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Radio Testing of the

ecobee Incorporated
Smart Thermostat Model: Ares

In accordance with FCC Part 15 Subpart C
§15.249 and ISED RSS-210 Issue 10 December
2019

ecobee Incorporated
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COMMERCIAL-IN-CONFIDENCE

Date: February 2022

Document Number: 72172883 Issue 01 | Version Number: 01

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Authorized Signatory	Xiaoying Zhang	February 11, 2022	

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EXECUTIVE SUMMARY

A sample of this product was tested and found to be in compliance with FCC Part 15 Subpart C §15.249 and ISED RSS-210 Issue 10 December 2019.



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REPORT ON	Radio Testing of the ecobee Incorporated Model ECB601 Ares Smart Thermostat
TEST REPORT NUMBER	72172883
TEST REPORT DATE	February 2022
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APPROVED BY	 Xiaoying Zhang Name Authorized Signatory Title: Senior RF Wireless Test Engineer
DATED	February 11, 2022



Revision History

72172883 ecobee Incorporated Model ECB601 Ares Smart Thermostat					
DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
02/11/2022	Initial Release				Xiaoying Zhang



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SECTION 1

REPORT SUMMARY

Radio Testing of the
ecobee Incorporated
Ares Smart Thermostat



1.1 INTRODUCTION

The information contained in this report is intended to show verification of the ecobee Incorporated Ares Smart Thermostat to the requirements of FCC Part 15 Subpart C §15.249 and ISSED RSS-210 Issue 10 December 2019.

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	ecobee Incorporated
EUT	Smart Thermostat
Trade Name	Ares
Model Name	ECB601
FCC ID	WR955470766937
IC Number	7981A-55470766937
Serial Number(s)	000242
Number of Samples Tested	1
Test Specification/Issue/Date	• FCC Part 15 Subpart C §15.249 (October 1, 2020). • ISSED RSS-210 Issue 10 December 2019: License-Exempt Radio Apparatus: Category I Equipment
Start of Test	September 13, 2021
Finish of Test	September 29, 2021
Name of Engineer(s)	Ferdinand Custodio
Related Document(s)	• ANSI C63.10-2013. American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices • Supporting documents for EUT certification are separate exhibits.



1.2 BRIEF SUMMARY OF RESULTS

A brief summary of the tests carried out in accordance with FCC Part 15 Subpart C §15.249 and ISSED RSS-210 Issue 10 December 2019 with cross-reference to the corresponding ISSED RSS standard are shown below.

Section	§15.249 Spec Clause	RSS	Test Description	Result	Comments /Base Standard
2.1	§15.207(a)	RSS-Gen 7.2	Conducted Emissions	Compliant	
2.2	§15.215(c)	RSS-Gen 6.7	20 dB Bandwidth	Compliant	
2.3		RSS-Gen 6.7	99% Emission Bandwidth	For Reference Only	
2.4	§15.249(a)	RSS-210 B10 (a)	Field Strength Limits for Fundamental and Harmonics	Compliant	
2.5	§15.249(d)	RSS-210 B10 (b)	Spurious Radiated Emissions	Compliant	
2.6		RSS-Gen 7.3	Receiver Spurious Emissions	N/A	

N/A Not performed as the EUT does not have a separate receiver function (24GHz radar).



1.3 PRODUCT INFORMATION

1.3.1 Technical Description

The Equipment Under Test (EUT) is an ecobee Incorporated Ares Smart Thermostat with voice control.

1.3.2 EUT General Description

EUT Description	Smart Thermostat
Model Name	Ares
Model Number	ECB601
Serial Number	000242
Input Voltage	24VAC
Output RF Power	89.76dBμV/m @ 3 meters (Peak)
Frequency Range (TX)	24.0 to 24.25GHz

1.4 EUT TEST CONFIGURATION

1.4.1 Test Configuration Description

Test Configuration	Description
Default	The EUT 24GHz radar will start transmitting once power is applied (24VAC from AC Adapter) and completes the booting process.

1.4.2 EUT Exercise Software

None. No special software was utilized to exercise the EUT during verifications.

1.4.3 Support Equipment and I/O cables

Manufacturer	Equipment/Cable	Description
-	AC Adapter	Model: AD-2410 Input AC110V 60Hz Output AC 24V 1000mA

1.4.4 Simplified Test Configuration Diagram

Not required. The EUT was verified on a stand-alone 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: 000242		
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 C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

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 – 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
ecobee Incorporated
Ares Smart Thermostat

2.1 CONDUCTED EMISSIONS

2.1.1 Specification Reference

Part 15 Subpart C §15.207(a) and RSS-GEN, Clause 7.2

2.1.2 Standard Applicable

(b) The field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

An intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μ H/50 ohms line impedance stabilization network (LISN).

Frequency of emission (MHz)	Conducted limit (dB μ V)	
	Quasi-peak	Average
0.15–0.5	66 to 56*	56 to 46*
0.5–5	56	46
5–30	60	50

*Decreases with the logarithm of the frequency.

2.1.3 Equipment Under Test and Modification State

Serial No: 000242 / Default Test Configuration

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

September 24, 2021 / FSC

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	24.0 °C
Relative Humidity	41.6 %
ATM Pressure	100.3 kPa



2.1.7 Additional Observations

Measurement was done using EMC32 V10.50.40 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 2.1.8 for sample computation.

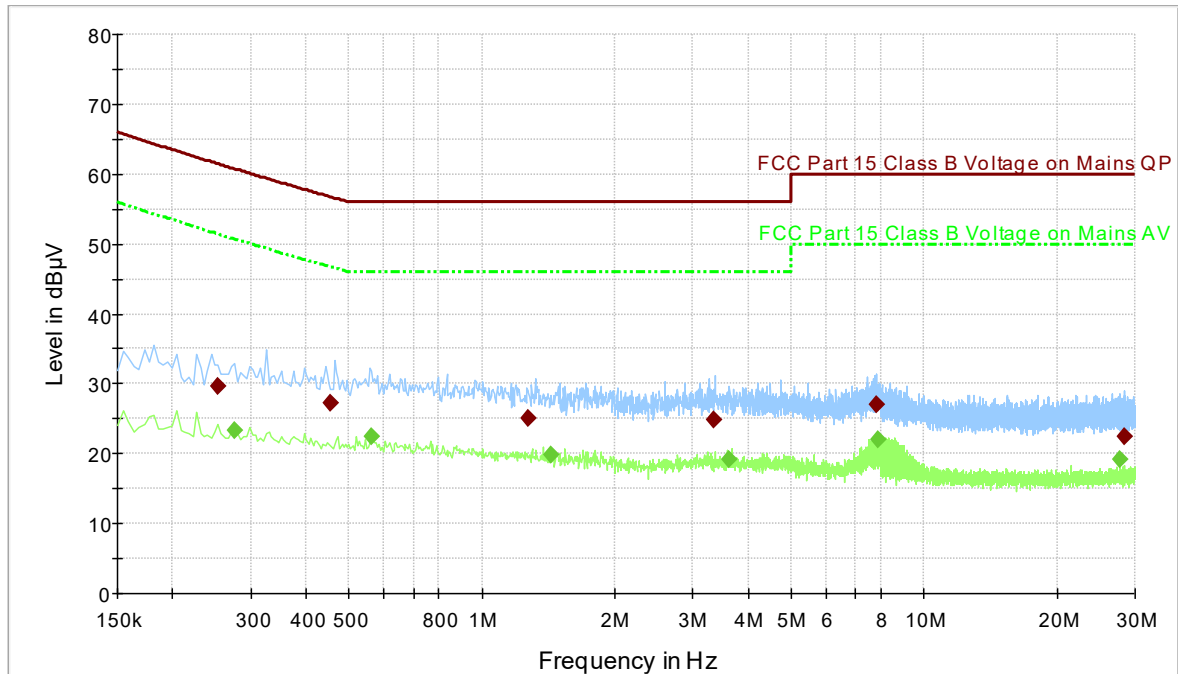
2.1.8 Sample Computation (Conducted Emission – Quasi Peak)

Measuring equipment raw measurement (dbμV) @ 150kHz		5.5
Correction Factor (dB)	Asset# 8607 (20 dB attenuator)	19.9
	Asset# 1177 (cable)	0.15
	Asset# 1176 (cable)	0.35
	Asset# 7568 (LISN)	0.30
Reported QuasiPeak Final Measurement (dbμV) @ 150kHz		26.2

2.1.9 Test Results

Compliant. See attached plots and tables.

