RHEIN TECH LABORATORIES, INC.

Engineering Solutions & Electromagnetic Compatibility Services

VEGA Grieshaber KG
Am Hohenstein 113
D-77761 Schiltach
Germany

MODEL: VEGAPULS 69
FCC ID: O6QPS60XW1
IC: 3892A-PS60XW1

March 16, 2017

Standards Referenced for this Report	
Part 2: 0ctober 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
77	0.0024*	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 16, 2017

Typed/Printed Name: Desmond Fraser Position: President

Signature: _____ Date: March 16, 2017

Typed/Printed Name: Daniel Baltzell Position: Test Engineer

Document Number: 2016254-209

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.

Table of Contents

Table of Tables

Table of Plots

Table of Figures

Table of Photographs

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 69 Level Probing Radar, FCC ID: O6QPS60XW1, IC: 3892A-PS60XW1, tested with three different antennas, each having the highest gain within its antenna type in metal, fiberglass and concrete tanks.

The EUT is available with the PS69HW 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 was issued June 15, 2015, with a Class II permissive change granted March 21, 2017. The original IC certificate was issued November 20, 2015, with a Class II permissive change granted March 23, 2017. The VEGAPULS 69 operates at 77 GHz channel (sweeping from 76.5GHz -77.5GHz). The 79 GHz channel (78.5-79.5GHz) is no longer being supported. If in the future the 79GHz channel is needed, a new CL2PC application will be submitted.

Please refer to the document CIIPC_Changes PULS69.pdf, uploaded with this report, for 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.).

- 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.

- 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.

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	Manufacturer	Model	Serial Number	FCC ID	Cable Type	RTL Bar Code
VEGAPULS 69 (TC#1)	VEGA Grieshaber KG	PS69 IXBXXCHXKJAXX	35036989	06QPS60XW1	N/A	22287
75mm Plastic Horn Antenna (33.3 dBi) (TC#1)	VEGA Grieshaber KG	N/A	N/A	N/A	N/A	N/A
VEGAPULS 69 (TC#2)	VEGA Grieshaber KG	PS69 IXCFDAHXKJXXX	35036988	06QPS60XW1	N/A	22288
67mm DN80 Lens-Antenna (31.3 dBi) (TC#2)	VEGA Grieshaber KG	N/A	N/A	N/A	N/A	N/A
VEGAPULS 69 (TC#3)	VEGA Grieshaber KG	PS69 IXTTCAHXAKJXXX	35036990	06QPS60XW1	N/A	22286
36mm Threaded Integrated Horn Antenna (24.3 dBi) (TC#3)	VEGA Grieshaber KG	N/A	N/A	N/A	N/A	N/A
Electronics	VEGA Grieshaber KG	PS60HW.-03	XXXXXXXX	N/A	N/A	22197

Table 2-2: Additional Test Equipment Used

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

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 69	PS69 IXBXXCHXKJAXX	VEGA Grieshaber KG	N/A	22287
Electronics	PS60HW.-03	VEGA Grieshaber KG	N/A	22197
75mm Plastic Horn Antenna (33.3 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 69	PS69 IXCFDAHXKJXXX	VEGA Grieshaber KG	N/A	22288
Electronics	PS60HW.-03	VEGA Grieshaber KG	N/A	22197
67mm DN80 Lens-Antenna (31.3 dBi)	N/A	VEGA Grieshaber KG	N/A	N/A

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

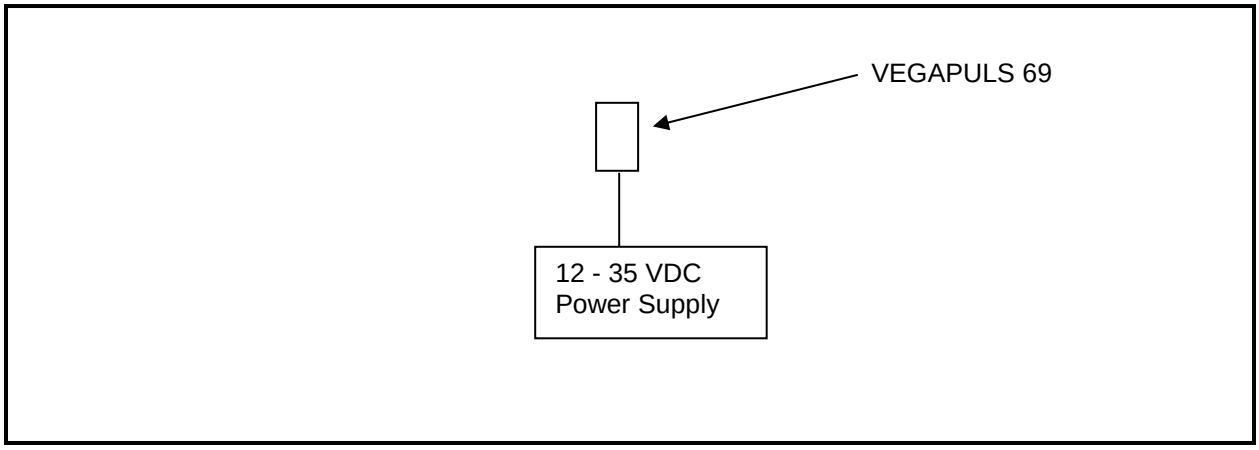
Table 2-5: Test Configuration #3 (TC #3)

Part	Model	Manufacturer	Cable Type	RTL Bar Code
VEGAPULS 69	PS69 IXTTCAHXAKJXXX	VEGA Grieshaber KG	N/A	22286
Electronics	PS60HW.-03	VEGA Grieshaber KG	N/A	22197
36mm Threaded Integrated Horn Antenna (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.

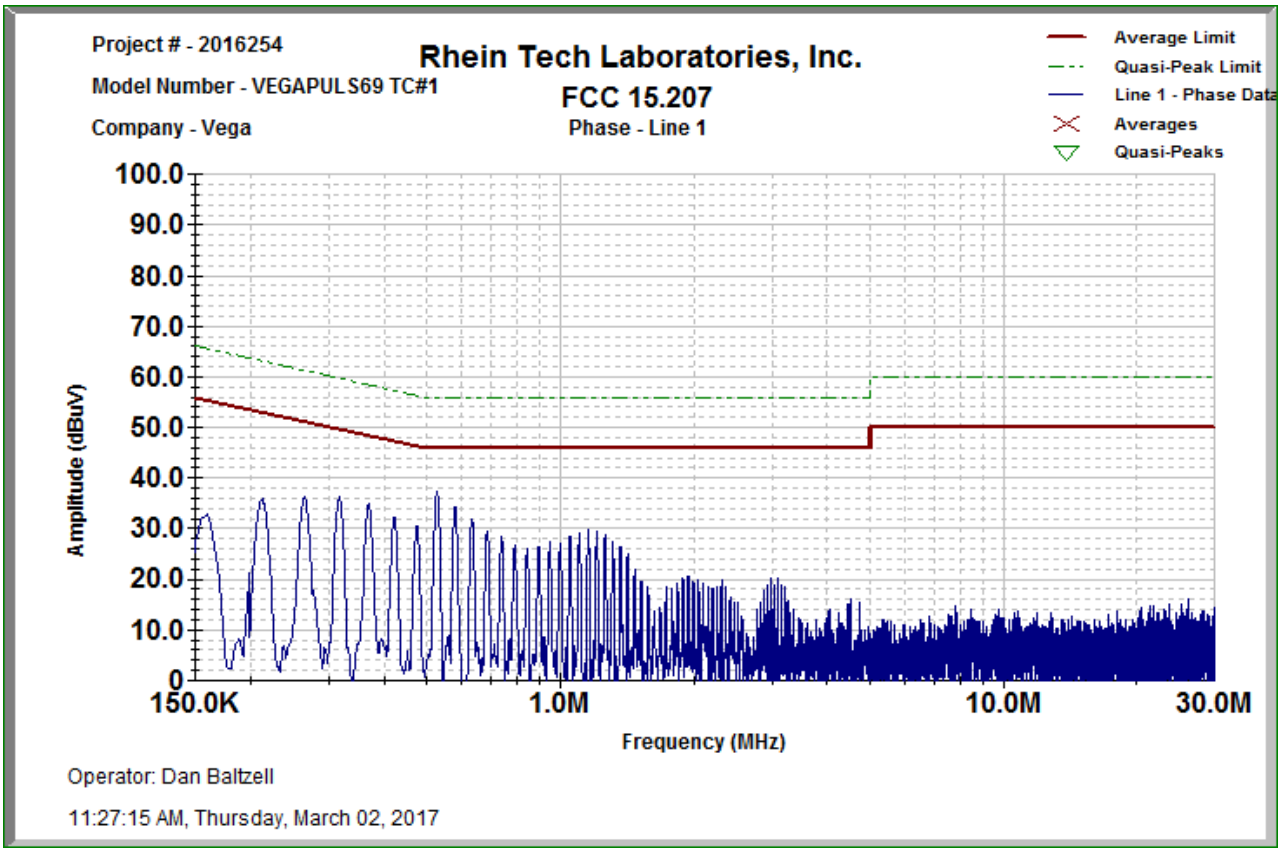
3 Conducted Limits - FCC §15.207, IC RSS-Gen

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.

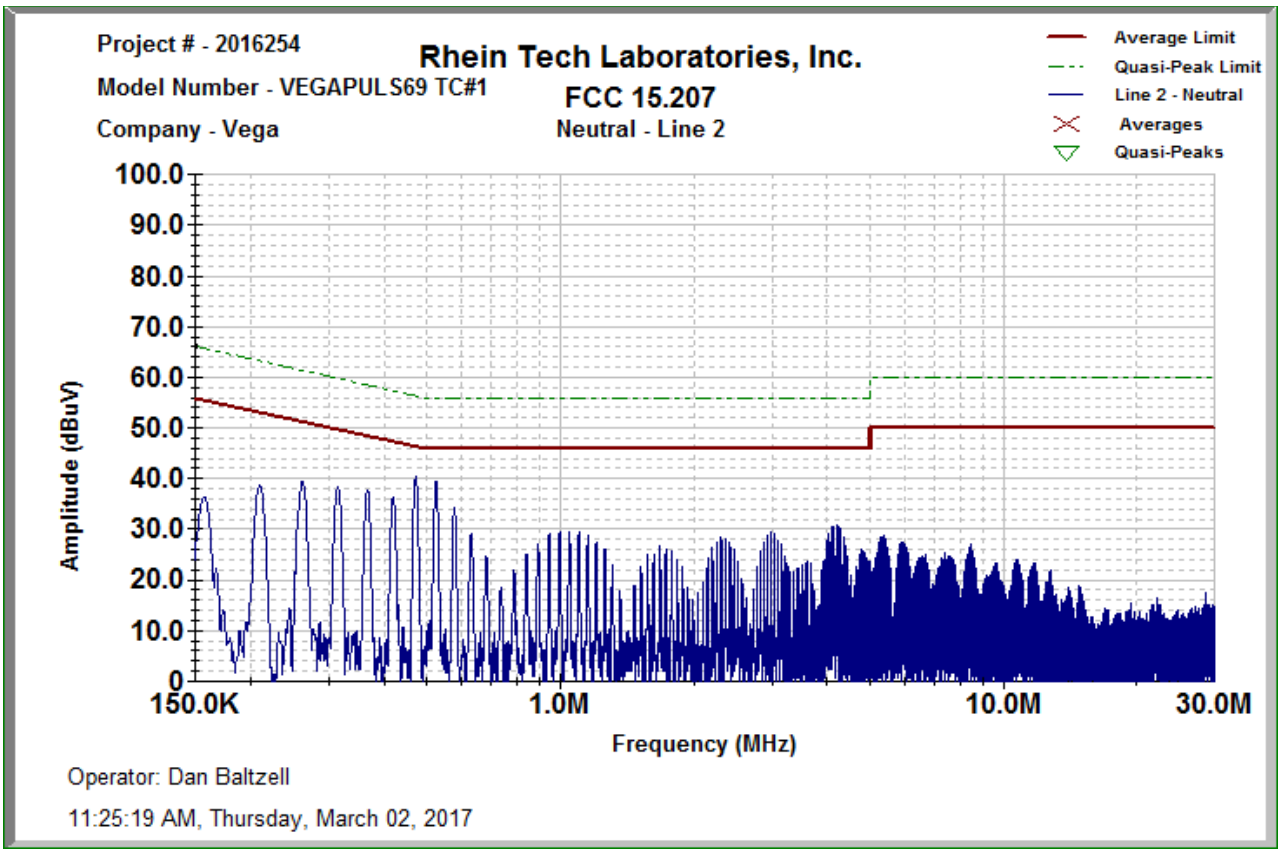
3.1 Conducted Emission Limits Test Data

3.1.1 Test Configuration #1 (TC #1)

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

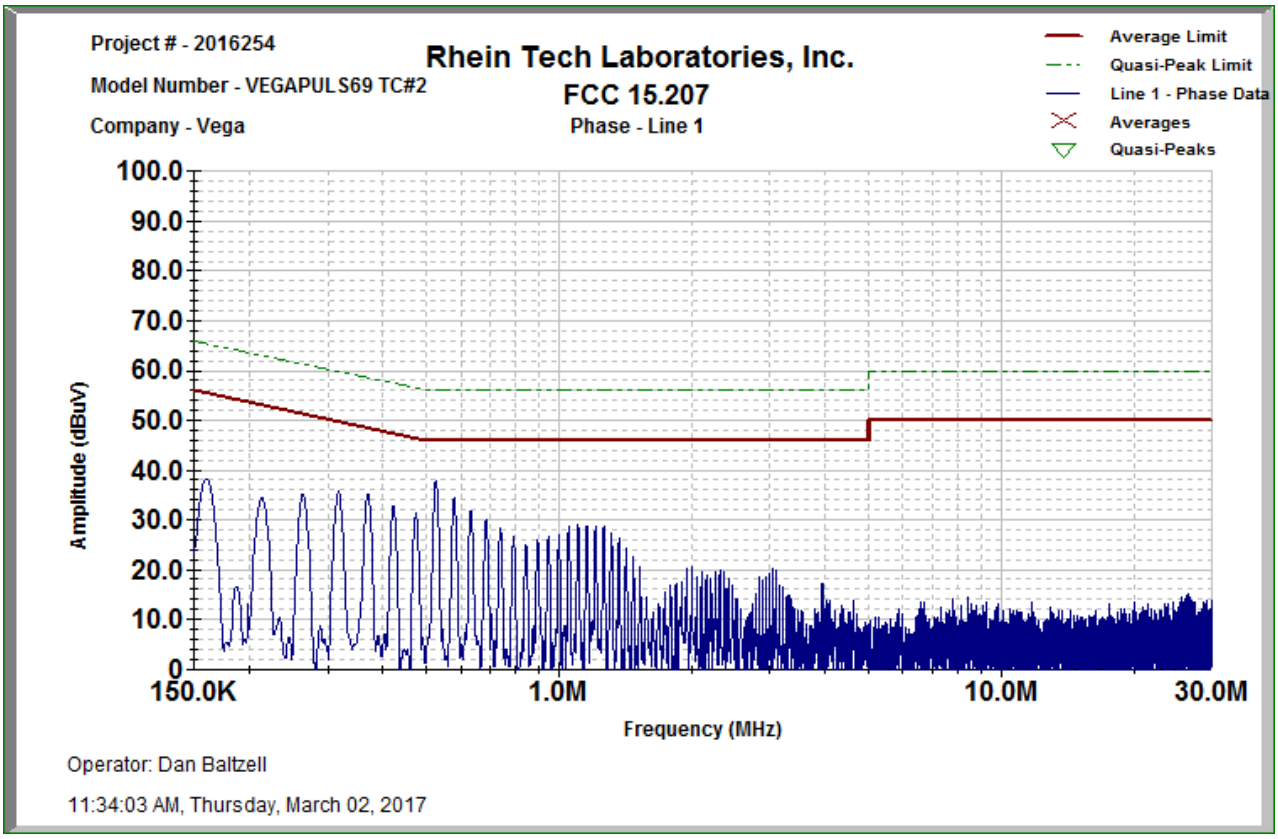


Plot 3-2: Conducted Emissions Transmit – Neutral (TC #1)

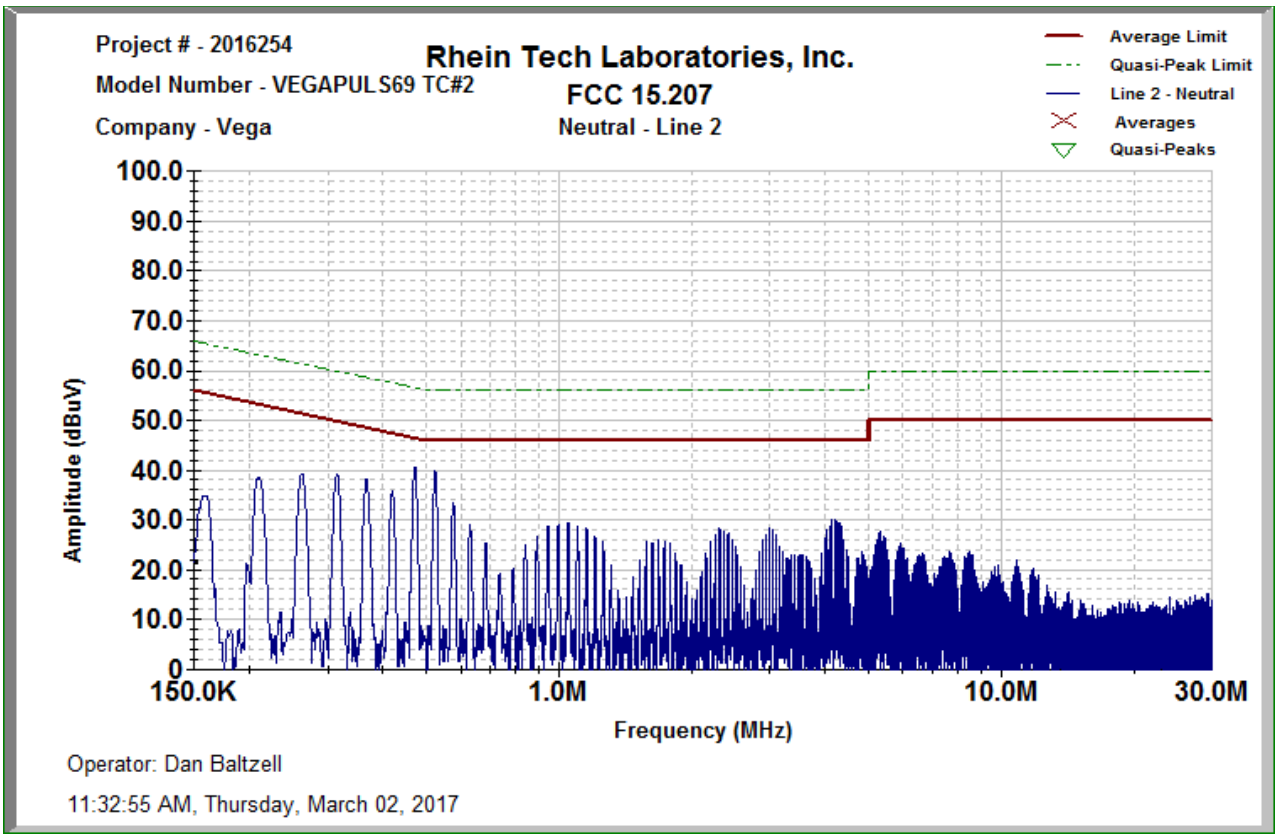


3.1.2 Test Configuration #2 (TC #2)

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

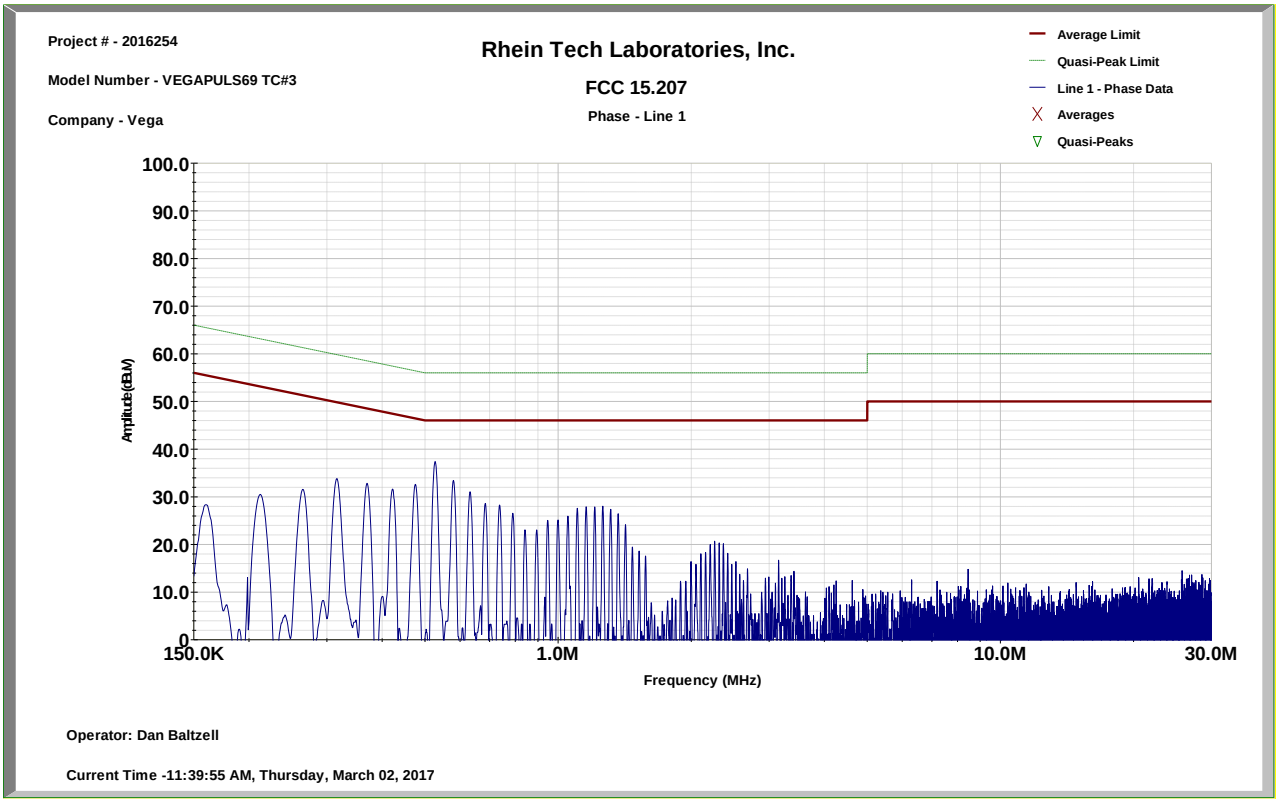


Plot 3-4: Conducted Emissions Transmit – Neutral (TC #2)



3.1.3 Test Configuration #3 (TC #3)

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



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

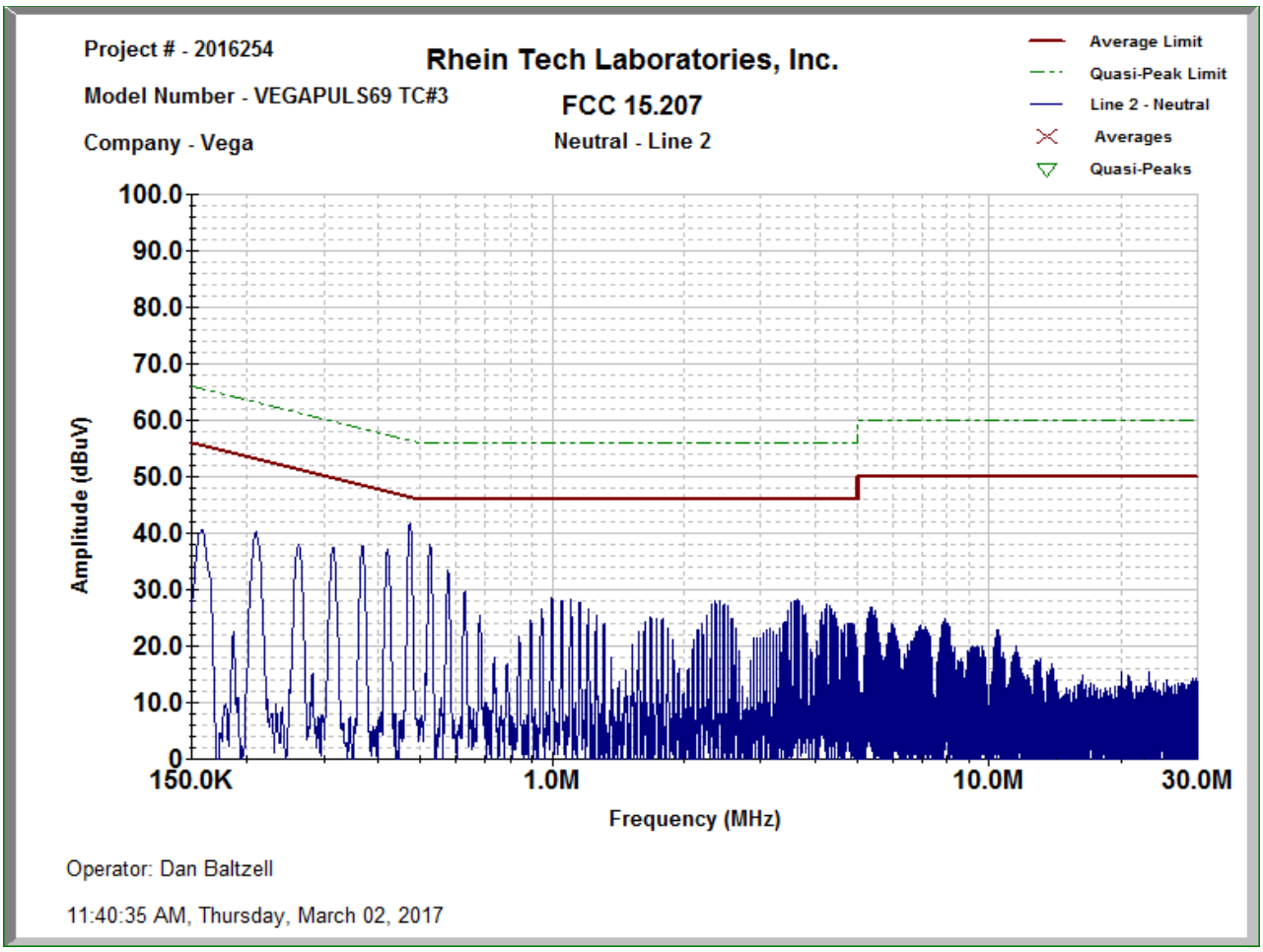
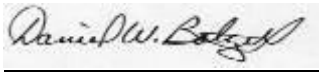


Table 3-1: Conducted Line Emissions Test Equipment

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		March 2, 2017
Test Engineer	Signature	Date of Test

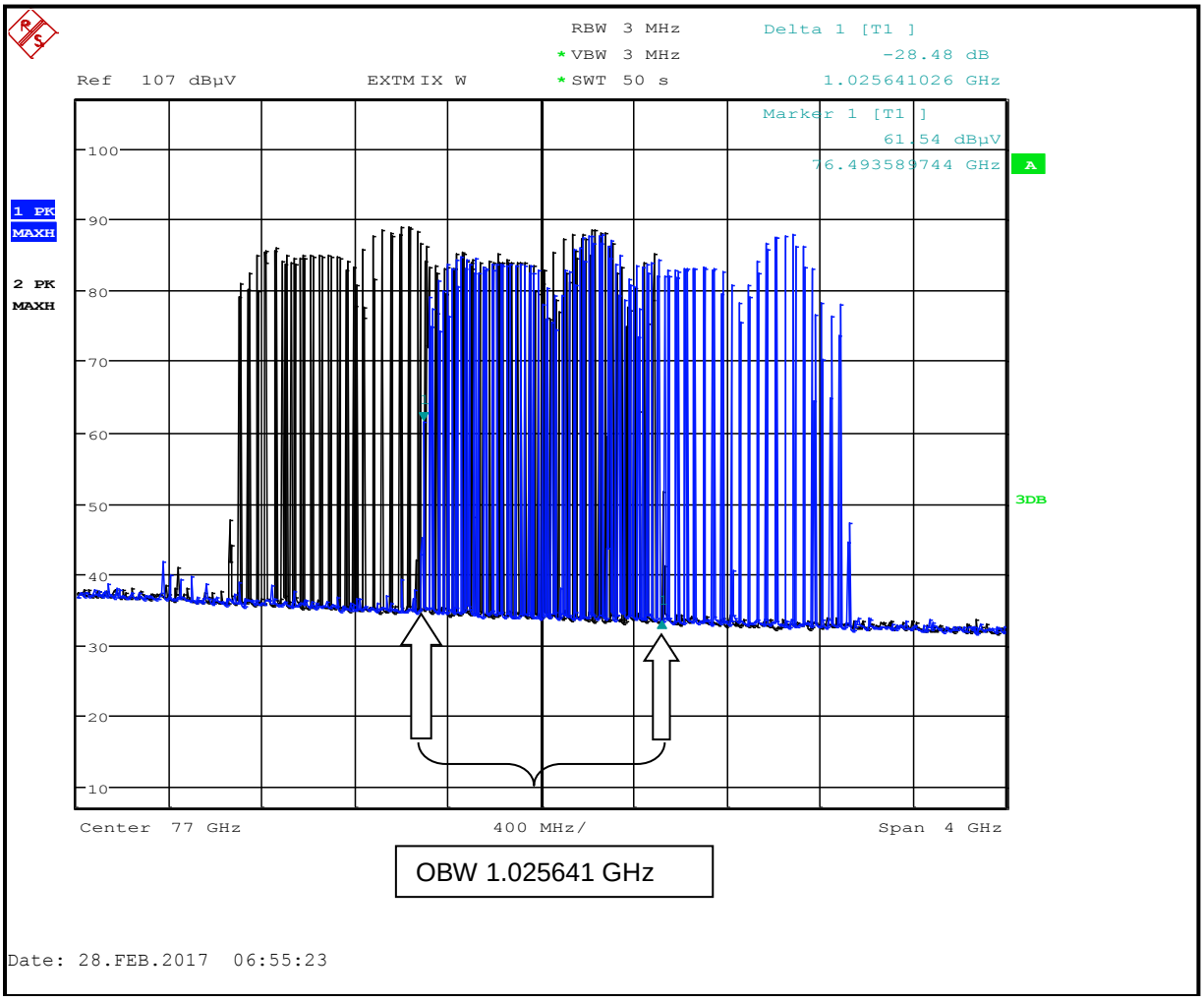
4 Modulated Bandwidth – ANSI C63.10 6.9; IC RSS-211 5.1(a)

4.1 Modulated Bandwidth Test Procedure

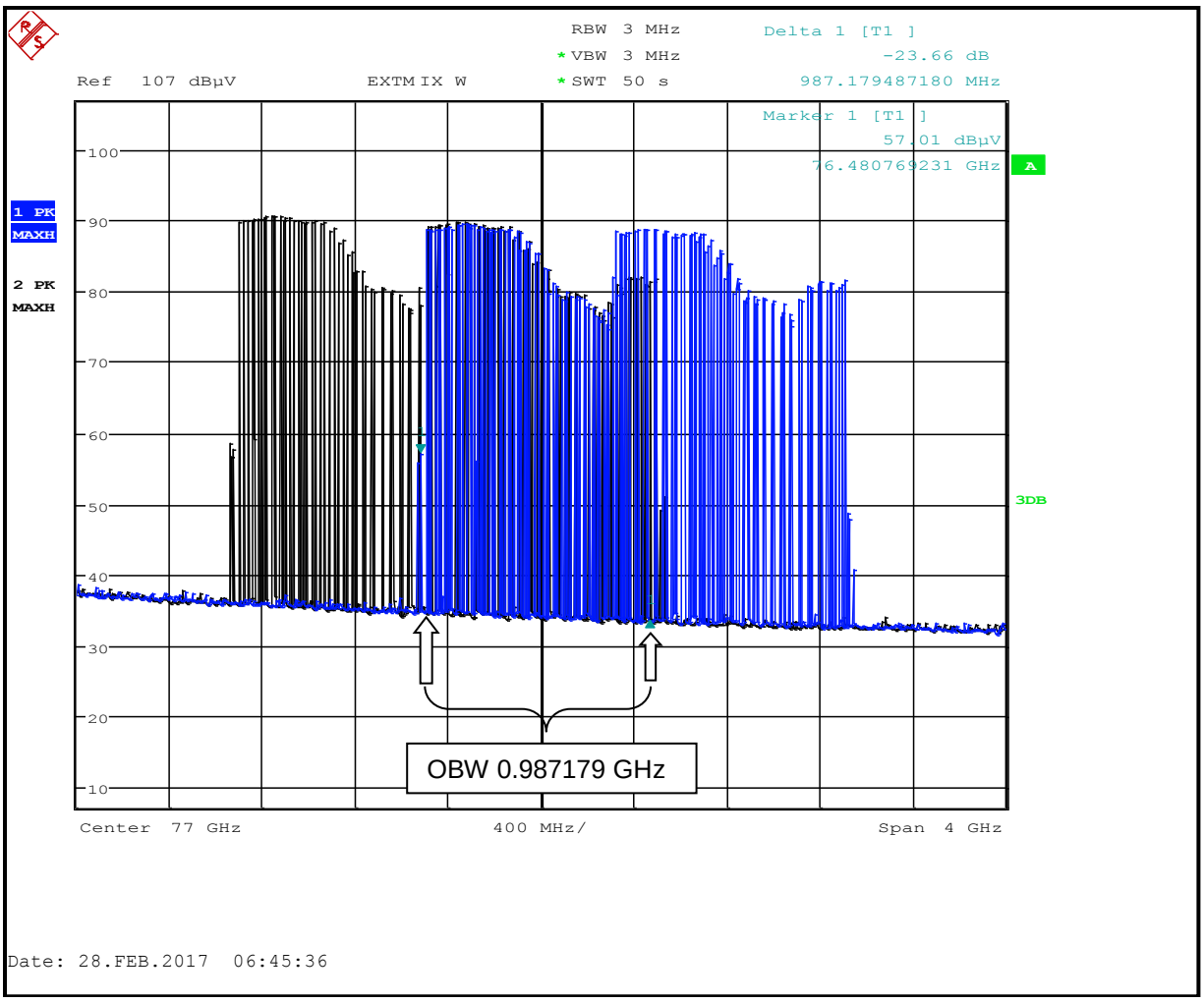
The minimum 26 dB bandwidth was measured using a 50-ohm spectrum analyzer with the resolution bandwidth set at 1 MHz and the video bandwidth set at 3 MHz. The spectrum analyzer's mixer mode resulted in an overlapping bandwidth image with the actual image and a ghost image. The analyzer "Signal ID" and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

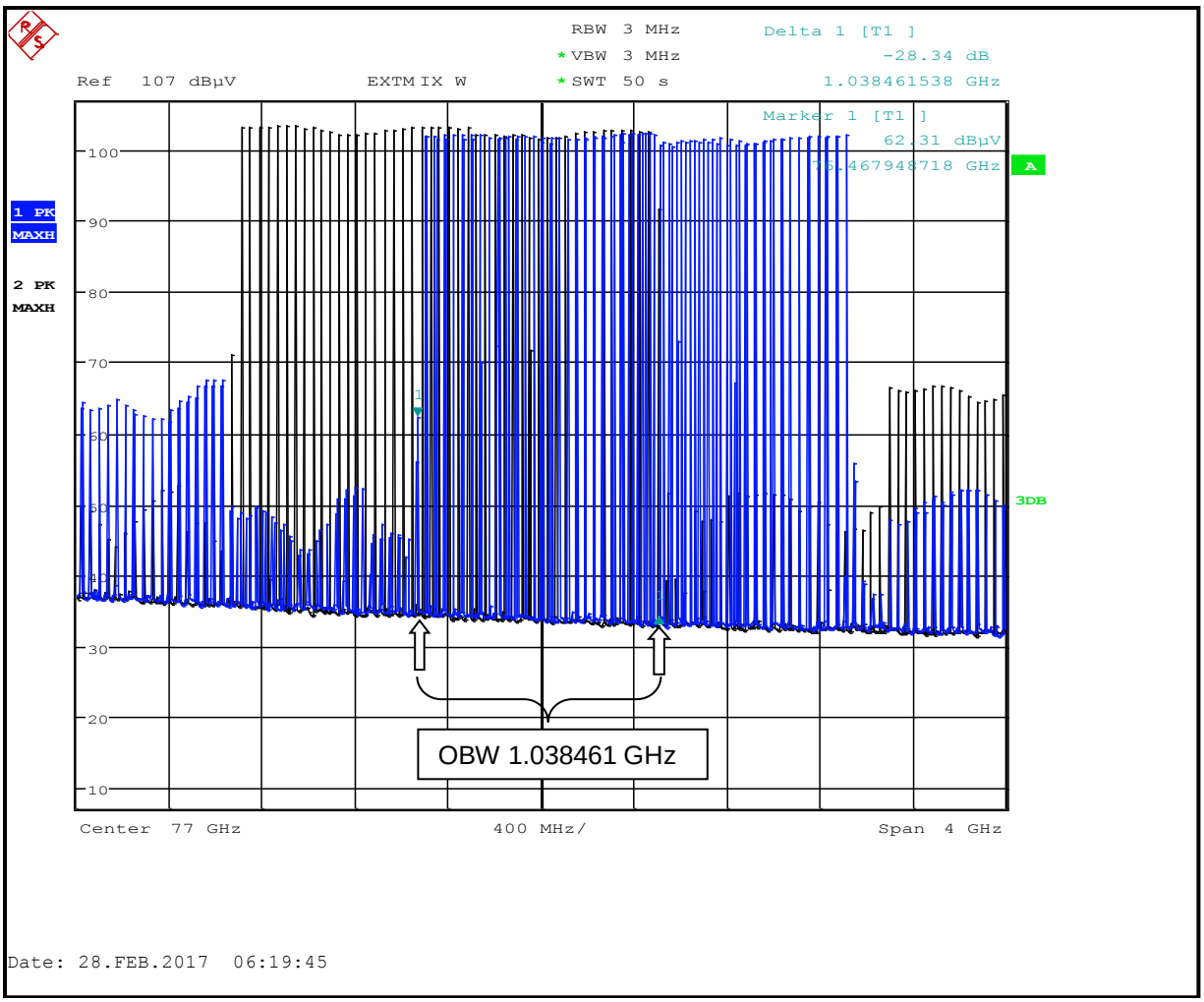


Table 4-1: Modulated Bandwidth Data

EUT Configurations	26 dB Bandwidth (GHz)
TC #1	1.025641
TC #2	0.987179
TC #3	1.038461

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

February 28, 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 #2 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: 90%										
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
305.000	Qp	H	180	2.0	38.4	-12.0	26.4	46.0	-19.6	Pass
333.362	Qp	V	225	2.0	36.2	-11.2	25.0	46.0	-21.0	Pass
355.000	Qp	V	270	1.8	33.1	-10.2	22.9	46.0	-23.1	Pass
365.000	Qp	V	225	1.5	32.4	-9.8	22.6	46.0	-23.4	Pass
410.000	Qp	H	180	1.5	33.8	-8.1	25.7	46.0	-20.3	Pass
485.000	Qp	V	180	2.0	32.1	-6.0	26.1	46.0	-19.9	Pass

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

Temperature: 43°F Humidity: 90%										
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
305.000	Qp	H	0	1.0	31.8	-12.0	19.8	46.0	-26.2	Pass
333.362	Qp	H	225	1.0	37.1	-11.2	25.9	46.0	-20.1	Pass
355.000	Qp	H	0	1.0	33.1	-10.2	22.9	46.0	-23.1	Pass
365.000	Qp	H	0	1.0	32.1	-9.8	22.3	46.0	-23.7	Pass
410.000	Qp	V	270	1.8	32.6	-8.1	24.5	46.0	-21.5	Pass
485.000	Qp	V	180	1.5	32.1	-6.0	26.1	46.0	-19.9	Pass

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

Temperature: 43°F Humidity: 90%										
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
305.000	Qp	H	180	2.0	31.7	-12.0	19.7	46.0	-26.3	Pass
333.362	Qp	V	135	2.0	35.6	-11.2	24.4	46.0	-21.6	Pass
355.000	Qp	V	180	2.0	32.0	-10.2	21.8	46.0	-24.2	Pass
365.000	Qp	H	90	2.1	31.9	-9.8	22.1	46.0	-23.9	Pass
410.000	Qp	V	0	2.0	32.0	-8.1	23.9	46.0	-22.1	Pass
485.000	Qp	V	0	2.0	32.1	-6.0	26.1	46.0	-19.9	Pass

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

Temperature: 43°F Humidity: 90%										
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
285.100	Qp	H	180	1.0	31.9	-12.3	19.6	46.0	-26.4	Pass
305.000	Qp	H	0	1.0	34.4	-12.0	22.4	46.0	-23.6	Pass
335.000	Qp	V	225	1.2	37.7	-11.1	26.6	46.0	-19.4	Pass
355.000	Qp	V	225	1.0	41.5	-10.2	31.3	46.0	-14.7	Pass
365.025	Qp	V	225	1.0	42.8	-9.8	33.0	46.0	-13.0	Pass
485.013	Qp	V	225	1.0	39.0	-6.0	33.0	46.0	-13.0	Pass

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

Temperature: 43°F Humidity: 90%										
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
285.100	Qp	V	180	1.0	35.3	-12.3	23.0	46.0	-23.0	Pass
305.000	Qp	V	270	1.0	40.6	-12.0	28.6	46.0	-17.4	Pass
335.000	Qp	V	180	1.0	42.4	-11.1	31.3	46.0	-14.7	Pass
355.000	Qp	V	180	1.0	44.7	-10.2	34.5	46.0	-11.5	Pass
365.025	Qp	V	180	1.0	40.8	-9.8	31.0	46.0	-15.0	Pass
485.013	Qp	V	180	1.0	35.8	-6.0	29.8	46.0	-16.2	Pass

