



TEST REPORT

Test Report No. : UL-RPT-RP13534277-916A V2.0

Customer : Umpi S.r.l
Model No : Syra RE 61456NF-915-H-LW
FCC ID : 2A3M2-25A080
Technology : LoRa
Test Standard(s) : FCC Parts 15.207, 15.209(a) & 15.247
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: 04 March 2022

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Report Revision History

Version Number	Issue Date	Revision Details	Revised By
1.0	28/02/2022	Initial Version	Ben Mercer
2.0	04/03/2022	Implemented TCB comments	Ben Mercer

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1 Attestation of Test Results

1.1 Description of EUT

The equipment under test was a point-to-point transceiver used for street lighting control in urban and rural installations. The EUT incorporates LoRaWAN and 6LowPAN wireless technology to provide communication in the 902-928 MHz frequency band.

1.2 General Information

Specification Reference:	47CFR15.247
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart C (Intentional Radiators) – Section 15.247
Specification Reference:	47CFR15.207 & 15.209
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart C (Intentional Radiators) – Sections 15.207 & 15.209
FCC Site Registration:	685609
FCC Lab. Designation No.:	UK2011
Location of Testing:	Unit 3 Horizon, Wade Road, Kingsland Business Park, Basingstoke, Hampshire, G24 8AH, United Kingdom
Test Dates:	22 September 2021 to 17 February 2022

1.3 Summary of Test Results

FCC Reference (47CFR)	Measurement	Result
Part 15.35(c)	Transmitter Duty Cycle	Note 1
Part 2.1049	Transmitter Occupied Bandwidth	Note 2
Part 15.247(a)(2)	Transmitter Minimum 6 dB Bandwidth	✓
Part 15.247(b)(3)	Transmitter Maximum Output Power	✓
Part 15.247(e)	Transmitter Power Spectral Density	✓
Part 15.247(d) & 15.209(a)	Transmitter Radiated Emissions	✓
Part 15.247(d) & 15.209(a)	Transmitter Band Edge Radiated Emissions	✓
Part 15.207	Transmitter AC Conducted Emissions	✓
Key to Results  = Complied  = Did not comply		

Note(s):

- Duty Cycle measurement was performed to assist in the measurement of Maximum Output Power and Power Spectral Density. The EUT cannot transmit continuously, and sweep triggering/signal gating cannot be implemented.
- Occupied Bandwidth measurements were performed to assist in the measurement of Maximum Output Power.

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

Reference:	ANSI C63.10-2013
Title:	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
Reference:	KDB 558074 D01 15.247 Meas Guidance v05r02, April 2, 2019
Title:	Guidance for Compliance Measurements on Digital Transmission System, Frequency Hopping Spread Spectrum System, and Hybrid System Devices Operating Under Section 15.247 of the FCC Rules
Reference:	KDB 174176 D01 Line Conducted FAQ v01r01 June 3, 2015
Title:	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
Duty Cycle	902 MHz to 928 MHz	95%	±1.14 %
Minimum 6 dB Bandwidth	902 MHz to 928 MHz	95%	±4.59 %
Spectral Power Density	902 MHz to 928 MHz	95%	±2.94 dB
Conducted Maximum Peak Output Power	902 MHz to 928 MHz	95%	±1.13 dB
Radiated Spurious Emissions	9 kHz to 30 MHz	95%	±5.32 dB
Radiated Spurious Emissions	30 MHz to 1 GHz	95%	±3.30 dB
Radiated Spurious Emissions	1 GHz to 9.3 GHz	95%	±2.94 dB
AC Conducted Spurious 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 Conducted Tests

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M2002	Thermohygrometer	Testo	608-H1	45041825	09 Dec 2022	12
M2036	Signal Analyser	Rohde & Schwarz	FSV30	101791	21 May 2022	12
A3117	Attenuator	AtlanTecRF	AN18-10	237378#1	Calibrated before use	-
G0615	Signal Generator	Rohde & Schwarz	SMBV100A	260473	03 Mar 2023	36

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 2022	12
K0001	3m RSE Chamber	Rainford EMC	N/A	N/A	06 Sep 2022	12
M2044	Test Receiver	Rohde & Schwarz	ESU26	100122	29 Apr 2022	12
A3141	Pre-Amplifier	Schwarzbeck	BBV 9718 B	00021	24 Aug 2022	12
A3154	Pre-Amplifier	Com Power	PAM-103	18020012	24 Aug 2022	12
A3155	Pre-Amplifier	Com Power	PAM-118A	18040037	24 Aug 2022	12
A553	Antenna	Chase	CBL6111A	1593	15 Mar 2022	12
A3138	Antenna	Schwarzbeck	BBHA 9120 B	00702	27 Aug 2022	12
A3139	Antenna	Schwarzbeck	HWRD750	00027	27 Aug 2022	12
A2937	Attenuator	AtlanTecRF	AN18W5-06	208147#1	03 Feb 2022	12
A2972	High Pass Filter	AtlanTecRF	AFH-01000	02371	19 Nov 2021	12
A3093	High Pass Filter	AtlanTecRF	AFH-03000	18051800077	03 Feb 2022	12
A3095	High Pass Filter	AtlanTecRF	AFH-07000	18051600012	03 Feb 2022	12
A3165	Loop Antenna	ETS Lindgren	6502	00224383	12 Oct 2022	12

Test Equipment Used for Transmitter Band Edge Radiated Emissions Tests

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M2040	Thermohygrometer	Testo	608-H1	45124934	10 Dec 2021	12
K0001	3m RSE Chamber	Rainford EMC	N/A	N/A	06 Sep 2022	12
A3154	Pre Amplifier	Com Power	PAM-103	18020012	24 Aug 2022	12
M2044	Test Receiver	Rohde & Schwarz	ESU26	100122	29 Apr 2022	12
A553	Antenna	Chase	CBL6111A	1593	15 Mar 2022	12
A2523	Attenuator	AtlanTecRF	AN18W5-10	832827#1	03 Feb 2022	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	09 Dec 2021	12
A649	LISN	Rohde & Schwarz	ESH3-Z5	825562/008	04 Aug 2022	12
A1830	Pulse Limiter	Rohde & Schwarz	ESH3-Z2	100668	21 Apr 2022	12
M1273	Test Receiver	Rohde & Schwarz	ESIB 26	100275	14 Dec 2021	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)

Brand Name:	Umpi
Model Name or Number:	Syra RE 61456NF-915-H-LW
Test Sample Serial Number:	AZ000012
Hardware Version:	25A080 + 25A022
Software Version:	N/A
Firmware Version:	1.1.1
FCC ID:	2A3M2-25A080

Brand Name:	Umpi
Model Name or Number:	Syra RE 61456NF-915-H-LW
Test Sample Serial Number:	AZ000014
Hardware Version:	25A080 + 25A022
Software Version:	N/A
Firmware Version:	1.1.1
FCC ID:	2A3M2-25A080

3.2 Untested Variants

Model Name or Number:	Syra RE 61456NF-915-H-LC
Model Name or Number:	Syra RE 61456NF-915-L-LW
Model Name or Number:	Syra RE 61456NF-915-L-LC

The customer declared that these variants are identical to the tested model from an RF perspective. Further information is provided in Annex A.

3.3 Modifications Incorporated in the EUT

No modifications were applied to the EUT during testing.

