

# Radio Testing of the

Fortem Technologies, Inc.  
Radar Model: R30

## In accordance with FCC Title 47 Chapter I Subchapter D Part 87

Fortem Technologies, Inc.  
1064 S N County Blvd 6th Floor  
Pleasant Grove, UT 84062  
USA



America

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## COMMERCIAL-IN-CONFIDENCE

Date: January 2022

Document Number: 72173712A Issue 01 | Version Number: 01

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Authorized Signatory	Xiaoying Zhang	January 03, 2022	

Signatures in this approval box have checked this document in line with the requirements of TÜV SÜD document control rules.

### EXECUTIVE SUMMARY

A sample of this product was tested and found to be in compliance with FCC Title 47 Chapter I Subchapter D Part 87



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TÜV SÜD America, Inc.  
10040 Mesa Rim Road  
San Diego, CA 92121-2912

TÜV SÜD America, Inc.  
Rancho Bernardo Facility  
16936 Via Del Campo  
San Diego, CA 92127

Phone: 858 678 1400  
www.tuv-sud-america.com




**REPORT ON** Radio Testing of the  
Fortem Technologies, Inc.  
Model R30 Radar

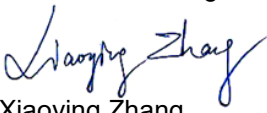
**TEST REPORT NUMBER** 72173712A

**TEST REPORT DATE** January 2022

**PREPARED FOR** Fortem Technologies, Inc.  
1064 S N County Blvd 6th Floor  
Pleasant Grove, UT 84062  
USA

**CONTACT PERSON** Jeffery Davis  
Electrical Engineer and Regulatory & Compliance Officer  
jeffery.davis@fortemtech.com  
(801) 822-8043

**PREPARED BY**   
Omar Castillo  
**Name**  
Authorized Signatory  
Title: EMC Test Engineer

**APPROVED BY**   
Xiaoying Zhang  
**Name**  
Authorized Signatory  
Title: Senior RF Wireless Test Engineer

**DATED** January 03, 2022



**Revision History**

72173712A Fortem Technologies, Inc. Model R30 Radar					
DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
01/03/2022	—	Initial Release			Xiaoying Zhang



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## SECTION 1

### REPORT SUMMARY

Radio Testing of the  
Fortem Technologies, Inc.  
TrueView R30 Radar



## 1.1 INTRODUCTION

The information contained in this report is intended to show verification of the Fortem Technologies, Inc. TrueView R30 Radar to the requirements of FCC Title 47 Chapter I Subchapter D Part 87.

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. This report is an update to Report No. 72153658A. Prior to certification, the manufacturer updated the power level necessitating re-evaluation of power measurements and associated spurious emissions. In addition to measurements not affected by the change, this test report covers the test results resulting from the updates.
Manufacturer	Fortem Technologies, Inc.
EUT	Radar
Trade Name	TrueView R30 Radar
Model Name	R30
FCC ID	2APIM-FTR30V002
IC Number	N/A
Serial Number(s)	X00330153
Number of Samples Tested	1
Test Specification/Issue/Date	FCC Title 47 Chapter I Subchapter D Part 87 Aviation Services (October 1, 2020).
Start of Test	November 22, 2021
Finish of Test	November 30, 2021
Name of Engineer(s)	Ferdinand Custodio Alex Chang Omar Castillo Ivan Retana
Related Document(s)	<ul style="list-style-type: none"><li>ANSI C63.26-2015. American National Standard for Compliance Testing of Transmitters Used in Licensed radio Services.</li><li>Test Report 72153658A Fortem R30 FCC Part 87 Test Report Issue 3. Issued by TÜV SÜD America, 10040 Mesa Rim Rd, San Diego, CA 92121 on March 18, 2020. Supporting documents for EUT certification are separate exhibits.</li></ul>



**1.2 BRIEF SUMMARY OF RESULTS**

A brief summary of the tests carried out in accordance with FCC Title 47 Chapter I Subchapter D Part 87 are shown below:

Part 2	Part 87	Test Description	Result	Comments/ Base Standard
§2.1046	§87.131	RF Power Output	Verified*	
§2.1051	§87.139(a)	Unwanted Emissions	Compliant	
§2.1053	§87.139(a)(3)	Field Strength of Radiated Spurious Emissions	Compliant	
§2.1049		Occupied Bandwidth	Compliant	
§2.1047		Audio Low Pass Filter (Voice Input)	N/A	
§2.10479		Audio Frequency Response	N/A	
§2.1047		Modulation Limiting	N/A	
§2.1055	§87.133(a)	Frequency Stability (Temperature Variation)	Compliant	
§2.1055	§87.133(a)	Frequency Stability (Voltage Variation)	Compliant	

Verified\*  
 N/A

*The maximum power will be determined by appropriate standards during the certification process  
 The EUT does not employ an audio input*



### 1.3 PRODUCT INFORMATION

#### 1.3.1 Technical Description

The Equipment Under Test (EUT) is a Fortem Technologies, Inc. TrueView R30 Radar. The EUT is a small, compact, powerful radar detection system providing tracking capabilities that monitor a marked or defined airspace and reports all airborne activity within that space.

#### 1.3.2 EUT General Description

EUT Description	Radar
Model Name	TrueView R30 Radar
Model Number	R30
Serial Number	X00330153
Software Version	3.0
Input Voltage	24VDC (AC/DC Adapter, Traco Power TIB 480-124)
Operating Voltage Range	18VDC to 36VDC
Output RF Power	54.5 dBm EIRP (rated)
Mode Verified	15.4GHz to 15.7GHz (radio navigation)
Capability	15.4GHz to 15.7GHz (radio navigation) and 16.2GHz to 16.7GHz (radio location)
Operating Temperature	-40°C to 60°C
Primary Unit (EUT)	<input checked="" type="checkbox"/> Production <input type="checkbox"/> Pre-Production <input type="checkbox"/> Engineering
Emission Designator	170MQXN
Antenna Type	Internal Array
Antenna Model	N/A
Antenna gain	15 dBi
Modulation	FMCW





## 1.4 EUT TEST CONFIGURATION

### 1.4.1 Test Configuration Description

Test Configuration	Description
Default	EUT is configured by the support laptop through the ethernet port. The EUT was configured to transmit in either full radar swept mode or in single CW mode, depending on the test. The EUT was also configured to transmit in the frequencies at the extreme low, mid-range, and high ends of the allotted band through Python scripts and with the GUI using a web browser. Alternative configuration via remote setup is using the support laptop connected to the internet while both the EUT and the laptop connected to a common router. Using this setup, Fortem Engineer could remotely configure the EUT on the fly.

### 1.4.2 EUT Exercise Software

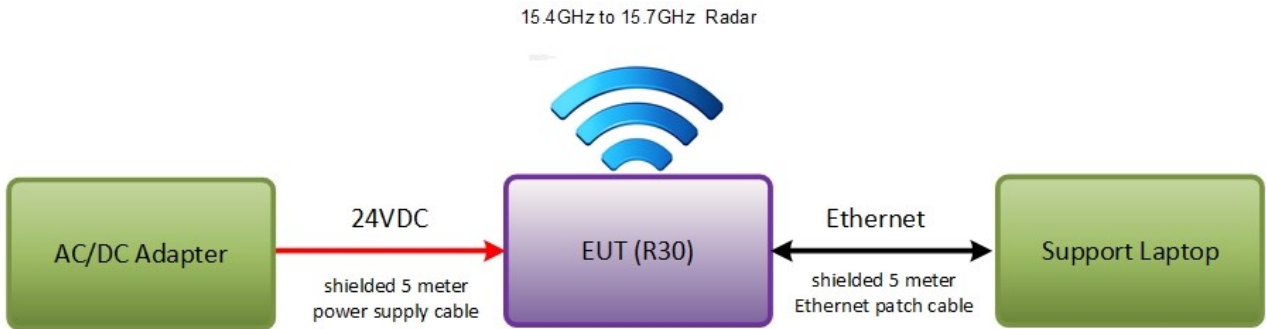
Web browser GUI (integrated with the EUT) and Python 3.7.

### 1.4.3 Support Equipment and I/O cables

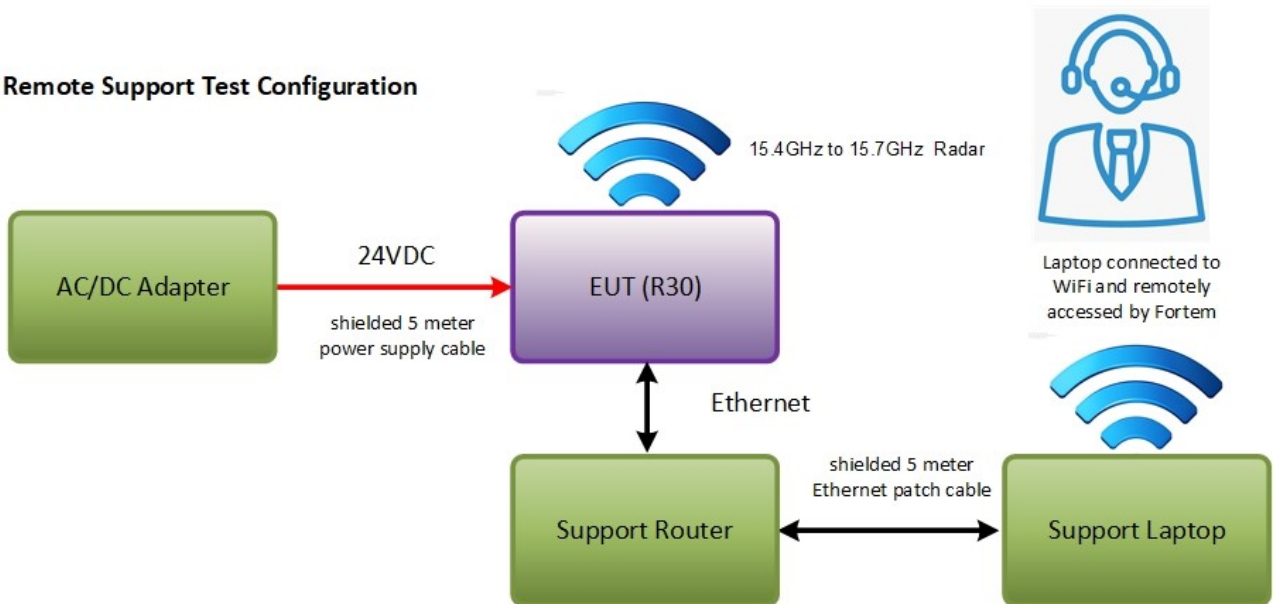
Manufacturer	Equipment/Cable	Description
Dell	Support Laptop	Model: XPS 15 9570
HP	Support Laptop	Model: HSTNN-C87C
Asus	Dual Band Gigabit Router	Model: RT-AC68U
Traco Power	EUT AC/DC Adapter	Part No. TIB 480-124 24VDC 480W
-	Ethernet Patch Cable	FPN: 220-0057. Shielded, 5m, RJ-45 to 26-pin ODU AMC
-	DC power supply end cable*	FPN: 220-0061. Shielded, 305mm, 5-pin ODU AMC to 3-pin DH-20 Series
-	DC power supply long cable*	FPN: 220-0084. Shielded, 12AWG, 2C, 5m. 3-pin DH-20 Series to 3-wire pigtail

\* Note: Above "long" and "end" power cables connect to each other in series.

### 1.4.4 Simplified Test Configuration Diagram



### Remote Support Test Configuration





**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: X00330153		
None	—	—

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 C63.26-2015. American National Standard for Compliance Testing of Transmitters Used in Licensed radio Services.

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 C63.26-2015. 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 – Designation No.: US1146**

TÜV SÜD 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 TÜV SÜD 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 TÜV SÜD 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)**

TÜV 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)**

TÜV SÜD 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**

TÜV SÜD 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**

TÜV SÜD 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**

TÜV SÜD 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  
Fortem Technologies, Inc.  
R30 Radar



## 2.1 RF POWER OUTPUT

### 2.1.1 Specification Reference

FCC 47 CFR Part 87, Clause 87.131

### 2.1.2 Standard Applicable

Class of Station	Frequency Band/Frequency	Authorized Emission(s) <sup>9</sup>	Maximum Power <sup>1</sup>
Radionavigation	Various <sup>7</sup>	Various <sup>7</sup>	Various <sup>7</sup>

<sup>1</sup>The power is measured at the transmitter output terminals and the type of power is determined according to the emission designator as follows:

(i) Mean power (pY) for amplitude modulated emissions and transmitting both sidebands using unmodulated full carrier.

(ii) Peak envelope power (pX) for all emission designators other than those referred to in paragraph (i) of this note.

<sup>7</sup>Frequency, emission, and maximum power will be determined by appropriate standards during the certification process.

<sup>9</sup>Excludes automatic link establishment.

### 2.1.3 Equipment Under Test and Modification State

Serial No: X00330153 / Default Test Configuration

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

November 22, 2021 / OC

### 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 performed at TÜV SÜD America Inc. Mira Mesa facility

Ambient Temperature	23.5 °C
Relative Humidity	37.6 %
ATM Pressure	100.5 kPa



**2.1.7 Additional Observations**

- This is a radiated test utilizing a spectrum analyzer.
- Test guidance is per Section 5.2.7 of ANSI C63.26-2015. The formula (d) was used to convert the measured field strength level to an equivalent power level for reporting:

$$EIRP (dBm) = E (dB\mu V/m) + 20\log(D) - 104.8$$

where D is the measurement distance (in the far field region) in meter

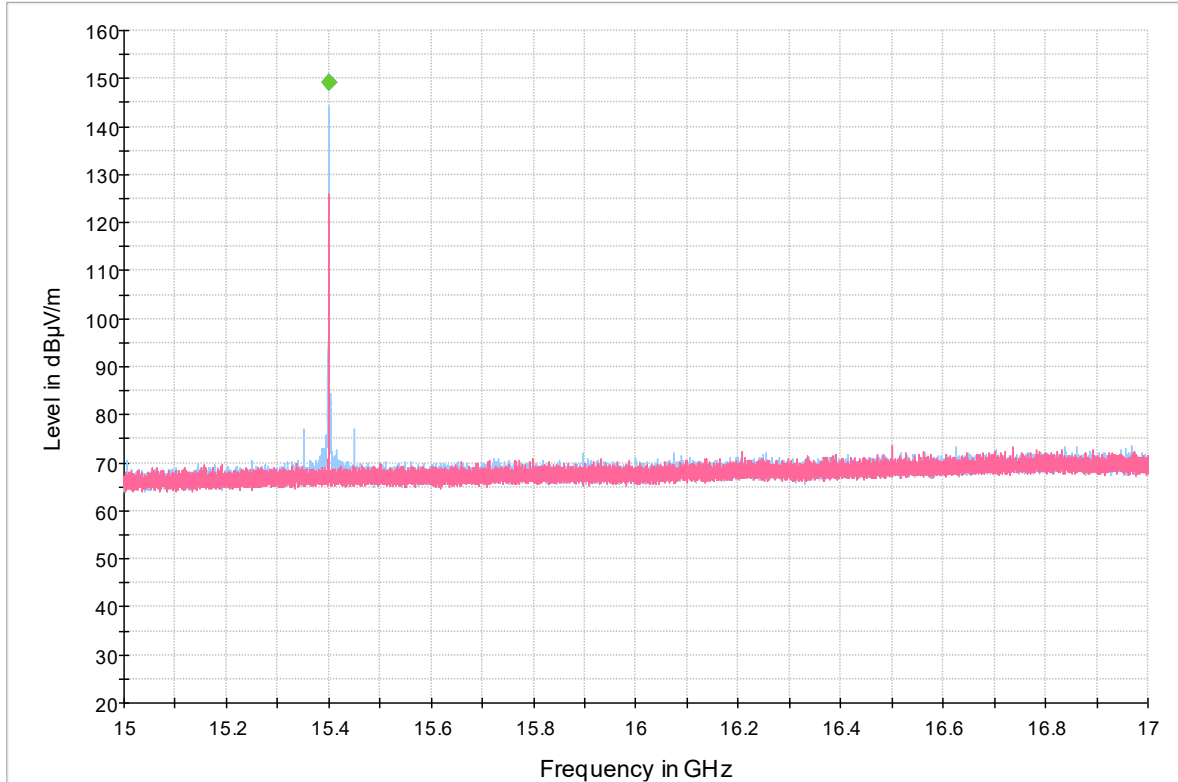
- The EUT was switched to CW mode for this test.
- EUT verified on both X and Y axis, only the worst axis presented.
- The actual limit for this test will be determined by appropriate standards during the certification process. The limit used during verifications will be ignored (greyed out on the test plots presented).

