RHEIN TECH LABORATORIES, INC.

Engineering Solutions & Electromagnetic Compatibility Services

VEGA Grieshaber KG
Am Hohenstein 113
77761 Schiltach
Germany

MODEL: VEGAPULS64
FCC ID: O6QPS60XW2
IC: 3892A-PS60XW2

March 22, 2016

Standards Referenced for this Report	
Part 2: 2015	Frequency Allocations and Radio Treaty Matters; General Rules and Regulations
Part 15: 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

Frequency Range	Output Power (W) (Peak EIRP)	Frequency Tolerance (ppm)	Emission Designator
76.0 – 80.0 GHz	1.595	N/A	N/A

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 22, 2016

Typed/Printed Name: Desmond Fraser Position: President

Signature: _____ Date: March 22, 2016

Typed/Printed Name: Jon Wilson Position: Test Engineer

Signature: _____ Date: March 22, 2016

Typed/Printed Name: Dan Baltzell Position: Test Engineer

Document Number: 2016058

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

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1 General Information

1.1 Scope

The following Type Certification 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 in metal, fiberglass, and concrete containers, with three different antennas, each having the highest gain within its antenna type,

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 C63.10-2013 American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices. The instrumentation utilized for the measurements conforms to the ANSI C63.10 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 is an original FCC §15.209/IC RSS-211 application report to support a composite application.

Vega Grieshaber KG submitted justification to IC, and received their approval, for tilted installation for in-tank measurements, provided the assessment includes compliant in-tank measurements with tilted installation and follows the test guidance in ETSI EN 302 372. A copy of the approved justification, and IC's response, was submitted with this application.

1.4 Modifications

None.

2 Tested System Details

The test sample was received on December 28, 2015. Listed below are the identifiers and descriptions of all equipment, cables, and internal devices used with the EUT for this testing, as applicable.

Table 2-1: Equipment under Test (EUT)

Part	Manufacturer	Model	Serial Number	FCC ID	Cable Type	RTL Bar Code
3/4" (19mm) Encapsulated Metal Horn Antenna (18.5 dBi)	VEGA Grieshaber KG	N/A	N/A	N/A	N/A	N/A
1-1/2" (36mm) Encapsulated Metal Horn Antenna (24.3 dBi)	VEGA Grieshaber KG	N/A	N/A	N/A	N/A	21967
75mm Encapsulated Plastic Horn Antenna (33.2 dBi)	VEGA Grieshaber KG	N/A	N/A	N/A	N/A	21968
2" Encapsulated Horn Antenna (29.7 dBi)	VEGA Grieshaber KG	N/A	N/A	N/A	N/A	N/A
3" Encapsulated Horn Antenna (33.7 dBi)	VEGA Grieshaber KG	N/A	N/A	N/A	N/A	21969
VEGAPULS 64	VEGA Grieshaber KG	PS64. AXTTCAHXAMAXX	N/A	O6QPS60XW2	N/A	21970
VEGAPULS 64	VEGA Grieshaber KG	PS64.AXBXXCHXK MAXX	N/A	O6QPS60XW2	N/A	21971
VEGAPULS 64	VEGA Grieshaber KG	PS64.AXXXHIHXA MAXX	N/A	O6QPS60XW2	N/A	21972
Electronics	VEGA Grieshaber KG	PS64HW	N/A	N/A	N/A	21973
Electronics	VEGA Grieshaber KG	PS64HW	N/A	N/A	N/A	21974
Electronics	VEGA Grieshaber KG	PS64HW	N/A	N/A	N/A	21975

2.1 Test Configurations

The EUT was tested with the highest gain antenna in each antenna family. As a result, three EUT/antenna configurations with corresponding test data are included in this report, though all five antennas intended for operation with this EUT are listed in the EUT Table 2-1. The test configuration numbers (TC #1-3) are provided with the test data.

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

Part	Model	Manufacturer	Cable Type	RTL Bar Code
VEGAPULS 64	PS64.AXTTCAHXAMAXX	VEGA Grieshaber KG	N/A	21970
Electronics	PS64HW	VEGA Grieshaber KG	N/A	21973
1-1/2" (36mm) Encapsulated Metal Horn Antenna (24.3 dBi)	1.4404GP5	VEGA Grieshaber KG	N/A	21967

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

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

Part	Model	Manufacturer	Cable Type	RTL Bar Code
VEGAPULS 64	PS64.AXBXXCHXKMAXX	VEGA Grieshaber KG	N/A	21971
Electronics	PS64HW	VEGA Grieshaber KG	N/A	21974
75mm Encapsulated Plastic Horn Antenna (33.2 dBi)	N/A	VEGA Grieshaber KG	N/A	21968

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

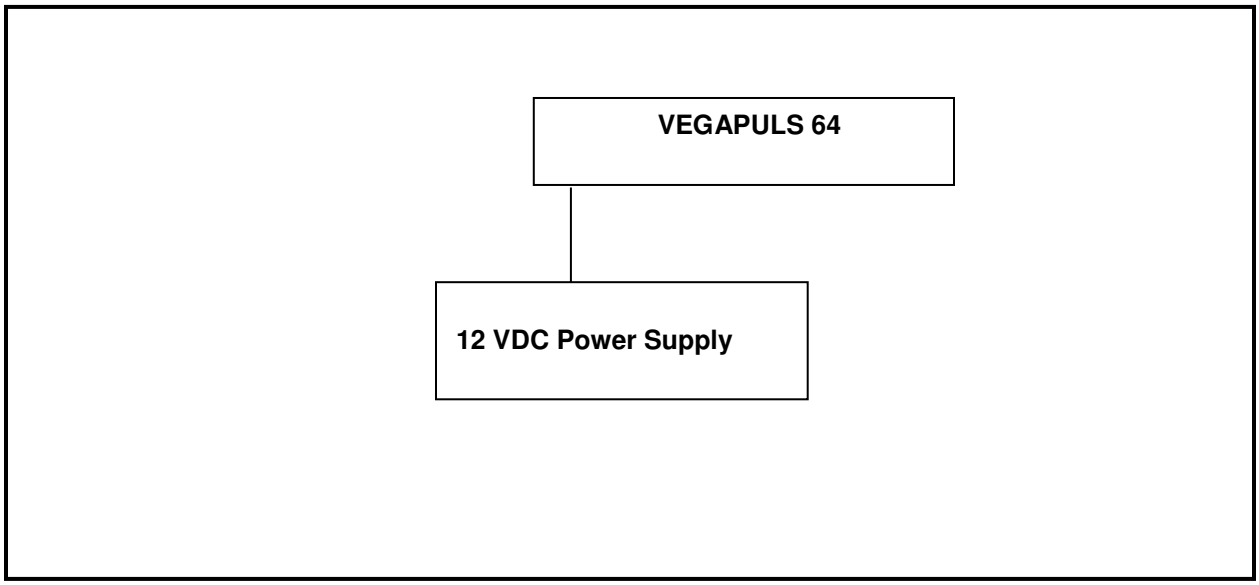
Photograph 3: Test Configuration #2 (TC #2); Swivel Bracket

Table 2-4: Test Configuration #3 (TC #3)

Part	Model	Manufacturer	Cable Type	RTL Bar Code
VEGAPULS 64	PS64.AXFFHIHXAMAXX	VEGA Grieshaber KG	N/A	21972
Electronics	PS64HW	VEGA Grieshaber KG	N/A	21975
3" Encapsulated Horn Antenna (33.7 dBi)	N/A	VEGA Grieshaber KG	N/A	21969

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

Figure 2-1: Configuration of Tested System



3 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.

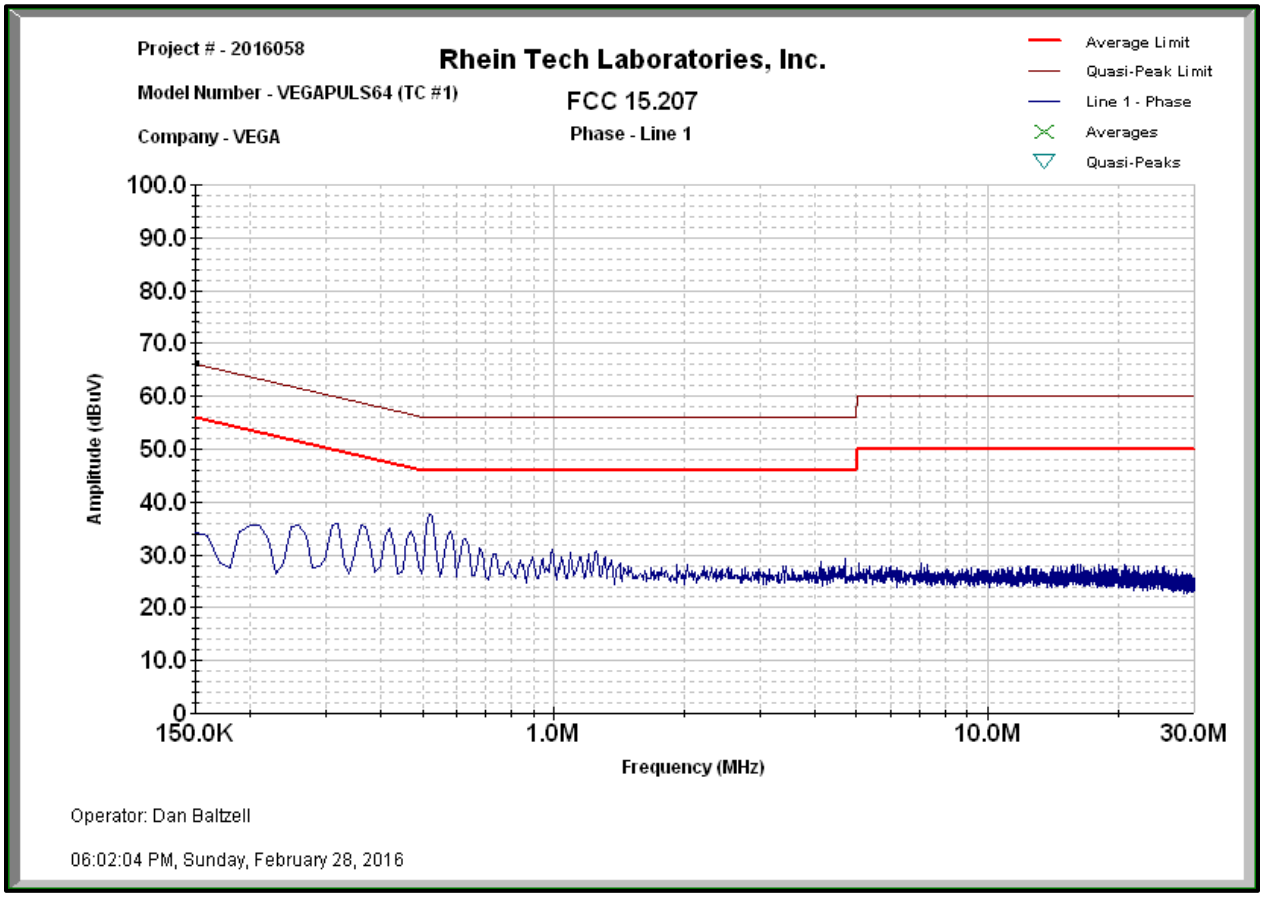
4 Conducted Limits - FCC §15.207, IC RSS-Gen

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.

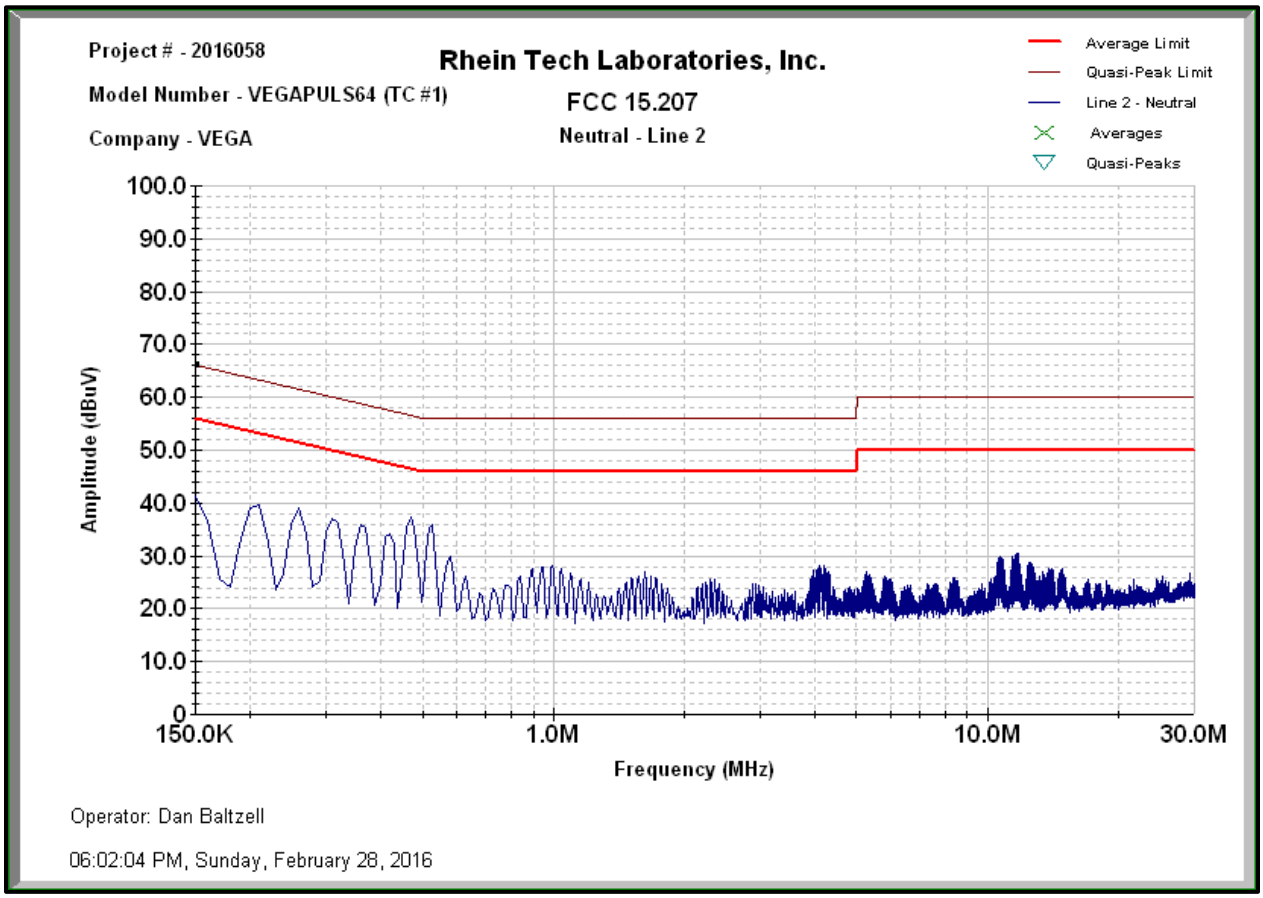
4.1 Conducted Emission Limits Test Data

4.1.1 Test Configuration #1 (TC #1)

Plot 4-1: Conducted Emissions Transmit - Phase (TC #1)

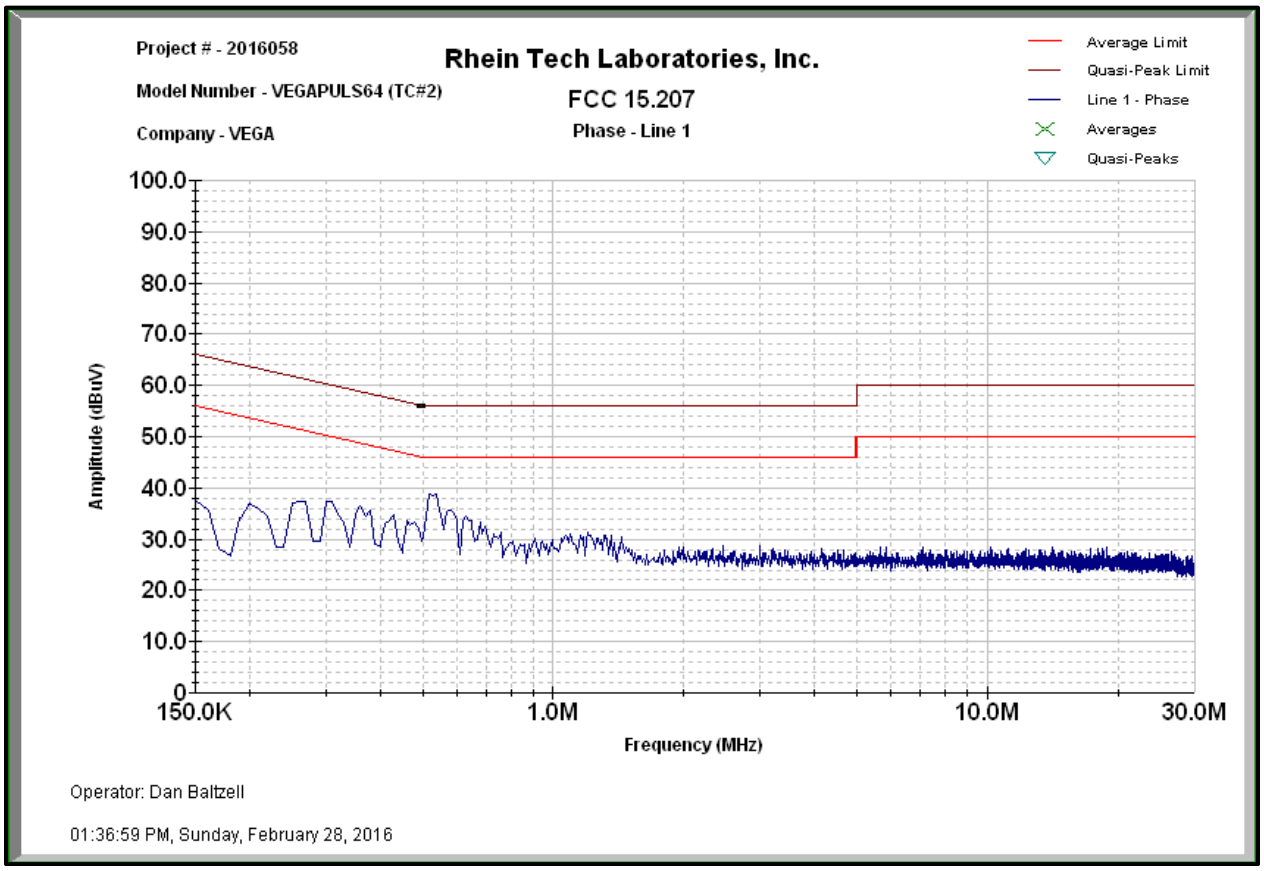


Plot 4-2: Conducted Emissions Transmit – Neutral (TC #1)

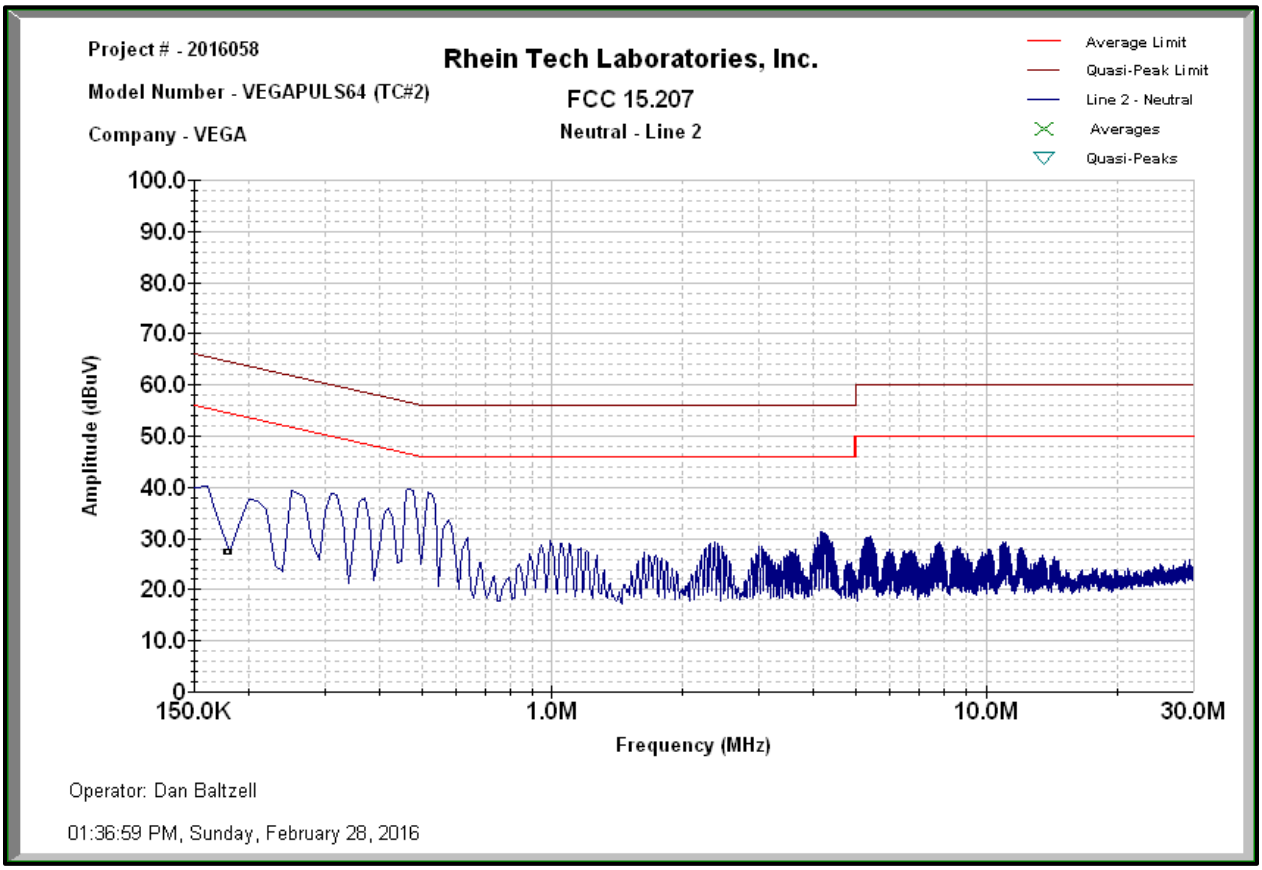


4.1.2 Test Configuration #2 (TC #2)

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

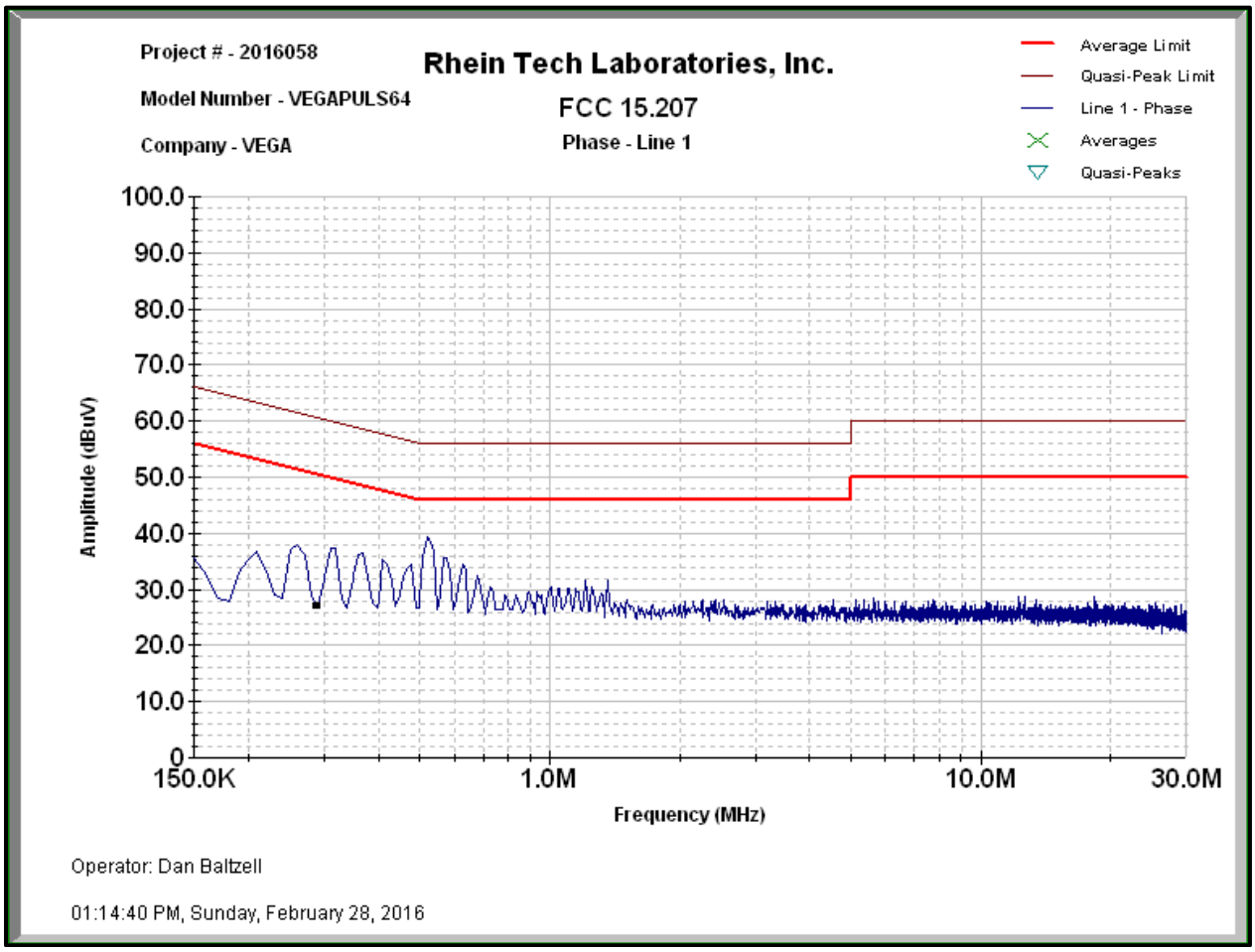


Plot 4-4: Conducted Emissions Transmit – Neutral (TC #2)



4.1.3 Test Configuration #3 (TC #3)

Plot 4-5: Conducted Emissions Transmit - Phase (TC #3)



Plot 4-6: Conducted Emissions Transmit – Neutral (TC #3)

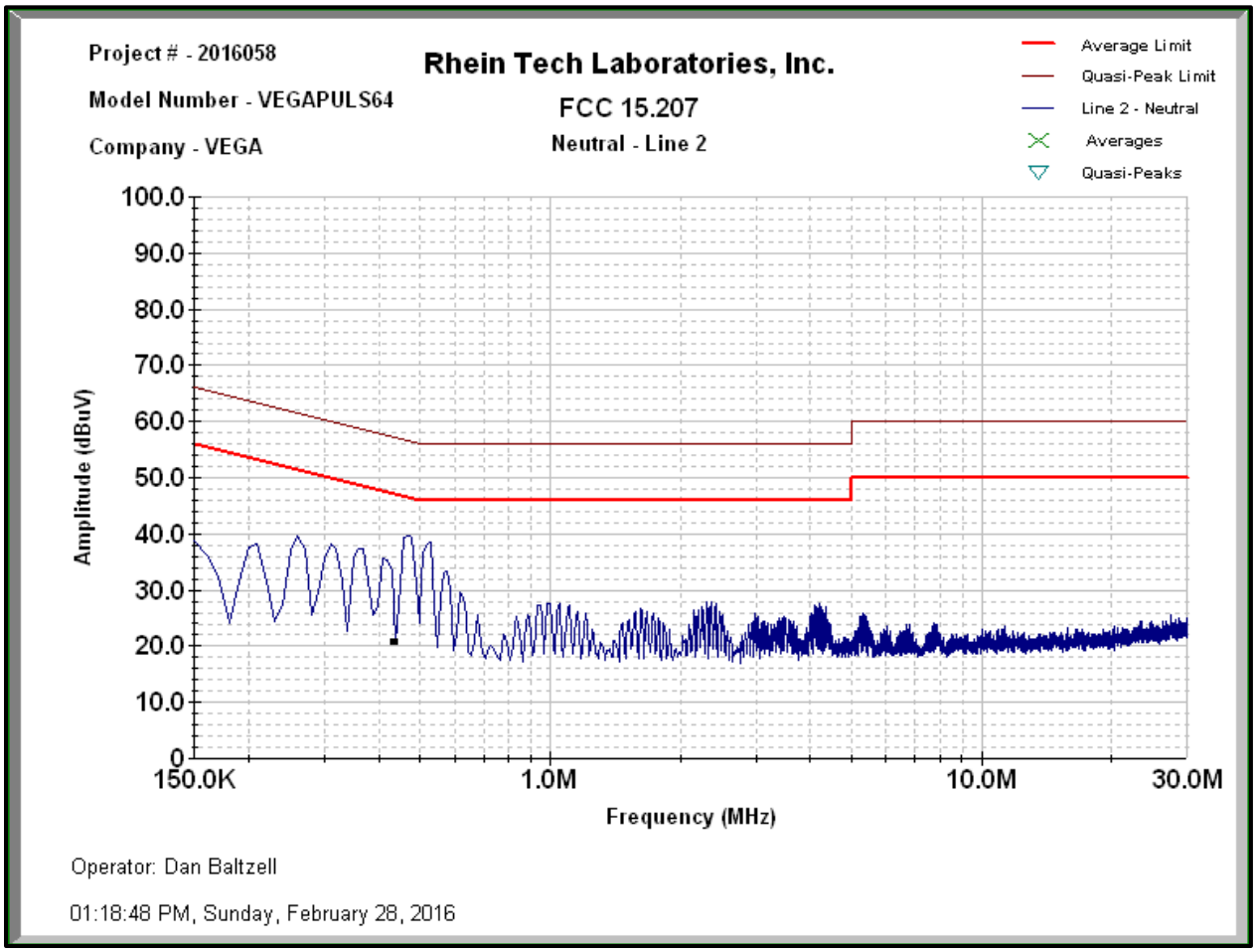


Table 4-1: Conducted Line Emissions Test Equipment

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

Test Personnel:

Daniel W. Baltzell		February 28, 2016
Test Engineer	Signature	Date of Test

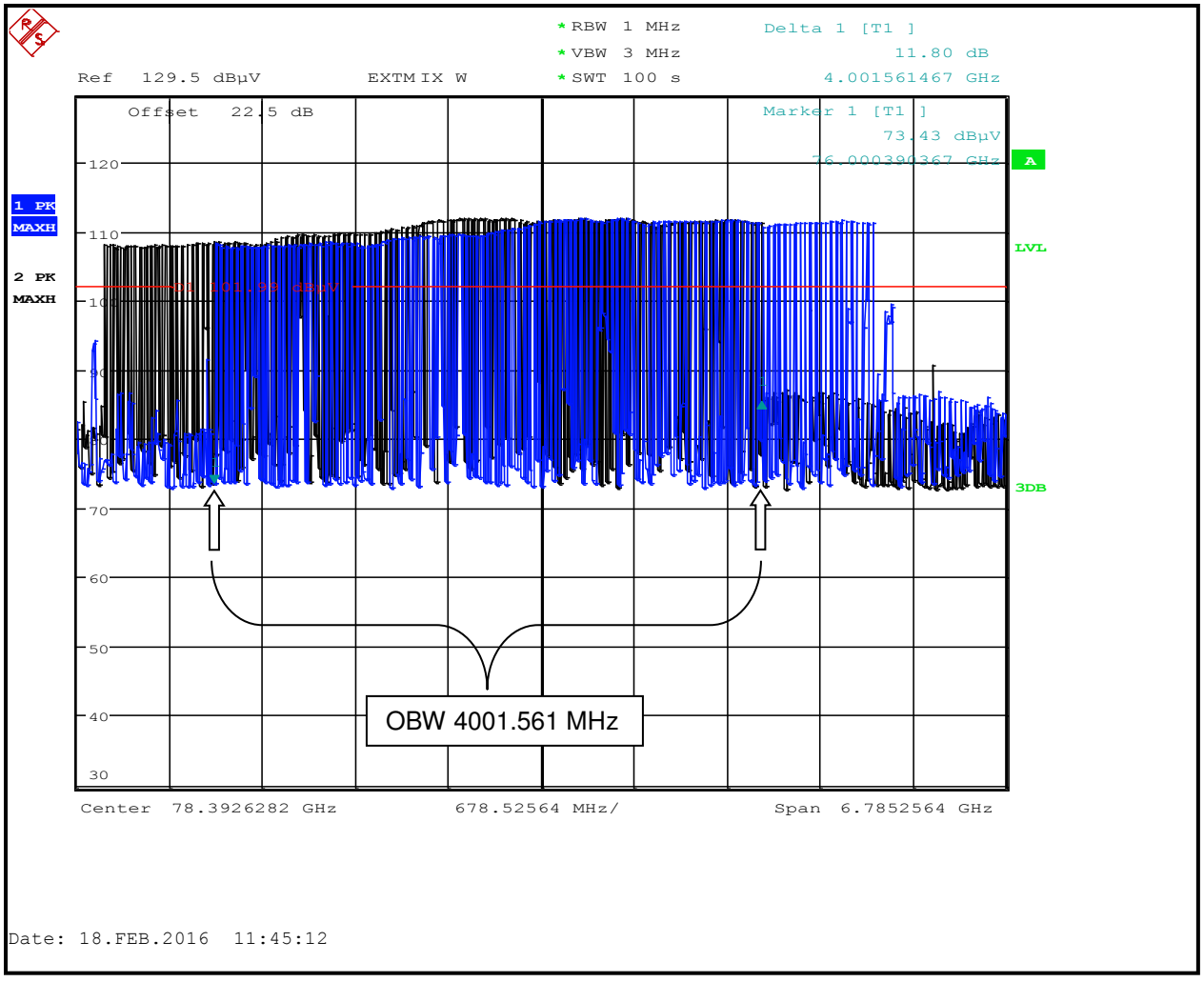
5 Modulated Bandwidth – ANSI C63.10 6.9; IC RSS-211 5.1(a)

5.1 Modulated Bandwidth Test Procedure

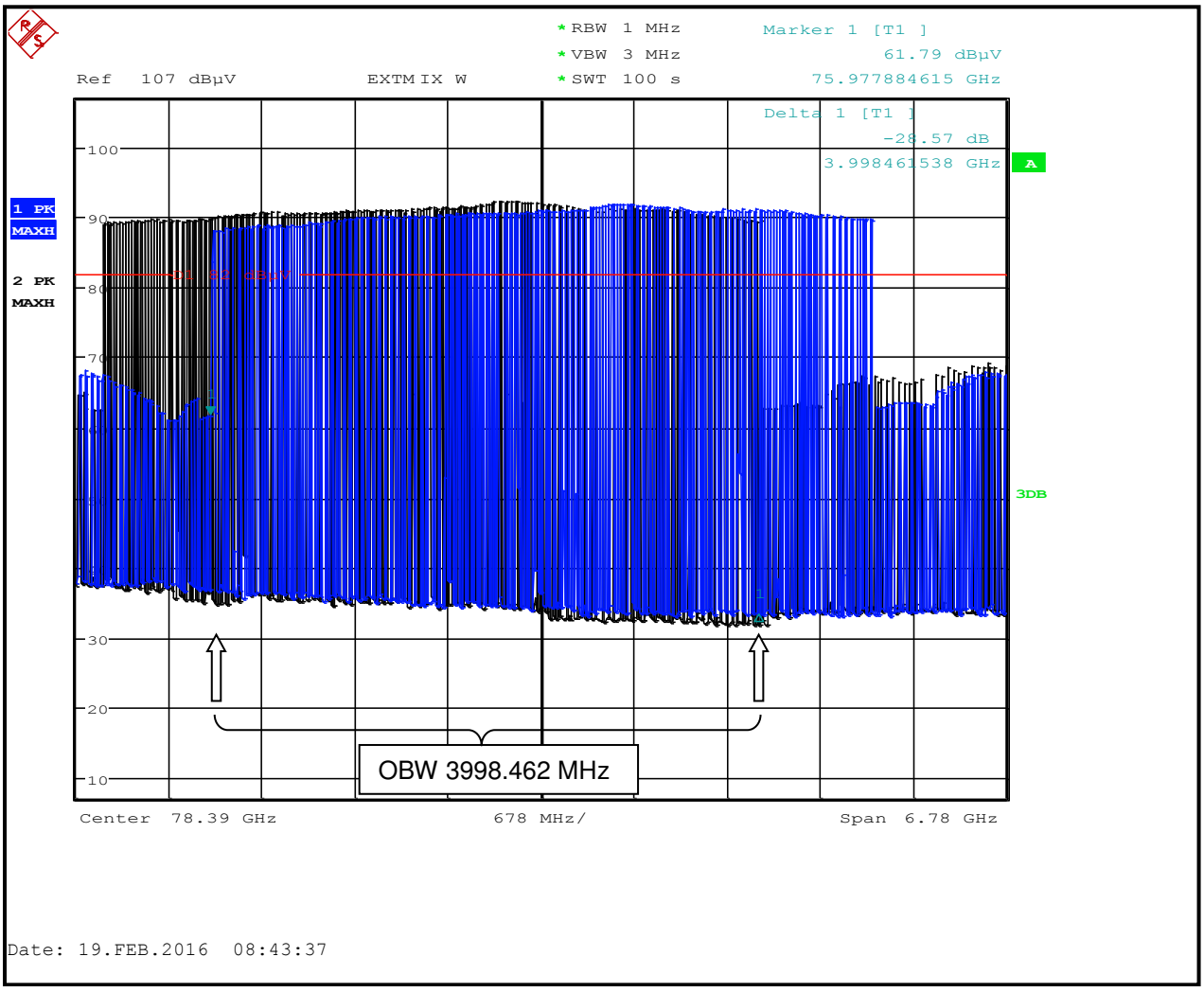
The minimum 26 dB and 99% bandwidths were measured using a 50 ohm spectrum analyzer with the resolution bandwidth set at 1 MHz and the video bandwidth set at 3 MHz. The spectrum analyzer's mixer mode resulted in an overlapping bandwidth image with the actual image and a ghost image. The analyzer "Signal 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 or 99% 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. As such, the 26 dB and 99% bandwidth measurement data are the same.

5.2 Modulated Bandwidth Test Data

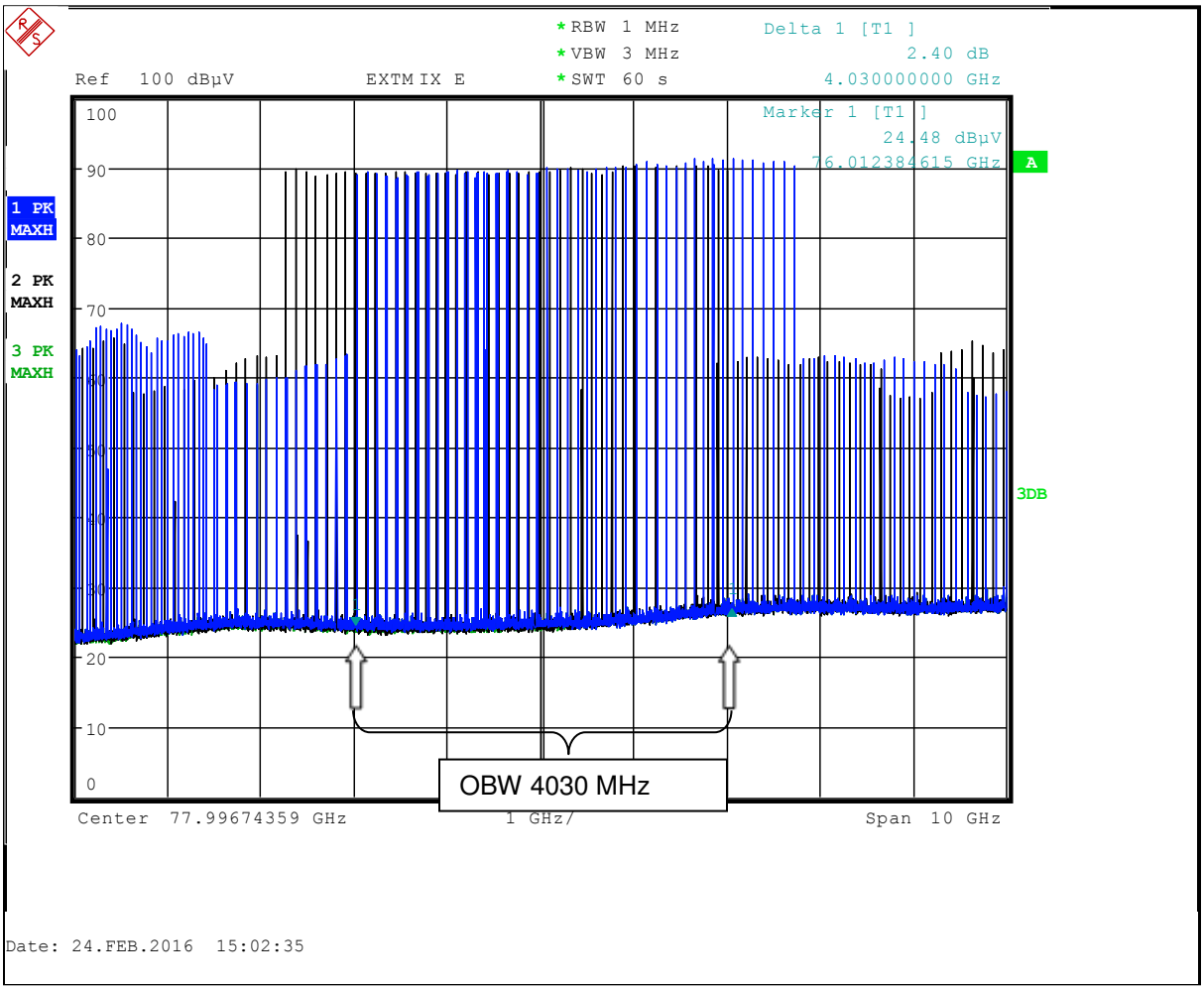
Plot 5-1: Modulated Bandwidth - TC #1



Plot 5-2: Modulated Bandwidth - TC #2



Plot 5-3: Modulated Bandwidth - TC #3



Marker 1: 76012.384615 MHz; Marker Delta 1: 80042.384615 MHz; OBW= 4030 MHz

Table 5-1: Modulated Bandwidth Data

Model	EUT Configuration	26 dB /99% Bandwidth (MHz)
Electronics PS64HW	TC #1	4001.561
	TC #2	3998.462
	TC #3	4030.000

Table 5-2: Modulated Bandwidth Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901581	Rohde & Schwarz	FSU	Spectrum Analyzer	1166.1660.50	11/13/16

Test Personnel:

Daniel W. Baltzell	Daniel W. Baltzell	February 18-19, 24, 2016
Test Engineer	Signature	Dates of Test

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

6.1 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 C63.10 2013. 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 metal 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 1 GHz to 200 GHz. Horizontal and vertical antenna polarization radiated spurious emissions plots are provided from 2 GHz to 26.5 GHz to demonstrate that the EUT has no discernable radiated spurious emissions to measure above 26.5 GHz. A handheld test-antenna measurement method was also used in, around, and close to the EUT, to investigate radiated spurious emissions; no radiated spurious emissions were found, except the carrier at 79 GHz.

The EUT was investigated and tested with test configurations TC #1-3 in enclosed metal, concrete, and fiberglass containers.

