

Radio Testing of the

SMK Electronics Corp.
Brisbane Remote Control
Model: 54.5 UHF 2G, 221661

In accordance with FCC Part 15 Subpart C
§15.249

SMK Electronics Corp.
1055 Tierra Del Rey, Suite H
Chula Vista, CA 91910
USA

COMMERCIAL-IN-CONFIDENCE

Date: January 2022
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RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Authorized Signatory	Xiaoying Zhang	January 11, 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 Part 15 Subpart C §15.249.



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REPORT ON	Radio Testing of the SMK Electronics Corp. Model 54.5 UHF 2G, 221661 Brisbane Remote Control
TEST REPORT NUMBER	72173339B
TEST REPORT DATE	January 2022
PREPARED FOR	SMK Electronics Corp. 1055 Tierra Del Rey, Suite H Chula Vista, CA 91910 USA
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PREPARED BY	 Ferdinand S. Custodio Name Authorized Signatory Title: Senior EMC Test Engineer / Wireless Team Lead
APPROVED BY	 Xiaoying Zhang Name Authorized Signatory Title: Senior RF Wireless Test Engineer
DATED	January 11, 2022



Revision History

72173339B SMK Electronics Corp. Model 54.5 UHF 2G, 221661 Brisbane Remote Control					
DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
01/11/2022	-	Initial Release			Xiaoying Zhang



CONTENTS

	REPORT SUMMARY	5
1.1	Introduction	6
1.2	Brief Summary Of Results	7
1.3	Product Information	8
1.4	EUT Test Configuration	9
1.5	Deviations From The Standard.....	11
1.6	Modification Record	11
1.7	Test Methodology	11
1.8	Test Facility Location	11
1.9	Test Facility Registration	11
	TEST DETAILS	13
2.1	Conducted Emissions.....	14
2.2	20dB Bandwidth.....	15
2.3	Field Strength Limits For Fundamental And Harmonics.....	18
2.4	Spurious Radiated Emissions.....	23
	TEST EQUIPMENT USED	35
3.2	Measurement Uncertainty	37
	DIAGRAM OF TEST SETUP	39
4.1	Test Setup Diagram.....	40
	ACCREDITATION, DISCLAIMERS AND COPYRIGHT.....	42
5.1	Accreditation, Disclaimers And Copyright	43



SECTION 1

REPORT SUMMARY

Radio Testing of the
SMK Electronics Corp.
Brisbane Remote Control



1.1 INTRODUCTION

The information contained in this report is intended to show verification of the SMK Electronics Corp. Brisbane Brisbane Remote Control to the requirements of FCC Part 15 Subpart C §15.249.

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	SMK Electronics Corp.
EUT	Brisbane Remote Control
Model Name	54.5 UHF 2G, 221661
FCC ID	QVE4BRIS2
Serial Number(s)	RF Test No. 1 and RF Test No. 2
Number of Samples Tested	2
Test Specification/Issue/Date	FCC Part 15 Subpart C §15.249 (October 1, 2020)
Start of Test	December 29, 2021
Finish of Test	January 04, 2022
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 are shown below.

Section	§15.249 Spec Clause	Test Description	Result	Comments/Base Standard
-	§15.207(a)	Conducted Emissions	N/A	
2.1	§15.215(c)	20 dB Bandwidth	Compliant	
2.2	§15.249(a)	Field Strength Limits for Fundamental and Harmonics	Compliant	
2.3	§15.249(d)	Spurious Radiated Emissions	Compliant	
2.4	§15.249(d)	Band Edge Verifications	Compliant	

N/A Not performed. EUT is battery powered remote control.



1.3 PRODUCT INFORMATION

1.3.1 Technical Description

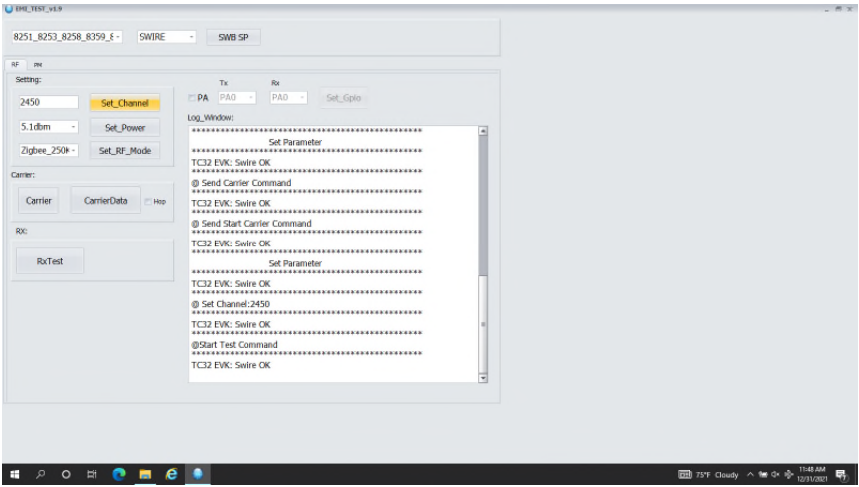
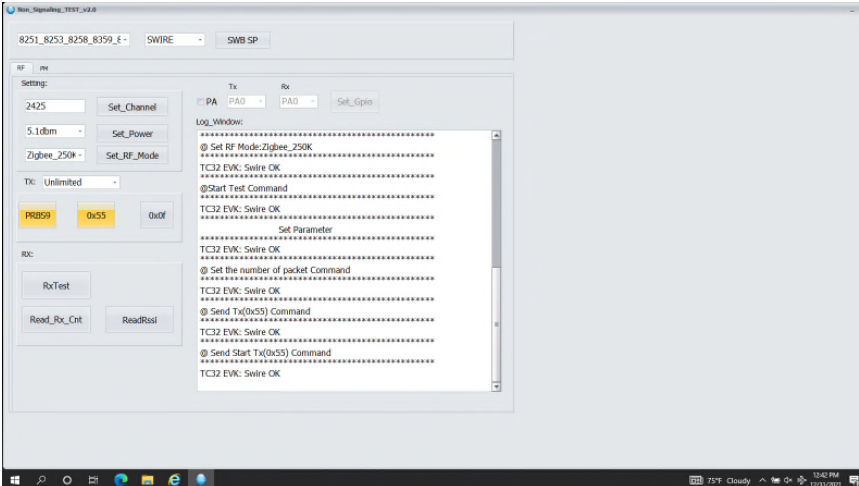
The Equipment Under Test (EUT) is a SMK Electronics Corp. Brisbane Remote Control Model 54.5 UHF 2G, 221661. The EUT is a battery powered, hand-held remote control. It incorporates a low power radio operating in the 2400-2483.5 MHz ISM band.

1.3.2 EUT General Description

EUT Description	Brisbane Remote Control	
Model Number	54.5 UHF 2G, 221661	
Serial Number/s	RF Test No. 1 (conducted sample) and RF Test No. 2 (radiated sample)	
Input Voltage	3VDC	
Output RF Power	93.48dBμV/m @ 3 meters	
Frequency Range (TX)	2425 MHz to 2475 MHz in the 2400 MHz to 2483.5 MHz Band	
Number of Operating Frequencies	3	
Channels Verified	Low Channel	2425 MHz
	Mid Channel	2450 MHz
	High Channel	2475 MHz
Modulation Used	QPSK	

1.4 EUT TEST CONFIGURATION

1.4.1 Test Configuration Description

Test Configuration	Description
Default	EMI_TEST_v1.9 is used to configure the EUT for 100% duty cycle. This configuration is for Fundamental power and Harmonics measurements:  Non_Signalling_TEST_v2.0 is used to configure the EUT for Normal duty cycle. This configuration is for Spurious Emissions and 20dB Bandwidth measurements: 

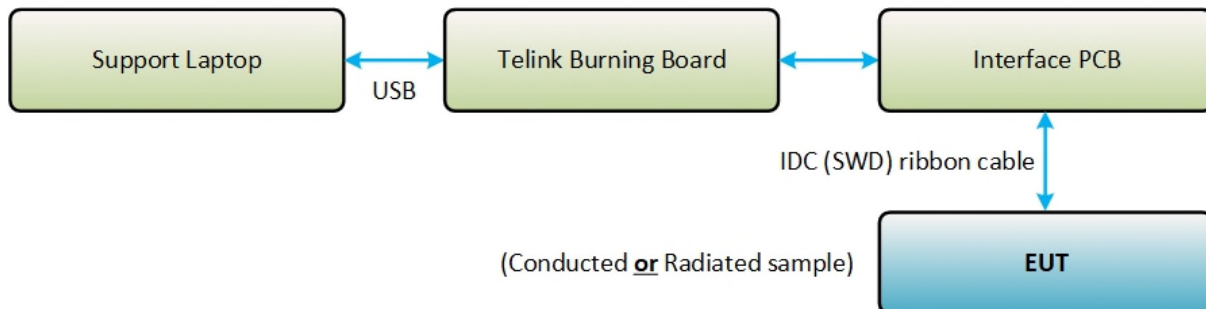
1.4.2 EUT Exercise Software

EMI_TEST_v1.9 and Non_Signalling_TEST_v2.0.

1.4.3 Support Equipment and I/O cables

Manufacturer	Equipment/Cable	Description
Monoprice	USB Cable	USB-A to Micro-B 2.0 Cable - 5-Pin, Retractable, Black, 2.5ft
Telink	Adapter Burning Board	Model EVK TLSR8266BR56 S/N TLSRGSOCBK56B
-	Interface PCB with 10-pin 2x5 socket IDC (SWD) cable	PCB interfacing the EUT with the Telink board
Lenovo	Laptop ThinkPad T440S	Type: 20AR-S4250S S/N PC-03BBGR
Lenovo	Laptop Power Supply	Model ADLX45NCC2A S/N 10E75794C1SG7B84A60

1.4.4 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: RF Test No. 1 and RF Test No. 2		
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
SMK Electronics Corp.
Brisbane Remote Control



2.1 CONDUCTED EMISSIONS

2.1.1 Specification Reference

Part 15 Subpart C §15.207(a)

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

Not applicable. EUT is a battery powered handheld remote control.



