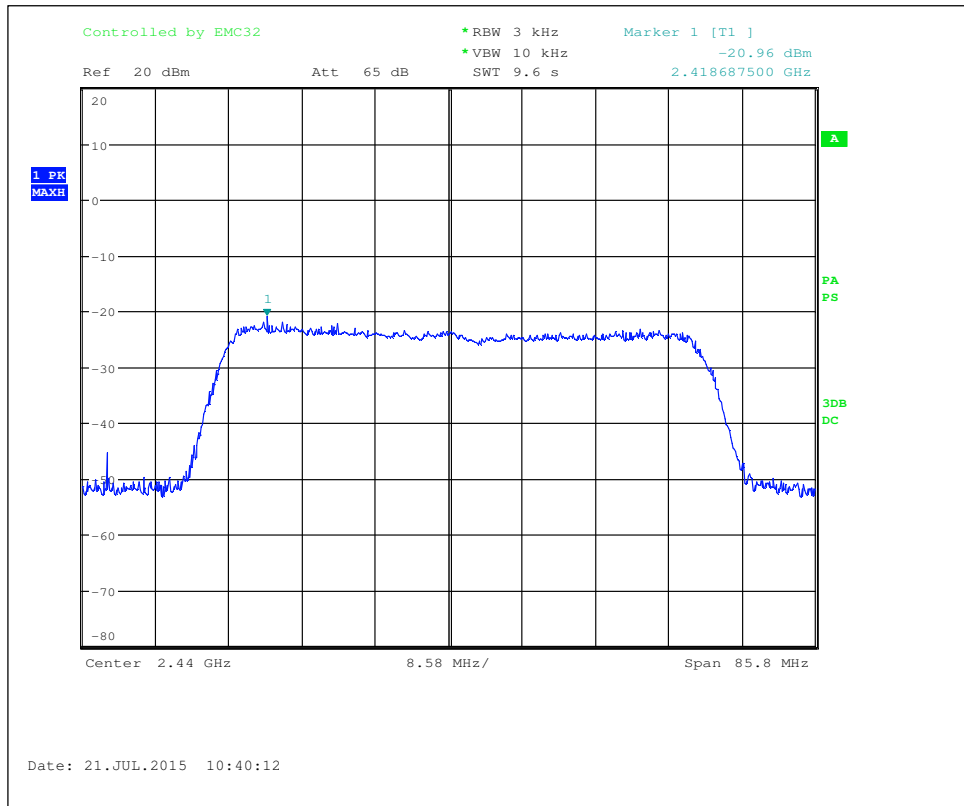
The peak power spectral density shall not exceed +8dBm in any 3 kHz band during any time interval of continuous transmission.

Power spectral density measurements were performed at a resolution bandwidth of 3 kHz (video bandwidth set at 10 KHz). The peak spectral densities were measured at 2.44 GHz.



11.2 Peak Power Spectral Density Test Data

Test Date(s):	July 21, 2015	Test Engineer:	J. Knepper
Standards:	CFR 47 Part 15.247; KDB558074	Air Temperature:	21.5°C
		Relative Humidity:	43%





12 FCC PART 15.31 – VOLTAGE VARIATIONS

The EUT was fitted with a SMA connector and was measured directly from the output of the radio.

The nominal voltage was varied by $\pm 15\%$ and the output power was measured to ensure that there was not an increase or shift of the fundamental frequency.

For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. For battery operated equipment, the equipment tests shall be performed using a new battery. A nominal voltage of 120VAC was used and then 100VAC and 138VAC were used as the 85% and 115% variations.

