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Report On

Radio Testing of the
Aptiv Deutschland GmbH
J4TR Short Range Radar

FCC Part 95 Subpart M
ISED RSS-251 Issue 2 July 2018

Report No. 72142985A

November 2018



TÜV SÜD America Inc., 10040 Mesa Rim Road, San Diego, CA 92121
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REPORT ON Radio Testing of the
Aptiv Deutschland GmbH
J4TR Short Range Radar

TEST REPORT NUMBER 72142985A

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DATED December 13, 2018



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Revision History

72142985A Aptiv Deutschland GmbH J4TR Short Range Radar					
DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
12/13/18		Initial Release			Ferdinand S. Custodio
2/27/2019	Second Release	Rev-1	Peak Power Re-measurement	15-24	Ferdinand S. Custodio



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SECTION 1

REPORT SUMMARY

Radio Testing of the
Aptiv Deutschland GmbH
J4TR Short Range Radar



1.1 INTRODUCTION

The information contained in this report is intended to show verification of the Aptiv Deutschland GmbH Short Range Radar to the requirements of FCC Part 95 Subpart M and ISSED RSS-251 Issue 2 July 2018.

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	Aptiv Deutschland GmbH
Product Name	J4TR
Model Number(s)	J4TR
FCC ID Number	LTQJ4TR
IC Number	3659A-J4TR
Serial Number(s)	28508527.C.6, 28508527.C.4, 28508527.C.3
Number of Samples Tested	3
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 2, July 2018). • RSS-Gen - General Requirements and Information for the Certification of Radio Apparatus (Issue 5, April 2018). • KDB 653005 76-81 GHz Radars v01
Start of Test	October 22, 2018
Finish of Test	December 13, 2018
Name of Engineer(s)	Sandipan Basu
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 8 & 9	Power Density Limits	Compliant	
2.2	FCC 47 CFR Part 2 2.1049 and 2.202(a)	RSS-GEN 6.7	99% Emission Bandwidth	Compliant	
2.3	§95.3379(a)	RSS-251 10	Spurious Emissions	Compliant	
2.4	§95.3379(b)	RSS-251 11	Frequency stability	Compliant	



1.3 PRODUCT INFORMATION

1.3.1 Technical Description

The Equipment Under Test (EUT) was a Aptiv Deutschland GmbH J4TR . The EUT is a Short Range Radar . The EUT operates in the 76-77 GHz band. The device employs a dynamic chirp modulated transmit array. 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 or 24.0 VDC.

1.3.2 EUT General Description

EUT Description	Third Generation Short Range Radar
Product Name	J4TR Short Range Radar
Model Number(s)	J4TR
Rated Voltage	12.0 VDC or 24.0 VDC
Output Power	27.05 dBm Peak EIRP
Frequency Range	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

1.3.3 Antenna Details

Manufacturer	Aptiv Services Deutschland GmbH
Antenna Type	Planar Array Antenna
Antenna Gain	14 dBi
EUT Antenna Connector	N/A
Maximum Dimensions	96.5 mm x 73.9 mm x 23.0 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

Before each test, the EUT is configured using BMWCalFlasher v3.01. 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	Dell Precision M65 (Delphi Wireless Test Configuration Support Laptop)
Dell	PA-12 AC Adapter	M/N: LA65NS2-01
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

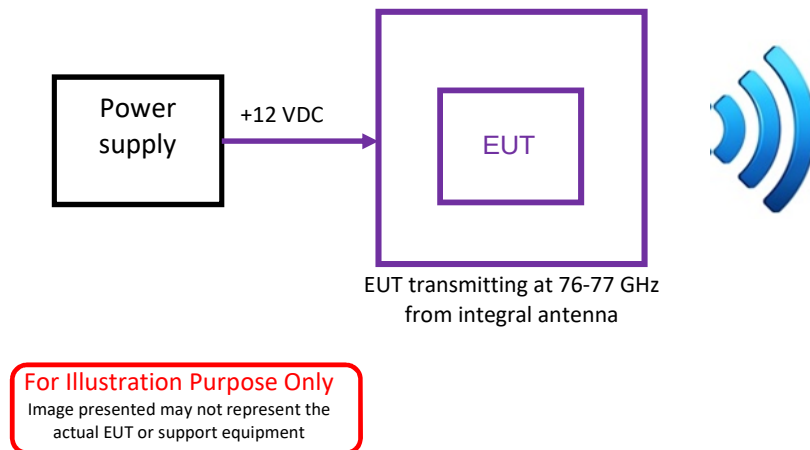
1.4.4 Single Case Configuration

Single-case configuration used in this test report.

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

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

1.4.5 Simplified Test Configuration Diagram





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: 28508527.C.6, 28508527.C.4, 28508527.C.3		
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-0280 and A-0281

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.

1.9.6 RRA – Identification No. US0102

TUV SUD America Inc. (San Diego) is National Radio Research Agency (RRA) recognized laboratory under Phase I of the APEC Tel MRA.

1.9.7 OFCA – U.S. Identification No. US0102

TUV SUD America Inc. (San Diego) is recognized by Office of the Communications Authority (OFCA) under Appendix B, Phase I of the APEC Tel MRA.



SECTION 2

TEST DETAILS

Radio Testing of the
Aptiv Deutschland GmbH
J4TR



2.1 POWER DENSITY LIMITS

2.1.1 Specification Reference

Part 95 Subpart M §95.3367(a) and (b) and RSS-251 Issue 2 Sec. 8.0 and Section 9.0

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: 28508527.C.4, 28508527.C.3 / Default Test Configuration

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

October 23, 2018 /SB

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. Mira Mesa facility

Ambient Temperature	22.22°C
Relative Humidity	72 %
ATM Pressure	101.12 kPa

2.1.7 Additional Observations

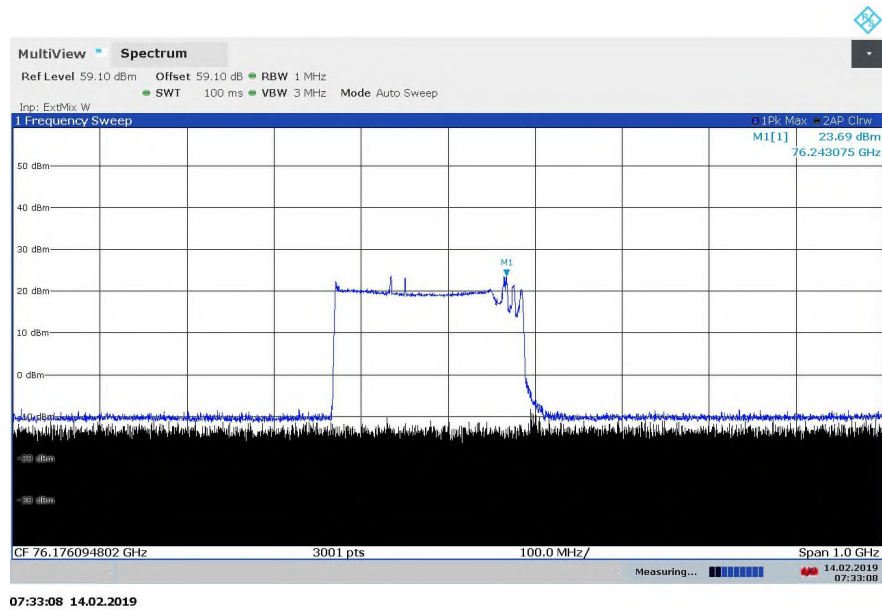
- This is a radiated test.
- Test distance of 3 m was used for the fundamental emissions measurement.
- A correction factor of 59.1 dB and mixer conversion loss table were used to account for the test antenna gain, free-space loss and external mixer loss. This was done only for the Average Power measurement. For Peak measurement the correction factor was directly entered in the Analyzer.
- Sample correction factor calculation @ 76.5 GHz:

Correction Factor (dB)	Asset# 7628 (antenna)	-22.5	59.1
	External 2 dB attenuator	2.0	
	Free space loss	79.6	

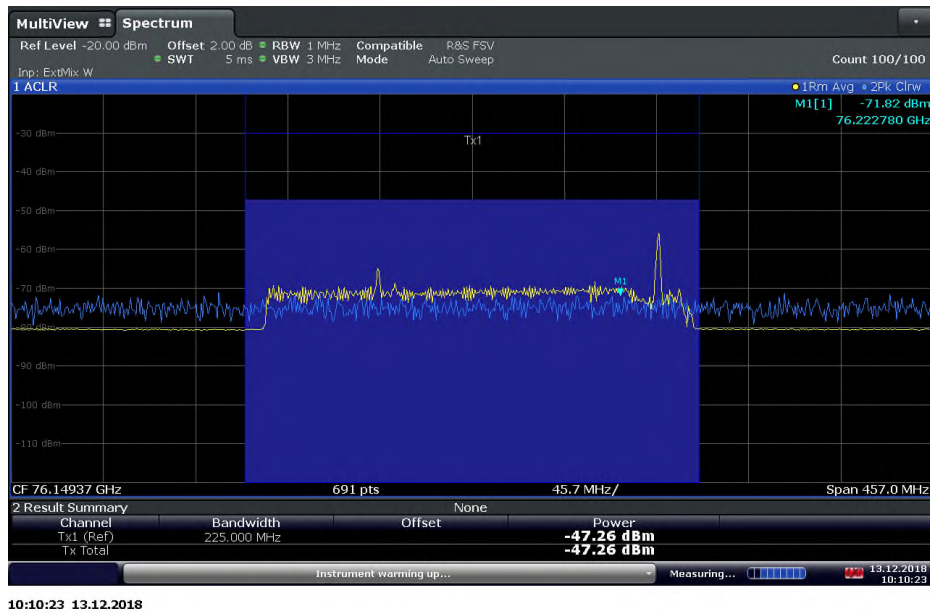
2.1.8 Test Results

Peak EIRP			
Modulation BW	Channel	Measured EIRP (dBm)	Limit (dBm)
175 MHz	Low (76.050 GHz)	23.69	55
	Mid (76.413GHz)	23.05	
	High (76.760 GHz)	23.69	
300 MHz	Low (76.050 GHz)	21.99	
	Mid (76.350 GHz)	22.89	
	High (76.575 GHz)	22.97	
425 MHz	Low (76.050 GHz)	22.70	
	Mid (76.288 GHz)	23.46	
	High (76.405 GHz)	24.20	
Average EIRP			
Modulation BW	Channel	Measured EIRP (dBm)	Limit (dBm)
175 MHz	Low (76.005 GHz)	11.84	50
	Mid (76.413GHz)	14.8	
	High (76.760 GHz)	16.28	
300 MHz	Low (76.005 GHz)	13.36	
	Mid (76.350 GHz)	14.73	
	High (76.575 GHz)	16.06	
425 MHz	Low (76.005 GHz)	13.79	
	Mid (76.288 GHz)	14.52	
	High (76.405 GHz)	15.42	
Result: EUT complies			

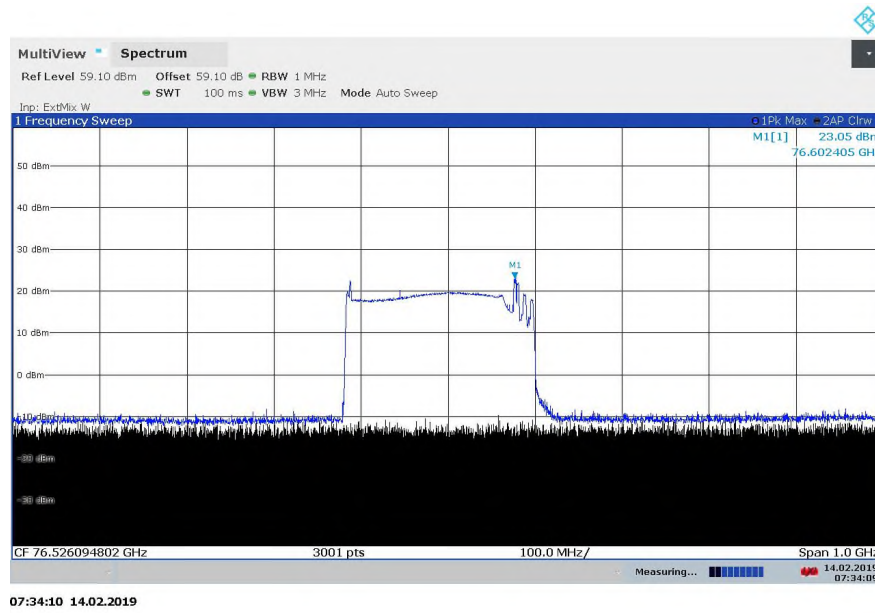
2.1.9 Test plots



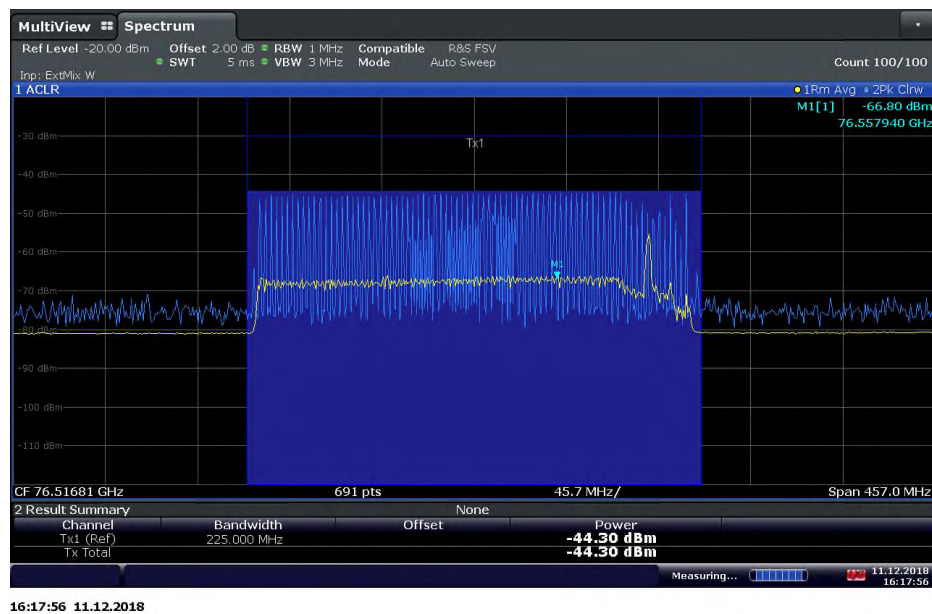
Low Channel 175 MHz BW (Peak detector)



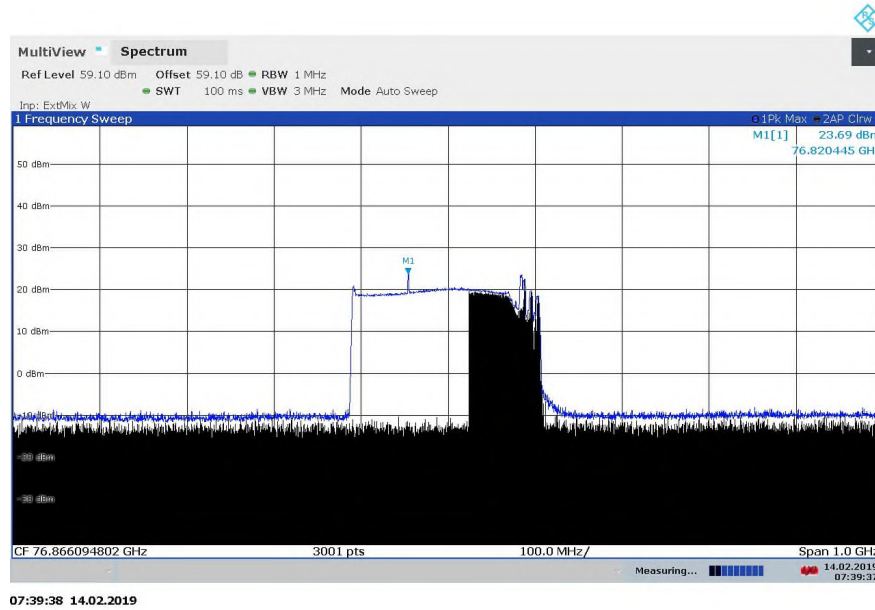
Low Channel 175 MHz BW (RMS detector)



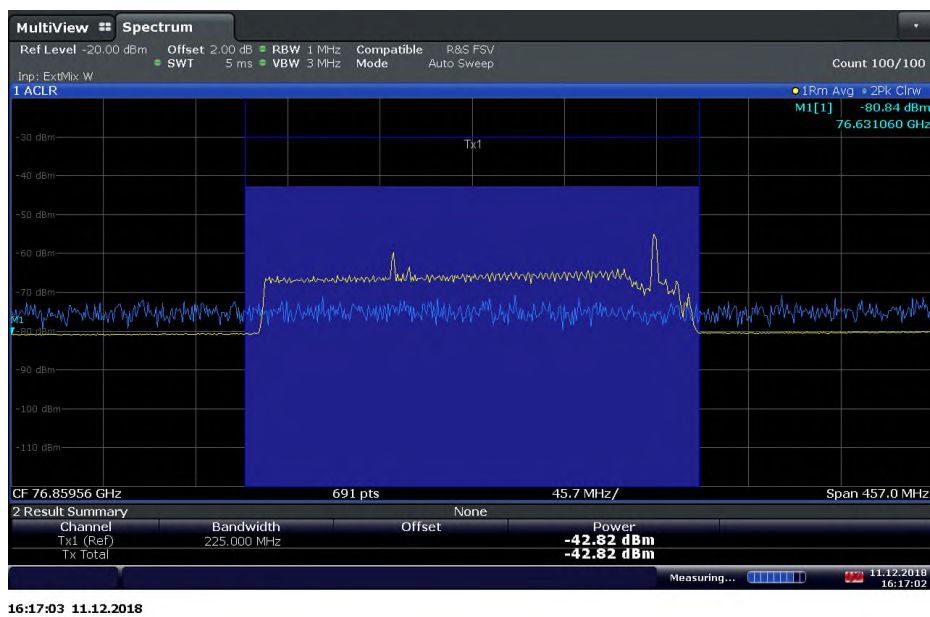
Mid Channel 175 MHz BW (Peak detector)



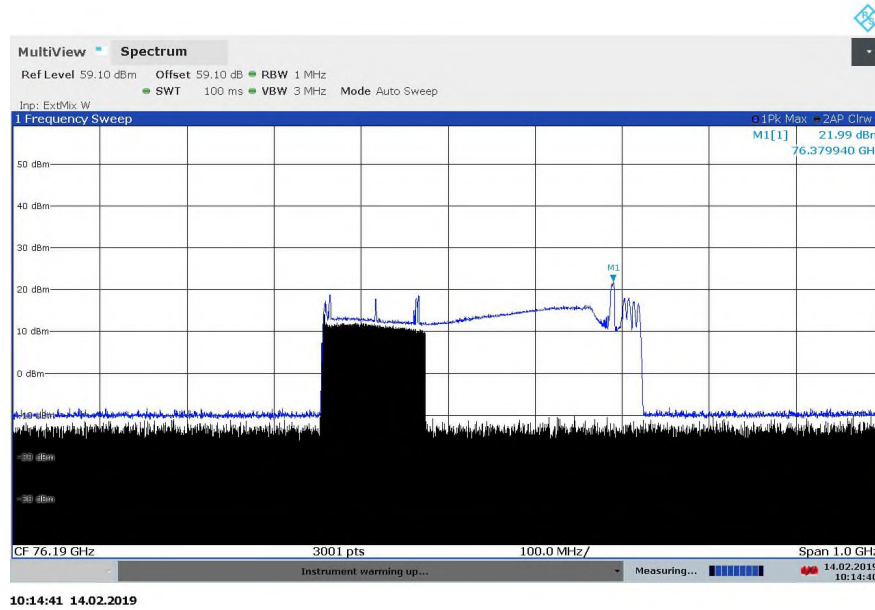
Mid Channel 175 MHz BW (RMS detector)



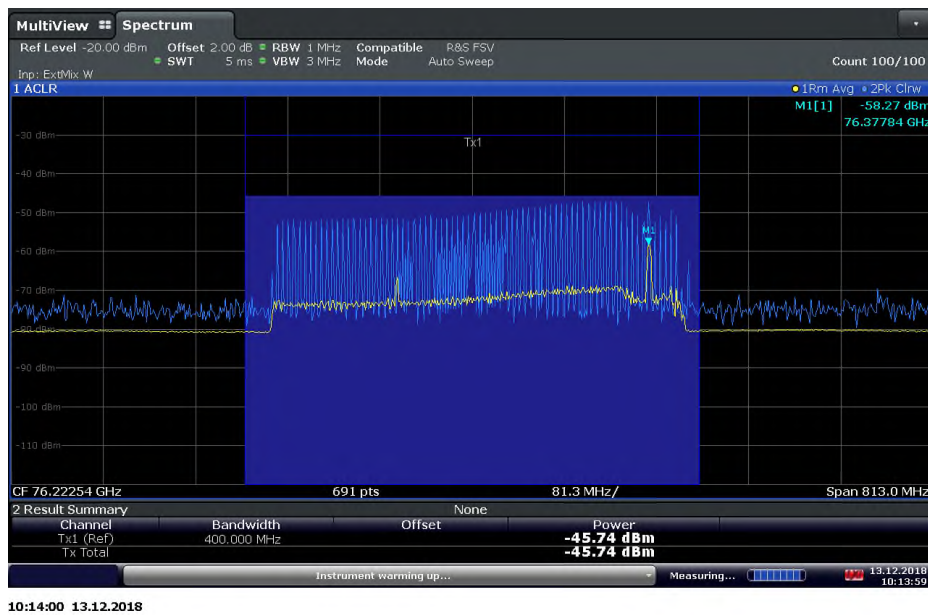
High Channel 175 MHz BW (Peak detector)



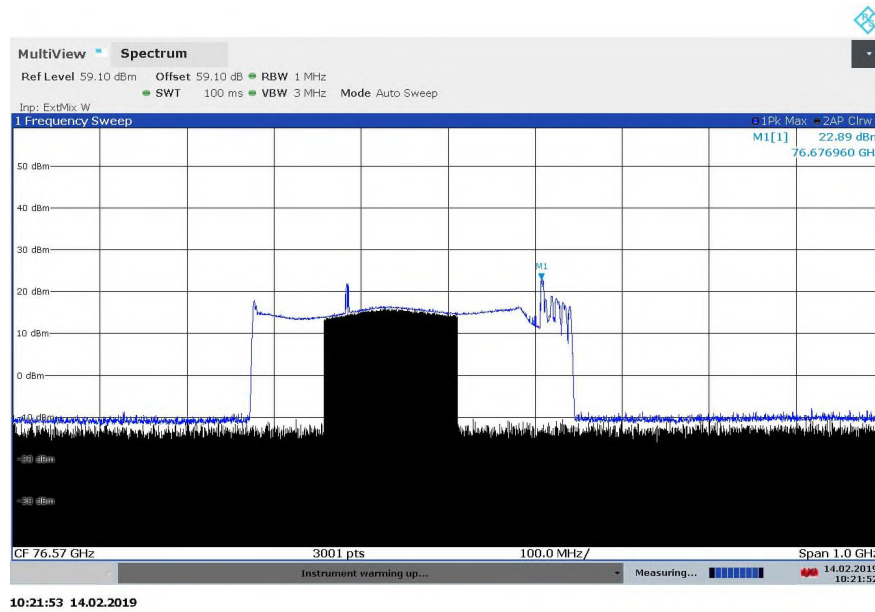
High Channel 175 MHz BW (RMS detector)



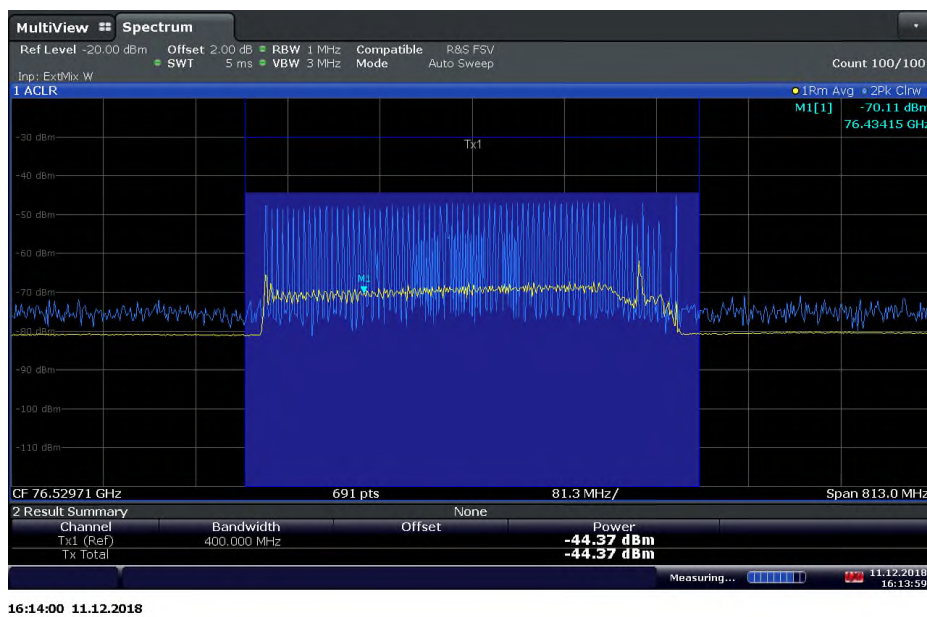
Low Channel 300 MHz BW (Peak detector)



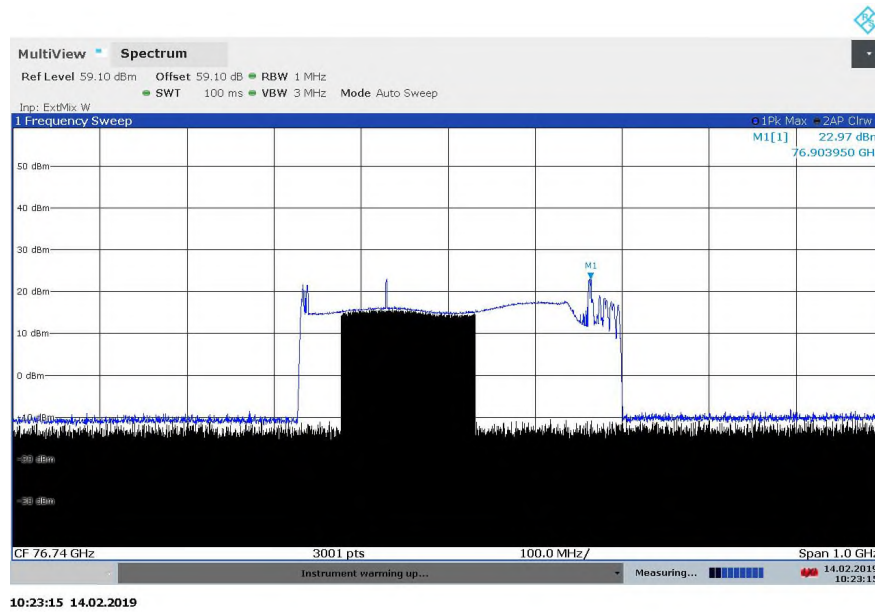
Low Channel 300 MHz BW (RMS detector)



