

Test Report

Prepared for: Globe Tracker

EUT Name: G2.5 Cargo Container Tracking Device
Model: CM2.5-1113120

FCC ID: 2ASJR-CM25-1113120

To

FCC Part 15.247 DTS
ISED RSS-247 Issue 2

Date of Issue: September 20, 2022

On the behalf of the applicant:

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Project No: p2110001
Test Result: Pass

Authorized By



Alex Macon
Sr Engineer

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All results contained herein relate only to the sample tested.

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 operates on battery with no provision to connect to the AC Mains utility

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*.

Test Report Revision History

Revision	Date	Revised By	Reason for Revision
1.0	9/22/2022	Alex Macon	Original Document

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ANAB

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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 (°C)	Humidity (%)	Pressure (mbar)
27.0	47.5	969.5

EUT Description

Model: CM2.5-1113120

Description: G2.5 Cargo Container Tracking Device

Firmware: NA

Software: NA

Serial Number: AP Conducted: 622130394

Radiated: 622131008

Frequency Range of Operation: 902 – 923 MHz

Modulation: Lora CSS

Spreading Factor: SF6

Antenna: chip antenna with -0.5 dBi gain

General Description of EUT and its intended use:

The DUT is a battery powered mobile transceiver for digital transmission.

EUT operation during test:

The DUT was operated at maximum RF output for all tests in this report. The EUT was placed in a continuous transmit mode with a LoRa SF6 500 kHz Bandwidth. This is the only modulation utilized within the band and therefore is worst case.

Simultaneous Transmission

The EUT does not support simultaneous transmission.

Support Equipment

Qty	Description	Manufacturer	Model	S/N
1	DC power supply	Mastech	HY1803D	N/A

Support Cables: N/A
Modifications:

none

15.203: Antenna Requirement:

- ☐ 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

Peak Output Power

Engineer: Alex Macon

Test Date: 8/18/2022

Test Procedure

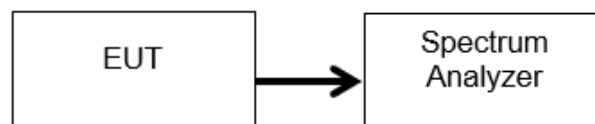
The EUT was connected to a spectrum analyzer to verify that the EUT met the requirements for peak output power. The peak readings were taken, and the result was then compared to the limit. The test was performed per section 11.9.1.1 of ANSI C63.10:2013 as the procedure for determining "Fundamental emission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

The Spectrum Analyzer was set to the following:

RBW \geq DTS Bandwidth
 VBW $\geq 3 \times$ RBW
 Span $\geq 3 \times$ 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 \geq DTS bandwidth method.

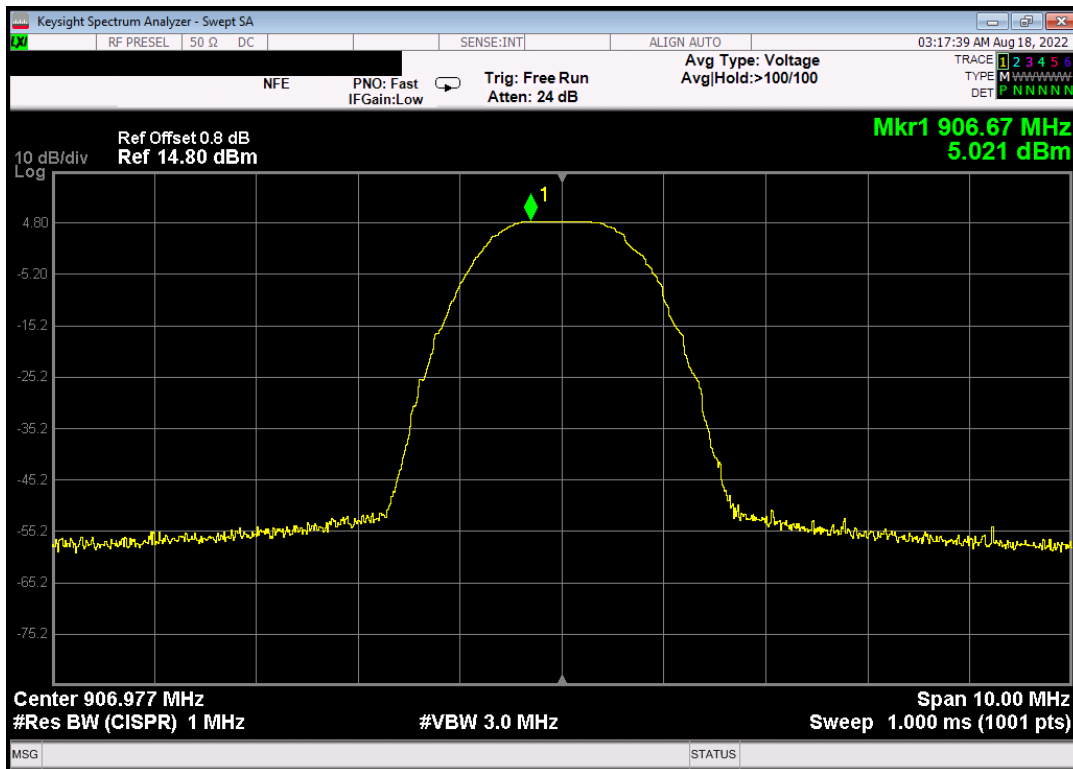
Test Setup



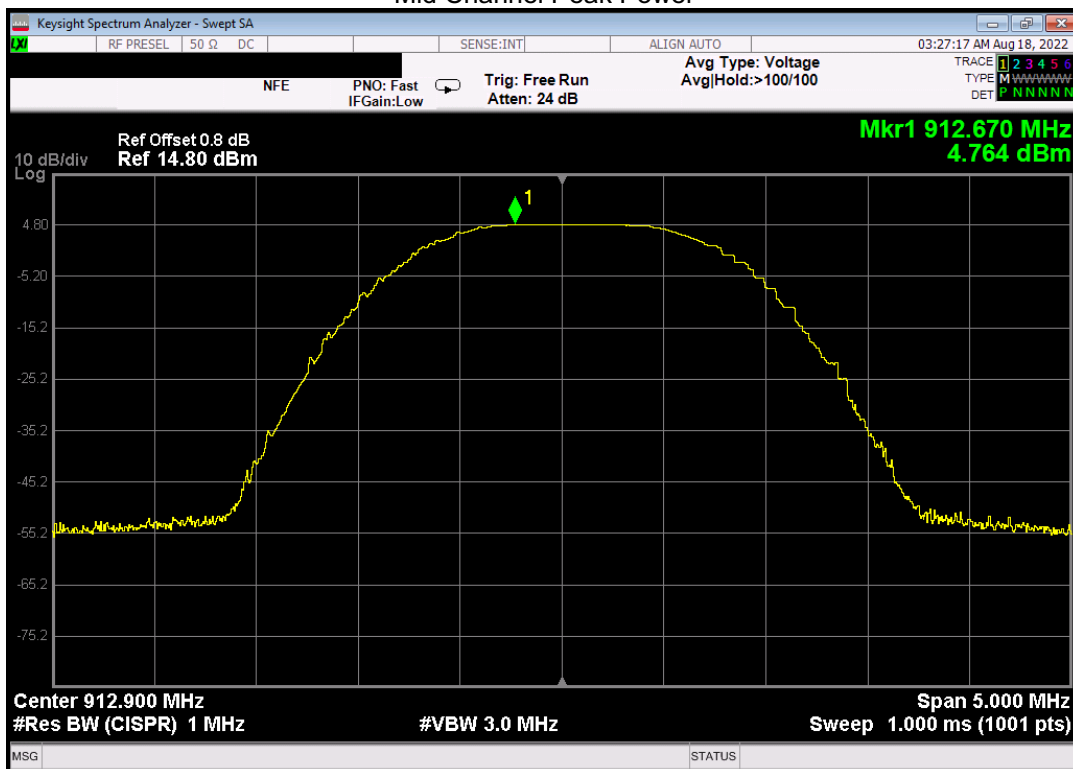
Transmitter Peak Output Power

Tuned Frequency (MHz)	Measured Value (dBm)	Specification Limit	Result
906	5.02	1 W (30 dBm)	Pass
912	4.76	1 W (30 dBm)	Pass
922	4.36	1 W (30 dBm)	Pass

