NVLAP Lab Code 200087-0

Rogers Labs, a division of The Compatibility Center LLC

7915 Nieman Rd.
Lenexa, KS 66214
Phone / Fax (913) 660-0666

47CFR, PART 15C - Intentional Radiators
47CFR Paragraph 15.255 and
Industry Canada RSS-210 Issue 10 and RSS-GEN Issue 5
Application For Grant of Certification

PMN: Freemile 60
FCC ID: W9Z-FREEMILE60
IC: 8855A-FREEMILE60
57 – 71 GHz

SAF Tehnika AS

24a, Ganibu dambis
Riga Latvia LV-1005

Test Report Number: 240723
Test Date: July 23, 2024

Authorized Signatory:

Patrick Powell
Rogers Labs, a division of The Compatibility Center LLC
FCC Designation: US5305
ISED Registration: 3041A

Revisions

Revision 1 – Issued October 28, 2024

Executive Summary

The following information is submitted for consideration in obtaining Grant of Certification for License Exempt Digital Transmission System Intentional Radiator operating under Code of Federal Regulations Title 47 (47CFR) Part 15C paragraph 15.255, Industry Canada RSS-210 Issue 10, and RSS-GEN Issue 5, operation in the 57 to 71 GHz band.

Name of Applicant: SAF Tehnika AS
24a, Ganibu dambis
Riga Latvia LV-1005

PMN: FREEMILE 60
P/N: Z60FEEB1 and Z60FEEU1 (N.A. plugs / B1=30cm cord; U1=1m cord)
FCC ID: W9Z-FREEMILE60 IC: 8855A-FREEMILE60
Operating Frequency Range: 2402-2480 MHz

FREEMILE 60 was chosen for transmitter configuration testing and used for final measurements.

Opinion / Interpretation of Results

Tests Performed	Pass/Fail
6dB Emission Bandwidth	PASS
99% Occupied Bandwidth	PASS
Equivalent Isotropic Radiated Power	PASS
Radiated Spurious Emissions (above 40GHz)	PASS
Radiated Spurious Emissions (1 - 40GHz)	PASS
Radiated Spurious Emissions (below 1 GHz)	PASS
AC Line Conducted EMI	PASS
Frequency Stability	PASS

NVLAP Lab Code 200087-0

Equipment Tested

Model: FREEMILE 60

SAF Tehnika AS
24a, Ganibu dambis
Riga Latvia LV-1005

Equipment	Model / PN	Serial Number
Freemile 60 EUT #1	Freemile 60	504340100027
Freemile 60 EUT #1	Freemile 60	504340100039
PoE power supply #1	LZD201-24W-48V-G	N/A
PoE power supply #1	LZD201-24W-48V-G	N/A

Test results in this report relate only to the items tested. Worst-case configuration data recorded in this report.

Software (FVIN): v1.12.0-rev54424

Equipment Operational Modes

Channels

Channel	Center Frequency (GHz)	Frequency Range (GHz) Full-channel bandwidth	Frequency Range (GHz) Half-channel bandwidth *
1	58.32	57.24 ~ 59.40	57.78 ~ 58.86
2	60.48	59.40 ~ 61.56	59.94 ~ 61.02
3	62.64	61.56 ~ 63.72	62.1 ~ 63.18
4	64.80	63.72 ~ 65.88	64.26 ~ 65.34
5	66.96	65.88 ~ 68.04	66.42 ~ 67.50
6	69.12	68.04 ~ 70.20	68.58 ~ 69.66

* Half-channel bandwidth is not supported in 802.11ad/ay

Modulations

MCS index	Modulation type
0 (Control-PHY)	DSSS with 32 π/2-BPSK chips per bit
1	π/2-BPSK (with each bit repeated twice)
2	
3	
4	
5	π/2-BPSK
6	
7	
8	
9	π/2-QPSK
10	
11	
12	π/2-16-QAM

Equipment Setup (Calmodes)

Calmode X Y
X = Channel #
Y = Modulation (MCS Index)

Antenna Description

The EUT contains one Tx antenna for 57-71 GHz transmission. It is a 16-element Phased Array Antenna (PAA). See below summary of the antenna gain by channel and modulation type.

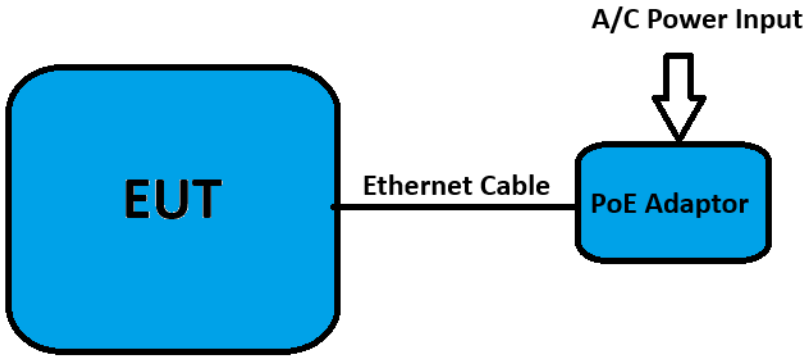
MCS	Antenna Gain (dBi) Boresight					
	Ch.1	Ch.2	Ch.3	Ch.4	Ch.5	Ch.6
0	14.6757	14.4047	15.4219	16.0622	16.106	16.156
1	14.6757	14.4047	15.4219	16.0622	16.106	16.156
2	14.6757	14.4047	15.4219	16.0622	16.106	16.156
3	14.6757	14.4047	15.4219	16.0622	16.106	16.156
4	14.6757	14.4047	15.4219	16.0622	16.106	16.156
5	14.6757	14.4047	15.4219	16.0622	16.106	16.156
6	14.6757	14.4047	15.4219	16.0622	16.106	16.156
7	14.6757	14.4047	15.4219	16.0622	16.106	16.156
8	14.6757	14.4047	15.4219	16.0622	16.106	16.156
9	14.6757	14.4047	15.4219	16.0622	16.106	16.156
10	14.6757	14.4047	15.4219	16.0622	16.106	16.156
11	14.6757	14.4047	15.4219	16.0622	16.106	16.156
12	14.6757	14.4047	15.4219	16.0622	16.106	16.156

Equipment Function

The EUT is a 60 GHz Point-to-Point and Point-to-Multipoint Digital Transmission System. The design provides operational capabilities in the the frequency band of 57240-70200 MHz. The design provides Modulation and Coding Scheme (MCS) options including MCS1; MCS2; MCS3; MCS4; MCS5; MCS6; MCS7; MCS8; MCS9; MCS10; MCS11; MCS12 to maintain quality communications link. The design may auto-select MCS or highest MCS may be set during installation to allow for longer distance link. The product provides two options for channel width 2160 MHz and 1080 MHz channel providing high data rates and full duplex operation for point-to-point and point-to-multipoint communications. The EUT requires direct current power supplied from an AC/DC Power Over Ethernet (POE) power supply. Software was provided internal to the EUT which provided the ability to set test channel and modulation scheme. The EUT provides two network ports, first for communications and power, second for communications. For testing purposes, the EUT was connected to a laptop computer at the

network port. A laptop computer provided communications and control to the EUT for testing purposes. The EUT provides no other interfacing options than those presented in this report. For testing purposes, the Freemile 60 test samples were configured to transmit in available data modes receiving power from the AC/DC POE adapter. As requested by the manufacturer and required by regulations, the equipment was tested for emissions compliance using the available configurations with the worst-case data presented. Test results in this report relate only to the products described in this report.

Equipment Configuration



Application for Certification

(1) Manufacturer: SAF Tehnika AS
24a, Ganibu dambis
Riga Latvia LV-1005

(2) Identification: HVIN: FREEMILE 60

FCC ID: W9Z-FREEMILE60 IC: 8855A-FREEMILE60

(3) Instruction Book:

Refer to Exhibit for Instruction Manual.

(4) Description of Circuit Functions:

Refer to Exhibit of Operational Description.

(5) Block Diagram with Frequencies:

Refer to Exhibit of Operational Description.

(6) Report of Measurements:

Report of measurements follows in this Report.

(7) Photographs: Construction, Component Placement, etc.:

Refer to Exhibit for photographs of equipment.

(8) List of Peripheral Equipment Necessary for operation. The equipment operates from external alternating current power input to a PoE adaptor which supplies 48V DC to the EUT. The EUT provides interface ports for power, loads and communications as presented in this filing.

(9) Transition Provisions of 47CFR 15.37 are not requested.

(10) Not Applicable. The unit is not a scanning receiver.

(11) Since this EUT operates in the 57-71 GHz range, this report details compliance with provisions of 47CFR 15.255.

(12) The equipment is not software defined and this section is not applicable.

(13) Not applicable as this unit is not a U-NII device.

(14) Contain at least one drawing or photograph showing the test set-up for each of the required types of tests applicable to the device for which certification is requested. These drawings or photographs must show enough detail to confirm other information contained in the test report. Any photographs used must be focused originals without glare or dark spots and must clearly show the test configuration used. This information is provided in this report and Test Setup Exhibits provided with the application filing.

Applicable Standards

The following information is submitted in accordance with the eCFR (electronic Title 47 Code of Federal Regulations) (47CFR), dated July 1, 2024: Part 2, Subpart J, Part 15C Paragraph 15.255, RSS-210 Issue 10, and RSS-GEN Issue 5. Test procedures used are the established Methods of Measurement of Radio-Noise Emissions as described in ANSI C63.10-2013. This report documents compliance for the EUT operations.

Test Procedures

AC Line Conducted Emission Test Procedure

Testing for the AC line-conducted emissions were performed as required in CFR47 15B, RSS-GEN, and directed in ANSI C63.4-2014. The test setup, including the EUT, was arranged in the test configurations as presented during testing. The test configuration was placed on a 1 x 1.5-meter bench, 0.8 meters high located in a screen room. The power lines of the system were isolated from the power source using a standard LISN with a 50-µHy choke. EMI was coupled to the spectrum analyzer through a 0.1 µF capacitor internal to the LISN. The LISN was positioned on the floor beneath the wooden bench supporting the EUT. The power lines and cables were draped over the back edge of the table. Refer to diagram one showing typical test arrangement and photographs in the test setup exhibit for EUT placement used during testing.

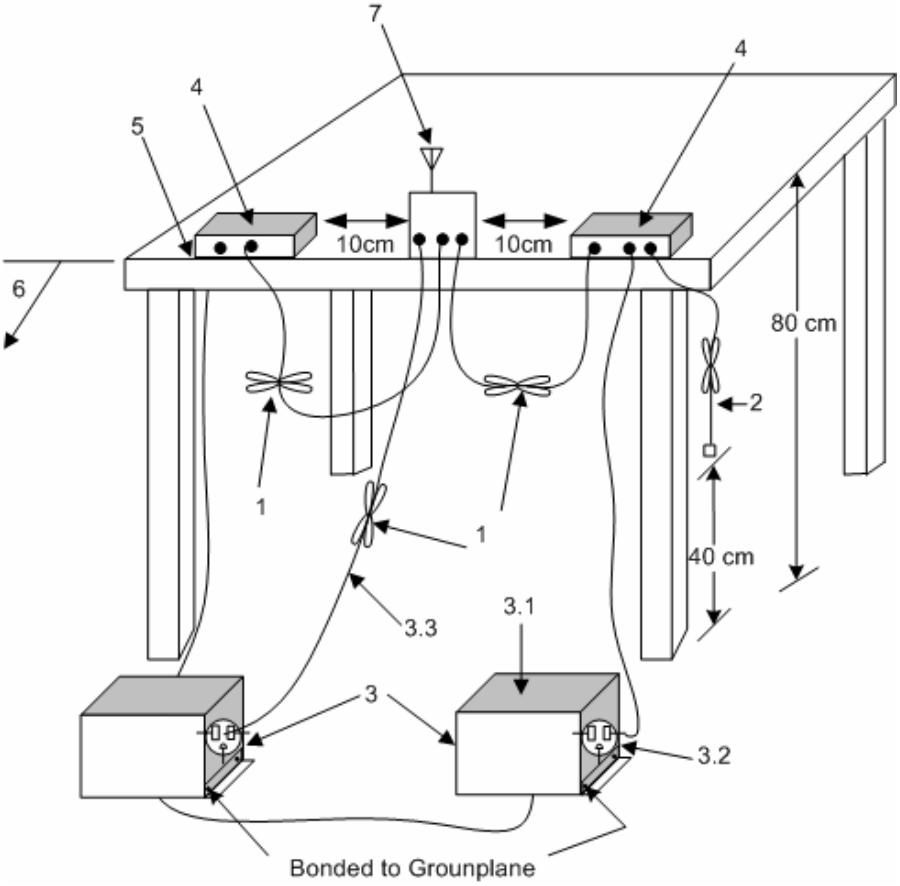
Radiated Emission Procedure

Radiated emissions testing was performed as required in 47CFR 15C, RSS-210 Issue 10, RSS-GEN and specified in ANSI C63.10-2013. The EUT was placed on a rotating 0.9 x 1.2-meter platform, elevated as required above the ground plane at a distance of 3 meters from the FSM antenna. For 57-71GHz radiated testing, adjustments were made for appropriate far field distance. EMI energy was maximized by equipment placement permitting orientation in three orthogonal axes, raising, and lowering the FSM antenna, changing the antenna polarization, and by rotating the turntable. Each emission was maximized before data was taken and recorded. The frequency spectrum from 9 kHz to 25,000 MHz was searched for emissions during preliminary investigation. Refer to diagrams two and three showing typical test setup. Refer to photographs in the test setup exhibits for specific EUT placement during testing.

Antenna Port Conducted Emission Test Procedure

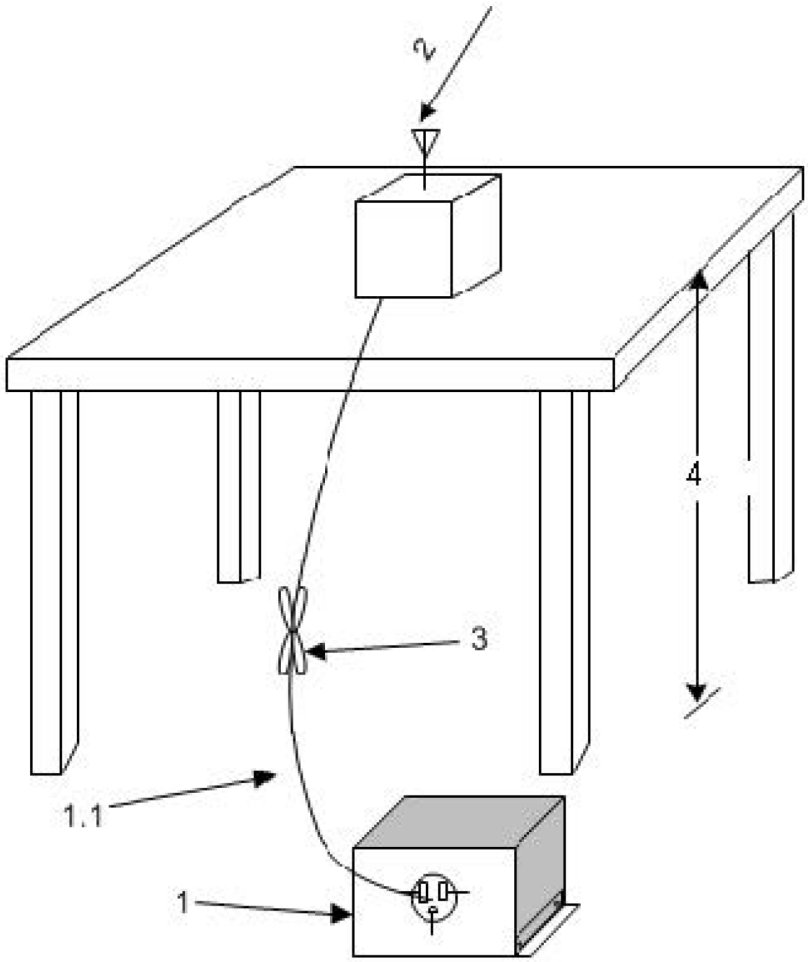
The EUT was not equipped with a conducted antenna port connection.

