

Report on the Testing of the Cooper Lighting Solutions Acoustic Ceiling Sensor

In accordance with:
FCC 47 CFR part 15.247
ISED RSS-247 Issue 2, February 2017

Prepared for: Cooper Lighting Solutions
1121 Highway 74 South
Peachtree City, GA - 30269



America

**Add value.
Inspire trust.**

COMMERCIAL-IN-CONFIDENCE

Document Number: AT72198945.2C1

SIGNATURE

NAME	JOB TITLE	RESPONSIBLE FOR	ISSUE DATE
Thierry Jean-Charles	Senior Engineer TUV SUD America Inc.	Authorized Signatory	6/17/2024

Signatures in this approval box have checked this document in line with the requirements of TÜV SÜD America, Inc. document control rules.

FCC Accreditation Designation Number US1233
FCC Test Site Registration Number 967699
Innovation, Science, and Economic Development Canada Lab Code 23932

EXECUTIVE SUMMARY

A sample of this product was tested and found to be compliant with the standards listed above.



A2LA Cert. No. 2955.09

DISCLAIMER AND COPYRIGHT

This non-binding report has been prepared by TÜV SÜD America with all reasonable skill and care. The document is confidential to the potential Client and TÜV SÜD America. No part of this document may be reproduced without the prior written approval of TÜV SÜD America.
© TÜV SÜD.

ACCREDITATION

Our A2LA Accreditation does not cover opinions and interpretations and any expressed are outside the scope of our A2LA Accreditation.

TÜV SÜD America
5945 Cabot Parkway, Suite 100
Alpharetta, GA 3005

Phone: 678-341-5900
www.tuv-sud-america.com

TÜV SÜD

TÜV®



Contents

1	Report Summary	3
1.1	Report Modification Record.....	3
1.2	Introduction.....	3
1.3	Brief Summary of Results	5
1.4	Product Information	6
1.5	Deviations from the Standard.....	8
1.6	EUT Modification Record	8
1.7	Test Location	9
2	Test Details	10
2.1	Antenna Requirement	10
2.2	Power Line Conducted Emissions	11
2.3	Fundamental Emission Output Power.....	14
2.4	6dB / 99% Bandwidth	17
2.5	Maximum Power Spectral Density in the Fundamental Emission	23
2.6	Band-Edge Compliance of RF Conducted Emissions	26
2.7	RF Conducted Spurious Emissions	28
2.8	Radiated Spurious Emissions into Restricted Frequency Bands.....	30
2.9	Test Equipment Used.....	38
3	Diagram of Test Set-ups.....	39
4	Accreditation, Disclaimers and Copyright.....	41



1 Report Summary

1.1 Report Modification Record

Alterations and additions to this report will be issued to the holders of each copy in the form of a complete document.

Table 1.1-1 – Modification Record

Issue	Description of Change	Date of Issue
0	First Issue	6/10/2024
1	Revised the power setting in section 1.4.3	06/17/2024

1.2 Introduction

The purpose of this report is to demonstrate compliance with Part 15 Subpart C of the FCC's Code of Federal Regulations Section 15.247 and Innovation Science and Economic Development Canada's Radio Standards Specification RSS-247 for the tests documented herein.

Applicant	Sreenivas Kalathoor
Manufacturer	Cooper Lighting Solutions
Applicant's Email Address	sreenivas.kalathoor@cooperlighting.com
Model Name	Acoustic Ceiling Sensor
Model Number	OCS-X-D-YY
Serial Number	DC Model unit – P175240600119
FCC ID	2AKCY-OCS-L-P-D
ISED Certification Number	4706A-OCSLPD
Hardware Version(s)	1.0
Software Version(s)	1.0
Number of Samples Tested	1
Test Specification/Issue/Date	US Code of Federal Regulation (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2023 ISED Canada Radio Standards Specification: RSS-247 – Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSS) and License-Exempt Local Area Network (LE-LAN) Devices, Issue 3, August 2023.
Order Number	72198945
Date of Receipt of EUT	4/16/2024
Start of Test	4/17/2024
Finish of Test	5/10/2024



Related Document(s)

ANSI C63.10-2020: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Device.

FCC OET KDB 558074 D01 15.247 Meas Guidance v05r02: Guidance for Compliance Measurements on Digital Transmission System, Frequency Hopping Spread Spectrum System, and Hybrid System Devices Operating under Section 15.247 of the FCC Rules, April 2, 2019

US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures, 2023.

ISED Canada Radio Standards Specification: RSS-GEN – General Requirements for Compliance of Radio Apparatus, Issue 5, Amendment 1 (March 2019), Amendment 2 (February 2021)



1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with FCC Part 15.247 and ISED Canada's RSS-247 is shown below.

Table 1.3-1: Test Result Summary

Test Parameter	Test Plan (Yes/No)	Test Result	FCC 47 CFR Rule Part	ISED Canada's RSS	Test Report Page No
Antenna Requirement	Yes	Pass	15.203	-----	10
6 dB Bandwidth	Yes	Pass	15.247(a)(2)	RSS-247 5.2(a)	17
99% Bandwidth	Yes	Pass	-----	RSS-GEN 6.7	17
Fundamental Emission Output Power	Yes	Pass	15.247(b)(3)	RSS-247 5.4(d)	14
Band-Edge Compliance of RF Conducted Emissions	Yes	Pass	15.247(d)	RSS-247 5.5	26
RF Conducted Spurious Emissions	Yes	Pass	15.247(d)	RSS-247 5.5	28
Radiated Spurious Emissions into Restricted Frequency Bands	Yes	Pass	15.205, 15.209	RSS-GEN 8.9, 8.10	30
Power Spectral Density	Yes	Pass	15.247(e)	RSS-247 5.2(b)	23
AC Power Line Conducted Emissions	Yes	Pass	15.207	RSS-GEN 8.8	11

1.4 Product Information

1.4.1 Technical Description

The Equipment Under Test (EUT) is a dual tech occupancy sensor. It includes 2 model variants: one operates on an AC Power Supply, and the other on a DC Power Supply.

Table 1.4.1-1 – Wireless Technical Information

Detail	Description
FCC ID	2AKCY-OCS-L-P-D
IC ID	4706A-OCSLPD
Transceiver Model #	OCS-X-D-YY
Frequency Range (MHz)	2400 – 2483.5 MHz
Modulation Format	OQPSK
Number of Channels	16
Channel Bandwidth	5 MHz
Data Rates	250 kbps
Operating voltage	24 VDC & 120VAC
Antenna Type / Gain:	DC Model: Isolated Magnetic Dipole / 2.3dBi AC Model: Isolated Magnetic Dipole / 1.6dBi

A full description and detailed product specification details are available from the manufacturer.



Photo 1.4.1-1 – Front view of the DC EUT



Photo 1.4.1-2– Front view of the AC EUT

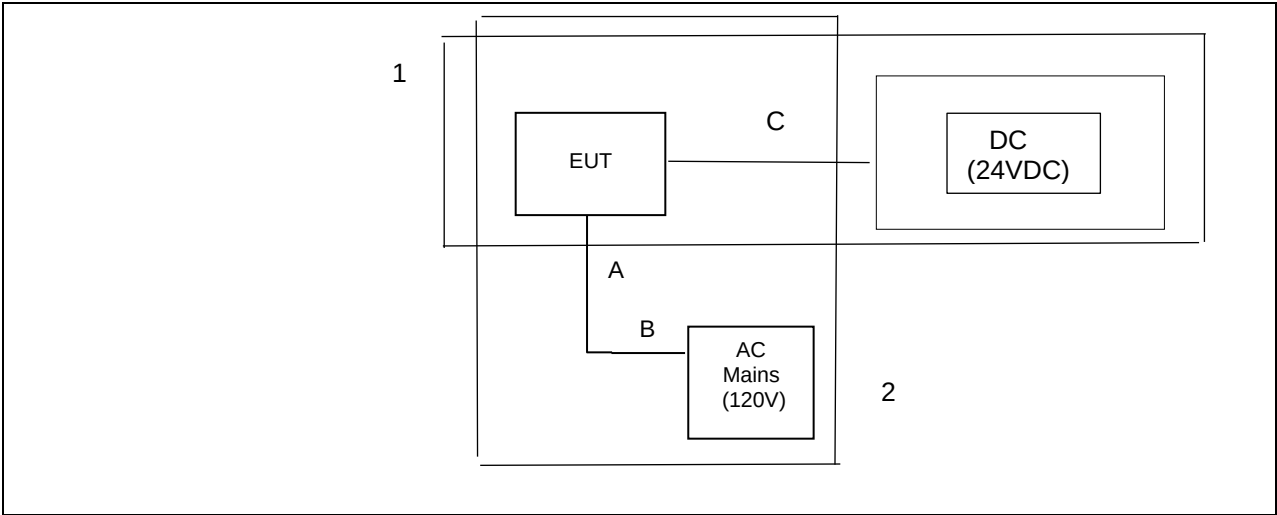


Figure 1.4.1-3: Test Setup Block Diagram

Table 1.4.1-2 – Cable Descriptions

Item	Cable/Port	Length	Shield
A	DC Power cable	20 cm	No
B	AC Power Cord	100 cm	No
C	DC Power cable	20 cm	No

Table 1.4.1-3 – EUT Setup

Item	Make/Model	Description
1	-----	DC Unit Test Setup
2	-----	AC unit Test Setup



1.4.2 Modes of Operation

OCS-X-D-YY model provides 1 mode of operation using Zigbee classifications as outlined below.

Mode of Operation	Frequency Range (MHz)	Number of Channels	Stack / Mode	Data Rates Supported	Classification
1	2400 – 2483.5	16	OQPSK	250 kbps	Zigbee

Note: Radiated pre-scans were conducted on both AC and DC supply units to determine the worst-case with BLE classification. Therefore, full compliance testing was performed on the worst-case scenario, which is the DC supply unit for both BLE and Zigbee and the test results were presented in the following sections.

1.4.3 Monitoring of Performance

For radiated emissions, the EUT was evaluated in three orthogonal orientations. The worst-case orientation was the Z-orientation. See test setup photos for more information. The EUT was programmed to generate a continuously modulated signal on each channel evaluated.

For RF Conducted measurements, the EUT (standalone module) was connected to the test equipment with a temporary antenna port to SMA connector.

Power setting during test: 8 dBm for 2405 MHz, 2440 MHz, and 2475 MHz
0 dBm for 2480 MHz

1.5 Deviations from the Standard

No deviations from the applicable test standard were made during testing.

1.6 EUT Modification Record

The table below details modifications made to the EUT during the test program. The modifications incorporated during each test are recorded on the appropriate test pages.

Modification State	Description of Modification still fitted to EUT	Modification Fitted By	Date Modification Fitted
0	Initial State		

The equipment was tested as provided without any modifications.



1.7 Test Location

TÜV SÜD conducted the following tests at our Alpharetta, GA test laboratory.

Test Name	Name of Engineer(s)	Accreditation
Antenna Requirement	Divya Adusumilli	A2LA
AC Power Line Conducted Emissions	Divya Adusumilli	A2LA
Fundamental Emission Output Power	Divya Adusumilli	A2LA
6dB / 99% Bandwidth	Divya Adusumilli	A2LA
Band-Edge Compliance of RF Conducted Emissions	Divya Adusumilli	A2LA
RF Conducted Spurious Emissions	Divya Adusumilli	A2LA
Radiated Spurious Emissions into Restricted Frequency Bands	Bhagyashree Chaudhary	A2LA
Power Spectral Density	Divya Adusumilli	A2LA

Office address:
TÜV SÜD America
5945 Cabot Parkway, Suite 100
Alpharetta, GA 30005, USA



2 Test Details

2.1 Antenna Requirement

2.1.1 Specification Reference

FCC Section: 15.203, 15.204

2.1.2 Equipment Under Test and Modification State

As shown in §1.4 with modification state "0", as noted in §1.6.

2.1.1 Date of Observation

5/13/2024

2.1.2 Test Method

N/A

2.1.3 Environmental Conditions

N/A

2.1.4 Test Results

The EUT utilizes Isolated Magnetic Dipole antenna with gain of 2.3 dBi for DC Model and 1.6dBi for AC Model which is internal to the enclosure and affixed to the PCB, therefore satisfying the requirements of Section 15.203.



