Test Report

Prepared for: Southwest Engineering Concepts

Model: i POP Glove Sensor

Description: Glove Sensor

Serial Number: NA
FCC ID: 2A9WT-CS2
IC ID: 30031-CS2

To

FCC Part 15.519
IC RSS-220 Issue 1

Date of Issue: February 20, 2023

On the behalf of the applicant:

Southwest Engineering Concepts
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Attention of:

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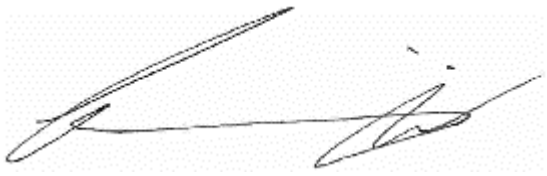
Project No: p22c0009
Test Result - Pass



John Michalowicz
Project Test Engineer

Test Results Summary

FCC 15.519 Specification	RSS-220 Specification	Test Name	Pass, Fail, N/A	Comments
15.519(b)	Section 4.1	10dBc Bandwidth	Pass	
15.519(a)	Section 5.3	Cessation Time	Pass	
15.519(e),	Section 4.1	Maximum Peak Power	Pass	
15.519(c)	Section 4.1	Maximum Average Emission	Pass	
15.519(c)	Sections 3.4	Radiated Emissions	Pass	
15.519(d)	Section 4.1	Emissions in the 1164 – 1240 MHz and 1559 – 1610 MHz	Pass	
15.207	RSS-GEN Section 8.8	A/C Powerline Conducted Emissions	N/A	EUT cannot transmit while charging

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 F	Ultra-Wideband Operation
ANSI C63.10-2013	American National standard for testing Unlicensed Wireless Devices
ISO/IEC 17025:2005	General requirements for the Competence of Testing and Calibrations Laboratories
KDB 393764 D01 v02r01	ULTRA-WIDEBAND (UWB) DEVICES FREQUENTLY ASKED QUESTIONS

Test Report Revision History

Revision	Date	Revised By	Reason for Revision
1.0	2/20/2023	John Michalowicz	Original Document
2.0	6/14/2023	John Michalowicz	Updated additional information section to include frequency band. Updated 10 dBc BW section. Included GPS band measurement 15.519(d)

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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

Non-accredited tests contained in this report:

N/A

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)**
21.2 – 23.4	24.1 – 37.8	966 - 976

EUT Description
Model: Glove Sensor
Description: Sensor placed on Glove
Firmware: v1
Software: N/A
Serial Number: N/A
Additional Information:
The EUT is a companion device to the Wrist Sensor. The EUT incorporates a UWB transmitter within the 3100 – 10600 MHz range. The EUT uses 1 channel centered at 6.491 GHz. The EUT is an original filing. The EUT incorporates a chip antenna with a peak gain of 6.5 dBi. The antenna gain was provided by the manufacturer.

EUT Operation during Tests
The EUT is in normal operating condition. A second sensor is used as a companion device and a cell phone with the manufacturer's app is used to enable the UWB transmission.

Accessories:

Qty	Description	Manufacturer	Model	S/N
1	Cell phone	Apple	NA	NA
1	Field sensor	Southwest Engineering	Wrist Sensor	NA

Cables: None

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

10dBc bandwidth

Engineer: John Michalowicz

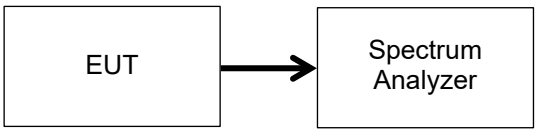
Test Date: 1/17/23

Test Procedure

For the purpose of this subpart, the UWB bandwidth is the frequency band bounded by the points that are 10 dB below the highest radiated emission, as based on the complete transmission system including the antenna. The upper boundary is designated f_H and the lower boundary is designated f_L. The frequency at which the highest radiated emission occurs is designated f_M.
The EUT was connected directly to a spectrum analyzer. The Spectrum Analyzer was set to the following:

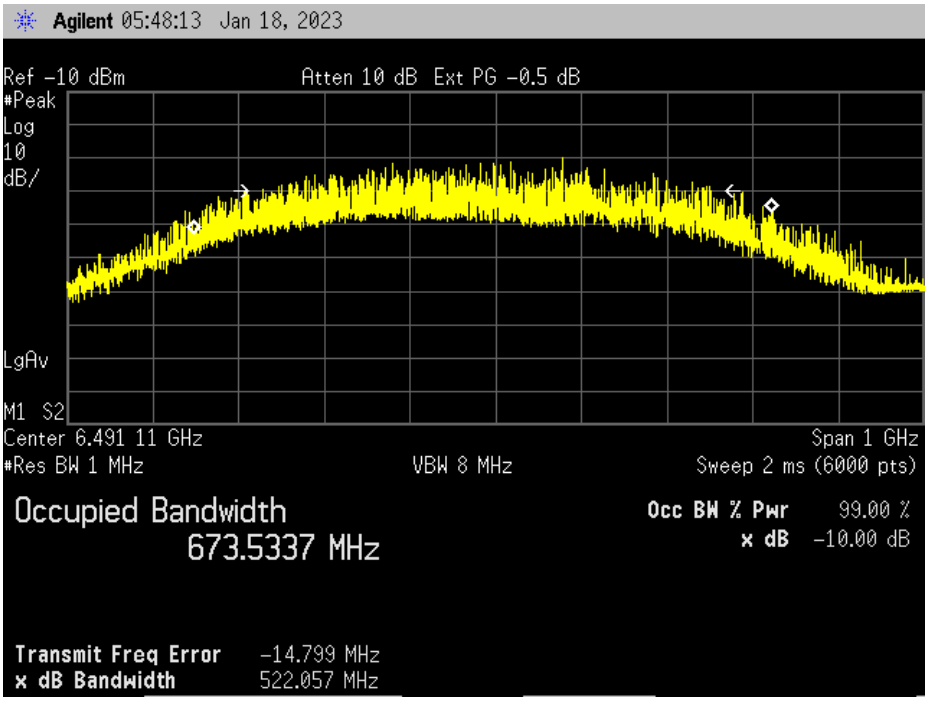
a) Set the RBW : 1 MHz
b) Set VBW ≥ [3 × RBW].
c) Set span ≥ [3 × RBW].
d) Sweep time = auto couple.
e) Detector = peak.
f) Trace mode = max hold.

Test Setup



Transmitter Output Power

Tuned Frequency (MHz)	Measured Value (MHz)	Specification Limit	Result
6491	522	500 MHz	Pass



10 dB bandwidth

$f_{L\ (GHz)}$	$F_{H\ (GHz)}$	$f_{m\ (GHz)}$	10 dBc BW (MHz)
6.23011	6.75211	6.49111	522

