



Engineering Solutions & Electromagnetic Compatibility Services

VEGA Grieshaber KG
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Germany

MODEL: VEGAPULS 64
FCC ID: O6QPS60XW2
IC: 3892A-PS60XW2

March 27, 2017

Standards Referenced for this Report	
Part 2: October 2015	Frequency Allocations and Radio Treaty Matters; General Rules and Regulations
Part 15: October 2015	Radio Frequency Devices - §15.209: Radiated Emissions Limits
RSS-Gen	General Requirements for Compliance of Radio Apparatus
RSS-211	Level Probing Radar Equipment
ANSI C63.10-2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
ANSI C63.4-2014	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

Frequency Range (GHz)	Output Power (W) Conducted	Frequency Tolerance (ppm)	Emission Designator
78	0.00032*	N/A	N/A

* +/-1 dBm deviation from original power value well within uncertainty of RF power measurement

We, the undersigned, hereby declare that the equipment tested and referenced in this report conforms to the identified standard(s) as described in this attached test record. 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 above standards for Certification methodology.

Signature: 

Date: March 27, 2017

Typed/Printed Name: Desmond Fraser

Position: President

Signature: 

Date: March 27, 2017

Typed/Printed Name: Daniel Baltzell

Position: Test Engineers

Document Number: 2016255-209

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

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1 General Information

1.1 Scope

The following Class II report is prepared on behalf of Vega Grieshaber KG in accordance with the Federal Communications Commission and Industry Canada Rules and Regulations. The Equipment Under Test (EUT) was the **VEGAPULS 64** Level Probing Radar, **FCC ID: O6QPS60XW2, IC: 3892A-PS60XW2**, tested with three different antennas, each having the highest gain within its antenna family type (namely, plastic horn, encapsulated horn flange, and encapsulated horn screw-in) in metal, fiberglass and concrete tanks.

Note: the FCC grant and IC certificate should list the 5 antennas in document "78 GHz Antennas PULS 64" submitted with this application. The EUT is available with the PS64HW electronics unit.

All measurements contained in this application were conducted in accordance with FCC Rules and Regulations CFR 47, and ANSI C63.4 Methods of Measurement of Radio Noise Emissions, 2010. The instrumentation utilized for the measurements conforms to the ANSI C63.4 standard for EMI and Field Strength Instrumentation. Calibration checks are performed regularly on the instruments, and all accessories including high pass filter, coaxial attenuator, preamplifier and cables.

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 Related Submittal(s)/Grant(s)

This FCC §15.209/IC RSS-211 report is intended to support a Class II application for a composite device. The original FCC grant and IC certificate was issued June 20, 2016. The VEGAPULS 64 operates at 78 GHz channel (sweeping from 76GHz - 80GHz). The changes are:

- New front-end PCB with new PLL. The new front-end PCB is the result of an end-of-life component. Please refer to the document the CIIPC_Changes, for a detailed explanation of the change.

1.4 Other Related Application Report Items

- The user manual includes references to software updates; software updates do not change any TX parameters (i.e. power, gain, frequency, BW, etc.). Any bandwidth values in the user manual are mean values of the E and H-planes, to make it easier for the grantee's customers to understand what they are.
- The lab power supply was EMI unfiltered. The EUT is typically used in industrial applications where an AC-to-DC unfiltered power supply supplies DC power. As such, this represents typical use.
- All antennas were investigated with the swivel bracket attached to the EUT during the in-tank, LPR-installed radiated emissions measurements. However, there were no discernible differences between the radiated emissions measured data with the swivel bracket attached to the antennas, and the antennas mounted pointing vertically downwards inside the tanks; as such, the radiated emissions data without the swivel bracket presented in the report represents the worst-case radiated emissions data.

- Though the EUT appears large enough to have the two-part FCC statement on it, the applicant states that there that there is not any space left on the type label to add the FCC two-part statement. An exclamation point is placed on the label with a notice to review the user manual wherein all necessary information and the FCC two-part statement is included. The document number of the manual is also printed on the label. The applicant also states that they have submitted the same type of FCC labeling in previous submittals of their sensors and they were acceptable to the FCC.

1.5 Modifications

None.

2 Tested System Details

The test sample was received on November 28, 2016 and February 24, 2017. 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	Model	Manufacturer	FCC ID	Cable Type	RTL Bar Code	Serial Number
VEGAPULS 64 (TC #1)	PS64 IXTTCAHXAKJXXX	VEGA Grieshaber KG	O6QPS60XW2	N/A	22286	35036990
Electronics (TC #1)	PS64HW.-02	VEGA Grieshaber KG	N/A	N/A	22198	N/A
75mm Plastic Horn Antenna (33.2 dBi) (TC #1)	N/A	VEGA Grieshaber KG	N/A	N/A	N/A	N/A
VEGAPULS 64 (TC #2)	PS64 IXTTCAHXAKJXXX	VEGA Grieshaber KG	O6QPS60XW2	N/A	22286	35036990
Electronics (TC #2)	PS64HW.-02	VEGA Grieshaber KG	N/A	N/A	22198	N/A
75mm 3" Flange (DN80) Antenna (33.7 dBi) (TC #2)	N/A	VEGA Grieshaber KG	N/A	N/A	21969	N/A
VEGAPULS 64 (TC #3)	PS64 IXTTCAHXAKJXXX	VEGA Grieshaber KG	O6QPS60XW2	N/A	22286	35036990
Electronics (TC #3)	PS64HW.-02	VEGA Grieshaber KG	N/A	N/A	22198	N/A
36mm 1 1/2" Encapsulated Horn Antenna, Screw-in (24.3 dBi) (TC #3)	N/A	VEGA Grieshaber KG	N/A	N/A	N/A	N/A
45mm 2" Flange (DN50) Antenna (29.7 dBi)	N/A	VEGA Grieshaber KG	N/A	N/A	N/A	N/A
19mm 3/4" Encapsulated Horn Antenna, Screw-in (18.5 dBi)l)	N/A	VEGA Grieshaber KG	N/A	N/A	N/A	N/A

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Client: VEGA Grieshaber KG
Model: VEGAPULS 64
ID's: O6QPS60XW2/3892A-PS60XW2
Standards: FCC 15.209/IC RSS-211
Report Number: 2016255-209

Table 2-2: Additional Test Equipment Used

Part	Model	Manufacturer	FCC ID	Cable Type	RTL Bar Code	Serial Number
AC Adapter (12VDC)	TR45A12 11A02	CINCON Electronics Co., Ltd.	N/A	1m unshielded DC/1.9 feet unshielded DC	15932	45120-0016390

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, TC #2, or TC #3) are provided with the test data as appropriate.

Table 2-3: Test Configuration #1 (TC #1)

Part	Model	Manufacturer	Cable Type	RTL Bar Code
VEGAPULS 64	PS64 IXTTCAHXAKJXXX	VEGA Grieshaber KG	N/A	22286
Electronics	PS64HW.-02	VEGA Grieshaber KG	N/A	22198
75mm Plastic Horn Antenna (33.2 dBi)	N/A	VEGA Grieshaber KG	N/A	N/A

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



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

Part	Model	Manufacturer	Cable Type	RTL Bar Code
VEGAPULS 64	PS64 IXTTCAHXAKJXXX	VEGA Grieshaber KG	N/A	22286
Electronics	PS64HW.-02	VEGA Grieshaber KG	N/A	22198
75mm 3" Flange (DN80) Antenna (33.7 dBi)	N/A	VEGA Grieshaber KG	N/A	21969

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



Table 2-5: Test Configuration #3 (TC #3)

Part	Model	Manufacturer	Cable Type	RTL Bar Code
VEGAPULS 64	PS64 IXTTCAHXAKJXXX	VEGA Grieshaber KG	N/A	22286
Electronics	PS64HW.-02	VEGA Grieshaber KG	N/A	22198
36mm 1 1/2" Encapsulated Horn Antenna, Screw-in (24.3 dBi)	N/A	VEGA Grieshaber KG	N/A	N/A

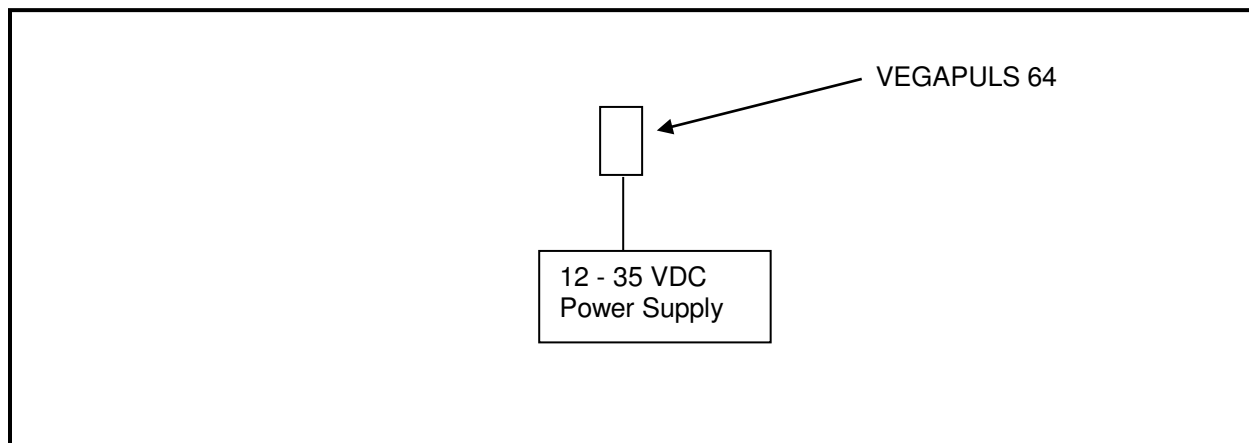
Photograph 3: Test Configuration #3 (TC #3)



Photograph 4: Swivel Holder



Figure 2-1: Configuration of Tested System



2.2 Test Distance and Exercising the EUT

The EUT's normal operating measurement mode is transmitting 2 pulses every second continuously. In measurement mode, the EUT maintains its full power. The EUT's spurious emissions were investigated and tested in the restricted and non-restricted bands from 9 kHz to 200 GHz at 3 meters. Furthermore, test antenna handheld measurements were performed in and around the EUT to determine radiated emissions emanating from the EUT **since it was mounted on metal, concrete and fiberglass containers** such that its main beam was enclosed and perpendicularly pointing downwards.

All measurements above 1 GHz were performed at an antenna–EUT test distance of 1.0 meter with the test antenna polarized horizontally and vertically in order to determine the EUT's worst-case emissions. The measurement results were then corrected to the 3 meter limit. Measurements below 1 GHz were performed at an antenna distance of 3 meters on the EUT as a digital interface device. **The EUT was tested with its main beam pointing vertically downward within metal, concrete, and fiberglass enclosed containers.**

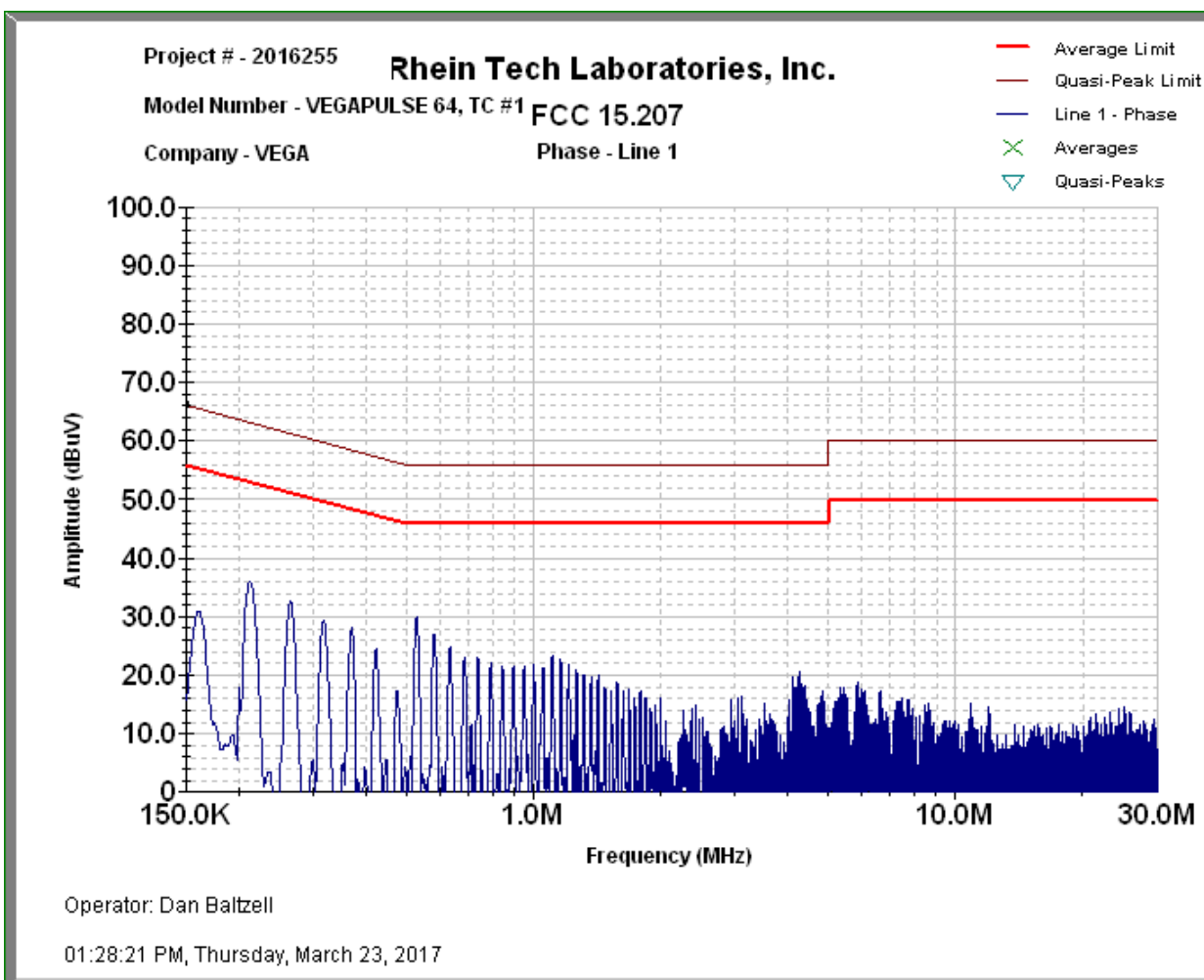
Furthermore, the EUT configurations, TC #1, TC #2, and TC #3, were also investigated and tested configured with a swivel holder attached to the EUT installed inside the enclosed steel, concrete, and fiberglass containers.

3 Conducted Limits - FCC §15.207, IC RSS-Gen

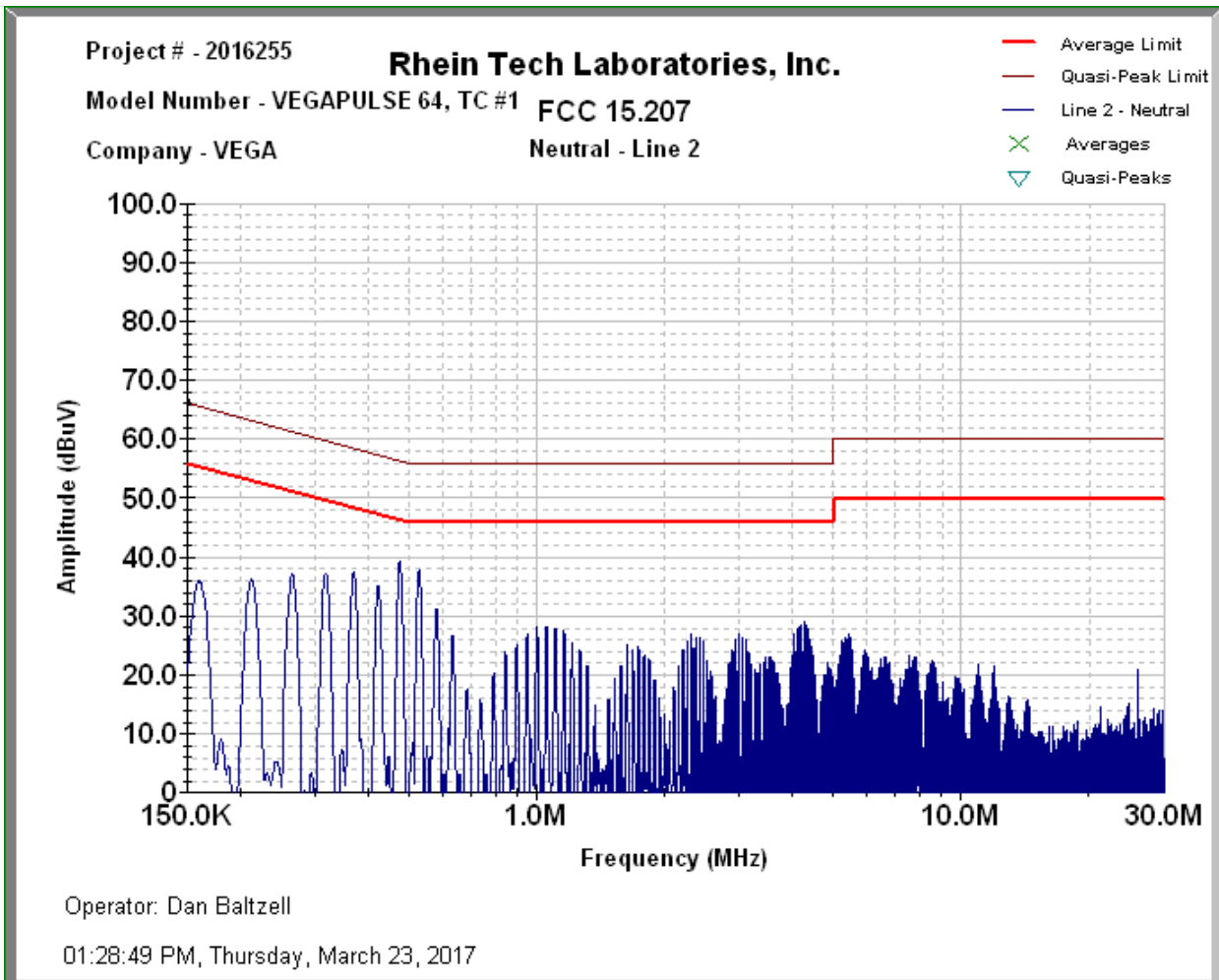
Conducted emissions were performed on the EUT using an off-the-shelf 12-volt power supply. This was considered adequate since the EUT is used in industrial environments where industrial 12 VDC power is provided. The general conducted limit under Part 15.207 was applied. The EUT was investigated and tested in TC #1, TC #2, and TC #3. The data below shows the worst-case emissions from each configuration.

3.1 Conducted Emission Limits Test Data

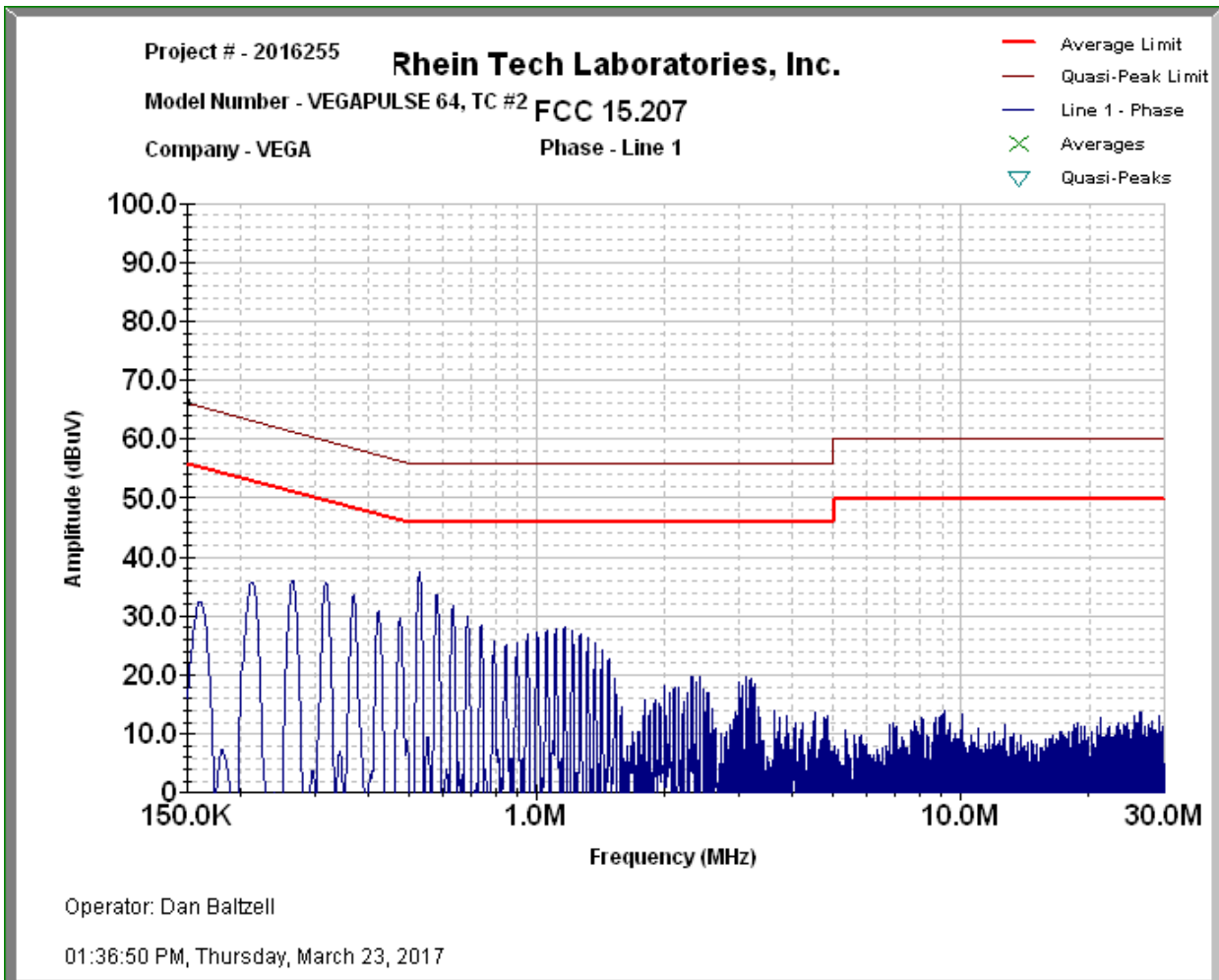
Plot 3-1: Conducted Emissions Transmit - Phase (TC #1)



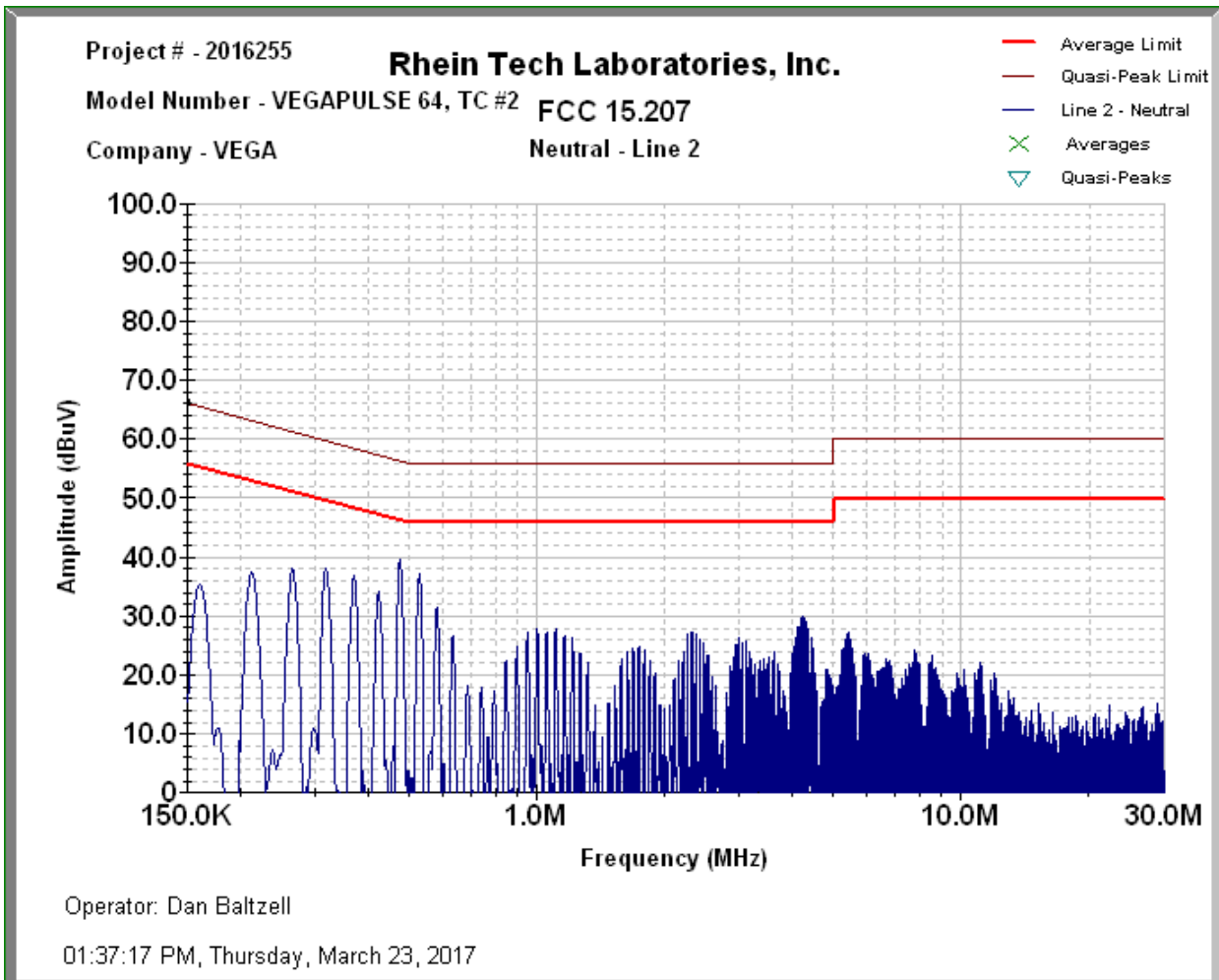
Plot 3-2: Conducted Emissions Transmit – Neutral (TC #1)



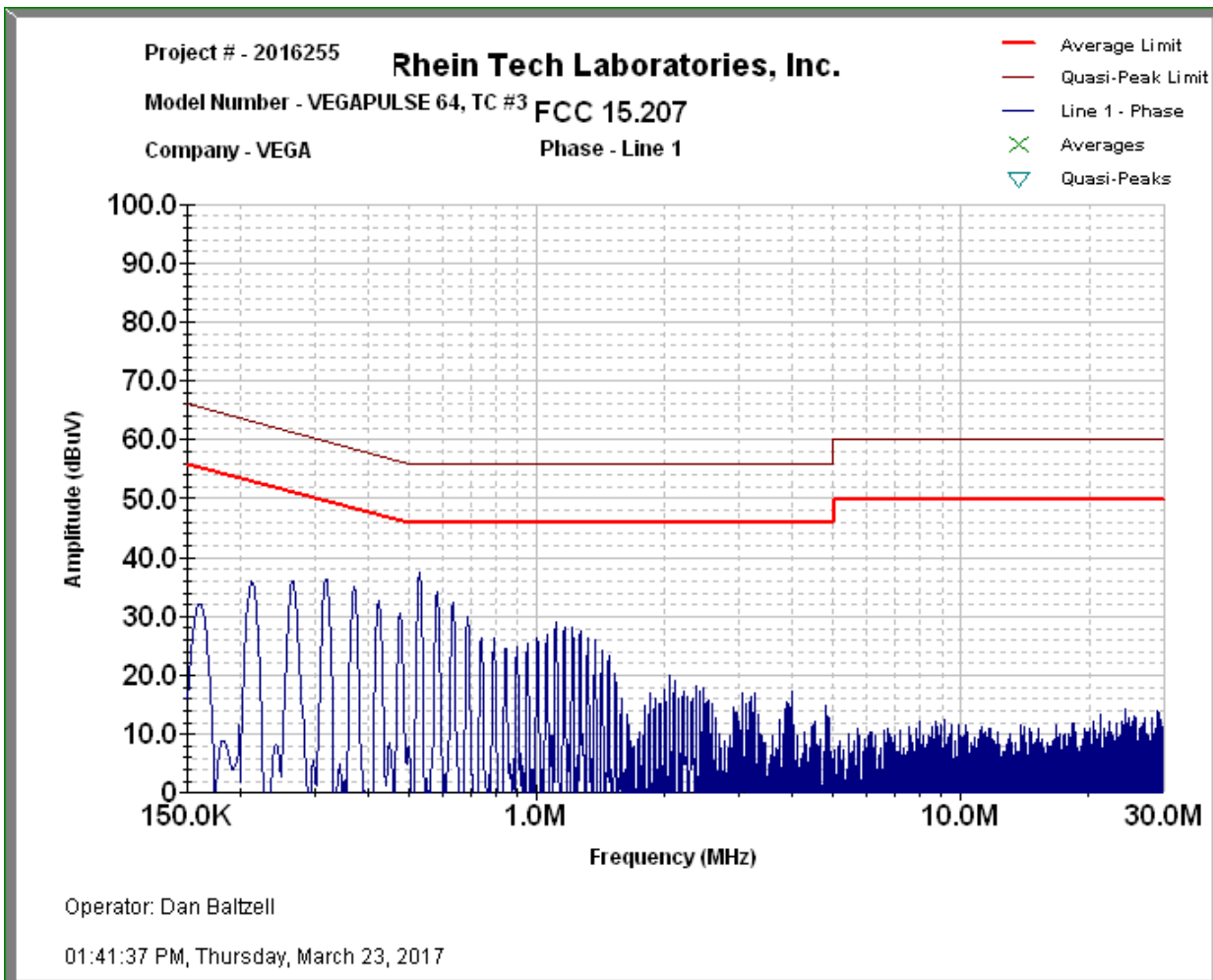
Plot 3-3: Conducted Emissions Transmit - Phase (TC #2)



Plot 3-4: Conducted Emissions Transmit – Neutral (TC #2)



Plot 3-5: Conducted Emissions Transmit - Phase (TC #3)



Plot 3-6: Conducted Emissions Transmit – Neutral (TC #3)

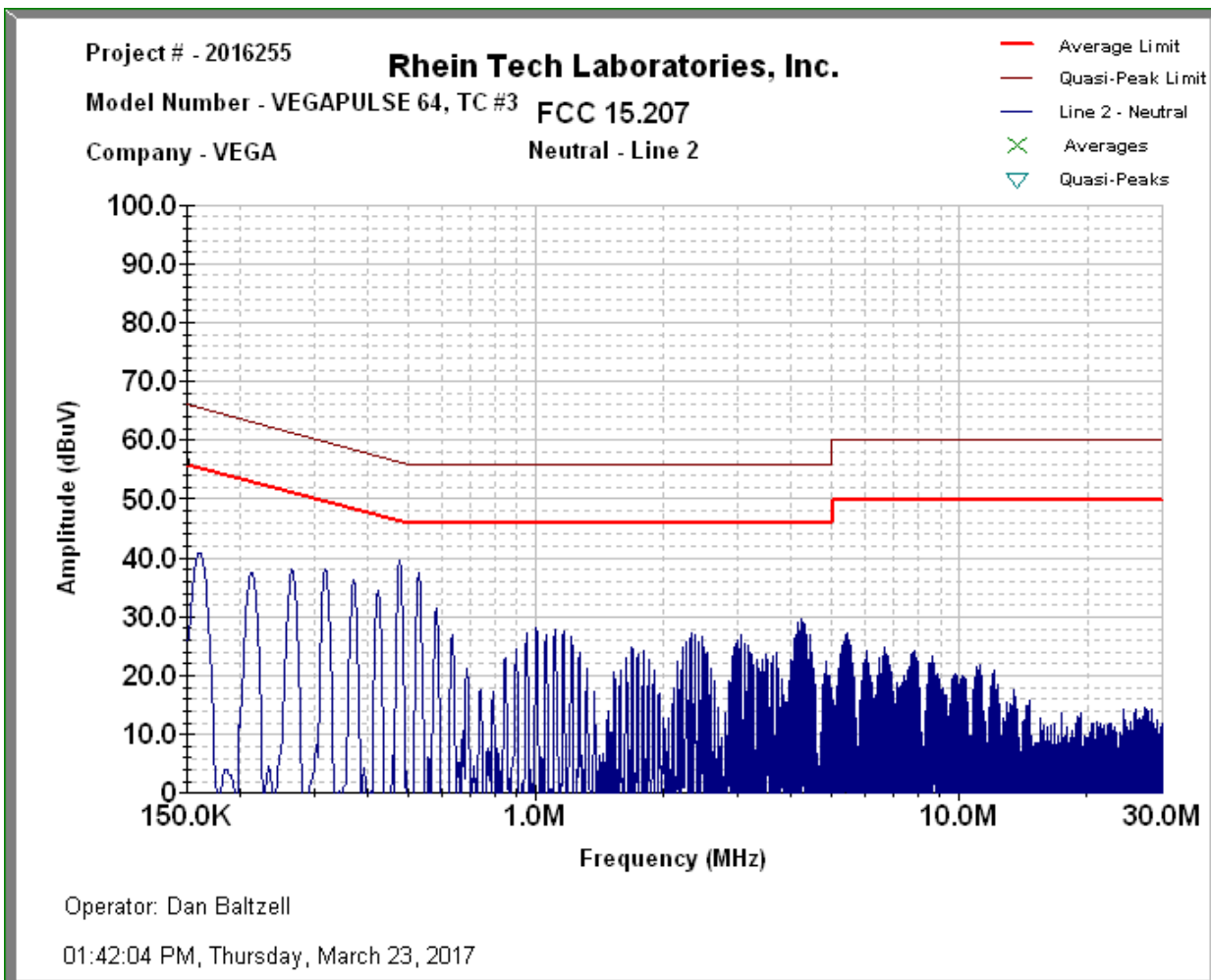


Table 3-1: Conducted Line Emissions Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901581	Rohde & Schwarz	FSU	Spectrum Analyzer	1166.1660.50	3/22/18
901084	AFJ International	LS16	16A LISN	16010020082	3/24/17
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
Test Engineer


Signature

March 23, 2017
Date of Test

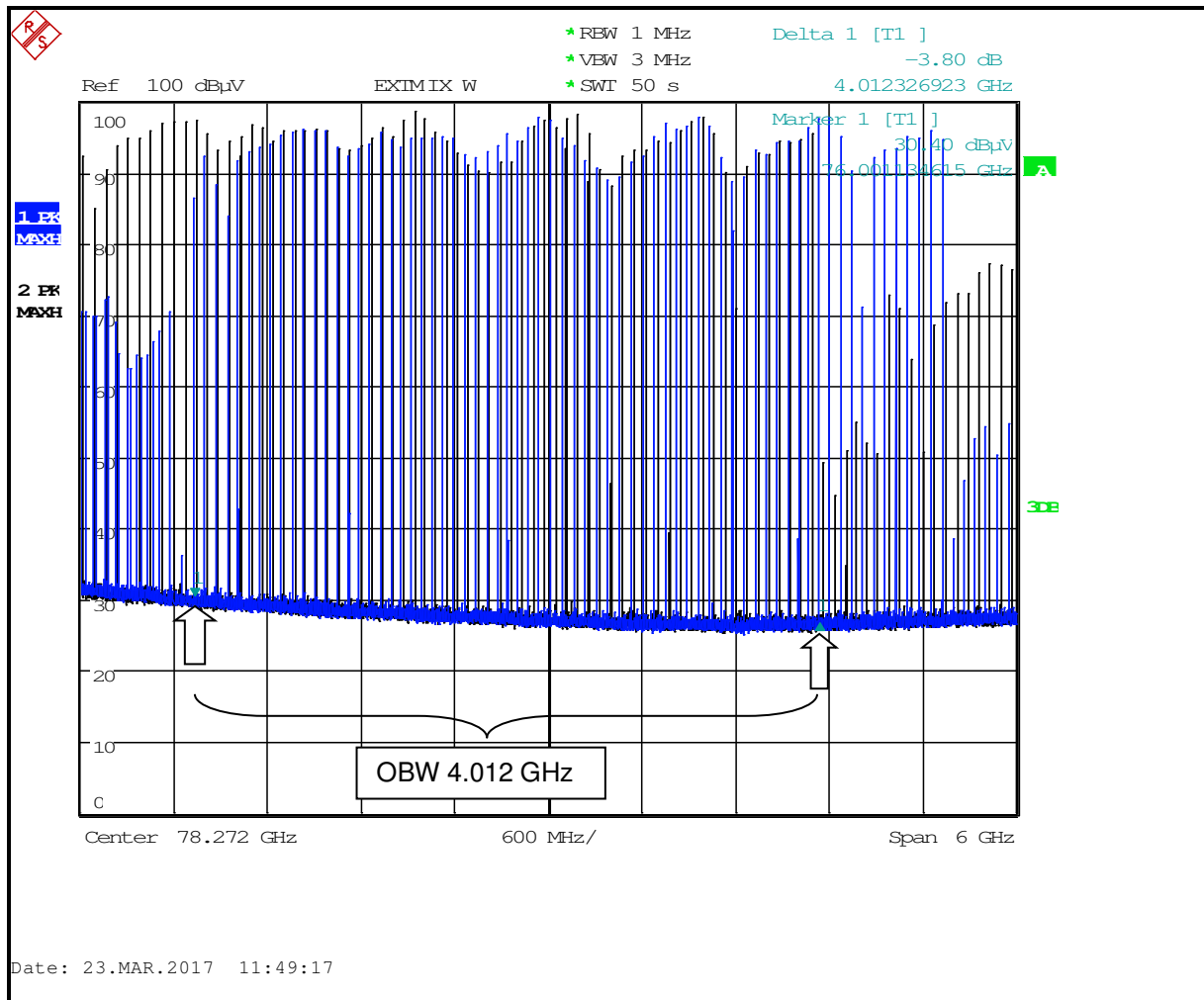
4 Modulated Bandwidth – ANSI C63.10 6.9; IC RSS-211 5.1(a)

4.1 Modulated Bandwidth Test Procedure

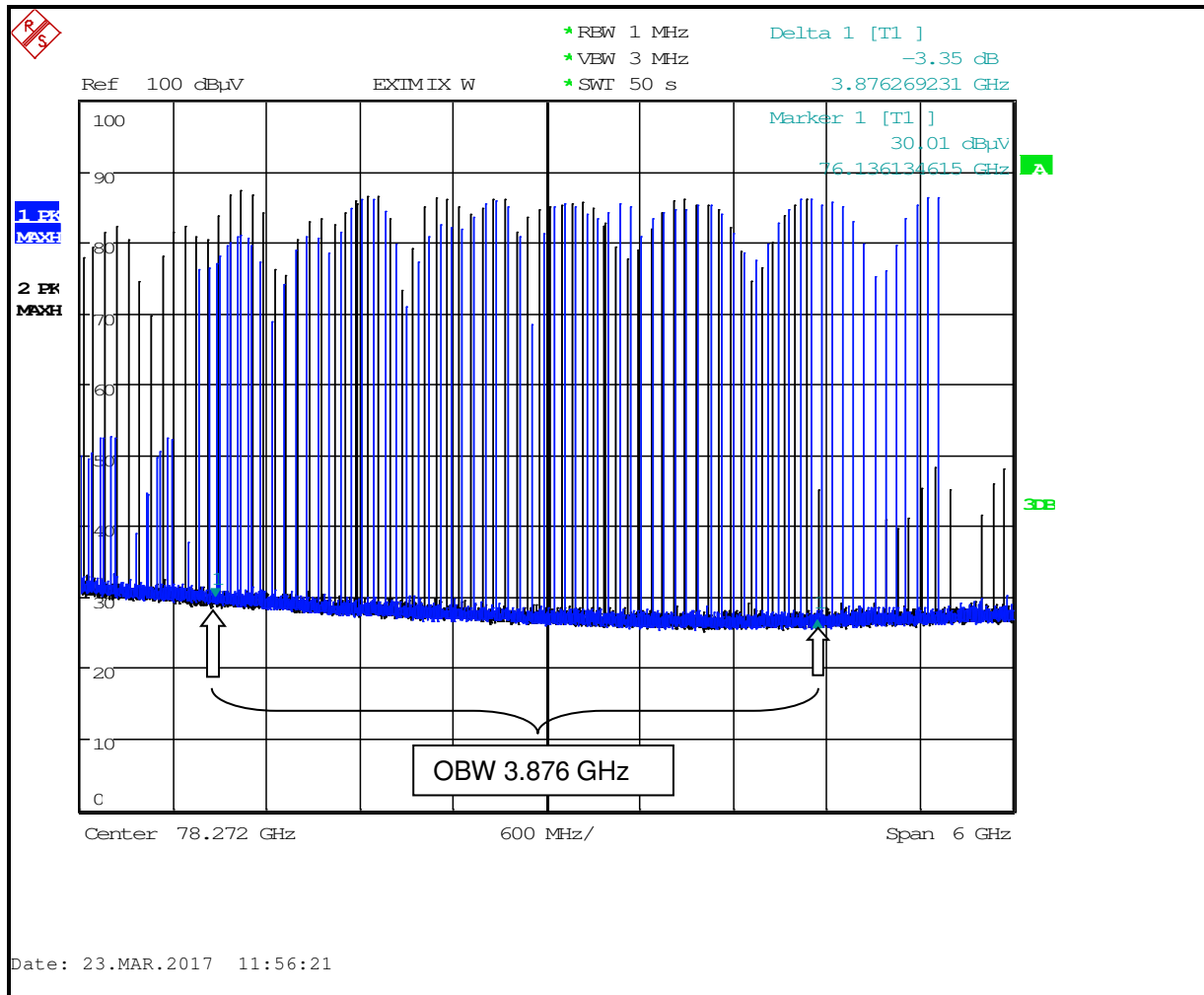
The minimum 26 dB bandwidth was measured using a 50-ohm spectrum analyzer with the resolution bandwidth set at 1 MHz and the video bandwidth set at 3 MHz. The spectrum analyzer's mixer mode resulted in an overlapping bandwidth image with the actual image and a ghost image. The analyzer "Signal ID" and "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 -26 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.

