

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 3, August 2023

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



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Thierry Jean-Charles	Senior Engineer TUV SUD America Inc.	Authorized Signatory	7/18/2024

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

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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	7/18/2024

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 to ensure continued compliance of the host product after the PCB changes have been made.

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)	1.1
Software Version(s)	ACS_RAIL_A_8dBm_RANGE_AND_FCC
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	721001594
Date of Receipt of EUT	6/18/2024
Start of Test	6/19/2024
Finish of Test	6/21/2024



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	No	Not Tested	15.247(a)(2)	RSS-247 5.2(a)	-----
99% Bandwidth	No	Not Tested	-----	RSS-GEN 6.7	-----
Fundamental Emission Output Power	No	Not Tested	15.247(b)(3)	RSS-247 5.4(d)	-----
Band-Edge Compliance of RF Conducted Emissions	No	Not Tested	15.247(d)	RSS-247 5.5	-----
RF Conducted Spurious Emissions	No	Not Tested	15.247(d)	RSS-247 5.5	-----
Radiated Spurious Emissions into Restricted Frequency Bands	Yes	Pass	15.205, 15.209	RSS-GEN 8.9, 8.10	14
Power Spectral Density	No	Not Tested	15.247(e)	RSS-247 5.2(b)	-----
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

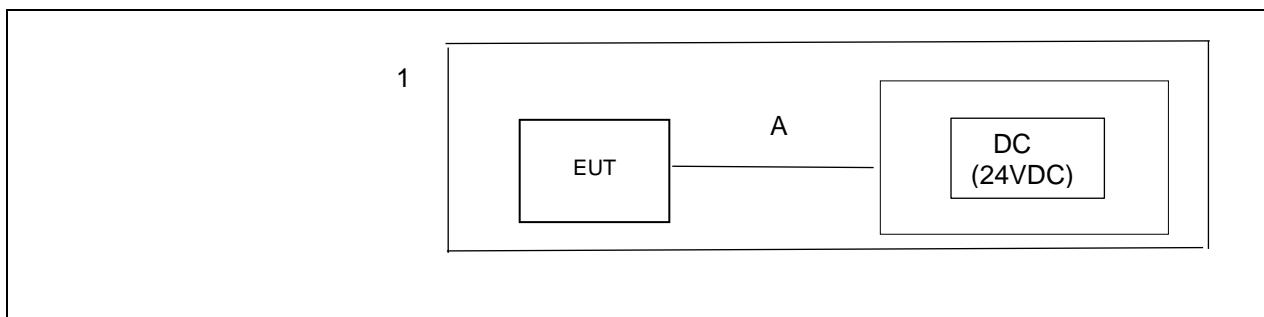


Figure 1.4.1-3: Test Setup Block Diagram

Table 1.4.1-2 – Cable Descriptions

Item	Cable/Port	Length	Shield
A	DC Power cable	20 cm	No

Table 1.4.1-3 – EUT Setup

Item	Make/Model	Description
1	-----	DC 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 Emissions testing was performed on the worst-case model and channel, which is the DC supply unit and frequency 2475 MHz, as determined from Test Report No. AT72198945.2C0

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.

Power setting during test: 8 dBm for 2475 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
Radiated Spurious Emissions into Restricted Frequency Bands	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

6/19/2024

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

6/21/2024

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
0.52	46	27.3	17.7	9.649	-18.7	PASS
1.96	46	26.1	16.4	9.685	-19.9	PASS
2.08	46	27.5	17.8	9.689	-18.5	PASS
2.21	46	28.2	18.5	9.694	-17.8	PASS
2.32	46	28.8	19.1	9.698	-17.2	PASS
4.3	46	30.9	21.1	9.764	-15.1	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
0.52	56	33.5	23.9	9.649	-22.5	PASS
1.96	56	30.6	20.9	9.685	-25.4	PASS
2.08	56	32	22.3	9.689	-24	PASS
2.21	56	32.6	22.9	9.694	-23.4	PASS
2.32	56	32.8	23.1	9.698	-23.2	PASS
4.3	56	35.6	25.8	9.764	-20.4	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
0.5	46	27.3	17.6	9.627	-18.7	PASS
0.56	46	26.8	17.2	9.632	-19.2	PASS
2	46	35.2	25.5	9.676	-10.8	PASS
2.14	46	33.4	23.7	9.678	-12.6	PASS
2.26	46	33.5	23.8	9.681	-12.5	PASS
4.3	46	30.8	21	9.75	-15.2	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
0.5	56	33.5	23.9	9.627	-22.5	PASS
0.56	56	33.1	23.5	9.632	-22.9	PASS
2	56	37.2	27.6	9.676	-18.8	PASS
2.14	56	36.8	27.1	9.678	-19.2	PASS
2.26	56	36.3	26.6	9.681	-19.7	PASS
4.3	56	35.5	25.7	9.75	-20.5	PASS



