FCC Part 15.256 & Industry Canada RSS-Gen
Certification Application Report

Test Lab:	Applicant:
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FCC ID **IC**	O6QPS60XK2 3892A-PS60XK2	**Test Report Date**	December 30, 2016
Platform	N/A	**RTL Work Order #**	2014076
Model	PS60K	**RTL Quote #**	QRTL14-076A
FCC Classification	DXX – Part 15 Low Power Communication Device Transmitter		
FCC Rule Part(s)/Guidance	Part 15C, 15.256: Radio Frequency Devices 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)		
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		
Test Procedure	ANSI C63.10-2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices		
Industry Canada	RSS-Gen Issue 4: General Requirements for Compliance of Radio Apparatus RSS-211 Level Probing Radar Equipment		
Digital Interface Information	Digital Interface was found to be compliantt		

Frequency Range (GHz)	Output Power (W)	Frequency Tolerance	Emission Designator
26.0	0.000201	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 Industry Canada RSS-Gen and ANSI C63.4.

Signature: ______________ Date: December 30, 2016

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

This report may not be reproduced, except in full, without the written approval of Rhein Tech Laboratories, Inc. and VEGA Grieshaber KG. The test results relate only to the item(s) tested.

These tests are accredited and meet the requirements of ISO/IEC 17025 as verified by ANSI-ASQ National Accreditation Board/ACLASS. 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 Commissionand Industry Canada rules and regulations.

The Equipment Under Test (EUT) was the Level Probing Radar Model PS60K, Level Probing Radar, with PS60HK electronics, FCC ID: O6QPS60XK2, IC: 3892A-PS60XK2 tested with five different antennas.

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 May 2, 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 (HVIN)	Serial Number	FCC ID	Cable Type	RTL Bar Code
UXBXCHKMAX	VEGA Grieshaber KG	PS60K	27522102	O6QPS60XK2	N/A	21455
UXDND2HKMAX	VEGA Grieshaber KG	PS60K	27522103	O6QPS60XK2	N/A	21456
UXKND2HKMAX	VEGA Grieshaber KG	PS60K	27522104	O6QPS60XK2	N/A	21457
UXNCCHKMAX	VEGA Grieshaber KG	PS60K	27522105	O6QPS60XK2	N/A	21458
95mm Horn Antenna (27.0 dBi)	VEGA Grieshaber KG	N/A	N/A	N/A	N/A	21136
75mm Horn Antenna (24.5 dBi)	VEGA Grieshaber KG	N/A	N/A	N/A	N/A	21137
75mm Encapsulated Horn Antenna (23.6 dBi)	VEGA Grieshaber KG	N/A	N/A	N/A	N/A	21138
245mm Parabolic Dish Antenna (32.8 dBi)	VEGA Grieshaber KG	N/A	N/A	N/A	N/A	21139
75mm Plastic Horn Antenna (24.8 dBi)	VEGA Grieshaber KG	N/A	N/A	N/A	N/A	21140
Standard Electronics	VEGA Grieshaber KG	PS60HK	27114308	N/A	N/A	21459
Standard Electronics	VEGA Grieshaber KG	PS60HK	27114352	N/A	N/A	21460
Standard Electronics	VEGA Grieshaber KG	PS60HK	27114315	N/A	N/A	21461
Standard Electronics	VEGA Grieshaber KG	PS60HK	27114274	N/A	N/A	21462
DC Power Supply	Hewlett Packard	6024A	1912A00331	N/A	1m 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 number (TC #1, TC #3, TC #5, TC #7 or TC #9) is provided with the test data as appropriate.

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

Part	Model (HVIN)	Manufacturer	Cable Type	RTL Bar Code
UXBXCHKMAX	PS60K	VEGA Grieshaber KG	N/A	21455
Standard Electronics	PS60HK	VEGA Grieshaber KG	N/A	21460
75mm Plastic Horn Antenna (24.8 dBi)	N/A	VEGA Grieshaber KG	N/A	21140

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

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

Part	Model	Manufacturer	Cable Type	RTL Bar Code
UXDND2HKMAX	PS60K	VEGA Grieshaber KG	N/A	21456
Standard Electronics	PS60HK	VEGA Grieshaber KG	N/A	21461
75mm Horn Antenna (24.5 dBi)	N/A	VEGA Grieshaber KG	N/A	21137

Photograph 2: Test Configuration #3 (TC #3)

Table 2-4: Test Configuration #5 (TC #5)

Part	Model	Manufacturer	Cable Type	RTL Bar Code
UXDND2HKMAX	PS60K	VEGA Grieshaber KG	N/A	21456
Standard Electronics	PS60HK	VEGA Grieshaber KG	N/A	21461
95mm Horn Antenna (27.0 dBi)	N/A	VEGA Grieshaber KG	N/A	21136

Photograph 3: Test Configuration #5 (TC #5)

Table 2-5: Test Configuration #7 (TC #7)

Part	Model	Manufacturer	Cable Type	RTL Bar Code
UXKND2HKMAX	PS60K	VEGA Grieshaber KG	N/A	21457
Standard Electronics	PS60HK	VEGA Grieshaber KG	N/A	21462
245mm Parabolic Dish Antenna (32.8 dBi)	N/A	VEGA Grieshaber KG	N/A	21139

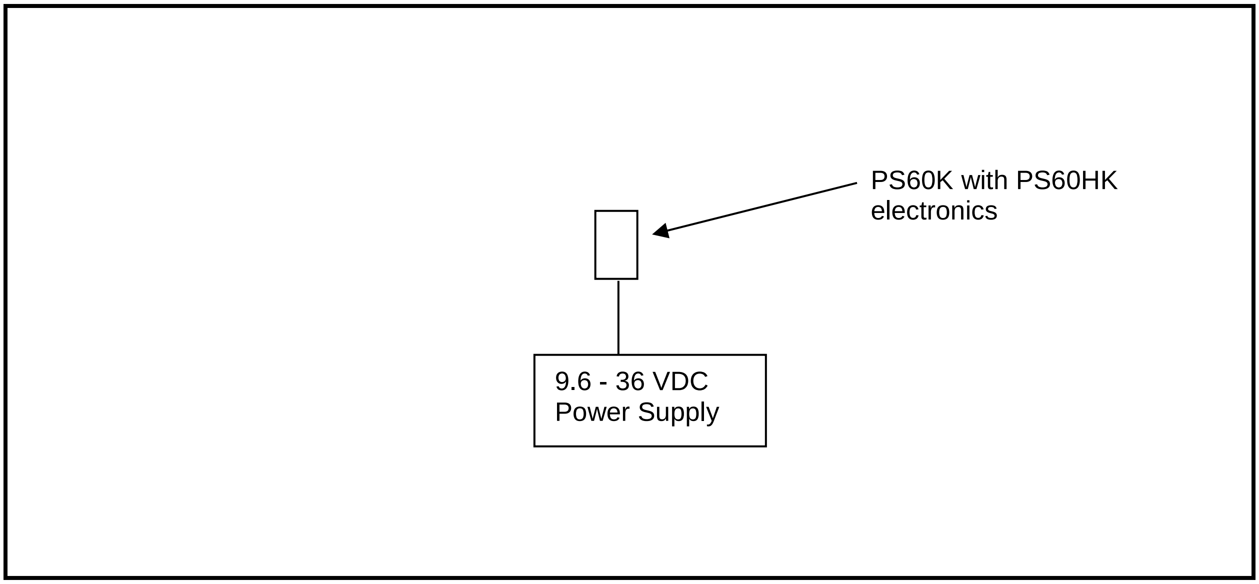
Photograph 4: Test Configuration #7 (TC #7)

Table 2-6: Test Configuration #9 (TC #9)

Part	Model	Manufacturer	Cable Type	RTL Bar Code
UXNCCHKMAX	PS60K	VEGA Grieshaber KG	N/A	21458
Standard Electronics	PS60HK	VEGA Grieshaber KG	N/A	21459
75mm Encapsulated/Filled Horn Antenna (23.6 dBi)	N/A	VEGA Grieshaber KG	N/A	21138

Photograph 5: Test Configuration #9 (TC #9)

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))RSS-Gen 4.6

3.1 Modulated Bandwidth Test Procedure - FCC 14-2 (15.256(f)(1))RSS-Gen 4.6.1

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 display markers were set to -10 dB using max hold until the spectrum was filled and a plot taken.

3.2 Limits

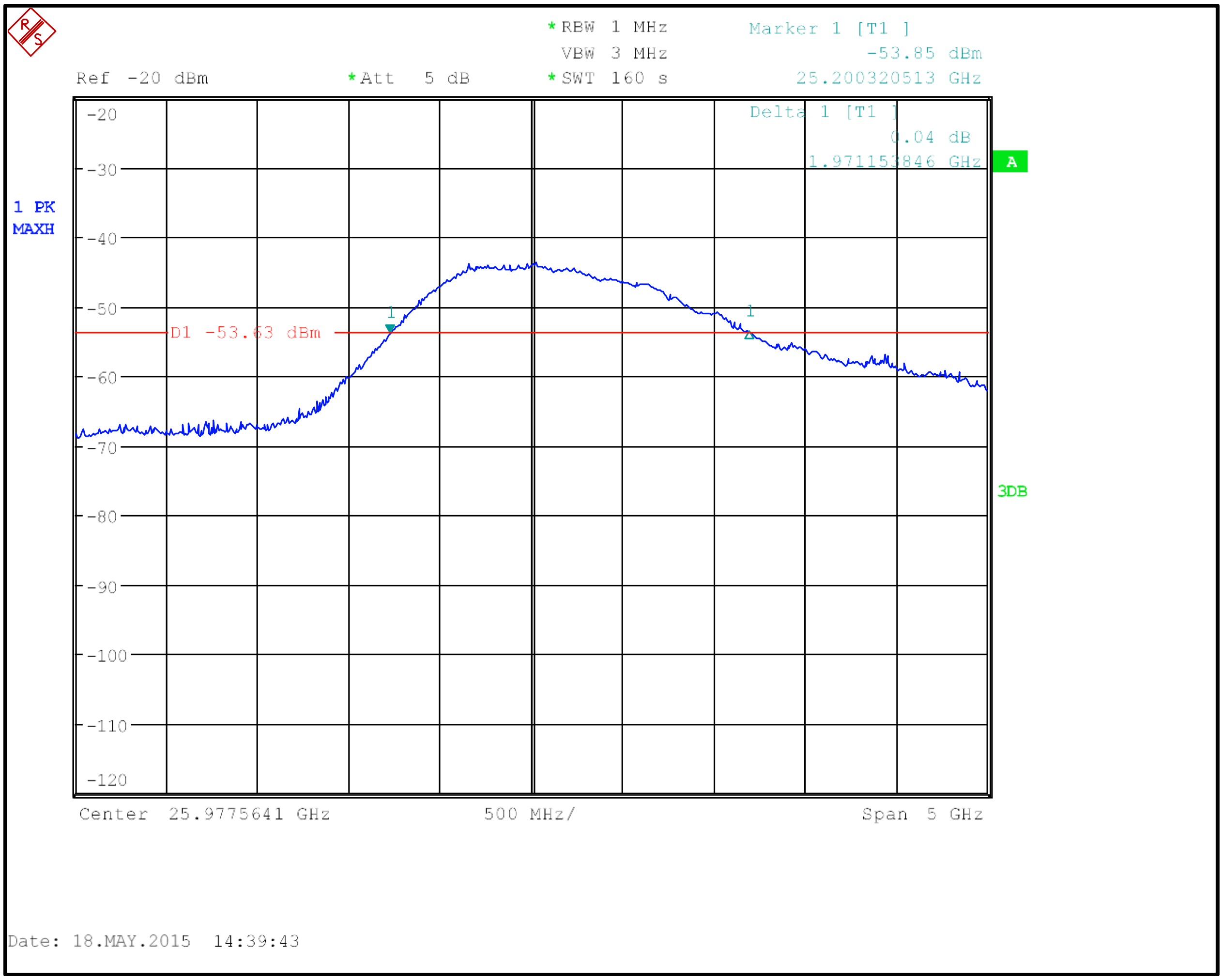
(f) The fundamental bandwidth of an LPR emission is defined as the width of the signal between two points, one below and one above the center frequency, outside of which all emissions are attenuated by at least 10 dB relative to the maximum transmitter output power when measured in an equivalent resolution 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)
Standard Electronics PS60HK	1971.153	50	-1921.153

Plot 3-1: 10 dB Modulated Bandwidth – Standard Electronics PS60HK



Marker T1 Delta: 27171.474 MHz; Marker T1: 25200.321 MHz; OBW= 1971.153 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	11/13/16

Test Personnel:

Dan Baltzell	[signature]	May 18-21, 2015
Test Engineer	Signature	Dates of Test

4 Radiated Emissions – ANSI C63.10 6.3, FCC 15.256(g)(3); RSS-Gen 4.8

4.1 Radiated Fundamental Emissions Test Procedure – FCC 15.256(g)(3); RSS-Gen 4.8

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 -14 dBm/1 MHz power density limit and peak detector for 26 dBm/50 MHz limit. Limits are -14 dBm/MHz and 26 dBm/50 MHz bandwidth (corrected to 20 MHz). Since these limits are power density, no pulse desensitization correction factor is required. Both were also measured finding the maximum amplitude at 3 meters and switching from 1 MHz to 20 MHz resolution bandwidths.

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 equation from KDB 890966 6 b:

For radiated emission measurements

EIRP (dBm) = field strength (dBμV/m) – 104.8 + 20 Log D

where:

D is the measurement distance

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 and 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: Number of sampling BINS used = 1501

4.2.1 Test Configuration #1

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

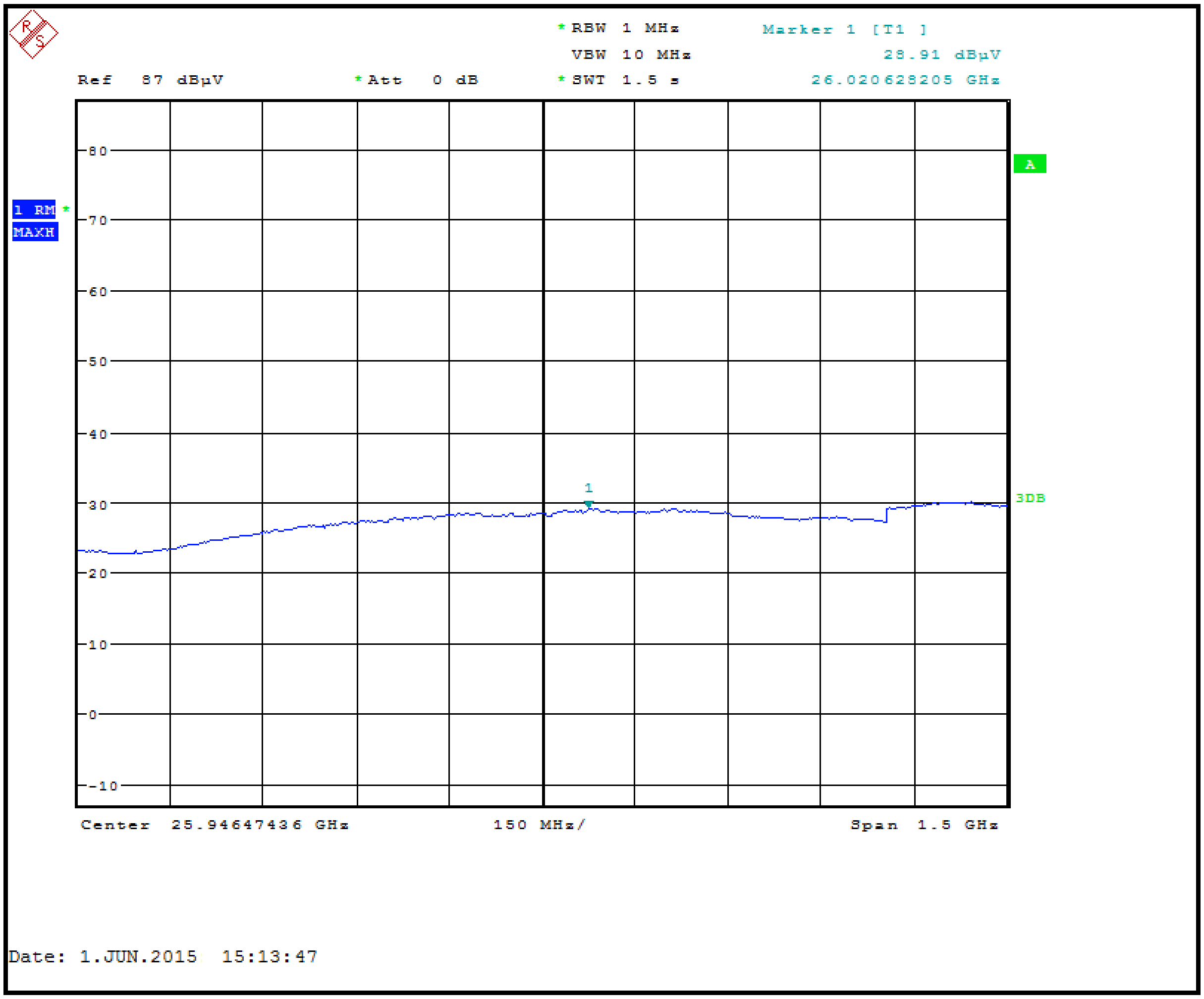
Frequency (GHz)	Average Spectrum Analyzer Level (dBuV)	Antenna Correction Factor (dB/m)	Corrected Average Measurement (dBuV/m)	Converted to dBm	Limit (dBm)	Margin (dB)
26.0	28.9	40.6	69.5	-25.7	-14.0	-11.7

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

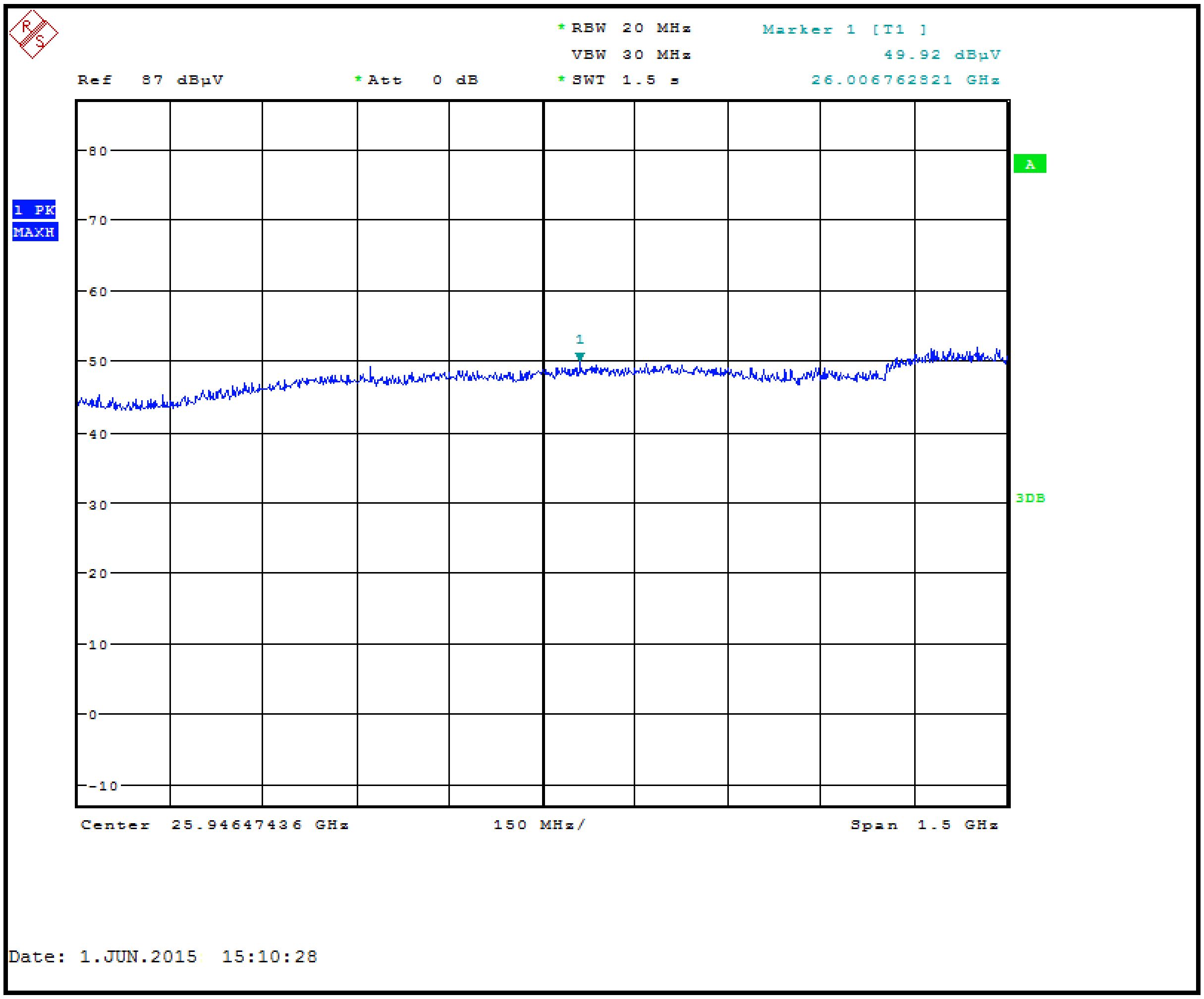
Frequency (GHz)	Peak EIRP Measured (dBuV)	Site Correction Factor (dB/m) + 8 dB*	Corrected Peak Measurement (dBuV/m)	Converted to dBm	Limit (dBm)	Margin (dB)
25.9	49.9	48.6	98.5	3.3	26.0	-22.7

*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, a lower RBW of 20 MHz was adjusted to the limit using 20 log(RBW/50) dB. The resolution bandwidth used is 20 MHz, therefore 20log(20/50) = 8 dB increase of the fundamental to adjust towards the 50 MHz EIRP BW requirement.