4.2 Modulated Bandwidth Test Data

Plot 4-1: Modulated Bandwidth - TC #1



Plot 4-2: Modulated Bandwidth - TC #2



Plot 4-3: Modulated Bandwidth - TC #3

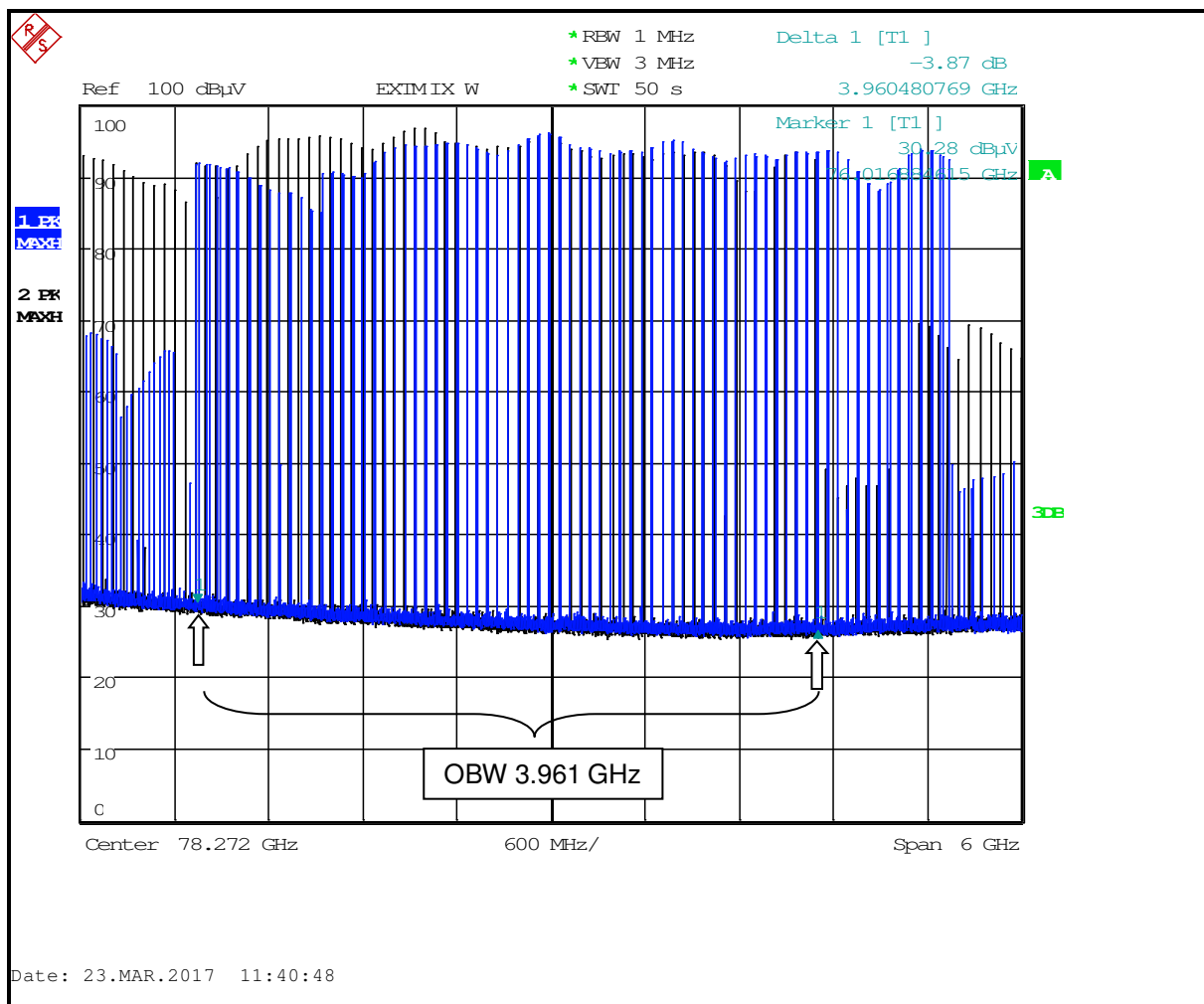


Table 4-1: Modulated Bandwidth Data

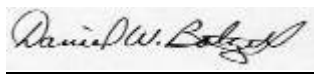
EUT Configurations	26 dB Bandwidth (GHz)
TC #1	4.012
TC #2	3.876
TC #3	3.961

Table 4-2: Modulated Bandwidth Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901581	Rohde & Schwarz	FSU	Spectrum Analyzer	1166.1660.50	3/22/18

Test Personnel:

Daniel W. Baltzell
Test Engineer


Signature

March 23, 2017
Date of Test

5 Radiated Emission Limits - FCC §15.209; IC RSS-Gen, IC RSS-211 5.3

5.1 Radiated Emission Limits Test Procedure

The EUT's radiated spurious emissions, comprised of harmonic and spurious emissions that fall in the restricted and non-restricted bands, were investigated and tested from 0.009 kHz to 200 GHz in accordance with C63.4 2009. The restricted bands are listed in Part 15.205. The maximum permitted average field strength for the restricted band is listed in Part 15.209. To determine worst-case emissions, the EUT was tested while installed perpendicularly downwards in steel and concrete containers, and the EUT was rotated along its axis.

The test antenna was horizontally and vertically polarized during testing. The general limit under Part 15.209 was applied for all frequencies from 0.009 kHz to 200 GHz, per FCC 15.209. Radiated spurious emissions were detected between 30 MHz and 1000 MHz and data provided in Tables 5.1 to 5.9; none were detected from 40 GHz to 200 GHz, except the carrier at 77GHz. Horizontal and vertical antenna polarization radiated spurious emissions plots are provided from 2 GHz to 40 GHz. A handheld test-antenna measurement method was also used in, around, and close to the EUT, to investigate radiated spurious emissions from 1GHz up to 200GHz; no radiated spurious emissions were found, except the carrier at 77 GHz.

The EUT was investigated and tested with test configurations TC #1, TC #2, and TC #3, in enclosed steel, concrete, and fiberglass containers. Furthermore, the EUT configurations TC #1, TC #2, and TC #3 were also investigated and tested configured with a swivel holder attached to the EUT and installed inside the enclosed steel, concrete, and fiberglass containers. There were no discernible differences between the EUT attached to the swivel installed inside the containers, and the EUT without the swivel attached installed inside the containers. As such, data without the swivel attached to the EUT represents the worst-case data in this report.

5.2 Field Strength Calculation

The field strength is calculated by adding the antenna factor and the cable factor from the measured Spectrum Analyzer reading.

The formula, Spectrum Analyzer Level Corrected (dBuV/m) = Spectrum Analyzer Level (dBuV/m) + AF (dB/m) + CL (dB); where AF = antenna factor and CL = cable loss, is used to calculate the field strength values in the radiated emissions test data in Section 5.3.

5.3 Radiated Emissions Test Data

5.3.1 Radiated Emissions Below 1 GHz, FCC §15.209; IC RSS-Gen

Table 5-1: Digital Radiated Emissions Test Data - TC #1; Concrete Container

Temperature: 43°F Humidity: 62%										
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
33.298	Qp	H	0	1.0	32.4	-12.7	19.7	40.0	-20.3	Pass
34.656	Qp	H	30	2.0	32.4	-13.3	19.1	40.0	-20.9	Pass
365.178	Qp	V	0	1.0	41.5	-9.8	31.7	46.0	-14.3	Pass
374.997	Qp	V	30	1.0	46.1	-9.4	36.7	46.0	-9.3	Pass
395.008	Qp	V	0	1.0	46.4	-8.5	37.9	46.0	-8.1	Pass
453.625	Qp	H	30	1.0	31.6	-7.0	24.6	46.0	-21.4	Pass

Table 5-2: Digital Radiated Emissions Test Data - TC #1; Metal Container

Temperature: 39°F Humidity: 61%										
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
270.010	Qp	V	90	1.5	39.3	-12.4	26.9	46.0	-19.1	Pass
349.000	Qp	H	140	3.0	34.0	-10.5	23.5	46.0	-22.5	Pass
414.850	Qp	V	0	1.0	40.6	-7.9	32.7	46.0	-13.3	Pass
415.026	Qp	V	180	1.5	42.8	-7.9	34.9	46.0	-11.1	Pass
472.250	Qp	H	30	1.5	41.3	-6.3	35.0	46.0	-11.0	Pass
898.991	Qp	H	90	1.0	31.5	1.6	33.1	46.0	-12.9	Pass

Table 5-3: Digital Radiated Emissions Test Data - TC #1; Fiberglass Container

Temperature: 42°F Humidity: 53%										
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
40.935	Qp	H	270	1.8	33.0	-15.8	17.2	40.0	-22.8	Pass
209.000	Qp	H	30	3.5	38.4	-16.9	21.5	43.5	-22.0	Pass
405.044	Qp	V	0	1.0	39.3	-8.2	31.1	46.0	-14.9	Pass
415.028	Qp	V	0	1.0	46.8	-7.9	38.9	46.0	-7.1	Pass
425.003	Qp	V	35	2.0	38.8	-7.7	31.1	46.0	-14.9	Pass
438.875	Qp	H	270	1.4	32.4	-7.3	25.1	46.0	-20.9	Pass

Table 5-4: Digital Radiated Emissions Test Data - TC #2; Concrete Container

Temperature: 42°F Humidity: 63%										
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
44.875	Qp	H	30	2.0	34.9	-17.3	17.6	40.0	-22.4	Pass
139.000	Qp	V	120	1.4	37.1	-16.6	20.5	43.5	-23.0	Pass
334.935	Qp	V	30	1.0	32.4	-11.1	21.3	46.0	-24.7	Pass
345.628	Qp	V	50	1.0	32.5	-10.6	21.9	46.0	-24.1	Pass
430.577	Qp	H	180	1.0	32.1	-7.5	24.6	46.0	-21.4	Pass
435.007	Qp	H	180	2.0	32.7	-7.4	25.3	46.0	-20.7	Pass

Table 5-5: Digital Radiated Emissions Test Data - TC #2; Metal Container

Temperature: 39°F Humidity: 61%										
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
75.000	Qp	V	240	1.0	44.4	-21.1	23.3	40.0	-16.7	Pass
119.760	Qp	V	30	1.0	39.2	-15.8	23.4	43.5	-20.1	Pass
344.991	Qp	V	19	1.0	37.4	-10.7	26.7	46.0	-19.3	Pass
345.131	Qp	V	180	1.0	35.3	-10.7	24.6	46.0	-21.4	Pass
414.993	Qp	H	30	2.0	32.5	-7.9	24.6	46.0	-21.4	Pass
415.542	Qp	H	240	2.0	32.0	-7.9	24.1	46.0	-21.9	Pass

Table 5-6: Digital Radiated Emissions Test Data - TC #2; Fiberglass Container

Temperature: 43°F Humidity: 45%										
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
43.313	Qp	V	180	1.8	45.5	-16.7	28.8	40.0	-11.2	Pass
51.800	Qp	H	90	2.5	37.7	-19.8	17.9	40.0	-22.1	Pass
120.030	Qp	H	120	1.4	43.5	-15.8	27.7	43.5	-15.8	Pass
371.375	Qp	V	90	1.4	31.5	-9.6	21.9	46.0	-24.1	Pass
425.000	Qp	H	90	1.0	34.7	-7.7	27.0	46.0	-19.0	Pass
448.000	Qp	V	90	1.0	33.7	-7.1	26.6	46.0	-19.4	Pass

Table 5-7: Digital Radiated Emissions Test Data - TC #3; Concrete Container

Temperature: 39°F Humidity: 61%										
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
89.580	Qp	H	180	1.5	41.1	-18.9	22.2	43.5	-21.3	Pass
118.150	Qp	V	70	2.0	36.5	-15.9	20.6	43.5	-22.9	Pass
451.875	Qp	V	50	1.0	32.6	-7.0	25.6	46.0	-20.4	Pass
830.000	Qp	H	30	3.5	33.9	0.4	34.3	46.0	-11.7	Pass
846.983	Qp	H	180	2.0	32.6	0.4	33.0	46.0	-13.0	Pass
847.588	Qp	V	180	1.0	40.7	0.4	41.1	46.0	-4.9	Pass

Table 5-8: Digital Radiated Emissions Test Data - TC #3; Metal Container

Temperature: 39°F Humidity: 61%										
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
30.582	Qp	H	270	2.0	33.4	-11.5	21.9	40.0	-18.1	Pass
65.000	Qp	V	90	1.0	46.8	-22.2	24.6	40.0	-15.4	Pass
113.710	Qp	H	120	1.2	38.6	-16.2	22.4	43.5	-21.1	Pass
415.575	Qp	V	30	1.0	32.2	-7.9	24.3	46.0	-21.7	Pass
829.675	Qp	V	0	1.0	34.2	0.4	34.6	46.0	-11.4	Pass
841.599	Qp	H	120	2.0	32.1	0.3	32.4	46.0	-13.6	Pass

Table 5-9: Digital Radiated Emissions Test Data - TC #3; Fiberglass Container

Temperature: 52°F Humidity: 34%										
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
33.880	Qp	H	90	1.2	31.8	-12.9	18.9	40.0	-21.1	Pass
68.567	Qp	V	25	1.4	49.2	-21.8	27.4	40.0	-12.6	Pass
369.378	Qp	H	120	1.4	31.0	-9.6	21.4	46.0	-24.6	Pass
398.000	Qp	V	30	1.3	32.2	-8.4	23.8	46.0	-22.2	Pass
662.900	Qp	H	90	3.0	41.5	-2.9	38.6	46.0	-7.4	Pass
825.600	Qp	V	120	1.4	32.9	0.5	33.4	46.0	-12.6	Pass

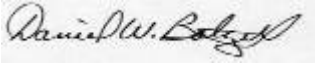
Note: Unwanted emissions were investigated as a digital device (other than harmonics) as required by 15.33(a)(3).

Table 5-10: Digital Radiated Emissions Test Equipment

Part	Manufacturer	Model	Serial Number	RTL Bar Code	Calibration Due Date
Amplifier (20 MHz-2 GHz)	Rhein Tech Laboratories, Inc.	PR-1040	900905	900905	9/16/17
Antenna (30 MHz-2 GHz)	Chase	CBL6112	2099	900791	6/11/17
EMI Receiver RF Section (9 kHz-6.5 GHz)	Hewlett Packard	85462A	3325A00159	900913	12/9/17
RF Filter Section (100 kHz-6.5 GHz)	Hewlett Packard	85460A	3330A00107	900914	12/9/17

Test Personnel:

Daniel W. Baltzell
Test Engineer


Signature

March 24, 2017
Date of Test

5.3.2 Radiated Emissions Carrier, EUT in Containers, FCC §15.209; IC RSS-211 5.3(b)

5.3.2.1 Fiberglass Tank

Plot 5-1: Radiated Emissions (30-1000 MHz) (TC #1)

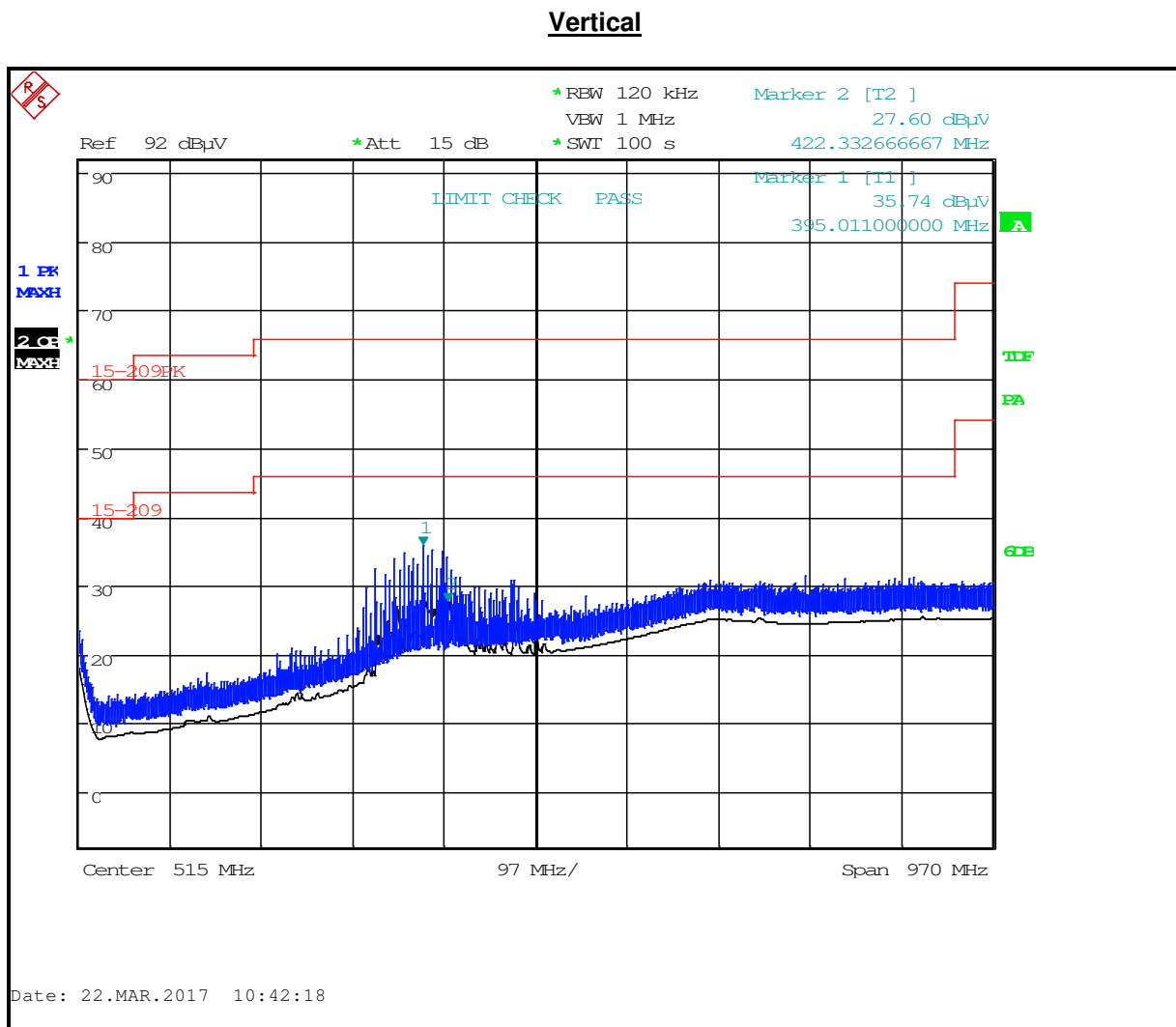


Table 5-11: Radiated Emissions (30-1000 MHz) (TC #1)

Frequency (MHz)	Corrected EIRP Measured (dBμV)	Limit (dBμV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/Average
395.011	35.7	74.0	-38.3	-67.6	-41.3	-26.3	Peak
422.333	27.6	54.0	-26.4				Quasi-Peak
422.333	27.6						Quasi-Peak

Plot 5-2: Radiated Emissions (1 – 2 GHz) (TC #1)

Vertical

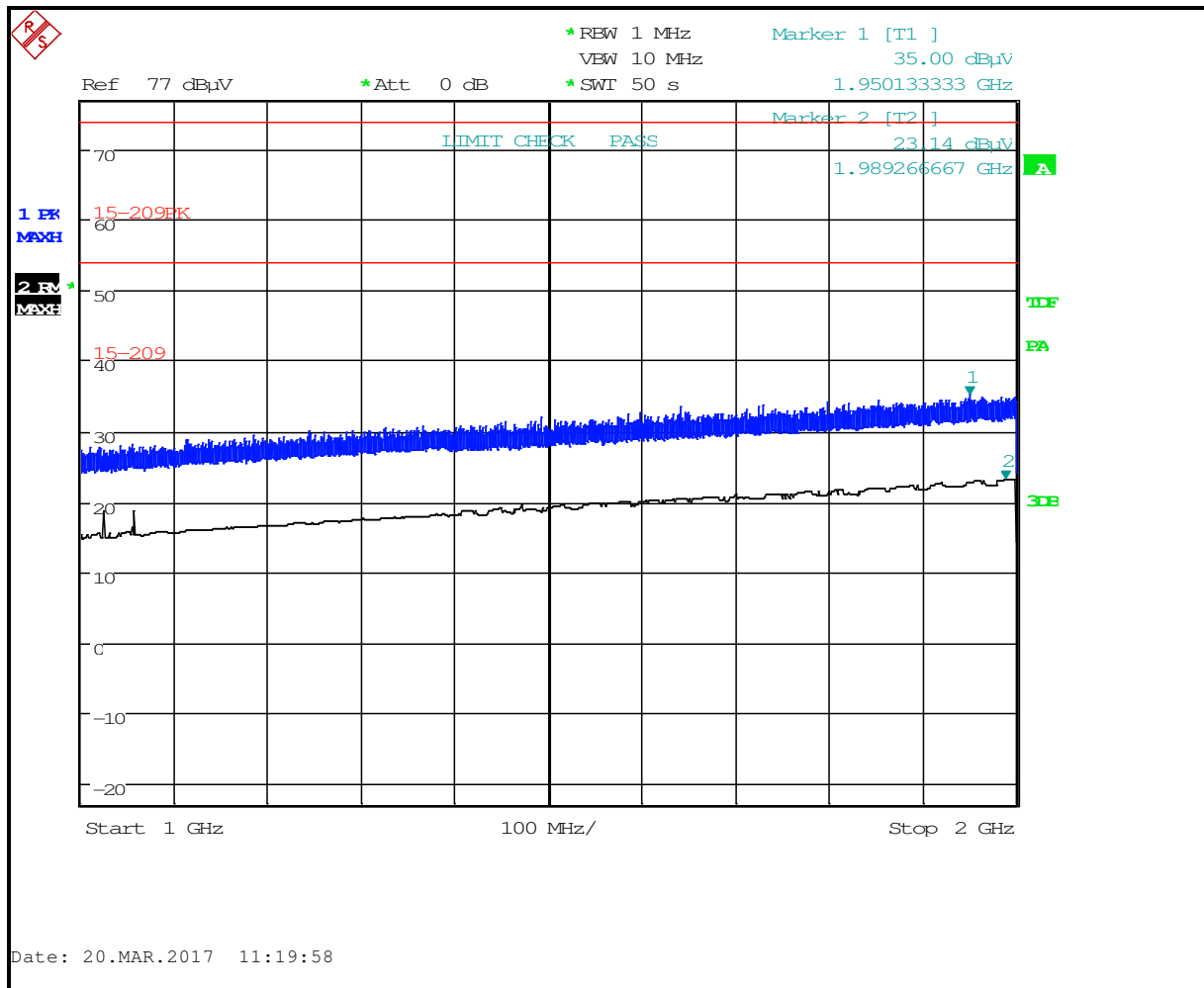


Table 5-12: Radiated Emissions (1 – 2 GHz) (TC #1)

Frequency (MHz)	Corrected EIRP Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
1950.133	35.0	74.0	-39.0				Peak
1989.267	23.1	54.0	-30.9				Average
1989.267	23.1			-72.1	-41.3	-30.8	Average

Plot 5-3: Radiated Emissions (2 – 4 GHz) (TC #1)

Horizontal

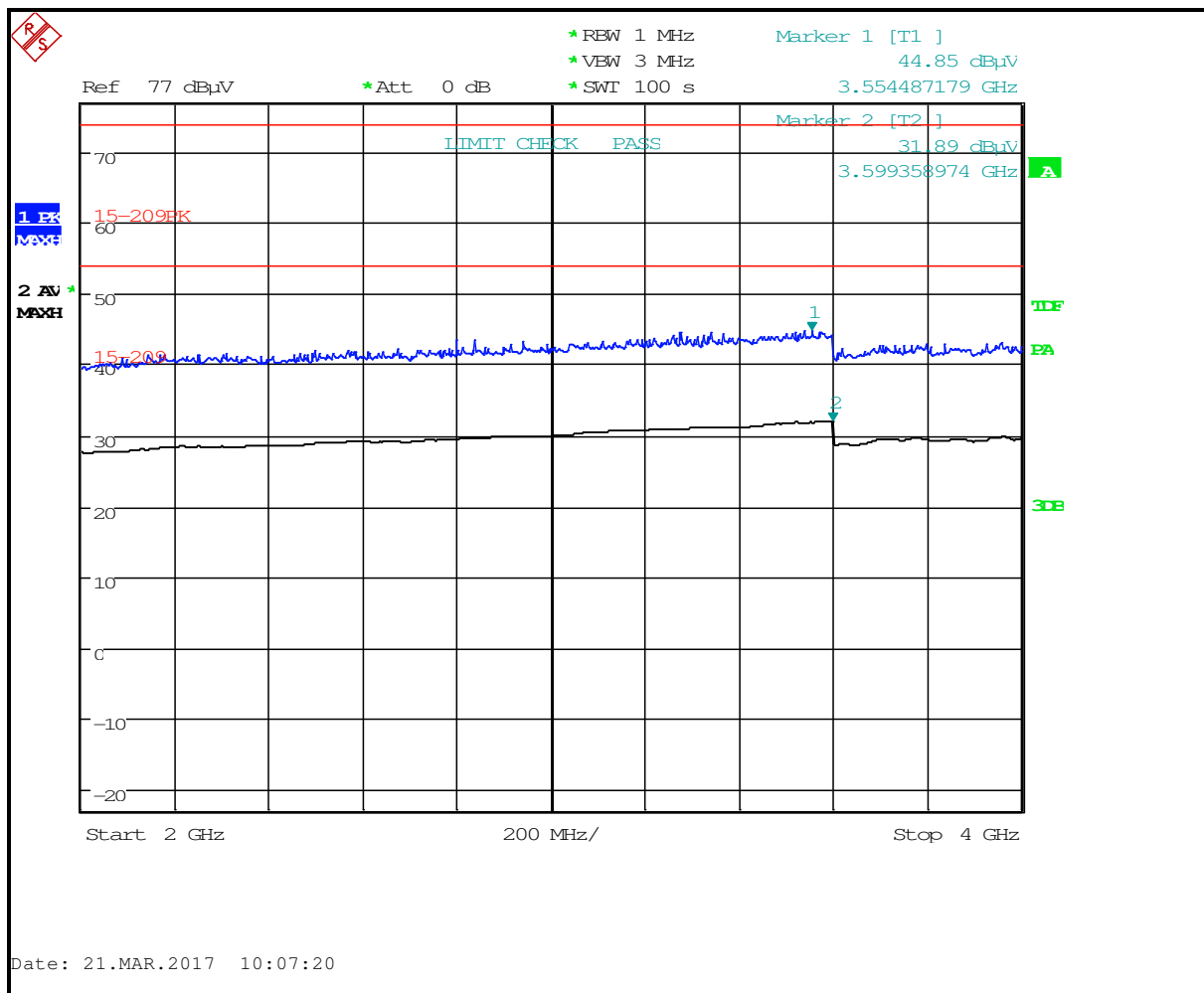


Table 5-13: Radiated Emissions (2 – 4 GHz) (TC #1)

Frequency (MHz)	Corrected EIRP Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
3554.487	44.9	74.0	-29.1				Peak
3599.359	31.9	54.0	-22.1				Average
3599.359	31.9			-63.3	-41.3	-22.0	Average

Plot 5-4: Radiated Emissions (4 – 8.2 GHz) (TC #1)

Horizontal

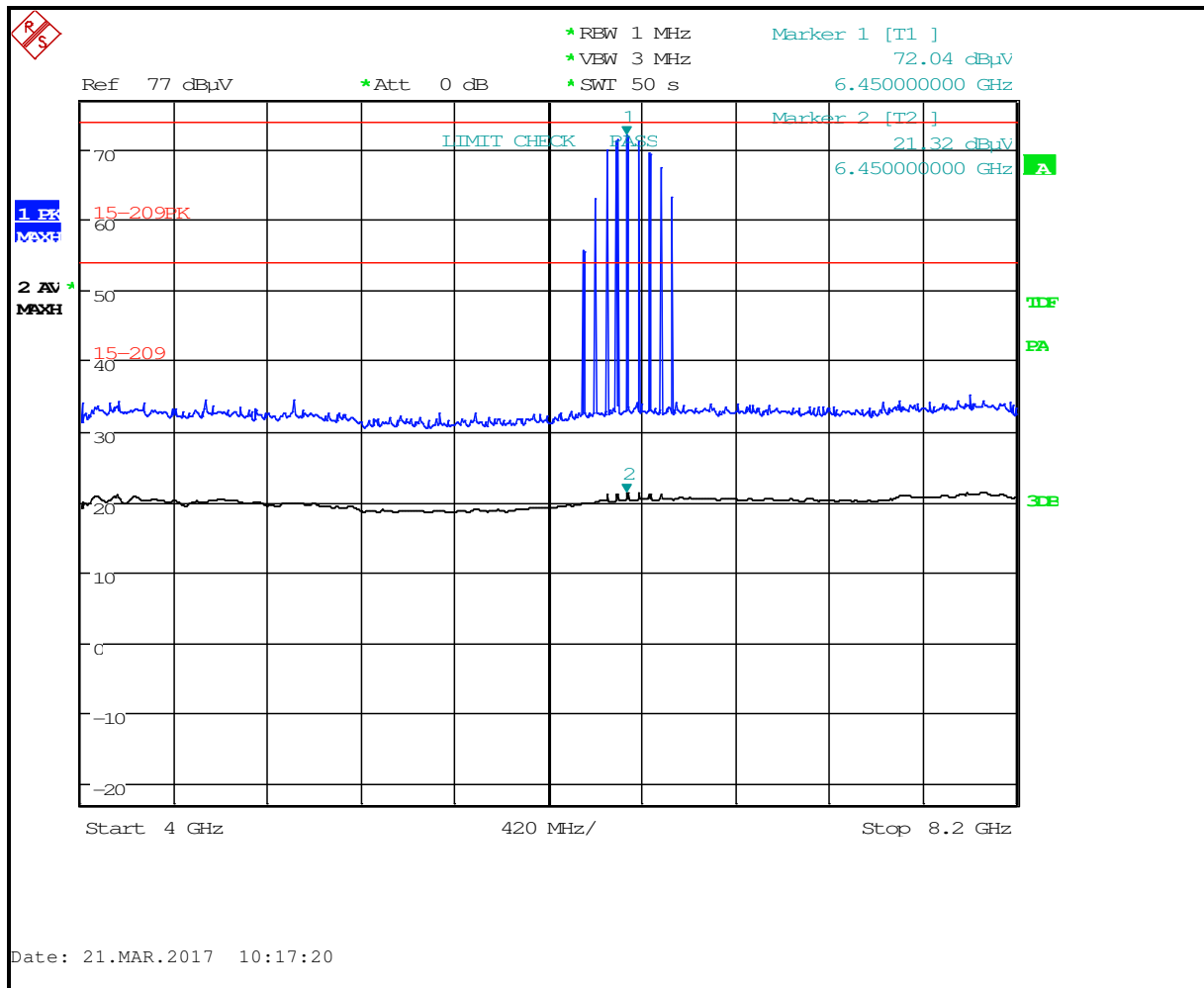


Table 5-14: Radiated Emissions (4 – 8.2 GHz) (TC #1)

Frequency (MHz)	Corrected EIRP Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
6450.000	72.0	74.0	-2.0				Peak
6450.000	21.3	54.0	-32.7				Average
6450.000	21.3			-73.9	-41.3	-32.6	Average

Plot 5-5: Radiated Emissions (8.2 – 12.4 GHz) (TC #1)

Horizontal

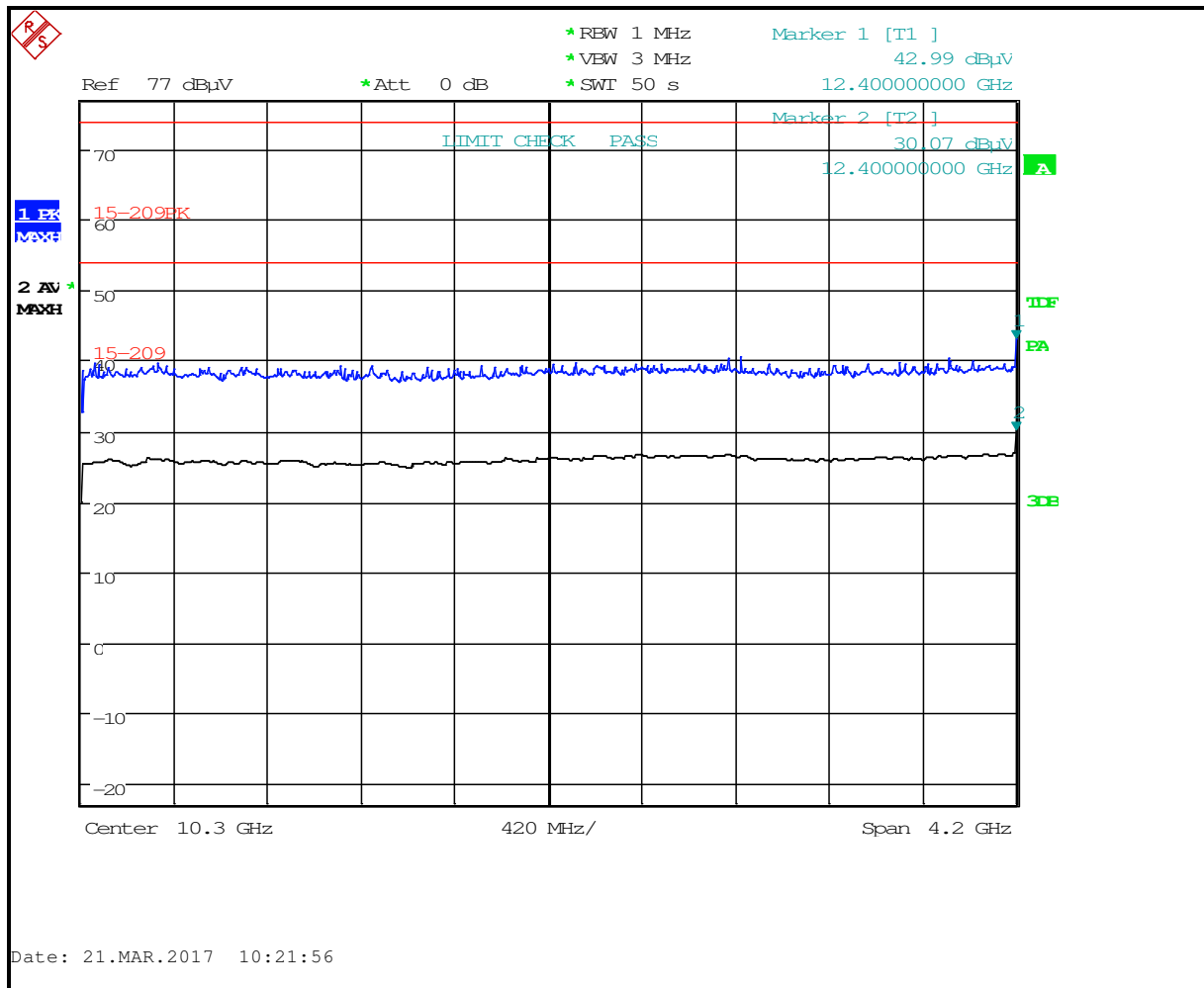


Table 5-15: Radiated Emissions (8.2 – 12.4 GHz) (TC #1)

Frequency (MHz)	Corrected EIRP Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
12400.000	43.0	74.0	-31.0				Peak
12400.000	30.0	54.0	-24.0				Average
12400.000	30.0			-65.2	-41.3	-23.9	Average

Plot 5-7: Radiated Emissions (18 – 26.5 GHz) (TC #1)