2.1.10 Representative AC Adapter Line 1



- FCC Part 15 Class B Voltage on Mains QP [..\EMI conducted\]
- - - FCC Part 15 Class B Voltage on Mains AV [..\EMI conducted\]
- Preview Result 1-PK+ [Preview Result 1.Result:1]
- Preview Result 2-AVG [Preview Result 2.Result:2]
- ◆ Final Result 1-QPK [Final Result 1.Result:1]
- ◆ Final Result 2-AVG [Final Result 2.Result:1]

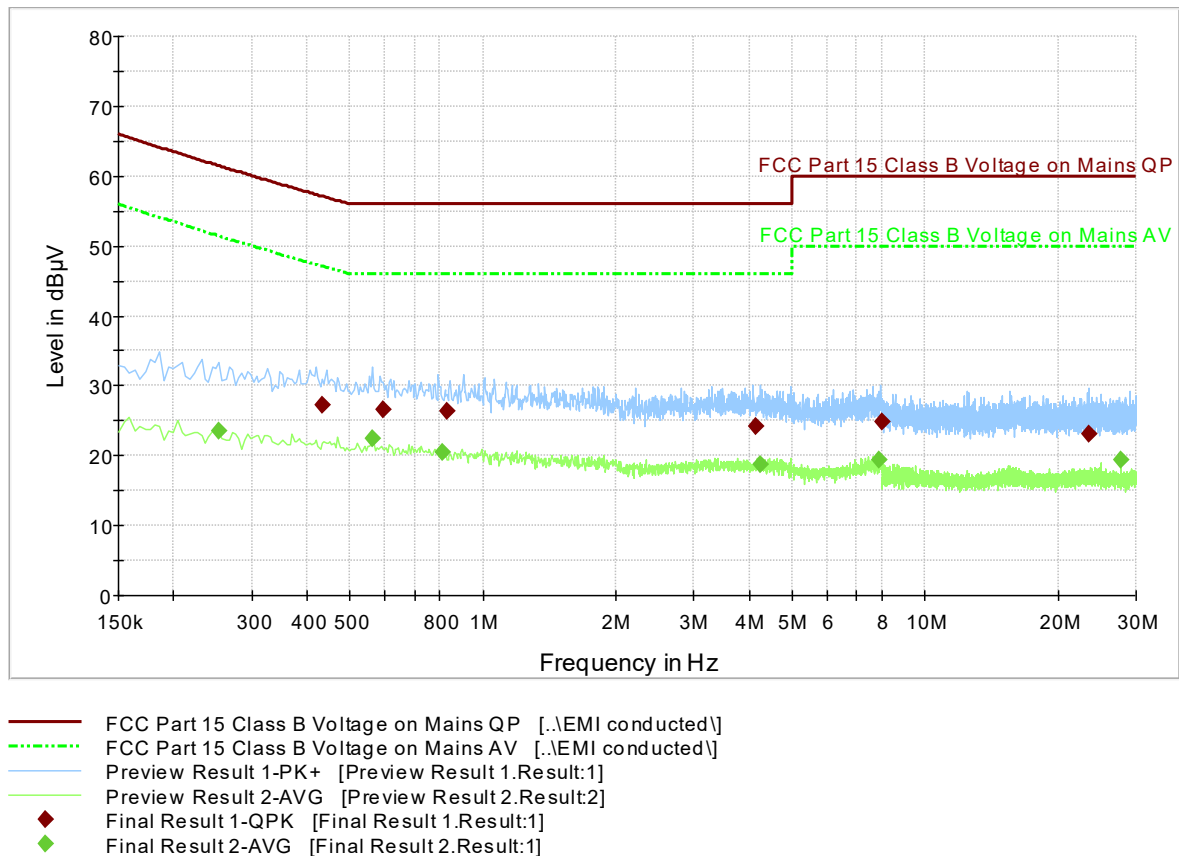
Quasi Peak

Frequency (MHz)	QuasiPeak (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.253500	29.6	1000.0	9.000	Off	L1	20.2	31.8	61.4
0.456000	27.2	1000.0	9.000	Off	L1	20.2	29.5	56.7
1.270500	25.1	1000.0	9.000	Off	L1	20.5	30.9	56.0
3.345000	24.9	1000.0	9.000	Off	L1	20.6	31.1	56.0
7.809000	27.1	1000.0	9.000	Off	L1	20.4	32.9	60.0
28.441500	22.6	1000.0	9.000	Off	L1	20.5	37.4	60.0

Average

Frequency (MHz)	Average (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.276000	23.4	1000.0	9.000	Off	L1	20.2	27.3	50.7
0.564000	22.4	1000.0	9.000	Off	L1	20.2	23.6	46.0
1.428000	19.8	1000.0	9.000	Off	L1	20.5	26.2	46.0
3.610500	19.2	1000.0	9.000	Off	L1	20.6	26.8	46.0
7.858500	22.0	1000.0	9.000	Off	L1	20.4	28.0	50.0
27.649500	19.3	1000.0	9.000	Off	L1	20.5	30.7	50.0

2.1.11 Representative AC Adapter Line 2



Quasi Peak

Frequency (MHz)	QuasiPeak (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.433500	27.2	1000.0	9.000	Off	N	20.2	29.9	57.1
0.595500	26.6	1000.0	9.000	Off	N	20.3	29.4	56.0
0.829500	26.3	1000.0	9.000	Off	N	20.4	29.7	56.0
4.141500	24.2	1000.0	9.000	Off	N	20.7	31.8	56.0
7.980000	24.9	1000.0	9.000	Off	N	20.4	35.1	60.0
23.442000	23.0	1000.0	9.000	Off	N	20.6	37.0	60.0

Average

Frequency (MHz)	Average (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.253500	23.6	1000.0	9.000	Off	N	20.2	27.8	51.4
0.564000	22.4	1000.0	9.000	Off	N	20.2	23.6	46.0
0.811500	20.5	1000.0	9.000	Off	N	20.4	25.5	46.0
4.258500	18.8	1000.0	9.000	Off	N	20.7	27.2	46.0
7.881000	19.5	1000.0	9.000	Off	N	20.4	30.5	50.0
27.649500	19.3	1000.0	9.000	Off	N	20.5	30.7	50.0



2.2 20dB BANDWIDTH

2.2.1 Specification Reference

Part 15 Subpart C §15.215(c) and RSS-GEN, Clause 6.7

2.2.2 Standard Applicable

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in [subpart E of this part](#), must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. In the case of intentional radiators operating under the provisions of subpart E, the emission bandwidth may span across multiple contiguous frequency bands identified in that subpart. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

2.2.3 Equipment Under Test and Modification State

Serial No: 000242 / Default Test Configuration

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

September 28, 2021 / FSC

2.2.5 Test Equipment Used

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

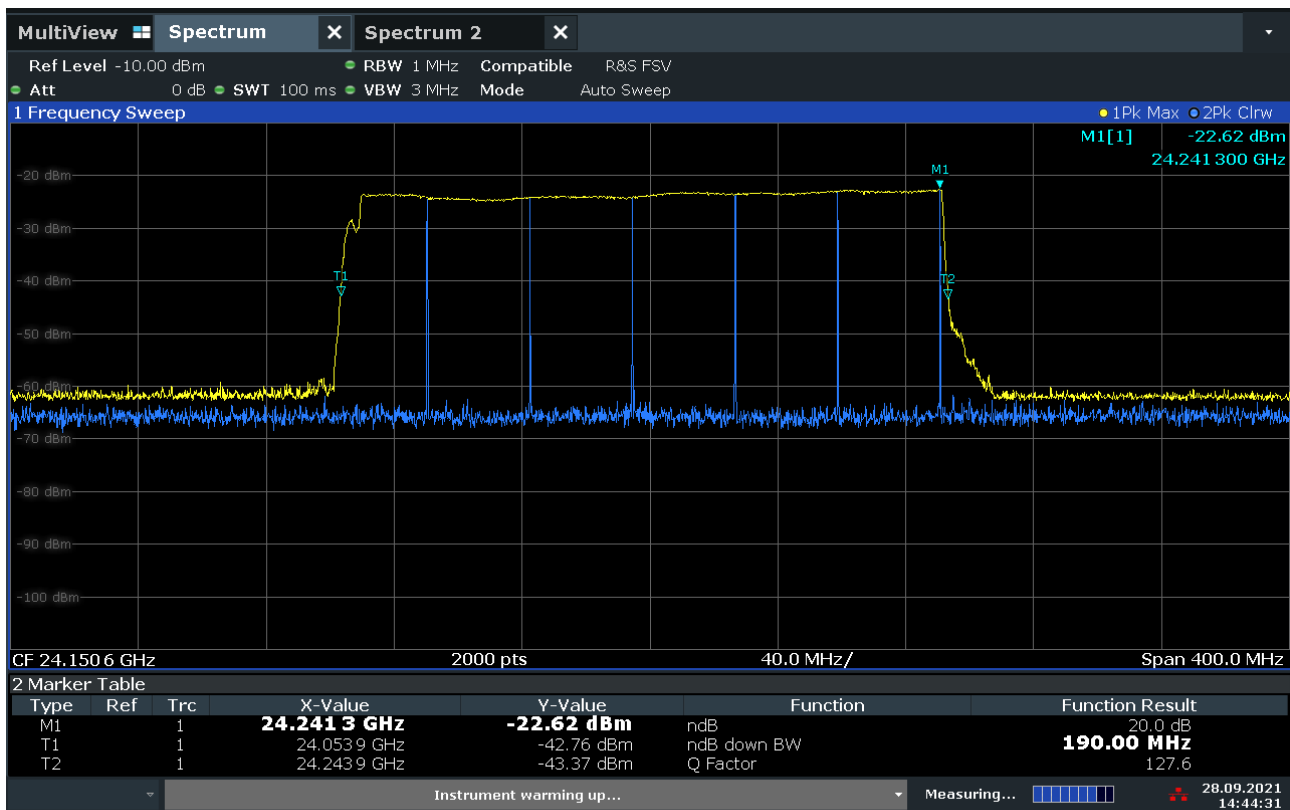
2.2.6 Environmental Conditions

Test performed at TÜV SÜD America Inc. Mira Mesa facility

Ambient Temperature	26.9 °C
Relative Humidity	42.5 %
ATM Pressure	100.0 kPa

2.2.7 Test Results

Complies. The 20dB bandwidth of the EUT is within the specified frequency band (24.0 to 24.25GHz)



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20 dB Bandwidth



2.3 99% OCCUPIED BANDWIDTH

2.3.1 Specification Reference

RSS-GEN, Clause 6.7

2.3.2 Standard Applicable

The occupied bandwidth or the “99% emission bandwidth” is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained. The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs.