Cessation Time

Engineer: John Michalowicz

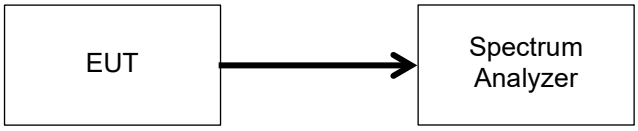
Test Date: 1/18/23

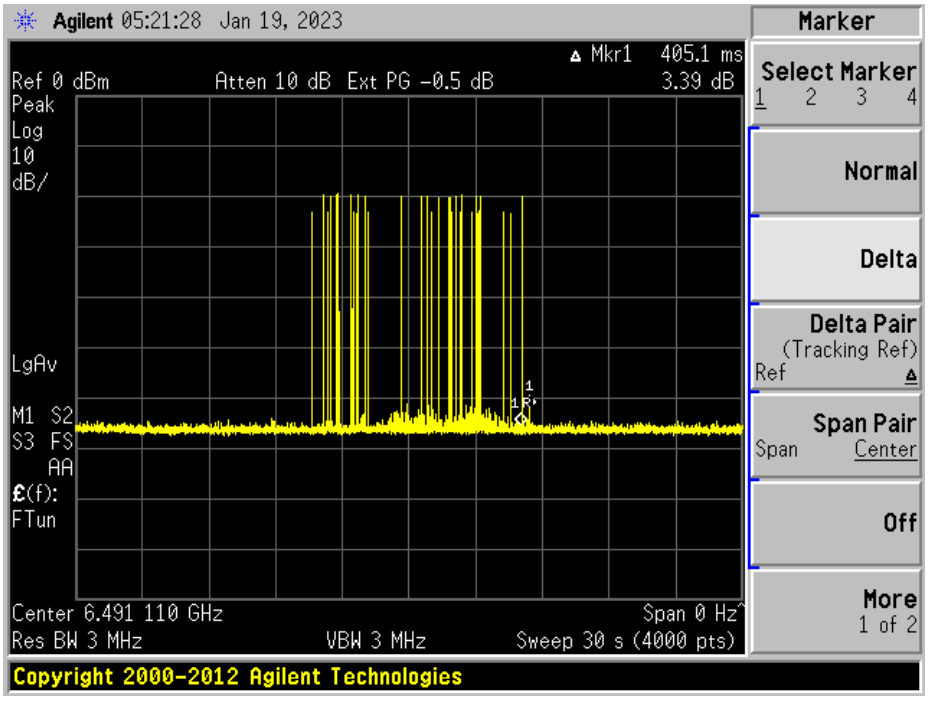
A UWB device operating under the provisions of this section shall transmit only when it is sending information to an associated receiver. The UWB intentional radiator shall cease transmission within 10 seconds unless it receives an acknowledgement from the associated receiver that its transmission is being received. An acknowledgment of reception must continue to be received by the UWB intentional radiator at least every 10 seconds or the UWB device must cease transmitting.

The EUT was connected directly to a spectrum analyzer. The Spectrum Analyzer was set to the following:

a) Set the RBW : 3 MHz
b) Set VBW : 3 MHz
c) Set span: 0 Span
d) Sweep time = 30 s
e) Detector = peak.
f) Trace mode = max hold.

Test Setup





Note: 1R represents the EUT when the UWB stops receiving and Mark 1 shows the EUT when transmission ceases.

Peak Power and Maximum Average Emission

Engineer: John Michalowicz

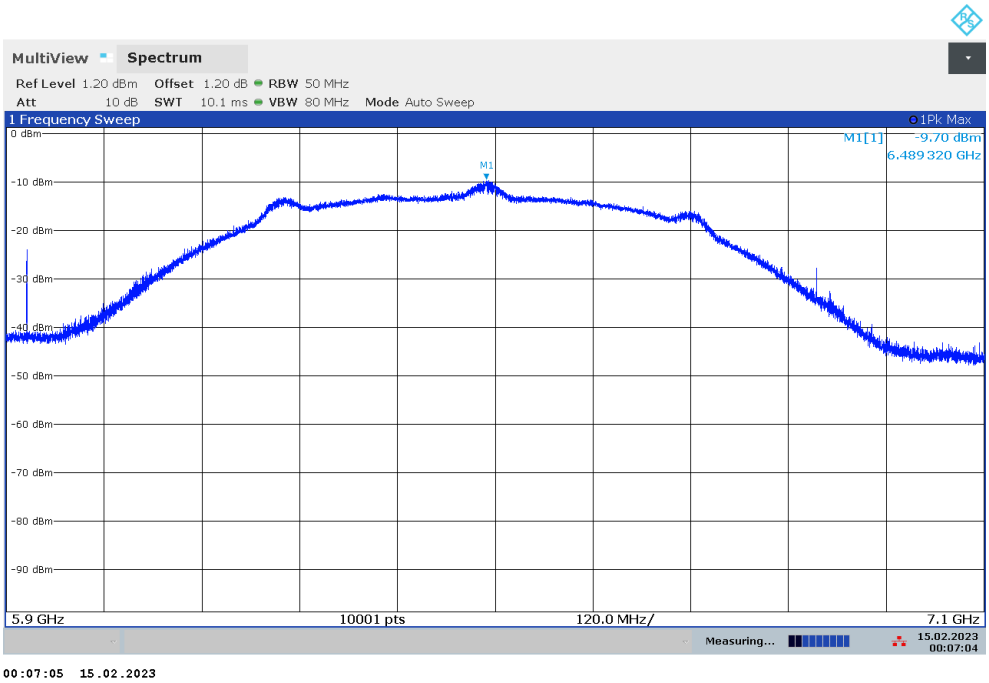
Test Date: 2/16/23

15.519(e)There is a limit on the peak level of the emissions contained within a 50 MHz bandwidth centered on the frequency at which the highest radiated emission occurs, f_M. That limit is 0 dBm EIRP. It is acceptable to employ a different resolution bandwidth, and a correspondingly different peak emission limit, following the procedures described in § 15.521.

