



TEST REPORT

Test Report No. : UL-RPT-RP-13534277-3416-1-FCC

Applicant : Umpi S.r.l
Model No. : Syra RE-C 61456NCF-915-H-LW
FCC ID : Contains FCC ID: 2A3M2-25A083
Technology : LoRa
Test Standard(s) : FCC Parts 15.207, 15.209(a) & 15.247
For details of applied tests refer to test result summary

1. This test report shall not be reproduced in full or partial, without the written approval of UL International Germany GmbH.
2. The results in this report apply only to the sample tested.
3. The test results in this report are traceable to the national or international standards.
4. **Test Report Version 1.1 supersede Version 1.0 with immediate effect**
Test Report No. UL-RPT-RP-13534277-3416-1-V1.1-FCC Version 1.1, Issue Date 05 DECEMBER 2022 replaces Test Report No. UL-RPT-RP-13534277-3416-1-FCC Version 1.0, Issue Date 16 NOVEMBER 2022, which is no longer valid.
5. Result of the tested sample: **PASS**

Prepared by: Muhamamd Faiq, Khan
Title: Project Engineer
Date: 05 December 2022

Approved by: Rachid, Acharkaoui
Title: Operations Manager
Date: 05 December 2022



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The tests reported herein have been performed in accordance with its' terms of accreditation.

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1. Customer Information

1.1. Applicant Information

Company Name:	Umpi S.r.l
Company Address:	Via S.S. Consolare Rimini-RSM 11, 47923 Rimini, Italy
Company Phone No.:	+39 0541 833160
Company E-Mail:	info@umpi.it
Contact Person:	Luca Pietro Borsani
Contact E-Mail Address:	lucapietro.borsani@dplatforms.it
Contact Phone No.:	+39 0331 4561 59

1.2. Manufacturer Information

Company Name:	Umpi S.r.l
Company Address:	Via S.S. Consolare Rimini-RSM 11, 47923 Rimini, Italy
Company Phone No.:	+39 0541 833160
Company E-Mail:	info@umpi.it
Contact Person:	Luca Pietro Borsani
Contact E-Mail Address:	lucapietro.borsani@dplatforms.it
Contact Phone No.:	+39 0331 4561 59

2. Summary of Testing

2.1. General Information

Applied Standards

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 and 47CFR15.209
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart C (Intentional Radiators) – Sections 15.209

Location

Location of Testing:	UL International Germany GmbH Hedelfinger Str. 61 70327 Stuttgart Germany
Test Firm Registration:	399704

Date information

Order Date:	30 September 2020
EUT Arrived:	09 June 2022
Test Dates:	20 July 2022 to 01 December 2022
EUT Returned:	-/-

2.2. Summary of Test Results

Clause	Measurement	Complied	Did not comply	Not performed	Not applicable
Part 15.207	Transmitter AC Conducted Emissions	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Part 15.35(c)	Transmitter Duty Cycle	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Part 2.1049	Transmitter 99% Occupied Bandwidth	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Part 15.247(a)(2)	Transmitter Minimum 6 dB Bandwidth	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Part 15.247(b)(3)	Transmitter Maximum Output Power	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Part 15.247(e)	Transmitter Power Spectral Density	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Part 15.247(d) & 15.209(a)	Transmitter Radiated Emissions	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Part 15.247(d) & 15.209(a)	Transmitter Band Edge Radiated Emissions	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

2.3. Methods and Procedures

Reference:	ANSI C63.10-2013
Title:	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
Reference:	FCC 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:	FCC KDB 174176 D01 Line Conducted FAQ v01r01 June 3, 2015
Title:	AC Power-Line Conducted Emissions Frequently Asked Questions

2.4. 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.

3. Equipment Under Test (EUT)

3.1. Identification of Equipment Under Test (EUT)

Brand Name:	Umpi
Model Name or Number:	Syra RE-C 61456NCF-915-H-LW
Test Sample Serial Number:	BB915003 (Radiated Test Sample)
Hardware Version Number:	25A080 + 25A022
Firmware Version Number:	1.1.1
FCC ID:	Contains FCC ID: 2A3M2-25A083

Brand Name:	Umpi
Model Name or Number:	Syra RE-C 61456NCF-915-H-LW
Test Sample Serial Number:	BB915002 (Conducted Test Sample)
Hardware Version Number:	25A080 + 25A022
Firmware Version Number:	1.1.1
FCC ID:	Contains FCC ID: 2A3M2-25A083

3.2. Untested Variants

Model Name or Number:	Syra RE-C 61456NCF-915-H-LC
Model Name or Number:	Syra RE-C 61456NCF-915-L-LW
Model Name or Number:	Syra RE-C 61456NCF-915-L-LC
Model Name or Number:	Syra RE-ZC 61556CF-915-LC
Model Name or Number:	Syra RE-ZC 61556CF-915-LW

Note(s):

1. As per applicant's declaration these variants are identical to the tested model from an RF perspective. Further information is provided in Annex A.

3.3. Description of EUT

The equipment under test was an point-to-point transceiver used for lightning system control in urban and rural installations with Model: Syra RE-C 61456NCF-915-H-LW supporting LoRa technology in 902-928MHz range containing module with FCC ID: 2A3M2-25A083.

3.4. Modifications Incorporated in the EUT

No modifications were applied to the EUT during testing.

3.5. 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:	21.87 dBm		
Antenna Gain:	2.0 dBi		
Transmit Frequency Range:	915.900 MHz to 925.500 MHz		
Transmit Channels Tested:	Channel ID	Channel Number	Channel Frequency (MHz)
	Bottom	0	915.900
	Middle	3	920.700
	Top	6	925.500

3.6. Support Equipment

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

A. Support Equipment (In-house)

Item	Description	Brand Name	Model Name or Number	Serial Number
1	Test Laptop PC With test software Tera Term	HP	HP Probook 650 G1	5CG614419V

B. Support Equipment (Manufacturer supplied)

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

4. Operation and Monitoring of the EUT during Testing

4.1. Operating Modes

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

☒ Continuous Transmitting Mode - Fixed Channel Frequency Mode.

- | Bottom Channel | 915.900 MHz | Data rate 12.5 kbps (DR6) | MAX PWR 22 dBm |
- | Middle Channel | 920.700 MHz | Data rate 12.5 kbps (DR6) | MAX PWR 22 dBm |
- | Top Channel | 925.500 MHz | Data rate 12.5 kbps (DR6) | MAX PWR 22 dBm |

4.2. Configuration and Peripherals

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

EUT Power Supply:

- The EUT was powered via AC power supply. The measurements were carried out with 120 VAC / 60 Hz.

Test Mode Activation:

- The customer provided Test instruction guide "EX01-T0004_20220503_A_Syra_MiniGW_Test_Instructions" issued on 03 May 2022 was used to configure the EUT into respective testmodes.
- The EUT was connected to the Test laptop via a USB-UART cable. The Terminal software "Tera Term" was used to give the commands for respective modes.
- It was possible to select the above mentioned three different channels in continuous transmit mode , the data rate and the power levels.

AC Conducted Emissions Measurements:

- The EUT radiated sample was used for AC conducted emissions measurements.
- The Toyo EMI Software EP5/CE Ver 4.0.1. was used for these measurements.

Conducted Measurements:

- All conducted measurements were carried out by using conducted samples.
- The RF port on the EUT was connected to the spectrum analyser using suitable attenuation and RF cable. The measured values takes into consideration the external attenuation correction factors. The U.FL-SMA (Female) RF Cable with maximum attenuation of 0.4 dB at the tested frequencies. The RF cable attenuation maximum 0.3 dB@ tested frequencies from the EUT to Analyzer including the 10 dB attenuation at the input of Spectrum Analyzer Therefore, total a reference level offset 10.7 dB was added to each of the at the tested frequencies conducted plots.

Radiated Measurements:

- The radiated samples were used for radiated testing.
- Before starting final radiated measurments "worst case verification" with the EUT in Standing-position & Laying-position was performed by Lab.
- The EUT in Standing-position was found to be the worst case therefore this report includes relevant results.
- Radiated measurements below 30 MHz were performed with the EUT positioned on the turn table and rotating 360 degrees while the loop antenna height was set at 100 cm.
- Radiated measurments were performed with the EUT positioned on the turn table and rotating 360 degrees while the antenna height varies from 1 m to 4 m over the measurement frequency range
- EMC32 V11.30.0 Software was used for the Radiated spurious emission measurements.

Duty Cycle Correction Details:

- As the EUT continuous transmission of the EUT ($D \geq 98\%$) cannot be achieved and EUT was transmitting continuously with a constant Duty Cycle of 18.52 % (duty cycle variations are less than $\pm 2\%$). Therefore, a Duty Cycle Correction Factor of 7.32 dB was added to all average measurements, to compute the corrected average values of the emissions that would have been measured had the test been performed at 100% Duty Cycle.

5. Measurements, Examinations and Derived Results

5.1. General Comments

Measurement uncertainties are evaluated in accordance with current best practice. Our reported expanded uncertainties are based on standard uncertainties, which are multiplied by an appropriate coverage factor to provide a statistical confidence level of approximately 95%. Please refer to Section 6 *Measurement Uncertainty* for details.

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

5.2. Test Results

5.2.1. Transmitter AC Conducted Spurious Emissions

Test Summary:

Test Engineer:	Muhammad Faiq Khan	Test Date:	28 September 2022 & 30 November 2022
Test Sample Serial Number:	BB915003 (Radiated Test Sample)		
Test Site Identification	SR 7/8		

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

Environmental Conditions:

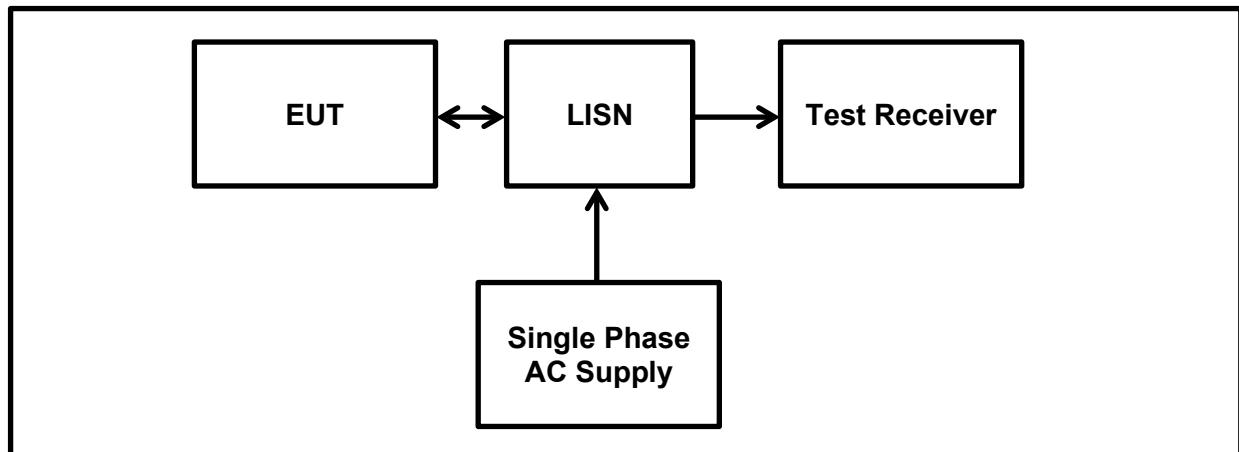
Temperature (°C):	20.1 to 24.6
Relative Humidity (%):	41.8 to 48.6

Settings of the Instrument:

Detector:	Quasi Peak/ Average Peak
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Note(s):

1. Radiated sample was used for AC conducted emissions measurements.
2. EUT was powered via AC power supply. The measurement was performed with 120 VAC/60Hz and 240VAC/60Hz as it was within the voltage range of the device.
3. The EUT was configured on the following worst-case mode.
 - LoRa / MAX PWR / Middle Channel / DR6
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.
5. The final measured value, for the given emission, in the table below incorporates the cable loss.
6. All other emissions shown on the pre-scan plot were investigated. Only the highest 6 emissions have been reported in the tables below in accordance with ANSI C63.10 section 6.2.5.
7. Measurements were performed in shielded room (SR7/ 8 Asset Number 1603671). The EUT was placed at a height of 80 cm above the reference ground plane and in a distance of 40 cm from the vertical ground plane at the edge of the table.
8. Measurement software used: Toyo EMI Software; CE measurement software EP5/CE Ver 4.0.1.

