FCC 47 CFR PART 15 SUBPART C
ISED RSS-210 ISSUE 11

TEST REPORT
FOR

60GHz Radar

MODEL NUMBER: PS01

FCC ID: 2BL2J-PS001
IC: 33216-PS001

REPORT NUMBER: R15489208-E2

ISSUE DATE: 2025-03-10

Prepared for
Deeplocal Inc
1601 Mary's Ave, Ste 3G
Sharpsburg, PA USA

Prepared by
UL LLC
12 LABORATORY DR.
RESEARCH TRIANGLE PARK, NC 27709 USA
TEL: (919) 549-1400

ACCREDITED
CERT #0751.06

Revision History

Rev.	Issue Date	Revisions	Revised By
V1	2025-02-04	Initial Issue	Henry Lindbo
V2	2025-02-13	Misc. editorial updates	Mike Antola
V3	2025-03-04	Misc. editorial update	Mike Antola
V4	2025-03-10	Updated Frequency Stability data	Henry Lindbo

UL LLC
12 Laboratory Dr., RTP, NC 27709 TEL: (919) 549-1400

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: Deeplocal Inc
1601 Mary's Ave, Ste 3G
Sharpsburg, PA, USA

EUT DESCRIPTION: 60GHz Radar

MODEL: PS01

SERIAL NUMBER: 04:91:62:41:f7:4f

SAMPLE RECEIPT DATE: 2024-11-14

DATES TESTED: 2024-11-20 to 2025-03-10

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
CFR 47 Part 15 Subpart C	Complies
ISED RSS-210 Issue 11 Annex J	Complies
ISED RSS-GEN Issue 5 + A1 + A2	Complies

UL LLC tested the above equipment in accordance with the requirements set forth in the above standards. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. All samples tested were in good operating condition throughout the entire test program. Measurement Uncertainties are published for informational purposes only and were not taken into account unless noted otherwise.

This document may not be altered or revised in any way unless done so by UL LLC and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL LLC will constitute fraud and shall nullify the document.

Approved & Released For
UL LLC By:

Mike Antola
Sr. Staff Engineer
CONSUMER TECHNOLOGY DIVISION
UL LLC

Prepared By:

Henry Lindbo
Associate project engineer
CONSUMER TECHNOLOGY DIVISION
UL LLC

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.10-2020, FCC CFR 47 Part 2, FCC CFR 47 Part 15, FCC KDB 364244 D01, RSS-GEN Issue 5 + A1 + A2, and RSS-210 Issue 11.

This report contains data provided by the applicant which can impact the validity of results. UL LLC is only responsible for the validity of results after the integration of the data provided by the customer.

3. FACILITIES AND ACCREDITATION

UL LLC is accredited by A2LA, Cert. No. 751.06, for all testing performed within the scope of this report. Testing was performed at the locations noted below.

	Address	ISED CABID	ISED Company Number	FCC Registration
☐	12 Laboratory Drive Research Triangle Park, NC 27709, U.S.A.	US0067	2180C	825374
☒	2800 Perimeter Dr., Suite B, Morrisville, NC 27560, U.S.A.		27265	

4. DECISION RULES AND MEASUREMENT UNCERTAINTY

4.1. METROLOGICAL TRACEABILITY

All test and measuring equipment utilized to perform the tests documented in this report are calibrated on a regular basis, with a maximum time between calibrations of one year or the manufacturers' recommendation, whichever is less, and where applicable is traceable to recognized national standards.

4.2. DECISION RULES

The Decision Rule is based on Simple Acceptance in accordance with ISO Guide 98-4:2012 Clause 8.2. (Measurement uncertainty is not taken into account when stating conformity with a specified requirement.)

4.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus.

PARAMETER	U_{LAB}	U_{MAX}
All emission, radiated	6 dB	±6 dB
Temperature	0.57 °C	±1 °C
Humidity	3.39 %	±5 %

Uncertainty figures are valid to a confidence level of 95%.

4.4. SAMPLE CALCULATION

RADIATED EMISSIONS

Where relevant, the following sample calculation is provided:

Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) – Preamp Gain (dB)

36.5 dBuV + 18.7 dB/m + 0.6 dB – 26.9 dB = 28.9 dBuV/m

MAINS CONDUCTED EMISSIONS

Where relevant, the following sample calculation is provided:

Final Voltage (dBuV) = Measured Voltage (dBuV) + Cable Loss (dB) + Limiter Factor (dB) + LISN Insertion Loss.

36.5 dBuV + 0 dB +10.1 dB+ 0 dB = 46.6 dBuV

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is a presence sensor that contains an FMCW radar. The chipset utilized in this device has an operating range of 60-64GHz, however, for this application, only a sub-section of this full range is utilized. In this case, the device is intended to operate from approximately 60.75-64GHz.

The radio module is manufactured by Texas Instruments.

5.2. OUTPUT POWER

The antenna is integral thus radiated measurements are made. The EIRP was measured at the worst-case condition, thus the EIRP measurement conditions correspond to the maximum EUT antenna gain. Therefore, the maximum antenna gain is used to calculate the conducted Peak Output Power.

The highest conducted peak output power is 5.44 dBm.

5.3. MANUFACTURER'S DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an integrated patch antenna array (IWR6843AOPEVM), with a maximum gain of 5 dBi. This is the only antenna variant that is used with this device.

5.4. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was version 2.16.2+e64fc34.

5.5. WORST-CASE CONFIGURATION AND MODE

The product only supports one transmit mode, so all testing was done with that mode.

To comply with spurious emissions in the 30 – 1000 MHz range, a shielded ethernet cable was required.

6. DESCRIPTION OF TEST SETUP

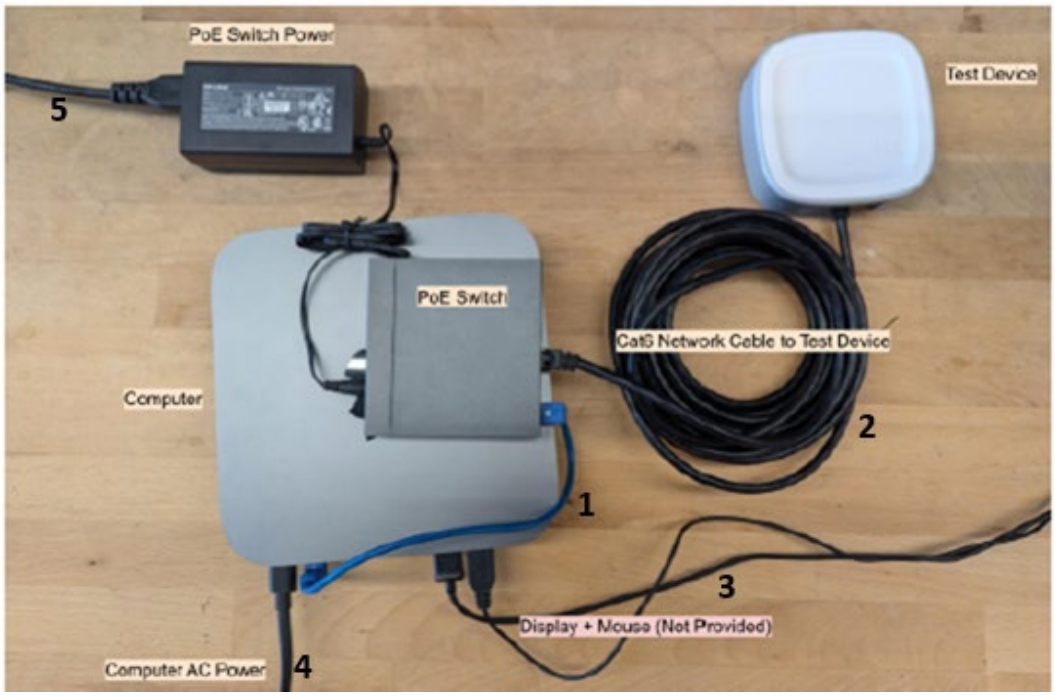
SUPPORT EQUIPMENT

Support Equipment List				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID**
Desktop computer	Apple	A1993	C07XR2F1JYVW	BCGA1993
POE injector	TP-Link	TL-SG1005P	Y23C0A5006020	-
Monitor for desktop	Viewsonic	VS15562	WAV2143G9011	-
Power supply for POE injector	TP-Link	T535131-2-DT	23C105 1429	-

I/O CABLES

I/O Cable List					
Cable No.	**Port**	**# of Identical Ports**	**Cable Type**	**Cable Length (m)**	**Remarks**
1	RJ45	2	Ethernet	<3m	Support equipment
2	RJ45	2	Ethernet	>3m	Shielded cable, Connected to EUT
3	HDMI	2	Digital video	<3m	Support equipment
4	US single phase	1	Single phase AC power	<3m	Support equipment
5	US single phase	1	Single phase AC power	<3m	Support equipment

TEST SETUP



7. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

Test Equipment Used – Frequency Stability Measurement Equipment

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
	Conducted Room 1				
206459	Spectrum Analyzer	Rohde & Schwarz	FSW50	2024-12-23	2025-12-23
207161	Signal Generator	Rohde and Schwarz	SMA100B	2024-07-11	2025-07-11
207726	Temp/Humid Chamber	Thermotron	SM-32-8200	2025-01-15	2026-01-15
179892	Environmental Meter	Fisher Scientific	15-077-963	2024-08-12	2025-08-12

Test Equipment Used - Line-Conducted Emissions – Voltage (Morrisville – Conducted 1)

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
CBL087	Coax cable, RG223, N-male to BNC-male, 20-ft.	Pasternack	PE3W06143-240	2024-04-04	2025-04-04
179892	Environmental Meter	Fisher Scientific	15-077-963	2024-08-12	2025-08-12
80391	LISN, 50-ohm/50-uH, 250uH 2-conductor, 25A	Fischer Custom Com.	FCC-LISN-50/250-25-2-01	2024-08-01	2025-08-01
75141	EMI Test Receiver 9kHz-7GHz	Rohde & Schwarz	ESCI 7	2024-08-01	2025-08-01
52859	Transient Limiter, 0.009-100MHz	Electro-Metrics	EM-7600	2024-04-04	2025-04-04
PS216	AC Power Source	Elgar	CW2501M	NA	NA
SOFTEMI	EMI Software	UL	Version 9.5 (18 Oct 2021)		
	Miscellaneous				
91432	LISN, 50-ohm/50-uH, 2-conductor, 25A (For support gear only.)	Solar Electronics	8012-50-R-24-BNC	NA	NA

Test Equipment Used - Radiated Disturbance Emissions Test Equipment (Morrisville – Chamber 2)

Equip. ID	Description	Manufacturer/Brand	Model Number	Last Cal.	Next Cal.
	0.009-30MHz				
135144	Active Loop Antenna	ETS-Lindgren	6502	2024-10-02	2025-10-02
	30-1000 MHz				
159203	Hybrid Broadband Antenna	Sunol Sciences Corp.	JB3	2024-03-05	2026-03-05
	1-18 GHz				
86408	Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz	ETS Lindgren	3117	2023-06-19	2025-06-19
	Gain-Loss Chains				
91975	Gain-loss string: 0.009-30MHz	Various	Various	2024-05-10	2025-05-10
91978	Gain-loss string: 25-1000MHz	Various	Various	2024-05-10	2025-05-10
91977	Gain-loss string: 1-18GHz	Various	Various	2024-07-17	2025-07-17
	Receiver & Software				
206496	Spectrum Analyzer	Rohde & Schwarz	ESW44	2024-08-29	2025-08-29
SOFTEMI	EMI Software	UL	Version 9.5 (18 Oct 2021)		
	Additional Equipment used				
200540	Environmental Meter	Fisher Scientific	15-077-963	2023-07-19	2025-07-19

Test Equipment Used - mmWave Test Equipment (Morrisville – Chamber 3)

