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www.ComplianceTesting.com
info@ComplianceTesting.com

Test Report

Prepared for: Pulse Roller

Model: EZQube-W

Description: Single motor, drive controller module for Synergy Motors

Serial Number: 973 156

FCC ID: 2A5FK-EZQUBEW
ISED ID: 28311-EZQUBEW

To

FCC Part 15.247 DTS
ISED RSS-247 Issue 2

Date of Issue: February 23, 2022

On behalf of the applicant:	**Pulse Roller** **2748 Circleport Dr.** **Erlanger, KY 41018**
Attention of:	**Pat Knapke** **pknapke@pulseroller.com** **Direct: 859-647-8945**

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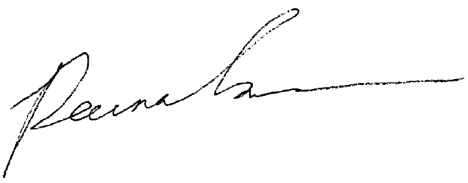

Poona Saber
Project Test Engineer

Test Report Revision History

Revision	Date	Revised By	Reason for Revision
1.0	Feb 23, 2022	Poona Saber	Original Document
2.0	March 29, 2022	Greg Corbin	Added references for ISED.

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ANAB

Compliance Testing, LLC, has been accredited in accordance with the recognized International Standard ISO/IEC 17025:2017. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to the joint ISO-ILAC-IAF Communiqué dated January 2009).

The tests results contained within this test report all fall within our scope of accreditation, unless noted below.

Please refer to http://www.compliancetesting.com/labscope.html for current scope of accreditation.

FCC Site Reg. #349717

IC Site Reg. #2044A-2

The applicant has been cautioned as to the following

15.21 - Information to User

The user's manual or instruction manual for an intentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

15.27(a) - Special Accessories

Equipment marked to a consumer must be capable of complying with the necessary regulations in the configuration in which the equipment is marketed. Where special accessories, such as shielded cables and/or special connectors are required to enable an unintentional or intentional radiator to comply with the emission limits in this part, the equipment must be marketed with, i.e. shipped and sold with, those special accessories. However, in lieu of shipping or packaging the special accessories with the unintentional or intentional radiator, the responsible party may employ other methods of ensuring that the special accessories are provided to the consumer without an additional charge.

Information detailing any alternative method used to supply the special accessories for a grant of equipment authorization or retained in the verification records, as appropriate. The party responsible for the equipment, as detailed in § 2.909 of this chapter, shall ensure that these special accessories are provided with the equipment. The instruction manual for such devices shall include appropriate instructions on the first page of text concerned with the installation of the device that these special accessories must be used with the device. It is the responsibility of the user to use the needed special accessories supplied with the equipment.

Standard Test Conditions Engineering Practices

Except as noted herein, the following conditions and procedures were observed during the testing:

In accordance with ANSI C63.10-2013 and unless otherwise indicated in the specific measurement results, the ambient temperature of the actual EUT was maintained within the range of 10° to 40°C (50° to 104°F) unless the particular equipment requirements specified testing over a different temperature range. Also, unless otherwise indicated, the humidity levels were in the range of 10% to 90% relative humidity.

Measurement results, unless otherwise noted, are worst-case measurements.

Environmental Conditions		
Temperature (ºC)	**Humidity (%)**	**Pressure (mbar)**
25.6	42.3	985.0

EUT Description
Model: EZQube-W
Description: EZ-Qube is an economical single motor, drive controller module for Senergy Motors
Firmware: NA
Software: NA
Serial Number: 973 156

PMN: EZ-Qube-W
HVIN: EZQUBEW

Additional Information:

EZ-Qube is an economical single motor, drive controller module for Senergy Motors. Its input power is 24 VDC and has 3 connectors- motor, power and I/0 terminal.

It utilizes a Bluetooth low energy radio module that is controlled for testing purpose via an ESP RF test tool connected to a PC with a USB-UART bridge between UART connector on the module and USB port of the PC.

Module has a PCB trace antenna of 2 dBi gain.

EUT Operation during Test

EUT is put on test put at highest transmit power of 3 dBm corresponding to level 5 on the software. The prbs mode is used for continuous testing on low, Mid and High channels. The operation frequency band is 2404-2480 MHz.

For conducted testing a UFL to SMA connector is used connect to spectrum analyzer.

Accessories:

Qty	Description	Manufacturer	Model	S/N
1	USB-UART bridge	NA	NA	NA

Cables:

Qty	Description	Length (M)	Shielding Y/N	Shielded Hood Y/N	Ferrite Y/N
1	DC Power Cable	<3	NA	NA	N
1	I/O terminal cable	<3	NA	NA	N
1	Motor cable	<3	NA	NA	N

Modifications: None

15.203: Antenna Requirement:

X	The antenna is permanently attached to the EUT
	The antenna uses a unique coupling
	The EUT must be professionally installed
	The antenna requirement does not apply

Test Results Summary

FCC 15.247 Specification	RSS-247 Specification	Test Name	Pass, Fail, N/A	Comments
15.247(b)	Section 5.4(d)	Peak Output Power	Pass	
15.247(d)	Section 5.5	Conducted Spurious Emissions	Pass	
15.247(d), 15.209(a), 15.205	Section 5.5	Radiated Spurious Emissions	Pass	
15.247(d), 15.209(a), 15.205	Section 5.5	Emissions At Band Edges	Pass	
15.247(a)(2)	Sections 5.2(a)	Occupied Bandwidth	Pass	
15.247(e)	Section 5.2(b)	Transmitter Power Spectral Density	Pass	
15.207	RSS-GEN Section 8.8	A/C Powerline Conducted Emissions	N/A	Unit runs on DC power

Statements of conformity are reported as:

- Pass - the measured value is below the acceptance limit, *acceptance limit = test limit*.
- Fail - the measured value is above the acceptance limit, *acceptance limit = test limit*.

Peak Output Power

Engineer: Poona Saber

Test Date: 2/7/22

Test Procedure

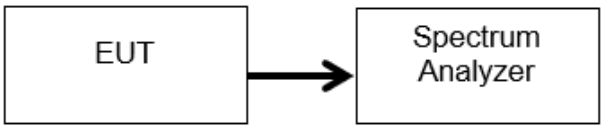
The EUT was connected to a spectrum analyzer to verify that the EUT met the requirements for peak output power. The peak readings were taken, and the result was then compared to the limit. The test was performed per section 11.9.1.1 of ANSI C63.10:2013 as the procedure for determining “Fundamental emission output power, RBW greater than or equal to DTS bandwidth.”

The Spectrum Analyzer was set to the following:

RBW ≥ DTS Bandwidth
VBW ≥ 3 x RBW
Span ≥ 3 x RBW
Sweep time = auto couple
Detector = peak
Trace Mode = max hold

The EUT was set to transmit on the lowest, middle, and highest frequencies at the maximum power level. The RF output power was measured using the RBW ≥ DTS bandwidth method.

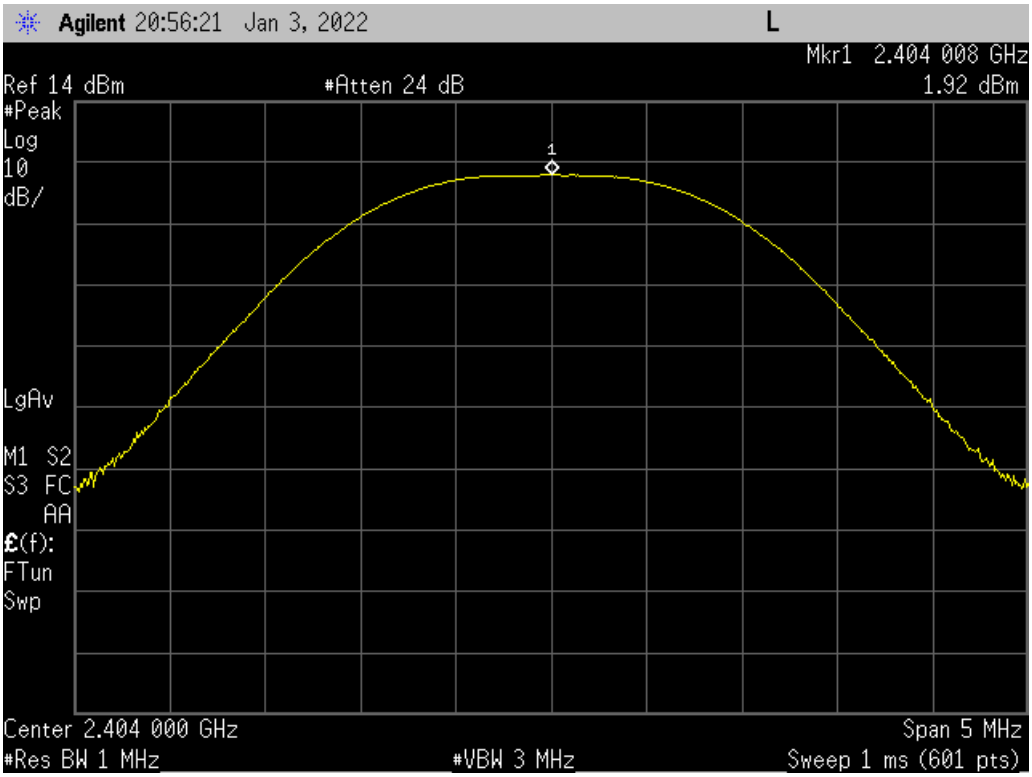
Test Setup



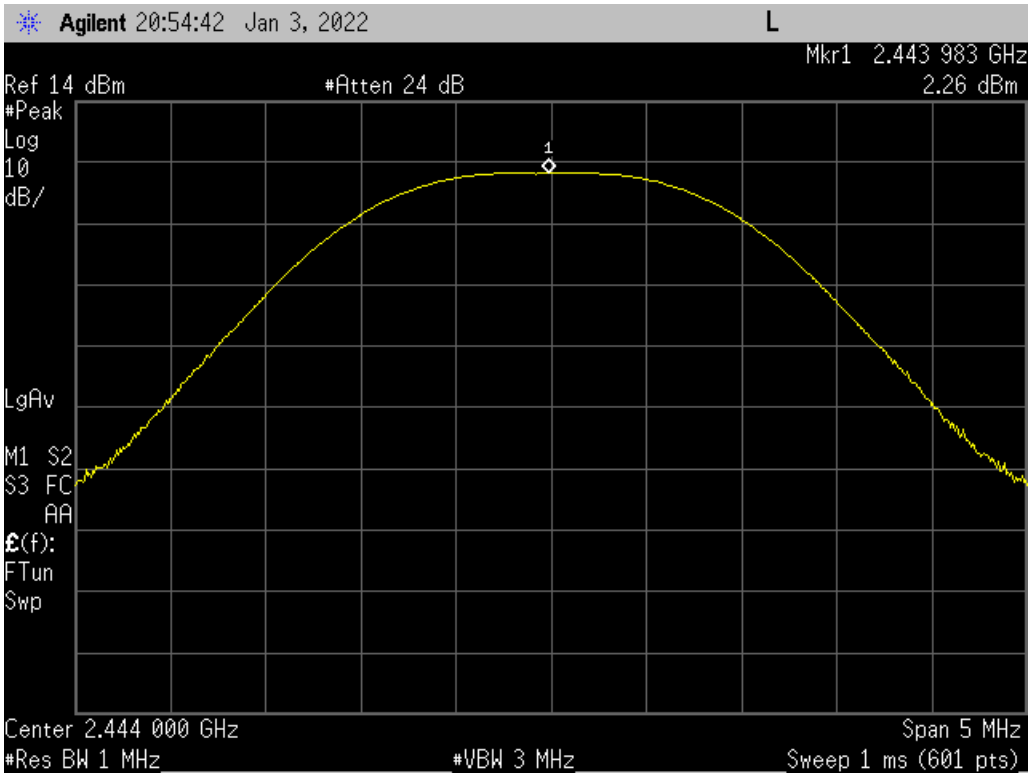
Transmitter Peak Output Power

Tuned Frequency (MHz)	Measured Value (dBm)	Specification Limit	Result
2404	1.92	1 W (30 dBm)	Pass
2444	2.26	1 W (30 dBm)	Pass
2480	2.8	1 W (30 dBm)	Pass