Transmitter AC Conducted Spurious Emissions (continued)**Test setup:**

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

Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.280260	Live	25.90	60.80	34.90	Complied
0.661520	Live	26.90	56.00	29.10	Complied
1.138080	Live	29.10	56.00	26.90	Complied
6.672350	Live	37.10	60.00	22.90	Complied
12.240480	Live	20.70	60.00	39.30	Complied
13.733470	Live	19.20	60.00	40.80	Complied

Results: Live / Average / 120 VAC 60 Hz

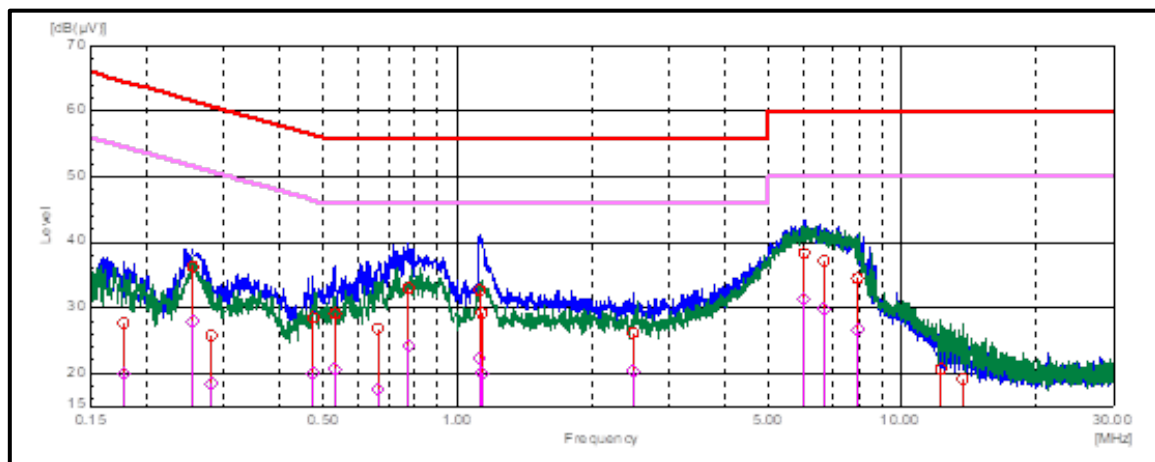
Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.280260	Live	18.50	50.80	32.30	Complied
0.661520	Live	17.60	46.00	28.40	Complied
1.138080	Live	19.90	46.00	26.10	Complied
6.672350	Live	29.80	50.00	20.20	Complied
12.240480	Live	13.40	50.00	36.60	Complied
13.733470	Live	12.10	50.00	37.90	Complied

Results: Neutral / Quasi Peak / 120 VAC 60 Hz

Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.178060	Neutral	27.70	64.60	36.90	Complied
0.254210	Neutral	36.40	61.60	25.20	Complied
0.473150	Neutral	28.50	56.50	28.00	Complied
0.531260	Neutral	29.10	56.00	26.90	Complied
0.775750	Neutral	33.00	56.00	23.00	Complied
1.122650	Neutral	32.70	56.00	23.30	Complied
2.484970	Neutral	26.10	56.00	29.90	Complied
6.013030	Neutral	38.30	60.00	21.70	Complied
7.959920	Neutral	34.50	60.00	25.50	Complied

Transmitter AC Conducted Spurious Emissions (continued)**Results : Middle Channel / MAX PWR****Results: Neutral / Average / 120 VAC 60 Hz**

Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.178060	Neutral	20.00	54.60	34.60	Complied
0.254210	Neutral	27.90	51.60	23.70	Complied
0.473150	Neutral	20.00	46.50	26.50	Complied
0.531260	Neutral	20.70	46.00	25.30	Complied
0.775750	Neutral	24.20	46.00	21.80	Complied
1.122650	Neutral	22.30	46.00	23.70	Complied
2.484970	Neutral	20.30	46.00	25.70	Complied
6.013030	Neutral	31.30	50.00	18.70	Complied
7.959920	Neutral	26.70	50.00	23.30	Complied

Result: Pass**Plot: Live and Neutral Line / 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 : Middle Channel / MAX PWR****Results: Live / Quasi Peak / 240 VAC 60 Hz**

Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.223150	Live	35.00	62.70	27.70	Complied
0.829860	Live	37.80	56.00	18.20	Complied
1.177760	Live	41.90	56.00	14.10	Complied
2.865730	Live	29.80	56.00	26.20	Complied
4.778560	Live	37.10	56.00	18.90	Complied
5.381760	Live	40.80	60.00	19.20	Complied
6.083170	Live	40.50	60.00	19.50	Complied

Results: Live / Average / 240 VAC 60 Hz

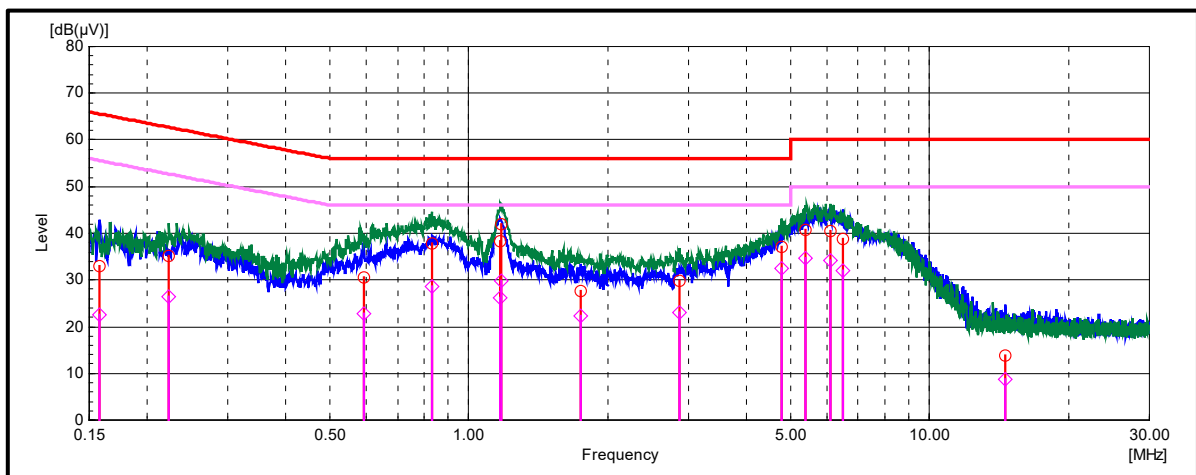
Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.223150	Live	26.30	52.70	26.40	Complied
0.829860	Live	28.60	46.00	17.40	Complied
1.177760	Live	29.70	46.00	16.30	Complied
2.865730	Live	23.00	46.00	23.00	Complied
4.778560	Live	32.60	46.00	13.40	Complied
5.381760	Live	34.70	50.00	15.30	Complied
6.083170	Live	34.10	50.00	15.90	Complied

Results: Neutral / Quasi Peak / 240 VAC 60 Hz

Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.158020	Neutral	33.00	65.60	32.60	Complied
0.590380	Neutral	30.60	56.00	25.40	Complied
1.171140	Neutral	38.40	56.00	17.60	Complied
1.748700	Neutral	27.60	56.00	28.40	Complied
6.489980	Neutral	38.80	60.00	21.20	Complied
14.635270	Neutral	13.80	60.00	46.20	Complied

Transmitter AC Conducted Spurious Emissions (continued)**Results : Middle Channel / MAX PWR****Results: Neutral / Average / 240 VAC 60 Hz**

Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.158020	Neutral	22.60	55.60	33.00	Complied
0.590380	Neutral	22.70	46.00	23.30	Complied
1.171140	Neutral	26.20	46.00	19.80	Complied
1.748700	Neutral	22.30	46.00	23.70	Complied
6.489980	Neutral	32.10	50.00	17.90	Complied
14.635270	Neutral	8.60	50.00	41.40	Complied

Result: Pass**Plot: Live and Neutral Line / 240 VAC 60 Hz**

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

5.2.2. Transmitter Duty Cycle**Test Summary:**

Test Engineer:	Muhammad Faiq Khan	Test Date:	20 July 2022
Test Sample Serial Number:	BB915002 (Conducted Test Sample)		
Test Site Identification	SR 9		

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):	21.9
Relative Humidity (%):	40.7

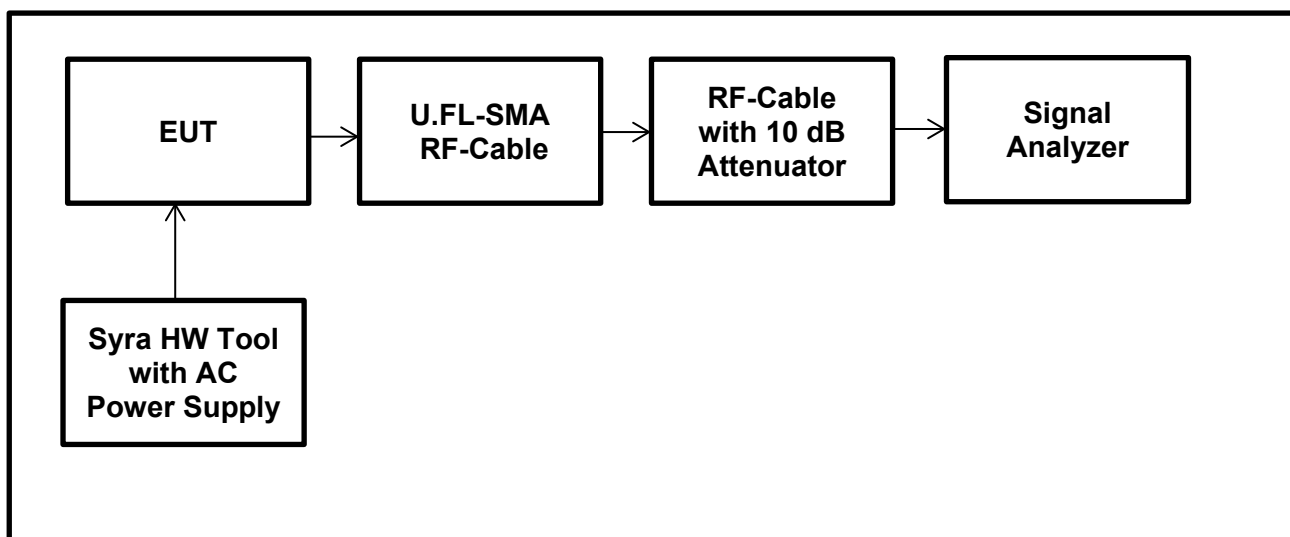
Notes:

- The transmitter duty cycle was measured using a spectrum analyser in the time domain and calculated by using the following calculation:

$$\text{Duty Cycle (\%)} = 100 \times [\text{On Time (T}_{\text{ON}})] / [\text{Period(T}_{\text{ON}} + \text{T}_{\text{OFF}}) \text{ or } 100\text{ms whichever is the lesser}]$$

