

Test Report

Prepared for: Qdes Works BV

Model: Receiver Station

Description: Wireless Audio Receiver

Serial Number: N/A

FCC ID: 2AJK5-RE001

To

FCC Part 15.407

Test Result: PASS

Date of Issue: June 25, 2024

On the behalf of the applicant:

Qdes Works BV
Kropaarstraat 12
1032 LA Amsterdam,
The Netherlands

Attention of:

Jochem Welvaadt, CEO
Ph: 31621556176
E-mail: jwelvaadt@systecdesigns.com

Prepared By
Compliance Testing, LLC
1724 S. Nevada Way
Mesa, AZ 85204
(480) 926-3100 phone / (480) 926-3598 fax
www.compliancetesting.com
Project No: p2430010

Reviewed / Authorized By:



John Michalowicz
Test Engineer

This report may not be reproduced, except in full, without written permission from Compliance Testing. All results contained herein relate only to the sample tested.

Test Results Summary

Specification	Test Name	Pass, Fail, N/A	Comments
§15.203	Antenna Requirements	Pass	
§15.207 §15.407(b)(6)	Line Conducted Emissions	Pass	
§15.407(a)(3)	Conducted Output Power	Pass	
§15.407(a)(3),(5)	Power Spectral Density	Pass	
§15.403(i) §15.407(e)	6dB Occupied Bandwidth	Pass	
	99% Occupied Bandwidth		
§15.407(b)(4)	Undesirable Emissions	Pass	
§15.205 §15.407(b)(4),(5),(6)	General Field Strength Limits (Restricted Bands and Radiated Emission limits)	Pass	
§15.407(f)	RF Exposure	Pass	

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*.

References	Description
CFR47, Part 15, Subpart B	Unintentional Radiators
CFR47, Part 15, Subpart C	Intentional Radiators
CFR47, Part 15, Subpart E	Unlicensed Nation Information Infrastructure Devices (U-NII)
ANSI C63.10-2009	American National standard for testing Unlicensed Wireless Devices
ANSI C63.4-2009	Method and Measurements of Radio-Noise Emissions from low-Voltage Electrical and Electronic Equipment in the range 9kHz to 40GHz.
ISO/IEC 17025:2005	General requirements for the Competence of Testing and Calibrations Laboratories
KDB 644545 D03	Guidance for IEEE 802 11ac New Rules
KDB 789033 D02	General U-NII Test Procedures New Rules V01
KDB 926956 D01	U-NII Transition Plan

Test Report Revision History

Revision	Date	Revised By	Reason for Revision
1.0	6/25/2024	John Michalowicz	Original Document
2.0	9/27/2024	John Michalowicz	Added EIRP information and Mask for 5852 MHz
3.0	10/23/2024	John Michalowicz	Removed 5852 MHz channel and changed the tested high channel to 5850 MHz
4.0	12/2/2024	John Michalowicz	Changed the tested low channel to 5730 MHz

Table of Contents

<u>Description</u>	<u>Page</u>
Test Results Summary	2
Standard Test Conditions Engineering Practices	7
Peak Output Power	10
Transmitter Power Spectral Density	13
Undesirable Emissions Conducted	16
Undesirable Emissions Radiated	23
Occupied Bandwidth	28
A/C Powerline Conducted Emission	32
Test Equipment Utilized	35

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 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)
22.2 – 24.1	25.3 – 36.7	966.1 – 969.5

EUT Operation during Tests

The EUT was placed into a constant transmit mode using pre-loaded test software.

EUT Description

Model: Receiver Station

Description: Wireless Audio Receiver

Firmware: Main PCB: v0.04, Display PCB: v0.08

Software: NA

Serial Number: NA

Additional Information: The EUT is a wireless guitar receiver that is powered by an AC/DC adaptor.

The products is available in two versions, Jack Receiver Station and mXLR Receiver Station, which differ only in the type of charge port.

EUT Specifications

Equipment Code	NII
Model(s) Tested	Receiver Station
Model(s) covered	Jack Receiver Station, mXLR Receiver Station
Maximum Output Power	15.84 dBm
Frequency Range	5730 - 5850
Bandwidths	2.2 MHz
Data Rates	2 Mbps
Modulations	GFSK

Antenna List

No.	Manufacturer	Part #	Antenna Type	Peak Gain
1	Tekfun Co., Ltd.	F04-S	Omni	2.7 dBi

15.203: Antenna Requirement:

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

Accessories:

Qty	Description	Manufacturer	Model	S/N
1	Switching power supply	TRIAD	812WSU090-1300	NA

Cables:

Qty	Description	Length (M)	Shielding Y/N	Shielded Hood Y/N	Ferrite Y/N
1	XLR	<3m	N	N	N
2	¼ inch cable	<3m	N	N	N

Modifications:

Peak Output Power

Engineer: John Michalowicz

Test Date: 4/30/24 – 12/2/24

Test Requirements

For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. If transmitting antennas of directional gain greater than 6 dBi are used, the maximum conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

The maximum peak antenna gain is 2.7 dBi

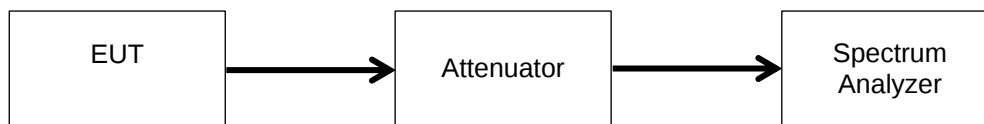
Test Procedure

The RF power was calculated using the spectrum analyzers' band power function per Method SA-1 from KDB 789033 D02 General U-NII Test Procedures New Rules v01. Measurements were made at the low, mid and high channels of the band.

The Spectrum analyzer was set to the following:

- RBW = 3 MHz
- VBW $\geq$ 9 MHz
- Sweep time = auto
- Detector = peak

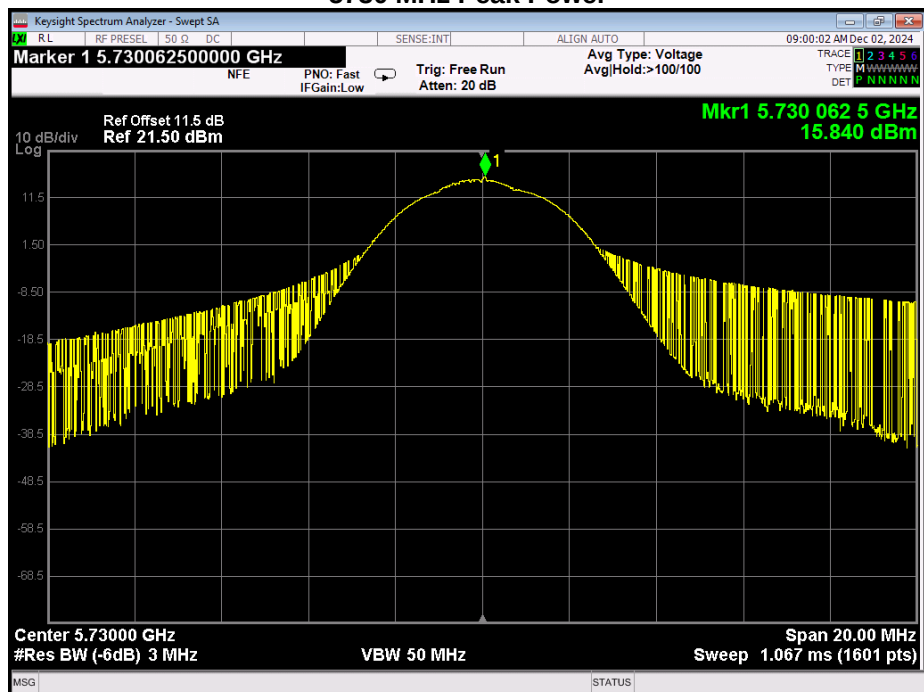
Test Setup



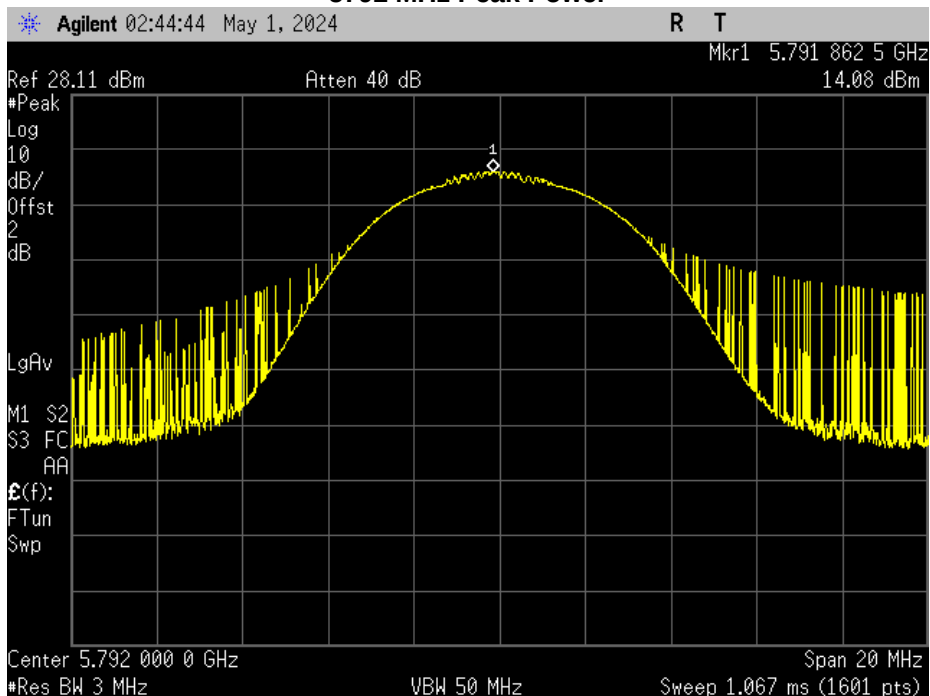
Frequency (MHz)	Conducted Power (dBm)	Limit (dBm)	Result
5730	15.84	30	Pass
5792	14.08	30	Pass
5850	14.02	30	Pass