Equip. ID	Description	Manufacturer/Brand	Model Number	Last Cal.	Next Cal.
	18-40 GHz				
204907	Horn Antenna, 18-26.5GHz	Com Power	AH-826	2024-02-14	2025-02-28
204908	Horn Antenna, 26.5-40GHz	Com Power	AH-640	2024-02-14	2025-02-28
240019	18-40GHz Amplifier	Amplical	AMP18G40-50	2024-03-05	2025-03-31
	40-50 GHz				
206209	Standard Gain Horn, 40-50GHz	Custom Microwave Inc.	HO22R	2024-02-14	2025-02-28
205910	Low Noise Amplifier	Eravant	SBL-3335033040-2222-E1	2024-03-14	2025-03-31
207949	Band Pass Filter	Eravant	SWF-4510460-2F2F-B1	2024-03-14	2025-03-31
	50-75 GHz				
206203	Standard Gain Horn, 50-75GHz	Custom Microwave Inc.	HO15R	2024-02-14	2025-02-28
206607	WR15 Downconverter	VDI	WR15.0SAX-F	2024-04-16	2025-04-30
205911	Low Noise Amplifier	Eravant	SBL-5037531850-1515-E1	2024-04-02	2025-04-30
170553	WR15 Downconverter	OML	C15H1DC01	2024-09-12	2025-09-12
	75-110 GHz				
206222	Standard Gain Horn, 75-110GHz	Custom Microwave Inc.	HO10R	2024-02-14	2025-02-28
207249	WR10 Downconverter	VDI	WR10.0SAX-F	2024-04-16	2025-04-30
205913	Low Noise Amplifier	Eravant	SBL-7531142050-1010-E1	2024-04-03	2025-04-30
	110-170 GHz				
206242	Standard Gain Horn, 110-170GHz	Custom Microwave Inc.	HO6R	2024-02-14	2025-02-28
206555	WR6.5 Downconverter	VDI	WR6.5SAX-F	2024-04-16	2025-04-30
205912	Low Noise Amplifier	Eravant	SBL-1141741860-0606-E1	2024-04-18	2025-04-30
	170-260 GHz				
206244	Standard Gain Horn, 170-260GHz	Custom Microwave Inc.	HO4R	2024-02-14	2025-02-28
206556	WR4.3 Downconverter	VDI	WR4.3SAX-F	2024-04-16	2025-04-30
	Receiver & Software				
214284	Spectrum Analyzer	Rohde & Schwarz	FSW50	2024-02-04	2025-02-04
mmWave	mmWave Software	UL	V2022.7.29		
	Additional Equipment used				

Equip. ID	Description	Manufacturer/Brand	Model Number	Last Cal.	Next Cal.
207161	Signal Generator	Rohde and Schwarz	SMA100B	2024-07-11	2025-07-11
206568	Isolator, 50-75GHz	Mi-Wave	115V/385	NA	NA
206569	Diode Detector, 50-75GHz	Mi-Wave	950V/385	NA	NA
239539	Environmental Meter	Fisher Scientific	15-077-963	2023-07-19	2025-07-19
208201	350 MHz High-Definition Oscilloscope	Teledyne Lecroy	HDO6034A	2023-12-21	2024-12-21
211004	200 MHz Low-Noise Voltage Amplifier	Femto	HVA-200M-40-B	NA	NA

Test Equipment Used - Radiated Disturbance Emissions Test Equipment (Morrisville – Chamber 4)

Equip. ID	Description	Manufacturer/Brand	Model Number	Last Cal.	Next Cal.
	30-1000 MHz				
90628	Hybrid Broadband Antenna	Sunol Sciences Corp.	JB3	2024-01-02	2026-01-02
	Gain-Loss Chains				
207639	Gain-loss string: 25-1000MHz	Various	Various	2024-05-22	2025-05-22
	Receiver & Software				
197955	Spectrum Analyzer	Rohde & Schwarz	ESW44	2024-04-16	2025-04-16
SOFTEMI	EMI Software	UL	Version 9.5 (18 Oct 2021)		
	Additional Equipment used				
241204	Environmental Meter	Fisher Scientific	15-077-963	2023-09-05	2025-09-05

Note: All equipment was in calibration at the time of test

8. SUMMARY TABLE

FCC Section	RSS Section	Test Description	Test Limit	Test Result
15.255 (c) (2) (iii)	RSS-210 J.3.2 b) (iii)	Peak EIRP FDS/Radar (57-64GHz)	14 dBm (25.5ms Off-Time per 33ms)	Complies
15.255 (e)	RSS-210 J.4 (b), J.4 (a)	Conducted Power (non-FDS/Radar)	500 mW (Peak)	Complies
15.255 (d)	RSS-210 J.4, J.5	Spurious Emissions < 40GHz	FCC 15.209 RSS-Gen	Complies
15.255 (d)	RSS-210 J.4, J.5	Spurious Emissions 40 – 200GHz	90 pW/cm^2	Complies
15.255 (f)	RSS-210 J.6	Frequency Stability	Within Band	Complies
15.255 (h)	RSS-210 J.7	Group installation	No Beam Forming / Phase Locking	Complies

9. APPLICABLE LIMITS AND TEST RESULTS

9.1. FAR-FIELD DISTANCE AND MEASUREMENT DISTANCE

The measurement distance is in the far field per formula $2D^2/\lambda$ where D is the largest dimension of the antenna.

For fundamental / band edge emissions, the largest far-field distance of either the EUT antenna or measurement antenna shall be used. In this case, the measurement antenna has the largest far-field distance. For above 18 GHz spurious emissions, the far-field distance shall be based on the measurement antenna. The EUT is manipulated through all orthogonal planes representative of its typical use to achieve the highest EIRP reading on the receive spectrum analyzer.

Frequency Range (GHz)	Wavelength (m)	Rx Antenna max dim. (m)	Far Field Distance (m)	Measurement Distance Used (m)
18-26.5	0.0113	0.104	1.91	3.00
26.5-40	0.0075	0.074	1.48	3.00
40-50	0.0060	0.055	1.01	3.00
50-75	0.0040	0.037	0.66	3.00
75-110	0.0027	0.025	0.45	3.00
110-170	0.0018	0.016	0.29	3.00
170-200	0.0012	0.011	0.19	3.00

Radiated spurious emissions limits above 40 GHz are based on a 3-meter measurement distance. As such, testing from 40-200 GHz was performed at 3-meters.

In-band testing was performed at a 3-meter distance, which was still in the far-field based on the maximum EUT / measurement antenna dimension.

Radiated power levels are investigated while the receive antenna was rotated through all angles to determine the worst-case polarization/positioning. The worse-case orientation of the EUT was with the front fact facing the RX antenna, which was polarized vertically. Refer to test setup photos exhibit for details.

9.2. DUTY CYCLE

REQUIREMENT

§15.215 (c) (2) (iii) (A)

The peak EIRP shall not exceed 14 dBm, and the sum of continuous transmitter off-times of at least two milliseconds shall equal at least 25.5 milliseconds within any contiguous interval of 33 milliseconds, except as specific in paragraph (c)(2)(iii)(B) of this section;

TEST PROCEDURE

The fundamental is measured using a Standard Gain Horn Antenna, Low Noise Amplifier and a Diode Detector connected to an Oscilloscope. Pulse widths, burst lengths, and periods are measured, then the duty cycle is calculated.

RESULTS

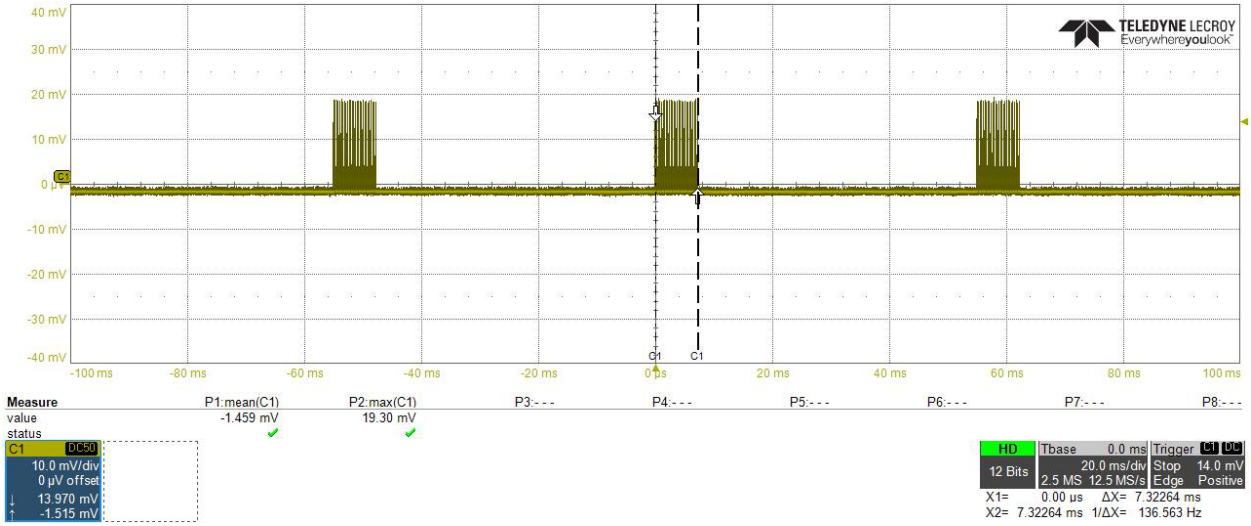
Duty cycle linear = (Burst On Time / Burst Period) * (Chirp On Time / Chirp Period)
Duty cycle % = Duty cycle linear * 100

Burst ON Time (ms)	Burst Period (ms)	Chirp ON Time (us)	Chirp Period (us)	Total DC (%)	OFF Time (ms)	Minimum OFF Time (ms)
7.323	54.883	58.226	88.416	8.787	47.560	25.5