3.4 Additional Information Related to Testing

Technology Tested:	LoRa		
Type of Unit:	Transceiver		
Channel Spacing:	1600 kHz		
Modulation:	Chirp Spread Spectrum (CSS)		
Data Rate:	12.5 Kbps		
Power Supply Requirement(s):	Nominal	120 VAC	
Maximum Conducted Output Power:	19.2 dBm		
Transmit Frequency Range:	915.900 MHz to 927.100 MHz		
Transmit Channels Tested:	Channel ID	Channel Number	Channel Frequency (MHz)
	Bottom	0	915.900
	Middle	3	920.700
	Top	7	927.100

3.5 Description of Available Antennas

The radio utilizes an integrated antenna, with the following maximum gain:

Frequency Range (MHz)	Antenna Gain (dBi)
902 to 928	0.0

3.6 Description of Test Setup

Support Equipment

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

Description:	Test Laptop
Brand Name:	Lenovo
Model Name or Number:	ThinkPad L470
Serial Number:	PF10T3JS

Description:	USB Interface Board and USB Cable
Brand Name:	Not marked or stated
Model Name or Number:	Not marked or stated
Serial Number:	Not marked or stated

Description:	Syra RE Test HW Tool
Brand Name:	Not marked or stated
Model Name or Number:	Not marked or stated
Serial Number:	Not marked or stated

Description:	Test Laptop
Brand Name:	Lenovo
Model Name or Number:	ThinkPad L470
Serial Number:	PF10T3HL

Description:	Test Laptop
Brand Name:	Lenovo
Model Name or Number:	ThinkPad L480
Serial Number:	PF1EHZQQ

Operating Modes

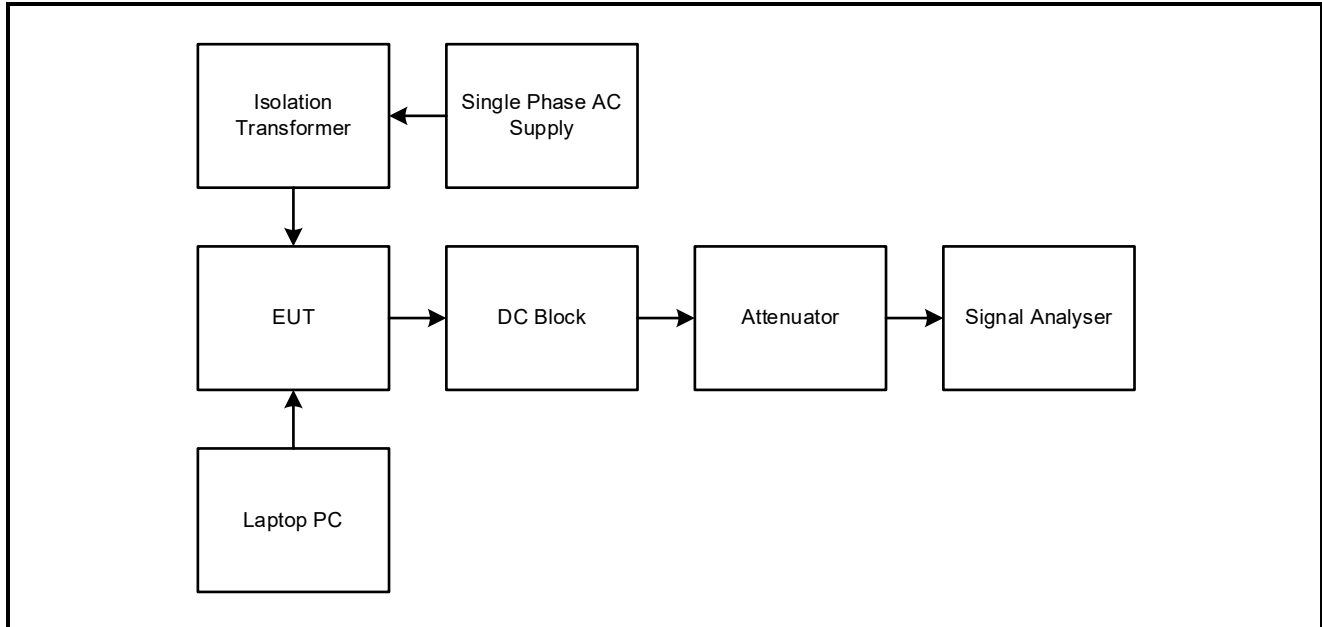
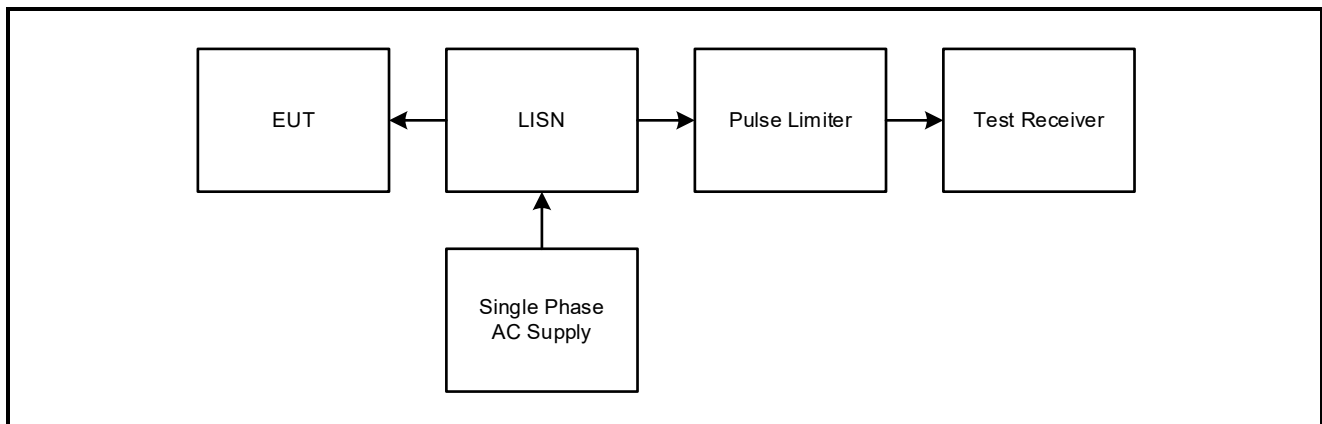
The EUT was tested in the following operating mode(s):

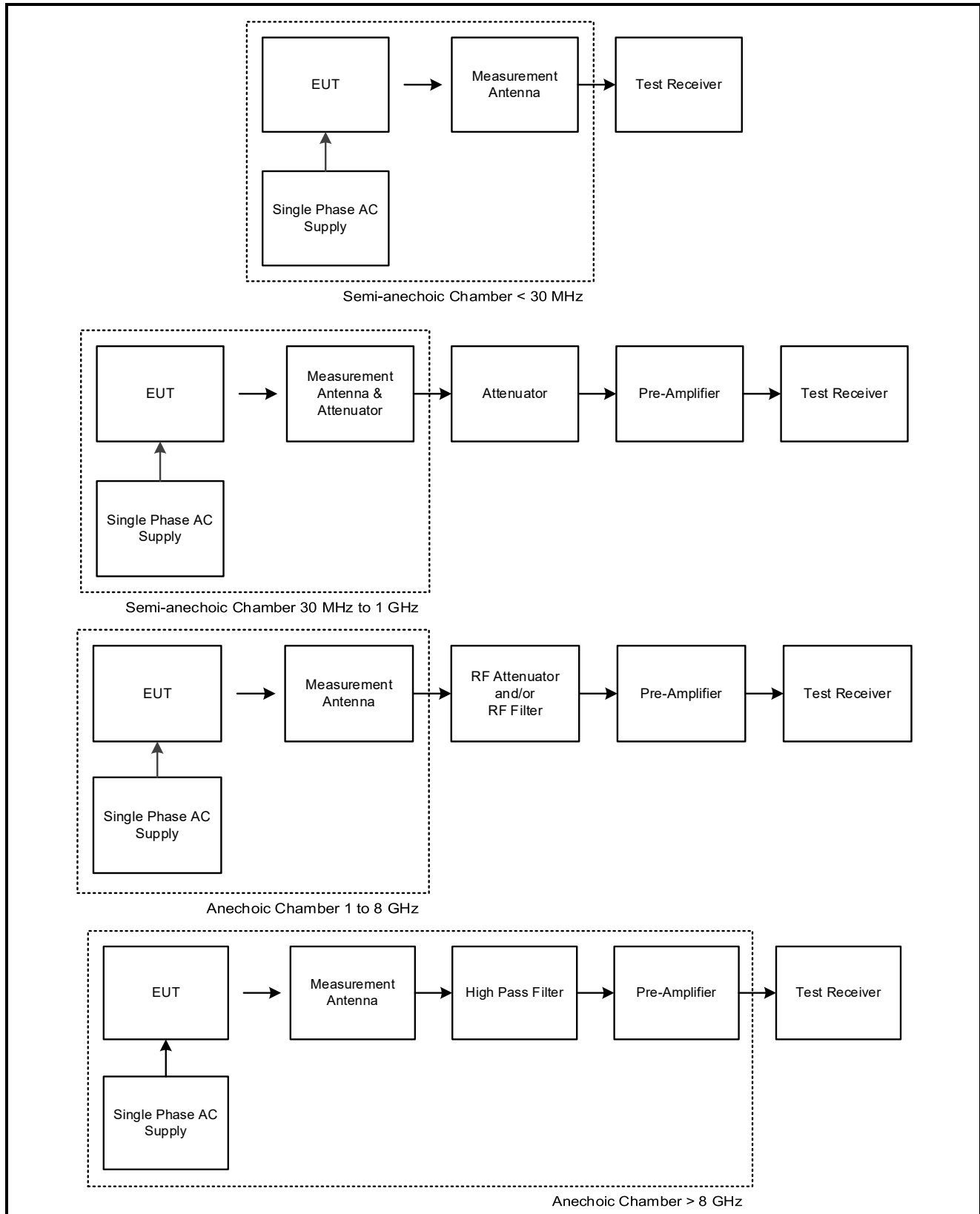
- Transmitting continuously at maximum power with a data rate of 12.5 kbps and maximum packet length on bottom, middle and top channels as required.

