America

Choose certainty.
Add value.

Report On

Radio Testing of the
Delphi Deutschland GmbH
R3TR Short Range Radar

FCC Part 15 Subpart C §15.253
IC RSS-251 Issue 1 November 2014

Report No. SD72117086-0516B **October 2016**

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 R3TR Short Range Radar
TEST REPORT NUMBER	SD72117086-0516B
PREPARED FOR	Delphi Deutschland GmbH Delphiplatz 1 42119 Wuppertal, Germany
CONTACT PERSON(S)	Ljiljana Trivic +49 2261 971415 Ljiljana_Trivic@Delphi.com Aniruddha Shirahatti +49 202 291 2826 aniruddha.2.shirahatti@delphi.com
PREPARED BY	Nikolay Shtin **Name** Authorized Signatory Title: EMC/Wireless Test Engineer
APPROVED BY	Juan Manuel Gonzalez **Name** Authorized Signatory Title: EMC Service Line Manager Western Region
DATED	October 12, 2016

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

Revision History

SD72117086-0516B Delphi Deutschland GmbH R3TR Short Range Radar					
DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
10/12/16	Initial Release				Juan M. Gonzalez

CONTENTS

Section **Page No**

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

SECTION 1

REPORT SUMMARY

Radio Testing of the
Delphi Deutschland GmbH
R3TR Short Range Radar

1.1 INTRODUCTION

The information contained in this report is intended to show verification of the Delphi Deutschland GmbH Third-Generation Short Range Radar to the requirements of FCC Part 15 Subpart C §15.253 and IC 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	R3TR Short Range Radar
Model Number(s)	R3TR
FCC ID Number	LTQR3TR
IC Number	3659A-R3TR
Serial Number(s)	5194300131
Number of Samples Tested	1
Test Specification/Issue/Date	• FCC Part 15 Subpart C §15.253 (October 1, 2016). • 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	June 7, 2016
Finish of Test	September 29, 2016
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 15 Subpart C §15.253 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	§15.253(d)(1)(2)	RSS-251 5.2.2	Power Density Limits	Compliant	
2.2	§2.1049	RSS-GEN	99% Emission Bandwidth	Compliant	
2.3	§15.253(e)(1)(2)(3) and (4)	RSS-251 5.3	Spurious Emissions	Compliant	
2.4	§15.253(f)	RSS-251 5.4	Frequency stability	Compliant	

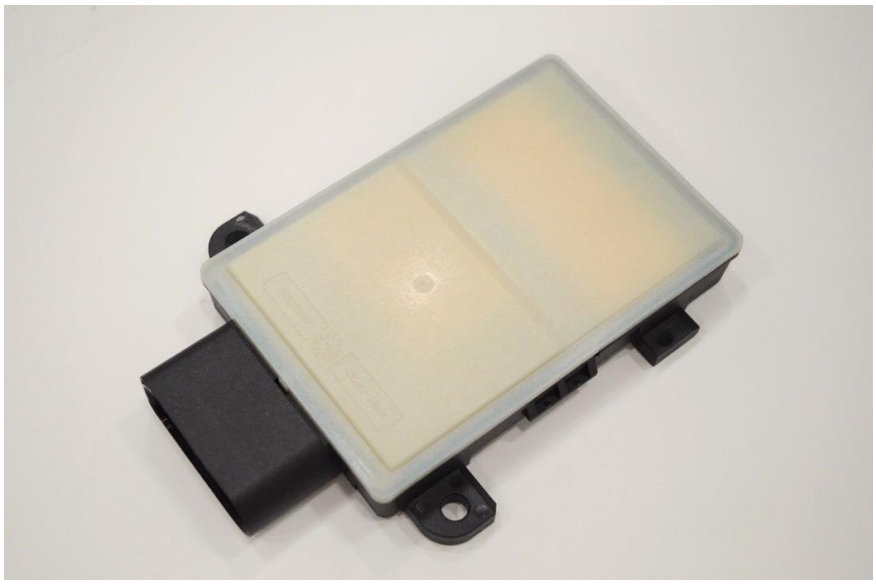
TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

Page **7** of **98**

1.3 PRODUCT INFORMATION

1.3.1 Technical Description

The Equipment Under Test (EUT) was a Delphi Deutschland GmbH R3TR Short Range Radar. The EUT is a Third-Generation Short 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 VDC.



Equipment Under Test

1.3.2 EUT General Description

EUT Description	Third-Generation Short Range Radar
Product Name	R3TR Short Range Radar
Model Number(s)	R3TR
Rated Voltage	12.0 VDC
Output Power	25.83 dBm Peak EIRP
Frequency Range	76.004305 GHz to 76.985277 GHz in the 76.0 GHz to 77.0 GHz Band
Number of Operating Frequencies	7
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 Corp.
Antenna Type	Planar array antenna
Antenna Gain	14 dBi
EUT Antenna Connector	N/A .
Maximum Dimensions	118.4 mm x 64.1 mm x 17.8 mm

1.4 EUT TEST CONFIGURATION

1.4.1 Test Configuration Description

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

1.4.2 EUT Exercise Software

Initially EUT is activated using wake up executable XCPCANGateway 5.01. Before each test, the EUT is configured using VAG Flash Tool version 4.02. The tool allows configuration of operating channel and modulation bandwidth.

1.4.3 Support Equipment and I/O cables

Manufacturer	Equipment/Cable	Description
Dell	Support Laptop	Latitude D630 (Delphi Wireless Test configuration Support Laptop)
Dell	PA-10 AC Adapter	M/N: LA90PS1-00
Vector	Single channel CAN HW	Used for communication between EUT and Support Laptop
	Harness with pins for power supply and CAN connector.	Connects the EUT to a 12 VDC power supply and to the CAN HW

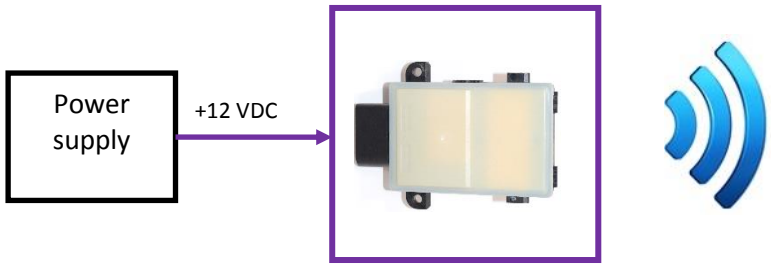
1.4.4 Worst Case Configuration

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

Modulation BW	Channel
175 MHz	Low Channel
300 MHz	Low Channel
425 MHz	Low Channel

EUT is mobile device designed to be installed on a vehicular environment, 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

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)

16530 Via Esprillo, San Diego, CA 92127-1708 (33.018644,-117.092409). Phone: 858 942 5542 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 Registration is US1146.

1.9.2 Innovation, Science and Economic Development Canada Registration No.: 3067A

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

SECTION 2

TEST DETAILS

Radio Testing of the
Delphi Deutschland GmbH
R3TR Short Range Radar

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

2.1 POWER DENSITY

2.1.1 Specification Reference

Part 15 Subpart C §15.253(d)(1),(2) and RSS-251 Issue 1 Sec. 5.2.2

2.1.2 Standard Applicable

(d) The radiated emission limits within the band 76.0-77.0 GHz are as follows:

(1) The average power density of any emission within the bands specified in this section shall not exceed 88 μW/cm^2 at a distance of 3 meters from the exterior surface of the radiating structure (average EIRP of 50 dBm).

(2) The peak power density of any emission within the band 76-77 GHz shall not exceed 279 μW/cm^2 at a distance of 3 meters from the exterior surface of the radiating structure (peak EIRP of 55 dBm).

2.1.3 Equipment Under Test and Modification State

Serial No: 5194300131 / Default Test Configuration

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

September 1 and September 2, 2016/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	25.8-26.2°C
Relative Humidity	43.0-44.4%
ATM Pressure	98.9-99.1 kPa

2.1.7 Additional Observations

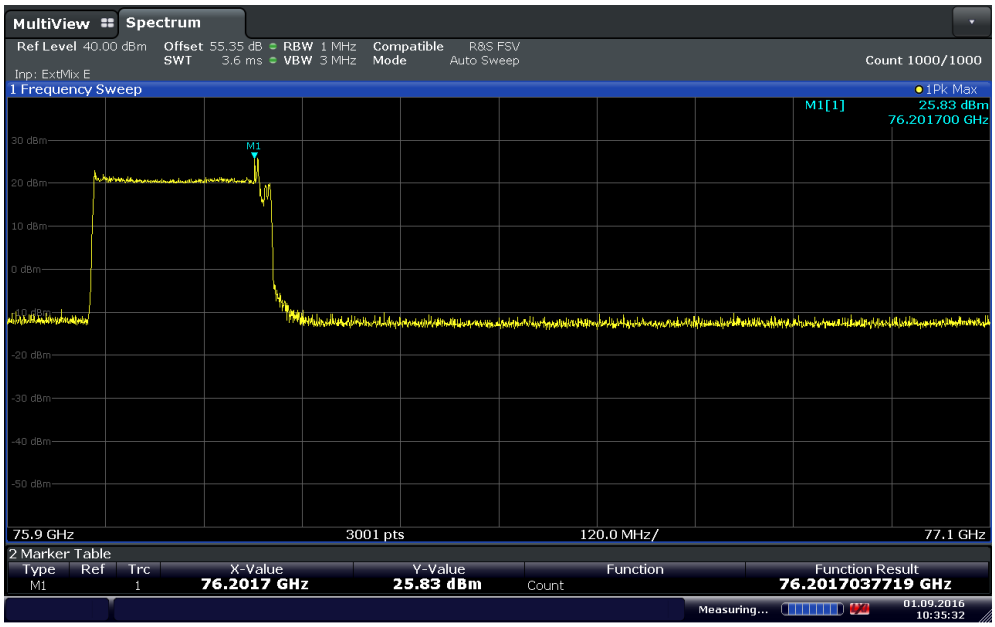
- This is a radiated test.
- Test distance of 3 m was used for the fundamental emissions measurement.
- A correction factor of 55.35 dB and mixer conversion loss table were used to account for the test antenna gain, free-space loss and external mixer loss.

2.1.8 Test Results

Peak EIRP			
Modulation BW	**Channel**	**Measured EIRP (dBm)**	**Limit (dBm)**
175 MHz	Low (76.0925 GHz)	**25.83**	55
	Mid (76.5000 GHz)	25.33	
	High (76.8625 GHz)	25.50	
300 MHz	Low (76.155 GHz)	25.61	
	Mid (76.500 GHz)	25.09	
	High (76.725 GHz)	25.08	
425 MHz	Low (76.2175 GHz)	25.69	
	Mid (76.500 GHz)	25.22	
	High (76.6175 GHz)	25.23	
Average EIRP			
Modulation BW	**Channel**	**Measured EIRP (dBm)**	**Limit (dBm)**
175 MHz	Low (76.0925 GHz)	14.67	50
	Mid (76.5000 GHz)	14.57	
	High (76.8625 GHz)	14.40	
300 MHz	Low (76.155 GHz)	14.41	
	Mid (76.500 GHz)	14.02	
	High (76.725 GHz)	14.23	
425 MHz	Low (76.2175 GHz)	14.47	
	Mid (76.500 GHz)	14.27	
	High (76.6175 GHz)	14.18	
EUT complies			

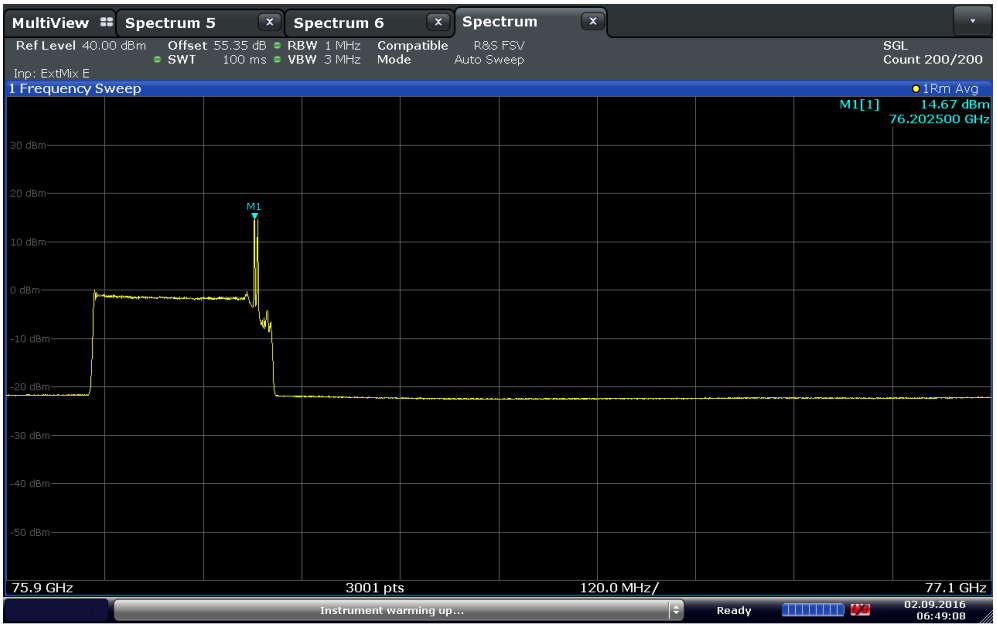
TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

2.1.9 Test plots



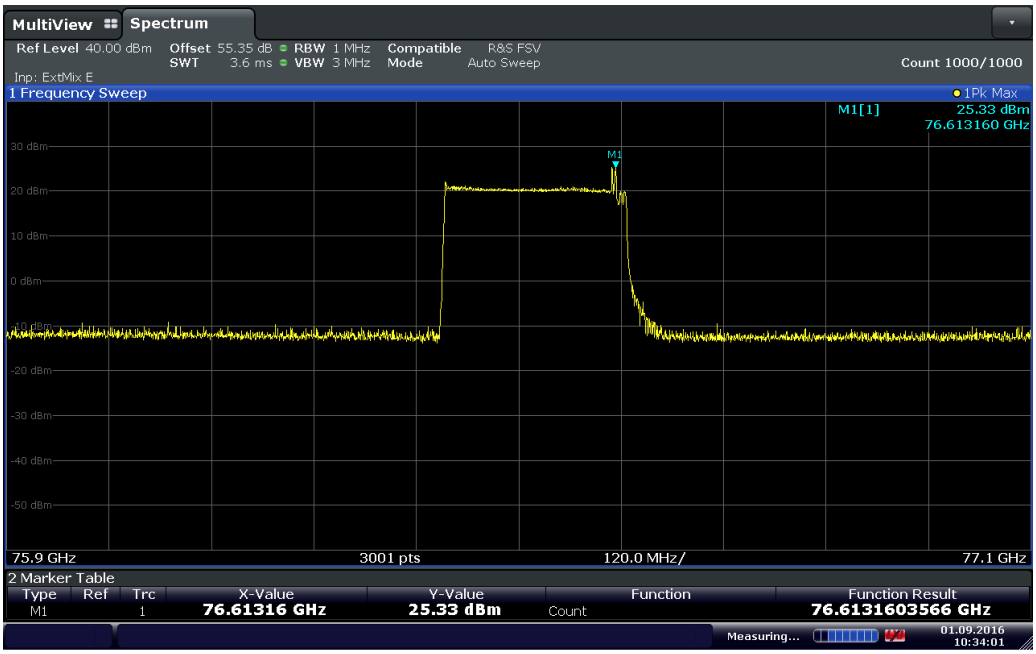
10:35:33 01.09.2016

Low Channel 175 MHz BW (Peak detector)



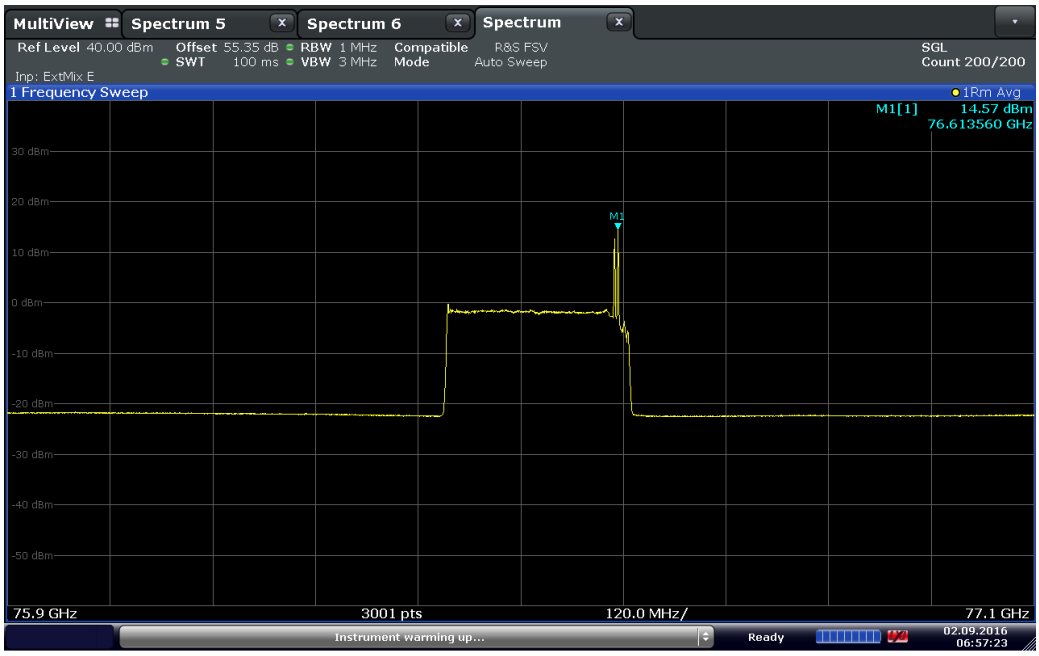
06:49:09 02.09.2016

Low Channel 175 MHz BW (RMS detector)



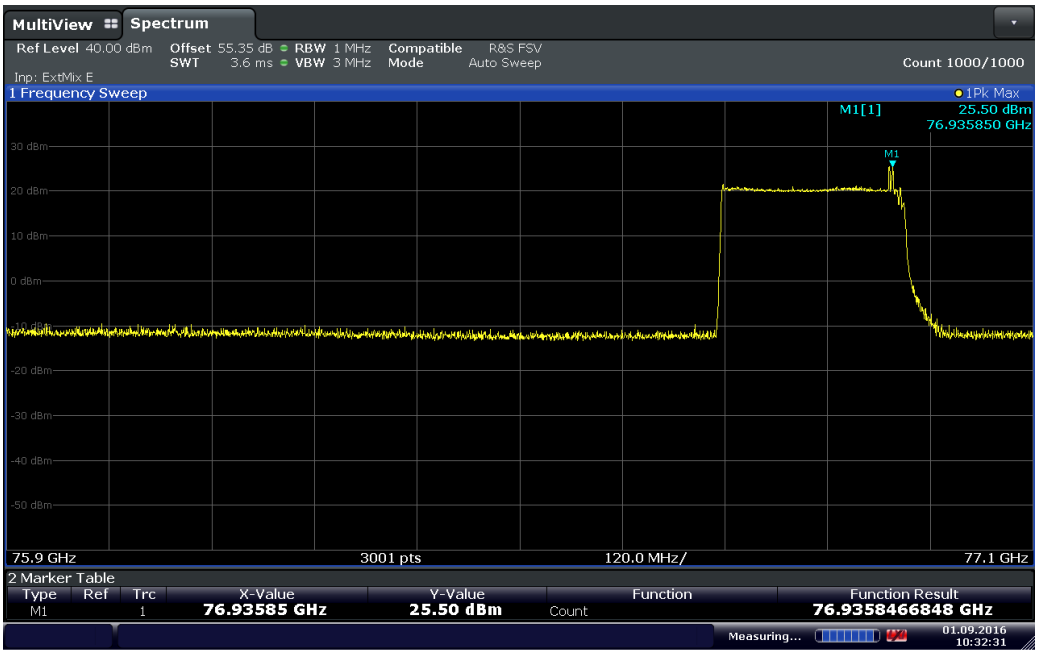
10:34:02 01.09.2016

Mid Channel 175 MHz BW (Peak detector)



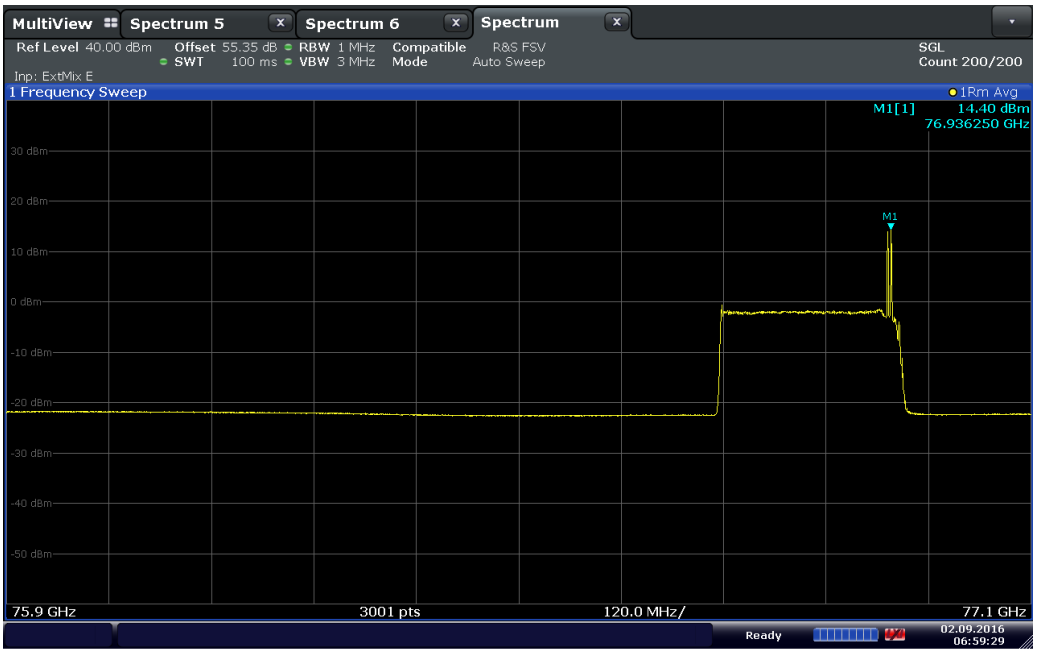
06:57:23 02.09.2016

Mid Channel 175 MHz BW (RMS detector)



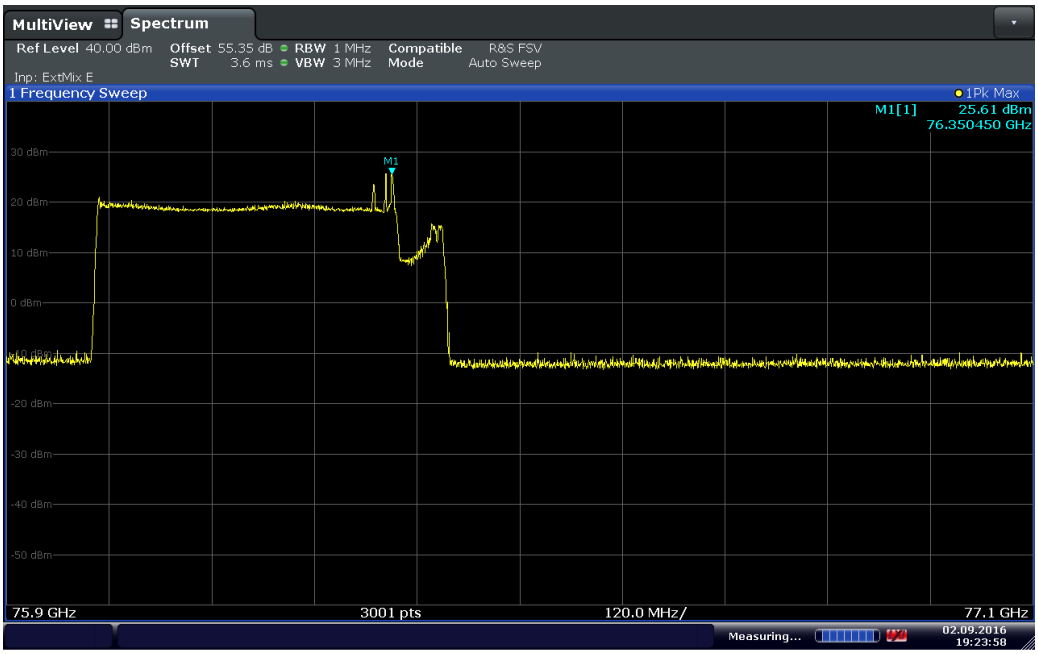
10:32:31 01.09.2016

High Channel 175 MHz BW (Peak detector)



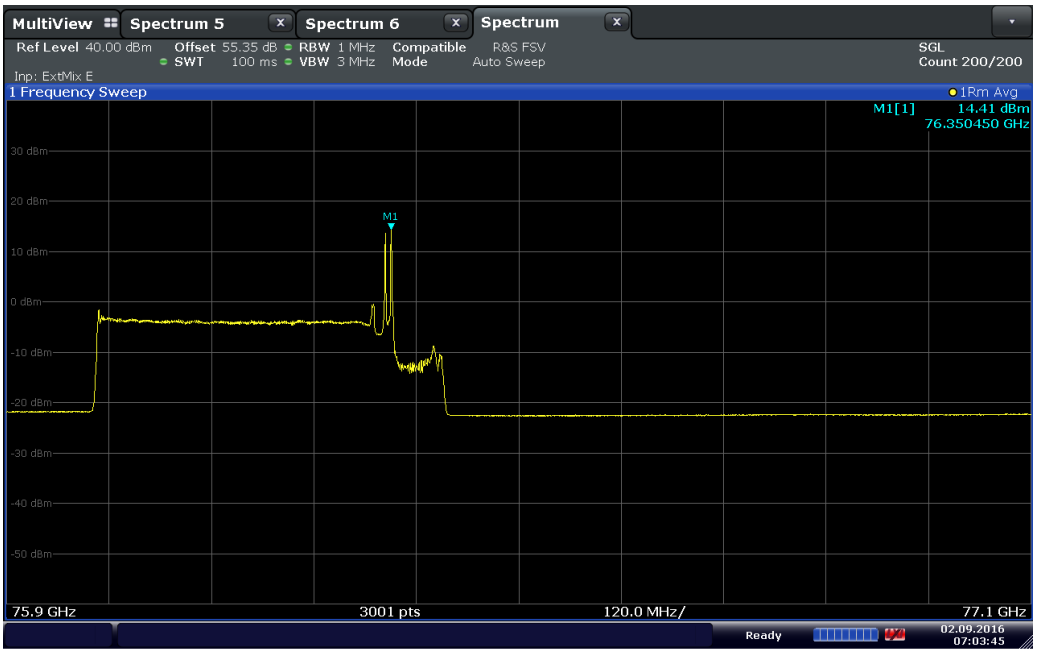
06:59:30 02.09.2016

High Channel 175 MHz BW (RMS detector)



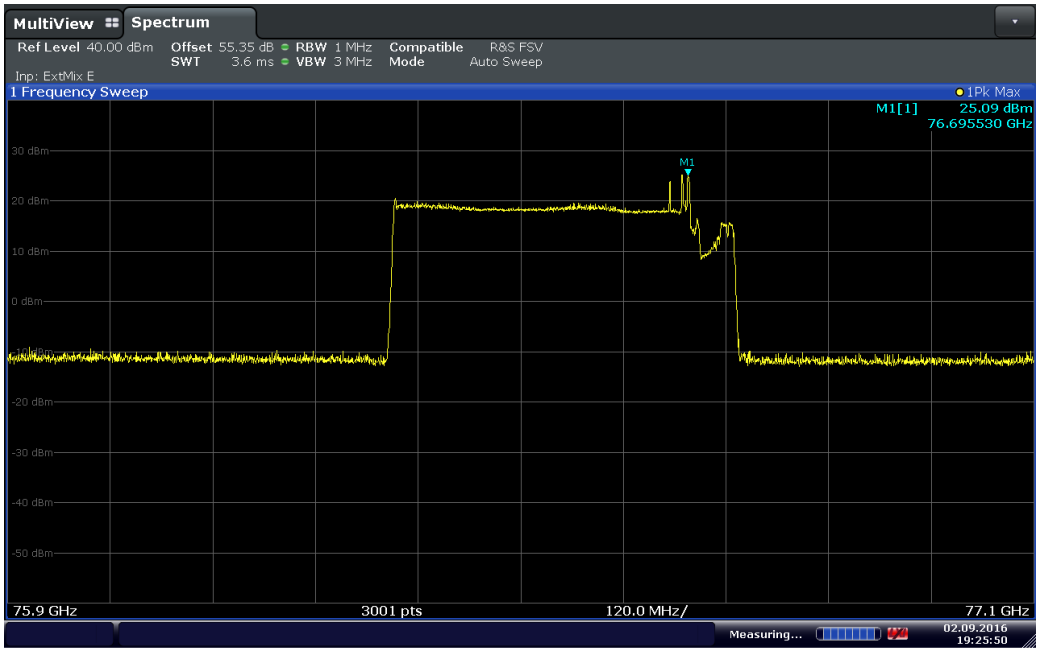
19:23:58 02.09.2016

Low Channel 300 MHz BW (Peak detector)