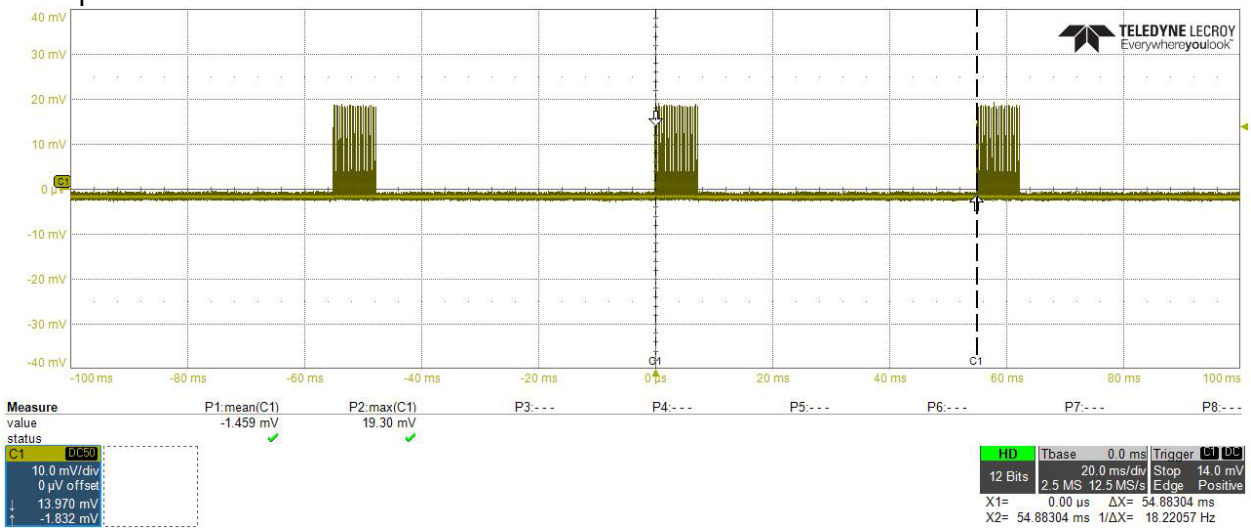
TESTED BY

Employee IDs: 23854
Test Dates: 12-05-2024
Test Location: Chamber 3

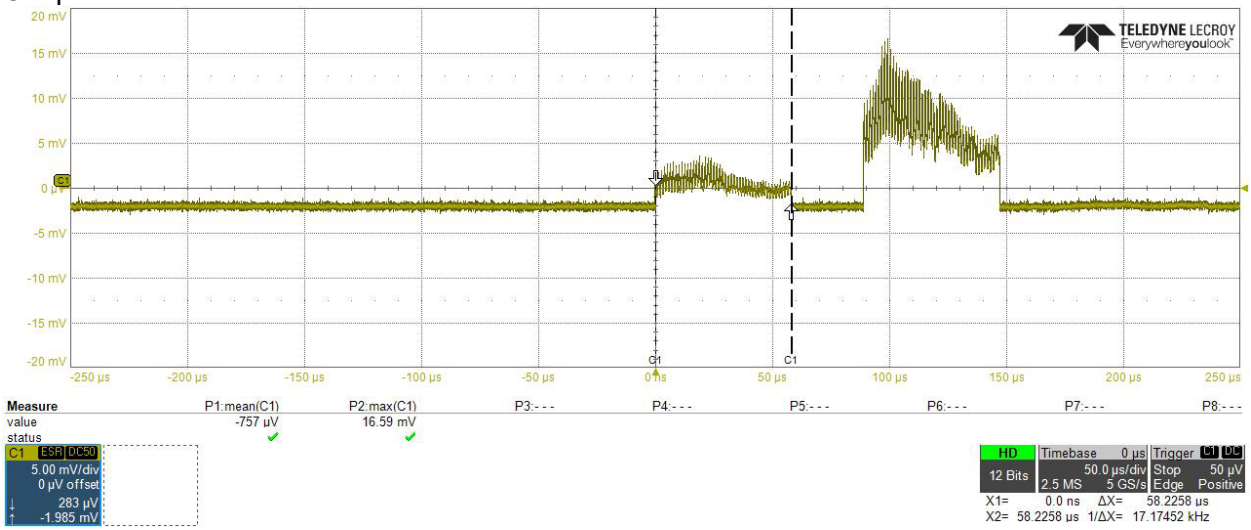
Burst on time



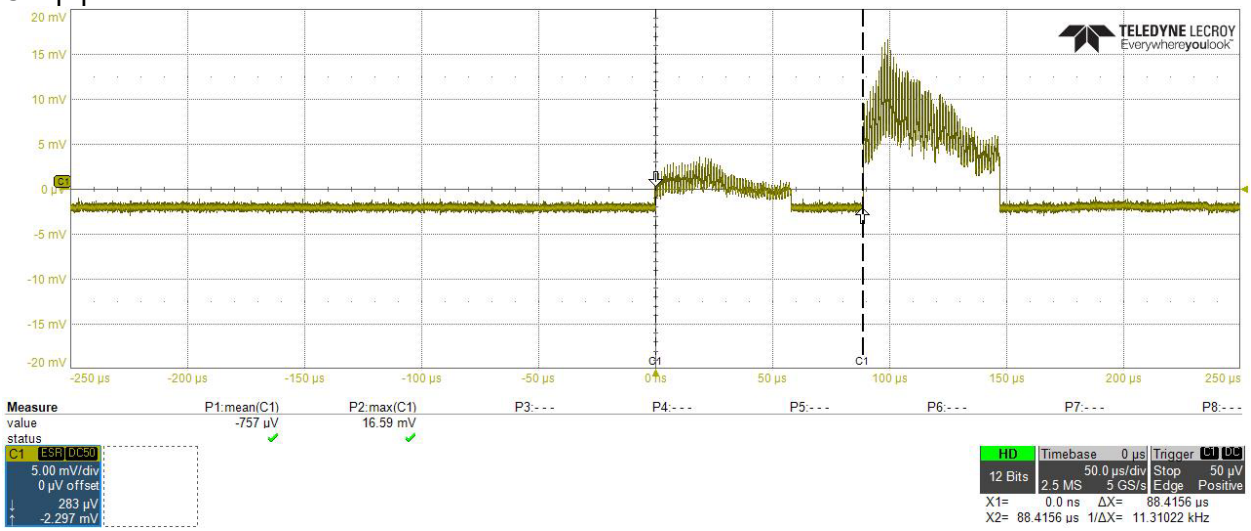
Burst period



Chirp on time



Chirp period



9.3. 99% / 20dB BANDWIDTH

REQUIREMENT

§15.215 (c)

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

§RSS-GEN 6.7

The occupied bandwidth or the “99% emission bandwidth” is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained. The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs.

TEST PROCEDURE

The spectrum analyzer and external mixer are set up to measure the radiated output of the transmitter. Refer to C63.10, Clause 9 for details.

RESULTS

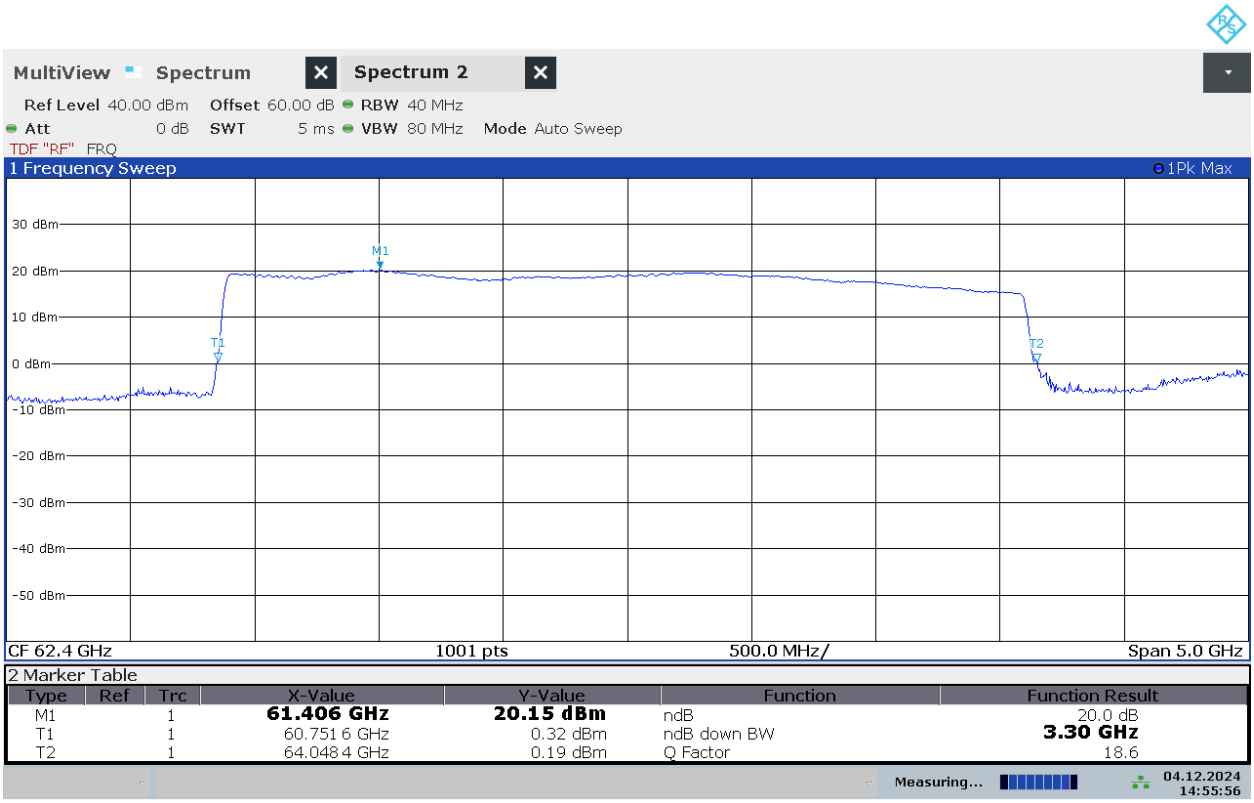
99% Bandwidth (GHz)	20dB Bandwidth (GHz)
3.187884953	3.30

TESTED BY

Employee IDs: 23854
Test Dates: 12-05-2024
Test Location: Chamber 3

99% bandwidth

20dB bandwidth



9.4. RADIATED POWER

REQUIREMENT

FCC

§15.255 (c)

Within the 57-71 GHz band, emission levels shall not exceed the following equivalent isotropically radiated power (EIRP):

(2) Field disturbance sensors/radars shall not exceed −10 dBm peak conducted output power and 10 dBm peak EIRP except that field disturbance sensors/radars that limit their operation to all or part of the specified frequency band may operate without being subject to a transmitter conducted output power limit if they operate in compliance with paragraph (b)(3) of this section or with one or more of the provisions below:

(iii) ***57.0-64.0 GHz:***

(A) The peak EIRP shall not exceed 14 dBm, and the sum of continuous transmitter off-times of at least two milliseconds shall equal at least 25.5 milliseconds within any contiguous interval of 33 milliseconds, except as specific in paragraph (c)(2)(iii)(B) of this section;

ISED

RSS-210 Clause J.3.2

FDS devices operating in the 57-71 GHz band shall not exceed –10 dBm peak transmitter conducted output power and 10 dBm peak e.i.r.p. The following exceptions apply:

(b) FDS devices may operate in any mode as indicated in J.3.2(b)(i) and J.3.2(b)(ii), as long as they operate in only one of these modes for at least 33 ms before switching to another mode.

(iii) FDS operating in the 57.0-64.0 GHz band shall comply with one of the following limits, depending on the operating condition of the device:

(1) the peak e.i.r.p. shall not exceed 14 dBm and the sum of continuous transmitter off-times of at least 2 ms shall equal at least 25.5 ms within any contiguous interval of 33 ms

TEST PROCEDURE

ANSI C63.10-2020 Clause 9.8

RESULTS

Peak EIRP

RBW (MHz)	VBW (MHz)	Span (GHz)	Sweep Time (s)	Measured PK Power (dBm)	FMCW Correction Factor (dB)	Corrected Peak Power (dBm)	Radiated Limit (dBm)	Radiated Limit Margin (dB)
1	3	5	2000	-3.39	-13.83	10.44	14	-3.56

FMCW correction factor (equation L.1) and sweep time are calculated using guidance from C63.10 2020 Annex L.

FMCW correction factor (Equation L.1) is calculated as follows:

$$\alpha = \frac{1}{\sqrt{1+\left(\frac{2\ln(2)}{\pi}\right)^2\left(\frac{BW_{Chirp}}{T_{Chirp}B^2}\right)^2}}$$

where

α	is the reduction in amplitude
BW_{Chirp}	is the FMCW Chirp Bandwidth
T_{Chirp}	is the FMCW Chirp Time
B	is the 3 dB IF Bandwidth = RBW

Sweep time is calculated as follows:

Sweep time ≥ N * (signal period) * (span / RBW), where N is a positive integer

TESTED BY

Employee IDs: 23854
Test Dates: 12-04-2024
Test Location: Chamber 3

Peak EIRP

9.5. CONDUCTED OUTPUT POWER

REQUIREMENT

FCC

§15.255 (e)

(1) Except as specified in paragraph (e)(2) of this section, the peak transmitter conducted output power of devices other than field disturbance sensors/radars shall not exceed 500 mW. Depending on the gain of the antenna, it may be necessary to operate the intentional radiator using a lower peak transmitter output power in order to comply with the EIRP limits specified in paragraph (c) of this section.

(2) Devices other than field disturbance sensors/radars with an emission bandwidth of less than 100 megahertz must limit their peak transmitter conducted output power to the product of 500 mW times their emission bandwidth divided by 100 megahertz. For the purposes of this paragraph, 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. The center frequency must be stationary during the measurement interval, even if not stationary during normal operation (*e.g.,* for frequency hopping devices).

