

# TEST REPORT

**Test Report No. :** UL-RPT-RP14415455-416A

**Customer** : VEGA Grieshaber KG  
**Model No.** : VEGAPULS 42  
**FCC ID** : O6QPS40W  
**Technology** : Tank Level Probing Radar  
**Test Standard(s)** : FCC Parts 15.31(q), 15.207 & 15.209(a)  
**Test Laboratory** : UL International (UK) Ltd, Basingstoke, Hampshire, RG24 8AH, United Kingdom

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2. The results in this report apply only to the sample(s) tested.
3. The sample tested is in compliance with the above standard(s).
4. The test results in this report are traceable to the national or international standards.
5. Version 2.0 supersedes all previous versions.

**Date of Issue:** 05 April 2023

**Checked by:**



Ben Mercer  
Lead Project Engineer, Radio Laboratory

**Company Signatory:**



Sarah Williams  
RF Operations Leader, Radio Laboratory



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## **Customer Information & Manufacturer Information**

### **Customer**

<b>Company Name:</b>	VEGA Grieshaber KG
<b>Address:</b>	Am Hohenstein 113 D-77761 Schiltach Germany

### **Manufacturer**

<b>Company Name:</b>	VEGA Americas, Inc.
<b>Address:</b>	3877 Mason Research Parkway Ohio Mason 45036 United States of America

<b>Company Name:</b>	VEGA India Level and Pressure Measurement Pvt. Ltd
<b>Address:</b>	Plot No. 1, Gat No. 181, Village – Phulgaon Tal. Haveli Pune 412216 India

## **Report Revision History**

<b>Version Number</b>	<b>Issue Date</b>	<b>Revision Details</b>	<b>Revised By</b>
1.0	02/03/2023	Initial Version	Ben Mercer
2.0	05/04/2023	FCC ID updated	Ben Mercer

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## **1 Attestation of Test Results**





### **1.1 Description of EUT**

The equipment under test was a radar sensor for the continuous level measurement of liquids, operating in the 75 GHz to 85 GHz band using FMCW.

### **1.2 General Information**

<b>Specification Reference:</b>	47CFR15.31
<b>Specification Title:</b>	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart A (General) – Section 15.31
<b>Specification Reference:</b>	47CFR15.207 and 47CFR15.209
<b>Specification Title:</b>	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart C (Intentional Radiators) – Sections 15.207 & 15.209
<b>Site Registration:</b>	685609
<b>Lab Designation No.:</b>	UK2011
<b>Location of Testing:</b>	Unit 3 Horizon, Wade Road, Kingsland Business Park, Basingstoke, Hampshire, RG24 8AH, United Kingdom
<b>Test Dates:</b>	27 January 2023 to 22 February 2023

### **1.3 Summary of Test Results**

<b>FCC Reference (47CFR)</b>	<b>Measurement</b>	<b>Result</b>
Part 15.31(q) & 15.209(a)	Transmitter Radiated Emissions	
Part 15.207	Transmitter AC Conducted Emissions	
<b>Key to Results</b>  = Complied  = Did not comply		

### **1.4 Deviations from the Test Specification**

For the measurements contained within this test report, there were no deviations from, additions to, or exclusions from the test specification identified above.

## **2 Summary of Testing**

### **2.1 Facilities and Accreditation**

The test site and measurement facilities used to collect data are located at Unit 3 Horizon, Wade Road, Kingsland Business Park, Basingstoke, Hampshire, RG24 8AH, United Kingdom. The following table identifies which facilities were utilised for radiated emission measurements documented in this report. Specific facilities are also identified in the test results sections.

Site 1	X
Site 2	-
Site 17	-

UL International (UK) Ltd is accredited by the United Kingdom Accreditation Service (UKAS). UKAS is one of the signatories to the International Laboratory Accreditation Co-operation (ILAC) Arrangement for the mutual recognition of test reports. The tests reported herein have been performed in accordance with its terms of accreditation.

### **2.2 Methods and Procedures**

<b>Reference:</b>	ANSI C63.10-2013
<b>Title:</b>	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
<b>Reference:</b>	KDB 174176 D01 Line Conducted FAQs v01r01
<b>Title:</b>	AC Power-Line Conducted Emissions Frequently Asked Questions

## **2.3 Calibration and Uncertainty**

### **Measuring Instrument Calibration**

In accordance with UKAS requirements all the measurement equipment is on a calibration schedule. All equipment was within the calibration period on the date of testing.

### **Measurement Uncertainty & Decision Rule**

#### **Overview**

No measurement or test can ever be perfect and the imperfections give rise to error of measurement in the results. Consequently the result of a measurement is only an approximation to the value of the measurand (the specific quantity subject to measurement) and is only complete when accompanied by a statement of the uncertainty of the approximation.

The expression of uncertainty of a measurement result allows realistic comparison of results with reference values and limits given in specifications and standards.

#### **Decision Rule**

The decision rule applied is based upon the accuracy method criteria. The measurement uncertainty is met and the result is considered in conformance with the requirement criteria if the observed value is within the prescribed limit.

#### **Measurement Uncertainty**

The reported expanded uncertainties below are based on a standard uncertainty multiplied by an appropriate coverage factor such that a confidence level of approximately 95% is maintained. For the purposes of this document “approximately” is interpreted as meaning “effectively” or “for most practical purposes”.

Measurement Type	Range	Confidence Level (%)	Calculated Uncertainty
Radiated Emissions	9 kHz to 30 MHz	95%	±5.32 dB
Radiated Emissions	30 MHz to 1 GHz	95%	±3.30 dB
Radiated Emissions	1 GHz to 40 GHz	95%	±3.16 dB
Radiated Emissions	40 GHz to 200 GHz	95%	±5.12 dB
Transmitter AC Conducted Emissions	0.15 MHz to 30 MHz	95%	±1.96 dB

The methods used to calculate the above uncertainties are in line with those recommended within the various measurement specifications. Where measurement specifications do not include guidelines for the evaluation of measurement uncertainty the published guidance of the appropriate accreditation body is followed.

## 2.4 Test and Measurement Equipment

### Test Equipment Used for Transmitter Radiated Emissions Tests

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M2040	Thermohygrometer	Testo	608-H1	45124934	09 Dec 2023	12
K0001	3m RSE Chamber	Rainford EMC	N/A	N/A	05 Sep 2023	12
M1995	Test Receiver	Rohde & Schwarz	ESU40	100428	02 Nov 2023	12
M2077	Test Receiver	Rohde & Schwarz	ESW44	102026	15 Feb 2023	12
A3165	Magnetic Loop Antenna	ETS-Lindgren	6502	00224383	05 May 2023	12
A3154	Pre-Amplifier	Com-Power	PAM-103	18020012	18 Aug 2023	12
A3161	Antenna	Chase	CBL6111A	50859	03 May 2023	12
A3113	6dB Attenuator	AtlanTecRF	AN18-06	219706#3	03 May 2023	12
A3085	Low Pass Filter	AtlanTecRF	AFL-02000	18051600014	26 Jan 2024	12
A3138	Antenna	Schwarzbeck	BBHA 9120 B	00702	22 Aug 2023	12
A3139	Antenna	Schwarzbeck	HWRD750	00027	22 Aug 2023	12
A222867	Pre-Amplifier	Atlantic Microwave	A-LNAKX-380116-S5S5	210865001	26 Aug 2023	12
A2523	10dB Attenuator	AtlanTecRF	AN18W5-10	832827#1	26 Jan 2024	12
A3093	High Pass Filter	AtlanTecRF	AFH-03000	18051800077	26 Jan 2024	12
A212041	High Pass Filter	Micro-Tronics	HPS20723	001	26 Jan 2024	12
A2892	Antenna	Schwarzbeck	BBHA 9170	9170-727	31 Oct 2023	12
A3265	Pre-Amplifier	Schwarzbeck	BBV 9721	9721-069	31 Oct 2023	12
M1832	Signal Analyser	Keysight	N9010A	MY53470303	18 May 2024	24
A219915	Downconverter	Virginia Diodes	WR19SAX	SAX 897	14 Apr 2023	12
M2069	Downconverter	Virginia Diodes	WR15SAX	SAX 394	09 Jul 2023	24
M2064	Downconverter	Virginia Diodes	WR12SAX	SAX 325	29 Jul 2023	24
M2065	Downconverter	Virginia Diodes	WR10SAX	SAX 393	30 Jul 2023	24
M2066	Downconverter	Virginia Diodes	WR6.5SAX	SAX 392	31 May 2024	24
M2067	Downconverter	Virginia Diodes	WR4.3SAX	SAX 391	31 May 2024	24
A2963	Antenna	Link Microtek	AM19HA-ULV1	14929	20 Jun 2023	12
A2964	Antenna	Link Microtek	AM15HA-ULV1	14930	24 Jun 2023	12
A2967	Antenna	Link Microtek	AM10HA-ULV1	14933	13 Jul 2023	12
A2968	Antenna	Link Microtek	AM7HA-ULV1	14934	04 Feb 2023	12
A2969	Antenna	Link Microtek	AM4HA-ULV1	14935	04 Feb 2023	12

**Test and Measurement Equipment (continued)****Test Equipment Used for Transmitter AC Conducted Spurious Emissions:**

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M2037	Thermohygrometer	Testo	608-H1	45124925	08 Dec 2023	12
A649	LISN	Rohde & Schwarz	ESH3-Z5	825562/008	01 Sep 2023	12
A1830	Pulse Limiter	Rohde & Schwarz	ESH3-Z2	100668	31 May 2023	12
M1124	Test Receiver	Rohde & Schwarz	ESIB26	100046	06 Oct 2023	12
A215746	Variable DC Power Supply	Rohde & Schwarz	NGSM 32/10	192.0810.31	Cal before use	-
M1251	Digital Voltmeter	Fluke	175	89170179	19 May 2023	12