Vertical

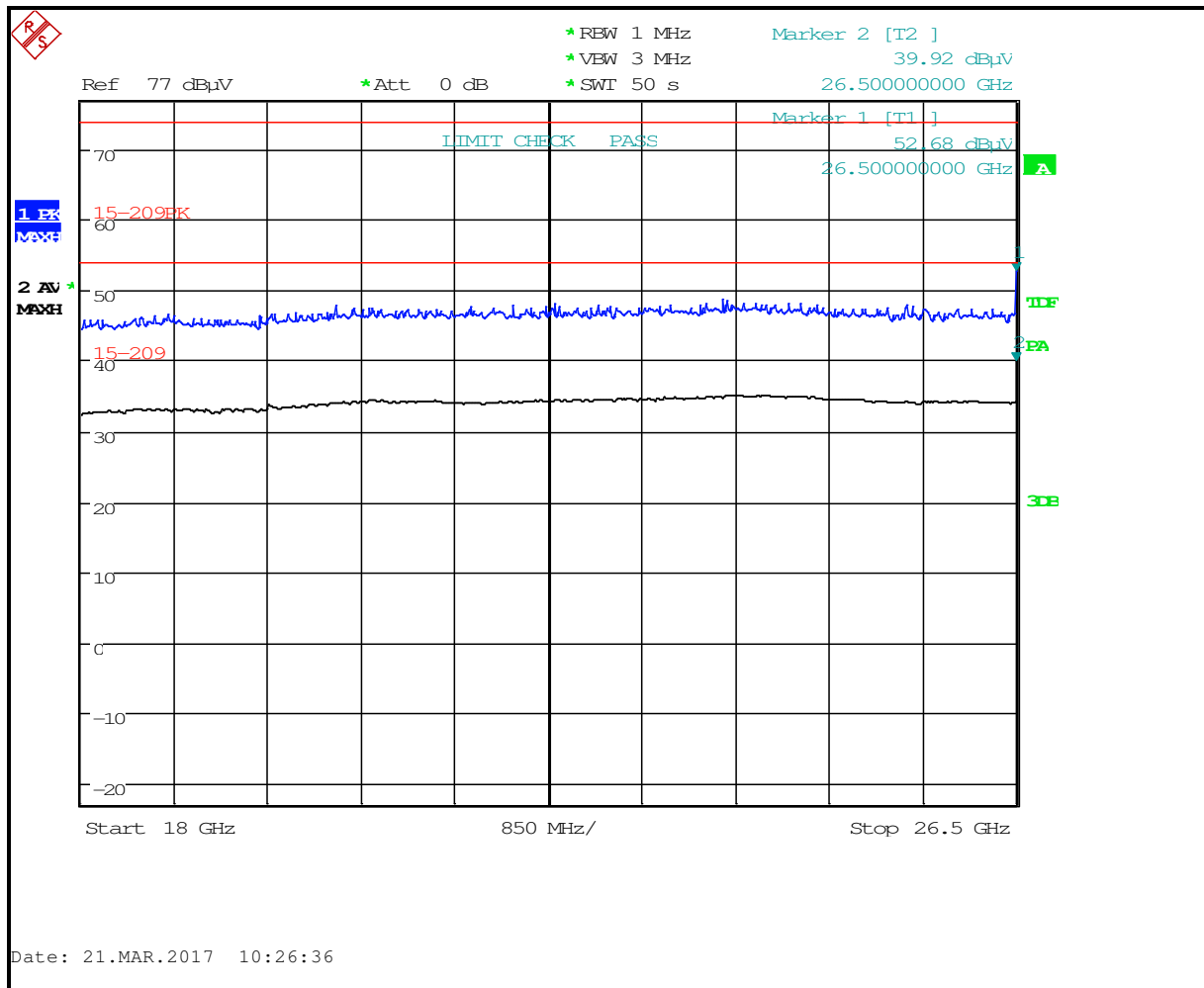


Table 5-17: Radiated Emissions (18 – 26.5 GHz) (TC #1)

Frequency (MHz)	Corrected EIRP Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
26500.000	52.7	74.0	-21.3				Peak
26500.000	39.9	54.0	-14.1				Average
26500.000	39.9			-55.3	-41.3	-14.0	Average

Plot 5-8: Radiated Emissions (26.5 – 40 GHz) (TC #1)

Vertical

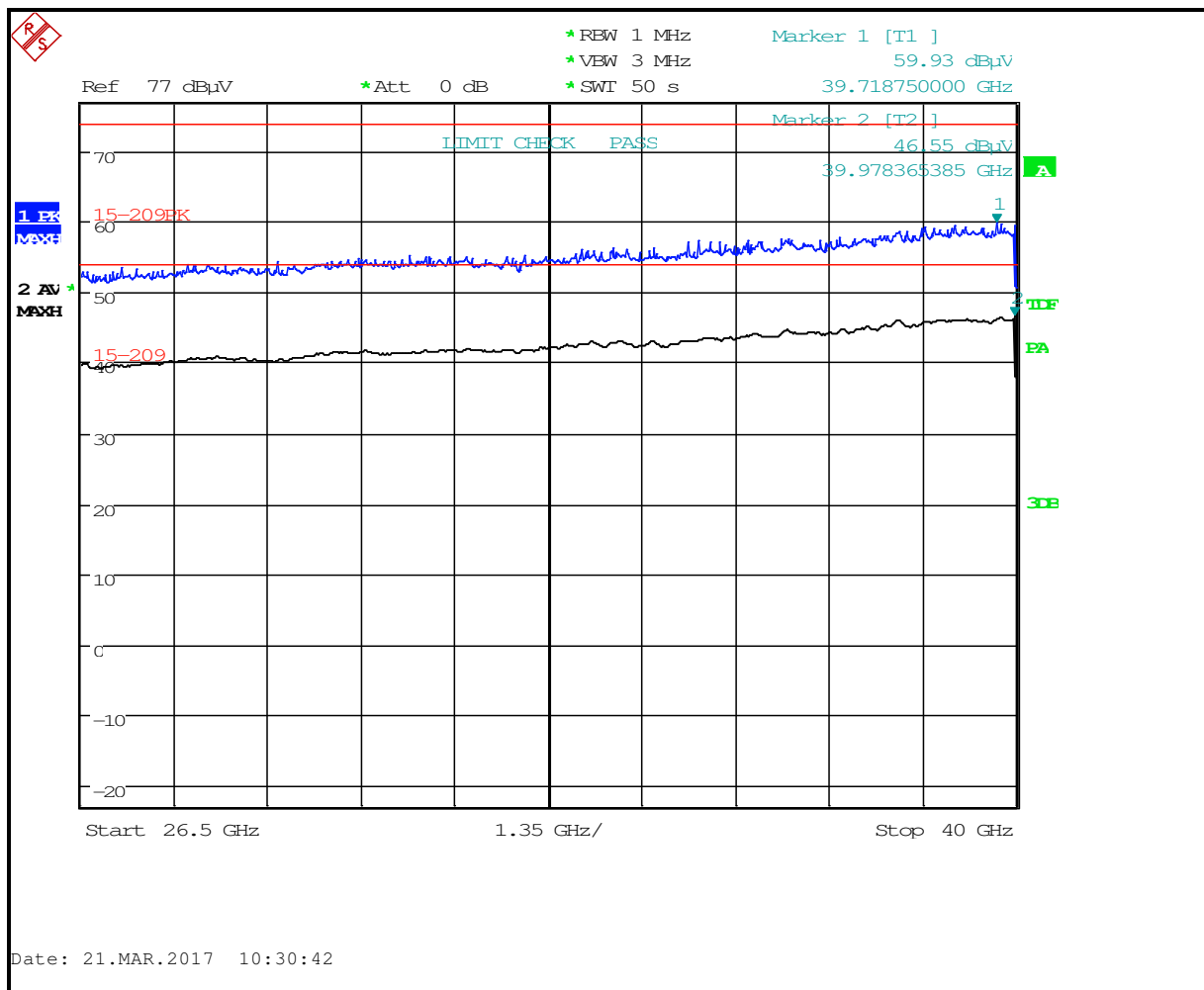


Table 5-18: Radiated Emissions (26.5 – 40 GHz) (TC #1)

Frequency (MHz)	Corrected EIRP Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
39718.750	59.9	74.0	-14.1				Peak
39978.365	46.6	54.0	-7.4				Average
39978.365	46.6			-48.6	-41.3	-7.3	Average

Plot 5-9: Radiated Emissions (30-1000 MHz) (TC #2)

Vertical

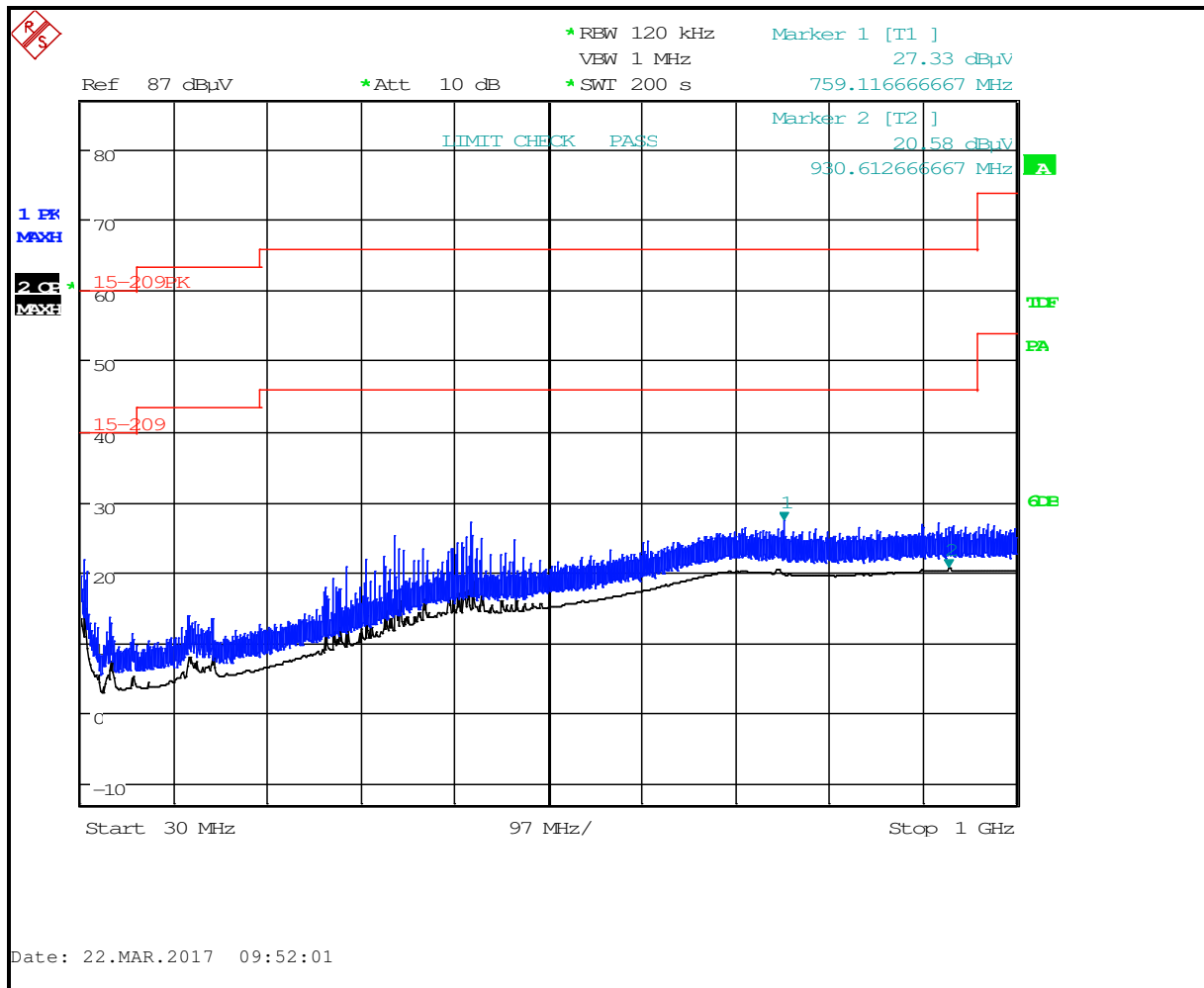


Table 5-19: Radiated Emissions (30-1000 MHz) (TC #2)

Frequency (MHz)	Corrected EIRP Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
759.117	27.3	74.0	-46.7	-74.6	-41.3	-33.3	Peak
930.613	20.6	54.0	-33.4				Quasi-Peak
930.613	20.6						Quasi-Peak

Plot 5-10: Radiated Emissions (1 – 2 GHz) (TC #2)

Vertical

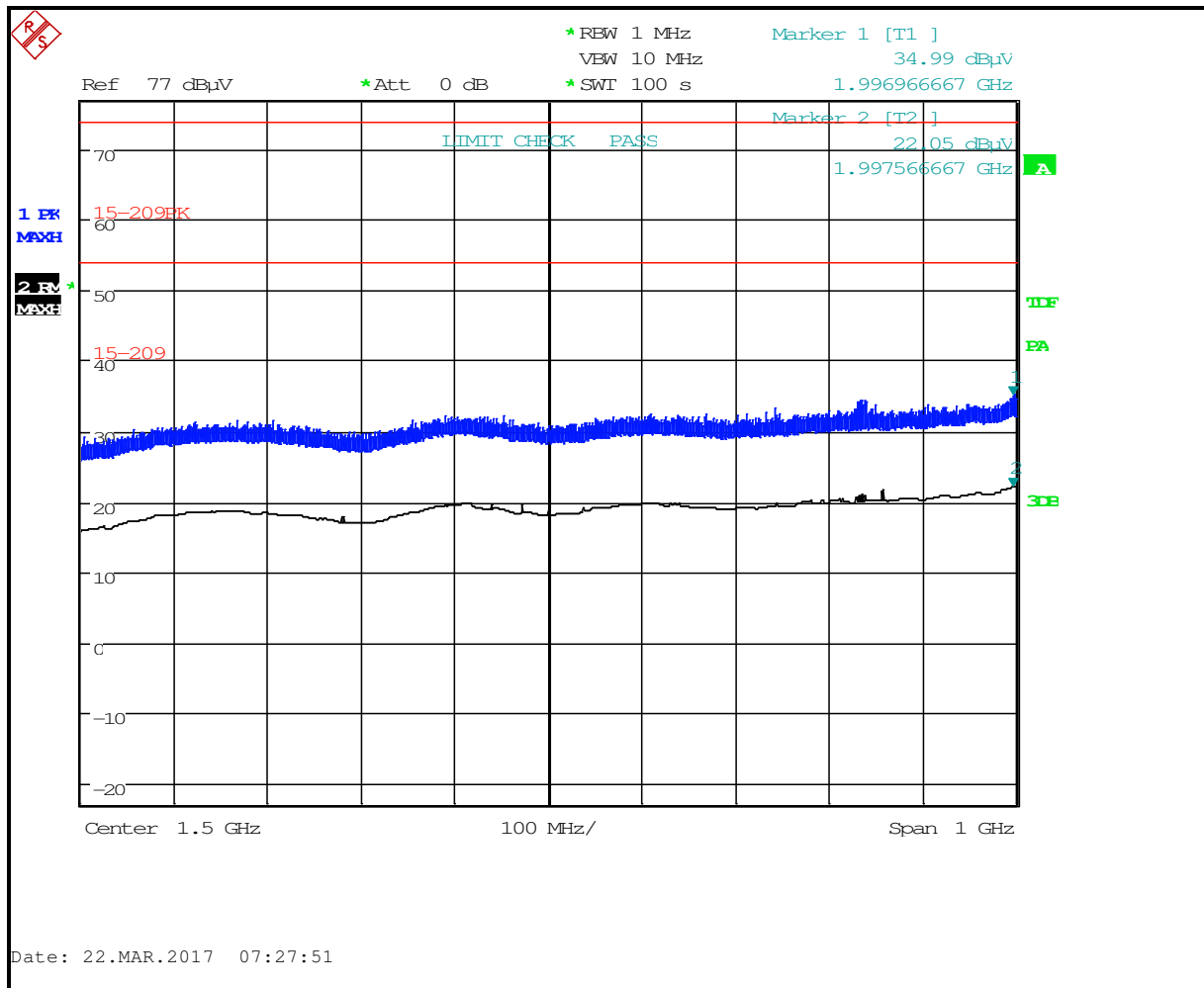


Table 5-20: Radiated Emissions (1 – 2 GHz) (TC #2)

Frequency (MHz)	Corrected EIRP Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
1996.967	35.0	74.0	-39.0				Peak
1997.567	22.1	54.0	-31.9				Average
1997.567	22.1			-73.1	-41.3	-31.8	Average

Plot 5-12: Radiated Emissions (4 – 8.2 GHz) (TC #2)

Vertical

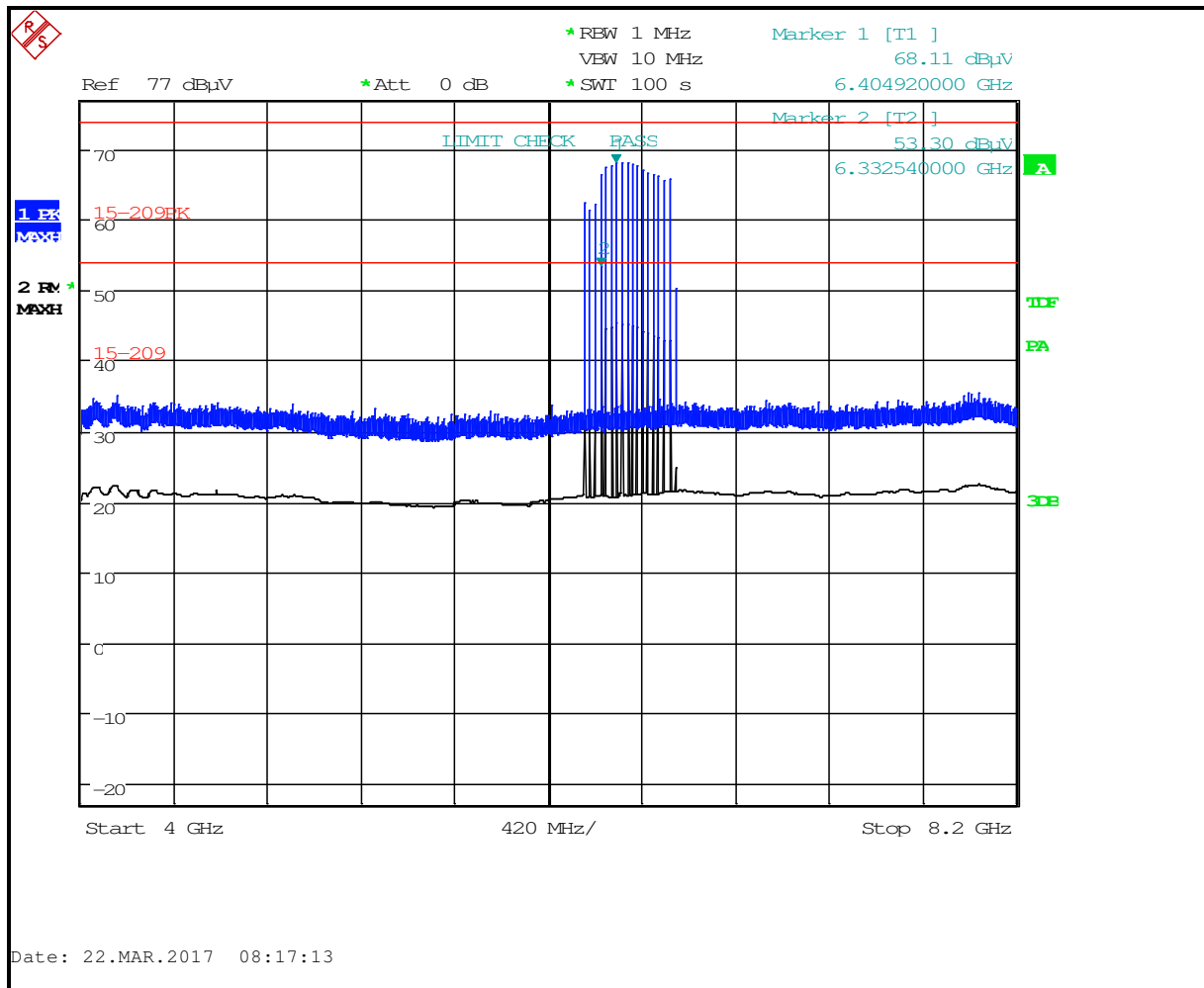


Table 5-22: Radiated Emissions (4 – 8.2 GHz) (TC #2)

Frequency (MHz)	Corrected EIRP Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
6404.920	68.1	74.0	-5.9				Peak
6332.540	53.3	54.0	-0.7				Average
6332.540	53.3			-41.9	-41.3	-0.6	Average

Plot 5-13: Radiated Emissions (8.2 – 12.4 GHz) (TC #2)

Horizontal

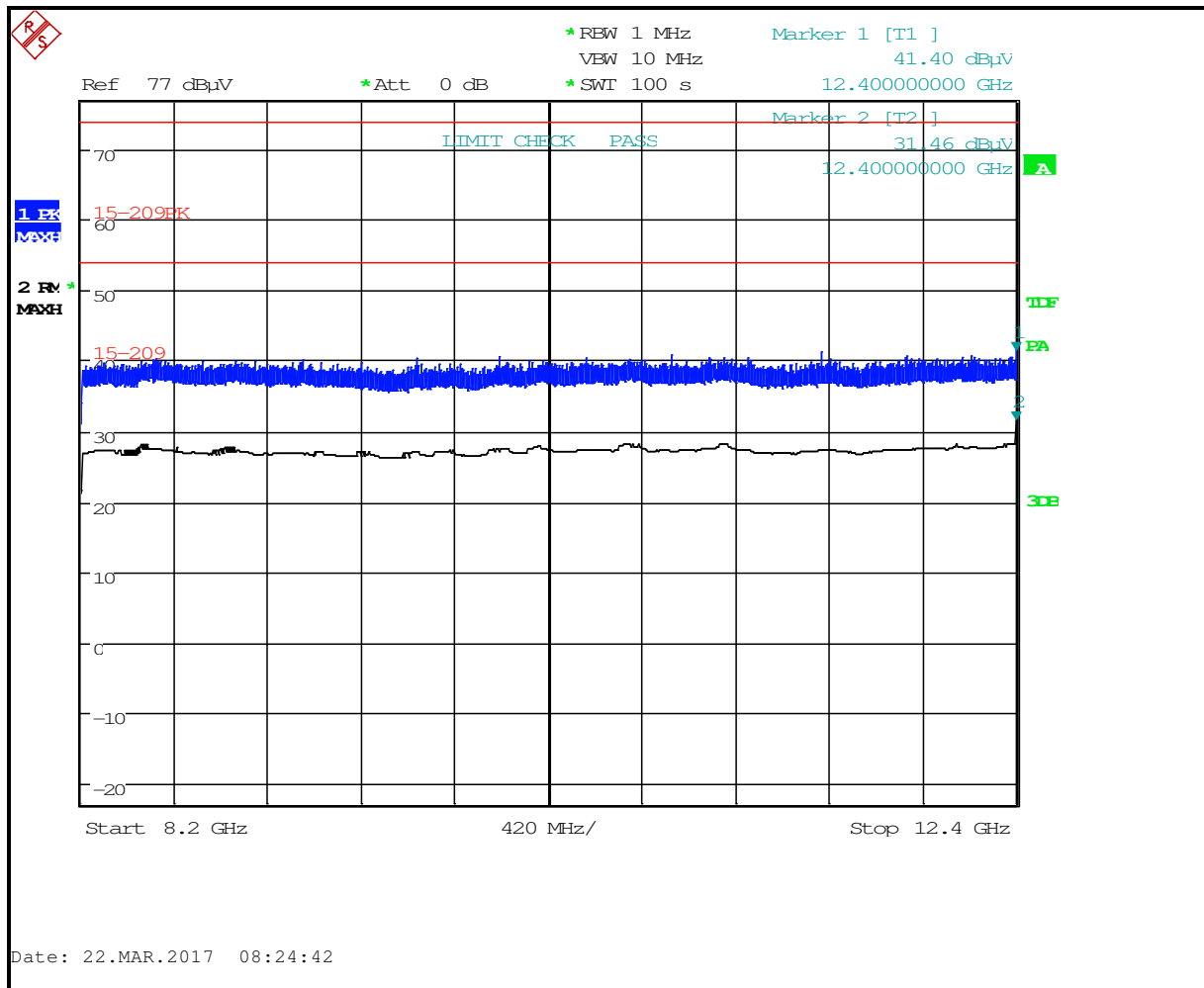


Table 5-23: Radiated Emissions (8.2 – 12.4 GHz) (TC #2)

Frequency (MHz)	Corrected EIRP Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
12400.000	41.4	74.0	-32.6				Peak
12400.000	31.5	54.0	-22.5				Average
12400.000	31.5			-63.7	-41.3	-22.4	Average

Plot 5-14: Radiated Emissions (12.4 – 18 GHz) (TC #2)

Vertical

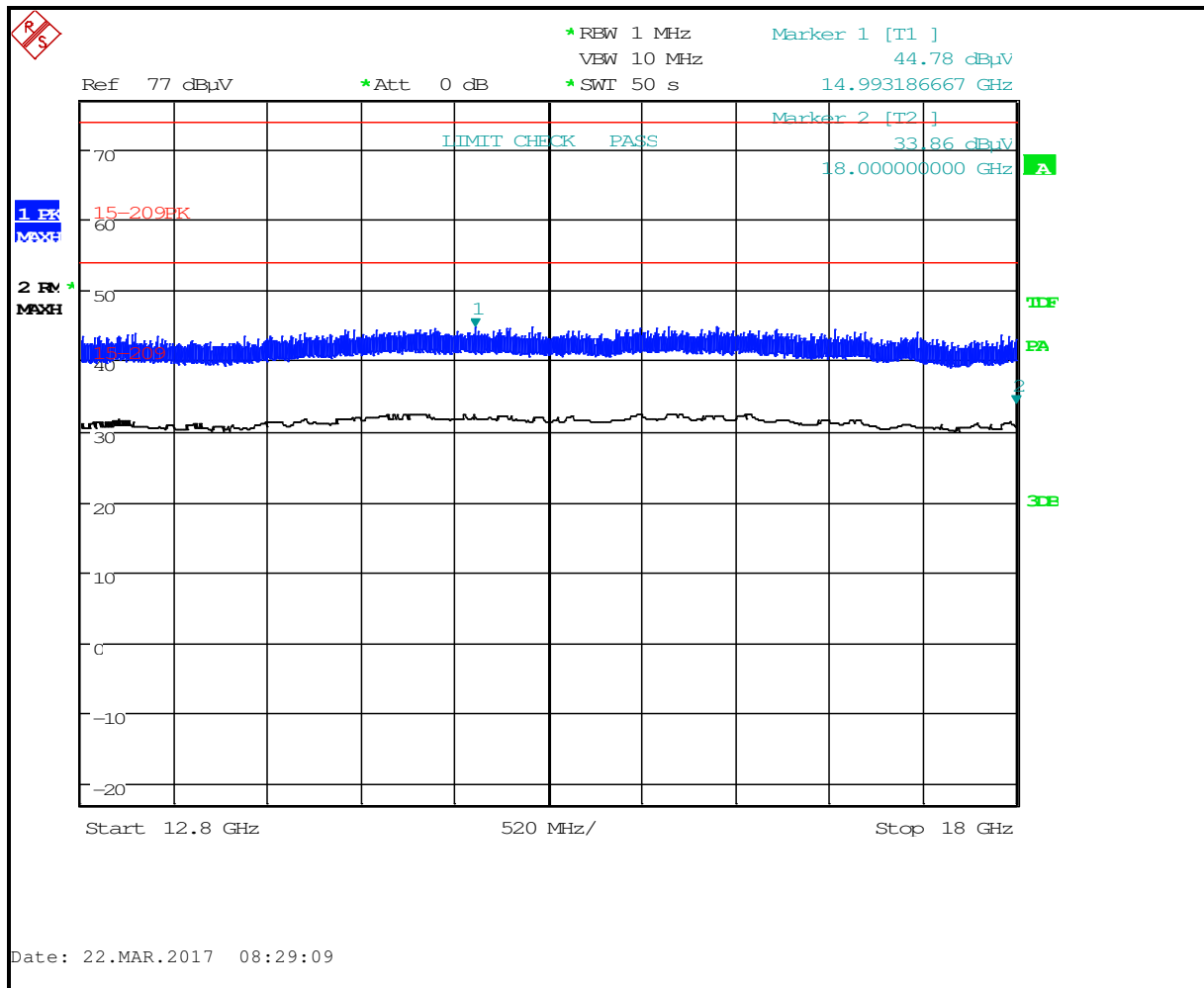


Table 5-24: Radiated Emissions (12.4 – 18 GHz) (TC #2)

Frequency (MHz)	Corrected EIRP Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
14993.187	44.8	74.0	-29.2				Peak
18000.000	33.9	54.0	-20.1				Average
18000.000	33.9			-61.3	-41.3	-20.0	Average

Plot 5-15: Radiated Emissions (18 – 26.5 GHz) (TC #2)

Horizontal

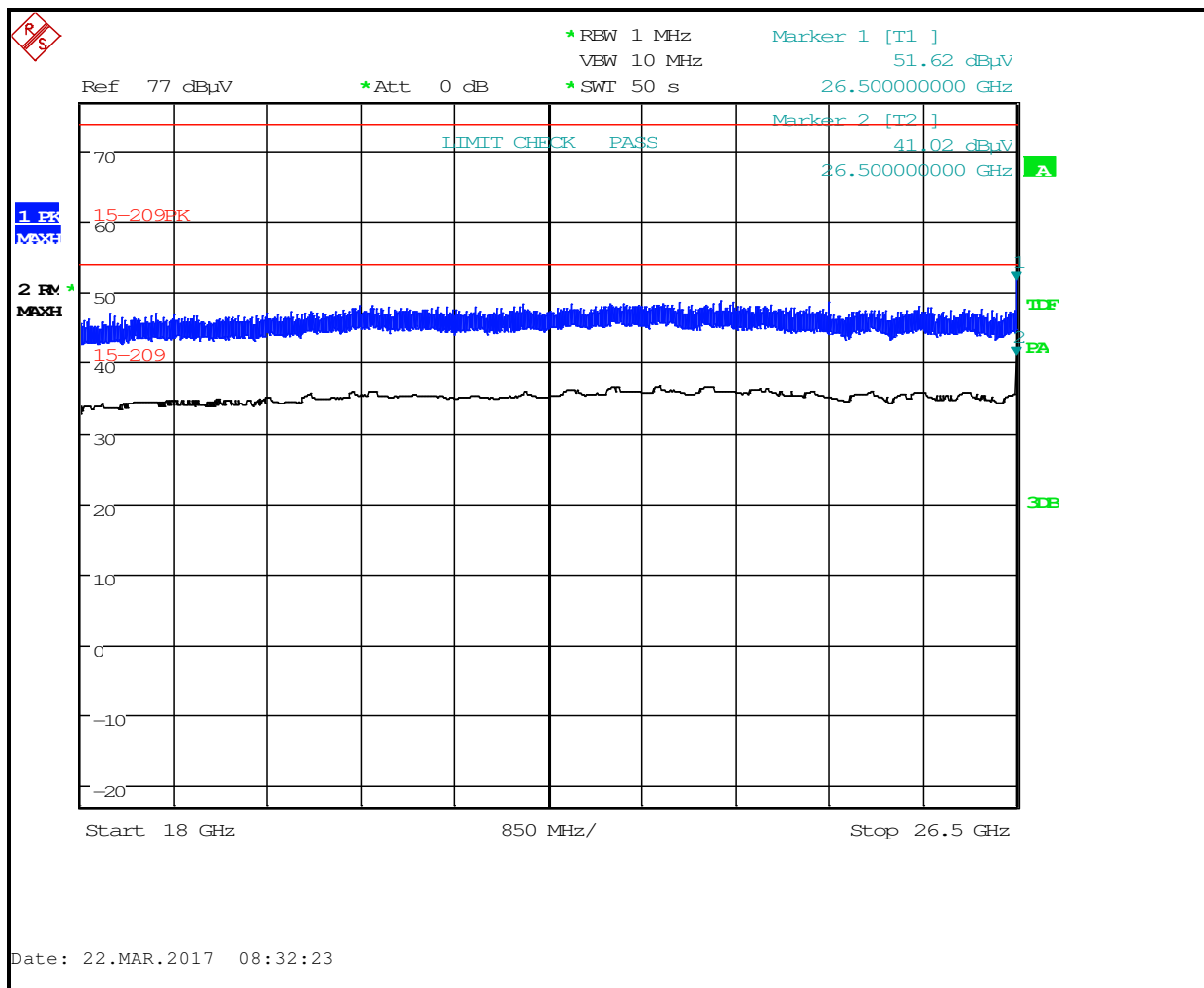


Table 5-25: Radiated Emissions (18 – 26.5 GHz) (TC #2)

Frequency (MHz)	Corrected EIRP Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
26500.000	51.6	74.0	-22.4				Peak
26500.000	41.0	54.0	-13.0				Average
26500.000	41.0			-54.2	-41.3	-12.9	Average

Plot 5-16: Radiated Emissions (26.5 – 40 GHz) (TC #2)

Vertical

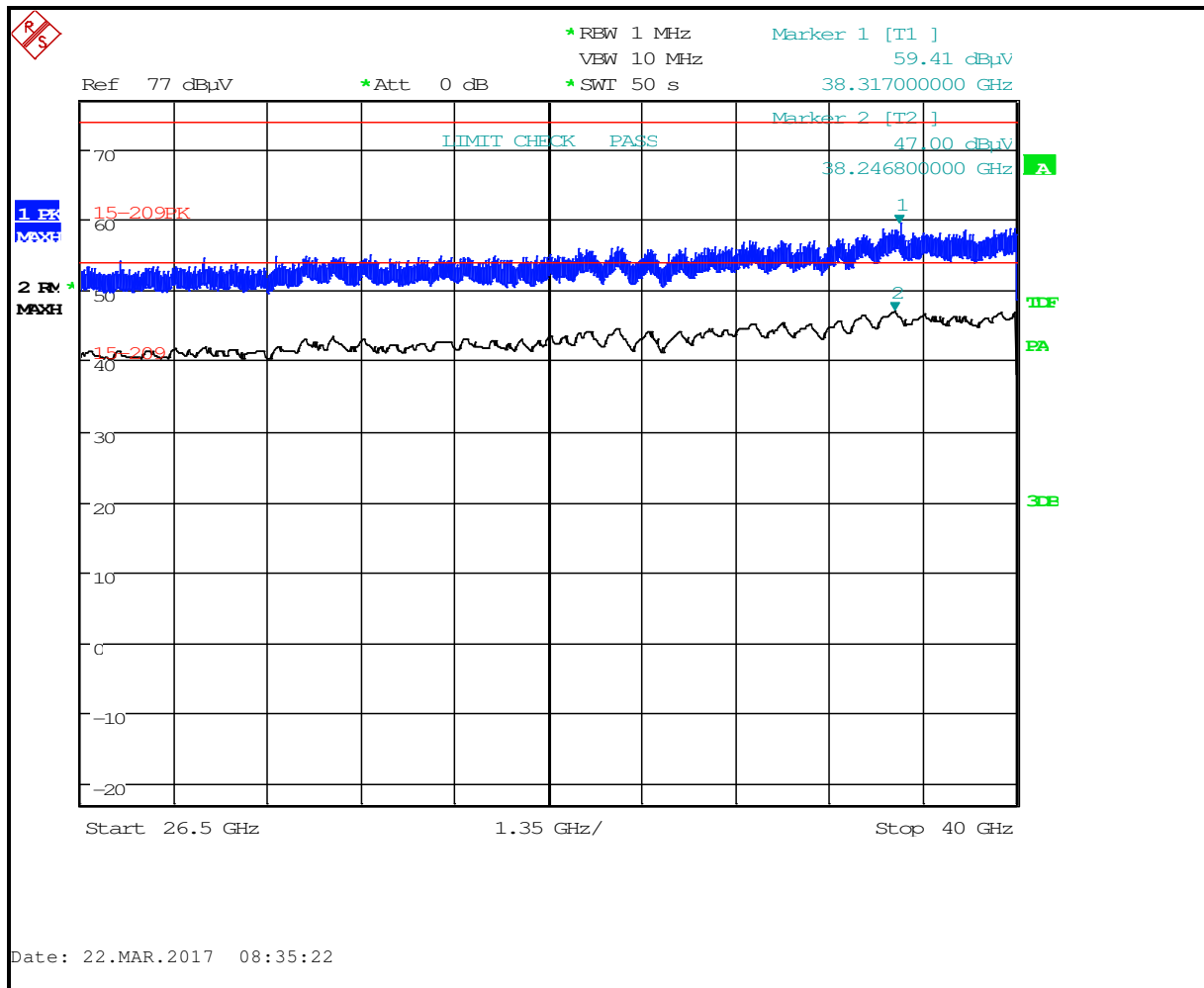


Table 5-26: Radiated Emissions (26.5 – 40 GHz) (TC #2)

Frequency (MHz)	Corrected EIRP Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
38317.000	59.4	74.0	-14.6				Peak
38246.800	47.0	54.0	-7.0				Average
38246.800	47.0			-48.2	-41.3	-6.9	Average

Plot 5-17: Radiated Emissions (30 – 1000 MHz) (TC #3)

Vertical

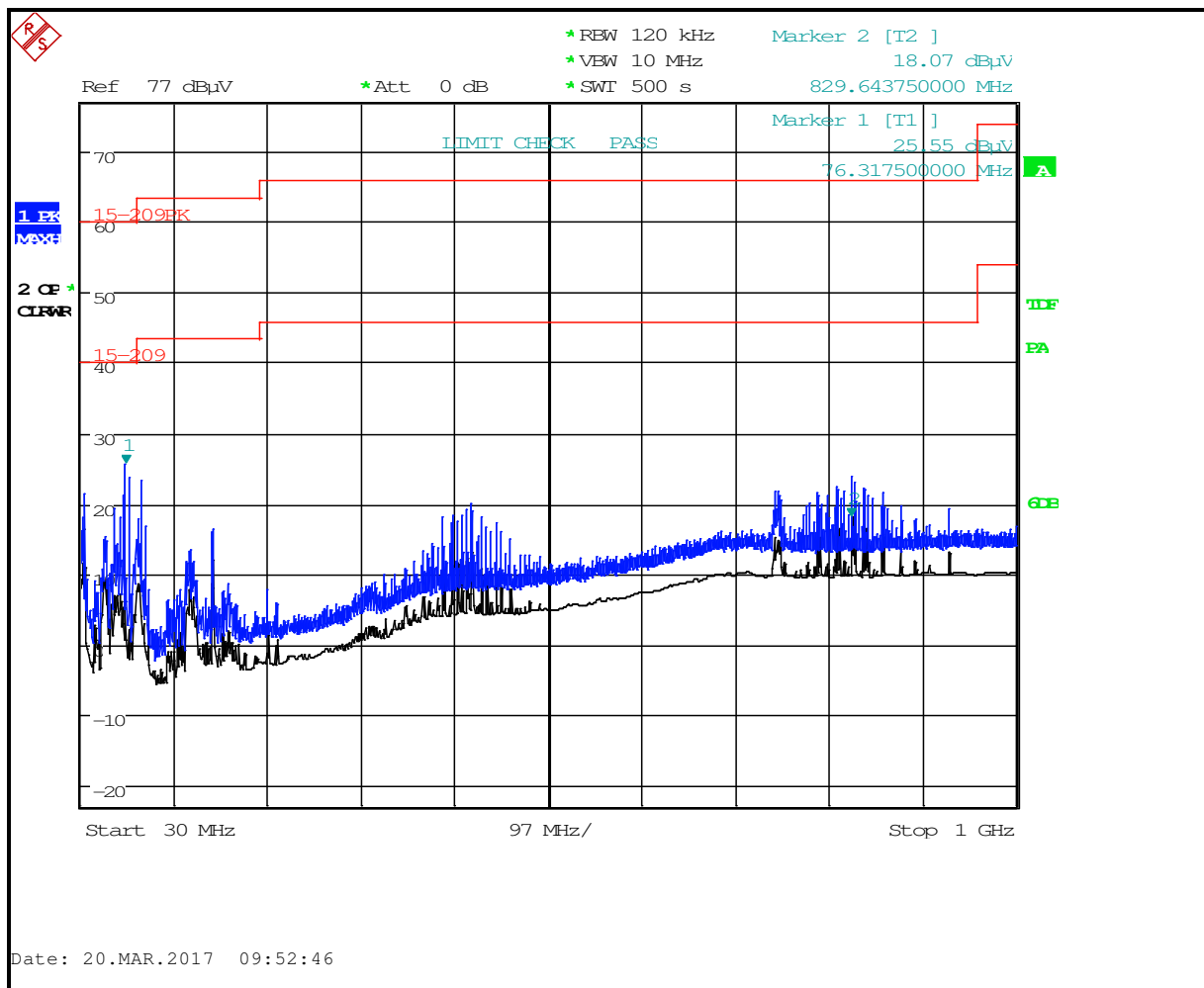


Table 5-27: Radiated Emissions (30 – 1000 MHz) (TC #3)