2.3.3 Equipment Under Test and Modification State

Serial No: 000242 / Default Test Configuration

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

September 28, 2021 / FSC

2.3.5 Test Equipment Used

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

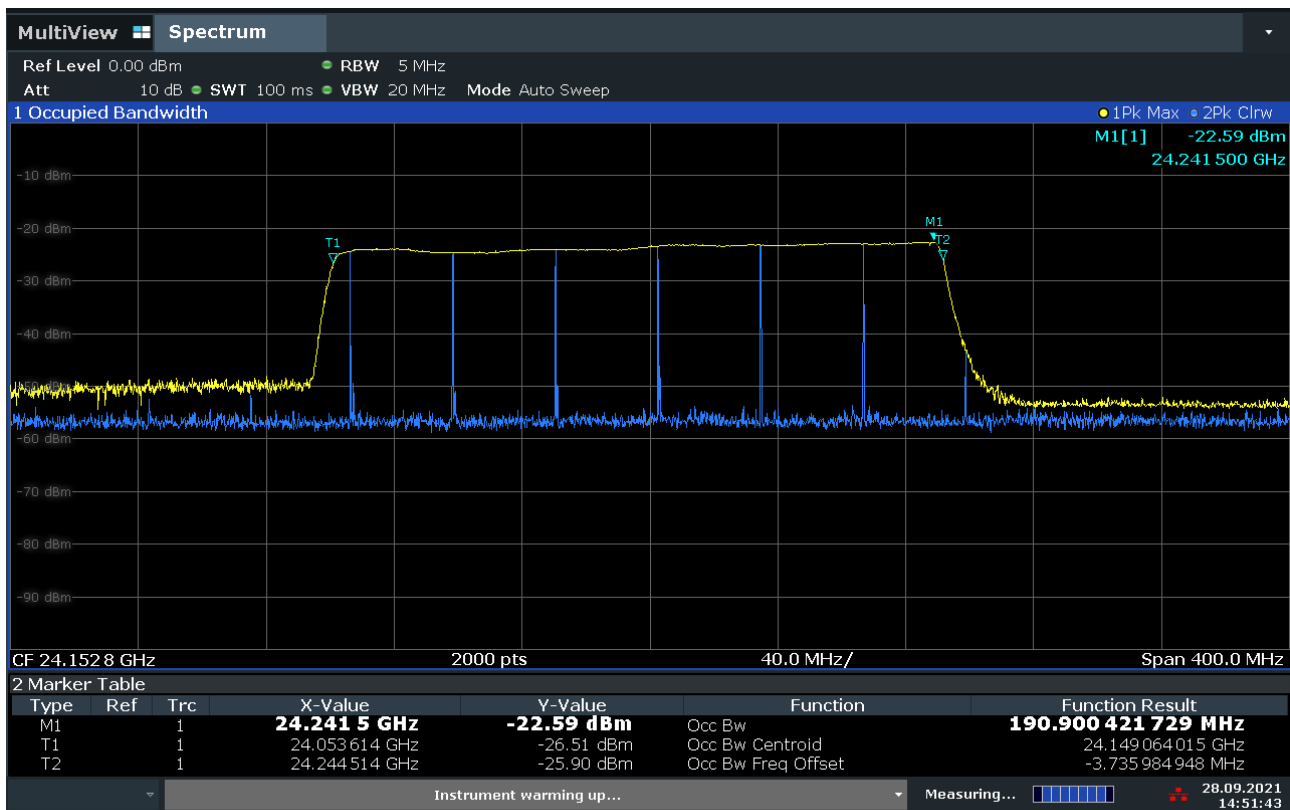
2.3.6 Environmental Conditions

Test performed at TÜV SÜD America Inc. Mira Mesa facility

Ambient Temperature	26.9 °C
Relative Humidity	42.5 %
ATM Pressure	100.0 kPa

2.3.7 Test Results

For reference only. The measured 99% OBW is **190.9 MHz**.



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99% OBW

2.4 FIELD STRENGTH LIMITS FOR FUNDAMENTAL AND HARMONICS

2.4.1 Specification Reference

FCC 47 Chapter I Subchapter A Part 15 Subpart C §15.249(a) and RSS-210, B10 (b)

2.4.2 Standard Applicable

(a) The field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental frequency (MHz)	Field strength of fundamental (mv/m)	Field strength of harmonics (µv/m)
902–928 MHz	50	500
2400–2483.5 MHz	50	500
5725–5875 MHz	50	500
24.0–24.25 GHz	250	2500

2.4.3 Equipment Under Test and Modification State

Serial No: 000242 / Default Test Configuration

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

September 13, 2021 / 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	27.5 °C
Relative Humidity	43.5 %
ATM Pressure	100.1 kPa

2.4.7 Additional Observation

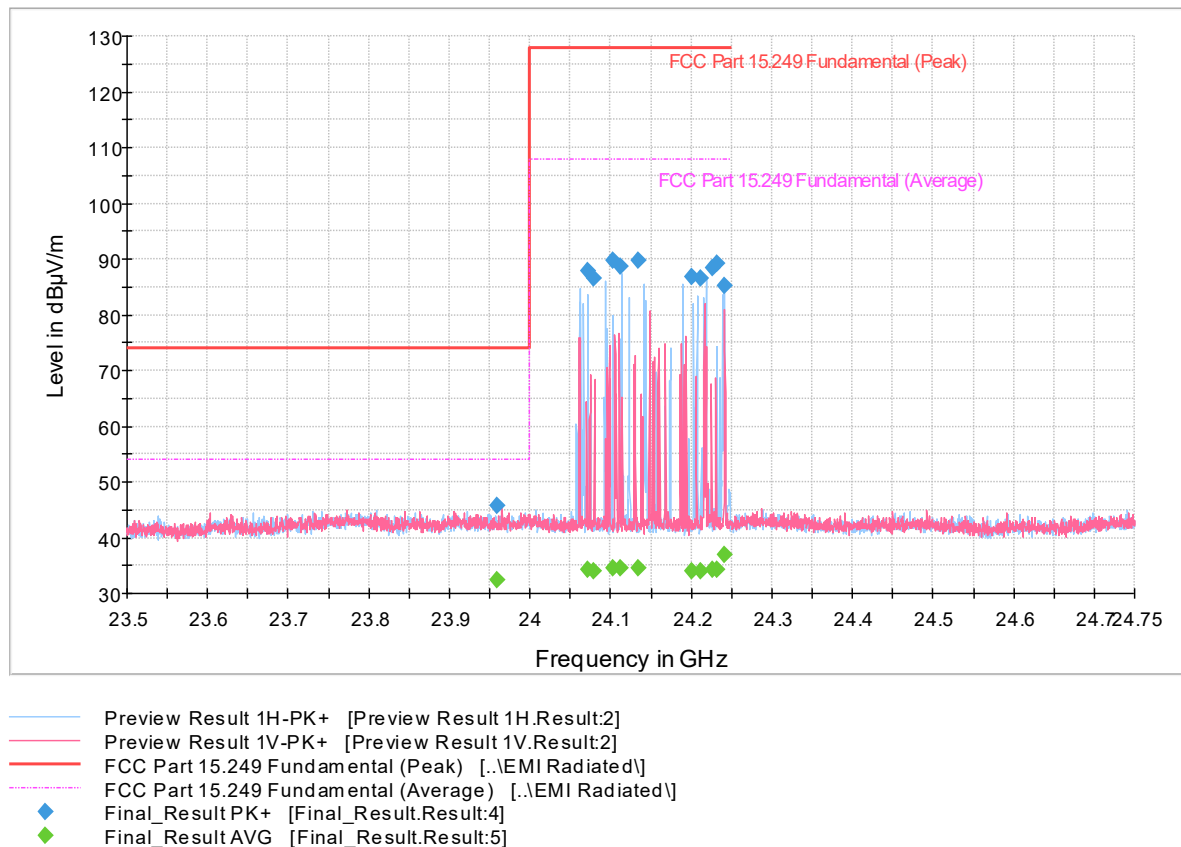
Fundamental only presented. Harmonics (if any) will be evaluated under Section 2.5 of this test report.

2.4.8 Test Results

Complies. See attached test plot.

2.4.9 24.0–24.25 GHz Fundamental Scan

Full Spectrum



Peak Data (only Peak presented as it complies with Average limits)

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
24072.089500	87.79	127.96	40.17	1000.0	1000.000	212.0	H	84.0	0
24078.843000	86.60	127.97	41.36	1000.0	1000.000	139.0	H	84.0	0
24103.459500	89.76	127.97	38.22	1000.0	1000.000	137.0	H	15.0	0
24112.713500	88.70	127.97	39.28	1000.0	1000.000	140.0	H	33.0	0
24134.791000	89.67	127.98	38.31	1000.0	1000.000	137.0	H	14.0	0
24200.445000	86.84	127.99	41.15	1000.0	1000.000	140.0	H	54.0	0
24212.115500	86.61	127.99	41.38	1000.0	1000.000	192.0	H	32.0	0
24226.676000	88.52	128.00	39.47	1000.0	1000.000	142.0	H	31.0	0
24232.221500	89.17	128.00	38.83	1000.0	1000.000	137.0	H	13.0	0
24241.036000	85.31	128.00	42.69	1000.0	1000.000	212.0	H	329.0	0

2.5 SPURIOUS RADIATED EMISSIONS

2.5.1 Specification Reference

FCC 47 Chapter I Subchapter A Part 15 Subpart C §15.249(d) and RSS-210, B10 (b)

2.5.2 Standard Applicable

(d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

2.5.3 Equipment Under Test and Modification State

Serial No: 000242 / Default Test Configuration

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

September 13 and 29, 2021 / 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. Mira Mesa facility

Ambient Temperature	27.5 °C
Relative Humidity	43.5 %
ATM Pressure	100.1 kPa

2.5.7 Additional Observations

- This is a radiated test.
- The spectrum was searched from 9kHz to 100GHz.
- For 1 to 18GHz scan, fundamental and associated harmonics of known intentional radiator (e.g. 2.4GHz and 5GHz WLAN) will be ignored.
- For 18 to 26GHz scan, the fundamental for the 24GHz radar will be ignored when verified against Part 15.209 limits.
- For 40 to 100GHz maximized plots, only Peak detector results presented since the limit used is for Average.
- Measurement was done using EMC32 automated software below 40GHz. Reported level is the actual level with all the correction factors factored in. Correction Factor column is for informational purposes only. See Section 2.5.8 for sample computation.