**Test Measurement Software/Firmware Used:**

Name	Version	Release Date
Rohde & Schwarz EMC32	6.30.0	2018



### **3 Equipment Under Test (EUT)**

#### **3.1 Identification of Equipment Under Test (EUT)**

<b>Brand Name:</b>	VEGAPULS
<b>Model No.:</b>	VEGAPULS 42 (Antenna 1)
<b>Test Sample Serial Number:</b>	61489212 ( <i>Radiated sample #1</i> )
<b>Hardware Version:</b>	1.0.0
<b>Software Version:</b>	1.0.0
<b>FCC ID:</b>	O6QPS40W
<b>Date of Receipt:</b>	20 January 2023

<b>Brand Name:</b>	VEGAPULS
<b>Model No.:</b>	VEGAPULS 42 (Antenna 3)
<b>Test Sample Serial Number:</b>	61489166 ( <i>Radiated sample #2</i> )
<b>Hardware Version:</b>	1.0.0
<b>Software Version:</b>	1.0.0
<b>FCC ID:</b>	O6QPS40W
<b>Date of Receipt:</b>	20 January 2023

#### **3.2 Modifications Incorporated in the EUT**

No modifications were applied to the EUT during testing.

#### **3.3 Additional Information Related to Testing**

<b>Technology Tested:</b>	Tank Level Probing Radar	
<b>Type of Unit:</b>	Transceiver	
<b>Modulation:</b>	FMCW	
<b>Power Supply Requirement(s):</b>	Nominal	24.0 VDC
<b>Transmit Frequency Range:</b>	75 GHz to 85 GHz	
<b>Transmit Channels Tested:</b>	<b>Channel Bandwidth (GHz)</b>	<b>Channel Frequency (GHz)</b>
	8	80.000

**3.4 Description of Available Antennas**

The radio utilizes various integrated antennas, with the following maximum gains:

ID	Type	HPBW	Frequency Range (MHz)	Gain (dBi)
1	1" Thread	13.2°	75000 to 85000	22.2
2	¾" Thread	14.2°	75000 to 85000	18.2
3	1" Thread with Hygiene Adapter	14.1°	75000 to 85000	20.8

### **3.5 Description of Test Setup**

#### **Support Equipment**

The following support equipment was used to exercise the EUT during testing:

<b>Description:</b>	240 Litre Tank
<b>Brand Name:</b>	Speidel
<b>Model Name or Number:</b>	Not marked or stated
<b>Serial Number:</b>	Not marked or stated

<b>Description:</b>	Test Laptop
<b>Brand Name:</b>	Lenovo
<b>Model Name or Number:</b>	L480
<b>Serial Number:</b>	PF1EJ3BY

<b>Description:</b>	DC Power Supply (UL Asset S0537)
<b>Brand Name:</b>	TTI
<b>Model Name or Number:</b>	EL302D
<b>Serial Number:</b>	249928

#### **Operating Modes**

The EUT was tested in the following operating mode(s):

- Transmitting at maximum power with FMCW modulation.

#### **Configuration and Peripherals**

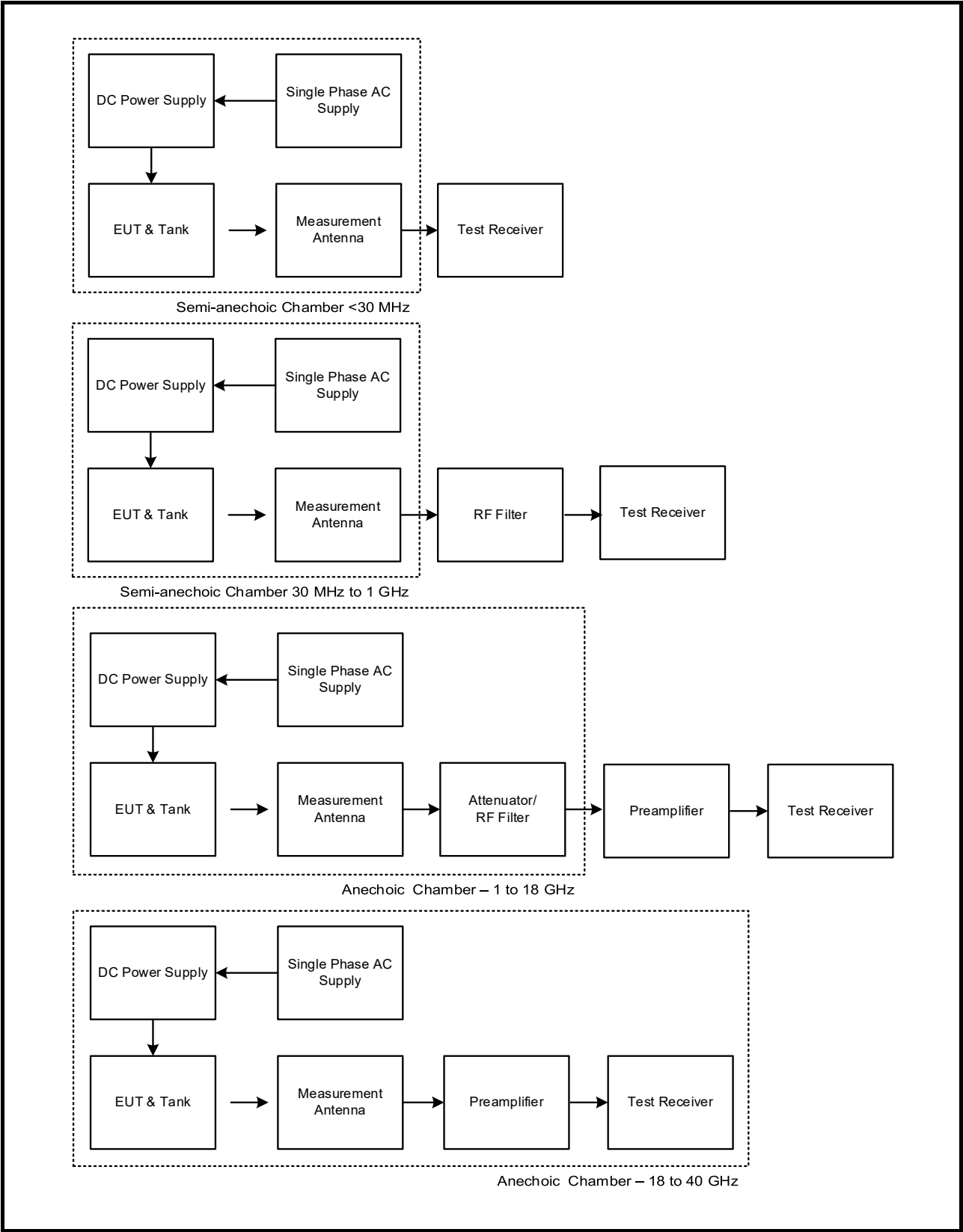
The EUT was tested in the following configuration(s):

- The EUT was pre-configured to transmit when powered on.
- The EUT was powered via a 24 VDC bench power supply connected to a 120 VAC 60 Hz mains supply.
- Testing was performed with the EUT installed in a representative metal tank. No accessories/peripherals were employed during test as there were no ports on the EUT to populate.
- The EUT can be supplied with a range of antennas. Testing was performed on the highest gain antenna of each type.
- For AC Conducted Emissions tests, the *Bluetooth* LE transceiver was also active and sending data to a test laptop running VEGA PACTware 5.0 software.

Test Setup Diagrams

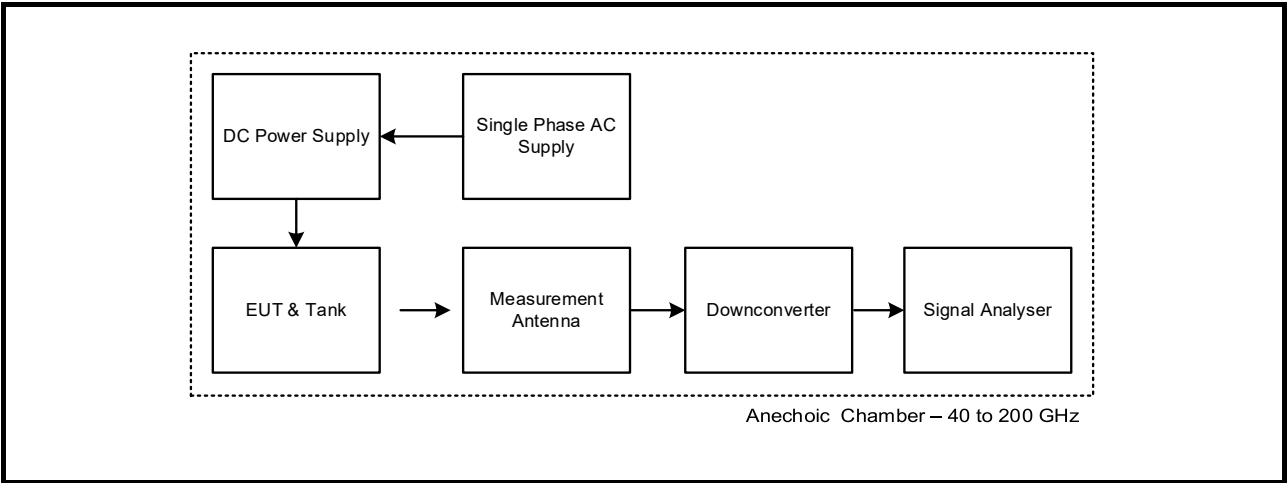
Radiated Tests:

Test Setup for Transmitter Radiated Emissions

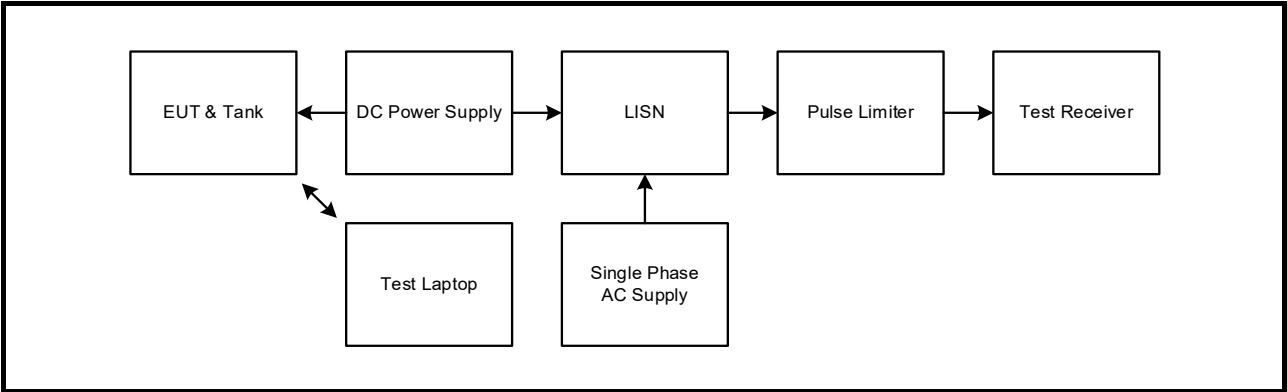


**Test Setup Diagrams (continued)**

**Test Setup for Transmitter Radiated Emissions (continued)**



**Test Setup for Transmitter AC Conducted Spurious Emissions**



## **4 Radiated Test Results**

### **4.1 Transmitter Radiated Emissions <1 GHz**

#### **Test Summary:**

<b>Test Engineer:</b>	Vi Van	<b>Test Dates:</b>	03 February 2023 & 04 February 2023
<b>Test Sample Serial Number:</b>	61489212 & 61489166		

<b>FCC Reference:</b>	Part 15.31(q) & 15.209(a)
<b>Test Method Used:</b>	ANSI C63.10 Sections 6.3, 6.4 and 6.5
<b>Frequency Range</b>	9 kHz to 1000 MHz

#### **Environmental Conditions:**

<b>Temperature (°C):</b>	21
<b>Relative Humidity (%):</b>	38 to 39

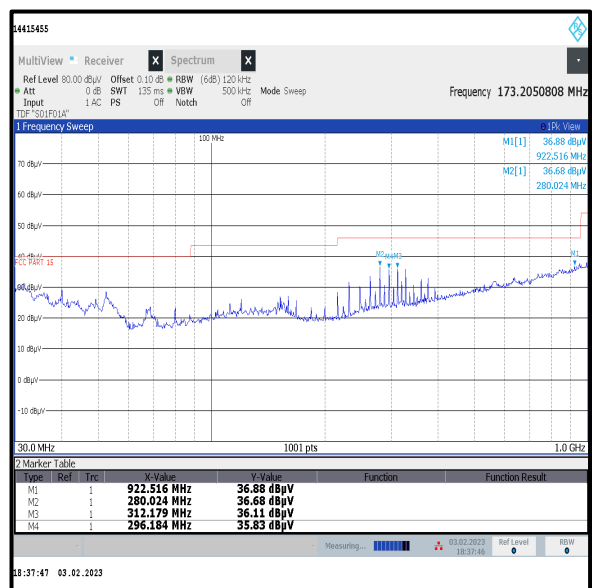
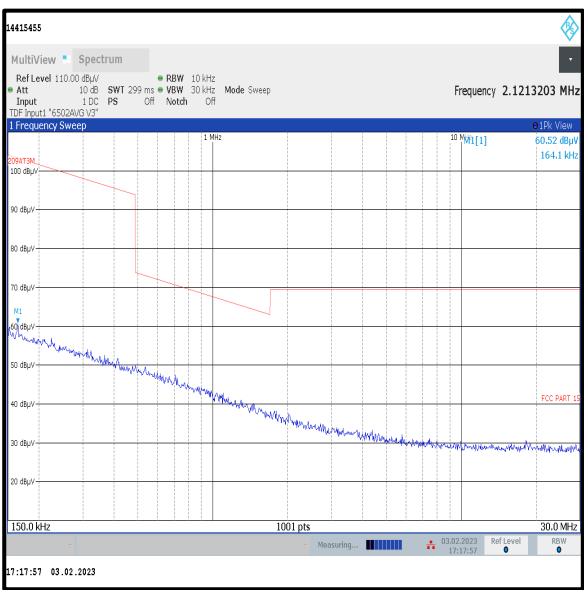
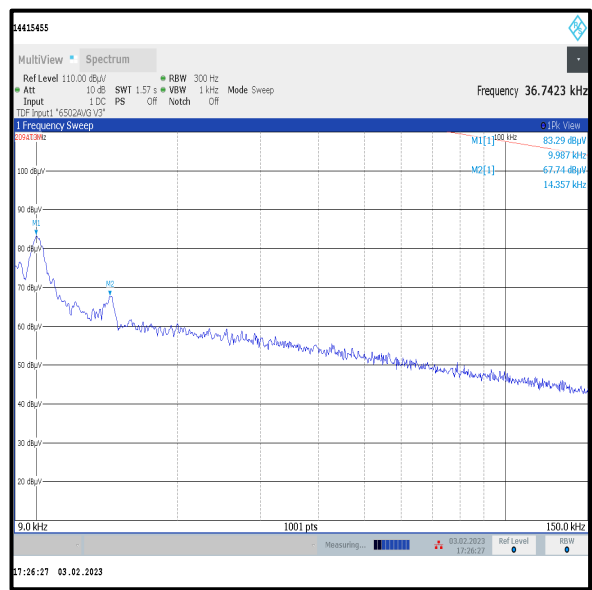
#### **Note(s):**

1. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
2. All other emissions shown on the pre-scans were investigated and found to be ambient, > 20 dB below the appropriate limit or below the noise floor of the measurement system.
3. Measurements below 1 GHz were performed in a semi-anechoic chamber (Asset Number K0001) at a distance of 3 metres. Radiated Transmitter Unwanted Emissions were performed with the EUT installed in a representative tank. The tank was placed on the turntable using non-conductive supports. No other accessories/peripherals were employed during test as there were no ports on the EUT to populate.
4. Between 30 MHz and 1 GHz, maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.
5. Pre-scans were performed and markers placed on the highest measured levels. The test receiver was configured as follows: For 9 kHz to 150 kHz, the resolution bandwidth was set to 300 Hz and video bandwidth 1 kHz. A peak detector was used and trace mode was Max Hold. For 150 kHz to 30 MHz, the resolution bandwidth was set to 10 kHz and video bandwidth 30 kHz, trace mode was Max Hold. For 30 MHz to 1 GHz, the resolution bandwidth was set to 120 kHz and video bandwidth 500 kHz. A peak detector was used, sweep time was set to auto and trace mode was Max Hold.
6. Final measurements were performed on the marker frequencies and the results entered into the table below. The test receiver resolution bandwidth was set to 120 kHz, using a CISPR quasi-peak detector and span wide enough to see the whole emission.

**Transmitter Radiated Emissions (continued)****Results: Antenna 1 / Quasi-Peak**

Frequency (MHz)	Antenna Polarity	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
40.007	Vertical	26.6	40.0	13.4	Complied
160.008	Vertical	25.8	43.0	17.2	Complied
216.006	Vertical	28.1	43.0	14.9	Complied
231.993	Vertical	31.2	46.0	14.8	Complied
248.004	Vertical	30.5	46.0	15.5	Complied
263.992	Vertical	33.5	46.0	12.5	Complied
280.007	Vertical	36.3	46.0	9.7	Complied
296.009	Vertical	35.4	46.0	10.6	Complied
312.006	Vertical	35.3	46.0	10.7	Complied
328.013	Vertical	34.6	46.0	11.4	Complied
344.005	Vertical	30.2	46.0	15.8	Complied
360.008	Vertical	30.8	46.0	15.2	Complied
376.021	Vertical	30.3	46.0	15.7	Complied

Transmitter Radiated Emissions (continued)