Frequency (MHz)	Corrected EIRP Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
76.318	25.6	74.0	-48.4	-77.1	-41.3	-35.8	Peak
829.644	18.1	54.0	-35.9				Quasi-Peak
829.644	18.1						Quasi-Peak

Plot 5-18: Radiated Emissions (1 – 2 GHz) (TC #3)

Horizontal

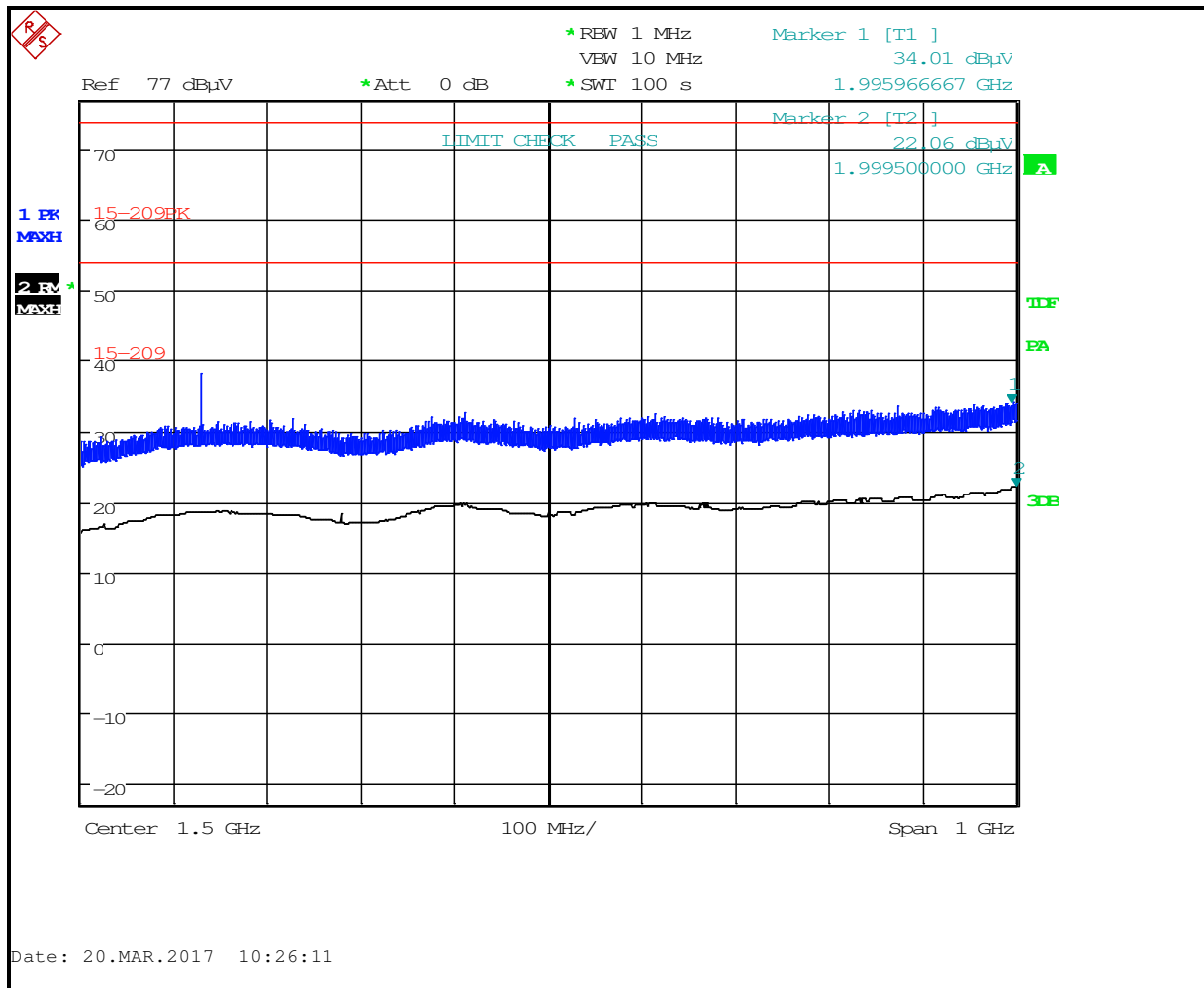


Table 5-28: Radiated Emissions (1 – 2 GHz) (TC #3)

Frequency (MHz)	Corrected EIRP Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
1995.967	34.0	74.0	-40.0				Peak
1999.500	22.1	54.0	-31.9				Average
1999.500	22.1			-73.1	-41.3	-31.8	Average

Plot 5-20: Radiated Emissions (4 – 8.2 GHz) (TC #3)

Vertical

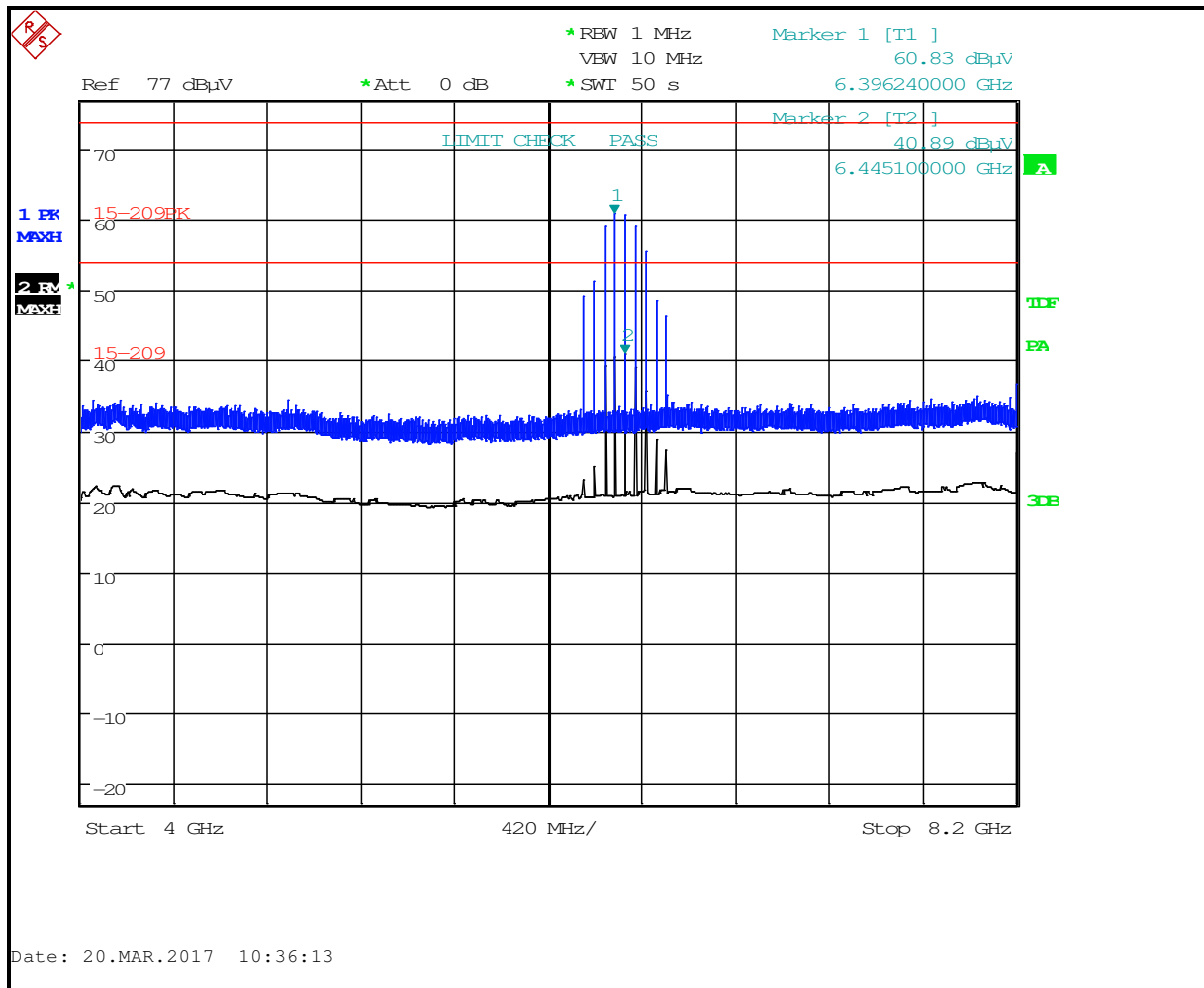


Table 5-30: Radiated Emissions (4 – 8.2 GHz) (TC #3)

Frequency (MHz)	Corrected EIRP Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
6396.240	60.8	74.0	-13.2				Peak
6445.100	40.9	54.0	-13.1				Average
6445.100	40.9			-54.3	-41.3	-13.0	Average

Plot 5-21: Radiated Emissions (8.2 – 12.4 GHz) (TC #3)

Horizontal

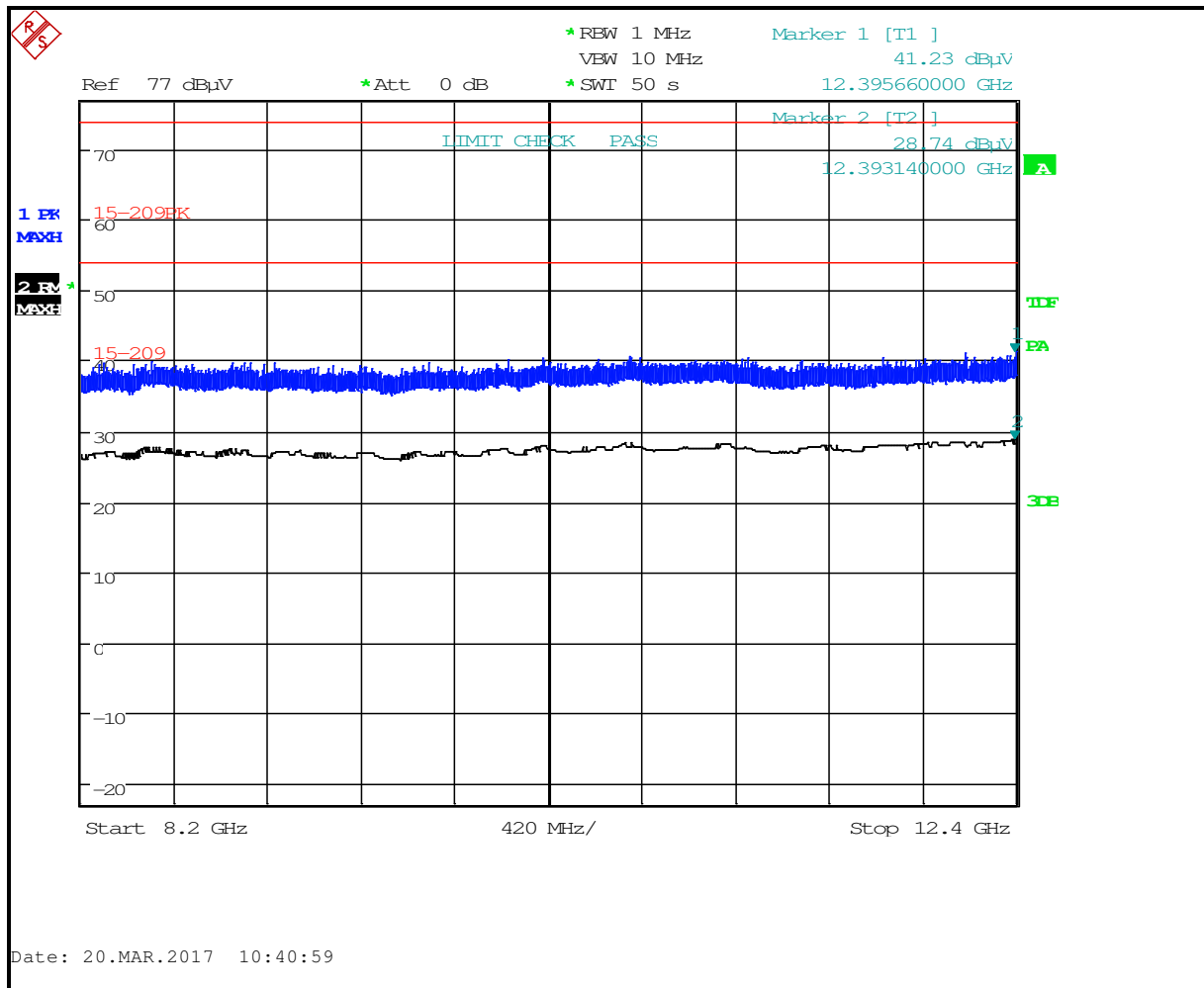


Table 5-31: Radiated Emissions (8.2 – 12.4 GHz) (TC #3)

Frequency (MHz)	Corrected EIRP Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
12395.660	41.2	74.0	-32.8				Peak
12393.140	28.7	54.0	-25.3				Average
12393.140	28.7			-66.5	-41.3	-25.2	Average

Plot 5-23: Radiated Emissions (18 – 26.5 GHz) (TC #3)

Vertical

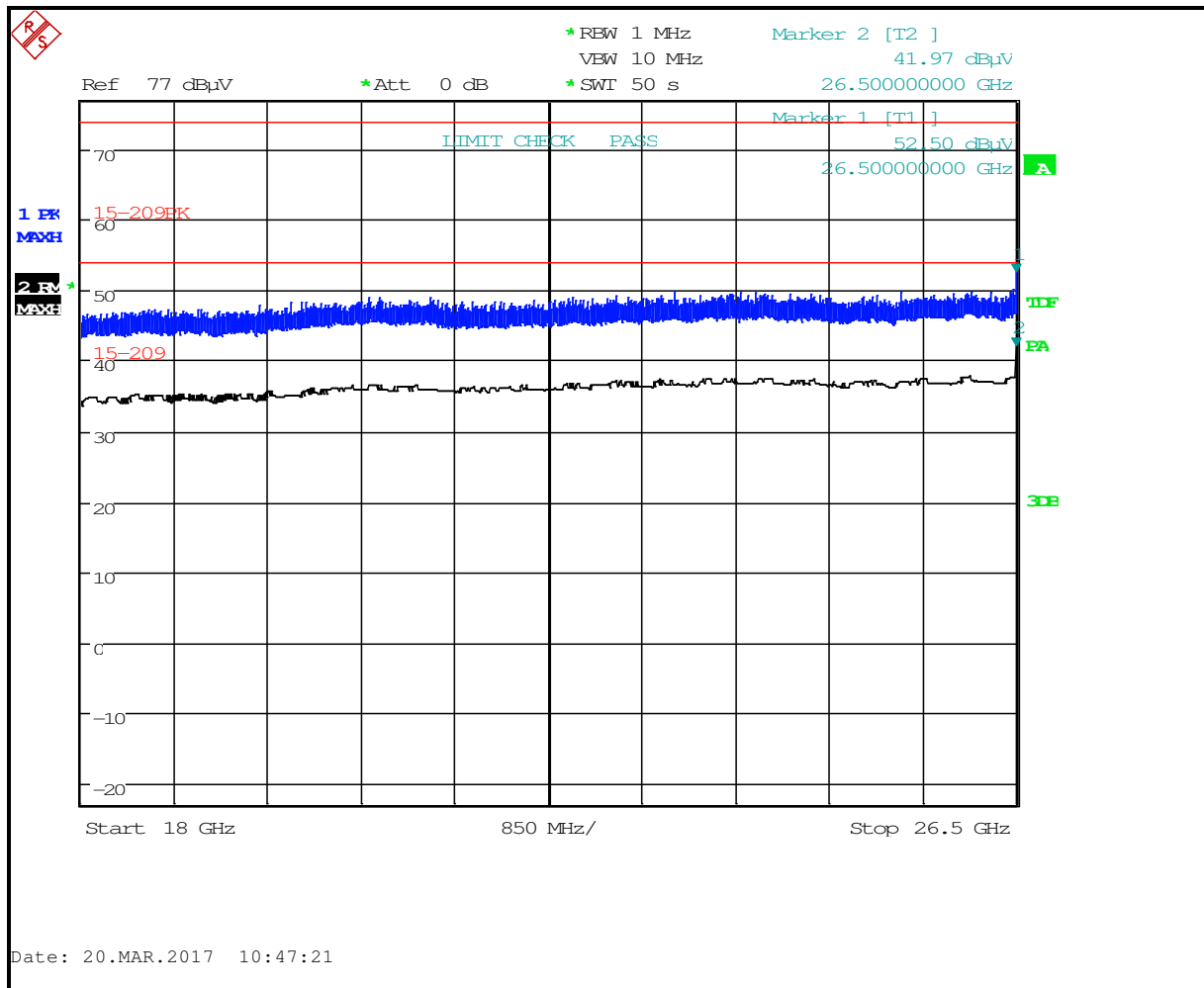


Table 5-33: Radiated Emissions (18 – 26.5 GHz) (TC #3)

Frequency (MHz)	Corrected EIRP Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
26500.000	52.5	74.0	-21.5				Peak
26500.000	42.0	54.0	-12.0				Average
26500.000	42.0			-53.2	-41.3	-11.9	Average

Plot 5-24: Radiated Emissions (26.5 – 40 GHz) (TC #3)

Horizontal

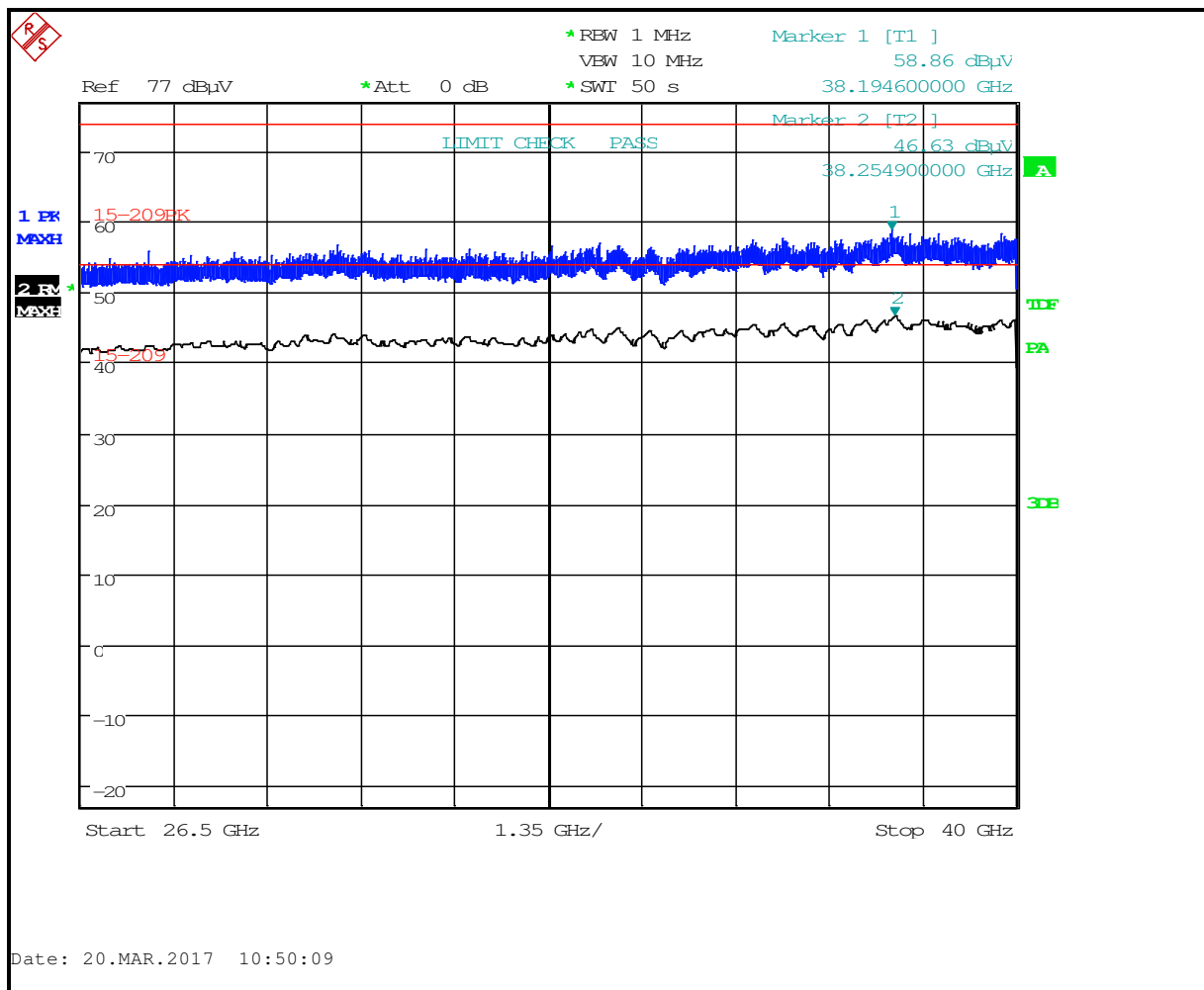


Table 5-34: Radiated Emissions (26.5 – 40 GHz) (TC #3)

Frequency (MHz)	Corrected EIRP Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
38194.600	58.9	74.0	-15.1				Peak
38254.900	46.6	54.0	-7.4				Average
38254.900	46.6			-48.6	-41.3	-7.3	Average

5.3.2.2 Steel Drum

Plot 5-25: Radiated Emissions (30 – 1000 MHz) (TC #1)

Vertical

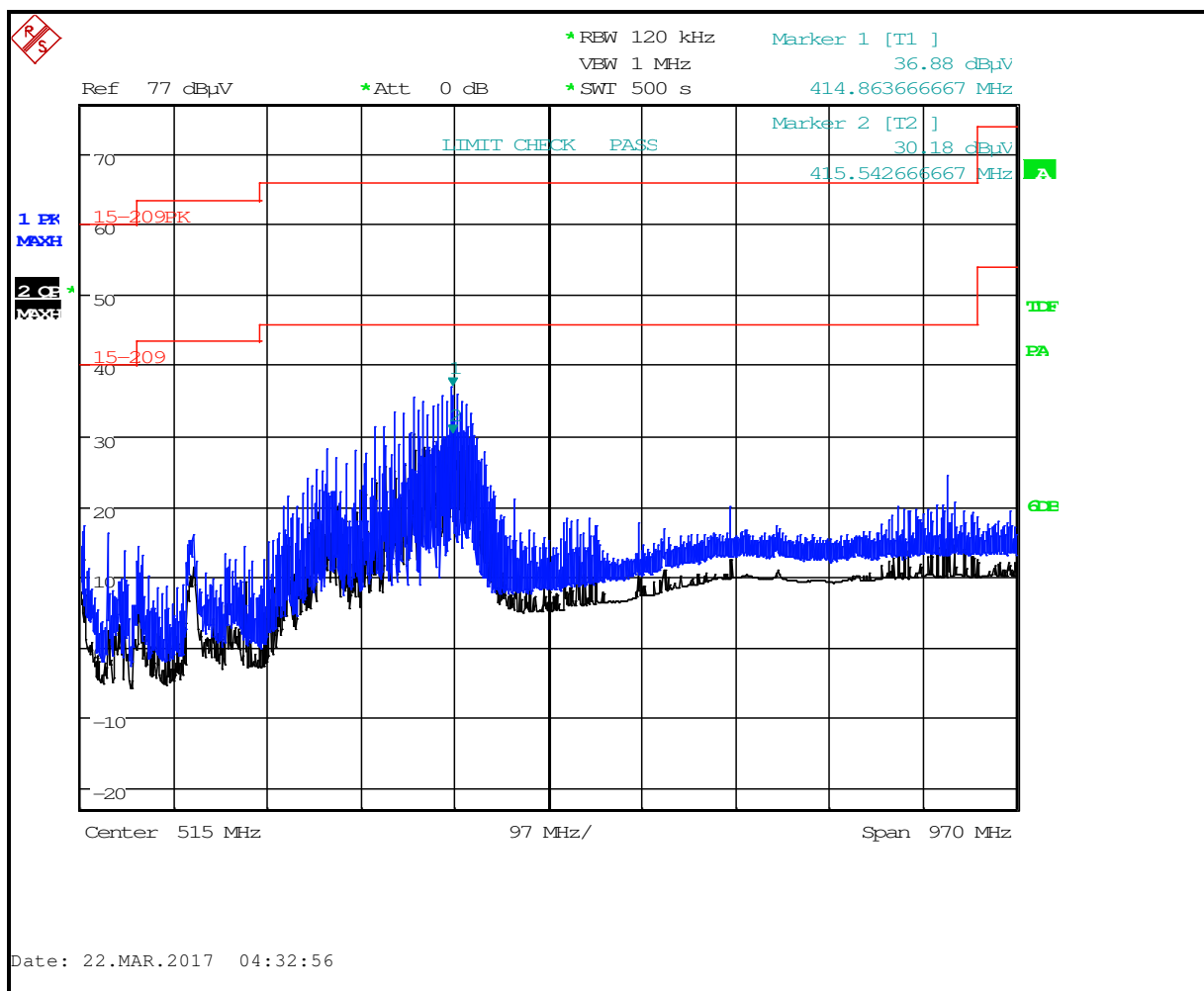


Table 5-35: Radiated Emissions (30 – 1000 MHz) (TC #1)

Frequency (MHz)	Corrected EIRP Measured (dBμV)	Limit (dBμV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/Average
414.864	36.9	74.0	-37.1	-65.0	-41.3	-23.7	Peak
415.543	30.2	54.0	-23.8				Quasi-Peak
415.543	30.2						Quasi-Peak

Plot 5-26: Radiated Emissions (1 – 2 GHz) (TC #1)

Vertical

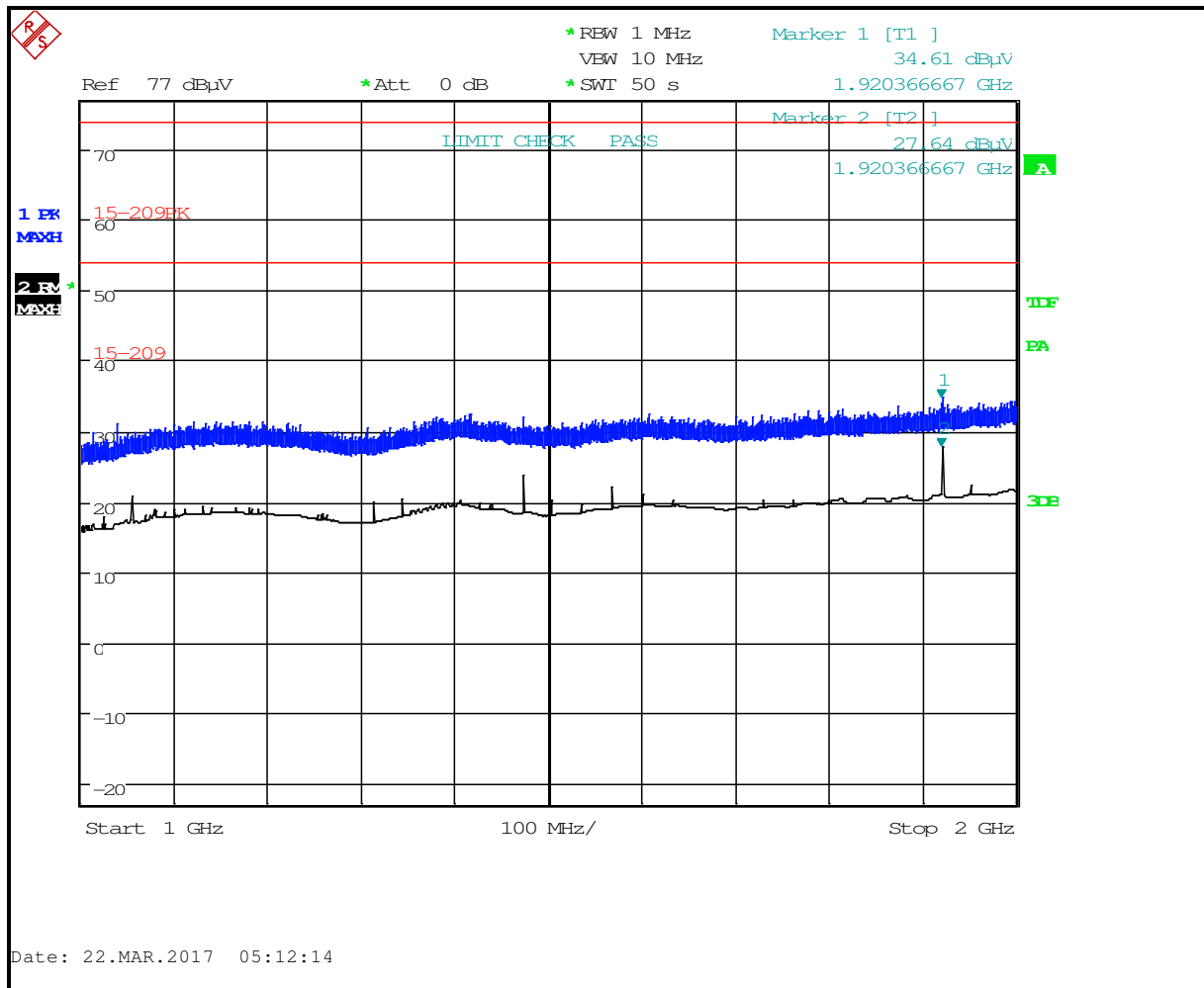


Table 5-36: Radiated Emissions (1 – 2 GHz) (TC #1)

Frequency (MHz)	Corrected EIRP Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
1920.367	34.6	74.0	-39.4				Peak
1920.367	27.6	54.0	-26.4				Average
1920.367	27.6			-67.6	-41.3	-26.3	Average

Plot 5-27: Radiated Emissions (2 – 4 GHz) (TC #1)

Horizontal

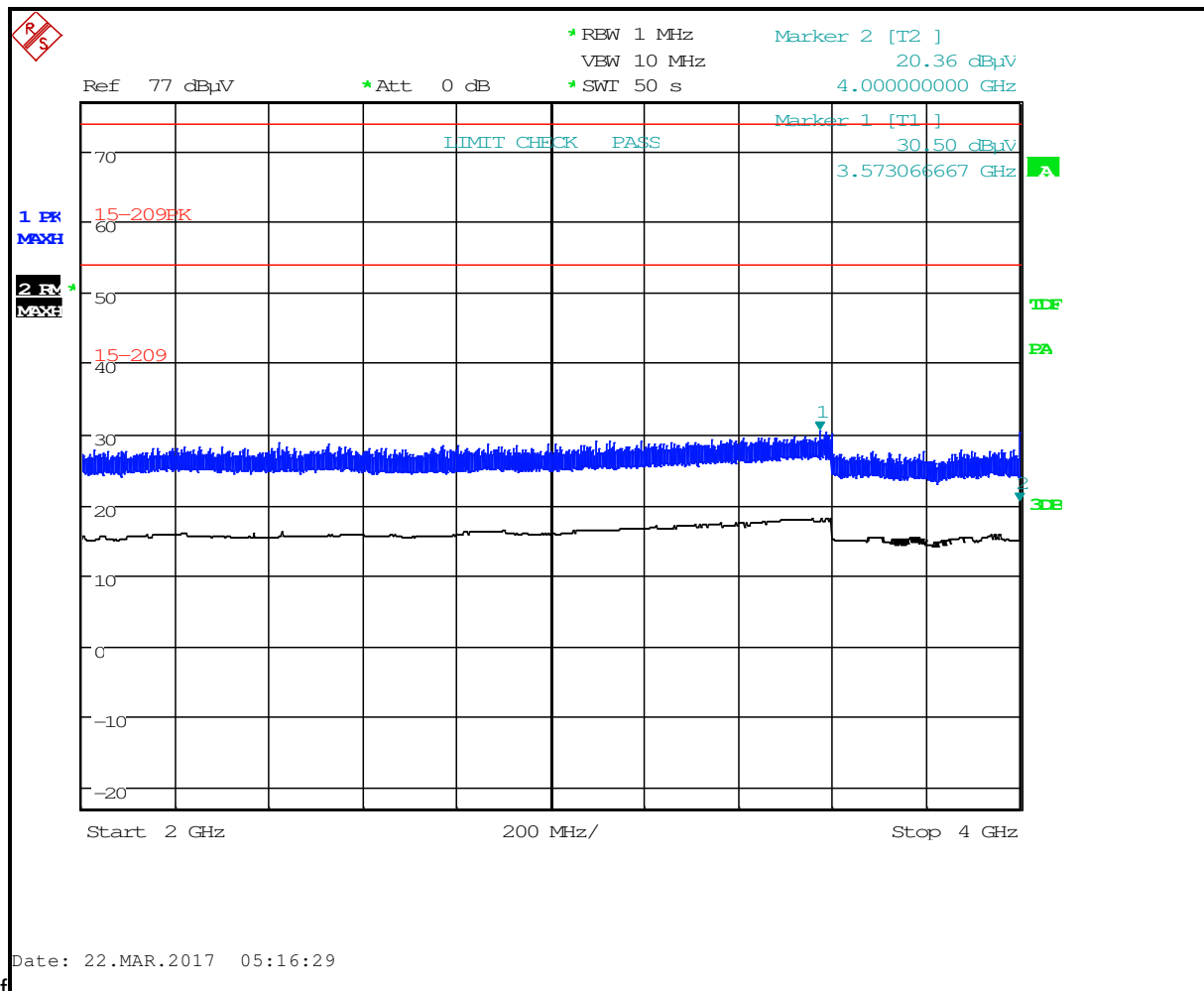


Table 5-37: Radiated Emissions (2 – 4 GHz) (TC #1)

Frequency (MHz)	Corrected EIRP Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
3573.067	30.5	74.0	-43.5				Peak
4000.000	20.4	54.0	-33.6				Average
4000.000	20.4			-74.8	-41.3	-33.5	Average

Plot 5-28: Radiated Emissions (4 – 8.2 GHz) (TC #1)

Vertical

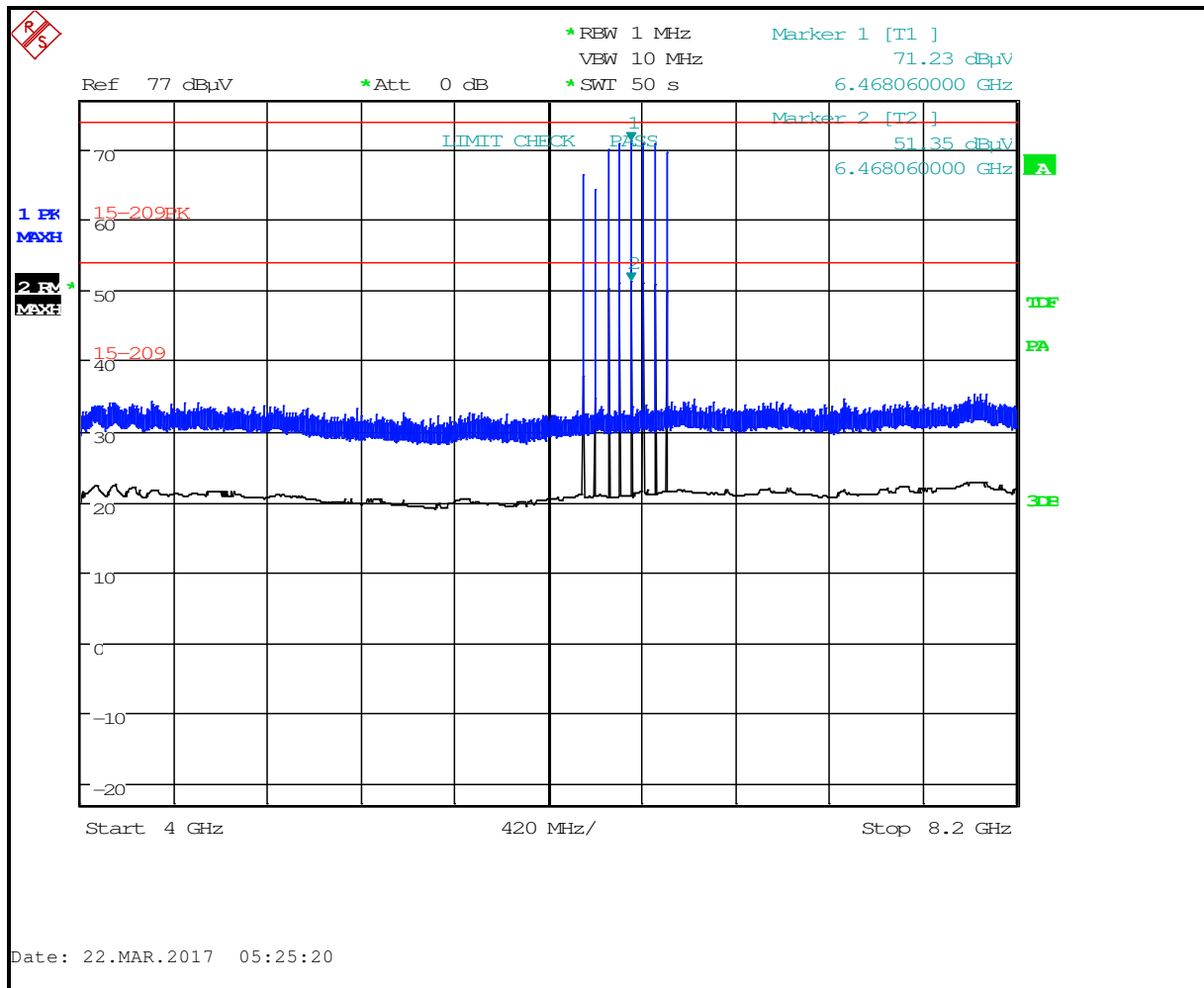


Table 5-38: Radiated Emissions (4 – 8.2 GHz) (TC #1)

Frequency (MHz)	Corrected EIRP Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
6468.060	71.2	74.0	-2.8				Peak
6468.060	51.4	54.0	-2.6				Average
6468.060	51.4			-43.8	-41.3	-2.5	Average

Plot 5-29: Radiated Emissions (8.2 – 12.4 GHz) (TC #1)

