



Solutions

TEST REPORT

Test Report No. : UL-RPT-RP-14539865-416-FCC

Applicant * : Eltek S.p.A.
Model No. * : 10129850
FCC ID * : 2BBE8-101298
Technology * : LoRaWAN (902 – 928 MHz)
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-14539865-416-FCC Version 1.1, Issue Date 02 AUGUST 2023 replaces
Test Report No. UL-RPT-RP-14539865-416-FCC Version 1.0, Issue Date 05 JULY 2023, which is no longer valid.
5. Result of the tested sample: **PASS**
6. All information marked with a (*) were provided by customer / applicant or authorized representative

Prepared by: Muhammad Faiq Khan
Title: Project Engineer
Date: 02 August 2023

Approved by: Rachid Acharkaoui
Title: Operations Manager
Date: 02 August 2023



Deutsche
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D-PL-19381-02-00

This laboratory is accredited by DAkkS.
The tests reported herein have been performed in
accordance with its' terms of accreditation.

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Table of Contents

1. Customer Information *	4
1.1.Applicant Information	4
1.2.Manufacturer Information	4
2. Summary of Testing	5
2.1. General Information	5
Applied Standards	5
Location	5
Date information	5
2.2. Summary of Test Results	6
2.3. Methods and Procedures	6
2.4. Deviations from the Test Specification	6
3. Equipment Under Test (EUT)	7
3.1. Identification of Equipment Under Test (EUT) *	7
3.2. Description of EUT *	7
3.3. Modifications Incorporated in the EUT	7
3.4. Additional Information Related to Testing *	8
3.5. Support Equipment	8
A. Support Equipment (In-house)	8
B. Support Equipment (Manufacturer supplied)	8
4. Operation and Monitoring of the EUT during Testing	9
4.1. Operating Modes	9
4.2. Configuration and Peripherals	9
5. Measurements, Examinations and Derived Results	10
5.1. General Comments	10
5.2. Test Results	11
5.2.1. Transmitter Carrier Frequency Separation	11
5.2.2. Transmitter Number of Hopping Frequencies	13
5.2.3. Transmitter Average Time of Occupancy	15
5.2.4. Transmitter 20 dB Bandwidth	17
5.2.5. Transmitter Maximum Peak Output Power	19
5.2.6. Transmitter Radiated Emissions	26
5.2.7. Transmitter Band Edge Radiated Emissions	34
6. Measurement Uncertainty	38
7. Used equipment	39
8. Report Revision History	40

1. Customer Information *

1.1.Applicant Information

Company Name:	Eltek S.p.A.
Company Address:	Strada Valenza 5/A, 15033 Casale Monferrato AL, Italy
Company Phone No.:	+39 0142 335511
Company E-Mail:	e.guaschino@eltekgroup.it
Contact Person:	Mr. Engles Guaschino
Contact E-Mail Address:	e.guaschino@eltekgroup.it
Contact Phone No.:	+39 0142 335511

1.2.Manufacturer Information

Company Name:	Eltek S.p.A.
Company Address:	Strada Valenza 5/A, 15033 Casale Monferrato AL, Italy
Company Phone No.:	+39 0142 335511
Company E-Mail:	e.guaschino@eltekgroup.it
Contact Person:	Mr. Engles Guaschino
Contact E-Mail Address:	e.guaschino@eltekgroup.it
Contact Phone No.:	+39 0142 335511

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:	18 October 2022
EUT arrived:	03 February 2023
Test Dates:	08 February 2023 to 20 July 2023
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 ⁽¹⁾	☐	☐	☐	☒
Part 15.247(a)(1)	Transmitter Carrier Frequency Separation	☒	☐	☐	☐
Part 15.247(a)(1)(i)	Transmitter Number of Hopping Frequencies	☒	☐	☐	☐
Part 15.247(a)(1)(i)	Transmitter Average Time of Occupancy	☒	☐	☐	☐
Part 15.247(a)(1)(i)	Transmitter Minimum 20 dB Bandwidth	☒	☐	☐	☐
Part 15.247(b)(3)	Transmitter Maximum Peak Output Power	☒	☐	☐	☐
Part 15.247(d) /15.209(a)	Transmitter Radiated Emissions	☒	☐	☐	☐
Part 15.247(d) /15.209(a)	Transmitter Band Edge Radiated Emissions	☒	☐	☐	☐
Decision rule: If the decision rule is not included in the applied customer specification or testing standard, the binary statement for simple acceptance, as defined in ILAC G8: 2019 Section 4.2.1, is applied as the decision rule for a pass / fail statement. If the measured value is on the limit, the result is defined as a pass. In this case the risk of a false positive is 50%. For further information regarding risk assessment refer to ILAC G8: 2019.					