6.2 Field Strength Calculation

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

Spectrum Analyzer Level Corrected (dBuV/m) =

Spectrum Analyzer Level (dBuV/m) + AF (dB/m) + CL (dB);

where AF = antenna factor and CL = cable loss

6.3 Radiated Emissions Test Data

6.3.1 Radiated Emissions Below 1 GHz Test Data, FCC §15.209; IC RSS-Gen

Table 6-1: Digital Radiated Emissions Test Data - TC #1; Concrete Container

Temperature: 54°F Humidity: 99%										
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**
71.400	Qp	V	95	1.0	46.3	-25.0	21.3	40.0	-18.7	Pass
142.000	Qp	H	45	2.0	42.9	-20.7	22.2	43.5	-21.3	Pass
157.000	Qp	H	345	1.5	39.3	-21.0	18.3	43.5	-25.2	Pass
309.000	Qp	V	50	1.0	37.3	-17.0	20.3	46.0	-25.7	Pass
340.100	Qp	H	180	1.0	38.0	-16.0	22.0	46.0	-24.0	Pass
345.000	Qp	V	110	1.0	37.6	-15.8	21.8	46.0	-24.2	Pass
380.000	Qp	V	275	1.0	39.1	-14.7	24.4	46.0	-21.6	Pass
384.968	Qp	V	10	1.0	37.4	-14.5	22.9	46.0	-23.1	Pass
484.829	Qp	H	300	2.0	37.2	-11.9	25.3	46.0	-20.7	Pass
494.950	Qp	H	180	1.0	38.6	-12.1	26.5	46.0	-19.5	Pass

Table 6-2: Digital Radiated Emissions Test Data - TC #1; Metal Container

Temperature: 46°F Humidity: 66%										
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**
71.400	Qp	V	90	1.0	44.7	-25.0	19.7	40.0	-20.3	Pass
141.950	Qp	V	355	1.0	41.7	-20.7	21.0	43.5	-22.5	Pass
156.999	Qp	V	270	1.2	41.1	-21.0	20.1	43.5	-23.4	Pass
309.000	Qp	H	45	2.0	36.6	-17.0	19.6	46.0	-26.4	Pass
339.850	Qp	H	180	2.0	35.6	-16.0	19.6	46.0	-26.4	Pass
344.970	Qp	H	275	2.0	35.6	-15.8	19.8	46.0	-26.2	Pass
380.000	Qp	H	300	1.8	39.9	-14.7	25.2	46.0	-20.8	Pass
385.000	Qp	H	45	2.0	37.1	-14.5	22.6	46.0	-23.4	Pass
485.000	Qp	V	10	2.0	36.4	-11.9	24.5	46.0	-21.5	Pass
495.000	Qp	V	75	2.0	36.4	-12.1	24.3	46.0	-21.7	Pass

Table 6-3: Digital Radiated Emissions Test Data - TC #1; Fiberglass Container

Temperature: 48°F Humidity: 66%										
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
71.380	Qp	H	75	3.0	45.4	-25.0	20.4	40.0	-19.6	Pass
142.000	Qp	V	180	1.0	44.3	-20.7	23.6	43.5	-19.9	Pass
157.000	Qp	V	330	1.0	39.9	-21.0	18.9	43.5	-24.6	Pass
309.000	Qp	V	45	1.5	36.2	-17.0	19.2	46.0	-26.8	Pass
340.100	Qp	V	90	1.0	36.7	-16.0	20.7	46.0	-25.3	Pass
345.000	Qp	H	270	1.5	37.2	-15.8	21.4	46.0	-24.6	Pass
379.990	Qp	H	25	1.5	41.2	-14.7	26.5	46.0	-19.5	Pass
384.968	Qp	V	180	1.0	38.6	-14.5	24.1	46.0	-21.9	Pass
484.829	Qp	V	120	1.2	37.2	-11.9	25.3	46.0	-20.7	Pass
494.950	Qp	V	345	1.0	37.3	-12.1	25.2	46.0	-20.8	Pass

Table 6-4: Digital Radiated Emissions Test Data - TC #2; Concrete Container

Temperature: 54°F Humidity: 99%										
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
71.400	Qp	H	180	2.5	45.4	-25.0	20.4	40.0	-19.6	Pass
142.000	Qp	V	90	1.5	42.5	-20.7	21.8	43.5	-21.7	Pass
157.000	Qp	V	40	1.0	39.4	-21.0	18.4	43.5	-25.1	Pass
309.000	Qp	V	165	1.0	35.8	-17.0	18.8	46.0	-27.2	Pass
340.100	Qp	V	300	1.5	37.6	-16.0	21.6	46.0	-24.4	Pass
345.000	Qp	V	10	1.1	42.3	-15.8	26.5	46.0	-19.5	Pass
380.000	Qp	V	90	1.0	38.9	-14.7	24.2	46.0	-21.8	Pass
384.968	Qp	V	150	2.0	45.1	-14.5	30.6	46.0	-15.4	Pass
484.829	Qp	V	75	1.0	43.0	-11.9	31.1	46.0	-14.9	Pass
494.950	Qp	H	100	1.5	37.0	-12.1	24.9	46.0	-21.1	Pass

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

Temperature: 45°F Humidity: 66%										
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
71.400	Qp	V	355	1.0	47.1	-25.0	22.1	40.0	-17.9	Pass
142.000	Qp	V	45	1.5	38.9	-20.7	18.2	43.5	-25.3	Pass
156.995	Qp	V	265	1.0	39.7	-21.0	18.7	43.5	-24.8	Pass
308.985	Qp	V	90	1.5	36.7	-17.0	19.7	46.0	-26.3	Pass
340.000	Qp	H	45	1.5	38.9	-16.0	22.9	46.0	-23.1	Pass
345.000	Qp	V	145	1.6	40.3	-15.8	24.5	46.0	-21.5	Pass
380.000	Qp	V	180	1.4	39.1	-14.7	24.4	46.0	-21.6	Pass
384.947	Qp	V	345	1.8	36.9	-14.5	22.4	46.0	-23.6	Pass
484.800	Qp	H	180	1.5	36.6	-11.9	24.7	46.0	-21.3	Pass
494.950	Qp	V	25	1.5	37.4	-12.1	25.3	46.0	-20.7	Pass

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

Temperature: 48°F Humidity: 66%										
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
71.400	Qp	V	180	1.0	46.0	-25.0	21.0	40.0	-19.0	Pass
142.060	Qp	V	45	1.5	41.1	-20.7	20.4	43.5	-23.1	Pass
157.000	Qp	V	175	1.0	37.2	-21.0	16.2	43.5	-27.3	Pass
308.999	Qp	H	10	2.0	37.3	-17.0	20.3	46.0	-25.7	Pass
340.070	Qp	H	180	1.2	37.3	-16.0	21.3	46.0	-24.7	Pass
345.000	Qp	H	175	1.4	41.0	-15.8	25.2	46.0	-20.8	Pass
379.960	Qp	H	220	1.5	43.6	-14.7	28.9	46.0	-17.1	Pass
384.968	Qp	V	355	1.0	44.5	-14.5	30.0	46.0	-16.0	Pass
484.819	Qp	V	45	1.0	38.8	-11.9	26.9	46.0	-19.1	Pass
494.950	Qp	H	265	1.5	39.5	-12.1	27.4	46.0	-18.6	Pass

Table 6-7: Digital Radiated Emissions Test Data - TC #3; Concrete Container

Temperature: 54°F Humidity: 99%										
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
71.400	Qp	H	45	2.5	41.3	-25.0	16.3	40.0	-23.7	Pass
142.000	Qp	H	5	1.5	38.1	-20.7	17.4	43.5	-26.1	Pass
157.000	Qp	V	290	1.0	37.5	-21.0	16.5	43.5	-27.0	Pass
308.995	Qp	V	255	1.0	37.6	-17.0	20.6	46.0	-25.4	Pass
340.100	Qp	H	90	1.2	37.0	-16.0	21.0	46.0	-25.0	Pass
345.000	Qp	V	255	1.0	37.9	-15.8	22.1	46.0	-23.9	Pass
380.000	Qp	H	95	1.2	37.9	-14.7	23.2	46.0	-22.8	Pass
384.968	Qp	H	120	2.0	38.3	-14.5	23.8	46.0	-22.2	Pass
484.829	Qp	V	45	1.0	37.1	-11.9	25.2	46.0	-20.8	Pass
494.950	Qp	V	75	1.5	38.1	-12.1	26.0	46.0	-20.0	Pass

Table 6-8: Digital Radiated Emissions Test Data - TC #3; Metal Container

Temperature: 46°F Humidity: 66%										
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
71.400	Qp	V	185	2.0	46.1	-25.0	21.1	40.0	-18.9	Pass
142.000	Qp	V	90	2.0	41.0	-20.7	20.3	43.5	-23.2	Pass
157.000	Qp	H	295	2.0	42.9	-21.0	21.9	43.5	-21.6	Pass
308.995	Qp	V	265	1.5	39.0	-17.0	22.0	46.0	-24.0	Pass
340.100	Qp	V	90	1.8	35.9	-16.0	19.9	46.0	-26.1	Pass
345.000	Qp	V	355	2.0	39.9	-15.8	24.1	46.0	-21.9	Pass
380.000	Qp	H	125	2.0	39.4	-14.7	24.7	46.0	-21.3	Pass
384.970	Qp	V	45	1.6	37.9	-14.5	23.4	46.0	-22.6	Pass
484.829	Qp	V	180	1.5	37.5	-11.9	25.6	46.0	-20.4	Pass

Table 6-9: Digital Radiated Emissions Test Data - TC #3; Fiberglass Container

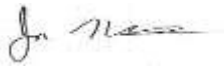
Temperature: 54°F Humidity: 99%										
Emission Frequency (MHz)	Test Detector	Antenna Polarity (H/V)	Turntable Azimuth (deg)	Antenna Height (m)	Analyzer Reading (dBuV)	Site Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pass/ Fail
71.400	Qp	V	270	1.2	47.1	-25.0	22.1	40.0	-17.9	Pass
142.000	Qp	H	55	2.0	45.0	-20.7	24.3	43.5	-19.2	Pass
157.000	Qp	V	300	1.3	41.0	-21.0	20.0	43.5	-23.5	Pass
308.900	Qp	V	75	1.0	36.6	-17.0	19.6	46.0	-26.4	Pass
340.100	Qp	V	195	1.2	37.0	-16.0	21.0	46.0	-25.0	Pass
345.000	Qp	V	265	1.5	36.9	-15.8	21.1	46.0	-24.9	Pass
380.000	Qp	H	185	1.4	39.8	-14.7	25.1	46.0	-20.9	Pass
384.968	Qp	H	355	1.0	37.9	-14.5	23.4	46.0	-22.6	Pass
484.830	Qp	V	180	1.0	36.9	-11.9	25.0	46.0	-21.0	Pass
494.950	Qp	V	95	1.0	36.8	-12.1	24.7	46.0	-21.3	Pass

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

Table 6-10: 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	9/11/16
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	12/9/16
RF Filter Section (100 kHz-6.5 GHz)	Hewlett Packard	85460A	3330A00107	900914	12/9/16

Test Personnel:

Jon Wilson		March 16-17, 2016
Test Engineer	Signature	Dates of Test

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

Plot 6-1: Radiated Emissions of Carrier - TC #1; Metal Container

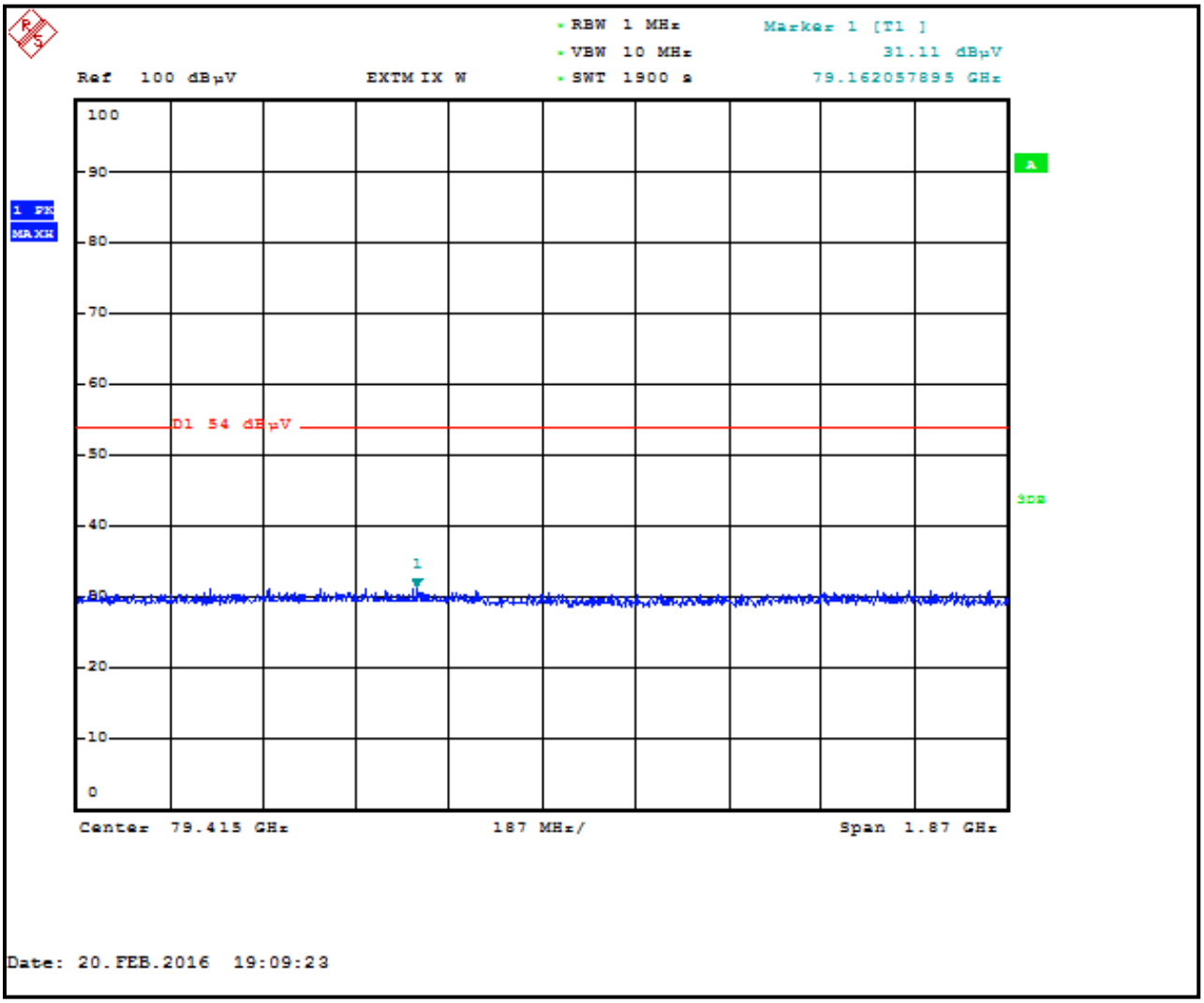


Table 6-11: Radiated Emissions of Carrier – TC #1; Metal Container

Frequency (GHz)	Detector	Test Antenna Pol	Measured Spectrum Analyzer Level (dBuV)	Test Antenna Correction Factor (dB/m)	Correction from .01m to 3m	Corrected Spectrum Analyzer Level (dBuV/m)	FCC Limit (dBuV)	Margin (dB)
79.312	Peak	H	31.4	42.1	-49.5	24.0	54.0	-30.0

Plot 6-2: Radiated Emissions of Carrier - TC #2; Concrete Container

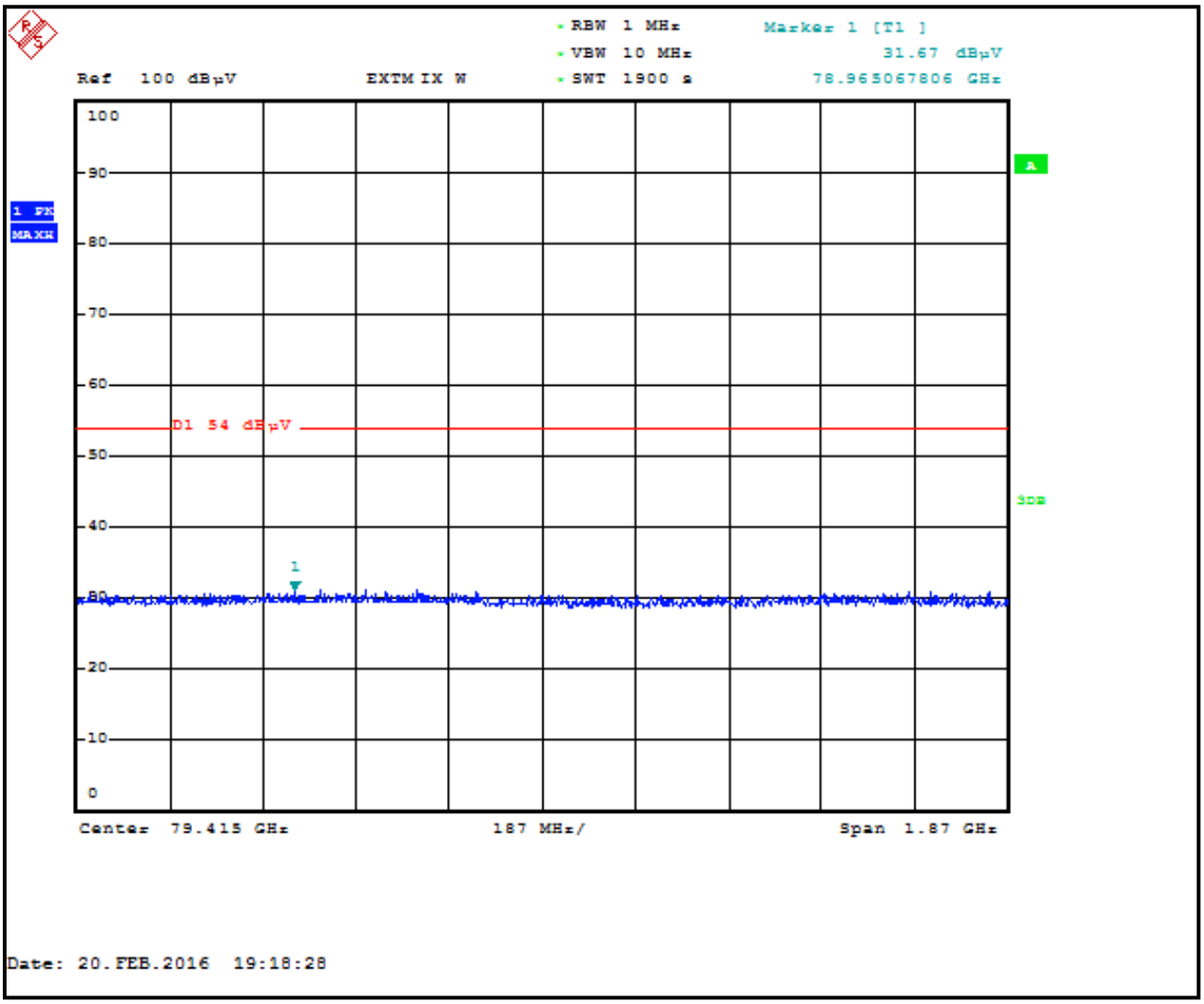


Table 6-12: Radiated Emissions of Carrier – TC #2; Concrete Container

Frequency (GHz)	Detector	Test Antenna Pol	Measured Spectrum Analyzer Level (dBuV)	Test Antenna Correction Factor (dB/m)	Correction From .01m to 3m	Corrected Spectrum Analyzer Level (dBuV/m)	FCC Limit (dBuV)	Margin (dB)
79.162	Peak	H	31.2	42.1	-49.5	23.8	54.0	-30.2

Plot 6-3: Radiated Emissions of Carrier - TC #3; Fiberglass Container

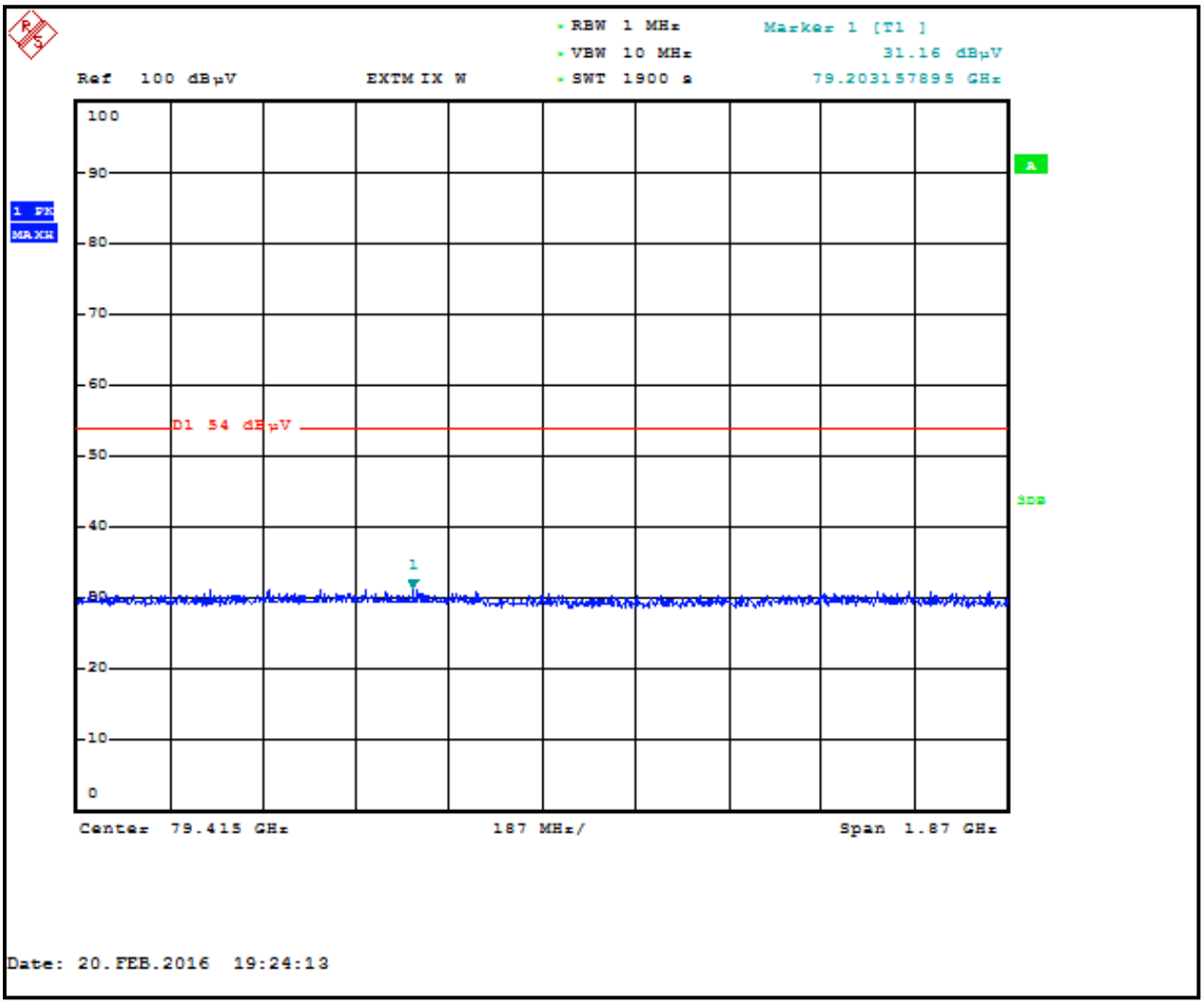


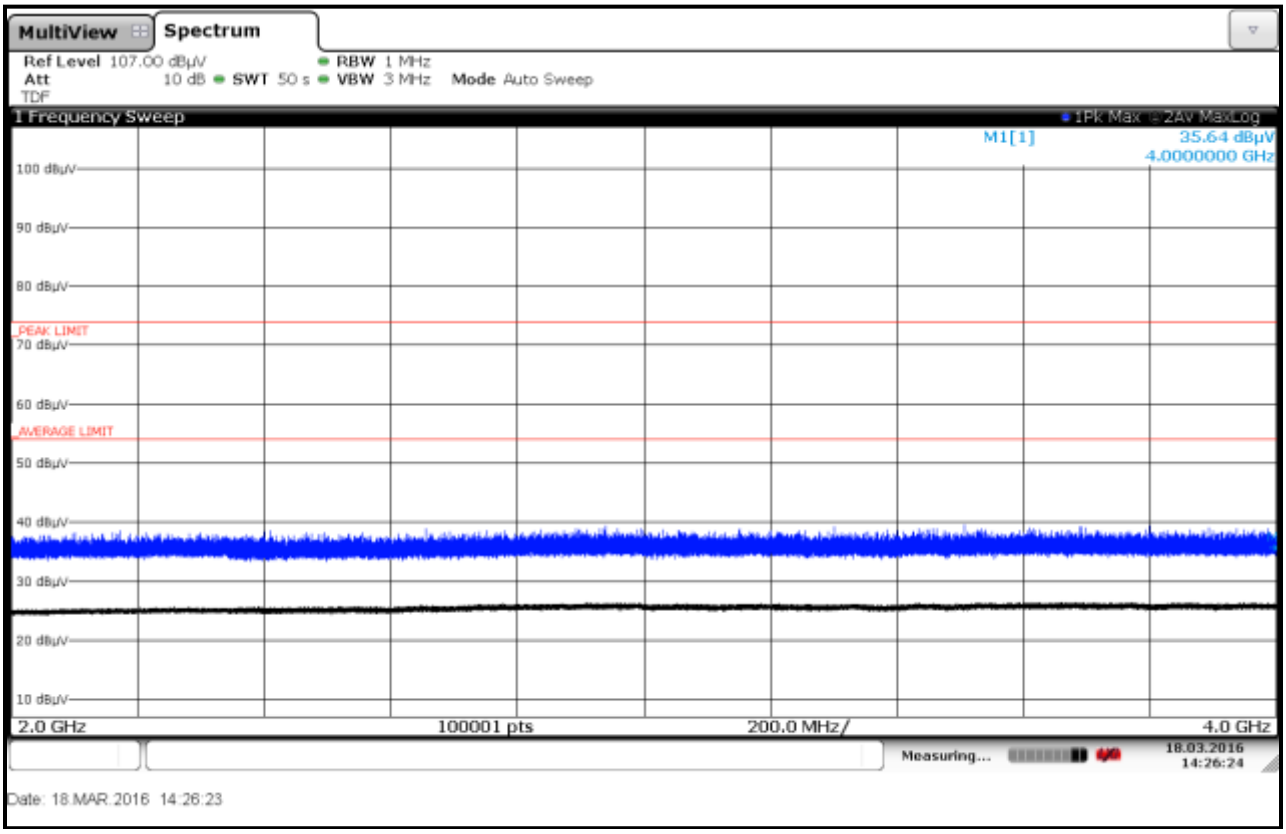
Table 6-13: Radiated Emissions of Carrier – TC #3; Fiberglass Container

Frequency (GHz)	Detector	Test Antenna Pol	Measured Spectrum Analyzer Level (dBuV)	Test Antenna Correction Factor (dB/m)	Correction from .01m to 3m	Corrected Spectrum Analyzer Level (dBuV/m)	FCC Limit (dBuV)	Margin (dB)
79.100	Peak	H	31.0	42.1	-49.5	23.6	54.0	-30.4

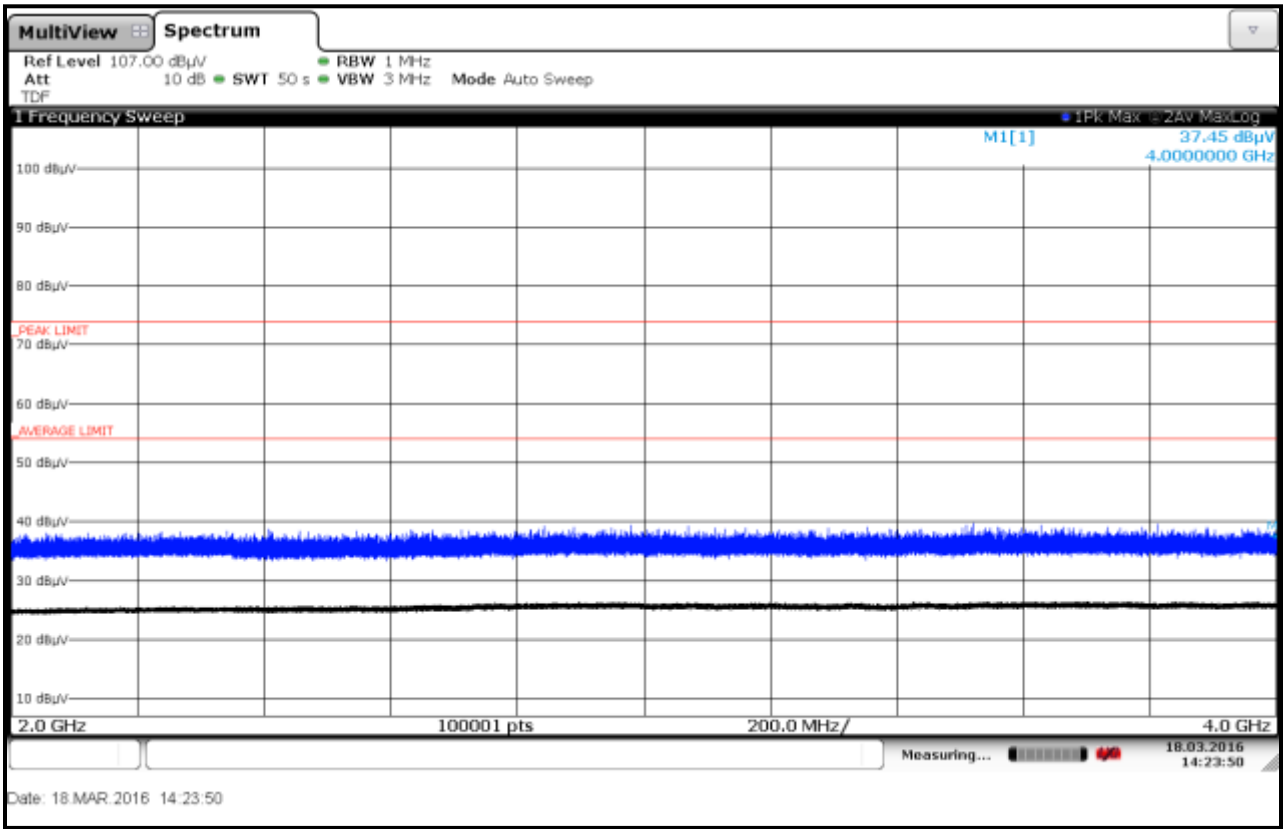
Notes:
The worst-case IC carrier emission is 24 dBuV/m – 95.2 = -71.2 dBm/MHz.
The IC limit = -41dBm/MHz; the IC margin = -30.2 dB.
All other carrier emissions are well below the limit.

6.3.3 Radiated Emissions Test Data - 2 GHz – 26.5 GHz; Metal Container, TC #1

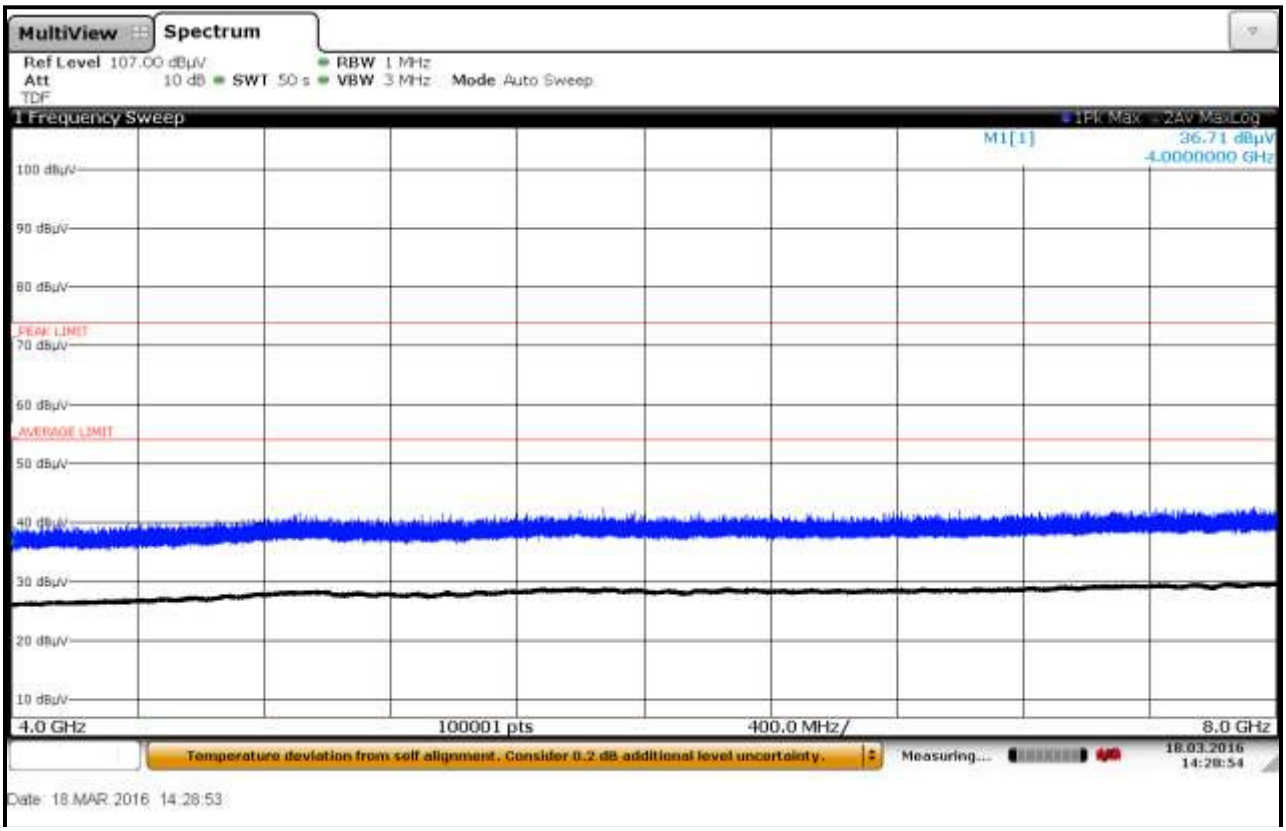
Plot 6-4: Radiated Emissions 2 GHz – 4 GHz; Metal Container; TC #1; Horizontal



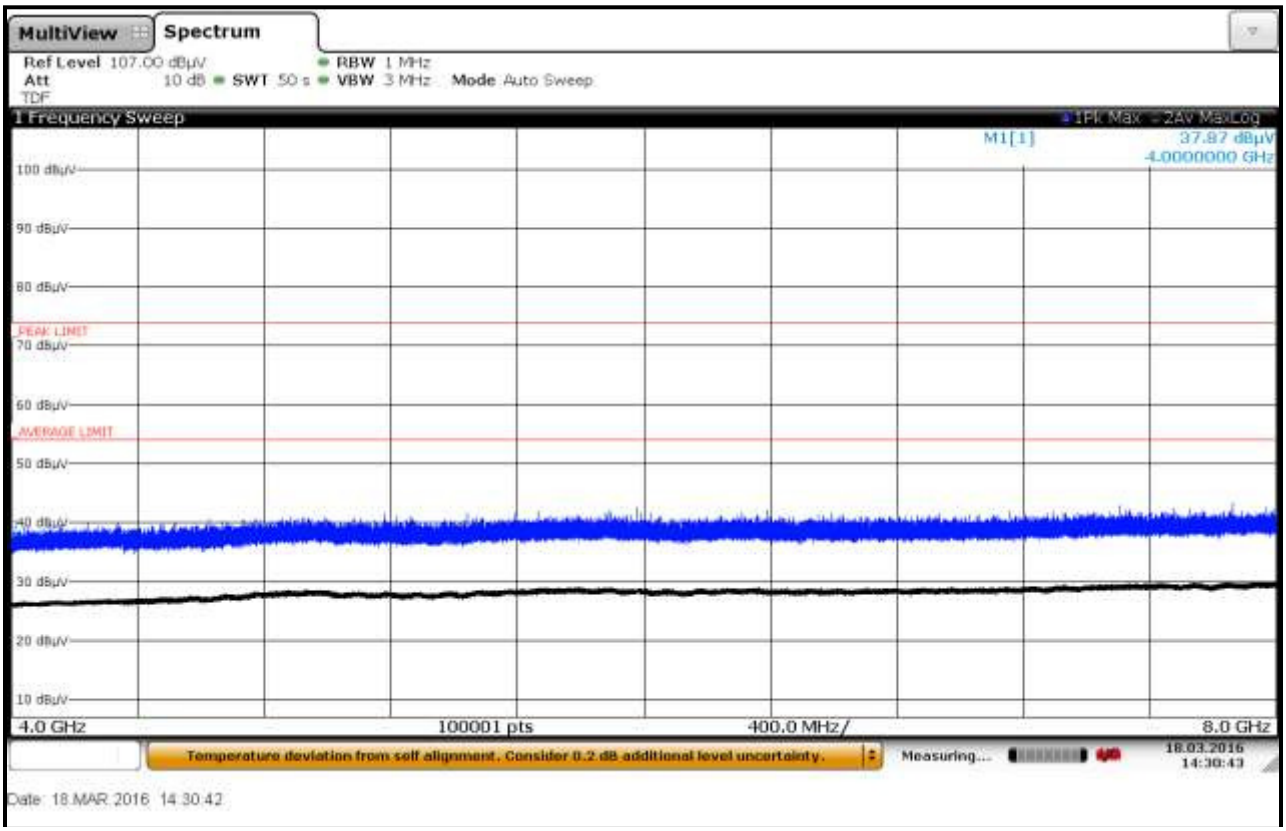
Plot 6-5: Radiated Emissions 2 GHz – 4 GHz; Metal Container; TC #1; Vertical



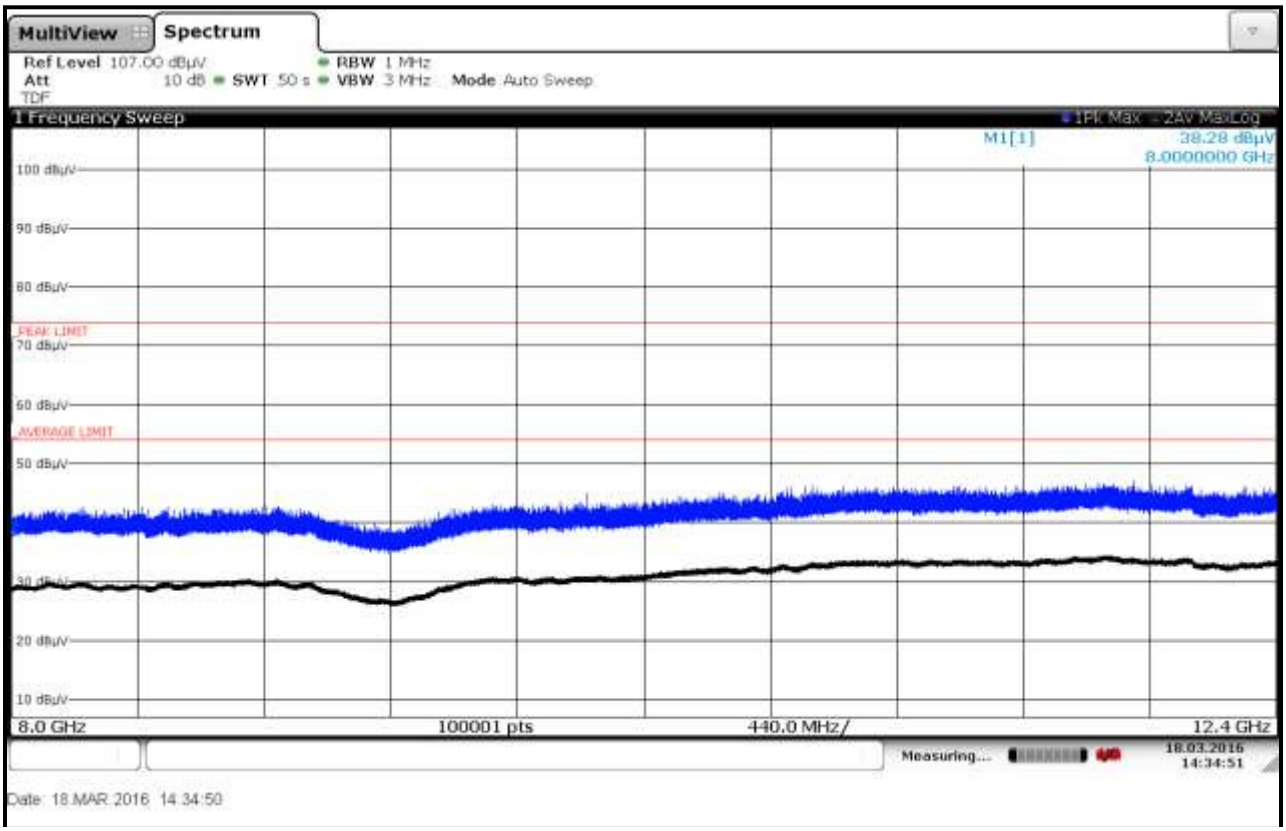
Plot 6-6: Radiated Emissions 4 GHz – 8 GHz; Metal Container; TC #1; Horizontal



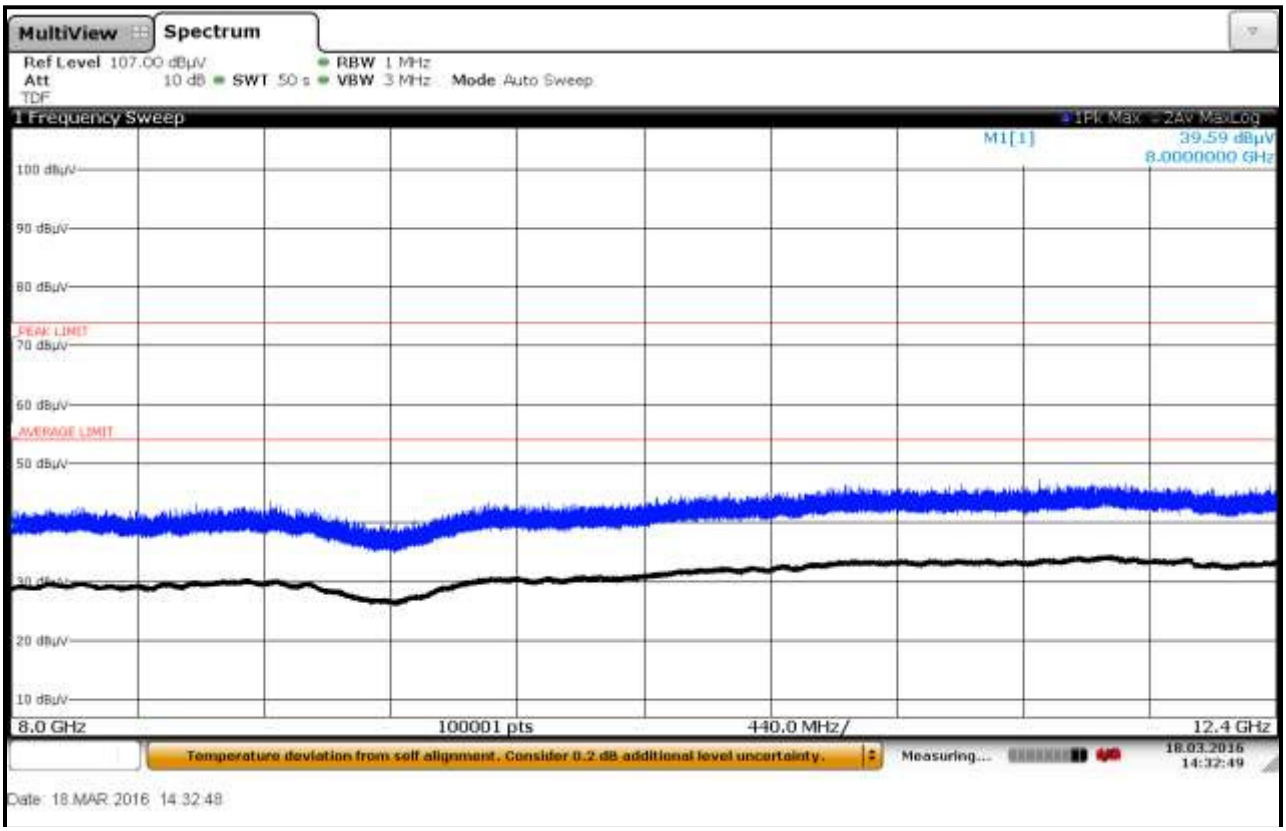
Plot 6-7: Radiated Emissions 4 GHz – 8 GHz; Metal Container; TC #1; Vertical



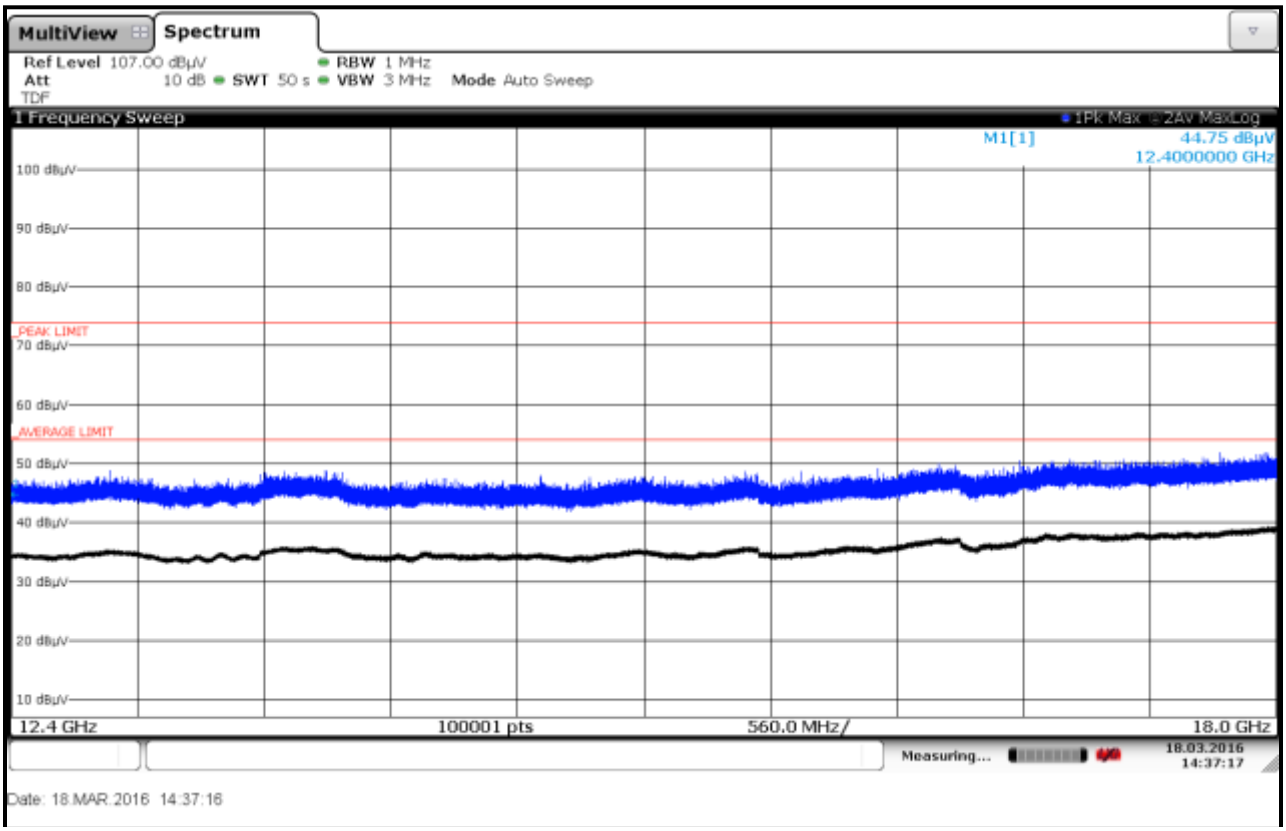
Plot 6-8: Radiated Emissions 8 GHz – 12.4 GHz; Metal Container; TC #1, Horizontal



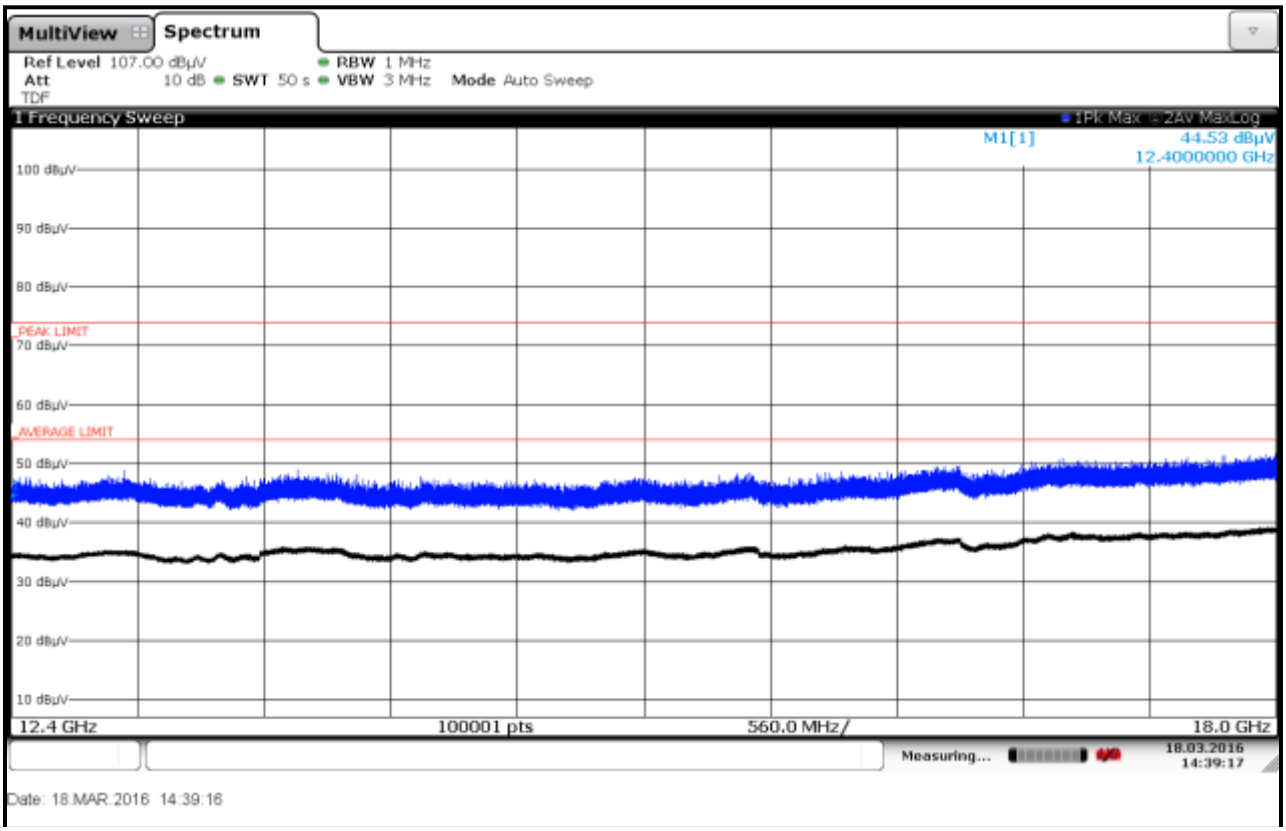
Plot 6-9: Radiated Emissions 8 GHz – 12.4 GHz; Metal Container; TC #1, Vertical