**2.1.8 Summary of Test Results**

Frequency (MHz)	Peak (dBμV/m @ 3 meters)	Average (dBμV/m @ 3 meters)	Peak EIRP (dBm)	Average EIRP (dBm)
15400.00	149.21	149.10	53.98	53.87
15550.00	149.74	149.55	54.51	54.32
15700.00	149.88	149.75	54.55	54.52



**2.1.9 Low Channel Test Results**



◆ Preview Result 1H-PK+ [Preview Result 1H.Result:2] Final\_Result PK+ [Final\_Result.Result:4]
 ◆ Preview Result 1V-PK+ [Preview Result 1V.Result:2] Final\_Result AVG [Final\_Result.Result:5]

**Peak (Field Strength @ 3 meters)**

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
15399.800000	149.21	73.90	-75.31	1000.0	1000.000	138.0	H	31.0	49

**Average (Field Strength @ 3 meters)**

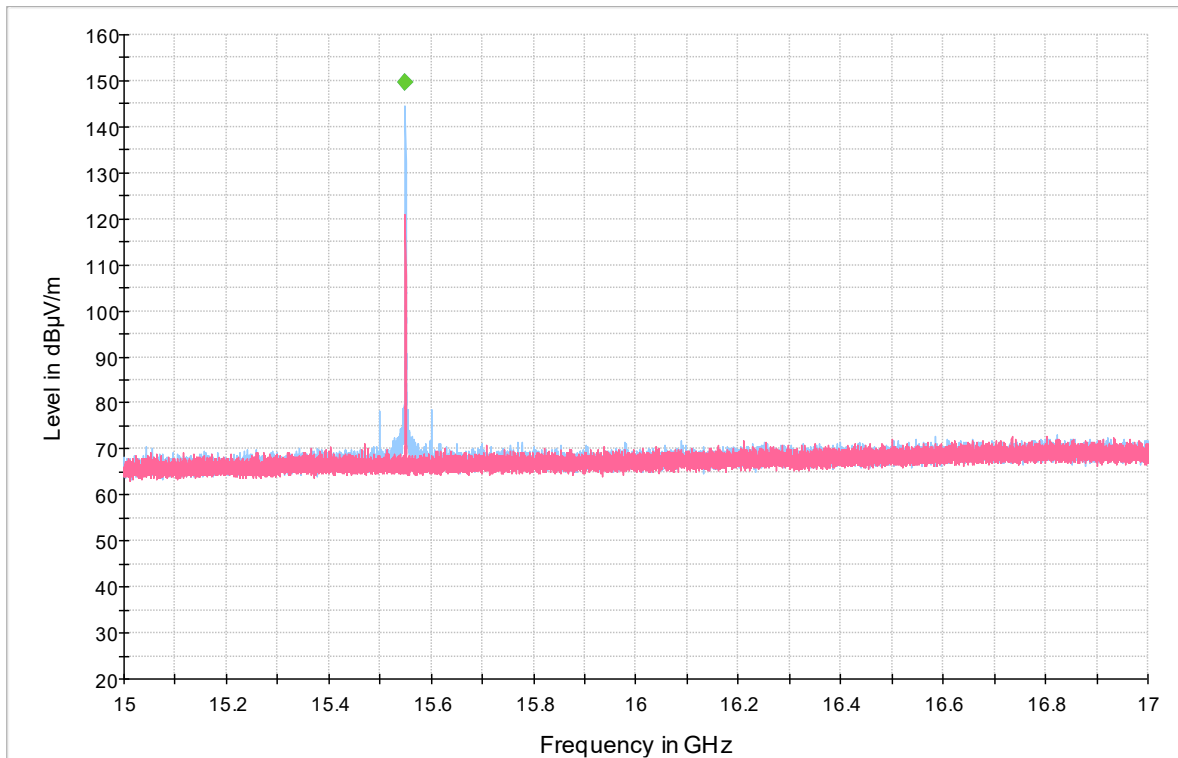
Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
15399.800000	149.10	53.90	-95.20	1000.0	1000.000	138.0	H	31.0	49





**2.1.10 Mid Channel Test Results**

Full Spectrum



◆ Preview Result 1H-PK+ [Preview Result 1H.Result:2] Final\_Result PK+ [Final\_Result.Result:4]
 ◆ Preview Result 1V-PK+ [Preview Result 1V.Result:2] Final\_Result AVG [Final\_Result.Result:5]

**Peak (Field Strength @ 3 meters)**

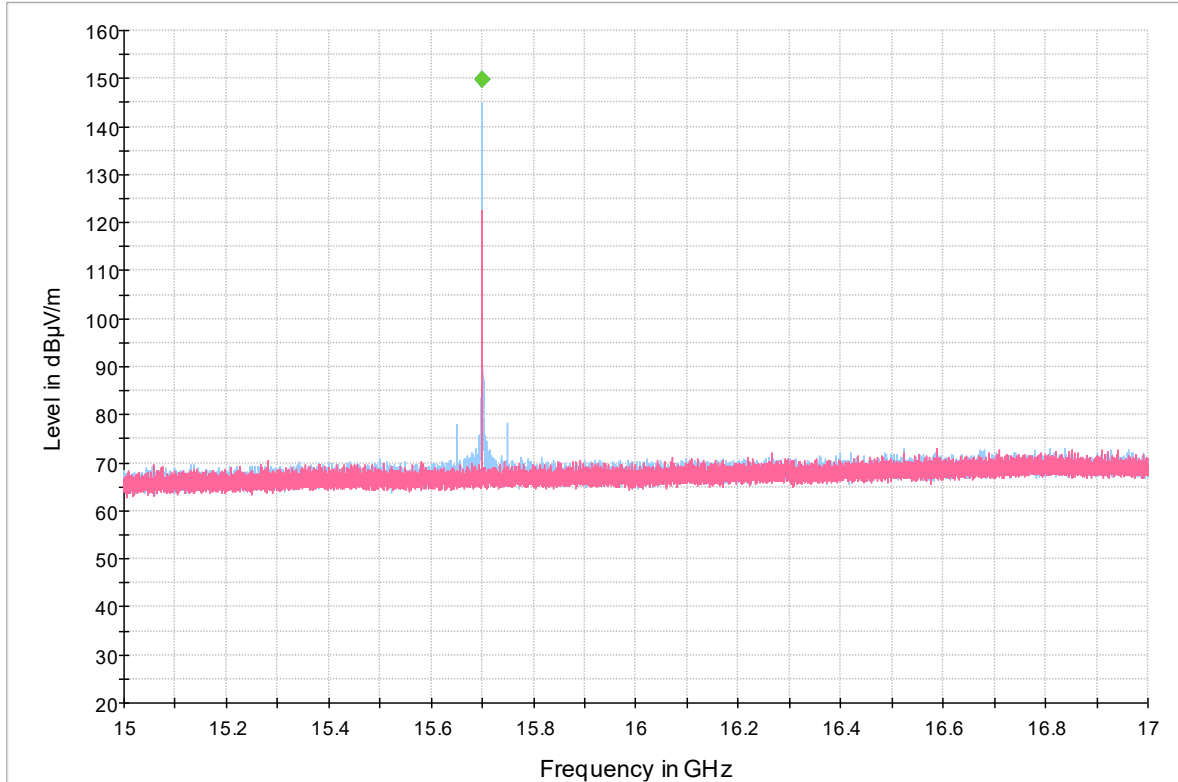
Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
15549.800000	149.74	73.90	-75.84	1000.0	1000.000	138.0	H	28.0	50

**Average (Field Strength @ 3 meters)**

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
15549.800000	149.55	53.90	-95.65	1000.0	1000.000	138.0	H	28.0	50



**2.1.11 High Channel Test Results**



◆ Preview Result 1H-PK+ [Preview Result 1H.Result:2] Final\_Result PK+ [Final\_Result.Result:4]
 ◆ Preview Result 1V-PK+ [Preview Result 1V.Result:2] Final\_Result AVG [Final\_Result.Result:5]

**Peak (Field Strength @ 3 meters)**

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
15699.800000	149.88	73.90	-75.98	1000.0	1000.000	138.0	H	30.0	50

**Average (Field Strength @ 3 meters)**

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
15699.800000	149.75	53.90	-95.85	1000.0	1000.000	138.0	H	30.0	50



## 2.2 SPURIOUS EMISSIONS AT ANTENNA TERMINALS

### 2.2.1 Specification Reference

FCC 47 CFR Part 87, Clause 87.139(a)

### 2.2.2 Standard Applicable

(a) Except for ELTs and when using single sideband (R3E, H3E, J3E), or frequency modulation (F9) or digital modulation (F9Y) for telemetry or telecommand in the 1435-1525 MHz, 2345-2395 MHz, or 5091-5150 MHz band or digital modulation (G7D) for differential GPS, the mean power of any emissions must be attenuated below the mean power of the transmitter (pY) as follows:

- (1) When the frequency is removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth the attenuation must be at least 25 dB;
- (2) When the frequency is removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth the attenuation must be at least 35 dB.
- (3) When the frequency is removed from the assigned frequency by more than 250 percent of the authorized bandwidth the attenuation for aircraft station transmitters must be at least 40 dB; and the attenuation for aeronautical station transmitters must be at least  $43 + 10 \log_{10} pY$  dB.

### 2.2.3 Equipment Under Test and Modification State

Serial No: X00330153 / Default Test Configuration

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

November 07, 2019 / AC

### 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. Mira Mesa facility

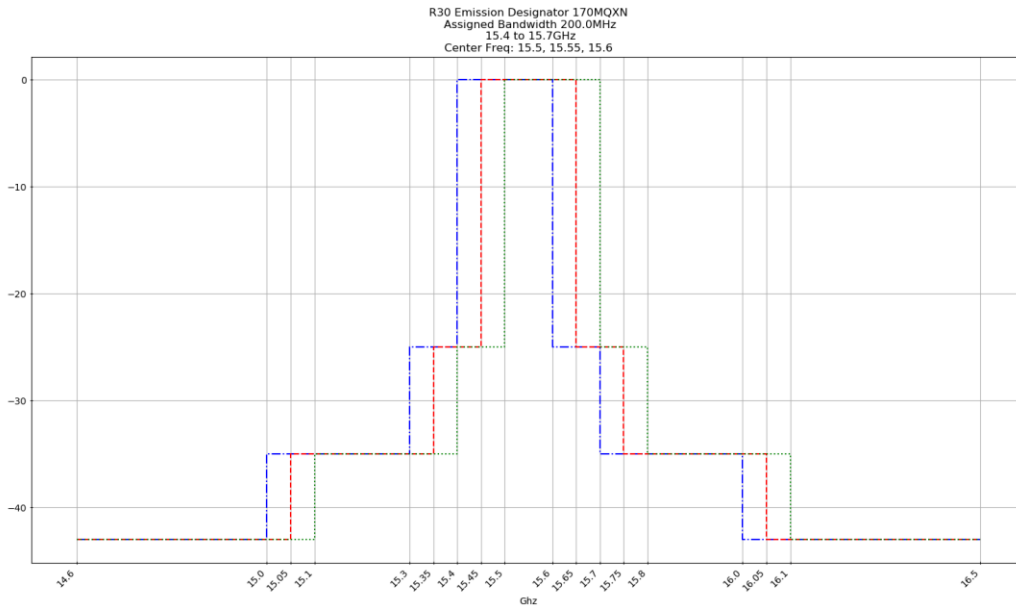
Ambient Temperature	25.0 °C
Relative Humidity	49.4 %
ATM Pressure	99.0 kPa

### 2.2.7 Additional Observations

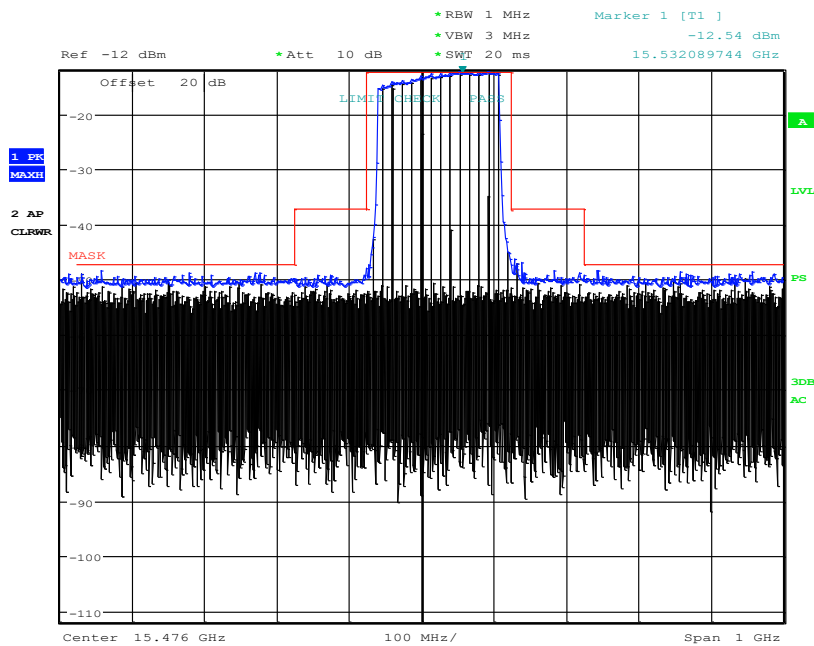
- This is a relative radiated measurement.
- EUT is on full radar swept mode for this test.
- The emission mask was applied per Section 5.7.3 of ANSI C63.26-2015.
- §87.139(a)(3) is covered under Section 2.3 of this test report.



### 2.2.8 Channel Emission Masks

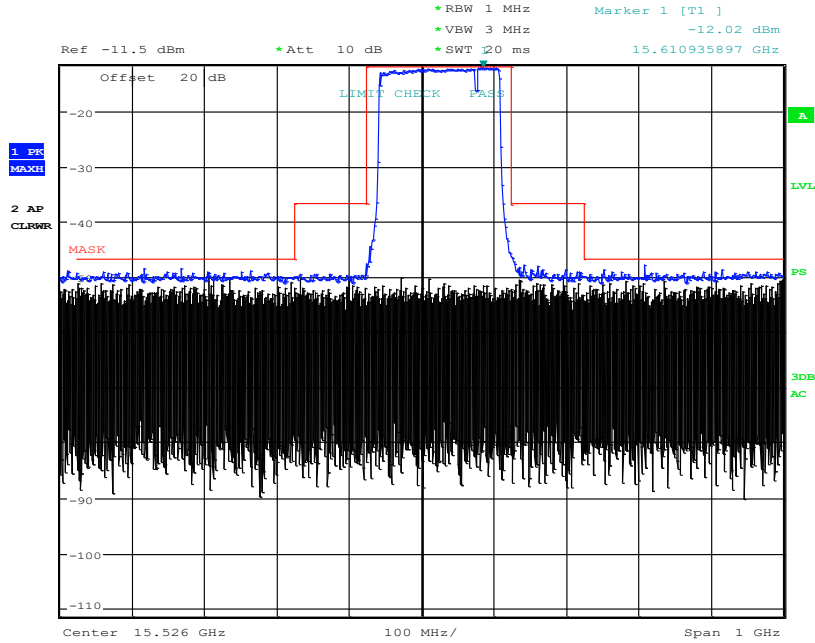


### 2.2.9 Test Result Plots



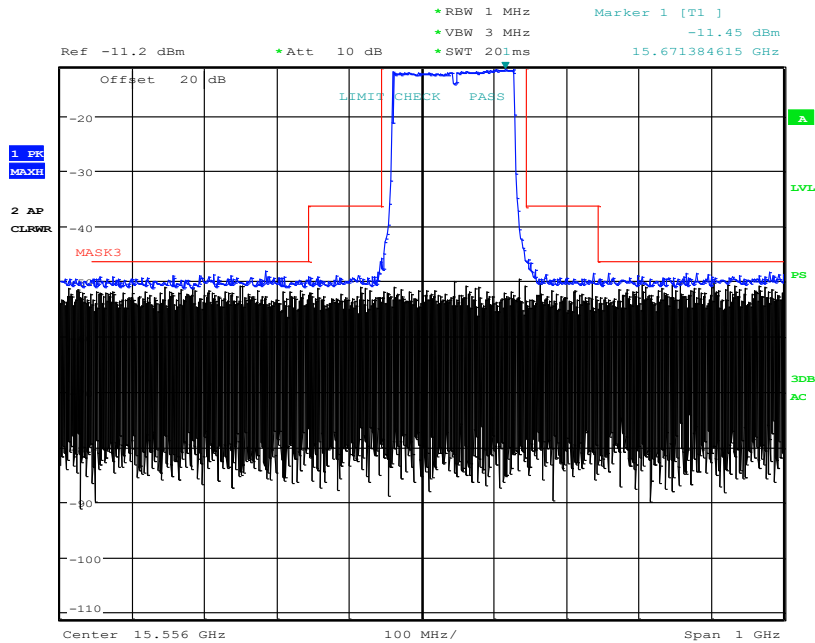
Date: 7.NOV.2019 16:15:04

Low Channel



Date: 7.NOV.2019 16:21:49

### Mid Channel



Date: 7.NOV.2019 16:25:42

### High Channel



## 2.3 FIELD STRENGTH OF RADIATED SPURIOUS EMISSIONS

### 2.3.1 Specification Reference

FCC 47 CFR Part 2, Clause 2.1053(a) and (b)  
FCC 47 CFR Part 87, Clause 87.139(a)(3)

### 2.3.2 Standard Applicable

(a) Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the magnitude of each harmonic and other spurious emission. For this test, single sideband, independent sideband, and controlled carrier transmitters shall be modulated under the conditions specified in paragraph (c) of §2.1049, as appropriate.

(b) The measurements specified in paragraph (a) of this section shall be made for the following equipment:

- (1) Those in which the spurious emissions are required to be 60 dB or more below the mean power of the transmitter.
- (2) All equipment operating on frequencies higher than 25 MHz
- (3) All equipment where the antenna is an integral part of and attached directly to the transmitter.
- (4) Other types of equipment as required, when deemed necessary by the Commission.

FCC 47 CFR Part 87, Clause 87.139(a)

(a) Except for ELTs and when using single sideband (R3E, H3E, J3E), or frequency modulation (F9) or digital modulation (F9Y) for telemetry or telecommand in the 1435-1525 MHz, 2345-2395 MHz, or 5091-5150 MHz band or digital modulation (G7D) for differential GPS, the mean power of any emissions must be attenuated below the mean power of the transmitter (pY) as follows:

- (3) When the frequency is removed from the assigned frequency by more than 250 percent of the authorized bandwidth the attenuation for aircraft station transmitters must be at least 40 dB; and the attenuation for aeronautical station transmitters must be at least  $43 + 10 \log_{10} pY$  dB.