Note:

1. The measurement was not performed since the EUT is battery powered device and will not be connected to AC mains.

2.3. Methods and Procedures

Reference:	ANSI C63.10-2013
Title:	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

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:	eWATER BLOCK
Model Name or Number:	10129850
Test Sample Serial Number:	eWB LR0015 (Radiated Test Sample)
Hardware Version Number:	10.1298.50 (main electronic board 13.8001.00)
Firmware Version Number:	104_71
FCC ID:	2BBE8-101298

Brand Name:	eWATER BLOCK
Model Name or Number:	10129850
Test Sample Serial Number:	eWB LR0049 (Conducted Test Sample)
Hardware Version Number:	10.1298.50 (main electronic board 13.8001.00)
Firmware Version Number:	104_71
FCC ID:	2BBE8-101298

3.2. Description of EUT *

The equipment under test was an anti-flooding system based on electromagnetic flow sensing technology with Model Nr: 10129850, supporting LoraWAN technology in the 902MHz – 928 MHz range.

3.3. Modifications Incorporated in the EUT

No modifications were applied to the EUT during testing.

3.4. Additional Information Related to Testing *

Tested Technology:	LoRaWAN	
FCC Equipment Classification:	Frequency Hopping Spread System (FHSS)	
Type of Unit:	Transceiver (Mobile)	
Power Supply Requirement:	Nominal	3.6V DC
Power Supply Type(s):	Internal Battery	
Channel Spacing:	199.7 kHz	
Time of occupancy at each channel:	347.8 ms	
Modulation:	LoRa	
Measured Maximum Conducted Output Power:	11.83	
Antenna Gain:	1 dBi	
Antenna Type:	Omnidirectional flexible Antenna with Cable	
Antenna Details :	Molex 2111400100	
Transmit Frequency Range:	902 MHz to 915 MHz	
Number of Channels:	64	
Transmit Channels Tested:	Channel ID	Channel Frequency (MHz)
	Bottom	902.30
	Middle	908.50
	Top	914.90
Highest Frequency Generated:	915 MHz (oscillator frequency for RF application) 32 MHz (oscillator frequency for internal functionality e.g. bus/CPU clock etc)	

3.5. 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 with Test software: "Validation tool for eWB LoRa"	HP	ProBook 650	5CG6143YWB
2	Programming cable USB - C	N/A	N/A	N/A

B. Support Equipment (Manufacturer supplied)

Item	Description	Brand Name	Model Name or Number	Serial Number
1	Antenna cable UFL to SMA	N/A	N/A	N/A

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 Fixed Channel Frequency Mode (Hopping OFF) with Modulated Carrier.
 - Maximum Power: PWR 14
 - Test Channels: Bottom / Middle / Top
 - Data Rates: SF 7- 12 (7, 8, 9, 10, 11, 12)
- ☒ Continuous Transmitting Hopping Frequency Mode (Hopping ON) with Modulated Carrier.
 - Maximum Power: PWR 14
 - Data Rates: SF12*

*) According to max output power, SF12 was the worst-case.

4.2. Configuration and Peripherals

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

EUT Power supply:

- Normally powered from a 3.6 V DC internal battery.

Test Mode Activation:

- Customer supplied test instructions
'UL_Radio_test__Instruction_for_samples_preparation_and_sw_tool_for_eWB_LoRa_rev_1.pdf',
Rev 1.0, Issue Date 25 January 2023 were used to activate test modes.
- The EUT can be connected with the Test Laptop via a USB-C cable, the software "Validation tool for eWB LoRa - Rel1.01" from customer was used to configure it into respective fixed transmit and frequency hopping modes.
- The USB-C cable was removed after the configuration.

Conducted Measurements:

- All conducted measurements were carried out by using the conducted samples with U.FL connector. The U.FL connector was then connected with a SMA to U.FL RF cable with an attenuation of 0.2 dB @ 900 MHz.

Radiated Measurements:

- In accordance with ANSI C63.10 section 5.10.7, emission tests shall be performed with the EUT and accessories configured in a manner that tends to produce maximum emissions; therefore the EUT radiated samples with fully charged internal battery were used for radiated spurious emission & radiated band edge measurements.
- Before starting final radiated measurements "worst case verification" with the EUT in Standing, Laying- and tilting position was performed by Lab.
- The EUT in Standing position vertically was found to be the worst case therefore this report includes relevant results.
- The 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 to 80 cm.
- The radiated measurements above 30 MHz were performed with the EUT positioned on the turn table and rotating 360 degrees while the antenna height varies from 1 to 4 m over the measurement frequency range.
- R&S® EMC32 V11.30.00 Software was used for the Radiated spurious emission measurements.