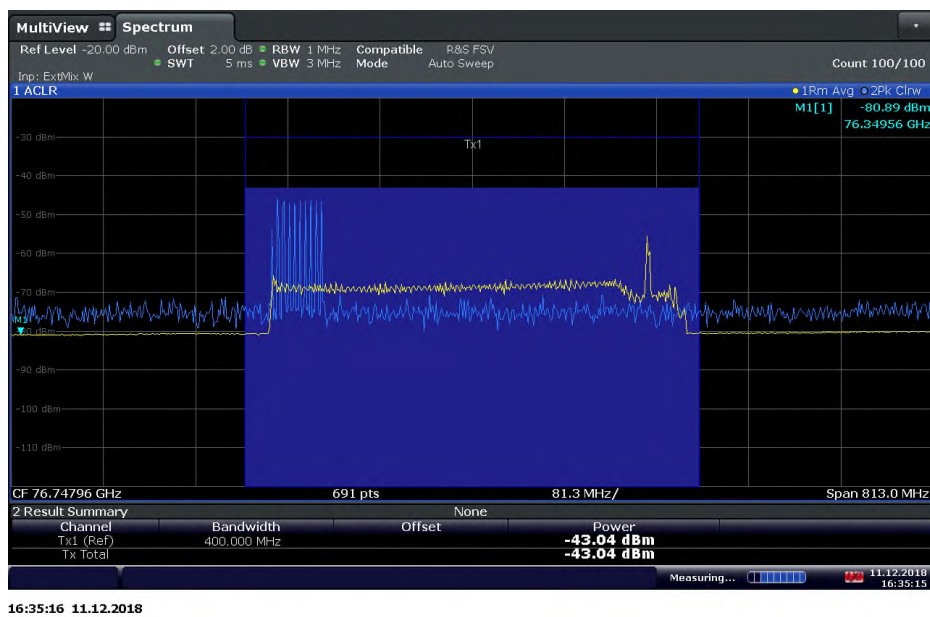
Mid Channel 300 MHz BW (Peak detector)



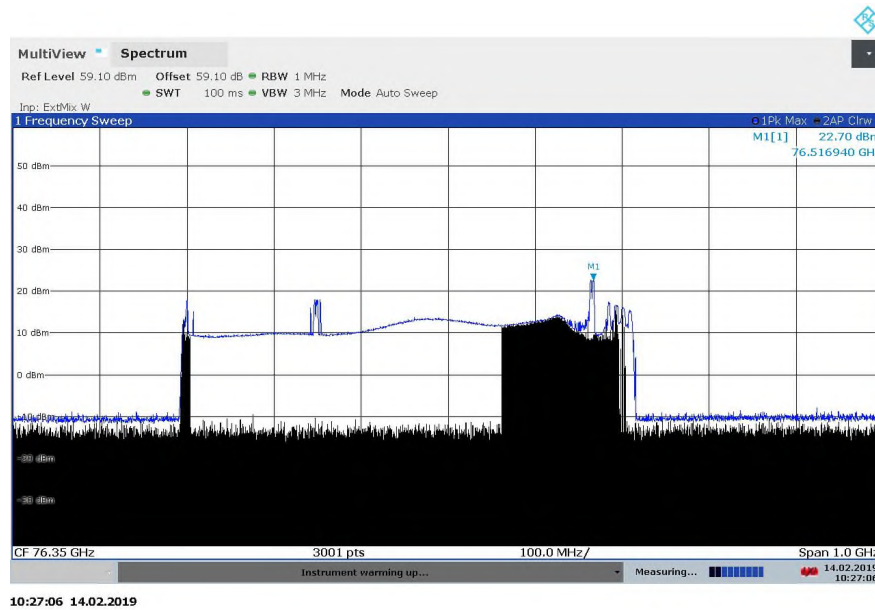
Mid Channel 300 MHz BW (RMS detector)



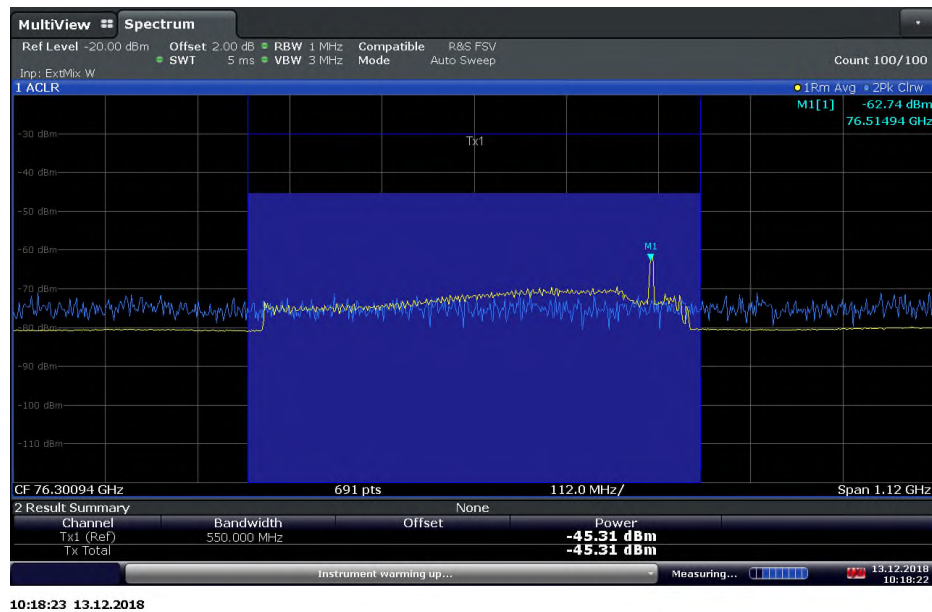
High Channel 300 MHz BW (Peak detector)



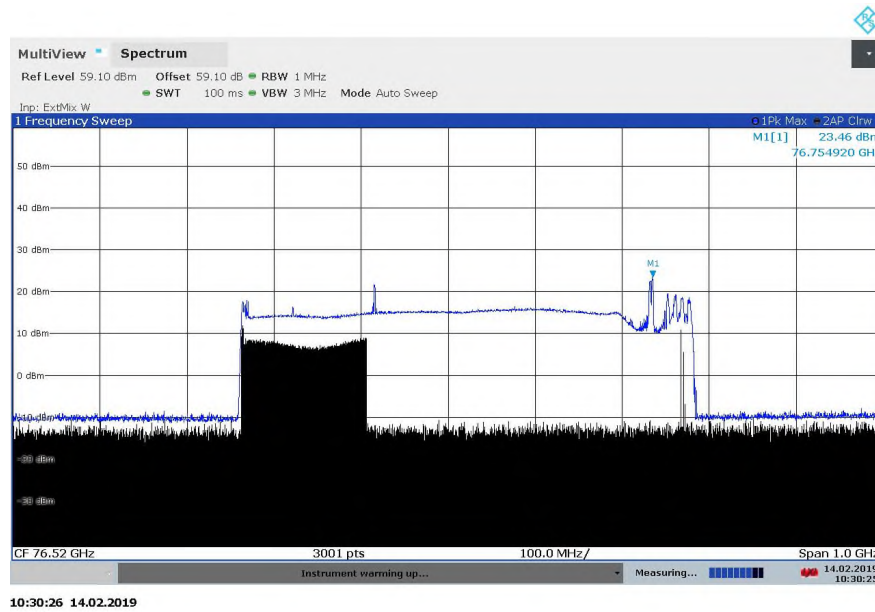
High Channel 300 MHz BW (RMS detector)



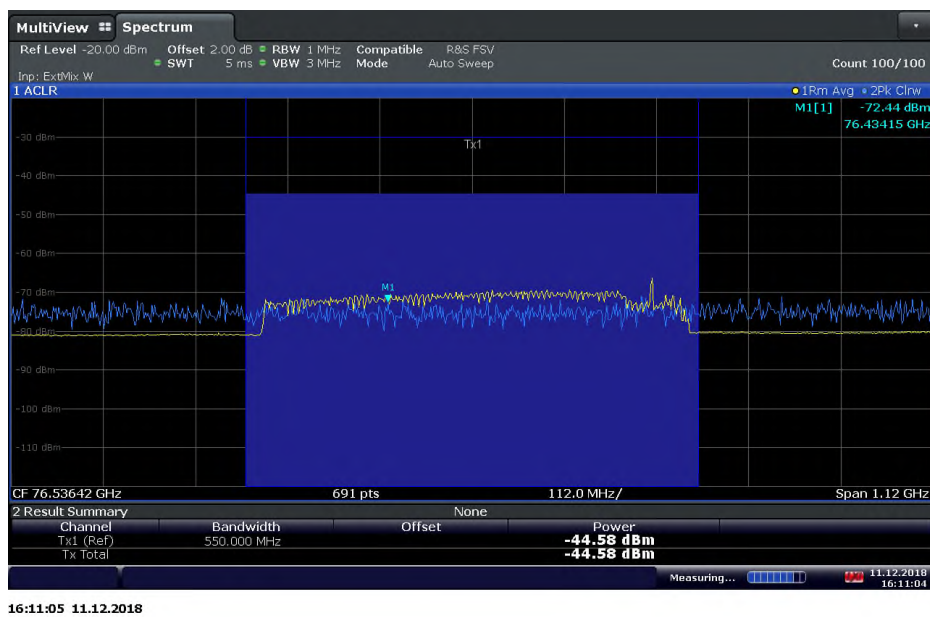
Low Channel 425 MHz BW (Peak detector)



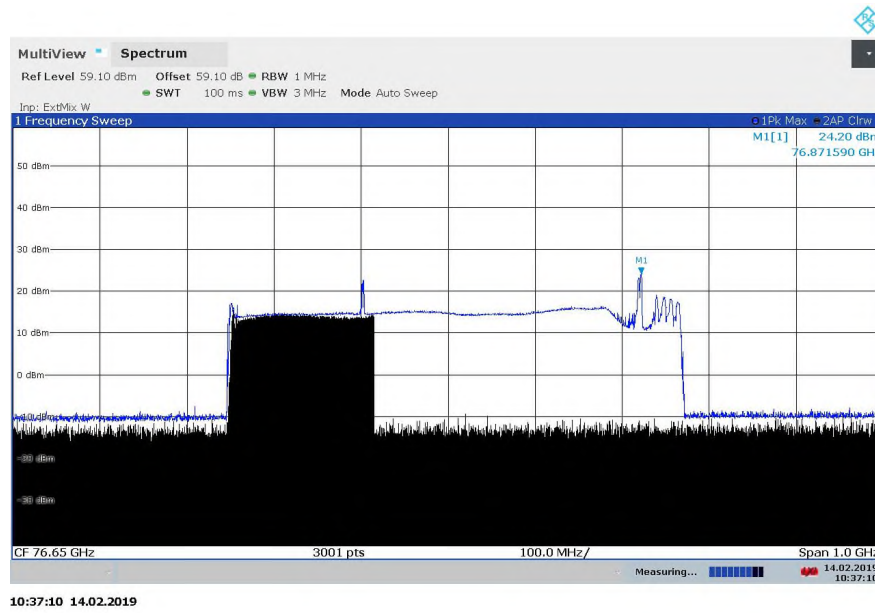
Low Channel 425 MHz BW (RMS detector)



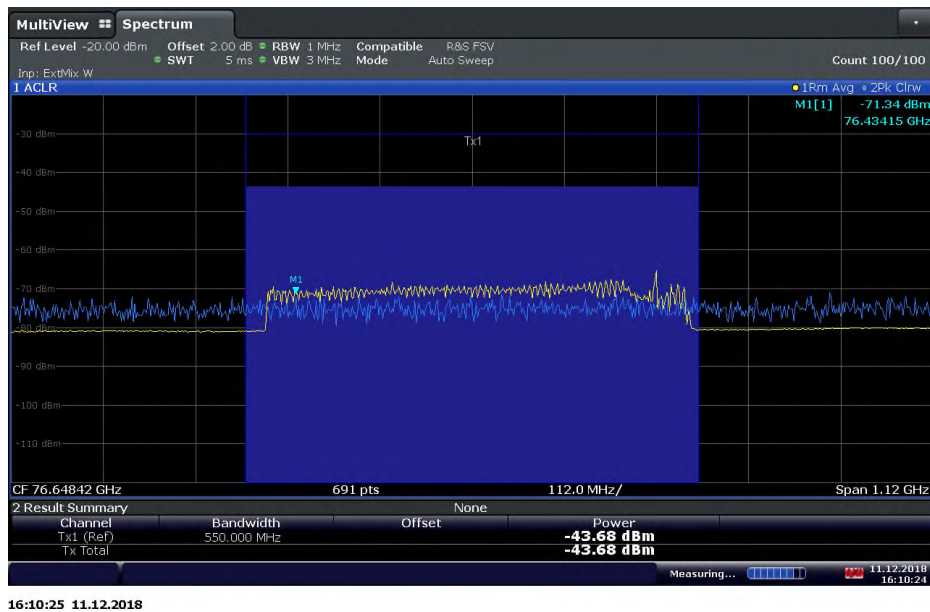
Mid Channel 425 MHz BW (Peak detector)



Mid Channel 425 MHz BW (RMS detector)



High Channel 425 MHz BW (Peak detector)



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 5 Section 6.7

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: 28508527.C.6 / Default Test Configuration

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

October 23, 2018/SB

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	22.22°C
Relative Humidity	72%
ATM Pressure	101.12 kPa

2.2.7 Additional Observations

- This is a radiated test.
- Span is wide enough to capture the channel transmission.
- 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).

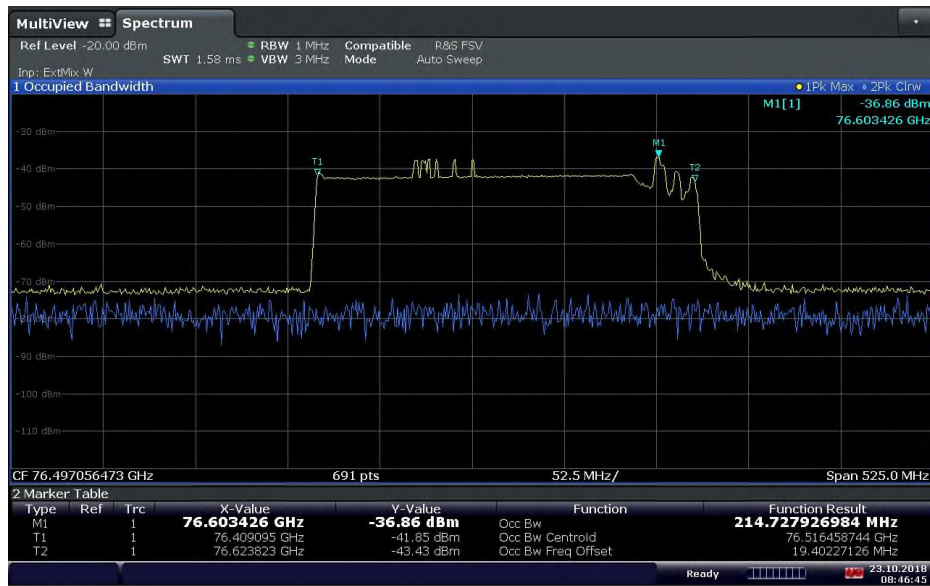
2.2.8 Summary Test Results (as reported)

Occupied Bandwidth			
Modulation BW	Low Channel	Mid Channel	High Channel
175 MHz	211.44 MHz	214.73 MHz	212.98 MHz
300 MHz	365.29 MHz	365.58 MHz	365.49 MHz
425 MHz	517.31 MHz	516.65 MHz	515.93 MHz

2.2.9 Test Plots

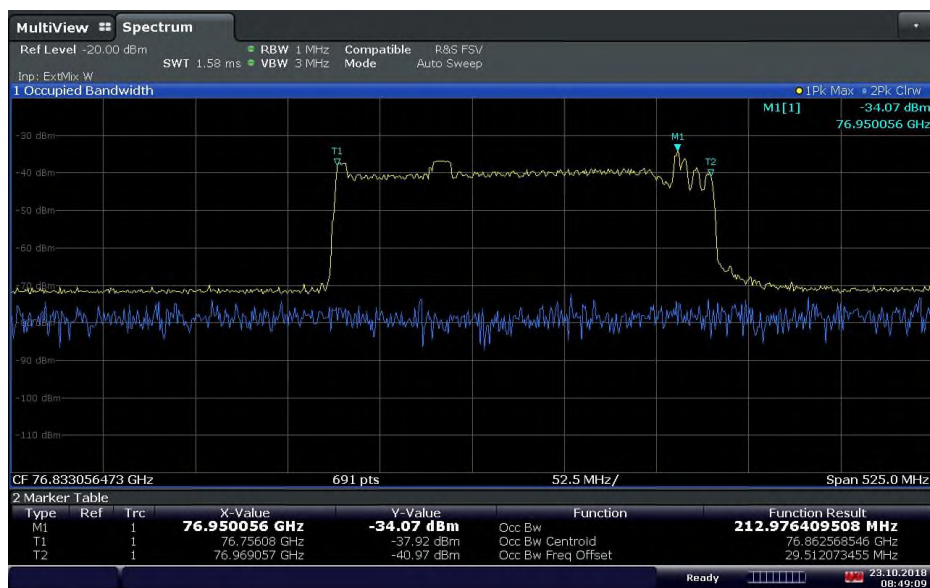


Low channel 175 MHz BW



08:46:45 23.10.2018

Mid channel 175 MHz BW



08:49:09 23.10.2018

High channel 175 MHz BW



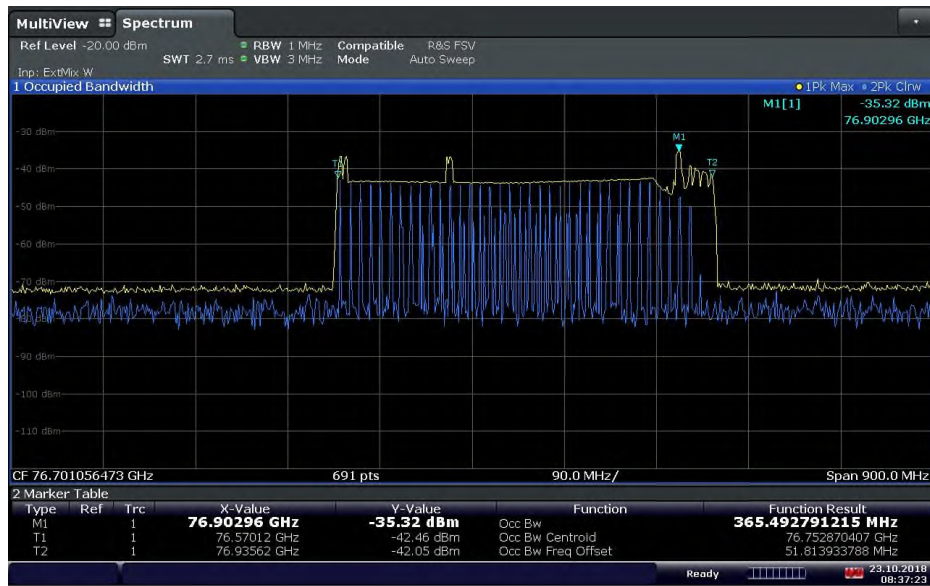
08:33:52 23.10.2018

Low channel 300 MHz BW



08:35:22 23.10.2018

Mid channel 300 MHz BW



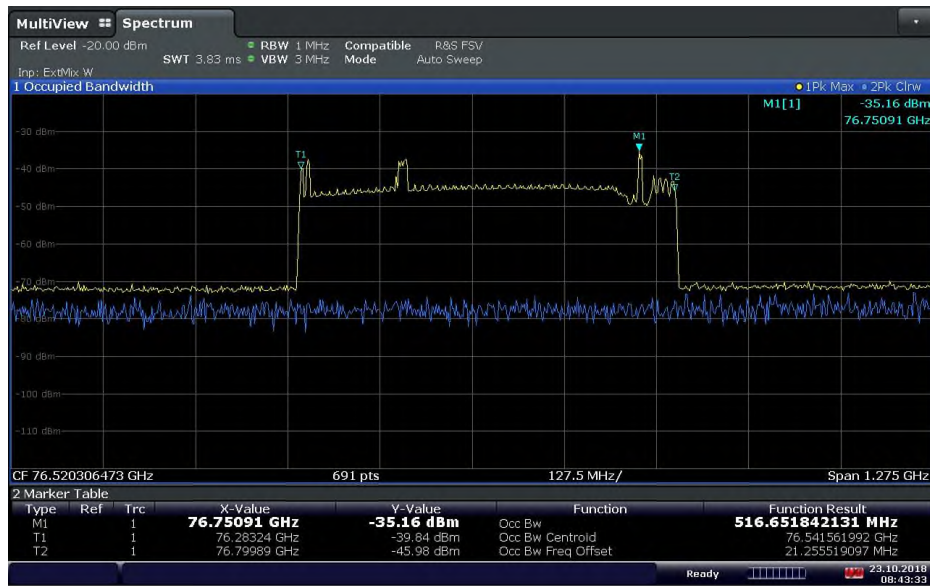
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High channel 300 MHz BW



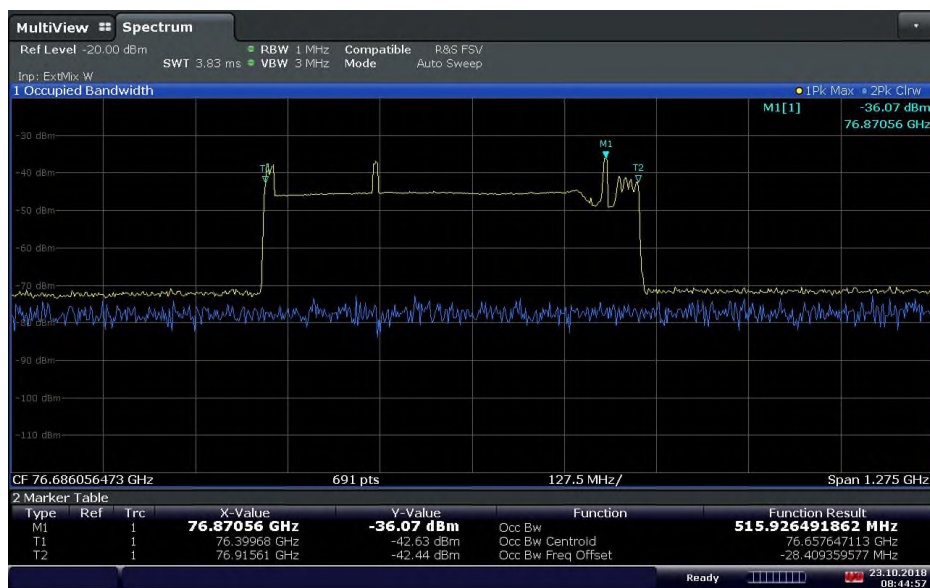
08:39:56 23.10.2018

Low channel 425 MHz BW



08:43:34 23.10.2018

Mid channel 425 MHz BW



08:44:58 23.10.2018

High channel 425 MHz BW



2.3 SPURIOUS RADIATED EMISSIONS

2.3.1 Specification Reference

FCC Part 95 Subpart M §95.3379(a) and RSS-251 Issue 2 Sec. 10.

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: 28508527.C.6 / Default Test Configuration



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

October 24 – November 6, 2018 /SB

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. Mira Mesa and Rancho Berando facility

Ambient Temperature	21.0-23.8°C
Relative Humidity	70.0 -89.0%
ATM Pressure	100.5-102.0 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.
- Measurements below 40 GHz were done using EMC32 V9.26.0 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.

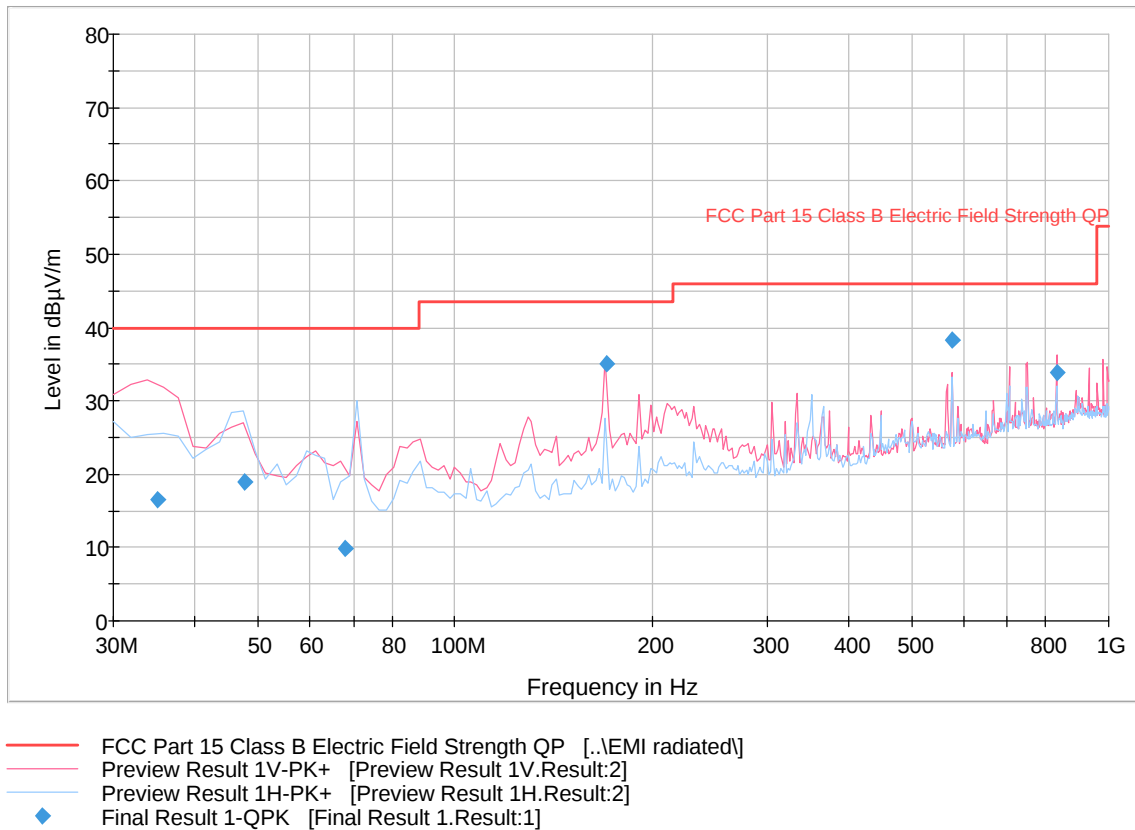
2.3.8 Sample Computation (Radiated Emission)

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

Compliant. See attached plots.