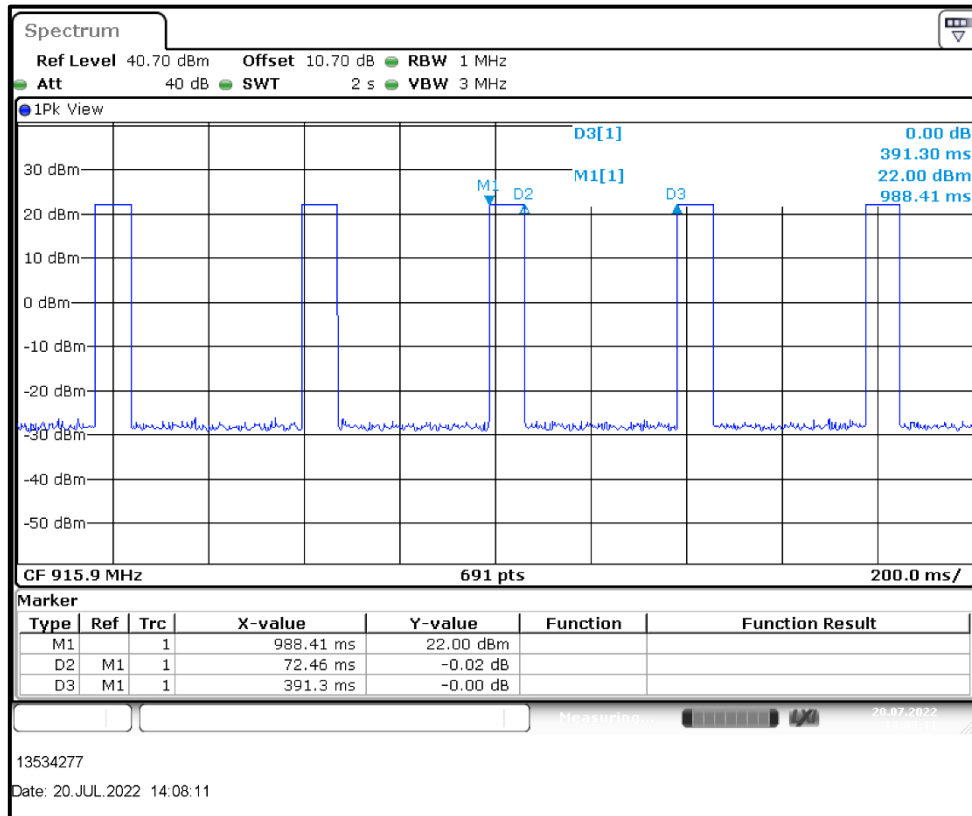
$$\text{Duty Cycle Correction Factor} = 10 \log 1 / [\text{On Time (T}_{\text{ON}})] / [\text{Period(T}_{\text{ON}} + \text{T}_{\text{OFF}}) \text{ or } 100\text{ms whichever is the lesser}]$$
- The RF port on the EUT was connected to the spectrum analyser using suitable attenuation and RF cable. The measured values takes into consideration the external attenuation correction factors.
 - The U.FL-SMA (Female) RF Cable with maximum attenuation of 0.3 dB at the tested frequencies.
 - The RF cable attenuation maximum 0.4 dB@ tested frequencies from the EUT to Analyzer including the 10 dB attenuation at the input of Spectrum Analyzer

Therefore, total a reference level offset 10.7 dB was added to each of the at the tested frequencies conducted plots.
- The EUT's pulse train is periodic (i.e., consists of a series of pulses that repeat in a characteristic pattern over a constant time period), and the period (T) is less than or equal to 100 ms.
- The total Pulse On Time (T_{ON}) was calculated by adding all the intervals where the EUT is transmitting withing a time period.

Test Setup:

Transmitter Duty Cycle (continued)**Results : LoRa / Bottom Channel / MAX PWR**

Pulse On Time (T _{ON}) (ms)	Pulse Period (T _{ON} + T _{OFF}) (ms)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)
72.46	391.30	18.52	7.32



5.2.3. Transmitter 99% Occupied Bandwidth**Test Summary:**

Test Engineer:	Muhammad Faiq Khan	Test Date:	20 July 2022 & 30 September 2022
Test Sample Serial Number:	BB915002 (Conducted Test Sample)		
Test Site Identification	SR 9		

FCC Reference:	2.1049
Test Method Used:	ANSI C63.10:2013 Section 6.9.3

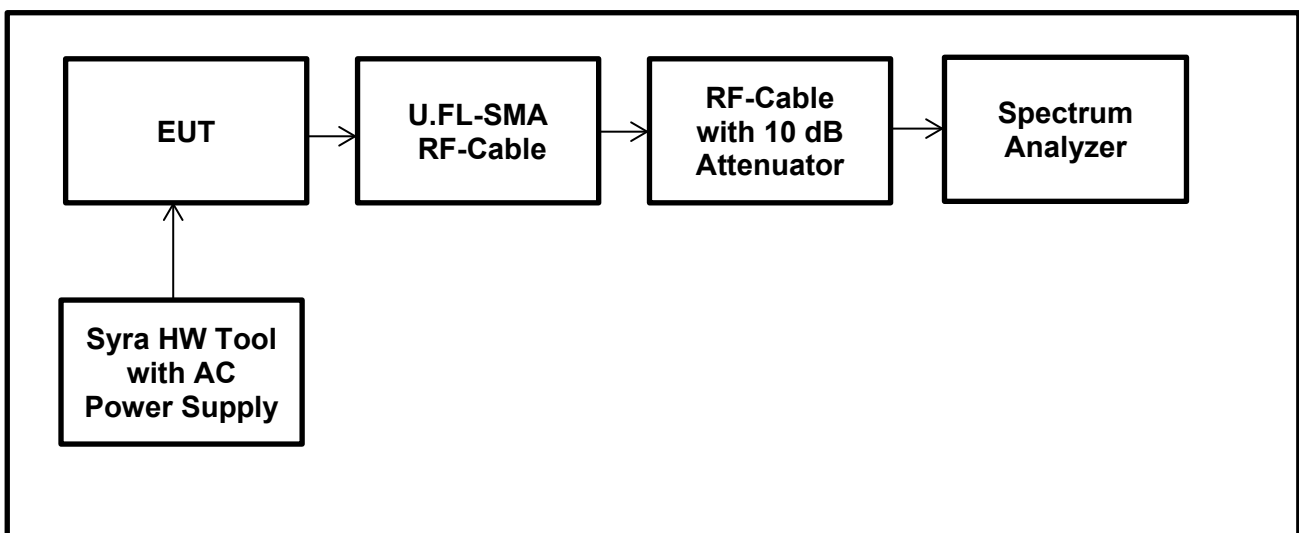
Environmental Conditions:

Temperature (°C):	21.9 to 24.8
Relative Humidity (%):	40.7 to 60.5

Notes:

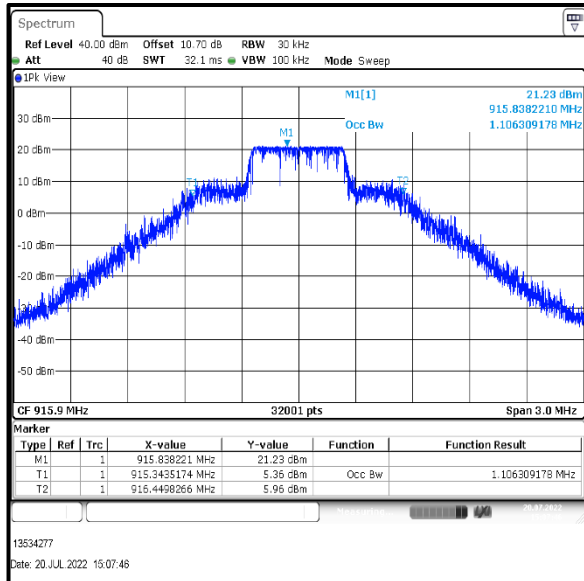
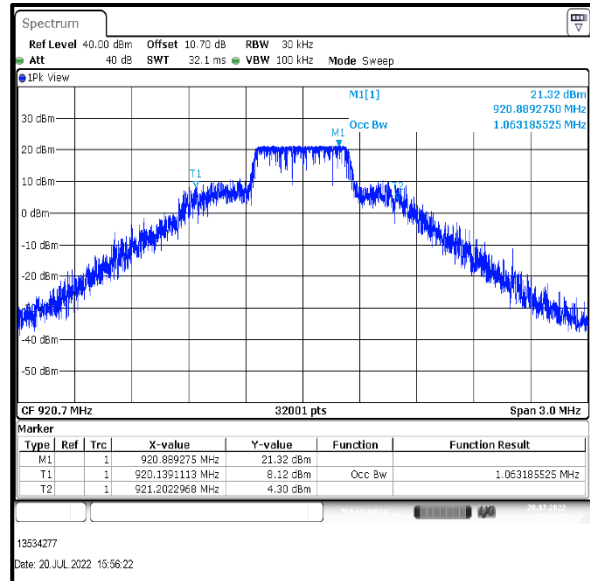
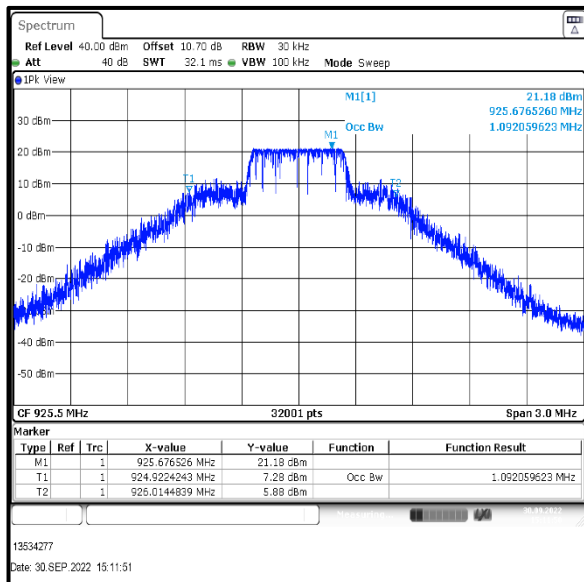
1. The 99% emission bandwidth was measured using the signal analyser occupied bandwidth function. The resolution bandwidth was set in the range of 1% to 5% of the occupied bandwidth and the video bandwidth set to 3 times the resolution bandwidth. The span was set to capture all products of the modulation process including emission skirts.
2. The signal analyser resolution bandwidth was set to 30 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 RF port on the EUT was connected to the spectrum analyser using suitable attenuation and RF cable. The measured values takes into consideration the external attenuation correction factors.
 - The U.FL-SMA (Female) RF Cable with maximum attenuation of 0.3 dB at the tested frequencies.
 - The RF cable attenuation maximum 0.4 dB@ tested frequencies from the EUT to Analyzer including the 10 dB attenuation at the input of Spectrum Analyzer

Therefore, total a reference level offset 10.7 dB was added to each of the at the tested frequencies conducted plots.

Test Setup:

Transmitter 99% Occupied Bandwidth (continued)**Results : LoRA / MAX PWR**

Channel	99% Occupied Bandwidth (kHz)	Result
Bottom	1106.31	Complied
Middle	1063.19	Complied
Top	1092.06	Complied

**Bottom Channel****Middle Channel****Top Channel****Result: Pass**

5.2.4. Transmitter Minimum 6 dB Bandwidth**Test Summary:**

Test Engineer:	Muhammad Faiq Khan	Test Date:	20 July 2022 & 30 September 2022
Test Sample Serial Number:	BB915002 (Conducted Test Sample)		
Test Site Identification	SR 9		

FCC Reference:	Part 15.247(a)(2)
Test Method Used:	FCC KDB 558074 Section 8.2 referencing ANSI C63.10:2013 Section 11.8.1

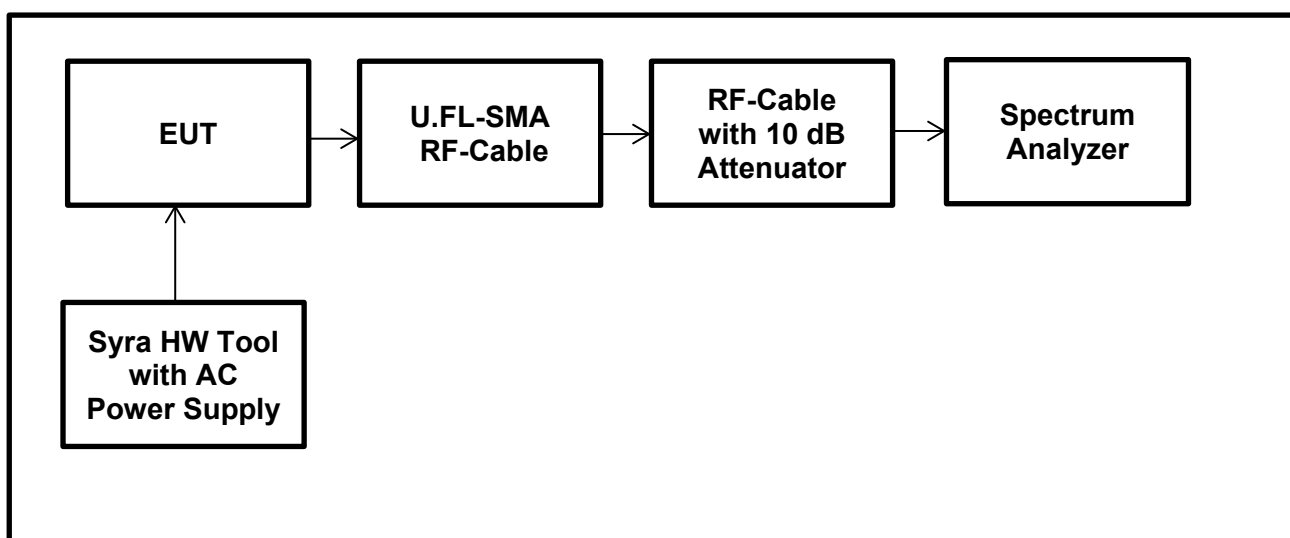
Environmental Conditions:

Temperature (°C):	21.9 to 24.8
Relative Humidity (%):	40.7 to 60.5

Notes:

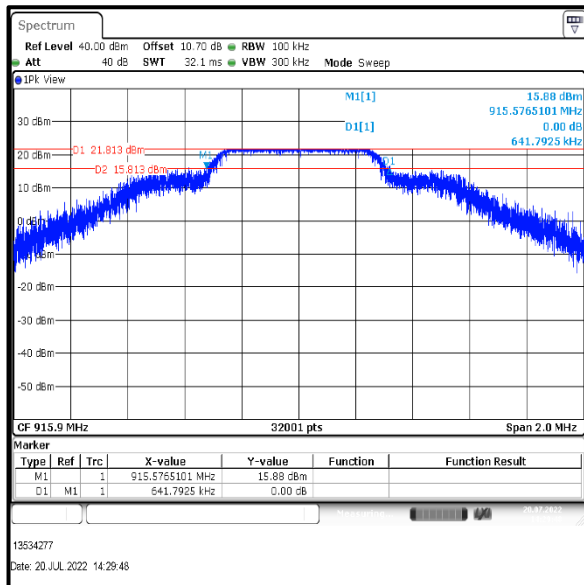
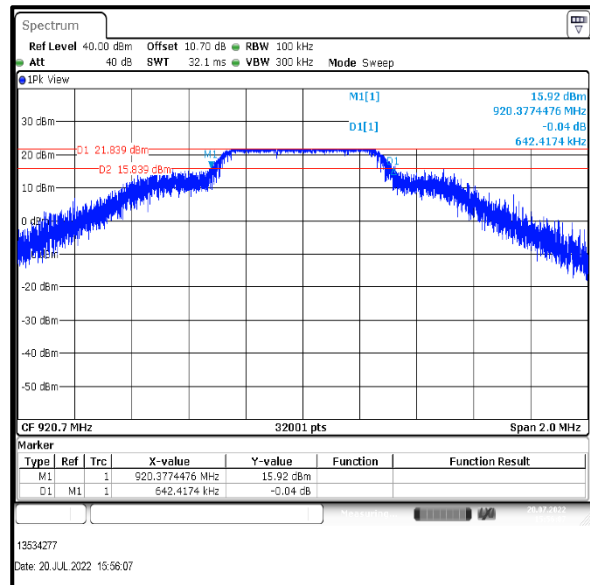
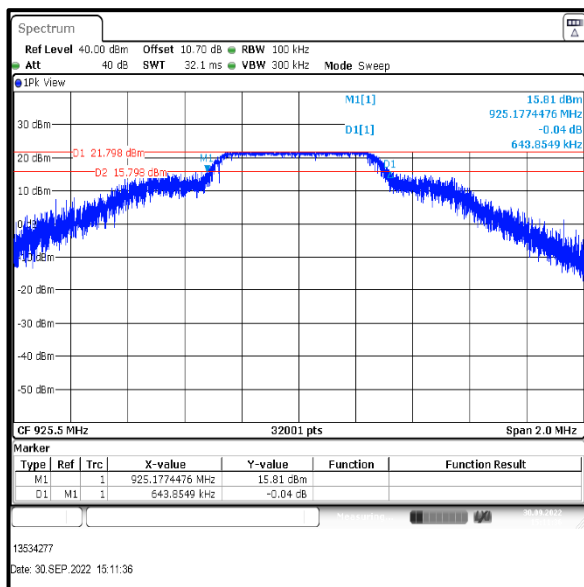
- 6 dB DTS bandwidth tests were performed using a signal analyser in accordance with ANSI C63.10 Section 11.8.1 Option 1 measurement procedure. The signal analyser resolution bandwidth was set to 100 kHz and video bandwidth 300 kHz. A peak detector was used, sweep time was set to auto and the trace mode was Max Hold. The DTS bandwidth was measured at 6 dB down from the peak of the signal.
- The RF port on the EUT was connected to the spectrum analyser using suitable attenuation and RF cable. The measured values takes into consideration the external attenuation correction factors.
 - The U.FL-SMA (Female) RF Cable with maximum attenuation of 0.3 dB at the tested frequencies.
 - The RF cable attenuation maximum 0.4 dB@ tested frequencies from the EUT to Analyzer including the 10 dB attenuation at the input of Spectrum Analyzer

Therefore, total a reference level offset 10.7 dB was added to each of the at the tested frequencies conducted plots.

Test Setup:

Transmitter Minimum 6 dB Bandwidth (continued)**Results : LoRA / MAX PWR**

Channel	6 dB Bandwidth (kHz)	Limit (kHz)	Margin (kHz)	Result
Bottom	641.792	> 500	141.792	Complied
Middle	642.417	> 500	142.417	Complied
Top	643.855	> 500	143.855	Complied

**Bottom Channel****Middle Channel****Top Channel****Result: Pass**

5.2.5. Transmitter Maximum (Average) Output Power**Test Summary:**

Test Engineer:	Muhammad Faiq Khan	Test Date:	01 December 2022
Test Sample Serial Number:	BB915002 (Conducted Test Sample)		
Test Site Identification	SR 9		

FCC Reference:	Part 15.247(b)(3)
Test Method Used:	FCC KDB 558074 Section 8.3.2.2 referencing ANSI C63.10:2013 Section 11.9.2.2.4 and notes below

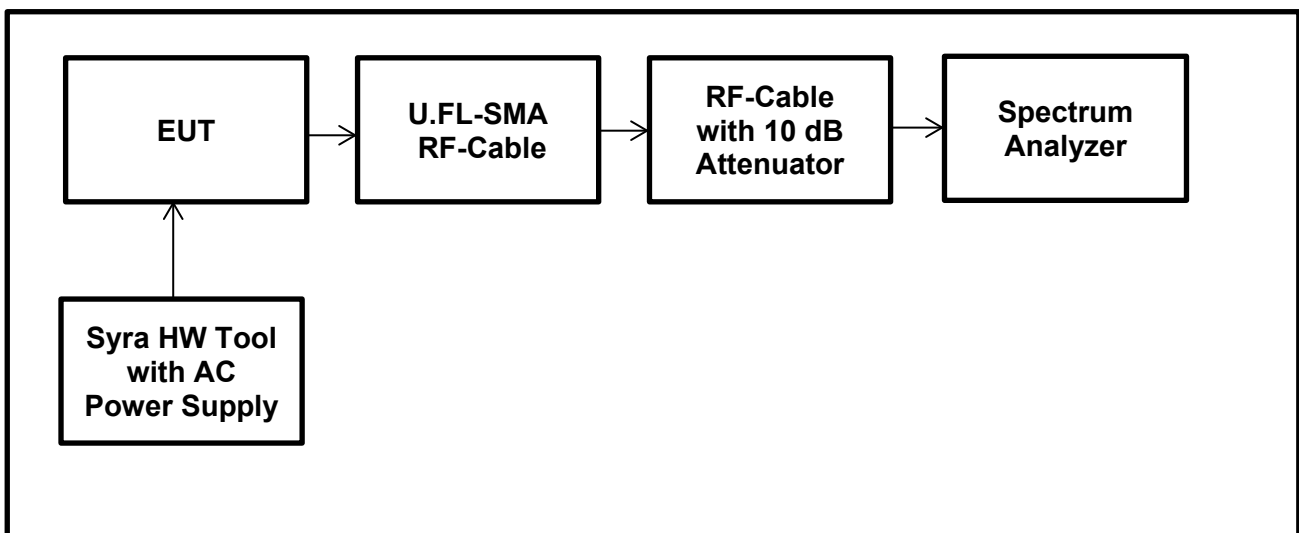
Environmental Conditions:

Temperature (°C):	20.6
Relative Humidity (%):	52.7

Notes:

- Conducted power tests were performed using a power meter in accordance with ANSI C63.10 Section 11.9.2.2.4 Method AVGSA-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% bandwidth. The span was set to at least 1.5 times the OBW. The result was recorded and duty cycle correction factor was added.
- The conducted power was added to the declared antenna gain to obtain the EIRP.
- The RF port on the EUT was connected to the spectrum analyser using suitable attenuation and RF cable. The measured values take into consideration the external attenuation correction factors.
 - The U.FL-SMA (Female) RF Cable with maximum attenuation of 0.3 dB at the tested frequencies.
 - The RF cable attenuation maximum 0.4 dB @ tested frequencies from the EUT to Analyzer including the 10 dB attenuation at the input of Spectrum Analyzer

Therefore, total a reference level offset 10.7 dB was added to each of the at the tested frequencies conducted plots.

Test Setup:

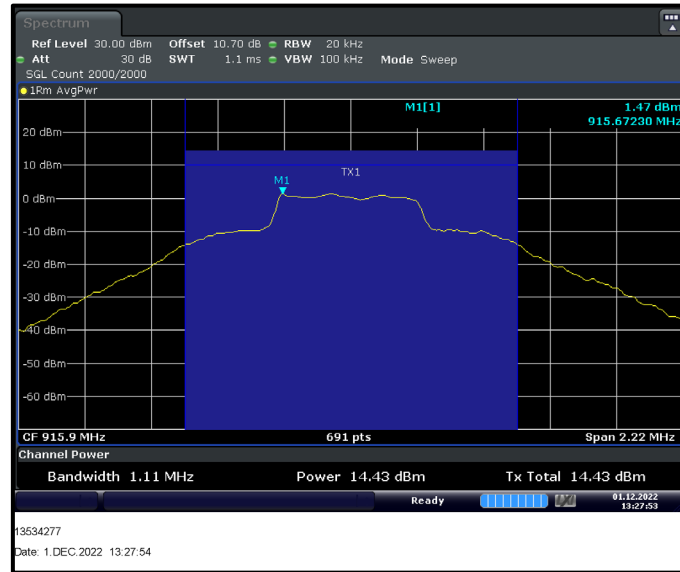
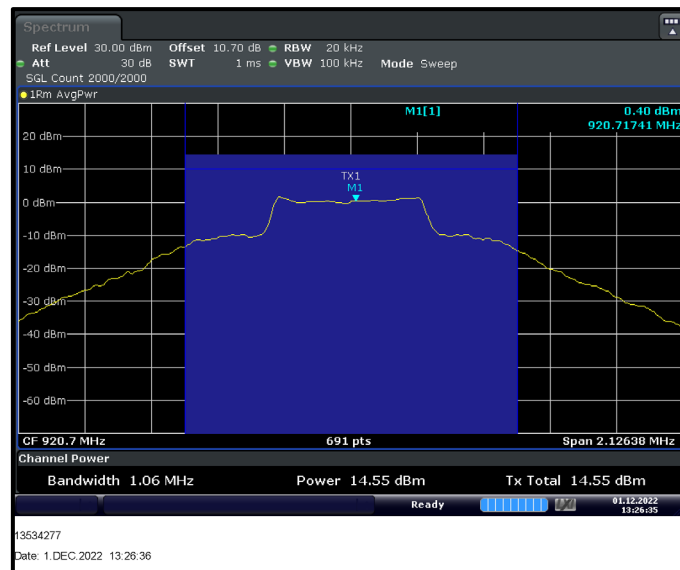
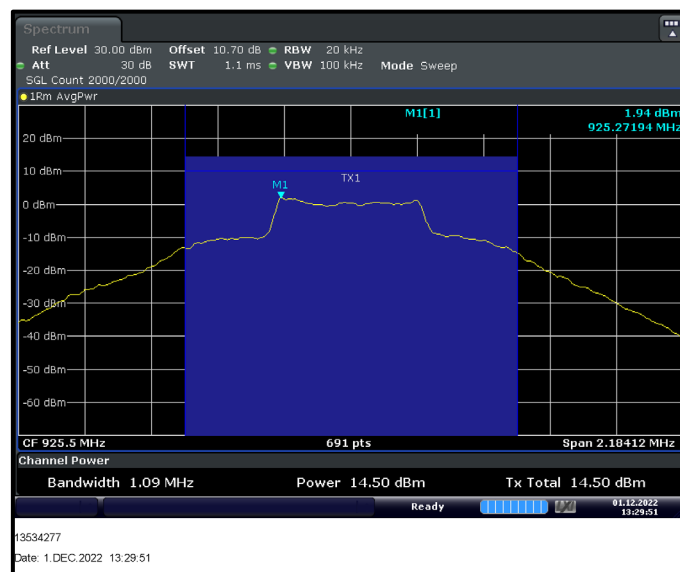
Transmitter Maximum (Average) Output Power (continued)**Results : LoRa / MAX PWR**

