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Report On

Radio Testing of the
Delphi Deutschland GmbH
VMRR2 Medium Range Radar

FCC Part 95 Subpart M
ISED RSS-251 Issue 1 November 2014

Report No. SD72132220-1017E **December 2017**

TÜV SÜD America Inc., 10040 Mesa Rim Road, San Diego, CA 92121
Tel: (858) 678-1400. Website: www.TUVamerica.com

REPORT ON	Radio Testing of the Delphi Deutschland GmbH VMRR2 Medium Range Radar
TEST REPORT NUMBER	SD72132220-1017E
PREPARED FOR	Delphi Deutschland GmbH Delphiplatz 1 42119 Wuppertal, Germany
CONTACT PERSON(S)	Mattias Wallman Technical Manager 0046317204422 Mattias.Wallmann@Delphi.com
PREPARED BY	Nikolay Shtin **Name** Authorized Signatory Title: EMC/Wireless Test Engineer
APPROVED BY	Ferdie S. Custodio **Name** Authorized Signatory Title: EMC/ Senior Wireless Test Engineer
DATED	December 27, 2017

Revision History

SD72132220-1017E Delphi Deutschland GmbH VMRR2 Medium Range Radar					
DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
12/27/17	Initial Release				Ferdie S. Custodio

CONTENTS

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SECTION 1

REPORT SUMMARY

Radio Testing of the
Delphi Deutschland GmbH
VMRR2 Medium Range Radar

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1.1 INTRODUCTION

The information contained in this report is intended to show verification of the Delphi Deutschland GmbH VMRR2 Medium Range Radar to the requirements of FCC Part 95 Subpart M and ISED RSS-251 Issue 1 November 2014.

Objective	To perform Radio Testing to determine the Equipment Under Test's (EUT's) compliance with the Test Specification, for the series of tests carried out.
Manufacturer	Delphi Deutschland GmbH
Product Name	Medium Range Radar
Model Number(s)	VMRR2
FCC ID Number	LTQVMRR2
IC Number	3659A-VMRR2
Serial Number(s)	01354000E7, 01354000GQ, 01354000JL, 01354000KX, 01354000FP and 01354000K8
Number of Samples Tested	6
Test Specification/Issue/Date	• FCC Part 95 Subpart M (October 1, 2017). • RSS-251 – Field Disturbance Sensors in the Bands 46.7-46.9 GHz (Vehicular Radar) and 76-77 GHz (Vehicular and Airport Fixed Radar) (Issue 1, November 2014). • RSS-Gen - General Requirements and Information for the Certification of Radio Apparatus (Issue 4, November 2014).
Start of Test	October 2, 2017
Finish of Test	October 13, 2017
Name of Engineer(s)	Nikolay Shtin
Related Document(s)	None. Supporting documents for EUT certification are separate exhibits.

1.2 BRIEF SUMMARY OF RESULTS

A brief summary of the tests carried out in accordance with FCC Part 95 Subpart M with cross-reference to the corresponding ISED RSS standard is shown below.

Section	FCC Spec Clause	RSS	Test Description	Result	Comments/Base Standard
2.1	§95.3367(a) and (b)	RSS-251 5.2.2	Power Density Limits	Compliant	
2.2	§2.1049	RSS-GEN	Occupied Bandwidth / 99% Emission Bandwidth	As reported	
2.3	§95.3379(a)	RSS-251 5.3	Spurious Emissions	Compliant	
2.4	§95.3379(b)	RSS-251 5.4	Frequency stability	Compliant	

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Page **7** of **82**

1.3 PRODUCT INFORMATION

1.3.1 Technical Description

The Equipment Under Test (EUT) was a Delphi Deutschland GmbH VMRR2 Radar. The EUT is a Medium Range Radar. The EUT operates in the 76-77 GHz band. The device employs a dynamic chirp modulated transmit array. Multiple receive antennas are used to determine target angular resolution through digital beam forming. The device is intended to be mounted at the front and rear corners of a vehicle. The EUT nominal operating voltage is 12.0/24.0 VDC.

Equipment Under Test

1.3.2 EUT General Description

EUT Description	Medium Range Radar
Product Name	Medium Range Radar
Model Number(s)	VMRR2
Rated Voltage	12.0 VDC/ 24.0 VDC
Output Power	26.93 dBm Peak EIRP
Frequency Range	76.0152 GHz to 76.9930 GHz in the 76.0 GHz to 77.0 GHz Band
Number of Operating Frequencies	6
Channels Verified	Low, Mid and High
Antenna Type (used during evaluation)	Integral (Complies with Part 15.203 requirements)

1.3.3 Antenna Details

Manufacturer	Delphi Deutschland GmbH
Antenna Type	Planar array antenna
Antenna Gain	18.0 dBi
EUT Antenna Connector	N/A
Maximum Dimensions	97.0 mm x 64.0 mm x 15.0 mm

1.4 EUT TEST CONFIGURATION

1.4.1 Test Configuration Description

Test Configurations	Description
Default	Radiated configuration. EUT transmitting modulated signal continuously through the integral antenna.

1.4.2 EUT Exercise Software

None.

1.4.3 Support Equipment and I/O cables

Manufacturer	Equipment/Cable	Description
Delphi	Harness with pins for power supply and CAN connector	Connects the EUT to a 12 VDC power supply and to the CAN HW

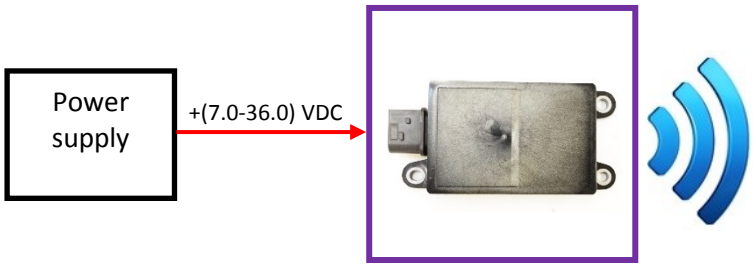
1.4.4 Worst Case Configuration

Worst-case configuration used in this test report based from Peak Power Density measurement:

Channel	Modulation BW
Low Channel	90 MHz
Mid Channel	90 MHz
High Channel	90 MHz

EUT is mobile device designed to be installed on a vehicle, for radiated spurious measurement only default configuration was evaluated (See test setup picture exhibit).

1.4.5 Simplified Test Configuration Diagram



EUT transmitting at 76-77 GHz
from integral antenna

For Illustration Purpose Only
Image presented may not represent the actual EUT or support equipment

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1.5 DEVIATIONS FROM THE STANDARD

No deviations from the applicable test standards or test plan were made during testing.

1.6 MODIFICATION RECORD

Description of Modification	Modification Fitted By	Date Modification Fitted
Serial Number: N/A		
N/A	-	-

The table above details modifications made to the EUT during the test programme. The modifications incorporated during each test (if relevant) are recorded on the appropriate test pages.

1.7 TEST METHODOLOGY

All measurements contained in this report were conducted with ANSI C63.10-2013, 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.

For conducted and radiated emissions the equipment under test (EUT) was configured to measure its highest possible emission level. This level was based on the maximized cable configuration from exploratory testing per ANSI C63.10-2013. The test modes were adapted according to the Operating Instructions provided by the manufacturer/client.

1.8 TEST FACILITY LOCATION

1.8.1 TÜV SÜD America Inc. (Mira Mesa)

10040 Mesa Rim Road, San Diego, CA 92121-2912 (32.901268,-117.177681). Phone: 858 678 1400 FAX: 858-546 0364

1.8.2 TÜV SÜD America Inc. (Rancho Bernardo)

16936 Via Del Campo, San Diego, CA 92127-1708 (33.018644,-117.092409). Phone: 858 678-1400 Fax: 858 546 0364.

1.9 TEST FACILITY REGISTRATION

1.9.1 FCC – Registration No.: US1146

TUV SUD America Inc. (San Diego), is an accredited test facility with the site description report on file and has met all the requirements specified in §2.948 of the FCC rules. The acceptance letter from the FCC is maintained in our files and the Designation is US1146.

1.9.2 Innovation, Science and Economic Development Canada (IC) Registration No.: 3067A-1 & 22806-1

The 10m Semi-anechoic chamber of TUV SUD America Inc. (San Diego Rancho Bernardo) has been registered by Certification and Engineering Bureau of Innovation, Science and Economic Development Canada for radio equipment testing with Registration No. 3067A-1.

The 3m Semi-anechoic chamber of TUV SUD America Inc. (San Diego Mira Mesa) has been registered by Certification and Engineering Bureau of Innovation, Science and Economic Development Canada for radio equipment testing with Registration No. 22806-1.

1.9.3 BSMI – Laboratory Code: SL2-IN-E-028R (US0102)

TUV Product Service Inc. (San Diego) is a recognized EMC testing laboratory by the BSMI under the MRA (Mutual Recognition Arrangement) with the United States. Accreditation includes CNS 13438 up to 6GHz.

1.9.4 NCC (National Communications Commission - US0102)

TUV SUD America Inc. (San Diego) is listed as a Foreign Recognized Telecommunication Equipment Testing Laboratory and is accredited to ISO/IEC 17025 (A2LA Certificate No.2955.13) which under APEC TEL MRA Phase 1 was designated as a Conformity Assessment Body competent to perform testing of equipment subject to the Technical Regulations covered under its scope of accreditation including RTTE01, PLMN01 and PLMN08 for TTE type of testing and LP002 for Low-Power RF Device type of testing.

1.9.5 VCCI – Registration No. A-0230

TUV SUD America Inc. (San Diego) is a VCCI registered measurement facility which includes radiated field strength measurement, radiated field strength measurement above 1GHz, mains port interference measurement and telecommunication port interference measurement.

SECTION 2

TEST DETAILS

Radio Testing of the
Delphi Deutschland GmbH
VMRR2 Medium Range Radar

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2.1 POWER DENSITY LIMITS

2.1.1 Specification Reference

Part 95 Subpart M §95.3367(a) and (b) and RSS-251 Issue 1 Sec. 5.2.2

2.1.2 Standard Applicable

The fundamental radiated emission limits within the 76-81 GHz band are expressed in terms of Equivalent Isotropically Radiated Power (EIRP) and are as follows:

(a) The maximum power (EIRP) within the 76-81 GHz band shall not exceed 50 dBm based on measurements employing a power averaging detector with a 1 MHz Resolution Bandwidth (RBW).

(b) The maximum peak power (EIRP) within the 76-81 GHz band shall not exceed 55 dBm based on measurements employing a peak detector with a 1 MHz RBW

2.1.3 Equipment Under Test and Modification State

Serial No: 01354000E7, 01354000GQ, 01354000JL, 01354000FP, 01354000KX and 01354000K8 / Default Test Configuration

2.1.4 Date of Test/Initial of test personnel who performed the test

October 02, 2017/NS

2.1.5 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.1.6 Environmental Conditions/ Test Location

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	25.8°C
Relative Humidity	45.3%
ATM Pressure	98.9 kPa

2.1.7 Additional Observations

- This is a radiated test.
- Test distance of 3 m was used for the fundamental emissions measurement.
- A correction factor of 59.81-59.90 dB and mixer conversion loss table were used to account for the test antenna gain, free-space loss and external mixer loss.
- Sample correction factor calculation @ 76.5 GHz:

Correction Factor (dB)	Asset# 7628 (antenna)	-21.8	59.86
	External 2 dB attenuator	2.0	
	Free space loss	79.66	

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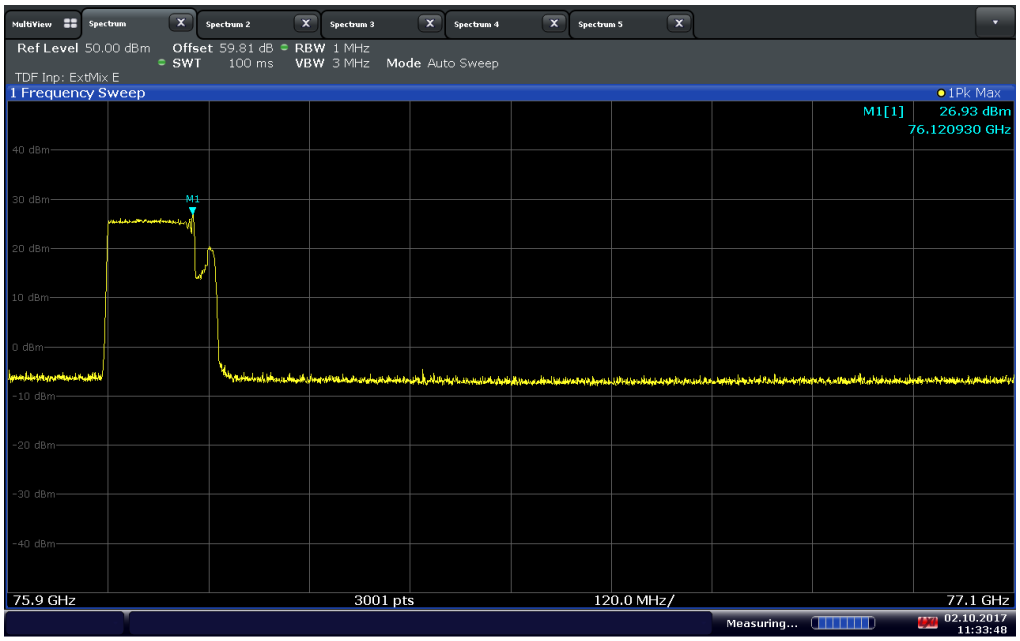
2.1.8 Test Results

Peak EIRP			
Modulation BW	**Channel**	**Measured EIRP (dBm)**	**Limit (dBm)**
90 MHz	Low (76.080 GHz)	26.93	55
	Mid (76.500 GHz)	26.26	
	High (76.920 GHz)	26.03	
240 MHz	Low (76.185 GHz)	25.73	
	Mid (76.515 GHz)	26.06	
	High (76.815 GHz)	26.01	
Average EIRP			
Modulation BW	**Channel**	**Measured EIRP (dBm)**	**Limit (dBm)**
90 MHz	Low (76.080 GHz)	8.16	50
	Mid (76.500 GHz)	7.83	
	High (76.920 GHz)	7.35	
240 MHz	Low (76.185 GHz)	5.60	
	Mid (76.515 GHz)	7.36	
	High (76.815 GHz)	7.07	
EUT complies			

2.1.9 Test plots



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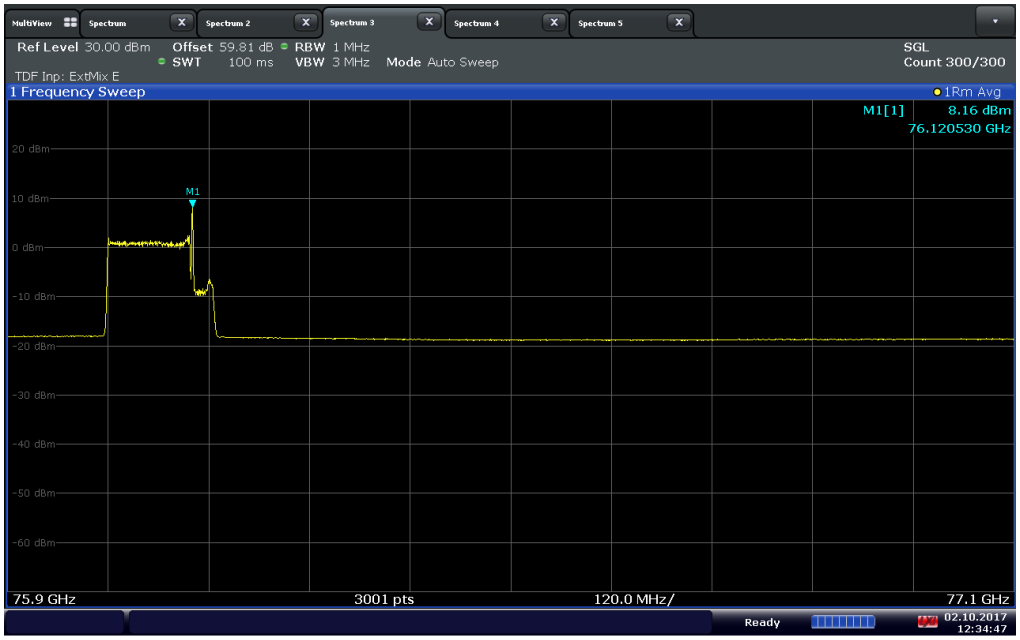
Low Channel 90 MHz BW (Peak detector)



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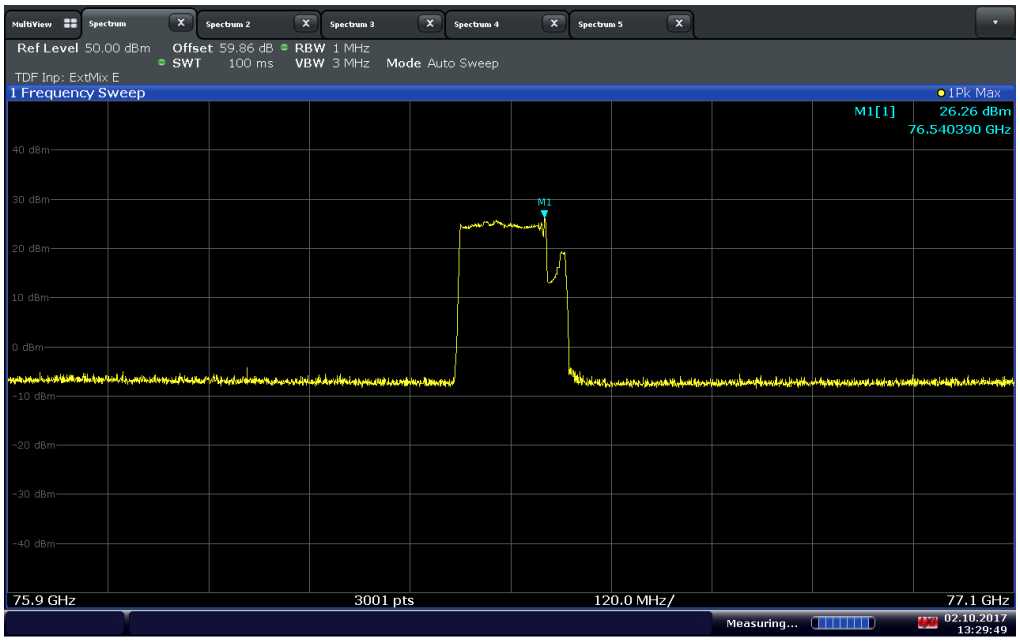
Low Channel 90 MHz BW (RMS detector)



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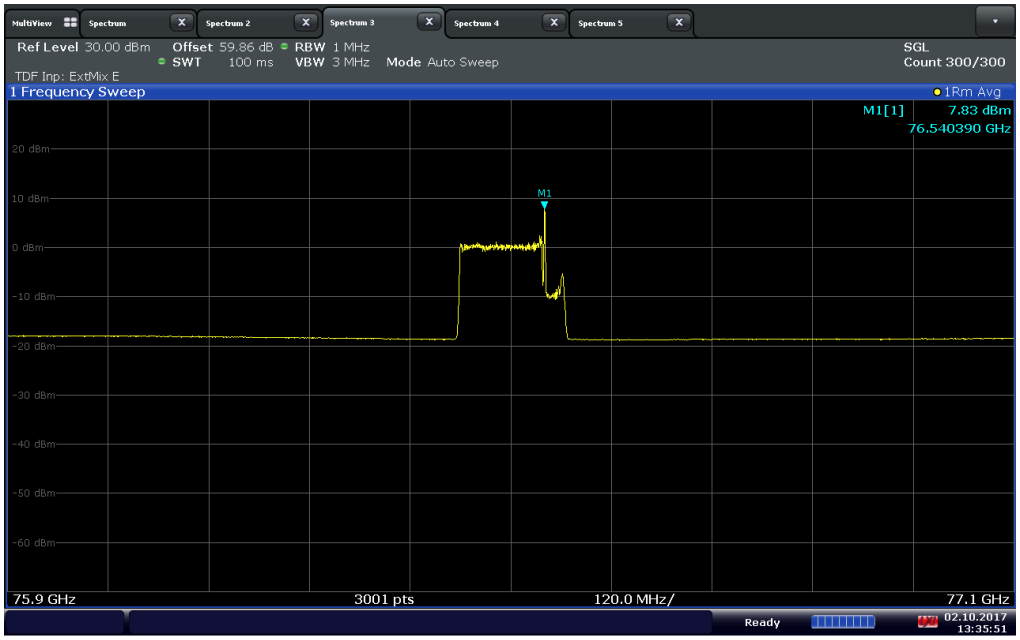
Mid Channel 90 MHz BW (Peak detector)



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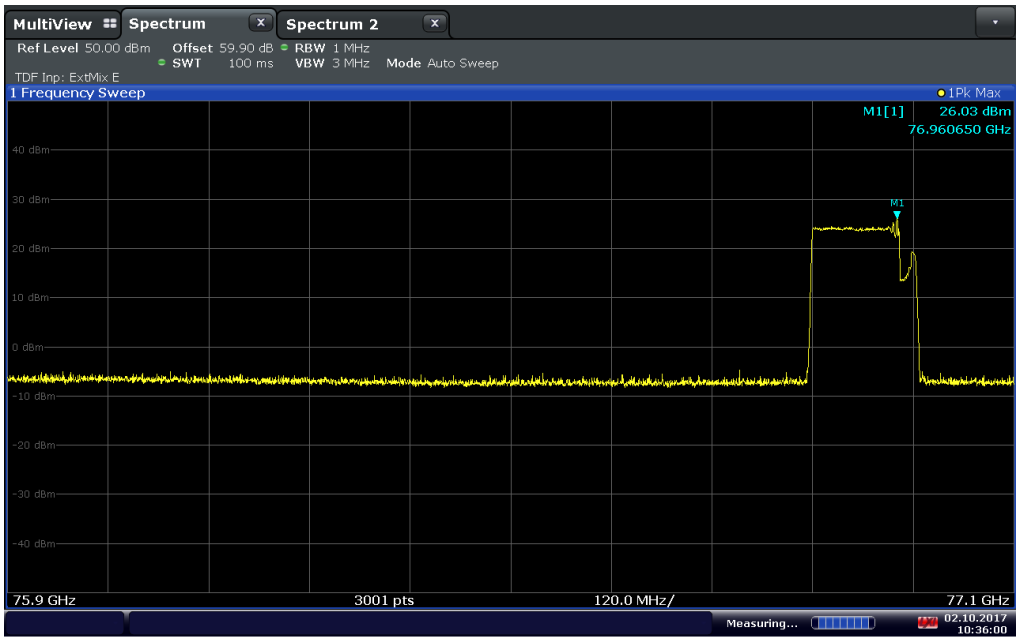
Mid Channel 90 MHz BW (RMS detector)



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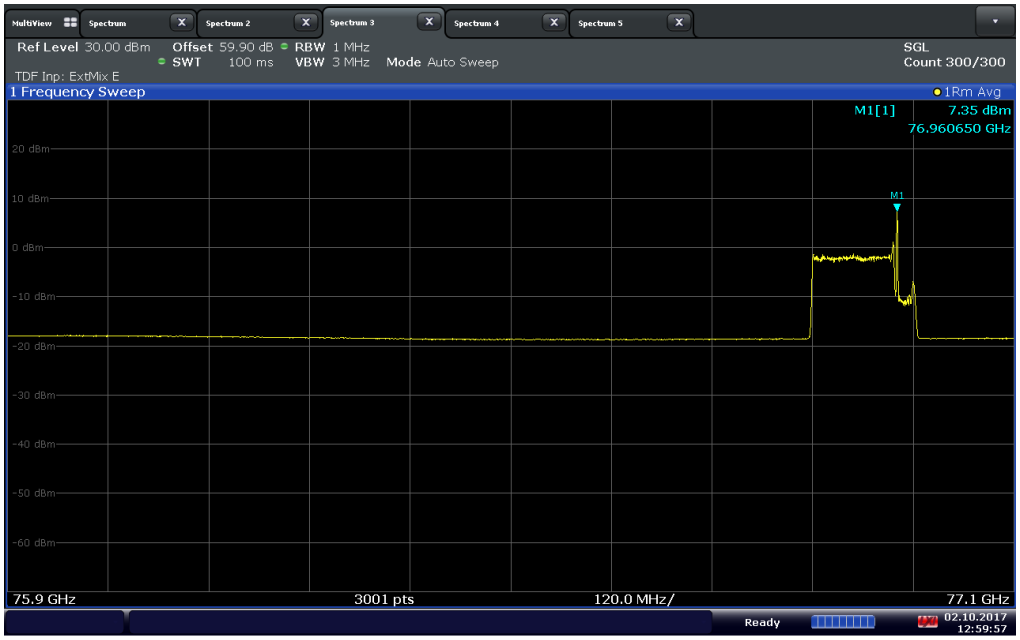
High Channel 90 MHz BW (Peak detector)



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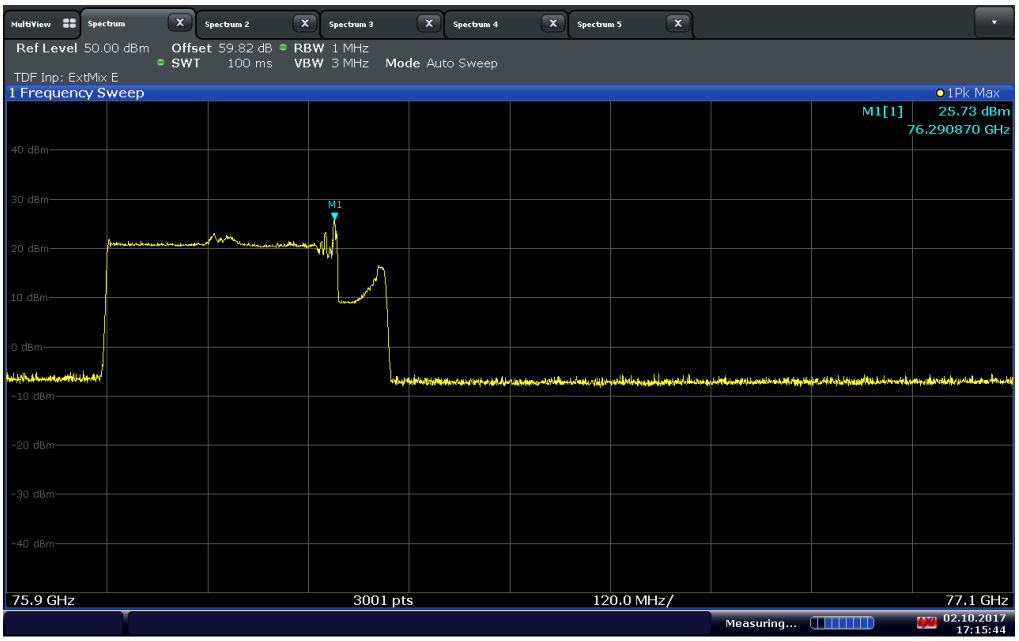
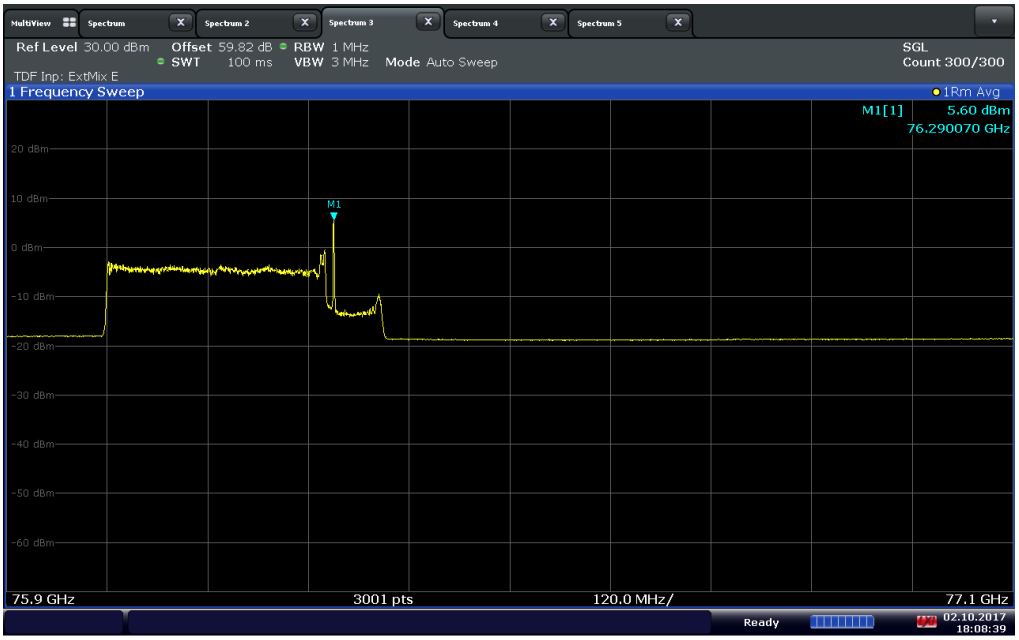
High Channel 90 MHz BW (RMS detector)



17:15:44 02.10.2017

Low Channel 240 MHz BW (Peak detector)