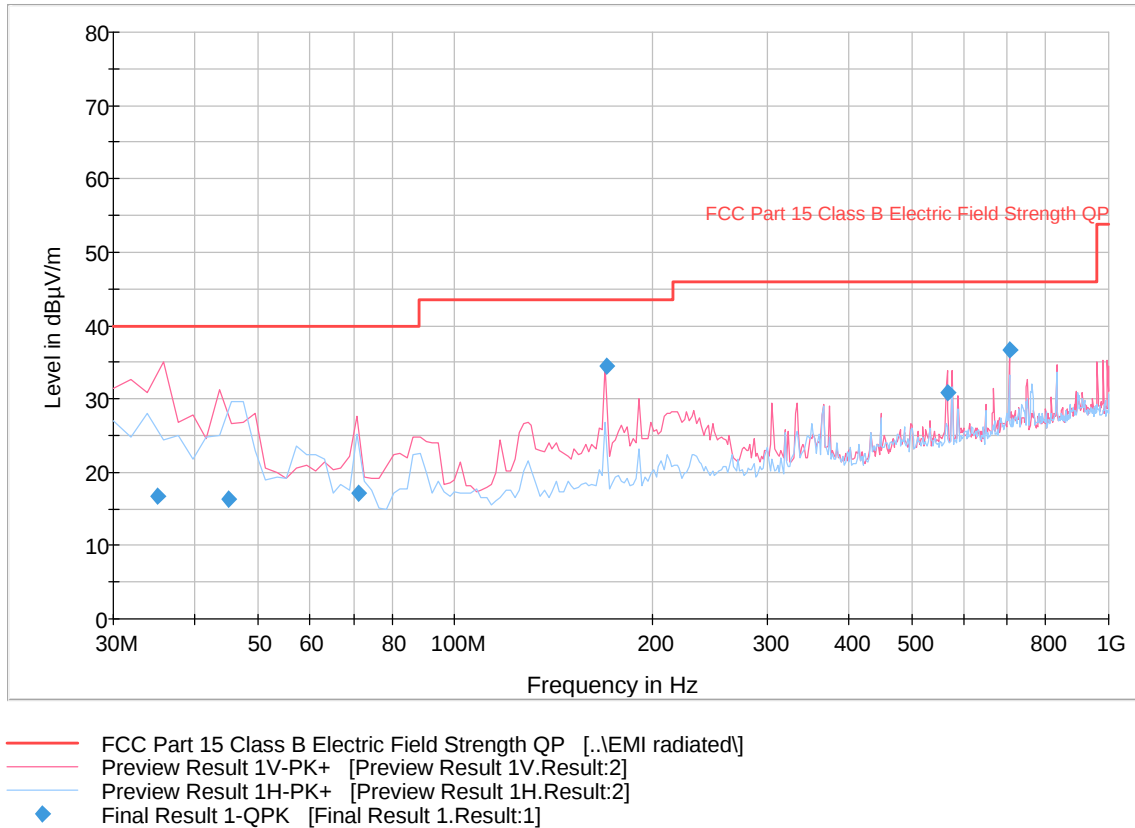
2.3.10 Test Results Below 1GHz Low Channel 175 MHz BW



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)	Comment
35.127776	16.5	1000.0	120.000	203.0	V	118.0	-	23.5	40.0	
47.614990	19.0	1000.0	120.000	300.0	H	191.0	-	21.0	40.0	
67.981643	9.8	1000.0	120.000	400.0	H	1.0	-	30.2	40.0	
170.119920	35.0	1000.0	120.000	100.0	V	210.0	-	8.5	43.5	
575.992465	38.2	1000.0	120.000	100.0	V	248.0	-	7.8	46.0	
831.985651	33.8	1000.0	120.000	132.0	V	199.0	4	12.2	46.0	

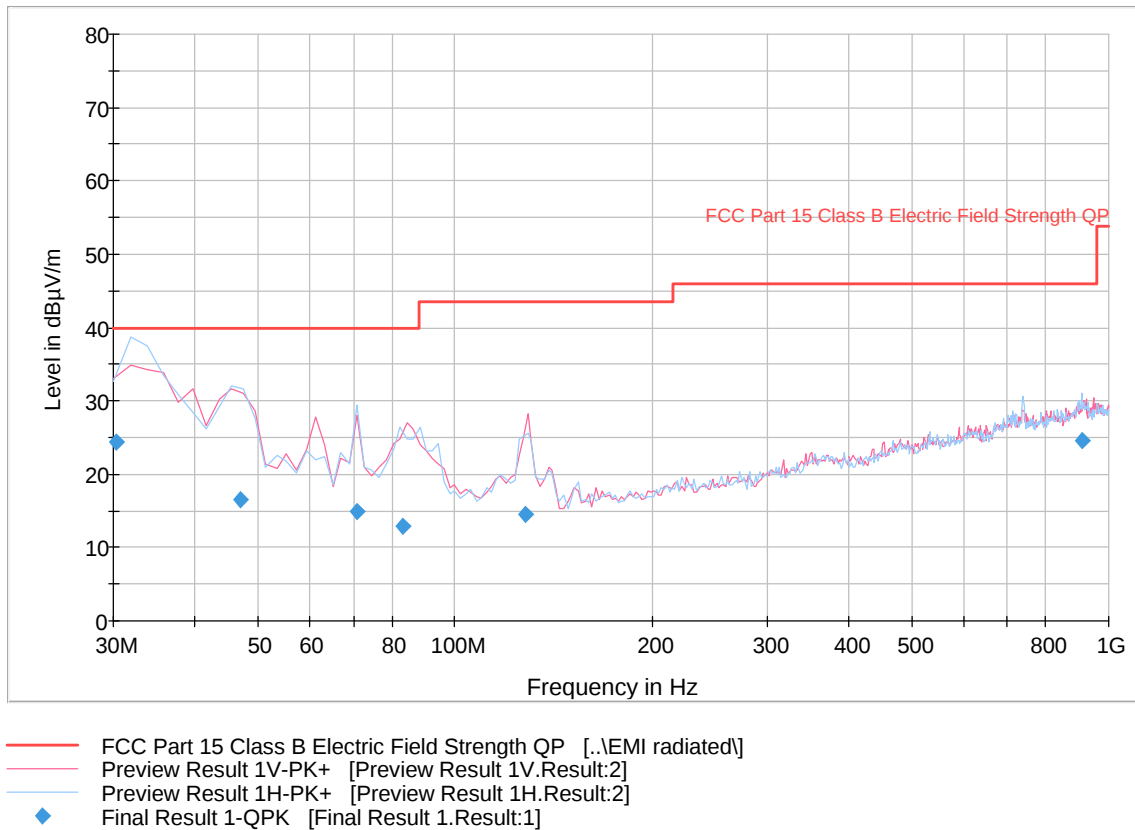
2.3.11 Test Results Below 1GHz Low Channel 300 MHz BW



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)	Comment
35.071663	16.8	1000.0	120.000	100.0	V	282.0	-9.9	23.2	40.0	
45.087214	16.2	1000.0	120.000	196.0	V	255.0	-13.5	23.8	40.0	
70.981643	17.2	1000.0	120.000	400.0	V	349.0	-16.9	22.8	40.0	
170.119920	34.5	1000.0	120.000	100.0	V	217.0	-11.6	9.0	43.5	
566.433026	30.9	1000.0	120.000	100.0	V	260.0	-0.8	15.1	46.0	
704.009058	36.6	1000.0	120.000	172.0	V	265.0	2.9	9.4	46.0	

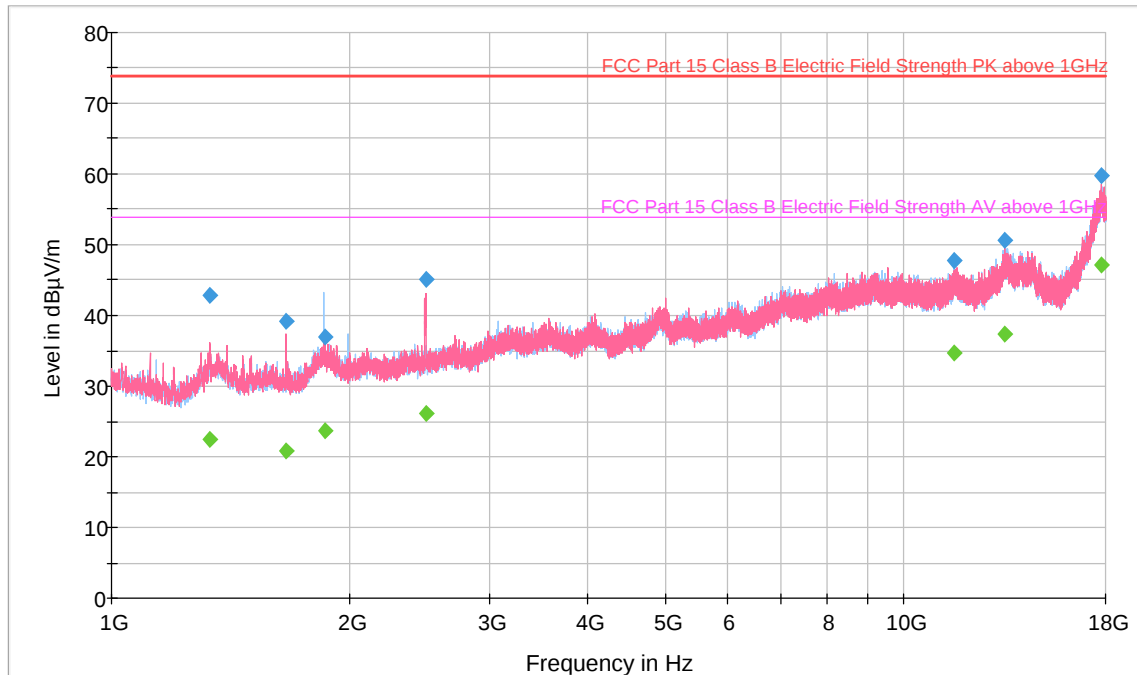
2.3.12 Test Results Below 1GHz Low Channel 425 MHz BW



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)	Comment
30.280000	24.3	1000.0	120.000	400.0	H	125.0	-7.9	15.7	40.0	
47.031102	16.6	1000.0	120.000	350.0	H	15.0	-14.1	23.4	40.0	
70.821643	15.0	1000.0	120.000	250.0	H	355.0	-16.9	25.0	40.0	
83.212745	12.9	1000.0	120.000	300.0	V	1.0	-16.3	27.1	40.0	
128.018277	14.5	1000.0	120.000	100.0	V	0.0	-14.3	29.0	43.5	
909.701162	24.7	1000.0	120.000	250.0	H	74.0	5.9	21.3	46.0	

2.3.13 Test Results 1 GHz to 18 GHz Low Channel 175 MHz BW



— Preview Result 1H-PK+ [Preview Result 1H.Result:2]
— Preview Result 1V-PK+ [Preview Result 1V.Result:2]
— FCC Part 15 Class B Electric Field Strength PK above 1GHz [..\EMI Radiated\
— FCC Part 15 Class B Electric Field Strength AV above 1GHz [..\EMI Radiated\
◆ Final_Result PK+ [Final_Result.Result:4]
◆ Final_Result AVG [Final_Result.Result:5]

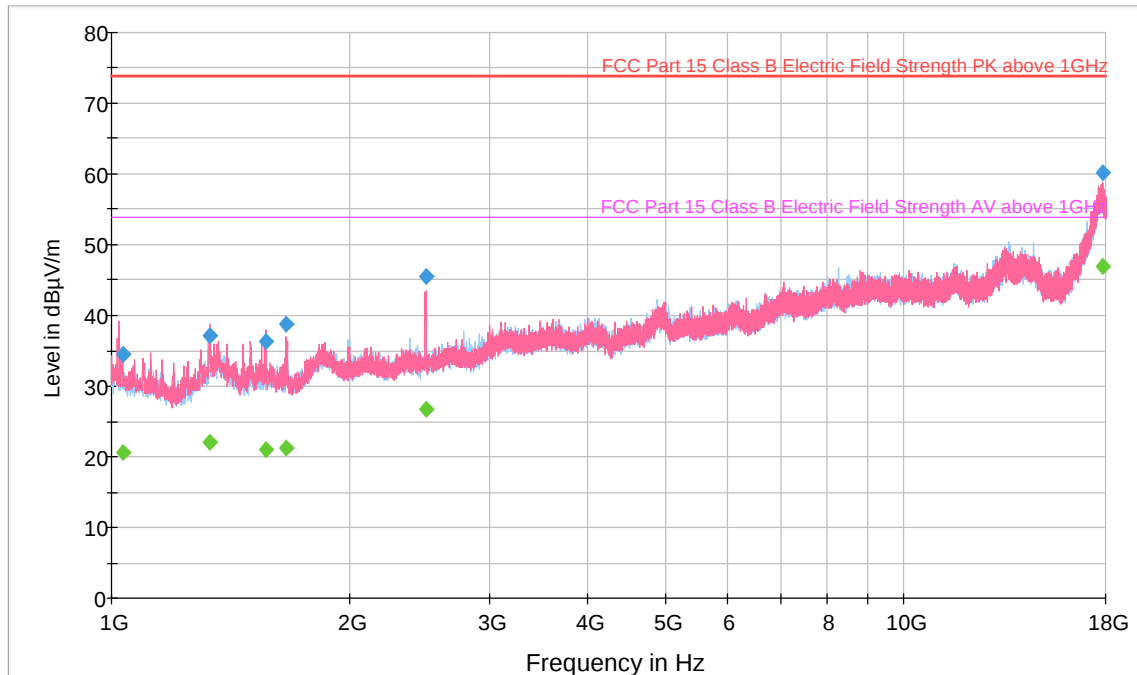
Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
1328.333333	42.93	73.90	30.97	1000.0	1000.000	291.1	V	83.0	-5.5	
1661.166667	39.25	73.90	34.65	1000.0	1000.000	99.9	V	191.0	-4.9	
1861.966667	36.84	73.90	37.06	1000.0	1000.000	121.1	H	232.0	-2.8	
2499.766667	45.20	73.90	28.70	1000.0	1000.000	99.8	V	170.0	-1.6	
11588.733333	47.84	73.90	26.06	1000.0	1000.000	121.0	H	48.0	14.3	
13443.933333	50.54	73.90	23.36	1000.0	1000.000	121.0	V	-14.0	16.7	
17805.533333	59.89	73.90	14.01	1000.0	1000.000	311.7	V	226.0	27.1	

Average Data

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
1328.333333	22.54	53.90	31.36	1000.0	1000.000	291.1	V	83.0	-5.5	
1661.166667	20.80	53.90	33.10	1000.0	1000.000	99.9	V	191.0	-4.9	
1861.966667	23.65	53.90	30.25	1000.0	1000.000	121.1	H	232.0	-2.8	
2499.766667	26.08	53.90	27.82	1000.0	1000.000	99.8	V	170.0	-1.6	
11588.733333	34.60	53.90	19.30	1000.0	1000.000	121.0	H	48.0	14.3	
13443.933333	37.41	53.90	16.49	1000.0	1000.000	121.0	V	-14.0	16.7	
17805.533333	47.23	53.90	6.67	1000.0	1000.000	311.7	V	226.0	27.1	

2.3.14 Test Results 1 GHz to 18 GHz Low Channel 300 MHz BW



— Preview Result 1H-PK+ [Preview Result 1H.Result:2]
 — Preview Result 1V-PK+ [Preview Result 1V.Result:2]
 — FCC Part 15 Class B Electric Field Strength PK above 1GHz [..EMI Radiated\
 — FCC Part 15 Class B Electric Field Strength AV above 1GHz [..EMI Radiated\
 ◆ Final_Result PK+ [Final_Result.Result:4]
 ◆ Final_Result AVG [Final_Result.Result:5]

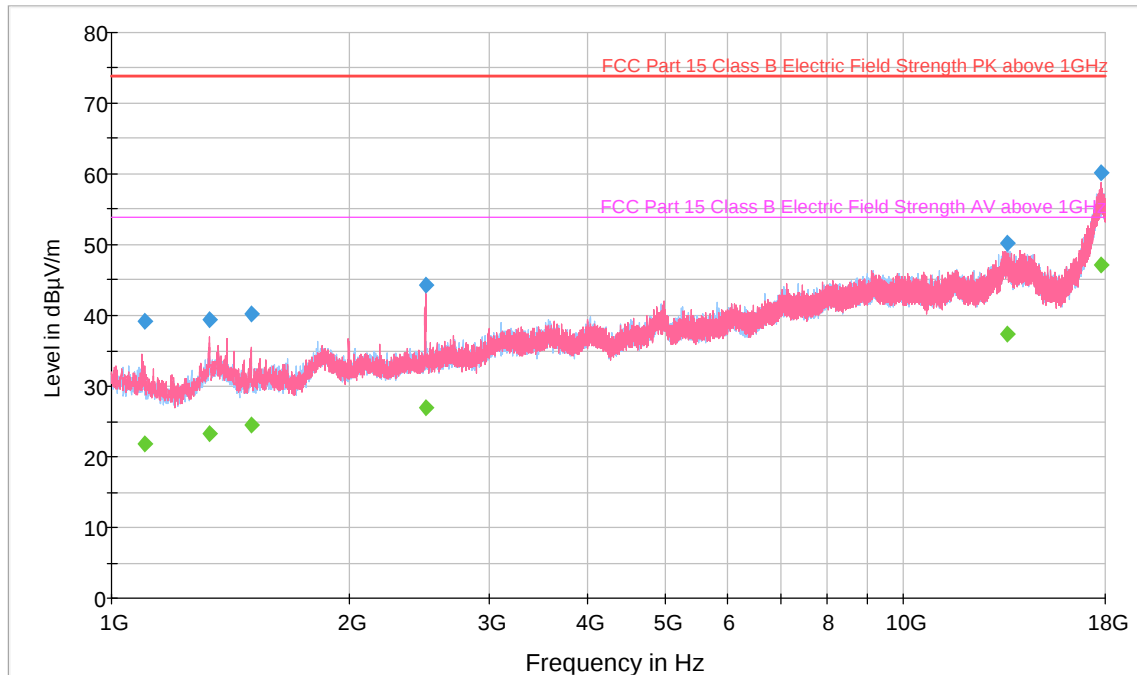
Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
1032.233333	34.52	73.90	39.38	1000.0	1000.000	189.1	V	218.0	-6.4	
1331.100000	37.19	73.90	36.71	1000.0	1000.000	176.3	V	224.0	-5.5	
1567.333333	36.34	73.90	37.56	1000.0	1000.000	375.9	V	214.0	-5.1	
1662.733333	38.82	73.90	35.08	1000.0	1000.000	410.1	V	136.0	-4.9	
2499.600000	45.46	73.90	28.44	1000.0	1000.000	121.2	V	180.0	-1.6	
17814.833333	60.29	73.90	13.61	1000.0	1000.000	410.2	V	348.0	27.1	

Average Data

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
1032.233333	20.59	53.90	33.31	1000.0	1000.000	189.1	V	218.0	-6.4	
1331.100000	22.14	53.90	31.76	1000.0	1000.000	176.3	V	224.0	-5.5	
1567.333333	21.10	53.90	32.80	1000.0	1000.000	375.9	V	214.0	-5.1	
1662.733333	21.19	53.90	32.71	1000.0	1000.000	410.1	V	136.0	-4.9	
2499.600000	26.83	53.90	27.07	1000.0	1000.000	121.2	V	180.0	-1.6	
17814.833333	47.02	53.90	6.88	1000.0	1000.000	410.2	V	348.0	27.1	

2.3.15 Test Results 1 GHz to 18 GHz Low Channel 425 MHz BW



— Preview Result 1H-PK+ [Preview Result 1H.Result:2]
 — Preview Result 1V-PK+ [Preview Result 1V.Result:2]
 — FCC Part 15 Class B Electric Field Strength PK above 1GHz [..EMI Radiated]
 — FCC Part 15 Class B Electric Field Strength AV above 1GHz [..EMI Radiated]
 ◆ Final_Result PK+ [Final_Result.Result:4]
 ◆ Final_Result AVG [Final_Result.Result:5]

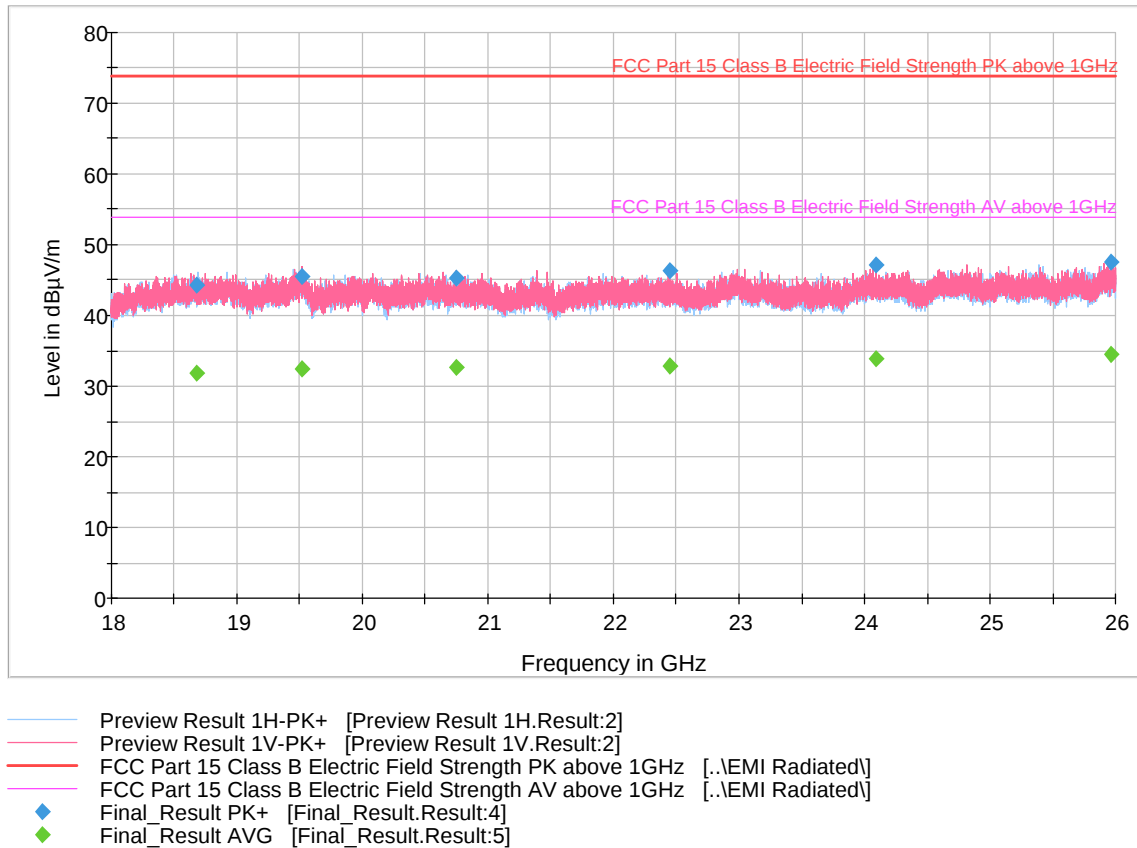
Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
1099.266667	39.13	73.90	34.77	1000.0	1000.000	121.0	V	186.0	-5.8	
1328.700000	39.37	73.90	34.53	1000.0	1000.000	325.1	V	141.0	-5.5	
1499.833333	40.11	73.90	33.79	1000.0	1000.000	325.0	V	173.0	-5.3	
2499.333333	44.20	73.90	29.70	1000.0	1000.000	121.0	V	172.0	-1.6	
13556.966667	50.13	73.90	23.77	1000.0	1000.000	224.9	H	5.0	16.9	
17787.433333	60.30	73.90	13.60	1000.0	1000.000	410.1	V	14.0	27.2	

Average Data

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
1099.266667	21.82	53.90	32.08	1000.0	1000.000	121.0	V	186.0	-5.8	
1328.700000	23.18	53.90	30.72	1000.0	1000.000	325.1	V	141.0	-5.5	
1499.833333	24.54	53.90	29.36	1000.0	1000.000	325.0	V	173.0	-5.3	
2499.333333	26.96	53.90	26.94	1000.0	1000.000	121.0	V	172.0	-1.6	
13556.966667	37.43	53.90	16.47	1000.0	1000.000	224.9	H	5.0	16.9	
17787.433333	47.20	53.90	6.70	1000.0	1000.000	410.1	V	14.0	27.2	

2.3.16 Test Results from 18 GHz to 26 GHz Low Channel 175 MHz BW



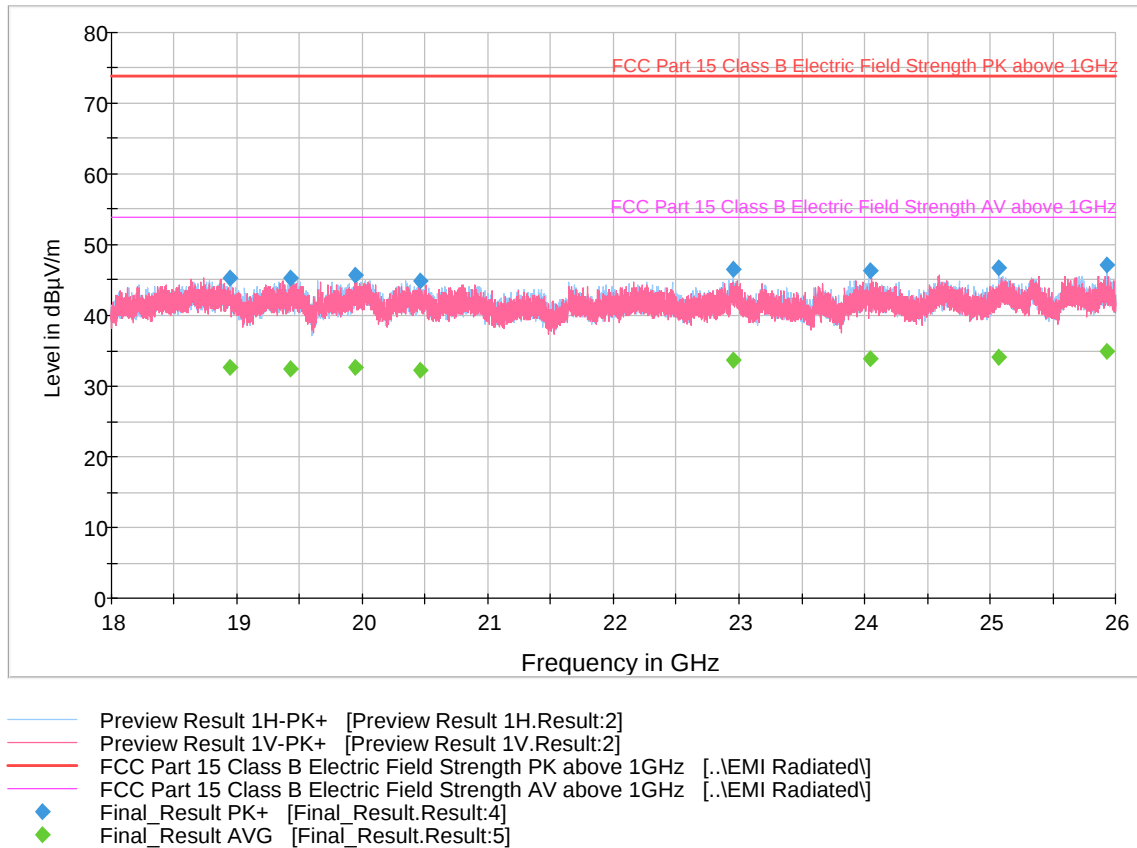
Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
18678.468500	44.35	73.90	29.55	1000.0	1000.000	162.3	H	129.0	-0.6	
19522.031500	45.52	73.90	28.38	1000.0	1000.000	136.9	V	-2.0	-1.1	
20748.856500	45.39	73.90	28.51	1000.0	1000.000	162.5	V	20.0	-0.1	
22446.918500	46.28	73.90	27.62	1000.0	1000.000	162.5	V	67.0	0.7	
24086.551000	47.16	73.90	26.74	1000.0	1000.000	149.5	H	231.0	1.3	
25964.682000	47.60	73.90	26.30	1000.0	1000.000	162.5	V	60.0	1.8	