15.519(c)The radiated emissions at or below 960 MHz from a device operating under the provisions of this section shall not exceed the emission levels in § 15.209. The radiated emissions above 960 MHz from a device operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz:

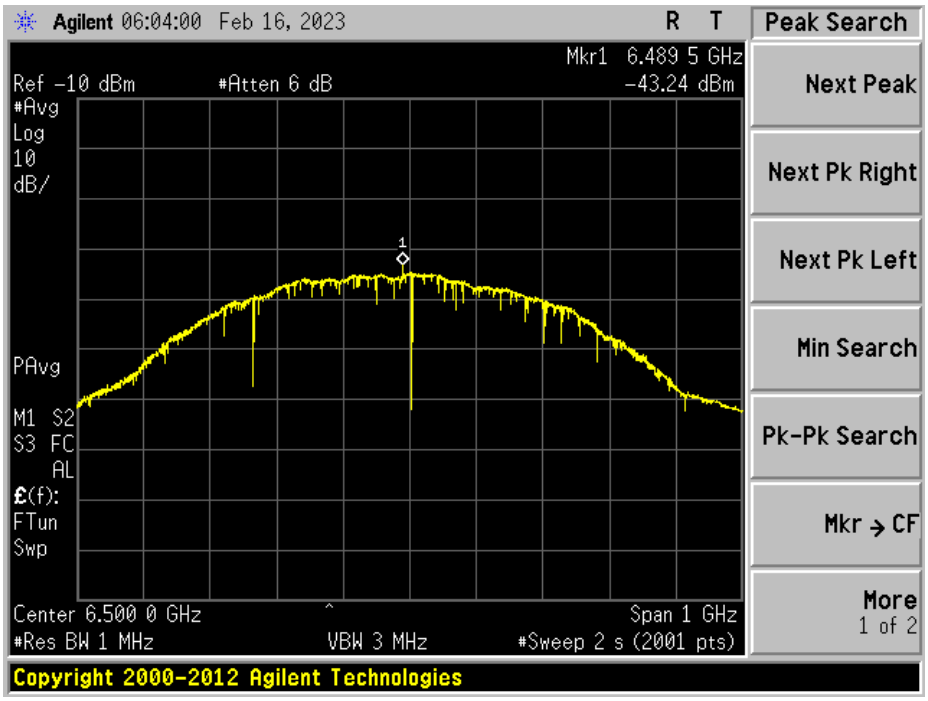
Frequency in MHz	EIRP in dBm
3100 - 10600	-41.3

Peak:
a) Set the RBW : 50 MHz
b) Set VBW : 80 MHz
c) Set span: 1.2 GHz
d) Sweep time = Auto
e) Detector = peak.
f) Trace mode = max hold.
The EUT was measured conducted and the antenna gain (supplied by the manufacturer) was added to the measured power



Peak Power _dBm/50MHz	Antenna Gain (dB)	Peak EIRP _dBm/50MHz	Peak Limit (dBm/50MHz)	Margin (dBm)
-9.7	6.5	-3.2	0	-3.2

Average:
a) Set the RBW to 1 MHz.
b) Set the VBW to 3 MHz
c) Set the frequency span to examine the spectrum across a convenient frequency segment
d) Select the power averaging (rms) detector.
e) Set the sweep time so that there is no more than a 1 ms integration period over each measurement bin.
The EUT was tested in a semi-anechoic chamber at a 3m distance. The turntable and mast were varied to find the highest emission level



Average Emission

AVG EIRP _(dBm)	AVG Limit (dBm)	Margin (dBm)
-43.24	-41.3	-1.94

Radiated Measurements above 960MHz

Engineer: John Michalowicz

Test Date: 2/20/23

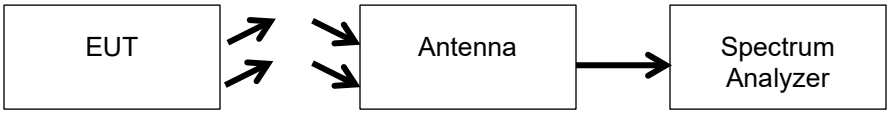
Test Procedure
Radiated Spurious Emissions: 30 – 1000 MHz