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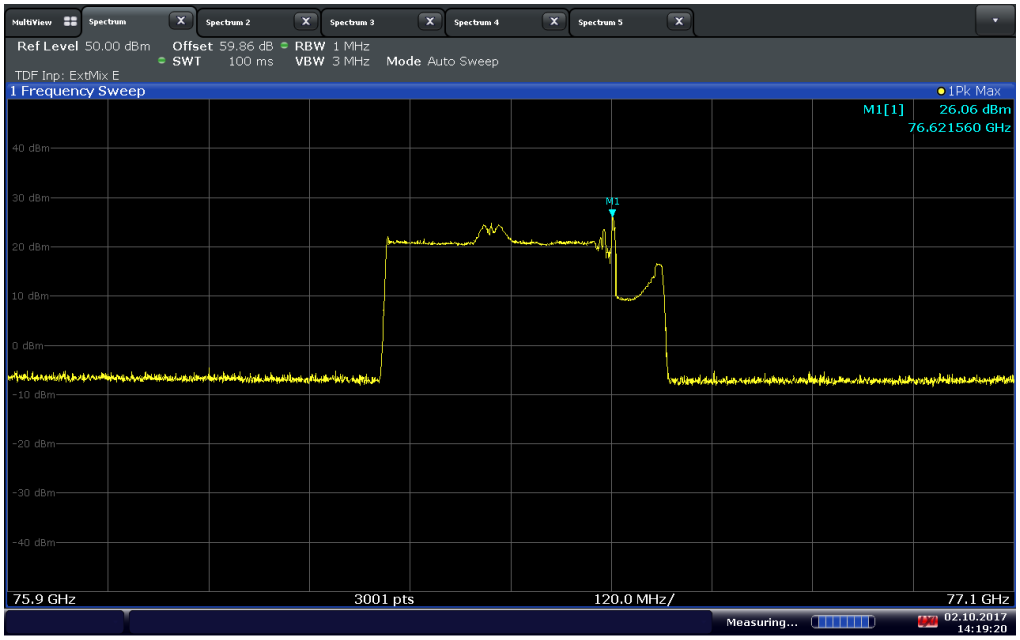
Low Channel 240 MHz BW (RMS detector)



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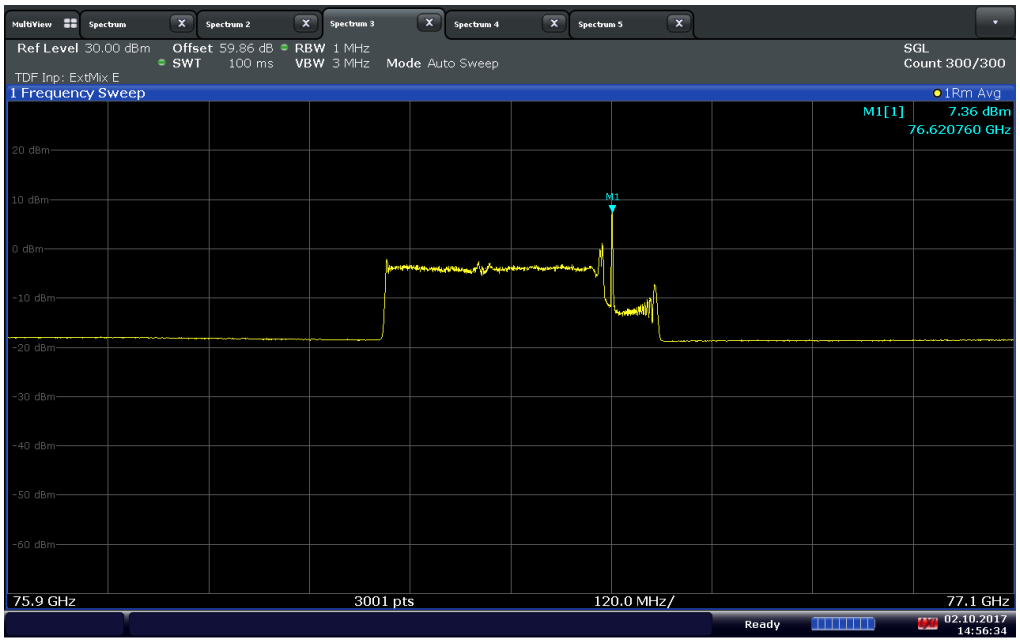
Mid Channel 240 MHz BW (Peak detector)



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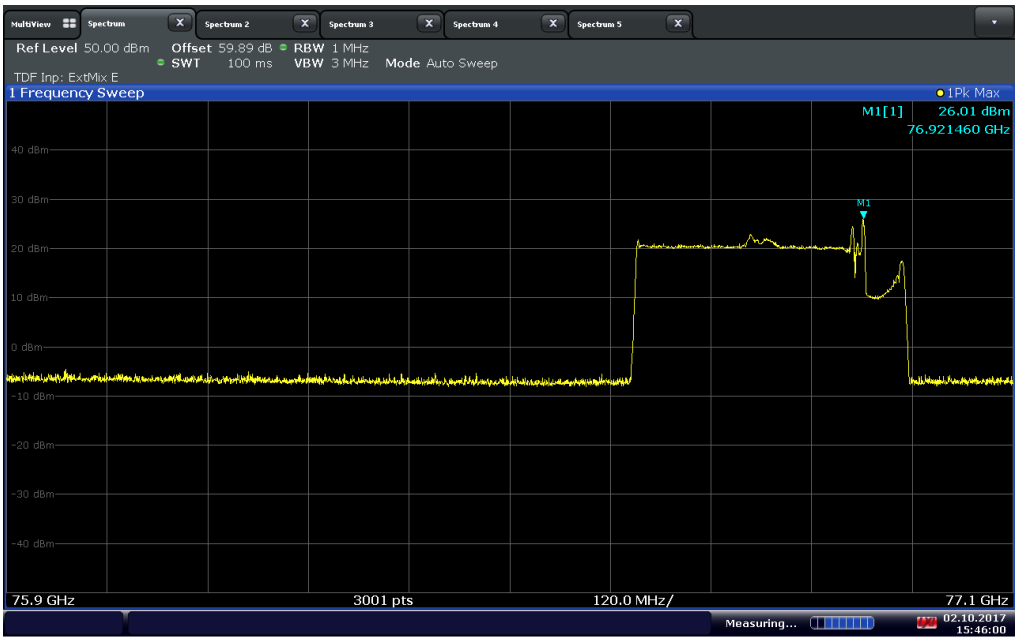
Mid Channel 240 MHz BW (RMS detector)



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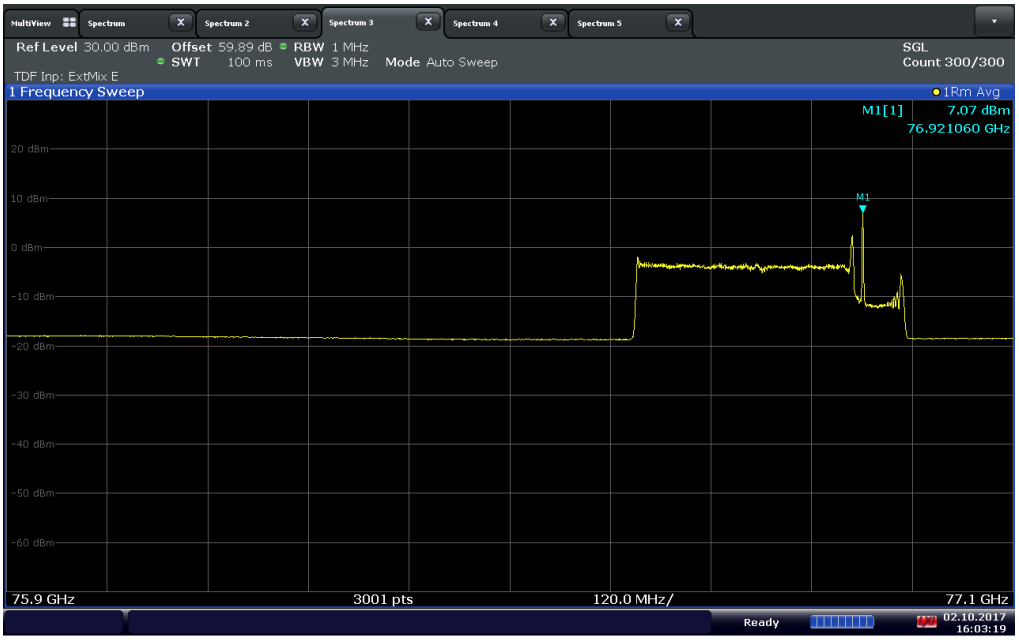
High Channel 240 MHz BW (Peak detector)



16:03:20 02.10.2017

High Channel 240 MHz BW (RMS detector)

2.2 OCCUPIED BANDWIDTH / 99% EMISSION BANDWIDTH

2.2.1 Specification Reference

FCC 47 CFR Part 2, Clause 2.1049 and 2.202(a)
RSS-GEN Issue 4 Section 6.6

2.2.2 Standard Applicable

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured.

2.2.3 Equipment Under Test and Modification State

Serial No: 01354000E7, 01354000GQ, 01354000JL, 01354000FP, 01354000KX and 01354000K8 / Default Test Configuration

2.2.4 Date of Test/Initial of test personnel who performed the test

October 02, 2017/NS

2.2.5 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.2.6 Environmental Conditions

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	25.8°C
Relative Humidity	45.3%
ATM Pressure	98.9 kPa

2.2.7 Additional Observations

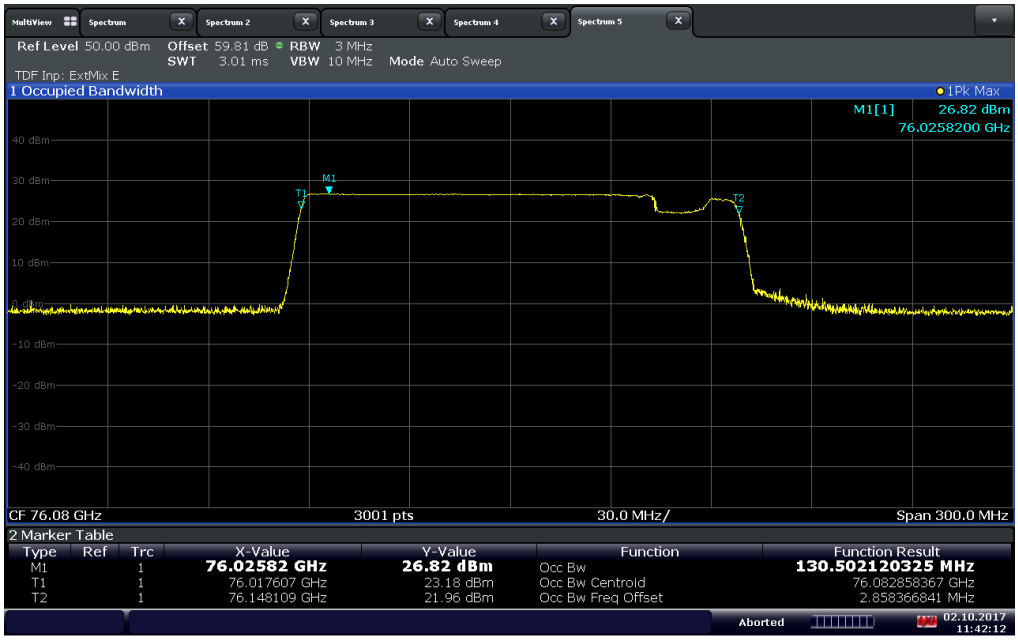
- This is a radiated test.
- A correction factor of 59.81-59.90 dB and mixer conversion loss table were used to account for the test antenna gain, free-space loss and external mixer loss.
- Span is wide enough to capture the channel transmission.
- RBW is 1% initially set approx. to 1% of anticipated EBW.
- VBW > RBW.
- Trace is max hold.
- Detector is peak.

- Sweep time is set to Auto.
- 99% OBW measurement function of the spectrum analyzer was used for this test.
- RBW adjusted until RBW/EBW ratio is approximately 1% or as the SA setting permits (i.e next setting after 3 MHz RBW is limited to 5 MHz).

2.2.8 Summary Test Results (as reported)

Occupied Bandwidth			
Modulation BW	**Low Channel**	**Mid Channel**	**High Channel**
90 MHz	130.5 MHz	128.7 MHz	126.6 MHz
240 MHz	332.6 MHz	328.1 MHz	322.1 MHz

2.2.9 Test Plots



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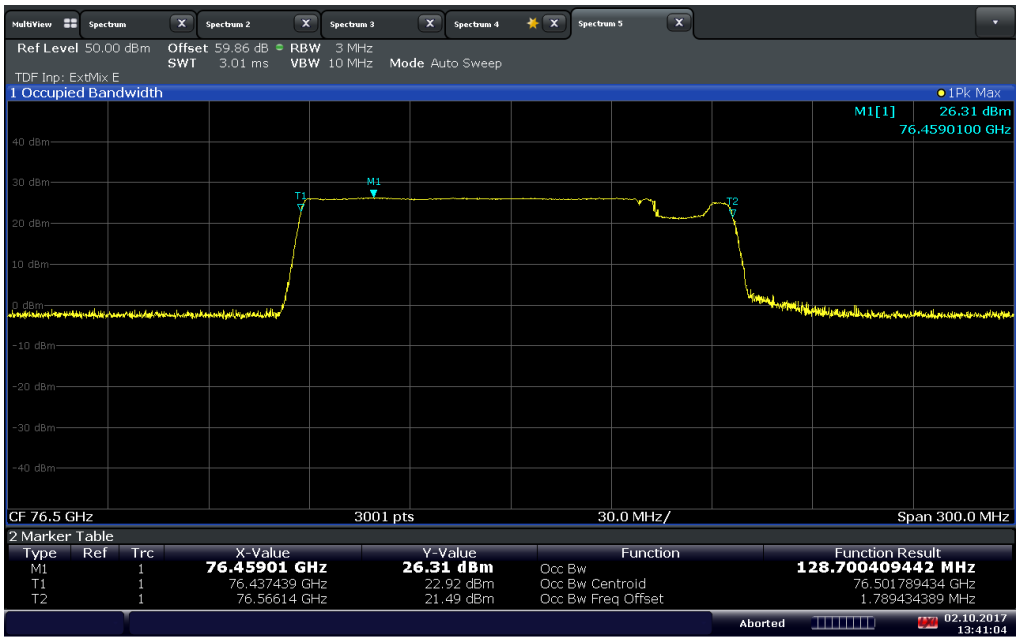
Low channel 90 MHz BW



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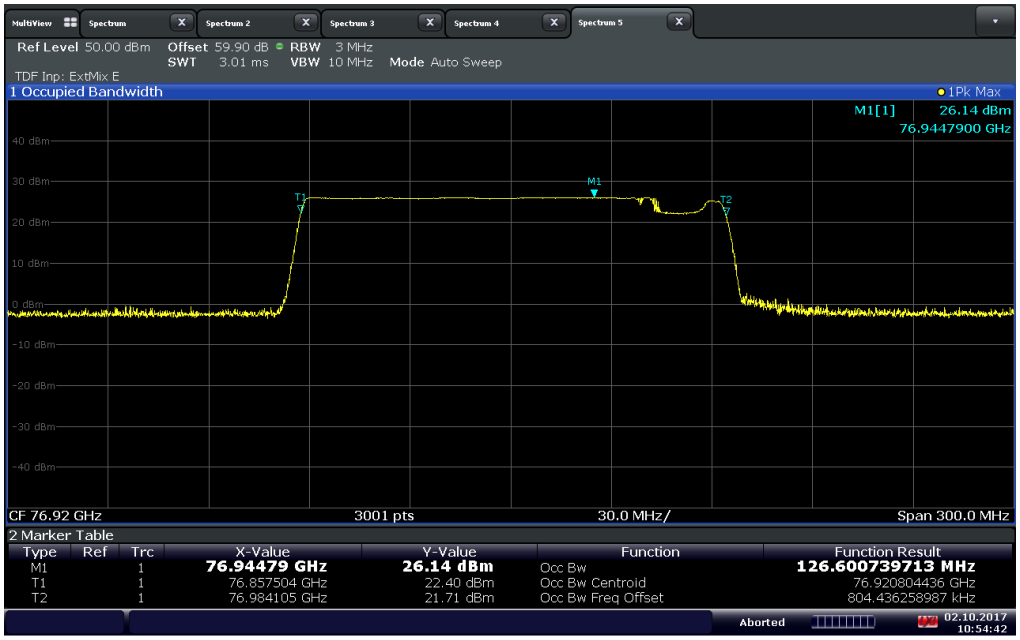
Mid channel 90 MHz BW



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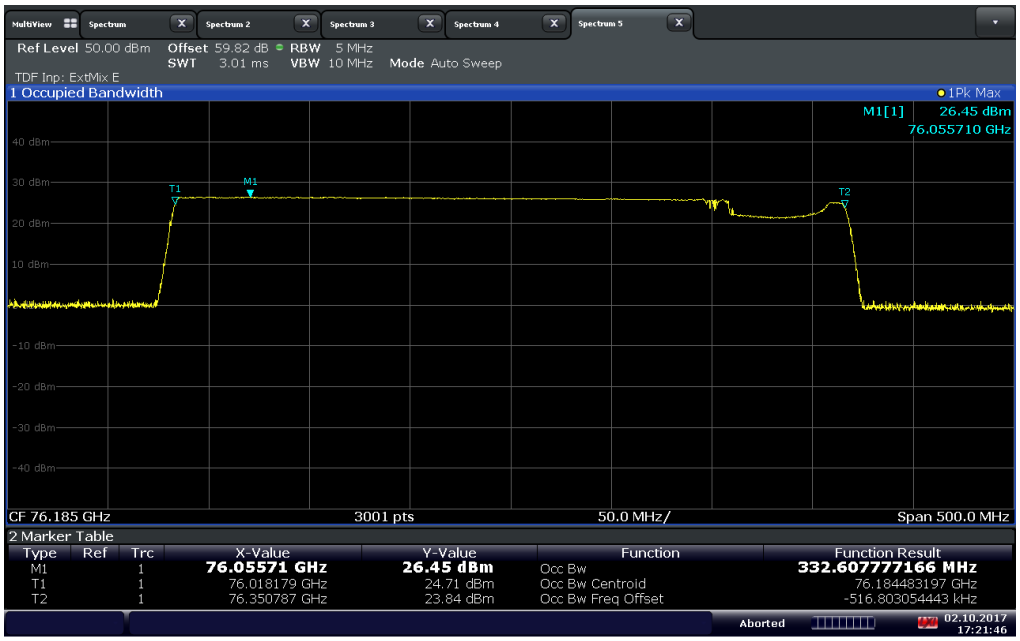
High channel 90 MHz BW



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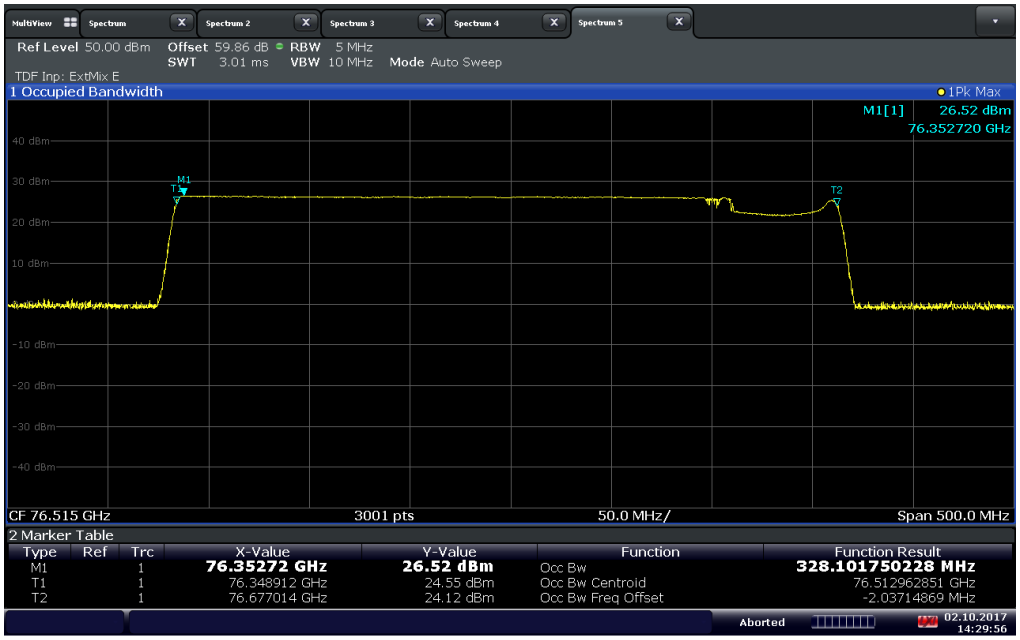
Low channel 240 MHz BW



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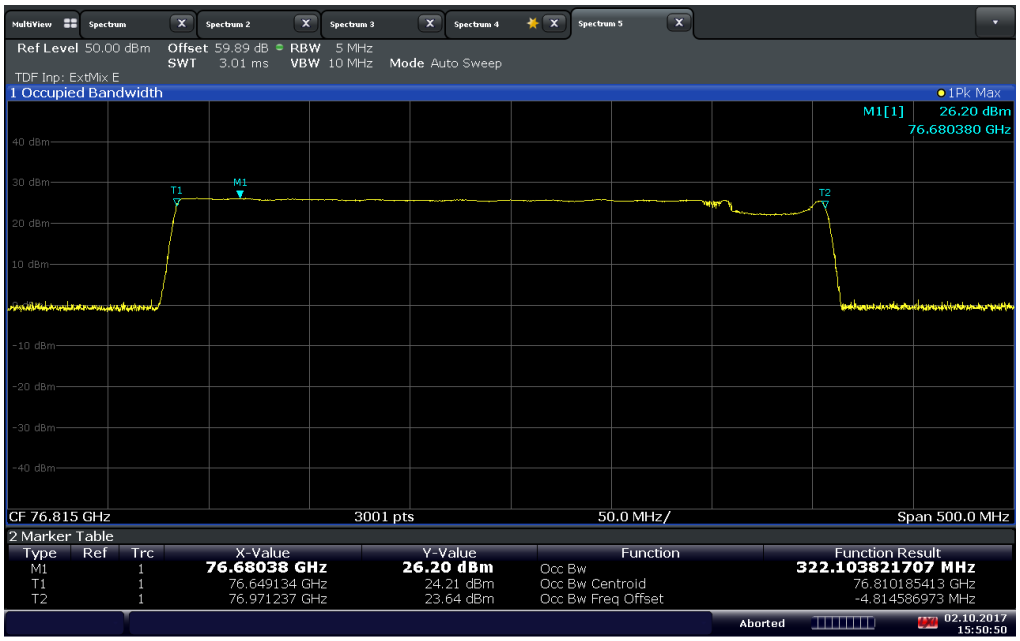
Mid channel 240 MHz BW



15:50:51 02.10.2017

High channel 240 MHz BW

2.3 SPURIOUS RADIATED EMISSIONS

2.3.1 Specification Reference

FCC Part 95 Subpart M §95.3379(a) and RSS-251 Issue 1 Sec. 5.3

2.3.2 Standard Applicable

(a) The power density of any emissions outside the 76-81 GHz band shall consist solely of spurious emissions and shall not exceed the following:

(1) Radiated emissions below 40 GHz shall not exceed the field strength as shown in the following emissions table.

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

(i) In the emissions table in paragraph (a)(1) of this section, the tighter limit applies at the band edges.

(ii) The limits in the table in paragraph (a)(1) of this section are based on the frequency of the unwanted emissions and not the fundamental frequency. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.

(iii) The emissions limits shown in the table in paragraph (a)(1) of this section are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9.0-90.0 kHz, 110.0-490.0 kHz, and above 1000 MHz. Radiated emissions limits in these three bands are based on measurements employing an average detector with a 1 MHz RBW.

(2) The power density of radiated emissions outside the 76-81 GHz band above 40.0 GHz shall not exceed the following, based on measurements employing an average detector with a 1 MHz RBW:

(i) For radiated emissions outside the 76-81 GHz band between 40 GHz and 200 GHz from field disturbance sensors and radar systems operating in the 76-81 GHz band: 600 pW/cm2 at a distance of 3 meters from the exterior surface of the radiating structure.

(ii) For radiated emissions above 200 GHz from field disturbance sensors and radar systems operating in the 76-81 GHz band: 1000 pW/cm2 at a distance of 3 meters from the exterior surface of the radiating structure.

(3) For field disturbance sensors and radar systems operating in the 76-81 GHz band, the spectrum shall be investigated up to 231.0 GHz.

2.3.3 Equipment Under Test and Modification State

Serial No: 01354000E7, 01354000GQ, 01354000JL, 01354000FP, 01354000KX and 01354000K8 / Default Test Configuration

2.3.4 Date of Test/Initial of test personnel who performed the test

October 04-06, October 09-11 and October 13, 2017/NS

2.3.5 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.3.6 Environmental Conditions/ Test Location

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	24.0-25.8°C
Relative Humidity	34.1-47.2%
ATM Pressure	98.5-99.0 kPa

2.3.7 Additional Observations

- This is a radiated test. The spectrum was searched from 30 MHz to 300 GHz. There are no significant spurious emissions observed.
- Test distance of 3 m was used for the spurious emissions measurement below 60 GHz. The emissions in the range from 60 GHz to 160 GHz were evaluated at 1.0 m distance. For the measurements in the ranges from 160 GHz to 220 GHz and 220 GHz to 300 GHz, the test distance was respectively reduced to 0.5 m and 0.2 m to assure that the noise floor is at least 10 dB below the applicable limit.
- Corrections factors of 9.54 dB, 15.56 dB and 23.52 dB were used to extrapolate the field strengths measured at 1.0 metres, 0.5 meters and 0.2 meters to the 3 meters distance as specified in § 15.31.
- All the emissions below 40 GHz comply with the general radiated emission limits of §15.209.
- Part 15.253 and Part 95 Subpart M Spurious Emissions limits are identical.
- Measurements below 40 GHz were done using EMC32 V8.53 automated software. Reported level is the actual level with all the correction factors factored in. Correction Factor column is for informational purposes only. See Section 2.3.8 for sample computation.

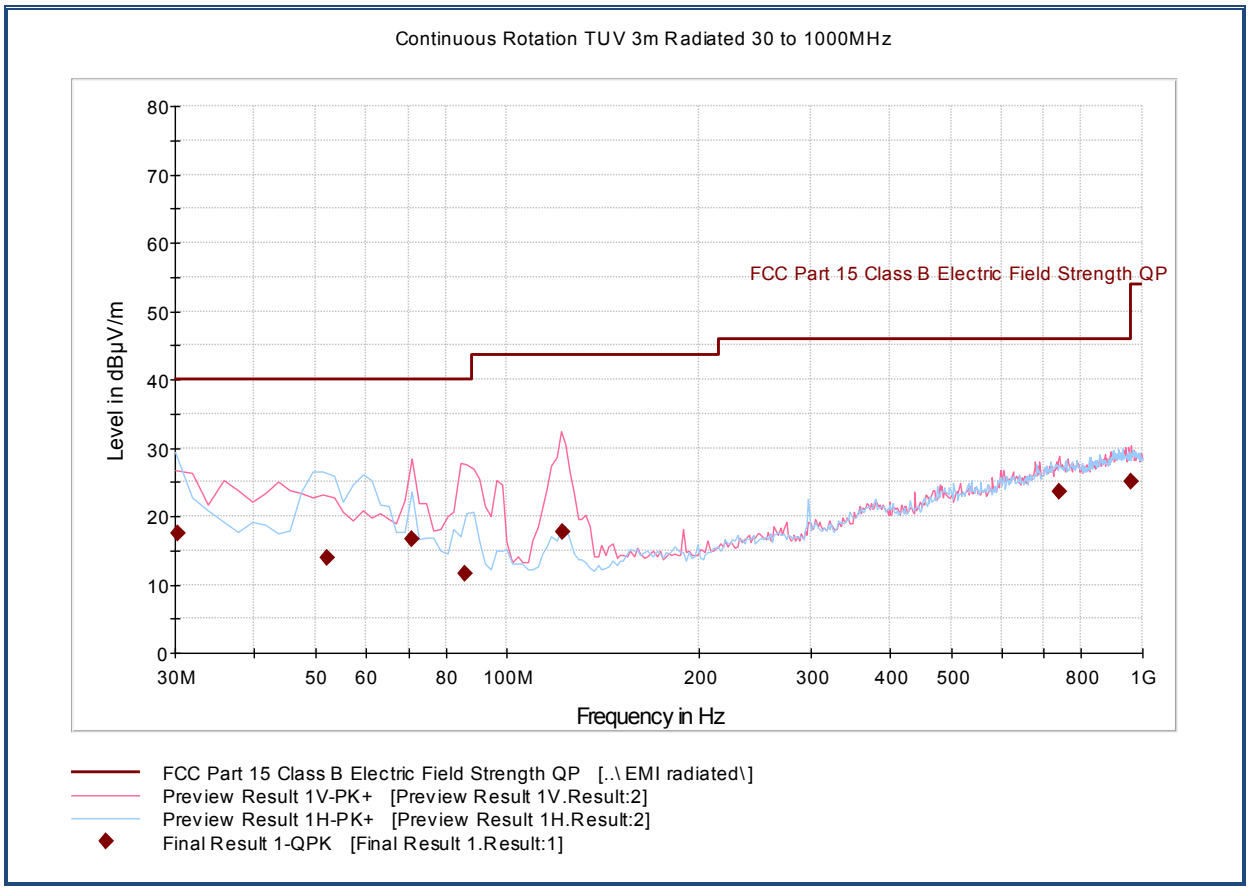
2.3.8 Sample Computation (Radiated Emission)

Measuring equipment raw measurement (dbµV) @ 30 MHz			24.4
Correction Factor (dB)	Asset# 1066 (cable)	0.3	-12.6
	Asset# 1172 (cable)	0.3	
	Asset# 1016 (preamplifier)	-30.7	
	Asset# 1175(cable)	0.3	
	Asset# 1002 (antenna)	17.2	
Reported QuasiPeak Final Measurement (dbµV/m) @ 30MHz			**11.8**

2.3.9 Test Results

See attached plots.