Average Data

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
18678.468500	31.91	53.90	21.99	1000.0	1000.000	162.3	H	129.0	-0.6	
19522.031500	32.43	53.90	21.47	1000.0	1000.000	136.9	V	-2.0	-1.1	
20748.856500	32.73	53.90	21.17	1000.0	1000.000	162.5	V	20.0	-0.1	
22446.918500	32.94	53.90	20.96	1000.0	1000.000	162.5	V	67.0	0.7	
24086.551000	33.90	53.90	20.00	1000.0	1000.000	149.5	H	231.0	1.3	
25964.682000	34.43	53.90	19.47	1000.0	1000.000	162.5	V	60.0	1.8	

2.3.17 Test Results from 18 GHz to 26 GHz Low Channel 300 MHz BW



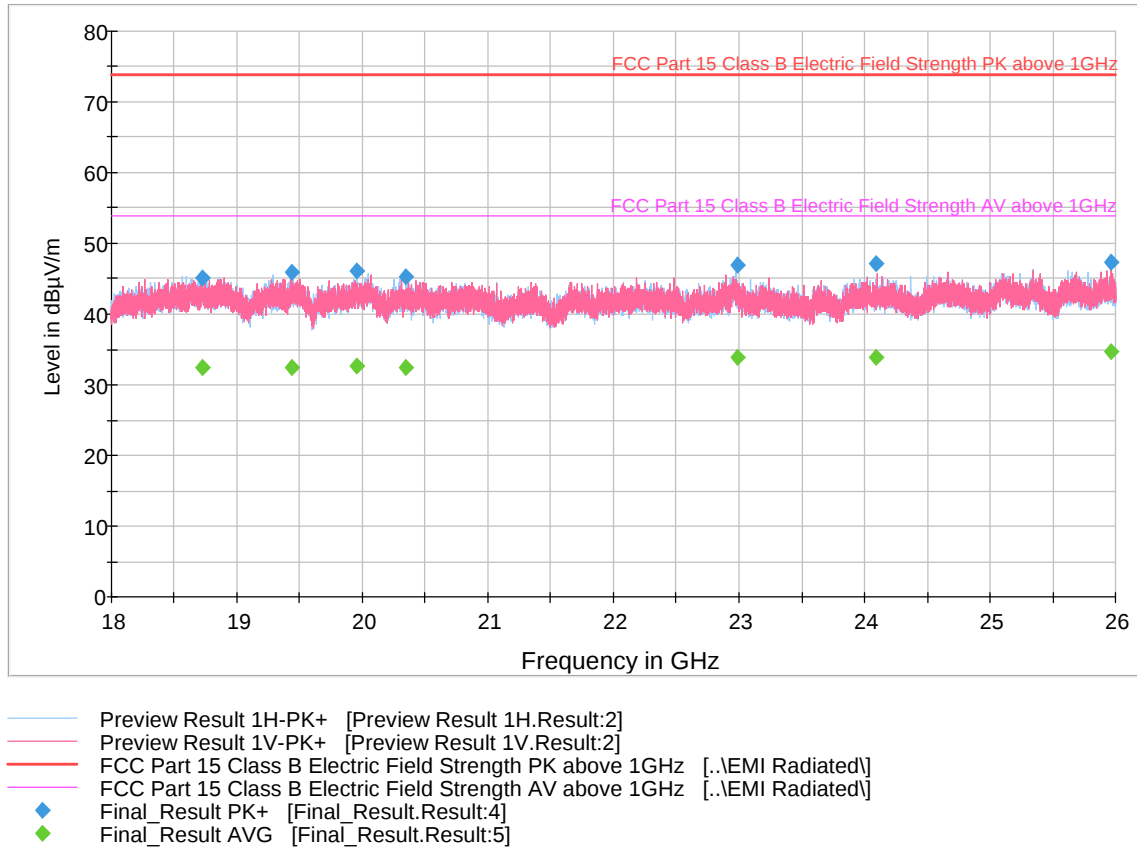
Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
18937.627000	45.33	73.90	28.57	1000.0	1000.000	162.3	H	255.0	-0.7	
19422.424000	45.31	73.90	28.59	1000.0	1000.000	149.1	H	-3.0	-1.0	
19947.428000	45.73	73.90	28.17	1000.0	1000.000	162.4	V	215.0	-0.7	
20457.924500	44.93	73.90	28.97	1000.0	1000.000	162.5	V	14.0	-0.7	
22951.537500	46.56	73.90	27.34	1000.0	1000.000	162.4	H	-1.0	0.8	
24049.259000	46.37	73.90	27.53	1000.0	1000.000	149.8	H	323.0	1.3	
25065.251000	46.80	73.90	27.10	1000.0	1000.000	149.7	H	10.0	1.9	
25930.313500	47.19	73.90	26.71	1000.0	1000.000	162.3	H	164.0	1.8	

Average Data

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
18937.627000	32.71	53.90	21.19	1000.0	1000.000	162.3	H	255.0	-0.7	
19422.424000	32.43	53.90	21.47	1000.0	1000.000	149.1	H	-3.0	-1.0	
19947.428000	32.60	53.90	21.30	1000.0	1000.000	162.4	V	215.0	-0.7	
20457.924500	32.34	53.90	21.56	1000.0	1000.000	162.5	V	14.0	-0.7	
22951.537500	33.58	53.90	20.32	1000.0	1000.000	162.4	H	-1.0	0.8	
24049.259000	33.90	53.90	20.00	1000.0	1000.000	149.8	H	323.0	1.3	
25065.251000	34.09	53.90	19.81	1000.0	1000.000	149.7	H	10.0	1.9	
25930.313500	34.88	53.90	19.02	1000.0	1000.000	162.3	H	164.0	1.8	

2.3.18 Test Results from 18 GHz to 26 GHz Low Channel 425 MHz BW



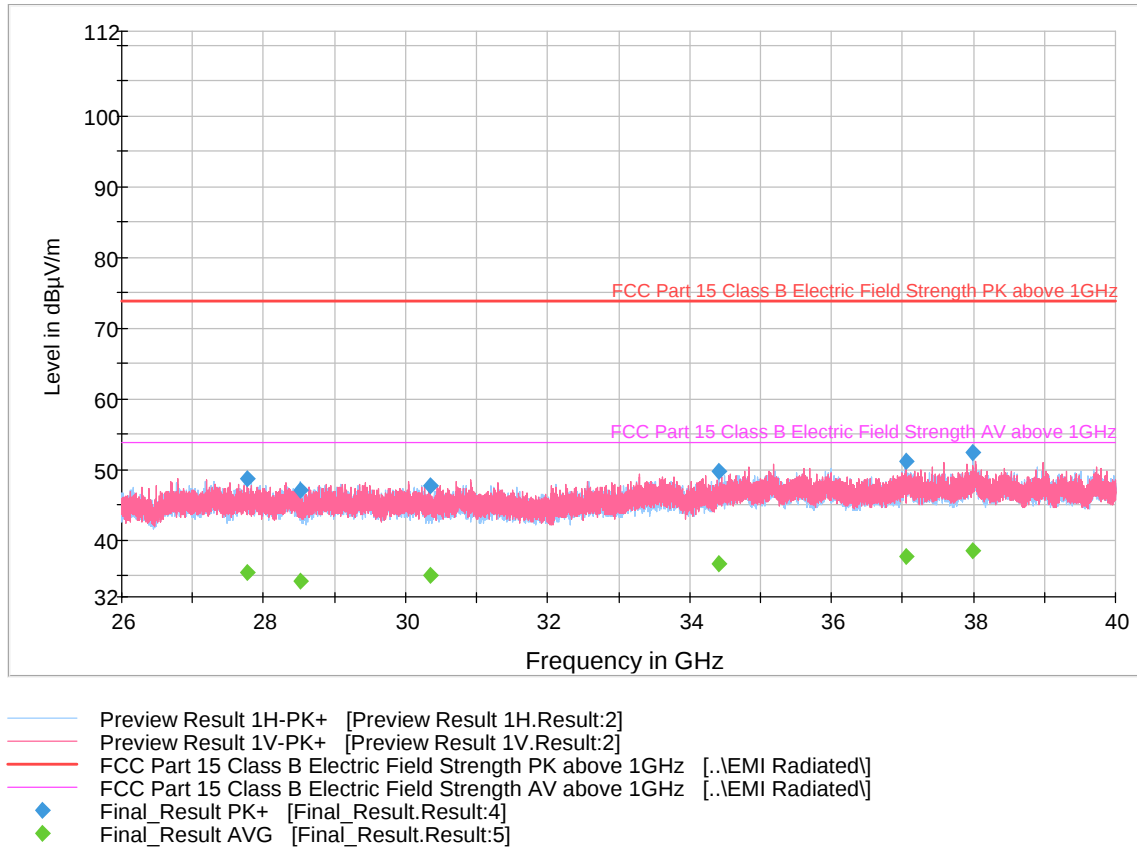
Peak Data

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
18726.376000	45.06	73.90	28.84	1000.0	1000.000	162.5	H	164.0	-0.7	
19439.141500	45.99	73.90	27.91	1000.0	1000.000	162.5	H	25.0	-1.0	
19954.134000	46.21	73.90	27.69	1000.0	1000.000	162.4	H	223.0	-0.7	
20347.214500	45.39	73.90	28.51	1000.0	1000.000	162.4	H	124.0	-0.7	
22991.241500	47.00	73.90	26.90	1000.0	1000.000	149.7	H	9.0	0.9	
24092.223000	47.19	73.90	26.71	1000.0	1000.000	162.4	V	188.0	1.3	
25965.213000	47.37	73.90	26.53	1000.0	1000.000	162.4	V	27.0	1.8	

Average Data

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
18726.376000	32.40	53.90	21.50	1000.0	1000.000	162.5	H	164.0	-0.7	
19439.141500	32.41	53.90	21.49	1000.0	1000.000	162.5	H	25.0	-1.0	
19954.134000	32.57	53.90	21.33	1000.0	1000.000	162.4	H	223.0	-0.7	
20347.214500	32.45	53.90	21.45	1000.0	1000.000	162.4	H	124.0	-0.7	
22991.241500	33.87	53.90	20.03	1000.0	1000.000	149.7	H	9.0	0.9	
24092.223000	33.81	53.90	20.09	1000.0	1000.000	162.4	V	188.0	1.3	
25965.213000	34.68	53.90	19.22	1000.0	1000.000	162.4	V	27.0	1.8	

2.3.19 Test Results from 26 GHz to 40 GHz Low Channel 175 MHz BW



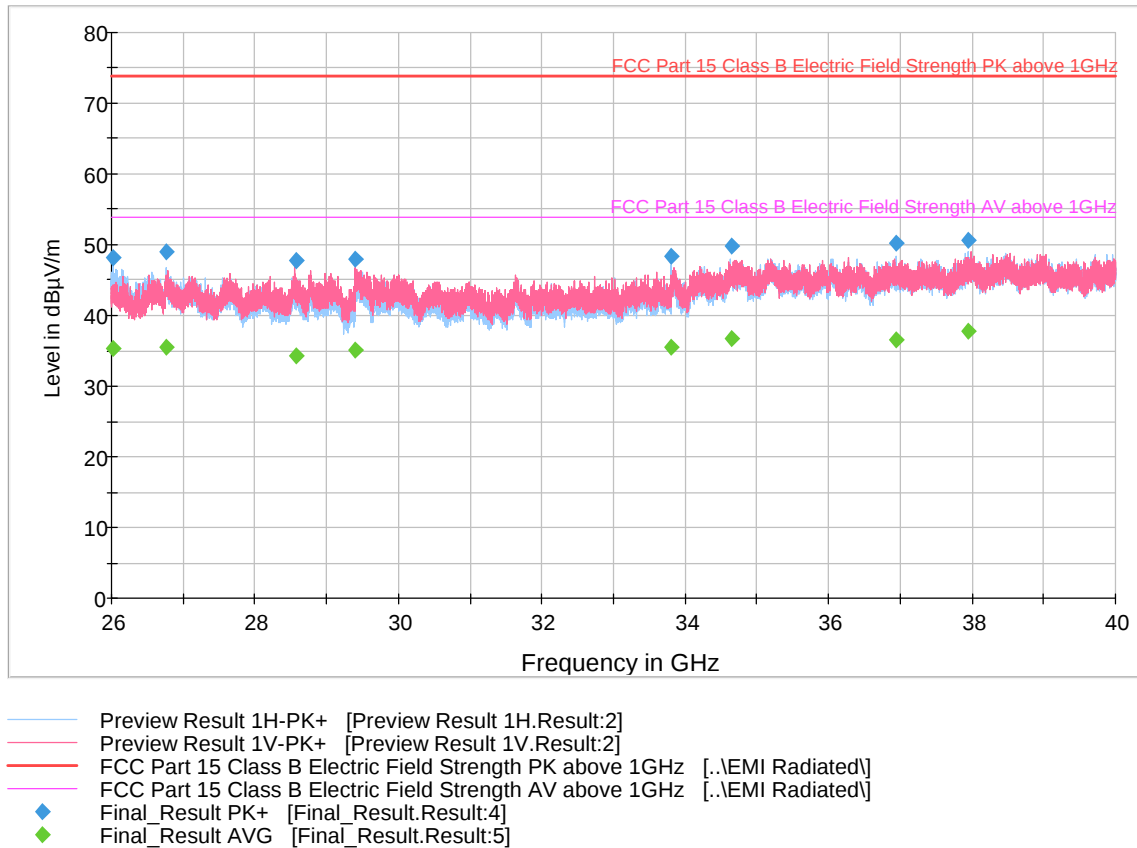
Peak Data

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
27770.862308	48.77	73.90	25.13	1000.0	1000.000	149.7	H	17.0	3.1	
28519.247692	47.13	73.90	26.77	1000.0	1000.000	121.0	H	324.0	3.5	
30346.134616	47.71	73.90	26.19	1000.0	1000.000	99.8	V	326.0	4.0	
34410.812692	49.69	73.90	24.21	1000.0	1000.000	144.2	H	49.0	6.1	
37060.877308	51.26	73.90	22.64	1000.0	1000.000	175.0	V	68.0	7.1	
37993.186154	52.36	73.90	21.54	1000.0	1000.000	121.2	H	153.0	8.0	

Average Data

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
27770.862308	35.48	53.90	18.42	1000.0	1000.000	149.7	H	17.0	3.1	
28519.247692	34.16	53.90	19.74	1000.0	1000.000	121.0	H	324.0	3.5	
30346.134616	35.00	53.90	18.90	1000.0	1000.000	99.8	V	326.0	4.0	
34410.812692	36.60	53.90	17.30	1000.0	1000.000	144.2	H	49.0	6.1	
37060.877308	37.68	53.90	16.22	1000.0	1000.000	175.0	V	68.0	7.1	
37993.186154	38.53	53.90	15.37	1000.0	1000.000	121.2	H	153.0	8.0	

2.3.20 Test Results from 26 GHz to 40 GHz Low Channel 300 MHz BW



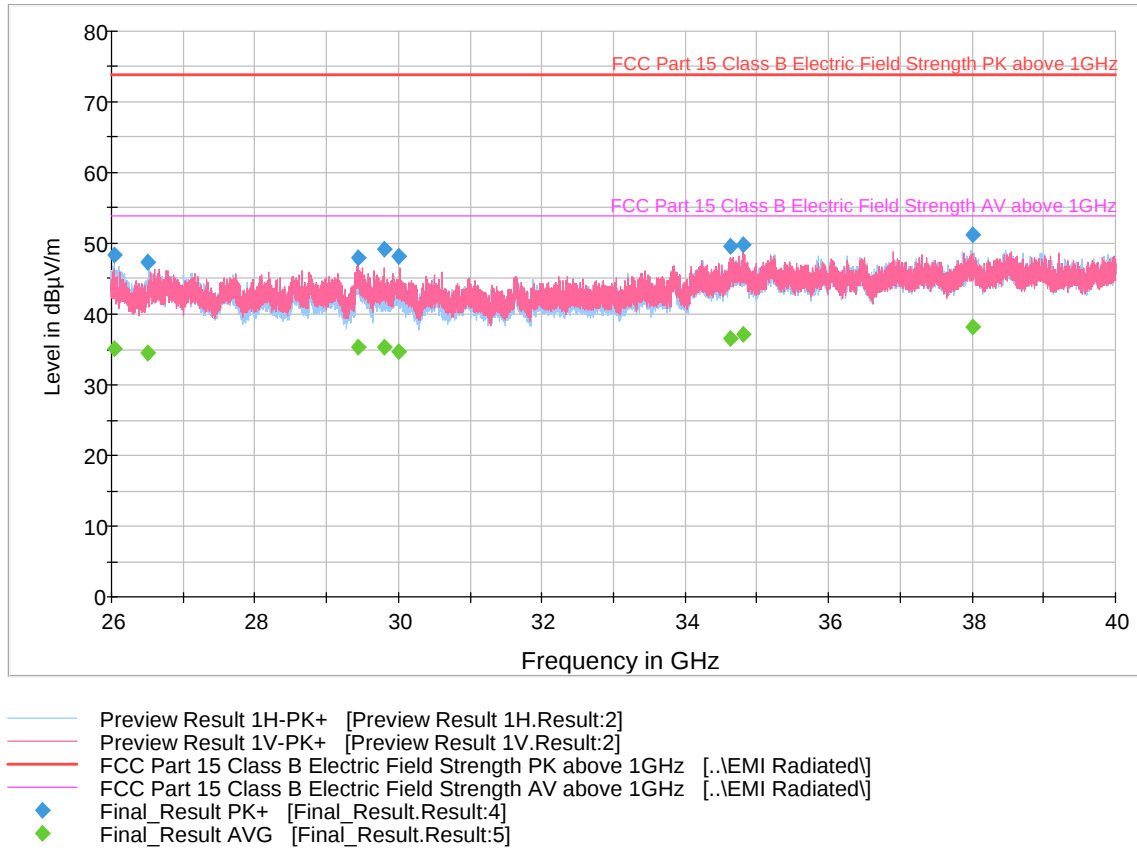
Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
26029.077692	48.24	73.90	25.66	1000.0	1000.000	175.2	H	152.0	2.3	
26762.786538	48.91	73.90	24.99	1000.0	1000.000	99.9	H	96.0	2.4	
28574.401155	47.72	73.90	26.18	1000.0	1000.000	121.2	V	110.0	3.5	
29408.485769	47.95	73.90	25.95	1000.0	1000.000	175.1	V	332.0	3.4	
33807.762307	48.35	73.90	25.55	1000.0	1000.000	149.7	H	209.0	6.0	
34643.574231	49.88	73.90	24.02	1000.0	1000.000	121.1	H	168.0	6.3	
36940.260000	50.17	73.90	23.73	1000.0	1000.000	175.1	H	20.0	6.9	
37944.889615	50.66	73.90	23.24	1000.0	1000.000	147.1	H	78.0	7.9	

Average Data

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
26029.077692	35.31	53.90	18.59	1000.0	1000.000	175.2	H	152.0	2.3	
26762.786538	35.55	53.90	18.35	1000.0	1000.000	99.9	H	96.0	2.4	
28574.401155	34.38	53.90	19.52	1000.0	1000.000	121.2	V	110.0	3.5	
29408.485769	35.18	53.90	18.72	1000.0	1000.000	175.1	V	332.0	3.4	
33807.762307	35.58	53.90	18.32	1000.0	1000.000	149.7	H	209.0	6.0	
34643.574231	36.78	53.90	17.12	1000.0	1000.000	121.1	H	168.0	6.3	
36940.260000	36.62	53.90	17.28	1000.0	1000.000	175.1	H	20.0	6.9	
37944.889615	37.73	53.90	16.17	1000.0	1000.000	147.1	H	78.0	7.9	

2.3.21 Test Results from 26 GHz to 40 GHz Low Channel 425 MHz BW



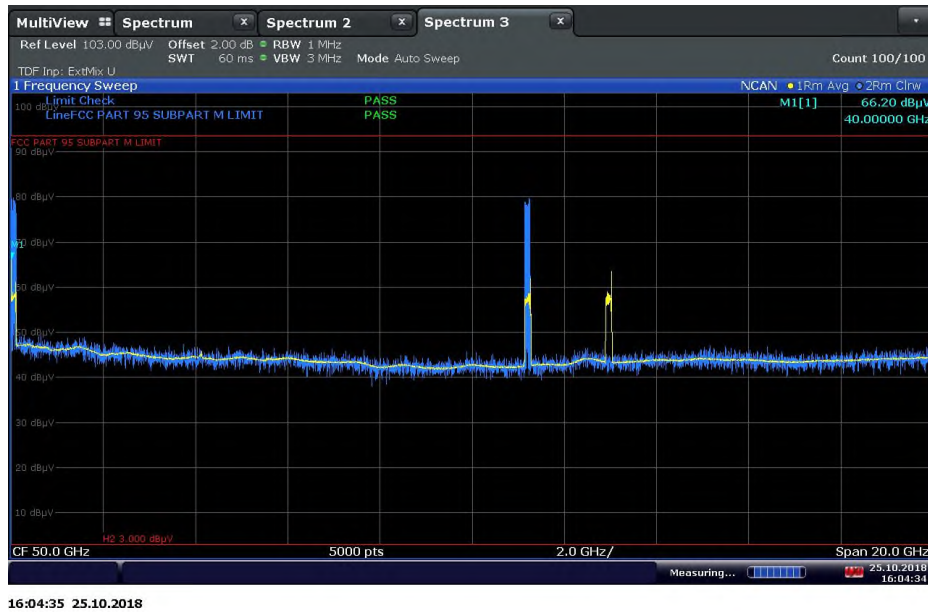
Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
18678.468500	44.35	73.90	29.55	1000.0	1000.000	162.3	H	129.0	-0.6	
19522.031500	45.52	73.90	28.38	1000.0	1000.000	136.9	V	-2.0	-1.1	
20748.856500	45.39	73.90	28.51	1000.0	1000.000	162.5	V	20.0	-0.1	
22446.918500	46.28	73.90	27.62	1000.0	1000.000	162.5	V	67.0	0.7	
24086.551000	47.16	73.90	26.74	1000.0	1000.000	149.5	H	231.0	1.3	
25964.682000	47.60	73.90	26.30	1000.0	1000.000	162.5	V	60.0	1.8	

Average Data

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
18678.468500	31.91	53.90	21.99	1000.0	1000.000	162.3	H	129.0	-0.6	
19522.031500	32.43	53.90	21.47	1000.0	1000.000	136.9	V	-2.0	-1.1	
20748.856500	32.73	53.90	21.17	1000.0	1000.000	162.5	V	20.0	-0.1	
22446.918500	32.94	53.90	20.96	1000.0	1000.000	162.5	V	67.0	0.7	
24086.551000	33.90	53.90	20.00	1000.0	1000.000	149.5	H	231.0	1.3	
25964.682000	34.43	53.90	19.47	1000.0	1000.000	162.5	V	60.0	1.8	