### 2.3.3 Equipment Under Test and Modification State

Serial No: X00330153 / Default Test Configuration

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

November 23, 24 and 30 2021 / OC and IR

### 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 performed at TÜV SÜD America Inc. Mira Mesa facility

Ambient Temperature	23.5 °C	22.7 °C	25.8 °C
Relative Humidity	37.6 %	43.2 %	44.8 %
ATM Pressure	100.5 kPa	100.6 kPa	100.5 kPa

### 2.3.7 Additional Observations

- This is a radiated test. The spectrum was searched from 30MHz to 100GHz.
- Only the worst-case transmit mode presented.
- EUT verified on both X and Y axis, only the worst axis presented.
- In-band measurements are covered under Section 2.2 of this test report.
- For measurements between 1GHz and 40GHz, only average detector is relevant for this frequency range.
- Measurements below 40GHz were done using EMC32 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.
- Measurement above 40GHz were done using harmonic mixers. Corresponding TDF (Transducer Factor) are programmed for each range.
- Test distance and frequency ranges performed are summarized below:

Frequency Range	Test Distance
30 MHz to 1GHz	3 meters
1 GHz to 18 GHz	3 meters
18 GHz to 26.5 GHz	3 meters
26 GHz to 40 GHz	3 meters
40 GHz to 60 GHz	3 meters
60 GHz to 75 GHz	1 meter
75 GHz to 100 GHz	1 meter

### 2.3.8 Sample Computation (Radiated Emission)

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

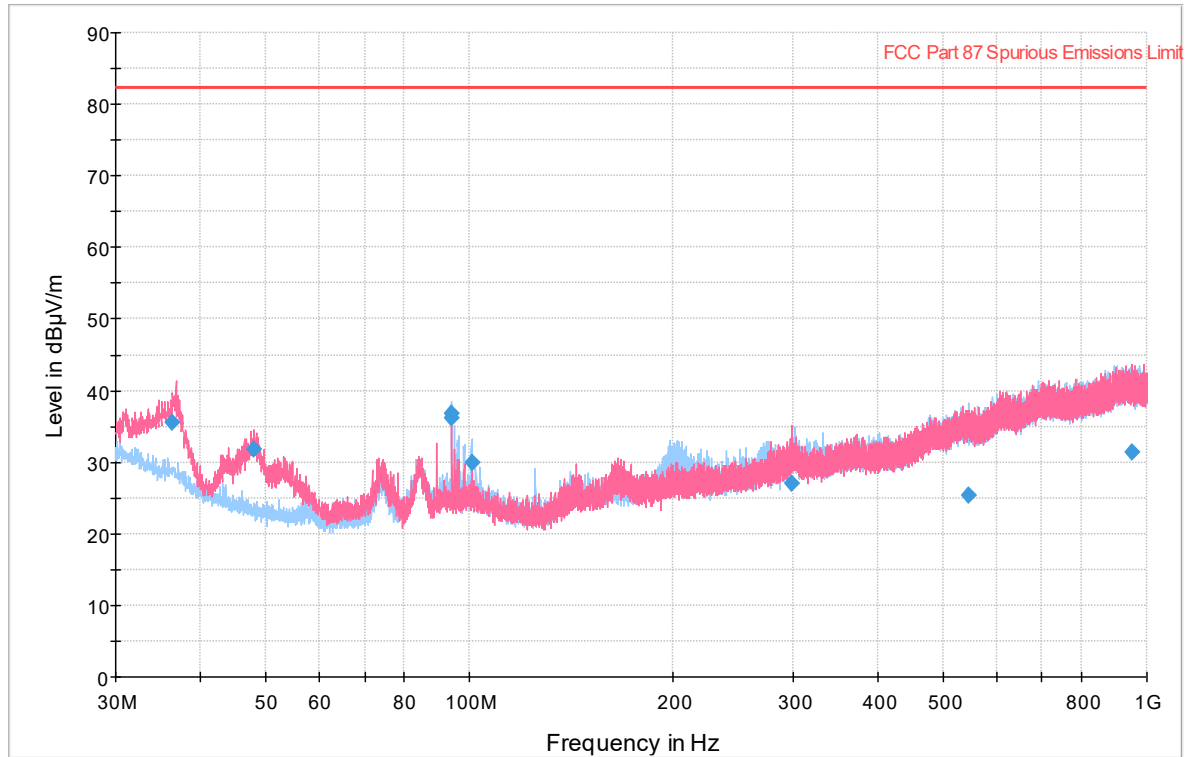
### 2.3.9 Test Results

**Compliant.** See attached plots.



**2.3.10 Worst Case Channel Below 1GHz Radiated Emission Test**

Full Spectrum



— Preview Result 1H-PK+ [Preview Result 1H.Result:2]    
 — Preview Result 1V-PK+ [Preview Result 1V.Result:4]  
— FCC Part 87 Spurious Emissions Limit [.\EMI Radiated\]    
 ◆ Final\_Result QPK [Final\_Result.Result:4]

**Quasi-Peak Data**

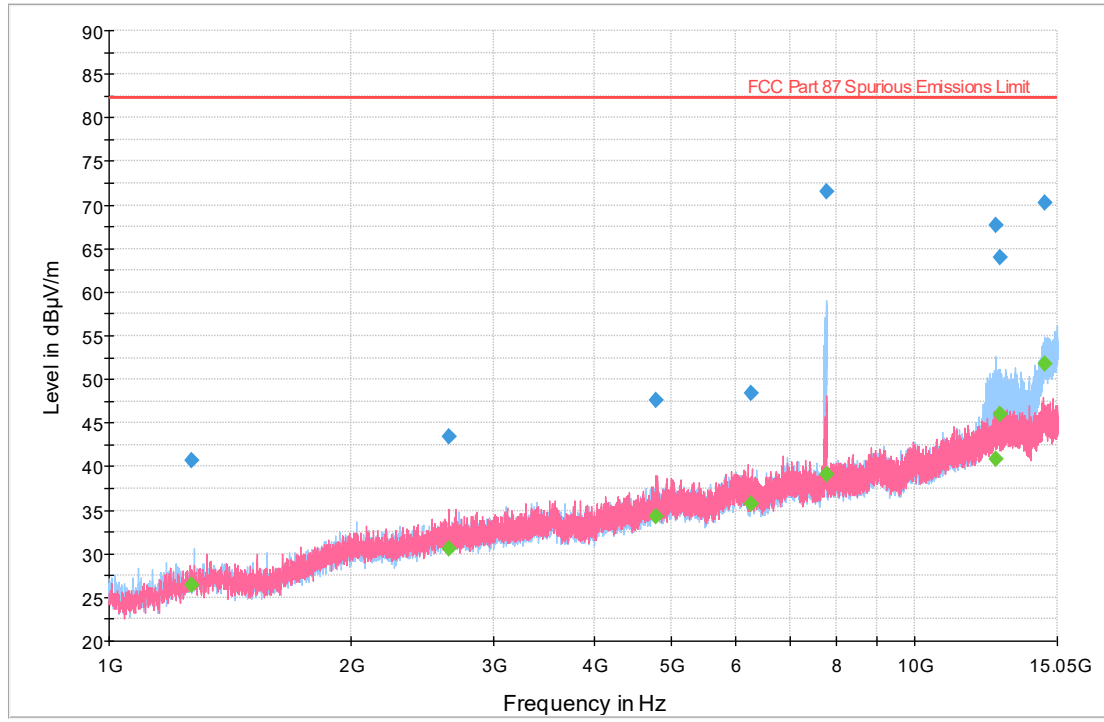
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
36.382333	35.49	82.23	46.74	1000.0	120.000	112.0	V	126.0	19
48.114333	31.89	82.23	50.34	1000.0	120.000	100.0	V	318.0	15
94.125333	36.87	82.23	45.36	1000.0	120.000	225.0	H	83.0	15
94.157000	36.19	82.23	46.04	1000.0	120.000	208.0	H	94.0	15
100.768333	29.97	82.23	52.26	1000.0	120.000	204.0	H	288.0	16
299.229667	27.09	82.23	55.14	1000.0	120.000	217.0	V	251.0	21
544.527000	25.43	82.23	56.80	1000.0	120.000	204.0	H	180.0	26
949.782000	31.37	82.23	50.86	1000.0	120.000	275.0	V	229.0	31

**Test Notes:** Power supply and router connected to the EUT are placed outside the chamber causing some FM bands to couple with the setup. Margins are more than 20 dB from the limit, no additional actions were taken.





2.3.11 1GHz up to lower edge of the emission mask used (Low Channel)



— Preview Result 1H-PK+ [Preview Result 1H.Result:2]     — Preview Result 1V-PK+ [Preview Result 1V.Result:4]  
— FCC Part 87 Spurious Emissions Limit [.\EMI Radiated]     ◆ Final\_Result PK+ [Final\_Result.Result:4]  
◆ Final\_Result AVG [Final\_Result.Result:5]

Peak Data

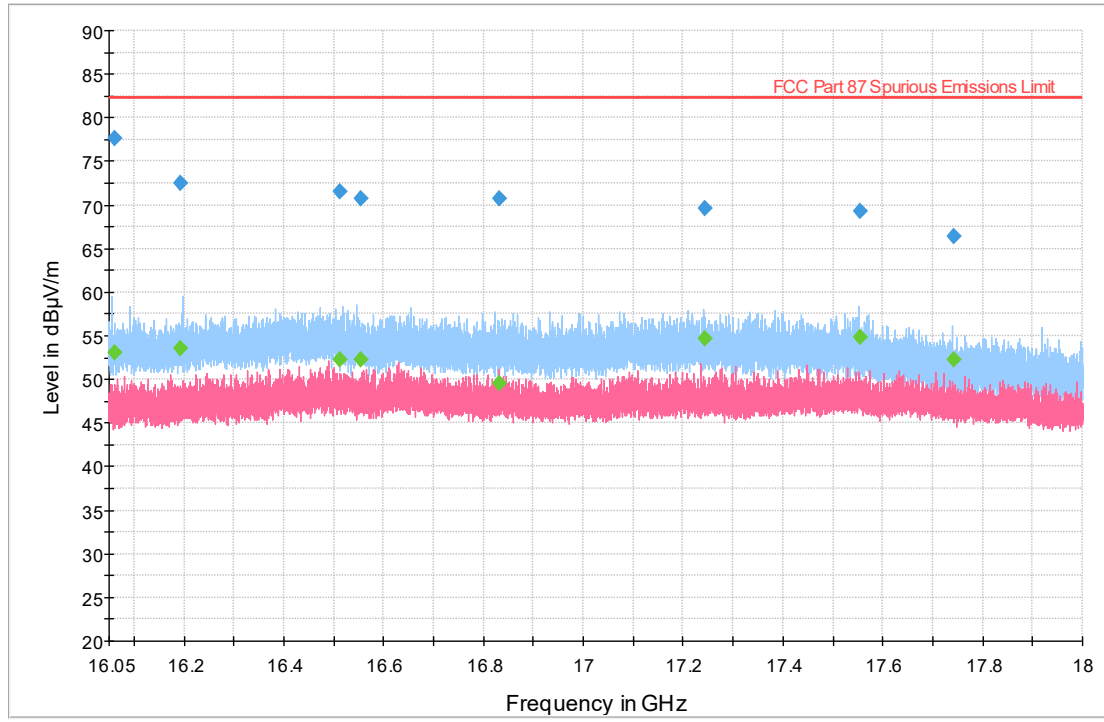
Frequency (MHz)	Max Peak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1265.716667	40.74	82.23	41.49	1000.0	1000.000	332.0	H	20.0	-4
2641.961667	43.41	82.23	38.82	1000.0	1000.000	175.0	V	112.0	1
4778.020000	47.61	82.23	34.62	1000.0	1000.000	228.0	V	48.0	5
6261.895000	48.36	82.23	33.87	1000.0	1000.000	205.0	V	50.0	5
7778.378333	71.58	82.23	10.65	1000.0	1000.000	255.0	H	78.0	9
12600.105000	67.61	82.23	14.62	1000.0	1000.000	230.0	H	6.0	13
12756.128333	64.05	82.23	18.18	1000.0	1000.000	365.0	H	18.0	13
14524.770000	70.28	82.23	11.95	1000.0	1000.000	205.0	H	-14.0	13

Average Data

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1265.716667	26.47	82.23	55.76	1000.0	1000.000	332.0	H	20.0	-4
2641.961667	30.55	82.23	51.68	1000.0	1000.000	175.0	V	112.0	1
4778.020000	34.22	82.23	48.01	1000.0	1000.000	228.0	V	48.0	5
6261.895000	35.68	82.23	46.55	1000.0	1000.000	205.0	V	50.0	5
7778.378333	39.05	82.23	43.18	1000.0	1000.000	255.0	H	78.0	9
12600.105000	40.92	82.23	41.31	1000.0	1000.000	230.0	H	6.0	13
12756.128333	45.97	82.23	36.26	1000.0	1000.000	365.0	H	18.0	13
14524.770000	51.81	82.23	30.42	1000.0	1000.000	205.0	H	-14.0	13



2.3.12 Upper edge of the emission mask used up to 18GHz (High Channel)



— Preview Result 1H-PK+ [Preview Result 1H.Result:2]     — Preview Result 1V-PK+ [Preview Result 1V.Result:4]  
— FCC Part 87 Spurious Emissions Limit [.\EMI Radiated]     ◆ Final\_Result PK+ [Final\_Result.Result:4]  
◆ Final\_Result AVG [Final\_Result.Result:5]

Peak Data

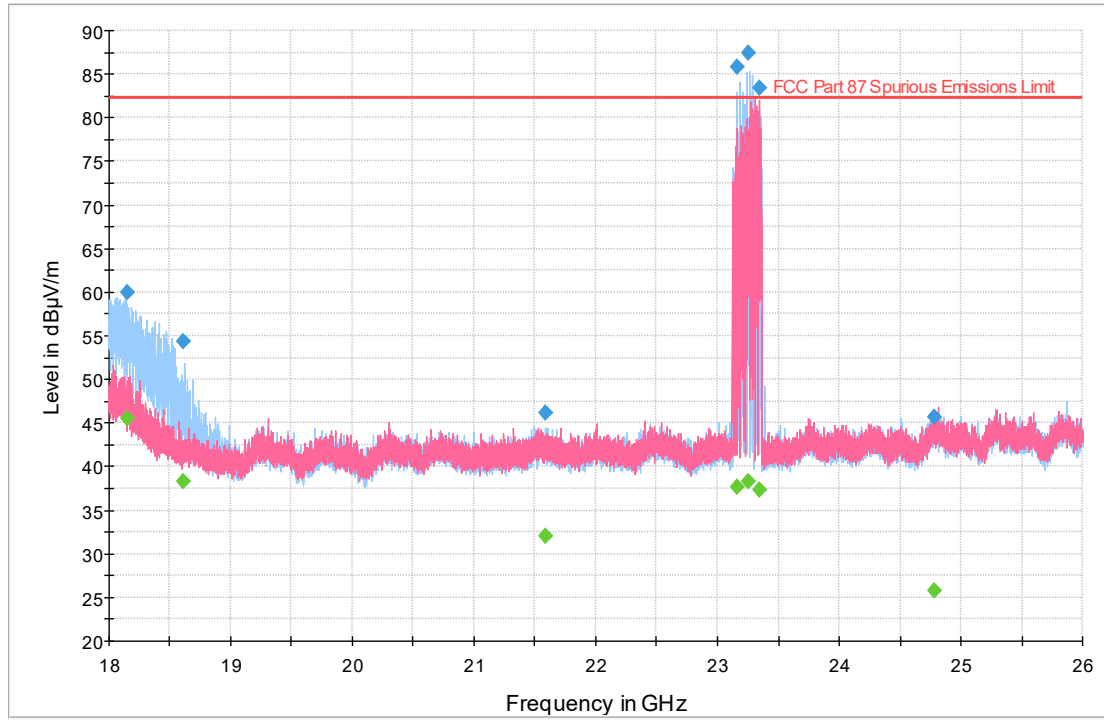
Frequency (MHz)	Max Peak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
16060.600000	77.60	82.23	4.63	1000.0	1000.000	175.0	H	51.0	15
16191.580000	72.43	82.23	9.80	1000.0	1000.000	357.0	H	357.0	15
16512.935000	71.53	82.23	10.70	1000.0	1000.000	239.0	H	14.0	16
16553.685000	70.66	82.23	11.57	1000.0	1000.000	209.0	H	48.0	16
16832.480000	70.78	82.23	11.45	1000.0	1000.000	219.0	H	14.0	17
17243.900000	69.59	82.23	12.64	1000.0	1000.000	205.0	H	346.0	18
17553.345000	69.27	82.23	12.96	1000.0	1000.000	175.0	H	-8.0	19
17741.960000	66.45	82.23	15.78	1000.0	1000.000	317.0	H	356.0	19

Average Data

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
16060.600000	53.12	82.23	29.11	1000.0	1000.000	175.0	H	51.0	15
16191.580000	53.59	82.23	28.64	1000.0	1000.000	357.0	H	357.0	15
16512.935000	52.24	82.23	29.99	1000.0	1000.000	239.0	H	14.0	16
16553.685000	52.21	82.23	30.02	1000.0	1000.000	209.0	H	48.0	16
16832.480000	49.55	82.23	32.68	1000.0	1000.000	219.0	H	14.0	17
17243.900000	54.61	82.23	27.62	1000.0	1000.000	205.0	H	346.0	18
17553.345000	54.90	82.23	27.33	1000.0	1000.000	175.0	H	-8.0	19
17741.960000	52.35	82.23	29.88	1000.0	1000.000	317.0	H	356.0	19



