RHEIN TECH LABORATORIES, INC.

Engineering Solutions & Electromagnetic Compatibility Services

FCC Part 15.256
Certification Application Report

Test Lab:		Applicant:	
Rhein Tech Laboratories, Inc. Tel: 703-689-0368 360 Herndon Parkway Fax: 703-689-2056 Suite 1400 www.rheintech.com Herndon, VA 20170 E-Mail: atcbinfo@rheintech.com		VEGA Grieshaber KG Tel: 49-7836-50113 Am Hohenstein 113 D-77716 Schiltach Germany Contact: Juergen Motzer	
FCC ID	O6QPS60XW1	**Test Report Date**	May 8, 2015
Platform	N/A	**RTL Work Order #**	2014196
Model	VEGAPULS 69	**RTL Quote #**	QRTL14-196A
FCC Classification	LPR – Level Probing Radar		
FCC Rule Part(s)/Guidance	Part 15.256: Level Probing Radar FCC 14-2: ET Docket No. 10-23: Amendment of Part 15 of the Commission's Rules To Establish Regulations for Level Probing Radars and Tank Level Probing Radars in the Frequency Bands 5.925-7.250 GHz, 24.05-29.00 GHz and 75-85 GHz KDB 890966-D01 Meas Level Probing Radars V01 (April 4, 2014) TR 14-1007 Measurement of Fundamental Emissions of FMCW Level Probing Radars (LPR) under Part 15, Section 15.256 (June 13, 2014)		
Test Procedure	ANSI C63.4-2009: Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz		
Digital Interface Information	Digital Interface was found to be compliant		

Frequency Range (GHz)	**Output Power (W) (Peak EIRP)**	**Frequency Tolerance**	**Emission Designator**
78.5 – 79.5	0.575	N/A	N/A

I, the undersigned, hereby declare that the equipment tested and referenced in this report conforms to the identified standard(s) as described in this test report. No modifications were made to the equipment during testing in order to achieve compliance with these standards. Furthermore, there was no deviation from, additions to, or exclusions from, the applicable parts of FCC Part 2, FCC Part 15 and ANSI C63.4.

Signature: [signature] Date: May 8, 2015

Typed/Printed Name: Desmond A. Fraser Position: President

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These test(s) are accredited under Rhein Tech Laboratories, Inc. ISO/IEC 17025 accreditation issued by the ANSI-ASQ National Accreditation Board. Refer to certificate and scope of accreditation AT-1445.

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1 General Information

1.1 Scope

This measurement report is prepared on behalf of VEGA Grieshaber KG in accordance with the applicable Federal Communications Commission rules and regulations.

The Equipment Under Test (EUT) was the Model VEGAPULS 69 Level Probing Radar, FCC ID: O6QPS60XW1, tested with two different antennas. The EUT is available with two different electronics units:

1) HART (PS60HW)
2) PA and FF (PS60PAW and PS60FFW

The worst case emissions are found with the HART electronic unit implemented in the EUT.

1.2 Test Facility

The open area test site and conducted measurement facility used to collect the radiated data is located on the parking lot of Rhein Tech Laboratories, Inc., 360 Herndon Parkway, Suite 1400, Herndon, Virginia 20170. This site has been fully described in a report submitted to and approved by the Federal Communications Commission to perform AC line conducted and radiated emissions testing.

1.3 Modifications

None.

2 Tested System Details

The test sample was received on January 30, 2015. Listed below are the identifiers and descriptions of all equipment, cables, and internal devices used with the EUT for this testing, as applicable.

Table 2-1: Equipment under Test (EUT)

Part	Manufacturer	Model	Serial Number	FCC ID	Cable Type	RTL Bar Code
VEGAPULS 69	VEGA Grieshaber KG	PS69 AXBXXCH XKNAXX	29045593	O6Q PS60XW1	N/A	21607
VEGAPULS 69	VEGA Grieshaber KG	PS69 AXCFDAH XANAXX	29045594	O6Q PS60XW1	N/A	21606
75mm Plastic Horn Antenna (33.8 dBi)	VEGA Grieshaber KG	N/A	N/A	N/A	N/A	21604
67mm DN80 Lens-Antenna (32.1 dBi)	VEGA Grieshaber KG	N/A	N/A	N/A	N/A	21605
DC Power Supply	Hewlett Packard	6024A	1912A00331	N/A	1 m un-shielded	901635

2.1 Test Configurations

The EUT was tested in the following configurations and the test data is included in this report. The test configuration numbers (TC #1 or TC #2) are provided with the test data as appropriate.

Table 2-2: Test Configuration #1 (TC #1)

Part	Model	Manufacturer	Cable Type	RTL Bar Code
VEGAPULS 69	PS69 AXBXXCHXKNAXX	VEGA Grieshaber KG	N/A	21607
Electronics	PS60HW	VEGA Grieshaber KG	N/A	N/A
75mm Plastic Horn Antenna (33.8 dBi)	N/A	VEGA Grieshaber KG	N/A	21604

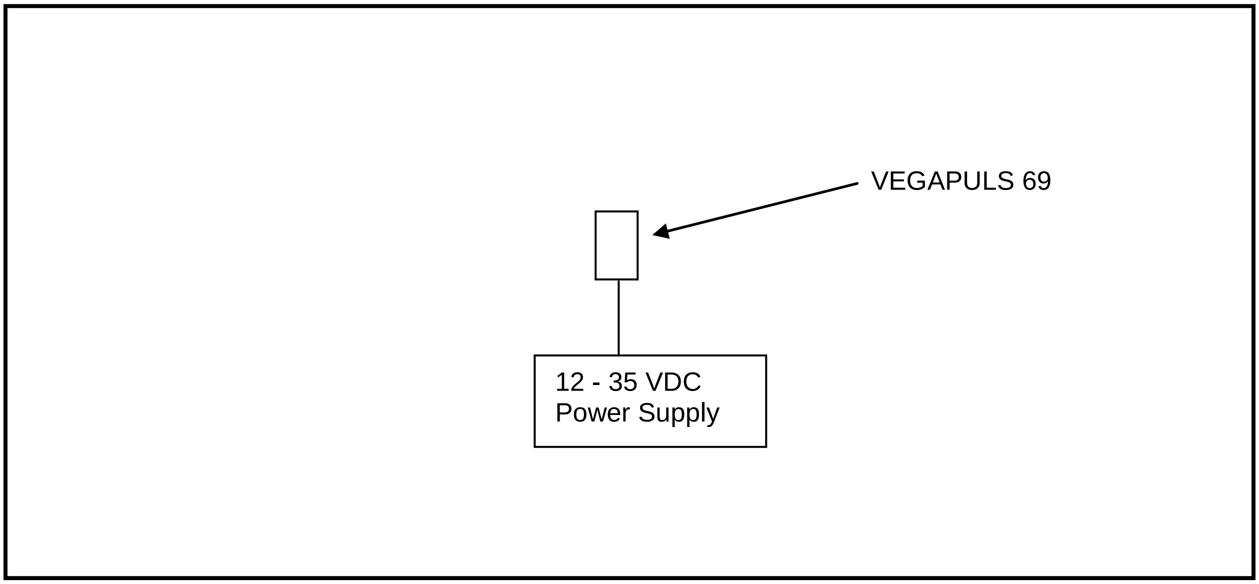
Photograph 1: Test Configuration #1 (TC #1)

Table 2-3: Test Configuration #2 (TC #2)

Part	Model	Manufacturer	Cable Type	RTL Bar Code
VEGAPULS 69	PS69 AXCFDAHXANAXX	VEGA Grieshaber KG	N/A	21606
Electronics	PS60HW	VEGA Grieshaber KG	N/A	N/A
67mm DN80 Lens-Antenna (32.1 dBi)	N/A	VEGA Grieshaber KG	N/A	21605

Photograph 2: Test Configuration #2 (TC #2)

Figure 2-1: Configuration of Tested System



2.2 Test Distance

The final radiated emissions tests were performed at a 3 meter horizontal distance from the edge of the radar to the test antenna. The EUT was also investigated at closer test distances in order to discern any emissions.

3 Modulated Bandwidth – ANSI C63.10 6.9, FCC 14-2 (15.256(f)(1))

3.1 Modulated Bandwidth Test Procedure - FCC 14-2 (15.256(f)(1))

The minimum 10 dB bandwidth was measured using a 50 ohm spectrum analyzer with the resolution bandwidth set at 1 MHz and the video bandwidth set at 3 MHz. The spectrum analyzer's mixer mode resulted in an overlapping bandwidth image with the actual image and a ghost image. The analyzer "Signal ID" and "Auto ID" were used to aid in discerning between the ghost images displayed by the mixer, the left and right markers can be calculated from twice the intermediate frequency of 404.4 MHz (808.8 MHz) from the ghost edge images to the actual bandwidth edges (distance between ghost images). The display markers could not be set to -10 dB from the peak since the spectral lines were completely vertical resulting in a noise floor placement. Max hold was used until the spectrum was adequately filled to portray the bandwidth and a plot was taken.

3.2 Limits

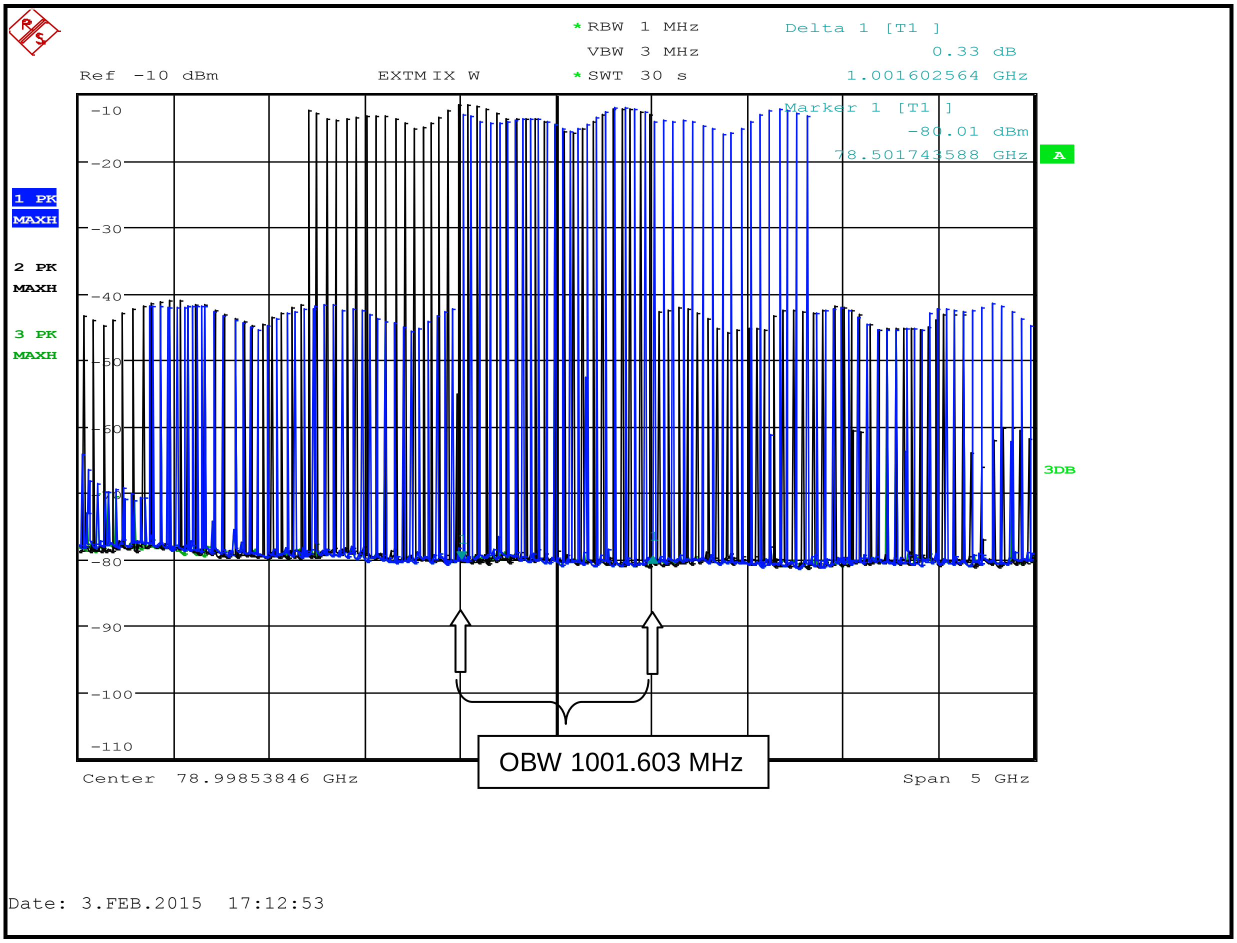
(f) The fundamental bandwidth of an LPR emission is defined as the width of the signal between two points, one below and one above the center frequency, outside of which all emissions are attenuated by at least 10 dB relative to the maximum transmitter output power when measured in an equivalent resolution bandwidth.
(1) The minimum fundamental emission bandwidth shall be 50 MHz for LPR operation under the provisions of this section.

3.3 Modulated Bandwidth Test Data

Table 3-1: 10 dB Modulated Bandwidth - 15.256(f)(1)

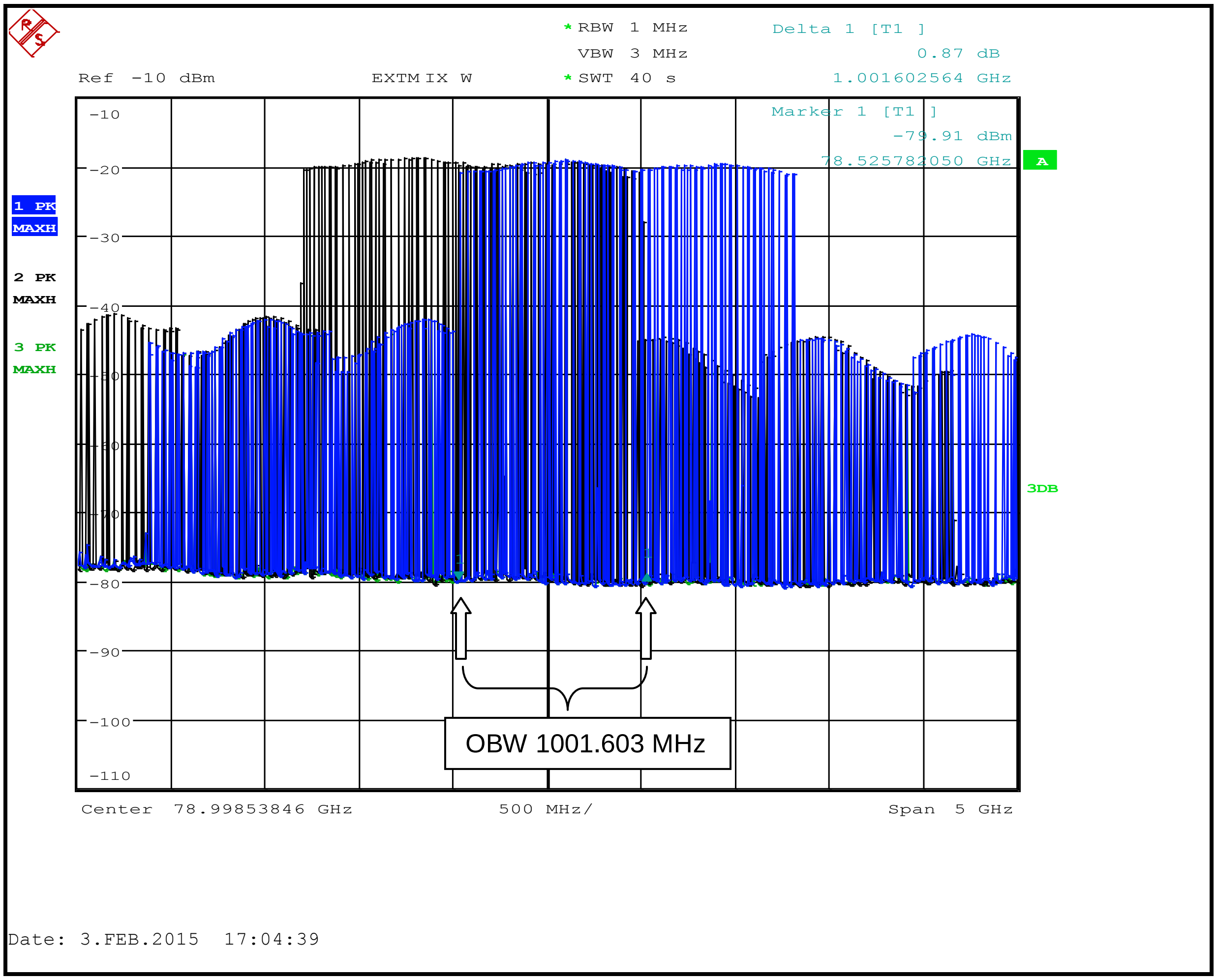
Model	10 dB Bandwidth (MHz)	Minimum Limit (MHz)	Margin (MHz)
Electronics PS60HW	1001.603	50	-951.603