Diagram 1 Test arrangement for power-line conducted emissions



1. Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 cm to 40 cm long see (see 6.2.3.1).
2. I/O cables that are not connected to an accessory shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m (see 6.2.2).
3. EUT connected to one LISN. Unused LISN measuring port connectors shall be terminated in 50 Ω loads. LISN can be placed on top of, or immediately beneath, reference ground plane (see 6.2.2 and 6.2.3).
   3.1 All other equipment powered from additional LISN(s).
   3.2 Multiple-outlet strip can be used for multiple power cords of non-EUT equipment.
   3.3 LISN at least 80 cm from nearest part of EUT chassis.
4. Non-EUT components of EUT system being tested.
5. Rear of EUT, including peripherals, shall all be aligned and flush with rear of tabletop (see 6.2.3.1).
6. Edge of tabletop shall be 40 cm removed from a vertical conducting plane that is bonded to the ground plane (see 6.2.2 for options).
7. Antenna may be integral or detachable. If detachable, the antenna shall be attached for this test

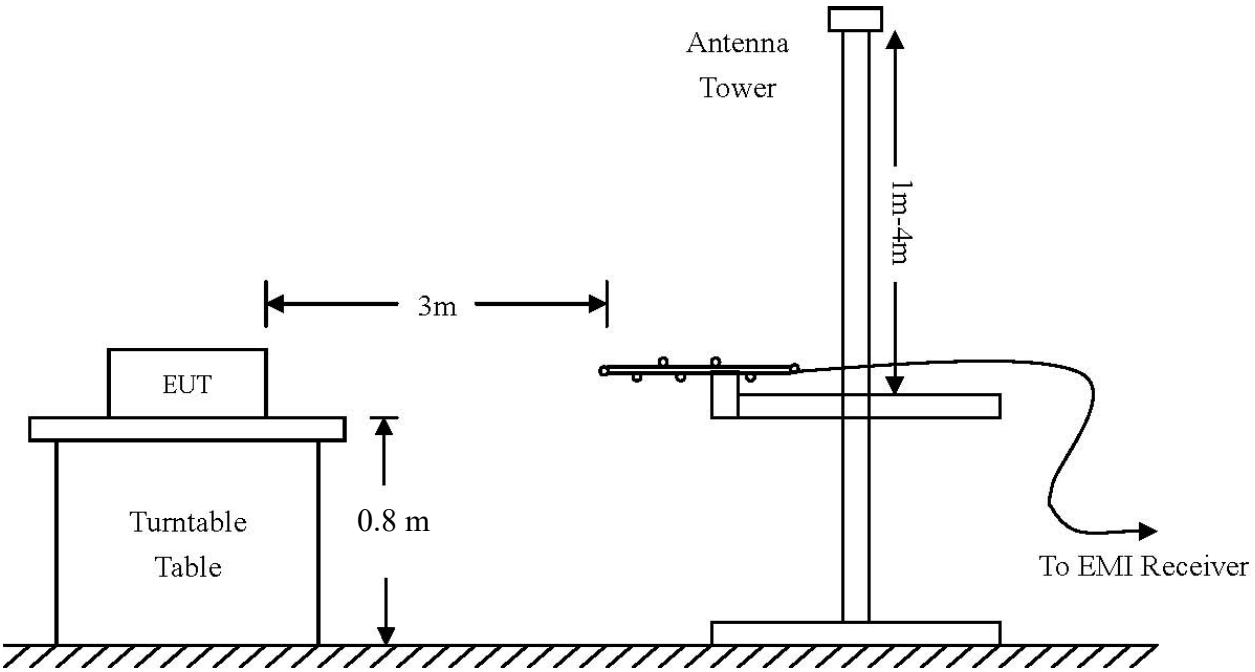
Diagram 2 Test arrangement for radiated emissions of tabletop equipment



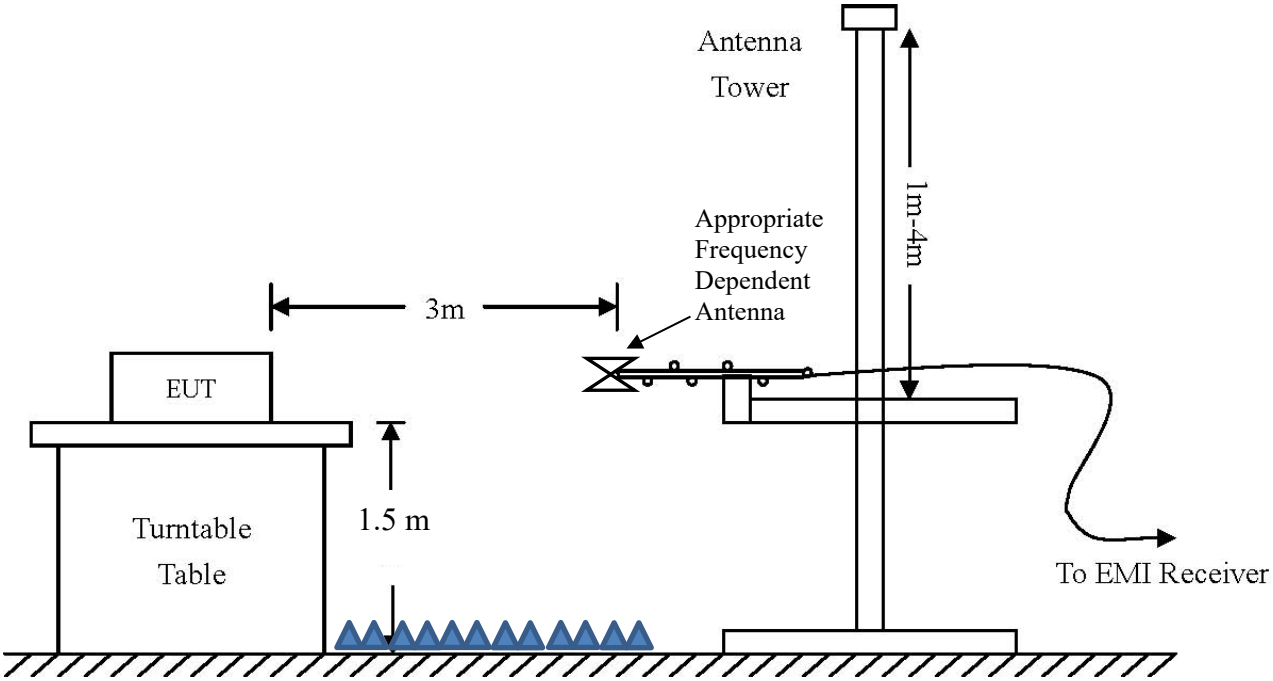
1. A LISN is optional for radiated measurements between 30 MHz and 1000 MHz but not allowed for measurements below 30 MHz and above 1000 MHz (see 6.3.1). If used, then connect EUT to one LISN. Unused LISN measuring port connectors shall be terminated in 50 Ω loads. The LISN may be placed on top of, or immediately beneath, the reference ground plane (see 6.2.2 and 6.2.3.2).
   1.1. LISN spaced at least 80 cm from the nearest part of the EUT chassis.
2. Antenna can be integral or detachable, depending on the EUT (see 6.3.1).
3. Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 cm to 40 cm long (see 6.3.1).
4. For emission measurements at or below 1 GHz, the table height shall be 80 cm. For emission measurements above 1 GHz, the table height shall be 1.5 m for measurements, except as otherwise specified (see 6.3.1 and 6.6.3.1).

Diagram 3 Test arrangement for radiated emissions tested in Semi-Anechoic Chamber (SAC) and Outdoor Area Test Site (OATS)

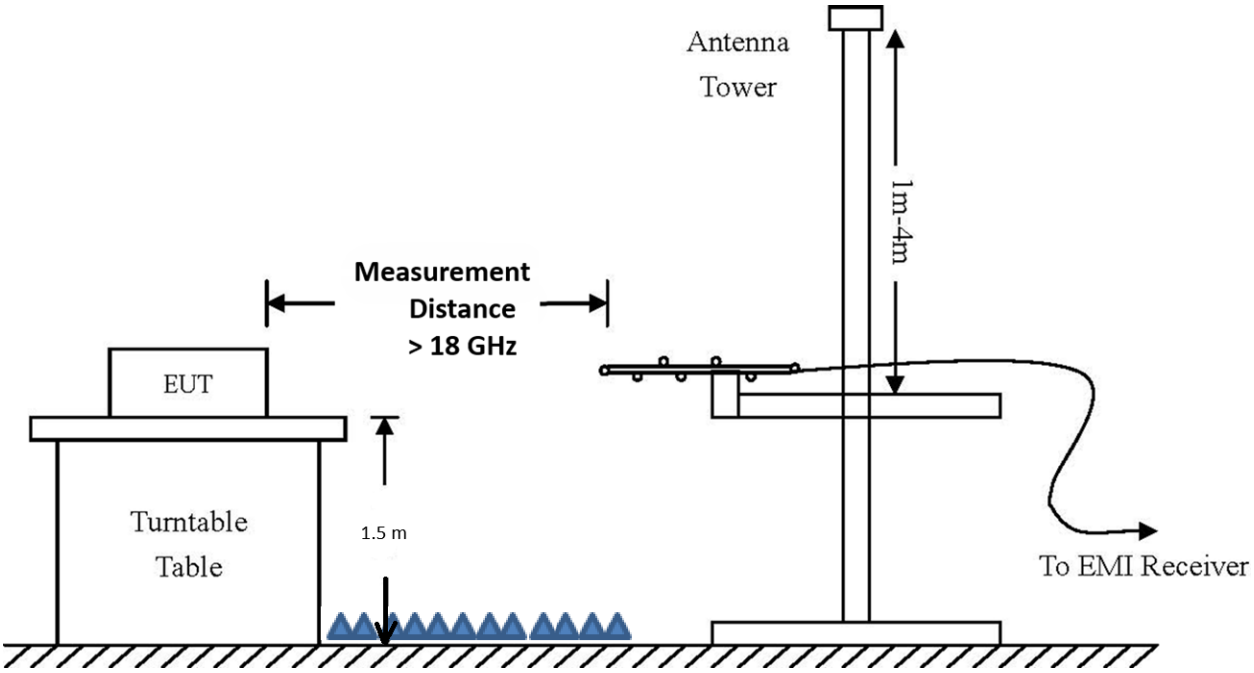
Below 1 GHz



1-18 GHz:



18-200 GHz



Radiated Emissions Measurement Distance

The measurement antenna is in the far field of the EUT per formula 2D2/γ, where D is the larger between the dimensions of the measurement antenna and the transmitting antenna of the EUT. In this case, "D" is the largest dimension of the measurement antenna. The EUT is manipulated through all orthogonal planes representative of its typical use and for both polarities of the measurement antenna to achieve the highest signal level. The worst-case position found was used for all radiated testing.

Table 1-1 Far-Field Distance & Measurement Distance per Frequency Range (Out-of-Band Testing)

Frequency Range [GHz]	Wavelength [centimeters]	Farfield Distance [meters]	Measurement Distance [meters]
18-40	0.750	0.65	1.00
40-57	0.526	0.99	1.00
71-90	0.333	0.71	1.00
90-140	0.214	0.54	1.00
240-200	0.150	0.32	1.00

Table 1-2 Far-Field Distance & Measurement Distance per Frequency Range (In-Band Testing)

Frequency Range [GHz]	Wavelength [centimeters]	Farfield Distance [meters]	Measurement Distance [meters]
57-71	0.422	0.60	1.00

Test Site Locations

Conducted EMI	AC line conducted emissions testing performed in a shielded screen room located at Rogers Labs, a division of The Compatibility Center LLC, 7915 Nieman Rd., Lenexa, KS (or satellite location).
Antenna port	Antenna port conducted emissions testing was performed in a shielded screen room located at Rogers Labs, a division of The Compatibility Center LLC, 7915 Nieman Rd., Lenexa, KS (or satellite location).
Radiated EMI	The radiated emissions tests were performed at the 3 meters Semi-Anechoic Chamber (SAC) located at Rogers Labs, a division of The Compatibility Center LLC, 7915 Nieman Rd., Lenexa, KS or at the 3 meters Outdoor Area Test Site (OATS) in the satellite location.

Registered Site information: FCC Site: US5305, ISED: 3041A, CAB Identifier: US0096

NVLAP Accreditation Lab code 200087-0

Units of Measurements

Conducted EMI Data presented in dBµV; dB referenced to one microvolt

Antenna port Conducted Data is in dBm; dB referenced to one milliwatt

Radiated EMI Data presented in dBµV/m; dB referenced to one microvolt per meter

Note: The limit is expressed for a measurement in dBµV/m when the measurement is taken at a distance of 3 or 10 meters. Data taken for this report was taken at distance of 3 meters. Sample calculation demonstrates corrected field strength reading for Semi-Anechoic Chamber using the measurement reading and correcting for receive antenna factor, cable losses, and amplifier gains.

Sample Calculation:

RFS = Radiated Field Strength, FSM = Field Strength Measured

A.F. = Receive antenna factor, Losses = attenuators/cable losses, Gain = amplification gains

RFS (dBµV/m @ 3m) = FSM (dBµV) + A.F. (dB/m) + Losses (dB) - Gain (dB)

Frequency: 9 kHz-30 MHz	Frequency: 30 MHz- 1 GHZ	Frequency: Above 1 GHz
Loop Antenna	Broadband Biconilog	Horn
RBW = 9 kHz	RBW = 120 kHz	RBW = 1 MHz
VBW = 30 kHz	VBW = 500 kHz	VBW = 3 MHz
Sweep time = Auto	Sweep time = Auto	Sweep time = Auto
Detector = PK, QP	Detector = PK, QP	Detector = PK, AV
Antenna Height 1m	Antenna Height 1-4m	Antenna Height 1-4m

Environmental Conditions

Ambient Temperature 23.3° C

Relative Humidity 48.0 %

Atmospheric Pressure 1021.6 mb

Statement of Modifications and Deviations

No modifications to the EUT were required for the equipment to demonstrate compliance with the 47CFR Part 15C, Industry Canada RSS-210 Issue 10, and RSS-GEN Issue 5 emission requirements. There were no deviations to the specifications.

Test Results

The following information is submitted supporting compliance with the requirements of 47CFR, Subpart C, paragraph 15.255, Industry Canada RSS-210 Issue 10, and RSS-GEN Issue 5.

Summary

FCC Part Section(s)	RSS Part Section(s)	Test Description	Test Limit	Test Condition	Test Results
15.255(e)(1)	RSS-210 Annex J.4.c	6dB Emission Bandwidth	N/A	RADIATED	PASS
2.1049	RSS-Gen [6.7]	99% Occupied Bandwidth	N/A		PASS
15.255(c)(1)(i)	RSS-210 Annex J.2.2.b	Equivalent Isotropic Radiated Power	43dBm (Peak) & 40dBm (Avg)		PASS
15.255(e)	RSS-210 Annex J.4.a	Peak Conducted Output Power	(EBW x 500 mW) / 100 MHz if EBW < 100MHz; 500 mW if EBW > 100MHz		PASS
15.255(d)	RSS-210 Annex J.3.c	Radiated Spurious Emissions (Above 40GHz)	90 pW/cm2 at a distance of 3 meters		PASS
15.205 15.209	RSS-Gen [8.9]	Radiated Spurious Emissions (Below 40GHz)	Emissions in restricted bands must meet the radiated limits detailed in 15.209 (RSS-Gen [8.9]		PASS
15.255(f)	RSS-210 Annex J.6	Frequency Stability	Fundamental emissions stay within authorized frequency block over the temperature and voltage ranges tested		
15.207	RSS-Gen [8.8]	AC Line Conducted Emissions (150kHz - 30MHz	< FCC 15.207 limits (RSS-Gen [8.8])	AC LINE CONDUCTED	PASS

6dB Emission Bandwidth

§15.255(e)(1); RSS-210 Annex J.4.c

Test Overview

The emission bandwidth is defined as the instantaneous frequency range occupied by a steady state radiated signal with modulation, outside which the radiated power spectral density never exceeds 6 dB below the maximum radiated power spectral density in the band, as measured with a 100 kilohertz resolution bandwidth spectrum analyzer.

