

EMC Test Report

regarding

USA: CFR Title 47, Part 15.255 (Emissions)

Canada: ISED RSS-210 Issue 11 (Emissions)

for



Waffle

Category: Field Disturbance Sensor

Judgments:

FCC 15.255 and ISED RSS-210v11 Compliant

Testing Completed: December 20, 2024



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1 Test Report Scope and Limitations

1.1 Laboratory Authorization

Test Facility description and attenuation characteristics are on file with the FCC Laboratory, Columbia, Maryland (FCC Reg. No: US5348 and US5356) and with ISED Canada, Ottawa, ON (File Ref. No: 3161A and 24249). Amber Helm Development L.C. holds accreditation under NVLAP Lab Code 200129-0.

1.2 Report Retention

For equipment verified to comply with the regulations herein, the manufacturer is obliged to retain this report with the product records for the life of the product, and no less than ten years. A copy of this Report will remain on file with this laboratory until January 2035.

1.3 Subcontracted Testing

This report does not contain data produced under subcontract.

1.4 Test Data

This test report contains data included within the laboratory's scope of accreditation. Any data in this report that is not covered under the laboratory's scope is clearly identified.

1.5 Limitation of Results

The test results contained in this report relate only to the item(s) tested. Any electrical or mechanical modification made to the test item subsequent to the test date shall invalidate the data presented in this report. Any electrical or mechanical modification made to the test item subsequent to this test date shall require reevaluation.

1.6 Copyright

This report shall not be reproduced, except in full, without the written approval of Amber Helm Development L.C.

1.7 Endorsements

This report shall not be used to claim product endorsement by any accrediting, regulatory, or governmental agency.

1.8 Test Location

The EUT was fully tested by **Amber Helm Development L.C.**, headquartered at 92723 Michigan Hwy-152, Sister Lakes, Michigan 49047 USA. Table 1.8.0 lists all sites employed herein. Specific test sites utilized are also listed in the test results sections of this report where needed.

Table 1.8.0 Test Site List.

Description	Location	Quality Num.
OATS (3 meter)	3615 E Grand River Rd., Williamston, Michigan 48895	OATSD

1.9 Traceability and Equipment Used

Pertinent test equipment used for measurements at this facility is listed in Table 1.9.0 . The quality system employed at Amber Helm Development L.C. has been established to ensure all equipment has a clearly identifiable classification, calibration expiry date, and that all calibrations are traceable to the SI through NIST, other recognized national laboratories, accepted fundamental or natural physical constants, ratio type of calibration, or by comparison to consensus standards. All equipment is evaluated on a cycle no greater than 12 months following laboratory validation procedures and is calibrated following manufacturer recommended intervals.

Table 1.9.0 Equipment List.

Description	Manufacturer/Model	SN	Quality Num.	Cal/Ver By / Date Due
Spectrum Analyzer	R & S / FSW67	103233	RSFSW67	RS / Sept-2025
Pk/Avg Pwr Mtr	BK Prec. / RFP3008	620C22101	BKPM300801	BK / Mar-2026
LISN	Solar / 8012-50-R-24-BNC	970917	LISNB	AHD / March-2025
BNC-BNC Coax	WRTL / RG58/U	001	CAB001-BLACK	AHD / March-2025
Harmonic Mixer	VDI / SAX 063	US54250105	MIX50TO7501	AHD / On-use
Harmonic Mixer	VDI / SAX 108	A30316	MIX60TO9001	AHD / On-use
Harmonic Mixer	Hewlett Packard / 11970W	2521A00179	MIX70TO11001	AHD / Mar-2025
Harmonic Mixer	Pacific mmWave / GMA	26	MIX110TO23001	PMP / On-use
Biconical	EMCO / 93110B	9802-3039	BICEMCO01	Keysight / Aug-2025
Log Periodic Antenna	EMCO / 3146	9305-3614	LOGEMCO01	Keysight / Aug-2025
Quad Ridge Horn	Singer / A6100	C35200	HQR1TO18S01	Keysight / Aug-2025
K-Band Horn	JEF / NRL Std.	001	HRNK01	AHD / On Use
Ka-Band Horn	JEF / NRL Std.	001	HRNKA001	AHD / On-Use
U-Band Horn	Cust. Micro. / HO19R	-	HRNU01	Cust.M. / On-Use
E-Band Horn	Flann / 26240-25-1030B	250901	HRNE01	Flann / On-Use
W-Band Horn	Cust. Micro. / HO10R	-	HRNW01	Cust.M. / On-Use
D/G-Band Horn	Cust. Micro. / HO5R	-	HRNG01	Cust.M. / On-Use

2 Test Specifications and Procedures

2.1 Test Specification and General Procedures

The goal of Density Inc. is to demonstrate that the Equipment Under Test (EUT) complies with the Rules and/or Directives below. Detailed in this report are the results of testing the Density Inc. Waffle for compliance to:

Country/Region/Manu.	Rules or Directive	Referenced Section(s)
United States	Code of Federal Regulations	CFR Title 47, Part 15.255
Canada	ISED Canada	ISED RSS-210 Issue 11

It has been determined that the equipment under test is subject to the rules and directives above at the date of this testing. In conjunction with these rules and directives, the following specifications and procedures are followed herein to demonstrate compliance (in whole or in part) with these regulations.

ANSI C63.4:2014	"Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz"
ANSI C63.10:2020	"American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices"
KDB 364244 D01 v01	"RADAR DEVICES CERTIFYING UNDER THE PROVISIONS OF §15.255"
WR-ITP0102RA	"AHD Internal Document - Radiated Emissions Test Method"
WR-ITP0101LC	"AHD Internal Document - Conducted Emissions Test Method"
ICES-003; Issue 7 (2020)	"Information Technology Equipment (ITE) - Limits and methods of measurement"

3 Configuration and Identification of the Equipment Under Test

3.1 Description and Declarations

The EUT is an indoor field disturbance sensor. The EUT is approximately 8 x 8 x 2 cm in dimension, and is depicted in Figure 3.1.0 . It is powered by 115 Vac AC power adapter. In use, this device is permanently affixed by professional installers above a door or on a wall in a commercial room or office. Table 3.1.0 outlines provider declared EUT specifications.

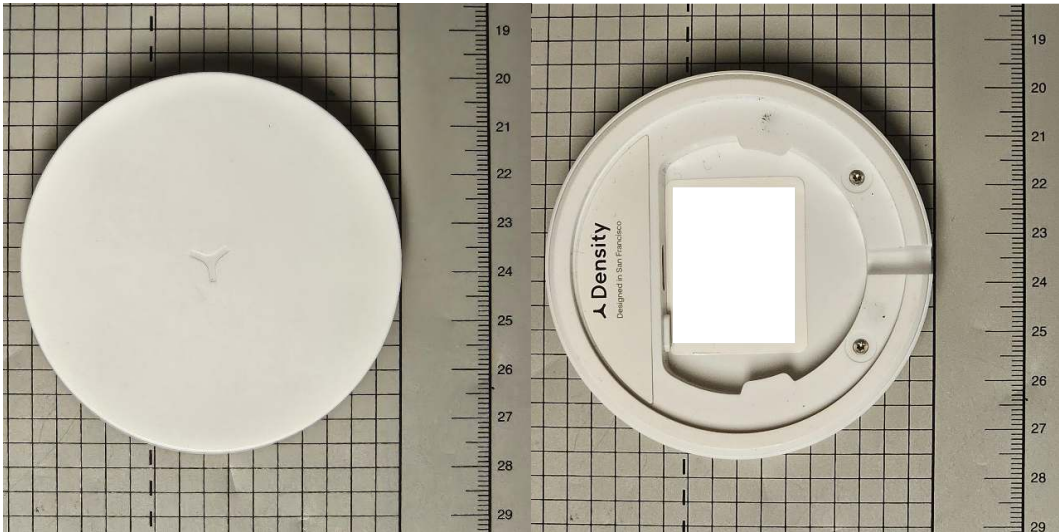


Figure 3.1.0 Photos of EUT.