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

Temperature: 43°F Humidity: 90%										
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
285.100	Qp	V	90	2.0	33.3	-12.3	21.0	46.0	-25.0	Pass
305.000	Qp	V	45	2.0	34.8	-12.0	22.8	46.0	-23.2	Pass
335.000	Qp	V	90	2.0	35.4	-11.1	24.3	46.0	-21.7	Pass
355.000	Qp	V	180	2.0	38.9	-10.2	28.7	46.0	-17.3	Pass
365.025	Qp	V	180	2.0	39.8	-9.8	30.0	46.0	-16.0	Pass
485.013	Qp	V	90	1.8	35.7	-6.0	29.7	46.0	-16.3	Pass

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

Temperature: 43°F Humidity: 90%										
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
66.800	Qp	V	135	2.0	44.9	-22.0	22.9	40.0	-17.1	Pass
150.000	Qp	V	270	2.0	35.5	-16.7	18.8	43.5	-24.7	Pass
282.500	Qp	V	270	2.0	32.2	-12.3	19.9	46.0	-26.1	Pass
333.337	Qp	H	90	1.8	35.4	-11.2	24.2	46.0	-21.8	Pass
376.000	Qp	V	0	1.8	32.4	-9.4	23.0	46.0	-23.0	Pass
488.225	Qp	V	0	3.0	32.7	-6.1	26.6	46.0	-19.4	Pass

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

Temperature: 43°F Humidity: 90%										
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
66.800	Qp	V	90	1.0	35.9	-22.0	13.9	40.0	-26.1	Pass
150.000	Qp	V	180	1.0	34.1	-16.7	17.4	43.5	-26.1	Pass
282.500	Qp	H	180	2.0	31.9	-12.3	19.6	46.0	-26.4	Pass
333.337	Qp	V	90	1.0	36.8	-11.2	25.6	46.0	-20.4	Pass
376.000	Qp	V	10	1.0	32.7	-9.4	23.3	46.0	-22.7	Pass
488.225	Qp	H	0	2.0	32.3	-6.1	26.2	46.0	-19.8	Pass

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

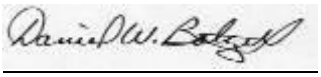
Temperature: 43°F Humidity: 90%										
Emission Frequency (MHz)	Test Detector	Antenna Polarity (H/V)	Turntable Azimuth (deg)	Antenna Height (m)	Analyzer Reading (dBuV)	Site Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pass/ Fail
66.800	Qp	H	0	1.8	37.5	-22.0	15.5	40.0	-24.5	Pass
150.000	Qp	H	135	2.0	34.0	-16.7	17.3	43.5	-26.2	Pass
282.500	Qp	V	180	2.0	31.9	-12.3	19.6	46.0	-26.4	Pass
333.337	Qp	V	180	2.0	35.3	-11.2	24.1	46.0	-21.9	Pass
376.000	Qp	V	180	2.0	32.4	-9.4	23.0	46.0	-23.0	Pass
488.225	Qp	V	90	2.0	32.3	-6.1	26.2	46.0	-19.8	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		March 16, 2017
Test Engineer	Signature	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)

Vertical

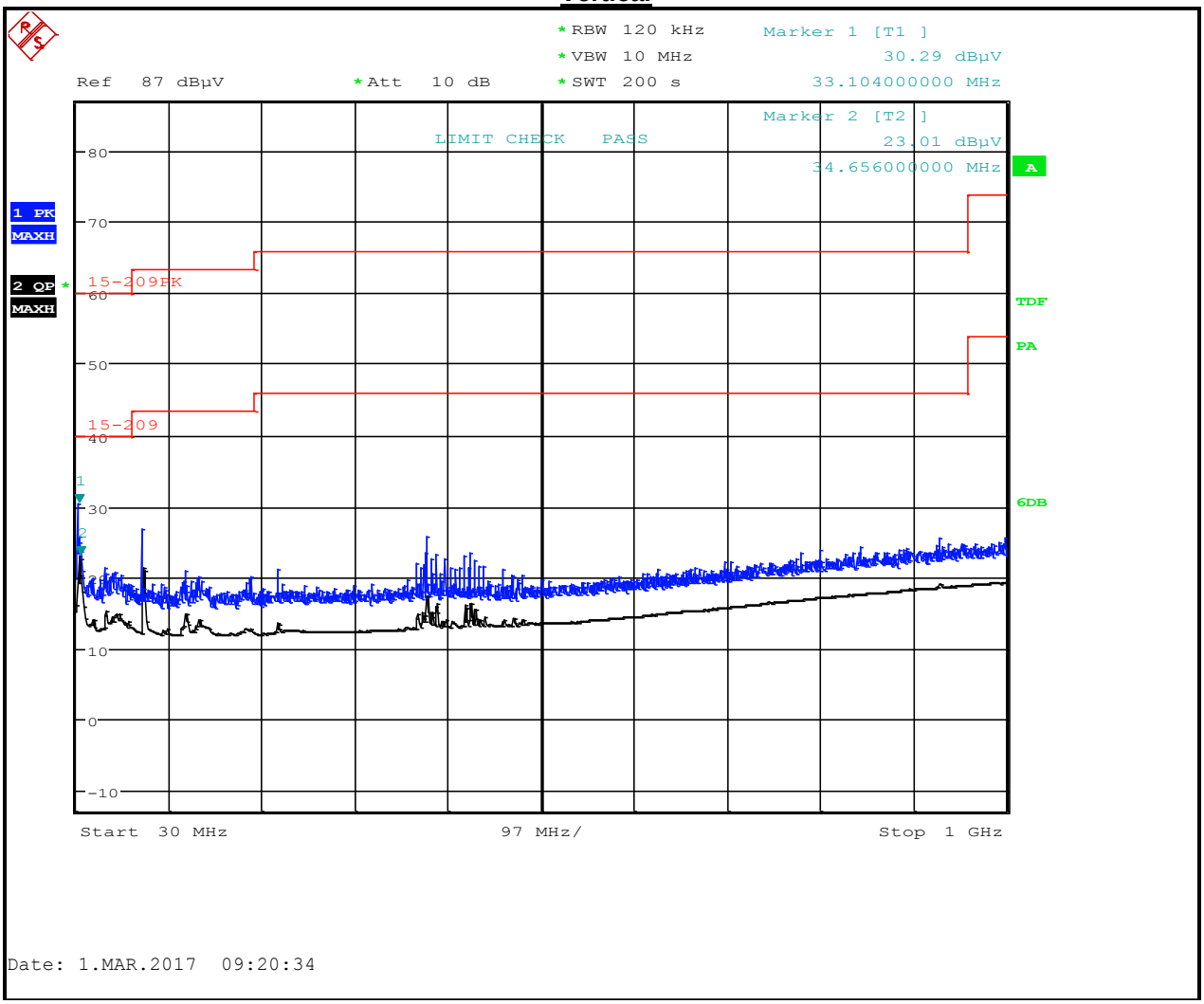


Table 5-11: Radiated Emissions (30-1000 MHz) (TC #1)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
33.104	30.3	74.0	-43.7				Peak
34.656	23.1	54.0	-30.9				Average
34.656	23.1			23.1	-41.3	-30.8	Average

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

Vertical

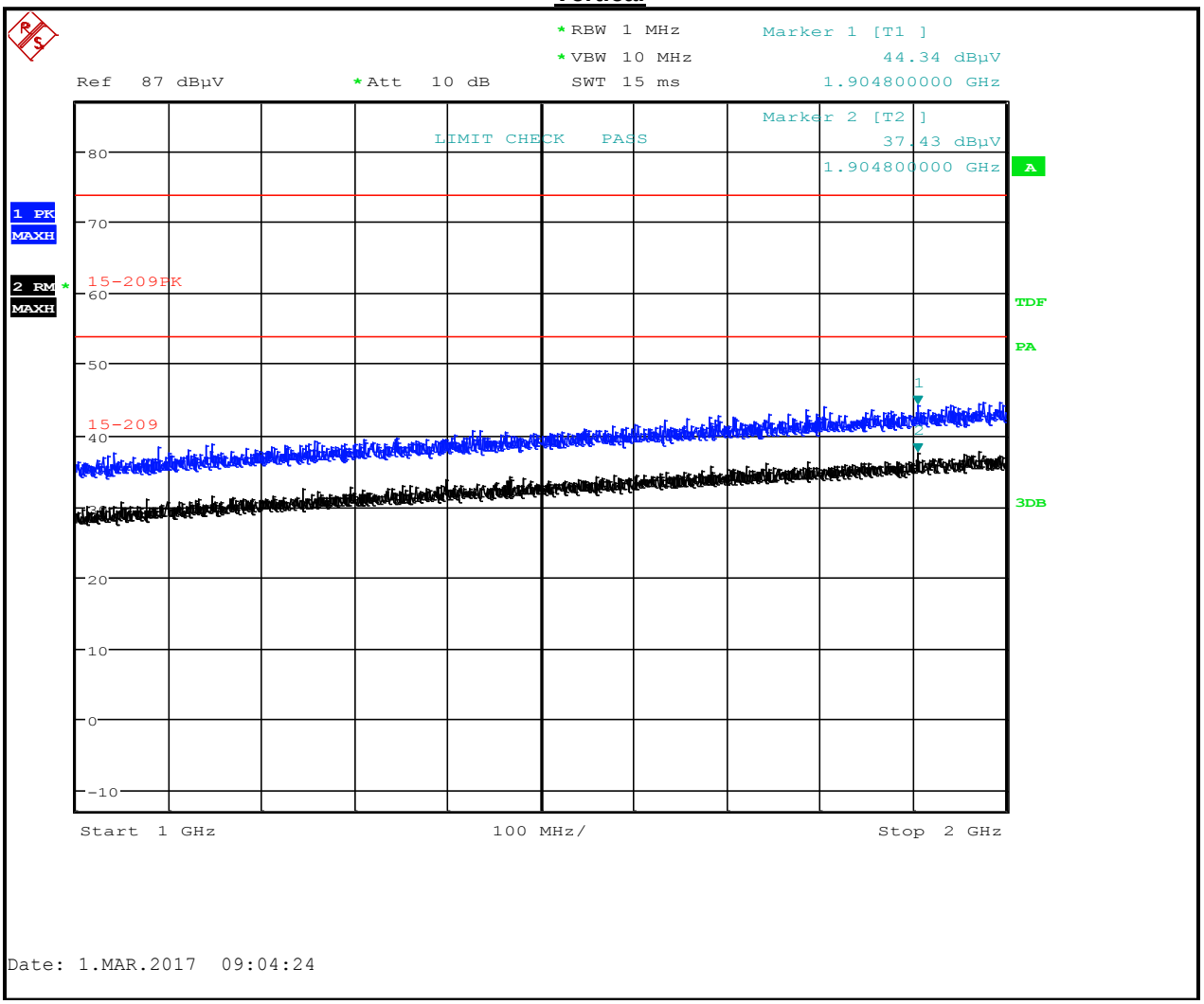


Table 5-12: Radiated Emissions (1 – 2 GHz) (TC #1)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
1904.800	44.3	74.0	-29.7				Peak
1904.800	37.4	54.0	-16.6				Average
1904.800	37.4			-57.8	-41.3	-16.5	Average

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

Horizontal

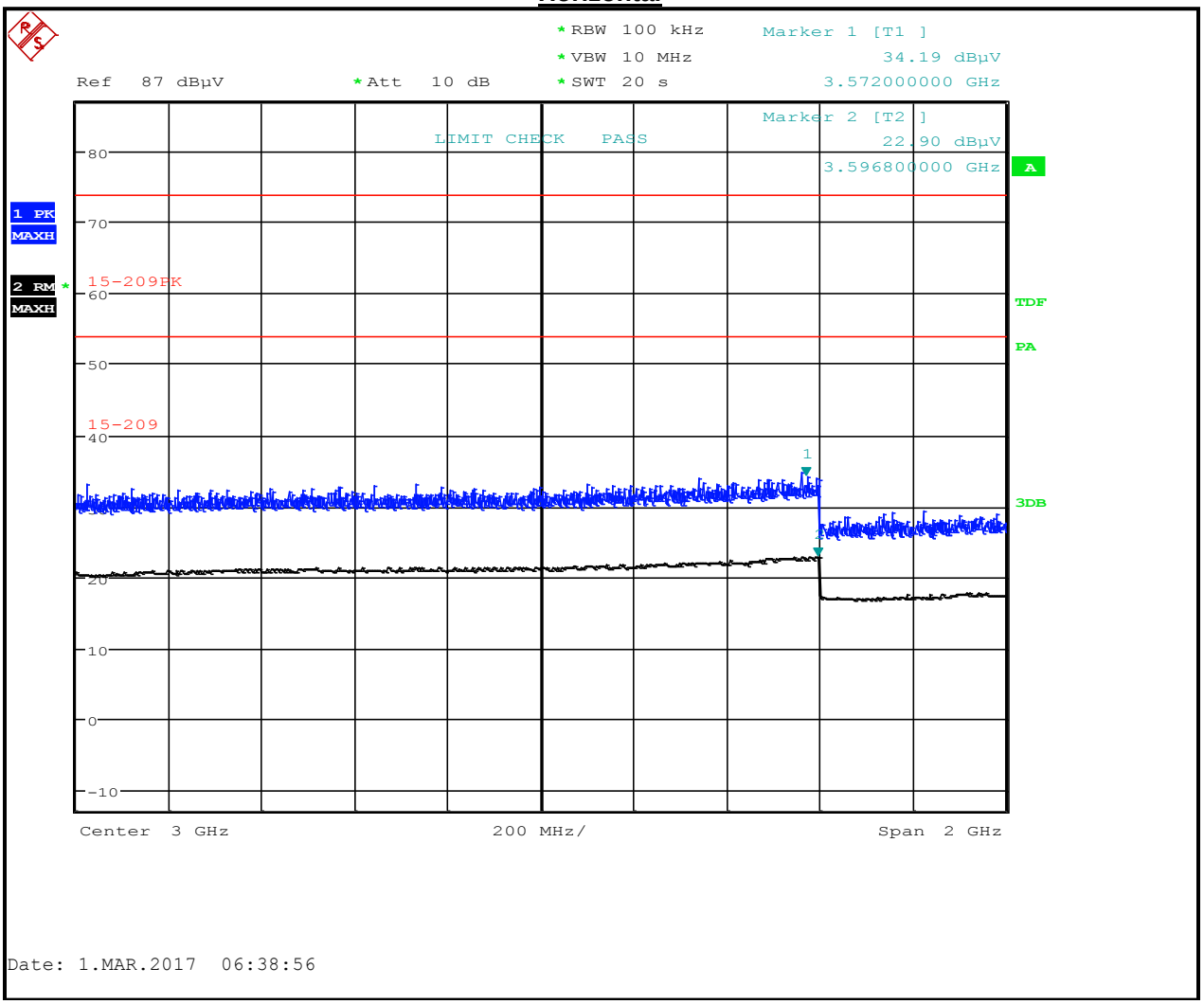


Table 5-13: Radiated Emissions (2 – 4 GHz) (TC #1)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
3572.000	34.2	74.0	-39.8				Peak
3596.800	22.9	54.0	-31.1				Average
3596.800	22.9			-72.3	-41.3	-31.0	Average

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

Horizontal

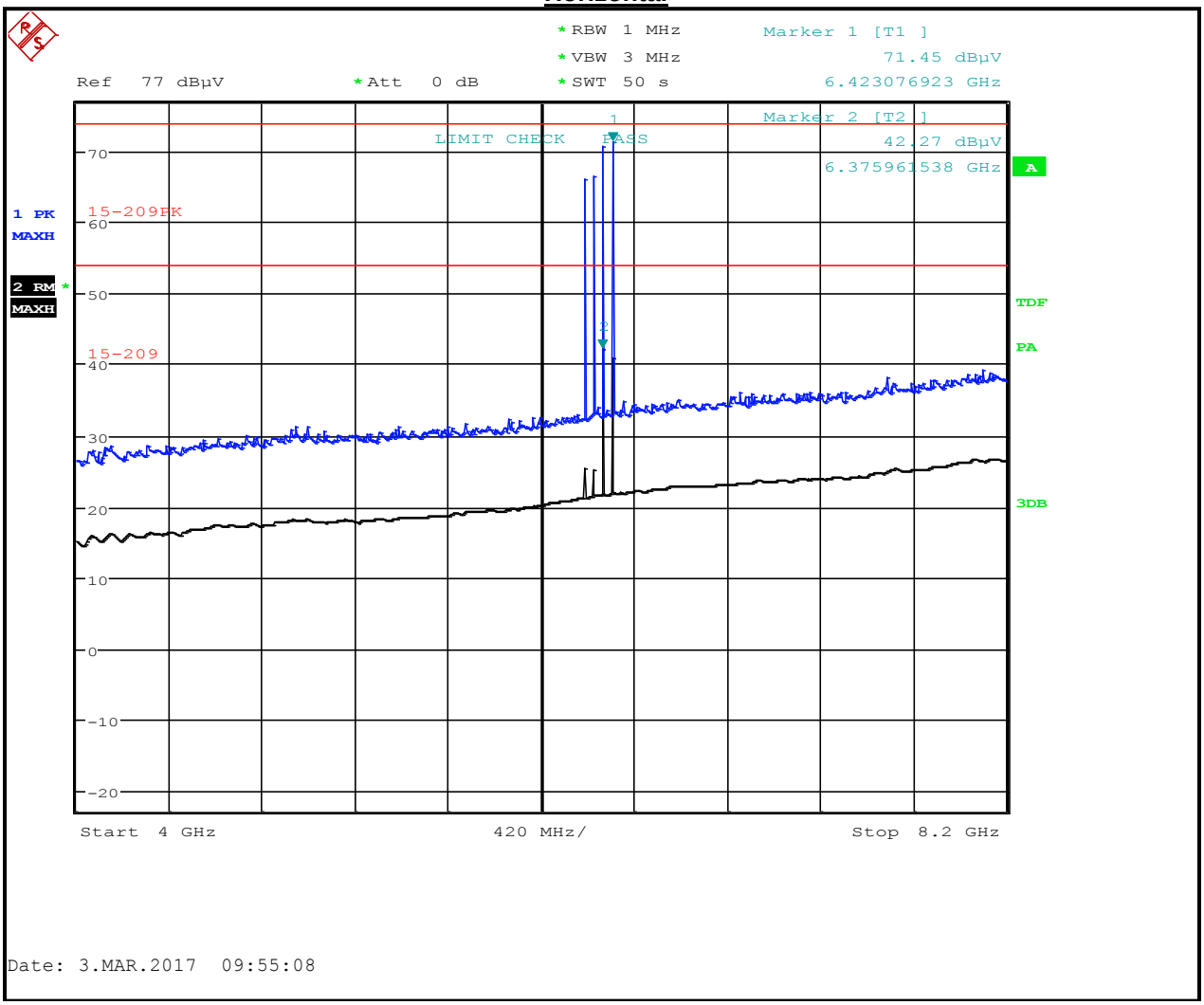


Table 5-14: Radiated Emissions (4 – 8.2 GHz) (TC #1)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
6423.077	71.5	74.0	-2.5				Peak
6375.962	42.3	54.0	-11.7				Average
6375.962	42.3			-52.9	-41.3	-11.6	Average

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

Horizontal

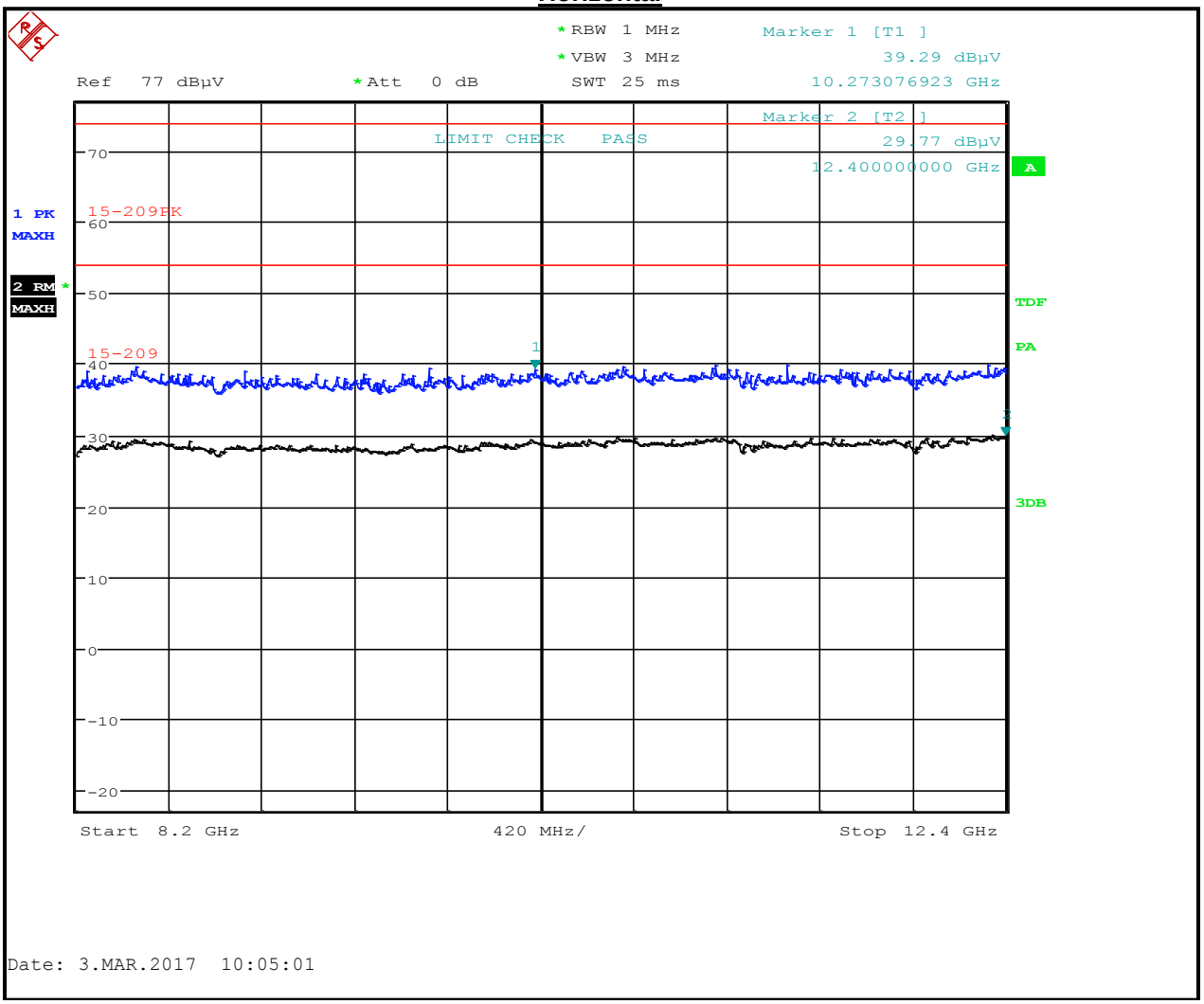


Table 5-15: Radiated Emissions (8.2 – 12.4 GHz) (TC #1)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
10273.077	39.3	74.0	-34.7				Peak
12400.000	29.8	54.0	-24.2				Average
12400.000	29.8			-65.4	-41.3	-24.1	Average

Plot 5-6: Radiated Emissions (12.4 – 18 GHz) (TC #1)

Vertical

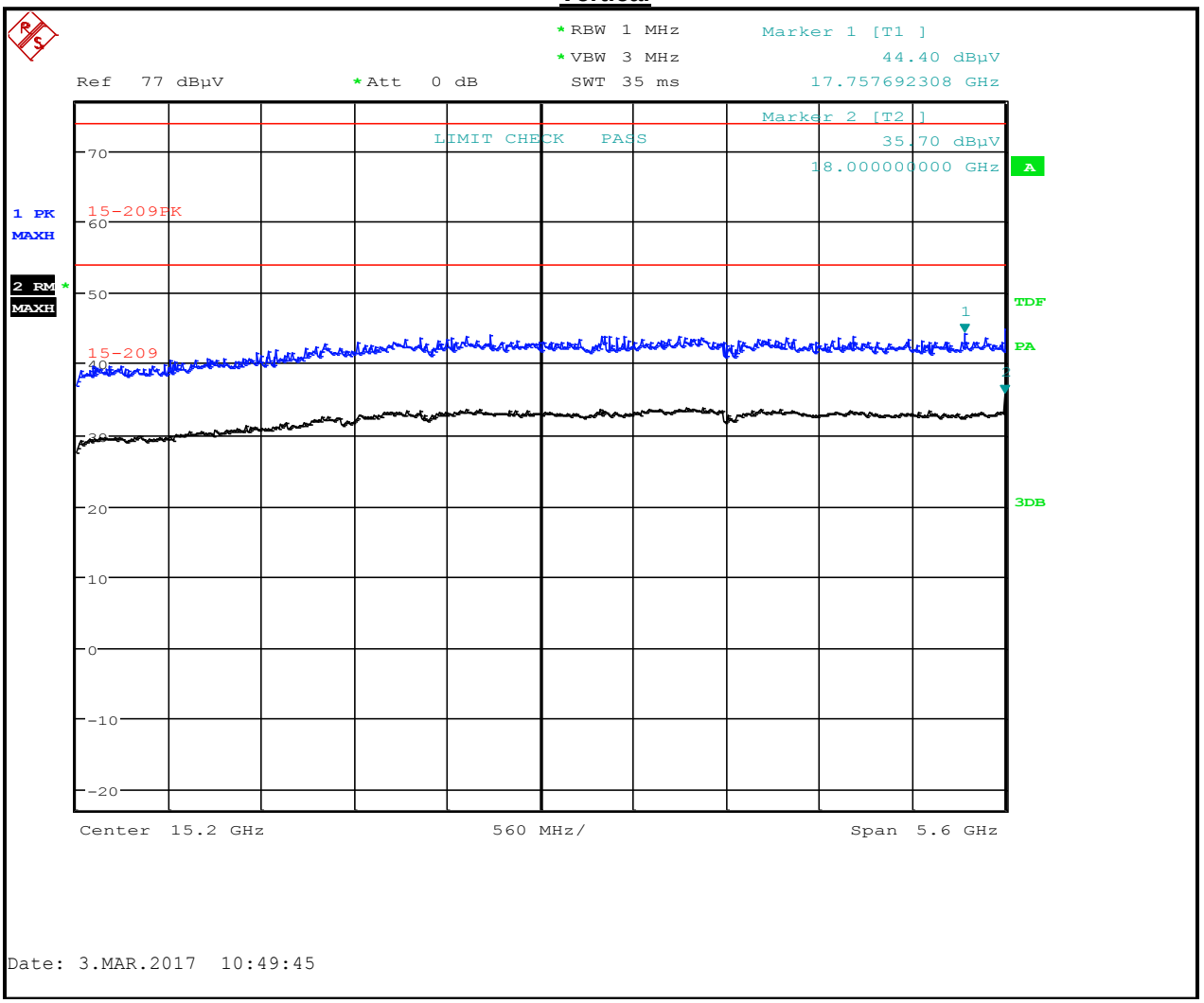


Table 5-16: Radiated Emissions (12.4 – 18 GHz) (TC #1)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
17757.692	44.4	74.0	-29.6				Peak
18000.000	35.7	54.0	-18.3				Average
18000.000	35.7			-59.5	-41.3	-18.2	Average

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

Vertical

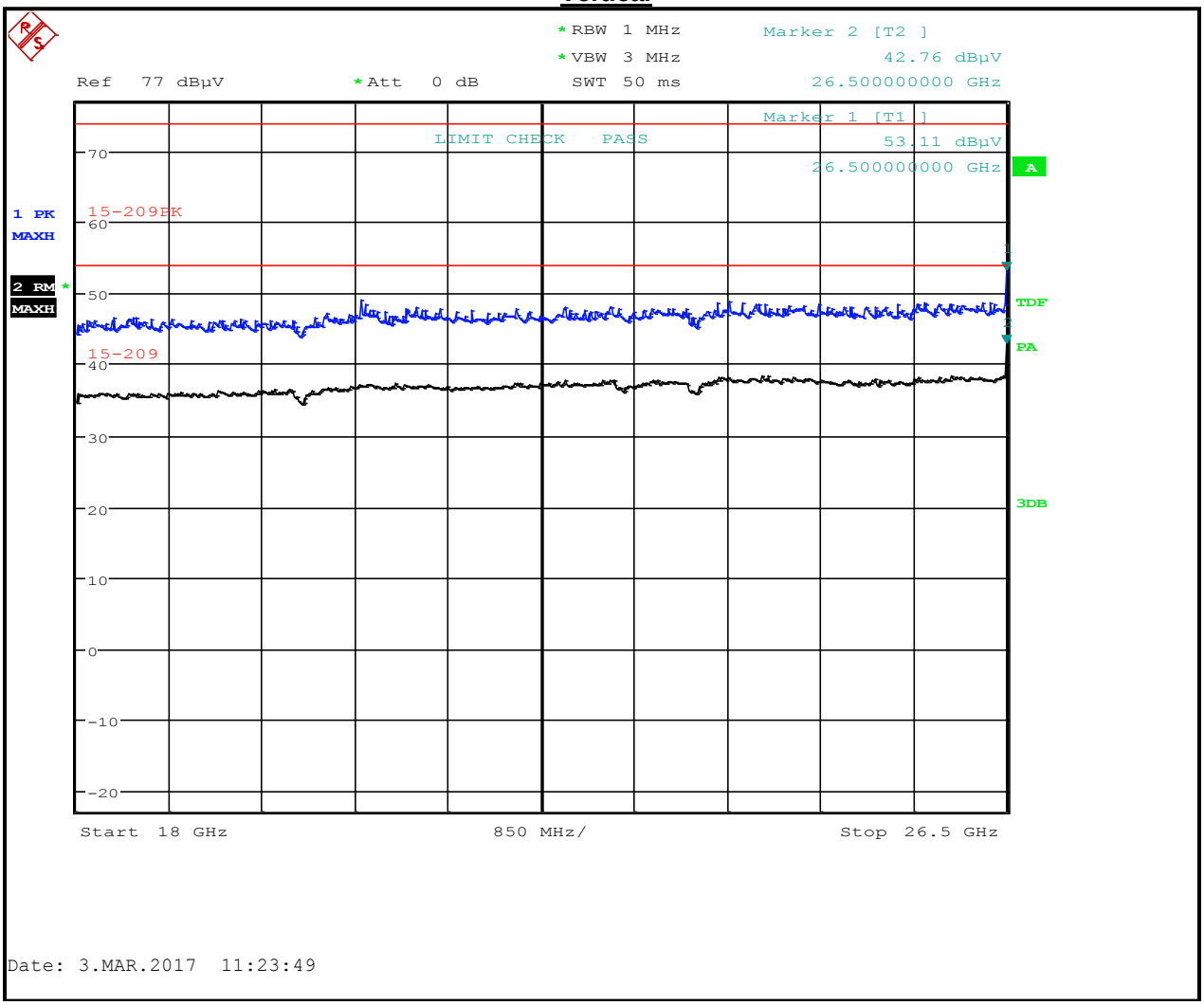


Table 5-17: Radiated Emissions (18 – 26.5 GHz) (TC #1)

Frequency (MHz)	Corrected EIRP Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
26500.000	53.1	74.0	-20.9				Peak
26500.000	42.8	54.0	-11.2				Average
26500.000	42.8			-52.4	-41.3	-11.1	Average

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

Vertical

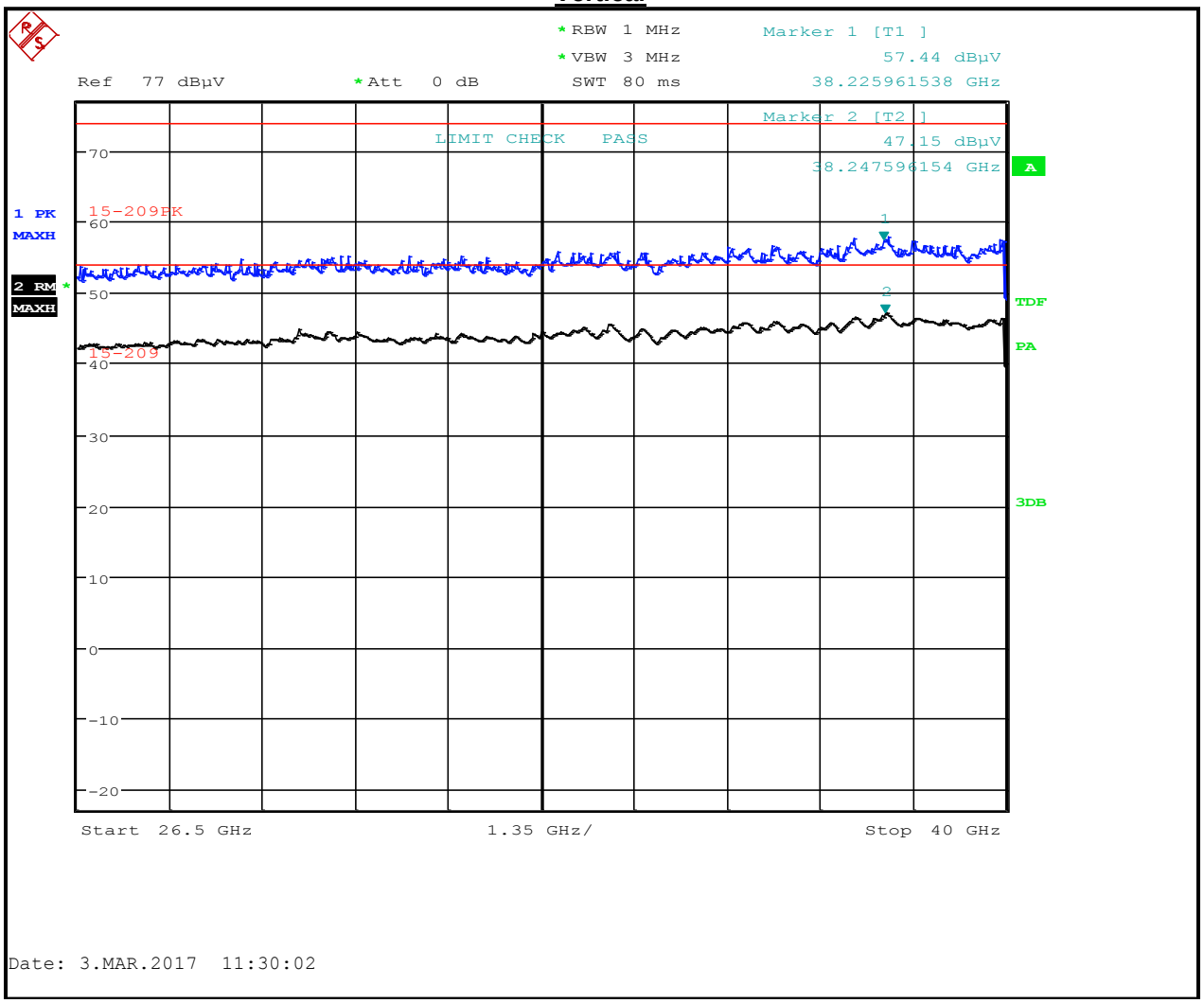


Table 5-18: Radiated Emissions (26.5 – 40 GHz) (TC #1)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
38225.961	57.4	74.0	-16.6				Peak
38247.596	47.2	54.0	-6.8				Average
38247.596	47.2			-48	-41.3	-6.9	Average

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

Vertical

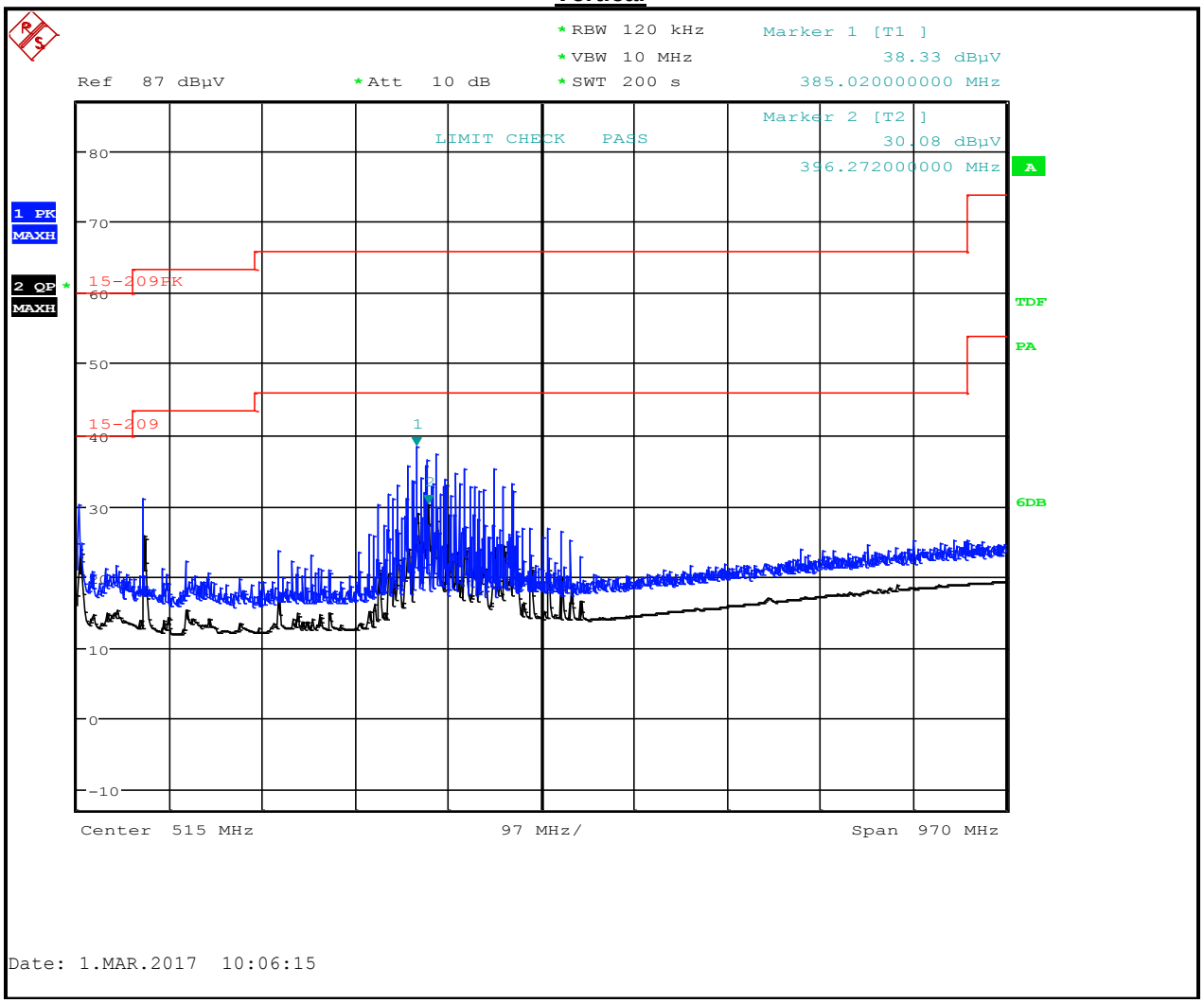


Table 5-19: Radiated Emissions (30-1000 MHz) (TC #2)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
385.020	38.3	74.0	-35.7				Peak
396.272	30.1	54.0	-23.9				Average
396.272	30.1			-65.1	-41.3	-23.8	Average

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

Horizontal

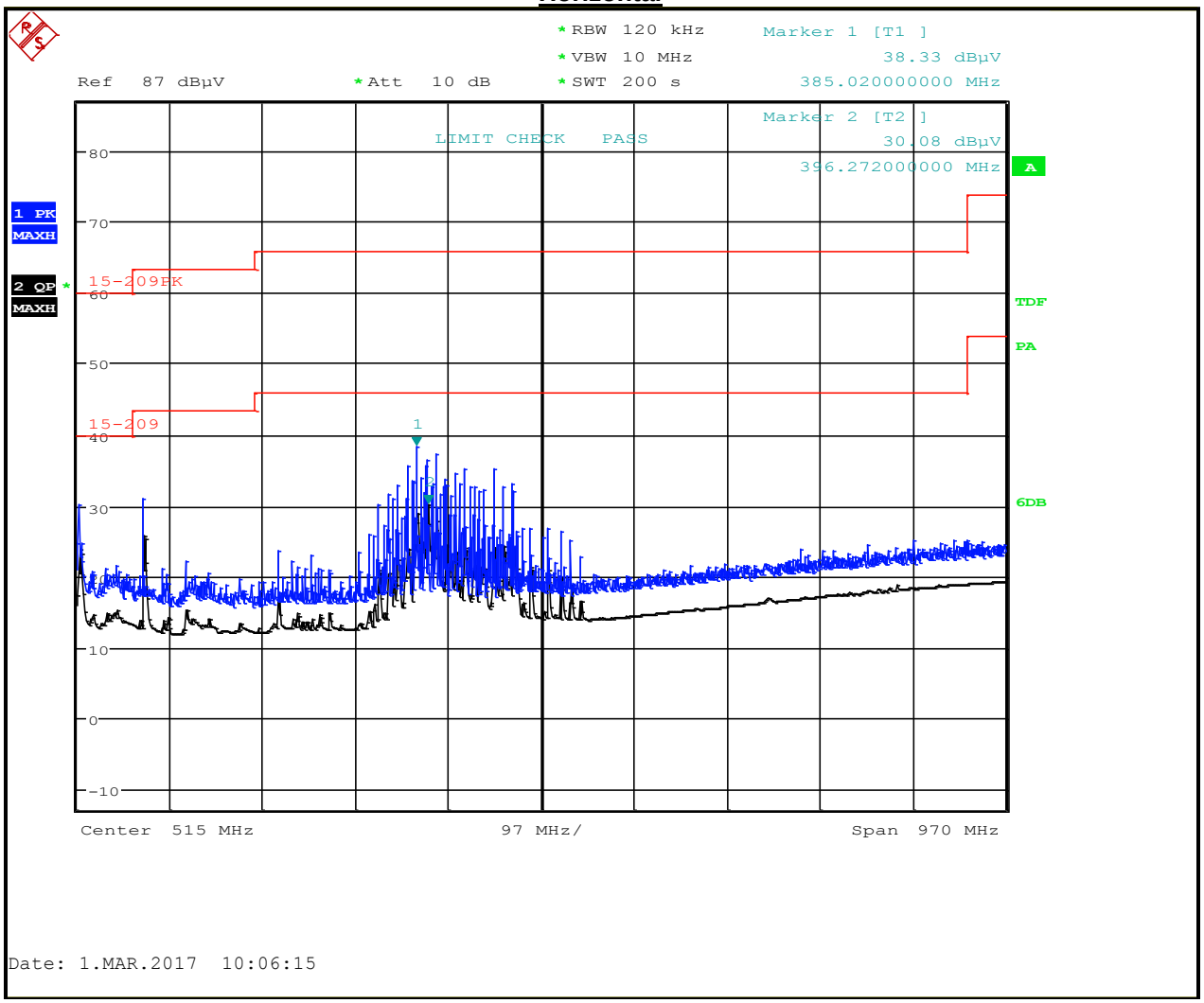


Table 5-20: Radiated Emissions (1 – 2 GHz) (TC #2)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
385.020	38.3	74.0	-35.7				Peak
396.272	30.1	54.0	-23.9				Average
396.272	30.1			-65.1	-41.3	-23.8	Average