ISED

RSS-210 Clause J.3.3

c) Except as specified in J.3.3(d), the peak transmitter conducted output power shall not exceed 500 mW. Depending on the gain of the antenna, it may be necessary to operate the intentional radiator using a lower peak transmitter output power in order to comply with the e.i.r.p. limits specified in J.3.3(a) and J.3.3(b).

d) For devices with an emission bandwidth less than 100 MHz, the peak transmitter conducted output power (PTCOP) shall be less than or equal to the product of 500 mW times their emission bandwidth divided by 100 MHz. For the purpose of J.3.3(d), emission bandwidth is the instantaneous frequency range occupied by a steady radiated signal with modulation, outside which the radiated power spectral density is 6 dB below the maximum radiated power spectral density in the band, as measured with a 100 kHz resolution bandwidth. The centre frequency shall be stationary during the measurement interval, even if not stationary during normal operation (e.g. for frequency hopping devices).

TEST PROCEDURE

The maximum EUT antenna gain is subtracted from the Peak EIRP.

RESULTS

Peak conducted power

EIRP Peak Power (dBm)	EUT Ant. Gain (dBi)	Conducted Power (dBm)	Conducted Limit (mW)	Conducted Limit (dBm)	Conducted Limit Margin (dB)
10.44	5	5.44	500.00	26.99	-21.55

TESTED BY

Employee IDs: 23854
Test Dates: 12-04-2024
Test Location: Chamber 3

9.6. SPURIOUS EMISSIONS

REQUIREMENT

FCC

§15.255 (e)

(1) The power density of any emissions outside the 57-71 GHz band shall consist solely of spurious emissions.

(2) Radiated emissions below 40 GHz shall not exceed the general limits in § 15.209.

(3) Between 40 GHz and 200 GHz, the level of these emissions shall not exceed 90 pW/cm^2 at a distance of 3 meters.

(4) The levels of the spurious emissions shall not exceed the level of the fundamental emission.

ISED

RSS-210 Clause J.4

Any emissions outside the band 57-71 GHz shall consist solely of spurious emissions and shall not exceed:

(a) the fundamental emission levels

(b) the general field strength limits specified in RSS-Gen, *General Requirements for Compliance of Radio Apparatus*, for emissions below 40 GHz

(c) 90 pW/cm2 at a distance of 3 m for emissions between 40 GHz and 200 GHz

TEST PROCEDURE - BELOW 50 GHz

The EUT is placed on a non-conducting table 80 cm above the ground plane for measurement below 1 GHz; 1.5 m above the ground plane for measurement above 1GHz. The antenna to EUT distance is 3 meters. The EUT is configured in accordance with ANSI C63.10 and set to transmit in a continuous mode.

For measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements in the 30-1000MHz range. Peak detection is used unless otherwise noted as quasi-peak or average.

For pre-scans above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 3 MHz for peak measurements.

For final measurements above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 3 MHz for peak measurements; as applicable for linear voltage averaging measurements.

The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.

Base on FCC 15.31 (f) (2): measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field.

OFS and chamber correlation testing had been performed and chamber measured test result is the worst-case test result.

TEST PROCEDURE – ABOVE 50 GHz

ANSI C63.10-2020 Clause 9.10

External harmonic mixers are utilized.

The measurement distance is in the far field per formula $2D^2/\lambda$ where D is the larger dimension of the antenna.

Frequency Range (GHz)	Wavelength (m)	Rx Antenna max dim. (m)	Far Field Distance (m)	Measurement Distance Used (m)
18-26.5	0.0113	0.104	1.91	3.00
26.5-40	0.0075	0.074	1.48	3.00
40-50	0.0060	0.055	1.01	3.00
50-75	0.0040	0.037	0.66	3.00
75-110	0.0027	0.025	0.45	3.00
110-170	0.0018	0.016	0.29	3.00
170-200	0.0012	0.011	0.19	3.00

Radiated spurious emissions limits above 40 GHz are based on a 3-meter measurement distance. As such, testing from 40-200GHz was performed at 3-meters.

The antenna is scanned around the entire perimeter surface of the EUT, in both horizontal and vertical polarizations.

A final test is made at any frequencies at which emissions are found. During this final scan, the antenna is kept no further from the EUT than the maximum distance calculated for each mixer band that yields a minimum system noise floor at least 6 dB below the spurious emissions limit.

The power is measured, the EIRP is calculated, then the extrapolated power density at a 3-meter distance is calculated.

The 90 pW/cm^2 limit for 40-200GHz was converted to dBm by the following equation:

10 * log(90 [pW/cm^2] * 100^2 * 10^{-12} * 4pi* (3m)^2 *1000) = -9.92 dBm

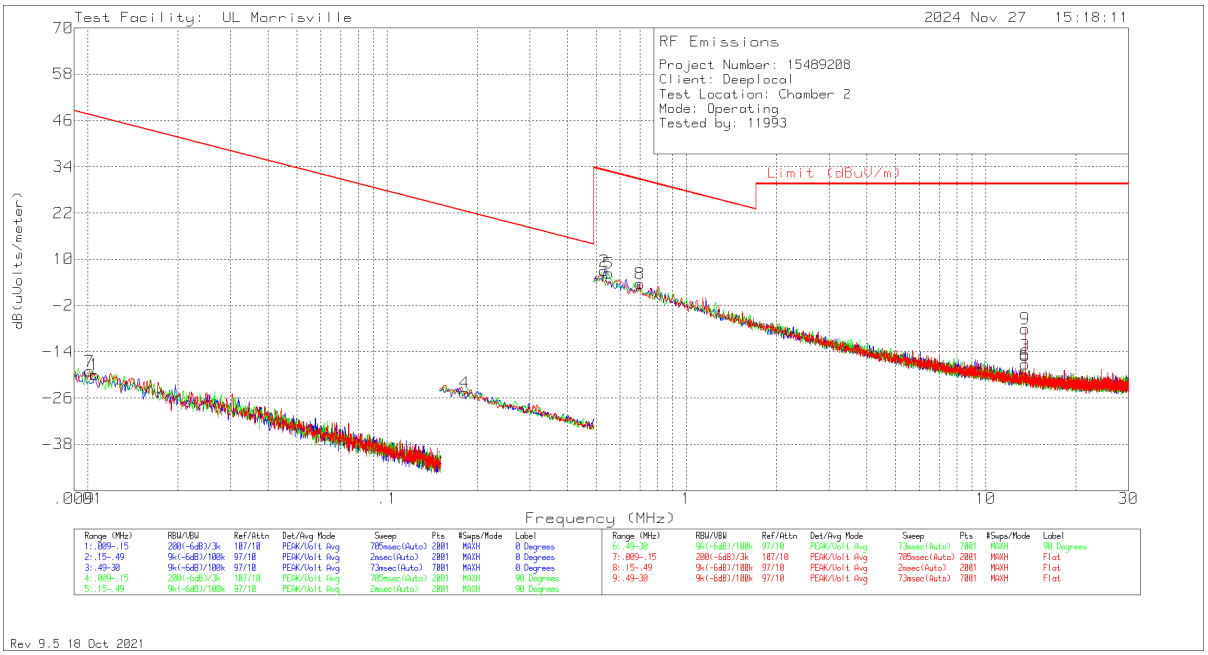
The 500 uV/m @3m limit for 18-40GHz was converted to dBm by the following equation:

20 * log(500 uV/m) + 20 * log(3m) – 104.8 = -41.25 dBm

TESTED BY

Employee IDs: 23854, 11993, 85501, 19289
Test Dates: 11-20-2024 to 01-02-2024
Test Location: Chamber 3, Chamber 2, Chamber 4

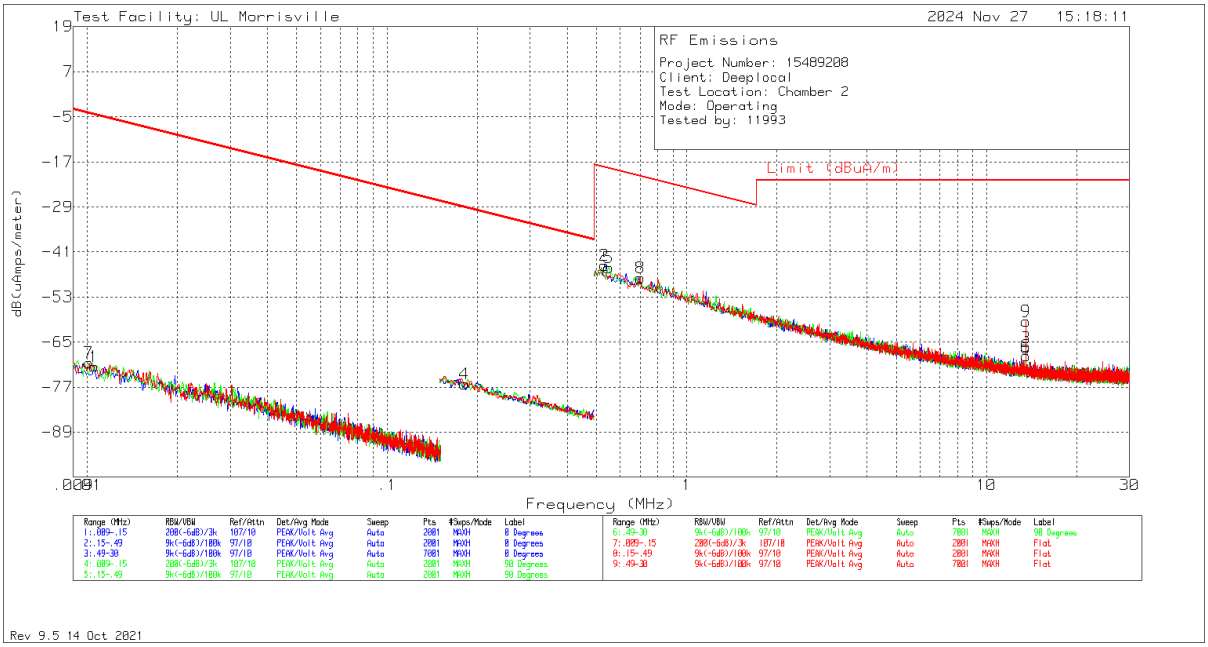
SPURIOUS EMISSION 9 kHz TO 30 MHz (E field)



Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	135144 (dB/m)	Gain/Loss (dB)	Dist. Corr. Factor (dB)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Loop Angle
7	.01014	42.75	Pk	18.1	.1	-80	-19.05	47.49	-66.54	0-360	Flat
1	.01056	41.92	Pk	18	.1	-80	-19.98	47.13	-67.11	0-360	0 degs
4	.18137	44.24	Pk	11	.1	-80	-24.66	22.43	-47.09	0-360	90 degs
2	.53216	35.87	Pk	11	.1	-40	6.97	33.08	-26.11	0-360	0 degs
5	.54902	35.23	Pk	11	.1	-40	6.33	32.81	-26.48	0-360	90 degs
8	.7008	32.53	Pk	11	.1	-40	3.63	30.69	-27.06	0-360	Flat
3	13.5596	14.62	Pk	9.8	.6	-40	-14.98	29.54	-44.52	0-360	0 degs
6	13.5596	12.39	Pk	9.8	.6	-40	-17.21	29.54	-46.75	0-360	90 degs
9	13.5596	21.59	Pk	9.8	.6	-40	-8.01	29.54	-37.55	0-360	Flat