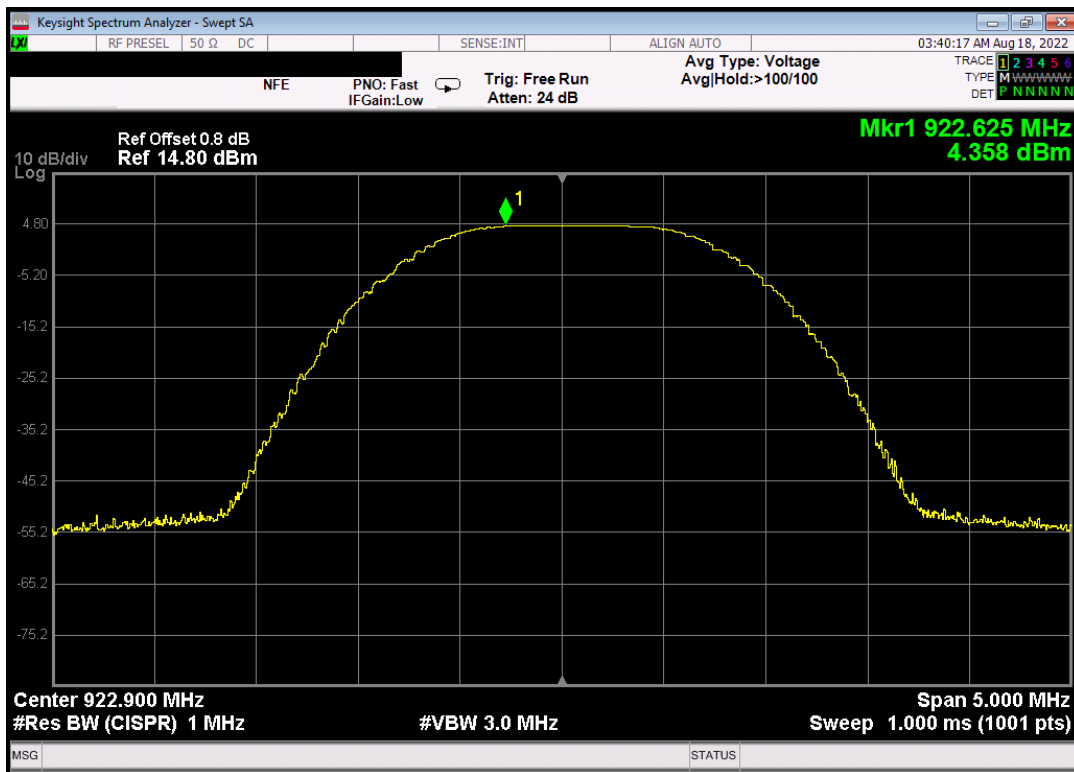
Low Channel Peak Power



Mid Channel Peak Power



High Channel Peak Power



Occupied Bandwidth

Engineer: Alex Macon

Test Date: 8/18/2022

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 $\geq 3 \times$ RBW

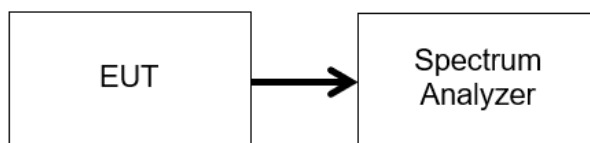
Peak Detector

Trace mode = max hold

Sweep = auto couple

Span = 1.5 x EBW

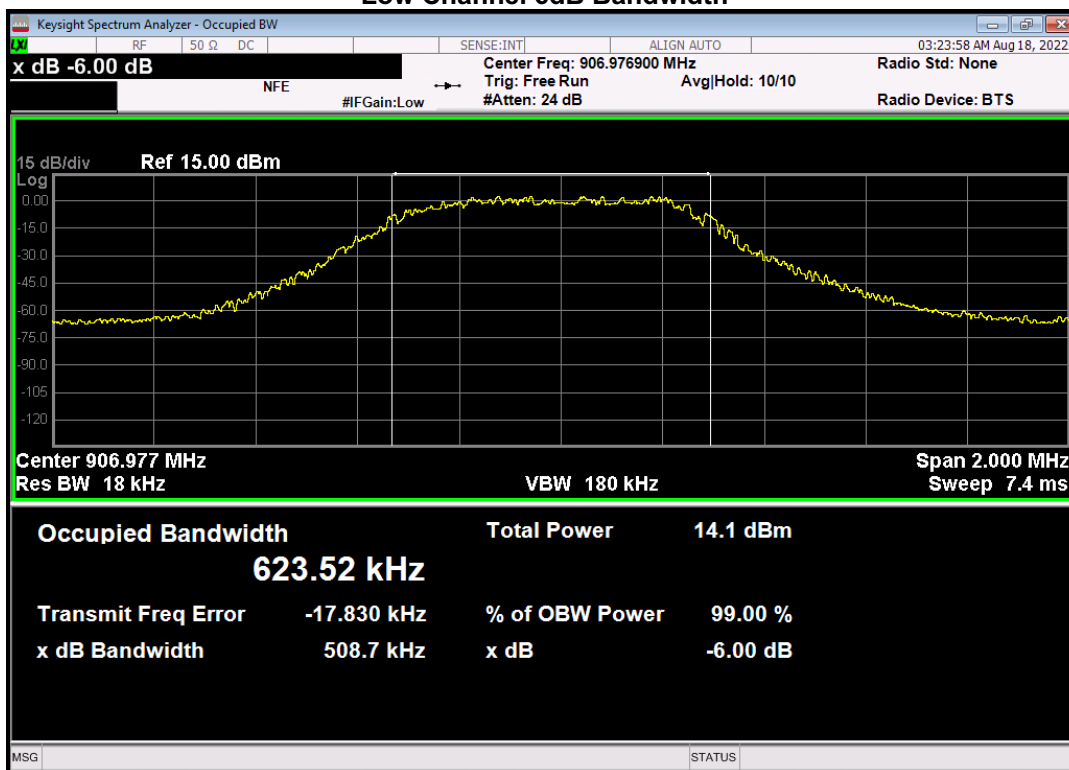
Test Setup



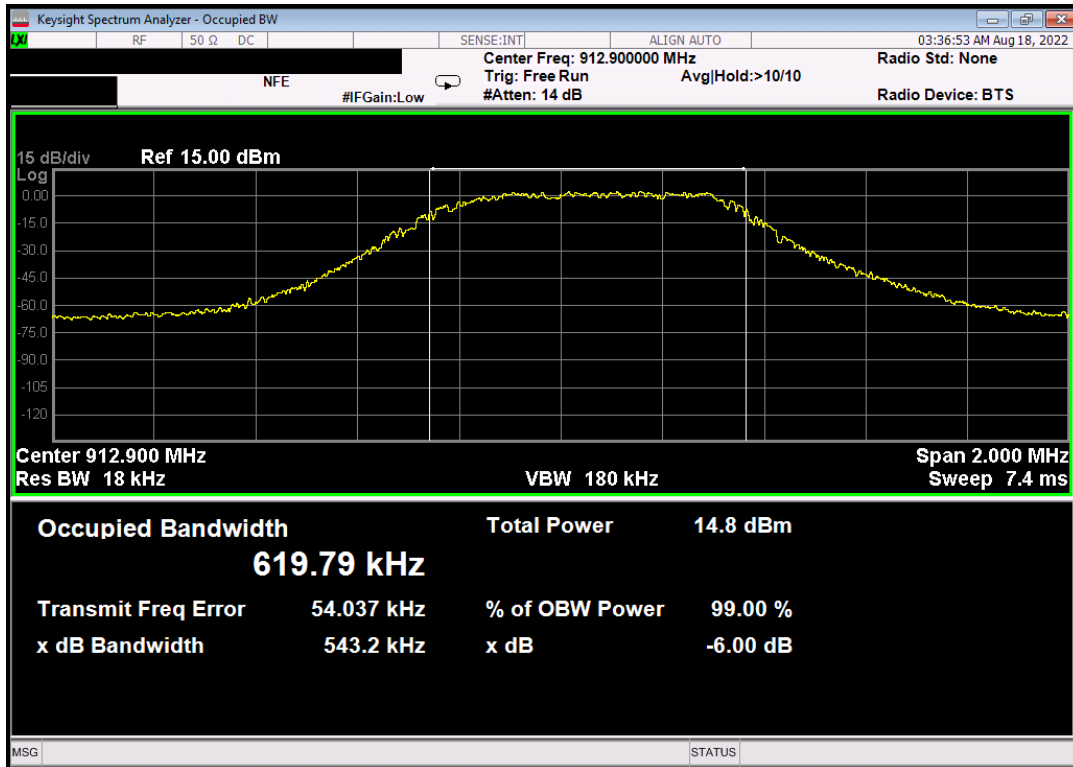
6 dB Occupied Bandwidth Summary

Frequency (MHz)	6 dB Measured Bandwidth (kHz)	Specification Limit (kHz)	Result	99% OCBW (kHz)
906	508.7	≥ 500	Pass	623.52
912	543.2	≥ 500	Pass	619.79
922	541.8	≥ 500	Pass	620.57

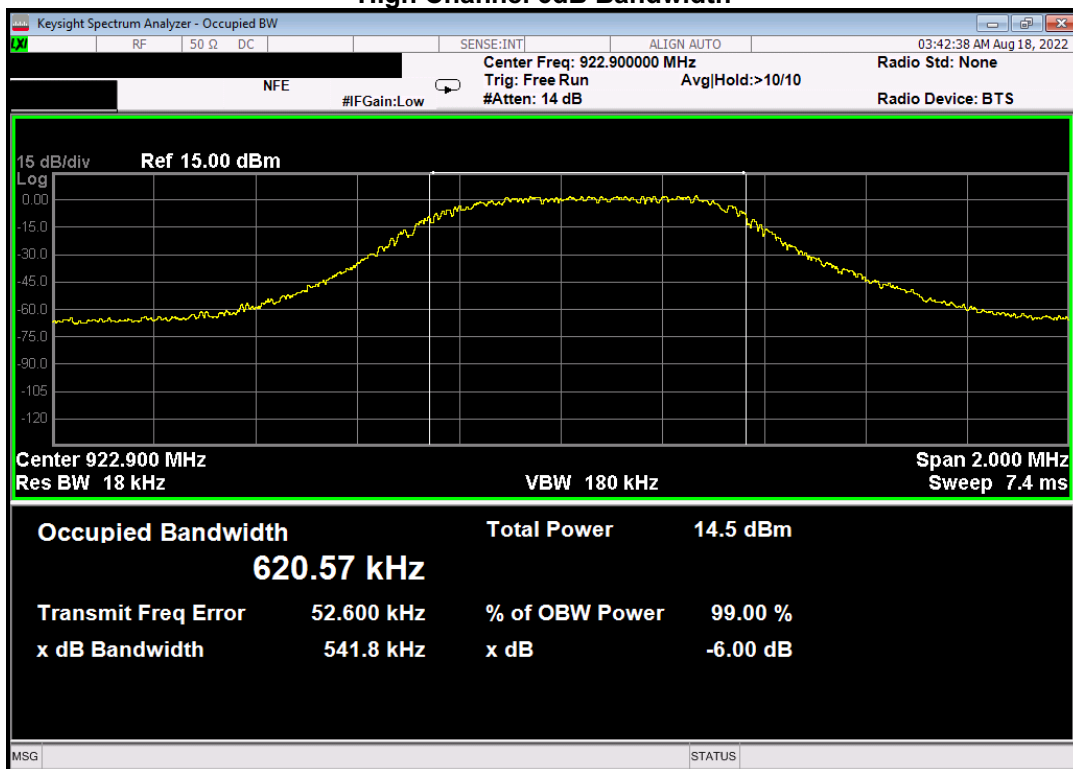
Low Channel 6dB Bandwidth



Mid Channel 6dB Bandwidth



High Channel 6dB Bandwidth



Transmitter Power Spectral Density (PSD)