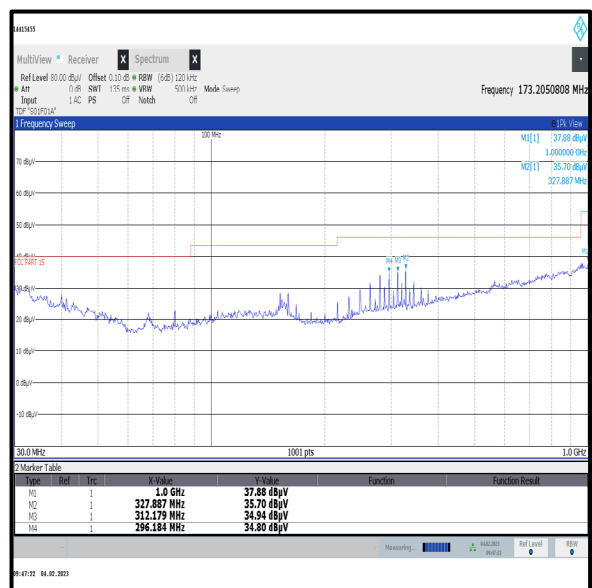
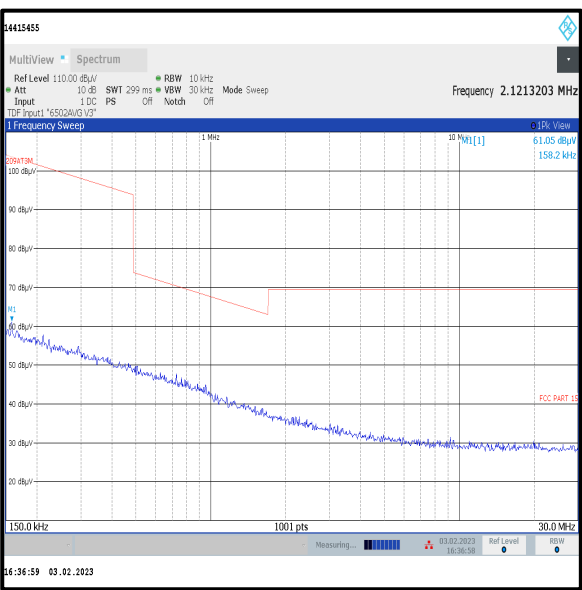
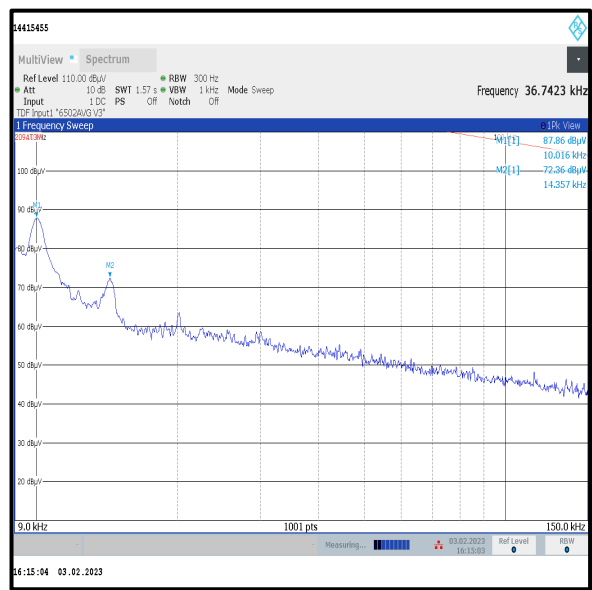
Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying table.



**Transmitter Radiated Emissions (continued)****Results: Antenna 3 / Quasi-Peak**

Frequency (MHz)	Antenna Polarity	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
79.987	Vertical	21.5	40.0	18.5	Complied
152.006	Vertical	26.7	43.0	16.3	Complied
160.005	Vertical	27.9	43.0	15.1	Complied
215.994	Vertical	23.8	43.0	19.2	Complied
232.015	Vertical	26.6	46.0	19.4	Complied
247.989	Vertical	30.2	46.0	15.8	Complied
263.999	Vertical	32.0	46.0	14.0	Complied
280.003	Vertical	34.7	46.0	11.3	Complied
288.006	Vertical	28.0	46.0	18.0	Complied
295.992	Vertical	34.4	46.0	11.6	Complied
312.017	Vertical	34.0	46.0	12.0	Complied
319.996	Vertical	29.6	46.0	16.4	Complied
328.006	Vertical	35.0	46.0	11.0	Complied
336.000	Vertical	27.8	46.0	18.2	Complied
343.993	Vertical	30.1	46.0	15.9	Complied

Transmitter Radiated Emissions (continued)



Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying table.

## 4.2 Transmitter Radiated Emissions >1 GHz

### Test Summary:

Test Engineer:	Vi Van	Test Dates:	27 January 2023 to 03 February 2023
Test Sample Serial Number:	61489212 & 61489166		

FCC Reference:	Part 15.31(q) & 15.209(a)
Test Method Used:	ANSI C63.10 Sections 6.3, 6.6, 9.8 and 9.12
Frequency Range	1 GHz to 200 GHz

### Environmental Conditions:

Temperature (°C):	19 to 21
Relative Humidity (%):	33 to 38

### Note(s):

1. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
2. The emissions seen on the 1 GHz to 3 GHz plots are advertising signals from the Bluetooth radio. These could not be disabled.
3. All other emissions shown on the pre-scans were investigated and found to be ambient, > 20 dB below the appropriate limit or below the noise floor of the measurement system.
4. Pre-scans between 1GHz and 18GHz were performed in fully anechoic chambers (Asset Numbers K0001) at a distance of 3 metres; pre-scans between 18GHz and 40GHz were performed at measurement distance of 1 metre.
5. Radiated Transmitter Unwanted Emissions were performed with the EUT installed in a representative tank. The tank was placed on the turntable using non-conductive supports, the EUT is at 1.5m above the ground plane. No other accessories/peripherals were employed during test as there were no ports on the EUT to populate.
6. Final measurements between 1 GHz and 40 GHz were performed in fully anechoic chambers (Asset Numbers K0001). The tank was placed on the turntable using non-conductive supports in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.
7. Measurements above 40 GHz were performed in accordance with ANSI C63.10 Clause 9.12.
8. Measurement distances above 40 GHz were determined according to ANSI C63.10 Clause 9.8. Measurement distances were reduced until 6 dB noise floor clearance was achieved:

40-110 GHz – 0.5 metres

110-150 GHz – 0.3 metres

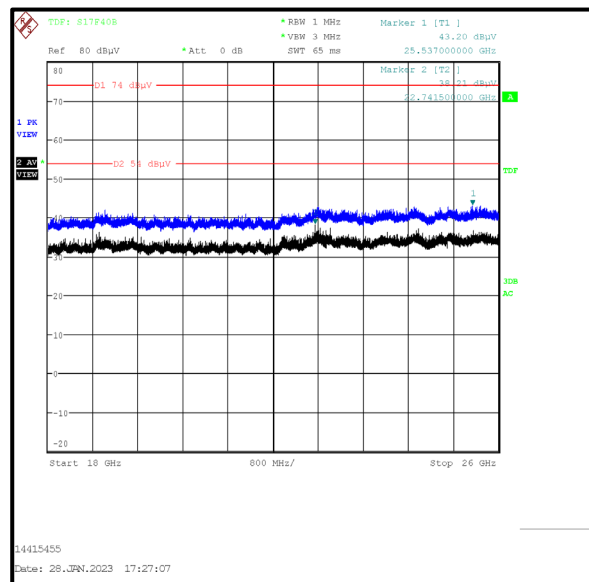
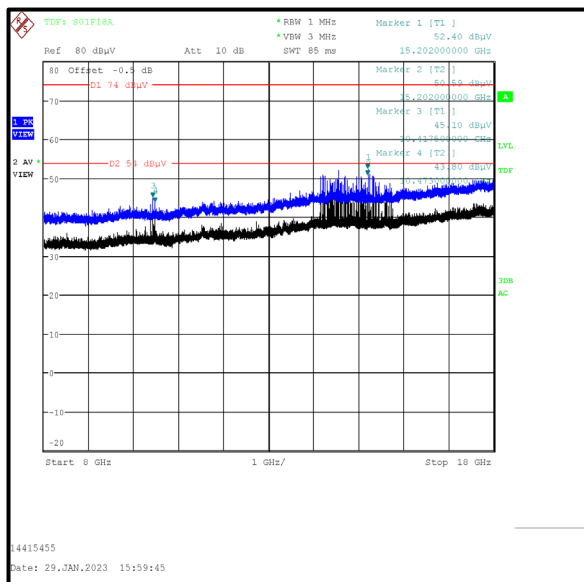
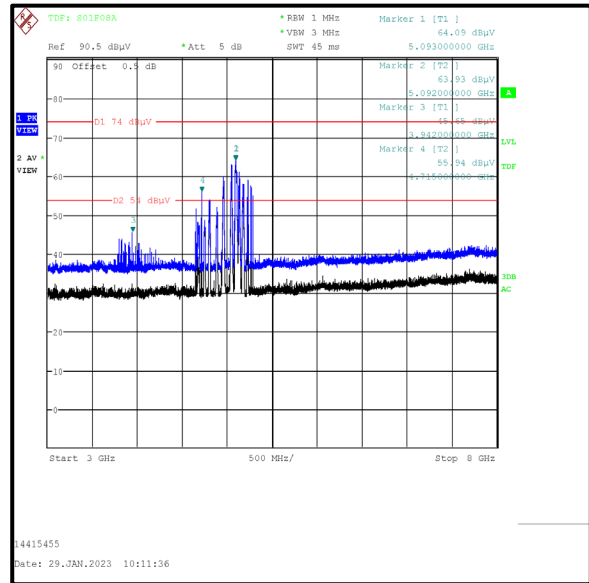
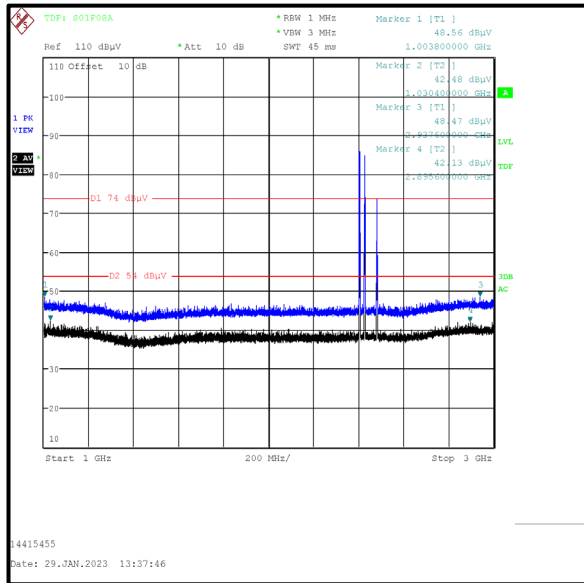
150-200 GHz – 0.2 metres