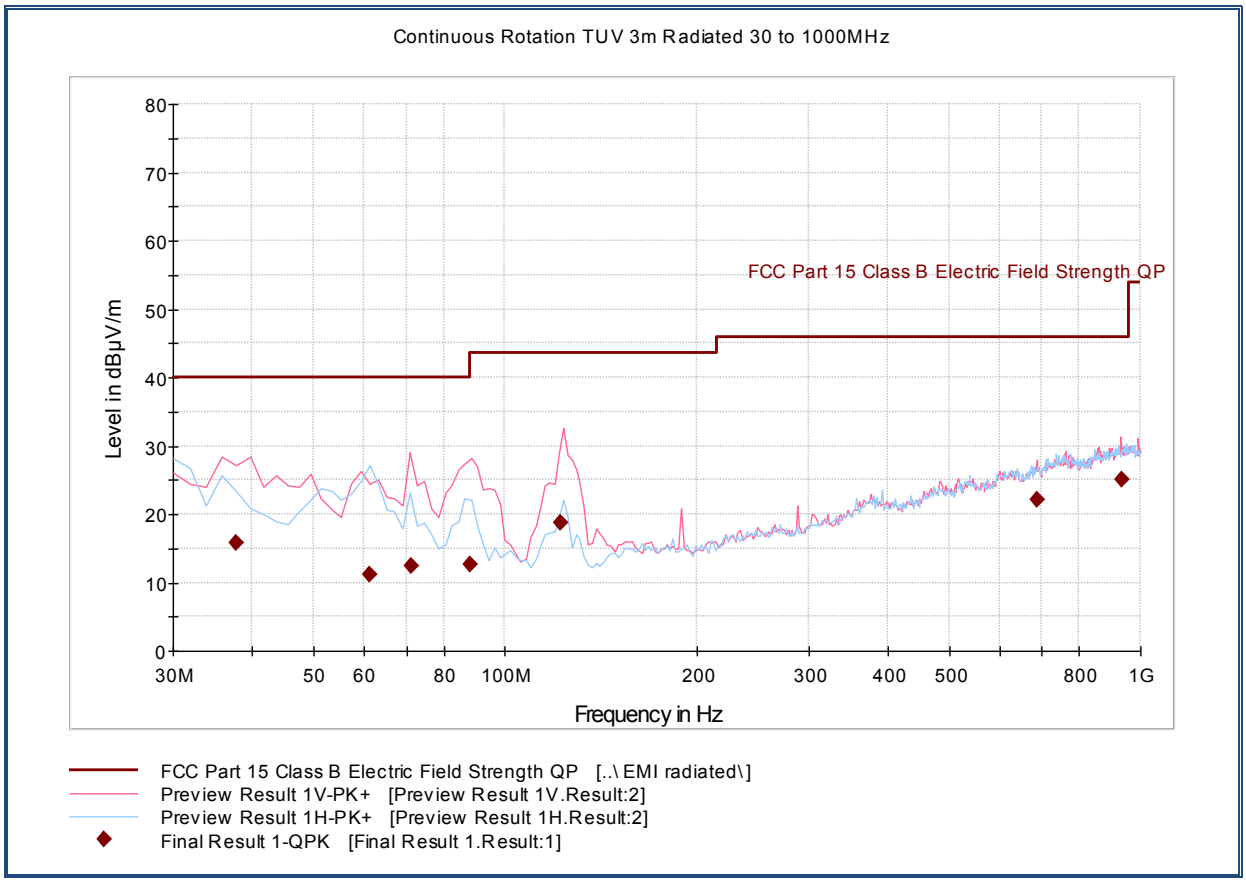
2.3.10 Test Results Below 1GHz Low Channel 90 MHz BW (worst case configuration)



Quasi Peak Data

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
30.360000	17.5	1000.0	120.000	315.0	H	344.0	-6.2	22.5	40.0
51.942766	14.0	1000.0	120.000	300.0	H	-15.0	-14.8	26.0	40.0
70.821643	16.5	1000.0	120.000	300.0	V	144.0	-17.0	23.5	40.0
85.748858	11.7	1000.0	120.000	115.0	V	-5.0	-16.7	28.3	40.0
122.522725	17.7	1000.0	120.000	200.0	V	1.0	-15.9	25.8	43.5
738.239038	23.7	1000.0	120.000	139.0	V	251.0	3.3	22.3	46.0
958.858357	25.1	1000.0	120.000	400.0	V	279.0	6.3	20.9	46.0

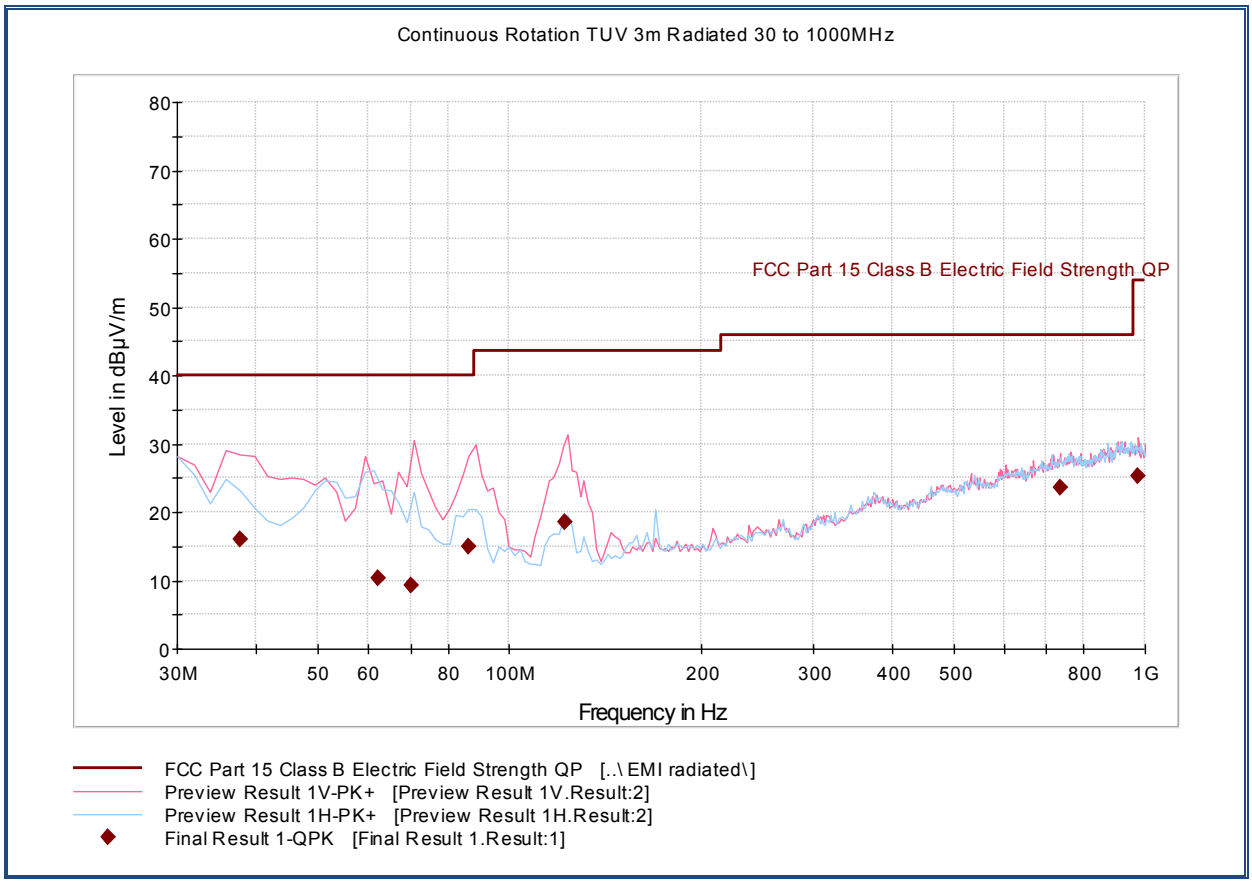
2.3.11 Test Results Below 1GHz Mid Channel 90 MHz BW (worst case configuration)



Quasi Peak Data

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
37.759439	15.7	1000.0	120.000	100.0	V	300.0	-11.2	24.3	40.0
61.078317	11.2	1000.0	120.000	120.0	V	321.0	-16.9	28.8	40.0
71.061643	12.3	1000.0	120.000	133.0	V	173.0	-17.0	27.7	40.0
87.852745	12.6	1000.0	120.000	200.0	V	10.0	-16.3	27.4	40.0
122.466613	18.6	1000.0	120.000	100.0	V	1.0	-15.9	24.9	43.5
686.434068	22.1	1000.0	120.000	350.0	V	216.0	2.6	23.9	46.0
934.363928	25.0	1000.0	120.000	320.0	V	30.0	6.1	21.0	46.0

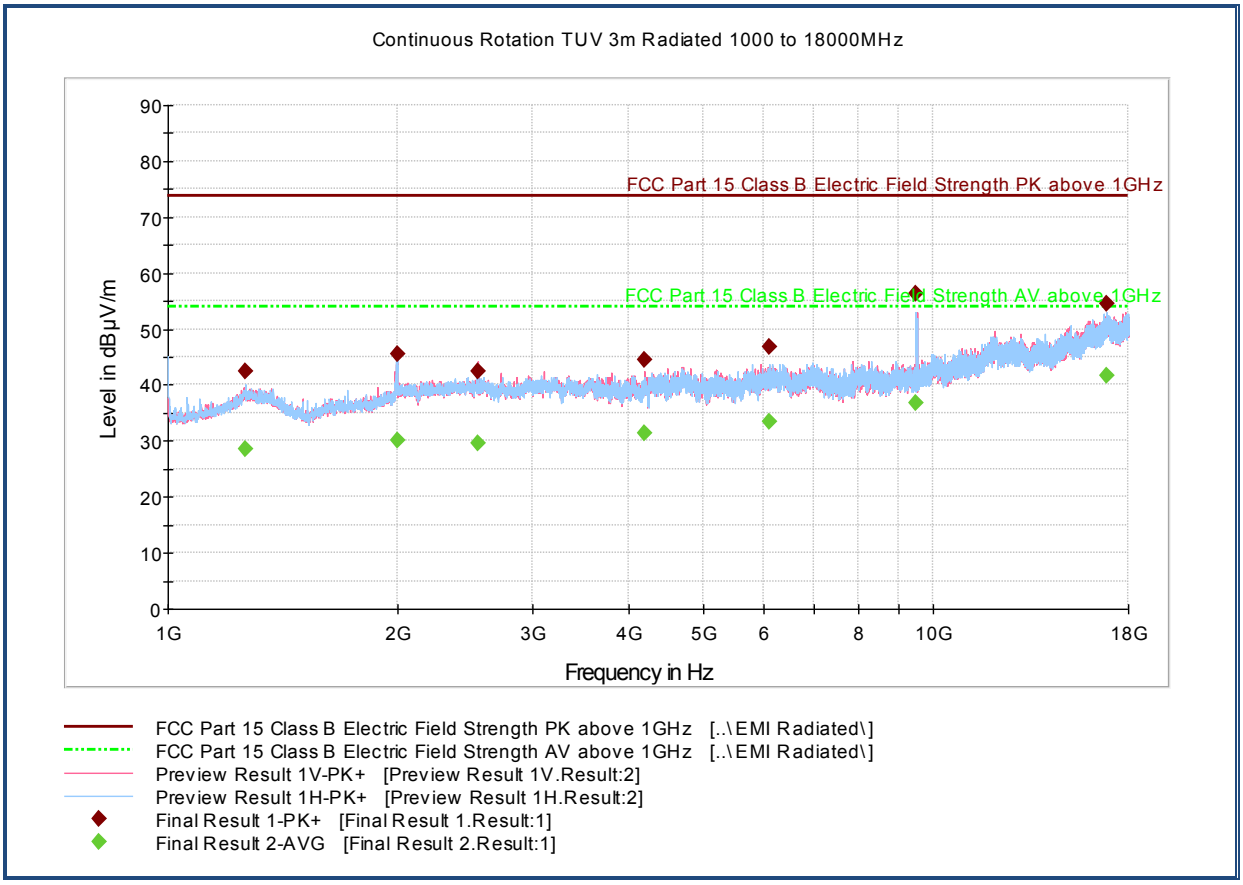
2.3.12 Test Results Below 1GHz High Channel 90 MHz BW (worst case configuration)



Quasi Peak Data

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
37.671663	16.0	1000.0	120.000	100.0	V	111.0	-11.2	24.0	40.0
62.238317	10.4	1000.0	120.000	300.0	V	98.0	-17.0	29.6	40.0
70.061643	9.3	1000.0	120.000	150.0	V	172.0	-17.0	30.7	40.0
86.052745	15.0	1000.0	120.000	110.0	V	305.0	-16.7	25.0	40.0
122.506613	18.6	1000.0	120.000	100.0	V	7.0	-15.9	24.9	43.5
736.711263	23.6	1000.0	120.000	350.0	V	279.0	3.3	22.4	46.0
974.953347	25.2	1000.0	120.000	243.0	V	263.0	6.2	28.7	53.9

2.3.13 Test Results 1 GHz to 18 GHz Low Channel 90 MHz BW (worst case configuration)



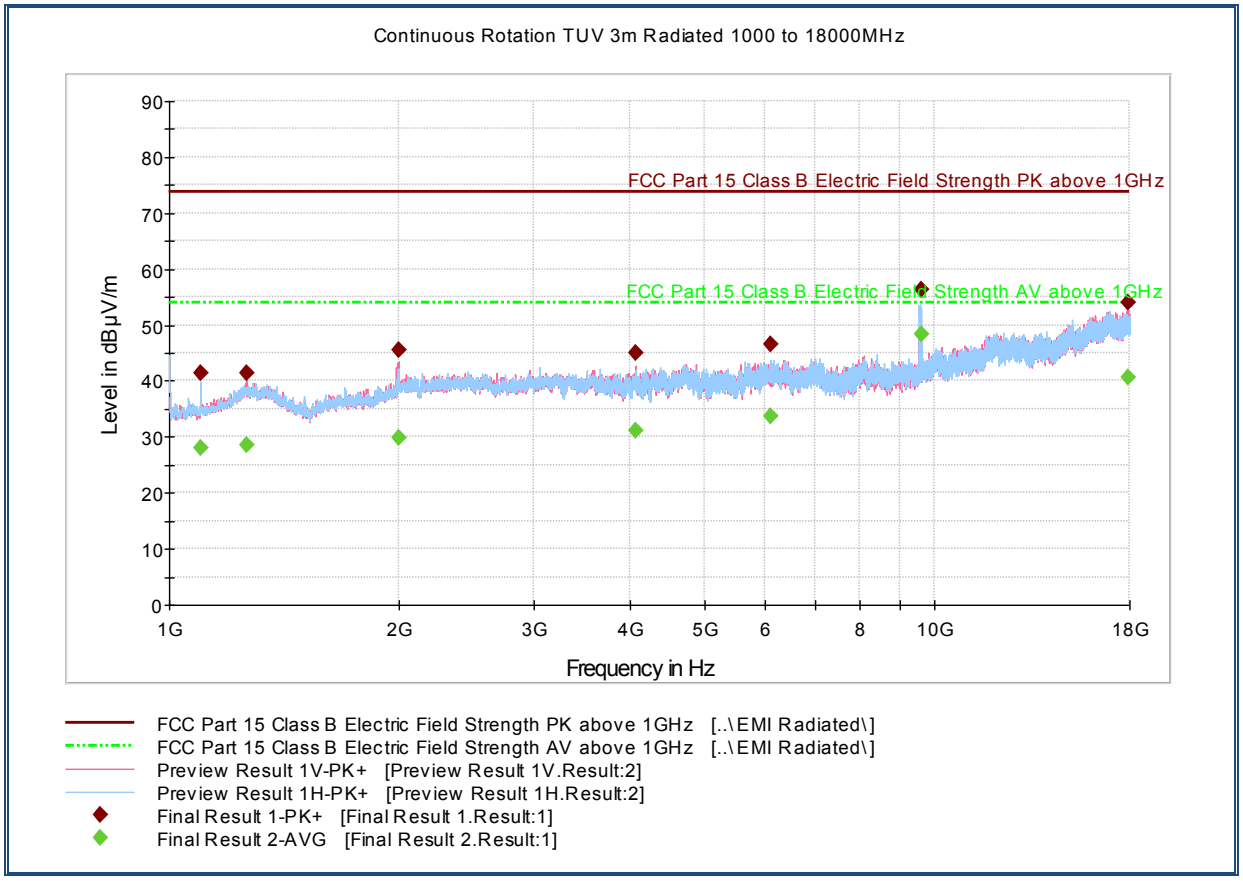
Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1263.33333	42.5	1000.0	1000.000	123.4	H	348.0	-5.3	31.4	73.9
1992.23333	45.4	1000.0	1000.000	101.4	H	197.0	-2.0	28.5	73.9
2546.43333	42.4	1000.0	1000.000	406.7	V	102.0	-0.4	31.5	73.9
4194.30000	44.5	1000.0	1000.000	251.2	V	326.0	3.0	29.4	73.9
6103.03333	46.7	1000.0	1000.000	136.4	H	20.0	7.0	27.2	73.9
9504.33333	56.2	1000.0	1000.000	206.3	H	13.0	10.3	17.7	73.9
16906.5333	54.6	1000.0	1000.000	402.0	H	65.0	23.1	19.3	73.9

Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1263.33333	28.6	1000.0	1000.000	123.4	H	348.0	-5.3	25.3	53.9
1992.23333	30.1	1000.0	1000.000	101.4	H	197.0	-2.0	23.8	53.9
2546.43333	29.5	1000.0	1000.000	406.7	V	102.0	-0.4	24.4	53.9
4194.30000	31.4	1000.0	1000.000	251.2	V	326.0	3.0	22.5	53.9
6103.03333	33.5	1000.0	1000.000	136.4	H	20.0	7.0	20.4	53.9
9504.33333	36.8	1000.0	1000.000	206.3	H	13.0	10.3	17.1	53.9
16906.5333	41.6	1000.0	1000.000	402.0	H	65.0	23.1	12.3	53.9

2.3.14 Test Results 1 GHz to 18 GHz Mid Channel 90 MHz BW (worst case configuration)



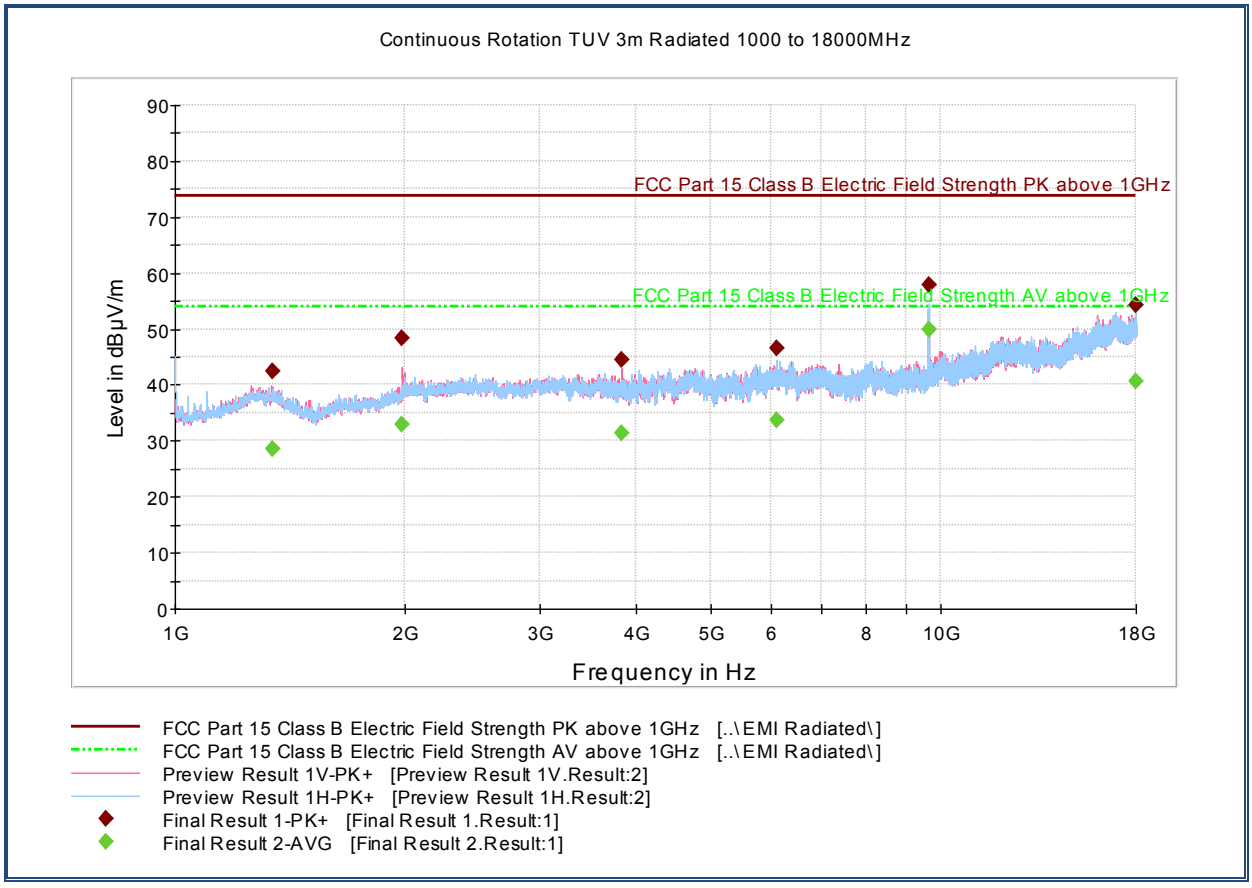
Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1099.93333	41.4	1000.0	1000.000	100.4	H	275.0	-6.8	32.5	73.9
1264.60000	41.5	1000.0	1000.000	337.1	V	12.0	-5.3	32.4	73.9
1992.60000	45.6	1000.0	1000.000	150.4	V	13.0	-2.0	28.3	73.9
4071.33333	44.9	1000.0	1000.000	352.0	V	-17.0	2.8	29.0	73.9
6106.03333	46.6	1000.0	1000.000	250.6	H	106.0	7.0	27.3	73.9
9599.93333	56.4	1000.0	1000.000	202.3	H	5.0	10.5	17.5	73.9
17921.8333	54.0	1000.0	1000.000	352.7	V	12.0	23.3	19.9	73.9

Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1099.93333	28.1	1000.0	1000.000	100.4	H	275.0	-6.8	25.8	53.9
1264.60000	28.5	1000.0	1000.000	337.1	V	12.0	-5.3	25.4	53.9
1992.60000	29.9	1000.0	1000.000	150.4	V	13.0	-2.0	24.0	53.9
4071.33333	31.1	1000.0	1000.000	352.0	V	-17.0	2.8	22.8	53.9
6106.03333	33.6	1000.0	1000.000	250.6	H	106.0	7.0	20.3	53.9
9599.93333	48.3	1000.0	1000.000	202.3	H	5.0	10.5	5.6	53.9
17921.8333	40.6	1000.0	1000.000	352.7	V	12.0	23.3	13.3	53.9

2.3.15 Test Results 1 GHz to 18 GHz High Channel 90 MHz BW (worst case configuration)



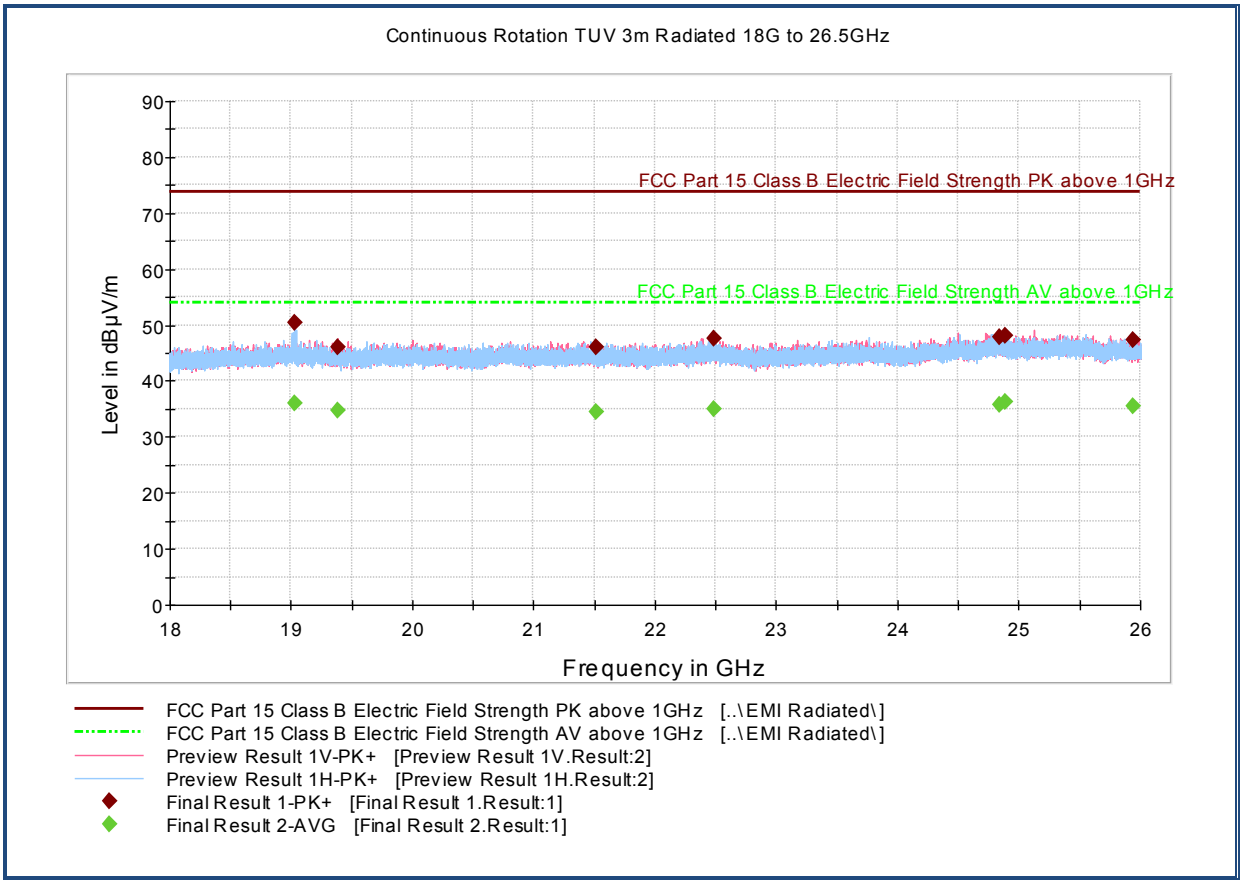
Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1338.73333	42.5	1000.0	1000.000	266.2	V	176.0	-5.1	31.4	73.9
1981.26666	48.4	1000.0	1000.000	136.4	V	297.0	-2.1	25.5	73.9
3825.40000	44.4	1000.0	1000.000	251.6	V	326.0	2.1	29.5	73.9
6106.03333	46.5	1000.0	1000.000	390.0	H	212.0	7.0	27.4	73.9
9679.83333	57.9	1000.0	1000.000	219.2	H	5.0	11.0	16.0	73.9
17982.0000	54.2	1000.0	1000.000	101.4	H	263.0	23.4	19.7	73.9

Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1338.73333	28.4	1000.0	1000.000	266.2	V	176.0	-5.1	25.5	53.9
1981.26666	33.0	1000.0	1000.000	136.4	V	297.0	-2.1	20.9	53.9
3825.40000	31.3	1000.0	1000.000	251.6	V	326.0	2.1	22.6	53.9
6106.03333	33.7	1000.0	1000.000	390.0	H	212.0	7.0	20.2	53.9
9679.83333	49.8	1000.0	1000.000	219.2	H	5.0	11.0	4.1	53.9
17982.0000	40.6	1000.0	1000.000	101.4	H	263.0	23.4	13.3	53.9

2.3.16 Test Results from 18 GHz to 26 GHz Low Channel 90 MHz BW (worst case configuration)



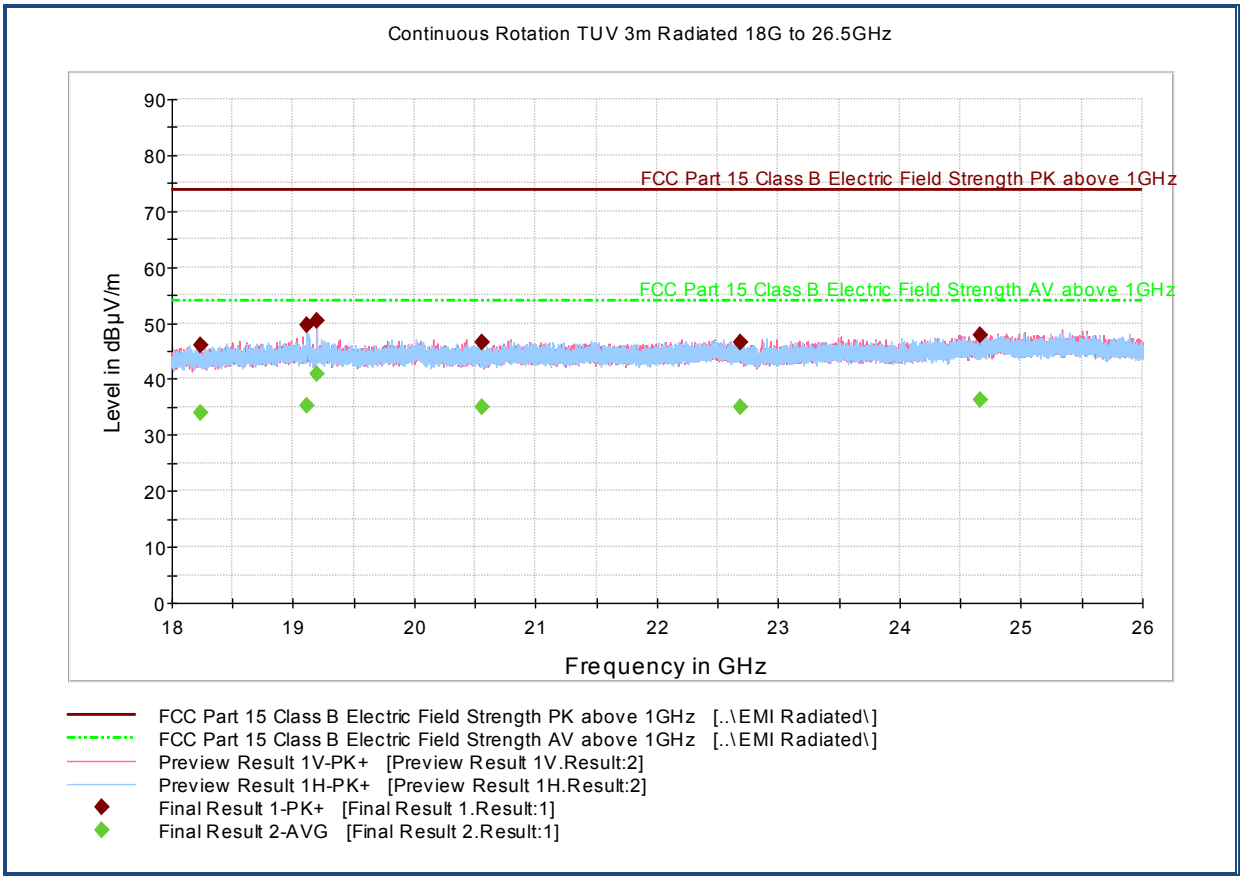
Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
19030.4000	50.3	1000.0	1000.000	102.5	H	15.0	-0.8	23.6	73.9
19388.7500	46.1	1000.0	1000.000	100.4	V	163.0	-0.9	27.8	73.9
21510.9833	46.1	1000.0	1000.000	100.4	H	0.0	0.0	27.8	73.9
22480.2666	47.7	1000.0	1000.000	175.0	H	-8.0	0.7	26.2	73.9
24839.8000	47.9	1000.0	1000.000	125.0	H	338.0	1.8	26.0	73.9
24887.4000	48.2	1000.0	1000.000	132.4	V	311.0	1.9	25.7	73.9
25946.6000	47.3	1000.0	1000.000	102.5	H	87.0	1.7	26.6	73.9

Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
19030.4000	35.9	1000.0	1000.000	102.5	H	15.0	-0.8	18.0	53.9
19388.7500	34.6	1000.0	1000.000	100.4	V	163.0	-0.9	19.3	53.9
21510.9833	34.5	1000.0	1000.000	100.4	H	0.0	0.0	19.4	53.9
22480.2666	34.9	1000.0	1000.000	175.0	H	-8.0	0.7	19.0	53.9
24839.8000	35.8	1000.0	1000.000	125.0	H	338.0	1.8	18.1	53.9
24887.4000	36.2	1000.0	1000.000	132.4	V	311.0	1.9	17.7	53.9
25946.6000	35.4	1000.0	1000.000	102.5	H	87.0	1.7	18.5	53.9

2.3.17 Test Results from 18 GHz to 26 GHz Mid Channel 90 MHz BW (worst case configuration)



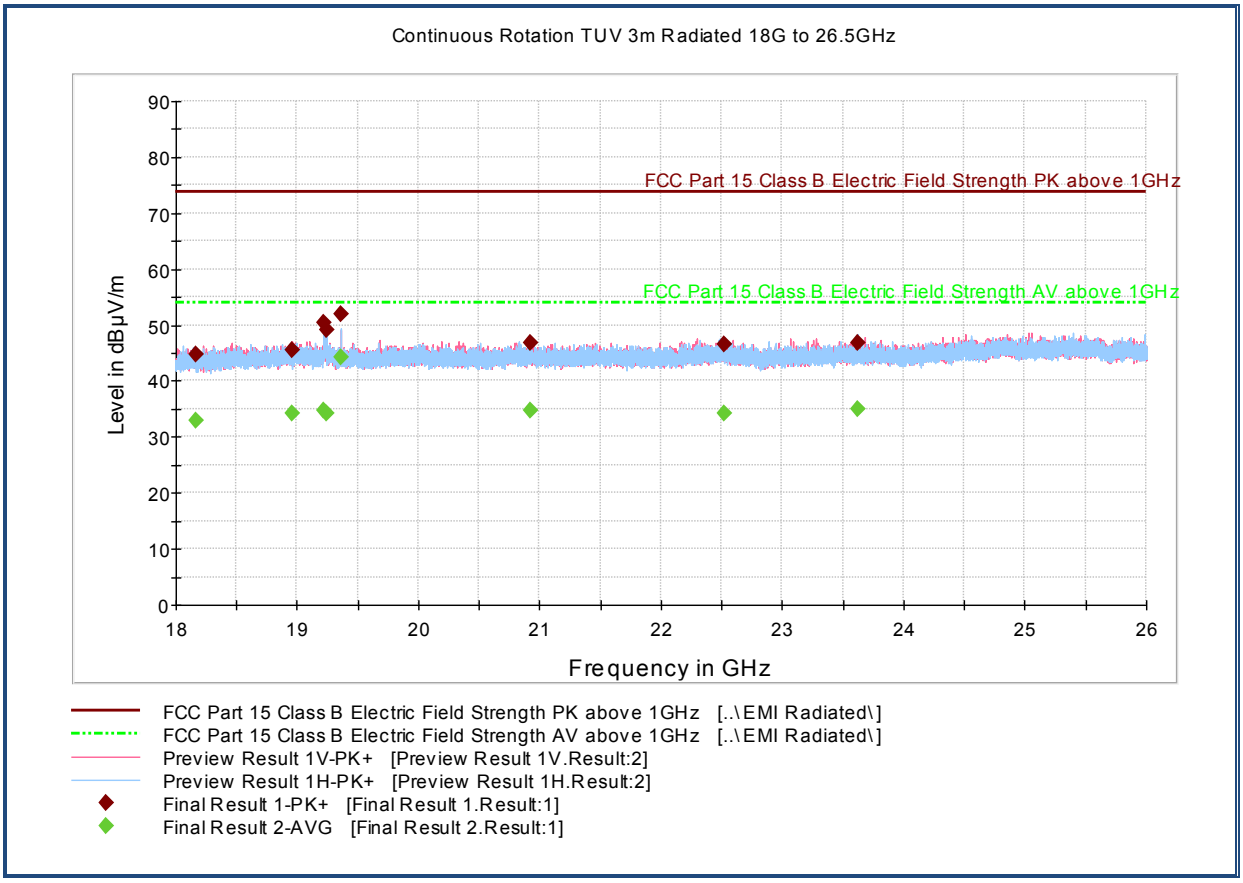
Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
18232.9000	45.9	1000.0	1000.000	110.4	V	200.0	-0.6	28.0	73.9
19113.5000	49.6	1000.0	1000.000	110.4	H	5.0	-0.8	24.3	73.9
19199.8333	50.5	1000.0	1000.000	100.4	V	225.0	-0.8	23.4	73.9
20553.7166	46.7	1000.0	1000.000	143.4	V	128.0	-0.4	27.2	73.9
22690.5500	46.6	1000.0	1000.000	155.4	V	352.0	0.6	27.3	73.9
24663.9666	47.9	1000.0	1000.000	168.4	H	69.0	1.7	26.0	73.9

Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
18232.9000	34.1	1000.0	1000.000	110.4	V	200.0	-0.6	19.8	53.9
19113.5000	35.3	1000.0	1000.000	110.4	H	5.0	-0.8	18.6	53.9
19199.8333	40.9	1000.0	1000.000	100.4	V	225.0	-0.8	13.0	53.9
20553.7166	35.1	1000.0	1000.000	143.4	V	128.0	-0.4	18.8	53.9
22690.5500	34.9	1000.0	1000.000	155.4	V	352.0	0.6	19.0	53.9
24663.9666	36.3	1000.0	1000.000	168.4	H	69.0	1.7	17.6	53.9
26394.7166	36.1	1000.0	1000.000	167.4	H	10.0	2.1	17.8	53.9

2.3.18 Test Results from 18 GHz to 26 GHz High Channel 90 MHz BW (worst case configuration)



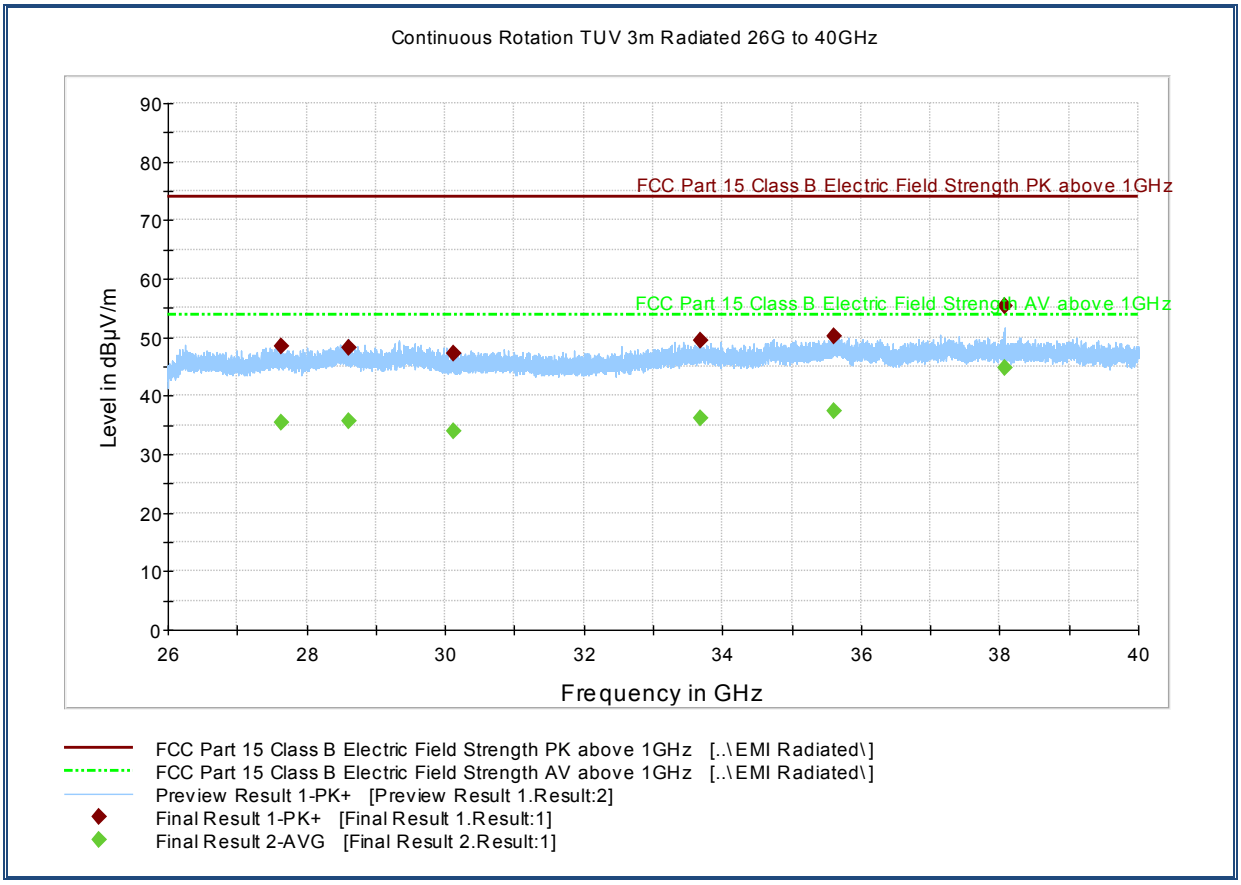
Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
18169.1500	44.8	1000.0	1000.000	161.4	V	10.0	-0.7	29.1	73.9
18960.3500	45.4	1000.0	1000.000	165.4	V	61.0	-0.8	28.5	73.9
19218.9000	50.4	1000.0	1000.000	135.4	H	108.0	-0.8	23.5	73.9
19239.2666	49.1	1000.0	1000.000	100.4	H	89.0	-0.8	24.8	73.9
19359.6333	51.9	1000.0	1000.000	150.4	H	112.0	-0.9	22.0	73.9
20922.5500	46.7	1000.0	1000.000	106.4	V	214.0	0.0	27.2	73.9
22522.6500	46.7	1000.0	1000.000	108.5	V	10.0	0.7	27.2	73.9
23623.4333	46.9	1000.0	1000.000	107.4	H	233.0	0.9	27.0	73.9

Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
18169.1500	32.9	1000.0	1000.000	161.4	V	10.0	-0.7	21.0	53.9
18960.3500	34.2	1000.0	1000.000	165.4	V	61.0	-0.8	19.7	53.9
19218.9000	34.7	1000.0	1000.000	135.4	H	108.0	-0.8	19.2	53.9
19239.2666	34.2	1000.0	1000.000	100.4	H	89.0	-0.8	19.7	53.9
19359.6333	44.3	1000.0	1000.000	150.4	H	112.0	-0.9	9.6	53.9
20922.5500	34.8	1000.0	1000.000	106.4	V	214.0	0.0	19.1	53.9
22522.6500	34.3	1000.0	1000.000	108.5	V	10.0	0.7	19.6	53.9
23623.4333	34.9	1000.0	1000.000	107.4	H	233.0	0.9	19.0	53.9

2.3.19 Test Results from 26 GHz to 40 GHz Low Channel 90 MHz BW (worst case configuration)



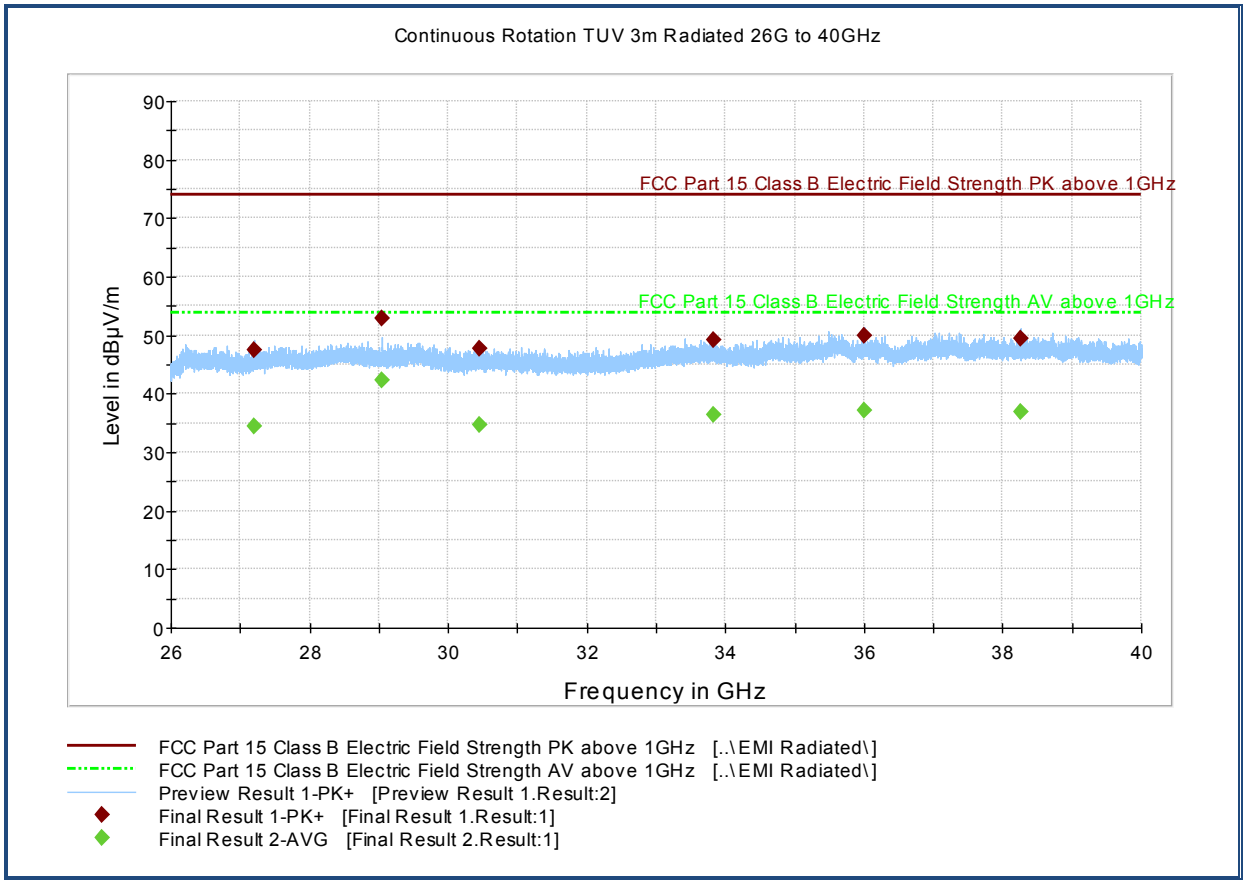
Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
27629.2666	48.3	1000.0	1000.000	111.5	V	237.0	2.9	25.6	73.9
28610.2666	48.1	1000.0	1000.000	125.5	V	60.0	3.5	25.8	73.9
30117.8000	47.2	1000.0	1000.000	159.4	V	125.0	3.7	26.7	73.9
33678.7333	49.3	1000.0	1000.000	100.4	H	307.0	5.7	24.6	73.9
35602.4000	50.0	1000.0	1000.000	125.5	H	10.0	6.6	23.9	73.9
38079.4666	55.4	1000.0	1000.000	158.4	H	66.0	7.9	18.5	73.9

Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
27629.2666	35.4	1000.0	1000.000	111.5	V	237.0	2.9	18.5	53.9
28610.2666	35.6	1000.0	1000.000	125.5	V	60.0	3.5	18.3	53.9
30117.8000	34.0	1000.0	1000.000	159.4	V	125.0	3.7	19.9	53.9
33678.7333	36.2	1000.0	1000.000	100.4	H	307.0	5.7	17.7	53.9
35602.4000	37.4	1000.0	1000.000	125.5	H	10.0	6.6	16.5	53.9
38079.4666	44.9	1000.0	1000.000	158.4	H	66.0	7.9	9.0	53.9

2.3.20 Test Results from 26 GHz to 40 GHz Mid Channel 90 MHz BW (worst case configuration)



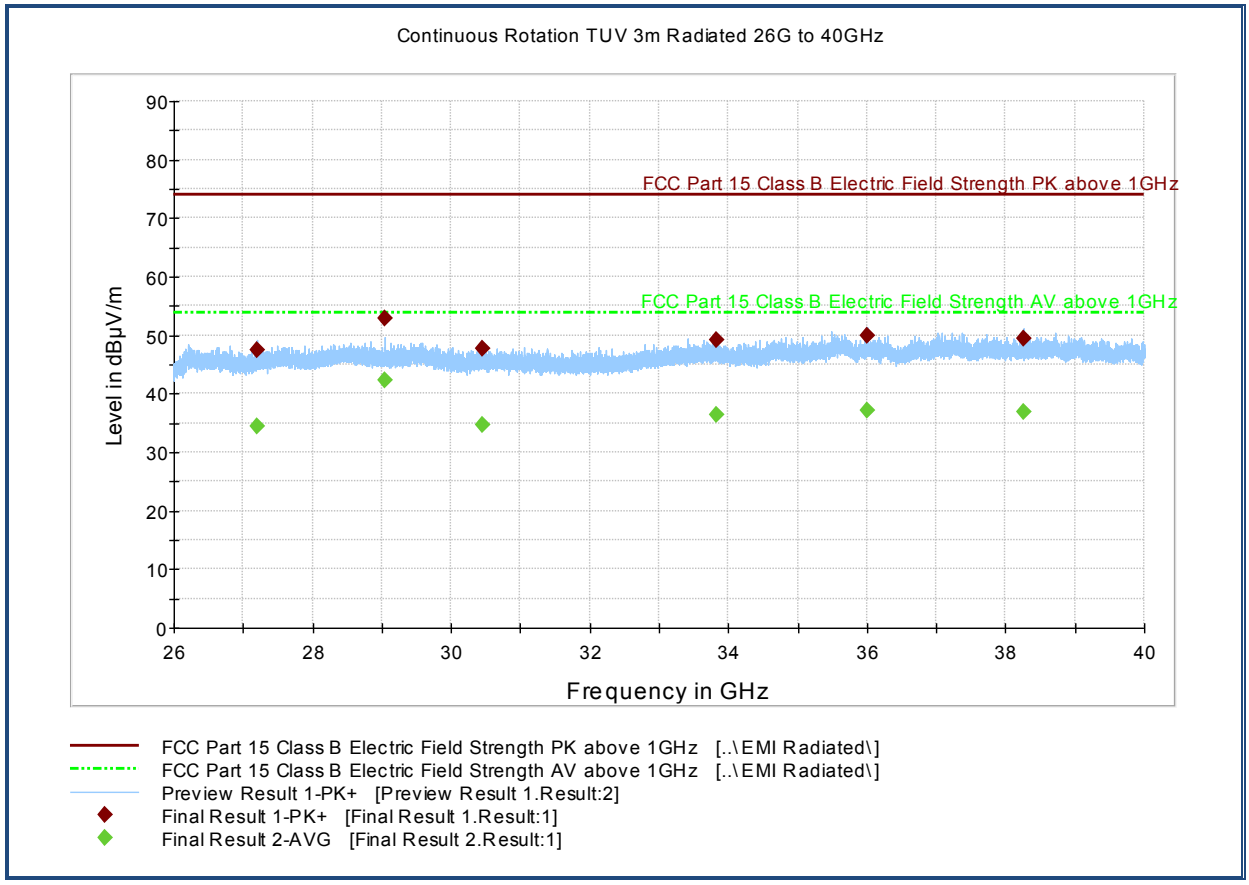
Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
27208.1333	47.4	1000.0	1000.000	175.5	V	314.0	2.5	26.5	73.9
29039.2000	52.8	1000.0	1000.000	100.4	H	41.0	3.5	21.1	73.9
30446.6666	47.7	1000.0	1000.000	100.4	V	345.0	3.8	26.2	73.9
33820.4000	49.3	1000.0	1000.000	150.4	H	269.0	5.7	24.6	73.9
35995.6000	49.8	1000.0	1000.000	136.4	H	311.0	6.5	24.1	73.9
38257.1333	49.5	1000.0	1000.000	159.4	V	275.0	8.1	24.4	73.9

Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
27208.1333	34.4	1000.0	1000.000	175.5	V	314.0	2.5	19.5	53.9
29039.2000	42.4	1000.0	1000.000	100.4	H	41.0	3.5	11.5	53.9
30446.6666	34.6	1000.0	1000.000	100.4	V	345.0	3.8	19.3	53.9
33820.4000	36.4	1000.0	1000.000	150.4	H	269.0	5.7	17.5	53.9
35995.6000	37.2	1000.0	1000.000	136.4	H	311.0	6.5	16.7	53.9
38257.1333	36.9	1000.0	1000.000	159.4	V	275.0	8.1	17.0	53.9

2.3.21 Test Results from 26 GHz to 40 GHz High Channel 90 MHz BW (worst case configuration)



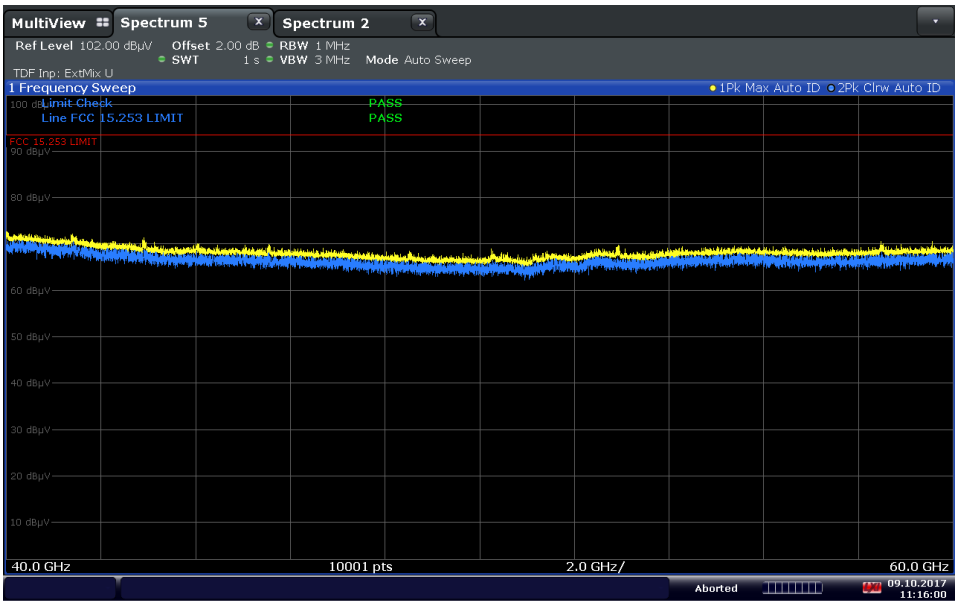
Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
27208.1333	47.4	1000.0	1000.000	175.5	V	314.0	2.5	26.5	73.9
29039.2000	52.8	1000.0	1000.000	100.4	H	41.0	3.5	21.1	73.9
30446.6666	47.7	1000.0	1000.000	100.4	V	345.0	3.8	26.2	73.9
33820.4000	49.3	1000.0	1000.000	150.4	H	269.0	5.7	24.6	73.9
35995.6000	49.8	1000.0	1000.000	136.4	H	311.0	6.5	24.1	73.9
38257.1333	49.5	1000.0	1000.000	159.4	V	275.0	8.1	24.4	73.9

Average Data

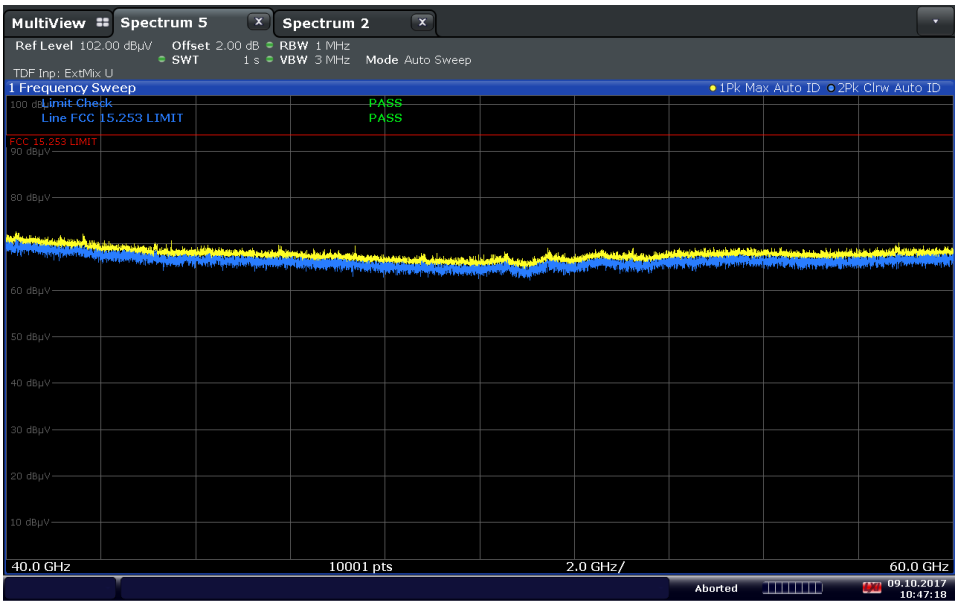
Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
27208.1333	34.4	1000.0	1000.000	175.5	V	314.0	2.5	19.5	53.9
29039.2000	42.4	1000.0	1000.000	100.4	H	41.0	3.5	11.5	53.9
30446.6666	34.6	1000.0	1000.000	100.4	V	345.0	3.8	19.3	53.9
33820.4000	36.4	1000.0	1000.000	150.4	H	269.0	5.7	17.5	53.9
35995.6000	37.2	1000.0	1000.000	136.4	H	311.0	6.5	16.7	53.9
38257.1333	36.9	1000.0	1000.000	159.4	V	275.0	8.1	17.0	53.9