2.5.8 Sample Computation (Radiated Emission)

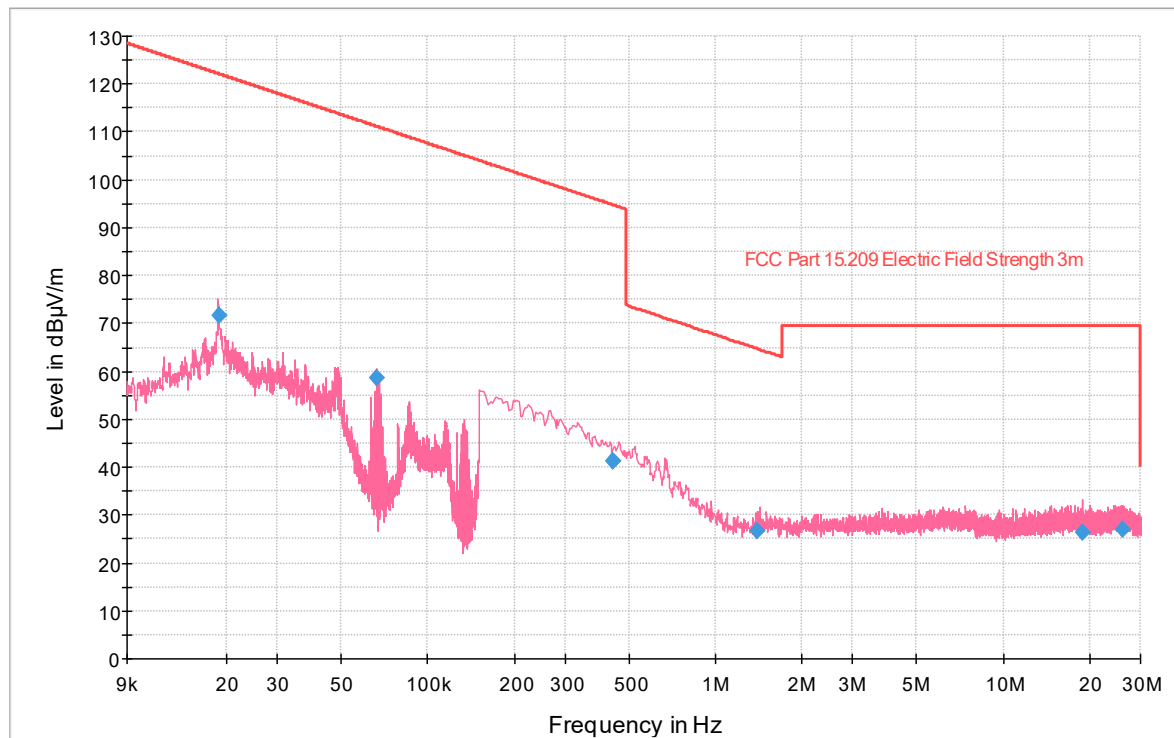
Measuring equipment raw measurement (db μ V) @ 30 MHz			24.4
Correction Factor (dB)	Asset# 1066 (cable)	0.3	-12.6
	Asset# 1172 (cable)	0.3	
	Asset# 1016 (preamplifier)	-30.7	
	Asset# 1175(cable)	0.3	
	Asset# 1002 (antenna)	17.2	
Reported QuasiPeak Final Measurement (db μ V/m) @ 30MHz			11.8

2.5.9 Test Results

Compliant. See attached plots.

2.5.10 Below 30MHz Radiated Emission Test

Full Spectrum

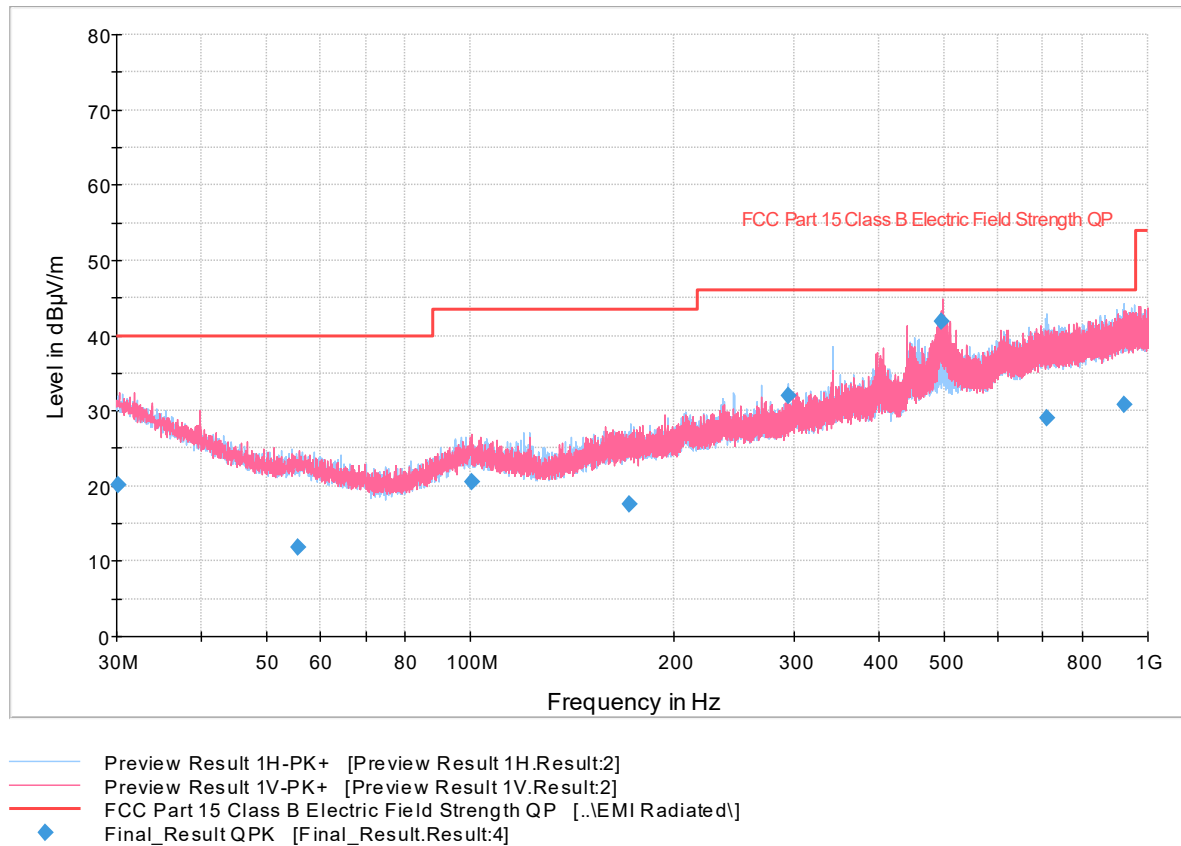


Quasi-Peak Data

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Height (cm)	Azimuth (degrees)	Corr. (dB/m)
0.018718	71.65	122.15	50.50	1000.0	0.200	100.0	H	16.0	22
0.066571	58.60	111.13	52.54	1000.0	0.200	100.0	H	13.0	20
0.437625	41.34	94.78	53.45	1000.0	9.000	100.0	H	347.0	19
0.437655	41.39	94.78	53.39	1000.0	9.000	100.0	H	7.0	19
1.397582	26.80	64.69	37.89	1000.0	9.000	100.0	H	187.0	20
18.874378	26.43	69.50	43.07	1000.0	9.000	100.0	H	250.0	23
25.901492	27.03	69.50	42.47	1000.0	9.000	100.0	H	199.0	25