Pk - Peak detector

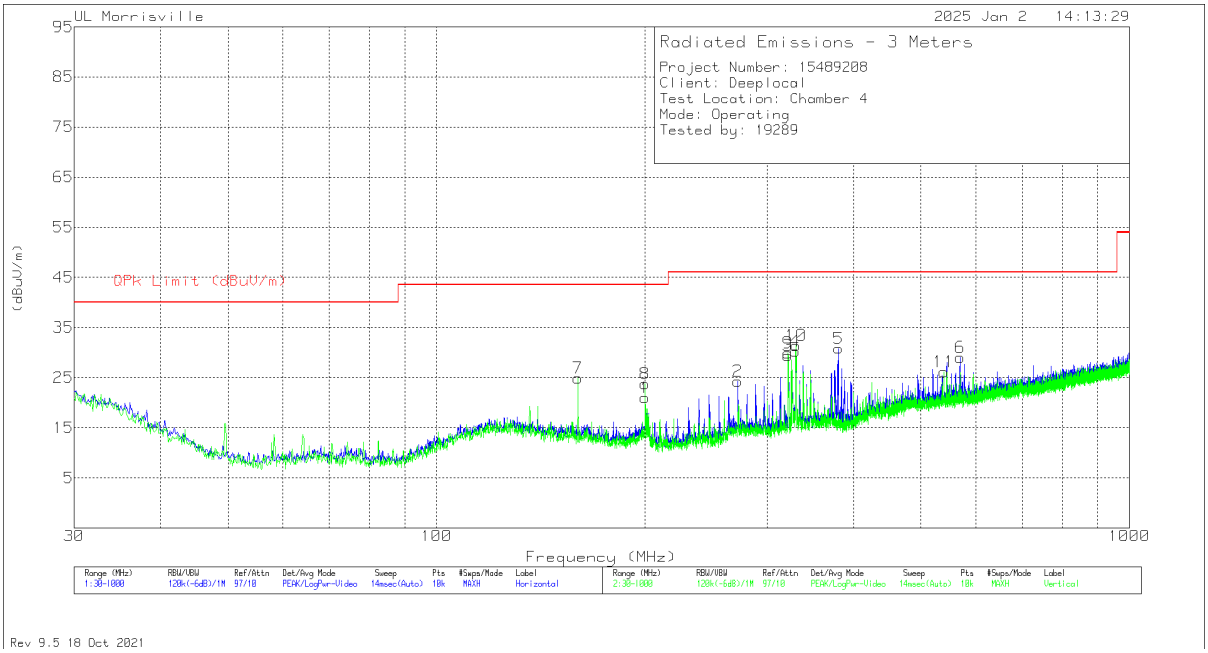
SPURIOUS EMISSION 9 kHz TO 30 MHz (H field)



Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	135144 (dB/m)	Gain/Loss (dB)	Dist. Corr. Factor (dB)	Corrected Reading dB(uAmps/meter)	Limit (dBuA/m)	Margin (dB)	Azimuth (Degs)	Loop Angle
7	.01014	42.75	Pk	-33.4	.1	-80	-70.55	-4.01	-66.54	0-360	Flat
1	.01056	41.92	Pk	-33.5	.1	-80	-71.48	-4.37	-67.11	0-360	0 degs
4	.18137	44.24	Pk	-40.5	.1	-80	-76.16	-29.07	-47.09	0-360	90 degs
2	.53216	35.87	Pk	-40.5	.1	-40	-44.53	-18.42	-26.11	0-360	0 degs
5	.54902	35.23	Pk	-40.5	.1	-40	-45.17	-18.69	-26.48	0-360	90 degs
8	.7008	32.53	Pk	-40.5	.1	-40	-47.87	-20.81	-27.06	0-360	Flat
3	13.5596	14.62	Pk	-41.7	.6	-40	-66.48	-21.96	-44.52	0-360	0 degs
6	13.5596	12.39	Pk	-41.7	.6	-40	-68.71	-21.96	-46.75	0-360	90 degs
9	13.5596	21.59	Pk	-41.7	.6	-40	-59.51	-21.96	-37.55	0-360	Flat

Pk - Peak detector

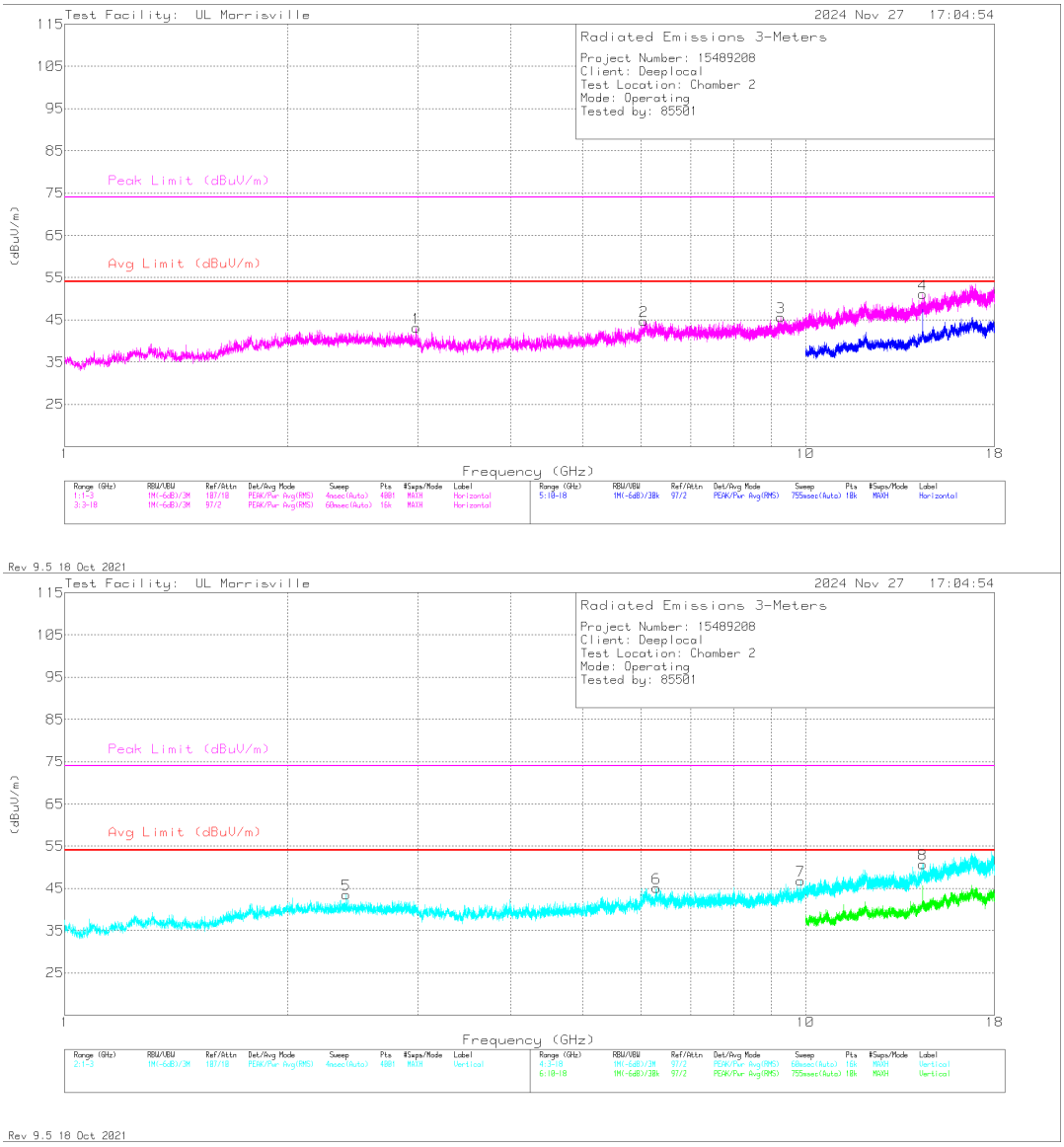
SPURIOUS EMISSION 30 TO 1000 MHz



Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	90628 (dB/m)	Gain/Loss (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
7	159.98	37.5	Pk	18.4	-31	24.9	43.52	-18.62	0-360	100	V
1	199.944	32.77	Pk	18.9	-30.7	20.97	43.52	-22.55	0-360	300	H
8	199.944	35.63	Pk	18.9	-30.7	23.83	43.52	-19.69	0-360	100	V
2	272.209	35.29	Pk	19.4	-30.4	24.29	46.02	-21.73	0-360	100	H
3	321.582	39.66	Pk	20	-30.2	29.46	46.02	-16.56	0-360	100	H
9	321.679	40.07	Pk	20	-30.2	29.87	46.02	-16.15	0-360	100	V
4	329.73	40.25	Pk	20.1	-30.1	30.25	46.02	-15.77	0-360	100	H
10	330.409	41.4	Pk	20.1	-30.1	31.4	46.02	-14.62	0-360	100	V
5	380.461	39.65	Pk	21.1	-29.9	30.85	46.02	-15.17	0-360	100	H
11	540.026	31.36	Pk	24.2	-29.4	26.16	46.02	-19.86	0-360	100	V
6	569.999	33.89	Pk	24.5	-29.3	29.09	46.02	-16.93	0-360	200	H

Pk - Peak detector

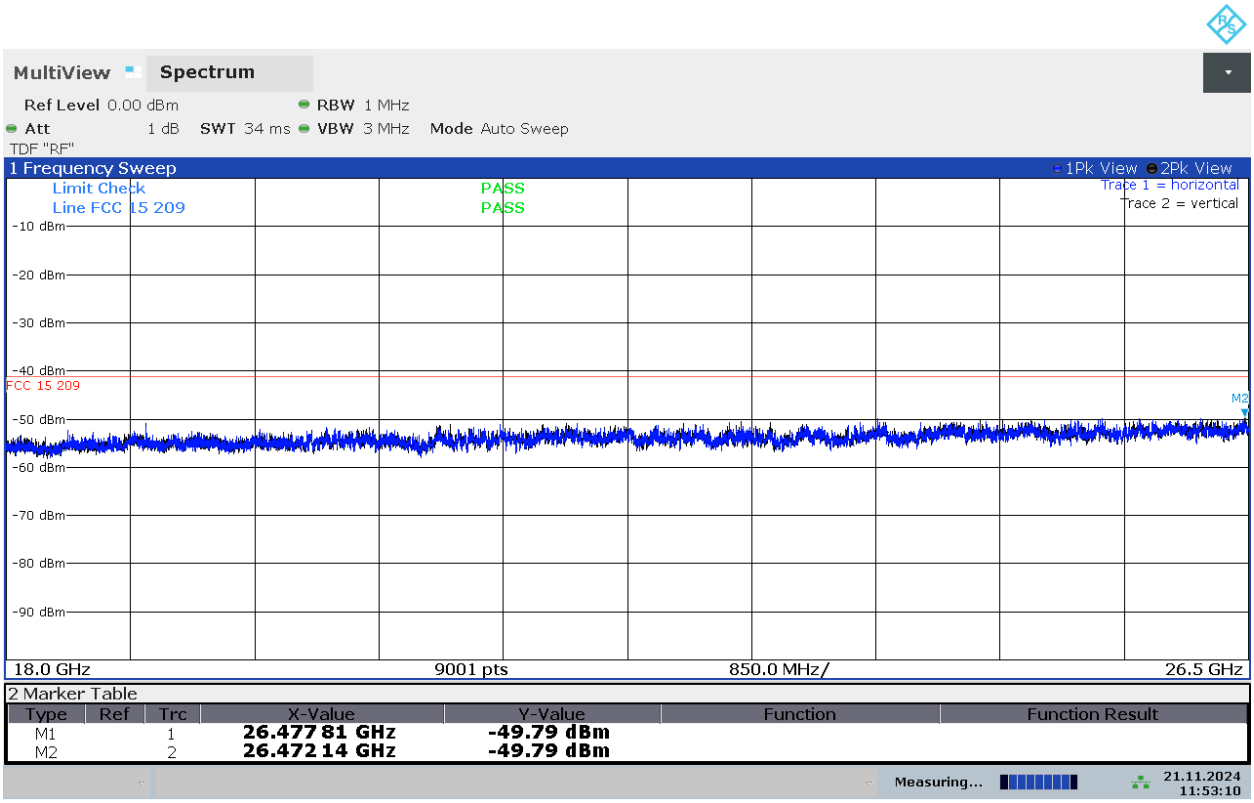
SPURIOUS EMISSION 1 GHz TO 18 GHz



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	86408 (dB/m)	Gain/Loss (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
5	2.4005	35.16	Pk	32.3	-23.9	43.56	54	-10.44	74	-30.44	0-360	200	V
1	2.981	36.19	Pk	32.8	-25.8	43.19	54	-10.81	74	-30.81	0-360	199	H
2	6.05531	50.92	Pk	35.4	-41.6	44.72	54	-9.28	74	-29.28	0-360	100	H
6	6.29625	49.97	Pk	35.6	-40.5	45.07	54	-8.93	74	-28.93	0-360	200	V
3	9.25781	49.34	Pk	36	-39.7	45.64	54	-8.36	74	-28.36	0-360	200	H
7	9.84844	50.13	Pk	37	-40.3	46.83	54	-7.17	74	-27.17	0-360	100	V
4	14.40002	53.35	Pk	39.4	-37.5	55.25	-	-	74	-18.75	346	182	H
	14.40002	45.79	Av	39.4	-37.5	47.69	54	-6.31	-	-	346	182	H
8	14.39988	50.64	Pk	39.4	-37.5	52.54	-	-	74	-21.46	112	192	V
	14.39988	39.79	Av	39.4	-37.5	41.69	54	-12.31	-	-	112	192	V