2.2 Power Line Conducted Emissions

2.2.1 Specification Reference

FCC Section: 15.207
ISED Canada: RSS-Gen 8.8

2.2.2 Equipment Under Test and Modification State

As shown in §1.4 with modification state "0", as noted in §1.6.

2.2.3 Date of Test

5/14/2024

2.2.4 Test Method

ANSI C63.10 section 6 was the guiding documents for this evaluation. Conducted emissions were performed from 150kHz to 30MHz with the spectrum analyzer's resolution bandwidth set to 9kHz and the video bandwidth set to 30kHz. The calculation for the conducted emissions is as follows:

Corrected Reading = Analyzer Reading + LISN Loss + Cable Loss
Margin = Corrected Reading - Applicable Limit

2.2.5 Environmental Conditions

The EUT was evaluated within the temperature, humidity and pressure range of the EUT as specified by the standard. The laboratory shall have an ambient temperature range of 15°C to 35°C, relative humidity range of 30% to 60% and atmospheric pressure range of 86 kPa to 106 kPa.

Ambient Temperature 25 °C
Relative Humidity 41 %
Atmospheric Pressure 972.2 mbar

2.2.6 Test Results

Table 2.2.6-1: Conducted EMI Results-Avg – Line 1

Frequency (MHz)	Avg Limit	Avg Level Corrected	Avg Level	Correction Fact.	Avg Margin	Result
0.81	46	34.5	24.8	9.668	-11.5	PASS
1.88	46	34.8	25	9.755	-11.2	PASS
2.02	46	39.3	29.5	9.771	-6.7	PASS
2.14	46	38.4	28.6	9.776	-7.6	PASS
2.28	46	35.8	26	9.781	-10.2	PASS
4.27	46	33.8	24	9.78	-12.2	PASS

**Table 2.2.6-2: Conducted EMI Results-QP – Line 1**

Frequency (MHz)	QP Limit	QP Level Corrected	QP Level	Correction Fact.	QP Margin	Result
0.81	56	37.1	27.4	9.668	-18.9	PASS
1.88	56	38.3	28.5	9.755	-17.7	PASS
2.02	56	42.3	32.6	9.771	-13.7	PASS
2.14	56	42.4	32.6	9.776	-13.6	PASS
2.28	56	39.2	29.4	9.781	-16.8	PASS
4.27	56	38.2	28.4	9.78	-17.8	PASS

Table 2.2.6-3: Conducted EMI Results-Avg – Line 2

Frequency (MHz)	Avg Limit	Avg Level Corrected	Avg Level	Correction Fact.	Avg Margin	Result
1.87	46	34.1	24.3	9.75	-11.9	PASS
2	46	38.8	29	9.76	-7.2	PASS
2.13	46	39.2	29.5	9.763	-6.8	PASS
2.26	46	35.5	25.7	9.765	-10.5	PASS
4.26	46	34.6	24.8	9.8	-11.4	PASS
6.39	50	30.3	20.5	9.82	-19.7	PASS

Table 2.2.6-4: Conducted EMI Results-QP – Line 2

Frequency (MHz)	QP Limit	QP Level Corrected	QP Level	Correction Fact.	QP Margin	Result
1.87	56	37.1	27.4	9.75	-18.9	PASS
2	56	42.3	32.6	9.76	-13.7	PASS
2.13	56	42.6	32.9	9.763	-13.4	PASS
2.26	56	39.2	29.4	9.765	-16.8	PASS
4.26	56	38.7	28.9	9.8	-17.3	PASS
6.39	60	34.8	25	9.82	-25.2	PASS



Figure 2.2.6-1: Conducted Emission Plot – Line 1

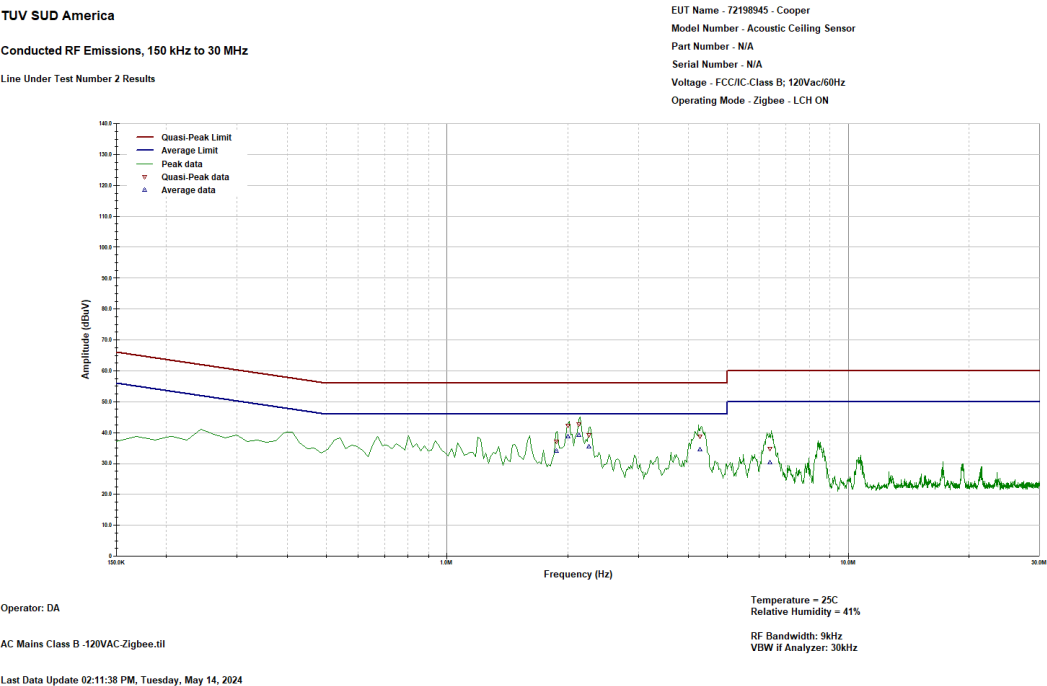
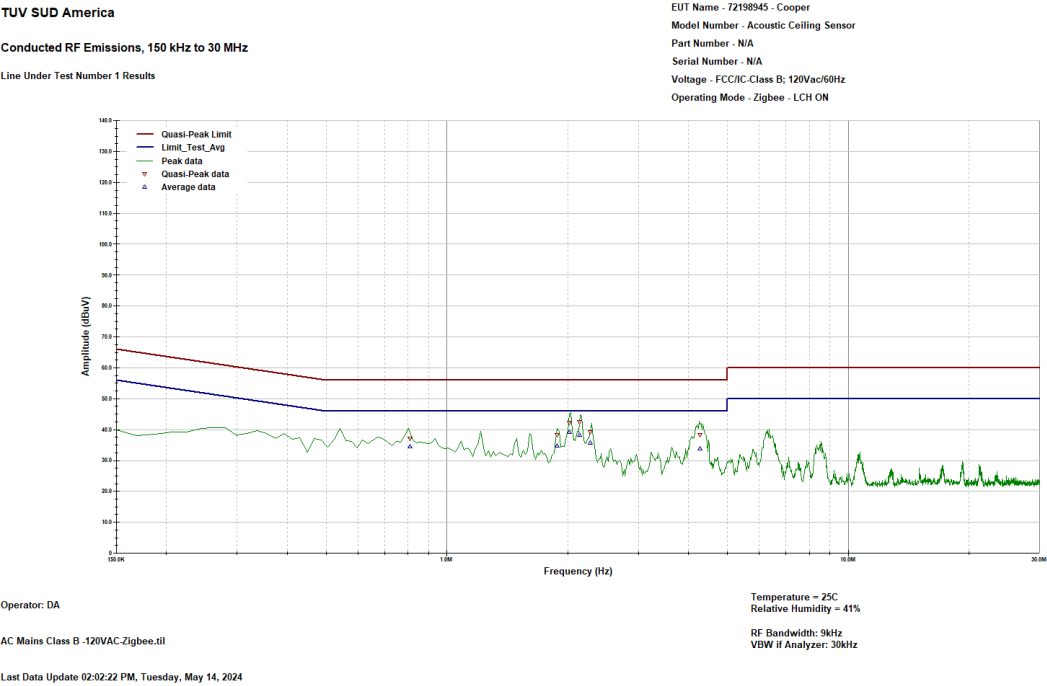


Figure 2.2.6-2: Conducted Emission Plot – Nuetral



2.3 Fundamental Emission Output Power

2.3.1 Specification Reference

FCC Sections: 15.247(b)(3)
ISED Canada: RSS-247 5.4(d)

2.3.2 Equipment Under Test and Modification State

As shown in §1.4 with modification state "0", as noted in §1.6.

2.3.3 Date of Test

5/10/2024

2.3.4 Test Method

The maximum peak conducted output power was measured in accordance with ANSI C63.10 Subclause 11.9.1.1 utilizing the RBW $\geq$ DTS Bandwidth method. The RF output of the equipment under test was directly connected to the input of the analyzer applying suitable attenuation.

2.3.5 Environmental Conditions

The EUT was evaluated within the temperature, humidity and pressure range of the EUT as specified by the standard. The laboratory shall have an ambient temperature range of 15°C to 35°C, relative humidity range of 30% to 60% and atmospheric pressure range of 86 kPa to 106 kPa.

Ambient Temperature	22.3 °C
Relative Humidity	53.8 %
Atmospheric Pressure	972.2 mbar

2.3.6 Test Results

Test Summary: EUT was set to transmit mode.

Test Results: Pass

See data below for detailed results.



Table 2.3.6-1: RF Output Power

Frequency [MHz]	Peak Output Power (dBm)	Data Rate
2405	7.8	250 kbps
2440	7.5	250 kbps
2475	7.7	250 kbps
2480	0.9	250 kbps