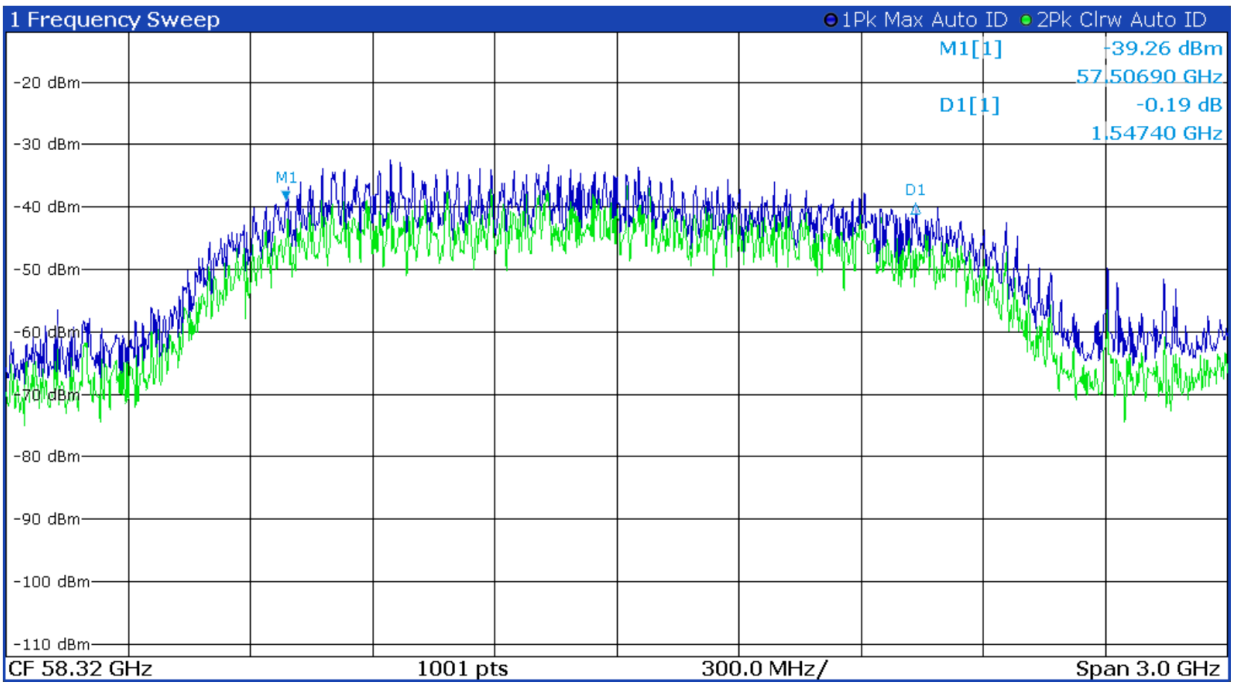
Test Procedure

ANSI C63.10-2013 Subclause 9.3

Test Setup

1. See Diagram 3 (18-200 GHz) for setup. Radiated measurements were taken in the far field.
2. All modes of operation were tried with the worst case configuration results being reported here.

Figure 1 6dB Emissions Bandwidth



Settings:

Center Freq: 58.32 GHz	Freq Offset: 0 Hz	Start: 56.82 GHz	Stop: 59.82 GHz
Span: 3 GHz	RBW: 100 kHz	Filter Type: Normal(3dB)	VBW: 300 kHz
SWT: 30 ms	Ref Level: -12 dBm	Level Offset: 0 dB	Rf Att: 10 dB
Input: 1 AC	Preamplifier: OFF	Preselector: Off	

Test Results

Channel 1, Modulation 6
Measured 6 dB Bandwidth = 1.547 GHz

Summary of Results for 6dB Emission Bandwidth

The EUT demonstrated compliance with the spurious emissions requirements of §15.255(e)(1) and RSS-210 Annex J.4.c.

99% Occupied Bandwidth

§2.1049; RSS-GEN 6.7

Test Overview

The occupied bandwidth (99% emission bandwidth) is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission.

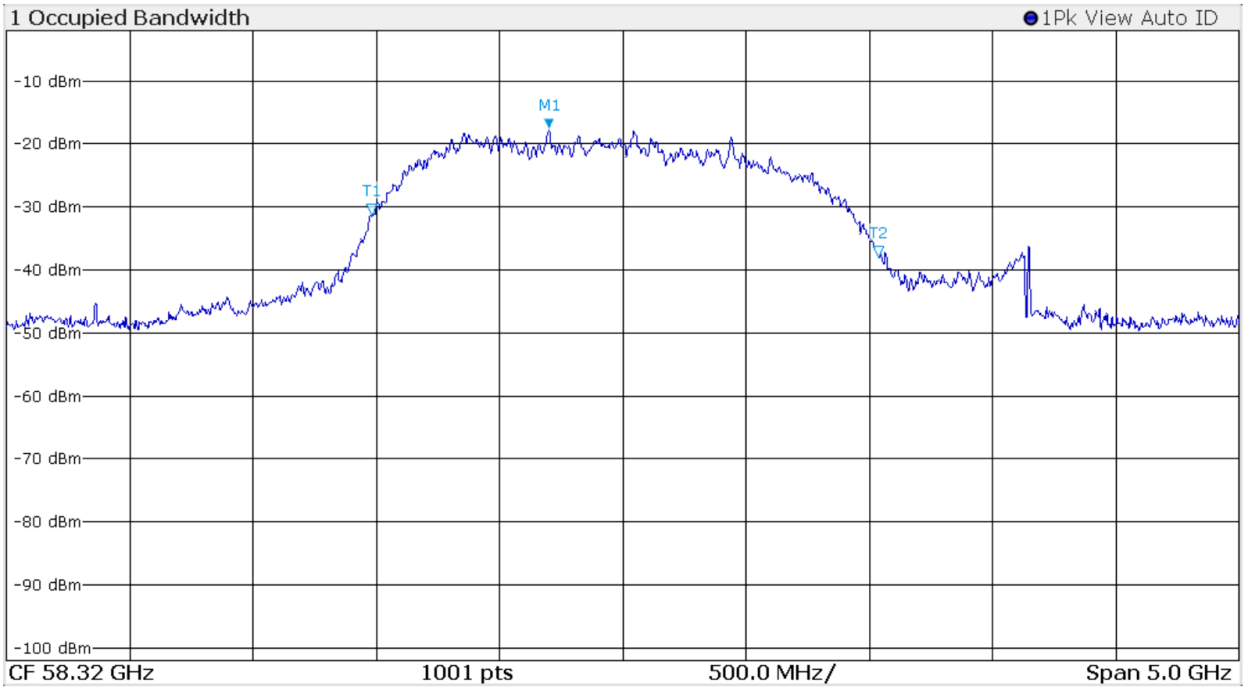
Test Procedure

ANSI C63.10-2013 Subclause 6.9.3
RSS-Gen [6.7]

Test Setup

1. See Diagram 3 (18-200 GHz) for setup. Radiated measurements were taken in the far field.
2. All modes of operation were tried with the worst case configuration results being reported here.

Figure 2 99% Occupied Bandwidth



Settings:

Center Freq: 58.32 GHz	Freq Offset: 0 Hz	Start: 55.82 GHz	Stop: 60.82 GHz
Span: 5 GHz	RBW: 10 MHz	Filter Type: Normal(3dB)	VBW: 10 MHz
SWT: 15 ms	Ref Level: -2 dBm	Level Offset: 0 dB	Rf Att: 10 dB
Input: 1 AC	Preamplifier: OFF	Preselector: Off	

Marker Table:

Type	Ref	Trace	X-Value	Y-Value	Function	Func Result
M1		1	58.02 GHz	-17.8 dBm	Occ Bw	2.054 GHz
T1		1	57.3 GHz	-31.4 dBm	Occ Bw Centroid	58.33 GHz
T2		1	59.36 GHz	-38 dBm	Occ Bw Freq Offset	10.74 MHz

Test Results

Channel 1, Modulation 6
Measured 99% Occupied Bandwidth = 2.054 GHz

Summary of Results for 99% Occupied Bandwidth

The EUT demonstrated compliance with the spurious emissions requirements of §2.1049 and RSS-GEN 6.7.

Equivalent Isotropic Radiated Power

§15.255(c)(1)(i); RSS-210 Annex J.2.2.b

Test Overview

Within the 57-71 GHz band, the average power of any emission shall not exceed +40 dBm and the peak power of any emission shall not exceed +43 dBm.

Test Procedure

ANSI C63.10-2013 Subclause 9.11

Test Setup

1. See Diagram 3 (18-200 GHz) for setup. Radiated measurements were taken in the far field.
2. All modes of operation were tried with the worst case configuration results being reported here.
3. The measurement equipment included a horn antenna and mixer to convert the 57-71 GHz fundamentals down to a frequency in the range of our ESW 44 receiver with maximum frequency capability of 44 GHz.

Sample Calculations

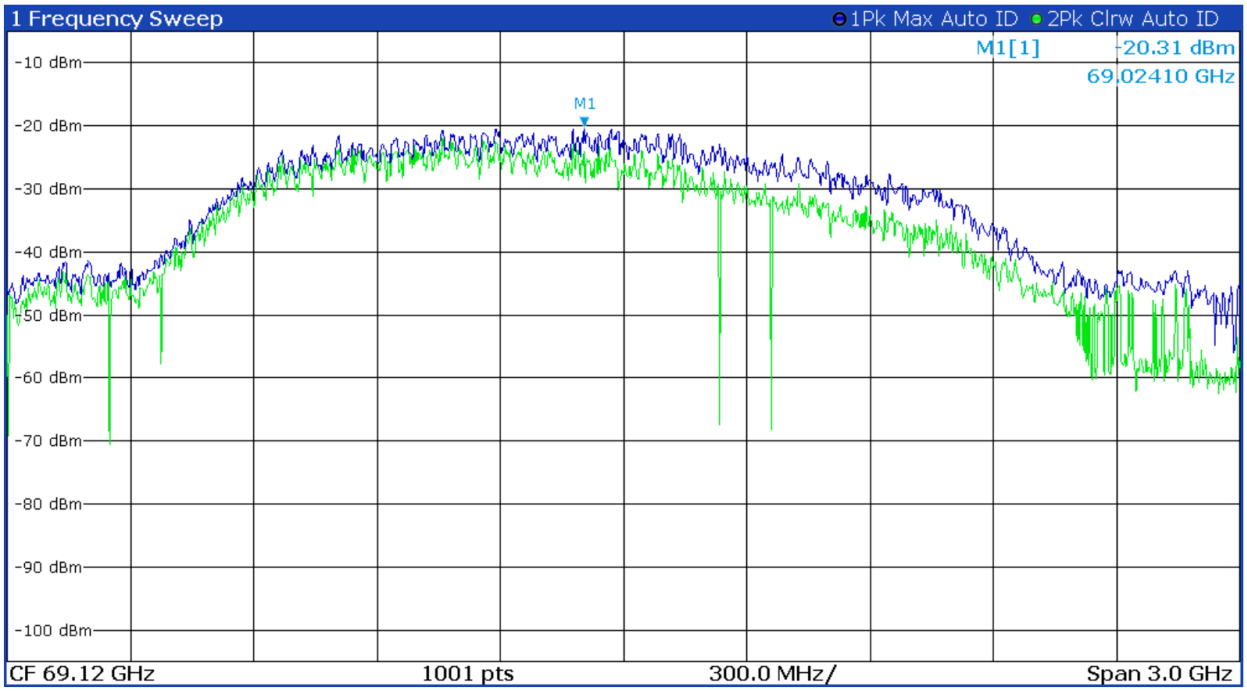
Calculating Field Strength:

$$E_{[dBuV/m]} = 126.8 - 20 \log_{10}(\gamma) + P - G$$

Where:

E	field strength of the emission at the measurement distance, in dBuV/m
P	power measured at the output of the test antenna, in dBm (including correction factors)
γ	wavelength of the emission under investigation [300 / fMHz], in m
G	gain of the test antenna, in dBi

Figure 3 EIRP Power



Center Freq: 69.12 GHz	Freq Offset: 0 Hz	Start: 67.62 GHz	Stop: 70.62 GHz
Span: 3 GHz	RBW: 3 MHz	Filter Type: Normal(3dB)	VBW: 3 MHz
SWT: 9 ms	Ref Level: -5 dBm	Level Offset: 0 dB	Rf Att: 10 dB
Input: 1 AC	Preamplifier: OFF	Preselector: Off	

Test Results

Measured Peak = -20.3 dBm
$\gamma = (3x10^8) / (69.12x10^9) = 0.00465$

$E_{[dBuV/m]} = 126.8 - 20 \log_{10}(\gamma) + P - G = 126.8 - 20 \log_{10}(0.00465)$ -20.3 – 16.156 =**137.0 dBuV/m**

EIRP = 137.0 + 20 $\log_{10}$ (distance) – 104.7 = 137.0 + 20 $\log_{10}$ (1) – 104.7 = **EIRP = 32.3 dBm (PASS)**

Table 1 EIRP Power

Frequency (GHz)	Calmode (Channel / Mod)	Test Distance (m)	EUT Peak (dBm)	Calculated Peak EIRP (dBm)	Peak EIRP Limit (dBm)	Peak EIRP (Watts)	Margin (dB)	Pass/Fail
58.32	1 / 6	1.0	-20.68	32.4	43.0	1.74	-10.6	PASS
64.80	4 / 1	1.0	-20.44	32.3	43.0	1.69	-10.7	PASS
69.12	6 / 6	1.0	-20.30	32.3	43.0	1.70	-10.7	PASS

Summary of Results for Radiated Emissions (Above 40 GHz)

The EUT demonstrated compliance with the spurious emissions requirements of §15.255(c)(1)(i); RSS-210 Annex J.2.2.b

Peak Conducted Output Power

§15.255(e); RSS-210 Annex J.4.a

Test Overview

EUT peak conducted power must be calculated to compare to corresponding limits

The peak transmitter output power shall not exceed 500mW for devices with an emission bandwidth greater than or equal to 100 MHz. If the emissions bandwidth is less than 100 MHz, the peak power shall be less than the emission bandwidth times 500mW divided by 100 MHz.

Test Procedure

ANSI C63.10-2013 Subclause 9.5

Test Setup

1. EBW (6dB BW) is measured as described above.
2. Peak EIRP is measured as described above.
3. Peak Conducted Output Power is calculated from EIRP.
4. Peak Conducted Output Power is compared to the limit.

Note: See Diagram 3 (18-200 GHz) for setup. Radiated measurements were taken in the far field.