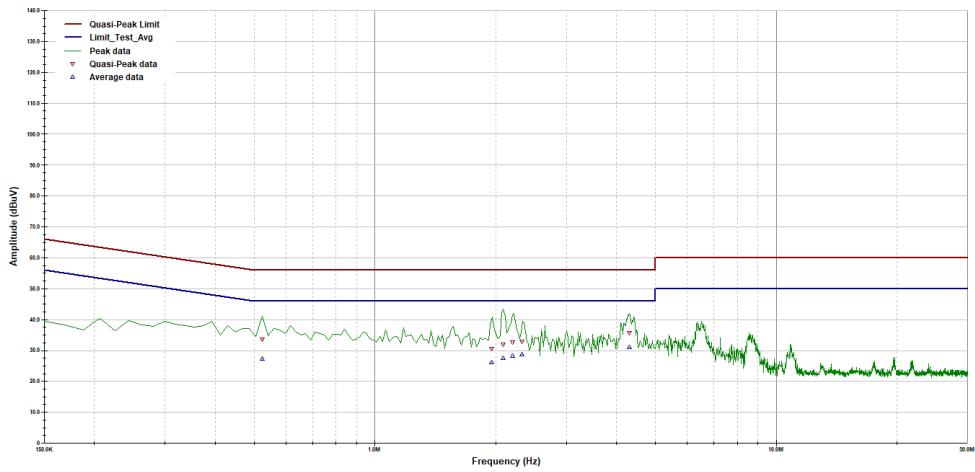
Figure 2.2.6-1: Conducted Emission Plot – Line 1

TUV SUD America

Conducted RF Emissions, 150 kHz to 30 MHz

Line Under Test Number 1 Results

EUT Name - 721001594-Cooper
 Model Number - ACS
 Part Number - N/A
 Serial Number - N/A
 Voltage - FCC/C/Class B: 120Vac/60Hz
 Operating Mode - Operating mode; Zigbee LCH ON



Operator: DA

Temperature = 25C
 Relative Humidity = 40%

AC Mains Class B-120V-Zigbee ON.til

RF Bandwidth: 9kHz
 VBW if Analyzer: 30kHz

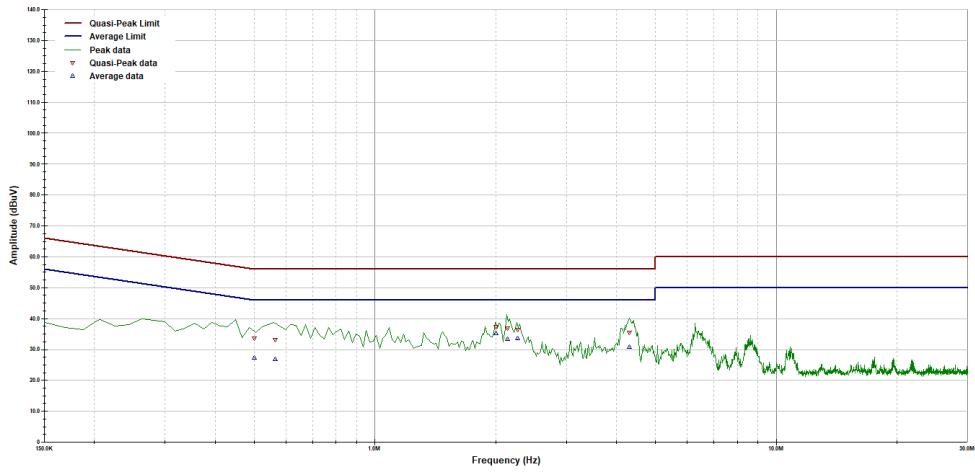
Last Data Update 01:16:37 PM, Friday, June 21, 2024