Configuration and Peripherals

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

- Controlled in test mode using a software application on the laptop PC. The application was used to enable continuous transmission and to select the test channels, data rate and packet length as required. The customer supplied a document containing the setup instructions 'EX01-T001_Syra_Radio_Node_Test_Instructions.pdf'. The laptop PC was connected to the EUT via the USB interface board and the Syra RE Test HW Tool. During Radiated and AC Conducted Emissions tests, the laptop was disconnected after the EUT was configured.
- The EUT was powered from a 120 VAC 60 Hz single phase mains supply. For conducted tests, the EUT was connected to the mains supply via an isolation transformer to isolate the antenna connector.
- Transmitter radiated spurious emissions tests were performed with the EUT in the worst-case orientation with respect to emissions. There were no active ports to terminate.
- Transmitter radiated spurious emissions below 30 MHz were found to be independent of technology. Measurements have therefore been reported for LoRa only.

Test Setup Diagrams**Conducted Tests:****Test Setup for Transmitter Conducted Tests****Test Setup for Transmitter AC Conducted Spurious Emissions**

Test Setup Diagrams (continued)**Radiated Tests:****Test Setup for Transmitter Radiated Emissions**

4 Antenna Port Test Results

4.1 Transmitter Duty Cycle

Test Summary:

Test Engineers:	Chanthu Thevarajah & Nick Raptopoulos	Test Date:	22 September 2021
Test Sample Serial Number:	AZ000012		

FCC Reference:	Part 15.35(c)
Test Method Used:	FCC KDB 558074 Section 6 referencing ANSI C63.10 Section 11.6

Environmental Conditions:

Temperature (°C):	23
Relative Humidity (%):	54

Note(s):

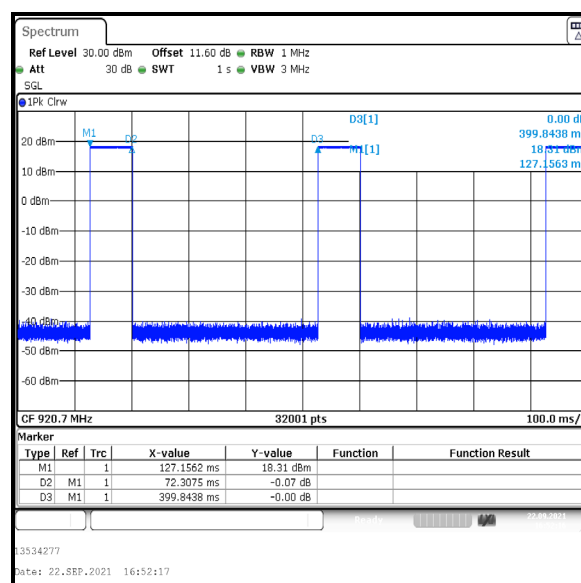
- To assist with the determination of the average level of maximum Output Power and Power Spectral Density, measurements were made of duty cycle to determine the transmission duration and the silent period time of the transmitter. The transmitter duty cycle was measured using a signal analyser in the time domain and calculated by using the following calculation:

$$10 \log (1 / (\text{On Time} / \text{Period})).$$

$$10 \log (1 / (72.308 \text{ ms} / 399.844 \text{ ms})) = 7.4 \text{ dB}$$

Results:

Pulse Duration (ms)	Period (ms)	Duty Cycle (dB)
72.308	399.844	7.4



4.2 Transmitter 99% Occupied Bandwidth

Test Summary:

Test Engineers:	Chanthu Thevarajah & Nick Raptopoulos	Test Date:	22 September 2021
Test Sample Serial Number:	AZ000012		

FCC Reference:	2.1049
Test Method Used:	ANSI C63.10 Section 6.9.3

Environmental Conditions:

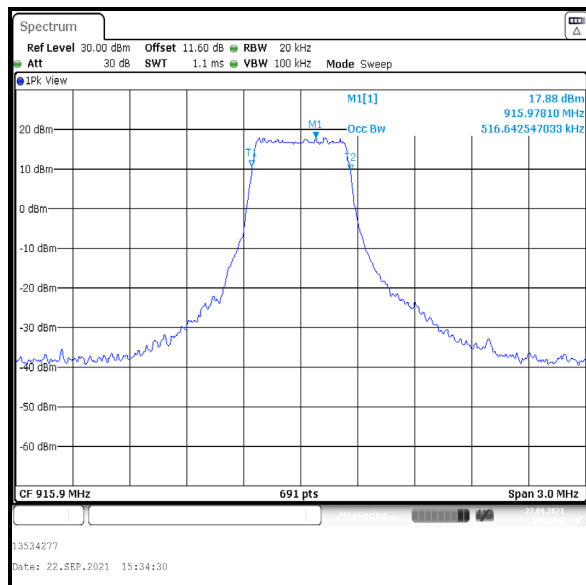
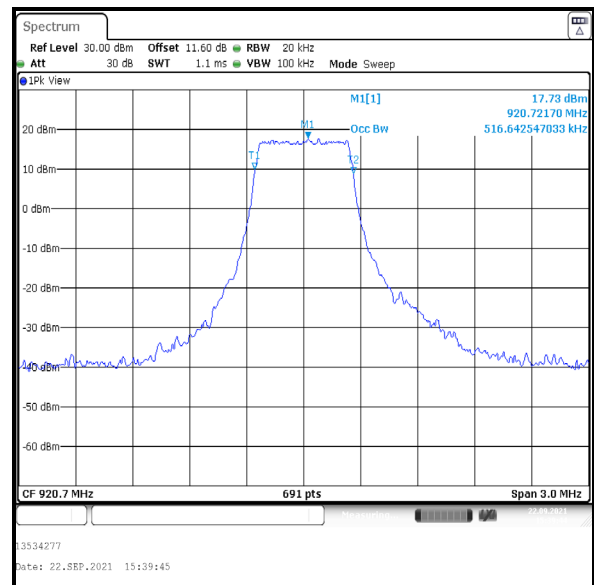
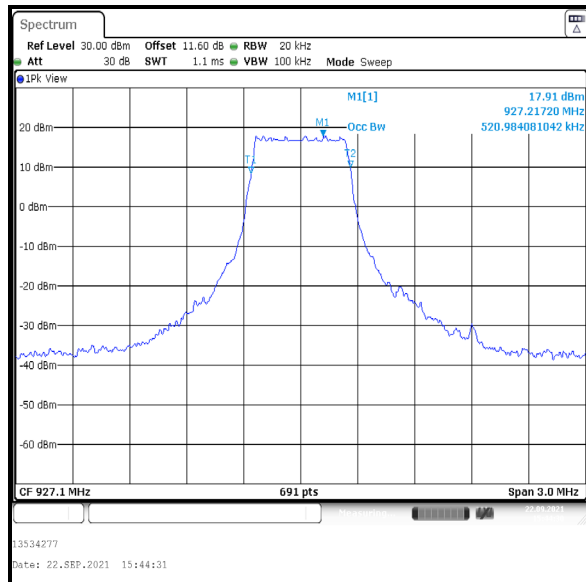
Temperature (°C):	23
Relative Humidity (%):	54

Note(s):

1. The 99% emission bandwidth was measured using the signal analyser occupied bandwidth function. The resolution bandwidth was set in the range of 1% to 5% of the occupied bandwidth and the video bandwidth set to 3 times the resolution bandwidth. The span was set to capture all products of the modulation process including emission skirts.
2. The signal analyser resolution bandwidth was set to 20 kHz and video bandwidth 100 kHz. A peak detector was used, sweep time was set to auto and the trace mode was Max Hold. The span was set to 3 MHz. The signal analyser function set the measurements to be made at 99% of the emission bandwidth. The results are given in the tables below.
3. The signal analyser was connected to the RF port on the EUT using suitable attenuation and coaxial cable.