Test Results

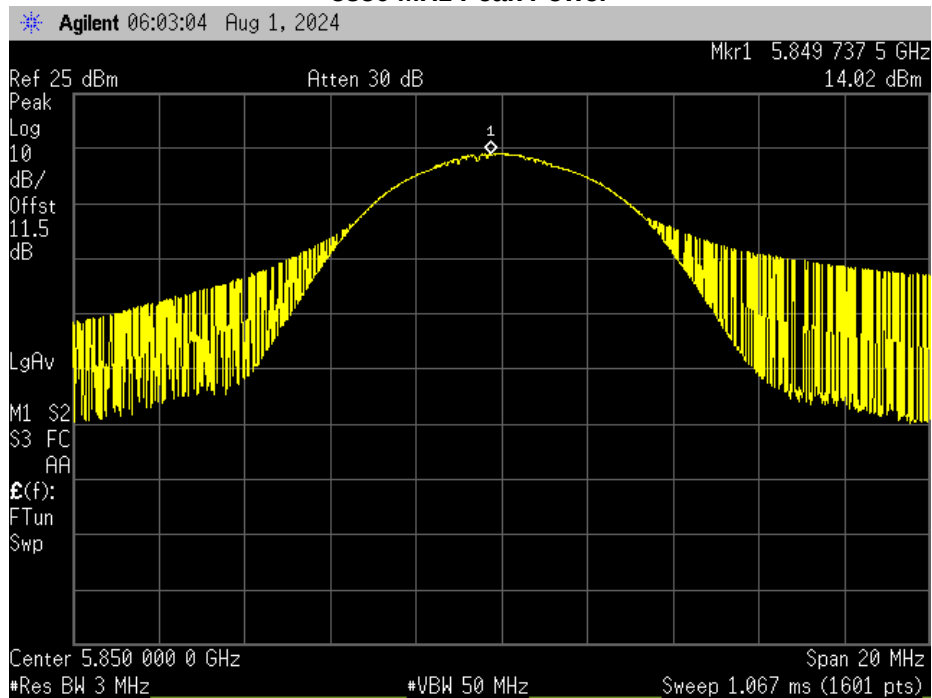
5730 MHz Peak Power



5792 MHz Peak Power



5850 MHz Peak Power



Transmitter Power Spectral Density

Engineer: John Michalowicz

Test Date: 4/30/24 – 12/2/24

Test Requirements

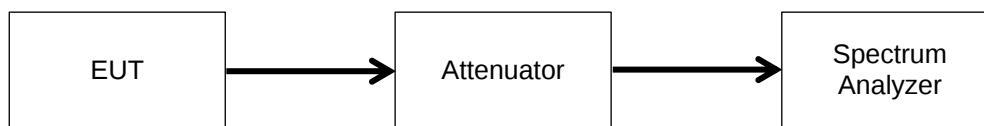
For the band 5.725-5.85 GHz, the maximum power spectral density shall not exceed 30 dBm in any 500 kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in power spectral density.

The maximum peak antenna gain is 2.7 dBi

Test Procedure

The Power Spectral Density was measured using the method per SA-1 from KDB 789033 D02 General U-NII Test Procedures New Rules v01. Measurements were made at the low, mid and high channels of the band. The maximum PSD was determine by finding the peak value across the carrier bandwidth.

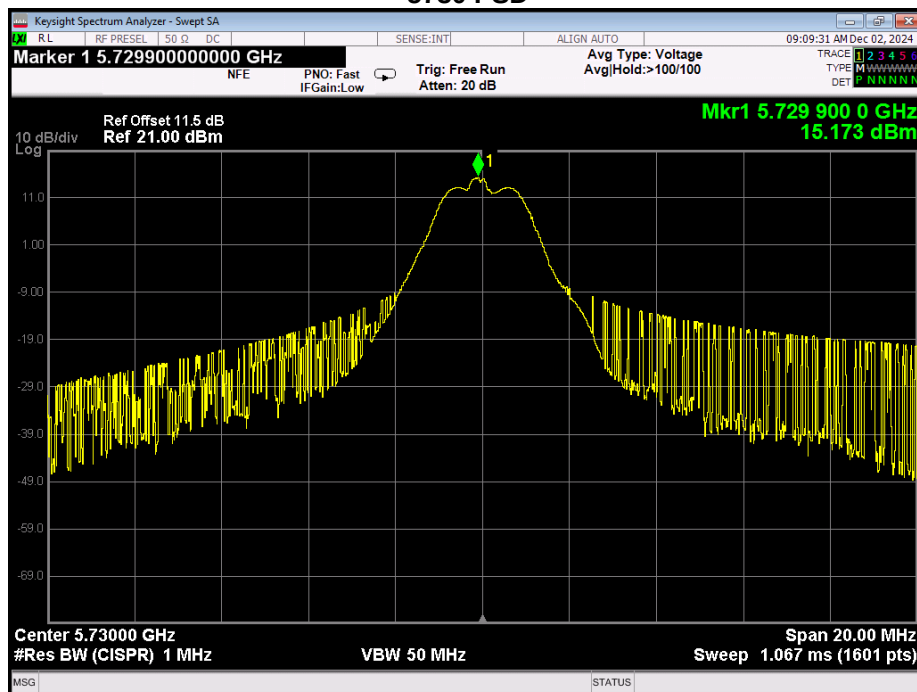
Test Setup



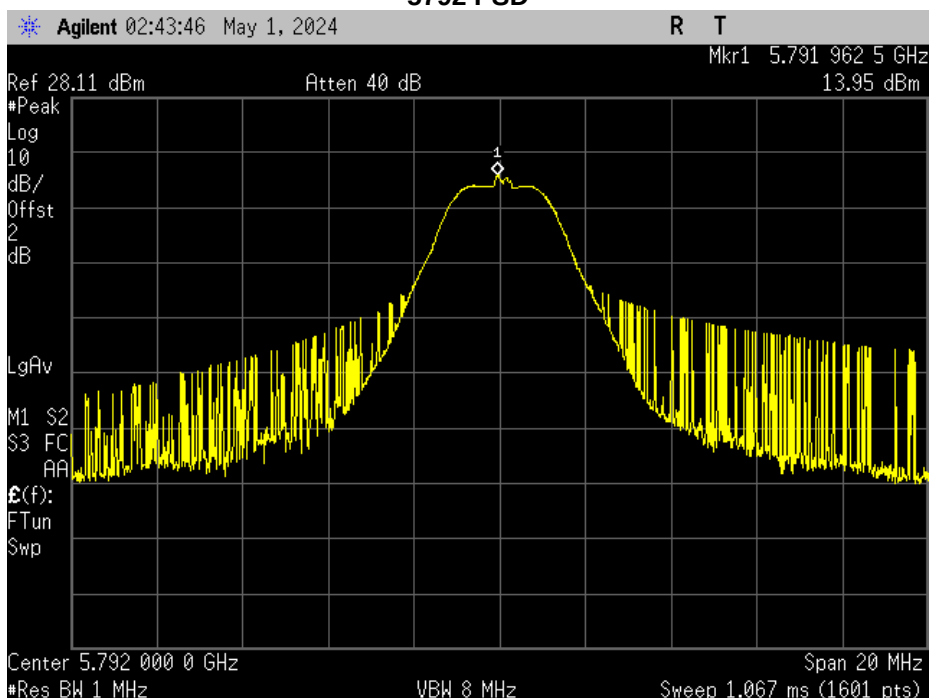
Frequency (MHz)	Conducted Power (dBm)	Limit (dBm)	Result
5730	15.17	30	Pass
5792	13.95	30	Pass
5850	14.00	30	Pass

Test Results

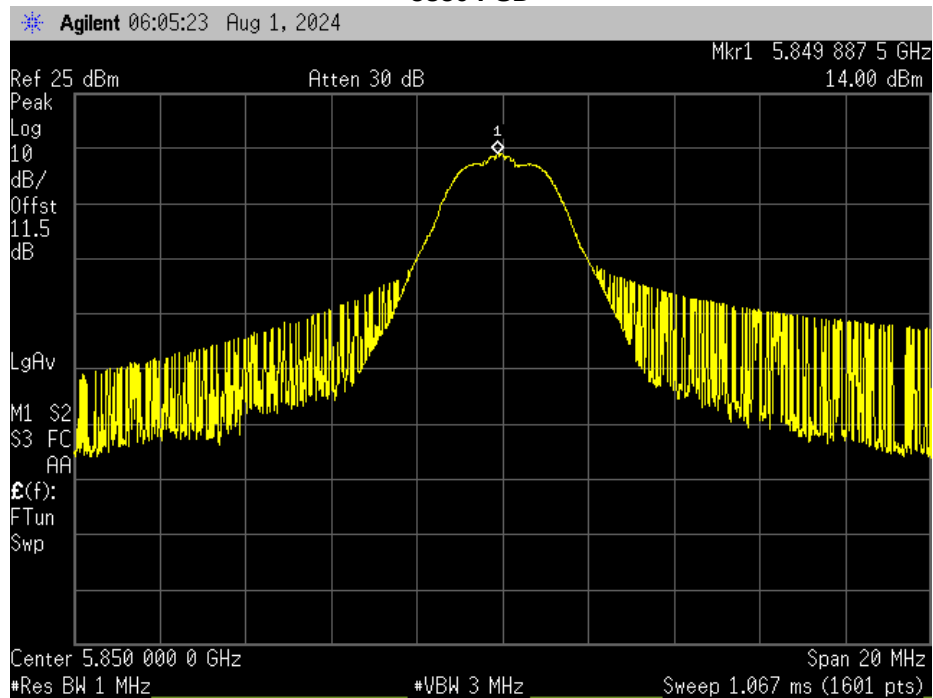
5730 PSD



5792 PSD



5850 PSD



Undesirable Emissions Conducted

Engineer: John Michalowicz

Test Date: 5/02/24

Test Requirements

Unwanted Emissions that fall Outside Restricted Bands

For transmitters operating in the 5.725-5.85 GHz band: All emissions within the frequency range from the band edge to 10 MHz above or below the band edge shall not exceed an e.i.r.p. of -17 dBm/MHz; for frequencies 10 MHz or greater above or below the band edge, emissions shall not exceed an e.i.r.p. of -27 dBm/MHz. The emission measurements shall be performed using a minimum resolution bandwidth of 1 MHz. A lower resolution bandwidth may be employed near the band edge, when necessary, provided the measured energy is integrated to show the total power over 1 MHz.