Plot 3-1: 10 dB Modulated Bandwidth – TC #1



Marker Delta 1: 77500.141 MHz; Marker 1: 78501.744 MHz; OBW= 1001.603 MHz

Plot 3-2: 10 dB Modulated Bandwidth – TC #2



Marker Delta 1: 77524.179 MHz; Marker 1: 78525.782 MHz; OBW= 1001.603 MHz

Table 3-2: Modulated Bandwidth Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901581	Rohde & Schwarz	FSU	Spectrum Analyzer	1166.1660.50	11/13/15

Test Personnel:

Dan Baltzell	[signature]	February 3, 2015
Test Engineer	Signature	Date of Test

4 Radiated Emissions – ANSI C63.10 6.3, FCC 15.256(g)(3)

4.1 Radiated Fundamental Emissions Test Procedure – FCC 15.256(g)(3)

Radiated emissions of the fundamental were tested by "bore sighting" the main-beam emissions to produce the maximum realizable antenna coupling. The EUT was also checked in all three orthogonal planes. Measurement was based on an average detector for -3 dBm/1 MHz power density limit and peak detector for 34 dBm/50 MHz limit. Limits are -3 dBm/MHz and 34 dBm/50 MHz bandwidth (20 MHz was used). Since these limits are power density, no pulse desensitization correction factor is required. Both were also measured finding the maximum amplitude at 1 meter and switching from 1 MHz to 20 MHz resolution bandwidths. One meter measuring distance was used since the antenna gain calibration was accomplished at one meter, a correction was used in the correction to dBm as 20 Log (1) = 0 dB.

Limits: The EIRP limits for LPR operations in the bands authorized by this rule section are provided in the following table. These emission limits are based on bore sight measurements (i.e., measurements performed within the main beam of the LPR antenna).

Frequency Band of Operation (GHz)	Average Emission Limit (EIRP in dBm measured in 1 MHz)	Peak Emission Limit (EIRP in dBm measured in 50 MHz)
5.925-7.250	-33	7
24.05-29.00	-14	26
75-85	-3	34

4.2 Radiated Fundamental Emissions Test Data

Radiated measurements are converted from dBuV/m to dBm using the following equations from KDB 890966 6 b:

For radiated emission measurements

EIRP (dBm) = F.S. (dBµV/m) – 104.8 + 20 Log D

where:

D is the measurement distance (one meter was used)

All power averaging (RMS) emission levels are to be measured utilizing a 1 MHz resolution bandwidth with a one millisecond dwell time over each 1 MHz segment. The frequency span of the analyzer should equal the number of sampling bins times 1 MHz; the sweep rate of the analyzer should equal the number of sampling bins times one millisecond. The video bandwidth of the measurement instrument shall not be less than the resolution bandwidth and trace averaging shall not be employed. The RMS average emission measurement is to be repeated over multiple sweeps with the analyzer set for maximum hold until the amplitude stabilizes. The peak emission measurement is to be repeated over multiple sweeps with the analyzer set for maximum hold until the amplitude stabilizes.

NOTE: The number of sampling BINS used is 1901 corresponding to a span of 1870 MHz, and there are two pulses/second from the DUT; therefore, two pulses will occur per MHz in each second for proper RMS averaging. If one millisecond dwell/MHz is used it will cause artificially high RMS averaging levels per FCC TR 14-1007.

4.2.1 Test Configuration #1

Table 4-1: Radiated Fundamental Emissions (EIRP in 1 MHz, Average Detector) (TC #1)

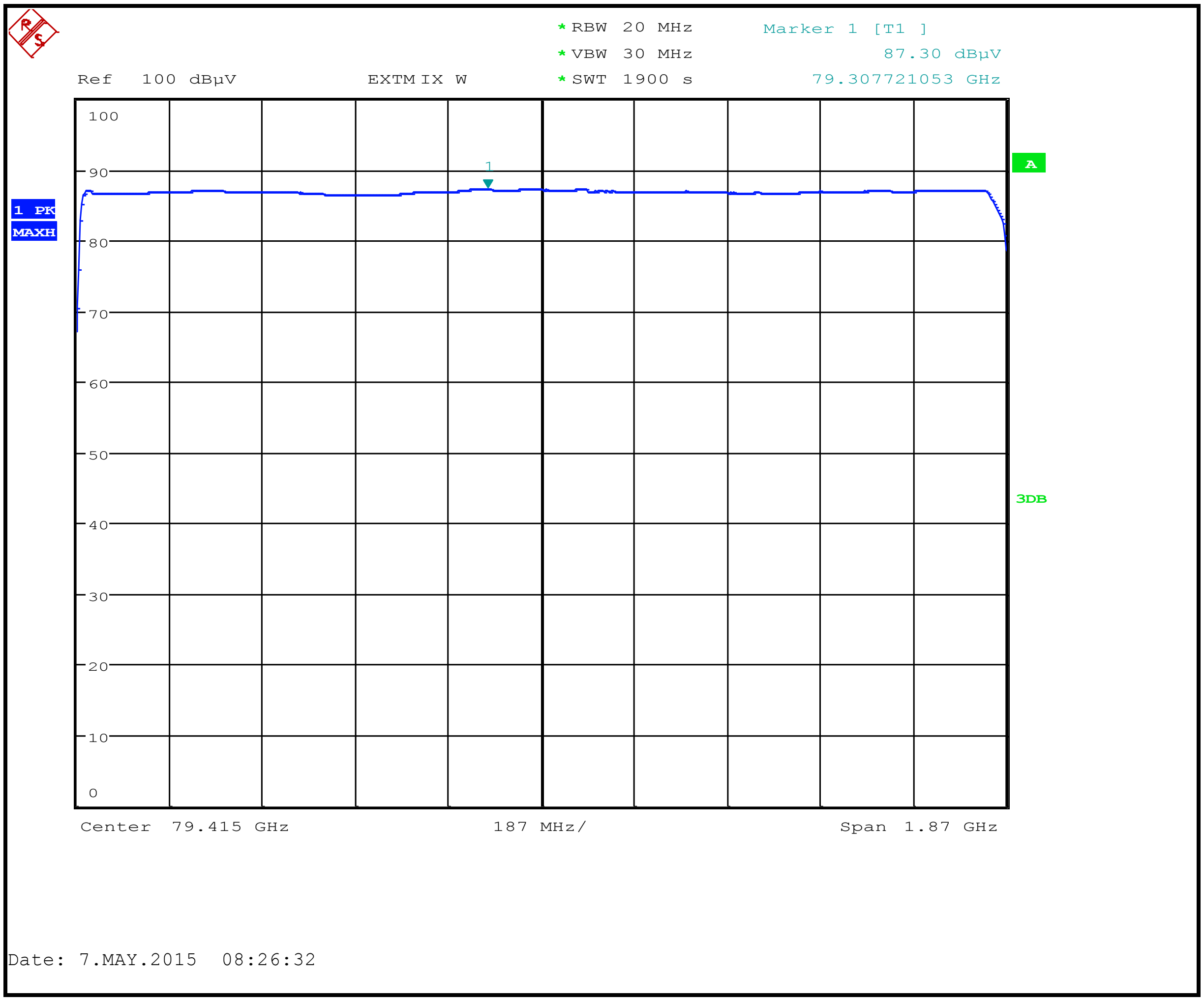
Frequency (GHz)	Average Spectrum Analyzer Level (dBuV)	Antenna Correction Factor (dB/m)	Corrected Average Measurement (dBuV/m)	Converted to dBm	Limit (dBm)	Margin (dB)
78.5	55.6	45.1	100.7	-4.1	-3.0	-1.1

Table 4-2: Radiated Fundamental Emissions (EIRP in 50 MHz, Peak Detector) (TC #1)

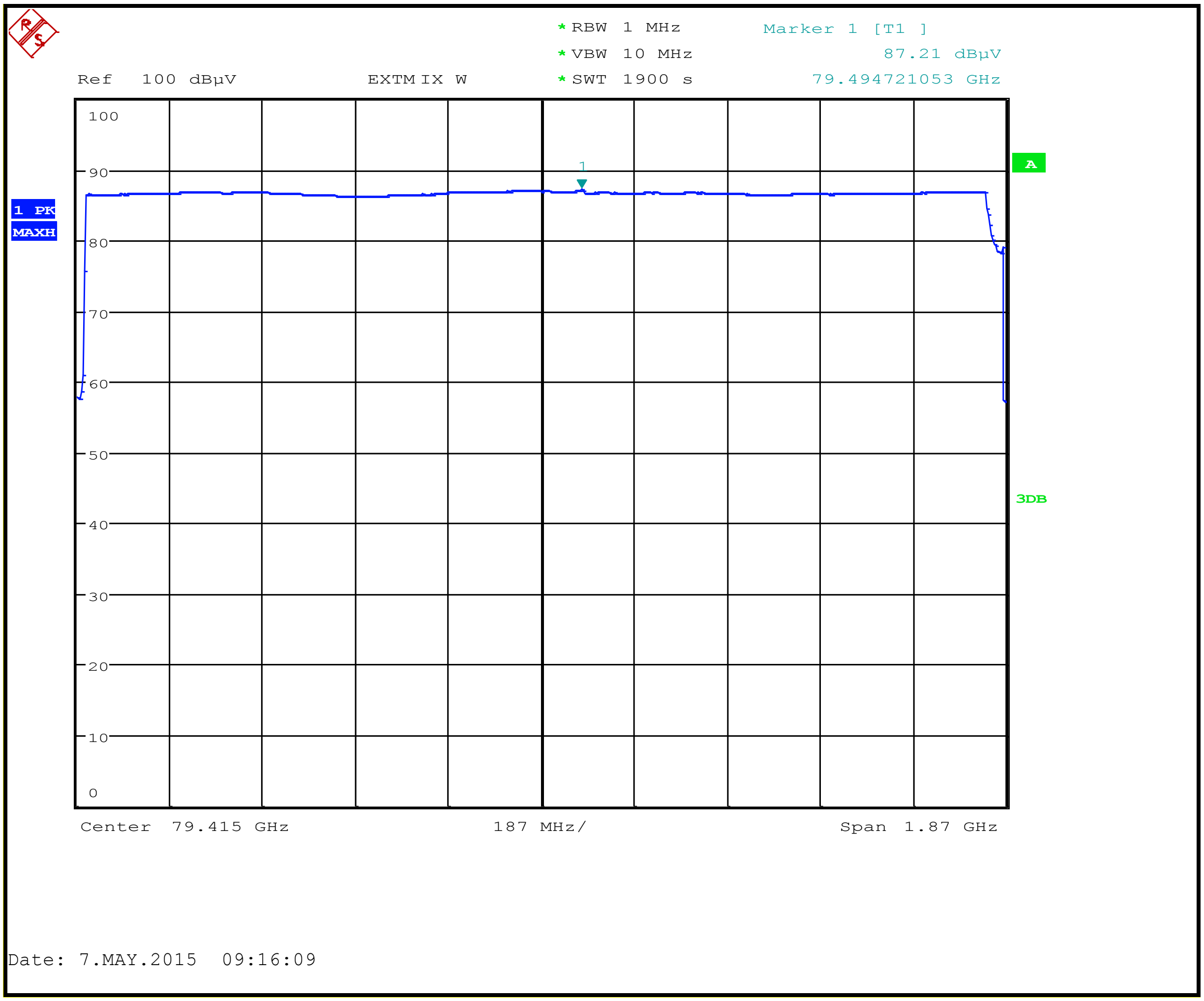
Frequency (GHz)	Peak EIRP Measured (dBuV)	Site Correction Factor (dB/m)	Corrected Peak Measurement (dBuV/m)	Converted to dBm	Limit (dBm)	Margin (dB)
79.3	87.3	45.1	132.4	27.6	34.0	-6.4

Note: Per FCC 15.256(g)(2)(ii): The Rhode & Schwarz FSU 50 spectrum analyzer used a maximum video bandwidth resolution of 20 MHz, which is less than the required 50 MHz RBW; however, no bandwidth correction factor should be used for peak measurements, when the resolution is above 1 MHz, since the amplitude is a carrier wave and no amplitude change occurs after the resolution bandwidth is higher than 1 MHz. Reference plot 4-1 and 4-2, which are 87.3 and 87.2 dBuV, respectively, for 20 MHz resolution bandwidth and 1 MHz resolution bandwidth, which theoretically should be 20Log(20/1) or 26 dB difference, and is shown to be similar in amplitude.