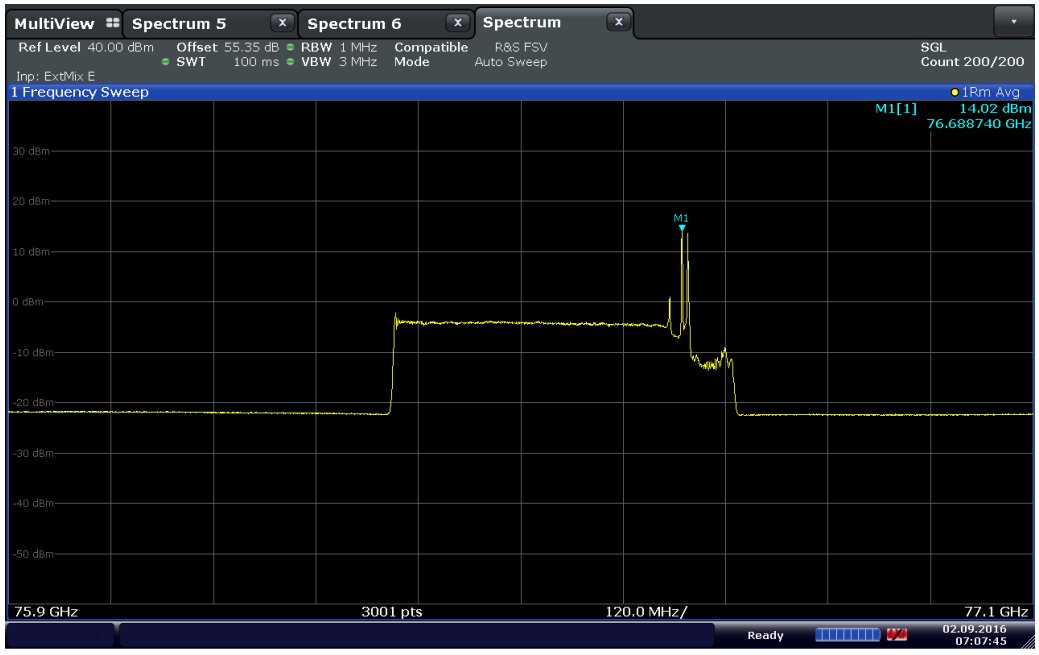
07:03:45 02.09.2016

Low Channel 300 MHz BW (RMS detector)



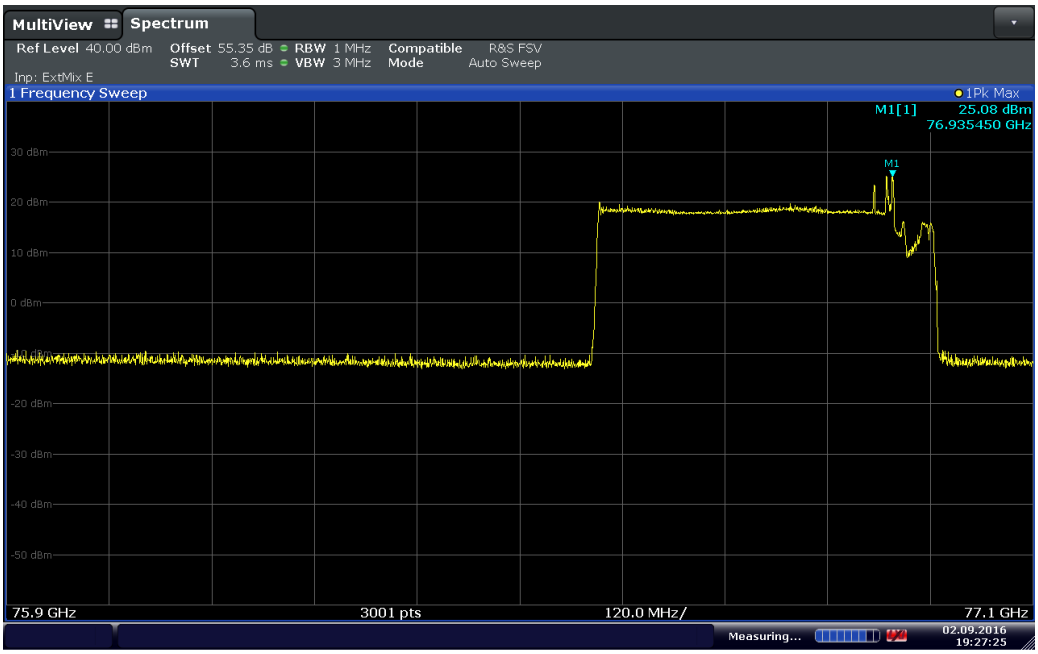
19:25:51 02.09.2016

Mid Channel 300 MHz BW (Peak detector)



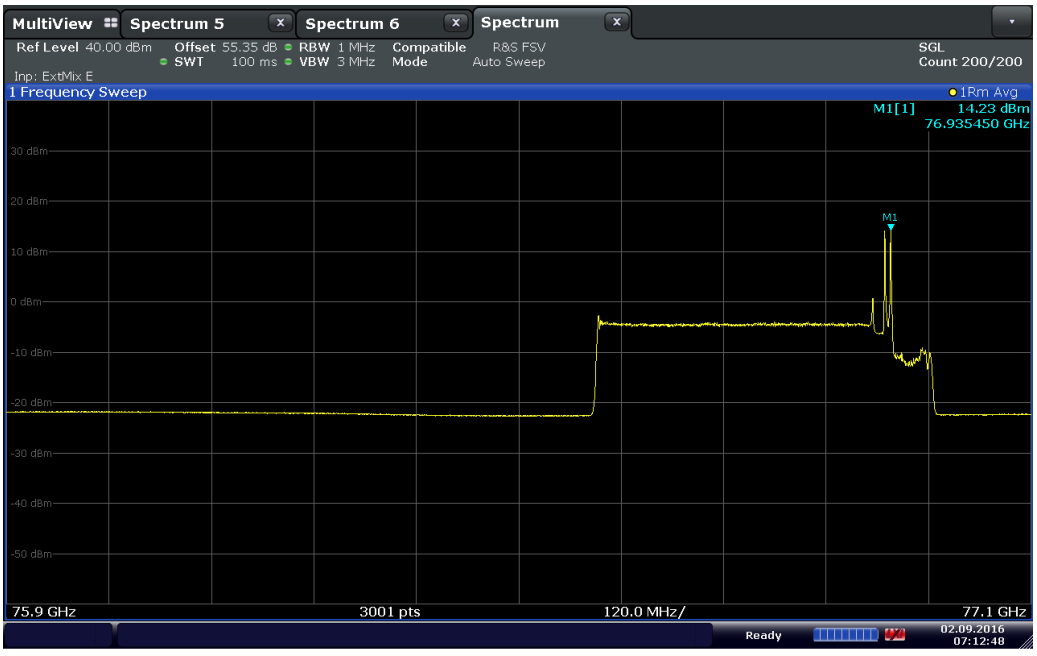
07:07:46 02.09.2016

Mid Channel 300 MHz BW (RMS detector)



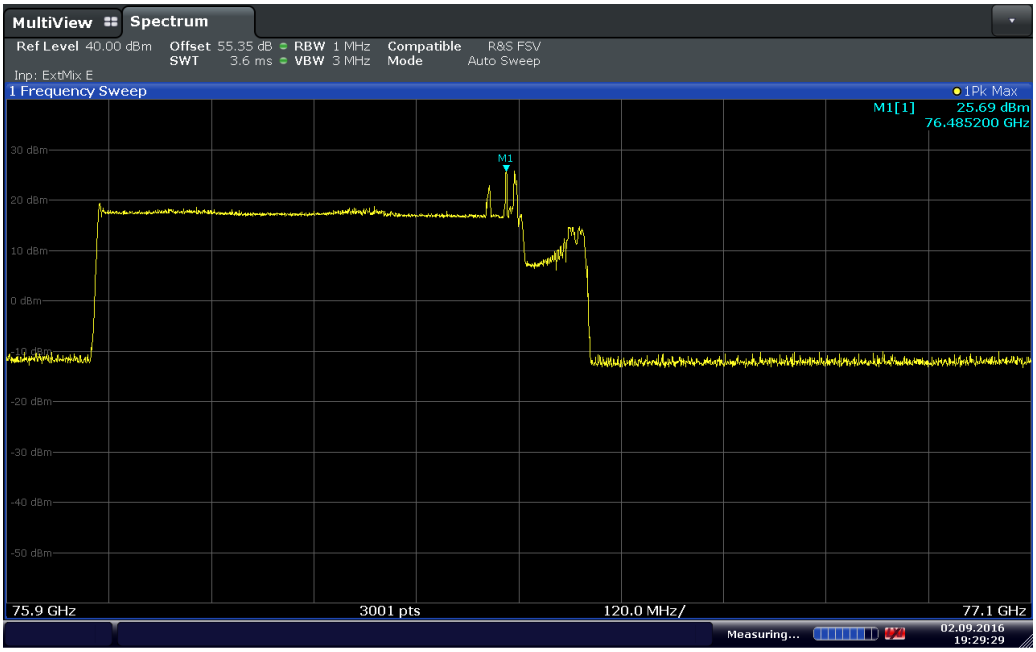
19:27:26 02.09.2016

High Channel 300 MHz BW (Peak detector)



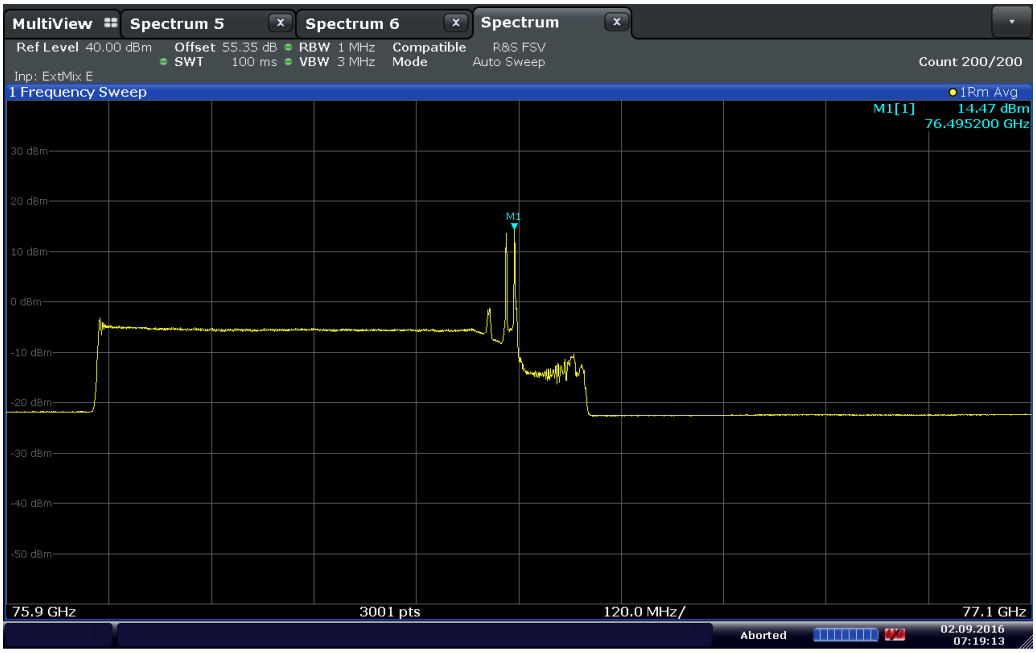
07:12:48 02.09.2016

High Channel 300 MHz BW (RMS detector)



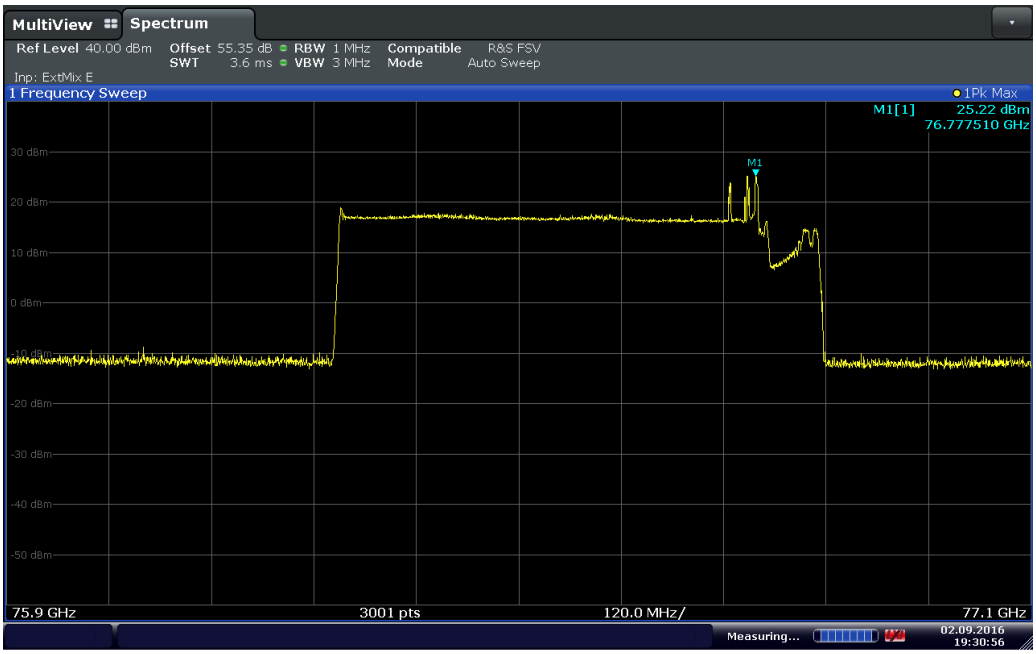
19:29:30 02.09.2016

Low Channel 425 MHz BW (Peak detector)



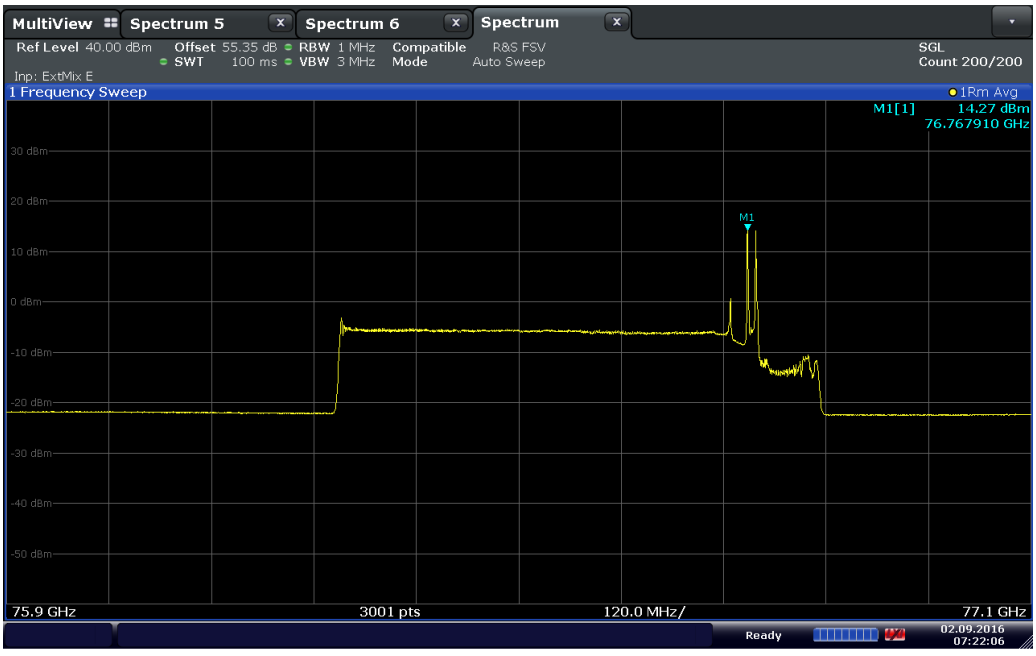
07:19:13 02.09.2016

Low Channel 425 MHz BW (RMS detector)



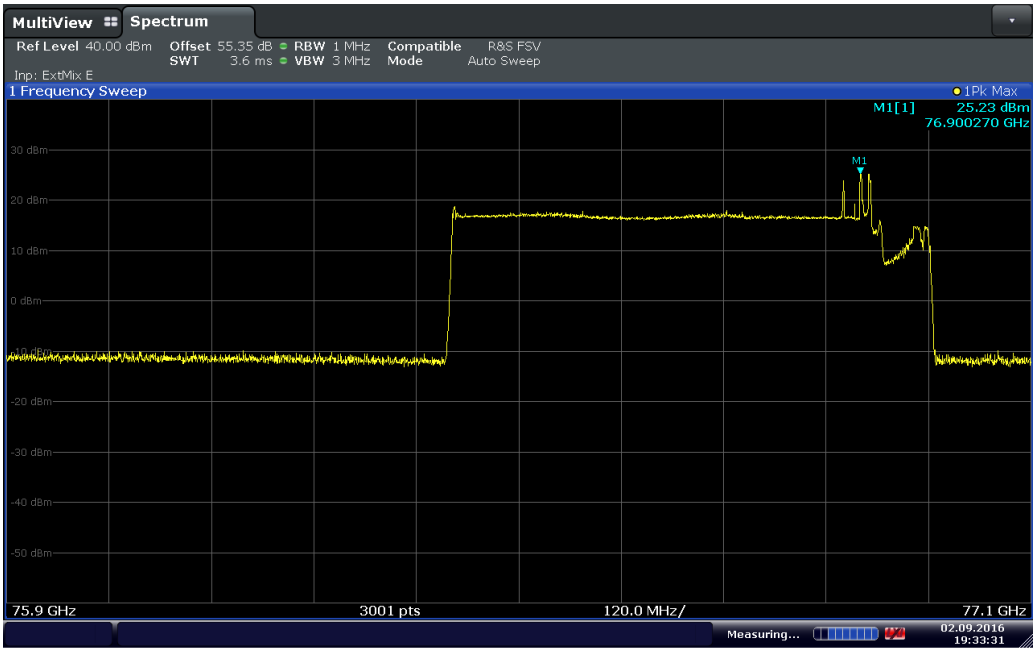
19:30:57 02.09.2016

Mid Channel 425 MHz BW (Peak detector)



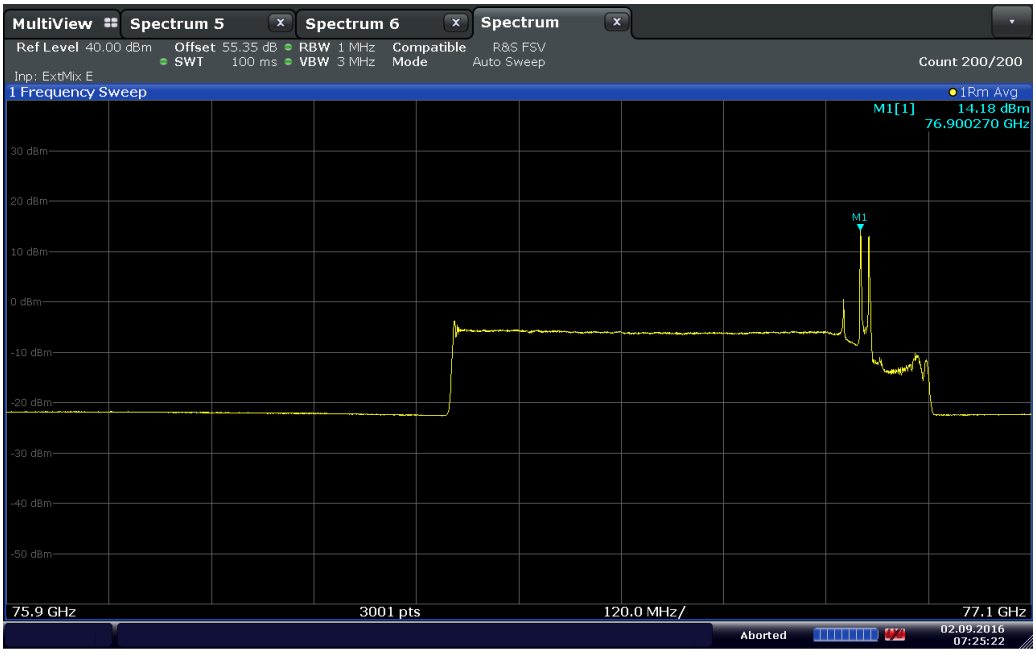
07:22:07 02.09.2016

Mid Channel 425 MHz BW (RMS detector)



19:33:32 02.09.2016

High Channel 425 MHz BW (Peak detector)



07:25:22 02.09.2016

High Channel 425 MHz BW (RMS detector)

2.2 OCCUPIED 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: 5194300131 / Default Test Configuration

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

September 2, 2016/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	26.5°C
Relative Humidity	45.3%
ATM Pressure	99.2 kPa

2.2.7 Additional Observations

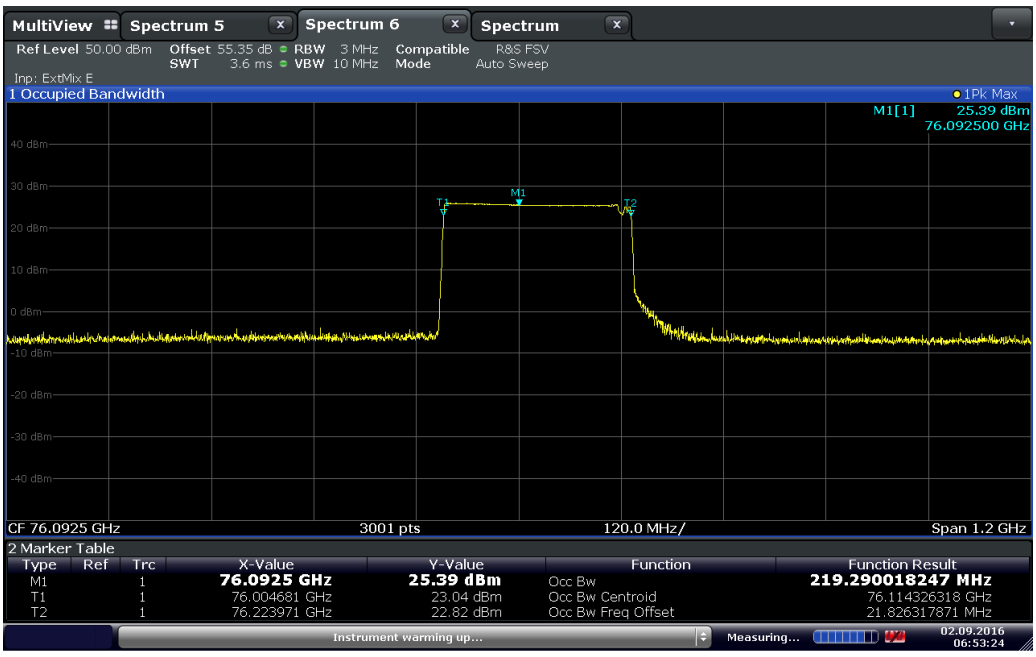
- This is a radiated test.
- A correction factor of 55.35 dB and mixer conversion loss table were used to account for the test antenna gain, free-space loss and external mixer loss.
- Span is wide enough to capture the channel transmission.
- RBW is 1% initially set approx. to 1% of anticipated EBW.
- 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**
175 MHz	219.29 MHz	215.60 MHz	216.97 MHz
300 MHz	408.10 MHz	400.79 MHz	395.46 MHz
425 MHz	570.26 MHz	561.54 MHz	558.02 MHz