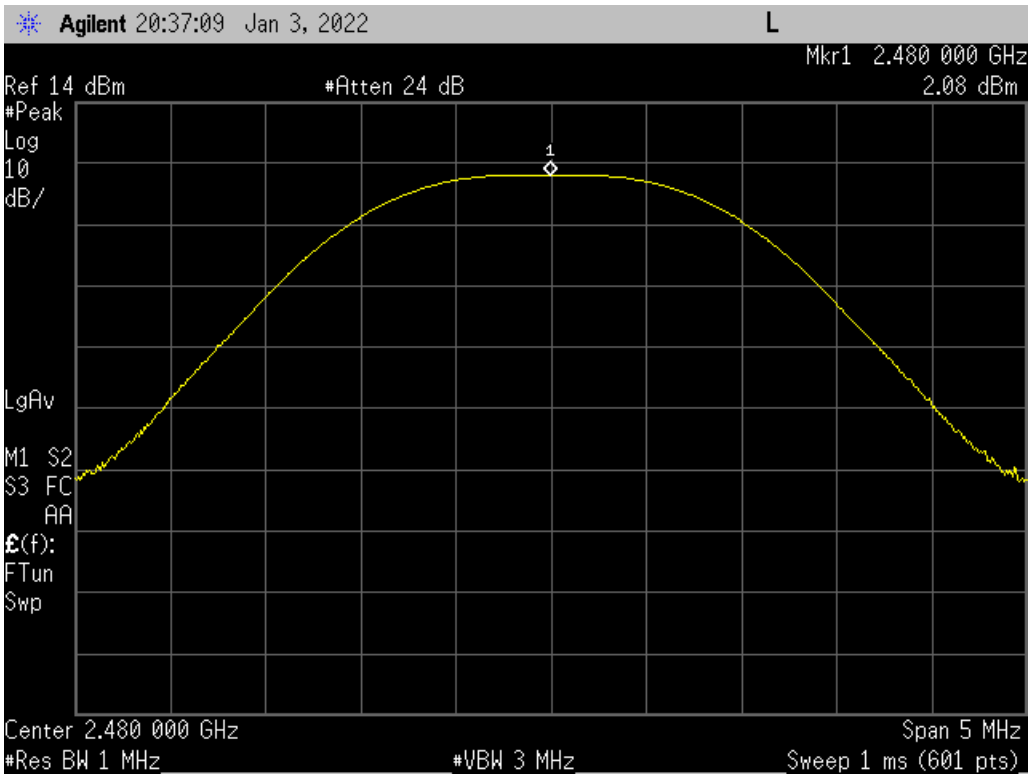
Low Channel Peak Power



Mid Channel Peak Power



High Channel Peak Power



Occupied Bandwidth

Engineer: Poona Saber

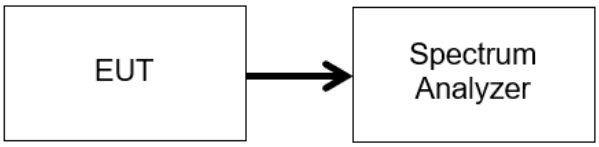
Test Date:2/2/22

Test Procedure

The EUT was connected directly to a spectrum analyzer. The 6dB bandwidth test was performed per section 11.8.1 of ANSI C63.10:2013 “Procedure for determining DTS Bandwidth for DTS devices”.

The Spectrum Analyzer was set to the following for 6 dB DTS BW:
RBW = 100 kHz
VBW ≥ 3 x RBW
Peak Detector
Trace mode = max hold
Sweep = auto couple
Span = 1.5 x EBW

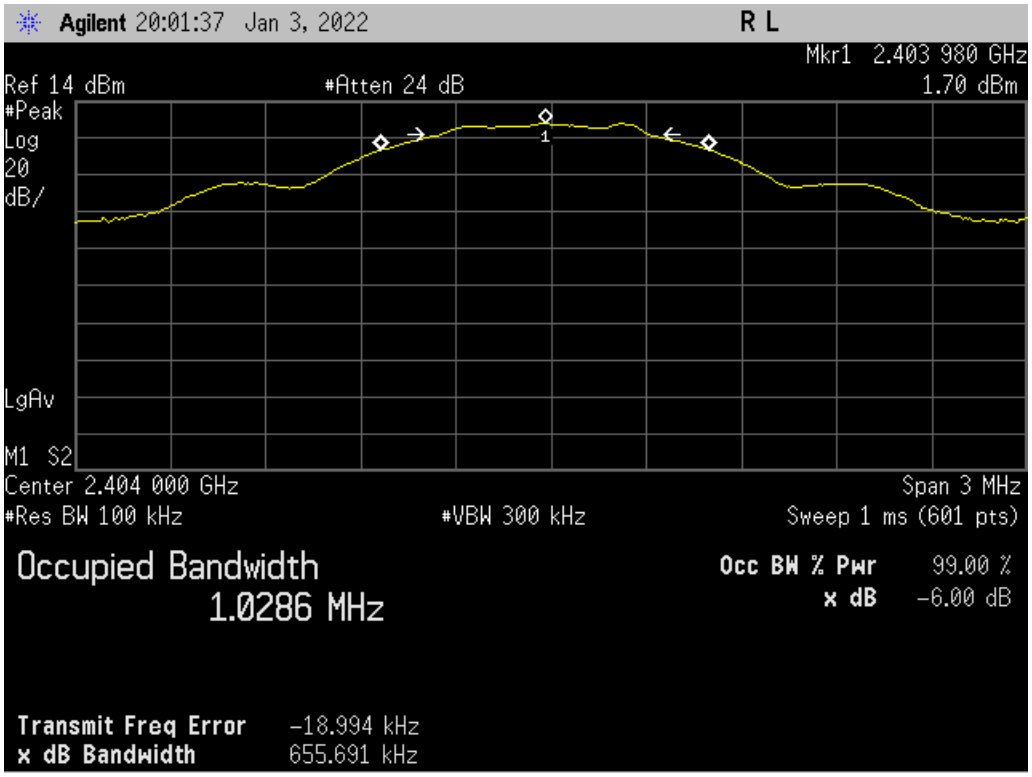
Test Setup



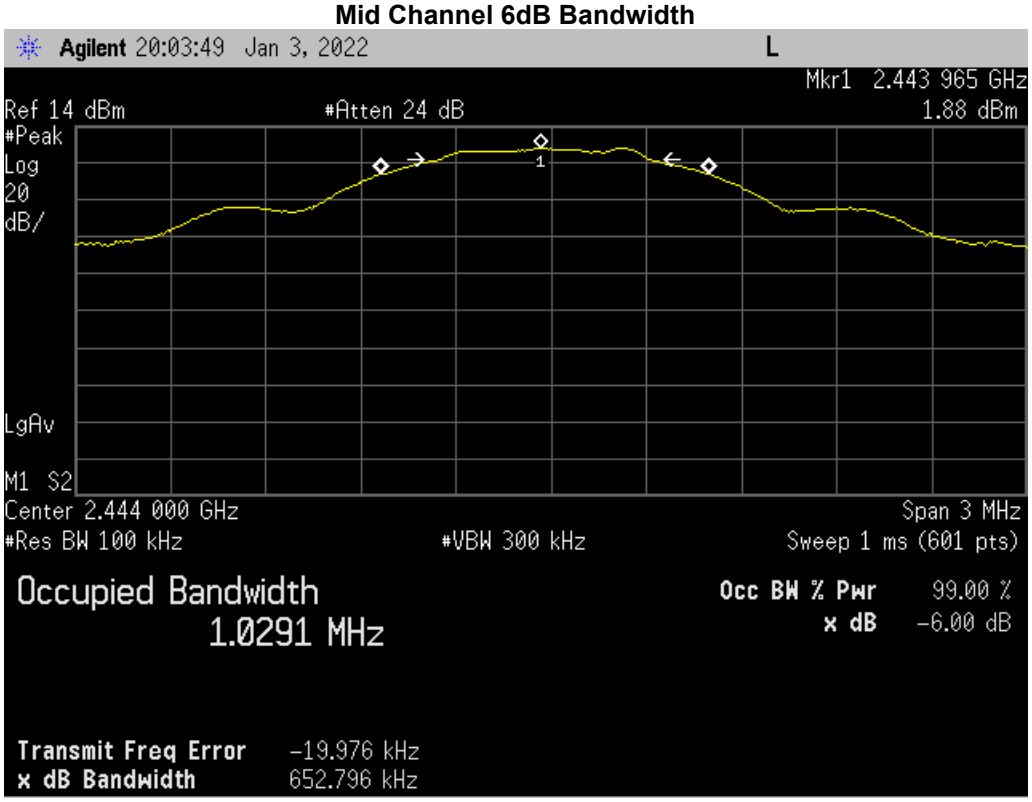
6 dB Occupied Bandwidth Summary

Frequency (MHz)	Measured Bandwidth (kHz)	Specification Limit (kHz)	Result
2404	655.6	≥ 500	Pass
2444	652.7	≥ 500	Pass
2480	651.7	≥ 500	Pass