2.3.13 18GHz to 26GHz Radiated Emission Test (Low Channel)



— Preview Result 1H-PK+ [Preview Result 1H.Result:2]     — Preview Result 1V-PK+ [Preview Result 1V.Result:4]  
— FCC Part 87 Spurious Emissions Limit [.\EMI Radiated]     ◆ Final\_Result PK+ [Final\_Result.Result:4]  
◆ Final\_Result AVG [Final\_Result.Result:5]

Peak Data

Frequency (MHz)	Max Peak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
18154.129000	60.03	82.23	22.20	1000.0	1000.000	213.0	H	62.0	-2
18614.688000	54.29	82.23	27.94	1000.0	1000.000	213.0	H	62.0	-3
21590.864500	46.25	82.23	35.98	1000.0	1000.000	163.0	H	144.0	-1
23159.164500	85.83	82.23	-3.60	1000.0	1000.000	202.0	H	62.0	0
23254.313000	87.44	82.23	-5.21	1000.0	1000.000	200.0	H	353.0	0
23343.650500	83.39	82.23	-1.16	1000.0	1000.000	140.0	V	332.0	0
24781.696000	45.71	82.23	36.52	1000.0	1000.000	142.0	H	4.0	2

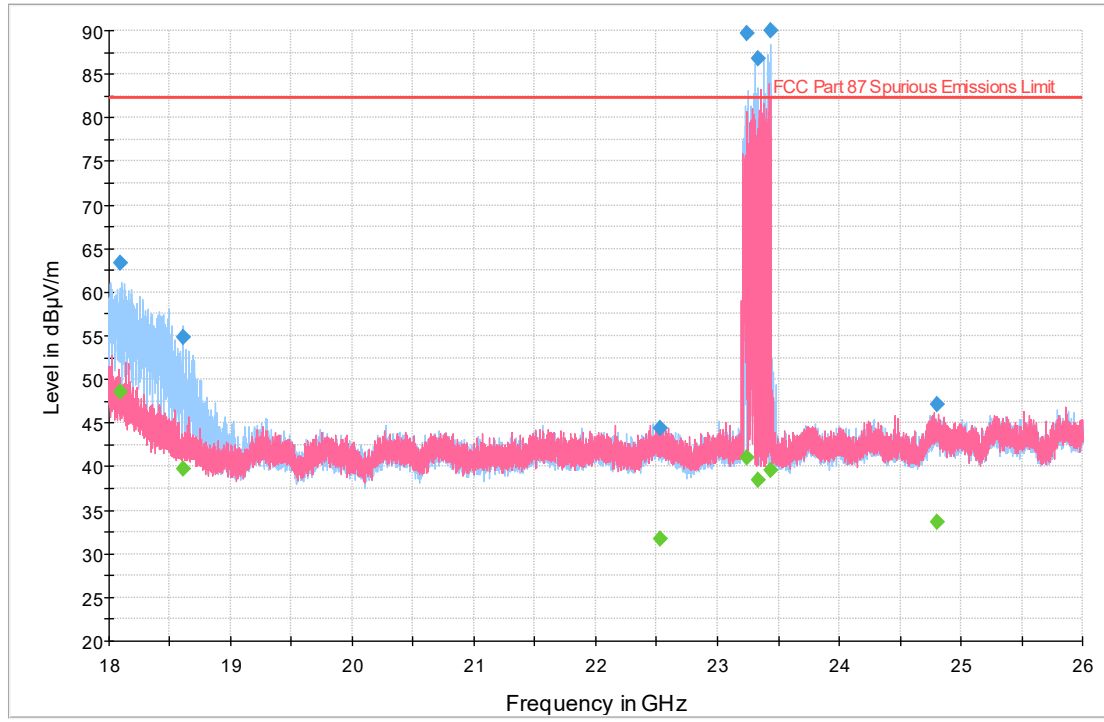
Average Data

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
18154.129000	45.58	82.23	36.65	1000.0	1000.000	213.0	H	62.0	-2
18614.688000	38.34	82.23	43.89	1000.0	1000.000	213.0	H	62.0	-3
21590.864500	31.99	82.23	50.24	1000.0	1000.000	163.0	H	144.0	-1
23159.164500	37.72	82.23	44.51	1000.0	1000.000	202.0	H	62.0	0
23254.313000	38.38	82.23	43.85	1000.0	1000.000	200.0	H	353.0	0
23343.650500	37.28	82.23	44.95	1000.0	1000.000	140.0	V	332.0	0
24781.696000	25.74	82.23	56.49	1000.0	1000.000	142.0	H	4.0	2

Note: Only average detector is relevant for this frequency range.



**2.3.14 18GHz to 26GHz Radiated Emission Test (Mid Channel)**



— Preview Result 1H-PK+ [Preview Result 1H.Result:2]     — Preview Result 1V-PK+ [Preview Result 1V.Result:4]  
— FCC Part 87 Spurious Emissions Limit [.\EMI Radiated]     ◆ Final\_Result PK+ [Final\_Result.Result:4]  
◆ Final\_Result AVG [Final\_Result.Result:5]

**Peak Data**

Frequency (MHz)	Max Peak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
18093.269500	63.40	82.23	18.83	1000.0	1000.000	145.0	H	62.0	-2
18606.235000	54.76	82.23	27.47	1000.0	1000.000	140.0	H	62.0	-3
22524.261500	44.47	82.23	37.76	1000.0	1000.000	213.0	H	193.0	0
23242.195500	89.70	82.23	-7.47	1000.0	1000.000	163.0	H	60.0	0
23331.378000	86.72	82.23	-4.49	1000.0	1000.000	187.0	H	63.0	0
23434.995500	89.99	82.23	-7.76	1000.0	1000.000	140.0	H	61.0	0

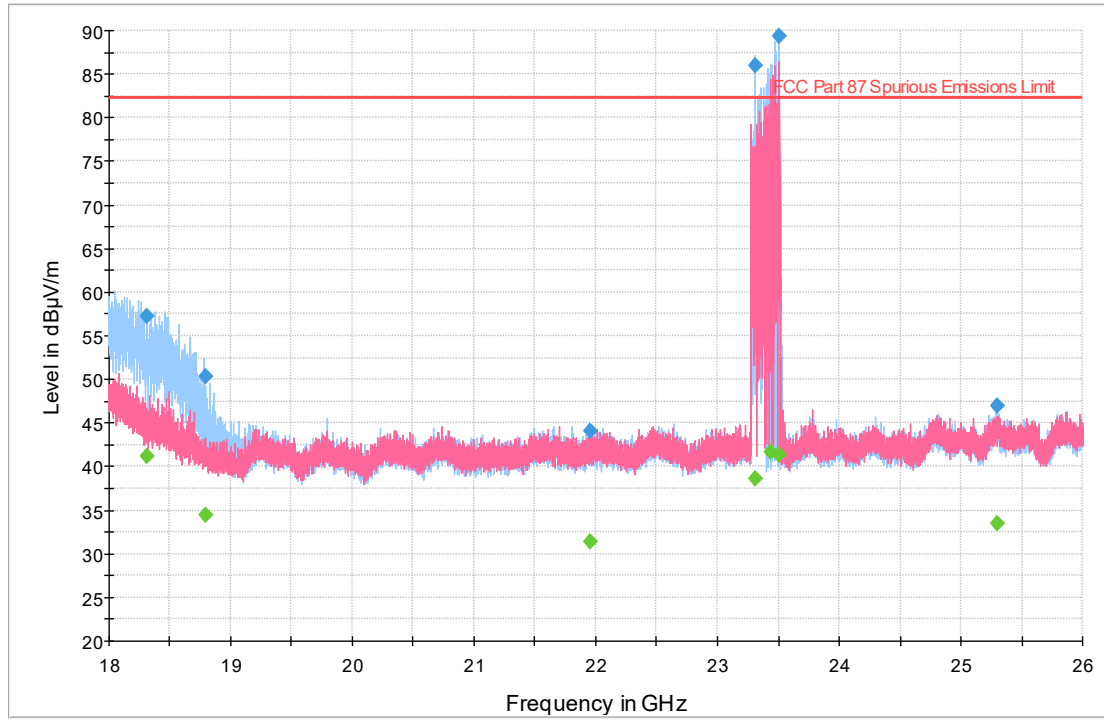
**Average Data**

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
18093.269500	48.57	82.23	33.66	1000.0	1000.000	145.0	H	62.0	-2
18606.235000	39.70	82.23	42.53	1000.0	1000.000	140.0	H	62.0	-3
22524.261500	31.79	82.23	50.44	1000.0	1000.000	213.0	H	193.0	0
23242.195500	41.05	82.23	41.18	1000.0	1000.000	163.0	H	60.0	0
23331.378000	38.54	82.23	43.69	1000.0	1000.000	187.0	H	63.0	0
23434.995500	39.59	82.23	42.64	1000.0	1000.000	140.0	H	61.0	0
24803.975500	33.61	82.23	48.62	1000.0	1000.000	137.0	H	150.0	2

Note: Only average detector is relevant for this frequency range.



**2.3.15 18GHz to 26GHz Radiated Emission Test (High Channel)**



— Preview Result 1H-PK+ [Preview Result 1H.Result:2]     — Preview Result 1V-PK+ [Preview Result 1V.Result:4]  
— FCC Part 87 Spurious Emissions Limit [.\EMI Radiated]     ◆ Final\_Result PK+ [Final\_Result.Result:4]  
◆ Final\_Result AVG [Final\_Result.Result:5]

**Peak Data**

Frequency (MHz)	Max Peak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
18313.683500	57.29	82.23	24.94	1000.0	1000.000	158.0	H	356.0	-3
18794.745000	50.32	82.23	31.91	1000.0	1000.000	144.0	H	62.0	-3
21948.642000	44.10	82.23	38.13	1000.0	1000.000	213.0	V	135.0	-1
23311.712500	85.99	82.23	-3.76	1000.0	1000.000	194.0	H	63.0	0
23436.906500	90.53	82.23	-8.30	1000.0	1000.000	187.0	H	61.0	0
23500.796000	89.35	82.23	-7.12	1000.0	1000.000	212.0	H	353.0	0
25297.507000	46.90	82.23	35.33	1000.0	1000.000	142.0	H	204.0	2

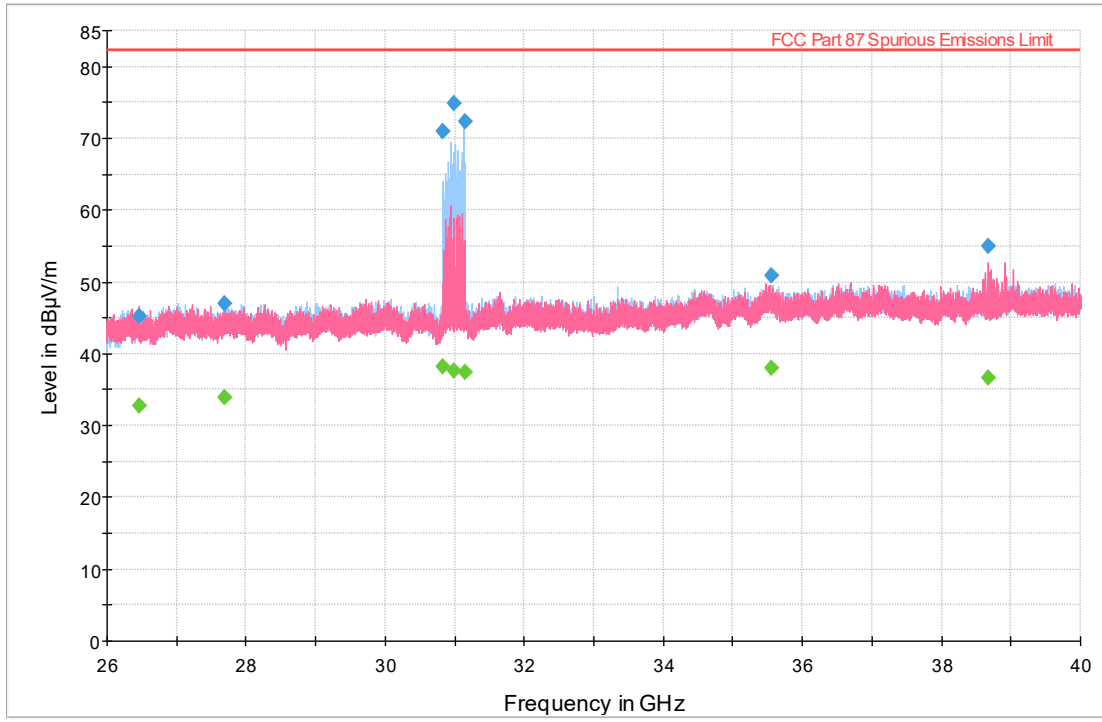
**Average Data**

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
18313.683500	41.12	82.23	41.11	1000.0	1000.000	158.0	H	356.0	-3
18794.745000	34.39	82.23	47.84	1000.0	1000.000	144.0	H	62.0	-3
21948.642000	31.47	82.23	50.76	1000.0	1000.000	213.0	V	135.0	-1
23311.712500	38.64	82.23	43.59	1000.0	1000.000	194.0	H	63.0	0
23436.906500	41.62	82.23	40.61	1000.0	1000.000	187.0	H	61.0	0
23500.796000	41.28	82.23	40.95	1000.0	1000.000	212.0	H	353.0	0
25297.507000	33.49	82.23	48.74	1000.0	1000.000	142.0	H	204.0	2

Note: Only average detector is relevant for this frequency range.



**2.3.16 26GHz to 40GHz Radiated Emission Test (Low Channel)**



— Preview Result 1H-PK+ [Preview Result 1H.Result:2]    
 — Preview Result 1V-PK+ [Preview Result 1V.Result:4]  
— FCC Part 87 Spurious Emissions Limit [.\EMI Radiated]    
 ◆ Final\_Result PK+ [Final\_Result.Result:4]  
◆ Final\_Result AVG [Final\_Result.Result:5]

**Peak Data**

Frequency (MHz)	Max Peak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
26464.806154	45.24	82.23	36.99	1000.0	1000.000	179.0	V	54.0	2
27693.299231	46.99	82.23	35.24	1000.0	1000.000	143.0	H	66.0	3
30832.086923	70.96	82.23	11.27	1000.0	1000.000	169.0	H	41.0	4
30996.540769	74.87	82.23	7.36	1000.0	1000.000	130.0	H	48.0	4
31140.654616	72.42	82.23	9.81	1000.0	1000.000	192.0	H	47.0	5
35546.276539	50.98	82.23	31.25	1000.0	1000.000	225.0	H	294.0	7
38672.821539	54.95	82.23	27.28	1000.0	1000.000	175.0	V	336.0	7

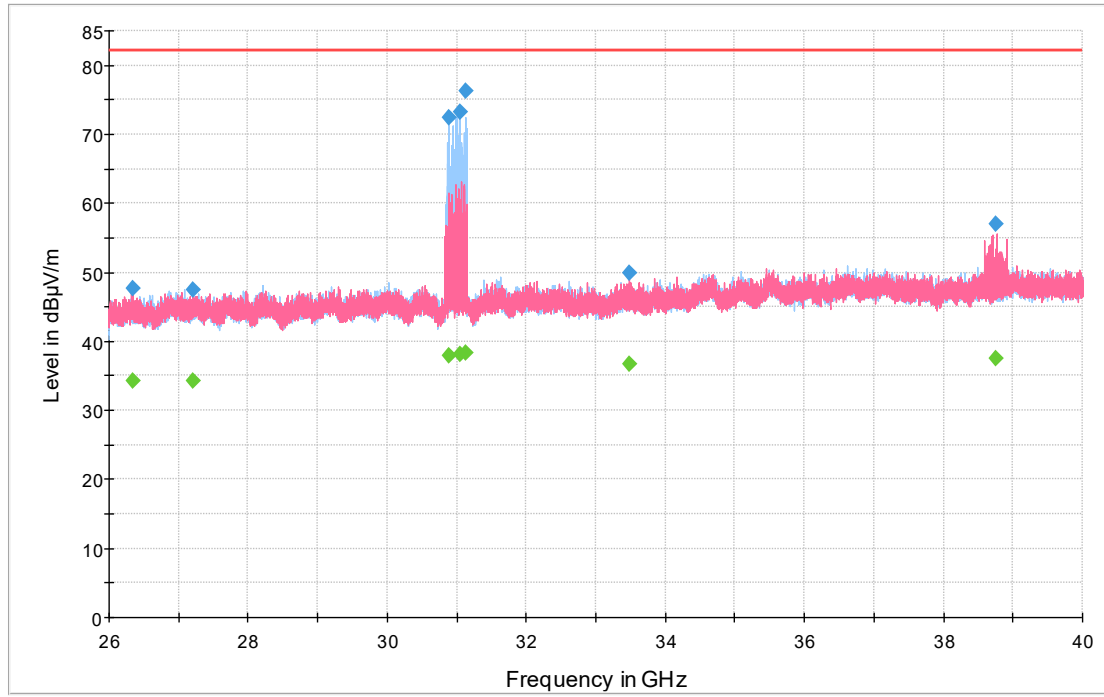
**Average Data**

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
26464.806154	32.72	82.23	49.51	1000.0	1000.000	179.0	V	54.0	2
27693.299231	33.92	82.23	48.31	1000.0	1000.000	143.0	H	66.0	3
30832.086923	38.17	82.23	44.06	1000.0	1000.000	169.0	H	41.0	4
30996.540769	37.64	82.23	44.59	1000.0	1000.000	130.0	H	48.0	4
31140.654616	37.47	82.23	44.76	1000.0	1000.000	192.0	H	47.0	5
35546.276539	37.94	82.23	44.29	1000.0	1000.000	225.0	H	294.0	7
38672.821539	36.60	82.23	45.63	1000.0	1000.000	175.0	V	336.0	7