Sample Calculations

Calculating Field Strength from substitution power:

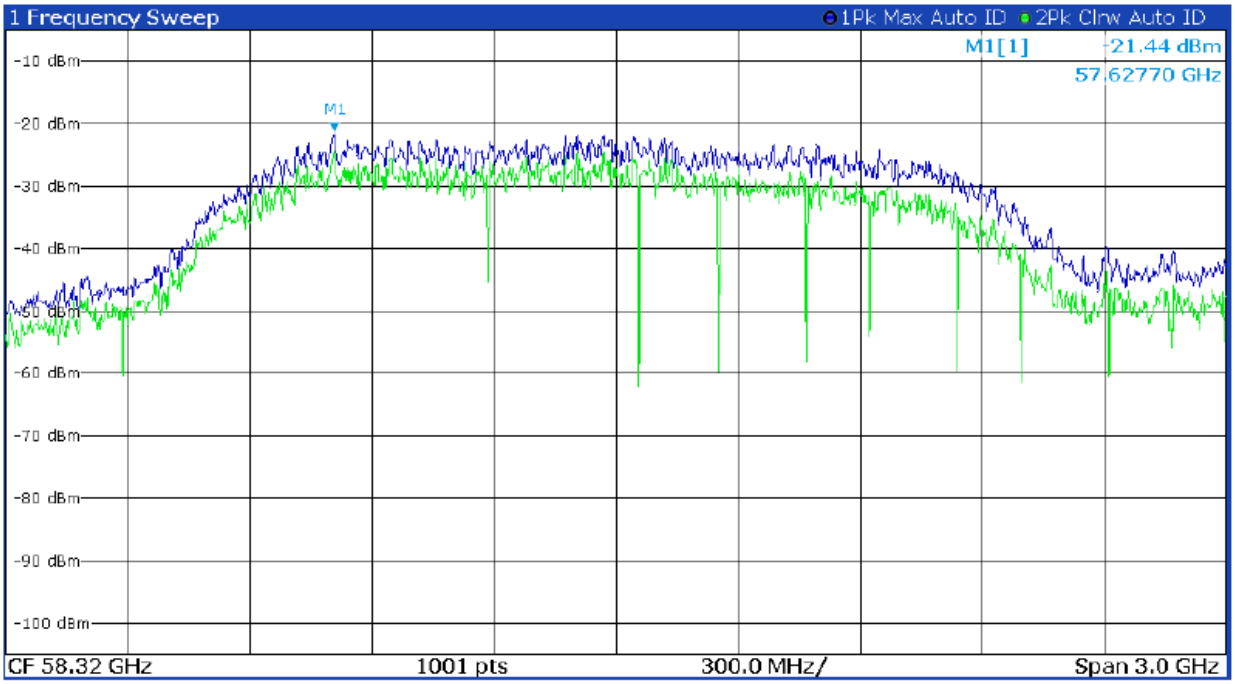
$$EIRP = P_{cond} + G_{EUT}$$

Where:

EIRP Equivalent Isotropically Radiated Power, in dBm
P_{cond} Measured power at feedpoint of the EUT antenna, in dBm
G_{EUT} Gain of the EUT radiating element (antenna), in dBi

$EIRP = P_{cond} + G_{EUT}$
$P_{cond} = EIRP - G_{EUT}$
$P_{cond} = 31.65$ dBm – 14.6757 dBi
$P_{cond} = 16.98$ dBm = 0.499 Watts = **499 mW (PASSES)**

Calmode	Frequency (GHz)	Wavelength	Test distance (m)	EUT Peak Measured (dBm)	Antenna Gain (dBi) @ Frequency	E[dBuV/m]	Calculated Pk EIRP (dBm)	Calculated Pd EIRP (Watts)	Peak Conducted Output Power (dBm)	Peak Conducted Output Power (Watts)
Calmode 1 1	57762600000.0	0.0051937	1.0	-22.69	14.6757	135.12	30.42	1.10	15.75	0.0376
Calmode 1 6	57627700000.0	0.0052058	1.0	-21.44	14.6757	136.35	31.65	1.46	16.98	0.0499
Calmode 1 a	58290000000.0	0.0051467	1.0	-24.54	14.6757	133.35	28.65	0.73	13.98	0.0250
Calmode 4 1	64800000000.0	0.0046296	1.0	-20.44	16.0622	136.99	32.29	1.69	16.22	0.0419
Calmode 4 6	64800000000.0	0.0046296	1.0	-20.68	16.0622	136.75	32.05	1.60	15.98	0.0397
Calmode 4 a	64800000000.0	0.0046296	1.0	-23.27	16.0622	134.16	29.46	0.88	13.39	0.0219
Calmode 6 1	68796300000.0	0.0043607	1.0	-20.37	16.1560	137.48	32.78	1.90	16.63	0.0460
Calmode 6 6	69024100000.0	0.0043463	1.0	-20.31	16.1560	137.57	32.87	1.94	16.72	0.0469
Calmode 6 a	69024100000.0	0.0043463	1.0	-27.39	16.1560	130.49	25.79	0.38	9.64	0.0092



Center Freq: 58.32 GHz	Freq Offset: 0 Hz	Start: 56.82 GHz	Stop: 59.82 GHz
Span: 3 GHz	RBW: 3 MHz	Filter Type: Normal(3dB)	VBW: 3 MHz
SWT: 9 ms	Ref Level: -5 dBm	Level Offset: 0 dB	Rf Att: 10 dB
Input: 1 AC	Preamplifier: OFF	Preselector: Off	

Summary of Results for Radiated Emissions (Above 40 GHz)

The EUT demonstrated compliance with the spurious emissions requirements of §15.255(e) and RSS-210 Annex J.4.a.

Radiated Spurious Emissions (Above 40GHz)

§15.255(d); RSS-210 Annex J.3.c

Test Overview

The power density of any emissions outside the 57-71 GHz band shall consist solely of spurious emissions. Between 40 GHz and 200 GHz, the level of these emissions shall not exceed 90 pW/cm^2 at a distance of 3 meters. The levels of the spurious emissions shall not exceed the level of the fundamental emission.

Test Procedure

ANSI C63.10-2013 Subclauses 9.8 & 9.9.

Test Setup

1. The emissions are measured in a radiated test setup while the EUT is operating at its maximum duty cycle, at maximum power and at the appropriate frequencies.
2. Scan the spectrum from 40 GHz to 200 GHz
3. Receiver setup:
    a. RBW = 1 MHz
    b. VBW = 3 MHz
    c. Detector = Peak
    d. Trace Mode = Max Hold
    e. Sweep Time = auto couple
    f. Number of Sweep points =/> 2 x Span/RBW
4. Compare results to the limit.

Note: See Diagram 3 (18-200 GHz) for setup. Radiated measurements were taken in the far field at 3m, per regulation.

Test Notes

1. Once again, all modes of operation were evaluated and the worst case configurations were used for this report.
2. Emissions above 40 GHz were made using horn antennas, harmonic mixers and our ESW 44 spectrum analyzer receiver supporting these configurations.
3. Measurements were made in the far field and in our 3m semi-anechoic chamber. Refer to table 1-1 for distance vs frequency calculations.

Sample Calculations

- Field Strength Level [dBuV/m] = Analyzer Level [dBm] + 107 + AFCL [dBm]
- AFCL [dBm] = Antenna Factor [dBm] + Cable Loss [dB] – Preamplifier Gain [dB]
- Margin [dB] = Field Strength Level [dBuV/m] – Limit [dBuV/m]
- RSE EIRP [dBm] = $E_{measured}$ [dBuV/m] + 20 $\log_{10}$ (distance measured) – 104.7
- PD (Power Density in pW/cm^2) = EIRP [pW] / ($4\pi D^2$)

Test Results

Figure 4.1 Radiated Spurious Emissions 40 – 60 GHz (Horizontal)

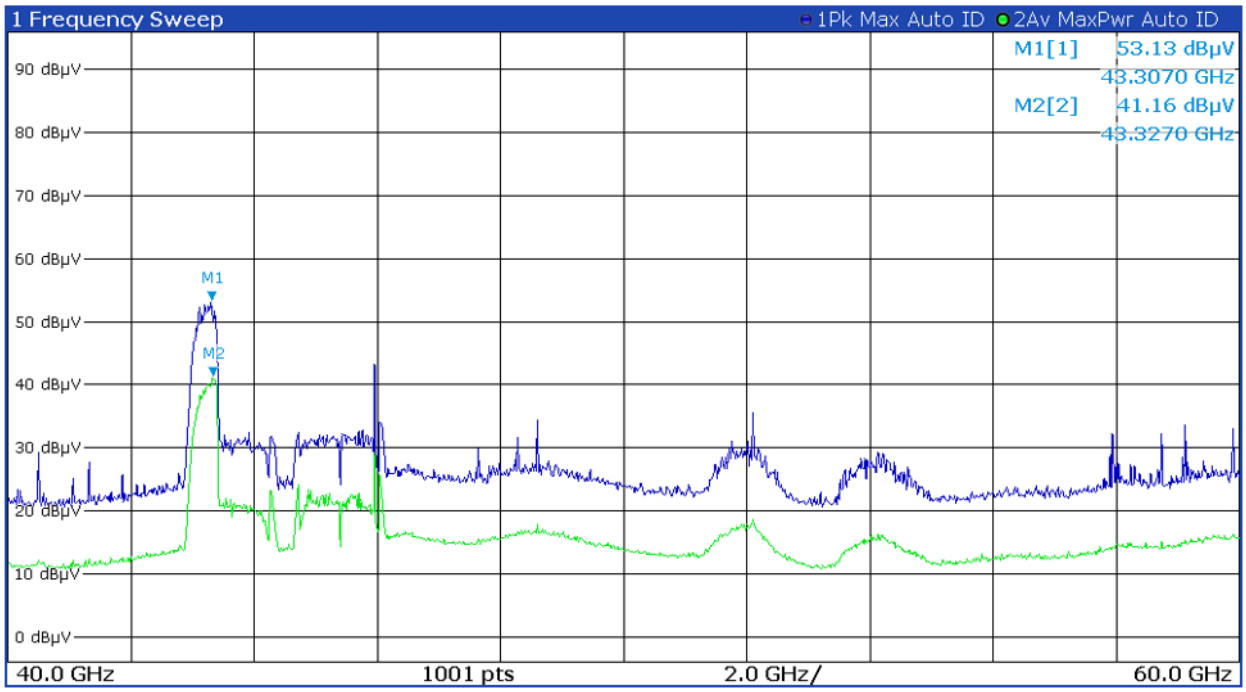


Figure 4.2 Radiated Spurious Emissions 40 – 60 GHz (Vertical)

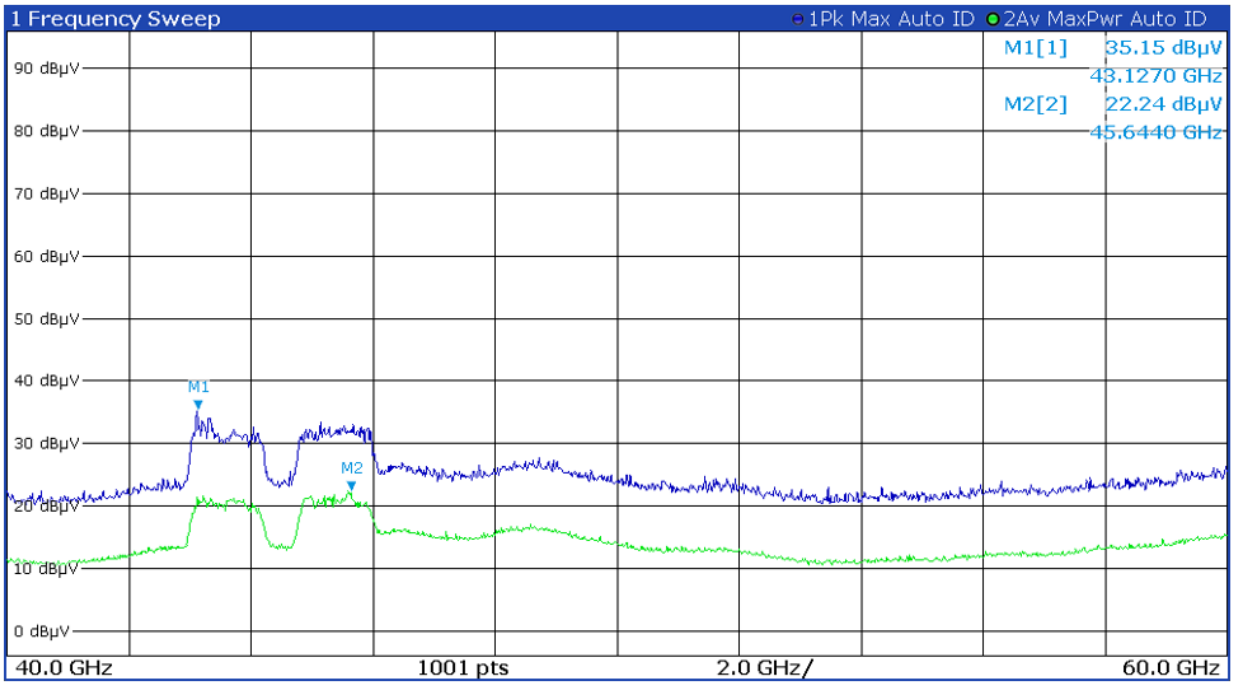


Figure 4.3 Radiated Spurious Emissions 60 – 90 GHz (Horizontal)

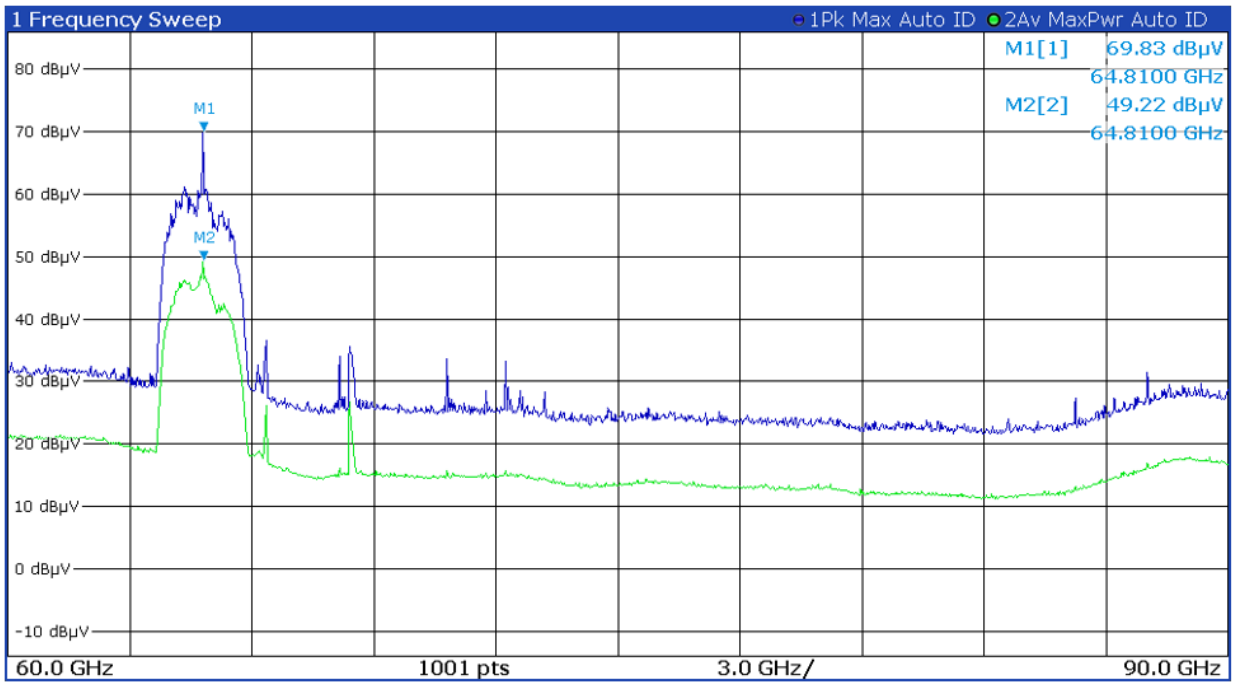


Figure 4.4 Radiated Spurious Emissions 60 – 90 GHz (Vertical)

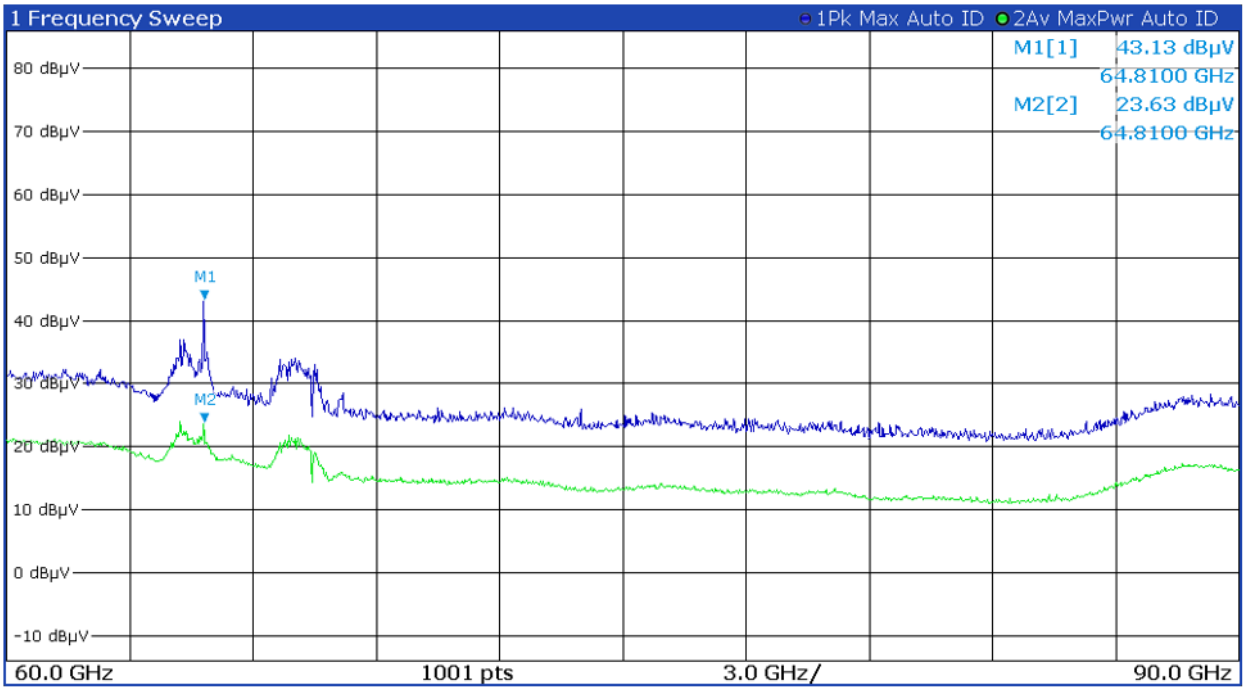


Figure 4.5 Radiated Spurious Emissions 90 – 140 GHz (Horizontal)

