# Radio Testing of the
# Watkins Manufacturing Corporation
# Connected Spa Kit 2 Model: 2001030

## In accordance with FCC Part 15 Subpart C §15.247 and IC RSS-247 Issue 3 August 2023

America

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Watkins Manufacturing Corporation
1280 Park Center Dr
Vista, CA 92081 USA

## COMMERCIAL-IN-CONFIDENCE

Date: November 2024
Document Number: 721003029A Issue 01 | Version Number: 01

| RESPONSIBLE FOR | NAME | DATE | SIGNATURE |
|---|---|---|---|
| **Authorized Signatory** | Ferdinand S. Custodio | November 11, 2024 |  |

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 §15.247 and IC RSS-247 Issue 3 August 2023.

A2LA Cert. No. 2955.13



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| | |
|---|---|
| **REPORT ON** | Radio Testing of the<br>Watkins Manufacturing Corporation<br>Model: 2001030 Connected Spa Kit 2 |
| **TEST REPORT NUMBER** | 721003029A |
| **TEST REPORT DATE** | November 2024 |
| **PREPARED FOR** | Watkins Manufacturing Corporation<br>1280 Park Center Dr<br>Vista, CA 92081 USA |
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| **APPROVED BY** | Ferdinand S. Custodio<br>**Name**<br>Authorized Signatory<br>Title: Senior EMC Test Engineer / Wireless Team Lead |
| **DATED** | November 11, 2024 |

## Revision History

| 721003029A<br>Watkins Manufacturing Corporation<br>Connected Spa Kit 2 Model: 2001030 | | | | | |
|---|---|---|---|---|---|
| DATE | OLD REVISION | NEW REVISION | REASON | PAGES AFFECTED | APPROVED BY |
| 11/11/2024 | — | Initial Release | | | Ferdinand S. Custodio |
| | | | | | |
| | | | | | |
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| | | | | | |

# CONTENTS

# SECTION 1

# REPORT SUMMARY

Radio Testing of the
Watkins Manufacturing Corporation
Connected Spa Kit 2 2001030

## 1.1 INTRODUCTION

The information contained in this report is intended to show verification of the 2001030 Connected Spa Kit 2 to the requirements of FCC Part 15 Subpart C §15.247 and IC RSS-247 Issue 3 August 2023.

| | |
|---|---|
| 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 | Watkins Manufacturing Corporation |
| EUT | Connected Spa Kit 2 |
| Model Name | 2001030 |
| FCC ID | LDL-000036 |
| ISED/IC Number | 7322A-000036 |
| FCC Classification | Low power Communications Device Transmitter (DTS) |
| Serial Number(s) | D48AFCEDFCE4<br>D48AFCEDA2D8<br>D48AFCEDB5C4 |
| Number of Samples Tested | 3 |
| Test Specification/Issue/Date | • FCC Part 15 Subpart C §15.247 (October 1, 2023).<br>• RSS-247–Digital Transmission Systems (DTS), Frequency Hopping Systems (FHSS) and Licence-Exempt Local Area Network (LE-LAN) Devices (Issue 3, August 2023).<br>• RSS-Gen - General Requirements for Compliance of Radio Apparatus (Issue 5, Amendment 2 February 2021). |
| Start of Test | October 04, 2024 |
| Finish of Test | October 18, 2024 |
| Name of Engineer(s) | Omar Castillo |

| | |
|---|---|
| Related Document(s) | • ANSI C63.10-2013. American National Standard of Procedures for Compliance testing of Unlicensed Wireless Devices.<br>• KDB 558074 D01 15.247 v05r02 Guidance for compliance measurements on Digital Transmission System, Frequency Hopping Spread Spectrum System, and Hybrid System Devices operating under Section 15.247 of the FCC rules.<br>• Supporting documents and test setup pictures for EUT certification are separate exhibits.<br>• SWE030 PN:SW20023EB56.pdf<br>• 140mm 868+915MHz 天线规格书.pdf<br>• Xinhengyang#W.01.00001061.pdf |

## 1.2 BRIEF SUMMARY OF RESULTS

A brief summary of the tests carried out in accordance with FCC Part 15 Subpart C §15.247 and IC RSS-247 Issue 3 August 2023 with cross-reference to the corresponding IC RSS standard are shown below.

| Section | §15.247 Spec Clause | RSS | Test Description | Result | Comments /Base Standard |
|---|---|---|---|---|---|
| 2.1 | §15.247(b)(3) | RSS-247 5.4(d) | Peak Output Power | Compliant | |
| 2.2 | §15.207(a) | RSS-Gen 8.8 | Conducted Emissions | Compliant | |
| 2.3 | - | RSS-Gen 6.7 | 99% Emission Bandwidth | Compliant | |
| 2.4 | §15.247(a)(2) | RSS-247 5.2(a) | Minimum 6 dB RF Bandwidth | Compliant | |
| 0 | §15.247(d) | RSS-247 5.5 | Out-of-Band Emissions - Conducted | Compliant | |
| 2.6 | §15.247(d) | RSS-247 5.5 | Band-edge Compliance of RF Conducted Emissions | Compliant | |
| 2.7 | §15.247(d) | RSS-247 5.5 | Radiated Spurious Emissions | Compliant | |
| - | - | RSS-Gen 7.3 and 7.4 | Receiver Spurious Emissions | N/A* | |
| 2.8 | §15.247(e) | RSS-247 5.2(b) | Power Spectral Density for Digitally Modulated Device | Compliant | |

Note: N/A* Not required as per RSS-Gen 5.3 The EUT does not fall into any category defined as Receiver under RSS-Gen.

## 1.3 PRODUCT INFORMATION

### 1.3.1 Technical Description

The Equipment Under Test (EUT) is an Watkins Manufacturing Corporation Connected Spa Kit 2 2001030. The Connected Spa Kit 2 solution is a two-module system that provides Mobile app based control for hot tubs manufactured by Watkins Wellness. The modules are interchangeable in their roles.
A full description and detailed product specification are available from the manufacturer.

### 1.3.2 EUT General Description

| | |
|---|---|
| EUT Description | Connected Spa Kit 2 |
| Model Name | 2001030 |
| Rated Voltage | 5 VDC (AC/DC Adapter) |
| Mode Verified | LoRA (US 903MHz to 927MHz) |
| Capability | LoRA (US 903MHz to 927MHz, SF5, through SF12) and Wi-Fi 2.4GHzb/g/nHT20 and nHT40 |
| Primary Unit (EUT) | ☐ Production<br>☒ Pre-Production<br>☐ Engineering (same as Production) |
| Manufacturer Declared Temperature Range | -10°C to 60°C |
| **Antenna Type (1)** | **868/915MHz** |
| Manufacturer (1) | Sunnyway |
| Antenna Model (1) | SW20023EB56 |
| Peak Antenna Gain (1) | 1.96 dBi (915 MHz) |
| **Antenna Type (2)** | **860/915MHz** |
| Manufacturer (2) | Xinhengyang |
| Antenna Model (2) | W.01.00001061 |
| Peak Antenna Gain (2) | 0.61 dBi (915 MHz) |
| **Antenna Type (3)** | **868/915MHz** |
| Manufacturer (3) | Xinhengyang |
| Antenna Model (3) | SW.01.00001044 |
| Peak Antenna Gain (3) | 1.17 dBi (915 MHz) |

Note: Above antenna specifications were taken from pdf specs provided by manufacturer (See section 1.1).
Note*: Manufacturer Declared the antenna will be bonded to the EUT.

### 1.3.3 Maximum Conducted Output Power

| LoRa | Frequency Range (MHz) | RMS (dBm) | Duty Cycle (%) |
|---|---|---|---|
| LoRa Alliance | 902 – 928 MHz | 14.0 | 48.0 |

## 1.4 EUT TEST CONFIGURATION

### 1.4.1 Test Configuration Description

| Test Configuration | Description |
|---|---|
| Default | EUT in a test mode configuration. EUT has an SMA connector for LoRa antenna. EUT was programmed in test mode with the highest possible Duty Cycle and Lowest and Highest Spreading Factors (SF5 and SF12).<br><br>For cabinet spurious Emissions the EUT was programmed with the highest Duty Cycle, the antenna port was terminated with a 20dB attenuator and a 50 Ohm load. |

### 1.4.2 EUT Exercise Software

EUT programmed in test mode by manufacturer

### 1.4.3 Support Equipment and I/O cables

| Manufacturer | Equipment/Cable | Description |
|---|---|---|
| Shenzhen putuo technology co. ltd | USB AC/DC Adapter | PT-WC-03 |
| Watkins | Hot tub's Control box | Model Name: Eagle Board<br>Model Number: 1302501-XX |
| Sony | USB ACDC adapter- | AC-UB10- |
| Generic | USB Type A to Type C | USB Type A to Type C |

### 1.4.1 Simplified Test Configuration Diagram

Not applicable. EUT verified on a standalone configuration.
Supporting documents and test setup pictures for EUT certification are separate exhibits.

## 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: No modifications | | |
| N/A | - | - |

The table above details modifications made to the EUT during the test programme. The modifications incorporated during each test (if relevant) are recorded on the appropriate test pages.

## 1.7 TEST METHODOLOGY

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard 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 (ISED) 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 LP0002 for Low-Power RF Device type of testing.

### 1.9.5 VCCI – Registration No. A-0412 and A-0413

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
Watkins Manufacturing Corporation
Connected Spa Kit 2 2001030

## 2.1 PEAK OUTPUT POWER

### 2.1.1 Specification Reference

FCC 47 CFR Part 15, Clause 15.247(b)(3)
RSS-247, Clause 5.4 (d)

### 2.1.2 Standard Applicable

For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands, the maximum peak conducted output shall not exceed 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

### 2.1.3 Equipment Under Test and Modification State

Serial No: D48AFCEDFCE4, D48AFCEDA2D8, D48AFCEDB5C4 and / Default Test Configuration

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

October 4, 7, 8 and 9, 2024 / 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 (Rancho Bernardo Satellite Facility)

| | | |
|---|---|---|
| Ambient Temperature | 23.9 °C | 22.0 °C |
| Relative Humidity | 34.6 % | 41.8 % |
| ATM Pressure | 99.8 kPa | 98.9 kPa |

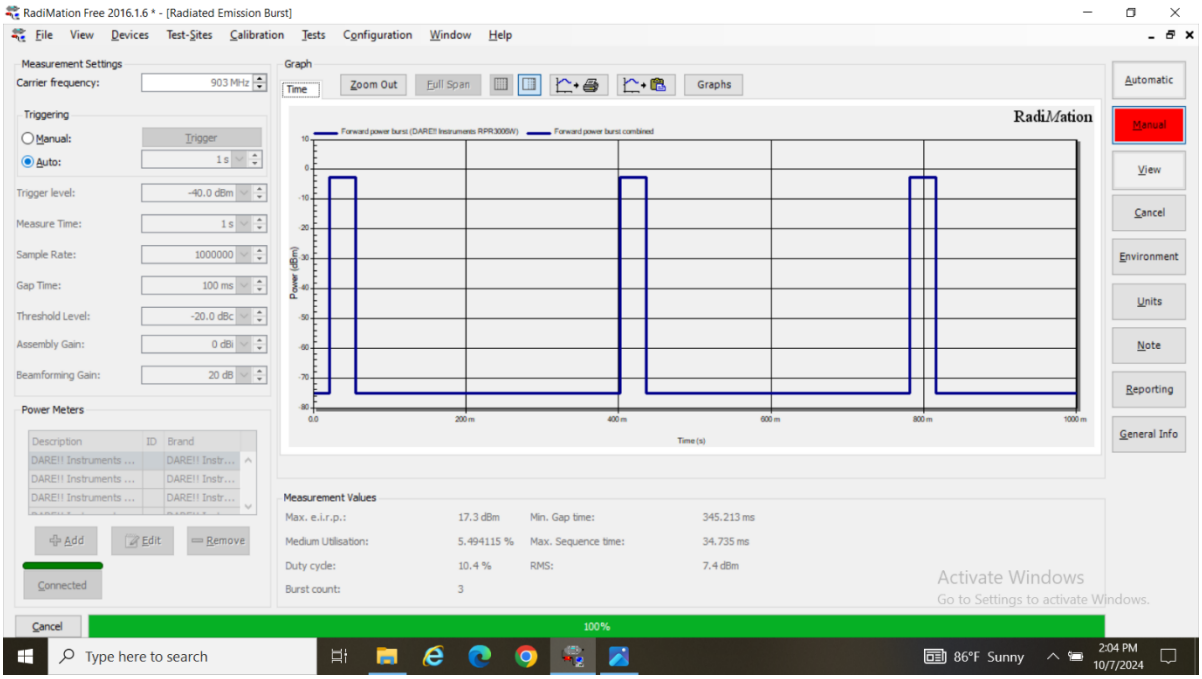
### 2.1.7 Additional Observations

- This is a conducted test using a Power Meter (peak and rms).
- Burst function of the Power Meter used for this test (rms measurements and Duty Cycle).

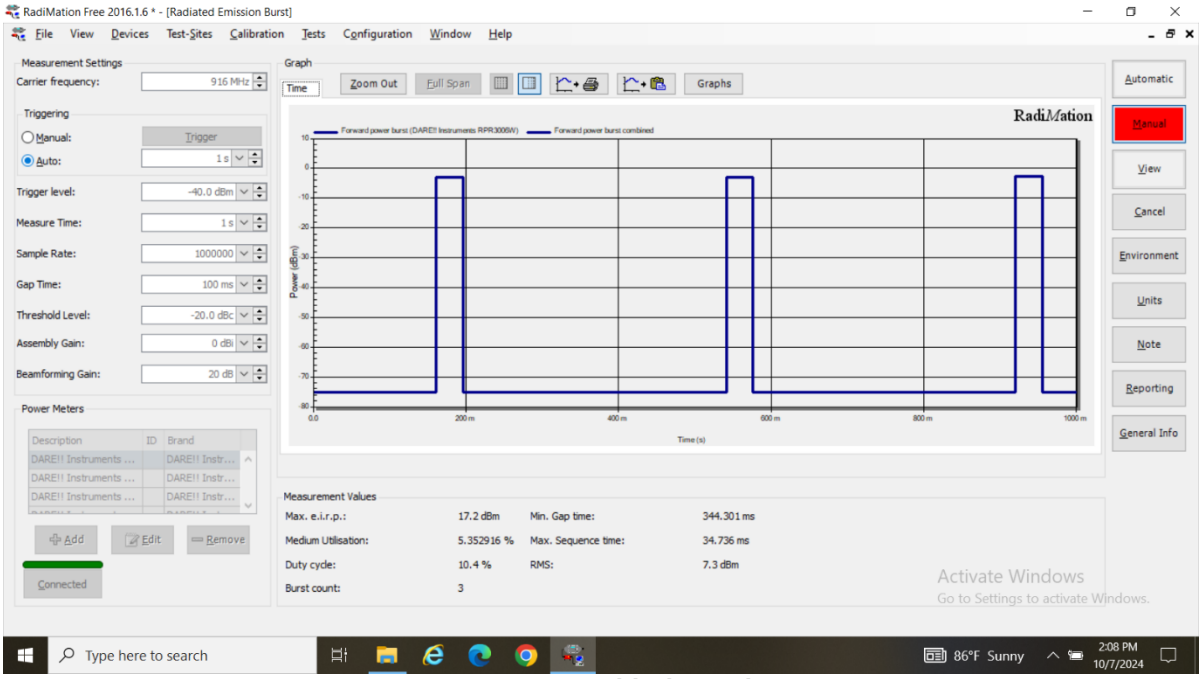
### 2.1.8 Test Results

| DUT Frequency (MHz) | Spreading Factor | Peak (dBm) | Burst -RMS (dBm) | Limit Max (dBm) | DutyCycle (%) | Burst |
|---|---|---|---|---|---|---|
| 903.00 | SF5 | **20.02** | **7.40** | 30.0 | 10.4 | PASS |
| 916.00 | SF5 | **19.54** | **7.30** | | 10.4 | PASS |
| 927.00 | SF5 | **12.64** | **1.00** | | 10.4 | PASS |
| 903.00 | SF12 | **20.02** | **14.0** | | 48.0 | PASS |
| 916.00 | SF12 | **19.51** | **13.90** | | 48.9 | PASS |
| 927.00 | SF12 | **13.55** | **7.70** | | 48.8 | PASS |

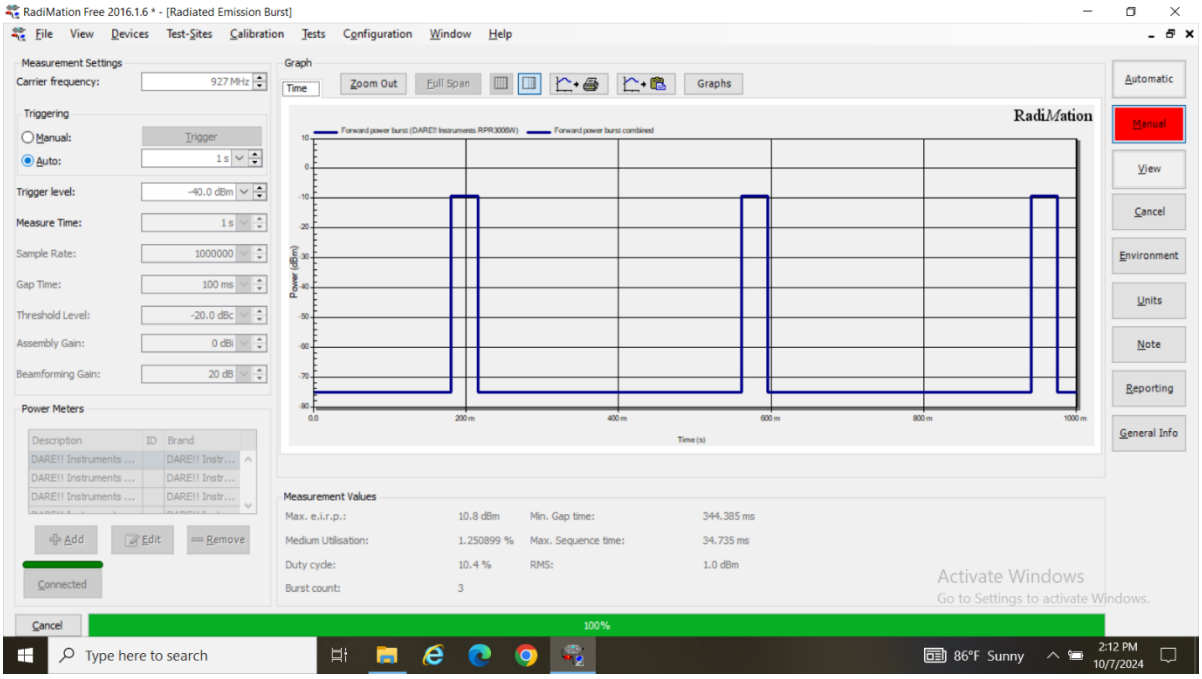
### 2.1.9 Test Plots (RMS)