2.5.11 30MHz to 1GHz Radiated Emission Test

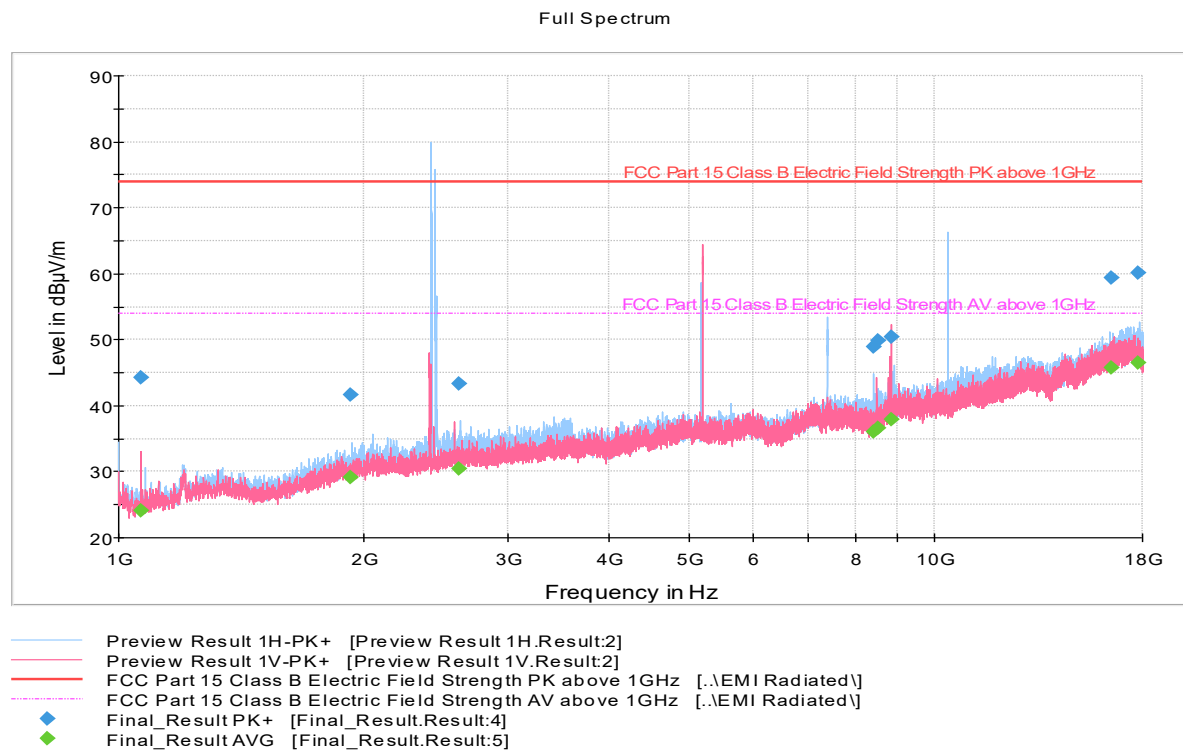
Full Spectrum



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)
30.200000	20.10	40.00	19.90	1000.0	120.000	225.0	V	16.0	23
55.668667	11.76	40.00	28.24	1000.0	120.000	316.0	H	224.0	14
100.180333	20.56	43.50	22.94	1000.0	120.000	110.0	V	317.0	16
171.352667	17.52	43.50	25.98	1000.0	120.000	225.0	H	323.0	17
293.783000	32.09	46.00	13.91	1000.0	120.000	100.0	H	208.0	20
496.446333	41.86	46.00	4.14	1000.0	120.000	182.0	V	147.0	25
709.150333	28.97	46.00	17.03	1000.0	120.000	282.0	H	73.0	29
920.934000	30.87	46.00	15.13	1000.0	120.000	389.0	H	188.0	31

2.5.12 From 1GHz to 18GHz Radiated Emission Test



Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1000.000000	47.15	73.90	26.75	1000.0	1000.000	138.0	H	282.0	-6.1
2613.700000	43.40	73.90	30.50	1000.0	1000.000	350.0	H	170.0	1.5
3633.900000	45.87	73.90	28.03	1000.0	1000.000	255.0	V	43.0	3.5
6017.500000	49.54	73.90	24.36	1000.0	1000.000	175.0	V	305.0	5.5
11032.633333	53.69	73.90	20.21	1000.0	1000.000	335.0	H	17.0	13.7
17639.566667	60.49	73.90	13.41	1000.0	1000.000	305.0	V	8.0	19.3
17641.566667	60.14	73.90	13.76	1000.0	1000.000	335.0	V	0.0	19.3

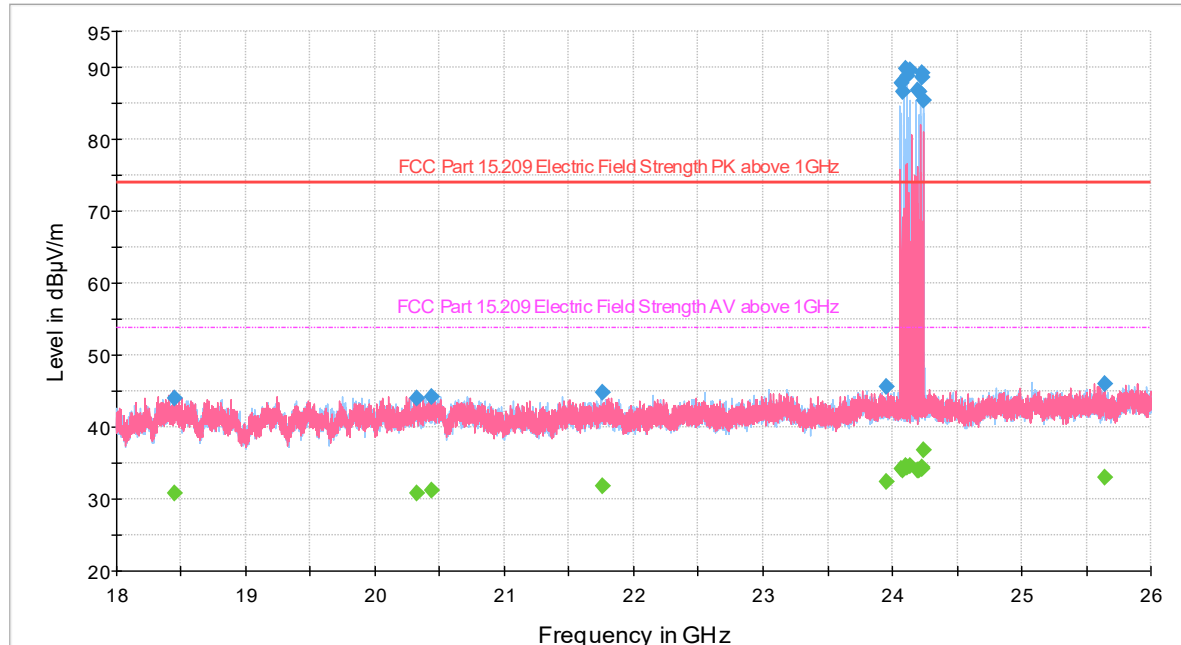
Average Data

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1000.000000	33.70	53.90	20.20	1000.0	1000.000	138.0	H	282.0	-6.1
2613.700000	30.64	53.90	23.26	1000.0	1000.000	350.0	H	170.0	1.5
3633.900000	32.61	53.90	21.29	1000.0	1000.000	255.0	V	43.0	3.5
6017.500000	37.01	53.90	16.89	1000.0	1000.000	175.0	V	305.0	5.5
11032.633333	40.99	53.90	12.91	1000.0	1000.000	335.0	H	17.0	13.7
17639.566667	47.08	53.90	6.82	1000.0	1000.000	305.0	V	8.0	19.3
17641.566667	46.83	53.90	7.07	1000.0	1000.000	335.0	V	0.0	19.3

Test Notes: See Section 2.5.7 for additional details regarding the test results.

2.5.13 18GHz to 26GHz Radiated Emission Test

Full Spectrum



— Preview Result 1H-PK+ [Preview Result 1H.Result:2]
 — Preview Result 1V-PK+ [Preview Result 1V.Result:2]
 — FCC Part 15.209 Electric Field Strength PK above 1GHz [.\EMI Radiated\
 — FCC Part 15.209 Electric Field Strength AV above 1GHz [.\EMI Radiated\
 ◆ Final_Result PK+ [Final_Result.Result:4]
 ◆ Final_Result AVG [Final_Result.Result:5]

Peak Data

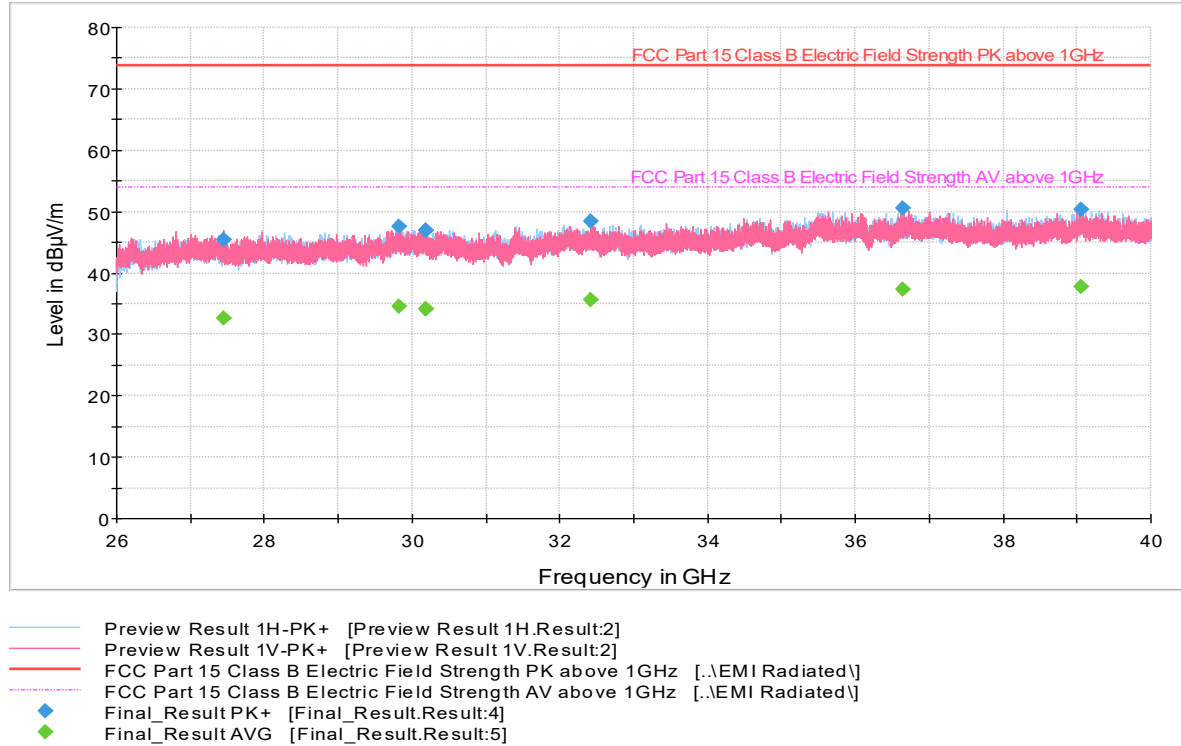
Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
18443.504500	44.03	73.90	29.87	1000.0	1000.000	142.0	V	13.0	-3
20322.534500	44.03	73.90	29.87	1000.0	1000.000	156.0	V	39.0	-3
20431.488000	44.11	73.90	29.79	1000.0	1000.000	150.0	V	214.0	-3
21756.501500	44.76	73.90	29.14	1000.0	1000.000	213.0	H	188.0	-2
23958.346500	45.68	73.90	28.22	1000.0	1000.000	153.0	V	25.0	0
25638.711000	46.02	73.90	27.88	1000.0	1000.000	153.0	V	103.0	1