Table 3.1.0 EUT Declarations.

General Declarations	
Equipment Type:	Field Disturbance Sensor
Country of Origin:	USA
Nominal Supply:	115 Vac
Oper. Temp Range:	0°C to +35°C (manuf. declared)
Frequency Range:	57 to 61.56 GHz
Antenna Dimension:	6cm
Antenna Type:	integral patch arrays
Antenna Gain:	9 dBi (arrayed)
Number of Channels:	1
Channel Spacing:	Not Applicable
Alignment Range:	Not Declared
Type of Modulation:	FMCW
United States	
FCC ID Number:	2AYY6W1
Classification:	FDS
Canada	
IC Number:	26986-W1
Classification:	Radar

3.1.1 EUT Configuration

The EUT is configured for testing as depicted in Figure 3.1.1 .

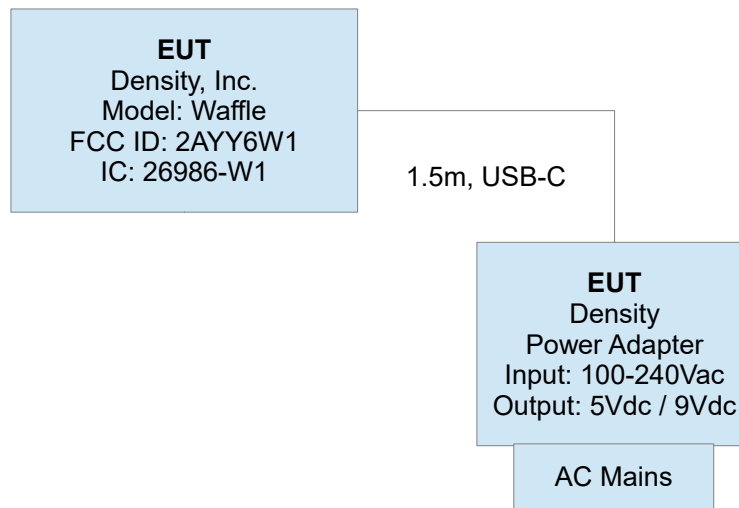


Figure 3.1.1 EUT Test Configuration Diagram.

3.1.2 Modes of Operation

The EUT is fully tested for two modes of operation, a narrowband and a wideband FMCW chirp. Both chirps employ identical timing parameters, but different chirp bandwidths. The EUT may employ an adjustable chirp bandwidth between the narrow and wide bandwidths fully tested herein, but chirp timing as reported will remain the same.

3.1.3 Variants

There is only a single variant of the EUT, as tested.

3.1.4 Test Samples

Two normal operating samples (SN: S4HGN003 and SN: S4HGN007) were provided for testing, along with a third sample (SN: S4HGN005) for photos and SDoC spurious.

3.1.5 Functional Exerciser

Normal operating EUT functionality was verified prior to testing by observation of the emissions spectrum.

3.1.6 Modifications Made

There were no modifications made to the EUT by this laboratory.

3.1.7 Production Intent

The EUT appears to be a production ready sample.

3.1.8 Declared Exemptions and Additional Product Notes

This product is professionally installed only in commercial environments. In addition to its radar functionality, the EUT implements a pre-certified modular BLE/WILAN transceiver (FCC ID: VPYLBES5PL2EL, IC: 772C-LBES5PL2EL) following the module manufacturer's guidelines, and was verified to remain in compliance during

testing performed in this report. All testing performed here is completed with the modular radio active. The EUT employs the integral BLE/WLAN radio module to connect to a commercial business IT infrastructure, and testing inline with the product as a PC Peripheral is addressed separately through manufacturer SDoC. Additionally, as narrow pulses arise when an the FMCW signal chirps past a receiver tuned frequency, the test lab has taken care to ensure we measure peak emissions only after evaluating the pulse desensitization effect per ANSI C63.10-2020 Corr. 1 Annex L - see duty cycle and fundamental data tables for details.

4 Emissions

4.1 General Test Procedures

4.1.1 Radiated Test Setup and Procedures

Radiated electromagnetic emissions from the EUT are first pre-scanned in our screen room. Spectrum and modulation characteristics of all emissions are recorded. Instrumentation, including spectrum analyzers and other test equipment as detailed in Section 1.8 are employed. After pre-scan, emission measurements are made on the test site of record. If the EUT connects to auxiliary equipment and is table or floor standing, the configurations prescribed in relevant test standards are followed. Alternatively, a layout closest to normal use (as declared by the provider) is employed if the resulting emissions appear to be worst-case in such a configuration. See Figure 4.1.1 . All intentionally radiating elements that are not fixed-mounted in use are placed on the test table lying flat, on their side, and on their end (3-axes) and the resulting worst case emissions are recorded. If the EUT is fixed-mounted in use, measurements are made with the device oriented in the manner consistent with installation and then emissions are recorded. If the EUT exhibits spurious emissions due to internal receiver circuitry, such emissions are measured with an appropriate carrier signal applied.

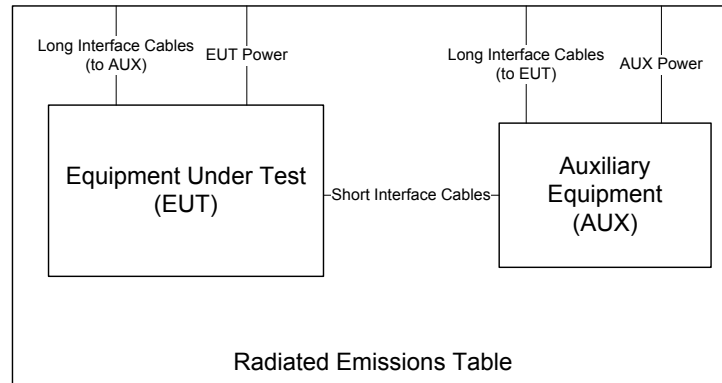


Figure 4.1.1 Radiated Emissions Diagram of the EUT.

For devices with intentional emissions below 30 MHz, a shielded loop antenna and/or E-field and H-Field broadband probes are used depending on the regulation. Shielded loops are placed at a 1 meter receive height at the desired measurement distance. For exposure in this band, 10cm diameter single-axis broadband probes meeting the requirements of ISSED SPR-002 section 5.2 are employed. Measurements are repeated and summed over three axes, and the entire frequency range is measured with and without the EUT transmitting.