The provisions of §15.205 apply to intentional radiators operating under this section.

Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in §15.209.

For Conducted Unwanted Emissions in the Restricted Bands

For conducted measurements above 1000 MHz, EIRP was determined and then the field strength computed by the following:

$E[\text{dB}\mu\text{V/m}] = \text{EIRP}[\text{dBm}] - 20 \log(d[\text{meters}]) + 104.77$, where E = field strength and $d = 3\text{m}$

$E[\text{dB}\mu\text{V/m}] = \text{EIRP}[\text{dBm}] + 95.2$, for $d = 3\text{ meters}$.

Test Procedure

Per KDB 789033 D02 General U-NII Test Procedures New Rules v01 conducted RF port measurements were made in lieu of radiated. In addition, Cabinet Emissions measurements were performed in a semi-anechoic chamber with the antenna port terminated by a matching load. See additional section for Radiated Emissions.

The following criteria were addressed:

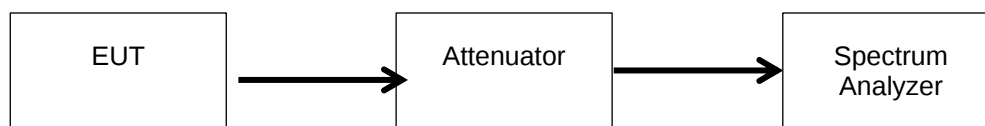
The Spectrum Analyzer was set to the following for emissions > 1000MHz:

- a. RBW = 1 MHz
- b. VBW $\geq$ 3 MHz
- c. Detector = Peak.
- d. Sweep time = auto.
- e. Trace mode = max hold.
 1. Note: For emissions where the peak exceeded that of the average 15.209 emission limit the following was performed.
- f. RBW = 1 MHz
- g. VBW $\leq$ RBW/100 (i.e., 10 kHz) but not less than 10 Hz.

For emissions below 1000MHz the Spectrum Analyzer settings were as follows:

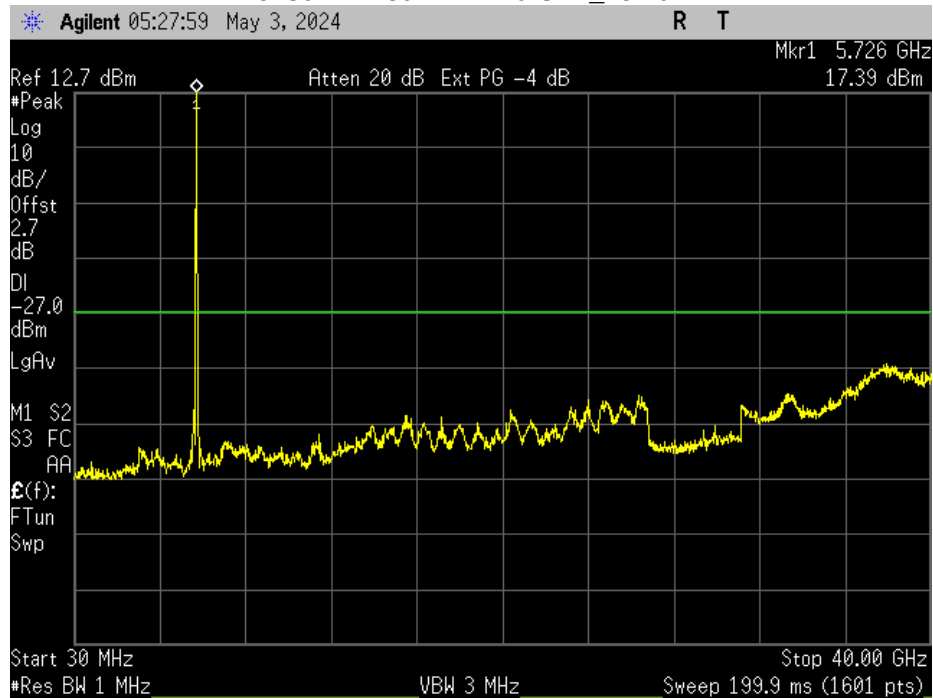
- a. RBW = 100 kHz
- b. VBW $\geq$ 300 kHz
- c. Detector = Peak.
- d. Sweep time = auto.
- e. Trace mode = max hold.

Test Setup

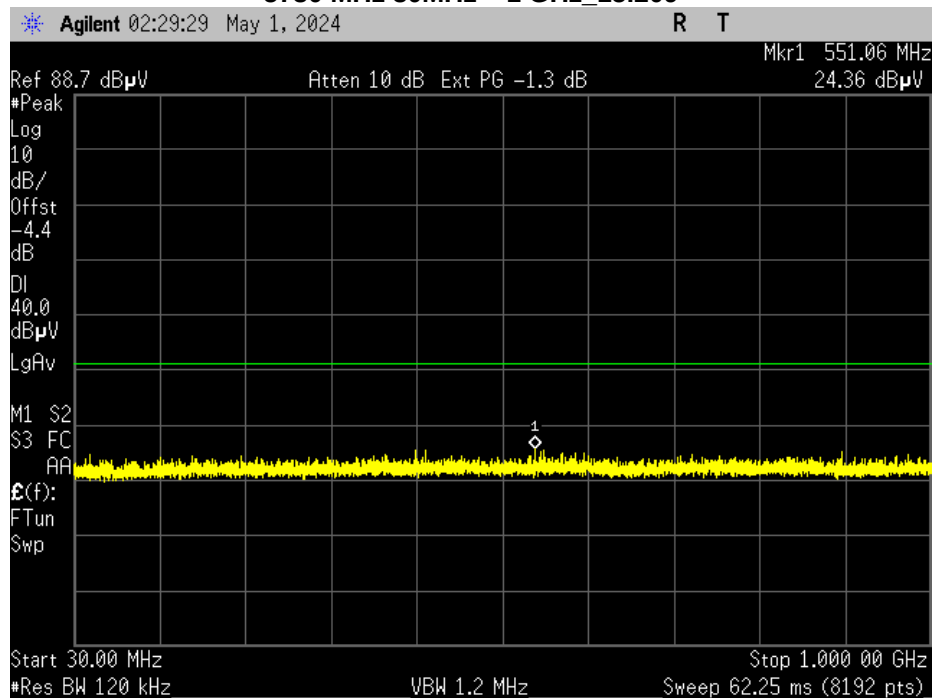


Test Results:

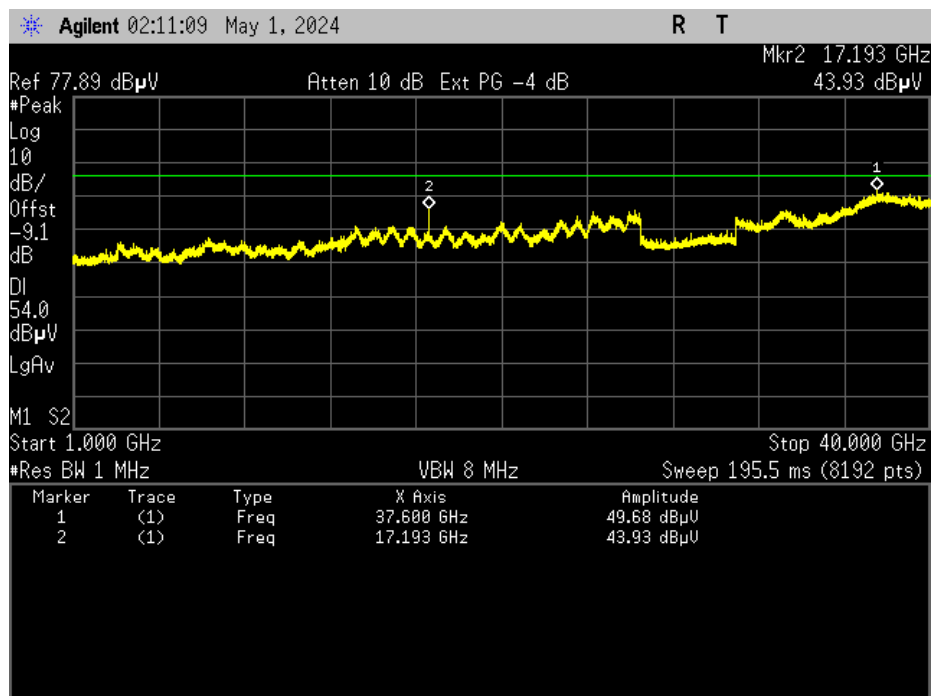
5730 MHz 30MHz – 40 GHz_15.407



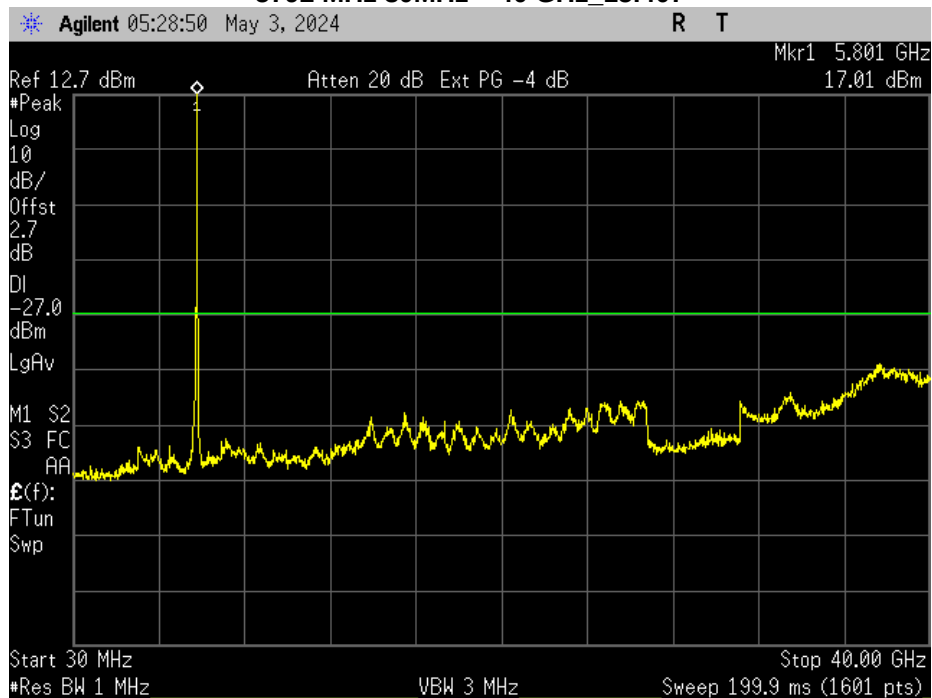
5730 MHz 30MHz – 1 GHz_15.209



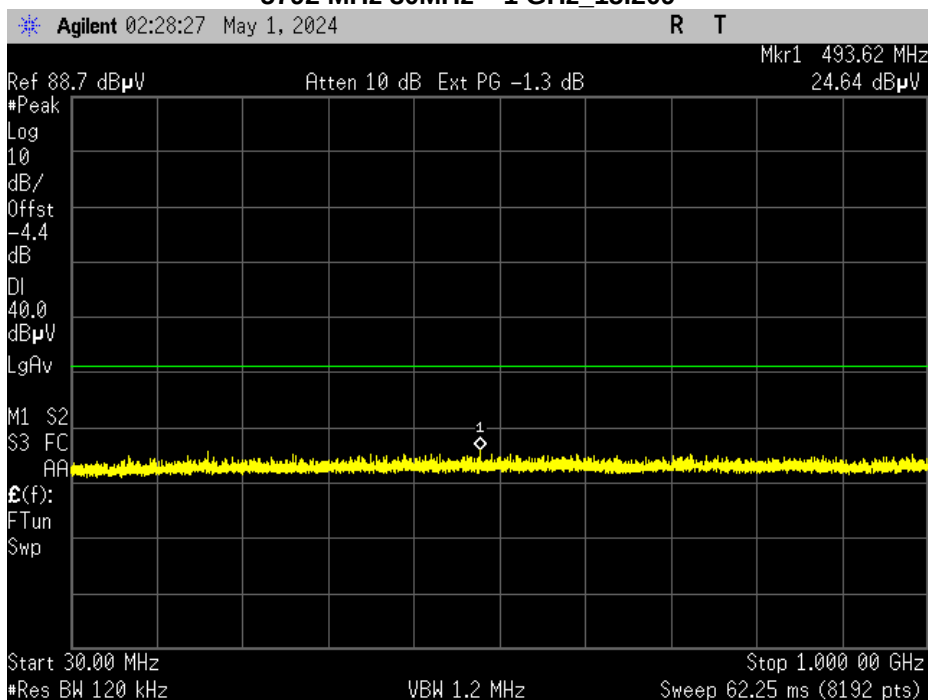
5730 MHz 1 GHz – 40 GHz_15.209



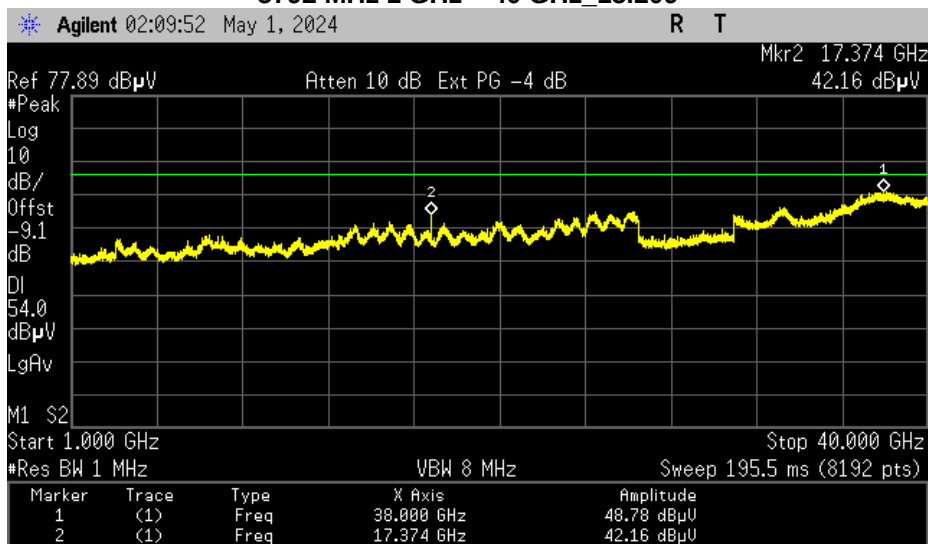
5792 MHz 30MHz – 40 GHz_15.407



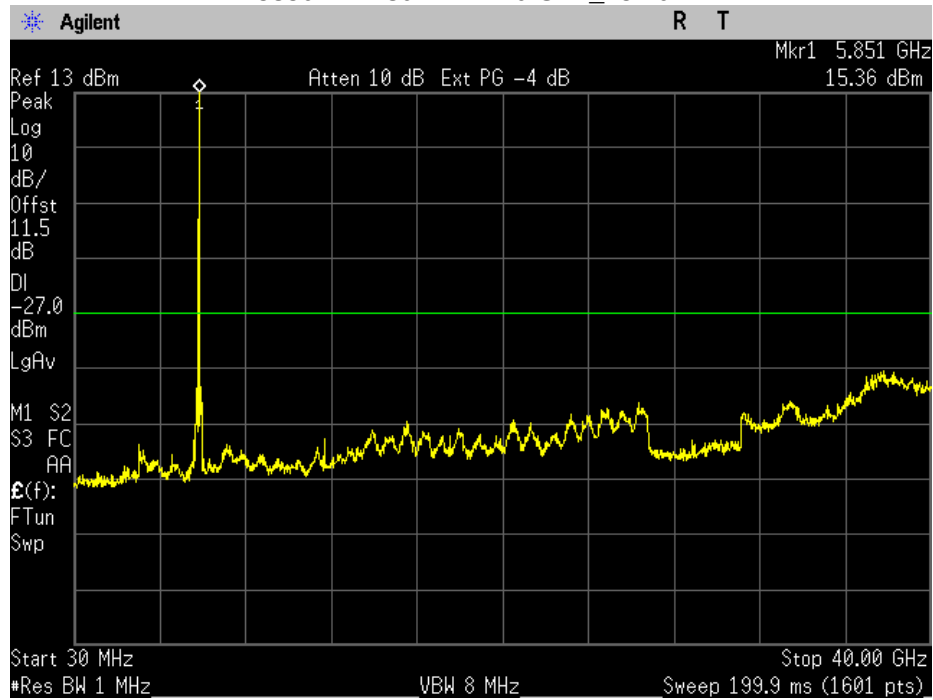
5792 MHz 30MHz – 1 GHz_15.209



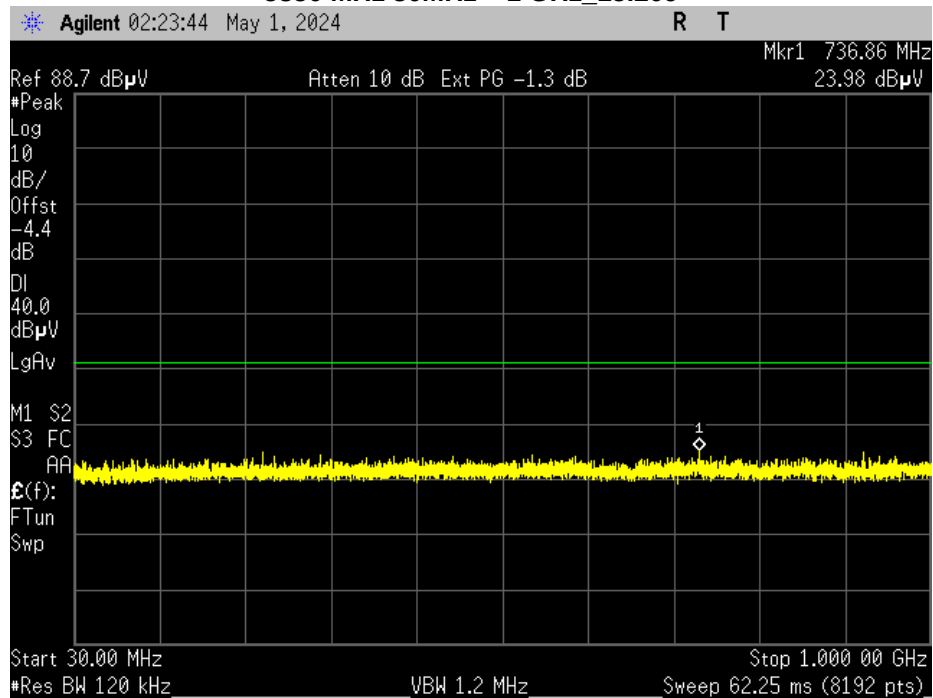
5792 MHz 1 GHz – 40 GHz_15.209



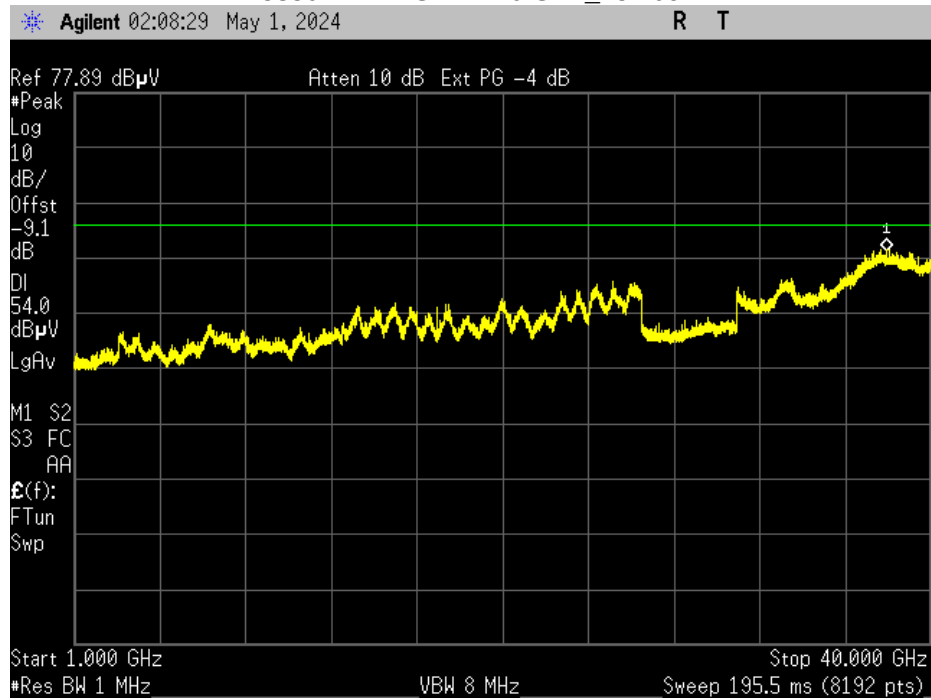
5850 MHz 30MHz – 40 GHz_15.407



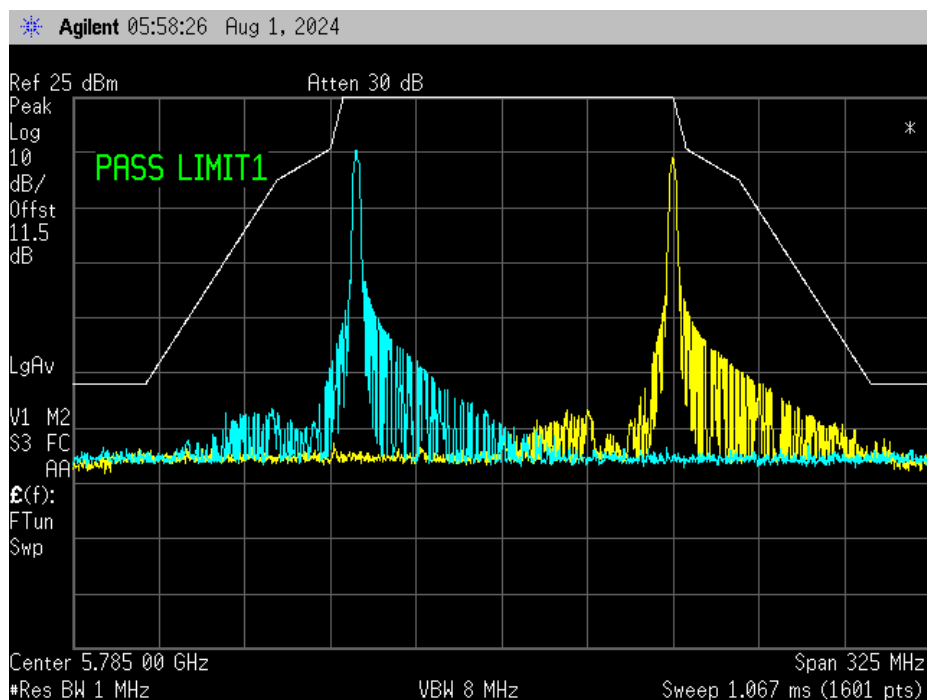
5850 MHz 30MHz – 1 GHz_15.209



5850 MHz 1 GHz – 40 GHz_15.209



Mask per KDB 291074 D02 Section 2.10.2



Undesirable Emissions Radiated

Engineer: John Michalowicz

Test Date: 5/01/24

Test Requirements

The provision of §15.209 were applied. In addition the requirements of §15.205 were also applied.

FCC Part 15 Subpart C Paragraph 15.209(a) Limits

Frequency (MHz)	Frequency (microvolts/meter)	Frequency (meter)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Remarks: E field strength (dBμV/m) = 20 log E field strength (uV/m)

Test Procedure