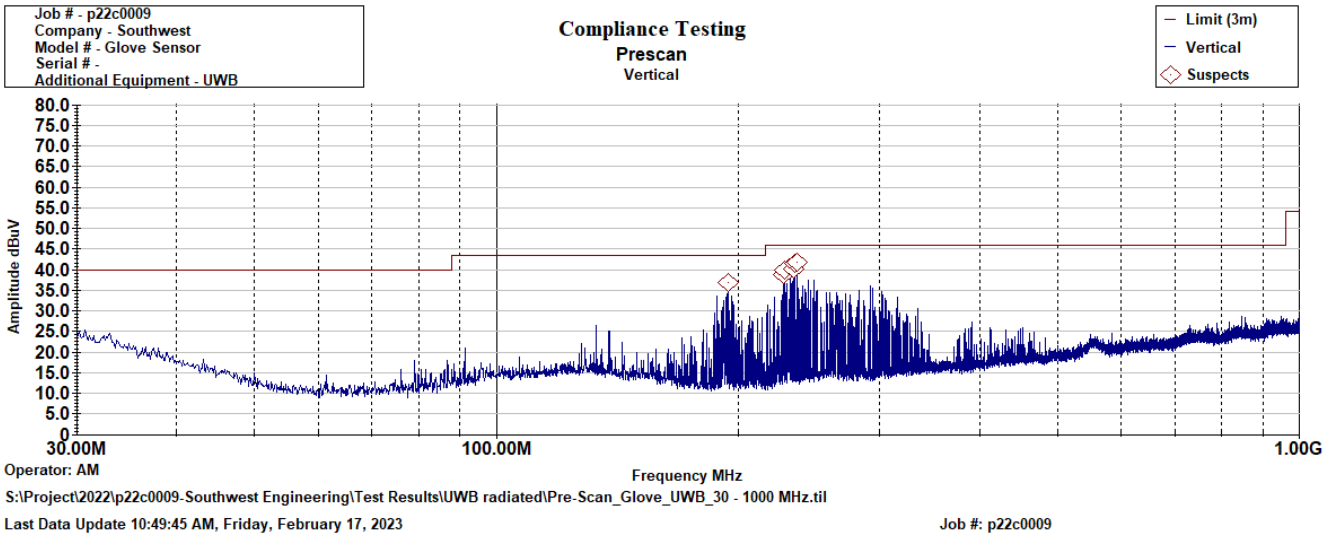
The EUT was setup in a semi-anechoic test chamber set 3m from the receiving antenna. The output of the transmitter was connected to a non-radiating balance load. The EUT was set to transmit on the lowest, middle and highest frequencies at the maximum power level. A spectrum analyzer was used to verify that the EUT met the requirements for Radiated Emissions. 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 emissions from 30 MHz to 1 GHz were examined.
Measured Level includes antenna and receiver cable correction factors.
Correction factors were input into the spectrum analyzer before recording “Measured Level”.