Channel	Conducted Average Power (dBm)	Duty Cycle Correction (dBm)	Corrected Conducted Average Power (dBm)	Conducted Power Limit (dBm)	Margin (dB)	Result
Bottom	14.43	7.32	21.75	30.000	8.25	Complied
Middle	14.55	7.32	21.87	30.000	8.13	Complied
Top	14.50	7.32	21.82	30.000	8.18	Complied

De Facto EIRP Results: LoRa / MAX PWR

Channel	Corrected Conducted Peak Power (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
Bottom	21.75	2.00	23.75	36.00	12.25	Complied
Middle	21.87	2.00	23.87	36.00	12.13	Complied
Top	21.82	2.00	23.82	36.00	12.18	Complied

Result: Pass

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

5.2.6. Transmitter Power Spectral Density**Test Summary:**

Test Engineer:	Muhammad Faiq Khan	Test Date:	20 July 2022 & 30 September 2022
Test Sample Serial Number:	BB915002 (Conducted Test Sample)		
Test Site Identification	SR 9		

FCC Reference:	Part 15.247(e)
Test Method Used:	FCC KDB 558074 Section 8.4 referencing ANSI C63.10:2013 Section 11.10.5

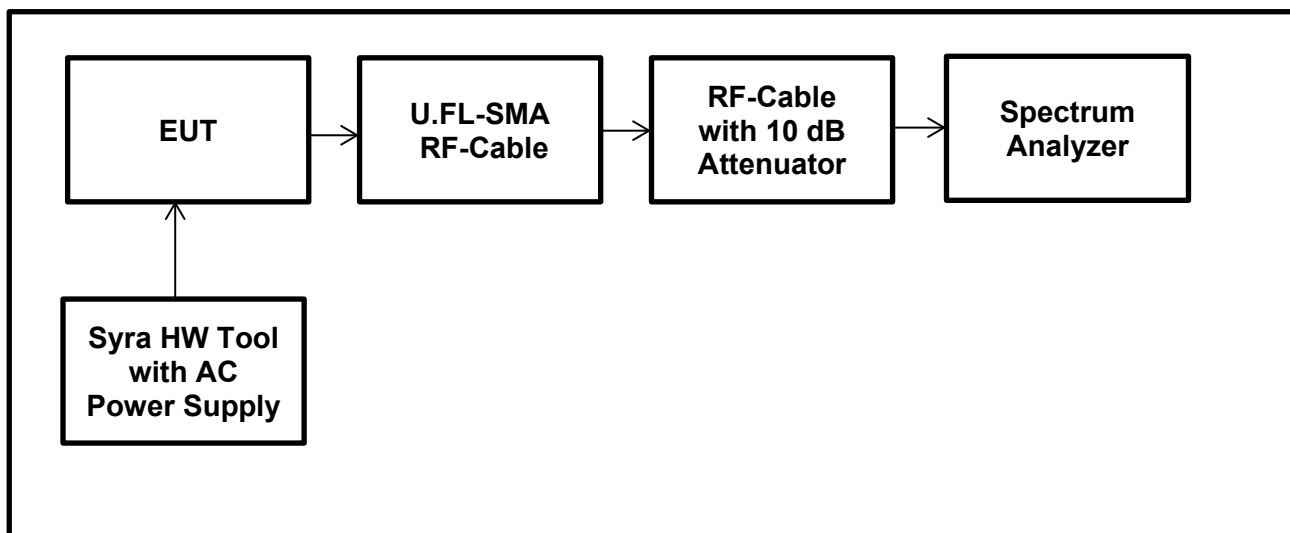
Environmental Conditions:

Temperature (°C):	21.9 to 24.8
Relative Humidity (%):	40.7 to 60.5

Notes:

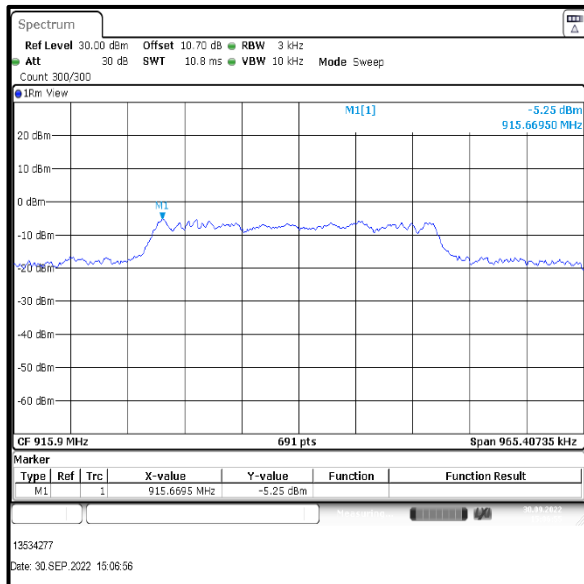
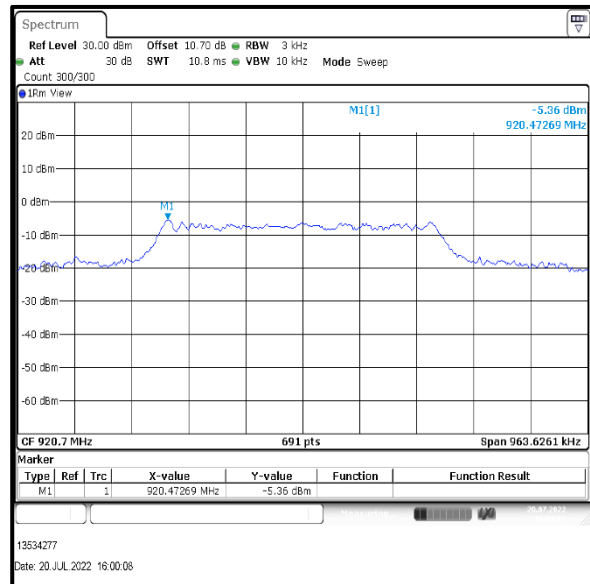
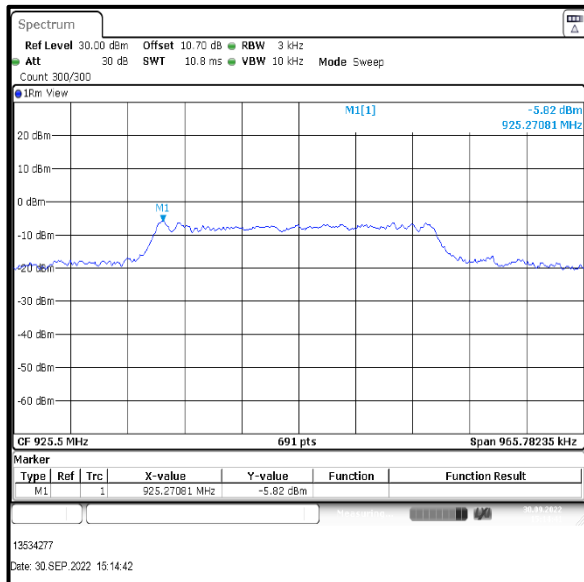
- Transmitter Power Spectral Density tests were performed using a signal analyser in accordance with ANSI C63.10 Section 11.10.5.
- The signal analyser resolution bandwidth was set to 3 kHz and video bandwidth 10 kHz. An RMS detector was used, sweep time was set to auto and trace averaging was performed over 300 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.
- The RF port on the EUT was connected to the spectrum analyser using suitable attenuation and RF cable. The measured values takes into consideration the external attenuation correction factors.
 - The U.FL-SMA (Female) RF Cable with maximum attenuation of 0.3 dB at the tested frequencies.
 - The RF cable attenuation maximum 0.4 dB@ tested frequencies from the EUT to Analyzer including the 10 dB attenuation at the input of Spectrum Analyzer

Therefore, total a reference level offset 10.7 dB was added to each of the at the tested frequencies conducted plots

Test Setup:

Transmitter Number of Hopping Frequencies (continued)**Results : LoRa / MAX PWR**

Channel	PSD (dBm/3kHz)	Duty Cycle Correction Factor (dB)	Corrected PSD (dBm / 3 kHz)	Limit (dBm / 3kHz)	Margin (dB)	Result
Bottom	-5.25	7.32	2.07	8.00	5.93	Complied
Middle	-5.36	7.32	1.96	8.00	6.04	Complied
Top	-5.82	7.32	1.50	8.00	6.50	Complied

**Bottom Channel****Middle Channel****Top Channel****Result: Pass**

5.2.7. Transmitter Radiated Emissions**Test Summary:**

Test Engineer:	Muhammad Faiq Khan	Test Date:	19 September 2022
Test Sample Serial Number:	BB915003 (Radiated Test Sample)		
Test Site Identification	SR 1/2		

FCC Reference:	Parts 15.247(d) & 15.209(a)
Test Method Used:	ANSI C63.10:2013 Sections 6.3 and 6.4
Frequency Range	9 kHz to 30 MHz

Environmental Conditions:

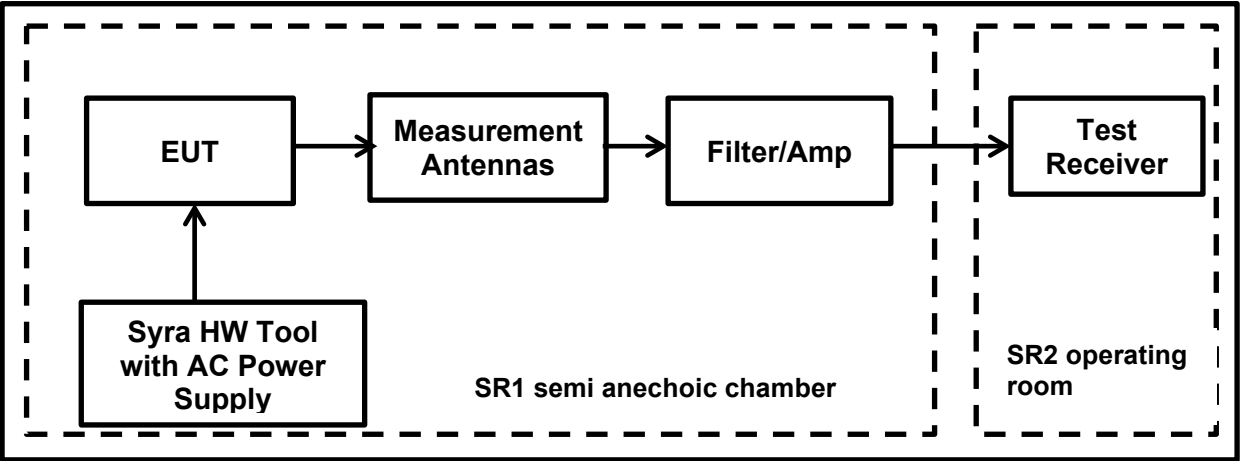
Temperature (°C):	22.0
Relative Humidity (%):	47.0

Note(s):