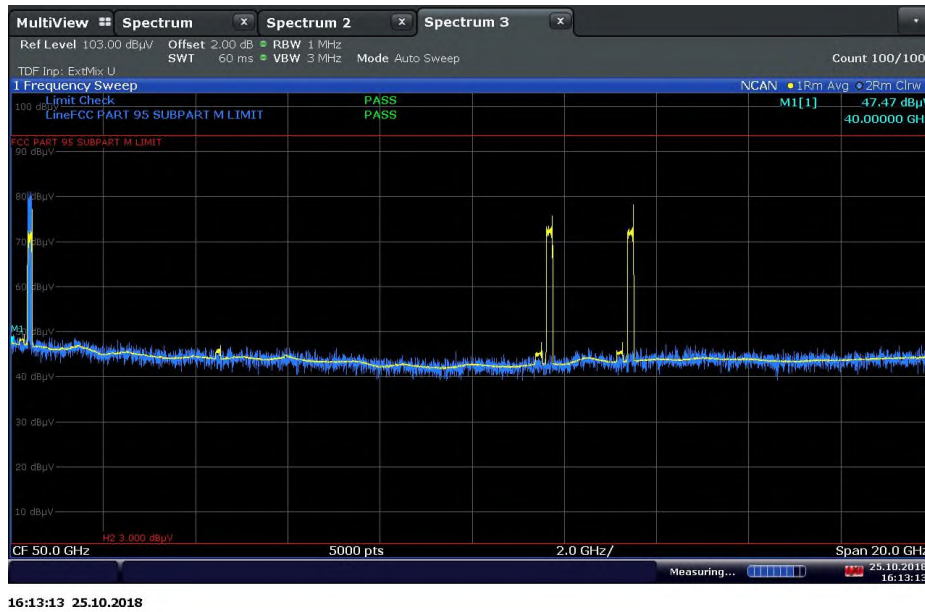
2.3.22 Test Results 40 GHz to 300 GHz



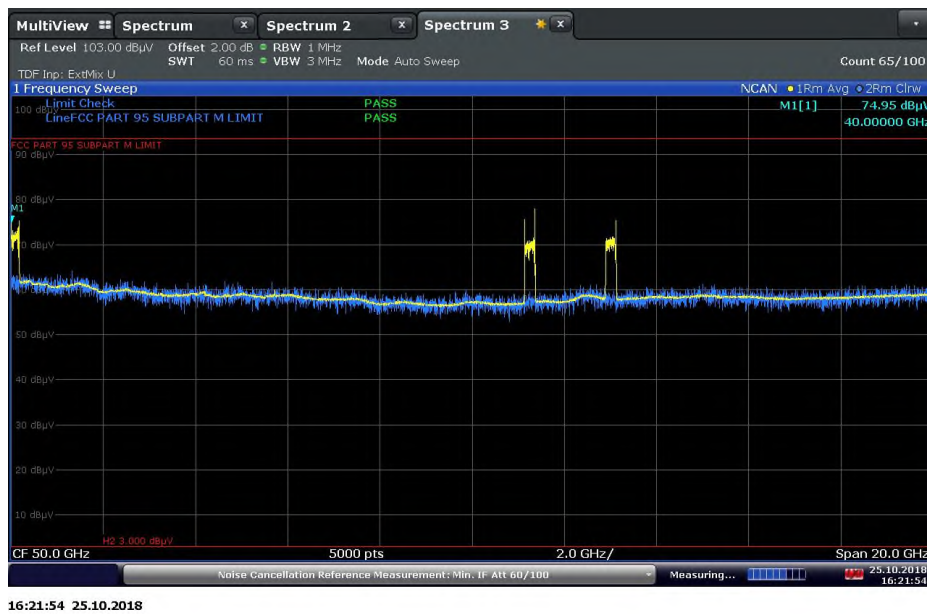
40 to 60 GHz Low Channel 175 MHz BW



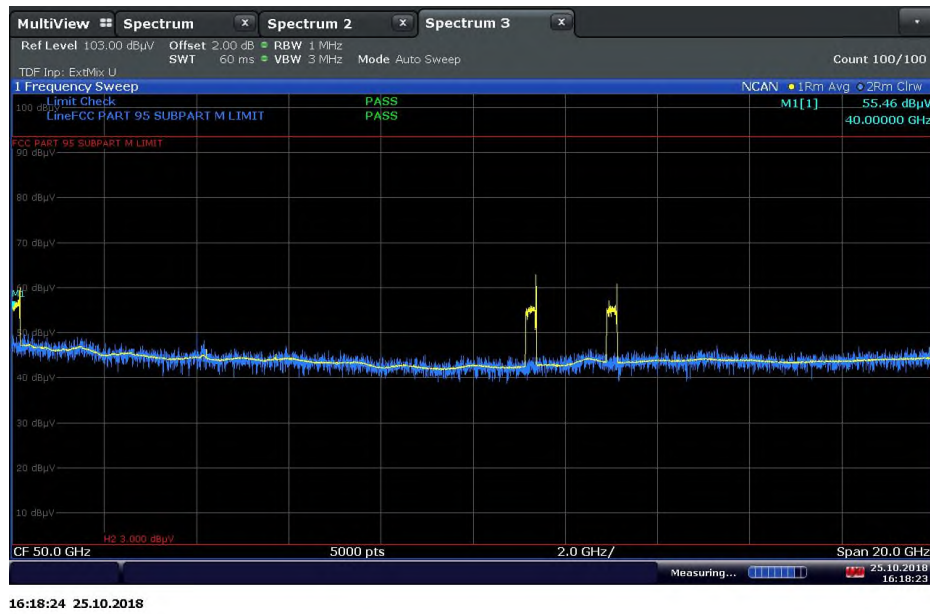
40 to 60 GHz Mid Channel 175 MHz BW



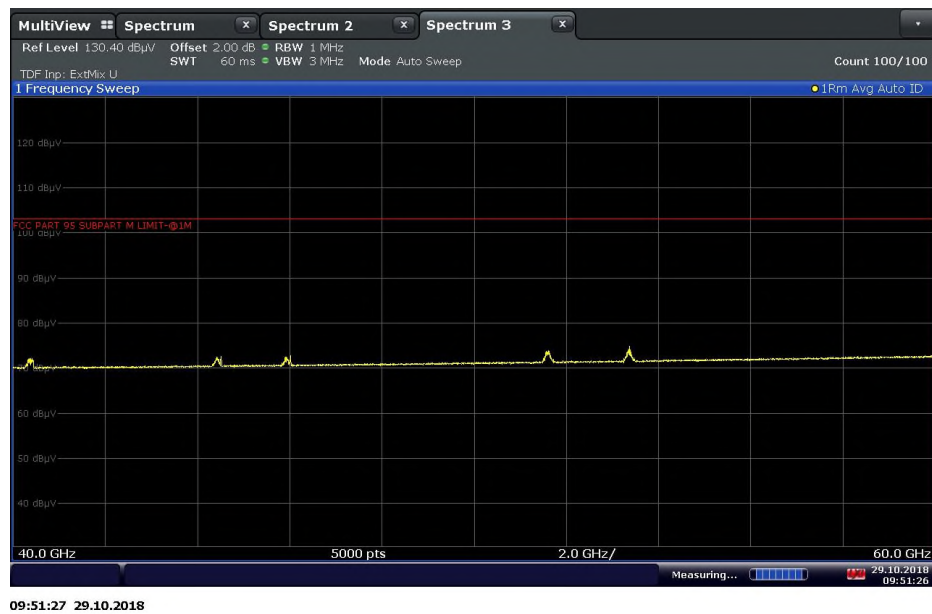
40 to 60 GHz High Channel 175 MHz BW



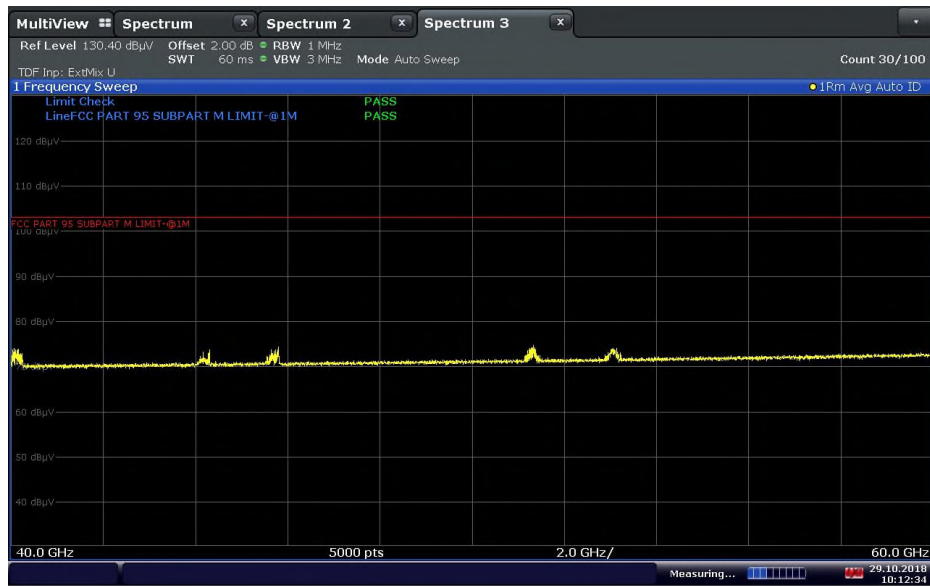
40 to 60 GHz Low Channel 300 MHz BW



40 to 60 GHz Mid Channel 300 MHz BW

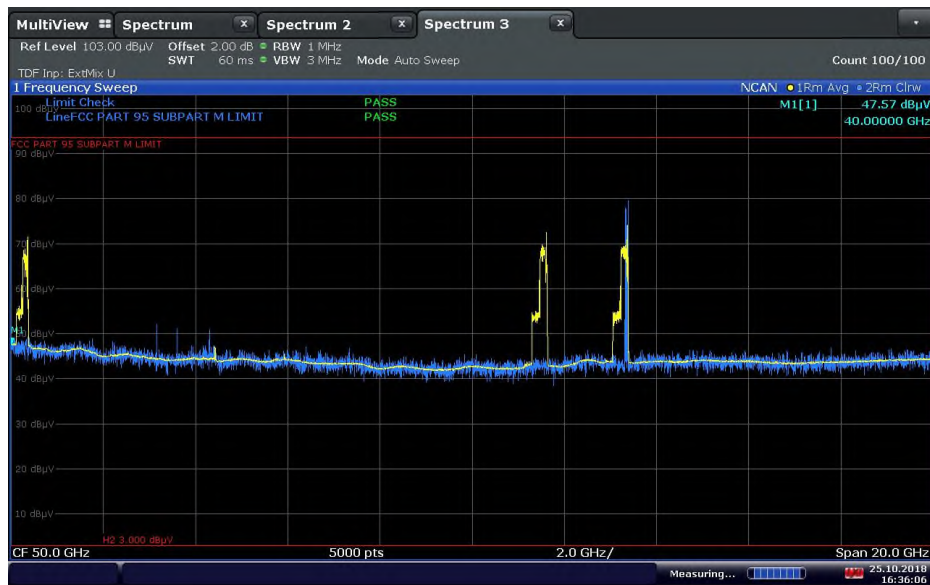


40 to 60 GHz High Channel 300 MHz BW



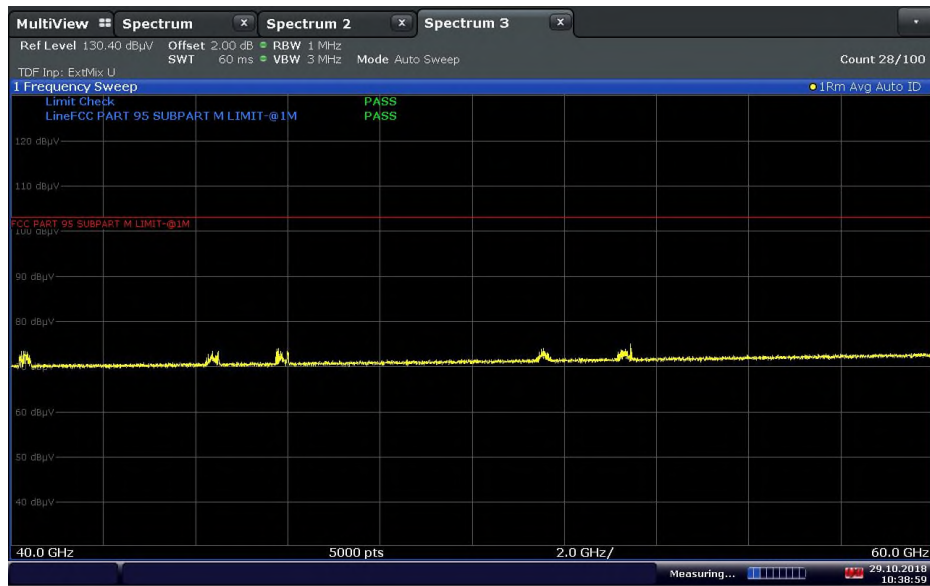
10:12:34 29.10.2018

40 to 60 GHz Low Channel 425 MHz BW



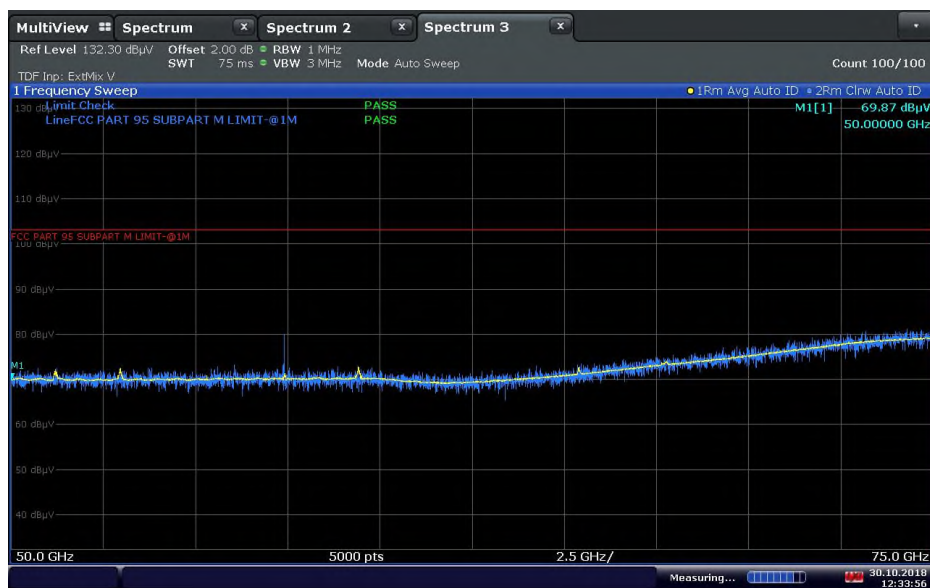
16:36:06 25.10.2018

40 to 60 GHz Mid Channel 425 MHz BW



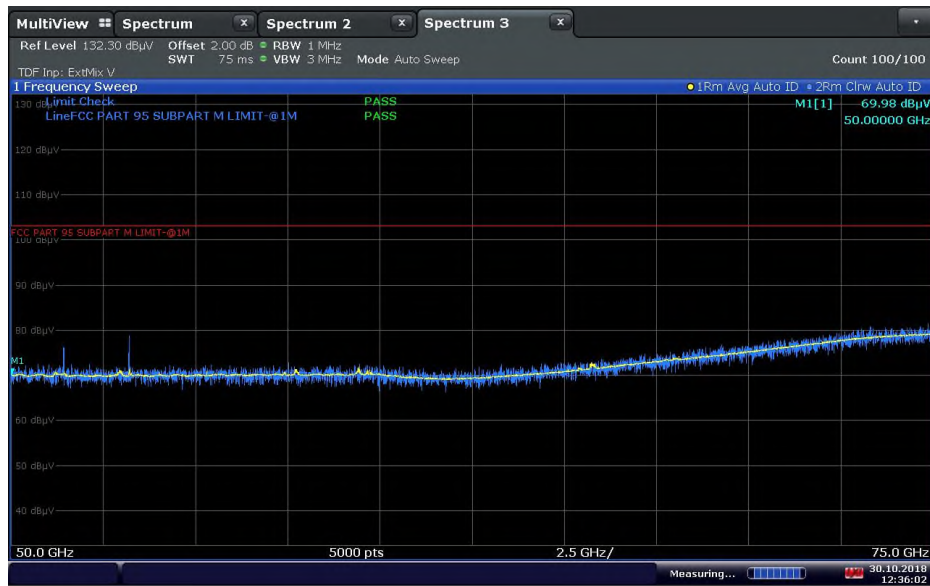
10:38:59 29.10.2018

40 to 60 GHz High Channel 425 MHz BW



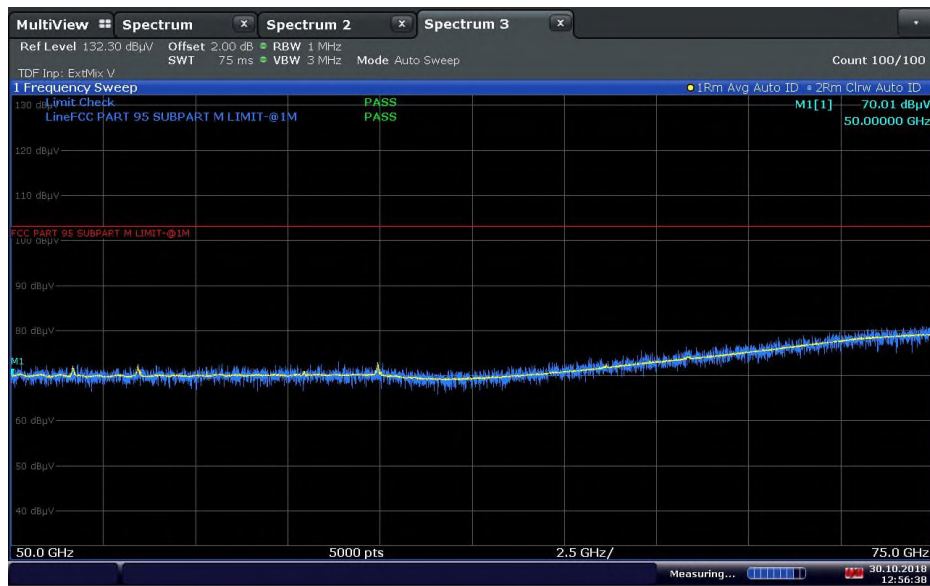
12:33:56 30.10.2018

60 to 75 GHz Low Channel 175 MHz BW



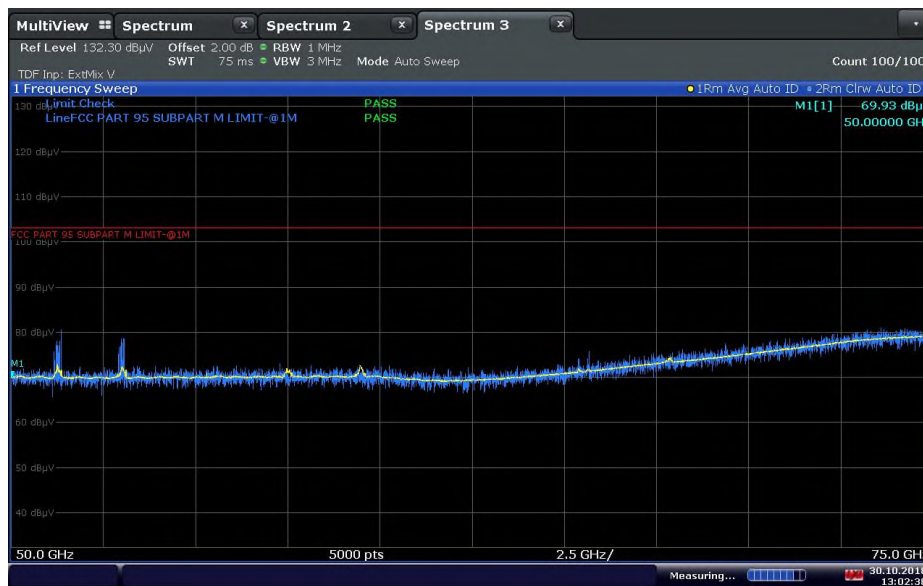
12:36:03 30.10.2018

60 to 75 GHz Mid Channel 175 MHz BW



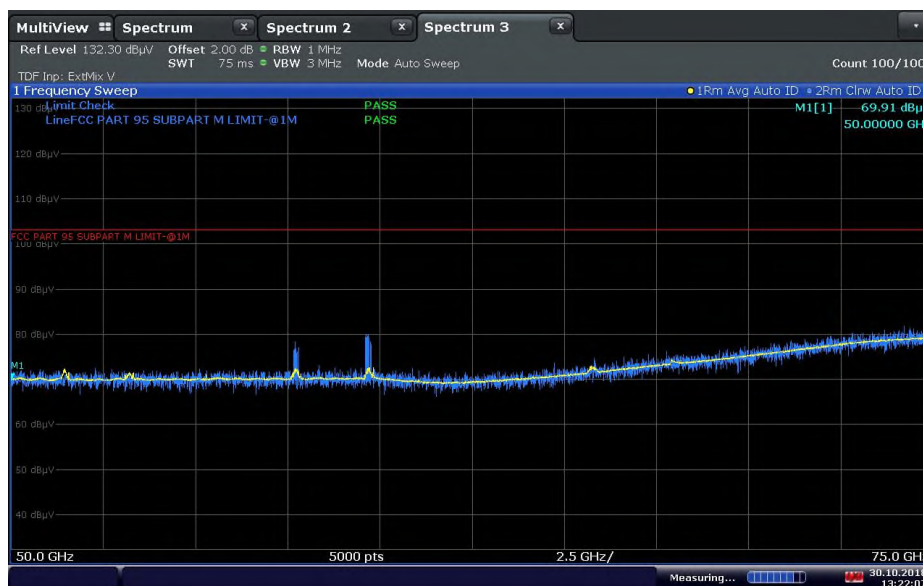
12:56:39 30.10.2018

60 to 75 GHz High Channel 175 MHz BW



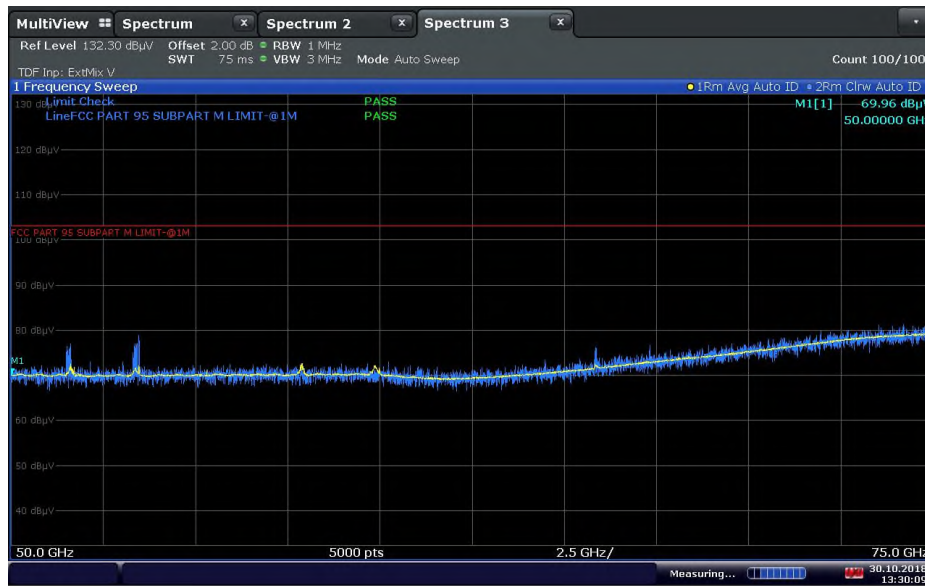
13:02:39 30.10.2018

60 to 75 GHz Low Channel 300 MHz BW



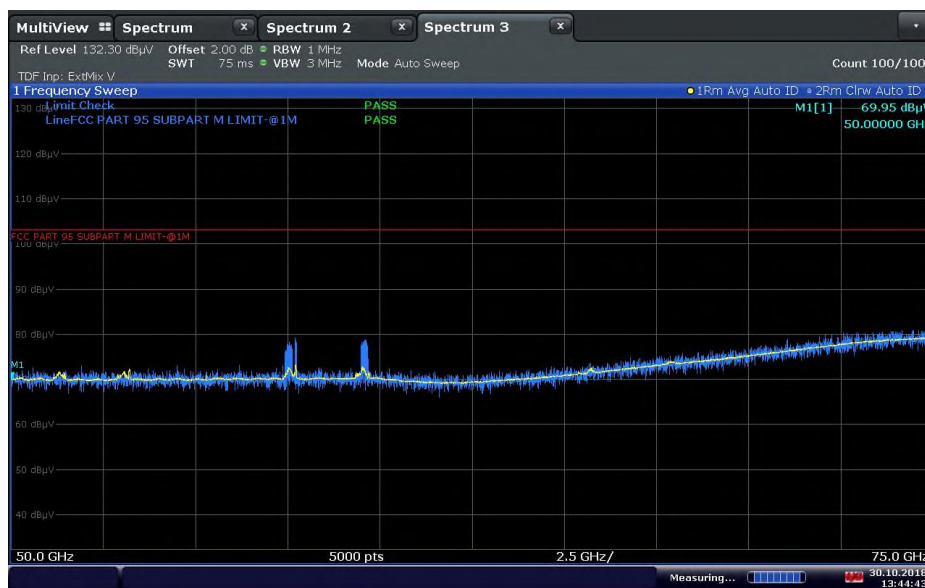
13:22:07 30.10.2018

60 to 75 GHz Mid Channel 300 MHz BW



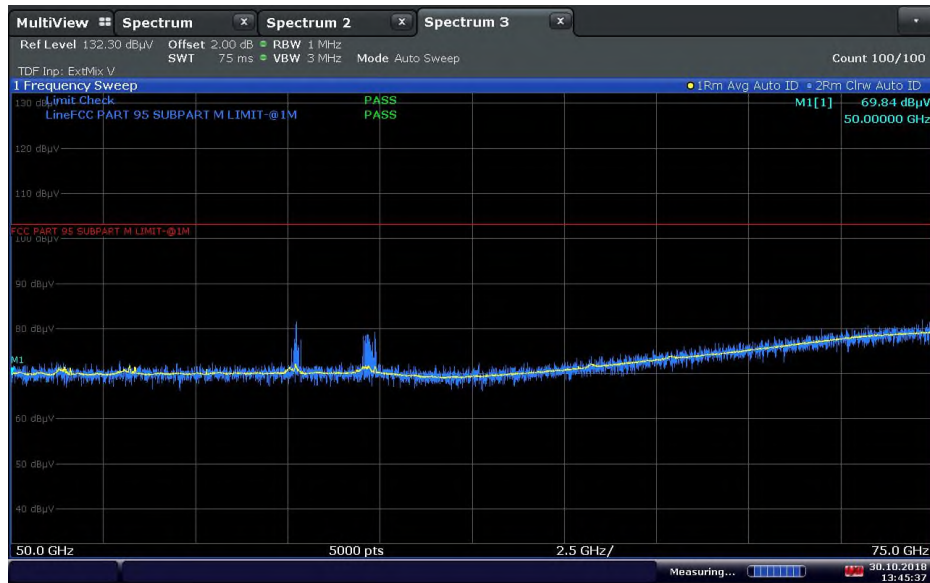
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60 to 75 GHz High Channel 300 MHz BW