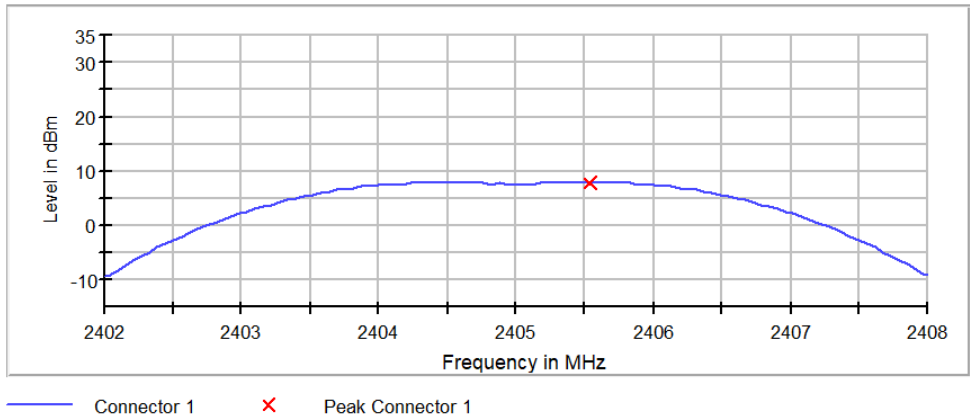


Figure 2.3.6-1: Output Power - LCH

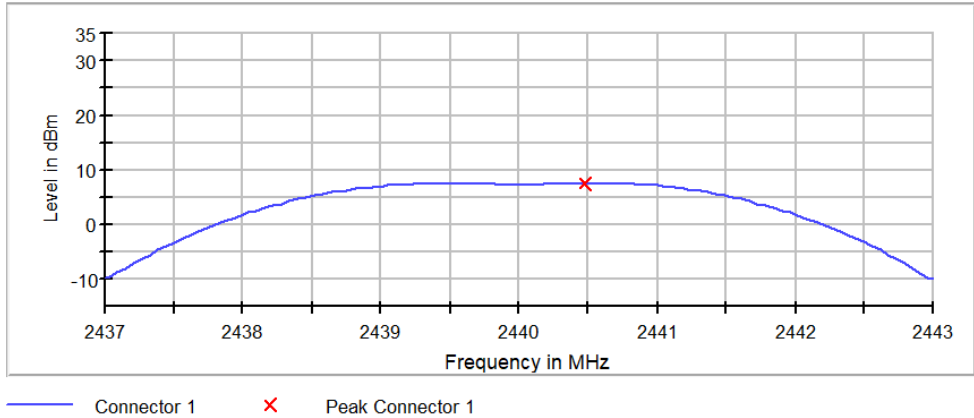


Figure 2.3.6-2: Output Power - MCH

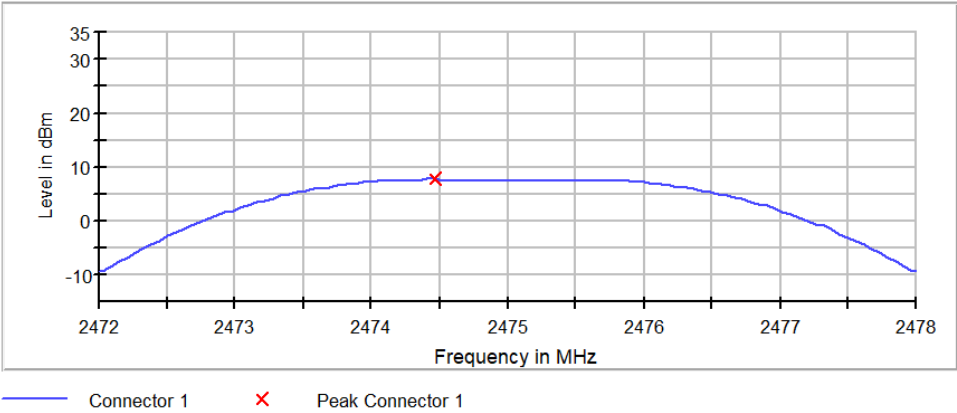


Figure 2.3.6-3: Output Power - HCH – 2475 MHz

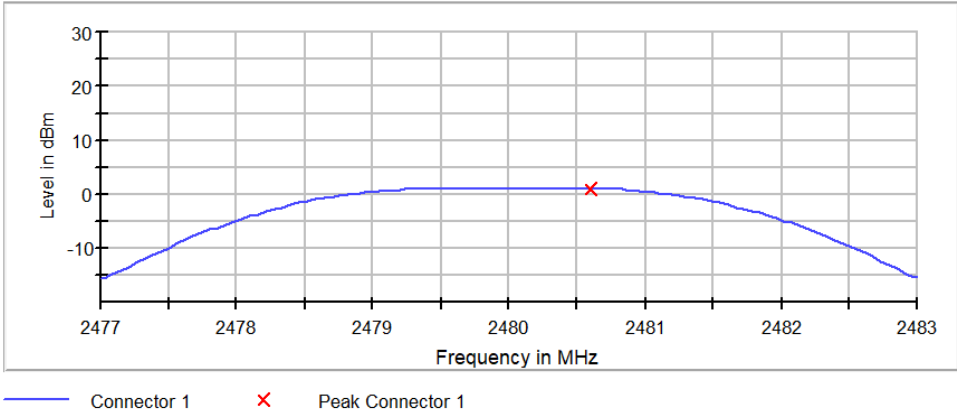


Figure 2.3.6-4: Output Power - HCH – 2480 MHz

Table 2.3.6-2: Sample Measurement Settings

Setting	Instrument Value	Target Value
Start Frequency	2.40200 GHz	2.40200 GHz
Stop Frequency	2.40800 GHz	2.40800 GHz
Span	6.000 MHz	6.000 MHz
RBW	2.000 MHz	>= 1.743 MHz
VBW	10.000 MHz	>= 6.000 MHz
Sweep Points	101	~ 101
Sweep time	953.450 ns	AUTO
Reference Level	20.000 dBm	20.000 dBm
Attenuation	40.000 dB	AUTO
Detector	MaxPeak	MaxPeak
Sweep Count	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweep type	FFT	AUTO
Preamp	off	off
Stable mode	Trace	Trace
Stable value	0.50 dB	0.50 dB
Run	4 / max. 150	max. 150
Stable	3 / 3	3
Max Stable Difference	0.03 dB	0.50 dB



2.4 6dB / 99% Bandwidth

2.4.1 Specification Reference

FCC Sections: 15.247(a)(2)
ISED Canada: RSS-247 5.2(a), RSS-GEN 6.7

2.4.2 Equipment Under Test and Modification State

As shown in §1.4 with modification state "0", as noted in §1.6.

2.4.3 Date of Test

5/10/2024

2.4.4 Test Method

The 6dB bandwidth was measured in accordance with the ANSI C63.10 Section 11.8. The Resolution Bandwidth (RBW) of the spectrum analyzer was set to 100 kHz. The Video Bandwidth (VBW) was set to ≥ 3 times the RBW. The trace was set to max hold with a peak detector active. The marker-delta function of the spectrum analyzer was utilized to determine the 6 dB bandwidth of the emission.

The occupied bandwidth measurement function of the spectrum analyzer was used to measure the 99% bandwidth. The span of the analyzer was set to capture all products of the modulation process, including the emission sidebands. The resolution bandwidth was set to 1% to 5% of the occupied bandwidth. The video bandwidth was set to 3 times the resolution bandwidth. A peak detector was used.

2.4.5 Environmental Conditions

The EUT was evaluated within the temperature, humidity and pressure range of the EUT as specified by the standard. The laboratory shall have an ambient temperature range of 15°C to 35°C, relative humidity range of 30% to 60% and atmospheric pressure range of 86 kPa to 106 kPa.

Ambient Temperature	22.3 °C
Relative Humidity	53.8 %
Atmospheric Pressure	972.2 mbar

2.4.6 Test Results

Test Summary: EUT was set to transmit mode.

Test Results: Pass

See data below for detailed results.



Table 2.4.6-1: 6dB / 99% Bandwidth

Frequency [MHz]	6dB Bandwidth (MHz)	99% Bandwidth (MHz)	Data Rate
2405	1.743	2.21	250 kbps
2440	1.703	2.22	250 kbps
2475	1.703	2.22	250 kbps
2480	1.663	2.22	250 kbps