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



Plot 4-2: Radiated Fundamental (EIRP in 20 MHz) (TC #1)



4.2.2 Test Configuration #3

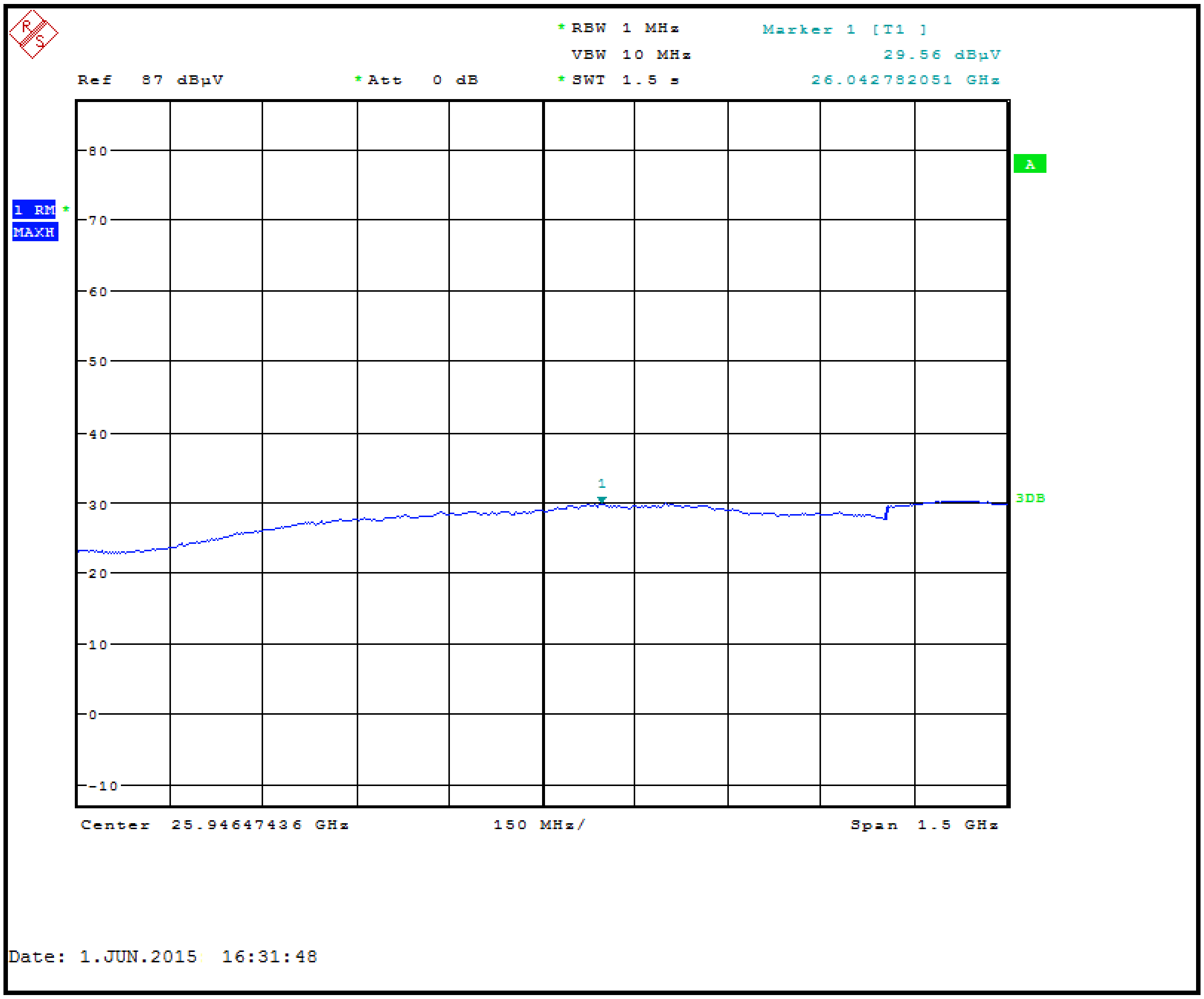
Table 4-3: Radiated Fundamental Emissions (EIRP in 1 MHz, Average Detector) (TC #3)

Frequency (GHz)	Average Spectrum Analyzer Level (dBuV)	Antenna Correction Factor (dB/m)	Corrected Average Measurement (dBuV/m)	Converted to dBm	Limit (dBm)	Margin (dB)
26.1	29.7	40.6	70.3	-25.0	-14.0	-11.0

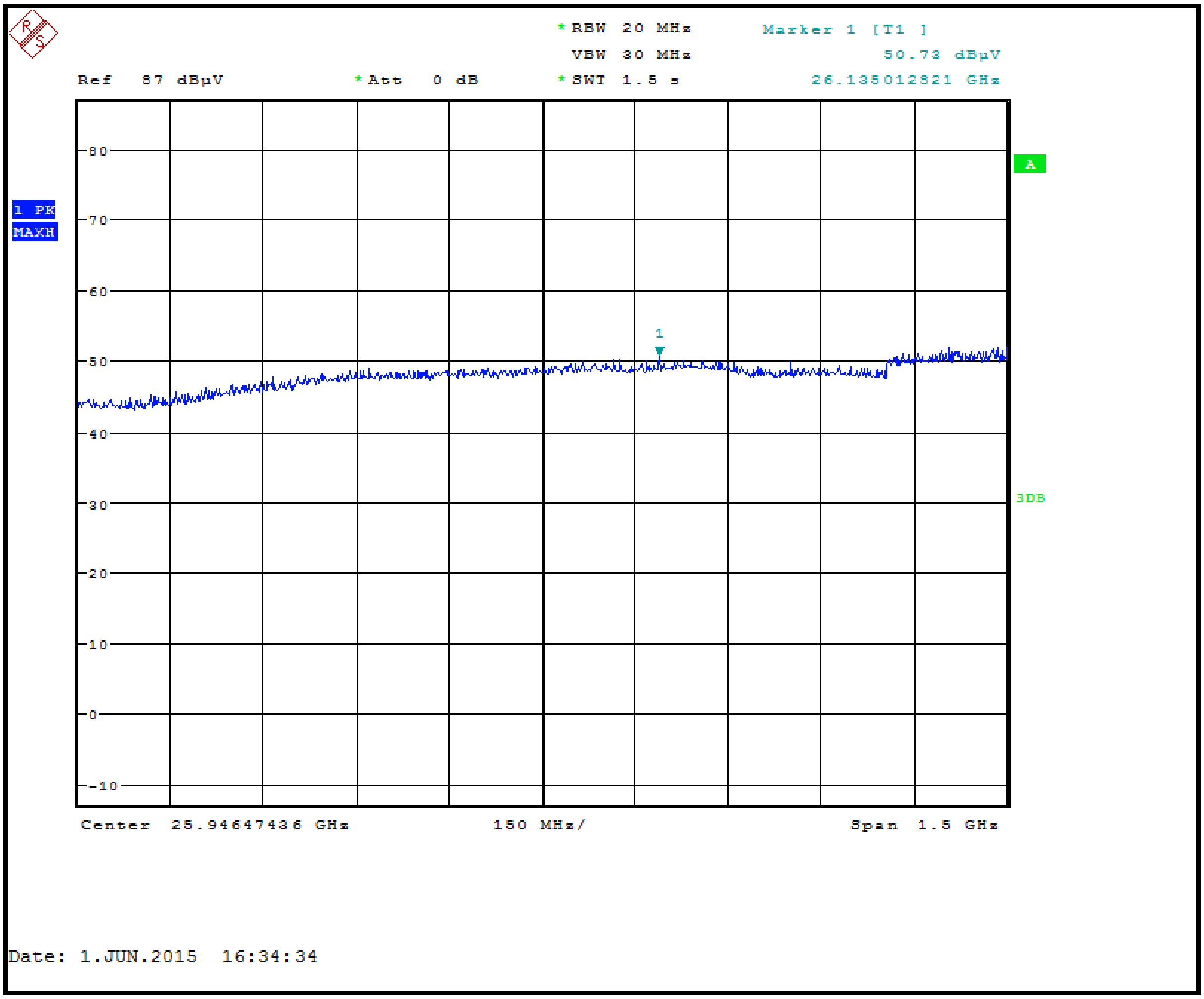
Table 4-4: Radiated Fundamental Emissions (EIRP in 50 MHz, Peak Detector) (TC #3)

Frequency (GHz)	Peak EIRP Measured (dBuV)	Site Correction Factor (dB/m) + 8 dB*	Corrected Peak Measurement (dBuV/m)	Converted to dBm	Limit (dBm)	Margin (dB)
26.0	50.7	48.6	99.3	4.1	26.0	-21.9

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



Plot 4-4: Radiated Fundamental (EIRP in 50 MHz) (TC #3)



4.2.3 Test Configuration #5

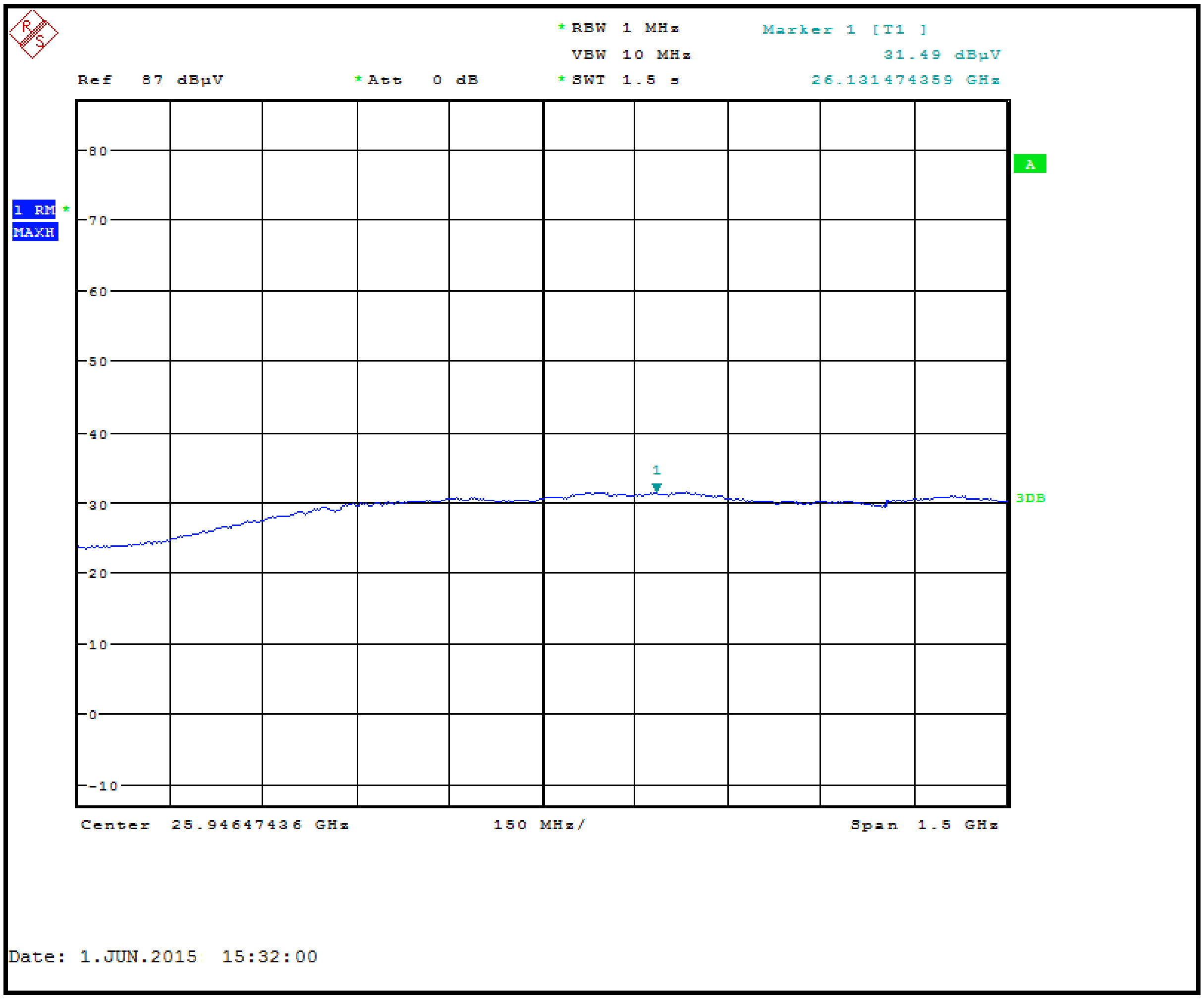
Table 4-5: Radiated Fundamental Emissions (EIRP in 1 MHz, Average Detector) (TC #5)

Frequency (GHz)	Average Spectrum Analyzer Level (dBuV)	Antenna Correction Factor (dB/m)	Corrected Average Measurement (dBuV/m)	Converted to dBm	Limit (dBm)	Margin (dB)
26.1	28.9	40.6	69.5	-25.7	-14.0	-11.7

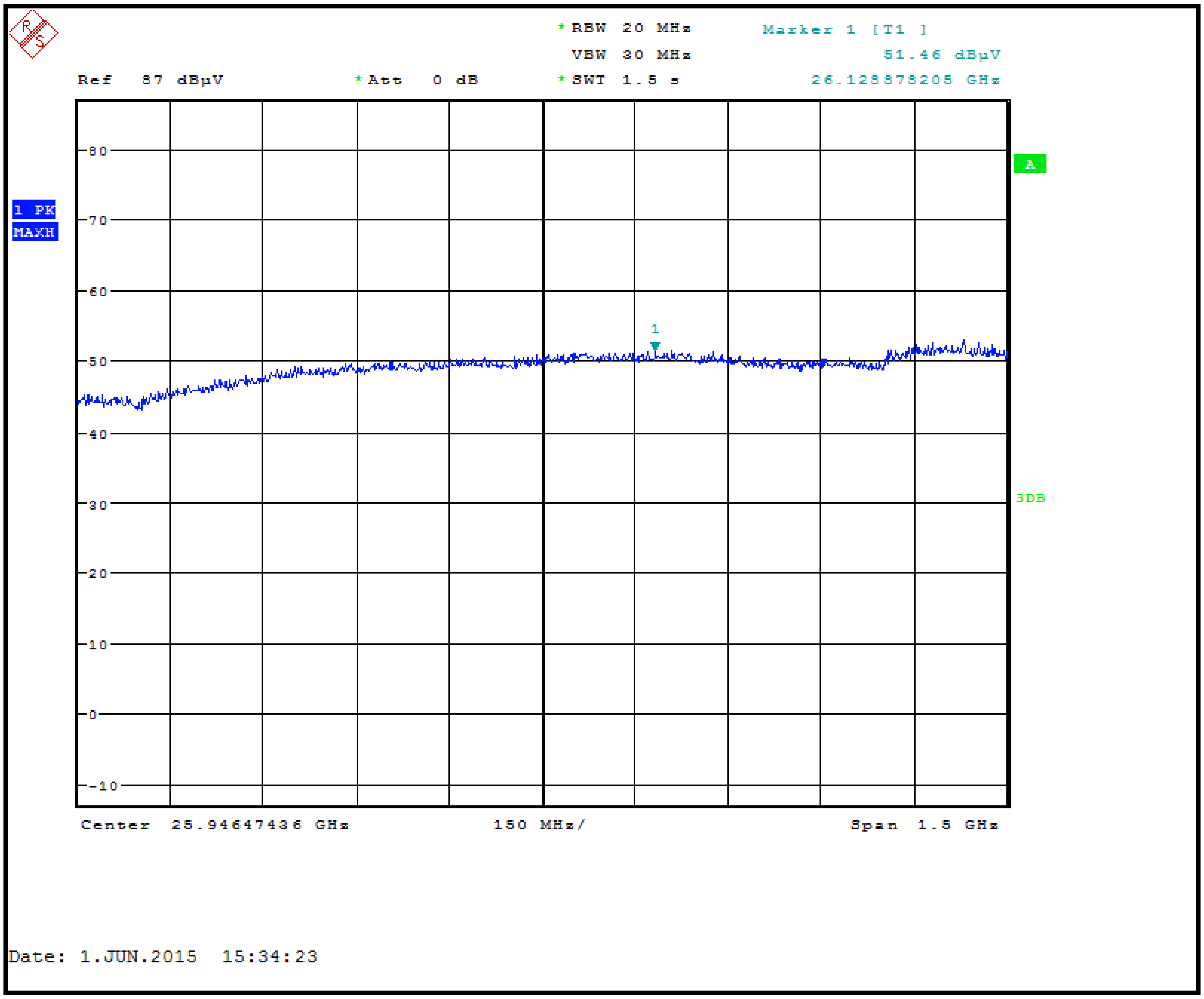
Table 4-6: Radiated Fundamental Emissions (EIRP in 50 MHz, Peak Detector) (TC #5)

Frequency (GHz)	Peak EIRP Measured (dBuV)	Site Correction Factor (dB/m) + 8 dB*	Corrected Peak Measurement (dBuV/m)	Converted to dBm	Limit (dBm)	Margin (dB)
26.0	51.5	48.6	100.1	4.9	26.0	-21.1

Plot 4-5: Radiated Fundamental (EIRP in 1 MHz) (TC #5)



Plot 4-6: Radiated Fundamental (EIRP in 20 MHz) (TC #5)



4.2.4 Test Configuration #7

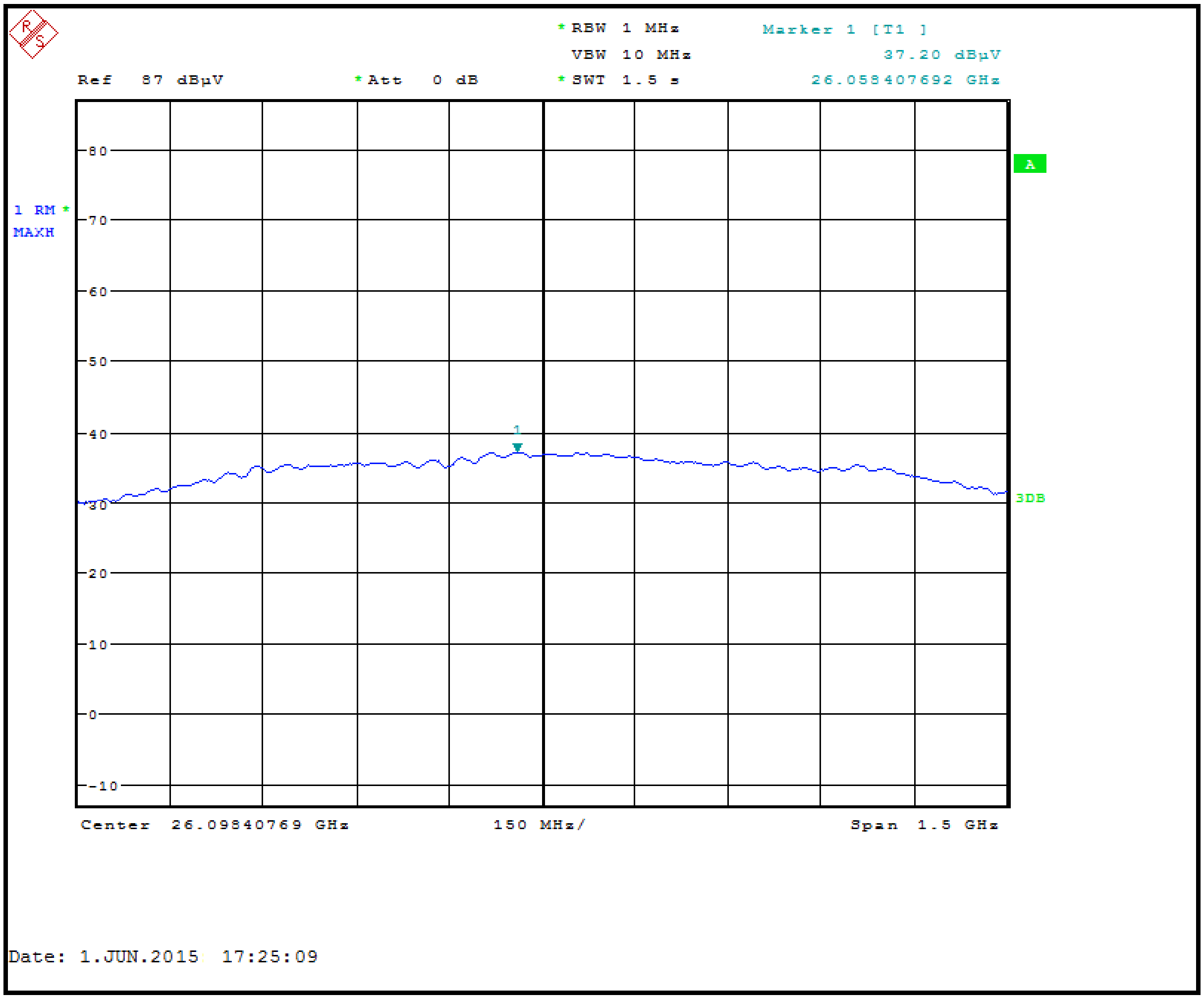
Table 4-7: Radiated Fundamental Emissions (EIRP in 1 MHz, Average Detector) (TC #7)

Frequency (GHz)	Average Spectrum Analyzer Level (dBuV)	Antenna Correction Factor (dB/m)	Corrected Average Measurement (dBuV/m)	Converted to dBm	Limit (dBm)	Margin (dB)
26.1	37.2	40.6	77.8	-17.4	-14.0	-3.4