Figure 4.6 Radiated Spurious Emissions 90 – 140 GHz (Vertical)

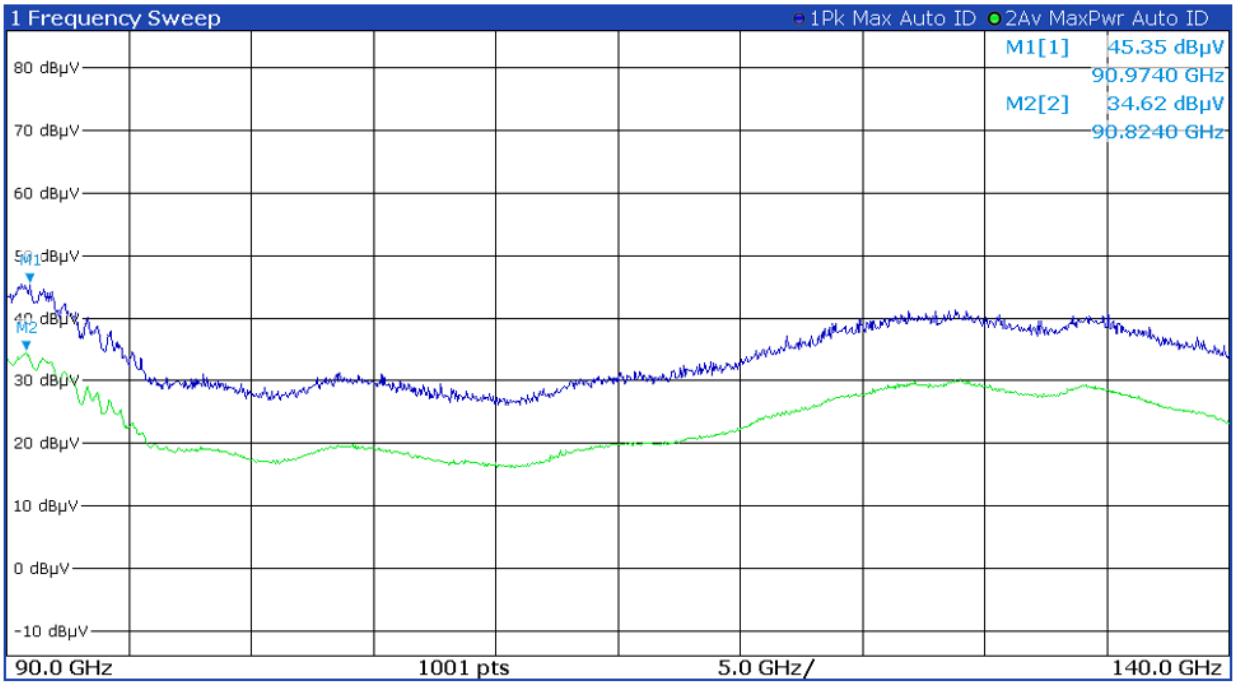


Figure 4.7 Radiated Spurious Emissions 140 – 220 GHz (Horizontal)

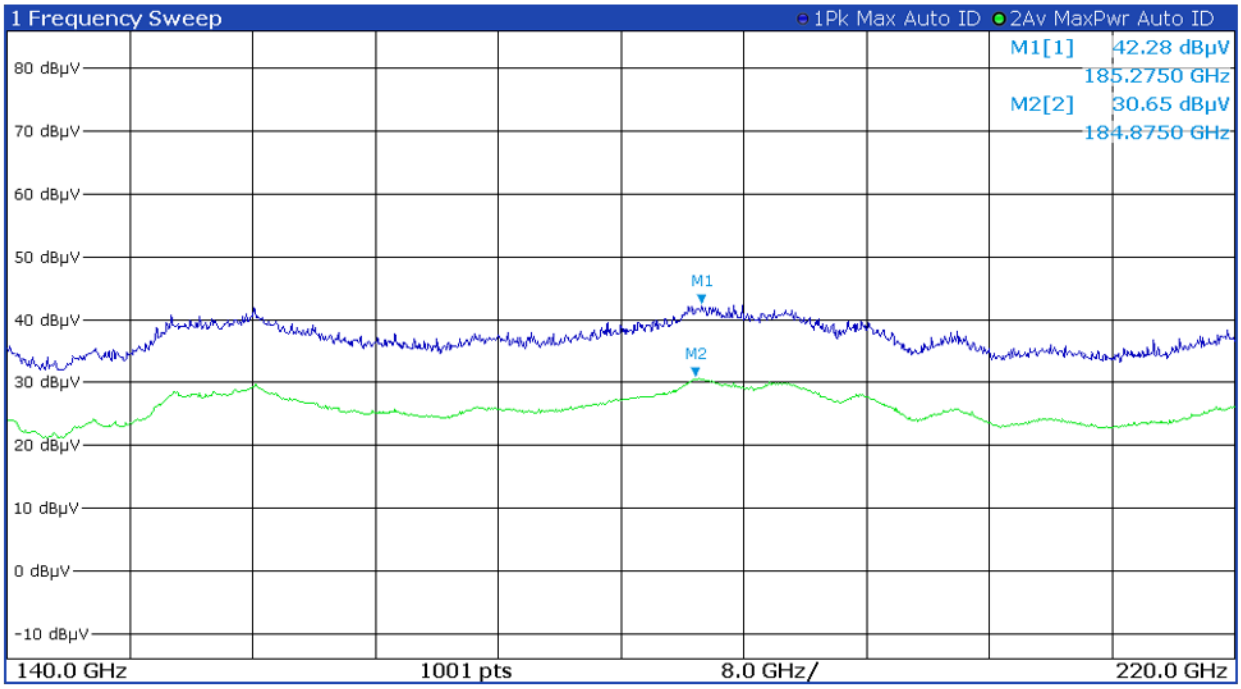


Figure 4.8 Radiated Spurious Emissions 140 – 220 GHz (Vertical)

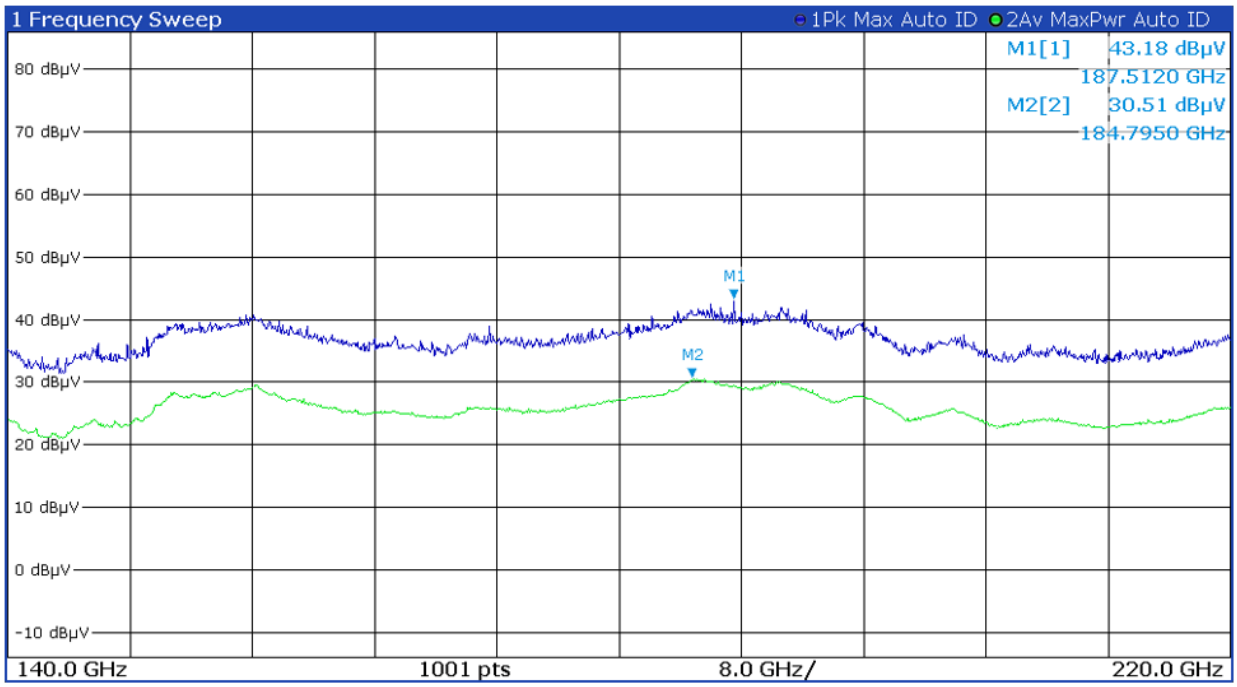


Table 2 Radiated Spurious Emissions 18 – 40 GHz

Modulation	Frequency (GHz)	Antenna Polarization	Field Strength @ 1 meters (dBuV/m)	RSE EIRP (dBm)	Power Density @ 3 meters (pW/cm^2)	Power Density @ 3 meters (pW/cm^2)	Pass/Fail
4 / 1	43.307	H	53.13	-51.57	0.0554	90	PASS
4 / 1	90.970	V	45.35	-59.35	0.0092	90	PASS
4 / 1	185.275	H	42.28	-62.42	0.0046	90	PASS
4 / 1	187.512	V	43.18	-61.52	0.0056	90	PASS

Summary of Results for Radiated Emissions (Above 40 GHz)

The EUT demonstrated compliance with the spurious emissions requirements of §15.255(d) and RSS-210 Annex J.3.c.

Radiated Spurious Emissions (1 - 40GHz)

§15.255(d); §15.205; §15.209; RSS-Gen [8.9]

Test Overview

The power density of any emissions outside the 57-71 GHz band shall consist solely of spurious emissions. Radiated emissions below 40 GHz shall not exceed the general limits in § 15.209. The levels of the spurious emissions shall not exceed the level of the fundamental emission.

All out of band emissions appearing in a restricted band as specified in Section 15.205 of the Title 47 CFR and Table 7 of RSS-Gen (8.10) must not exceed the limits shown in Table below per Section 15.209 and RSS-Gen (8.9).

Frequency (MHz)	Field Strength (uV/m)	Measured Distance (meters)
960 - 40,000	500.000	3

Test Procedure

ANSI C63.10-2013 Subclauses 9.13.

Test Setup

1. The emissions are measured in a radiated test setup while the EUT is operating at its maximum duty cycle, at maximum power and at the appropriate frequencies.
2. Scan the spectrum from 1 GHz to 40 GHz
3. Receiver setup (Average Field Strength):
    a. Analyzer center frequency set to that of radiated emission of interest
    b. RBW = 1 MHz
    c. VBW = 3 MHz
    d. Detector = power average (RMS)
    e. Trace (RMS) averaging performed over at least 100 traces
    f. Sweep Time = auto
    g. Number of Sweep points =/> 2 x Span/RBW
4. Receiver setup (Peak Field Strength):
    a. Analyzer center frequency set to that of radiated emission of interest
    b. RBW = 1 MHz
    c. VBW = 3 MHz
    d. Detector = Peak
    e. Trace mode = max hold
    f. Trace was stabilized over at least 100 traces
    g. Sweep Time = auto
    h. Number of Sweep points =/> 2 x Span/RBW

Note: See Diagram 3 (1 - 40 GHz) for setup. Radiated measurements were taken in the far field at 3m, per regulation.

Test Notes

1. Once again, all modes of operation were evaluated and the worst case configurations were used for this report.
2. Emissions 1 – 18 GHz were measured at 3m test distance while emissions from 18 – 40 GHz were measured at 1m with the application of a distance correction factor.
3. The plots that follow were used for the purpose of emission identification. Any emissions within 20dB of the limit are fully investigated and the results are shown in this section.

Sample Calculations

- Field Strength Level [dBuV/m] = Analyzer Level [dBm] + 107 + AFCL [dBm]
- AFCL [dBm] = Antenna Factor [dBm] + Cable Loss [dB] – Preamplifier Gain [dB]
- Margin [dB] = Field Strength Level [dBuV/m] – Limit [dBuV/m]
- RSE EIRP [dBm] = $E_{measured}$ [dBuV/m] + 20 $\log_{10}$ (distance measured) – 104.7
- PD (Power Density in pW/cm^2) = EIRP [pW] / ($4\pi D^2$)

Test Results

Figure 5.1 Radiated Spurious Emissions 1 – 18 GHz (Horizontal)

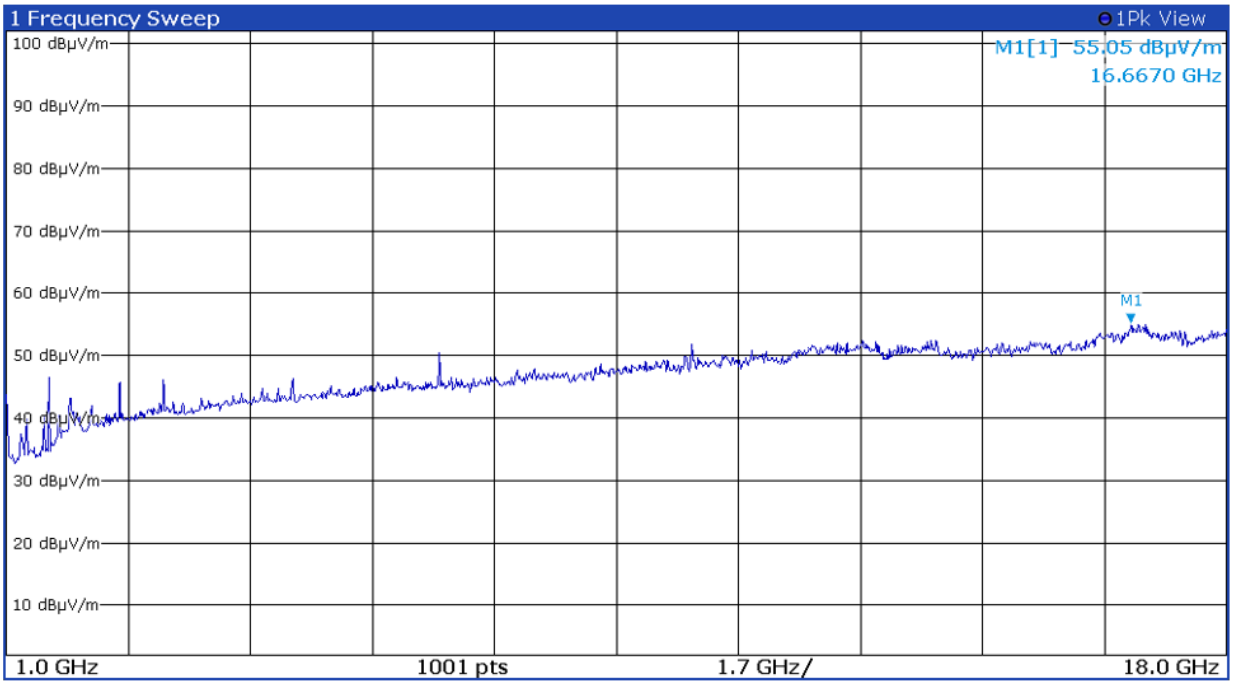


Figure 5.2 Radiated Spurious Emissions 1 – 18 GHz (Vertical)