Engineer: Alex Macon

Test Date: 8/18/2022

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 \leq RBW \leq 100 kHz

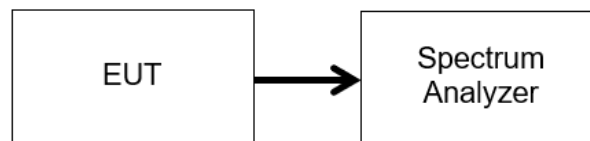
VBW \geq 3 x RBW

Peak Detector

Sweep time = auto couple

Trace mode = max hold

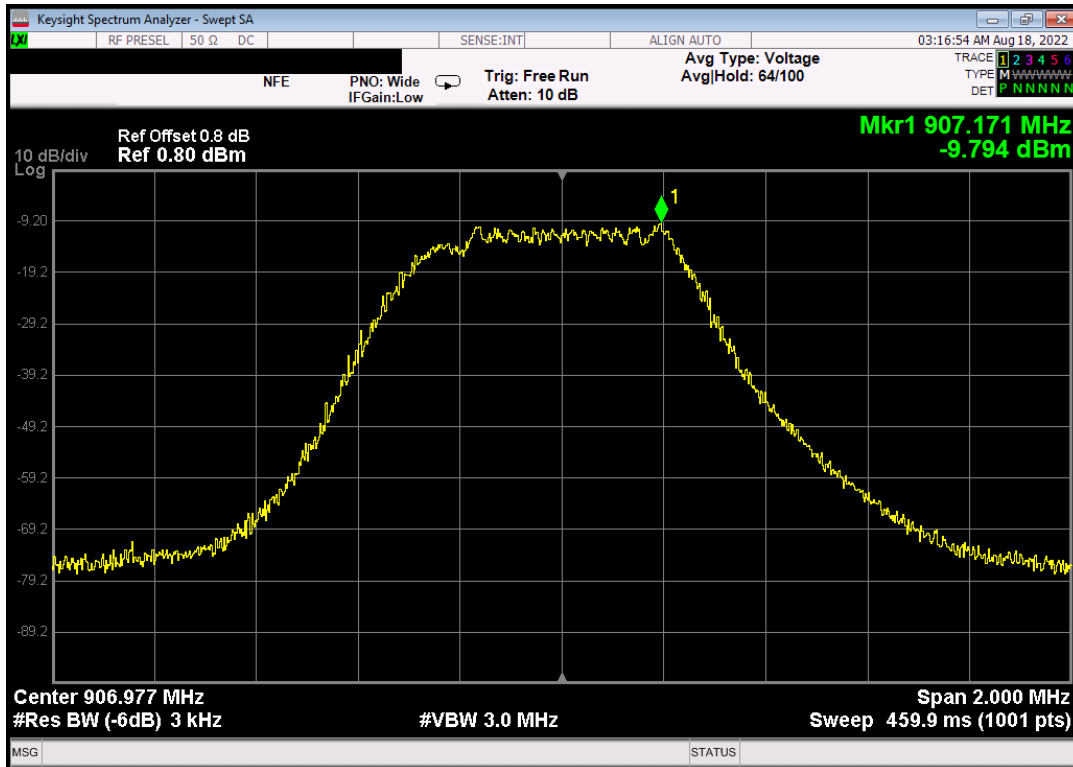
Test Setup



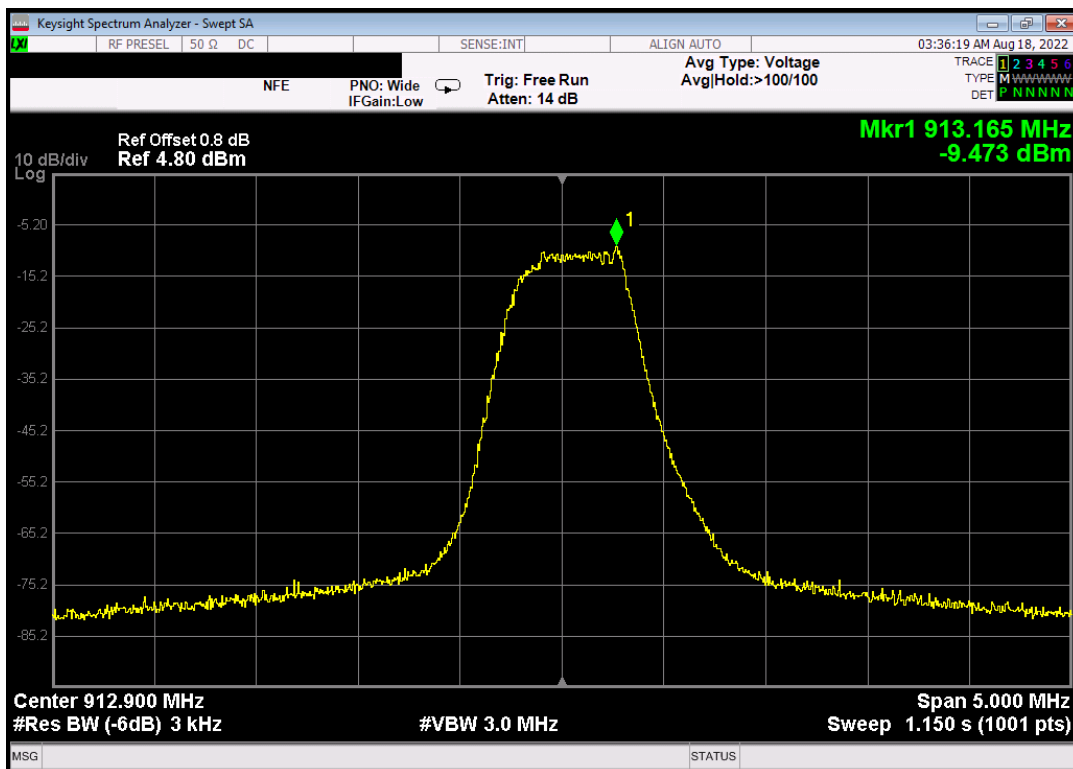
PSD Summary

Frequency (MHz)	Measured Data (dBm)	Specification Limit (dBm)	Result
906	-9.79	8	Pass
912	-9.47	8	Pass
922	-10.61	8	Pass