TUV SUD America

Conducted RF Emissions, 150 kHz to 30 MHz

Line Under Test Number 2 Results

EUT Name - 721001594-Cooper
 Model Number - ACS
 Part Number - N/A
 Serial Number - N/A
 Voltage - FCC/C/Class B: 120Vac/60Hz
 Operating Mode - Operating mode; Zigbee LCH ON



Operator: DA

Temperature = 25C
 Relative Humidity = 40%

AC Mains Class B-120V-Zigbee ON.til

RF Bandwidth: 9kHz
 VBW if Analyzer: 30kHz

Last Data Update 01:27:47 PM, Friday, June 21, 2024

Figure 2.2.6-2: Conducted Emission Plot – Neutral



2.3 Radiated Spurious Emissions into Restricted Frequency Bands

2.3.1 Specification Reference

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

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

06/19/2024 to 06/20/2024

2.3.4 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

2.3.5 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: 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
HCH - 2475 MHz							
345.638	----	31.215	H	----	46	----	14.78
740.042	----	32.972	H	----	46	----	13.03
771.662	----	29.059	H	----	46	----	16.94
48.093	----	17.883	V	----	40	----	22.12
331.889	----	25.069	V	----	46	----	20.93
703.13	----	18.17	V	----	46	----	27.83
7426.675	54.668	42.237	H	74	54	19.33	11.76
7426.625	55.358	43.46	V	74	54	18.64	10.54

Table 2.3.6-2: Radiated Band-Edge Tabulated Data

Frequency (MHz)	Level (dBuV)		Antenna Polarity (H/V)	Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg		pk	Qpk/Avg	pk	Qpk/Avg
HCH - 2480 MHz							
2483.5	47.944	32.897	H	74	54	26.06	21.1
2483.5	48.694	34.511	V	74	54	25.31	19.49