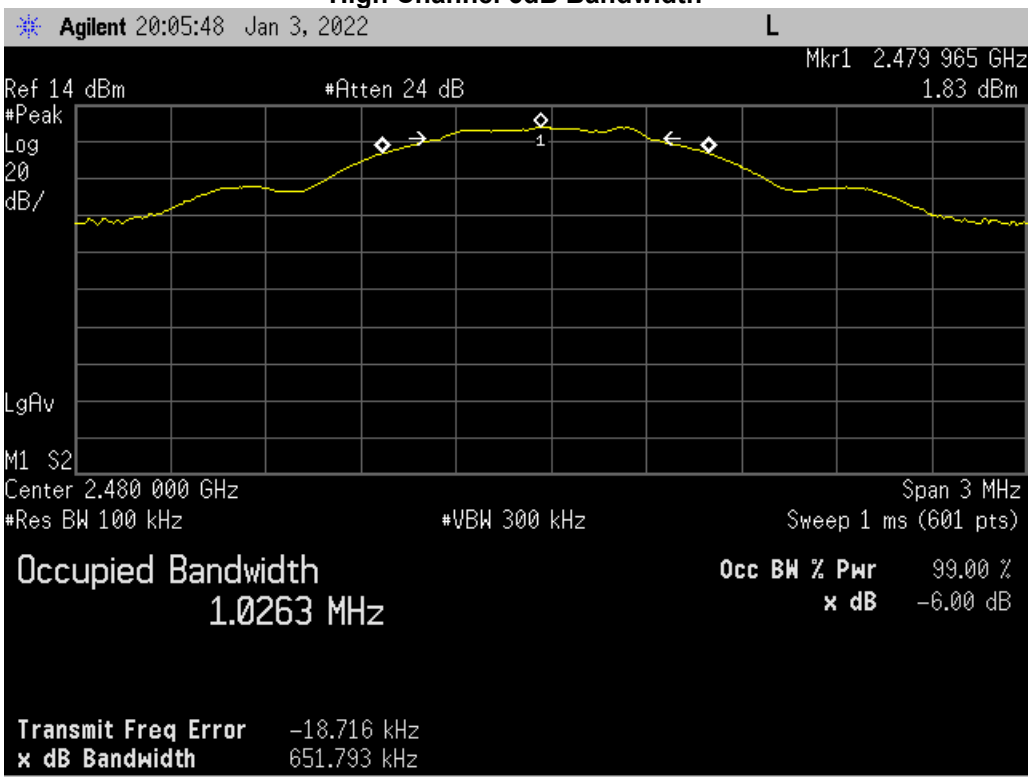
Low Channel 6dB Bandwidth



Mid Channel 6dB Bandwidth



High Channel 6dB Bandwidth



Transmitter Power Spectral Density (PSD)

Engineer: Poona Saber

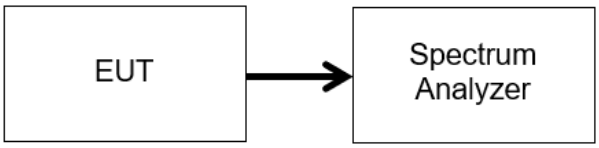
Test Date: 2/7/22

Test Procedure

The EUT was connected directly to a spectrum analyzer. The test was performed per section 11.10.2 of ANSI C63.10:2013 “Maximum power spectral density level in the fundamental emission, Method PKPSD (peak PSD).”

The Spectrum Analyzer was set to the following:
DTS channel center frequency
Span 1.5 x DTS bandwidth
RBW =3 kHz ≤ RBW ≤ 100 kHz
VBW ≥ 3 x RBW
Peak Detector
Sweep time = auto couple
Trace mode = max hold

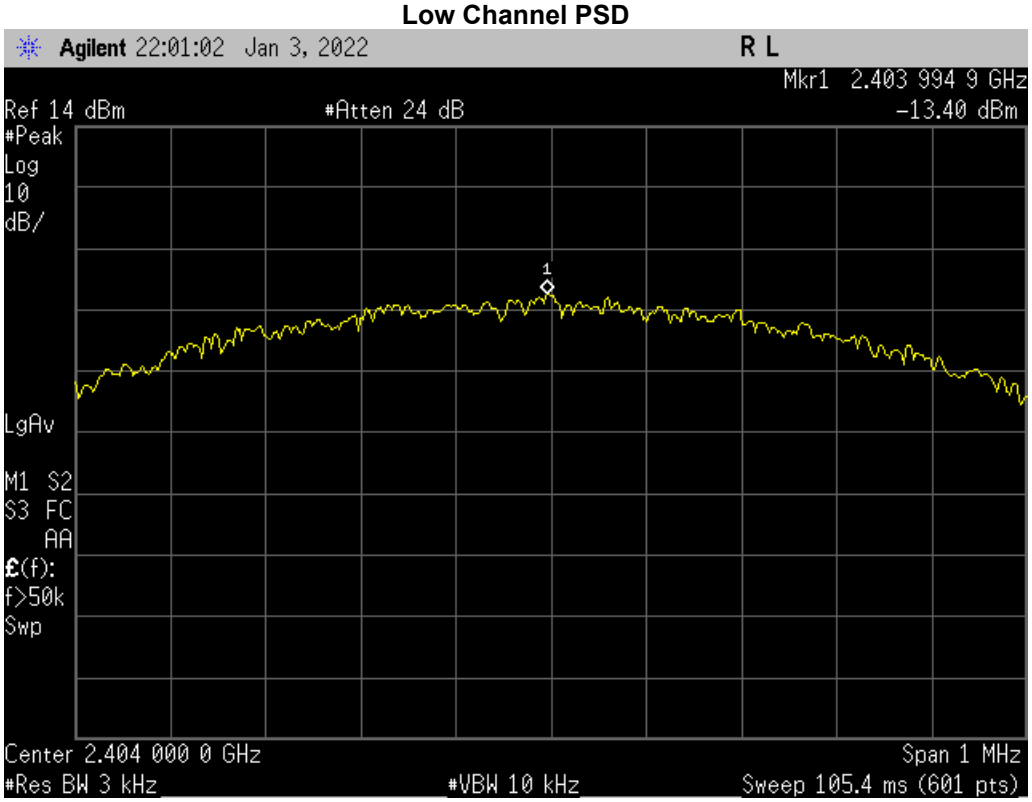
Test Setup



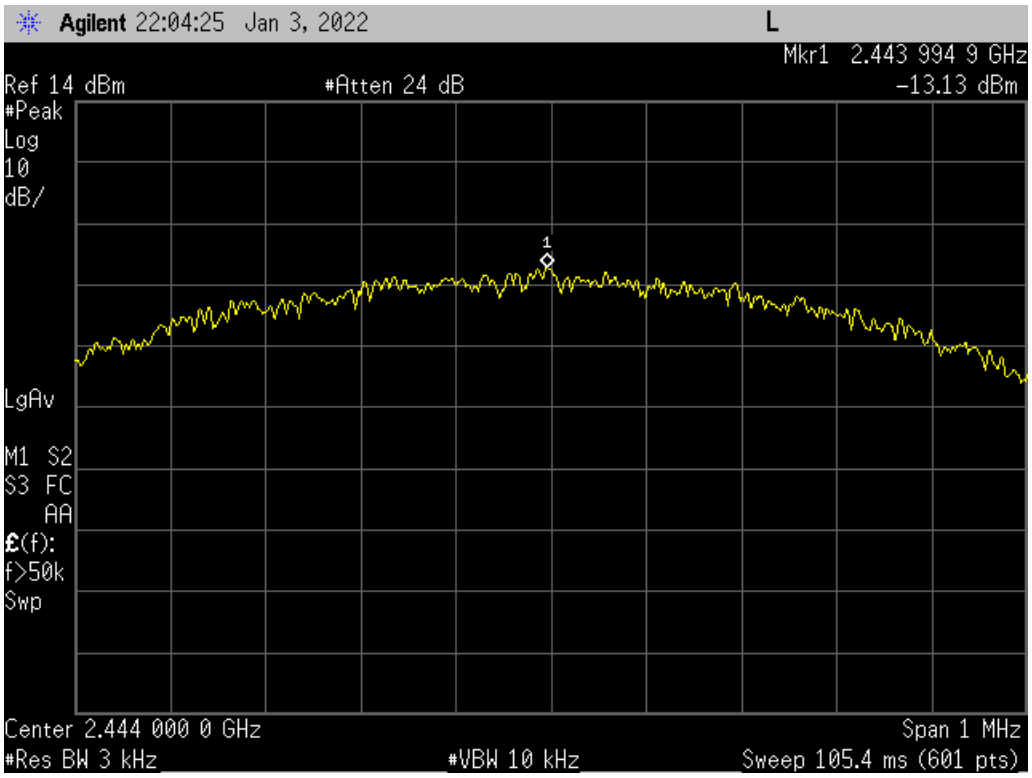
PSD Summary

Frequency (MHz)	Measured Data (dBm)	Specification Limit (dBm)	Result
2404	-13.40	8	Pass
2444	-13.13	8	Pass
2480	-13.36	8	Pass