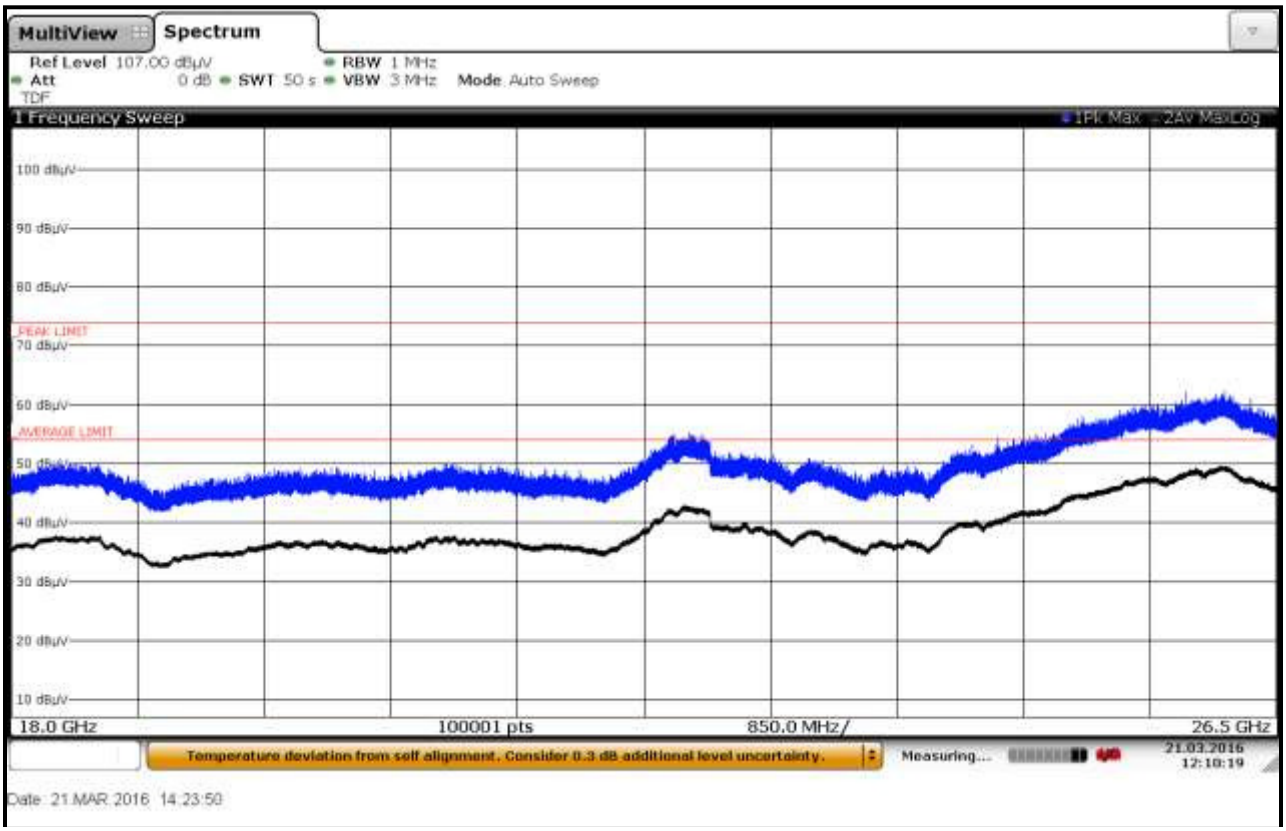
Plot 6-10: Radiated Emissions 12.4 GHz – 18 GHz; Metal Container; TC #1, Horizontal



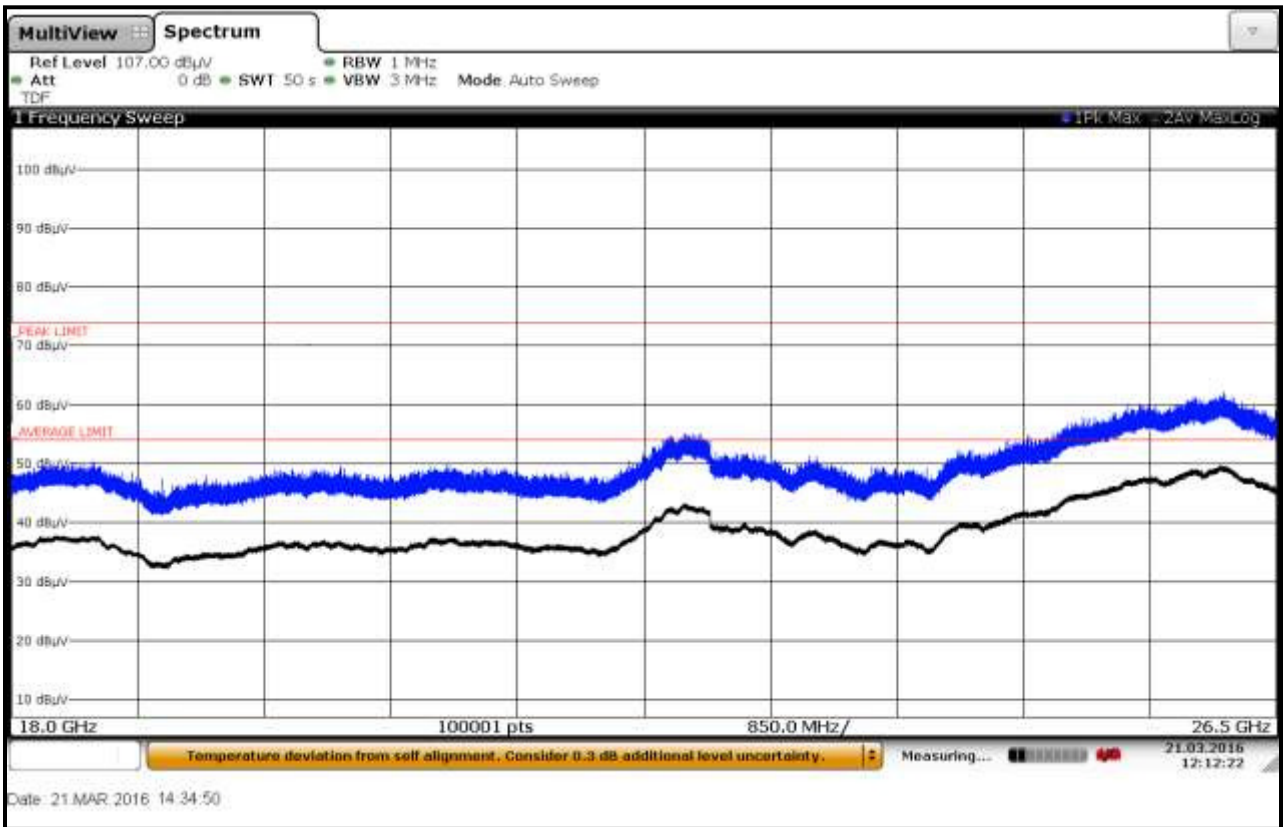
Plot 6-11: Radiated Emissions 12.4 GHz – 18 GHz; Metal Container; TC #1, Vertical



Plot 6-12: Radiated Emissions 18 GHz – 26.5 GHz; Metal Container; TC #1, Horizontal

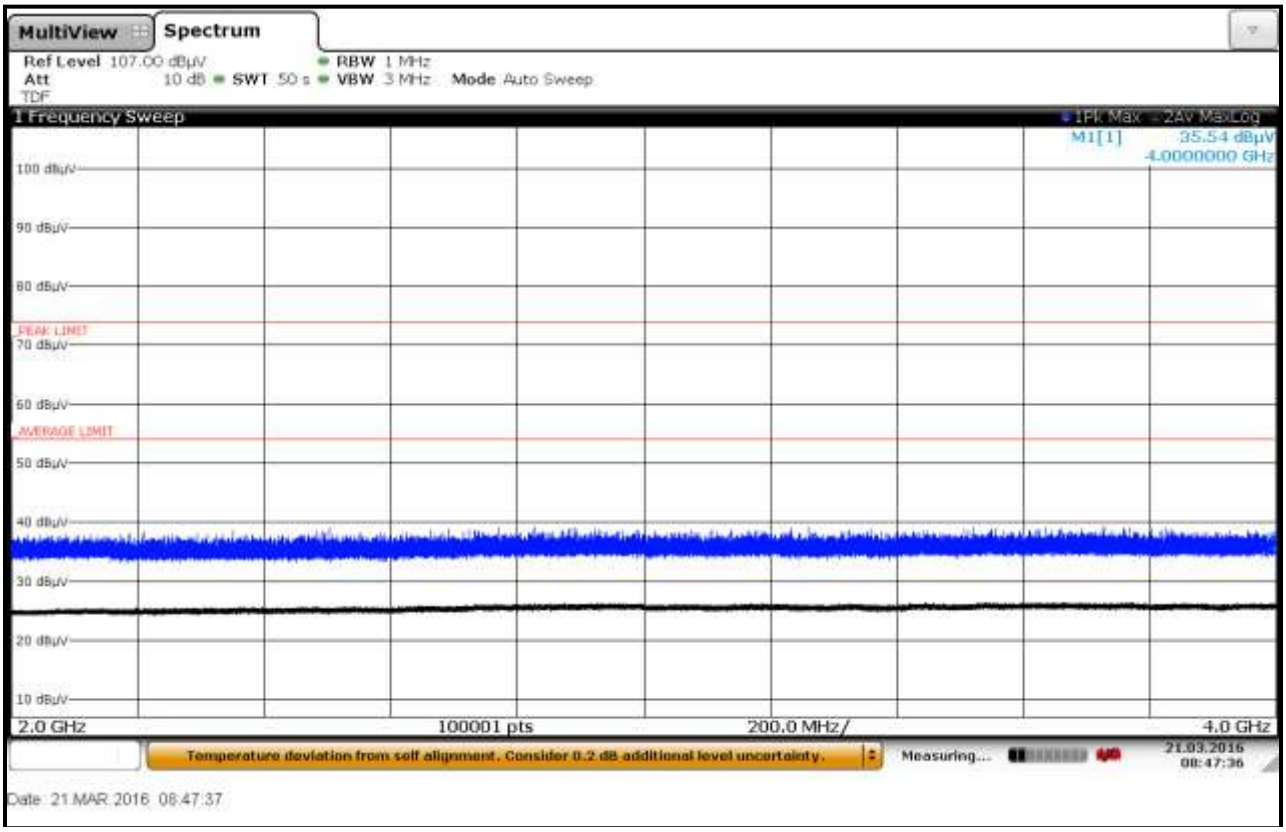


Plot 6-13: Radiated Emissions 18 GHz – 26.5 GHz; Metal Container; TC #1, Vertical

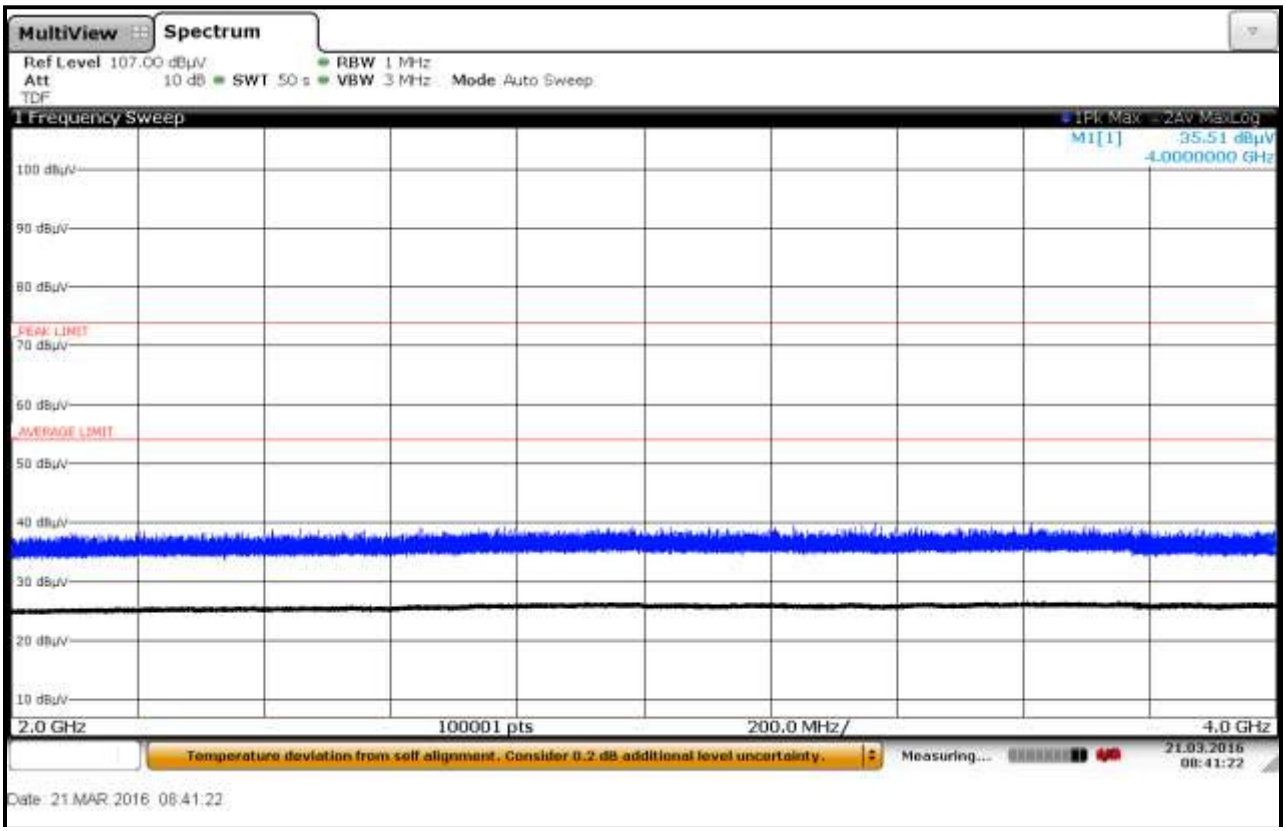


6.3.4 Radiated Emissions Test Data - 2 GHz – 26.5 GHz; Concrete Container, TC #1

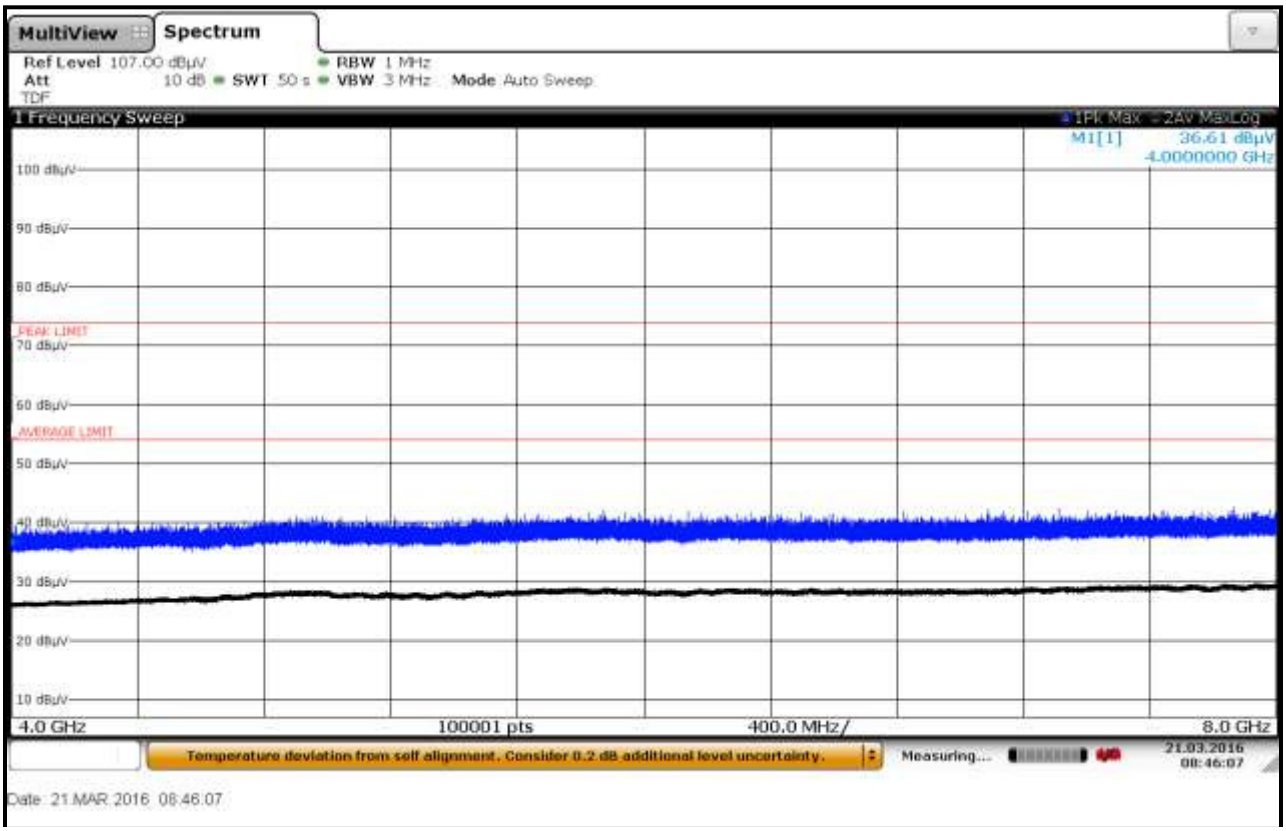
Plot 6-14: Radiated Emissions 2 GHz – 4 GHz; Concrete Container; TC #1; Horizontal



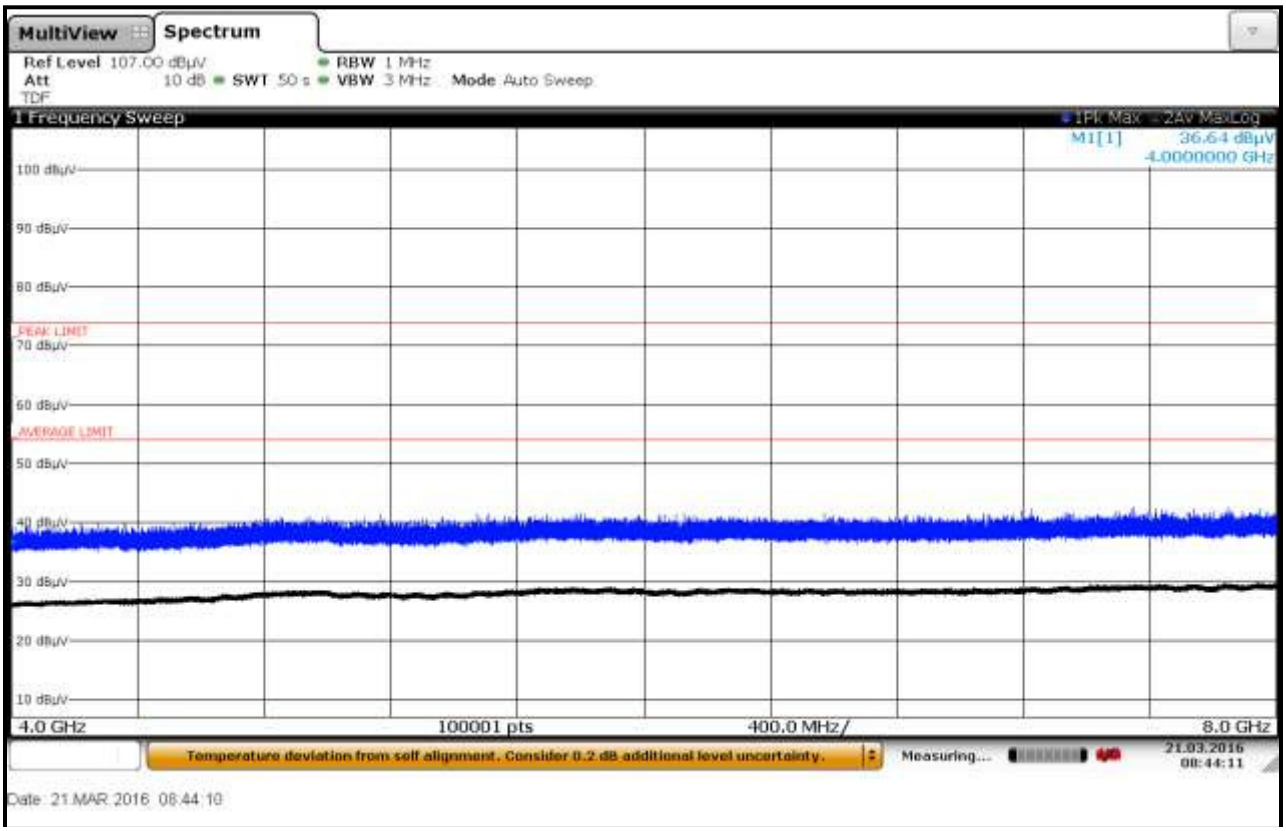
Plot 6-15: Radiated Emissions 2 GHz – 4 GHz; Concrete Container; TC #1; Vertical



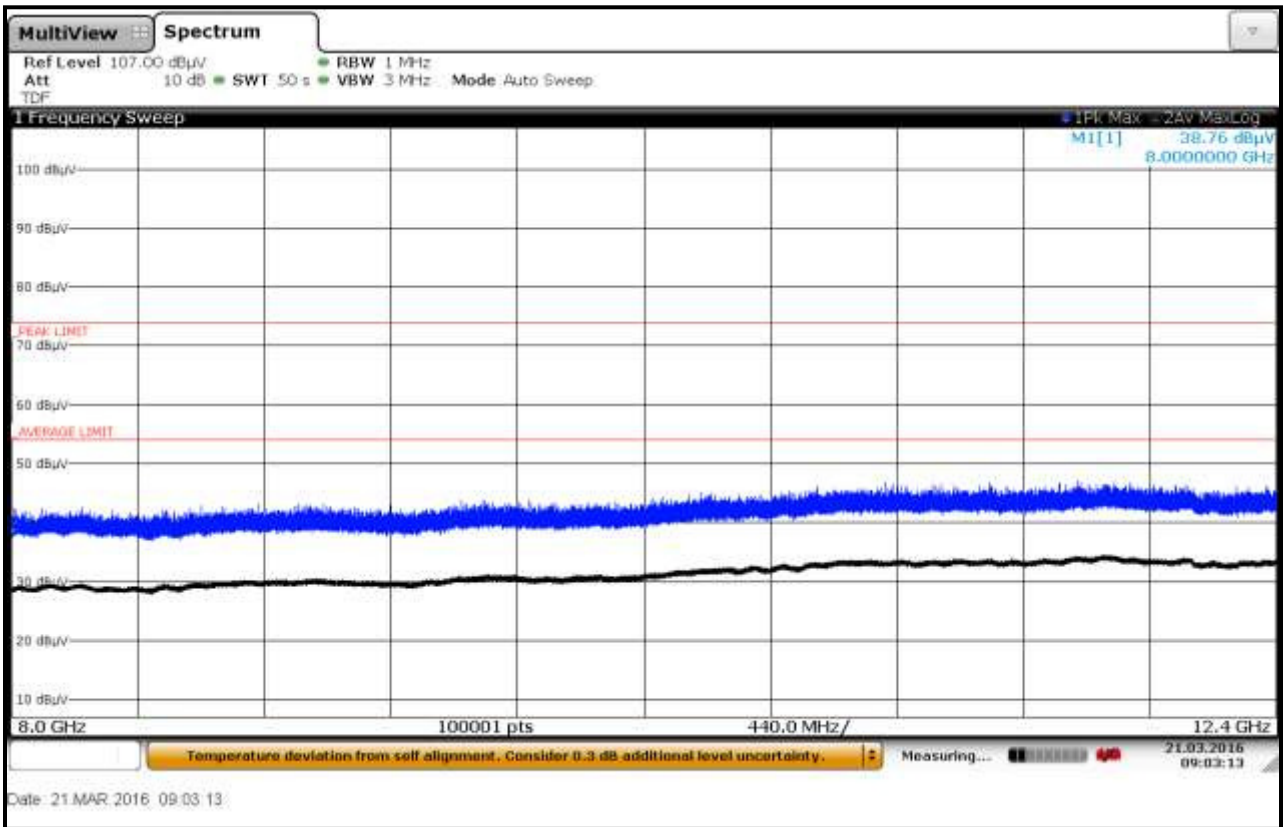
Plot 6-16: Radiated Emissions 4 GHz – 8 GHz; Concrete Container; TC #1; Horizontal



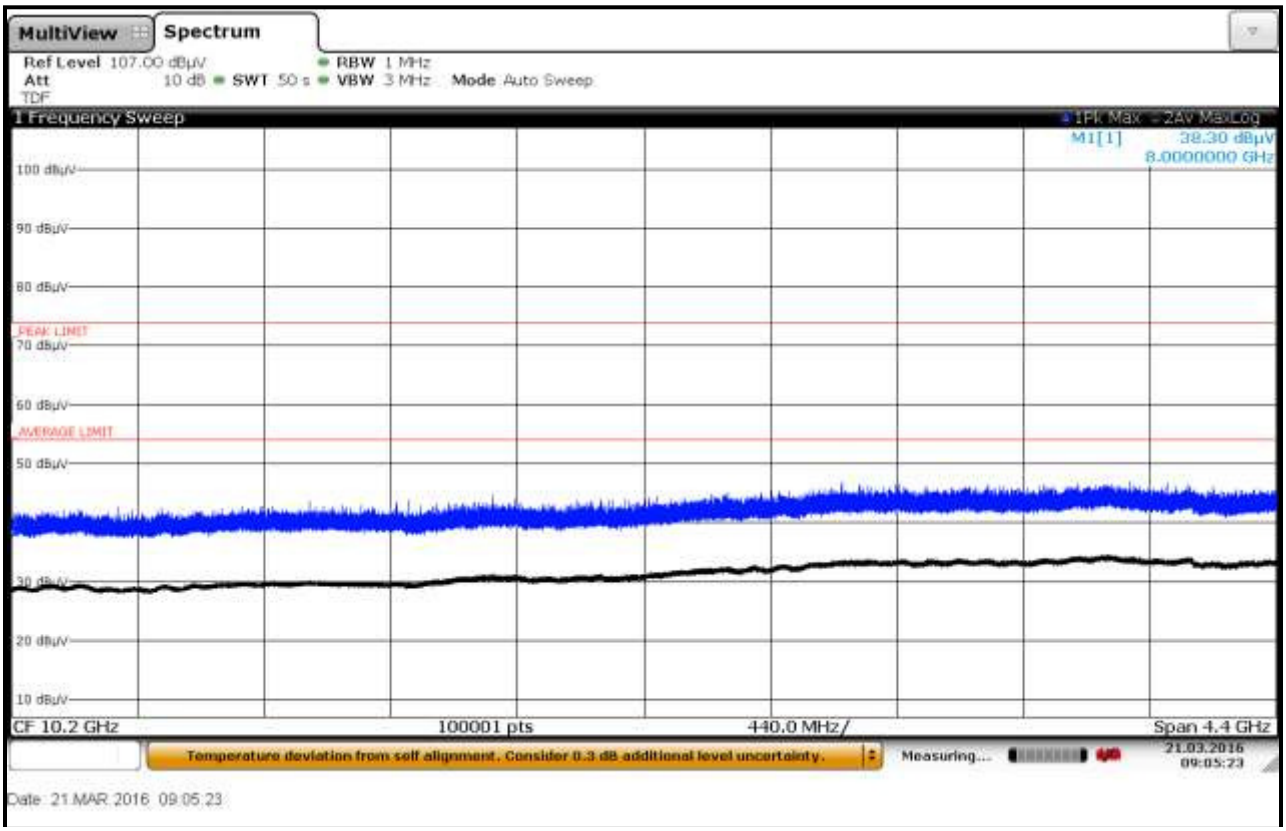
Plot 6-17: Radiated Emissions 4 GHz – 8 GHz; Concrete Container; TC #1; Vertical



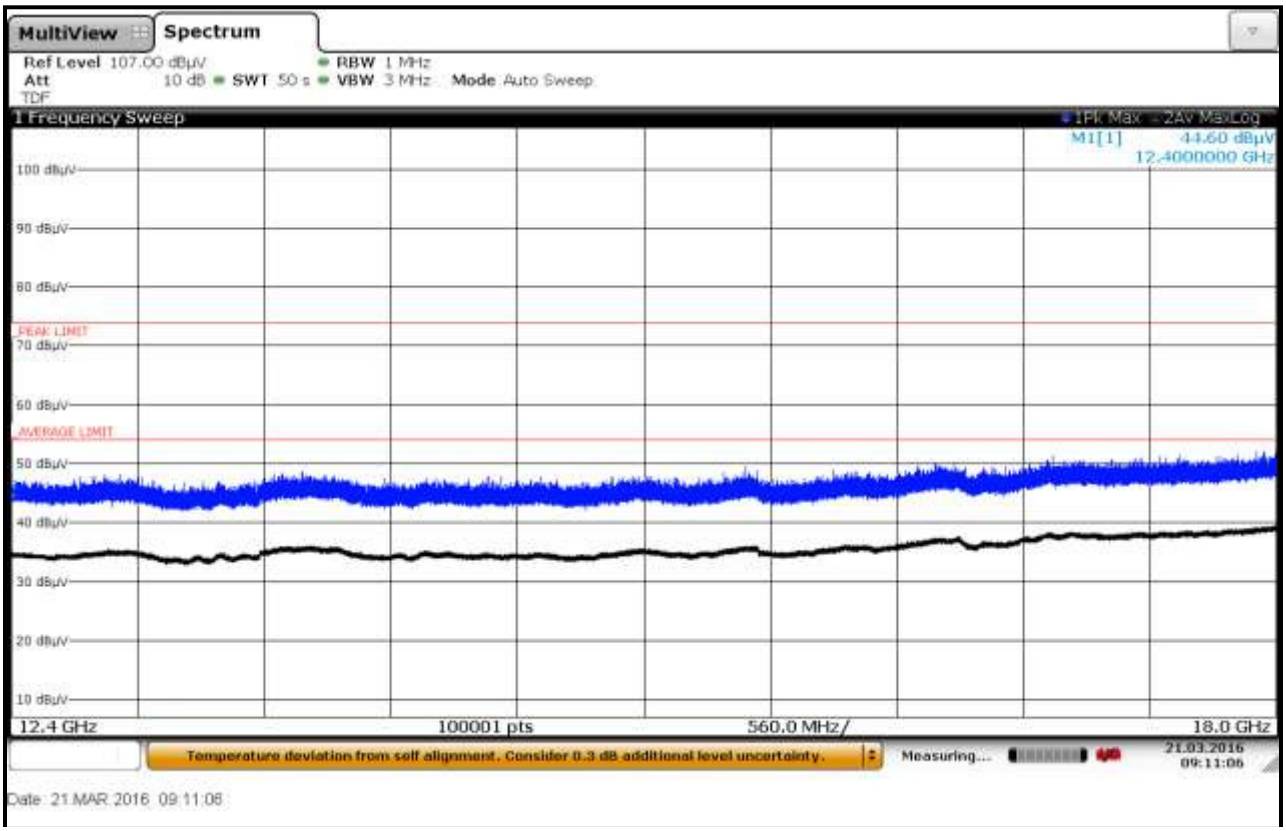
Plot 6-18: Radiated Emissions 8 GHz – 12.4 GHz; Concrete Container; TC #1, Horizontal



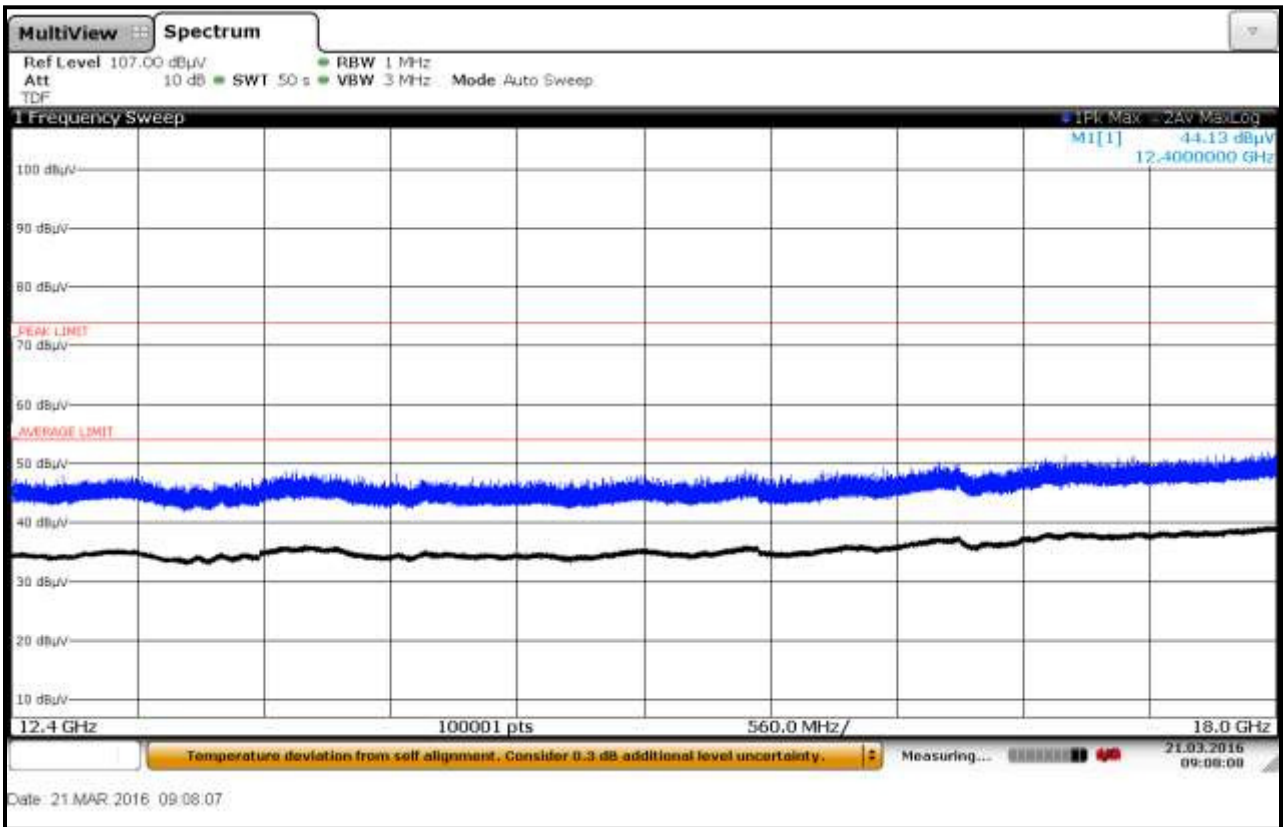
Plot 6-19: Radiated Emissions 8 GHz – 12.4 GHz; Concrete Container; TC #1, Vertical



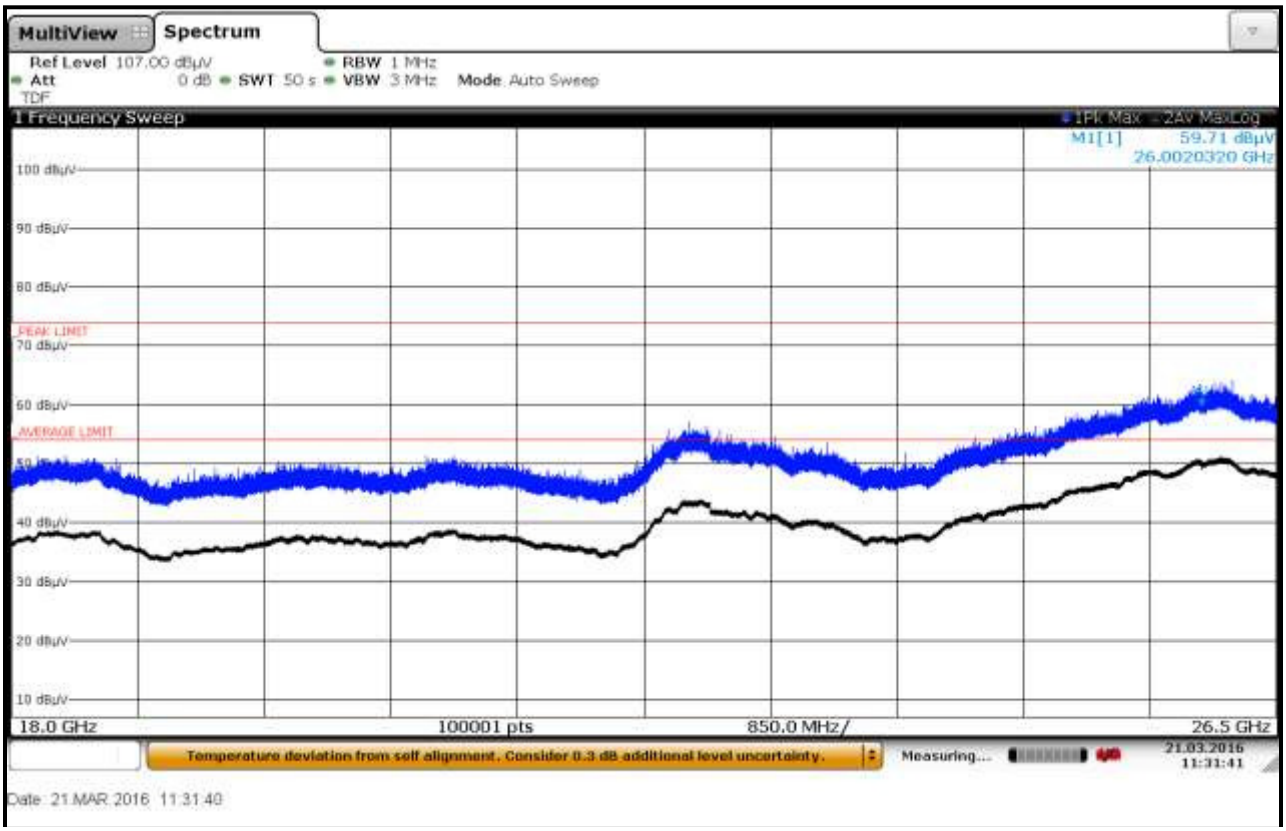
Plot 6-20: Radiated Emissions 12.4 GHz – 18 GHz; Concrete Container; TC #1, Horizontal



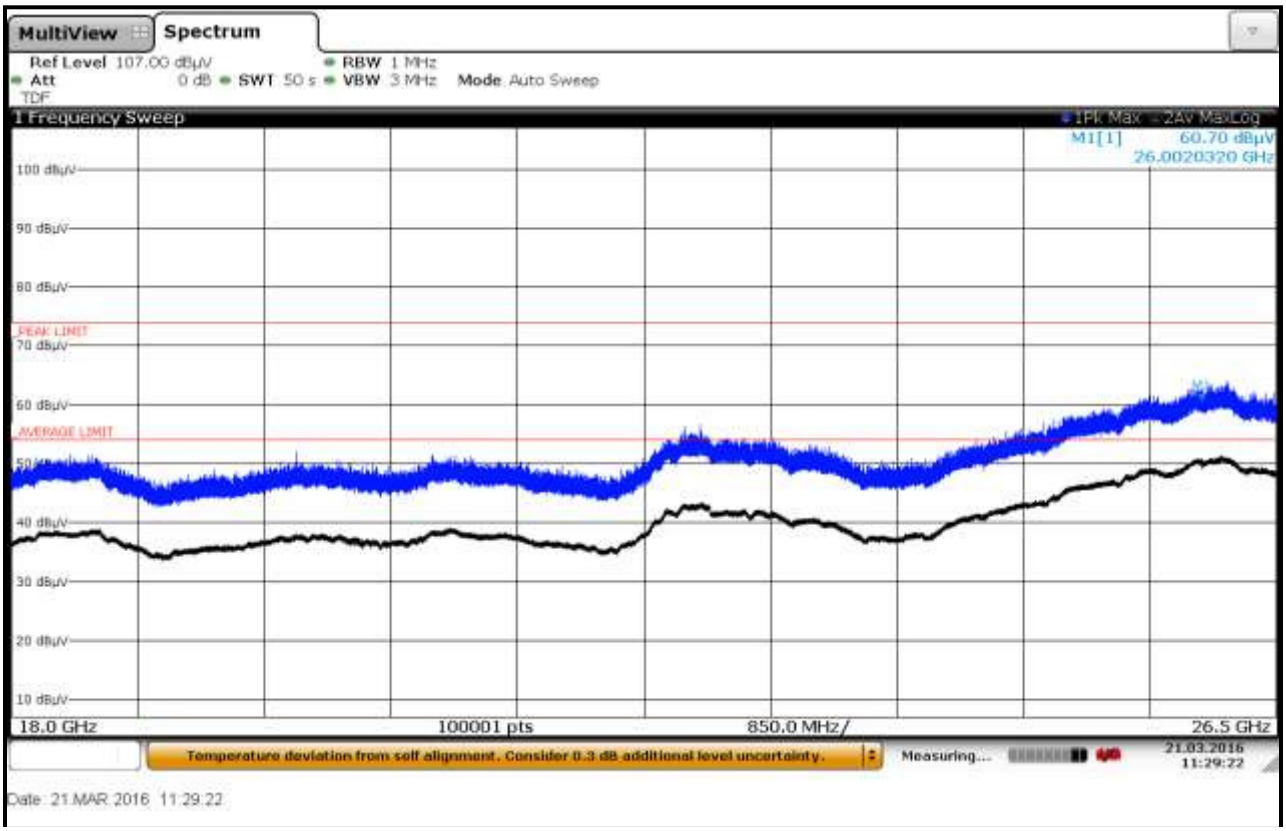
Plot 6-21: Radiated Emissions 12.4 GHz – 18 GHz; Concrete Container; TC #1, Vertical



Plot 6-22: Radiated Emissions 18 GHz – 26.5 GHz; Concrete Container; TC #1, Horizontal

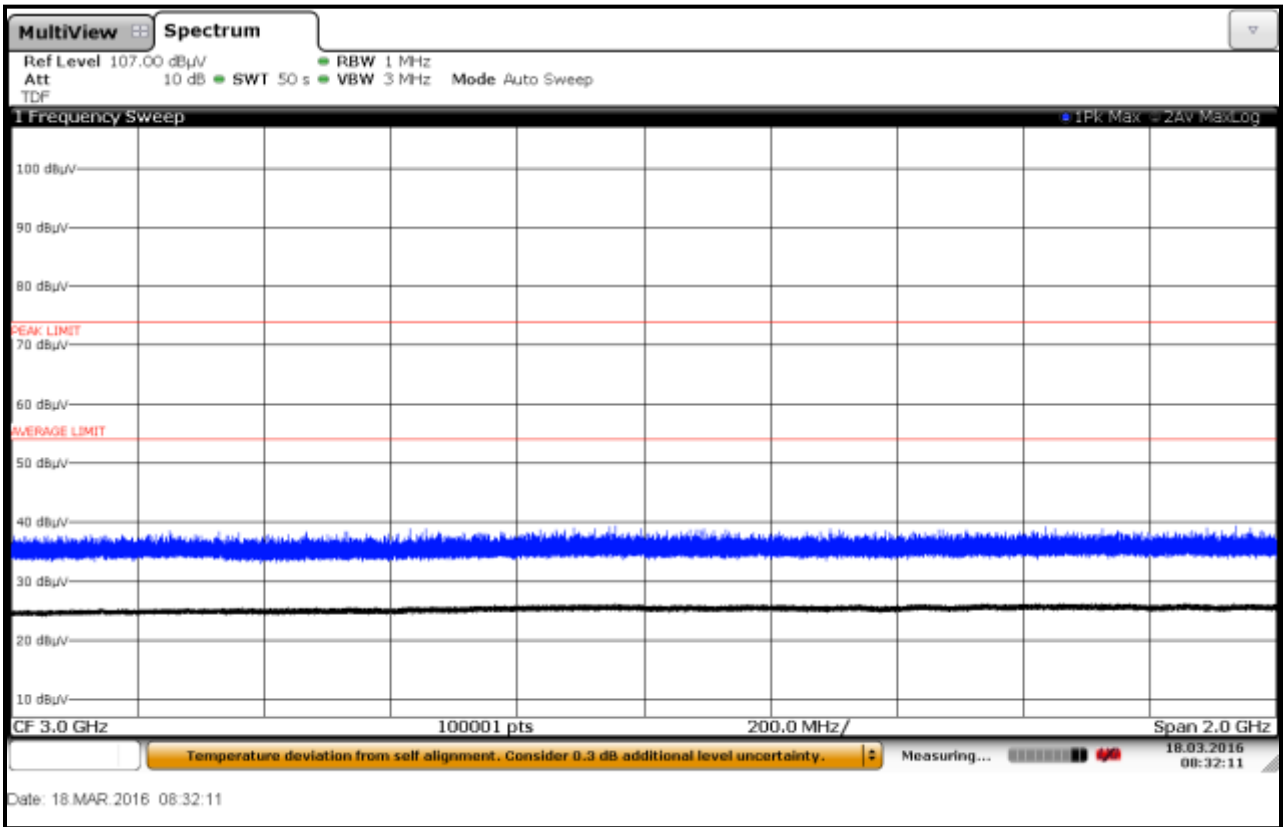


Plot 6-23: Radiated Emissions 18 GHz – 26.5 GHz; Concrete Container; TC #1, Vertical