- In accordance with FCC KDB 414788 D01 Radiated Test Site & ANSI C63.10 clause 5.2 an alternative test site that can demonstrate equivalence to a open area test site may be used. Therefore, the measurement was performed in a Semi Anechoic Chamber. (The OATS / SAC comparison data is available upon request).
- The limits are specified at a test distances of 30 and 300 metres. However, as specified in FCC Section 15.31 (f)(2) & ANSI C63.10 clause 6.4.3, measurements may be performed at a closer distance and the measured level extrapolated to the specified measurement distance using the method described in clauses 6.4.4, specifically sub-clause 6.4.4.1 which specifies that the measured level shall be extrapolated to the specified distance by conservatively presuming that the field strength decays at 40 dB/decade.
Therefore, measurements were performed at a measurement distance of 3 m.
- Therefore, the limit values are extrapolated to a measurement distance of 3 m.
 - 9 kHz- 490 kHz: limits extrapolated from 300 m to 3 m by adding 80 dB at 40 dB /decade.
 - 490 kHz-1705 kHz: limits extrapolated from 30 m to 3 m by adding 40 dB at 40 dB /decade.
- The preliminary scans showed similar emission levels below 30 MHz, for each channel. Therefore, final radiated emissions measurements were performed with the EUT set to the following worst case modes:
 - LoRa / MAX PWR / Middle Channel / DR6
- The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
- Measurements below 30 MHz were performed in a semi-anechoic chamber SR1/ 2 (Asset Number 1603665) at a distance of 3 m. The EUT was placed at a height of 80 cm above the reference ground plane in the centre of the chamber turntable. The measurement loop antenna height was 100 cm.
- Pre-scans were performed and markers placed on the highest measured levels. The test receiver was set to:
 - Frequency range: 9 kHz-150 kHz : RBW: 1 kHz /VBW: 3 kHz
 - Frequency range: 150 kHz – 30 MHz: RBW: 10 kHz /VBW: 30 kHz
 - Detector: Max-Peak detector
 - Trace Mode: Max Hold

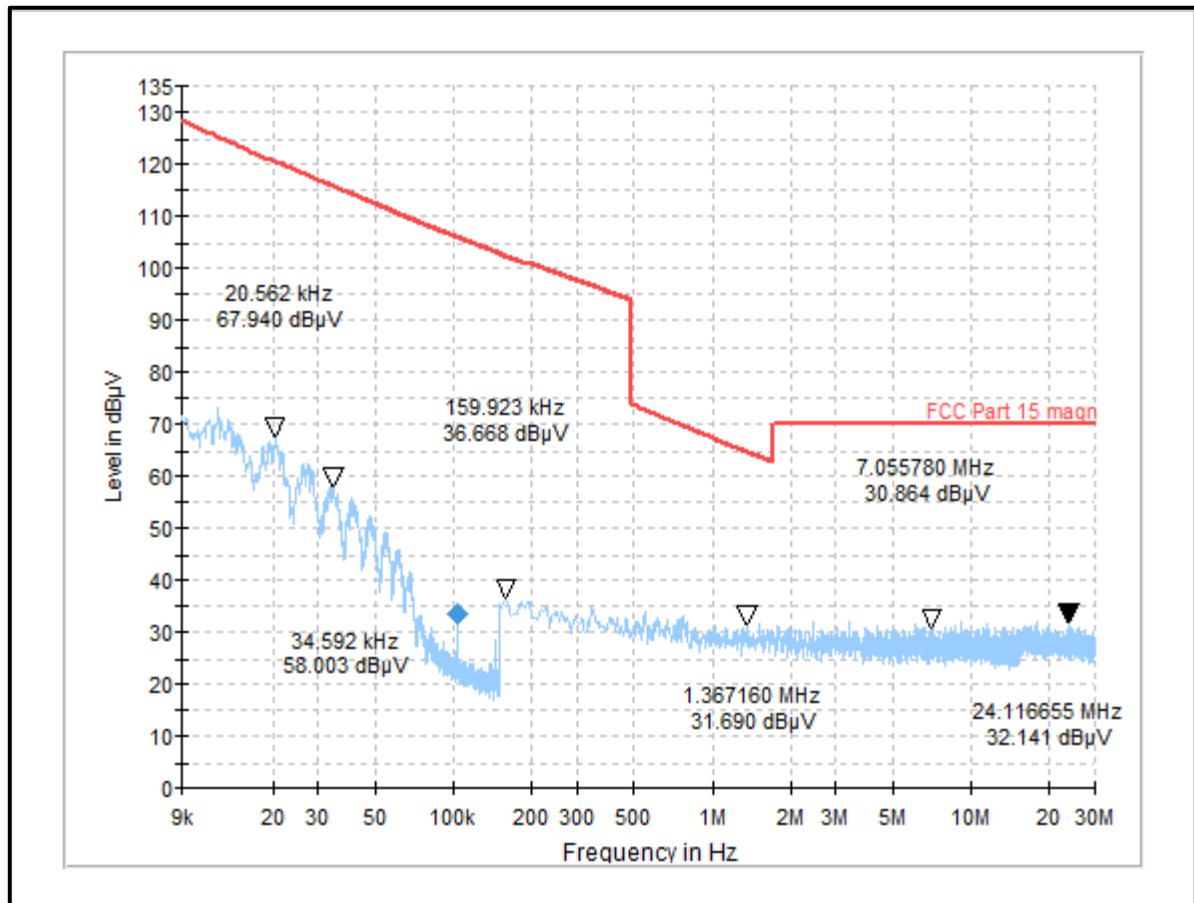
Transmitter Radiated Emissions (continued)

Test Setup:



Transmitter Radiated Emissions (continued)**Results: LoRa / Middle Channel / MAX PWR**

Frequency (MHz)	Loop Antenna orientation	MaxPeak Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
0.104	0° to EUT	33.57	105.96	72.39	Complied

**Result: Pass**

Transmitter Radiated Emissions (continued)**Test Summary:**

Test Engineer:	Muhammad Faiq Khan	Test Date:	09 August 2022
Test Sample Serial Number:	BB915003 (Radiated Test Sample)		
Test Site Identification	SR 1/2		

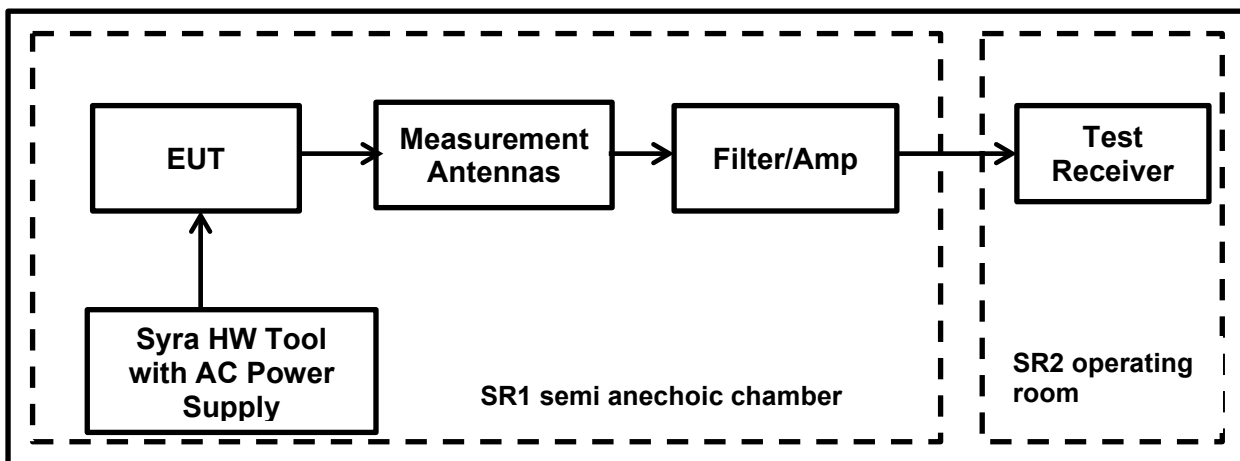
FCC Reference:	Parts 15.247(d) & 15.209(a)
Test Method Used:	ANSI C63.10:2013 Sections 6.3 and 6.5
Frequency Range	30 MHz to 1000 MHz

Environmental Conditions:

Temperature (°C):	22.4
Relative Humidity (%):	49.4

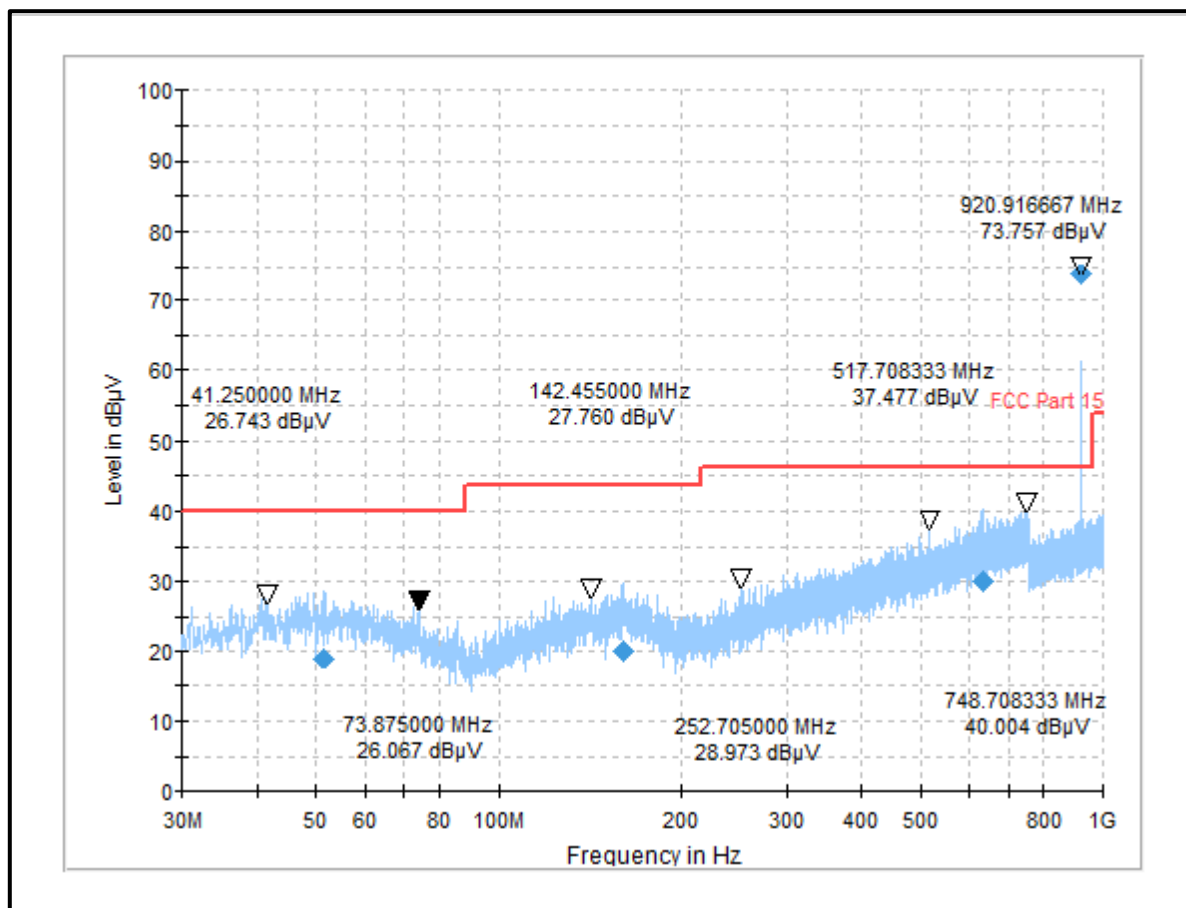
Note(s):

- Measurements below 1 GHz were performed in a semi-anechoic chamber SR1/ 2 (Asset Number 1603665) at a distance of 3 m. 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 m to 4 m.
- The emissions shown at frequencies approximately 915 MHz to 928 MHz on the 30 MHz to 1 GHz plots are the EUT fundamental for the tested channel.
- Pre-scans were performed and markers placed on the highest measured levels. 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 preliminary scans showed similar emission levels below 1 GHz for each channel. Therefore, final radiated emissions measurements were performed with the EUT set to the following worst case modes:
 - LoRa / MAX PWR / Middle Channel / DR6
- The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.