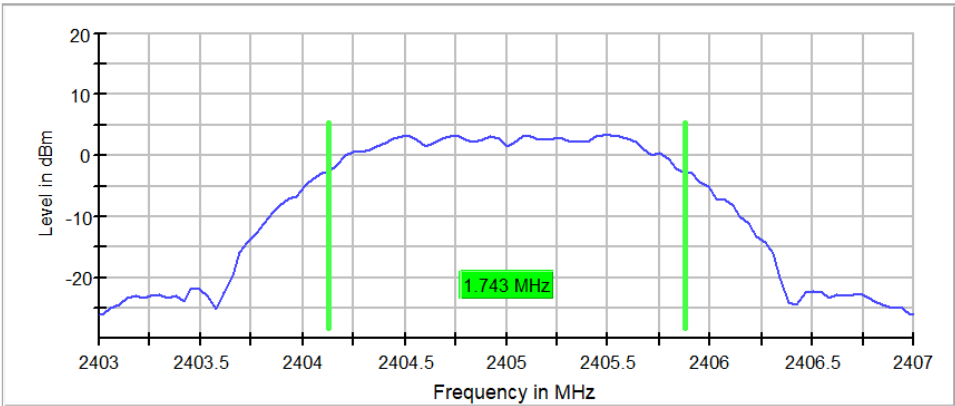


Figure 2.4.6-1: 6 dB BW - LCH

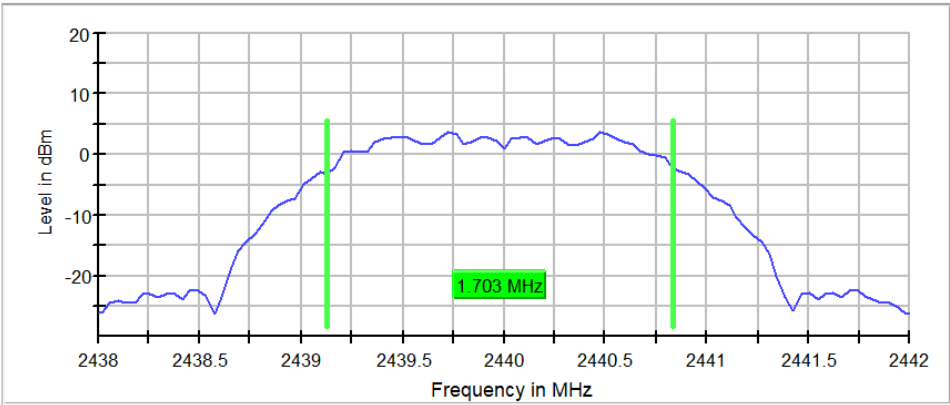


Figure 2.4.6-2: 6 dB BW - MCH

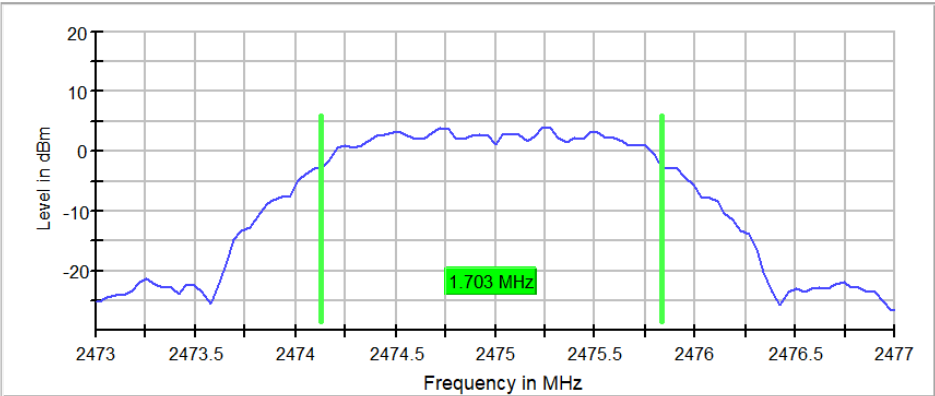


Figure 2.4.6-3: 6 dB BW - HCH – 2475 MHz

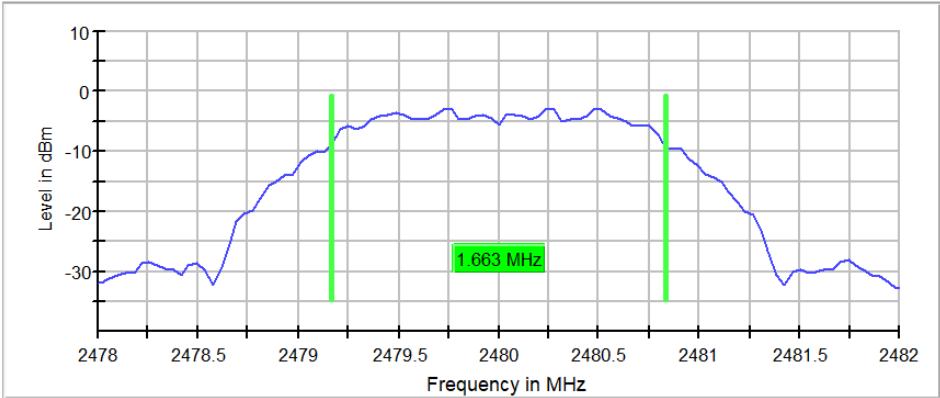


Figure 2.4.6-4: 6 dB BW - HCH – 2480 MHz

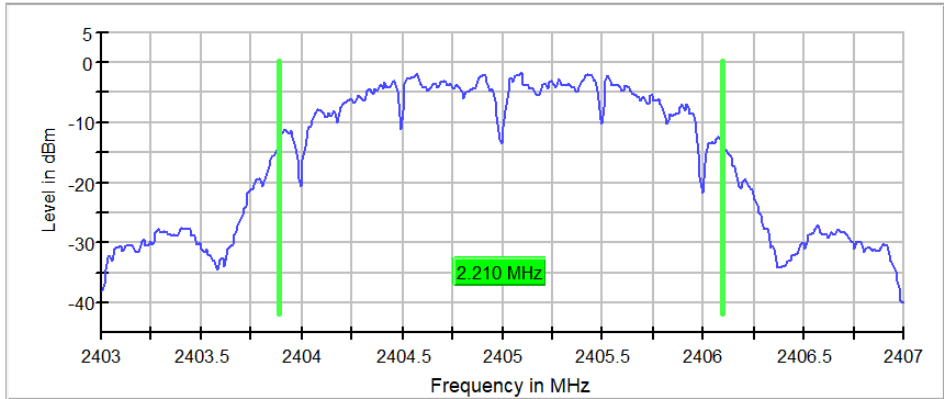


Figure 2.4.6-5: 99% BW - LCH

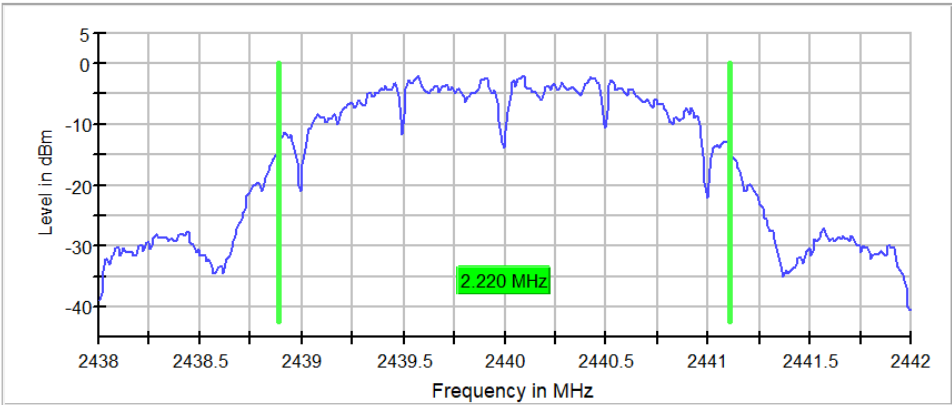


Figure 2.4.6-6: 99% BW - MCH

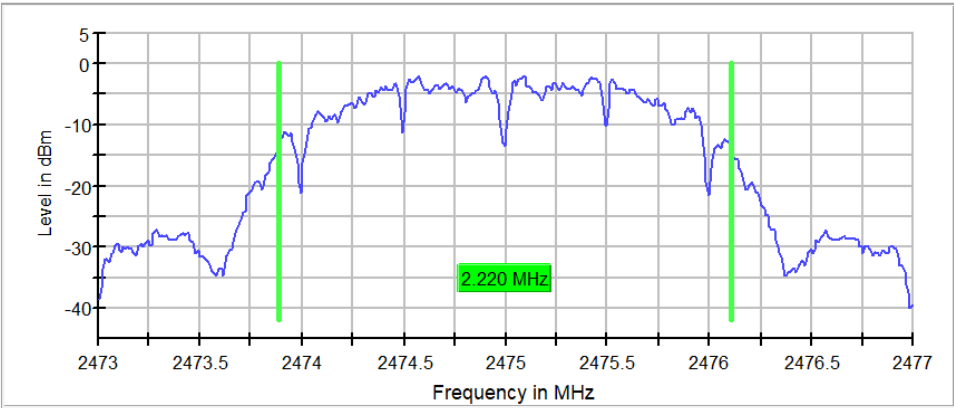


Figure 2.4.6-7: 99% BW - HCH - 2475 MHz

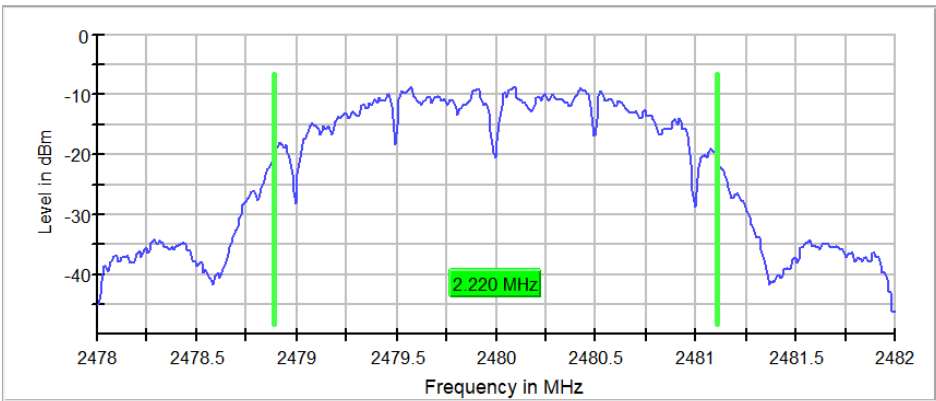


Figure 2.4.6-8: 99% BW - HCH – 2480 MHz

**Table 2.4.6-2: Sample Measurement Setting (6dB BW)**

Setting	Instrument Value	Target Value
Start Frequency	2.40300 GHz	2.40300 GHz
Stop Frequency	2.40700 GHz	2.40700 GHz
Span	4.000 MHz	4.000 MHz
RBW	100.000 kHz	~ 100.000 kHz
VBW	300.000 kHz	~ 300.000 kHz
Sweep Points	101	~ 80
Sweep time	18.938 μ s	AUTO
Reference Level	10.000 dBm	10.000 dBm
Attenuation	30.000 dB	AUTO
Detector	MaxPeak	MaxPeak
Sweep Count	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweep type	FFT	AUTO
Preamp	off	off
Stable mode	Trace	Trace
Stable value	0.50 dB	0.50 dB
Run	14 / max. 150	max. 150
Stable	5 / 5	5
Max Stable Difference	0.18 dB	0.50 dB

**Table 2.4.6-3: Sample Measurement Setting (99% BW)**

Setting	Instrument Value	Target Value
Start Frequency	2.40300 GHz	2.40300 GHz
Stop Frequency	2.40700 GHz	2.40700 GHz
Span	4.000 MHz	4.000 MHz
RBW	20.000 kHz	>= 20.000 kHz
VBW	100.000 kHz	>= 60.000 kHz
Sweep Points	400	~ 400
Sweep time	94.824 μ s	AUTO
Reference Level	10.000 dBm	10.000 dBm
Attenuation	30.000 dB	AUTO
Detector	MaxPeak	MaxPeak
Sweep Count	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweep type	FFT	AUTO
Preamp	off	off
Stable mode	Trace	Trace
Stable value	0.30 dB	0.30 dB
Run	16 / max. 150	max. 150
Stable	3 / 3	3
Max Stable Difference	0.12 dB	0.30 dB



2.5 Maximum Power Spectral Density in the Fundamental Emission

2.5.1 Specification Reference

FCC Sections: 15.247(e)
ISED Canada: RSS-247 5.2(b)

2.5.2 Equipment Under Test and Modification State

As shown in §1.4 with modification state "0", as noted in §1.6.

2.5.3 Date of Test

5/10/2024

2.5.4 Test Method

The power spectral density was measured in accordance with the ANSI C63.10 Section 11.10.2. The RF output of the equipment under test was directly connected to the input of the spectrum analyzer applying suitable attenuation. The Resolution Bandwidth (RBW) of the spectrum analyzer was set to 10 kHz. The Video Bandwidth (VBW) was set to 30 kHz. Span was set to 1.5 times the channel bandwidth. The trace was set to max hold with the peak detector active.

2.5.5 Environmental Conditions

The EUT was evaluated within the temperature, humidity and pressure range of the EUT as specified by the standard. The laboratory shall have an ambient temperature range of 15°C to 35°C, relative humidity range of 30% to 60% and atmospheric pressure range of 86 kPa to 106 kPa.

Ambient Temperature	22.3 °C
Relative Humidity	53.8 %
Atmospheric Pressure	972.2 mbar

2.5.6 Test Results

Test Summary: EUT was set to transmit mode.

Test Results: Pass

See data below for detailed results.



Table 2.5.6-1: RF Power Spectral Density

Frequency [MHz]	PSD (dBm)	Data Rate
2405	-3.233	250 kbps
2440	-3.482	250 kbps
2475	-3.440	250 kbps
2480	-10.268	250 kbps

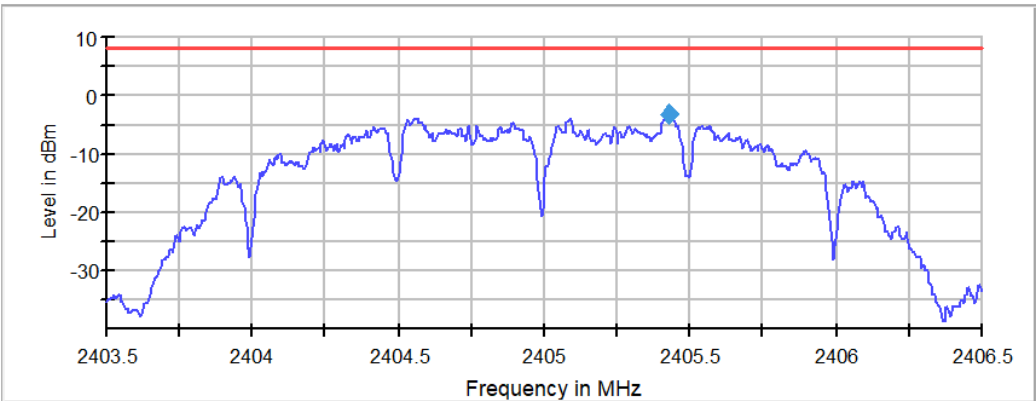


Figure 2.5.6-1: PSD – LCH

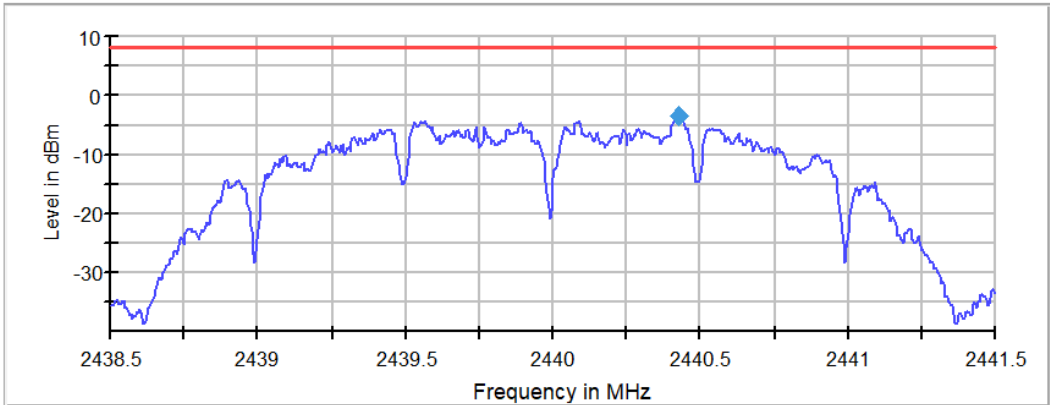


Figure 2.5.6-2: PSD – MCH

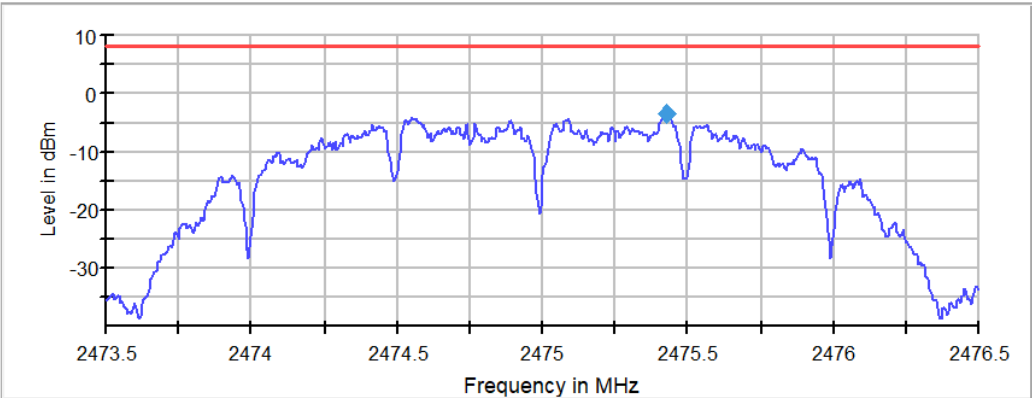


Figure 2.5.6-3: PSD – HCH – 2475 MHz

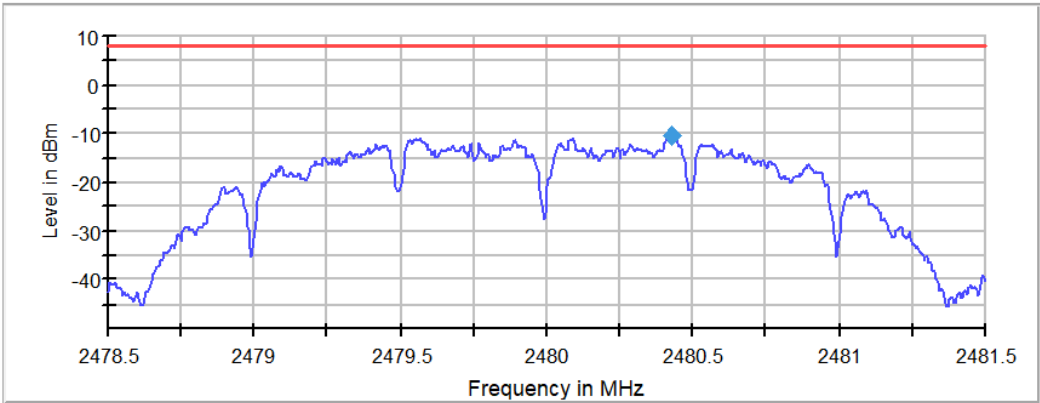


Figure 2.5.6-4: PSD – HCH – 2480 MHz

Table 2.5.6-2: Sample Measurement Settings (PSD)