Plot 5-11: Radiated Emissions (2 – 4 GHz) (TC #2)

Horizontal

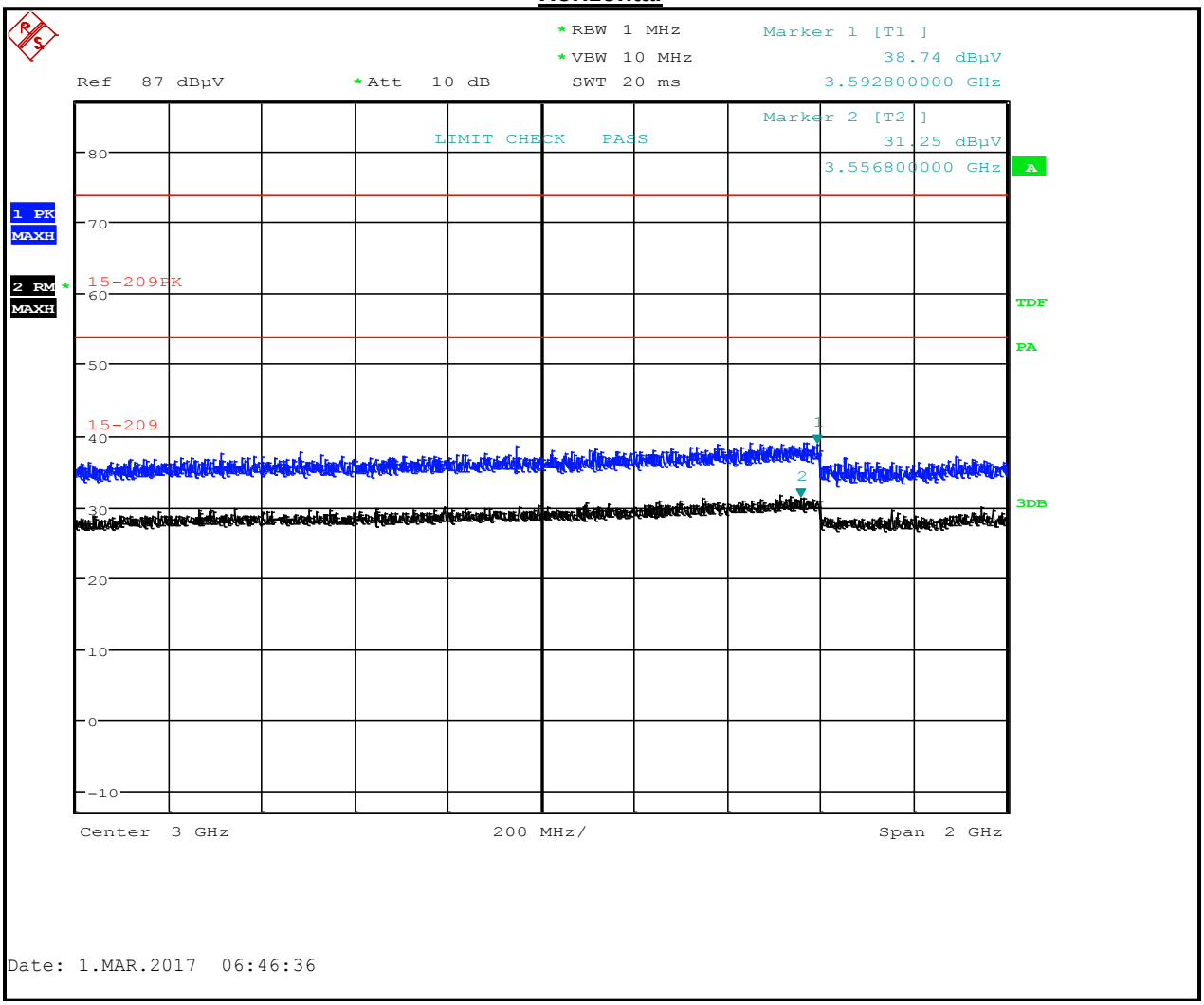


Table 5-21: Radiated Emissions (2 – 4 GHz) (TC #2)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
3592.800	38.7	74.0	-35.3				Peak
3556.800	31.3	54.0	-22.7				Average
3556.800	31.3			-63.9	-41.3	-22.6	Average

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

Horizontal

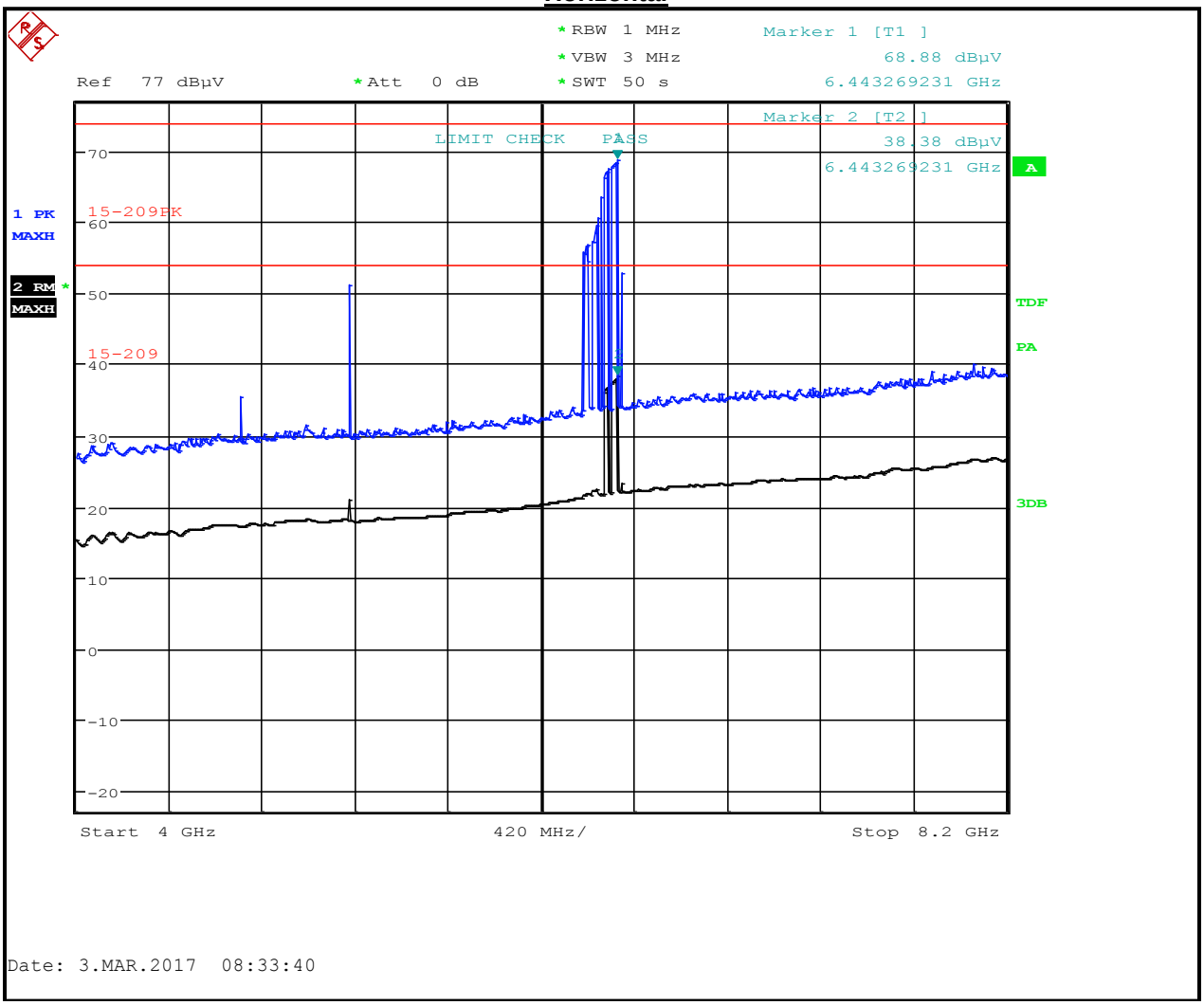


Table 5-22: Radiated Emissions (4 – 8.2 GHz) (TC #2)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
6443.269	68.9	74.0	-5.1				Peak
6443.269	38.4	54.0	-15.6				Average
6443.269	38.4			-56.8	-41.3	-15.5	Average

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

Horizontal

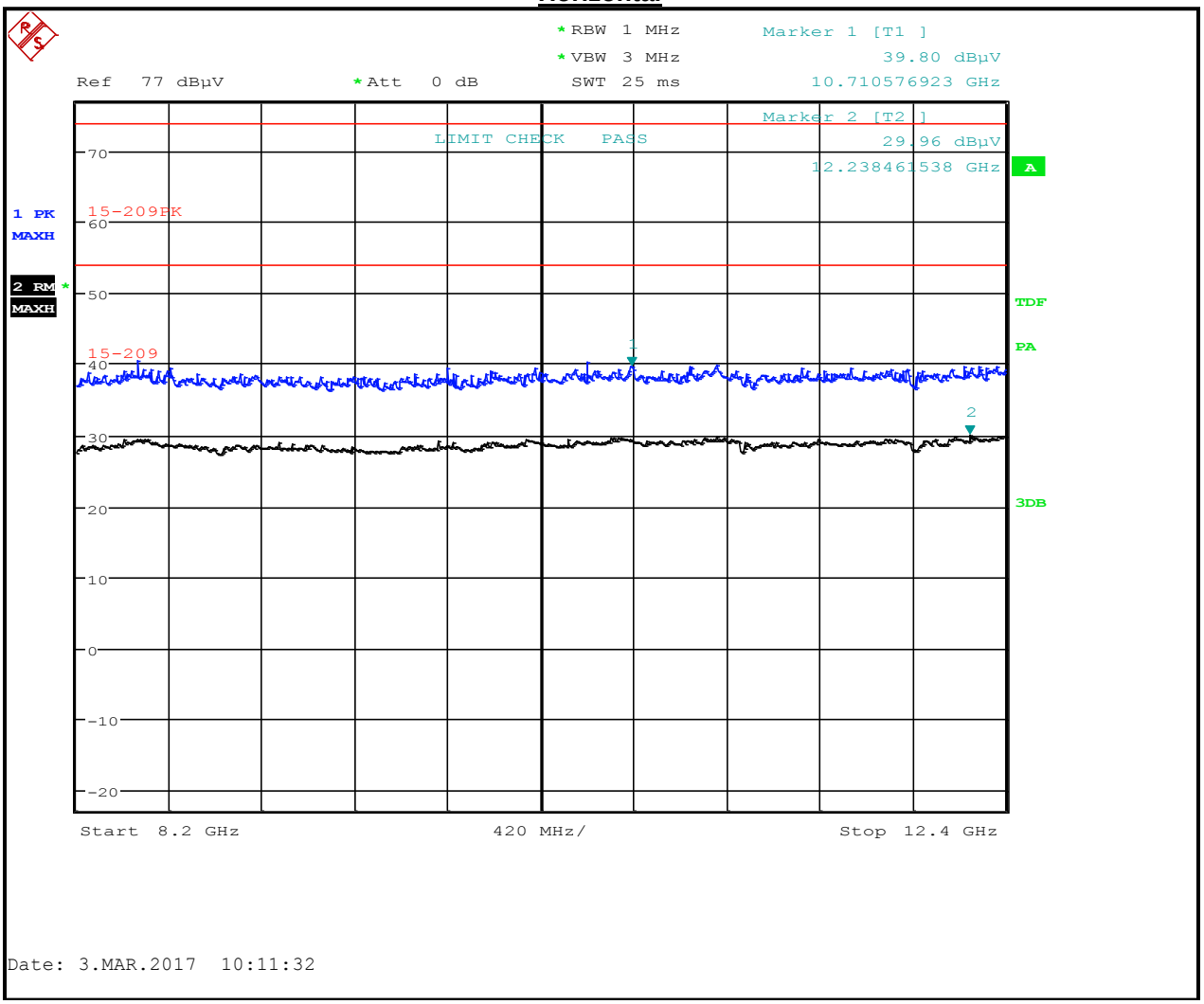


Table 5-23: Radiated Emissions (8.2 – 12.4 GHz) (TC #2)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
10710.577	39.8	74.0	-34.2				Peak
12238.461	30.0	54.0	-24.0				Average
18000.000	35.5			-65.2	-41.3	-23.9	Average

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

Vertical

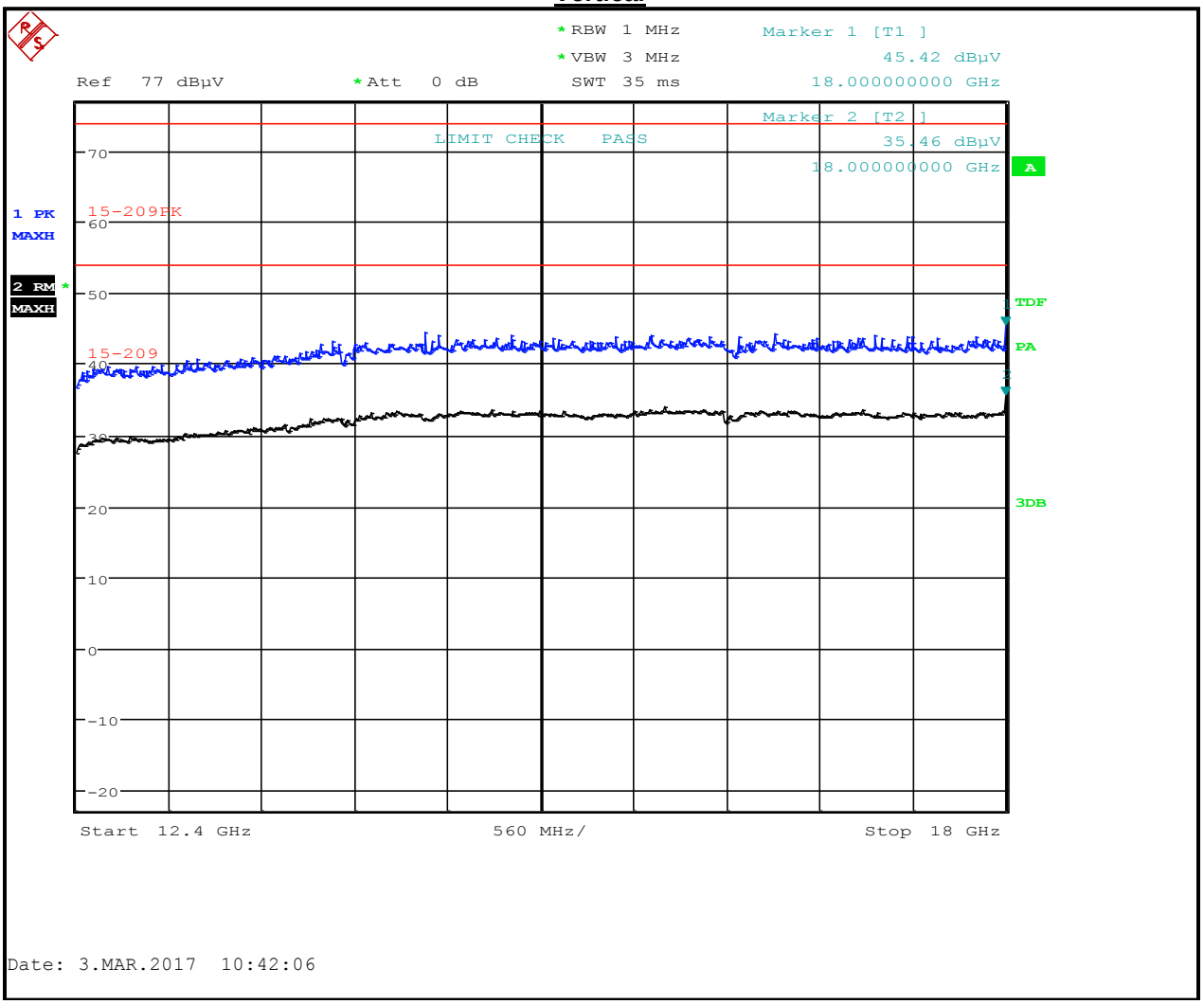


Table 5-24: Radiated Emissions (12.4 – 18 GHz) (TC #2)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
18000.000	45.4	74.0	-28.6				Peak
18000.000	35.5	54.0	-18.5				Average
18000.000	35.5			-59.7	-41.3	-18.4	Average

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

Vertical

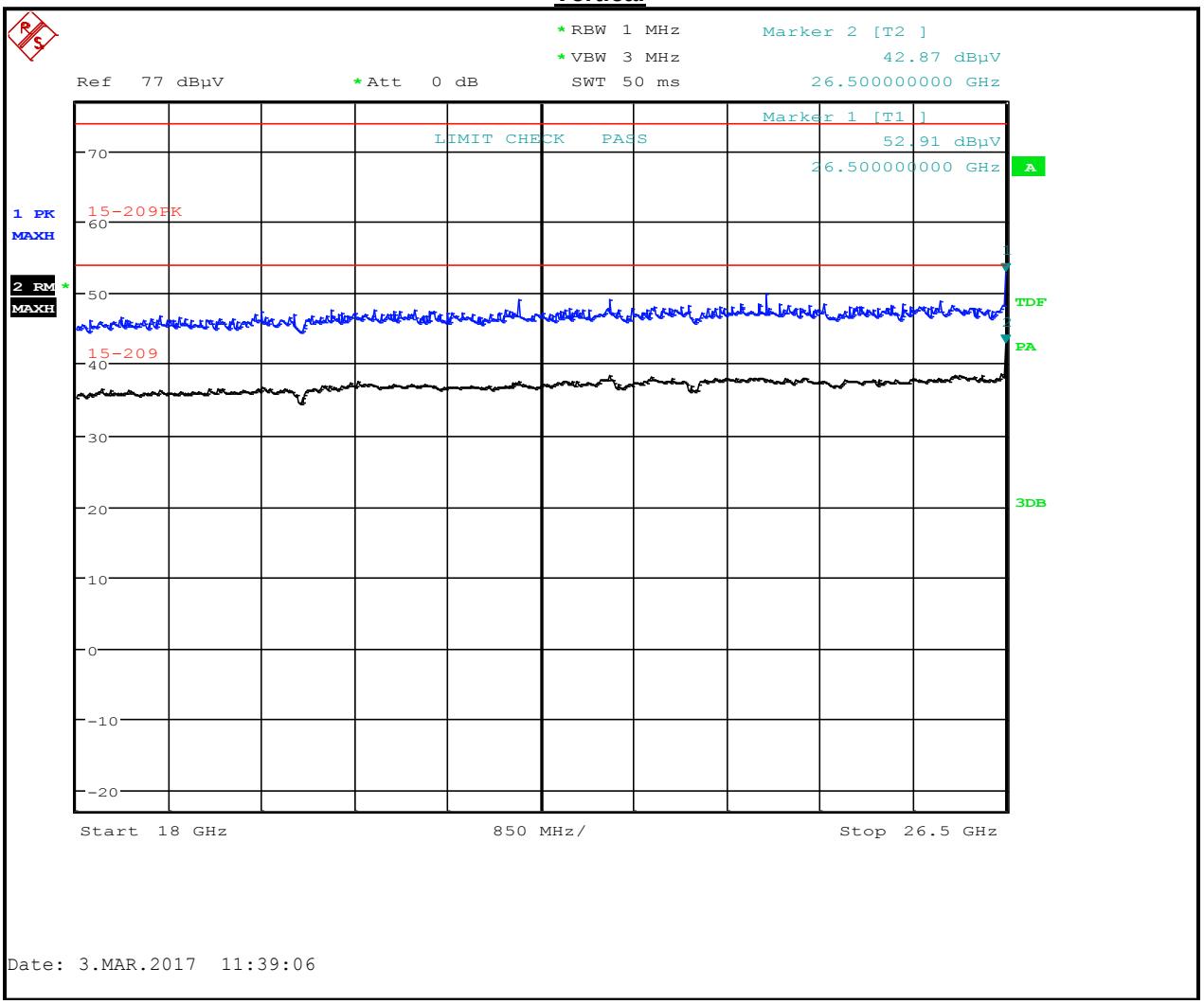


Table 5-25: Radiated Emissions (18 – 26.5 GHz) (TC #2)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
26500.000	52.9	74.0	-21.1				Peak
26500.000	42.9	54.0	-11.1				Average
26500.000	42.9			-52.3	-41.3	-11.0	Average

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

Horizontal

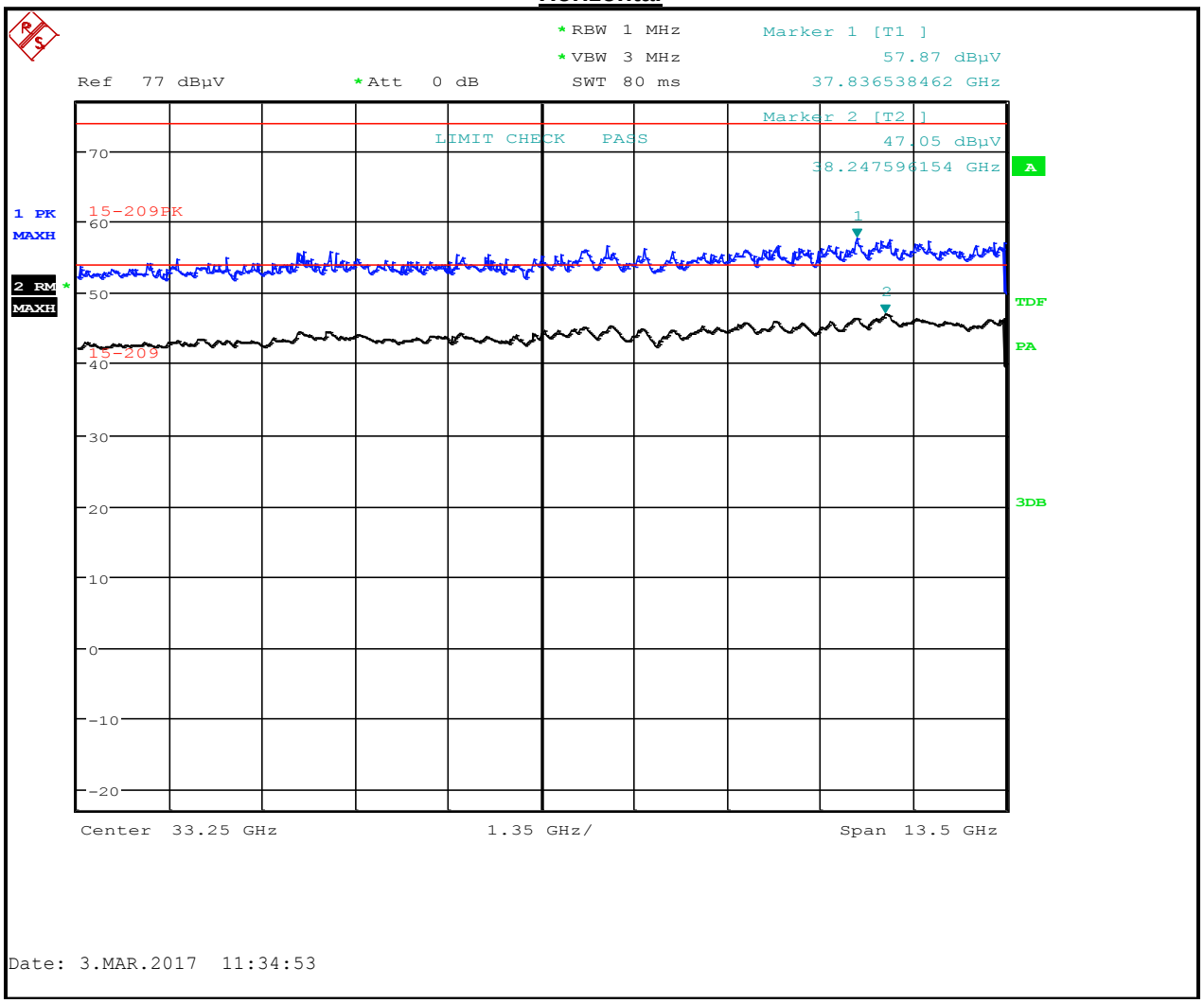


Table 5-26: Radiated Emissions (26.5 – 40 GHz) (TC #2)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
37836.538	57.9	74.0	-16.1				Peak
38247.596	47.1	54.0	-6.9				Average
38247.596	47.1			-48.1	-41.3	-6.8	Average

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

Vertical

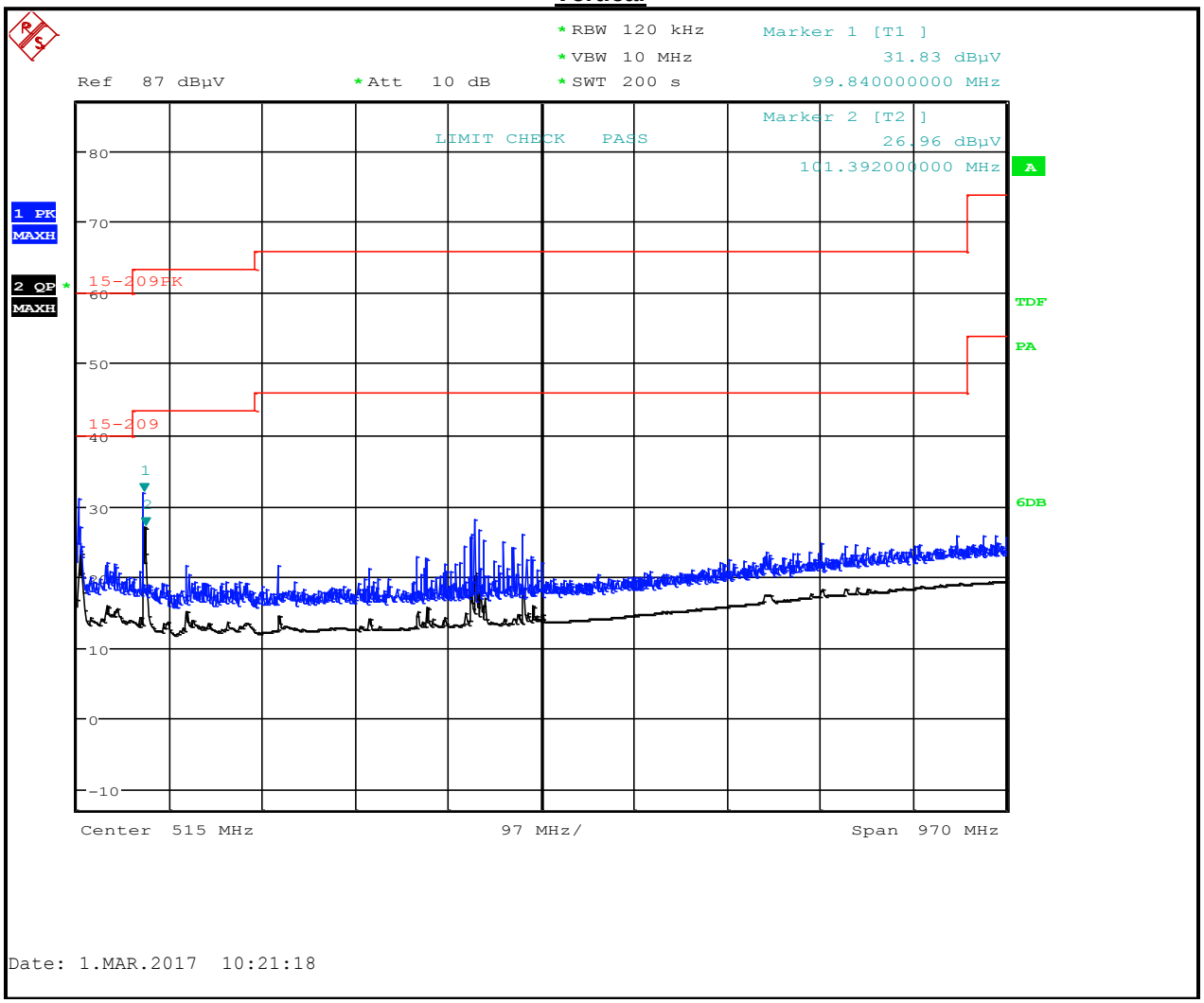


Table 5-27: Radiated Emissions (30 – 1000 MHz) (TC #3)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
99840.000	31.8	74.0	-42.2				Peak
101392.000	27.0	54.0	-27.0				Quasi-Peak
101392.000	27.0			-68.2	-41.3	-26.9	Quasi-Peak

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

Vertical

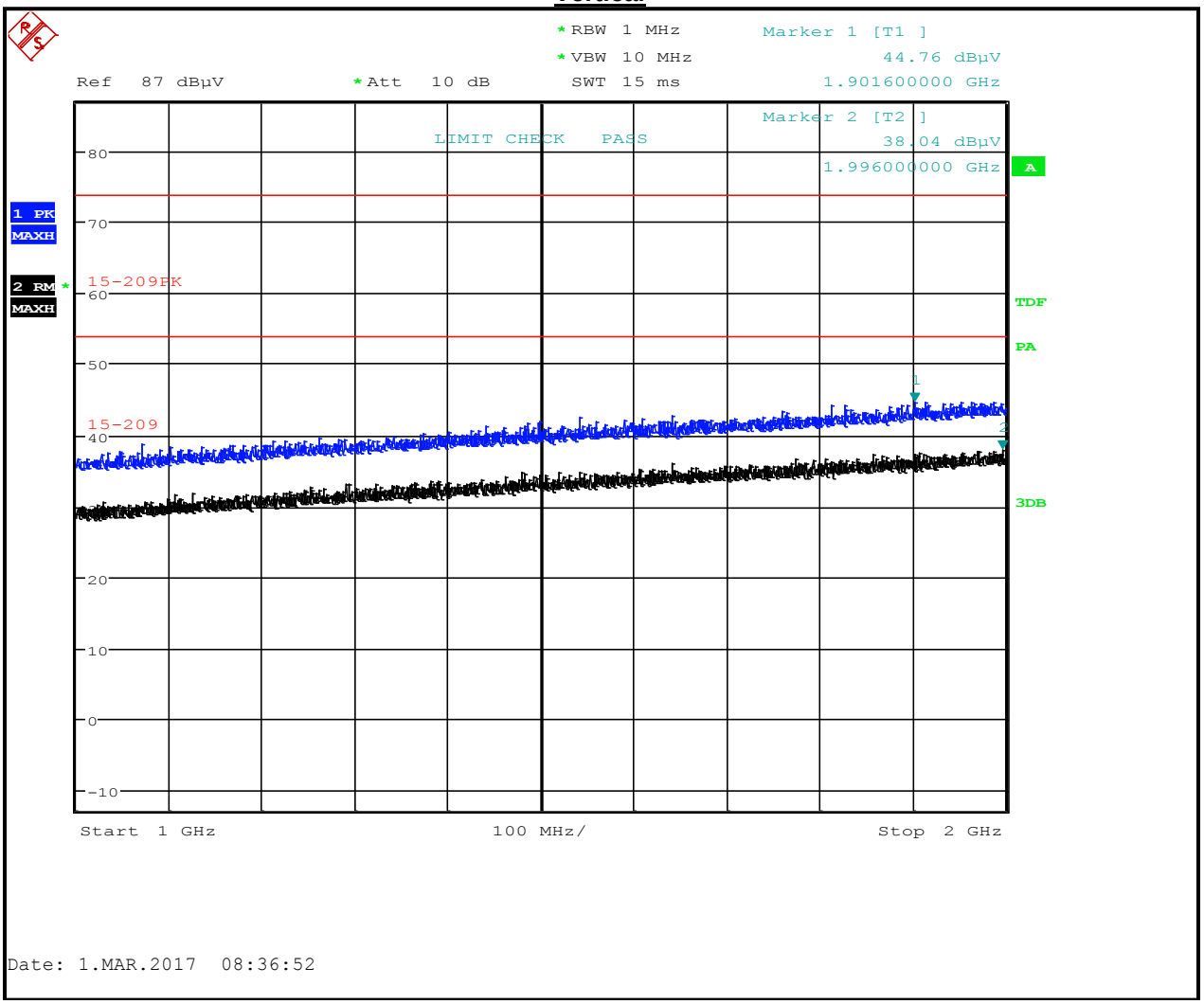


Table 5-28: Radiated Emissions (1 – 2 GHz) (TC #3)

Frequency (MHz)	Corrected EIRP Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
1901.600	44.8	74.0	-29.2				Peak
1996.000	38.0	54.0	-16.0				Average
1996.000	38.0			-57.2	-41.3	-15.9	Average

Plot 5-19: Radiated Emissions (2 – 4 GHz) (TC #3)

Horizontal

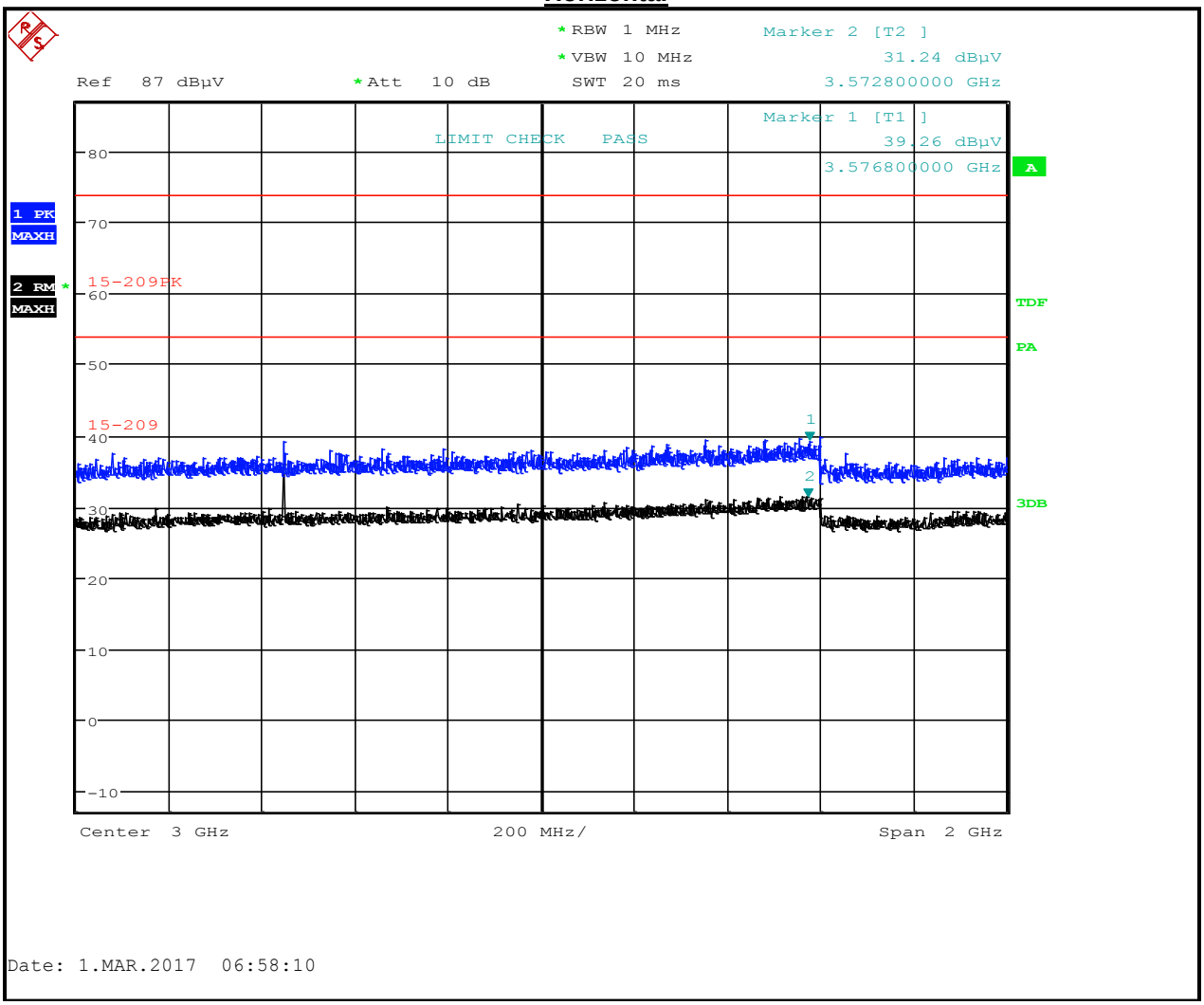


Table 5-29: Radiated Emissions (2 – 4 GHz) (TC #3)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
3576.800	39.3	74.0	-34.7				Peak
3572.800	31.2	54.0	-22.8				Average
3572.800	31.2			-64.0	-41.3	-22.7	Average

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

Vertical

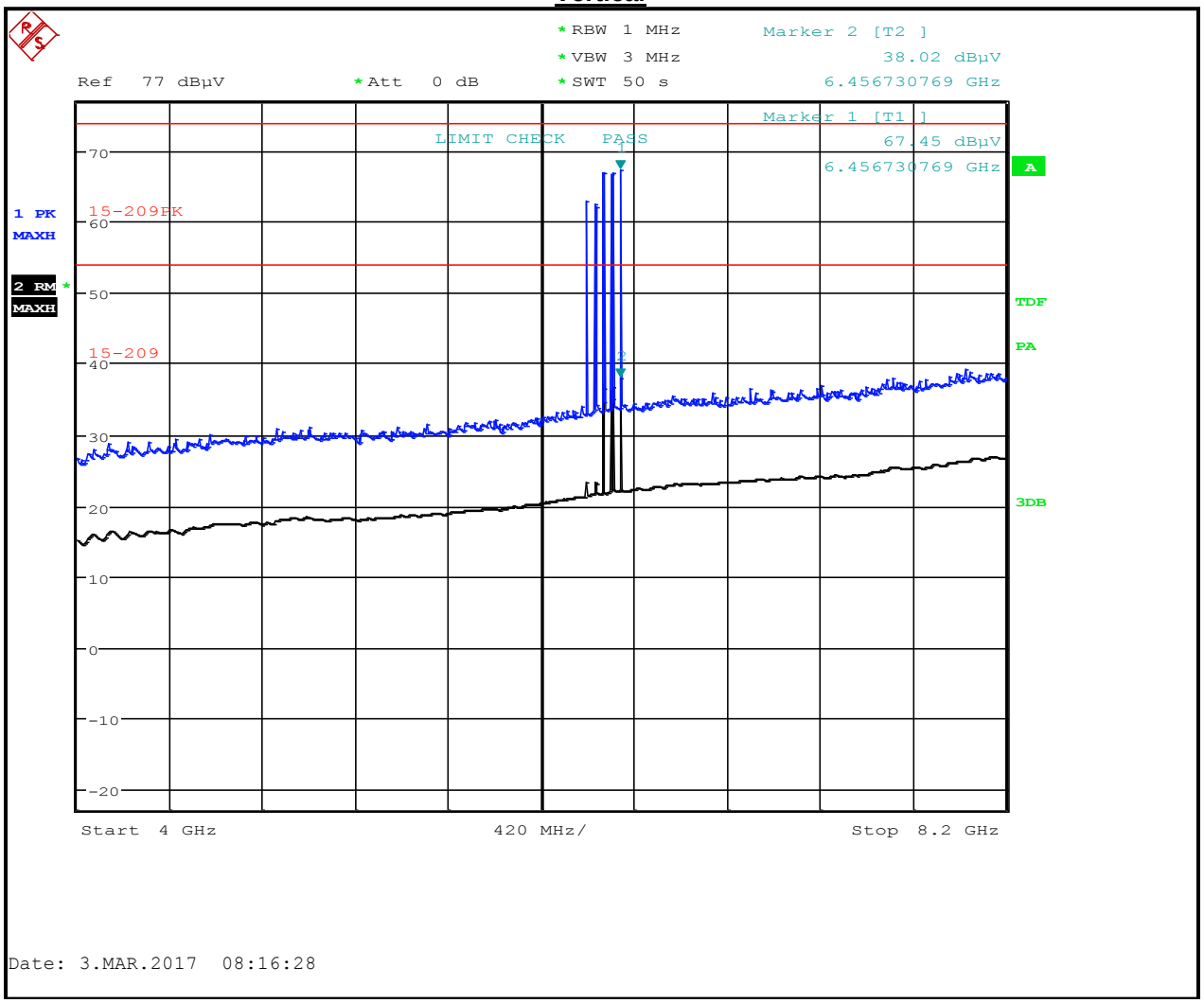


Table 5-30: Radiated Emissions (4 – 8.2 GHz) (TC #3)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
6456.731	67.5	74.0	-6.5				Peak
6456.731	38.0	54.0	-16.0				Average
6456.731	38.0			-57.2	-41.3	-15.9	Average