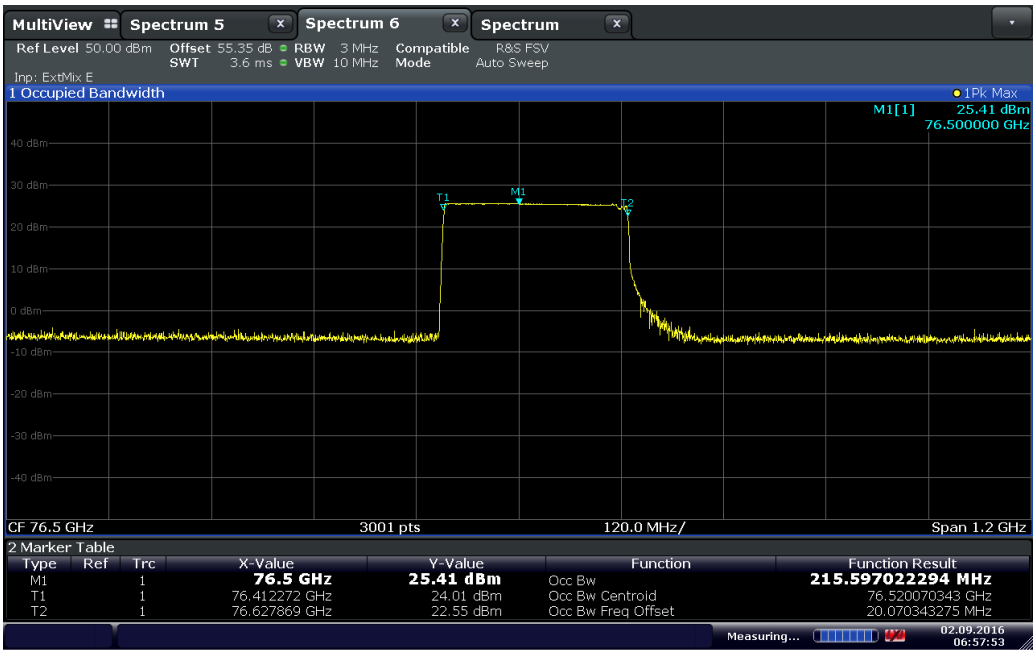
2.2.9 Test Plots



06:53:25 02.09.2016

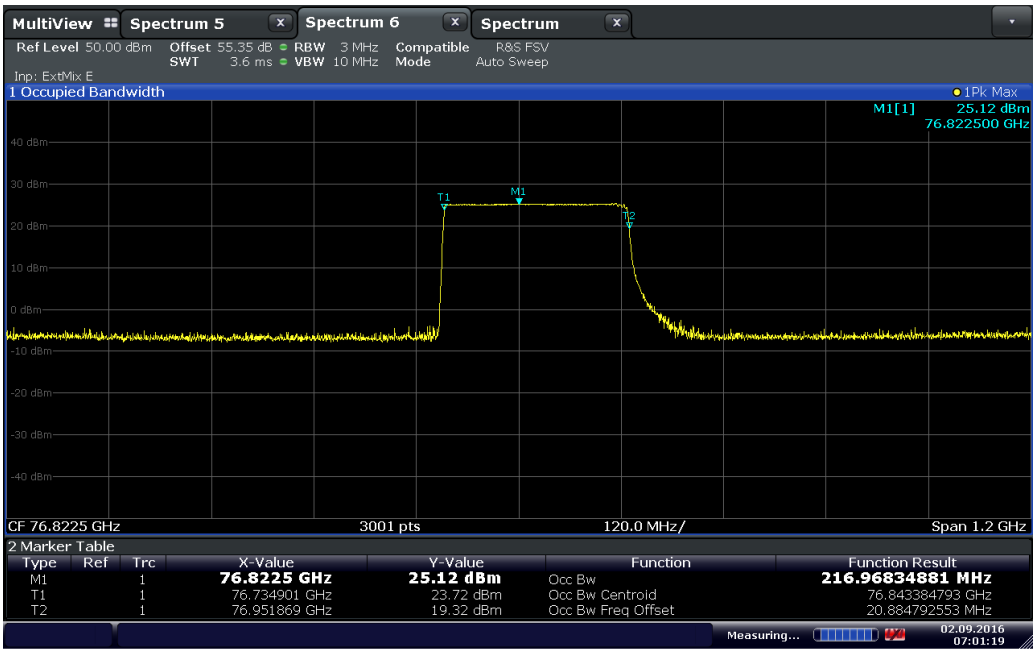
Low channel 175 MHz BW

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364



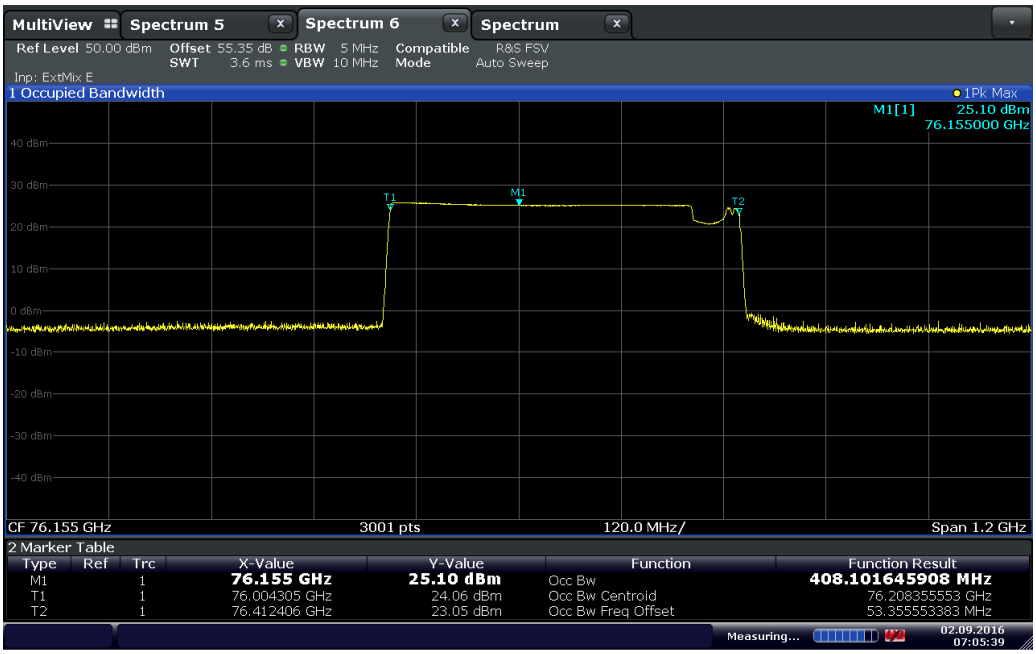
06:57:54 02.09.2016

Mid channel 175 MHz BW



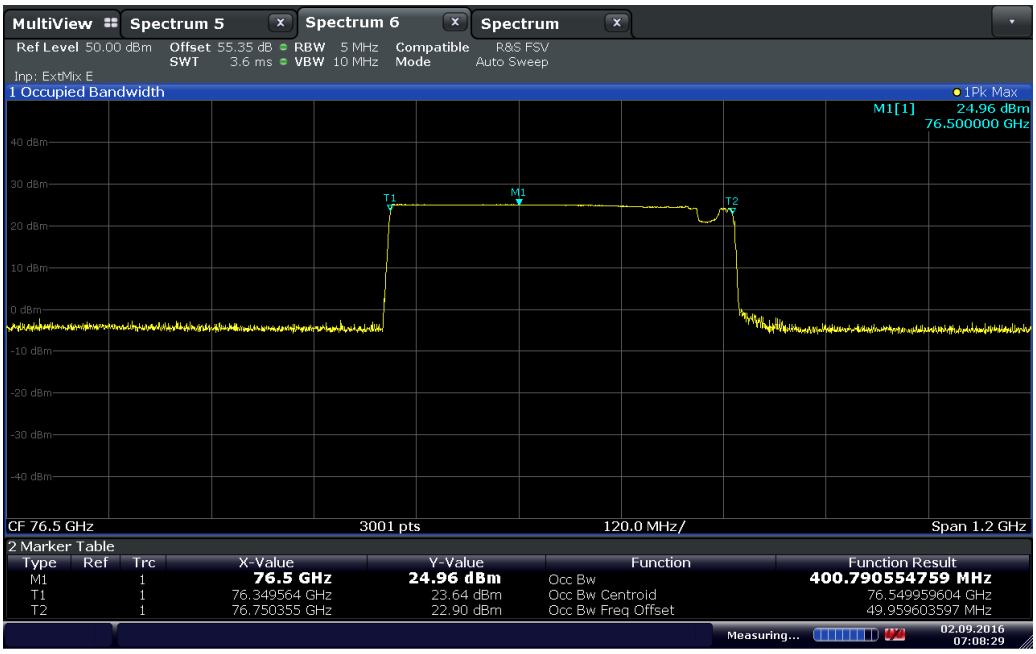
07:01:19 02.09.2016

High channel 175 MHz BW



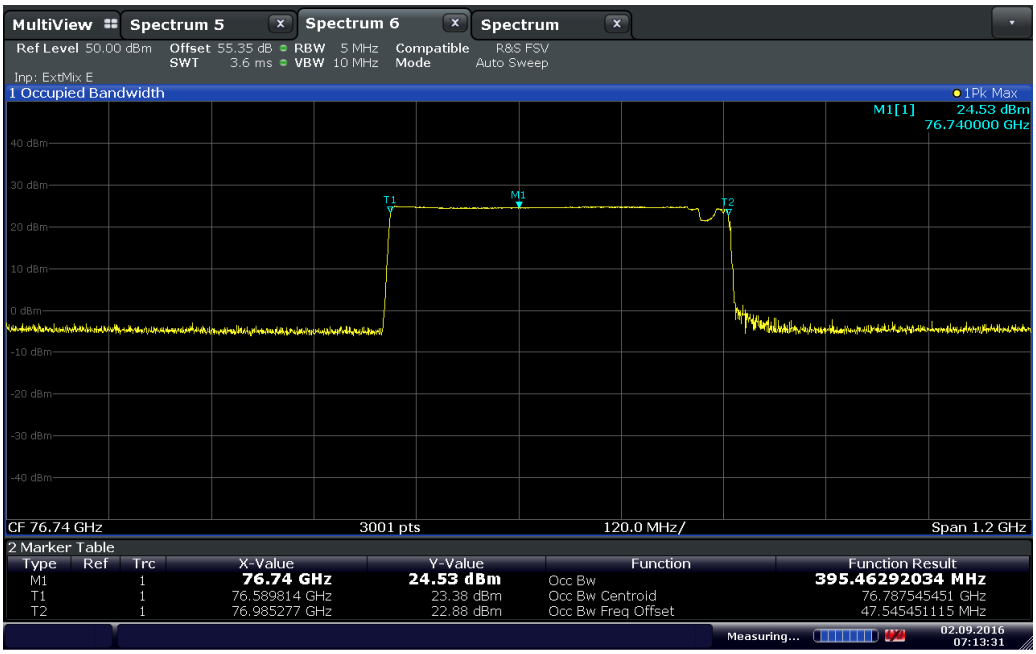
07:05:39 02.09.2016

Low channel 300 MHz BW



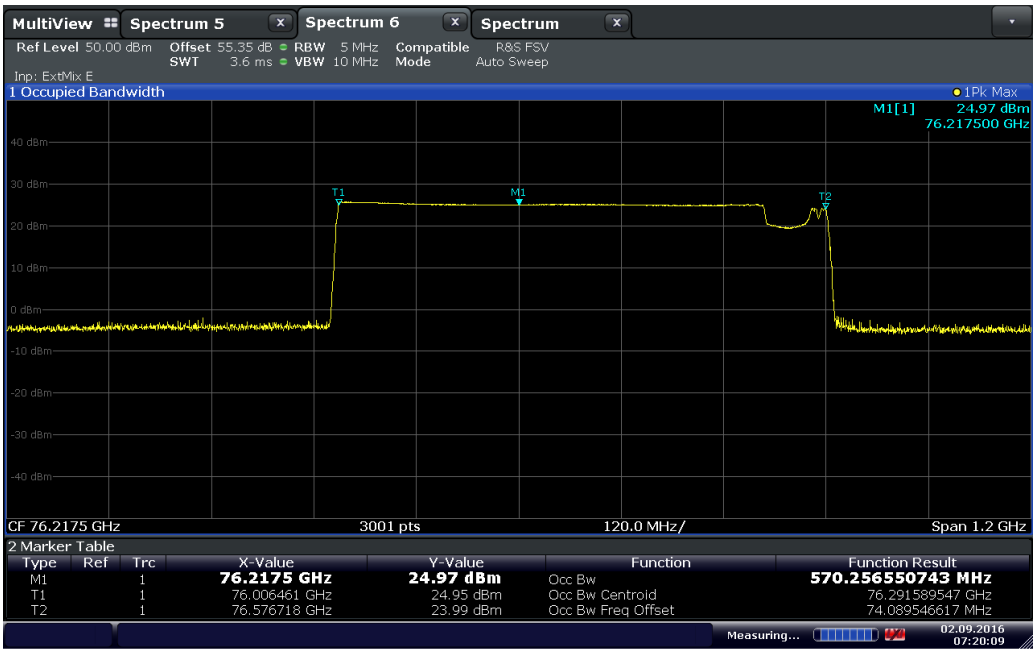
07:08:30 02.09.2016

Mid channel 300 MHz BW



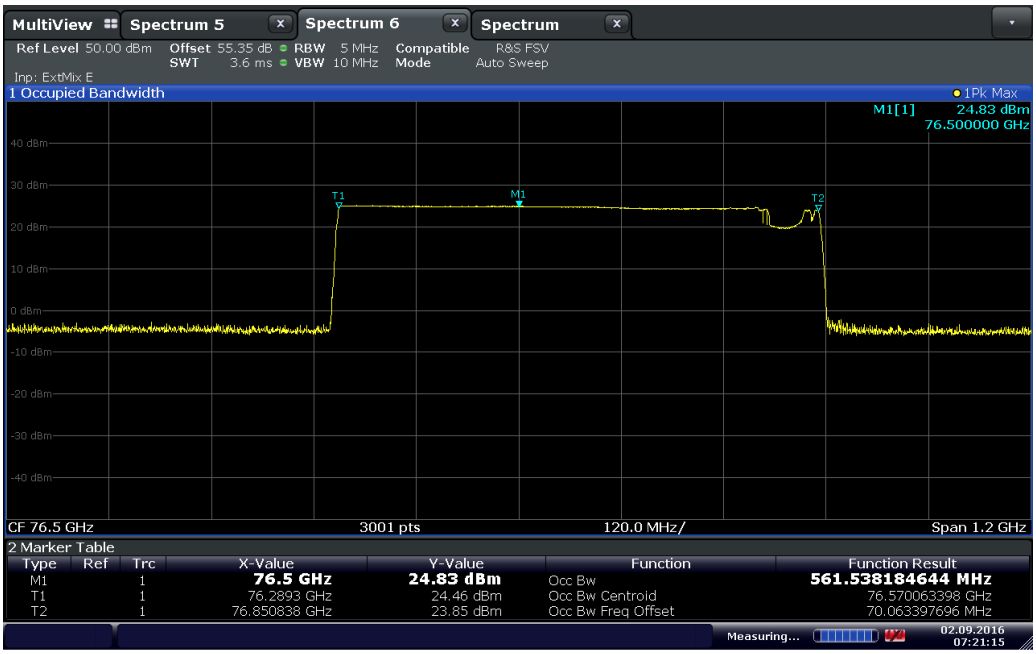
07:13:31 02.09.2016

High channel 300 MHz BW



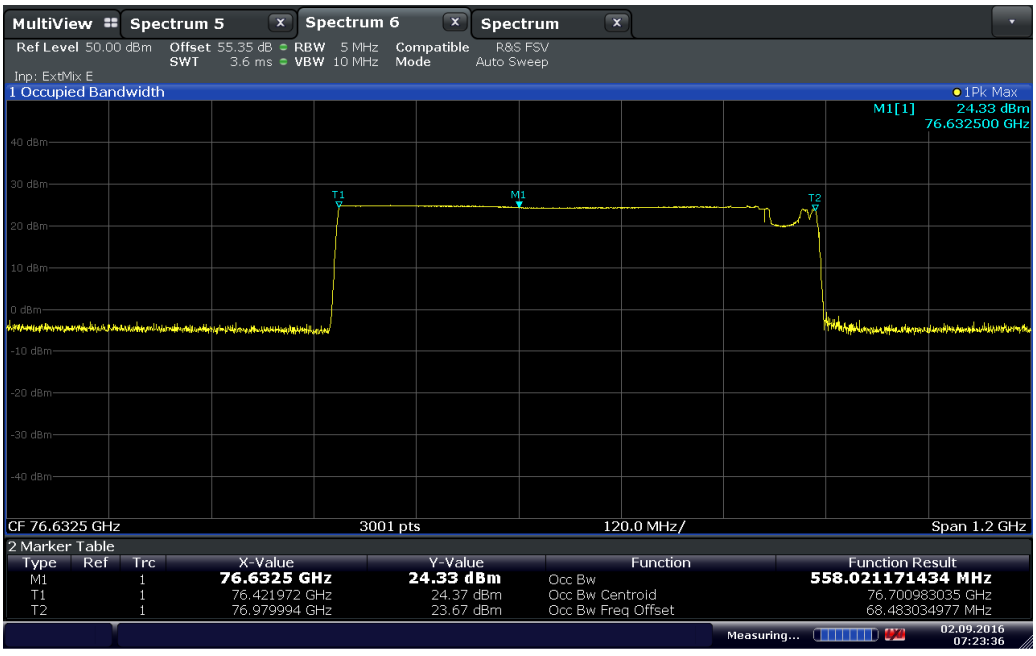
07:20:09 02.09.2016

Low channel 425 MHz BW



07:21:15 02.09.2016

Mid channel 425 MHz BW



07:23:37 02.09.2016

High channel 425 MHz BW

2.3 SPURIOUS RADIATED EMISSIONS

2.3.1 Specification Reference

FCC Part 15 Subpart C §15.253(e) and RSS-251 Issue 1 Sec. 5.3

2.3.2 Standard Applicable

(e) The power density of any emissions outside the operating band shall consist solely of spurious emissions and shall not exceed the following:

(1) Radiated emissions below 40 GHz shall not exceed the general limits in § 15.209.

(2) Radiated emissions outside the operating band and between 40 GHz and 200 GHz shall not exceed the following:

(i) For field disturbance sensors operating in the band 46.7-46.9 GHz: 2 pW/cm^2 at a distance of 3 meters from the exterior surface of the radiating structure.

(ii) For field disturbance sensors operating in the band 76-77 GHz: 600 pW/cm^2 at a distance of 3 meters from the exterior surface of the radiating structure.

(3) For radiated emissions above 200 GHz from field disturbance sensors operating in the 76-77 GHz band: the power density of any emission shall not exceed 1000 pW/cm^2 at a distance of 3 meters from the exterior surface of the radiating structure.

(4) For field disturbance sensors operating in the 76-77 GHz band, the spectrum shall be investigated up to 231 GHz.

2.3.3 Equipment Under Test and Modification State

Serial No: 5194300131 / Default Test Configuration

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

June 14, June 28 and June 29, 2016/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	23.0-23.4°C
Relative Humidity	44.6-50.5%
ATM Pressure	98.9-99.1 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 75 GHz. The emissions in the range from 75 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 9.64 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.
- Measurement below 40 GHz was 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.

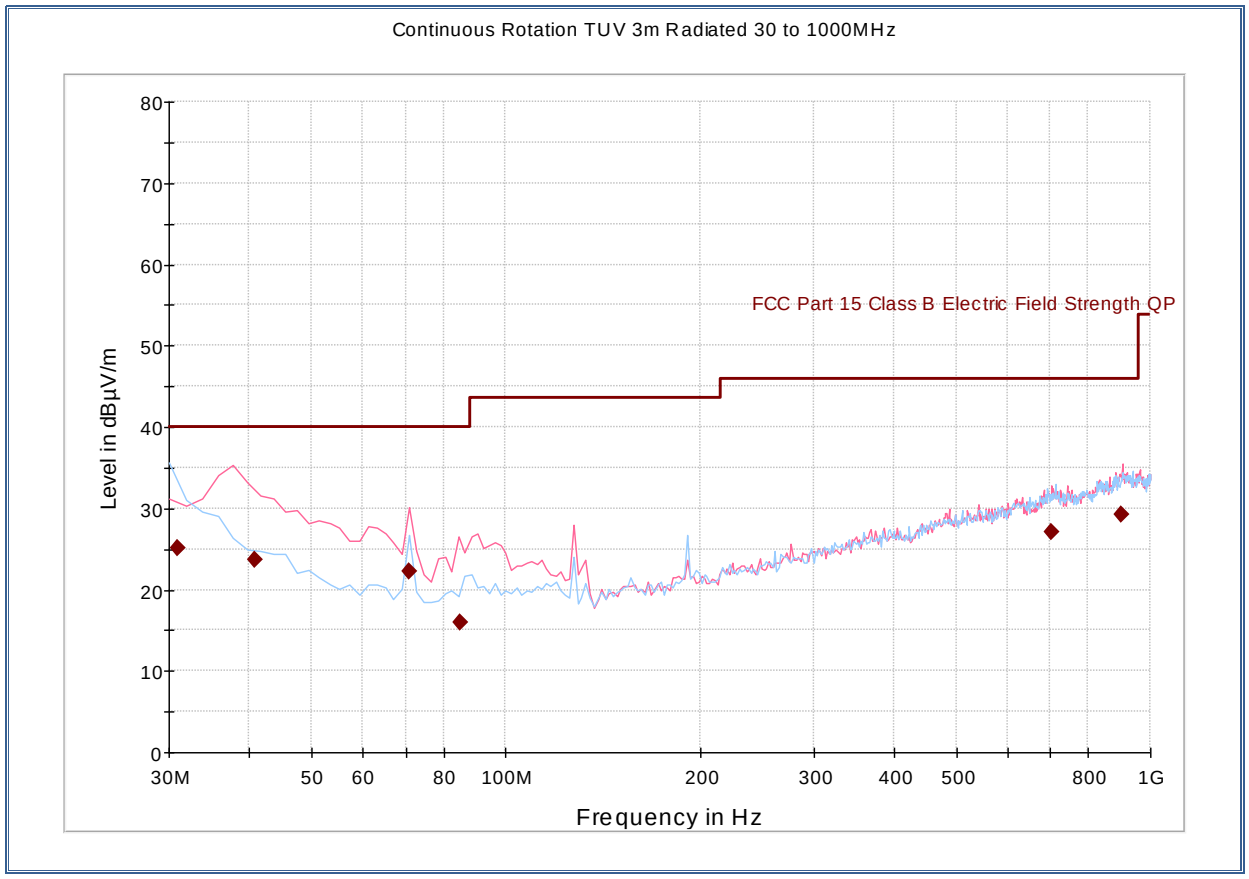
2.3.8 Sample Computation (Radiated Emission)

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.

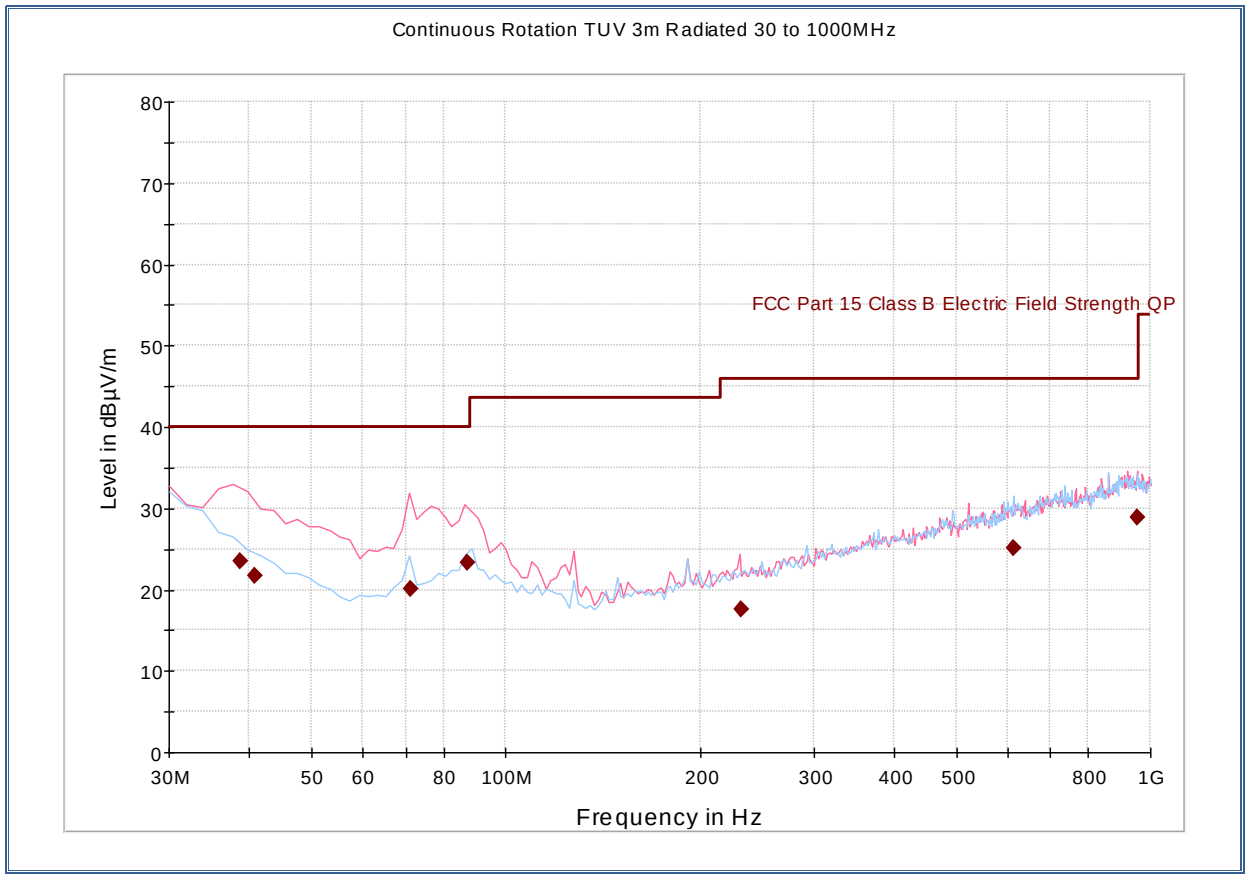
2.3.10 Test Results Below 1GHz Low Channel 175 MHz BW (worst case configuration)



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)
30.880000	25.0	1000.0	120.000	326.0	H	11.0	-6.3	15.0	40.0
40.807214	23.7	1000.0	120.000	100.0	V	281.0	-11.4	16.3	40.0
70.701643	22.3	1000.0	120.000	100.0	V	198.0	-16.8	17.7	40.0
85.132745	15.9	1000.0	120.000	155.0	V	193.0	-16.1	24.1	40.0
703.345170	27.0	1000.0	120.000	400.0	V	352.0	2.9	19.0	46.0
903.309499	29.2	1000.0	120.000	309.0	V	35.0	6.0	16.8	46.0

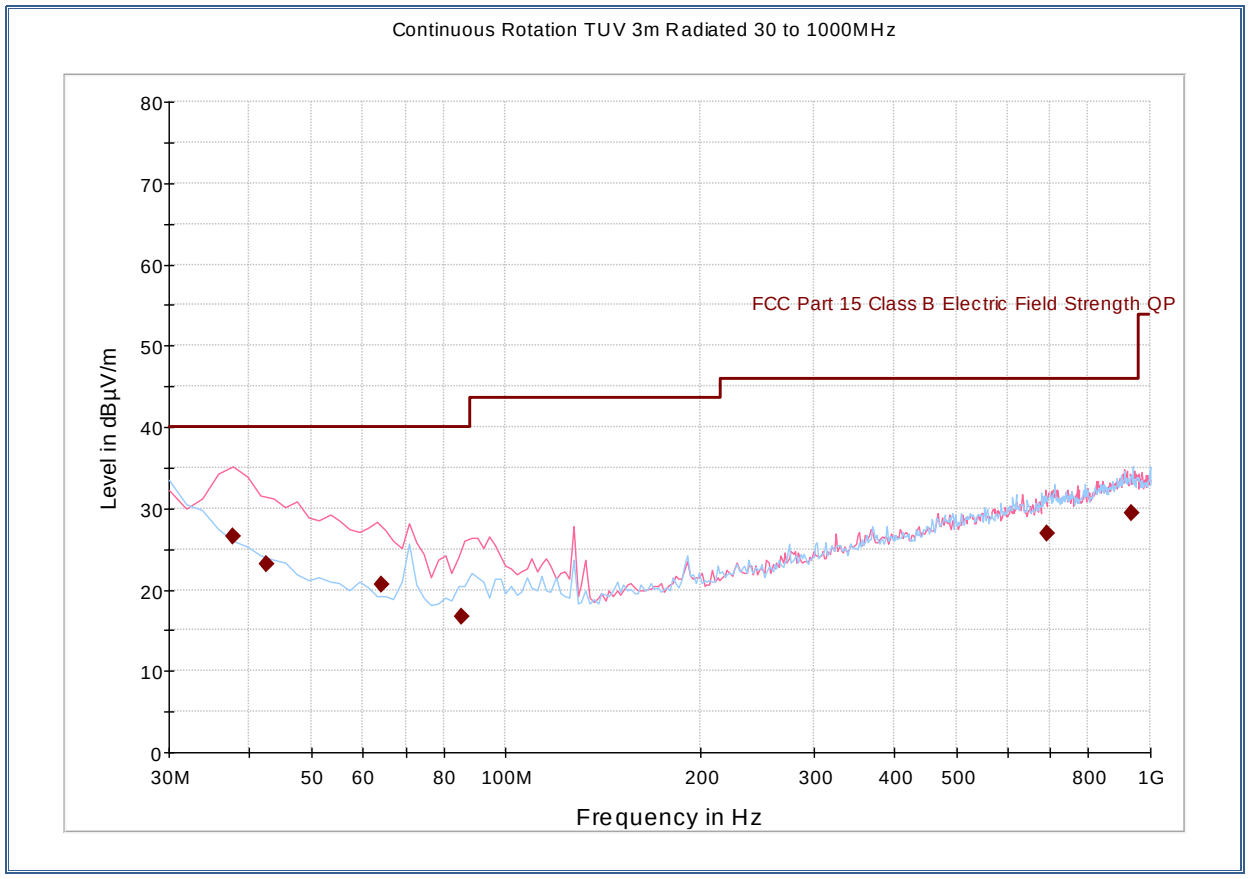
2.3.11 Test Results Below 1GHz Mid Channel 175 MHz BW (worst case configuration)



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)
38.775551	23.4	1000.0	120.000	100.0	V	71.0	-10.5	16.6	40.0
40.847214	21.7	1000.0	120.000	100.0	V	200.0	-11.5	18.3	40.0
71.261643	20.1	1000.0	120.000	100.0	V	230.0	-16.8	19.9	40.0
87.292745	23.3	1000.0	120.000	100.0	V	229.0	-15.8	16.7	40.0
231.860441	17.6	1000.0	120.000	250.0	V	133.0	-9.6	28.4	46.0
614.206333	25.2	1000.0	120.000	400.0	H	225.0	1.1	20.8	46.0
953.826693	28.9	1000.0	120.000	400.0	V	148.0	6.2	17.1	46.0