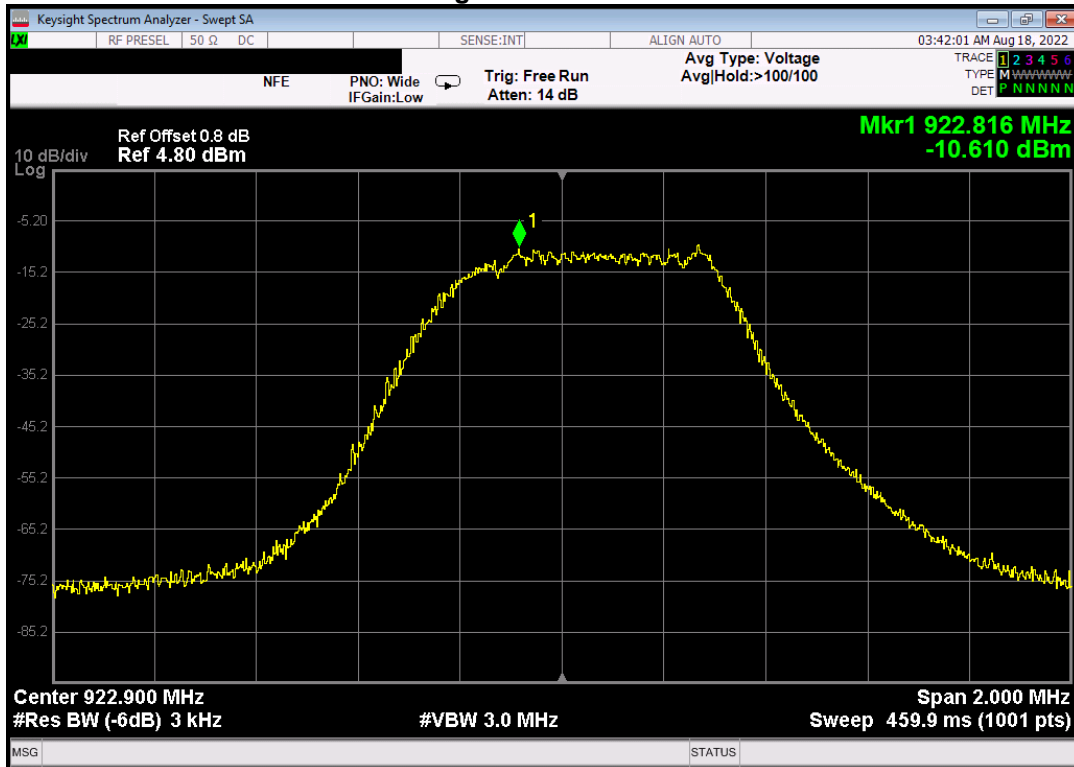
Low Channel PSD



Mid Channel PSD



High Channel PSD



Conducted Spurious Emission

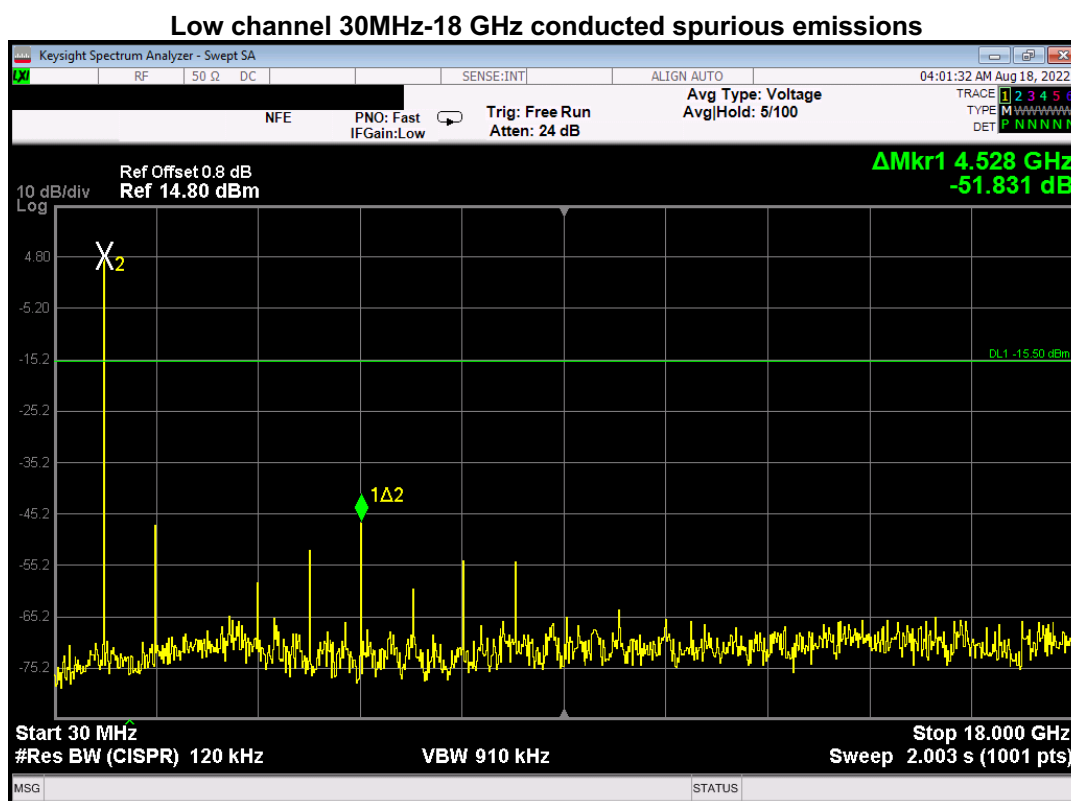
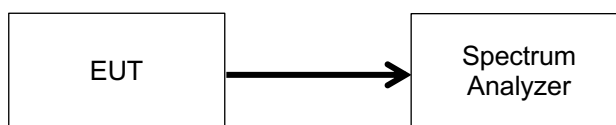
Engineer: Alex Macon

Test Date: 8/18/2022

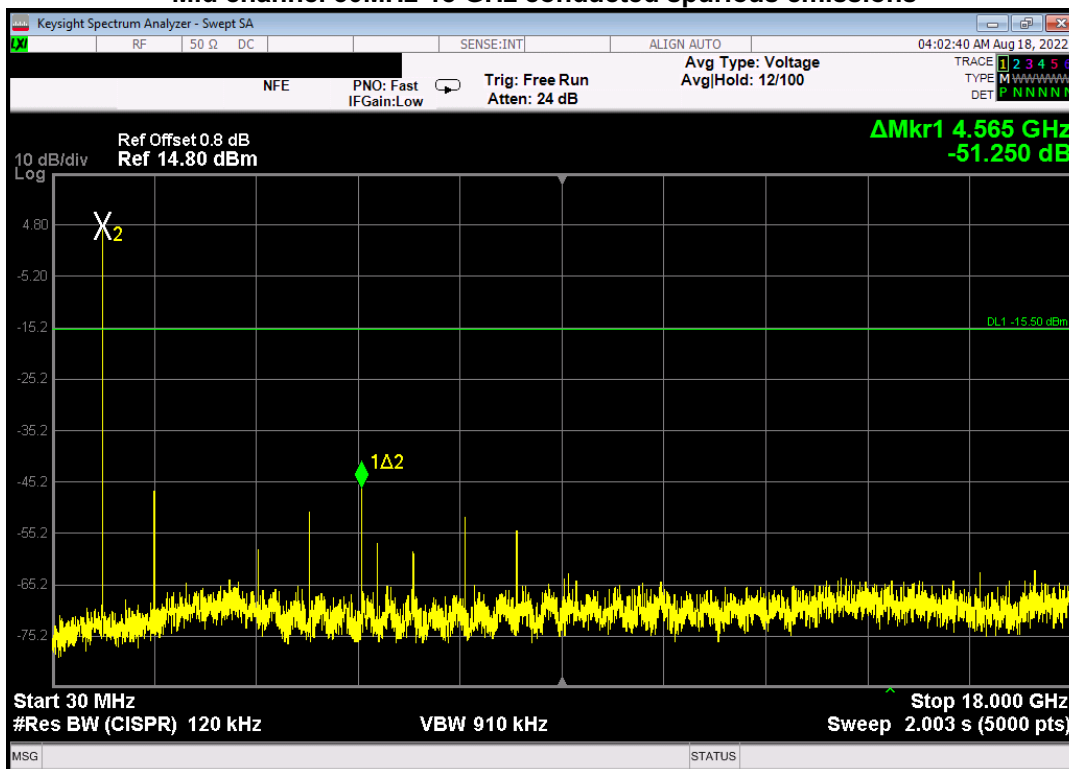
Test Procedure

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.

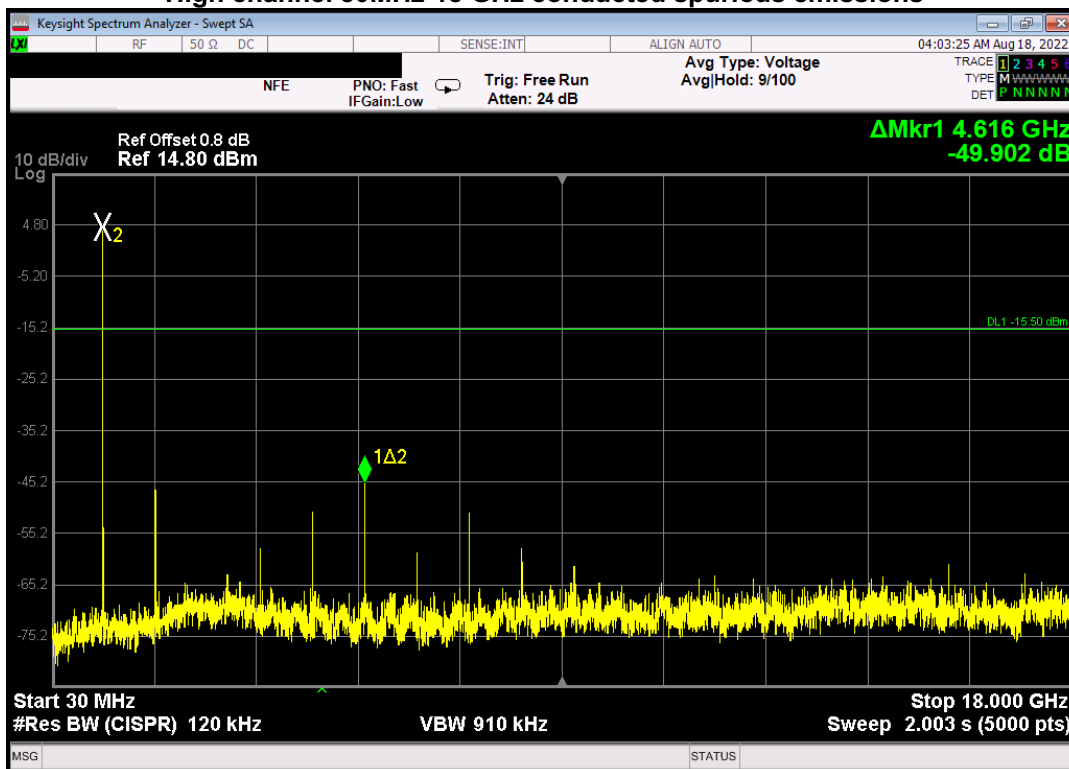
Test Setup



Mid channel 30MHz-18 GHz conducted spurious emissions



High channel 30MHz-18 GHz conducted spurious emissions



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

Radiated Spurious Emissions

Engineer: Alex Macon

Test Date: 9/19/22

Test Procedure Radiated Spurious Emissions:

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. All 3 axis were investigated in this manner and the worst case is reported. The EUT was terminated into a 50 ohm load for radiated testing. 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:

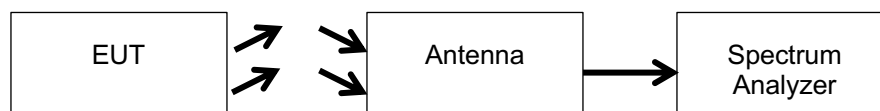
RBW = 120 kHz
VBW = 300 kHz
Detector – Quasi Peak

For emissions above 1 GHz:

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

Test Setup

Below 1 GHz

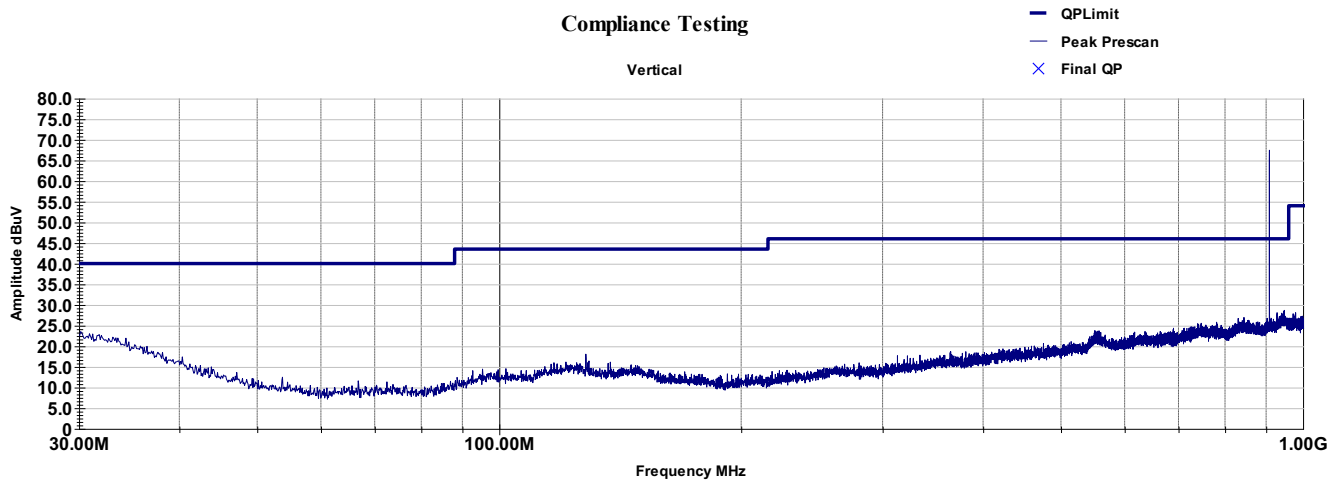
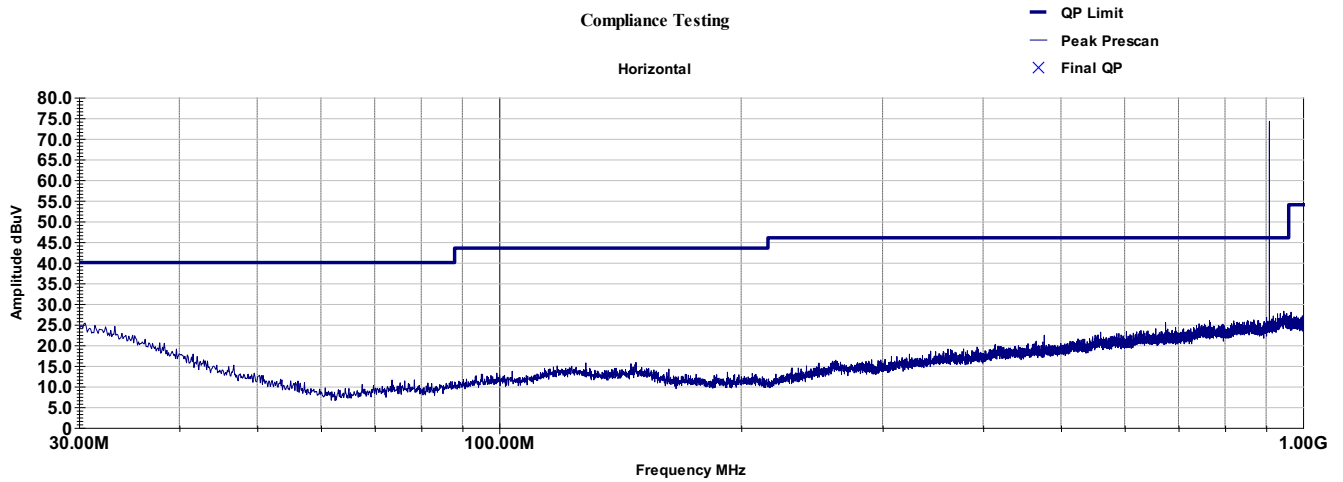


Above 1GHz



No emissions were detectable above noise floor beyond 18 GHz.