Test Setup:

Transmitter Radiated Emissions (continued)**Results: LoRA / Middle Channel / MAX PWR**

Frequency (MHz)	Antenna Polarization	MaxPeak Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
51.51	Vertical	18.90	40.00	21.10	Complied
161.72	Vertical	20.23	43.50	23.27	Complied
633.33	Horizontal	29.83	46.00	16.17	Complied

**Result: Pass**

Transmitter Radiated Emissions (continued)**Test Summary:**

Test Engineer:	Muhammad Faiq Khan	Test Date:	29 August 2022 & 09 September 2022
Test Sample Serial Number:	BB915003 (Radiated Test Sample)		
Test Site Identification	SR 1/2		

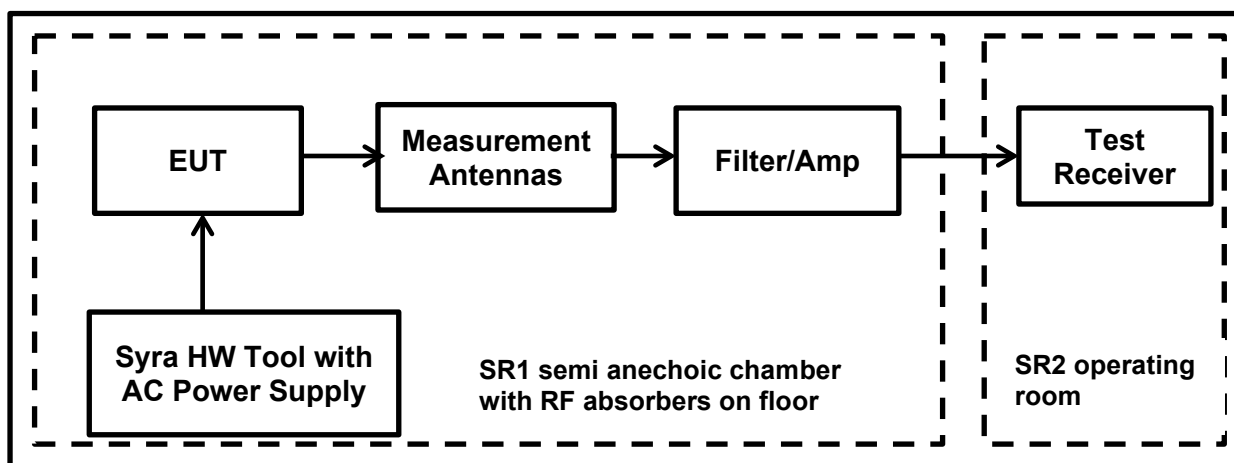
FCC Reference:	Parts 15.247(d) & 15.209(a)
Test Method Used:	ANSI C63.10:2013 Sections 6.3 and 6.6
Frequency Range	1 GHz to 10 GHz

Environmental Conditions:

Temperature (°C):	23.2 & 21.5
Relative Humidity (%):	55.4 & 57.5

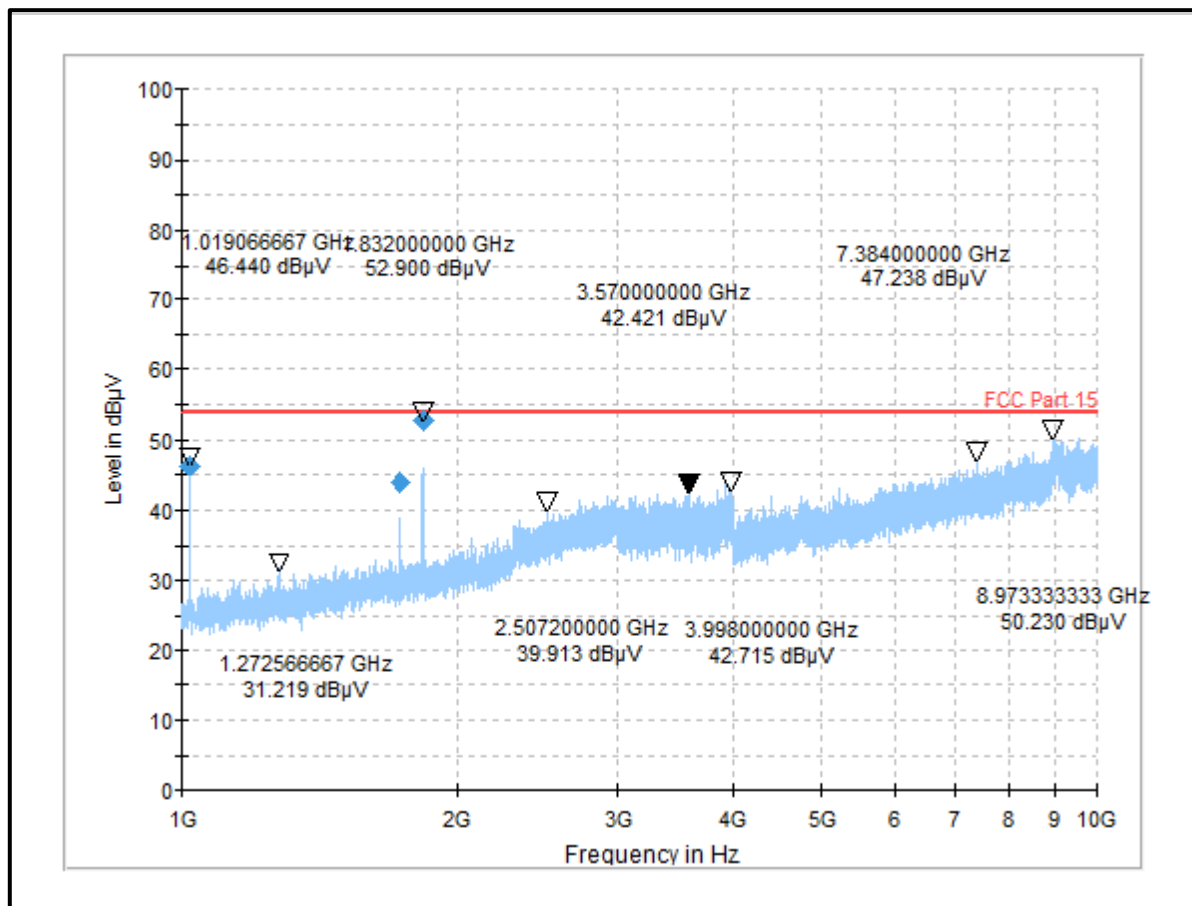
Note(s):

1. Pre-scans above 1 GHz were performed in a semi-anechoic chamber SR1/ 2 (Asset Number 1603665) with RF absorbers on the floor at a distance of 3 m. The EUT was placed at a height of 1.5 m above the test chamber floor in the centre of the chamber turntable. All measurement antennas were placed at a fixed height of 1.5 m above the test chamber floor, in line with the EUT. Final measurements above 1 GHz were performed in a semi-anechoic chamber SR1/ 2 (Asset Number 1603665) with absorber on the floor at a distance of 3 m. 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 m to 4 m.
2. Pre-scans were performed and a marker placed on the highest measured level of the appropriate plot. The test receiver resolution bandwidth was set to 1 MHz and video bandwidth 3 MHz. The sweep time was set to auto.
3. The measurement were performed on Bottom, Middle and Top Channel with following configuration.
 - LoRa / MAX PWR / DR6
4. All emissions shown on the pre-scans were investigated and found to be below the noise floor of the measurement system.

Test Setup:

Transmitter Radiated Emissions (continued)**Results: LoRa / Bottom Channel / MAX PWR**

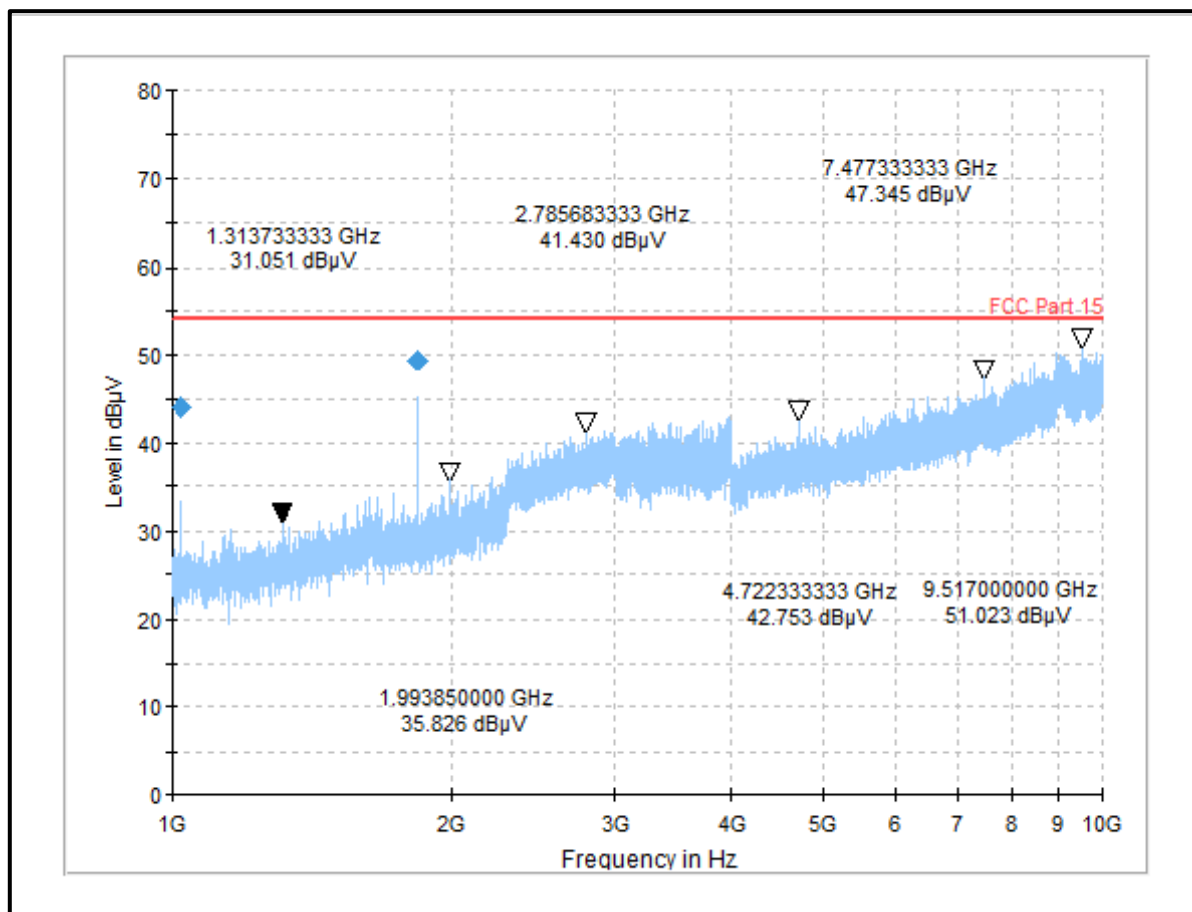
Frequency (MHz)	Antenna Polarization	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
1019.07	Vertical	46.44	54.00	7.56	Complied
1729.08	Vertical	43.79	54.00	10.21	Complied
1832.00	Vertical	52.90	54.00	1.10	Complied



Result: **Pass with measurement uncertainty**

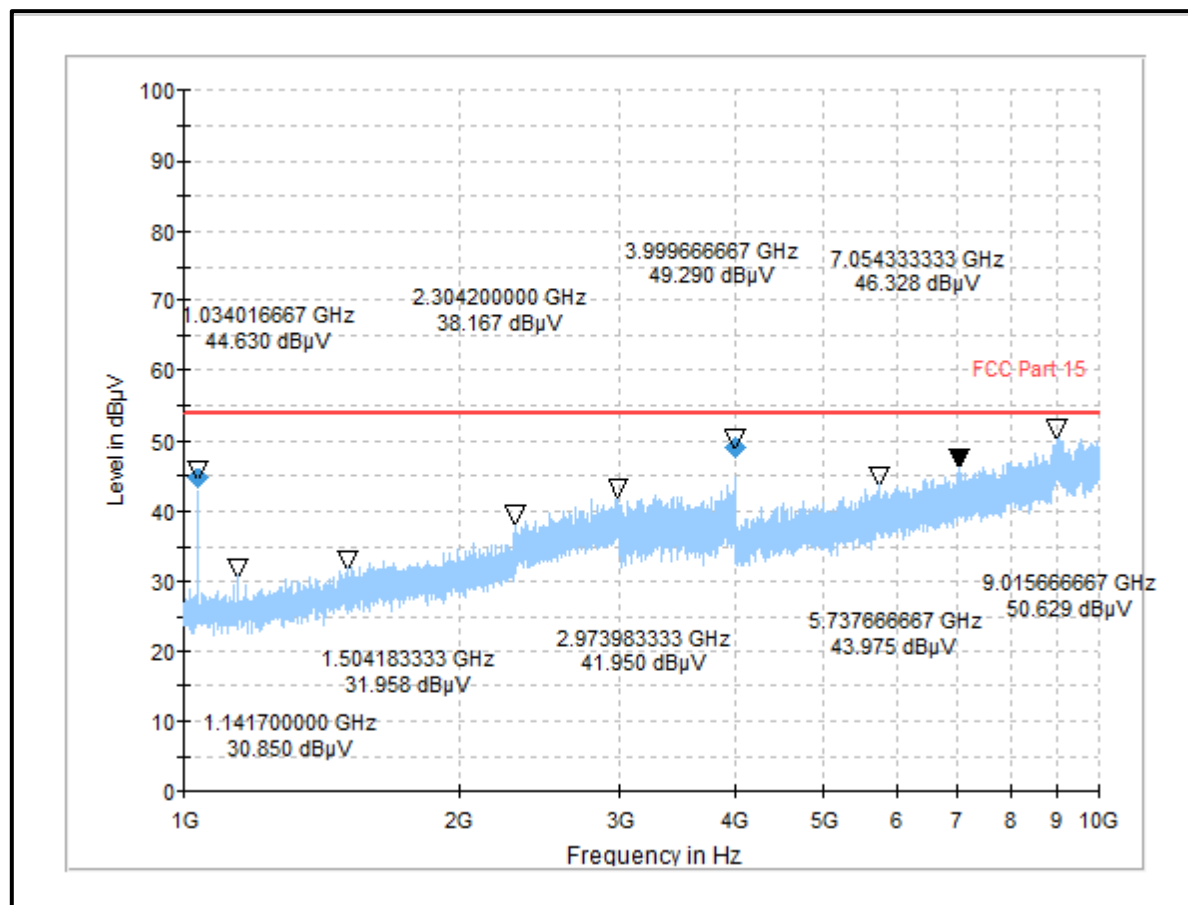
Transmitter Radiated Emissions (continued)**Results: LoRA / Middle Channel / MAX PWR**