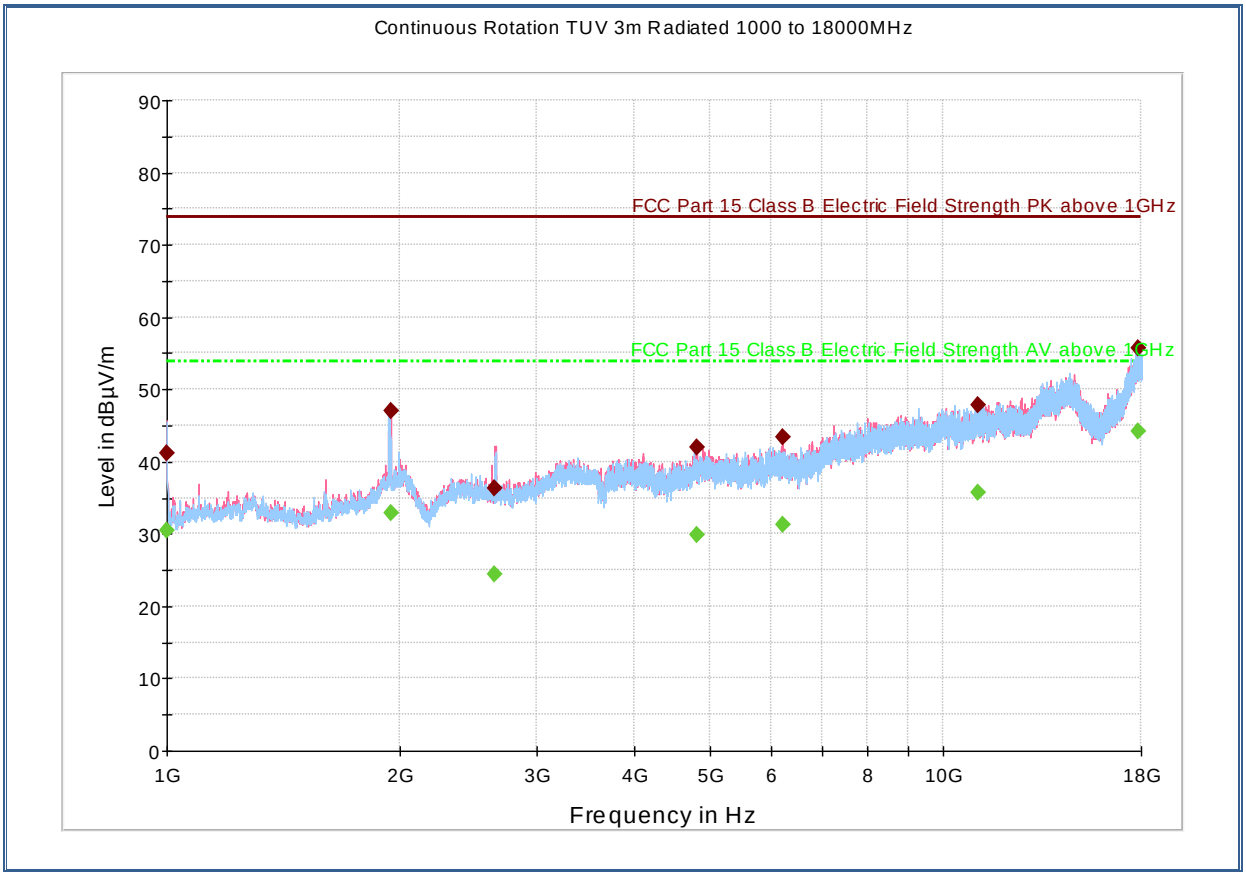
2.3.12 Test Results Below 1GHz High Channel 175 MHz BW (worst case configuration)



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)
37.735551	26.6	1000.0	120.000	100.0	V	8.0	-9.9	13.4	40.0
42.567214	23.1	1000.0	120.000	100.0	V	234.0	-12.1	16.9	40.0
63.966092	20.7	1000.0	120.000	100.0	V	254.0	-16.5	19.3	40.0
85.452745	16.7	1000.0	120.000	105.0	V	254.0	-16.0	23.3	40.0
692.057956	26.9	1000.0	120.000	240.0	V	241.0	2.7	19.1	46.0
936.739479	29.4	1000.0	120.000	312.0	H	299.0	6.3	16.6	46.0

2.3.13 Test Results 1 GHz to 18 GHz Low Channel 175 MHz BW (worst case configuration)



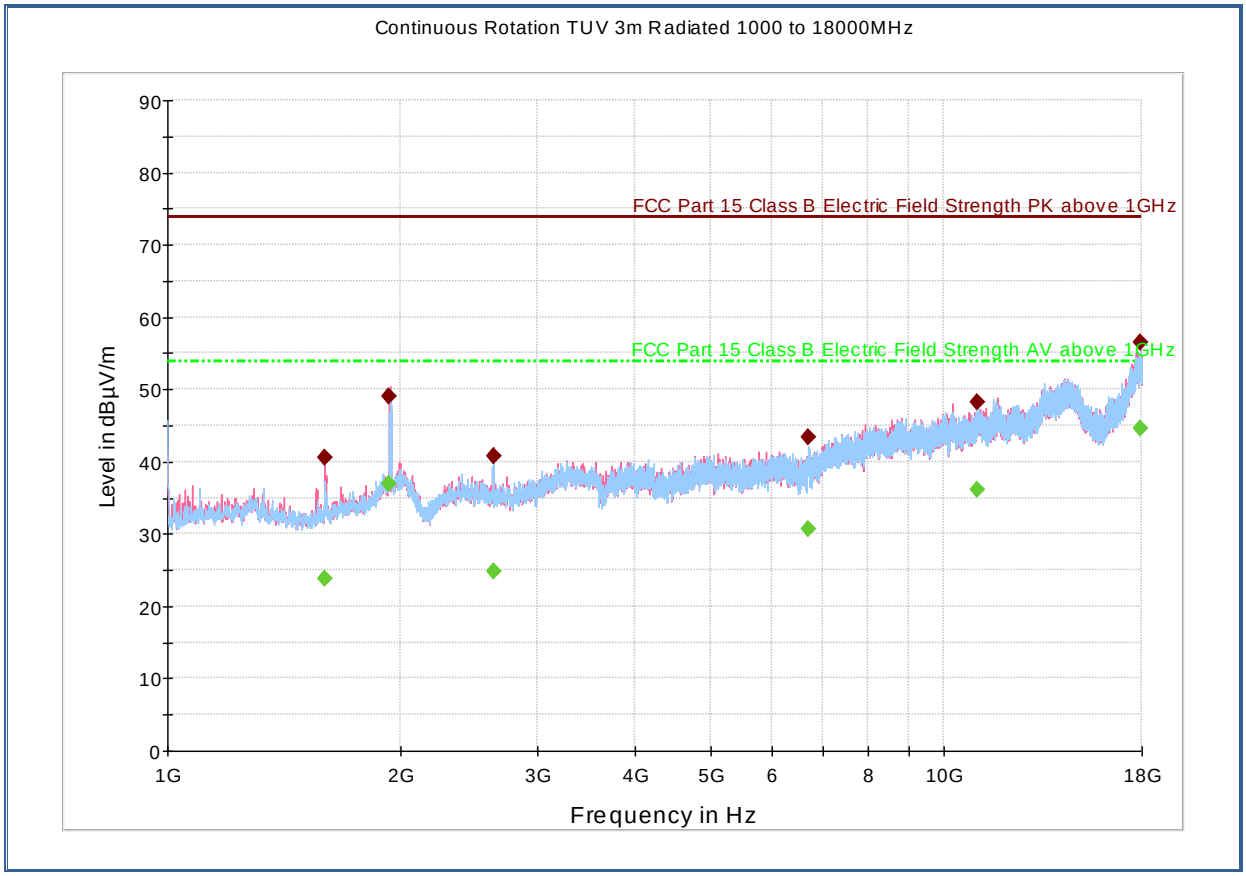
Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1000.00000	41.2	1000.0	1000.000	188.5	V	90.0	-11.2	32.7	73.9
1941.03333	47.1	1000.0	1000.000	302.2	V	152.0	-4.6	26.8	73.9
2639.73333	36.3	1000.0	1000.000	326.2	V	262.0	-4.7	37.6	73.9
4809.50000	41.9	1000.0	1000.000	151.6	V	337.0	2.0	32.0	73.9
6226.23333	43.3	1000.0	1000.000	181.6	V	92.0	4.8	30.6	73.9
11113.1333	47.9	1000.0	1000.000	363.1	H	37.0	13.2	26.0	73.9
17825.8666	55.6	1000.0	1000.000	231.4	V	64.0	23.6	18.3	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)
1000.00000	30.4	1000.0	1000.000	188.5	V	90.0	-11.2	23.5	53.9
1941.03333	32.8	1000.0	1000.000	302.2	V	152.0	-4.6	21.1	53.9
2639.73333	24.4	1000.0	1000.000	326.2	V	262.0	-4.7	29.5	53.9
4809.50000	29.8	1000.0	1000.000	151.6	V	337.0	2.0	24.1	53.9
6226.23333	31.3	1000.0	1000.000	181.6	V	92.0	4.8	22.6	53.9
11113.1333	35.7	1000.0	1000.000	363.1	H	37.0	13.2	18.2	53.9
17825.8666	44.1	1000.0	1000.000	231.4	V	64.0	23.6	9.8	53.9

2.3.14 Test Results 1 GHz to 18 GHz Mid Channel 175 MHz BW (worst case configuration)



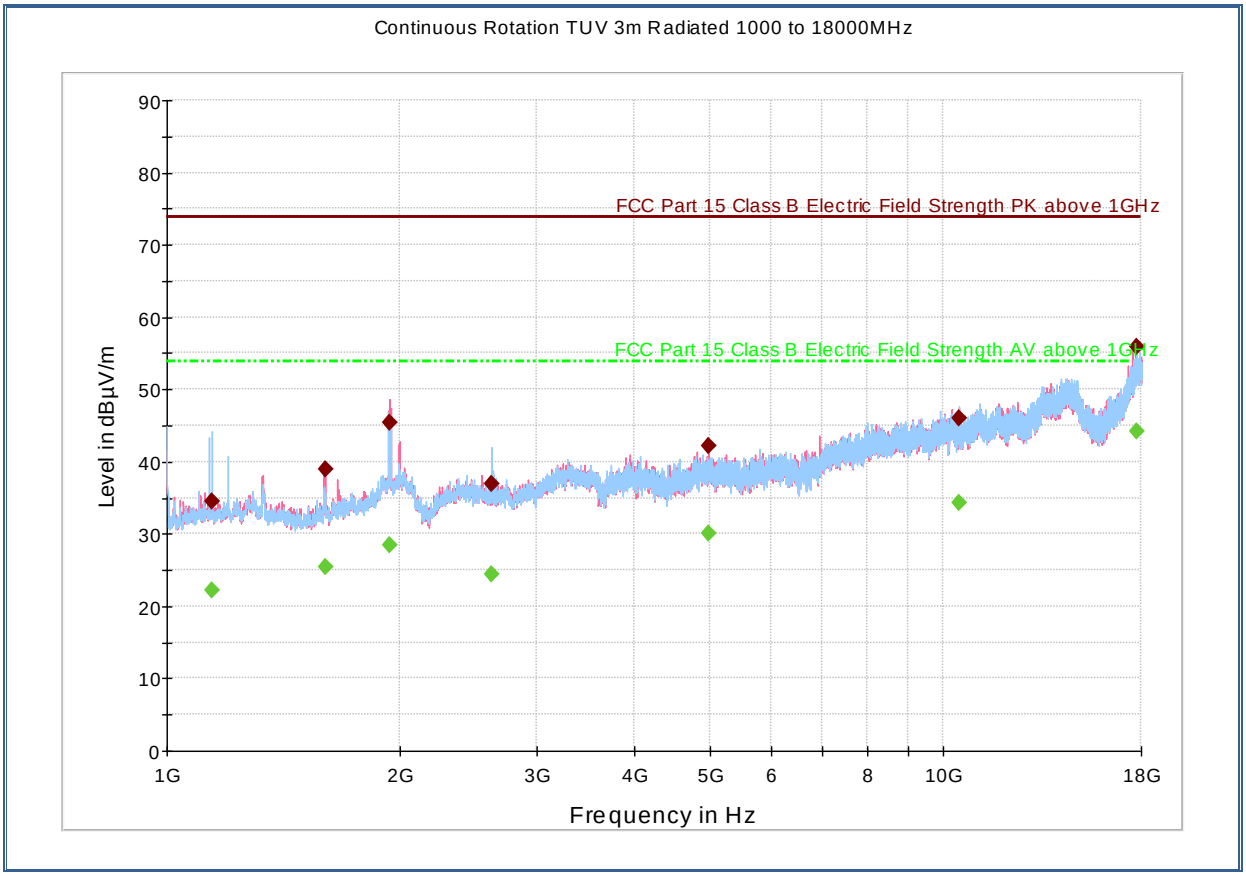
Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1596.00000	40.5	1000.0	1000.000	223.4	V	6.0	-8.5	33.4	73.9
1932.53333	49.1	1000.0	1000.000	404.2	V	99.0	-4.6	24.8	73.9
2633.36666	40.7	1000.0	1000.000	270.2	V	197.0	-4.7	33.2	73.9
6685.76666	43.5	1000.0	1000.000	191.5	H	210.0	5.0	30.4	73.9
11033.2000	48.2	1000.0	1000.000	404.2	V	329.0	13.1	25.7	73.9
17937.3000	56.5	1000.0	1000.000	177.5	V	71.0	24.2	17.4	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)
1596.00000	23.9	1000.0	1000.000	223.4	V	6.0	-8.5	30.0	53.9
1932.53333	37.0	1000.0	1000.000	404.2	V	99.0	-4.6	16.9	53.9
2633.36666	24.9	1000.0	1000.000	270.2	V	197.0	-4.7	29.0	53.9
6685.76666	30.7	1000.0	1000.000	191.5	H	210.0	5.0	23.2	53.9
11033.2000	36.1	1000.0	1000.000	404.2	V	329.0	13.1	17.8	53.9
17937.3000	44.6	1000.0	1000.000	177.5	V	71.0	24.2	9.3	53.9

2.3.15 Test Results 1 GHz to 18 GHz High Channel 175 MHz BW (worst case configuration)



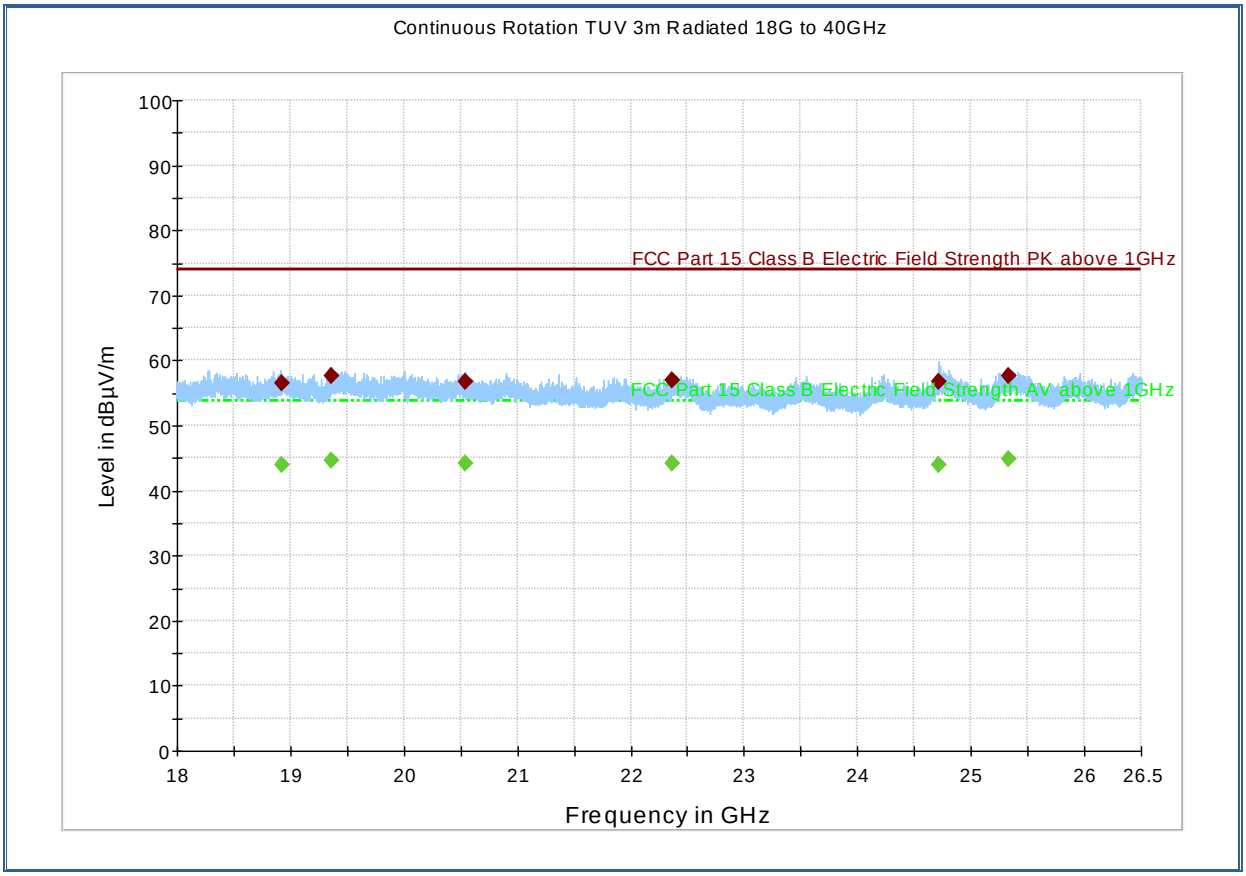
Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1142.60000	34.5	1000.0	1000.000	316.1	H	343.0	-10.3	39.4	73.9
1599.76666	38.9	1000.0	1000.000	188.5	V	357.0	-8.5	35.0	73.9
1935.60000	45.4	1000.0	1000.000	404.2	V	-5.0	-4.6	28.5	73.9
2624.66666	36.9	1000.0	1000.000	139.7	H	221.0	-4.7	37.0	73.9
4989.13333	42.2	1000.0	1000.000	129.7	V	339.0	2.2	31.7	73.9
10476.7333	46.0	1000.0	1000.000	251.3	H	302.0	12.1	27.9	73.9
17775.0333	55.9	1000.0	1000.000	404.2	H	140.0	23.3	18.0	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)
1142.60000	22.2	1000.0	1000.000	316.1	H	343.0	-10.3	31.7	53.9
1599.76666	25.3	1000.0	1000.000	188.5	V	357.0	-8.5	28.6	53.9
1935.60000	28.4	1000.0	1000.000	404.2	V	-5.0	-4.6	25.5	53.9
2624.66666	24.5	1000.0	1000.000	139.7	H	221.0	-4.7	29.4	53.9
4989.13333	30.0	1000.0	1000.000	129.7	V	339.0	2.2	23.9	53.9
10476.7333	34.4	1000.0	1000.000	251.3	H	302.0	12.1	19.5	53.9
17775.0333	44.2	1000.0	1000.000	404.2	H	140.0	23.3	9.7	53.9

2.3.16 Test Results from 18 GHz to 26 GHz Low Channel 175 MHz BW (worst case configuration)



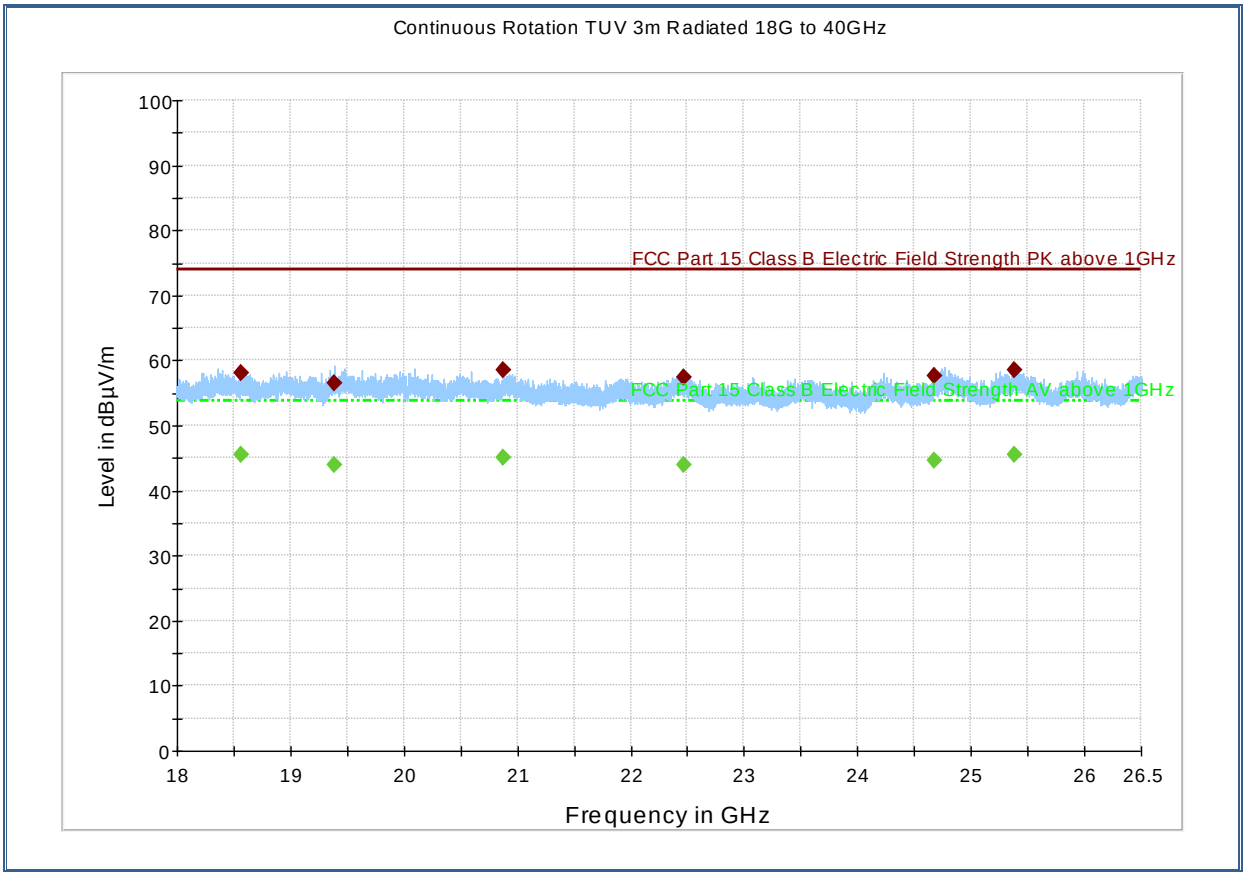
Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
18918.2333	56.6	1000.0	1000.000	102.5	V	-18.0	14.2	17.3	73.9
19356.4333	57.5	1000.0	1000.000	102.5	V	0.0	14.2	16.4	73.9
20536.1166	56.7	1000.0	1000.000	102.5	V	335.0	13.9	17.2	73.9
22370.1000	57.0	1000.0	1000.000	102.5	H	337.0	14.7	16.9	73.9
24721.1500	56.7	1000.0	1000.000	150.4	V	234.0	15.3	17.2	73.9
25326.8666	57.6	1000.0	1000.000	102.5	V	308.0	15.5	16.3	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)
18918.2333	43.9	1000.0	1000.000	102.5	V	-18.0	14.2	10.0	53.9
19356.4333	44.6	1000.0	1000.000	102.5	V	0.0	14.2	9.3	53.9
20536.1166	44.2	1000.0	1000.000	102.5	V	335.0	13.9	9.8	53.9
22370.1000	44.1	1000.0	1000.000	102.5	H	337.0	14.7	9.8	53.9
24721.1500	44.0	1000.0	1000.000	150.4	V	234.0	15.3	9.9	53.9
25326.8666	44.8	1000.0	1000.000	102.5	V	308.0	15.5	9.1	53.9

2.3.17 Test Results from 18 GHz to 26 GHz Mid Channel 175 MHz BW (worst case configuration)



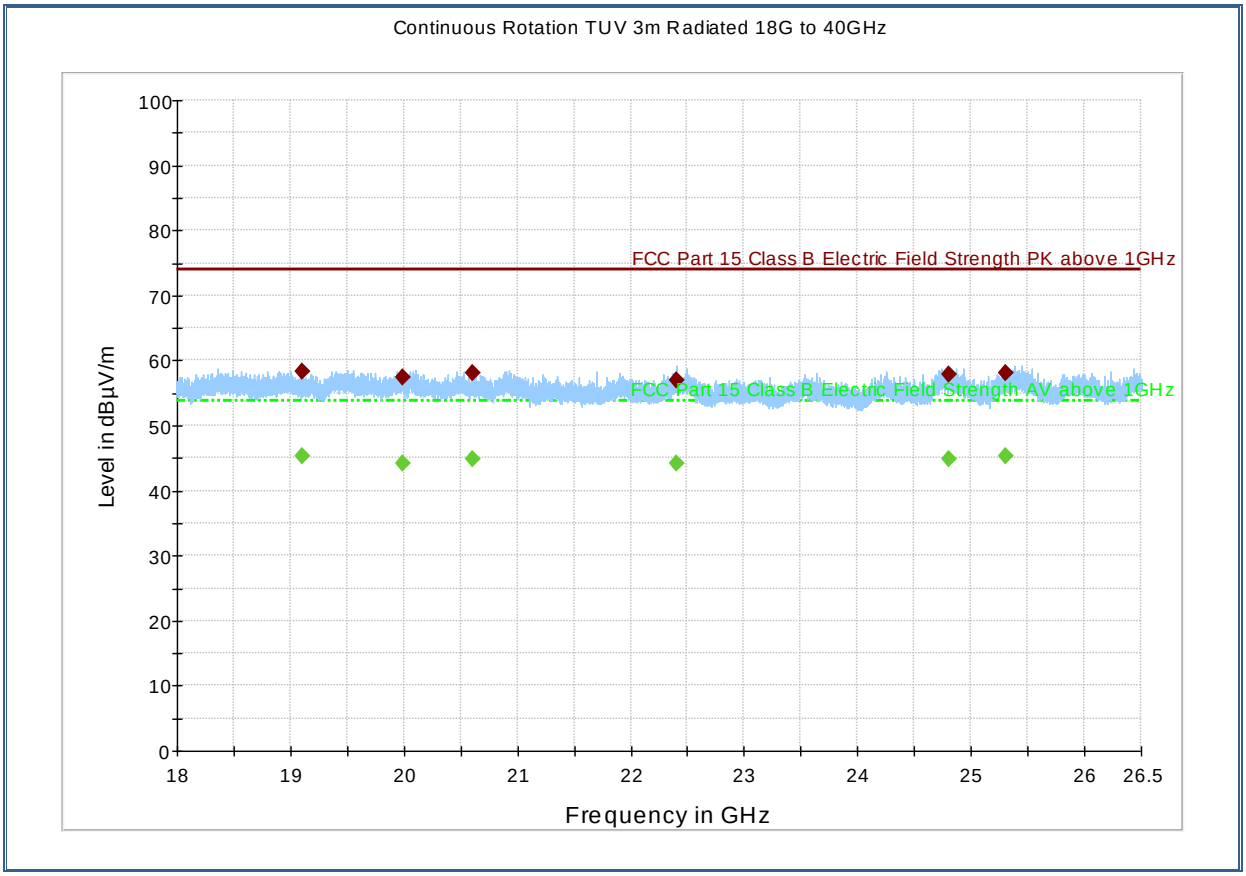
Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
18562.1333	58.1	1000.0	1000.000	102.5	V	-18.0	14.5	15.8	73.9
19390.2333	56.5	1000.0	1000.000	149.5	H	179.0	14.2	17.4	73.9
20876.7666	58.4	1000.0	1000.000	98.5	V	347.0	14.3	15.5	73.9
22462.1833	57.4	1000.0	1000.000	135.5	H	8.0	14.7	16.5	73.9
24678.1666	57.6	1000.0	1000.000	117.4	H	353.0	15.2	16.3	73.9
25383.8000	58.5	1000.0	1000.000	154.5	V	0.0	15.4	15.4	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)
18562.1333	45.5	1000.0	1000.000	102.5	V	-18.0	14.5	8.4	53.9
19390.2333	44.0	1000.0	1000.000	149.5	H	179.0	14.2	9.9	53.9
20876.7666	45.1	1000.0	1000.000	98.5	V	347.0	14.3	8.8	53.9
22462.1833	43.9	1000.0	1000.000	135.5	H	8.0	14.7	10.0	53.9
24678.1666	44.6	1000.0	1000.000	117.4	H	353.0	15.2	9.3	53.9
25383.8000	45.5	1000.0	1000.000	154.5	V	0.0	15.4	8.4	53.9