Emissions between 30 MHz and 1 GHz are measured using calibrated broadband antennas. For both horizontal and vertical polarizations, the test antenna is raised and lowered from 1 to 4 m in height until a maximum emission level is detected. The EUT is then rotated through 360° in azimuth until the highest emission is detected. The test antenna is then raised and lowered one last time from 1 to 4 m and the worst case value is recorded. Emissions above 1 GHz are characterized using standard gain or broadband ridge-horn antennas on our OATS with a 4 × 5 m rectangle of ECCOSORB absorber covering the OATS ground screen and a 1.5m table height. Care is taken to ensure that test receiver resolution and video bandwidths meet the regulatory requirements, and that the emission bandwidth of the EUT is not reduced. Photographs of the test setup employed are depicted in Figure 4.1.1 .

Where regulations allow for direct measurement of field strength, power values (dBm) measured on the test receiver / analyzer are converted to dBμV/m at the regulatory distance, using

$$E_{dist} = 107 + P_R + K_A - K_G + K_E - C_F$$

where P_R is the power recorded on spectrum analyzer, in dBm, K_A is the test antenna factor in dB/m, K_G is the combined pre-amplifier gain and cable loss in dB, K_E is duty correction factor (when applicable) in dB, and C_F is a distance conversion (employed only if limits are specified at alternate distance) in dB. This field strength value is then compared with the regulatory limit. If effective isotropic radiated power (EIRP) is computed, it is computed as

$$EIRP(dBm) = E_{3m}(dB\mu V/m) - 95.2.$$

When presenting data at each frequency, the highest measured emission under all possible EUT orientations (3-axes) is reported.

Where regulations call for substitution method measurements, the EUT is replaced by a substitution antenna if field strength measurements indicate the emission is close to the regulatory limit. This antenna is co-polarized with the test antenna and tuned (when necessary) to the emission frequency, after which the test antenna height is again optimized. The substitution antenna's signal level is adjusted such that its emission is equal to the level measured from the EUT. The signal level applied to the substitution antenna is then recorded. Effective isotropic radiated power (EIRP) and effective radiated power (ERP) in dBm are formulated from

$$EIRP = P_T - G_A = ERP + 2.16, \quad (1)$$

where P_T is the power applied to substitution antenna in dBm, including correction for cable loss, and G_A is the substitution antenna gain, in dBi.

When microwave measurements are made at a range different than the regulatory distance or made at close-range to improve receiver sensitivity, the reading is corrected back to the regulatory distance. This is done using a 20 dB/decade field behavior as dictated by the test procedures. When measurements are made in the near-field, the near-field/far-field boundary (N/F) is reported. It is computed as

$$N/F = 2D^2/\lambda$$

where D is the maximum dimension of the transmitter or receive antenna, and λ is the wavelength at the measurement frequency. Typically for high frequency measurements the receive antenna is connected to test receiver / analyzer through an external mixer. In this case, cable loss, IF amplifier gain, and mixer conversion losses are corrected for in the data table, or directly in the analyzer.

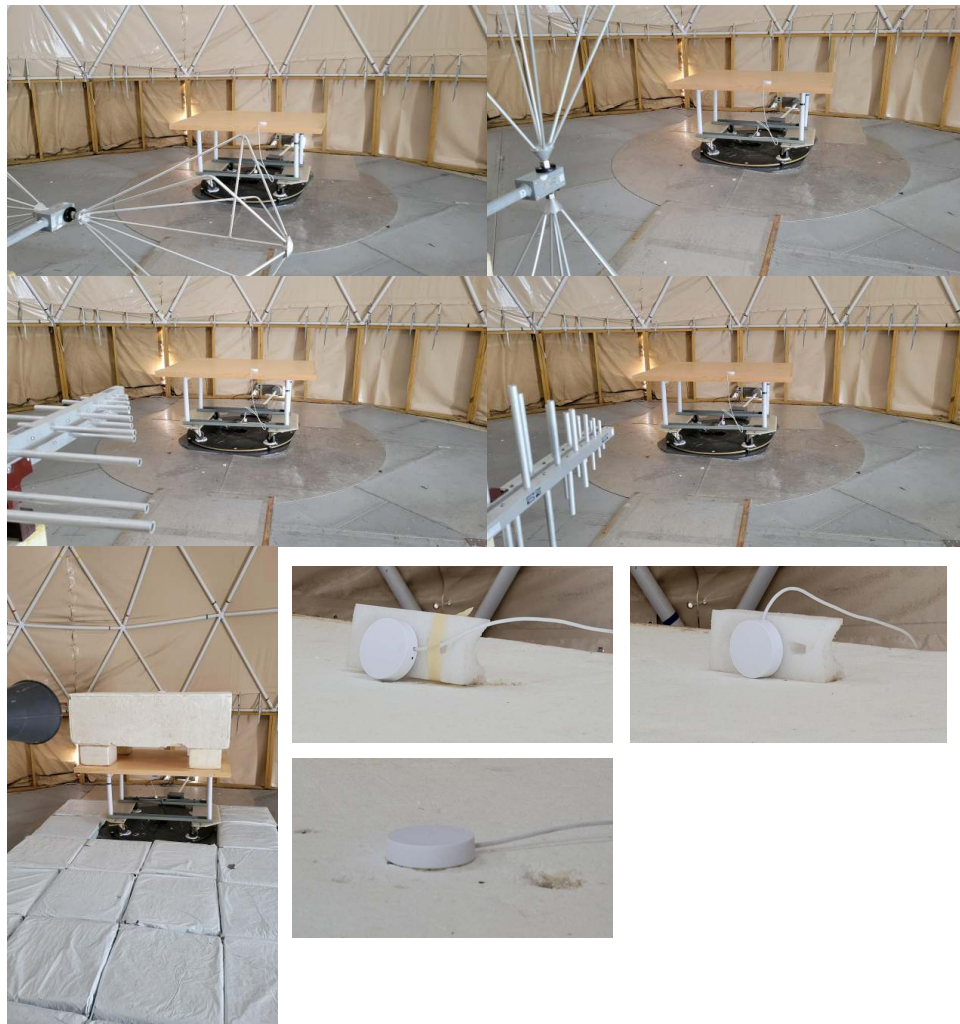


Figure 4.1.1 Radiated Emissions Test Setup Photograph(s).

4.1.2 Conducted Emissions Test Setup and Procedures

AC Port Conducted Spurious Spurious emissions from the EUT AC power port(s) are measured in our screen room. The EUT and auxiliary equipment are configured as prescribed by the standard. A layout most representative of actual use may be employed if the resulting emissions appear to be worst-case in such a configuration. Conducted emissions are measured and recorded for each AC mains port over the range of frequencies mandated in the standard, and on each conductor. The test receiver first measures peak emissions, after which worst case emissions are measured using quasi-peak and average detection if emissions approach the regulatory limit. See Figure 4.1.2 . Photographs of the test setup employed are depicted in Figure 4.1.2 .