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

Horizontal

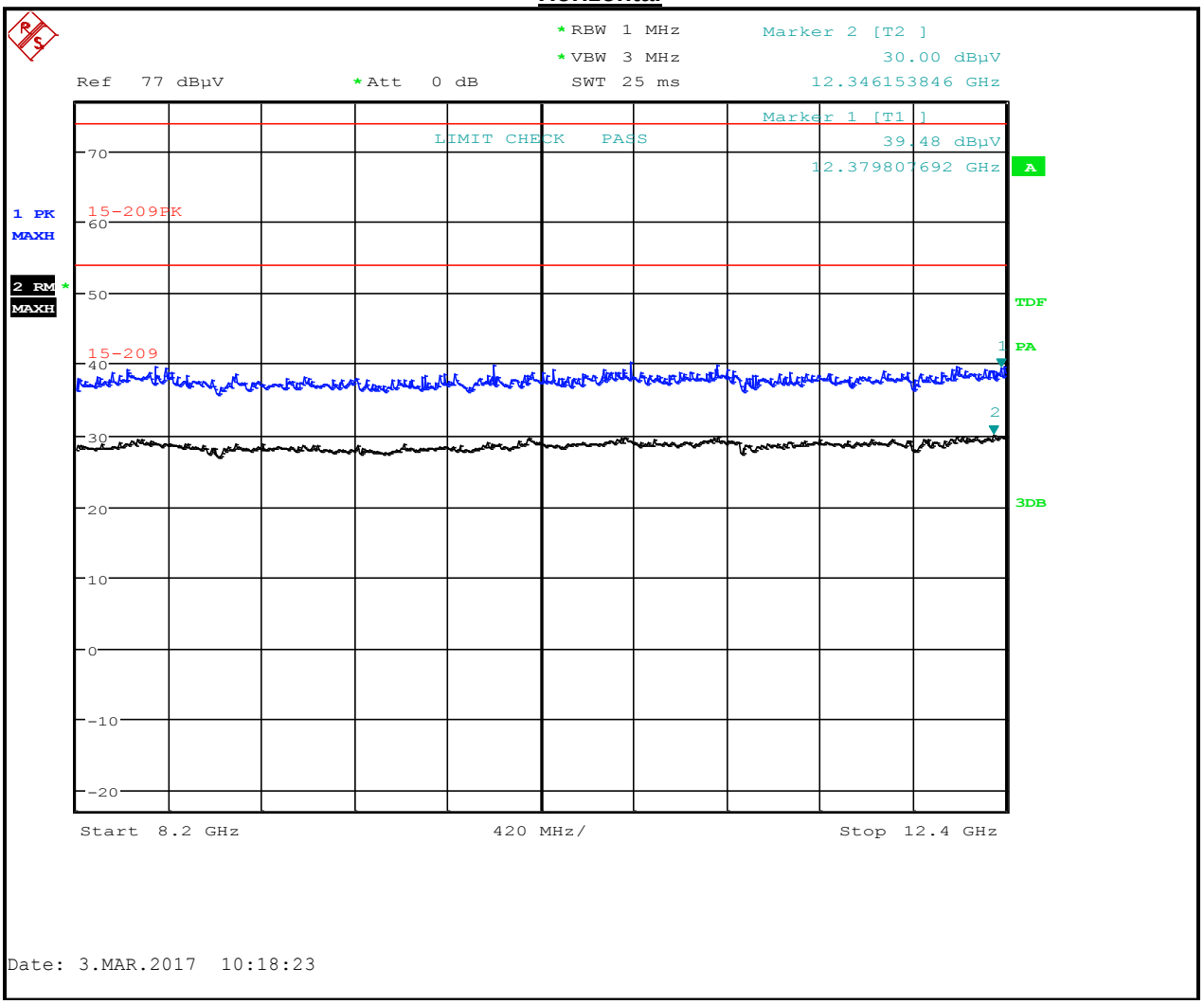


Table 5-31: Radiated Emissions (8.2 – 12.4 GHz) (TC #3)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
12379.808	39.5	74.0	-34.5				Peak
12346.154	30.0	54.0	-24.0				Average
12346.154	30.0			-65.2	-41.3	-23.9	Average

Plot 5-22: Radiated Emissions (12.4 – 18 GHz) (TC #3)

Horizontal

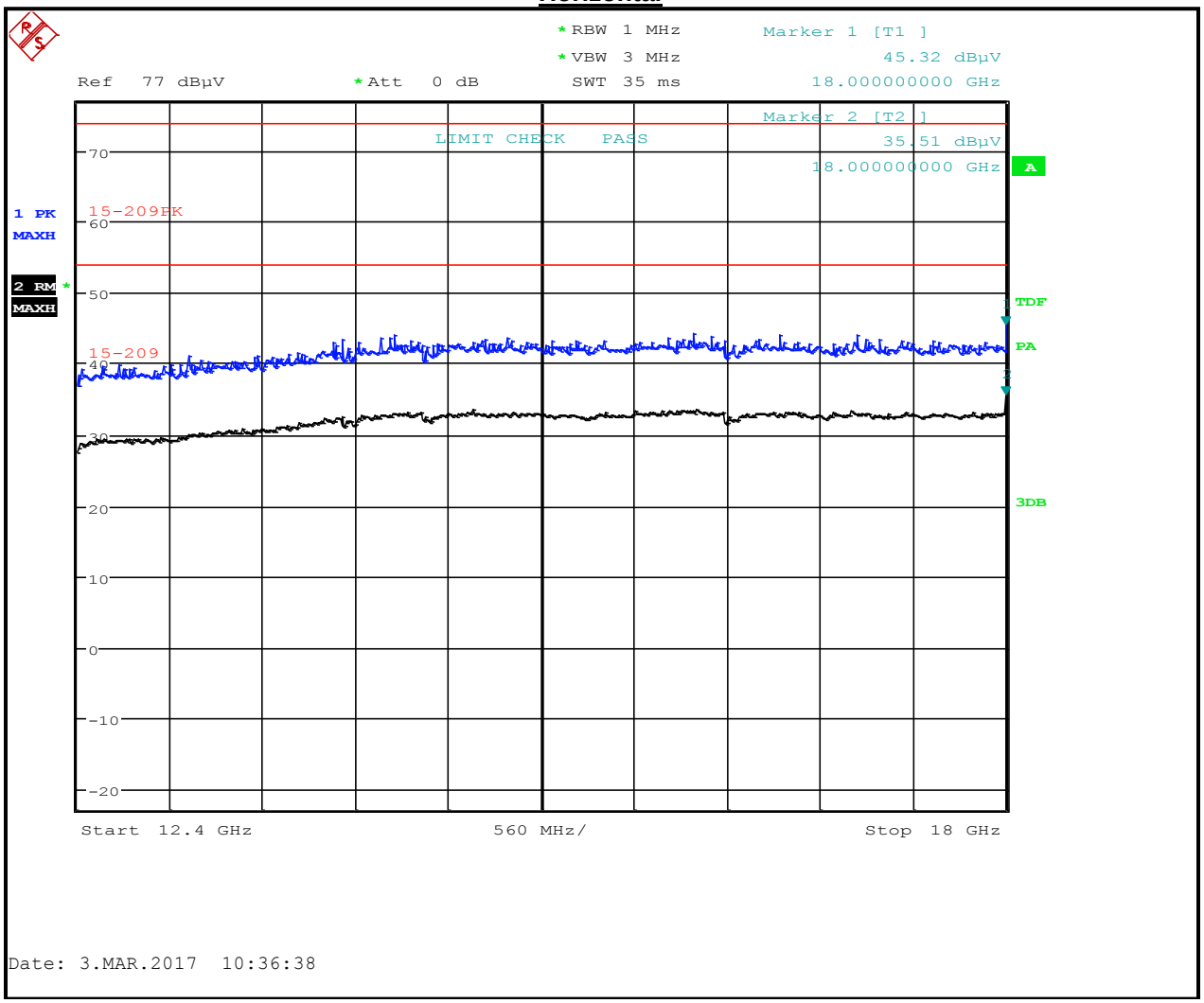


Table 5-32: Radiated Emissions (12.4 – 18 GHz) (TC #3)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
18000.000	45.3	74.0	-28.7				Peak
18000.000	35.5	54.0	-18.5				Average
18000.000	35.5			-59.7	-41.3	-18.4	Average

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

Vertical

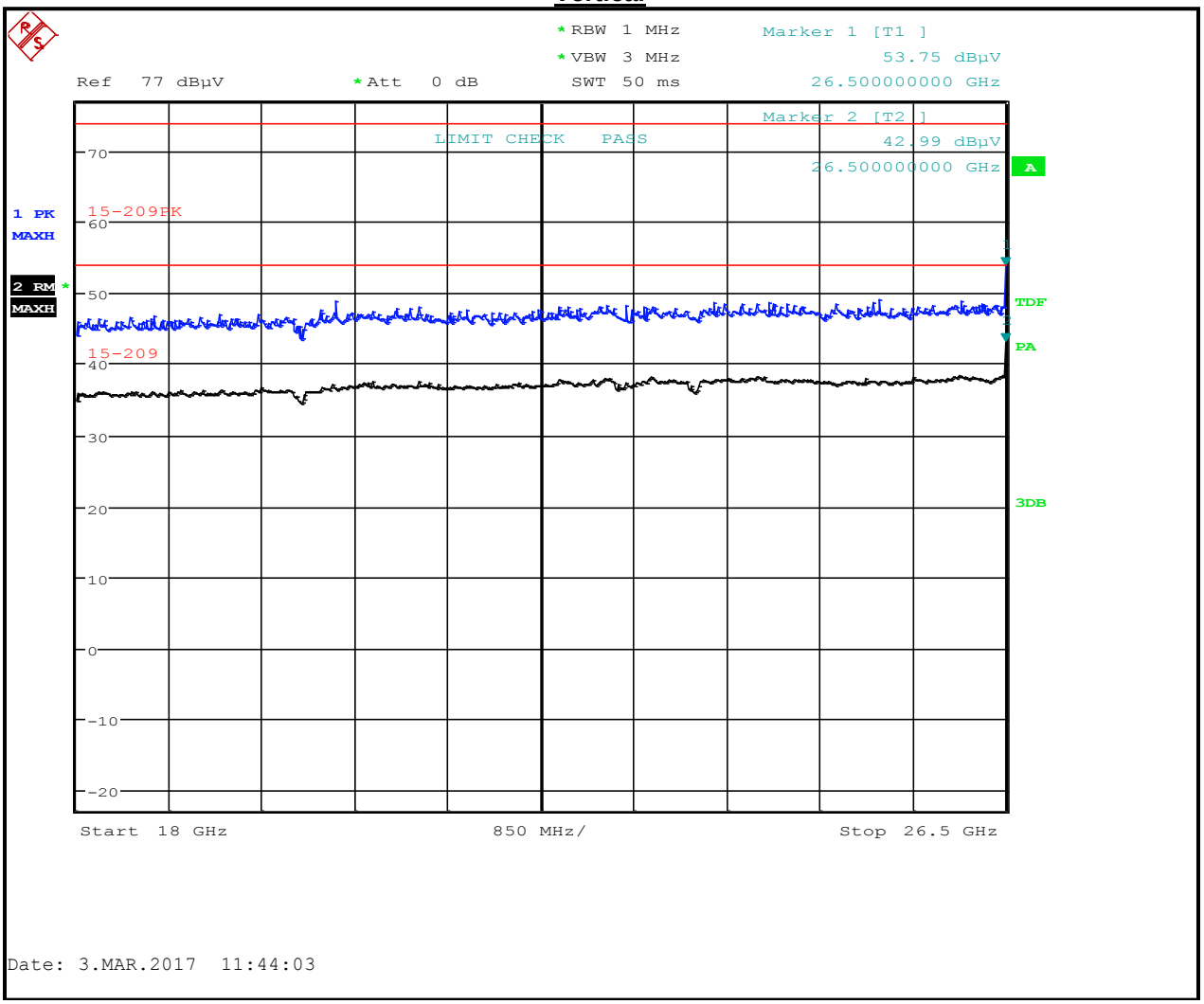


Table 5-33: Radiated Emissions (18 – 26.5 GHz) (TC #3)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
26500.000	53.8	74.0	-20.2				Peak
26500.000	43.0	54.0	-11.0				Average
26500.000	43.0			-52.2	-41.3	-10.9	Average

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

Vertical

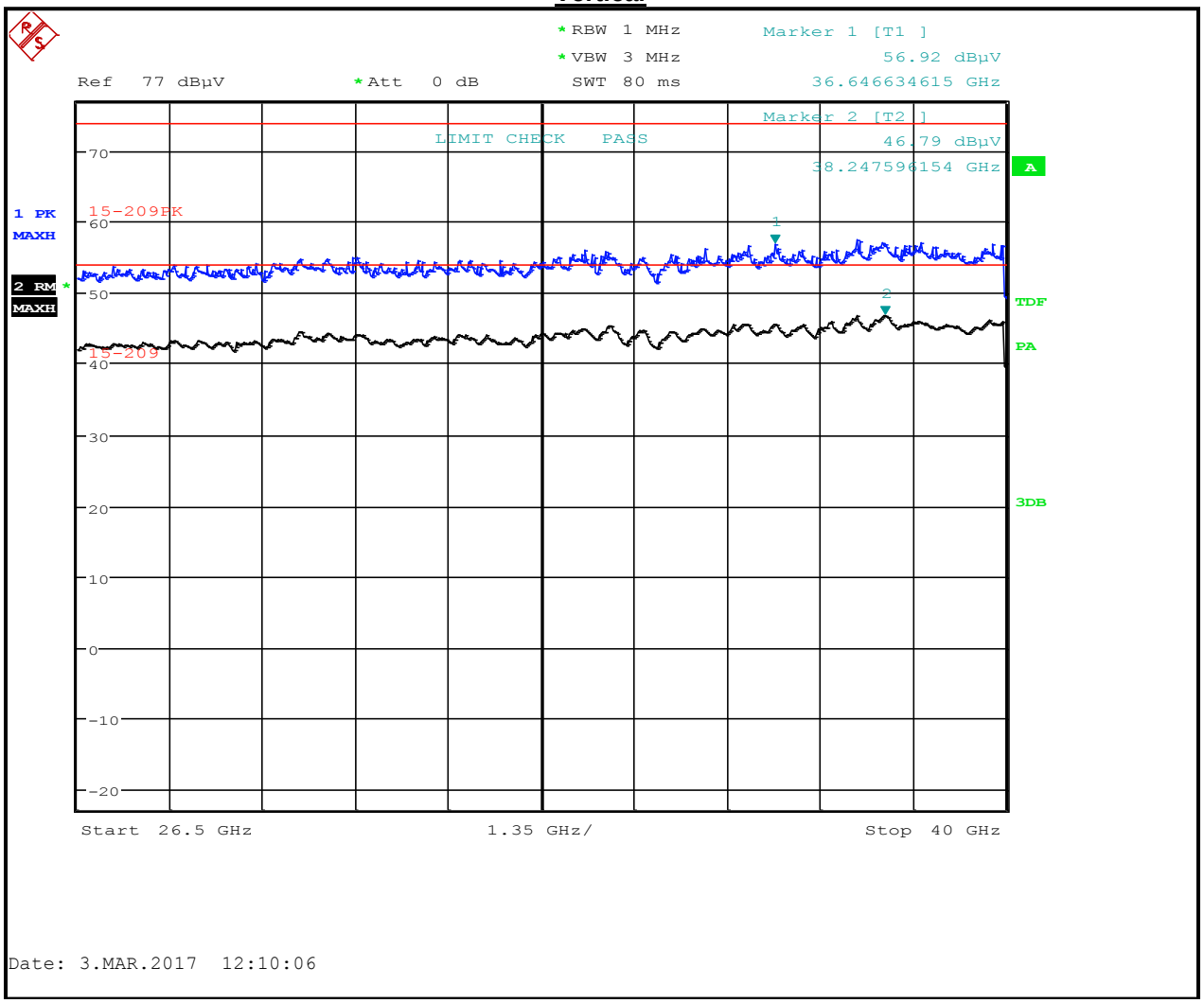


Table 5-34: Radiated Emissions (26.5 – 40 GHz) (TC #3)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
36646.634	56.9	74.0	-17.1				Peak
38247.596	46.8	54.0	-7.2				Average
38247.596	46.8			-48.4	-41.3	-7.1	Average

5.3.2.2 Steel Drum

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

Vertical

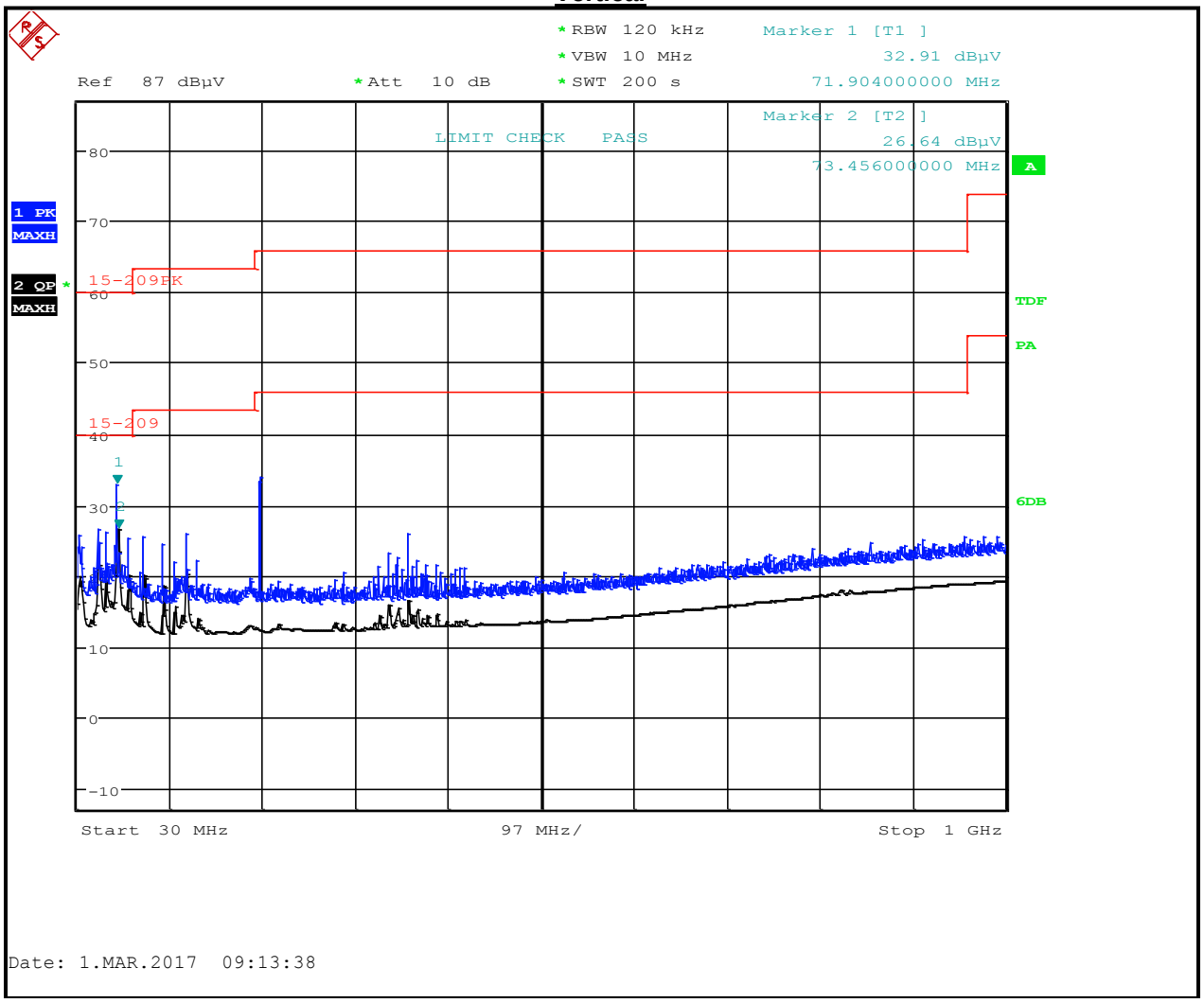


Table 5-35: Radiated Emissions (30 – 1000 MHz) (TC #1)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
71904.000	32.9	74.0	-41.1				Peak
73456.000	26.6	54.0	-27.4				Quasi-Peak
73456.000	26.6			-68.6	-41.3	-27.3	Quasi-Peak

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

Horizontal

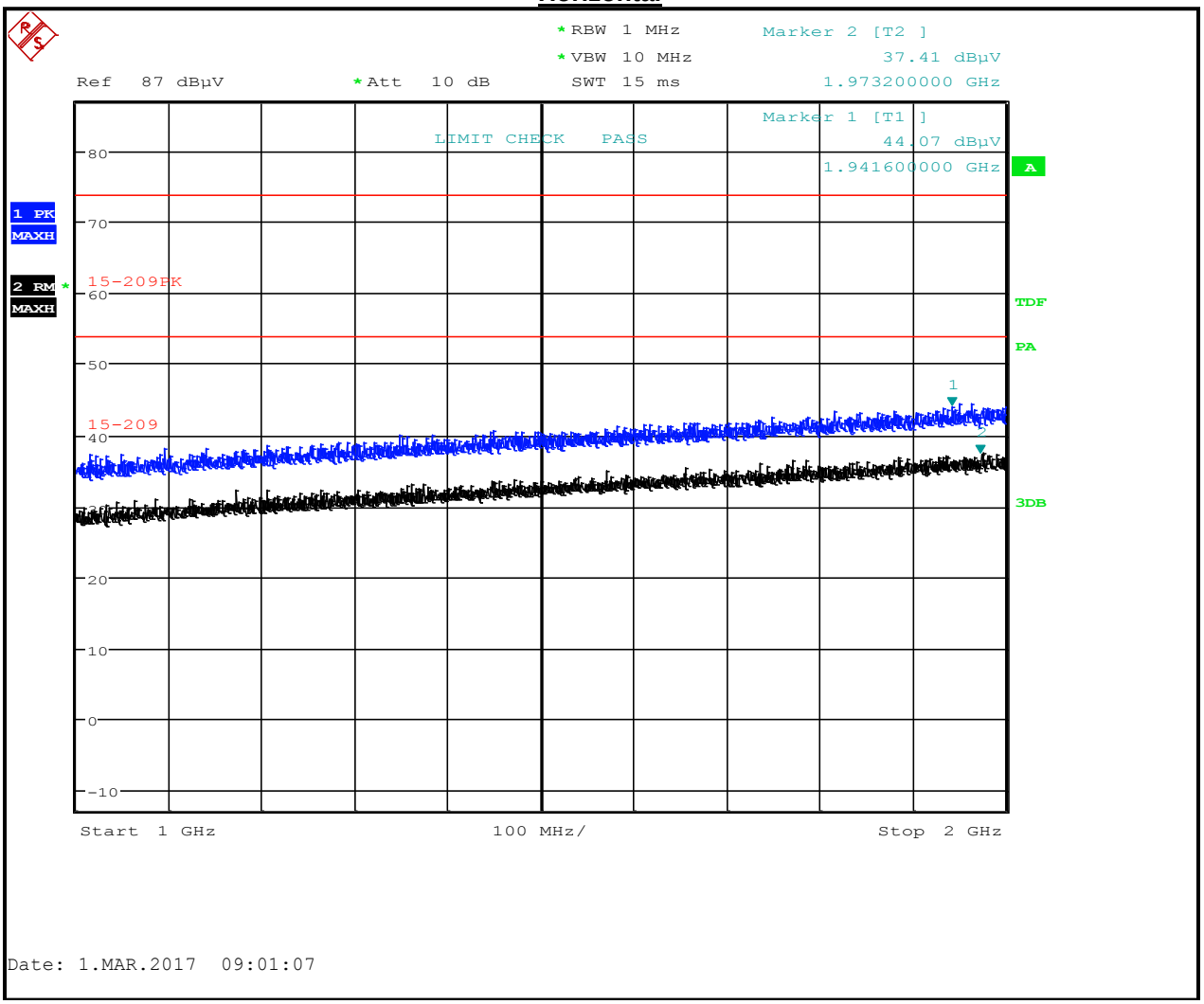


Table 5-36: Radiated Emissions (1 – 2 GHz) (TC #1)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
1941.600	44.1	74.0	-29.9				Peak
1973.200	37.4	54.0	-16.6				Average
1973.200	37.4			-57.8	-41.3	-16.5	Average

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

Vertical

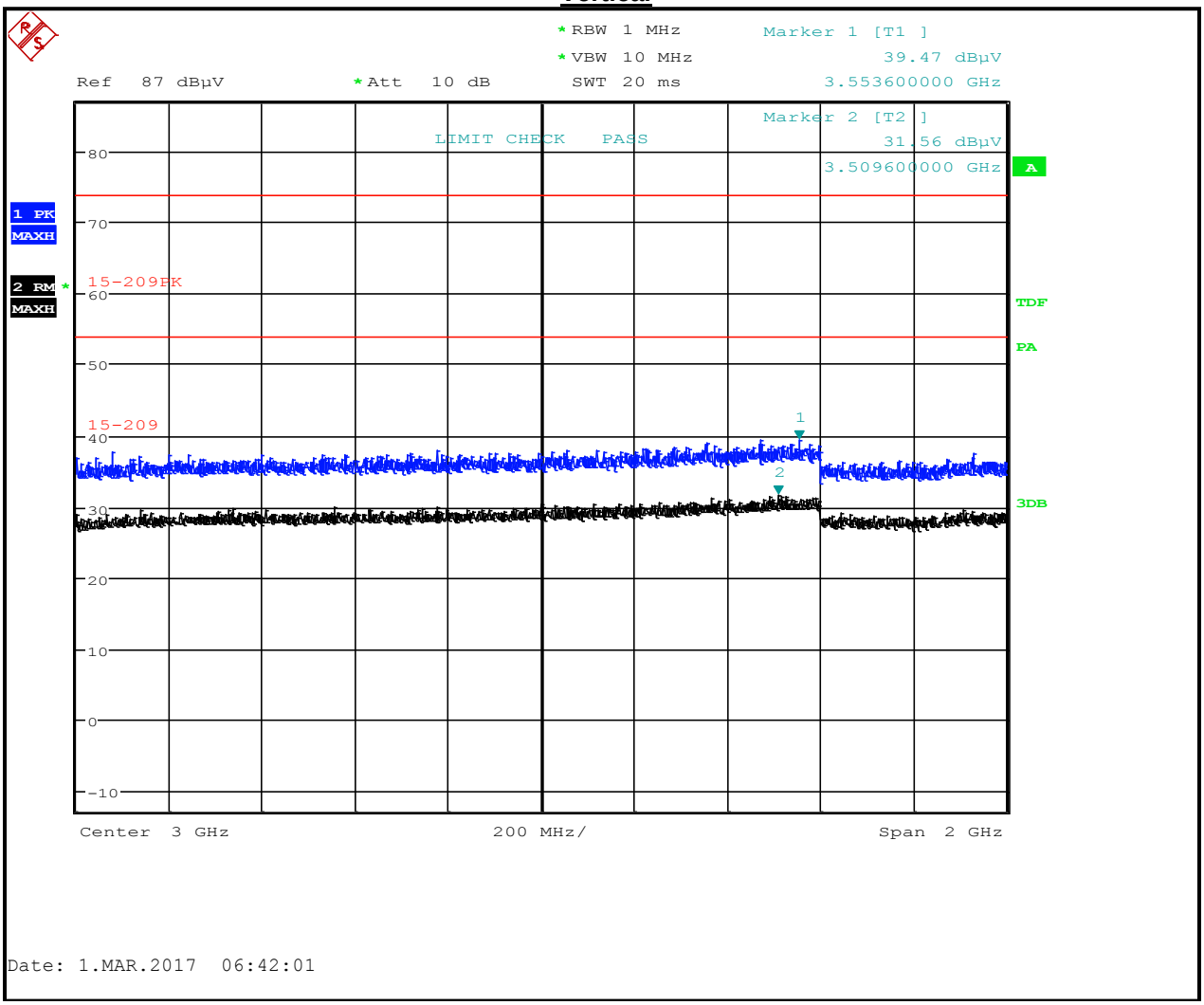


Table 5-37: Radiated Emissions (2 – 4 GHz) (TC #1)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
3553.600	39.5	74.0	-29.9				Peak
3509.600	31.6	54.0	-16.6				Average
3509.600	31.6			-57.8	-41.3	-16.5	Average

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

Horizontal

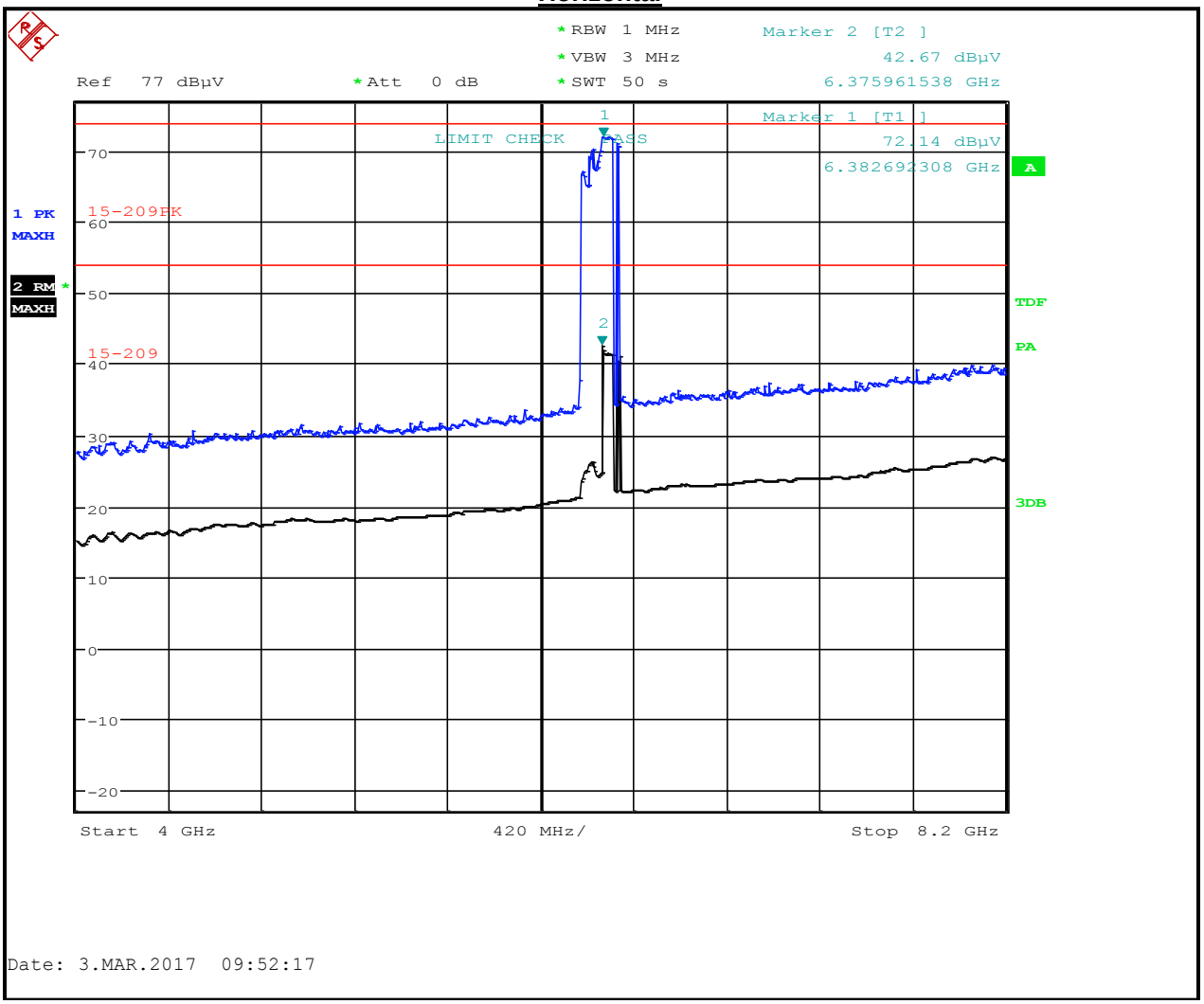


Table 5-38: Radiated Emissions (4 – 8.2 GHz) (TC #1)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
6382.692	72.1	74.0	-1.9				Peak
6357.961	42.7	54.0	-11.3				Average
6357.961	42.7			-52.5	-41.3	-11.2	Average

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

Horizontal

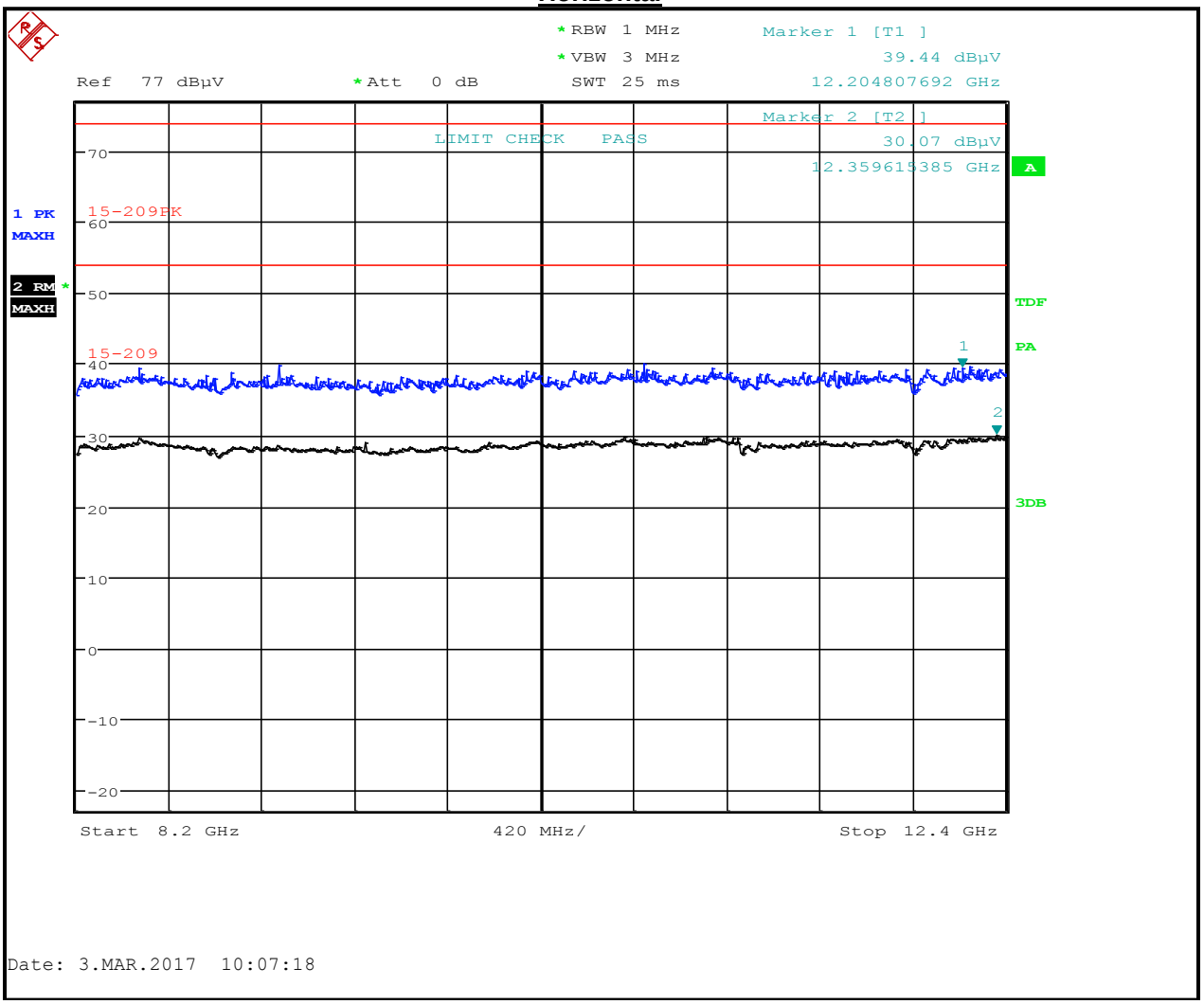


Table 5-39: Radiated Emissions (8.2 – 12.4 GHz) (TC #1)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
12204.807	39.4	74.0	-34.6				Peak
12359.615	30.1	54.0	-23.9				Average
12359.615	30.1			-65.1	-41.3	-23.8	Average

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

Horizontal

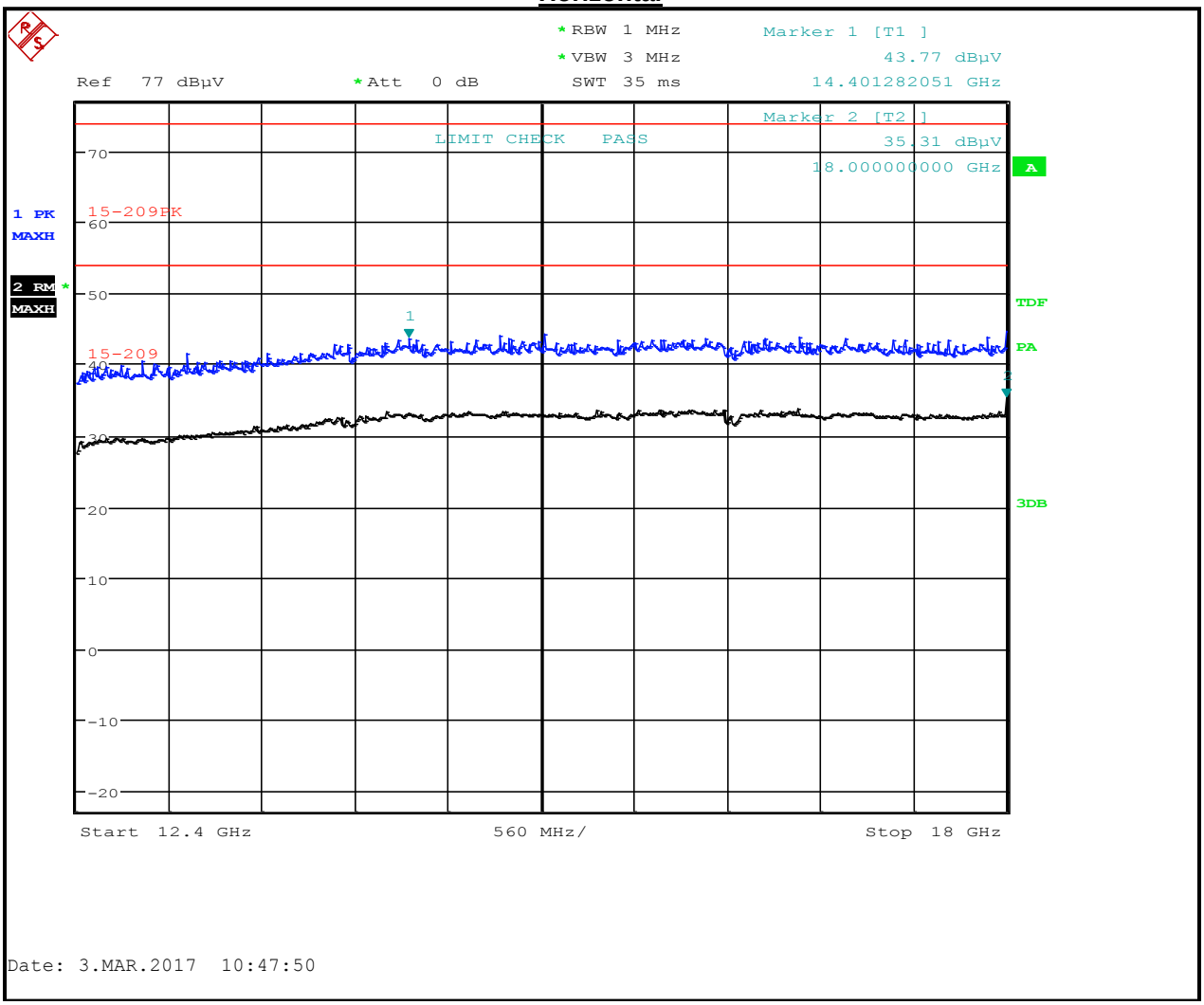


Table 5-40: Radiated Emissions (12.4 – 18 GHz) (TC #1)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
14401.282	43.8	74.0	-30.2				Peak
18000.000	35.3	54.0	-18.7				Average
18000.000	35.3			-59.9	-41.3	-18.6	Average

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

Horizontal

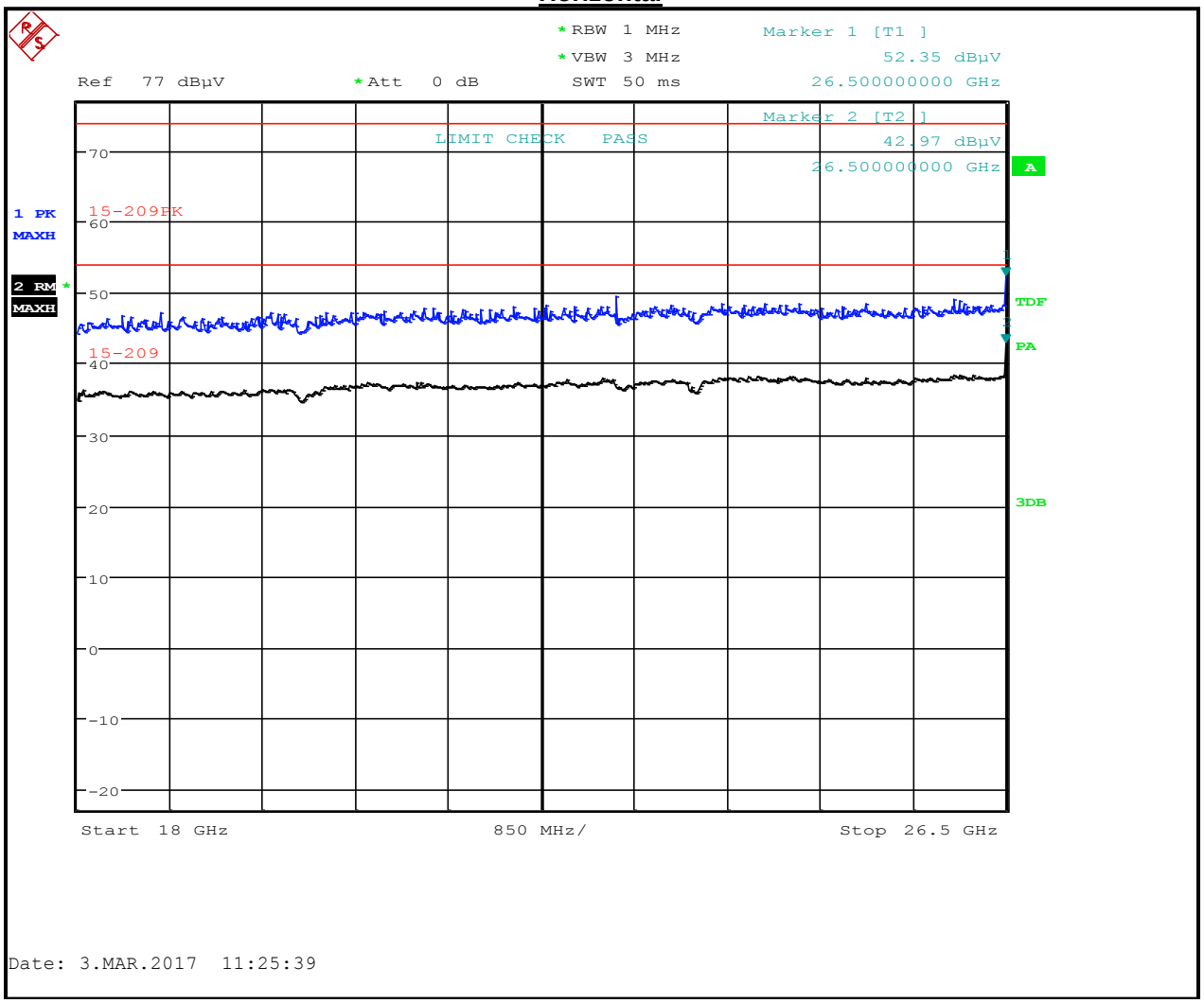


Table 5-41: Radiated Emissions (18 – 26.5 GHz) (TC #1)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
26500.000	52.4	74.0	-21.6				Peak
26500.000	43.0	54.0	-11.0				Average
26500.000	43.0			-52.2	-41.3	-10.9	Average