Transmitter 99% Occupied Bandwidth (continued)**Results:**

Channel	99% Occupied Bandwidth (kHz)
Bottom	516.643
Middle	516.643
Top	520.984

**Bottom Channel****Middle Channel****Top Channel**

4.3 Transmitter Minimum 6 dB Bandwidth

Test Summary:

Test Engineers:	Chanthu Thevarajah & Nick Raptopoulos	Test Date:	22 September 2021
Test Sample Serial Number:	AZ000012		

FCC Reference:	Part 15.247(a)(2)
Test Method Used:	FCC KDB 558074 Section 8.2 referencing ANSI C63.10 Section 11.8.1

Environmental Conditions:

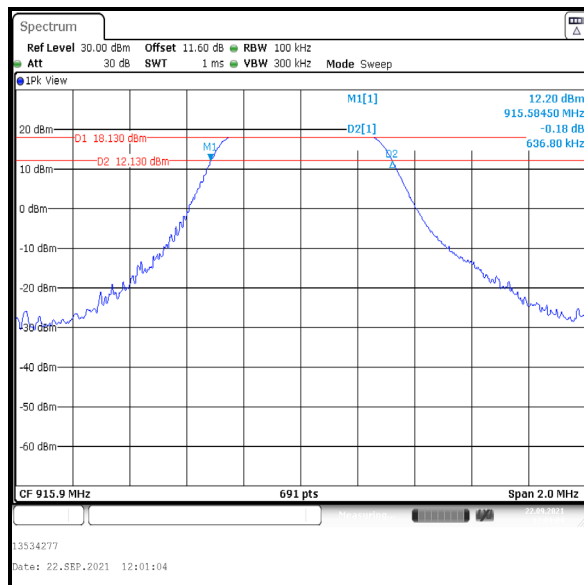
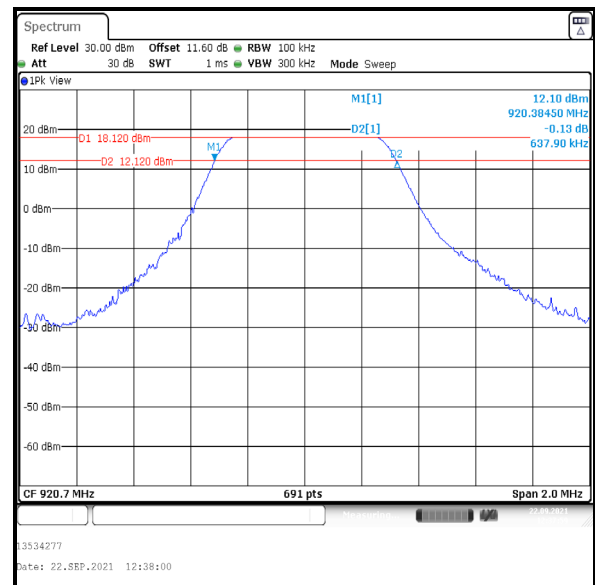
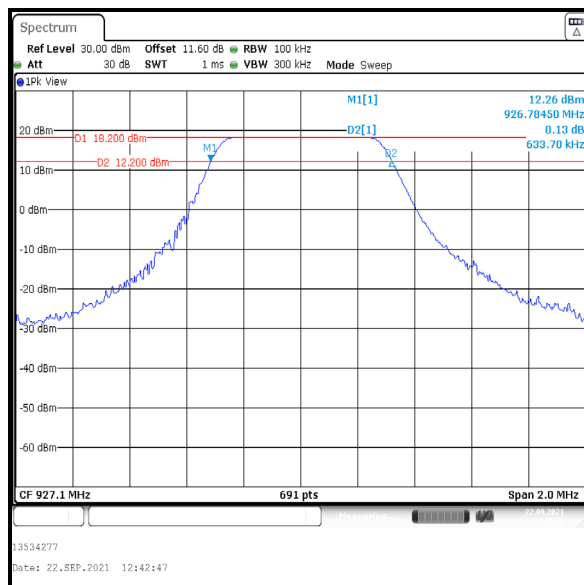
Temperature (°C):	23
Relative Humidity (%):	54

Note(s):

1. 6 dB DTS bandwidth tests were performed using a signal analyser in accordance with ANSI C63.10 Section 11.8.1 Option 1 measurement procedure. The signal analyser resolution bandwidth was set to 100 kHz and video bandwidth 300 kHz. A peak detector was used, sweep time was set to auto and the trace mode was Max Hold. The DTS bandwidth was measured at 6 dB down from the peak of the signal.
2. The signal analyser was connected to the RF port on the EUT using suitable attenuation and coaxial cable.

Transmitter Minimum 6 dB Bandwidth (continued)**Results:**

Channel	6 dB Bandwidth (kHz)	Limit (kHz)	Margin (kHz)	Result
Bottom	636.800	≥500	136.800	Complied
Middle	637.900	≥500	137.900	Complied
Top	633.700	≥500	133.700	Complied

**Bottom Channel****Middle Channel****Top Channel**

4.4 Transmitter Maximum (Average) Output Power

Test Summary:

Test Engineers:	Chanthu Thevarajah & Nick Raptopoulos	Test Date:	23 September 2021
Test Sample Serial Number:	AZ000012		

FCC Reference:	Part 15.247(b)(3)
Test Method Used:	FCC KDB 558074 Section 8.3.2.2 referencing ANSI C63.10 Section 11.9.2.2.4 and notes below

Environmental Conditions:

Temperature (°C):	23
Relative Humidity (%):	54

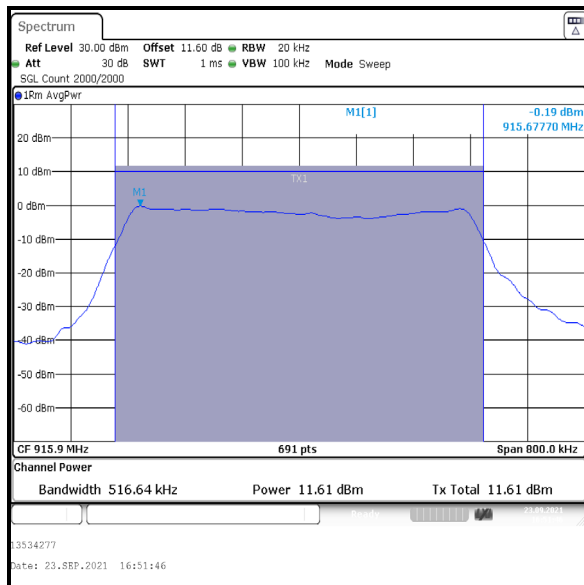
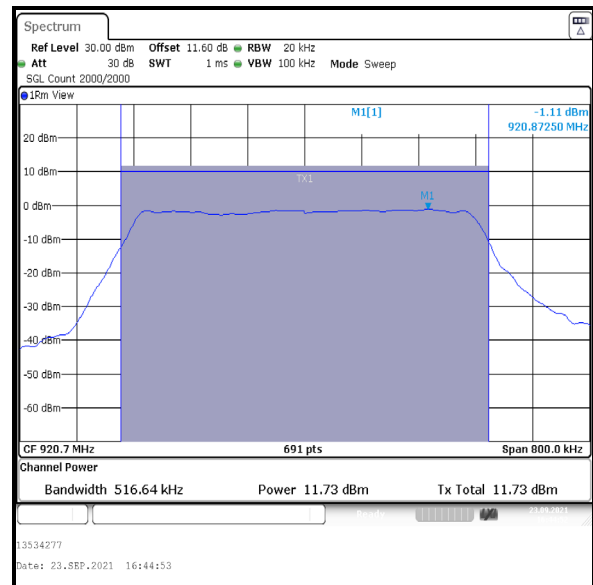
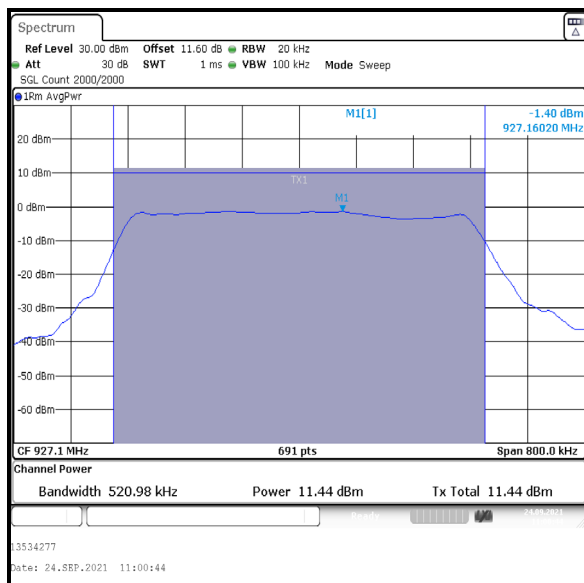
Note(s):