Pk - Peak detector
Av - Average detection

SPURIOUS EMISSIONS 18 GHz TO 26.5 GHz



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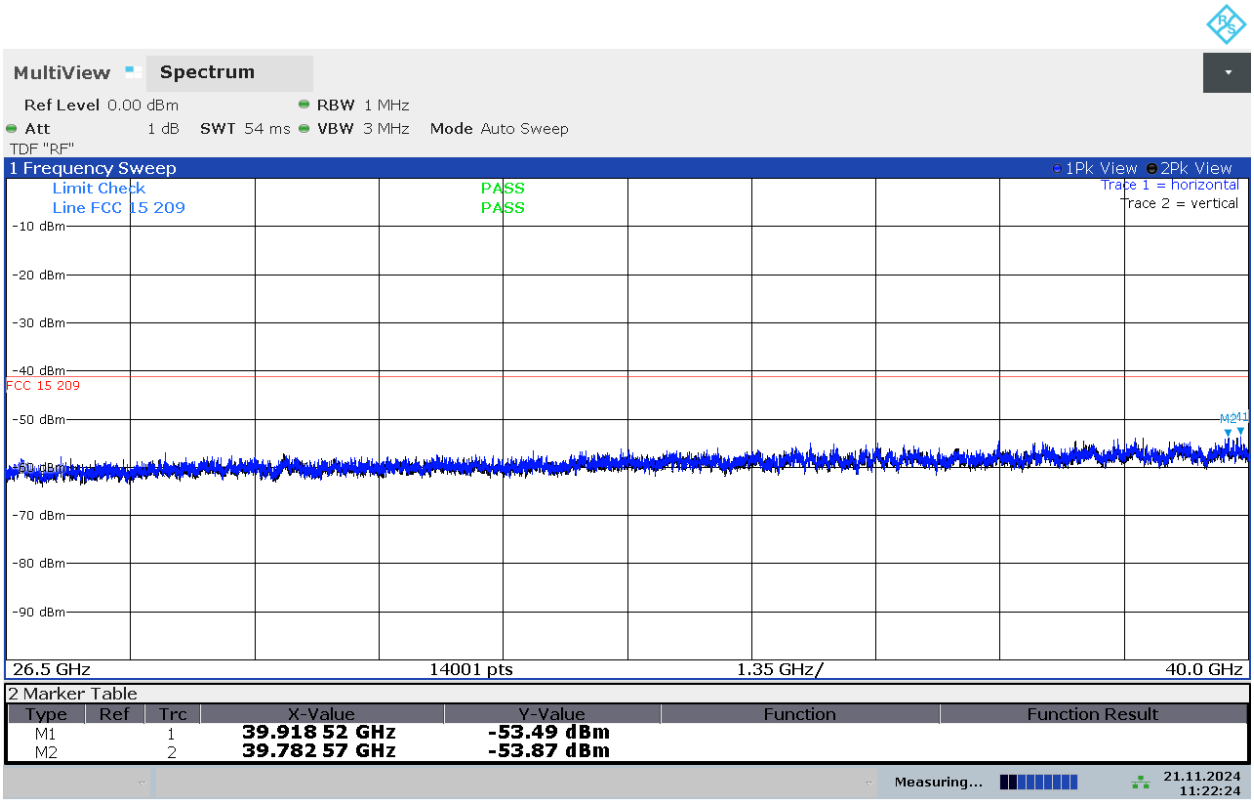
SPURIOUS EMISSIONS 26.5 GHz TO 40 GHz



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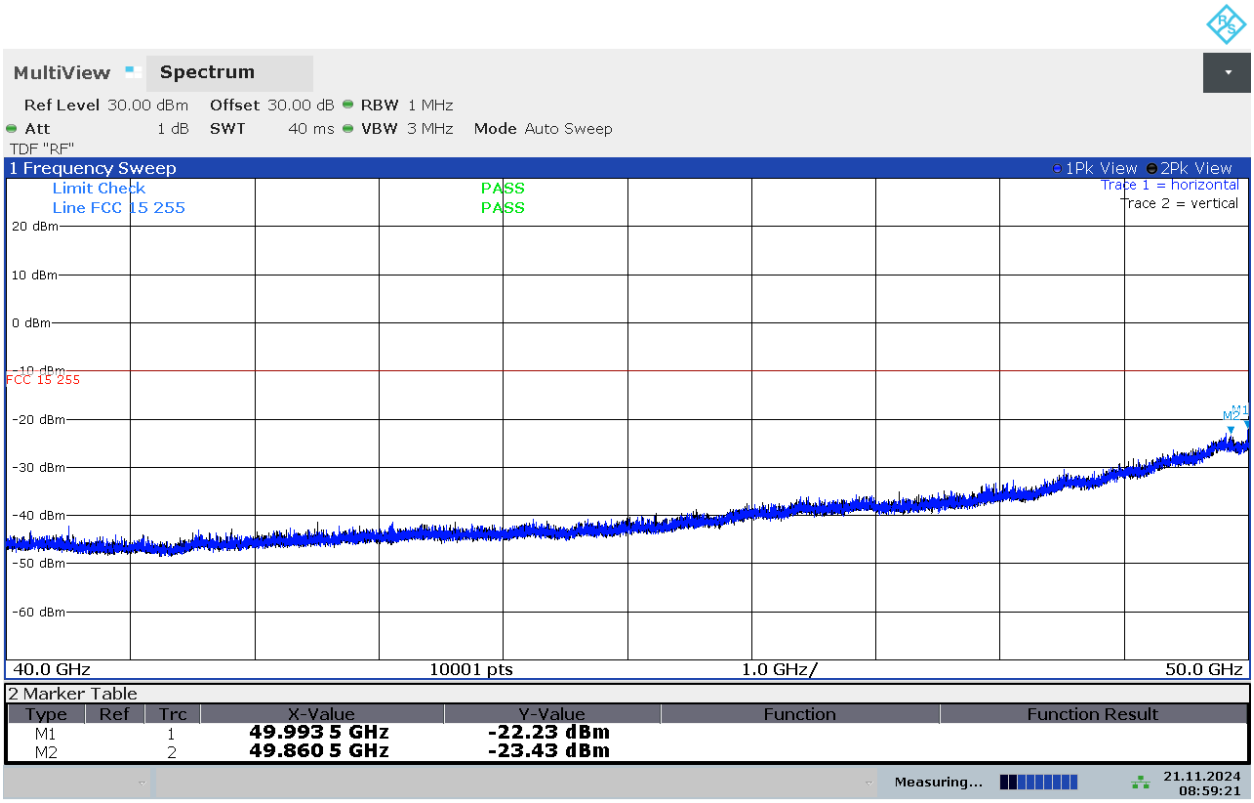
SPURIOUS EMISSIONS 40 GHz TO 50 GHz