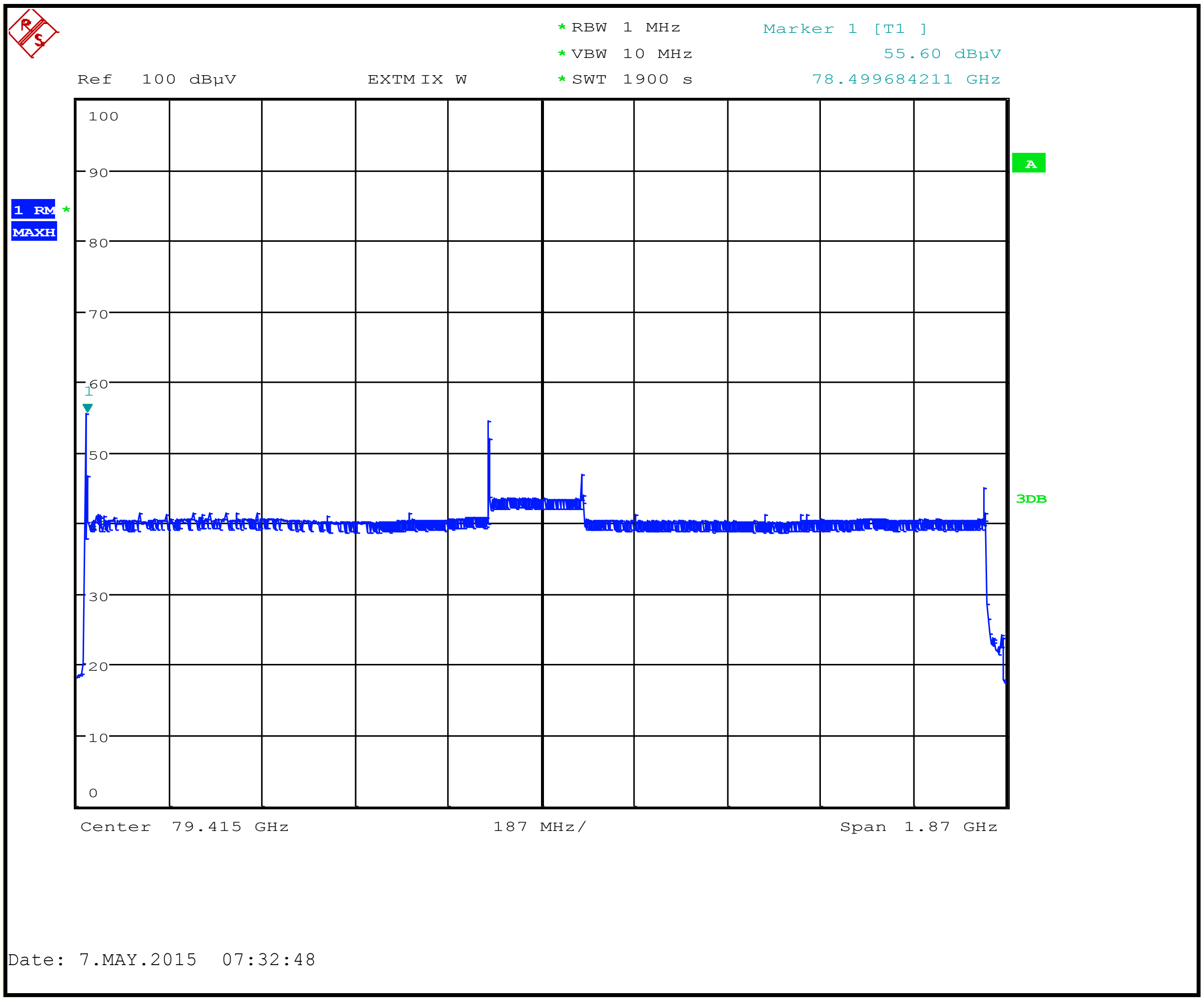
Plot 4-1: Radiated Fundamental (EIRP in 20 MHz, Peak Detector) (TC #1)



Plot 4-2: Peak Radiated Fundamental (EIRP in 1 MHz, Peak Detector) (TC #1)



Plot 4-3: Radiated Fundamental (EIRP in 1 MHz, RMS detector) (TC #1)



4.2.2 Test Configuration #2

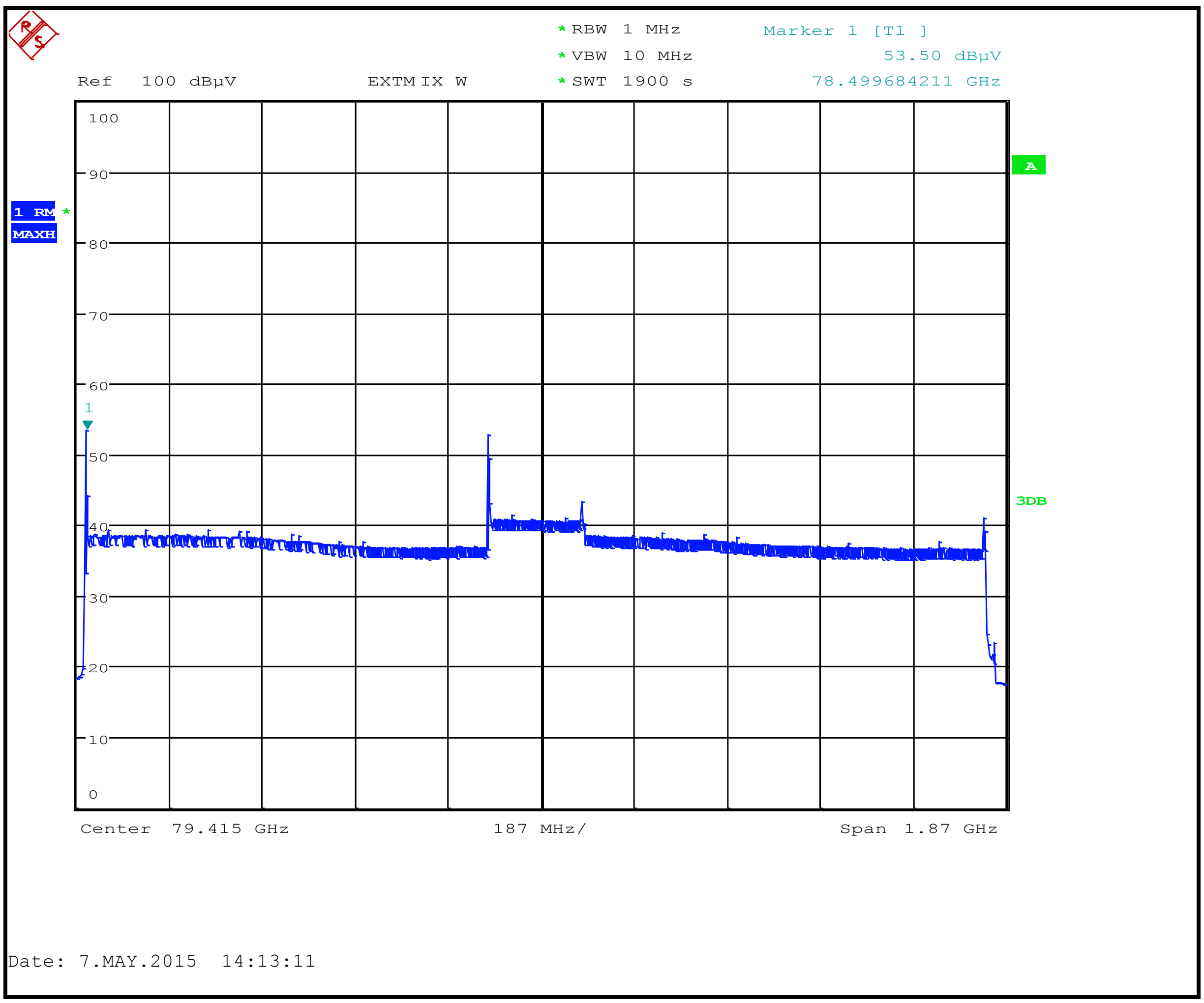
Table 4-3: Radiated Fundamental Emissions (EIRP in 1 MHz, Average Detector) (TC #2)

Frequency (GHz)	Average Spectrum Analyzer Level (dBuV)	Antenna Correction Factor (dB/m)	Corrected Average Measurement (dBuV/m)	Converted to dBm	Limit (dBm)	Margin (dB)
78.5	53.5	45.1	98.6	-6.2	-3.0	-3.2

Table 4-4: Radiated Fundamental Emissions (EIRP in 20 MHz, Peak Detector) (TC #2)

Frequency (GHz)	Peak EIRP Measured (dBuV)	Site Correction Factor (dB/m)	Corrected Peak Measurement (dBuV/m)	Converted to dBm	Limit (dBm)	Margin (dB)
79.3	83.0	45.1	128.1	23.3	34.0	-10.7

Plot 4-4: Radiated Fundamental (EIRP in 1 MHz) (TC #2)



Plot 4-5: Radiated Fundamental (EIRP in 20 MHz) (TC #2)

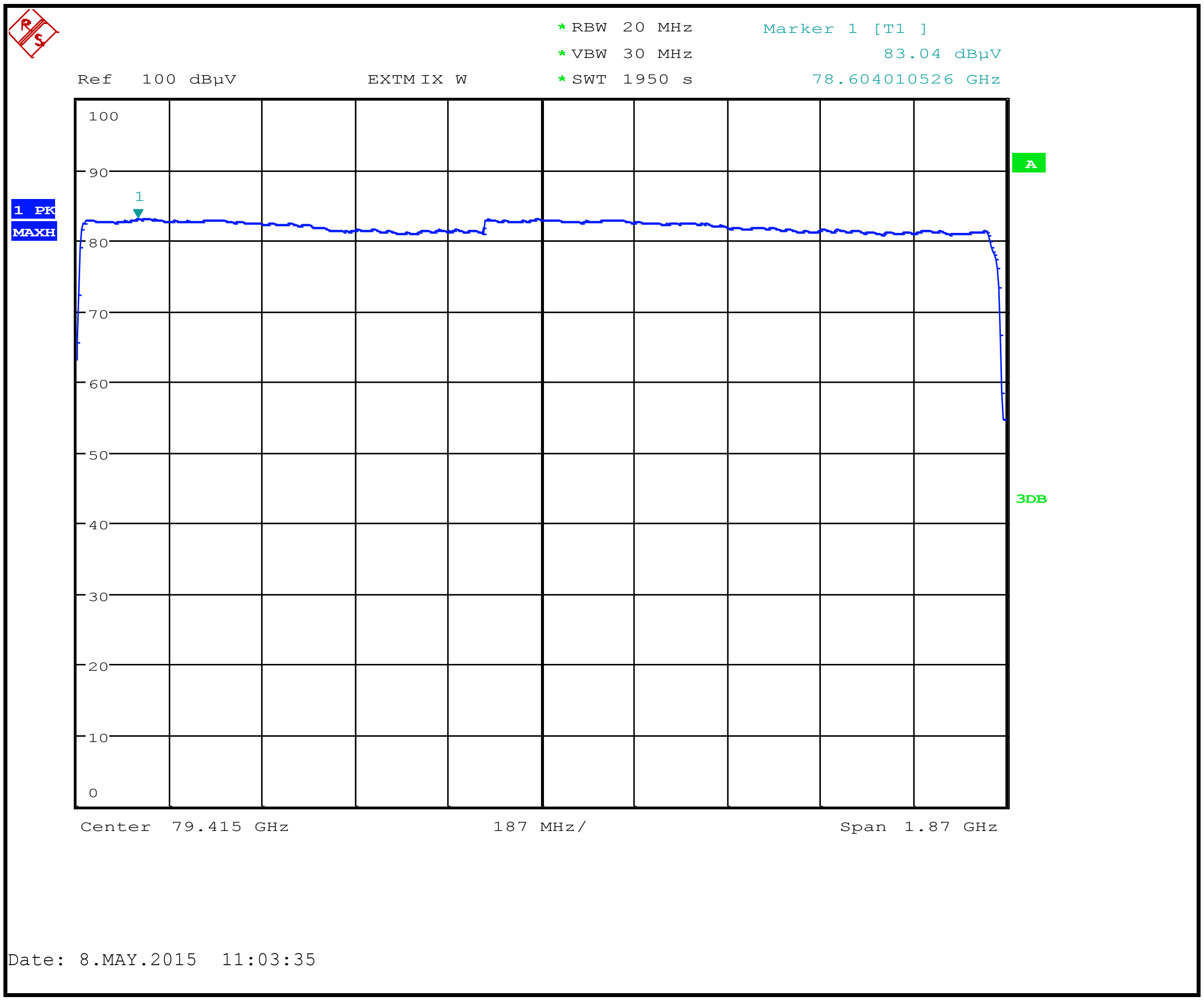


Table 4-5: Radiated Fundamental Emissions Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901581	Rohde & Schwarz	FSU	Spectrum Analyzer	1166.1660.50	11/13/15
901640	Rohde & Schwarz	FS-Z110	Mixer (75–110 GHz)	100010	4/2/17
900711	ATM	10-443-6R	Horn Antenna (75-110 GHz)	8051905-1	12/5/15

Test Personnel:

Dan Baltzell	[signature]	May 7-8, 2015
Test Engineer	Signature	Dates of Test

4.3 Radiated Emissions – ANSI C63.10 6.3, FCC 14-2 (15.256(h)(k))

4.4 Radiated Emissions Harmonics/Spurious Test Procedure - FCC 14-2 (15.256(h)(k))

No radiated emissions of the harmonics were found to be measured; noise floor data was taken and corrected to three meters. The EUT was checked in the three orthogonal planes with the receive antenna in both polarities. A resolution bandwidth of 100 kHz was used for frequencies less than 1000 MHz, and a resolution bandwidth of 1 MHz was used for frequencies greater than or equal to 1000 MHz.

Limit: Unwanted Emissions from LPR devices shall not exceed the general emission limit in §15.209 of this chapter.

4.5 Radiated Emissions Harmonics/Spurious Test Data

No radiated harmonics were found to be measured or unintentional emissions above 1 GHz. The following plots are provided as reference.

The plots were taken with the measuring antenna abutted to the transmit antenna, showing no indication or detectable frequencies, this reduces signal to noise ratio as a distance of 1 mm corrected to 3 m is 20 log (0.001/3) = -69.5 dB. The emissions from the EUT were investigated at 0.1 m and 3 m to ensure no indication of detectable emissions. 1 cm distance was used to insure a worst case scenario and is equivalent to -49.5 dB.

4.5.1 Test Configuration #1

Plot 4-6: Radiated Spurious Emissions (Second Harmonic) (140 GHz - 200 GHz) (TC #1)

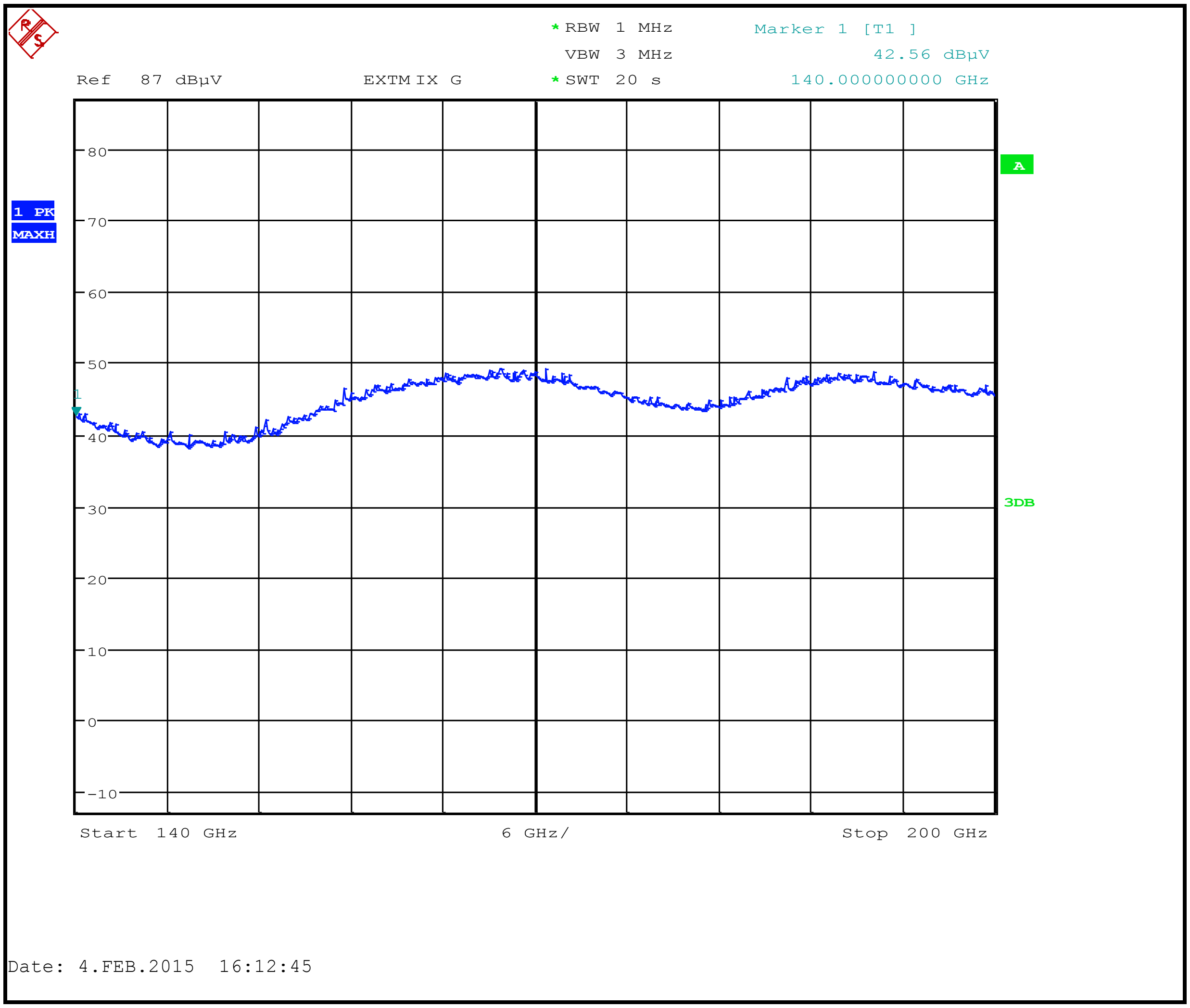


Table 4-6: Radiated Second Harmonic Noise Floor Calculation (TC #1)