1. Conducted power tests were performed using a signal analyser in accordance with ANSI C63.10 Section 11.9.2.2.4 Method AVGSA-2.
2. The signal analyser resolution bandwidth was set to 20 kHz and video bandwidth of 100 kHz. An RMS detector was used, sweep time was set to auto and trace averaging was performed over 2000 traces. The signal analyser's integration function was used to integrate across the 99% emission bandwidth. The span was set to at least 1.5 times the OBW. The result was recorded and a correction factor of $10 \log(1/D)$ was added.
3. The signal analyser was connected to the RF port on the EUT using suitable attenuation and coaxial cable. An RF level offset was entered on the signal analyser to compensate for the loss of the attenuator and cable.
4. The conducted power was added to the declared antenna gain to obtain the EIRP.

Transmitter Maximum (Average) Output Power (continued)**Results:**

Channel	Conducted Power (dBm)	Duty Cycle Correction Factor (dB)	Corrected Conducted Power (dBm)	Conducted Power Limit (dBm)	Margin (dB)	Result
Bottom	11.6	7.4	19.0	30.0	11.0	Complied
Middle	11.7	7.4	19.1	30.0	10.9	Complied
Top	11.4	7.4	18.8	30.0	11.2	Complied

Channel	Corrected Conducted Power (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
Bottom	19.0	0.0	19.0	36.0	17.0	Complied
Middle	19.1	0.0	19.1	36.0	16.9	Complied
Top	18.8	0.0	18.8	36.0	17.2	Complied

Transmitter Maximum (Average) Output Power (continued)**Results:****Bottom Channel****Middle Channel****Top Channel**

4.5 Transmitter Power Spectral Density

Test Summary:

Test Engineers:	Chanthu Thevarajah & Nick Raptopoulos	Test Date:	24 September 2021
Test Sample Serial Number:	AZ000012		

FCC Reference:	Part 15.247(e)
Test Method Used:	FCC KDB 558074 Section 8.4 referencing ANSI C63.10 Section 11.10.5

Environmental Conditions:

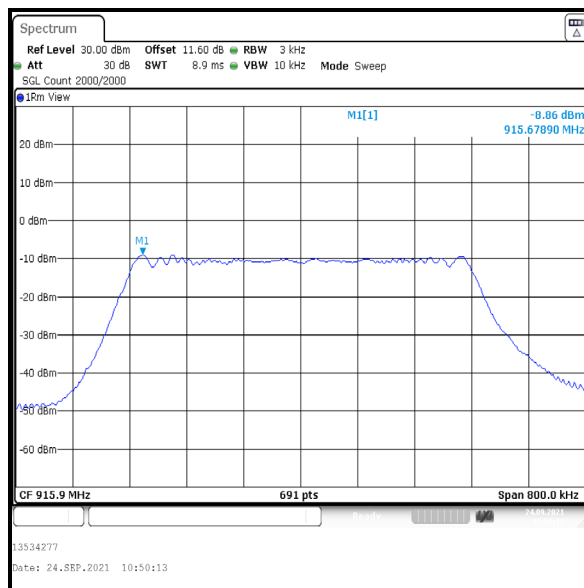
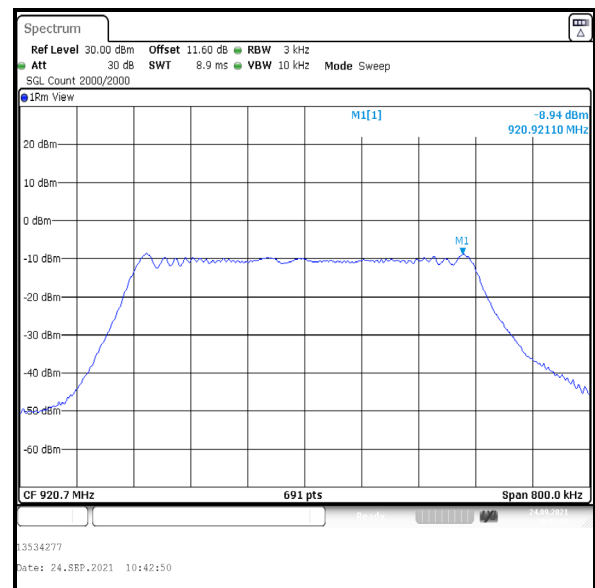
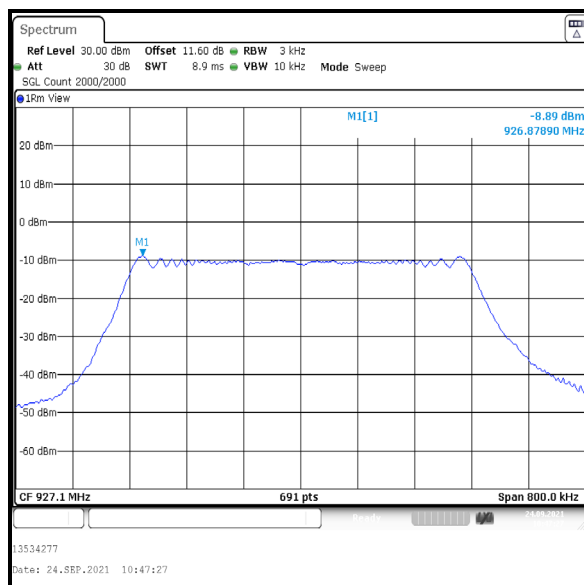
Temperature (°C):	23
Relative Humidity (%):	54

Note(s):

1. Transmitter Power Spectral Density tests were performed using a signal analyser in accordance with ANSI C63.10 Section 11.10.5.
2. The signal analyser resolution bandwidth was set to 3 kHz and video bandwidth 10 kHz. An RMS detector was used, sweep time was set to auto and trace averaging was performed over 2000 traces. The span was set to at least 1.5 times the measured DTS bandwidth. A marker was placed at the peak of the signal and the results recorded in the table below. A correction factor of $10 \log(1/D)$ was added to the recorded results.
3. The signal analyser was connected to the RF port on the EUT using suitable attenuation and coaxial cable. An RF level offset was entered on the signal analyser to compensate for the loss of the attenuator and cable.

Transmitter Power Spectral Density (continued)**Results:**

Channel	PSD (dBm/3 kHz)	Duty Cycle Correction Factor (dB)	Corrected PSD (dBm / 3 kHz)	Limit (dBm / 3 kHz)	Margin (dB)	Result
Bottom	-8.9	7.4	-1.5	8.0	9.5	Complied
Middle	-8.9	7.4	-1.5	8.0	9.5	Complied
Top	-8.9	7.4	-1.5	8.0	9.4	Complied

**Bottom Channel****Middle Channel****Top Channel**

5 Radiated Test Results

5.1 Transmitter Radiated Emissions <1 GHz

Test Summary:

Test Engineers:	Andrew Harding & Nick Tye	Test Dates:	22 September 2021 to 17 February 2022
Test Sample Serial Number:	AZ000014		

FCC Reference:	Parts 15.247(d) & 15.209(a)
Test Method Used:	ANSI C63.10 Sections 6.3, 6.4 and 6.5
Frequency Range	9 kHz to 1000 MHz

Environmental Conditions:

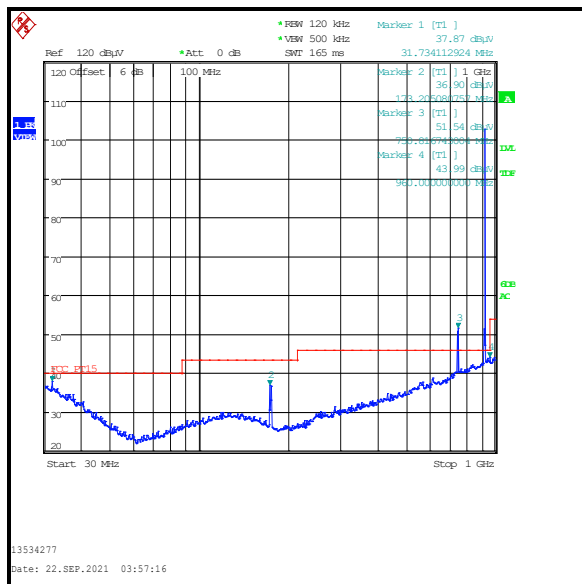
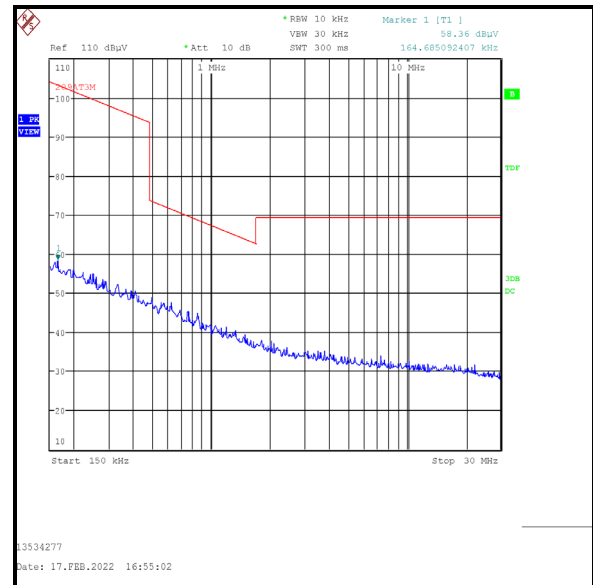
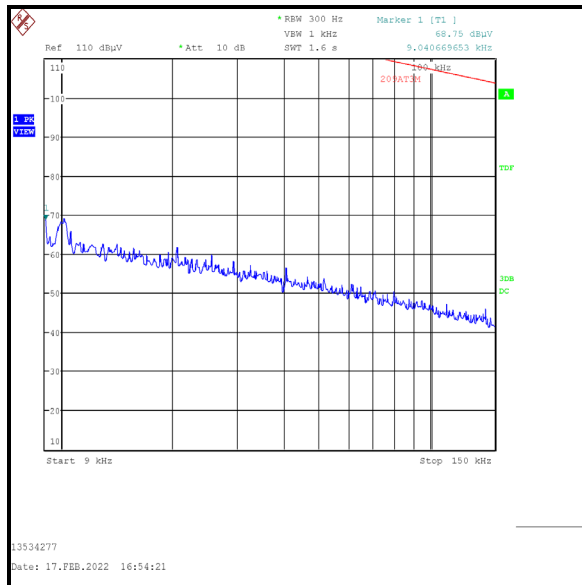
Temperature (°C):	22 to 24
Relative Humidity (%):	42 to 47

Note(s):

1. The emission at approximately 921 MHz is the EUT fundamental.
2. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
3. All other emissions were investigated and found to be ambient, > 20 dB below the appropriate limit or below the noise floor of the measurement system.
4. The preliminary scans showed similar emission levels below 1 GHz, for each channel of operation. Therefore, final measurements were performed on middle channel only.
5. Measurements below 30 MHz were performed in a semi-anechoic chamber (Asset Number K0001) at 3 metres. The EUT was placed at a height of 80 cm above the reference ground plane in the centre of the chamber turntable. The limit was extrapolated to 3 metres in accordance with ANSI C63.10 clause 6.4.3 using the method described in clause 6.4.4.2. ANSI C63.10 clause 5.2 states an alternative test site that can demonstrate equivalence to an open area test site may be used for measurements below 30 MHz. Therefore, measurements were performed in a semi-anechoic chamber. The correlation data between semi-anechoic chamber and an open field test site is available upon request.
6. Measurements from 30 MHz to 1 GHz were performed in a semi-anechoic chamber (Asset Number K0001) at a distance of 3 metres. The EUT was placed at a height of 80 cm above the reference ground plane 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. 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.

Transmitter Radiated Emissions (continued)**Results: Peak / Middle Channel**

Frequency (MHz)	Antenna Polarity	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
30.496	Vertical	31.8	40.0	8.2	Complied
747.868	Vertical	33.0	46.0	13.0	Complied



Note: This plot is a pre-scan and for indication purposes only. For final measurements, see accompanying table.

5.2 Transmitter Radiated Emissions >1 GHz

Test Summary:

Test Engineers:	Andrew Harding & Mohamed Toubella	Test Dates:	22 September 2021 to 29 September 2021
Test Sample Serial Number:	AZ000014		

FCC Reference:	Parts 15.247(d) & 15.209(a)
Test Method Used:	FCC KDB 558074 Sections 8.1 c)3), 8.5 & 8.6 referencing ANSI C63.10 Sections 6.3, 6.6, 11.11 & 11.12
Frequency Range	1 GHz to 9.3 GHz

Environmental Conditions:

Temperature (°C):	24
Relative Humidity (%):	46 to 49

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. *In accordance with ANSI C63.10 Section 6.6.4.3, Note 1, if the peak measured value complies with the average limit, it is unnecessary to perform an average measurement.
4. Pre-scans above 1 GHz were performed in a fully anechoic chamber (Asset Number K0001) at a distance of 3 metres. The EUT was placed at a height of 1.5 metres above the test chamber floor in the centre of the chamber turntable. All measurement antennas were placed at a fixed height of 1.5 metres above the test chamber floor, in line with the EUT.
5. Final measurements above 1 GHz were performed in a semi-anechoic chamber (Asset Number K0001) at a distance of 3 metres. The EUT was placed at a height of 1.5 m above the reference ground plane 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.
6. Pre-scans were performed and markers placed on the highest measured levels. The test receiver resolution bandwidth was set to 1 MHz and video bandwidth to 3 MHz. The sweep time was set to auto. Peak and average measurements were performed with their respective detectors.
7. The reference level for the emission in the non-restricted band was established in accordance with ANSI C63.10 Section 11.11.2.
8. ** -30 dBc limit.

Transmitter Radiated Emissions (continued)**Results: Bottom Channel / Peak**

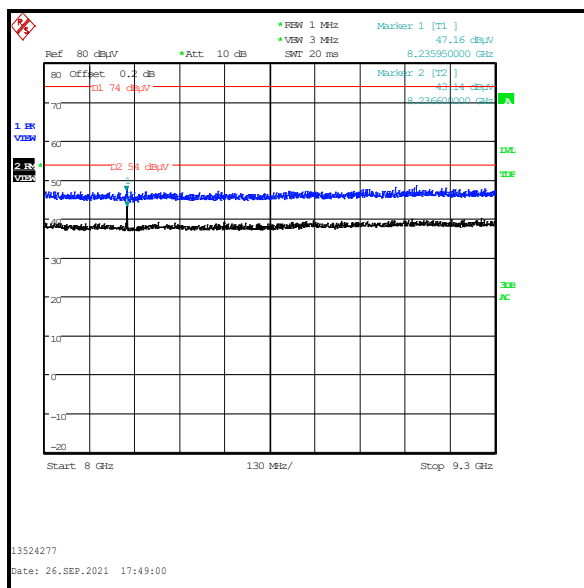
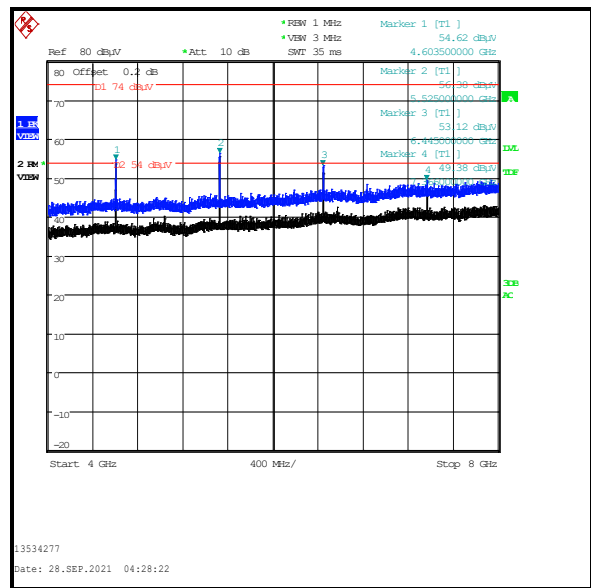
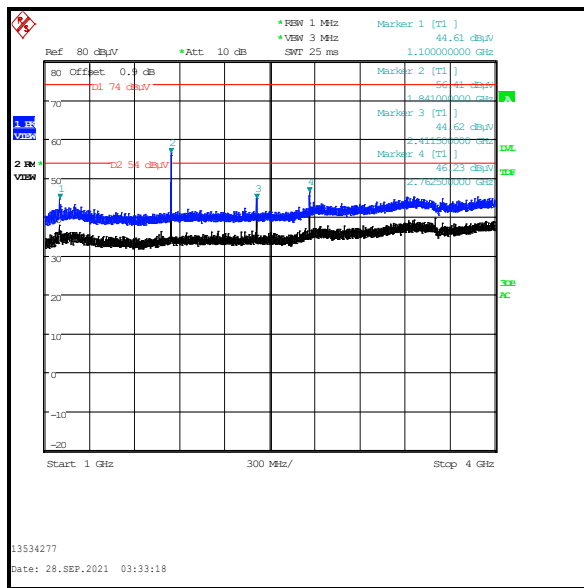
Frequency (MHz)	Antenna Polarity	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
2748.000	Vertical	46.8	54.0*	7.2	Complied
4579.500	Vertical	53.0	54.0*	1	Complied
7329.000	Vertical	50.7	54.0*	3.3	Complied