Setting	Instrument Value	Target Value
Start Frequency	2.40350 GHz	2.40350 GHz
Stop Frequency	2.40650 GHz	2.40650 GHz
Span	3.000 MHz	3.000 MHz
RBW	10.000 kHz	<= 10.000 kHz
VBW	30.000 kHz	>= 30.000 kHz
Sweep Points	600	~ 600
Sweep time	3.000 ms	AUTO
Reference Level	10.000 dBm	10.000 dBm
Attenuation	30.000 dB	AUTO
Detector	MaxPeak	MaxPeak
Sweep Count	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweep type	Sweep	Sweep
Preamp	off	off
Stable mode	Trace	Trace
Stable value	0.50 dB	0.50 dB
Run	12 / max. 150	max. 150
Stable	2 / 2	2
Max Stable Difference	0.26 dB	0.50 dB



2.6 Band-Edge Compliance of RF Conducted Emissions

2.6.1 Specification Reference

FCC Sections: 15.247(d)
ISED Canada: RSS-247 5.5

2.6.2 Equipment Under Test and Modification State

As shown in §1.4 with modification state “0”, as noted in §1.6.

2.6.3 Date of Test

5/10/2024

2.6.4 Test Method

The unwanted emissions into non-restricted bands were measured conducted in accordance with ANSI C63.10 Section 11.11. The RF output of the equipment under test was directly connected to the input of the spectrum analyzer applying suitable attenuation. The Resolution Bandwidth (RBW) of the spectrum analyzer was set to 100 kHz. The Video Bandwidth (VBW) was set to ≥ 300 kHz. The resulting spectrum analyzer peak level was used to determine the reference level with respect to the 20 dBc limit at the band edges. Environmental Conditions

The EUT was evaluated within the temperature, humidity and pressure range of the EUT as specified by the standard. The laboratory shall have an ambient temperature range of 15°C to 35°C, relative humidity range of 30% to 60% and atmospheric pressure range of 86 kPa to 106 kPa.

Ambient Temperature	22.3 °C
Relative Humidity	53.8 %
Atmospheric Pressure	972.2 mbar

2.6.5 Test Results

Test Summary: EUT was set to transmit mode.

Test Results: Pass

See data below for detailed results.

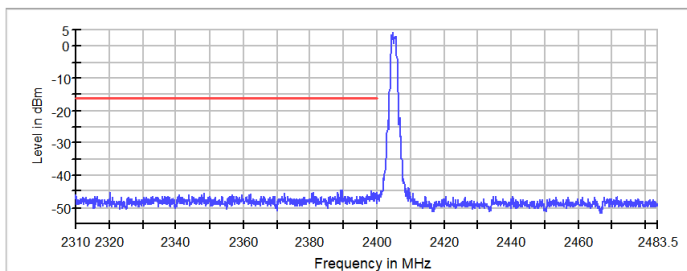


Figure 2.6.6-1: Lower Band-edge

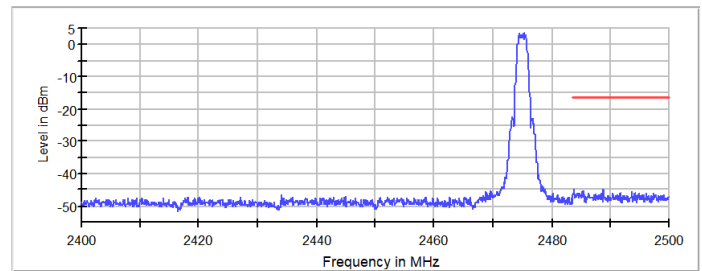


Figure 2.6.6-2: Upper Band-edge – 2475 MHz



Table 2.6.6-1: Lower Band-edge- Low Channel

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2389.325000	-44.7	28.8	-15.8	PASS
2398.275000	-44.9	29.1	-15.8	PASS
2389.375000	-44.9	29.1	-15.8	PASS
2398.325000	-45.1	29.2	-15.8	PASS
2320.475000	-45.2	29.3	-15.8	PASS
2399.925000	-45.2	29.4	-15.8	PASS
2399.025000	-45.3	29.4	-15.8	PASS
2388.225000	-45.3	29.4	-15.8	PASS
2389.275000	-45.4	29.5	-15.8	PASS
2320.425000	-45.4	29.5	-15.8	PASS
2398.975000	-45.5	29.6	-15.8	PASS
2348.425000	-45.5	29.7	-15.8	PASS
2380.775000	-45.6	29.7	-15.8	PASS
2380.425000	-45.6	29.8	-15.8	PASS
2399.625000	-45.6	29.8	-15.8	PASS

Table 2.6.6-2: Upper Band-edge – High Channel – 2475 MHz

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2483.775000	-44.9	28.6	-16.4	PASS
2488.775000	-45.0	28.7	-16.4	PASS
2488.825000	-45.1	28.7	-16.4	PASS
2485.375000	-45.1	28.8	-16.4	PASS
2485.325000	-45.3	28.9	-16.4	PASS
2483.725000	-45.4	29.1	-16.4	PASS
2483.825000	-45.4	29.1	-16.4	PASS
2493.675000	-45.7	29.4	-16.4	PASS
2493.625000	-45.8	29.4	-16.4	PASS
2485.275000	-45.8	29.4	-16.4	PASS
2484.475000	-45.8	29.5	-16.4	PASS
2496.075000	-45.9	29.5	-16.4	PASS
2484.425000	-45.9	29.6	-16.4	PASS
2488.425000	-46.0	29.6	-16.4	PASS
2485.225000	-46.0	29.6	-16.4	PASS

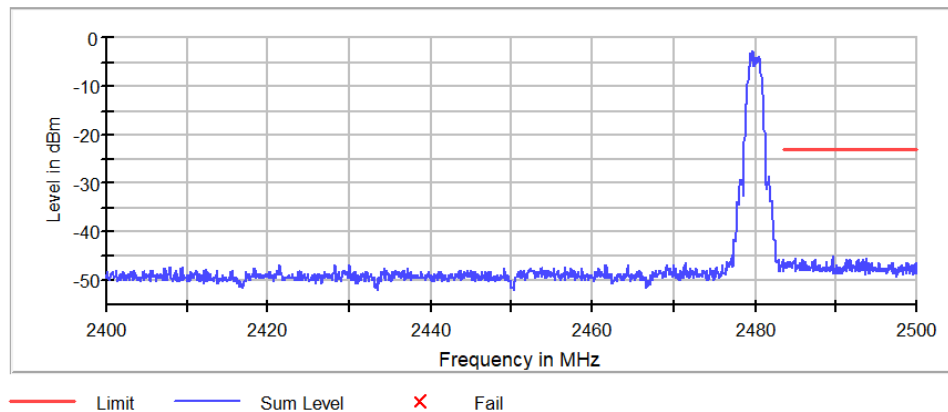


Figure 2.6.6-3: Upper Band-edge – 2480MHz

Table 2.6.6-3: Upper Band-edge- 2480 MHz

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2489.675000	-44.9	22.0	-22.9	PASS
2484.925000	-45.5	22.6	-22.9	PASS
2493.775000	-45.5	22.6	-22.9	PASS
2484.975000	-45.5	22.6	-22.9	PASS
2492.725000	-45.6	22.7	-22.9	PASS
2491.475000	-45.7	22.8	-22.9	PASS
2491.425000	-45.7	22.8	-22.9	PASS
2485.925000	-45.7	22.8	-22.9	PASS
2483.625000	-45.8	22.9	-22.9	PASS
2489.625000	-45.8	22.9	-22.9	PASS
2487.375000	-45.8	22.9	-22.9	PASS
2493.475000	-45.8	22.9	-22.9	PASS
2491.875000	-45.9	22.9	-22.9	PASS
2491.825000	-45.9	23.0	-22.9	PASS
2489.725000	-45.9	23.0	-22.9	PASS



2.7 RF Conducted Spurious Emissions

2.7.1 Specification Reference

FCC Sections: 15.247(d)
ISED Canada: RSS-247 5.5

2.7.2 Equipment Under Test and Modification State

As shown in §1.4 with modification state "0", as noted in §1.6.

2.7.3 Date of Test

5/10/2024

2.7.4 Test Method

The unwanted emissions into non-restricted bands were measured conducted in accordance with ANSI C63.10 Section 11.11. The RF output of the equipment under test was directly connected to the input of the spectrum analyzer applying suitable attenuation. The Resolution Bandwidth (RBW) of the spectrum analyzer was set to 100 kHz. The Video Bandwidth (VBW) was set to ≥ 300 kHz. The resulting spectrum analyzer peak level was used to determine the reference level with respect to the 20 dBc limit at the band edges. The spectrum span was then adjusted for the measurement of spurious emissions from 30MHz to 26GHz, 10 times the highest fundamental frequency.

2.7.5 Environmental Conditions

The EUT was evaluated within the temperature, humidity and pressure range of the EUT as specified by the standard. The laboratory shall have an ambient temperature range of 15°C to 35°C, relative humidity range of 30% to 60% and atmospheric pressure range of 86 kPa to 106 kPa.

Ambient Temperature	22.3 °C
Relative Humidity	53.8 %
Atmospheric Pressure	972.2 mbar

2.7.6 Test Results

Test Summary: EUT was set to transmit mode.

Test Results: Pass

See data below for detailed results.