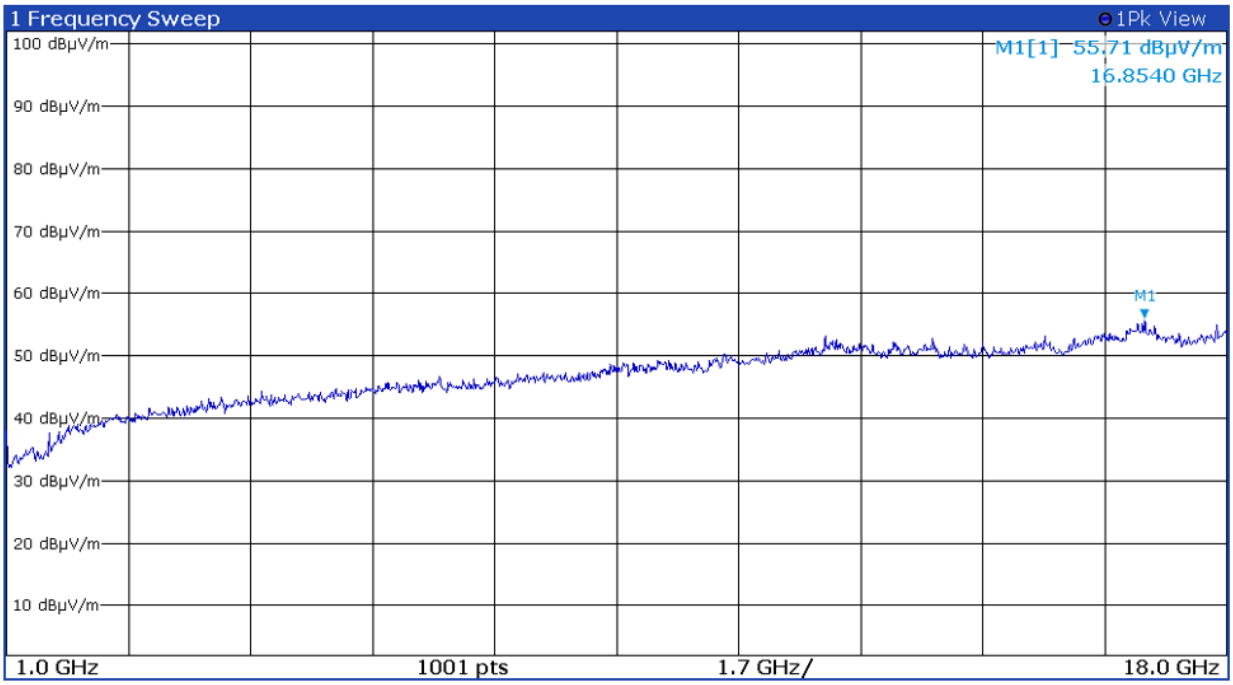


Table 3.1 Radiated Spurious Emissions 1 – 18 GHz

Modulation	Frequency (GHz)	Detector	Antenna Polarization	Antenna Height (cm)	Turntable Azimuth (Degrees)	Field Strength @ 3 meters (dBuV/m)	Field Strength Limit @ 3 meters (dBuV/m)	Margin (dB)	Pass/Fail
4 / 1	2.587	Peak	V	276	299	40.1	73.98	-33.88	PASS
4 / 1	2.587	Avg	V	276	299	27.3	53.98	-26.68	PASS
4 / 1	7.040	Peak	H	276	299	47.2	73.98	-26.78	PASS
4 / 1	7.040	Avg	H	276	299	34.6	53.98	-19.38	PASS
4 / 1	10.560	Peak	H	276	299	48.8	73.98	-25.18	PASS
4 / 1	10.560	Avg	H	276	299	36.6	53.98	-17.38	PASS
4 / 1	16.665	Peak	V	276	299	56.7	73.98	-17.28	PASS
4 / 1	16.665	Avg	V	276	299	42.5	53.98	-11.48	PASS

Modulation 4 / 1:
Channel 4 (64.80 GHz center)
Modulation 1 (MCS1 = π/2-BPSK)

Figure 5.3 Radiated Spurious Emissions 18 – 40 GHz (Horizontal)

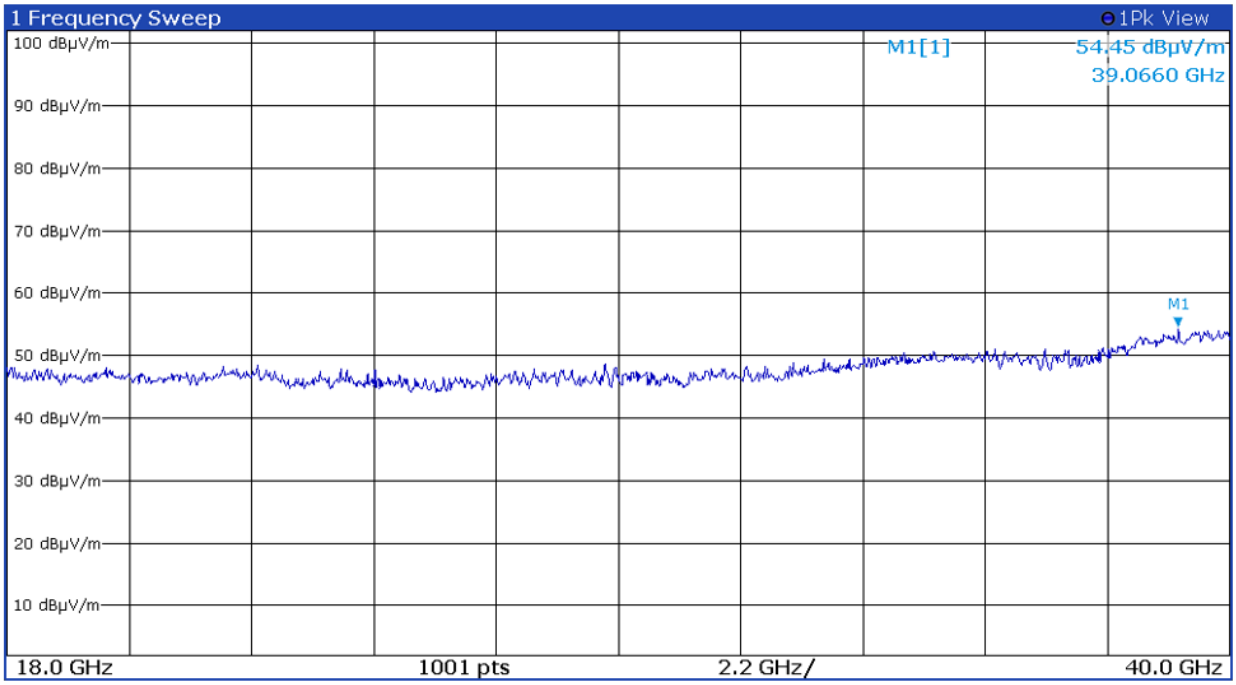


Figure 5.4 Radiated Spurious Emissions 18 – 40 GHz (Vertical)

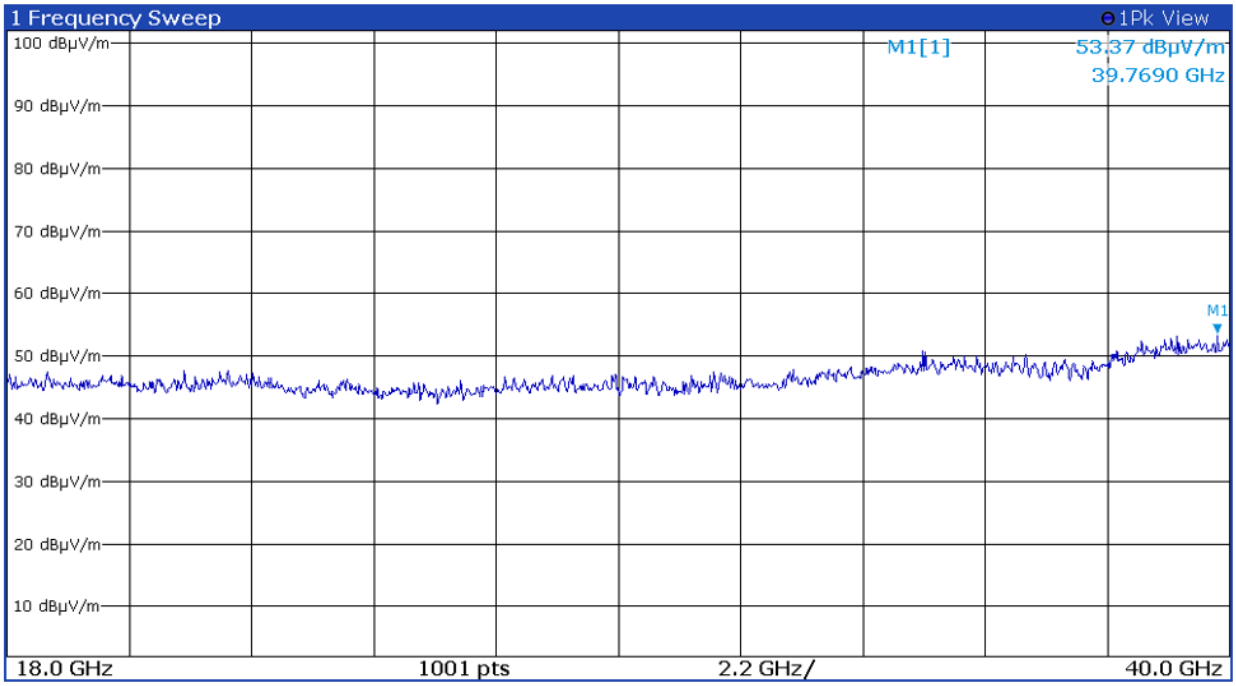


Table 3.2 Radiated Spurious Emissions 18 – 40 GHz

Modulation	Frequency (GHz)	Antenna Polarization	Field Strength @ 1 meters (dBuV/m)	RSE EIRP (dBm)	Power Density @ 3 meters (pW/cm^2)	Power Density @ 3 meters (pW/cm^2)	Pass/Fail
4 / 1	39.066	H	54.45	-50.25	0.075	90	PASS
4 / 1	39.769	V	53.37	-51.33	0.059	90	PASS

Modulation 4 / 1:
Channel 4 (64.80 GHz center)
Modulation 1 (MCS1 = $\pi/2$-BPSK)

Summary of Results for Radiated Emissions (1 – 40 GHz)

The EUT demonstrated compliance with the spurious emissions requirements of §15.255(d), §15.205, §15.209 and RSS-Gen [8.9]

Radiated Spurious Emissions (below 1 GHz)

§15.209; RSS-Gen [8.9]

Test Overview

All out of band radiated spurious emissions are measured with a spectrum analyzer connected to a receive antenna while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates and modes were investigated for radiated spurious emissions. Only the radiated emissions of the configuration that produced the worst case emission are reported in this section.

All out of band emissions appearing in a restricted band as specified in Section 15.205 of the Title 47 CFR and Table 7 of RSS-Gen (8.10) must not exceed the limits shown in Table below per Section 15.209 and RSS-Gen (8.9).

Frequency (MHz)	Field Strength (uV/m)	Measured Distance (meters)
0.009 - 0.490	2400/F (kHz)	300
0.490 - 1.705	24000/F (kHz)	30
1.705 - 30.00	30	30
30.00 - 88.00	100	3
88.00 - 216.00	150	3
216.00 - 960.00	200	3
960 - 40,000	500	3

Test Procedure

ANSI C63.10-2013 Subclauses 6.4 & 6.5.

Test Setup

1. Receiver setup (Quasi-Peak Field Strength):
    a. Analyzer center frequency set to that of radiated emission of interest
    b. RBW = 120 kHz (from 30MHz – 1GHz)
    c. VBW = 300 kHz
    d. Detector = Quasi-Peak
    e. Sweep Time = auto
    f. Trace mode = max hold
    g. Trace was stabilized over at least 100 traces
2. Receiver setup (Peak Field Strength):
    a. Analyzer center frequency set to that of radiated emission of interest
    b. RBW = 120 kHz
    c. VBW = 300 kHz
    d. Detector = Peak
    e. Sweep Time = auto
    f. Trace mode = max hold

Note: See Diagram 3 (< 1 GHz) for setup. Radiated measurements were taken in the far field at 3m, per regulation.

Test Notes

1. Once again, all modes of operation were evaluated and the worst case configurations were used for this report.
2. All emissions lying in the restricted bands specified in §15.205 and RSS-Gen [8.10] are below the limit shown in above table at beginning of this section.
3. Emissions were measured at 3 meter distance.
4. No spurious emissions were detected within 20dB of the limit below 30MHz.
5. The plots that follow were used for the purpose of emission identification. Any emissions within 20dB of the limit are fully investigated and the results are shown in this section.

Test Results

Figure 6.1 Radiated Spurious Emissions 30 MHz – 1 GHz (Horizontal / Tx On)

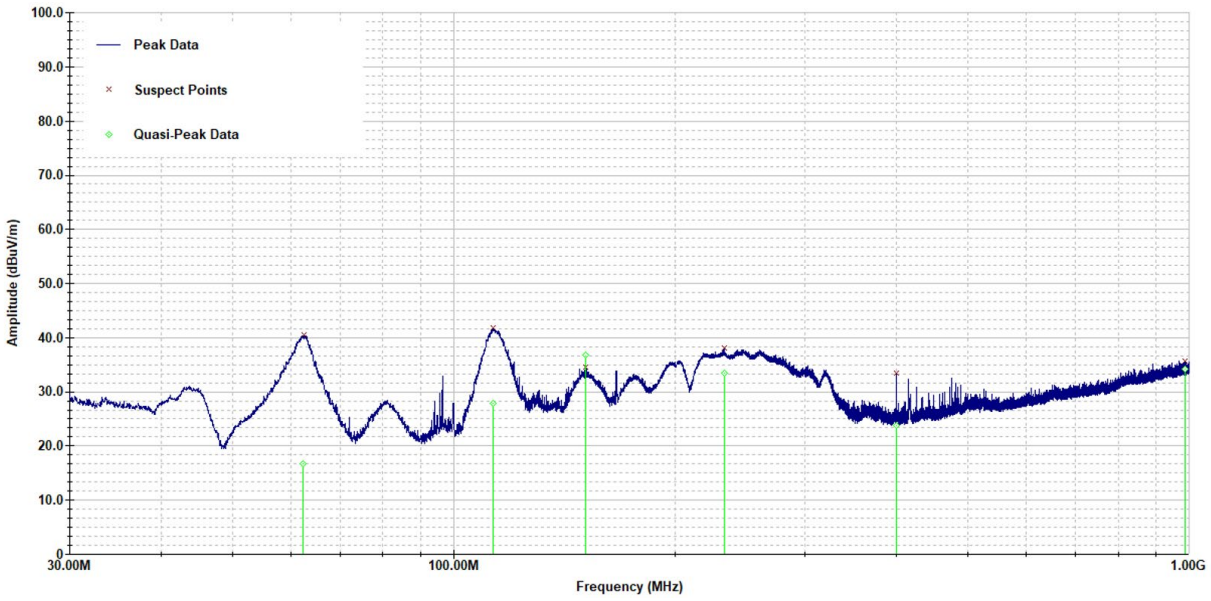


Figure 6.2 Radiated Spurious Emissions 30 MHz – 1 GHz (Vertical / Tx On)

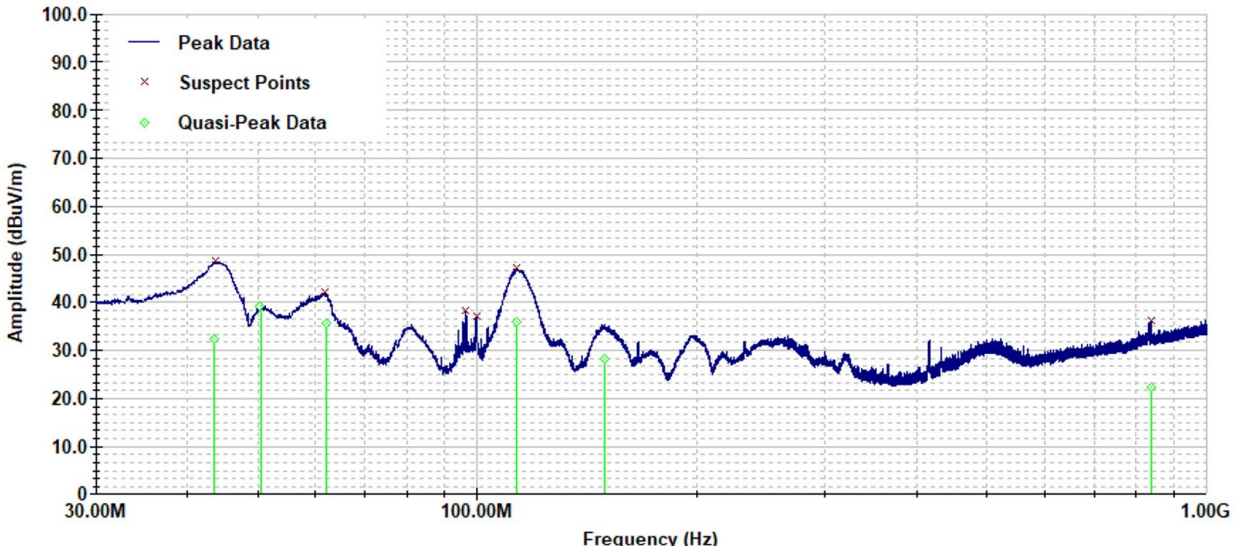


Table 4.1 Radiated Spurious Emissions 30 MHz – 1 GHz (Horizontal Polarization)

Frequency (GHz)	Antenna Orientation	Turntable Azimuth (Degrees)	Antenna Height (cm)	Peak (dBuV/m)	Quasi-Peak (dBuV/m)	Limit @ 3m (dBuV/m)	Margin (dB)	Pass/Fail
62.2	H	202	374	23.14	16.74	40.00	-23.26	PASS
113.0	H	117	154	32.44	27.87	43.52	-15.65	PASS
150.9	H	33	191	39.95	36.69	43.52	-6.83	PASS
233.3	H	205	137	37.77	33.53	46.02	-12.49	PASS
400.0	H	44	295	32.25	23.82	46.02	-22.20	PASS
986.6	H	0.0	378	42.27	34.2	46.02	-11.82	PASS

Other emissions present had amplitudes at least 20 dB below the limit. Peak and Quasi-Peak amplitude emissions are recorded for frequency range below 1000 MHz.