2.3.22 Test Results 40 GHz to 300 GHz



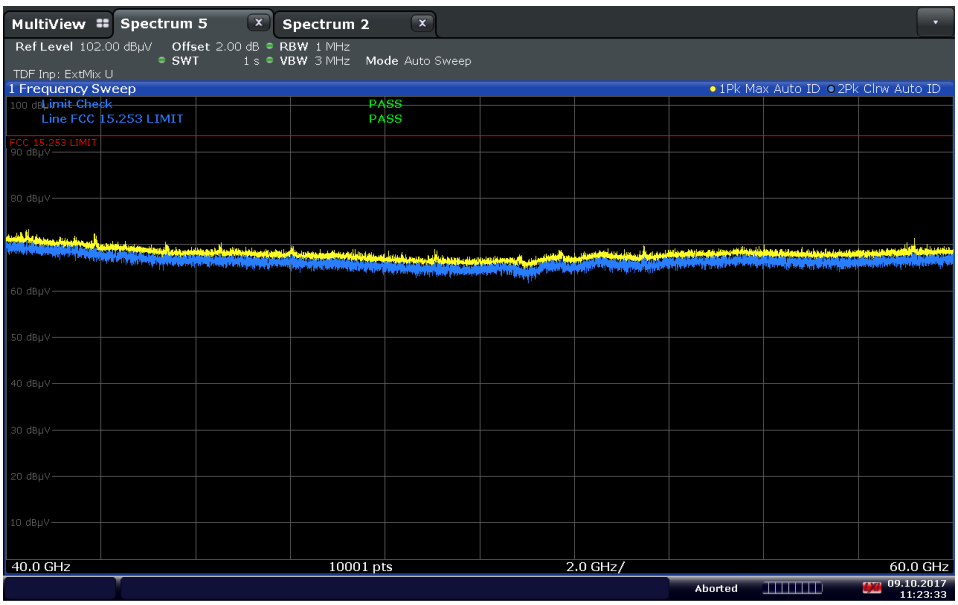
11:16:01 09.10.2017

40 to 60 GHz Low Channel 90 MHz BW



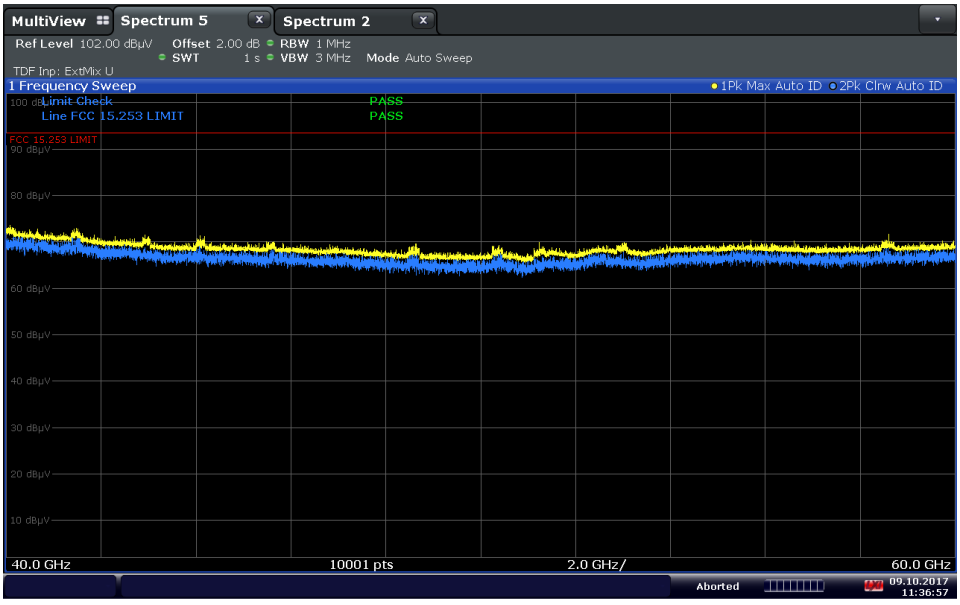
10:47:19 09.10.2017

40 to 60 GHz Mid Channel 90 MHz BW



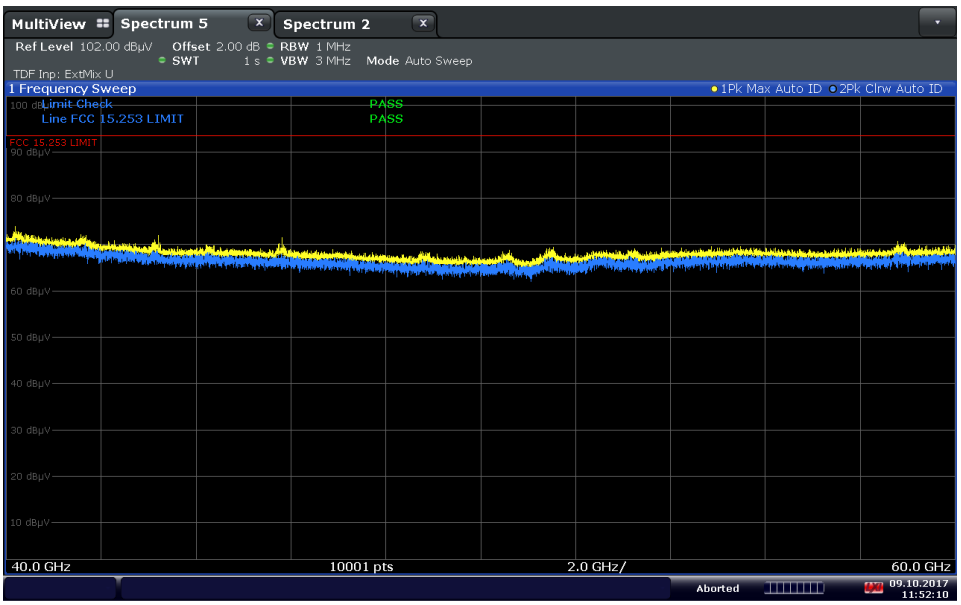
11:23:33 09.10.2017

40 to 60 GHz High Channel 90 MHz BW



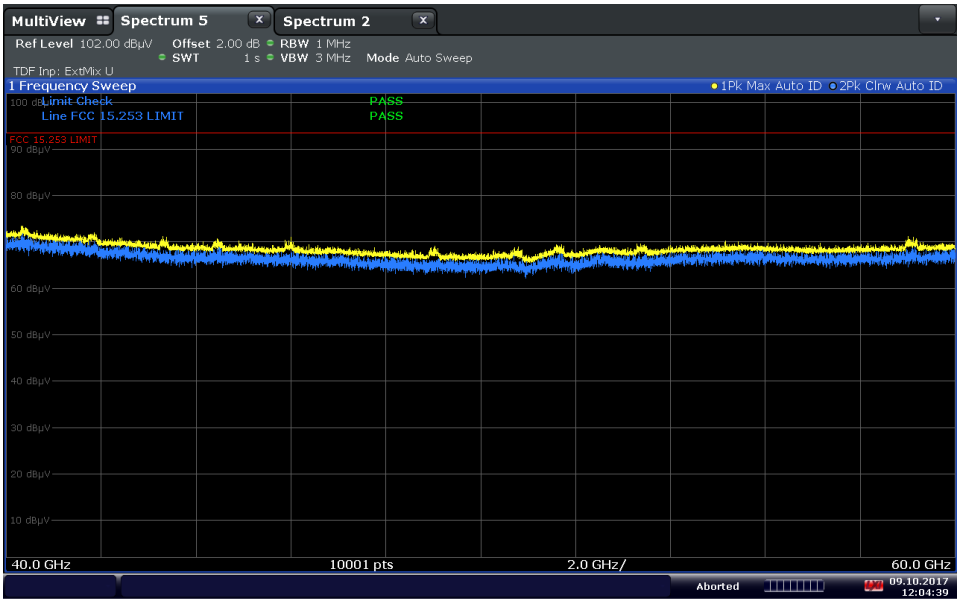
11:36:57 09.10.2017

40 to 60 GHz Low Channel 240 MHz BW



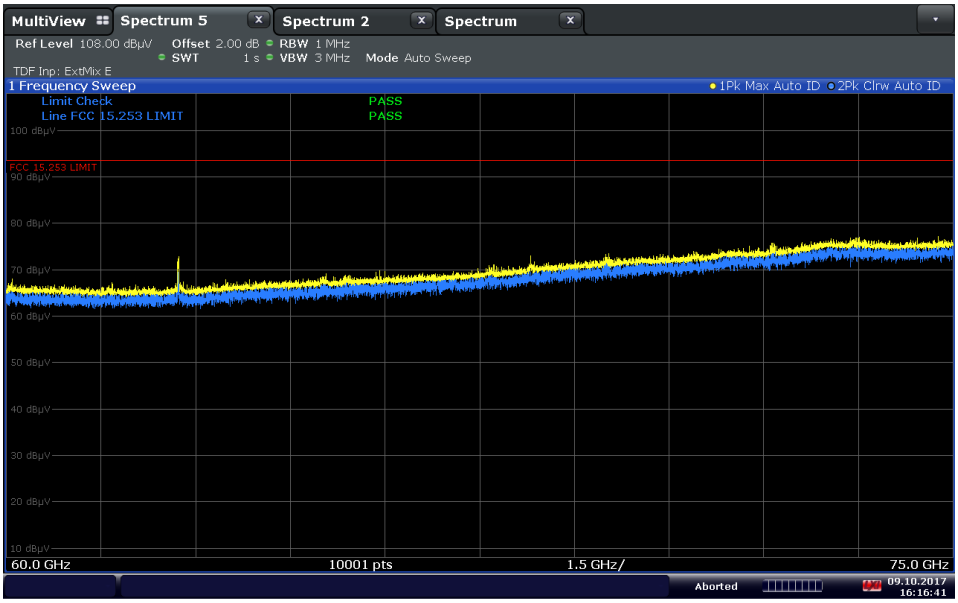
11:52:11 09.10.2017

40 to 60 GHz Mid Channel 240 MHz BW



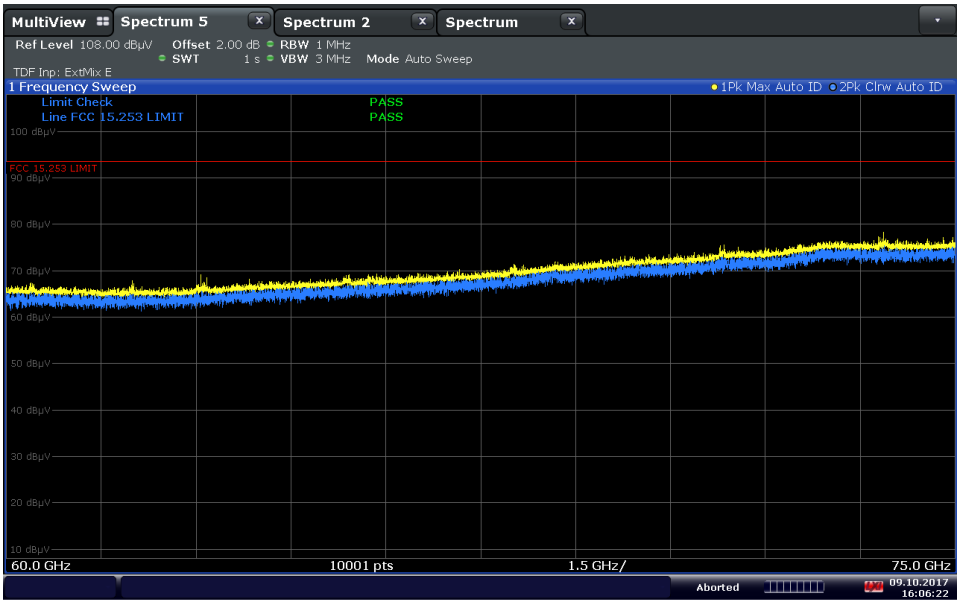
12:04:39 09.10.2017

40 to 60 GHz High Channel 240 MHz BW



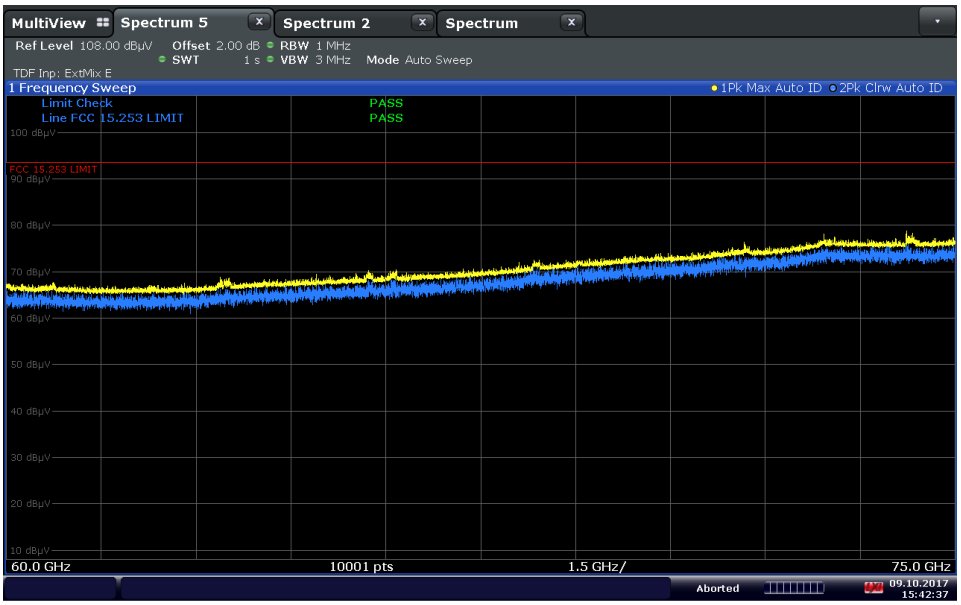
16:16:42 09.10.2017

60 to 75 GHz Low Channel 90 MHz BW



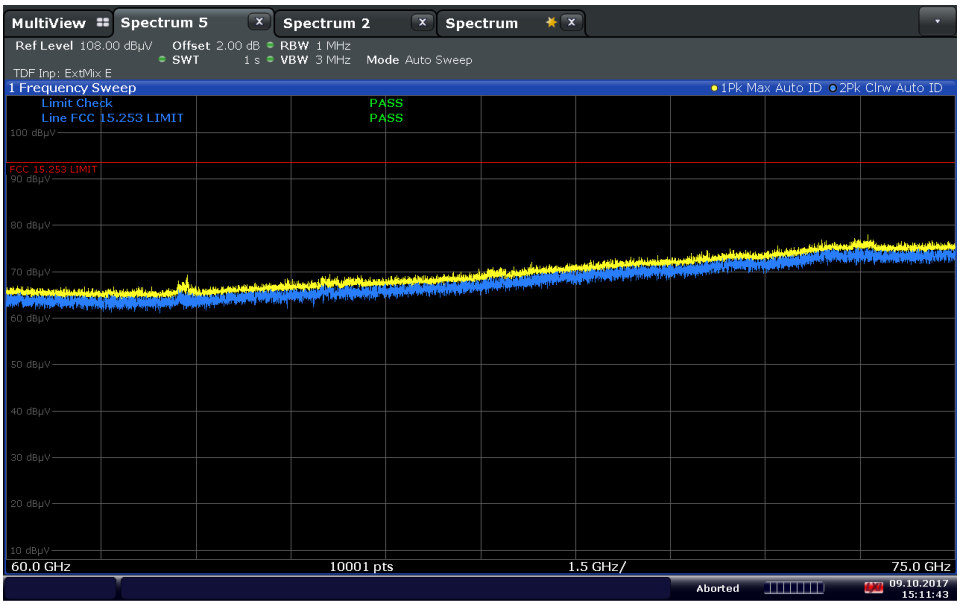
16:06:22 09.10.2017

60 to 75 GHz Mid Channel 90 MHz BW



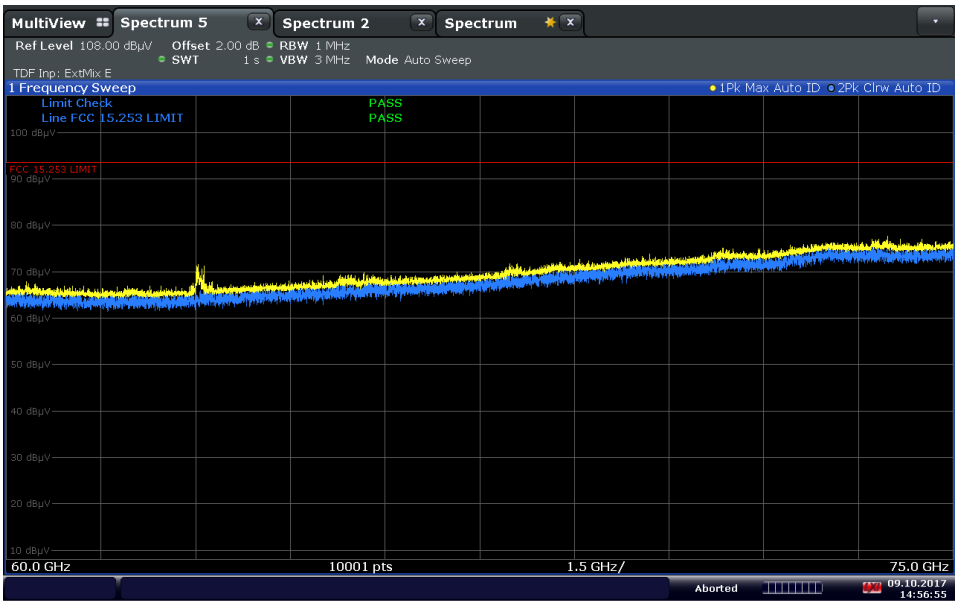
15:42:37 09.10.2017

60 to 75 GHz High Channel 90 MHz BW



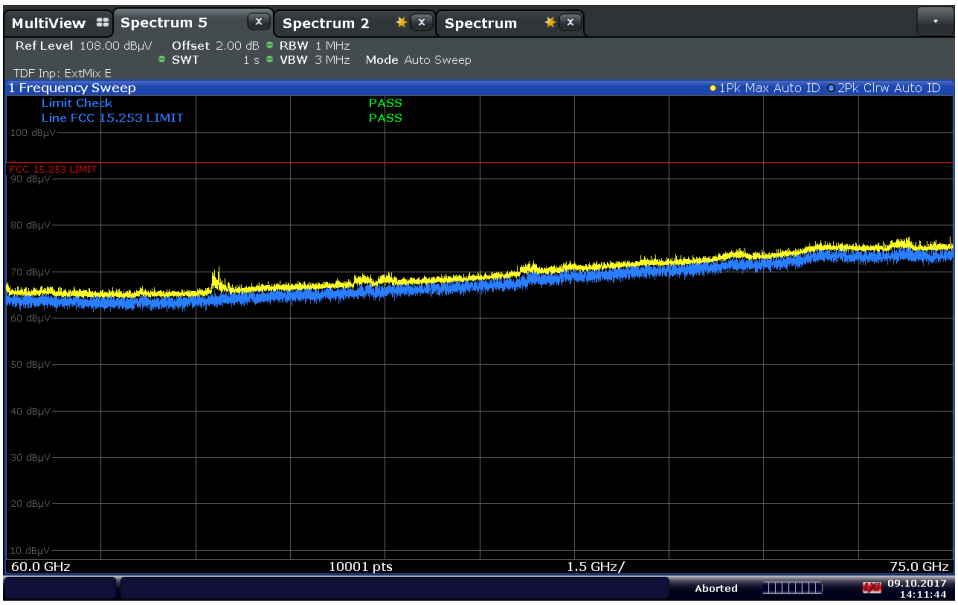
15:11:44 09.10.2017

60 to 75 GHz Low Channel 240 MHz BW



14:56:56 09.10.2017

60 to 75 GHz Mid Channel 240 MHz BW



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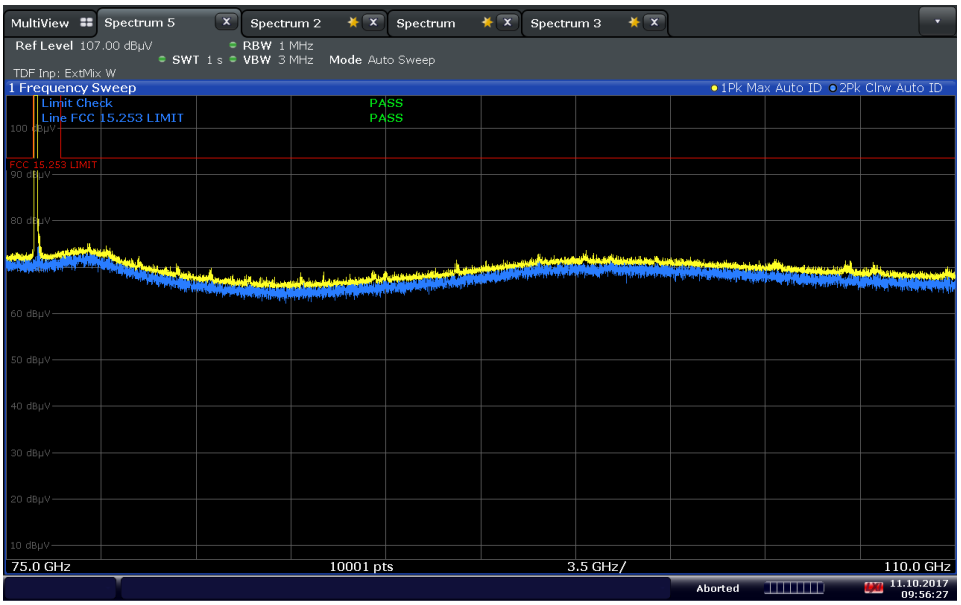
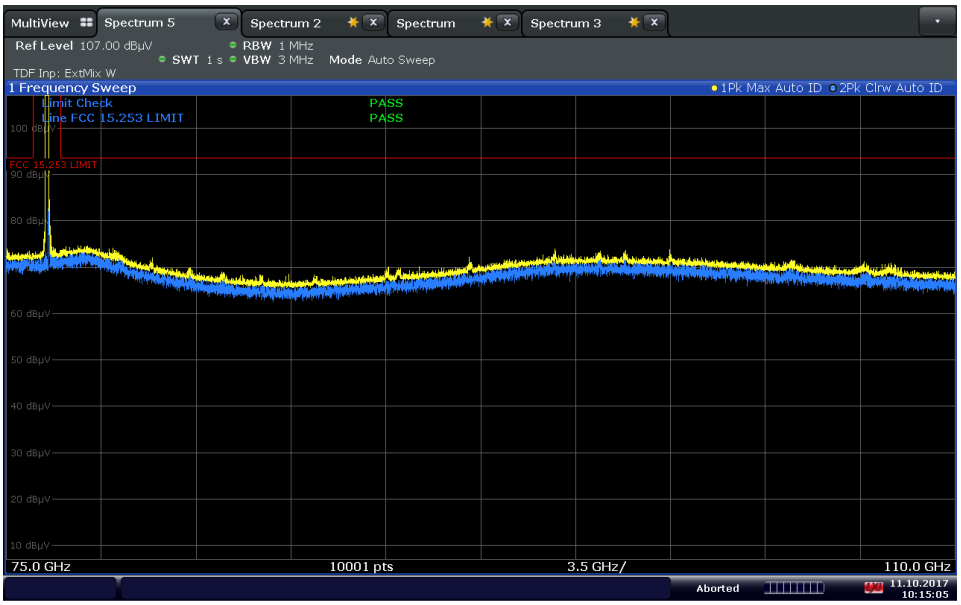
60 to 75 GHz High Channel 240 MHz BW



09:56:28 11.10.2017

75 to 110 GHz Low Channel 90 MHz BW



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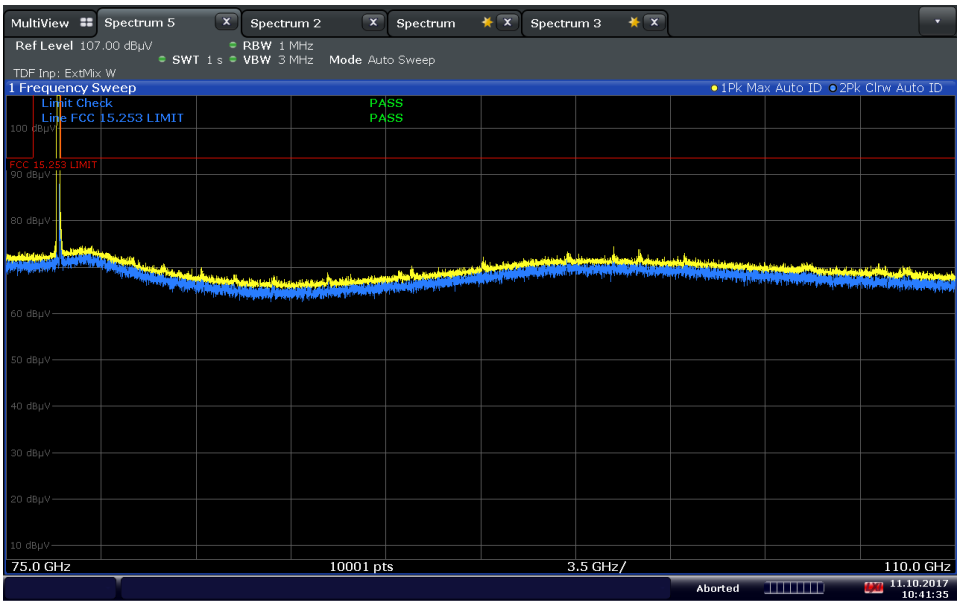
75 to 110 GHz Mid Channel 90 MHz BW



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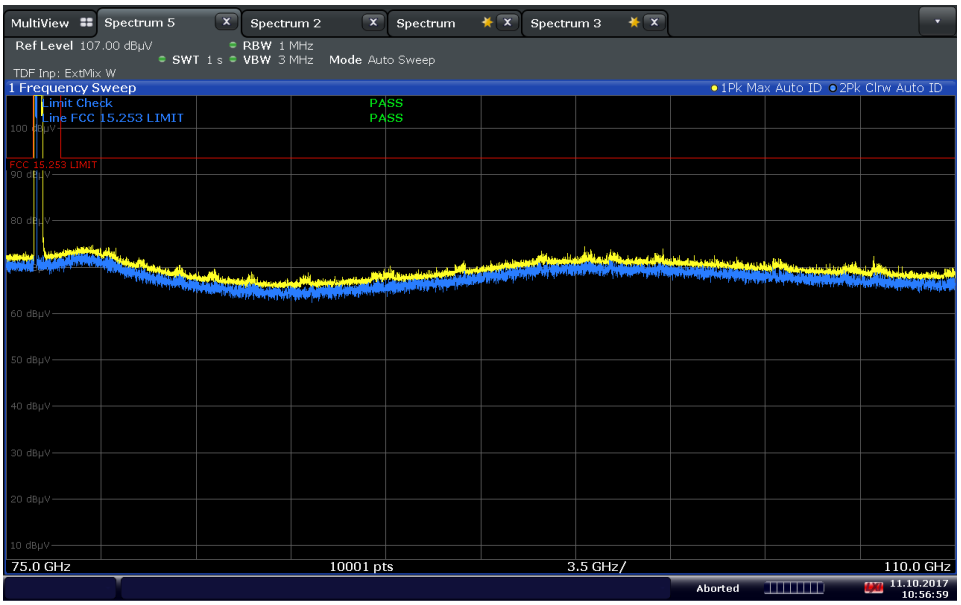
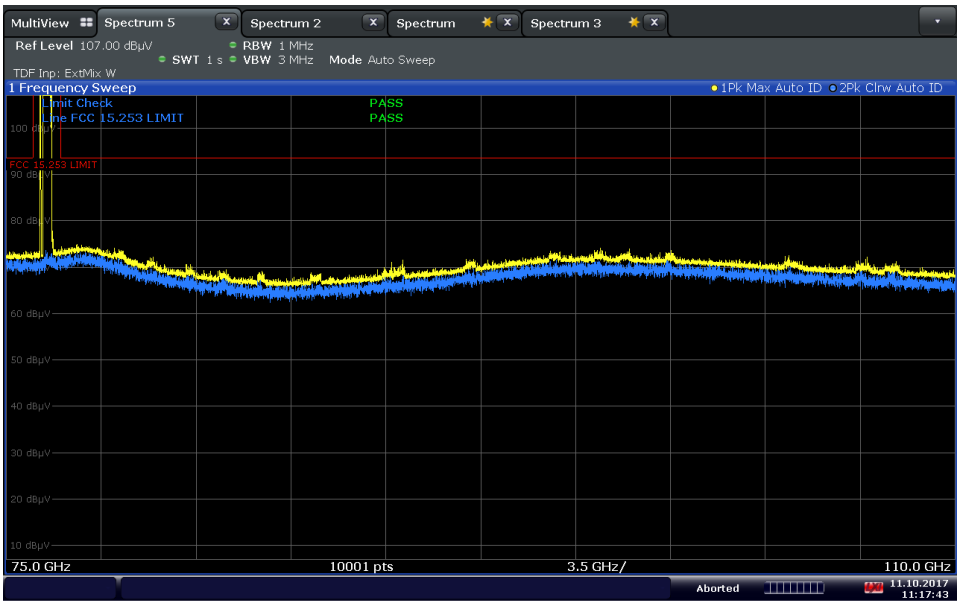
75 to 110 GHz High Channel 90 MHz BW