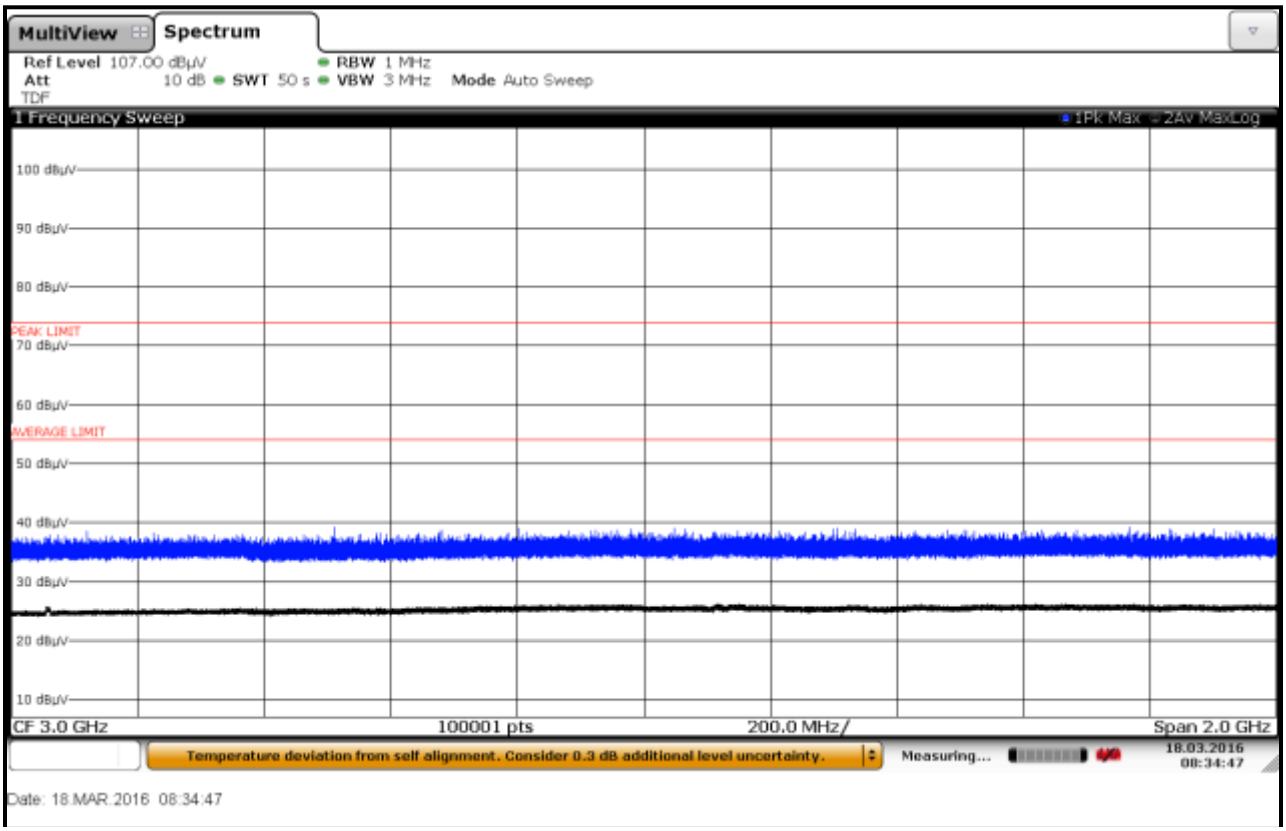


6.3.5 Radiated Emissions Test Data - 2 GHz – 26.5 GHz; Fiberglass Container, TC #1

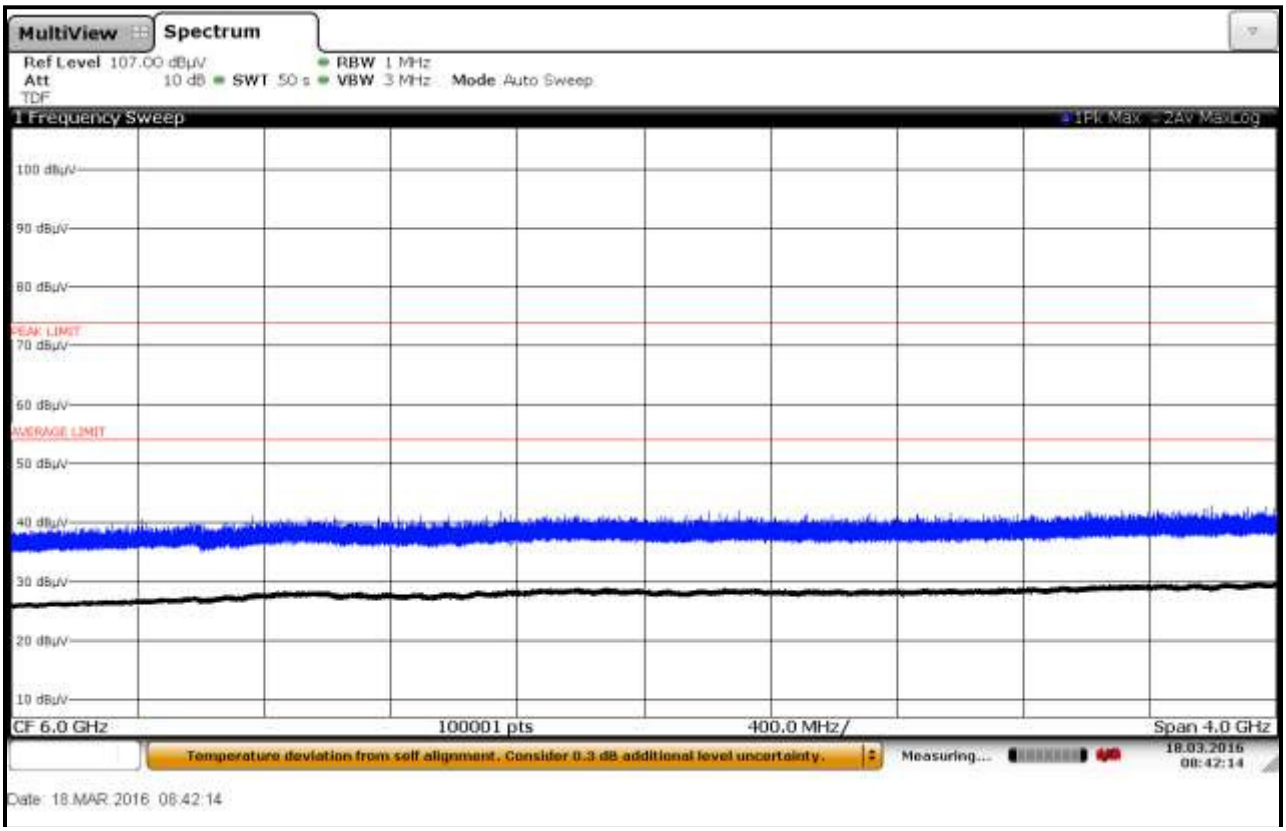
Plot 6-24: Radiated Emissions 2 GHz – 4 GHz; Fiberglass Container; TC #1; Horizontal



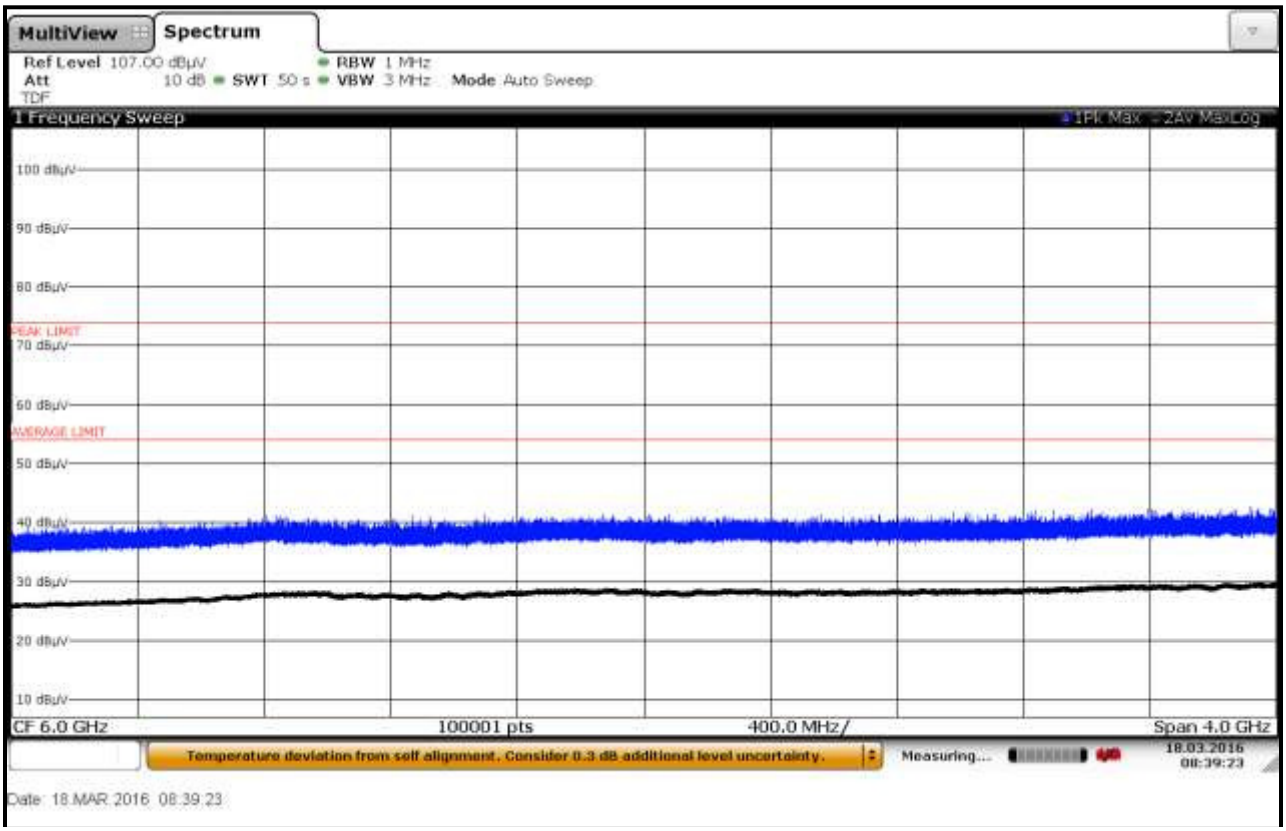
Plot 6-25: Radiated Emissions 2 GHz – 4 GHz; Fiberglass Container; TC #1; Vertical



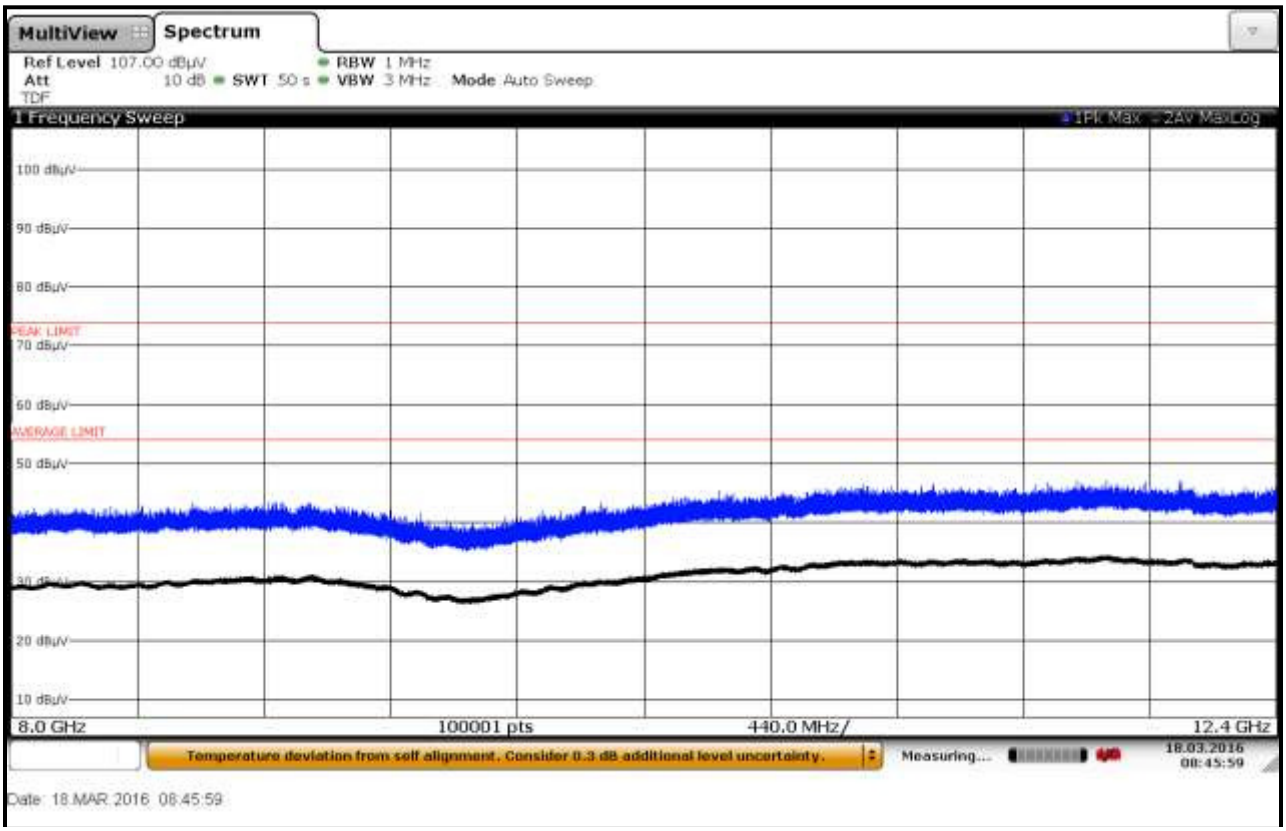
Plot 6-26: Radiated Emissions 4 GHz – 8 GHz; Fiberglass Container; TC #1; Horizontal



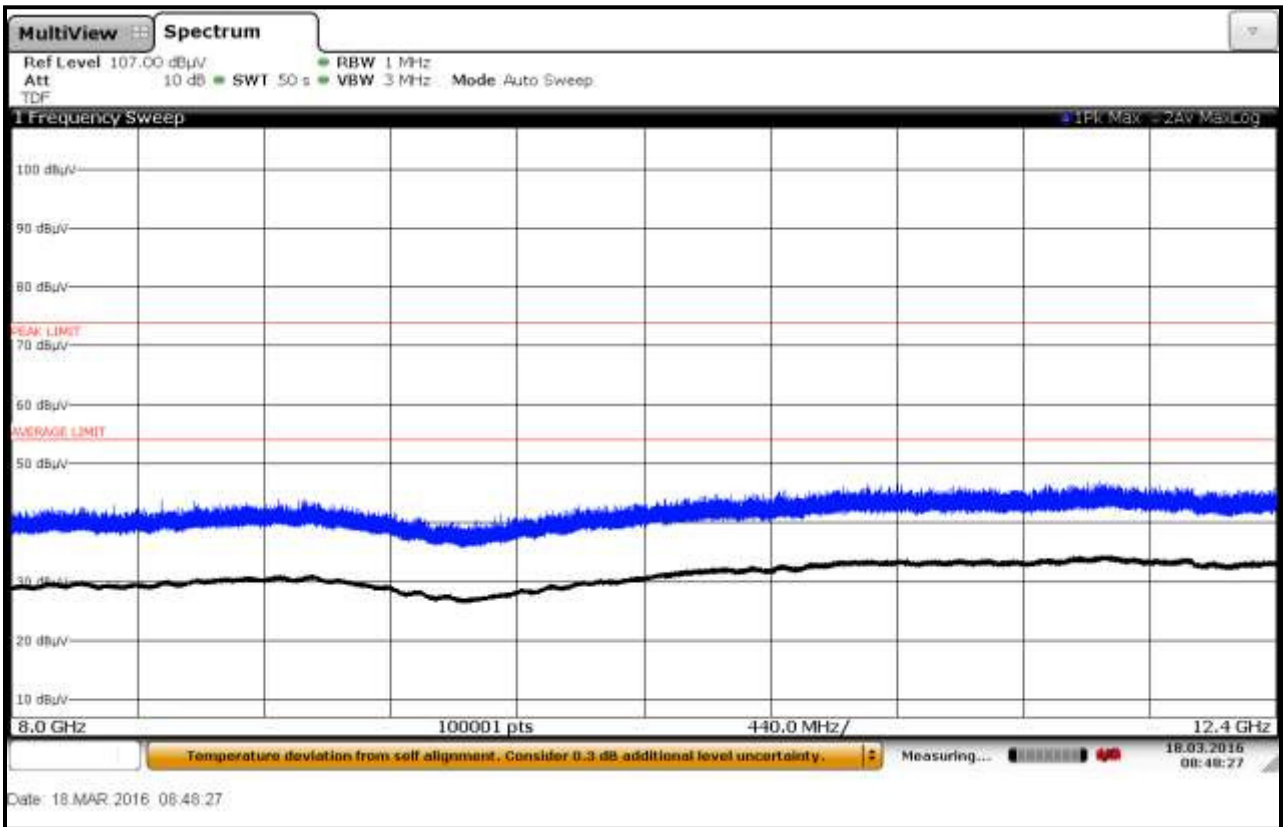
Plot 6-27: Radiated Emissions 4 GHz – 8 GHz; Fiberglass Container; TC #1; Vertical



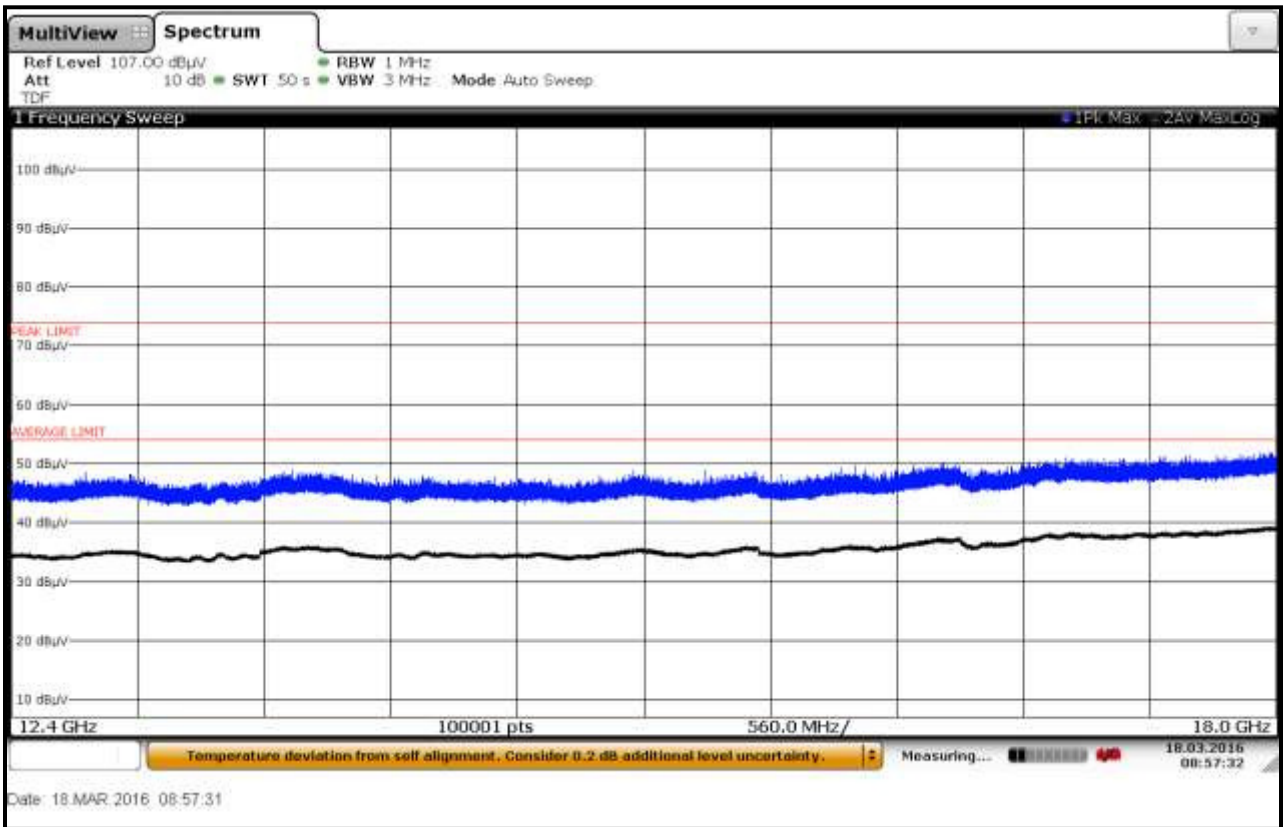
Plot 6-28: Radiated Emissions 8 GHz – 12.4 GHz; Fiberglass Container; TC #1, Horizontal



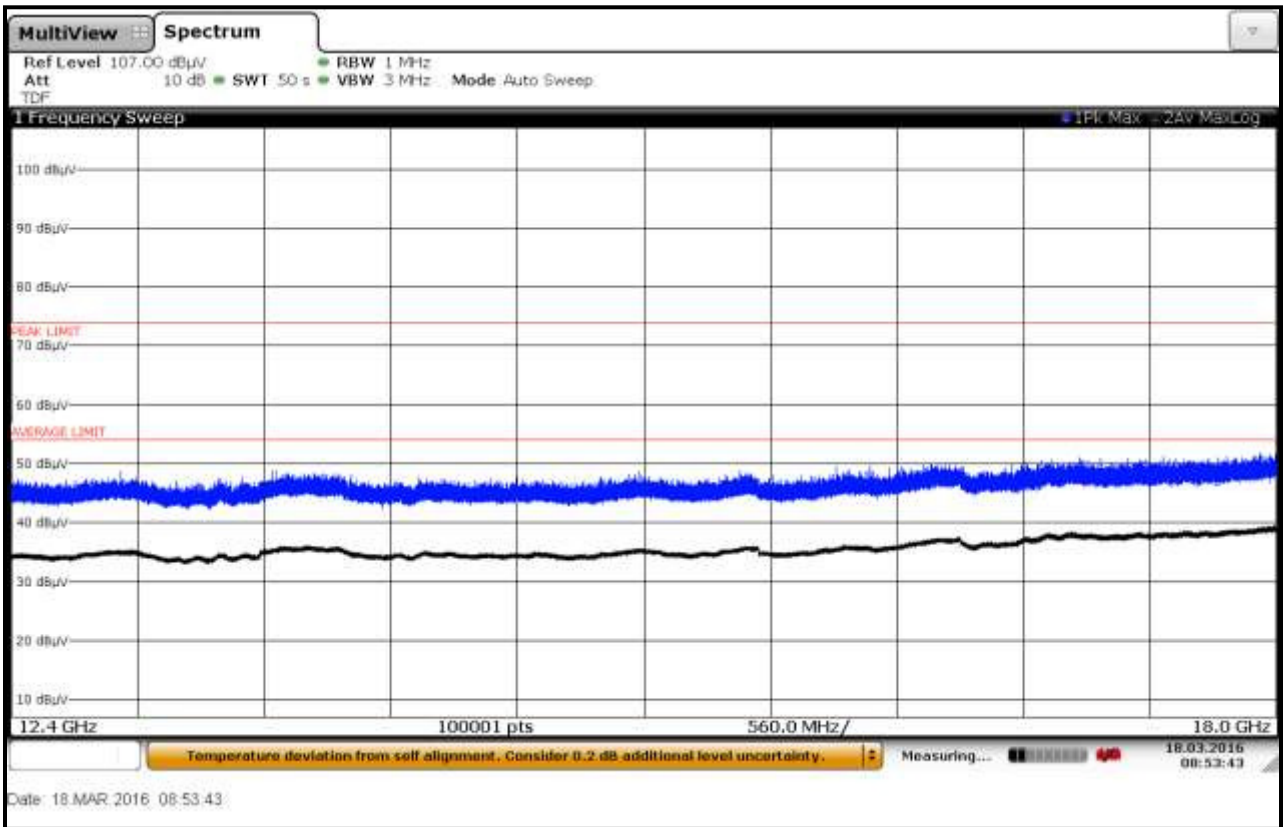
Plot 6-29: Radiated Emissions 8 GHz – 12.4 GHz; Fiberglass Container; TC #1, Vertical



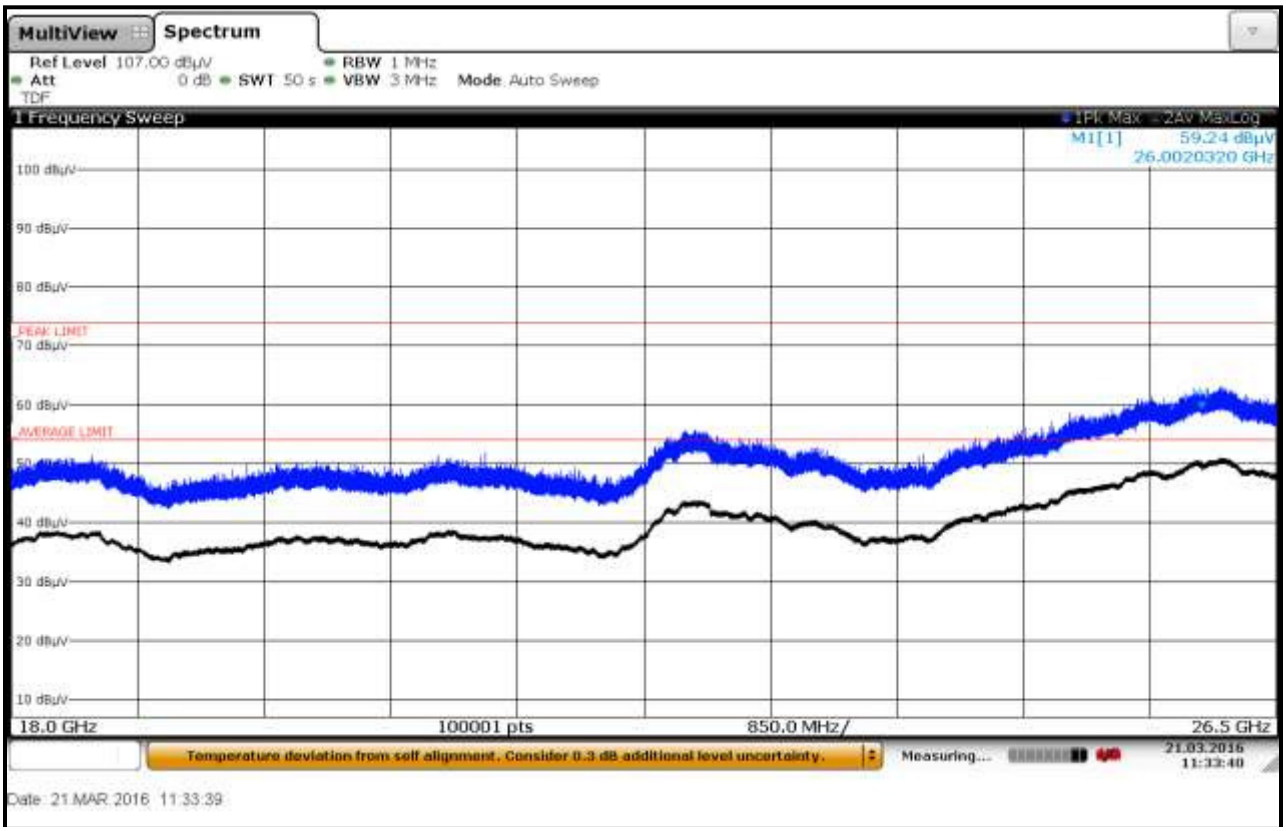
Plot 6-30: Radiated Emissions 12.4 GHz – 18 GHz; Fiberglass Container; TC #1, Horizontal



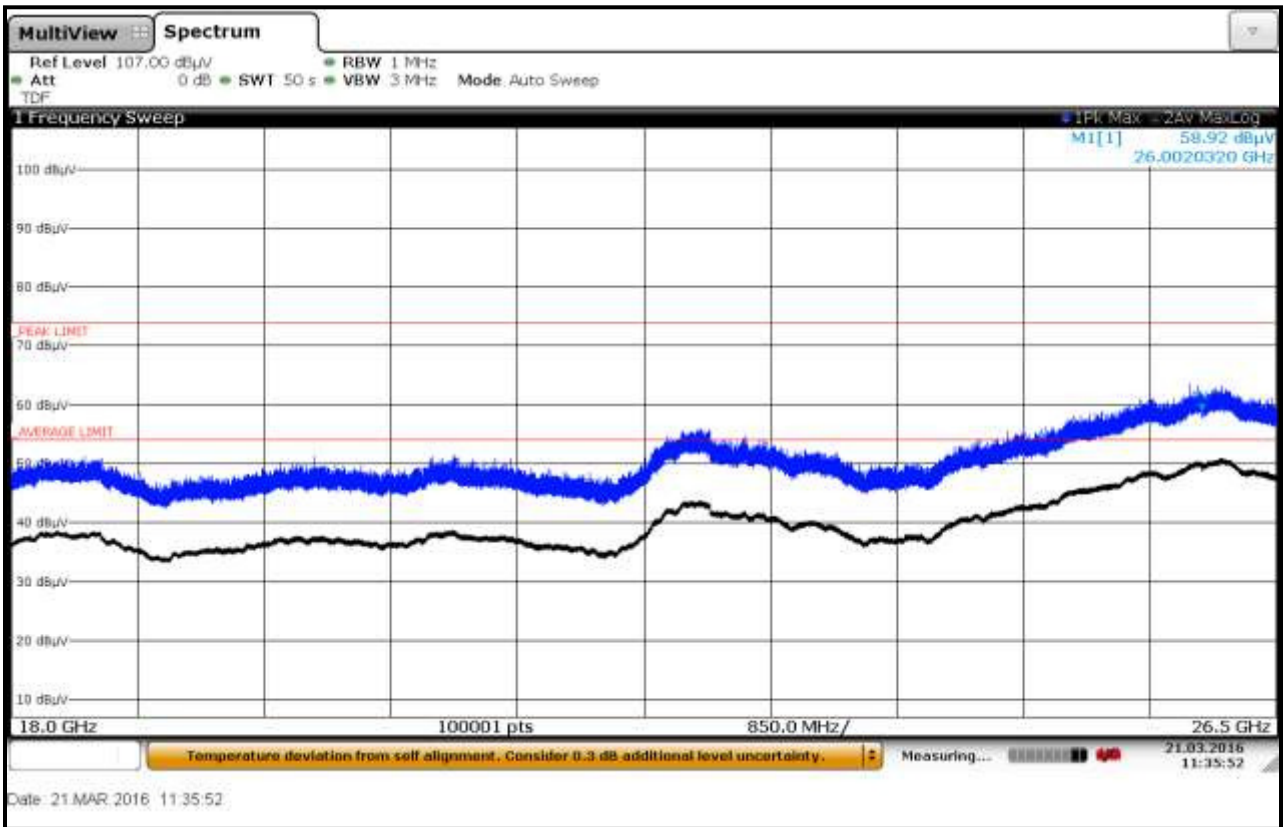
Plot 6-31: Radiated Emissions 12.4 GHz – 18 GHz; Fiberglass Container; TC #1, Vertical



Plot 6-32: Radiated Emissions 18 GHz – 26.5 GHz; Fiberglass Container; TC #1, Horizontal

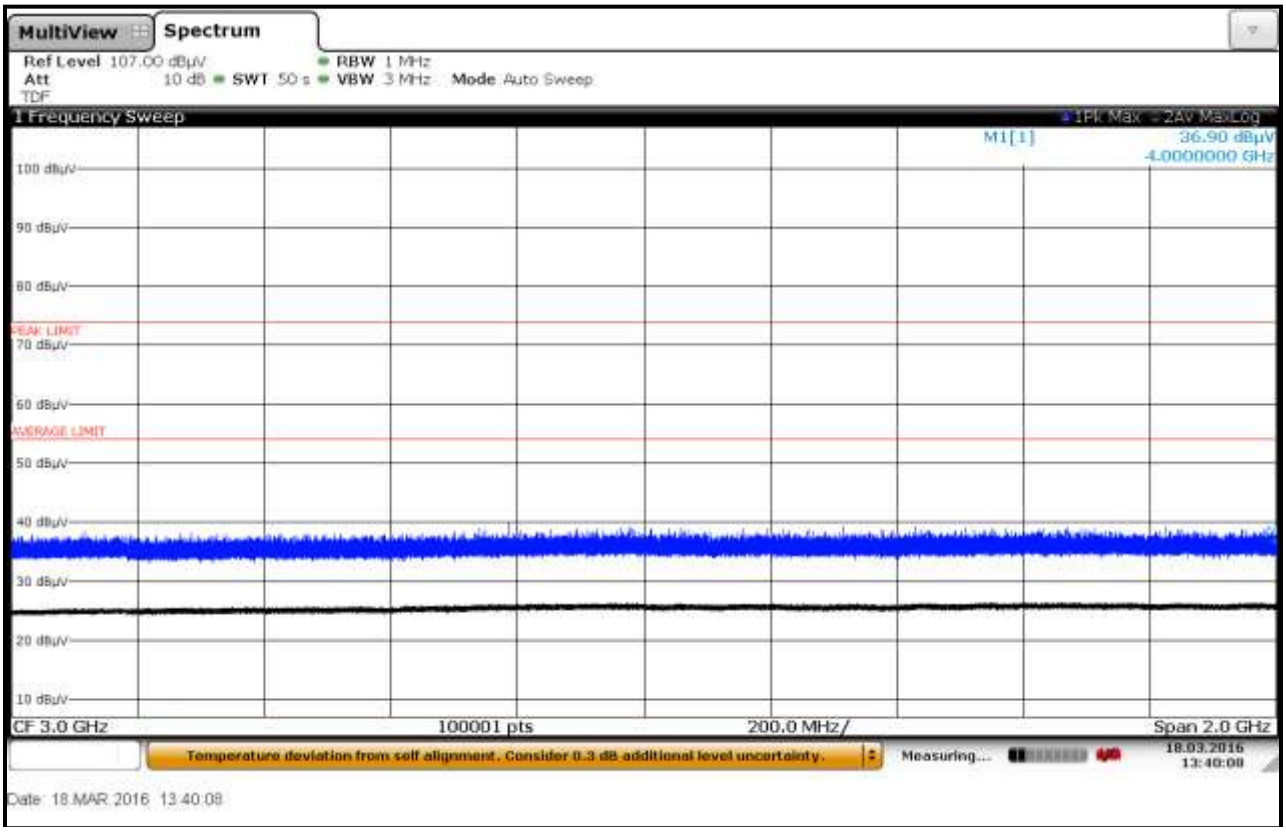


Plot 6-33: Radiated Emissions 18 GHz – 26.5 GHz; Fiberglass Container; TC #1, Vertical

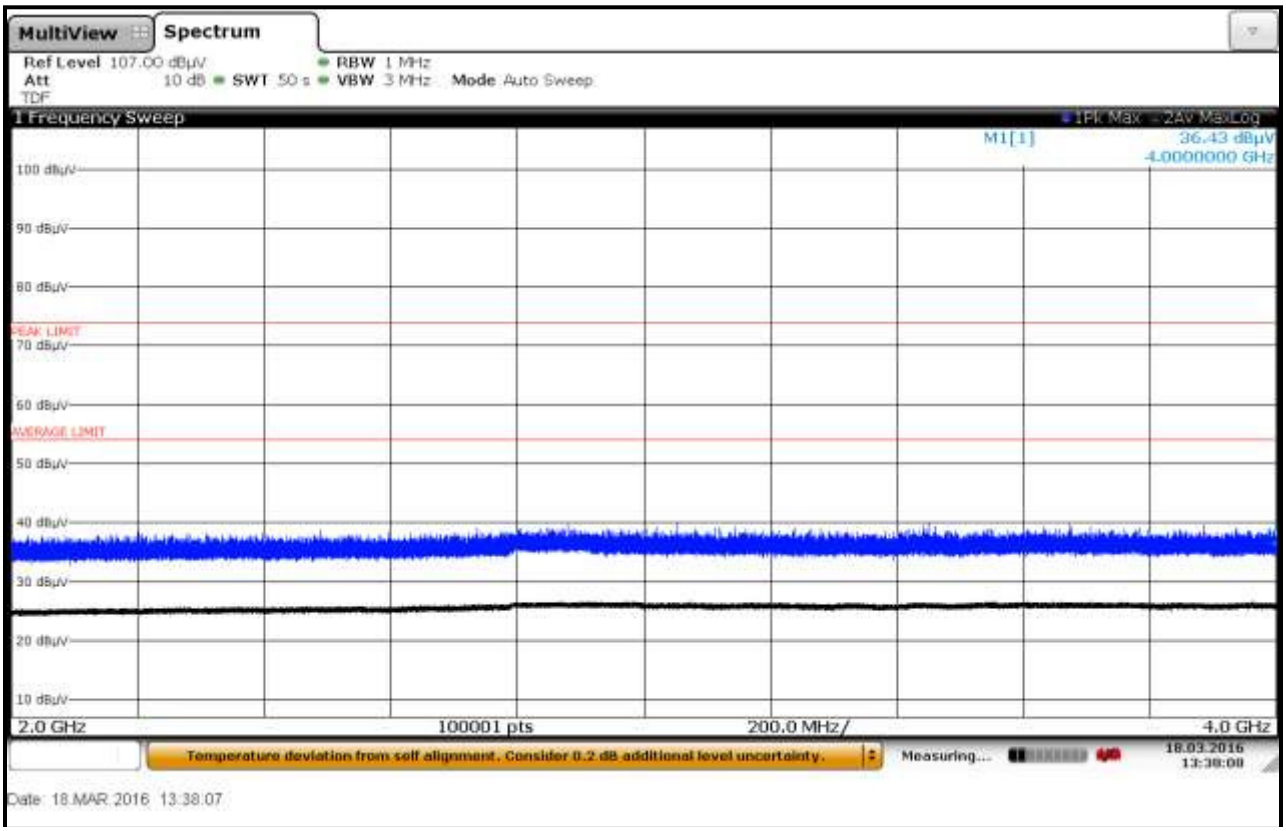


6.3.6 Radiated Emissions Test Data - 2 GHz – 26.5 GHz; Metal Container, TC #2

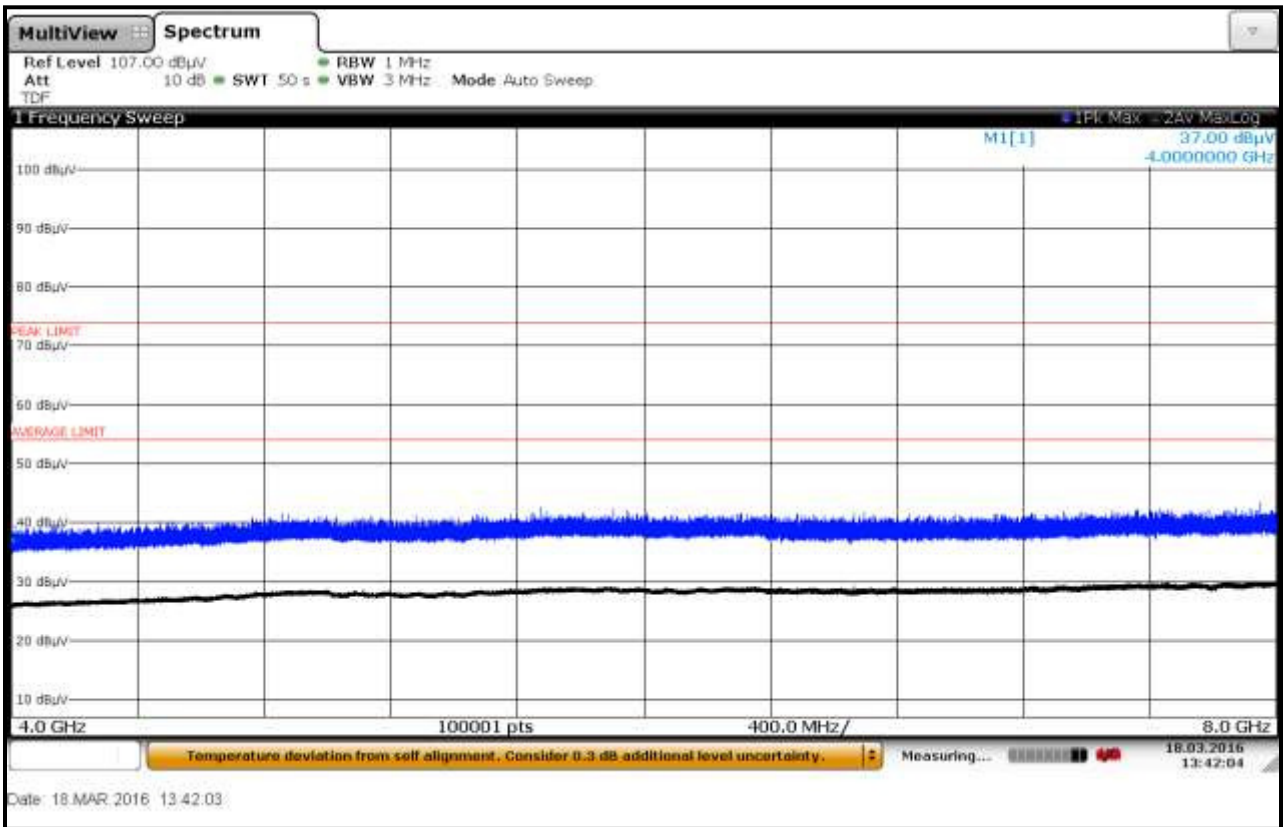
Plot 6-34: Radiated Emissions 2 GHz – 4 GHz; Metal Container; TC #2; Horizontal



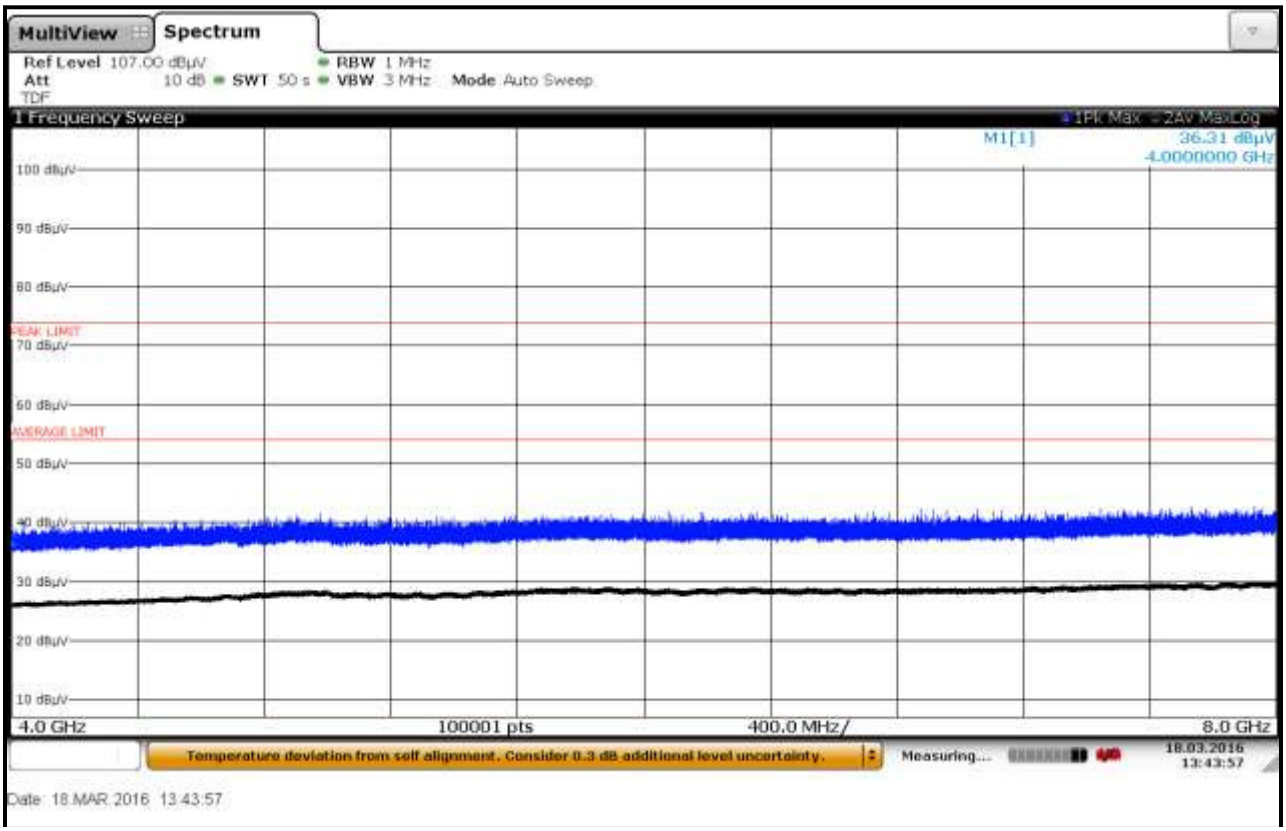
Plot 6-35: Radiated Emissions 2 GHz – 4 GHz; Metal Container; TC #2; Vertical



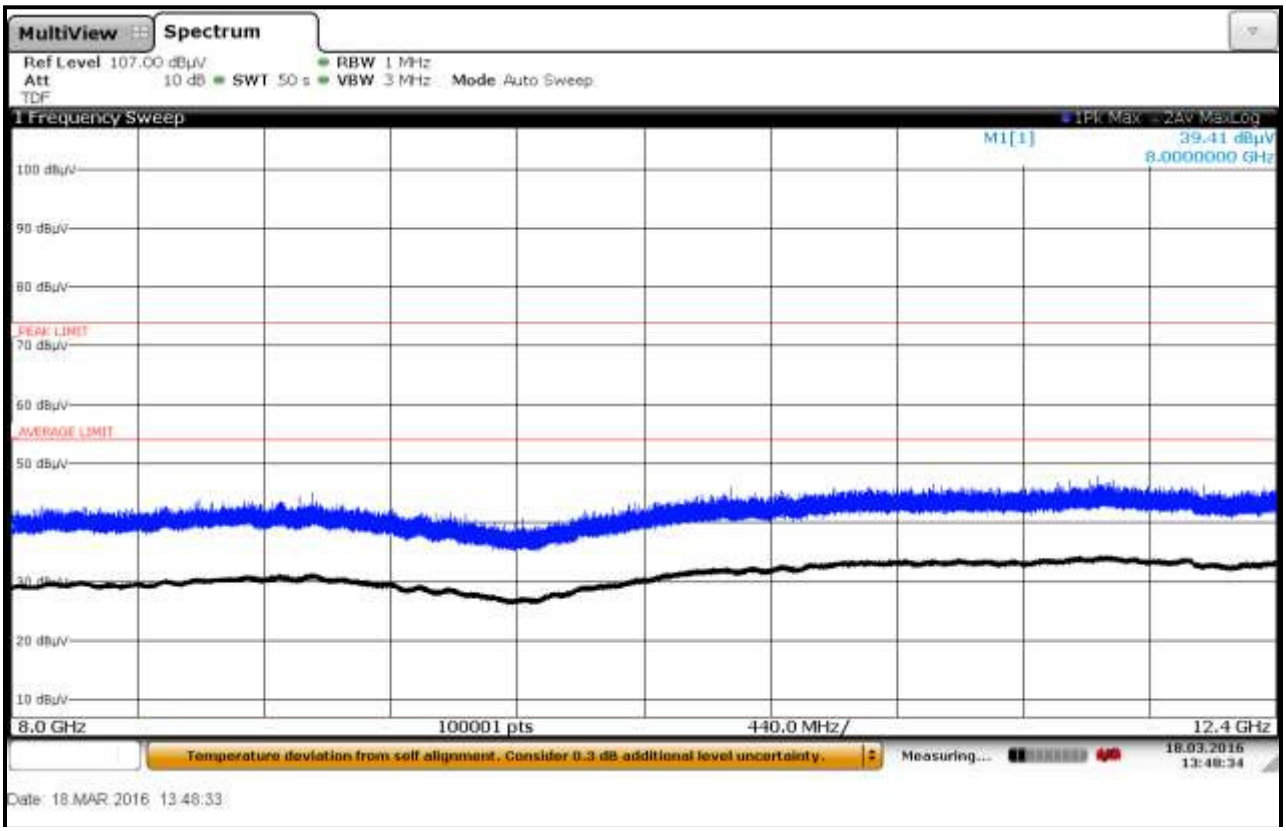
Plot 6-36: Radiated Emissions 4 GHz – 8 GHz; Metal Container; TC #2; Horizontal



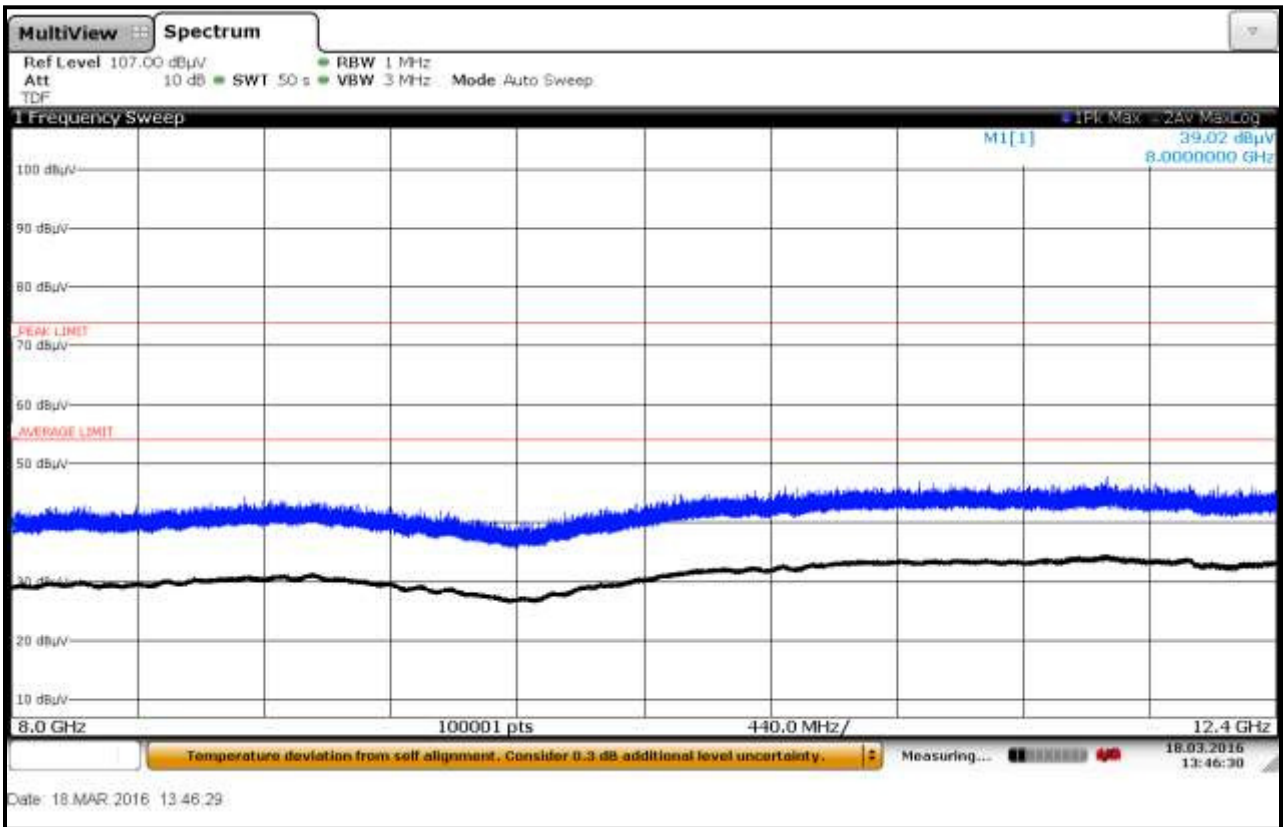
Plot 6-37: Radiated Emissions 4 GHz – 8 GHz; Metal Container; TC #2; Vertical