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 Carrier Frequency Separation

Test Summary:

Test Engineer:	Muhammad Faiq Khan	Test Date:	20 February 2023
Test Sample Serial Number:	eWB LR0049 (Conducted Test Sample)		
Test Site Identification	SR 9		

FCC Reference:	Part 15.247(a)(1)
Test Method Used:	ANSI C63.10:2013 Section 7.8.2

Environmental Conditions:

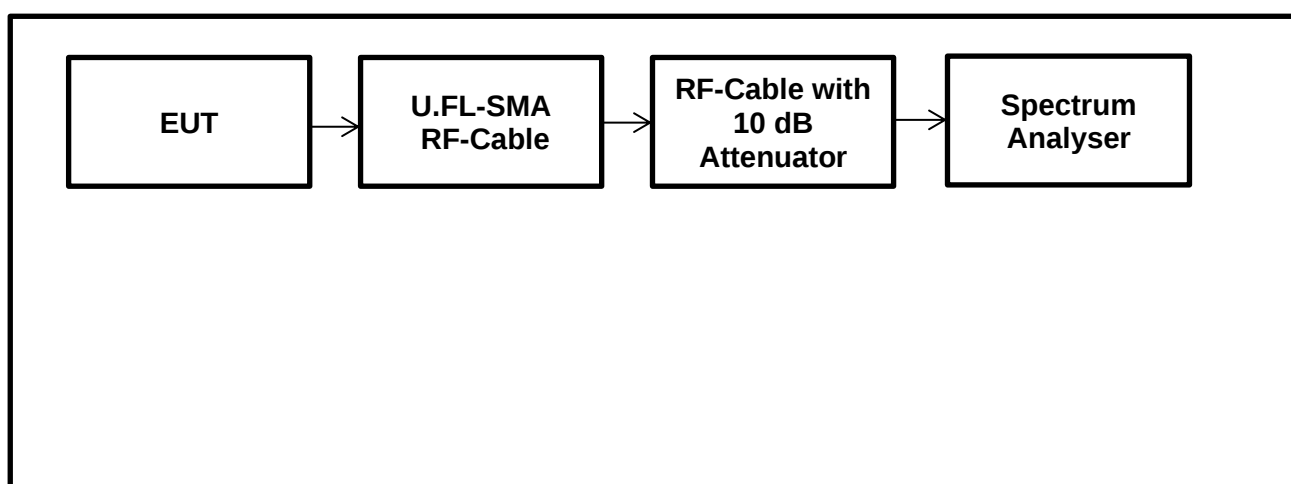
Temperature (°C):	22.3
Relative Humidity (%):	41.9

Notes:

1. The measurement was performed with the EUT set in hopping mode
2. The spectrum 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. Two markers were set on adjacent channels and the difference was calculated.
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 SMA (Female) RF Cable with maximum attenuation of 0.2 dB at the tested frequencies.
 - The RF cable attenuation maximum 0.2 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 10.40 dB was added to each of the at the tested frequencies conducted plots.

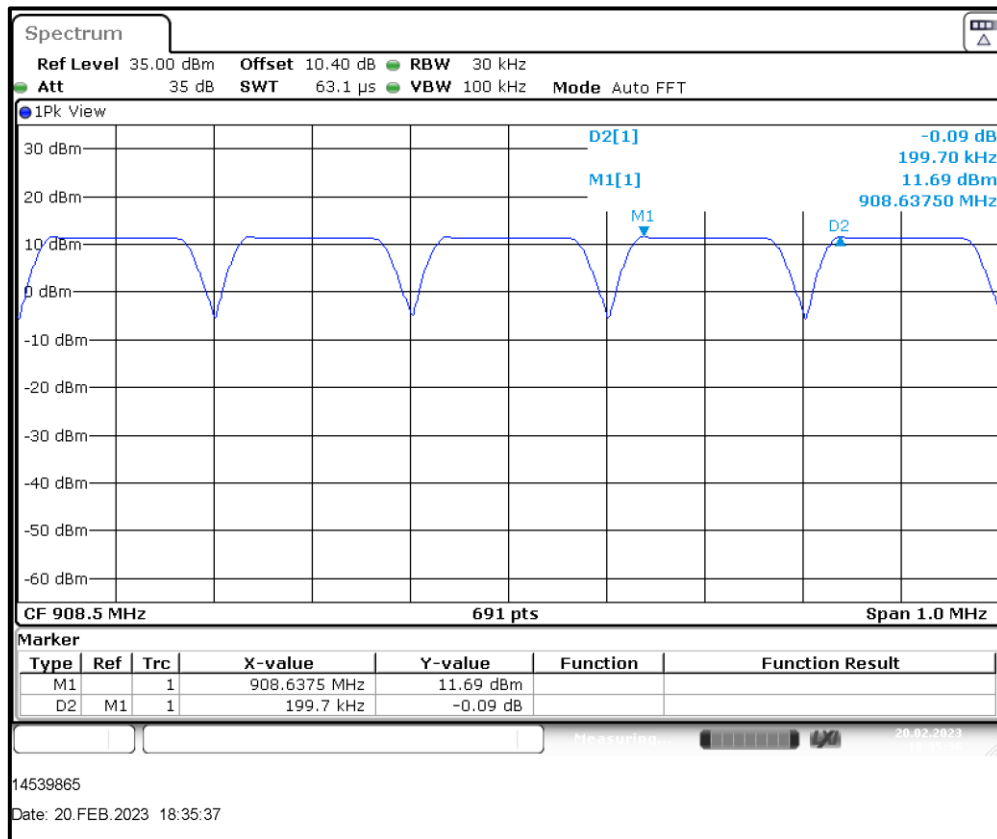
Test Setup :