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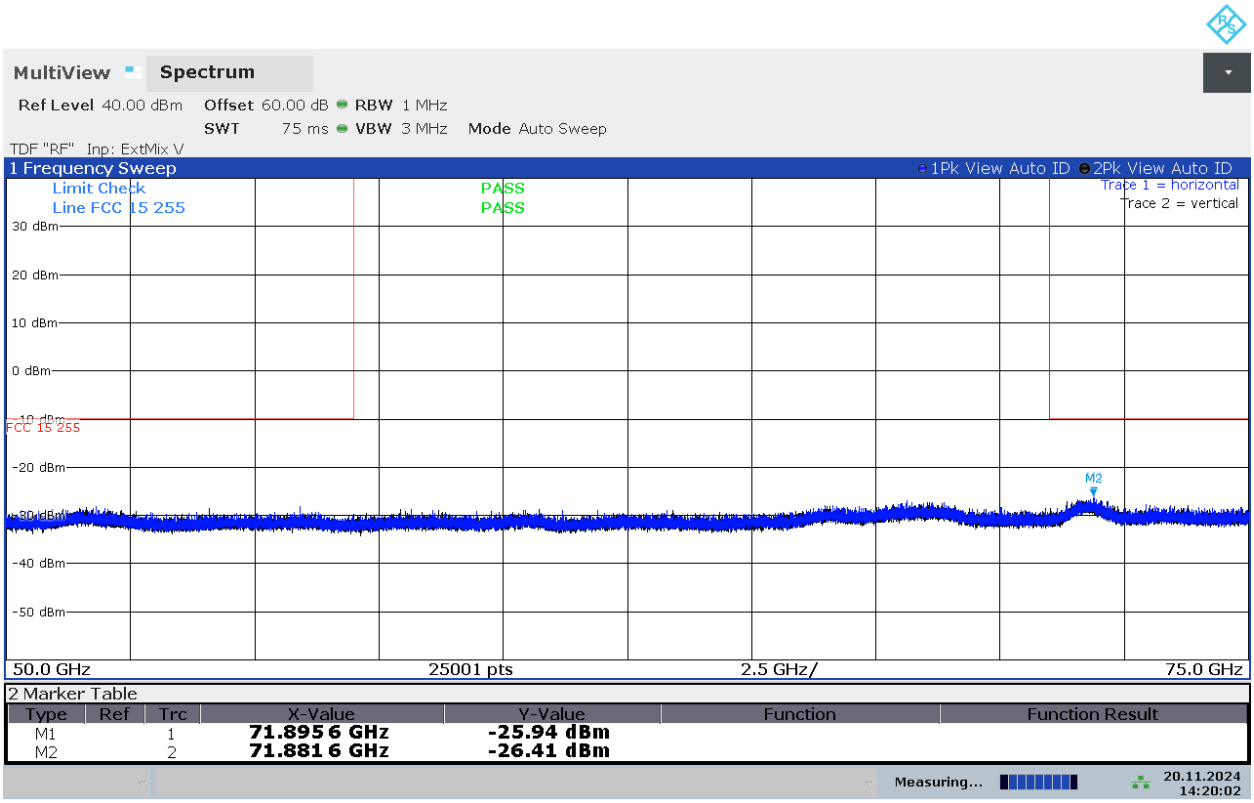
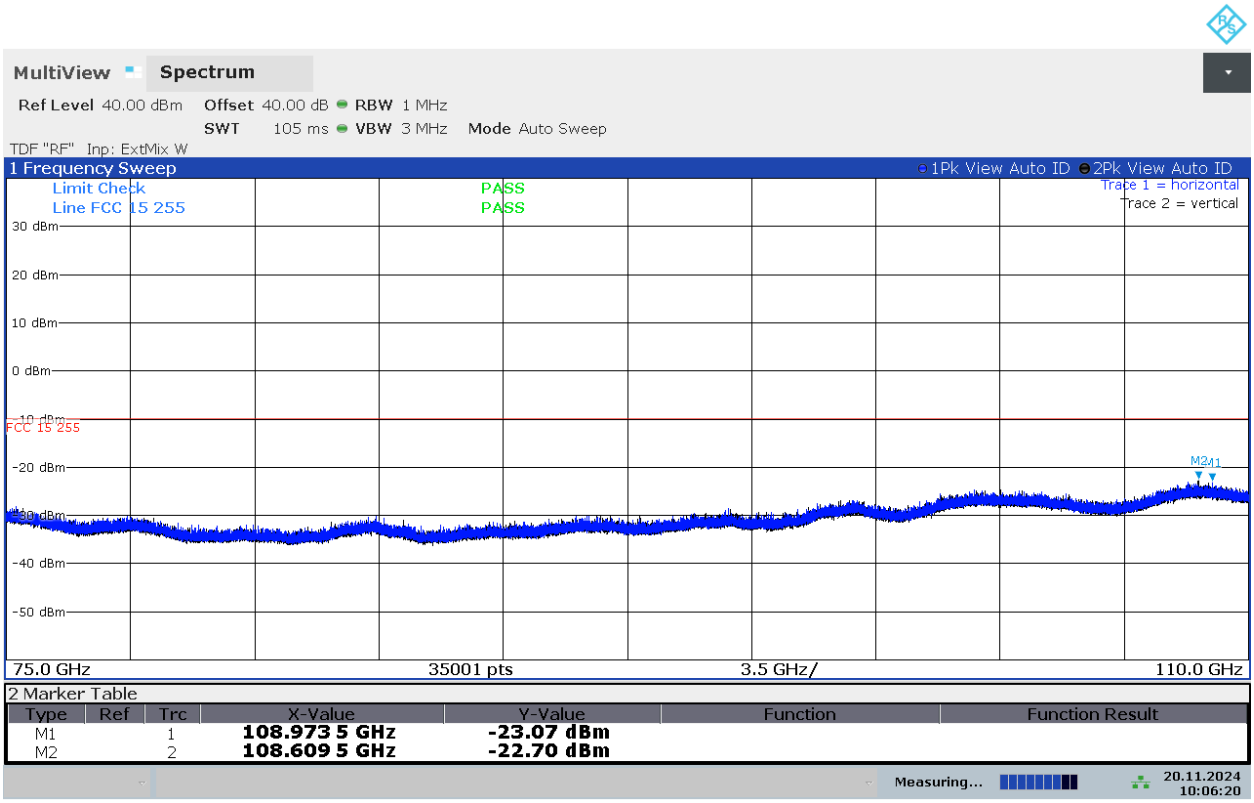
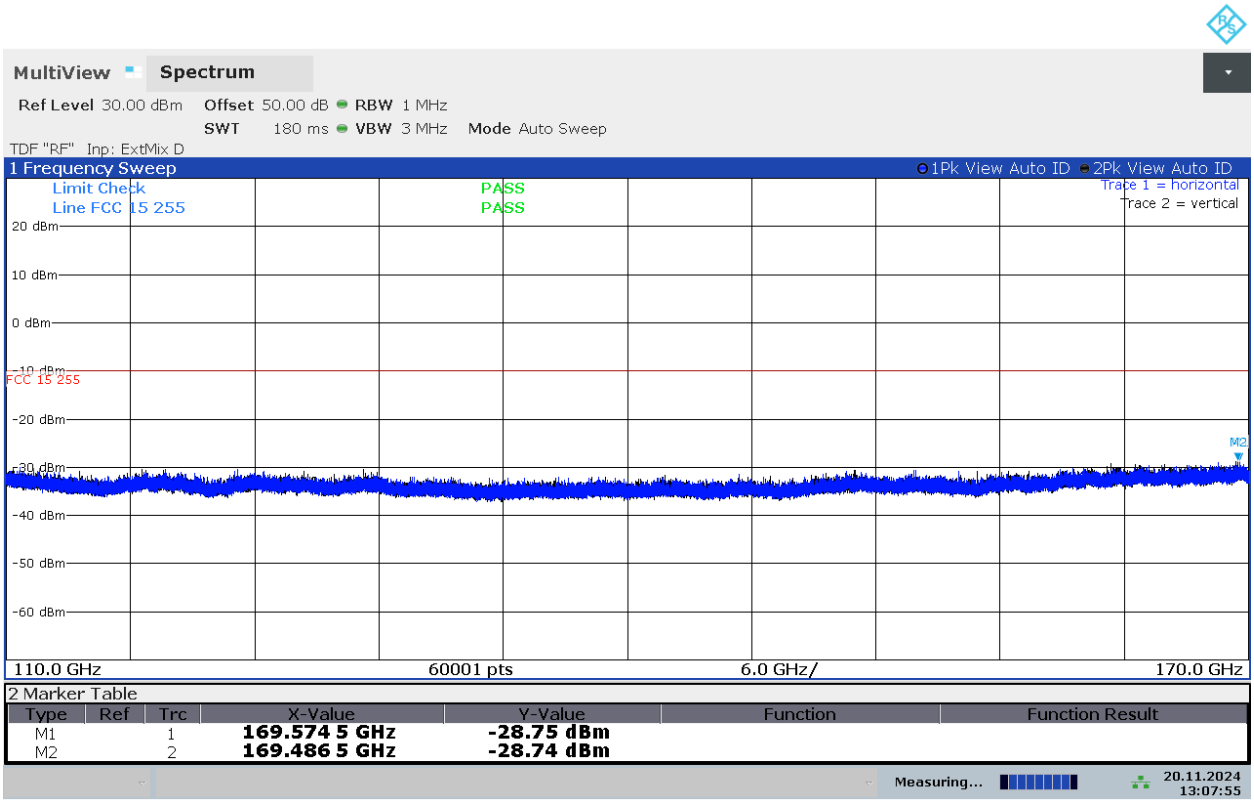
SPURIOUS EMISSIONS 50 GHz TO 75 GHz



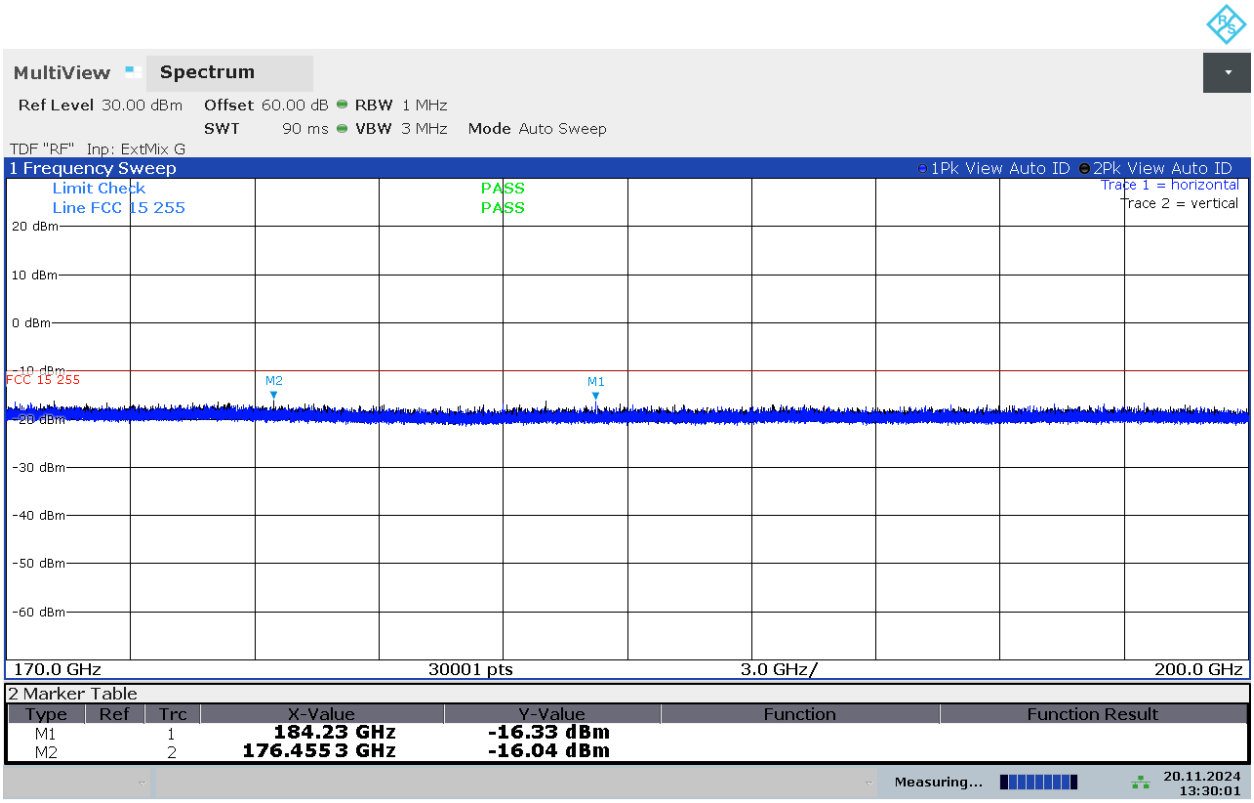
SPURIOUS EMISSIONS 75 GHz TO 110 GHz



SPURIOUS EMISSIONS 110 GHz TO 170 GHz



SPURIOUS EMISSIONS 170 GHz TO 200 GHz



9.7. RECEIVER SPURIOUS EMISSIONS

REQUIREMENT

The Rx spurious emission limits are the same as the Tx spurious emission limits. All emissions were measured with the transmitters and receivers operating simultaneously. The receiver spurious performance is documented by the transmit spurious results above.

9.8. AC MAINS LINE CONDUCTED EMISSIONS

REQUIREMENT

§15.207
RSS-GEN, Section 7.2.2

Frequency range (MHz)	Limits (dBµV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50
Notes: 1. The lower limit shall apply at the transition frequencies 2. The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.		

TEST PROCEDURE

The EUT is placed on a non-conducting table 40 cm from the vertical ground plane and 80 cm above the horizontal ground plane. The EUT is configured in accordance with ANSI C63.10.

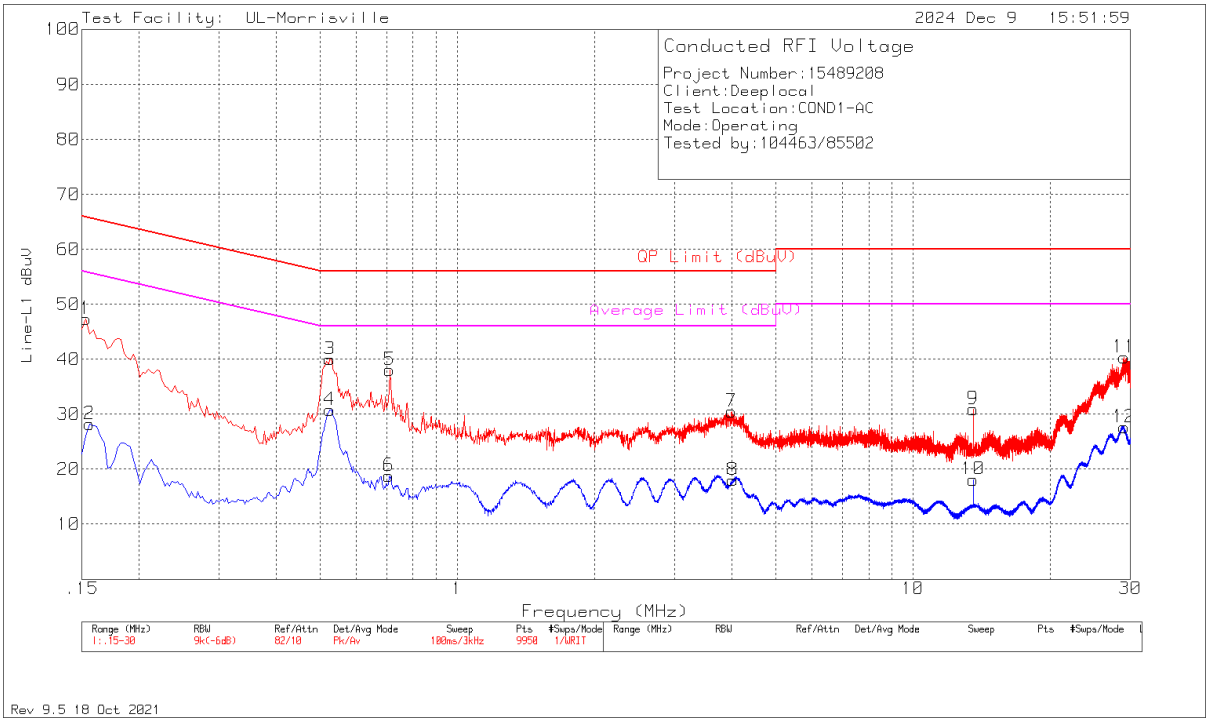
The receiver is set to a resolution bandwidth of 9 kHz. Peak detection is used unless otherwise noted as quasi-peak or average.