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

Horizontal

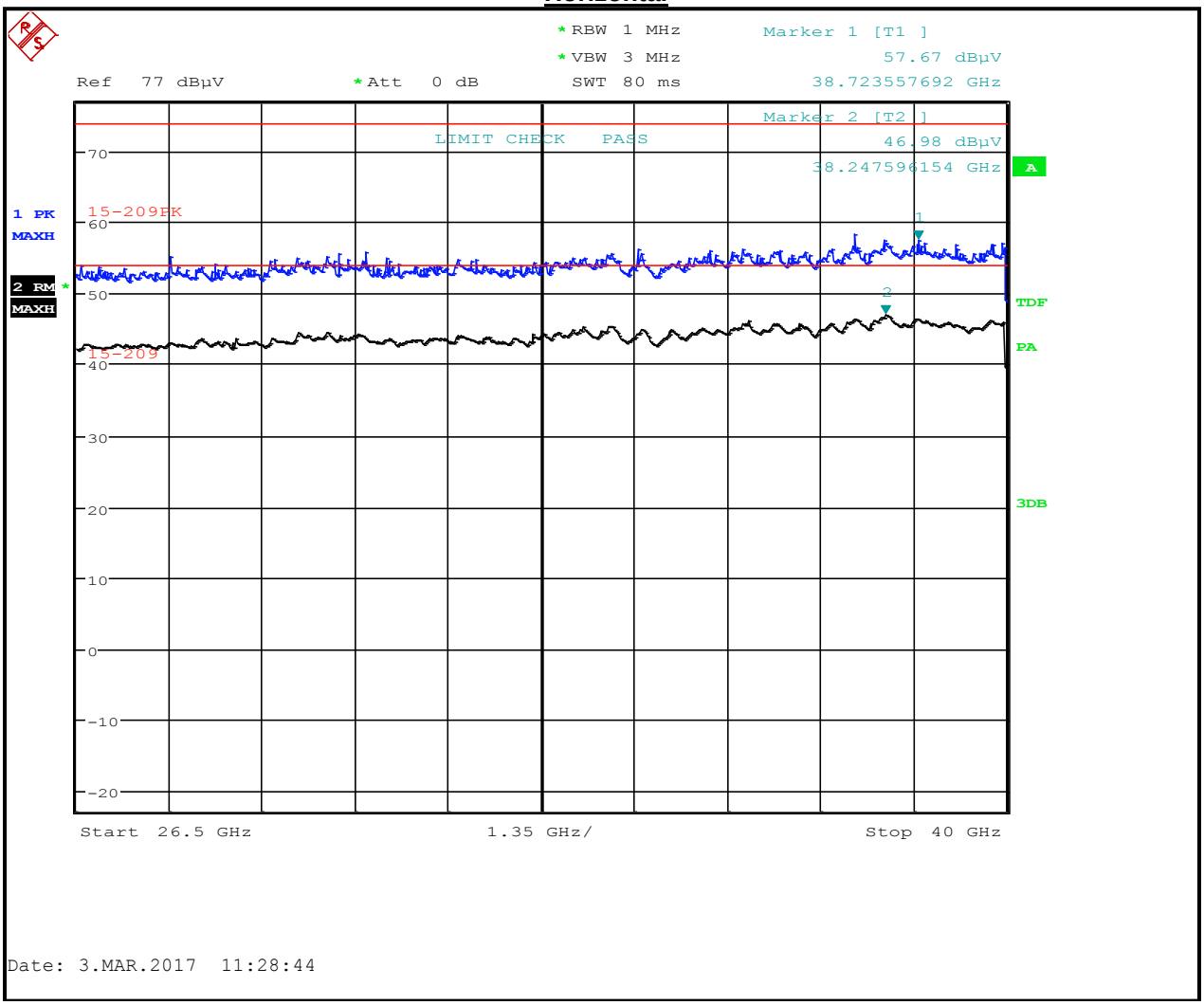


Table 5-42: Radiated Emissions (26.5 – 40 GHz) (TC #1)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
38723.558	57.7	74.0	-16.3				Peak
38247.596	47.0	54.0	-7.0				Average
38247.596	47.0			-48.2	-41.3	-6.9	Average

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

Vertical

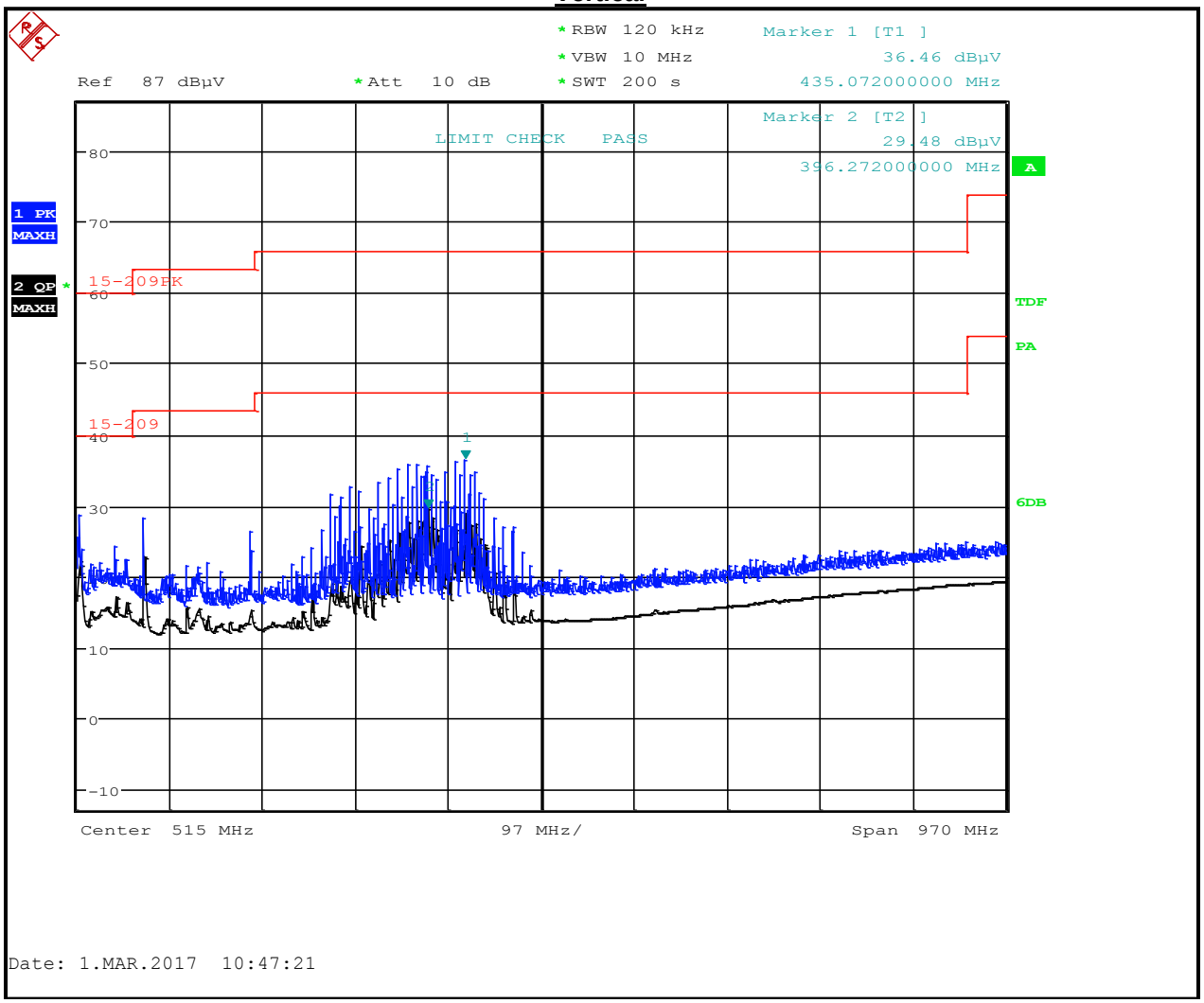


Table 5-43: Radiated Emissions (30 – 1000 MHz) (TC #2)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
435.072	36.5	74.0	-37.5				Peak
396.272	29.5	54.0	-24.5				Quasi-Peak
396.272	29.5			-65.7	-41.3	-24.4	Quasi-Peak

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

Horizontal

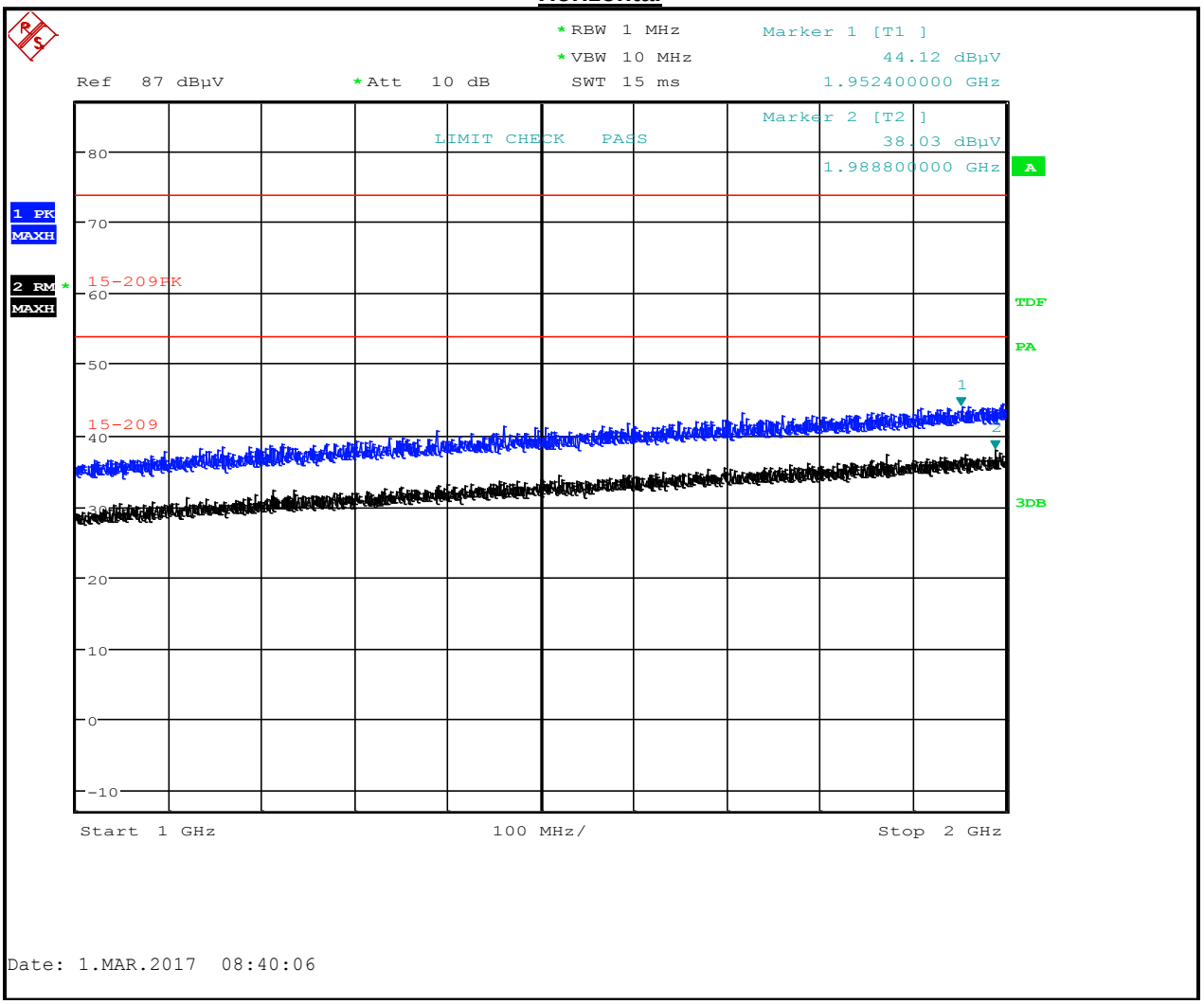


Table 5-44: Radiated Emissions (1 – 2 GHz) (TC #2)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
1952.400	44.1	74.0	-29.9				Peak
1988.800	38.0	54.0	-16.0				Average
1988.800	38.0			-57.2	-41.3	-15.9	Average

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

Vertical

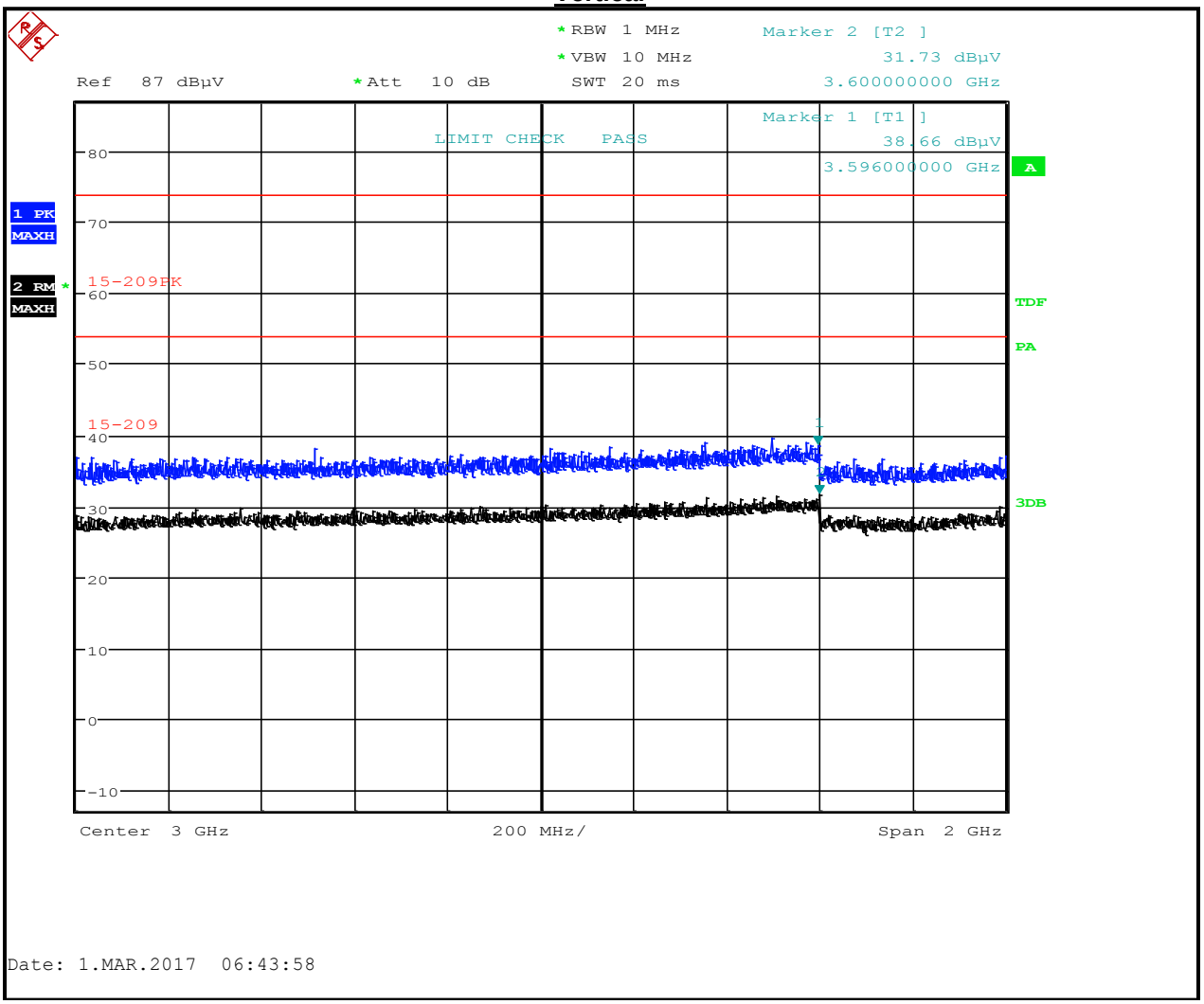


Table 5-45: Radiated Emissions (2 – 4 GHz) (TC #2)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
3596.000	38.7	74.0	-35.3				Peak
3600.000	31.7	54.0	-22.3				Average
3600.000	31.7			-63.5	-41.3	-22.2	Average

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

Horizontal

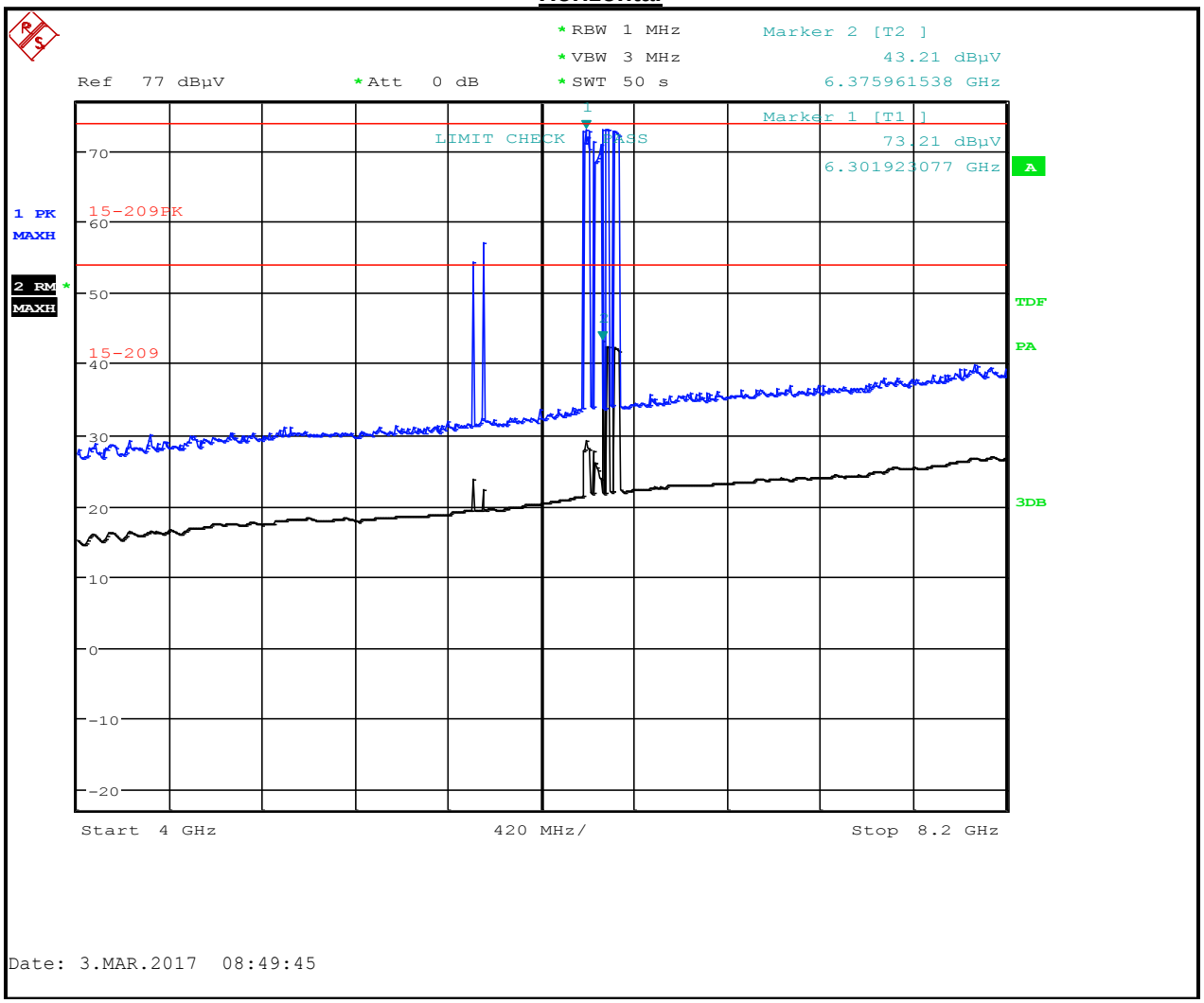


Table 5-46: Radiated Emissions (4 – 8.2 GHz) (TC #2)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
6301.923	73.2	74.0	-0.8				Peak
6375.961	43.2	54.0	-10.8				Average
6375.961	43.2			-52.0	-41.3	-10.7	Average

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

Vertical

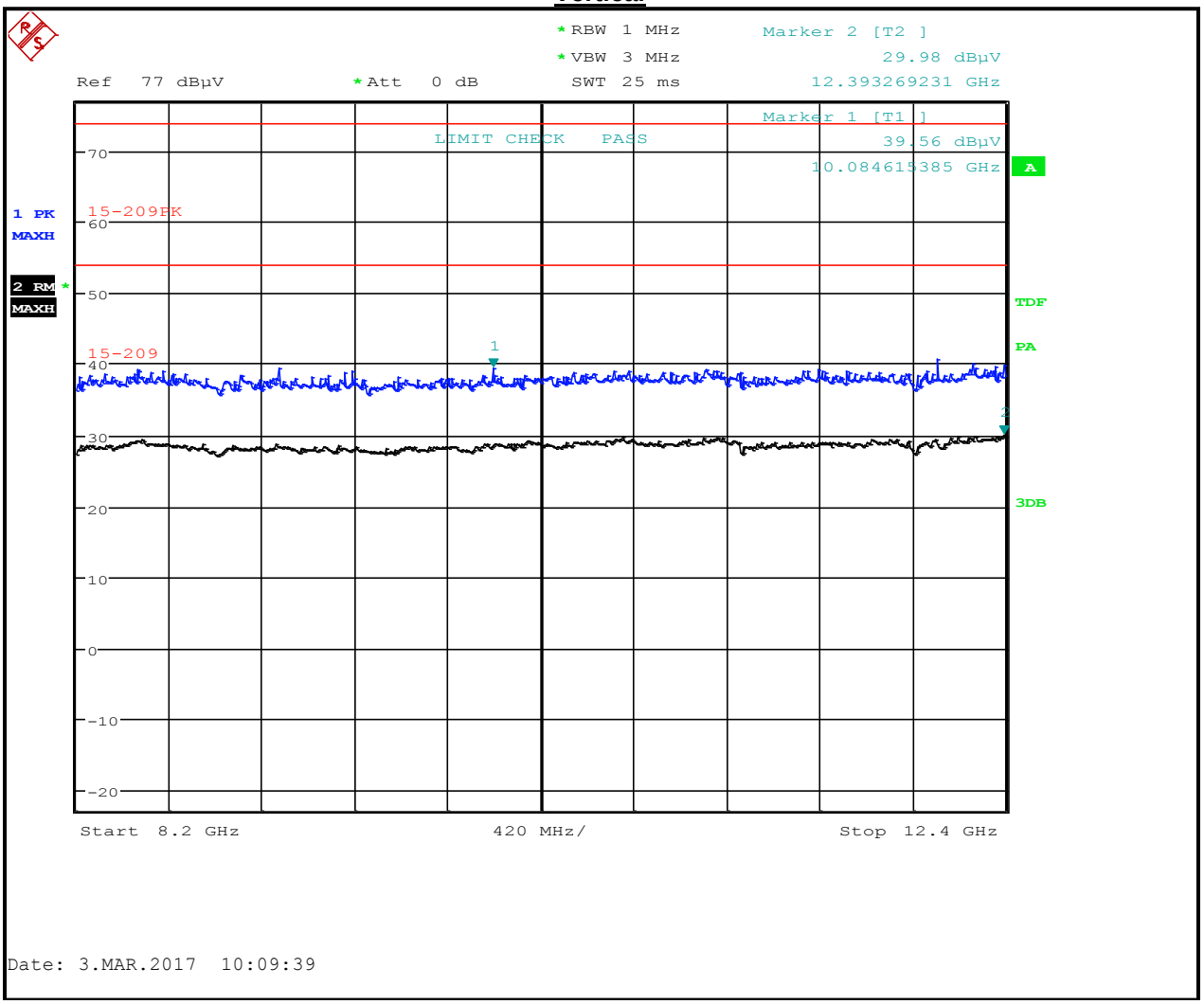


Table 5-47: Radiated Emissions (8.2 – 12.4 GHz) (TC #2)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
10084.615	39.6	74.0	-34.4				Peak
12392.269	30.0	54.0	-24.0				Average
12392.269	30.0			-65.2	-41.3	-23.9	Average

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

Vertical

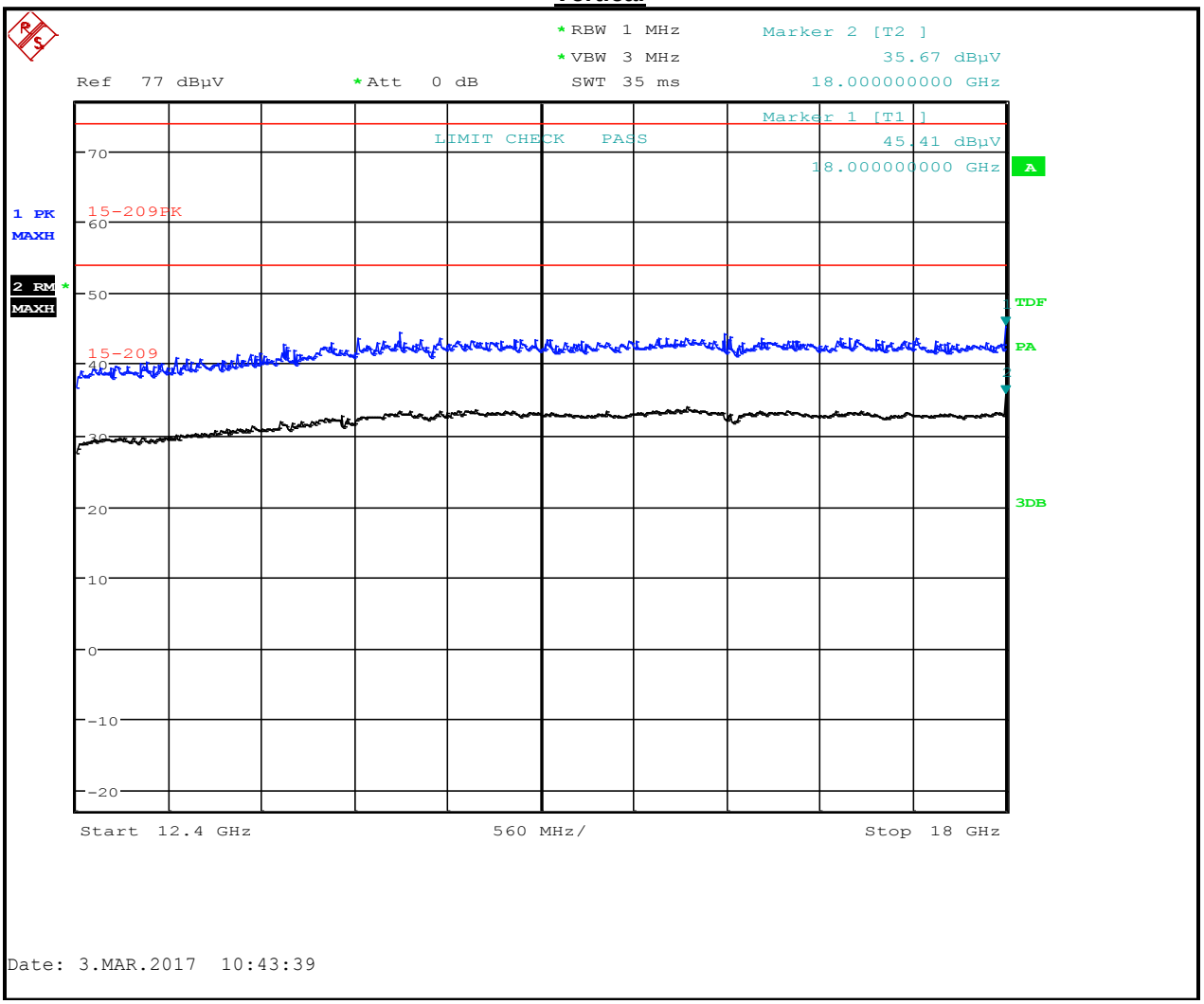


Table 5-48: Radiated Emissions (12.4 – 18 GHz) (TC #2)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
18000.000	45.4	74.0	-28.6				Peak
18000.000	35.7	54.0	-18.3				Average
18000.000	35.7			-59.5	-41.3	-18.2	Average

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

Vertical

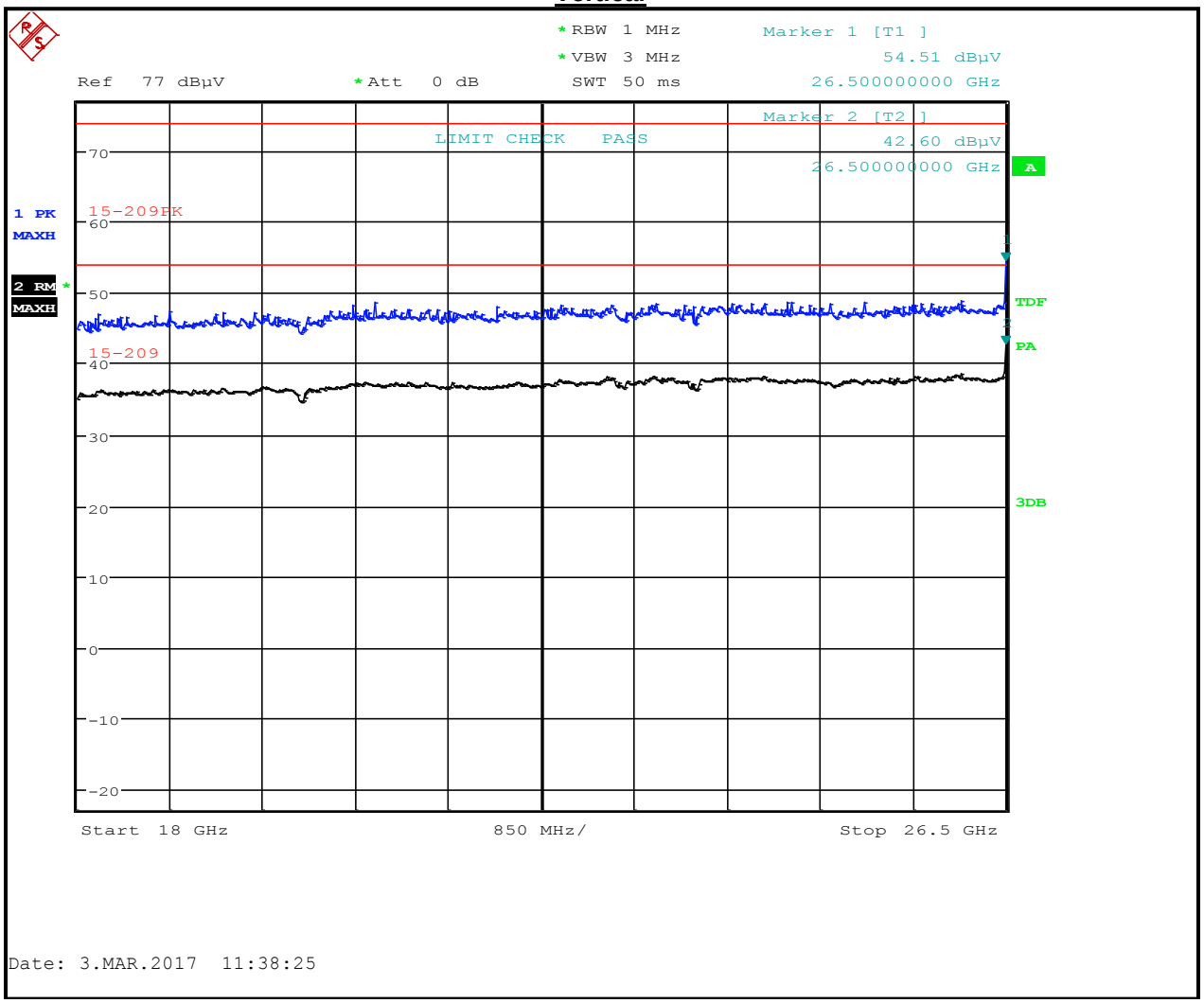


Table 5-49: Radiated Emissions (18 – 26.5 GHz) (TC #2)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
26500.000	54.5	74.0	-19.5				Peak
26500.000	42.6	54.0	-11.4				Average
26500.000	42.6			-52.6	-41.3	-11.3	Average

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

Vertical

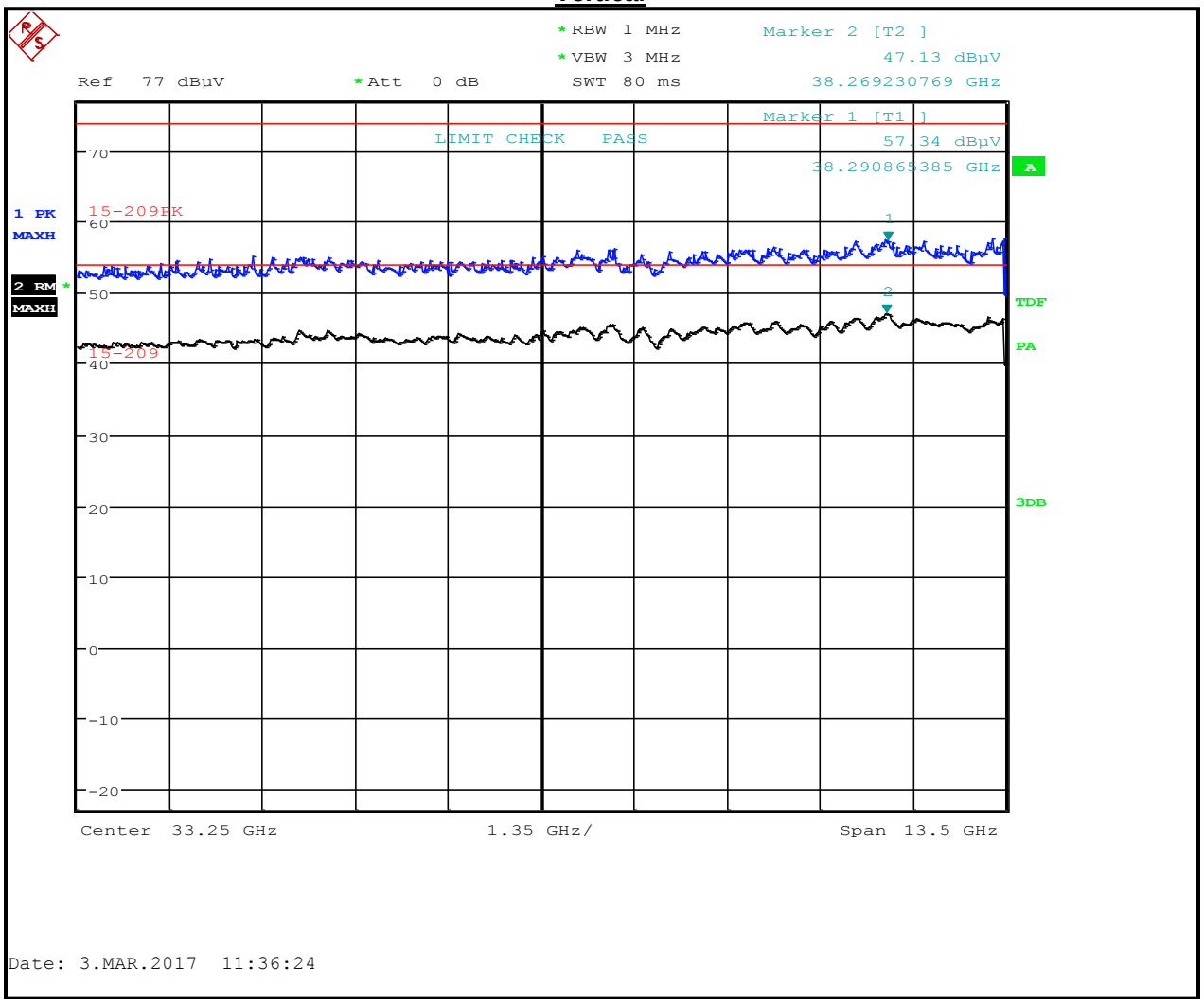


Table 5-50: Radiated Emissions (26.5 – 40 GHz) (TC #2)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
38290.865	57.3	74.0	-16.7				Peak
38269.231	47.1	54.0	-6.9				Average
38269.231	47.1			-48.1	-41.3	-6.8	Average

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

Vertical

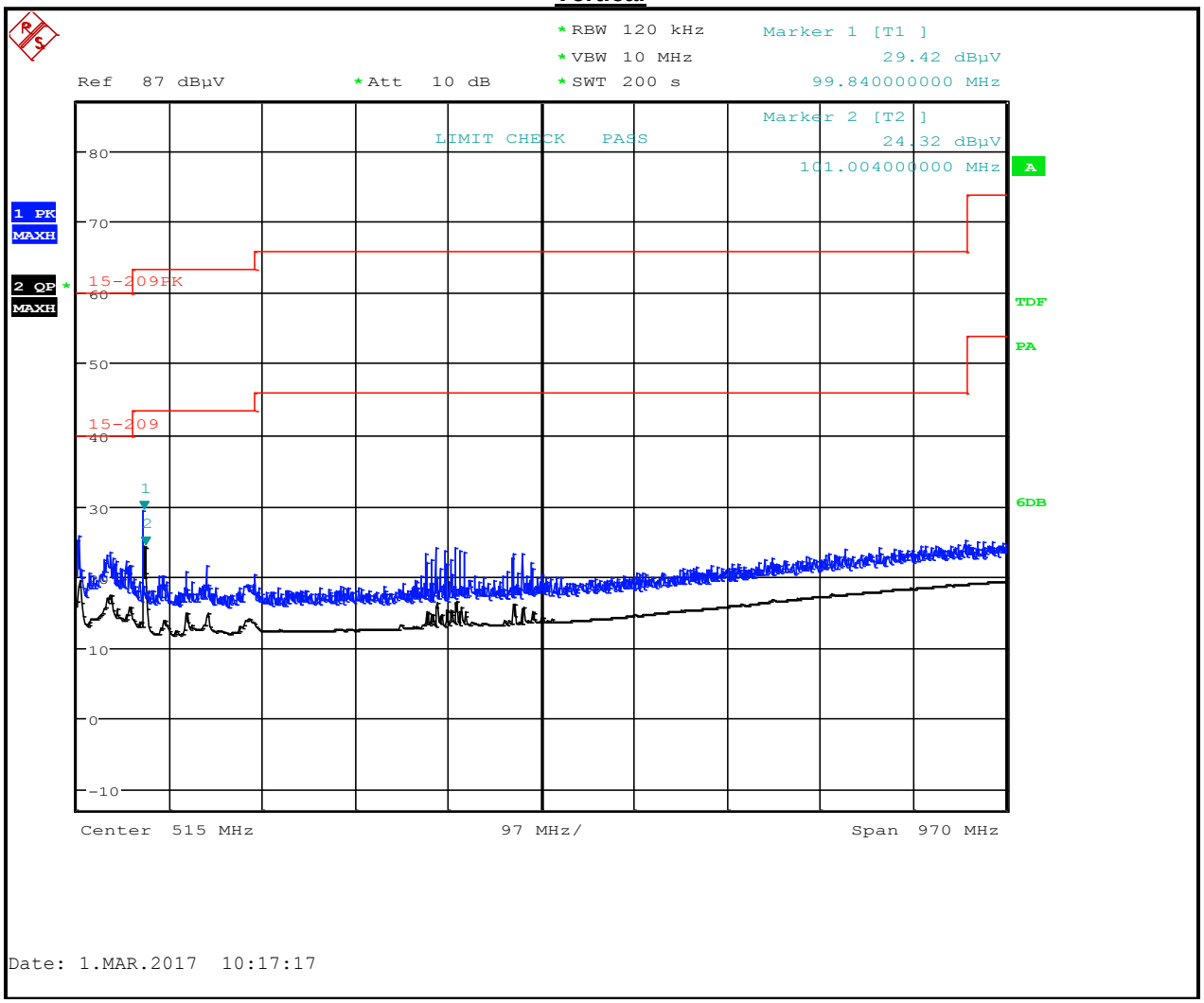


Table 5-51: Radiated Emissions (30 – 1000 MHz) (TC #3)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
99840.000	29.4	74.0	-44.6				Peak
101004.000	24.3	54.0	-29.7				Quasi-Peak
101004.000	24.3			-70.9	-41.3	-29.6	Quasi-Peak