30MHz to 1GHz Low channel

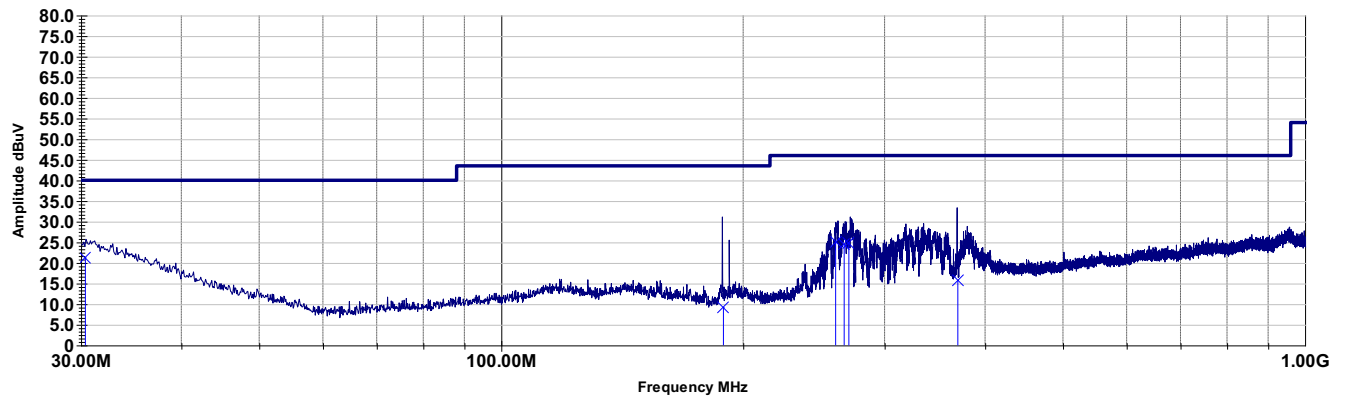


30MHz to 1GHz Mid channel

Compliance Testing

Horizontal

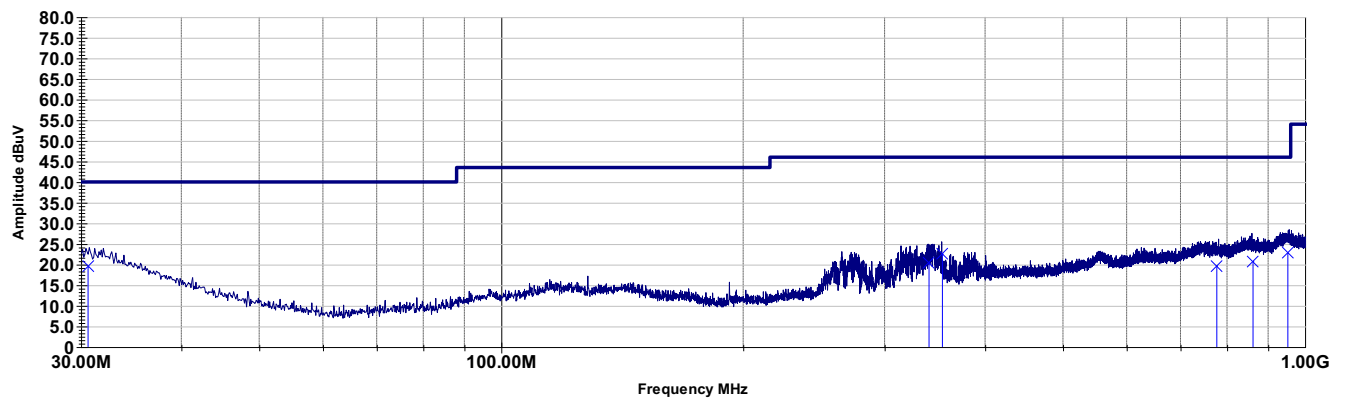
— QP Limit
— Peak Prescan
× Final QP



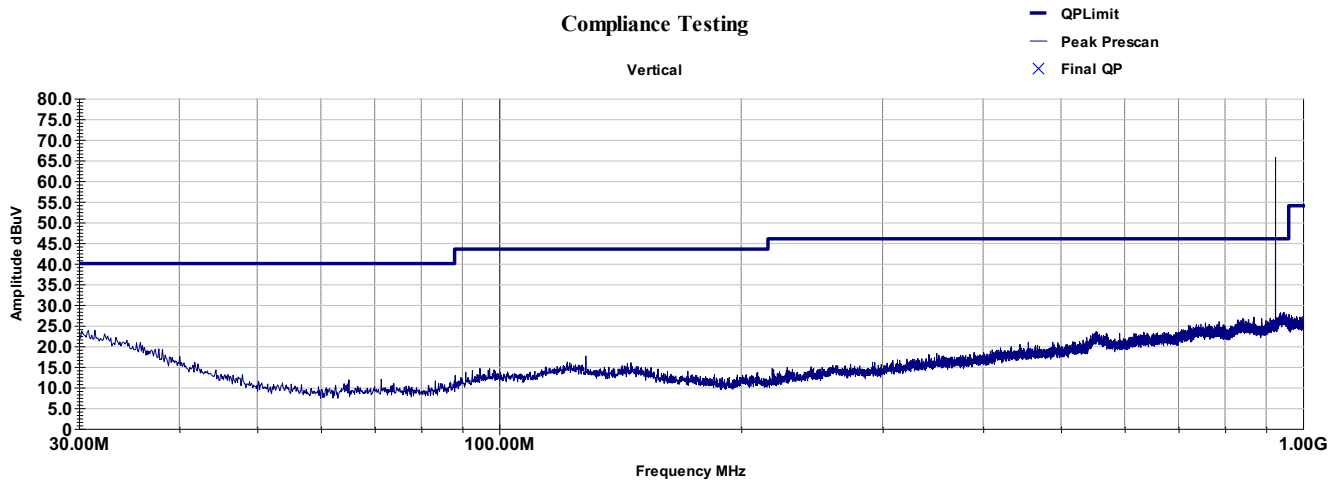
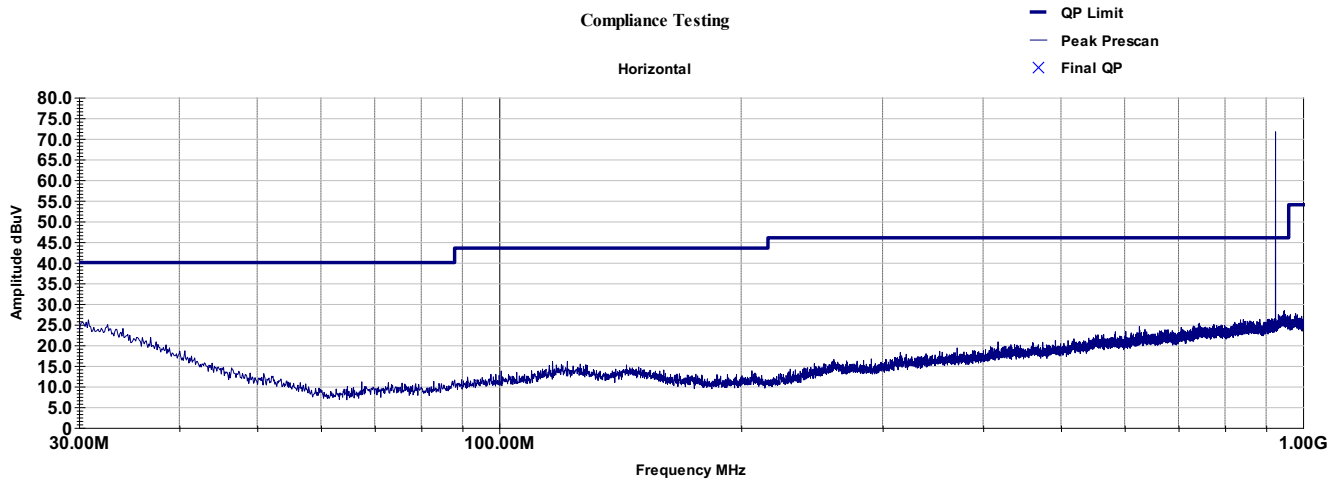
Compliance Testing