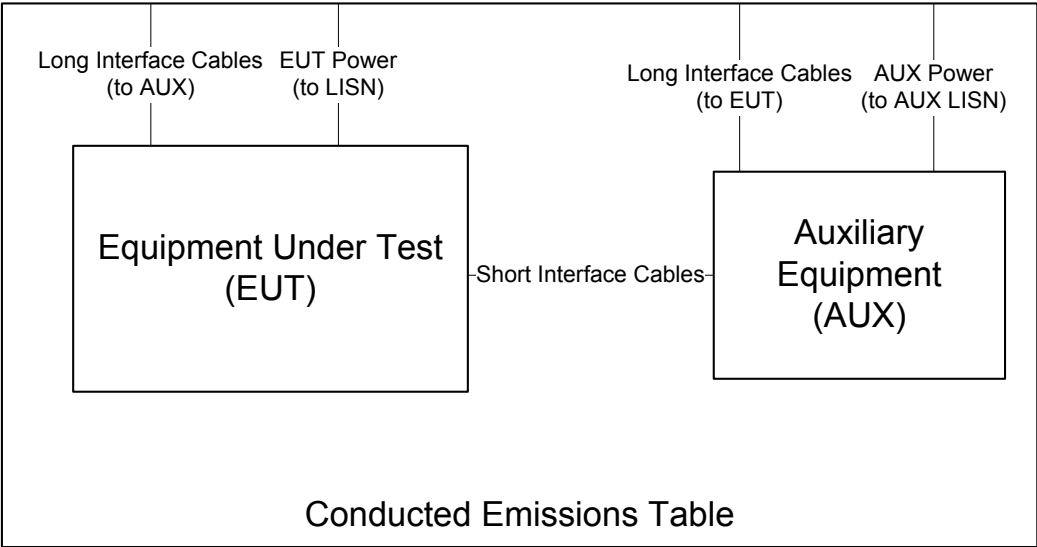


Figure 4.1.2 AC Conducted Emissions Setup Diagram of the EUT.



Figure 4.1.2 AC Conducted Emissions Test Setup Photograph(s).

4.1.3 Power Supply Variation

Tests at extreme supply voltages are made if required by the procedures specified in the test standard, and results of this testing are detailed in this report.

In the case of this EUT, measurements of the worst-case radiated emissions are performed with the supply voltage varied by no less than 85% and 115% of the nominal rated value for devices connecting to AC power mains.

4.2 Intentional Emissions

4.2.1 Fundamental Emission Pulsed Operation

The details and results of testing the EUT for pulsed operation are summarized in Table 4.2.1 . Plots showing the measurements made to obtain these values are provided in Figure 4.2.1 .

Table 4.2.1 Pulsed Emission Characteristics (Duty Cycle).

Det	IF Bandwidth	Video Bandwidth	Test Date:	16-Dec-24
SA Pk	10 MHz	10 MHz	Test Engineer:	J. Brunett
Pwr Mtr Pk	100 Ms/s	165 MHz	EUT	Density Waffle
			Meas. Distance:	3 m

FMCW Details – Exposure Duty Cycle														
R0	Transmit Mode	Voltage (V)	Test Frequency (GHz)	Total Cycle Time (ms)	FMCW On-Time (ms)	FMCW Off-Time per 33ms Window (ms)	Off-Time Limit per 33ms Window (ms)	Array Ant Duty (dB)	Chirp Period (us)	CHIRP BW (MHz)	Single Chirp On-Time (us)	Chirps / FMCW On-Time (#)	Total On-Time / Total Cycle Time (%)	Exposure Duty Factor (dB)
R1	Narrow Chirp	115.0	58.730	100.0	16.33	16.67	16.50	-3.0	34	1458.7	29	512	14.848	-11.3
R2	Wide Chirp	115.0	58.730	100.0	16.33	16.67	16.50	-3.0	34	4103.6	29	512	14.848	-11.3
#	C1	C2	C3	C4	C5	C6	C8	C9	C10	C11	C12	C13	C14	C15

(ROW) (COLUMN)

NOTE:

R0 C3 Worst-case frequency selected at center of operating band.

R0 C4 Total Period of the repeated set of FMCW chirps.

R0 C5 Time in which the FMCW chirp is repetitively sweeping.

R0 C8 Per FCC 15.255(2)(ii) / ISED RSS-210 J.3.2(b)(ii), limit of 20 dBm EIRP if off-time of 16.5 ms per 33 ms window in the 57.00 to 61.56 GHz band.

R0 C9 Alternating TX1+TX2, TX1-TX2 patterns (only 2 of 4 chirps have maximum array gain in a given direction): 50% Directional Duty = - 3 dB

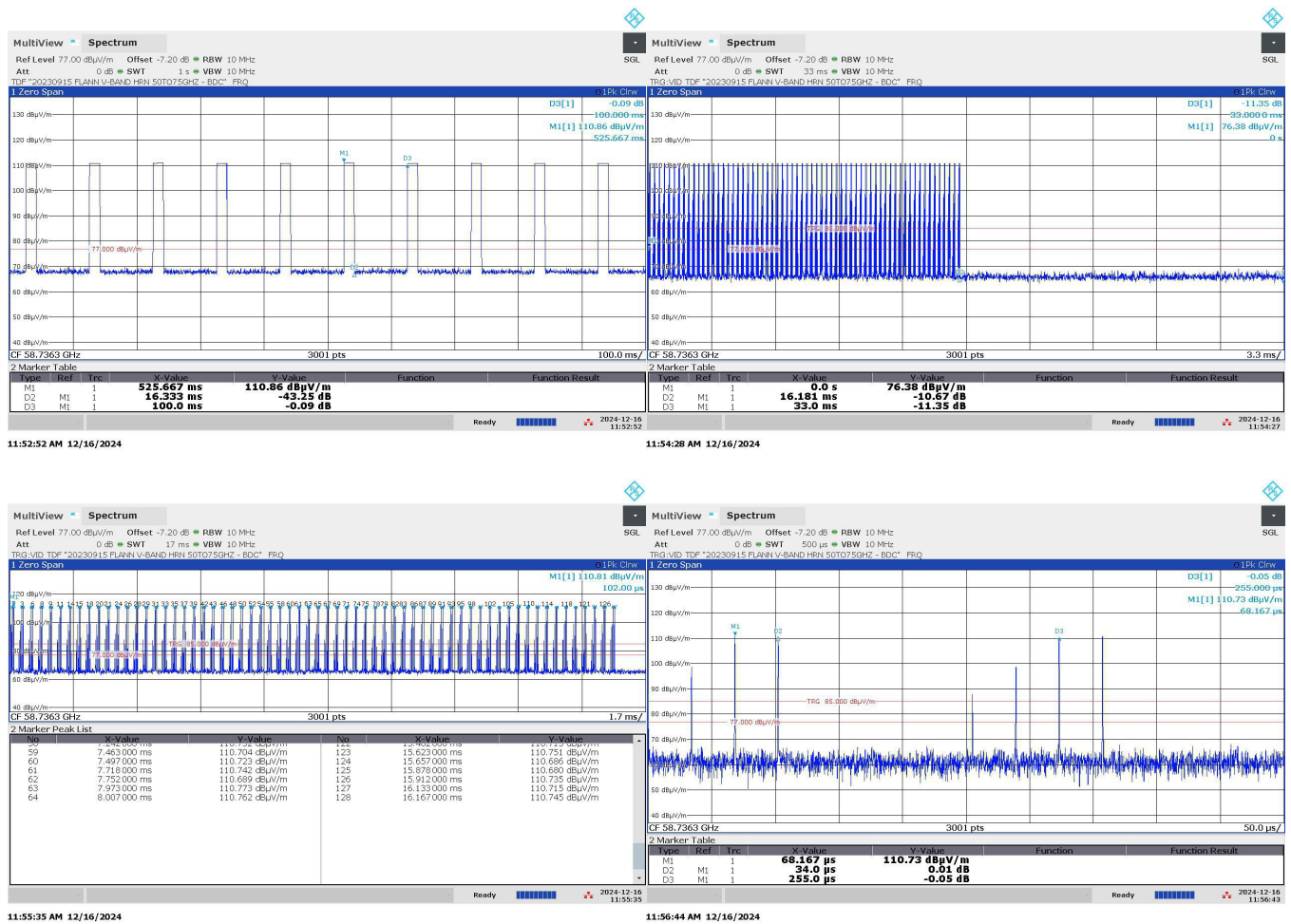
R0 C10 Period of individual FMCW chirps within the FMCW On-Time

R0 C12 Total On-time of a single FMCW chirp measured via peak power meter, Video Bandwidth = >165 MHz.