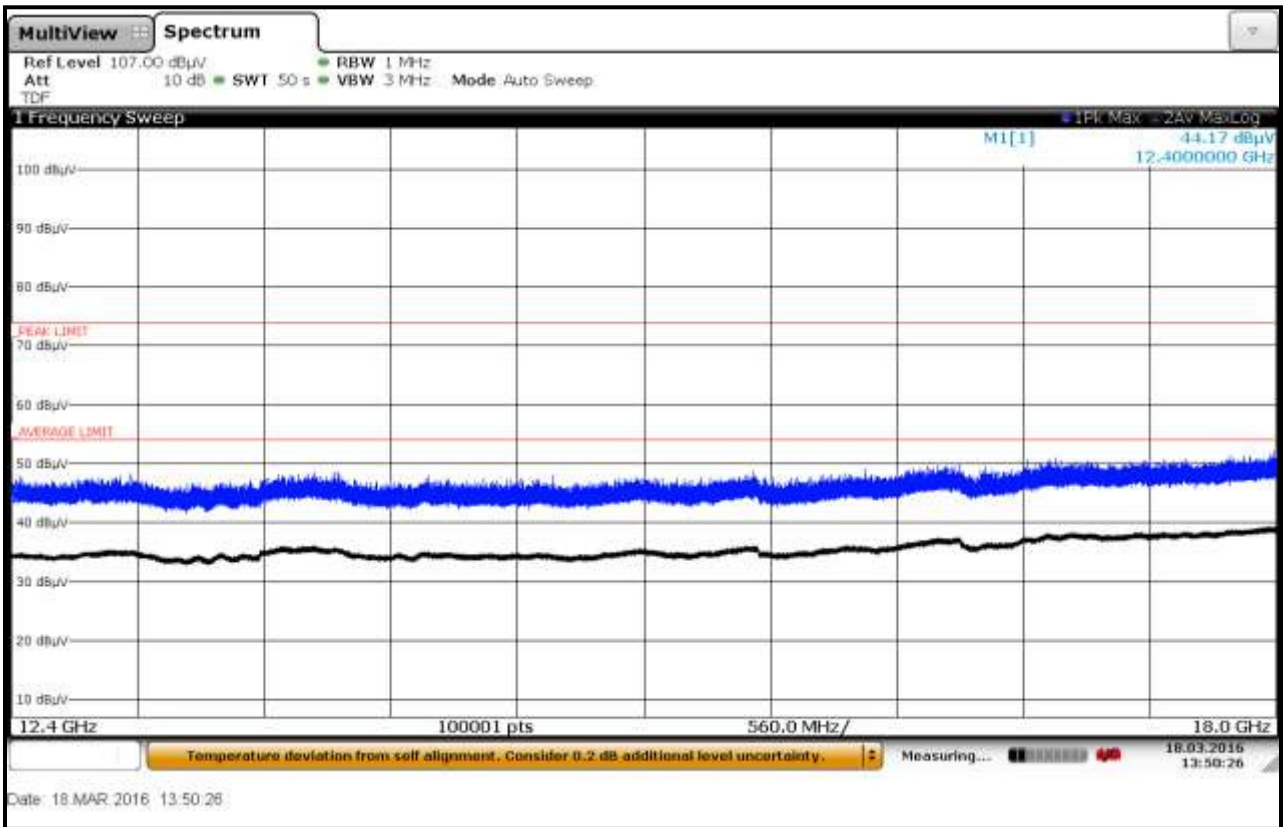
Plot 6-38: Radiated Emissions 8 GHz – 12.4 GHz; Metal Container; TC #2, Horizontal



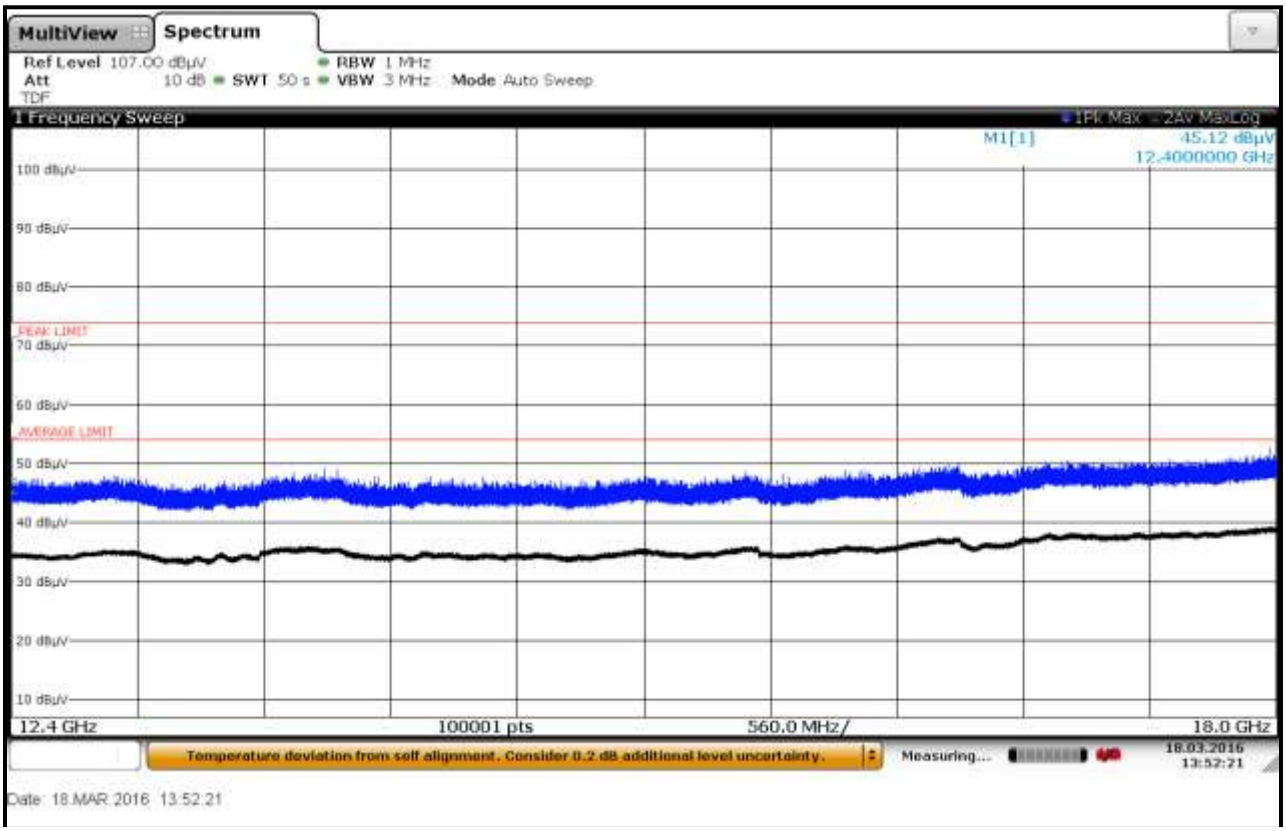
Plot 6-39: Radiated Emissions 8 GHz – 12.4 GHz; Metal Container; TC #2, Vertical



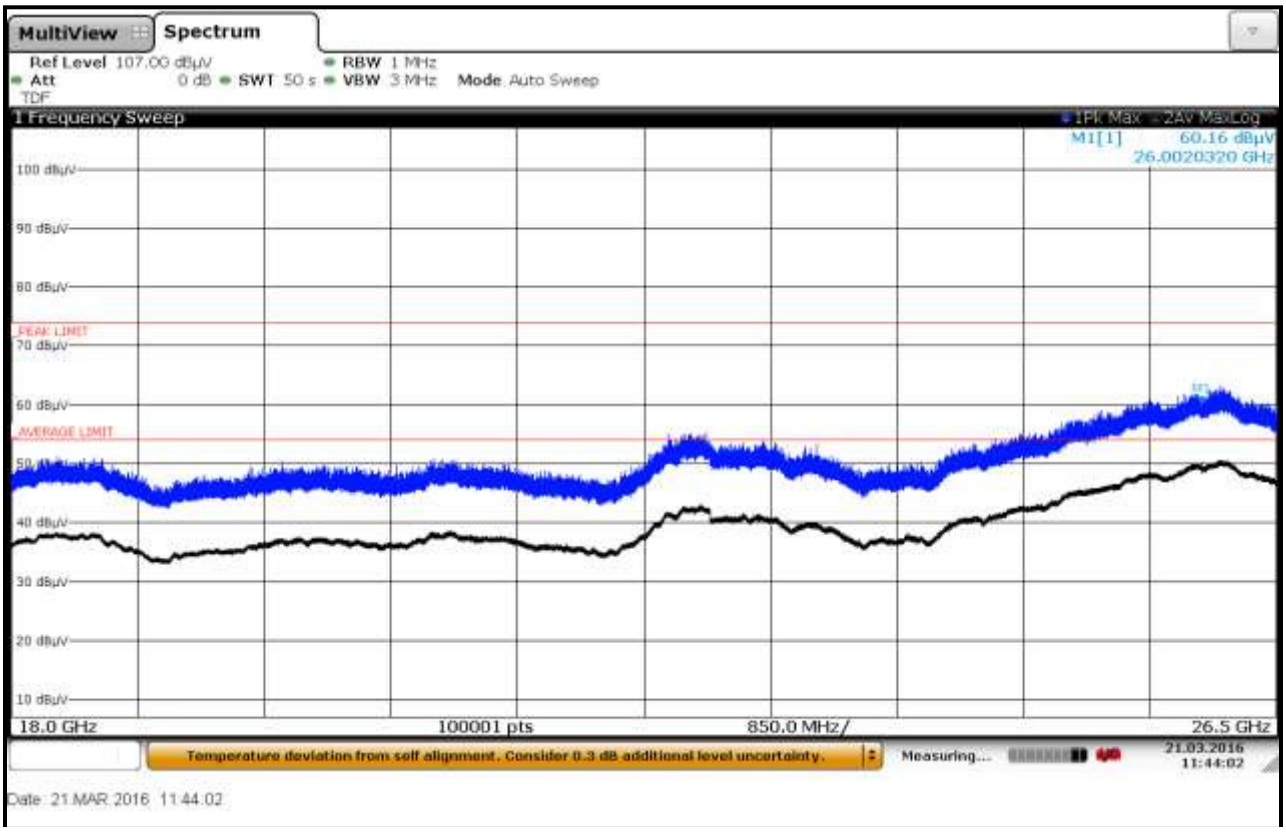
Plot 6-40: Radiated Emissions 12.4 GHz – 18 GHz; Metal Container; TC #2, Horizontal



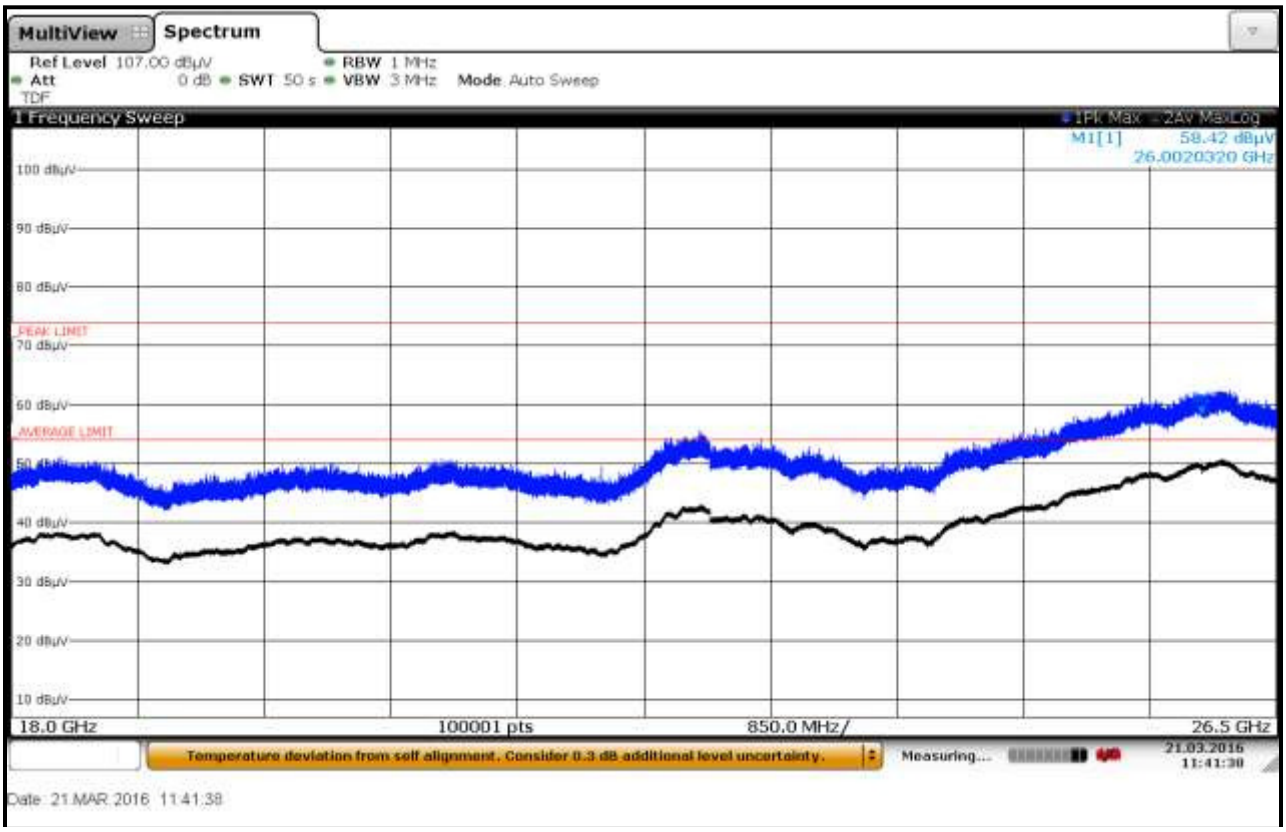
Plot 6-41: Radiated Emissions 12.4 GHz – 18 GHz; Metal Container; TC #2, Vertical



Plot 6-42: Radiated Emissions 18 GHz – 26.5 GHz; Metal Container; TC #2, Horizontal

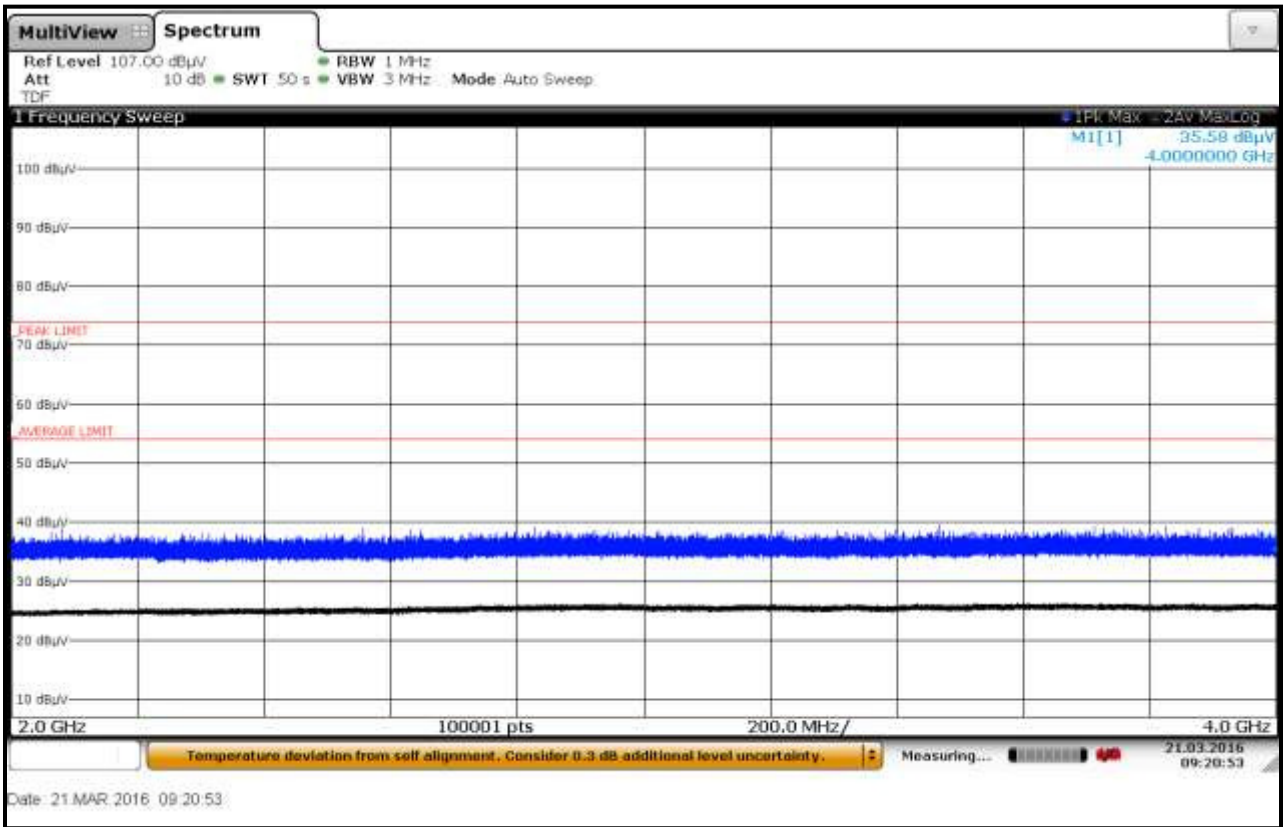


Plot 6-43: Radiated Emissions 18 GHz – 26.5 GHz; Metal Container; TC #2, Vertical

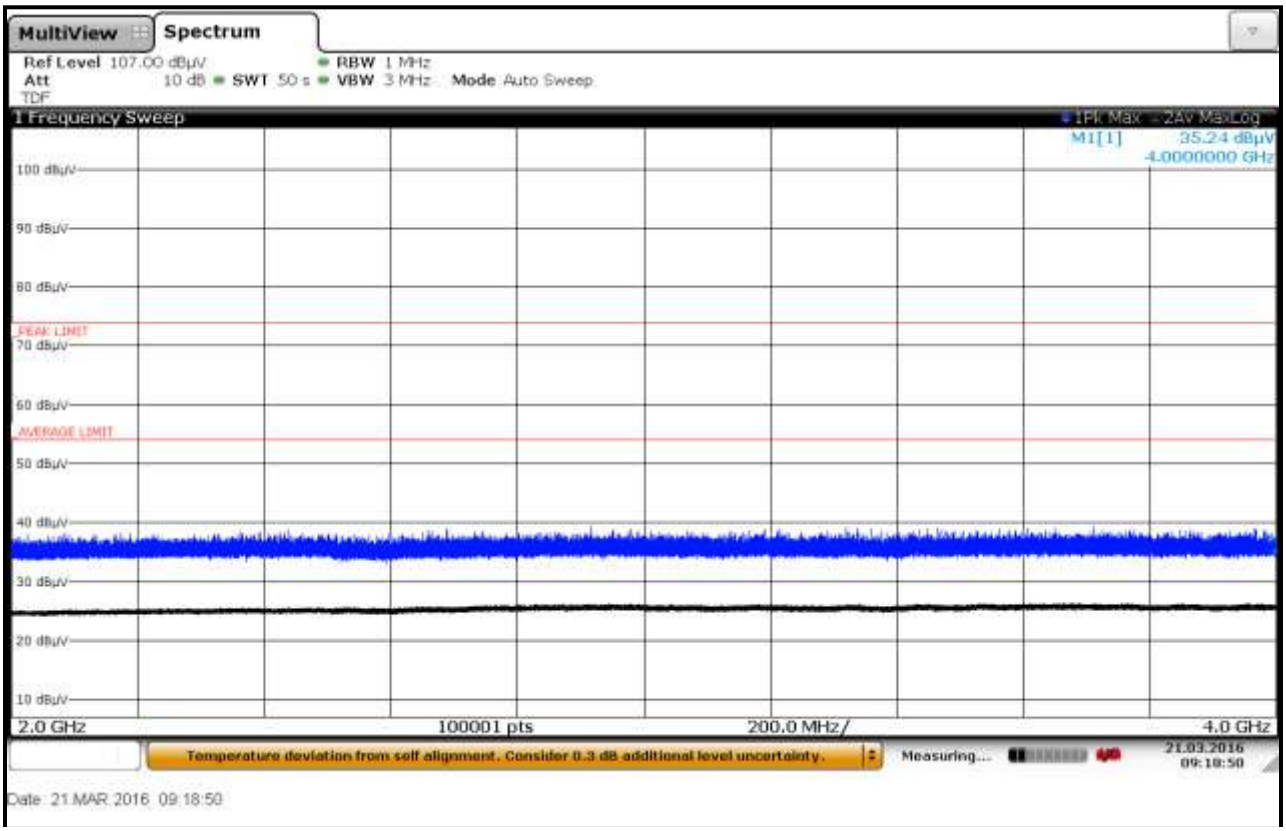


6.3.7 Radiated Emissions Test Data - 2 GHz – 26.5 GHz; Concrete Container, TC #2

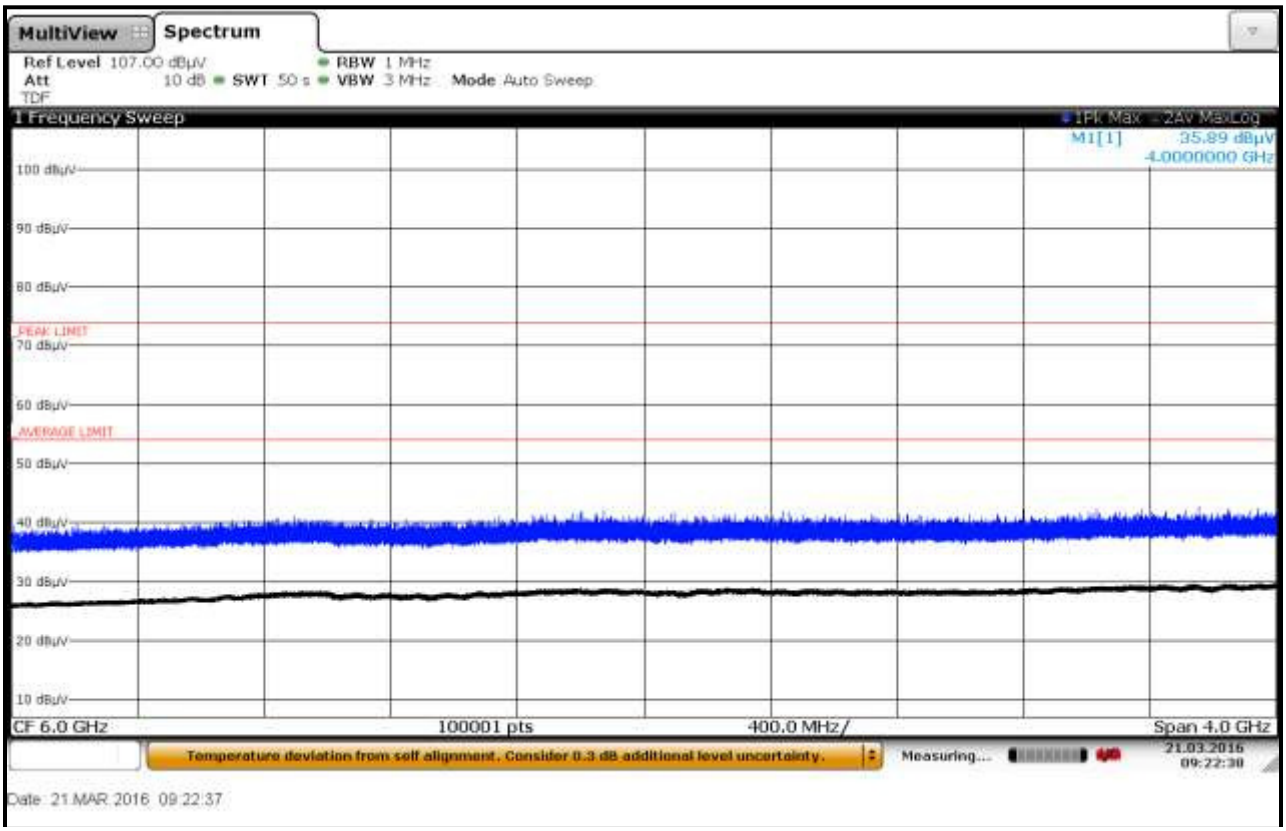
Plot 6-44: Radiated Emissions 2 GHz – 4 GHz; Concrete Container; TC #2; Horizontal



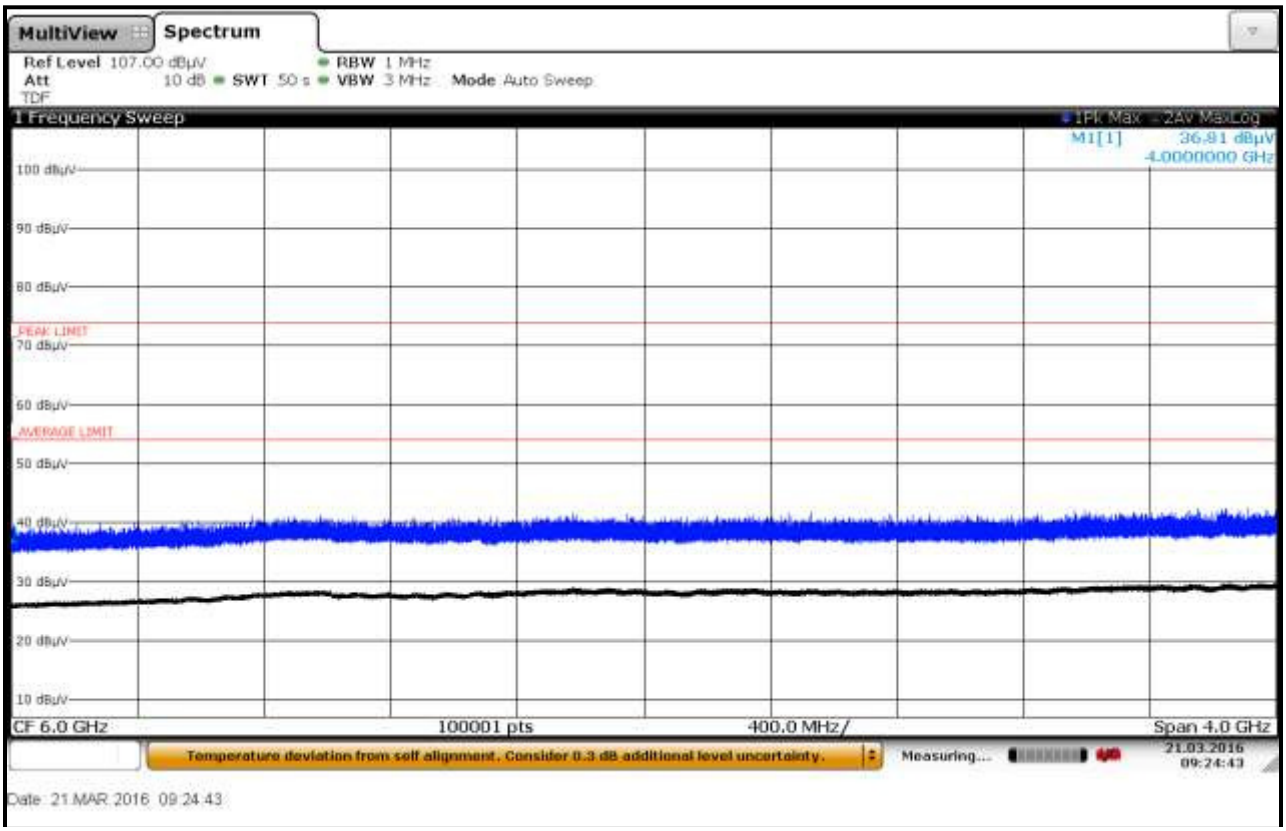
Plot 6-45: Radiated Emissions 2 GHz – 4 GHz; Concrete Container; TC #2; Vertical



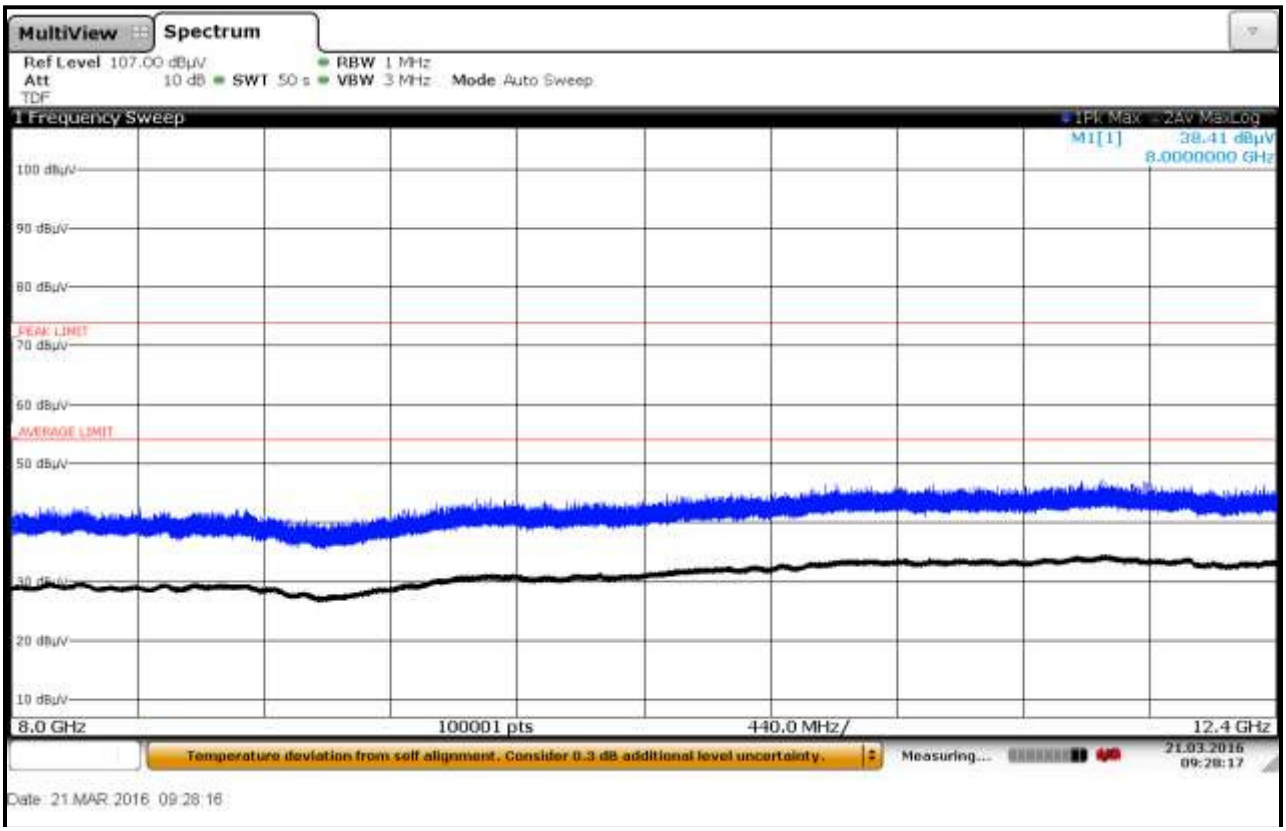
Plot 6-46: Radiated Emissions 4 GHz – 8 GHz; Concrete Container; TC #2; Horizontal



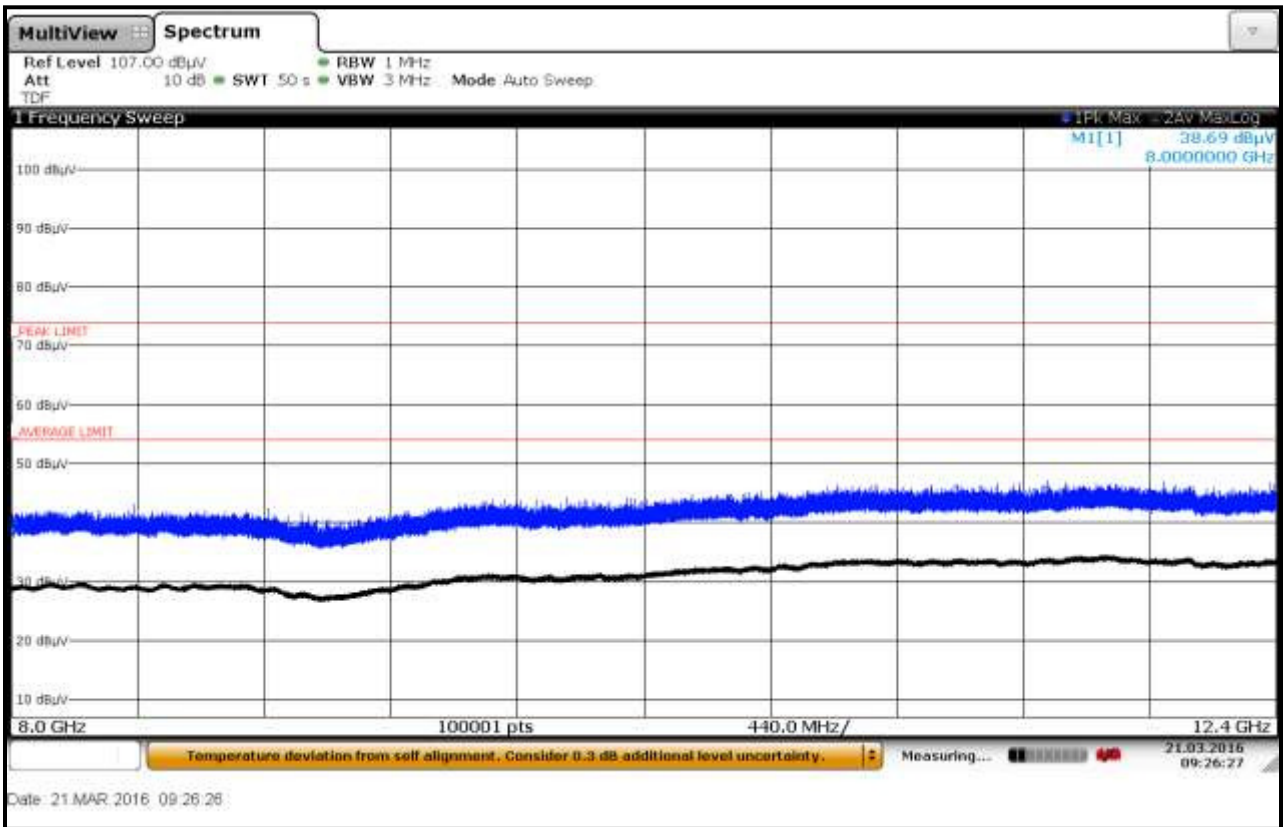
Plot 6-47: Radiated Emissions 4 GHz – 8 GHz; Concrete Container; TC #2; Vertical



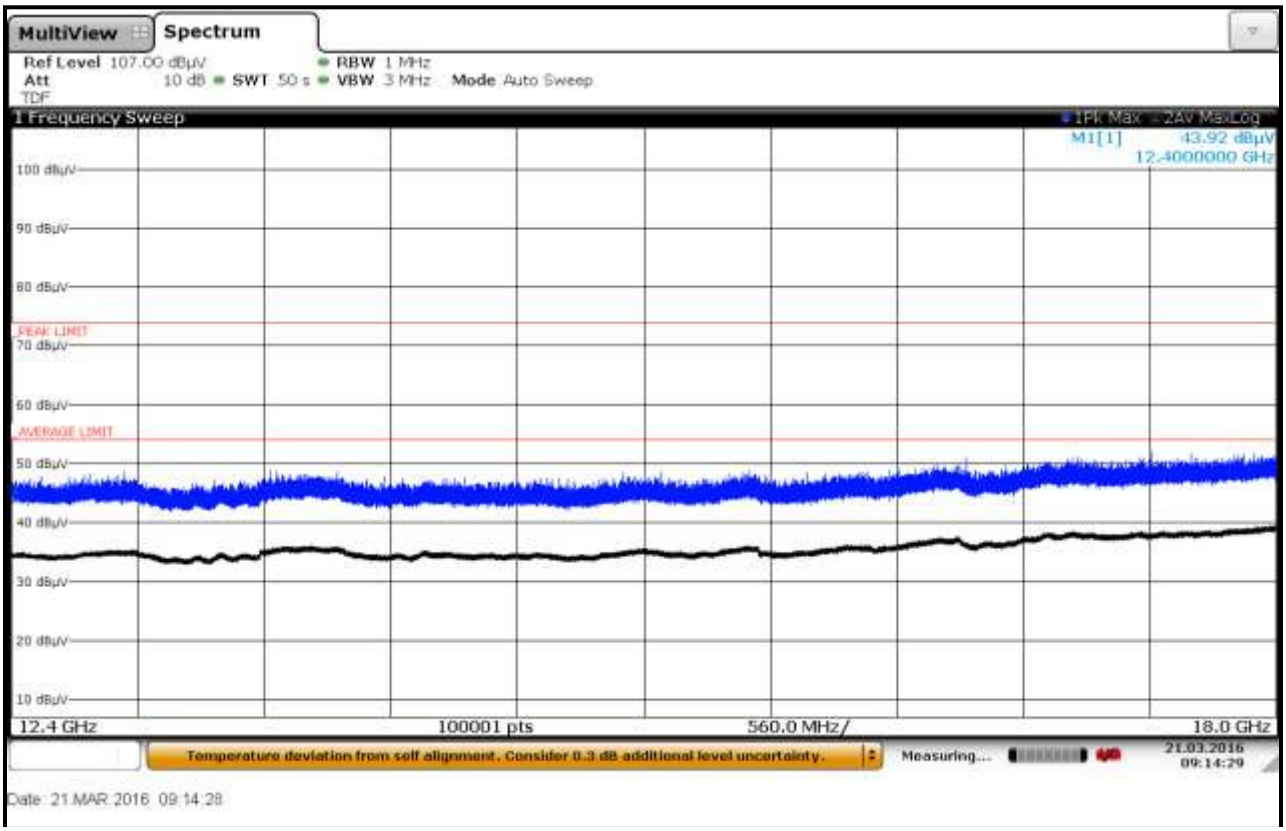
Plot 6-48: Radiated Emissions 8 GHz – 12.4 GHz; Concrete Container; TC #2, Horizontal



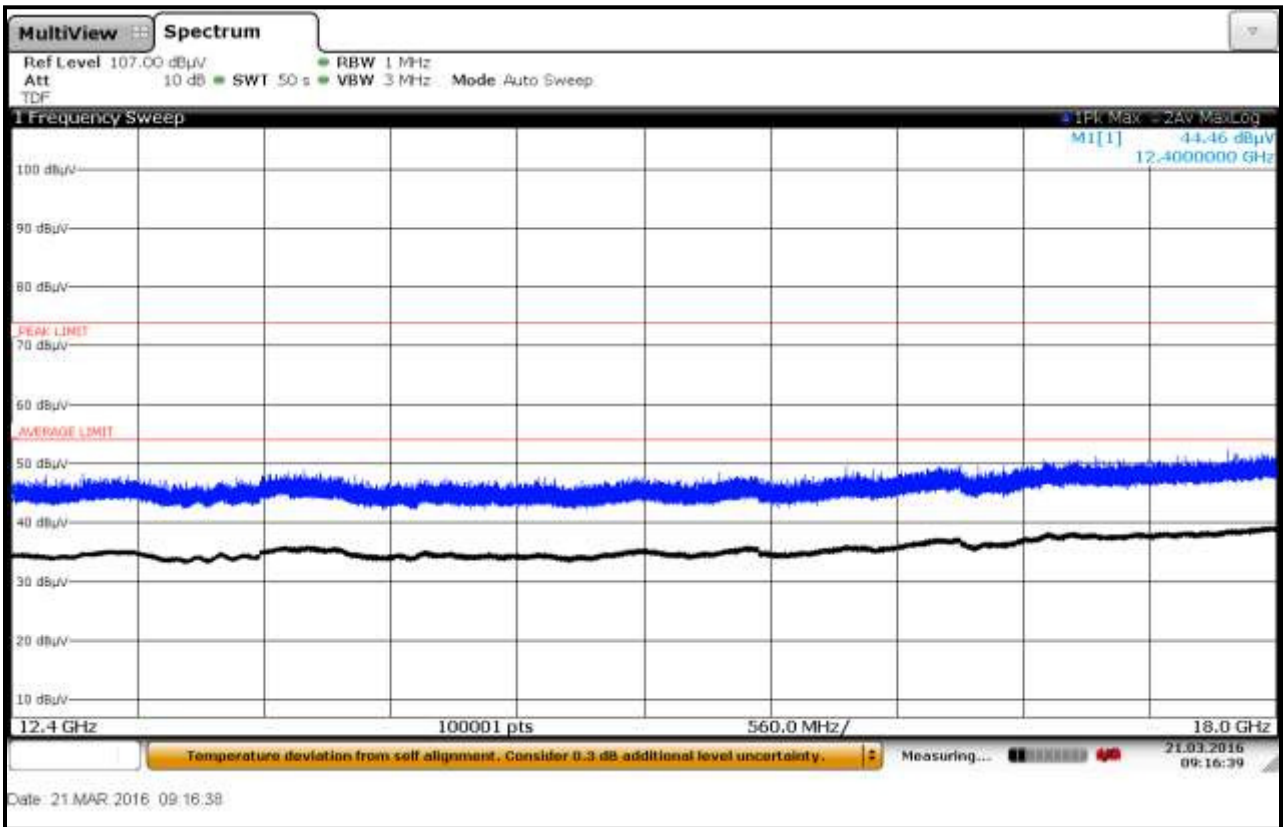
Plot 6-49: Radiated Emissions 8 GHz – 12.4 GHz; Concrete Container; TC #2, Vertical



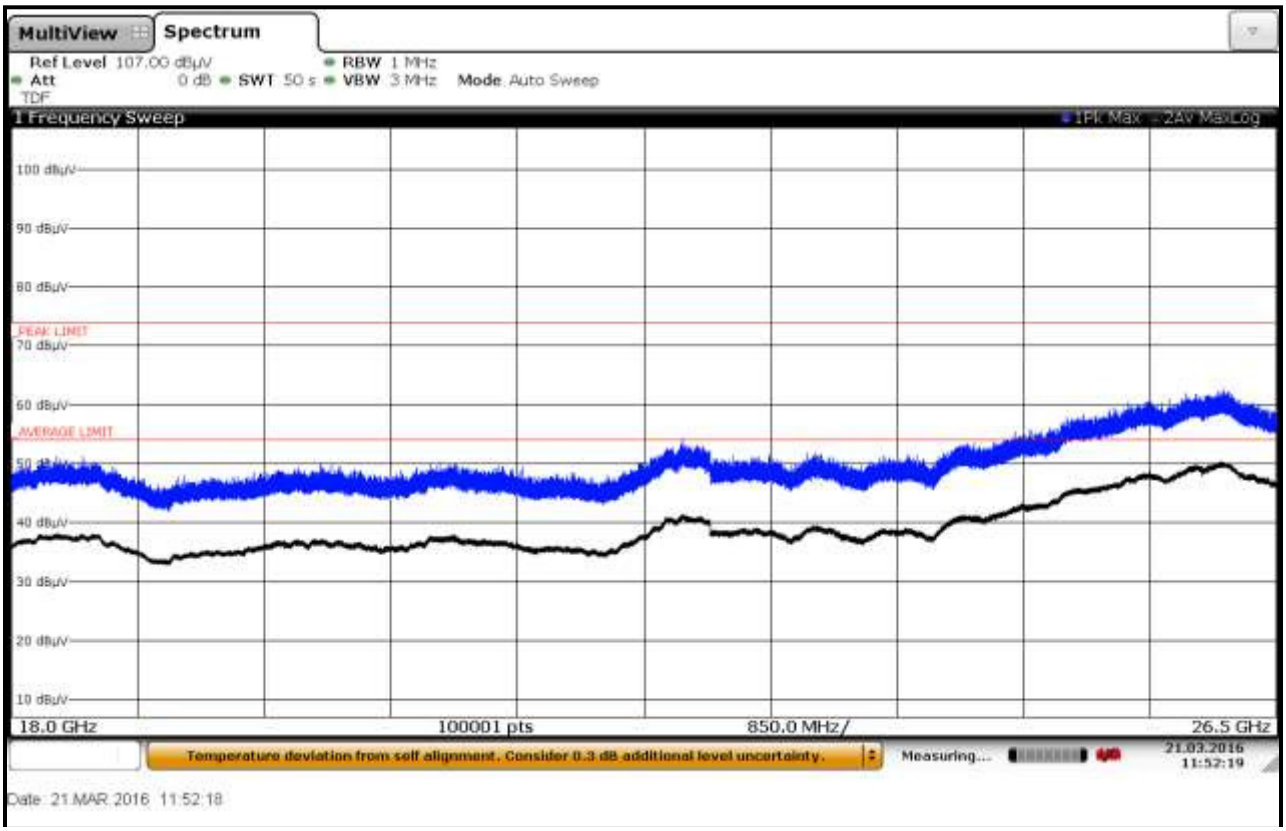
Plot 6-50: Radiated Emissions 12.4 GHz – 18 GHz; Concrete Container; TC #2, Horizontal