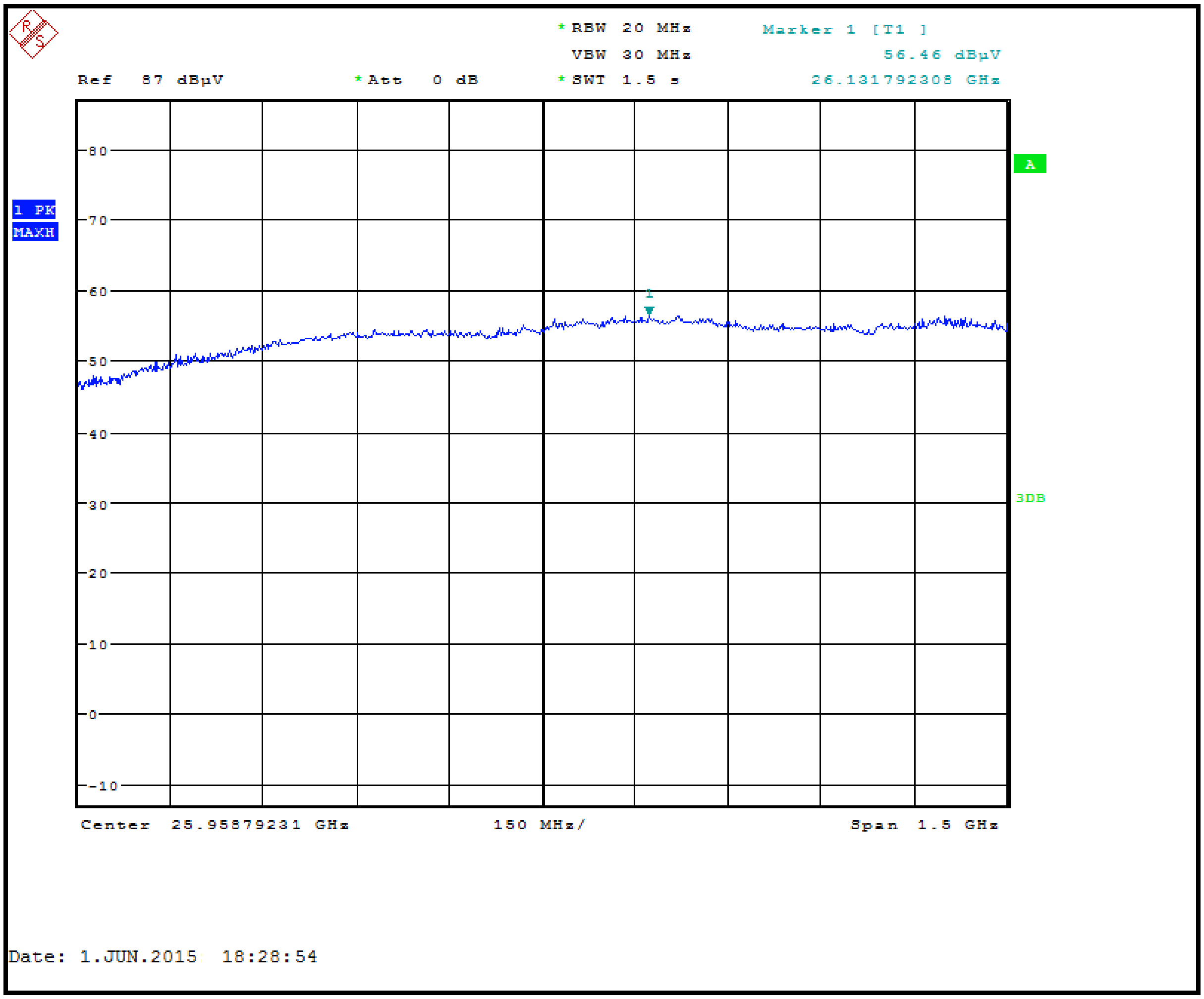
Table 4-8: Radiated Fundamental Emissions (EIRP in 50 MHz, Peak Detector) (TC #7)

Frequency (GHz)	Peak EIRP Measured (dBuV)	Site Correction Factor (dB/m) + 8 dB*	Corrected Peak Measurement (dBuV/m)	Converted to dBm	Limit (dBm)	Margin (dB)
26.0	56.5	48.6	105.1	9.9	26.0	-16.1

Plot 4-7: Radiated Fundamental (EIRP in 1 MHz) (TC #7)



Plot 4-8: Radiated Fundamental (EIRP in 20 MHz) (TC #7)



4.2.5 Test Configuration #9

Table 4-9: Radiated Fundamental Emissions (EIRP in 1 MHz, Average Detector) (TC #9)

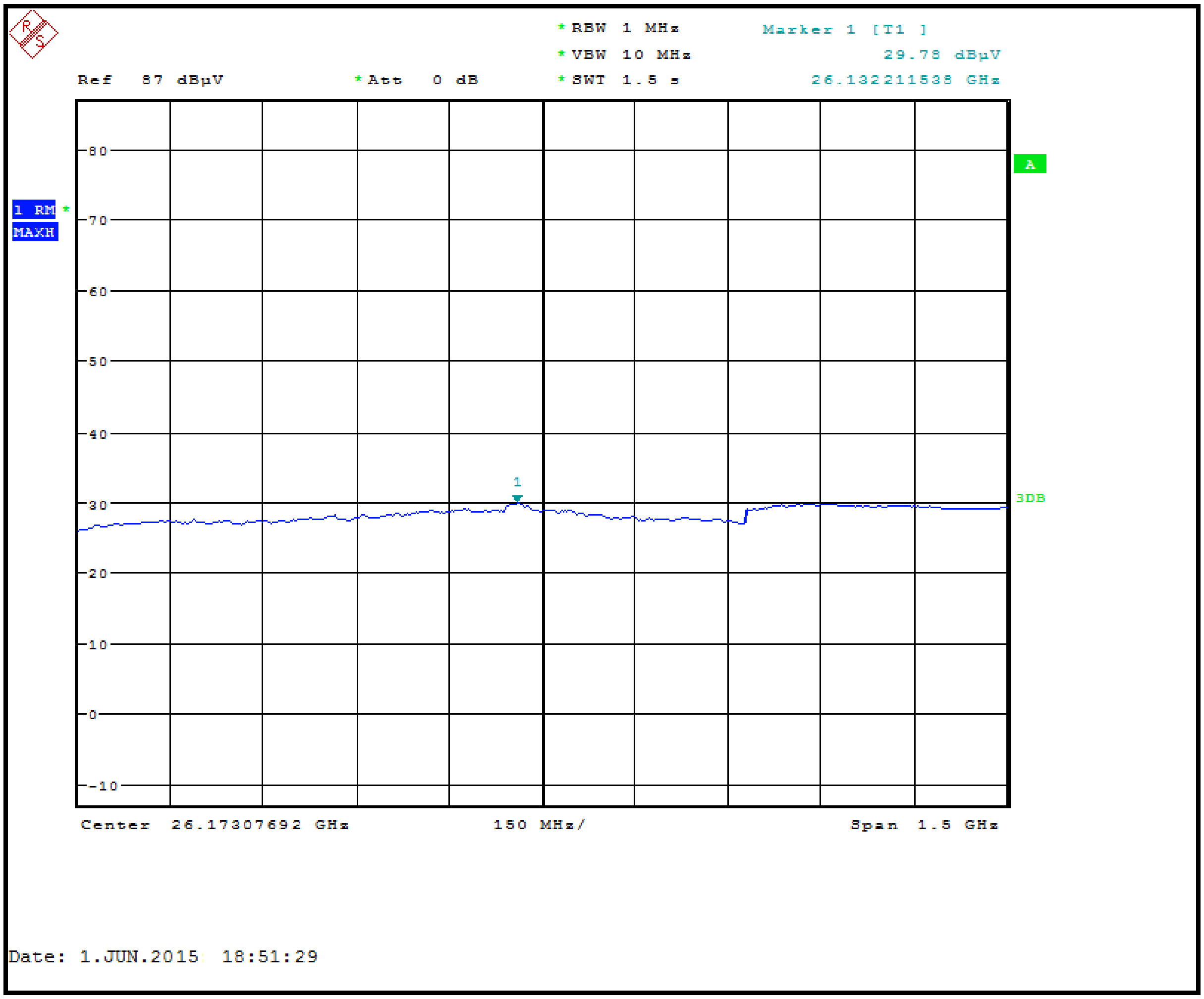
Frequency (GHz)	Average Spectrum Analyzer Level (dBuV)	Antenna Correction Factor (dB/m)	Corrected Average Measurement (dBuV/m)	Converted to dBm	Limit (dBm)	Margin (dB)
26.1	29.8	40.6	70.4	-24.8	-14.0	-10.8

Table 4-10: Radiated Fundamental Emissions (EIRP in 50 MHz, Peak Detector) (TC #9)

Frequency (GHz)	Peak EIRP Measured (dBuV)	Site Correction Factor (dB/m) + 8 dB*	Corrected Peak Measurement (dBuV/m)	Converted to dBm	Limit (dBm)	Margin (dB)
26.1	49.9	48.6	98.5	3.3	26.0	-22.7

*NOTE: Per FCC 15.256(g)(2)(ii): The Rhode & Schwarz FSU 50 spectrum analyzer used a maximum video bandwidth resolution of 20 MHz less than the required 50 MHz RBW, a lower RBW of 20 MHz was adjusted to the limit using 20 log(RBW/50) dB. The resolution bandwidth used is 20 MHz, therefore 20log(20/50) = 8 dB increase of the fundamental to adjust towards the 50 MHz EIRP BW requirement.

Plot 4-9: Radiated Fundamental (EIRP in 1 MHz) (TC #9)



Plot 4-10: Radiated Fundamental (EIRP in 20 MHz) (TC #9)

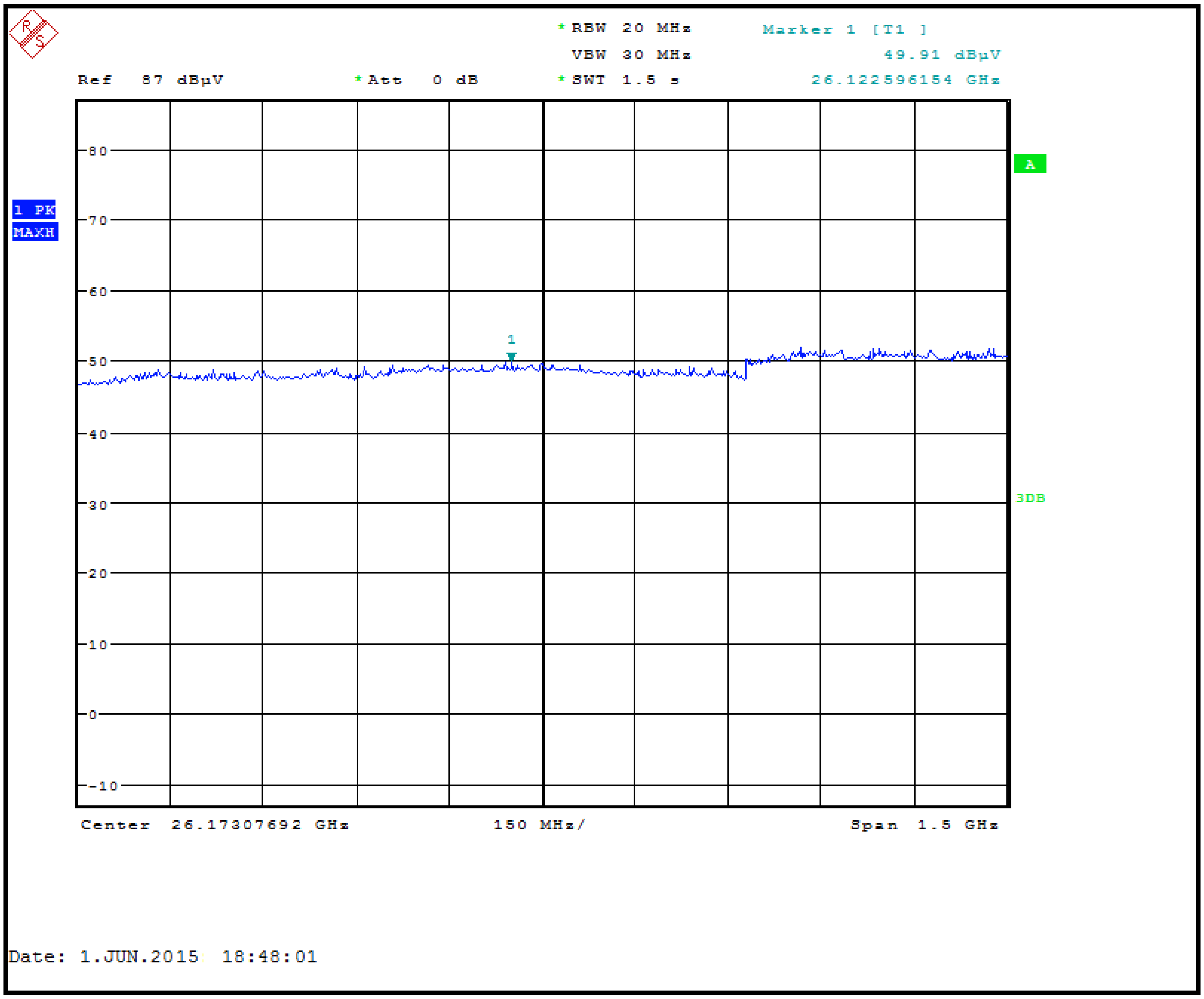


Table 4-11: Radiated Fundamental Emissions Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901581	Rohde & Schwarz	FSU	Spectrum Analyzer	1166.1660.50	11/13/16
901218	EMCO	3160-09	Horn Antenna (18-26.5 GHz)	960281-003	4/19/16
900874	Continental Microwave & Tool	RA42-K-F-4B-C	Waveguide (18-26.5 GHz)	990706-002	1/23/16

Test Personnel:

Test Engineer	Signature	Date of Test
Dan Baltzell		June 1, 2015

4.3 Radiated Emissions – ANSI C63.10 6.3, FCC 14-2 (15.256(h)(k)); RSS-Gen 4.9

4.4 Radiated Emissions Harmonics/Spurious Test Procedure - FCC 14-2 (15.256(h)(k)); RSS-Gen 4.9

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.

4.5.1 Test Configuration #1

Plot 4-11: Radiated Spurious Emissions (Second Harmonic) (TC #1)

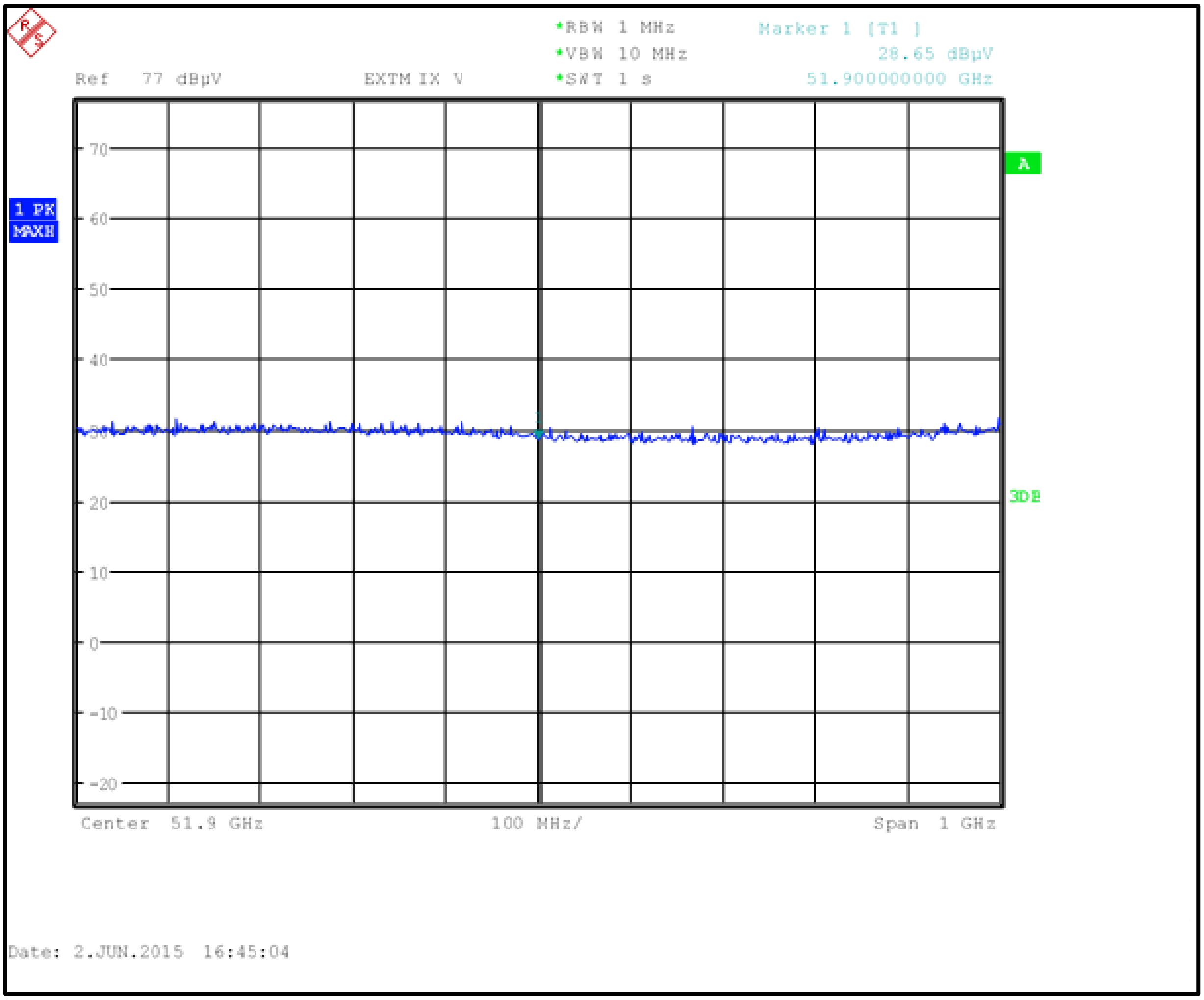


Table 4-12: Radiated Second Harmonic Noise Floor Calculation (TC #1)

Frequency (GHz)	EIRP Measured (dBuV)	Test Antenna Gain (dBi)	Correction from .001m to 3m (dB)	Corrected Measurement (dBuV/m)	Limit (dBuV/m)	Margin (dB)
51.9	28.7	22.5	-49.5	1.7	54.0	-52.3

Plot 4-12: Radiated Spurious Emissions (Third Harmonic) (TC #1)

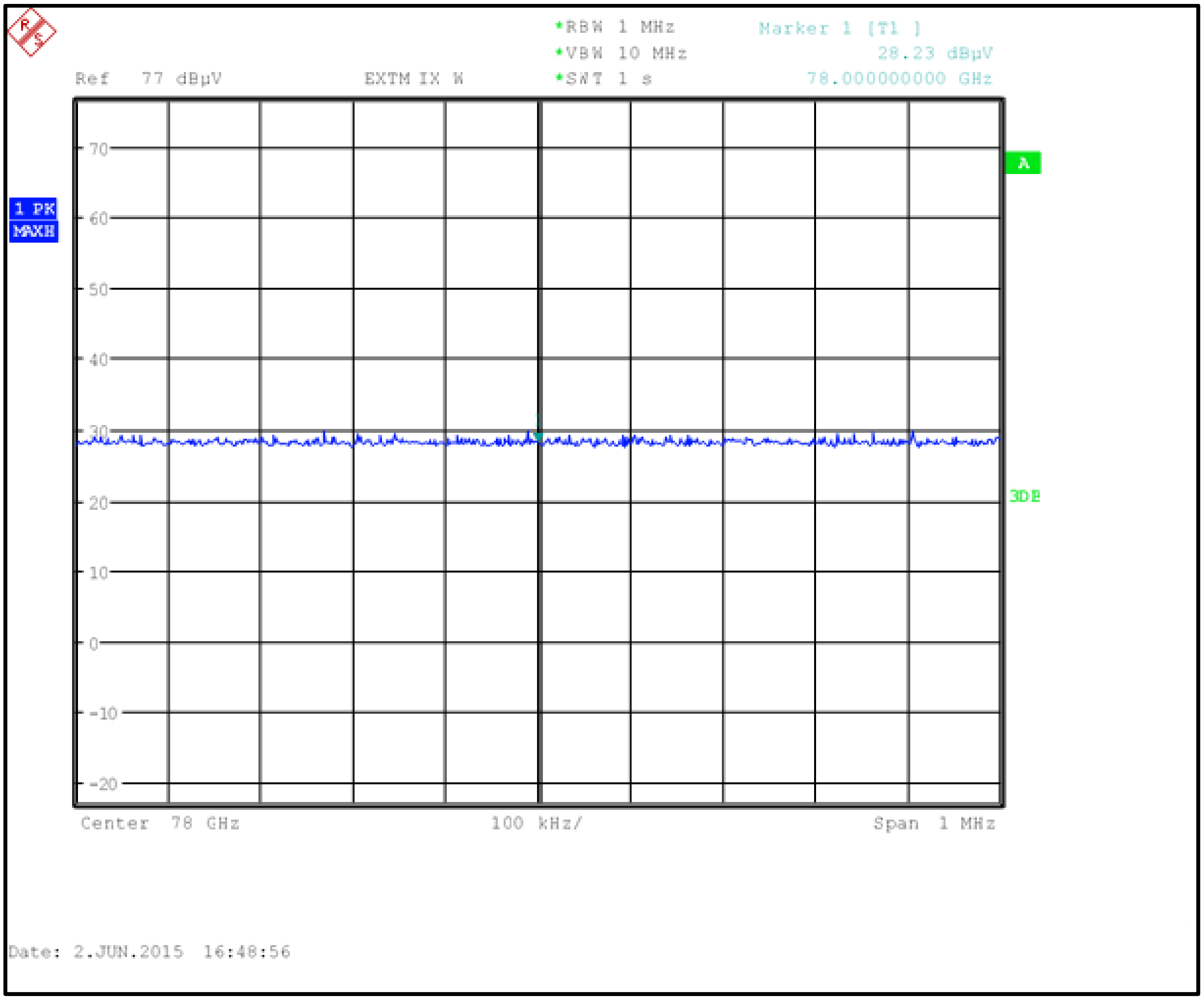


Table 4-13: Radiated Third Harmonic Noise Floor Calculation (TC #1)

Frequency (GHz)	EIRP Measured (dBuV)	Test Antenna Gain (dBi)	Correction from .01m to 3m (dB)	Corrected Measurement (dBuV/m)	Limit (dBuV/m)	Margin (dB)
78.0	28.2	22.5	-49.5	1.2	54.0	-52.8

Plot 4-13: Radiated Spurious Emissions (Fourth Harmonic) (TC #1)