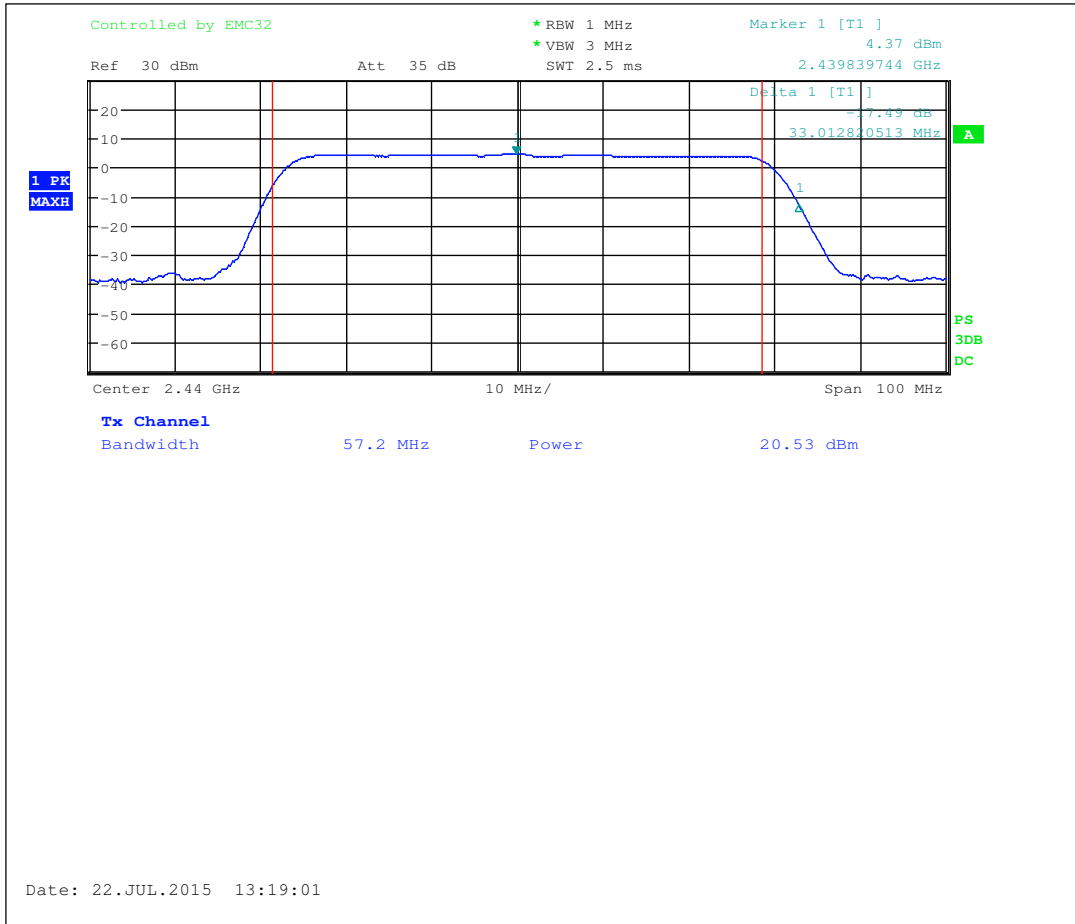
RESULTS: The results showed that the fundamental frequency did not move outside the frequency band and the field strength did not increase above the limit during the variations.



12.1 FCC PART 15.31 – VOLTAGE VARIATIONS

Test Date(s):	July 22, 2015	Test Engineer:	J. Knepper
Standards:	CFR 47 Part 15.247; KDB558074	Air Temperature:	21.2°C