Horizontal

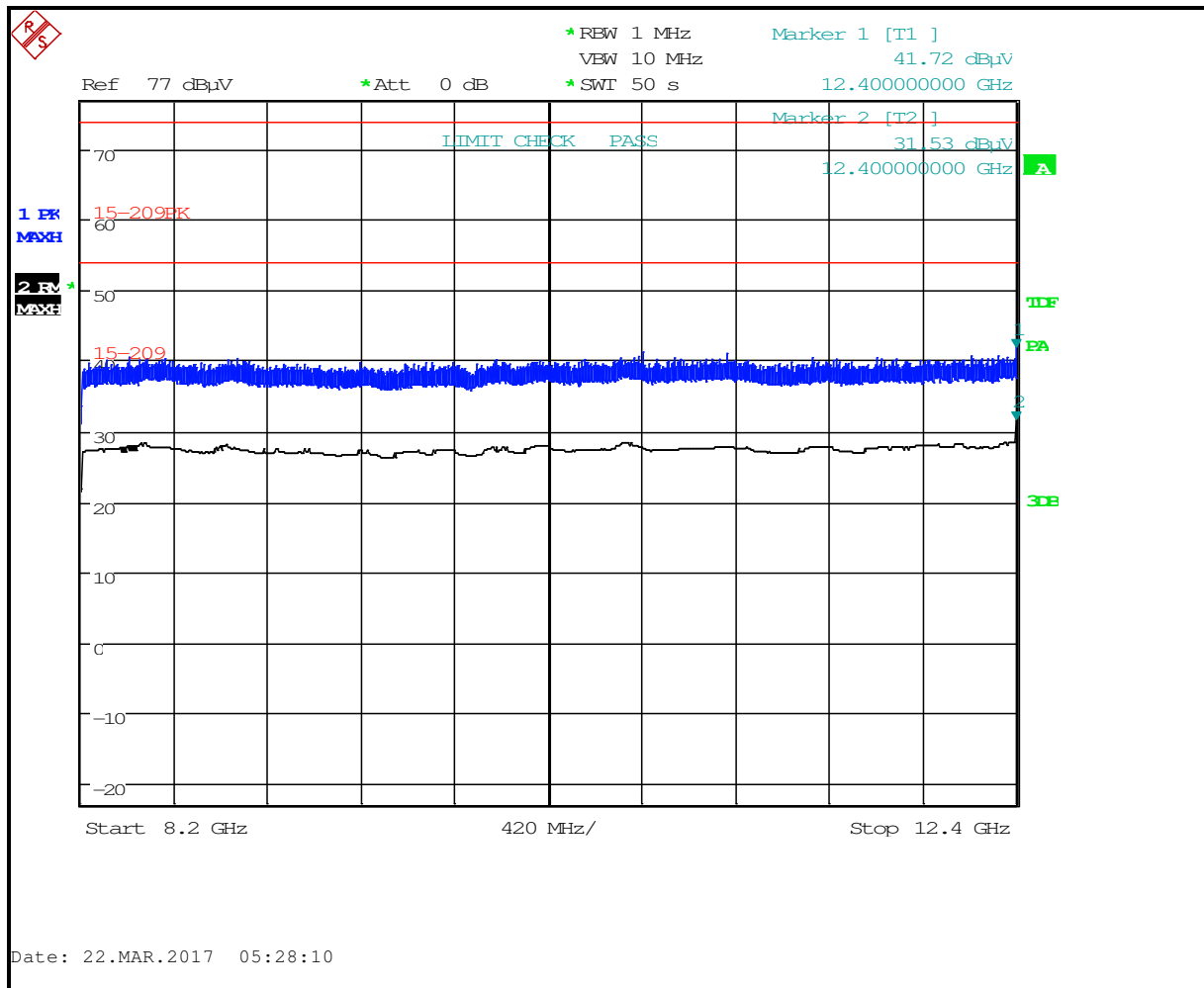


Table 5-39: Radiated Emissions (8.2 – 12.4 GHz) (TC #1)

Frequency (MHz)	Corrected EIRP Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
12400.000	41.7	74.0	-32.3				Peak
12400.000	31.5	54.0	-22.5				Average
12400.000	31.5			-63.7	-41.3	-22.4	Average

Plot 5-30: Radiated Emissions (12.4 – 18 GHz) (TC #1)

Vertical

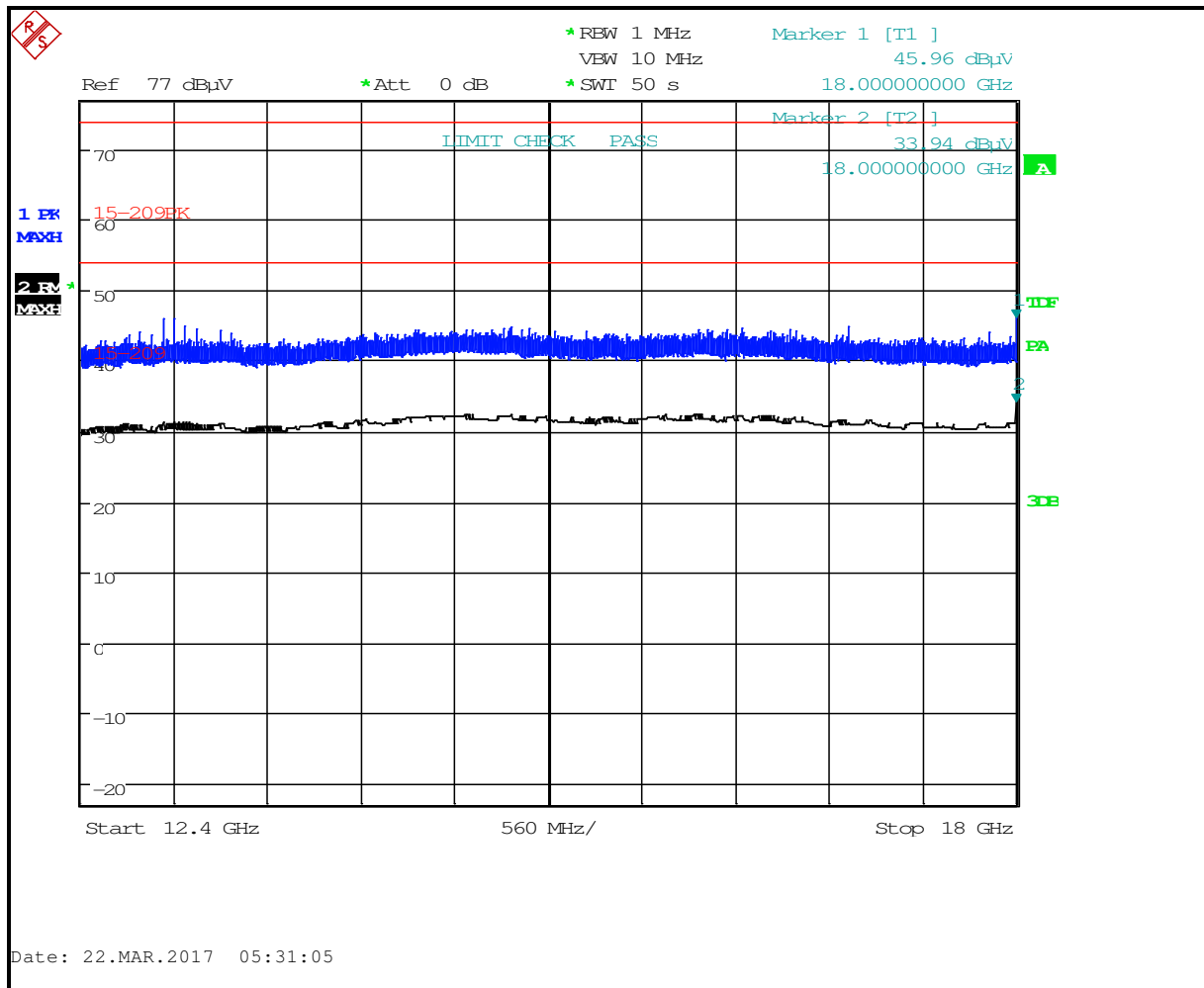


Table 5-40: Radiated Emissions (12.4 – 18 GHz) (TC #1)

Frequency (MHz)	Corrected EIRP Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
18000.000	46.0	74.0	-28.0				Peak
18000.000	33.9	54.0	-20.1				Average
18000.000	33.9			-61.3	-41.3	-20.0	Average

Plot 5-31: Radiated Emissions (18 – 26.5 GHz) (TC #1)

Vertical

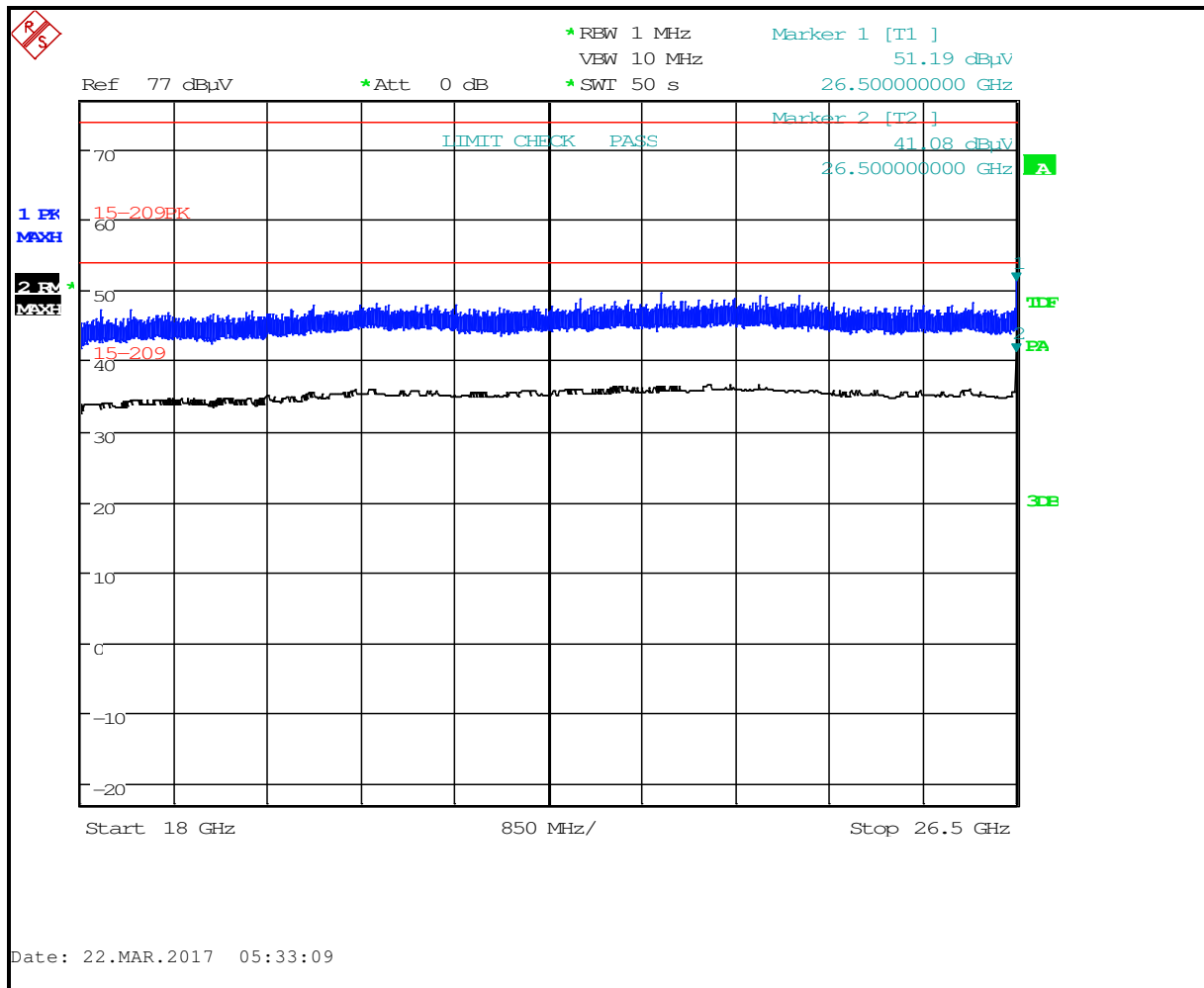


Table 5-41: Radiated Emissions (18 – 26.5 GHz) (TC #1)

Frequency (MHz)	Corrected EIRP Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
26500.000	51.2	74.0	-22.8				Peak
26500.000	41.1	54.0	-12.9				Average
26500.000	41.1			-54.1	-41.3	-12.8	Average

Plot 5-32: Radiated Emissions (26.5 – 40 GHz) (TC #1)

Vertical

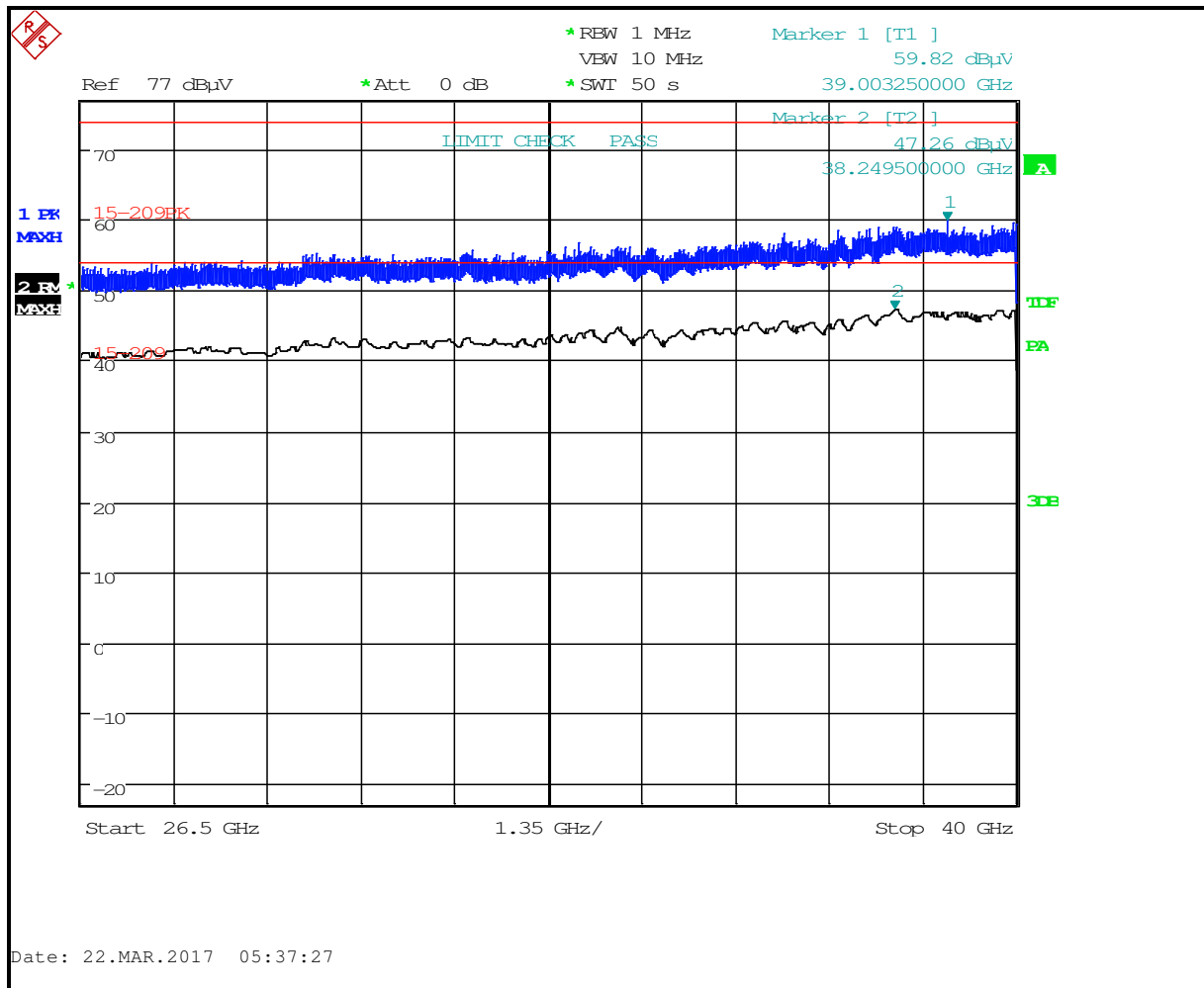


Table 5-42: Radiated Emissions (26.5 – 40 GHz) (TC #1)

Frequency (MHz)	Corrected EIRP Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
39003.250	59.8	74.0	-14.2				Peak
38249.500	47.3	54.0	-6.7				Average
38249.500	47.3			-47.9	-41.3	-6.6	Average

Plot 5-33: Radiated Emissions (30 – 1000 MHz) (TC #2)

Vertical

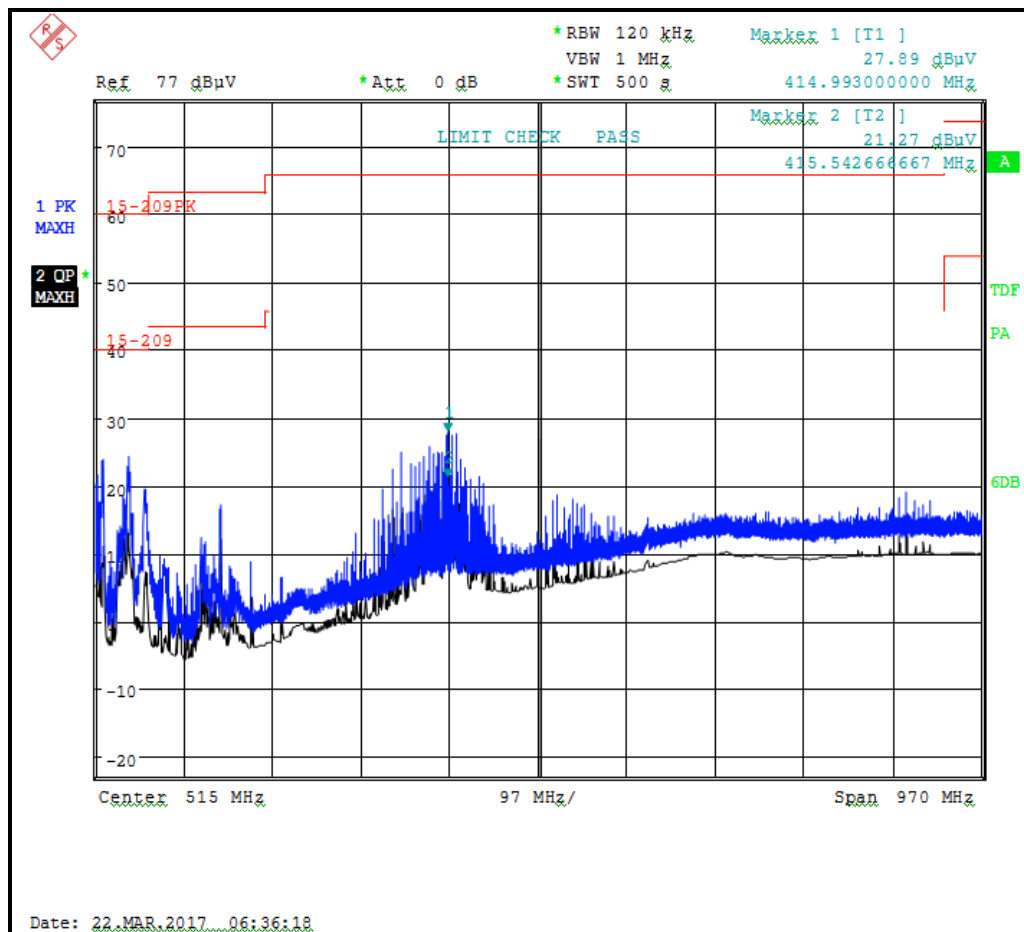


Table 5-43: Radiated Emissions (30 – 1000 MHz) (TC #2)

Frequency (MHz)	Corrected EIRP Measured (dBμV)	Limit (dBμV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
414.993	27.9	74.0	-46.1	-73.9	-41.3	-32.6	Peak
415.543	21.3	54.0	-32.7				Quasi-Peak
415.543	21.3						Quasi-Peak

Plot 5-34: Radiated Emissions (1 – 2 GHz) (TC #2)

Horizontal

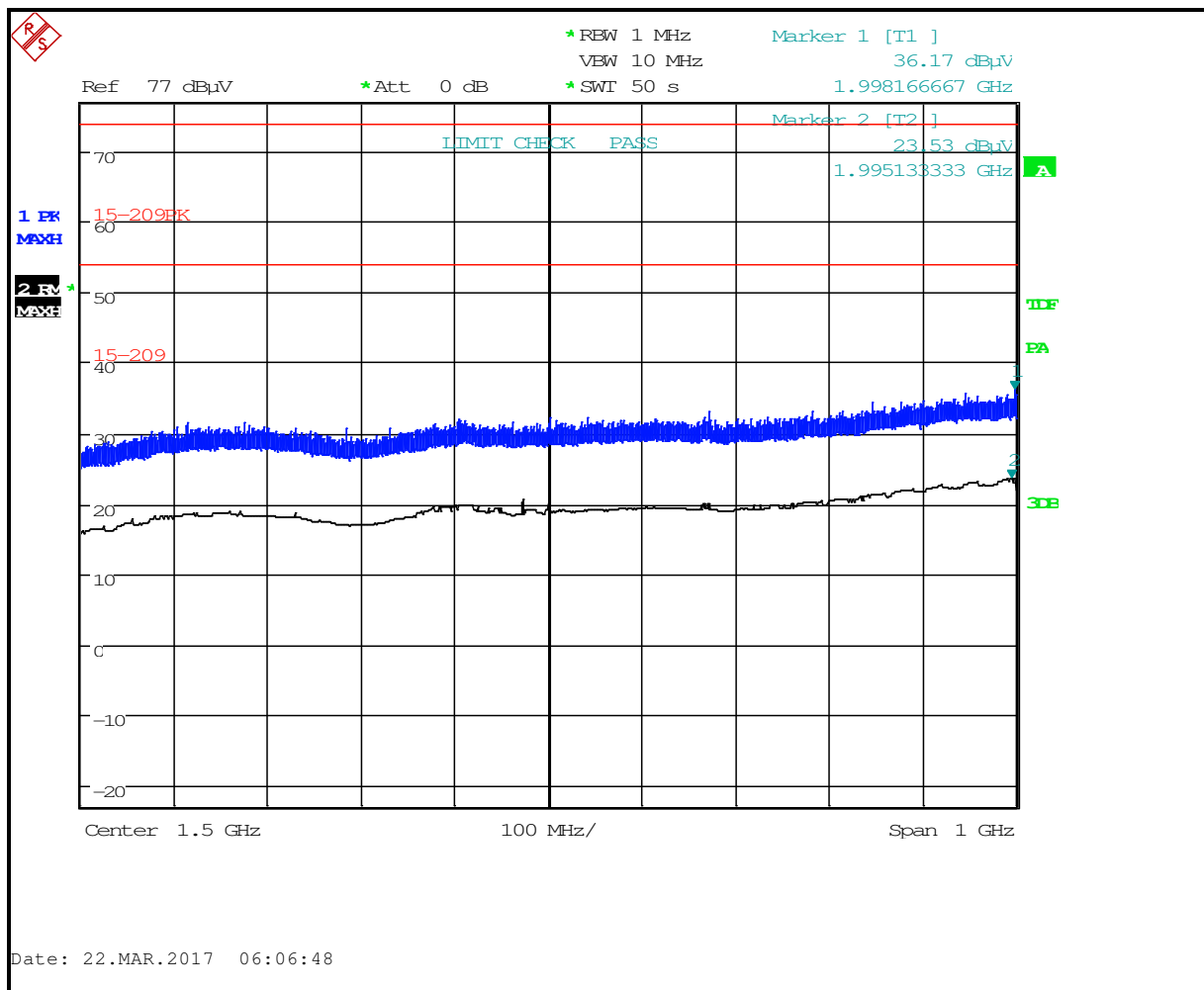


Table 5-44: Radiated Emissions (1 – 2 GHz) (TC #2)

Frequency (MHz)	Corrected EIRP Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/Average
1998.167	36.2	74.0	-37.8				Peak
1995.133	23.5	54.0	-30.5				Average
1995.133	23.5			-71.7	-41.3	-30.4	Average

Plot 5-35: Radiated Emissions (2 – 4 GHz) (TC #2)

Vertical

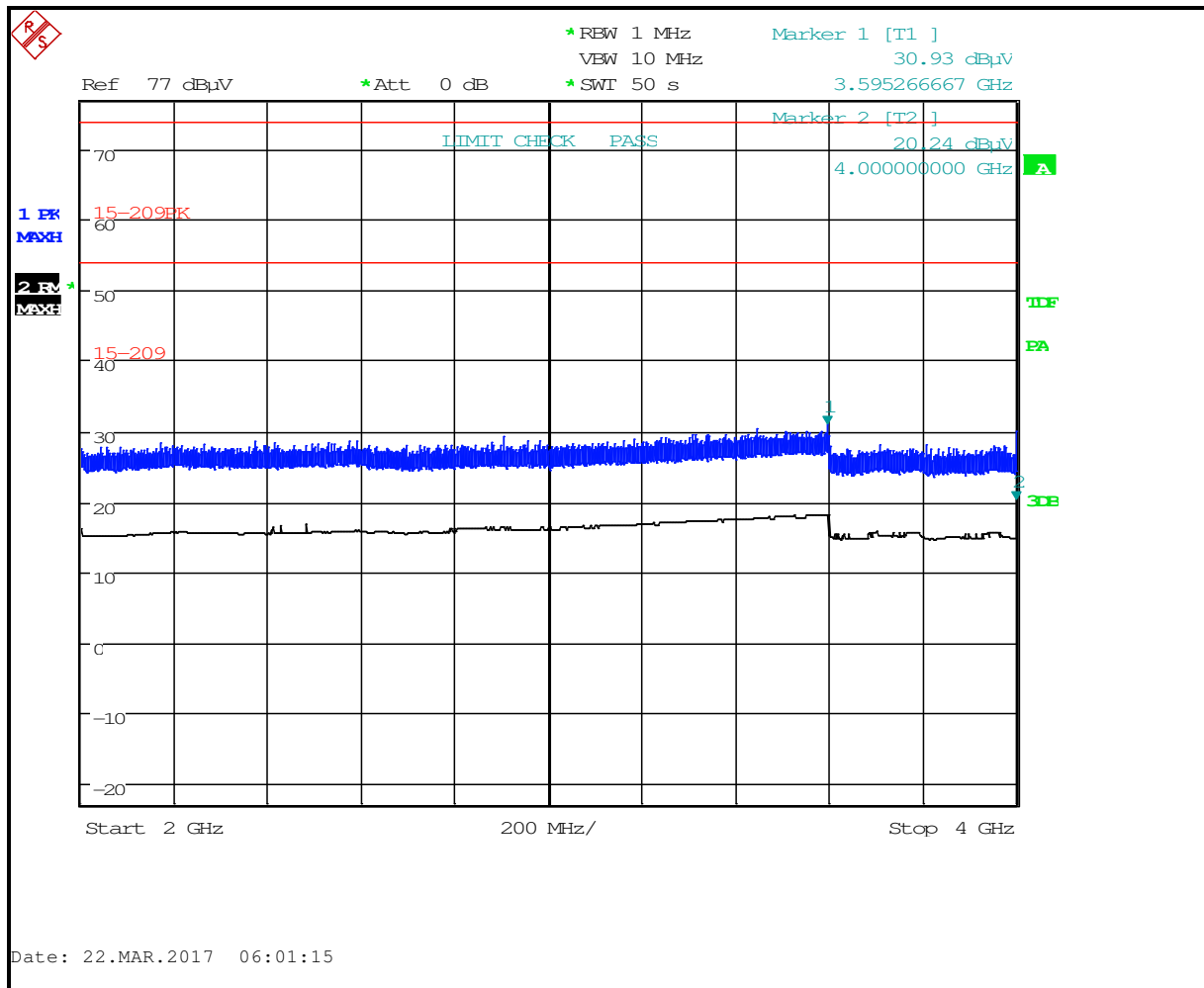


Table 5-45: Radiated Emissions (2 – 4 GHz) (TC #2)

Frequency (MHz)	Corrected EIRP Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
3595.267	30.9	74.0	-43.1				Peak
4000.000	20.2	54.0	-33.8				Average
4000.000	20.2			-75.0	-41.3	-33.7	Average

Plot 5-36: Radiated Emissions (4 – 8.2 GHz) (TC #2)

Vertical

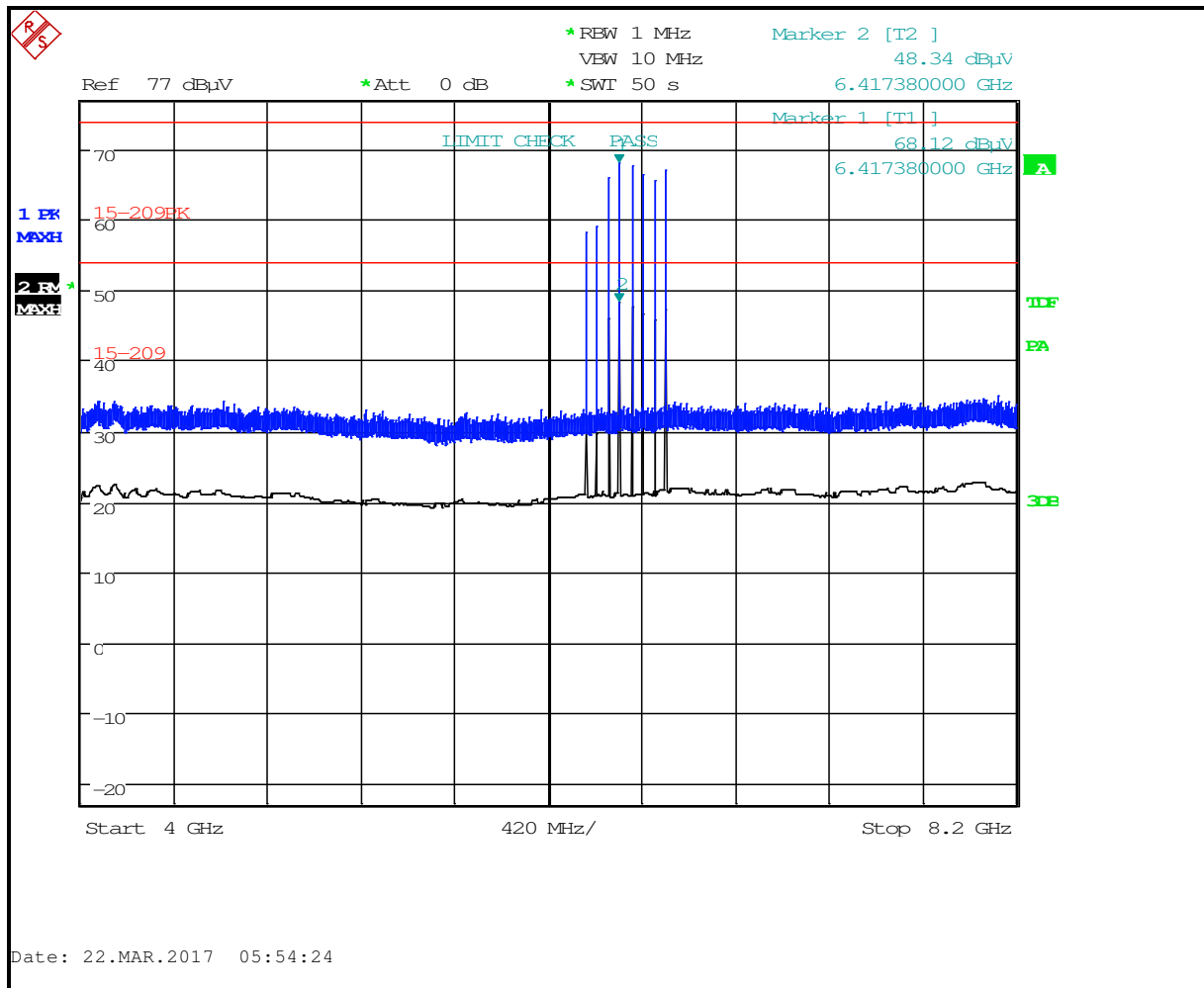


Table 5-46: Radiated Emissions (4 – 8.2 GHz) (TC #2)

Frequency (MHz)	Corrected EIRP Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
6417.380	68.1	74.0	-5.9				Peak
6417.380	48.3	54.0	-5.7				Average
6417.380	48.3			-46.9	-41.3	-5.6	Average

Plot 5-37: Radiated Emissions (8.2 – 12.4 GHz) (TC #2)

Vertical

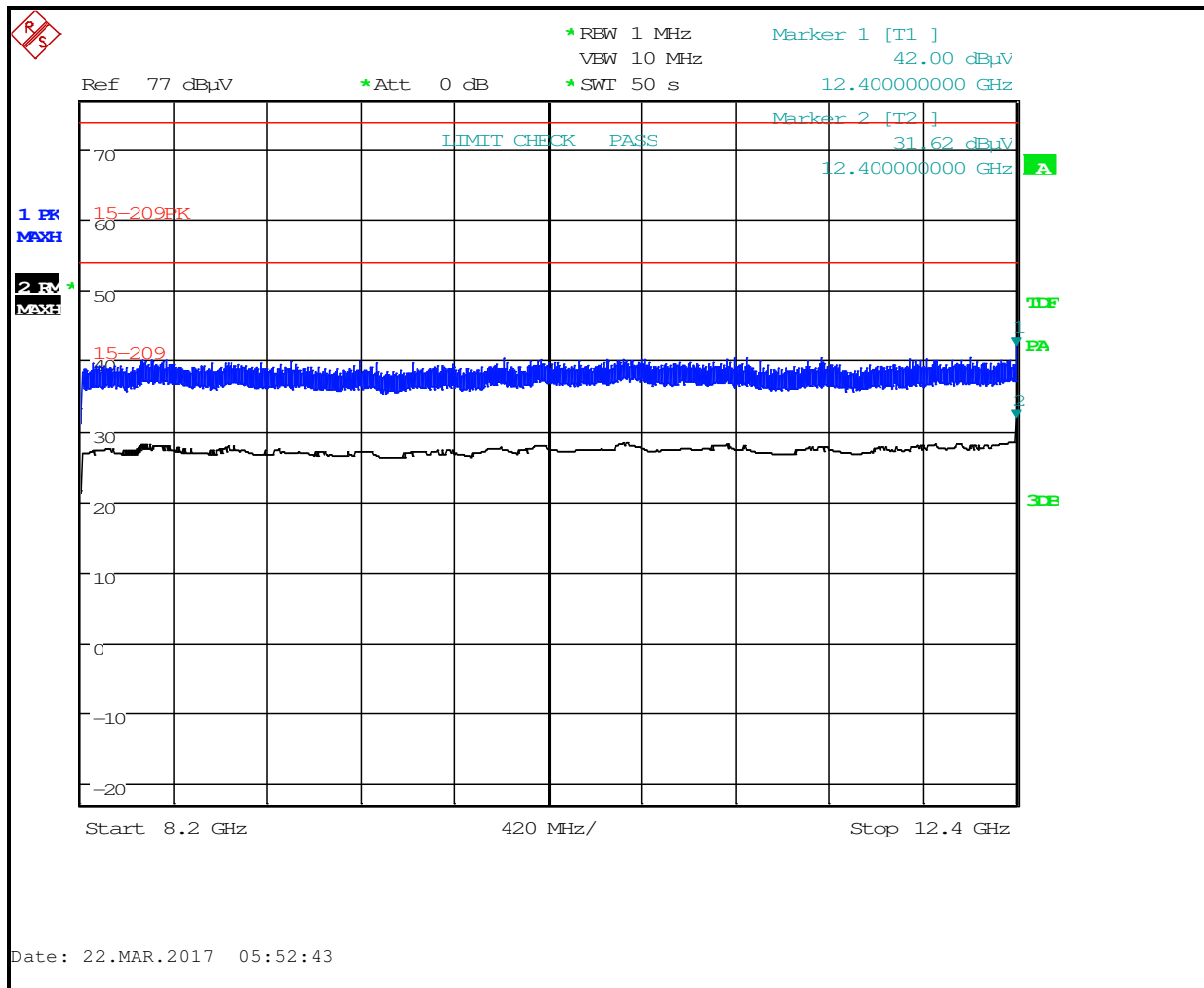


Table 5-47: Radiated Emissions (8.2 – 12.4 GHz) (TC #2)

Frequency (MHz)	Corrected EIRP Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
12400.000	42.0	74.0	-32.0				Peak
12400.000	31.6	54.0	-22.4				Average
12400.000	31.6			-63.6	-41.3	-22.3	Average

Plot 5-38: Radiated Emissions (12.4 – 18 GHz) (TC #2)

Horizontal

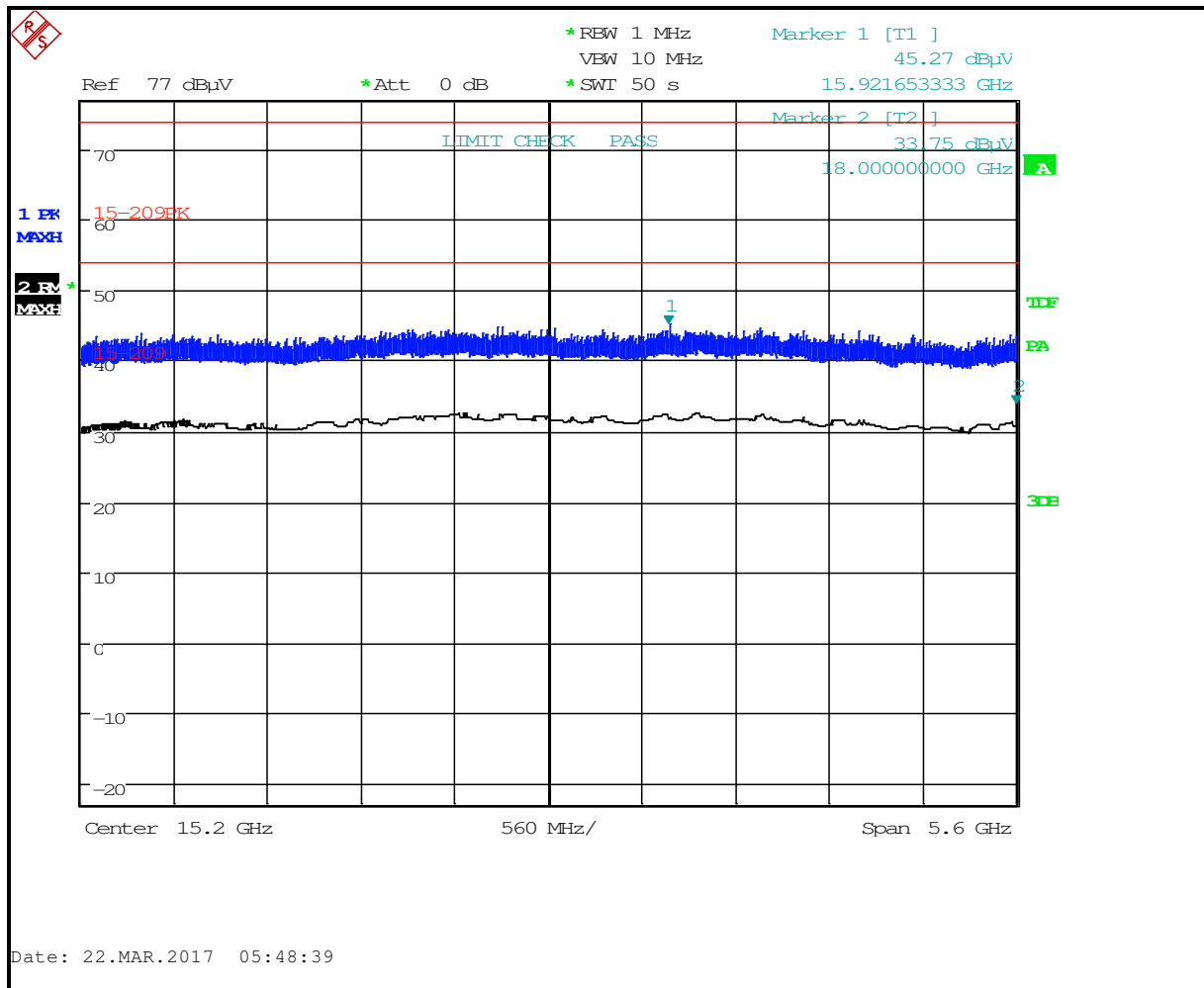


Table 5-48: Radiated Emissions (12.4 – 18 GHz) (TC #2)

Frequency (MHz)	Corrected EIRP Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
15921.653	45.3	74.0	-28.7				Peak
18000.000	33.8	54.0	-20.2				Average
18000.000	33.8			-61.4	-41.3	-20.1	Average

Plot 5-39: Radiated Emissions (18 – 26.5 GHz) (TC #2)