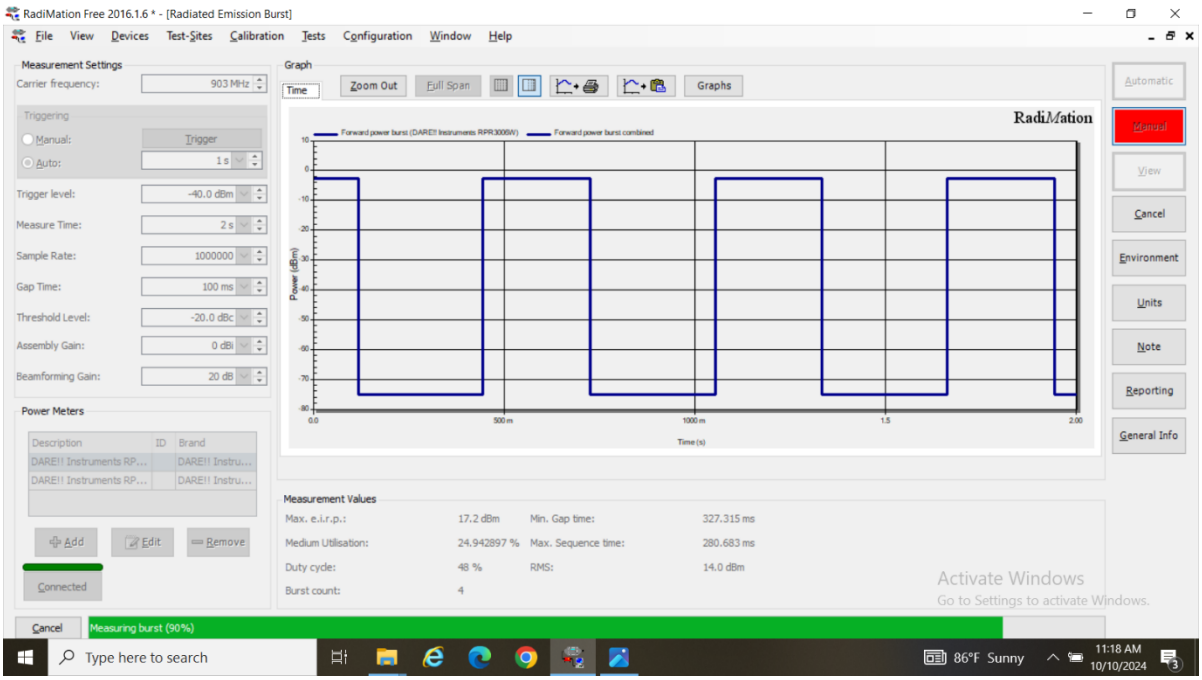

**LoRA. SF5 Low Channel**



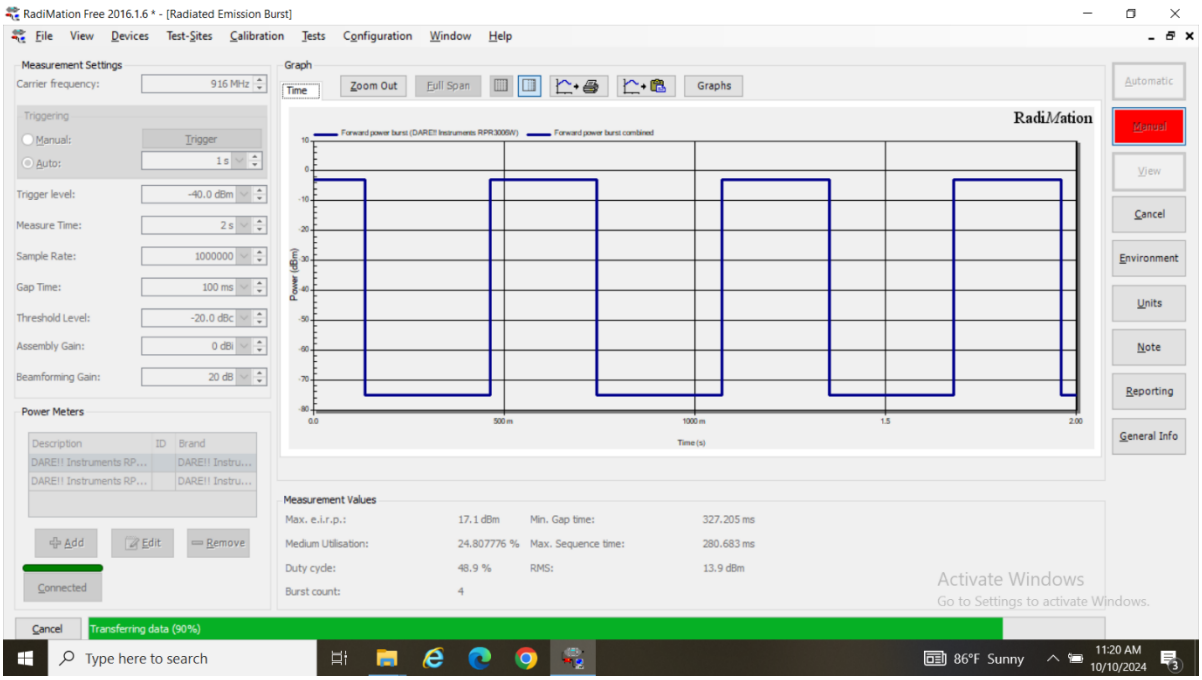

**LoRA. SF5 Mid Channel**



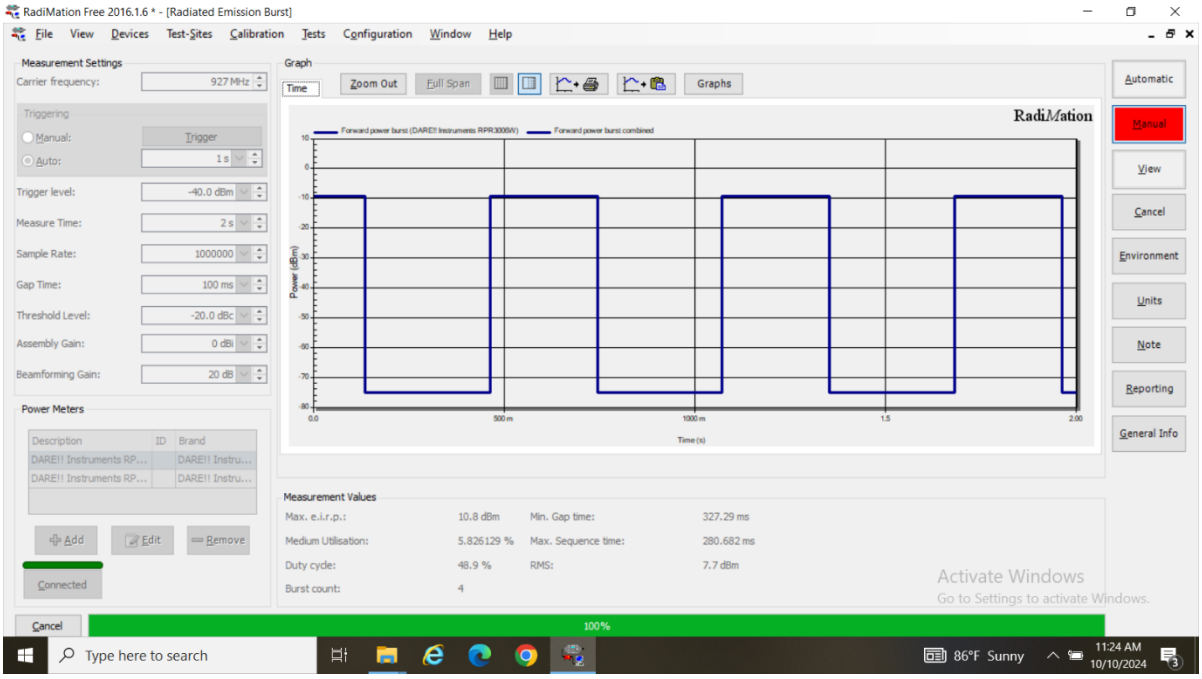

**LoRA. SF5 High Channel**




**LoRA. SF12 Low Channel**




**LoRA. SF12 Middle Channel**

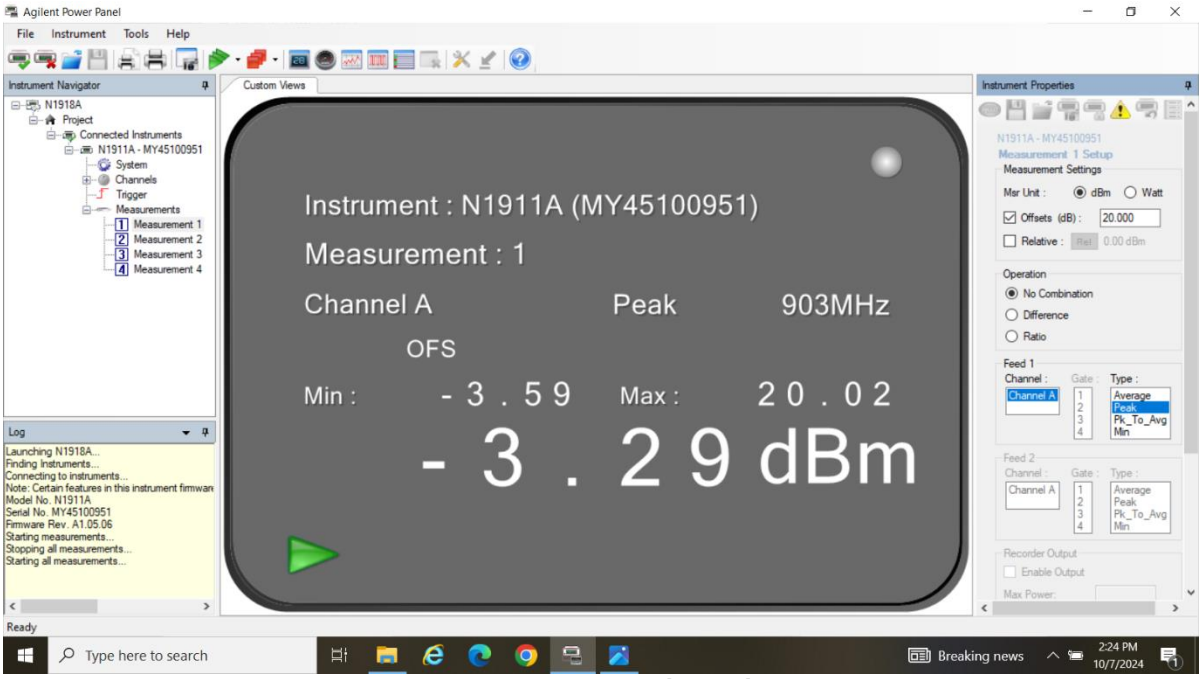



**LoRA. SF12 High Channel**

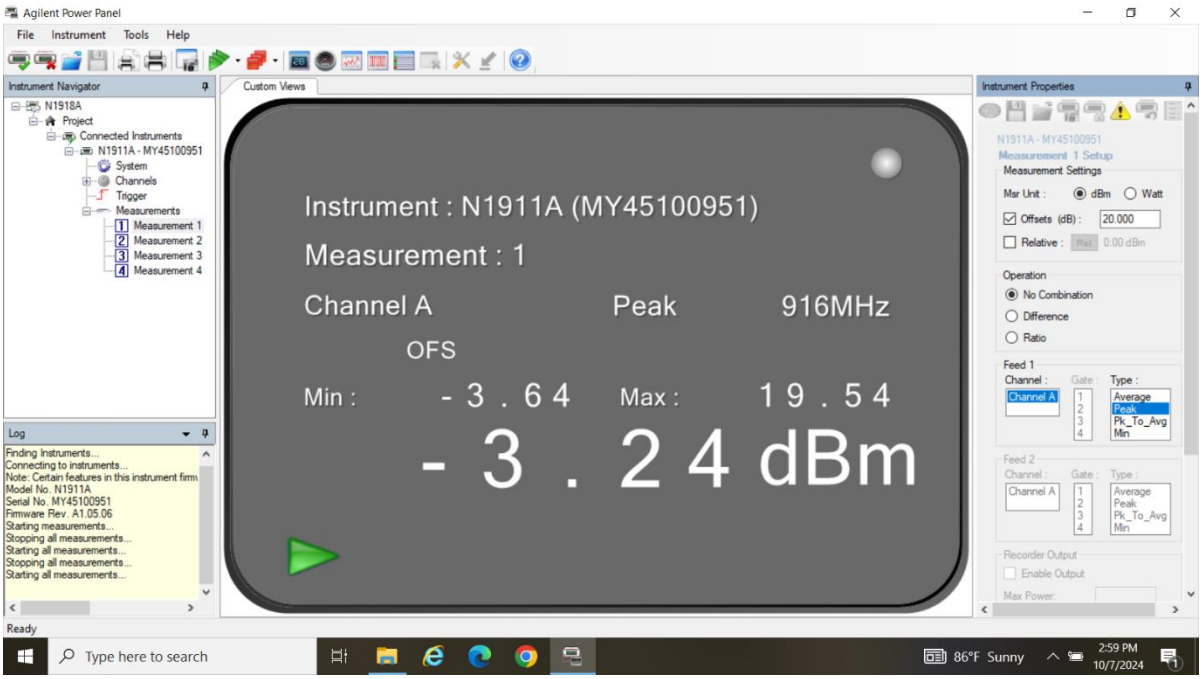
### 2.1.10 Power Meter Settings (RMS)

| Setting | Instrument Value | Target Value |
|---|---|---|
| Measurement Time | 1.000 s | 1.000 s |
| Points | 1000000 | 1000000 |
| Time resolution | 1.000 µs | 1.000 µs |

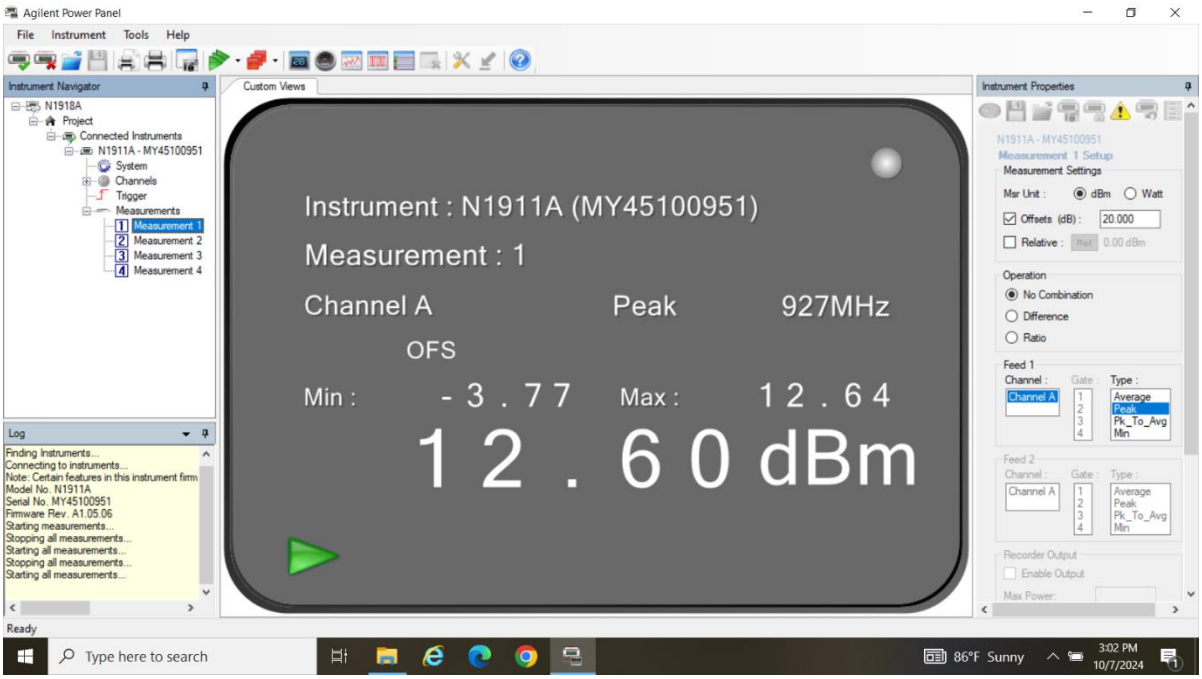
### 2.1.11 Test Plots (Peak Power)



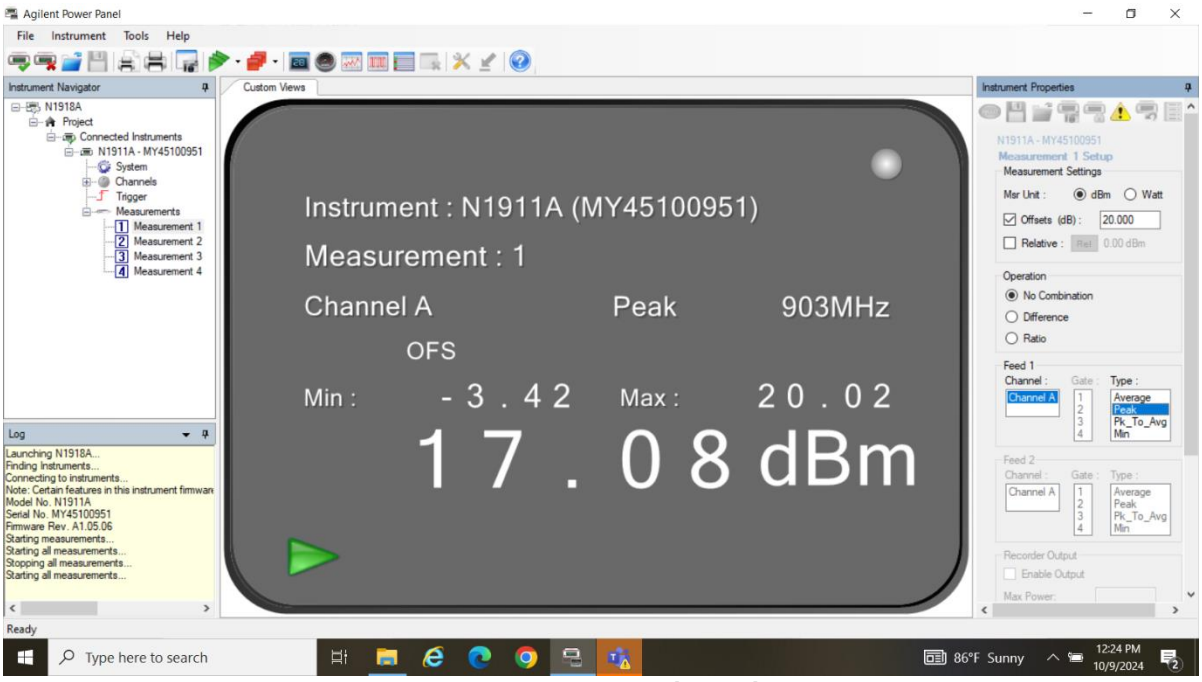

**LoRA SF5 Low Channel**



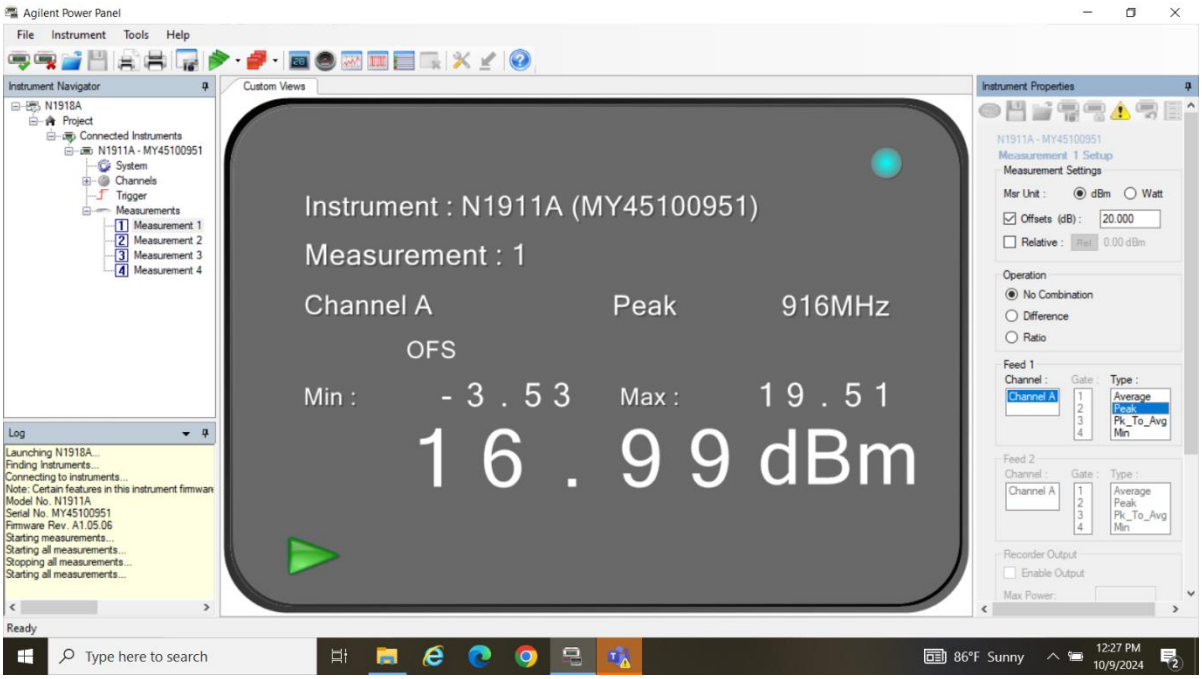

**LoRA SF5 Middle Channel**




**LoRA SF5 High Channel**




**LoRA SF12 Low Channel**




**LoRA SF12 Middle Channel**


**LoRA SF12 High Channel**

## 2.2 CONDUCTED EMISSIONS

### 2.2.1 Specification Reference

FCC 47 CFR Part 15, Clause 15.207(a)
RSS-GEN, Clause 8.8

### 2.2.2 Standard Applicable

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 µH/50 ohms line impedance stabilization network (LISN).

| Frequency of emission (MHz) | Conducted limit (dBµV) | |
|---|---|---|
| | 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.*

### 2.2.3 Equipment Under Test and Modification State

Serial No: D48AFCEDFCE4 / LoRa Transmitting continuously

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

October 11, 2024 / OC

### 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 EUT Test Voltage

120V 60Hz (ACDC adapter)
120V 60Hz to Eagle Board)

### 2.2.7 Environmental Conditions

| | |
|---|---|
| Ambient Temperature | 22.0 °C |
| Relative Humidity | 41.8 % |
| Atmospheric Pressure | 98.9 kPa |

### 2.2.8 Additional Observations

- Measurement was 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 2.2.9 for sample computation.
- This test was performed while EUT powered with a ACDC adapter (representative ACDC adapter model AC-UB10) and eagled board (both at 120V 60Hz).

### 2.2.9 Sample Computation (Conducted Emissions – Quasi Peak)

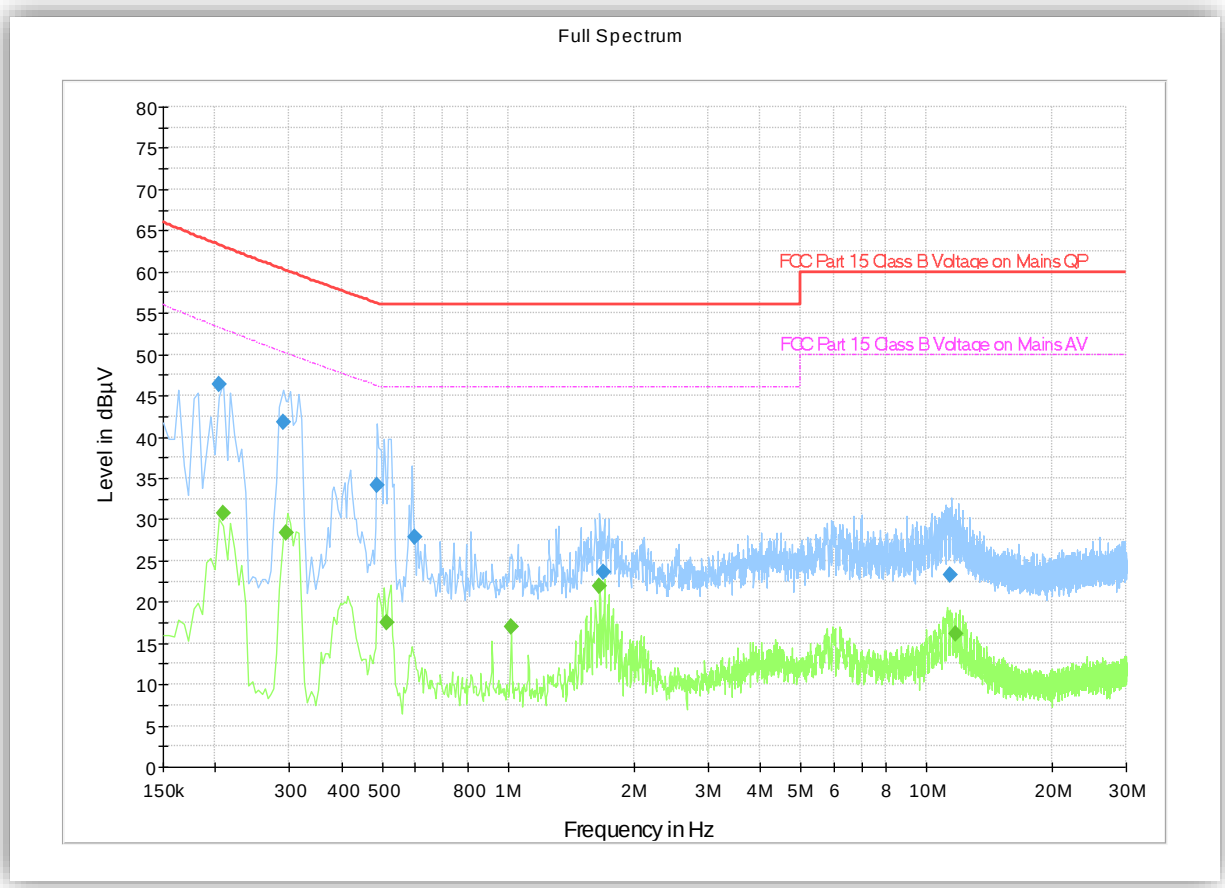
| | | | |
|---|---|---|---|
| Measuring equipment raw measurement (dbµV) @ 150kHz | | | 5.5 |
| Correction Factor (dB) | Asset# 8607 (20 dB attenuator) | 19.9 | 20.7 |
| | Asset# 1177 (cable) | 0.15 | |
| | Asset# 1176 (cable) | 0.35 | |
| | Asset# 7568 (LISN) | 0.30 | |
| **Reported QuasiPeak Final Measurement (dbµV) @ 150kHz** | | | **26.2** |

### 2.2.10 Test Results

Performance assessment of the EUT made during this test: Pass.

Detailed results are shown below.

### 2.2.10.1 Conducted Emissions Line 1 – 120V 60Hz to ACDC adapter




Note: FCC Part 15 Class Limits are identical as §15.207

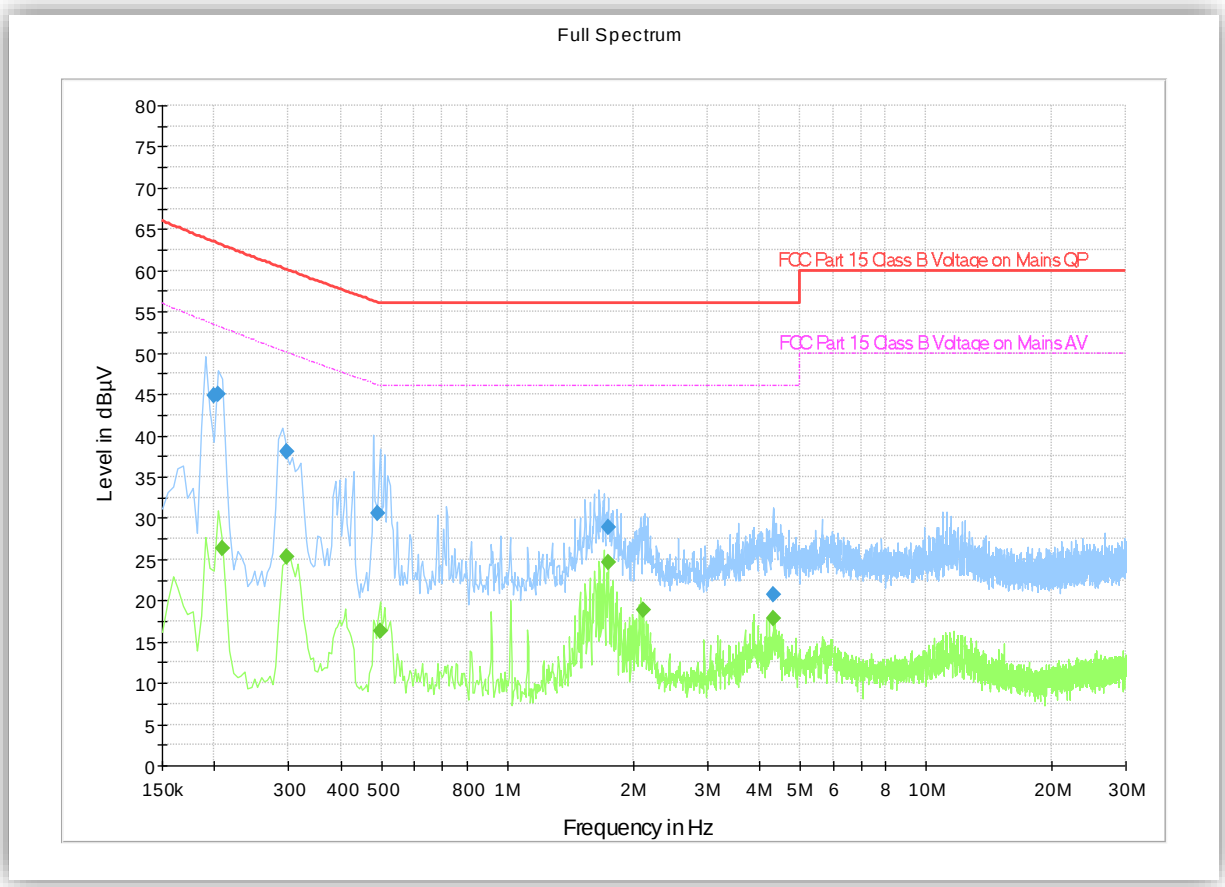
**Quasi Peak Result**

| Frequency (MHz) | QuasiPeak (dBµV) | Limit (dBµV) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Line | Filter | Corr. (dB) |
|---|---|---|---|---|---|---|---|---|
| 0.204000 | 46.37 | 63.29 | 16.92 | 1000.0 | 9.000 | L1 | OFF | 20.1 |
| 0.289500 | 41.85 | 60.34 | 18.48 | 1000.0 | 9.000 | L1 | OFF | 20.1 |
| 0.487500 | 34.15 | 56.19 | 22.04 | 1000.0 | 9.000 | L1 | OFF | 20.1 |
| 0.600000 | 27.86 | 56.00 | 28.14 | 1000.0 | 9.000 | L1 | OFF | 20.1 |
| 1.684500 | 23.58 | 56.00 | 32.42 | 1000.0 | 9.000 | L1 | OFF | 20.1 |
| 11.422500 | 23.34 | 60.00 | 36.66 | 1000.0 | 9.000 | L1 | OFF | 20.4 |

**Average Result**

| Frequency (MHz) | Average (dBµV) | Limit (dBµV) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Line | Filter | Corr. (dB) |
|---|---|---|---|---|---|---|---|---|
| 0.208500 | 30.66 | 53.07 | 22.41 | 1000.0 | 9.000 | L1 | OFF | 20.1 |
| 0.294000 | 28.39 | 50.17 | 21.78 | 1000.0 | 9.000 | L1 | OFF | 20.1 |
| 0.514500 | 17.55 | 46.00 | 28.45 | 1000.0 | 9.000 | L1 | OFF | 20.1 |
| 1.018500 | 16.99 | 46.00 | 29.01 | 1000.0 | 9.000 | L1 | OFF | 20.1 |
| 1.657500 | 21.97 | 46.00 | 24.03 | 1000.0 | 9.000 | L1 | OFF | 20.1 |
| 11.755500 | 16.15 | 50.00 | 33.85 | 1000.0 | 9.000 | L1 | OFF | 20.4 |

### 2.2.10.2 Conducted Emissions Neutral – 120V 60Hz to ACDC adapter




Note: FCC Part 15 Class Limits are identical as §15.207

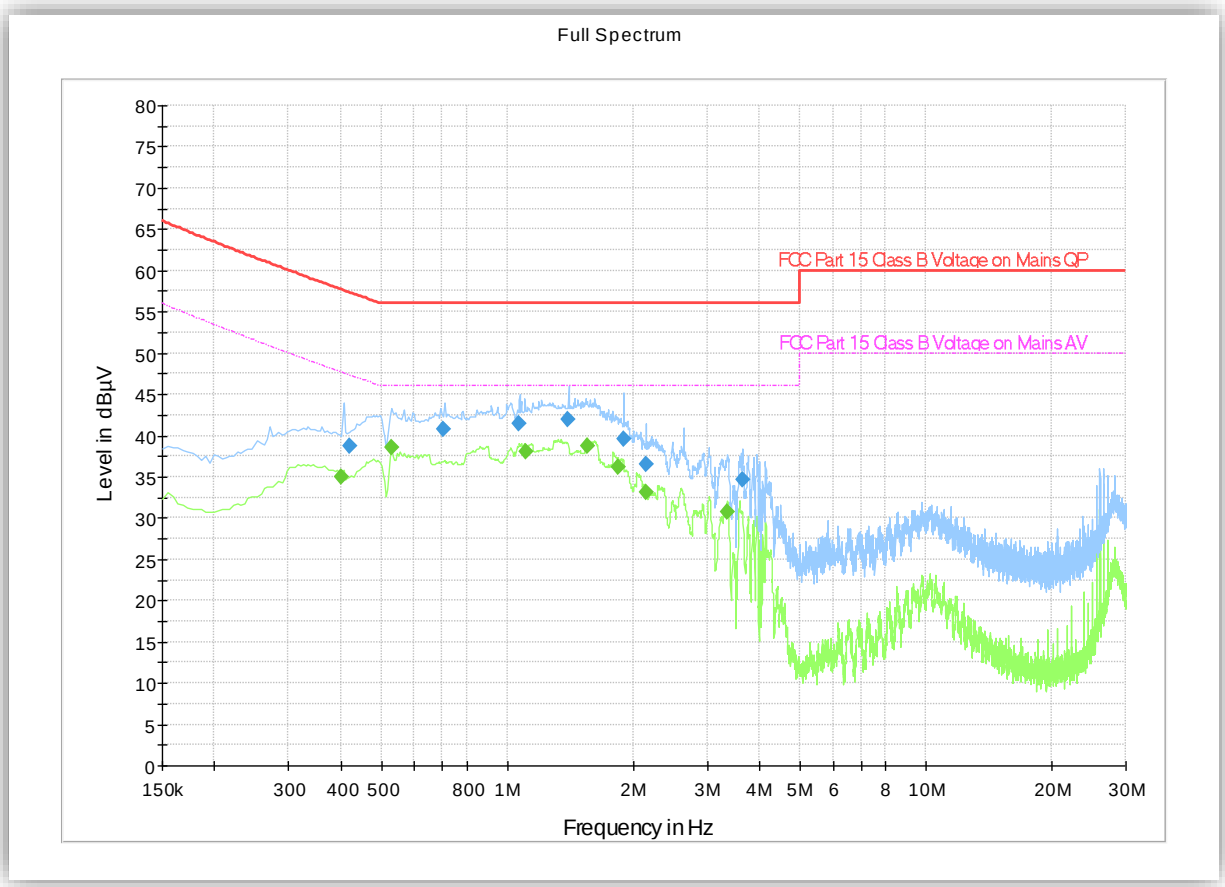
**Quasi Peak Result**

| Frequency (MHz) | QuasiPeak (dBµV) | Limit (dBµV) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Line | Filter | Corr. (dB) |
|---|---|---|---|---|---|---|---|---|
| 0.199500 | 44.77 | 63.48 | 18.71 | 1000.0 | 9.000 | N | OFF | 20.1 |
| 0.204000 | 45.08 | 63.29 | 18.20 | 1000.0 | 9.000 | N | OFF | 20.1 |
| 0.298500 | 37.97 | 60.08 | 22.11 | 1000.0 | 9.000 | N | OFF | 20.1 |
| 0.492000 | 30.62 | 56.12 | 25.51 | 1000.0 | 9.000 | N | OFF | 20.1 |
| 1.743000 | 28.84 | 56.00 | 27.16 | 1000.0 | 9.000 | N | OFF | 20.1 |
| 4.317000 | 20.64 | 56.00 | 35.36 | 1000.0 | 9.000 | N | OFF | 20.1 |