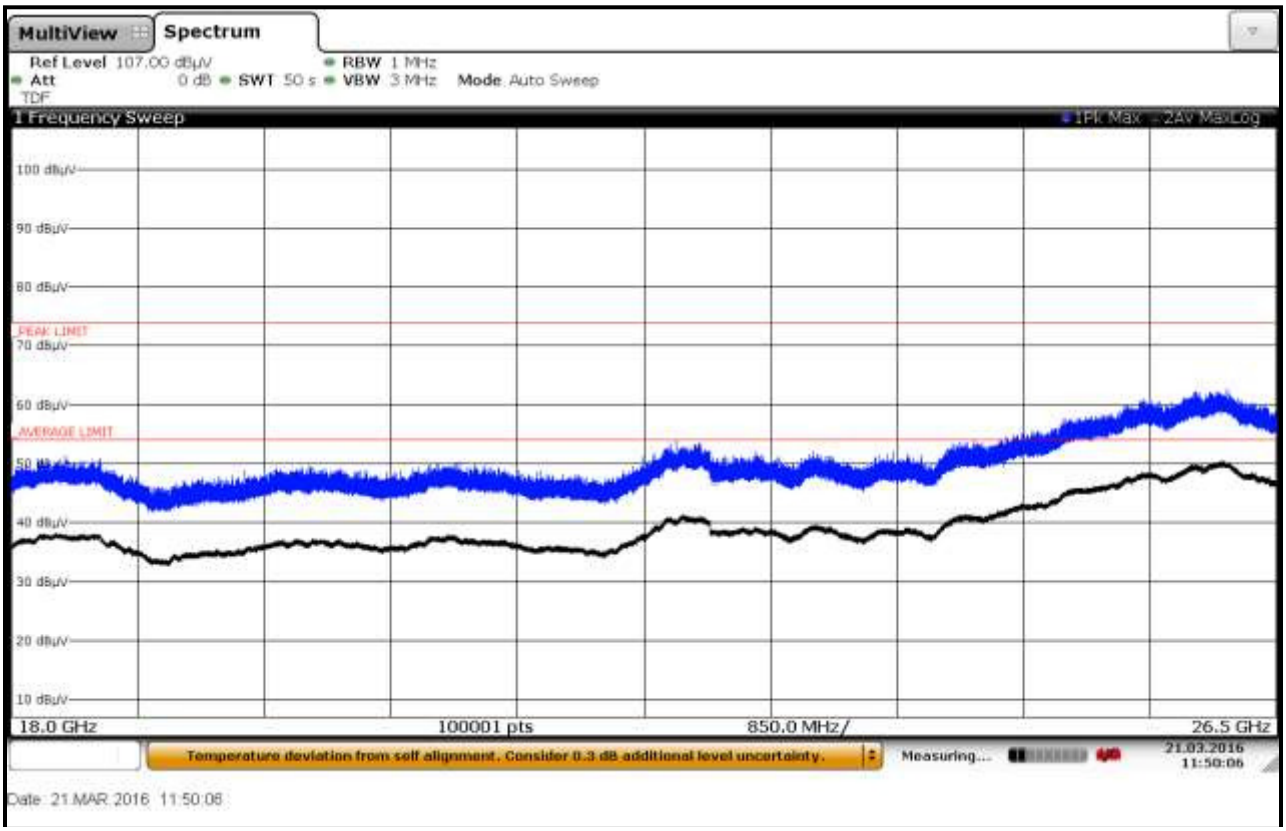
Plot 6-51: Radiated Emissions 12.4 GHz – 18 GHz; Concrete Container; TC #2, Vertical



Plot 6-52: Radiated Emissions 18 GHz – 26.5 GHz; Concrete Container; TC #2, Horizontal

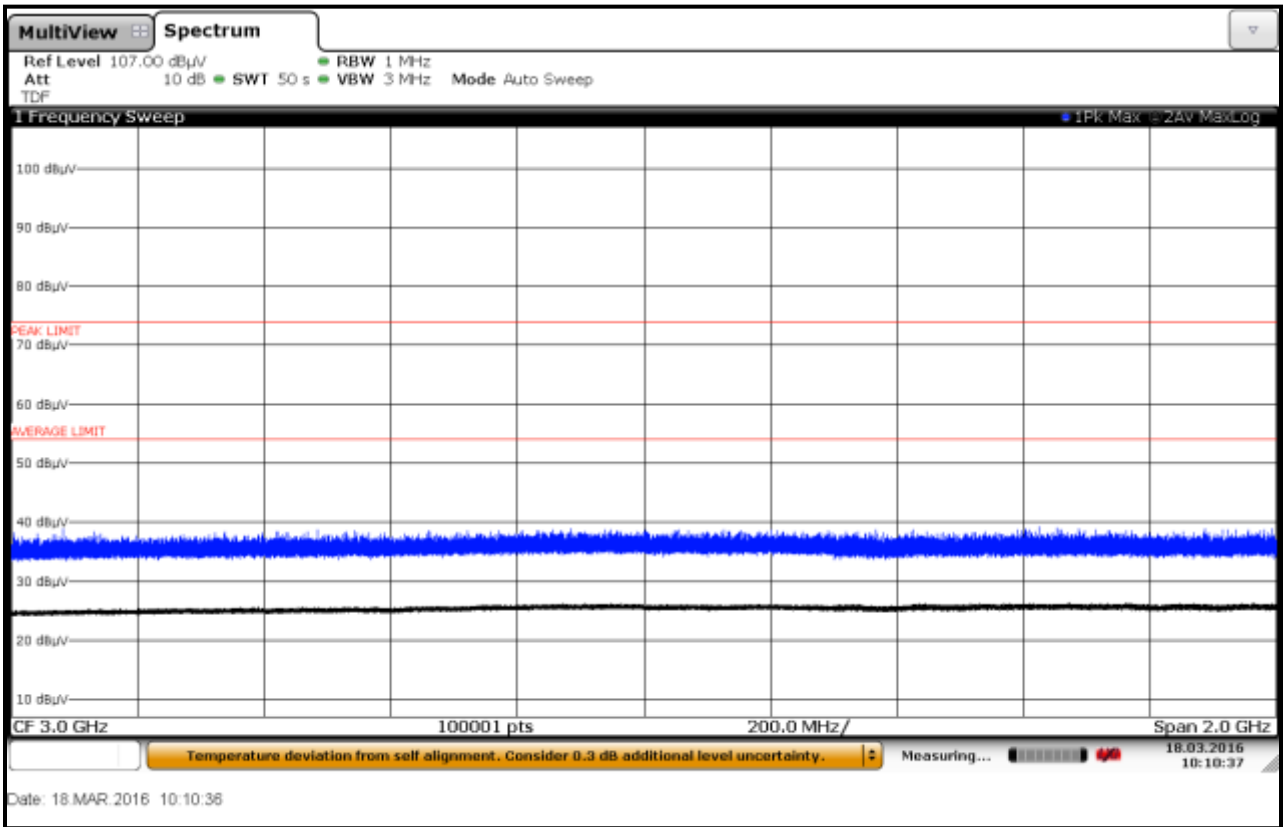


Plot 6-53: Radiated Emissions 18 GHz – 26.5 GHz; Concrete Container; TC #2, Vertical

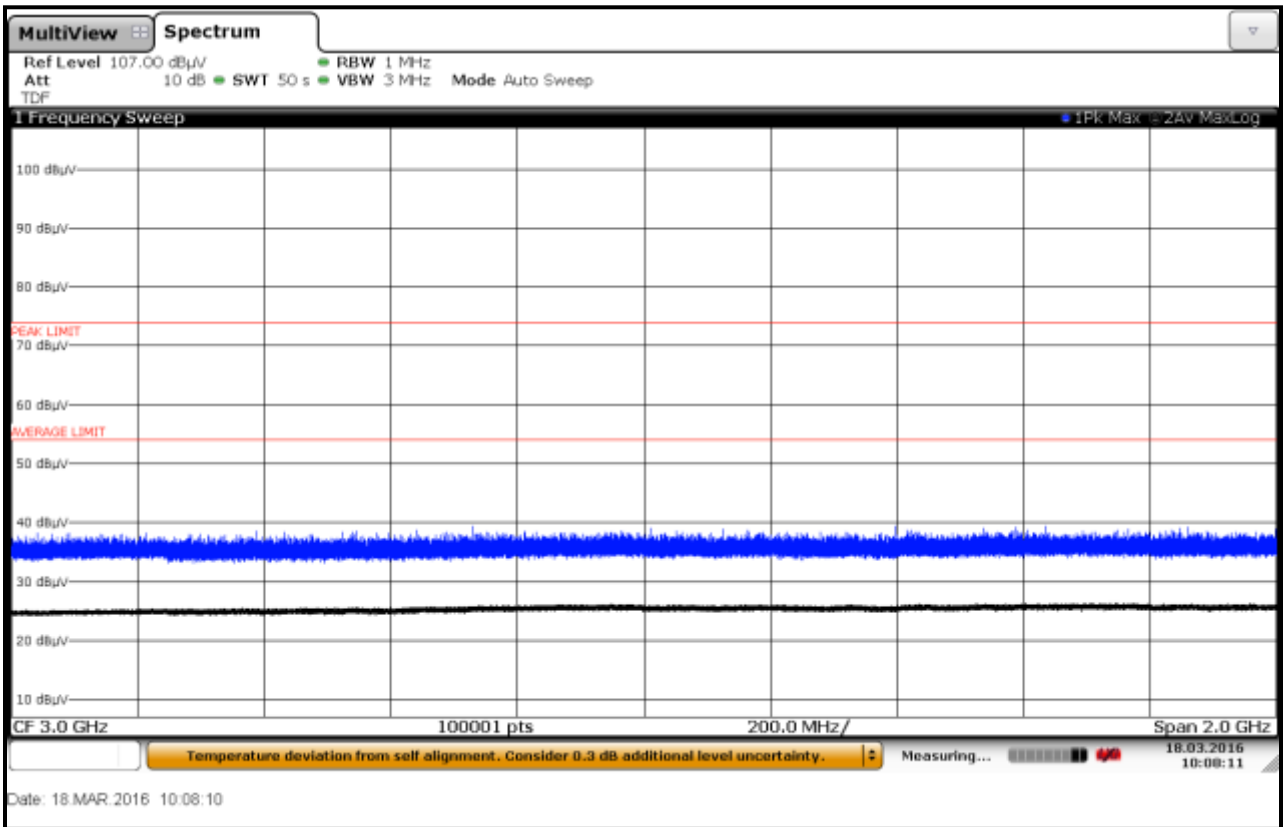


6.3.8 Radiated Emissions Test Data - 2 GHz – 26.5 GHz; Fiberglass Container, TC #2

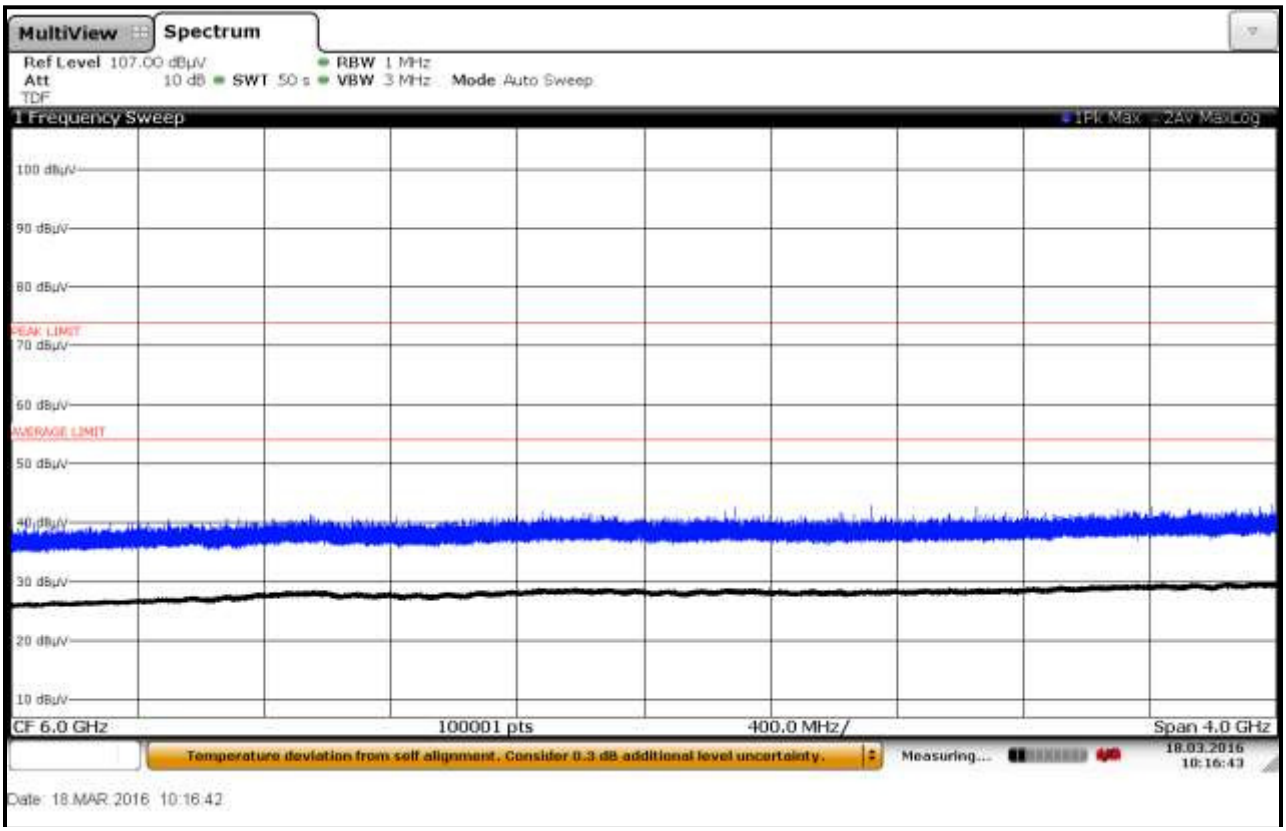
Plot 6-54: Radiated Emissions 2 GHz – 4 GHz; Fiberglass Container; TC #2; Horizontal



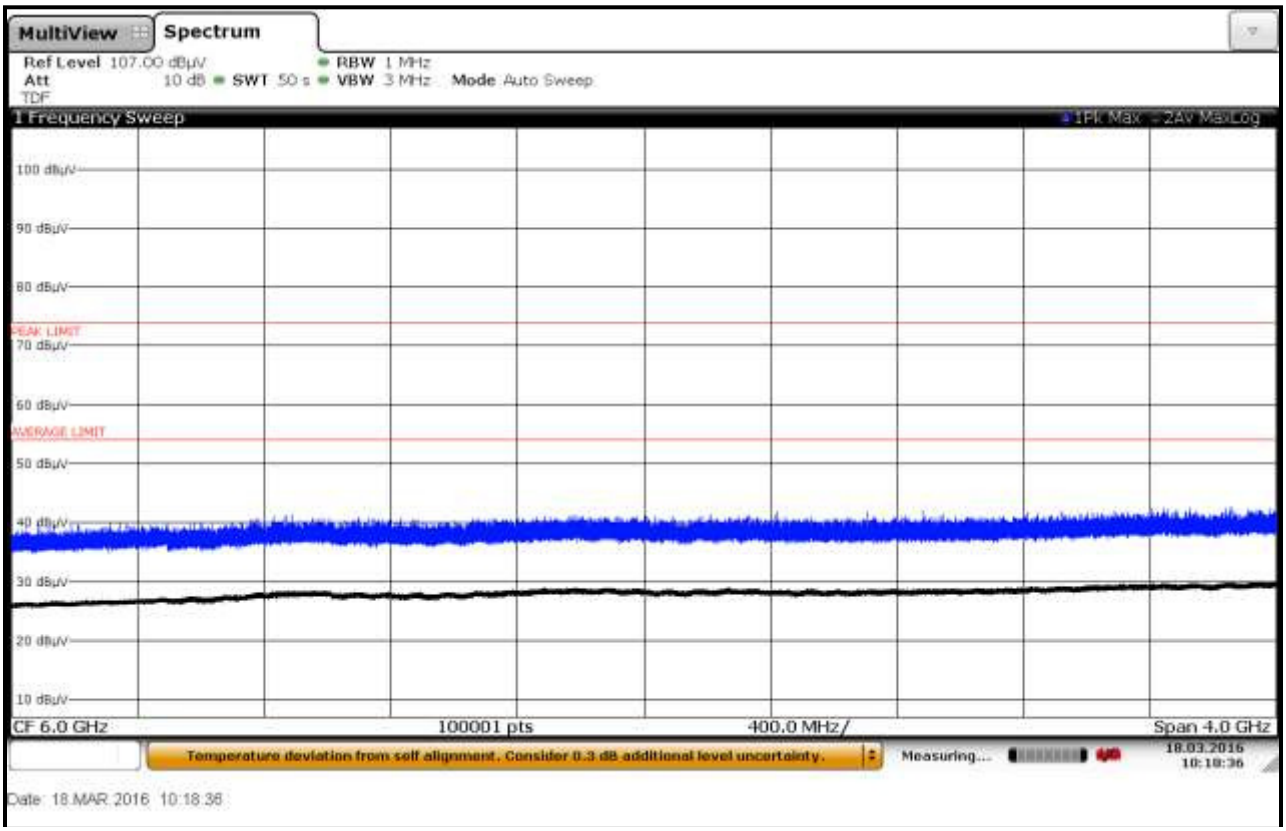
Plot 6-55: Radiated Emissions 2 GHz – 4 GHz; Fiberglass Container; TC #2; Vertical



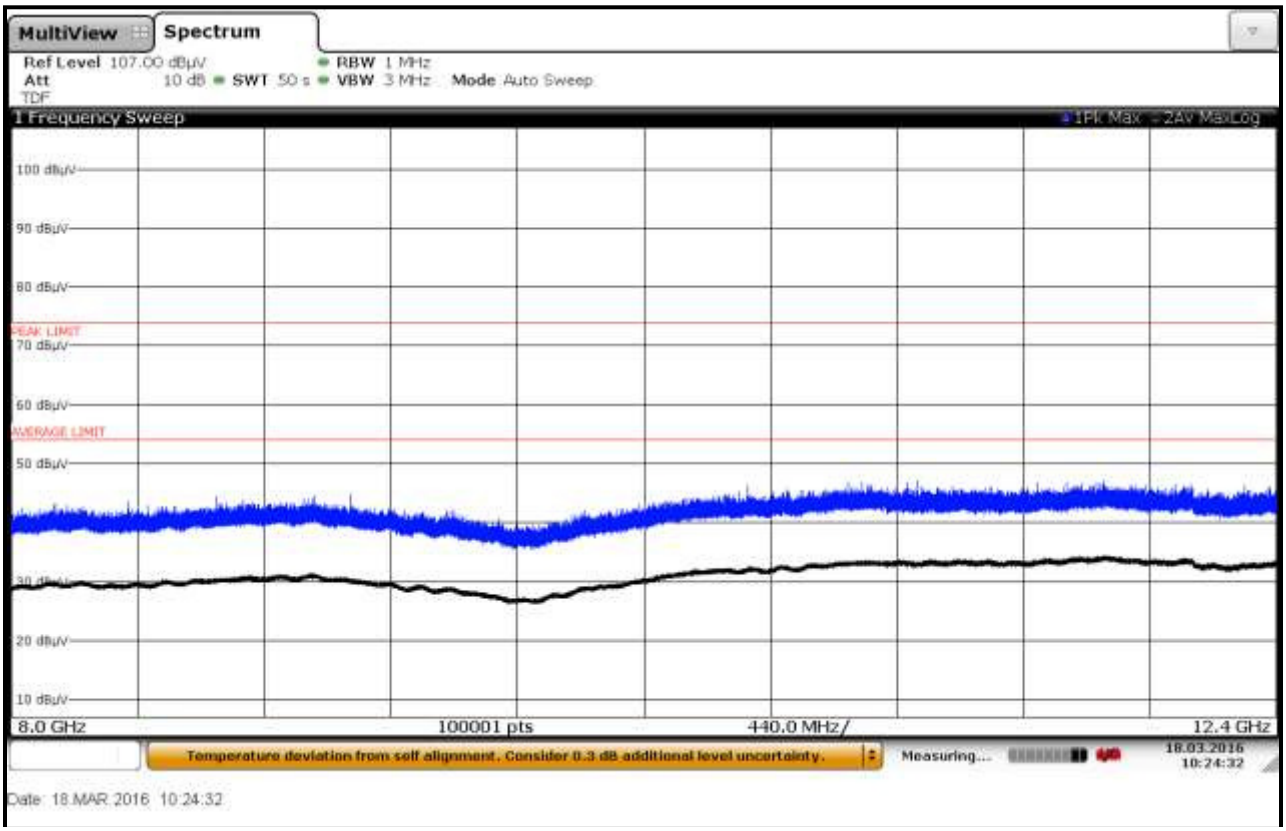
Plot 6-56: Radiated Emissions 4 GHz – 8 GHz; Fiberglass Container; TC #2; Horizontal



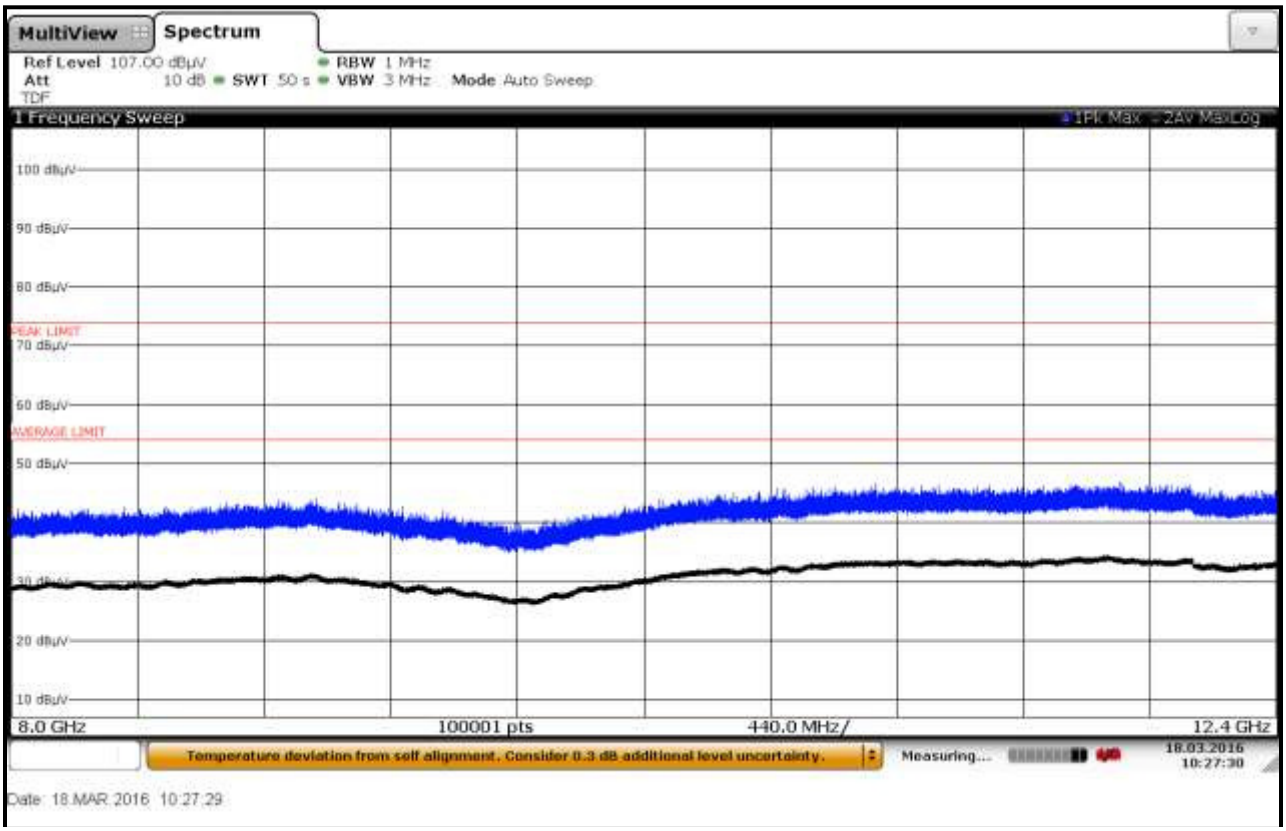
Plot 6-57: Radiated Emissions 4 GHz – 8 GHz; Fiberglass Container; TC #2; Vertical



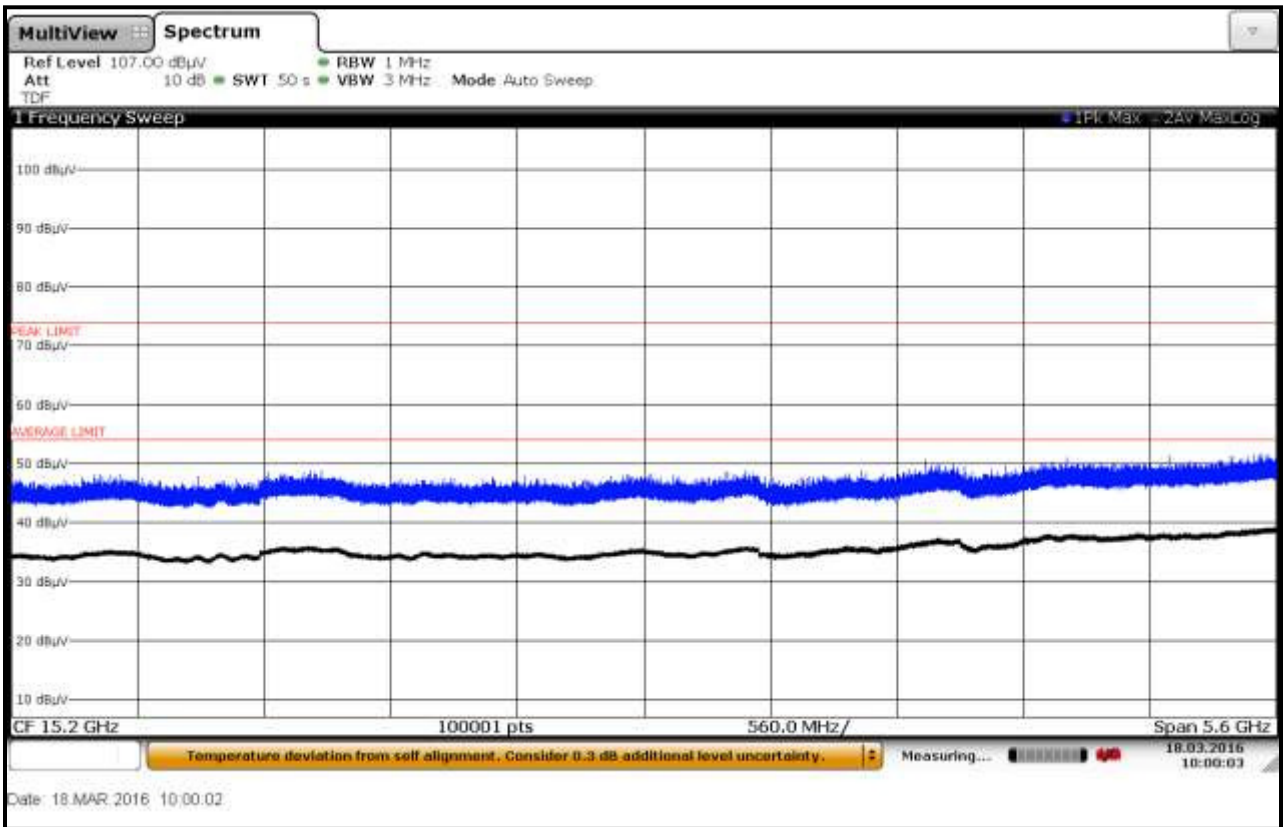
Plot 6-58: Radiated Emissions 8 GHz – 12.4 GHz; Fiberglass Container; TC #2, Horizontal



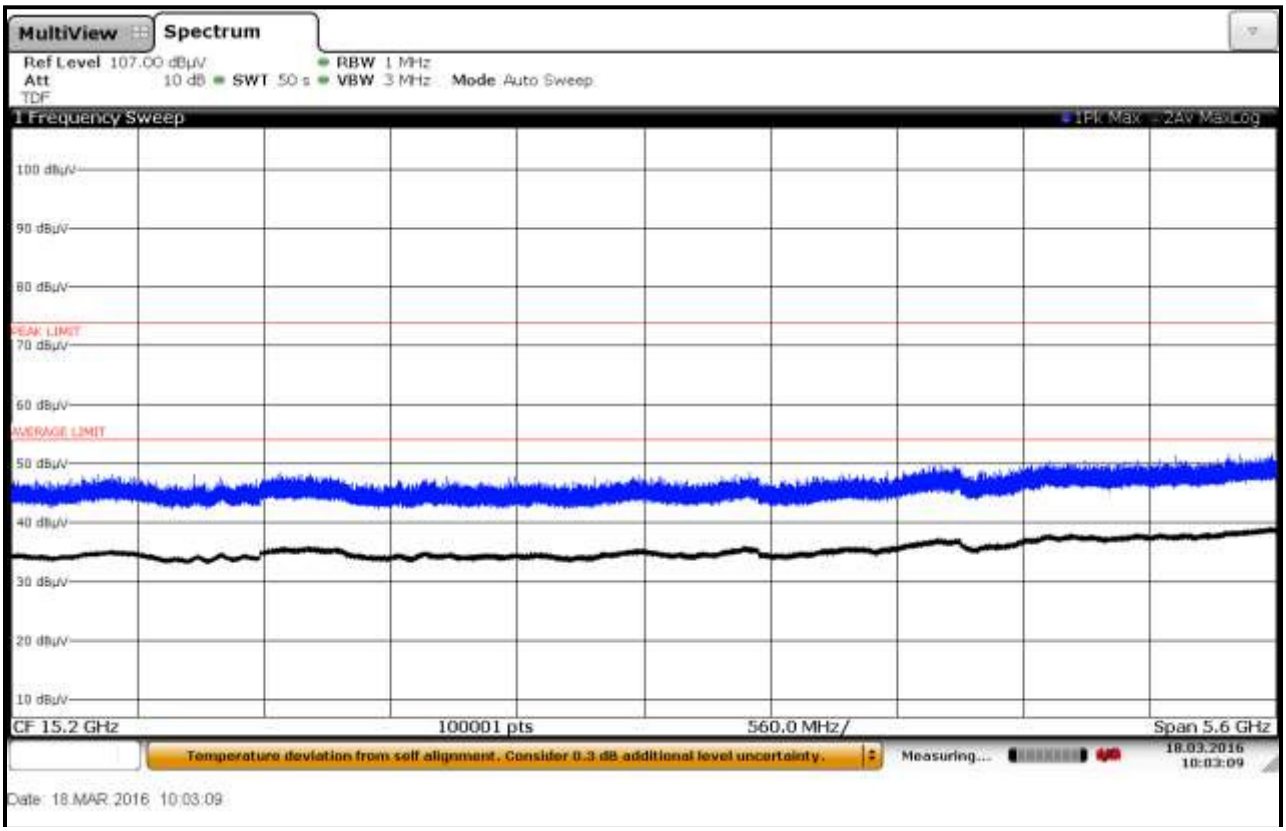
Plot 6-59: Radiated Emissions 8 GHz – 12.4 GHz; Fiberglass Container; TC #2, Vertical



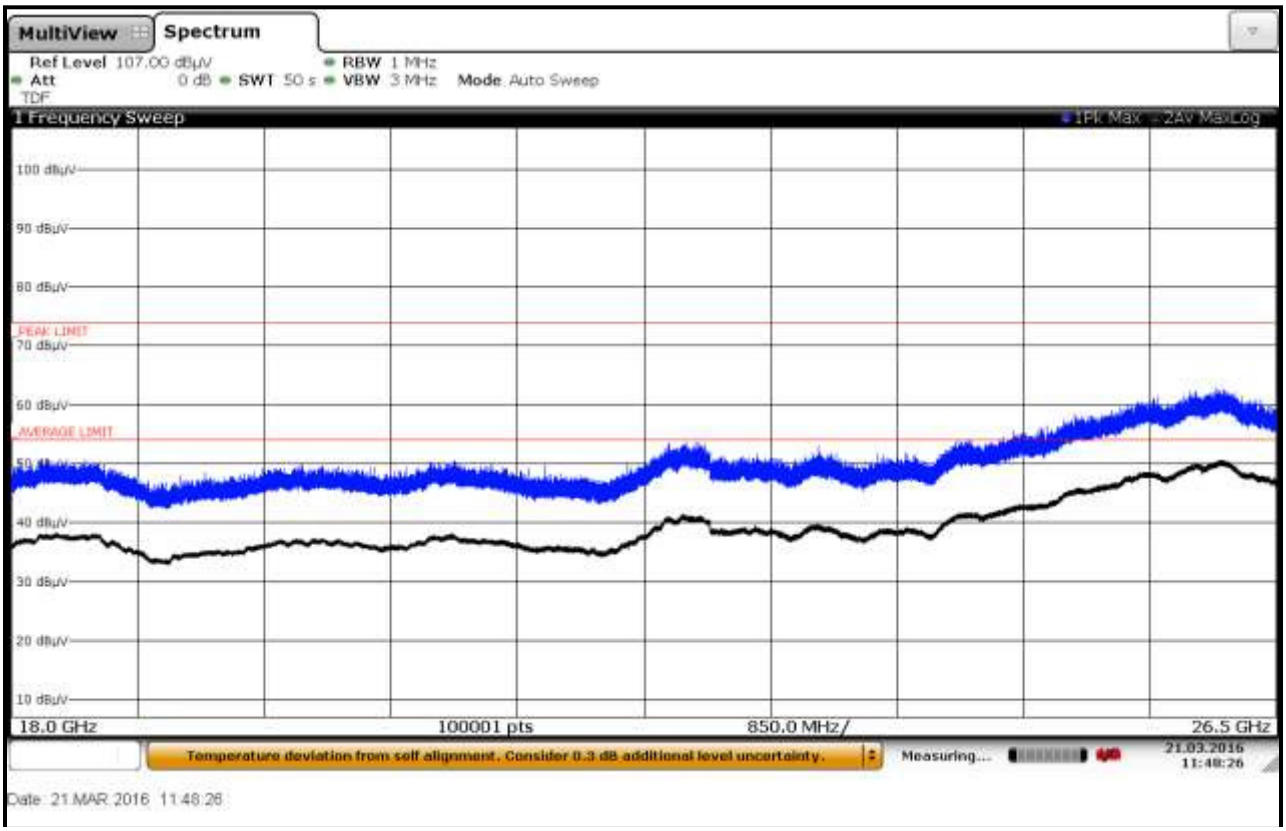
Plot 6-60: Radiated Emissions 12.4 GHz – 18 GHz; Fiberglass Container; TC #2, Horizontal



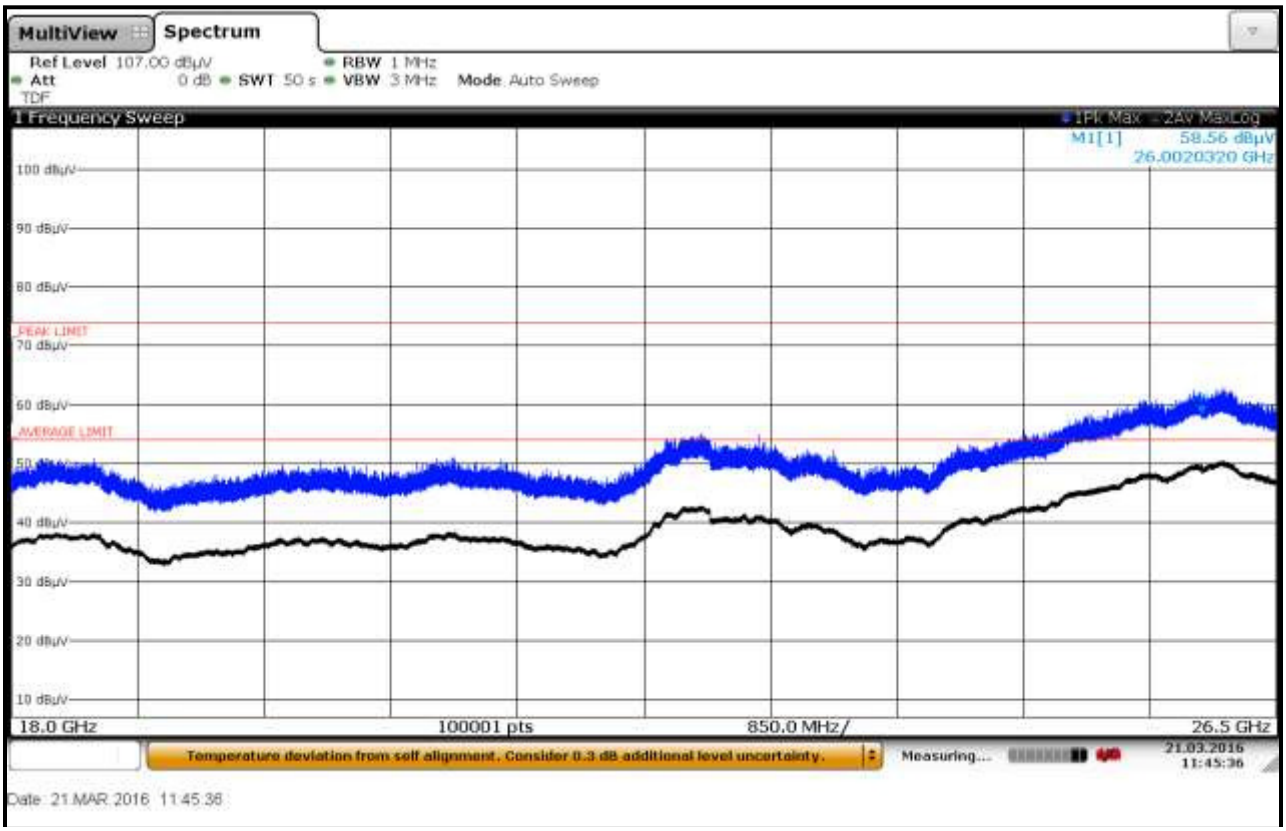
Plot 6-61: Radiated Emissions 12.4 GHz – 18 GHz; Fiberglass Container; TC #2, Vertical



Plot 6-62: Radiated Emissions 18 GHz – 26.5 GHz; Fiberglass Container; TC #2, Horizontal

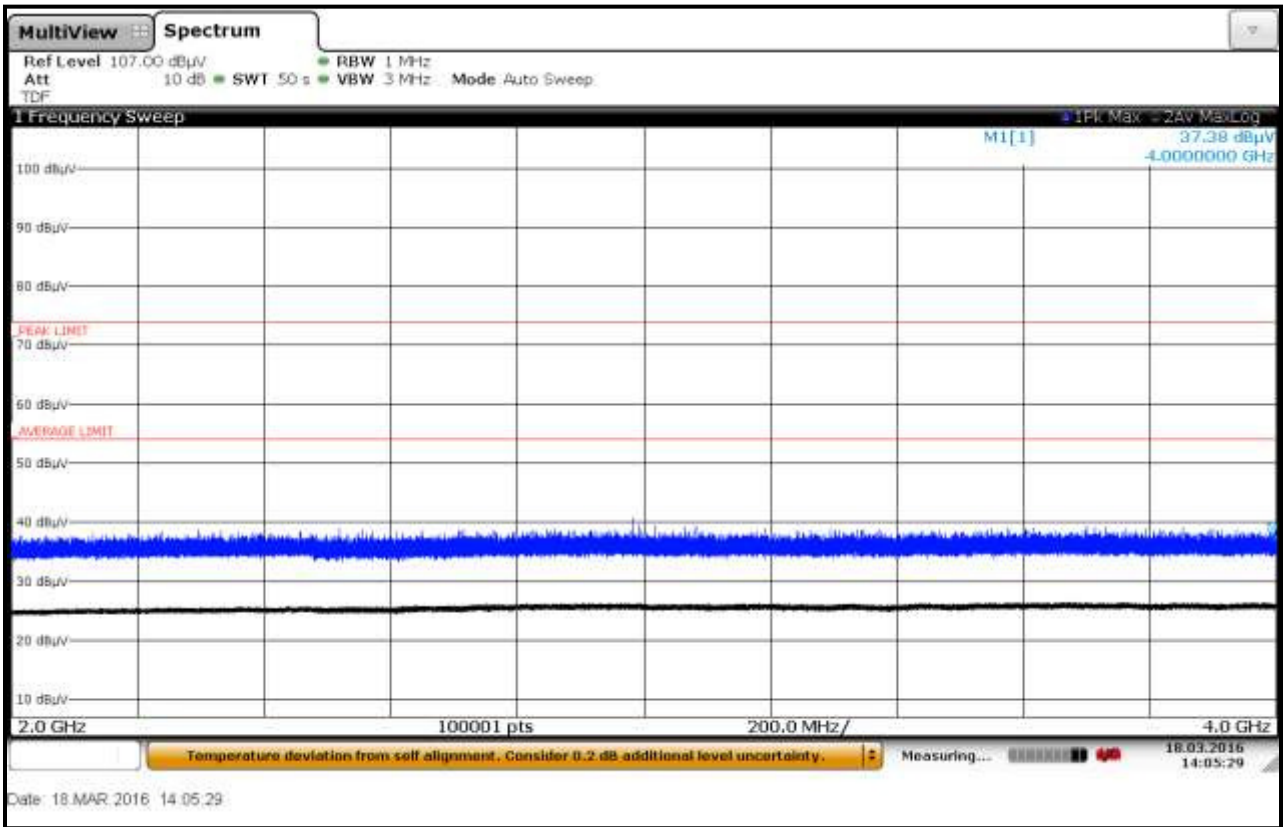


Plot 6-63: Radiated Emissions 18 GHz – 26.5 GHz; Fiberglass Container; TC #2, Vertical

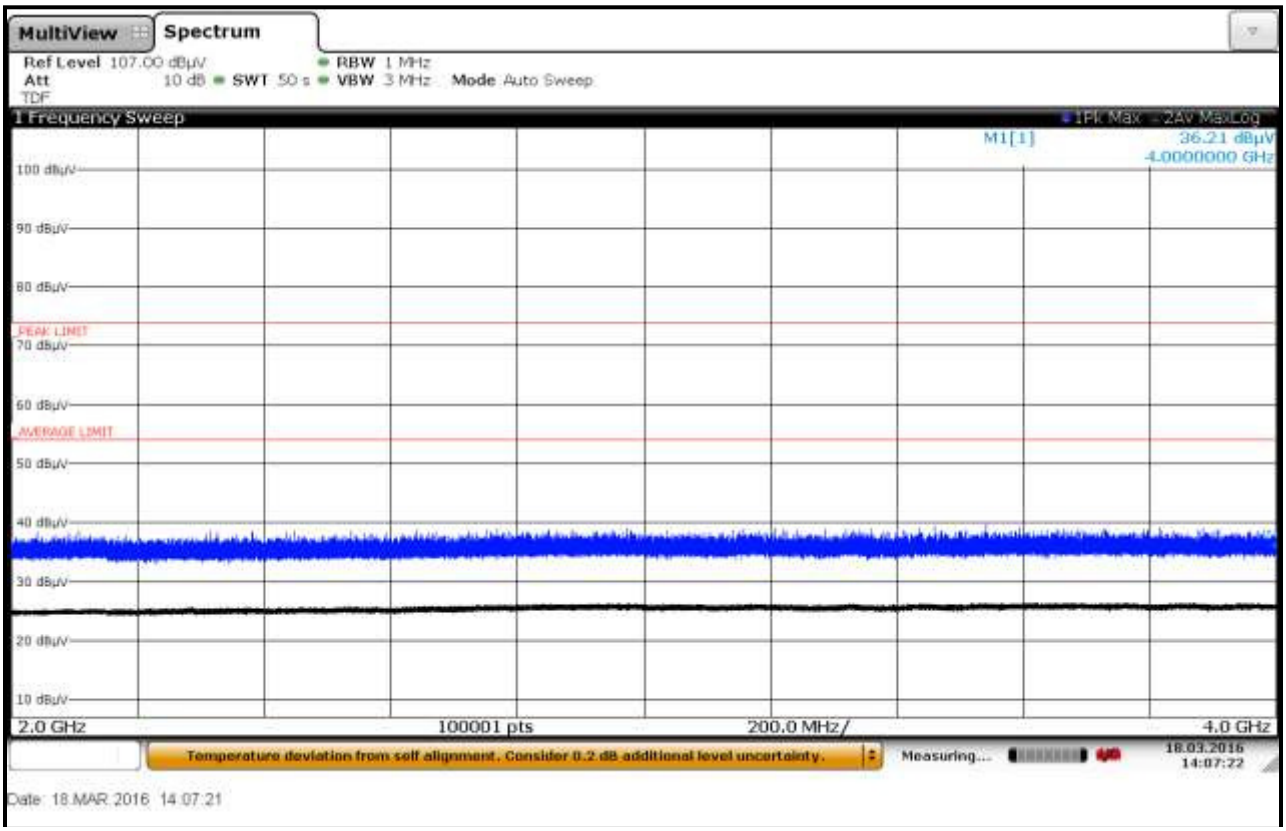


6.3.9 Radiated Emissions Test Data - 2 GHz – 26.5 GHz; Metal Container, TC #3

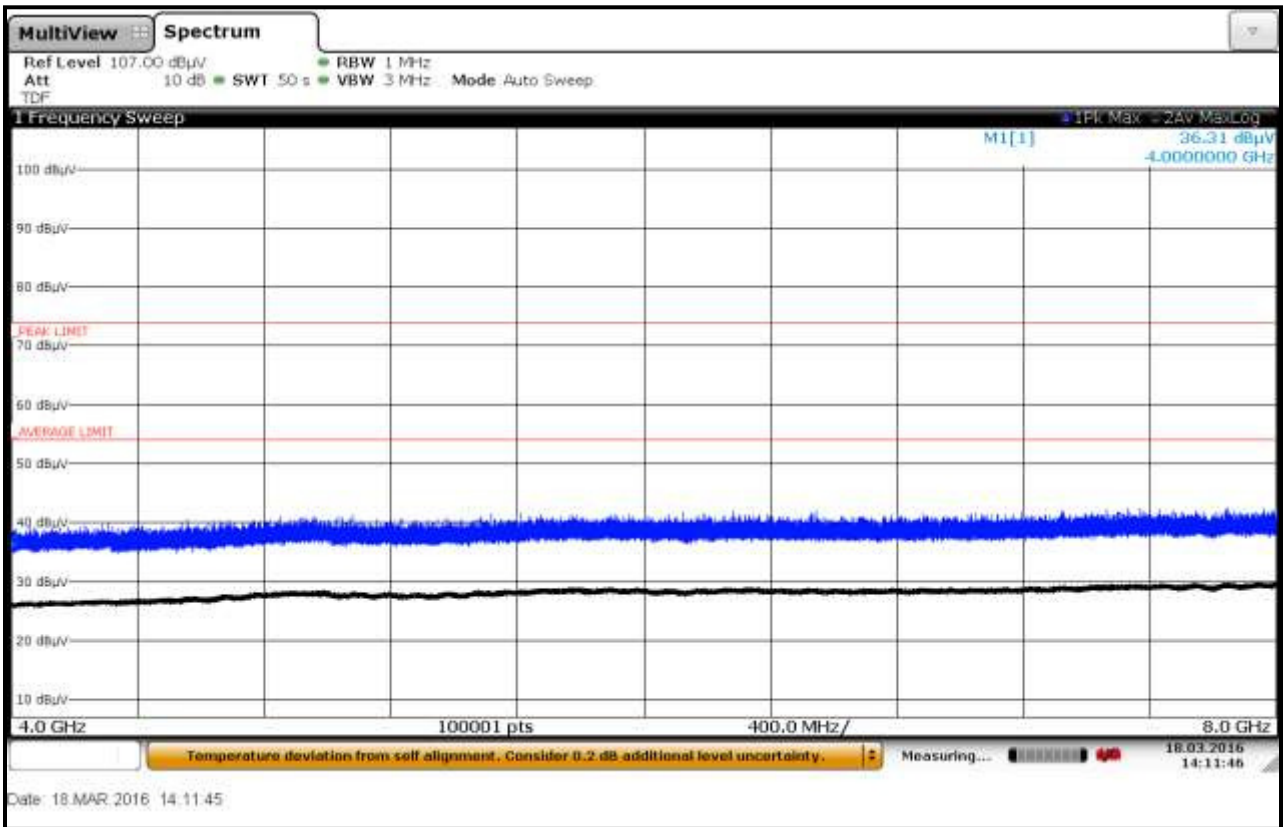
Plot 6-64: Radiated Emissions 2 GHz – 4 GHz; Metal Container; TC #3; Horizontal