**Transmitter Radiated Emissions (continued)****Results: Antenna 1 / Peak**

Frequency (MHz)	Antenna Polarity	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
4738.200	Vertical	57.5	74.0	16.5	Complied
5211.200	Vertical	65.9	74.0	8.1	Complied
15079.300	Vertical	54.5	74.0	19.5	Complied
22750.688	Vertical	42.2	74.0	31.8	Complied
77036.796	Vertical	69.2	74.0	4.8	Complied
79286.073	Vertical	68.4	74.0	5.6	Complied
83357.111	Vertical	61.5	74.0	12.5	Complied

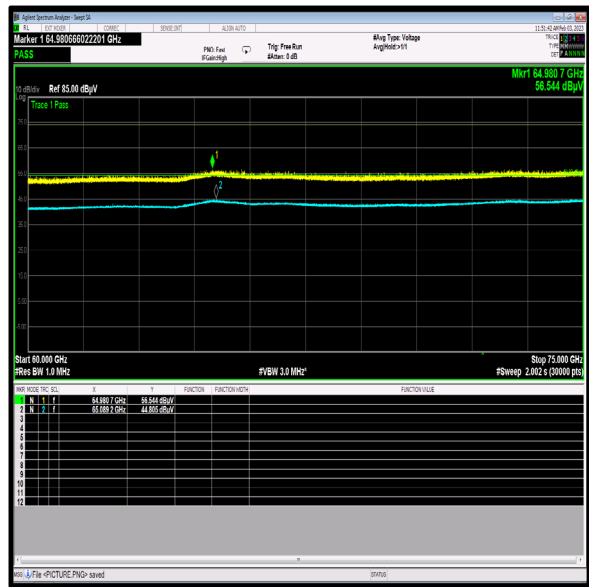
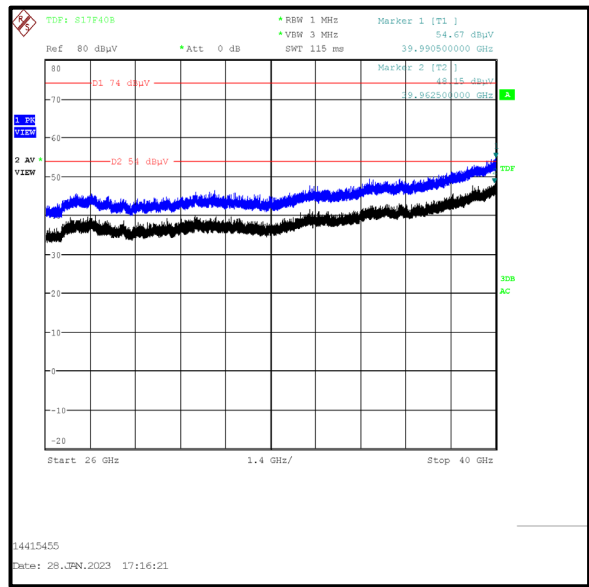
**Results: Antenna 1 / Average**

Frequency (MHz)	Antenna Polarity	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
4250.400	Vertical	30.9	54.0	23.1	Complied
4878.100	Vertical	31.1	54.0	22.9	Complied
14144.602	Vertical	38.2	54.0	15.8	Complied
22750.688	Vertical	41.5	54.0	12.5	Complied
77036.796	Vertical	43.7	54.0	10.3	Complied
79286.073	Vertical	43.2	54.0	10.8	Complied
83357.111	Vertical	41.9	54.0	12.1	Complied

**Transmitter Radiated Emissions (continued)**

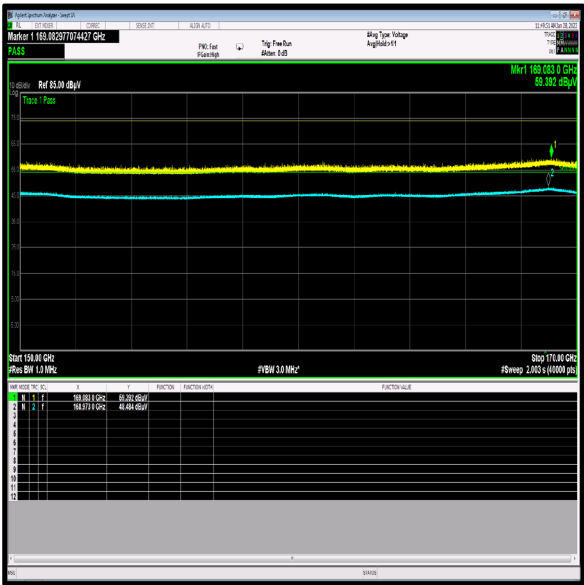
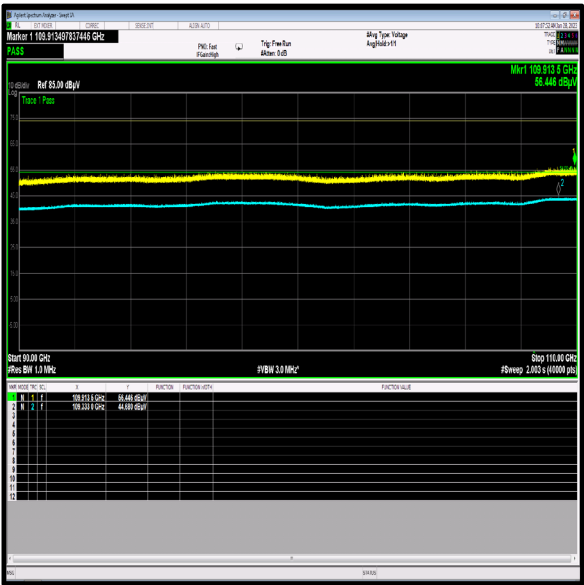
Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying table.

Transmitter Radiated Emissions (continued)



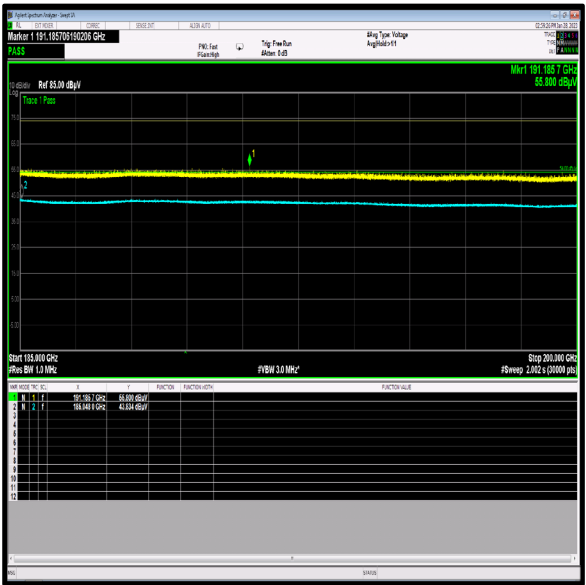
Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying table.

Transmitter Radiated Emissions (continued)



Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying table.

Transmitter Radiated Emissions (continued)



Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying table.