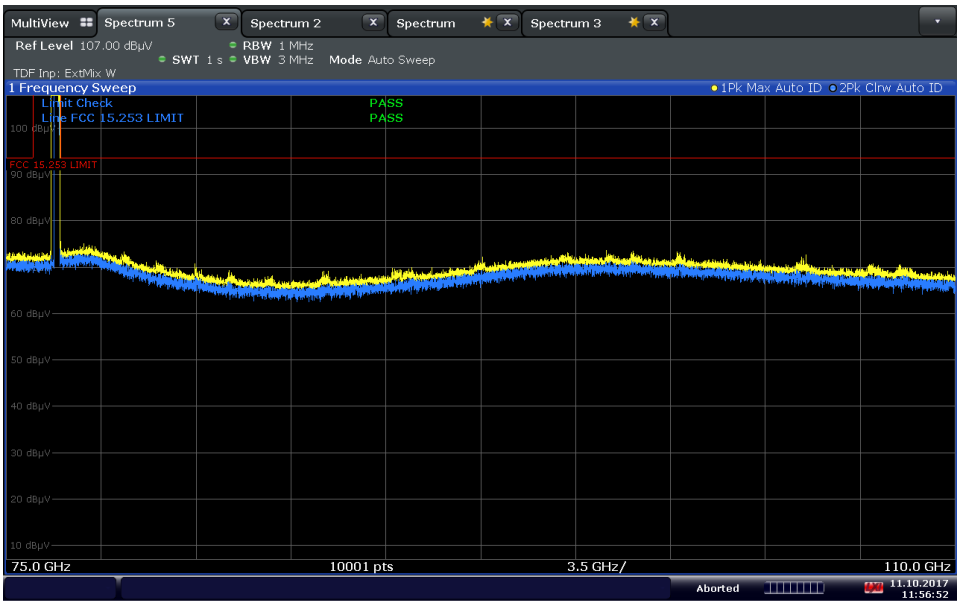
10:57:00 11.10.2017

75 to 110 GHz Low Channel 240 MHz BW



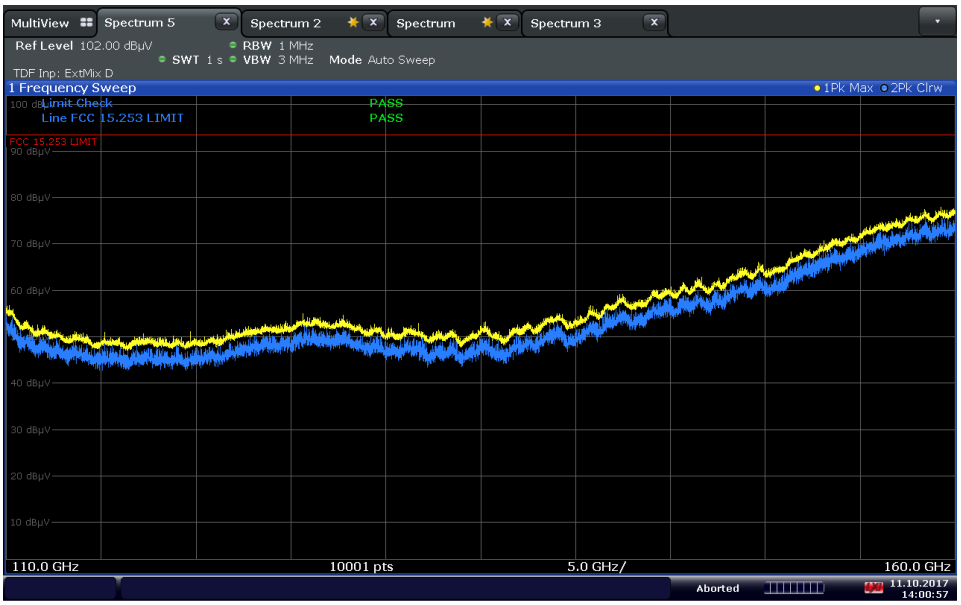
11:17:43 11.10.2017

75 to 110 GHz Mid Channel 240 MHz BW



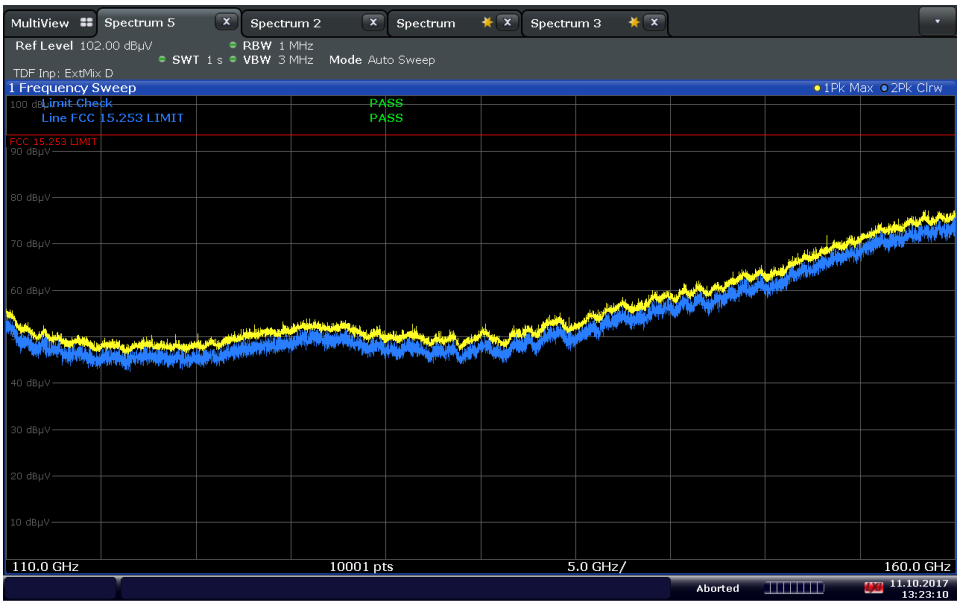
11:56:53 11.10.2017

75 to 110 GHz High Channel 240 MHz BW



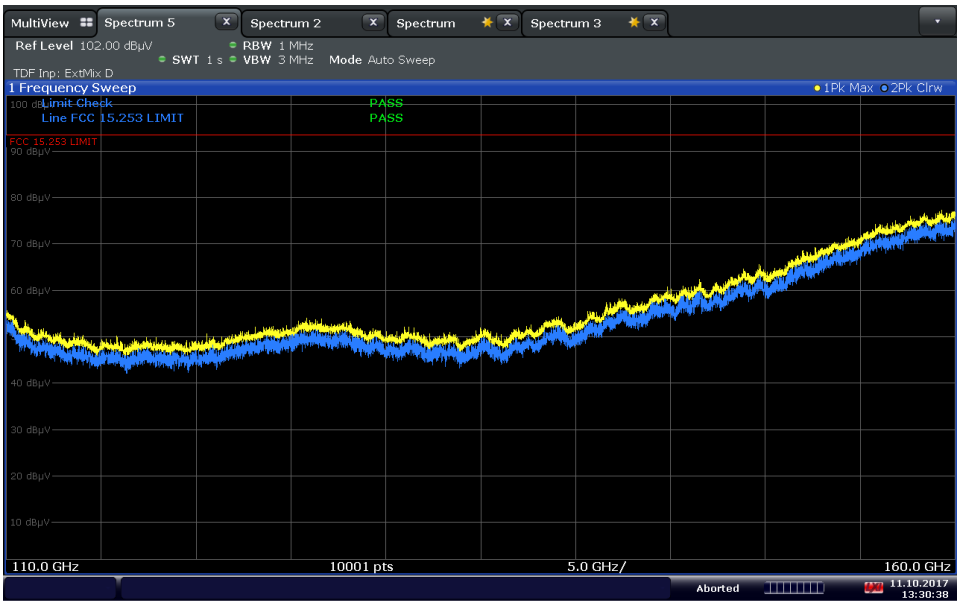
14:00:58 11.10.2017

110 to 160 GHz Low Channel 90 MHz BW



13:23:10 11.10.2017

110 to 160 GHz Mid Channel 90 MHz BW

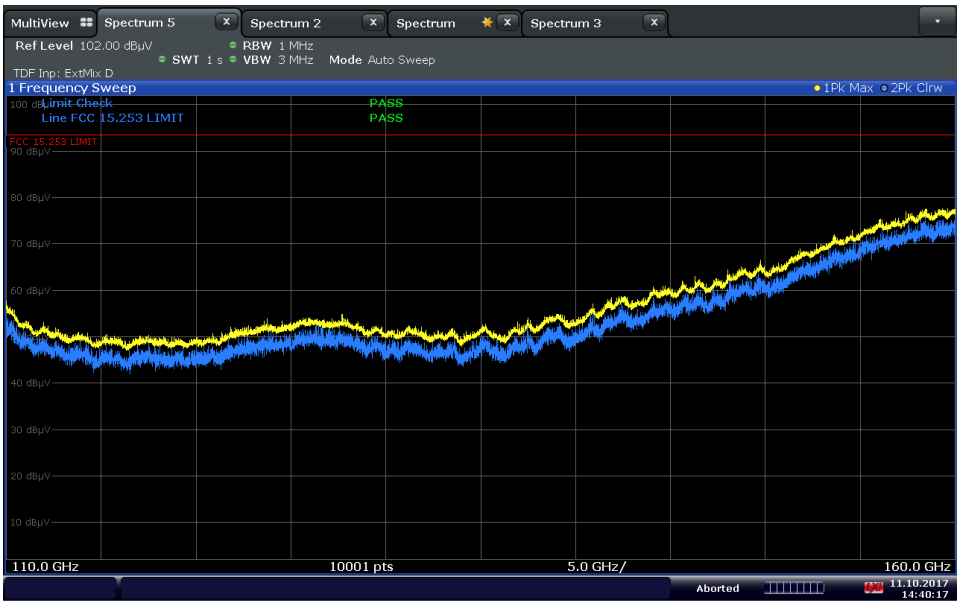


13:30:38 11.10.2017

110 to 160 GHz High Channel 90 MHz BW

14:07:37 11.10.2017

110 to 160 GHz Low Channel 240 MHz BW

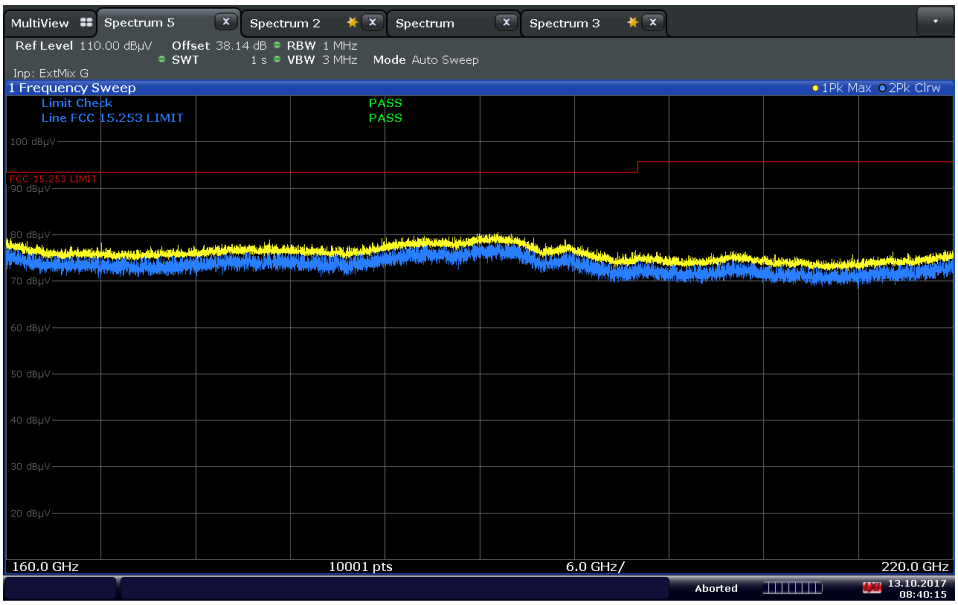


14:40:18 11.10.2017

110 to 160 GHz Mid Channel 240 MHz BW

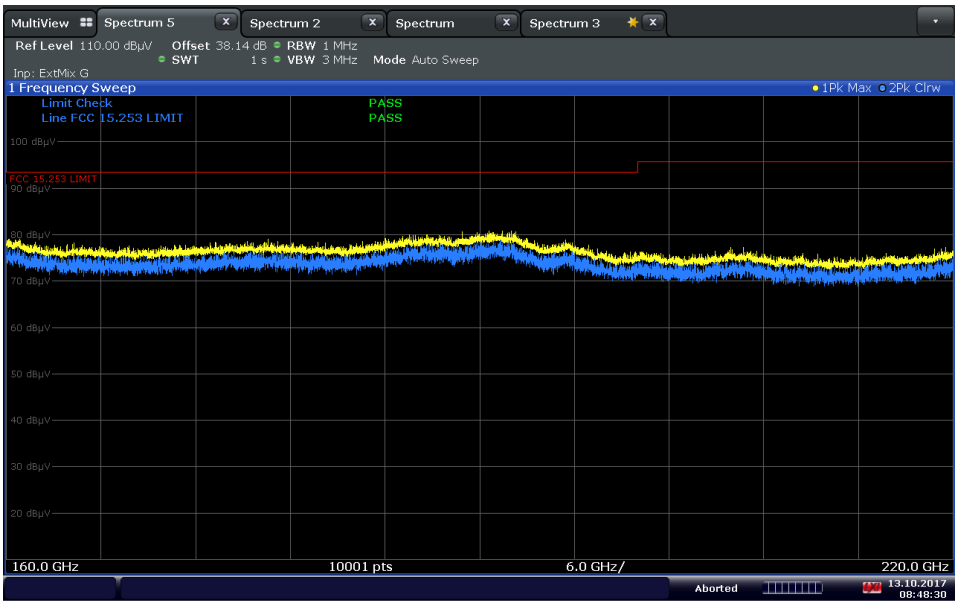
14:59:44 11.10.2017

110 to 160 GHz High Channel 240 MHz BW



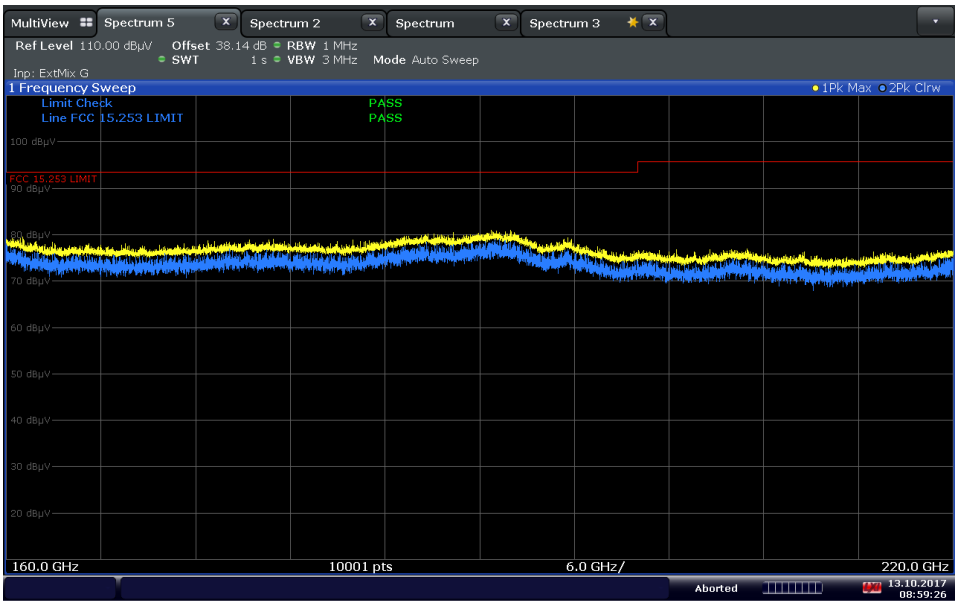
08:40:16 13.10.2017

160 to 220 GHz Low Channel 90 MHz BW



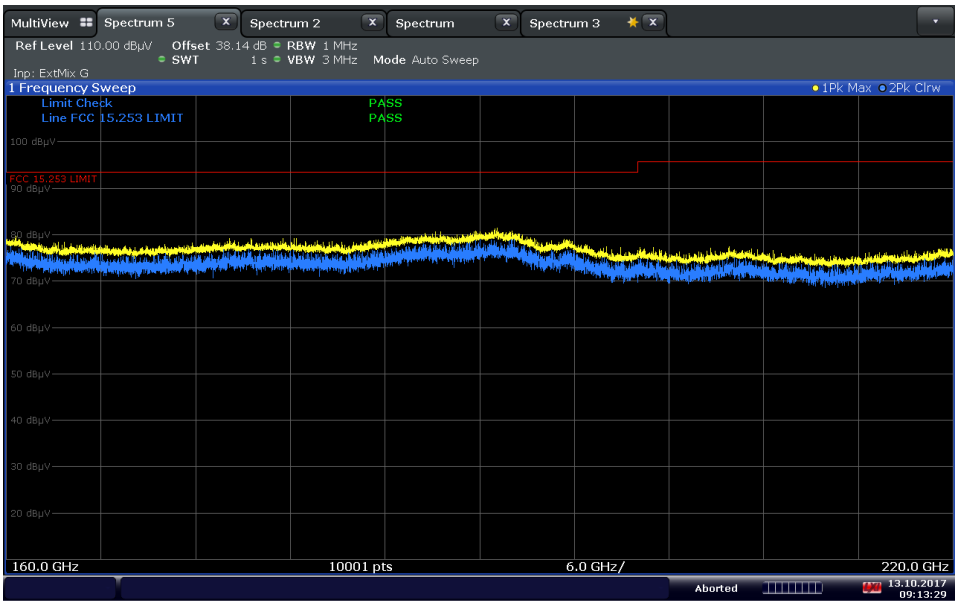
08:48:31 13.10.2017

160 to 220 GHz Mid Channel 90 MHz BW



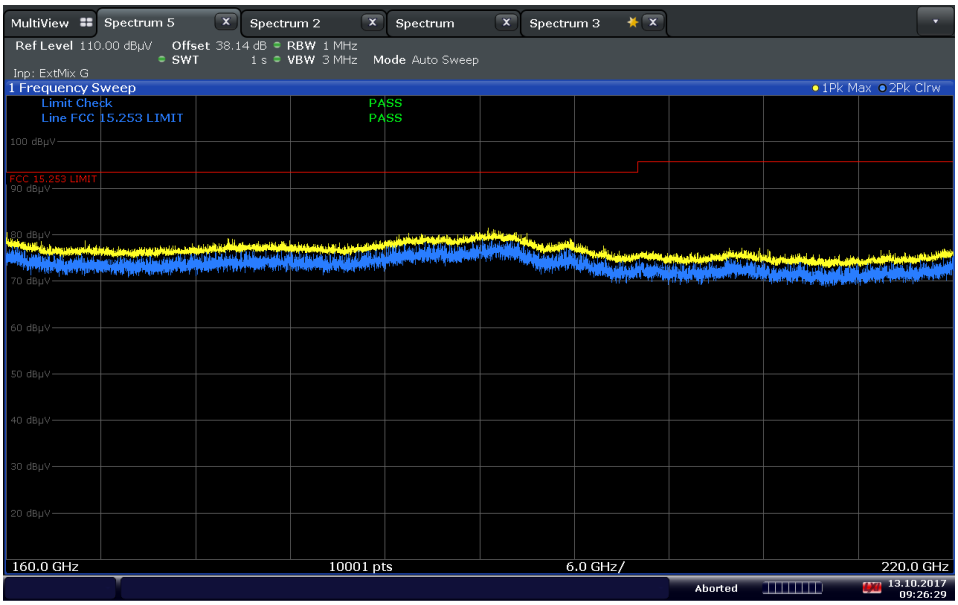
08:59:27 13.10.2017

160 to 220 GHz High Channel 90 MHz BW



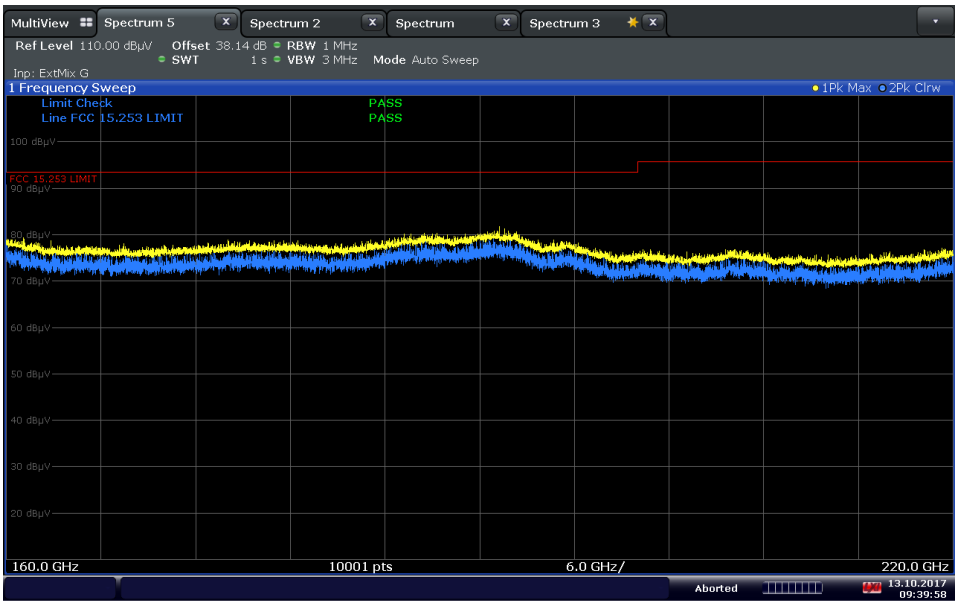
09:13:29 13.10.2017

160 to 220 GHz Low Channel 240 MHz BW



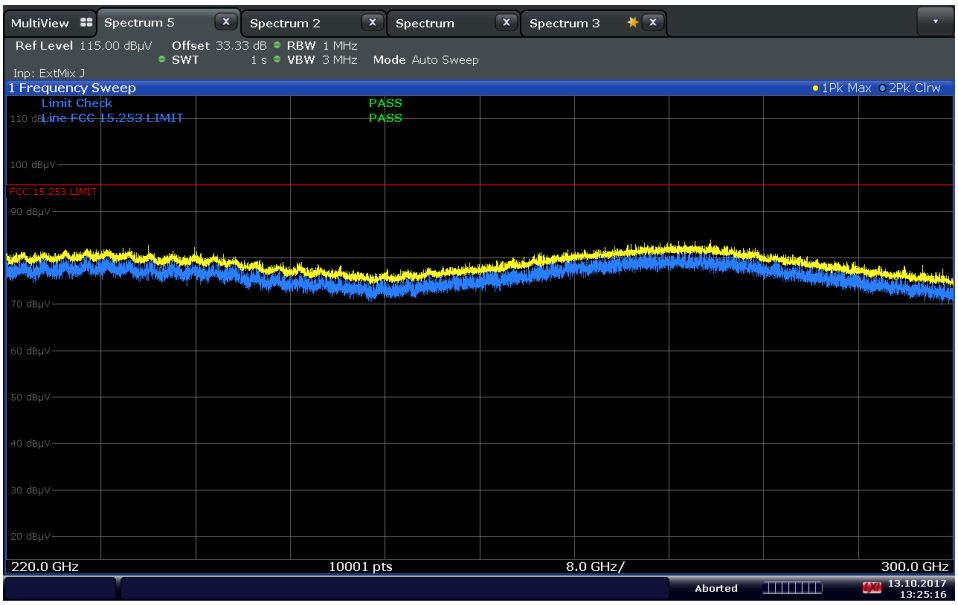
09:26:29 13.10.2017

160 to 220 GHz Mid Channel 240 MHz BW



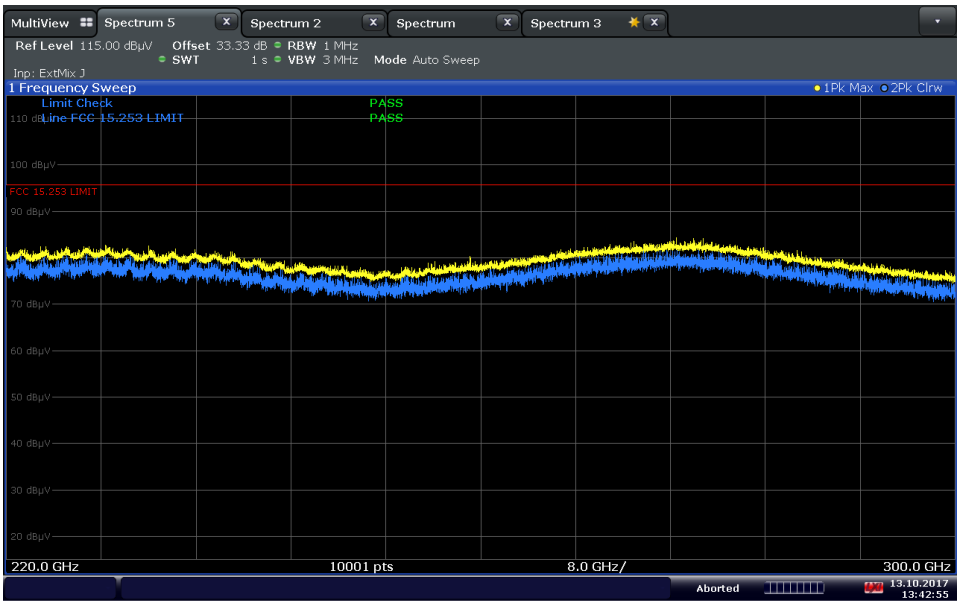
09:39:58 13.10.2017

160 to 220 GHz High Channel 240 MHz BW



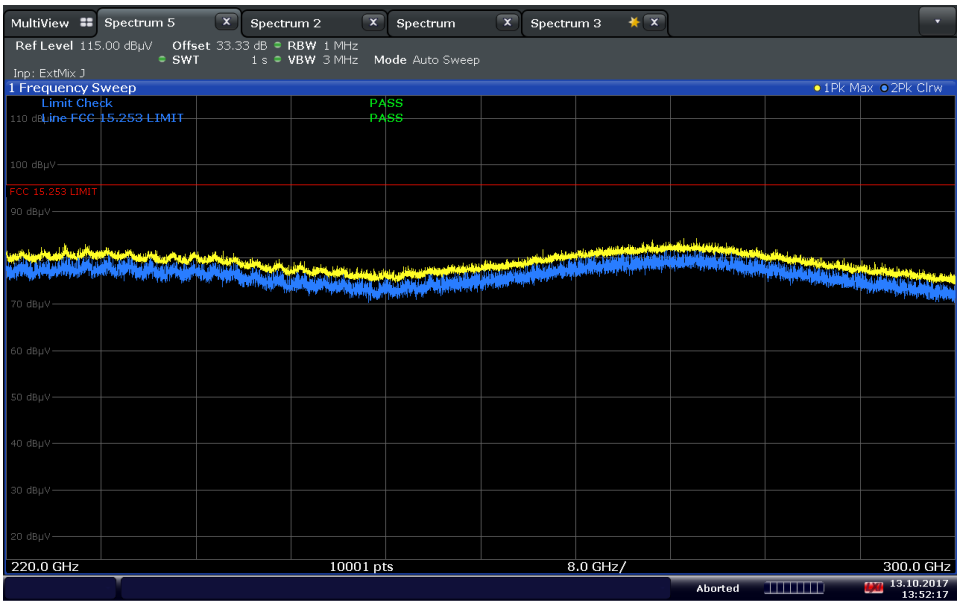
13:25:16 13.10.2017

220 to 300 GHz Low Channel 90 MHz BW



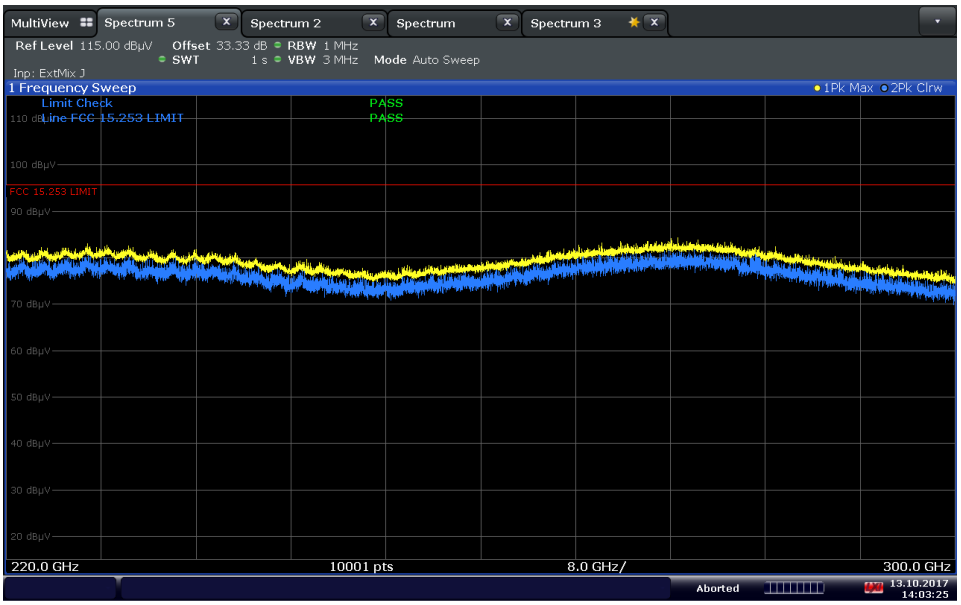
13:42:56 13.10.2017

220 to 300 GHz Mid Channel 90 MHz BW



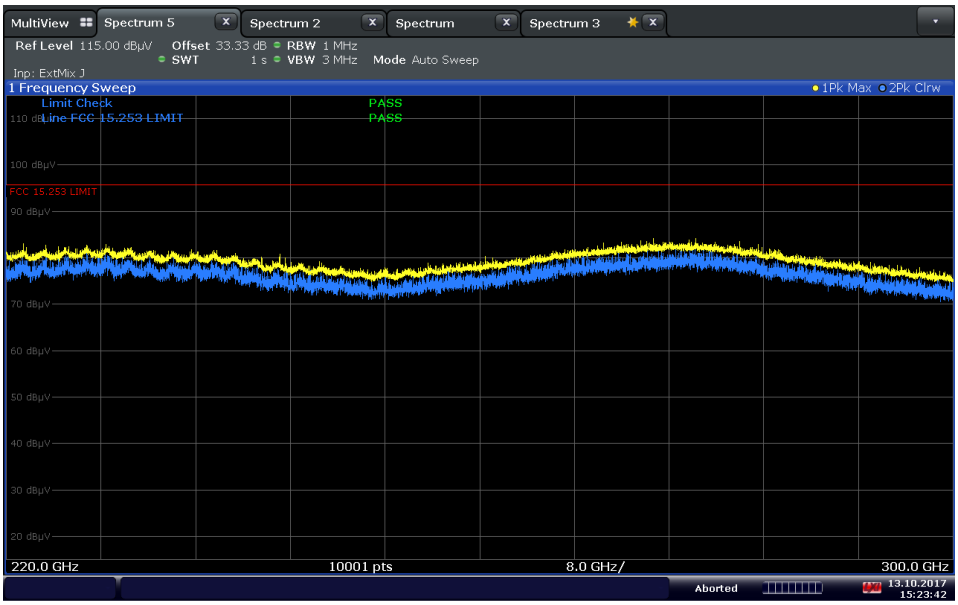
13:52:17 13.10.2017

220 to 300 GHz High Channel 90 MHz BW



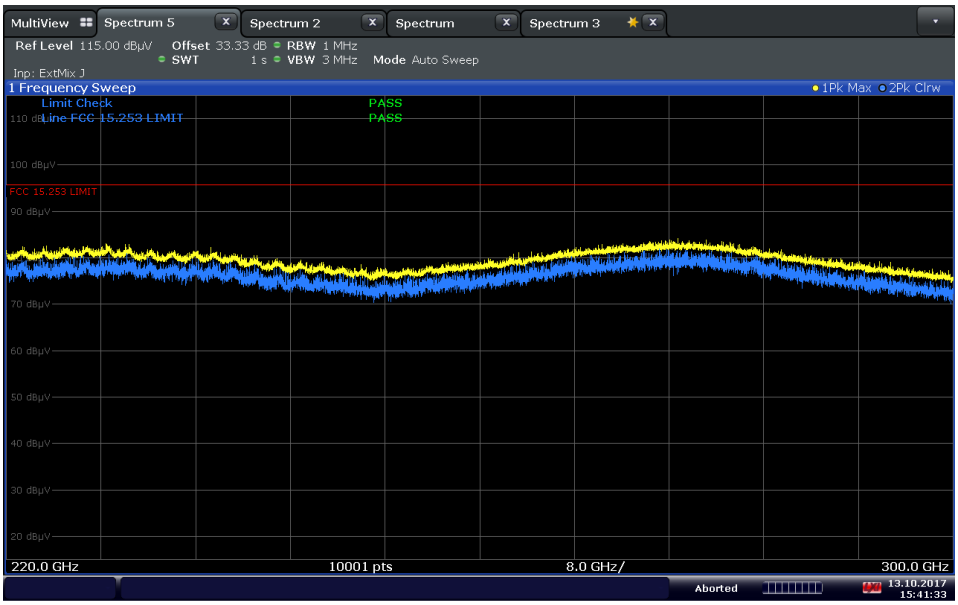
14:03:26 13.10.2017

220 to 300 GHz Low Channel 240 MHz BW



15:23:42 13.10.2017

220 to 300 GHz Mid Channel 240 MHz BW



15:41:33 13.10.2017

220 to 300 GHz High Channel 240 MHz BW

2.4 FREQUENCY STABILITY

2.4.1 Specification Reference

FCC Part 95 Subpart M §95.3379(b) and RSS-251 Issue 1 Sec. 5.4

2.4.2 Standard Applicable

(b) Fundamental emissions must be contained within the frequency bands specified in this section during all conditions of operation. Equipment is presumed to operate over the temperature range −20 to 50 degrees Celsius with an input voltage variation of 85% to 115% of rated input voltage, unless justification is presented to demonstrate otherwise.