**Average Result**

| Frequency (MHz) | Average (dBµV) | Limit (dBµV) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Line | Filter | Corr. (dB) |
|---|---|---|---|---|---|---|---|---|
| 0.208500 | 26.26 | 53.07 | 26.81 | 1000.0 | 9.000 | N | OFF | 20.1 |
| 0.298500 | 25.36 | 50.05 | 24.68 | 1000.0 | 9.000 | N | OFF | 20.1 |
| 0.496500 | 16.37 | 46.05 | 29.68 | 1000.0 | 9.000 | N | OFF | 20.1 |
| 1.738500 | 24.65 | 46.00 | 21.35 | 1000.0 | 9.000 | N | OFF | 20.1 |
| 2.116500 | 18.77 | 46.00 | 27.23 | 1000.0 | 9.000 | N | OFF | 20.1 |
| 4.317000 | 17.79 | 46.00 | 28.21 | 1000.0 | 9.000 | N | OFF | 20.1 |

### 2.2.10.3 Conducted Emissions Line 1 – 120V 60Hz to Eagle Board




Note: FCC Part 15 Class Limits are identical as §15.207

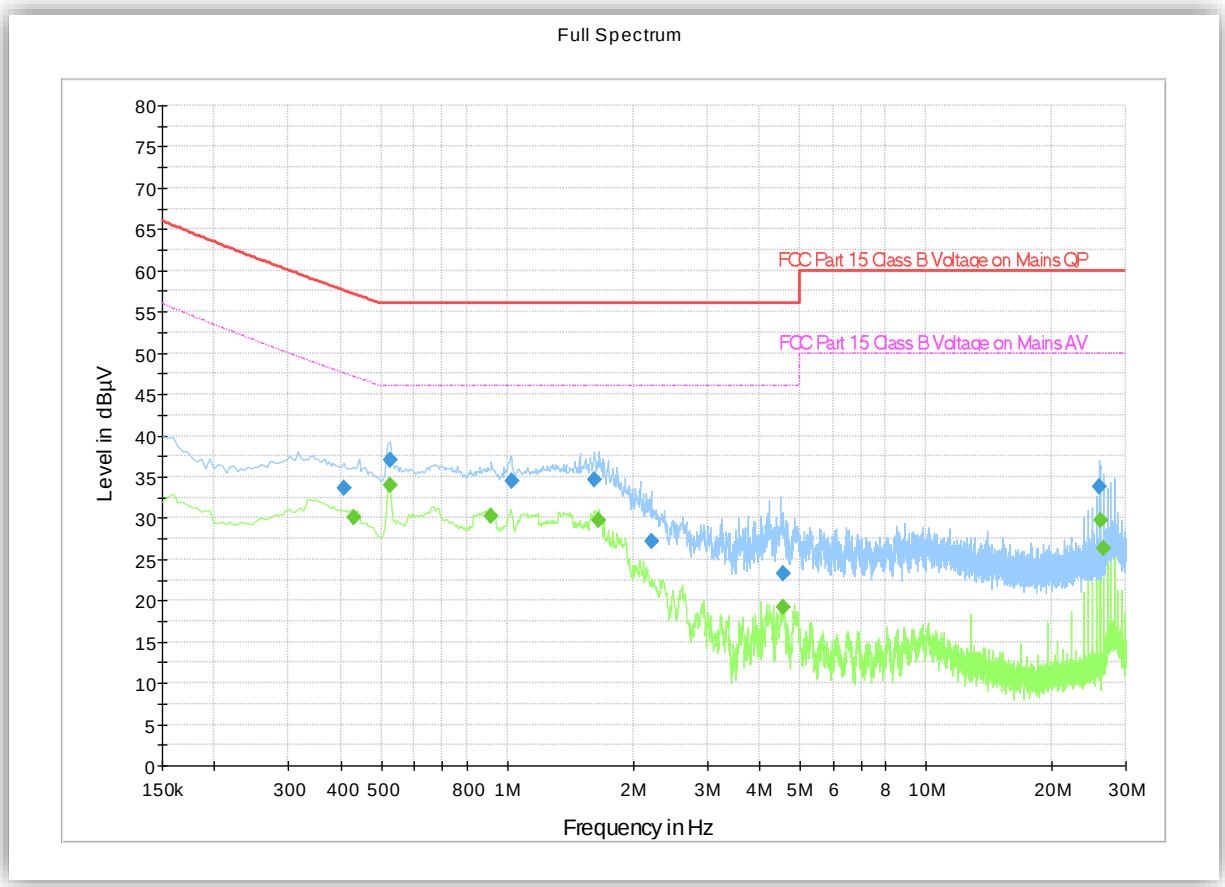
**Quasi Peak Result**

| Frequency (MHz) | QuasiPeak (dBµV) | Limit (dBµV) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Line | Filter | Corr. (dB) |
|---|---|---|---|---|---|---|---|---|
| 0.420000 | 38.69 | 57.35 | 18.66 | 1000.0 | 9.000 | L1 | OFF | 20.1 |
| 0.703500 | 40.74 | 56.00 | 15.26 | 1000.0 | 9.000 | L1 | OFF | 20.1 |
| 1.063500 | 41.50 | 56.00 | 14.50 | 1000.0 | 9.000 | L1 | OFF | 20.1 |
| 1.392000 | 41.92 | 56.00 | 14.08 | 1000.0 | 9.000 | L1 | OFF | 20.1 |
| 1.900500 | 39.60 | 56.00 | 16.40 | 1000.0 | 9.000 | L1 | OFF | 20.1 |
| 2.152500 | 36.55 | 56.00 | 19.45 | 1000.0 | 9.000 | L1 | OFF | 20.1 |
| 3.651000 | 34.71 | 56.00 | 21.29 | 1000.0 | 9.000 | L1 | OFF | 20.2 |

**Average Result**

| Frequency (MHz) | Average (dBµV) | Limit (dBµV) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Line | Filter | Corr. (dB) |
|---|---|---|---|---|---|---|---|---|
| 0.402000 | 34.93 | 47.67 | 12.74 | 1000.0 | 9.000 | L1 | OFF | 20.1 |
| 0.528000 | 38.59 | 46.00 | 7.41 | 1000.0 | 9.000 | L1 | OFF | 20.1 |
| 1.104000 | 38.12 | 46.00 | 7.88 | 1000.0 | 9.000 | L1 | OFF | 20.1 |
| 1.558500 | 38.64 | 46.00 | 7.36 | 1000.0 | 9.000 | L1 | OFF | 20.1 |
| 1.846500 | 36.10 | 46.00 | 9.90 | 1000.0 | 9.000 | L1 | OFF | 20.1 |
| 2.148000 | 33.17 | 46.00 | 12.83 | 1000.0 | 9.000 | L1 | OFF | 20.1 |
| 3.363000 | 30.68 | 46.00 | 15.32 | 1000.0 | 9.000 | L1 | OFF | 20.1 |

### 2.2.10.4 Conducted Emissions Neutral – 120V 60Hz to Eagle Board




Note: FCC Part 15 Class Limits are identical as §15.207

**Quasi Peak Result**

| Frequency (MHz) | QuasiPeak (dBµV) | Limit (dBµV) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Line | Filter | Corr. (dB) |
|---|---|---|---|---|---|---|---|---|
| 0.406500 | 33.68 | 57.61 | 23.93 | 1000.0 | 9.000 | N | OFF | 20.1 |
| 0.523500 | 36.96 | 56.00 | 19.04 | 1000.0 | 9.000 | N | OFF | 20.1 |
| 1.023000 | 34.40 | 56.00 | 21.60 | 1000.0 | 9.000 | N | OFF | 20.1 |
| 1.617000 | 34.57 | 56.00 | 21.43 | 1000.0 | 9.000 | N | OFF | 20.1 |
| 2.206500 | 27.18 | 56.00 | 28.82 | 1000.0 | 9.000 | N | OFF | 20.1 |
| 4.551000 | 23.24 | 56.00 | 32.76 | 1000.0 | 9.000 | N | OFF | 20.2 |
| 26.016000 | 33.78 | 60.00 | 26.22 | 1000.0 | 9.000 | N | OFF | 20.4 |

**Average Result**

| Frequency (MHz) | Average (dBµV) | Limit (dBµV) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Line | Filter | Corr. (dB) |
|---|---|---|---|---|---|---|---|---|
| 0.429000 | 30.04 | 47.17 | 17.13 | 1000.0 | 9.000 | N | OFF | 20.1 |
| 0.523500 | 34.03 | 46.00 | 11.97 | 1000.0 | 9.000 | N | OFF | 20.1 |
| 0.915000 | 30.17 | 46.00 | 15.83 | 1000.0 | 9.000 | N | OFF | 20.1 |
| 1.657500 | 29.71 | 46.00 | 16.29 | 1000.0 | 9.000 | N | OFF | 20.1 |
| 4.564500 | 19.20 | 46.00 | 26.80 | 1000.0 | 9.000 | N | OFF | 20.2 |
| 26.025000 | 29.78 | 50.00 | 20.22 | 1000.0 | 9.000 | N | OFF | 20.4 |
| 26.569500 | 26.32 | 50.00 | 23.68 | 1000.0 | 9.000 | N | OFF | 20.5 |

## 2.3 99% EMISSION BANDWIDTH

### 2.3.1 Specification Reference

RSS-Gen Clause 6.7

### 2.3.2 Standard Applicable

The emission bandwidth (x dB) is defined as the frequency range between two points, one above and one below the carrier frequency, at which the spectral density of the emission is attenuated x dB below the maximum in-band spectral density of the modulated signal. Spectral density (power per unit bandwidth) is to be measured with a detector of resolution bandwidth in the range of 1% to 5% of the anticipated emission bandwidth, and a video bandwidth at least 3x the resolution bandwidth.
When the occupied bandwidth limit is not stated in the applicable RSS or reference measurement method, the transmitted signal bandwidth shall be reported as the 99% emission bandwidth, as calculated or measured.

- The transmitter shall be operated at its maximum carrier power measured under normal test conditions.
- The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts.
- The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the occupied bandwidth (OBW) and video bandwidth (VBW) shall be approximately 3x RBW.

Note: Video averaging is not permitted.
A peak, or peak hold, may be used in place of the sampling detector as this may produce a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold may be necessary to determine the occupied bandwidth if the device is not transmitting continuously.
The trace data points are recovered and are directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded.
The difference between the two recorded frequencies is the 99% occupied bandwidth.

### 2.3.3 Equipment Under Test and Modification State

Serial No: D48AFCEDFCE4, D48AFCEDA2D8, D48AFCEDB5C4 / Default Test Configuration

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

October 07 and 09, 2024 / OC

### 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 (Rancho Bernardo Satellite Facility)

| | | |
|---|---|---|
| Ambient Temperature | 22.6 °C | 24.1 °C |
| Relative Humidity | 36.8 % | 47.6 % |
| ATM Pressure | 99.6 kPa | 98.8 kPa |

### 2.3.7 Additional Observations

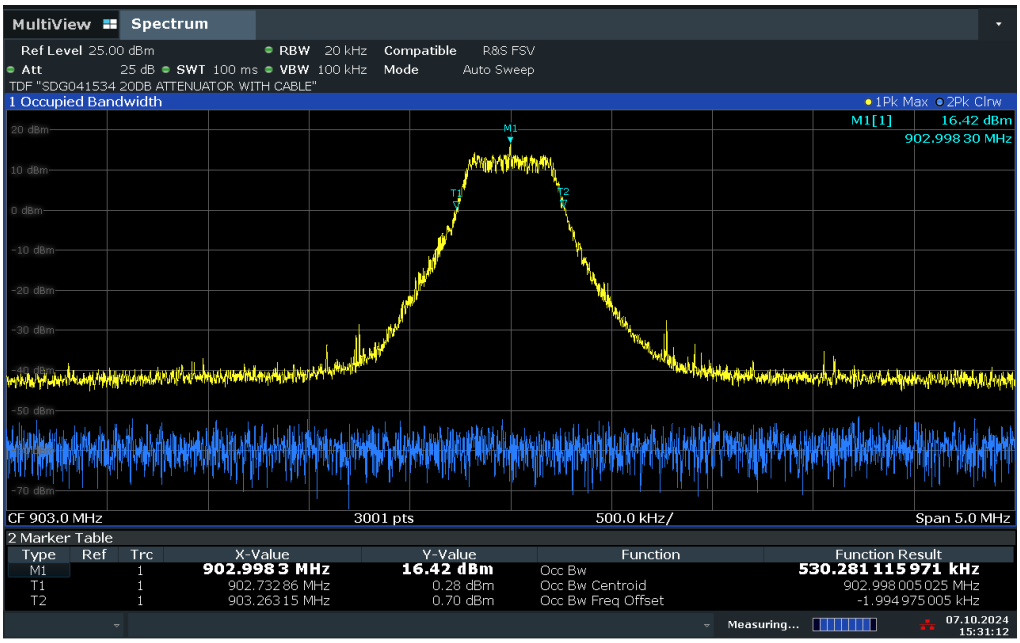
- This is a conducted test using direct connection to a spectrum analyzer.

- The path loss was all accounted for with the test setup calibration.

### 2.3.8 Test Results

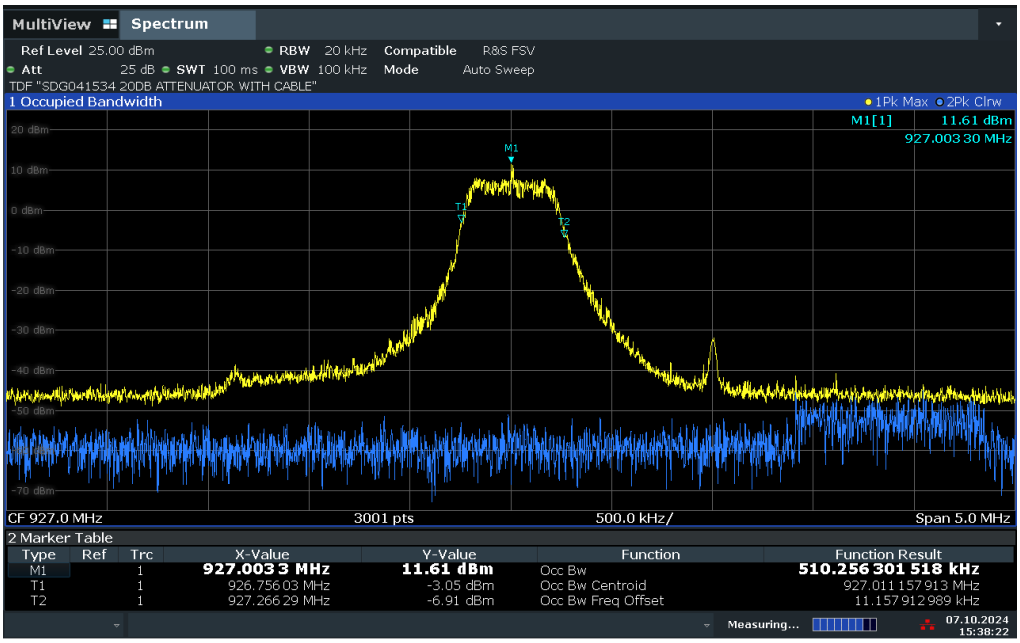
| DUT Frequency (MHz) | Spreading Factor | 99% Bandwidth (kHz) | Band Edge Left (MHz) | Band Edge Right (MHz) | Result |
|---|---|---|---|---|---|
| 903.00 | SF5 | 530.28 | ***902.73*** | 903.26 | PASS |
| 927.00 | SF5 | 510.25 | 926.75 | ***927.26*** | PASS |
| 903.00 | SF12 | 520.25 | ***902.73*** | 903.23 | PASS |
| 927.00 | SF12 | 523.32 | 926.73 | ***927.26*** | PASS |
| Operating band is from 902MHz to 928MHz. | | | | | |

### 2.3.9 Test Plots



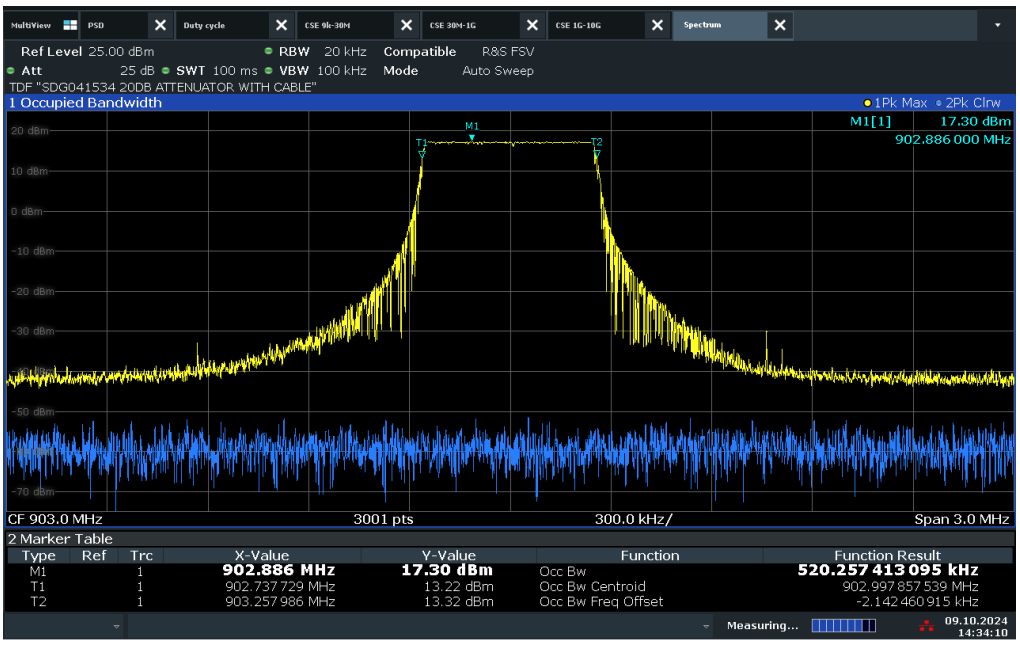

15:31:12 07.10.2024

**LoRA SF5 Low Channel**



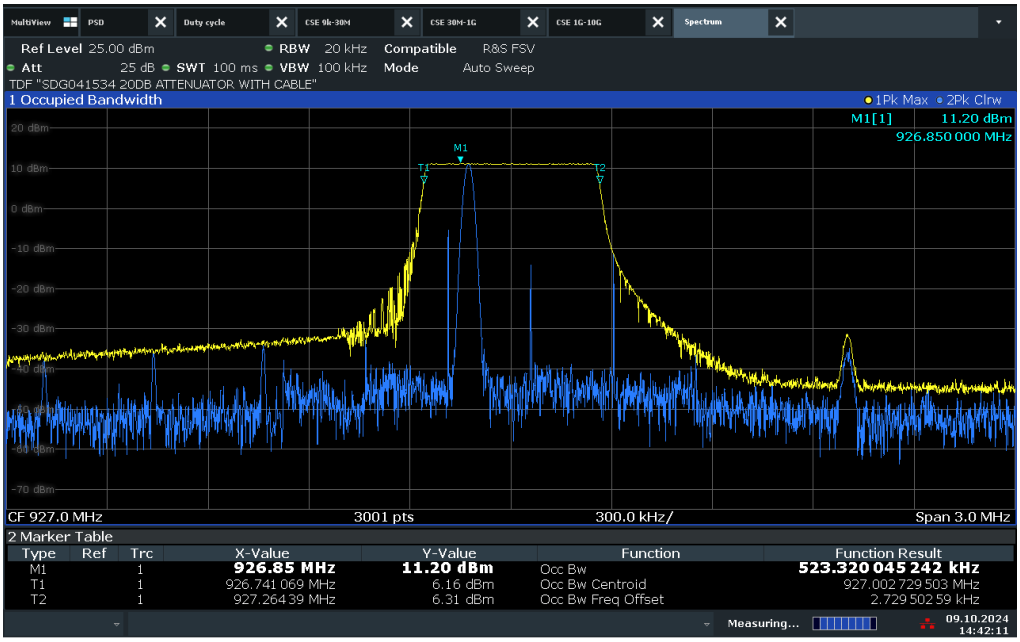

15:38:23 07.10.2024

**LoRA SF5 High Channel**




14:34:12 09.10.2024

**LoRA SF12 Low Channel**




14:42:12 09.10.2024

**LoRA SF12 High Channel**

## 2.4 MINIMUM 6 dB RF BANDWIDTH

### 2.4.1 Specification Reference

FCC 47 CFR Part 15, Clause 15.247(a)(2)
RSS-247, Clause 5.2 (a)

### 2.4.2 Standard Applicable

(2) Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

### 2.4.3 Equipment Under Test and Modification State

Serial No: D48AFCEDFCE4, D48AFCEDA2D8, D48AFCEDB5C4 / Default Test Configuration

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

October 07 and 09, 2024 / OC

### 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 (Rancho Bernardo Satellite Facility)

| | | |
|---|---|---|
| Ambient Temperature | 22.6 °C | 24.1 °C |
| Relative Humidity | 36.8 % | 47.6 % |
| ATM Pressure | 99.6 kPa | 98.8 kPa |

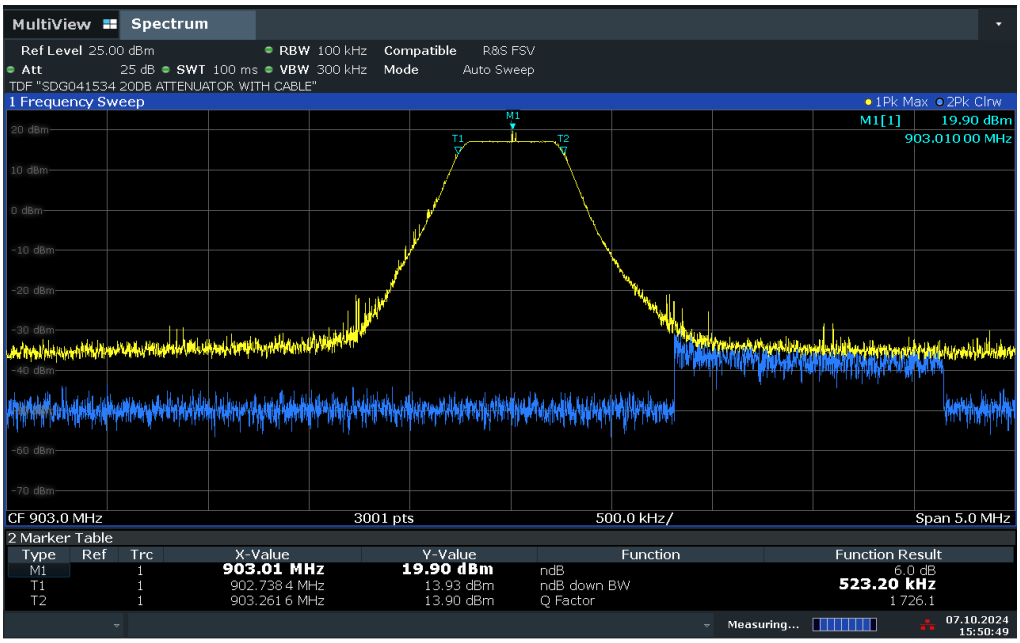
### 2.4.7 Additional Observations

- This is a conducted test using direct connection to a spectrum analyzer.
- The path loss was all accounted for with the test setup calibration.