2.2 20dB BANDWIDTH

2.2.1 Specification Reference

Part 15 Subpart C §15.215(c)

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: RF Test No. 1 / Default Test Configuration

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

December 31, 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	21.6 °C
Relative Humidity	49.6 %
ATM Pressure	99.5 kPa

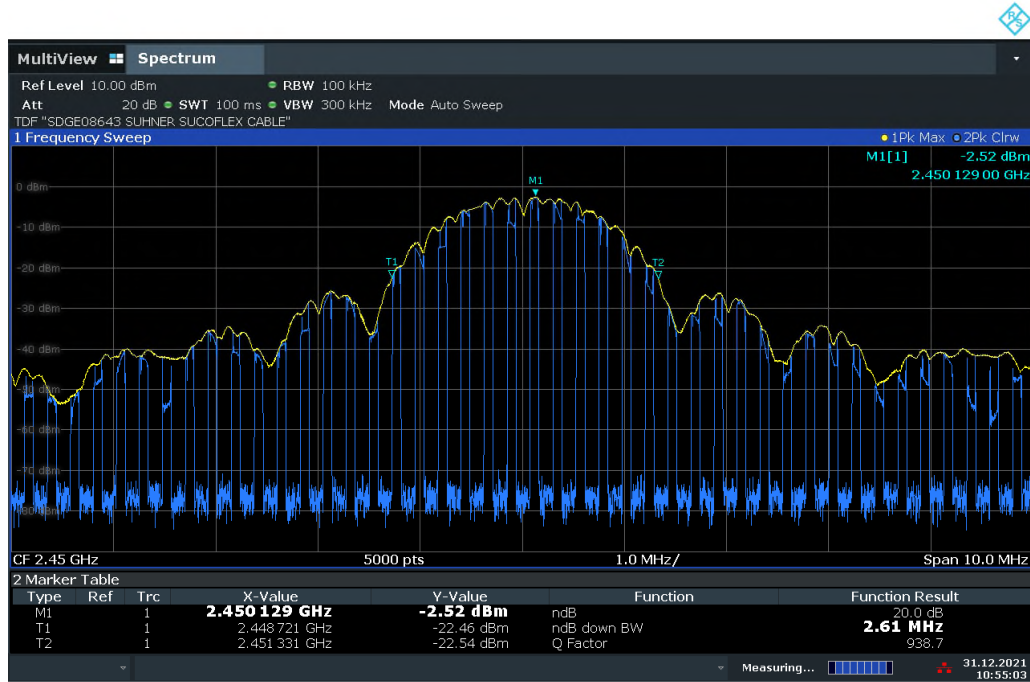
2.2.7 Test Results

Complies. The 20dB bandwidth of the EUT is within the specified frequency band (2400 to 2483.5MHz)



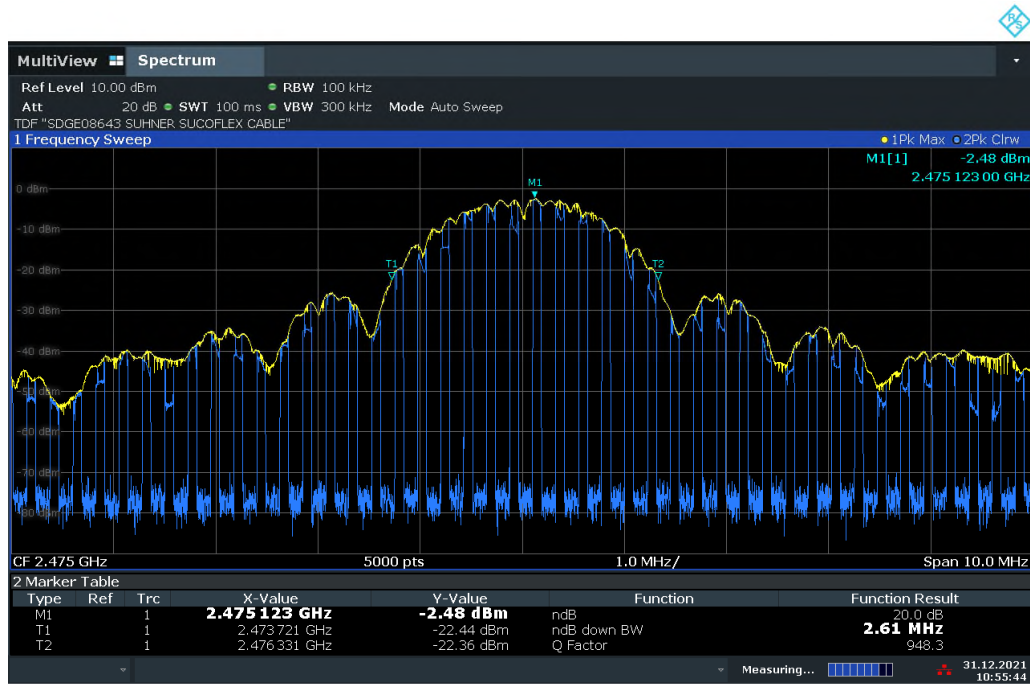
10:52:59 31.12.2021

Low Channel 20 dB Bandwidth



10:55:04 31.12.2021

Mid Channel 20 dB Bandwidth



10:55:44 31.12.2021

High Channel 20 dB Bandwidth



2.3 FIELD STRENGTH LIMITS FOR FUNDAMENTAL AND HARMONICS

2.3.1 Specification Reference

FCC 47 Chapter I Subchapter A Part 15 Subpart C §15.249(a)

2.3.2 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

2.3.3 Equipment Under Test and Modification State

Serial No: RF Test No. 2 / Default Test Configuration

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

December 30 and 31, 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	20.9 - 27.5 °C
Relative Humidity	43.5 - 49.5 %
ATM Pressure	99.8 - 100.1kPa

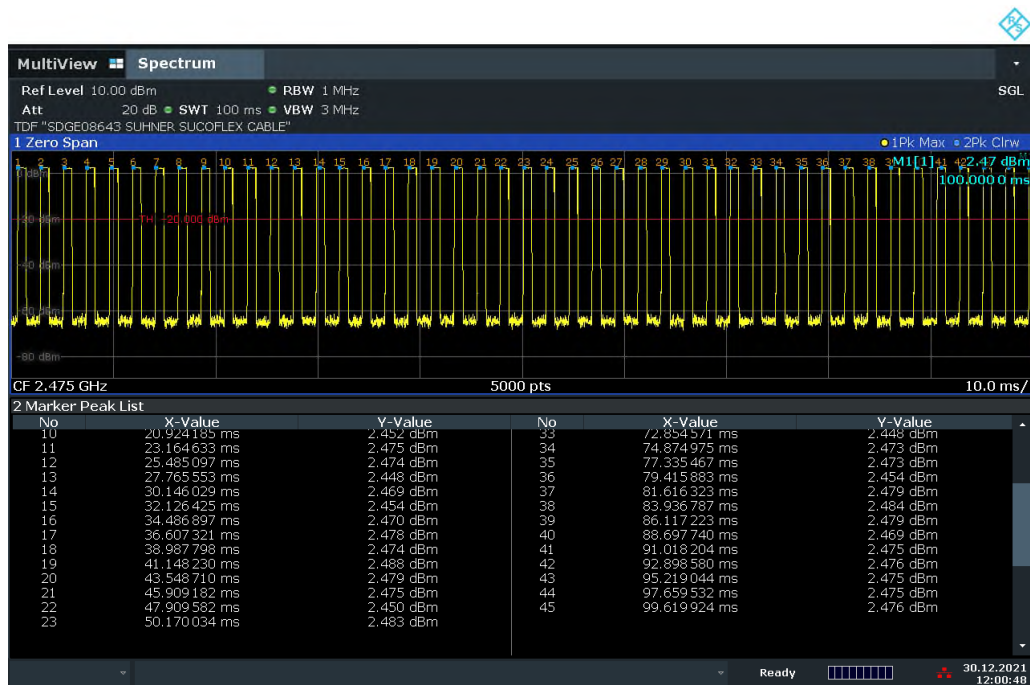
2.3.7 Additional Observation

Fundamental only presented. Harmonics (if any) will be evaluated under Section 2.4 of this test report.

2.3.8 Test Results

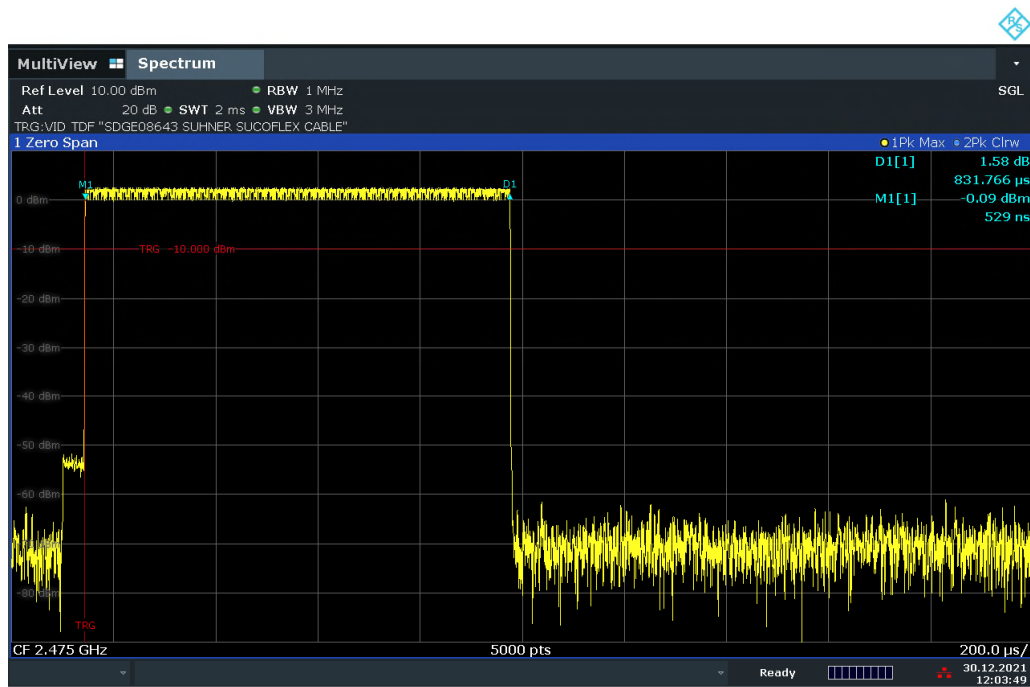
Complies. See attached test plot.