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

Horizontal

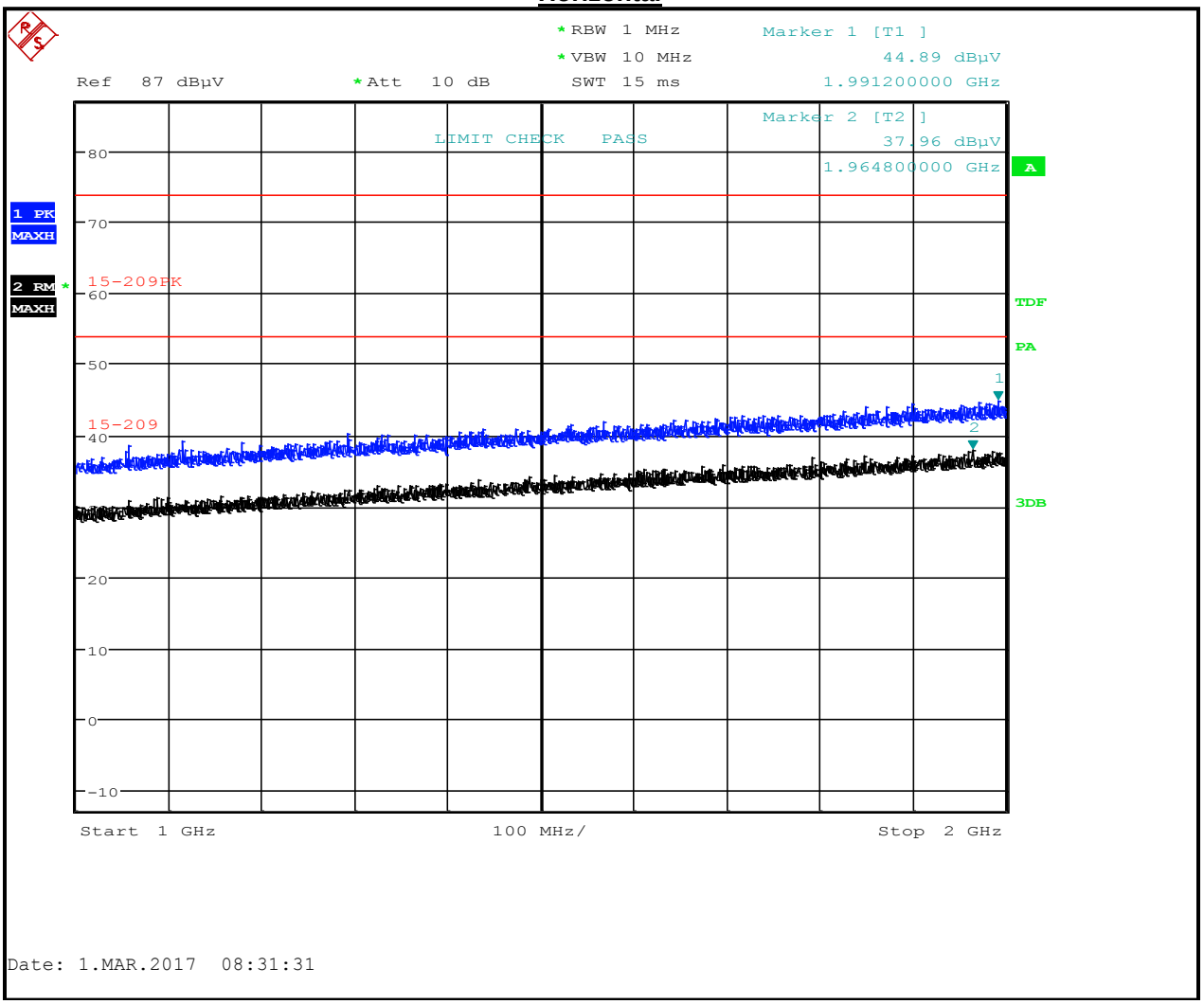


Table 5-52: Radiated Emissions (1 – 2 GHz) (TC #3)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
1991.200	44.9	74.0	-29.1				Peak
1964.800	38.0	54.0	-16.0				Average
1964.800	38.0			-57.2	-41.3	-15.9	Average

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

Horizontal

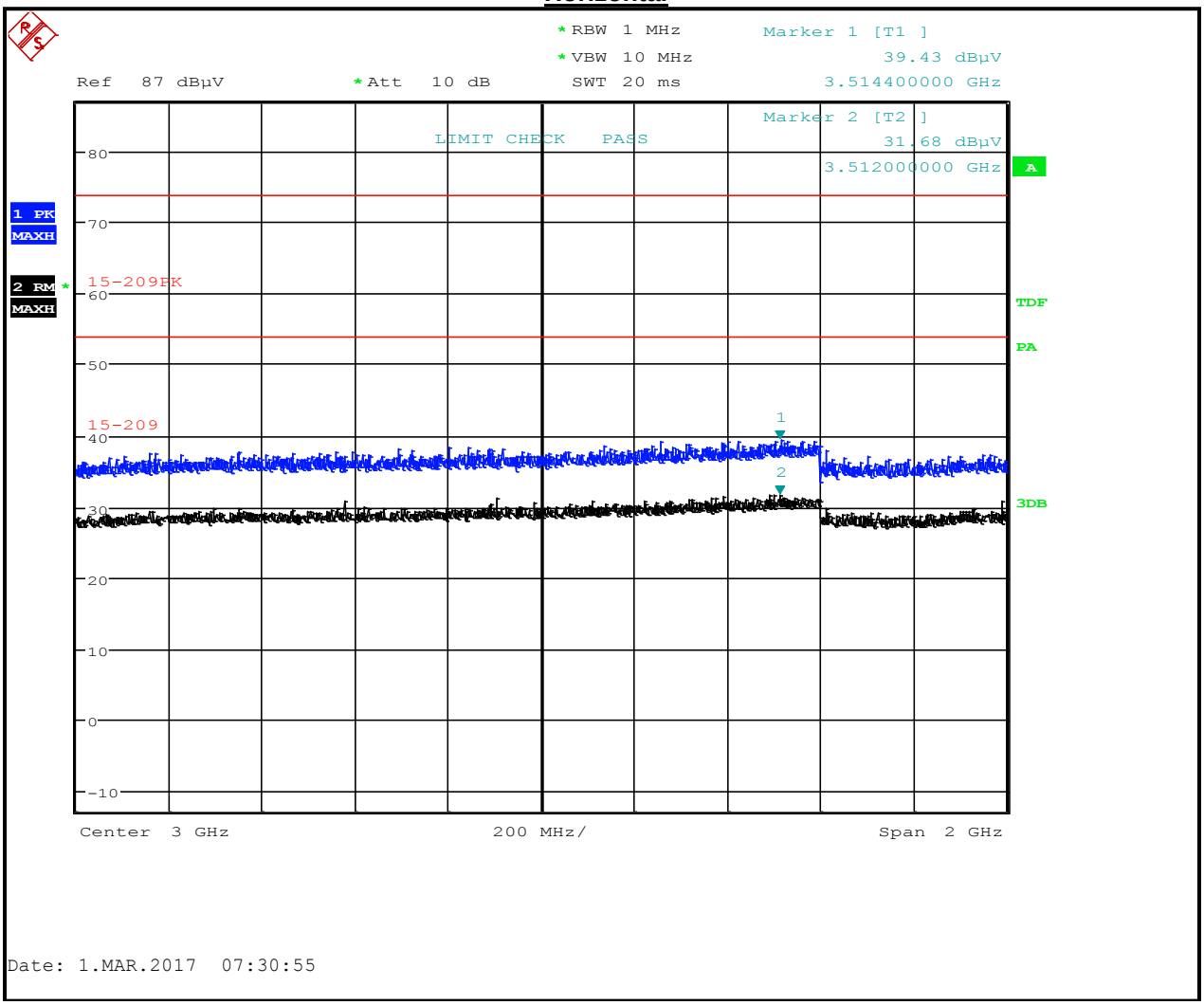


Table 5-53: Radiated Emissions (2 – 4 GHz) (TC #3)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
3514.400	39.4	74.0	-34.6				Peak
3512.000	31.7	54.0	-22.3				Average
3512.000	31.7			-63.5	-41.3	-22.2	Average

Plot 5-44: Radiated Emissions (4 – 8.2 GHz) (TC #3)

Horizontal

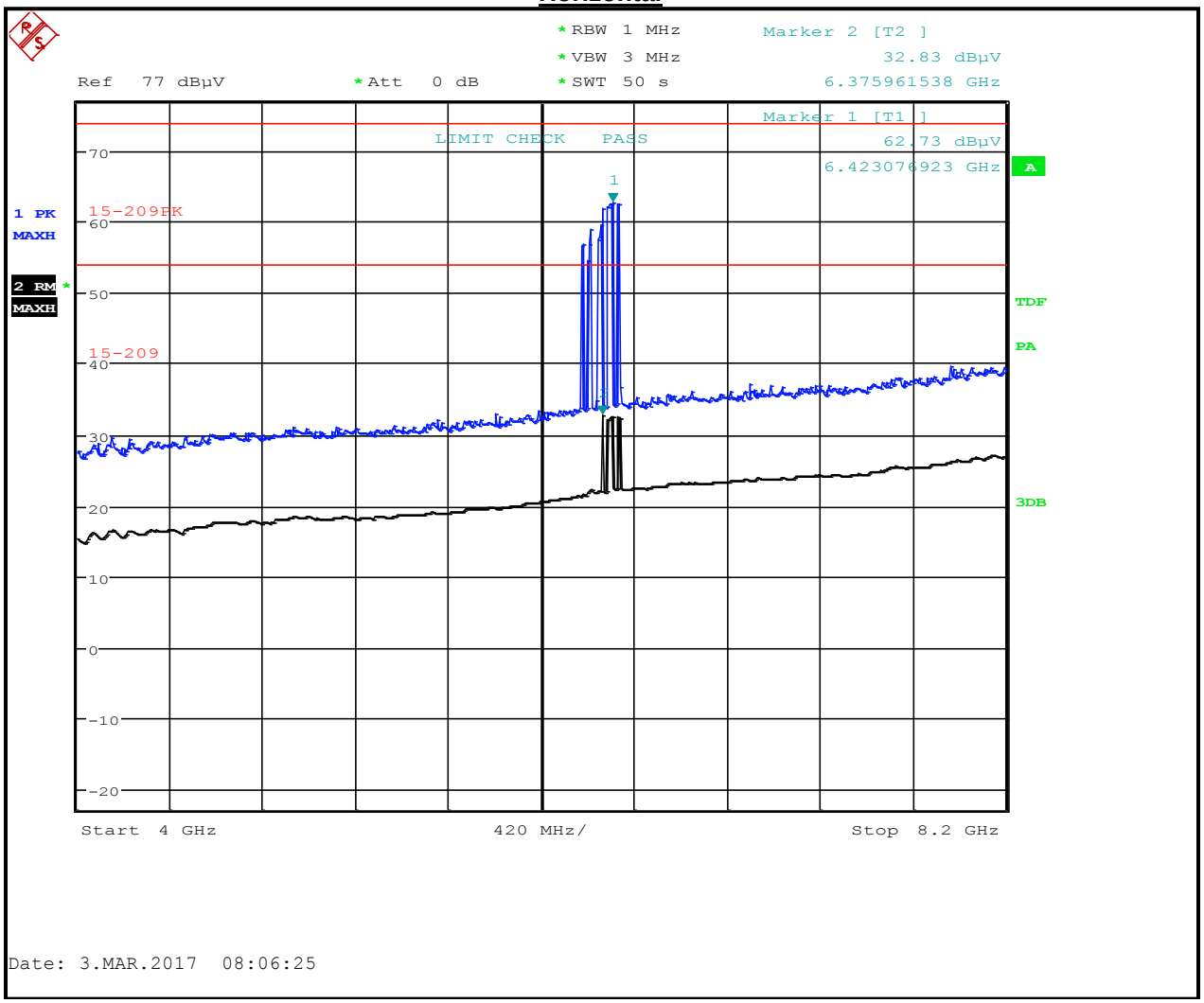


Table 5-54: Radiated Emissions (4 – 8.2 GHz) (TC #3)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
6423.077	62.7	74.0	-11.3				Peak
6375.962	32.8	54.0	-21.2				Average
6375.962	32.8			-62.4	-41.3	-21.1	Average

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

Vertical

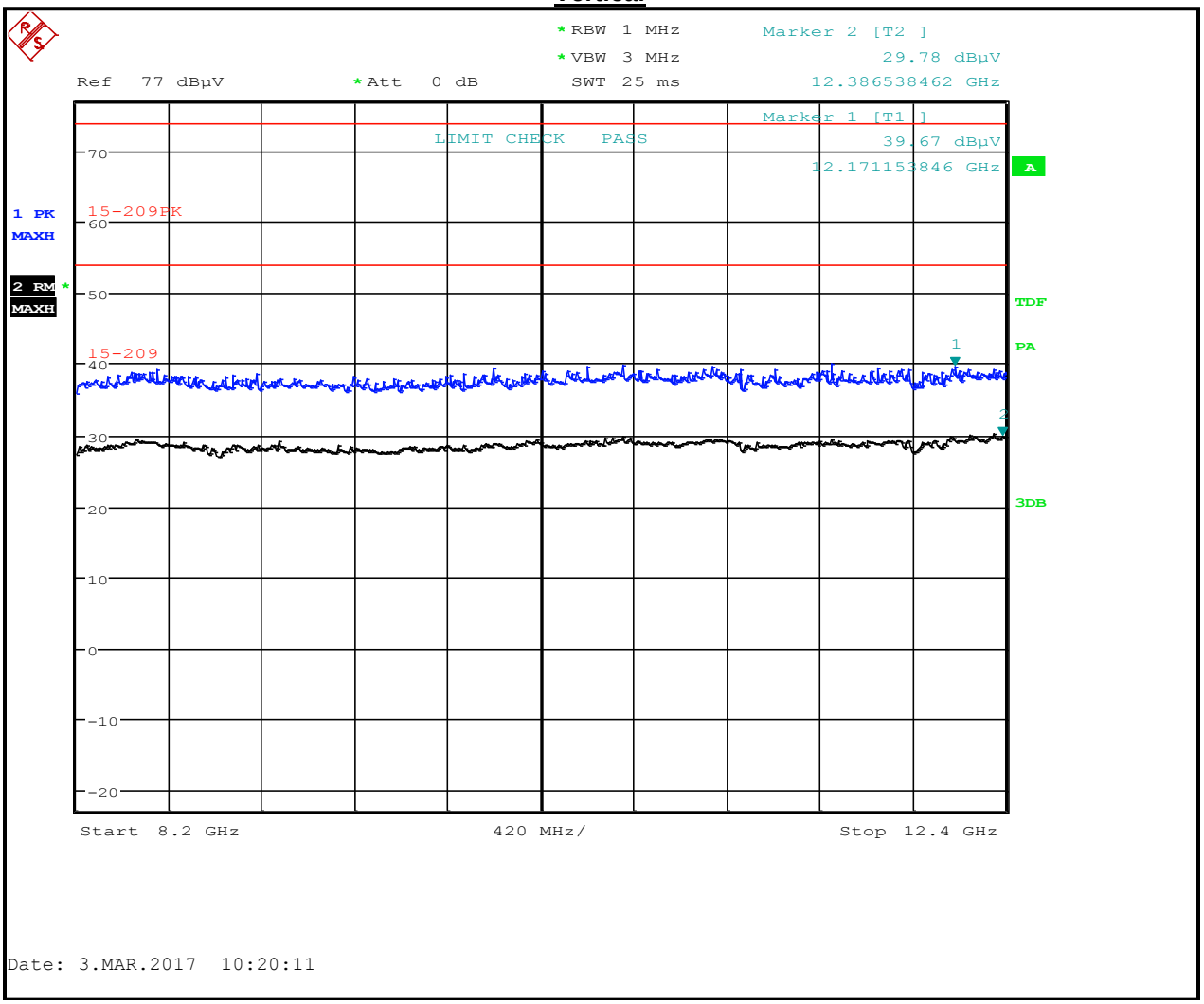


Table 5-55: Radiated Emissions (8.2 – 12.4 GHz) (TC #3)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
12171.153	39.7	74.0	-34.3				Peak
12386.539	29.8	54.0	-24.2				Average
12386.539	29.8			-65.4	-41.3	-24.1	Average

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

Vertical

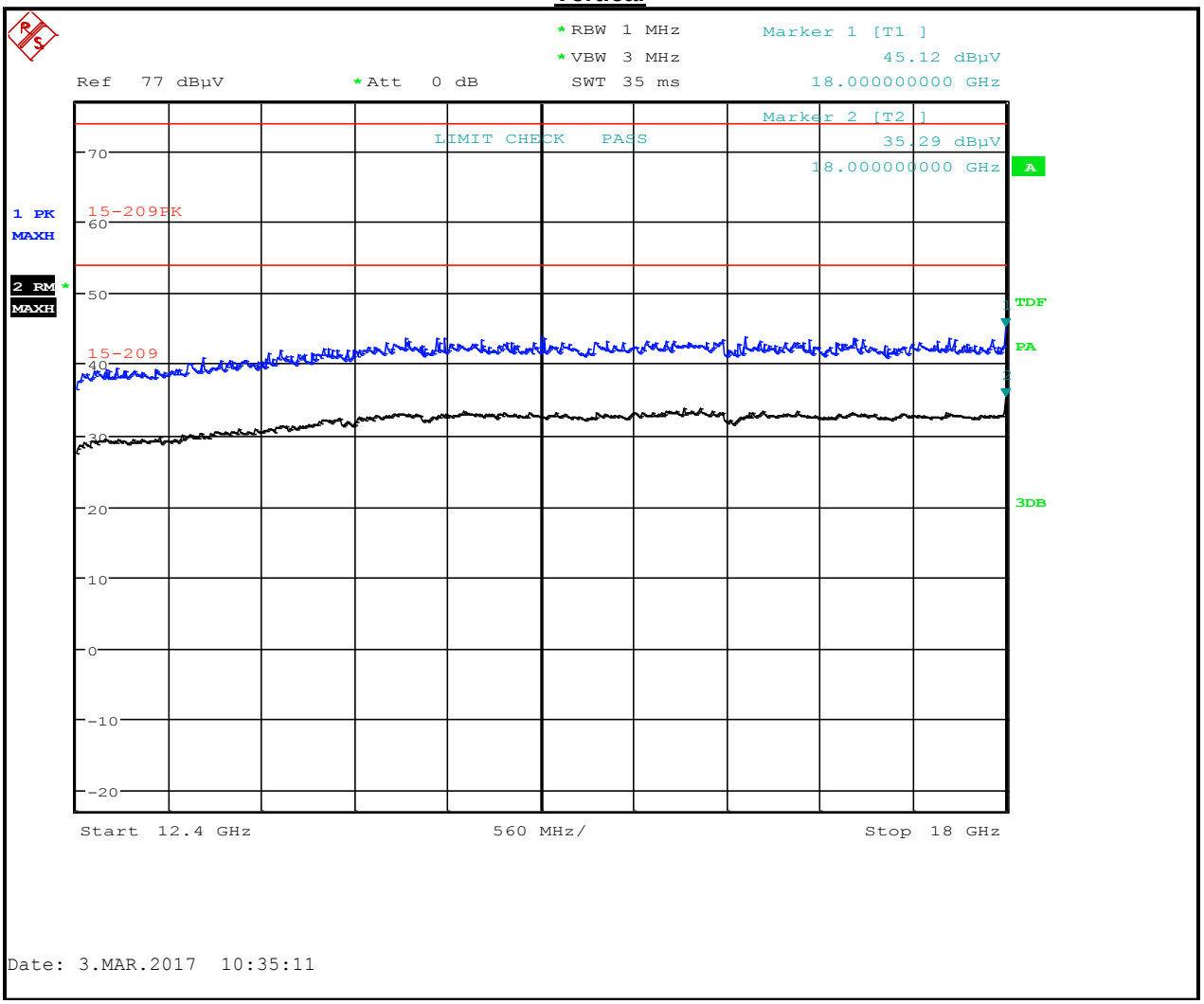


Table 5-56: Radiated Emissions (12.4 – 18 GHz) (TC #3)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
18000.000	45.1	74.0	-28.9				Peak
18000.000	35.3	54.0	-18.7				Average
18000.000	35.3			-59.9	-41.3	-18.6	Average

Plot 5-47: Radiated Emissions (18 – 26.5 GHz) (TC #3)

Horizontal

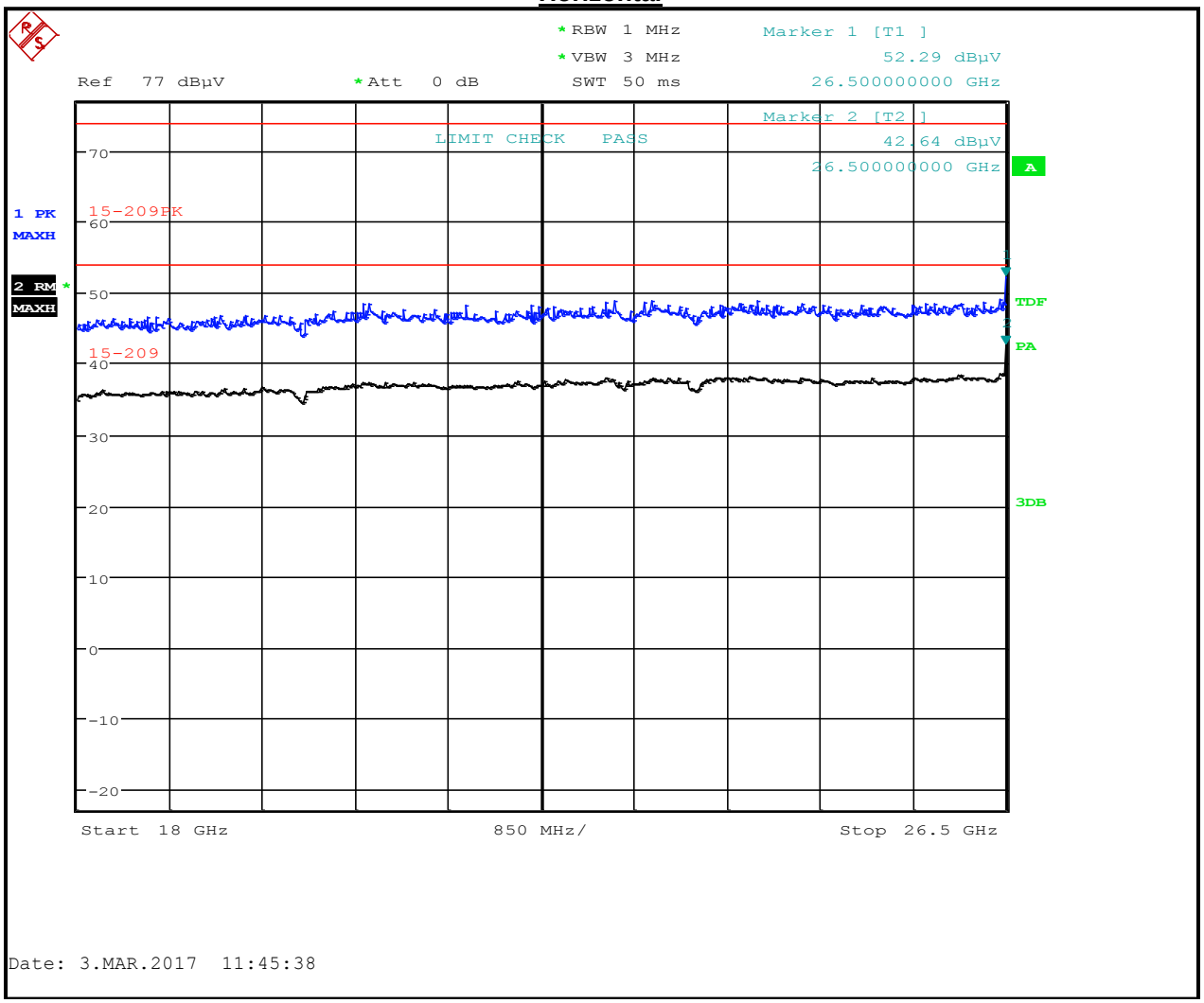


Table 5-57: Radiated Emissions (18 – 26.5 GHz) (TC #3)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
26500.000	52.3	74.0	-21.7				Peak
26500.000	42.6	54.0	-11.4				Average
26500.000	42.6			-52.6	-41.3	-11.3	Average

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

Vertical

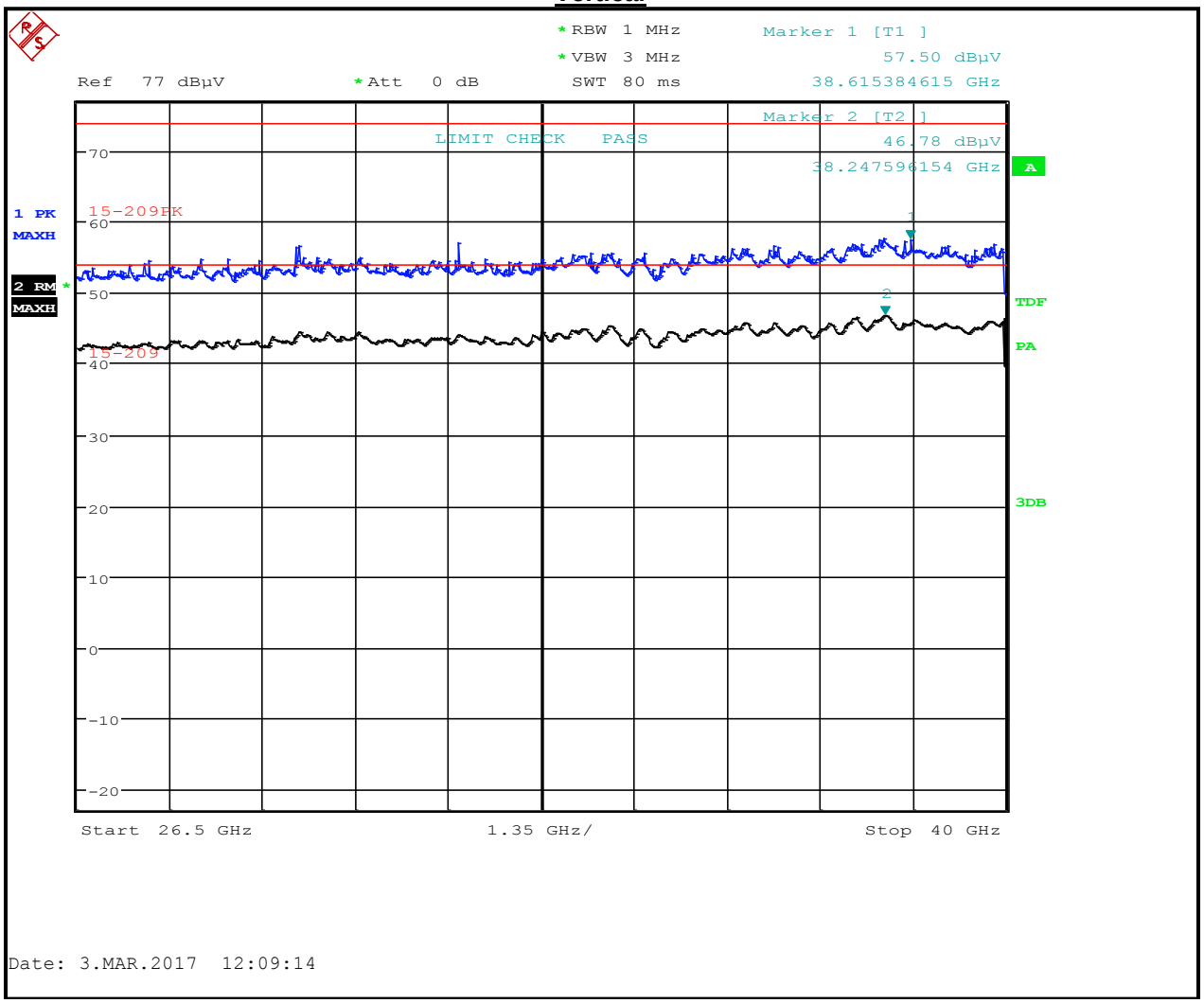


Table 5-58: Radiated Emissions (26.5 – 40 GHz) (TC #3)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
38615.385	57.5	74.0	-16.5				Peak
38247.596	46.8	54.0	-7.2				Average
38247.596	46.8			-48.4	-41.3	-7.1	Average

5.3.2.3 Concrete Drum

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

Vertical

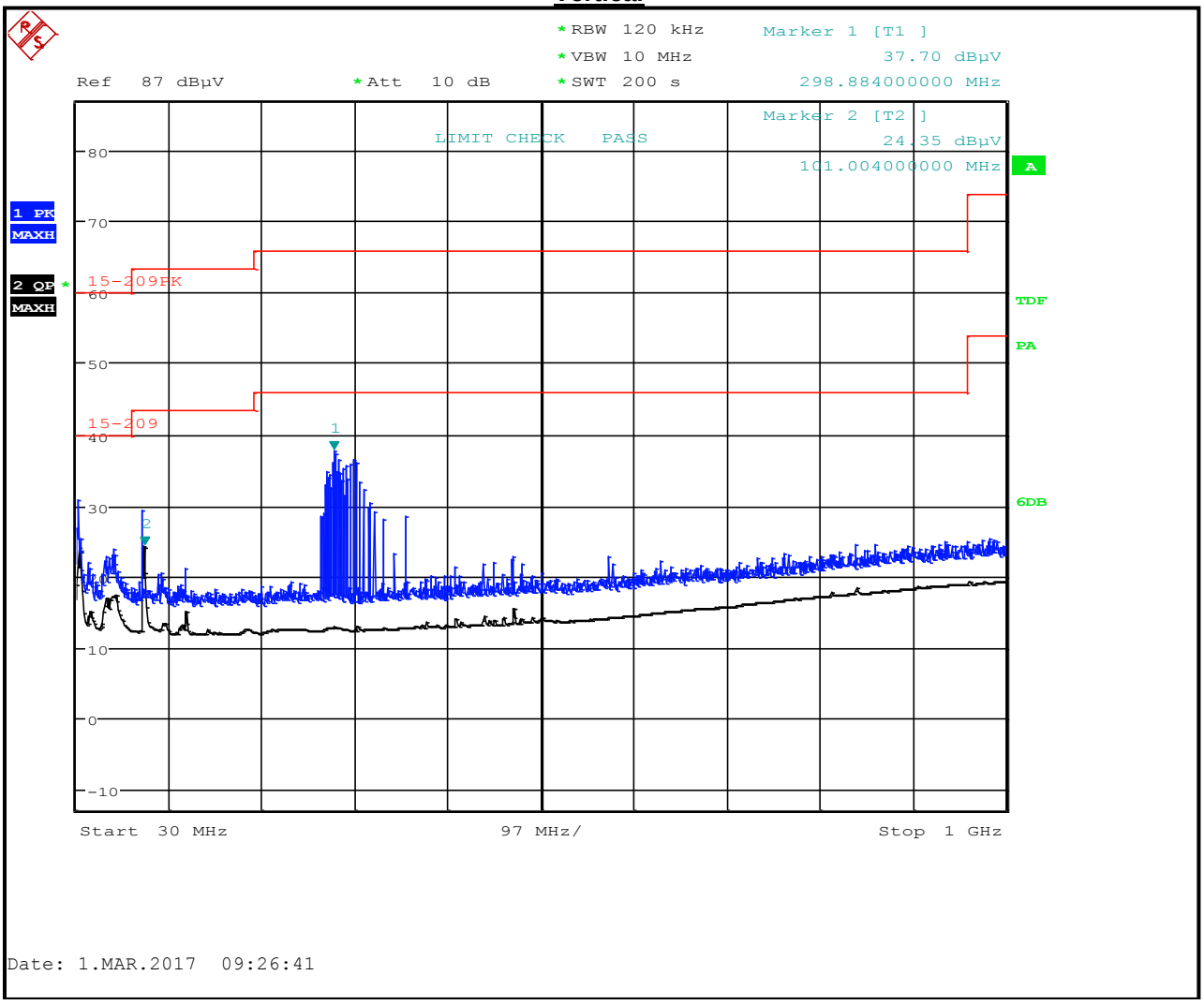


Table 5-59: Radiated Emissions (30 – 1000 MHz) (TC #1)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
298.884	37.7	74.0	-36.3				Peak
101.004	24.4	54.0	-29.6				Quasi-Peak
101.004	24.4			-70.8	-41.3	-29.5	Quasi-Peak

Plot 5-50: Radiated Emissions (1 – 2 GHz) (TC #1)

Horizontal

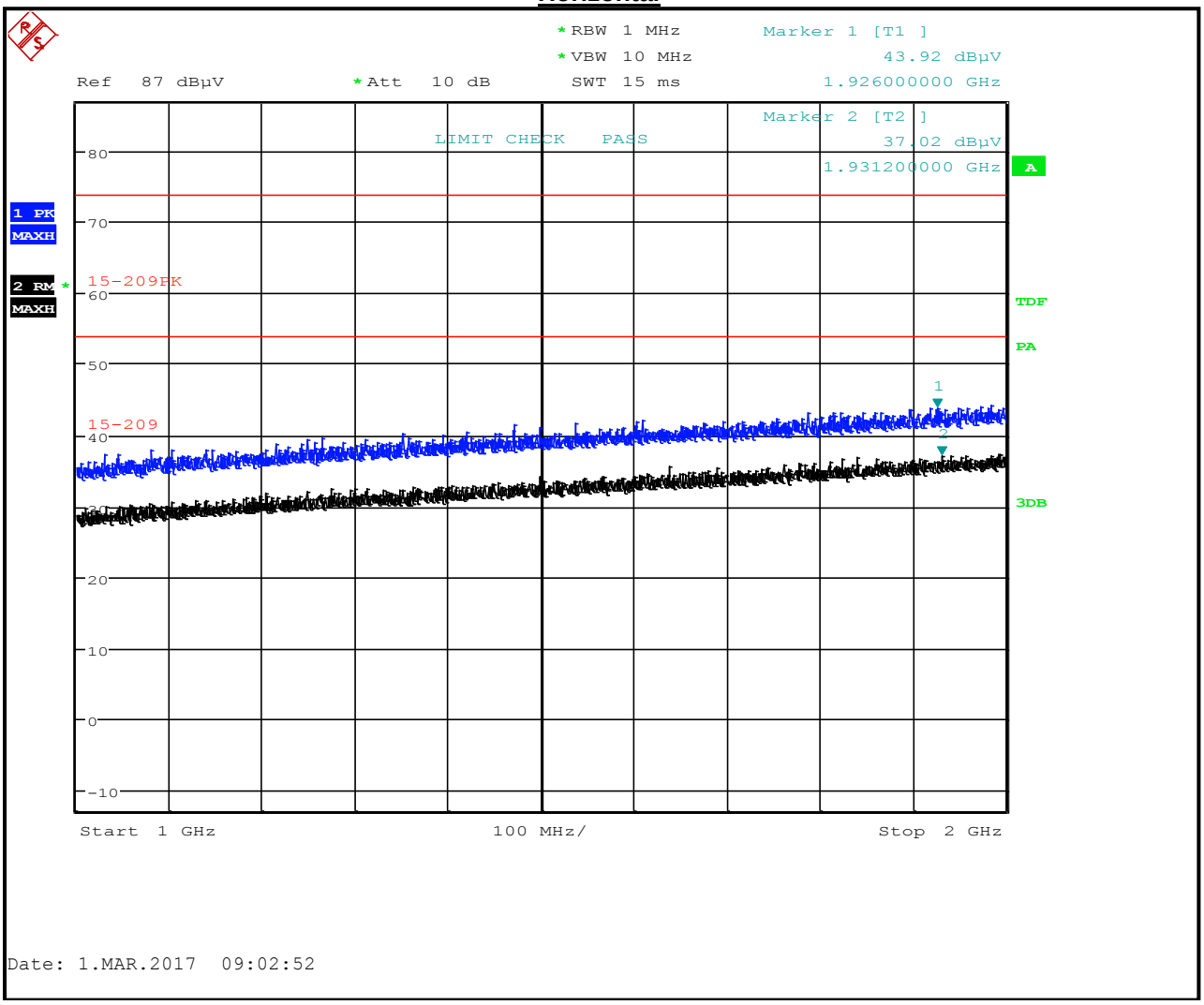


Table 5-60: Radiated Emissions (1 – 2 GHz) (TC #1)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
1926.000	43.9	74.0	-30.1				Peak
1931.200	37.0	54.0	-17.0				Average
1931.200	37.0			-58.2	-41.3	-16.9	Average

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

Horizontal

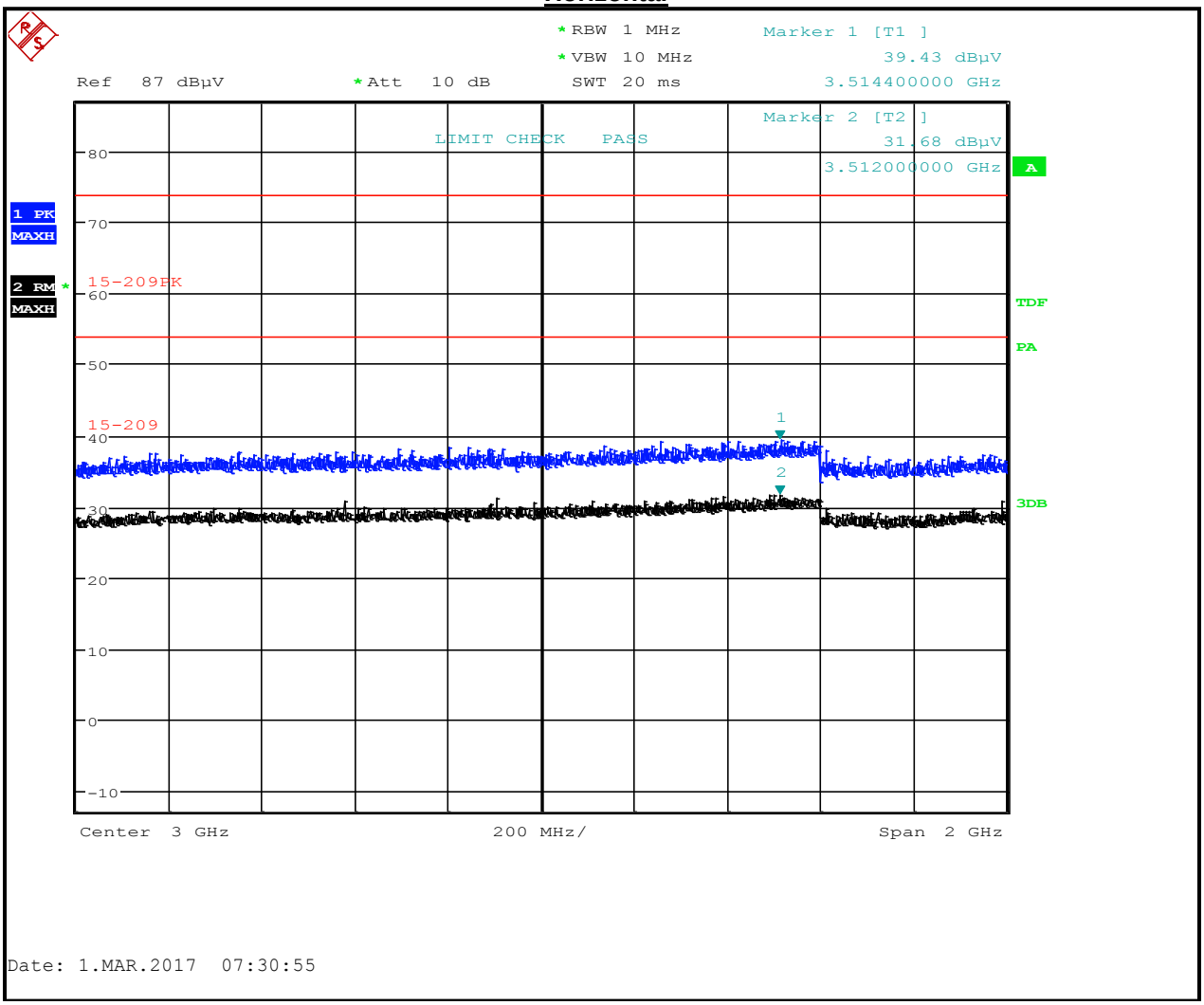


Table 5-61: Radiated Emissions (2 – 4 GHz) (TC #1)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
3514.400	39.4	74.0	-34.6				Peak
3512.000	31.7	54.0	-22.3				Average
3512.000	31.7			-63.5	-41.1	-22.2	Average

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

Vertical

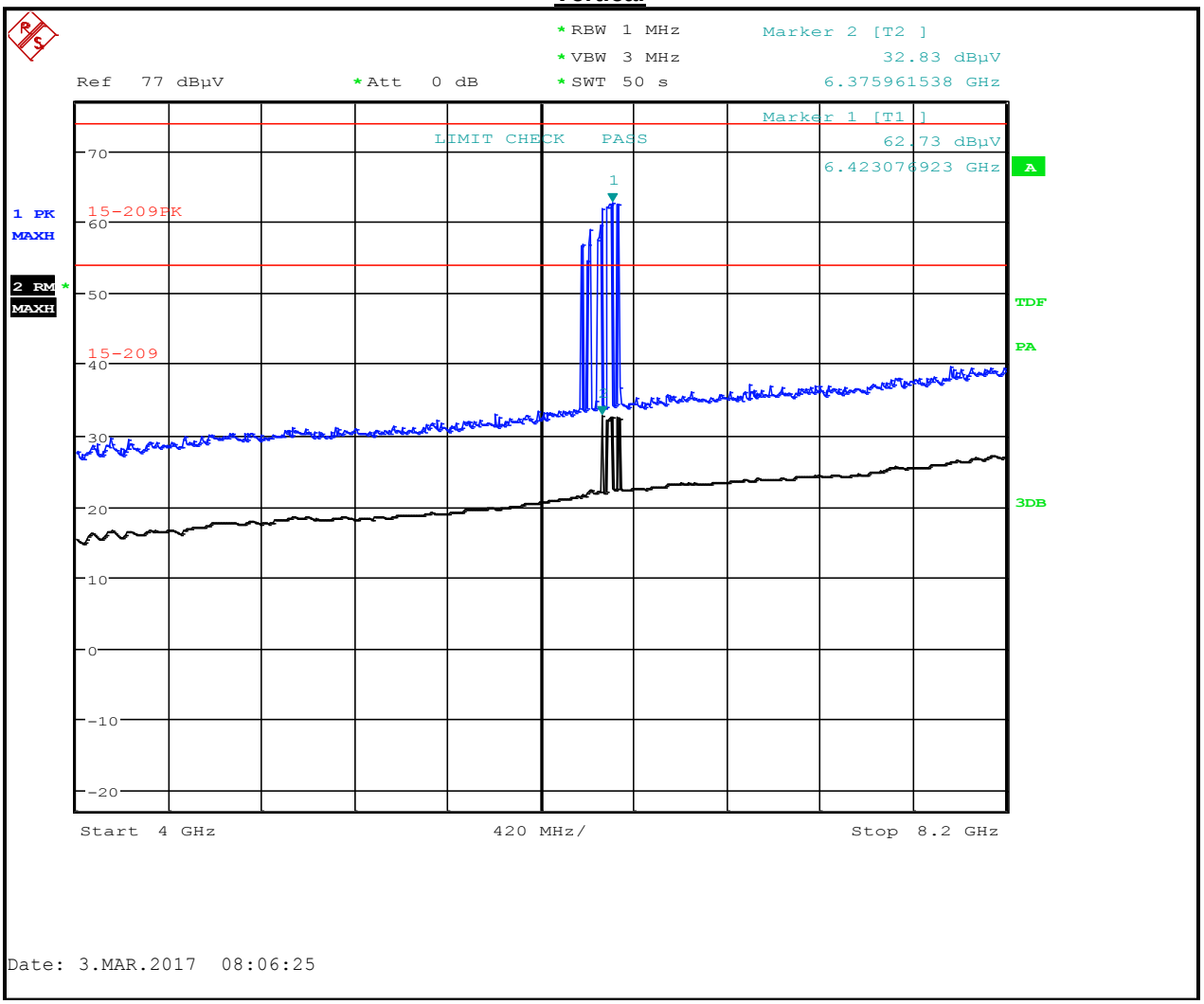


Table 5-62: Radiated Emissions (4 – 8.2 GHz) (TC #1)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
6423.077	62.7	74.0	-11.3				Peak
6375.962	32.8	54.0	-21.2				Average
6375.962	32.8			-62.4	-41.3	-21.1	Average