R0 C13 4 Chirps happen 128 times in 16.33ms, 4 x 128 = 512 chirps/On-Time

R0 C14 512 x 29us / 100ms = 14.848% On-Time / Cycle Time

ANSI C63.10-2020 Corr. 1 worse case Pulse Desensitization is computed for SA RBW = 10MHz as $\alpha = 1/(1+((2*\ln(2)/\pi(f))^2*(4100000000/(0.000034*10000000^2))^2))^{0.25} = 0.94 = -0.24 \text{ dB field strength} - \text{accounted for above.}$



TX1 + TX2 OUT-OF-PHASE
CHIRPS
(NULL @ BORESIGHT)

TX1 + TX2 IN-PHASE
CHIRPS
(PEAK @ BORESIGHT)

8 GHZ WIDEBAND PK POWER METER @ IF

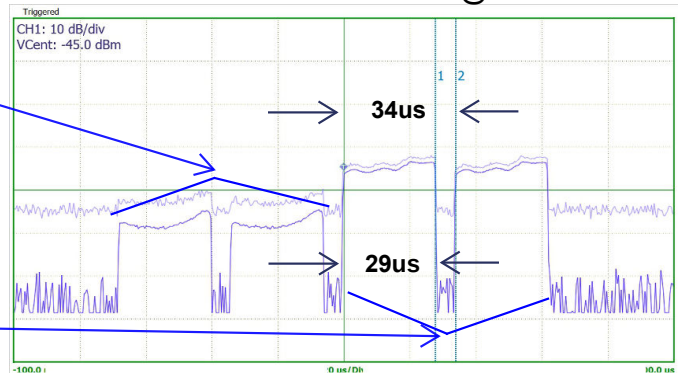


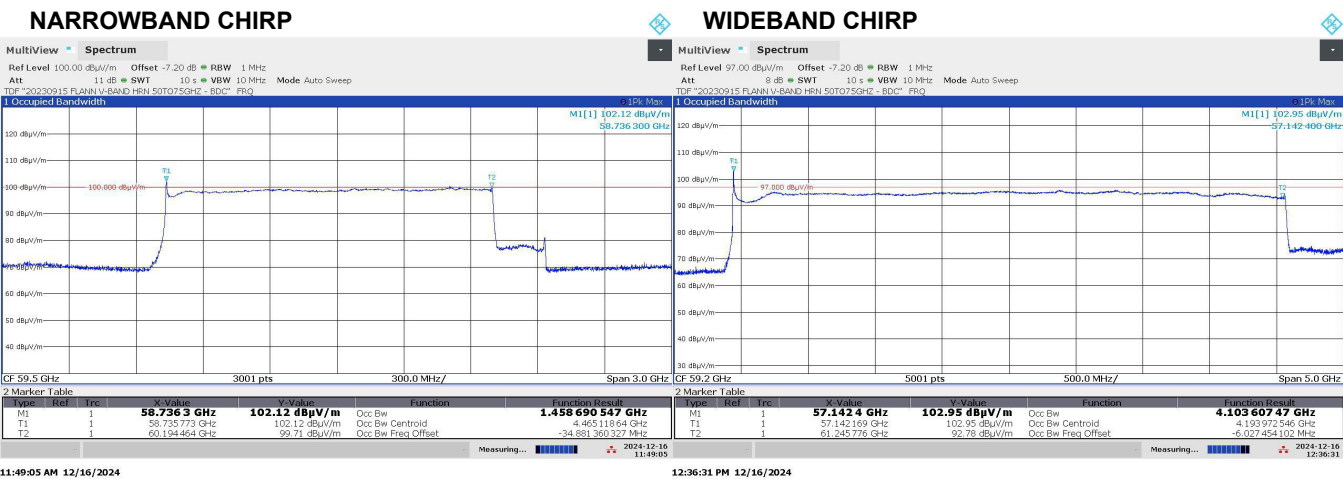
Figure 4.2.1 Example Pulsed Emission Characteristics (Duty Cycle).

4.2.2 Fundamental Emission Bandwidth

Emission bandwidth (EBW) of the EUT is measured with the device placed in the worst case test mode. Radiated emissions are recorded following the test procedures listed in Section 2.1. The 99% EBW is measured as the max-held peak-detected signal when the IF bandwidth is greater than or equal to 1% of the receiver span. The results of EBW testing are summarized in Table 4.2.2 . Plots showing measurements employed to obtain the emission bandwidth reported are provided in Figure 4.2.2 .

Table 4.2.2 Intentional Emission Bandwidth.

Det Pk		IF Bandwidth 10 MHz		Video Bandwidth 10 MHz		Test Date: 19-Dec-24					
				Test Engineer: J. Brunett							
				EUT: Density Waffle							
				Meas. Distance: 3 m							
Occupied Bandwidth											
R0	Transmit Mode	Channel	Temperature (C)	Voltage (V)	fL (MHz)	fL Limit (MHz)	fH (MHz)	fH Limit (MHz)	99% OBW (MHz)	OBW Limit (MHz)	Notes/Pass/Fail
R1	Narrowband	-	55.0	132.3	58735.5	57000.0	60194.2	61560.0	1458.7		
R2		-	55.0	97.8	58735.5	57000.0	60194.1	61560.0	1458.7		
R3		-	-20.0	132.3	58737.0	57000.0	60195.6	61560.0	1458.7		
R4		-	-20.0	97.8	58737.1	57000.0	60195.7	61560.0	1458.7		
R5		-	20.0	115.0	58735.8	57000.0	60194.5	61560.0	1458.7		
R6				fL _{MIN}	58735.5	fH _{MAX}	60195.7	OBW _{MAX}	1458.7		Pass
R7	Wideband	-	55.0	132.3	57141.7	57000.0	61245.5	61560.0	4103.8		
R8		-	55.0	97.8	57141.8	57000.0	61245.6	61560.0	4103.8		
R9		-	-20.0	132.3	57143.4	57000.0	61247.2	61560.0	4103.8		
R10		-	-20.0	97.8	57143.5	57000.0	61247.3	61560.0	4103.8		
R11		-	20.0	115.0	57142.0	57000.0	61245.8	61560.0	4103.8		
R12				fL _{MIN}	57141.7	fH _{MAX}	61247.3	OBW _{MAX}	4103.8		Pass
#	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11
(ROW)		(COLUMN) NOTE:									
R0		C5/C7		Computed via thermal chamber frequency shift and nominal OBW measurements.							
R0		C5/C7		OBW measured with Chirp active, equivalent to measurement with CW set at lowest and highest ends of chirp band.							