Frequency (GHz)	EIRP Measured (dBuV)	Test Antenna Correction Factor (dB/m)	Correction from .01m to 3m (dB)	Corrected Measurement (dBuV/m)	Limit (dBuV/m)	Margin (dB)
157	42.0	51.1	-49.5	43.6	54.0	-10.4

Plot 4-7: Radiated Spurious Emissions (110 GHz – 140 GHz) (TC #1)

Table 4-7: Radiated Noise Floor Calculation (110 GHz – 140 GHz) (TC #1)

Frequency (GHz)	EIRP Measured (dBuV)	Test Antenna Correction Factor (dB/m)	Correction from .01m to 3m (dB)	Corrected Measurement (dBuV/m)	Limit (dBuV/m)	Margin (dB)
130 (worst case)	48	48.5	-49.5	47.0	54.0	-7.0

Plot 4-8: Radiated Spurious Emissions (75 GHz - 110 GHz) (TC #1)

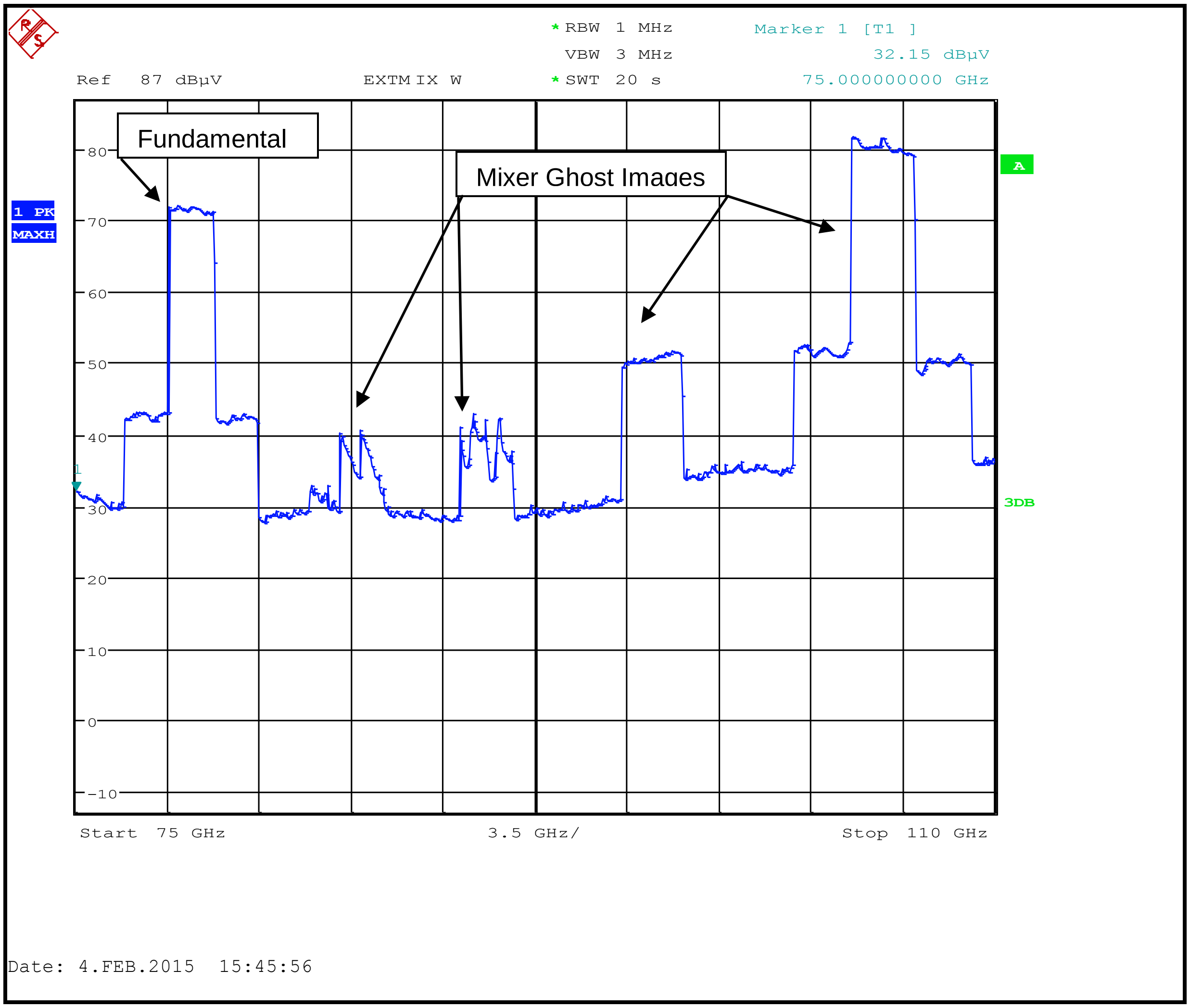


Table 4-8: Radiated Noise Floor Calculation (75 GHz – 110 GHz) (TC #1)

Frequency (GHz)	EIRP Measured (dBuV)	Test Antenna Correction Factor (dB/m)	Correction from .01m to 3m (dB)	Corrected Measurement (dBuV/m)	Limit (dBuV/m)	Margin (dB)
100.6 (worst case)	36.0	47.0	-49.5	33.5	54.0	-20.5

Plot 4-9: Radiated Spurious Emissions (50 GHz – 75 GHz) (TC #1)

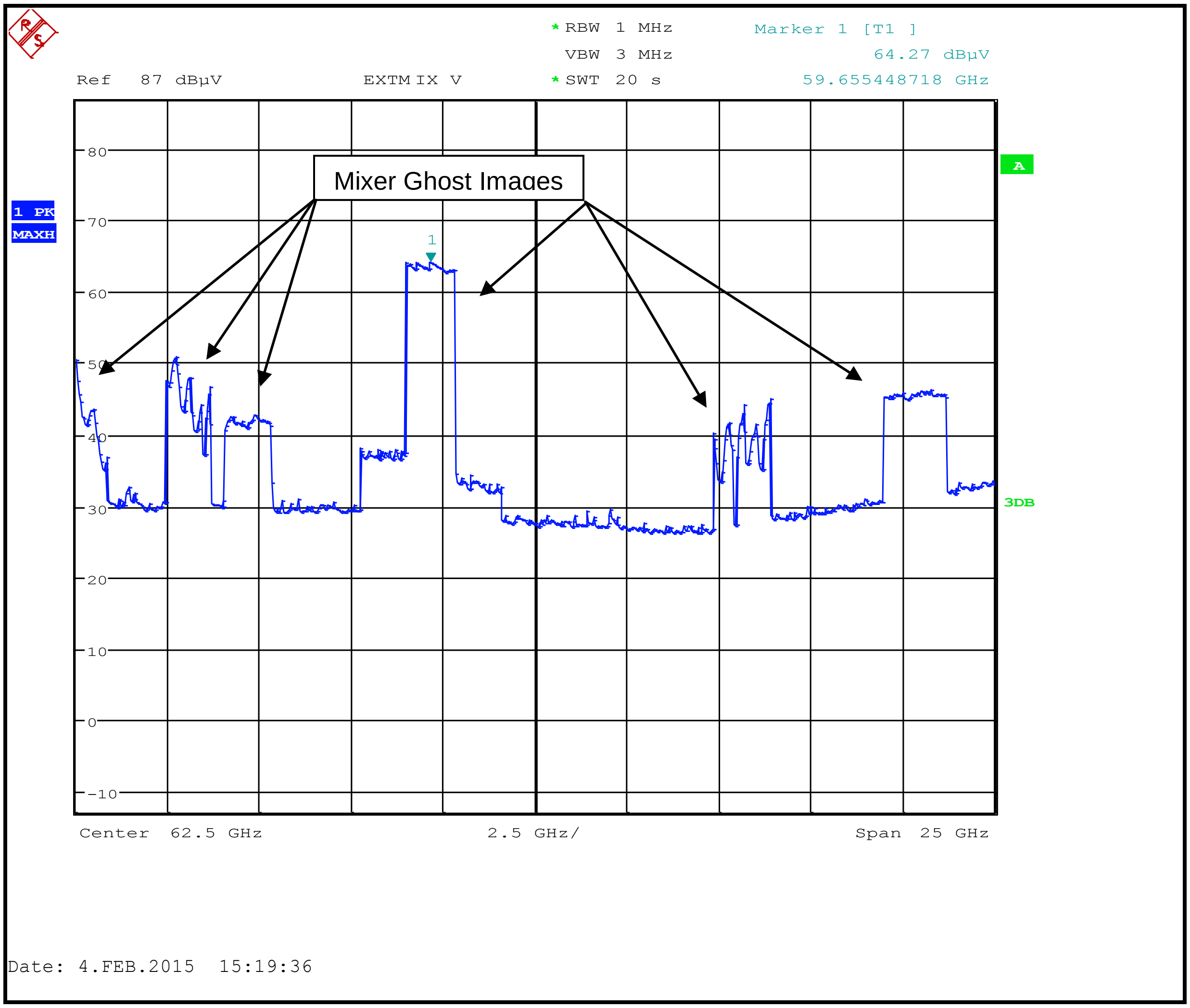


Table 4-9: Radiated Noise Floor Calculation (50 GHz – 75 GHz) (TC #1)

Frequency (GHz)	EIRP Measured (dBuV)	Test Antenna Correction Factor (dB/m)	Correction from .01m to 3m (dB)	Corrected Measurement (dBuV/m)	Limit (dBuV/m)	Margin (dB)
75.0 (worst case)	34.0	44.3	-49.5	28.8	54.0	-25.2

Plot 4-10: Radiated Spurious Emissions (40 GHz – 50 GHz) (TC #1)

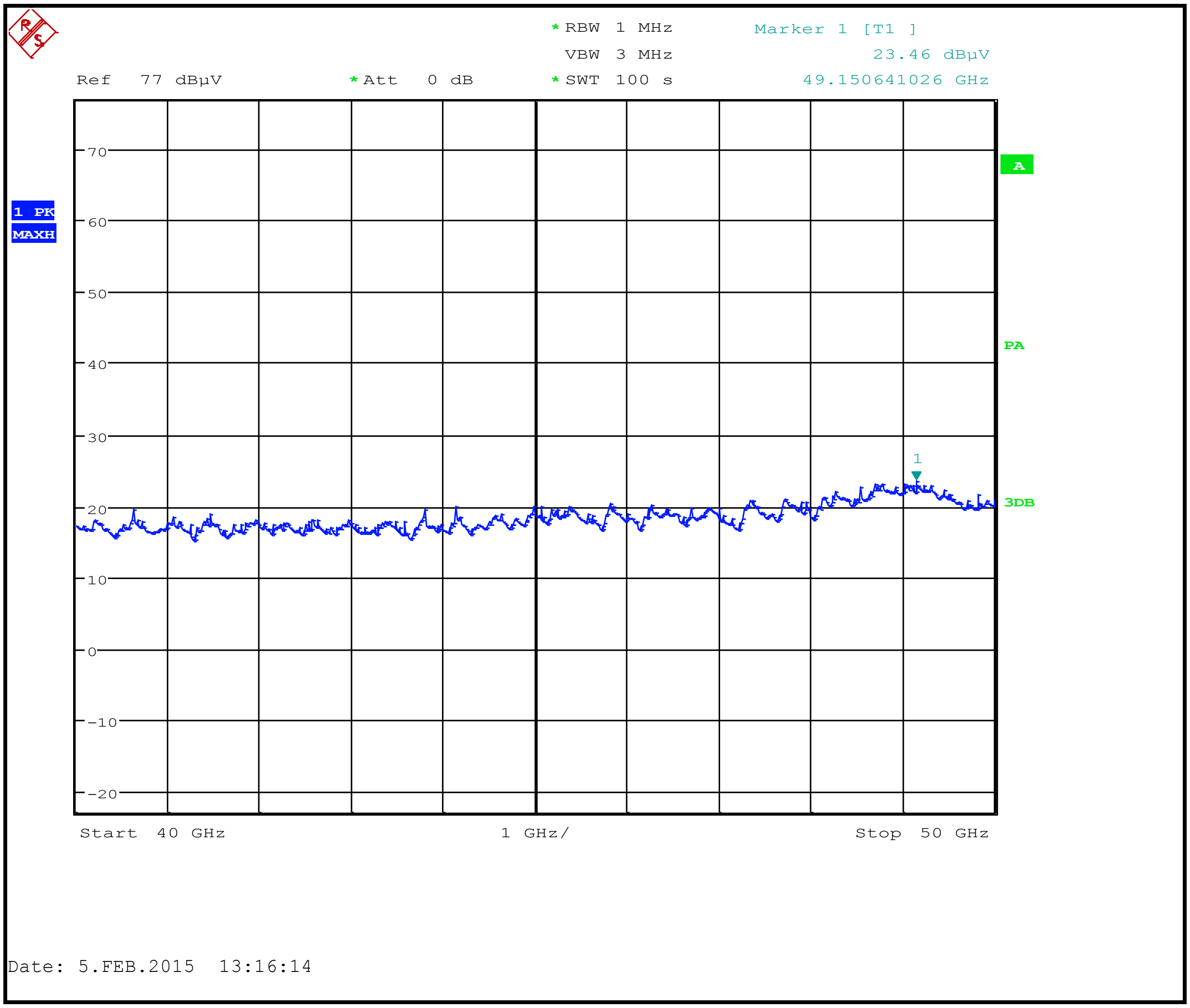


Table 4-10: Radiated Noise Floor Calculation (40 GHz – 50 GHz) (TC #1)

Frequency (GHz)	EIRP Measured (dBuV)	Test Antenna Correction Factor (dB/m)	Correction from .01m to 3m (dB)	Corrected Measurement (dBuV/m)	Limit (dBuV/m)	Margin (dB)
49.2 (worst case)	23.5	40.0	-49.5	14.0	54.0	-40.0

Plot 4-11: Radiated Spurious Emissions (26.5 GHz – 40 GHz) (TC #1)