Full Output, 100V



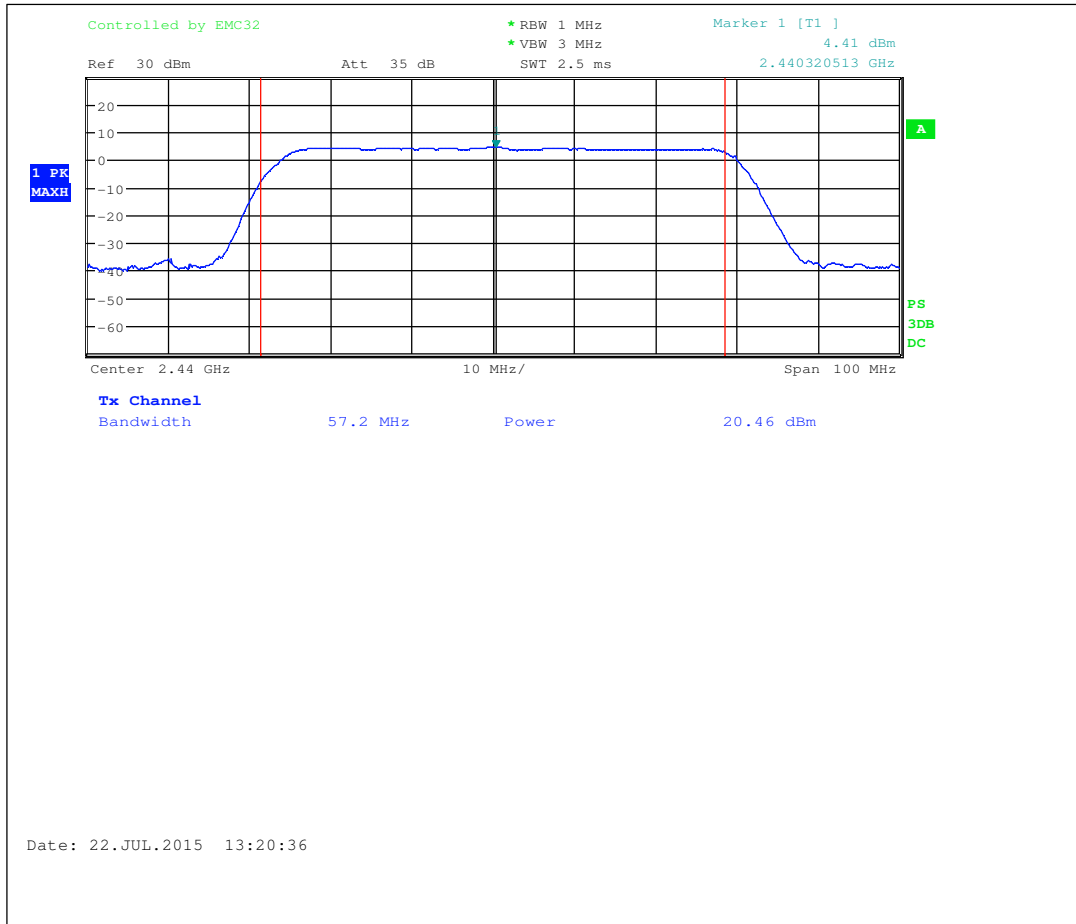


Reduced Output, 100V



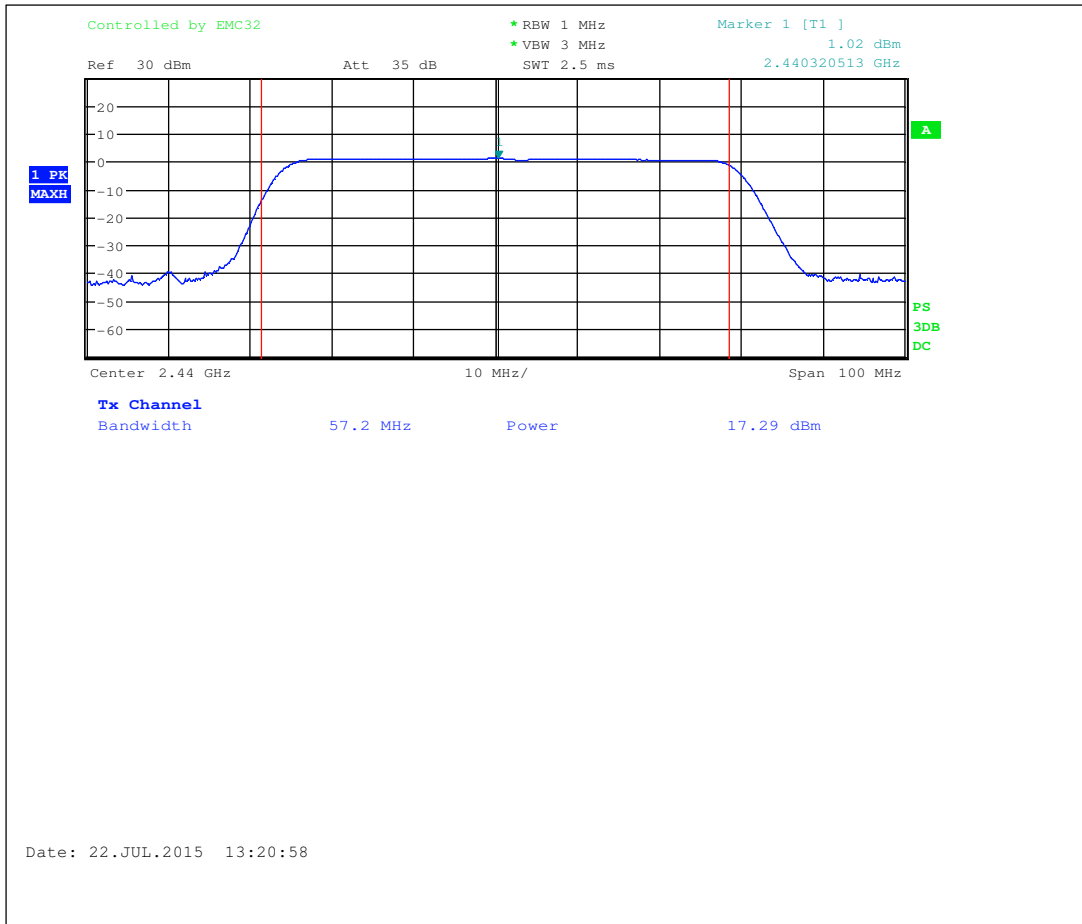


Full Output, 140V





Reduced Output, 140V





13 CONDUCTED EMISSIONS TEST

In accordance with FCC CFR 47 Part 15.207(a), “Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency of emission (MHz)	Conducted limit (dBμV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.

12.2 Procedure

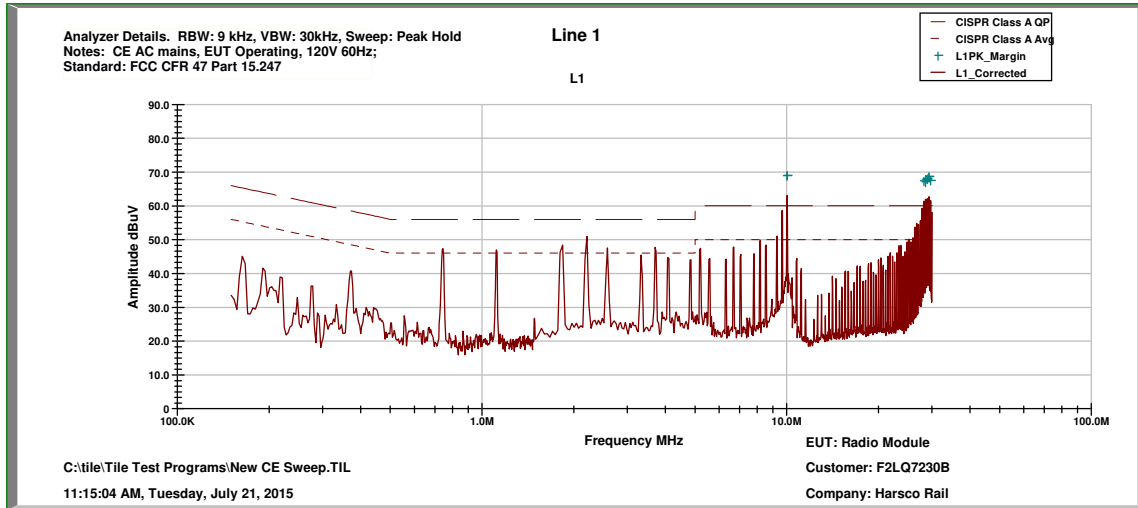
The EUT was placed on a 1.0 x 1.5 meter non-conductive table, 0.8 meter above a horizontal ground plane and 0.4 meter from a vertical ground plane. Power was provided to the EUT through a LISN bonded to a 3 x 2 meter ground plane. The LISN and peripherals were supplied power through a filtered AC power source. The output of the LISN was connected to the input of the receiver via a transient limiter, and emissions in the range 150 kHz to 30 MHz were measured. The measurements were recorded using the quasi-peak and average detectors as directed by the standard, and the resolution bandwidth during testing was 9 kHz. The raw measurements were corrected to allow for attenuation from the LISN, transient limiter and cables.