2.3.17 26GHz to 40GHz Radiated Emission Test (Mid Channel)

Full Spectrum



— Preview Result 1H-PK+ [Preview Result 1H.Result:2]     — Preview Result 1V-PK+ [Preview Result 1V.Result:4]  
— FCC Part 87 Spurious Emissions Limit [L.EMI Radiated]     ◆ Final\_Result PK+ [Final\_Result.Result:4]  
◆ Final\_Result AVG [Final\_Result.Result:5]

Peak Data

Frequency (MHz)	Max Peak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
26343.060769	47.68	82.23	34.55	1000.0	1000.000	138.0	H	246.0	3
27202.134615	47.39	82.23	34.84	1000.0	1000.000	138.0	V	245.0	3
30880.016539	72.35	82.23	9.88	1000.0	1000.000	225.0	H	49.0	4
31056.643076	73.15	82.23	9.08	1000.0	1000.000	216.0	H	47.0	4
31139.006923	76.33	82.23	5.90	1000.0	1000.000	209.0	H	46.0	5
33473.063846	49.86	82.23	32.37	1000.0	1000.000	215.0	V	39.0	7
38759.272692	56.98	82.23	25.25	1000.0	1000.000	200.0	V	334.0	7

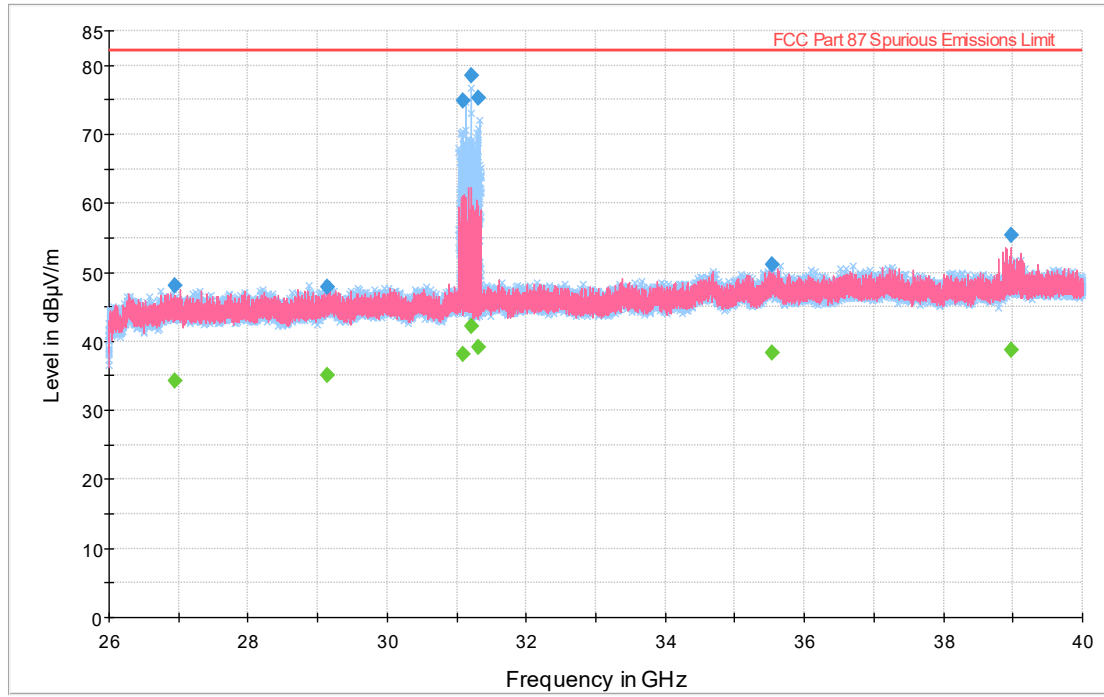
Average Data

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
26343.060769	34.36	82.23	47.87	1000.0	1000.000	138.0	H	246.0	3
27202.134615	34.37	82.23	47.86	1000.0	1000.000	138.0	V	245.0	3
30880.016539	38.00	82.23	44.23	1000.0	1000.000	225.0	H	49.0	4
31056.643076	38.06	82.23	44.17	1000.0	1000.000	216.0	H	47.0	4
31139.006923	38.26	82.23	43.97	1000.0	1000.000	209.0	H	46.0	5
33473.063846	36.80	82.23	45.43	1000.0	1000.000	215.0	V	39.0	7
38759.272692	37.53	82.23	44.7	1000.0	1000.000	200.0	V	334.0	7



2.3.18 26GHz to 40GHz Radiated Emission Test (High Channel)

Full Spectrum



—x— Preview Result 1H-PK+ [Preview Result 1H.Result:2]    
 — Preview Result 1V-PK+ [Preview Result 1V.Result:4]  
— FCC Part 87 Spurious Emissions Limit [.\EMI Radiated]    
 ◆ Final\_Result PK+ [Final\_Result.Result:4]  
◆ Final\_Result AVG [Final\_Result.Result:5]

Peak Data

Frequency (MHz)	Max Peak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
26937.410001	48.12	82.23	34.11	1000.0	1000.000	179.0	H	261.0	3
29127.884231	47.92	82.23	34.31	1000.0	1000.000	179.0	H	289.0	3
31082.084616	74.79	82.23	7.44	1000.0	1000.000	175.0	H	46.0	5
31205.819231	78.58	82.23	3.65	1000.0	1000.000	177.0	H	46.0	4
31312.926923	75.28	82.23	6.95	1000.0	1000.000	190.0	H	8.0	5
35541.838462	51.08	82.23	31.15	1000.0	1000.000	175.0	H	41.0	7
38980.301154	55.35	82.23	26.88	1000.0	1000.000	194.0	V	77.0	8

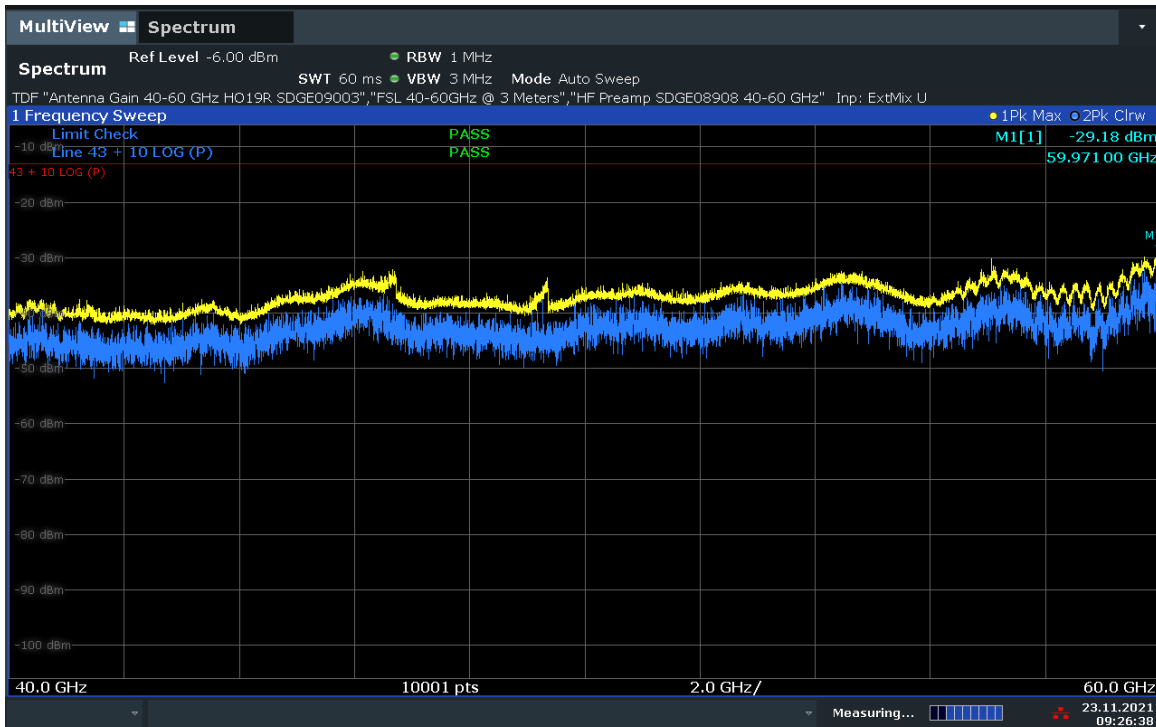
Average Data

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
26937.410001	34.27	82.23	47.96	1000.0	1000.000	179.0	H	261.0	3
29127.884231	35.19	82.23	47.04	1000.0	1000.000	179.0	H	289.0	3
31082.084616	38.18	82.23	44.05	1000.0	1000.000	175.0	H	46.0	5
31205.819231	42.12	82.23	40.11	1000.0	1000.000	177.0	H	46.0	4
31312.926923	39.06	82.23	43.17	1000.0	1000.000	190.0	H	8.0	5
35541.838462	38.37	82.23	43.86	1000.0	1000.000	175.0	H	41.0	7
38980.301154	38.74	82.23	43.49	1000.0	1000.000	194.0	V	77.0	8



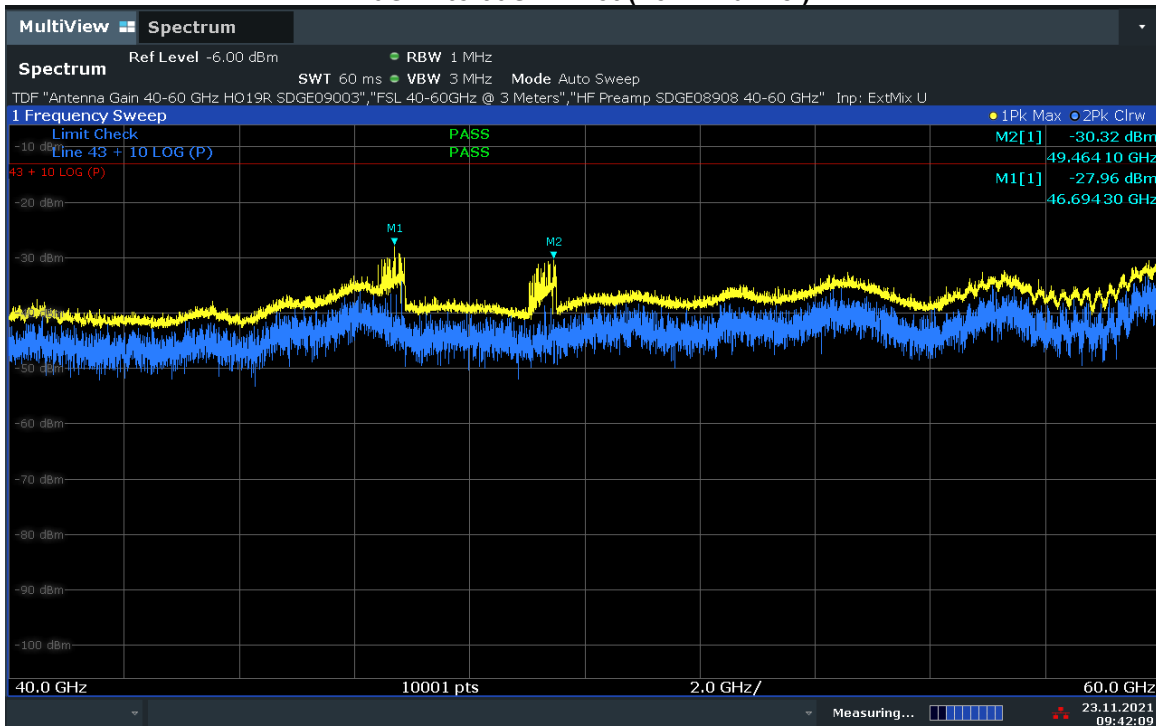


2.3.19 40GHz to 100GHz Maximized Plots



09:26:38 23.11.2021

40GHz to 60GHz Plot (Low Channel)

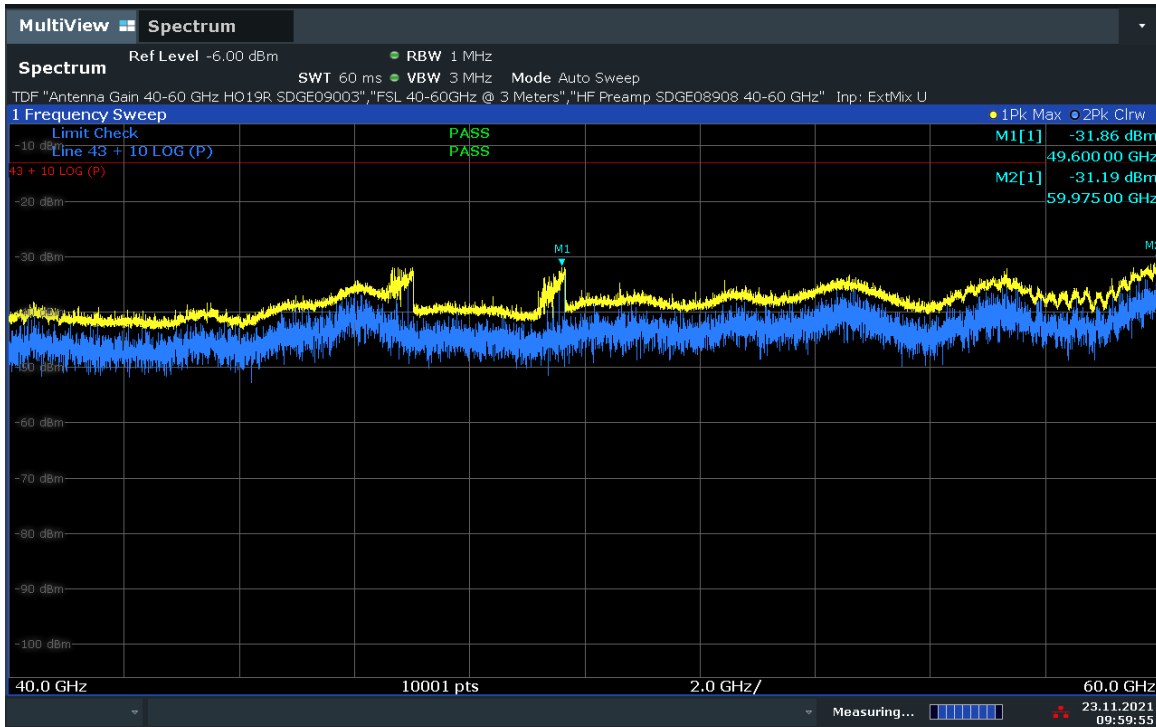


09:42:10 23.11.2021

40GHz to 60GHz Plot (Middle Channel)