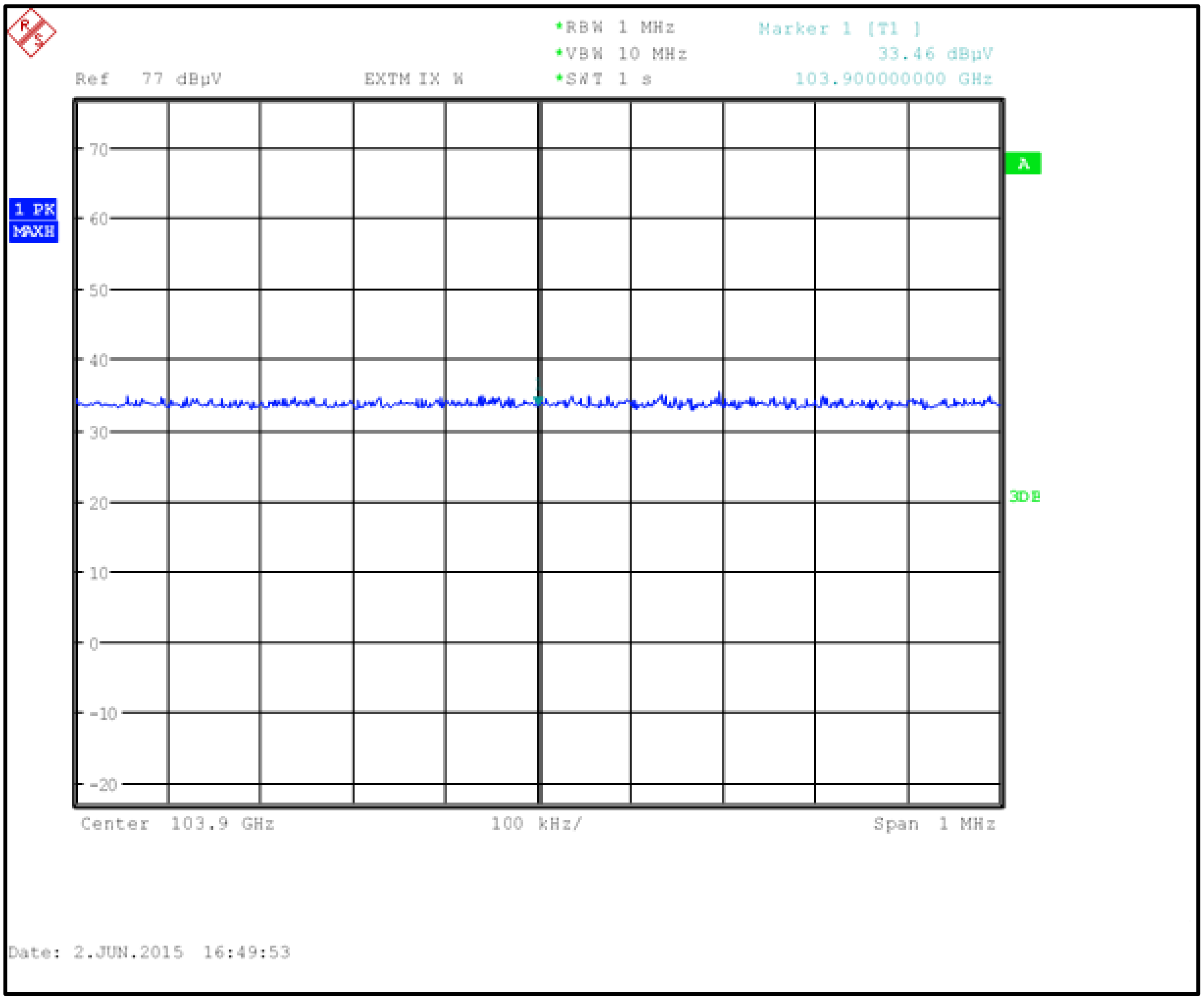


Table 4-14: Radiated Fourth Harmonic Noise Floor Calculation (TC #1)

Frequency (GHz)	EIRP Measured (dBuV)	Test Antenna Gain (dBi)	Correction from .001m to 3m (dB)	Corrected Measurement (dBuV/m)	Limit (dBuV/m)	Margin (dB)
103.9	33.5	23.2	-49.5	7.2	54.0	-46.8

Plot 4-14: Radiated Spurious Emissions (50 GHz – 75 GHz) (TC #1)

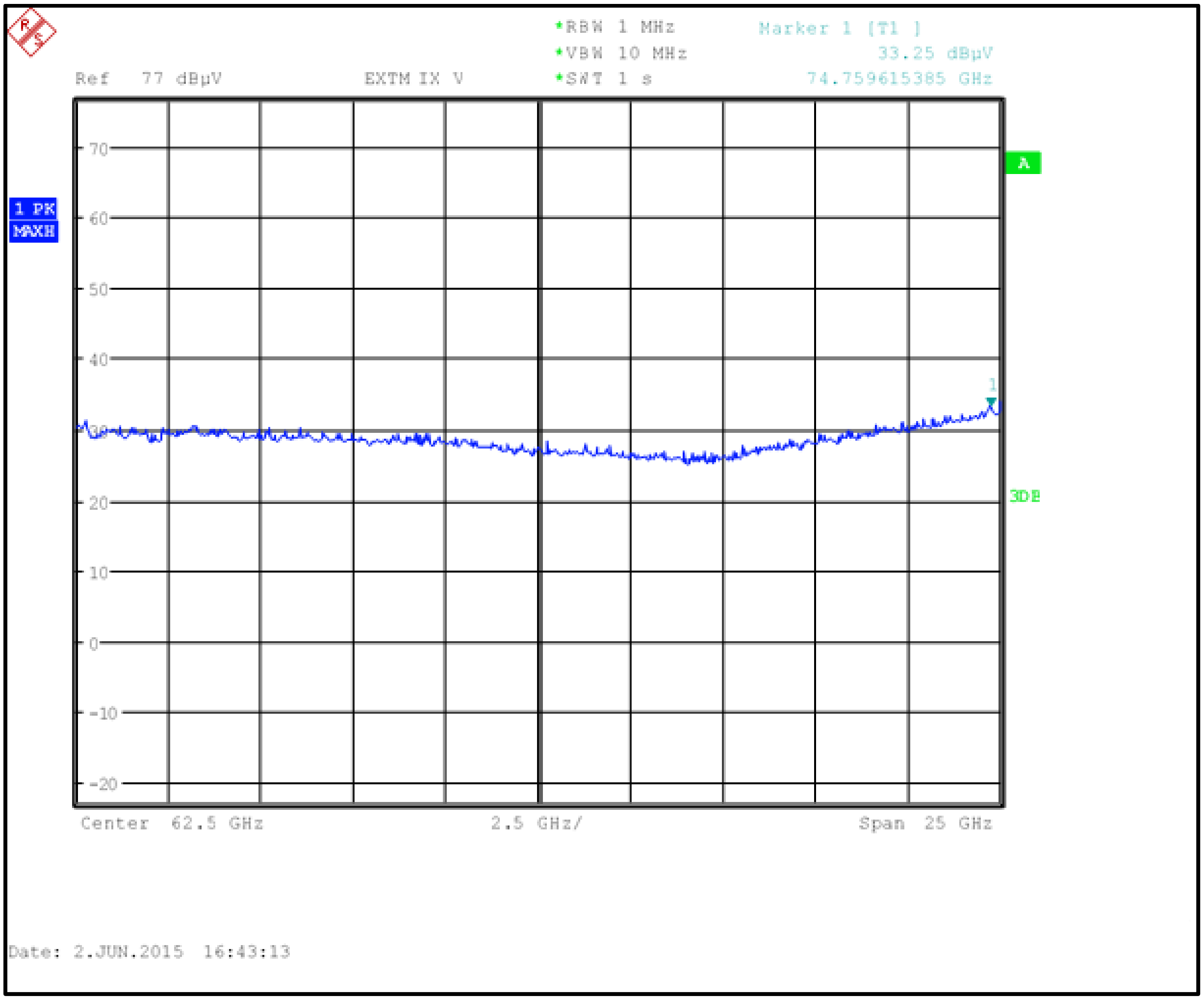


Table 4-15: Radiated Noise Floor Calculation (50 GHz – 75 GHz) (TC #1)

Frequency (GHz)	EIRP Measured (dBuV)	Test Antenna Gain (dBi)	Correction from .001m to 3m (dB)	Corrected Measurement (dBuV/m)	Limit (dBuV/m)	Margin (dB)
74.8 (worst case)	33.3	23.4	-49.5	7.2	54.0	-46.8

Plot 4-15: Radiated Spurious Emissions (75 GHz - 110 GHz) (TC #1)

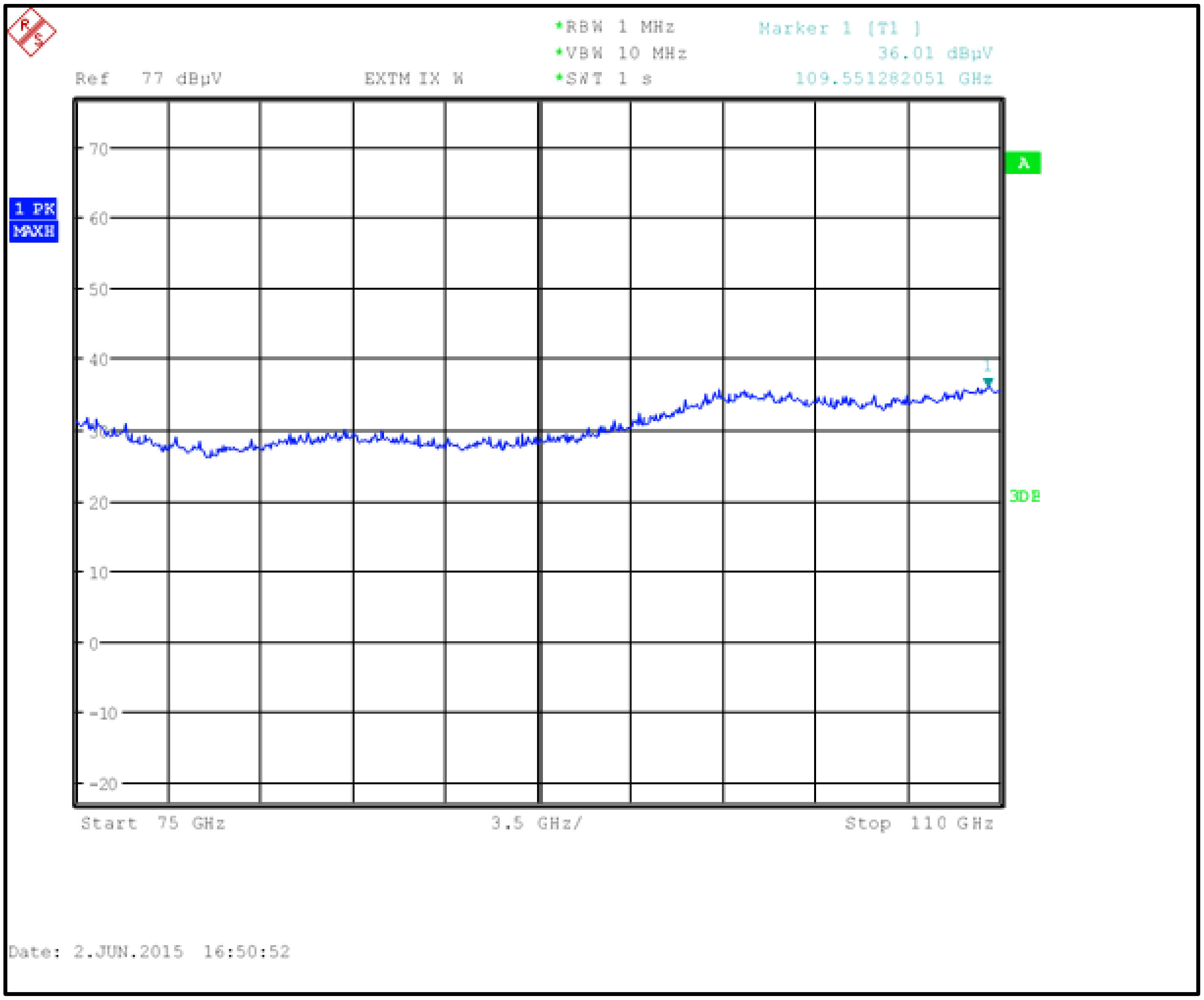


Table 4-16: Radiated Noise Floor Calculation (75 GHz – 110 GHz) (TC #1)

Frequency (GHz)	EIRP Measured (dBuV)	Test Antenna Gain (dBi)	Correction from .001m to 3m (dB)	Corrected Measurement (dBuV/m)	Limit (dBuV/m)	Margin (dB)
109.6 (worst case)	36.0	23.4	-49.5	9.9	54.0	-44.1

4.5.2 Test Configuration #3

Plot 4-16: Radiated Spurious Emissions (Second Harmonic) (TC #3)

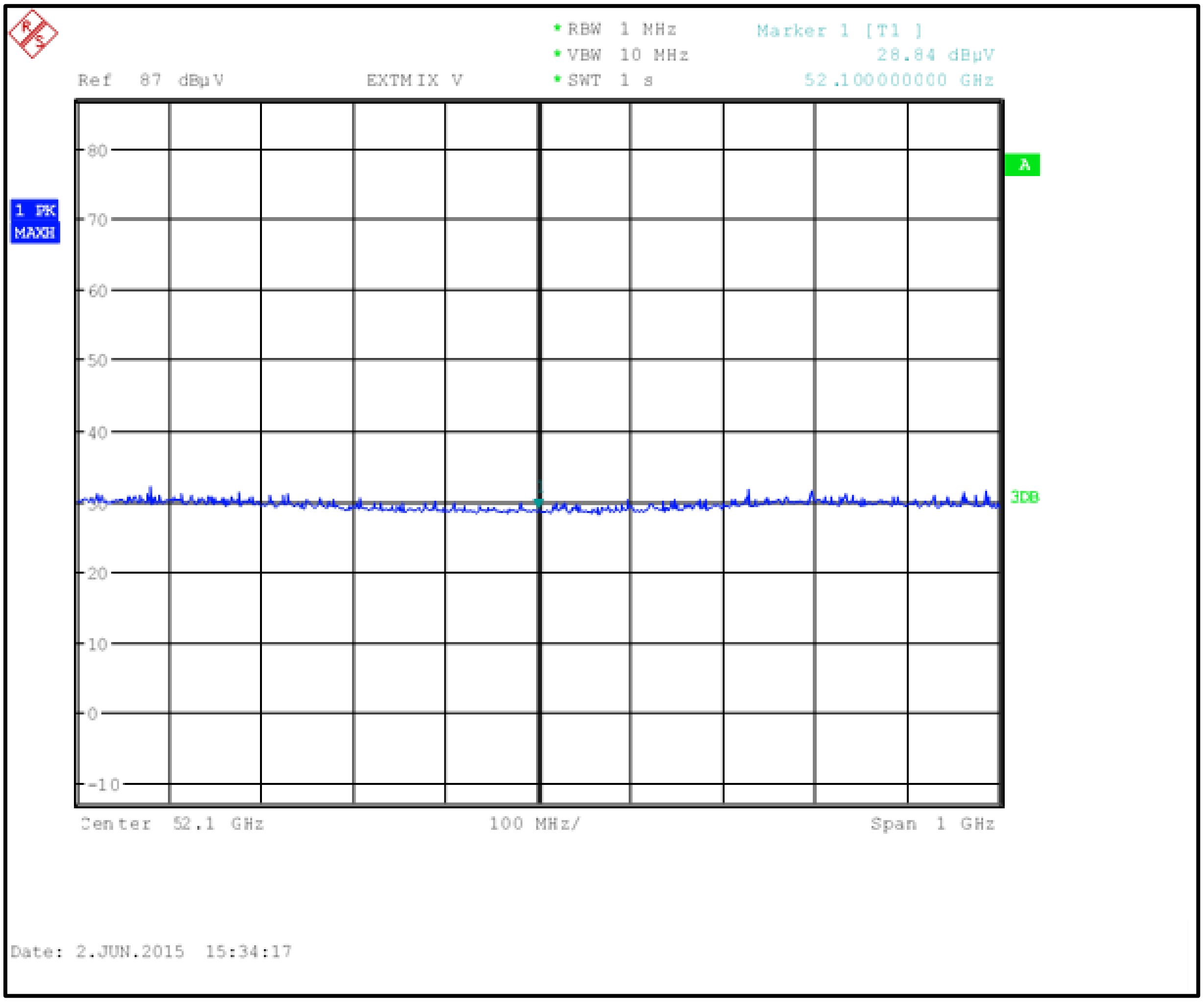


Table 4-17: Radiated Second Harmonic Noise Floor Calculation (TC #3)

Frequency (GHz)	EIRP Measured (dBuV)	Test Antenna Gain (dBi)	Correction from .001m to 3m (dB)	Corrected Measurement (dBuV/m)	Limit (dBuV/m)	Margin (dB)
52.1	28.8	22.5	-49.5	1.8	54.0	-52.2

Plot 4-17: Radiated Spurious Emissions (Third Harmonic) (TC #3)

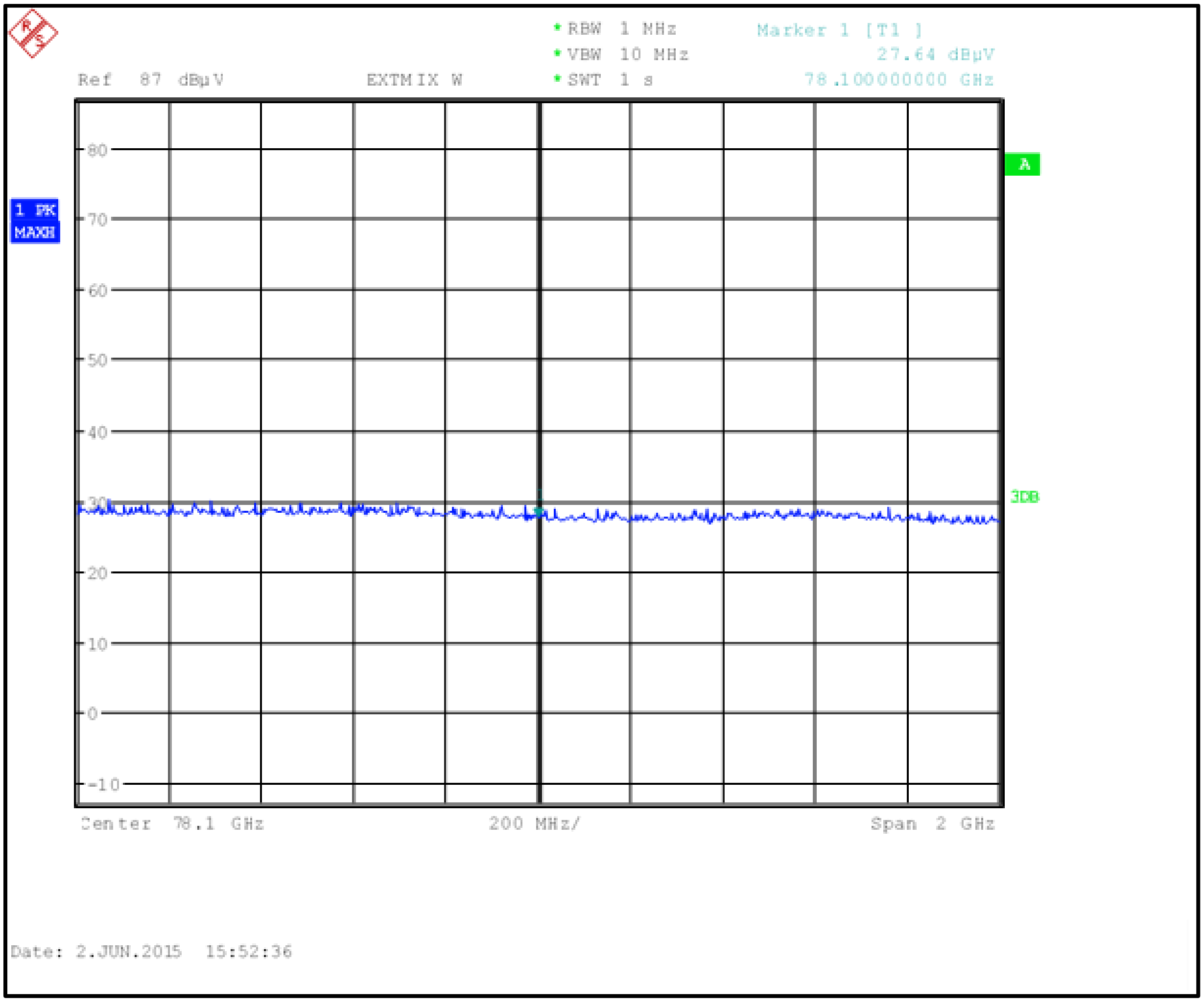


Table 4-18: Radiated Third Harmonic Noise Floor Calculation (TC #3)

Frequency (GHz)	EIRP Measured (dBuV)	Test Antenna Gain (dBi)	Correction from .001m to 3m (dB)	Corrected Measurement (dBuV/m)	Limit (dBuV/m)	Margin (dB)
78.1	27.6	22.5	-49.5	0.6	54.0	-53.4

Plot 4-18: Radiated Spurious Emissions (Fourth Harmonic) (TC #3)

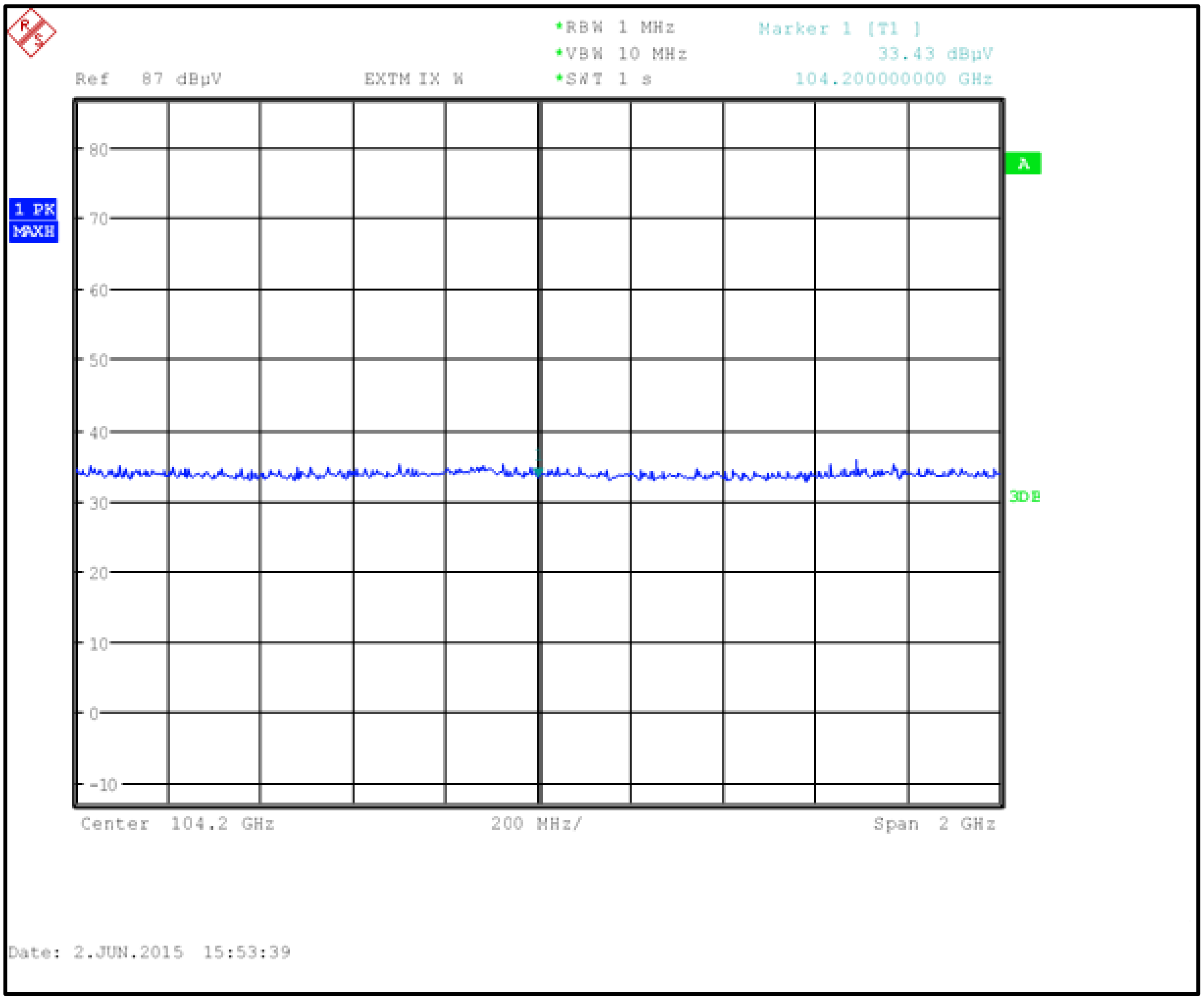


Table 4-19: Radiated Fourth Harmonic Noise Floor Calculation (TC #3)