Average Data

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
18443.504500	30.71	53.90	23.19	1000.0	1000.000	142.0	V	13.0	-3
20322.534500	30.89	53.90	23.01	1000.0	1000.000	156.0	V	39.0	-3
20431.488000	31.23	53.90	22.67	1000.0	1000.000	150.0	V	214.0	-3
21756.501500	31.88	53.90	22.02	1000.0	1000.000	213.0	H	188.0	-2
23958.346500	32.41	53.90	21.49	1000.0	1000.000	153.0	V	25.0	0
25638.711000	33.06	53.90	20.84	1000.0	1000.000	153.0	V	103.0	1

2.5.14 26GHz to 40GHz Radiated Emission Test

Full Spectrum



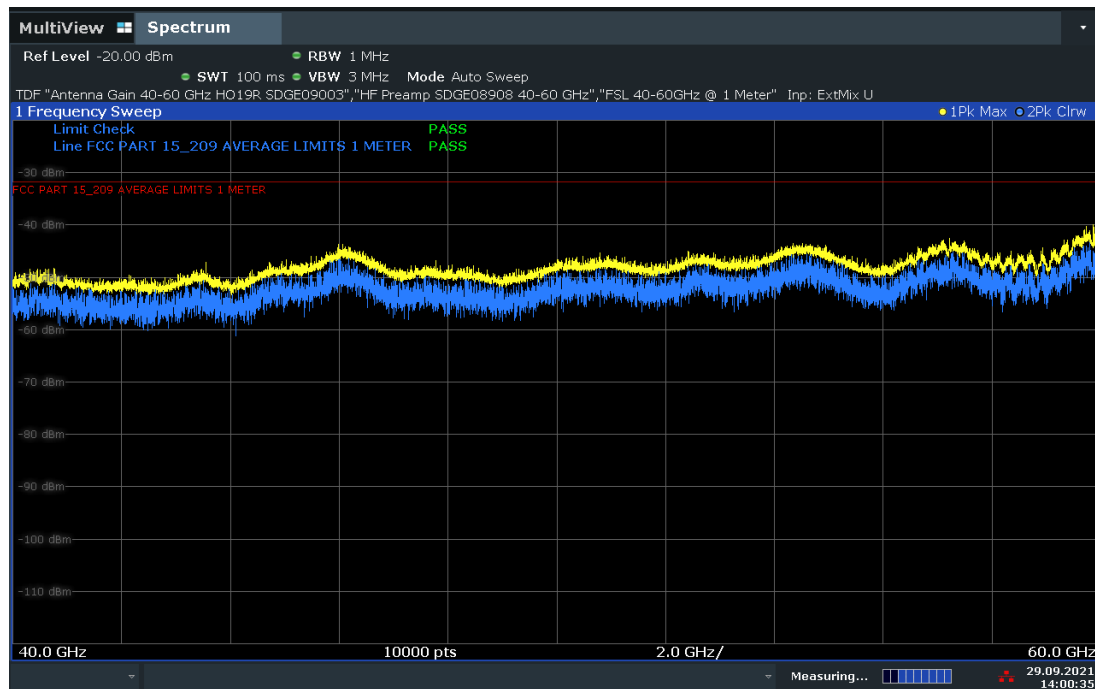
Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
27453.461923	45.44	73.90	28.46	1000.0	1000.000	175.0	V	300.0	2
29822.379230	47.50	73.90	26.40	1000.0	1000.000	138.0	H	273.0	3
30175.484615	46.96	73.90	26.94	1000.0	1000.000	225.0	V	80.0	3
30177.985385	47.02	73.90	26.88	1000.0	1000.000	225.0	V	114.0	3
32408.874231	48.37	73.90	25.53	1000.0	1000.000	177.0	V	248.0	5
36632.415769	50.53	73.90	23.37	1000.0	1000.000	175.0	H	313.0	7
39057.750385	50.40	73.90	23.50	1000.0	1000.000	202.0	V	2.0	7

Average Data

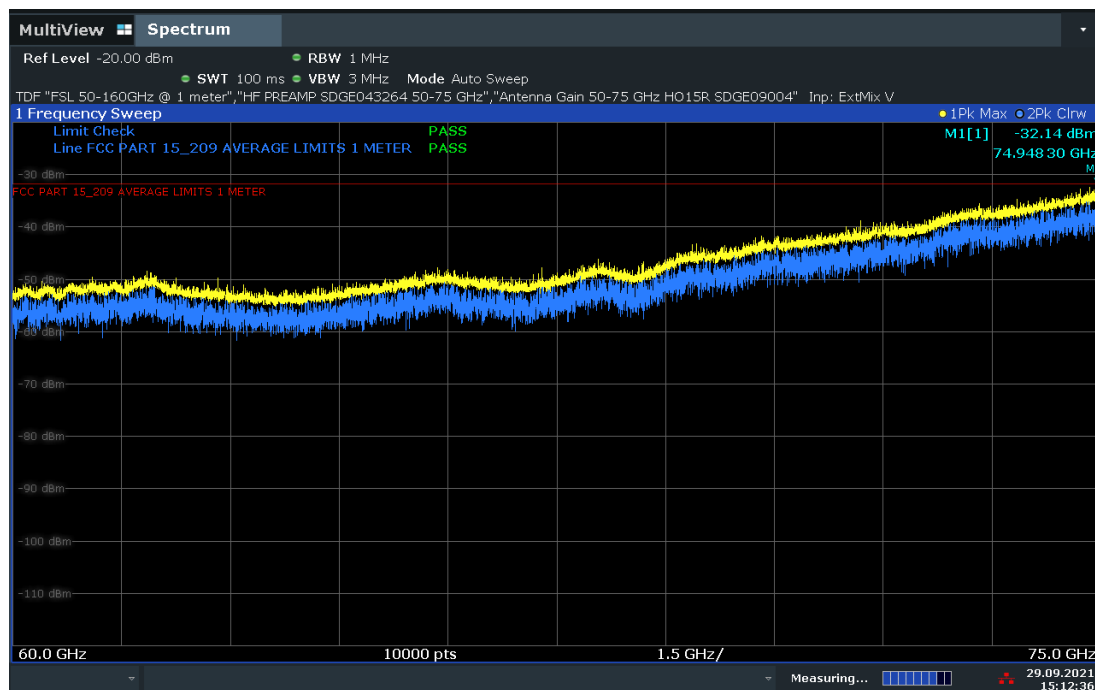
Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
27453.461923	32.71	53.90	21.19	1000.0	1000.000	175.0	V	300.0	2
29822.379230	34.64	53.90	19.26	1000.0	1000.000	138.0	H	273.0	3
30175.484615	34.17	53.90	19.73	1000.0	1000.000	225.0	V	80.0	3
30177.985385	34.06	53.90	19.84	1000.0	1000.000	225.0	V	114.0	3
32408.874231	35.56	53.90	18.34	1000.0	1000.000	177.0	V	248.0	5
36632.415769	37.23	53.90	16.67	1000.0	1000.000	175.0	H	313.0	7
39057.750385	37.74	53.90	16.16	1000.0	1000.000	202.0	V	2.0	7