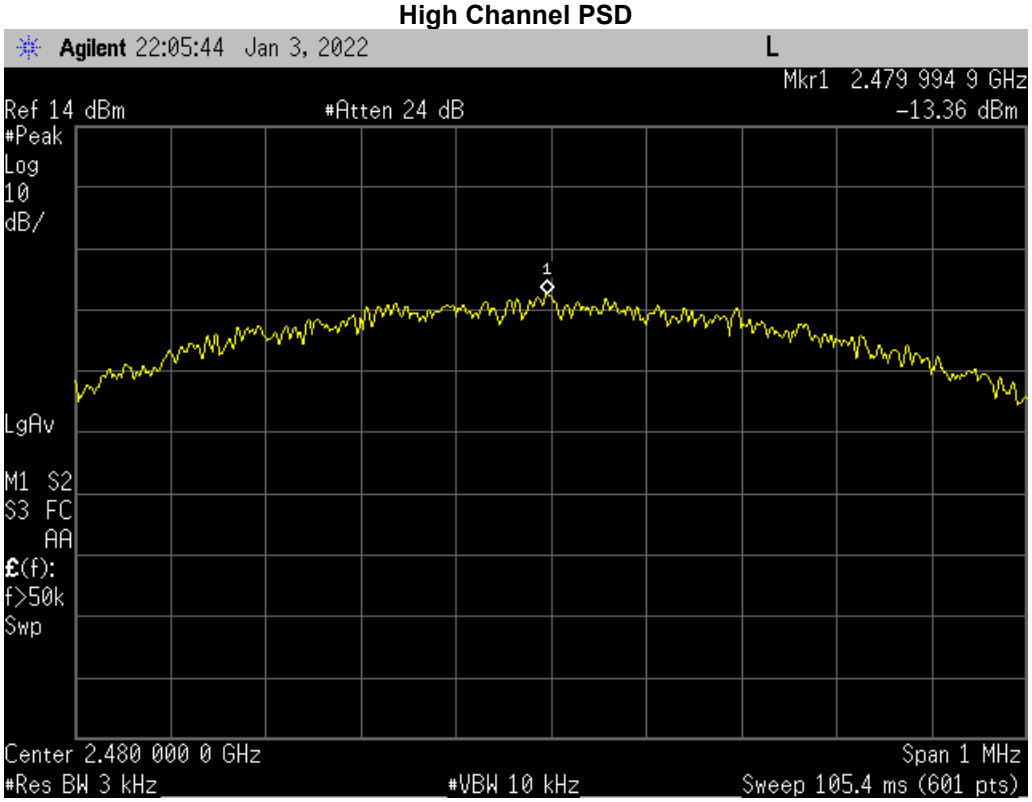
Low Channel PSD



Mid Channel PSD



High Channel PSD



Conducted Spurious Emission

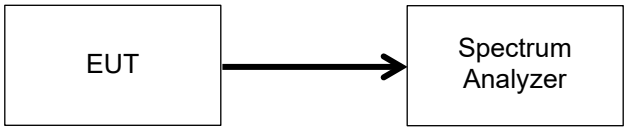
Engineer: Poona Saber

Test Date: 2/7/22

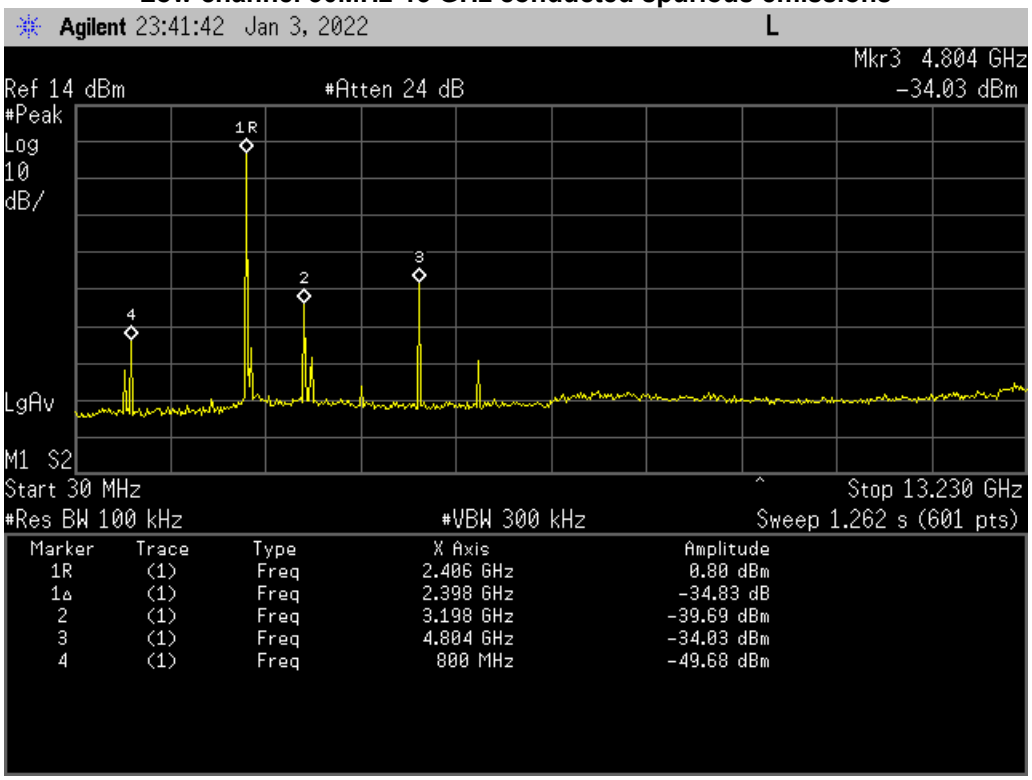
Test Procedure

The EUT was connected to a spectrum analyzer to verify that the EUT met the requirements for spurious emissions in 100 kHz bandwidth. The frequency range from 30 MHz to the 10th harmonic of the fundamental transmitter was observed. Only detectable spurious emissions were recorded and measured for 20 dBc from peak fundamental in 100 kHz bandwidth. The test was performed per section 11.11.2 of ANSI C63.10:2013.

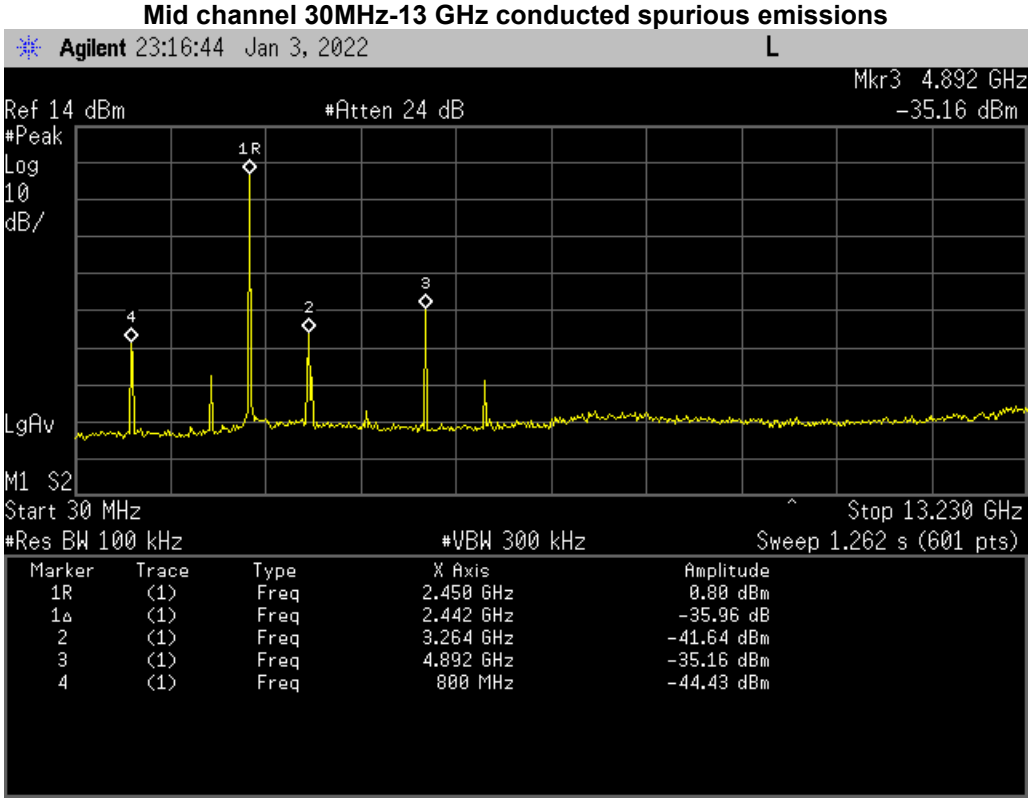
Test Setup



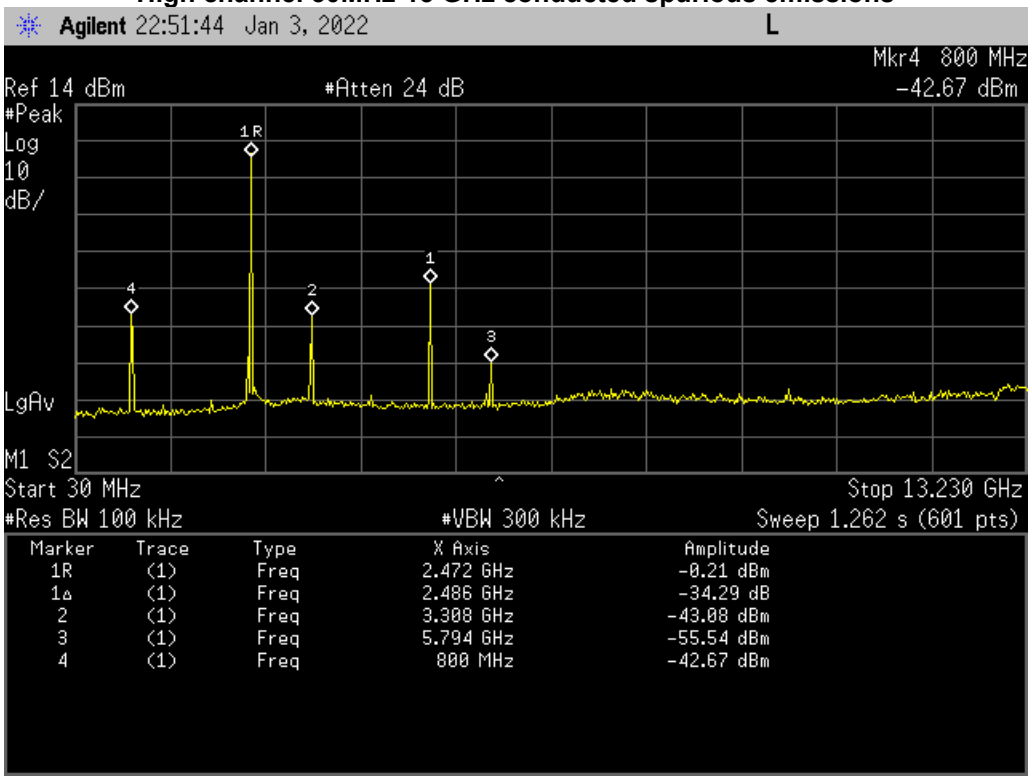
Low channel 30MHz-13 GHz conducted spurious emissions



Mid channel 30MHz-13 GHz conducted spurious emissions



High channel 30MHz-13 GHz conducted spurious emissions



Note: There were no emissions captured beyond the noise floor above 13 GHz.

Radiated Spurious Emissions

Engineer: Poona Saber

Test Date: 2/16/22

Test Procedure
Radiated Spurious Emissions: 30 – 1000 MHz

The EUT was tested in a semi-anechoic test chamber set 3m from the receiving antenna. A spectrum analyzer was used to verify that the EUT met the requirements for Radiated Emissions that fall under restricted bands of 15.205 to the requirements of 15.209. The EUT was tested by rotating it 360° with the antennas in both the vertical and horizontal orientation and was raised from 1 to 4 meters to ensure the TX signal levels were maximized.
The test was performed per section 11.12 of ANSI C63.10:2013

All emissions from 30 MHz to 10th harmonic of the fundamental were examined.
Measured Level includes antenna, preamplifier and the receiver cable correction factors.
Correction factors were input into the spectrum analyzer before recording "Measured Level".

For emissions below 1 GHz:

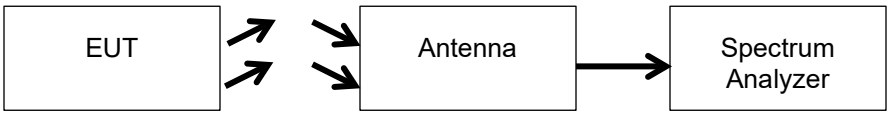
RBW = 120 kHz
VBW = 300 kHz
Detector – Quasi Peak

For emissions above 1 GHz:

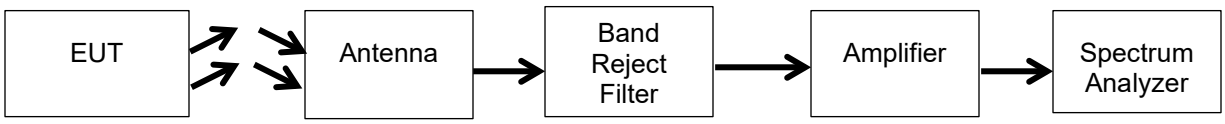
RBW = 1 MHz
VBW = 3 MHz
Detector – Peak and Average