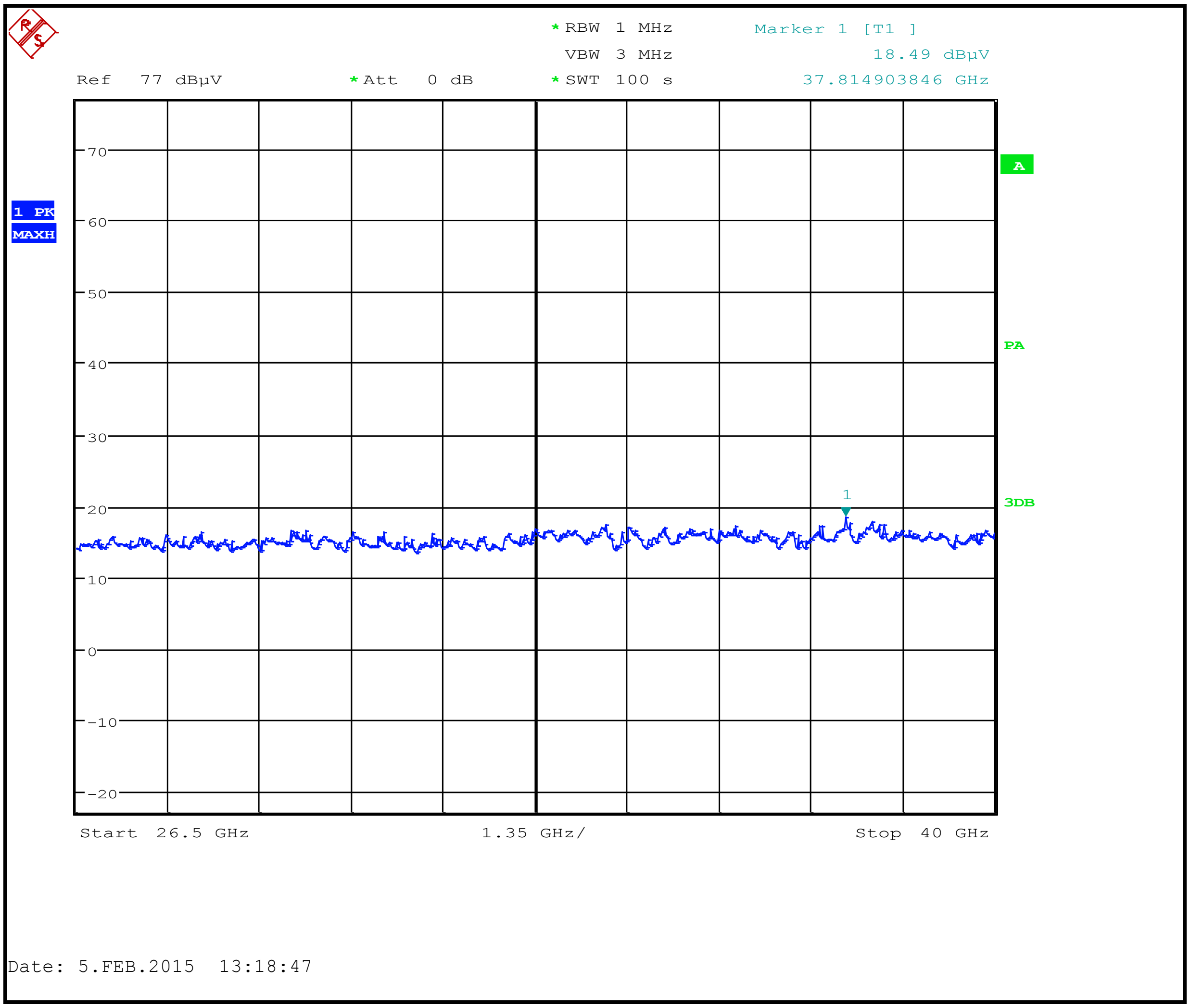


Table 4-11: Radiated Noise Floor Calculation (26.5 GHz – 40 GHz) (TC #1)

Frequency (GHz)	EIRP Measured (dBuV)	Test Antenna Correction Factor (dB/m)	Correction from .01m to 3m (dB)	Corrected Measurement (dBuV/m)	Limit (dBuV/m)	Margin (dB)
37.8 (worst case)	18.5	43.5	-49.5	12.5	54.0	-41.5

Plot 4-12: Radiated Spurious Emissions (18 GHz – 26.5 GHz) (TC #1)

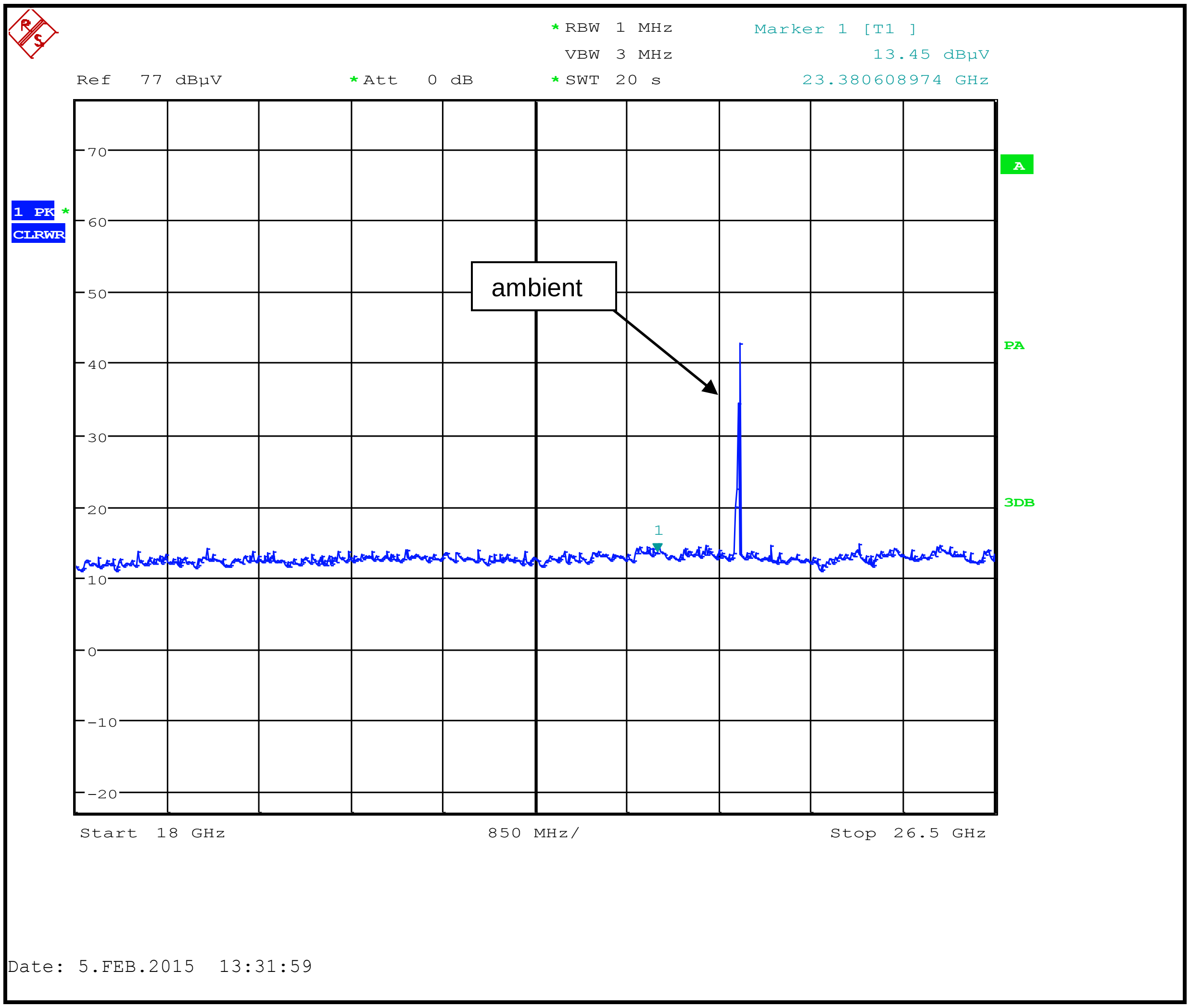


Table 4-12: Radiated Noise Floor Calculation (18 GHz – 26.5 GHz) (TC #1)

Frequency (GHz)	EIRP Measured (dBuV)	Test Antenna Correction Factor (dB/m)	Correction from .01m to 3m (dB)	Corrected Measurement (dBuV/m)	Limit (dBuV/m)	Margin (dB)
23.4 (worst case)	13.5	40.3	-49.5	4.3	54.0	-49.7

4.5.2 Test Configuration #2

Plot 4-13: Radiated Spurious Emissions (Second Harmonic) (140 GHz - 200 GHz) (TC #2)

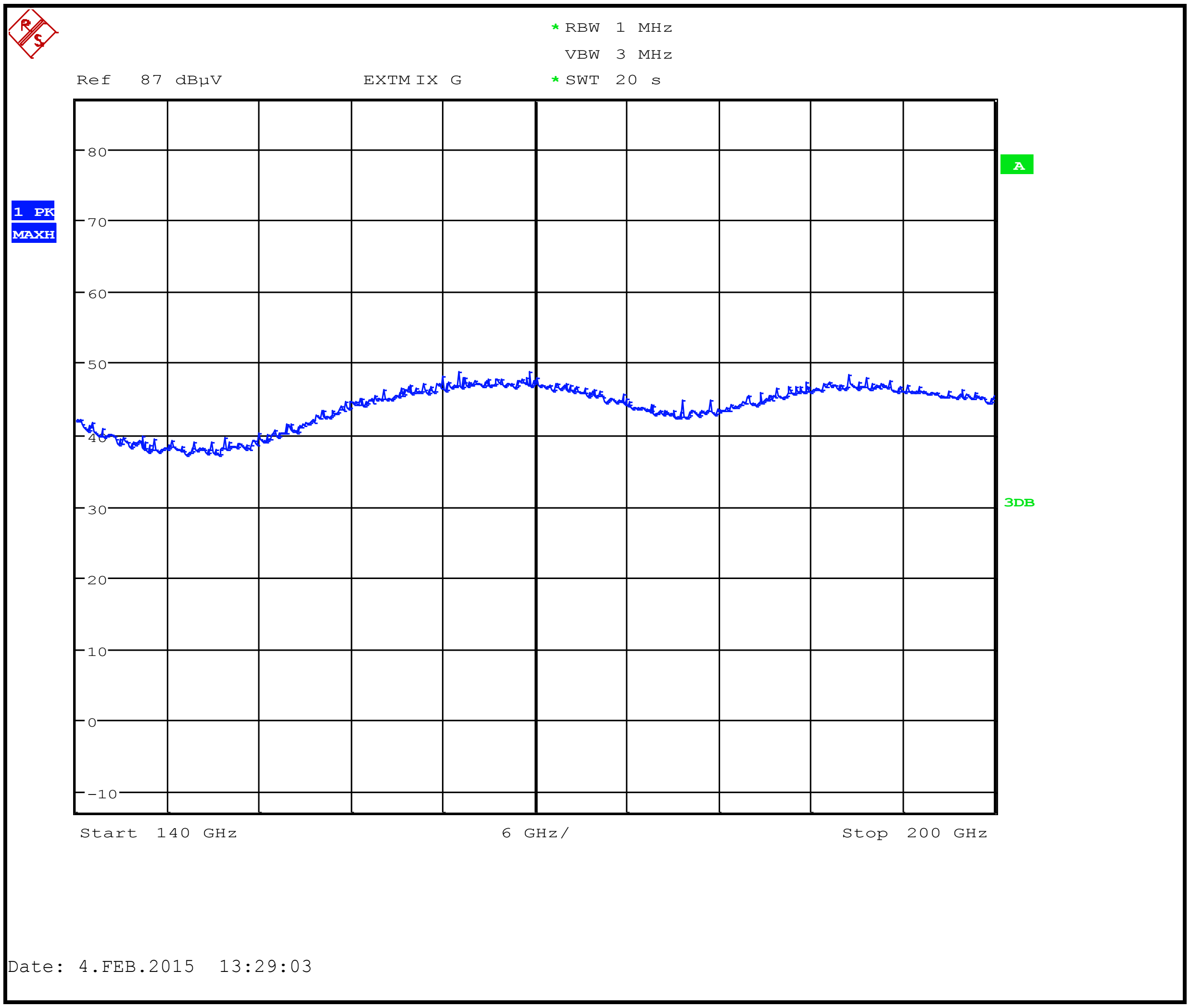


Table 4-13: Radiated Second Harmonic Noise Floor Calculation (140 GHz - 200 GHz) (TC #2)

Frequency (GHz)	EIRP Measured (dBuV)	Test Antenna Correction Factor (dB/m)	Correction from .01m to 3m (dB)	Corrected Measurement (dBuV/m)	Limit (dBuV/m)	Margin (dB)
157	40.0	51.1	-49.5	41.6	54.0	-12.4

Plot 4-14: Radiated Spurious Emissions (90 GHz – 140 GHz) (TC #2)

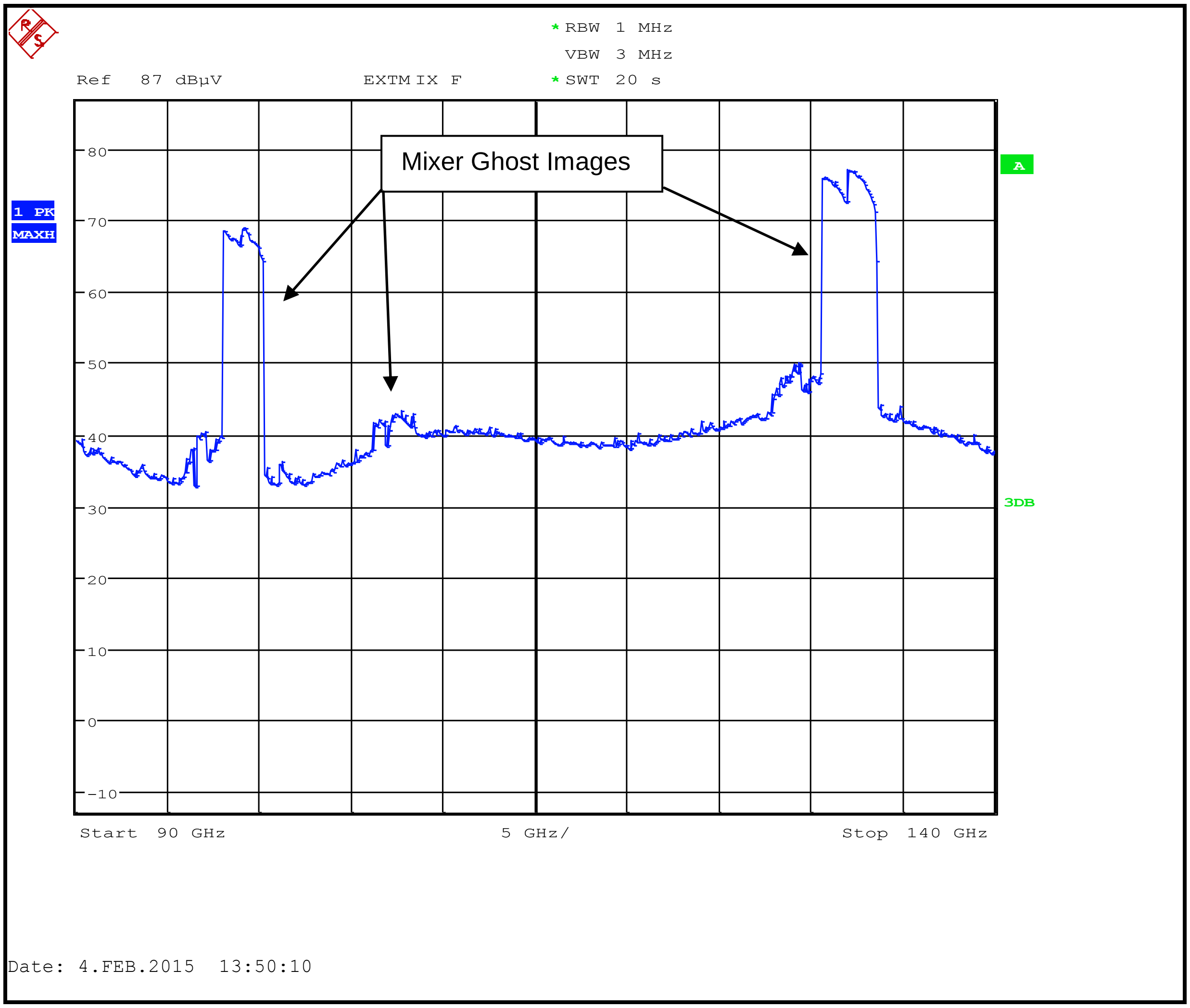


Table 4-14: Radiated Noise Floor Calculation (90 GHz – 140 GHz) (TC #2)

Frequency (GHz)	EIRP Measured (dBuV)	Test Antenna Correction Factor (dB/m)	Correction from .01m to 3m (dB)	Corrected Measurement (dBuV/m)	Limit (dBuV/m)	Margin (dB)
129 (worst case)	50	48.5	-49.5	49.0	54.0	-5.0

Plot 4-15: Radiated Spurious Emissions (75 GHz - 90 GHz) (TC #2)