### 2.4.8 Test Results

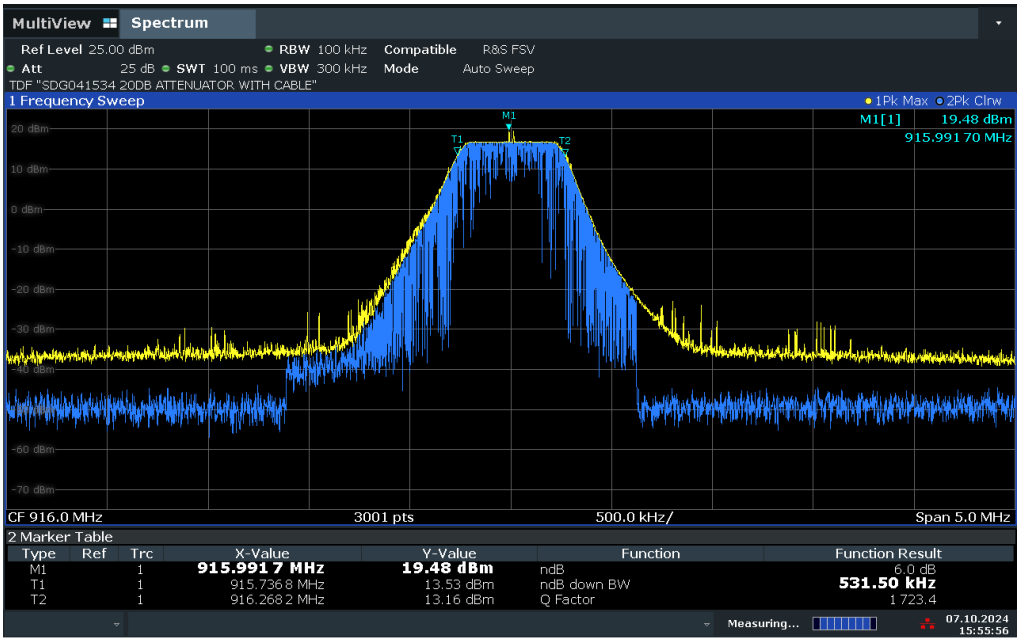
| DUT Frequency (MHz) | Spreading Factor | Limit Min (kHz) | 6 dB Bandwidth (kHz) | Result |
|---|---|---|---|---|
| 903.00 | SF12 | 500 | 523.20 | PASS |
| 916.00 | SF12 | | 531.50 | PASS |
| 927.00 | SF12 | | 523.20 | PASS |
| 903.00 | SF7 | | 598.80 | PASS |
| 916.00 | SF7 | | 607.80 | PASS |
| 927.00 | SF7 | | 599.80 | PASS |

### 2.4.9 Test Plots



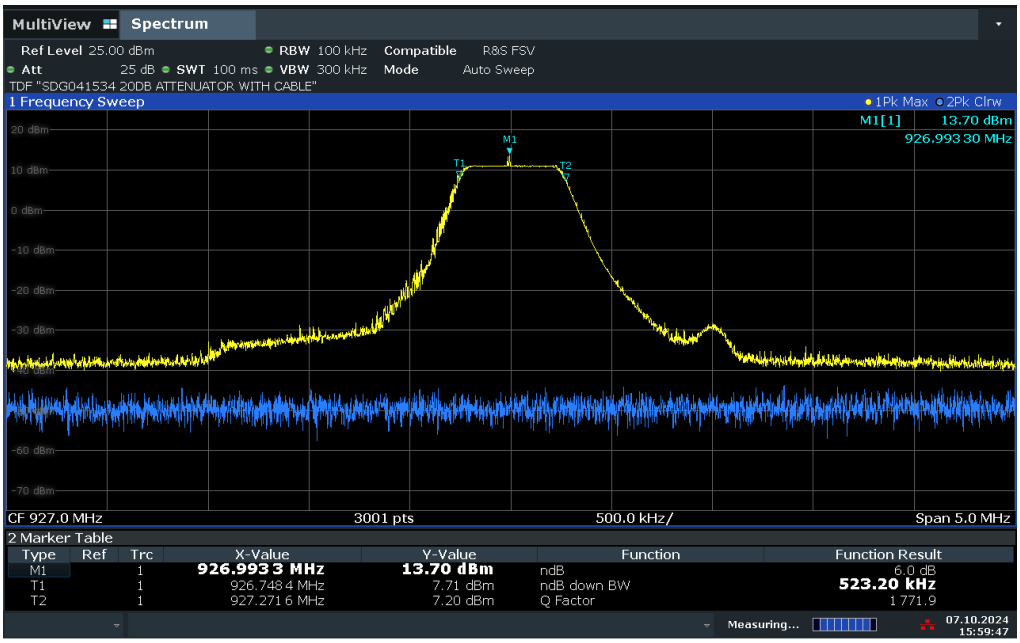

15:50:49 07.10.2024

**LoRA SF5 Low Channel**



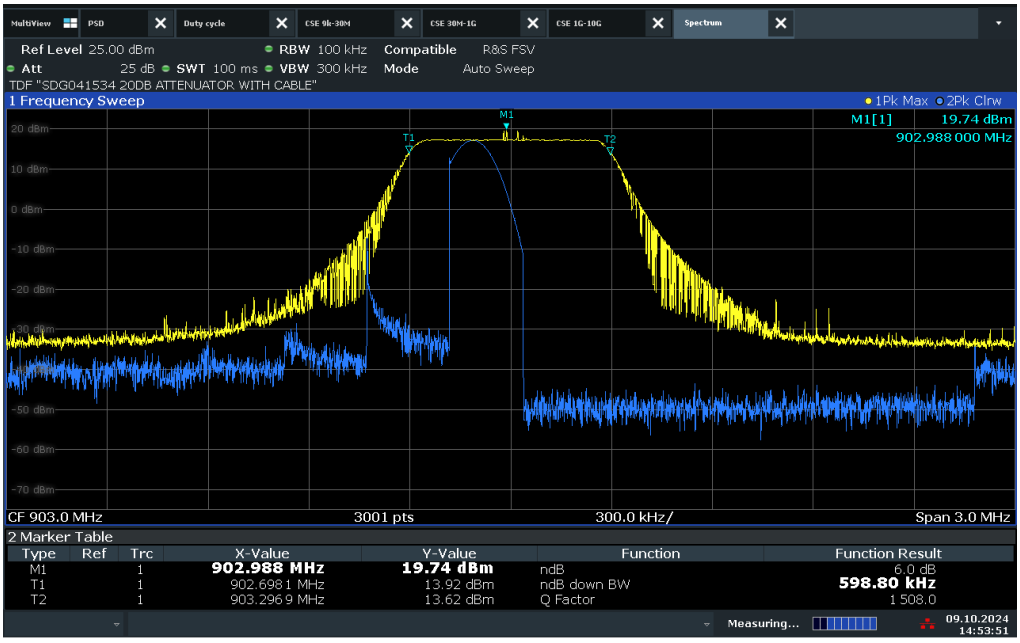

15:55:57 07.10.2024

**LoRA SF5 Middle Channel**



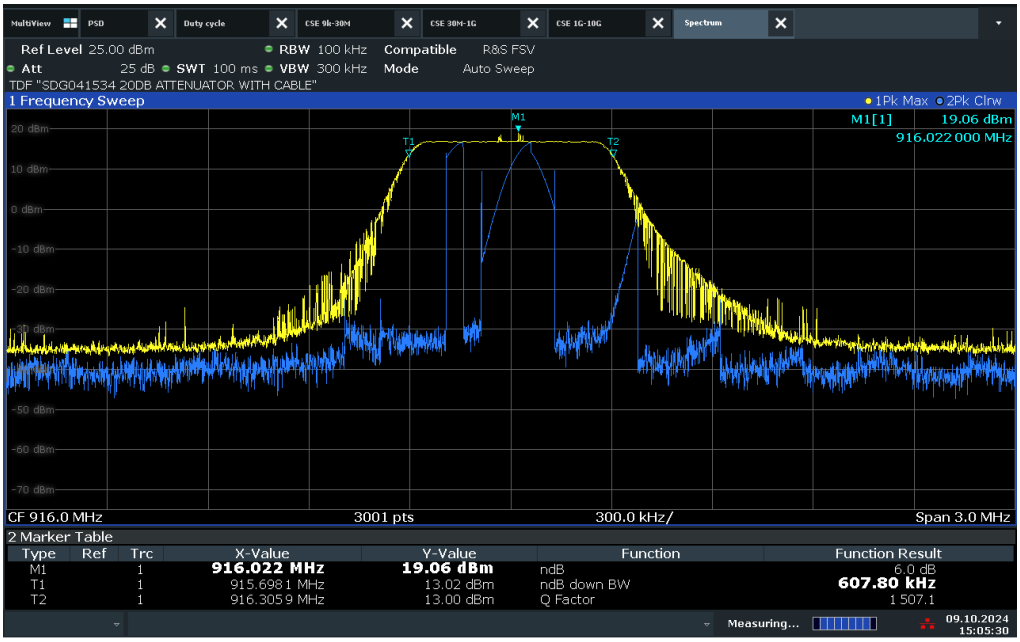

15:59:48 07.10.2024

**LoRA SF5 High Channel**



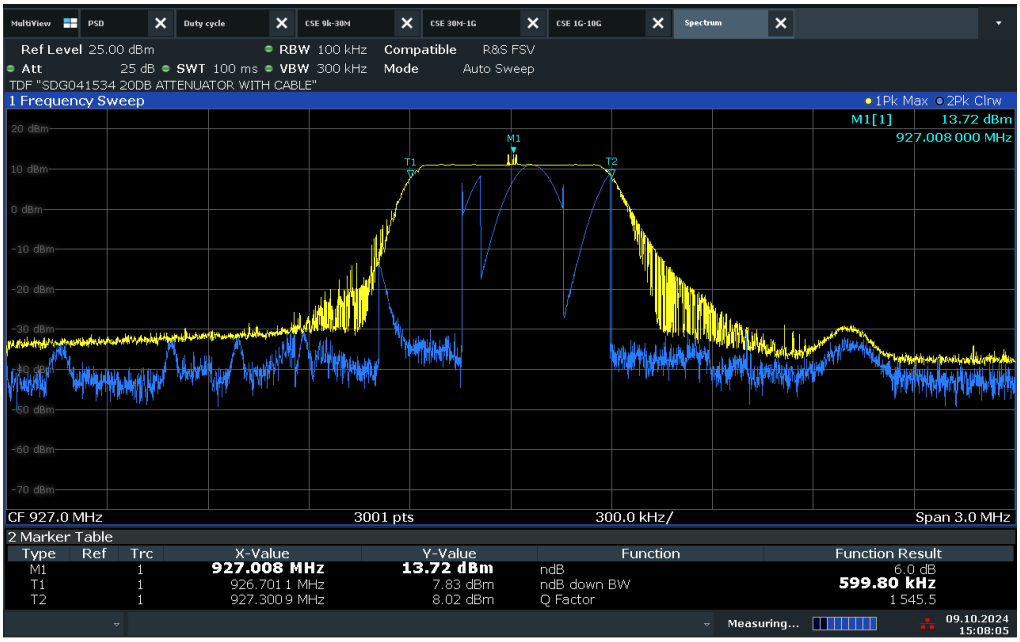

14:53:51 09.10.2024

**LoRA SF12 Low Channel**




15:05:31 09.10.2024

**LoRA SF12 Middle Channel**




15:08:06 09.10.2024

**LoRA SF12 High Channel**

## 2.5 OUT-OF-BAND EMISSIONS - CONDUCTED

### 2.5.1 Specification Reference

FCC 47 CFR Part 15, Clause 15.247(d)
RSS-247, Clause 5.5

### 2.5.2 Standard Applicable

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

### 2.5.3 Equipment Under Test and Modification State

Serial No: D48AFCEDFCE4, D48AFCEDA2D8, D48AFCEDB5C4 / Default Test Configuration

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

October 08 and 10, 2024 / OC

### 2.5.5 Test Equipment Used

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

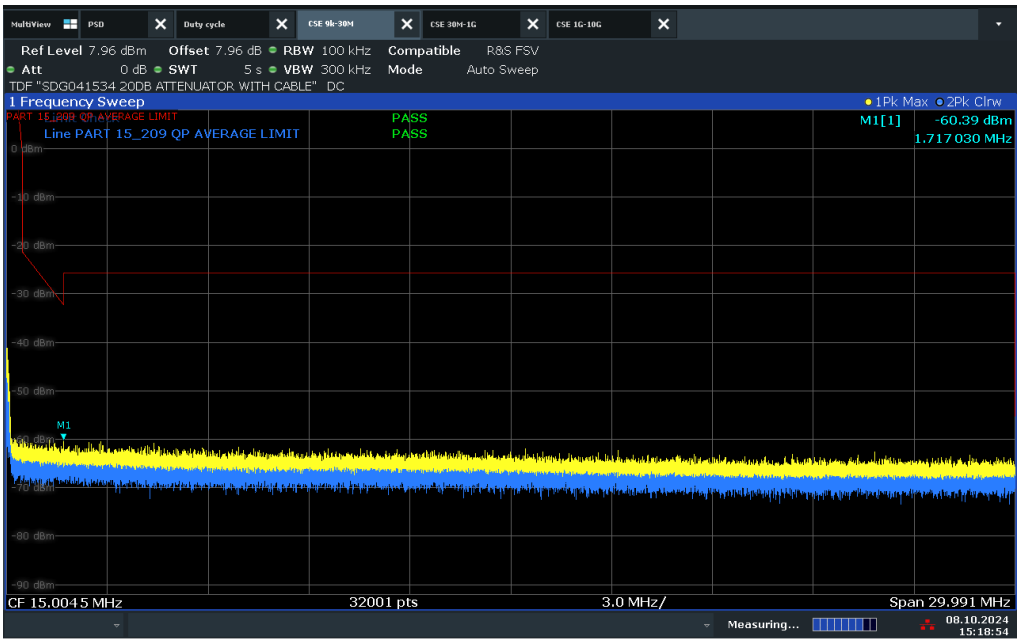
### 2.5.6 Environmental Conditions (Rancho Bernardo Satellite Facility)

| | |
|---|---|
| Ambient Temperature | 22.6 °C |
| Relative Humidity | 36.8 % |
| ATM Pressure | 99.6 kPa |

### 2.5.7 Additional Observations

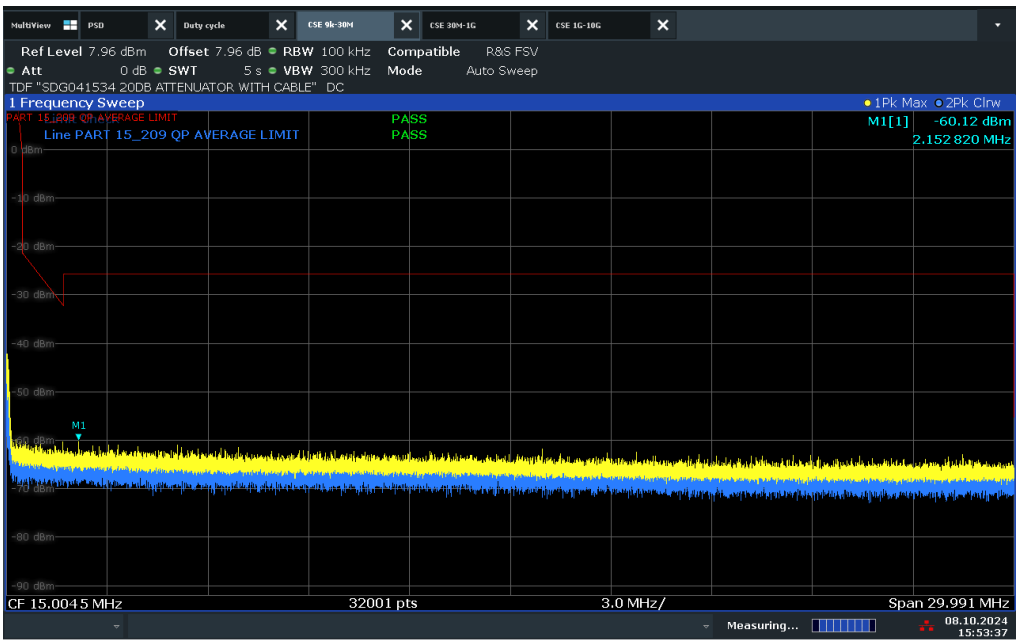
- This is a conducted test using a spectrum analyser.
- The path loss was all accounted for using a transducer factor (TDF).
- Only compliance to §15.205 presented being worse case over §15.247(d) requirements (limits of §15.247(d) is dBc).
- Limits of §15.209 is converted to EIRP using formula from Clause 12.7.2(d) of ANSI C63.10-2013. The declared antenna gain is programmed as an offset for §15.205 verification plus the appropriate maximum ground reflection factor per ANSI C63.10 Clause 11.12.2.2.

### 2.5.8 Test Results SF5



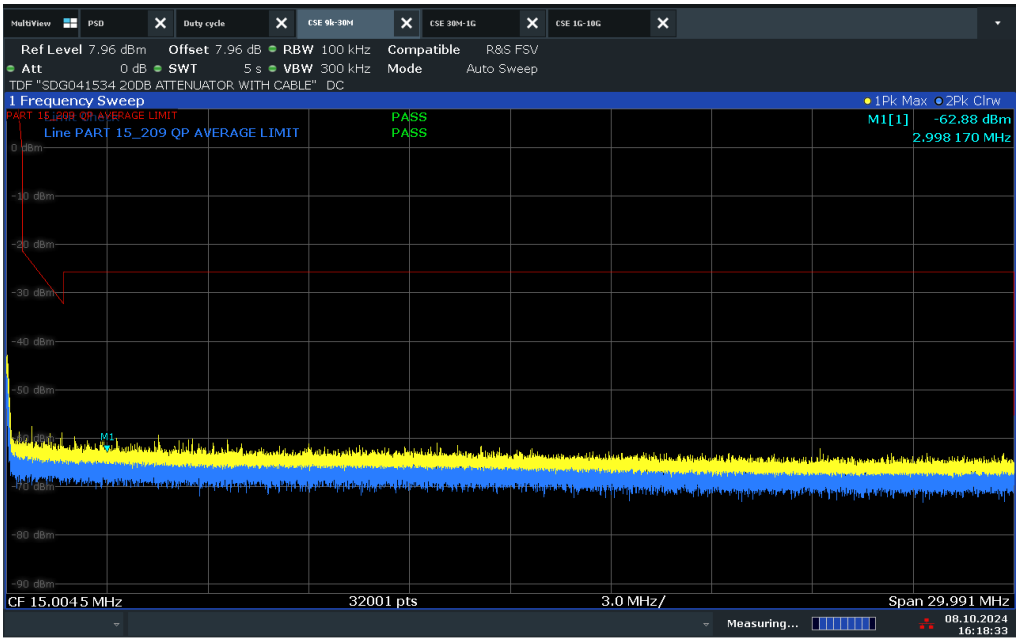

15:18:54 08.10.2024

**Low Channel (9kHz to 30MHz)**



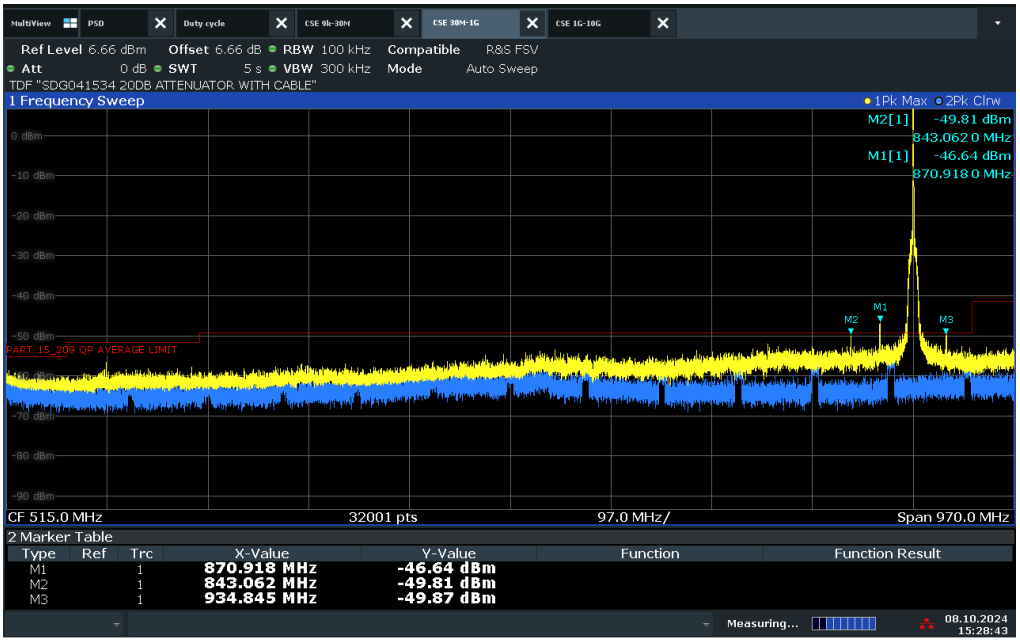

15:53:37 08.10.2024

**Middle Channel (9kHz to 30MHz)**



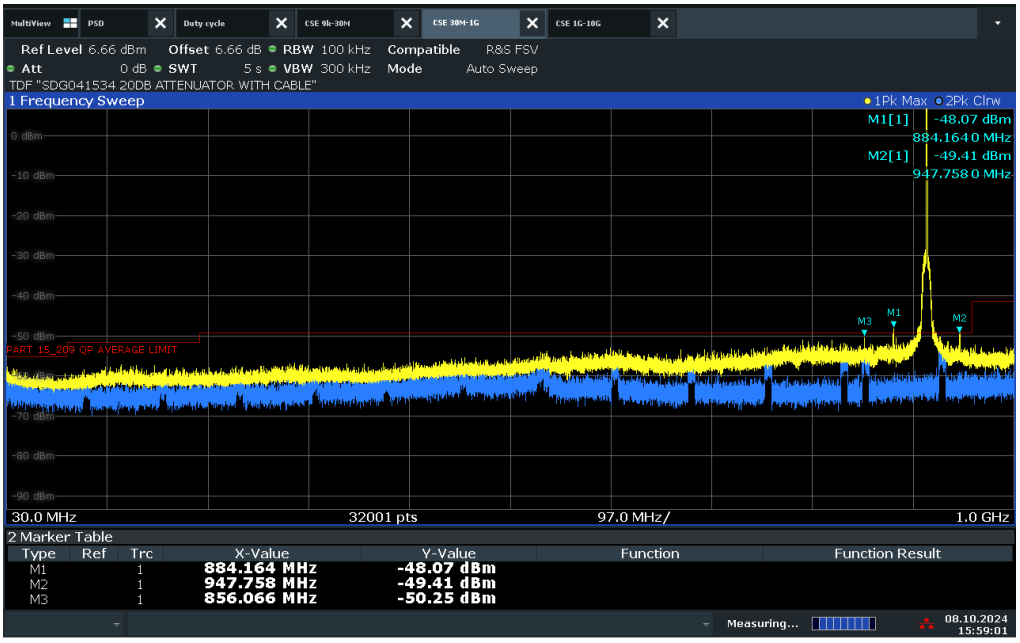

16:18:34 08.10.2024

**High Channel (9kHz to 30MHz)**



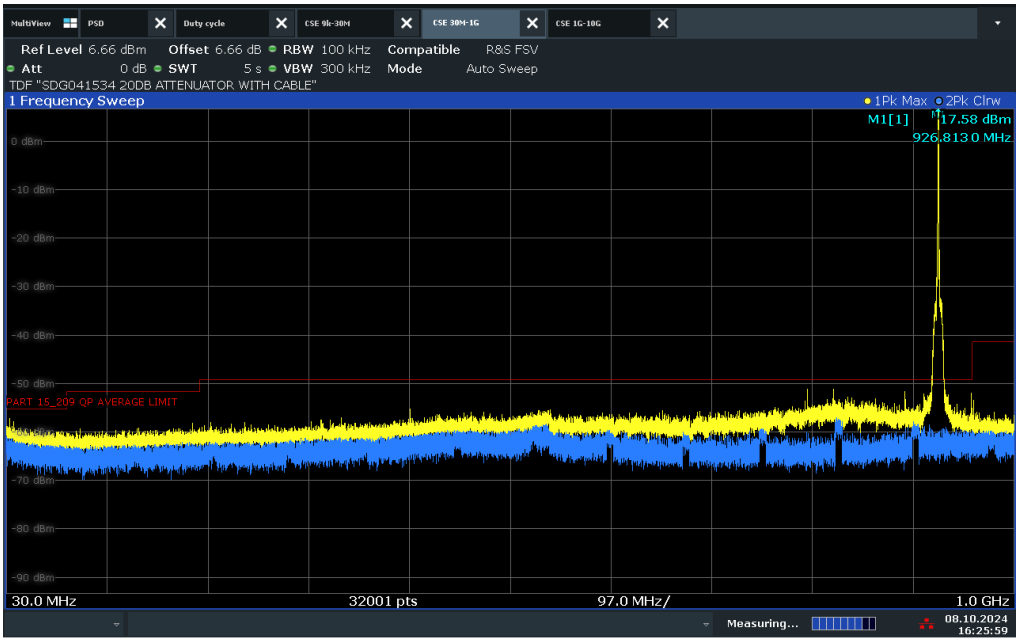

15:28:44 08.10.2024

**Low Channel (30MHz to 1GHz)**



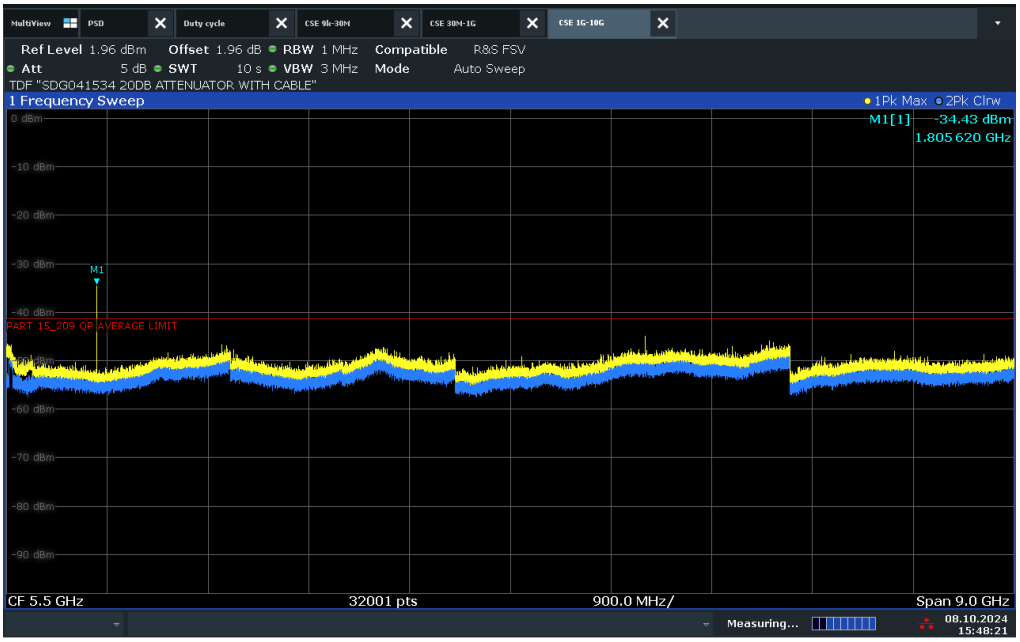

15:59:02 08.10.2024

**Middle Channel (30MHz to 1GHz)**



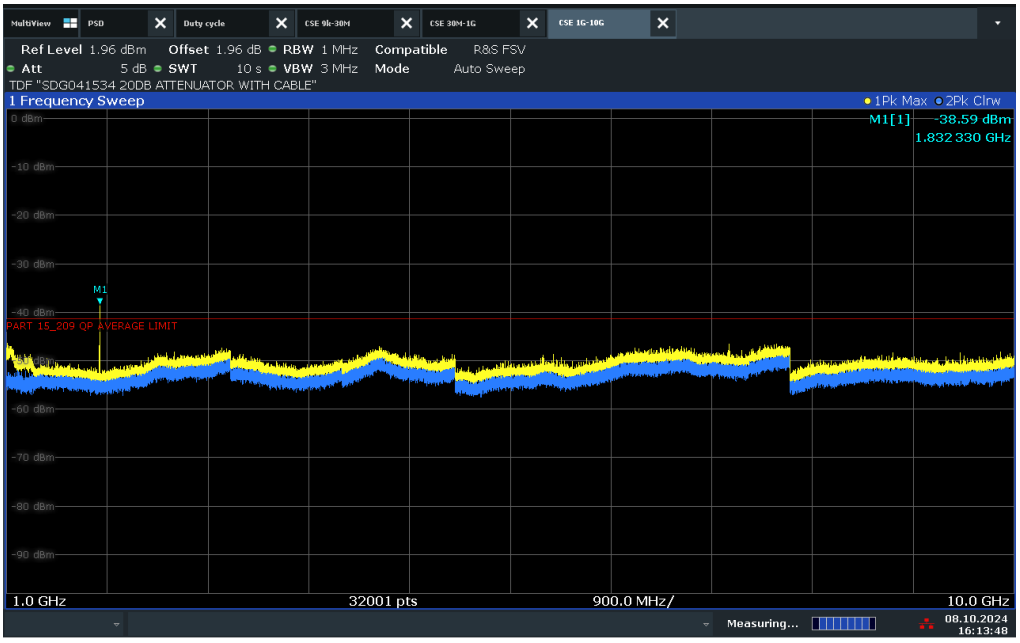

16:26:00 08.10.2024

**High Channel (30MHz to 1GHz)**



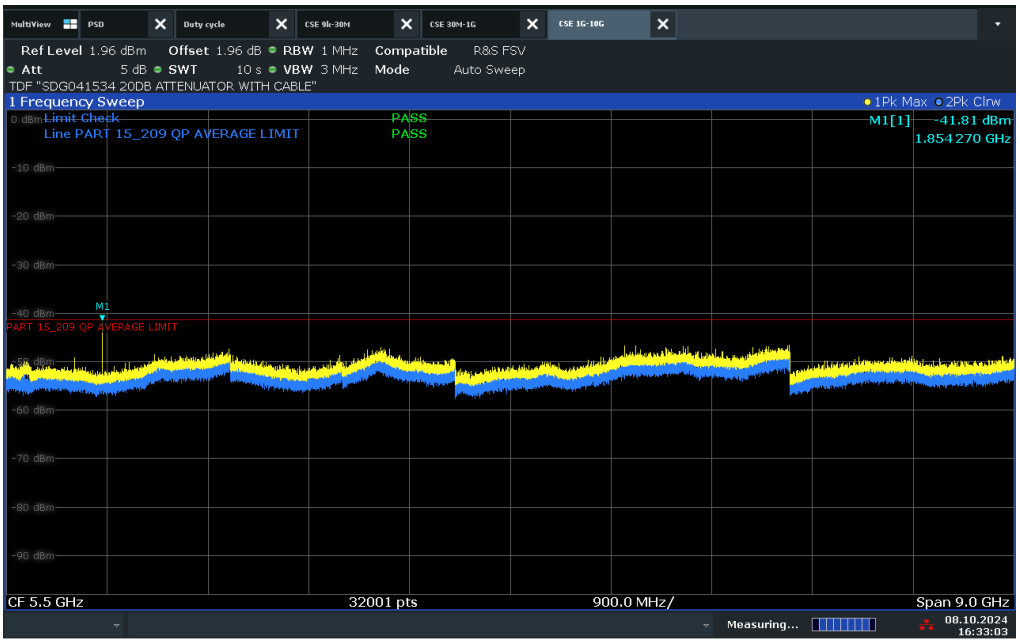

**15:48:21 08.10.2024**

**Low Channel (1GHz to 10GHz)**




**16:13:49 08.10.2024**

**Middle Channel (1GHz to 10GHz)**




**High Channel (1GHz to 10GHz)**

### 2.5.9 Sample Calculations for SF5

***Spectrum analyzer offset for 30MHz to 1GHz range:***

Offset = antenna gain + maximum ground reflection factor
= 1.96dBi + 4.7dB
= 6.66dB

***M,1 M2 and M3 marker points in the frequency range 30MHz to 1GHz:***

Reported worst case level = -46.64dBm EIRP (M1 for Low Channel)

None of M1 (870.918MHz), M2 (843.062MHz) and M3 (934.845MHz) are in the restricted bands per §15.205. Therefore, it should be subjected to §15.247(d) limits. Peak detector is used; therefore, the limit is 20dBc. Per data from Section 2.1.8 of this test report:

20.02 dBm (Peak Power for Low Channel)+ 1.96dBi (antenna gain) – (-46.64 dBm EIRP) = 68.62dB (>20dBc, EUT complies).