Transmitter Carrier Frequency Separation (continued)

Results: LoRa / Hopping mode / PWR 14 / SF12

Carrier Frequency Separation (kHz)	Limit (20 dB BW) (kHz)	Margin (kHz)	Result
199.70	≥ 135.46	64.24	Complied



5.2.2. Transmitter Number of Hopping Frequencies

Test Summary:

Test Engineer:	Muhammad Faiq Khan	Test Date:	20 February 2023
Test Sample Serial Number:	eWB LR0049 (Conducted Test Sample)		
Test Site Identification	SR 9		

FCC Reference:	Part 15.247(a)(1)(i)
Test Method Used:	ANSI C63.10:2013 Section 7.8.3

Environmental Conditions:

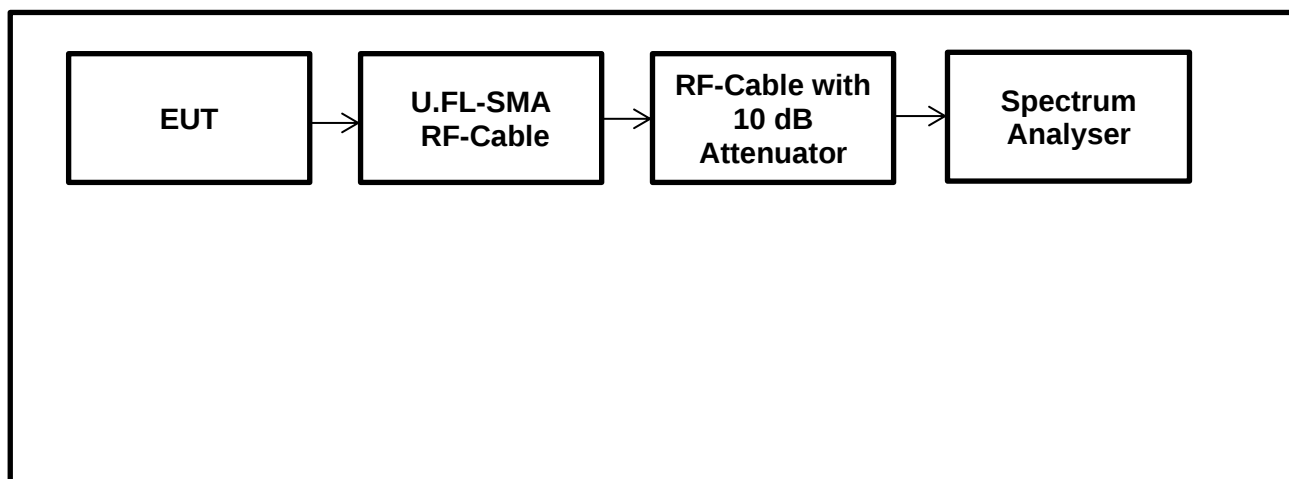
Temperature (°C):	22.3
Relative Humidity (%):	41.9

Notes:

1. The measurement was performed with the EUT set in hopping mode
2. The spectrum 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 number of hopping channels were counted in the complete transmitting band.
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 SMA (Female) RF Cable with maximum attenuation of 0.2 dB at the tested frequencies.
 - The RF cable attenuation maximum 0.2 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 10.40 dB was added to each of the at the tested frequencies conducted plots.