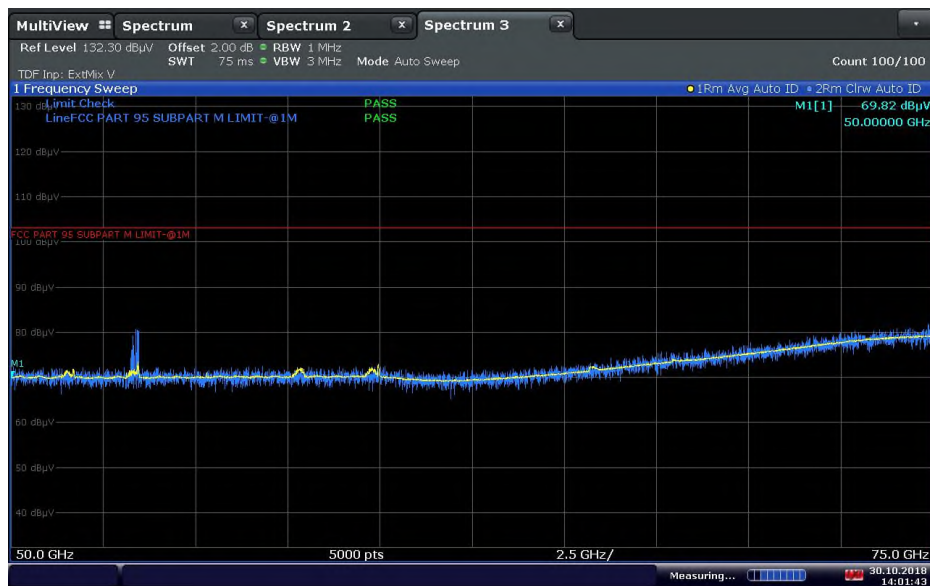
13:44:44 30.10.2018

60 to 75 GHz Low Channel 425 MHz BW



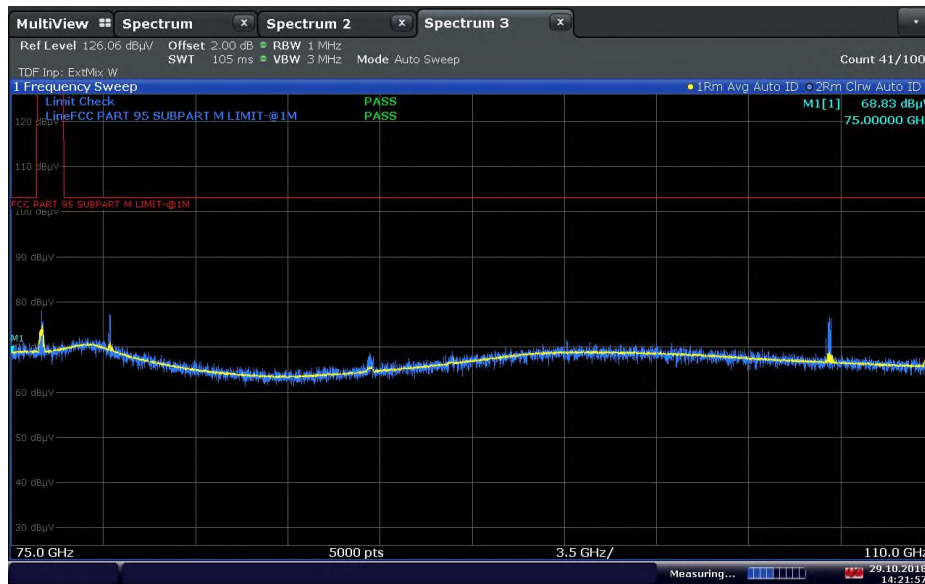
13:45:38 30.10.2018

60 to 75 GHz Mid Channel 425 MHz BW



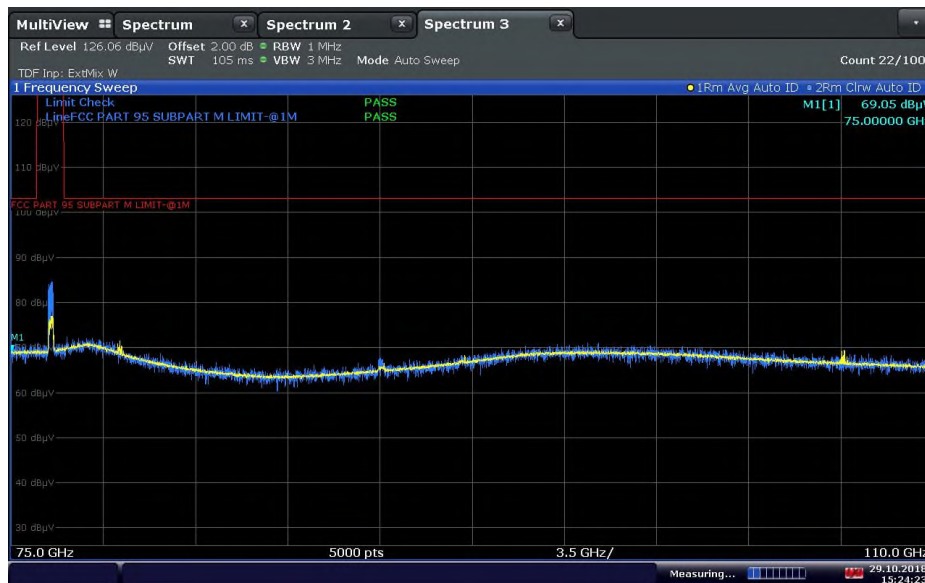
14:01:44 30.10.2018

60 to 75 GHz High Channel 425 MHz BW



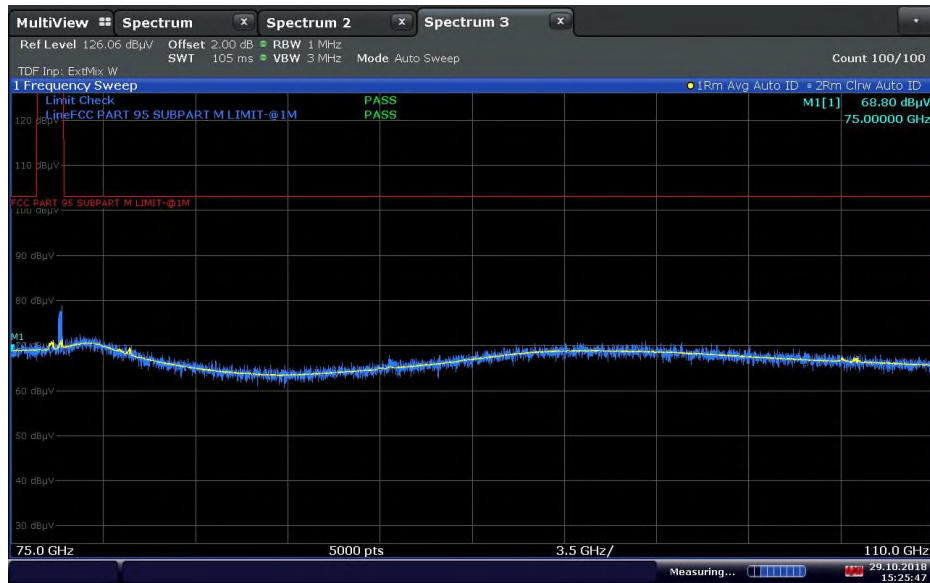
14:21:57 29.10.2018

75 to 110 GHz Low Channel 175 MHz BW



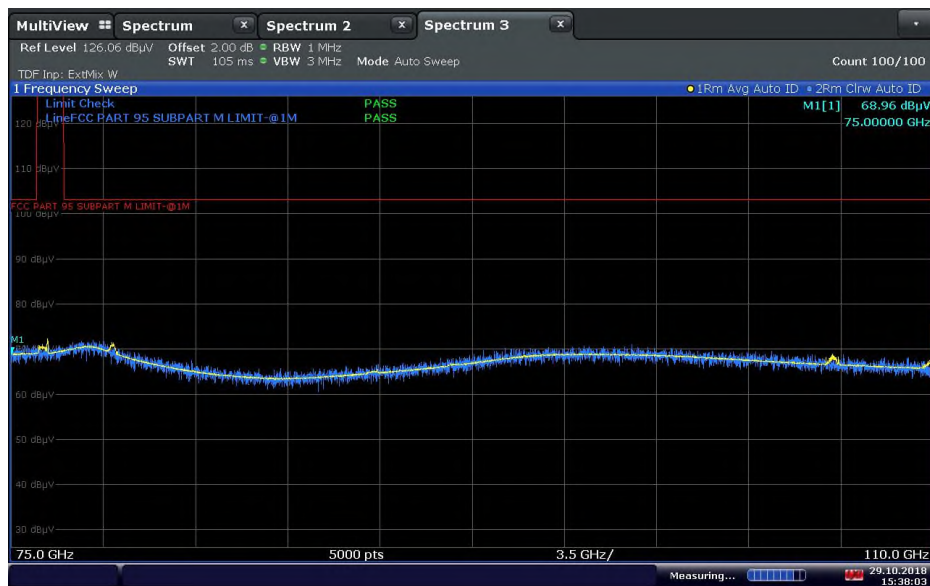
15:24:24 29.10.2018

75 to 110 GHz Mid Channel 175 MHz BW



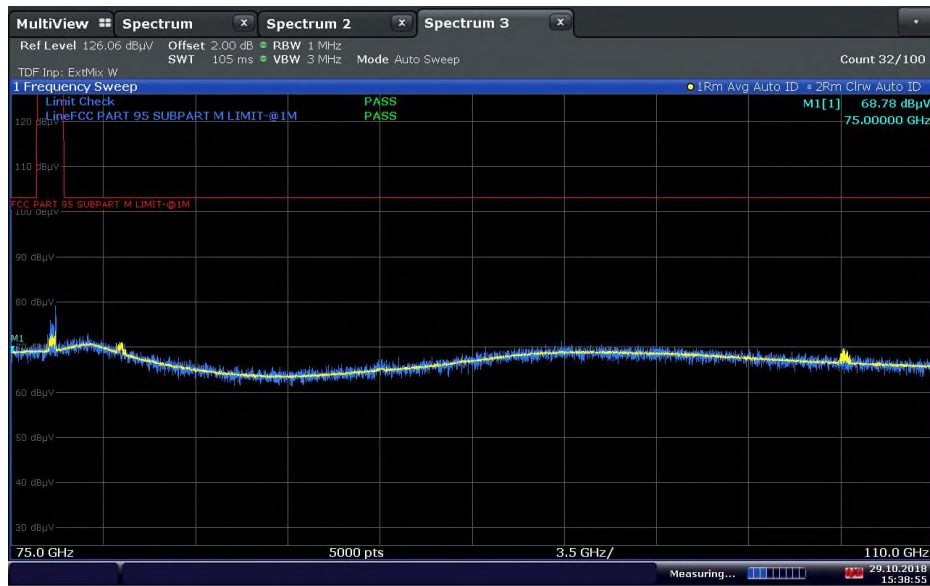
15:25:48 29.10.2018

75 to 110 GHz High Channel 175 MHz BW



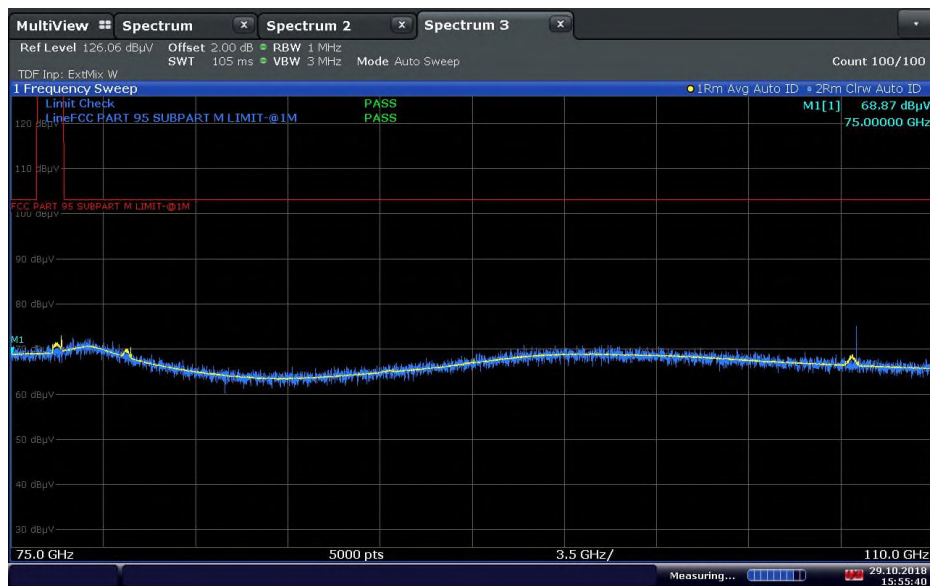
15:38:03 29.10.2018

75 to 110 GHz Low Channel 300 MHz BW



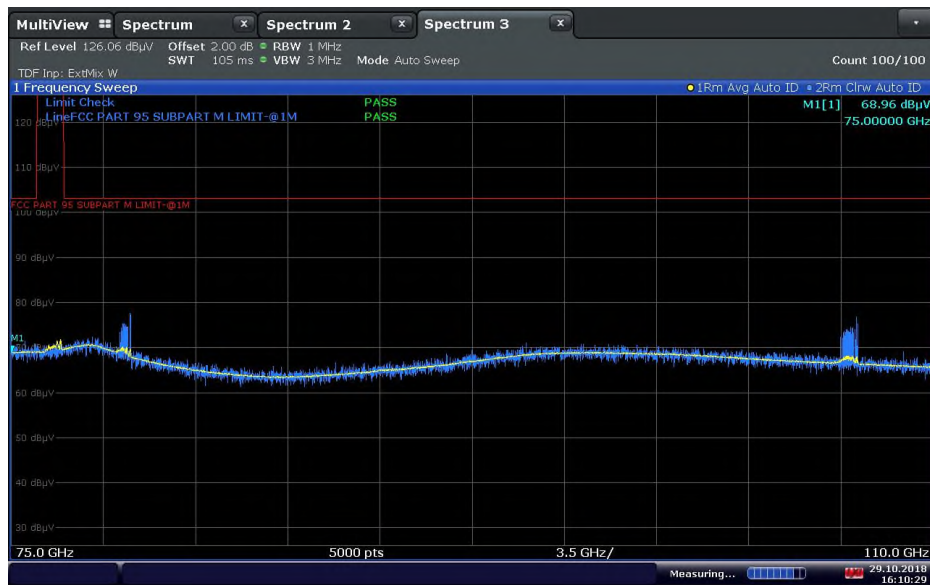
15:38:56 29.10.2018

75 to 110 GHz Mid Channel 300 MHz BW



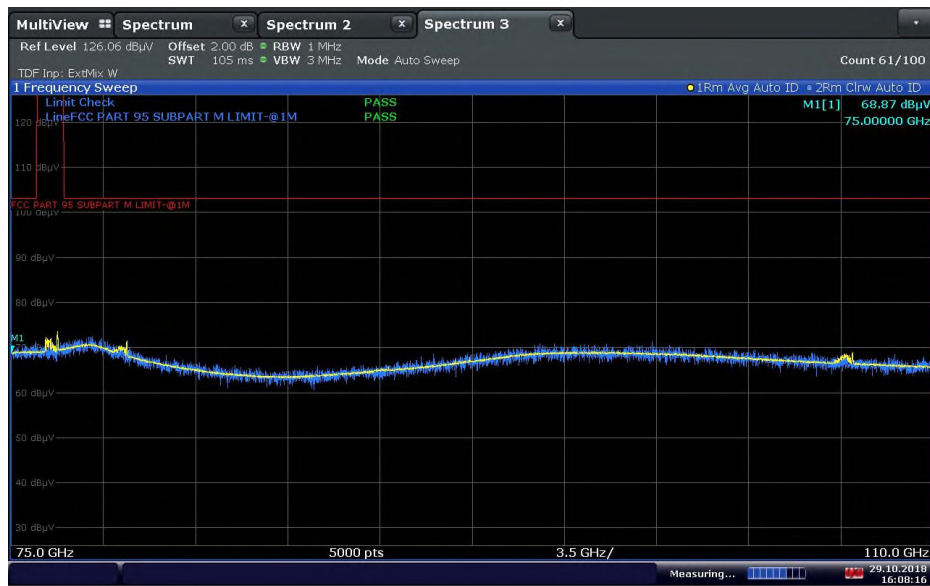
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75 to 110 GHz High Channel 300 MHz BW