Test Setup

Below 1 GHz

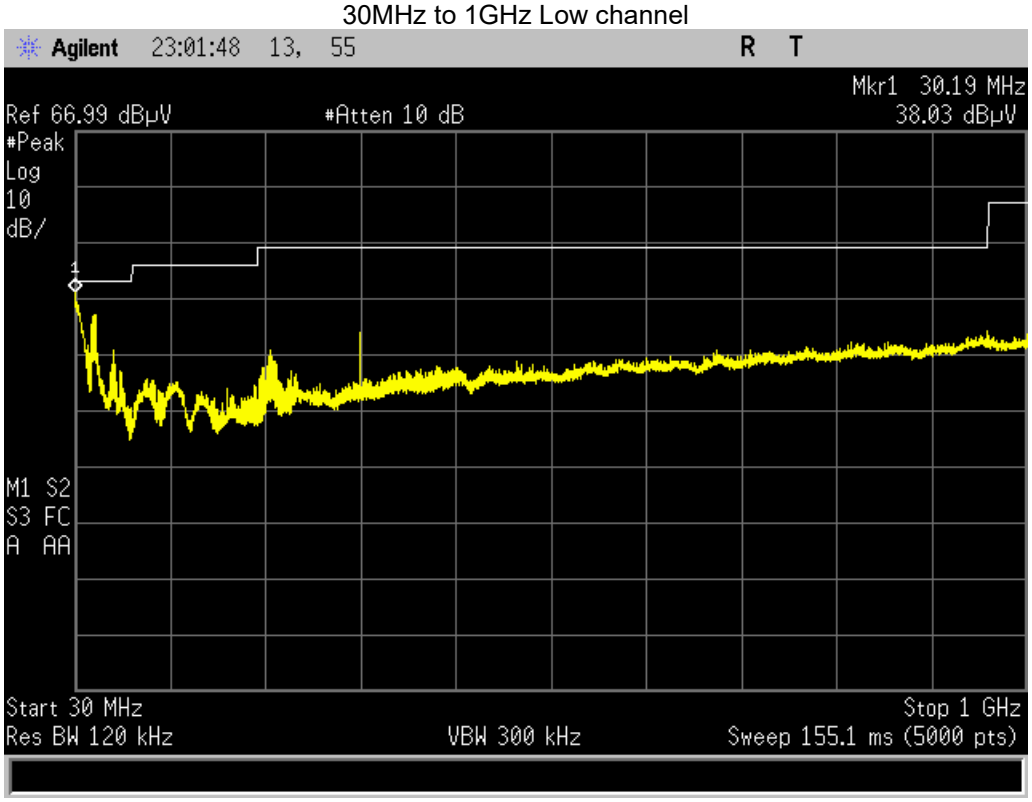


Above 1GHz

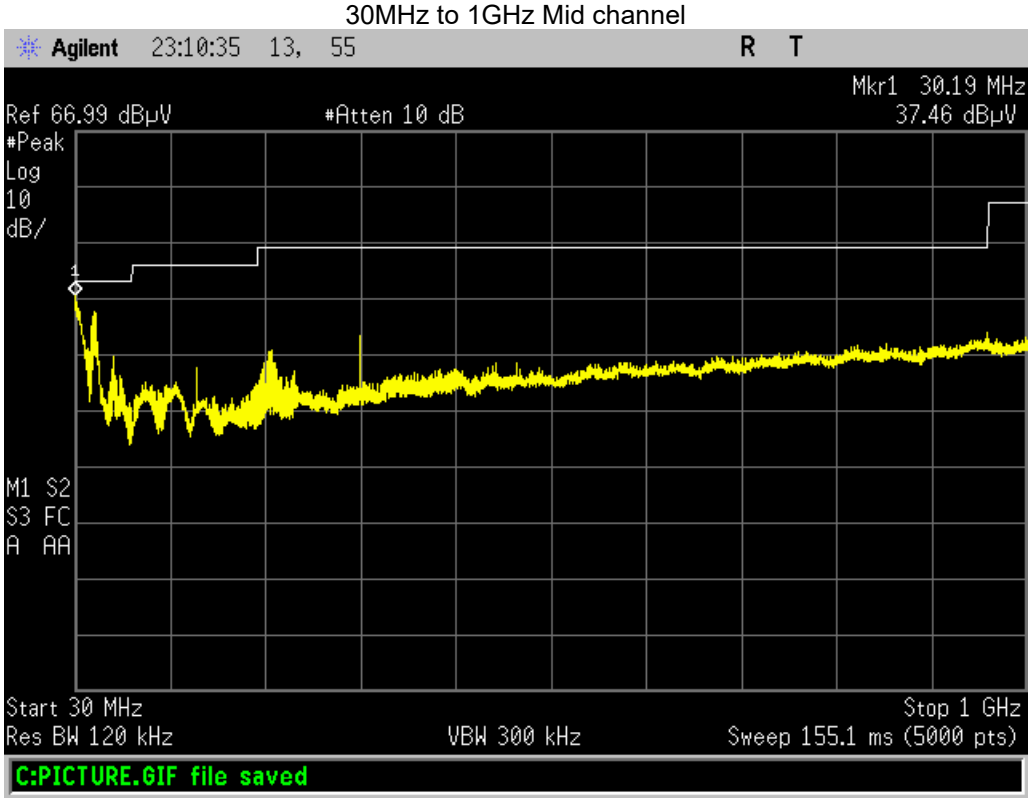


No emissions were detectable above noise floor beyond 18 GHz.