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

Vertical

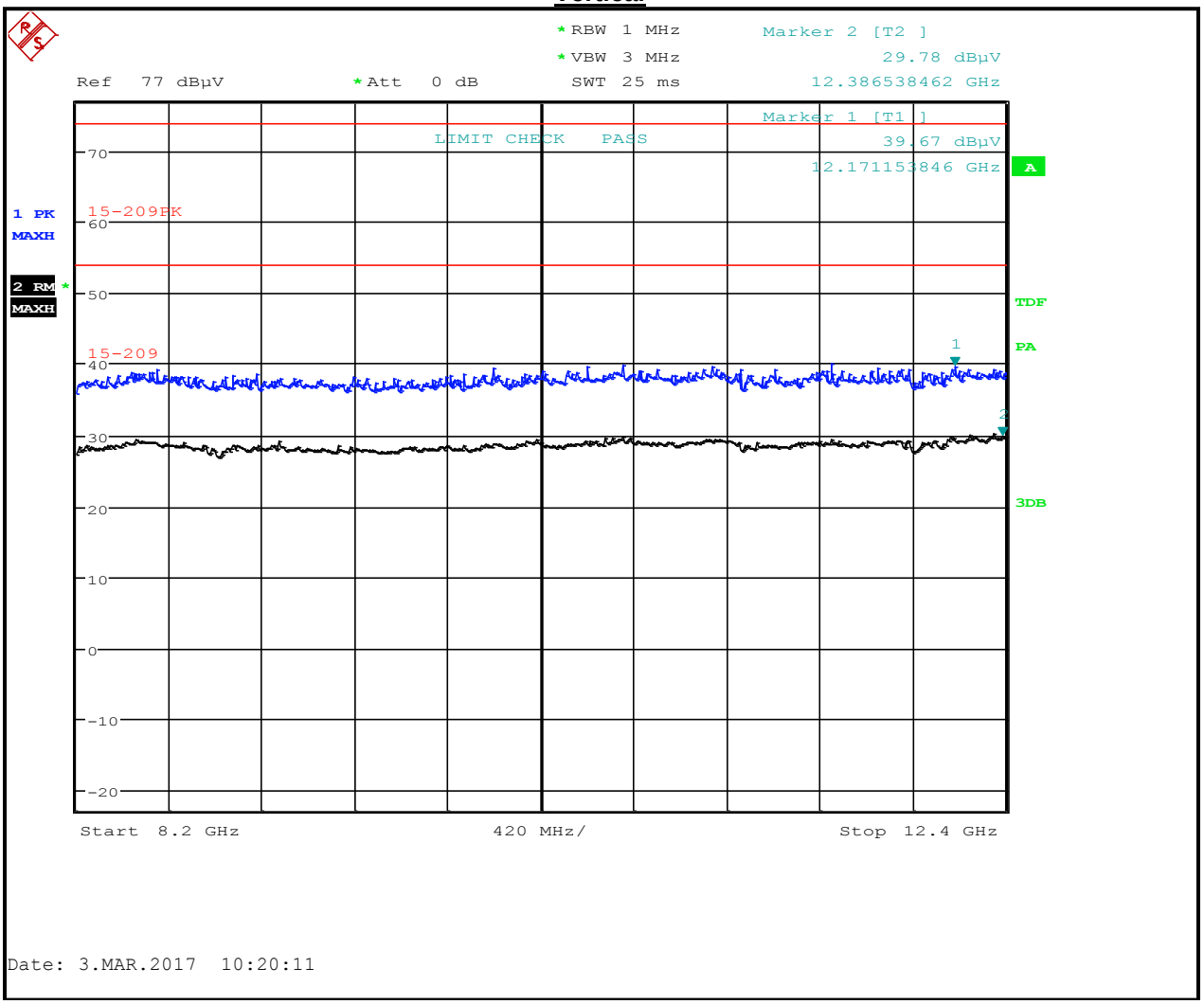


Table 5-63: Radiated Emissions (8.2 – 12.4 GHz) (TC #1)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
12171.154	39.7	74.0	-34.3				Peak
12386.539	29.8	54.0	-24.2				Average
12386.539	29.8			-65.4	-41.3	-24.3	Average

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

Vertical

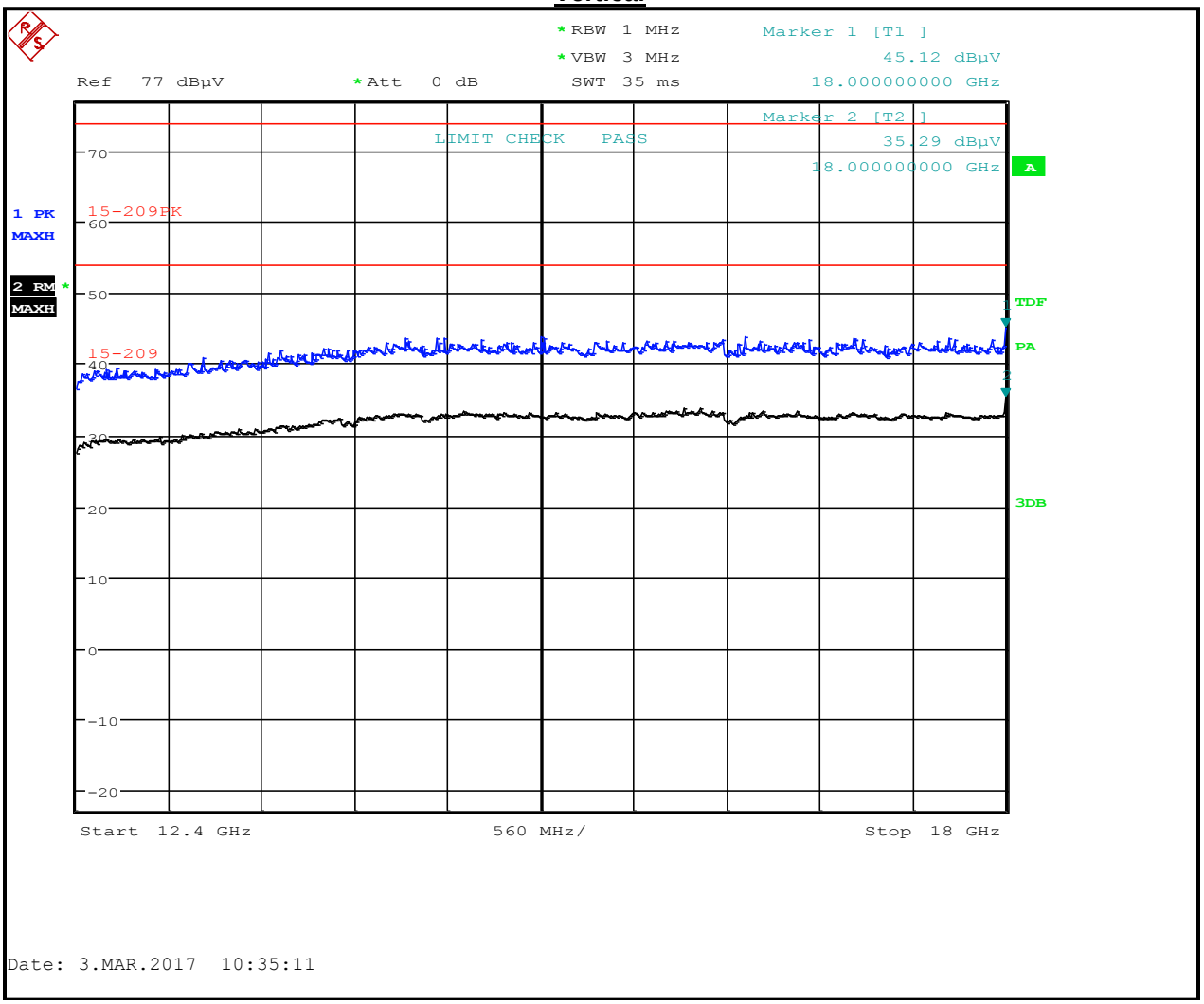


Table 5-64: Radiated Emissions (12.4 – 18 GHz) (TC #1)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
18000.000	45.1	74.0	-28.9				Peak
18000.000	35.3	54.0	-18.7				Average
18000.000	35.3			-59.9	-41.3	-18.6	Average

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

Vertical

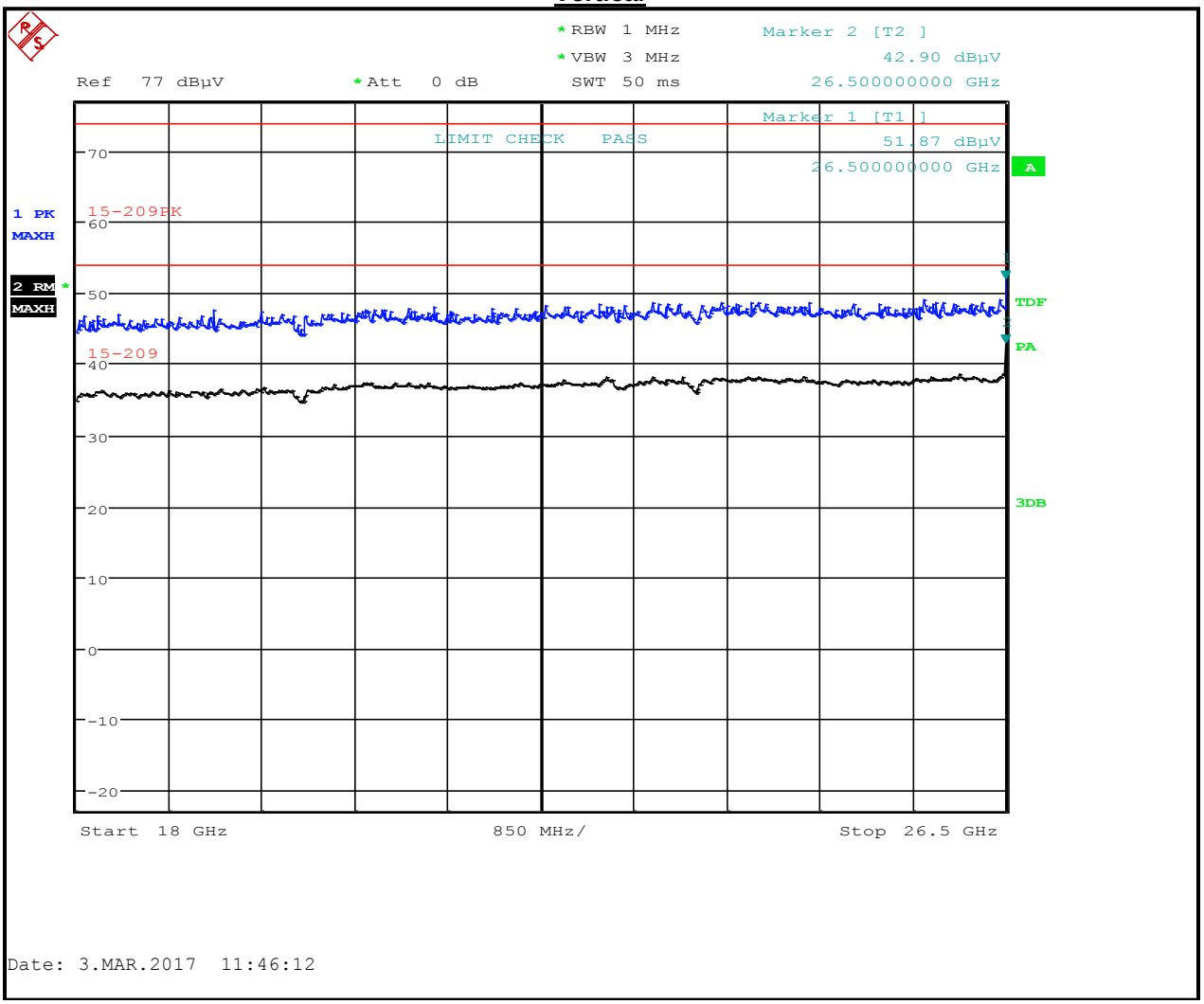


Table 5-65: Radiated Emissions (18 – 26.5 GHz) (TC #1)

Frequency (MHz)	Corrected Field strength 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	42.9	54.0	-11.1				Average
26500.000	42.9			-52.3	-41.3	-11.0	Average

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

Vertical

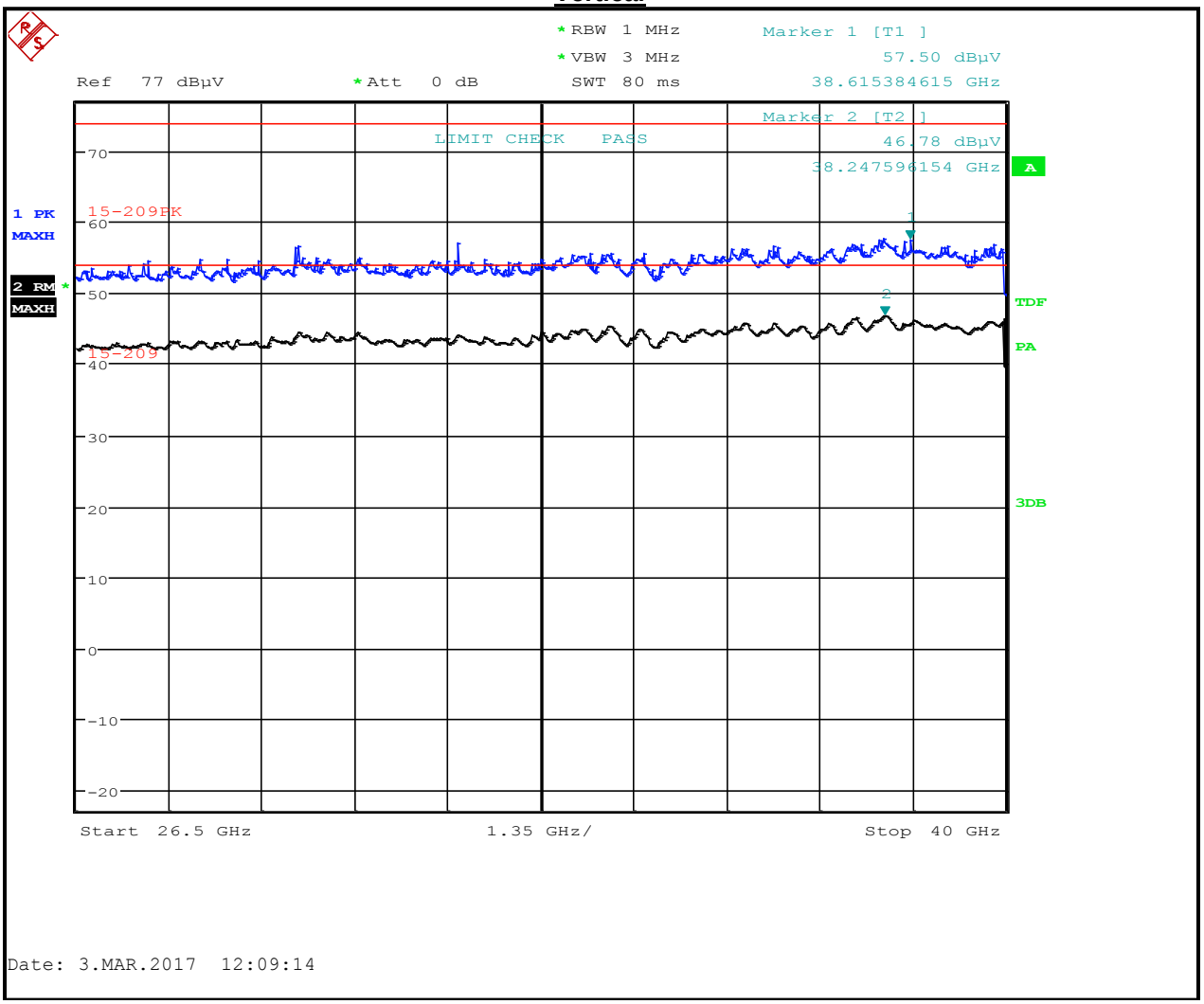


Table 5-66: Radiated Emissions (26.5 – 40 GHz) (TC #1)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
38615.384	57.5	74.0	-16.5				Peak
38247.596	46.8	54.0	-7.2				Average
38247.596	46.8			-48.4	-41.3	-7.1	Average

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

Vertical

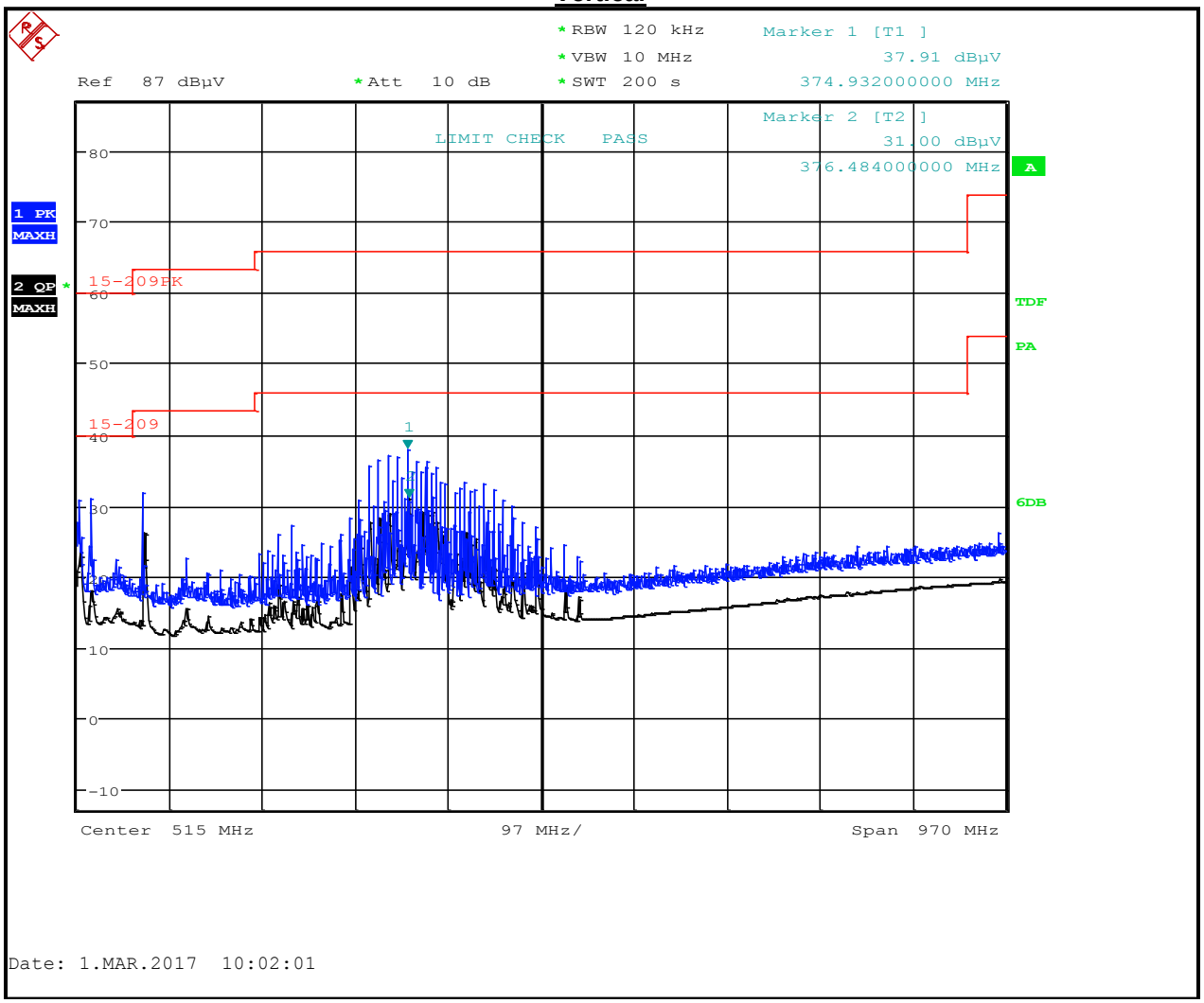


Table 5-67: Radiated Emissions (30 – 1000 MHz) (TC #2)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
374.932	37.9	74.0	-36.1				Peak
376.484	31.0	54.0	-23.0				Quasi-Peak
376.484	31.0			-64.2	-41.3	-22.9	Quasi-Peak

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

Horizontal

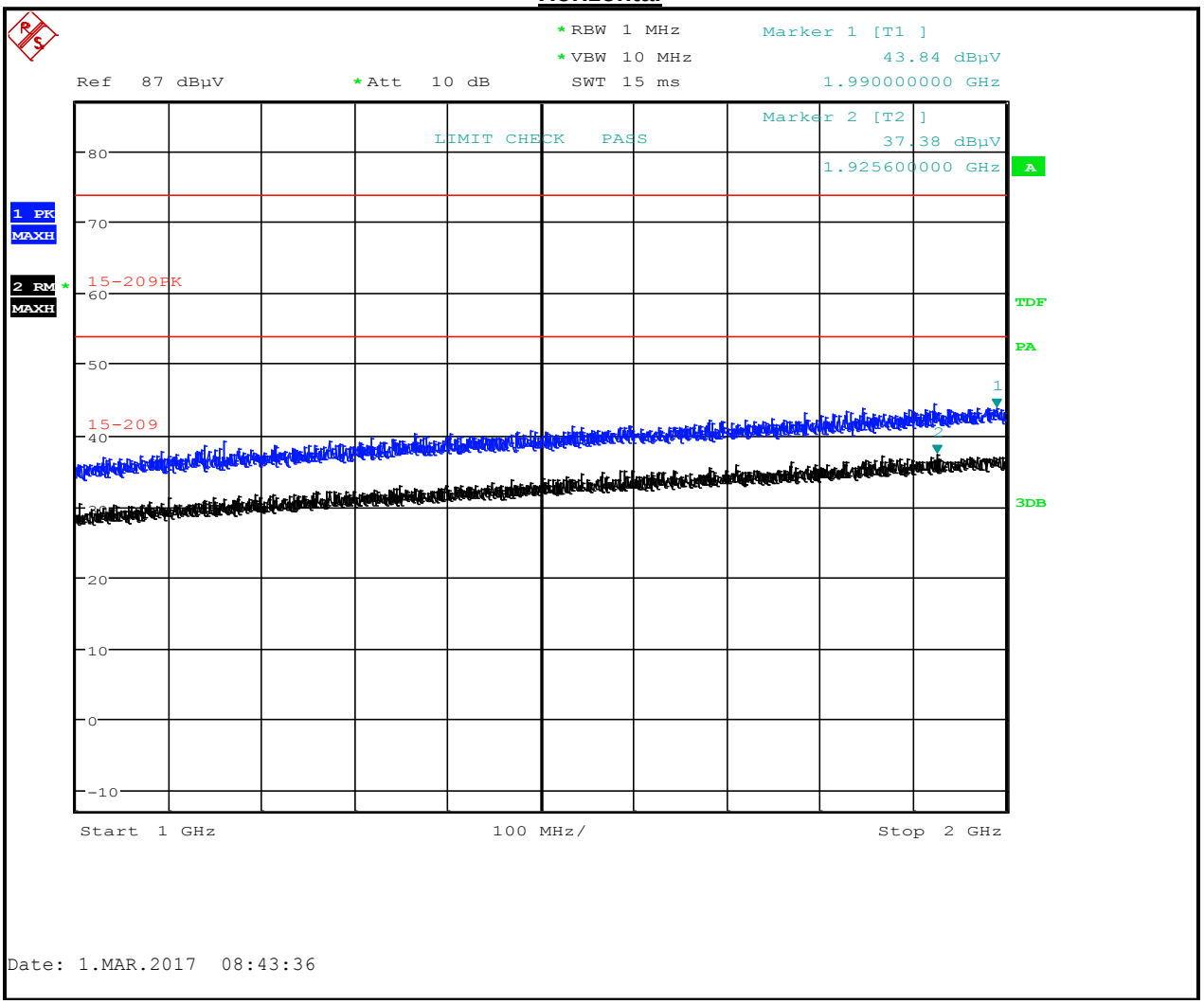


Table 5-68: Radiated Emissions (1 – 2 GHz) (TC #2)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
1990.000	43.8	74.0	-30.2				Peak
1925.600	37.4	54.0	-16.6				Average
1925.600	37.4			-57.8	-41.3	-16.5	Average

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

Vertical

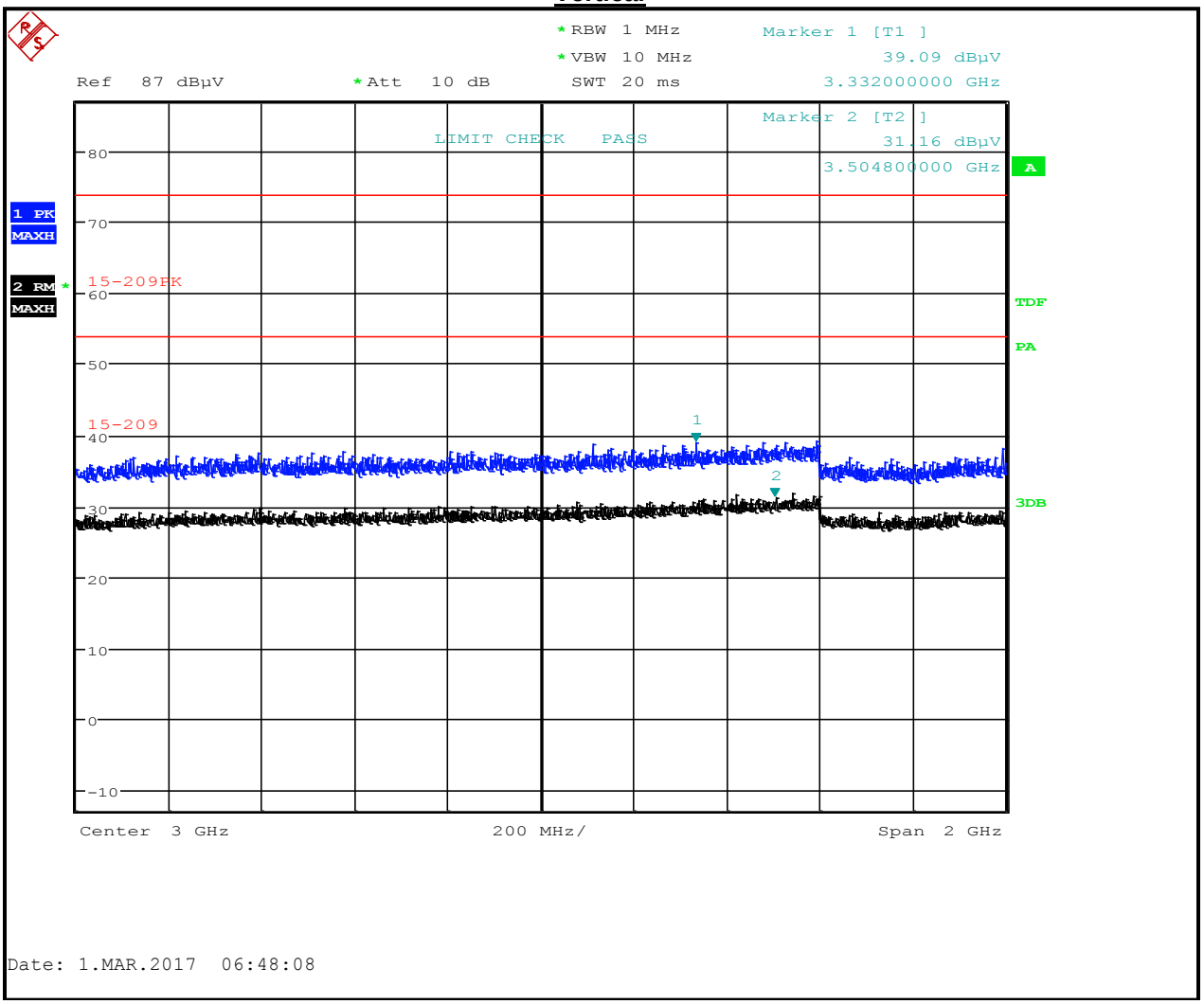


Table 5-69: Radiated Emissions (2 – 4 GHz) (TC #2)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
3332.000	39.9	74.0	-34.1				Peak
3504.800	31.2	54.0	-22.8				Average
3504.800	31.2			-64.0	-41.3	-22.7	Average

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

Vertical

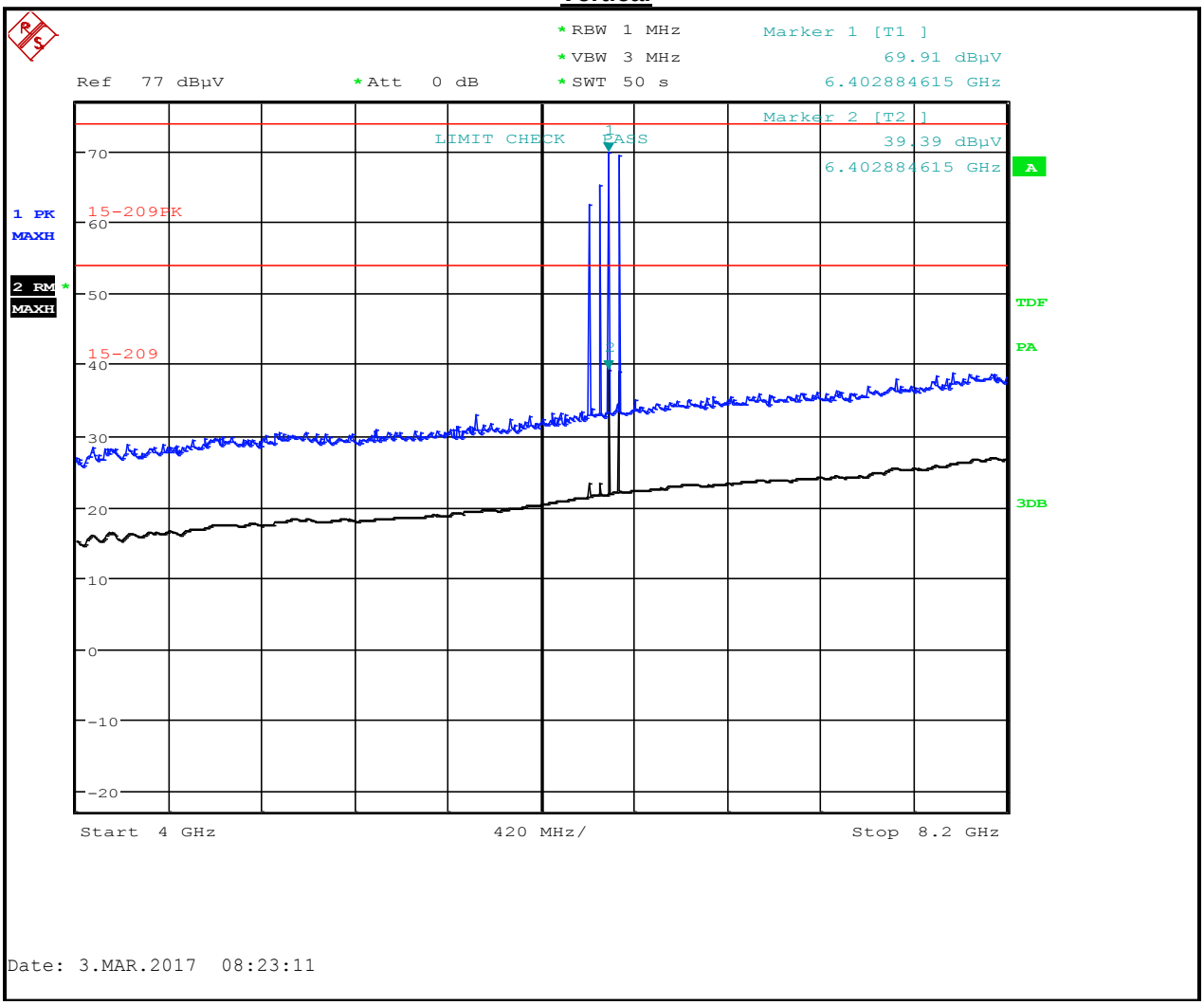


Table 5-70: Radiated Emissions (4 – 8.2 GHz) (TC #2)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
6402.885	69.9	74.0	-4.1				Peak
6402.885	39.4	54.0	-14.6				Average
6402.885	39.4			-55.8	-41.3	-14.5	Average

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

Vertical

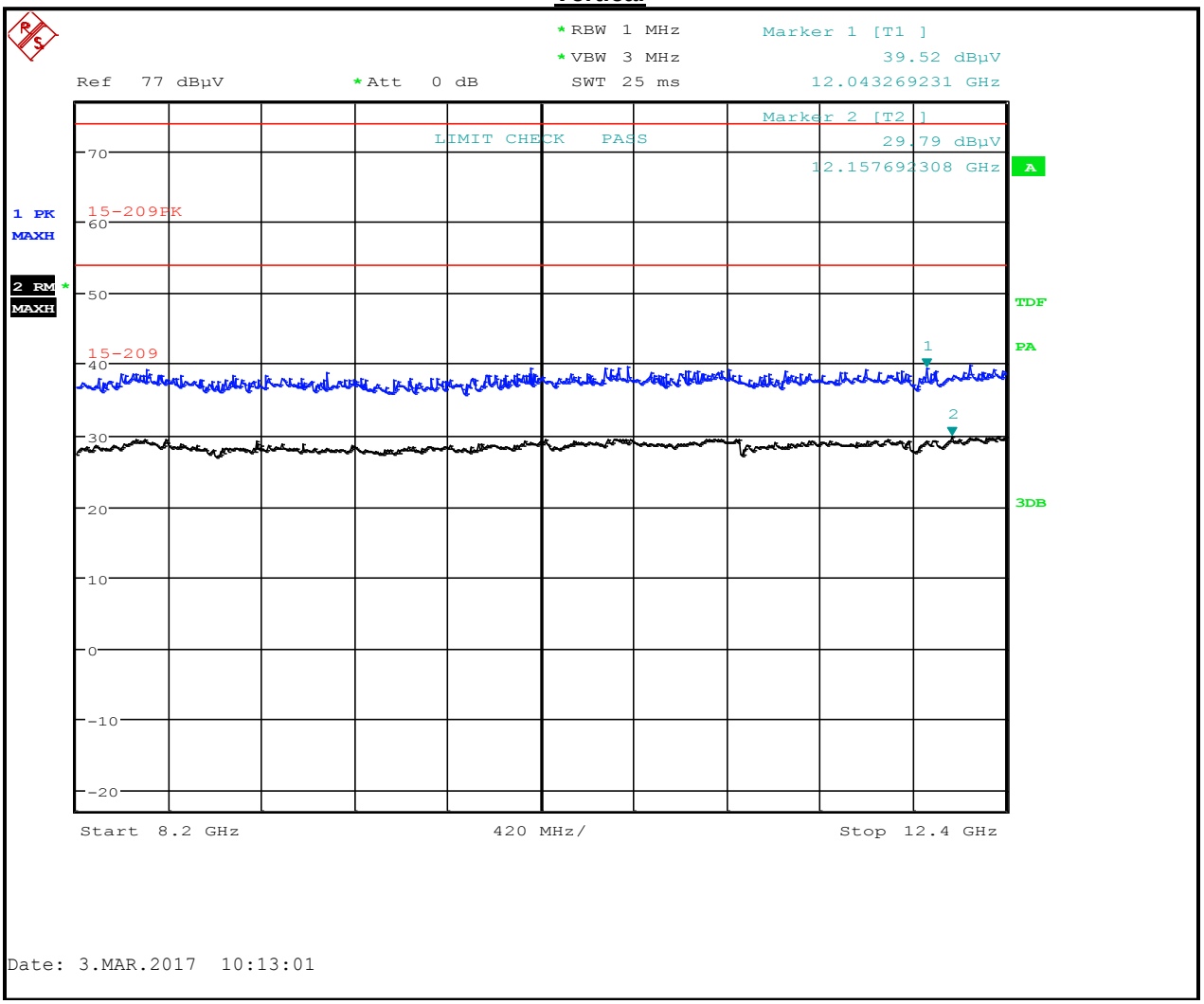


Table 5-71: Radiated Emissions (8.2 – 12.4 GHz) (TC #2)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
12043.269	39.5	74.0	-34.5				Peak
12157.692	29.8	54.0	-24.2				Average
12157.692	29.8			-65.4	-41.3	-24.1	Average

Plot 5-62: Radiated Emissions (12.4 – 18 GHz) (TC #2)

Vertical

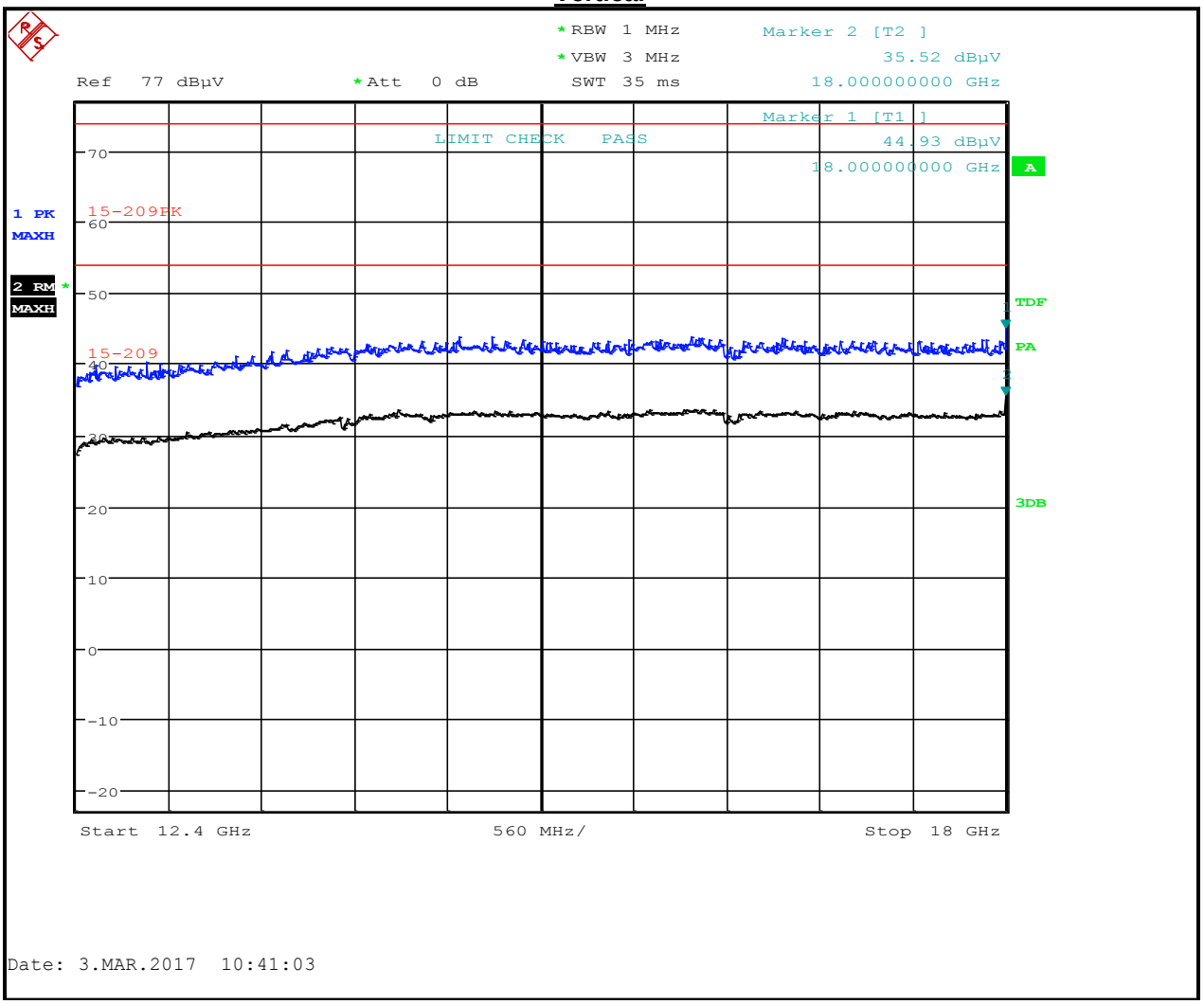


Table 5-72: Radiated Emissions (12.4 – 18 GHz) (TC #2)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
18000.000	44.9	74.0	-29.1				Peak
18000.000	35.5	54.0	-18.5				Average
18000.000	35.5			-59.7	-41.3	-18.4	Average