2.3.9 Duty Cycle Plots



12:00:49 30.12.2021

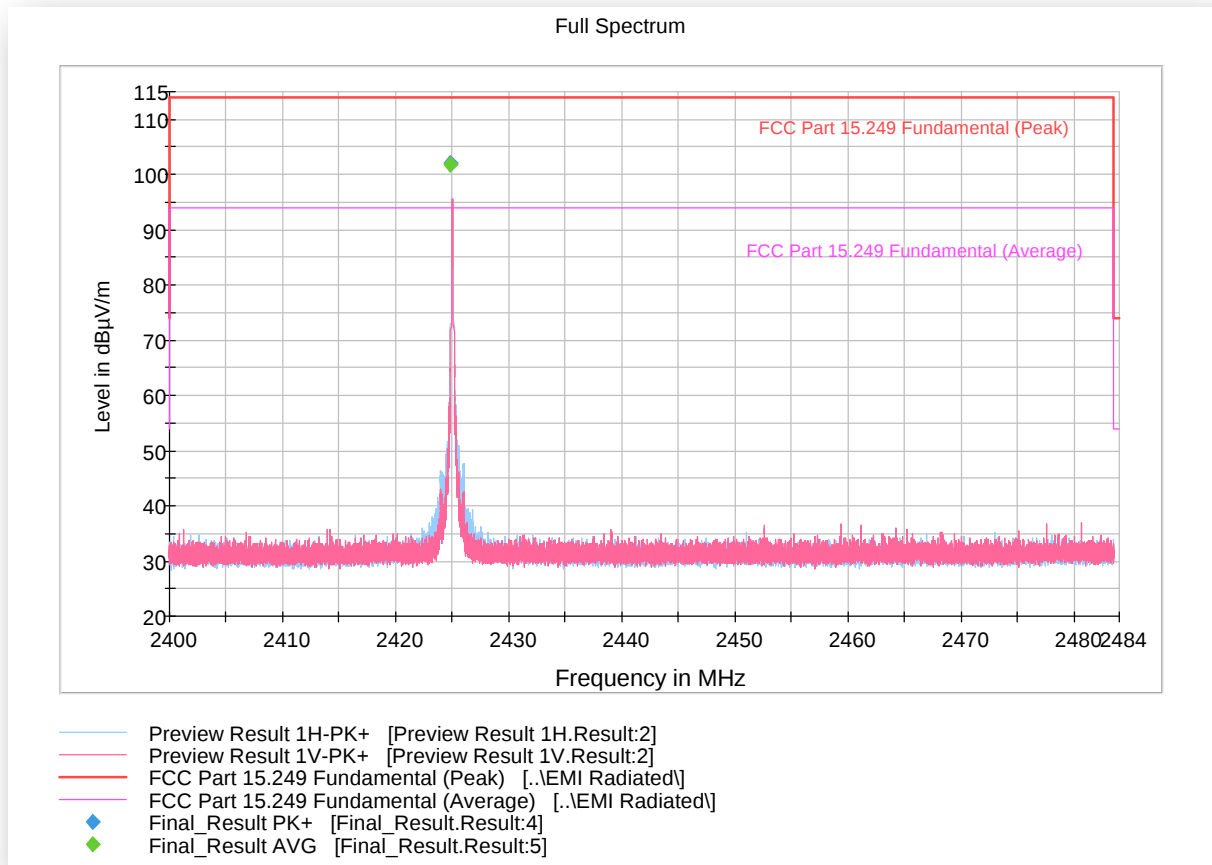
100ms Sweep (45 instances of "on" time)



12:03:50 30.12.2021

Single Pulse Measurement (0.831ms)

2.3.10 Low Channel Fundamental Scan



Peak Data

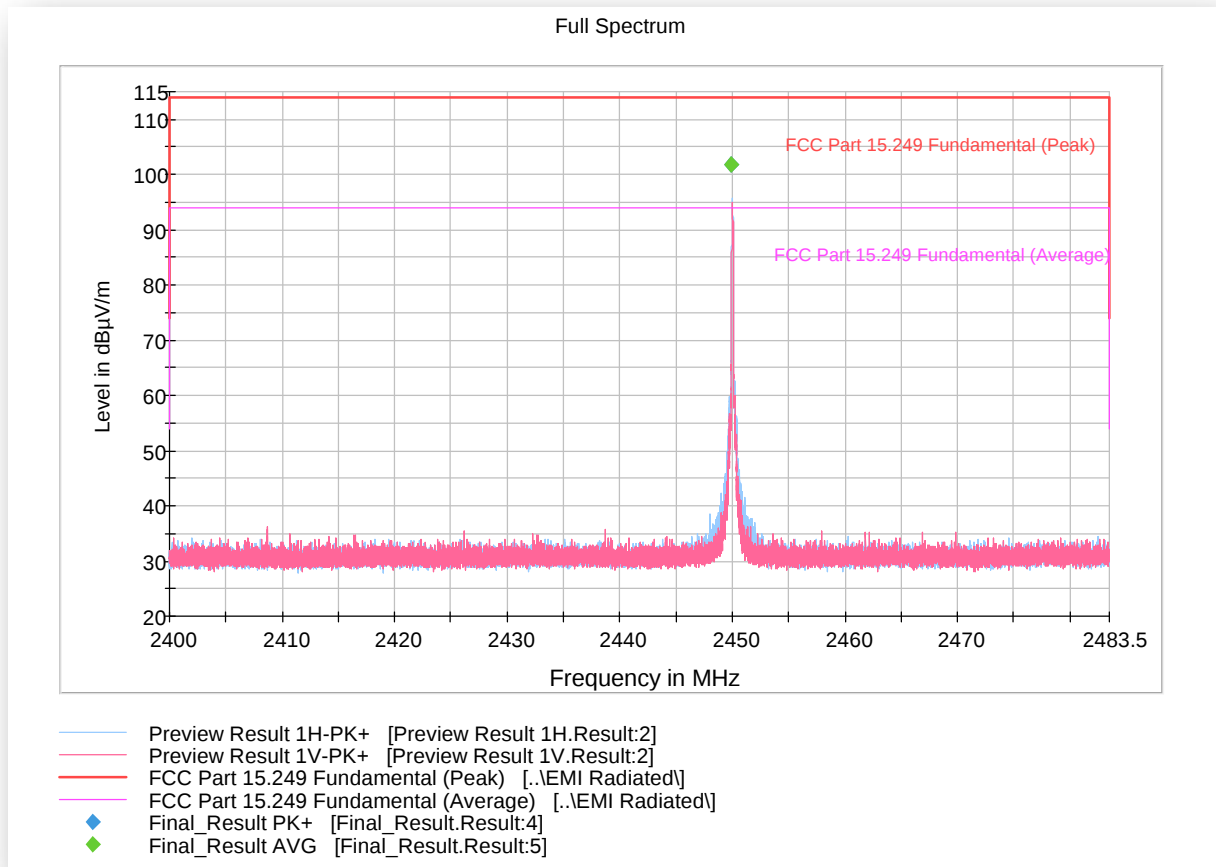
Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2424.813817	102.02	113.97	11.95	1000.0	1000.000	227.0	H	220.0	1

Average Data (Peak – DCCF)

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2424.813817	93.48	93.97	0.49	1000.0	1000.000	227.0	H	220.0	1

$$\begin{aligned} \text{DCCF (dB)} &= 20 \log ((45 \times 0.831\text{ms}) / 100\text{ms}) \\ &= -8.54 \text{ dB} \end{aligned}$$

2.3.11 Mid Channel Fundamental Scan



Peak Data

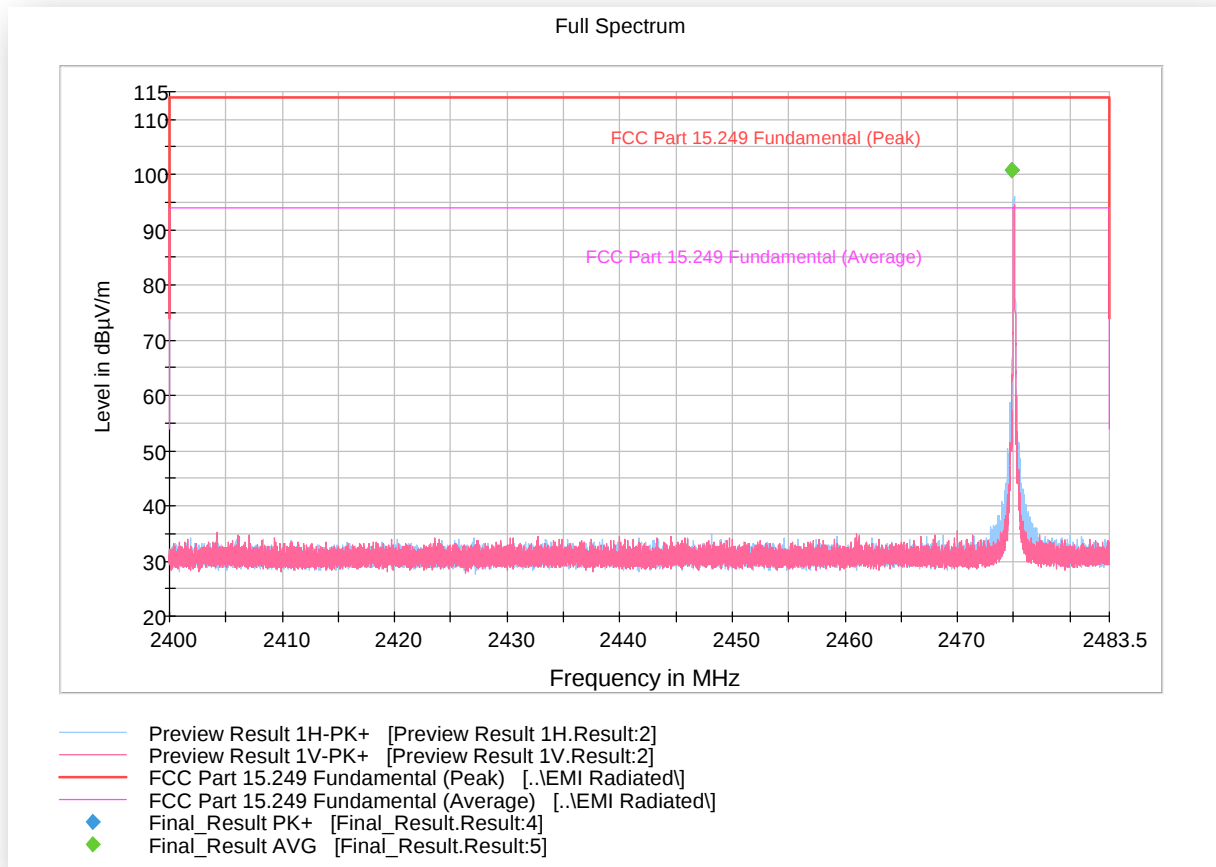
Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2449.816500	101.84	113.97	12.13	1000.0	1000.000	146.0	H	222.0	0.8

Average Data (Peak – DCCF)

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2449.816500	93.3	93.97	0.4	1000.0	1000.000	146.0	H	222.0	0.8

$$\begin{aligned} \text{DCCF (dB)} &= 20 \log ((45 \times 0.831\text{ms}) / 100\text{ms}) \\ &= -8.54 \text{ dB} \end{aligned}$$

2.3.12 High Channel Fundamental Scan



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)
2474.819183	100.78	113.97	13.19	1000.0	1000.000	225.0	H	45.0	1.0

Average Data (Peak – DCCF)

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2474.819183	92.24	93.97	1.73	1000.0	1000.000	225.0	H	45.0	1.0

$$\begin{aligned} \text{DCCF (dB)} &= 20 \log ((45 \times 0.831\text{ms}) / 100\text{ms}) \\ &= -8.54 \text{ dB} \end{aligned}$$



2.4 SPURIOUS RADIATED EMISSIONS

2.4.1 Specification Reference

FCC 47 Chapter I Subchapter A Part 15 Subpart C §15.249(d)

2.4.2 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.