DC Unit Plots

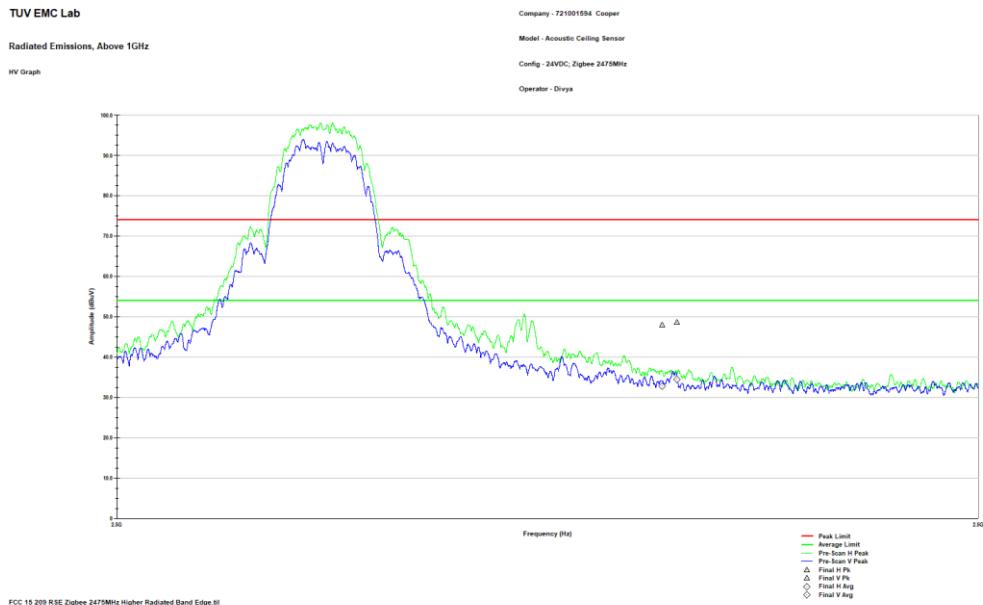


Figure 2.3.6-1: Radiated Upper Band-edge – HCH - 2475 MHz

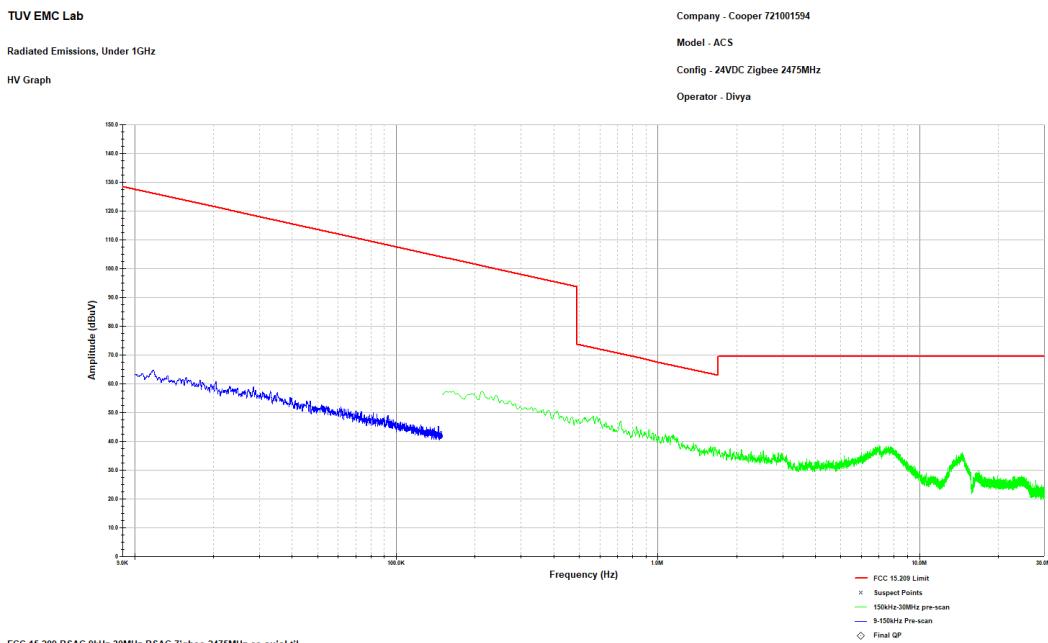


Figure 2.3.6-2: Radiated Spurious Emissions – 9 kHz – 30 MHz - HCH- 2475 MHz
Note: Emissions above the noise floor are ambient not associated with the EUT.



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Radiated Emissions, Under 1GHz