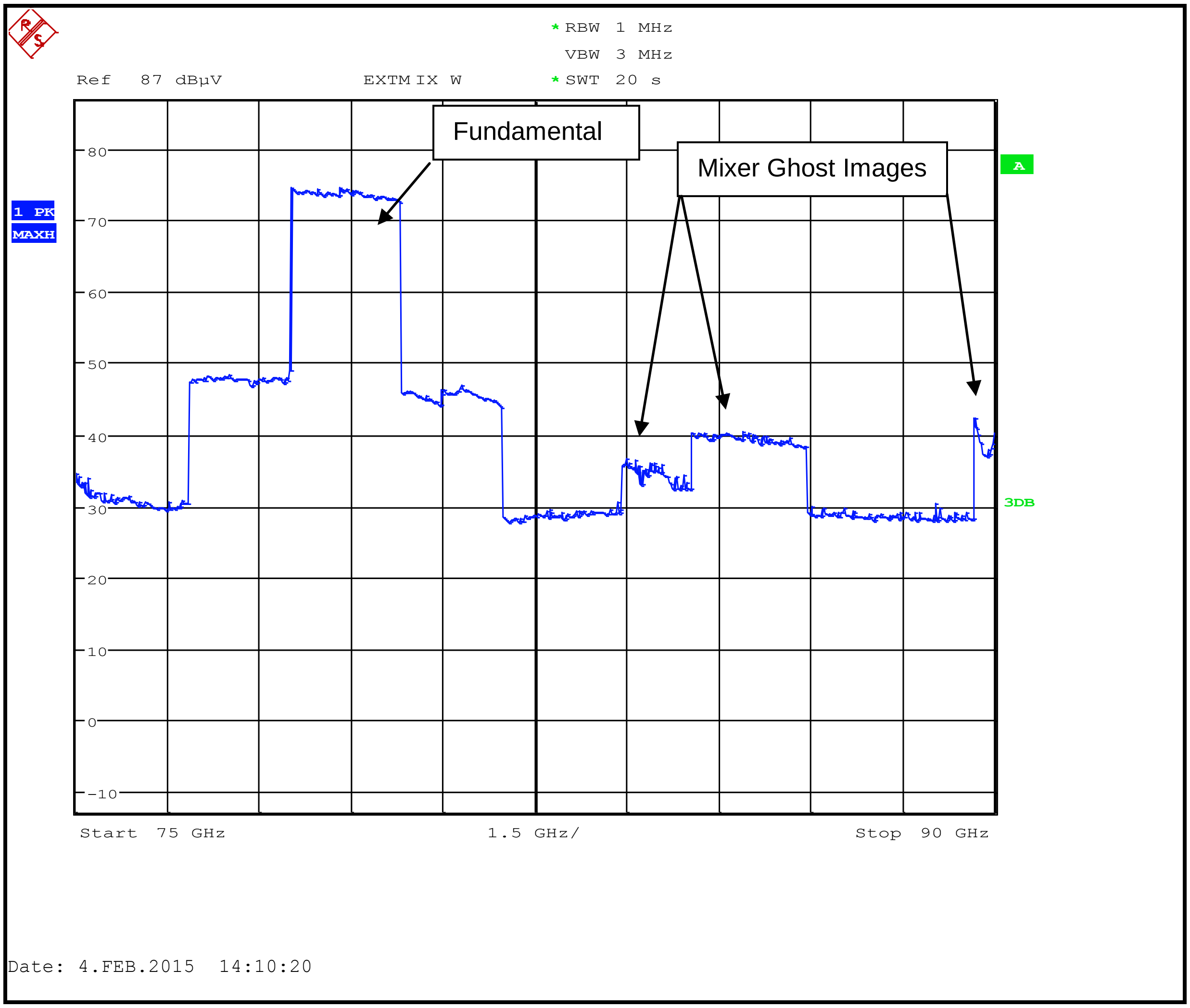


Table 4-15: Radiated Noise Floor Calculation (75 GHz – 90 GHz) (TC #2)

Frequency (GHz)	EIRP Measured (dBuV)	Test Antenna Correction Factor (dB/m)	Correction from .01m to 3m (dB)	Corrected Measurement (dBuV/m)	Limit (dBuV/m)	Margin (dB)
75 (worst case)	34.0	45.2	-49.5	29.7	54.0	-24.3

Plot 4-16: Radiated Spurious Emissions (50 GHz – 75 GHz) (TC #2)

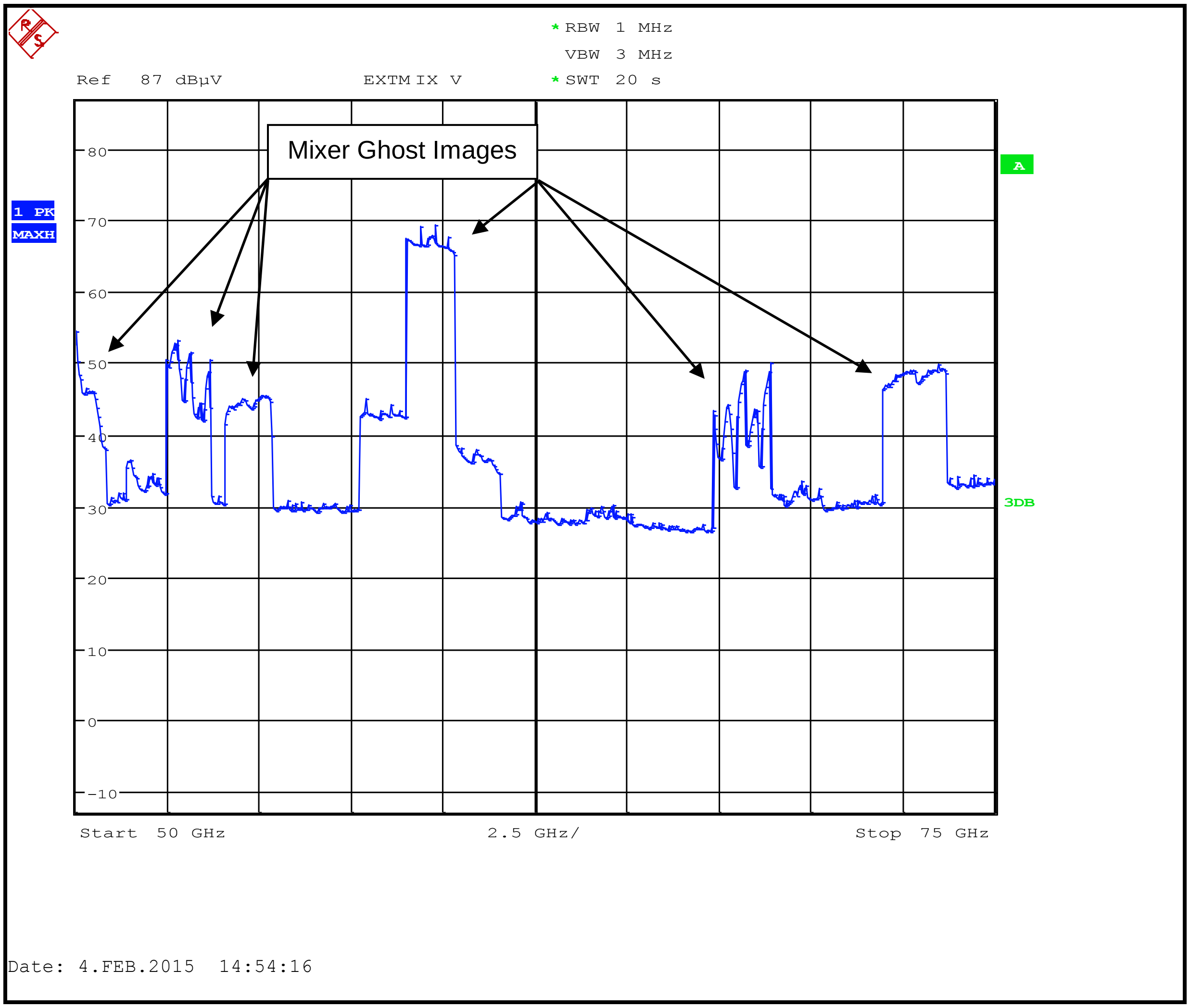


Table 4-16: Radiated Noise Floor Calculation (50 GHz – 75 GHz) (TC #2)

Frequency (GHz)	EIRP Measured (dBuV)	Test Antenna Correction Factor (dB/m)	Correction from .01m to 3m (dB)	Corrected Measurement (dBuV/m)	Limit (dBuV/m)	Margin (dB)
75.0 (worst case)	34.0	44.3	-49.5	28.8	54.0	-25.2

Plot 4-17: Radiated Spurious Emissions (40 GHz – 50 GHz) (TC #2)

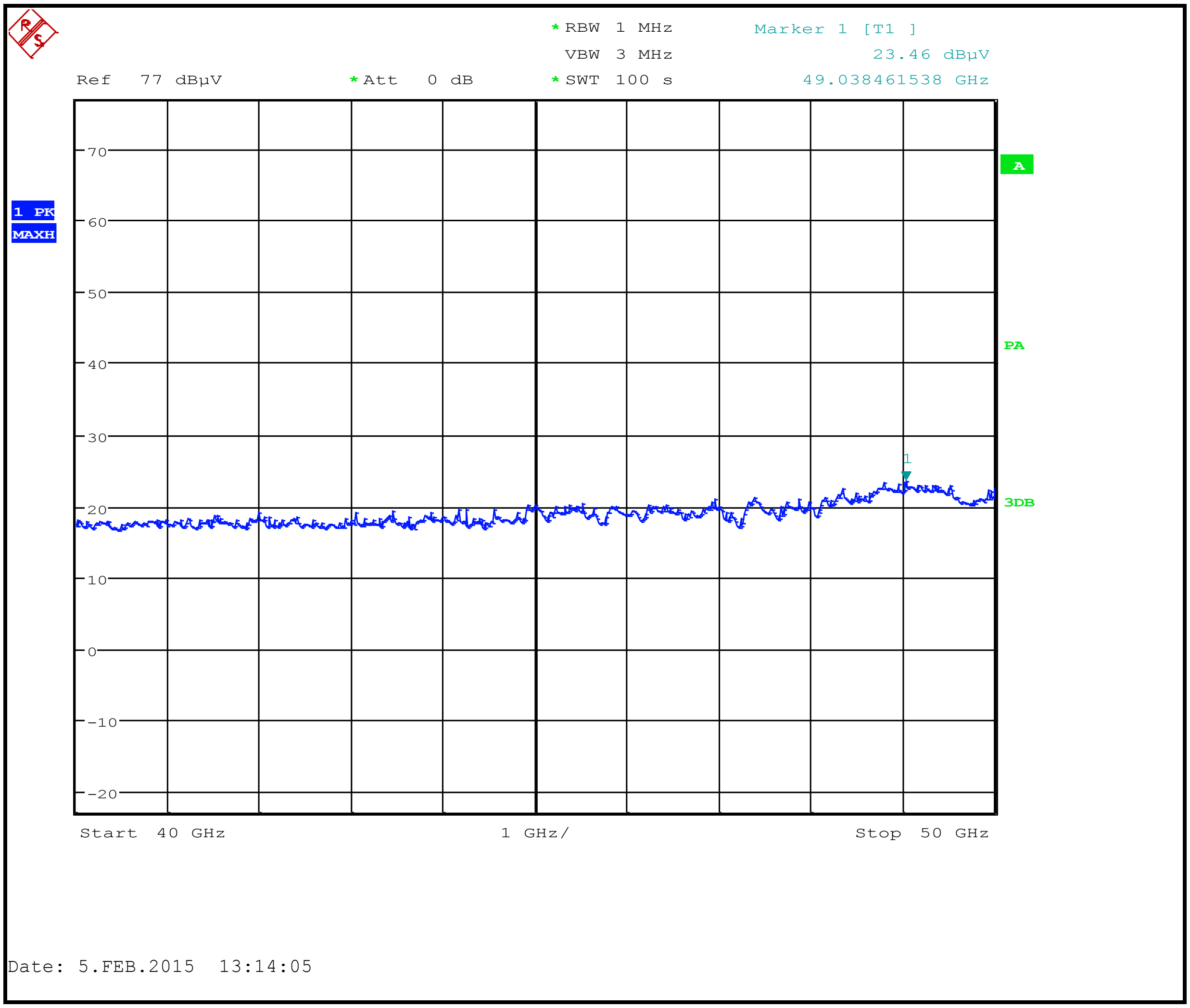


Table 4-17: Radiated Noise Floor Calculation (40 GHz – 50 GHz) (TC #2)

Frequency (GHz)	EIRP Measured (dBuV)	Test Antenna Correction Factor (dB/m)	Correction from .01m to 3m (dB)	Corrected Measurement (dBuV/m)	Limit (dBuV/m)	Margin (dB)
49 (worst case)	23.5	41.5	-49.5	15.5	54.0	-38.5

Plot 4-18: Radiated Spurious Emissions (26.5 GHz – 40 GHz) (TC #2)

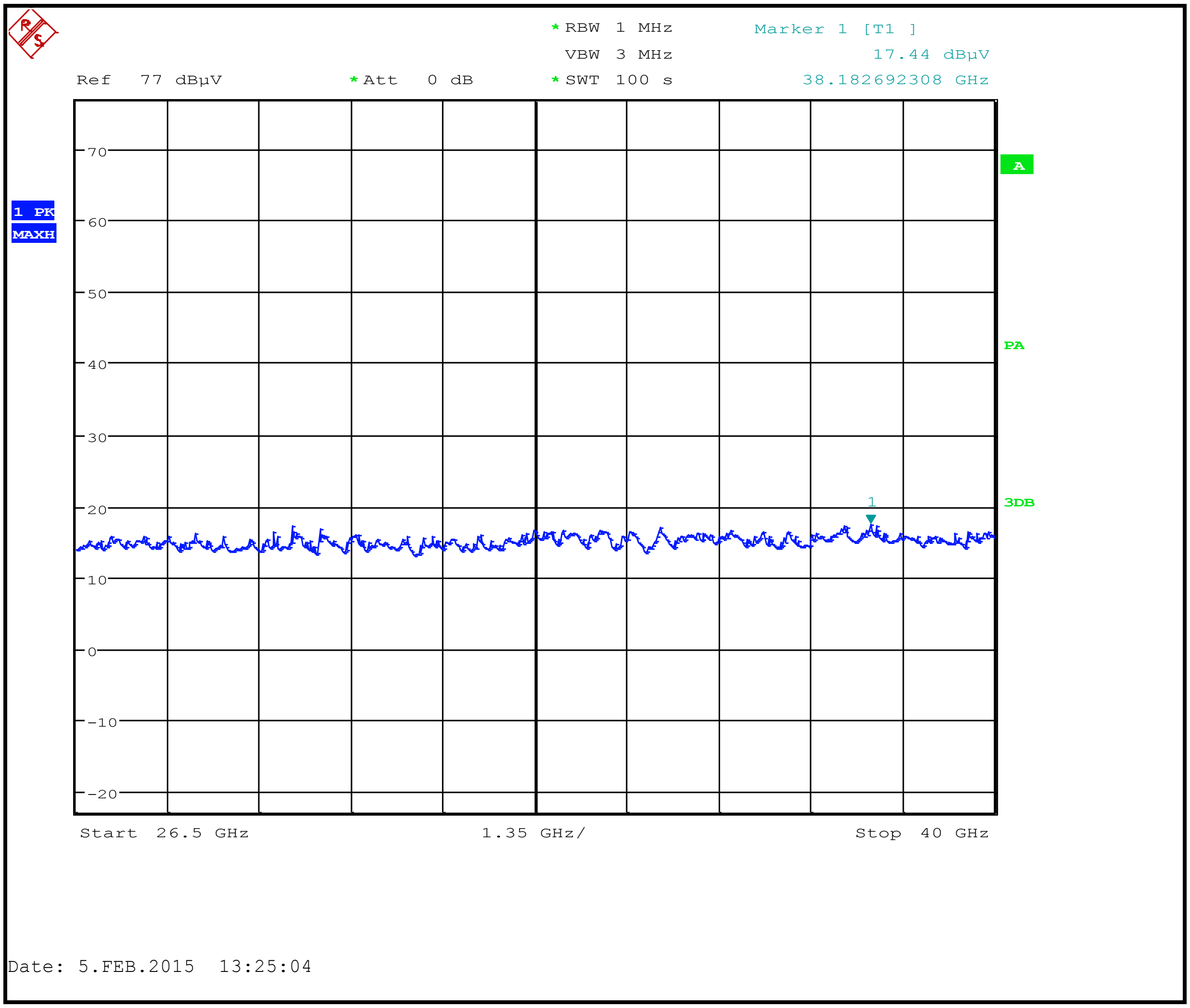


Table 4-18: Radiated Noise Floor Calculation (26.5 GHz – 40 GHz) (TC #2)