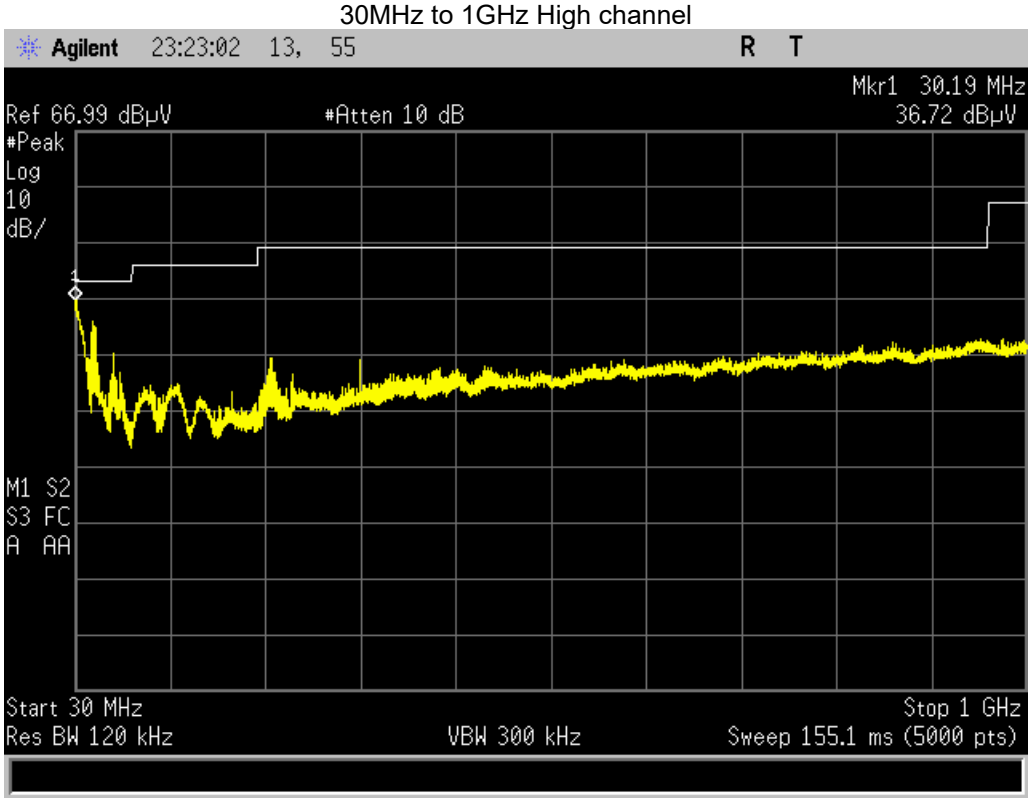
30MHz to 1GHz Low channel



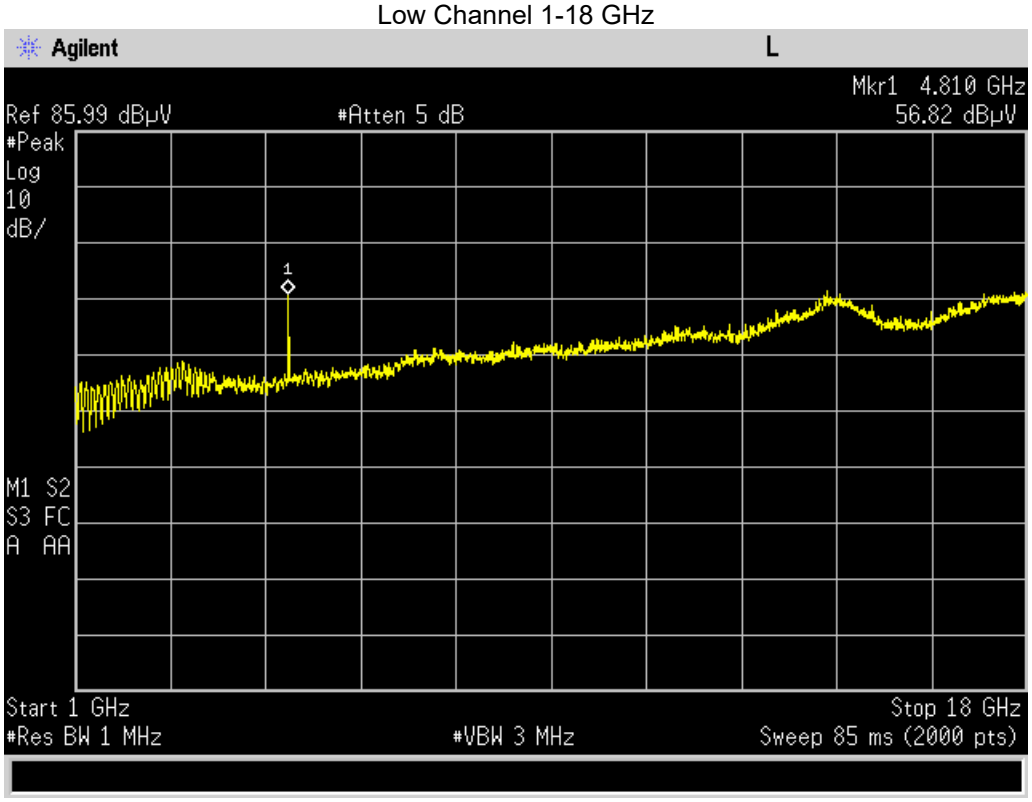
30MHz to 1GHz Mid channel



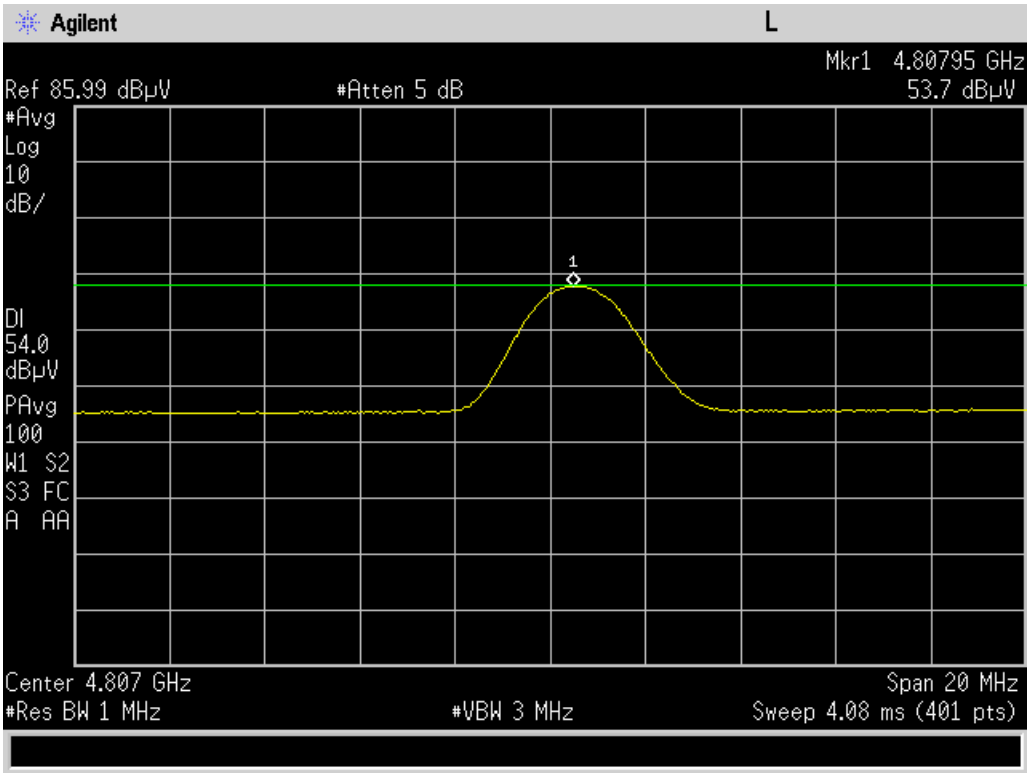
30MHz to 1GHz High channel



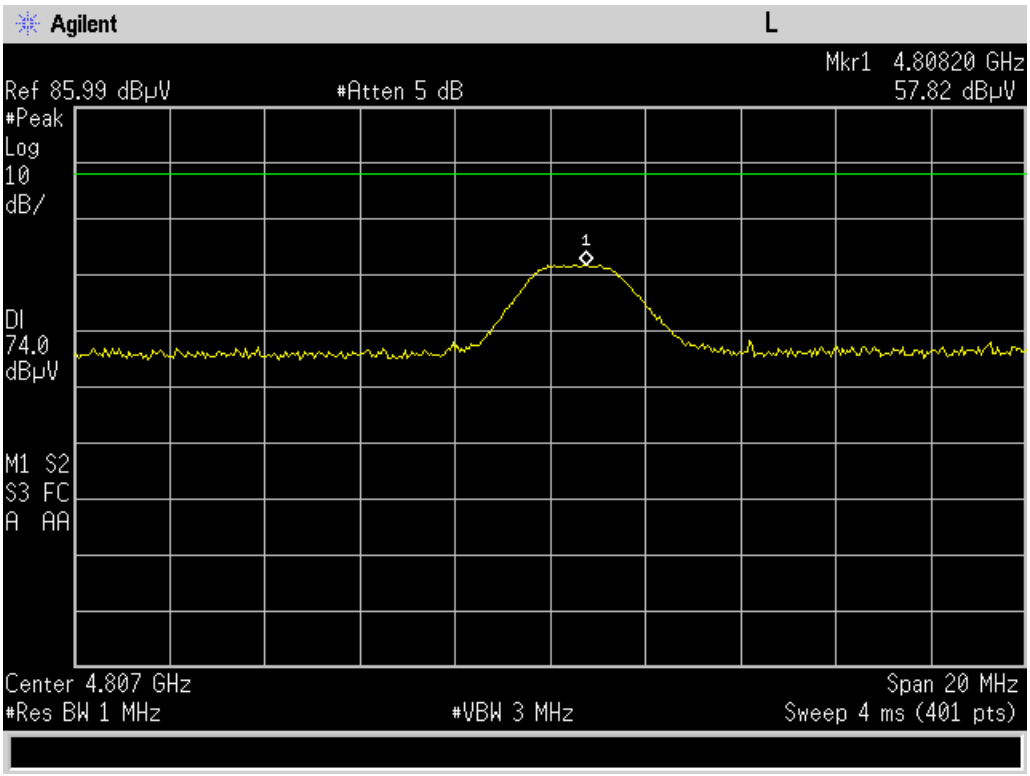
Low Channel 1-18 GHz



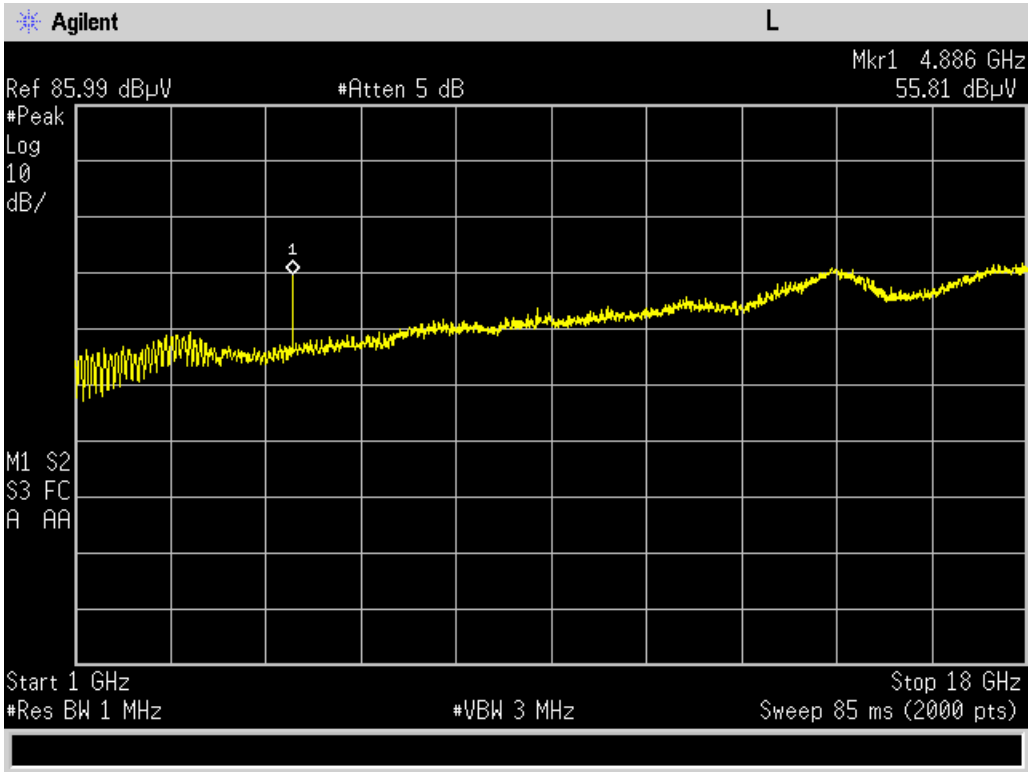
Low Channel at 4.8 GHz Average



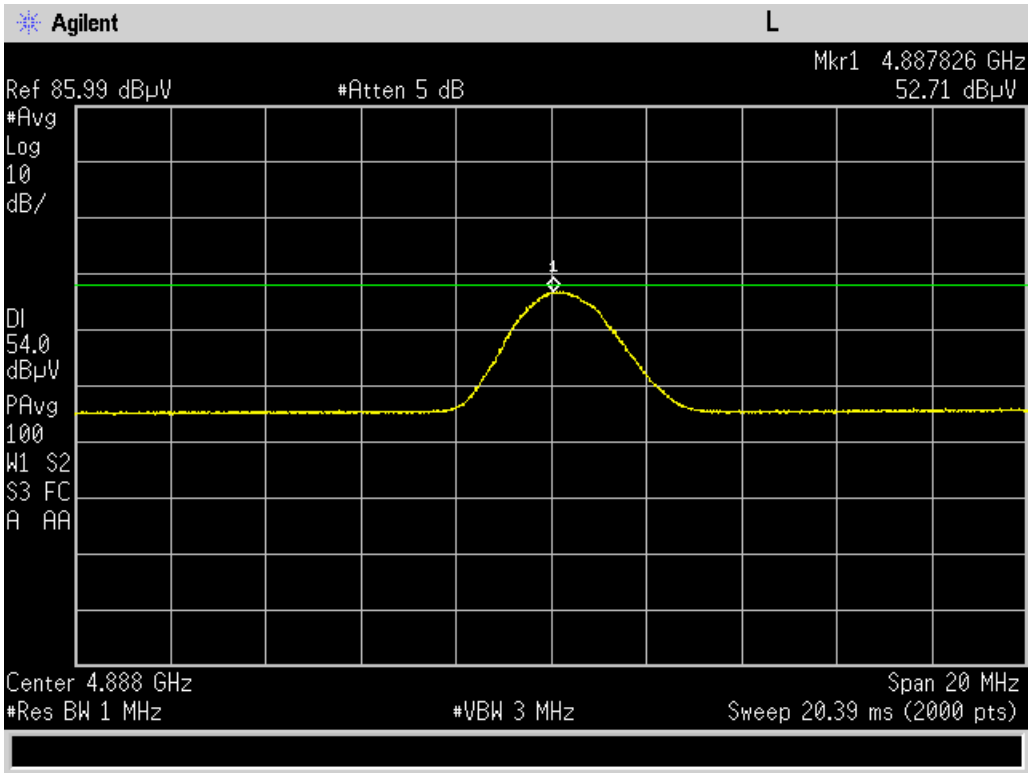
Low Channel at 4.8 GHz Peak



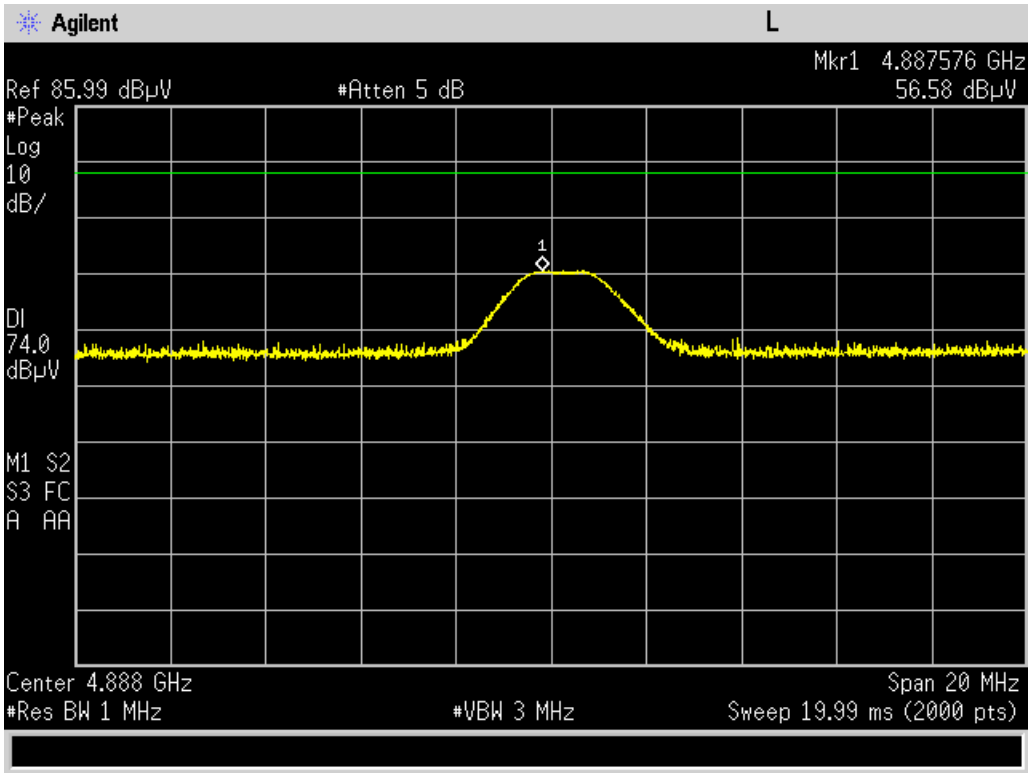
Mid Channel 1-18 GHz



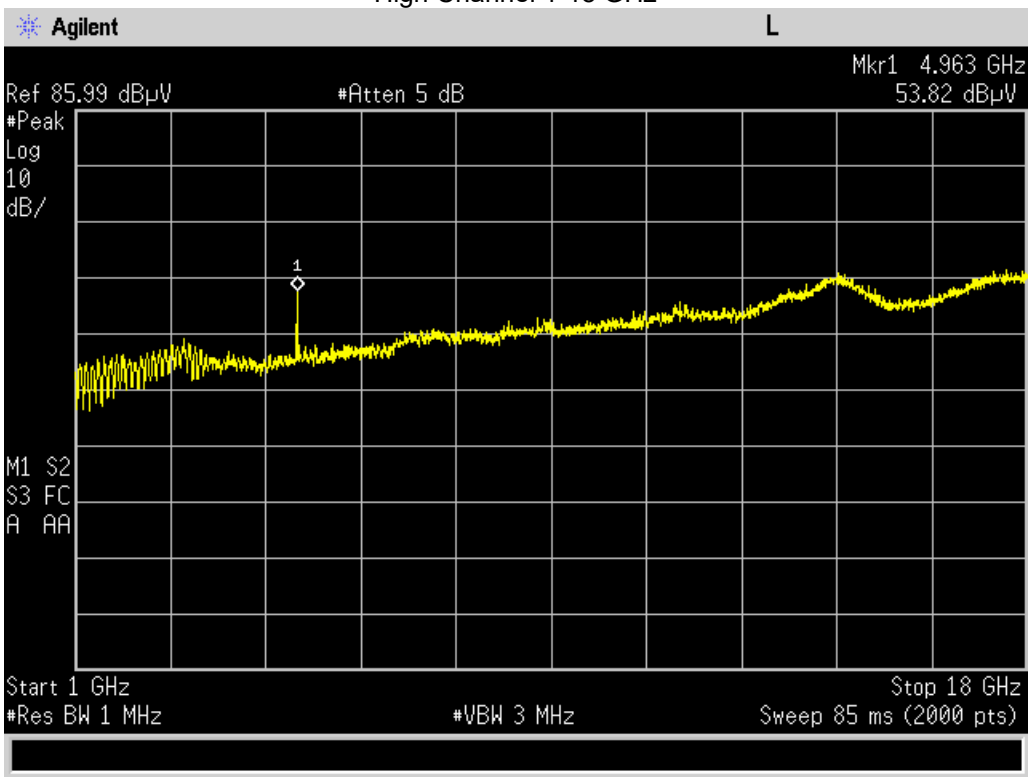
Mid Channel at 4.8 GHz Average