HV Graph

Company - Cooper

Model - ACS

Config - Zigbee-HCH-2475M:24VDC

Operator - Divya

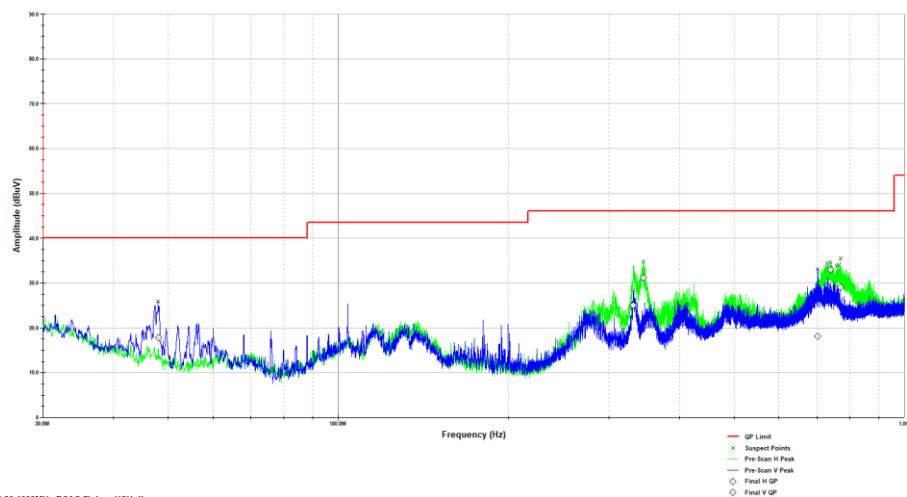


Figure 2.3.6-3: Radiated Spurious Emissions – 30 MHz – 1 GHz - HCH- 2475 MHz

TUV EMC Lab

Radiated Emissions, Above 1GHz

HV Graph

Company - 721001594 Cooper

Model - ACS

Config - 24VDC, Zigbee-2475MHz

Operator - Divya

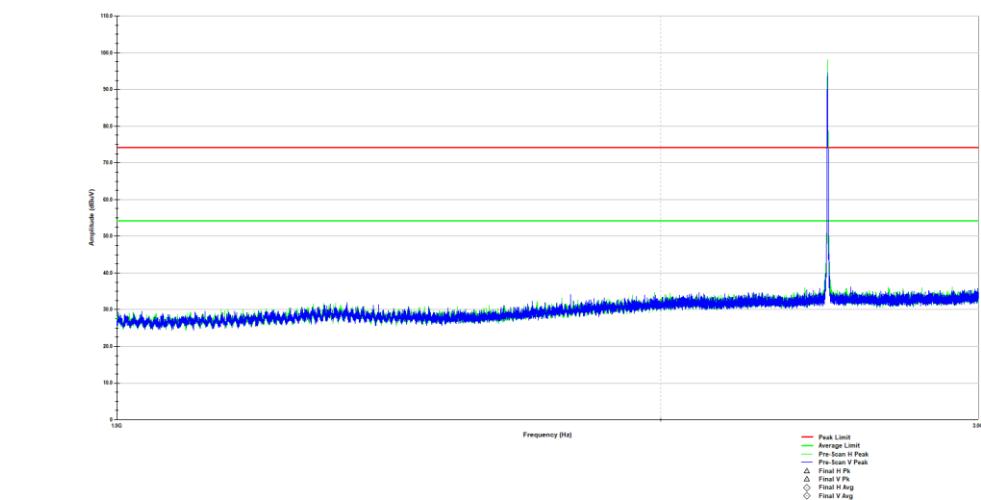


Figure 2.3.6-4: Radiated Spurious Emissions – 1 GHz – 3 GHz - HCH- 2475 MHz
Note: Emission above the limit line is the Fundamental Frequency.