Vertical

— QPLimit
— Peak Prescan
× Final QP

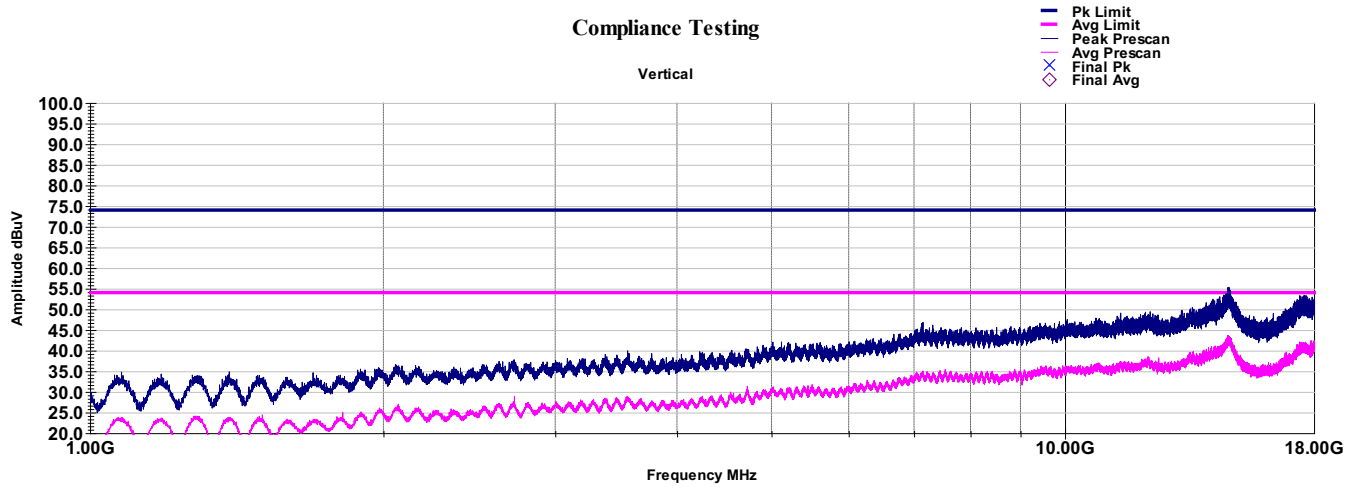


30MHz to 1GHz High channel

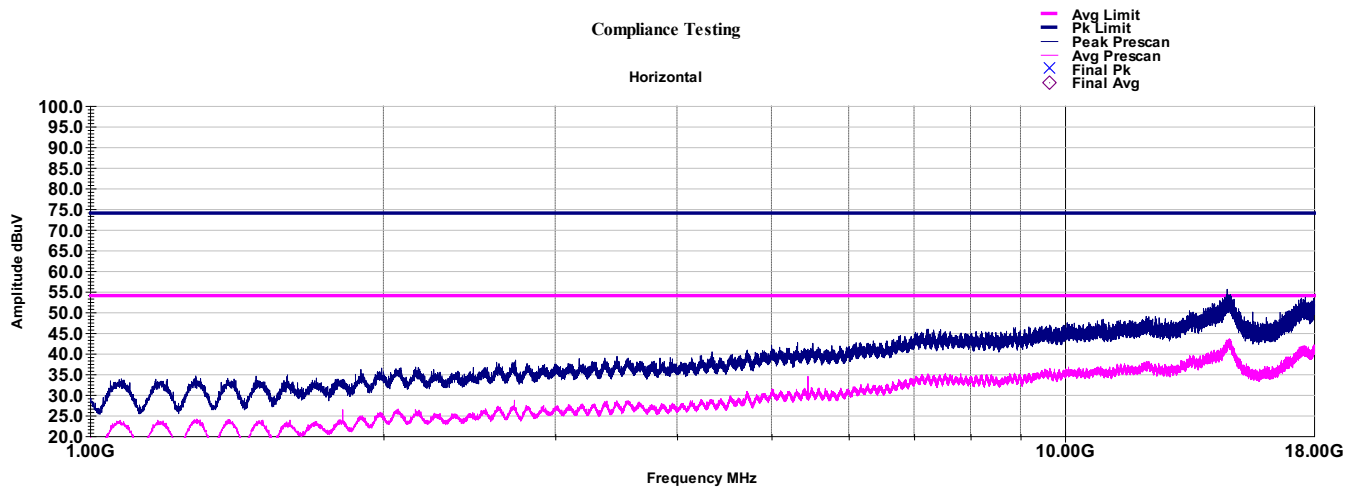


1GHz to 18 GHz Low channel

Compliance Testing

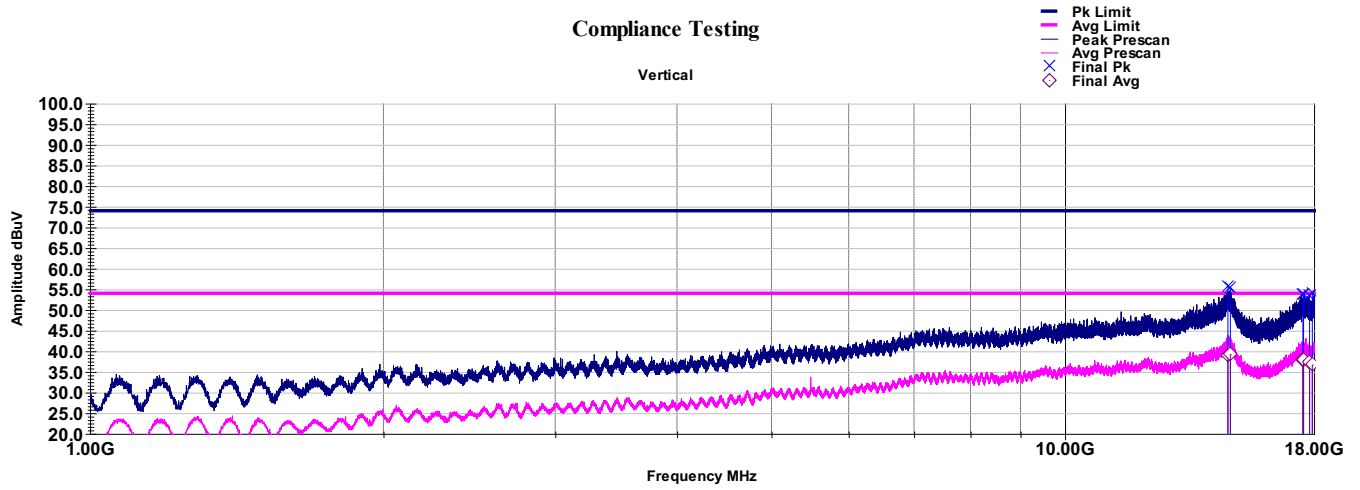


Compliance Testing

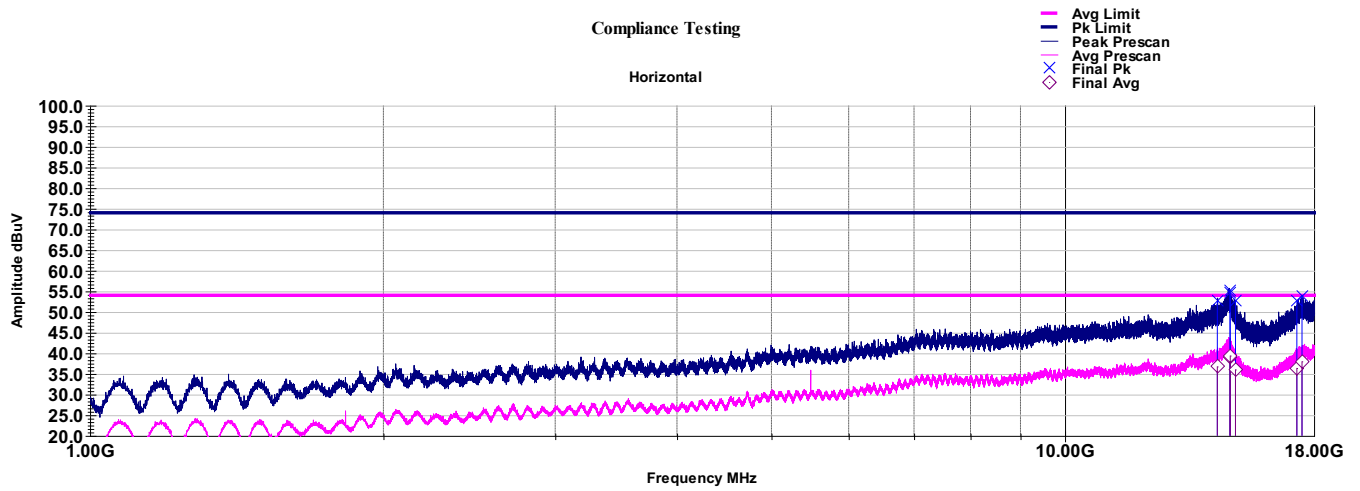


1GHz to 18 GHz Mid channel

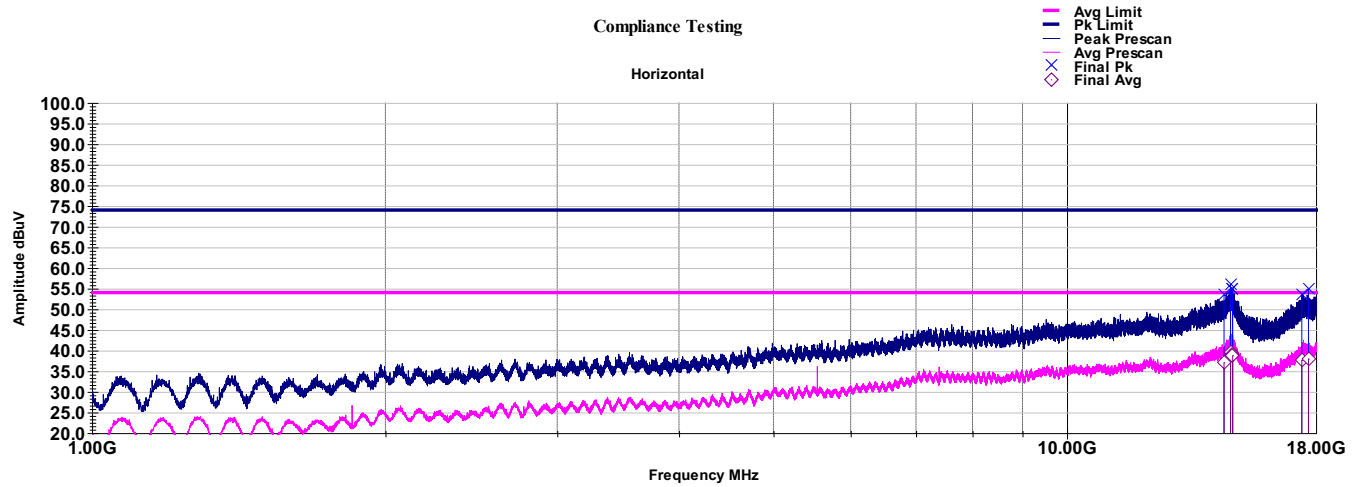
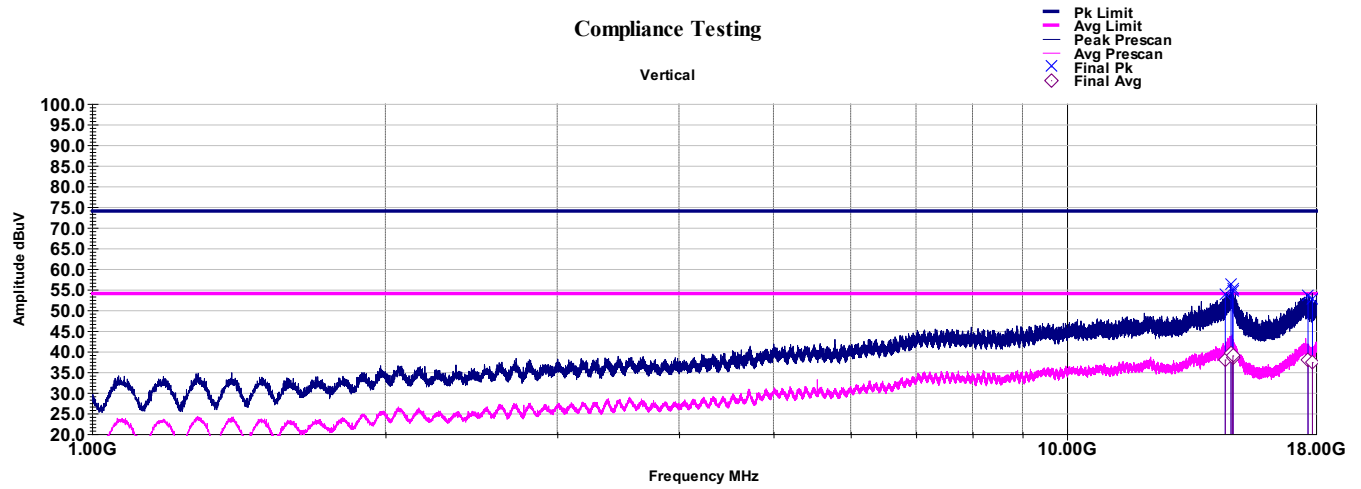
Compliance Testing