Table 4.2 Radiated Spurious Emissions 30 MHz – 1 GHz (Vertical Polarization)

Frequency (GHz)	Antenna Orientation	Turntable Azimuth (Degrees)	Antenna Height (cm)	Peak (dBuV/m)	Quasi-Peak (dBuV/m)	Limit @ 3m (dBuV/m)	Margin (dB)	Pass/Fail
43.5	V	155	118	34.98	32.49	40.00	-7.51	PASS
50.4	V	157	100	42.36	39.16	40.00	-0.84	PASS
62.0	V	281	100	38.78	35.72	40.00	-4.28	PASS
113.1	V	266	100	38.56	35.94	43.52	-7.58	PASS
149.3	V	160	100	31.31	28.35	43.52	-15.17	PASS
839.8	V	9.0	100	30.05	22.21	46.02	-23.81	PASS

Other emissions present had amplitudes at least 20 dB below the limit. Peak and Quasi-Peak amplitude emissions are recorded for frequency range below 1000 MHz.

Summary of Results for Radiated Emissions (below 1 GHz)

The EUT demonstrated compliance with the spurious emissions requirements of §15.209 and RSS-Gen [8.9]. The EUT demonstrated a minimum margin of -0.84 dB below the requirement. Other emissions were present with amplitudes at least 20 dB below the limit and worst-case amplitudes recorded.

AC Line Conducted EMI

Test Overview

All AC line conducted spurious emissions are measured with a receiver connected to a grounded LISN while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates and modes were investigated for AC Line conducted spurious emissions. Only the conducted emissions of the configuration that produced the worst case emissions are being reported.

All conducted emissions must not exceed the limits shown in the table below (refer to CFR section 15.207 and RSS-Gen section 8.8).

Class B 15.107 AC Mains	dBuV Quasi-Peak	dBuV Average
0.15 - 0.5	66 to 56*	56 to 46*
0.5 - 5	56.00	46.00
5 to 30	60.00	50.00

* Decreases with the logarithm of the frequency.

Test Procedure

ANSI C63.10-2013 Subclause 6.2.

Test Setup

1. Receiver setup (Quasi-Peak Field Strength):
    a. Analyzer center frequency set to that of radiated emission of interest
    b. RBW = 9 kHz (from 150kHz - 30MHz)
    c. Detector = Quasi-Peak
    d. Sweep Time = auto
    e. Trace mode = max hold
    f. Trace was allowed to stabilize
2. Receiver setup (Average Field Strength):
    a. Analyzer center frequency set to that of radiated emission of interest
    b. RBW = 9 kHz (from 150kHz - 30MHz)
    c. Detector = RMS
    d. Sweep Time = auto
    e. Trace mode = max hold
    f. Trace was allowed to stabilize

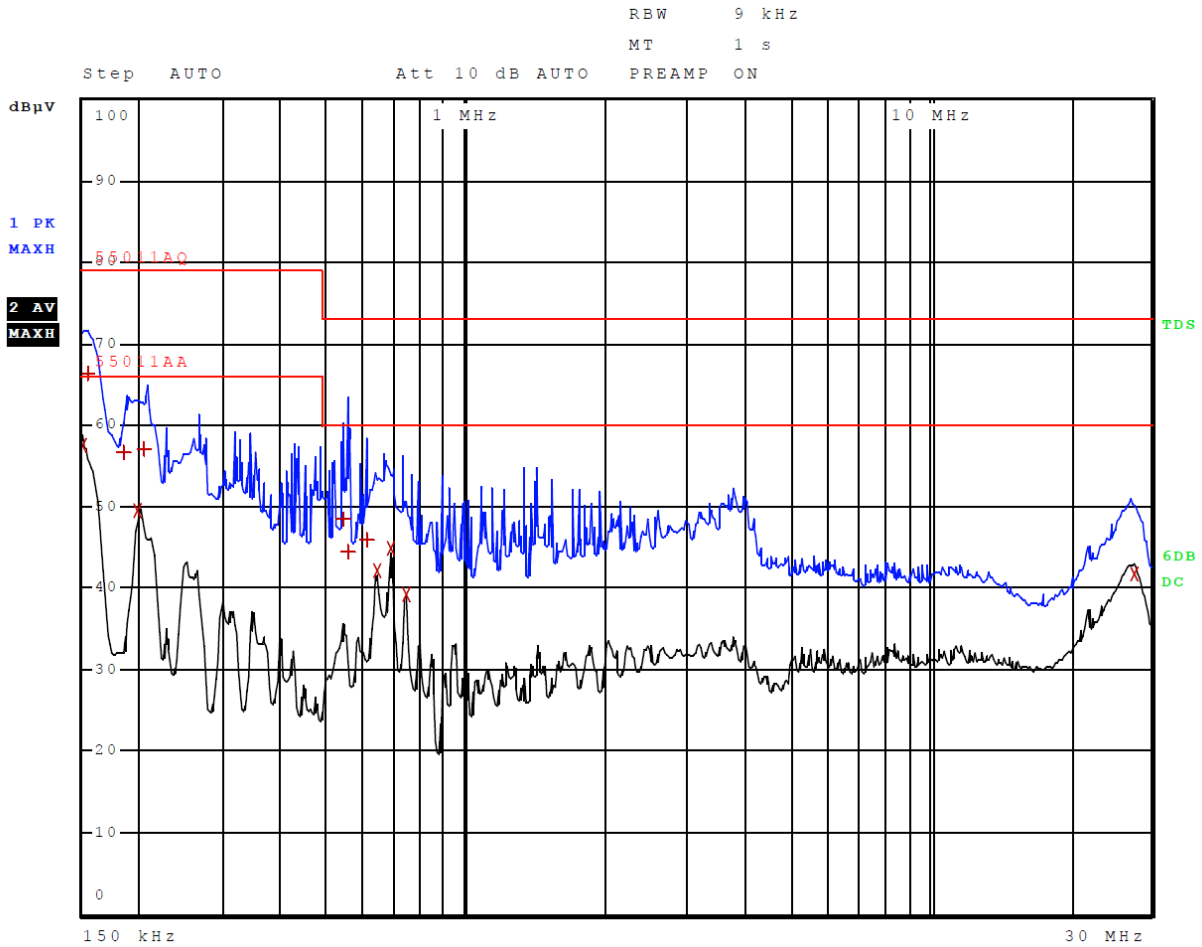
Note: See Diagram 1 for setup.

Test Notes

1. Once again, all modes of operation were evaluated and the worst case configurations were used for this report.
    a. Calmode 4 1 is worst case:
        i. Channel 4 (64.80 GHz center)
        ii. Modulation 1 (MCS1 = π/2-BPSK)
2. The limits from 150kHz to 30MHz are specified in CFR Part 15.207 and RSS-Gen (8.8).
3. Emissions were measured at 3 meter distance.
4. No spurious emissions were detected within 20dB of the limit below 150kHz.
5. Traces shown in plots below were made using quasi-peak and average detectors.
6. The following configuration was used for testing: EUT powered by PoE adapter via AC power from public utility.

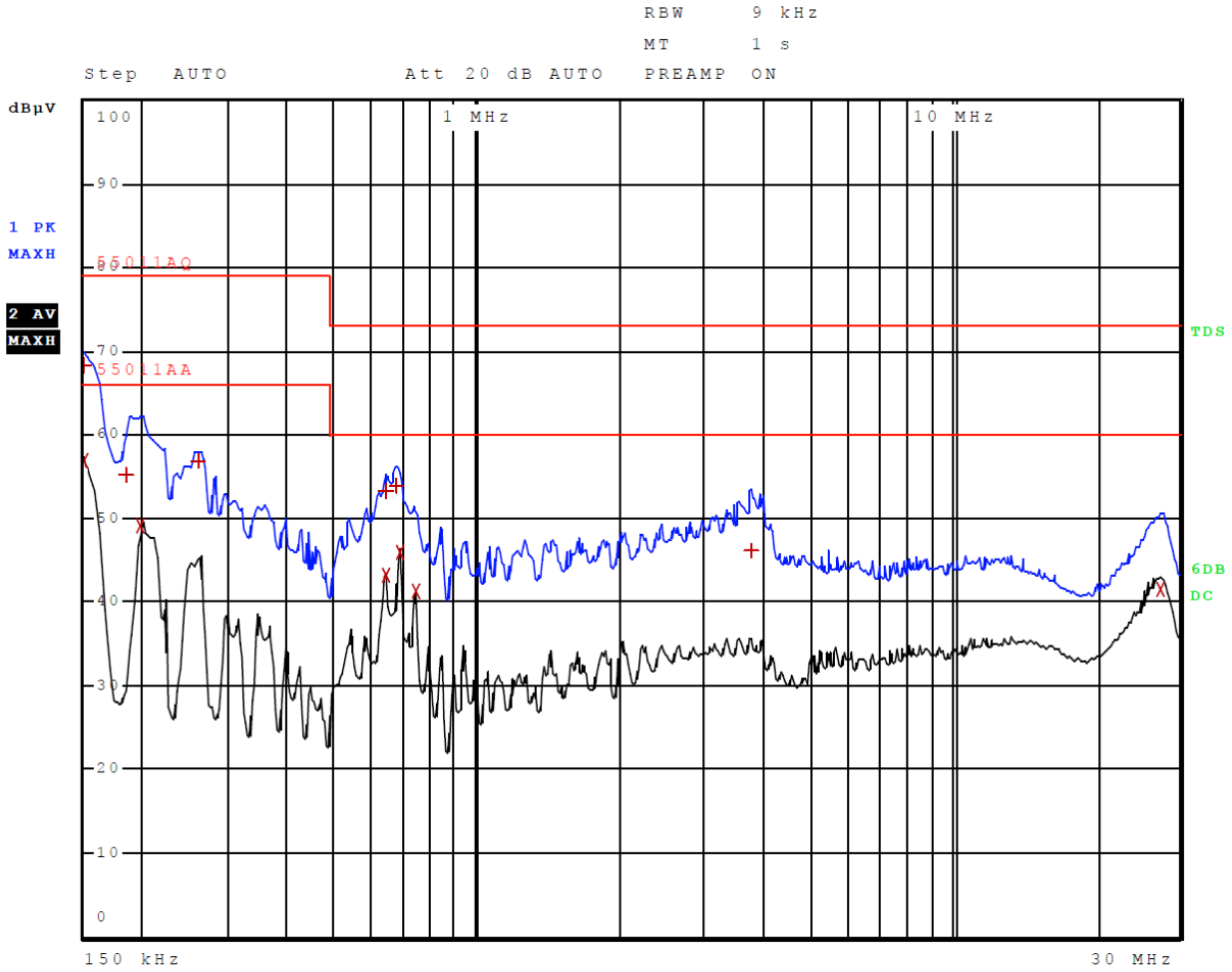
Test Results

Figure 7.1 AC Line Conducted Emissions Data L1 (PoE, Tx On)



Other emissions present had amplitudes at least 20 dB below the limit.

Figure 7.2 AC Line Conducted Emissions Data L2 (PoE, Tx On)



Other emissions present had amplitudes at least 20 dB below the limit.

Table 5.1 AC Line Conducted Emissions Data L1 (PoE, Tx On)

Trace	Frequency	Level (dBµV)	Detector	Delta Limit/dB
2	150.000000000 kHz	57.45	Average	-8.55
1	154.000000000 kHz	66.25	Quasi Peak	-12.75
1	186.000000000 kHz	56.70	Quasi Peak	-22.30
2	198.000000000 kHz	49.42	Average	-16.58
1	206.000000000 kHz	57.01	Quasi Peak	-21.99
1	542.000000000 kHz	48.43	Quasi Peak	-24.57
1	554.000000000 kHz	44.49	Quasi Peak	-28.51
1	610.000000000 kHz	45.96	Quasi Peak	-27.04
2	642.000000000 kHz	42.12	Average	-17.88
2	690.000000000 kHz	44.95	Average	-15.05
2	742.000000000 kHz	39.27	Average	-20.73
2	27.448000000 MHz	41.64	Average	-18.36

Other emissions present had amplitudes at least 20 dB below the limit.

Table 5.2 AC Line Conducted Emissions Data L2 (PoE, Tx On)

Trace	Frequency	Level (dBµV)	Detector	Delta Limit/dB
2	150.000000000 kHz	56.79	Average	-9.21
1	150.000000000 kHz	68.09	Quasi Peak	-10.91
1	186.000000000 kHz	55.22	Quasi Peak	-23.78
2	198.000000000 kHz	49.14	Average	-16.86
1	262.000000000 kHz	56.78	Quasi Peak	-22.22
2	642.000000000 kHz	43.13	Average	-16.87
1	642.000000000 kHz	53.35	Quasi Peak	-19.65
1	674.000000000 kHz	53.97	Quasi Peak	-19.03
2	690.000000000 kHz	45.87	Average	-14.13
2	742.000000000 kHz	41.19	Average	-18.81
1	3.778000000 MHz	46.20	Quasi Peak	-26.80
2	27.312000000 MHz	41.57	Average	-18.43

Other emissions present had amplitudes at least 20 dB below the limit.

Summary of Results for AC Line Conducted Emissions

The EUT demonstrated compliance with the AC Line Conducted Emissions requirements of 47CFR Part 15C, RSS-210 and RSS-Gen. The EUT demonstrated a minimum margin of -8.55 dB below the requirement. Other emissions were present with amplitudes at least 20 dB below the limit and worst-case amplitudes recorded.

Frequency Stability

§15.255(f); RSS-210 Annex J.6

Test Overview

Frequency stability testing is performed in accordance with the guidelines of ANSI C63.10-2013 Subclause 9.14. The frequency stability of the transmitter is measured while varying the following operating conditions:

1. Temperature: varied from -20C to +50C in 10C increments.
2. Primary supply voltage: The primary supply voltage is varied from 85% to 115% of rated input.

Fundamental emissions must be contained within the frequency bands specified in the according rule pars (57 – 71 GHz) during all conditions of operation.

Test Procedure

ANSI C63.10-2013 Subclause 9.14.