2.4.3 Equipment Under Test and Modification State

Serial No: RF Test No. 2 / Default Test Configuration

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

December 30 and 31, 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	20.9 - 27.5 °C
Relative Humidity	43.5 - 49.5 %
ATM Pressure	99.8 - 100.1kPa

2.4.7 Additional Observations

- This is a radiated test.
- The spectrum was searched from 9kHz to 26GHz.
- 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 2.4.8 for sample computation.

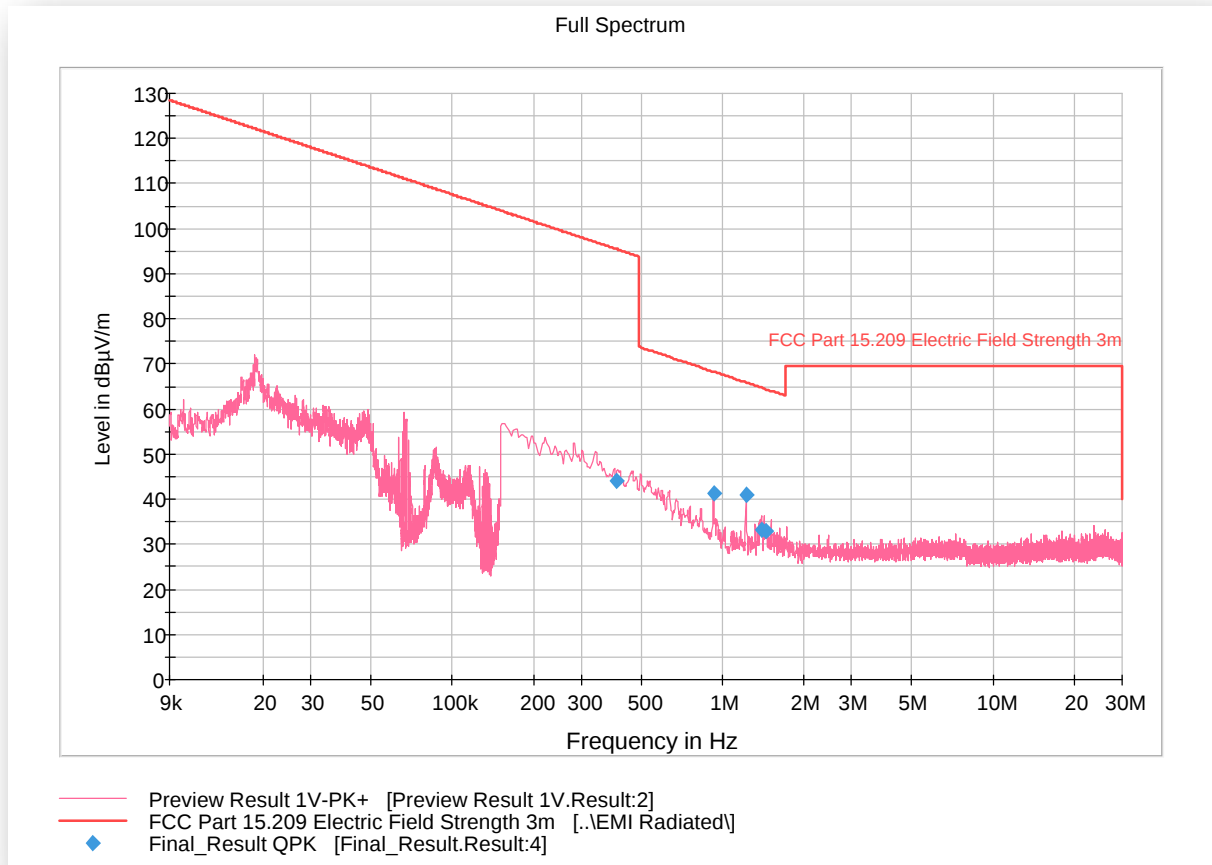
2.4.8 Sample Computation (Radiated Emission)

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

2.4.10 Test Results

Compliant. See attached plots.

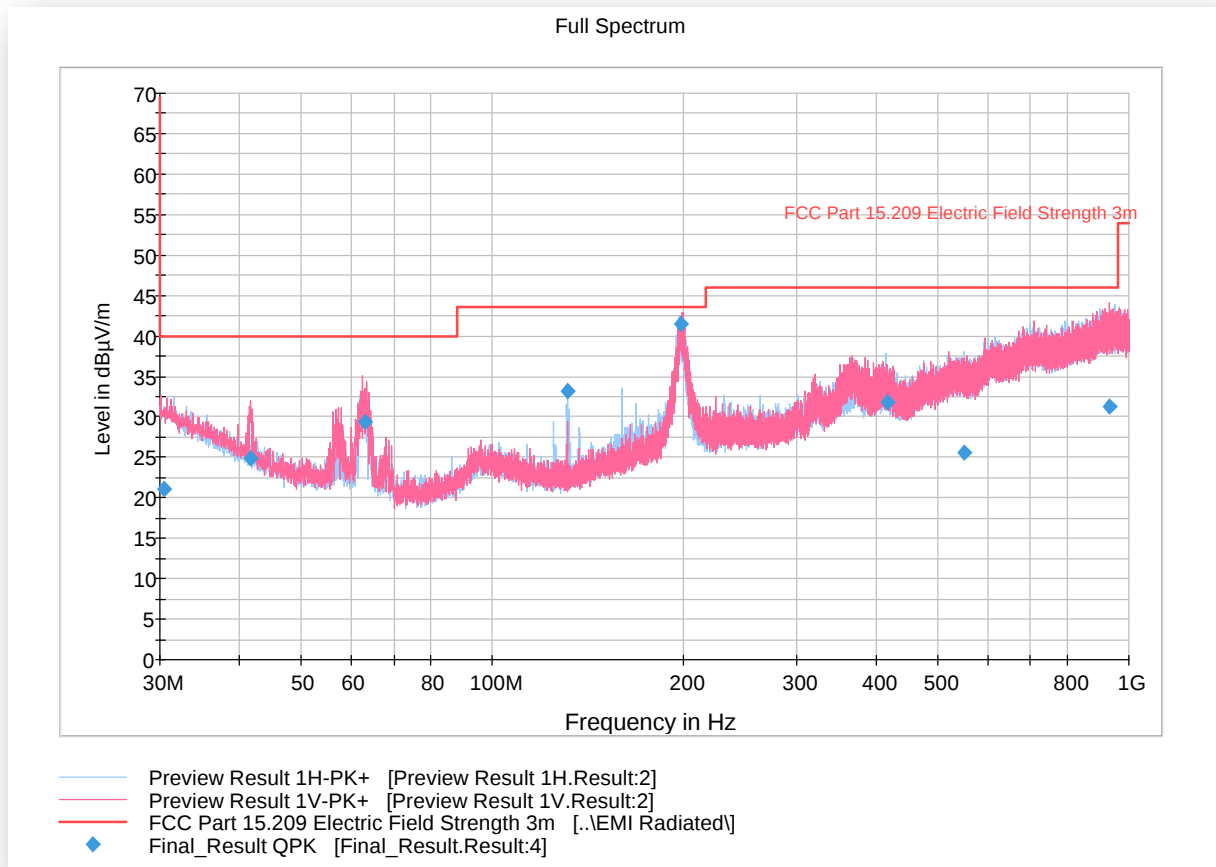
2.4.11 Below 30MHz Radiated Emission Test



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)
0.404760	44.07	95.46	51.39	1000.0	9.000	400.0	H	174.0	19
0.926470	41.19	68.26	27.07	1000.0	9.000	400.0	H	122.0	20
1.222497	41.07	65.85	24.78	1000.0	9.000	400.0	H	122.0	20
1.397776	33.34	64.69	31.35	1000.0	9.000	400.0	H	161.0	20
1.443387	32.78	64.41	31.62	1000.0	9.000	400.0	H	168.0	20