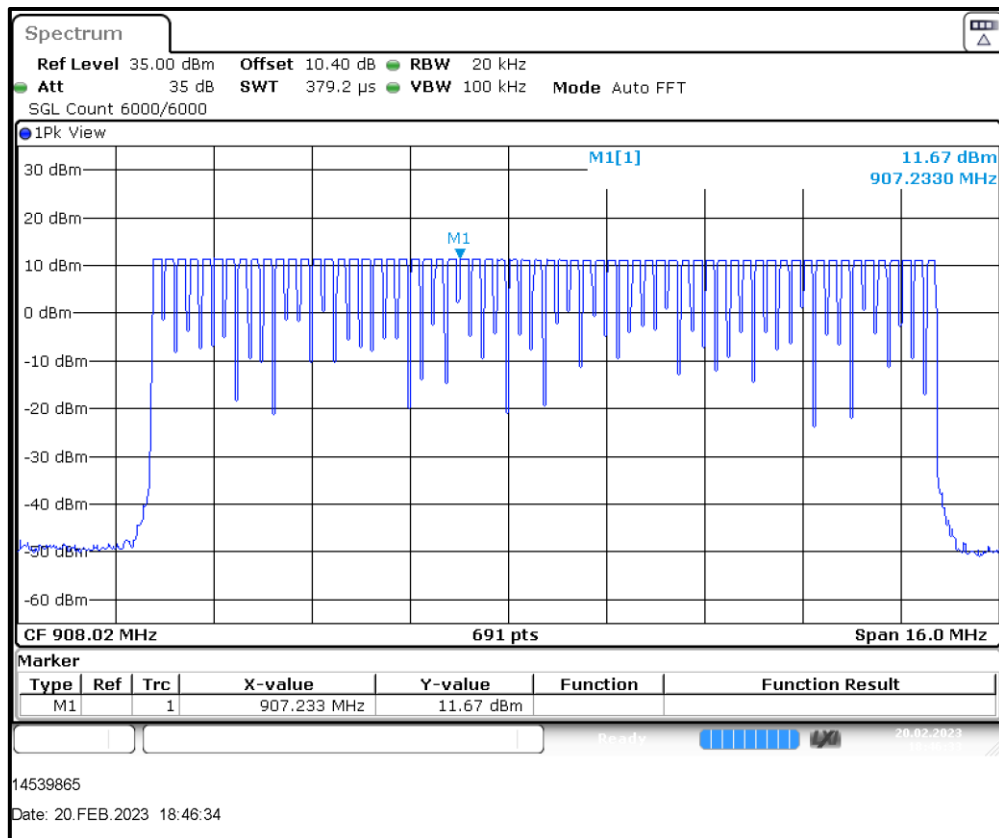
Test Setup :



Transmitter Number of Hopping Frequencies (continued)

Results: LoRa / Hopping mode / PWR 14 / SF12

Measured Number of Hopping Frequencies	Limit	Margin	Result
64	≥ 50	14	Complied



5.2.3. Transmitter Average Time of Occupancy

Test Summary:

Test Engineer:	Muhammad Faiq Khan	Test Date:	20 July 2023
Test Sample Serial Number:	eWB LR0049 (Conducted Test Sample)		
Test Site Identification	SR 9		

FCC Reference:	Part 15.247(a)(1)(i)
Test Method Used:	ANSI C63.10:2013 Section 7.8.4

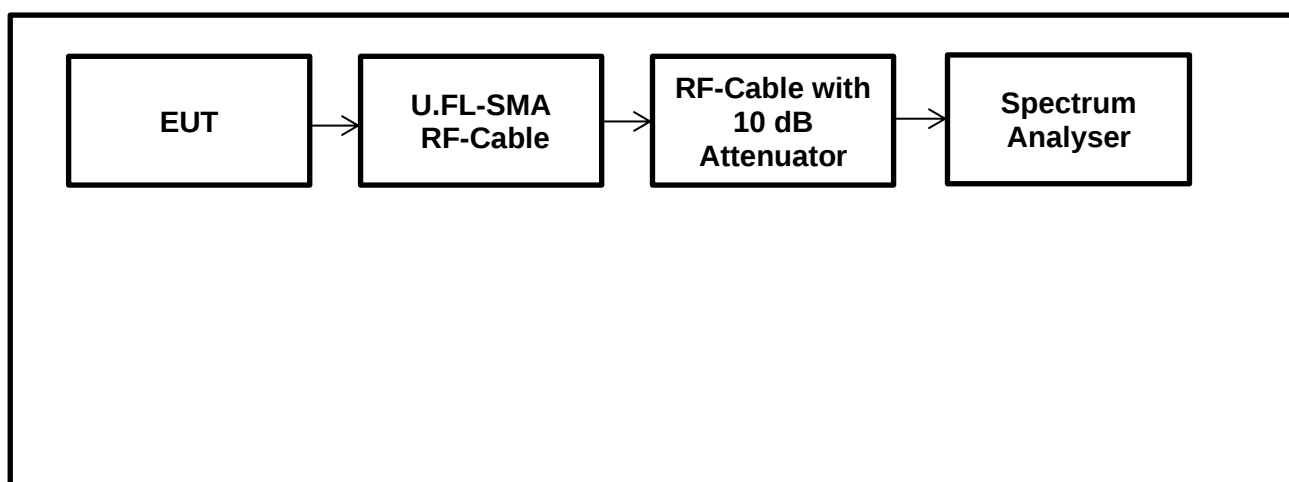
Environmental Conditions:

Temperature (°C):	21.7
Relative Humidity (%):	48.1

Notes:

1. The measurement was performed with the EUT set in hopping mode
2. The spectrum analyser resolution bandwidth was set to 100 kHz and video bandwidth 300 kHz. A peak detector was used, with a span of zero Hz, sweep time was set to 1s to measure the pulse width and the trace mode was Max Hold. Two markers were set on rising and falling edge and the difference was calculated as Emission Width.
3. In the second step the sweep time was set to 20s to calculate the Number of Hops in 20 Seconds time period.
4. The total average time of occupancy was then calculated by multiplying the Emission Width with the Number of Hops in 20 S time period.
5. The measurements were performed with the EUT set to the following worst case mode:
 - LoRa / PWR 14 / SF12

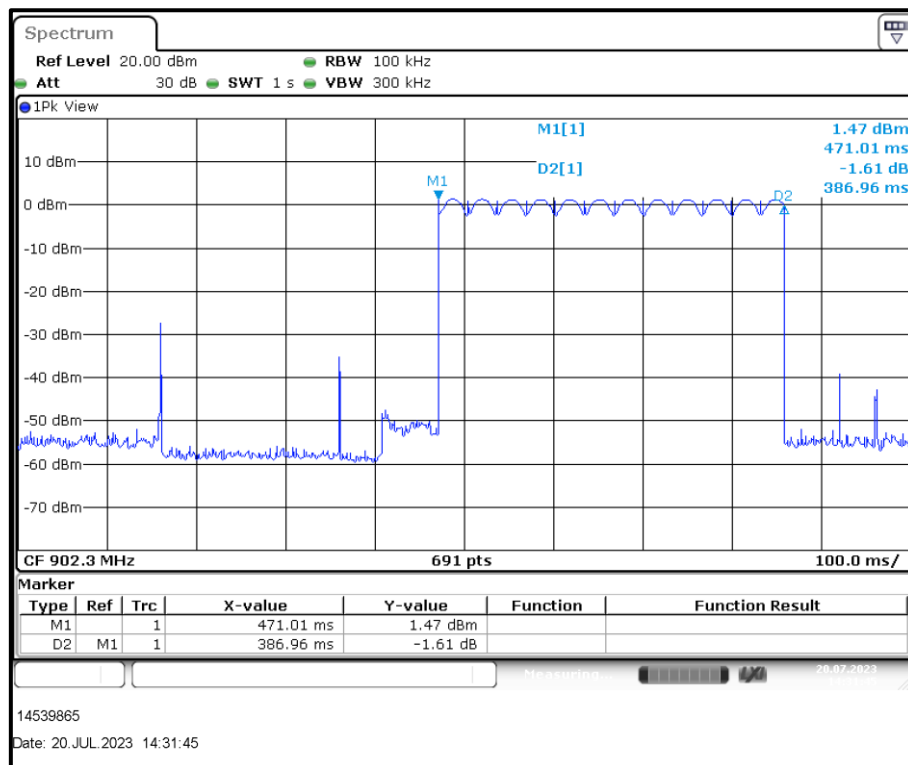
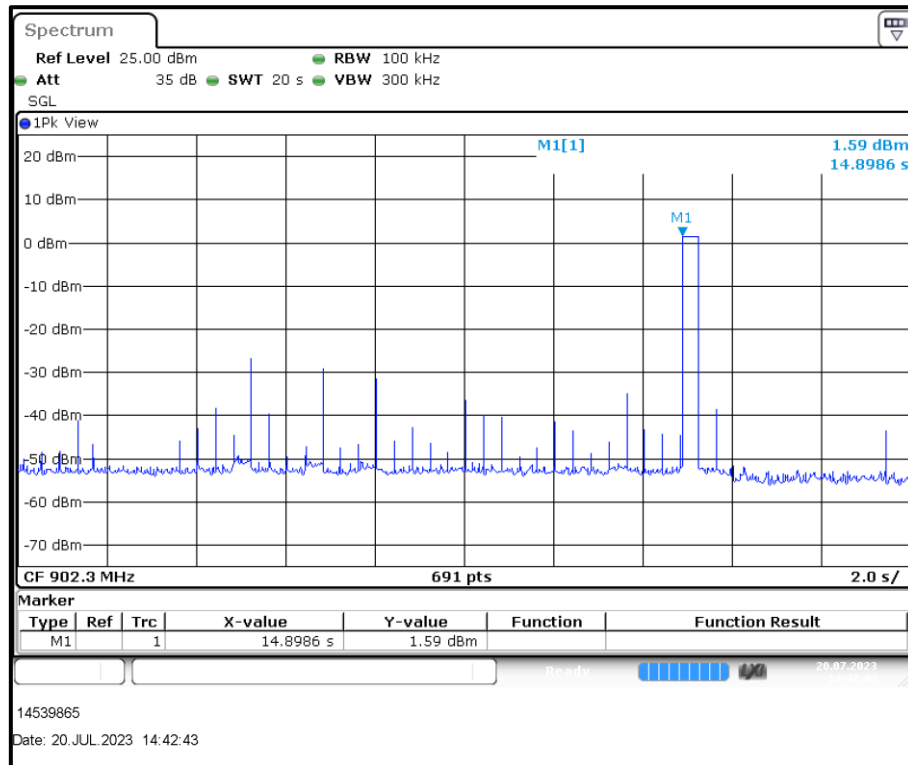
Test Setup :