2.5.15 Maximized Plot from 40GHz to 100GHz



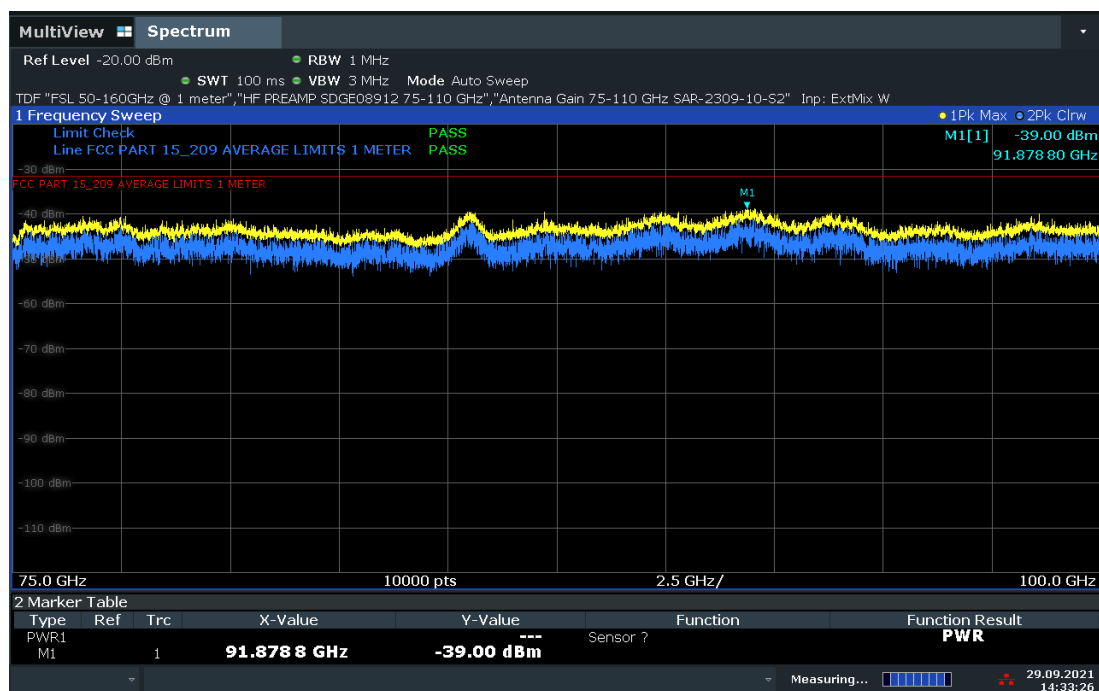
14:00:36 29.09.2021

40GHz to 60GHz



15:12:36 29.09.2021

60GHz to 75GHz



14:33:27 29.09.2021

75GHz to 100GHz Verification



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
AC Conducted Emissions						
1049	EMI Test Receiver	ESU40	100133	Rohde & Schwarz	09/25/20	09/25/21
7567	LISN	FCC-LISN-50-25-2-10	120304	Fischer Custom Comm.	02/19/21	02/19/22
8870	Bi-Directional Attenuator	34-20-34	BP8030	MCE / Weinschel	02/17/21	02/17/22
Radiated Emission						
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
1003	Signal Generator	SMR40	100443	Rohde & Schwarz	06/25/21	06/25/22
1002	Bilog Antenna	3142C	0058717	EMCO	10/09/19	10/09/21
7631	Double-ridged waveguide horn	3117	00205418	ETS-Lindgren	09/16/20	09/16/22
46797	Preamplifier	PA-122	181925	Com Power	10/28/20	10/28/21
6628	Loop Antenna	HFH2-Z2335.4711.52	FNr.800.458/25	Rohde & Schwarz	05/22/20	05/20/22
9001	Horn antenna (18-26.5GHz)	HO42S	101	Custom Microwave	09/09/19	10/09/21
9003	Horn antenna (26-40 GHz)	HO28S	102	Custom Microwaves	09/09/19	10/09/21
40815	Pre-amplifier (18-40 GHz)	19D18	15G27	Spacek Labs	10/05/20	10/05/21
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
51288	Harmonics mixer (50-75 GHz)	FS-Z75	102099	Rohde & Schwarz	03/11/21	07/29/23
7633	Harmonics mixer (75-110 GHz)	HM-110-7	101000	Radiometer Physics	02/22/21	07/29/23
8908	Pre-amplifier (40-60 GHz)	SBL-4036033080-1919-E1	12020-01	Sage Millimeter, Inc.	07/07/21	07/29/23
8892	Pre-amplifier (50-75 GHz)	SBL-5037533050-1515-E1	12020-01	Sage Millimeter, Inc.	07/07/21	07/29/23
8912	Pre-amplifier (75-110 GHz)	FLNA-10-0005	FTL17328	Farran Technology Ltd.	07/07/21	07/29/23
9003	Horn antenna (40-60 GHz)	HO19R	103	Custom Microwaves	Verified by 7611 and corresponding direct reading attenuator/active multiplier combination	
9004	Horn antenna (50-75 GHz)	HO15R	104	Custom Microwaves		
7628	Horn antenna (75-110 GHz)	SAR-2309-10-S2	13481-01	Sage Millimeter, Inc.		
8872	Direct Reading Attenuator (40-60)	STA-60-19-D1	11875-01	Sage Millimeter, Inc.	Verified by 7611 and corresponding antenna/mixer combination	
8860	Direct Reading Attenuator (50-75)	STA-60-15-D1	11466-01	Sage Millimeter, Inc.		



8861	Direct Reading Attenuator (75-110	STA-60-10-D1	11466-01	Sage Millimeter, Inc.		
8919	Direct Reading Attenuator (90-140	STA-60-08-D1	12605-01	Sage Millimeter, Inc.		
8873	Active Multiplier (40-60 GHz)	AMC-19-RFH00	124	Millitech, Inc.		
ID Number (SDGE/SDRB)	Test Equipment	Type	Serial Number	Manufacturer	Cal Date	Cal Due Date
8914	Active Multiplier (50-75 GHz)	AMC-15-RFH00	283	Millitech, Inc.	Verified by 7611 and corresponding antenna/mixer combination	
8915	Active Multiplier (75-110 GHz)	AMC-10-RFH00	606	Millitech, Inc.		
8920	Active Multiplier (90-140 GHz)	AMC-08-RFH00	58	Millitech, Inc.		
Miscellaneous						
43003	True RMS Multimeter	85 III	69880143	Fluke	10/23/20	10/23/21
7619	Temp/Humidity Sensor	iBTHX-W	15050268	Omega	03/09/21	03/09/22
-	Test Software	EMC32	V10.50.40	Rhode & Schwarz	N/A	

3.2 Measurement Uncertainty

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

3.2.1 AC Conducted Emissions Measurements

	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	LISN-receiver attenuation	0.10 dB	Normal, k=2	2.000	0.05	0.00
3	LISN voltage division factor	0.30 dB	Normal, k=2	2.000	0.15	0.02
4	Receiver sinewave accuracy	0.36 dB	Normal, k=2	2.000	0.18	0.03
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	0.00 dB	Rectangular	1.732	0.00	0.00
8	AMN VDF frequency interpolation	0.10 dB	Rectangular	1.732	0.06	0.00
9	Mismatch	0.07 dB	U-shaped	1.414	0.05	0.00
10	LISN impedance	2.65 dB	Triangular	2.449	1.08	1.17
11	Effect of mains disturbance	0.00 dB			0.00	0.00
12	Effect of the environment					
Combined standard uncertainty			Normal	1.66 dB		
Expanded uncertainty			Normal, k=2	3.31 dB		

3.2.2 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	0.75 dB	Normal, k=2	2.000	0.38	0.14
4	Receiver sinewave accuracy	0.45 dB	Normal, k=2	2.000	0.23	0.05
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	3.76 dB	Triangular	2.449	1.54	2.36
16	Separation distance at 3 m	0.30 dB	Rectangular	1.732	0.17	0.03

17	Effect of setup table material	0.77 dB	Rectangular	1.732	0.44	0.20
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	2.95 dB	
Expanded uncertainty				Normal, k=2	5.90 dB	

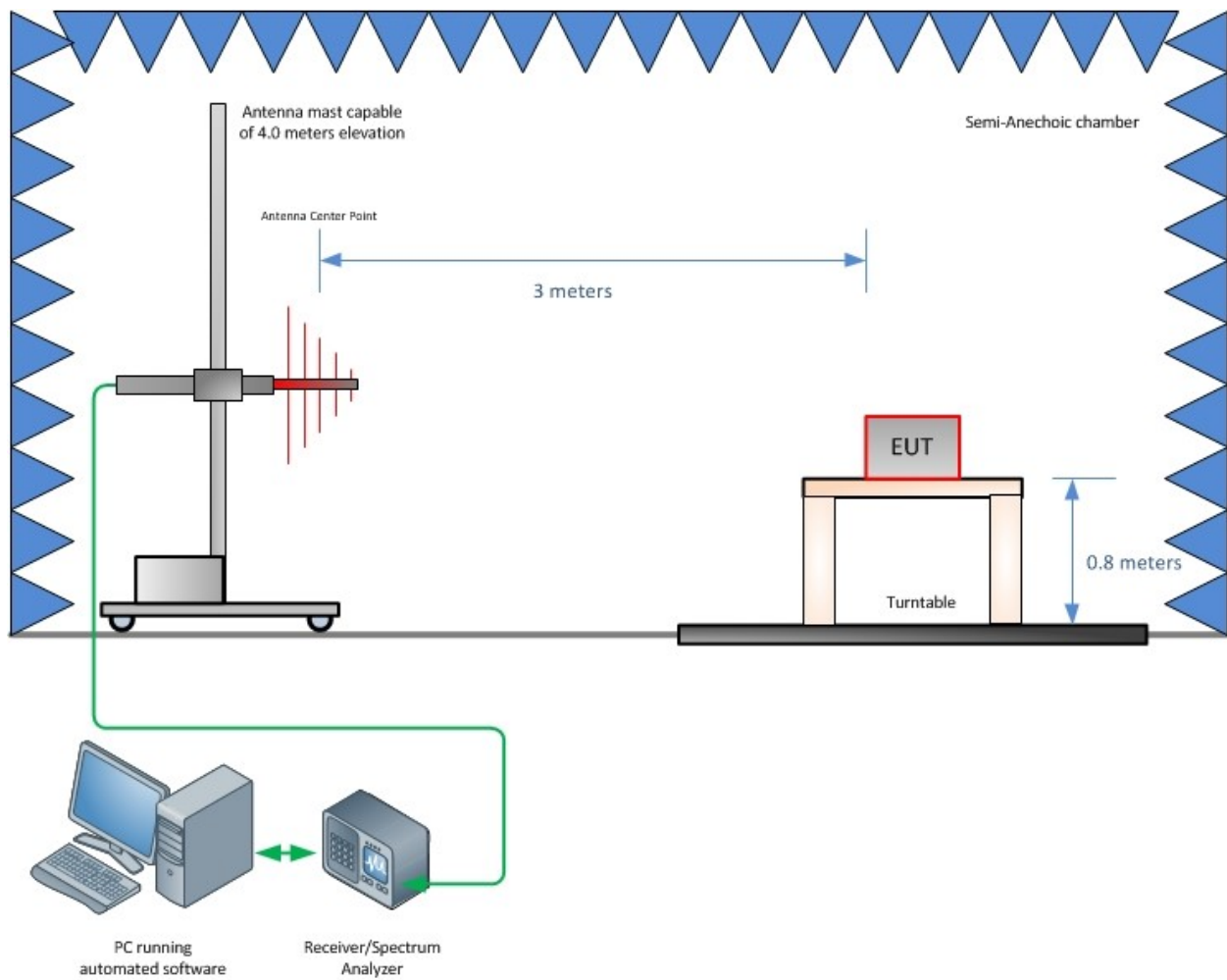
3.2.3 Radiated Emission Measurements (Above 1GHz)