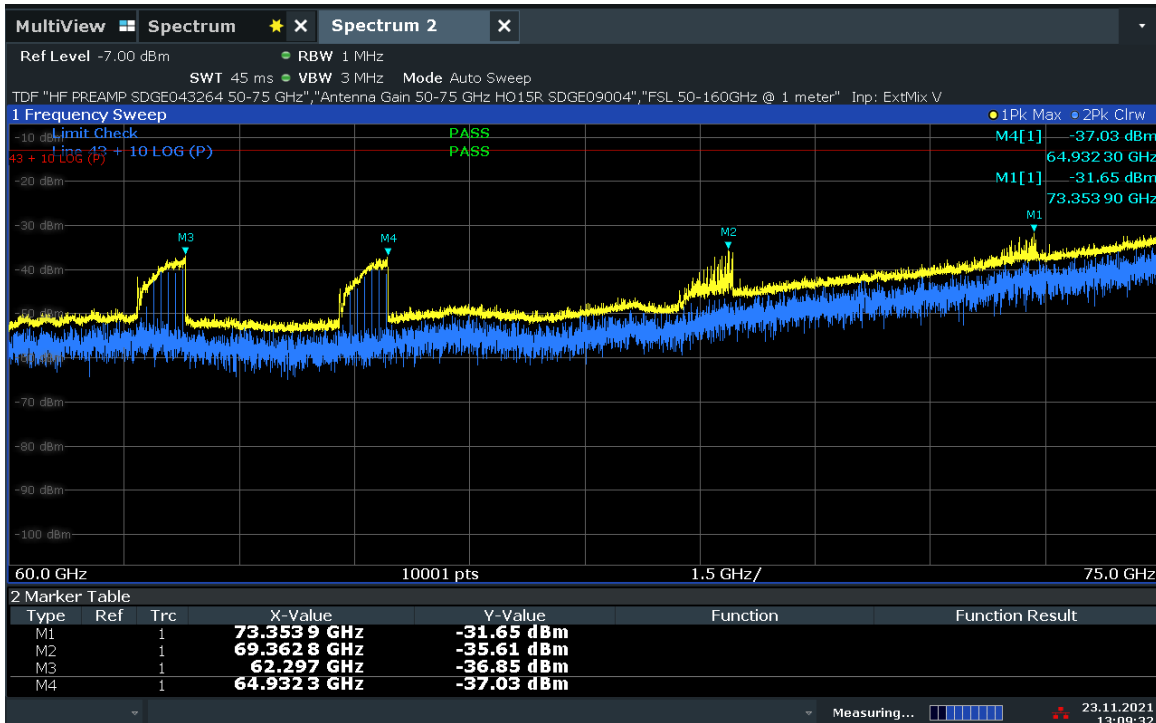


America



09:59:56 23.11.2021

### 40GHz to 60GHz Plot (High Channel)

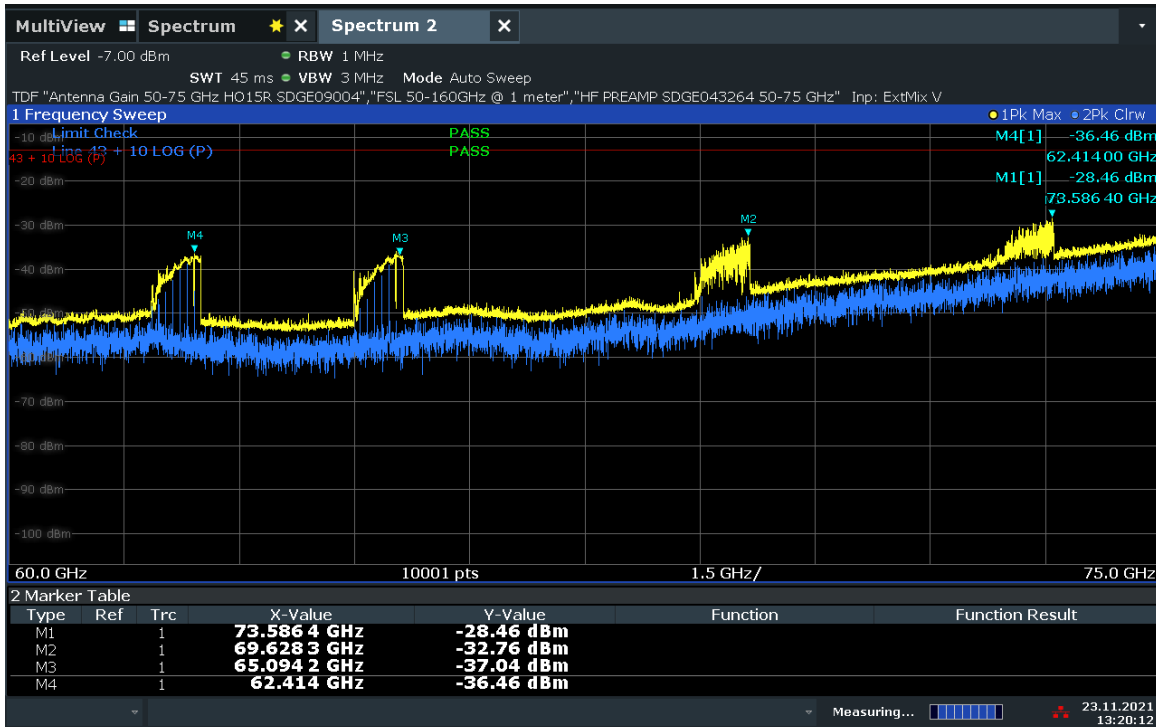


13:09:33 23.11.2021

### 60GHz to 75GHz Plot (Low Channel)

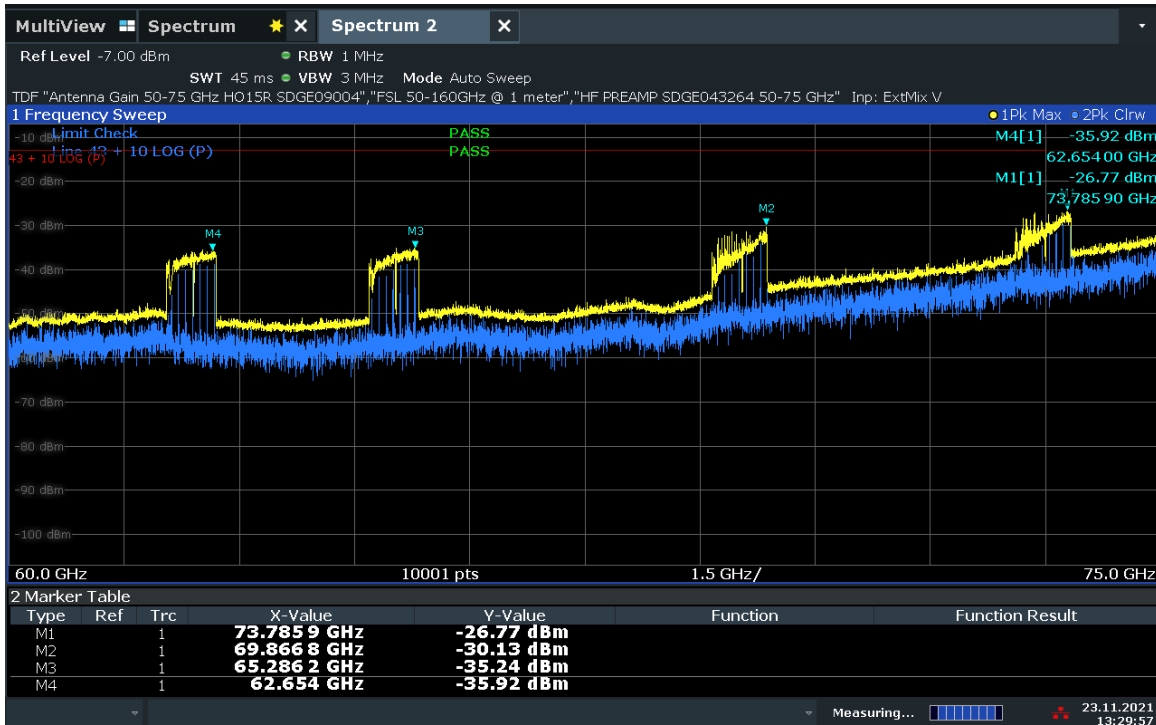


America



13:20:13 23.11.2021

### 60GHz to 75GHz Plot (Middle Channel)

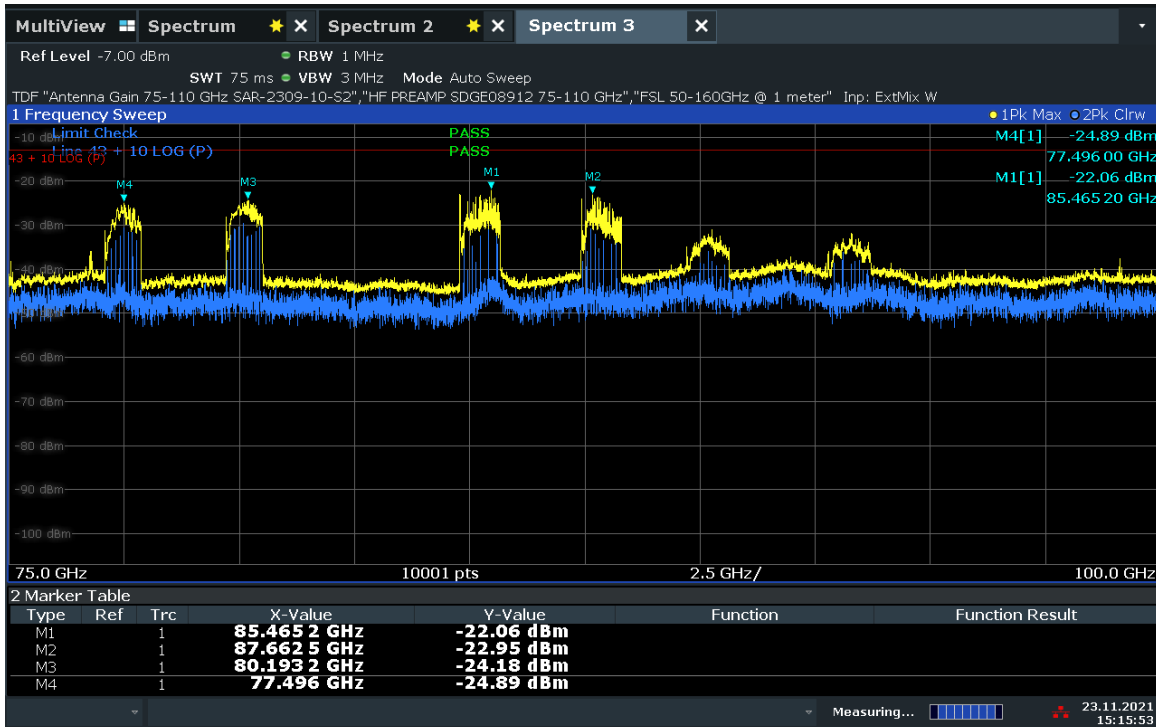


13:29:58 23.11.2021

### 60GHz to 75GHz Plot (High Channel)

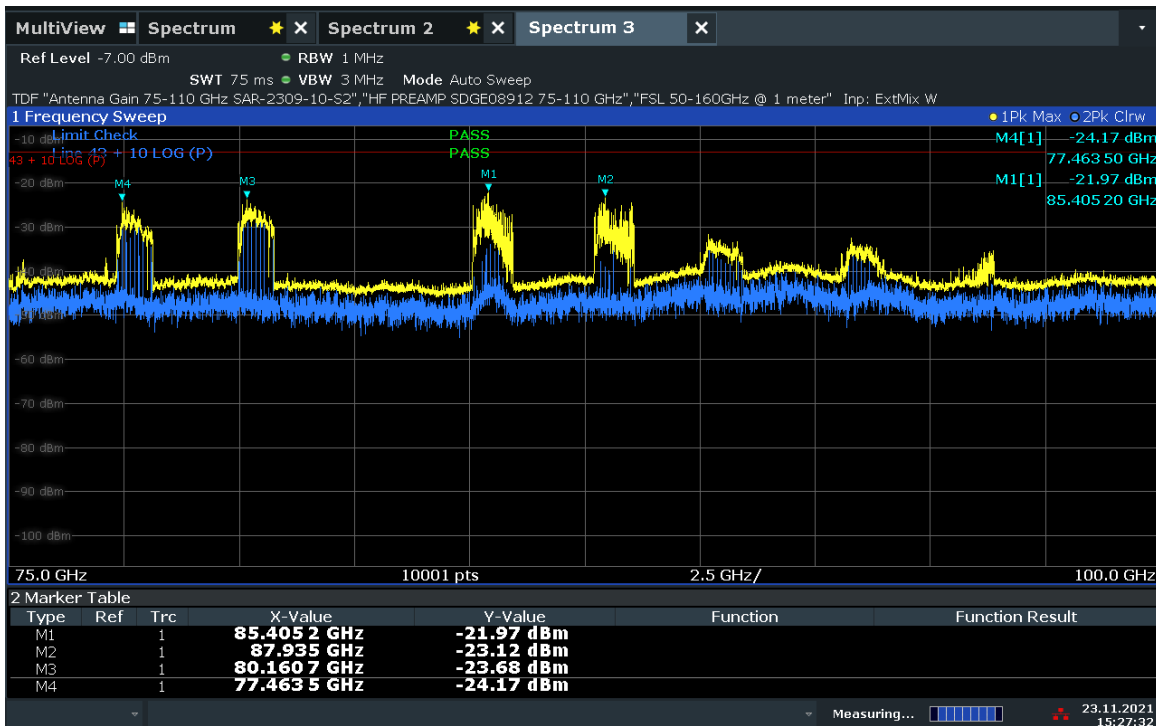


America



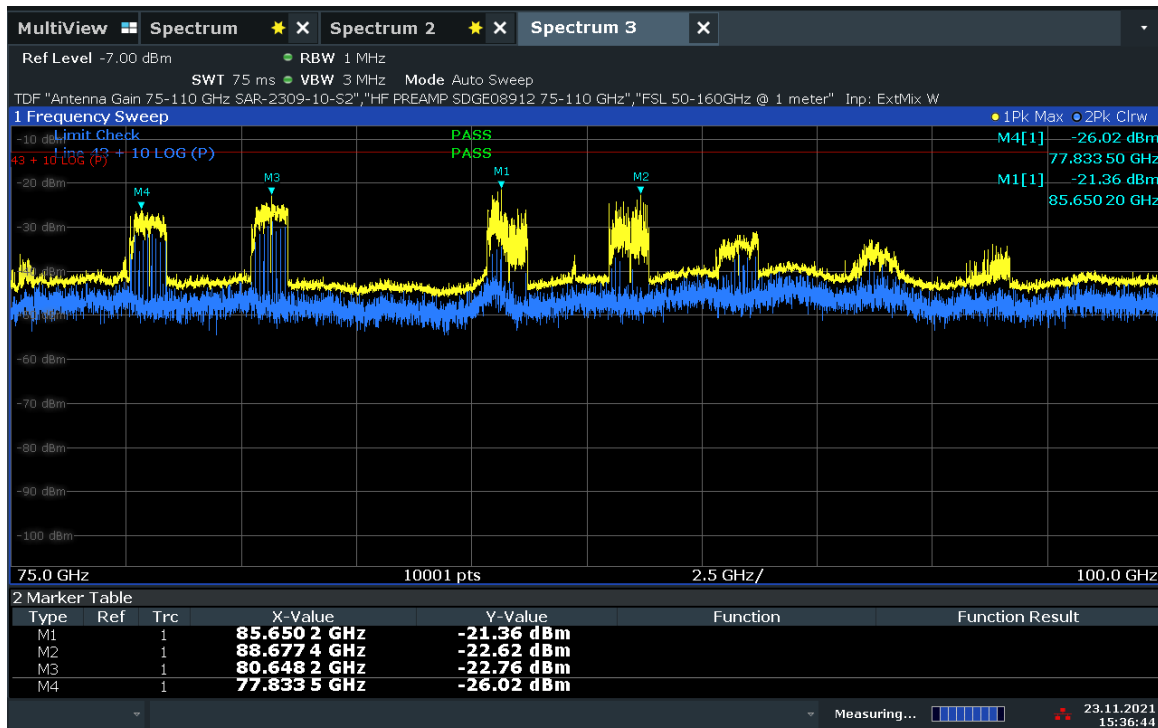
15:15:54 23.11.2021

75GHz to 100GHz Plot (Low Channel)



15:27:33 23.11.2021

75GHz to 100GHz Plot (Middle Channel)



15:36:45 23.11.2021

### 75GHz to 100GHz Plot (High Channel)



## 2.4 OCCUPIED BANDWIDTH

### 2.4.1 Specification Reference

FCC 47 CFR Part 2, Clause 2.1049

### 2.4.2 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.

### 2.4.3 Equipment Under Test and Modification State

Serial No: X00330153 / Default Test Configuration

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

November 21, 2019 / FSC

### 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 performed at TÜV SÜD America Inc. Mira Mesa facility

Ambient Temperature	25.4 °C
Relative Humidity	44.7 %
ATM Pressure	99.6 kPa

### 2.4.7 Additional Observations

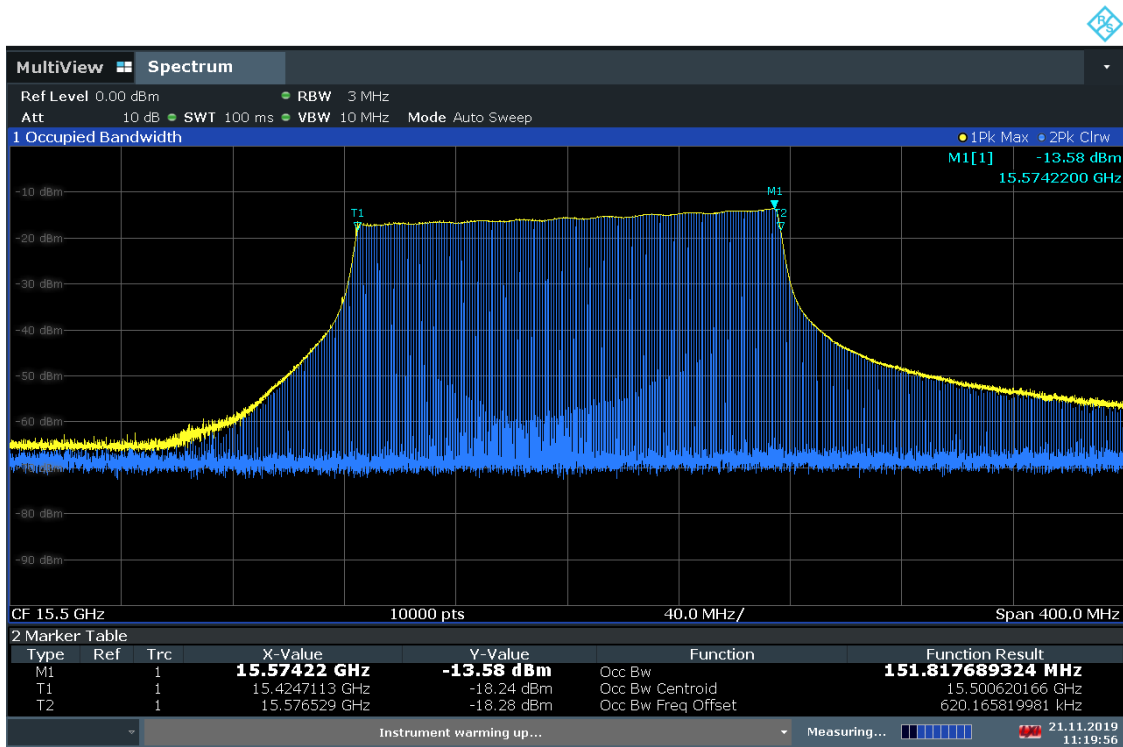
- This is a radiated test.
- This is a radiated test utilizing a spectrum analyser.
- The attenuation for the external attenuator, adapter and cable is measured and entered as a Transducer factor (TDF).
- Occupied bandwidth measurement function of the spectrum analyser was utilized for this test.
- Span is wide enough to capture the channel transmission.
- RBW is 1% to 5% of the occupied bandwidth.
- VBW is >3 X RBW.
- Sweep is auto.
- Detector is peak.
- Trace is max hold.