2.4.3 Equipment Under Test and Modification State

Serial No: 01354000E7, 01354000JL, 01354000KX and 01354000K8 / Default Test Configuration

2.4.4 Date of Test/Initial of test personnel who performed the test

October 03-05, 2017/NS

2.4.5 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.4.6 Environmental Conditions

Ambient Temperature	24.9-25.8°C
Relative Humidity	42.5-47.2%
ATM Pressure	98.5-98.8 kPa

2.4.7 Additional Observations

- EUT has no antenna port available. The measurements under this section were performed using radiated measurement method.
- Extreme temperature range used is -45°C to +85°C. During test the EUT spectrum was monitored in the entire temperature range but only the data obtained at extreme temperatures is presented as worst case results.
- Extreme test source voltage used is 7.0 VDC and 36.0 VDC. No considerable frequency variations were observed at extreme supply voltages.
- An offset of 40.6 dB was added to account for the test setup loss.
- RBW is 1 MHz while VBW is 3 MHz
- Detector is Peak
- Trace is Max Hold
- During the test low and high frequencies (f_L and f_H) of the signal spectrum were monitored. The applicable spurious emissions limit was used to define f_L and f_H.

2.4.8 Test Results

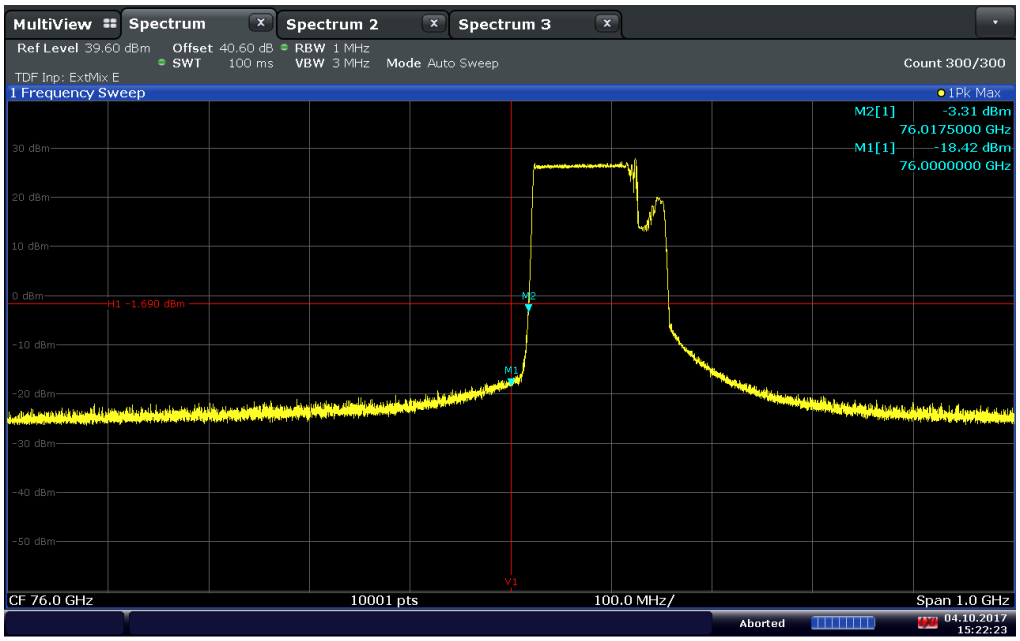
Temperature variation

Modulation BW	Temperature	Frequency Low f_L (GHz)	Frequency High f_H (GHz)
90 MHz	85°C	76.01530	76.98790
	20°C	76.01540	76.98730
	-45°C	76.01750	76.99300
240 MHz	85°C	76.01610	76.97080
	20°C	76.01530	76.97520
	-45°C	76.01780	76.98680
f_L=76.01530 GHz > 76.0 GHz f_H=76.99300 GHz < 77.0 GHz EUT Complies			

Voltage variation

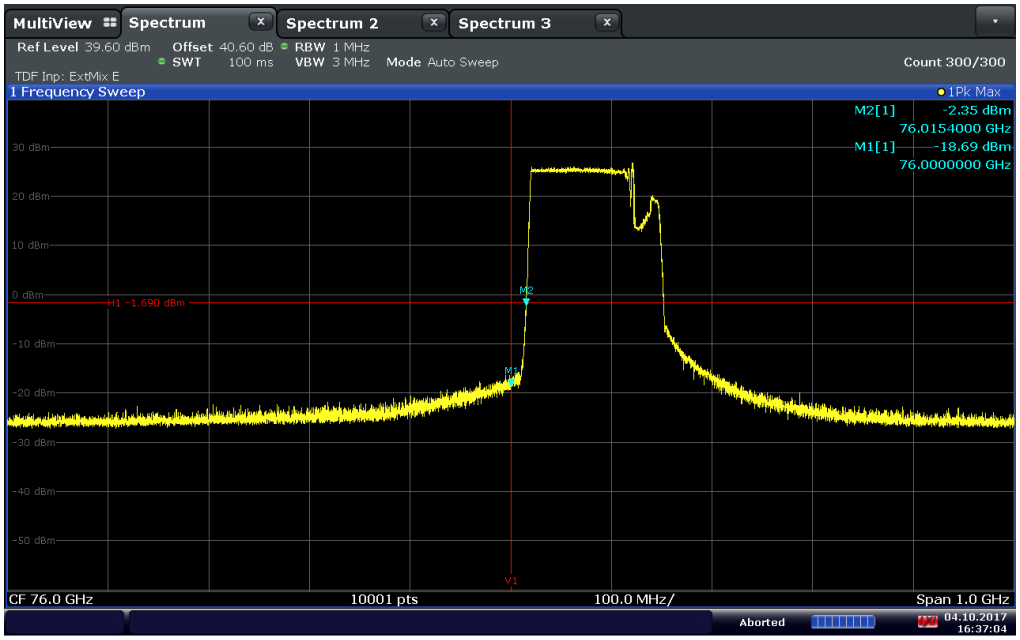
Modulation BW	Input Voltage (VDC)	Frequency Low f_L (GHz)	Frequency High f_H (GHz)
90 MHz	36.0	76.01520	76.98680
	12.0	76.01540	76.98730
	7.0	76.01520	76.98730
240 MHz	36.0	76.01560	76.97520
	12.0	76.01530	76.97520
	7.0	76.01530	76.97517
f_L=76.01520 GHz > 76.0 GHz f_H=76.98730 GHz < 77.0 GHz EUT Complies			

2.4.9 Test Plots



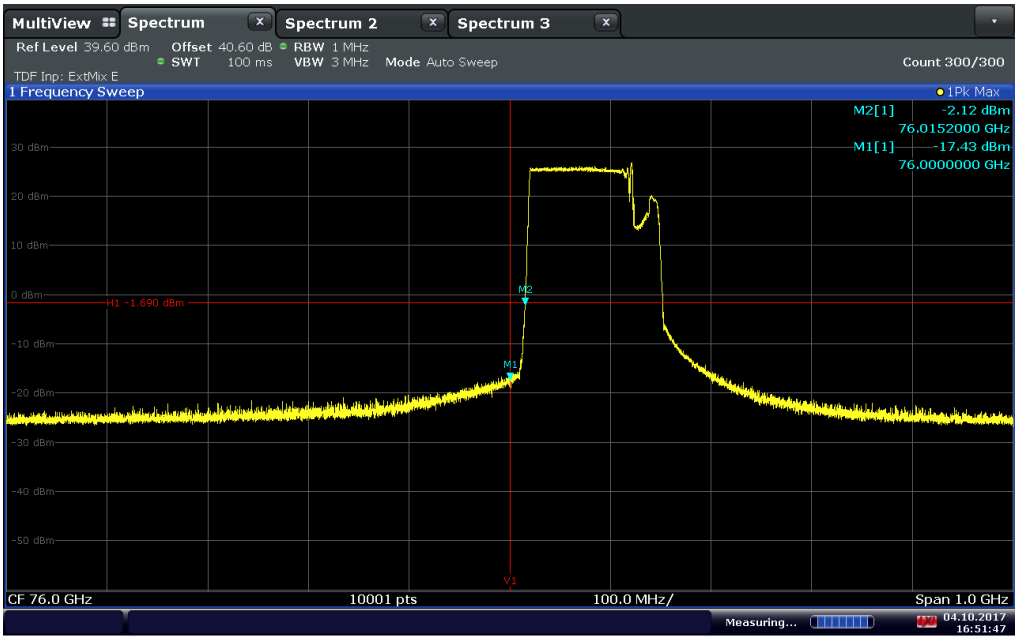
15:22:23 04.10.2017

-45 DEG 12.0 VDC Low channel 90 MHz BW



16:37:05 04.10.2017

20 DEG 12.0 VDC Low channel 90 MHz BW



16:51:47 04.10.2017

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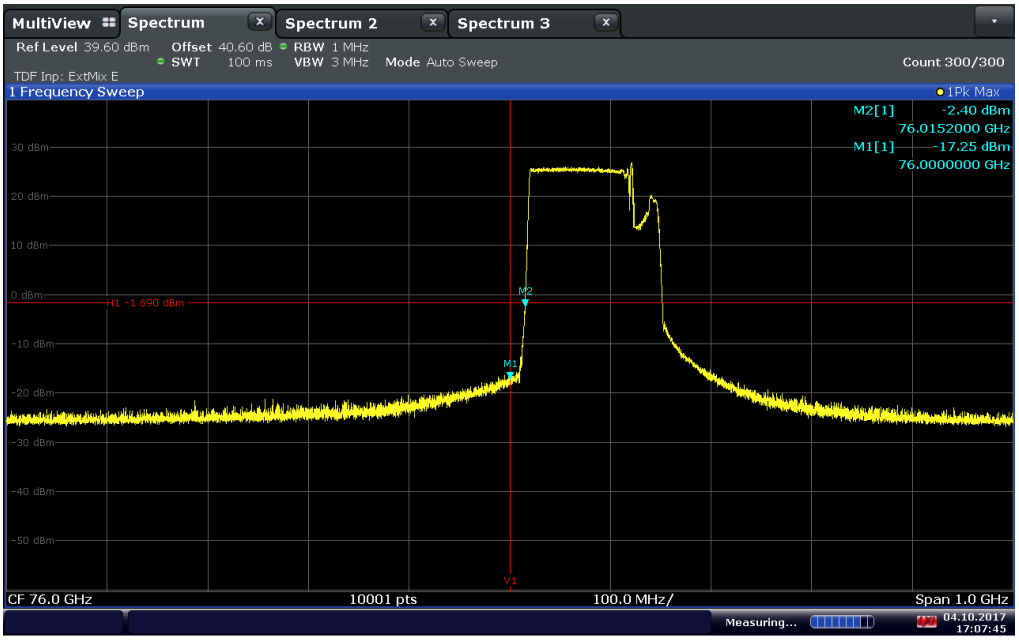
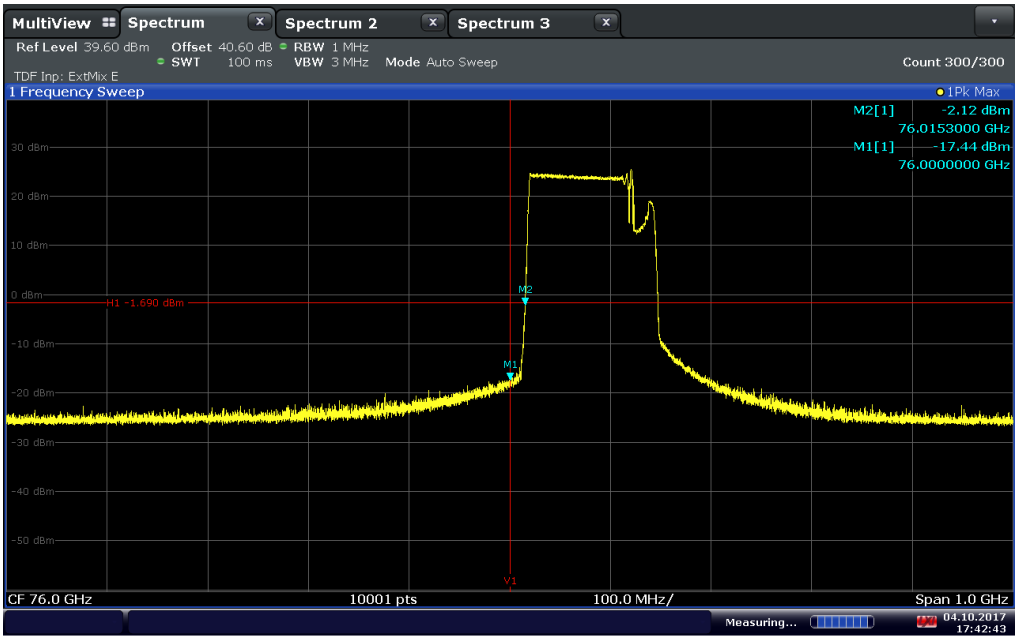


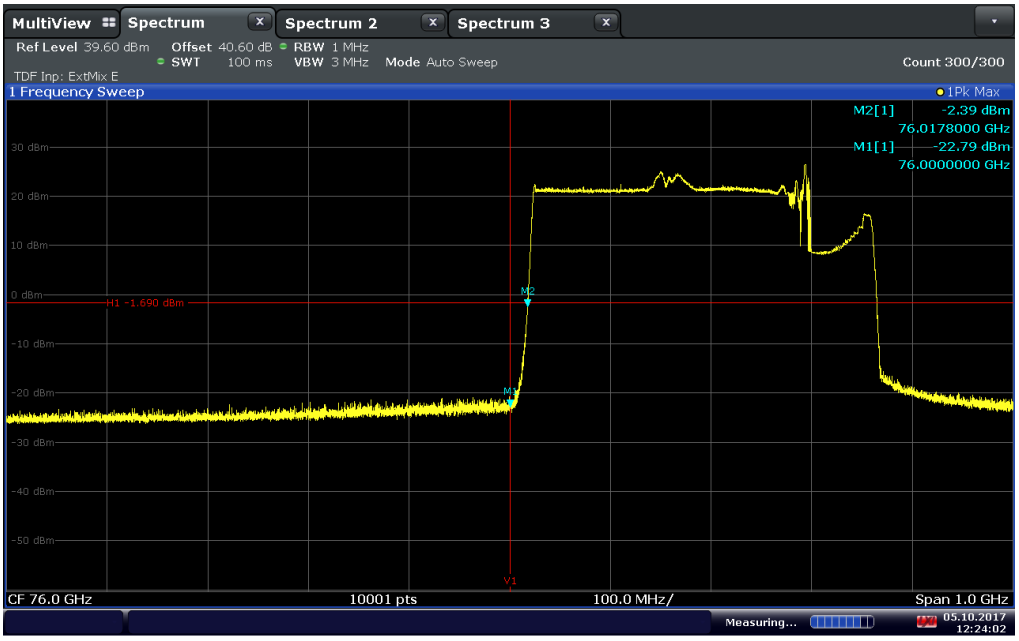
17:07:46 04.10.2017

20 DEG 36.0 VDC Low channel 90 MHz BW



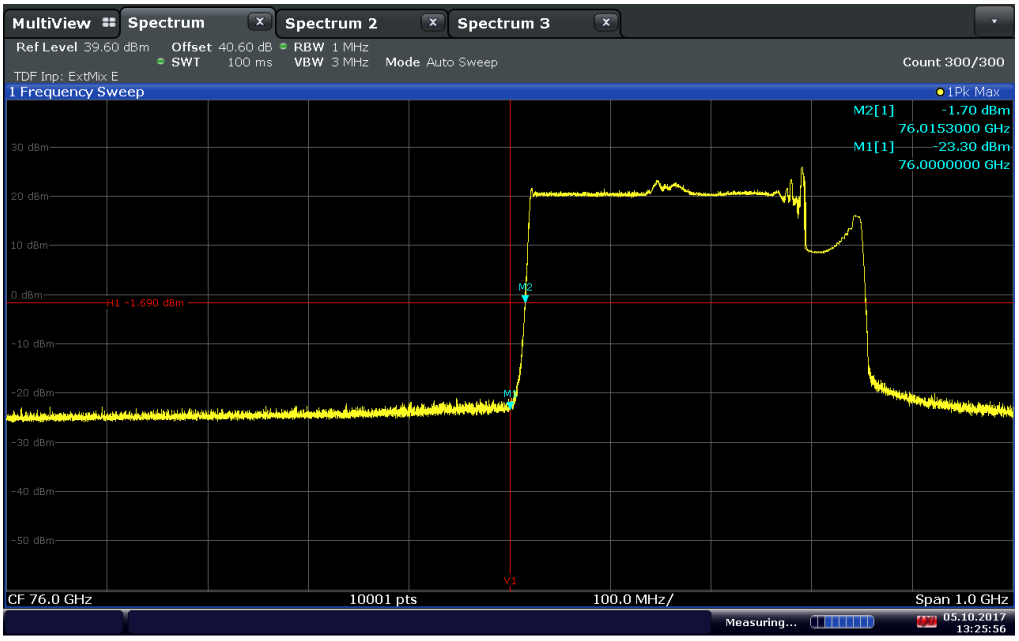
17:42:44 04.10.2017

85 DEG 12.0 VDC Low channel 90 MHz BW



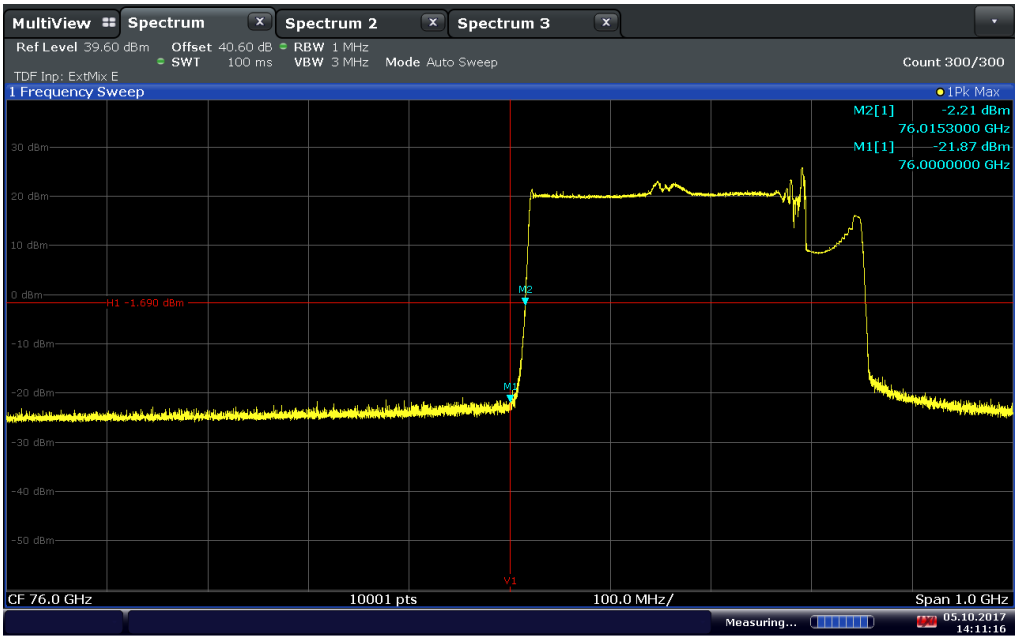
12:24:03 05.10.2017

-45 DEG 12 VDC Low channel 240 MHz BW



13:25:57 05.10.2017

20 DEG 12.0 VDC Low channel 240 MHz BW



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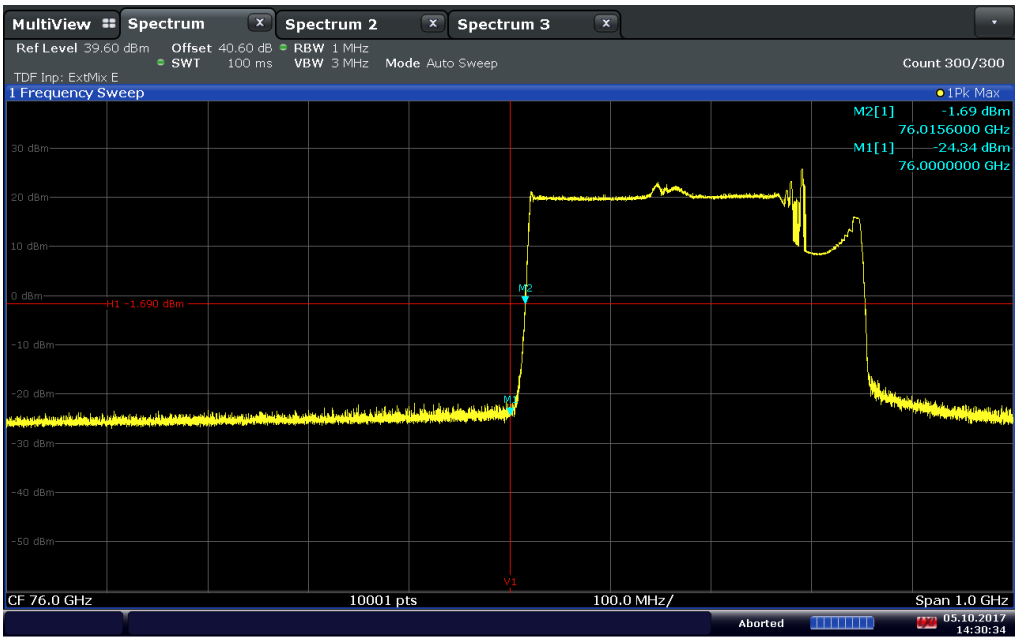
20 DEG 7.0 VDC Low channel 240 MHz BW



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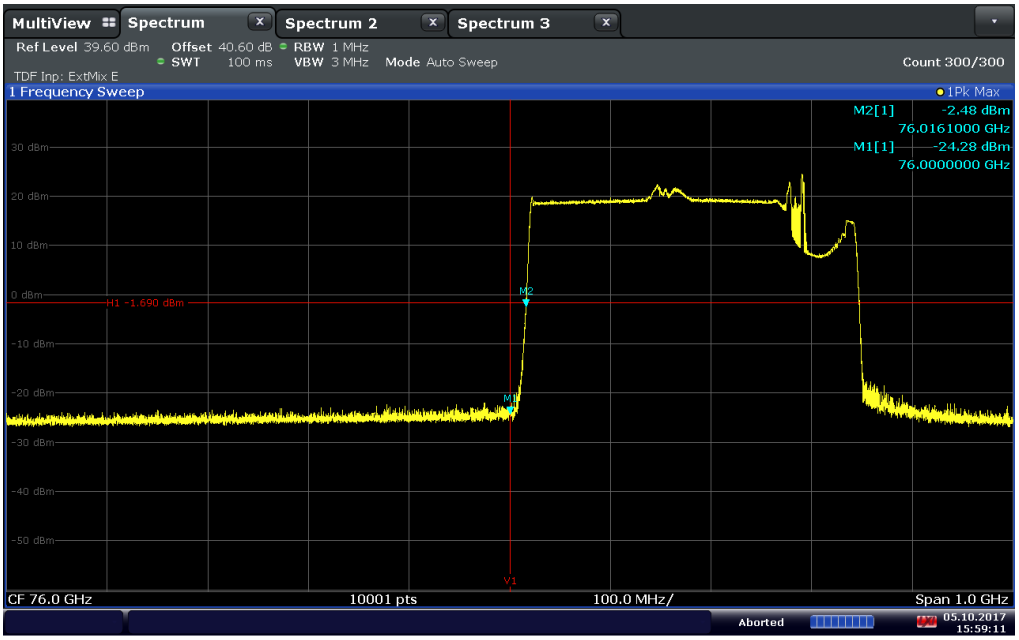
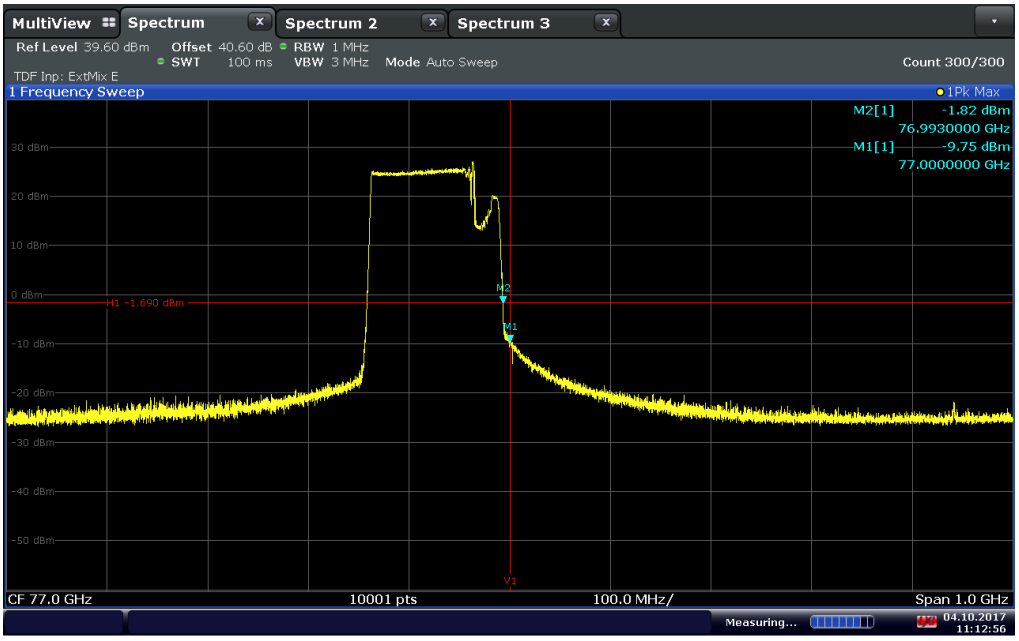
20 DEG 36.0 VDC Low channel 240 MHz BW



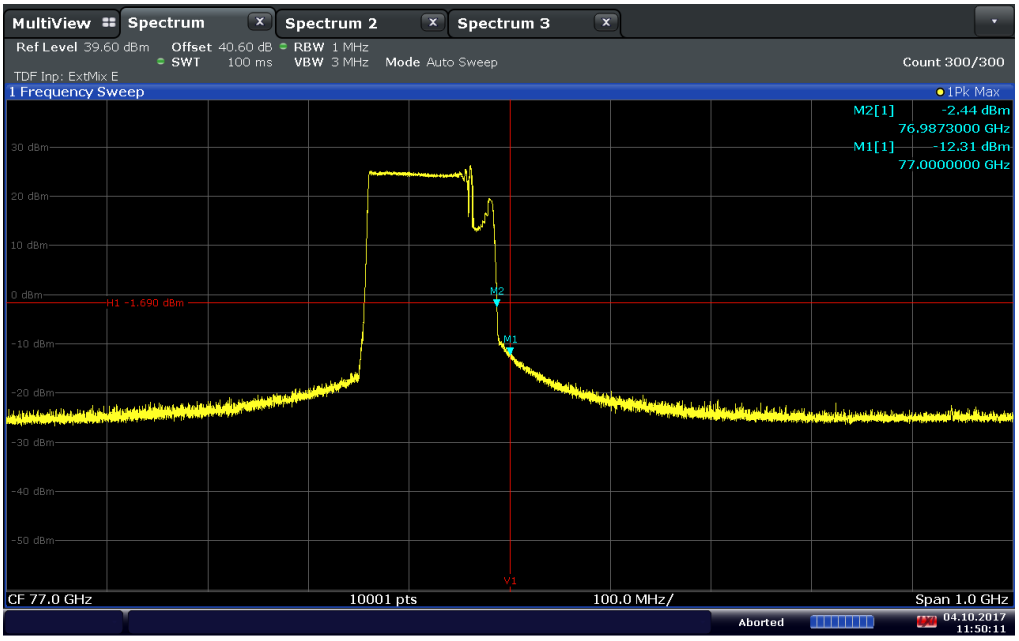
15:59:12 05.10.2017

85 DEG 12.0 VDC Low channel 240 MHz BW



11:12:56 04.10.2017

-45 DEG 12.0 VDC High channel 90 MHz BW



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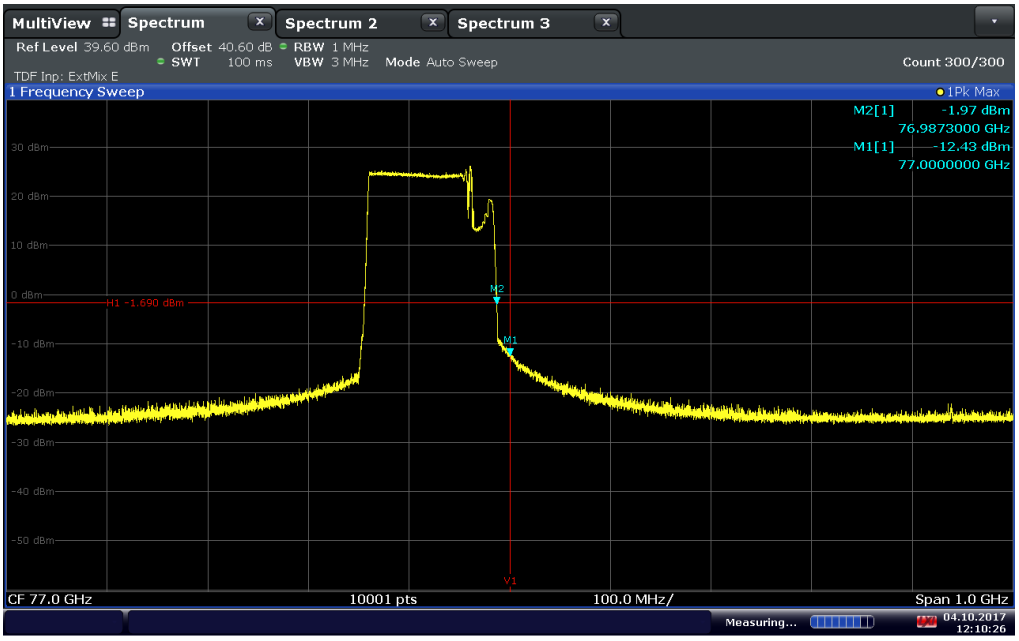

