

# INTENTIONAL RADIATOR (C2PC) TEST REPORT



**Report Reference Number:** E11197-2002\_ Particle B402 Antenna C2PC\_Rev-1.0  
**Total Number of Pages:** 28  
**Date of Issue:** March 30, 2021

**EMC Test Laboratory:** **QAI Laboratories Ltd.**  
**Address:** 3980 North Fraser Way, Burnaby, BC, V5J 5K5 Canada  
**Phone:** (604) 527-8378  
**Fax:** (604) 527-8368

## Laboratory Accreditations (per ISO/IEC 17025:2017)



This report has been completed in accordance with the requirements of ISO/IEC 17025.  
Test results contained in this report are within QAI Laboratories ISO/IEC 17025 accreditations.  
QAI Laboratories authorizes the applicant to reproduce this report, provided it is reproduced in its entirety and for the use by the company's employees only.

**Manufacturer:** **Particle Industries, Inc.**  
**Address:** 126 Post St, 4th floor  
San Francisco, 94108, USA

**Equipment Tested:** **C2PC: B402 with MT-4B-AC-BL13 Antenna**

**Model Number(s):** B402  
**FCC ID:** 2AEMI-B402  
**ISED ID:** 20127-B402



## REVISION HISTORY

Date	Report Number	Details	Author's Initials
March 30, 2021	E11197-2002_ Particle B402 Antenna C2PC_Rev-1.0	Final	RS
February 17, 2021	E11197-2002_ Particle B402 Antenna C2PC_Rev-0.0	Draft	RS

All previous versions of this report have been superseded by the latest dated revision as listed in the above table.  
 Please dispose of all previous electronic and paper printed revisions accordingly.

## REPORT AUTHORIZATION

The data documented in this report is for the test equipment provided by the manufacturer. The tests were conducted on the sample equipment as requested by the manufacturer for the purpose of demonstrating compliance with the standards outlined in Section I of this report as agreed upon by the Manufacturer under the quote 20SH12141.

The Manufacturer is responsible for the tested product configurations, continued product compliance, and for the appropriate auditing of subsequent products as required.

This report may comprise a partial list of tests that are required for FCC and ISED Declaration of Conformity can only be produced by the manufacturer. This is to certify that the following report is true and correct to the best of our knowledge.

Testing Performed by  
**Jack Qin**  
 Senior Electrical/Electronic Engineer

Report Prepared by  
**Ravi Sharma**  
 EMC Technical Writer



## QAI FACILITIES

### British Columbia

**QAI Laboratories Inc.**  
**Main Laboratory/Headquarters**  
 3980 North Fraser Way,  
 Burnaby, BC V5J Canada

### Ontario

**QAI Laboratories Inc.**  
 25 Royal Group Crescent #3,  
 Vaughan,  
 ON L4H 1X9 Canada

### Virginia

**QAI Laboratories Ltd.**  
 1047 Zachary Taylor Hwy,  
 Suite A Huntly,  
 VA 22640 USA

### China

**QAI Laboratories Ltd**  
 Room 408, No. 228, Jiangchang 3<sup>rd</sup>  
 Road Jing'An District, Shanghai,  
 China 200436

### California

**QAI Laboratories Ltd.**  
 8385 White Oak Avenue Rancho  
 Cucamonga, CA 91730 USA

### Oklahoma

**QAI Laboratories Ltd.**  
 5110 North Mingo Road  
 Tulsa, OK 74117, USA

### Miami

**QAI Laboratories Ltd.**  
 8148 NW 74th Ave,  
 Medley, FL 33166 USA

### South Korea

**QAI Laboratories Ltd**  
 #502, 8, Sanbon-ro 324beon-gil  
 Gunpo-si, Gyeonggi-do, 15829,  
 South Korea

## QAI EMC ACCREDITATION

QAI EMC is your one-stop regulatory compliance partner for electromagnetic compatibility (EMC) and electromagnetic interference (EMI). Products are tested to the latest and applicable EMC/EMI requirements for domestic and international markets. QAI EMC goes above and beyond being a testing facility—we are your regulatory compliance partner. QAI EMC has the capability to perform RF Emissions and Immunity for all types of electronics manufacturing including Industrial, Scientific, Medical, Information Technology, Telecom, Wireless, Automotive, Marine and Avionics.

EMC Laboratory Location	FCC Designation (3m SAC)	IC Registration (3m SAC)	A2LA Certificate
Burnaby, BC, Canada	CA9543	9543A	3657.02

### EMC Facility Burnaby BC, Canada





## TABLE OF CONTENTS

REVISION HISTORY .....	2
REPORT AUTHORIZATION .....	2
QAI FACILITIES .....	3
QAI EMC ACCREDITATION .....	3
TABLE OF CONTENTS .....	4
Section I: GENERAL INFORMATION .....	5
<b>1.1 Product Description</b> .....	5
<b>1.2 Environmental Conditions</b> .....	5
<b>1.3 Measurement Uncertainty</b> .....	6
<b>1.4 Worst Test Case</b> .....	6
1.5 Sample Calculations of Emissions Data .....	7
1.6 Test Equipment List .....	8
Section II: EXECUTIVE SUMMARY OF TEST STANDARDS AND RESULTS .....	9
2.1 Purpose.....	9
2.2 Summary of Test Standards.....	9
2.3 Summary of Test Results.....	9
Section III: DATA & TEST RESULTS .....	10
3.1 Radiated Output Power.....	10
3.2 Field Strength of Spurious Radiation .....	11
3.3 Conducted Spurious Emissions .....	17
3.4 Band Edge .....	21
Appendix A: TEST SETUP PHOTOS.....	27
Appendix B: ABBREVIATIONS.....	28

## Section I: GENERAL INFORMATION

### 1.1 Product Description

The information provided in this section is for the Equipment Under Test (EUT) and the corresponding Auxiliary Equipment needed to perform the tests as a complete system.



**Equipment Under Test (EUT)**

#### Equipment Under Test (EUT) Information – C2PC

<b>EUT</b>	B402
<b>FCC ID</b>	2AEMI-B402
<b>IC Number</b>	20127-B402
<b>HVIN/ Model No.</b>	<b>B402</b>
<b>PMN</b>	B Series B402
<b>Manufacturer</b>	Particle Industries, Inc.

#### Antenna Information

<b>Name</b>	2-in-1 5G NR/ 4G LTE/ GNSS Combination Antenna, Screw Mount
<b>Part Number</b>	MT-4B-AC-BL13
<b>Manufacturer</b>	Unictron
<b>Frequency Range</b>	LTE 698-960MHz, 1710-2690MHz, 3300-3800MHz

### 1.2 Environmental Conditions

The equipment under test was operated and tested under the following environmental conditions:

Parameter	Conditions
Location	Indoors
Temperature	21°C
Relative Humidity	49.9 %
Atmospheric Pressure	101.2 kPa



### 1.3 Measurement Uncertainty

Parameter	Uncertainty
Radiated Emissions, 10kHz.-1GHz.	$\pm 2.40$ dB
Radiated Emissions, 1GHz.-40GHz.	$\pm 2.48$ dB
Conducted Emissions, 10kHz. to 40GHz.	$\pm 2.82$ dB
Radio Frequency	$\pm 1.5 \times 10^{-5}$ MHz
Total RF Power Conducted	$\pm 1.36$ dB
Spurious Emissions, Conducted	$\pm 1.36$ dB
RF Power Density, Conducted	$\pm 1.36$ dB
Temperature	$\pm 1^{\circ}\text{C}$
Humidity	$\pm 5$ %
DC and low frequency voltages	$\pm 3$ %

### 1.4 Worst Test Case

Worst-case orientation was determined during the preliminary testing.  
The final radiated emissions were performed in the worst-case orientation.



## 1.5 Sample Calculations of Emissions Data

Radiated and conducted emissions were performed using EMC32 software developed by Rohdes & Schwarz. Transducer factors like Antenna factors, Cable Losses and Amplifier gains were stored in the test templates which are used to perform the emissions measurements. After test is finished, data is generated from the EMC32 consisting of product details, emission plots and final data tables as shown below.

Frequency (MHz)	Q-Peak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Ant. Ht. (cm)	Pol	Turntable Position (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
42.663900	33.0	1000.000	120.000	100.0	H	70.0	13.2	7.5	40.5

Quasi-Peak reading shown in the table above is already corrected by the software using correction factor shown in column “Corr.” The correction factor listed under “Corr.” table calculated as:

$$\text{Corr. (dB)} = \text{Antenna factor} + \text{Cable loss}$$

Or

$$\text{Corr. (dB)} = \text{Antenna factor} + \text{Cable Loss} - \text{Amp gain (if pre-amplifier was used)}$$

The final Quasi peak reading shown in the data is calculated by the software using following equation:

$$\text{Corrected Quasi-Peak (dBµV/m)} = \text{Raw Quasi-Peak Reading} + \text{Antenna factor} + \text{Cable loss}$$

To obtain the final Quasi-Peak or Average reading during power line conducted emissions, transducer factors are included in the final measurement as shown below.

Frequency (MHz)	Q-Peak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150	44.3	1000.000	9.000	GND	0.6	21.7	66.0

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150	27.2	1000.000	9.000	GND	0.6	28.8	56.0

Quasi Peak or Average reading shown in above table is already corrected by the software using the correction factor shown in column “Corr.” The correction factor listed under “Corr.” table calculated as:

$$\text{Corr. (dB)} = \text{Antenna factor} + \text{Cable loss}$$

The final Quasi-peak or Average reading shown in the data is calculated by the software using following equation:

$$\text{Corr. Quasi-Peak/Average Reading (dBµV)} = \text{Raw Quasi-Peak/Average Reading} + \text{Antenna factor} + \text{Cable loss}$$

The allowable margin from the limits, as per the standards, were calculated for both radiated and conducted emissions:

$$\text{Margin (dB)} = \text{Limit} - \text{Quasi-Peak or Average reading}$$



## 1.6 Test Equipment List

The tables below contain all the equipment used by QAI Laboratories in conducting all tests on the Equipment Under Test (EUT) as per Section 1.