Note:
Same approach applies to 30MHz to 1GHz range (Mid channel reults):
None of M1(884.164MHz), M2(947.758MHz) and M3(856.066MHz)

Reported worst case level = -48.07dBm EIRP (M1 for Mid Channel)

19.54 dBm (Peak Power for Low Channel)+ 1.96dBi (antenna gain) – (-48.07 dBm EIRP) = 69.57dB (>20dBc, EUT complies).

***M1 marker point in the frequency range 1GHz to 10GHz:***

Offset = antenna gain
= 1.96dBi
= 1.96dB

Reported worst case level = -34.43 dBm EIRP (M1 for Low Channel).

M1 (1.805GHz) is not in the restricted bands per §15.205. Therefore, it should be subjected to §15.247(d) limits. Peak detector is used; therefore, the limit is 20dBc. Per data from Section 2.1.8 of this test report:
Presented M1 EIRP level is with 1MHz RBW (worst case than 100kHz).

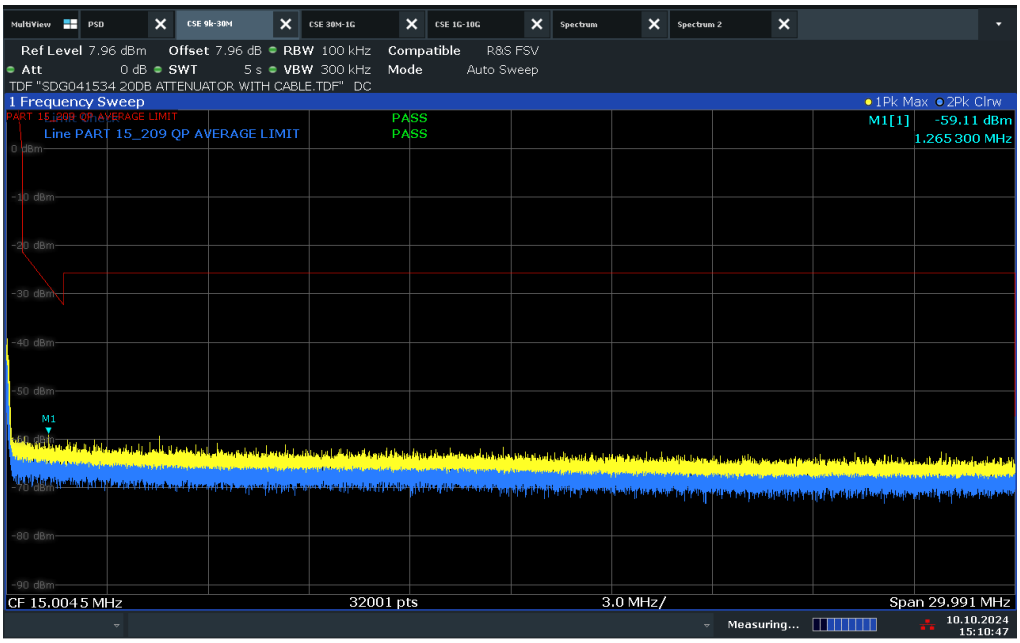
20.02 dBm (Peak Power for Low Channel)+ 1.96dBi (antenna gain) – (-34.43 dBm EIRP) = 56.41dB (>20dBc, EUT complies).

Note:
Same approach applies to 1GHz to 10GHz range (Mid channel results):
None of M1(1.832 GHz)

Reported worst case level = -38.59 EIRP (M1 for Mid Channel)

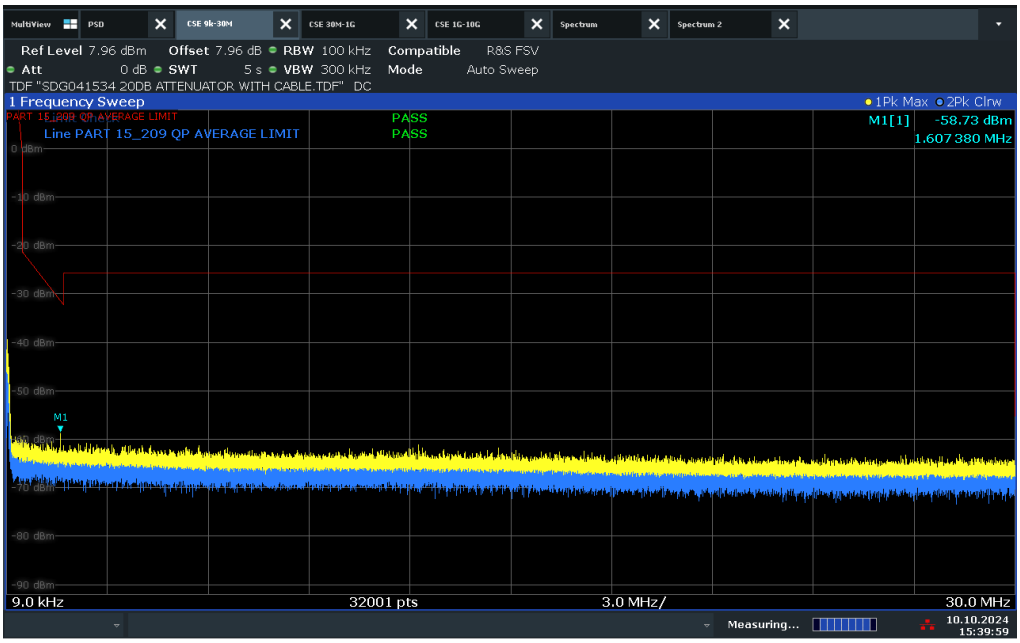
19.54 dBm (Peak Power for Low Channel)+ 1.96dBi (antenna gain) – (-38.59 dBm EIRP) = 60.09dB (>20dBc, EUT complies).

### 2.5.10 Test Results SF12



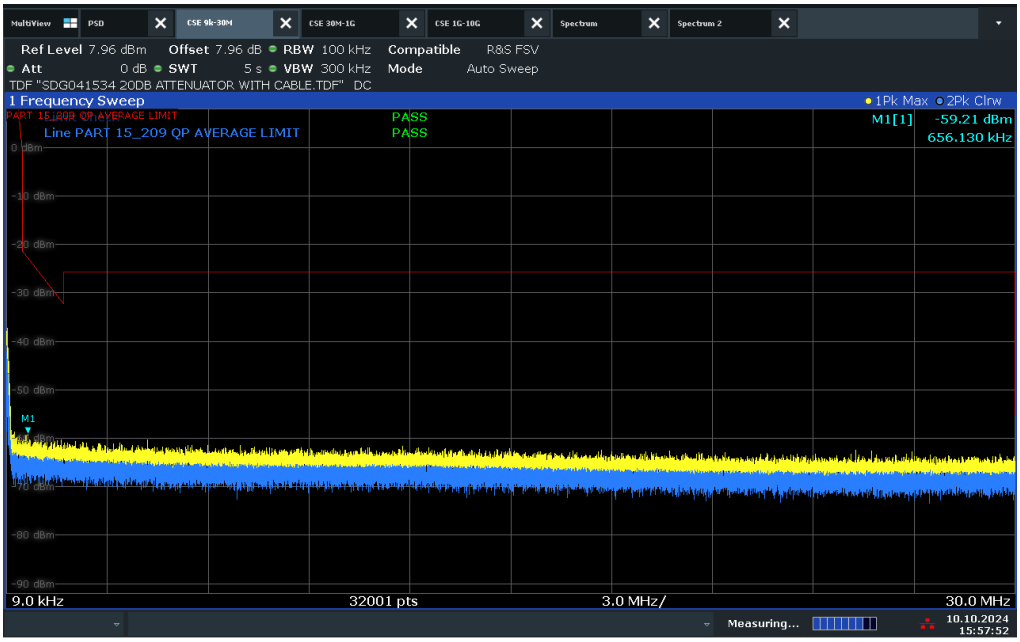

15:10:48 10.10.2024

**Low Channel (9kHz to 30MHz)**



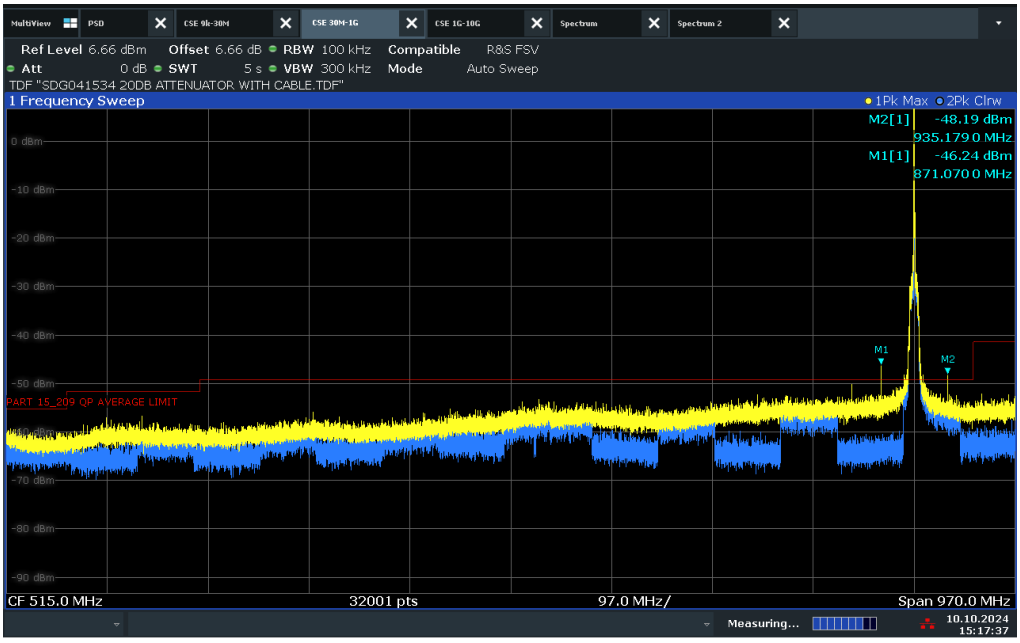

15:40:00 10.10.2024

**Middle Channel (9kHz to 30MHz)**



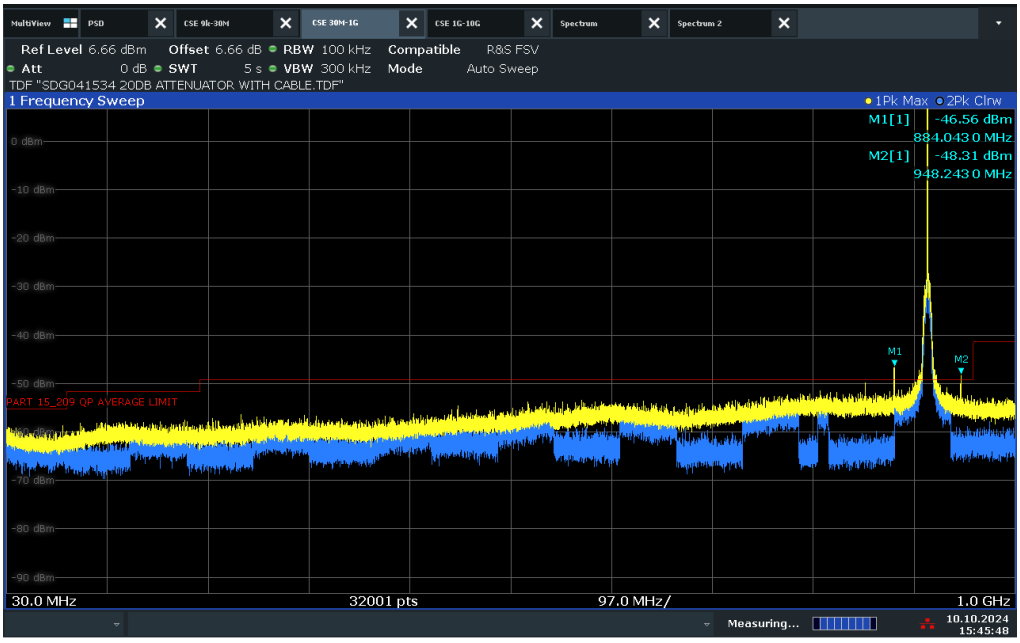

15:57:53 10.10.2024

**High Channel (9kHz to 30MHz)**



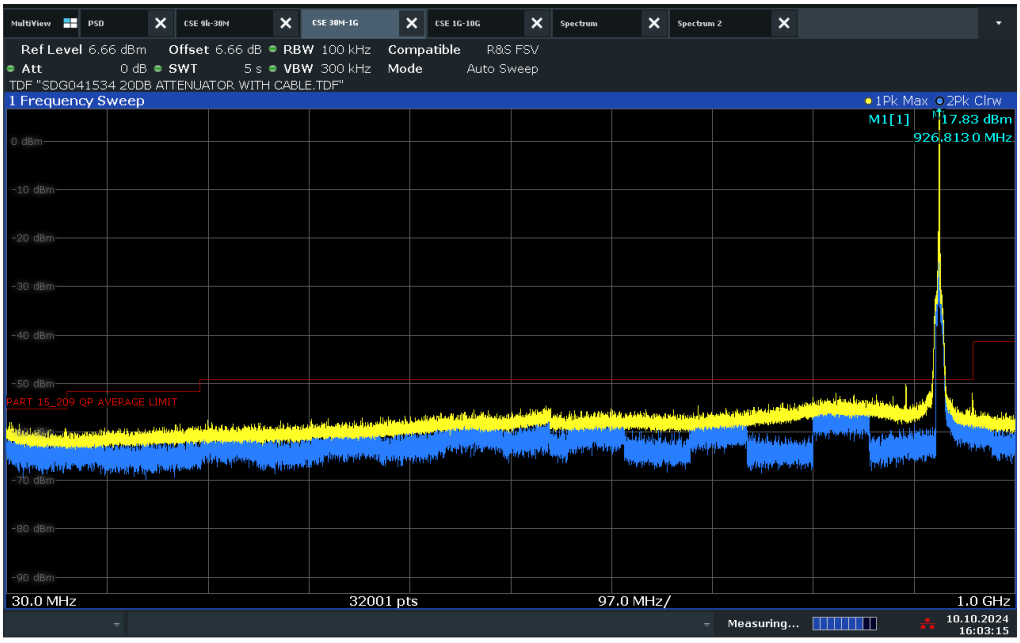

15:17:38 10.10.2024

**Low Channel (30MHz to 1GHz)**



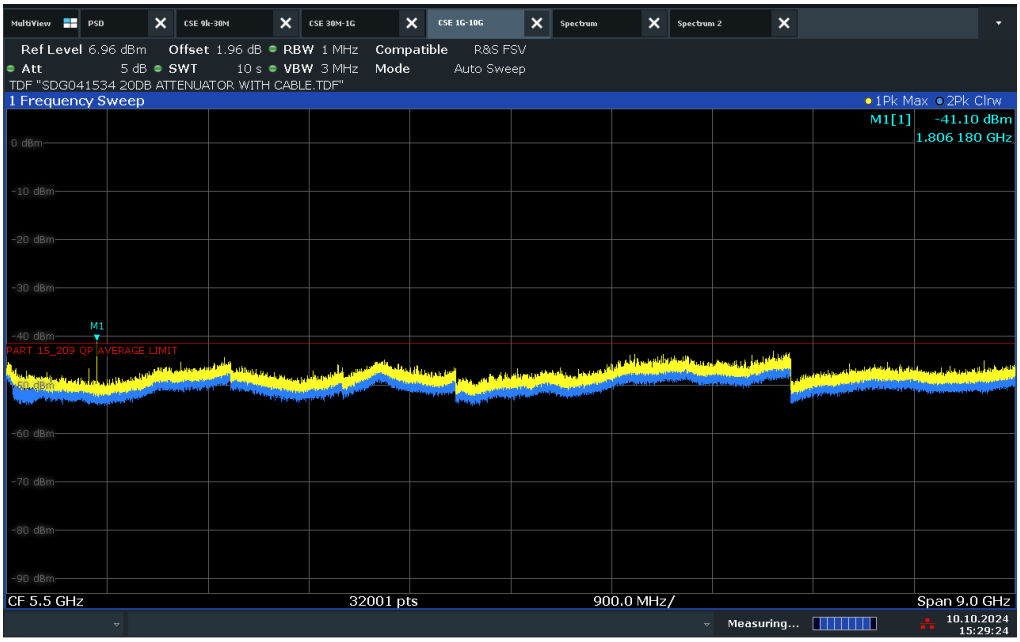

15:45:49 10.10.2024

**Middle Channel (30MHz to 1GHz)**



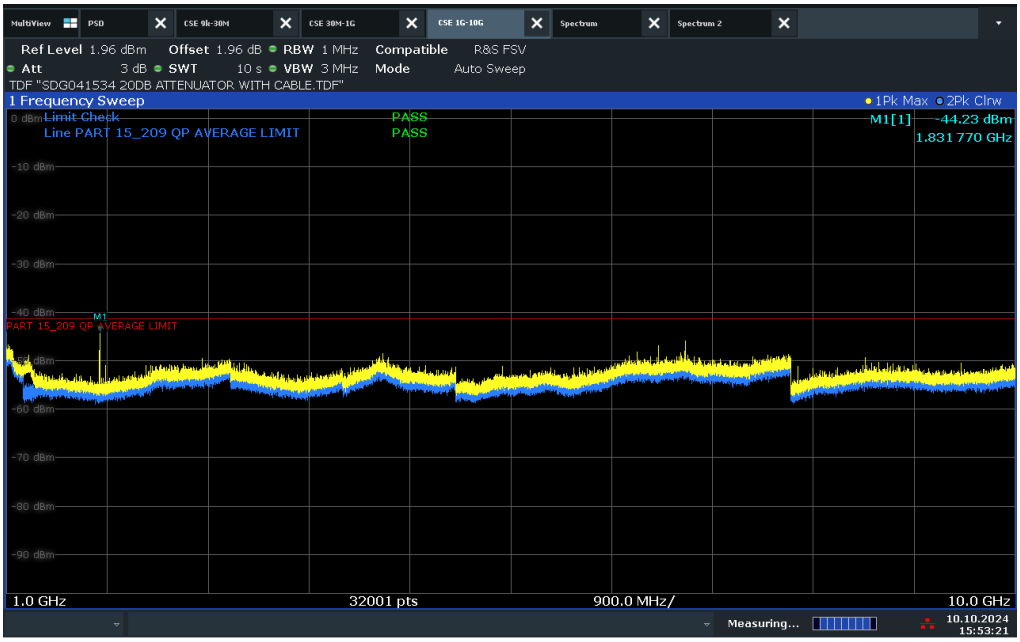

16:03:15 10.10.2024

**High Channel (30MHz to 1GHz)**



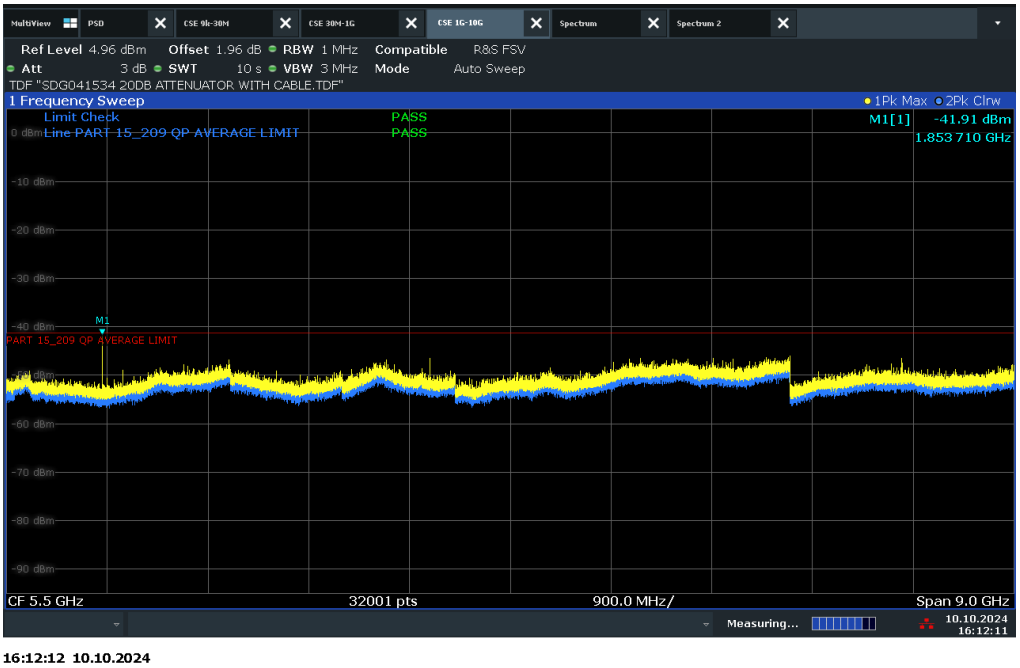

15:29:24 10.10.2024

**Low Channel (1GHz to 10GHz)**




15:53:22 10.10.2024

**Middle Channel (1GHz to 10GHz)**




16:12:12 10.10.2024

**High Channel (1GHz to 10GHz)**

### 2.5.11 Sample Calculations for SF12

***Spectrum analyzer offset for 30MHz to 1GHz range:***

Offset = antenna gain + maximum ground reflection factor
= 1.96dBi + 4.7dB
= 6.66dB

***M1 and M2 marker points in the frequency range 30MHz to 1GHz:***

Reported worst case level = -46.24dBm EIRP (M1 for Low Channel)

None of M1 (871.070MHz) and M2 (935.179MHz) are in the restricted bands per §15.205. Therefore, it should be subjected to §15.247(d) limits. Peak detector is used; therefore, the limit is 20dBc. Per data from Section 2.1.8 of this test report:

20.02 dBm (Peak Power for Low Channel)+ 1.96dBi (antenna gain) – (-46.24 dBm EIRP) = 68.22dB (>20dBc, EUT complies).

Note:
Same approach applies to 30MHz to 1GHz range (Mid channel results):
None of M1(884.043MHz) and M2(948.243MHz)

Reported worst case level = -46.56dBm EIRP (M1 for Mid Channel)

19.51 dBm (Peak Power for Low Channel)+ 1.96dBi (antenna gain) – (-46.56 dBm EIRP) = 68.03dB (>20dBc, EUT complies).

***M1 marker point in the frequency range 1GHz to 10GHz:***

Offset = antenna gain
= 1.96dBi
= 1.96dB

Reported worst case level = -41.10 dBm EIRP (M1 for Low Channel).

M1 (1.806GHz) is not in the restricted bands per §15.205. Therefore, it should be subjected to §15.247(d) limits. Peak detector is used; therefore, the limit is 20dBc. Per data from Section 2.1.8 of this test report:
Presented M1 EIRP level is with 1MHz RBW (worst case than 100kHz).

19.51 dBm (Peak Power for Low Channel)+ 1.96dBi (antenna gain) – (-41.10 dBm EIRP) = 62.57dB (>20dBc, EUT complies).