Transmitter Average Time of Occupancy (continued)

Results: LoRa / Hopping mode / PWR 14 / SF12

Emission width (T _{ON}) (ms)	Number of Hops in 20s	Average Time of Occupancy (s)	Limit (s)	Margin (s)	Result
386.96	1	0.38696	0.4	0.01304	Complied



5.2.4. Transmitter 20 dB Bandwidth

Test Summary:

Test Engineer:	Muhammad Faiq Khan	Test Date:	20 July 2023
Test Sample Serial Number:	eWB LR0049 (Conducted Test Sample)		
Test Site Identification:	SR 9		

FCC Reference:	Part 15.247(a)(1)(i)
Test Method Used:	ANSI C63.10:2013 Section 7.8.7 referencing Section 6.9.2

Environmental Conditions:

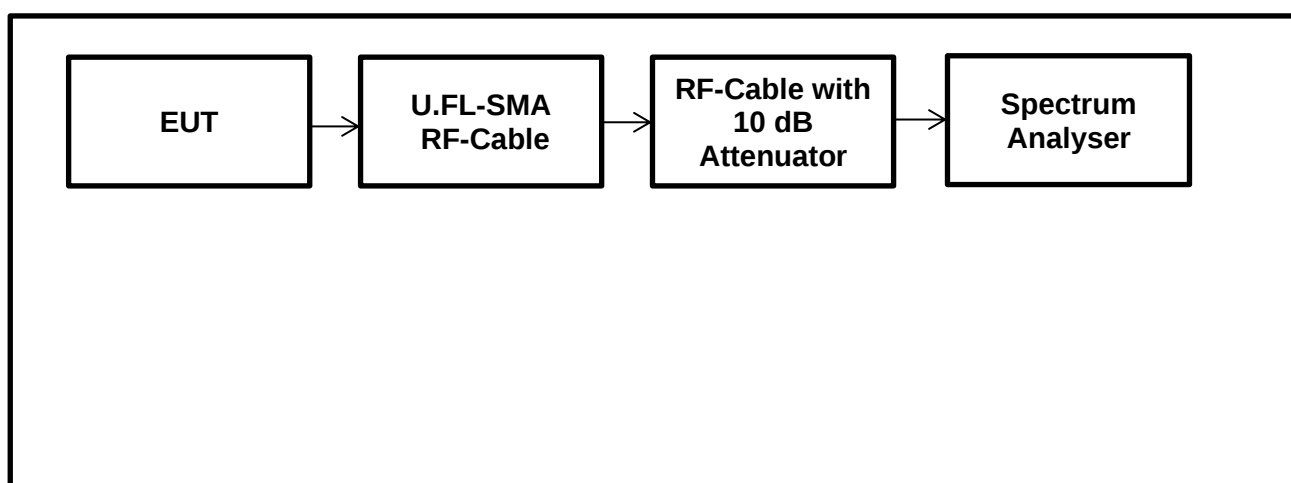
Temperature (°C):	21.7
Relative Humidity (%):	48.1

Notes:

1. The spectrum analyser resolution bandwidth was set to 2 kHz and video bandwidth 10 kHz. A peak detector was used, sweep time was set to auto and the trace mode was Max Hold. The bandwidth was measured at 20 dB down from the peak of the signal.
2. The measurements were performed with the EUT set to the following worst case mode:
 - LoRa / PWR 14 / SF12
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 SMA (Female) RF Cable with maximum attenuation of 0.2 dB at the tested frequencies.
 - The RF cable attenuation maximum 0.2 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 10.40 dB was added to each of the at the tested frequencies conducted plots.