Frequency (GHz)	EIRP Measured (dBuV)	Test Antenna Gain (dBi)	Correction from .001m to 3m (dB)	Corrected Measurement (dBuV/m)	Limit (dBuV/m)	Margin (dB)
104.2	33.4	23.2	-49.5	7.1	54.0	-46.9

Plot 4-19: Radiated Spurious Emissions (50 GHz – 75 GHz) (TC #3)

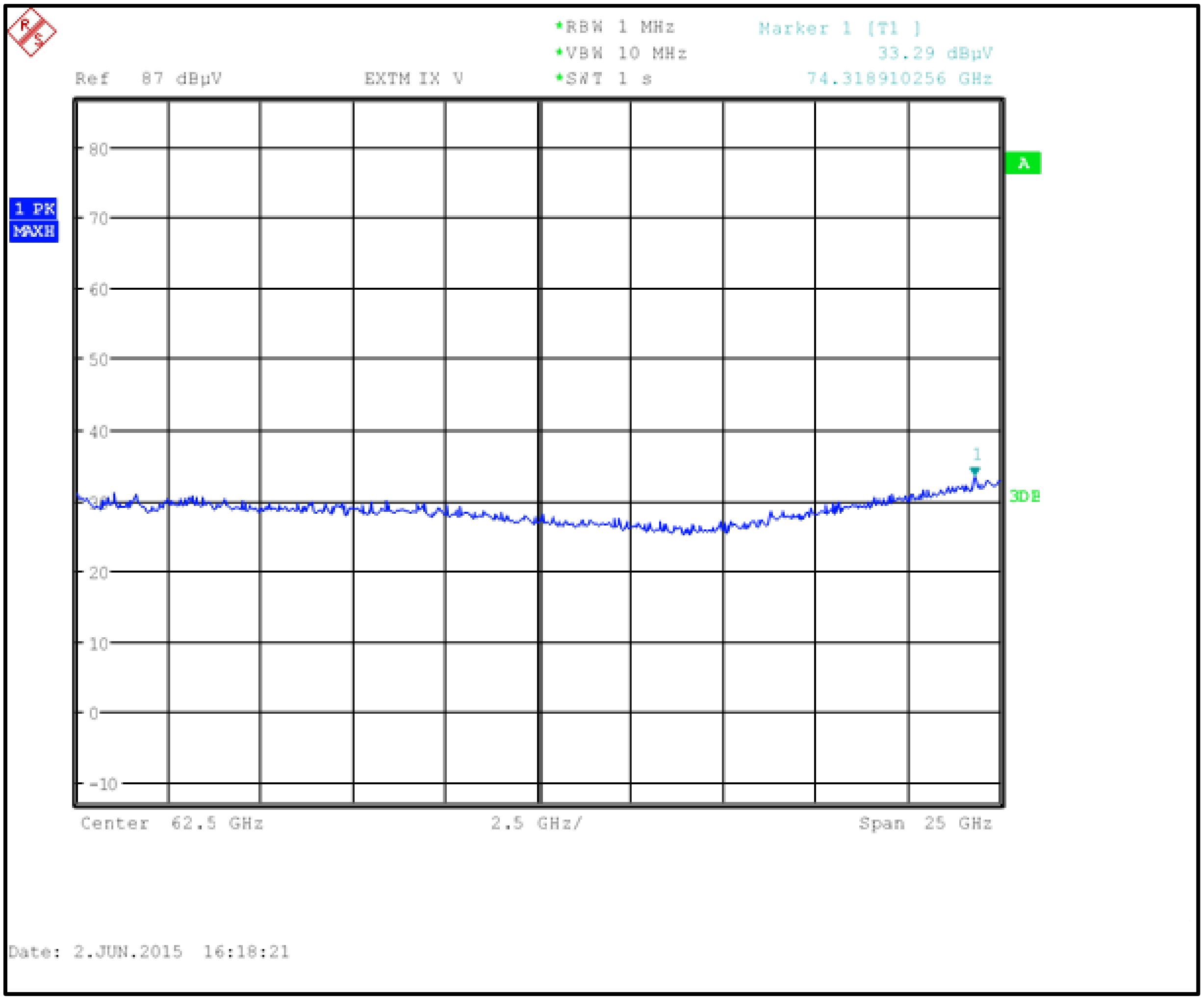


Table 4-20: Radiated Noise Floor Calculation (50 GHz – 75 GHz) (TC #3)

Frequency (GHz)	EIRP Measured (dBuV)	Test Antenna Gain (dBi)	Correction from .001m to 3m (dB)	Corrected Measurement (dBuV/m)	Limit (dBuV/m)	Margin (dB)
74.3 (worst case)	33.3	23.4	-49.5	7.2	54.0	-46.8

Plot 4-20: Radiated Spurious Emissions (75 GHz - 110 GHz) (TC #3)

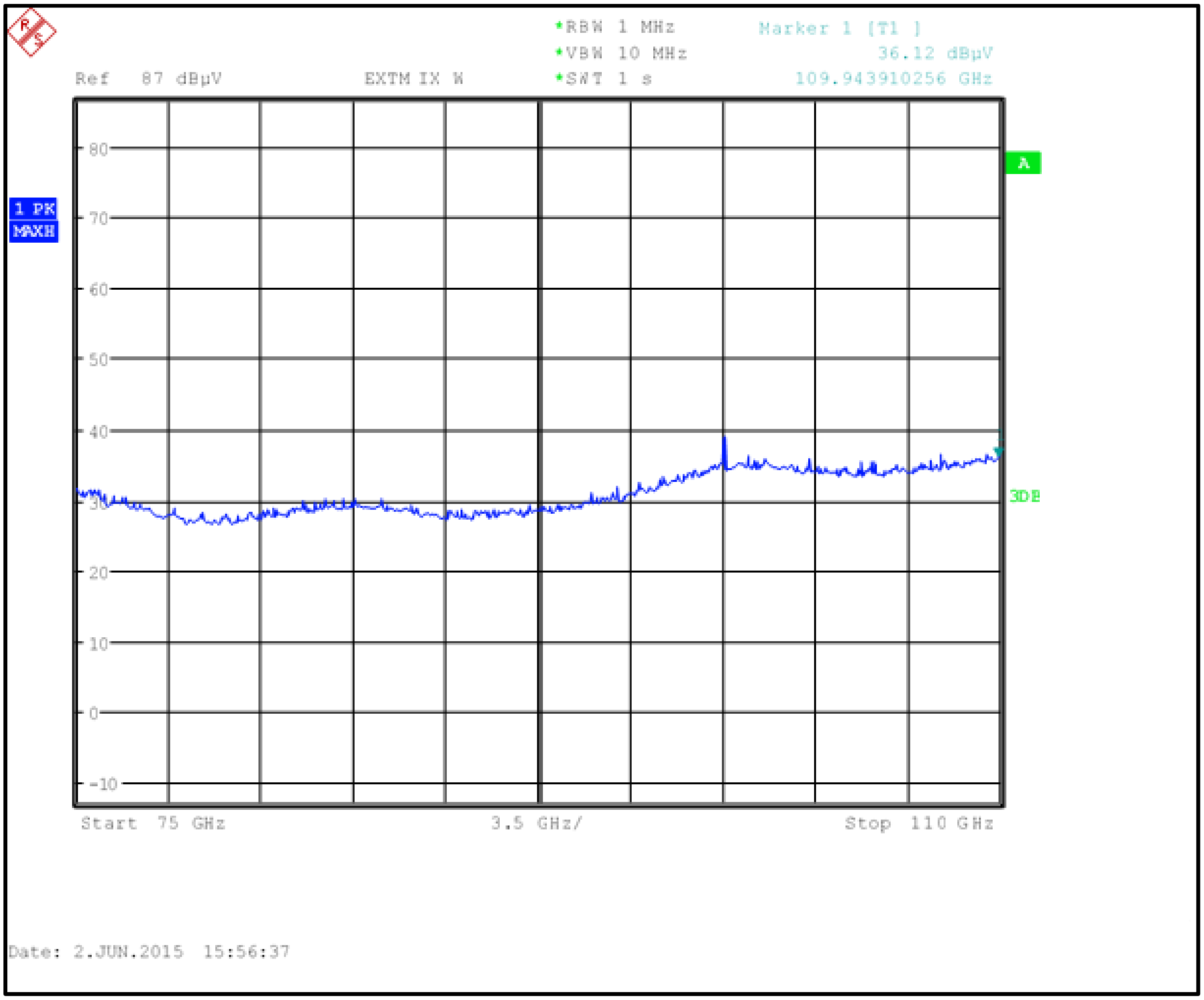


Table 4-21: Radiated Noise Floor Calculation (75 GHz – 110 GHz) (TC #3)

Frequency (GHz)	EIRP Measured (dBuV)	Test Antenna Gain (dBi)	Correction from .001m to 3m (dB)	Corrected Measurement (dBuV/m)	Limit (dBuV/m)	Margin (dB)
109.9 (worst case)	36.1	23.4	-49.5	10.0	54.0	-44.0

4.5.3 Test Configuration #5

Plot 4-21: Radiated Spurious Emissions (Second Harmonic) (TC #5)

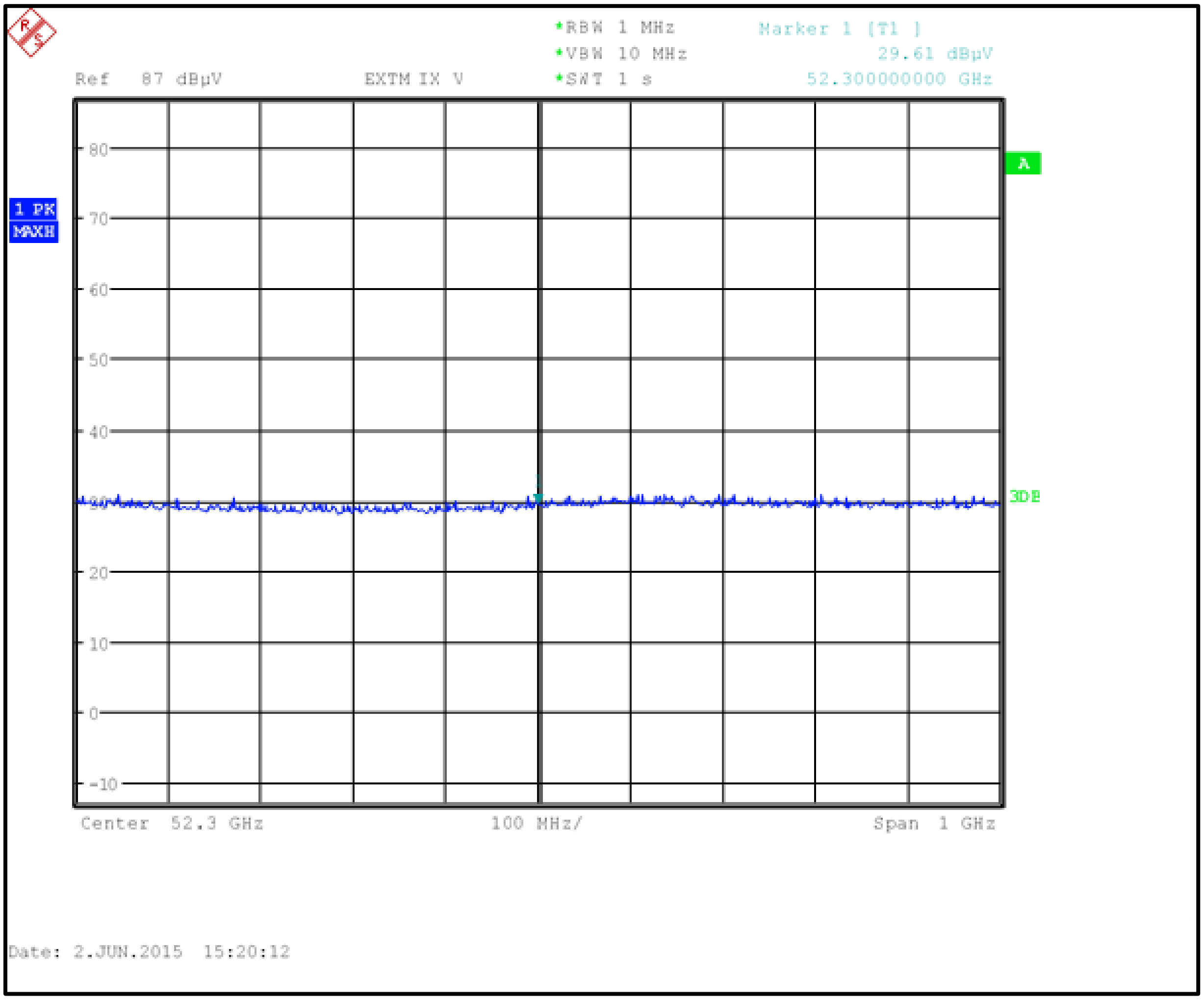


Table 4-22: Radiated Second Harmonic Noise Floor Calculation (TC #5)

Frequency (GHz)	EIRP Measured (dBuV)	Test Antenna Gain (dBi)	Correction from .001m to 3m (dB)	Corrected Measurement (dBuV/m)	Limit (dBuV/m)	Margin (dB)
52.3	29.6	22.5	-49.5	2.6	54.0	-51.4

Plot 4-22: Radiated Spurious Emissions (Third Harmonic) (TC #5)

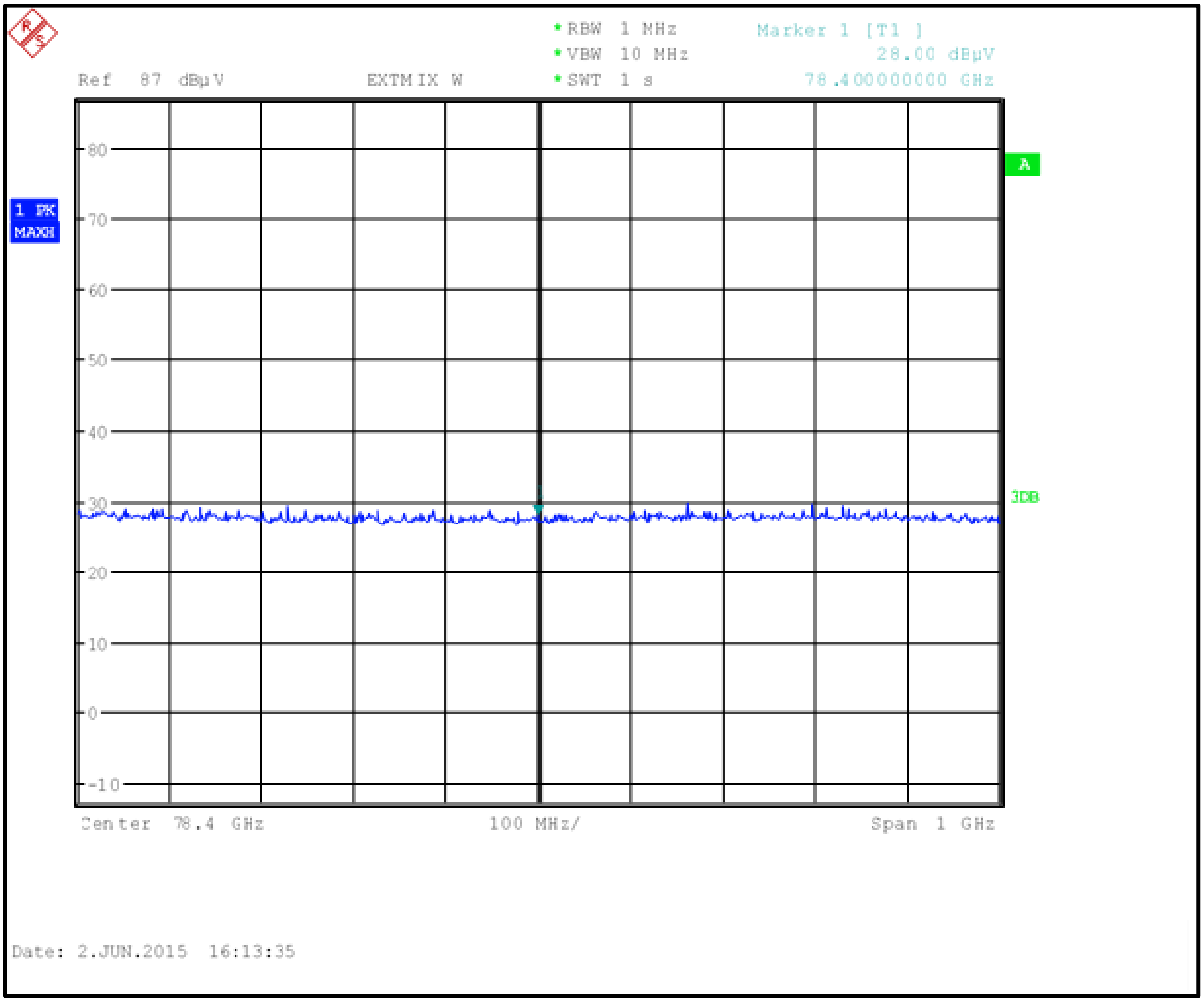


Table 4-23: Radiated Third Harmonic Noise Floor Calculation (TC #5)

Frequency (GHz)	EIRP Measured (dBuV)	Test Antenna Gain (dBi)	Correction from .001m to 3m (dB)	Corrected Measurement (dBuV/m)	Limit (dBuV/m)	Margin (dB)
78.4	28.0	22.5	-49.5	1.0	54.0	-53.0

Plot 4-23: Radiated Spurious Emissions (Fourth Harmonic) (TC #5)

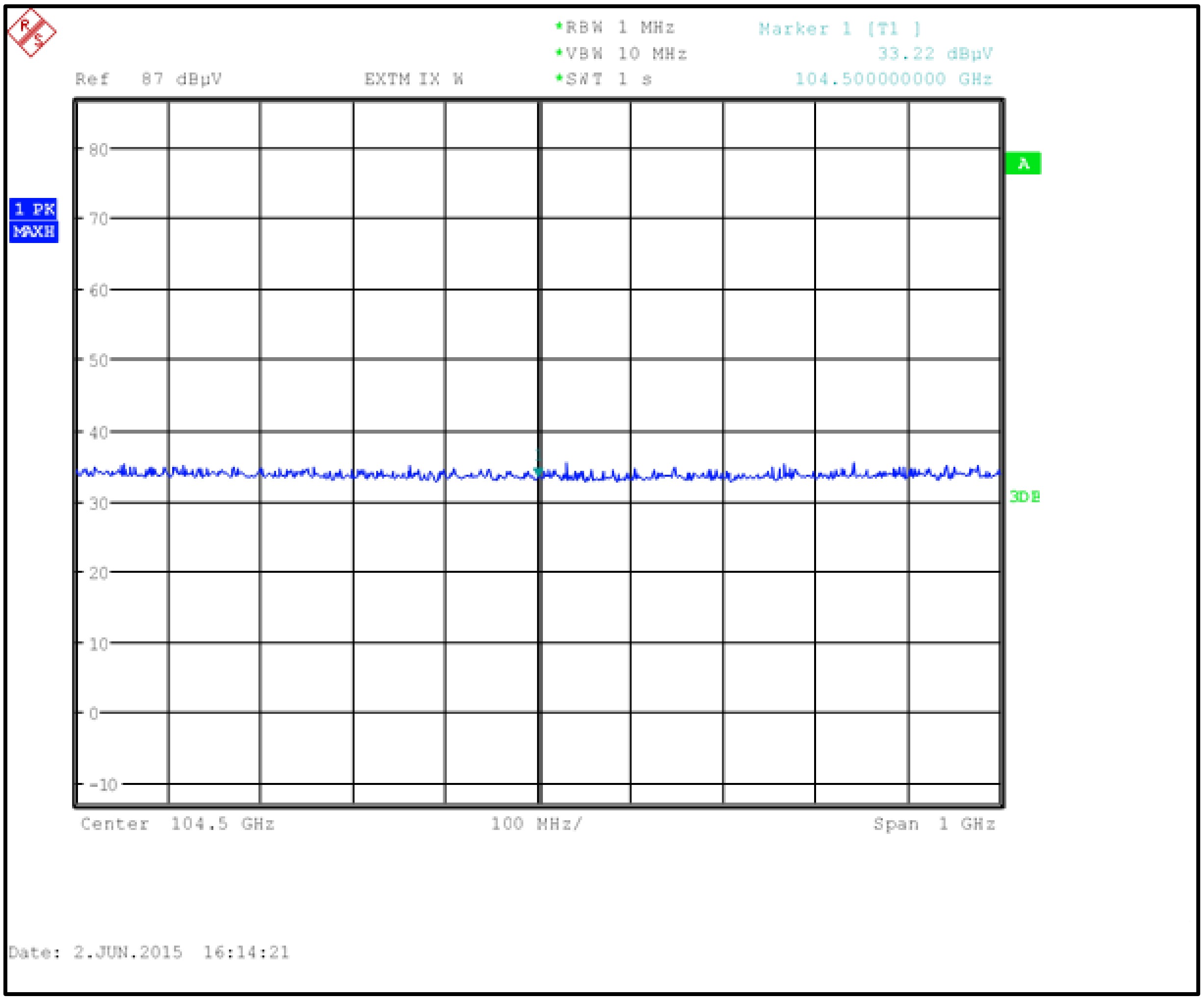


Table 4-24: Radiated Fourth Harmonic Noise Floor Calculation (TC #5)