## 2.6 BAND-EDGE COMPLIANCE OF RF CONDUCTED EMISSIONS

### 2.6.1 Specification Reference

FCC 47 CFR Part 15, Clause 15.247(d)
FCC 47 CFR Part 15, Clause 15.205
RSS-247, Clause 5.5

### 2.6.2 Standard Applicable

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

### 2.6.3 Equipment Under Test and Modification State

Serial No: D48AFCEDFCE4, D48AFCEDA2D8, D48AFCEDB5C4 / Default Test Configuration

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

October 08 and 09, 2024 / OC

### 2.6.5 Test Equipment Used

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

### 2.6.6 Environmental Conditions (Rancho Bernardo Satellite Facility)

| | | |
|---|---|---|
| Ambient Temperature | 23.8 °C | 24.1 °C |
| Relative Humidity | 39.4 % | 47.6 % |
| ATM Pressure | 98.9 kPa | 98.8 kPa |

### 2.6.7 Additional Observations

- This is a conducted test using Peak Detection per ANSI C63.10 Subclause 11.13.3.2.
- The path loss was all accounted for using a transducer factor.
- Limits used are from Section 2.1.8 of this test report. Peak results from Low and High channels are used adjusted 20 dB below in the 100 kHz bandwidth within the band.

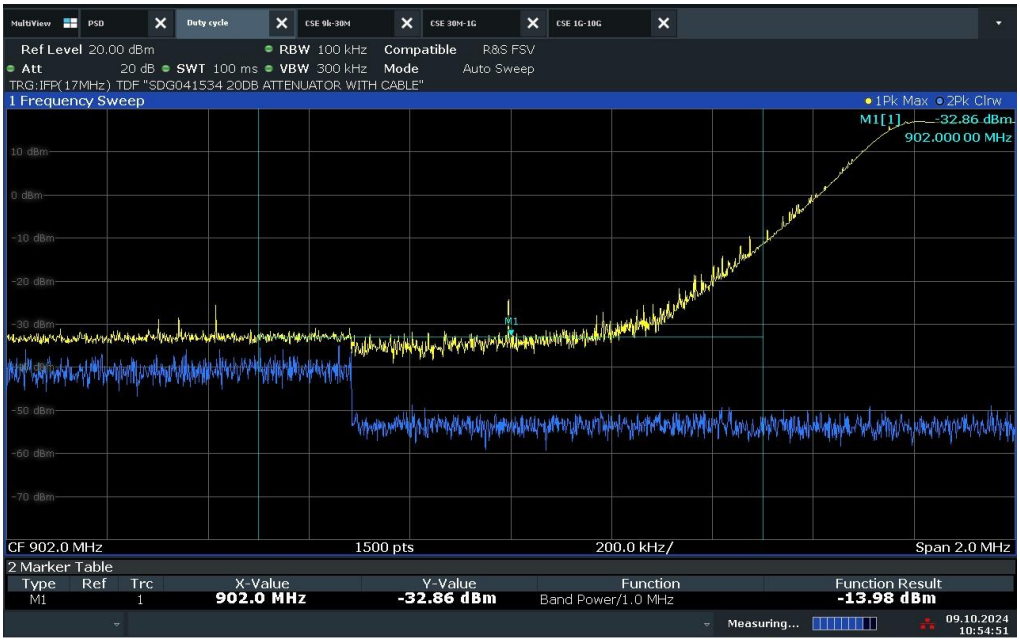
### 2.6.8 Test Results (Lower Band Edge)

| Modulation | Frequency (MHz) | Level (dBm) | Margin (dB) | Limit (dBm) | Result |
|---|---|---|---|---|---|
| SF5 | 902.00 | -13.98 | 14 | 0.02 | Complies |
| SF12 | 902.00 | -13.08 | 13.1 | 0.02 | Complies |

### 2.6.9 Test Results (Upper Band Edge)

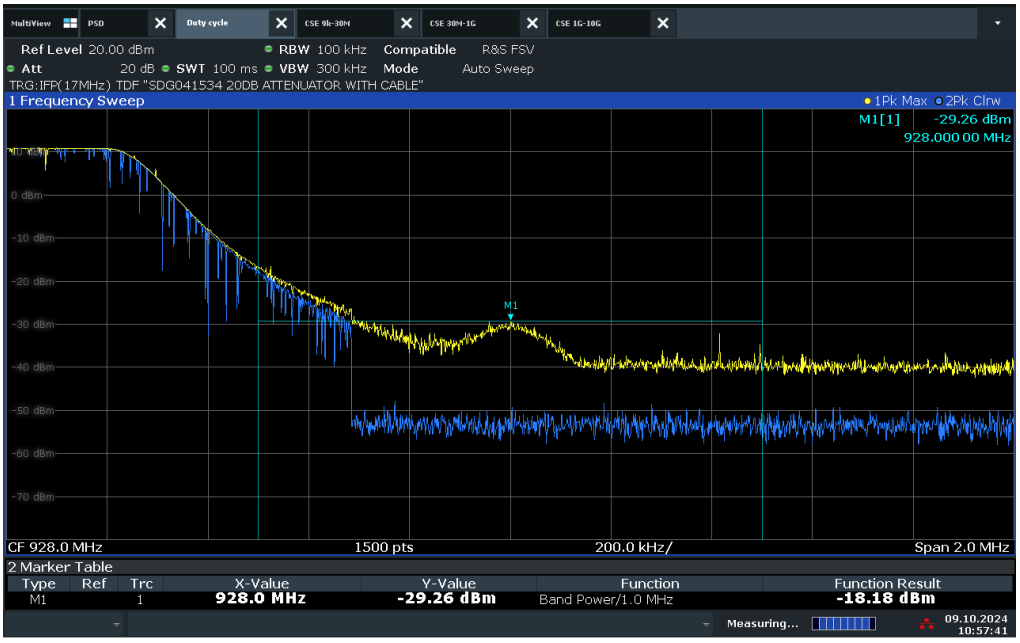
| Modulation | Frequency (MHz) | Level (dBm) | Margin (dB) | Limit (dBm) | Result |
|---|---|---|---|---|---|
| SF5 | 928.00 | -18.18 | 10.82 | -7.36 | Complies |
| SF12 | 928.00 | -18.26 | 11.81 | -6.45 | Complies |

### 2.6.10 Test Plots



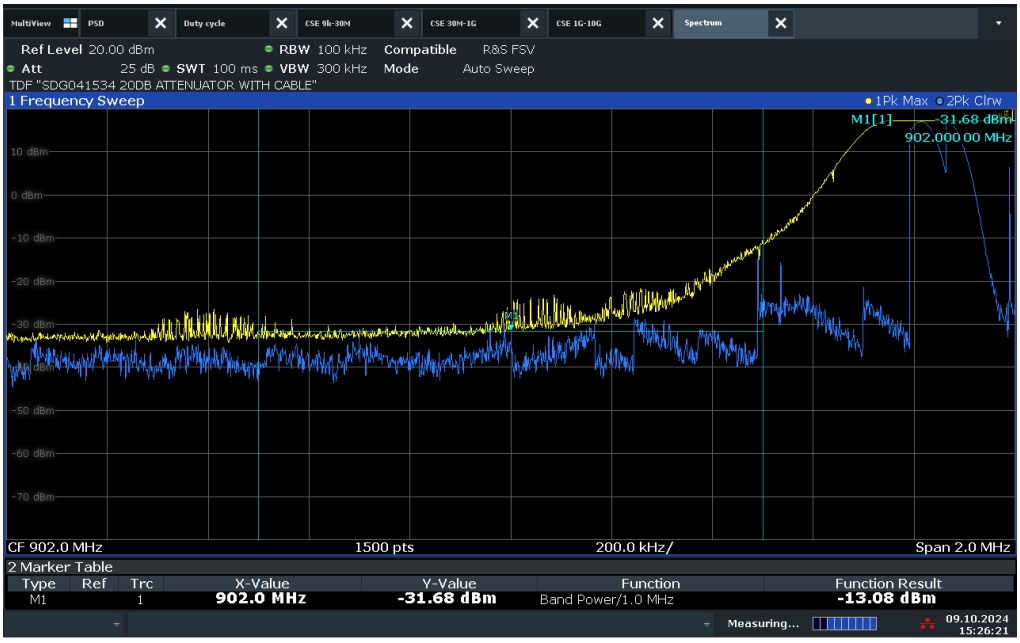

10:54:52 09.10.2024

**LoRA SF5 Low Channel**



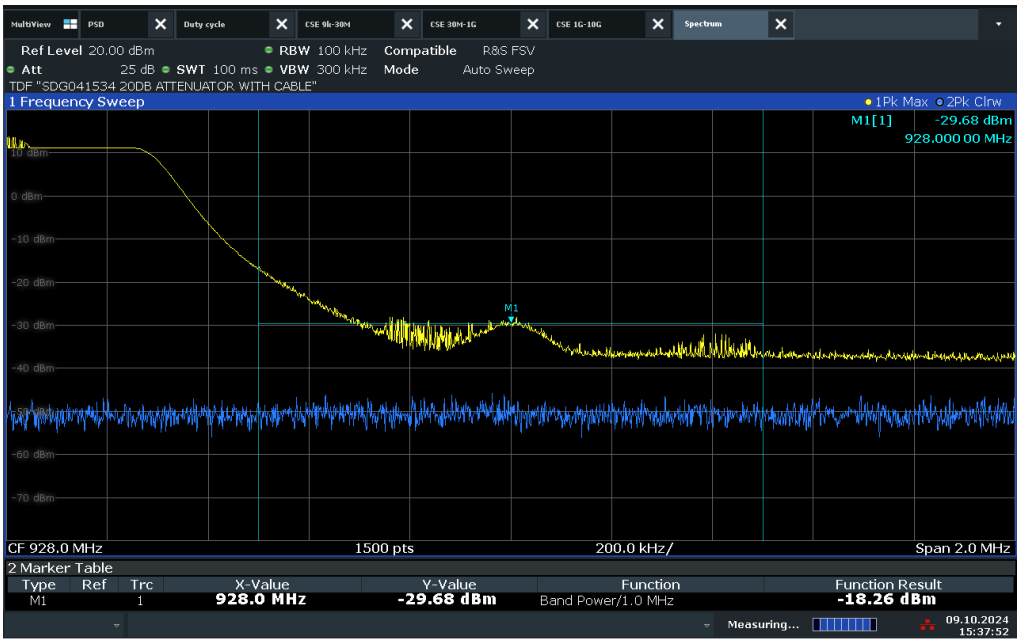

10:57:42 09.10.2024

**LoRA SF5 High Channel**




15:26:21 09.10.2024

**LoRA SF12 Low Channel**




**15:37:53 09.10.2024**

**LoRA SF12 High Channel**

## 2.7 RADIATED SPURIOUS EMISSIONS

### 2.7.1 Specification Reference

FCC 47 CFR Part 15, Clause 15.247(d)
RSS-247, Clause 5.5

### 2.7.2 Standard Applicable

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

### 2.7.3 Equipment Under Test and Modification State

Serial No: D48AFCEDFCE4, D48AFCEDA2D8, D48AFCEDB5C4/ Default Test Configuration

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

October 15 and 16, 2024 / OC

### 2.7.5 Test Equipment Used

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

### 2.7.6 Environmental Conditions (Mira Mesa)

| | |
|---|---|
| Ambient Temperature | 23.7 °C |
| Relative Humidity | 33.2 % |
| ATM Pressure | 100.3 kPa |

### 2.7.7 Additional Observations

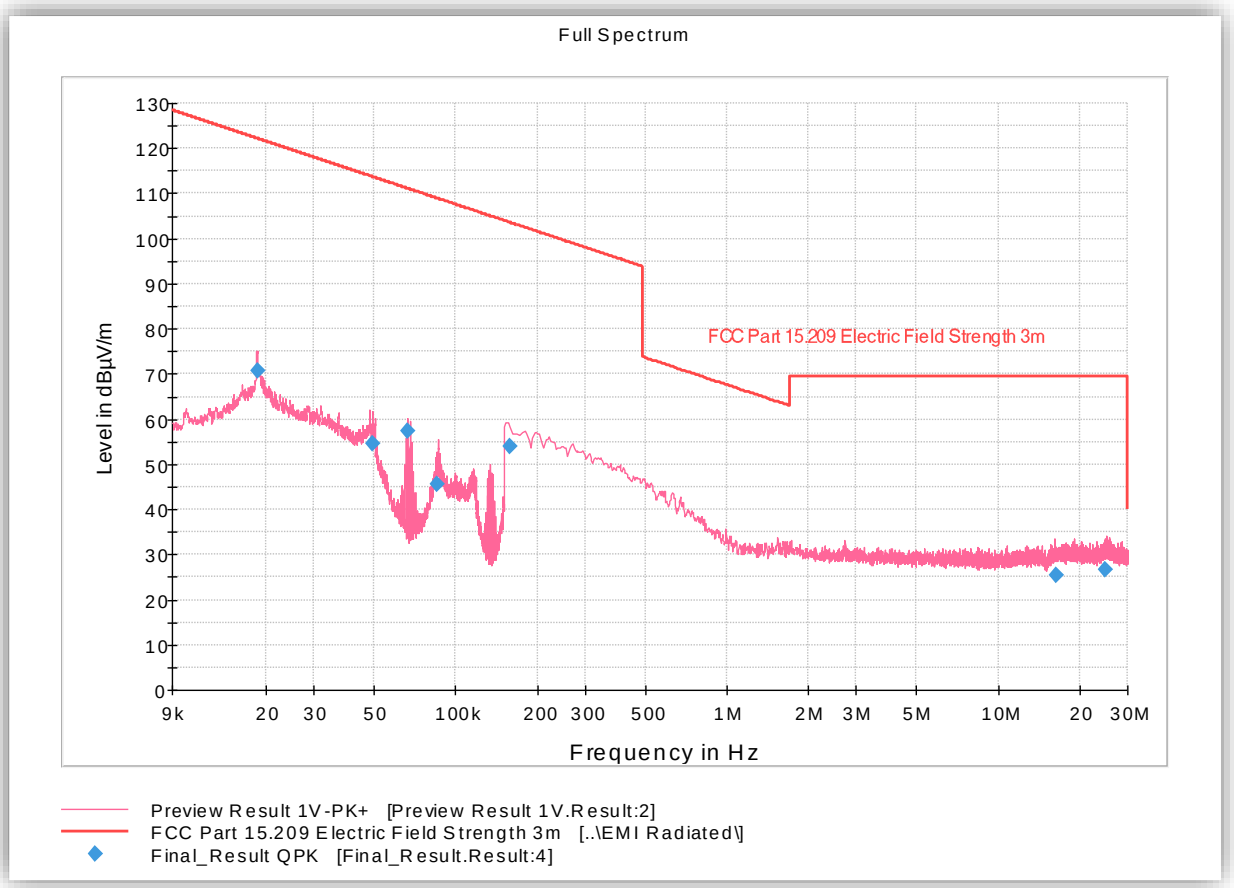
- This is a radiated test. The spectrum was searched from 9kHz to the 10$^{th}$ harmonic.
- There are no emissions found that do not comply to the restricted bands defined in FCC Part 15 Subpart C, 15.205 or Part 15.247(d).
- Only the worst-case spreading factor presented (SF12) per test plan. There are no significant differences in emissions between channels when verifying cabinet spurious emissions.
- Antenna port terminated with a 50 Ω load. Emissions coming out of the cabinet being verified.

- Measurement was 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 2.7.8 for sample computation.

### 2.7.8 Sample Computation (Radiated Emission)

| | | | |
|---|---|---|---|
| Measuring equipment raw measurement (dbµV) @ 30 MHz | | | -0.8 |
| Correction Factor (dB/m) | Asset# 1066 (cable) | 18.1 | 12.6 |
| | Asset# 1172 (cable) | 0.3 | |
| | Asset# 1175(cable) | 0.3 | |
| | Asset# 1002 (antenna) | 17.2 | |
| **Reported QuasiPeak Final Measurement (dbµV/m) @ 30MHz** | | | **11.8** |

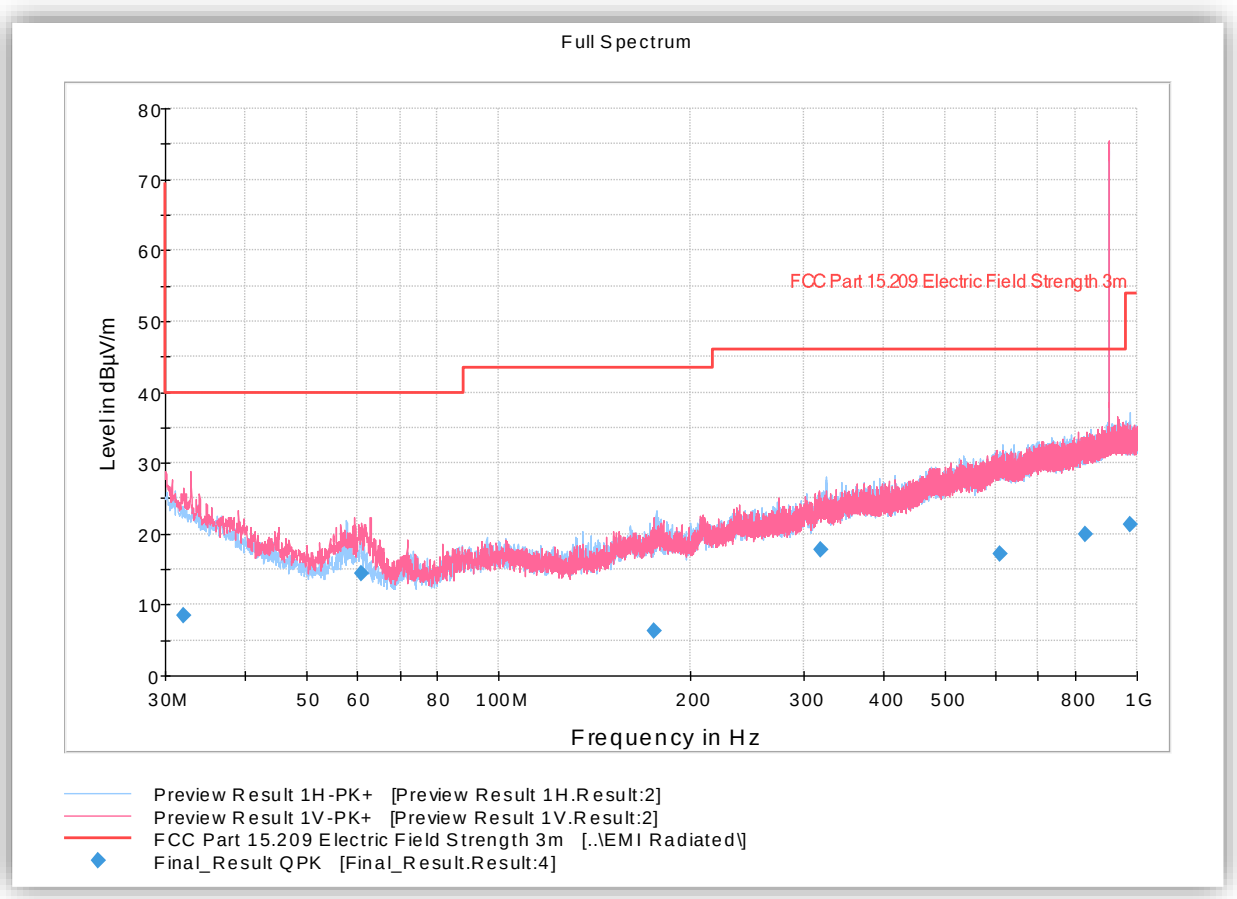
### 2.7.9 Test Results for 9kHz to 30MHz (worst-case channel and spreading factor)




**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) |
|---|---|---|---|---|---|---|---|---|---|
| 0.018535 | 70.59 | 122.24 | 51.64 | 1000. | 0.200 | 400.0 | H | 169.0 | 22 |
| 0.049052 | 54.59 | 113.79 | 59.20 | 1000. | 0.200 | 400.0 | H | 163.0 | 20 |
| 0.066680 | 57.32 | 111.12 | 53.80 | 1000. | 0.200 | 400.0 | H | 202.0 | 20 |
| 0.085103 | 45.59 | 109.00 | 63.41 | 1000. | 0.200 | 400.0 | H | 41.0 | 20 |
| 0.158500 | 53.85 | 103.60 | 49.75 | 1000. | 9.000 | 400.0 | H | 325.0 | 20 |
| 16.429970 | 25.59 | 69.50 | 43.91 | 1000. | 9.000 | 400.0 | H | 116.0 | 22 |
| 24.785381 | 26.66 | 69.50 | 42.84 | 1000. | 9.000 | 400.0 | H | 46.0 | 24 |

### 2.7.10 Test Results for 30MHz to 1GHz Low Channel

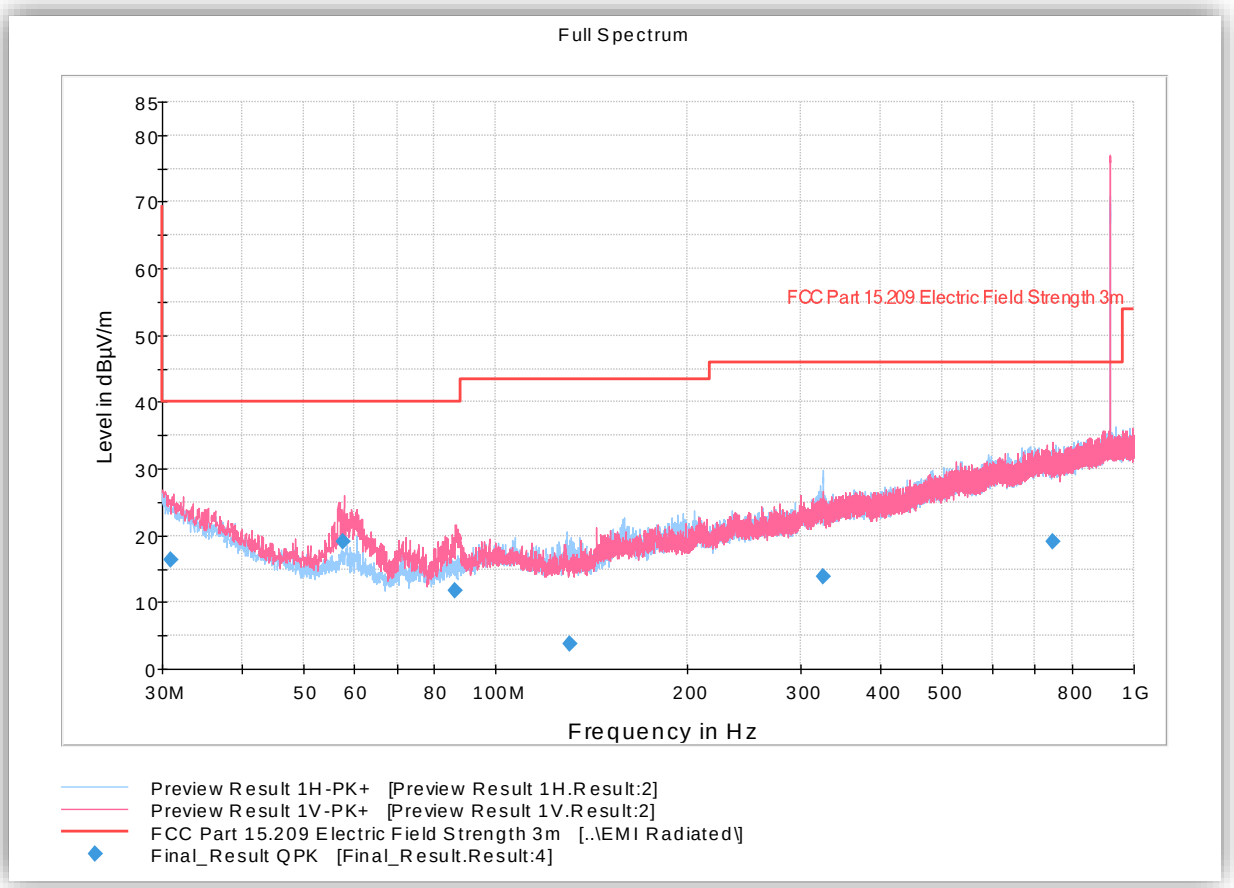



**Quasi Peak Data**

| Frequency (MHz) | QuasiPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB/m) |
|---|---|---|---|---|---|---|---|---|---|
| 32.117667 | 8.40 | 40.00 | 31.60 | 1000. | 120.000 | 175.0 | V | 319.0 | 21 |
| 60.719333 | 14.36 | 40.00 | 25.64 | 1000. | 120.000 | 160.0 | V | 4.0 | 13 |
| 175.03366 | 6.31 | 43.50 | 37.19 | 1000. | 120.000 | 233.0 | V | 47.0 | 17 |
| 319.58166 | 17.85 | 46.00 | 28.15 | 1000. | 120.000 | 302.0 | H | 270.0 | 21 |
| 609.44400 | 17.27 | 46.00 | 28.73 | 1000. | 120.000 | 335.0 | H | 279.0 | 28 |
| 830.83533 | 19.88 | 46.00 | 26.12 | 1000. | 120.000 | 136.0 | H | 313.0 | 30 |
| 975.44600 | 21.33 | 53.90 | 32.57 | 1000. | 120.000 | 255.0 | H | 286.0 | 31 |