2.3.18 Test Results from 18 GHz to 26 GHz High Channel 175 MHz BW (worst case configuration)



Peak Data

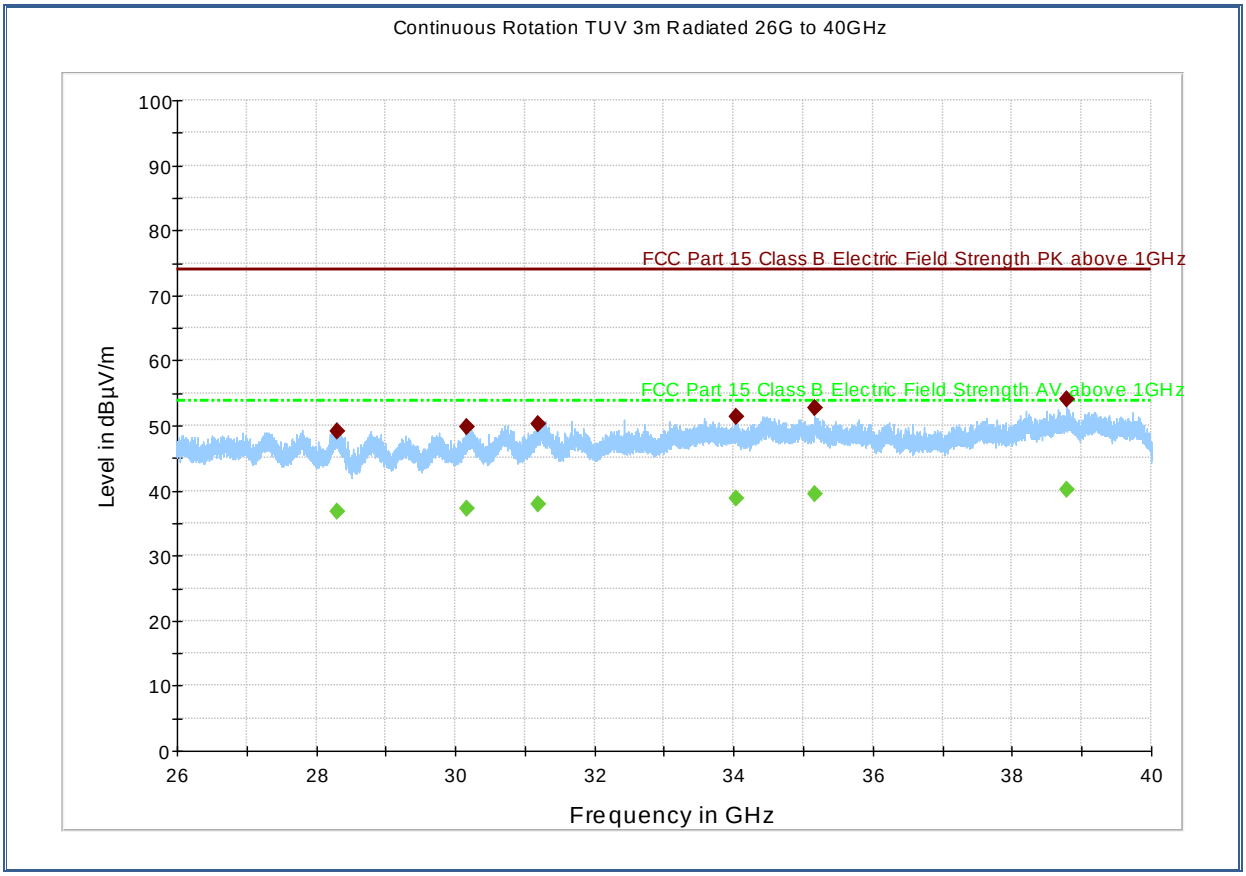
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
19109.0000	58.3	1000.0	1000.000	102.5	V	252.0	14.1	15.6	73.9
19995.0333	57.3	1000.0	1000.000	102.5	V	0.0	14.1	16.6	73.9
20610.6666	58.1	1000.0	1000.000	102.5	V	240.0	14.0	15.8	73.9
22406.3500	57.0	1000.0	1000.000	116.4	H	42.0	14.7	16.9	73.9
24809.7166	57.9	1000.0	1000.000	116.4	H	115.0	15.4	16.0	73.9
25307.8166	58.0	1000.0	1000.000	102.5	V	-18.0	15.5	15.9	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)
19109.0000	45.3	1000.0	1000.000	102.5	V	252.0	14.1	8.6	53.9
19995.0333	44.3	1000.0	1000.000	102.5	V	0.0	14.1	9.6	53.9
20610.6666	44.8	1000.0	1000.000	102.5	V	240.0	14.0	9.1	53.9
22406.3500	44.2	1000.0	1000.000	116.4	H	42.0	14.7	9.7	53.9
24809.7166	44.9	1000.0	1000.000	116.4	H	115.0	15.4	9.0	53.9
25307.8166	45.2	1000.0	1000.000	102.5	V	-18.0	15.5	8.7	53.9

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

2.3.19 Test Results from 26 GHz to 40 GHz Low Channel 175 MHz BW (worst case configuration)



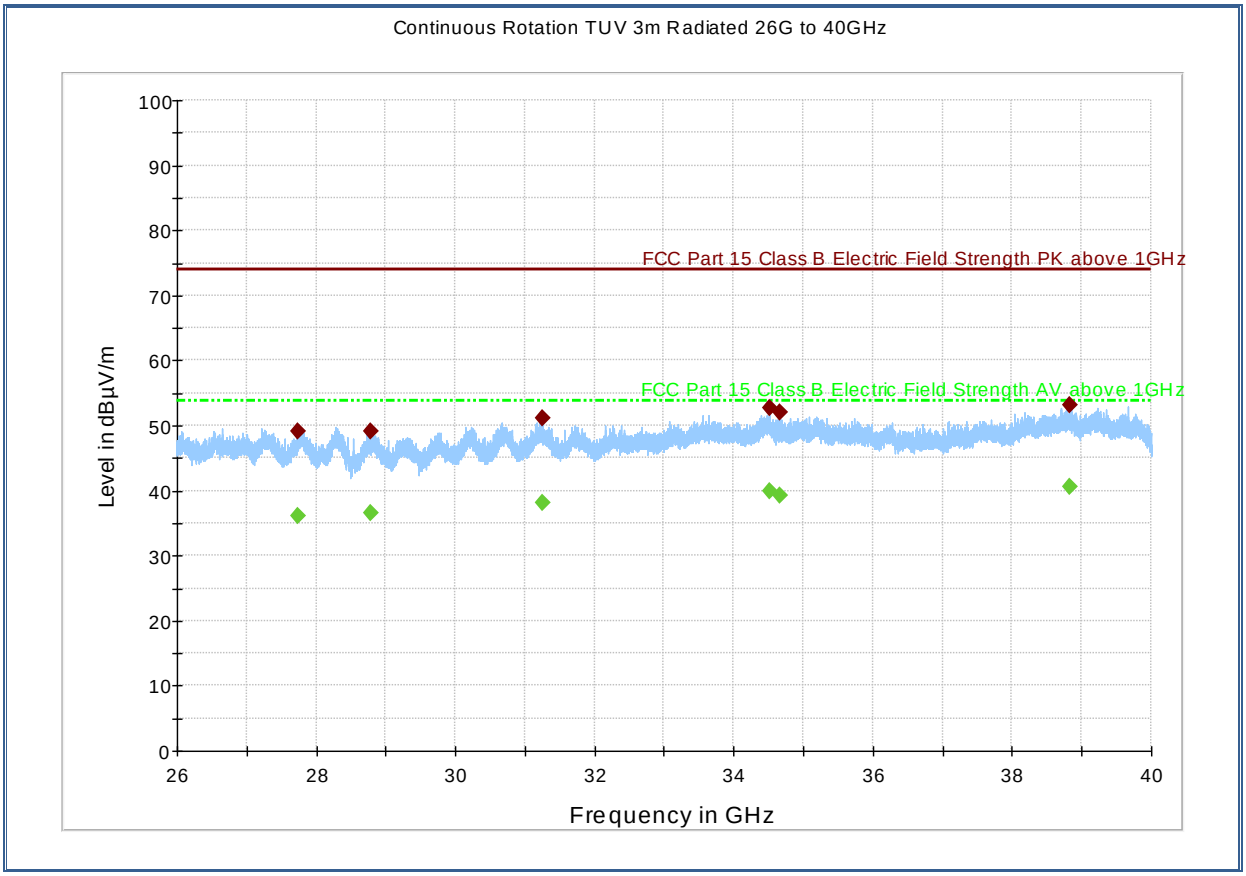
Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
28309.5333	49.2	1000.0	1000.000	150.9	V	329.0	6.6	24.7	73.9
30172.2000	49.7	1000.0	1000.000	143.9	V	326.0	8.8	24.2	73.9
31191.8666	50.3	1000.0	1000.000	103.9	V	74.0	9.4	23.6	73.9
34038.2000	51.4	1000.0	1000.000	99.9	V	80.0	11.7	22.5	73.9
35158.7333	52.8	1000.0	1000.000	152.9	V	218.0	12.4	21.1	73.9
38779.0666	54.0	1000.0	1000.000	150.9	H	311.0	14.9	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)
28309.5333	36.9	1000.0	1000.000	150.9	V	329.0	6.6	17.0	53.9
30172.2000	37.3	1000.0	1000.000	143.9	V	326.0	8.8	16.6	53.9
31191.8666	37.8	1000.0	1000.000	103.9	V	74.0	9.4	16.1	53.9
34038.2000	38.7	1000.0	1000.000	99.9	V	80.0	11.7	15.2	53.9
35158.7333	39.6	1000.0	1000.000	152.9	V	218.0	12.4	14.3	53.9
38779.0666	40.2	1000.0	1000.000	150.9	H	311.0	14.9	13.7	53.9

2.3.20 Test Results from 26 GHz to 40 GHz Mid Channel 175 MHz BW (worst case configuration)



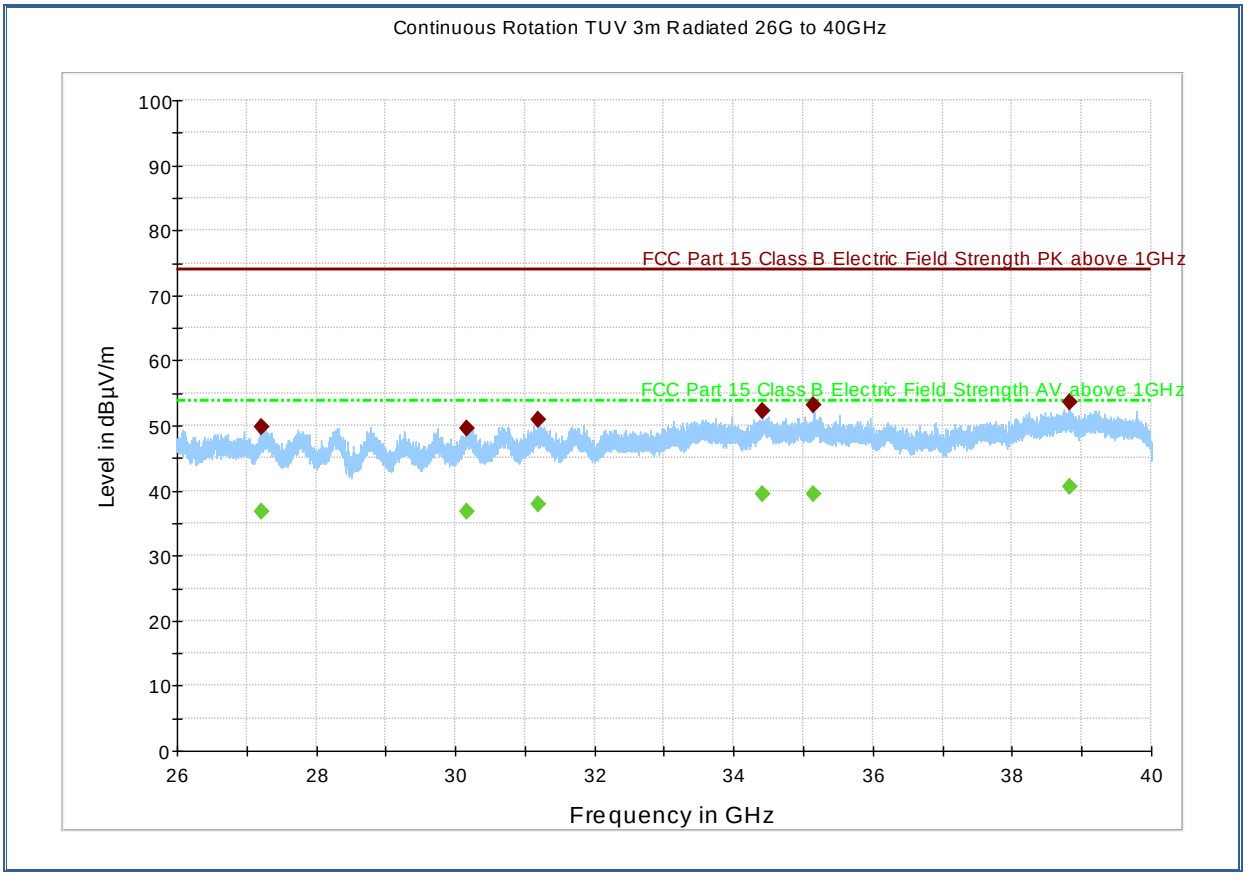
Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
27744.8666	49.2	1000.0	1000.000	116.0	H	65.0	6.8	24.7	73.9
28791.6000	49.2	1000.0	1000.000	116.0	H	61.0	7.4	24.7	73.9
31251.4000	51.1	1000.0	1000.000	116.0	H	58.0	9.7	22.8	73.9
34511.8666	52.7	1000.0	1000.000	109.9	V	20.0	12.3	21.2	73.9
34660.4666	51.9	1000.0	1000.000	116.0	H	347.0	12.4	22.0	73.9
38825.4666	53.2	1000.0	1000.000	116.0	V	38.0	14.8	20.7	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)
27744.8666	36.1	1000.0	1000.000	116.0	H	65.0	6.8	17.8	53.9
28791.6000	36.5	1000.0	1000.000	116.0	H	61.0	7.4	17.4	53.9
31251.4000	38.1	1000.0	1000.000	116.0	H	58.0	9.7	15.8	53.9
34511.8666	40.0	1000.0	1000.000	109.9	V	20.0	12.3	13.9	53.9
34660.4666	39.2	1000.0	1000.000	116.0	H	347.0	12.4	14.7	53.9
38825.4666	40.6	1000.0	1000.000	116.0	V	38.0	14.8	13.3	53.9

2.3.21 Test Results from 26 GHz to 40 GHz High Channel 175 MHz BW (worst case configuration)



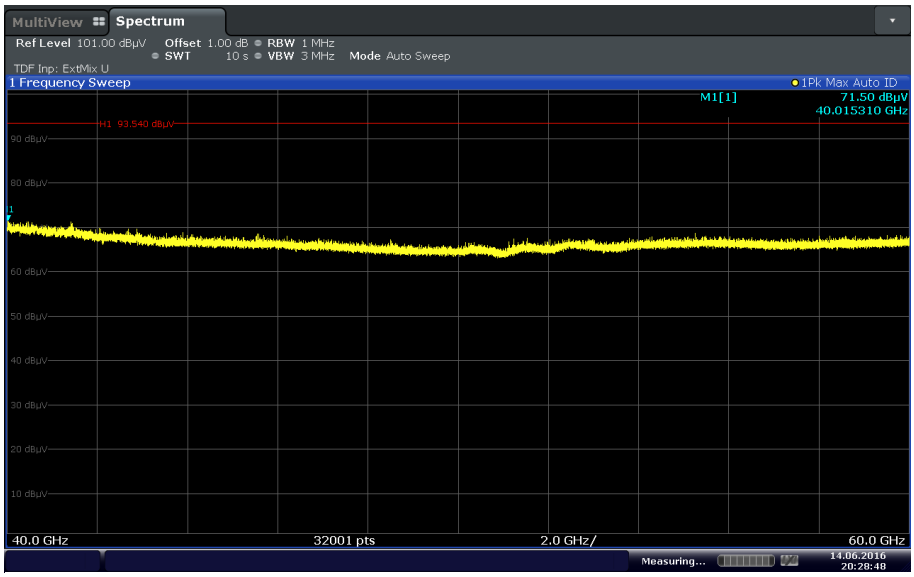
Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
27212.2000	49.7	1000.0	1000.000	105.9	H	240.0	7.1	24.2	73.9
30166.3333	49.6	1000.0	1000.000	152.9	H	272.0	8.8	24.3	73.9
31184.0666	50.8	1000.0	1000.000	117.0	V	70.0	9.4	23.1	73.9
34405.1333	52.3	1000.0	1000.000	117.0	V	134.0	12.2	21.6	73.9
35146.0666	53.2	1000.0	1000.000	102.9	H	14.0	12.4	20.7	73.9
38830.6666	53.5	1000.0	1000.000	108.9	V	127.0	14.8	20.4	73.9

Average Data

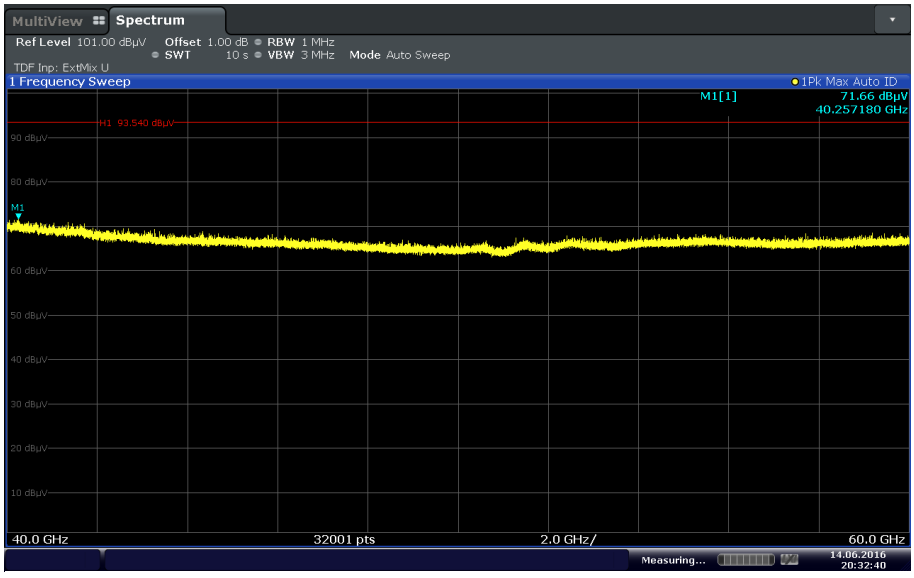
Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
27212.2000	36.7	1000.0	1000.000	105.9	H	240.0	7.1	17.2	53.9
30166.3333	36.8	1000.0	1000.000	152.9	H	272.0	8.8	17.1	53.9
31184.0666	37.9	1000.0	1000.000	117.0	V	70.0	9.4	16.0	53.9
34405.1333	39.4	1000.0	1000.000	117.0	V	134.0	12.2	14.5	53.9
35146.0666	39.5	1000.0	1000.000	102.9	H	14.0	12.4	14.4	53.9
38830.6666	40.7	1000.0	1000.000	108.9	V	127.0	14.8	13.2	53.9