4.2.3 Fundamental Emission

Following the test procedures listed in Section 2.1, radiated emissions measurements are made on the EUT for both Horizontal and Vertical polarized fields. Table 4.2.3 details the results of these measurements.

Table 4.2.3 Fundamental Radiated Emissions.

Frequency Range				Det		IF Bandwidth		Video Bandwidth				Test Date:		12/16/24	
25 MHz ≤ f ≤ 1 000 MHz				Pk/QPk		120 kHz		300 kHz				Test Engineer:		J. Brunett	
				Pk (SA)		10 MHz		10 MHz				EUT:		Density Waffle	
				Avg (RMS)		1 MHz		3 MHz				Mode:		Chirp	
f > 1 000 MHz				Pk (Pwr Mtr)		100 Ms/s		165 MHz				Meas. Distance:		See Table.	

R0	Mode	Env.		Frequency Band		Antenna / Cable			Range Correction				E3-Field meas.		EIRP		EIRP Limit		EUT Ant. Gain dBi	Power Output		Pass By dB	Comments		
		Temp. (C)	Volt. (V)	Start MHz	Stop MHz	Ant QN	Pol. H/V	Dim cm	Ka dB/m	Kg dB	MR	DR	N/F m	CF dB	Pk dBuV/m	Avg	Pk dBm	Avg		EUT Po dBm	Limit				
R1	NARROWBAND	5	115.0	58805.0	58805.0	HRNV01	H/V	3.0	40.8	-6.0	3.0	3.0	0.4	0.0	112.0		16.8	5.5	20.0	9.0	7.8		3.2		
R2		5	115.0	59987.0	59987.0	HRNV01	H/V	3.0	40.8	-6.0	3.0	3.0	0.4	0.0	112.5		17.3	6.0	20.0	9.0	8.3		2.7		
R3		5	115.0	60270.0	60270.0	HRNV01	H/V	3.0	40.8	-6.0	3.0	3.0	0.4	0.0	112.7		17.5	6.2	20.0	9.0	8.5		2.5		
R4	WIDEBAND	5	115.0	60205.0	60205.0	HRNV01	H/V	3.0	40.8	-6.0	3.0	3.0	0.4	0.0	111.4		16.2	4.9	20.0	9.0	7.2		3.8		
R5		5	115.0	59912.0	59912.0	HRNV01	H/V	3.0	40.8	-6.0	3.0	3.0	0.4	0.0	112.8		17.6	6.3	20.0	9.0	8.6		2.4		
R6		5	115.0	62340.0	62340.0	HRNV01	H/V	3.0	40.8	-6.0	3.0	3.0	0.4	0.0	111.9		16.7	5.4	20.0	9.0	7.7		3.3		
R7		Env.		Frequency Band		Antenna / Cable			Range Correction				Pr PWR MTR		EIRP		EIRP Limit		EUT Ant. Gain dBi	Power Output		Pass By dB	Comments		
		Temp. (C)	Volt. (V)	Start MHz	Stop MHz	Ant QN	Pol. H/V	Dim cm	Ka dB/m	Kg dB	MR	DR	N/F m	CF dB	Pk dBm	Avg	Pk dBm	Avg		EUT Po dBm	Limit				
R8	NARROWBAND	5	115.0	57000.0	61560.0	HRNV01	H/V	3.0	40.8	-6.0	3.0	3.0	0.4	0.0	-42.8	-53.6	15.8	5.0	20.0	9.0	6.8		4.2	Chirp	
R9	WIDEBAND	5	115.0	57000.0	61560.0	HRNV01	H/V	3.0	40.8	-6.0	3.0	3.0	0.4	0.0	-42.5	-53.4	16.1	5.2	20.0	9.0	7.1		3.9	Chirp	
R10																									
#	C0	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	C19	C20	C21	C22	C23	C24

(ROW) (COLUMN) NOTE:

R0 C10/C11/C12/C13 CF is computed assuming a 20 dB/decade Field Decay Rate. DR is Regulatory Range Distance. MR is Measurement Distance. N/F is near-far boundary.

R0 C14 Pk Field measured via SA per ANSI C63.10:2020 9.8, Pk Pwr measured with broadband Pk power meter per ANSI C63.10:2020 9.9

R0 C15 Avg measured via Broadband Pwr Meter w/ 1sec avg window.

R0 C16 EIRP/MHz is computed from field strength at 3m distance. EIRP = E3m – 95.2; E3m = 107 + Pr + Ka – Kg;

R1-R6 C17 EIRP Avg is computed from EIRP Pk – Power Duty Cycle with Spectrum Analyzer. e.g. 112.7 dBuV/m @ 3m – 95.2 = 17.5 dBm EIRP (R3/C16) – 11.3 dB Power Duty = 6.2 dBm EIR

R8,R9 C17 EIRP Avg is measured directly with broadband average power meter. e.g. (107 - -53.6 dBm + 40.8 - -6.0) – 95.2 = 5.0 dBm EIRP (R8/C17)

R0 C18 Per FCC 15.255(2)(ii) / ISED RSS-210 J.3.2(b)(ii), limit of 20 dBm EIRP if off-time of 16.5 ms per 33 ms window in the 57.00 to 61.56 GHz band.

ANSI C63.10-2020 Corr. 1 worse case Pulse Desensitization is computed for SA RBW = 10MHz as alpha = 1/(1+((2*LN(2)/PI())^2*(4100000000/(0.000034*10000000^2))^2))^0.25 = 0.94 = -0.24 dB field strength - accounted for above.

4.3 Unintentional Emissions

4.3.1 Transmit Chain Spurious Emissions

The results for the measurement of transmit chain spurious emissions at the nominal voltage and temperature are provided in Table 4.3.1 .

Table 4.3.1 Transmit Chain Spurious Emissions.