TUV EMC Lab

Radiated Emissions, Above 1GHz

HV Graph

Company - 721001594 Cooper

Model - Acoustic Ceiling Sensor

Config - 24VDC, Zigbee-2475MHz

Operator - Divya

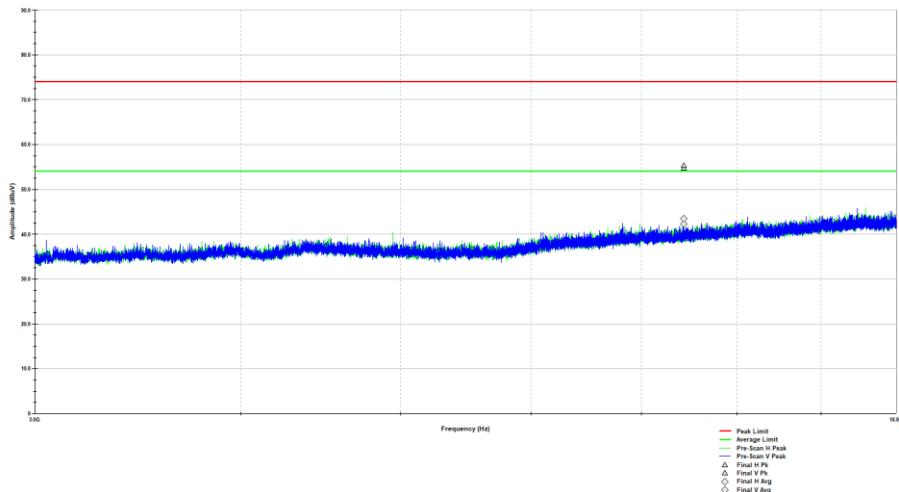


Figure 2.3.6-5: Radiated Spurious Emissions – 3 GHz – 10 GHz - HCH- 2475 MHz

TUV EMC Lab

Radiated Emissions, Above 1GHz

HV Graph

Company - 721001594 Cooper

Model - ACS

Config - 24VDC, Zigbee 2475MHz

Operator - Divya

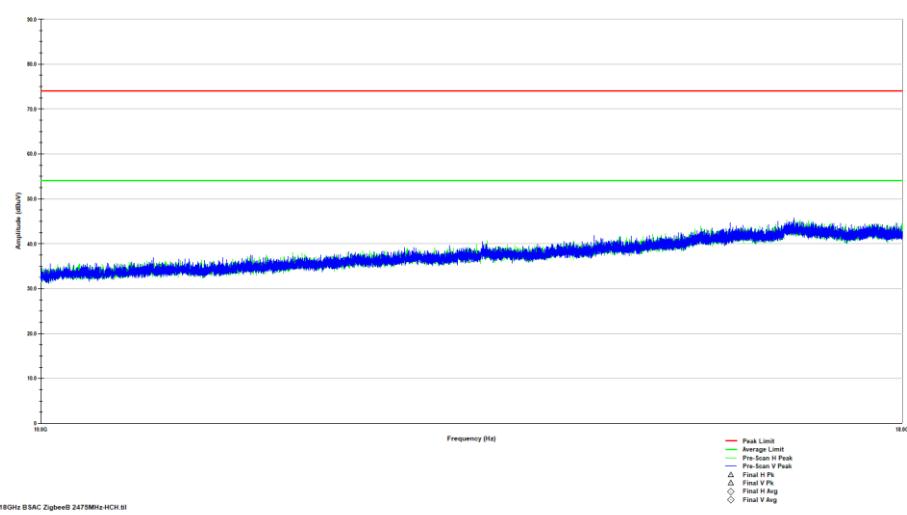


Figure 2.3.6-6: Radiated Spurious Emissions – 10 GHz – 18 GHz - HCH- 2475 MHz

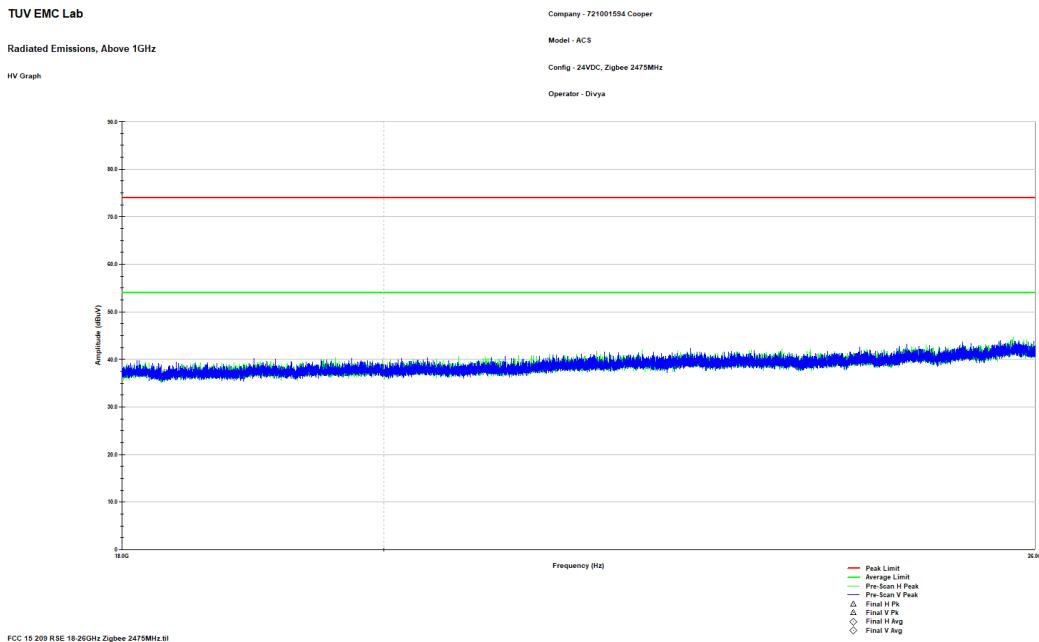


Figure 2.3.6-7: Radiated Spurious Emissions – 18 GHz – 26 GHz - HCH- 2475 MHz



2.4 Test Equipment Used

Table 2.4-1 –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	06/20/2025
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	06/18/2024	06/18/2025
432	Microwave Circuits	H3G020G4	High Pass Filter	264066	05/31/2024	05/31/2025
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	06/18/2024	06/18/2025
345	Suhner Sucoflex	102A	Cable 42(GHZ)	1077/2A	06/18/2024	06/18/2025
267	Hewlett Packard	N1911A	Power Meter	MY45100129	06/22/2023	06/22/2025
3010	Rohde & Schwarz	ENV216	Two-Line V-Network	3010	06/18/2024	06/18/2025
871	ACS	n/a	Conducted EMI Cable	871	3/22/2024	3/22/2025
872	HP	E7402A	EMI Receiver	US40240258	6/20/2024	6/20/2025
144	Omega	RH411	Temp / Humidity Meter	H0103373	02/03/2023	02/03/2025