2.4.8 Test Results Table (for reference only)

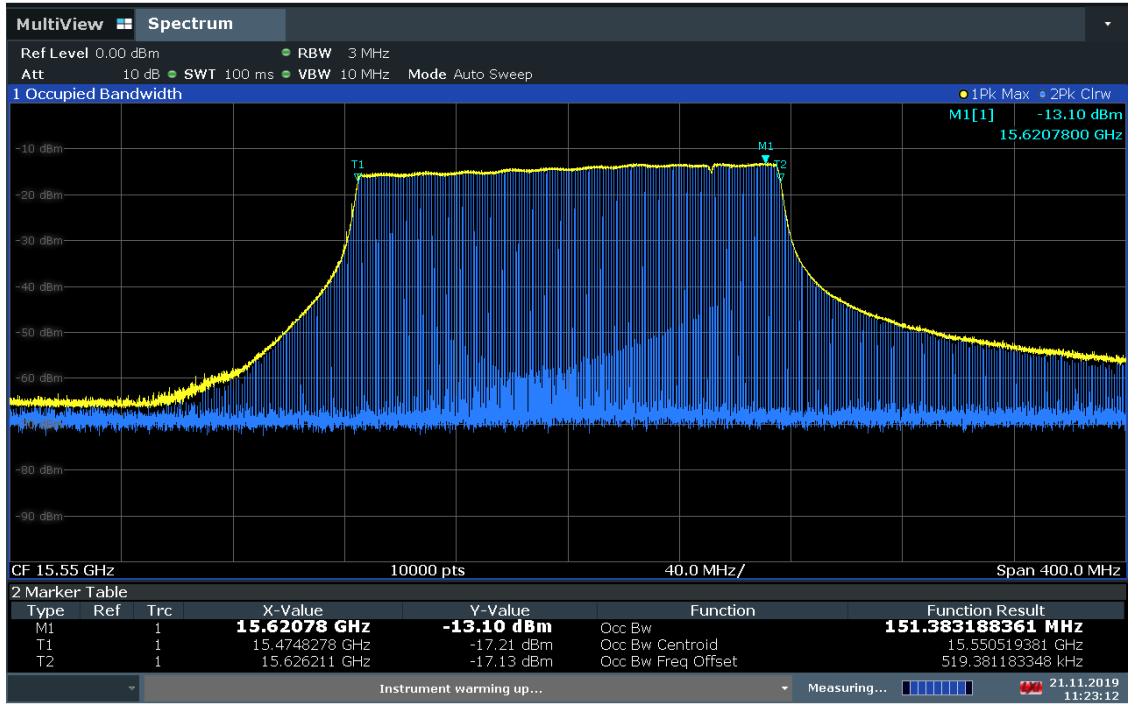
Channel	Center Frequency (GHz)	99% OBW (MHz)
Low	15.50	151.82
Mid	15.55	151.38
High	15.60	152.10

2.4.9 Test Result Plots



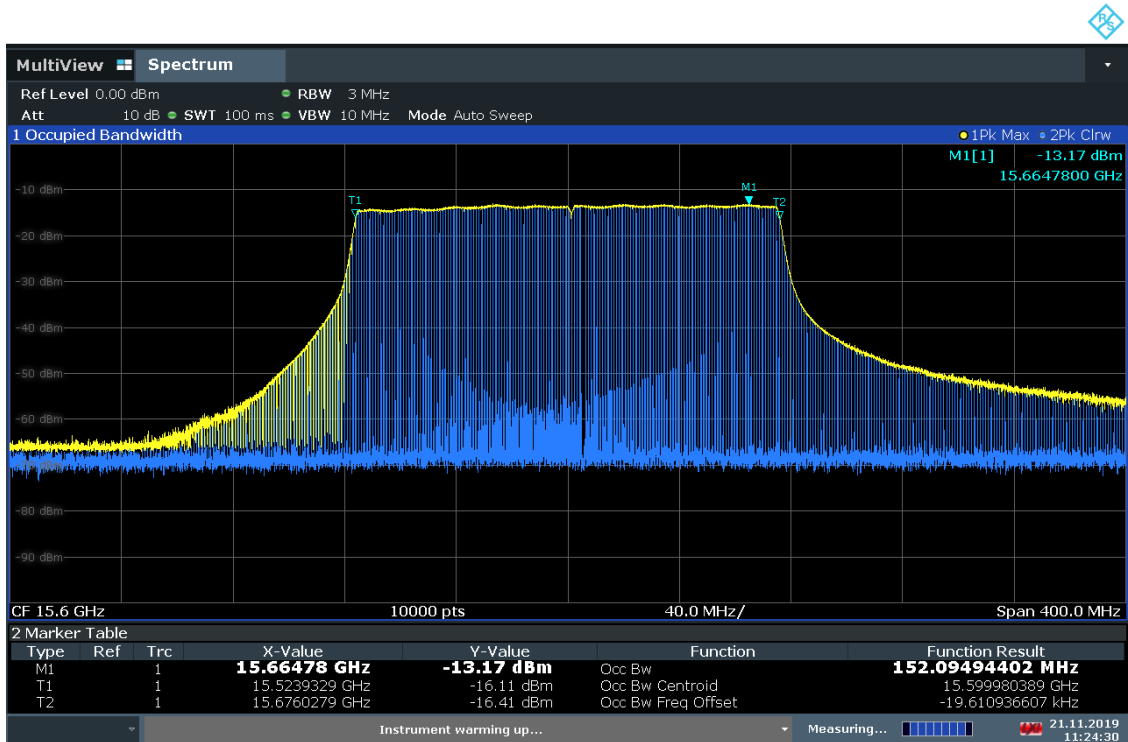
11:19:56 21.11.2019

Center Frequency @ 15.5GHz



11:23:13 21.11.2019

### Center Frequency @ 15.55GHz



11:24:31 21.11.2019

### Center Frequency @ 15.60GHz





## 2.5 FREQUENCY STABILITY

### 2.5.1 Specification Reference

FCC 47 CFR Part 87, Clause 87.133(a)

### 2.5.2 Standard Applicable

(a) Except as provided in paragraphs (c), (d), (f), and (g) of this section, the carrier frequency of each station must be maintained within these tolerances:

Frequency band (lower limit exclusive, upper limit inclusive), and categories of stations	Tolerance
Band 10.5 GHz to 40 GHz radionavigation stations	5000 ppm

### 2.5.3 Equipment Under Test and Modification State

Serial No: X00330153 / Default Test Configuration

### 2.5.4 Date of Test/Initial of test personnel who performed the test

November 20 and 21, 2019 / FSC

### 2.5.5 Test Equipment Used

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

### 2.5.6 Environmental Conditions

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	24.4 – 25.6 °C
Relative Humidity	43.1 – 44.7 %
ATM Pressure	97.9 – 98.9 kPa

### 2.5.7 Additional Observations

- This is a radiated test utilizing the spectrum analyser marker signal count function.
- Test Methodology is per Section 5.6 and Annex A A.2.9.7 of ANSI C63.26-2015.
- The EUT is in CW mode for this test.
- Nominal voltage was declared at 24VDC.

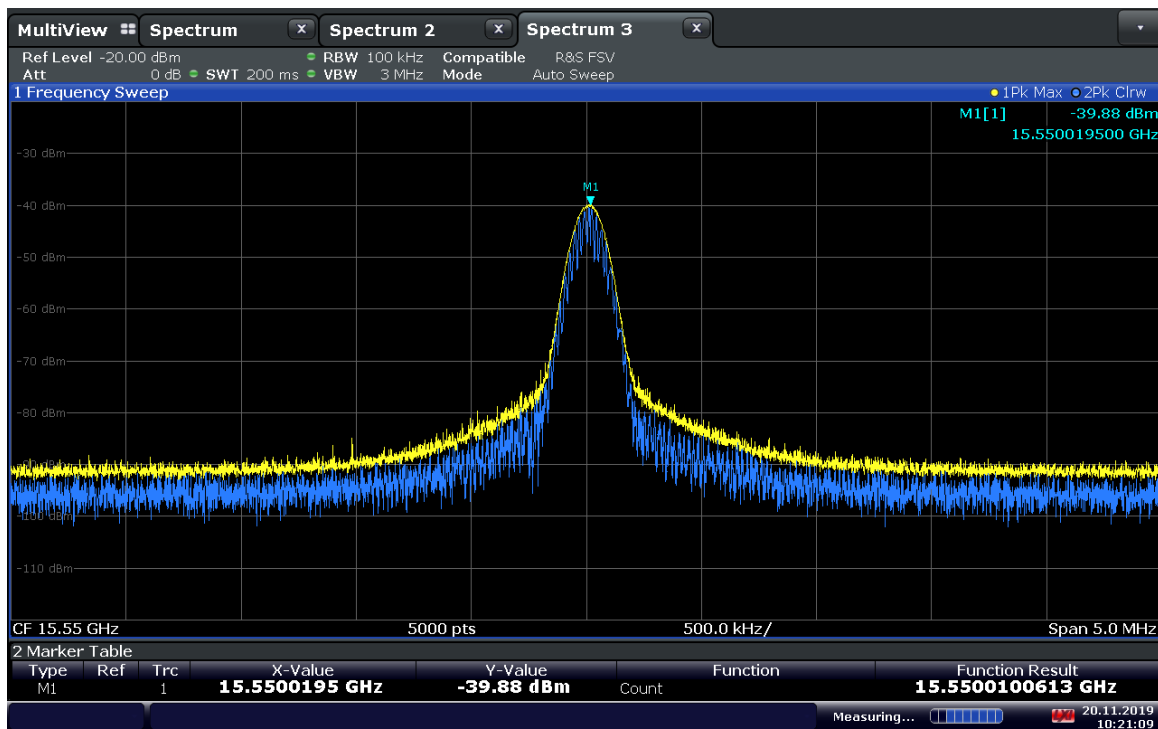


2.5.8 Test Result Table

Temperature (°C)	Frequency (MHz)	ppm
50°C	15,550,019.50	-0.84
40°C	15,550,015.50	-0.58
30°C	15,550,006.50	0.00
20°C	15,550,006.50	0.00
10°C	15,549,999.50	0.45
0°C	15,549,998.50	0.51
-10°C	15,550,002.50	0.26
-20°C	15,550,010.50	-0.26
-30°C	15,550,001.50	0.32
85% of Nominal Voltage	15,550,001.50	0.32
115% of Nominal Voltage	15,550,010.50	-0.26
Nominal Voltage	15,550,006.50	0.00

NOTE—Parts per million (ppm) is obtained as the difference from the reference frequency (in Hz) divided by the reference frequency (in MHz).

2.5.9 Sample Test Plots

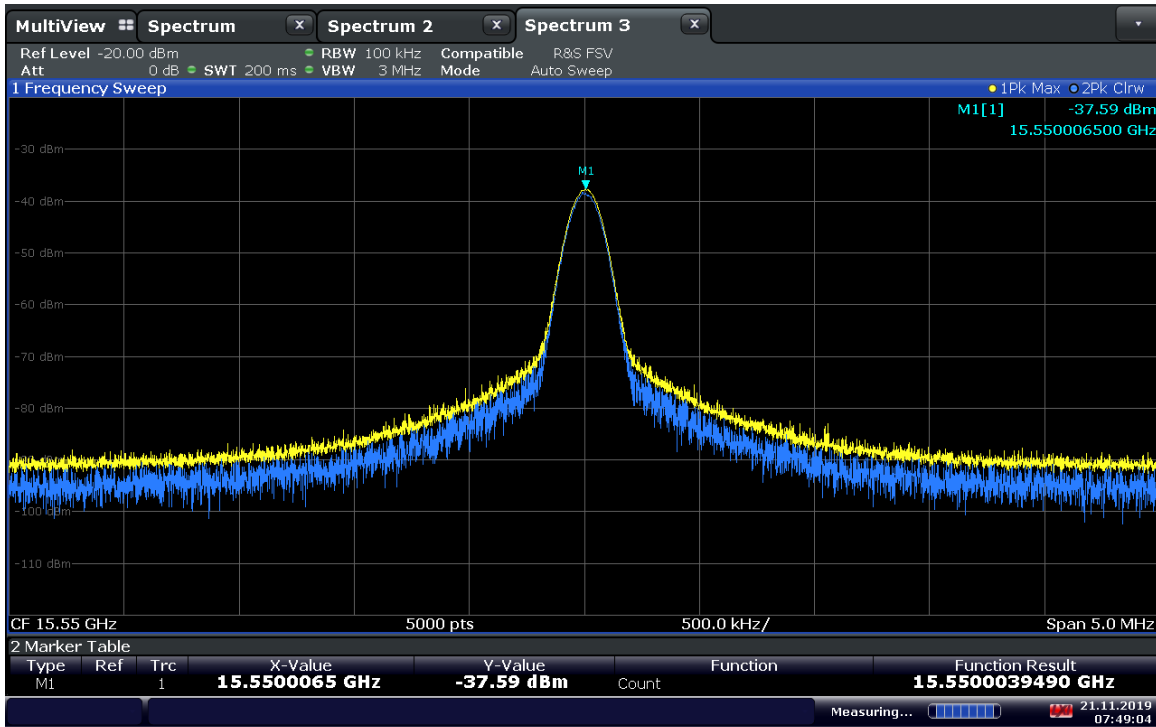


10:21:10 20.11.2019

Frequency Stability @ 50°C

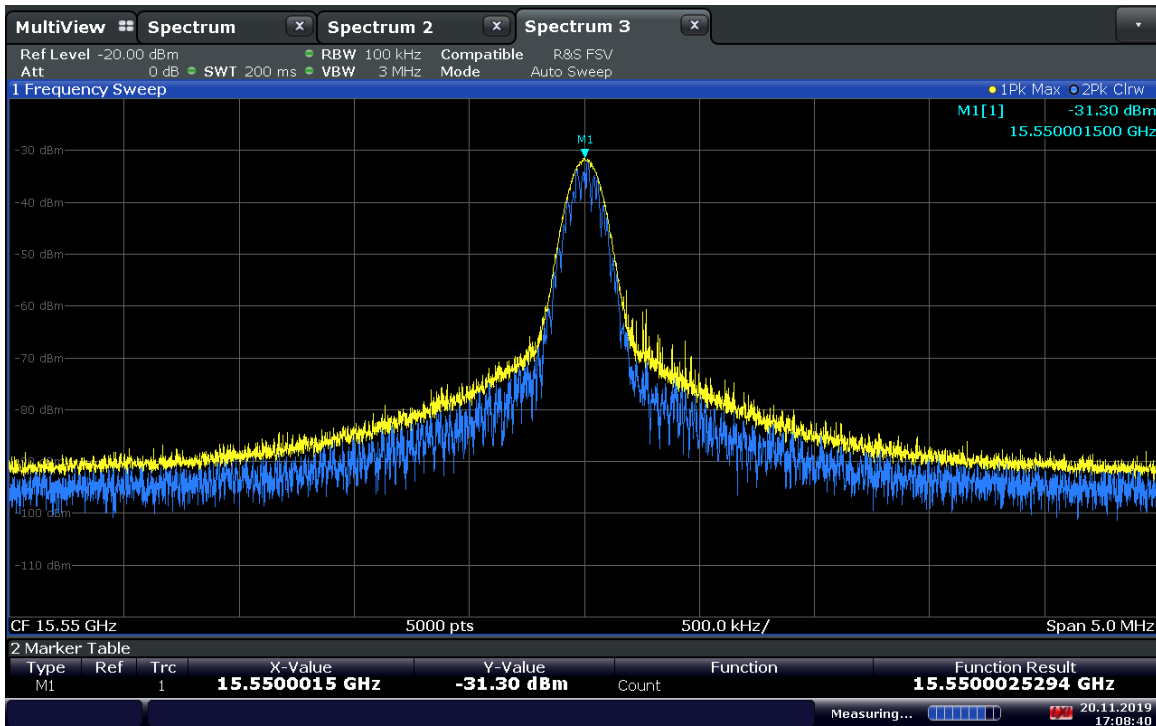


America



07:49:05 21.11.2019

**Frequency Stability @ 20°C (Nominal Voltage)**



17:08:40 20.11.2019

**Frequency Stability @ -30°C**



## 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
<b>Radiated Emission</b>						
1049	EMI Test Receiver	ESU40	100133	Rohde & Schwarz	10/01/21	10/01/22
7611	Signal/Spectrum Analyzer	FSW26	102017	Rohde & Schwarz	02/02/21	02/02/22
1002	Bilog Antenna	3142C	0058717	EMCO	10/21/21	10//21/23
1003	Signal Generator	SMR-40	1104.0002.40	Rhode & Schwarz	11/17/21	11/17/22
7631	Double-ridged waveguide horn	3117	00205418	ETS-Lindgren	09/16/20	09/16/22
46797	Preamplifier	PA-122	181925	Com Power	10//11/21	10/11/22
9001	Horn antenna (18-26.5GHz)	HO42S	101	Custom Microwave	09/23/21	09/23/23
9002	Horn antenna (26-40 GHz)	HO28S	102	Custom Microwaves	09/23/21	09/23/23
40815	Pre-amplifier (18-40 GHz)	19D18	15G27	Spacek Labs	10/11/21	10/11/22
7637	Harmonics mixer (40-60 GHz)	FS-Z60	100009	Rhode & Schwarz	07/29/20	07/29/23
7636	Harmonics mixer (60-90 GHz)	FS-Z90	100092	Rhode & Schwarz	07/29/20	07/29/23
7633	Harmonics mixer (75-110 GHz)	HM-110-7	101000	Radiometer Physics	02/22/21	07/29/23
9003	Horn antenna (40-60 GHz)	HO19R	103	Custom Microwaves	10/14/19	07/29/23
9004	Horn antenna (50-75 GHz)	HO15R	104	Custom Microwaves	10/10/19	07/29/23
7628	Horn antenna (75-110 GHz)	SAR-2309-10-S2	13481-01	Sage Millimeter, Inc.	Verified by 8861 and 8915	
8872	Direct Reading Attenuator (40-60 GHz)	STA-60-19-D1	11875-01	Sage Millimeter, Inc.	Verified by 7611 and corresponding antenna/mixer combination	
8860	Direct Reading Attenuator (50-75 GHz)	STA-60-15-D1	11466-01	Sage Millimeter, Inc.		
8861	Direct Reading Attenuator (75-110 GHz)	STA-60-10-D1	11466-01	Sage Millimeter, Inc.		
8919	Direct Reading Attenuator (90-140 GHz)	STA-60-08-D1	12605-01	Sage Millimeter, Inc.		
8873	Active Multiplier (40-60 GHz)	AMC-19-RFH00	124	Millitech, Inc.		
8914	Active Multiplier (50-75 GHz)	AMC-15-RFH00	283	Millitech, Inc.		
8915	Active Multiplier (75-110 GHz)	AMC-10-RFH00	606	Millitech, Inc.		
8920	Active Multiplier (90-140 GHz)	AMC-08-RFH00	58	Millitech, Inc.		