2.3.22 Test Results 40 GHz to 300 GHz



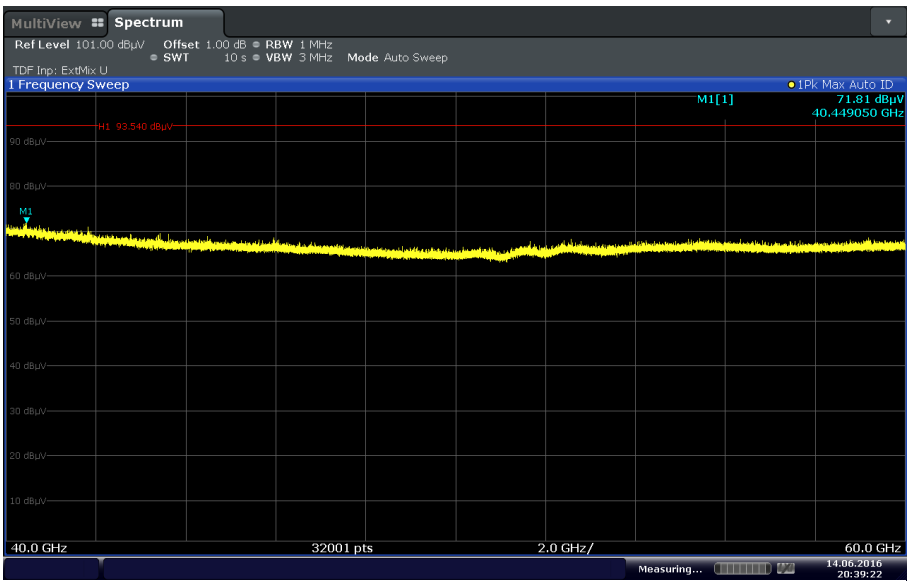
Date: 14.JUN.2016 20:28:48

40 to 60 GHz Low Channel 175 MHz BW



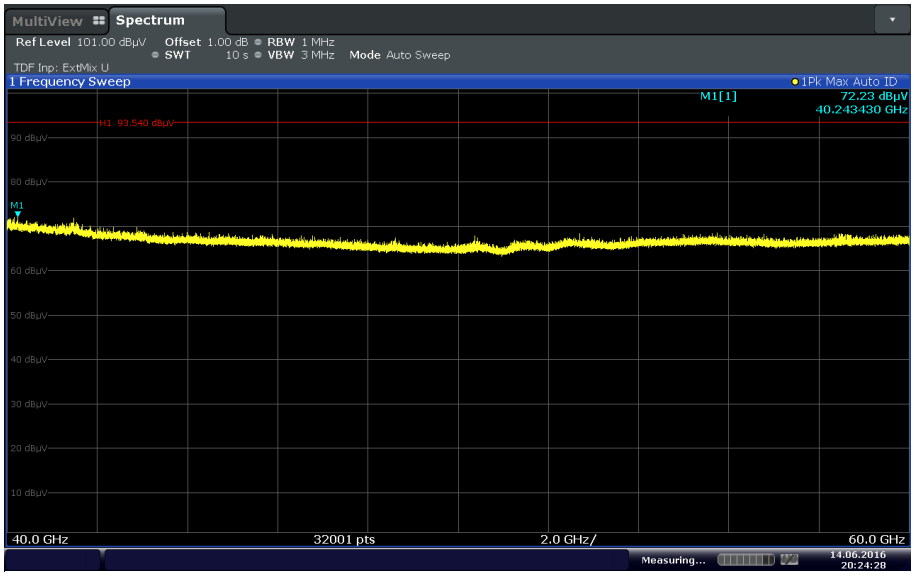
Date: 14.JUN.2016 20:32:40

40 to 60 GHz Mid Channel 175 MHz BW



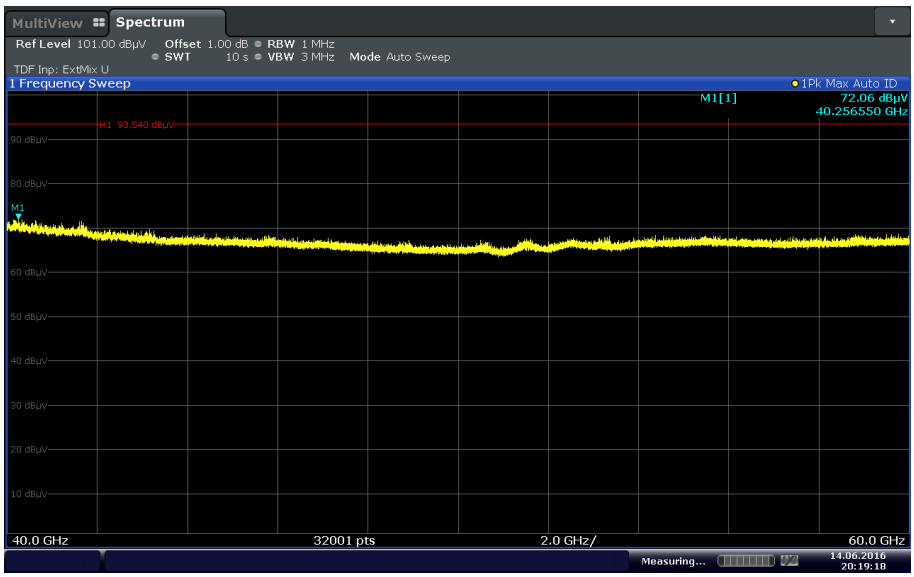
Date: 14.JUN.2016 20:39:22

40 to 60 GHz High Channel 175 MHz BW



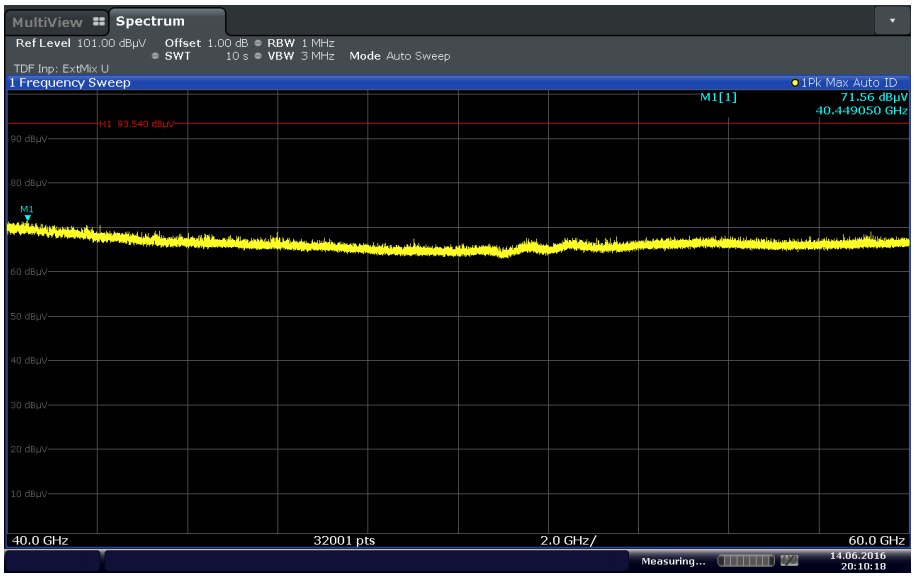
Date: 14.JUN.2016 20:24:28

40 to 60 GHz Low Channel 300 MHz BW



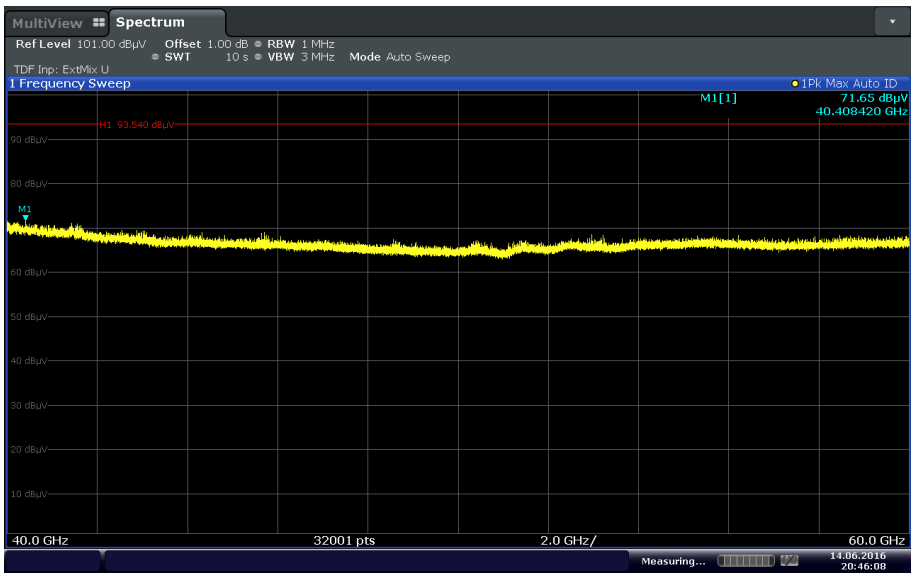
Date: 14.JUN.2016 20:19:18

40 to 60 GHz Mid Channel 300 MHz BW



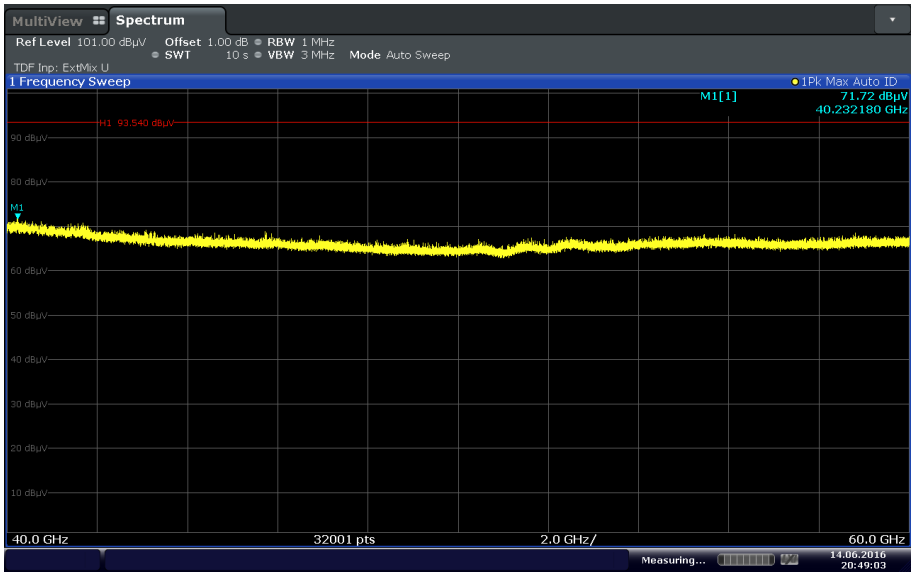
Date: 14.JUN.2016 20:10:19

40 to 60 GHz High Channel 300 MHz BW



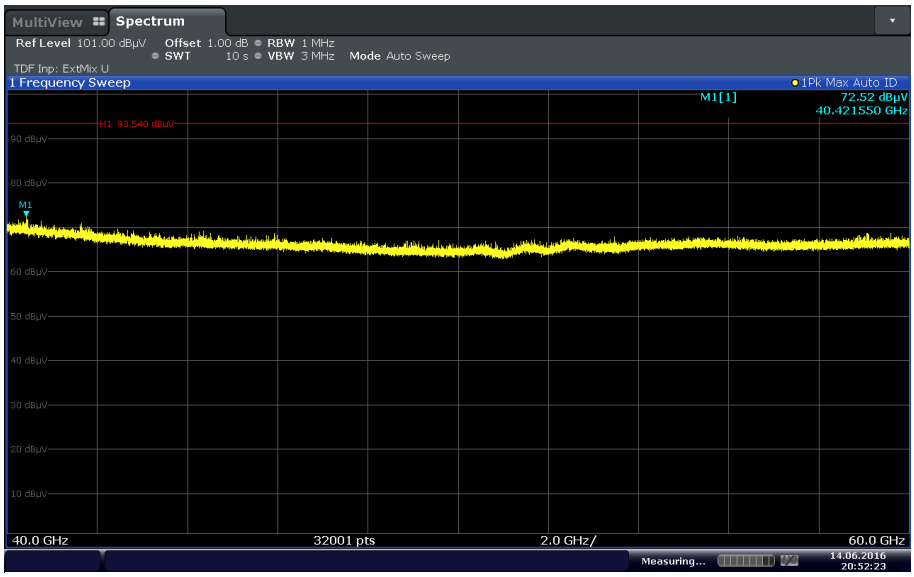
Date: 14.JUN.2016 20:46:08

40 to 60 GHz Low Channel 425 MHz BW



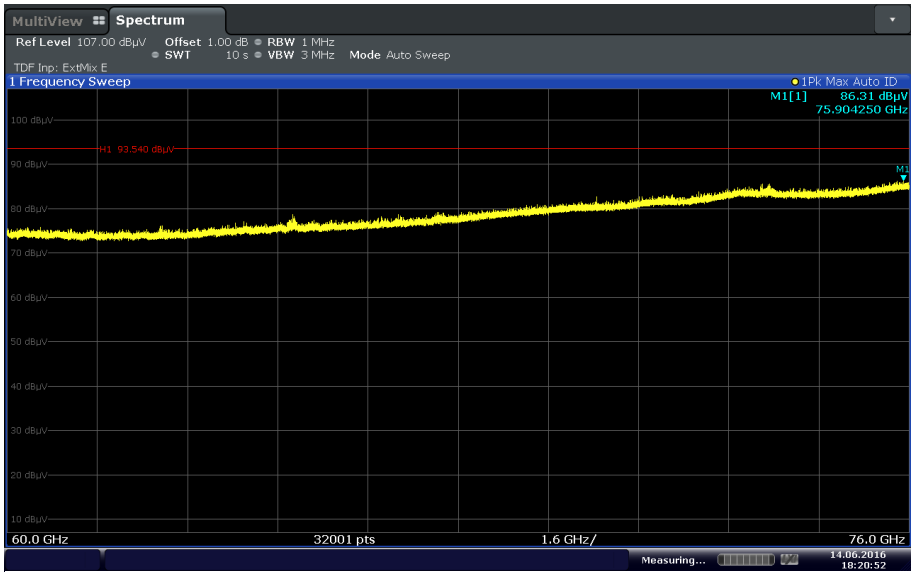
Date: 14.JUN.2016 20:49:03

40 to 60 GHz Mid Channel 425 MHz BW



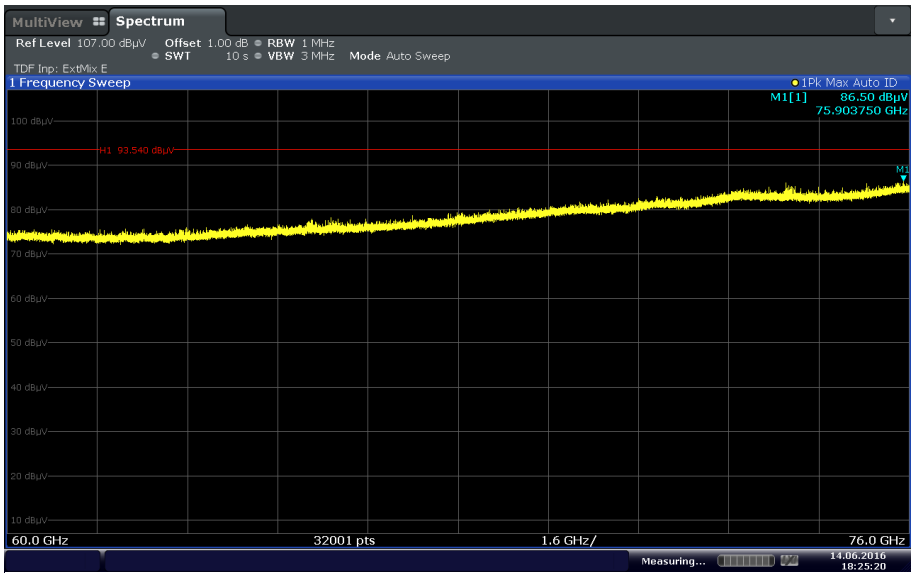
Date: 14.JUN.2016 20:52:24

40 to 60 GHz High Channel 425 MHz BW



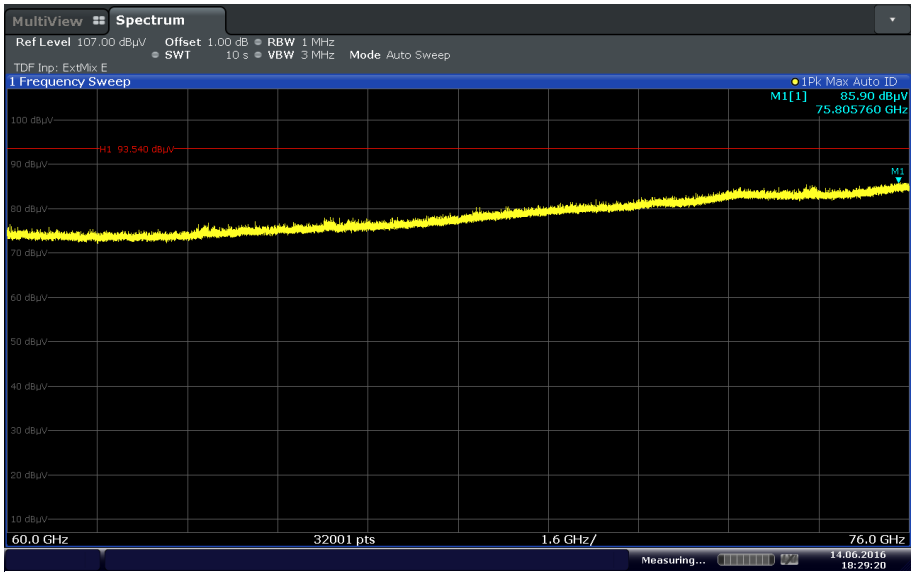
Date: 14.JUN.2016 18:20:55

60 to 75 GHz Low Channel 175 MHz BW



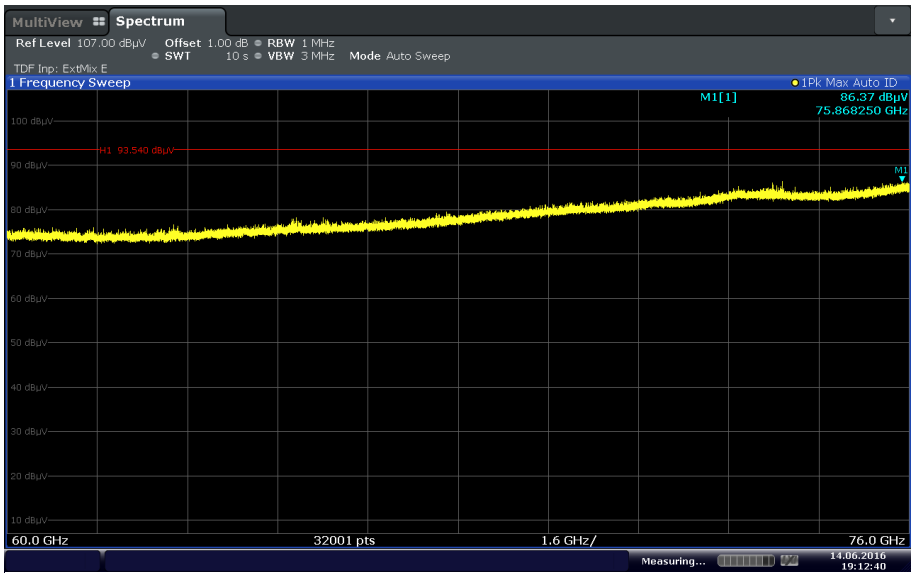
Date: 14.JUN.2016 18:25:20

60 to 75 GHz Mid Channel 175 MHz BW



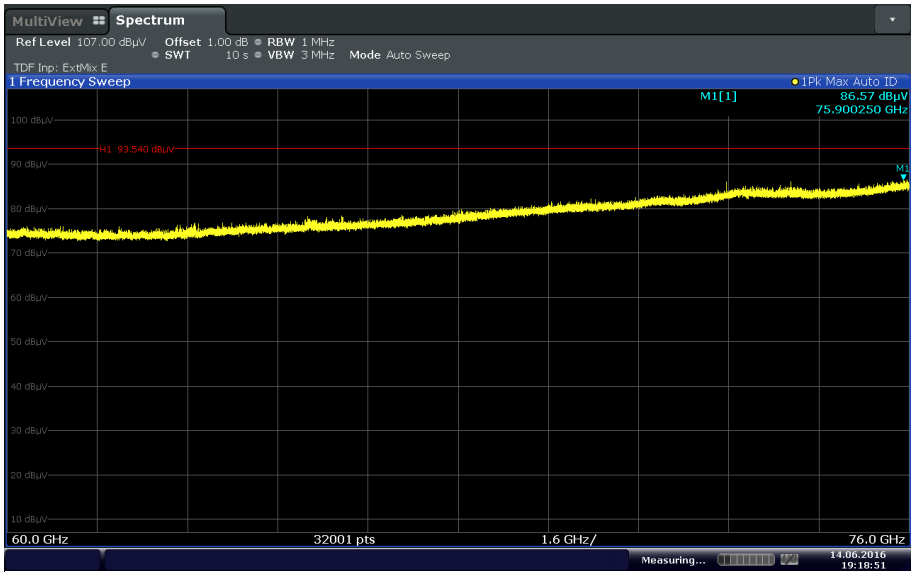
Date: 14.JUN.2016 18:29:20

60 to 75 GHz High Channel 175 MHz BW



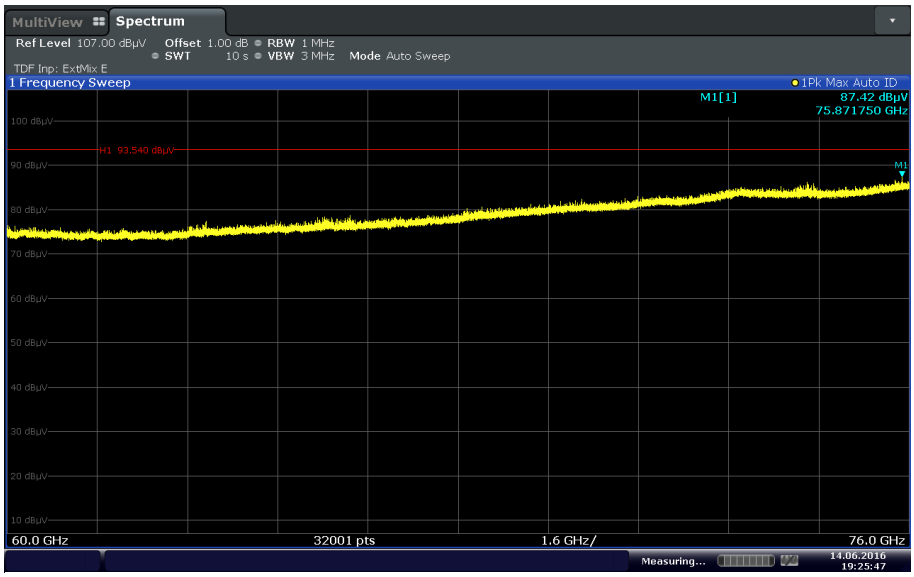
Date: 14.JUN.2016 19:12:41

60 to 75 GHz Low Channel 300 MHz BW



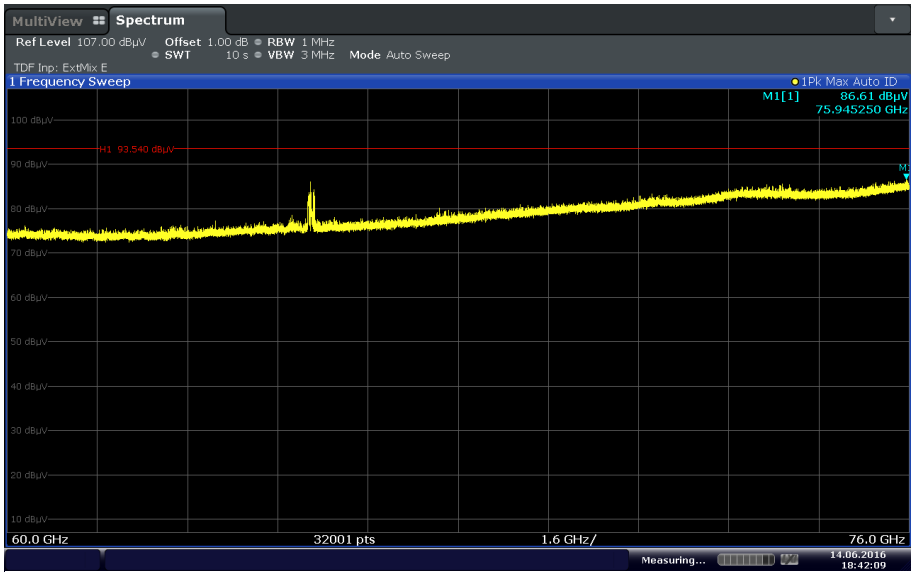
Date: 14.JUN.2016 19:18:51

60 to 75 GHz Mid Channel 300 MHz BW



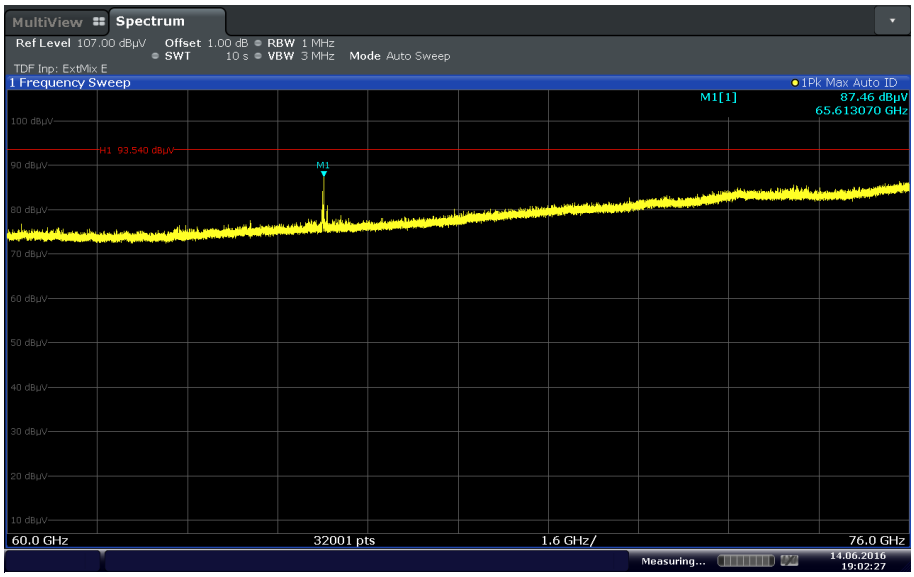
Date: 14.JUN.2016 19:25:47

60 to 75 GHz High Channel 300 MHz BW



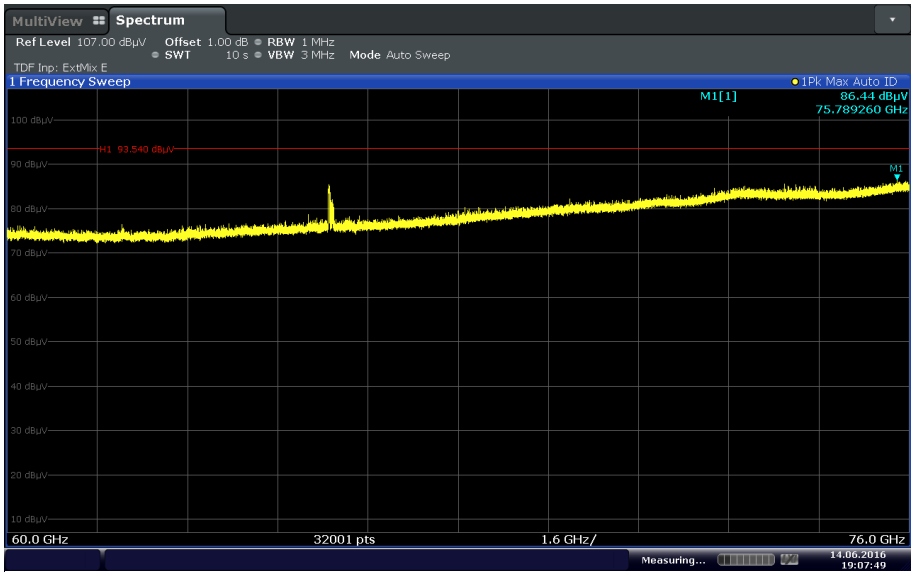
Date: 14.JUN.2016 18:42:10

60 to 75 GHz Low Channel 425 MHz BW



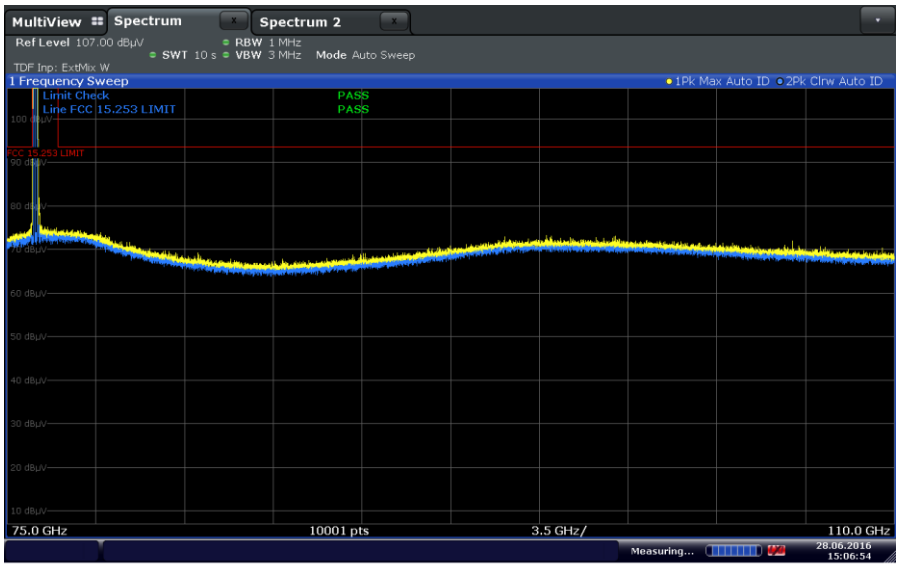
Date: 14.JUN.2016 19:02:27

60 to 75 GHz Mid Channel 425 MHz BW



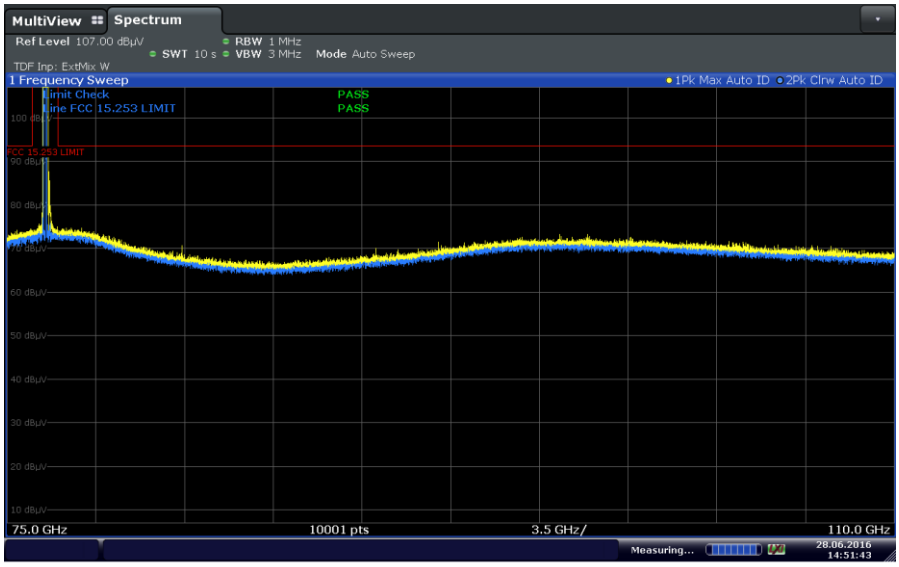
Date: 14.JUN.2016 19:07:50