**Test Notes:** Fundamental will be ignored for this test (antenna port terminated).

### 2.7.11 Test Results for 30MHz to 1GHz Middle Channel

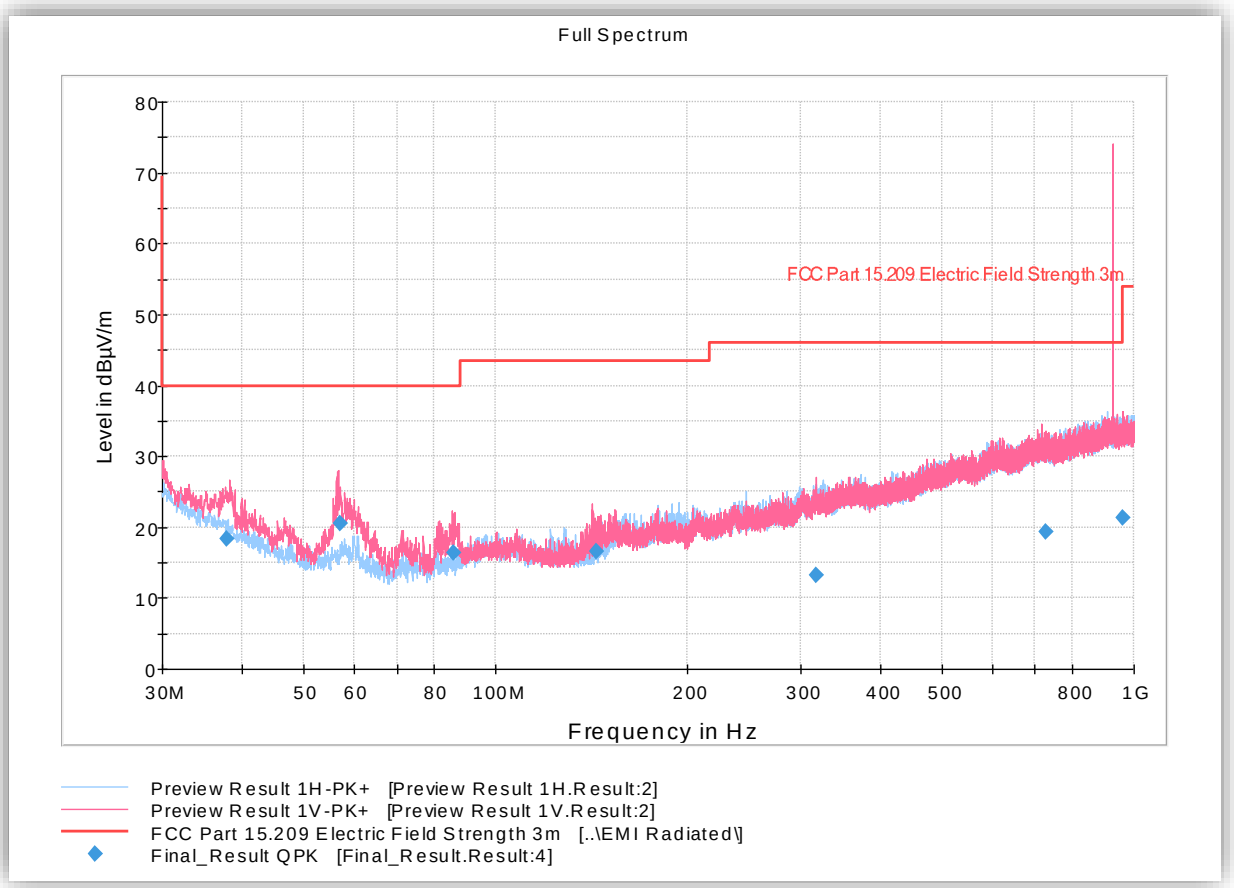



**Quasi Peak Data**

| Frequency (MHz) | QuasiPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB/m) |
|---|---|---|---|---|---|---|---|---|---|
| 30.867667 | 16.45 | 40.00 | 23.55 | 1000. | 120.000 | 132.0 | V | 80.0 | 22 |
| 57.518333 | 19.03 | 40.00 | 20.97 | 1000. | 120.000 | 132.0 | V | 5.0 | 14 |
| 86.200333 | 11.84 | 40.00 | 28.16 | 1000. | 120.000 | 175.0 | V | 157.0 | 14 |
| 130.44000 | 3.75 | 43.50 | 39.75 | 1000. | 120.000 | 144.0 | H | 241.0 | 14 |
| 326.20566 | 13.89 | 46.00 | 32.11 | 1000. | 120.000 | 322.0 | H | 23.0 | 22 |
| 744.24100 | 19.12 | 46.00 | 26.88 | 1000. | 120.000 | 400.0 | H | 193.0 | 29 |

**Test Notes:** Fundamental will be ignored for this test (antenna port terminated).

### 2.7.12 Test Results for 30MHz to 1GHz High Channel

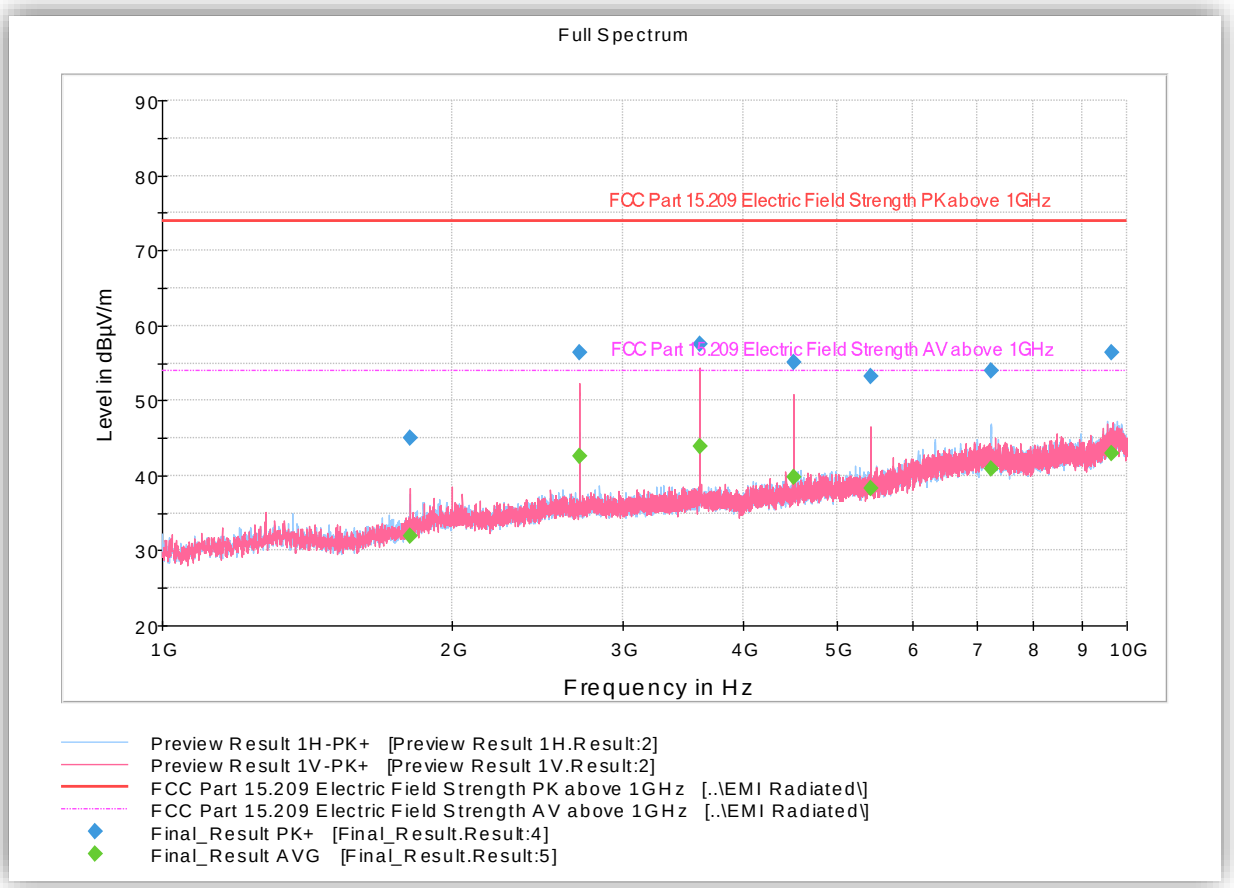



**Quasi Peak Data**

| Frequency (MHz) | QuasiPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB/m) |
|---|---|---|---|---|---|---|---|---|---|
| 37.783667 | 18.29 | 40.00 | 21.71 | 1000. | 120.000 | 100.0 | V | 167.0 | 18 |
| 56.995000 | 20.51 | 40.00 | 19.49 | 1000. | 120.000 | 116.0 | V | 311.0 | 14 |
| 85.684667 | 16.39 | 40.00 | 23.61 | 1000. | 120.000 | 110.0 | V | 189.0 | 14 |
| 143.48866 | 16.58 | 43.50 | 26.92 | 1000. | 120.000 | 100.0 | V | 51.0 | 15 |
| 317.01266 | 13.23 | 46.00 | 32.77 | 1000. | 120.000 | 400.0 | V | 330.0 | 21 |
| 727.86133 | 19.27 | 46.00 | 26.73 | 1000. | 120.000 | 125.0 | H | 261.0 | 29 |
| 958.60666 | 21.39 | 46.00 | 24.61 | 1000. | 120.000 | 392.0 | H | 25.0 | 31 |

**Test Notes:** Fundamental will be ignored for this test (antenna port terminated).

### 2.7.13 Test Results for 1GHz to 18GHz Low Channel



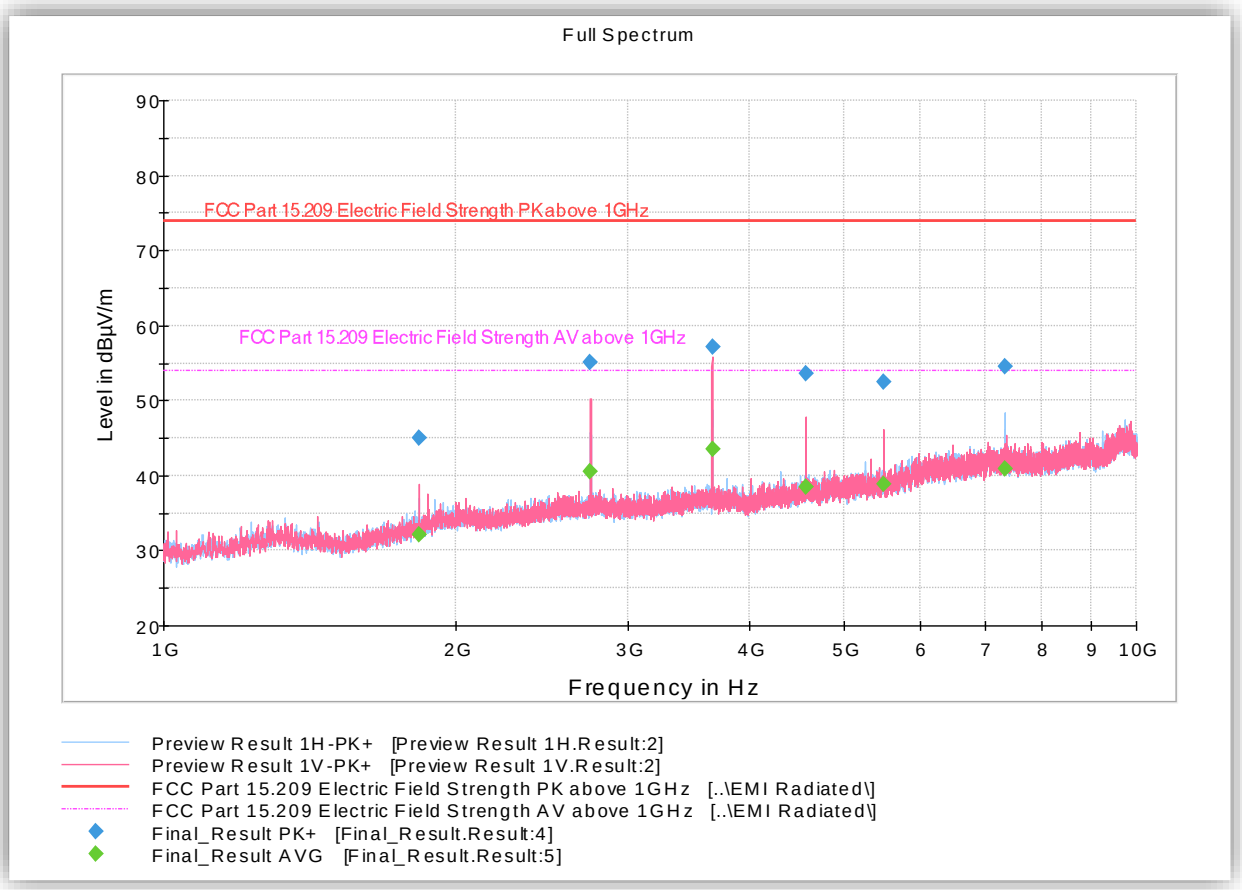

**Peak Data**

| Frequency (MHz) | MaxPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB/m) |
|---|---|---|---|---|---|---|---|---|---|
| 1806.40000 | 45.01 | 73.90 | 28.89 | 1000.0 | 1000.000 | 139.0 | V | 320.0 | 2 |
| 2708.46666 | 56.42 | 73.90 | 17.48 | 1000.0 | 1000.000 | 123.0 | V | 294.0 | 5 |
| 3611.50000 | 57.56 | 73.90 | 16.34 | 1000.0 | 1000.000 | 218.0 | V | 320.0 | 6 |
| 4515.96666 | 55.06 | 73.90 | 18.84 | 1000.0 | 1000.000 | 120.0 | V | 312.0 | 7 |
| 5419.30000 | 53.28 | 73.90 | 20.62 | 1000.0 | 1000.000 | 255.0 | V | 301.0 | 8 |
| 7222.23333 | 54.01 | 73.90 | 19.89 | 1000.0 | 1000.000 | 365.0 | H | 154.0 | 11 |
| 9641.53333 | 56.33 | 73.90 | 17.57 | 1000.0 | 1000.000 | 285.0 | V | 19.0 | 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) |
|---|---|---|---|---|---|---|---|---|---|
| 1806.40000 | 31.94 | 53.90 | 21.96 | 1000.0 | 1000.000 | 139.0 | V | 320.0 | 2 |
| 2708.46666 | 42.59 | 53.90 | 11.31 | 1000.0 | 1000.000 | 123.0 | V | 294.0 | 5 |
| 3611.50000 | 43.93 | 53.90 | 9.97 | 1000.0 | 1000.000 | 218.0 | V | 320.0 | 6 |
| 4515.96666 | 39.74 | 53.90 | 14.16 | 1000.0 | 1000.000 | 120.0 | V | 312.0 | 7 |
| 5419.30000 | 38.33 | 53.90 | 15.57 | 1000.0 | 1000.000 | 255.0 | V | 301.0 | 8 |
| 7222.23333 | 40.85 | 53.90 | 13.05 | 1000.0 | 1000.000 | 365.0 | H | 154.0 | 11 |
| 9641.53333 | 42.89 | 53.90 | 11.01 | 1000.0 | 1000.000 | 285.0 | V | 19.0 | 13 |

### 2.7.14 Test Results for 1GHz to 18GHz Middle Channel



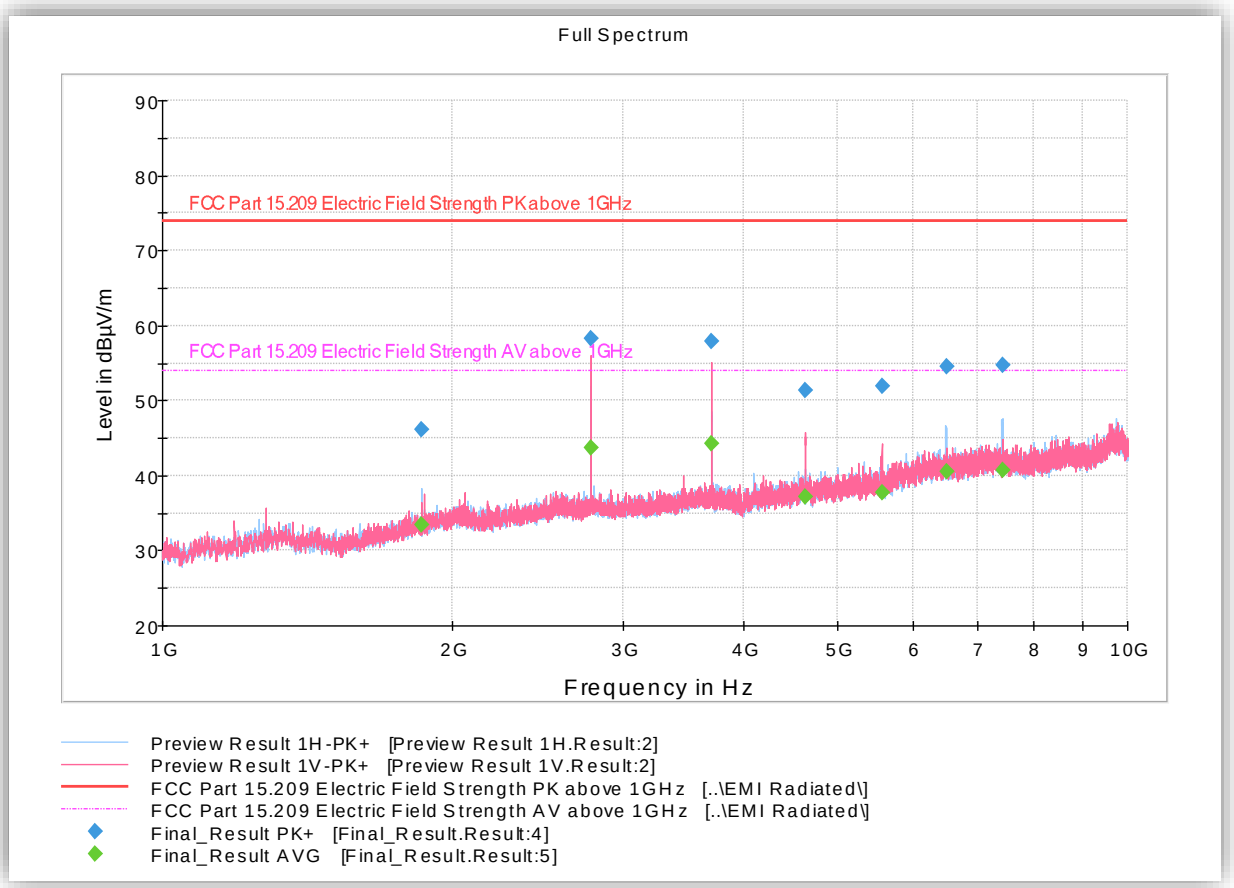

**Peak Data**

| Frequency (MHz) | MaxPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB/m) |
|---|---|---|---|---|---|---|---|---|---|
| 1832.06666 | 45.09 | 73.90 | 28.81 | 1000.0 | 1000.000 | 175.0 | V | 48.0 | 3 |
| 2747.40000 | 55.16 | 73.90 | 18.74 | 1000.0 | 1000.000 | 331.0 | V | 299.0 | 5 |
| 3664.33333 | 57.11 | 73.90 | 16.79 | 1000.0 | 1000.000 | 236.0 | V | 320.0 | 6 |
| 4579.43333 | 53.61 | 73.90 | 20.29 | 1000.0 | 1000.000 | 175.0 | V | 304.0 | 7 |
| 5496.06666 | 52.51 | 73.90 | 21.39 | 1000.0 | 1000.000 | 212.0 | V | 300.0 | 8 |
| 7329.76666 | 54.63 | 73.90 | 19.27 | 1000.0 | 1000.000 | 222.0 | H | 56.0 | 11 |

**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) |
|---|---|---|---|---|---|---|---|---|---|
| 1832.06666 | 32.17 | 53.90 | 21.73 | 1000.0 | 1000.000 | 175.0 | V | 48.0 | 3 |
| 2747.40000 | 40.62 | 53.90 | 13.28 | 1000.0 | 1000.000 | 331.0 | V | 299.0 | 5 |
| 3664.33333 | 43.48 | 53.90 | 10.42 | 1000.0 | 1000.000 | 236.0 | V | 320.0 | 6 |
| 4579.43333 | 38.48 | 53.90 | 15.42 | 1000.0 | 1000.000 | 175.0 | V | 304.0 | 7 |
| 5496.06666 | 38.92 | 53.90 | 14.98 | 1000.0 | 1000.000 | 212.0 | V | 300.0 | 8 |
| 7329.76666 | 40.83 | 53.90 | 13.07 | 1000.0 | 1000.000 | 222.0 | H | 56.0 | 11 |

### 2.7.15 Test Results for 1GHz to 18GHz 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) |
|---|---|---|---|---|---|---|---|---|---|
| 1854.00000 | 46.12 | 73.90 | 27.78 | 1000.0 | 1000.000 | 251.0 | H | 138.0 | 3 |
| 2781.63333 | 58.21 | 73.90 | 15.69 | 1000.0 | 1000.000 | 236.0 | V | 272.0 | 5 |
| 3707.90000 | 57.91 | 73.90 | 15.99 | 1000.0 | 1000.000 | 335.0 | V | 328.0 | 6 |
| 4636.33333 | 51.28 | 73.90 | 22.62 | 1000.0 | 1000.000 | 255.0 | V | 309.0 | 7 |
| 5563.40000 | 51.92 | 73.90 | 21.98 | 1000.0 | 1000.000 | 255.0 | V | 304.0 | 8 |
| 6490.20000 | 54.53 | 73.90 | 19.37 | 1000.0 | 1000.000 | 335.0 | H | 148.0 | 10 |
| 7415.83333 | 54.73 | 73.90 | 19.17 | 1000.0 | 1000.000 | 175.0 | H | 270.0 | 11 |

**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) |
|---|---|---|---|---|---|---|---|---|---|
| 1854.00000 | 33.50 | 53.90 | 20.40 | 1000.0 | 1000.000 | 251.0 | H | 138.0 | 3 |
| 2781.63333 | 43.63 | 53.90 | 10.27 | 1000.0 | 1000.000 | 236.0 | V | 272.0 | 5 |
| 3707.90000 | 44.18 | 53.90 | 9.72 | 1000.0 | 1000.000 | 335.0 | V | 328.0 | 6 |
| 4636.33333 | 37.12 | 53.90 | 16.78 | 1000.0 | 1000.000 | 255.0 | V | 309.0 | 7 |
| 5563.40000 | 37.69 | 53.90 | 16.21 | 1000.0 | 1000.000 | 255.0 | V | 304.0 | 8 |
| 6490.20000 | 40.46 | 53.90 | 13.44 | 1000.0 | 1000.000 | 335.0 | H | 148.0 | 10 |
| 7415.83333 | 40.78 | 53.90 | 13.12 | 1000.0 | 1000.000 | 175.0 | H | 270.0 | 11 |

## 2.8 POWER SPECTRAL DENSITY

### 2.8.1 Specification Reference

FCC 47 CFR Part 15, Clause 15.247(e)
RSS-247, Clause 5.2(b)

### 2.8.2 Standard Applicable

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

### 2.8.3 Equipment Under Test and Modification State

Serial No: D48AFCEDFCE4, D48AFCEDA2D8, D48AFCEDB5C4 / Default Test Configuration

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

July 08 and 10, 2024 / FSC

### 2.8.5 Test Equipment Used

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

### 2.8.6 Environmental Conditions (Rancho Bernardo Satellite Facility)

| | |
|---|---|
| Ambient Temperature | 24.1 °C |
| Relative Humidity | 47.6 % |
| ATM Pressure | 98.8 kPa |

### 2.8.7 Additional Observations

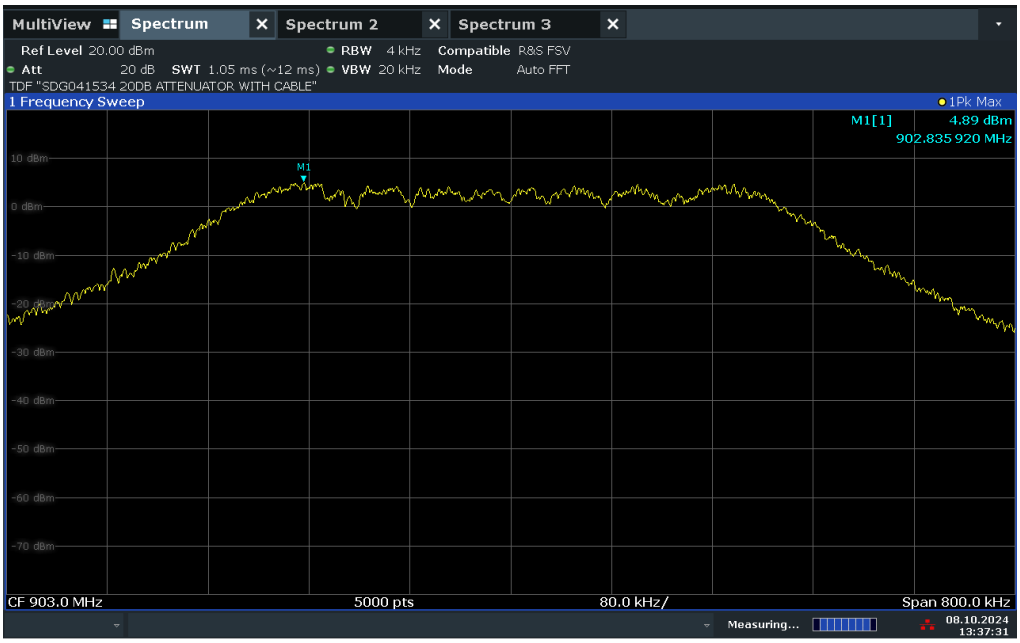
- This is a conducted test using Method (for spreading factor 5) PKPSD per ANSI C63.10 Subclause 11.10.2.
- This is a conducted test using Method (for spreading factor 5) AVGPSD-2 per ANSI C63.10 Subclause 11.10.5
- The path loss was all accounted for using a transducer factor.