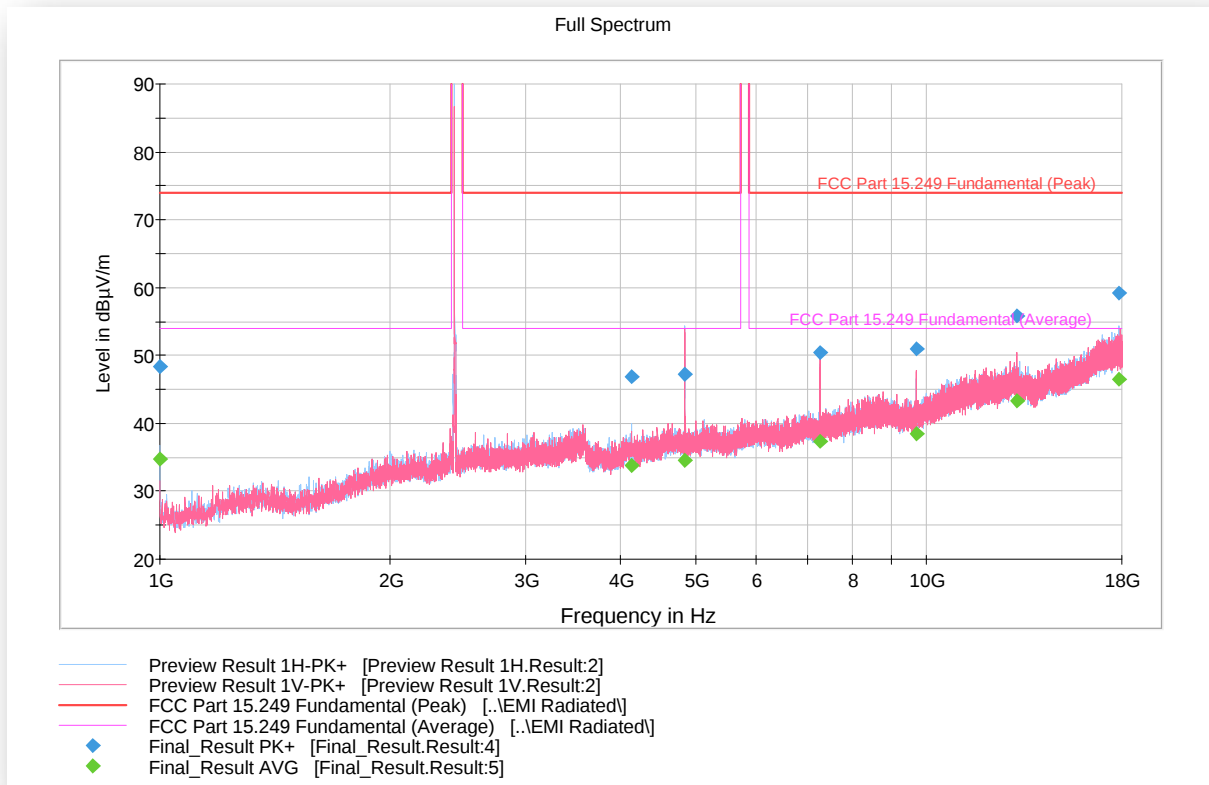
2.4.12 30MHz to 1GHz Radiated Emission Test



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)
30.480000	21.04	40.00	18.96	1000.0	120.000	106.0	V	242.0	22
41.617000	24.94	40.00	15.06	1000.0	120.000	106.0	V	83.0	17
62.950333	29.34	40.00	10.66	1000.0	120.000	211.0	V	132.0	12
130.992333	33.27	43.50	10.23	1000.0	120.000	225.0	H	83.0	14
197.952667	41.54	43.50	1.96	1000.0	120.000	125.0	V	122.0	17
416.759667	31.86	46.00	14.14	1000.0	120.000	203.0	H	202.0	23
552.143333	25.52	46.00	20.48	1000.0	120.000	186.0	H	11.0	26
929.647667	31.33	46.00	14.67	1000.0	120.000	325.0	V	20.0	31

2.4.13 From 1GHz to 18GHz Radiated Emission Test (Low Channel)



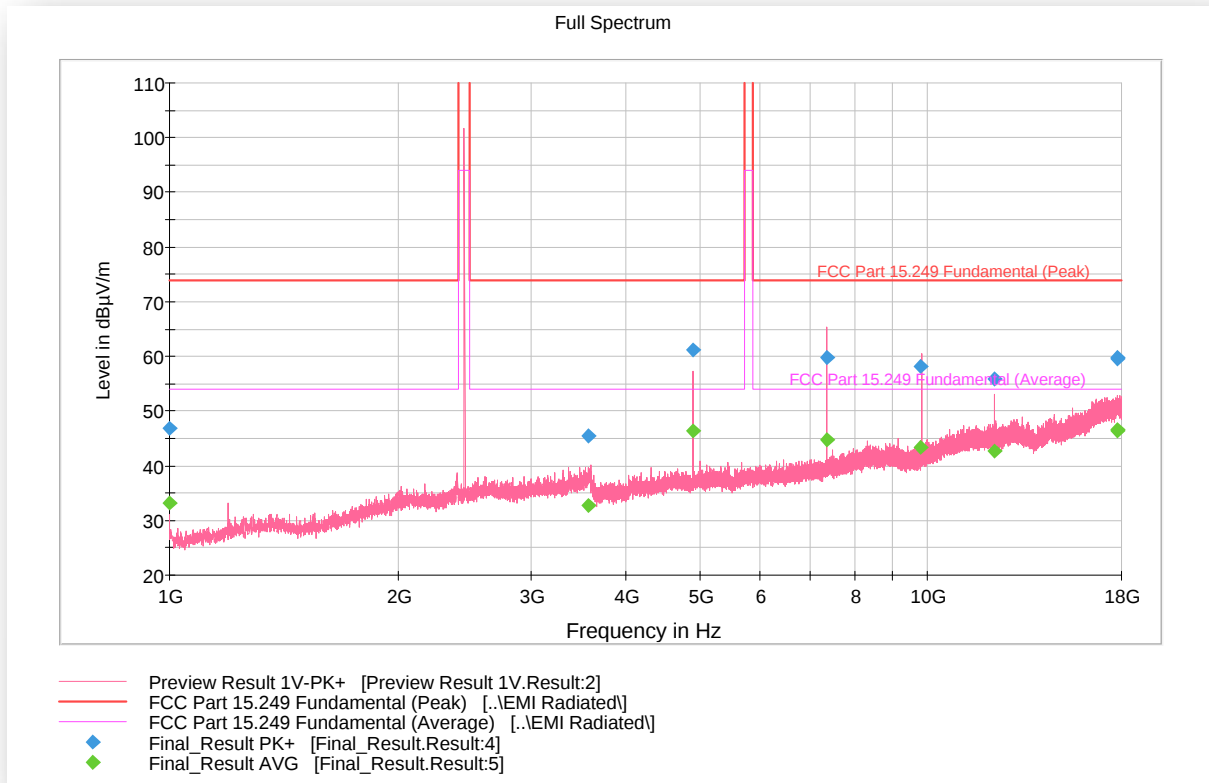
Peak Data

Frequency (MHz)	MaxPeak (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1000.000000	48.30	74.00	25.70	1000.0	1000.000	239.0	H	32.0	-6
4132.866667	46.91	74.00	27.09	1000.0	1000.000	302.0	H	32.0	4
4846.866667	47.28	74.00	26.72	1000.0	1000.000	223.0	H	215.0	5
7264.966667	50.38	74.00	23.62	1000.0	1000.000	205.0	V	100.0	7
9710.100000	51.01	74.00	22.99	1000.0	1000.000	317.0	V	167.0	9
13168.533333	55.87	74.00	18.13	1000.0	1000.000	335.0	V	229.0	13
17827.833333	59.14	74.00	14.86	1000.0	1000.000	287.0	H	74.0	20

Average Data

Frequency (MHz)	Average (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1000.000000	34.78	54.00	19.22	1000.0	1000.000	239.0	H	32.0	-6
4132.866667	33.79	54.00	20.21	1000.0	1000.000	302.0	H	32.0	4
4846.866667	34.50	54.00	19.50	1000.0	1000.000	223.0	H	215.0	5
7264.966667	37.29	54.00	16.71	1000.0	1000.000	205.0	V	100.0	7
9710.100000	38.56	54.00	15.44	1000.0	1000.000	317.0	V	167.0	9
13168.533333	43.36	54.00	10.64	1000.0	1000.000	335.0	V	229.0	13
17827.833333	46.52	54.00	7.48	1000.0	1000.000	287.0	H	74.0	20

2.4.14 From 1GHz to 18GHz Radiated Emission Test (Mid Channel)



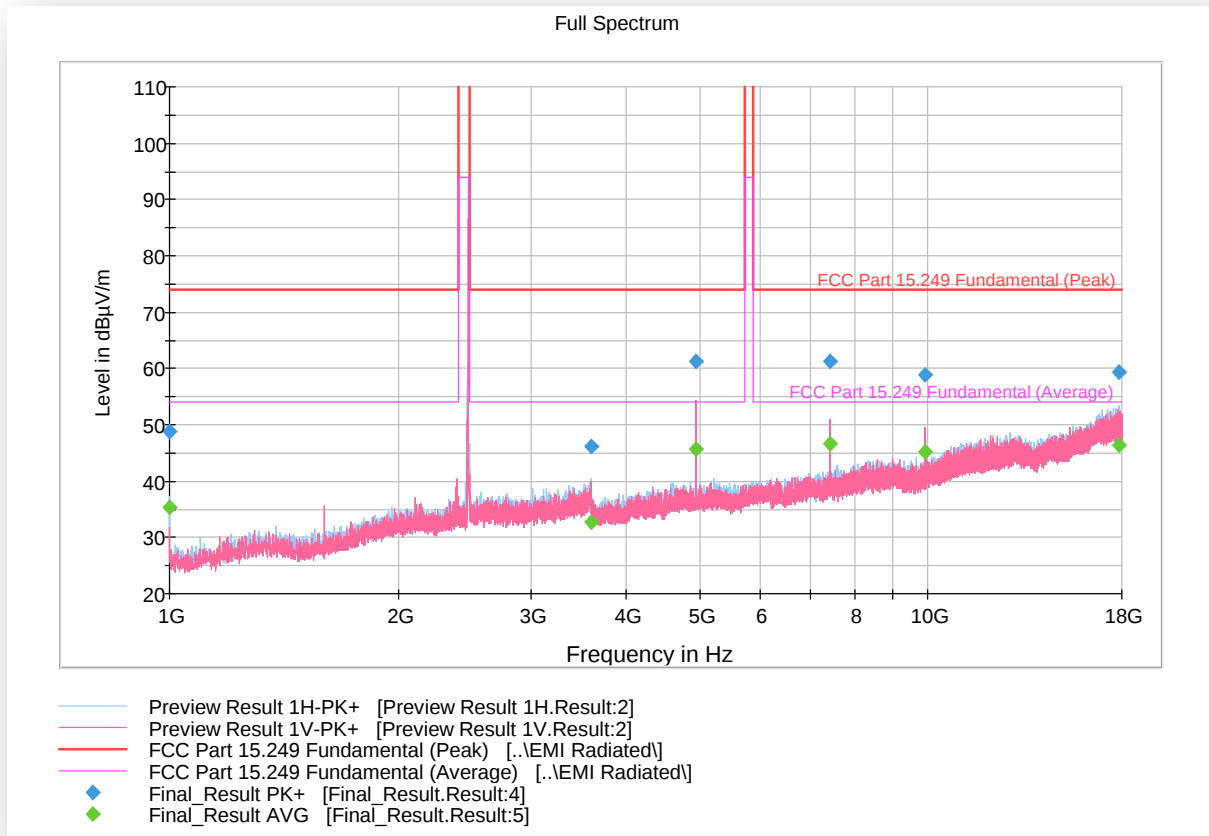
Peak Data

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	46.83	74.00	27.17	1000.0	1000.000	285.0	H	29.0	-6
3573.366667	45.46	74.00	28.54	1000.0	1000.000	320.0	H	28.0	4
4899.200000	61.20	74.00	12.80	1000.0	1000.000	365.0	V	95.0	5
7348.666667	59.87	74.00	14.13	1000.0	1000.000	205.0	H	138.0	7
9798.133333	58.11	74.00	15.89	1000.0	1000.000	244.0	V	220.0	9
12252.000000	55.78	74.00	18.22	1000.0	1000.000	350.0	H	61.0	14
17808.700000	59.86	74.00	14.14	1000.0	1000.000	335.0	H	16.0	20