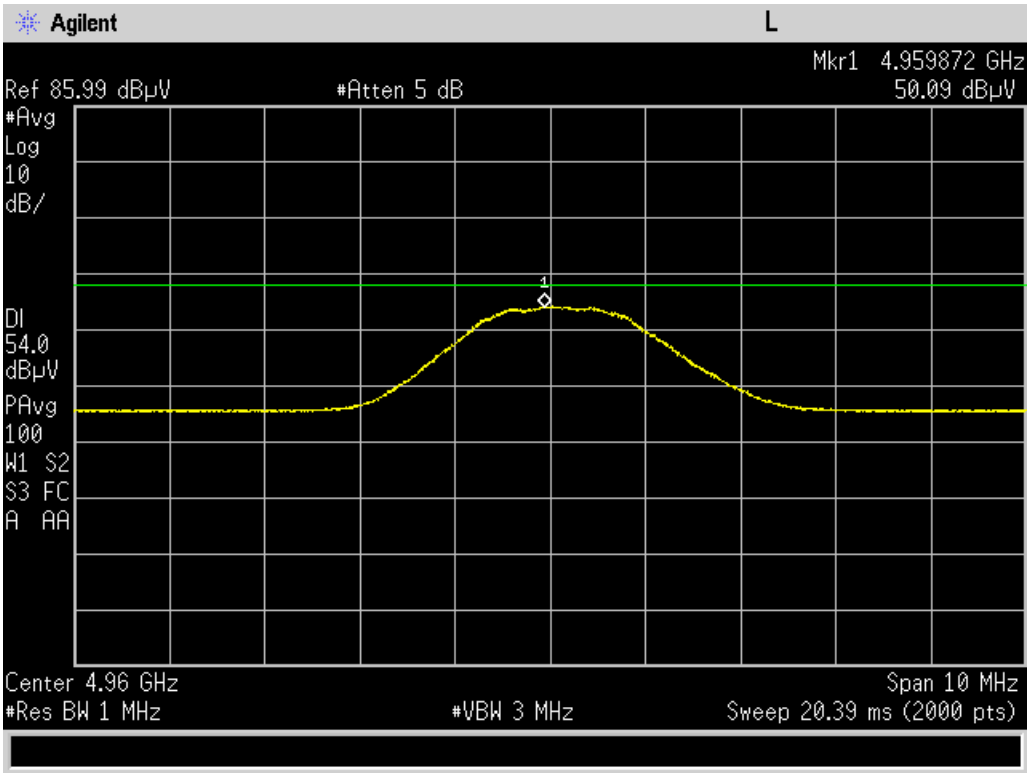
Mid Channel at 4.8 GHz Peak



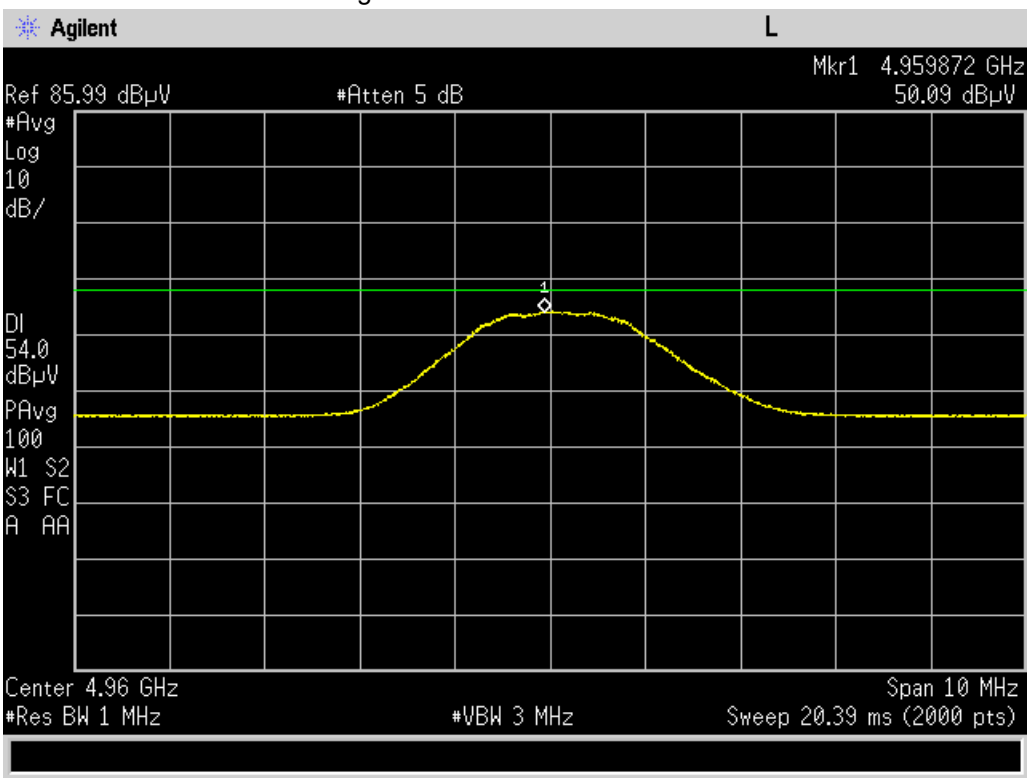
High Channel 1-18 GHz



High Channel at 4.9 GHz Average



High Channel at 4.9 GHz Peak



Emissions at Band Edges

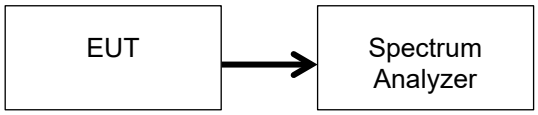
Engineer: Poona Saber

Test Date: 2/8/22

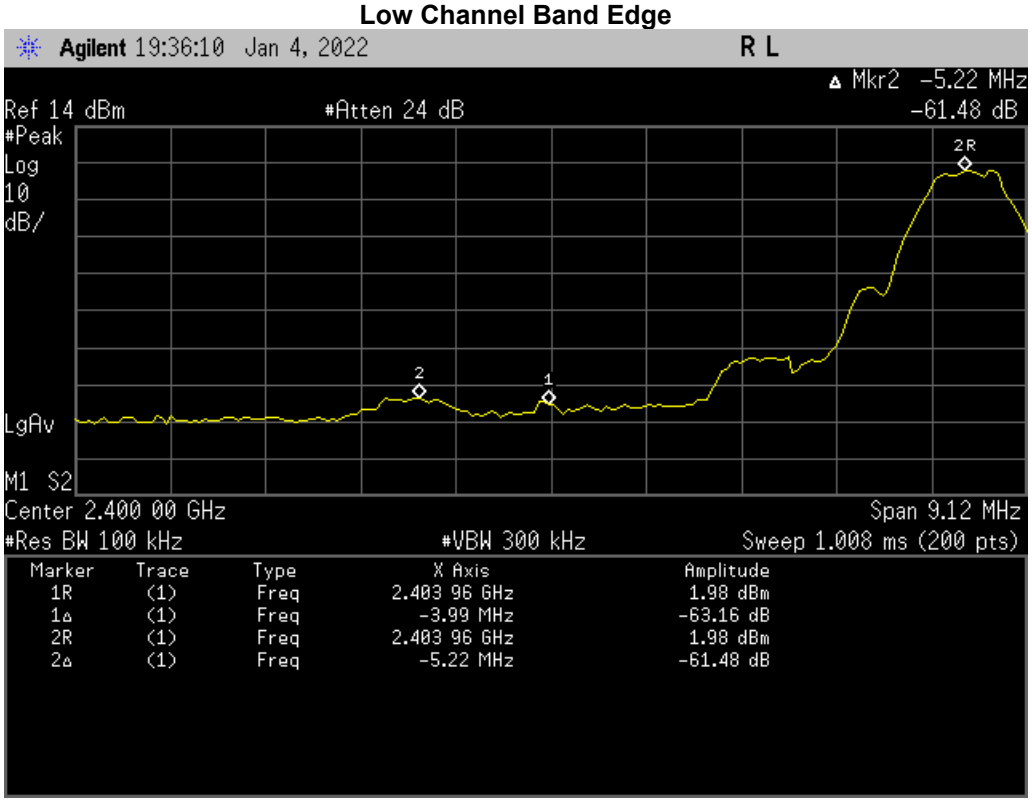
Test Procedure

The EUT was Connected to spectrum analyzer directly and the procedure from section 11.11 of ANSI C63.10 was followed to measure the emissions at the band edges in 100 kHz bandwidth.