13.1 Conducted Emissions Test Data

Test Date:	July 21, 2015	Test Engineer:	J. Knepper
Rule:	FCC CFR 47, Part 15, subpart B:2007, Part 15.107(a), Class B	Air Temperature:	21.9° C
Test Results:	Pass	Relative Humidity:	47%

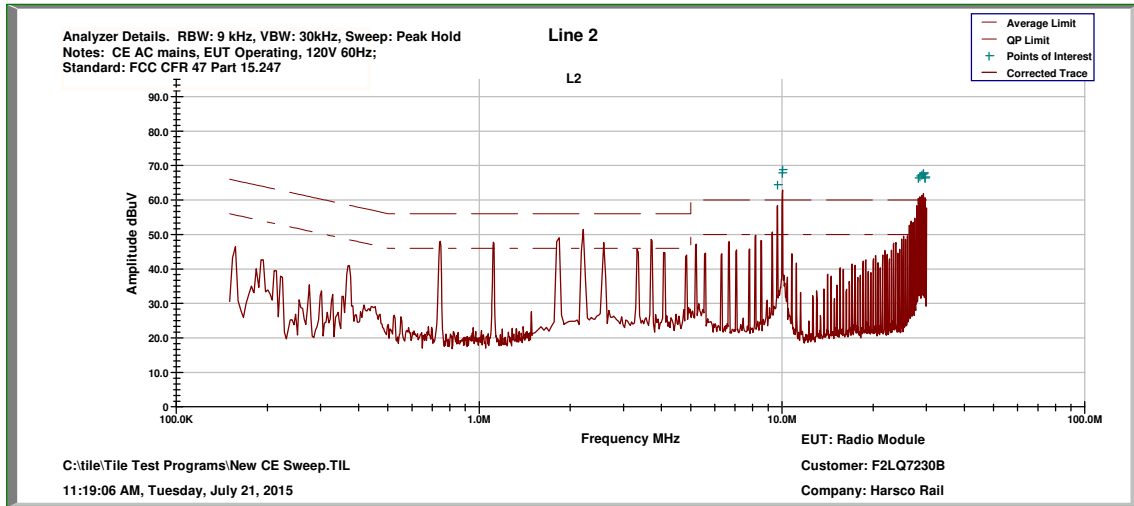
Conducted Test – Line 1: 0.15 MHz to 30.0 MHz



Top Discrete Measurements								
No.	Conductor	Frequency (MHz)	Detector	Level (dBµV)	Adjustment (dB)	Results (dBµV)	Limit (dBµV)	Margin (dB)
1	Line 1	10.005	Quasi-Peak	23.49	10.14	33.63	60.0	-26.37
		10.005	Average	19.883	10.14	30.023	50.0	-19.977
2	Line 1	10.0387	Quasi-Peak	22.61	10.139	32.749	60.0	-27.251
		10.0387	Average	15.757	10.139	25.896	50.0	-24.104
3	Line 1	28.1625	Quasi-Peak	21.66	10.288	31.948	60.0	-28.052
		28.1625	Average	13.938	10.288	24.226	50.0	-25.774
4	Line 1	28.5	Quasi-Peak	31.56	10.305	41.865	60.0	-18.135
		28.5	Average	26.373	10.305	36.678	50.0	-13.322
5	Line 1	28.5375	Quasi-Peak	21.71	10.307	32.017	60.0	-27.983
		28.5375	Average	15.04	10.307	25.347	50.0	-24.653
6	Line 1	28.875	Quasi-Peak	27.74	10.324	38.064	60.0	-21.936
		28.875	Average	21.917	10.324	32.241	50.0	-17.759
7	Line 1	28.9125	Quasi-Peak	22.09	10.326	32.416	60.0	-27.584
		28.9125	Average	14.693	10.326	25.019	50.0	-24.981
8	Line 1	29.25	Quasi-Peak	26.68	10.318	36.998	60.0	-23.002
		29.25	Average	20.142	10.318	30.460	50.0	-19.54
9	Line 1	29.2875	Quasi-Peak	22.45	10.316	32.766	60.0	-27.234
		29.2875	Average	14.533	10.316	24.849	50.0	-25.151
10	Line 1	29.6625	Quasi-Peak	20.1	10.297	30.397	60.0	-29.603
		29.6625	Average	13.705	10.297	24.002	50.0	-25.998