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)
1000.000000	33.26	54.00	20.74	1000.0	1000.000	285.0	H	29.0	-6
3573.366667	32.84	54.00	21.16	1000.0	1000.000	320.0	H	28.0	4
4899.200000	46.33	54.00	7.67	1000.0	1000.000	365.0	V	95.0	5
7348.666667	44.66	54.00	9.34	1000.0	1000.000	205.0	H	138.0	7
9798.133333	43.40	54.00	10.60	1000.0	1000.000	244.0	V	220.0	9
12252.000000	42.56	54.00	11.44	1000.0	1000.000	350.0	H	61.0	14
17808.700000	46.48	54.00	7.52	1000.0	1000.000	335.0	H	16.0	20

2.4.15 From 1GHz to 18GHz Radiated Emission Test (High Channel)



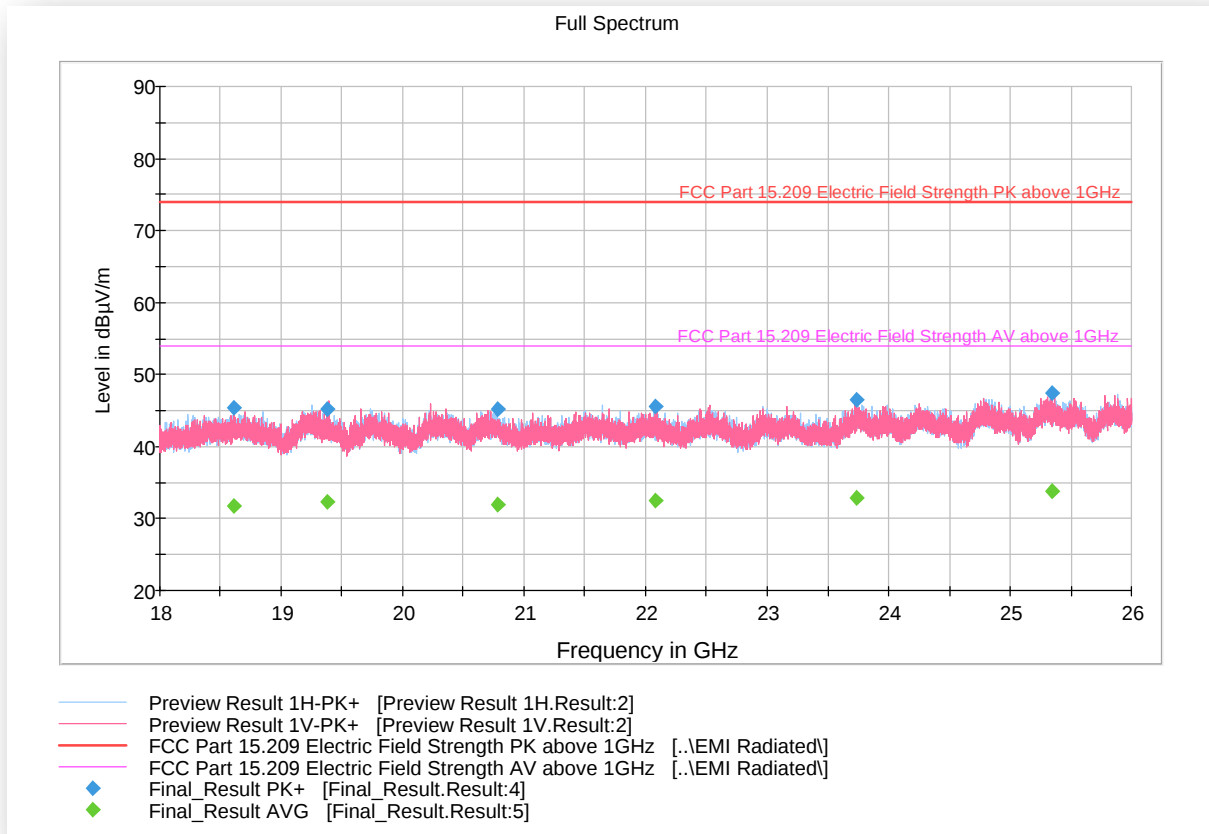
Peak Data

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	48.73	74.00	25.27	1000.0	1000.000	242.0	H	156.0	-6
3594.433333	46.09	74.00	27.91	1000.0	1000.000	335.0	H	172.0	4
4949.000000	61.24	74.00	12.76	1000.0	1000.000	319.0	V	121.0	5
7426.600000	61.22	74.00	12.78	1000.0	1000.000	335.0	V	78.0	7
9902.133333	58.90	74.00	15.10	1000.0	1000.000	245.0	V	250.0	10
17855.466667	59.34	74.00	14.66	1000.0	1000.000	365.0	H	4.0	20

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)
1000.000000	35.28	54.00	18.72	1000.0	1000.000	242.0	H	156.0	-6
3594.433333	32.81	54.00	21.19	1000.0	1000.000	335.0	H	172.0	4
4949.000000	45.79	54.00	8.21	1000.0	1000.000	319.0	V	121.0	5
7426.600000	46.75	54.00	7.25	1000.0	1000.000	335.0	V	78.0	7
9902.133333	45.10	54.00	8.90	1000.0	1000.000	245.0	V	250.0	10
17827.833333	46.52	54.00	7.48	1000.0	1000.000	287.0	H	74.0	20

2.4.16 18GHz to 26GHz Radiated Emission Test (Low Channel)



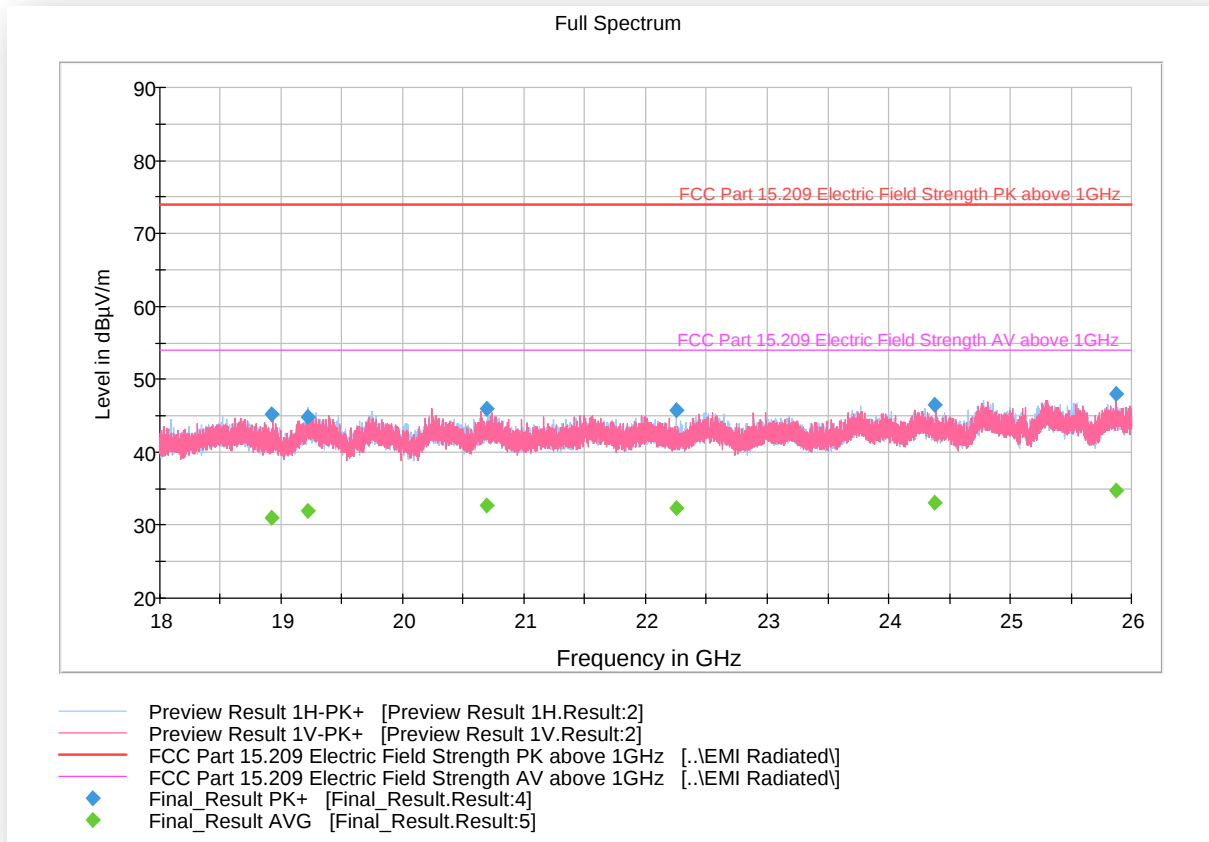
Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
18608.348500	45.47	73.90	28.43	1000.0	1000.000	203.0	V	149.0	-3
19382.774000	45.13	73.90	28.77	1000.0	1000.000	163.0	V	129.0	-3
20779.372500	45.14	73.90	28.76	1000.0	1000.000	150.0	H	254.0	-2
22081.464500	45.49	73.90	28.41	1000.0	1000.000	213.0	V	166.0	-1
23739.140000	46.48	73.90	27.42	1000.0	1000.000	204.0	H	112.0	1
25348.220000	47.42	73.90	26.48	1000.0	1000.000	195.0	V	156.0	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)
18608.348500	31.68	53.90	22.22	1000.0	1000.000	203.0	V	149.0	-3
19382.774000	32.39	53.90	21.51	1000.0	1000.000	163.0	V	129.0	-3
20779.372500	32.03	53.90	21.87	1000.0	1000.000	150.0	H	254.0	-2
22081.464500	32.56	53.90	21.34	1000.0	1000.000	213.0	V	166.0	-1
23739.140000	32.93	53.90	20.97	1000.0	1000.000	204.0	H	112.0	1
25348.220000	33.84	53.90	20.06	1000.0	1000.000	195.0	V	156.0	2