Test Setup

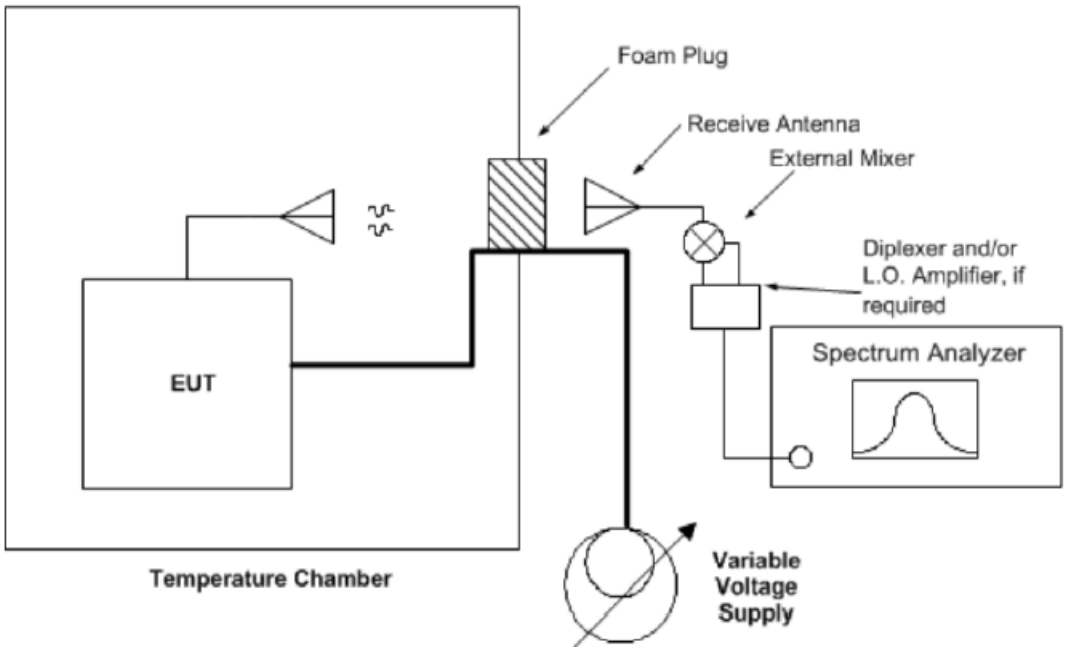
1. The spectral mask of the EUT emissions is measured at ambient room temp and nominal operating voltage for reference.
2. EUT primary supply voltage is varied between 85% and 115% of nominal (at room temp) and frequency variation is recorded.
3. With primary supply voltage set to nominal, the EUT operating temperature is varied from -20C to +50C. Frequency variation is then recorded.

Note: see diagram 4 for the test setup.

Test Notes

1. The spectrum mask of the EUT emission (notably F_{low} and F_{high}) is measured at ambient room temperature and nominal operating voltage to provide a reference.
2. EUT primary supply voltage is varied between 85% and 115% of the nominal supply voltage (at room temperature). Frequency excursion of the EUT emission mask is recorded at each of these conditions.
3. With EUT primary supply voltage at nominal level, frequency excursion of the EUT emission mask is recorded while varying the temperature between -20 and +50C.

Diagram 4 Frequency Stability Test Setup



Test Results

Table 6 Frequency Stability Measurements

Test Conditions	Transmitter Frequency Range (GHz)		Pass/Fail
	f_{low}	f_{high}	
-20 deg C / V_{nom}	57.2230	70.2002	PASS
-10 deg C / V_{nom}	57.2137	70.2048	PASS
0 deg C / V_{nom}	57.2305	70.1993	PASS
+10 deg C / V_{nom}	57.2359	70.1707	PASS
+20 deg C / V_{nom}	57.2198	70.1760	PASS
+30 deg C / V_{nom}	57.2216	70.2011	PASS
+40 deg C / V_{nom}	57.2770	70.1977	PASS
+50 deg C / V_{nom}	57.2228	70.1632	PASS
+20 deg C / 85% Voltage	57.2295	70.1985	PASS
+20 deg C / 115% Voltage	57.2305	70.2000	PASS

Summary of Results for Frequency Stability

The EUT demonstrated compliance with the spurious emissions requirements of §15.255(f) and RSS-210 Annex J.6.

Annex

- Annex A Measurement Uncertainty Calculations
- Annex B Test Equipment
- Annex C Laboratory Certificate of Accreditation

Annex A Measurement Uncertainty Calculations

The measurement uncertainty was calculated for all measurements listed in this test report according To CISPR 16–4. Result of measurement uncertainty calculations are recorded below. Component and process variability of production devices similar to those tested may result in additional deviations. The manufacturer has the sole responsibility of continued compliance.

Measurement	Expanded Measurement Uncertainty $U_{(lab)}$
3 Meter Horizontal 0.009-1000 MHz Measurements	4.16
3 Meter Vertical 0.009-1000 MHz Measurements	4.33
3 Meter Measurements 1-18 GHz	5.46
3 Meter Measurements 18-40 GHz	5.16
10 Meter Horizontal Measurements 0.009-1000 MHz	4.15
10 Meter Vertical Measurements 0.009-1000 MHz	4.32
AC Line Conducted	1.75
Antenna Port Conducted power	1.17
Frequency Stability	1.00E-11
Temperature	1.6˚C
Humidity	3%

Annex B Test Equipment

Equipment	Manufacturer	Model (SN)	Band	Cal Date(m/d/y)	Due
☒ LISN	FCC	FCC-LISN-50-25-10(1PA) (160611)	.15-30MHz	3/25/2024	3/25/2025
☐ LISN: Fischer Custom Communications Model: FCC-LISN-50-16-2-08				3/25/2024	3/25/2025
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(L10M)(303073)	9kHz-40 GHz	9/16/2024	9/16/2025
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(1.5M)(303069)	9kHz-40 GHz	9/16/2024	9/16/2025
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(1.5M)(303070)	9kHz-40 GHz	9/16/2024	9/16/2025
☒ Cable	Belden	RG-58 (L1-CAT3-11509)	9kHz-30 MHz	9/16/2024	9/16/2025
☐ Cable	Belden	RG-58 (L2-CAT3-11509)	9kHz-30 MHz	9/16/2024	9/16/2025
☒ Antenna	Com Power	AL-130 (121055)	.001-30 MHz	9/16/2024	9/16/2025
☐ Antenna:	EMCO	6509	.001-30 MHz	9/16/2024	9/16/2026
☒ Antenna	ARA	BCD-235-B (169)	20-350MHz	9/16/2024	9/16/2025
☒ Antenna	Sunol	JB-6 (A100709)	30-1000 MHz	9/16/2024	9/16/2025
☐ Antenna	ETS-Lindgren	3147 (40582)	200-1000MHz	9/16/2024	9/16/2026
☒ Antenna	ETS-Lindgren	3117 (200389)	1-18 GHz	3/25/2024	3/25/2026
☒ Antenna	Com Power	AH-118 (10110)	1-18 GHz	9/16/2024	9/16/2026
☒ Antenna	Com Power	AH-1840 (101046)	18-40 GHz	3/27/2023	3/27/2025
☒ Analyzer	Rohde & Schwarz	ESU40 (100108)	20Hz-40GHz	7/8/2024	7/8/2025
☒ Analyzer	Rohde & Schwarz	ESW44 (101534)	20Hz-44GHz	1/26/2024	1/26/2025
☐ Analyzer	Rohde & Schwarz	FS-Z60, 90, 140, and 220	40GHz-220GHz	12/22/2017	12/22/2027
☐ Amplifier	Com-Power	PA-010 (171003)	100Hz-30MHz	9/16/2024	9/16/2025
☐ Amplifier	Com-Power	CPPA-102 (01254)	1-1000 MHz	9/16/2024	9/16/2025
☒ Amplifier	Com-Power	PAM-118A (551014)	0.5-18 GHz	9/16/2024	9/16/2025
☒ Amplifier	Com-Power	PAM-840A (461328)	18-40 GHz	9/16/2024	9/16/2025
☒ Pwr Sensor	Rohde & Schwarz	NRP33T	0.05-33 GHz	9/26/2023	9/26/2025
☒ Power meter	Agilent	N1911A with N1921A	0.05-40 GHz	3/25/2024	3/25/2025
☒ Generator	Rohde & Schwarz	SMB100A6 (100150)	20Hz-6 GHz	3/25/2024	3/25/2025
☒ Generator	Rohde & Schwarz	SMBV100A6 (260771)	20Hz-6 GHz	3/25/2024	3/25/2025
☐ RF Filter	Micro-Tronics	BRC50722 (009).9G notch	30-18000 MHz	3/25/2024	3/25/2025
☐ RF Filter	Micro-Tronics	HPM50114 (017)1.5G HPF	30-18000 MHz	3/25/2024	3/25/2025
☐ RF Filter	Micro-Tronics	HPM50117 (063) 3G HPF	30-18000 MHz	3/25/2024	3/25/2025
☐ RF Filter	Micro-Tronics	HPM50105 (059) 6G HPF	30-18000 MHz	3/25/2024	3/25/2025
☒ RF Filter	Micro-Tronics	BRM50702 (172) 2G notch	30-18000 MHz	3/25/2024	3/25/2025
☒ RF Filter	Micro-Tronics	BRC50703 (G102) 5G notch	30-18000 MHz	3/25/2024	3/25/2025
☒ RF Filter	Micro-Tronics	BRC50705 (024) 5G notch	30-18000 MHz	3/25/2024	3/25/2025
☐ Attenuator	Fairview	SA6NFNF100W-40 (1625)	30-18000 MHz	3/25/2024	3/25/2025
☒ Attenuator	Mini-Circuits	VAT-3W2+ (1436)	30-6000 MHz	3/25/2024	3/25/2025
☒ Attenuator	Mini-Circuits	VAT-3W2+ (1445)	30-6000 MHz	3/25/2024	3/25/2025
☒ Attenuator	Mini-Circuits	VAT-3W2+ (1735)	30-6000 MHz	3/25/2024	3/25/2025
☒ Attenuator	Mini-Circuits	VAT-6W2+ (1438)	30-6000 MHz	3/25/2024	3/25/2025
☐ Attenuator	Mini-Circuits	VAT-6W2+ (1736)	30-6000 MHz	3/25/2024	3/25/2025

NVLAP Lab Code 200087-0

Equipment	Manufacturer	Model (SN)	Band	Cal Date(m/d/y)	Due
☐ Frequency Counter: Leader		LDC-825 (8060153)		3/28/2023	3/28/2025
☐ ISN	Com-Power	Model ISN T-8 (600111)		3/25/2024	3/25/2025
☐ LISN	Compliance Design	FCC-LISN-2.Mod.cd,(126)	.15-30MHz	9/16/2024	9/16/2025
☐ LISN:	Com-Power	Model LI-220A		9/16/2024	9/16/2026
☒ LISN:	Com-Power	Model LI-550C		9/16/2024	9/16/2025
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(1.5M)(303072)	9kHz-40 GHz	9/16/2024	9/16/2025
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(L1M)(281183)	9kHz-40 GHz	9/16/2024	9/16/2025
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(L4M)(281184)	9kHz-40 GHz	9/16/2024	9/16/2025
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(L10M)(317546)	9kHz-40 GHz	9/16/2024	9/16/2025
☒ Cable	Time Microwave	4M-750HF290-750 (L4M)	9kHz-24 GHz	9/16/2024	9/16/2025
☒ Cable	Mini-Circuits	KBL-2M-LOW+ (23090329)	9kHz-40 GHz	3/25/2024	3/25/2025
☐ RF Filter	Micro-Tronics	BRC17663 (001) 9.3-9.5 notch	30-1800 MHz	3/28/2023	3/28/2025
☐ RF Filter	Micro-Tronics	BRC19565 (001) 9.2-9.6 notch	30-1800 MHz	3/28/2023	3/28/2025
☒ Analyzer	HP	8562A (3051A05950)	9kHz-125GHz	3/25/2024	3/25/2025
☐ Wave Form Generator	Keysight	33500B (MY57400128)		3/25/2024	3/25/2025
☐ Antenna:	Solar	9229-1 & 9230-1		2/10/2024	2/10/2025
☐ CDN:	Com-Power	Model CDN325E		10/11/2022	10/11/2024
☐ Oscilloscope Scope:	Tektronix	MDO 4104		2/10/2024	2/10/2025
☐ EMC Transient Generator	HVT	TR 3000		2/10/2024	2/10/2025
☐ AC Power Source (Ametech, California Instruments)				2/10/2024	2/10/2025
☒ Field Intensity Meter: EFM-018				2/10/2024	2/10/2025
☒ ESD Simulator: MZ-15				2/10/2024	2/10/2025
☒ Weather station Davis		6152 (A70927D44N)		7/11/2024	7/11/2025
☐ Injection Clamp Luthi Model EM101				not required	
☐ R.F. Power Amp ACS 230-50W				not required	
☐ R.F. Power Amp EIN Model: A301				not required	
☐ R.F. Power Amp A.R. Model: 10W 1010M7				not required	
☐ R.F. Power Amp A.R. Model: 50U1000				not required	
☒ Temperature Chamber				not required	
☒ Shielded Room				not required	

Annex C Qualifications

Patrick Powell, Engineer

Rogers Labs, a division of The Compatibility Center LLC

Mr. Powell has approximately 40 years' experience in the field of electronics. Working experience includes automated test engineering in Military electronics; design & development in medical electronics; and application engineering / small business ownership in the semiconductor and display technology spaces.

Positions Held:

Test Engineer:	McDonnell Douglas (now Boeing)
	Allied Signal Aerospace (now Honeywell)
Electrical Engineer:	PPG Biomedical Systems
	Nellcor, Inc.
Applications Engineer / small business owner:	
	Sharp Electronics
	Lattice Semiconductor
EMC Test Engineering:	The Compatibility Center LLC (current)

Educational Background:

Bachelor of Science Degree in Electrical Engineering from Kansas State University

NVLAP Lab Code 200087-0

Annex D Laboratory Certificate of Accreditation

3/18/24 through 3/31/25:

United States Department of Commerce
National Institute of Standards and Technology

Certificate of Accreditation to ISO/IEC 17025:2017

NVLAP LAB CODE: 200087-0

Rogers Labs, a division of The Compatibility Center LLC
Lenexa, KS

is accredited by the National Voluntary Laboratory Accreditation Program for specific services, listed on the Scope of Accreditation, for:

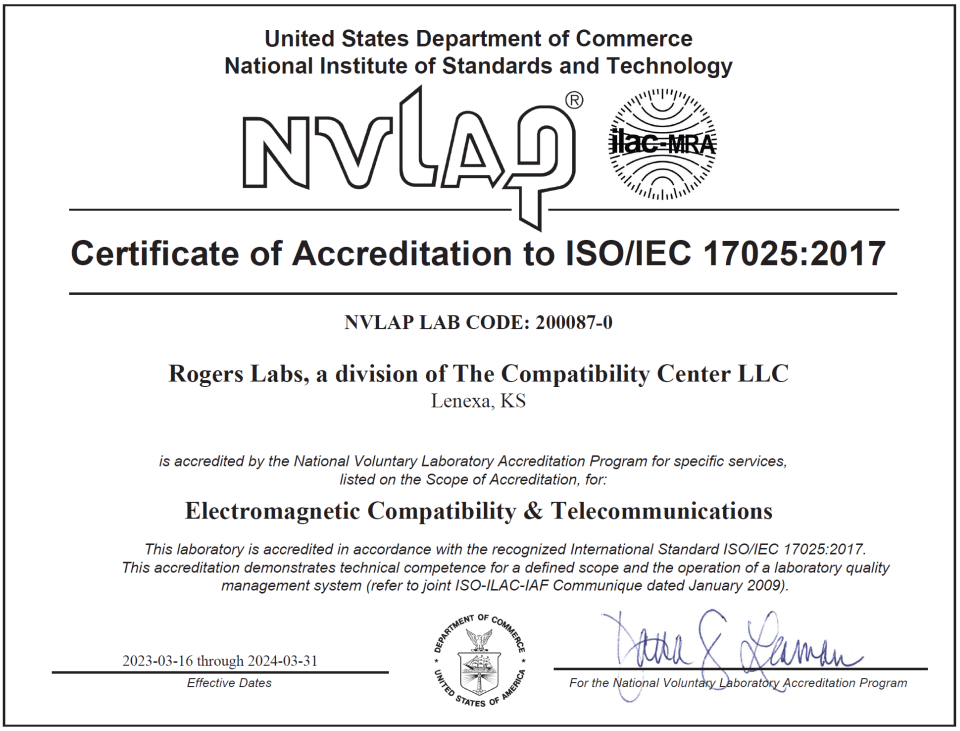
Electromagnetic Compatibility & Telecommunications

This laboratory is 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 joint ISO-ILAC-IAF Communique dated January 2009).

2024-03-18 through 2025-03-31
Effective Dates

For the National Voluntary Laboratory Accreditation Program

3/16/23 through 3/31/24:



United States Department of Commerce
National Institute of Standards and Technology

Certificate of Accreditation to ISO/IEC 17025:2017

NVLAP LAB CODE: 200087-0

Rogers Labs, a division of The Compatibility Center LLC
Lenexa, KS

is accredited by the National Voluntary Laboratory Accreditation Program for specific services, listed on the Scope of Accreditation, for:

Electromagnetic Compatibility & Telecommunications

This laboratory is 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 joint ISO-ILAC-IAF Communique dated January 2009).

2023-03-16 through 2024-03-31
Effective Dates

For the National Voluntary Laboratory Accreditation Program