ID Number (SDGE/SDRB)	Test Equipment	Type	Serial Number	Manufacturer	Cal Date	Cal Due Date
<b>Miscellaneous</b>						
43003	True RMS Multimeter	85 III	69880143	Fluke	10/23/20	10/23/21
7579	Temperature Chamber	115	151617	TestQuity	09/09/19	09/09/20
11312	Mini Environmental Quality Meter	850027	CF099-56010-340	11312	05/22/20	05/22/21
6726	Temp/Humidity Sensor	RTRH	16248370	Dickson	06/18/20	06/18/21
-	Test Software	EMC32	V10.50.40	Rhode & Schwarz	N/A	

**Note:** Test equipment listed in this table were verified within its calibration cycle when used.



### 3.2 MEASUREMENT UNCERTAINTY

Calculation of Measurement Uncertainty per CISPR 16-4-2:2011 with Corr. 1

#### 3.2.1 Radiated Measurements (Below 1GHz)

	Input Quantity (Contribution) $X_i$	Value	Prob. Dist.	Divisor	$u_i(x)$	$u_i(x)^2$
1	Receiver reading	0.10 dB	Normal, k=1	1.000	0.10	0.01
2	Attenuation: antenna-receiver	0.20 dB	Normal, k=2	2.000	0.10	0.01
3	Antenna factor AF	0.58 dB	Normal, k=2	2.000	0.38	0.08
4	Receiver sinewave accuracy	0.15 dB	Normal, k=2	2.000	0.23	0.01
5	Receiver pulse amplitude	1.50 dB	Rectangular	1.732	0.87	0.75
6	Receiver pulse repetition rate	1.50 dB	Rectangular	1.732	0.87	0.75
7	Noise floor proximity	0.50 dB	Rectangular	1.732	0.29	0.08
8	Mismatch: antenna-receiver	0.95 dB	U-shaped	1.414	0.67	0.45
9	AF frequency interpolation	0.30 dB	Rectangular	1.732	0.17	0.03
10	AF height deviations	0.10 dB	Rectangular	1.732	0.06	0.00
11	Directivity difference at 3 m	3.12 dB	Rectangular	1.732	1.80	3.24
12	Phase center location at 3 m	1.00 dB	Rectangular	1.732	0.58	0.33
13	Cross-polarisation	0.90 dB	Rectangular	1.732	0.52	0.27
14	Balance	0.00 dB	Rectangular	1.732	0.00	0.00
15	Site imperfections	3.99 dB	Triangular	2.449	1.54	2.65
16	Separation distance at 3 m	0.30 dB	Rectangular	1.732	0.17	0.03
17	Effect of setup table material	0.57 dB	Rectangular	1.732	0.44	0.11
18	Table height at 3 m	0.10 dB	Normal, k=2	2.000	0.05	0.00
19	Near-field effects	0.00 dB	Triangular	2.449	0.00	0.00
20	Effect of ambient noise on OATS	0.00 dB				0.00
Combined standard uncertainty				Normal	2.97 dB	
Expanded uncertainty				Normal, k=2	5.94 dB	



### 3.2.2 Radiated Emission Measurements (Above 1GHz)

	Input Quantity (Contribution) $X_i$	Value	Prob. Dist.	Divisor	$u_i(x)$	$u_i(x)^2$
1	Receiver reading	0.10 dB	Normal, k=1	1.000	0.10	0.01
2	Attenuation: antenna-receiver	0.30 dB	Normal, k=2	2.000	0.10	0.02
3	Antenna factor AF	0.20 dB	Normal, k=2	2.000	0.38	0.01
4	Receiver sinewave accuracy	0.47 dB	Normal, k=2	2.000	0.23	0.06
5	Receiver pulse amplitude	0.15 dB	Rectangular	1.732	0.87	0.01
6	Receiver pulse repetition rate	1.21 dB	Rectangular	1.732	0.87	0.49
7	Noise floor proximity	0.70 dB	Rectangular	1.732	0.29	0.16
8	Mismatch: antenna-receiver	1.41 dB	U-shaped	1.414	0.67	0.99
9	AF frequency interpolation	1.30 dB	Rectangular	1.732	0.17	0.85
10	AF height deviations	0.30 dB	Rectangular	1.732	0.06	0.03
11	Directivity difference at 3 m	1.50 dB	Rectangular	1.732	1.80	0.75
12	Phase center location at 3 m	0.30 dB	Rectangular	1.732	0.58	0.03
13	Cross-polarisation	0.90 dB	Rectangular	1.732	0.52	0.27
14	Balance	5.91 dB	Rectangular	1.732	0.00	1.21
15	Site imperfections	1.57 dB	Triangular	2.449	1.33	0.82
16	Separation distance at 3 m	0.30 dB	Rectangular	1.732	0.17	0.03
17	Effect of setup table material	0.00 dB	Rectangular	1.732	0.44	0.00
18	Table height at 3 m	0.10 dB	Normal, k=2	2.000	0.05	0.01
19	Near-field effects	0.30 dB	Triangular	2.449	0.00	0.02
20	Effect of ambient noise on OATS	0.20 dB				0.01
Combined standard uncertainty				Normal	2.39 dB	
Expanded uncertainty				Normal, k=2	4.79 dB	

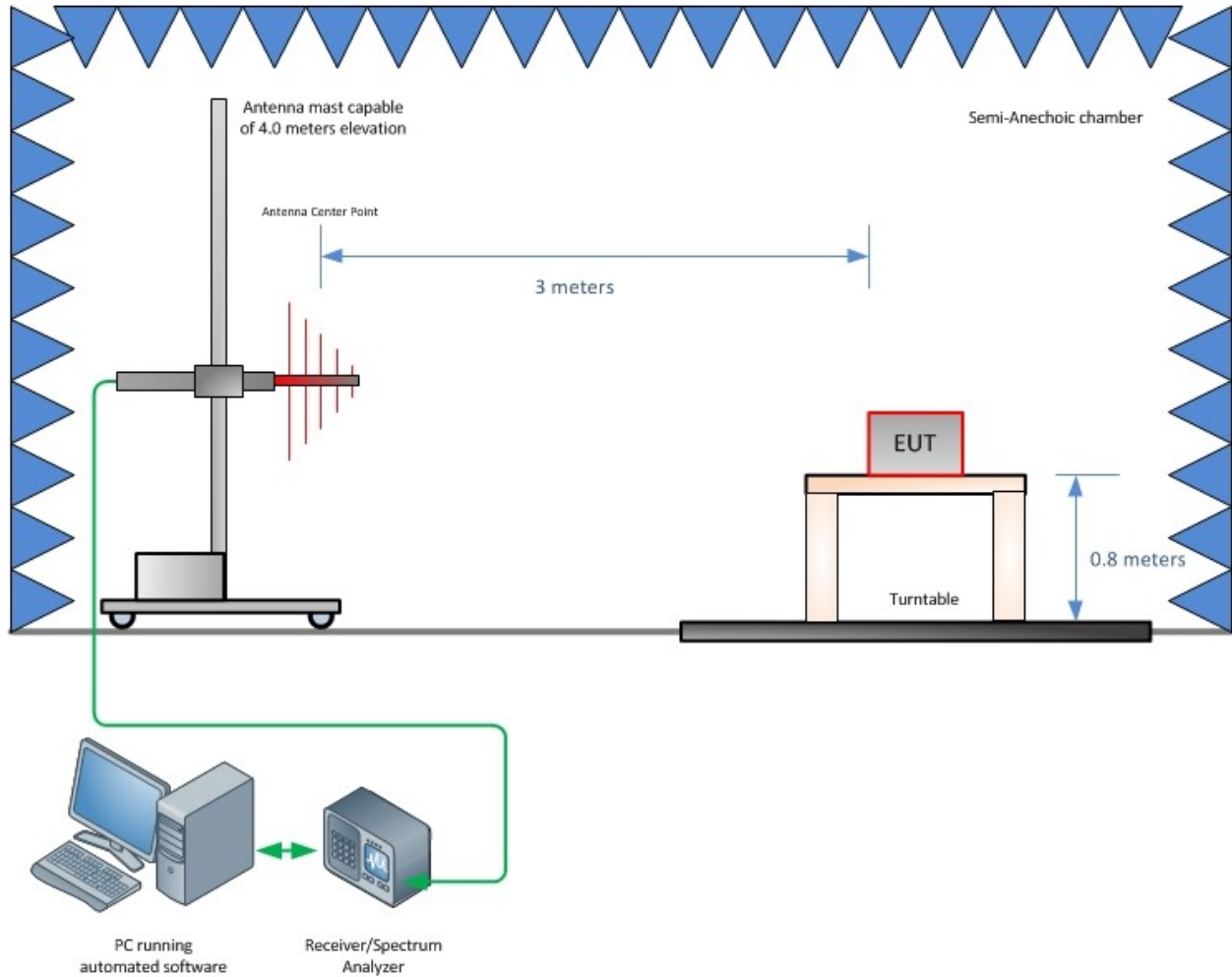




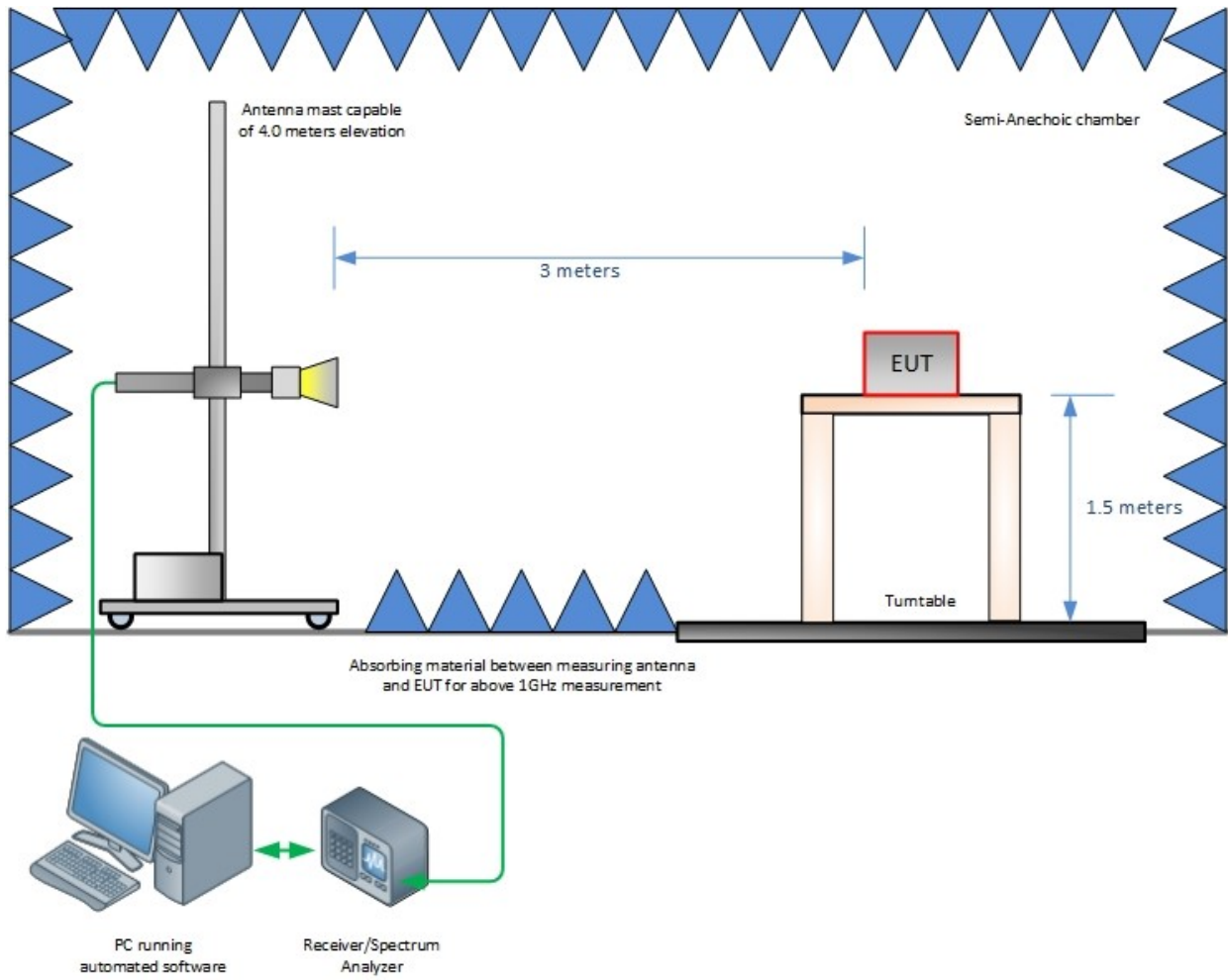
## SECTION 4

### Diagram of Test Setup

#### 4.1 TEST SETUP DIAGRAM

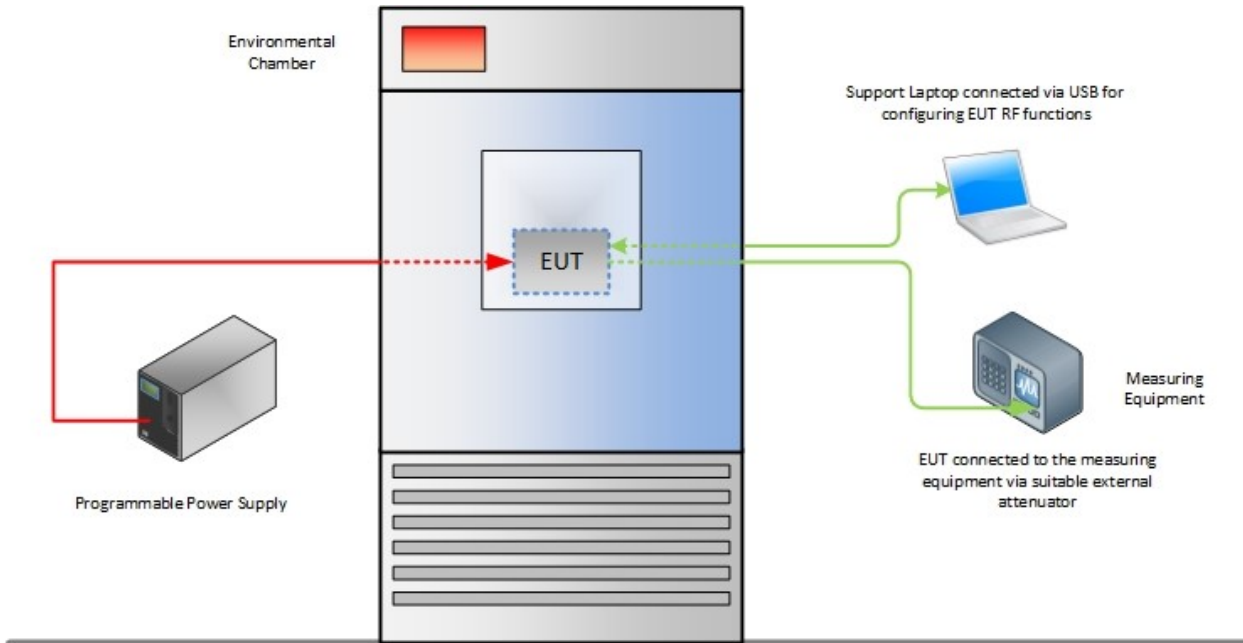


**Radiated Emission Test Setup (Below 1GHz)**



### Radiated Emission Test Setup (Above 1GHz)

*Refer to Section 2.3.7 for frequencies above 40GHz*



**Frequency Stability Test Configuration**



## SECTION 5

### ACCREDITATION, DISCLAIMERS AND COPYRIGHT



## 5.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT

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