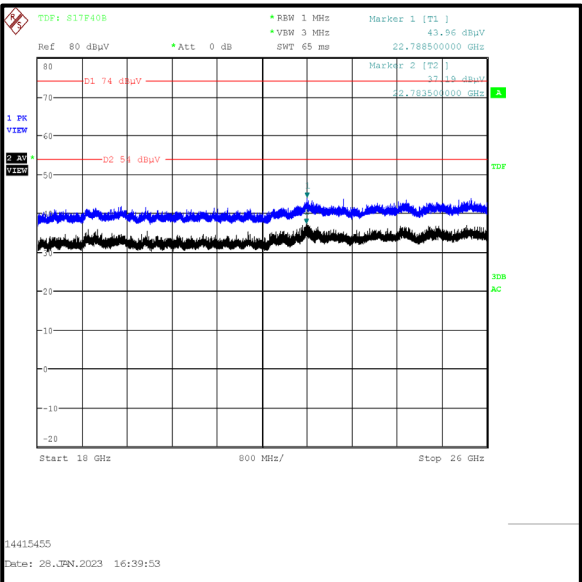
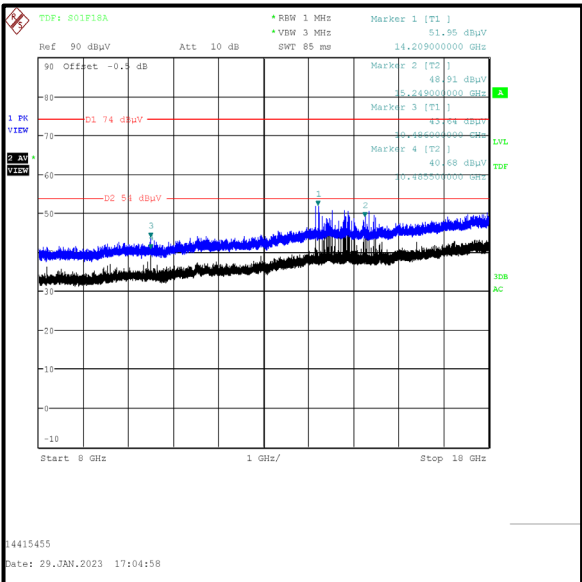
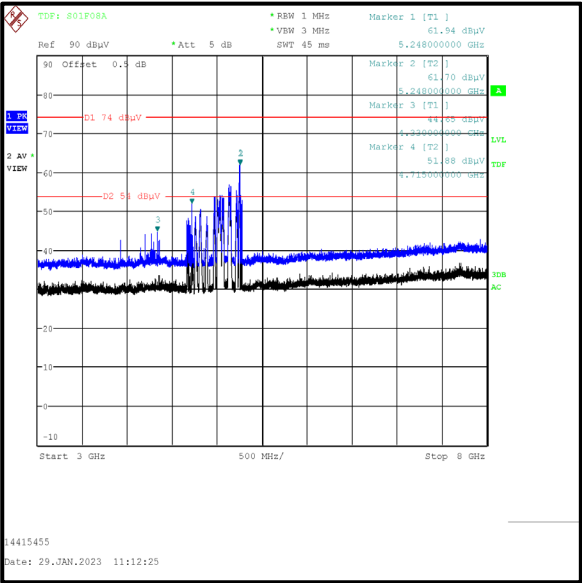
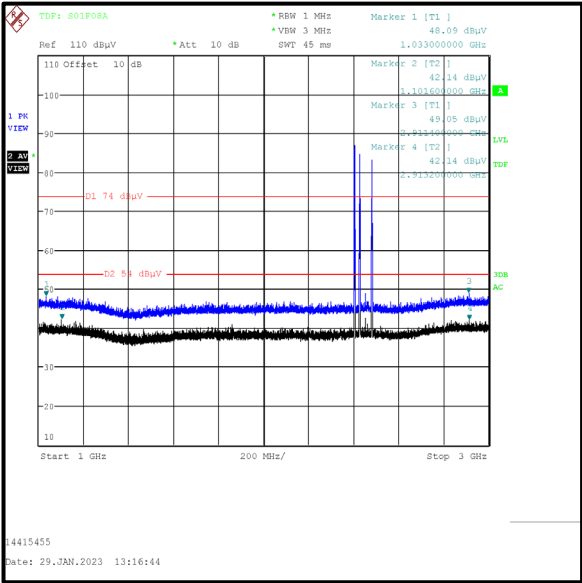
**Transmitter Radiated Emissions (continued)****Results: Antenna 3 / Peak**

Frequency (MHz)	Antenna Polarity	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
5102.000	Vertical	63.5	74.0	10.5	Complied
14153.200	Vertical	52.7	74.0	21.3	Complied
77892.700	Vertical	67.8	74.0	6.2	Complied
81432.205	Vertical	64.9	74.0	9.1	Complied

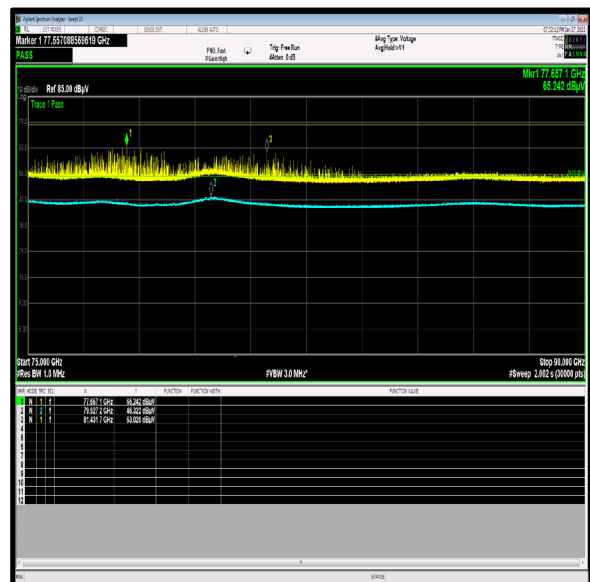
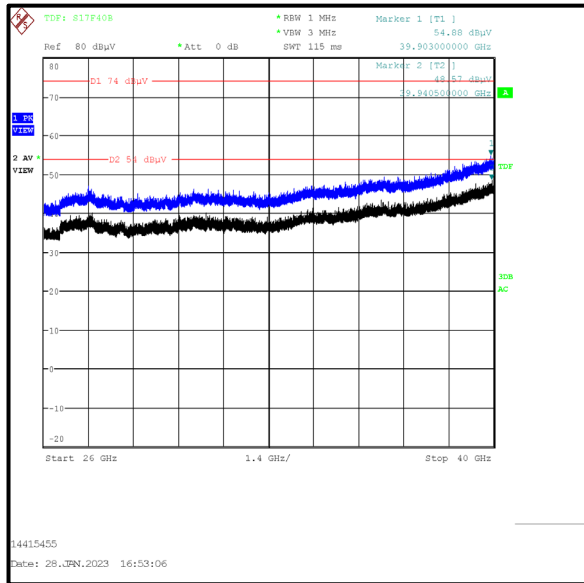
**Results: Antenna 3 / Average**

Frequency (MHz)	Antenna Polarity	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
4889.400	Vertical	34.8	54.0	19.2	Complied
14144.700	Vertical	35.0	54.0	19.0	Complied
77892.700	Vertical	42.4	54.0	11.6	Complied
81432.205	Vertical	44.8	54.0	9.2	Complied

Transmitter Radiated Emissions (continued)

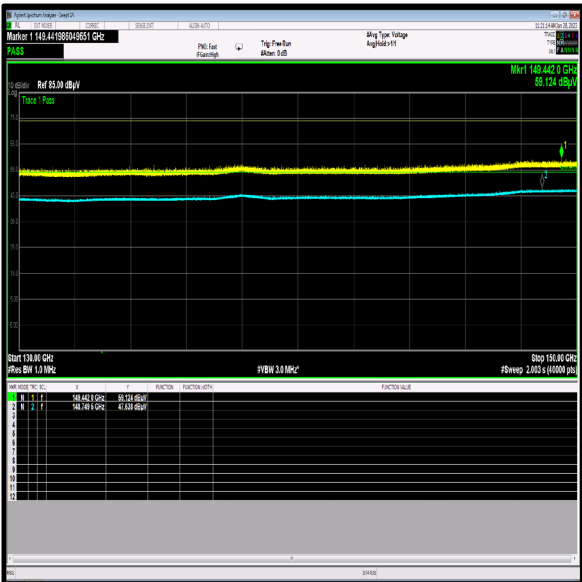
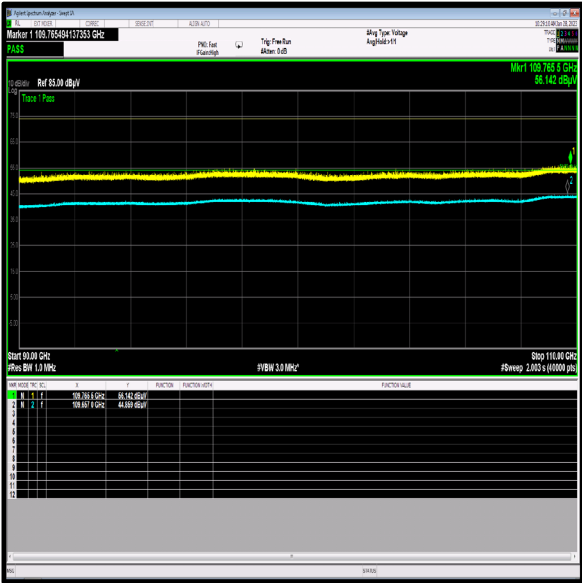


Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying table.

**Transmitter Radiated Emissions (continued)**

Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying table.

Transmitter Radiated Emissions (continued)



Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying table.

Transmitter Radiated Emissions (continued)



Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying table.

## **5 AC Power Line Conducted Emissions Test Results**

### **5.1 Transmitter AC Conducted Spurious Emissions**

#### **Test Summary:**

<b>Test Engineer:</b>	Alison Johnston	<b>Test Dates:</b>	21 February 2023 & 22 February 2023
<b>Test Sample Serial Number:</b>	61489212 & 61489166		

<b>FCC Reference:</b>	Part 15.207
<b>Test Method Used:</b>	ANSI C63.10 Section 6.2 / FCC KDB 174176 and notes below

#### **Environmental Conditions:**

<b>Temperature (°C):</b>	23
<b>Relative Humidity (%):</b>	46

#### **Note(s):**

1. The EUT was connected to a benchtop DC power supply which supplied the unit with 24 VDC. The DC power supply was connected to a 120 VAC 60 Hz single phase supply via a LISN.
2. A pulse limiter was fitted between the LISN and the test receiver.
3. In accordance with FCC KDB 174176 Q4, tests were performed with a 240 VAC 60 Hz single phase supply as this was within the input voltage range of the DC power supply.
4. Pre-scans were performed and markers placed on the highest live and neutral measured levels. Final measurements were performed on the marker frequencies and the results entered into the tables below.