The EUT was setup in accordance with ANSI C63.10. 2013 and tested per KDB 789033. The antenna was replaced with non-radiating matched load. The EUT is placed on non-conductive platform at a height of 0.8 meters above the ground plane of the semi-anechoic chambers. The EUT was rotated 360 degrees and the receive antenna raised and lowered to find the maximum emissions from 30MHz to the 10th harmonic of the fundamental. The EUT was set to the maximum power level allowed and the low, mid, and high channels were investigated for emissions. Both the vertical and Horizontal positions were investigated, the worst case are shown in the plots below.

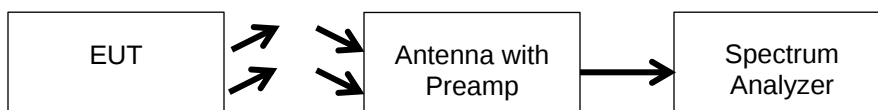
The Spectrum Analyzer was set to the following for emissions > 1000MHz:

- RBW = 1 MHz
- VBW ≥ 3 MHz
- Detector = Peak.
- Sweep time = auto.
- Trace mode = max hold.
 - Note: For emissions where the peak exceeded that of the average 15.209 emission limit the following was performed.
- RBW = 1 MHz
- VBW ≤ RBW/100 (i.e., 10 kHz) but not less than 10Hz

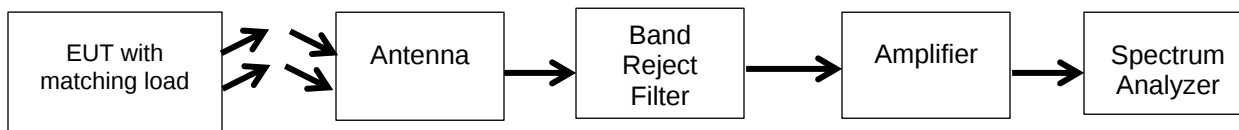
For emissions below 1000MHz the Spectrum Analyzer settings were as follows:

- RBW = 100 kHz
- VBW ≥ 300 kHz
- Detector = Peak.
- Sweep time = auto.
- Trace mode = max hold.
 - Note: A quasi peak detector was used for emissions where the peak exceeded that of the average 15.209 emission limits