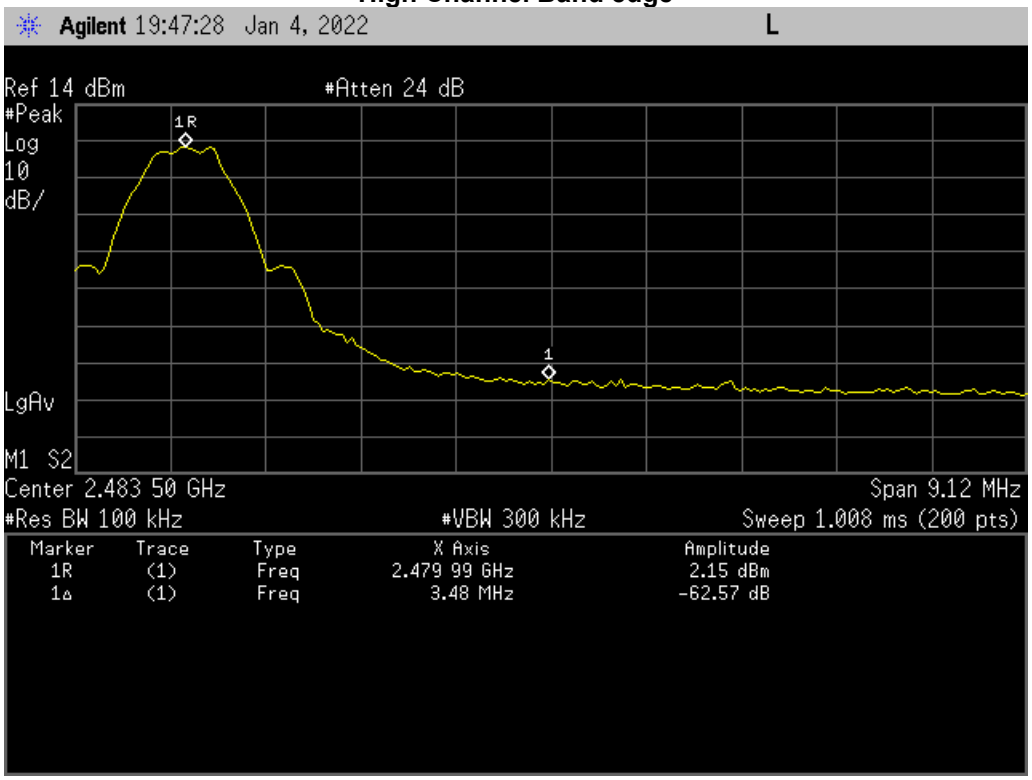
Band Edge Test Setup



Low Channel Band Edge



High Channel Band edge



Emissions at Restricted Band Edges

Engineer: Poona Saber

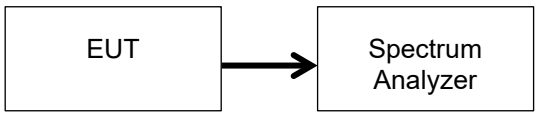
Test Date:2/8/22

Test Procedure

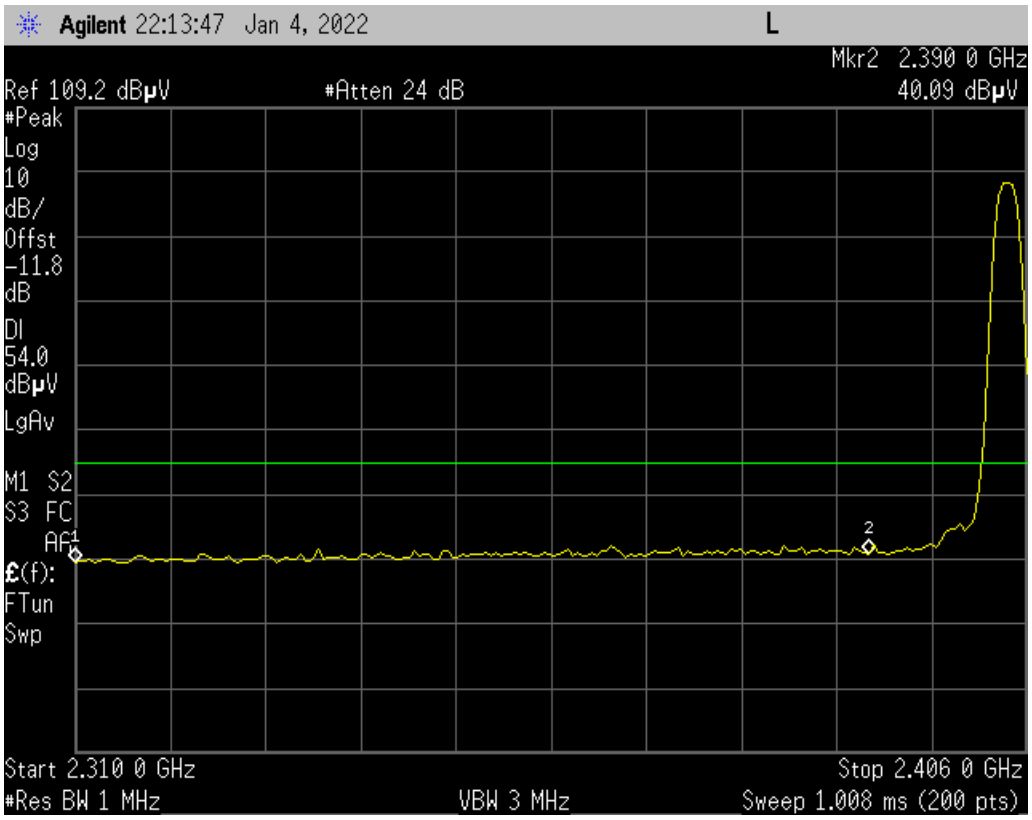
The EUT was Connected to spectrum analyzer directly, and the procedure from section 11.12 of ANSI C63.10 was followed to measure the Measurement. The Antenna gain of the unit for 2 dBi was used as an offset for conducted measurement in lieu of radiated.

Offset for dBuV/m to dBuV= -11.8
Compensating for Antenna gain= -11.8 + 2= -9.8

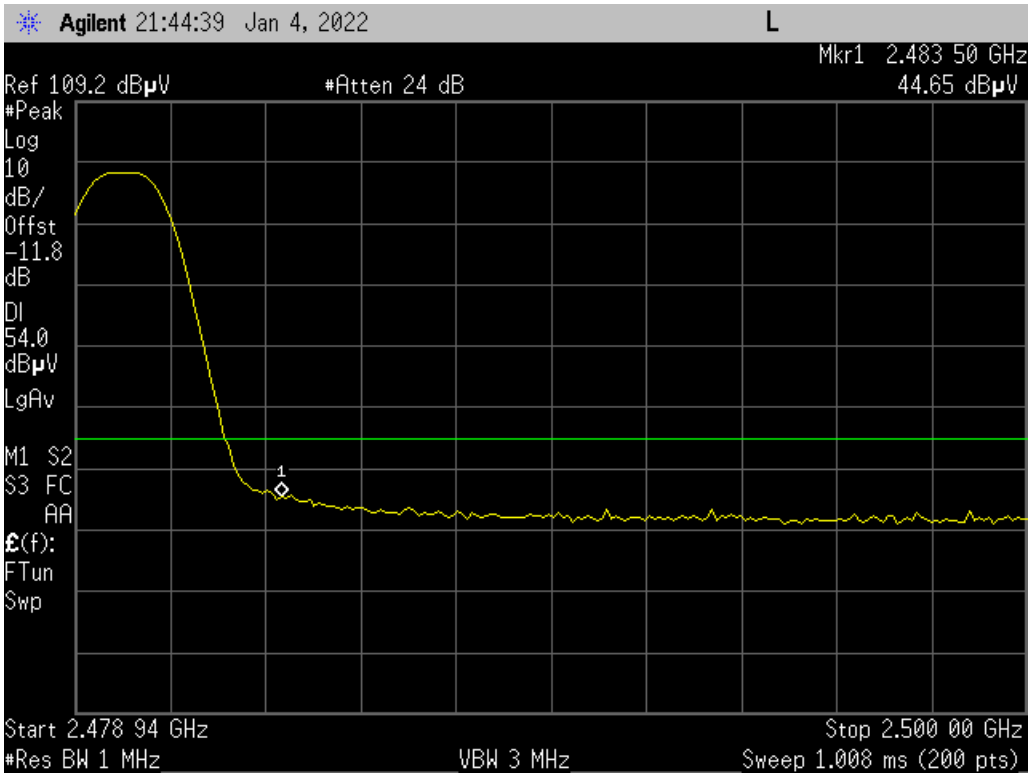
Band Edge Test Setup



Restricted Band 2300 – 2390 MHz – Peak below Average



Restricted Band 2483.5 – 2500 MHz – Peak below Average



Test Equipment Utilized

Description	Manufacturer	Model #	CT Asset #	Last Cal Date	Cal Due Date
Horn Antenna, 1-18 GHz	ARA	DRG-118/A	i00271	8/3/20	8/3/22
Horn Antenna, 18-40 GHz	EMCO	3116	i00085	2/22/21	2/22/23
Bi-Log antenna	EMC Shop	Bila2G	S/N 577	1/13/22	1/13/24
Temp./humidity/pressure monitor (rad.emissions)	Omega Engineering	iBTHX-W-5	i00631	11/3/21	11/3/22
Voltmeter	Fluke	87-iii	i00319	5/18/21	5/18/22
Spectrum Analyzer	Agilent	E4407B	i00331	12/28/21	12/28/22
3 Meter Semi-Anechoic Chamber	Panashield	3 Meter Semi-Anechoic Chamber	i00428	7/17/20	7/17/23
PSA Spectrum Analyzer	Agilent	E4445A	i00471	12/27/21	12/27/22
Preamplifier	Sage Millimeter	SBB-0105034018-2F2F-E3	i00591	N/A	
DC power Supply	HP	66344	I00004	Functional Verification	

Measurement Uncertainty

Measurement Uncertainty (U_{lab}) for Compliance Testing is listed in the table below.

Measurement	U_{lab}
Radio Frequency	± 3.3 x 10^{-8}
RF Power, conducted	± 1.5 dB
RF Power Density, conducted	± 1.0 dB
Conducted Emissions	± 1.8 dB
Radiated Emissions	± 4.5 dB
Temperature	± 1.5 deg C
Humidity	± 4.3 %
DC voltage	± 0.20 VDC
AC Voltage	± 1.2 VAC

The reported expanded uncertainty +/- U_{lab}(dB) has been estimated at a 95% confidence level (k=2)

U_{lab} is less than or equal to U_{ETSI} therefore

- Compliance is deemed to occur if no measured disturbance exceeds the disturbance limit
- Non-Compliance is deemed to occur if any measured disturbance exceeds the disturbance limit

In addition to the above listed equipment standard RF connectors and cables were utilized in the testing of the described equipment. Prior to testing these components were tested to verify proper operation.

END OF TEST REPORT