Frequency (GHz)	EIRP Measured (dBuV)	Test Antenna Gain (dBi)	Correction from .001m to 3m (dB)	Corrected Measurement (dBuV/m)	Limit (dBuV/m)	Margin (dB)
104.5	33.2	23.2	-49.5	6.9	54.0	-47.1

Plot 4-24: Radiated Spurious Emissions (50 GHz – 75 GHz) (TC #5)

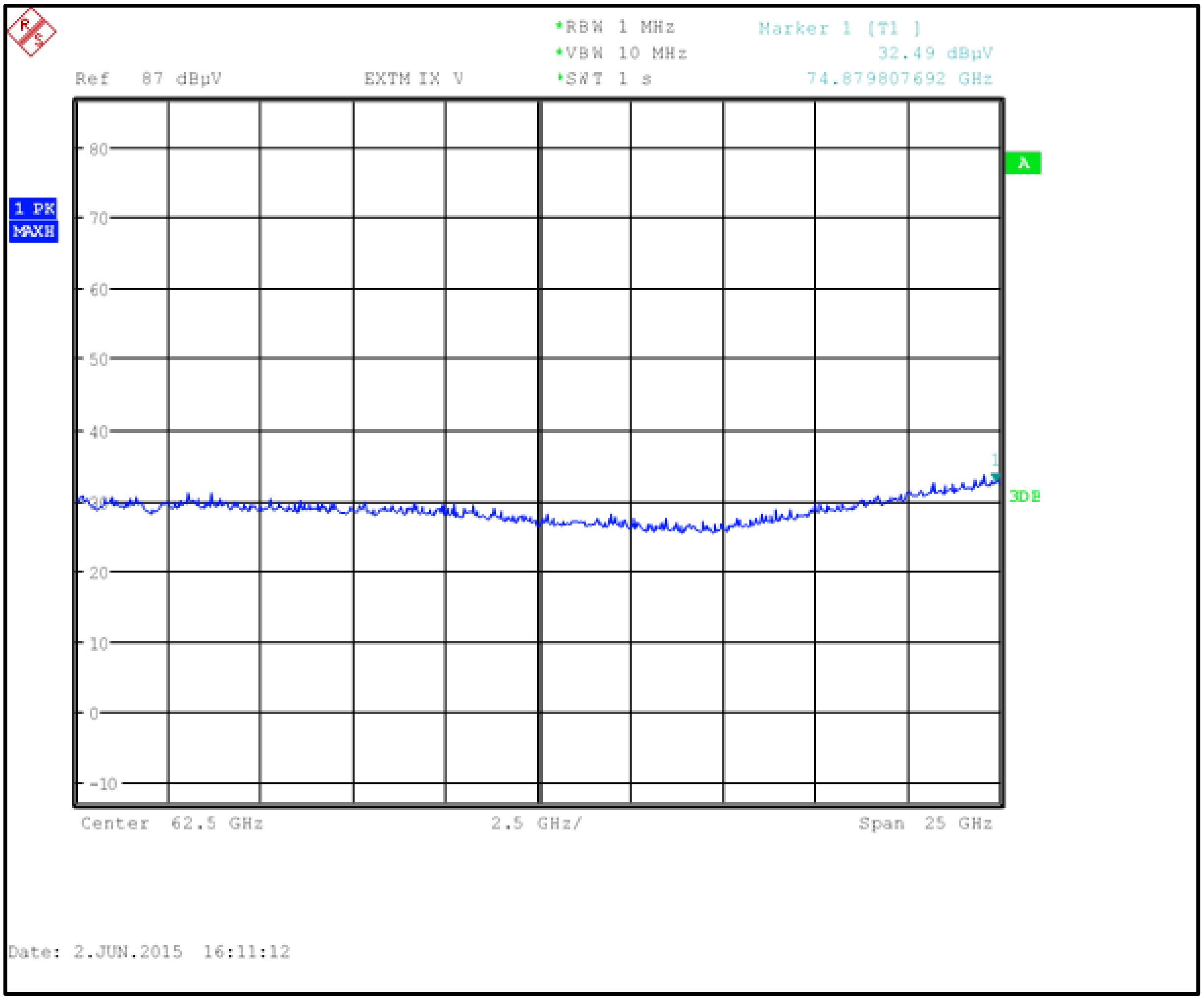


Table 4-25: Radiated Noise Floor Calculation (50 GHz – 75 GHz) (TC #5)

Frequency (GHz)	EIRP Measured (dBuV)	Test Antenna Gain (dBi)	Correction from .001m to 3m (dB)	Corrected Measurement (dBuV/m)	Limit (dBuV/m)	Margin (dB)
74.9 (worst case)	32.5	23.4	-49.5	6.4	54.0	-47.6

Plot 4-25: Radiated Spurious Emissions (75 GHz - 110 GHz) (TC #5)

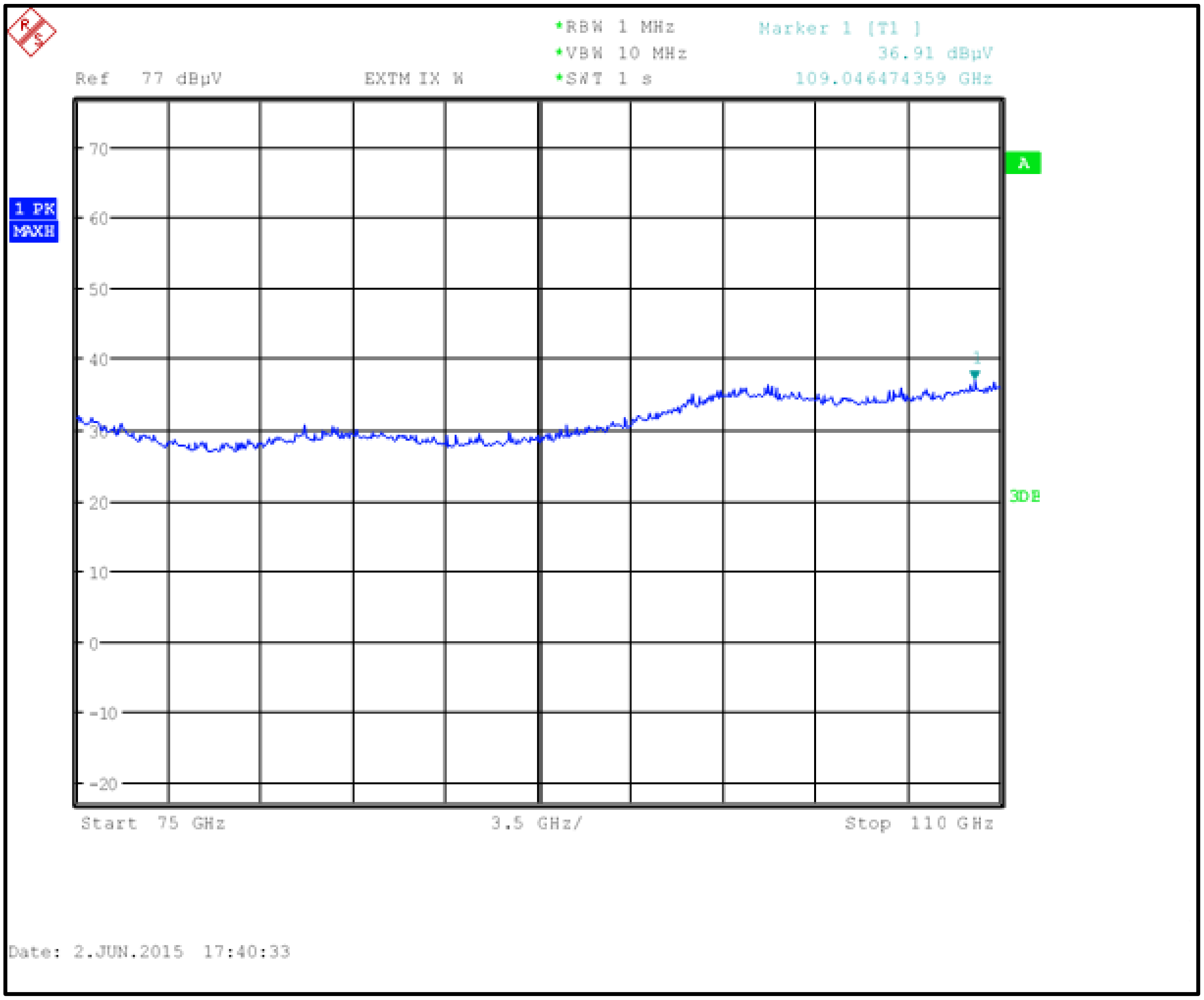


Table 4-26: Radiated Noise Floor Calculation (75 GHz – 110 GHz) (TC #5)

Frequency (GHz)	EIRP Measured (dBuV)	Test Antenna Gain (dBi)	Correction from .001m to 3m (dB)	Corrected Measurement (dBuV/m)	Limit (dBuV/m)	Margin (dB)
109.0 (worst case)	36.9	23.4	-49.5	10.8	54.0	-43.2

4.5.4 Test Configuration #7

Plot 4-26: Radiated Spurious Emissions (Second Harmonic) (TC #7)

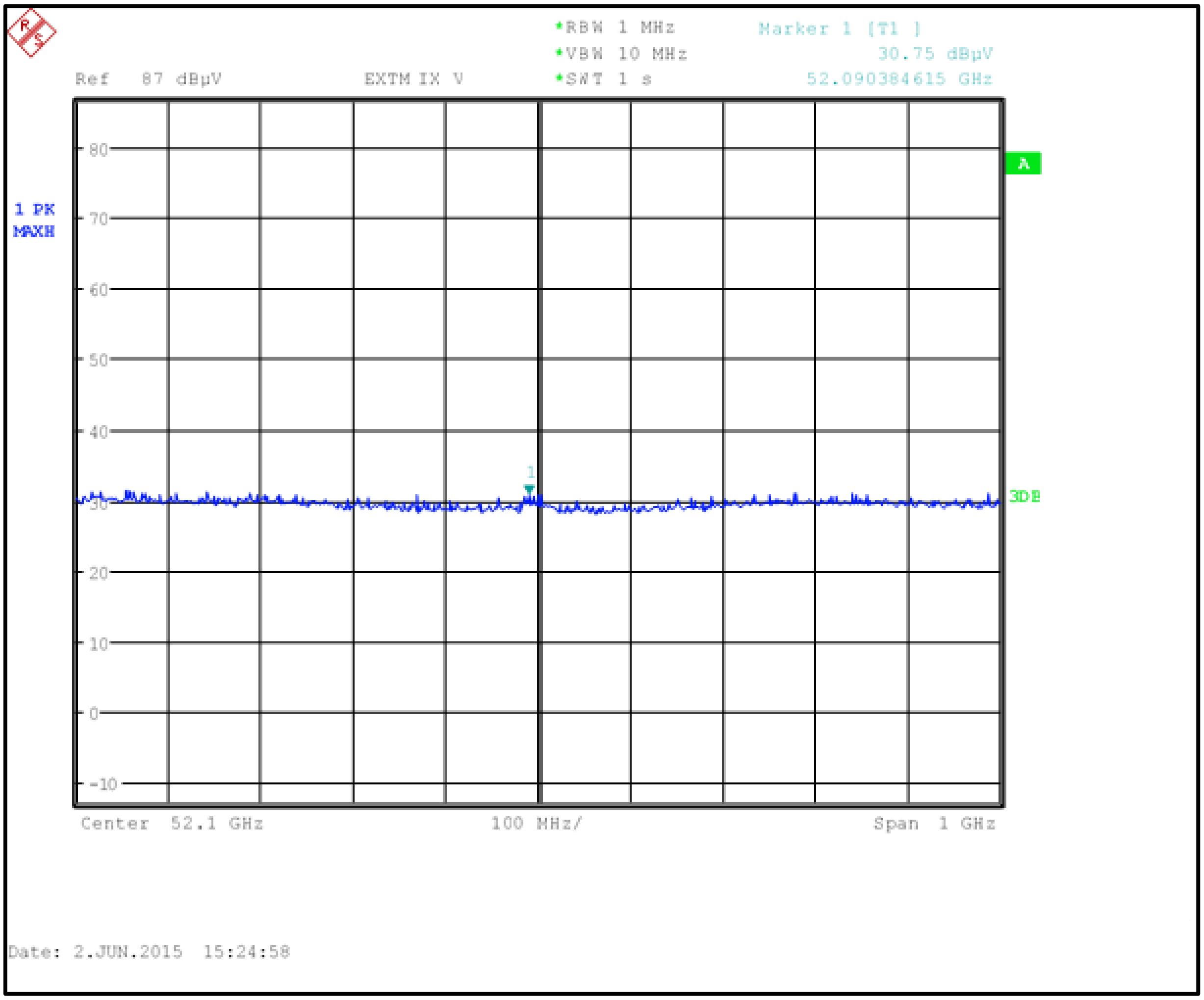


Table 4-27: Radiated Second Harmonic Noise Floor Calculation (TC #7)

Frequency (GHz)	EIRP Measured (dBuV)	Test Antenna Gain (dBi)	Correction from .001m to 3m (dB)	Corrected Measurement (dBuV/m)	Limit (dBuV/m)	Margin (dB)
52.1	30.8	22.5	-49.5	3.8	54.0	-50.2

Plot 4-27: Radiated Spurious Emissions (Third Harmonic) (TC #7)

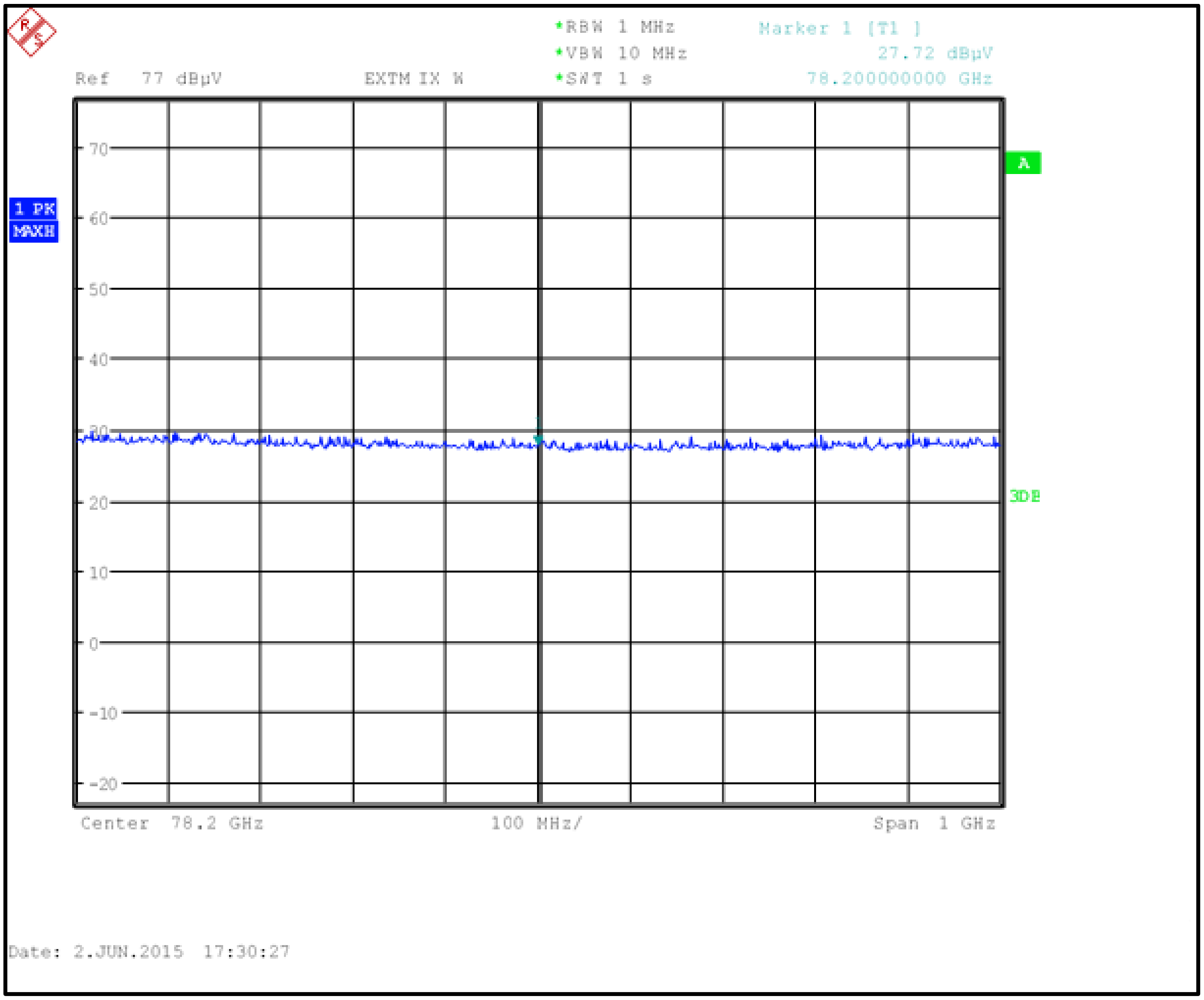


Table 4-28: Radiated Third Harmonic Noise Floor Calculation (TC #7)

Frequency (GHz)	EIRP Measured (dBuV)	Test Antenna Gain (dBi)	Correction from .001m to 3m (dB)	Corrected Measurement (dBuV/m)	Limit (dBuV/m)	Margin (dB)
78.2	27.7	22.5	-49.5	0.7	54.0	-53.3

Plot 4-28: Radiated Spurious Emissions (Fourth Harmonic) (TC #7)

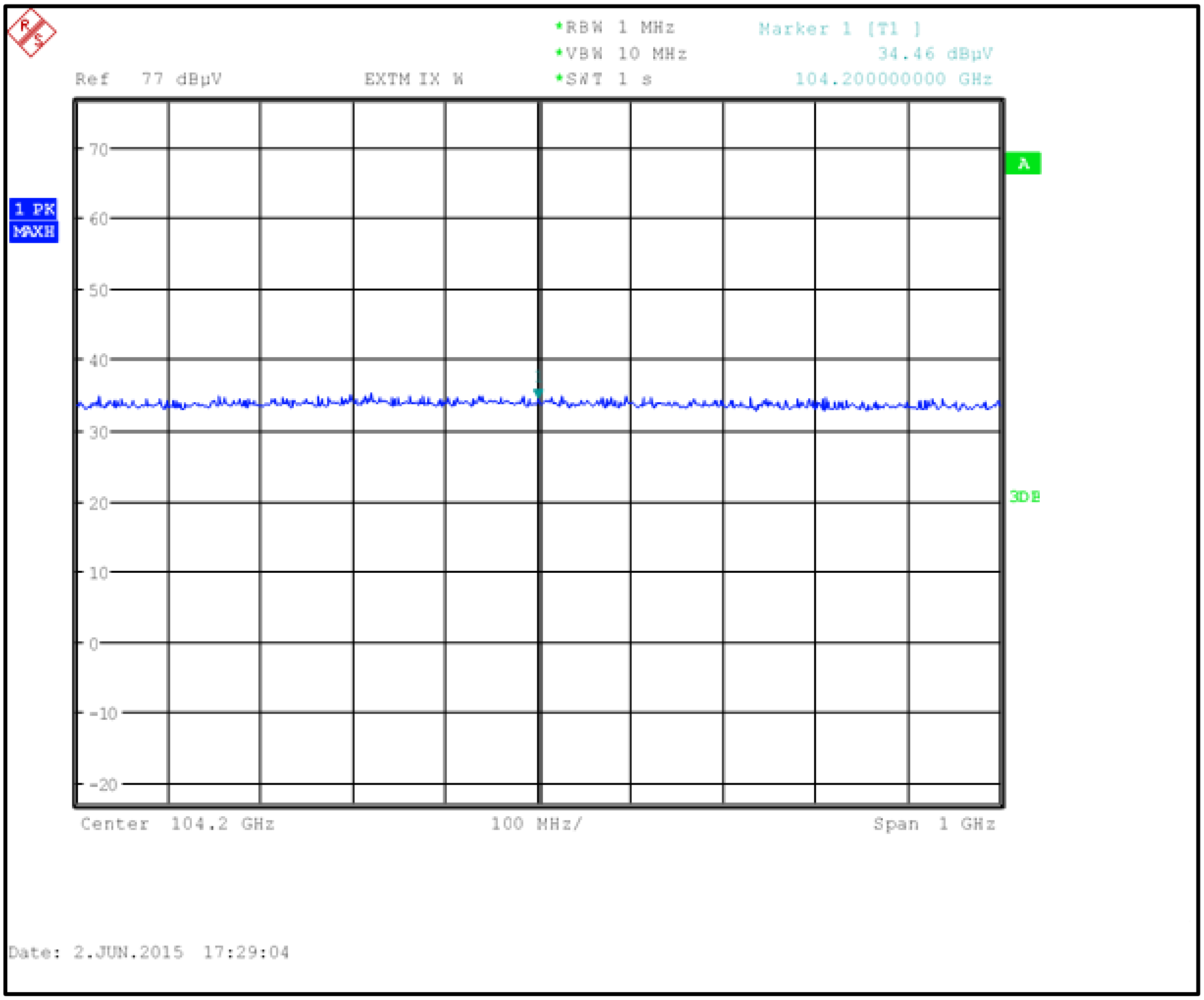


Table 4-29: Radiated Fourth Harmonic Noise Floor Calculation (TC #7)

Frequency (GHz)	EIRP Measured (dBuV)	Test Antenna Gain (dBi)	Correction from .001m to 3m (dB)	Corrected Measurement (dBuV/m)	Limit (dBuV/m)	Margin (dB)
104.2	34.5	23.2	-49.5	8.2	54.0	-45.8

Plot 4-29: Radiated Spurious Emissions (50 GHz – 75 GHz) (TC #7)