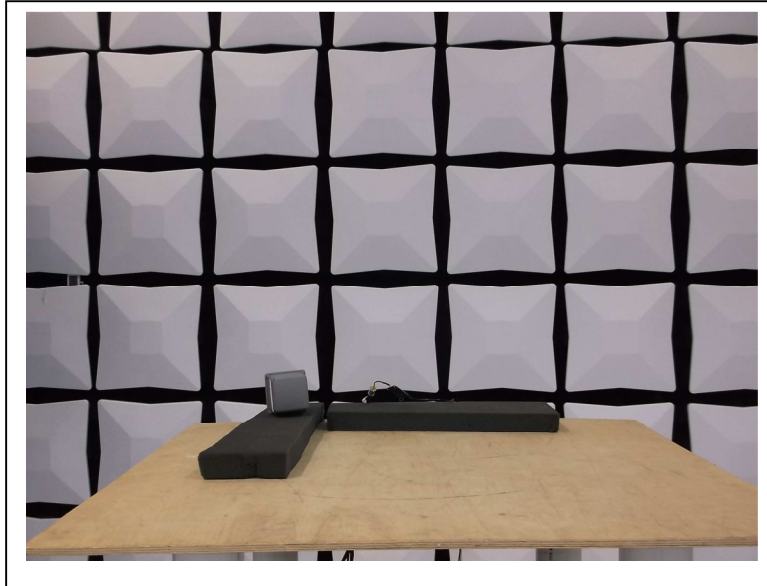
Conducted Test – Line 2: 0.15 MHz to 30.0 MHz



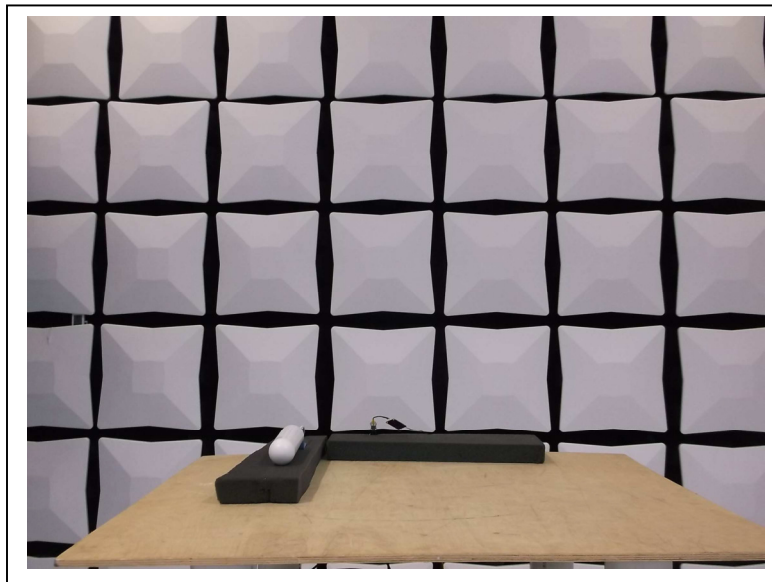
Top Discrete Measurements								
No.	Conductor	Frequency (MHz)	Detector	Level (dBµV)	Adjustment (dB)	Results (dBµV)	Limit (dBµV)	Margin (dB)
1	Line 2	9.6675	Quasi-Peak	17.04	10.127	27.167	60.0	-32.833
		9.6675	Average	9.93	10.127	20.057	50.0	-29.943
2	Line 2	10.005	Quasi-Peak	25.03	10.140	35.17	60.0	-24.83
		10.005	Average	22.44	10.140	32.58	50.0	-17.42
3	Line 2	10.0387	Quasi-Peak	21.83	10.139	31.969	60.0	-28.031
		10.0387	Average	15.528	10.139	25.667	50.0	-24.333
4	Line 2	28.1625	Quasi-Peak	40.48	10.288	50.768	60.0	-9.232
		28.1625	Average	12.715	10.288	23.003	50.0	-26.997
5	Line 2	28.5375	Quasi-Peak	20.28	10.307	30.587	60.0	-29.41
		28.5375	Average	13.595	10.307	23.902	50.0	-26.098
6	Line 2	28.9125	Quasi-Peak	20.26	10.326	30.586	60.0	-29.414
		28.9125	Average	13.488	10.326	23.814	50.0	-26.186
7	Line 2	29.25	Quasi-Peak	26.86	10.318	37.178	60.0	-22.822
		29.25	Average	20.325	10.318	30.643	50.0	-19.357
8	Line 2	29.2875	Quasi-Peak	20.7	10.316	31.016	60.0	-28.984
		29.2875	Average	13.4	10.316	23.716	50.0	-26.284