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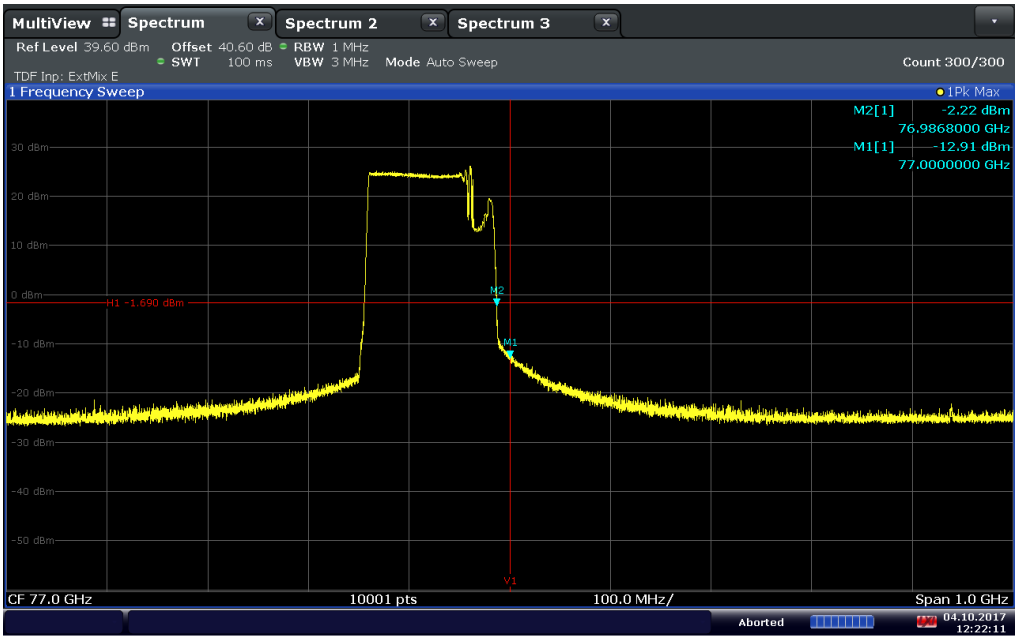

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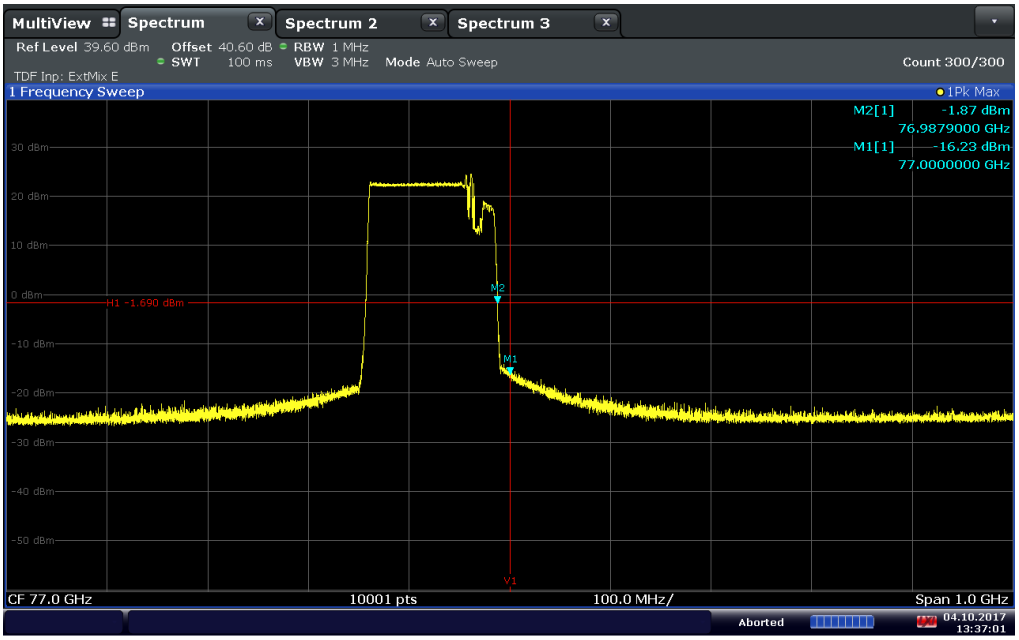

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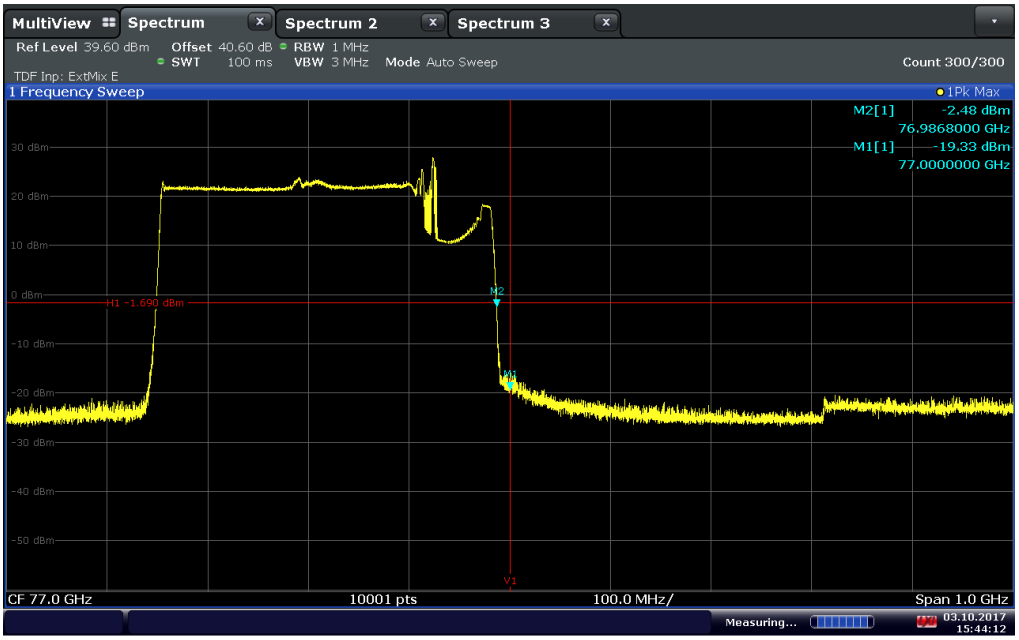

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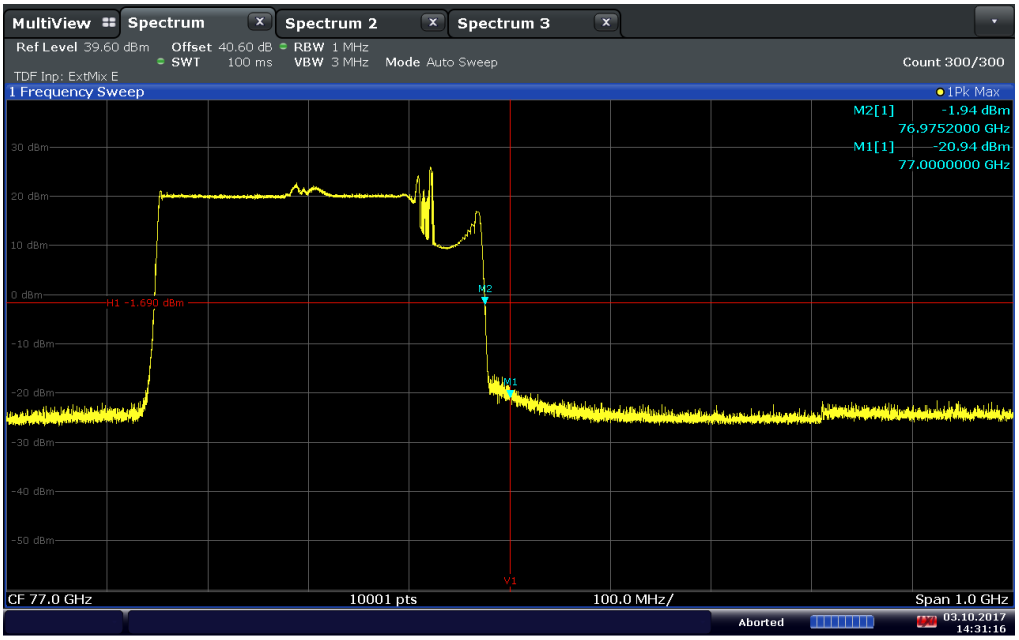
-45 DEG 12.0 VDC High channel 240 MHz BW



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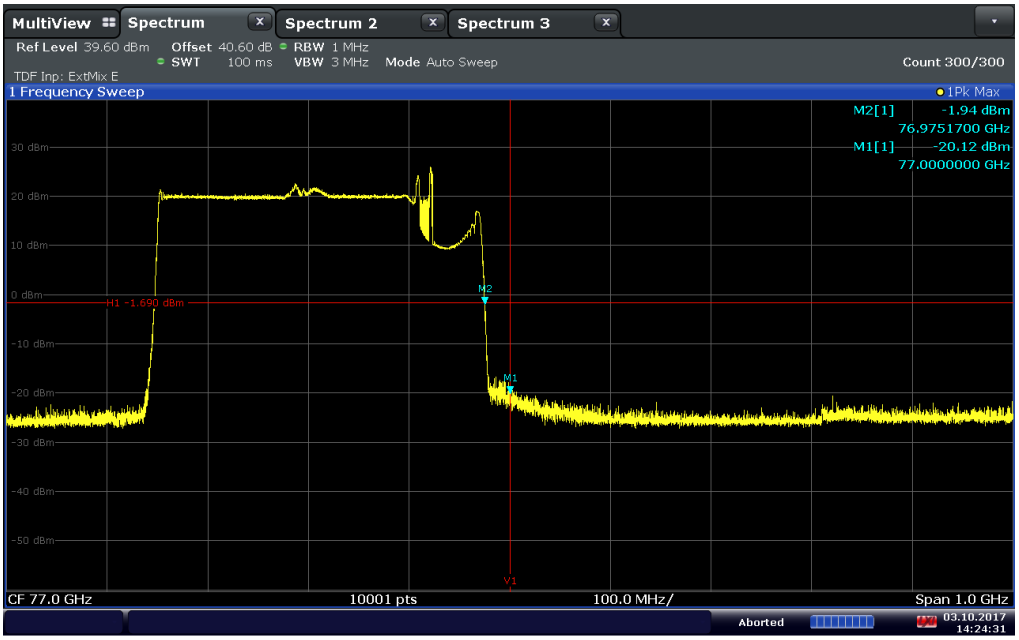

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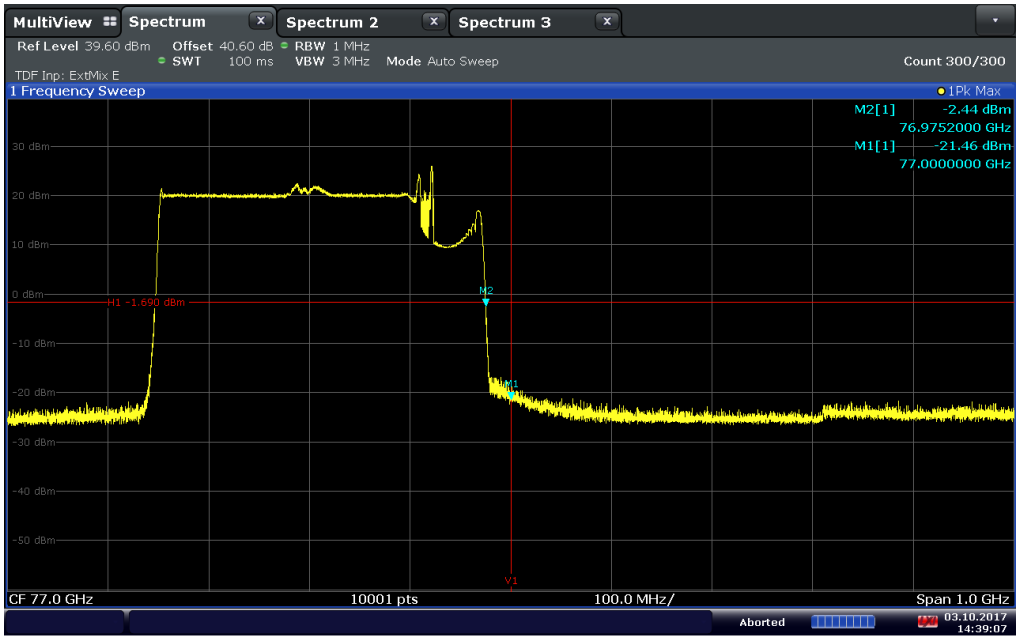

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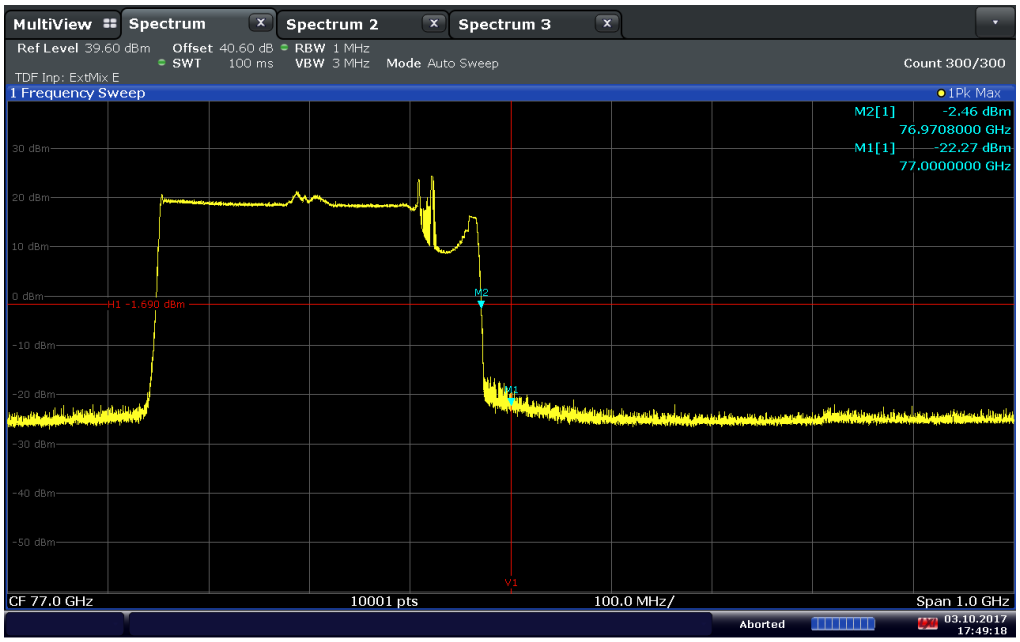
20 DEG 36.0 VDC High channel 240 MHz BW



17:49:19 03.10.2017

85 DEG 12.0 VDC High channel 240 MHz BW

SECTION 3

TEST EQUIPMENT USED

3.1 TEST EQUIPMENT USED

List of absolute measuring and other principal items of test equipment.

ID Number (SDGE/SDRB)	Test Equipment	Type	Serial Number	Manufacturer	Cal Date	Cal Due Date
Radiated Test Setup						
1003	Signal Generator	SMR-40	1104.0002.40	Rhode & Schwarz	05/16/17	05/16/18
7611	Signal/Spectrum Analyzer	FSW26	102017	Rhode & Schwarz	04/25/17	04/25/18
1033	Bilog Antenna	3142C	00044556	EMCO	10/11/16	10/11/18
1016	Pre-amplifier	PAM-0202	187	PAM	10/17/16	10/17/17
7575	Double-ridged waveguide horn antenna	3117	155511	EMCO	06/01/17	06/01/18
9001	Horn antenna (18-26 GHz)	HO42S	101	Custom Microwaves	08/18/17	08/18/19
9002	Horn antenna (26-40 GHz)	HO28S	102	Custom Microwaves	07/14/17	07/14/19
9003	Horn antenna (40-60 GHz)	HO19R	103	Custom Microwaves	07/19/17	07/19/19
9004	Horn antenna (50-75 GHz)	HO15R	104	Custom Microwaves	07/19/17	07/19/19
7628	Horn antenna (75-110 GHz)	SAR-2309-10-S2	13481-01	Sage Millimeter, Inc.	08/16/17	08/16/19
9081	Horn antenna (110-170 GHz)	HO6R	N/A	Custom Microwaves	Verified	
9082	Horn antenna (140-220 GHz)	HO5R	N/A	Custom Microwaves	Verified	
9080	Horn antenna (220-325 GHz)	HO3R	N/A	Custom Microwaves	Verified	
1049	EMI Test Receiver	ESU40	100133	Rohde & Schwarz	04/28/17	04/28/18
1040	EMI Test Receiver	ESIB40	100292	Rhode & Schwarz	10/07/16	10/07/17
8628	Pre-amplifier	QLJ 01182835-JO	8986002	QuinStar Technologies Inc.	02/09/17	02/09/18
8893	Pre-amplifier (18-40 GHz)	SLKKa-30-6	15G27	Spacek Labs	Verified by 1003 and 7611	
7637	Harmonics mixer (40-60 GHz)	FS-Z60	100009	Rhode & Schwarz	01/26/16	01/26/18
7636	Harmonics mixer (60-90 GHz)	FS-Z90	100092	Rhode & Schwarz	10/26/15	10/26/17
7633	Harmonics mixer (75-110 GHz)	HM-110-7	101000	Radiometer Physics	Verified	
7634	Harmonics mixer (110-170 GHz)	HM-170	0062	Radiometer Physics	05/10/16	05/10/18
7635	Harmonics mixer (170-220 GHz)	HM-220	020022	Radiometer Physics	06/10/16	06/10/18
7632	Harmonics mixer (220-325 GHz)	HM-325	020075	Radiometer Physics	06/14/16	06/14/18
8872	Direct Reading Attenuator	STA-60-19-D1	11875-01	Sage Millimeter, Inc.	Verified	
8860	Direct Reading Attenuator	STA-60-15-D1	11466-01	Sage Millimeter, Inc.	Verified	
8861	Direct Reading Attenuator	STA-60-10-D1	11466-01	Sage Millimeter, Inc.	Verified	
8873	Active Multiplier (40-60 GHz)	AMC-19-RFH00	124	Millitech, Inc.	Verified	
8914	Active Multiplier (50-75 GHz)	AMC-15-RFH00	283	Millitech, Inc.	Verified	
8915	Active Multiplier (75-110 GHz)	AMC-10-RFH00	606	Millitech, Inc.	Verified	
8922	High-frequency cable	R90-088-200	N/A	Teledyne	02/10/17	02/10/18
1026	High-frequency cable	3M-7/C2	N/A	MicroCoax	04/26/17	04/26/18
8849	High-frequency cable (1-18 GHz)	SAC-26G-6.1	363	A.H.Systems	04/23/17	04/23/18
8771	6dB attenuator	606-06-1F4/DR	N/A	MECA	10/11/17	10/11/18
Miscellaneous						
6708	Multimeter	34401A	US36086974	Hewlett Packard	07/05/17	07/05/18
7554	Barometer/Temperature/Humidity Transmitter	iBTHX-W	15250268	Omega	01/17/17	01/17/18
7579	Temperature Chamber	115	151617	TestEquity	08/22/17	08/22/18

118208	DC Power Supply	Pad 250-4.5L	29051058	Kikusui Electronics Corp.	Verified by 6708
9076	DC Power Supply	18020M	P802039	Protek	Verified by 6708
	Test Software	EMC32	V8.53	Rhode & Schwarz	N/A

3.2 MEASUREMENT UNCERTAINTY

For a 95% confidence level, the measurement uncertainties for defined systems are:

3.2.1 Radiated Emission Measurements (Below 1 GHz)

	Contribution	Probability Distribution Type	Probability Distribution x_i	Standard Uncertainty $u(x_i)$	$[u(x_i)]^2$
1	Receiver/Spectrum Analyzer	Rectangular	0.45	0.26	0.07
2	Cables	Rectangular	0.50	0.29	0.08
3	Preamp	Rectangular	0.50	0.29	0.08
4	Antenna	Rectangular	0.75	0.43	0.19
5	Site	Rectangular	3.52	1.44	2.07
6	EUT Setup	Rectangular	1.00	0.58	0.33
				Combined Uncertainty (u_c):	1.68
				Coverage Factor (k):	2
				Expanded Uncertainty:	3.36

3.2.2 Radiated Emission Measurements (1 GHz to 18 GHz)

	Contribution	Probability Distribution Type	Probability Distribution x_i	Standard Uncertainty $u(x_i)$	$[u(x_i)]^2$
1	Receiver/Spectrum Analyzer	Rectangular	0.57	0.33	0.11
2	Cables	Rectangular	0.70	0.40	0.16
3	Preamp	Rectangular	0.50	0.29	0.08
4	Antenna	Rectangular	0.37	0.21	0.05
5	Site	Rectangular	3.00	1.22	1.50
6	EUT Setup	Rectangular	1.00	0.58	0.33
				Combined Uncertainty (u_c):	1.49
				Coverage Factor (k):	2
				Expanded Uncertainty:	2.99

3.2.3 Radiated Emission Measurements (Above 18 GHz)

	Contribution	Probability Distribution Type	Probability Distribution x_i	Standard Uncertainty $u(x_i)$	$[u(x_i)]^2$
1	Spectrum Analyzer/External Mixer	Rectangular	0.70	0.40	0.16
2	Cables	Rectangular	0.50	0.29	0.08
3	Preamp	Rectangular	3.34	1.93	3.72
4	Antenna	Rectangular	2.70	1.56	2.43
6	EUT Setup	Rectangular	1.50	0.87	0.75
				Combined Uncertainty (u_c):	2.67
				Coverage Factor (k):	2
				Expanded Uncertainty:	5.35

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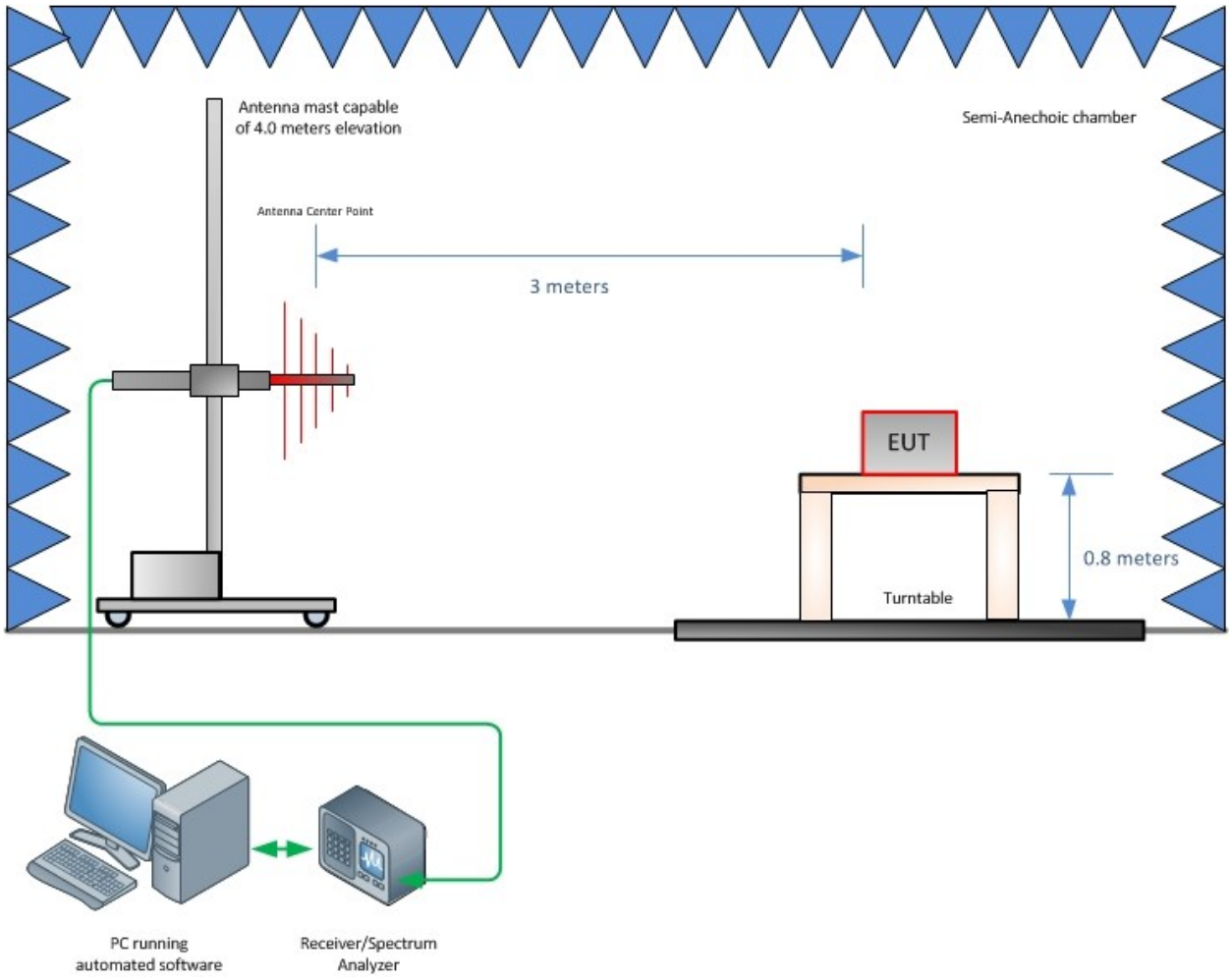
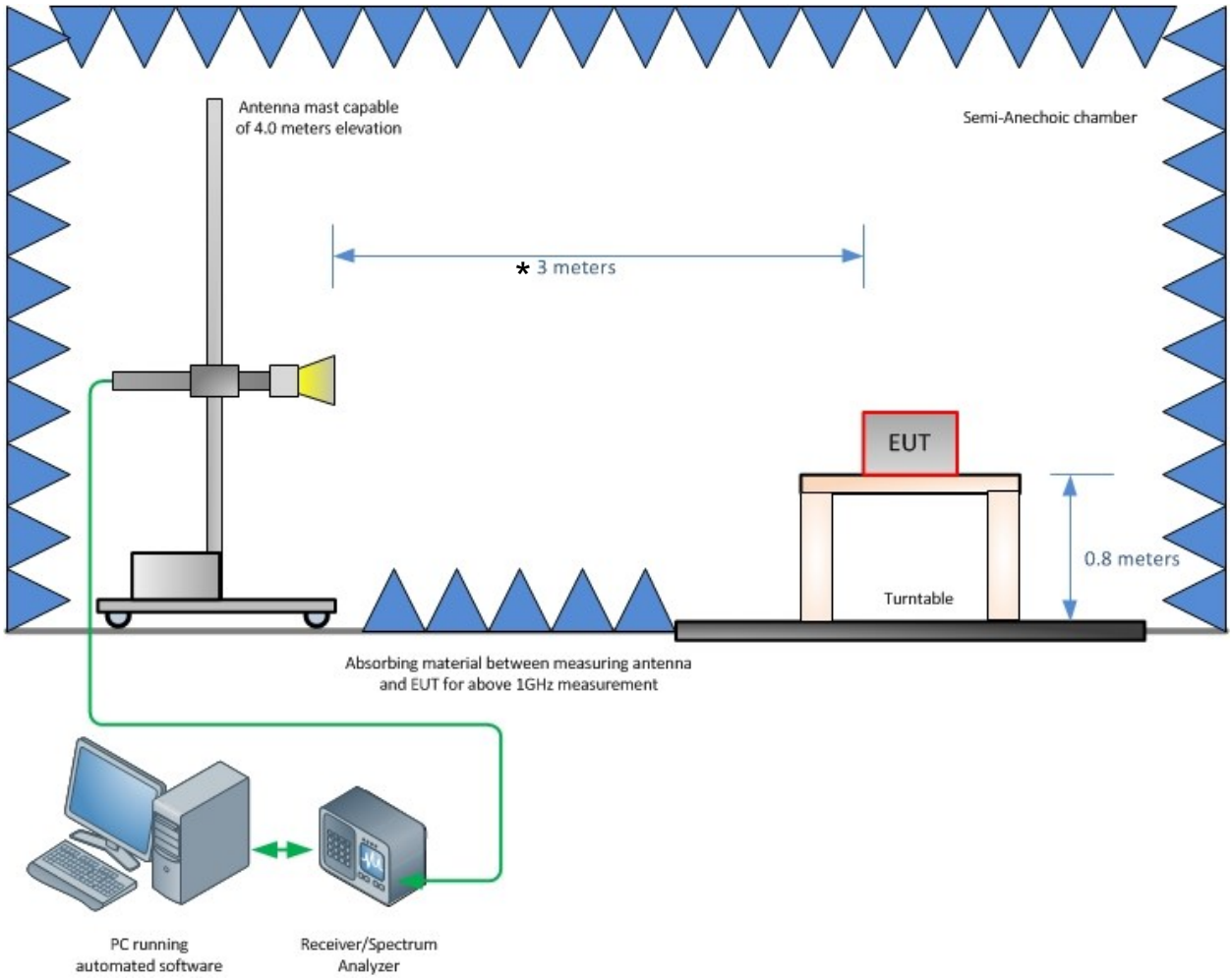
SECTION 4

DIAGRAM OF TEST SETUP

4.1 RADIATED EMISSION TEST SETUP (BELOW 1 GHZ)



4.2 RADIATED EMISSION TEST SETUP (ABOVE 1 GHZ)



*A test distance of 3 m was used for measurements below 60 GHz. The emissions in the range from 60 GHz to 160 GHz were evaluated at 1.0 m distance. For the measurements from 160 GHz to 220 GHz, the test distance was reduced to 0.5 m to assure that the noise floor is at least 10 dB below the applicable limit. Measurements above 220 GHz were taken at 0.2 m distance.

SECTION 5

ACCREDITATION, DISCLAIMERS AND COPYRIGHT

5.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT

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