Vertical

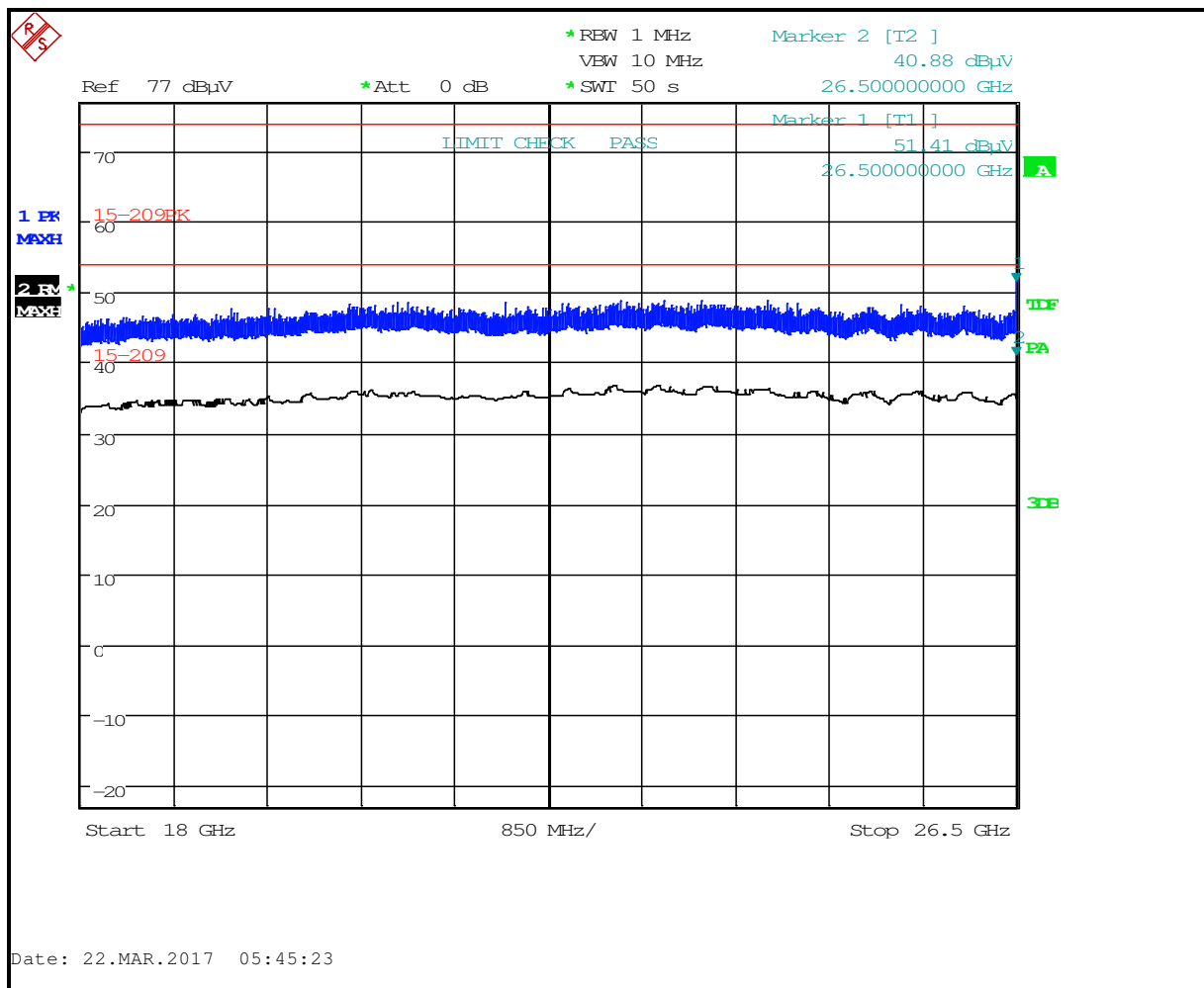


Table 5-49: Radiated Emissions (18 – 26.5 GHz) (TC #2)

Frequency (MHz)	Corrected EIRP Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
26500.000	51.4	74.0	-22.6				Peak
26500.000	40.9	54.0	-13.1				Average
26500.000	40.9			-54.3	-41.3	-13.0	Average

Plot 5-40: Radiated Emissions (26.5 – 40 GHz) (TC #2)

Vertical

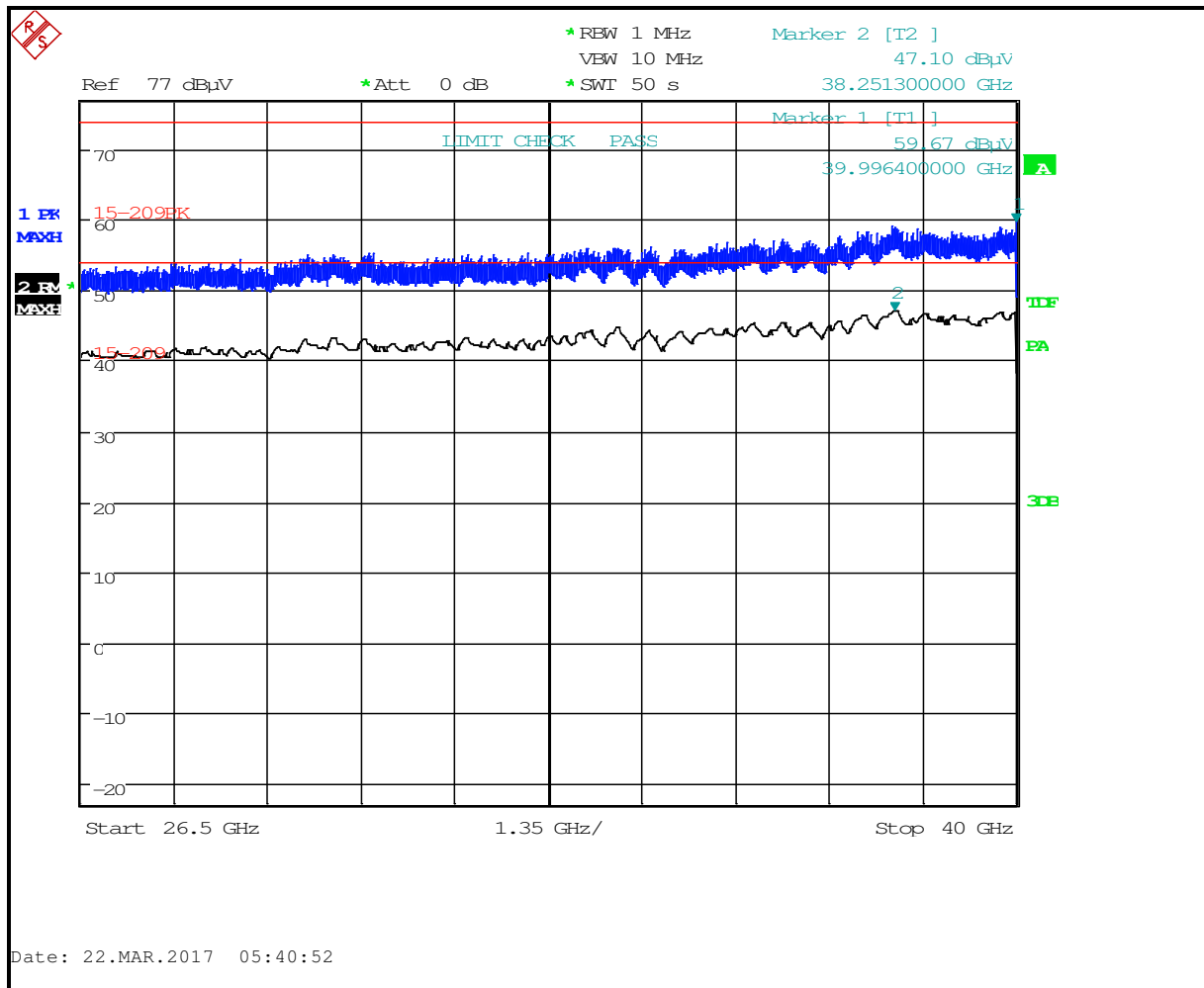


Table 5-50: Radiated Emissions (26.5 – 40 GHz) (TC #2)

Frequency (MHz)	Corrected EIRP Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
39996.400	59.7	74.0	-14.3				Peak
28251.300	47.1	54.0	-6.9				Average
28251.300	47.1			-48.1	-41.3	-6.8	Average

Plot 5-41: Radiated Emissions (30 – 1000 MHz) (TC #3)

Vertical

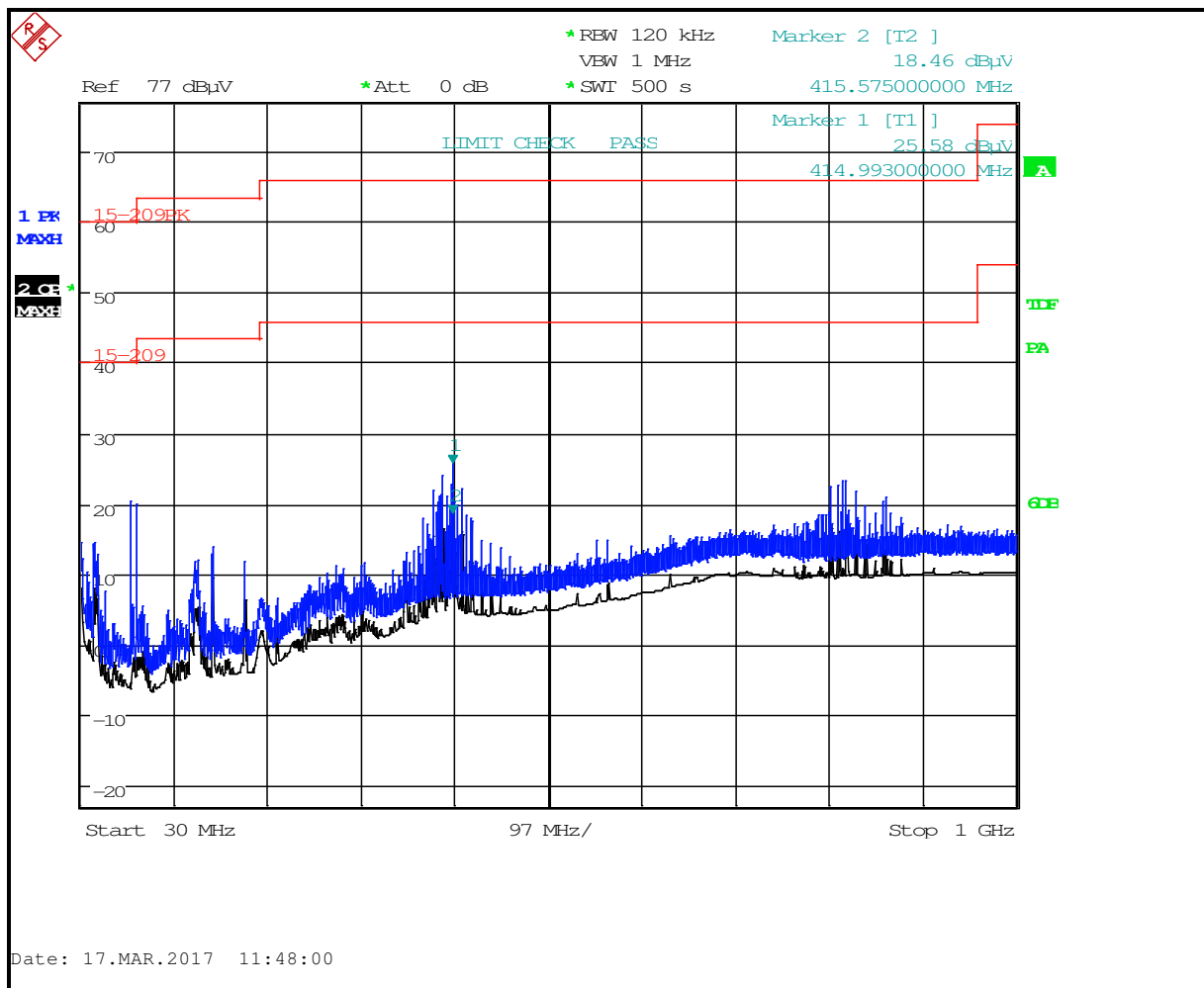


Table 5-51: Radiated Emissions (30 – 1000 MHz) (TC #3)

Frequency (MHz)	Corrected EIRP Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
414.993	25.6	74.0	-48.4	-76.7	-41.3	-35.4	Peak
415.575	18.5	54.0	-35.5				Quasi-Peak
415.575	18.5						Quasi-Peak

Plot 5-42: Radiated Emissions (1 – 2 GHz) (TC #3)

Vertical

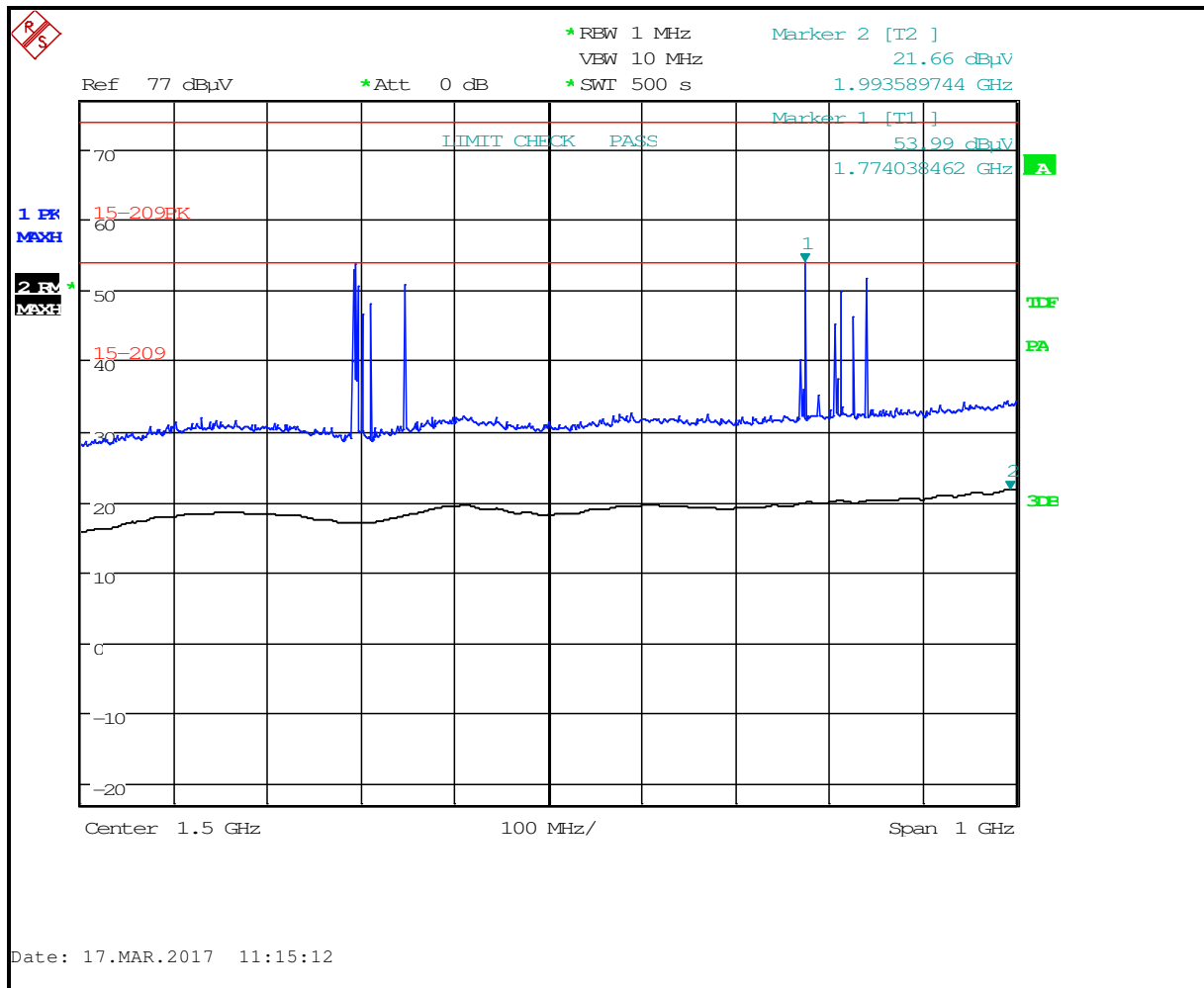


Table 5-52: Radiated Emissions (1 – 2 GHz) (TC #3)

Frequency (MHz)	Corrected EIRP Measured (dBμV)	Limit (dBμV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/Average
1774.039	54.0	74.0	-20.0				Peak
1993.590	21.7	54.0	-32.3				Average
1993.590	21.7			-73.5	-41.3	-32.2	Average

Plot 5-43: Radiated Emissions (2 – 4 GHz) (TC #3)

Vertical

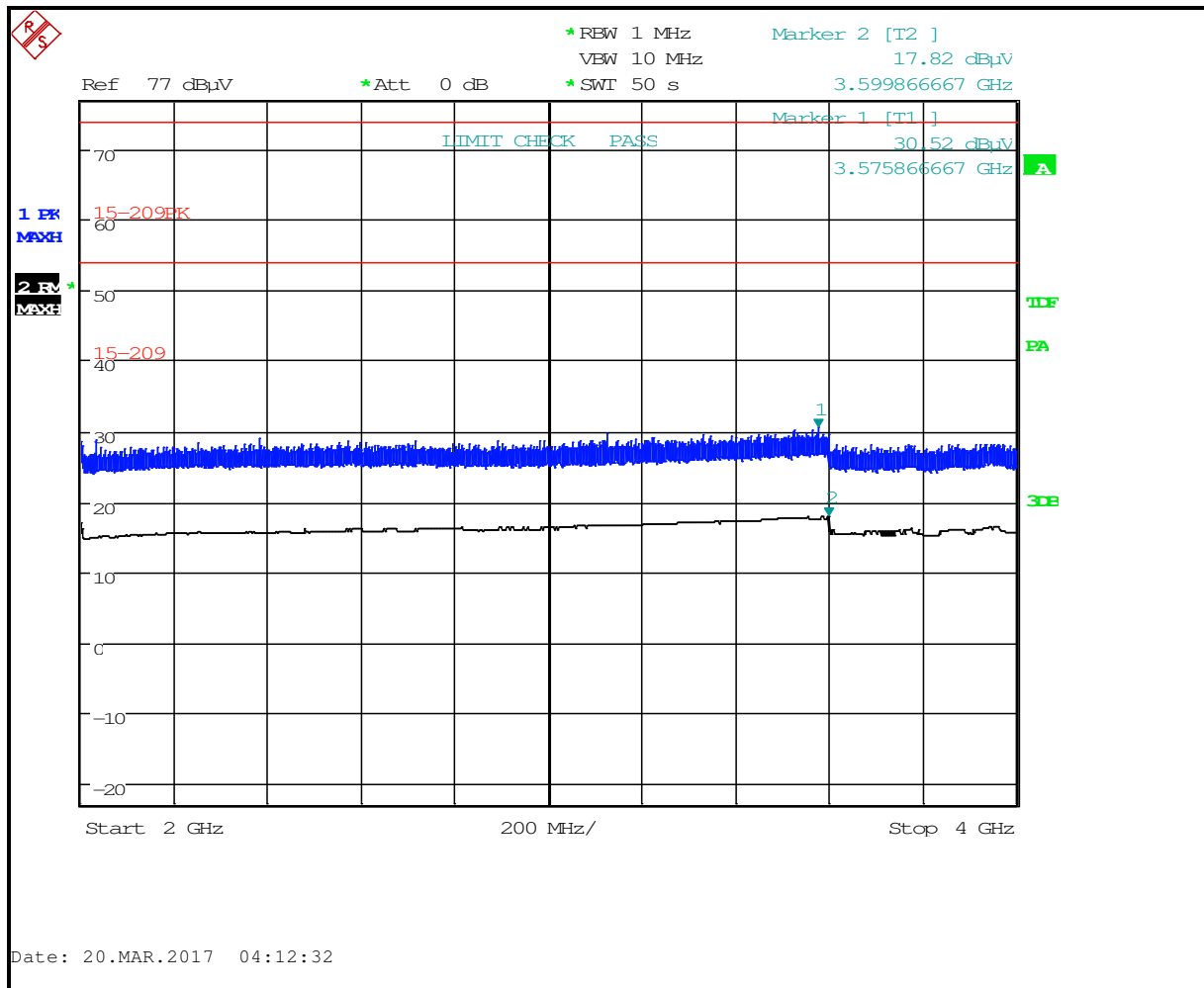


Table 5-53: Radiated Emissions (2 – 4 GHz) (TC #3)

Frequency (MHz)	Corrected EIRP Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
3575.867	30.5	74.0	-43.5				Peak
3599.867	17.8	54.0	-36.2				Average
3599.867	17.8			-77.4	-41.3	-36.1	Average

Plot 5-45: Radiated Emissions (8.2 – 12.4 GHz) (TC #3)

Vertical

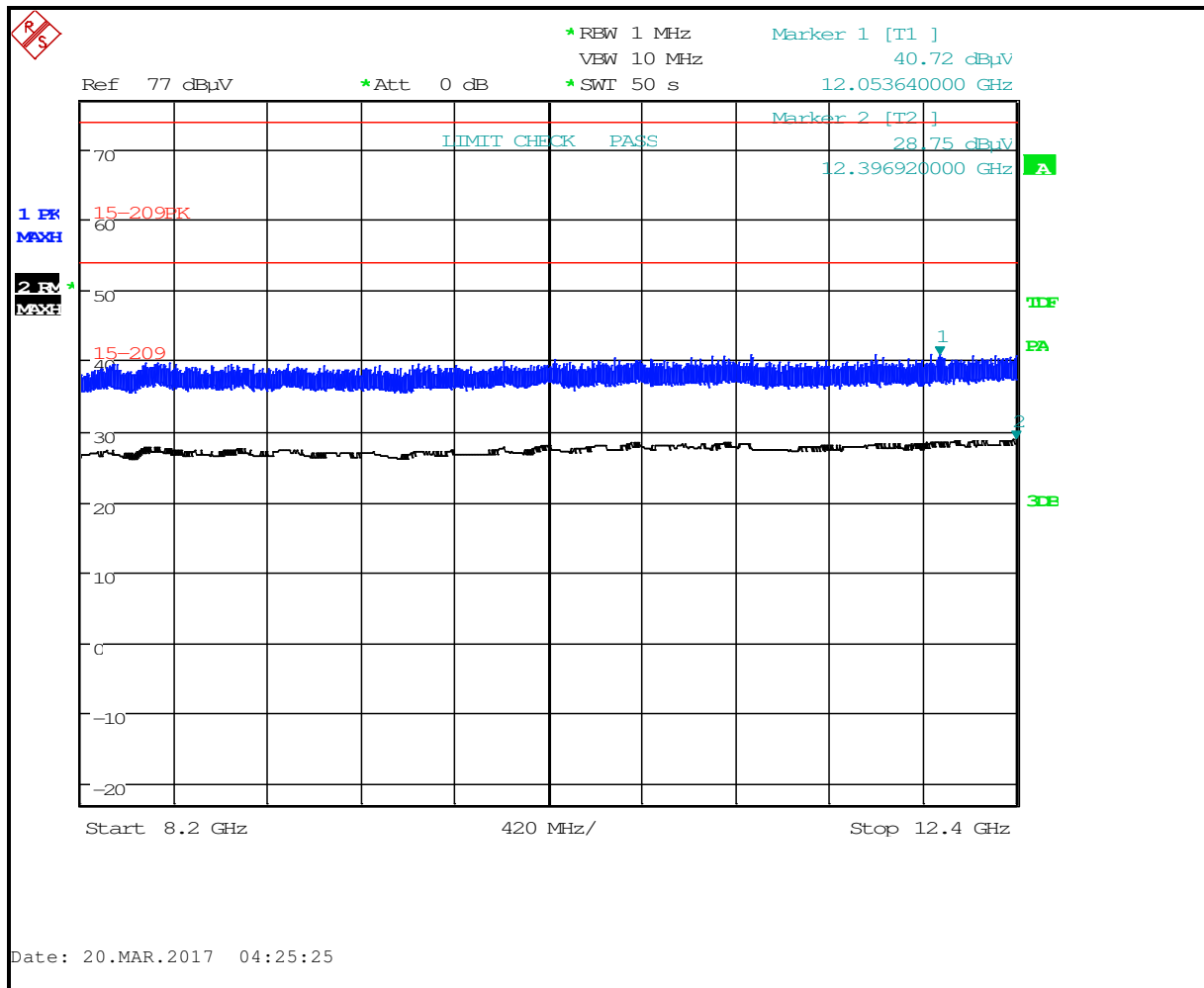


Table 5-55: Radiated Emissions (8.2 – 12.4 GHz) (TC #3)

Frequency (MHz)	Corrected EIRP Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
12053.640	40.7	74.0	-33.3				Peak
12396.920	28.8	54.0	-25.2				Average
12396.920	28.8			-66.4	-41.3	-25.1	Average

Plot 5-46: Radiated Emissions (12.4 – 18 GHz) (TC #3)

Vertical

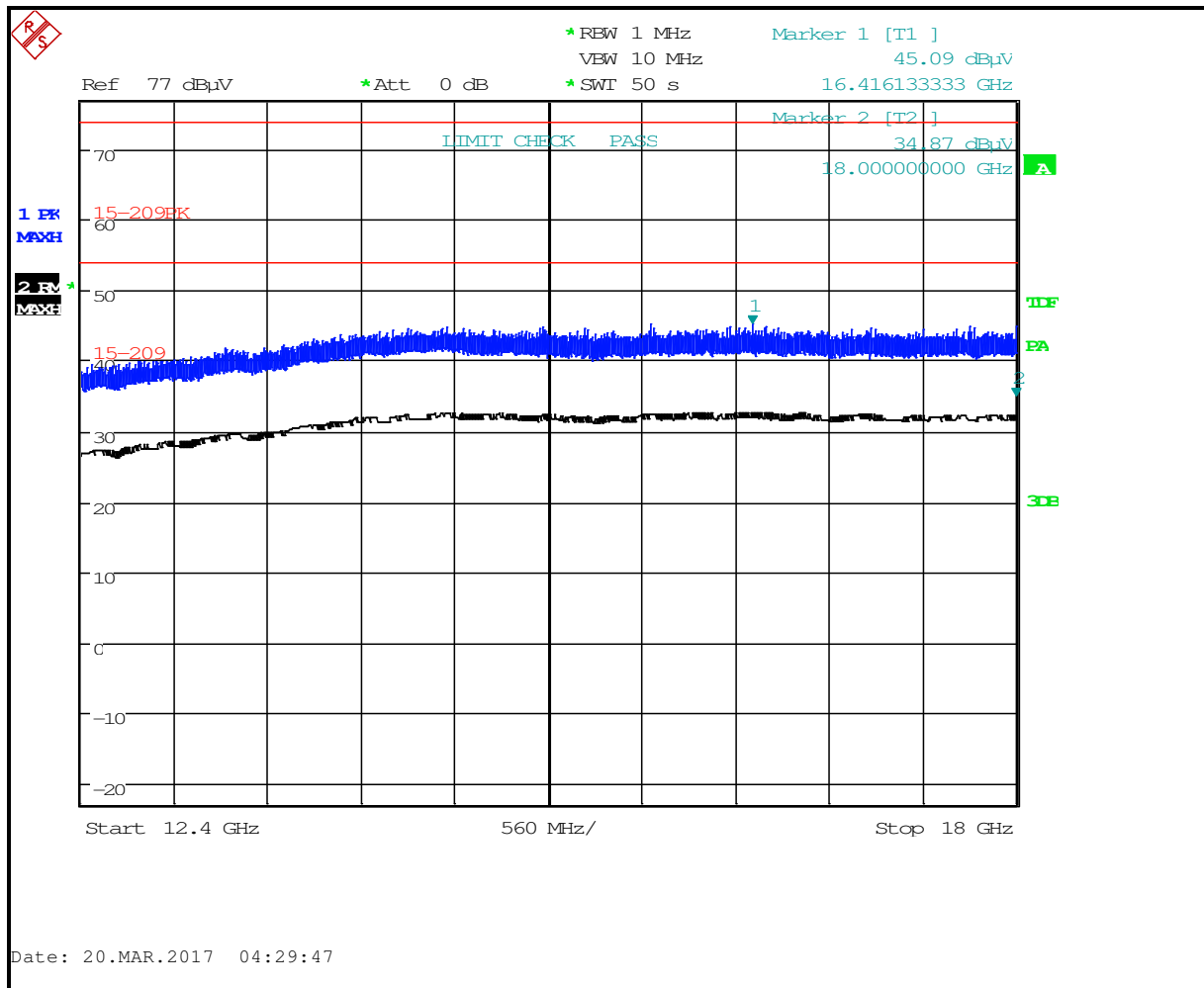


Table 5-56: Radiated Emissions (12.4 – 18 GHz) (TC #3)

Frequency (MHz)	Corrected EIRP Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
16416.133	45.1	74.0	-28.9				Peak
18000.000	34.9	54.0	-19.1				Average
18000.000	34.9			-60.3	-41.3	-19.0	Average

Plot 5-48: Radiated Emissions (26.5 – 40 GHz) (TC #3)

Horizontal

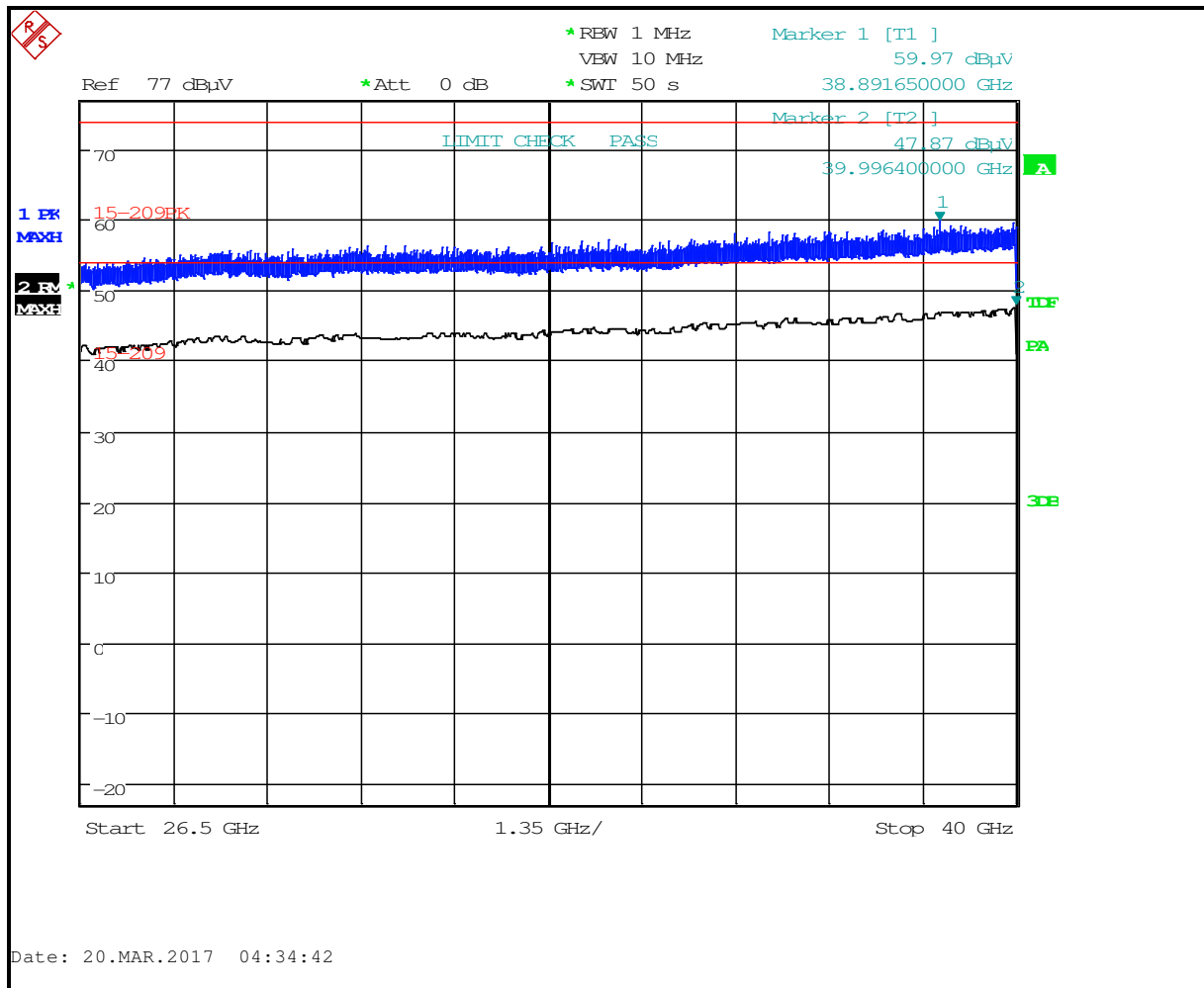


Table 5-58: Radiated Emissions (26.5 – 40 GHz) (TC #3)

Frequency (MHz)	Corrected EIRP Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
38891.650	60.0	74.0	-14.0				Peak
39996.400	47.9	54.0	-6.1				Average
39996.400	47.9			-47.3	-41.3	-6.0	Average

5.3.2.3 Concrete Drum

Plot 5-49: Radiated Emissions (30 – 1000 MHz) (TC #1)

Vertical

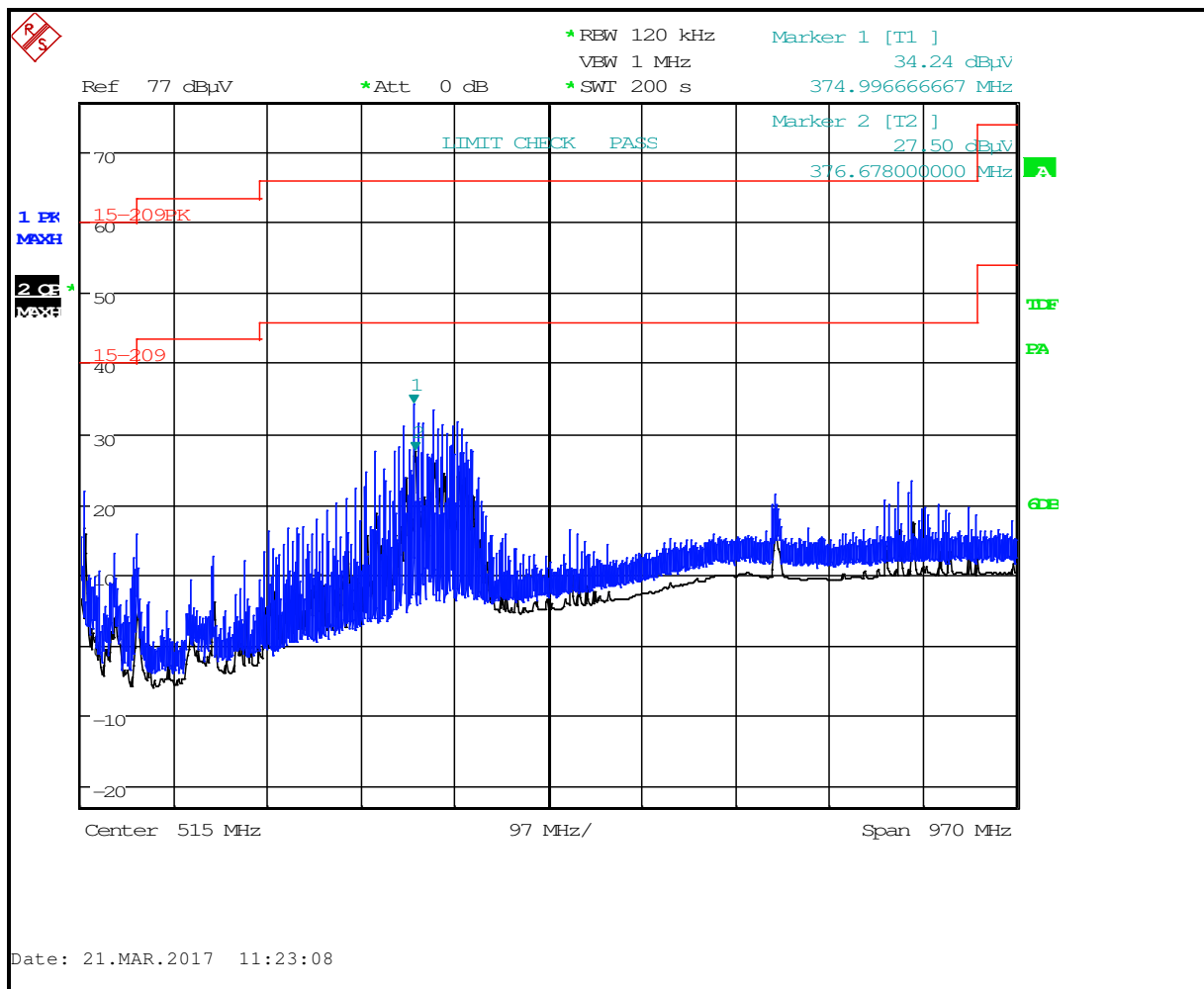


Table 5-59: Radiated Emissions (30 – 1000 MHz) (TC #1)

Frequency (MHz)	Corrected EIRP Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/Average
374.997	34.2	74.0	-39.8	-67.7	-41.3	-26.4	Peak
376.678	27.5	54.0	-26.5				Quasi-Peak
376.678	27.5						Quasi-Peak

Plot 5-51: Radiated Emissions (2 – 4 GHz) (TC #1)

Horizontal

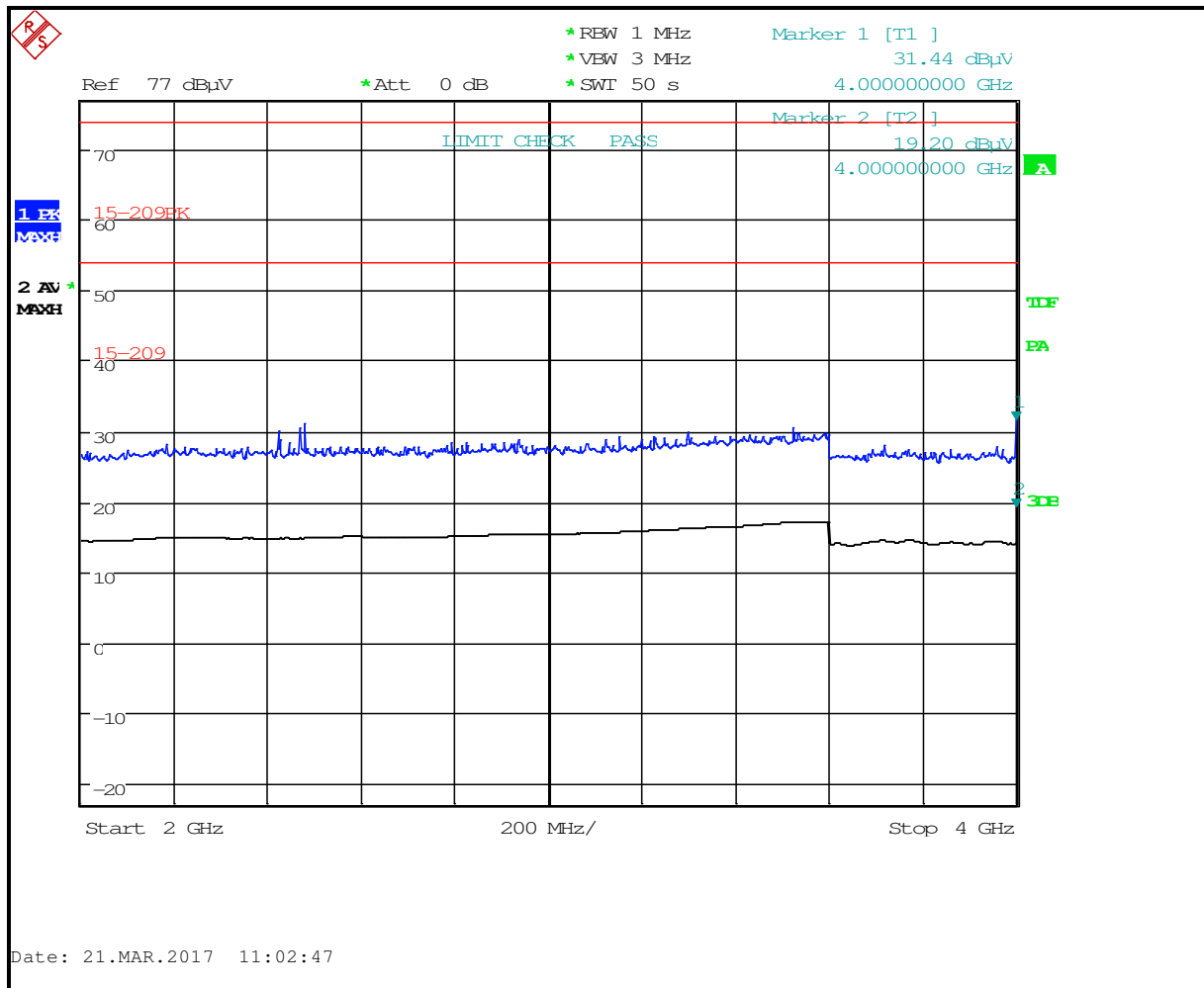


Table 5-61: Radiated Emissions (2 – 4 GHz) (TC #1)