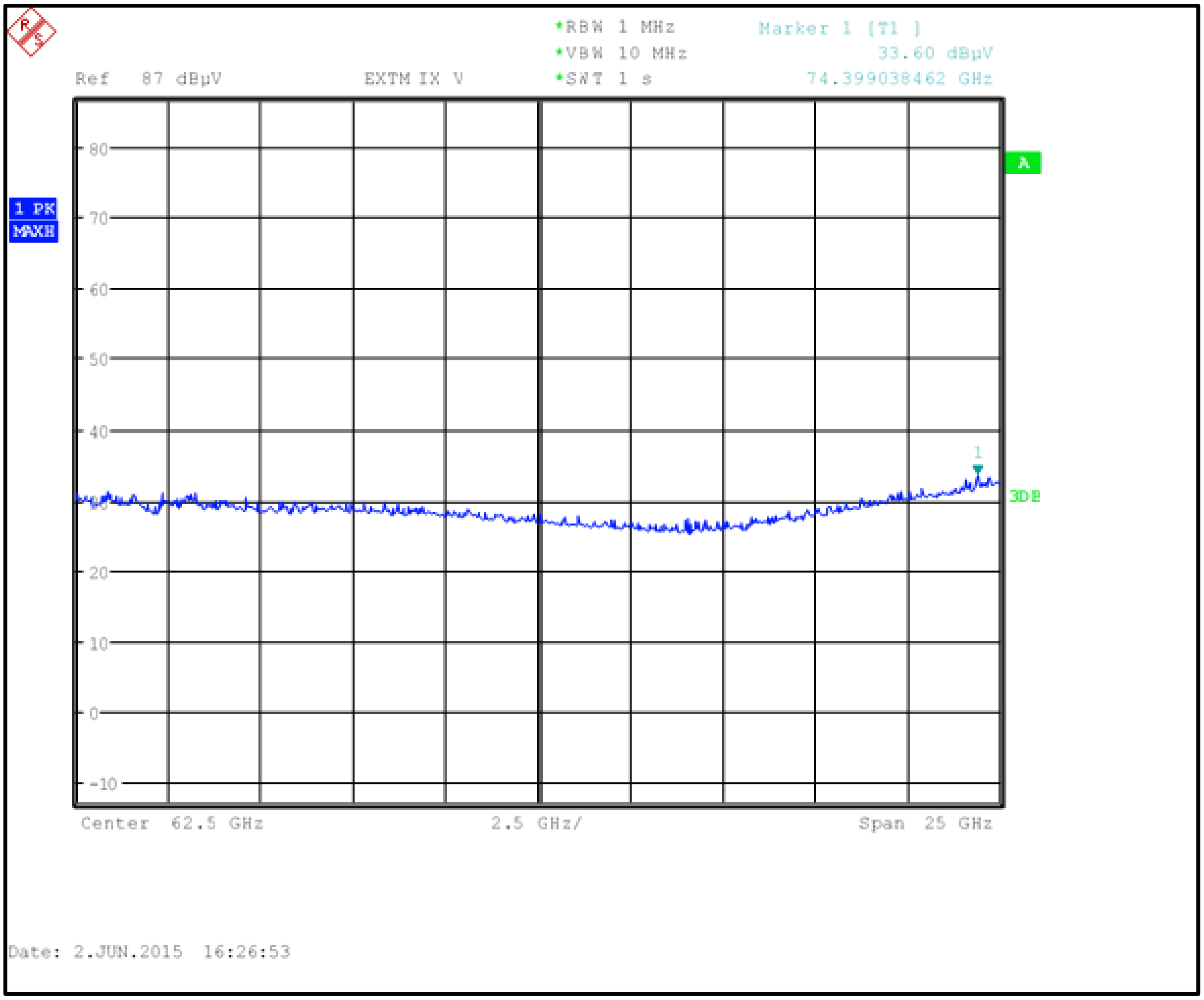


Table 4-30: Radiated Noise Floor Calculation (50 GHz – 75 GHz) (TC #7)

Frequency (GHz)	EIRP Measured (dBuV)	Test Antenna Gain (dBi)	Correction from .001m to 3m (dB)	Corrected Measurement (dBuV/m)	Limit (dBuV/m)	Margin (dB)
74.4 (worst case)	33.6	23.4	-49.5	7.5	54.0	-46.5

Plot 4-30: Radiated Spurious Emissions (75 GHz - 110 GHz) (TC #7)

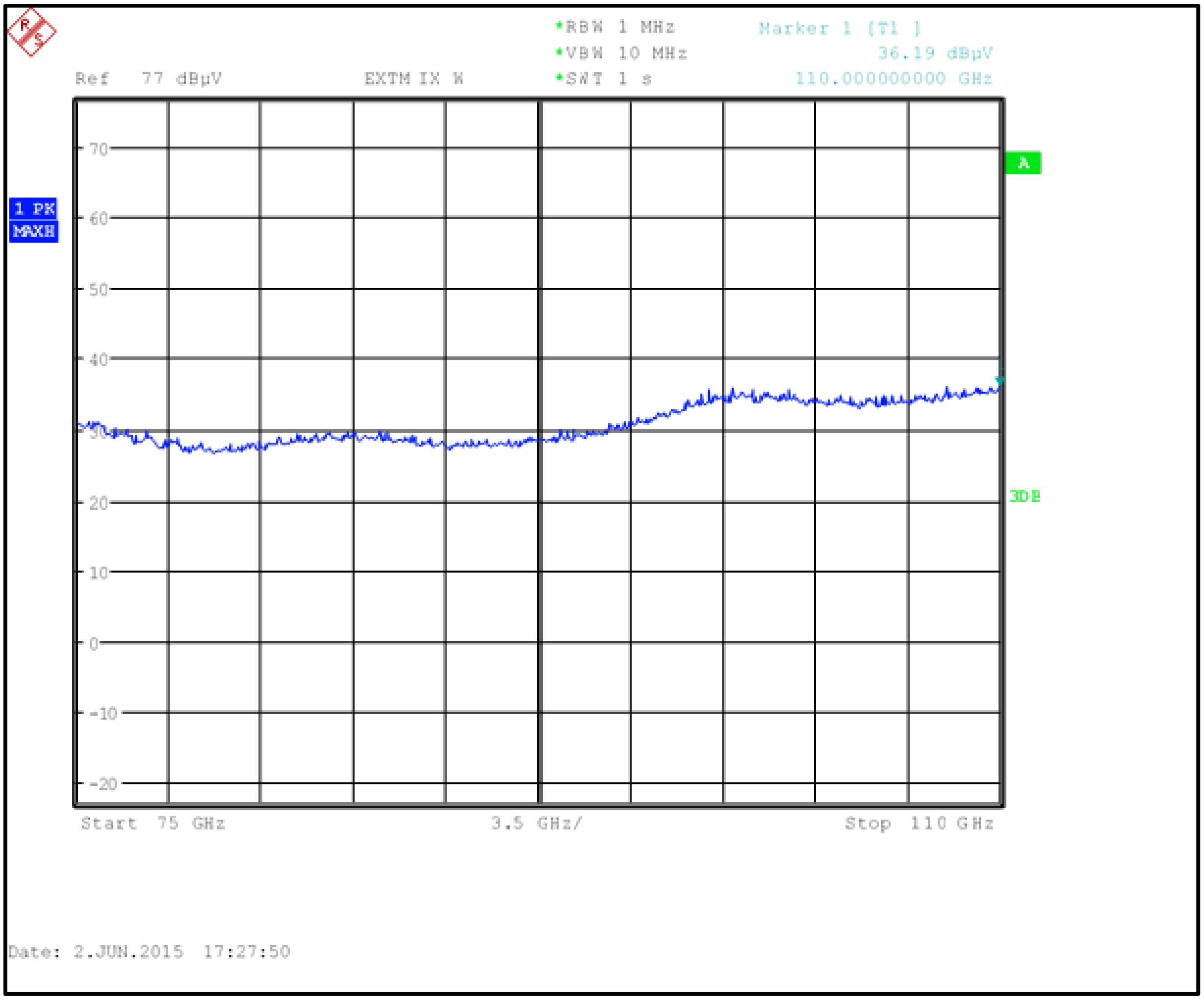


Table 4-31: Radiated Noise Floor Calculation (75 GHz – 110 GHz) (TC #7)

Frequency (GHz)	EIRP Measured (dBuV)	Test Antenna Gain (dBi)	Correction from .001m to 3m (dB)	Corrected Measurement (dBuV/m)	Limit (dBuV/m)	Margin (dB)
110.0 (worst case)	36.2	23.4	-49.5	10.1	54.0	-43.9

4.5.5 Test Configuration #9

Plot 4-31: Radiated Spurious Emissions (Second Harmonic) (TC #9)

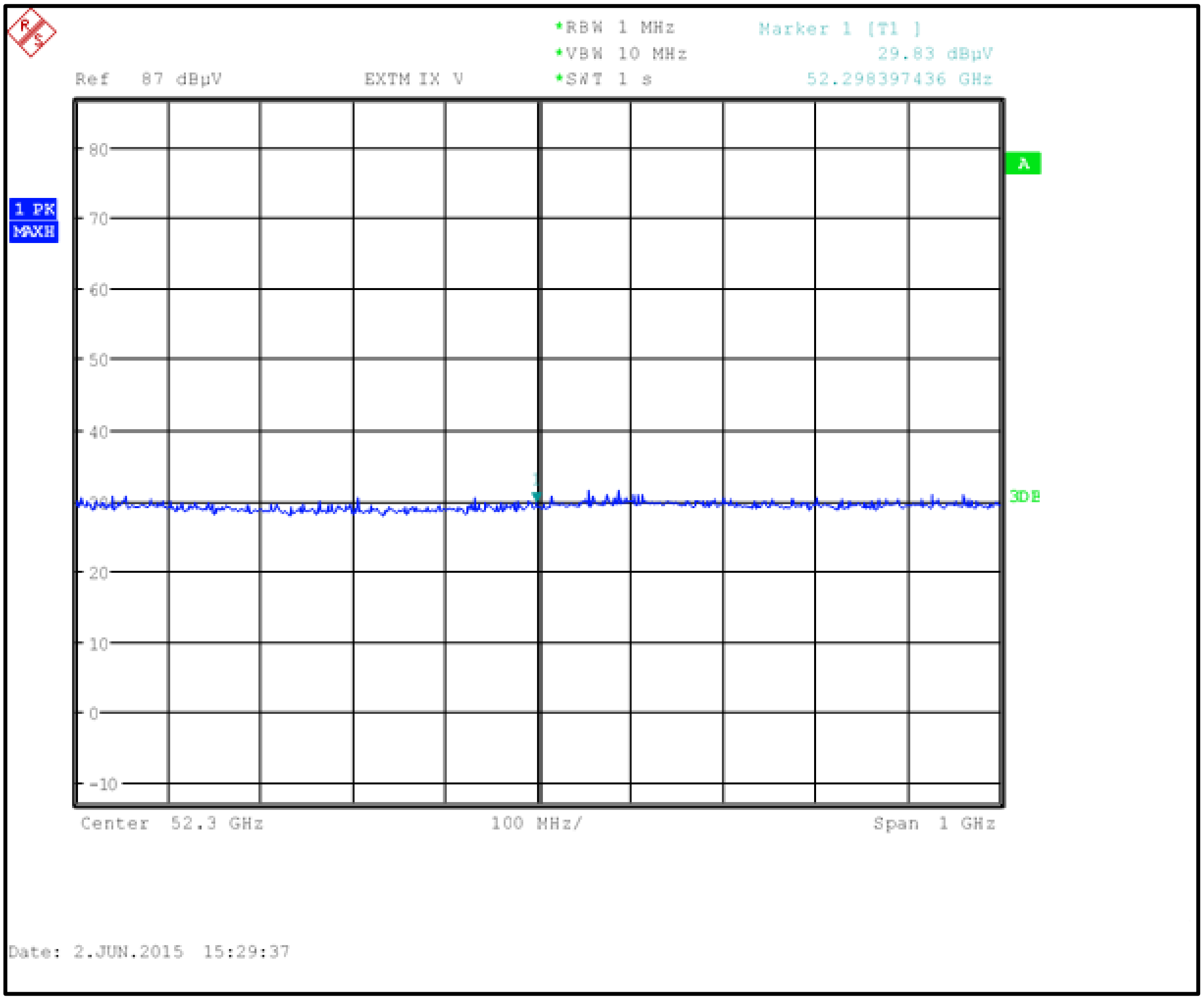


Table 4-32: Radiated Second Harmonic Noise Floor Calculation (TC #9)

Frequency (GHz)	EIRP Measured (dBuV)	Test Antenna Gain (dBi)	Correction from .001m to 3m (dB)	Corrected Measurement (dBuV/m)	Limit (dBuV/m)	Margin (dB)
52.3	29.8	22.5	-49.5	2.8	54.0	-51.2

Plot 4-32: Radiated Spurious Emissions (Third Harmonic) (TC #9)

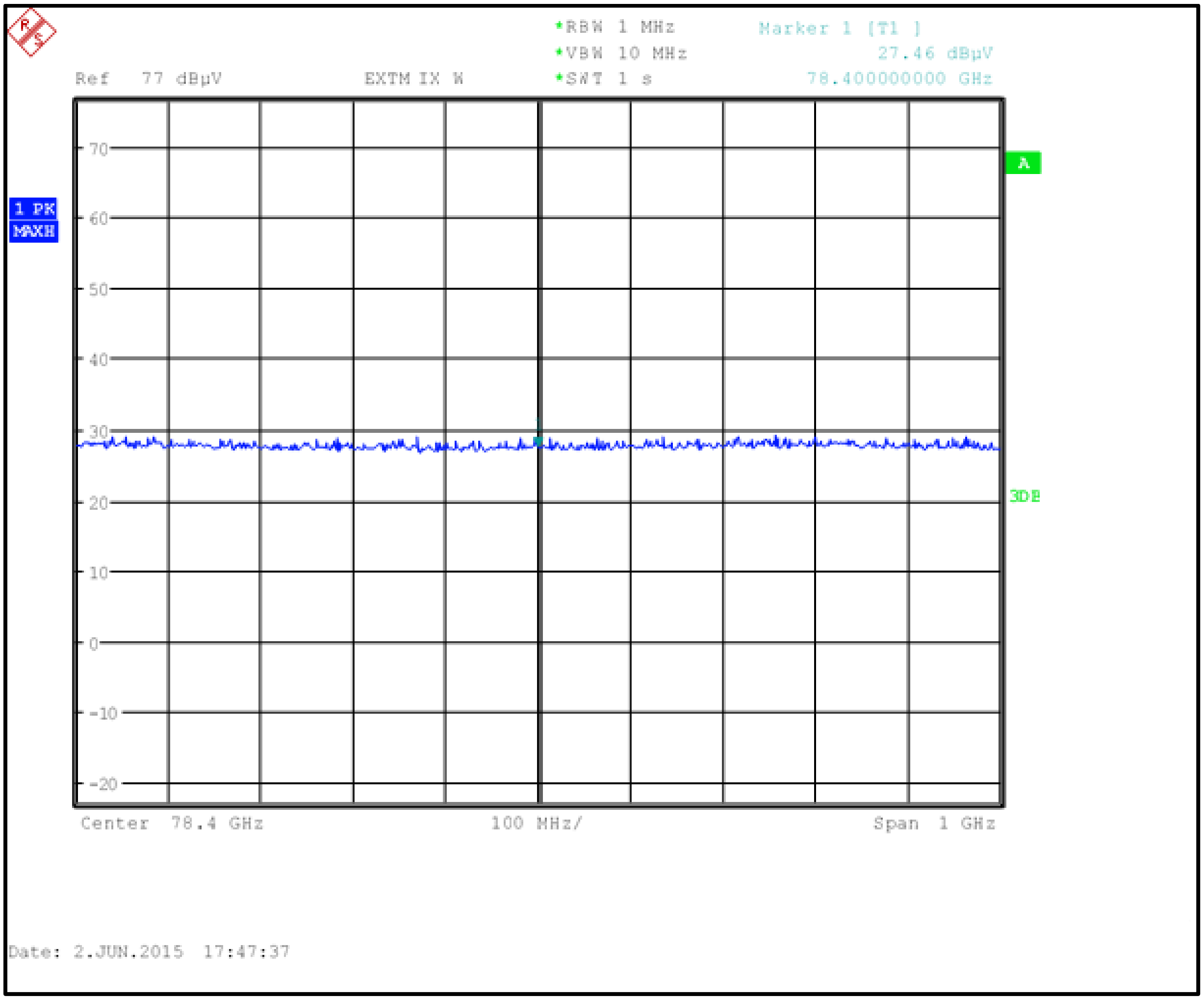


Table 4-33: Radiated Third Harmonic Noise Floor Calculation (TC #9)

Frequency (GHz)	EIRP Measured (dBuV)	Test Antenna Gain (dBi)	Correction from .001m to 3m (dB)	Corrected Measurement (dBuV/m)	Limit (dBuV/m)	Margin (dB)
78.4	27.5	22.5	-49.5	0.5	54.0	-53.5

Plot 4-33: Radiated Spurious Emissions (Fourth Harmonic) (TC #9)

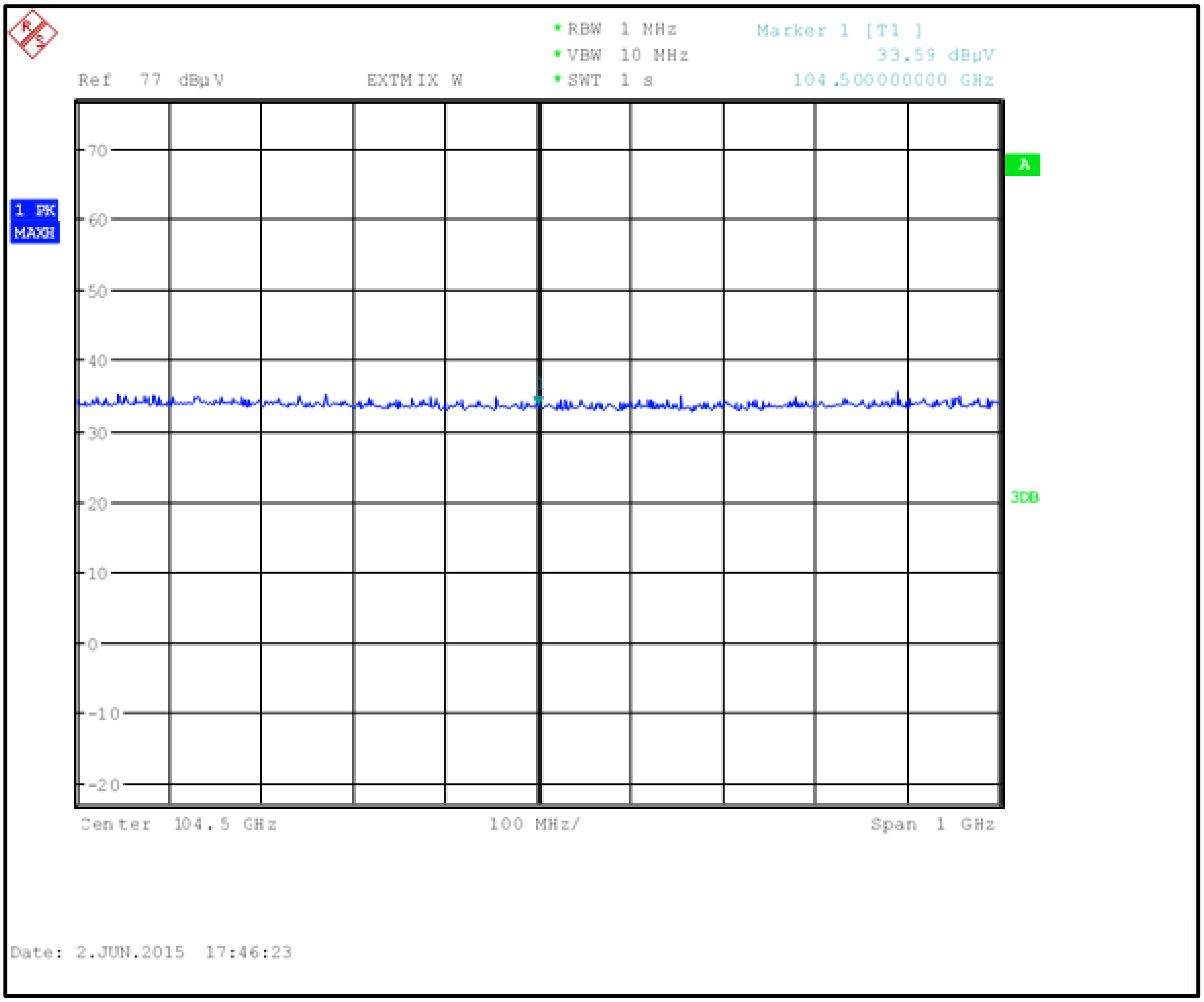


Table 4-34: Radiated Fourth Harmonic Noise Floor Calculation (TC #9)

Frequency (GHz)	EIRP Measured (dBuV)	Test Antenna Gain (dBi)	Correction from .001m to 3m (dB)	Corrected Measurement (dBuV/m)	Limit (dBuV/m)	Margin (dB)
104.5	33.6	23.2	-49.5	7.3	54.0	-46.7

Plot 4-34: Radiated Spurious Emissions (50 GHz – 75 GHz) (TC #9)

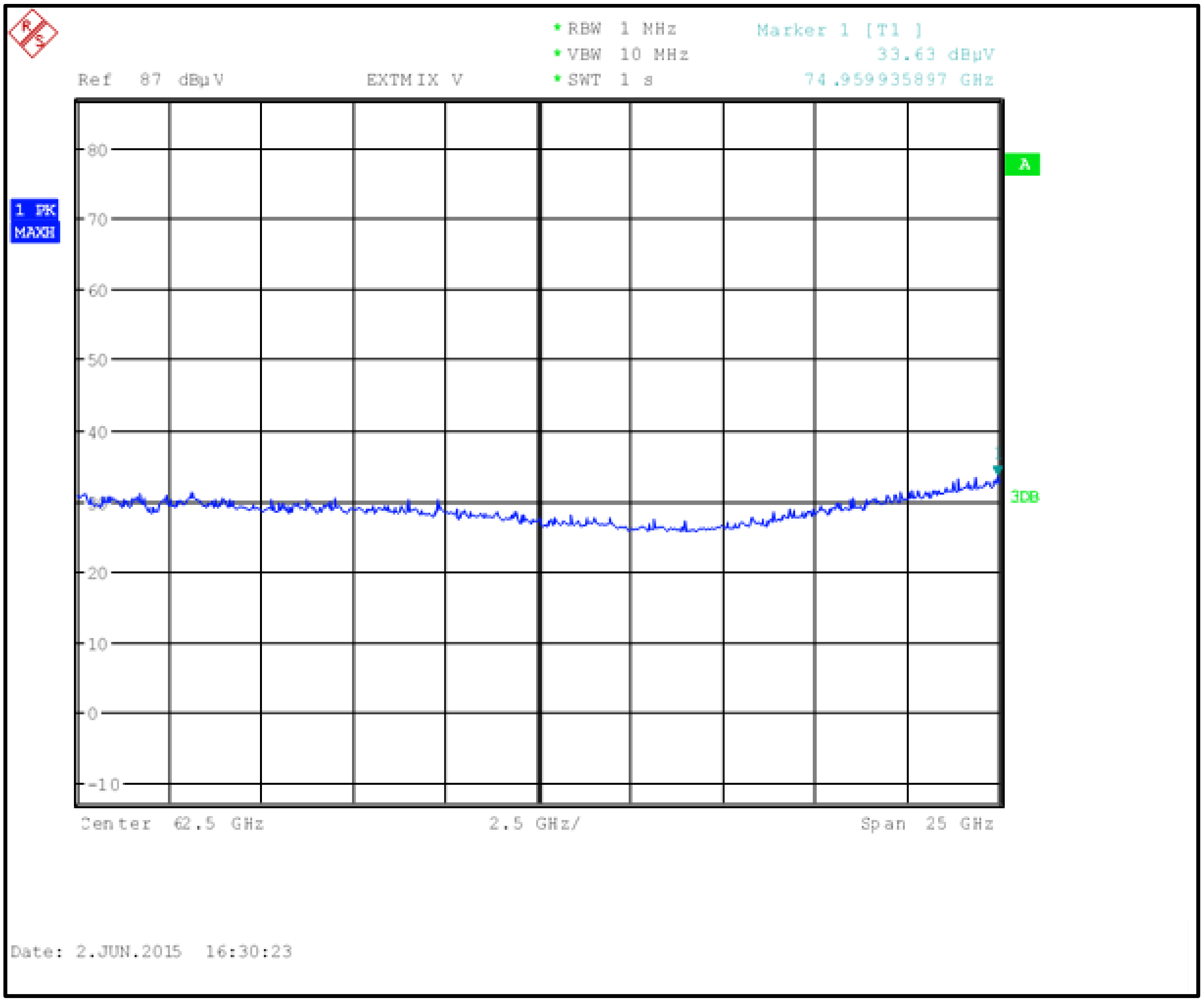


Table 4-35: Radiated Noise Floor Calculation (50 GHz – 75 GHz) (TC #9)