Results: Middle Channel / Peak

Frequency (MHz)	Antenna Polarity	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
1841.000	Vertical	56.4	72.5**	16.1	Complied
2762.500	Vertical	46.2	54.0*	7.8	Complied
4604.560	Vertical	51.6	54.0*	2.4	Complied
5525.000	Vertical	56.4	72.5**	16.1	Complied
6445.500	Vertical	53.1	72.5**	19.4	Complied
7366.000	Vertical	49.4	54.0*	4.6	Complied
8235.950	Vertical	49.7	54.0*	4.3	Complied

Results: Top Channel / Peak

Frequency (MHz)	Antenna Polarity	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
3600.000	Vertical	41.6	54.0*	32.4	Complied
4636.500	Vertical	51.4	54.0*	2.6	Complied
5173.500	Vertical	47.3	69.7**	22.4	Complied
5562.500	Vertical	53.9	69.7**	15.8	Complied
6490.000	Vertical	50.4	69.7**	19.3	Complied
7417.500	Vertical	49.4	54.0*	4.6	Complied

Transmitter Radiated Emissions (continued)

Note: The above plots are for indication purposes only. For final measurements, see accompanying tables.

5.3 Transmitter Band Edge Radiated Emissions

Test Summary:

Test Engineer:	Andrew Harding	Test Date:	23 September 2021
Test Sample Serial Number:	AZ000014		

FCC Reference:	Parts 15.247(d) & 15.209(a)
Test Method Used:	KDB 558074 Section 8.7 referencing ANSI C63.10 Sections 11.11, 11.12 & 11.13

Environmental Conditions:

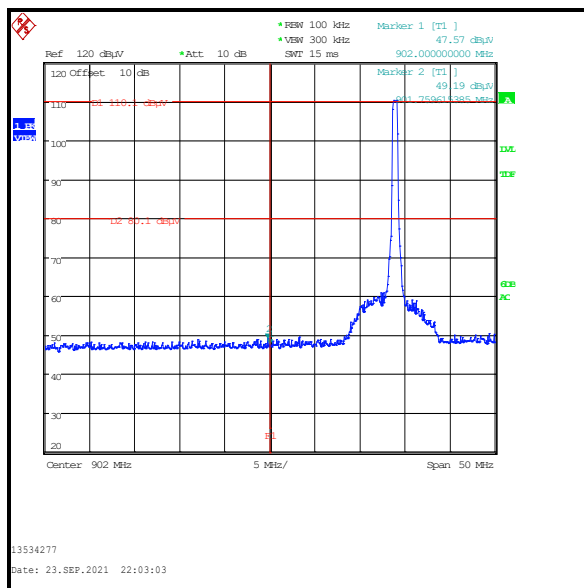
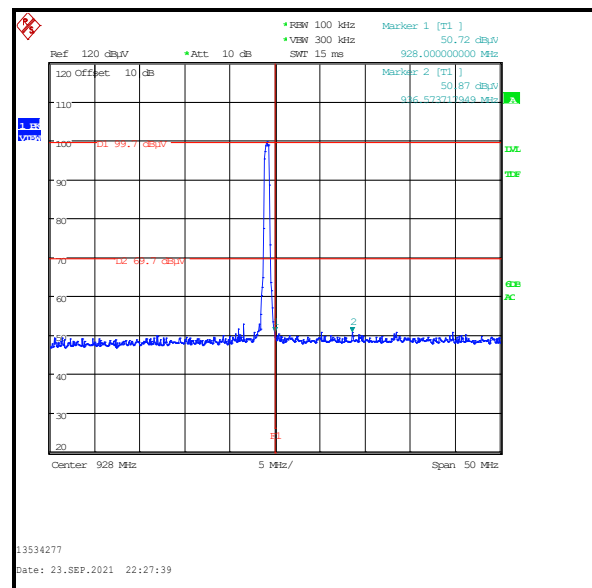
Temperature (°C):	23
Relative Humidity (%):	46

Note:

1. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
2. As both the band edges are adjacent to non-restricted bands, only peak measurements are required. In accordance with ANSI C63.10 Section 11.11.1, the test method in Section 11.3 was followed: the test receiver resolution bandwidth was set to 100 kHz and video bandwidth 300 kHz. A peak detector was used, sweep time was set to auto and trace mode was Max Hold. The test receiver was left to sweep for a sufficient length of time in order to maximise the carrier level and out-of-band emissions. A marker and corresponding reference level line were placed on the peak of the carrier. As the maximum conducted output power was measured using an RMS detector in accordance with ANSI C63.10 Section 11.9.2.2.4, an out-of-band limit line was placed 30 dB (ANSI C63.10 Section 11.11.1(b)) below the peak level. A marker was placed on the band edge frequencies. Marker frequency and levels were recorded.

Transmitter Band Edge Radiated Emissions (continued)**Results: Peak**

Frequency (MHz)	Antenna Polarity	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
901.760	Vertical	49.2	80.1	30.9	Complied
902.000	Vertical	47.6	80.1	32.5	Complied
928.000	Vertical	50.7	69.7	19.0	Complied
936.574	Vertical	50.9	69.7	18.8	Complied

**Lower Band Edge****Upper Band Edge**

6 AC Power Line Conducted Emissions Test Results

6.1 Transmitter AC Conducted Spurious Emissions

Test Summary:

Test Engineers:	Alison Johnston & Nick Raptopoulos	Test Date:	28 September 2021
Test Sample Serial Number:	AZ000014		

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

Environmental Conditions:

Temperature (°C):	24
Relative Humidity (%):	50

Note(s):

1. The EUT was connected to a 120 VAC 60 Hz single phase supply via a LISN.
2. In accordance with FCC KDB 174176 Q4, tests were performed with a 240 VAC 60 Hz single phase supply as this was within the voltage range marked on the EUT power supply (120 -277 VAC).
3. A pulse limiter was fitted between the LISN and the test receiver.
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 recorded in the tables below.