Test Setup below 1000MHz



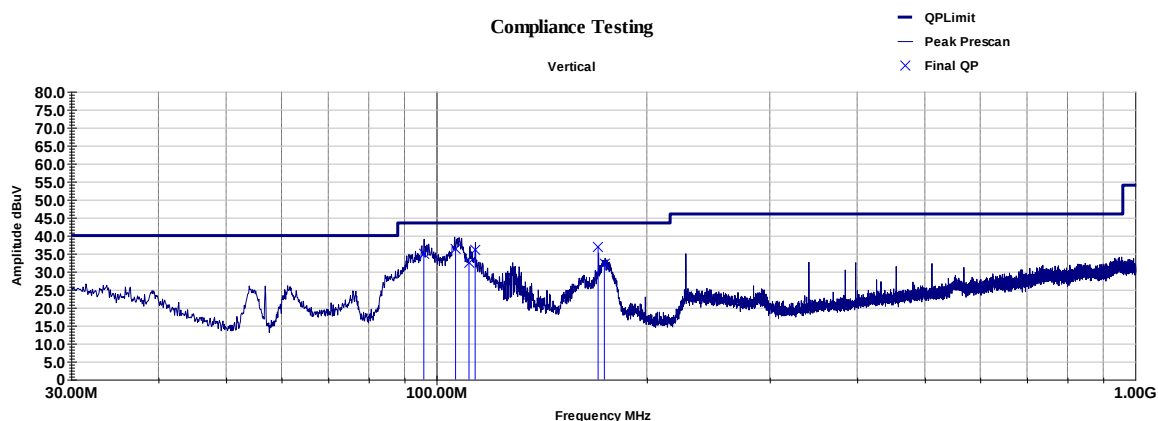
Test Setup above 1000MHz



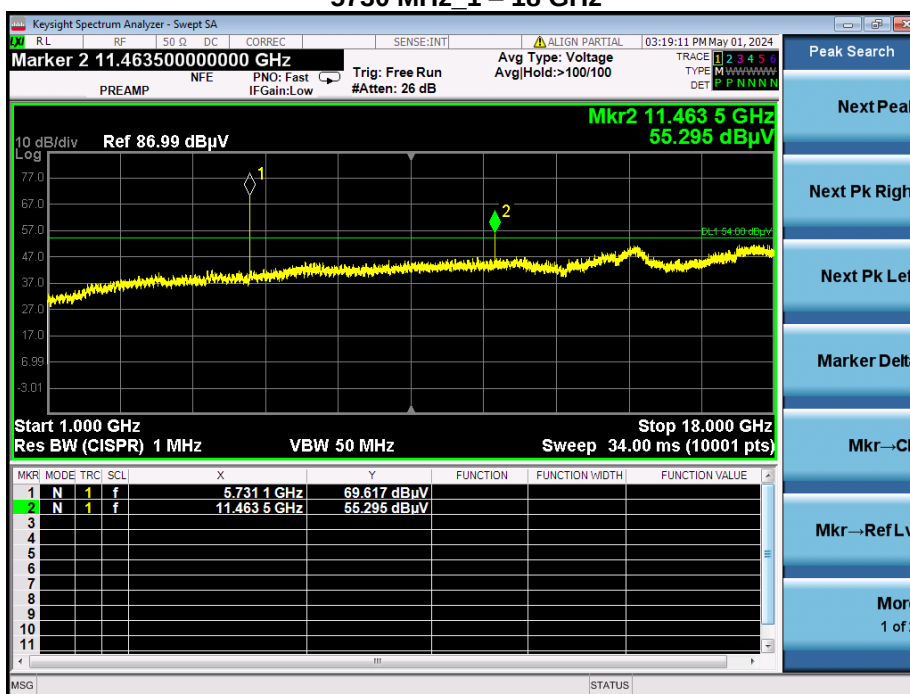
Test Results:

5730 MHz_30 – 1000 MHz

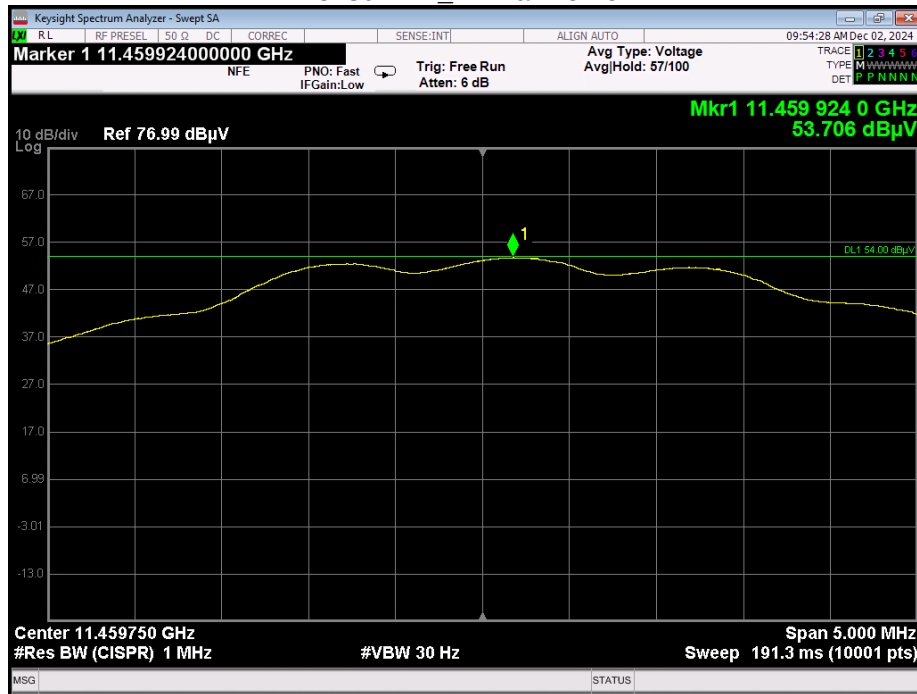
Compliance Testing



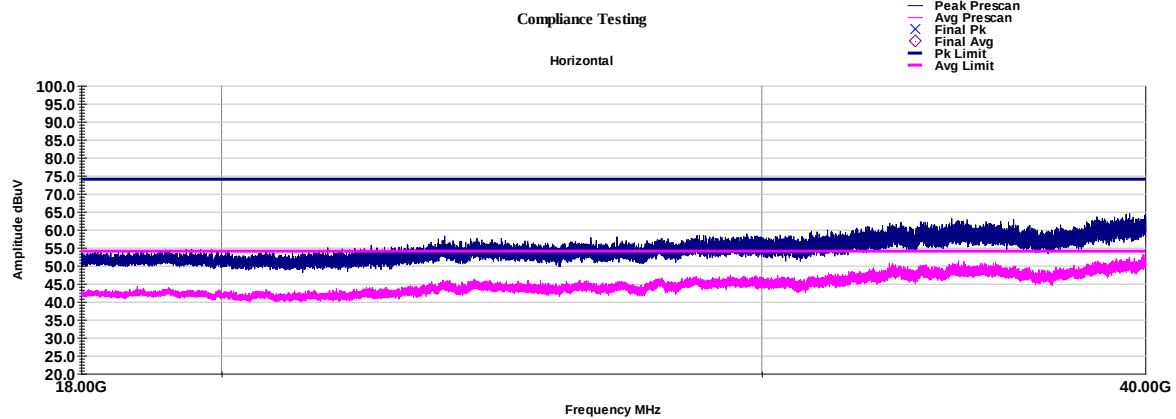
5730 MHz_1 – 18 GHz



5730 MHz_2nd Harmonic



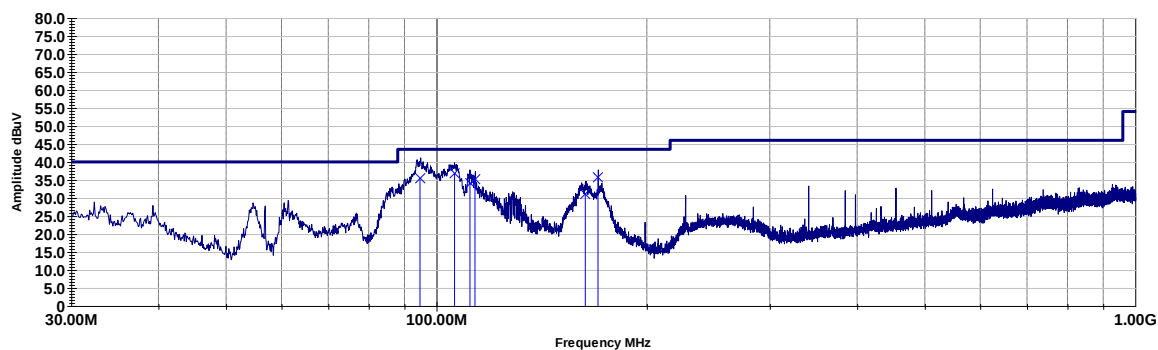
5730 MHz_18 – 40 GHz



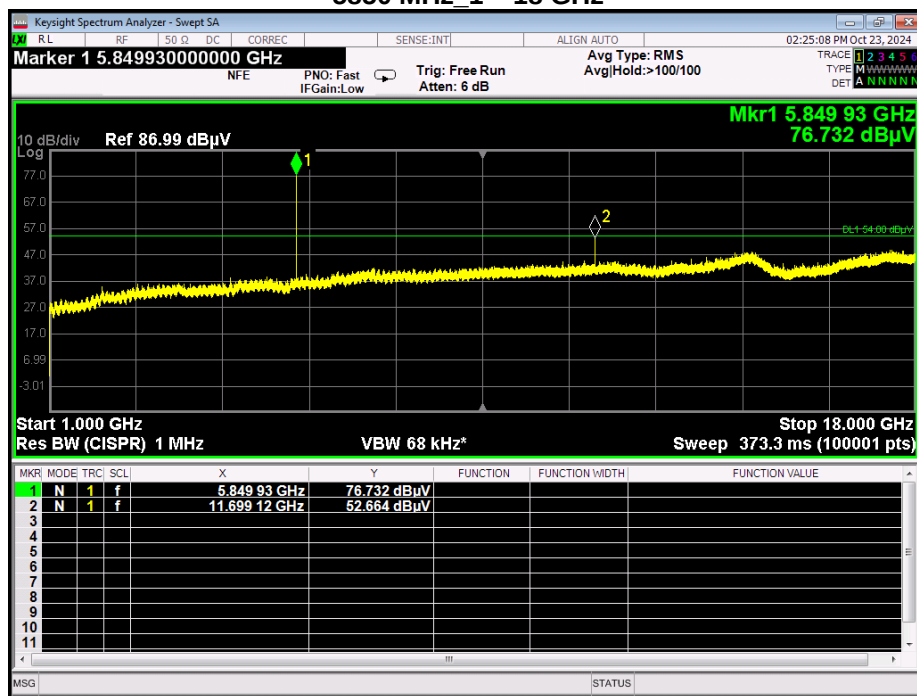
5850 MHz_30 – 1000 MHz

Compliance Testing

Vertical



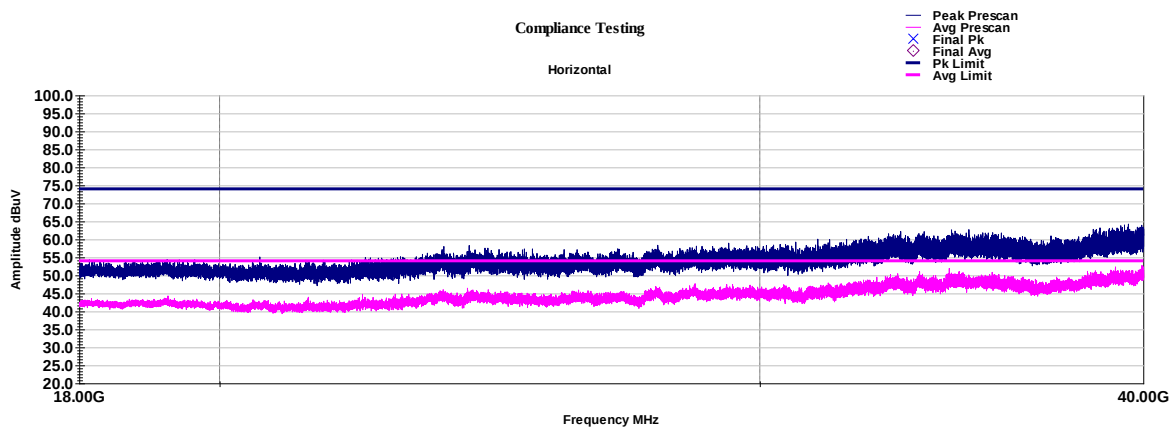
5850 MHz_1 – 18 GHz



5850 MHz_18 – 40 GHz

Compliance Testing

Horizontal



Occupied Bandwidth

Engineer: John Michalowicz

Test Date: 4/15/24 – 12/2/24

Test Requirement

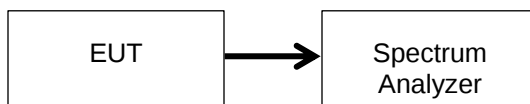
Within the 5.725-5.850 GHz and 5.850-5.895 GHz bands, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz. For purposes of this subpart the emission bandwidth shall be determined by measuring the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, that are 6 dB down relative to the maximum level of the modulated carrier. Determination of the emissions bandwidth is based on the use of measurement instrumentation employing a peak detector function with an instrument resolution bandwidth approximately equal to 1.0 percent of the emission bandwidth of the device under measurement

Test Procedure

The Spectrum analyzer was set to the following parameters

- RBW = 100 kHz.
- VBW $\geq$ 300 kHz
- Detector = Peak.
- Trace mode = max hold.

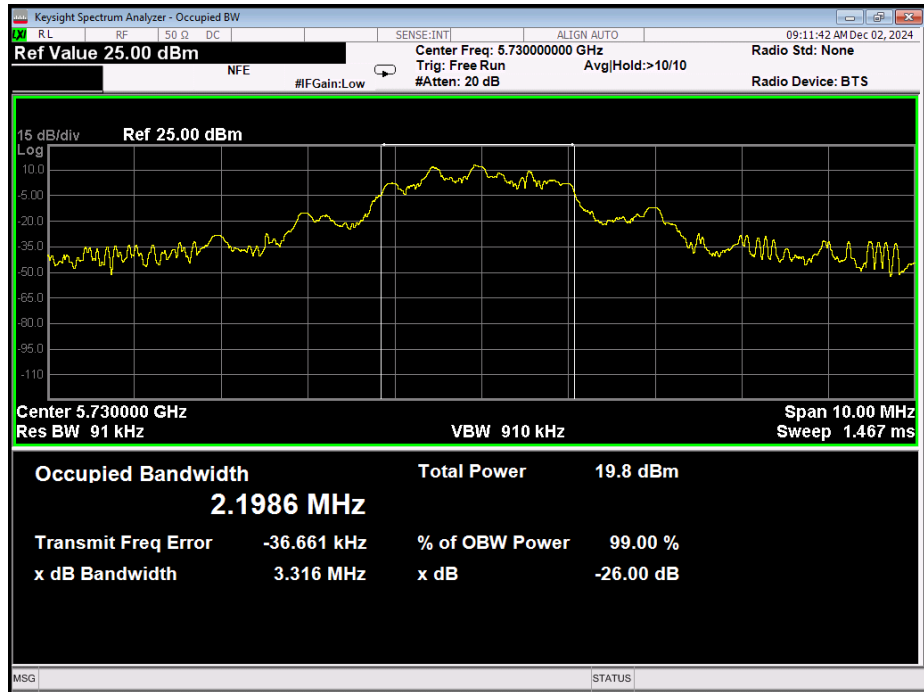
Test Setup



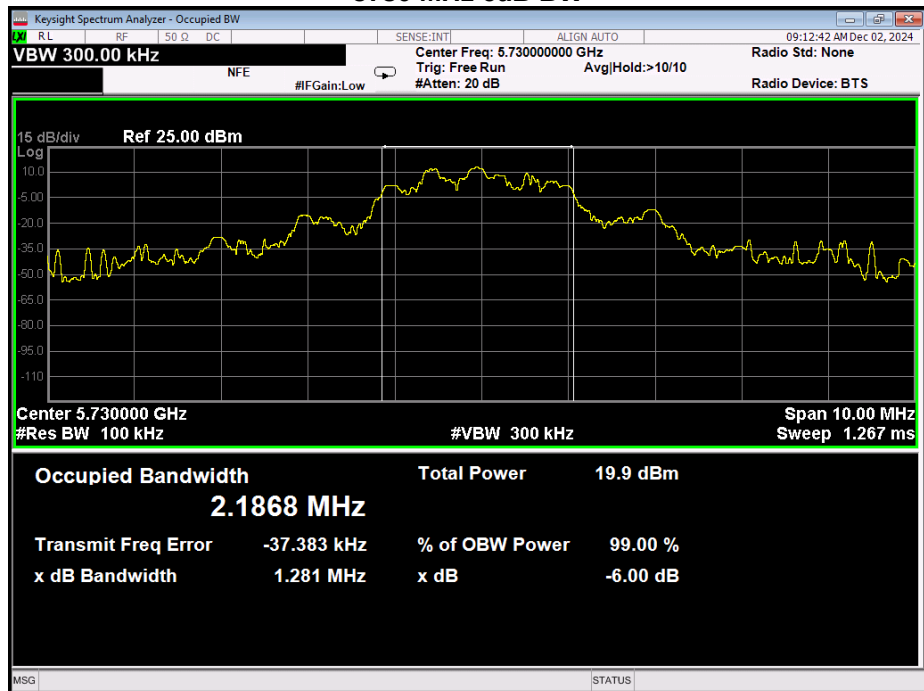
Test Results

Frequency (MHz)	6 dB BW (MHz)	99% BW (MHz)	Result
5730	1.281	2.1986	Pass
5792	1.313	2.2003	Pass
5850	1.329	2.2248	Pass