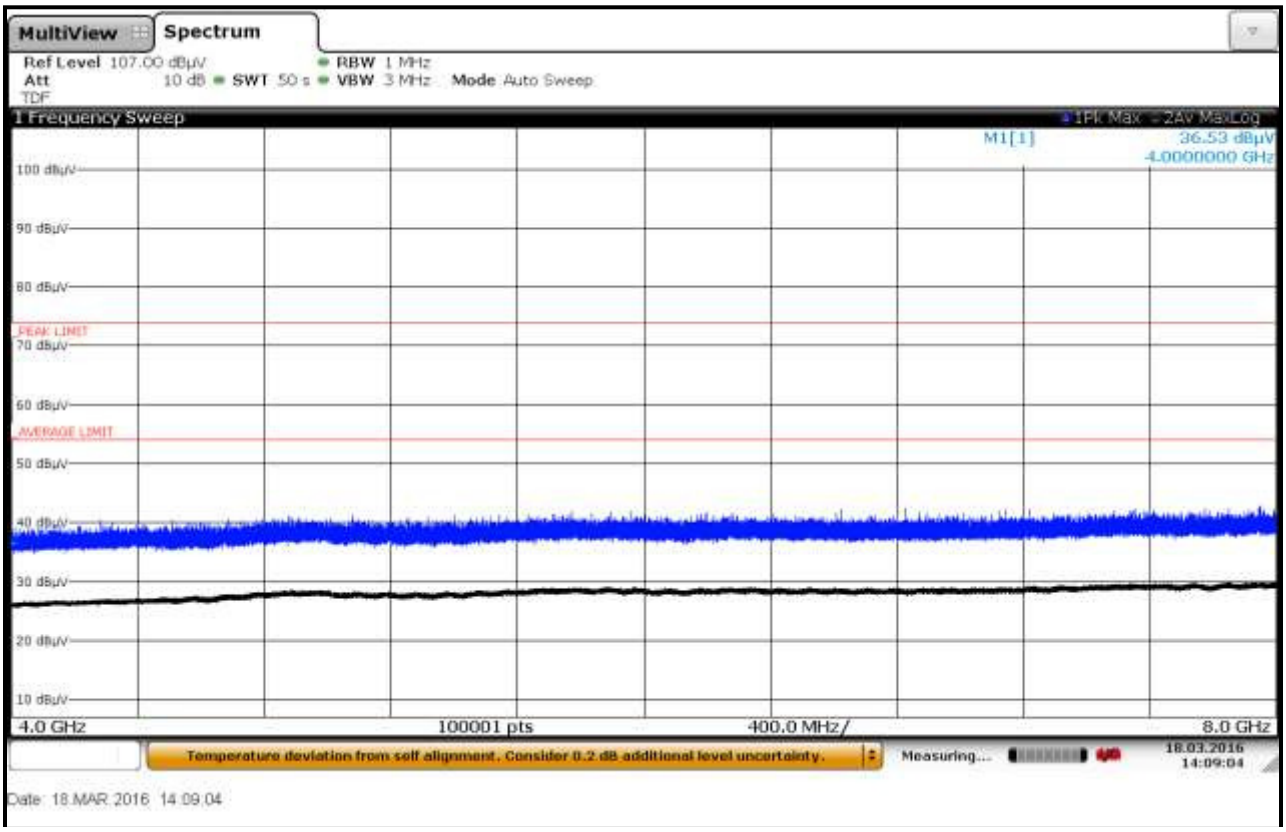
Plot 6-65: Radiated Emissions 2 GHz – 4 GHz; Metal Container; TC #3; Vertical



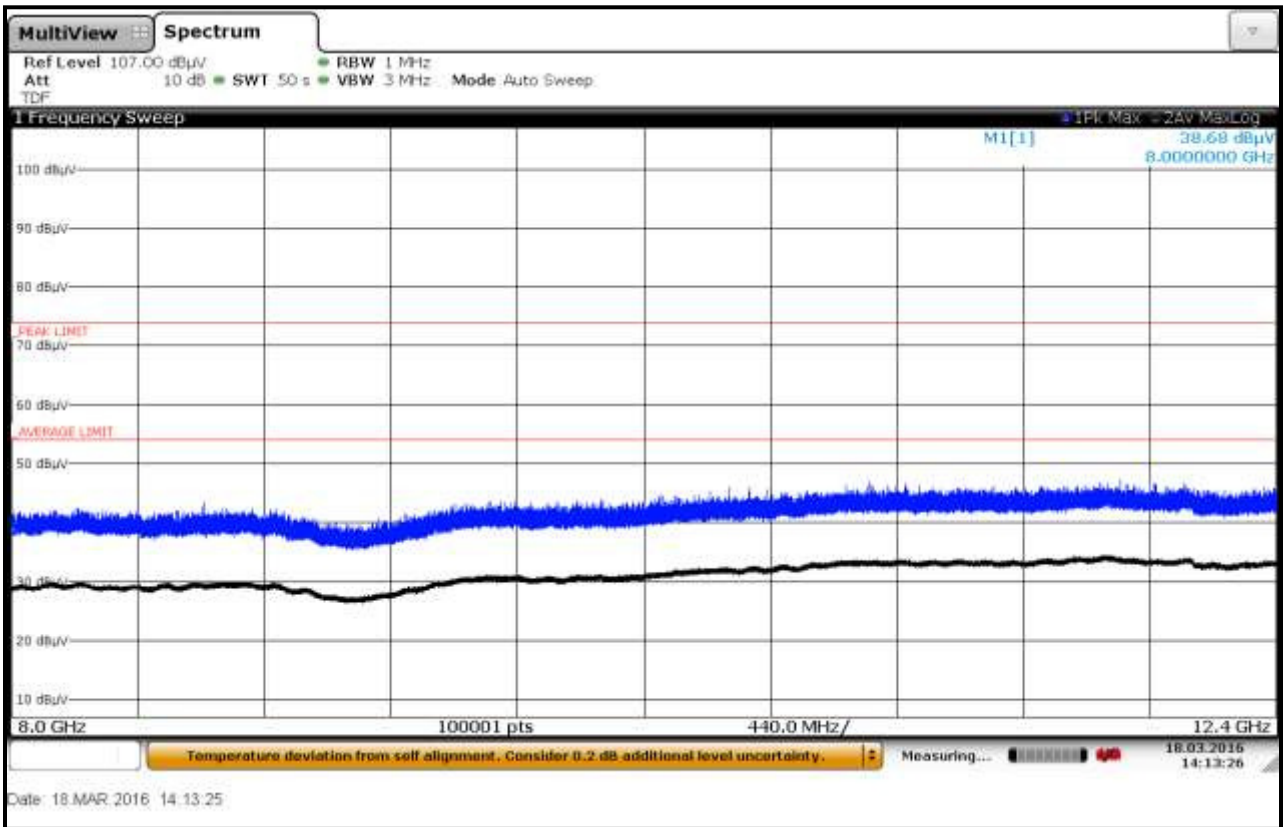
Plot 6-66: Radiated Emissions 4 GHz – 8 GHz; Metal Container; TC #3; Horizontal



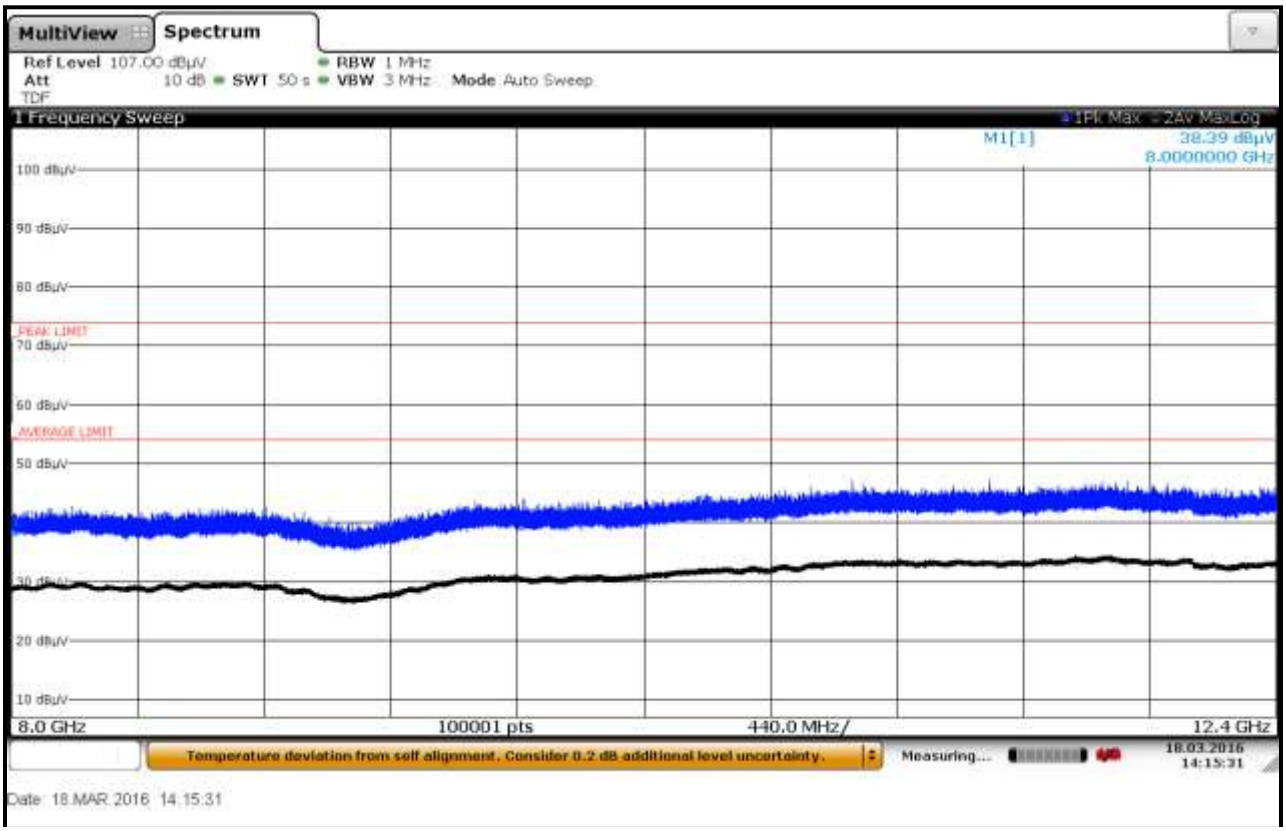
Plot 6-67: Radiated Emissions 4 GHz – 8 GHz; Metal Container; TC #3; Vertical



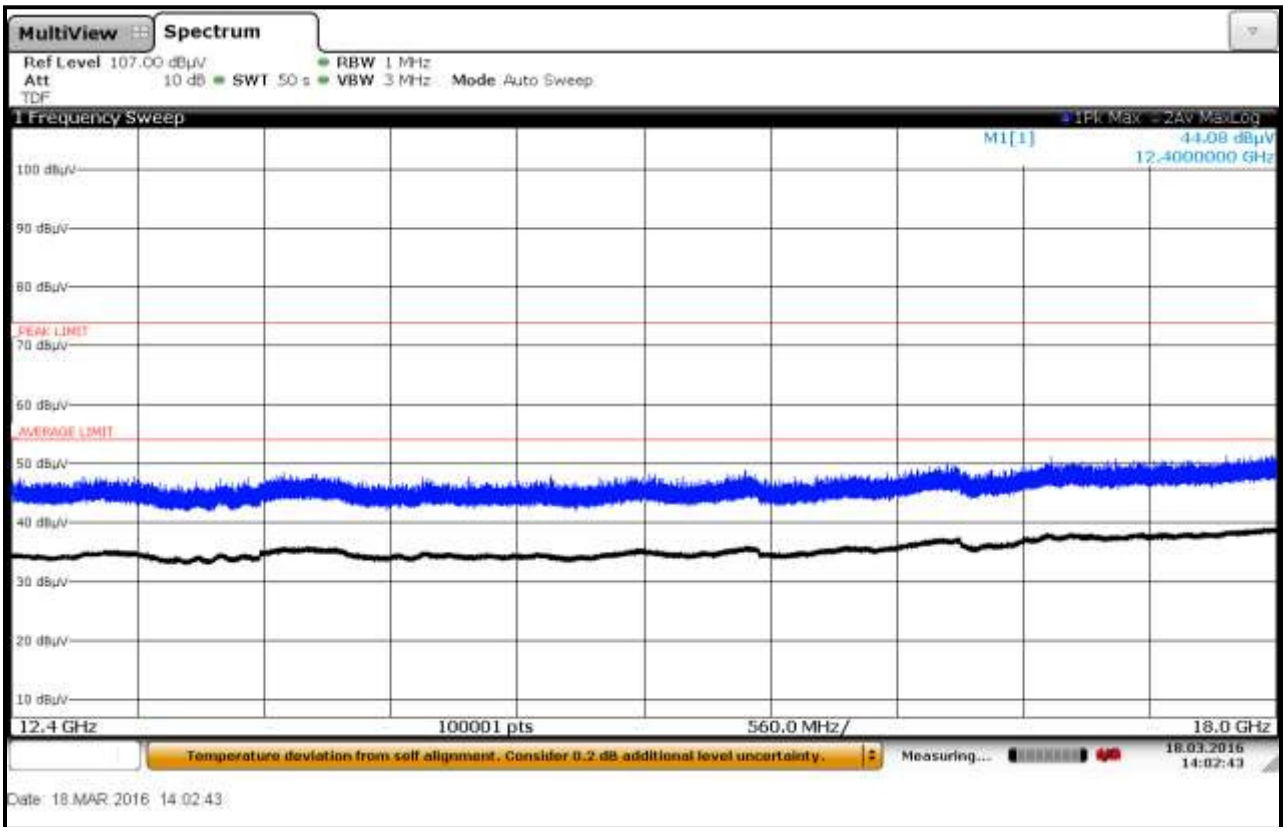
Plot 6-68: Radiated Emissions 8 GHz – 12.4 GHz; Metal Container; TC #3, Horizontal



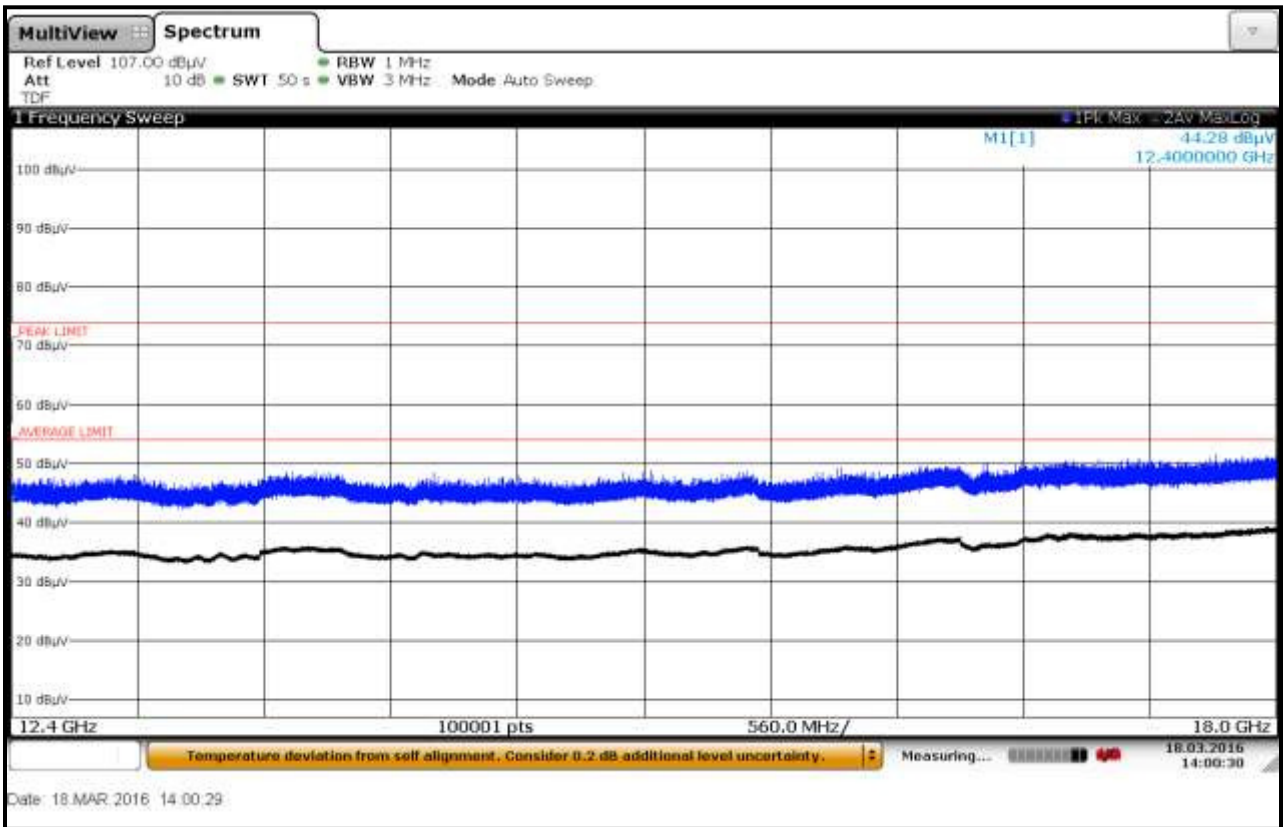
Plot 6-69: Radiated Emissions 8 GHz – 12.4 GHz; Metal Container; TC #3, Vertical



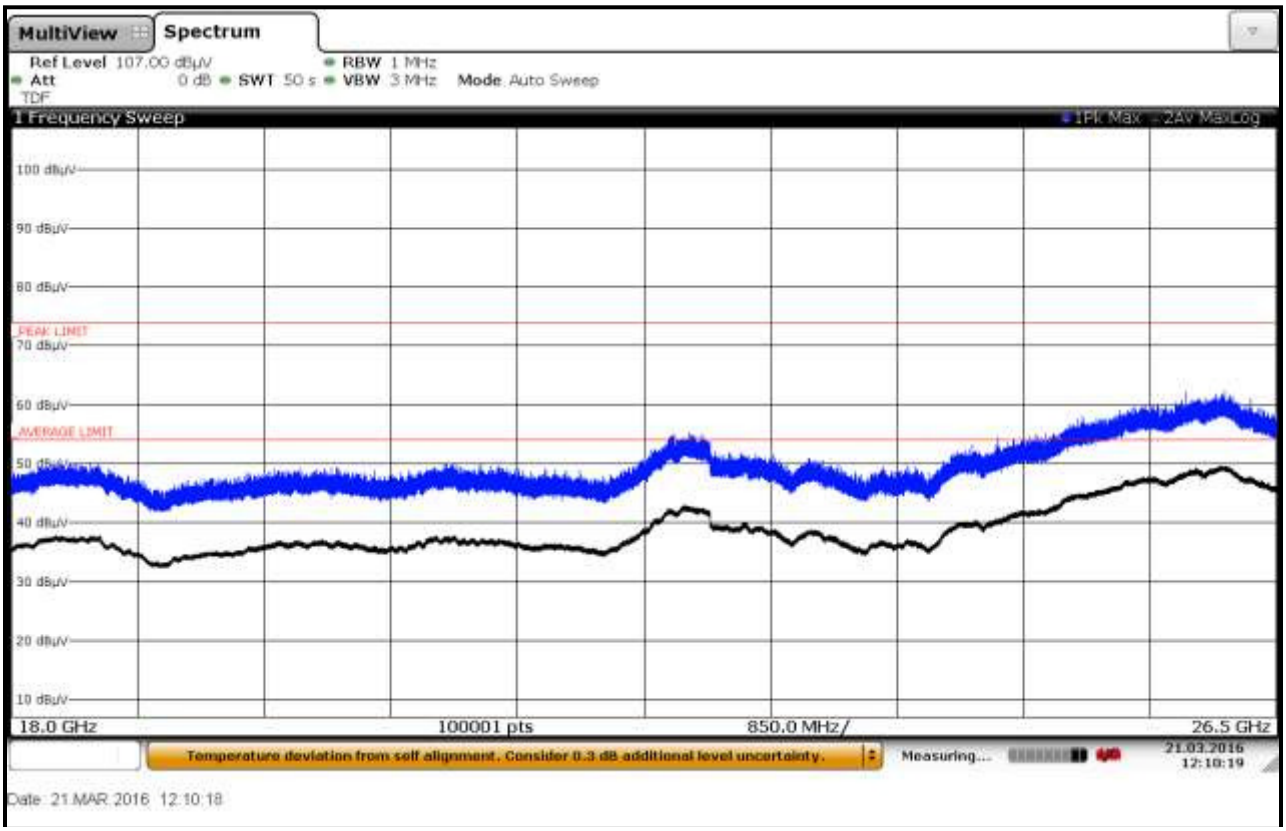
Plot 6-70: Radiated Emissions 12.4 GHz – 18 GHz; Metal Container; TC #3, Horizontal



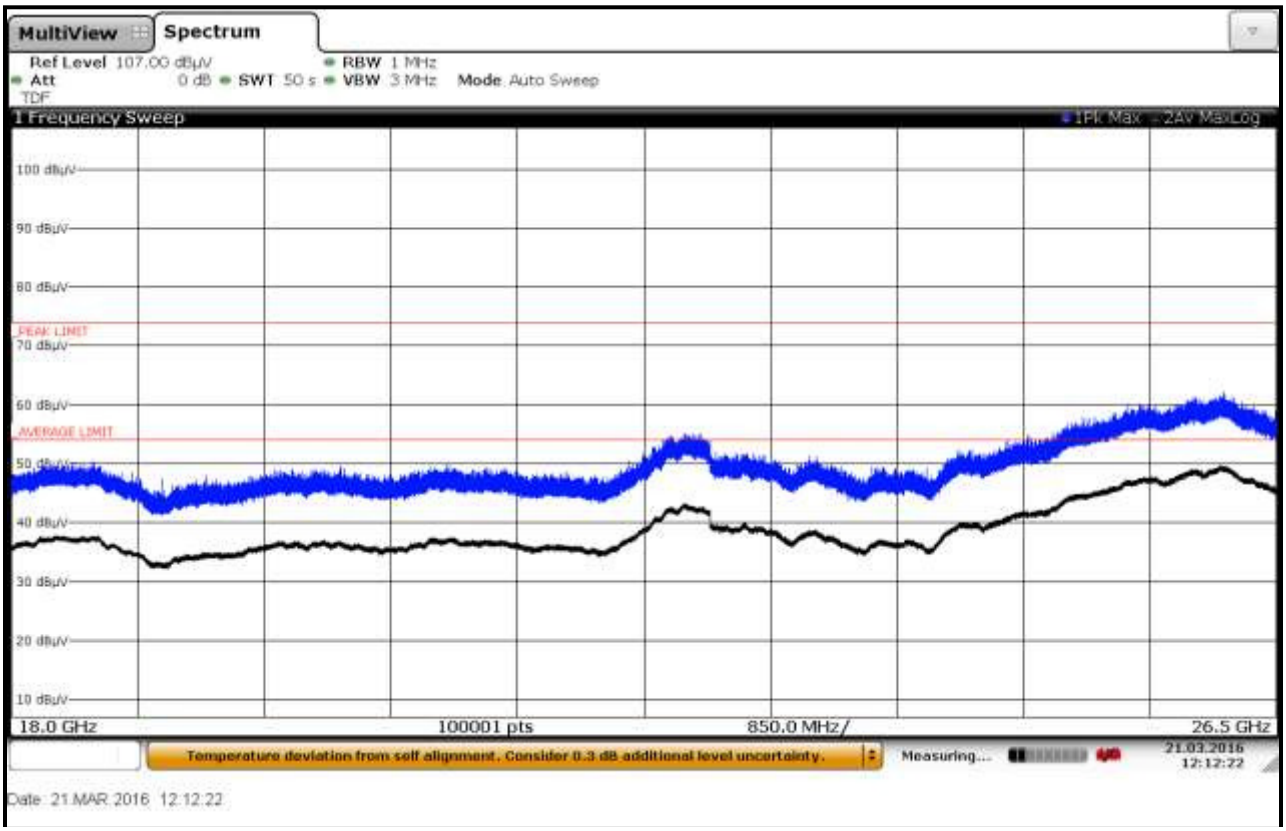
Plot 6-71: Radiated Emissions 12.4 GHz – 18 GHz; Metal Container; TC #3, Vertical



Plot 6-72: Radiated Emissions 18 GHz – 26.5 GHz; Metal Container; TC #3, Horizontal

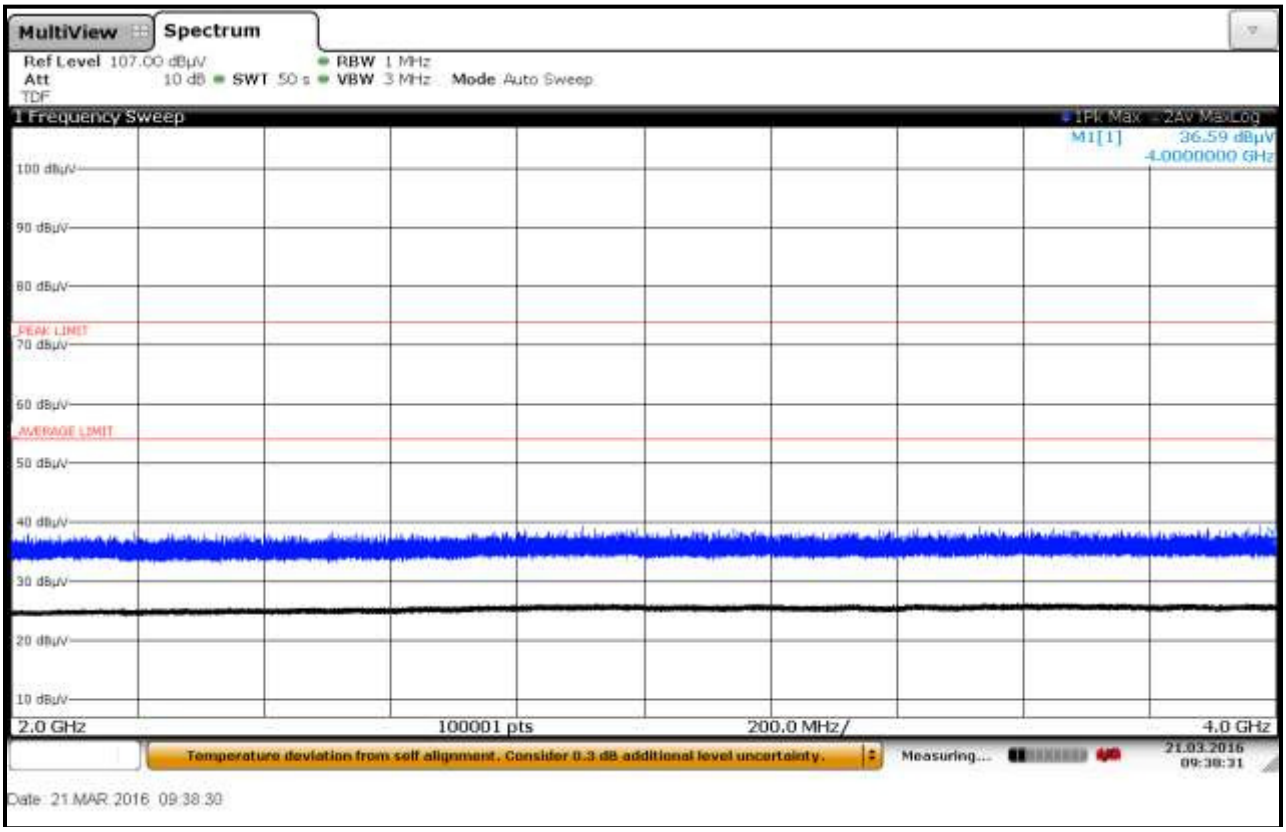


Plot 6-73: Radiated Emissions 18 GHz – 26.5 GHz; Metal Container; TC #3, Vertical

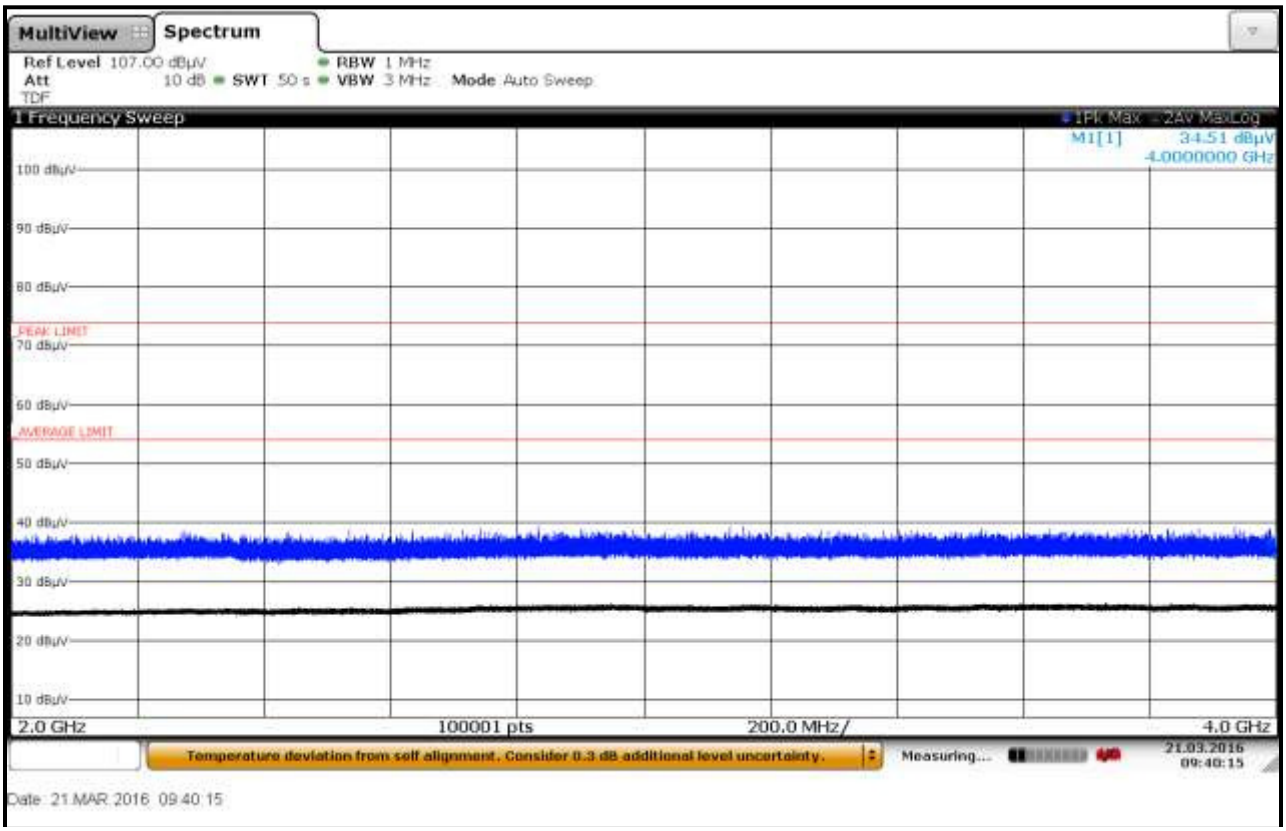


6.3.10 Radiated Emissions Test Data - 2 GHz – 26.5 GHz; Concrete Container, TC #3

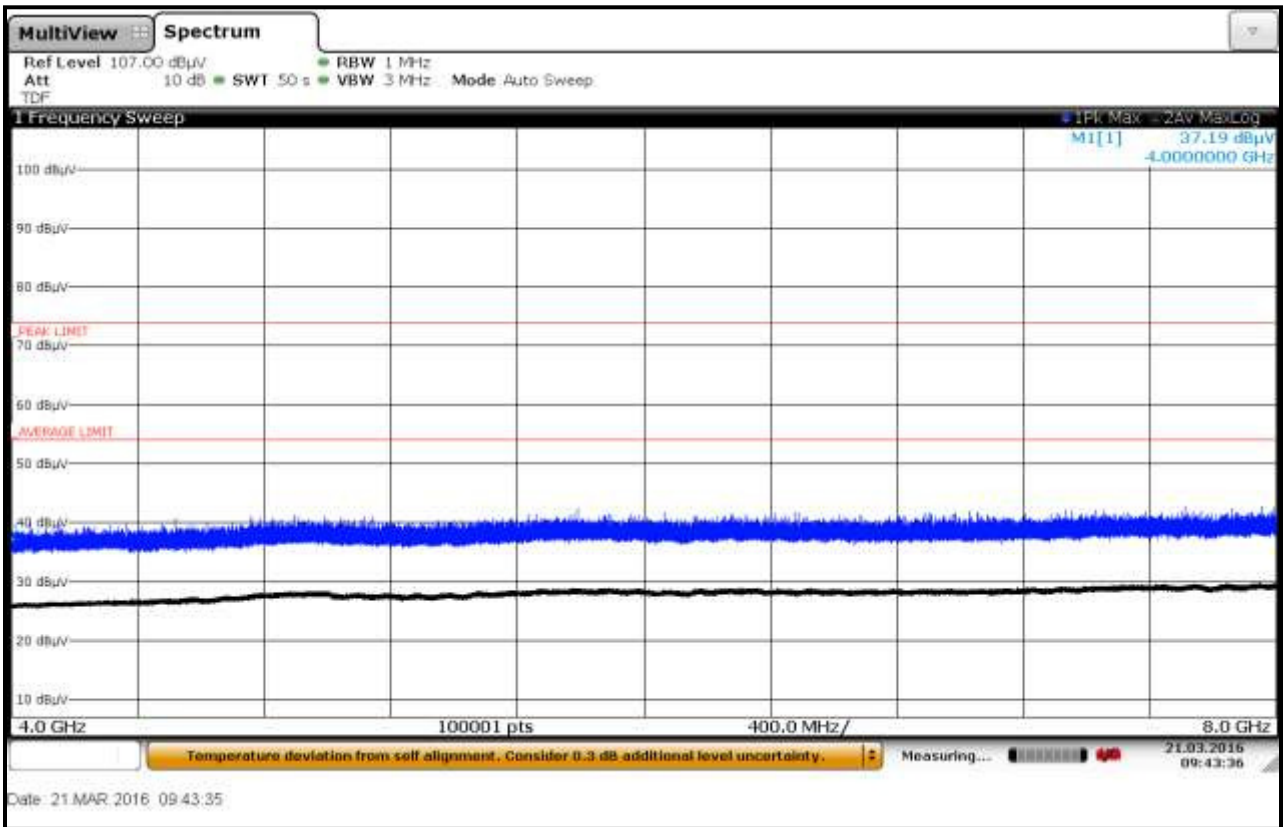
Plot 6-74: Radiated Emissions 2 GHz – 4 GHz; Concrete Container; TC #3; Horizontal



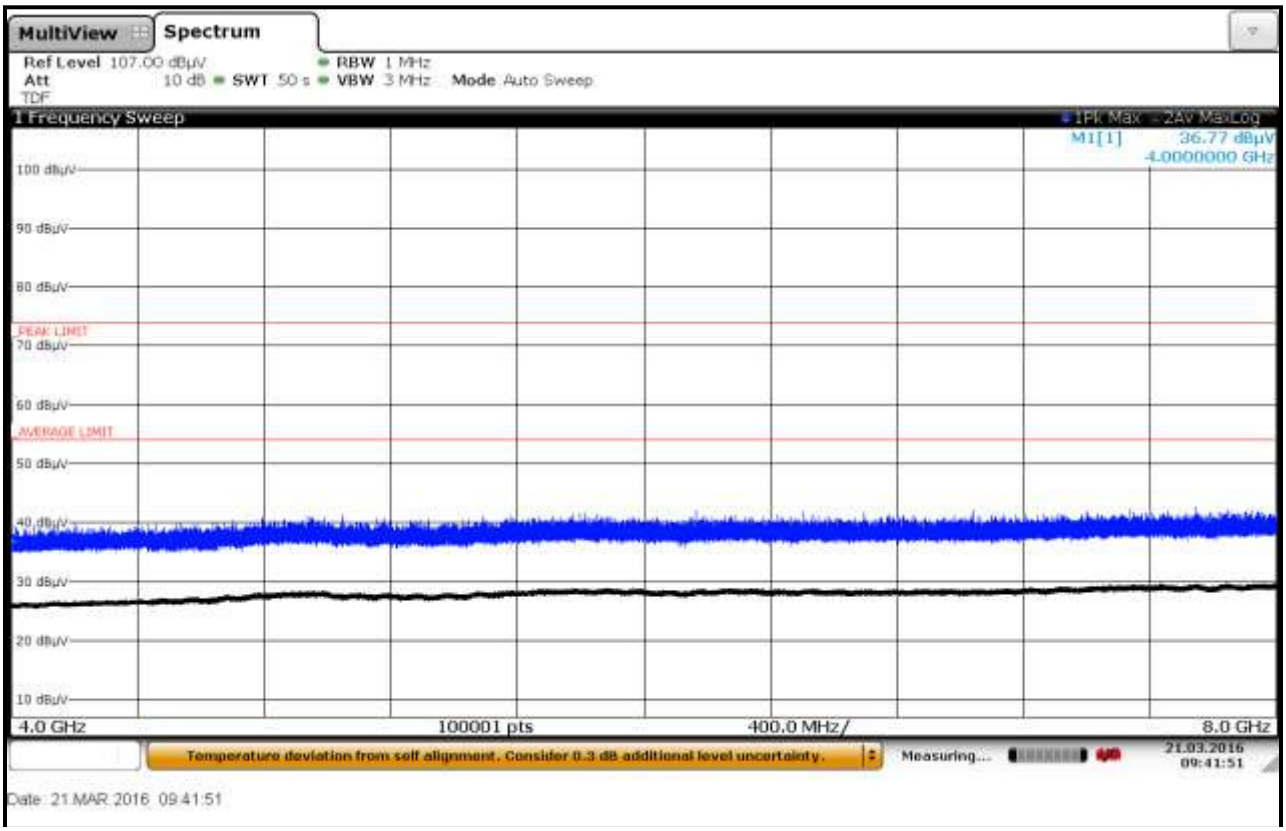
Plot 6-75: Radiated Emissions 2 GHz – 4 GHz; Concrete Container; TC #3; Vertical



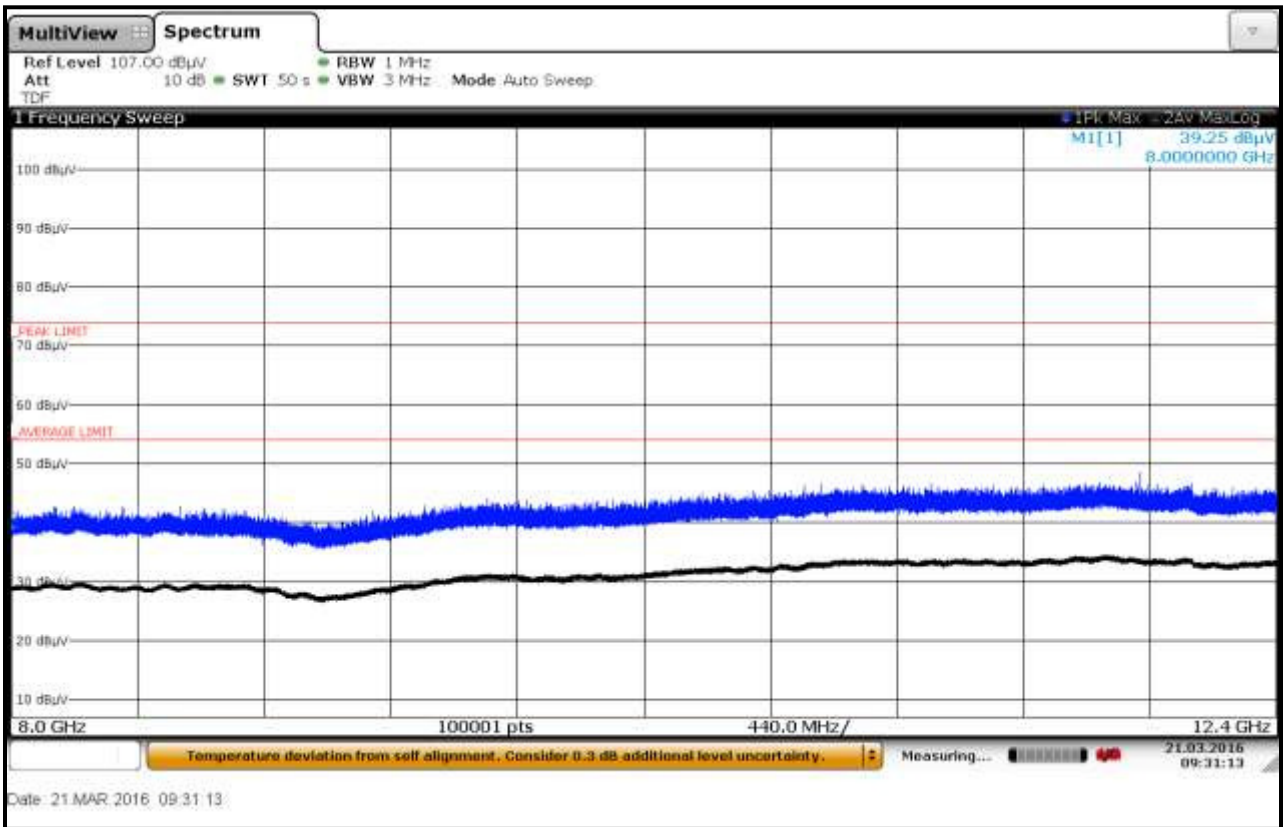
Plot 6-76: Radiated Emissions 4 GHz – 8 GHz; Concrete Container; TC #3; Horizontal



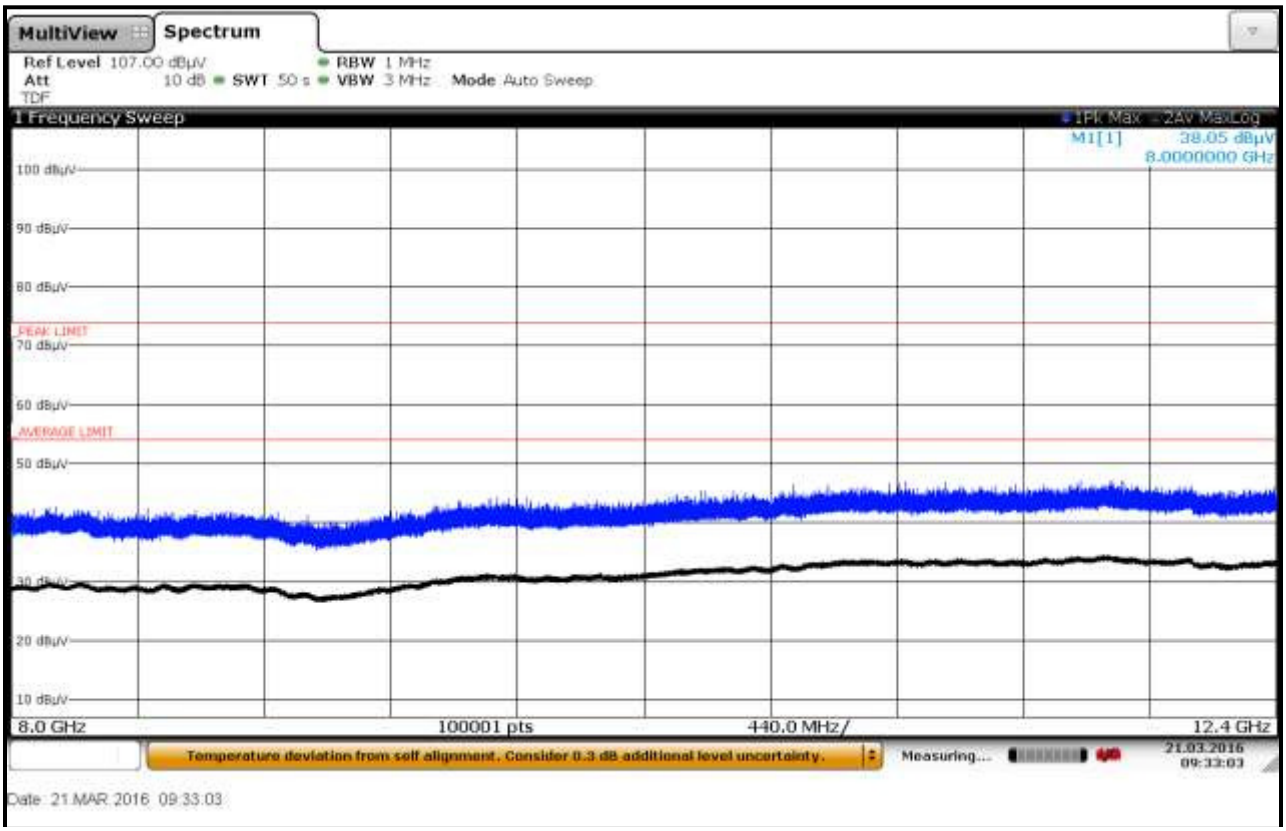
Plot 6-77: Radiated Emissions 4 GHz – 8 GHz; Concrete Container; TC #3; Vertical



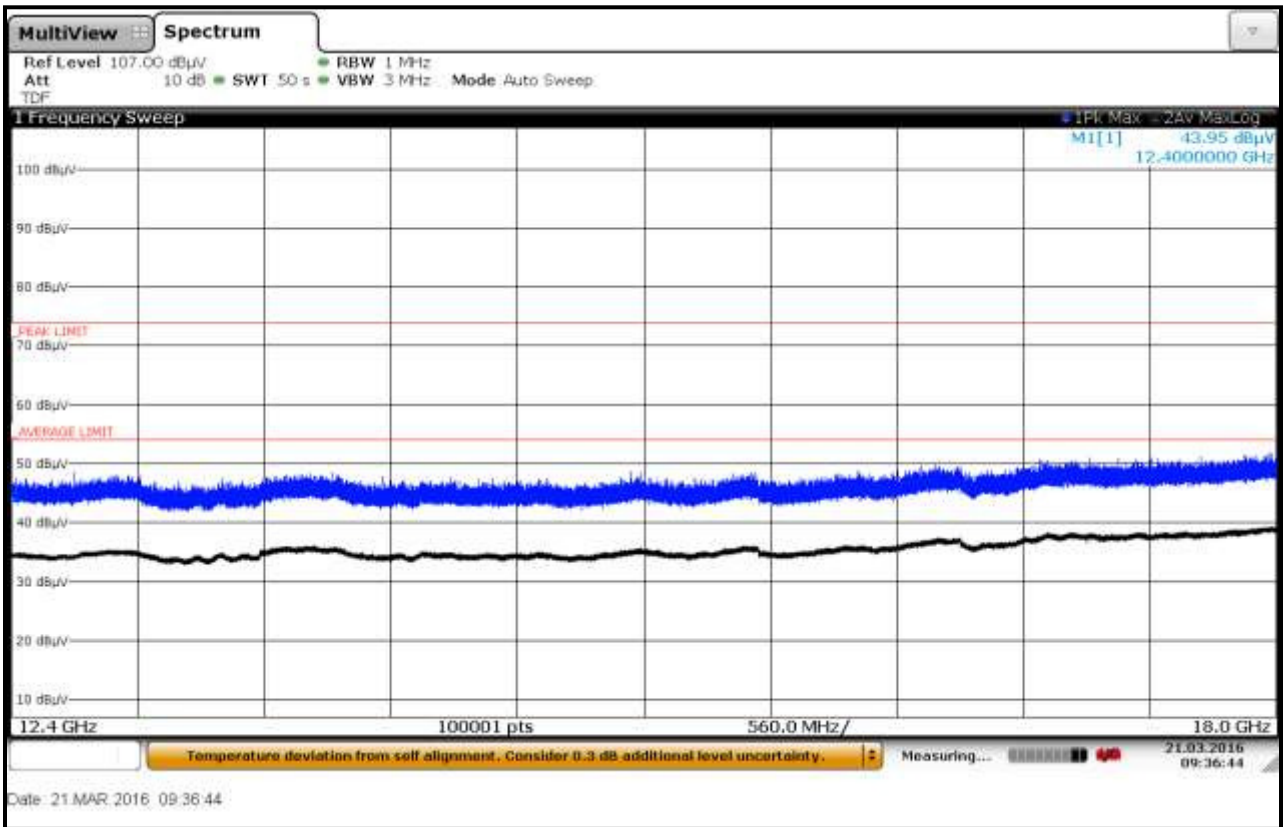
Plot 6-78: Radiated Emissions 8 GHz – 12.4 GHz; Concrete Container; TC #3, Horizontal