RBW = 100 KHz
VBW = 300 KHz
Detector – Quasi Peak

Test Setup

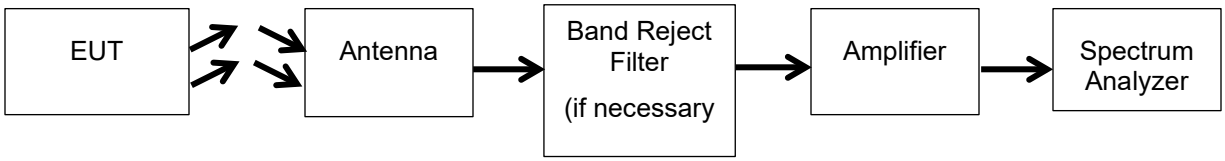


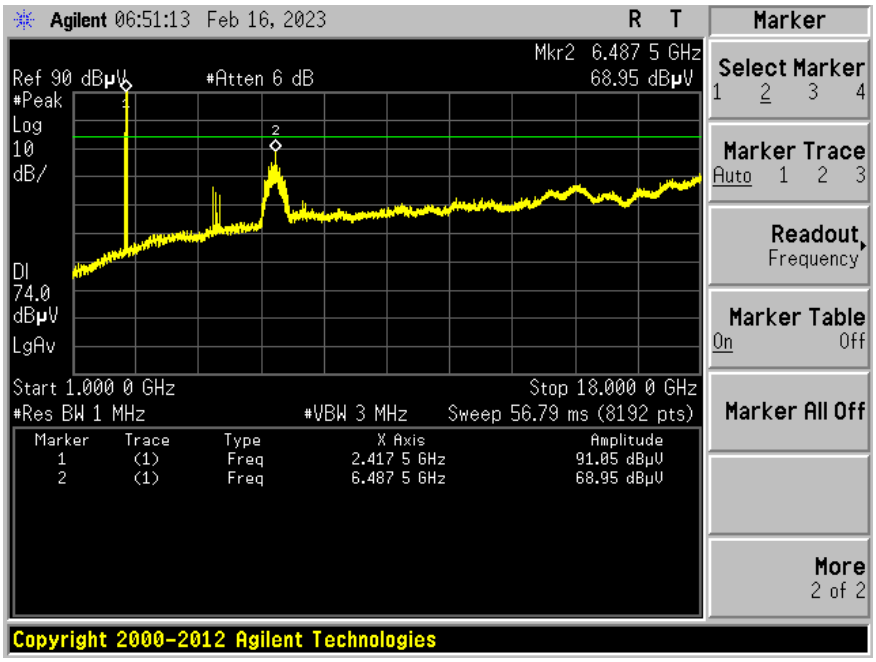


Test Procedure for
Radiated Spurious Emissions above 1 GHz

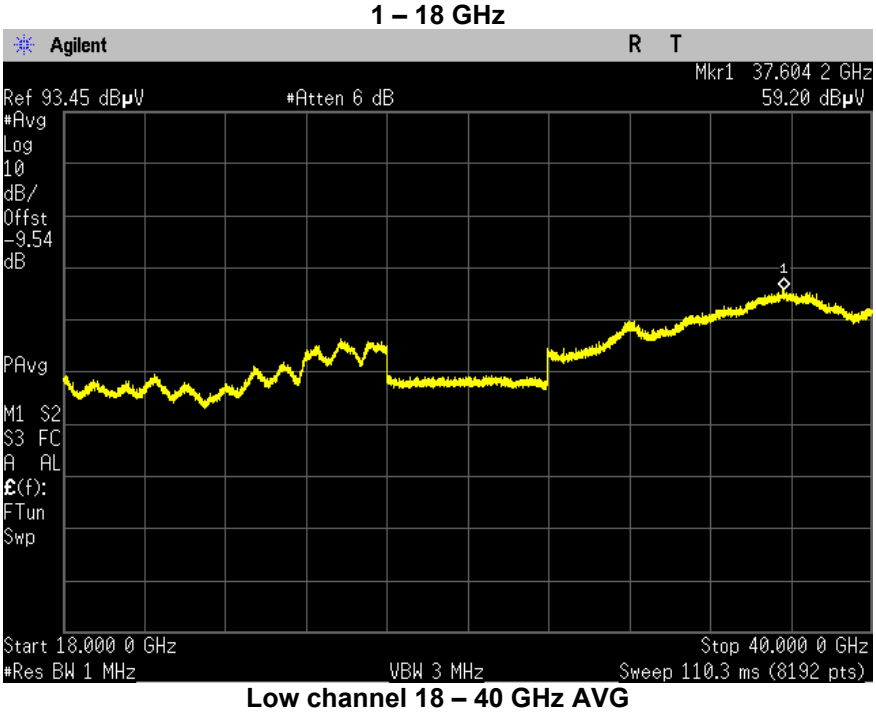
The EUT was setup in a semi-anechoic test chamber set 3m from the receiving antenna. The output of the transmitter was connected to a non-radiating balance load. The EUT was set to transmit on the lowest, middle and highest frequencies at the maximum power level. A spectrum analyzer was used to verify that the EUT met the requirements for Radiated Emissions. 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. No emissions were viewed beyond the 3rd harmonic.