### 2.8.8 Test Results Summary

| DUT Channel (MHz) | Modulation | PSD Frequency (MHz) | PSD (dBm) | Limit Max (dBm) | Result |
|---|---|---|---|---|---|
| 903.00 | SF5 | 902.835 | 4.89 | 8.0 | Complies |
| 916.00 | SF5 | 916.102 | 4.19 | 8.0 | Complies |
| 927.00 | SF5 | 927.004 | 1.55 | 8.0 | Complies |

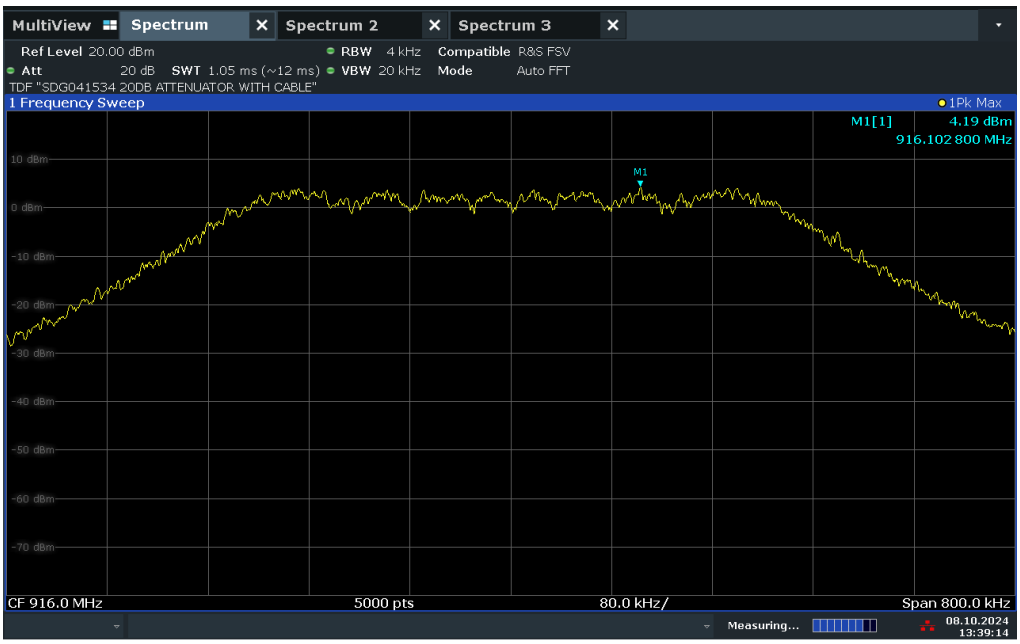
| DUT Channel (MHz) | Modulation | PSD Frequency (MHz) | Duty Cycle Corrected PSD (dBm) | Limit Max (dBm) | Result |
|---|---|---|---|---|---|
| 903.00 | SF12 | 902.882 | 2.31 | 8.0 | Complies |
| 916.00 | SF12 | 915.937 | 2.27 | 8.0 | Complies |
| 927.00 | SF12 | 927.124 | -3.67 | 8.0 | Complies |

### 2.8.9 Test Plots



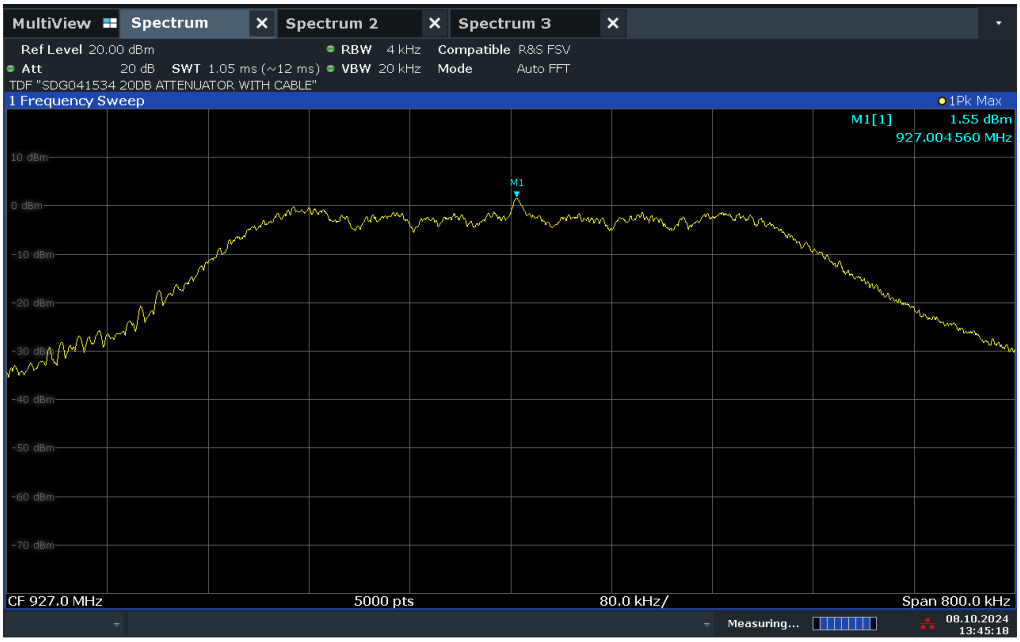

13:37:32 08.10.2024

**LoRA SF5 Low Channel**



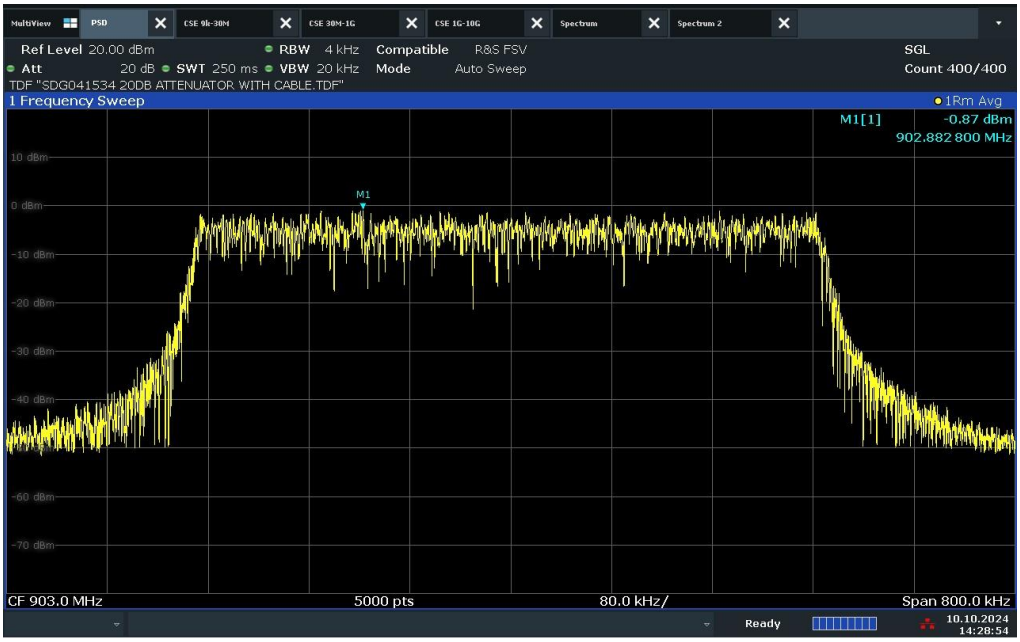

13:39:15 08.10.2024

**LoRA SF5 Middle Channel**



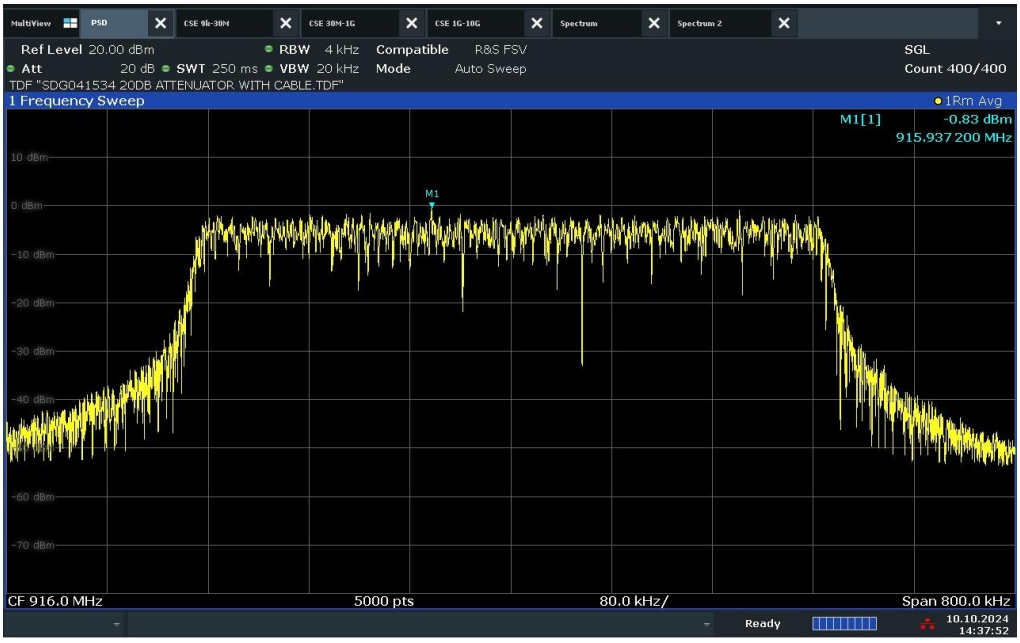

13:45:19 08.10.2024

**LoRA SF5 High Channel**



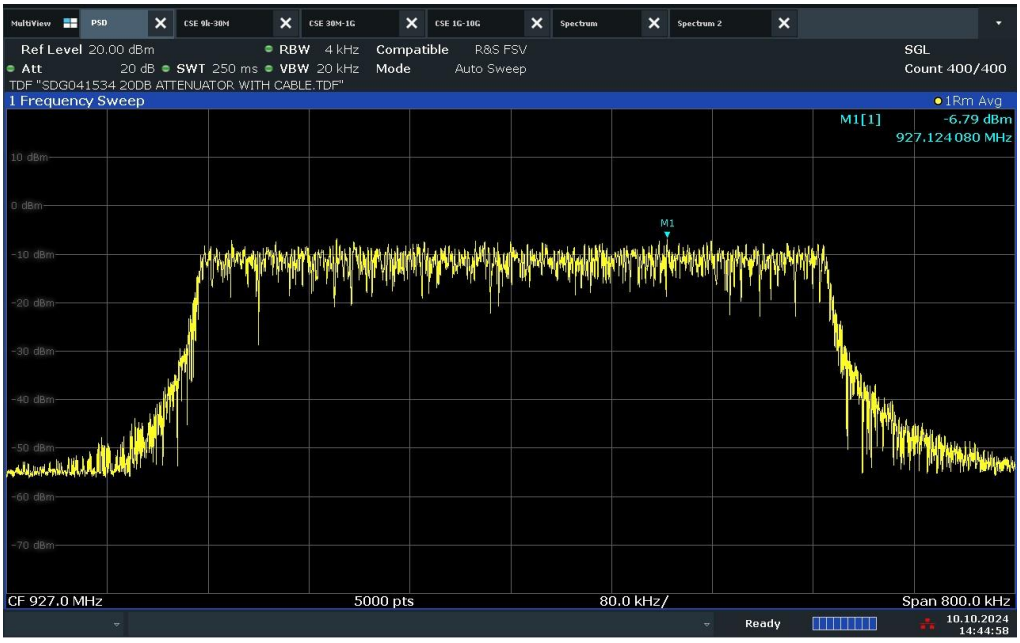

14:28:55 10.10.2024

**LoRA SF12 Low Channel**




14:37:53 10.10.2024

**LoRA SF12 Middle Channel**




14:44:59 10.10.2024

**LoRA SF12 High Channel**

# 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 |
|---|---|---|---|---|---|---|
| ***Conducted Port Setup*** | | | | | | |
| 7582 | Signal/Spectrum Analyzer | FSW26 | 101614 | Rohde & Schwarz | 01/25/24 | 01/25/25 |
| 41534 | 20 dB Attenuator + cable | ATX3518-20 + W17.03 | N/A | Mini-Circuits | 04/04/24 | 04/04/25 |
| 7605 | Power Sensor | N1921A | MY51100054 | Hewlett packard | 04/05/24 | 04/05/25 |
| 7662 | Power Meter | N1911A | MY45100951 | Agilent | 04/01/24 | 04/01/25 |
| 7607 | Pulse Wireless Power Head | RPR3006W | 14I0098SNO47 | Dare | 10/09/24 | 10/09/25 |
| ***Radiated Emission*** | | | | | | |
| SDGE68210 | ESW44 EMI Test Receiver | ESW44 with HF Option | 103416 | Rhode & Schwarz | 06/27/24 | 06/27/25 |
| SDGE06628 | Loop Antenna | HFH2-Z2335.4711.52 | FNr.800.458/25 | Rohde & Schwarz GmbH & Co KG | 07/02/24 | 07/02/26 |
| SDRB1033 | BiConiLog Antenna | 3142C | 00044556 | ETS Lindgren | 10/16/23 | 10/16/25 |
| SDGE08656 | SR-5 RF Cable 9k-2GHz | 8421F | M17/75-RG214 | RF Precision Cables | 09/03/24 | 09/03/25 |
| SDGE07631 | 1-18 GHz Horn Antenna | 3117 | 00205418 | ETS Lindgren | 01/0523 | 01/0525 |
| SDGE46797 | 0.5 to 22GHz Preamplifier | PA-122 | 181925 | Com Power | 01/05/24 | 01/01/25 |
| SDGE08878 | SR-5 cable 1-18GHz | R90-088-240 | 16-02-401 | Teledyne Microwave | 09/03/24 | 09/03/25 |
| SDGE07619 | Temp, Humidity and Barometric Sensor | iBTHX-W | 15050268 | Omega Engineering | 06/05/24 | 06/05/26 |
| ***Miscellaneous*** | | | | | | |
| 30215 | Barometer/Temperature/Humidity | iBTHX-W | 15050268 | Omega | 06/05/24 | 06/05/25 |
| 43003 | True RMS Multimeter | 85 III | 69880143 | Fluke | 10/09/24 | 10/09/25 |
| - | Test Software | EMC32 | v 11.50.0 | Rohde & Schwarz | NCR | |

## 3.2 MEASUREMENT UNCERTAINTY

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

### 3.2.1 AC Conducted 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 | 0.25 | dB | Normal, k=2 | 2.000 | 0.13 | 0.02 |
| 4 | Receiver sinewave accuracy | 0.08 | dB | Normal, k=2 | 2.000 | 0.04 | 0.00 |
| 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 | | 1.65 | dB |
| | **Expanded uncertainty** | | | Normal, k=2 | | **3.29** | **dB** |

### 3.2.2 Radiated Measurements (9kHz to 30MHz)

| | 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 | 0.44 | dB | Normal, k=2 | 2.000 | 0.22 | 0.05 |
| 4 | Receiver sinewave accuracy | 0.15 | dB | Normal, k=2 | 2.000 | 0.08 | 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 | 0.00 | dB | Triangular | 2.449 | 0.00 | 0.00 |
| 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 | 0.00 | 0.00 |
| 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 | 2.45 dB | | |
| | **Expanded uncertainty** | | | Normal, k=2 | **4.91 dB** | | |

### 3.2.3 Radiated Measurements (30MHz to 1GHz)

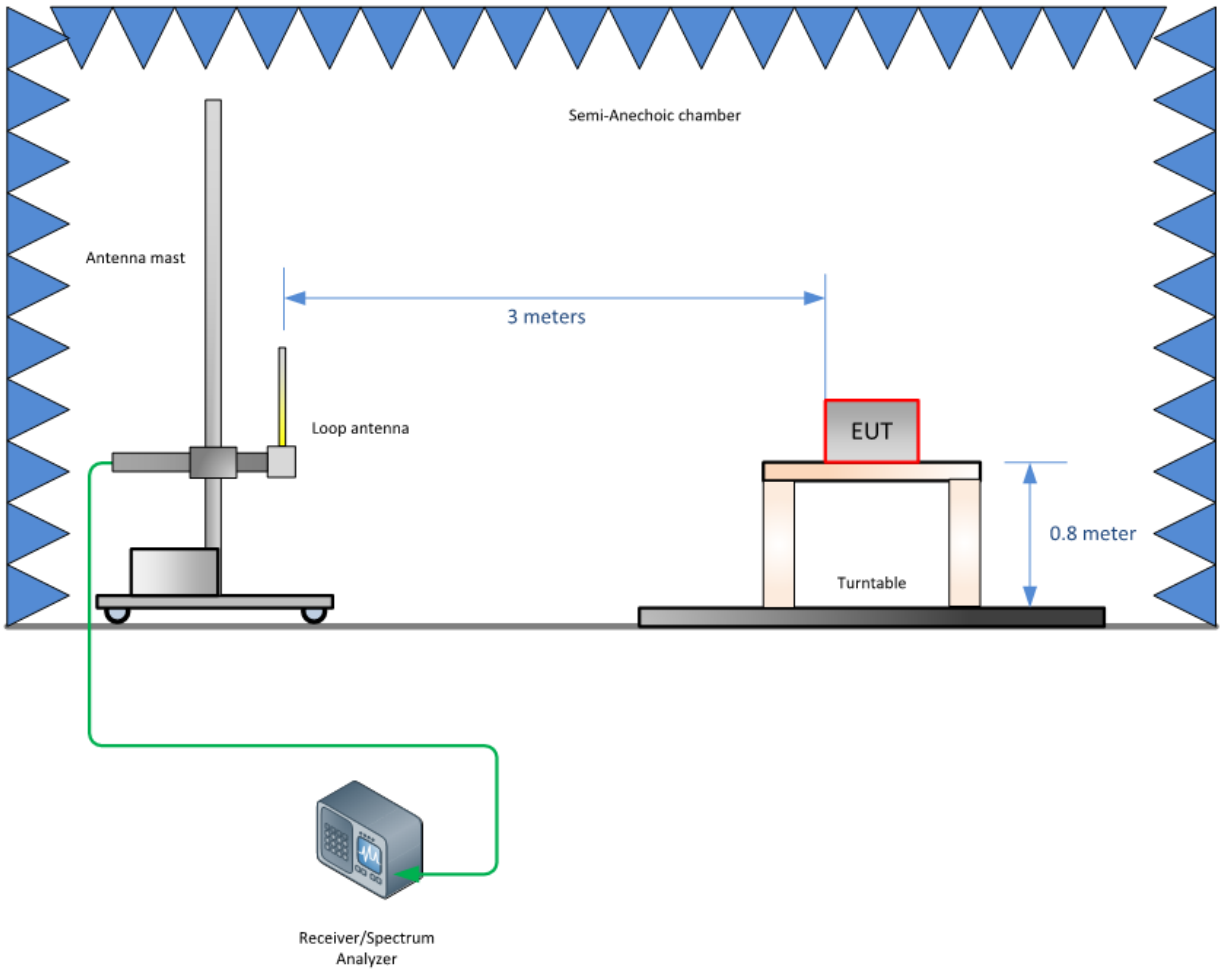
| | Input Quantity (Contribution) $X_i$ | Value | Prob. Dist. | Divisor | $u_i(x)$ | $u_i(x)^2$ |
|---|---|---|---|---|---|---|
| 1 | Receiver reading | 0.10 dB | Normal, k=1 | 1.000 | 0.10 | 0.01 |
| 2 | Attenuation: antenna-receiver | 0.20 dB | Normal, k=2 | 2.000 | 0.10 | 0.01 |
| 3 | Antenna factor AF | 0.58 dB | Normal, k=2 | 2.000 | 0.29 | 0.08 |
| 4 | Receiver sinewave accuracy | 0.15 dB | Normal, k=2 | 2.000 | 0.08 | 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 | 1.63 | 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 | 0.21 | 0.12 |
| 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** | | |

### 3.2.1 Radiated Emission Measurements (1GHz to 18GHz)

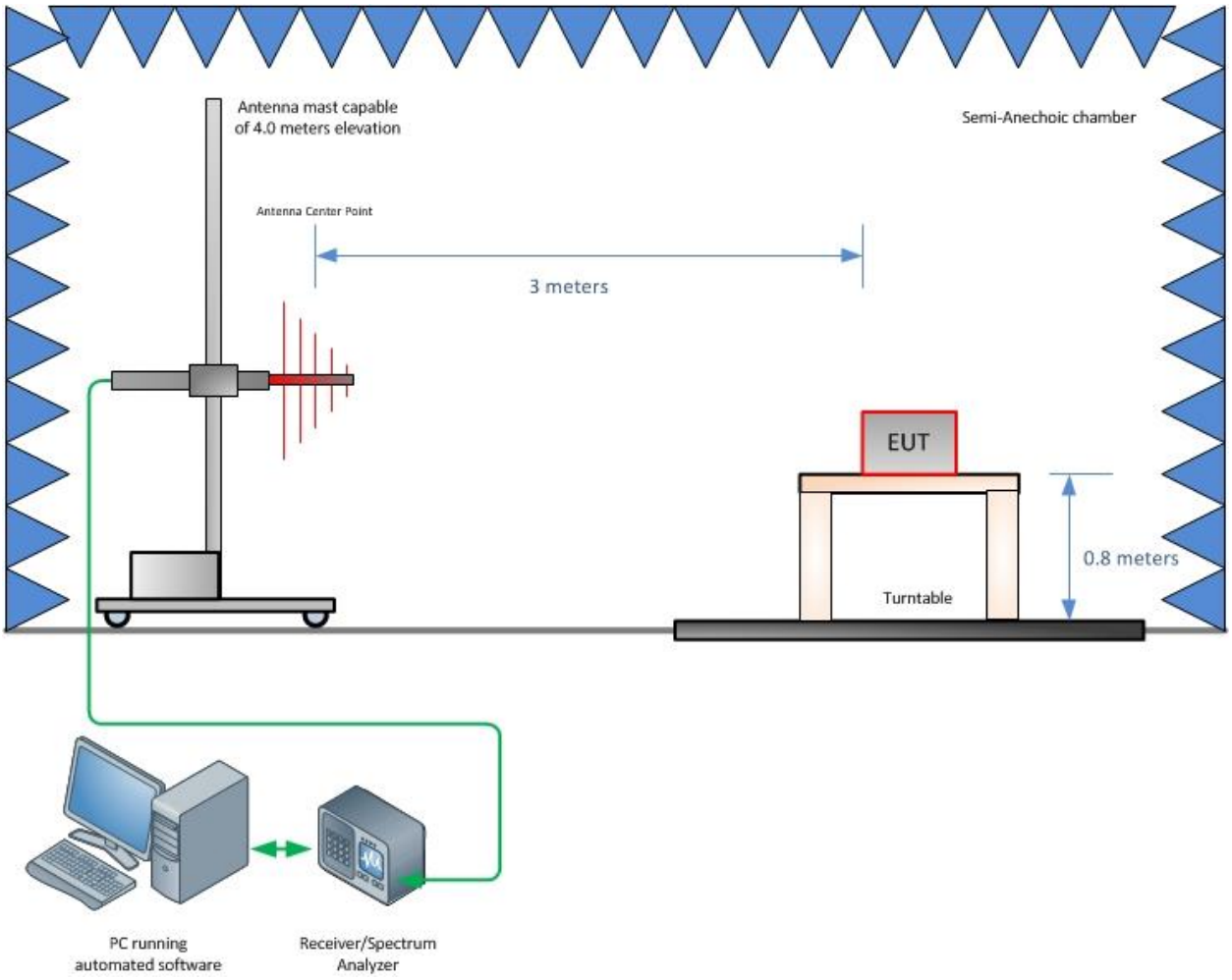
| | Input Quantity (Contribution) $X_i$ | Value | | Prob. Dist. | Divisor | $u_i(x)$ | $u_i(x)^2$ |
|---|---|---|---|---|---|---|---|
| 1 | Receiver reading | 0.10 | dB | Normal, k=1 | 1.000 | 0.10 | 0.01 |
| 2 | Attenuation: antenna-receiver | 0.30 | dB | Normal, k=2 | 2.000 | 0.15 | 0.02 |
| 3 | Preamplifier Gain | 0.20 | dB | Normal, k=2 | 2.000 | 0.10 | 0.01 |
| 4 | Antenna factor AF | 0.47 | dB | Normal, k=2 | 2.000 | 0.24 | 0.06 |
| 5 | Sinewave accuracy | 0.15 | dB | Normal, k=2 | 2.000 | 0.08 | 0.01 |
| 6 | Instability of preamp gain | 1.21 | dB | Rectangular | 1.732 | 0.70 | 0.49 |
| 7 | Noise floor proximity | 0.70 | dB | Rectangular | 1.732 | 0.40 | 0.16 |
| 8 | Mismatch: antenna-preamplifier | 1.41 | dB | U-shaped | 1.414 | 1.00 | 0.99 |
| 9 | Mismatch: preamplifier-receiver | 1.30 | dB | U-shaped | 1.414 | 0.92 | 0.85 |
| 10 | AF frequency interpolation | 0.30 | dB | Rectangular | 1.732 | 0.17 | 0.03 |
| 11 | Directivity difference at 3 m | 1.50 | dB | Rectangular | 1.732 | 0.87 | 0.75 |
| 12 | Phase center location at 3 m | 0.30 | dB | Rectangular | 1.732 | 0.17 | 0.03 |
| 13 | Cross-polarisation | 0.90 | dB | Rectangular | 1.732 | 0.52 | 0.27 |
| 14 | Site imperfections VSWR (Method 2) | 5.03 | dB | Triangular | 2.000 | 4.89 | 1.03 |
| 15 | Effect of setup table material | 1.57 | dB | Rectangular | 1.732 | 1.41 | 0.81 |
| 16 | Separation distance at 3 m | 0.30 | dB | Rectangular | 1.732 | 0.17 | 0.03 |
| 17 | Table height at 3 m | 0.00 | dB | Normal, k=2 | 2.000 | 0.00 | 0.00 |
| | | | | | | | |
| | Combined standard uncertainty | | | Normal | 2.35 dB | | |
| | **Expanded uncertainty** | | | Normal, k=2 | **4.71 dB** | | |

# SECTION 4

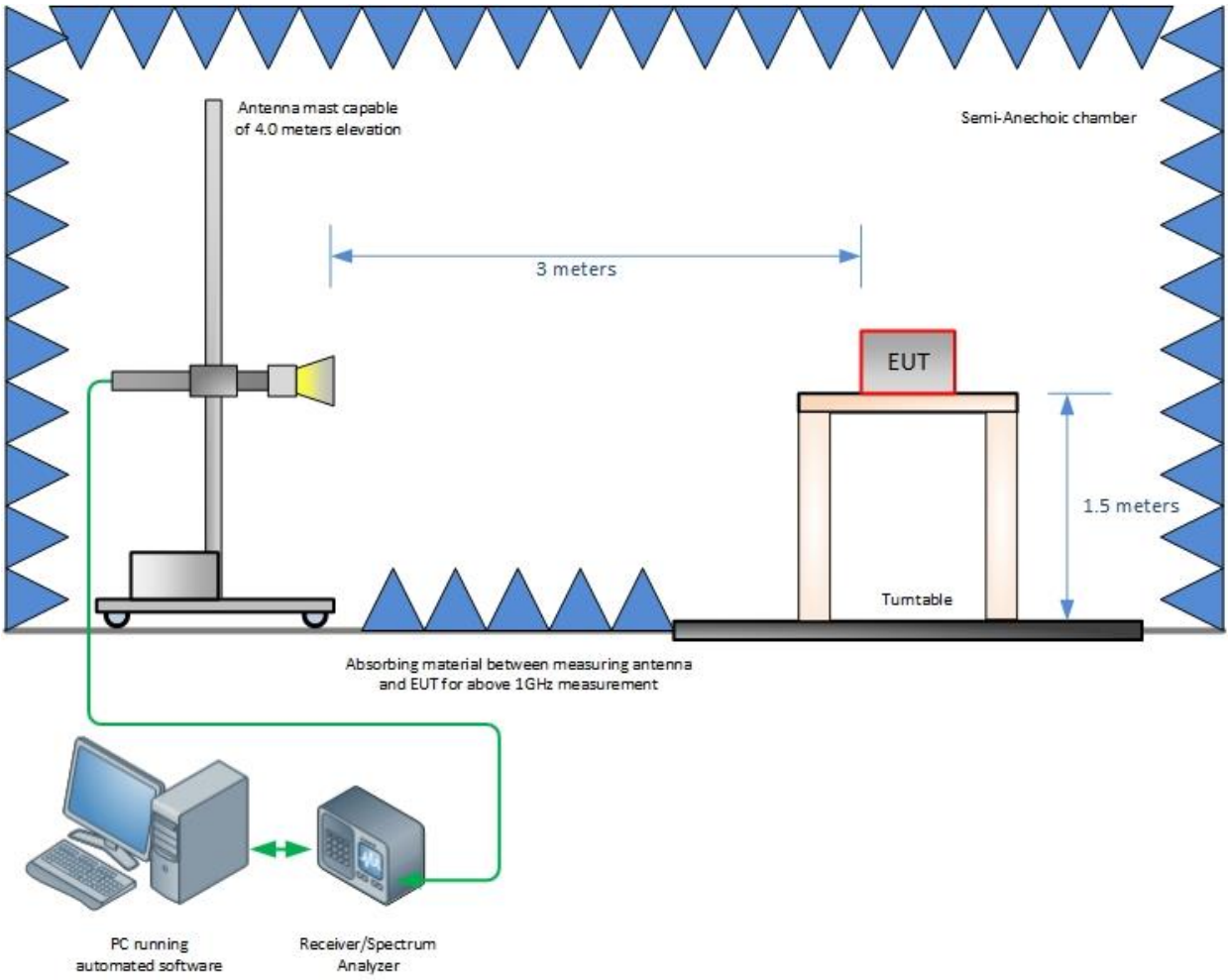
# DIAGRAM OF TEST SETUP




**Radiated Emission Test Setup (Below 30MHz)**




**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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