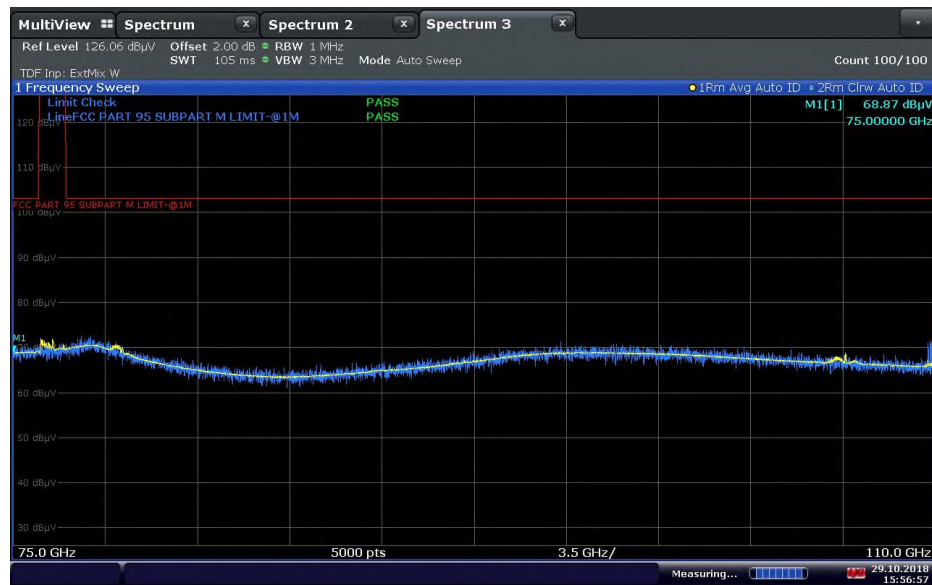
16:10:29 29.10.2018

75 to 110 GHz Low Channel 425 MHz BW



16:08:16 29.10.2018

75 to 110 GHz Mid Channel 425 MHz BW



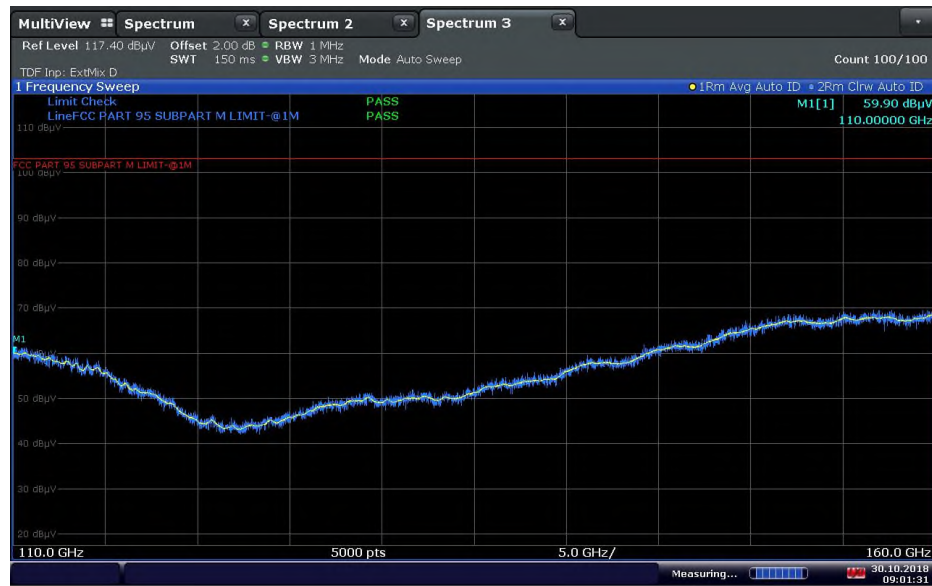
15:56:58 29.10.2018

75 to 110 GHz High Channel 425 MHz BW



08:54:48 30.10.2018

110 to 160 GHz Low Channel 175 MHz BW



09:01:31 30.10.2018

110 to 160 GHz Mid Channel 175 MHz BW



10:02:55 30.10.2018

110 to 160 GHz Low Channel 300 MHz BW



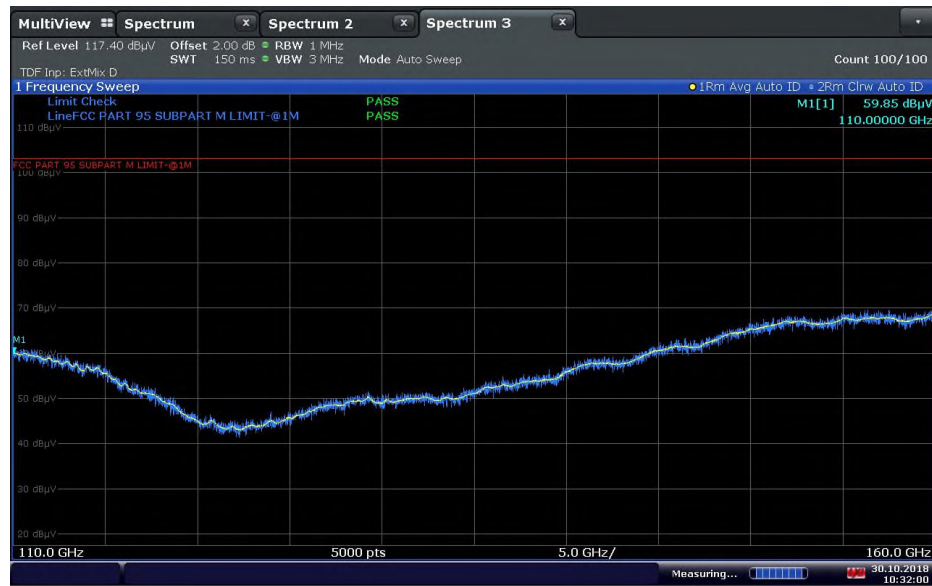
10:07:47 30.10.2018

110 to 160 GHz Mid Channel 300 MHz BW



10:29:11 30.10.2018

110 to 160 GHz High Channel 300 MHz BW



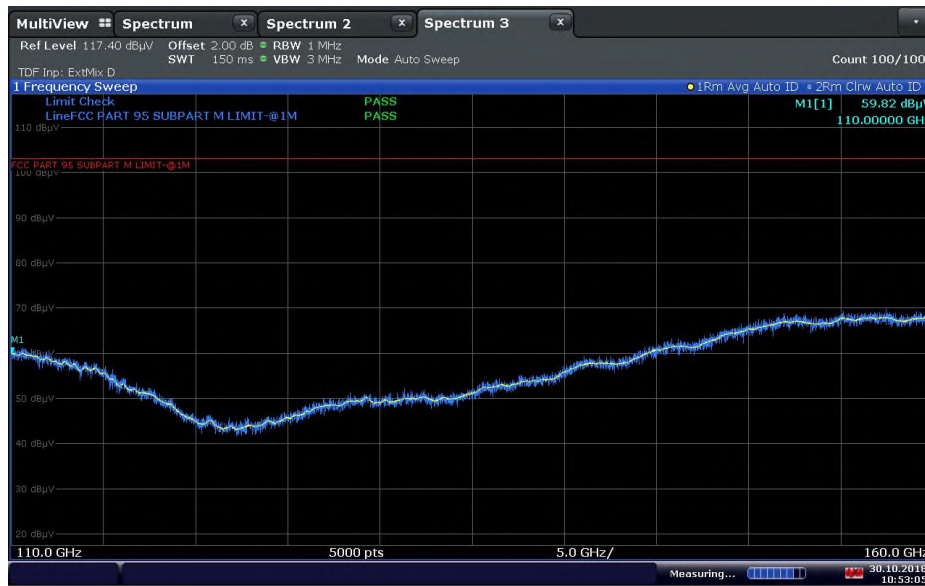
10:32:00 30.10.2018

110 to 160 GHz Low Channel 425 MHz BW



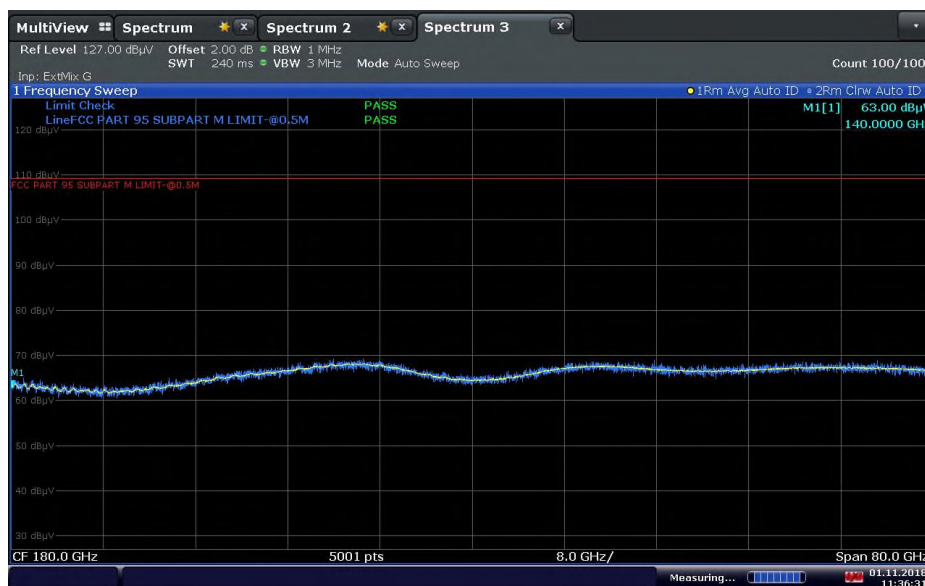
10:49:44 30.10.2018

110 to 160 GHz Mid Channel 425 MHz BW



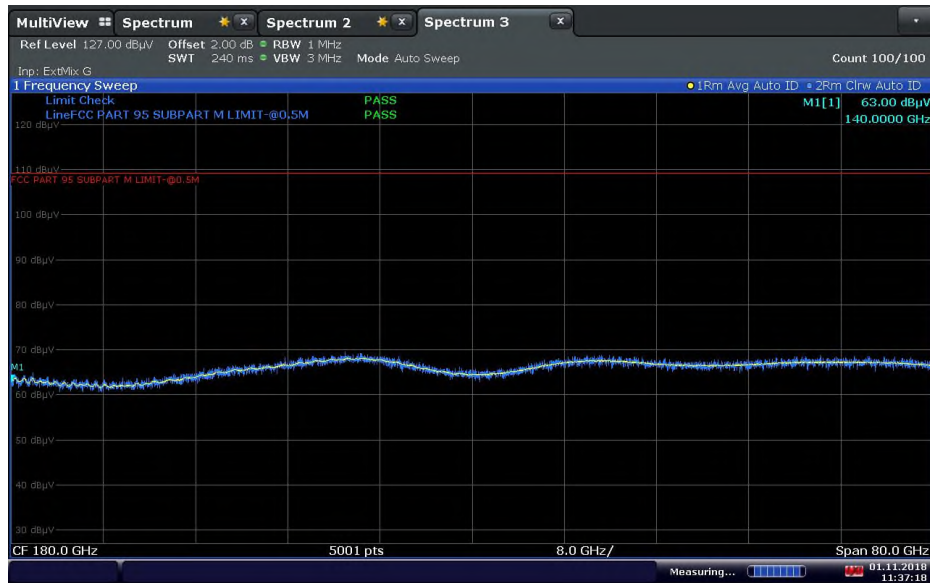
10:53:06 30.10.2018

110 to 160 GHz High Channel 425 MHz BW



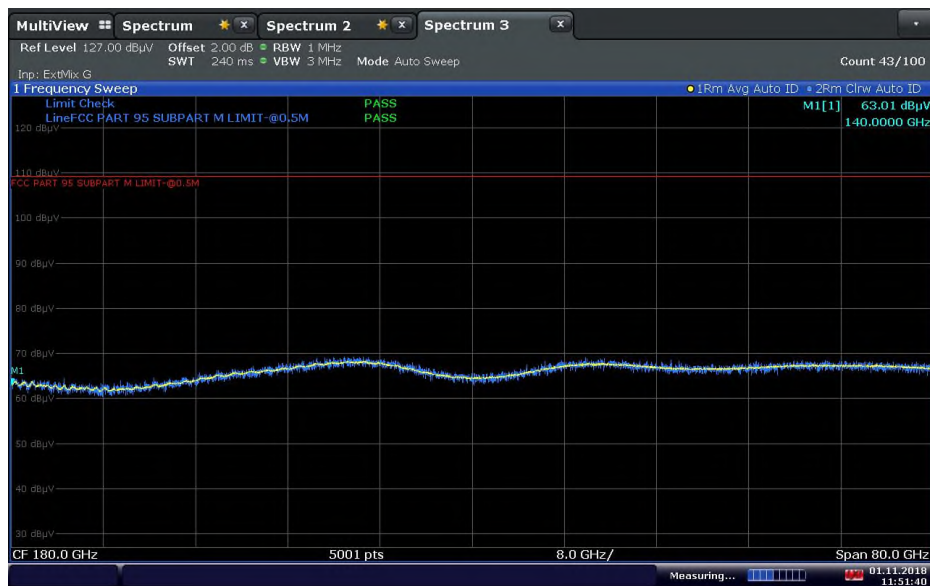
11:36:32 01.11.2018

160 to 220 GHz Low Channel 175 MHz BW



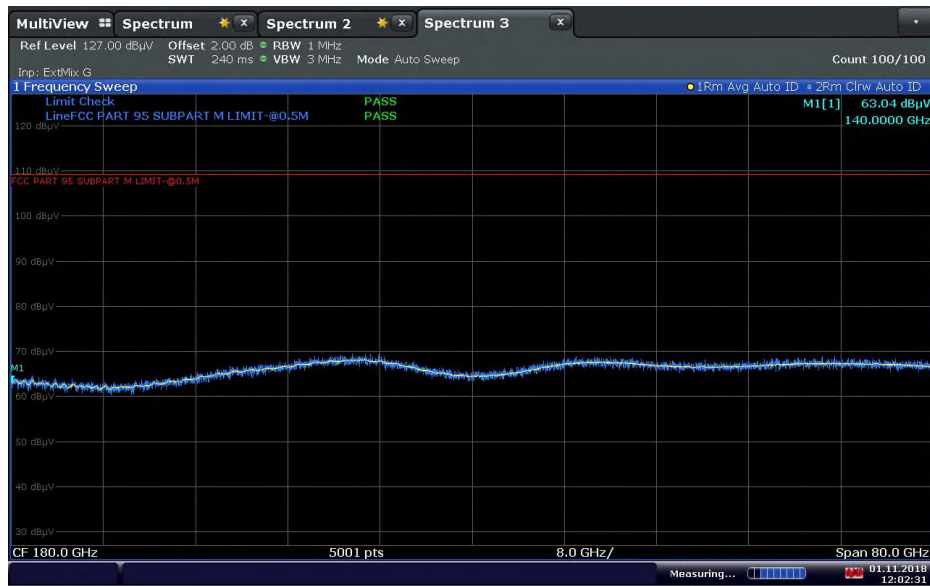
11:37:18 01.11.2018

160 to 220 GHz Mid Channel 175 MHz BW



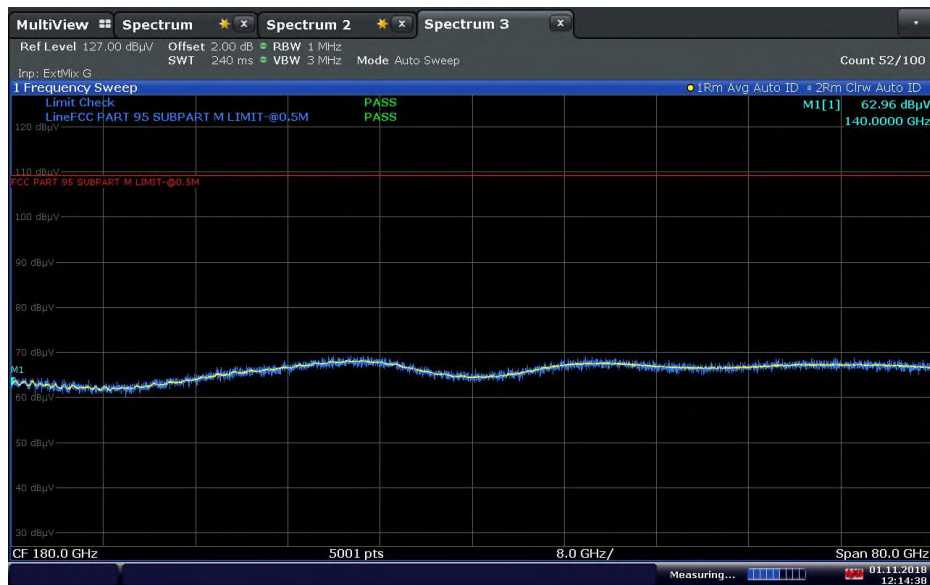
11:51:40 01.11.2018

160 to 220 GHz High Channel 175 MHz BW



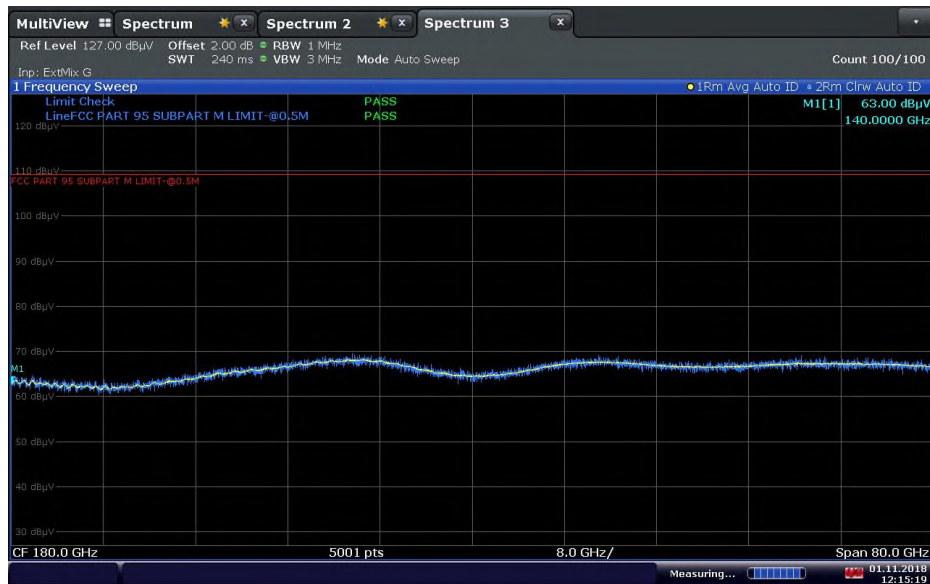
12:02:31 01.11.2018

160 to 220 GHz Low Channel 300 MHz BW



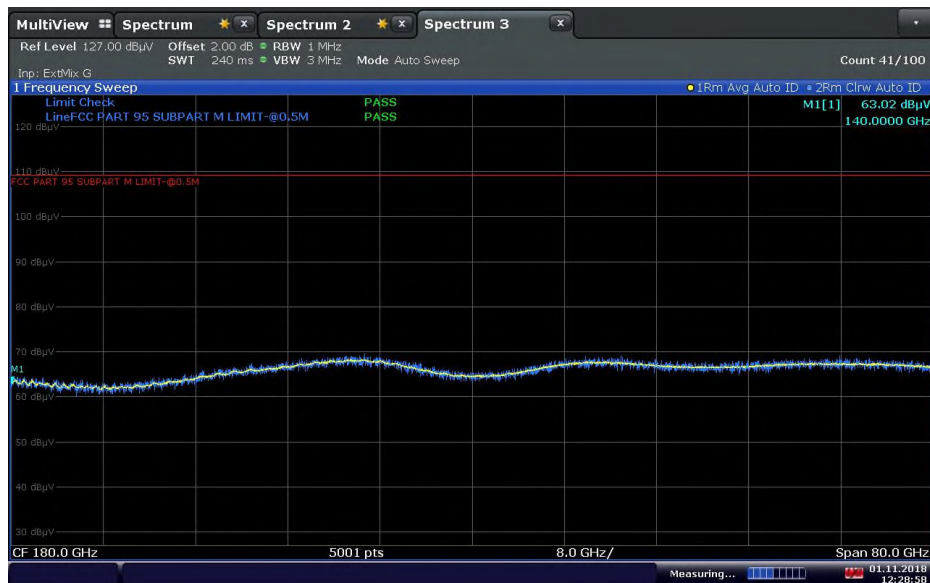
12:14:38 01.11.2018

160 to 220 GHz Mid Channel 300 MHz BW



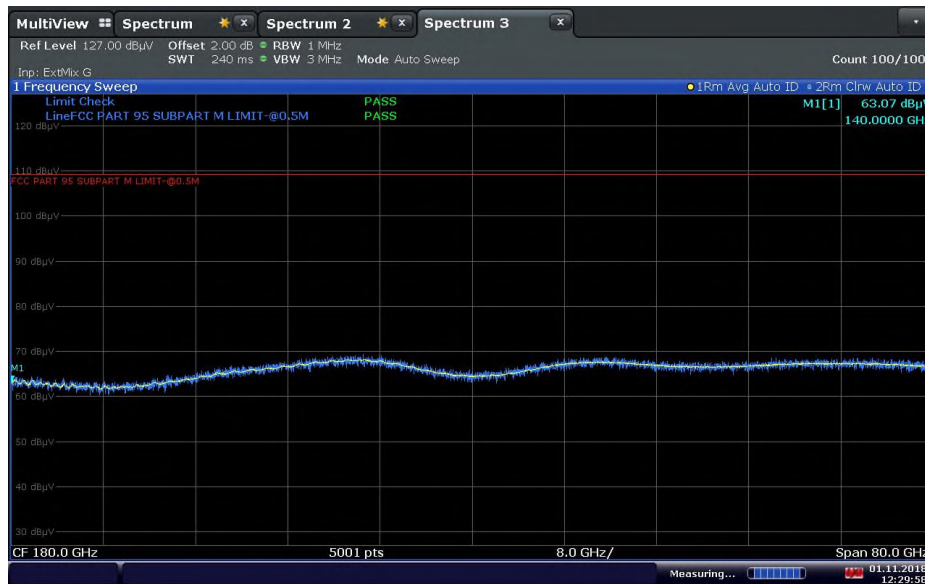
12:15:19 01.11.2018

160 to 220 GHz High Channel 300 MHz BW

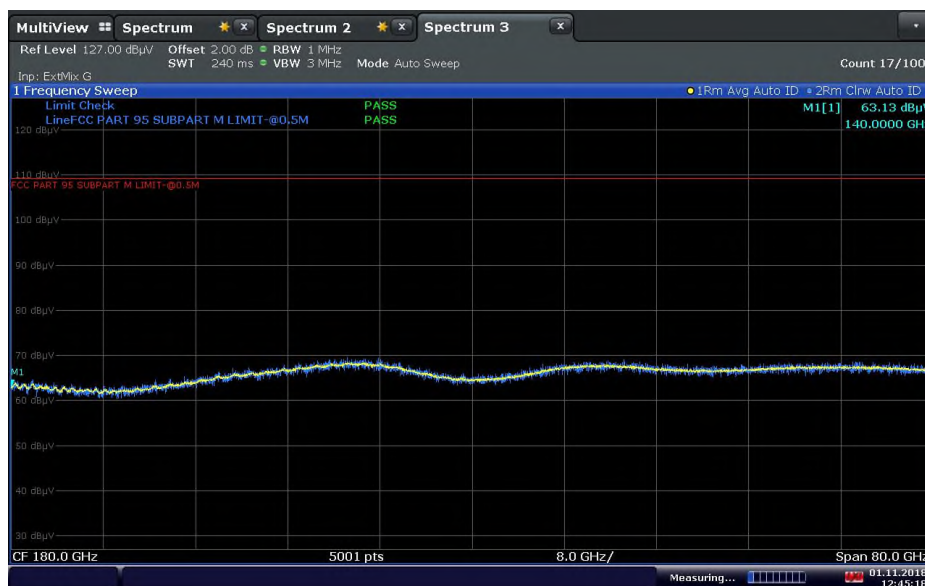


12:28:58 01.11.2018

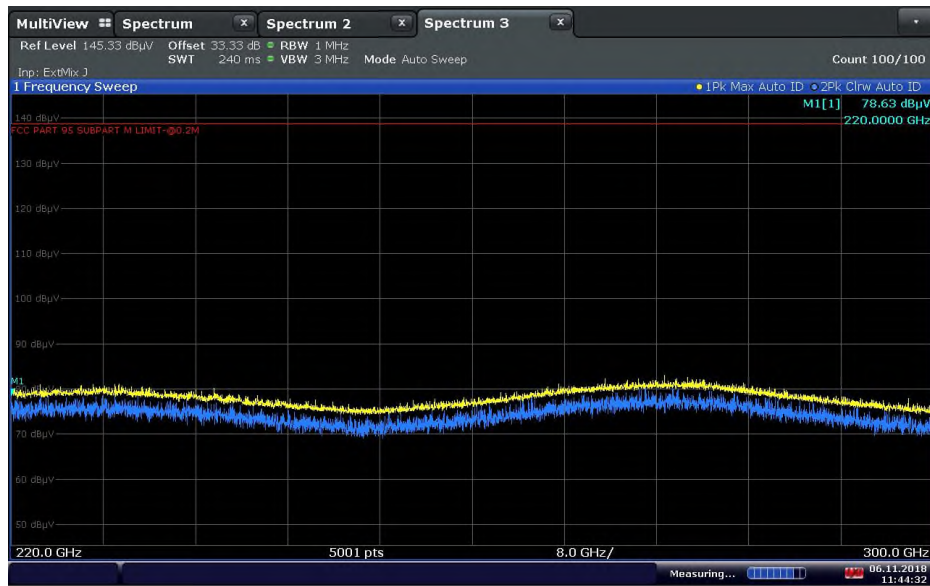
160 to 220 GHz Low Channel 425 MHz BW



160 to 220 GHz Mid Channel 425 MHz BW

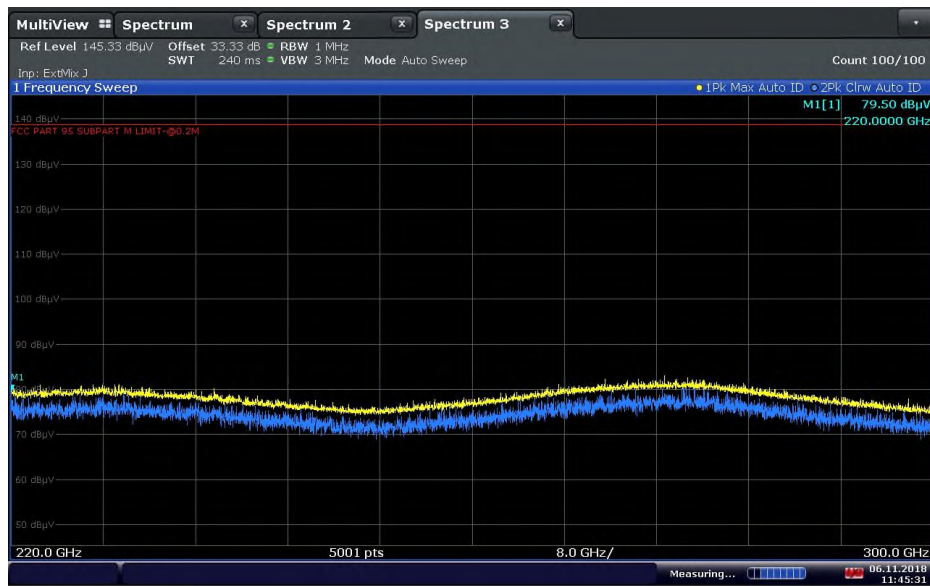


160 to 220 GHz High Channel 425 MHz BW



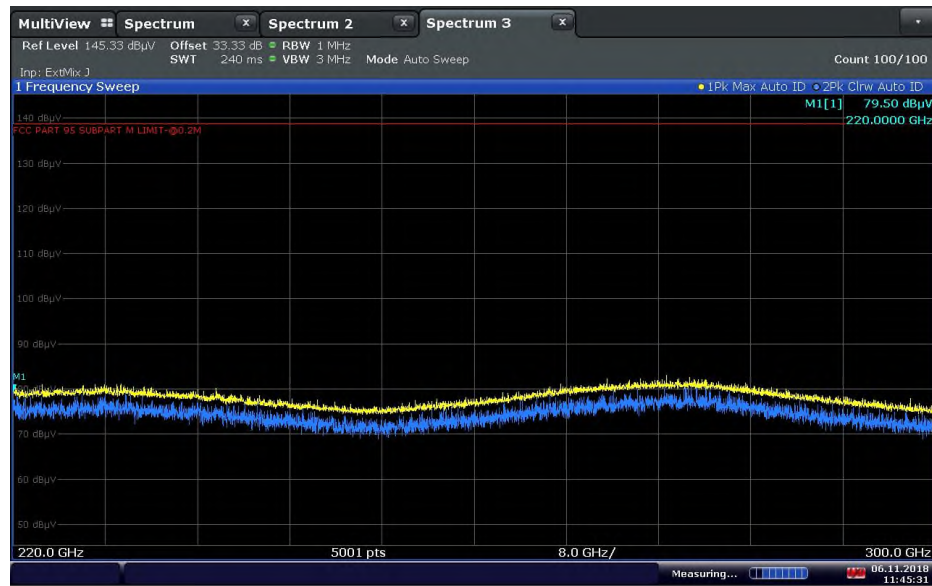
11:44:32 06.11.2018

220 to 300 GHz Low Channel 175 MHz BW



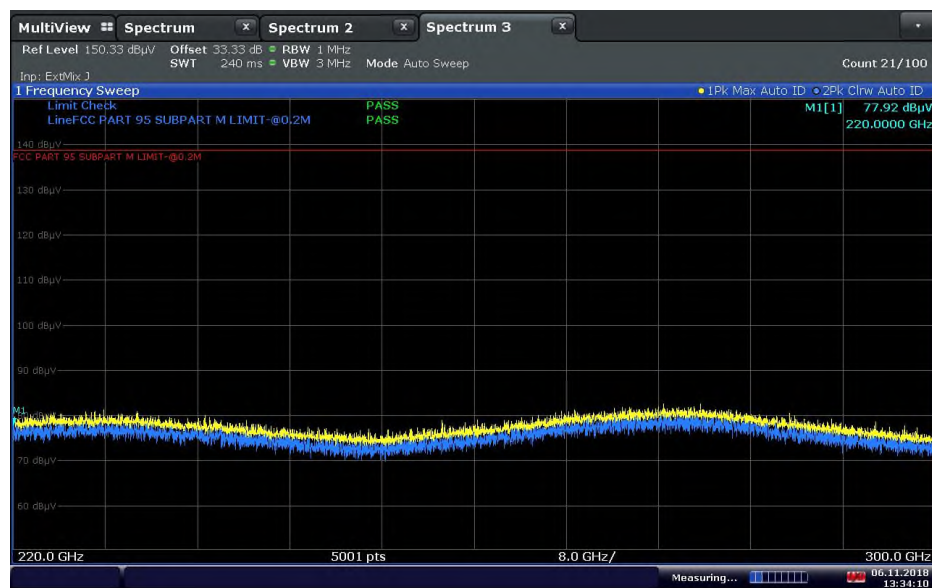
11:45:32 06.11.2018

220 to 300 GHz Mid Channel 175 MHz BW



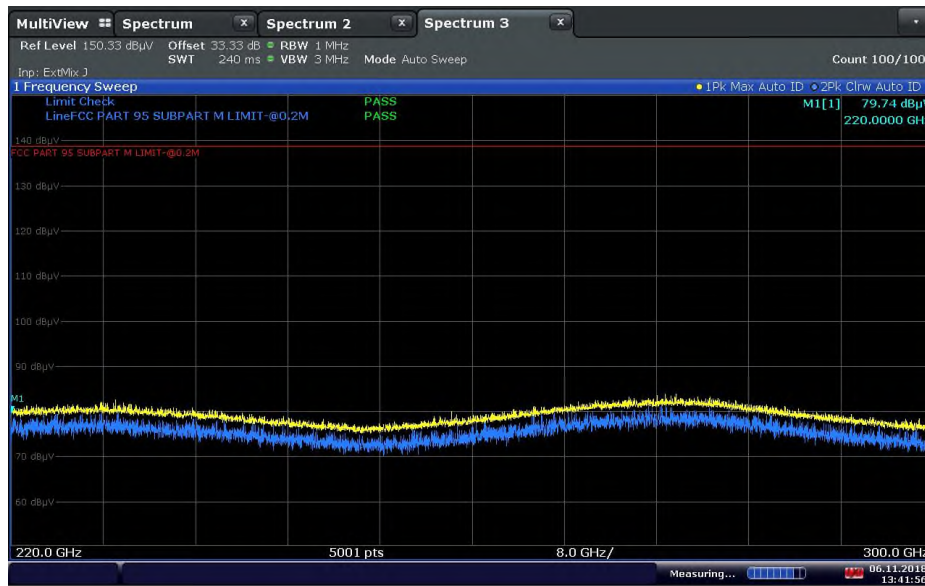
11:45:32 06.11.2018

220 to 300 GHz High Channel 175 MHz BW



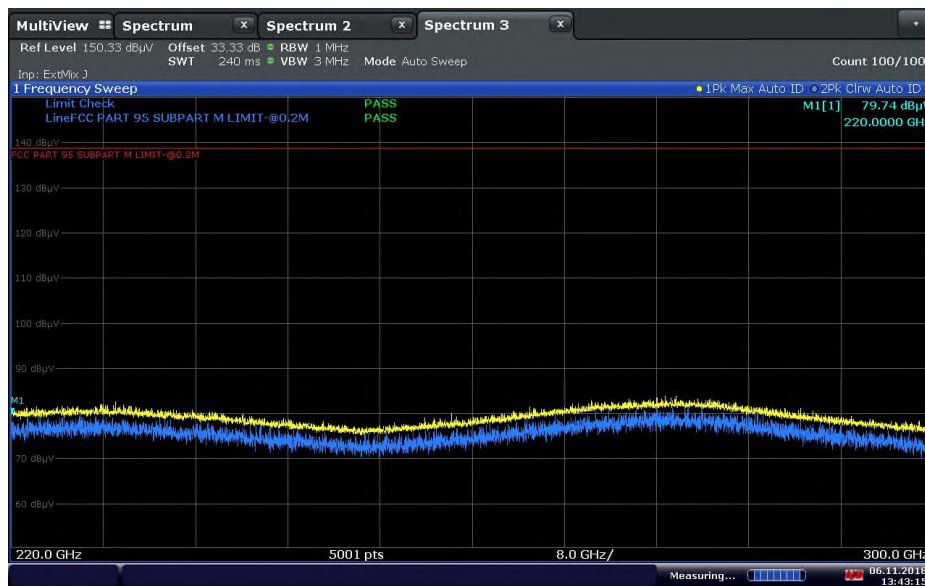
13:34:11 06.11.2018

220 to 300 GHz Low Channel 300 MHz BW



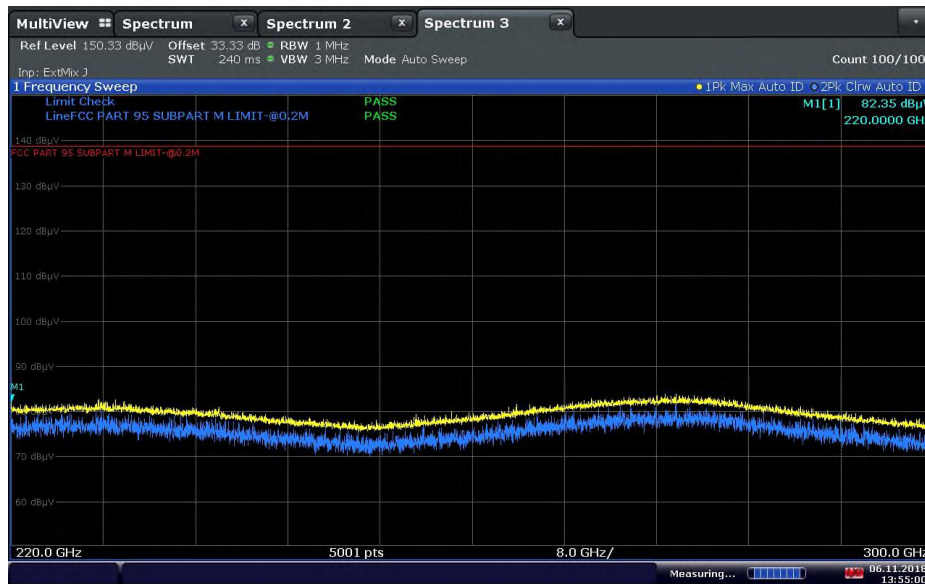
13:41:56 06.11.2018

220 to 300 GHz Mid Channel 300 MHz BW



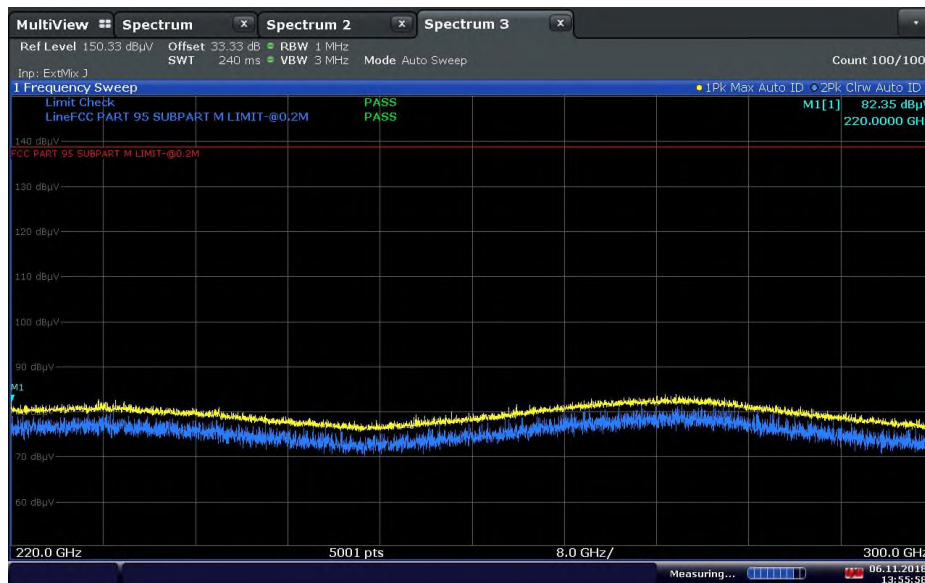
13:43:16 06.11.2018

220 to 300 GHz High Channel 300 MHz BW



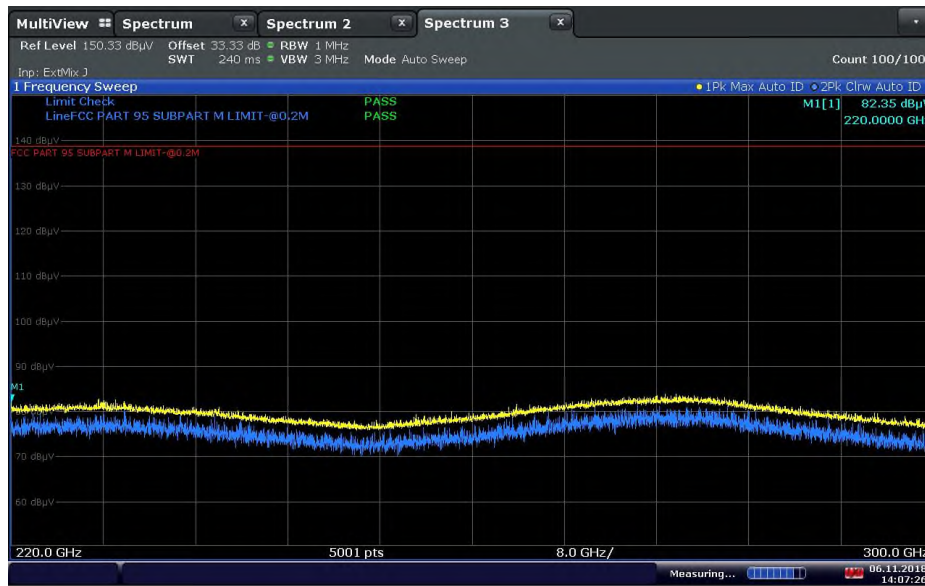
13:55:00 06.11.2018

220 to 300 GHz Low Channel 425 MHz BW



13:55:59 06.11.2018

220 to 300 GHz Mid Channel 425 MHz BW



14:07:27 06.11.2018

220 to 300 GHz High Channel 425 MHz BW



2.4 FREQUENCY STABILITY

2.4.1 Specification Reference

FCC Part 95 Subpart M §95.3379(b) and RSS-251 Issue 2 Sec. 11

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: 28508527.C.4/ Default Test Configuration

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

November 07, 2018/SB

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/Test Location

Test performed at TÜV SÜD America. Rancho Bernardo Facility.