### Emissions Test Equipment

Manufacturer	Model	Description	Serial No.	Calibration Due Date
AH Systems	PAM118	Amplifier 10KHz-18GHz	189	Conditional Use
ETS Lindgren	2165	Turntable	00043677	N/A
ETS Lindgren	2125	Mast	00077487	N/A
ETS Lindgren	S201	5-meter Semi-Anechoic Chamber	1030	N/A
Insulated Wire Inc.	SPS-1753-1140-SPS	Yellow cable, 3m	102395	N/A
Insulated Wire Inc.	SPS-1753-2400-SPS	Yellow cable, 6m	091096	N/A
Rohde & Schwarz	ESU40	EMI Receiver	100011	2023-Jul-05
Sunol Sciences	JB1	Biconilog Antenna 30MHz – 2GHz	A070209	2021-Aug-16
Sunol Sciences	DRH-118	Horn Antenna 1GHz-18GHz	A050905	2021-Mar-10
WEINSCHL ENGINEERING	44	6db attenuator	665	N/A

**Note:** Equipment listed above have 1 years calibration interval.

### Measurement Software List

Manufacturer	Model	Version	Description
Rhode & Schwarz	EMC 32	10.35.10	Emissions Test Software





## Section II: EXECUTIVE SUMMARY OF TEST STANDARDS AND RESULTS

### 2.1 Purpose

The purpose of this report is to demonstrate and document the compliance of “PARTICLE B402” with new antenna (C2PC) as per [Sections 2.2](#) and Quote 20SH12141 of this report.

### 2.2 Summary of Test Standards

Class II Permissive Change (C2PC) Testing of one (1) “B402” device with new antenna to the following standards:

- FCC Title 47 Part 22 – Public Mobile Services, Subpart H – Cellular Radiotelephone Service
- FCC Title 47 Part 24 – Personal Communications Services, Subpart E – Broadband PCS
- FCC Title 47 Part 27 – Miscellaneous Wireless Communications Services
- ICES-003 Issue 6 – Information Technology Equipment (Including Digital Apparatus)  
– Limits and Methods of Measurement
- RSS-130 Issue 2 – Equipment Operating in the Frequency Bands 617-652 MHz, 663-698 MHz, 698-756 MHz and 777-787 MHz
- RSS-132 Issue 6 – Cellular Telephone Systems Operating in the Bands 824-849 MHz and 869-894 MHz
- RSS-133 Issue 6 – 2 GHz Personal Communications Services
- RSS-139 Issue 3 – Advanced Wireless Services (AWS) Equipment Operating in the Bands 1710-1780 MHz and 2110-2180 MHz
- CFR Title 47 FCC Part 15 – Radio Frequency Devices, Subpart B – Unintentional Radiators
- ICES-003 Issue 6 – Information Technology Equipment (Including Digital Apparatus)  
– Limits and Methods of Measurement

### 2.3 Summary of Test Results

	Test Item	Requirements of Test Standard	Result
3.1	<b>Radiated Output Power</b>	Part 22 Subpart H §22.913(a)(2), Part 24 Subpart E §24.232(c), Part 27 §27.50(b)(10), RSS 130, Clause 4.6.3, RSS 132, Clause 5.4, RSS 133, Clause 6.4, SRSP-510 5.1.2, RSS 139, Clause 6.5	Comply
3.2	<b>Field Strength of Spurious Radiation</b>	Part 27 §27.53:(f) (g) (h); RSS 130 - 4.7.1; RSS 132 - 5.5; RSS 133 - 6.5.1; RSS 139 - 6.6	Comply
3.3	<b>Conducted Spurious Emissions</b>	Part 27 §27.53:(f) (g) (h); RSS 130 - 4.7.1; RSS 132 - 5.5; RSS 133 - 6.5.1; RSS 139 - 6.6	Comply
3.4	<b>Band Edge</b>	Part 27 §27.53:(f) (g) (h); RSS 130 - 4.7.1; RSS 132 - 5.5; RSS 133 - 6.5.1; RSS 139 - 6.6	Comply



## Section III: DATA & TEST RESULTS

### 3.1 Radiated Output Power

**Date Performed:** February 2,2021

**Test Standard:** As per [section 2.2](#) of this report

**Test Method:** As per [section 2.2](#) of this report

**Modifications:** No modification was required to comply for this test

**Result:** Complies with Standard

#### Measurement Data:

**Table 1:Output power of radiated measurement**

Band	Frequency (MHz)	Raw Average (dBuV)	AF (dB/m)	Cable lost (dB)	Field strength of RF Power at 3m (dBuv/m)	ERP of RF Power (dBm)	ERIP of RF Power (dBm)
5	848	80.8	23.6	8.5	112.9	15.52	17.67
2	1909	76.54	31.5	8	116.04	18.66	20.81
12	715	81.56	21.7	8.5	111.76	14.38	16.53
13	786	83	23	8.5	114.5	17.12	19.27
4	1711	72.6	29.9	8	110.5	13.12	15.27

**Table 2:Output power of conducted measurement**

Band	Frequency (MHz)	Raw Average (dBm)	Cable lost (dB)	Antenna Gain (dBi)	ERP of RF Power (dBm)	ERIP of RF Power (dBm)
5	848	-8.90	31.00	-5.00	14.95	17.10
2	1909	-9.44	31.50	-6.00	13.91	16.06
12	715	-8.33	31.00	-5.00	15.52	17.67
13	786	-8.71	31.00	-5.00	15.14	17.29
4	1711	-9.50	31.50	-6.00	13.85	16.00



### 3.2 Field Strength of Spurious Radiation

**Date Performed:** February 8,2021

**Test Standard:** As per [section 2.2](#) of this report

**Test Method:** As per [section 2.2](#) of this report

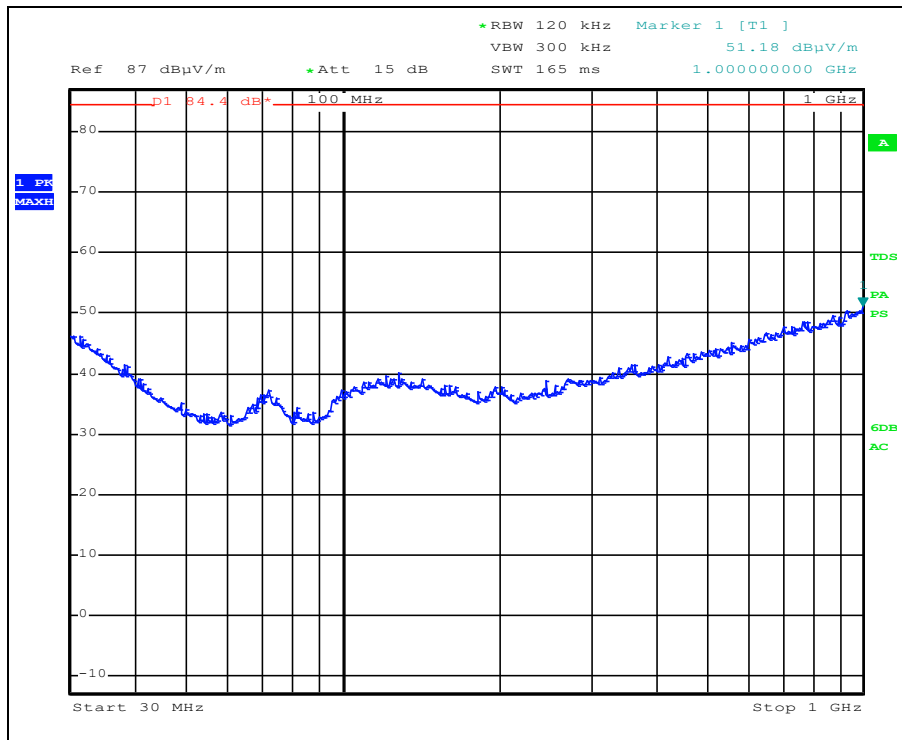
**Modifications:** No modification was required to comply for this test

**Result:** Complies with Standard

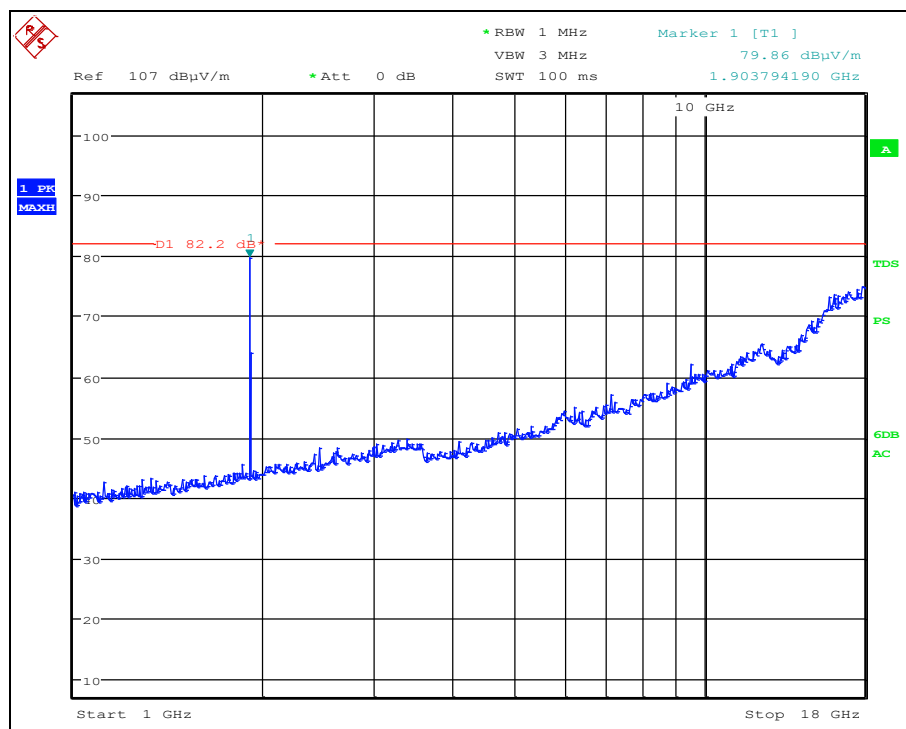
#### Measurement Data and Plot:

**Table 3:Field Strength of Spurious Radiation**

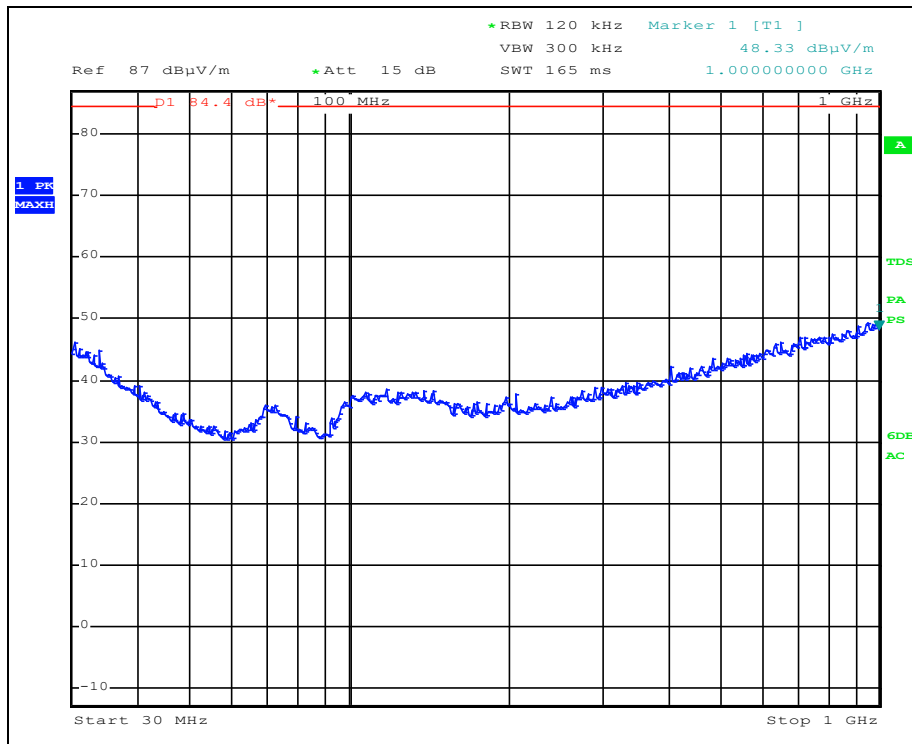
Band, Transmitter frequency	Frequency (MHz)	Pk at 3m (dBuv/m)	Limit (dBuv/m)
Band 5, 848 MHz	1696	71.6	82.2
	2544	60.8	82.2
	3392	53.9	82.2
Band 2, 1909 MHz	3818	52.5	82.2
Band 12, 715 MHz	1430	56.1	82.2
Band 13, 786 MHz	1572	69.6	82.2
	2358	60.8	82.2
Band 4, 1711 MHz	3422	55.1	82.2



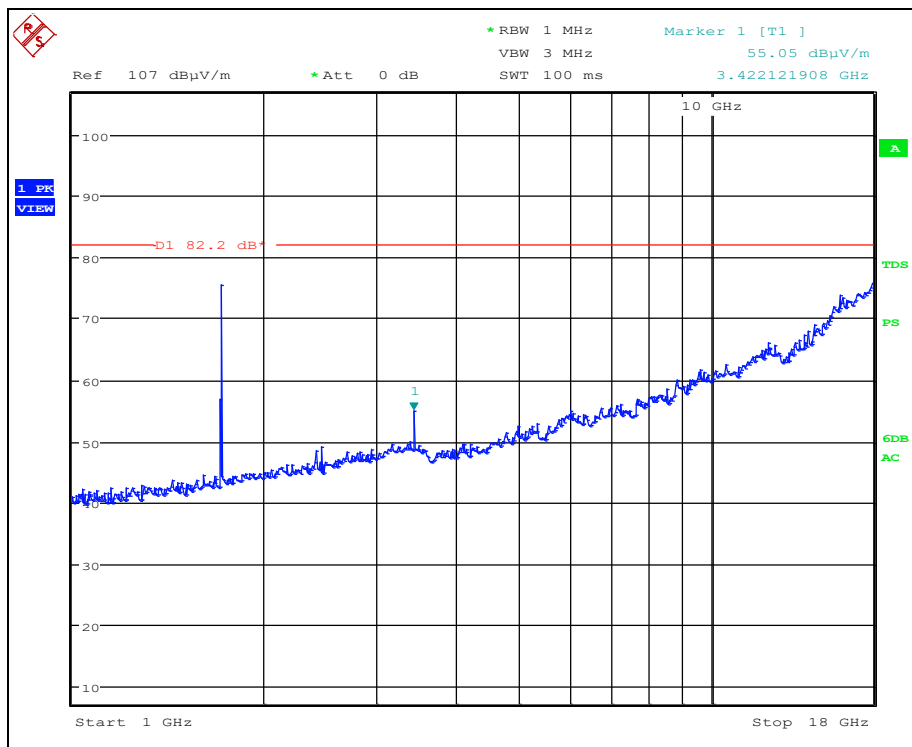
**Plot 1: Field strength of spurious radiation 30MHz – 1GHz, Band 2**



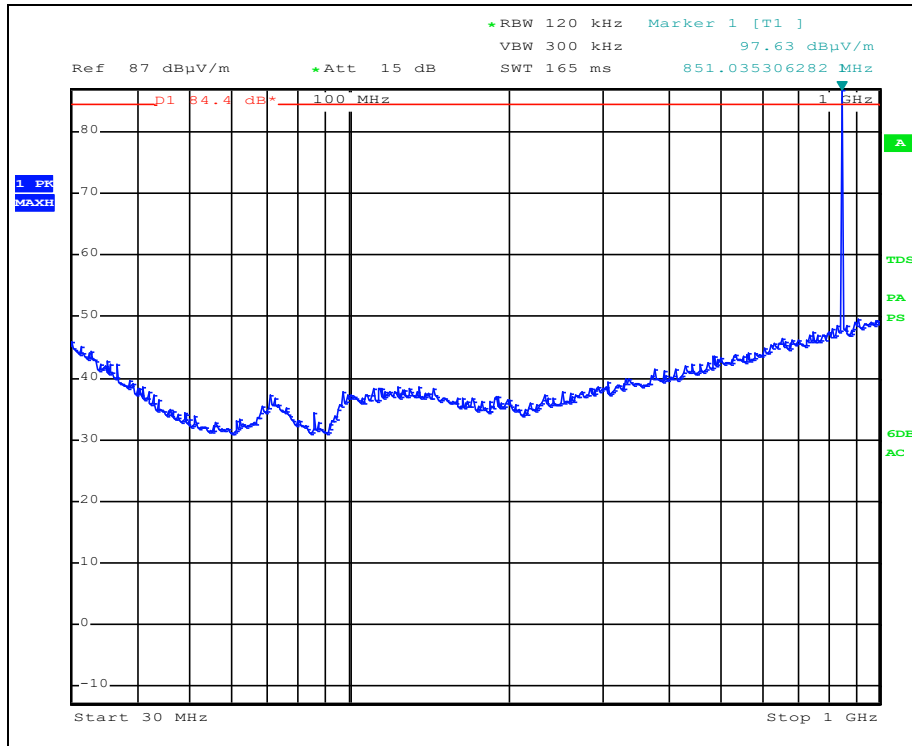
**Plot 2: Field strength of spurious radiation 1GHz – 18GHz, Band 2**



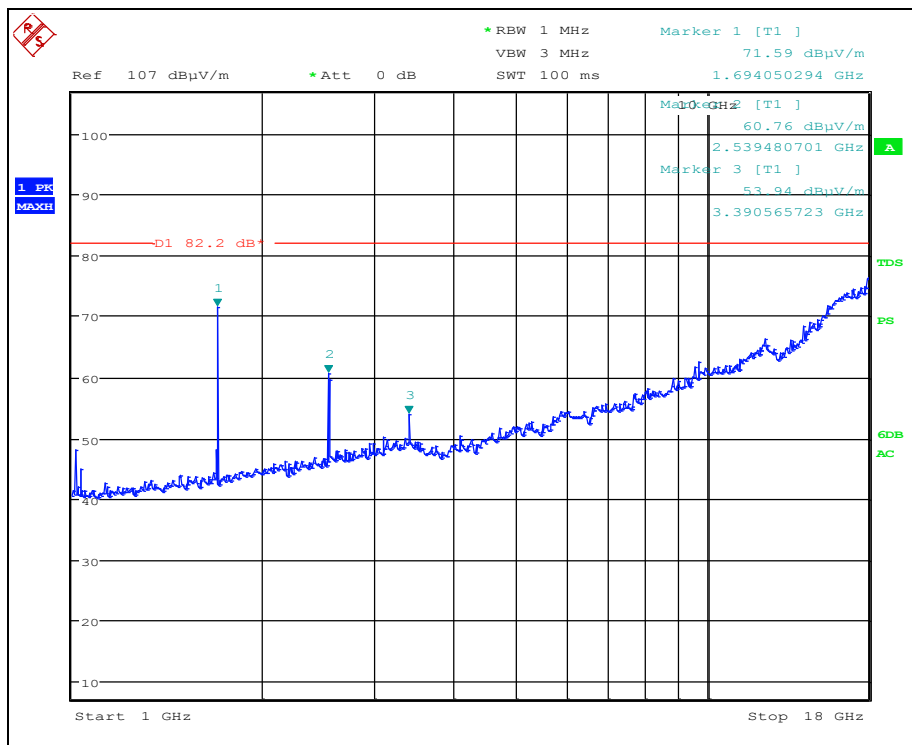
**Plot 3: Field strength of spurious radiation 30MHz – 1GHz, Band 4**