Frequency (GHz)	EIRP Measured (dBuV)	Test Antenna Gain (dBi)	Correction from .001m to 3m (dB)	Corrected Measurement (dBuV/m)	Limit (dBuV/m)	Margin (dB)
75.0 (worst case)	33.6	23.4	-49.5	7.5	54.0	-46.5

Plot 4-35: Radiated Spurious Emissions (75 GHz - 110 GHz) (TC #9)

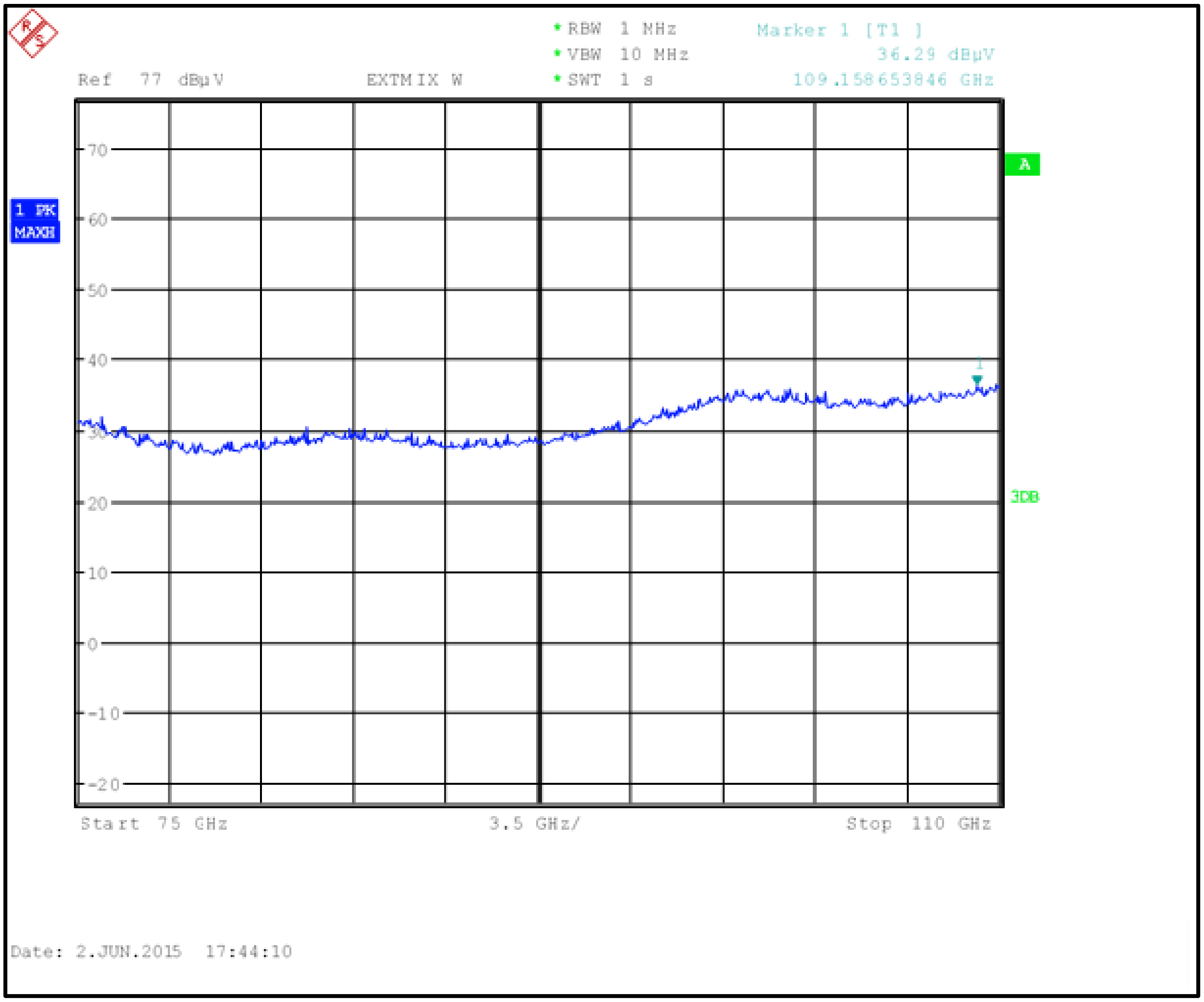


Table 4-36: Radiated Noise Floor Calculation (75 GHz – 110 GHz) (TC #9)

Frequency (GHz)	EIRP Measured (dBuV)	Test Antenna Gain (dBi)	Correction from .001m to 3m (dB)	Corrected Measurement (dBuV/m)	Limit (dBuV/m)	Margin (dB)
109.2 (worst case)	36.3	23.4	-49.5	10.2	54.0	-43.8

4.6 Radiated Emissions Unintentional/Digital Test Data

Table 4-37: Digital Radiated Emissions Test Data

Emission Frequency (MHz)	Antenna Height (m)	Analyzer Reading (dBuV)	Site Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pass/ Fail
30.109	1.0	17.4	-23.6	-6.2	40.0	-46.2	Pass
95.289	1.0	18.4	-30.6	-12.3	43.5	-55.8	Pass
134.151	1.0	17.5	-31.0	-13.6	43.5	-57.1	Pass
255.401	1.0	7.4	-29.4	-22.0	46.0	-68.0	Pass
365.769	1.0	7.8	-26.7	-19.0	46.0	-65.0	Pass
415.513	1.0	9.6	-25.8	-16.2	46.0	-62.2	Pass
505.673	1.0	7.0	-24.9	-17.9	46.0	-63.9	Pass
515.000	1.0	18.7	-24.4	-5.7	46.0	-51.7	Pass
855.574	1.0	26.5	-20.7	5.8	46.0	-40.2	Pass
1003.205	1.0	28.8	-18.4	10.3	54.0	-43.7	Pass
1048.077	1.0	27.2	-18.2	8.9	54.0	-45.1	Pass
1094.551	1.0	24.8	-17.9	6.9	54.0	-47.1	Pass
1294.872	1.0	21.5	-15.8	5.7	54.0	-48.3	Pass
1607.372	1.0	14.3	-13.8	0.5	54.0	-53.5	Pass
1626.603	1.0	19.2	-14.0	5.2	54.0	-48.8	Pass
1737.179	1.0	19.2	-13.2	6.0	54.0	-48.0	Pass
1937.500	1.0	14.9	-11.2	3.6	54.0	-50.4	Pass

Unwanted emissions were investigated (other than harmonics) as required by 15.33(a)(2).

“If the intentional radiator operates at or above 10 GHz and below 30 GHz: to the fifth harmonic of the highest fundamental frequency, or to 100 GHz, whichever is lower.”

Table 4-38: 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	8/27/15
901593	Insulated Wire Inc.	KPS-1503-360-KPR	SMK RF Cables 36"	NA	8/27/15
901594	Insulated Wire Inc.	KPS-1503-360-KPR	SMK RF Cables 36"	NA	8/27/15
900932	Hewlett Packard	8449B OPT H02	Preamplifier (1 - 26.5 GHz)	3008A00505	8/27/15
900151	Rohde and Schwarz	HFH2-Z2	Loop Antenna, (9 kHz - 30 MHz)	827525/019	10/01/15
900717	Hewlett Packard	11970U	Harmonic Mixer (40 – 60 GHz)	2332A01110	4/20/16
901639	Wiltron	35WR19F	Waveguide (40 – 50 GHz)	N/A	6/18/16
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	6/19/16
901161	Advanced Technical Materials	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	4/19/16
900932	Hewlett Packard	8449B OPT H02	Preamplifier (1 - 26.5 GHz)	3008A00505	8/27/15
901629	Teledyne Cougar	A4C2123	Amplifier	003-003	9/4/15
900772	EMCO	3161-02	Horn Antenna (2 - 4 GHz)	9804-1044	4/20/16
900321	EMCO	3161-03	Horn Antenna (4.0 - 8.2 GHz)	9508-1020	4/20/16

Radiated Emissions Test Equipment, continued

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
900323	EMCO	3160-07	Horn Antenna (8.2 - 12.4 GHz)	9605-1054	4/20/16
900356	EMCO	3160-08	Horn Antenna (12.4 - 18 GHz)	9607-1044	4/20/16
901218	EMCO	3160-09	Horn Antenna (18 - 26.5 GHz)	960281-003	4/19/16
900874	Continental Microwave & Tool	RA42-K-F-4B-C	18-26.5 GHz Waveguide	990706-002	1/23/16

Test Personnel:

Daniel W. Baltzell	Daniel W. Baltzell	5/31/15 – 6/2/15
Test Engineer	Signature	Dates of Test

5 Frequency Stability ANSI C63.10 6.8, FCC 14-2 (15.256(f)(2)); RSS-Gen 4.7

5.1 Frequency Stability Test Procedure - FCC 14-2 (15.256(f)(2)); RSS-Gen 4.7

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

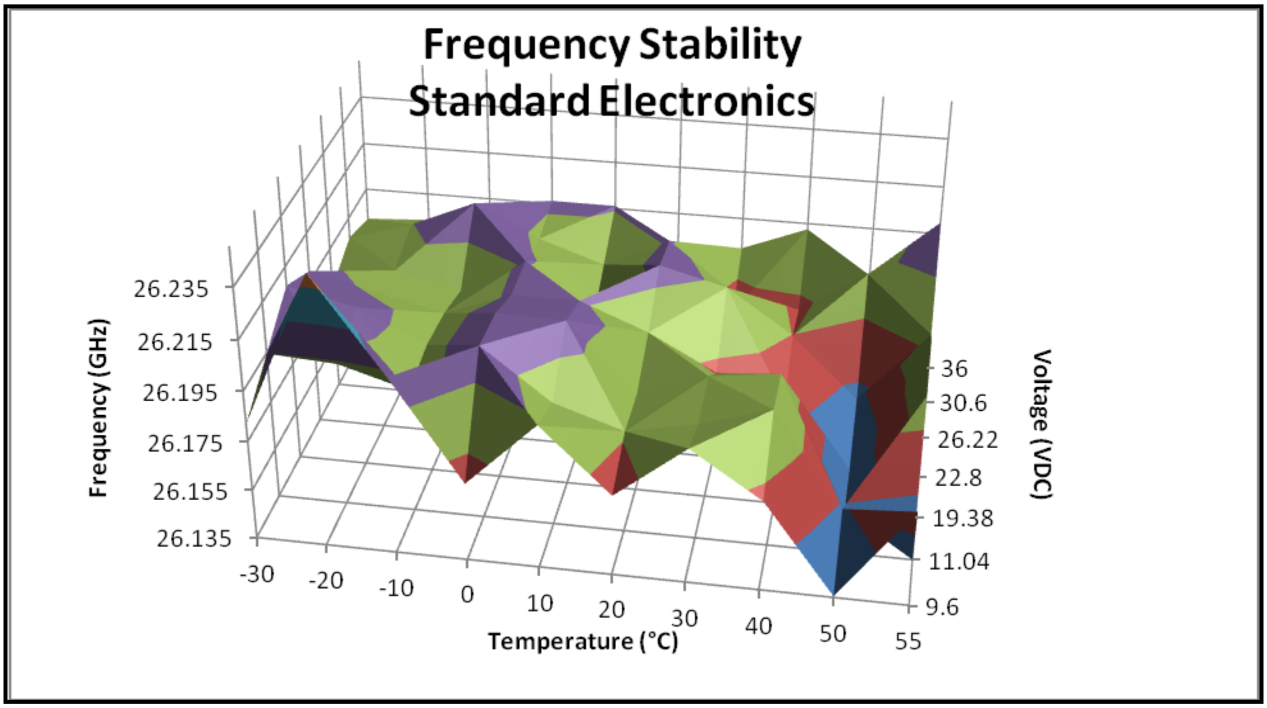
LPR devices operating under this section must confine their fundamental emission bandwidth within the 5.925-7.250 GHz, 24.05-29.00 GHz, and 75-85 GHz bands under all conditions of operation.

5.3 Temperature-Voltage Frequency Stability Test Data

Table 5-1: Temperature-Voltage Frequency Stability – Standard Electronics

Temp. (°C)	+/- 15% VDC						
	9.6 (Min.)	11.04 (Min. + 15%	19.38 (-15%)	22.8 (Mid.)	26.22 (+ 15%)	30.6 (Max. -15%	36 (Max.)
-30	26.181810962	26.194631475	26.207451987	26.199439167	26.178605834	26.186618654	26.181810962
-20	26.242708398	26.193028911	26.201041731	26.193028911	26.188221218	26.194631475	26.183413526
-10	26.205849423	26.185016090	26.188221218	26.186618654	26.181810962	26.205849423	26.186618654
0	26.166426346	26.205528911	26.203605834	26.196554552	26.196875064	26.192708398	26.196234045
10	26.192628270	26.185336603	26.203125064	26.196554552	26.171314167	26.183814167	26.196153911
20	26.167468013	26.176522500	26.175336599	26.185897500	26.199679552	26.196394295	26.175080193
30	26.189022500	26.182131475	26.185576987	26.171474423	26.192708398	26.167708398	26.181971218
40	26.171201987	26.190753270	26.189150705	26.162067372	26.174727628	26.171201987	26.192516090
50	26.135464808	26.153253270	26.135144295	26.135304552	26.149567372	26.188990449	26.147484039
55	26.172964808	25.162067372	26.185464808	26.192516090	26.180016090	26.203253270	26.199727628

Plot 5-1: Frequency Stability – Standard Electronics



To determine if the bandwidth of the signal remains within the band 24.05 GHz – 29 GHz, the lowest frequency generated, 25.162067372 GHz (at -55°C, 11.04VDC), and the highest frequency generated, 26.242708398 GHz (at -20°C, 9.6 VDC), are compared to the bandwidth of the signal as measured, 1971.153 MHz.

Half the bandwidth to determine the edge of the frequency is subtracted from the lowest frequency generated, and added to the highest frequency generated.

½ bandwidth = 1971.153 MHz / 2 = 985.5765 MHz.

Lowest frequency generated 25.162 GHz - 986 MHz = 24.176 GHz, which is within the band 24.05 - 29 GHz (passing with margin 24.05 - 24.176 = -126 MHz)

Highest frequency generated 26.242708398 GHz + 986 MHz = 27.22871 GHz, which is within the band 24.05 - 29 GHz (passing with margin 27.22871 – 29 = -1.77129 GHz)

<u>Results</u>: The EUT is compliant.

Table 5-2: 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	11/13/16
901593	Insulated Wire Inc.	KPS-1503-360-KPR	SMK RF Cables 36”	NA	8/27/16
901350	Meterman	33XR	Multimeter	040402802	3/20/16

Test Personnel:

Daniel Baltzell		May 18, 2015
Test Engineer	Signature	Date of Tests

6 AC Conducted Emissions - FCC Rules and Regulations ANSI C63.10 6.2, Part 15.207; RSS-Gen 7.2.4

6.1 Test Methodology for Conducted Line Emissions Measurements – Part 15.207; RSS-Gen 7.2.4

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.

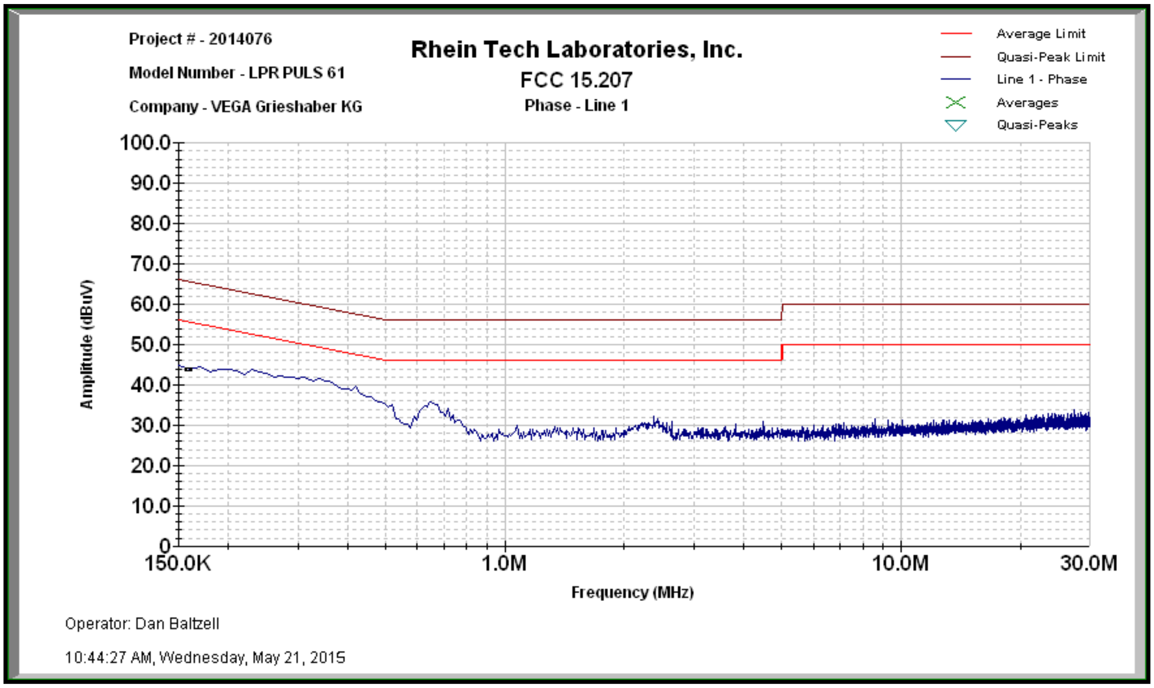
6.2 Conducted Line Emissions Test Procedure

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)

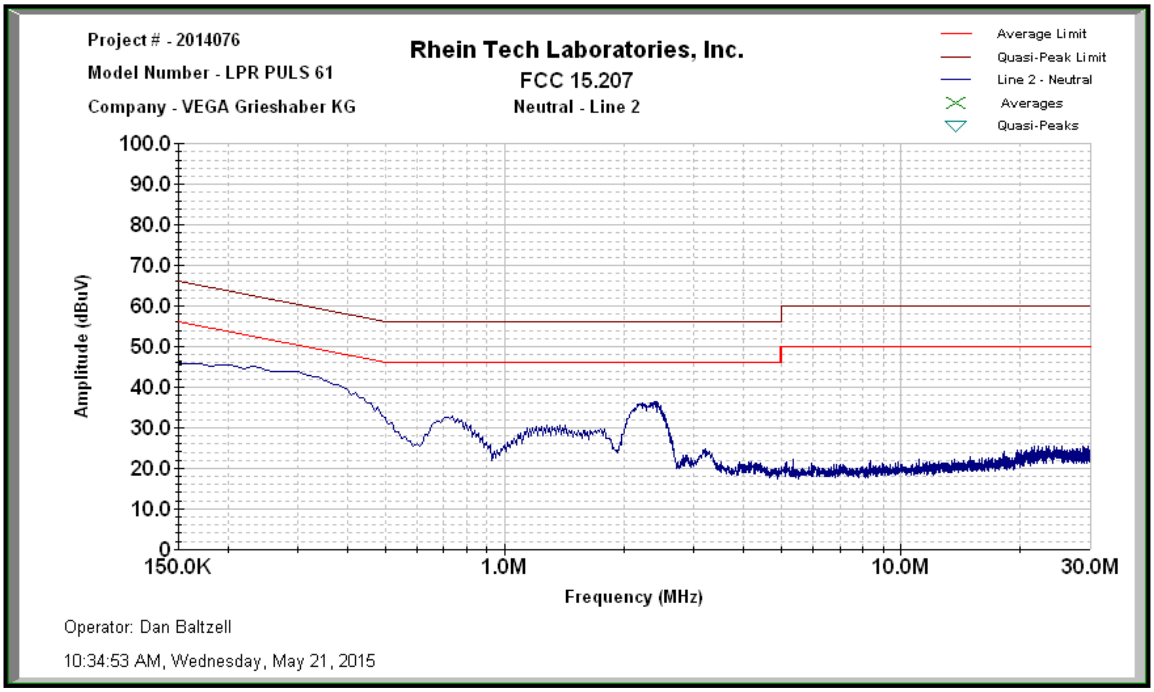
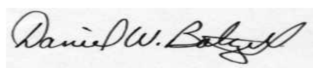


Table 6-1: Conducted Line Emissions Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
900968	Hewlett Packard	8567A	Spectrum Analyzer (10 kHz - 1.5 GHz)	2602A00160	2/17/16
900339	Hewlett Packard	85650A	Quasi-Peak Adapter	2521A00743	2/17/16
900970	Hewlett Packard	85662A	Spectrum Analyzer Display	2542A11239	2/17/16
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		May 21, 2015
Test Engineer	Signature	Date of Test

7 Conclusion

The data in this measurement report shows that the Vega Grieshaber KG Model PS60K, FCC ID: O6QPS60XK2, IC:3892A-PS60XK2, complies with the applicable requirements of Parts 2 and 15 of the FCC rules and regulations.