2.4.17 18GHz to 26GHz Radiated Emission Test (Mid Channel)



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)
18924.174500	45.14	73.90	28.76	1000.0	1000.000	142.0	V	54.0	-3.3
19224.046000	44.82	73.90	29.08	1000.0	1000.000	162.0	H	327.0	-2.4
20690.336000	45.89	73.90	28.01	1000.0	1000.000	142.0	H	5.0	-1.9
22250.007500	45.68	73.90	28.22	1000.0	1000.000	213.0	H	302.0	-1.0
24382.639500	46.42	73.90	27.48	1000.0	1000.000	142.0	V	135.0	0.6
25869.822500	47.98	73.90	25.92	1000.0	1000.000	206.0	V	41.0	2.1

Average Data

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
18924.174500	31.08	53.90	22.82	1000.0	1000.000	142.0	V	54.0	-3.3
19224.046000	31.94	53.90	21.96	1000.0	1000.000	162.0	H	327.0	-2.4
20690.336000	32.76	53.90	21.14	1000.0	1000.000	142.0	H	5.0	-1.9
22250.007500	32.36	53.90	21.54	1000.0	1000.000	213.0	H	302.0	-1.0
24382.639500	33.10	53.90	20.80	1000.0	1000.000	142.0	V	135.0	0.6
25869.822500	34.78	53.90	19.12	1000.0	1000.000	206.0	V	41.0	2.1

2.4.18 18GHz to 26GHz Radiated Emission Test (High Channel)



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)
18543.389000	44.96	73.90	28.94	1000.0	1000.000	213.0	H	115.0	-2.9
19223.575500	45.69	73.90	28.21	1000.0	1000.000	200.0	V	67.0	-2.4
21580.165500	46.11	73.90	27.79	1000.0	1000.000	153.0	V	228.0	-0.9
22490.061000	46.33	73.90	27.57	1000.0	1000.000	213.0	H	252.0	0.1
24253.204000	46.47	73.90	27.43	1000.0	1000.000	213.0	H	354.0	1.0
24788.962500	46.81	73.90	27.09	1000.0	1000.000	158.0	V	350.0	1.9
25857.001500	47.34	73.90	26.56	1000.0	1000.000	194.0	H	301.0	2.1

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)
18543.389000	31.97	53.90	21.93	1000.0	1000.000	213.0	H	115.0	-2.9
19223.575500	32.10	53.90	21.80	1000.0	1000.000	200.0	V	67.0	-2.4
21580.165500	32.80	53.90	21.10	1000.0	1000.000	153.0	V	228.0	-0.9
22490.061000	32.64	53.90	21.26	1000.0	1000.000	213.0	H	252.0	0.1
24253.204000	33.40	53.90	20.50	1000.0	1000.000	213.0	H	354.0	1.0
24788.962500	34.44	53.90	19.46	1000.0	1000.000	158.0	V	350.0	1.9
25857.001500	34.87	53.90	19.03	1000.0	1000.000	194.0	H	301.0	2.1



2.5 BAND EDGE VERIFICATIONS

2.5.1 Specification Reference

FCC 47 Chapter I Subchapter A Part 15 Subpart C §15.249(d)

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: RF Test No. 1 / Default Test Configuration

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

January 04, 2022 / 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	20.8 °C
Relative Humidity	43.9 %
ATM Pressure	101.0 kPa

2.5.7 Additional Observations

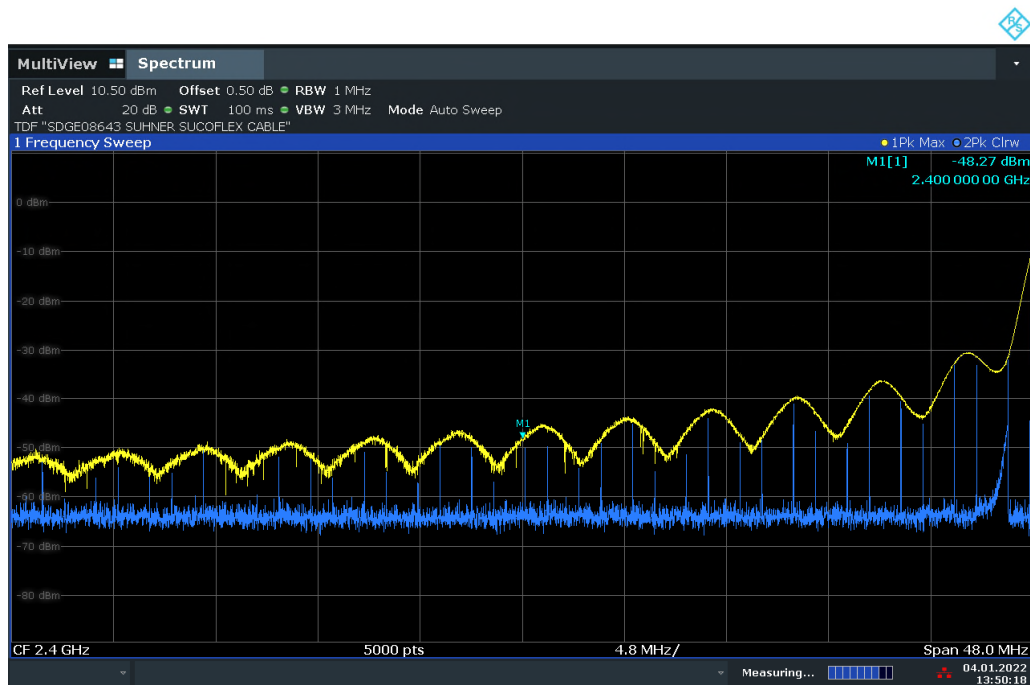
- This is a conducted test for reference only. The Low and High channels of the EUT are >3 standard bandwidth away from the band edges. Results from Section 2.4 confirmed no significant emissions at the band edges when the EUT is transmitting at Low and High channels.
- Field strength is calculated using the formula:

$$E_{Meas} = EIRP - 20\log(d_{Meas}) + 104.8$$

2.5.8 Test Results

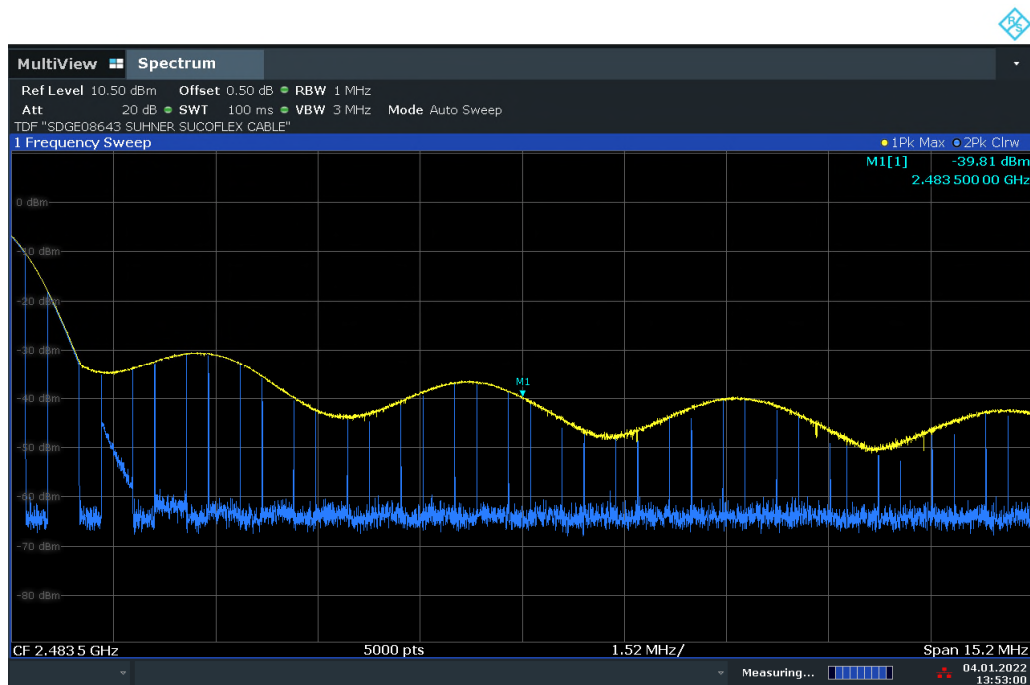
Compliant. See attached plots and calculations.

2.5.9 Test Plots



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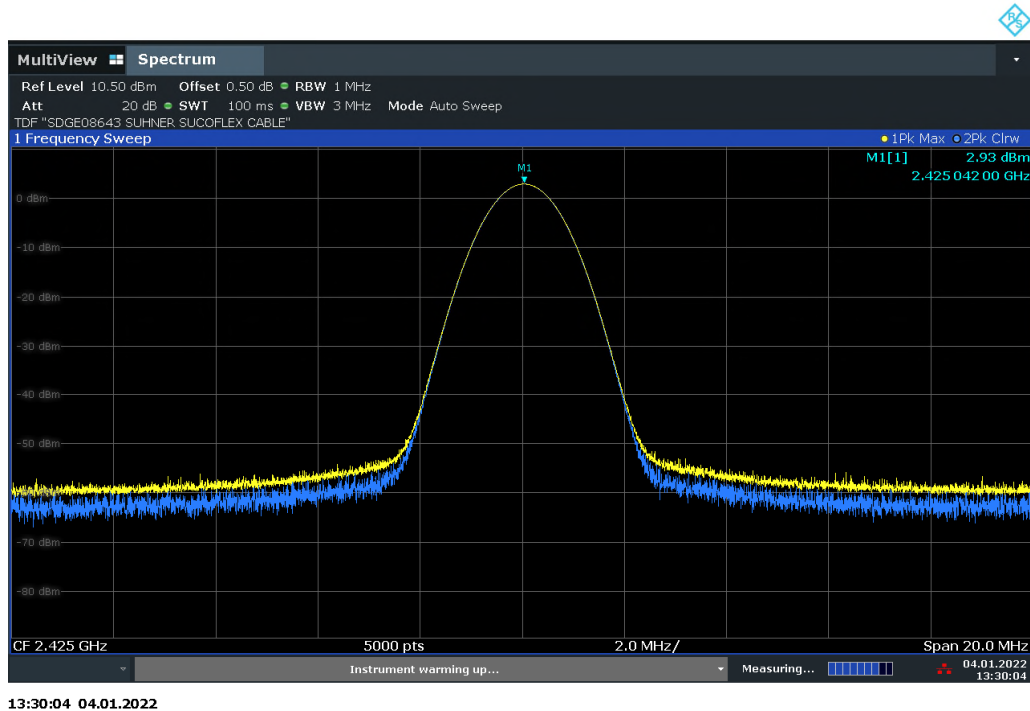
Lower Band Edge