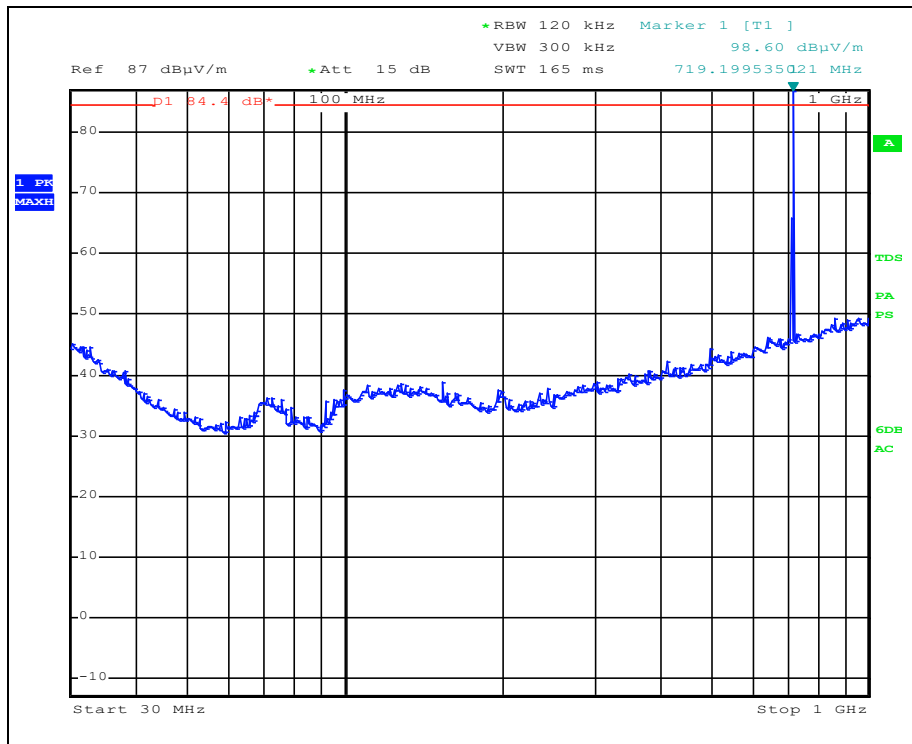
**Plot 4: Field strength of spurious radiation 1GHz – 18GHz, Band 4**



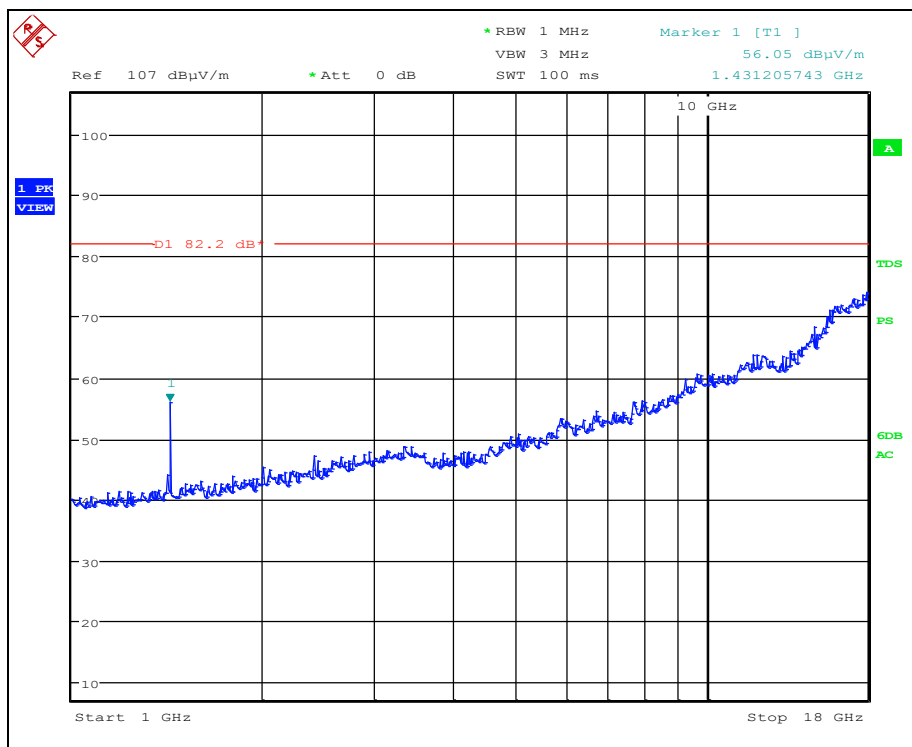
**Plot 5: Field strength of spurious radiation 30MHz – 1GHz, Band 5**



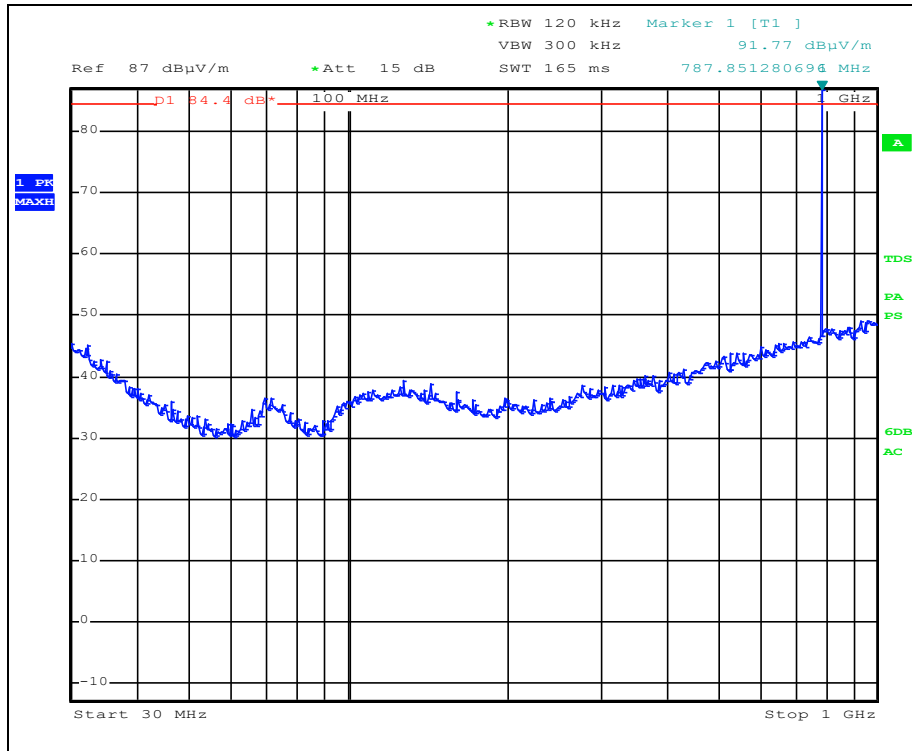
**Plot 6: Field strength of spurious radiation 1GHz – 18GHz, Band 5**



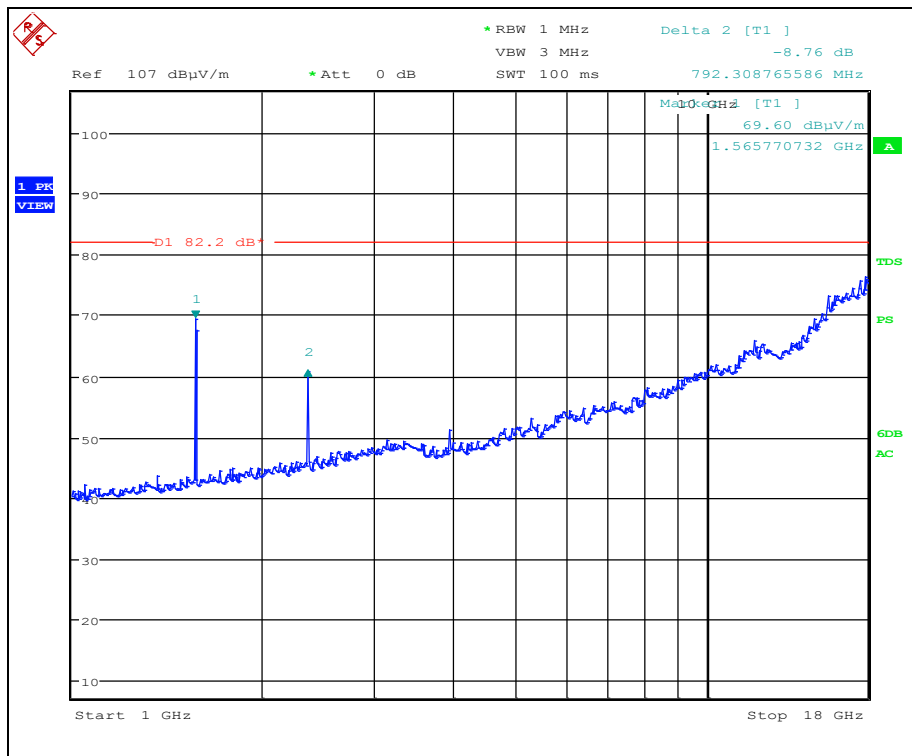
**Plot 7: Field strength of spurious radiation 30MHz – 1GHz, Band 12**