Test Setup



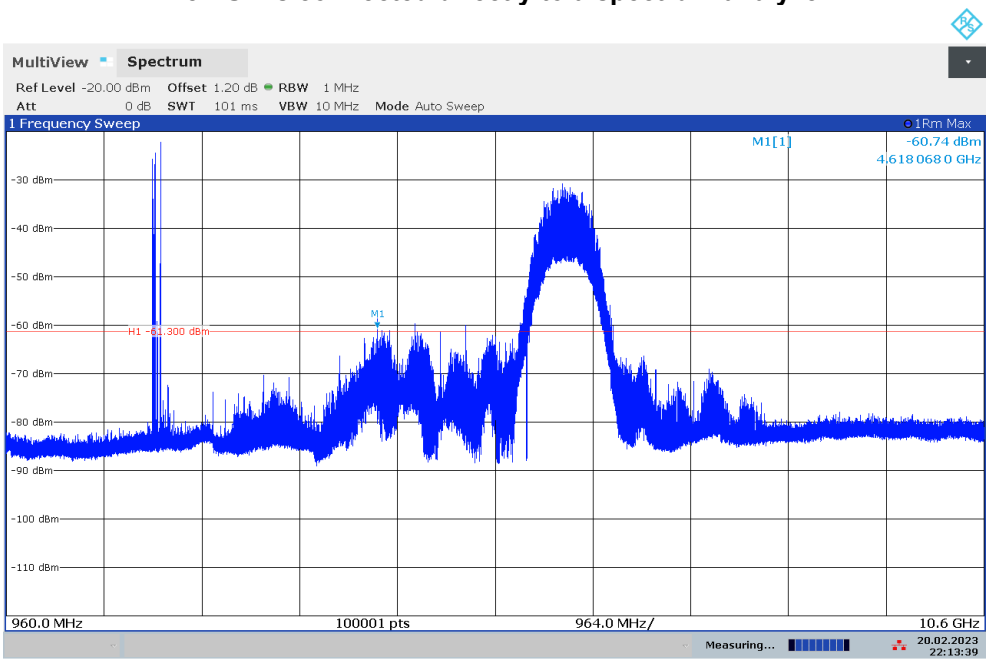


1 – 18 GHz



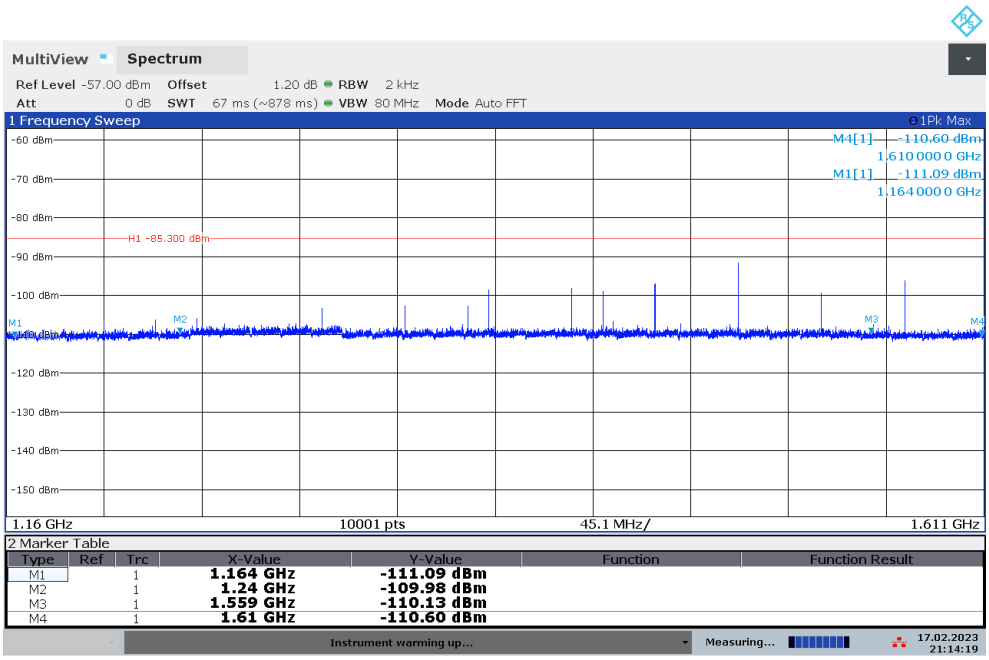
Low channel 18 – 40 GHz AVG

The following plots are retrieved using conducted means.
The EUT is connected directly to a spectrum analyzer.