**Transmitter AC Conducted Spurious Emissions (continued)****Results: Antenna 1 / Live / Quasi Peak / 120 VAC 60 Hz**

Frequency (MHz)	Line	Level (dB $\mu$ V)	Limit (dB $\mu$ V)	Margin (dB)	Result
0.154500	Live	17.1	65.8	48.7	Complied
0.190500	Live	15.3	64.0	48.7	Complied
10.855500	Live	14.1	60.0	45.9	Complied
12.003000	Live	17.9	60.0	42.1	Complied
14.280000	Live	29.3	60.0	30.7	Complied
24.000000	Live	30.7	60.0	29.3	Complied

**Results: Antenna 1 / Live / Average / 120 VAC 60 Hz**

Frequency (MHz)	Line	Level (dB $\mu$ V)	Limit (dB $\mu$ V)	Margin (dB)	Result
7.998000	Live	12.0	50.0	38.0	Complied
10.860000	Live	7.1	50.0	42.9	Complied
11.427000	Live	31.3	50.0	18.7	Complied
12.853500	Live	30.5	50.0	19.5	Complied
18.001500	Live	20.3	50.0	29.7	Complied
22.848000	Live	21.7	50.0	28.3	Complied

**Results: Antenna 1 / Neutral / Quasi Peak / 120 VAC 60 Hz**

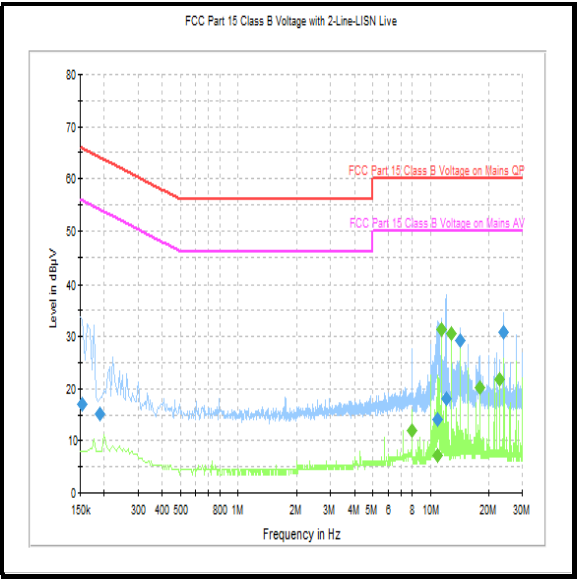
Frequency (MHz)	Line	Level (dB $\mu$ V)	Limit (dB $\mu$ V)	Margin (dB)	Result
0.150000	Neutral	17.5	66.0	48.5	Complied
7.998000	Neutral	24.2	60.0	35.8	Complied
11.004000	Neutral	16.5	60.0	43.5	Complied
12.003000	Neutral	20.8	60.0	39.2	Complied
14.280000	Neutral	29.6	60.0	30.4	Complied
24.000000	Neutral	29.0	60.0	31.0	Complied

**Results: Antenna 1 / Neutral / Average / 120 VAC 60 Hz**

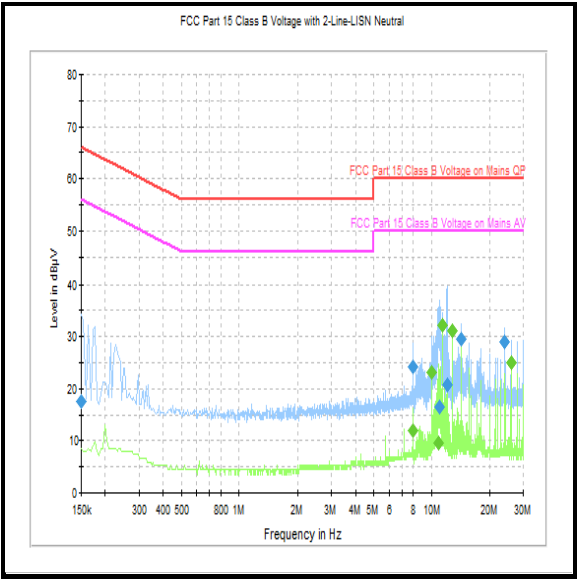
Frequency (MHz)	Line	Level (dB $\mu$ V)	Limit (dB $\mu$ V)	Margin (dB)	Result
7.998000	Neutral	12.0	50.0	38.0	Complied
9.996000	Neutral	23.2	50.0	26.8	Complied
10.851000	Neutral	9.5	50.0	40.5	Complied
11.427000	Neutral	32.1	50.0	17.9	Complied
12.853500	Neutral	31.2	50.0	18.8	Complied
26.002500	Neutral	25.0	50.0	25.0	Complied

**Transmitter AC Conducted Spurious Emissions (continued)**

**Results: Antenna 1 / 120 VAC 60 Hz**



**Live**



**Neutral**

*Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.*



**Transmitter AC Conducted Spurious Emissions (continued)****Results: Antenna 1 / Live / Quasi Peak / 240 VAC 60 Hz**

Frequency (MHz)	Line	Level (dB $\mu$ V)	Limit (dB $\mu$ V)	Margin (dB)	Result
0.186000	Live	17.4	64.2	46.8	Complied
7.998000	Live	23.8	60.0	36.2	Complied
12.003000	Live	15.3	60.0	44.7	Complied
14.280000	Live	29.5	60.0	30.5	Complied
24.000000	Live	30.4	60.0	29.6	Complied
28.000500	Live	27.3	60.0	32.7	Complied

**Results: Antenna 1 / Live / Average / 240 VAC 60 Hz**

Frequency (MHz)	Line	Level (dB $\mu$ V)	Limit (dB $\mu$ V)	Margin (dB)	Result
7.998000	Live	12.0	50.0	38.0	Complied
9.996000	Live	22.7	50.0	27.3	Complied
11.422500	Live	32.2	50.0	17.8	Complied
12.853500	Live	30.7	50.0	19.3	Complied
18.001500	Live	27.9	50.0	22.1	Complied
28.000500	Live	24.5	50.0	25.5	Complied

**Results: Antenna 1 / Neutral / Quasi Peak / 240 VAC 60 Hz**

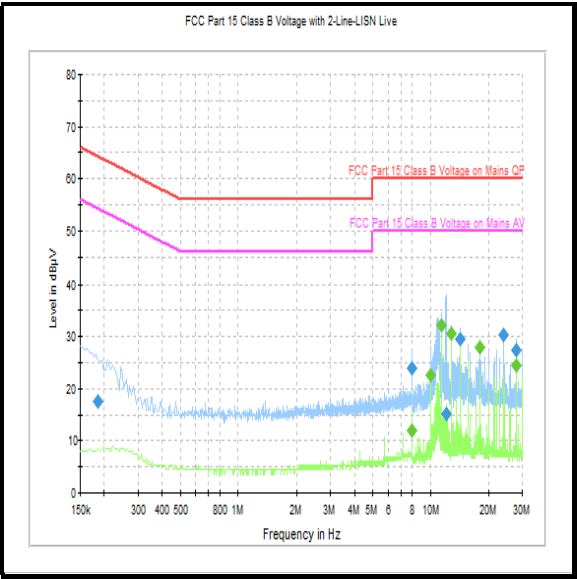
Frequency (MHz)	Line	Level (dB $\mu$ V)	Limit (dB $\mu$ V)	Margin (dB)	Result
0.168000	Neutral	13.6	65.1	51.5	Complied
7.998000	Neutral	24.6	60.0	35.4	Complied
10.851000	Neutral	16.0	60.0	44.0	Complied
11.998500	Neutral	16.8	60.0	43.2	Complied
14.280000	Neutral	29.7	60.0	30.3	Complied
24.000000	Neutral	28.7	60.0	31.3	Complied

**Results: Antenna 1 / Neutral / Average / 240 VAC 60 Hz**

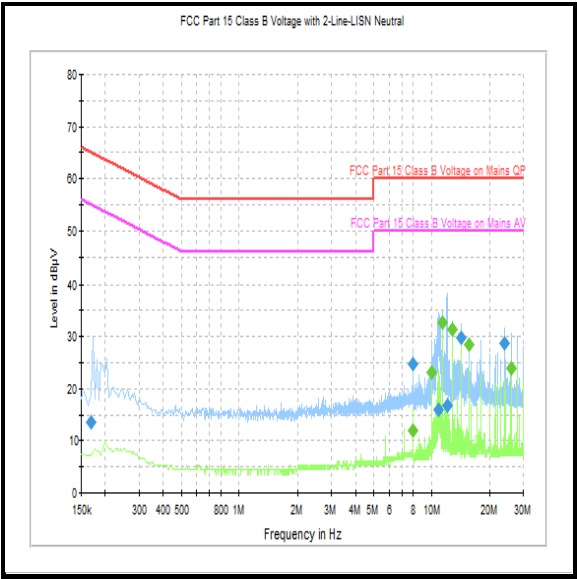
Frequency (MHz)	Line	Level (dB $\mu$ V)	Limit (dB $\mu$ V)	Margin (dB)	Result
7.998000	Neutral	12.0	50.0	38.0	Complied
9.996000	Neutral	23.0	50.0	27.0	Complied
11.422500	Neutral	32.6	50.0	17.4	Complied
12.853500	Neutral	31.2	50.0	18.8	Complied
15.711000	Neutral	28.3	50.0	21.7	Complied
26.002500	Neutral	23.9	50.0	26.1	Complied