**Plot 8: Field strength of spurious radiation 1GHz – 18GHz, Band 12**



**Plot 9: Field strength of spurious radiation 30MHz – 1GHz, Band 13**



**Plot 10: Field strength of spurious radiation 1GHz – 18GHz, Band 13**





### 3.3 Conducted Spurious Emissions

**Date Performed:** February 5,2021

**Test Standard:** As per [section 2.2](#) of this report

**Test Method:** As per [section 2.2](#) of this report

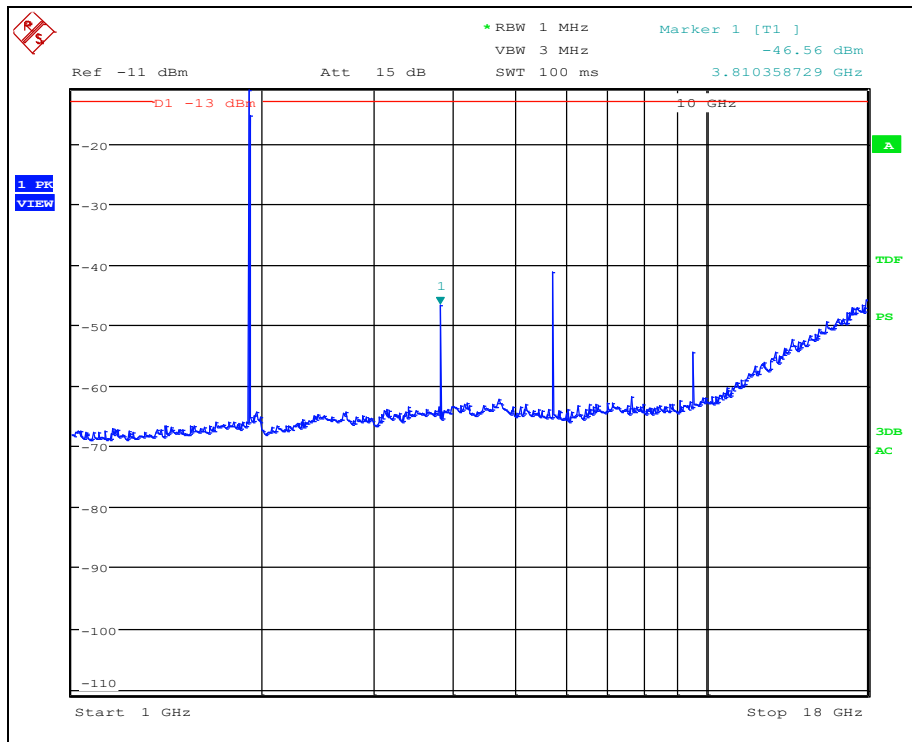
**Modifications:** No modification was required to comply for this test

**Result:** Complies with Standard

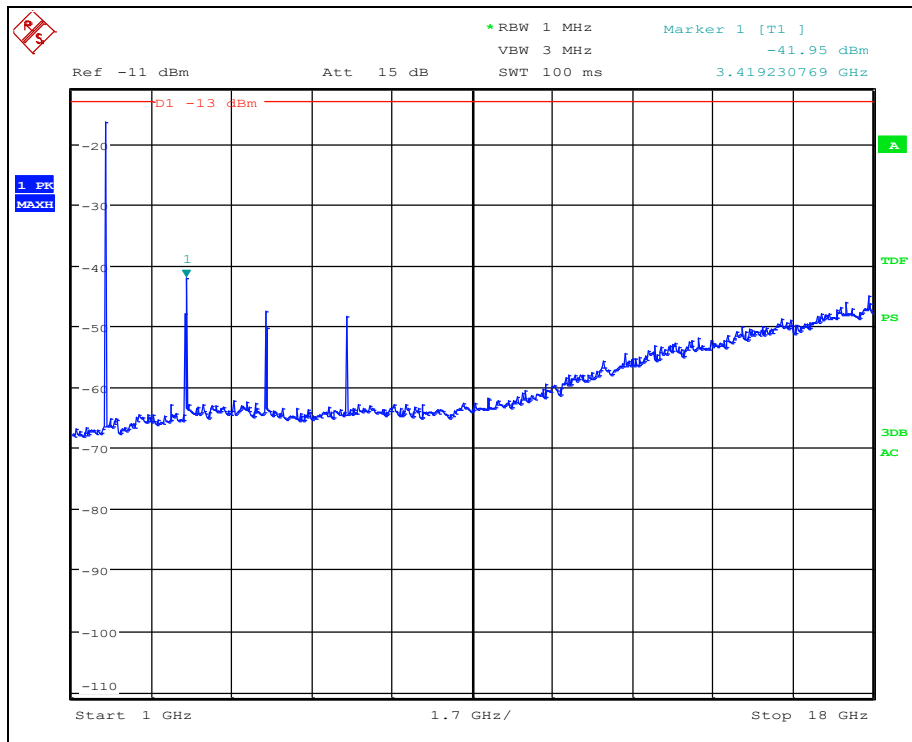
#### Measurement Data and Plot:

**Table 4:Field Strength Of Spurious Radiation**

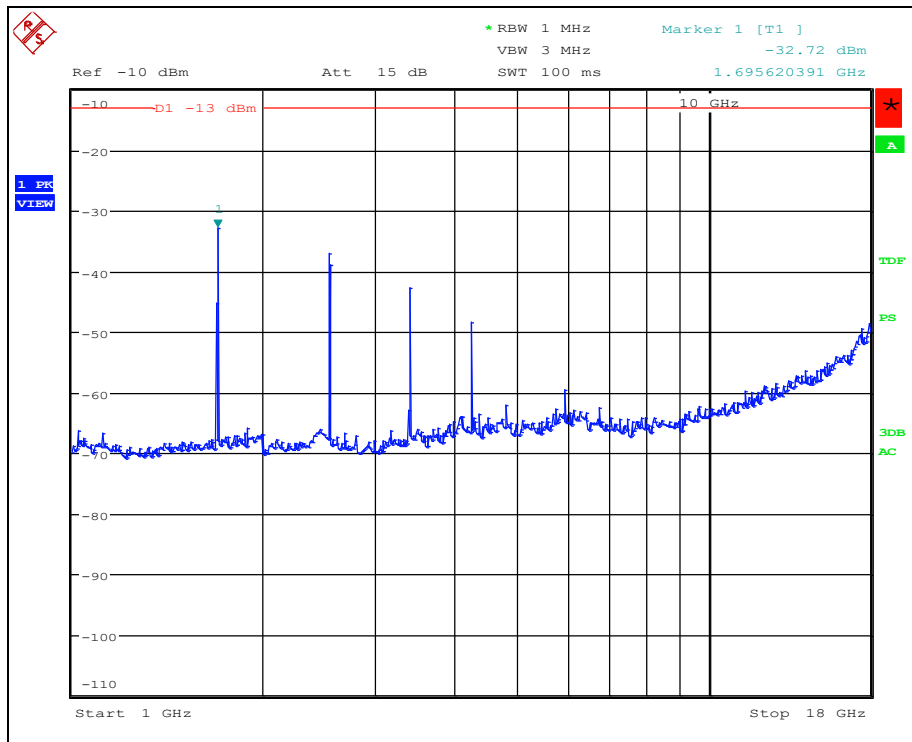
Band	Frequency (MHz)	Pk (dBm)	Limit (dBm)
5	1696	-32.1	-13
	2544	-36.29	-13
	3392	-41.08	-13
	4240	-44.4	-13
2	3818	-46.12	-13
	5727	-38.94	-13
12	1430	-30.46	-13
	2145	-60.26	-13
	2860	-47.16	-13
	3575	-40.26	-13
13	4290	-40.05	-13
	1572	-31.6	-13
	2358	-39.51	-13
	3144	-52.28	-13
4	3930	-35.38	-13
	3422	-42.4	-13
	5133	-46.61	-13
	6844	-47.29	-13



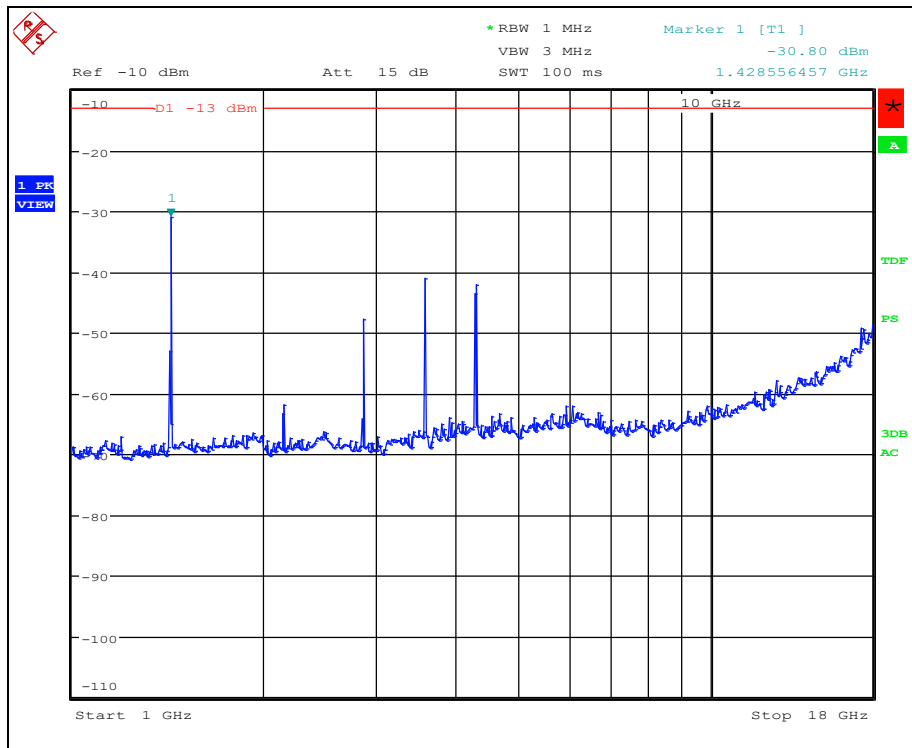
**Plot 11: Conducted Spurious Emissions: Band 2**