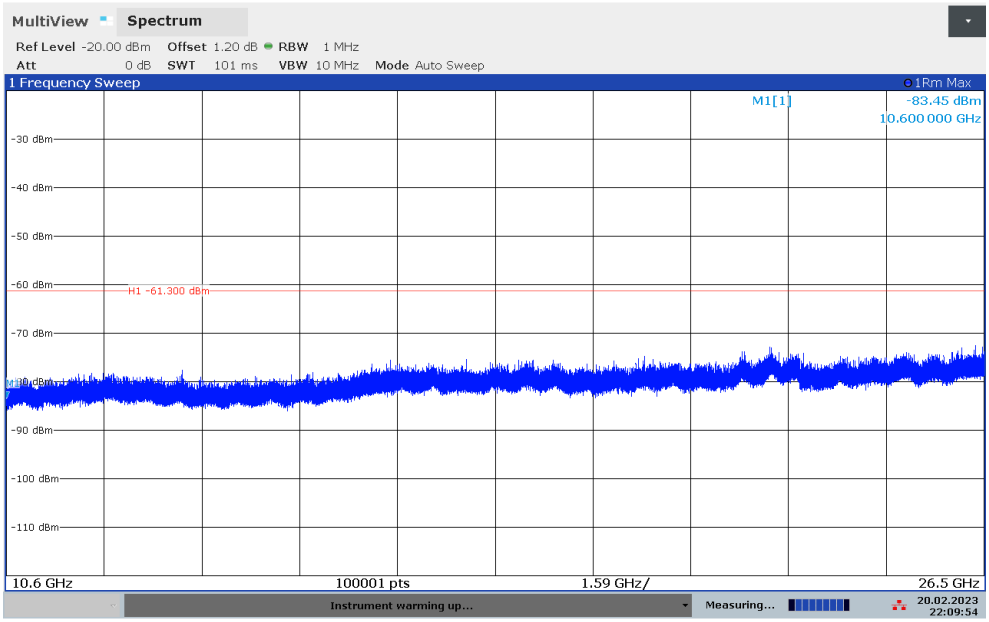
22:13:39 20.02.2023

1 – 10.6 GHz



21:14:19 17.02.2023

1160 – 1611 MHz 15.519(d)



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10 – 26 GHz

Frequency in MHz	EIRP in dBm
960 – 1610	-75.3
1610 – 1990	-63.3
1990 – 3100	-61.3
3100 – 10600	-41.3
Above 10600	-61.3

All emissions are well below the limit in the table above.

Test Equipment Utilized

Description	Manufacturer	Model #	CT Asset #	Last Cal Date	Cal Due Date
Horn Antenna (18-40GHz)	EMCO	3116	i00085	2/22/21	2/22/23
Bi-Log antenna	Chase	CBL6111C	i00267	8/10/22	8/10/24
Horn Antenna	ARA	DRG-118/A	i00271	8/11/22	8/11/24
44GHz EMI receiver	Keysight	N9038A	i00552	2/24/22	2/24/23
3 Meter Semi-Anechoic Chamber	Panashield	3 Meter Semi-Anechoic Chamber	i00428	7/17/20	7/17/23
Preamplifier	Eravant	SBB-0115034018-2F2F-E3	i00650	Verified on: 1/31/23	
Temp./humidity/pressure monitor	Omega Engineering	iBTHX-W-5	i00686	1/5/23	1/5/24
Spectrum Analyzer	Agilent	E4407B	i00687	11/18/22	11/18/23
PSA Spectrum Analyzer	Agilent	E4448A	i00688	11/8/22	11/8/23
Spectrum Analyzer	Rhode & Schwarz	FSW	SN: 102475	7/18/22	7/18/23

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	± 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

END OF TEST REPORT