Frequency (MHz)	Corrected EIRP Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
4000.000	31.4	74.0	-42.6				Peak
4000.000	19.2	54.0	-34.8				Average
4000.000	19.2			-76.0	-41.3	-34.7	Average

Plot 5-52: Radiated Emissions (4 – 8.2 GHz) (TC #1)

Vertical

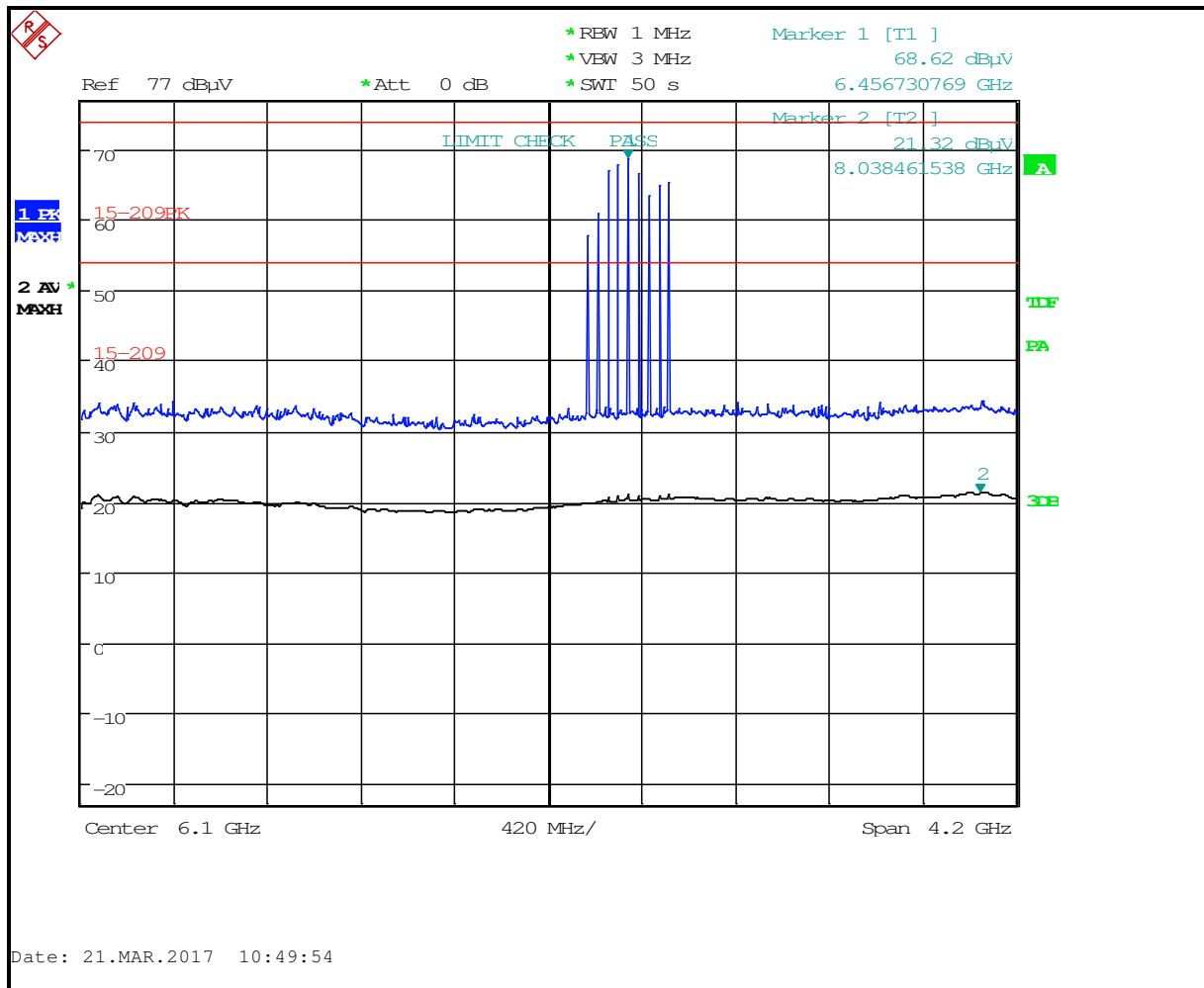


Table 5-62: Radiated Emissions (4 – 8.2 GHz) (TC #1)

Frequency (MHz)	Corrected EIRP Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
6456.731	68.6	74.0	-5.4				Peak
8038.462	21.3	54.0	-32.7				Average
8038.462	21.3			-73.9	-41.3	-32.6	Average

Plot 5-53: Radiated Emissions (8.2 – 12.4 GHz) (TC #1)

Vertical

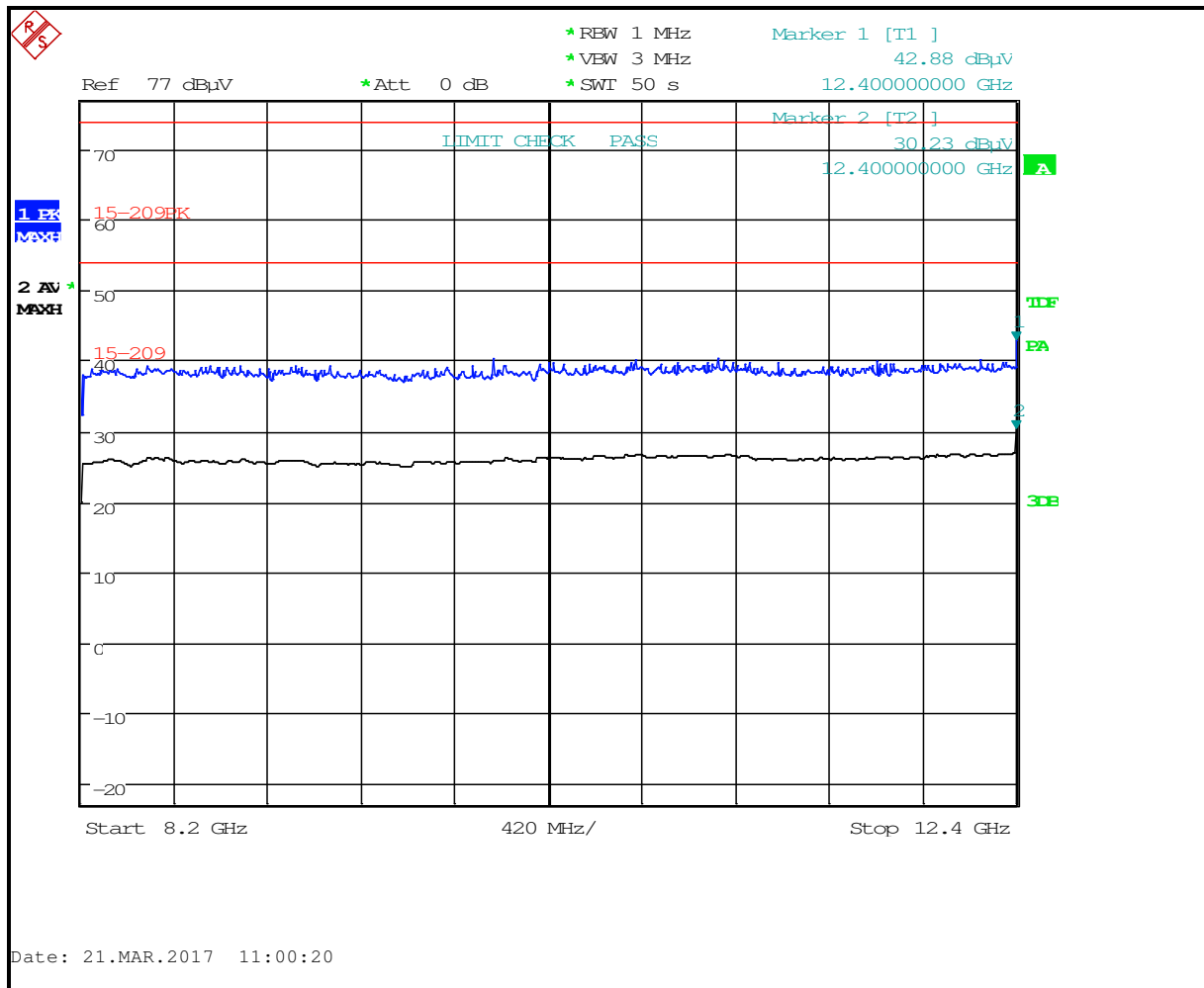


Table 5-63: Radiated Emissions (8.2 – 12.4 GHz) (TC #1)

Frequency (MHz)	Corrected EIRP Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
12400.000	42.9	74.0	-31.1				Peak
12400.000	30.2	54.0	-23.8				Average
12400.000	30.2			-65.0	-41.3	-23.7	Average

Plot 5-54: Radiated Emissions (12.4 – 18 GHz) (TC #1)

Horizontal

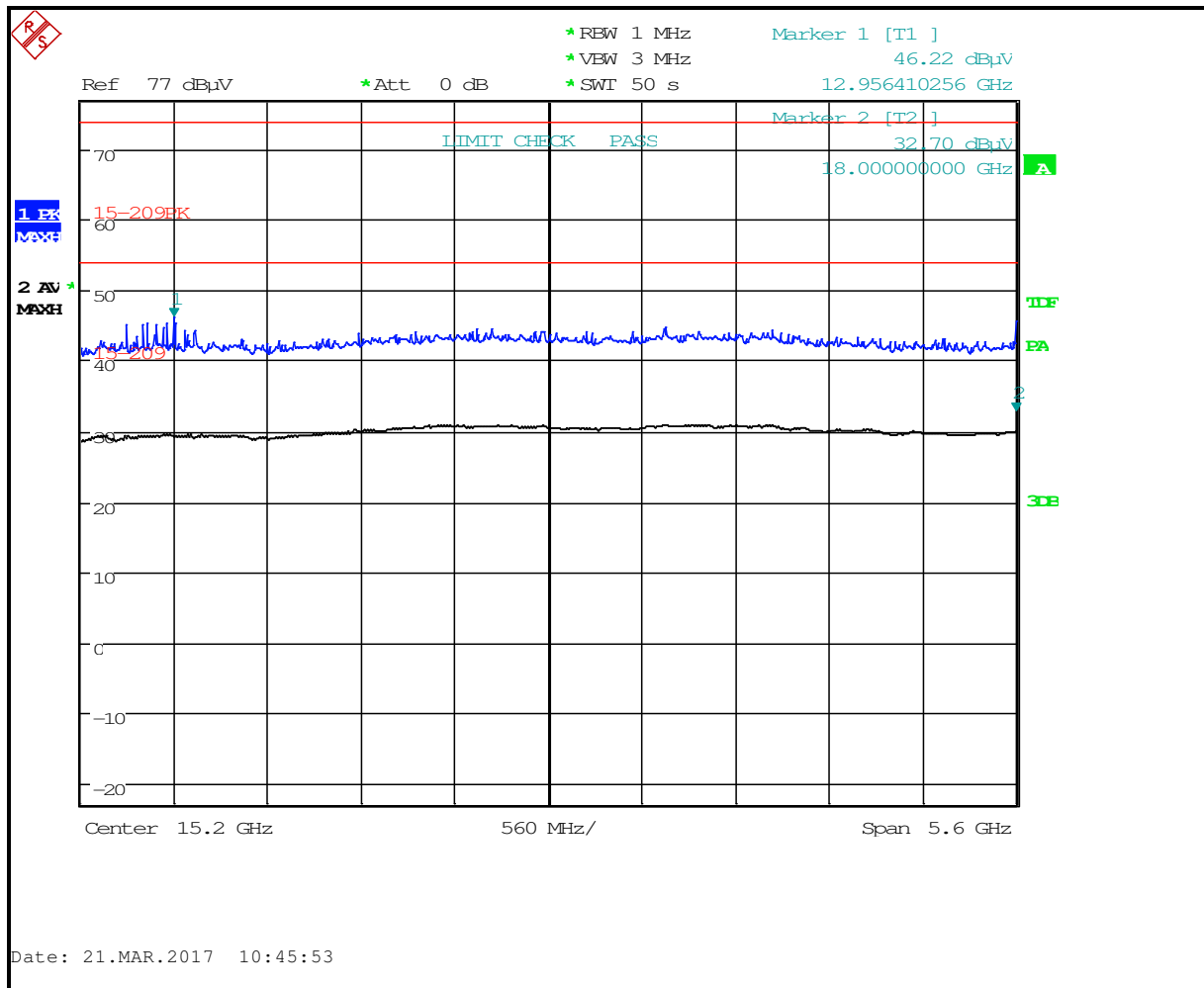


Table 5-64: Radiated Emissions (12.4 – 18 GHz) (TC #1)

Frequency (MHz)	Corrected EIRP Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
12956.410	46.2	74.0	-27.8				Peak
18000.000	32.7	54.0	-21.3				Average
18000.000	32.7			-62.5	-41.3	-21.2	Average

Plot 5-55: Radiated Emissions (18 – 26.5 GHz) (TC #1)

Horizontal

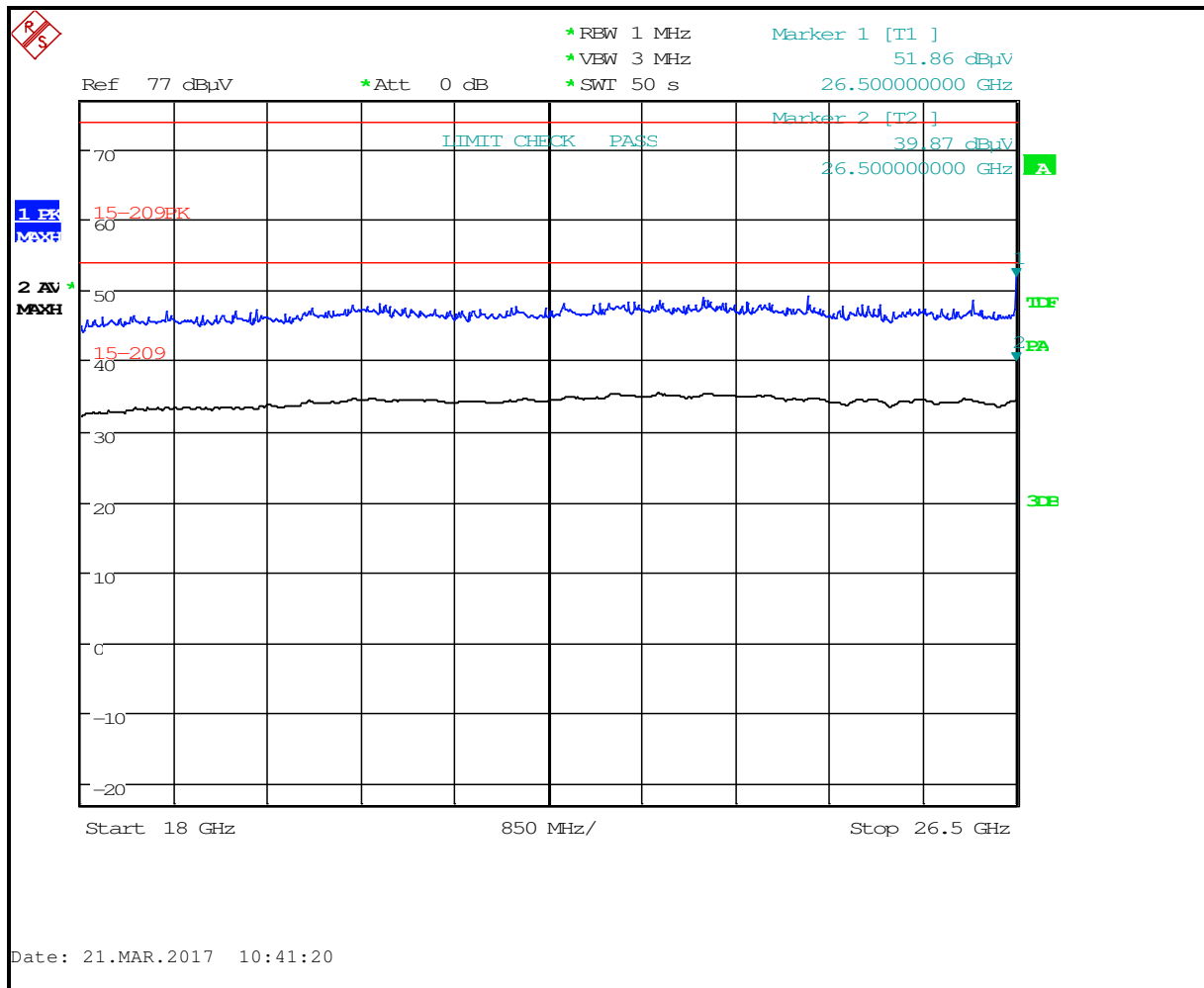


Table 5-65: Radiated Emissions (18 – 26.5 GHz) (TC #1)

Frequency (MHz)	Corrected EIRP Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
26500.000	51.9	74.0	-22.1				Peak
26500.000	39.9	54.0	-14.1				Average
26500.000	39.9			-55.3	-41.3	-14.0	Average

Plot 5-56: Radiated Emissions (26.5 – 40 GHz) (TC #1)

Horizontal

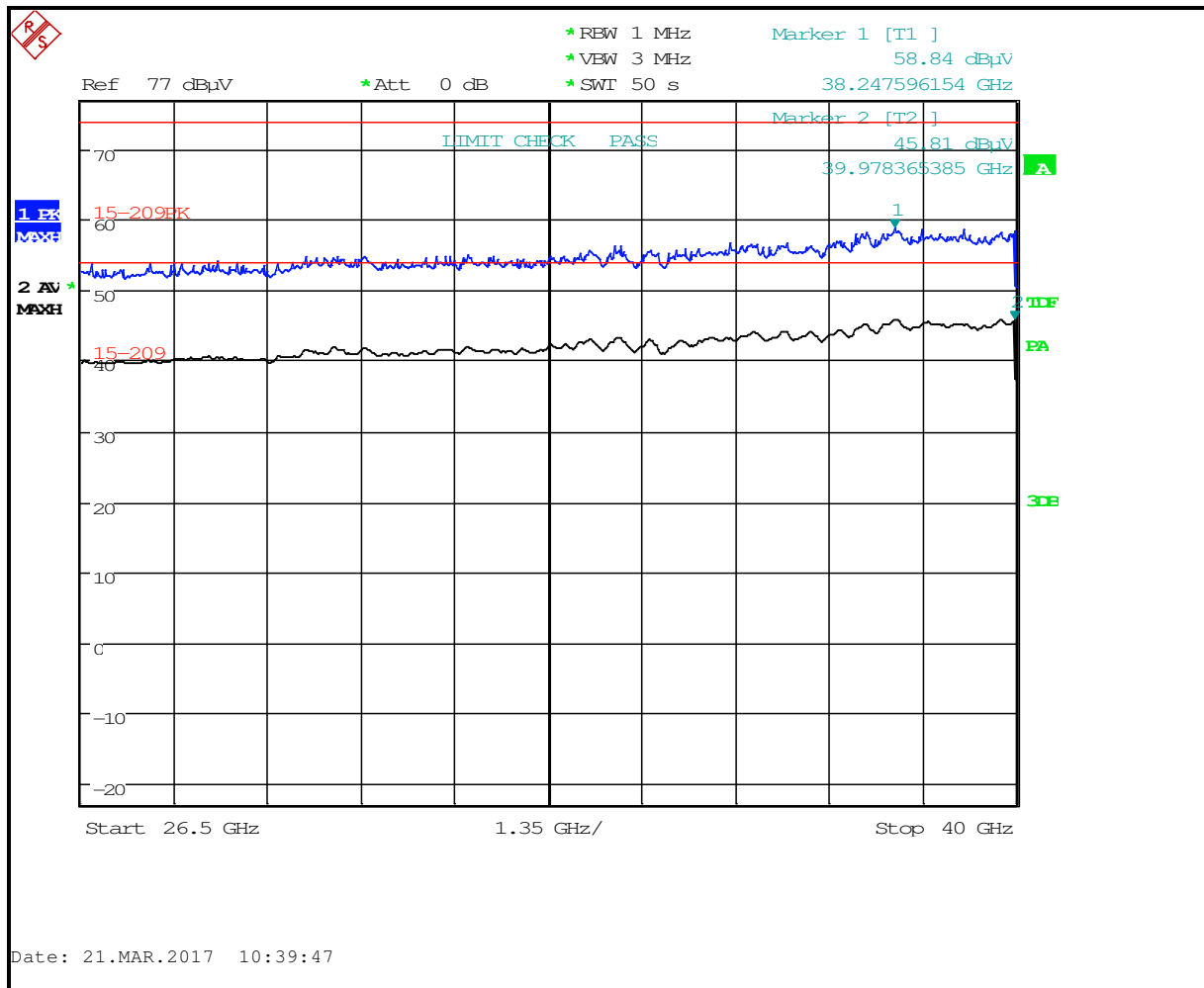


Table 5-66: Radiated Emissions (26.5 – 40 GHz) (TC #1)

Frequency (MHz)	Corrected EIRP Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/Average
38247.596	58.8	74.0	-15.2				Peak
39978.365	45.8	54.0	-8.2				Average
39978.365	45.8			-49.4	-41.3	-8.1	Average

Plot 5-57: Radiated Emissions (30 – 1000 MHz) (TC #2)

Horizontal

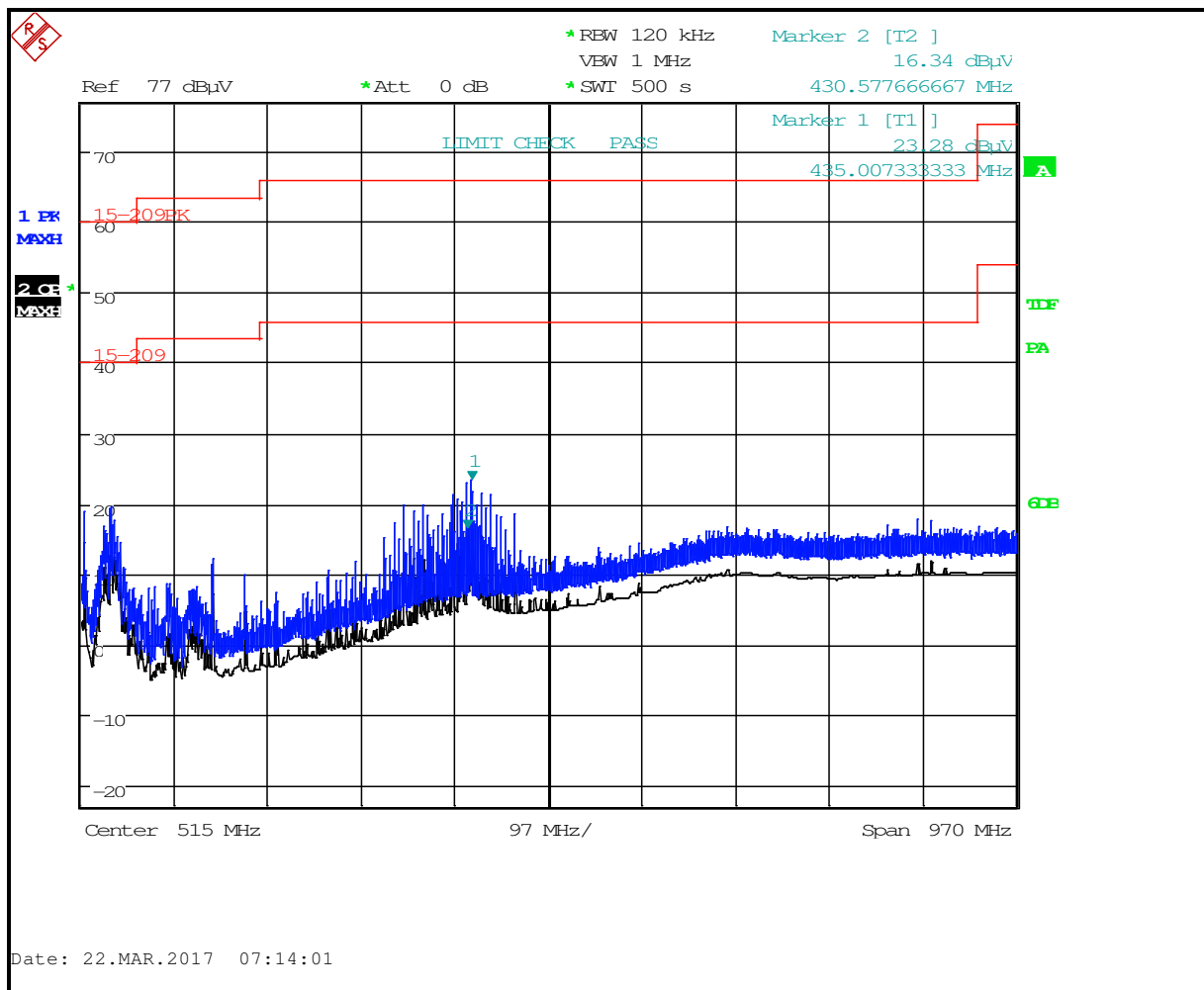


Table 5-67: Radiated Emissions (30 – 1000 MHz) (TC #2)

Frequency (MHz)	Corrected EIRP Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
435.007	23.3	74.0	-50.7	-78.9	-41.3	-37.6	Peak
430.578	16.3	54.0	-37.7				Quasi-Peak
430.578	16.3						Quasi-Peak

Plot 5-58: Radiated Emissions (1 – 2 GHz) (TC #2)

Horizontal

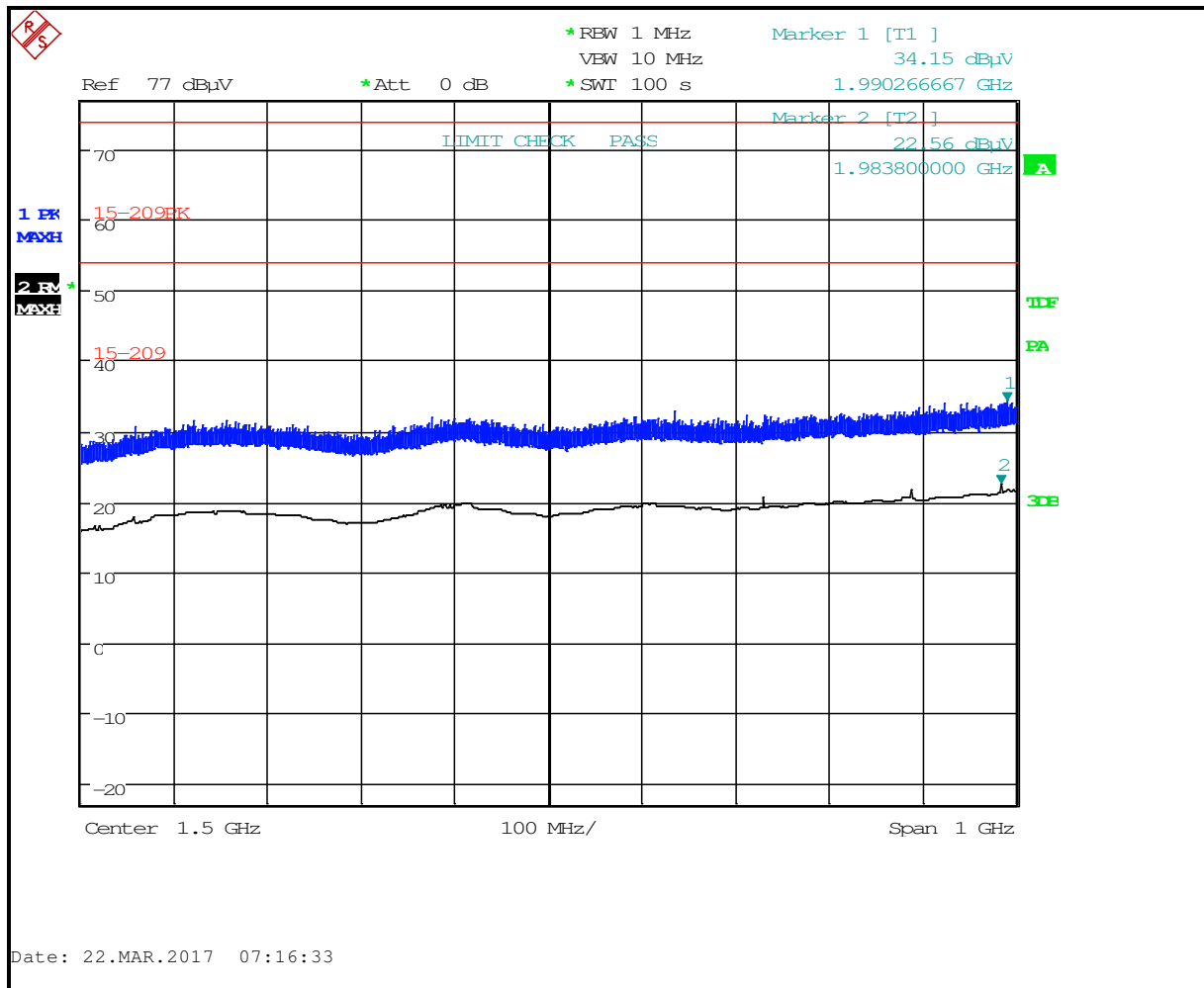


Table 5-68: Radiated Emissions (1 – 2 GHz) (TC #2)

Frequency (MHz)	Corrected EIRP Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/Average
1990.267	34.2	74.0	-39.8				Peak
1983.800	22.6	54.0	-31.4				Average
1983.800	22.6			-72.6	-41.3	-31.3	Average

Plot 5-59: Radiated Emissions (2 – 4 GHz) (TC #2)

Vertical

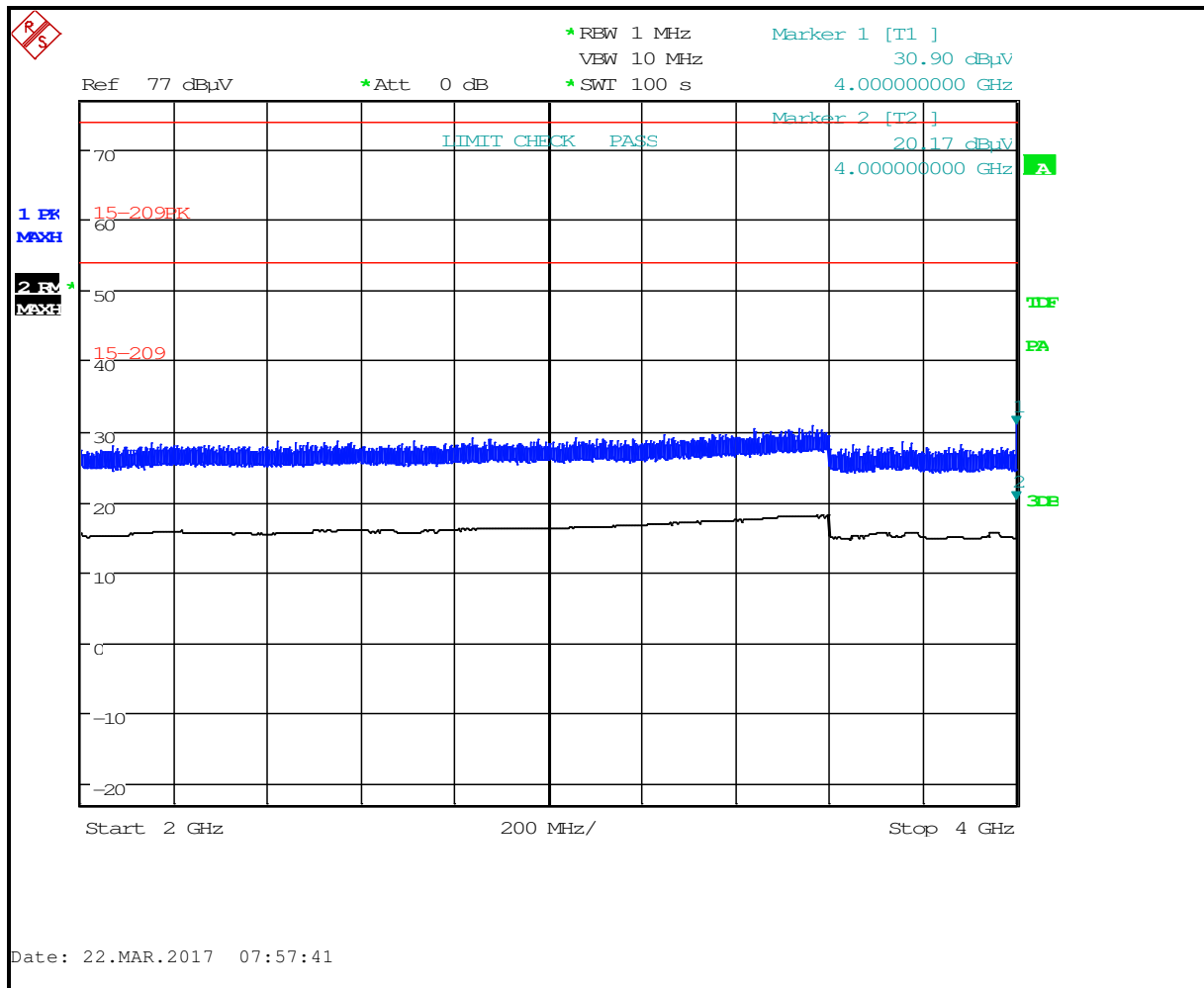


Table 5-69: Radiated Emissions (2 – 4 GHz) (TC #2)

Frequency (MHz)	Corrected EIRP Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
4000.000	30.9	74.0	-43.1				Peak
4000.000	20.2	54.0	-33.8				Average
4000.000	20.2			-75.0	-41.3	-33.7	Average

Plot 5-60: Radiated Emissions (4 – 8.2 GHz) (TC #2)

Vertical

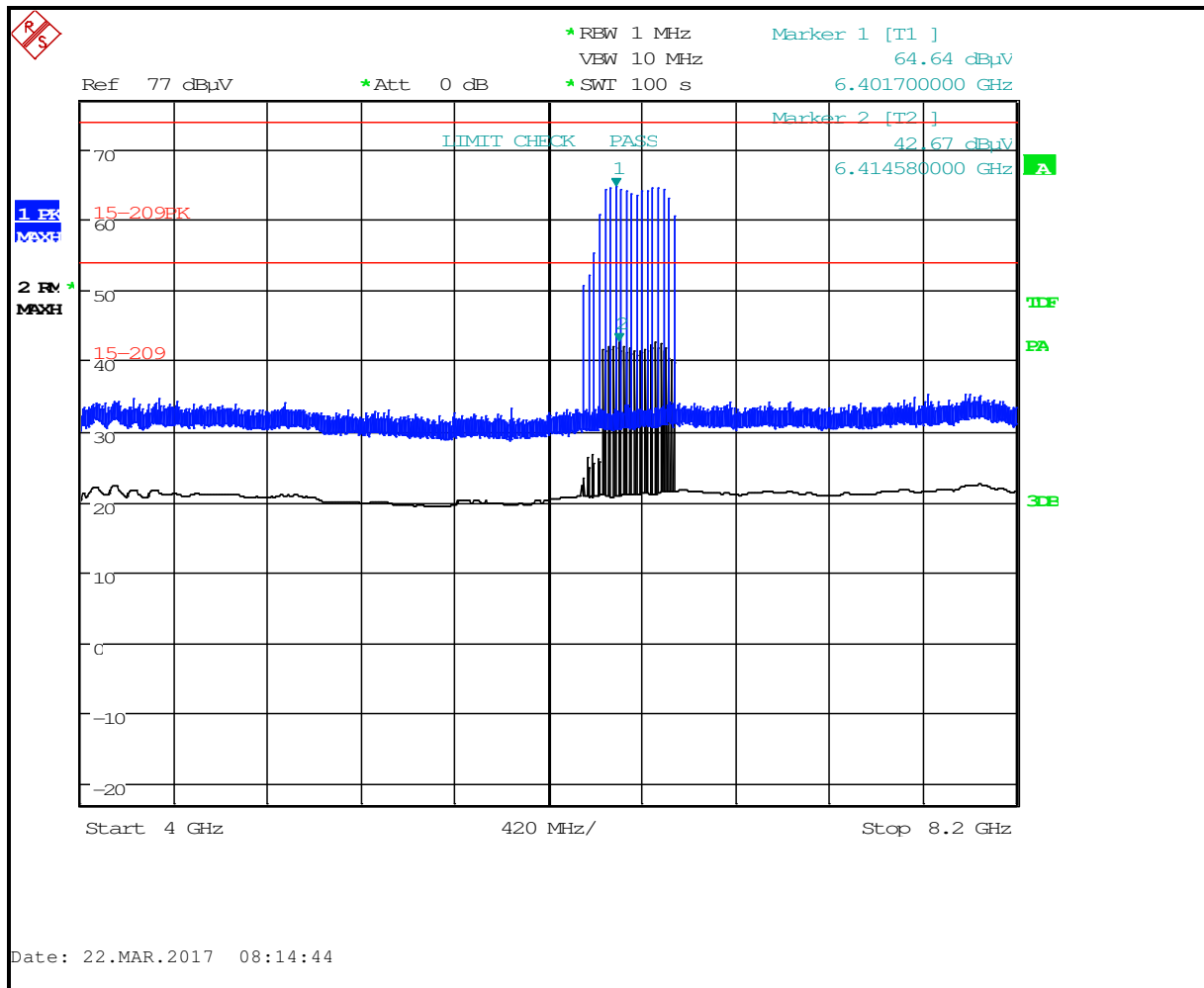


Table 5-70: Radiated Emissions (4 – 8.2 GHz) (TC #2)

Frequency (MHz)	Corrected EIRP Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
6401.700	64.5	74.0	-9.5				Peak
6414.580	42.7	54.0	-11.3				Average
6414.580	42.7			-52.5	-41.3	-11.2	Average

Plot 5-61: Radiated Emissions (8.2 – 12.4 GHz) (TC #2)