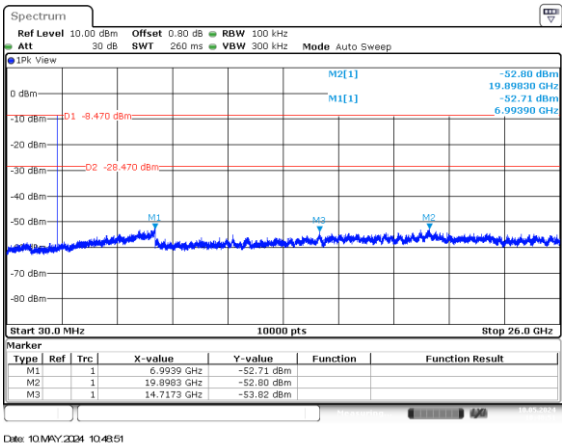


Figure 2.7.6-1: 30MHz – 26GHz – LCH – 2405 MHz

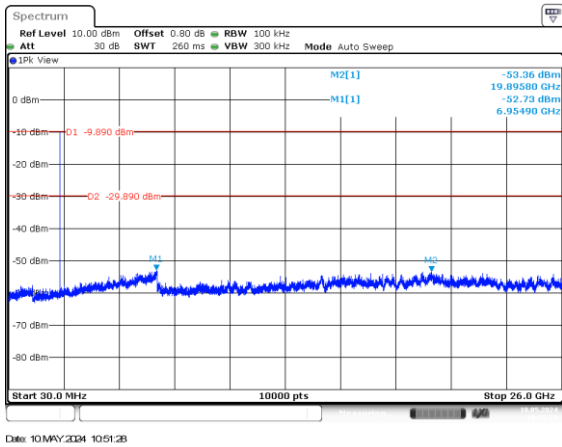


Figure 2.7.6-2: 30MHz – 26GHz – MCH – 2440 MHz

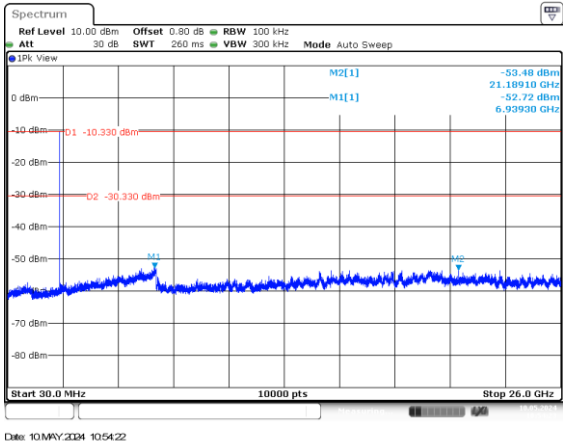


Figure 2.7.6-3: 30MHz – 26GHz – HCH – 2475 MHz

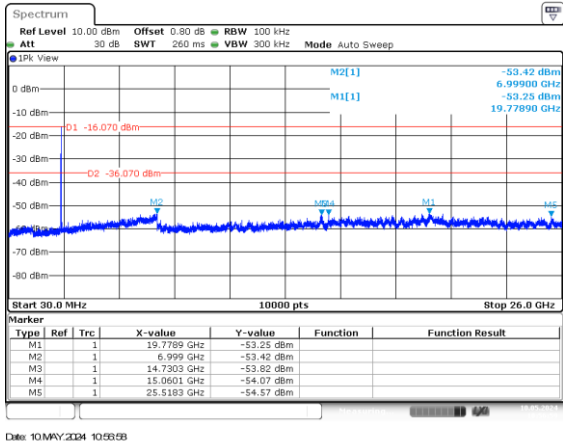


Figure 2.7.6-4: 30MHz – 26GHz – HCH – 2480 MHz



2.8 Radiated Spurious Emissions into Restricted Frequency Bands

2.8.1 Specification Reference

FCC Sections: 15.205, 15.209.
ISED Canada RSS – Gen 8.9/8.10

2.8.2 Equipment Under Test and Modification State

As shown in §1.4 with modification state “0”, as noted in §1.6.

2.8.3 Date of Test

05/06/2024 to 05/08/2024

2.8.4 Test Method

Radiated emissions tests were made over the frequency range of 9 kHz to 26 GHz, 10 times the highest fundamental frequency of 2.4 GHz. Each emission found to be in a restricted band as defined by section 15.205, including any emission at the operational band-edge, was compared to the radiated emission limits as defined in Section 15.209.

The EUT was rotated through 360° and the receive antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected. For frequencies below 150 kHz, quasi-peak measurements were made using a resolution bandwidth RBW of 300 Hz and a video bandwidth VBW of 1 kHz and frequencies between 150 kHz and 30MHz, quasi-peak measurements were made using a resolution bandwidth RBW of 10 kHz and a video bandwidth VBW of 30 kHz. For frequencies between 30 MHz and 1000 MHz, quasi-peak measurements were made using a resolution bandwidth RBW of 100 kHz and a video bandwidth VBW of 300 kHz. For frequencies above 1000 MHz, peak and average measurements were made with RBW of 1 MHz and VBW of 3 MHz

2.8.5 Environmental Conditions

The EUT was evaluated within the temperature, humidity and pressure range of the EUT as specified by the standard. The laboratory shall have an ambient temperature range of 15°C to 35°C, relative humidity range of 30% to 60% and atmospheric pressure range of 86 kPa to 106 kPa.

Ambient Temperature	22.3 °C
Relative Humidity	53.8 %
Atmospheric Pressure	972.2 mbar

2.8.6 Test Results

Test Summary: EUT was set to transmit mode.

Test Results: Pass

See data below for detailed results.

**Table 2.8.6-1: Radiated Spurious Emissions Tabulated Data - DC Power Supply Unit**

Frequency (MHz)	Level (dBuV)		Antenna Polarity (H/V)	Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg		pk	Qpk/Avg	pk	Qpk/Avg
LCH - 2405 MHz							
326.723	----	32.675	H	----	46	----	13.33
383.471	----	39.81	H	----	46	----	6.19
447.875	----	33.701	H	----	46	----	12.3
327.887	----	27.237	V	----	46	----	18.76
364.794	----	29.345	V	----	46	----	16.65
456.776	----	30.997	V	----	46	----	15
590.708	----	27.586	V	----	46	----	18.41
4810.15	49.073	34.457	H	74	54	24.93	19.54
7216.6	56.863	46.074	H	74	54	17.14	7.93
4811.025	49.834	36.744	V	74	54	24.17	17.26
7213.475	58.424	48.117	V	74	54	15.58	5.88
2389.85	44.657	30.594	H	74	54	29.34	23.41
2389.9	44.943	30.548	V	74	54	29.06	23.45
MCH - 2440 MHz							
326.387	----	32.758	H	----	46	----	13.24
394.966	----	40.135	H	----	46	----	5.86
459.028	----	33.744	H	----	46	----	12.26
367.169	----	29.674	V	----	46	----	16.33
459.128	----	31.171	V	----	46	----	14.83
588.115	----	27.692	V	----	46	----	18.31
4879.975	48.89	34.972	H	74	54	25.11	19.03
7321.675	55.764	43.	H	74	54	18.24	10.1
4880.075	50.082	35.323	V	74	54	23.92	18.68
7318.3	58.358	47.723	V	74	54	15.64	6.28
HCH - 2475 MHz							
326.335	----	32.99	H	----	46	----	13.01
383.368	----	38.541	H	----	46	----	7.46
452.917	----	32.846	H	----	46	----	13.15
372.849	----	29.287	V	----	46	----	16.71
453.553	----	29.551	V	----	46	----	16.45
4902.175	49.542	38.867	H	74	54	24.46	5.13
7424.85	51.209	37.152	H	74	54	22.79	16.85
4950.75	48.237	33.482	V	74	54	25.76	20.52



7427.05	51.411	37.212	V	74	54	22.59	16.79
2483.35	49.452	34.33	H	74	54	24.55	19.67
2483.4	47.53	33.725	V	74	54	26.47	20.27
HCH - 2480 MHz							
327.308	----	31.676	H	----	46	----	14.32
384.074	----	37.365	H	----	46	----	8.64
456.415	----	31.816	H	----	46	----	14.18
107.894	----	11.883	V	----	43.5	----	31.62
454.378	----	28.435	V	----	46	----	17.57
588.087	----	26.486	V	----	46	----	19.51
2401.85	47.851	29.69	H	74	54	26.15	24.31
2416.55	44.736	29.695	H	74	54	29.26	24.3
2401.875	44.247	29.648	V	74	54	29.75	24.35
2426.05	46.864	29.93	V	74	54	27.14	24.07
4960.025	48.754	34.427	H	74	54	25.25	19.57
7440.125	51.473	37.189	H	74	54	22.53	16.81
4960.175	48.365	34.019	V	74	54	25.63	19.98
7440.15	51.282	37.18	V	74	54	22.72	16.82
2483.45	54.789	38.995	H	74	54	19.21	15
2483.675	48.401	33.325	V	74	54	25.6	20.68



DC Unit Sample Plots

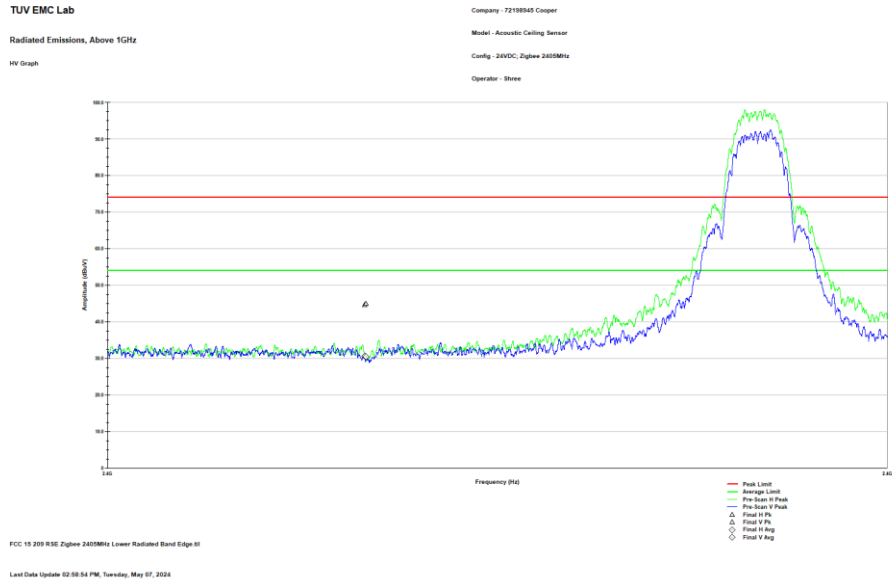


Figure 2.8.6-1: Radiated Lower Band-edge – LCH – 2405 MHz

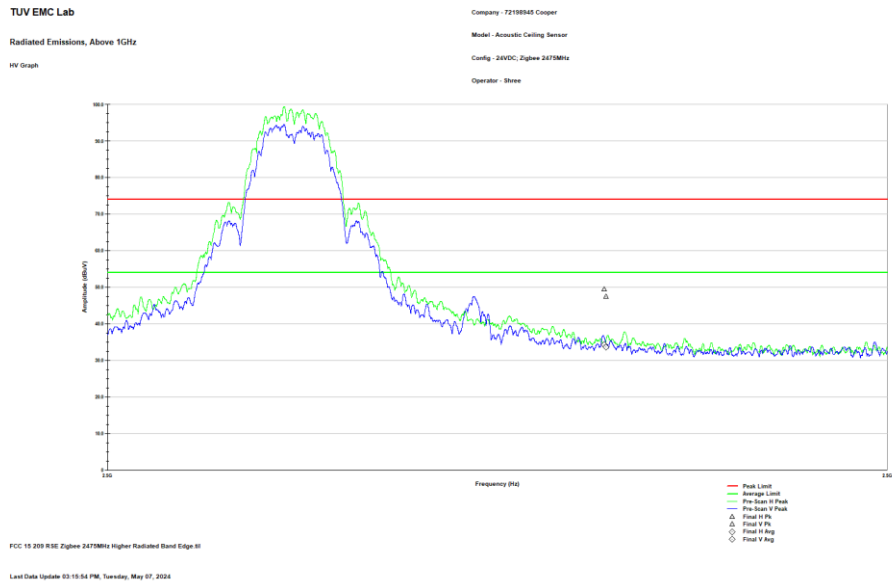
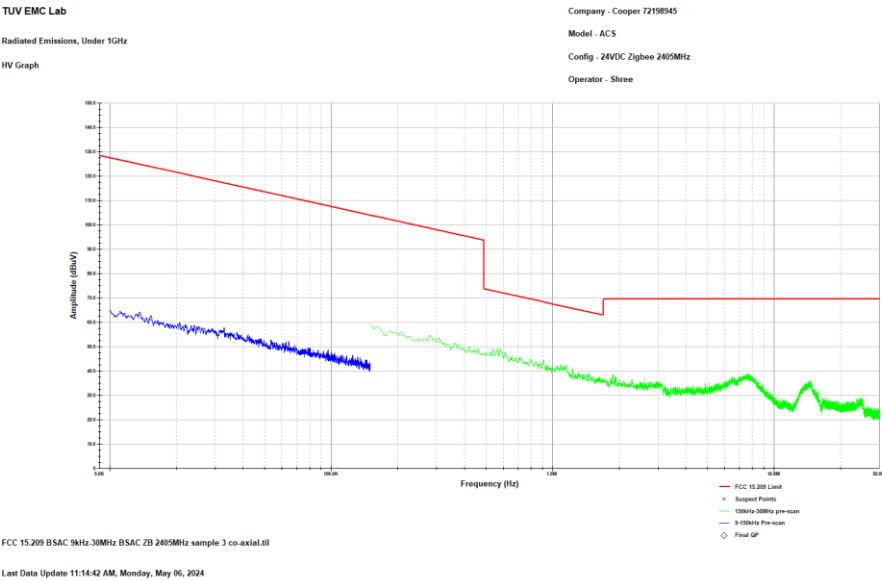
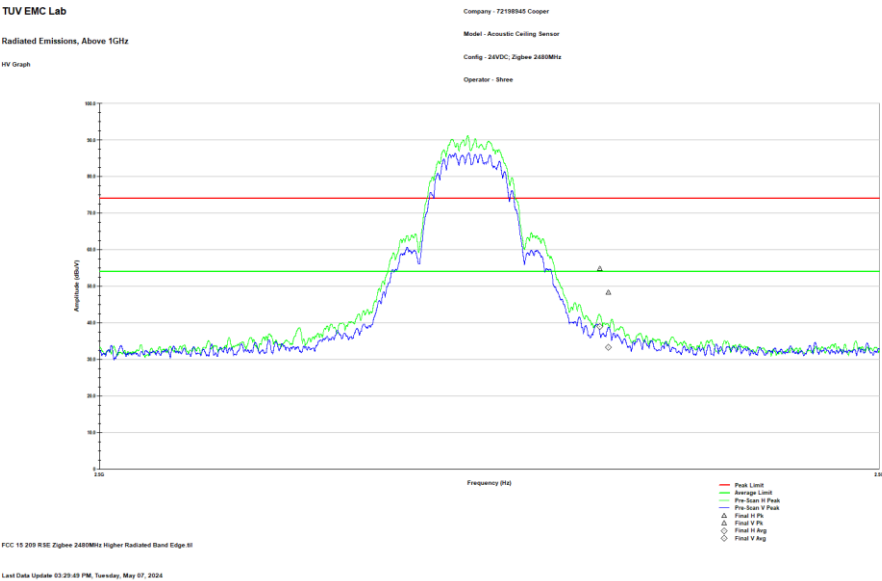