60 to 75 GHz High Channel 425 MHz BW



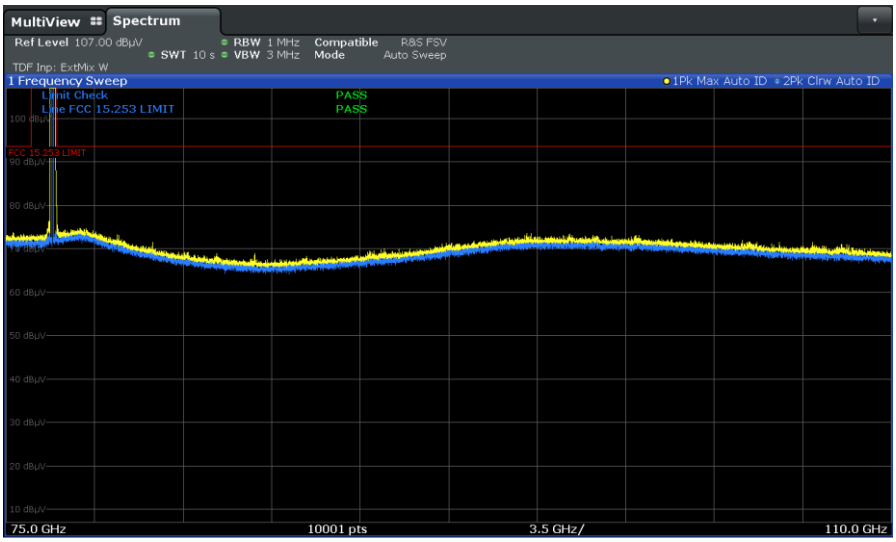
Date: 28.JUN.2016 15:06:54

75 to 110 GHz Low Channel 175 MHz BW

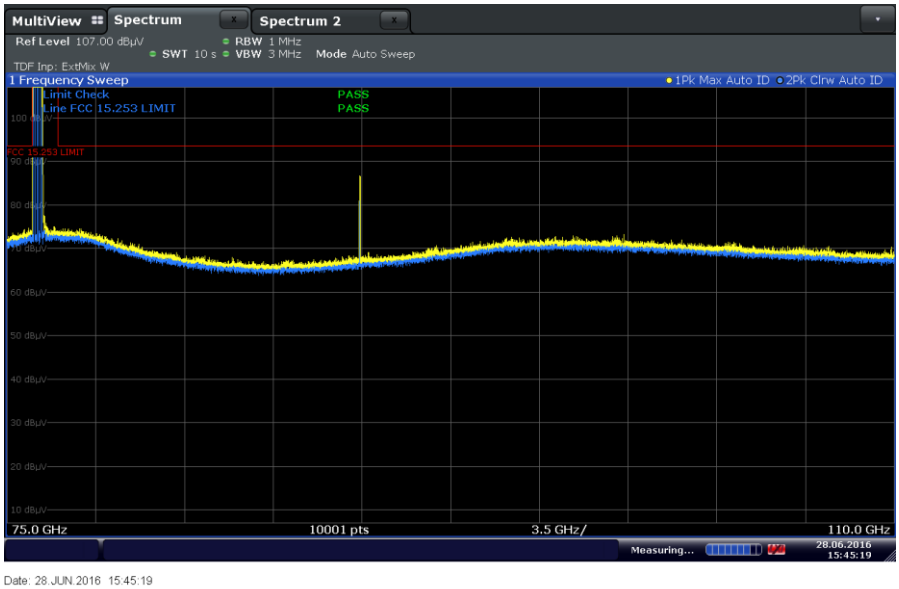


Date: 28.JUN.2016 14:51:43

75 to 110 GHz Mid Channel 175 MHz BW

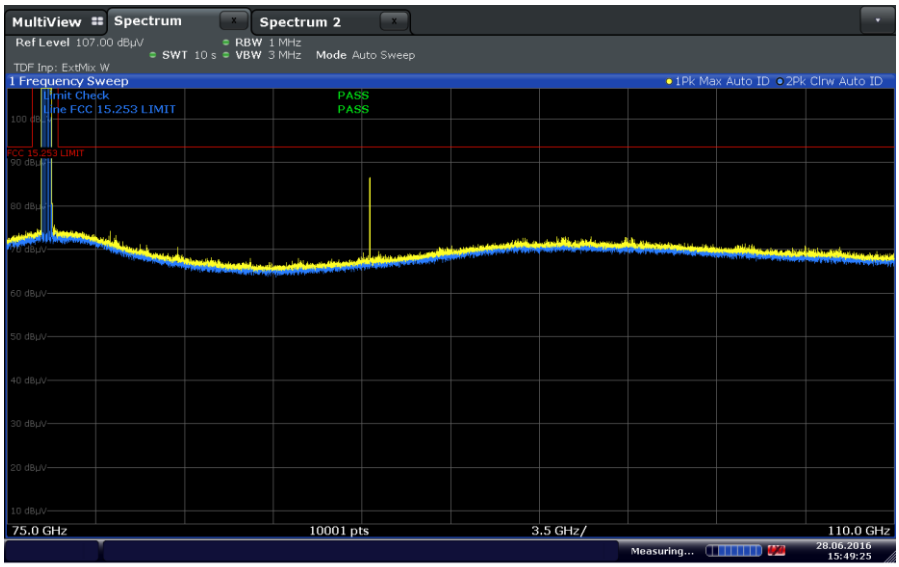


75 to 110 GHz High Channel 175 MHz BW



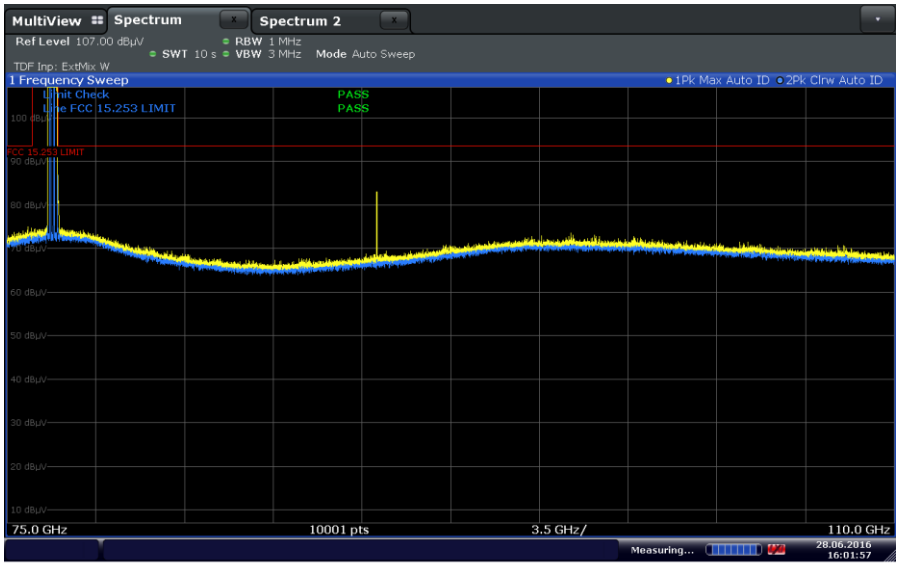
Date: 28.JUN.2016 15:45:19

75 to 110 GHz Low Channel 300 MHz BW



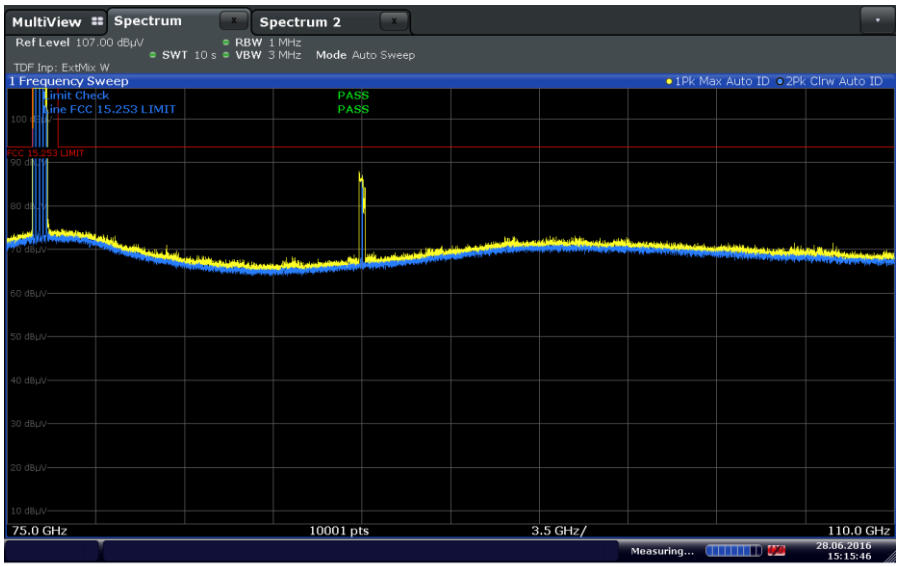
Date: 28.JUN.2016 15:49:25

75 to 110 GHz Mid Channel 300 MHz BW



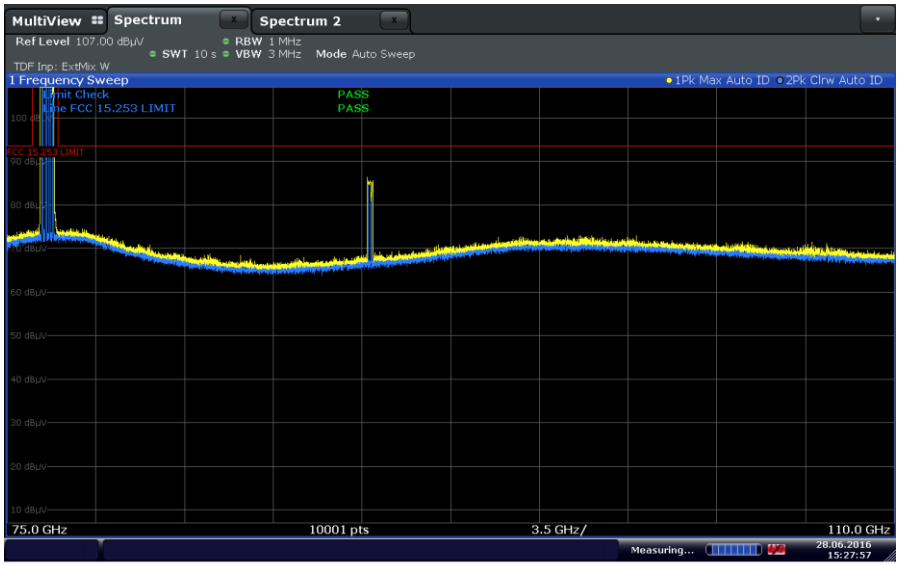
Date: 28.JUN.2016 16:01:57

75 to 110 GHz High Channel 300 MHz BW



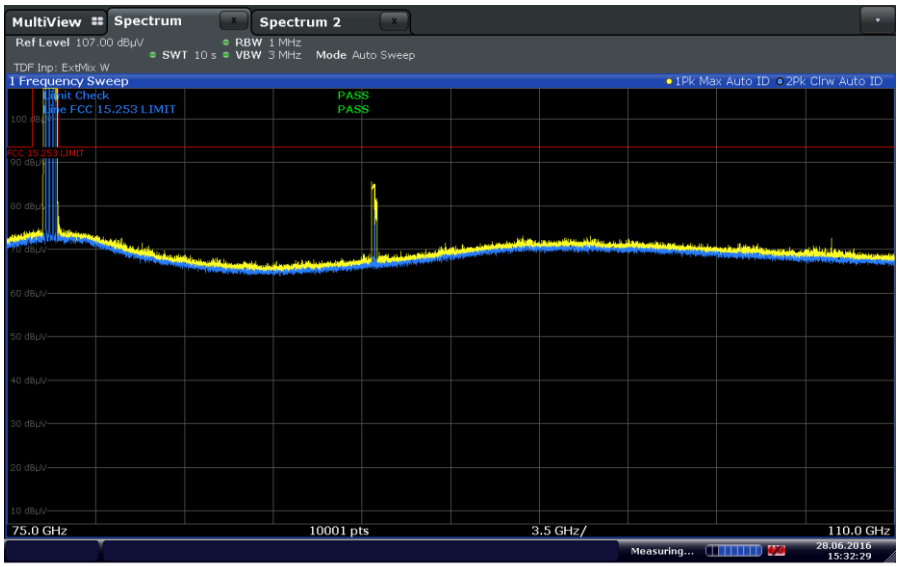
Date: 28.JUN.2016 15:15:46

75 to 110 GHz Low Channel 425 MHz BW



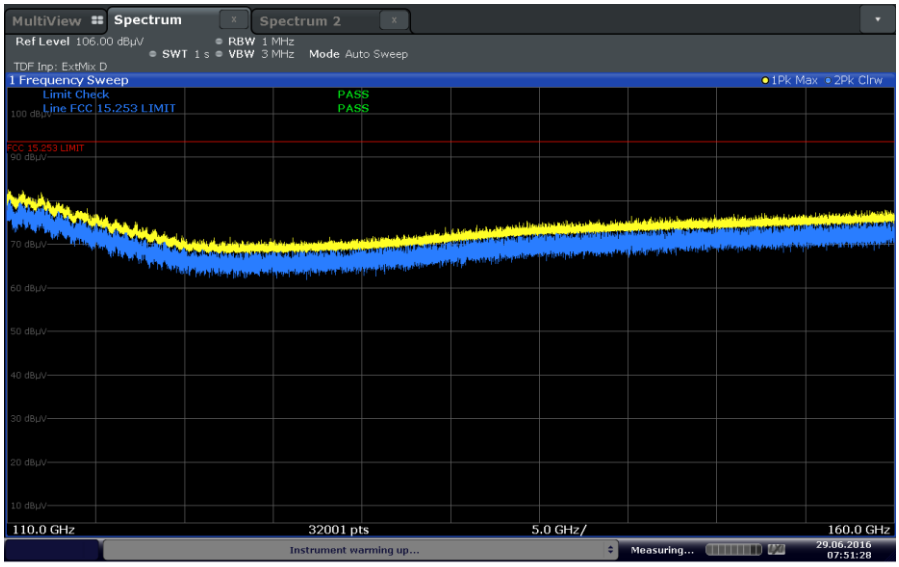
Date: 28.JUN.2016 15:27:58

75 to 110 GHz Mid Channel 425 MHz BW



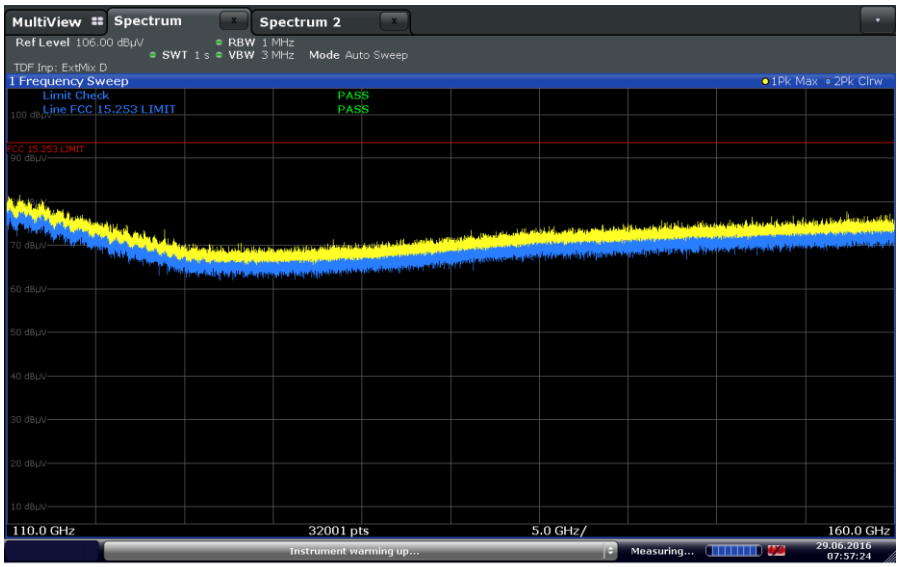
Date: 28.JUN.2016 15:32:29

75 to 110 GHz High Channel 425 MHz BW



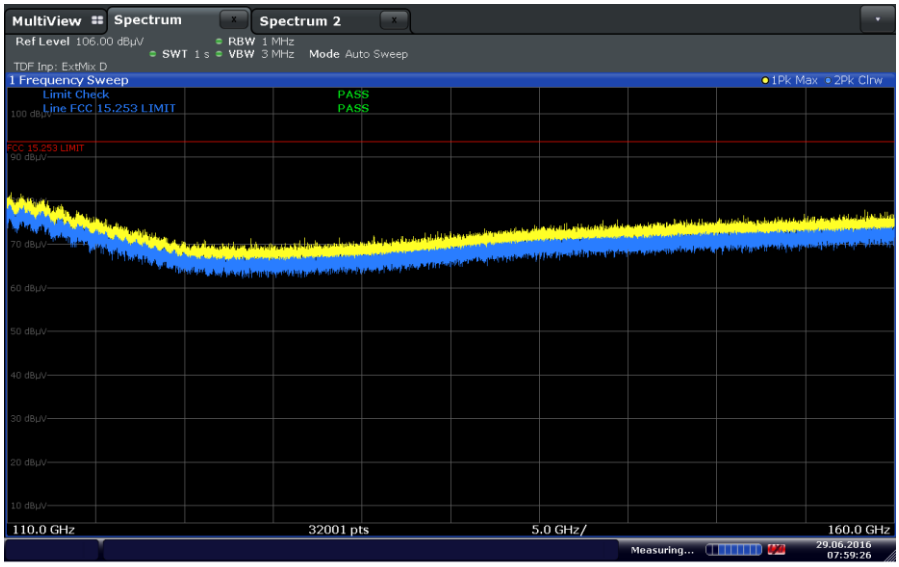
Date: 29.JUN.2016 07:51:28

110 to 160 GHz Low Channel 175 MHz BW



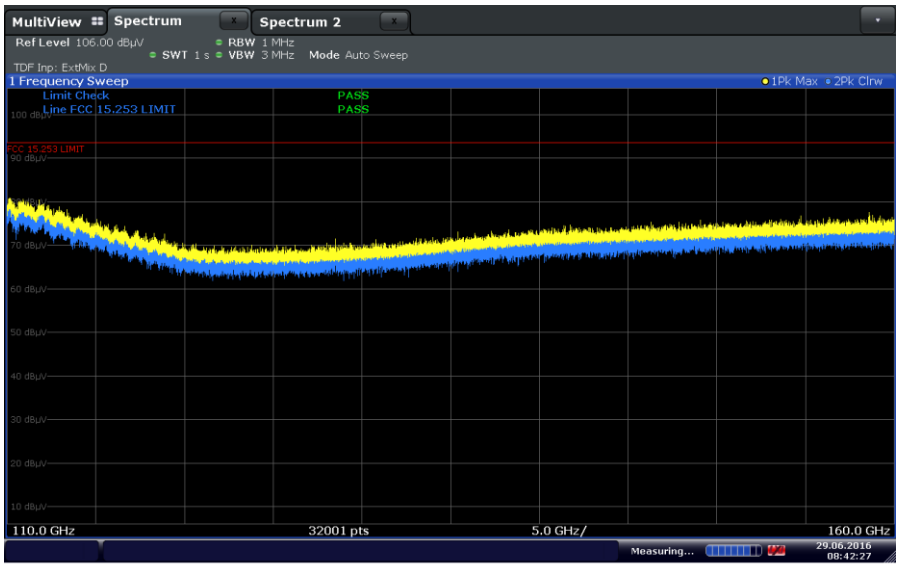
Date: 29.JUN.2016 07:57:24

110 to 160 GHz Mid Channel 175 MHz BW



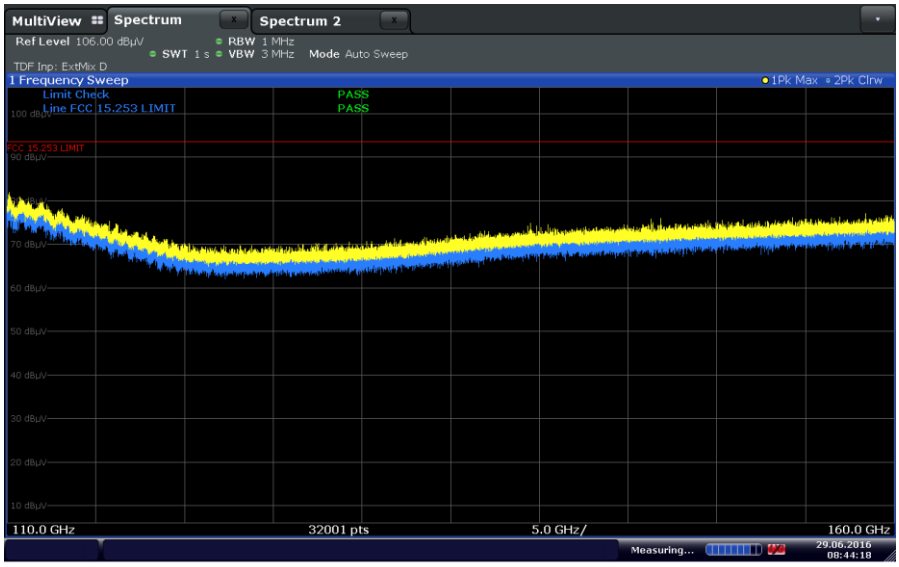
Date: 29.JUN.2016 07:59:27

110 to 160 GHz High Channel 175 MHz BW



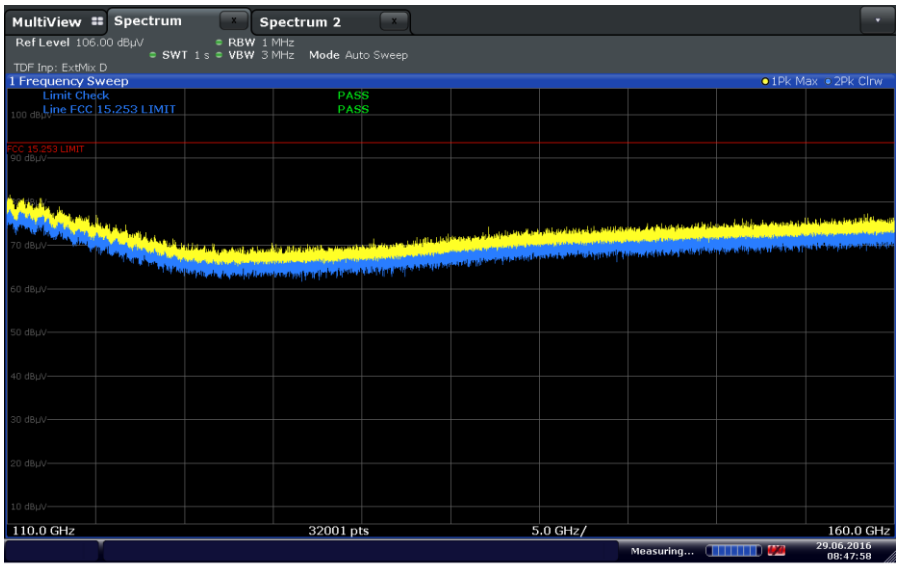
Date: 29.JUN.2016 08:42:27

110 to 160 GHz Low Channel 300 MHz BW



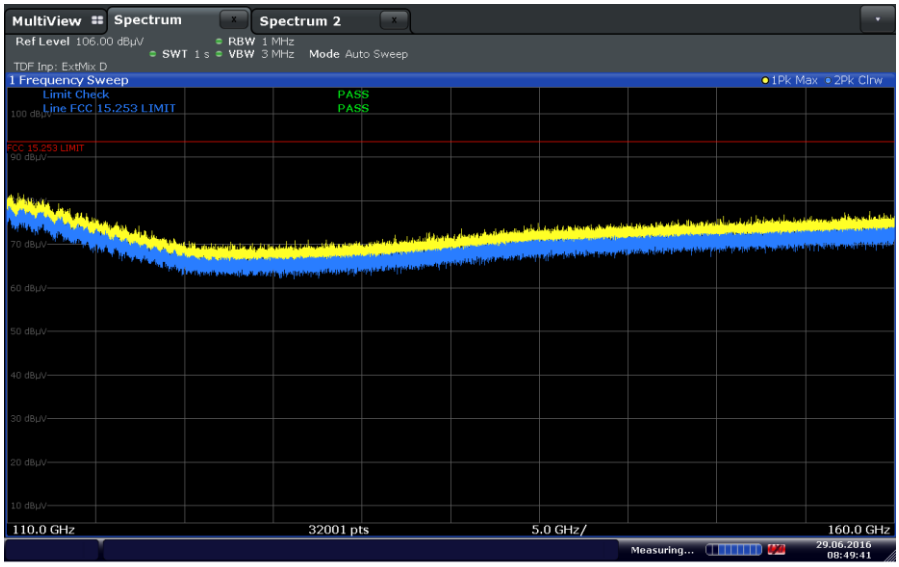
Date: 29.JUN.2016 08:44:18

110 to 160 GHz Mid Channel 300 MHz BW



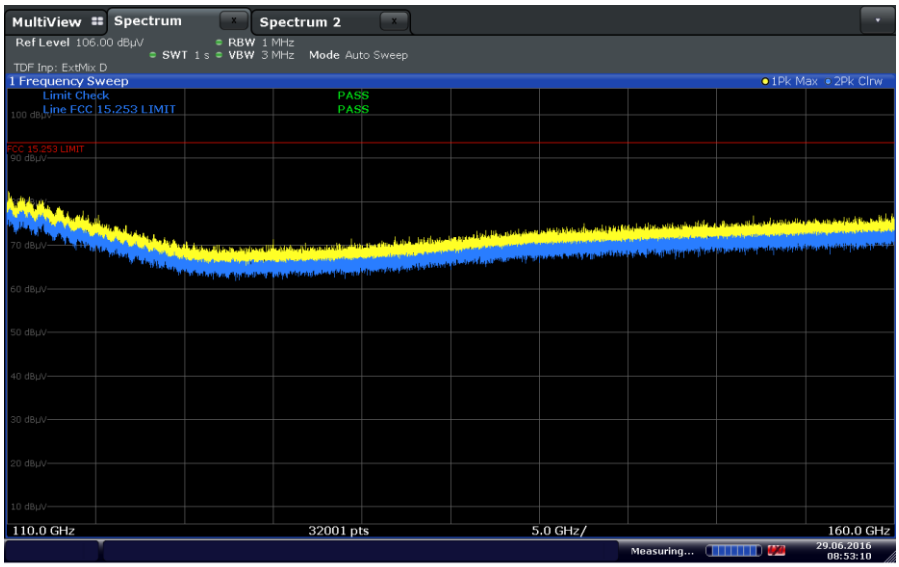
Date: 29.JUN.2016 08:47:58

110 to 160 GHz High Channel 300 MHz BW



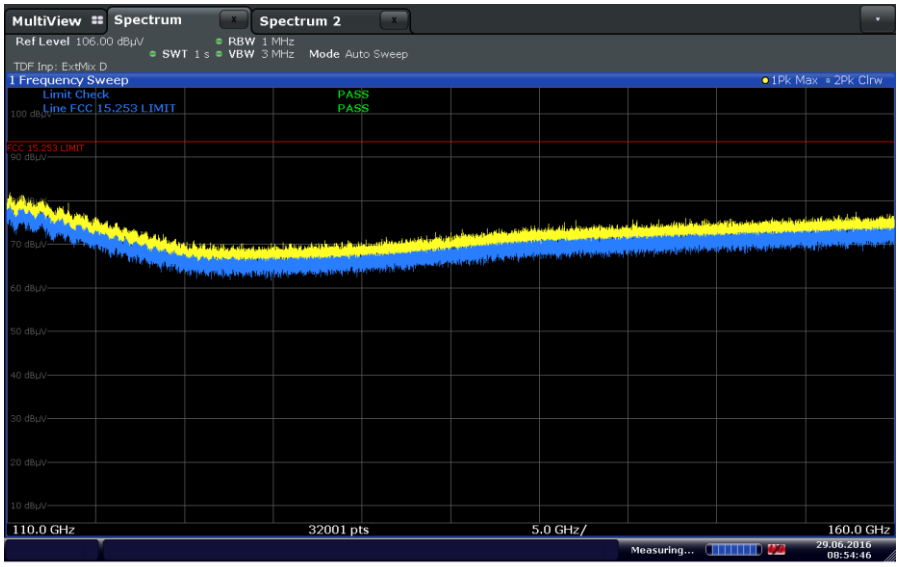
Date: 29.JUN.2016 08:49:42

110 to 160 GHz Low Channel 425 MHz BW



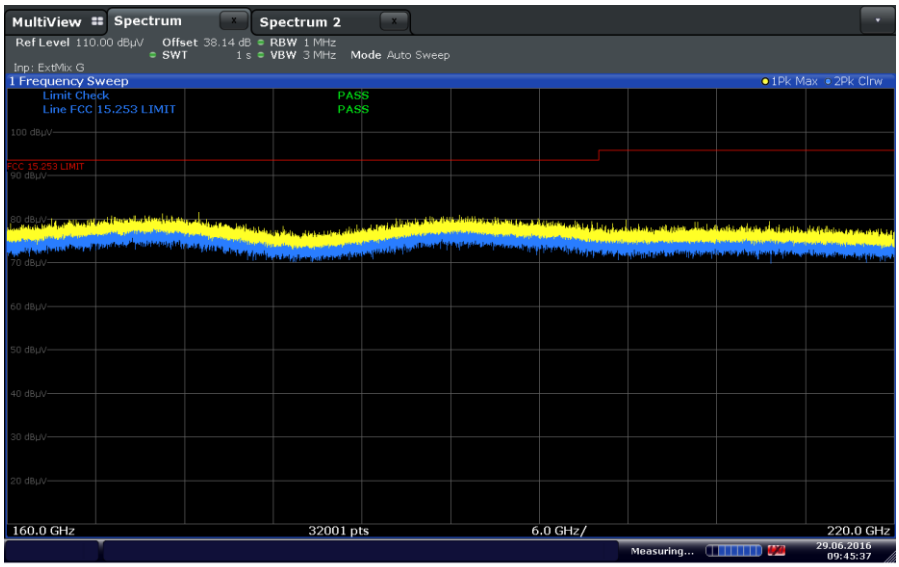
Date: 29.JUN.2016 08:53:10

110 to 160 GHz Mid Channel 425 MHz BW



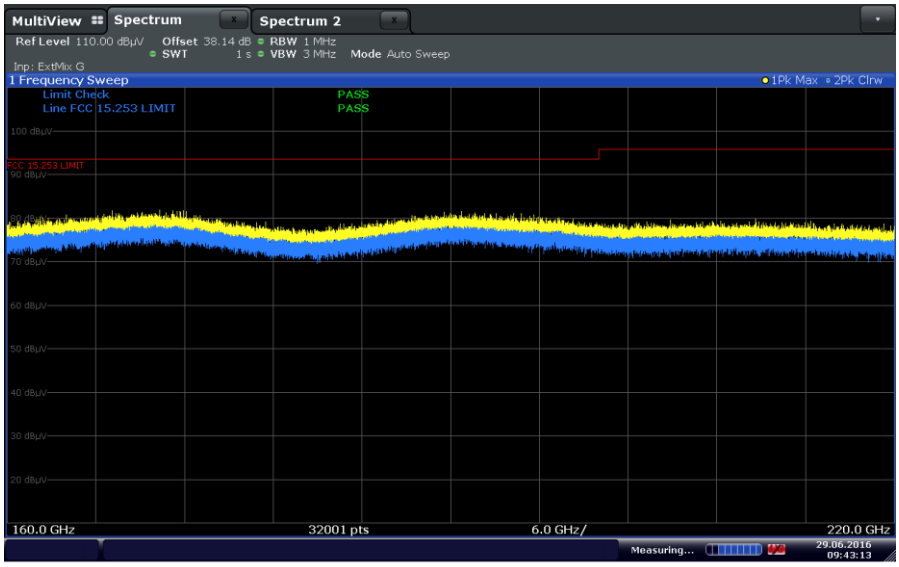
Date: 29.JUN.2016 08:54:47