Horizontal

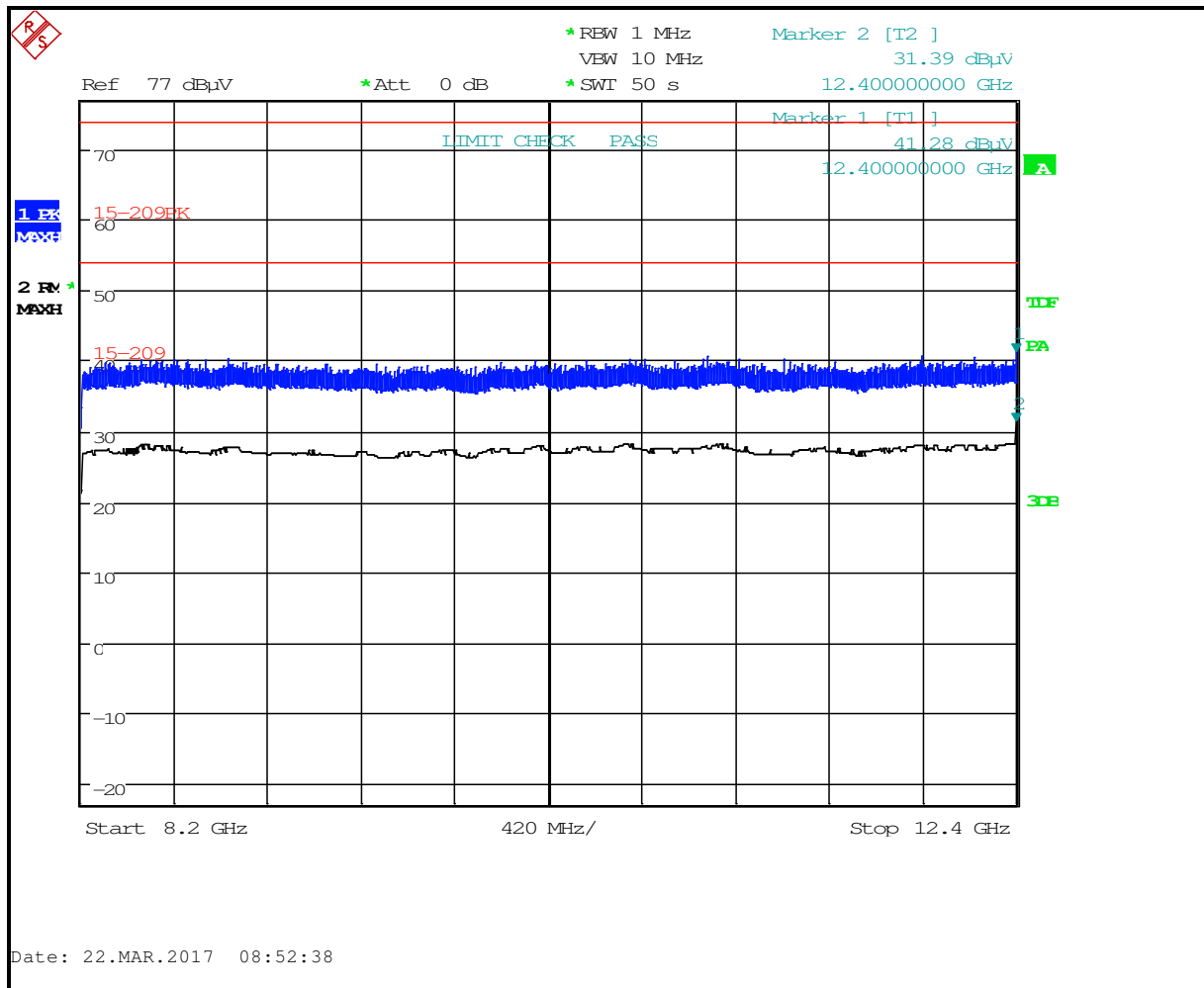


Table 5-71: Radiated Emissions (8.2 – 12.4 GHz) (TC #2)

Frequency (MHz)	Corrected EIRP Measured (dBμV)	Limit (dBμV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
12400.000	41.3	74.0	-32.7				Peak
12400.000	31.4	54.0	-22.6				Average
12400.000	31.4			-63.8	-41.3	-22.5	Average

Plot 5-63: Radiated Emissions (18 – 26.5 GHz) (TC #2)

Horizontal

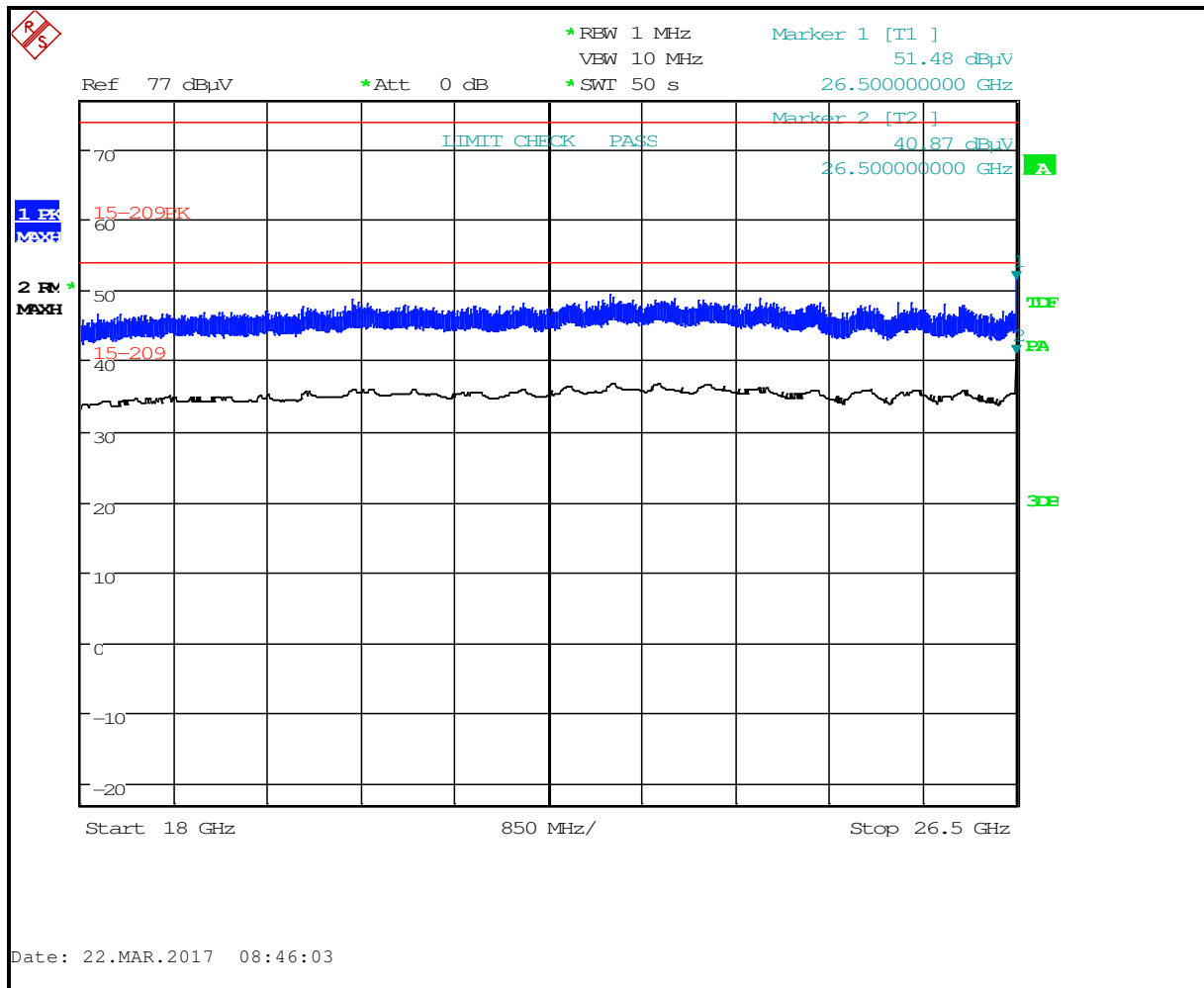


Table 5-73: Radiated Emissions (18 – 26.5 GHz) (TC #2)

Frequency (MHz)	Corrected EIRP Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
26500.000	51.5	74.0	-22.5				Peak
26500.000	40.9	54.0	-13.1				Average
26500.000	40.9			-54.3	-41.3	-13.0	Average

Plot 5-64: Radiated Emissions (26.5 – 40 GHz) (TC #2)

Vertical

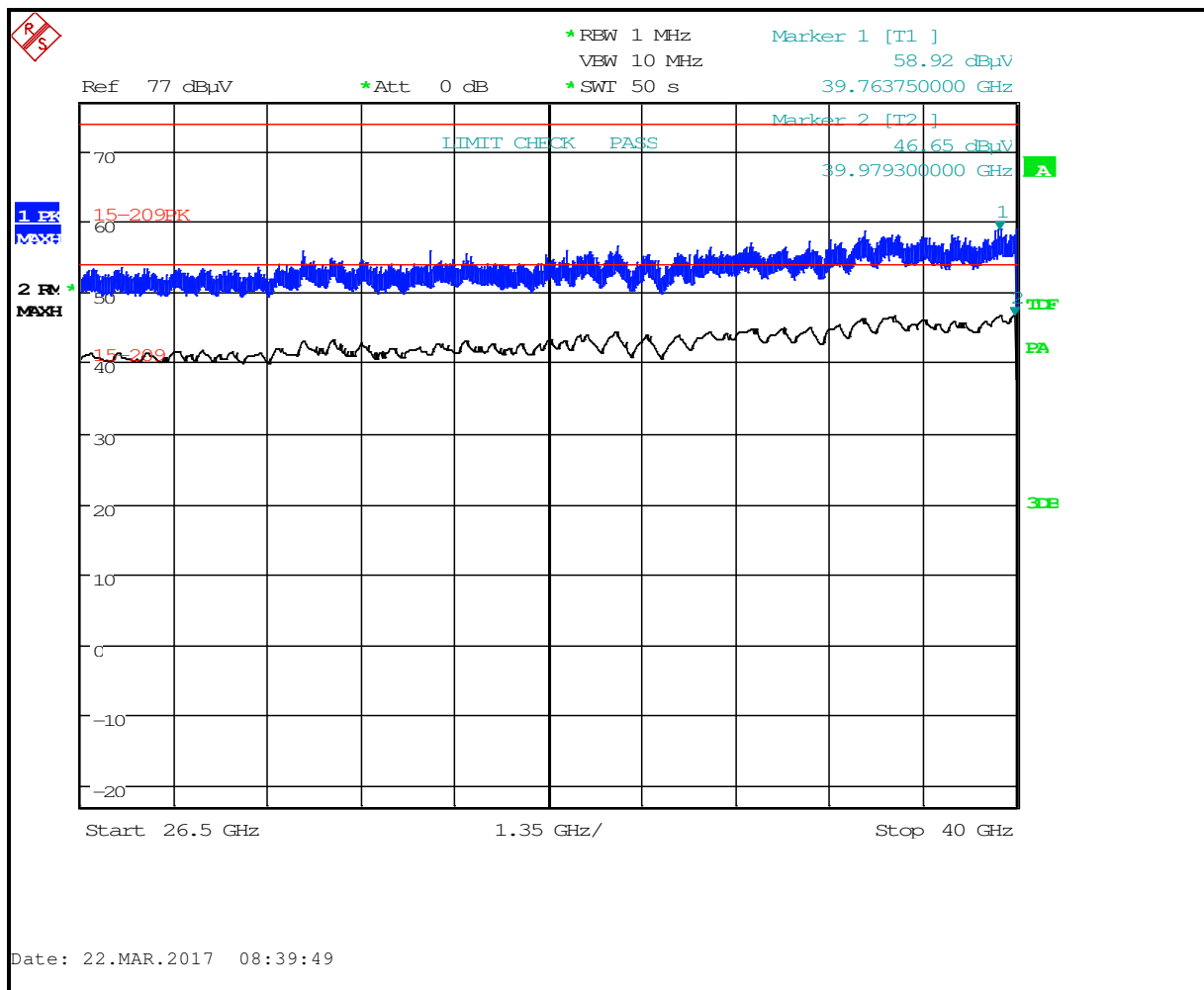


Table 5-74: Radiated Emissions (26.5 – 40 GHz) (TC #2)

Frequency (MHz)	Corrected EIRP Measured (dBμV)	Limit (dBμV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/Average
39763.750	58.9	74.0	-15.1				Peak
39979.300	46.7	54.0	-7.3				Average
39979.300	46.7			-48.5	-41.3	-7.2	Average

Plot 5-65: Radiated Emissions (30 – 1000 MHz) (TC #3)

Horizontal

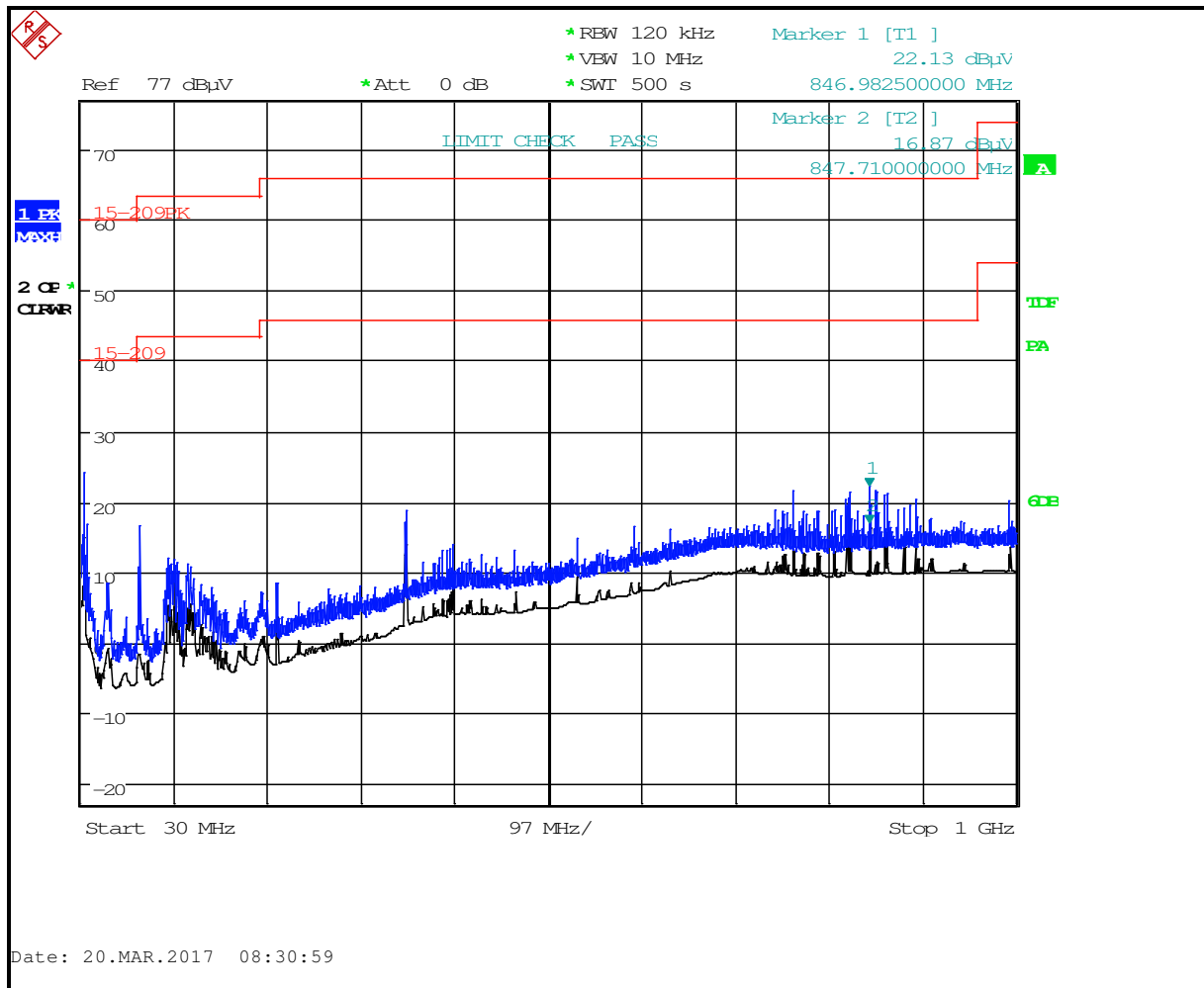


Table 5-75: Radiated Emissions (30 – 1000 MHz) (TC #3)

Frequency (MHz)	Corrected EIRP Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/Average
846.983	22.1	74.0	-51.9	-78.3	-41.3	-37.0	Peak
847.710	16.9	54.0	-37.1				Quasi-Peak
847.710	16.9						Quasi-Peak

Plot 5-67: Radiated Emissions (2 – 4 GHz) (TC #3)

Horizontal

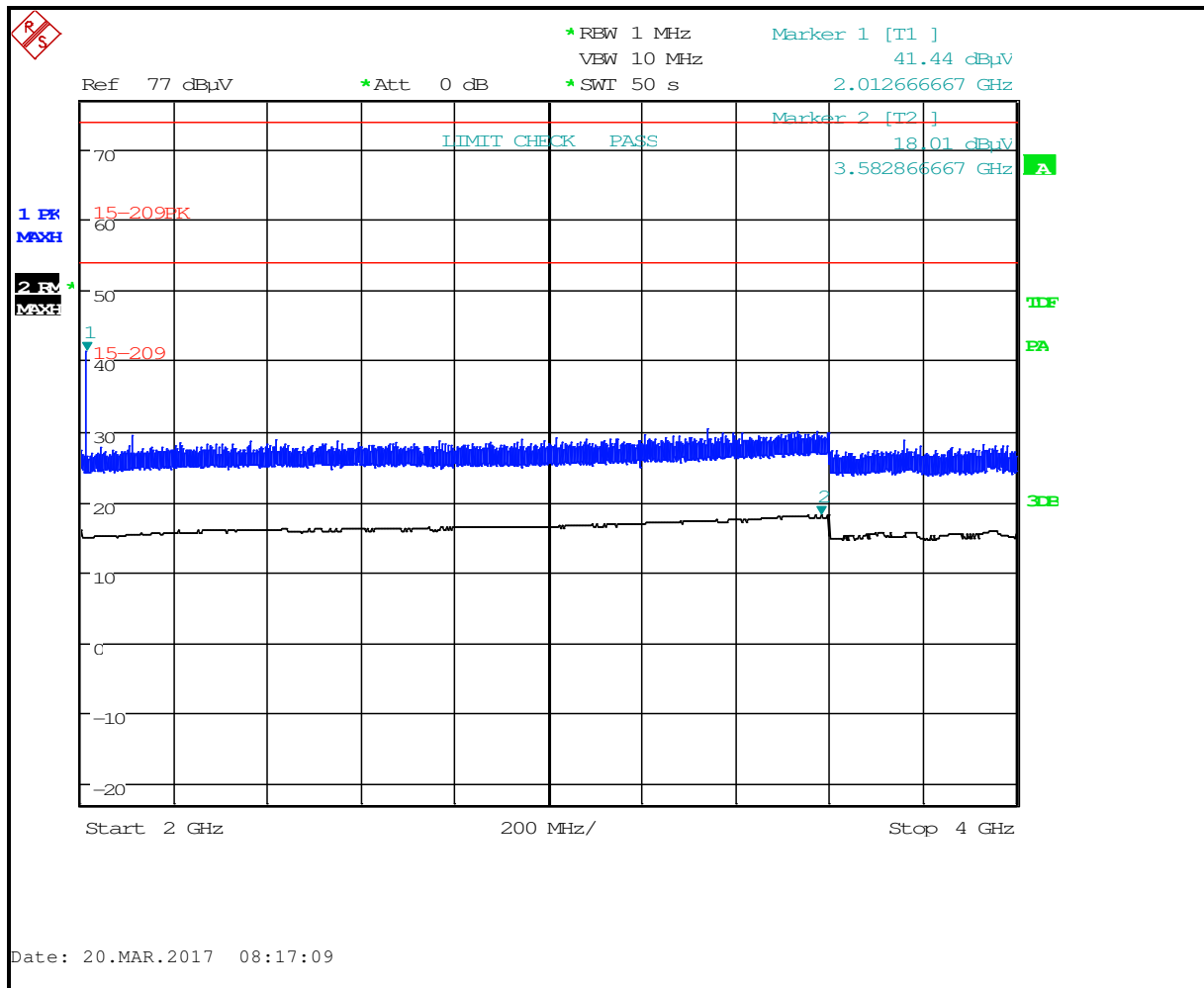


Table 5-77: Radiated Emissions (2 – 4 GHz) (TC #3)

Frequency (MHz)	Corrected EIRP Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
2012.667	41.4	74.0	-32.6				Peak
3582.867	18.0	54.0	-36.0				Average
3582.867	18.0			-77.2	-41.3	-35.9	Average

Plot 5-68: Radiated Emissions (4 – 8.2 GHz) (TC #3)

Vertical

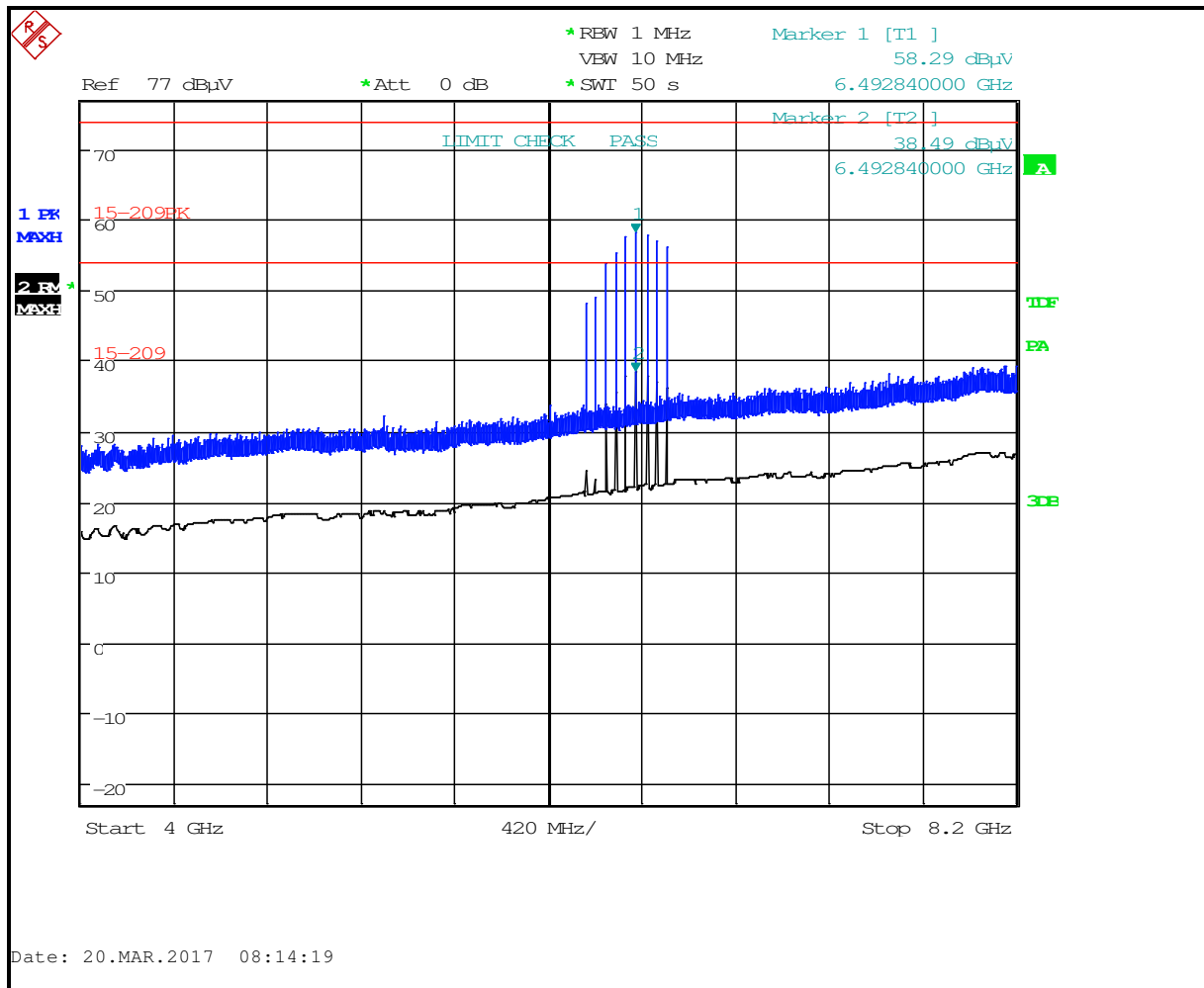


Table 5-78: Radiated Emissions (4 – 8.2 GHz) (TC #3)

Frequency (MHz)	Corrected EIRP Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
6492.840	58.3	74.0	-15.7				Peak
6492.840	38.5	54.0	-15.5				Average
6492.840	38.5			-56.7	-41.3	-15.4	Average

Plot 5-69: Radiated Emissions (8.2 – 12.4 GHz) (TC #3)

Vertical

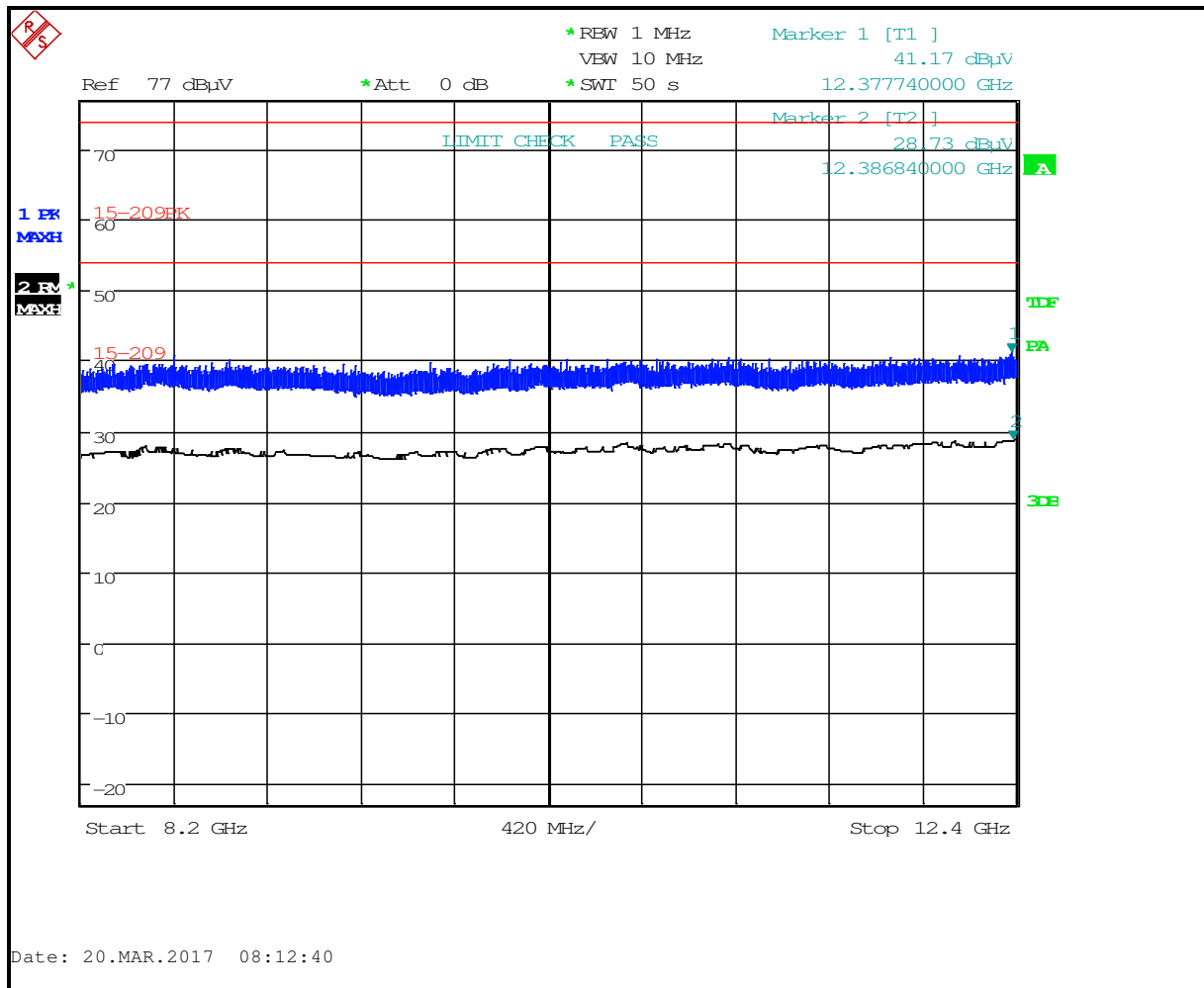


Table 5-79: Radiated Emissions (8.2 – 12.4 GHz) (TC #3)

Frequency (MHz)	Corrected EIRP Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
12377.774	41.2	74.0	-32.8				Peak
12386.840	28.7	54.0	-25.3				Average
12386.840	28.7			-66.5	-41.3	-25.2	Average

Plot 5-71: Radiated Emissions (18 – 26.5 GHz) (TC #1)

Vertical

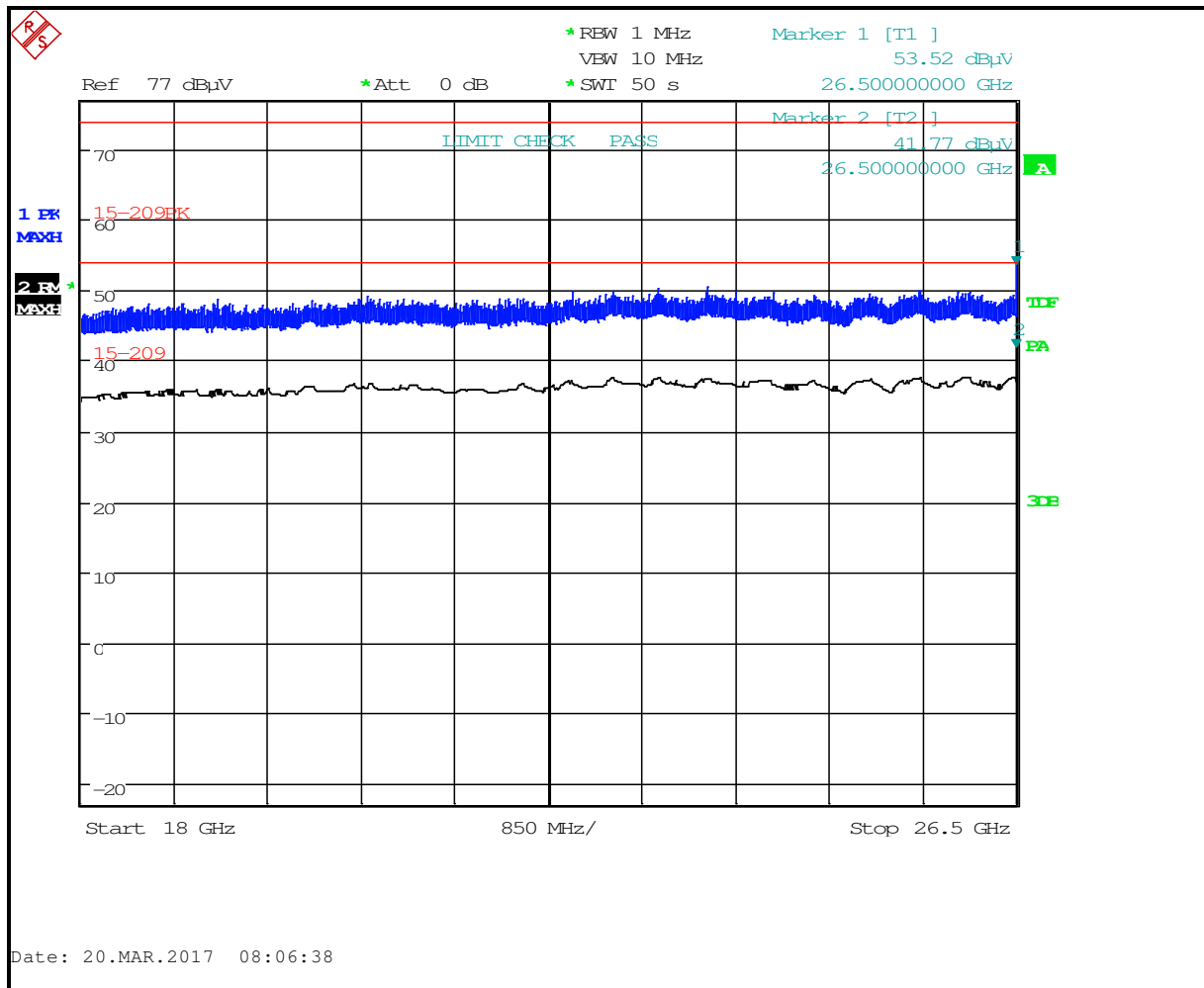


Table 5-81: Radiated Emissions (18 – 26.5 GHz) (TC #3)

Frequency (MHz)	Corrected EIRP Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
26500.000	53.5	74.0	-20.5				Peak
26500.000	41.8	54.0	-12.2				Average
26500.000	41.8			-53.4	-41.3	-12.1	Average

Plot 5-72: Radiated Emissions (26.5 – 40 GHz) (TC #3)

Horizontal

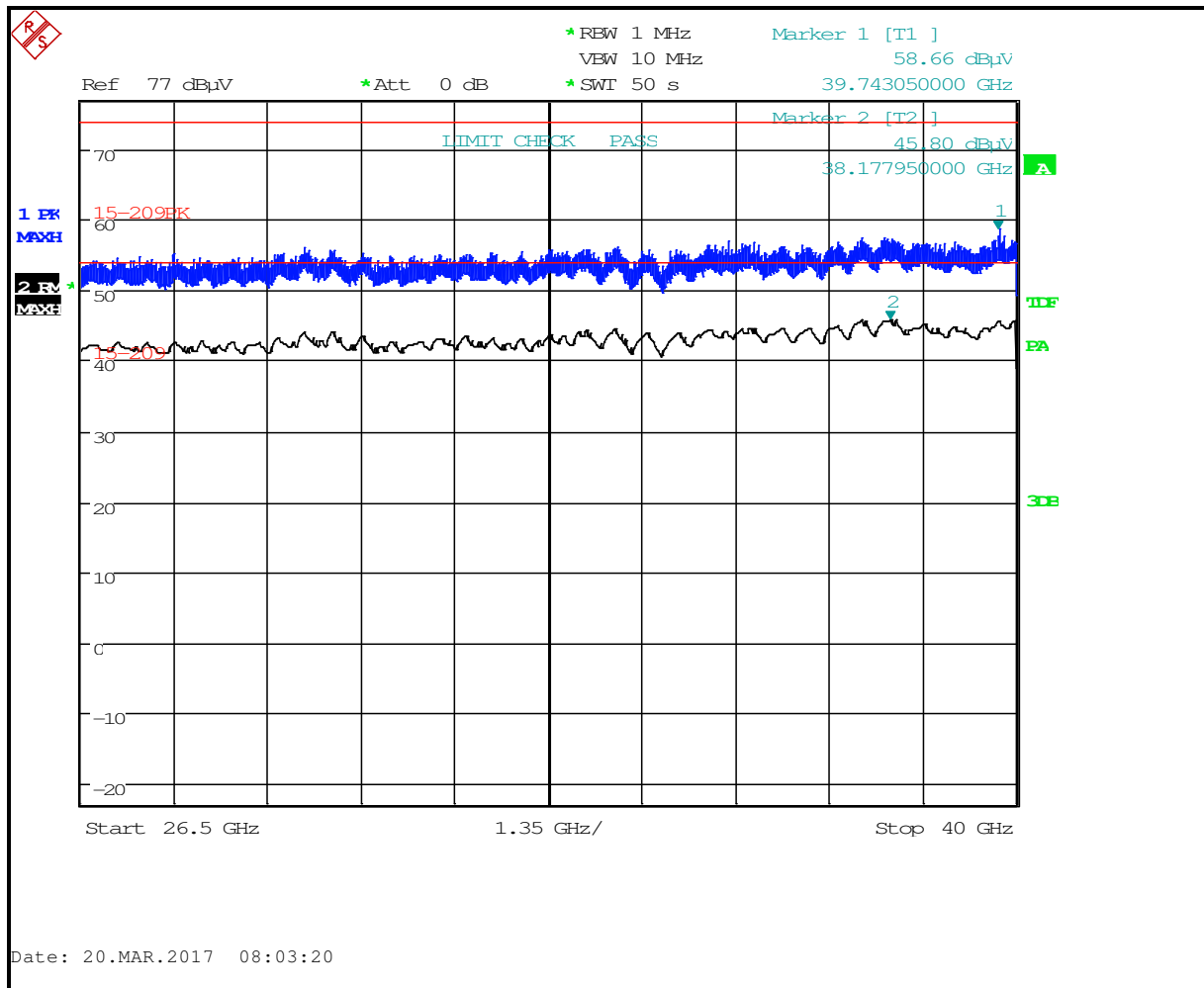


Table 5-82: Radiated Emissions (26.5 – 40 GHz) (TC #3)

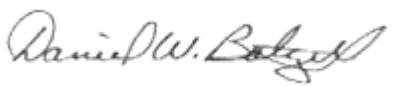
Frequency (MHz)	Corrected EIRP Measured (dBμV)	Limit (dBμV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
39743.050	58.7	74.0	-15.3				Peak
28177.950	45.8	54.0	-8.2				Average
28177.950	45.8			-49.4	-41.3	-8.1	Average

Table 5-83: Radiated Emissions Test Equipment for Enclosure Plots

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901593	Insulated Wire Inc.	KPS-1503-360-KPR	SMK RF Cables 36"	NA	8/1/17
901640	Rohde & Schwarz	FS-Z110	Mixer (75 – 110 GHz)	100010	4/2/17
901581	Rohde & Schwarz	FSU	Spectrum Analyzer	1166.1660.50	3/22/18
901303	EMCO	3160-10	Horn Antenna (26.5 - 40.0 GHz) WR-28	960452-007	6/19/17
901161	ATM	28-25K-6	Waveguide (26.5 – 40 GHz)	B082304	Not required
900724	Antenna Research Associates, Inc.	LPB-2520	BiLog Antenna (25 - 2000 MHz)	1037	4/30/17
900772	EMCO	3161-02	Horn Antenna (2 - 4 GHz)	9804-1044	4/9/18
900321	EMCO	3161-03	Horn Antenna (4.0 - 8.2 GHz)	9508-1020	4/9/18
900323	EMCO	3160-07	Horn Antenna (8.2 - 12.4 GHz)	9605-1054	4/19/18
900356	EMCO	3160-08	Horn Antenna (12.4 - 18 GHz)	9607-1044	4/9/18
901218	EMCO	3160-09	Horn Antenna (18 - 26.5 GHz)	960281-003	4/14/18

Test Personnel:

Daniel W. Baltzell
Test Engineer


Signature

March 1-24, 2017
Dates of Test

Results: Passing

The worst-case radiated emissions occur with the EUT in configurations TC #1, TC #2, and TC# tested with the main beam pointing perpendicularly downwards within the enclosed steel, concrete and fiberglass containers.

6 Conclusion

The data in this measurement report shows that the Vega Grieshaber KG, Inc., Model **VEGAPULS 64**, **FCC ID: O6QPS60XW2, IC: 3892A-PS60XW2**, complies with all the requirements of Parts 2 and 15 of the FCC Rules and Regulations, and Industry Canada RSS-211 and RSS-Gen.