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

Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.222000	Live	32.8	62.7	29.9	Complied
0.447000	Live	27.5	56.9	29.4	Complied
1.095000	Live	31.4	56.0	24.6	Complied
1.423500	Live	27.2	56.0	28.8	Complied
4.866000	Live	28.2	56.0	27.8	Complied
6.229500	Live	30.3	60.0	29.7	Complied

Results: Live / Average / 120 VAC 60 Hz

Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.253500	Live	20.7	51.6	30.9	Complied
0.339000	Live	19.7	49.2	29.5	Complied
1.144500	Live	22.3	46.0	23.7	Complied
2.904000	Live	21.8	46.0	24.2	Complied
5.442000	Live	24.9	50.0	25.1	Complied
25.057500	Live	17.5	50.0	32.5	Complied

Results: Neutral / Quasi Peak / 120 VAC 60 Hz

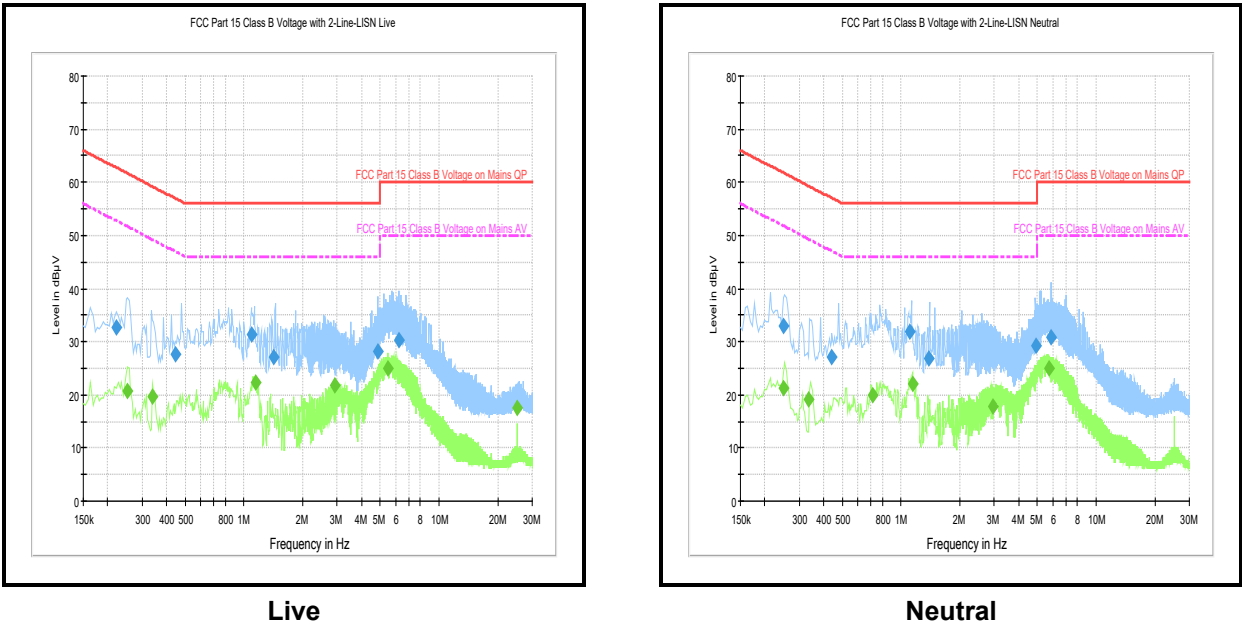
Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.249000	Neutral	33.0	61.8	28.8	Complied
0.442500	Neutral	27.1	57.0	29.9	Complied
1.104000	Neutral	31.9	56.0	24.1	Complied
1.378500	Neutral	27.0	56.0	29.0	Complied
4.884000	Neutral	29.1	56.0	26.9	Complied
5.896500	Neutral	30.8	60.0	29.2	Complied

Results: Neutral / Average / 120 VAC 60 Hz

Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.249000	Neutral	21.3	51.8	30.5	Complied
0.334500	Neutral	19.0	49.3	30.3	Complied
0.717000	Neutral	19.9	46.0	26.1	Complied
1.153500	Neutral	22.1	46.0	23.9	Complied
2.958000	Neutral	17.7	46.0	28.3	Complied
5.757000	Neutral	25.0	50.0	25.0	Complied

Transmitter AC Conducted Spurious Emissions (continued)

Results: 120 VAC 60 Hz



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

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

Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.442500	Live	31.7	57.0	25.3	Complied
0.604500	Live	32.1	56.0	23.9	Complied
0.793500	Live	33.3	56.0	22.7	Complied
1.140000	Live	32.9	56.0	23.1	Complied
4.704000	Live	31.8	56.0	24.2	Complied
5.307000	Live	34.8	60.0	25.2	Complied

Results: Live / Average / 240 VAC 60 Hz

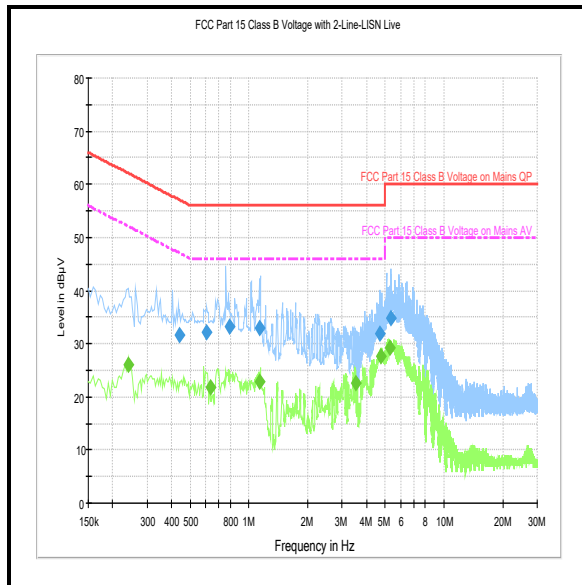
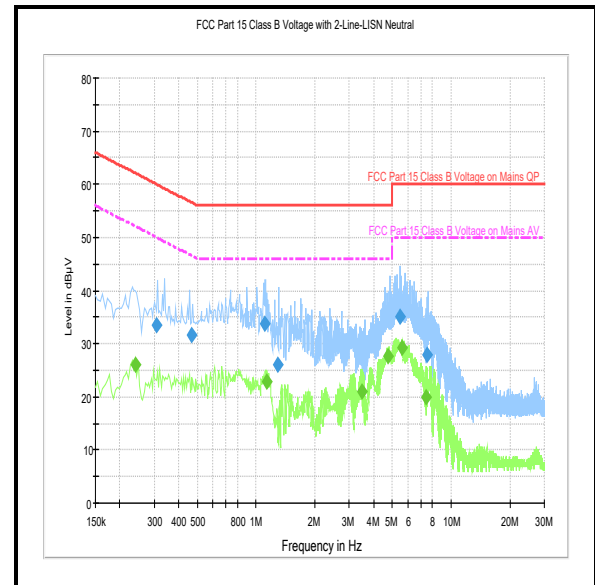
Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.240000	Live	26.0	52.1	26.1	Complied
0.631500	Live	21.8	46.0	24.2	Complied
1.140000	Live	22.9	46.0	23.1	Complied
3.511500	Live	22.5	46.0	23.5	Complied
4.762500	Live	27.6	46.0	18.4	Complied
5.257500	Live	29.2	50.0	20.8	Complied

Results: Neutral / Quasi Peak / 240 VAC 60 Hz

Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.307500	Neutral	33.6	60.0	26.4	Complied
0.465000	Neutral	31.5	56.6	25.1	Complied
1.113000	Neutral	33.7	56.0	22.3	Complied
1.284000	Neutral	26.1	56.0	29.9	Complied
5.455500	Neutral	35.0	60.0	25.0	Complied
7.557000	Neutral	28.0	60.0	32.0	Complied

Results: Neutral / Average / 240 VAC 60 Hz

Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.240000	Neutral	26.0	52.1	26.1	Complied
1.140000	Neutral	22.8	46.0	23.2	Complied
3.480000	Neutral	20.9	46.0	25.1	Complied
4.758000	Neutral	27.6	46.0	18.4	Complied
5.581500	Neutral	29.1	50.0	20.9	Complied
7.467000	Neutral	20.0	50.0	30.0	Complied

Transmitter AC Conducted Spurious Emissions (continued)**Results: 240 VAC 60 Hz****Live****Neutral**

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

Annex A

Untested Variants

The customer has declared that the following model numbers are identical in RF performance to the tested EUT as detailed in section 3.1.

Model Name or Number:	Syra RE 61456NF-915-H-LC
Model Name or Number:	Syra RE 61456NF-915-L-LW
Model Name or Number:	Syra RE 61456NF-915-L-LC

'L' and 'H' indicate whether a low or high voltage relay is used (120-230V vs 120-277V).

'LW' and 'LC' indicate whether LoRaWAN or LoRa Custom firmware is used (both using the same LoRa physical layer and RF parameters).

--- END OF REPORT ---