Figure 2.8.6-2: Radiated Upper Band-edge – HCH - 2475 MHz



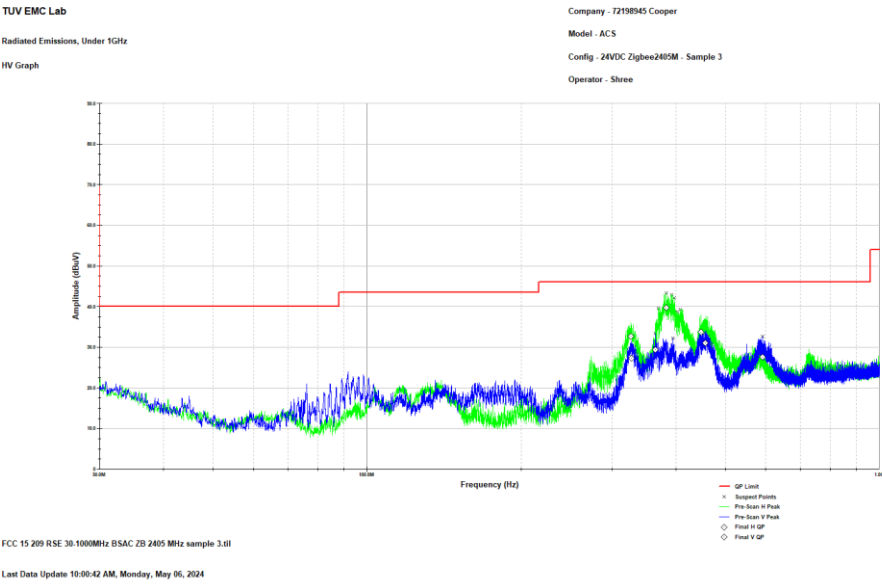


Figure 2.8.6-5: Reference plot for Radiated Spurious Emissions – 30 MHz – 1 GHz
Note: Frequencies that fall under restricted band are only evaluated and reported.

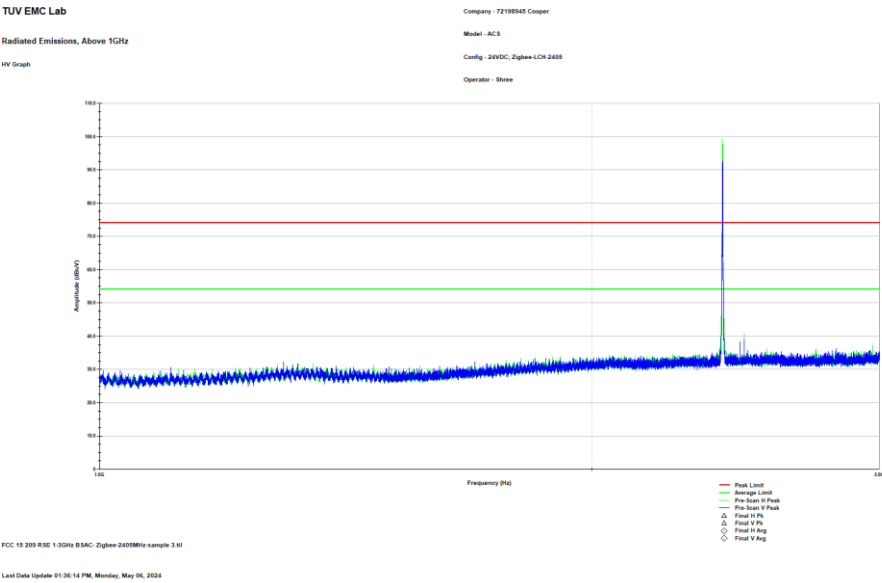


Figure 2.8.6-6: Reference plot for Radiated Spurious Emissions – 1 GHz – 3 GHz
Note: Emission above the limit line is the Fundamental Frequency.

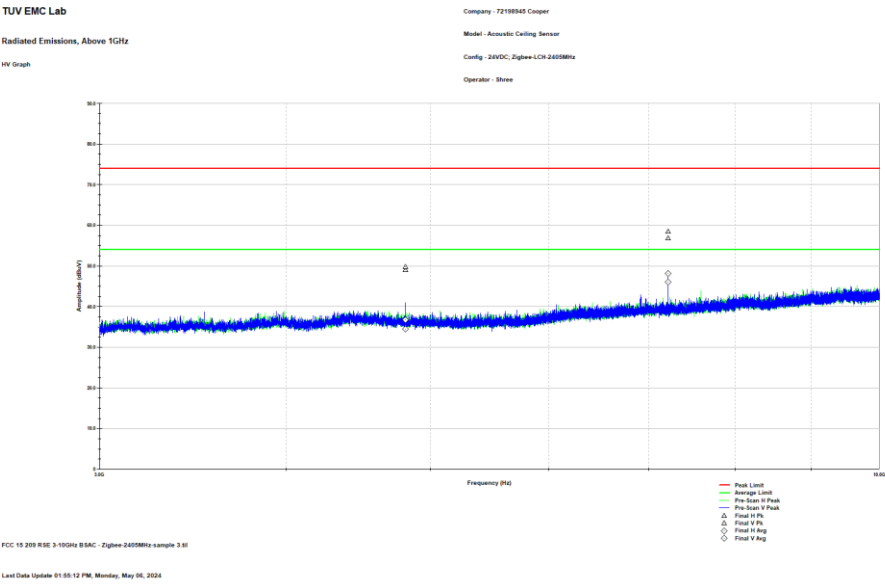


Figure 2.8.6-7: Reference plot for Radiated Spurious Emissions – 3 GHz – 10 GHz

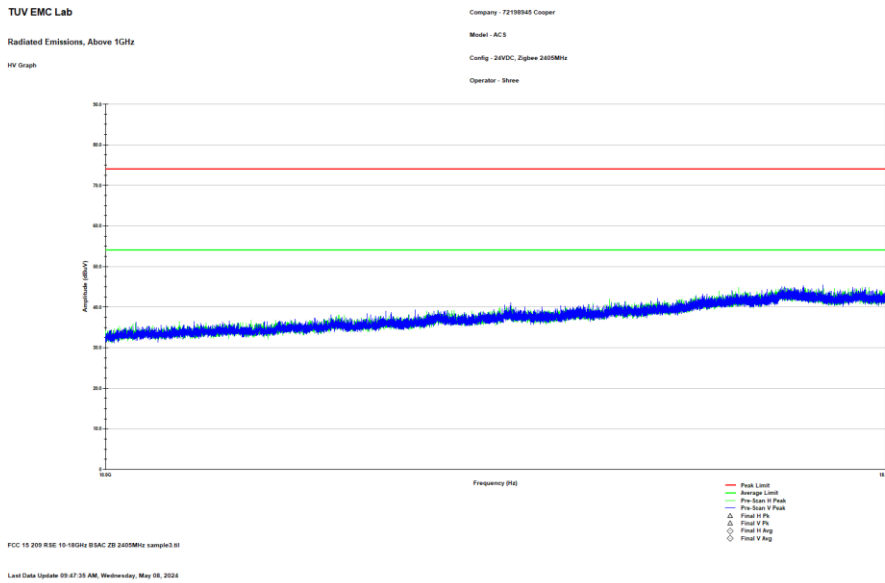


Figure 2.8.6-8: Reference plot for Radiated Spurious Emissions – 10 GHz – 18 GHz

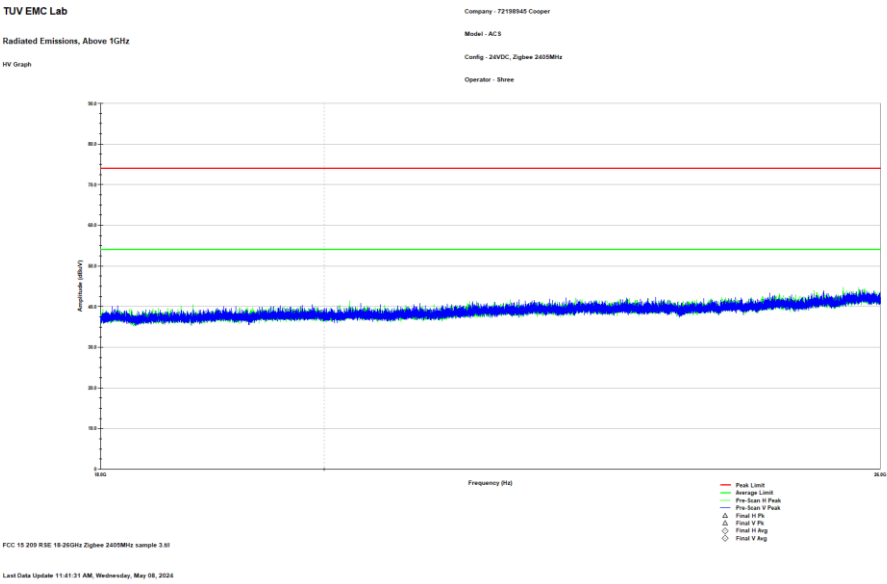


Figure 2.8.6-9: Reference plot for Radiated Spurious Emissions – 18 GHz – 26 GHz



2.9 Test Equipment Used

Table 2.9-1 –Equipment List

Asset ID	Manufacturer	Model	Equipment Type	Serial Number	Last Calibration Date	Calibration Due Date
628	EMCO	6502	Active Loop Antenna 10kHz-30MHz	9407-2877	06/20/2023	06/20/2024
853	Teseq	CBL6112D	BiLog Antenna	51616	11/01/2022	11/01/2024
884	ETS Lindgren (EMCO)	3117	DOUBLE-RIDGED GUIDE ANTENNA	240106	05/16/2023	05/16/2025
889	Com Power	PAM 103	Pre-amplifier	18020215	10/02/2023	10/02/2024
338	Hewlett Packard	8449B	High Frequency Pre-Amp	3008A01111	6/22/2023	06/22/2025
882	Rohde & Schwarz	ESW44	ESW44 EMI TEST RECEIVER	101961	06/21/2023	06/21/2024
22	Teledyne Storm Microwave	90-195-456	BSAC Cable	N/A	10/02/2023	10/02/2024
20	Teledyne Storm Microwave	R-90-195-036	BSAC Cable	N/A	07/13/2023	07/13/2024
21	Teledyne Storm Microwave	R-90-195-072	BSAC Cable	N/A	07/13/2023	07/13/2024
334	Rohde & Schwarz	3160-09	HF 18 -26.5 GHz antenna	49404	04/25/2024	04/25/2025
335	Suhner	SF-102A	Cable (40GHZ)	882/2A	06/22/2023	06/22/2024
345	Suhner Sucoflex	102A	Cable 42(GHZ)	1077/2A	06/22/2023	06/22/2024
827	Rohde & Schwarz	RF Cable set	TS8997 Rack cable set	N/A	01/02/2024	01/02/2025
622	Rohde & Schwarz	FSV40 (v3.40)	FSV Signal Analyzer 10Hz to 40GHz	101338	12/06/2023	12/06/2024
267	Hewlett Packard	N1911A	Power Meter	MY45100129	06/22/2023	06/22/2025
3010	Rohde & Schwarz	ENV216	Two-Line V-Network	3010	6/21/2023	6/21/2024
871	ACS	n/a	Conducted EMI Cable	871	3/22/2024	3/22/2025
872	HP	E7402A	EMI Receiver	US40240258	6/22/2023	6/22/2024
144	Omega	RH411	Temp / Humidity Meter	H0103373	02/03/2023	02/03/2025