Frequency Range				Det	IF Bandwidth	Video Bandwidth		Test Date:										19-Dec-24							
25 MHz ≤ f ≤ 1 000 MHz				Pk/QPk	120 kHz	300 kHz		Test Engineer:										J. Brunett							
f > 1 000 MHz				Pk	1 MHz	3 MHz		EUT:										Density Waffle							
f > 1 000 MHz				Avg	1 MHz	3 MHz		Mode:										Narrow + Wide Chirp modes							
										Meas. Distance:										See Table.					
FREQ < 40 GHZ																									
R0	Temp. (C.)	Env. Volt. (V)	Frequency Band		Antenna + Cable				Range Correction				E-Field @ DR		Pass By dB	Comments									
			Start MHz	Stop MHz	Quality Number	Pol. H/V	Dim. cm	Ka dB/m	Kg dB	MR m	DR m	N/F m	CF dB	Pk dBuV/m			Avg dBuV/m								
R1	5	115.0	1000.0	6000.0	HQR1TO18S01	H/V	15.0	33.0	-1.3	3.0	3.0	0.9	0.0	48.7	39.2	74.0	54.0	14.8	max all orientations						
R2	5	115.0	16000.0	16000.0	HQR1TO18S01	H	15.0	36.0	-2.5	3.0	3.0	2.4	0.0	49.8	41.0	74.0	54.0	13.0	LO SPUR – max all orient						
R3	5	115.0	16000.0	16000.0	HQR1TO18S01	V	15.0	36.0	-2.5	3.0	3.0	2.4	0.0	48.9	40.2	74.0	54.0	13.8	LO SPUR – max all orient						
R4	5	115.0	6000.0	18000.0	HQR1TO18S01	H/V	15.0	34.6	-3.1	3.0	3.0	2.7	0.0	44.5	36.7	74.0	54.0	17.3	max all orientations						
R5	5	115.0	18000.0	26500.0	HRNK001	H/V	10.2	33.7	40.0	3.0	3.0	1.8	0.0	47.9	39.5	74.0	54.0	14.5	max all orientations						
R6	5	115.0	26500.0	40000.0	HRNKA01	H/V	9.2	37.0	40.0	3.0	3.0	2.3	0.0	56.6	47.5	74.0	54.0	6.5	max all orientations						
FREQ >= 40 GHZ																									
R8	Temp. (C.)	Env. Volt. (V)	Frequency Band		Antenna + Cable				Range Correction				E-Field @ DR		EIRP		EIRP Limit		S @ DR		S Limit @ DR		Pass By dB	Comments	
			Start GHz	Stop GHz	Quality Number	Pol. H/V	Dim. cm	Ka dB/m	Kg dB	MR m	DR m	N/F m	CF dB	Pk dBuV/m	Avg dBuV/m	Pk dBm	Avg dBm	Pk dBm	Avg dBm	Pk dBm/cm2	Avg dBm/cm2				
R9	5	115.0	40.00	57.00	HRNU001	H/V	4.0	43.5	0.0	3.00	3.0	0.6	0.0	72.2	62.4	-23.0	-32.8			-83.5	-93.3		-70.5	22.8	max all orientations
R11	5	115.0	61.56	90.00	HRNE001	H/V	2.5	42.4	0.0	3.00	3.0	0.4	0.0	74.3	60.2	-20.9	-35.0			-81.4	-95.5		-70.5	25.0	max all orientations
R12	5	115.0	90.00	110.00	HRNW001	H/V	2.0	47.0	0.0	3.00	3.0	0.3	0.0	60.5	50.3	-34.7	-44.9			-95.2	-105.4		-70.5	34.9	max all orientations
R13	5	115.0	110.00	140.00	HRNG001	H/V	1.0	54.0	0.0	3.00	3.0	0.1	0.0	67.2	56.9	-28.0	-38.3			-88.5	-98.8		-70.5	28.3	max all orientations
R14	5	115.0	140.00	200.00	HRNG001	H/V	1.0	54.0	0.0	3.00	3.0	0.1	0.0	71.3	61.0	-23.9	-34.2			-84.4	-94.7		-70.5	24.2	max all orientations
R15																									
#	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	C19	C20	C21	C22	C23	C24	C25
(ROW)	(COLUMN)																								
R0/R9	NOTE:																								
R0/R9	C10/C11/C12/C13 CF is computed assuming a 20 dB/decade Decay Rate. DR is Regulatory Range Distance. MR is Measurement Distance, reduced as necessary to achieve Rx. sensitivity.																								
R9	C7 Dimension of antenna is taken to be larger of the test antenna and the DUT antenna; DUT antenna is 6cm in dimension.																								
R9	C16 EIRP is computed from field strength at 3 meter distance in a 1 MHz RBW / 3 MHz VBW.																								
R9	C23 S @ DR: 90 pW/cm2 = -70.5 dBm/cm2, FCC/ISED Regulatory Limit																								
R9	C20 Spatial Power Density S @ 3m (dBm/cm^2) = EIRP (dBm) – 10*log10(4*pi*(300cm)^2) = EIRP (dBm) – 60.5 dB.																								

4.3.2 General Radiated and Cabinet Spurious

The results for the measurement of general spurious emissions (emissions arising from digital circuitry) at the nominal voltage and temperature are provided in Table 4.3.2 . Radiation from digital components are measured up to 1000 MHz or to the highest frequency required by the applied standards, whichever is greater.

Table 4.3.2 Radiated Spurious Emissions.

Frequency Range		Det	IF Bandwidth	Video Bandwidth	Test Date:	19-Dec-24												
25 MHz ≤ f ≤ 1 000 MHz		Pk/QPk	120 kHz	300 kHz	Test Engineer:	J. Brunett												
f > 1 000 MHz		Pk	1 MHz	3 MHz	EUT:	Density Waffle												
f > 1 000 MHz		Avg	1 MHz	10kHz	EUT Mode:	All radios active (Wideband + Narrowband)												
					Meas. Distance:	3 meters												
Digital Spurious Emissions																		FCC/IC + CE(CISPR)
#	Test Freq. MHz	Antenna QN Used	Test Pol.	Ant Ht. m	Table Angle deg	Ka dB/m	Kg dB	Pk dBµV/m	QPk/Avg dBµV/m	FCC/IC Class B E3lim dBµV/m	Pass dB	CE Class B E3lim dBµV/m	Pass dB	FCC/IC Class A E3lim dBµV/m	Pass dB	CE Class A E3lim dBµV/m	Pass dB	Comments
1	35.0	BICEMCO01	H	1.0	max all	12.7	-3	30.1	21.2	40.0	18.8	40.5	19.3	49.5	28.3	50.5	29.3	
2	35.0	BICEMCO01	V	1.0	max all	12.7	-3	32.2	22.7	40.0	17.3	40.5	17.8	49.5	26.8	50.5	27.8	
3	60.0	BICEMCO01	H	1.0	max all	9.9	-4	33.2	24.5	40.0	15.5	40.5	16.0	49.5	25.0	50.5	26.0	
4	60.0	BICEMCO01	V	1.0	max all	9.9	-4	35.9	24.5	40.0	15.5	40.5	16.0	49.5	25.0	50.5	26.0	
5	88.0	BICEMCO01	H	2.0	max all	9.5	-5	35.2	24.3	40.0	15.7	40.5	16.2	49.5	25.2	50.5	26.2	
6	88.0	BICEMCO01	V	1.0	max all	9.5	-5	35.4	25.0	40.0	15.0	40.5	15.5	49.5	24.5	50.5	25.5	
7	125.7	BICEMCO01	H	2.0	max all	11.9	-6	28.2	22.7	43.5	20.8	40.5	17.8	54.0	31.3	50.5	27.8	
8	125.7	BICEMCO01	V	2.0	max all	11.9	-6	28.2	24.1	43.5	19.4	40.5	16.4	54.0	29.9	50.5	26.4	
9	156.3	BICEMCO01	H	2.0	max all	12.6	-7	26.8	21.6	43.5	21.9	40.5	18.9	54.0	32.4	50.5	28.9	
10	156.3	BICEMCO01	V	2.0	max all	12.6	-7	28.5	22.9	43.5	20.6	40.5	17.6	54.0	31.1	50.5	27.6	
11	360.0	LOGEMCO01	H	3.0	max all	15.0	-4.1	37.9	36.8	46.0	9.2	47.5	10.7	56.9	20.1	57.5	20.7	
12	360.0	LOGEMCO01	V	3.0	max all	15.0	-4.1	38.7	39.3	46.0	7.3	47.5	8.8	56.9	18.2	57.5	18.8	
13	600.0	LOGEMCO01	H	1.0	max all	19.0	-5.6	30.1	33.7	46.0	15.9	47.5	17.4	56.9	26.8	57.5	27.4	
14	600.0	LOGEMCO01	V	1.0	max all	19.0	-5.6	32.3	34.3	46.0	13.7	47.5	15.2	56.9	24.6	57.5	25.2	
15	840.0	LOGEMCO01	H	1.0	max all	21.9	-6.7	37.2	33.4	46.0	12.6	47.5	14.1	56.9	23.5	57.5	24.1	
16	840.0	LOGEMCO01	V	1.0	max all	21.9	-6.7	37.6	35.1	46.0	10.9	47.5	12.4	56.9	21.8	57.5	22.4	
17	2388.4	HQR1TO18S01	H/V	1.5	max all	30.5	-6.5	48.3	32.5	54.0	21.5	50.0	17.5					WLAN 2.4 BAND
18	2388.4	HQR1TO18S01	H/V	1.5	max all	30.5	-6.5	49.1	34.8	54.0	19.2	50.0	15.2					WLAN 5.2 BAND
19	2400.0	HQR1TO18S01	H/V	1.5	max all	30.5	-6.6	38.3	28.2	54.0	25.8	50.0	21.8					BLE 2.4 BAND
20	2483.5	HQR1TO18S01	H/V	1.5	max all	30.8	-6.7	44.6	29.5	54.0	24.5	50.0	20.5					WLAN 2.4 BAND
21	2483.5	HQR1TO18S01	H/V	1.5	max all	30.8	-6.7	42.4	30.5	54.0	23.5	50.0	19.5					BLE 2.4 BAND
22	2483.5	HQR1TO18S01	H/V	1.5	max all	30.8	-6.7	44.8	31.4	54.0	22.6	50.0	18.6					WLAN 5.2 BAND
23																		
24																		
25																		