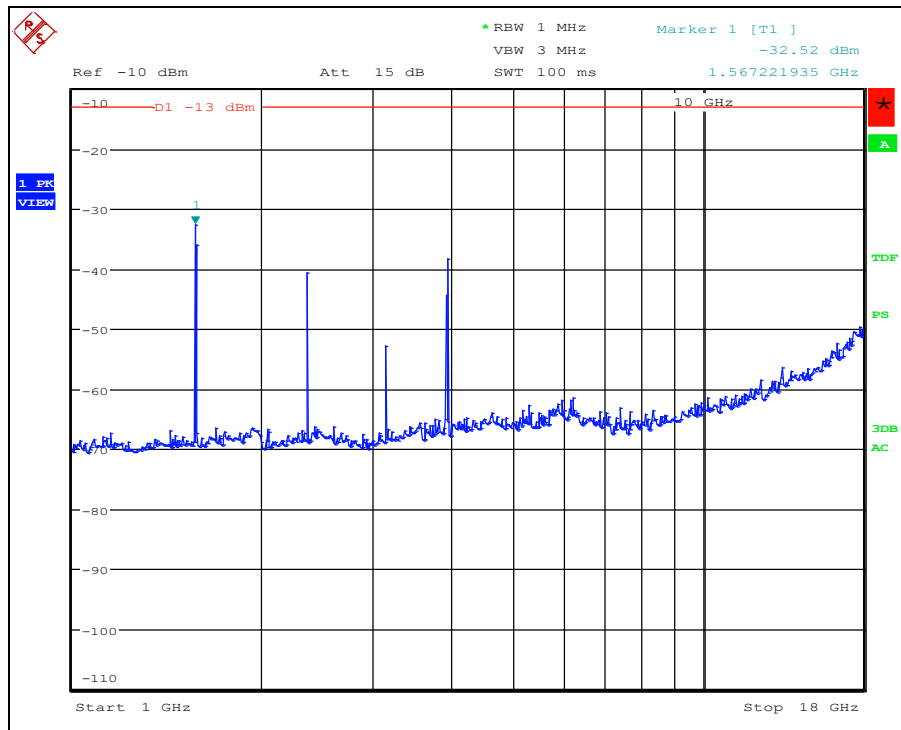
**Plot 12: Conducted Spurious Emissions: Band 4**



**Plot 13: Conducted Spurious Emissions: Band 5**



**Plot 14: Conducted Spurious Emissions: Band 12**



**Plot 15: Conducted Spurious Emissions: Band13**



### 3.4 Band Edge

**Date Performed:** February 5, 2021

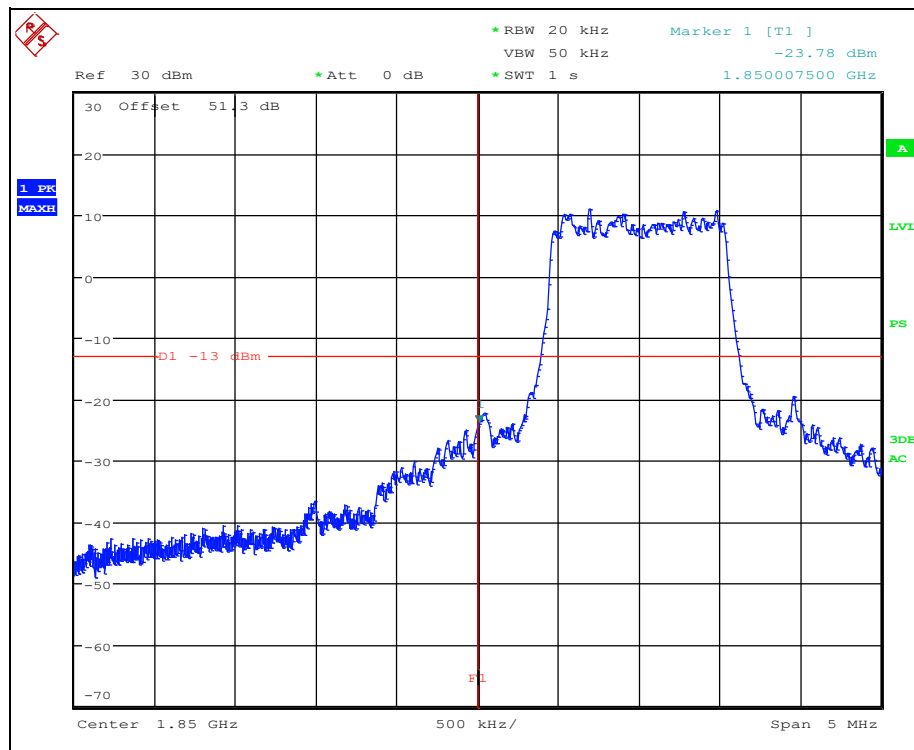
**Test Standard:** As per [section 2.2](#) of this report

**Test Method:** As per [section 2.2](#) of this report

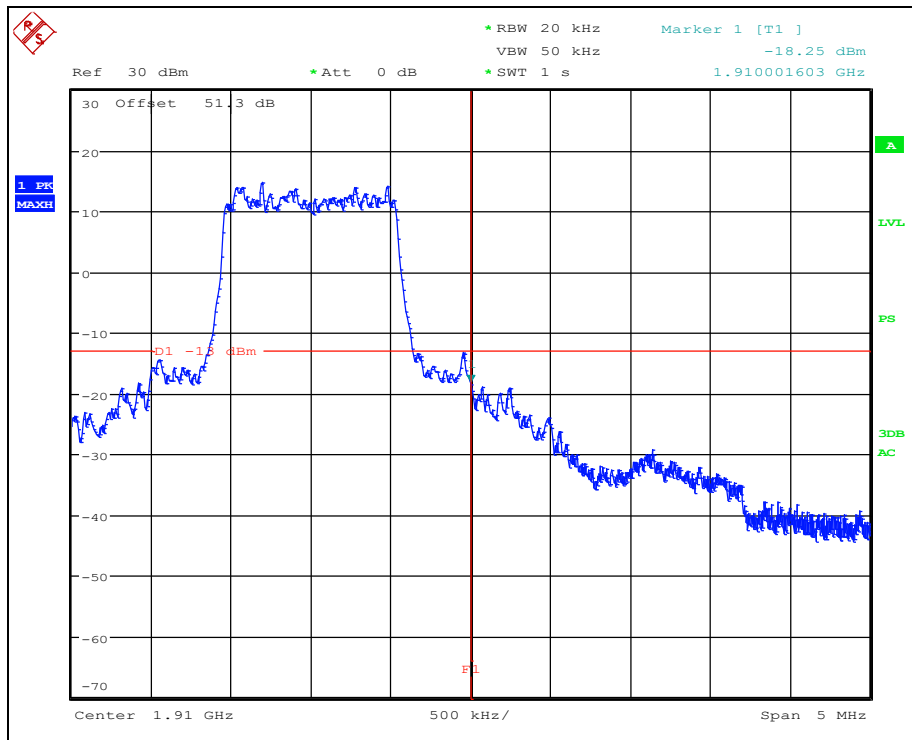
**Modifications:** No modification was required to comply for this test

**Result:** Complies with Standard

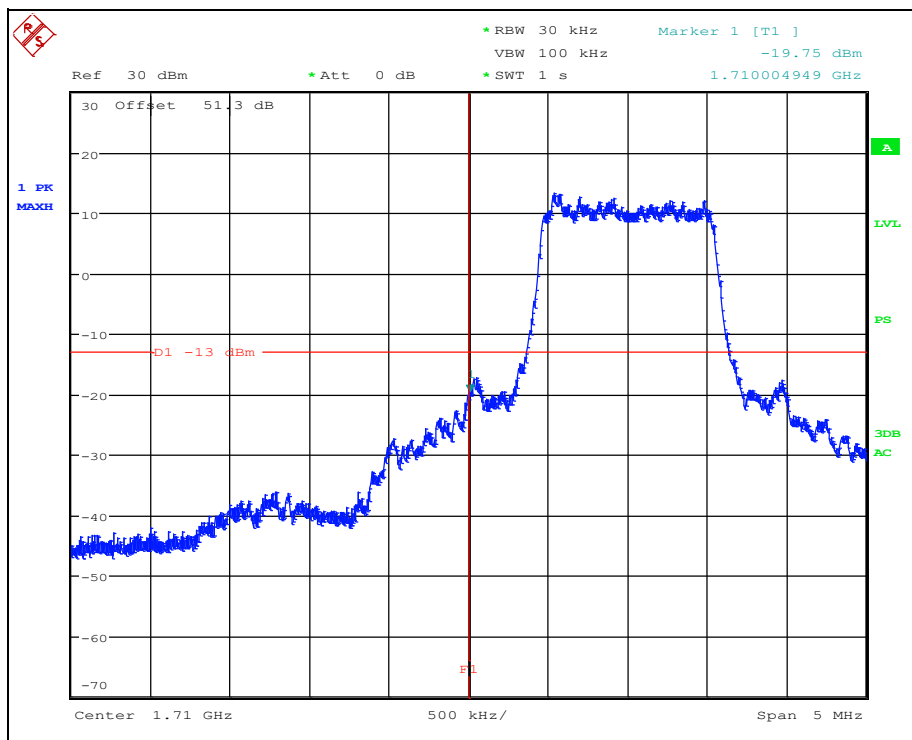
#### Measurement Data and Plot:



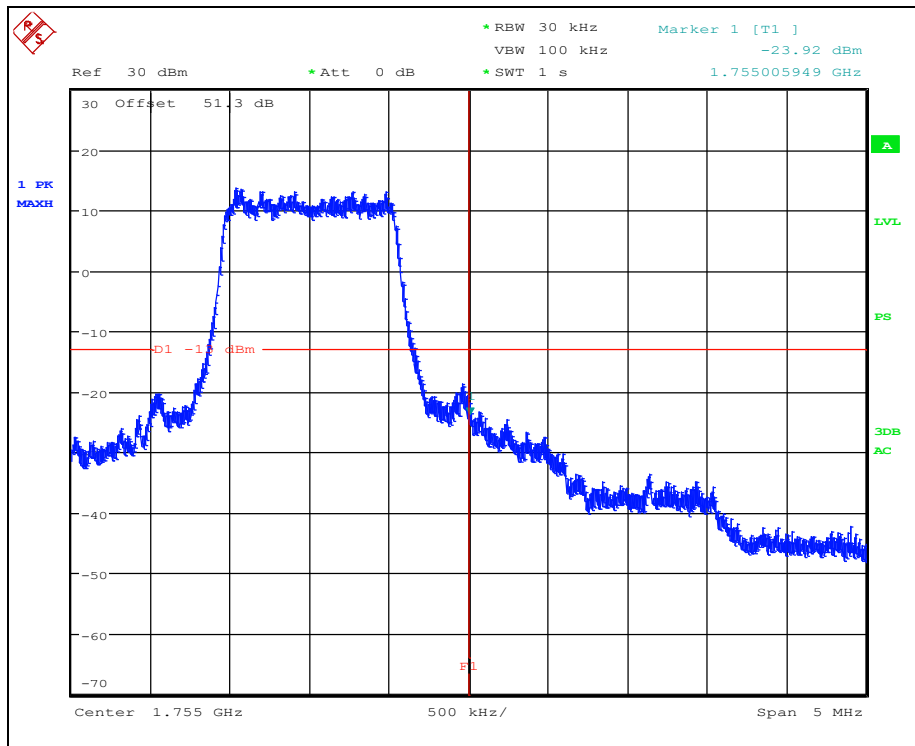
**Plot 16: Band Edge Band 2 1850 MHz – 1910 MHz: Low side**



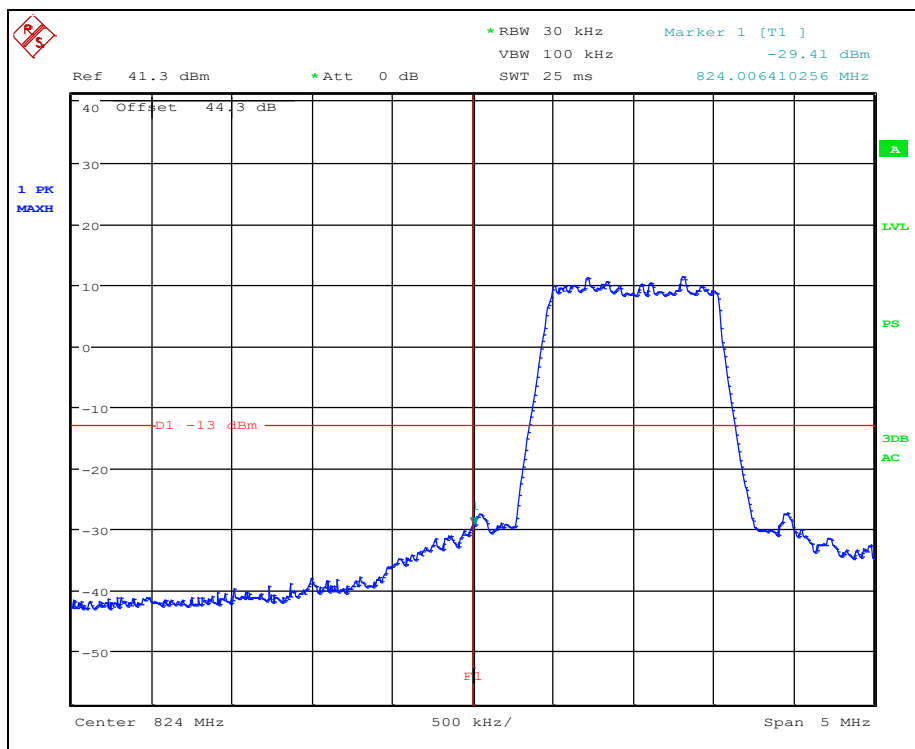
**Plot 17: Band Edge Band 2 1850 MHz – 1910 MHz: High side**



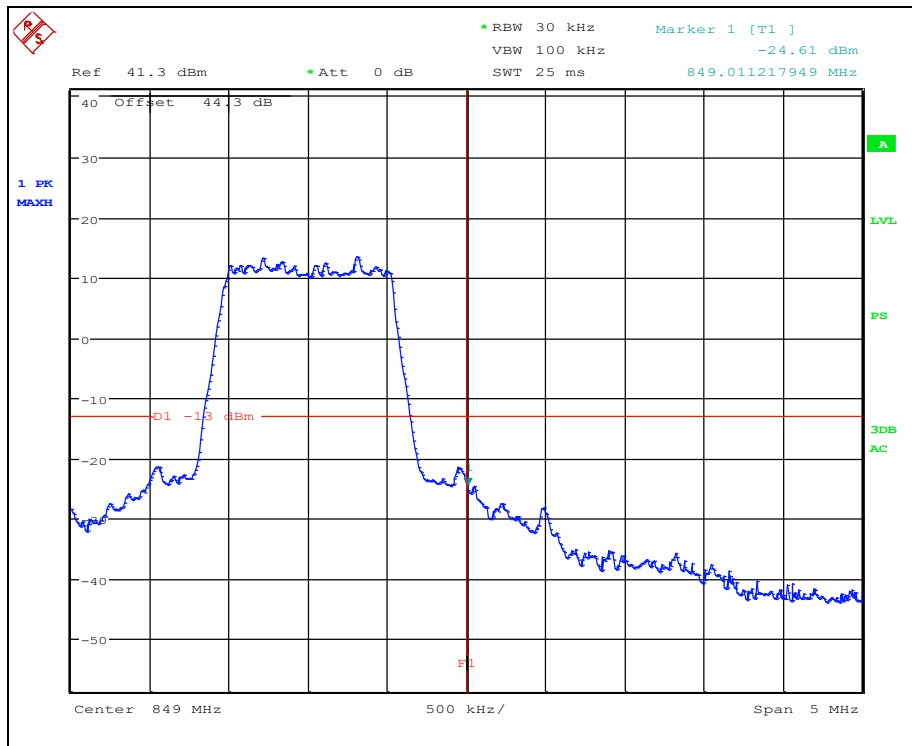
**Plot 18: Band Edge Band 4 1710 MHz – 1755 MHz: Low side**



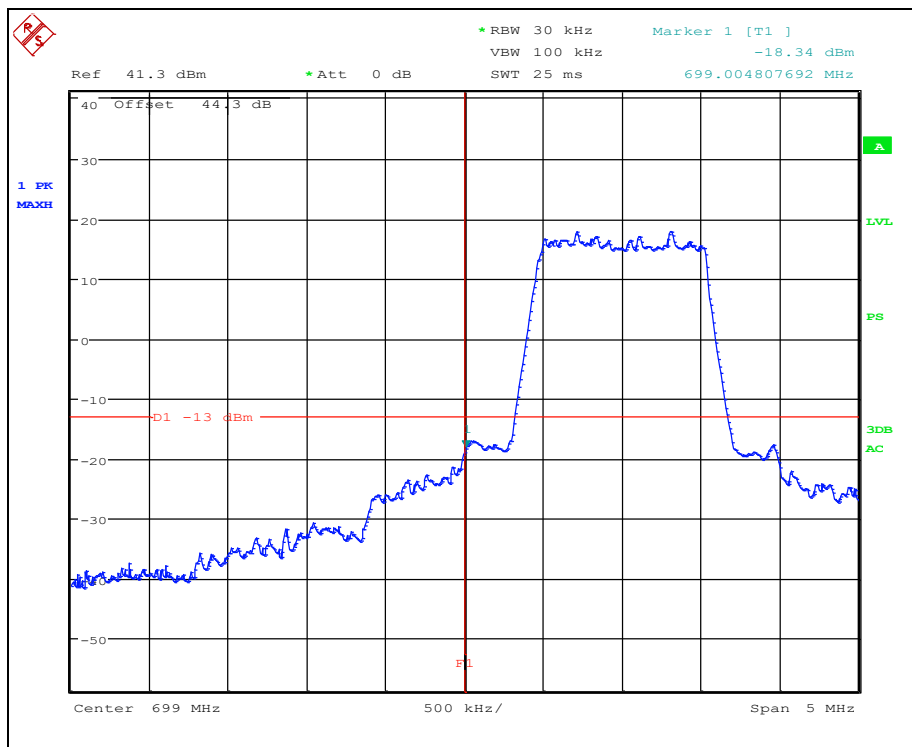
**Plot 19: Band Edge Band 4 1710 MHz – 1755 MHz: High side**