N/A – Not Applicable

3 Diagram of Test Set-ups

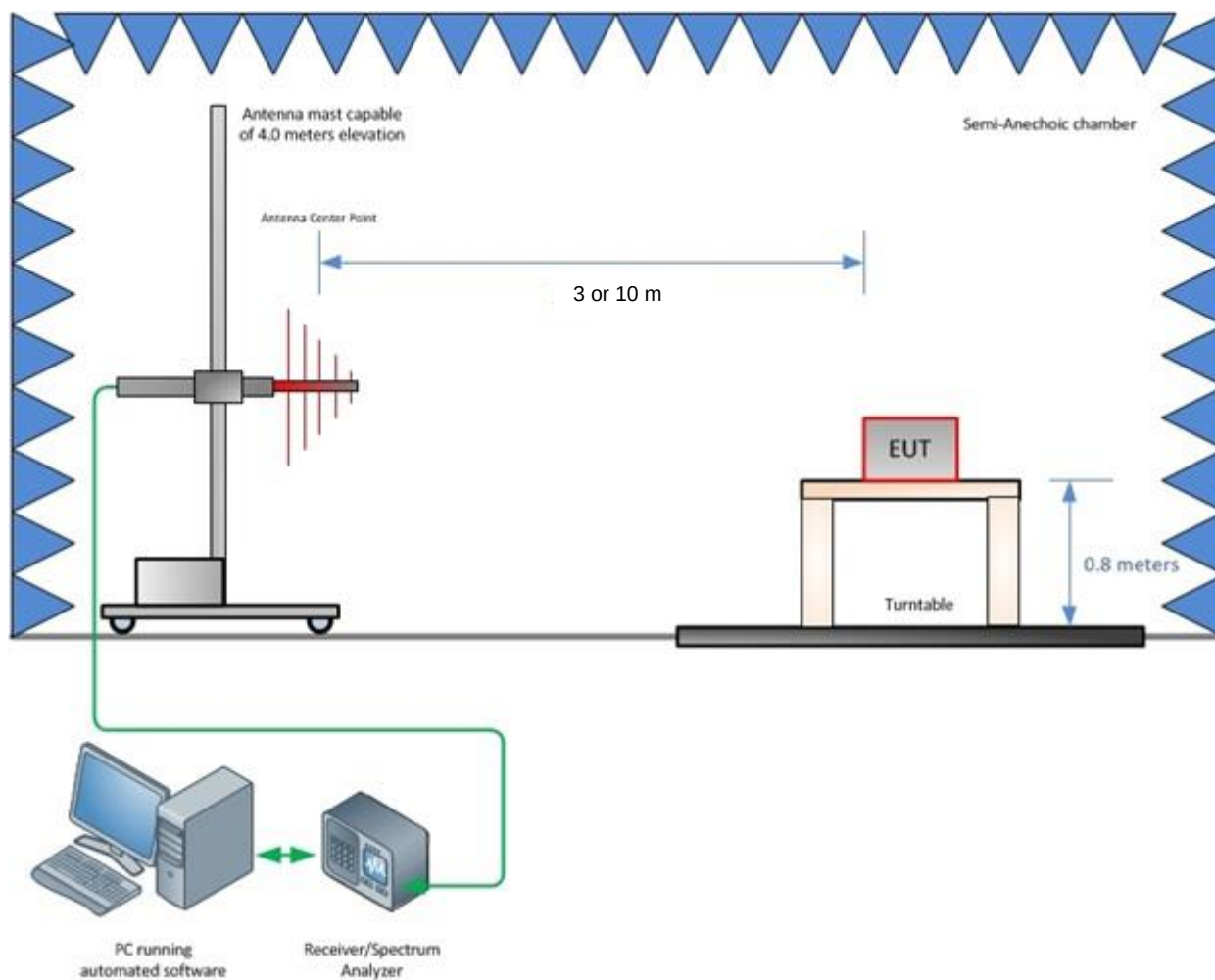


Figure 3-1 – Radiated Emissions Test Setup up to 1 GHz

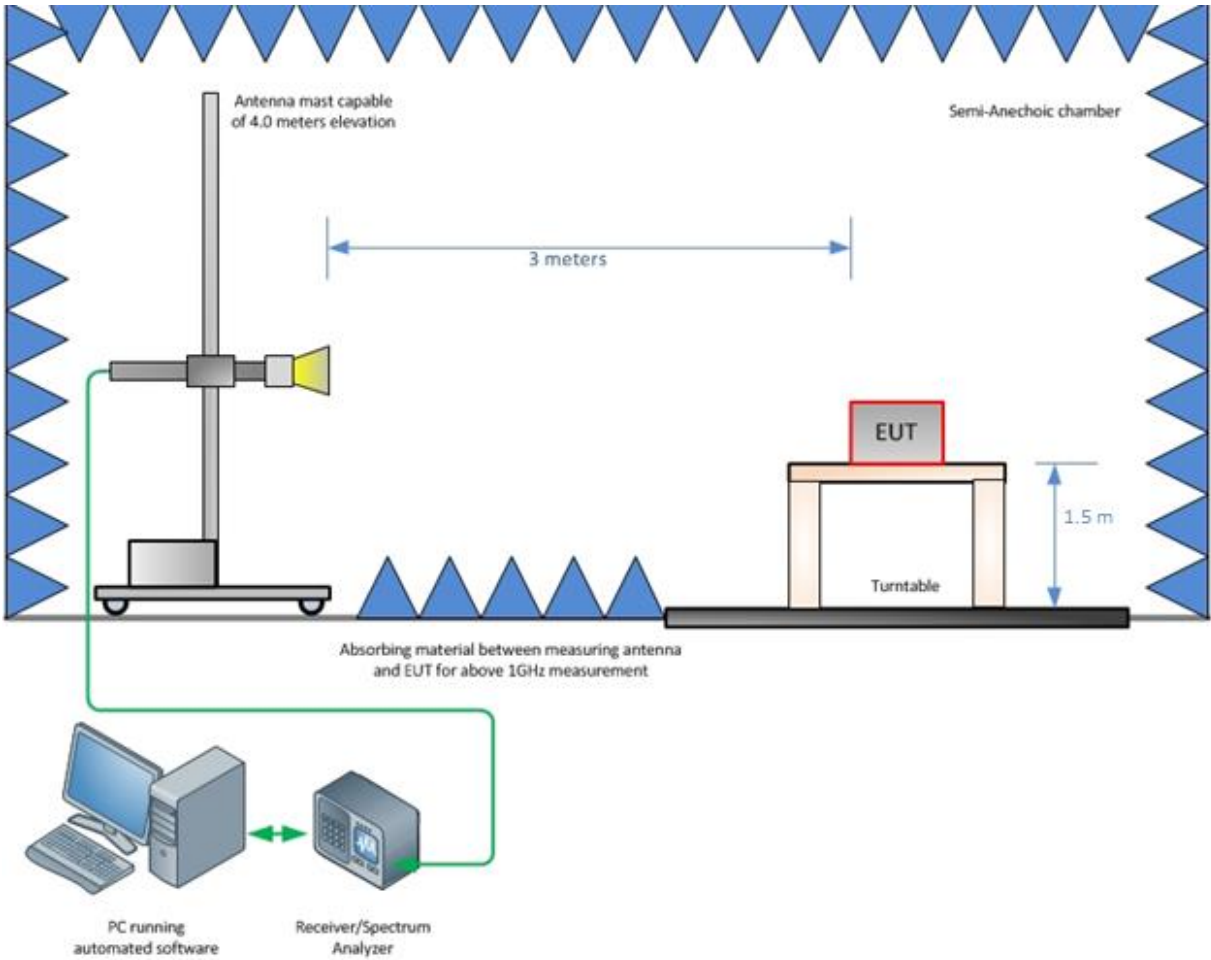


Figure 3-2 – Radiated Emissions Test Setup above 1 GHz

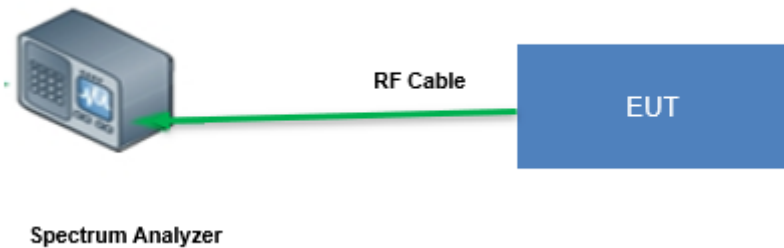


Figure 3-3 – Conducted Test Setup: Antenna Port measurement



4 Accreditation, Disclaimers and Copyright

TÜV SÜD America Inc.'s reports apply only to the specific sample tested under stated test conditions. It is the manufacturer's responsibility to assure the continued compliance of production units of this model. TÜV SÜD America, Inc. shall have no liability for any deductions, inferences or generalizations drawn by the client or others from TÜV SÜD America, Inc.'s issued reports.

This report is the confidential property of the client. As a mutual protection to our clients, the public and TÜV SÜD America, Inc., extracts from the test report shall not be reproduced, except in full without TÜV SÜD America, Inc.'s written approval.

This report must not be used to claim product certification, approval, or endorsement by A2LA, NIST, or any agency of the federal government.

STATEMENT OF MEASUREMENT UNCERTAINTY – Emissions

The expanded laboratory measurement uncertainty figures (U_{Lab}) provided below correspond to an expansion factor (coverage factor) $k = 1.96$ which provide confidence levels of 95%.

Table 4-1: Estimation of Measurement Uncertainty

Parameter	U_{lab}
Occupied Channel Bandwidth	$\pm 0.009 \%$
RF Conducted Output Power	$\pm 0.349 \text{ dB}$
Power Spectral Density	$\pm 0.372 \text{ dB}$
Antenna Port Conducted Emissions	$\pm 1.264 \text{ dB}$
Radiated Emissions $\leq 1 \text{ GHz}$	$\pm 5.814 \text{ dB}$
Radiated Emissions $> 1 \text{ GHz}$	$\pm 4.318 \text{ dB}$
Temperature	$\pm 0.860 \text{ }^{\circ}\text{C}$
Radio Frequency	$\pm 2.832 \times 10^{-8}$
AC Power Line Conducted Emissions	$\pm 3.360 \text{ dB}$

TEST EQUIPMENT

All measurement instrumentation is traceable to the National Institute of Standards and Technology and is calibrated to meet test method standard requirements and/or manufacturer's specifications