Compliance Testing

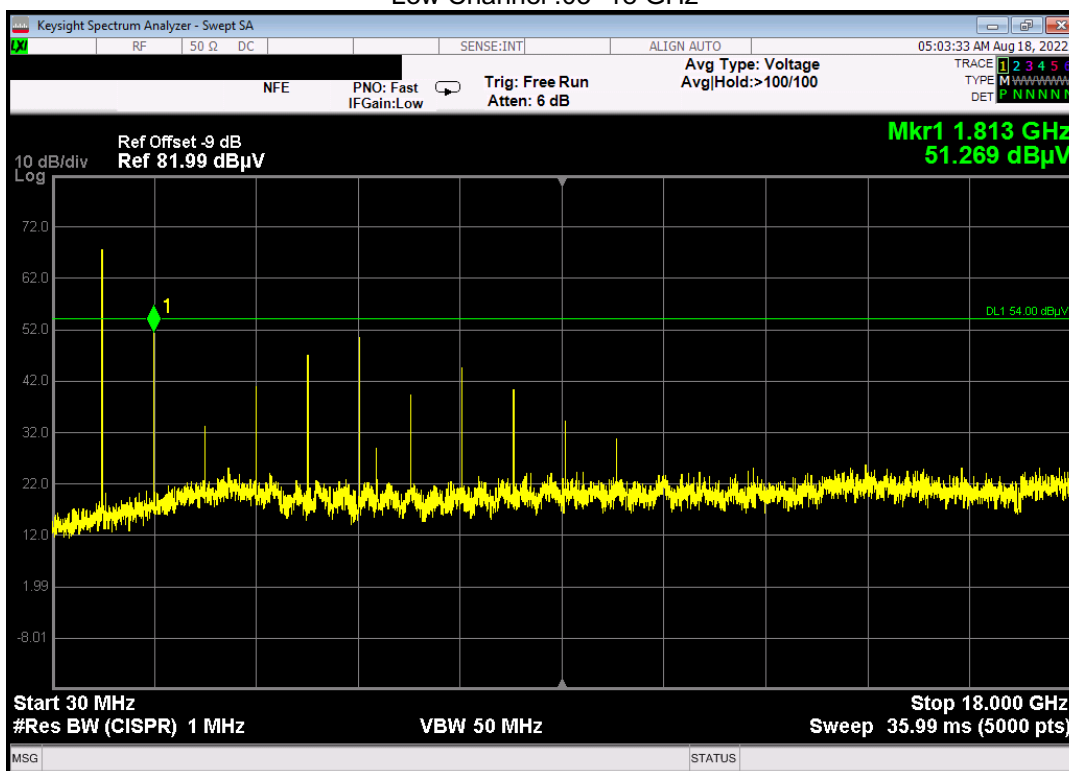


1GHz to 18 GHz High channel

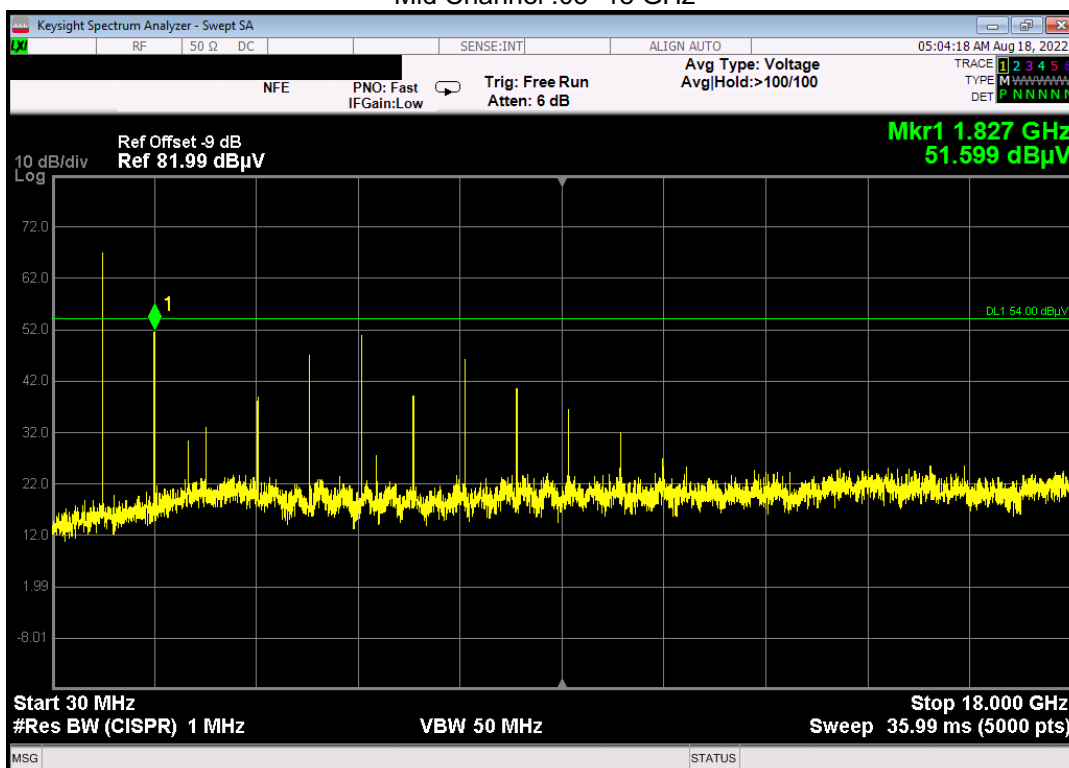


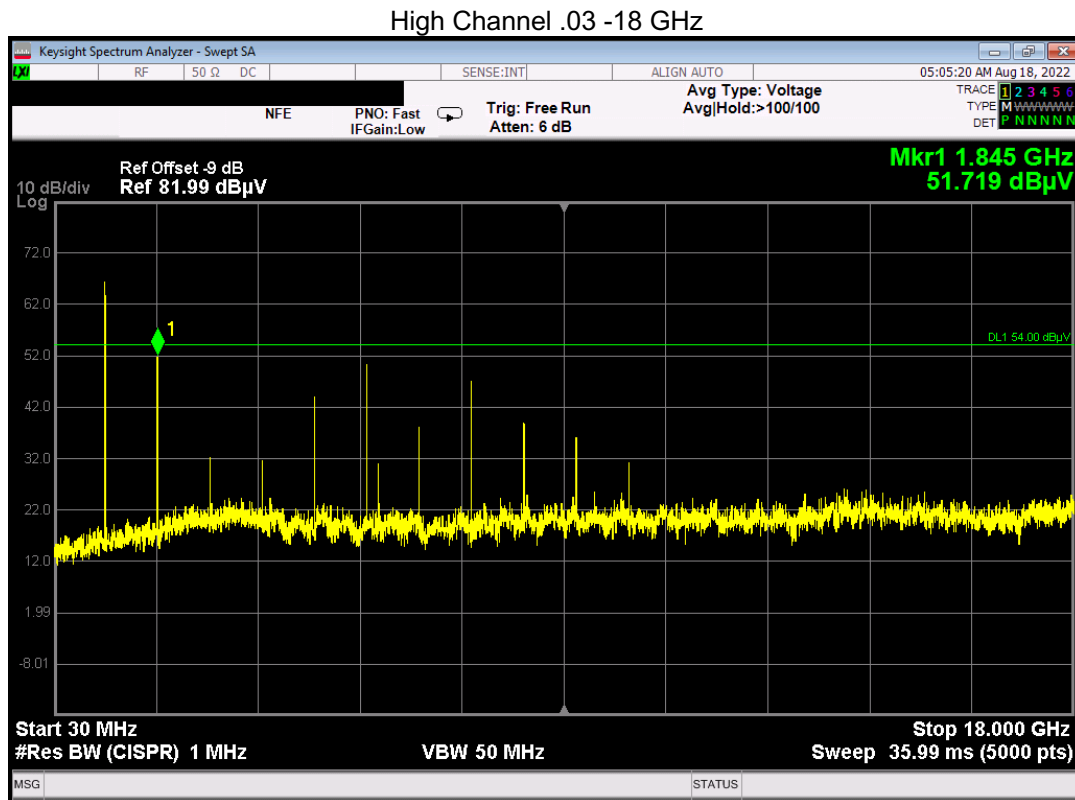
The following data is 15.209 data taken by conducted means. The Reference offset considers the dBm to dBuV conversion and the max antenna gain

Low Channel .03 -18 GHz



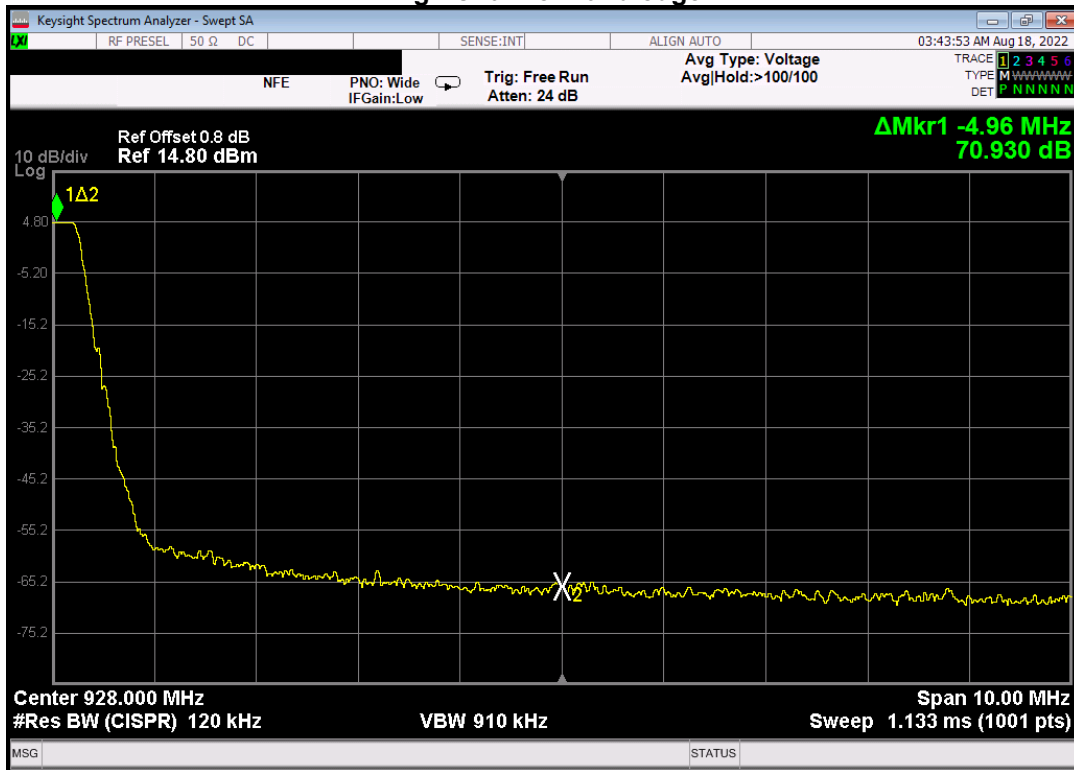
Mid Channel .03 -18 GHz





*For conducted tests, all peak emissions are below the average limit

High Channel Band edge



Test Equipment Utilized

Description	Manufacturer	Model #	CT Asset #	Last Cal Date	Cal Due Date
Horn Antenna, 1-18 GHz	ARA	DRG-118/A	i00271	8/11/22	8/11/24
Horn Antenna, 18-40 GHz	EMCO	3116	i00085	2/22/21	2/22/23
Bi-Log antenna	EMC Shop	Bila2G	i00349	2/27/22	2/27/24
Temp./humidity/pressure monitor (rad.emissions)	Omega Engineering	iBTHX-W-5	i00631	11/3/21	11/3/22
Voltmeter	Fluke	87-iii	i00319	5/5/22	5/5/23
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	
Tile Software 7	Est-Lindgren	7. 7. 1. 5	i00548	N/A	

Measurement Uncertainty

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

Measurement	U_{lab}
Radio Frequency	$\pm 3.3 \times 10^{-8}$
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 $\pm U_{lab}$ (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