Frequency (GHz)	EIRP Measured (dBuV)	Test Antenna Correction Factor (dB/m)	Correction from .01m to 3m (dB)	Corrected Measurement (dBuV/m)	Limit (dBuV/m)	Margin (dB)
38.2 (worst case)	17.4	44.8	-49.5	12.7	54.0	-41.3

Plot 4-19: Radiated Spurious Emissions (18 GHz – 26.5 GHz) (TC #2)

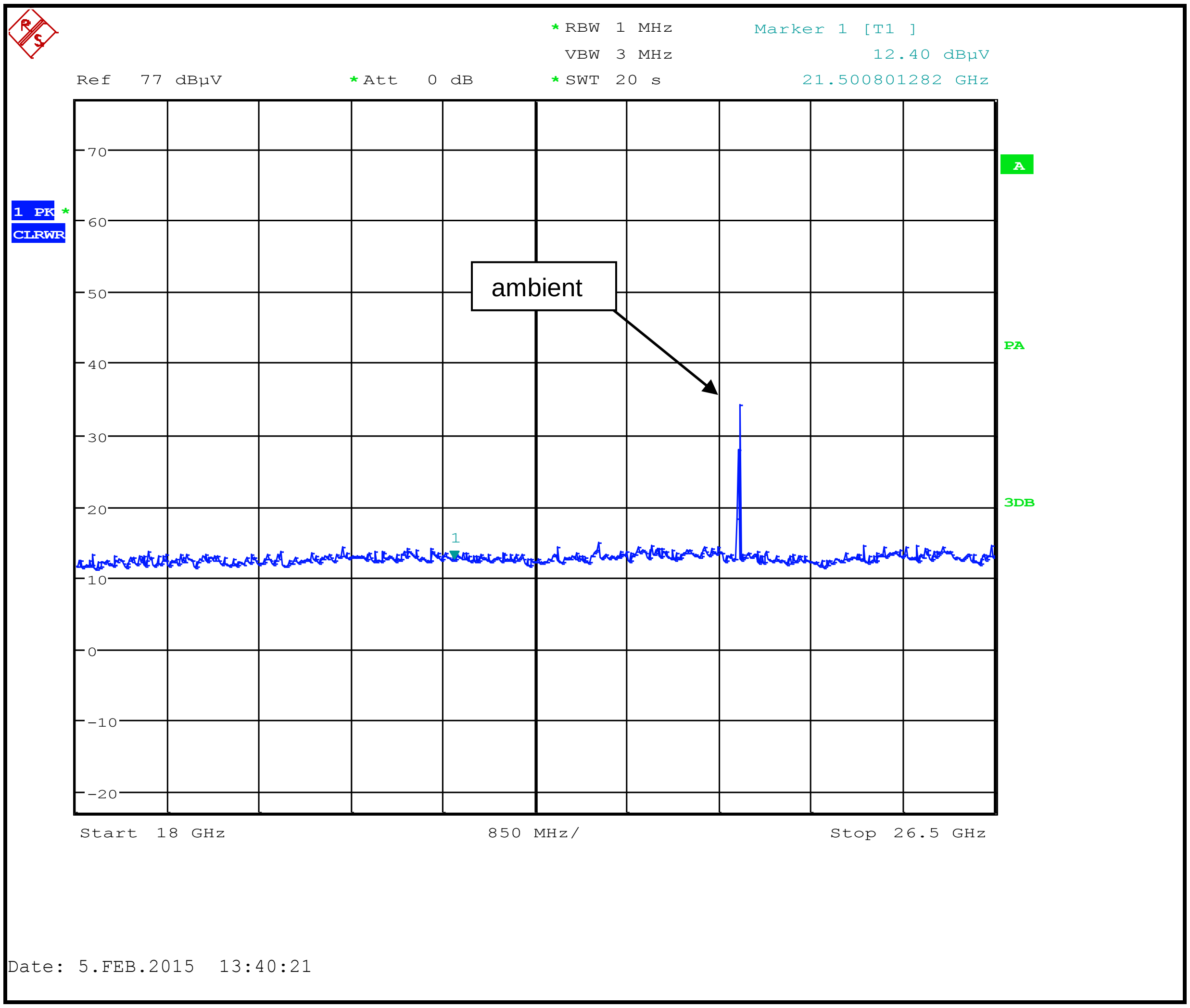


Table 4-19: Radiated Noise Floor Calculation (18 GHz – 26.5 GHz) (TC #2)

Frequency (GHz)	EIRP Measured (dBuV)	Test Antenna Correction Factor (dB/m)	Correction from .01m to 3m (dB)	Corrected Measurement (dBuV/m)	Limit (dBuV/m)	Margin (dB)
21.5 (worst case)	12.4	40.0	-49.5	2.9	54.0	-51.1

4.6 Radiated Emissions Unintentional/Digital Test Data

Table 4-20: Digital Radiated Emissions Test Data (TC #1)

Temperature: 32°F Humidity: 76%										
Emission Frequency (MHz)	Test Detector	Antenna Polarity (H/V)	Turntable Azimuth (deg)	Antenna Height (m)	Analyzer Reading (dBuV)	Site Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pass/ Fail
46.490	Qp	V	80	1.0	41.5	-18.0	23.5	40.0	-16.5	Pass
72.852	Qp	V	180	1.0	47.0	-23.8	23.2	40.0	-16.8	Pass
118.429	Qp	V	0	1.0	35.4	-20.0	15.4	43.5	-28.1	Pass
345.013	Qp	H	90	1.0	48.4	-15.2	33.2	46.0	-12.8	Pass
355.013	Qp	H	90	1.0	49.7	-15.2	34.5	46.0	-11.5	Pass
365.013	Qp	H	90	1.0	49.0	-15.0	34.0	46.0	-12.0	Pass
375.013	Qp	H	80	1.0	49.7	-14.5	35.2	46.0	-10.8	Pass
385.013	Qp	H	85	1.0	50.3	-14.2	36.1	46.0	-9.9	Pass
395.013	Qp	H	70	1.0	48.7	-14.1	34.6	46.0	-11.4	Pass
405.013	Qp	H	30	1.0	47.3	-13.8	33.5	46.0	-12.5	Pass
415.013	Qp	H	70	1.0	47.2	-13.5	33.7	46.0	-12.3	Pass
425.013	Qp	H	80	1.0	46.5	-13.4	33.1	46.0	-12.9	Pass
435.013	Qp	H	80	1.0	46.3	-13.7	32.6	46.0	-13.4	Pass
445.013	Qp	H	80	1.0	44.9	-13.5	31.4	46.0	-14.6	Pass

Table 4-21: Digital Radiated Emissions Test Data (TC #2)

Temperature: 32°F Humidity: 67%										
Emission Frequency (MHz)	Test Detector	Antenna Polarity (H/V)	Turntable Azimuth (deg)	Antenna Height (m)	Analyzer Reading (dBuV)	Site Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pass/ Fail
46.490	Qp	H	0	1.0	34.3	-17.7	16.6	40.0	-23.4	Pass
72.852	Qp	H	0	1.0	34.9	-23.7	11.2	40.0	-28.8	Pass
118.429	Qp	H	0	1.0	32.6	-20.5	12.1	43.5	-31.4	Pass
355.000	Qp	H	270	1.0	35.8	-15.3	20.5	46.0	-25.5	Pass
365.000	Qp	H	120	1.0	37.7	-15.0	22.7	46.0	-23.3	Pass
375.000	Qp	H	280	1.0	36.7	-14.4	22.3	46.0	-23.7	Pass
385.000	Qp	V	90	1.0	36.1	-14.1	22.0	46.0	-24.0	Pass
395.000	Qp	H	90	1.0	34.6	-14.2	20.4	46.0	-25.6	Pass
435.000	Qp	H	0	1.0	35.3	-13.1	22.2	46.0	-23.8	Pass
445.000	Qp	H	30	1.0	35.5	-13.0	22.5	46.0	-23.5	Pass
455.000	Qp	V	0	1.0	37.2	-12.9	24.3	46.0	-21.7	Pass
485.000	Qp	V	0	1.0	35.5	-12.1	23.4	46.0	-22.6	Pass

Unwanted emissions were investigated (other than harmonics) as required by 15.33(a)(3).

“If the intentional radiator operates at or above 30 GHz: to the fifth harmonic of the highest fundamental frequency or to 200 GHz, whichever is lower, unless specified otherwise elsewhere in the rules.”

Table 4-22: Radiated Emissions Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901592	Insulated Wire Inc.	KPS-1503-3600-KPR	SMK RF Cables 20’	NA	9/3/15
901593	Insulated Wire Inc.	KPS-1503-360-KPR	SMK RF Cables 36”	NA	9/3/15
901594	Insulated Wire Inc.	KPS-1503-360-KPR	SMK RF Cables 36”	NA	9/3/15
900932	Hewlett Packard	8449B OPT H02	Preamplifier (1 - 26.5 GHz)	3008A00505	9/5/15
900151	Rohde and Schwarz	HFH2-Z2	Loop Antenna, (9 kHz - 30 MHz)	827525/019	3/4/15
900717	Hewlett Packard	11970U	Harmonic Mixer (40 – 60 GHz)	2332A01110	4/20/15
901639	Wiltron	35WR19F	Waveguide (40 – 50 GHz)	N/A	6/18/15
901640	Rohde & Schwarz	FS-Z110	Mixer (75 – 110 GHz)	100010	4/02/17
901581	Rohde & Schwarz	FSU	Spectrum Analyzer	1166.1660.50	11/13/15
901586	Rohde & Schwarz	FS-Z75	Harmonic Mixer (50 – 75 GHz)	100098	1/23/17
901256	ATM	19-443-6R	Horn Antenna (40-60 GHz, WR-19)	8041704-01	1/23/16
901303	EMCO	3160-10	Horn Antenna (26.5-40.0 GHz) WR-28	960452-007	6/19/15
901161	ATM	28-25K-6	Waveguide (26.5 – 40 GHz)	B082304	Not required
900711	ATM	10-443-6R	Horn Antenna (75 - 110 GHz)	8051905-1	12/5/15
900712	ATM	15-443-6R	Horn Antenna (50 - 75 GHz)	8051805-1	3/16/16
900724	Antenna Research Associates, Inc.	LPB-2520	BiLog Antenna (25 - 2000 MHz)	1037	4/19/15
901629	Teledyne Cougar	A4C2123	Amplifier	003-003	9/5/15
900772	EMCO	3161-02	Horn Antenna (2 - 4 GHz)	9804-1044	4/20/15
900321	EMCO	3161-03	Horn Antenna (4.0 - 8.2 GHz)	9508-1020	4/20/15
901587	Radiometer Physics Gmbh	SAM-220	140-220 GHz Mixer	20005	2/13/17
900713	ATM	05-443-6R	Horn Antenna, 140-220	S0685	5/20/15
900323	EMCO	3160-07	Horn Antenna (8.2 - 12.4 GHz)	9605-1054	4/20/15
900356	EMCO	3160-08	Horn Antenna (12.4 - 18 GHz)	9607-1044	4/20/15
901218	EMCO	3160-09	Horn Antenna (18 - 26.5 GHz)	960281-003	4/19/15
900874	Continental Microwave & Tool	RA42-K-F-4B-C	Waveguide (18 - 26.5 GHz)	990706-002	1/23/16

Test Personnel:

Daniel W. Baltzell		February 4 &5, 2015
Test Engineer	Signature	Dates of Test

5 Frequency Stability ANSI C63.10 6.8, FCC 14-2 (15.256(f)(2))

5.1 Frequency Stability Test Procedure - FCC 14-2 (15.256(f)(2))

The carrier frequency stability is the ability of the transmitter to maintain an assigned carrier frequency.

The EUT was evaluated over the temperature range -30°C to +55°C.

The temperature was initially set to -30°C and a 1-hour period was observed for stabilization of the EUT. The frequency stability was measured within one minute after application of primary power to the transmitter. The temperature was raised at intervals of 10 degrees centigrade through the range. A ½-hour period was observed to stabilize the EUT at each measurement step and the frequency stability was measured within one minute after application of primary power to the transmitter. Additionally, the power supply voltage of the EUT was varied +/-15% nominal input voltage, +15% of minimum voltage and -15% of maximum voltage.

5.2 FCC 15.256(f)(2) Limit

LPR devices operating under this section must confine their fundamental emission bandwidth within the 5.925-7.250 GHz, 24.05-29.00 GHz, and 75-85 GHz bands under all conditions of operation.

5.3 Temperature-Voltage Frequency Stability Test Data

Table 5-1: Temperature Frequency Stability

Temp. (°C)	Lower Edge of Measured Frequency (GHz)	Upper Edge of Measured Frequency (GHz)	Margin (GHz)
-30	78.491987179	79.5	+3.492/-5.5
-20	78.496794872	79.5	+3.497/-5.5
-10	78.496794872	79.504807693	+3.497/-5.495
0	78.501602564	79.499999999897	+3.502/-5.5
10	78.491987179	79.5	+3.492/-5.5
20	78.5	79.455192307692	+3.5/-5.545
30	78.504807692	79.499999999692	+3.505/-5.5
40	78.5	79.495192307692	+3.5/-5.505
50	78.504807692	79.495192307385	+3.505/-5.505
55	78.5	79.455192307692	+3.5/-5.545

Table 5-2: Voltage Frequency Stability

Limit (GHz)	(GHz)	+/-15% VDC						
		12 (Min.)	13.8 (Min. + 15%	19.975 (-15%)	23.5 (Mid.)	27.025 (+ 15%)	29.75 (Max. -15%	35 (Max.)
75	Lower Edge	78. 52884615	78. 50961639	78. 50961539	78. 52884615	78. 50961539	78. 51923077	78. 52403846
85	Upper Edge	79. 48076923	79. 45673177	79. 48076923	79. 48076923	79. 49038462	79. 490384615	79. 480769231

Results: The EUT is within band and compliant.

Table 5-3: Frequency Stability Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
900946	Tenney Engineering, Inc.	TH65	Temperature Chamber with Humidity	11380	1/13/16
901581	Rohde & Schwarz	FSU	Spectrum Analyzer	1166.1660.50	11/13/15
901350	Meterman	33XR	Multimeter	040402802	3/20/15

Test Personnel:

Daniel Baltzell		February 5, 2015
Test Engineer	Signature	Date of Tests

6 AC Conducted Emissions - FCC Rules and Regulations ANSI C63.10 6.2, Part 15.207

6.1 Test Methodology for Conducted Line Emissions Measurements – Part 15.207

The power line conducted emission measurements were performed in a Series 81 type shielded enclosure manufactured by Rayproof. The EUT was placed on a wooden table. Power was fed to the EUT through a 50-ohm/50 μHenry Line Impedance Stabilization Network (LISN). The EUT LISN was fed power through an AC filter box on the outside of the shielded enclosure. The filter box and EUT LISN housing are bonded to the ground plane of the shielded enclosure. A second LISN, the peripheral LISN, provides isolation for the EUT's auxiliary equipment. This peripheral LISN was also fed AC power.