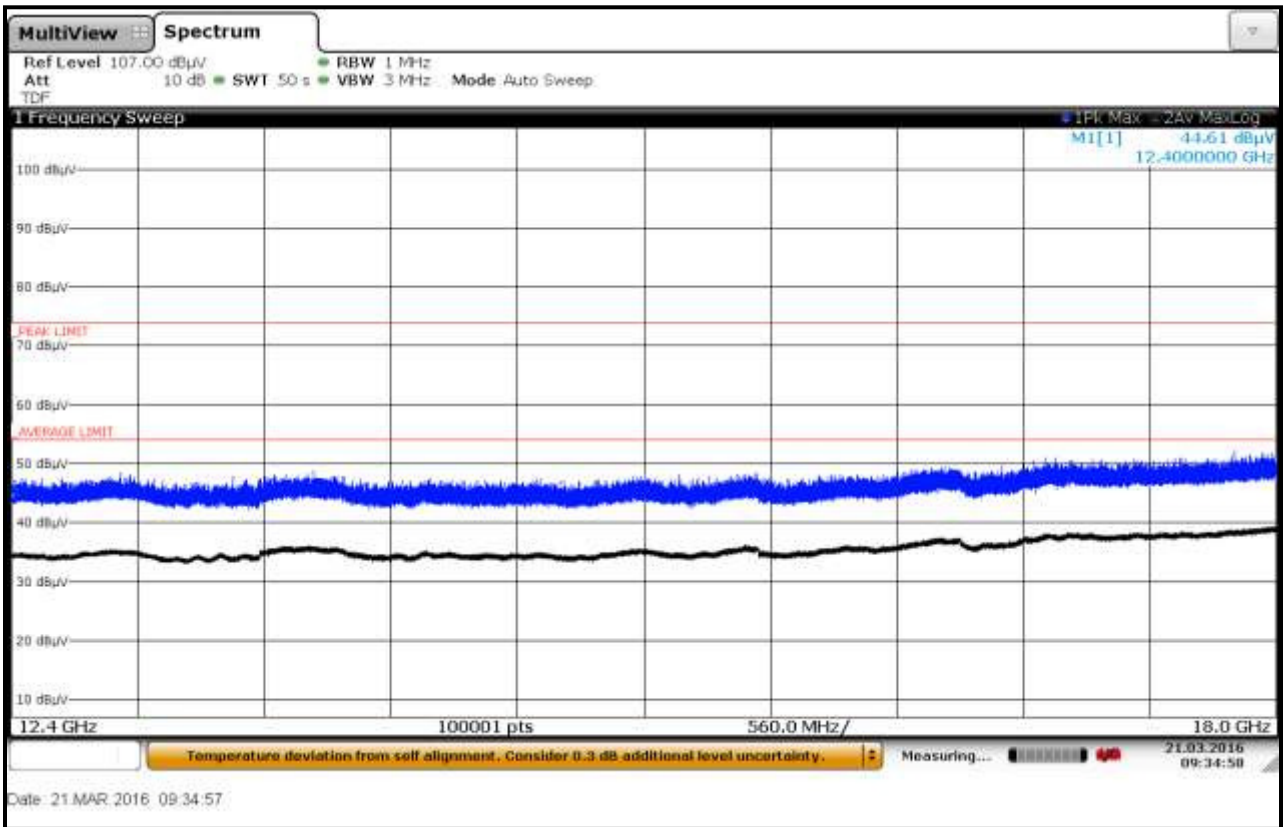
Plot 6-79: Radiated Emissions 8 GHz – 12.4 GHz; Concrete Container; TC #3, Vertical



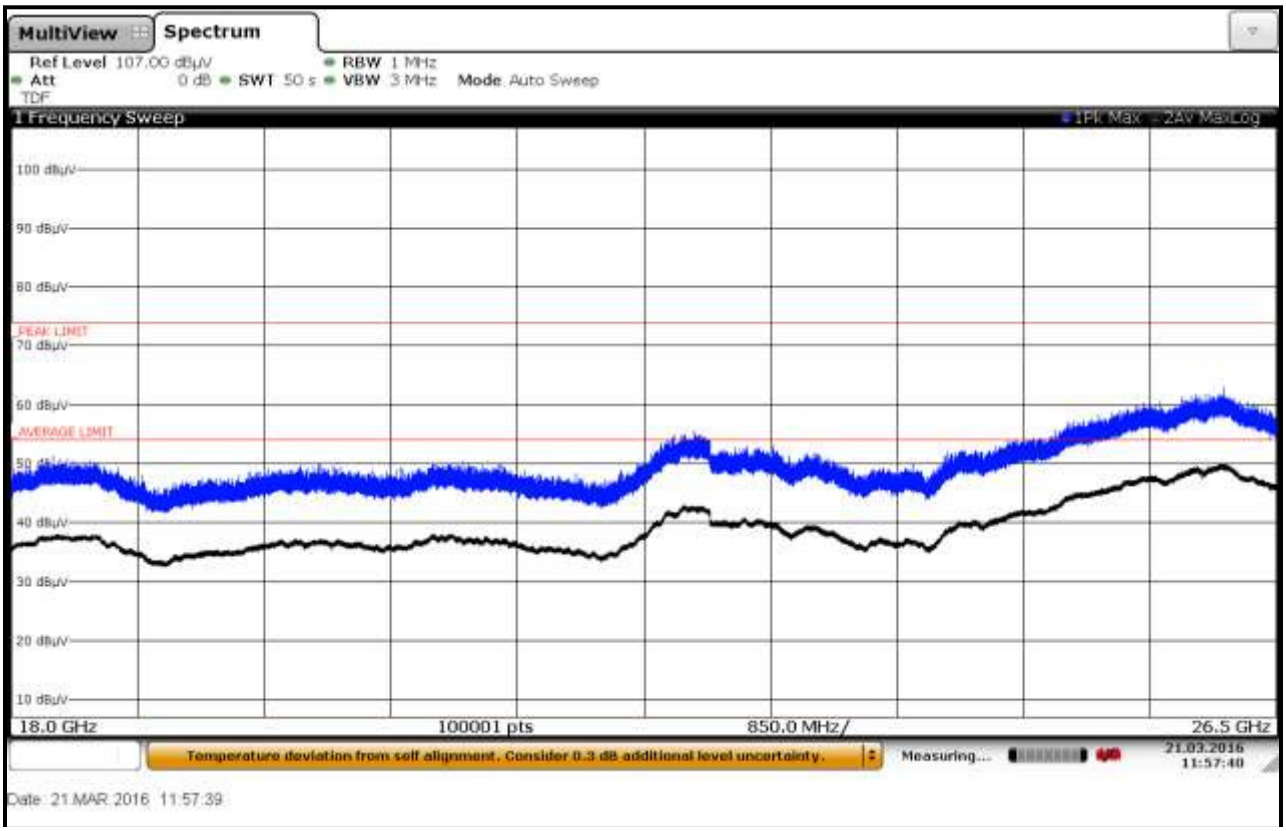
Plot 6-80: Radiated Emissions 12.4 GHz – 18 GHz; Concrete Container; TC #3, Horizontal



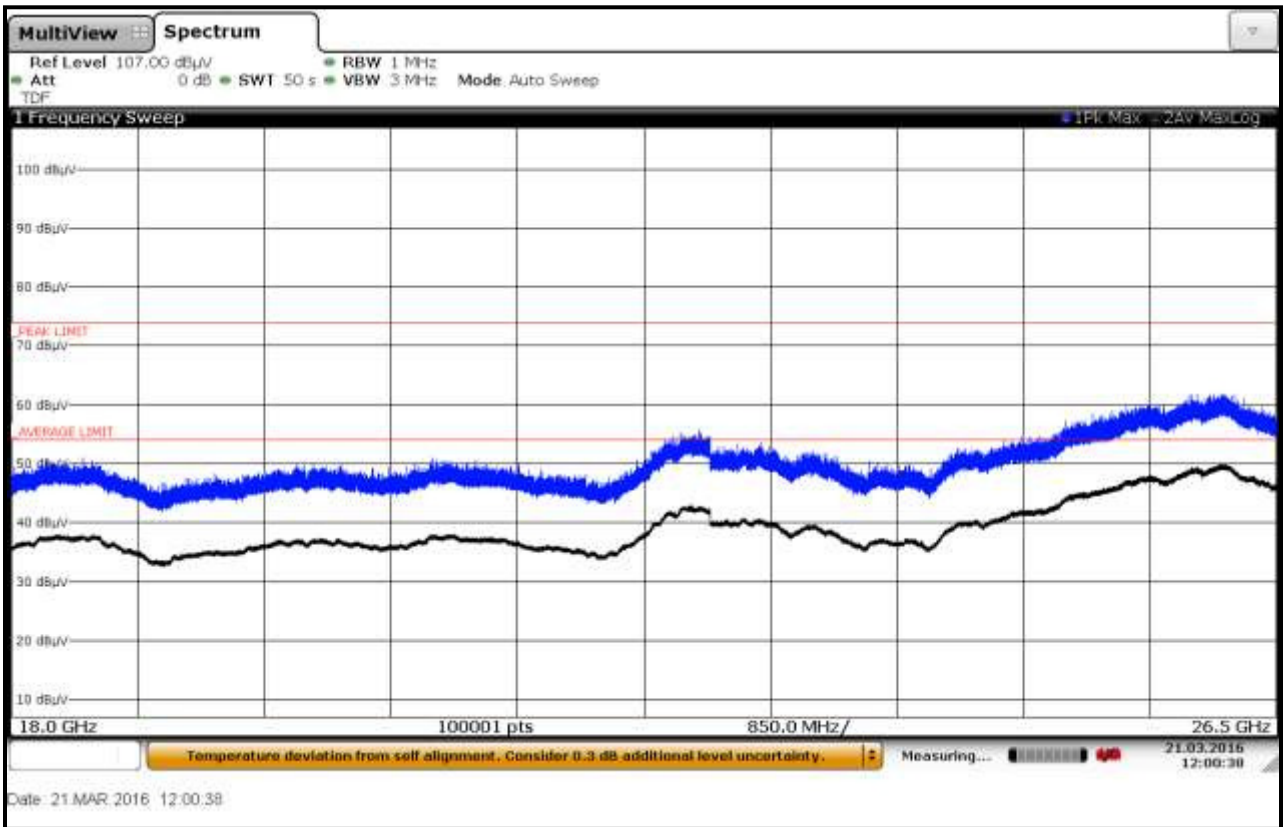
Plot 6-81: Radiated Emissions 12.4 GHz – 18 GHz; Concrete Container; TC #3, Vertical



Plot 6-82: Radiated Emissions 18 GHz – 26.5 GHz; Concrete Container; TC #3, Horizontal

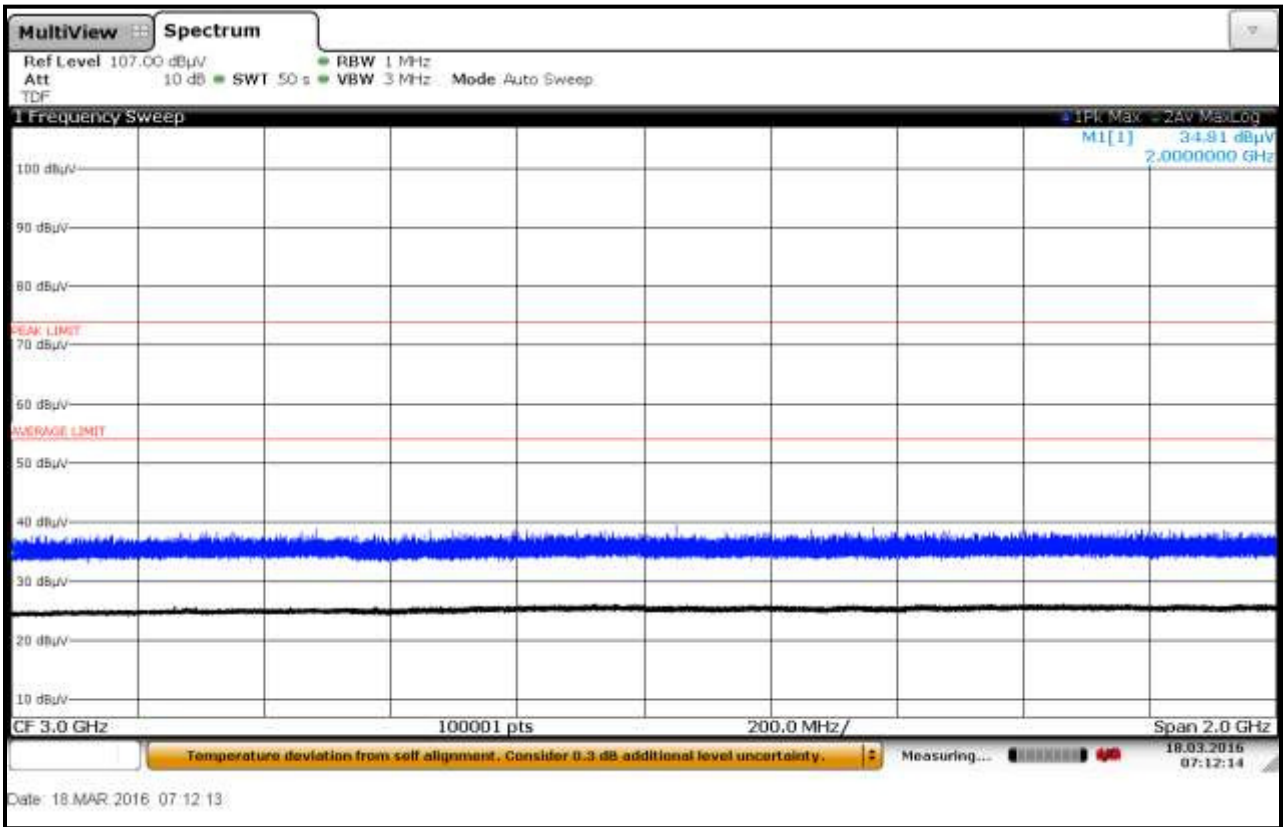


Plot 6-83: Radiated Emissions 18 GHz – 26.5 GHz; Concrete Container; TC #3, Vertical

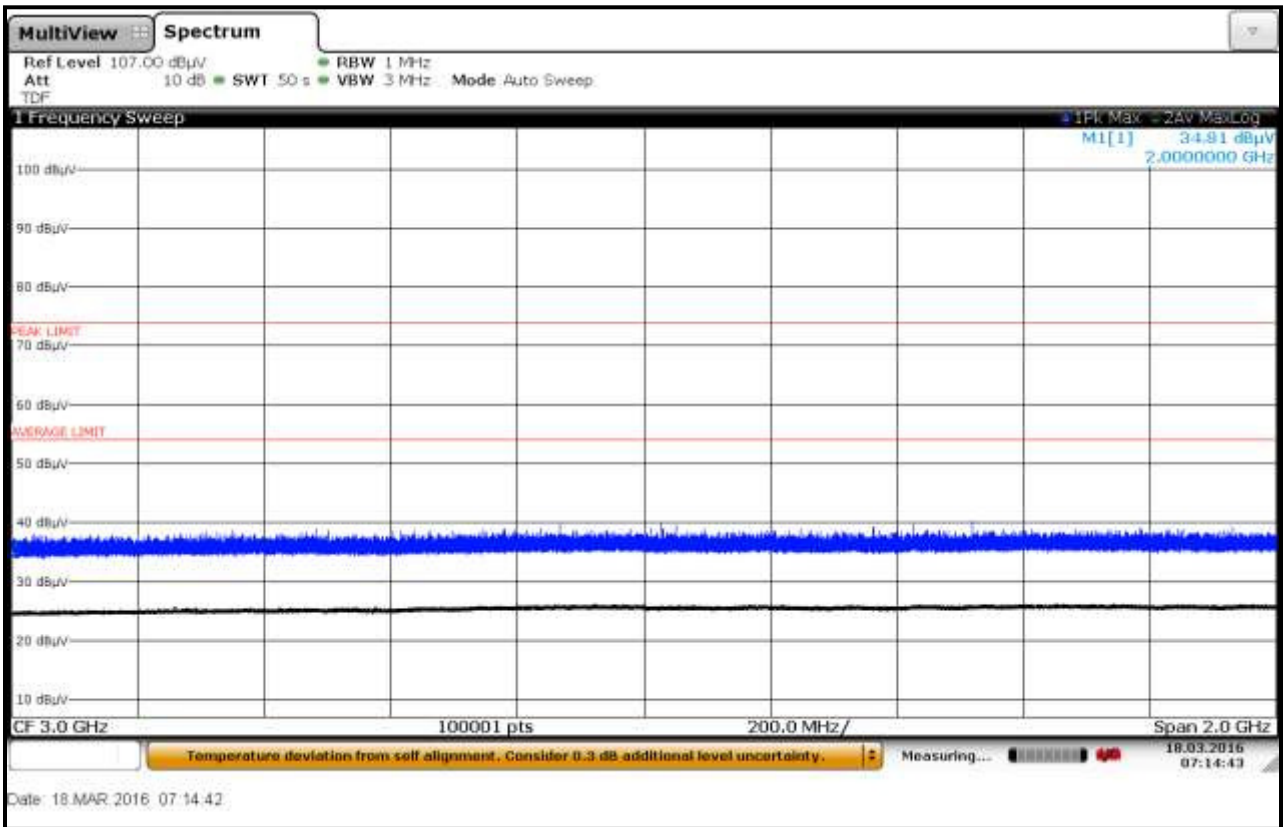


6.3.11 Radiated Emissions Test Data - 2 GHz – 26.5 GHz; Fiberglass Container, TC #3

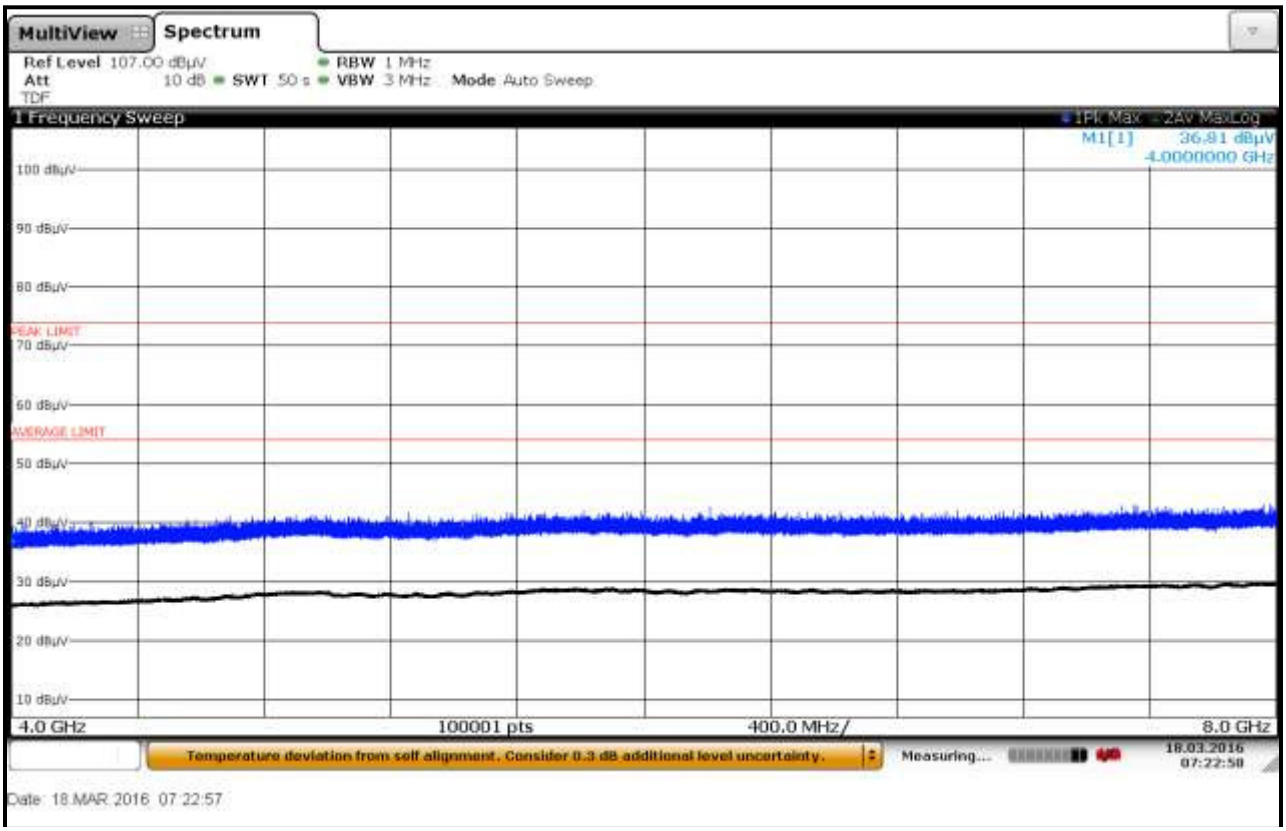
Plot 6-84: Radiated Emissions 2 GHz – 4 GHz; Fiberglass Container; TC #3; Horizontal



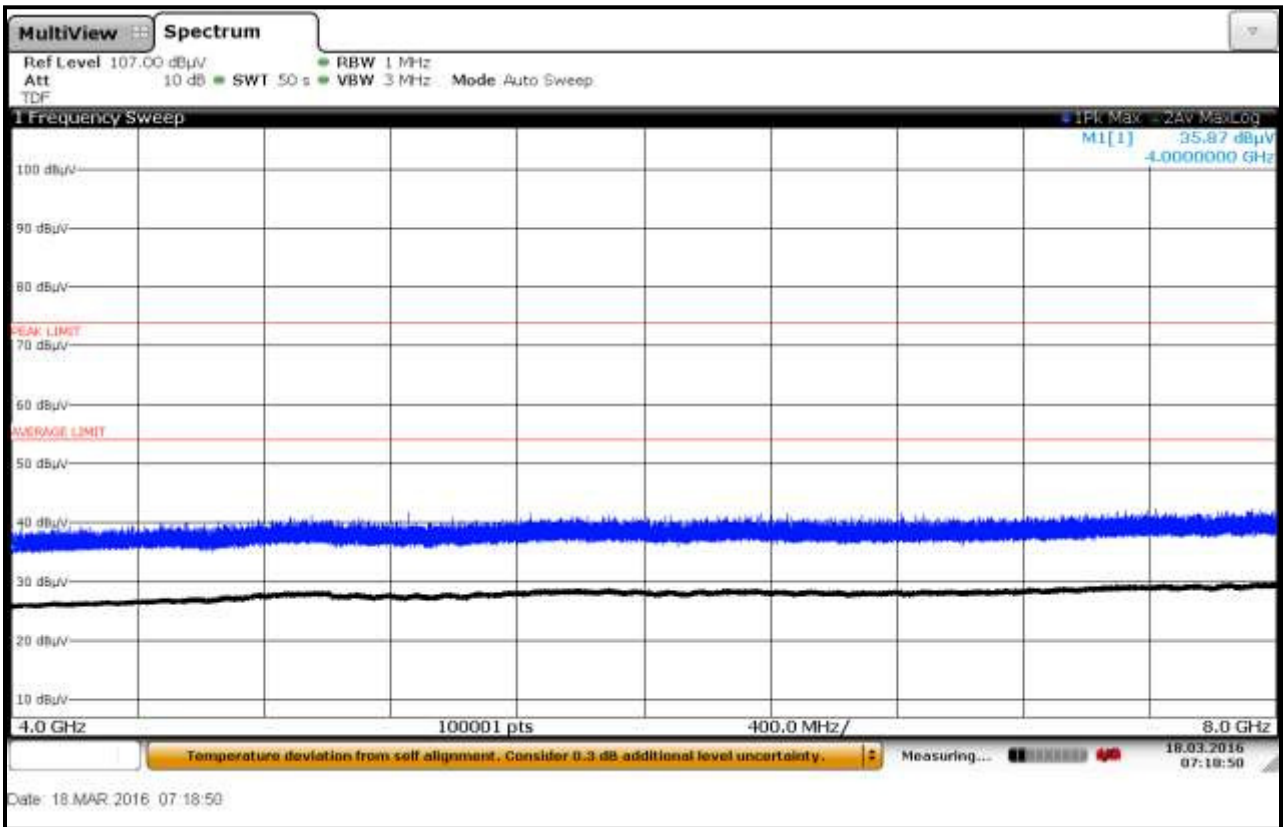
Plot 6-85: Radiated Emissions 2 GHz – 4 GHz; Fiberglass Container; TC #3; Vertical



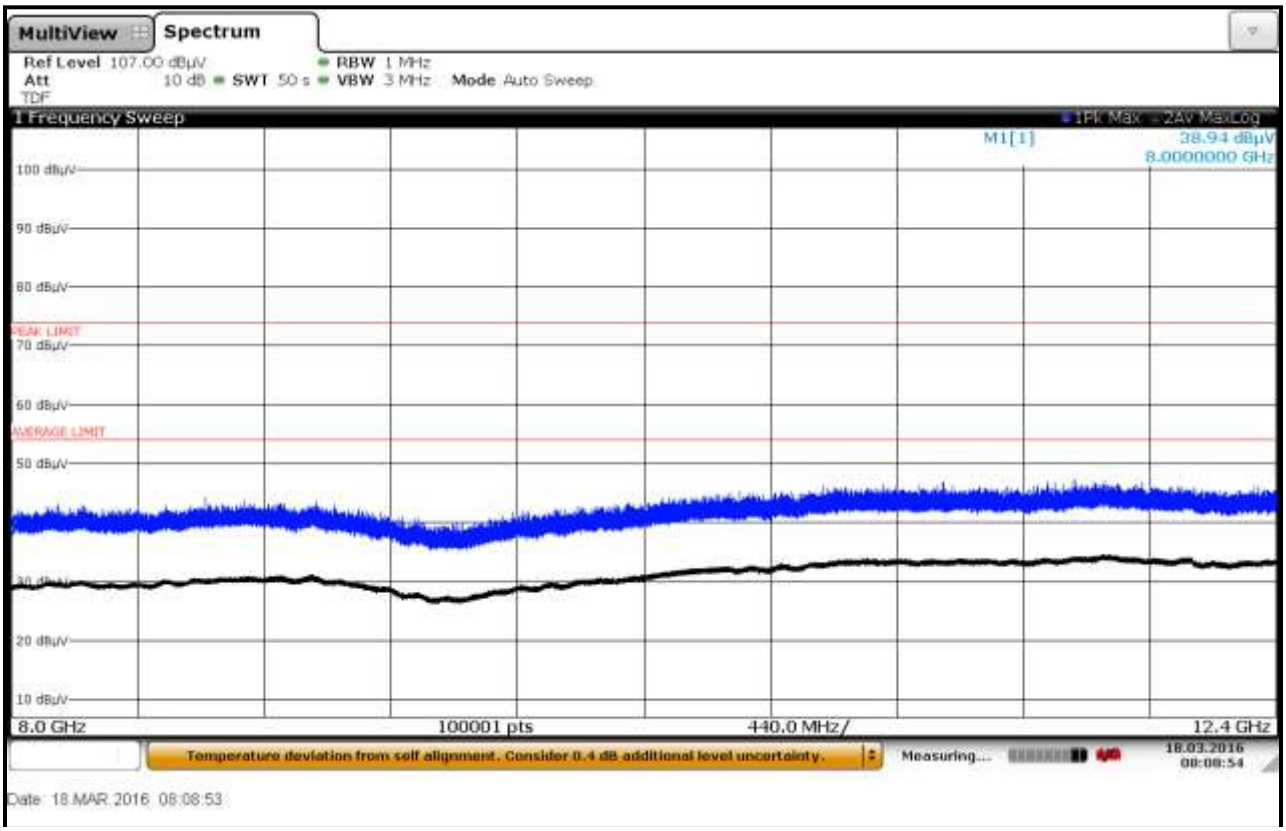
Plot 6-86: Radiated Emissions 4 GHz – 8 GHz; Fiberglass Container; TC #3; Horizontal



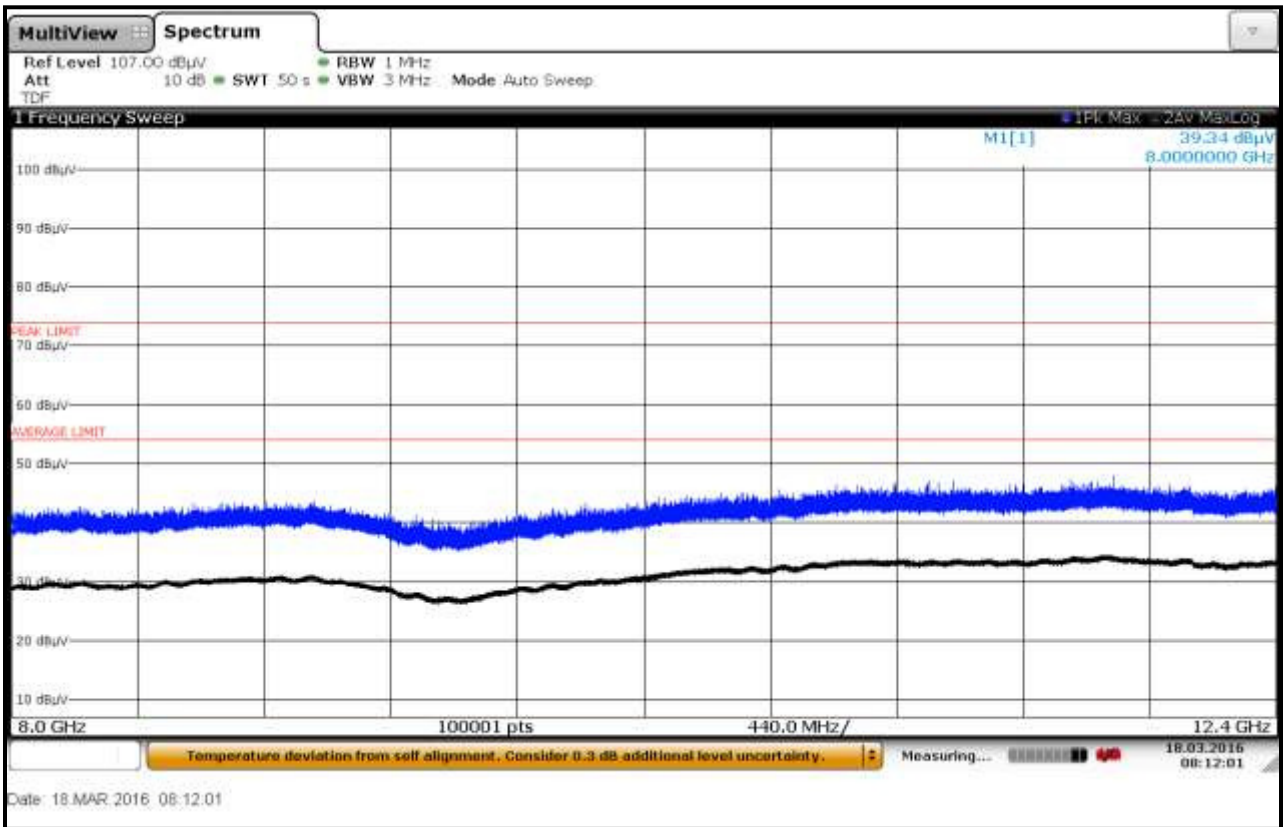
Plot 6-87: Radiated Emissions 4 GHz – 8 GHz; Fiberglass Container; TC #3; Vertical



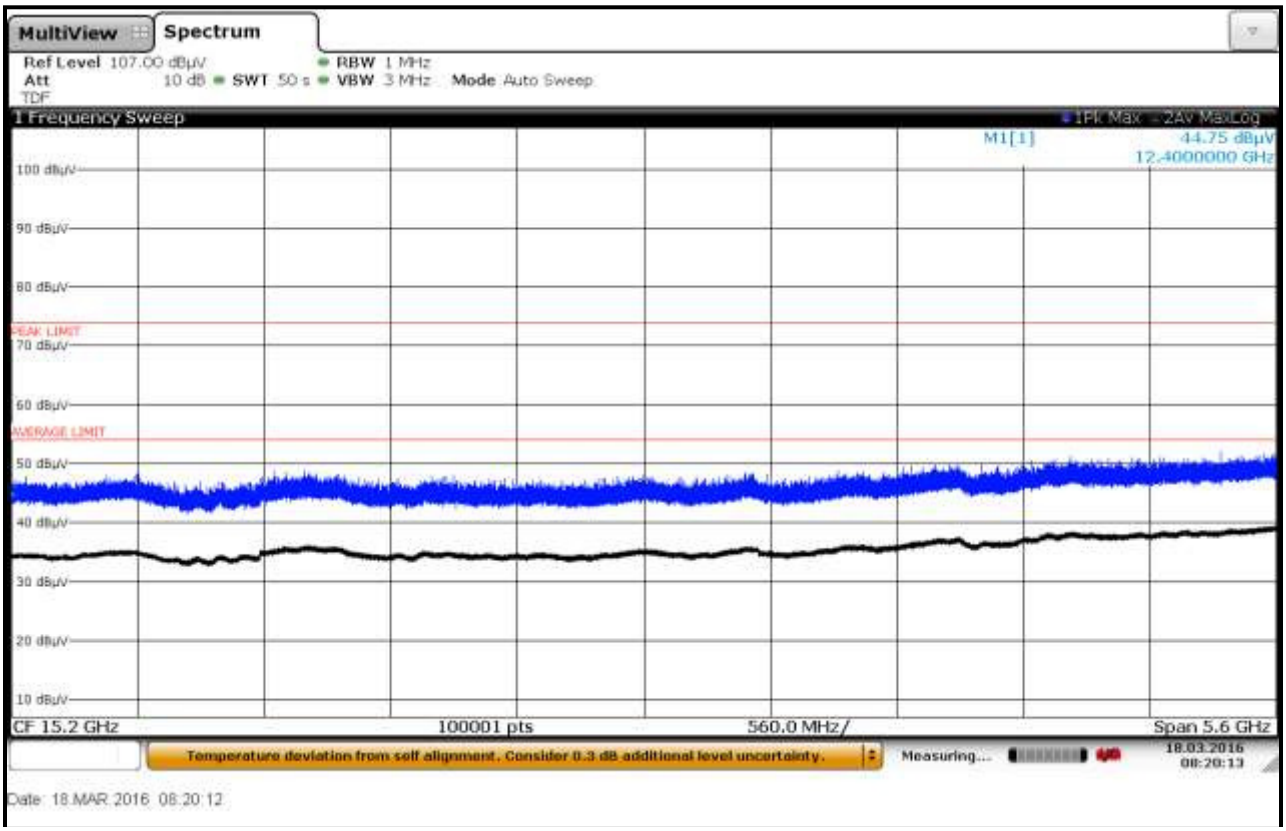
Plot 6-88: Radiated Emissions 8 GHz – 12.4 GHz; Fiberglass Container; TC #3, Horizontal



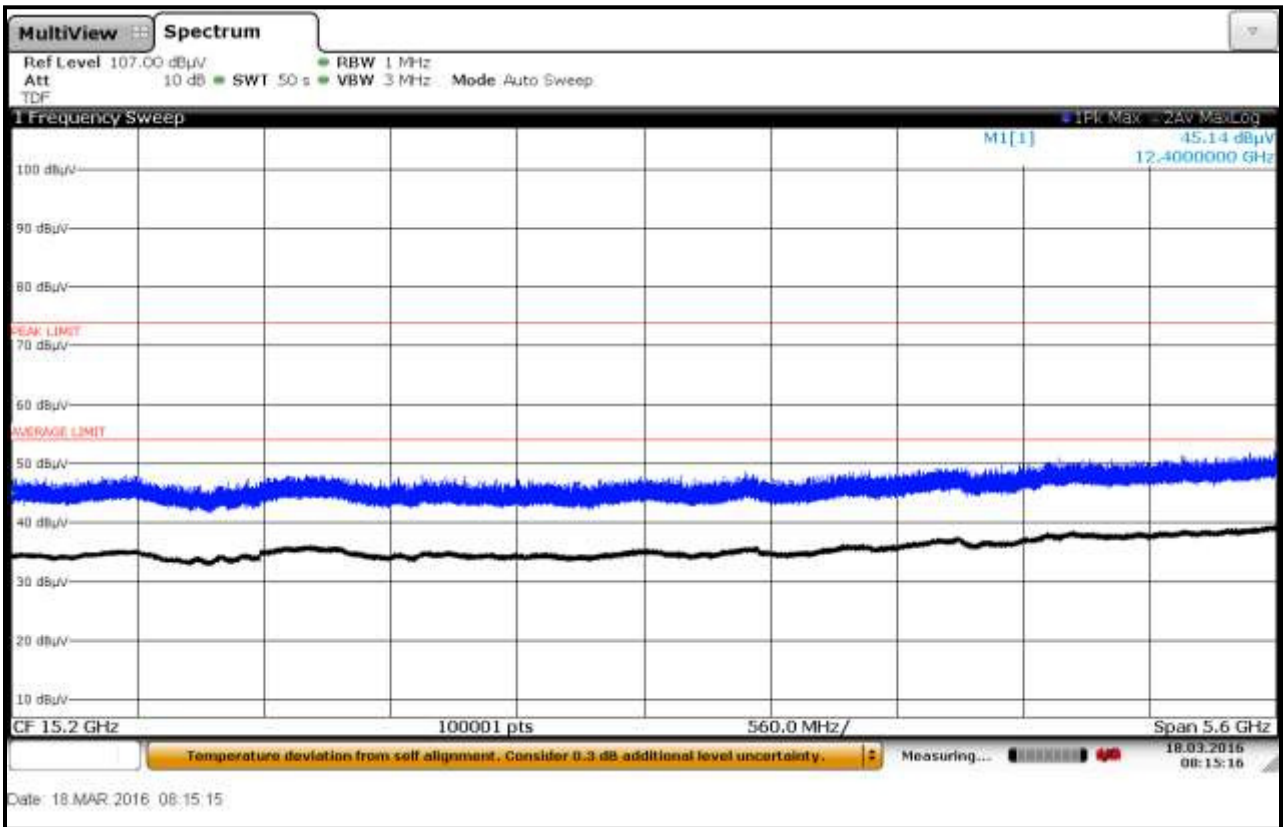
Plot 6-89: Radiated Emissions 8 GHz – 12.4 GHz; Fiberglass Container; TC #3, Vertical



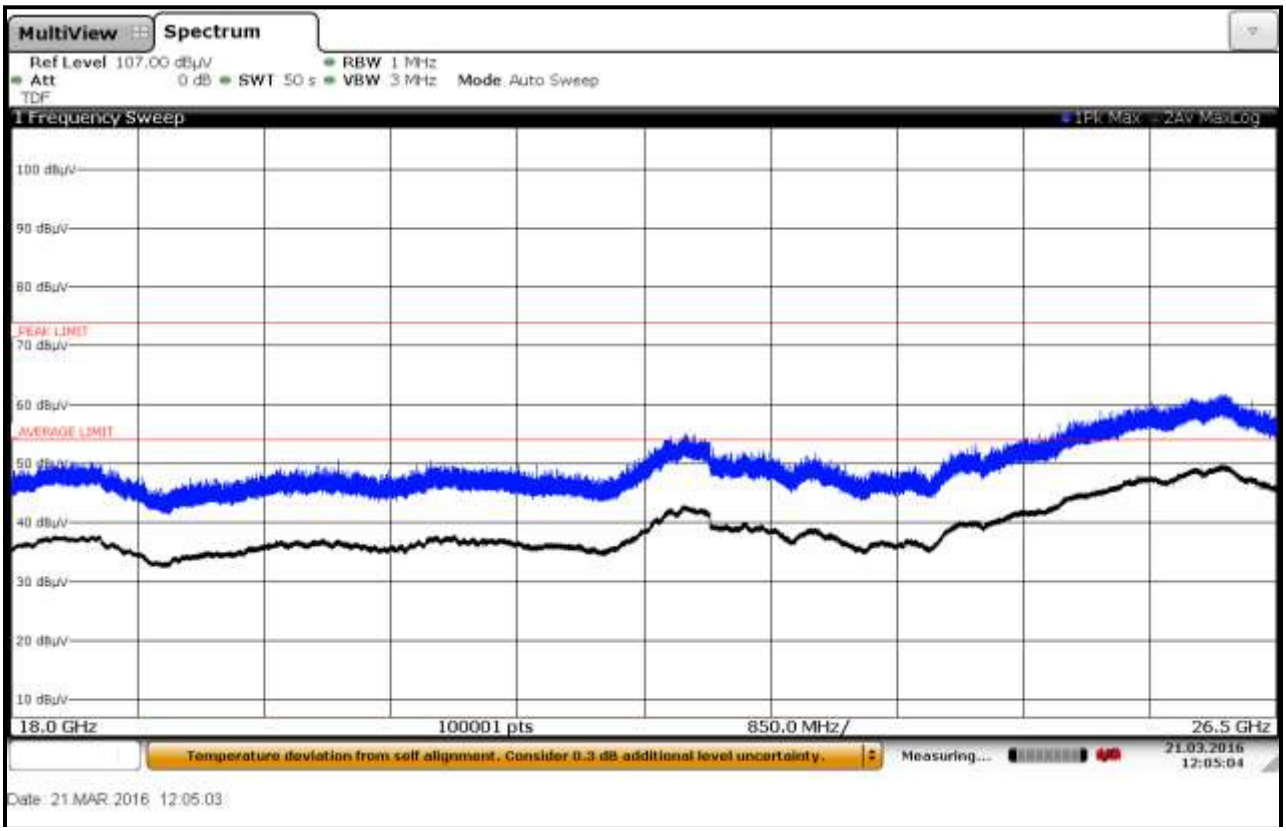
Plot 6-90: Radiated Emissions 12.4 GHz – 18 GHz; Fiberglass Container; TC #3, Horizontal



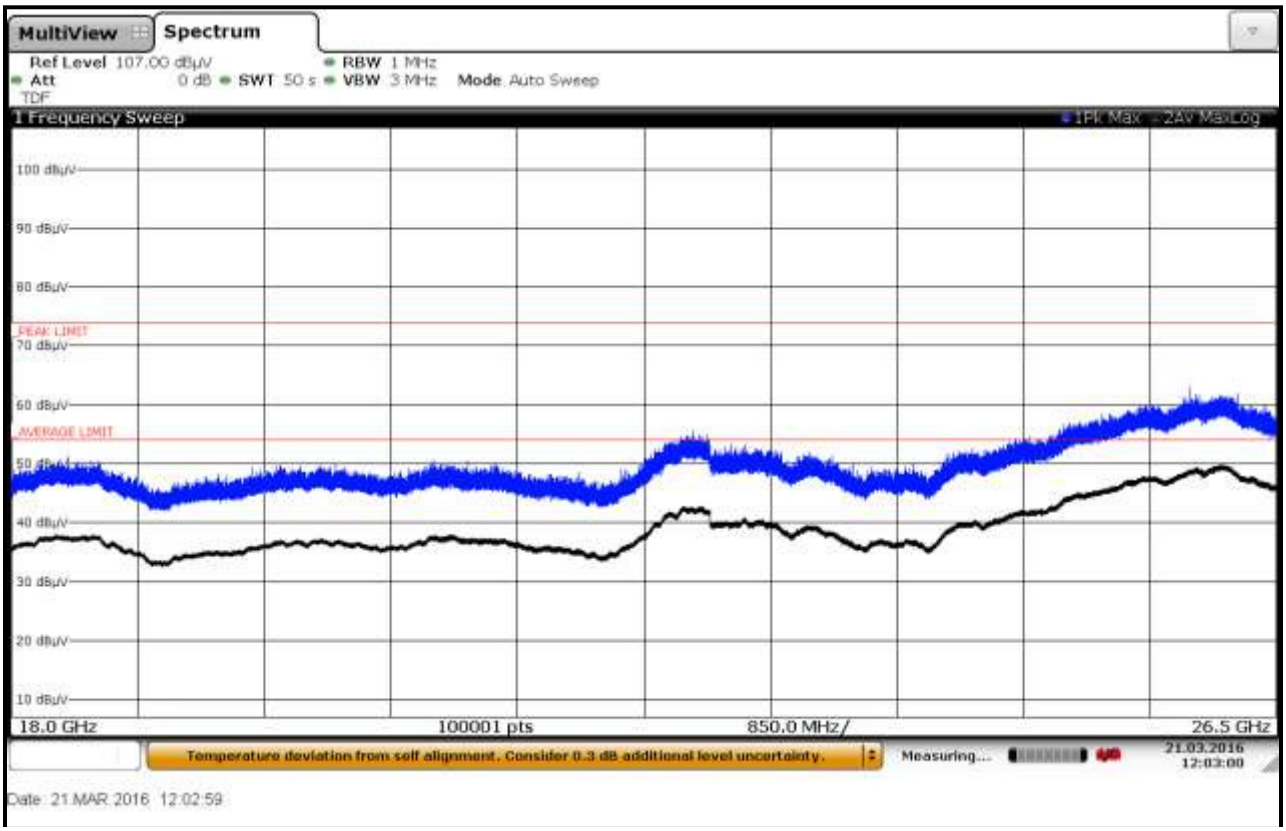
Plot 6-91: Radiated Emissions 12.4 GHz – 18 GHz; Fiberglass Container; TC #3, Vertical



Plot 6-92: Radiated Emissions 18 GHz – 26.5 GHz; Fiberglass Container; TC #3, Horizontal



Plot 6-93: Radiated Emissions 18 GHz – 26.5 GHz; Fiberglass Container; TC #3, Vertical



Results

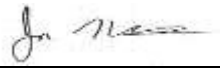
The worst-case radiated emissions occur with the EUT in configurations TC #1-3 tested with the main beam pointing perpendicularly downwards within the enclosed metal, fiberglass and concrete containers.

Please note: statement on some test results plots such as "Temperature deviation from self-alignment. Consider 0.3 dB additional level uncertainty", does not impact the test results. All plots with such statements are well below the peak and average limits of each corresponding plots.

Table 6-14: Radiated Emissions Test Equipment for Enclosure Plots

Part	Manufacturer	Model	Serial Number	RTL Bar Code	Calibration Due Date
Spectrum Analyzer (2 Hz-43.5 GHz)	Rohde & Schwarz	FSW Signal & Spectrum Analyzer, FSW43	10383	No	8/3/17
Amplifier (500-18,000 MHz)	Com-Power	PAM-118A	551076	901683	8/18/16
Horn (1-18 GHz)	ETS-Lindgren	3117	No	901650	9/26/16
Cable	RF Depot	3-ft	No	901336	9/22/16
Cable	RF Depot	20-ft	No	901334	9/22/16
Amplifier (1-26.5 GHz)	Hewlett Packard	8449 B OPT H02	3008A00505	900932	9/11/16
Horn (18-26.5 GHz)	EMCO	960281-003	990706-002	901218	4/14/18

Test Personnel:

Jon Wilson		March 18 & 21, 2016
Test Engineer	Signature	Dates of Test

7 Conclusion

The data in this measurement report shows that the Vega Grieshaber KG, Inc., Model VEGAPULS64, 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.