5730 MHz OCBW



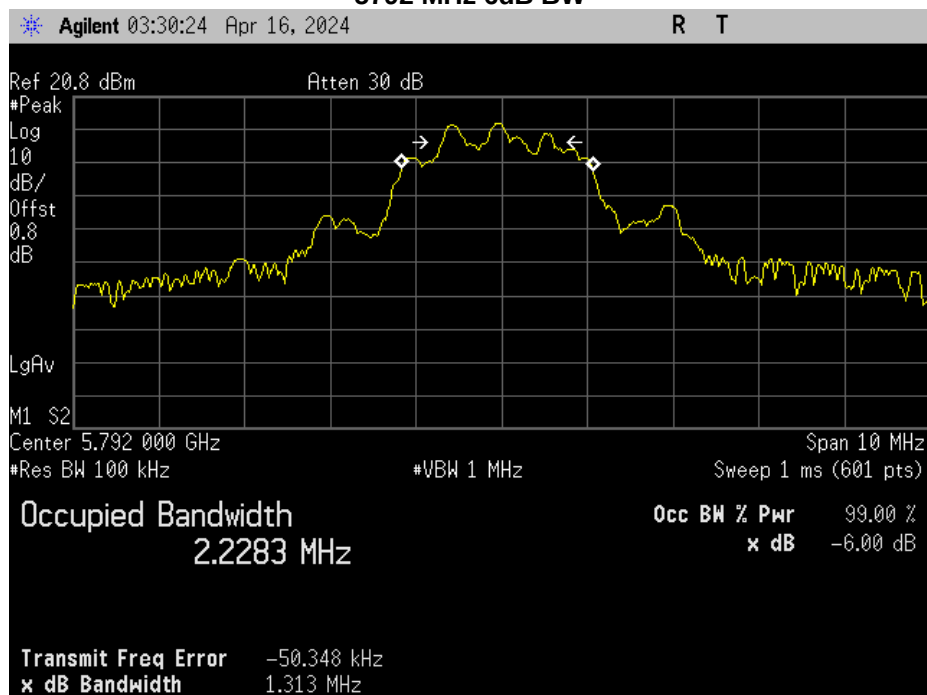
5730 MHz 6dB BW



5792 MHz OCBW



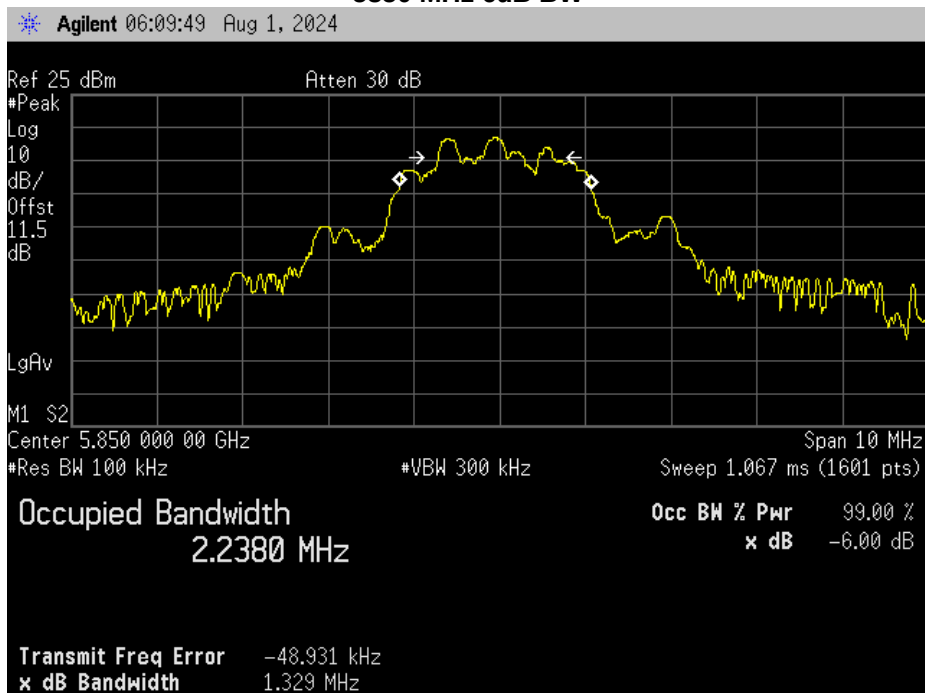
5792 MHz 6dB BW



5850 MHz OCBW



5850 MHz 6dB BW



A/C Powerline Conducted Emission

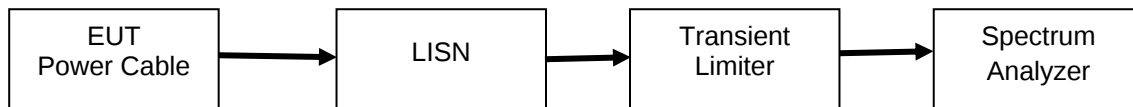
Engineer: John Michalowicz

Test Date: 6/17/24

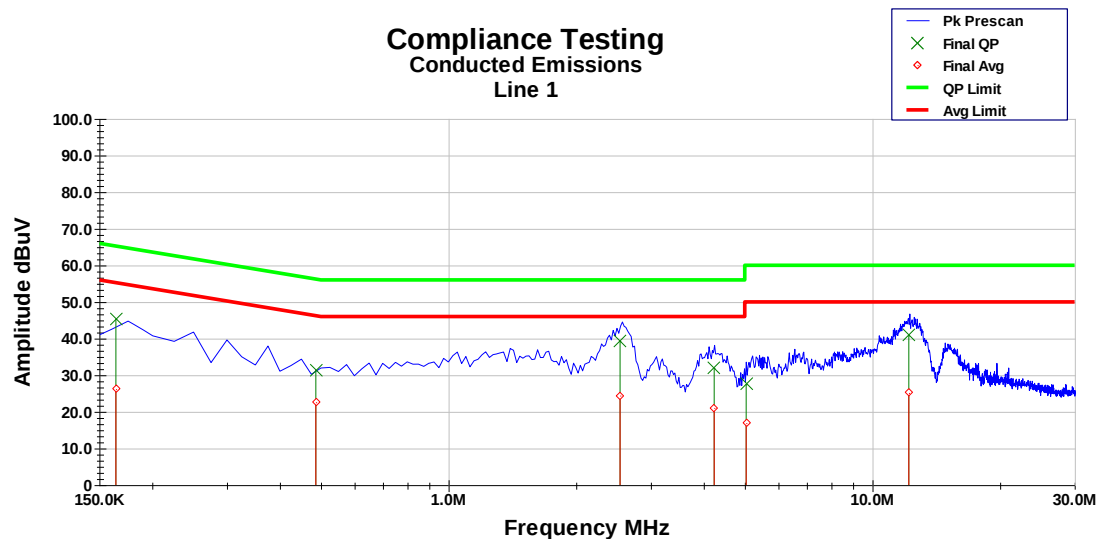
Test Procedure

The EUT power cable was connected to a LISN and the monitored output of the LISN was connected to a transient limiter, which then connected directly to a spectrum analyzer. The conducted emissions from 150 kHz to 30 MHz were measured and compared to the specification limits.

Test Setup

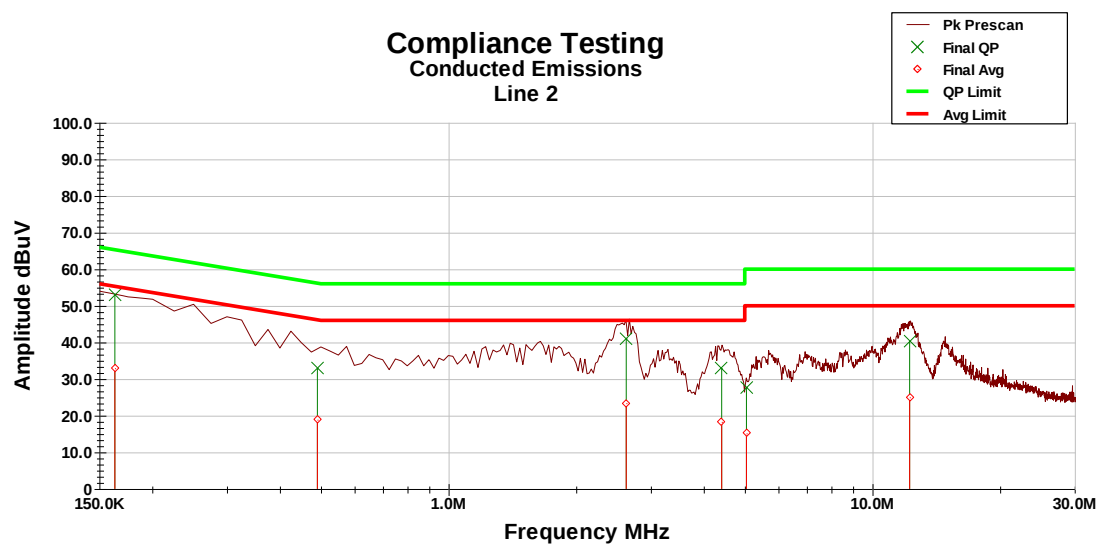


1300_C



Frequency	Raw QP	Raw Avg	Path Loss	Final QP	Final Avg	QP Limit	QP Margin	Avg Limit	Avg Margin
(MHz)	dBuV	dBuV	dB	dBuV	dBuV	dBuV	dB	dBuV	dB
164.19 KHz	35.50	16.30	9.90	45.40	26.20	65.60	-20.20	55.60	-29.40
486.38 KHz	21.40	12.50	10.10	31.40	22.60	56.40	-24.90	46.40	-23.80
2.5394 MHz	29.10	14.30	10.10	39.30	24.40	56.00	-16.70	46.00	-21.60
4.234 MHz	21.80	10.90	10.20	32.00	21.10	56.00	-24.00	46.00	-24.90
5.0373 MHz	17.30	6.80	10.20	27.50	16.90	60.00	-32.50	50.00	-33.10
12.187 MHz	30.50	14.80	10.30	40.90	25.20	60.00	-19.10	50.00	-24.80
Final = Raw + Path Loss									
Margin = Final - Limit									

Compliance Testing Conducted Emissions Line 2



Frequency (MHz)	Raw QP dBuV	Raw Avg dBuV	Path Loss dB	Final QP dBuV	Final Avg dBuV	QP Limit dBuV	QP Margin dB	Avg Limit dBuV	Avg Margin dB
163.31 KHz	43.28	23.10	9.90	53.10	33.00	65.60	-12.50	55.60	-22.70
490.38 KHz	22.90	8.90	10.00	32.90	18.90	56.30	-23.30	46.30	-27.40
2.626 MHz	31.06	13.30	10.10	41.20	23.40	56.00	-14.80	46.00	-22.60
4.4104 MHz	22.77	8.20	10.10	32.90	18.30	56.00	-23.10	46.00	-27.70
5.0436 MHz	17.67	5.00	10.10	27.80	15.20	60.00	-32.20	50.00	-34.80
12.241 MHz	30.13	14.70	10.30	40.50	25.00	60.00	-19.50	50.00	-25.00
Final = Raw + Path Loss									
Margin = Final - Limit									

Test Equipment Utilized

Description	Manufacturer	Model #	CT Asset #	Last Cal Date	Cal Due Date
EMI Receiver	HP	8546A	i00033	6/21/23	6/21/24
Horn Antenna	EMCO	3116	i00085	3/14/23	3/14/25
Horn Antenna	ARA	DRG-118/A	i00271	8/11/22	8/11/24
Bi-Log Antenna	Schaffner	CBL 6111D	i00349	2/7/23	2/7/25
3 Meter Semi-Anechoic Chamber	Panashield	3 Meter Semi-Anechoic Chamber	i00428	6/27/23	6/27/24
LISN	COM-Power	LI-125A	i00446	3/18/24	3/18/26
LISN	COM-Power	LI-125A	i00448	3/18/24	3/18/26
MXE EMI receiver	Keysight	N9038A	i00552	3/1/24	3/1/25
Spectrum Analyzer	Agilent	PSA E4448A	i00688	10/23/23	10/23/24
Preamplifier	Eravant	SBB-0115034019-2F2F-E3	i00722	Verified on: 2/7/24	

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.

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

END OF TEST REPORT