13:53:00 04.01.2022

Upper Band Edge

2.5.10 Sample Calculations



Antenna Gain Calculation: $102.02 \text{ dB}\mu\text{V/m}$ (from Section 2.3.10) = 6.79 dBm EIRP
 $6.79 \text{ dBm} - 2.93 \text{ dBm}$ (Conducted Power above) = 3.86 dB

Lower Band Edge Calculation: $-48.27 \text{ dBm} + 3.86 \text{ dB} = -44.41 \text{ dBm EIRP Peak}$
 $E_{\text{Meas}} = -44.41 \text{ dBm} - 20 \log(3 \text{ meters}) + 104.8$
 $= 50.75 \text{ dB}\mu\text{V/m Peak}$
 $= 42.21 \text{ dB}\mu\text{V/m Average}$ (with -8.54 dB DCCF)

Upper Band Edge Calculation: $-39.81 \text{ dBm} + 3.86 \text{ dB} = -35.95 \text{ dBm EIRP Peak}$
 $E_{\text{Meas}} = -35.95 \text{ dBm} - 20 \log(3 \text{ meters}) + 104.8$
 $= 59.21 \text{ dB}\mu\text{V/m Peak}$
 $= 50.67 \text{ dB}\mu\text{V/m Average}$ (with -8.54 dB DCCF)

Both Lower and Upper band edges **complies** with $74 \text{ dB}\mu\text{V/m}$ (Peak) and $54 \text{ dB}\mu\text{V/m}$ (Average) requirements of §15.209.



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
Antenna Conducted Port						
7611	Signal/Spectrum Analyzer	FSW26	102017	Rohde & Schwarz	02/02/21	02/02/22
Radiated Emission						
1049	EMI Test Receiver	ESU40	100133	Rohde & Schwarz	10/01/21	10/01/22
1033	Bilog Antenna	3142C	00044556	EMCO	10/05/21	10/05/23
9001	18-26 GHz Antenna	HO42S	101	Custom Microwave Inc.	09/23/21	09/21/23
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
6628	Loop Antenna	HFH2-Z2335.4711.52	FNr.800.458/25	Rohde & Schwarz	05/22/20	05/22/22
40815	Pre-amplifier (18-40 GHz)	19D18	15G27	Spacek Labs	10/11/21	10/11/22
Miscellaneous						
7619	Temp/Humidity Sensor	iBTHX-W	15050268	Omega	03/09/21	03/09/22
47045	True RMS Multimeter	87V	18290478	Fluke	03/02/21	03/02/22
	Test Software	EMC32	V11.20.00	Rohde & Schwarz	N/A	

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	0.75 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	

3.2.2 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	0.20 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



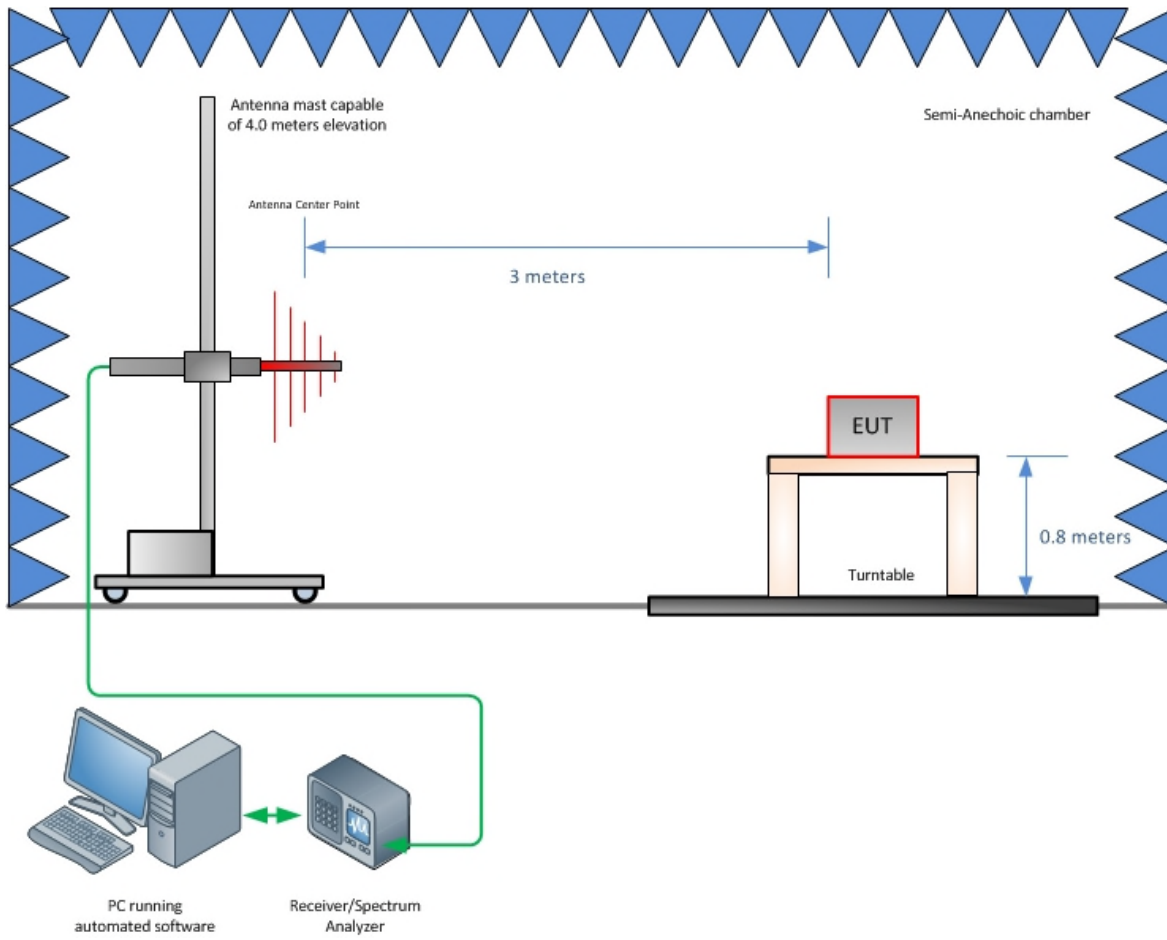
11	Directivity difference at 3 m	3.12 dB	Rectangular	1.732	1.80	3.24
12	Phase center location at 3 m	1.00 dB	Rectangular	1.732	0.58	0.33
13	Cross-polarisation	0.90 dB	Rectangular	1.732	0.52	0.27
14	Balance	0.00 dB	Rectangular	1.732	0.00	0.00
15	Site imperfections	3.25 dB	Triangular	2.449	1.33	1.76
16	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	



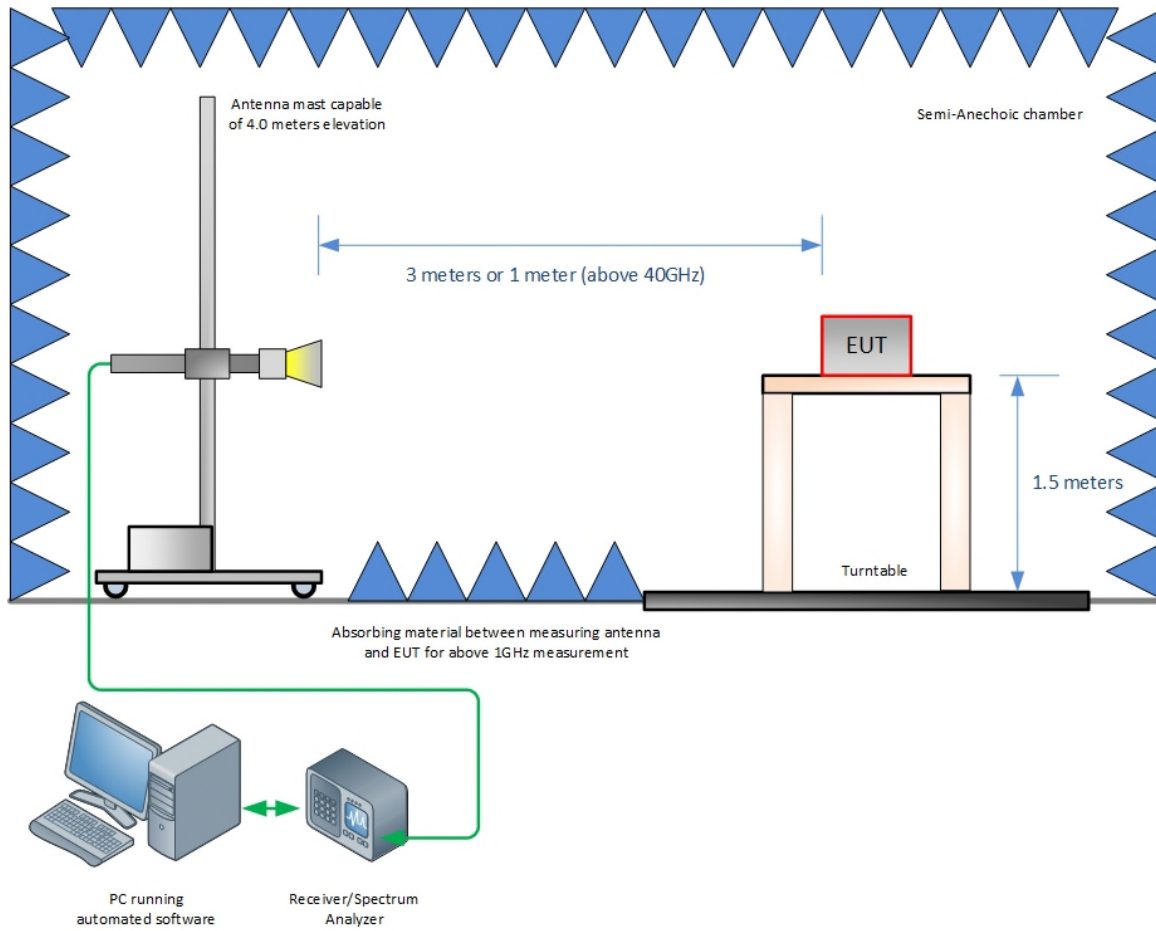
SECTION 4

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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