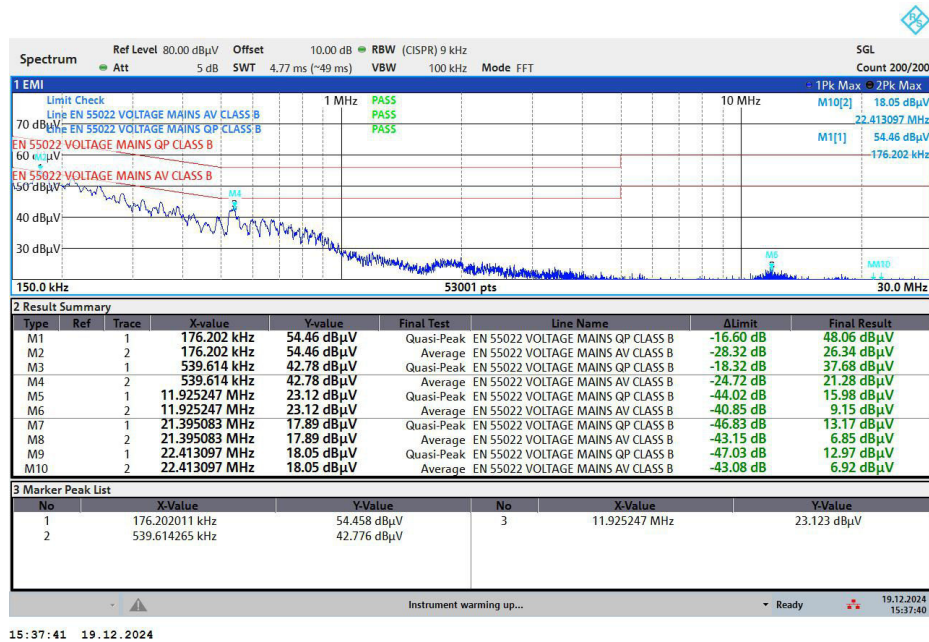
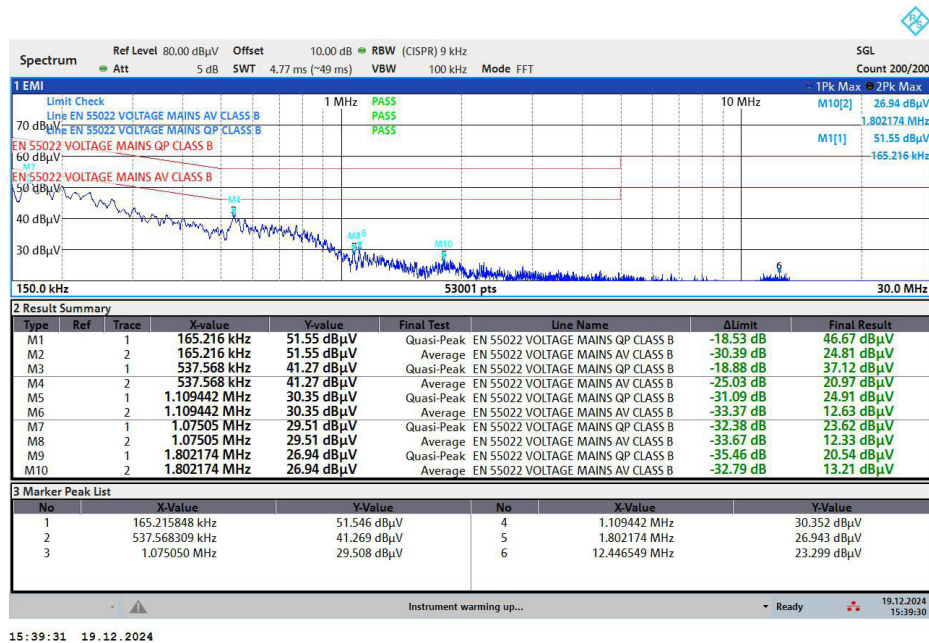
*QPk detection below 1 GHz, Avg detection at or above 1 GHz with receiver bandwidth as specified at top of table.

** When E-field is reported directly from Spectrum Analyzer, Antenna Factors and Cable losses are included directly in SA settings.

4.3.3 Conducted Emissions Test Results - AC Power Port(s)

The results of emissions from the EUT's AC mains power port(s) are reported in Table 4.3.3 .

Table 4.3.3 AC Mains Power Conducted Emissions Results.



5 Measurement Uncertainty and Accreditation Documents

The maximum values of measurement uncertainty for the laboratory test equipment and facilities associated with each test are given in the table below. This uncertainty is computed for a 95.45% confidence level based on a coverage factor of $k = 2$.

Table 5.0.0 Measurement Uncertainty.

Measured Parameter	Measurement Uncertainty [†]
Radio Frequency	$\pm(f_{Mkr}/10^7 + RBW/10 + (SPN/(PTS - 1))/2 + 1 \text{ Hz})$
Conducted Emm. Amplitude	±1.9 dB
Radiated Emm. Amplitude ($f < 30 \text{ MHz}$)	±3.1 dB
Radiated Emm. Amplitude (30 – 200 MHz)	±4.0 dB
Radiated Emm. Amplitude (200 – 1000 MHz)	±5.2 dB
Radiated Emm. Amplitude ($f > 1000 \text{ MHz}$)	±3.7 dB

[†]Ref: CISPR 16-4-2:2011+A1:2014



Figure 5.0.0 Accreditation Documents