	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	0.20 dB	Normal, k=2	2.000	0.10	0.01
3	Antenna factor AF	0.75 dB	Normal, k=2	2.000	0.38	0.14
4	Receiver sinewave accuracy	0.45 dB	Normal, k=2	2.000	0.23	0.05
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	3.25 dB	Triangular	2.449	1.33	1.76
16	Separation distance at 3 m	0.30 dB	Rectangular	1.732	0.17	0.03
17	Effect of setup table material	0.77 dB	Rectangular	1.732	0.44	0.20
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	2.85 dB	
Expanded uncertainty				Normal, k=2	5.70 dB	

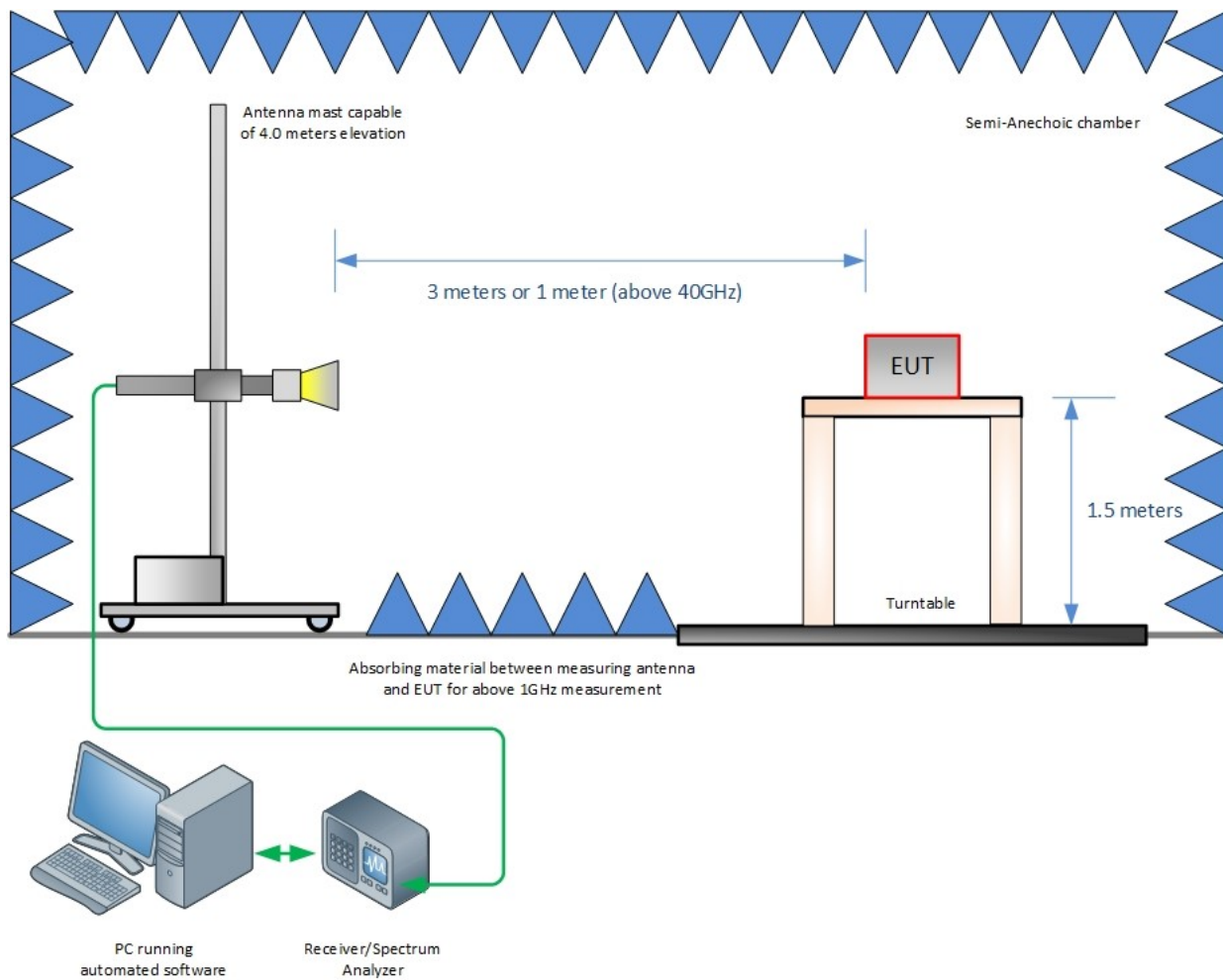
SECTION 4

DIAGRAM OF TEST SETUP

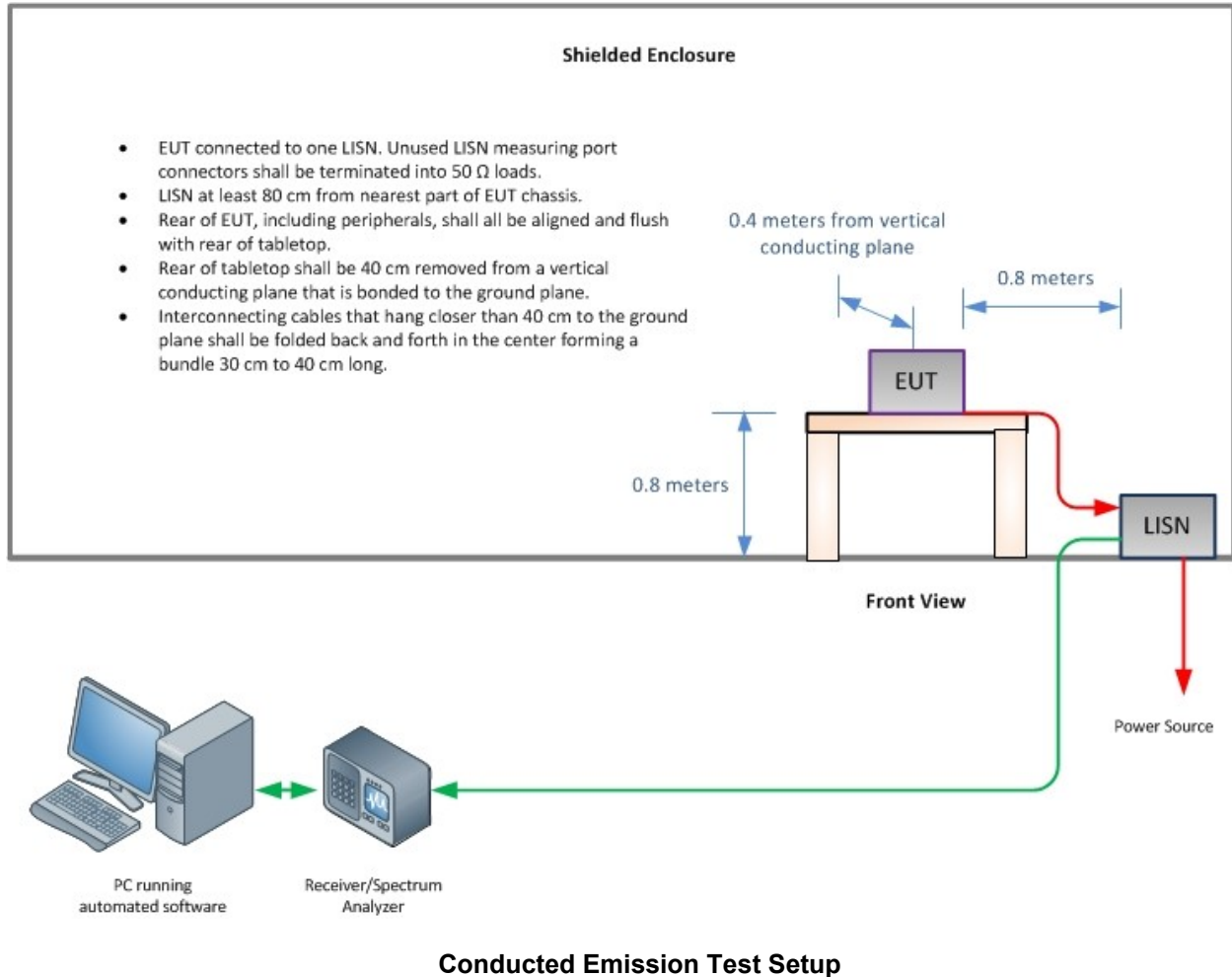
4.1 Test Setup Diagram



Radiated Emission Test Setup (Below 1GHz)



Radiated Emission Test Setup (Above 1GHz)





SECTION 5

ACCREDITATION, DISCLAIMERS AND COPYRIGHT



5.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT

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