**Transmitter AC Conducted Spurious Emissions (continued)**

**Results: Antenna 1 / 240 VAC 60 Hz**



**Live**



**Neutral**

*Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.*

**Transmitter AC Conducted Spurious Emissions (continued)****Results: Antenna 3 / Live / Quasi Peak / 120 VAC 60 Hz**

Frequency (MHz)	Line	Level (dB $\mu$ V)	Limit (dB $\mu$ V)	Margin (dB)	Result
0.172500	Live	17.0	64.8	47.8	Complied
10.927500	Live	13.8	60.0	46.2	Complied
11.998500	Live	19.8	60.0	40.2	Complied
14.230500	Live	30.5	60.0	29.5	Complied
24.000000	Live	30.7	60.0	29.3	Complied
28.000500	Live	28.3	60.0	31.7	Complied

**Results: Antenna 3 / Live / Average / 120 VAC 60 Hz**

Frequency (MHz)	Line	Level (dB $\mu$ V)	Limit (dB $\mu$ V)	Margin (dB)	Result
9.960000	Live	21.4	50.0	28.6	Complied
11.386500	Live	34.1	50.0	15.9	Complied
12.808500	Live	32.5	50.0	17.5	Complied
15.657000	Live	29.1	50.0	20.9	Complied
24.000000	Live	24.1	50.0	25.9	Complied
28.000500	Live	25.2	50.0	24.8	Complied

**Results: Antenna 3 / Neutral / Quasi Peak / 120 VAC 60 Hz**

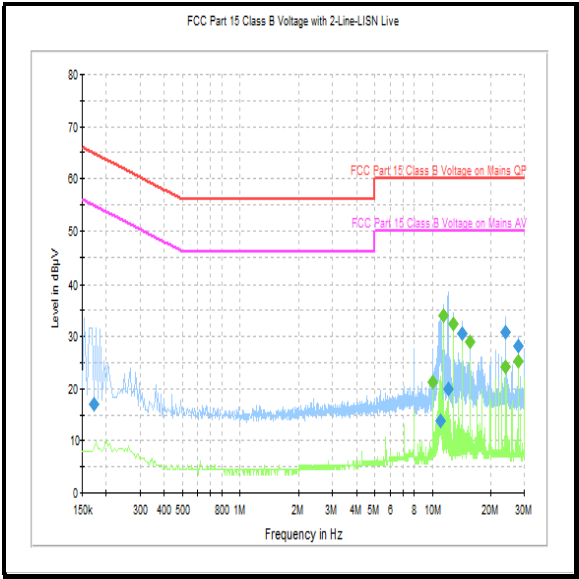
Frequency (MHz)	Line	Level (dB $\mu$ V)	Limit (dB $\mu$ V)	Margin (dB)	Result
0.154500	Neutral	17.3	65.8	48.5	Complied
7.998000	Neutral	24.3	60.0	35.7	Complied
10.851000	Neutral	17.0	60.0	43.0	Complied
11.998500	Neutral	22.3	60.0	37.7	Complied
14.230500	Neutral	30.5	60.0	29.5	Complied
24.000000	Neutral	29.2	60.0	30.8	Complied

**Results: Antenna 3 / Neutral / Average / 120 VAC 60 Hz**

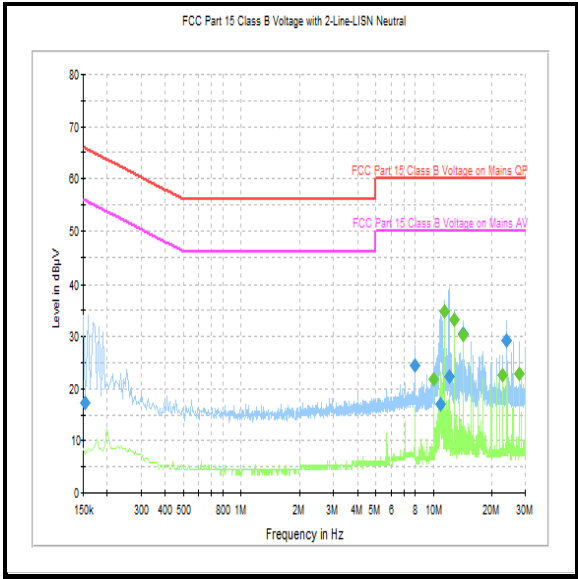
Frequency (MHz)	Line	Level (dB $\mu$ V)	Limit (dB $\mu$ V)	Margin (dB)	Result
9.964500	Neutral	21.7	50.0	28.3	Complied
11.386500	Neutral	34.8	50.0	15.2	Complied
12.808500	Neutral	33.2	50.0	16.8	Complied
14.230500	Neutral	30.2	50.0	19.8	Complied
22.771500	Neutral	22.6	50.0	27.4	Complied
28.000500	Neutral	22.8	50.0	27.2	Complied

Transmitter AC Conducted Spurious Emissions (continued)

Results: Antenna 3 / 120 VAC 60 Hz



Live



Neutral

Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

**Transmitter AC Conducted Spurious Emissions (continued)****Results: Antenna 3 / Live / Quasi Peak / 240 VAC 60 Hz**

Frequency (MHz)	Line	Level (dB $\mu$ V)	Limit (dB $\mu$ V)	Margin (dB)	Result
0.190500	Live	16.4	64.0	47.6	Complied
7.998000	Live	23.8	60.0	36.2	Complied
9.955500	Live	16.3	60.0	43.7	Complied
11.998500	Live	14.7	60.0	45.3	Complied
14.230500	Live	30.2	60.0	29.8	Complied
24.000000	Live	30.4	60.0	29.6	Complied

**Results: Antenna 3 / Live / Average / 240 VAC 60 Hz**

Frequency (MHz)	Line	Level (dB $\mu$ V)	Limit (dB $\mu$ V)	Margin (dB)	Result
8.002500	Live	11.2	50.0	38.8	Complied
9.960000	Live	21.0	50.0	29.0	Complied
11.386500	Live	34.8	50.0	15.2	Complied
12.808500	Live	32.5	50.0	17.5	Complied
14.230500	Live	29.7	50.0	20.3	Complied
28.000500	Live	24.6	50.0	25.4	Complied

**Results: Antenna 3 / Neutral / Quasi Peak / 240 VAC 60 Hz**

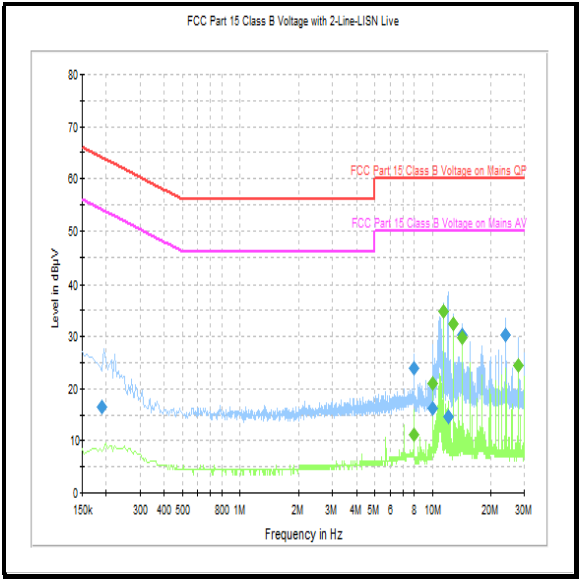
Frequency (MHz)	Line	Level (dB $\mu$ V)	Limit (dB $\mu$ V)	Margin (dB)	Result
0.190500	Neutral	13.6	64.0	50.4	Complied
7.998000	Neutral	24.8	60.0	35.2	Complied
10.851000	Neutral	15.3	60.0	44.7	Complied
11.998500	Neutral	16.6	60.0	43.4	Complied
14.230500	Neutral	30.6	60.0	29.4	Complied
24.000000	Neutral	28.8	60.0	31.2	Complied

**Results: Antenna 3 / Neutral / Average / 240 VAC 60 Hz**

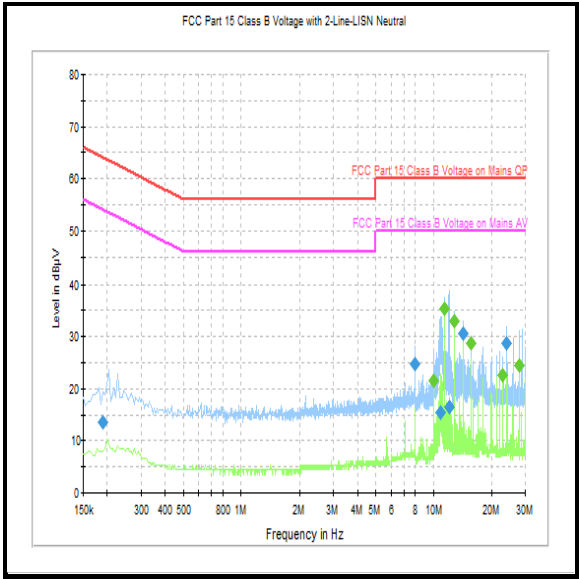
Frequency (MHz)	Line	Level (dB $\mu$ V)	Limit (dB $\mu$ V)	Margin (dB)	Result
9.964500	Neutral	21.6	50.0	28.4	Complied
11.386500	Neutral	35.4	50.0	14.6	Complied
12.808500	Neutral	33.0	50.0	17.0	Complied
15.657000	Neutral	28.6	50.0	21.4	Complied
22.771500	Neutral	22.6	50.0	27.4	Complied
28.000500	Neutral	24.4	50.0	25.6	Complied

Transmitter AC Conducted Spurious Emissions (continued)

Results: Antenna 3 / 240 VAC 60 Hz



Live



Neutral

Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

--- END OF REPORT ---