Line conducted data is recorded for both lines.

TESTED BY

Employee IDs: 104463/85502
Test Dates: 12-09-2024
Test Location: COND 1

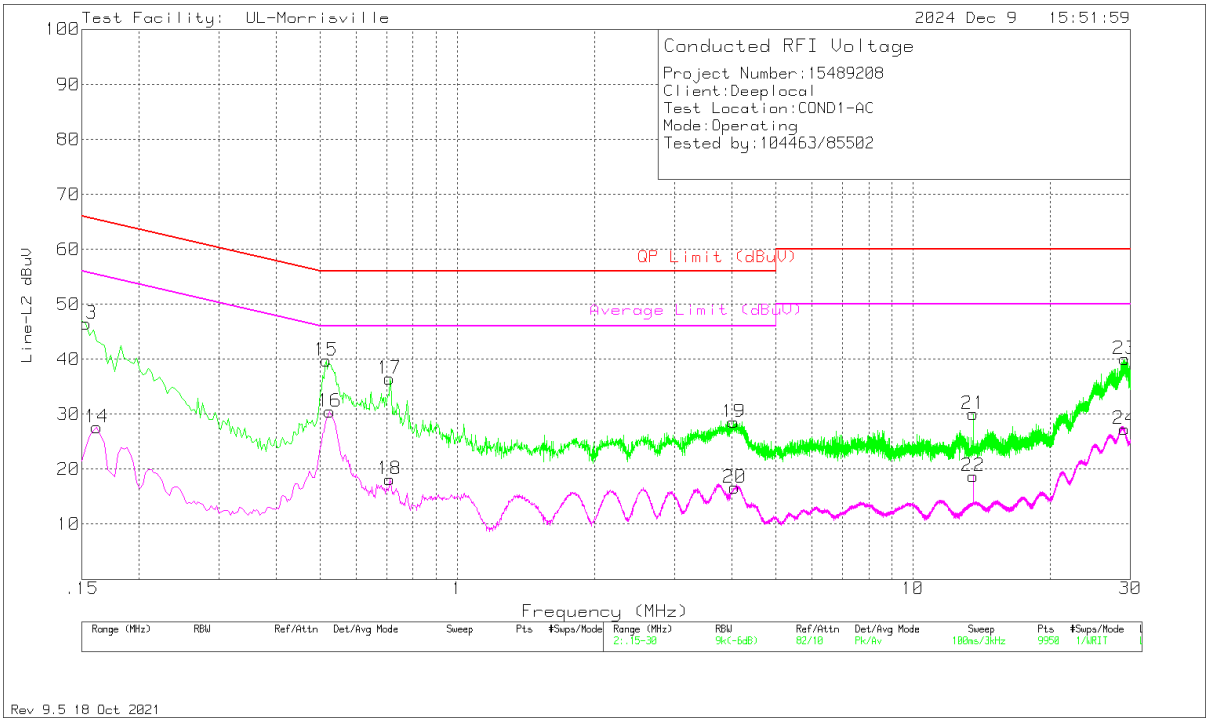
LINE 1 RESULTS



Range 1: Line-L1 .15 - 30MHz										
Marker	**Frequency (MHz)**	**Meter Reading (dBuV)**	**Det**	**LISN VDF (dB)**	**Cbl/Limiter (dB)**	**Corrected Reading dBuV**	**QP Limit (dBuV)**	**Margin (dB)**	**Average Limit (dBuV)**	**Margin (dB)**
1	.153	37.32	Pk	.2	9.8	47.32	65.84	-18.52	-	-
2	.156	18.23	Av	.2	9.8	28.23	-	-	55.67	-27.44
3	.525	30.17	Pk	0	9.8	39.97	56	-16.03	-	-
4	.525	20.97	Av	0	9.8	30.77	-	-	46	-15.23
6	.708	8.96	Av	0	9.8	18.76	-	-	46	-27.24
5	.711	28.21	Pk	0	9.8	38.01	56	-17.99	-	-
7	3.999	20.64	Pk	0	9.9	30.54	56	-25.46	-	-
8	4.029	8.1	Av	0	9.9	18	-	-	46	-28
9	13.563	20.82	Pk	.1	10	30.92	60	-29.08	-	-
10	13.563	8.03	Av	.1	10	18.13	-	-	50	-31.87
11	29.079	29.67	Pk	.5	10.2	40.37	60	-19.63	-	-
12	29.1	16.91	Av	.5	10.2	27.61	-	-	50	-22.39

Pk - Peak detector
Av - Average detection

LINE 2 RESULTS



Range 2: Line-L2 .15 - 30MHz										
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN VDF (dB)	Cbl/Limiter (dB)	Corrected Reading dBuV	QP Limit (dBuV)	Margin (dB)	Average Limit (dBuV)	Margin (dB)
13	.153	36.45	Pk	.2	9.8	46.45	65.84	-19.39	-	-
14	.162	17.64	Av	.2	9.8	27.64	-	-	55.36	-27.72
15	.516	29.98	Pk	0	9.8	39.78	56	-16.22	-	-
16	.525	20.71	Av	0	9.8	30.51	-	-	46	-15.49
17	.711	26.64	Pk	0	9.8	36.44	56	-19.56	-	-
18	.711	8.36	Av	0	9.8	18.16	-	-	46	-27.84
19	4.041	18.66	Pk	0	9.9	28.56	56	-27.44	-	-
20	4.065	6.71	Av	0	9.9	16.61	-	-	46	-29.39
21	13.563	20	Pk	.1	10	30.1	60	-29.9	-	-
22	13.563	8.63	Av	.1	10	18.73	-	-	50	-31.27
24	29.136	16.59	Av	.5	10.2	27.29	-	-	50	-22.71
23	29.16	29.35	Pk	.5	10.2	40.05	60	-19.95	-	-

Pk - Peak detector
Av - Average detection

9.9. FREQUENCY STABILITY

REQUIREMENT

FCC

§15.255 (f)

Fundamental emissions must be contained within the frequency bands specified in this section during all conditions of operation. Equipment is presumed to operate over the temperature range −20 to + 50 degrees Celsius with an input voltage variation of 85% to 115% of rated input voltage, unless justification is presented to demonstrate otherwise.

ISED

RSS-210 Clause J.6

Fundamental emissions shall be contained within the frequency bands specified in this annex during all conditions of operation when tested at the temperature and voltage variations specified for the frequency stability measurement in RSS-Gen.

TEST PROCEDURE

ANSI C63.10-2020 Clause 9.5

The radio module is placed in an environmental chamber, with power furnished by an adjustable source. The carrier frequency is counted at each condition and compared with the reference condition.

TESTED BY

Employee IDs: 23854
Test Dates: 2024-11-22 to 2025-03-10
Test Location: Cond 1

RESULTS

Time:	0	minutes
Nominal Frequency:	62.4	GHz
Nominal Voltage:	48	Vdc

Temperature (°C)	Voltage (V)	99% Bandwidth (GHz)	F_{low} Limit (GHz)	F_{low} (GHz)	F_{high} (GHz)	F_{high} Limit (GHz)
-20	48	3.152	57	60.811	63.963	64
-10	48	3.144	57	60.812	63.956	64
0	48	3.151	57	60.809	63.960	64
10	48	3.151	57	60.809	63.960	64
20	48	3.151	57	60.811	63.963	64
20	40.8	3.132	57	60.808	63.941	64
20	55.2	3.134	57	60.808	63.943	64
30	48	3.153	57	60.808	63.961	64
40	48	3.156	57	60.807	63.964	64
50	48	3.152	57	60.809	63.961	64

Time:	2	minutes
Nominal Frequency:	62.4	GHz
Nominal Voltage:	48	Vdc

Temperature (°C)	Voltage (V)	99% Bandwidth (GHz)	F_{low} Limit (GHz)	F_{low} (GHz)	F_{high} (GHz)	F_{high} Limit (GHz)
-20	48	3.146	57	60.813	63.959	64
-10	48	3.145	57	60.812	63.956	64
0	48	3.149	57	60.811	63.960	64
10	48	3.151	57	60.809	63.960	64
20	48	3.155	57	60.808	63.963	64
20	40.8	-	57	-	-	64
20	55.2	-	57	-	-	64
30	48	3.155	57	60.808	63.964	64
40	48	3.155	57	60.807	63.962	64
50	48	3.150	57	60.811	63.960	64

UL LLC
12 Laboratory Dr., RTP, NC 27709 TEL: (919) 549-1400

Time:	5	minutes
Nominal Frequency:	62.4	GHz
Nominal Voltage:	48	Vdc

Temperature (°C)	Voltage (V)	99% Bandwidth (GHz)	F_{low} Limit (GHz)	F_{low} (GHz)	F_{high} (GHz)	F_{high} Limit (GHz)
-20	48	48	3.144	57	60.813	63.957
-10	48	48	3.144	57	60.812	63.956
0	48	48	3.147	57	60.811	63.958
10	48	48	3.153	57	60.808	63.960
20	48	48	3.151	57	60.812	63.964
20	40.8	40.8	-	57	-	-
20	55.2	55.2	-	57	-	-
30	48	48	3.157	57	60.808	63.964
40	48	48	3.153	57	60.807	63.961
50	48	48	3.152	57	60.810	63.961

Time:	10	minutes
Nominal Frequency:	62.4	GHz
Nominal Voltage:	48	Vdc

Temperature (°C)	Voltage (V)	99% Bandwidth (GHz)	F_{low} Limit (GHz)	F_{low} (GHz)	F_{high} (GHz)	F_{high} Limit (GHz)
-20	48	48	3.144	57	60.810	63.955
-10	48	48	3.143	57	60.814	63.956
0	48	48	3.151	57	60.809	63.961
10	48	48	3.153	57	60.808	63.961
20	48	48	3.157	57	60.809	63.966
20	40.8	40.8	-	57	-	-
20	55.2	55.2	-	57	-	-
30	48	48	3.154	57	60.808	63.962
40	48	48	3.155	57	60.807	63.962
50	48	48	3.151	57	60.812	63.963

9.10. GROUP INSTALLATION

REQUIREMENT

FCC

§15.255 (h)

Any transmitter that has received the necessary FCC equipment authorization under the rules of this chapter may be mounted in a group installation for simultaneous operation with one or more other transmitter(s) that have received the necessary FCC equipment authorization, without any additional equipment authorization. However, no transmitter operating under the provisions of this section may be equipped with external phase-locking inputs that permit beam-forming arrays to be realized.

ISED

RSS-210 Clause J.7

Any transmitter that is certified under this annex may be mounted in a group installation for simultaneous operation with one or more certified transmitters, without any additional equipment authorization. However, no transmitter operating under the provisions of this annex shall be equipped with external phase-locking inputs that permit beam-forming arrays to be realized.

RESULTS

The EUT does not have any external phase locking inputs for beam forming.

10. SETUP PHOTOS

Please refer to report R15489208-EP1 for setup photos.

END OF TEST REPORT

UL LLC
12 Laboratory Dr., RTP, NC 27709 TEL: (919) 549-1400