14 PHOTOGRAPHS/EXHIBITS – PRODUCT PHOTOS, TEST SETUPS

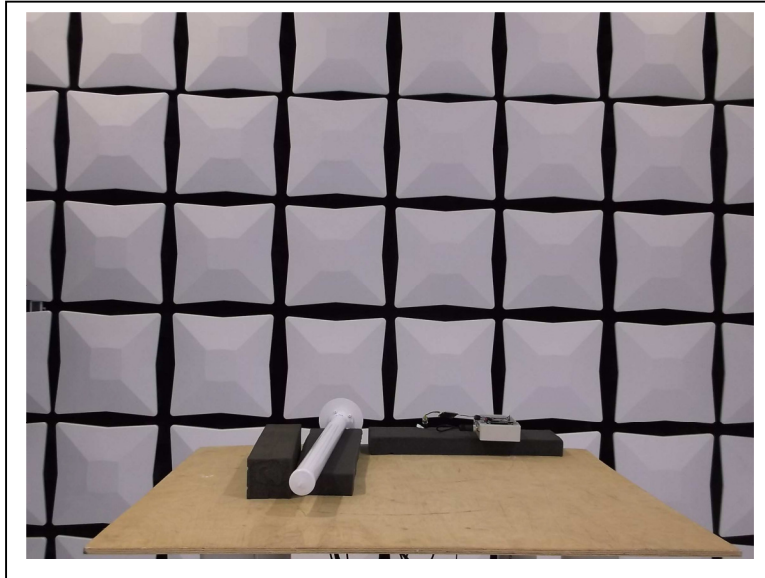
Radiated Spurious Emission with 12dBi Whip Antenna



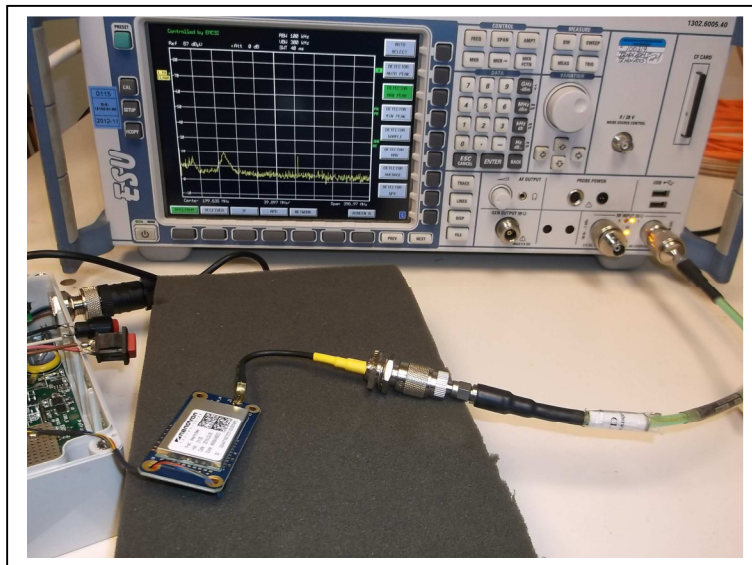
Radiated Spurious Emission with 15dBi Whip Antenna



Radiated Spurious Emission with 18dBi Whip Antenna



Conducted Output Power, Peak Power Spectral Density, -6dB Occupied Bandwidth, Conducted Spurious Emissions & Voltage Variations





Conducted Emissions