Frequency (MHz)	Antenna Polarization	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
1026.87	Horizontal	44.07	54.00	9.93	Complied
1841.32	Vertical	49.32	54.00	4.68	Complied

**Result: Pass**

Transmitter Radiated Emissions (continued)**Results: LoRA / Top Channel / MAX PWR**

Frequency (MHz)	Antenna Polarization	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
1034.017	Horizontal	44.63	54.00	9.37	Complied
3999.667	Vertical	49.29	54.00	4.71	Complied

**Result: Pass**

5.2.8. Transmitter Band Edge Radiated Emissions**Test Summary:**

Test Engineer:	Muhammad Faiq Khan	Test Date:	08 September 2022
Test Sample Serial Number:	BB915003 (Radiated Test Sample)		
Test Site Identification	SR 1/2		

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:

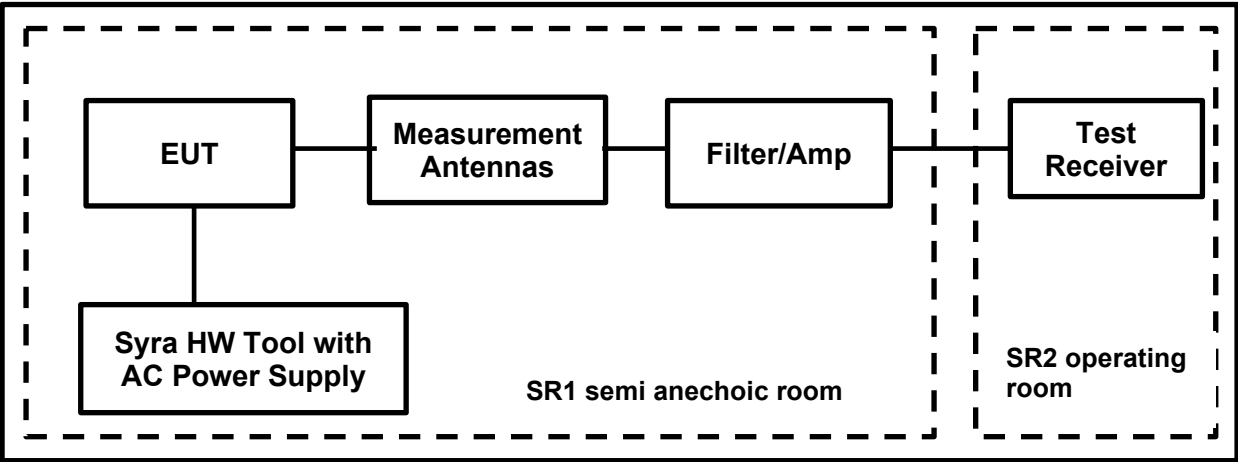
Temperature (°C):	22.5
Relative Humidity (%):	51.1

Note(s):

1. The measurements were in a semi-anechoic chamber SR1/ 2 (Asset Number 1603665) with RF absorbers on the floor at a distance of 3 m. The EUT was placed at a height of 1.5 m above the test chamber floor in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 m to 4 m
2. As both band edges are adjacent to non-restricted bands, only peak measurements are required. In accordance with ANSI C63.10 Section 6.10.4, was followed.
3. As the both band edges falls adjacent to non-restricted band, only peak measurements are required. In accordance with ANSI C63.10 Section 11.11.1, the test method is 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. Marker frequencies and levels were recorded.
4. The maximum conducted output power was previously measured with RMS detector. In accordance with ANSI C63.10 Section 11.9.2.2.4 an out-of-band limit line was placed at 30 dB below the peak level.
5. The final measured value, for the given emission, in the table below incorporates the calibrated

Transmitter Band Edge Radiated Emissions (continued)

Test Setup:

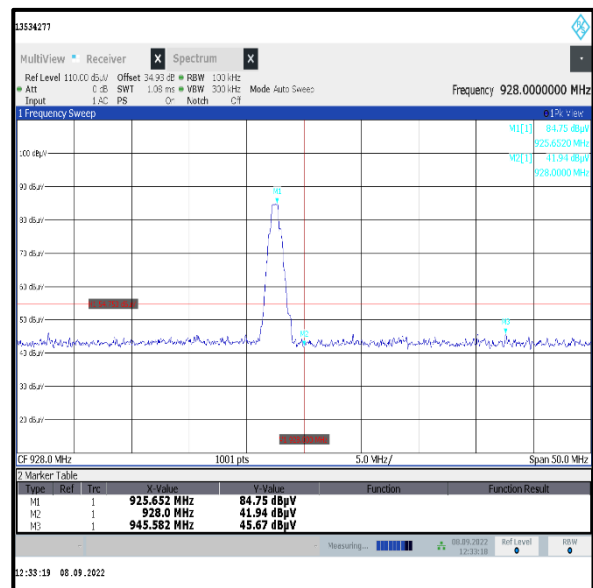


Transmitter Band Edge Radiated Emissions (Continued)**Results: LoRa / MAX PWR****Results: Lower Band Edge / Peak**

Frequency (MHz)	Peak Level (dB μ V/m)	-30 dBc Limit (dB μ V/m)	Margin (dB)	Result
897.25	44.97	49.73	4.76	Complied
902.00	42.40	49.73	7.33	Complied

Results: Upper Band Edge / Peak

Frequency (MHz)	Peak Level (dB μ V/m)	-30 dBc Limit (dB μ V/m)	Margin (dB)	Result
928.00	41.94	54.75	12.81	Complied
945.58	45.67	54.75	9.08	Complied

Plots:**Lower Band Edge Peak Measurement****Upper Band Edge Measurement****Result: Pass**

6. Measurement Uncertainty

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

The uncertainty of the result may need to be taken into account when interpreting the measurement results.

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	Confidence Level (%)	Calculated Uncertainty
Transmitter AC Conducted Emissions	95%	±2.49 dB
Transmitter Duty Cycle	95%	±0.59 dB
Transmitter 99% Occupied Bandwidth	95%	±0.59 dB
Transmitter Minimum 6 dB Bandwidth	95%	±0.59 dB
Transmitter Maximum Output Power	95%	±0.59 dB
Transmitter Power Spectral Density	95%	±0.59 dB
Transmitter Radiated Emissions	95%	±3.10 dB
Transmitter Band Edge Radiated Emissions	95%	±3.10 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.

7. Used equipment

Test site: SR 1/2

ID	Manufacturer	Type	Model	Serial	Calibration Date	Cal. Cycle (months)
1	Rohde & Schwarz	Antenna, Loop	HFH2-Z2	831247/012	10/07/2020	36
377	BONN Elektronik	Amplifier, Low Noise Pre	BLMA 0118-1A	025294B	13/07/2022	12
460	Deisel	Turntable	DT 4250 S	n/a	n/a	n/a
452	Schwarzbeck	Antenna, Trilog Broadband	VULB 9168	9168-240	02/09/2020	36
496	Rohde & Schwarz	Antenna, log. - periodical	HL050	100297	05/08/2020	36
587	Maturo	antenna mast, tilting	TAM 4.0-E	011/7180311	n/a	n/a
588	Maturo	Controller	NCD	029/7180311	n/a	n/a
669	Rohde & Schwarz	EMI Test Receiver	ESW 44	103087	03/02/2022	12
608	Rohde & Schwarz	Switch Matrix	OSP 120	101227	lab verification	n/a
628	Maturo	Antenna mast	CAM 4.0-P	224/19590716	n/a	n/a
629	Maturo	Kippeinrichtung	KE 2.5-R-M	MAT002	n/a	n/a
-/-	Testo	Thermo-Hygrometer	608-H1	01	lab verification	n/a
1603665	Siemens Matsushita Components	semi-anechoic chamber SR1/ 2	-/-	B83117-A1421-T161	n/a	n/a

Test site: SR 9

ID	Manufacturer	Type	Model	Serial	Calibration Date	Cal. Cycle (months)
445	Huber & Suhner	RF Attenuator (10 dB)	6810.17.AC	--	lab verification	12
637	Rohde & Schwarz	Spectrum Analyzer	FSV40	101587	15/07/2022	12
-/-	Huber+Suhner	RF Cable -OSP120-DUT1	ST18/SMAM/SMAM/72	605505	lab verification	n/a
-/-	Testo	Thermo-Hygrometer	608-H1	07	lab verification	n/a
1603668	Siemens Matsushita Components	shielded room	--	B83117-B1422-T161	n/a	n/a

Test site: SR 7/8

ID	Manufacturer	Type	Model	Serial	Calibration Date	Cal. Cycle (months)
23	Rohde & Schwarz	Artificial Mains	ESH3-Z5	831767/013	11/07/2022	12
28	Rohde & Schwarz	Passive Probe	ESH2-Z3	none	12/07/2022	36
349	Rohde & Schwarz	Receiver, EMI Test	ESIB7	836697/009	12/07/2022	12
351	Rohde & Schwarz	network, Artificial Mains	ESH3-Z5	862770/018	11/07/2022	12
564	Teseq	Impedance stabilization network (ISN)	ISN T800	26076	12/07/2021	24
616	Rohde & Schwarz	ISN	ENY81-CA6	101656	07/07/2020	36
-/-	Testo	Thermo-Hygrometer	608-H1	08	lab verification	n/a
327	SPS	AC/DC power distribution system	PAS 5000	A2464 00/1 0200	lab verification	n/a

8. 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-C 61456NCF-915-H-LC
Model Name or Number:	Syra RE-C 61456NCF-915-L-LW
Model Name or Number:	Syra RE-C 61456NCF-915-L-LC
Model Name or Number:	Syra RE-ZC 61556CF-915-LC
Model Name or Number:	Syra RE-ZC 61556CF-915-LW

Note(s):

1. 'L' and 'H' indicate whether a low or high voltage relay is used (120-230V vs 120-277V)
2. 'LC' and 'LW' use the radio LoRa modulation (both using the same LoRa physical layer RF parameters)

9. Report Revision History

Version Number	Revision Details		
	Page No(s)	Clause	Details
1.0	44	-	Initial Version
Test Report Version 1.1 supersede Version 1.0 with immediate effect Test Report No. UL-RPT-RP-13534277-3416-1-V1.1-FCC Version 1.1, Issue Date 05 DECEMBER 2022 replaces Test Report No. UL-RPT-RP-13534277-3416-1-FCC Version 1.0, Issue Date 16 NOVEMBER 2022, which is no longer valid.			
1.1	as below	as below	Current Version
	6	2.2	Summary of test results updated
	8	3.5	Output power updated
	12-17	5.2.1	Transmitter AC conducted measurements repeated with 240VAC 60Hz and notes updated.
	24-26	5.2.5	Transmitter Maximum Output Power measurement repeated.
	27	5.2.6	Notes updated
	38	5.2.8	Notes updated
	-	-	Tested dates, temperature and humidity values updated

--- END OF REPORT ---