Ambient Temperature	21°C
Relative Humidity	63%
ATM Pressure	101.56 kPa

2.4.7 Additional Observations

- EUT has no antenna port available. The measurements under this section were performed using radiated measurement method.
- Temperature range used is -20°C to +50°C. During test the EUT spectrum was monitored in the entire temperature range at 10 °C intervals.
- Extreme test source voltage used is 10.2 VDC and 13.8 VDC (85 % and 115 % of nominal voltage). No considerable frequency variations were observed at extreme supply voltages.
- An offset of 2.0 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 .
- The Test was done for one CW file.

2.4.8 Test Results

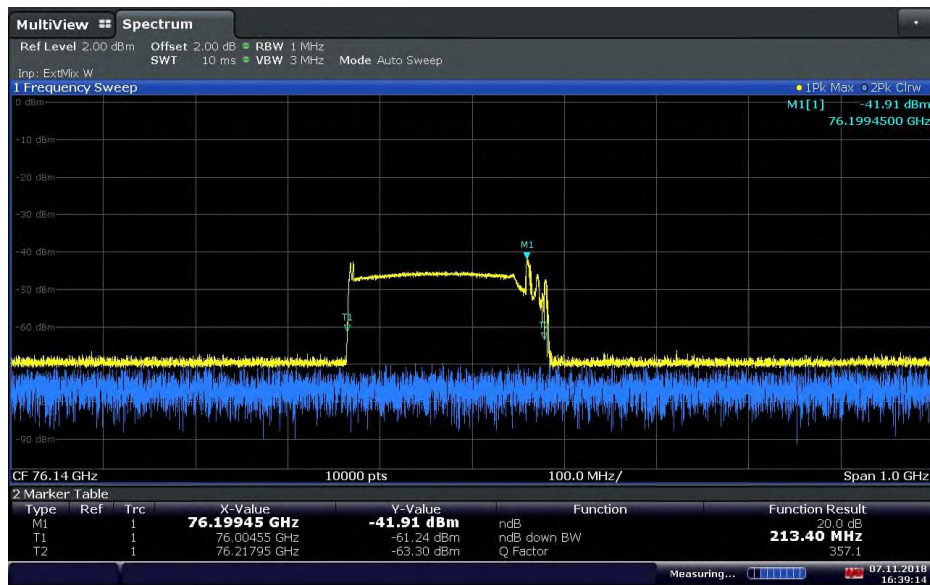
Temperature variation

Modulation BW	Temperature	Frequency Low f_L (GHz)	Frequency High f_H (GHz)
CW 76.050 GHz	50°C	76.00435	76.22405
	40°C	76.00455	76.21795
	30°C	76.00475	76.22165
	20°C	76.00535	76.22045
	10°C	76.00615	76.21535
	0°C	76.00625	76.21795
	-10°C	76.00595	76.21975
	-20 C	76.00595	76.21975
$f_L = 76.00435 \text{ GHz} > 76.0 \text{ GHz}$ $f_H = 76.21975 \text{ GHz} < 77.0 \text{ GHz}$ EUT Complies			

2.4.9 Test Plots

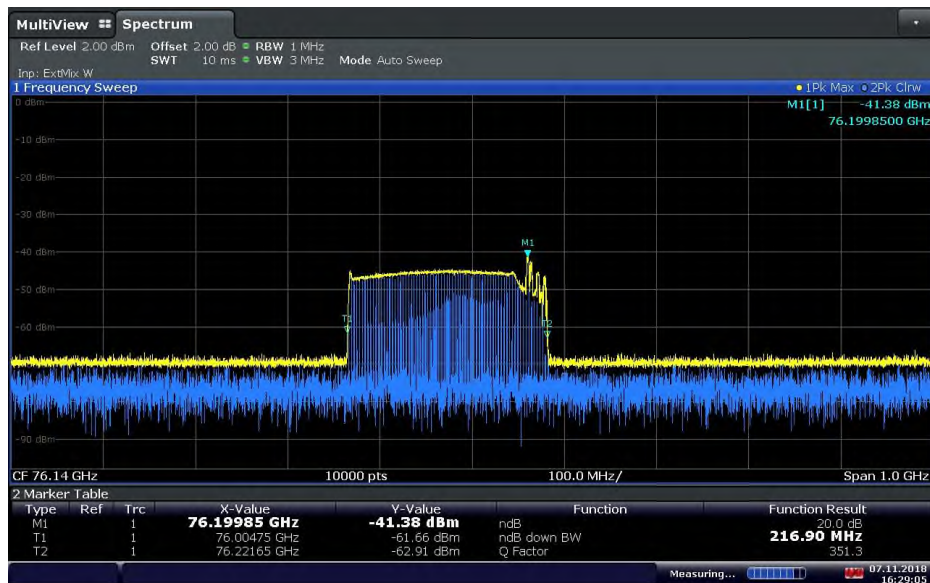


50 DEG 12.0 VDC CW 76.050 GHz



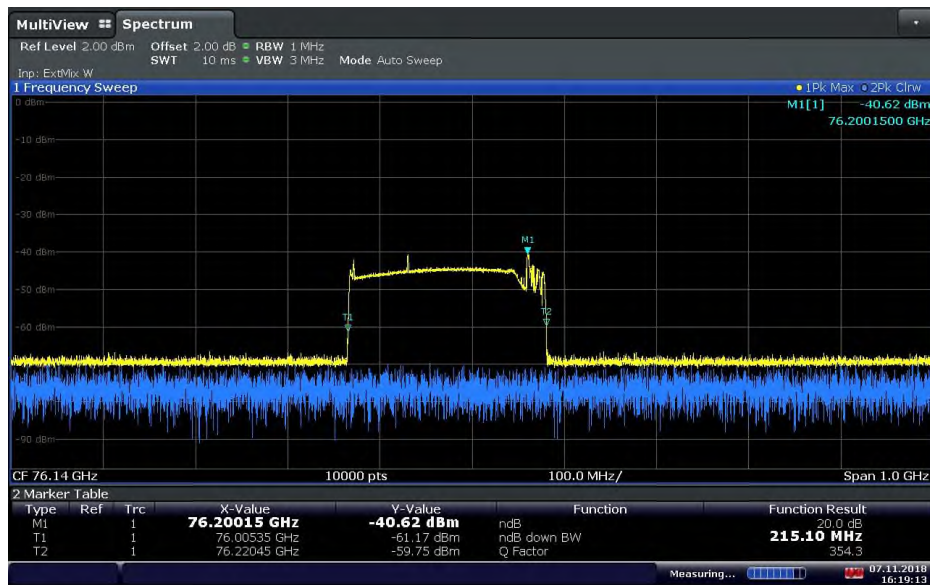
16:39:15 07.11.2018

40 DEG 12.0 VDC CW 76.050 GHz



16:29:06 07.11.2018

30 DEG 12.0 VDC CW 76.050 GHz



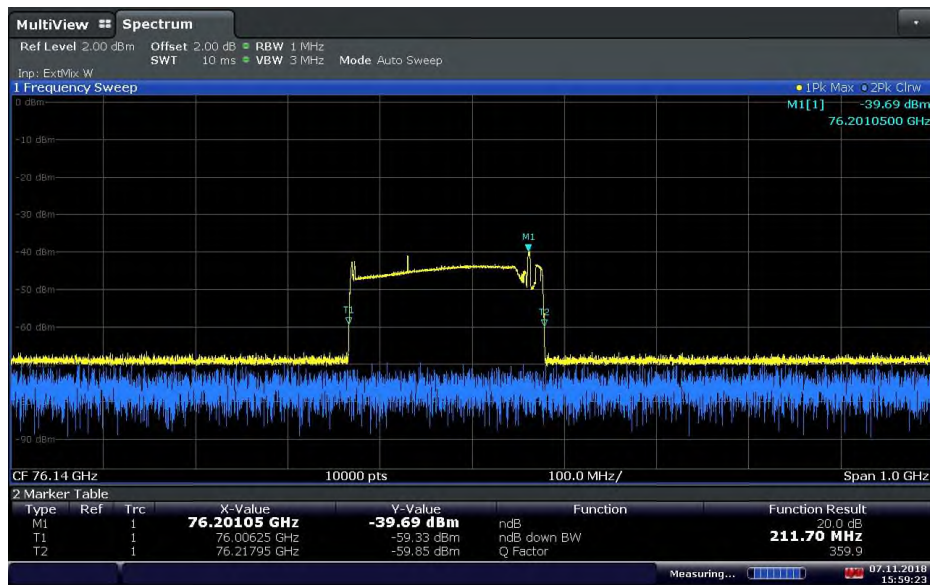
16:19:13 07.11.2018

20 DEG 12.0 VDC CW 76.050 GHz



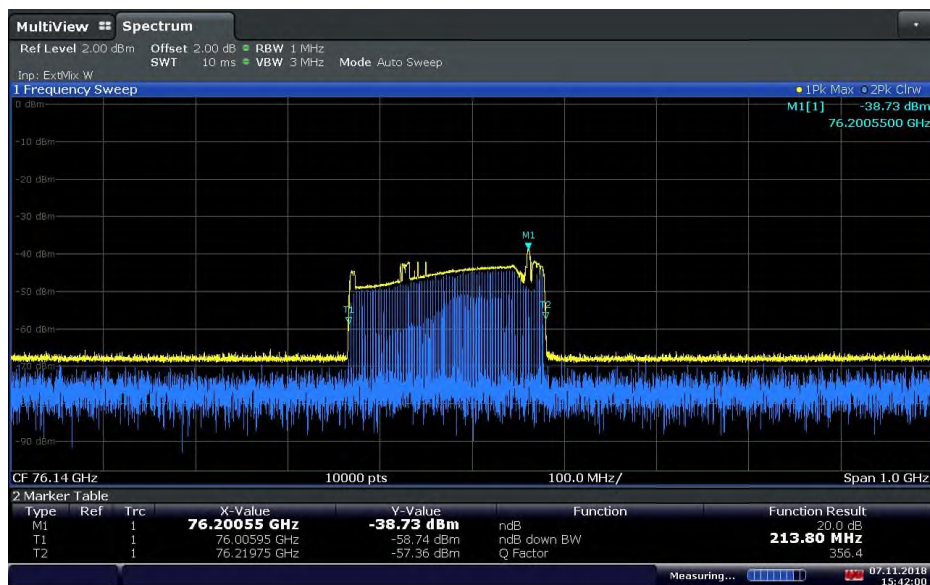
16:09:13 07.11.2018

10 DEG 12.0 VDC CW 76.050 GHz



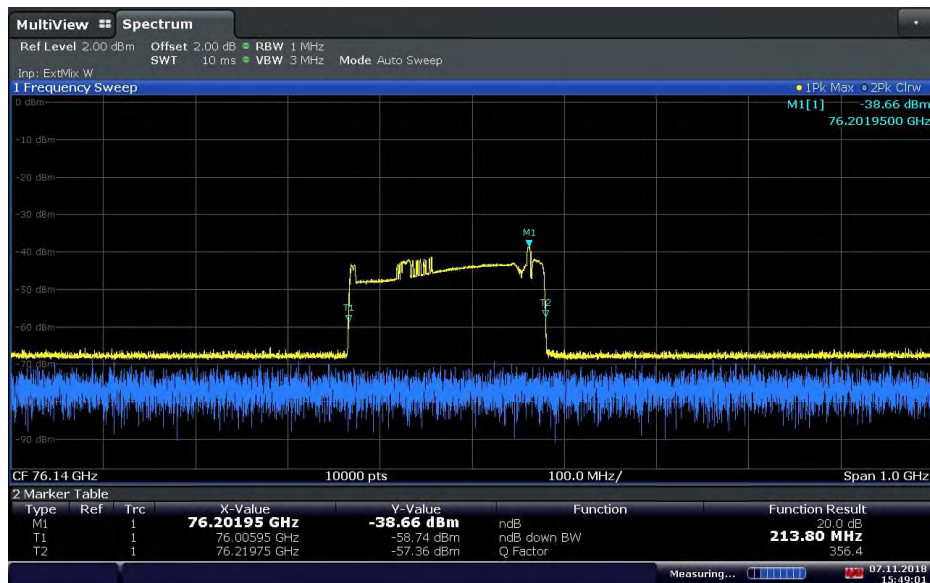
15:59:24 07.11.2018

0 DEG 12.0 VDC CW 76.050 GHz



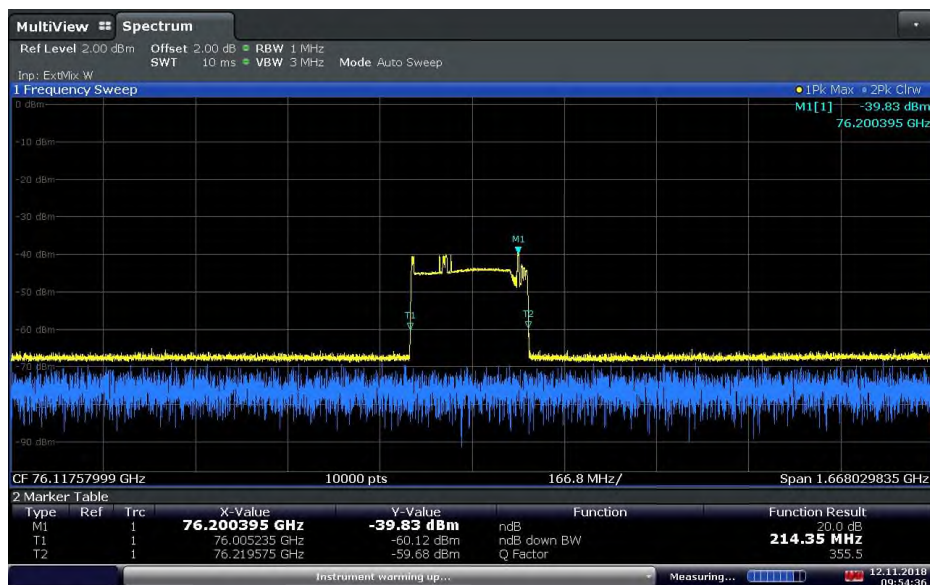
15:42:01 07.11.2018

-10 DEG 12.0 VDC CW 76.050 GHz



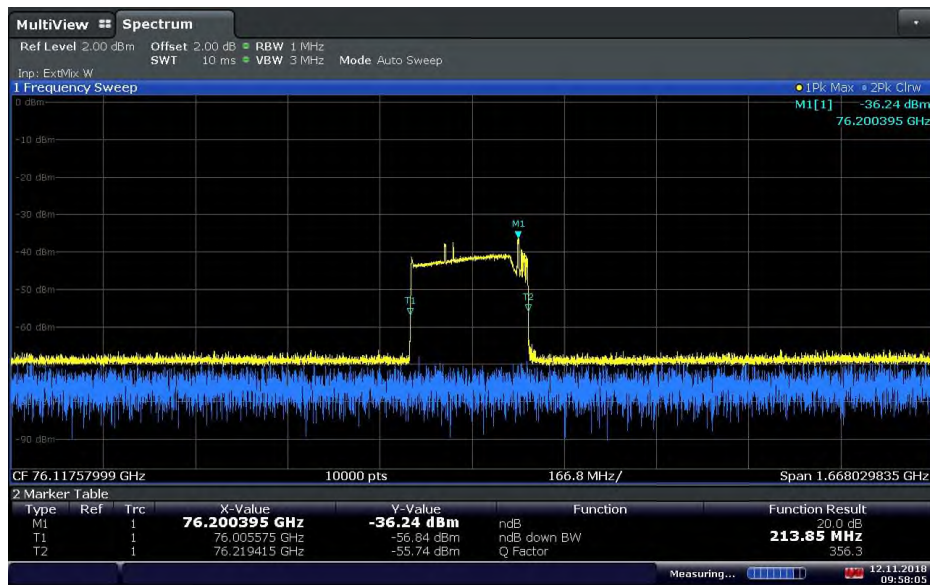
15:49:01 07.11.2018

-20 DEG 12.0 VDC CW 76.050 GHz



09:54:37 12.11.2018

20 DEG 10.2 VDC CW 76.050 GHz



09:58:06 12.11.2018

20 DEG 13.8 VDC CW 76.050 GHz



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	06/08/2018	06/08/2019
7611	Signal/Spectrum Analyzer	FSW26	102017	Rhode & Schwarz	05/09/2018	05/09/2019
1002	Bilog Antenna	3142C	00058717	ETS-Lindgren	11/20/17	11/20/19
8891	Pre-Amplifier	PE15A3262	1012	TUV SUD America	06/15/2017	06/15/2018
7631	Double-ridged waveguide horn antenna	3117	00205418	ETS-Lindgren	08/03/2017	08/03/2018
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	
7620	EMI Test Receiver	ESU40	100399	Rhode & Schwarz	10/17/2017	10/17/2018
8628	Pre-amplifier	QLJ 01182835-JO	8986002	QuinStar Technologies Inc.	03/06/2018	03/06/2019
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	05/31/2018	05/31/2020
7636	Harmonics mixer (60-90 GHz)	FS-Z90	100092	Rhode & Schwarz	Verified	
7633	Harmonics mixer (75-110 GHz)	HM-110-7	101000	Radiometer Physics	Verified	
7634	Harmonics mixer (110-170 GHz)	HM-170	0062	Radiometer Physics	Verified by 1003 & 7611	
7635	Harmonics mixer (170-220 GHz)	HM-220	020022	Radiometer Physics	Verified by 1003 & 7611	
7632	Harmonics mixer (220-325 GHz)	HM-325	020075	Radiometer Physics	Verified by 1003 & 7611	
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	Verified	
1026	High-frequency cable	3M-7/C2	N/A	MicroCoax	Verified	
8849	High-frequency cable (1-18 GHz)	SAC-26G-6.1	363	A.H.Systems	Verified	
8771	6dB attenuator	606-06-1F4/DR	N/A	MECA	Verified	



Miscellaneous						
6708	Multimeter	34401A	US36086974	Hewlett Packard	07/18/18	07/18/19
7554	Barometer/Temperature/Humidity Transmitter	iBTHX-W	0400706	Omega	05/25/18	05/25/19
7579	Temperature Chamber	115	151617	TestQuity	08/24/18	08/24/19
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	Triangular	3.55	1.45	2.10
6	EUT Setup	Rectangular	1.00	0.58	0.33
			Combined Uncertainty (u_c):		1.69
			Coverage Factor (k):		2
			Expanded Uncertainty:		3.38

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	Triangular	5.50	2.25	5.04
6	EUT Setup	Rectangular	1.00	0.58	0.33
			Combined Uncertainty (u_c):		2.40
			Coverage Factor (k):		2
			Expanded Uncertainty:		4.81

3.2.3 Radiated Emission Measurements (Above 18 GHz)

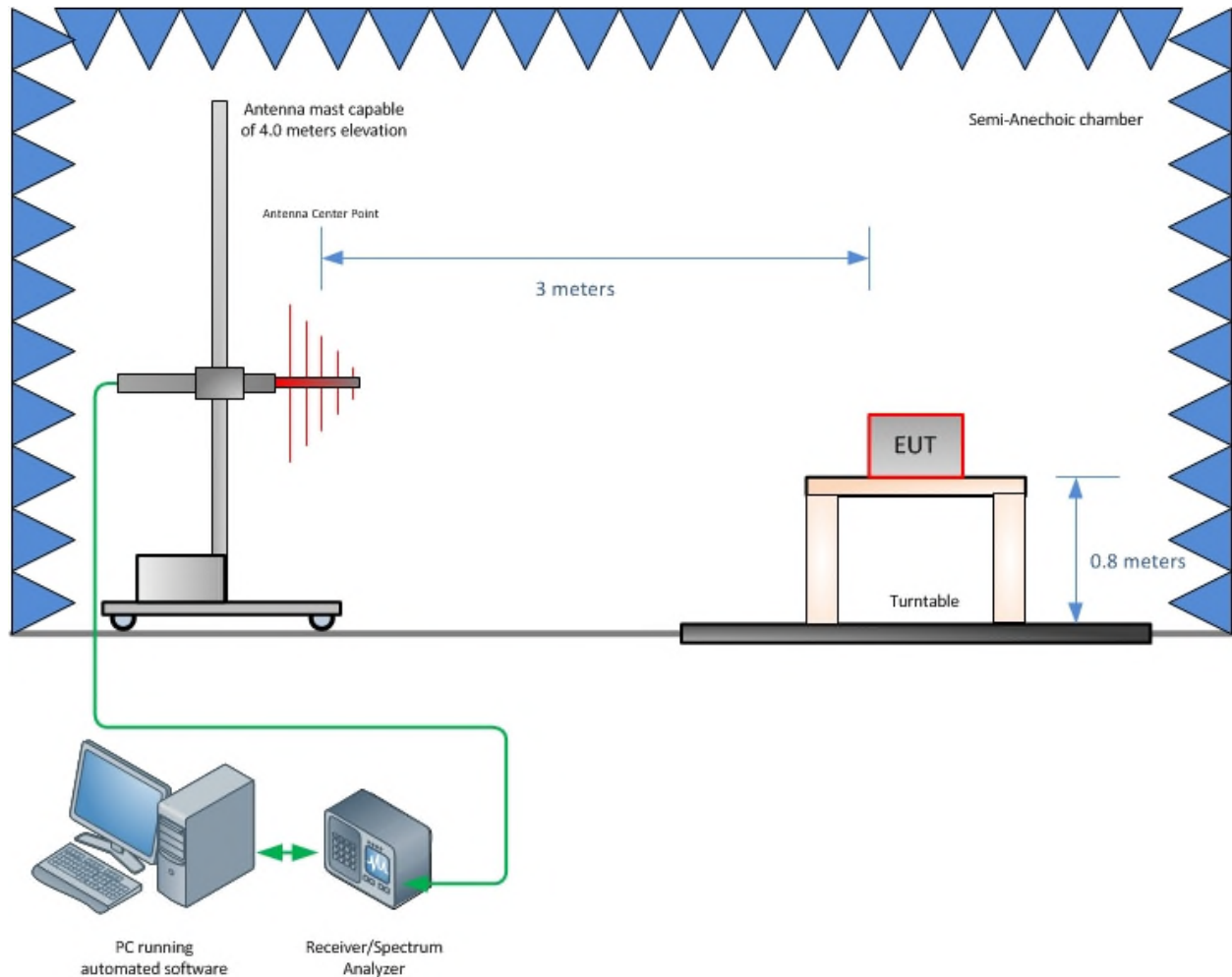
Contribution		Probability Distribution Type	Probability Distribution x_i	Standard Uncertainty $u(x_i)$	$[u(x_i)]^2$
1	Cables	Rectangular	0.70	0.40	0.16
2	Preamplifier	Rectangular	0.50	0.29	0.08
3	Spectrum Analyzer/Mixers	Rectangular	3.34	1.93	3.72
4	Antenna	Rectangular	2.70	1.56	2.43
5	EUT Setup	Rectangular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



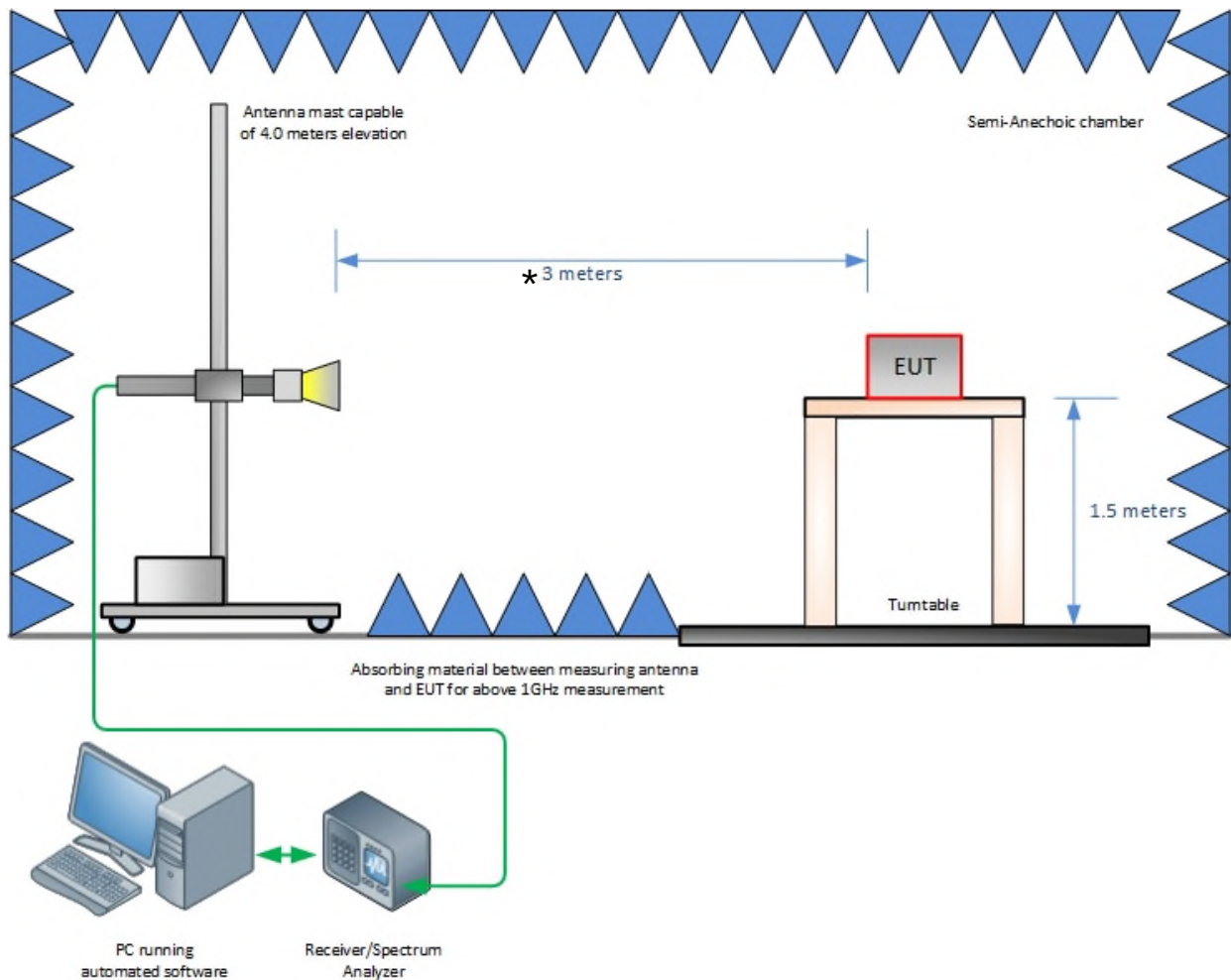
SECTION 4

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 75 GHz. The emissions in the range from 75 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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