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

Horizontal

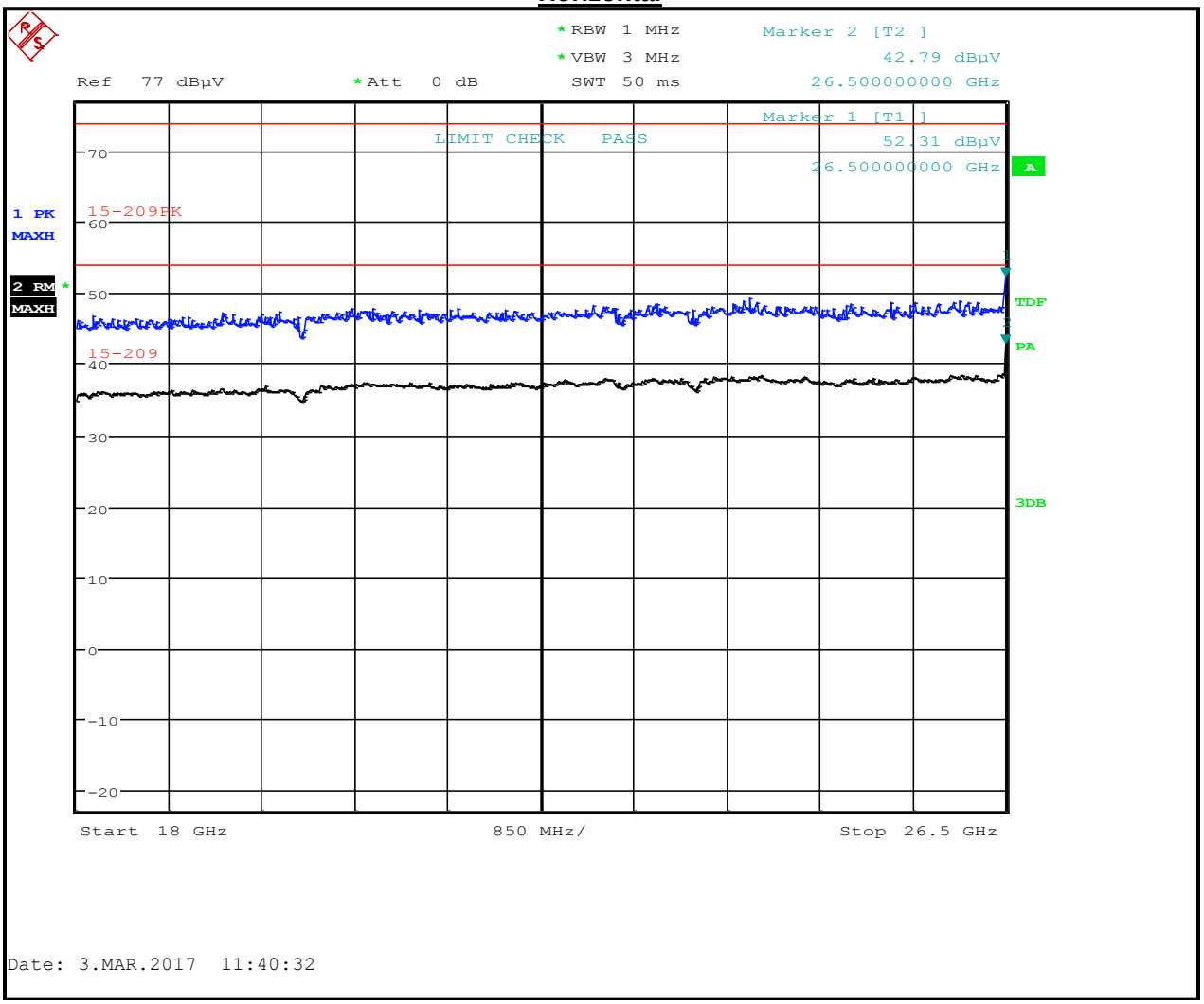


Table 5-73: Radiated Emissions (18 – 26.5 GHz) (TC #2)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
26500.000	52.3	74.0	-21.7				Peak
26500.000	42.8	54.0	-11.2				Average
26500.000	42.8			-52.4	-41.3	-11.1	Average

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

Vertical

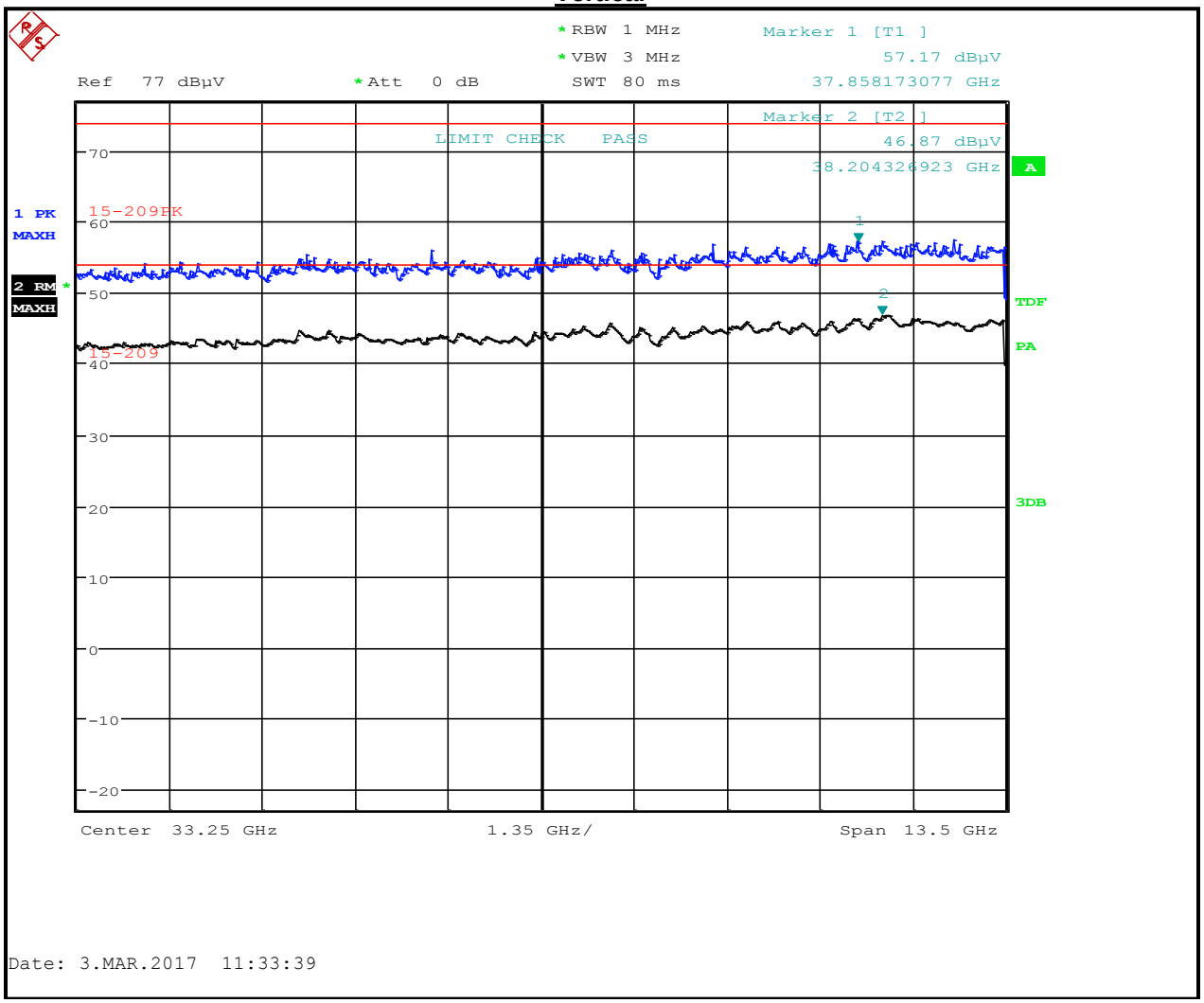


Table 5-74: Radiated Emissions (26.5 – 40 GHz) (TC #2)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
37858.173	57.2	74.0	-16.8				Peak
38204.326	46.9	54.0	-7.1				Average
38204.326	46.9			-48.3	-41.3	-7.0	Average

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

Vertical

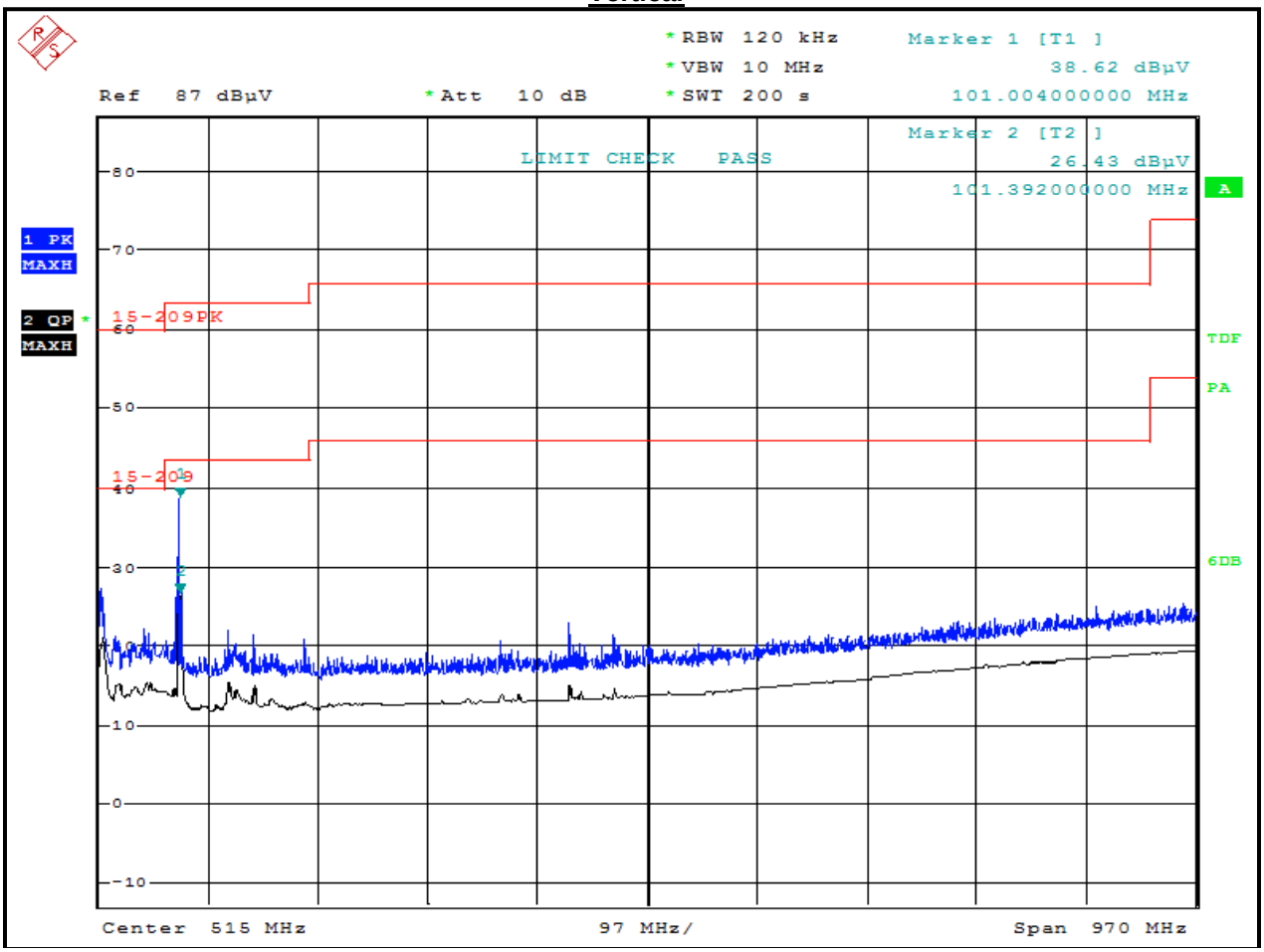


Table 5-75: Radiated Emissions (30 – 1000 MHz) (TC #3)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
101.004	38.6	74.0	-35.4				Peak
101.392	26.4	54.0	-27.6				Quasi-Peak
101.392	26.4			-68.8	-41.3	-27.5	Quasi-Peak

Plot 5-66: Radiated Emissions (1 – 2 GHz) (TC #3)

Horizontal

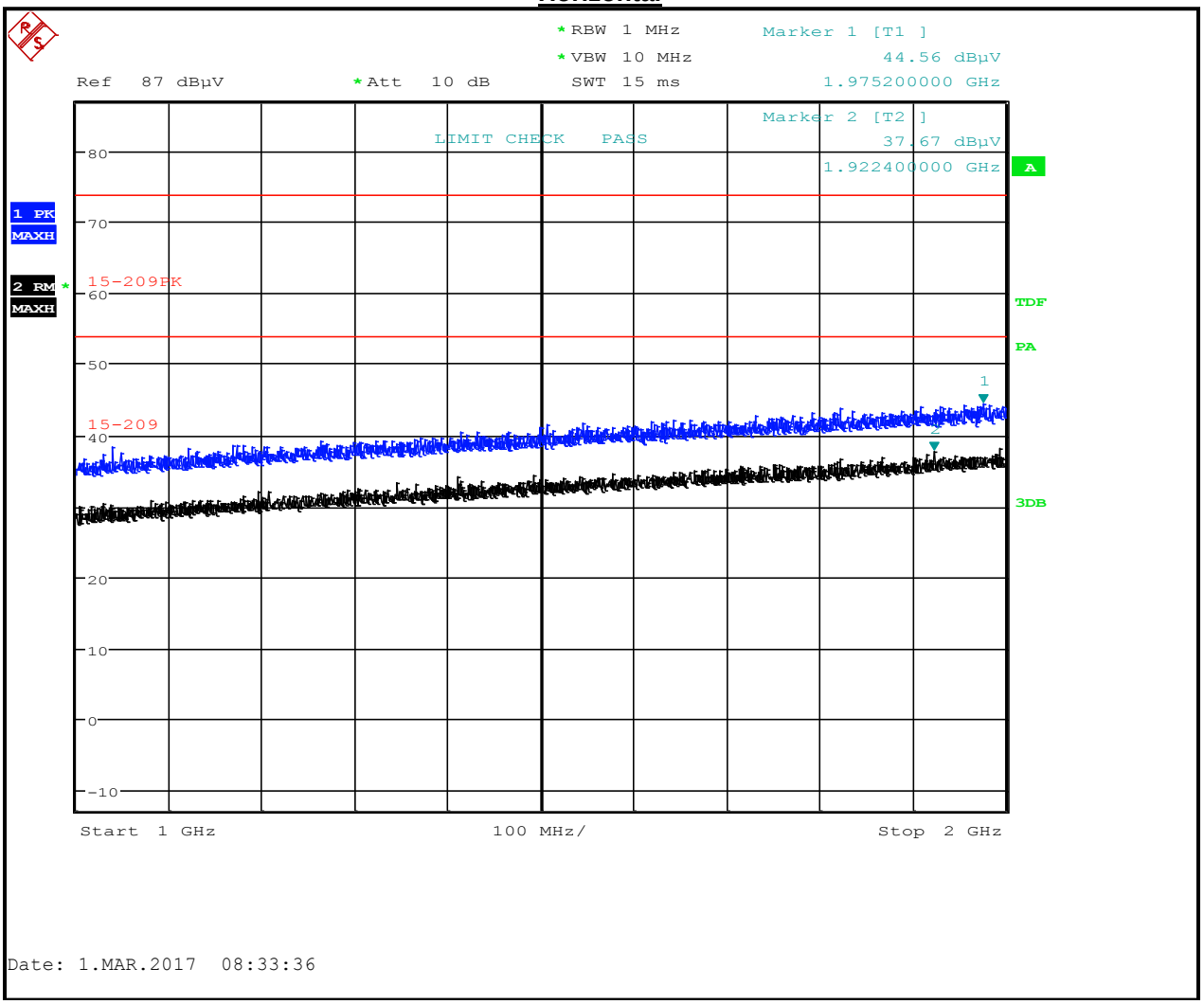


Table 5-76: Radiated Emissions (1 – 2 GHz) (TC #3)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
1975.200	44.6	74.0	-29.4				Peak
1922.400	37.7	54.0	-16.3				Average
1922.400	37.7			-57.5	-41.3	-16.2	Average

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

Horizontal

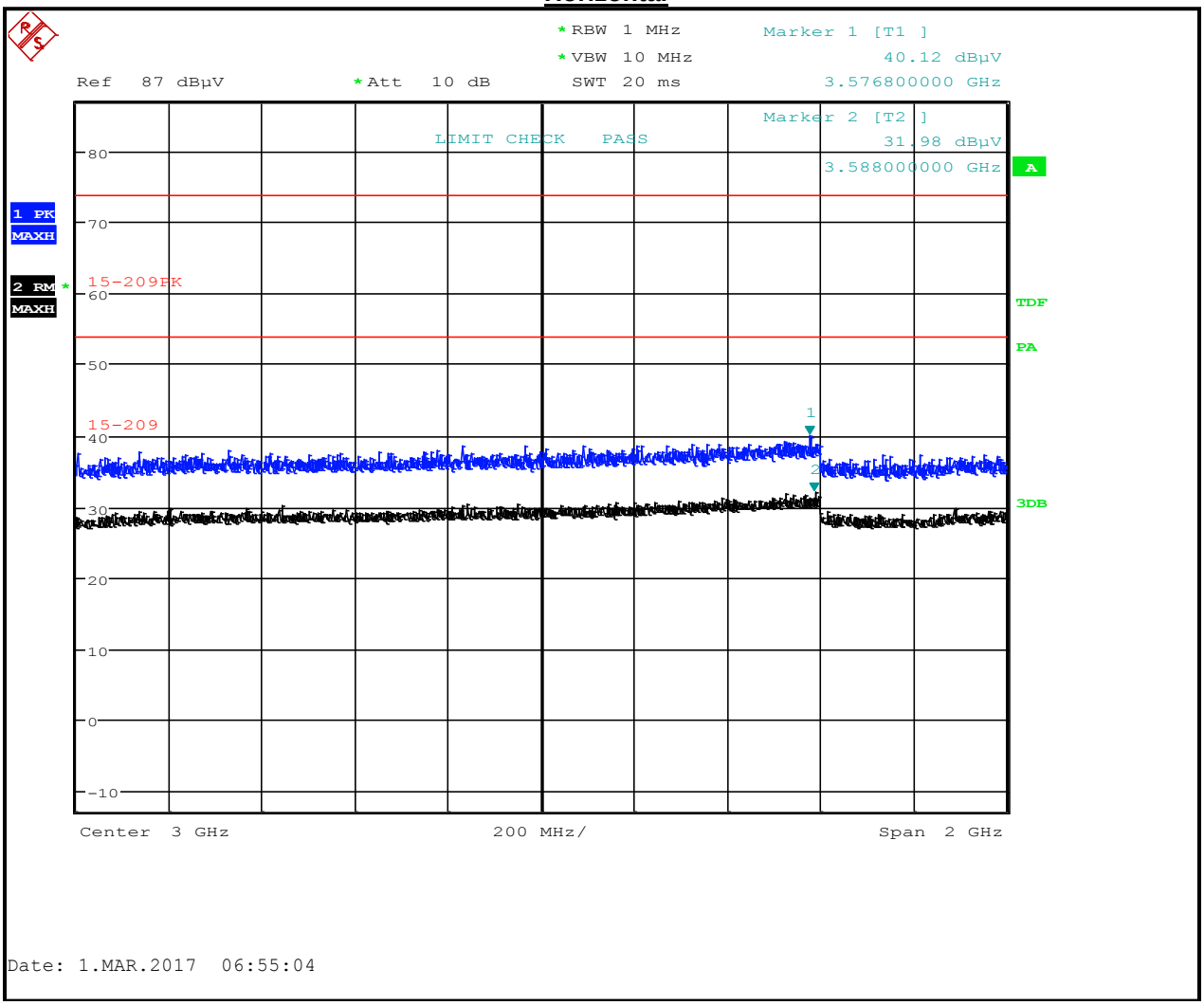


Table 5-77: Radiated Emissions (2 – 4 GHz) (TC #3)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
3576.800	40.1	74.0	-33.9				Peak
3558.000	32.0	54.0	-22.0				Average
3558.000	32.0			-63.2	-41.3	-21.9	Average

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

Vertical

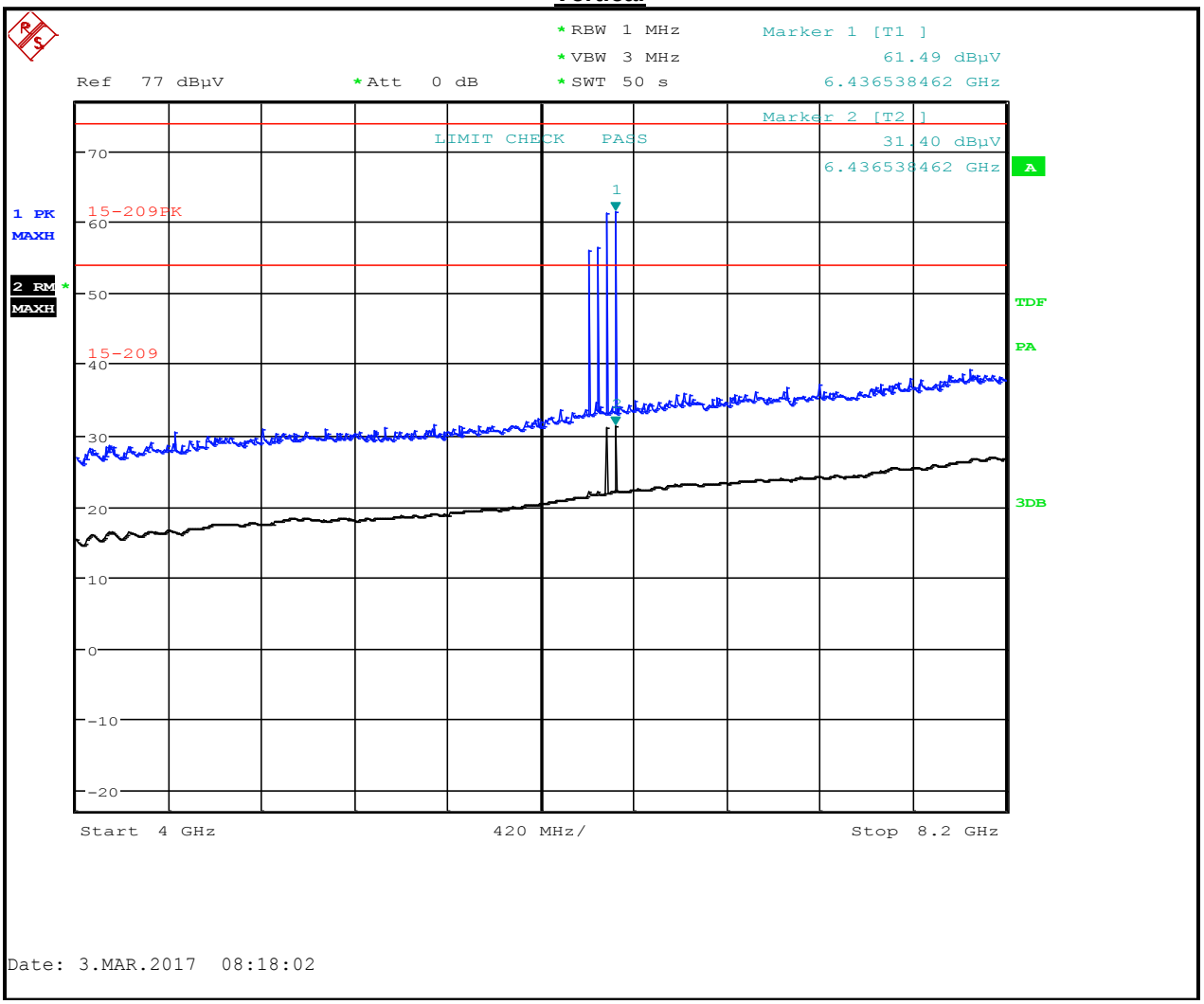


Table 5-78: Radiated Emissions (4 – 8.2 GHz) (TC #3)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
6436.539	61.5	74.0	-12.5				Peak
6436.535	31.4	54.0	-22.6				Average
6436.535	31.4			-63.8	-41.3	-22.5	Average

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

Horizontal

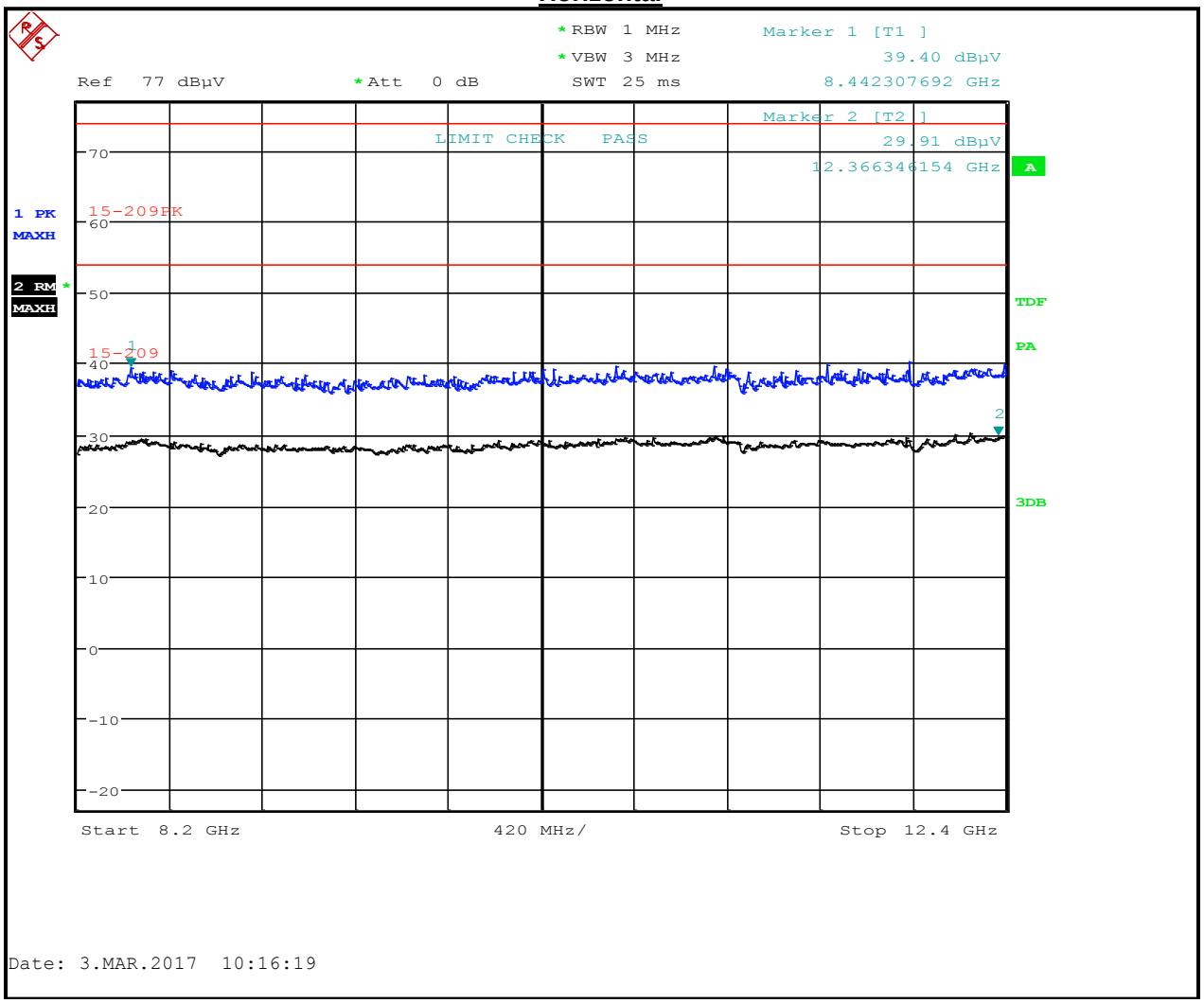


Table 5-79: Radiated Emissions (8.2 – 12.4 GHz) (TC #3)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
8442.307	39.4	74.0	-34.6				Peak
12366.346	29.9	54.0	-24.1				Average
12366.346	29.9			-65.3	-41.3	-24.0	Average

Plot 5-70: Radiated Emissions (12.4 – 18 GHz) (TC #3)

Vertical

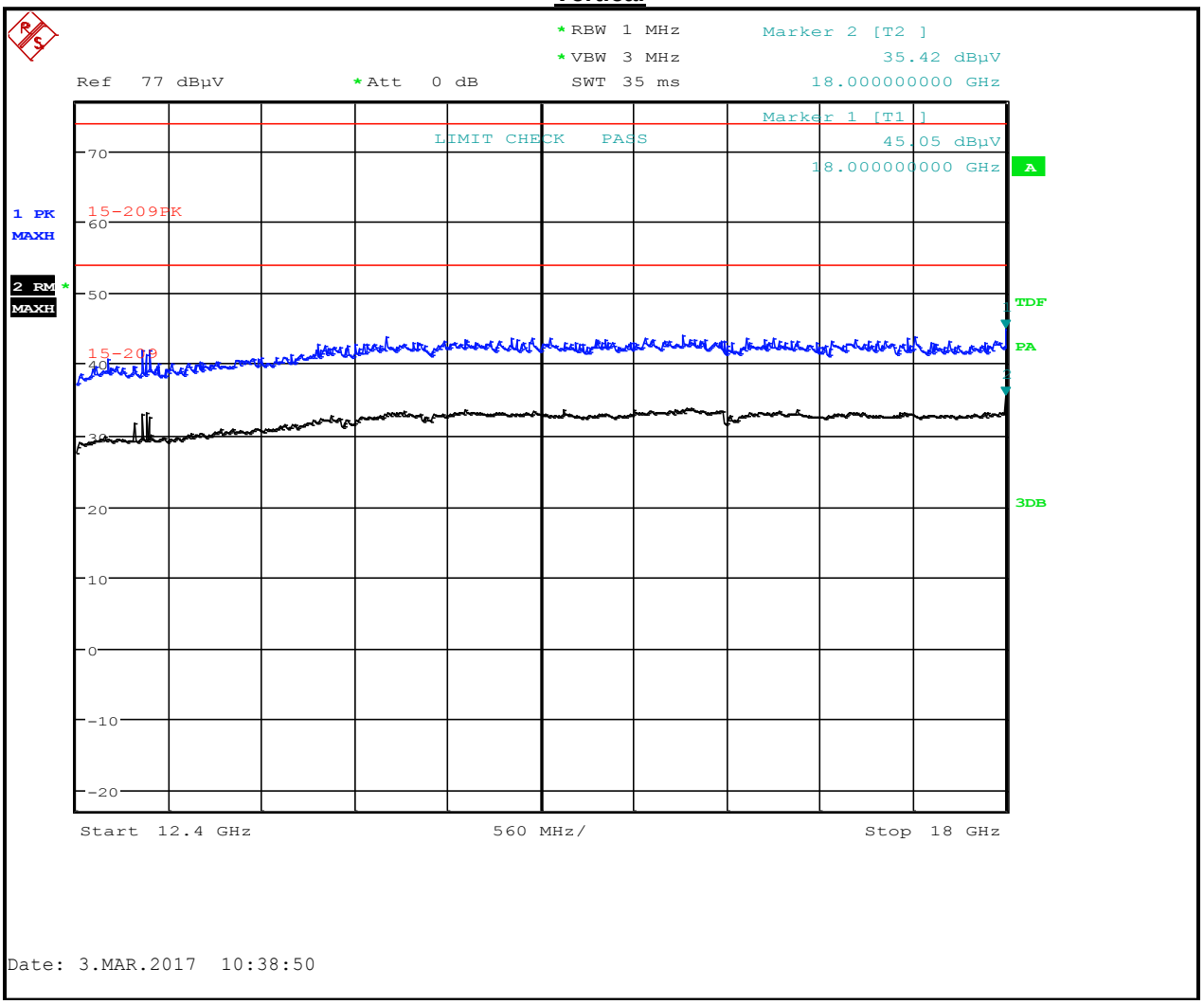


Table 5-80: Radiated Emissions (12.4 – 18 GHz) (TC #3)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
18000.000	45.1	74.0	-28.9				Peak
18000.000	35.4	54.0	-18.6				Average
18000.000	35.4			-59.8	-41.3	-18.5	Average

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

Vertical

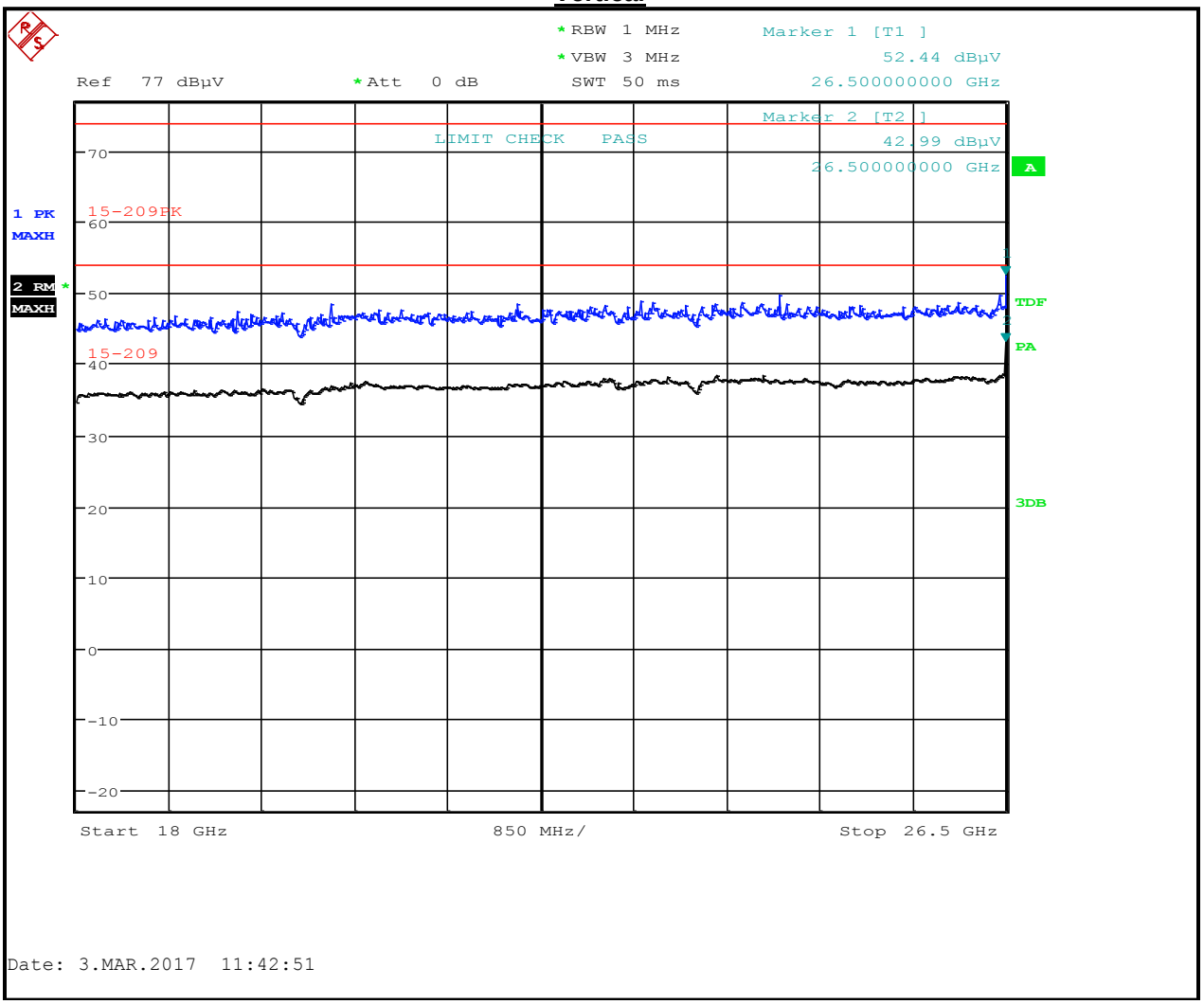


Table 5-81: Radiated Emissions (18 – 26.5 GHz) (TC #3)

Frequency (MHz)	Corrected Field strength Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
26500.000	52.4	74.0	-21.6				Peak
26500.000	43.0	54.0	-11.0				Average
26500.000	43.0			-52.2	-41.3	-10.9	Average

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

Vertical

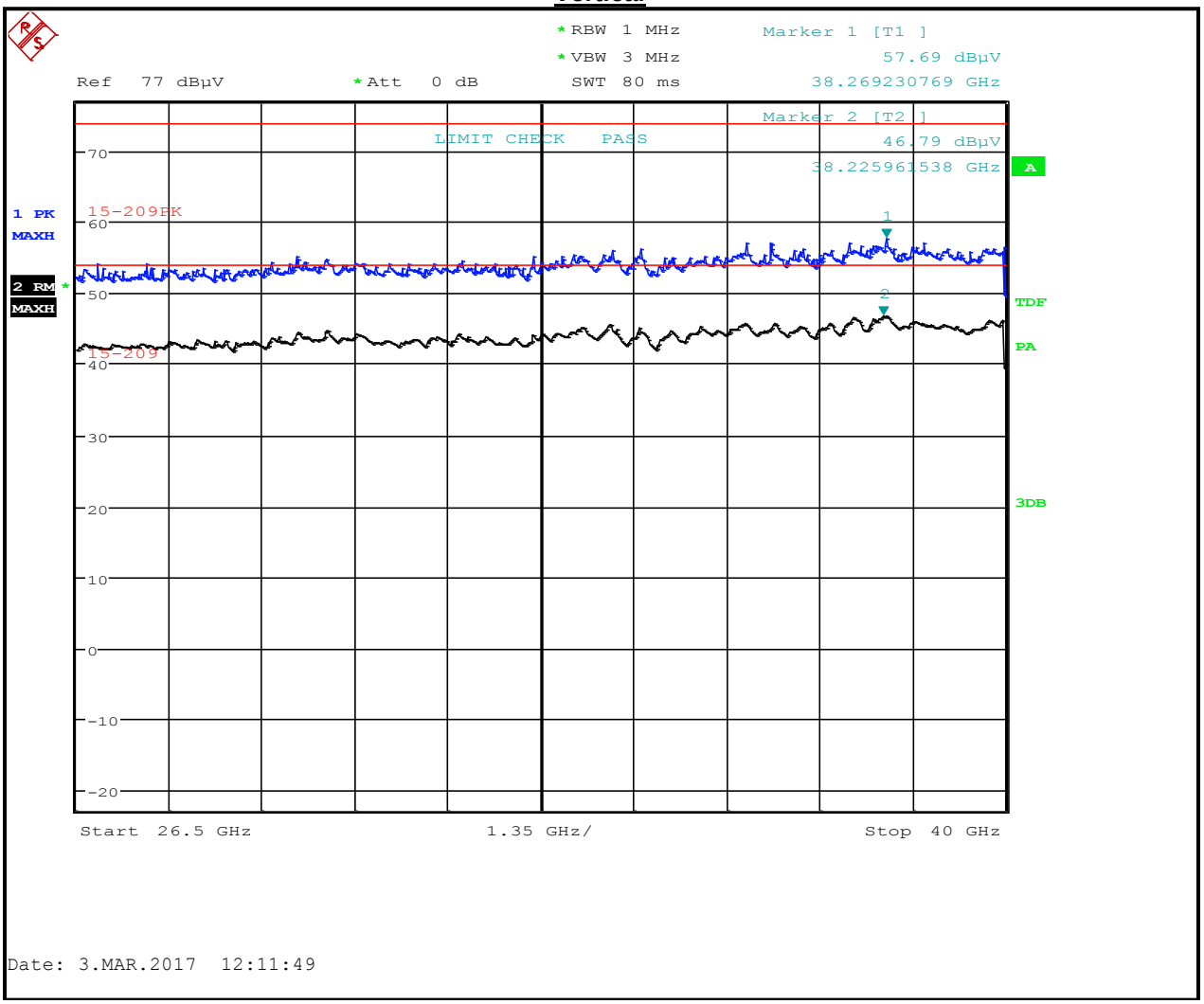


Table 5-82: Radiated Emissions (26.5 – 40 GHz) (TC #3)

Frequency (MHz)	Corrected EIRP Measured (dBuV)	Limit (dBuV/m)	Margin (dB)	Corrected EIRP Measured (dBm)	Limit (dBm/MHz)	Margin (dB)	Peak/ Average
38269.231	57.7	74.0	-16.3				Peak
38225.961	46.8	54.0	-7.2				Average
38225.961	46.8			-48.4	-41.3	-7.1	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		March 1-3, 2017
Test Engineer	Signature	Dates of Test

Results: Passing

The worst-case radiated emissions occur with the EUT in configurations TC #1, TC #2 and TC #3 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 69, FCC ID: O6QPS60XW1, IC: 3892A-PS60XW1, complies with all the requirements of Parts 2 and 15 of the FCC Rules and Regulations, and Industry Canada RSS-211 and RSS-Gen.

Appendix A: Test Configuration Test Photographs

Photograph 5: AC Conducted Emissions – Front View - TC #1

Photograph 6: AC Conducted Emissions - Rear View – TC #1

Photograph 7: AC Conducted Emissions – Front View - TC #2

Photograph 8: AC Conducted Emissions - Rear View – TC #2

Photograph 9: AC Conducted Emissions – Front View - TC #3

Photograph 10: AC Conducted Emissions - Rear View – TC #3

Photograph 11: Radiated Emissions – TC #1; Concrete Container

Photograph 12: Radiated Emissions – TC #1; Steel Container

Photograph 13: Radiated Emissions – TC #1; Fiberglass Container

Photograph 14: Radiated Emissions – TC #2; Concrete Container

Photograph 15: Radiated Emissions – TC #2; Steel Container

Photograph 16: Radiated Emissions – TC #2; Fiberglass Container

Photograph 17: Radiated Emissions – TC #3; Concrete Container

Photograph 18: Radiated Emissions – TC #3; Steel Container

Photograph 19: Radiated Emissions – TC #3; Fiberglass Container