N/A – Not Applicable

3 Diagram of Test Set-ups

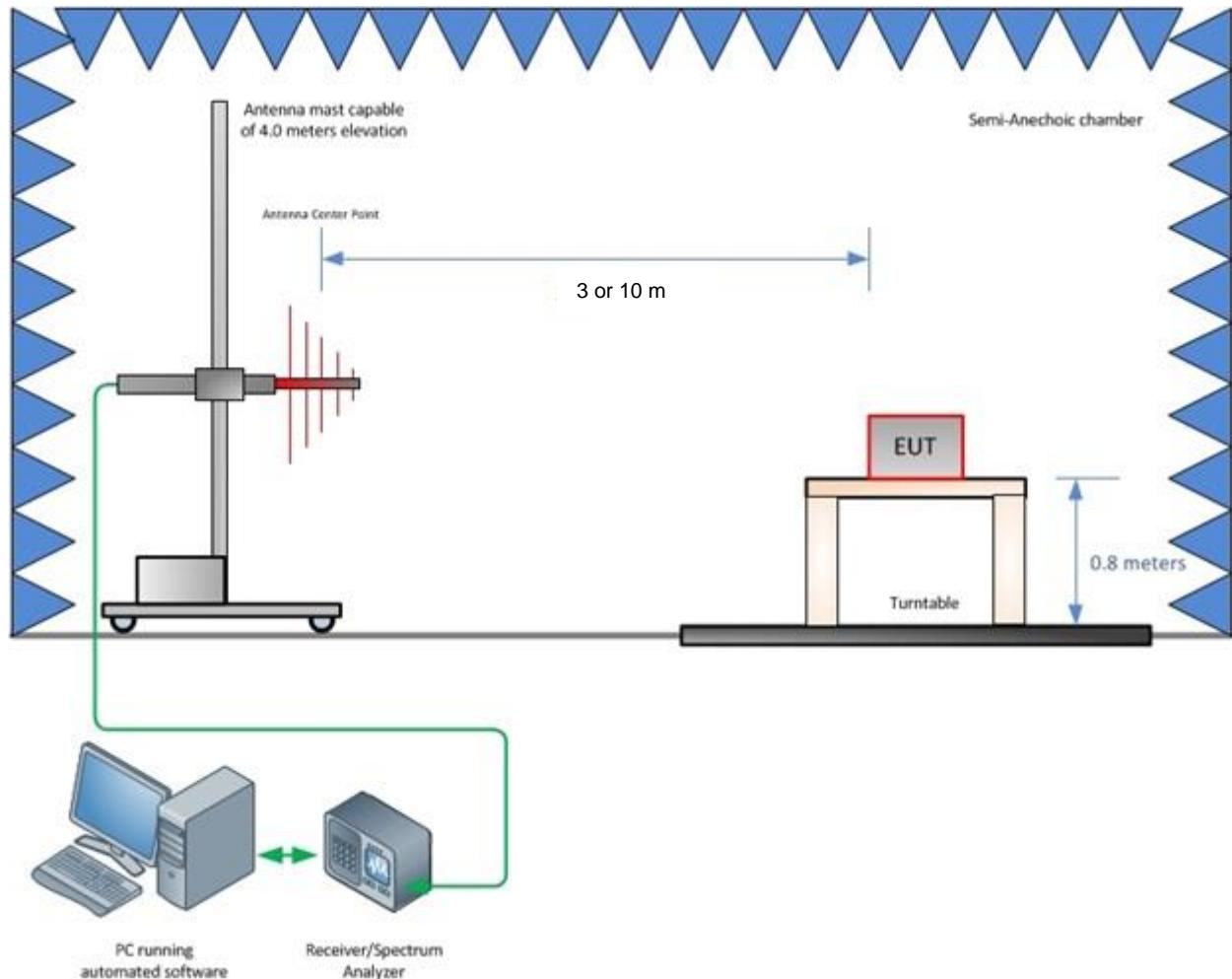


Figure 3-1 – Radiated Emissions Test Setup up to 1 GHz

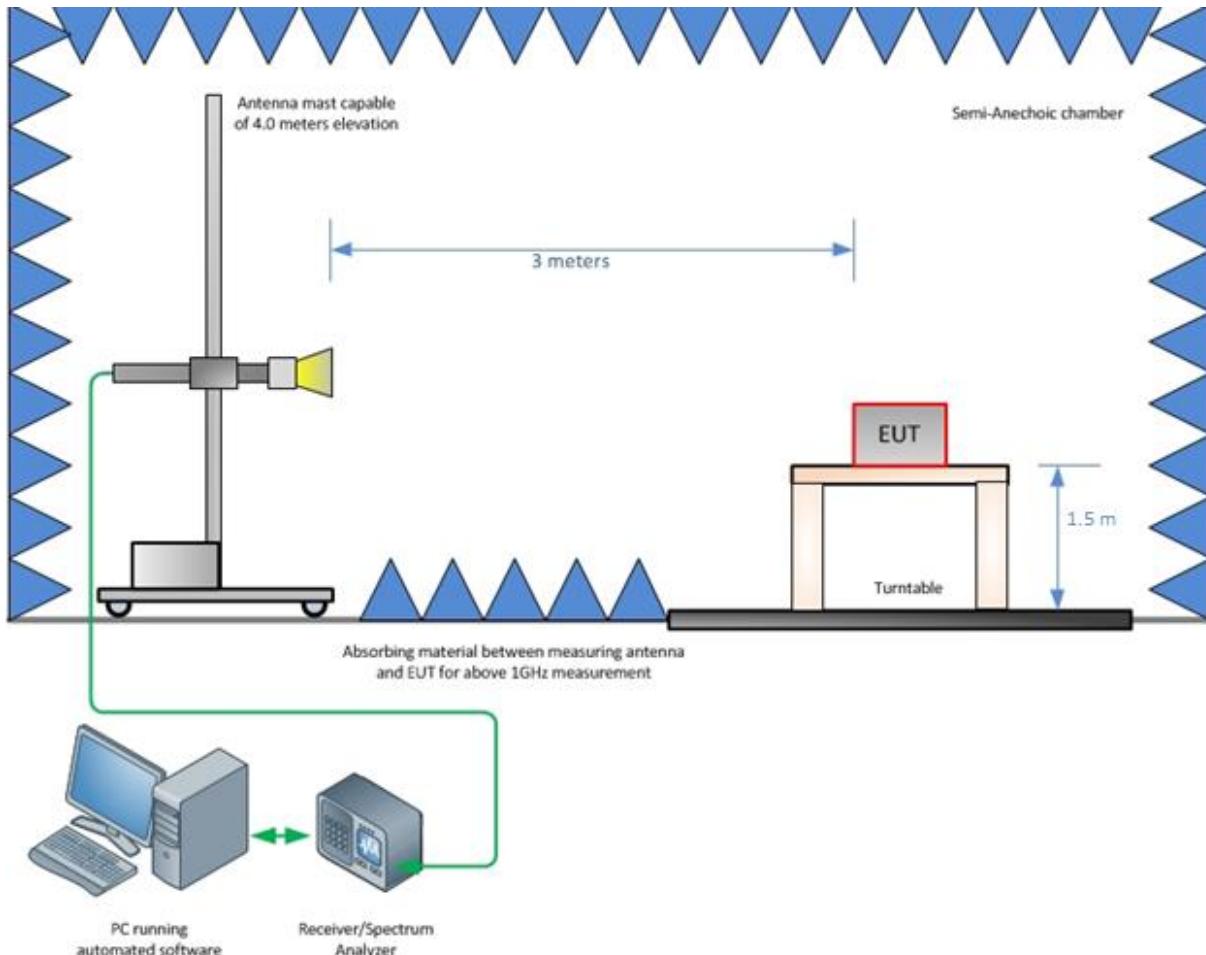


Figure 3-2 – Radiated Emissions Test Setup above 1 GHz



4 Accreditation, Disclaimers and Copyright

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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