The spectrum analyzer was connected to the AC line through an isolation transformer. The 50-ohm output of the EUT LISN was connected to the spectrum analyzer input through a Solar 100 kHz high-pass filter. The filter is used to prevent overload of the spectrum analyzer from noise below 100 kHz. Conducted emission levels were measured on each current-carrying line with the spectrum analyzer operating in the CISPR quasi-peak mode (or peak mode if applicable). The analyzer's 6 dB bandwidth was set to 9 kHz. Video filter less than 10 times the resolution bandwidth is not used. Average measurements are performed in linear mode using a 10 kHz resolution bandwidth, a 1 Hz video bandwidth, by increasing the sweep time in order to obtain a calibrated measurement. The emission spectrum was scanned from 150 kHz to 30 MHz. The highest emission amplitudes relative to the appropriate limits were measured and have been recorded.

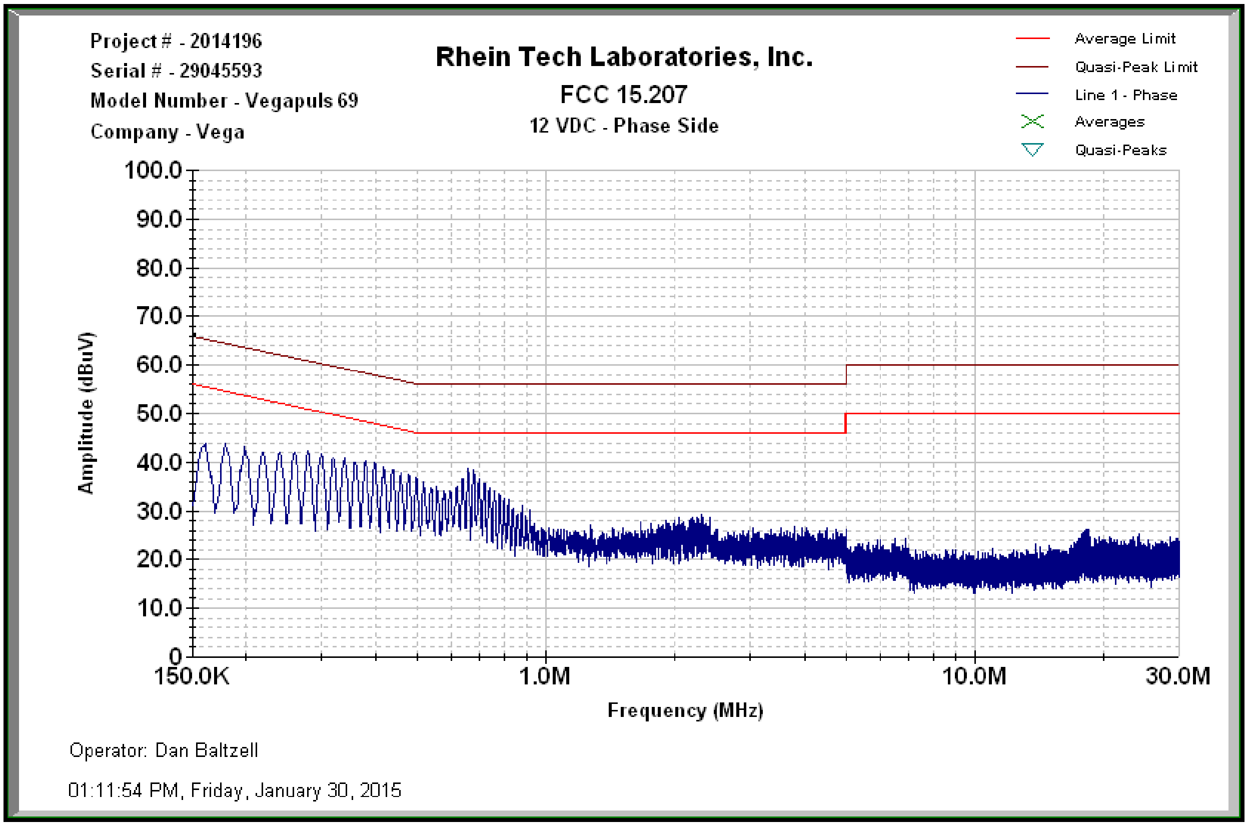
6.2 Conducted Line Emissions Test Procedure

Conducted emissions were performed on the EUT using an off-the-shelf power supply. The general conducted limit under Part 15.207 was applied. The emissions were scanned between 150 kHz to 30 MHz on the neutral and phase conductors.

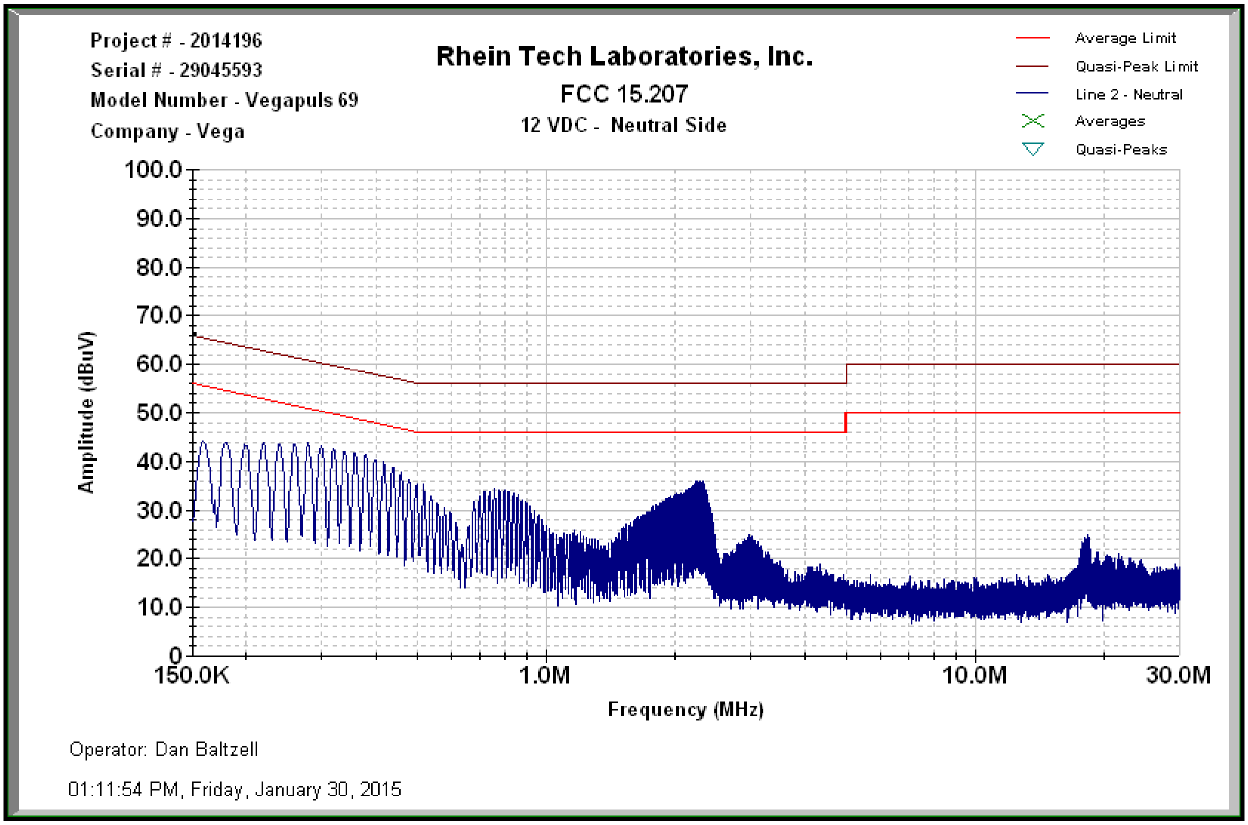
6.3 Conducted Line Emissions Test Data

6.3.1 Test Configuration #1

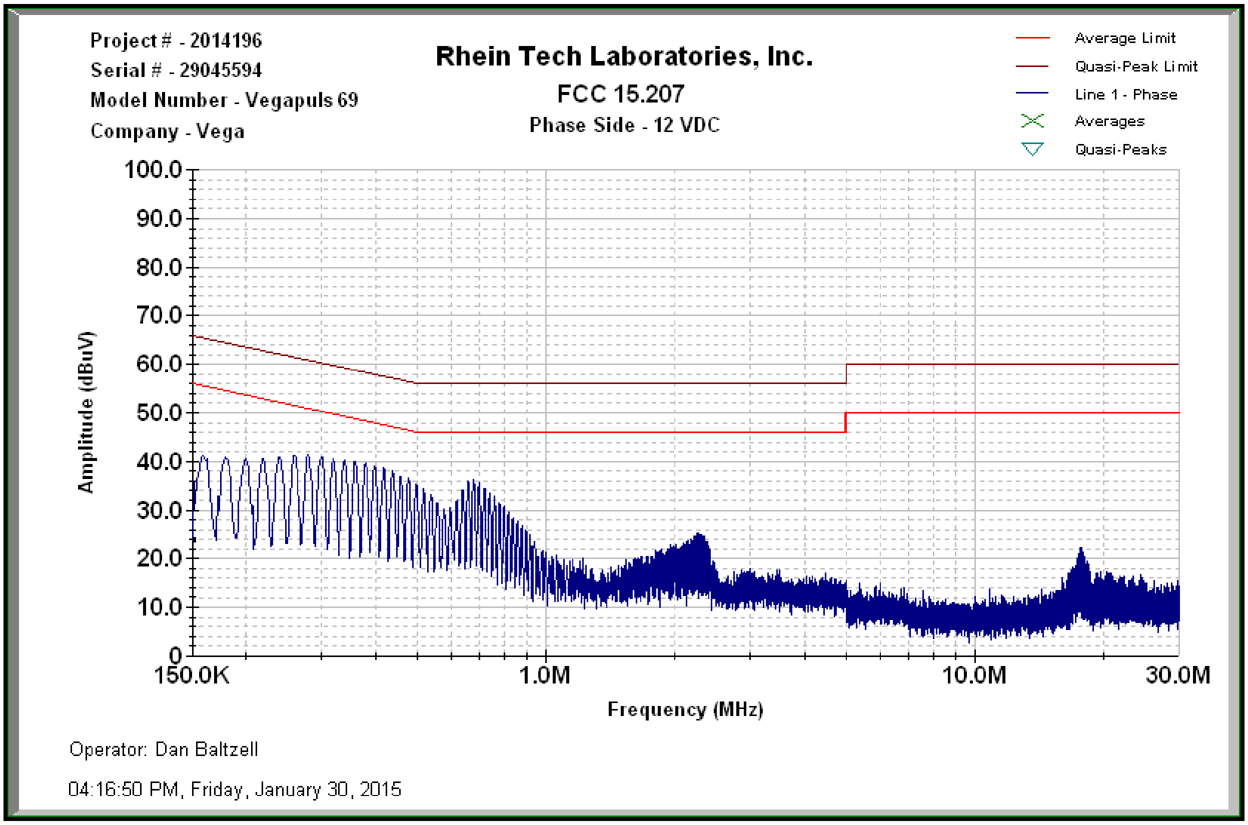
Plot 6-1: Conducted Emissions Transmit - Phase (TC #1)



Plot 6-2: Conducted Emissions Transmit – Neutral (TC #1)



Plot 6-3: Conducted Emissions Transmit - Phase (TC #2)



Plot 6-4: Conducted Emissions Transmit – Neutral (TC #2)

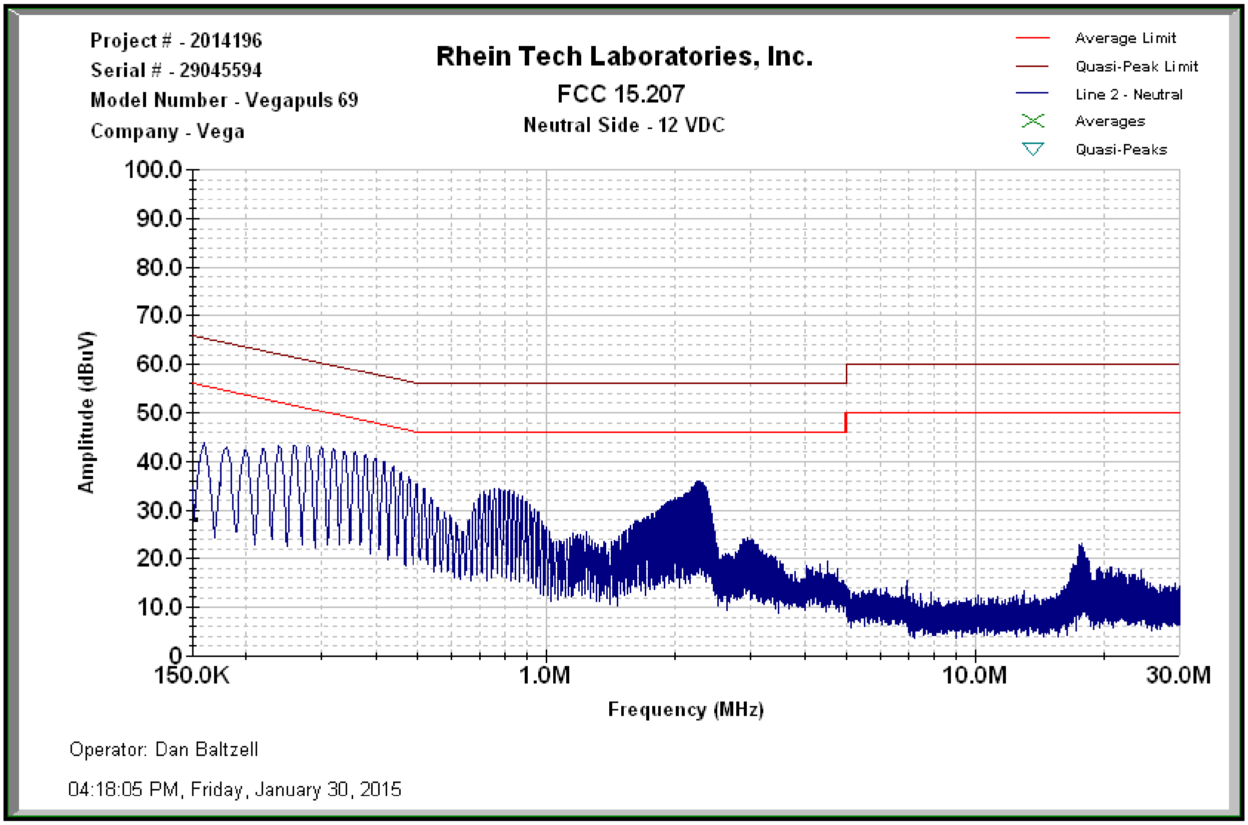
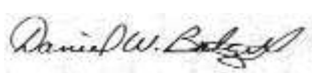


Table 6-1: Conducted Line Emissions Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
900968	Hewlett Packard	8567A	Spectrum Analyzer (10 kHz - 1.5 GHz)	2602A00160	2/17/15
900339	Hewlett Packard	85650A	Quasi-Peak Adapter	2521A00743	2/17/16
900970	Hewlett Packard	85662A	Spectrum Analyzer Display	2542A11239	2/17/15
901083	AFJ International	LS16	16A LISN (110 V)	16010020080	8/27/15
N/A	Rhein Tech Laboratories, Inc.	Automated Emissions Tester	Emissions Testing Software Rev. 14.0.2	N/A	N/A

Test Personnel:

Daniel W. Baltzell		January 30, 2015
Test Engineer	Signature	Date of Test

7 Conclusion

The data in this measurement report shows that the Vega Grieshaber KG Model VEGAPULS 69, FCC ID: O6QPS60XW1, complies with the applicable requirements of Parts 2 and 15 of the FCC rules and regulations.