110 to 160 GHz High Channel 425 MHz BW



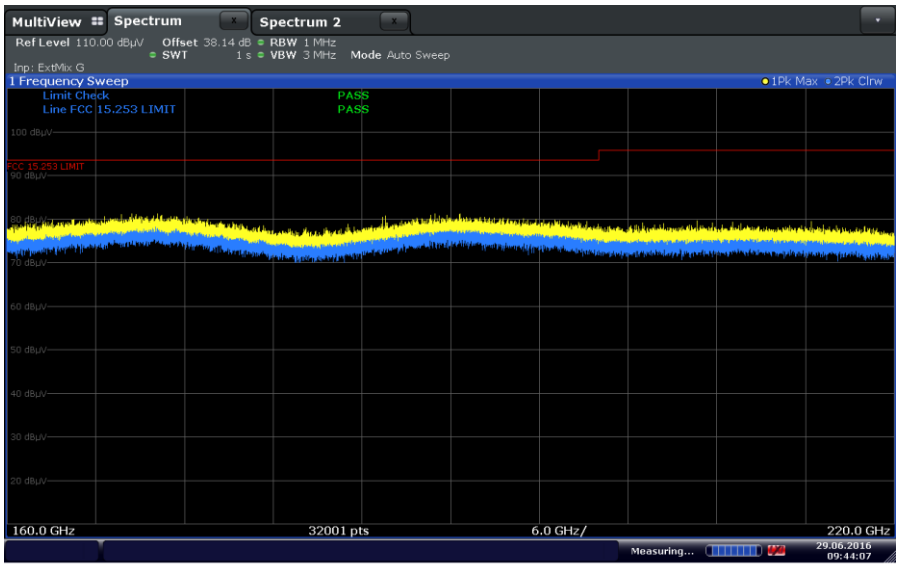
Date: 29.JUN.2016 09:45:38

160 to 220 GHz Low Channel 175 MHz BW



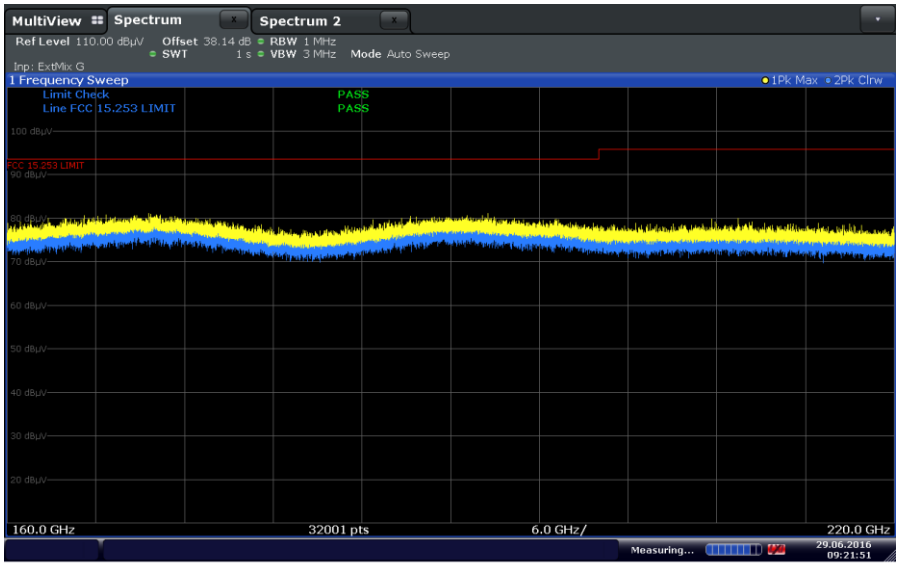
Date: 29.JUN.2016 09:43:14

160 to 220 GHz Mid Channel 175 MHz BW



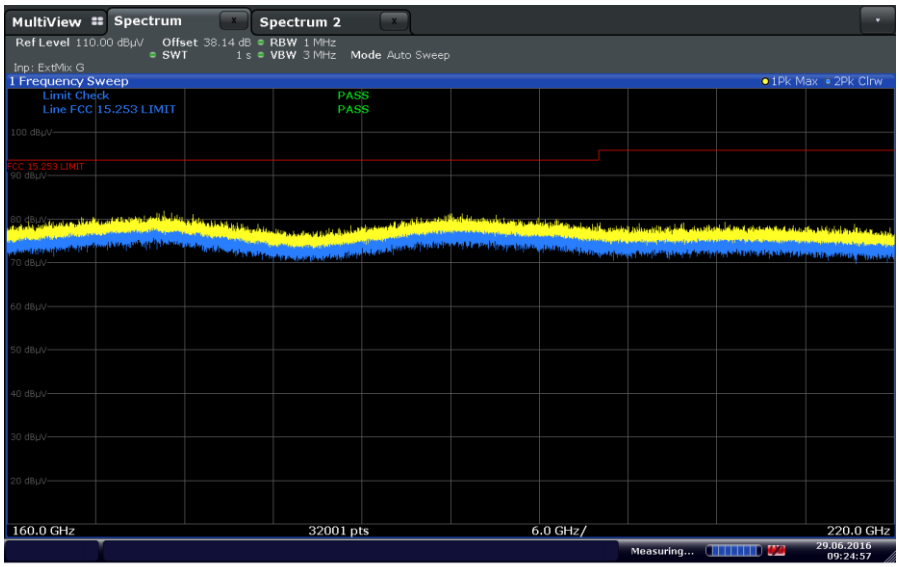
Date: 29.JUN.2016 09:44:07

160 to 220 GHz High Channel 175 MHz BW



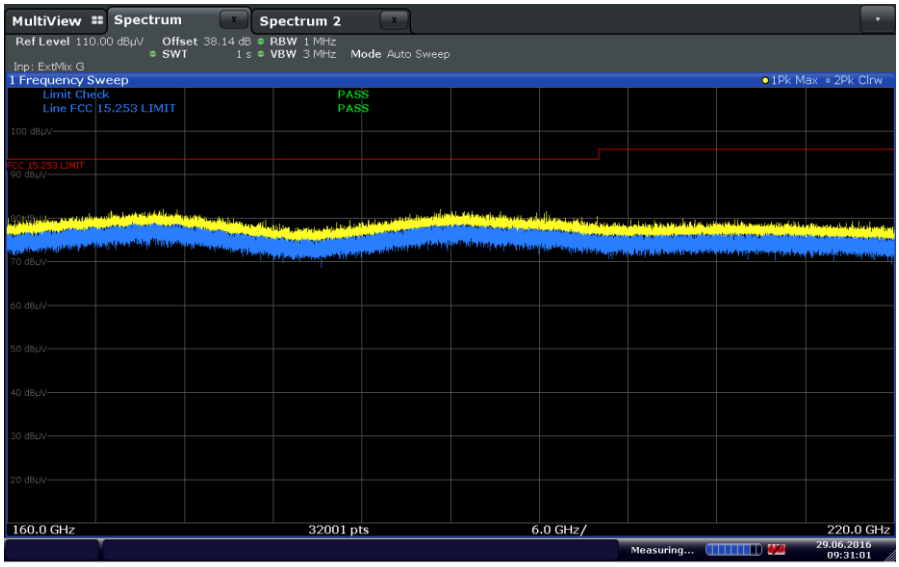
Date: 29.JUN.2016 09:21:51

160 to 220 GHz Low Channel 300 MHz BW



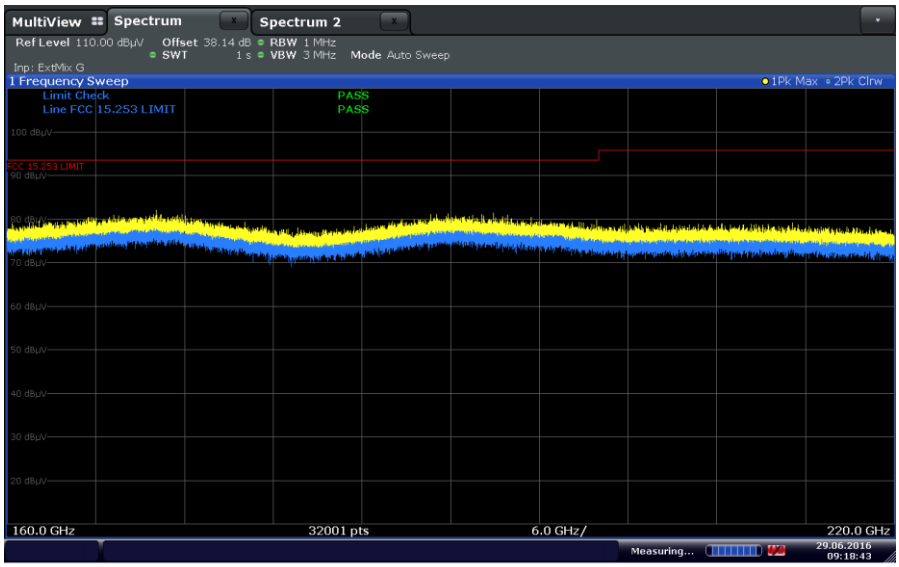
Date: 29.JUN.2016 09:24:57

160 to 220 GHz Mid Channel 300 MHz BW



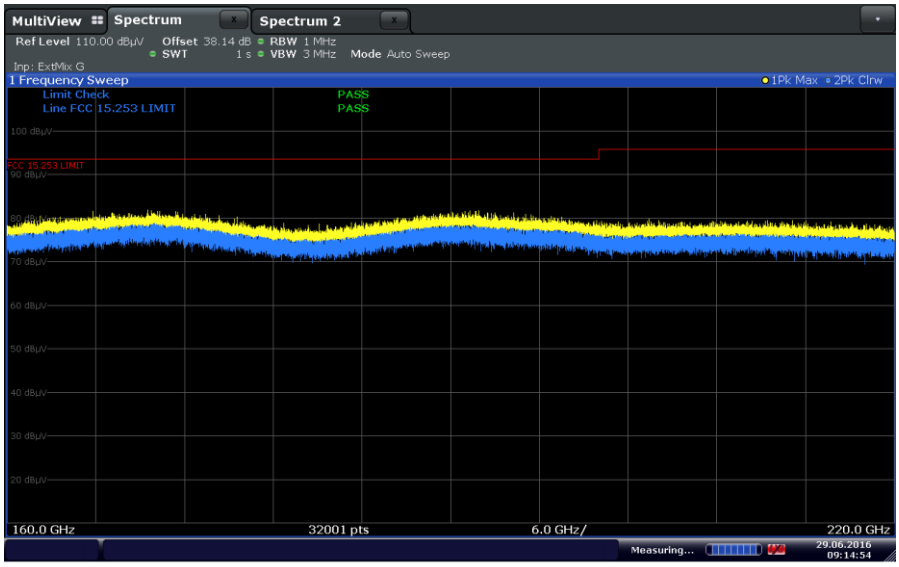
Date: 29.JUN.2016 09:31:02

160 to 220 GHz High Channel 300 MHz BW



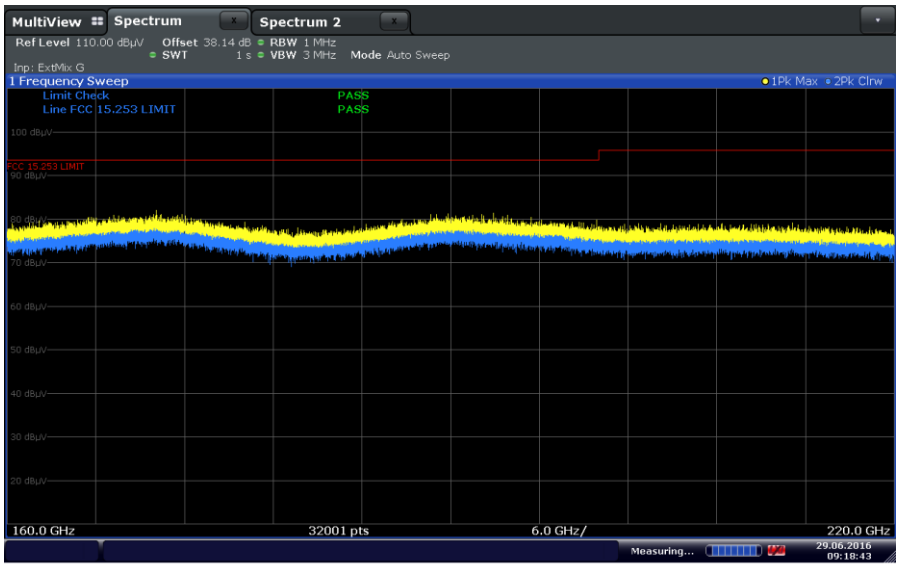
Date: 29.JUN.2016 09:18:43

160 to 220 GHz Low Channel 425 MHz BW



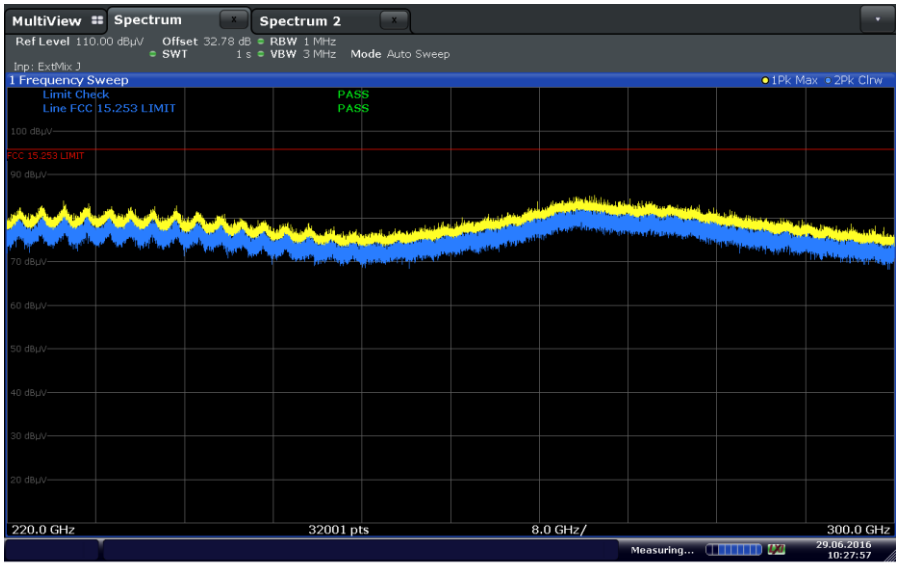
Date: 29.JUN.2016 09:14:54

160 to 220 GHz Mid Channel 425 MHz BW



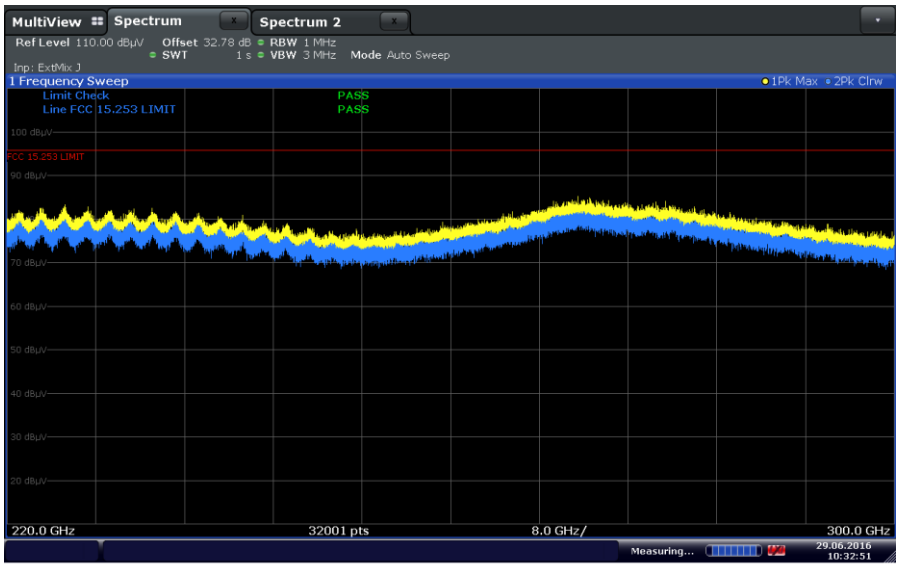
Date: 29.JUN.2016 09:18:43

160 to 220 GHz High Channel 425 MHz BW



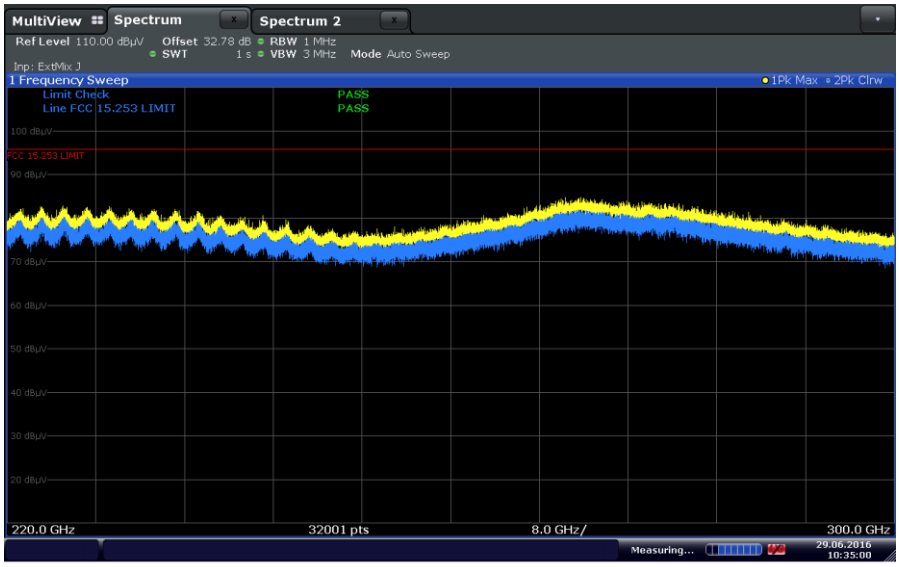
Date: 29.JUN.2016 10:27:56

220 to 300 GHz Low Channel 175 MHz BW



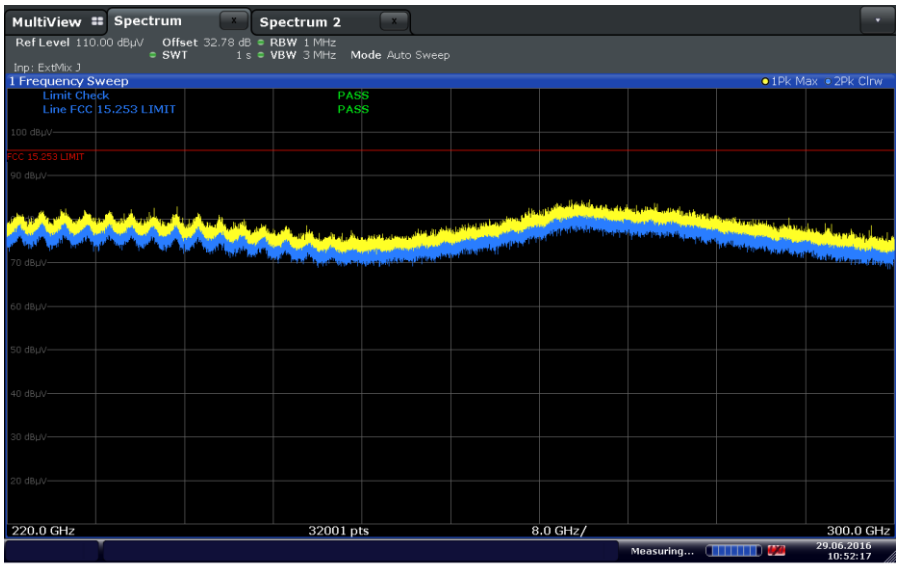
Date: 29.JUN.2016 10:32:50

220 to 300 GHz Mid Channel 175 MHz BW



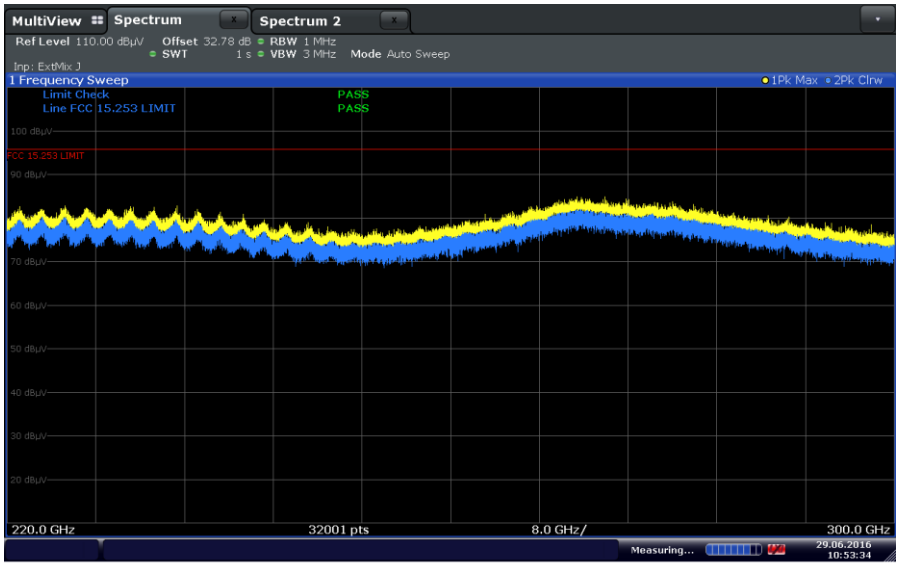
Date: 29.JUN.2016 10:35:00

220 to 300 GHz High Channel 175 MHz BW



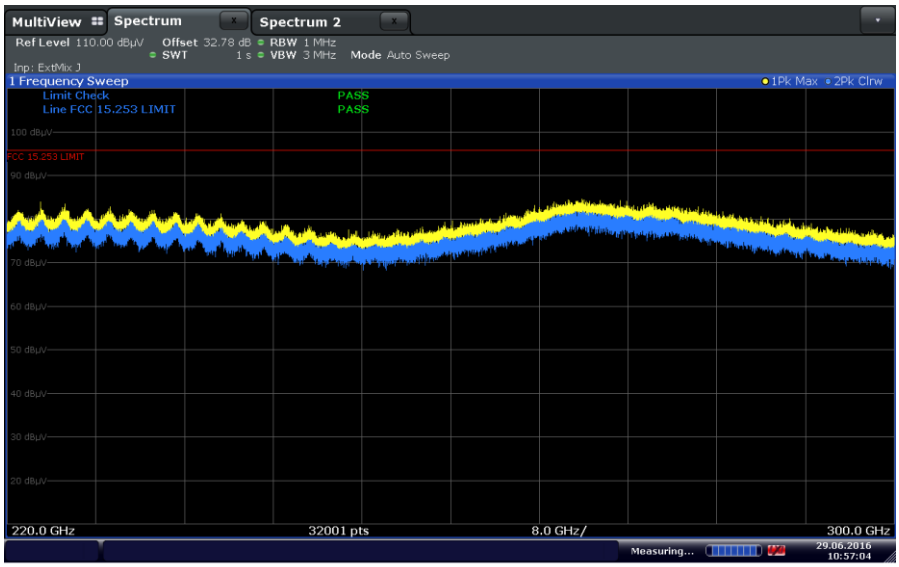
Date: 29.JUN.2016 10:52:17

220 to 300 GHz Low Channel 300 MHz BW



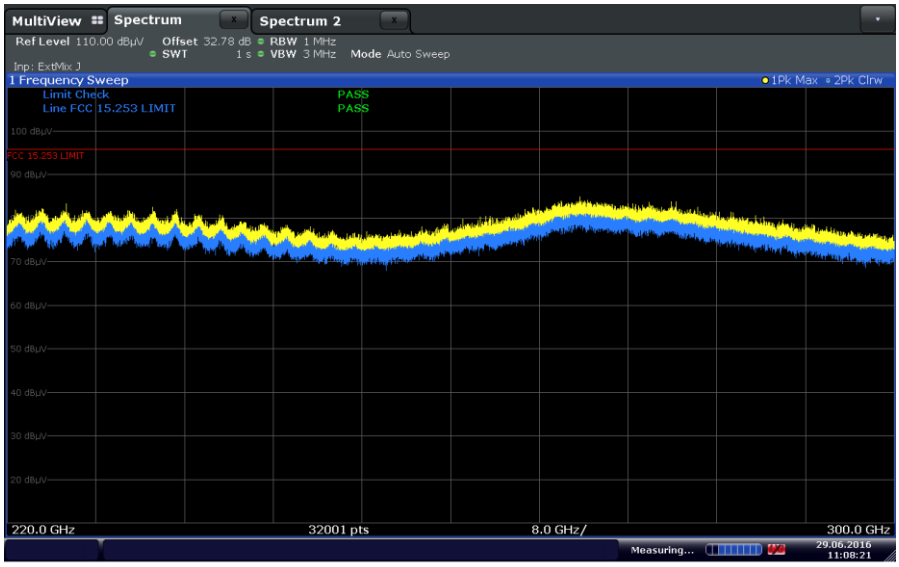
Date: 29.JUN.2016 10:53:34

220 to 300 GHz Mid Channel 300 MHz BW



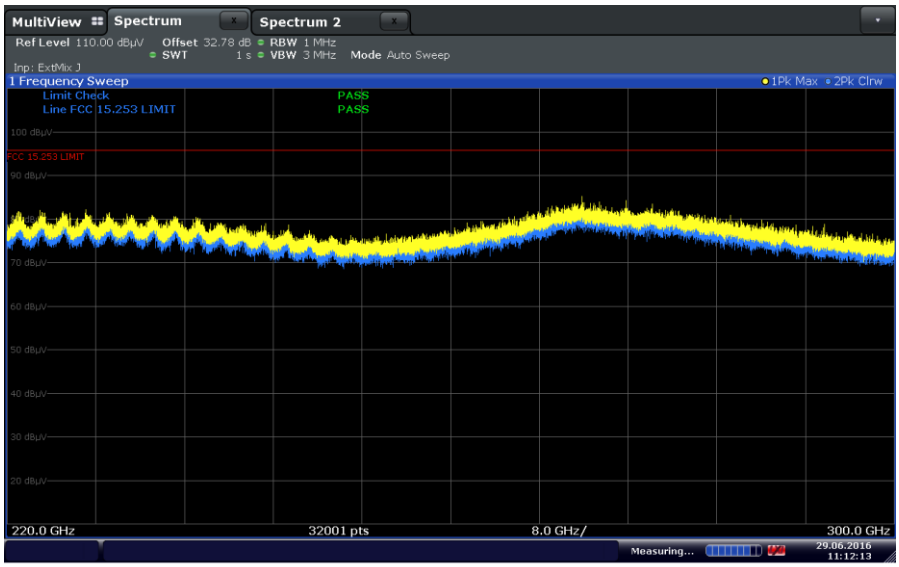
Date: 29.JUN.2016 10:57:04

220 to 300 GHz High Channel 300 MHz BW



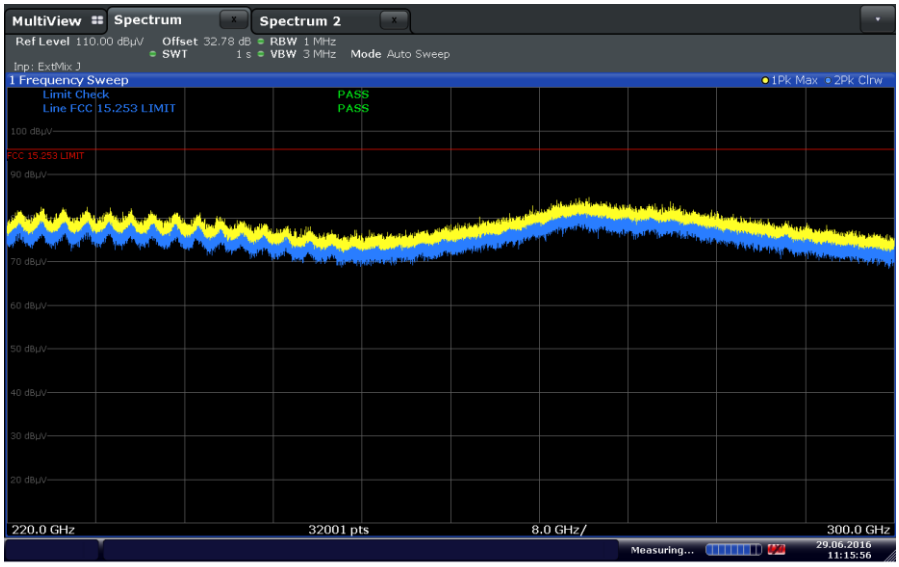
Date: 29.JUN.2016 11:08:21

220 to 300 GHz Low Channel 425 MHz BW



Date: 29.JUN.2016 11:12:13

220 to 300 GHz Mid Channel 425 MHz BW



Date: 29.JUN.2016 11:15:56

220 to 300 GHz High Channel 425 MHz BW