**Plot 20: Band Edge Band 5 824MHz-849MHz: Low side**

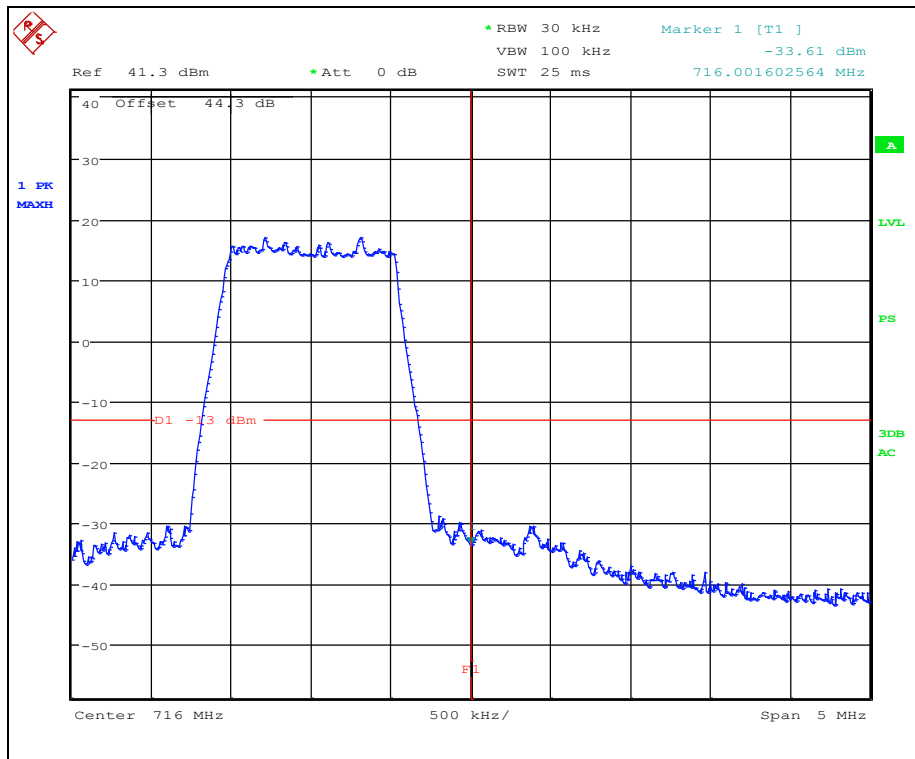


**Plot 21: Band Edge Band 5 824MHz-849MHz: High side**

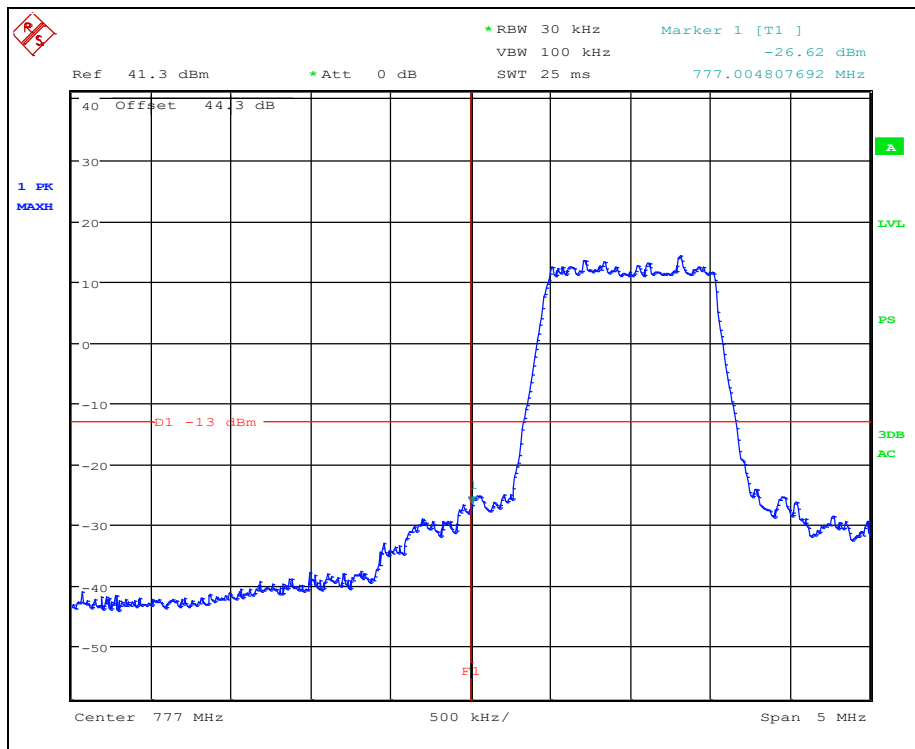


**Plot 22: Band Edge Band 12 699MHz-716MHz: Low side**

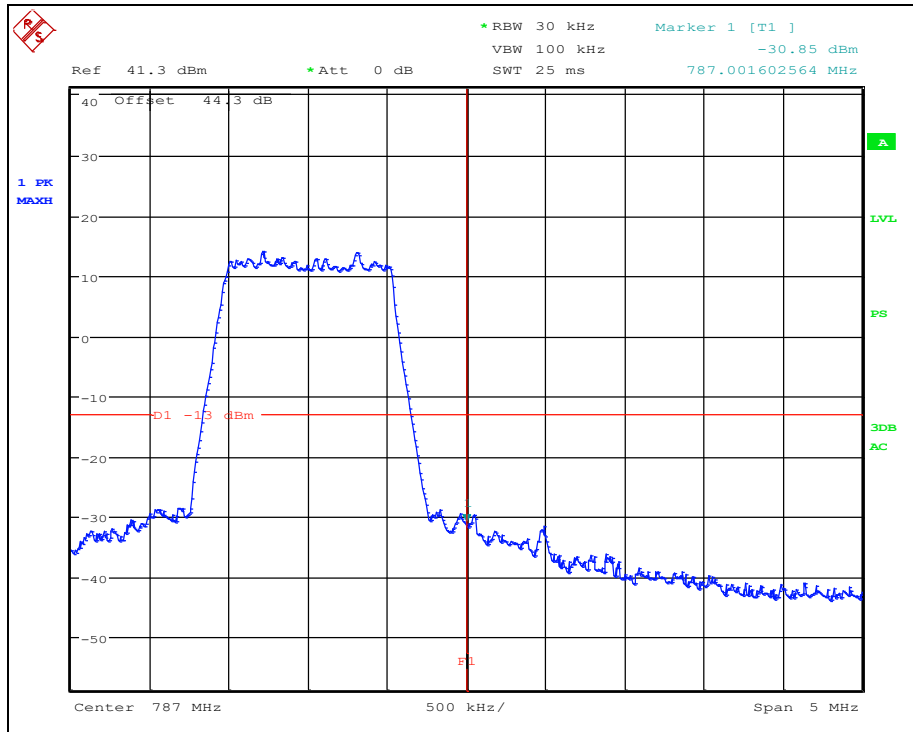




**Plot 23: Band Edge Band 12 699MHz-716MHz: High side**



**Plot 24: Band Edge Band 13 777MHz-787MHz: Low side**

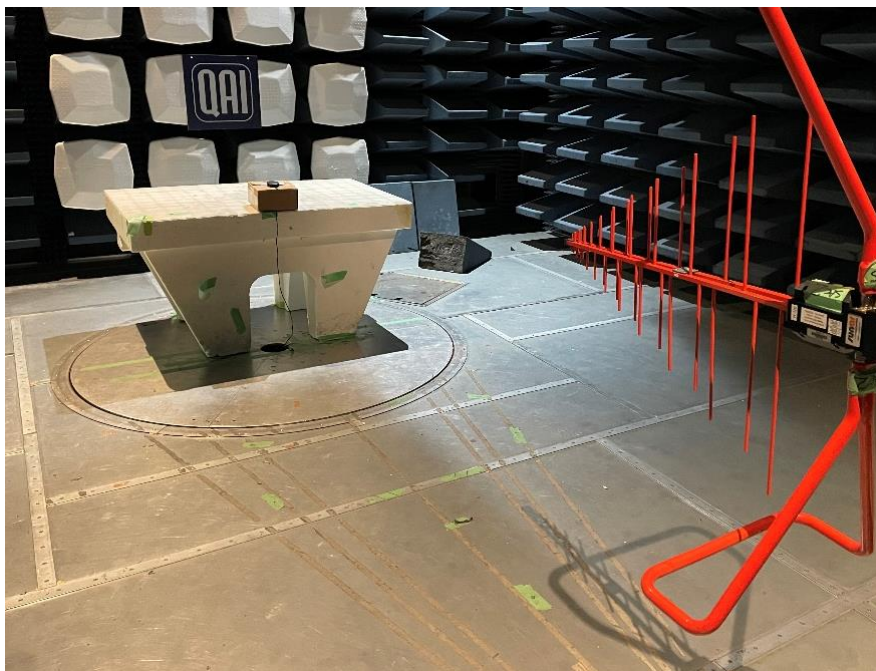


**Plot 25: Band Edge Band 13 777MHz-787MHz: High side**

## Appendix A: TEST SETUP PHOTOS



*Figure 1: Intentional radiated emissions 1GHz – 18GHz*



*Figure 2: Intentional radiated emissions 30MHz – 1GHz*



## Appendix B: ABBREVIATIONS

Abbreviation	Definition
AC	Alternating Current
AM	Amplitude Modulation
CE	European Conformity
CISPR	Comité International Spécial des Perturbations Radioélectriques (International Special Committee on Radio Interference)
DC	Direct Current
EFT	Electrical Fast Transient
EMC	Electro Magnetic Compatibility
EMI	Electro Magnetic Interference
ESD	Electrostatic Discharge
EUT	Equipment Under Test
FCC	Federal Communications Commission
FVIN	Firmware Version Identification Number FVIN
IC	Industry Canada
ICES	Interference Causing Equipment Standard
IEC	International Electrotechnical Commission
LISN	Line Impedance Stabilizing Network
OATS	Open Area Test Site
RF	Radio Frequency
RMS	Root-Mean-Square
SAC	Semi-Anechoic Chamber

**END OF REPORT**