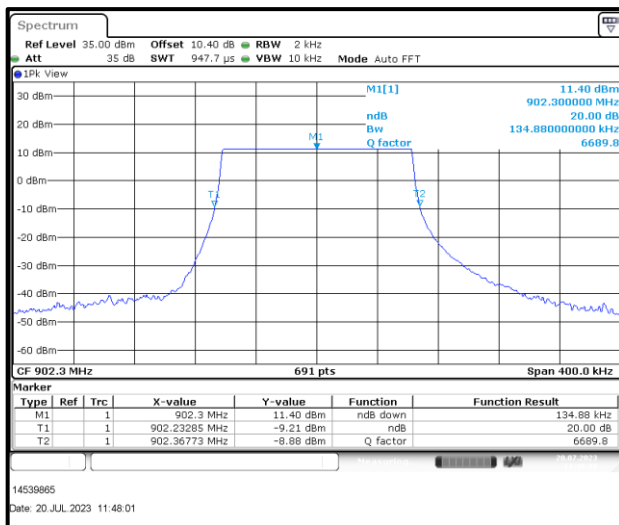
Test Setup :



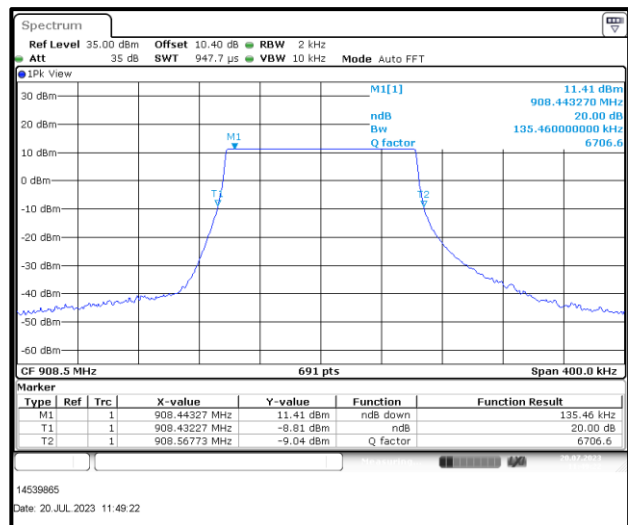
Transmitter Minimum 20 dB Bandwidth (continued)

Results: LoRa / TX / PWR 14 / SF12

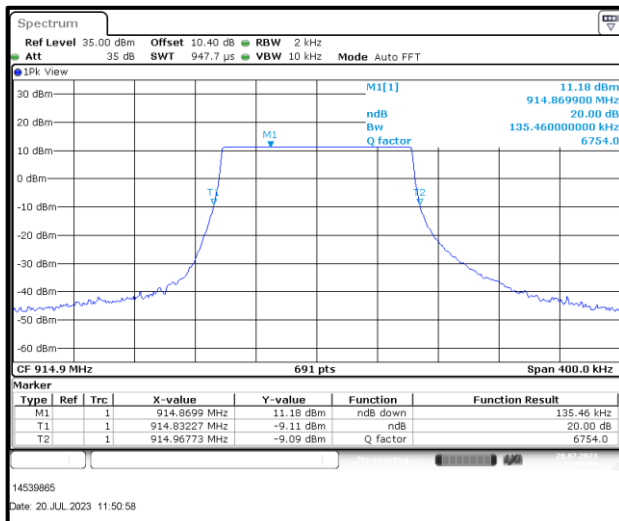
Channel	20 dB Bandwidth (kHz)	Limit (kHz)	Margin (kHz)	Result
Bottom	134.880	≤ 250	115.120	Complied
Middle	135.460	≤ 250	114.540	Complied
Top	135.460	≤ 250	114.540	Complied



Bottom Channel



Middle Channel



Top Channel

Result: **Pass**

5.2.5. Transmitter Maximum Peak Output Power

Test Summary:

Test Engineer:	Muhammad Faiq Khan	Test Date:	20 July 2023
Test Sample Serial Number:	eWB LR0049 (Conducted Test Sample)		
Test Site Identification	SR 9		

FCC Reference:	Part 15.247(b)(3)
Test Method Used:	ANSI C63.10:2013 Section 7.8.5

Environmental Conditions:

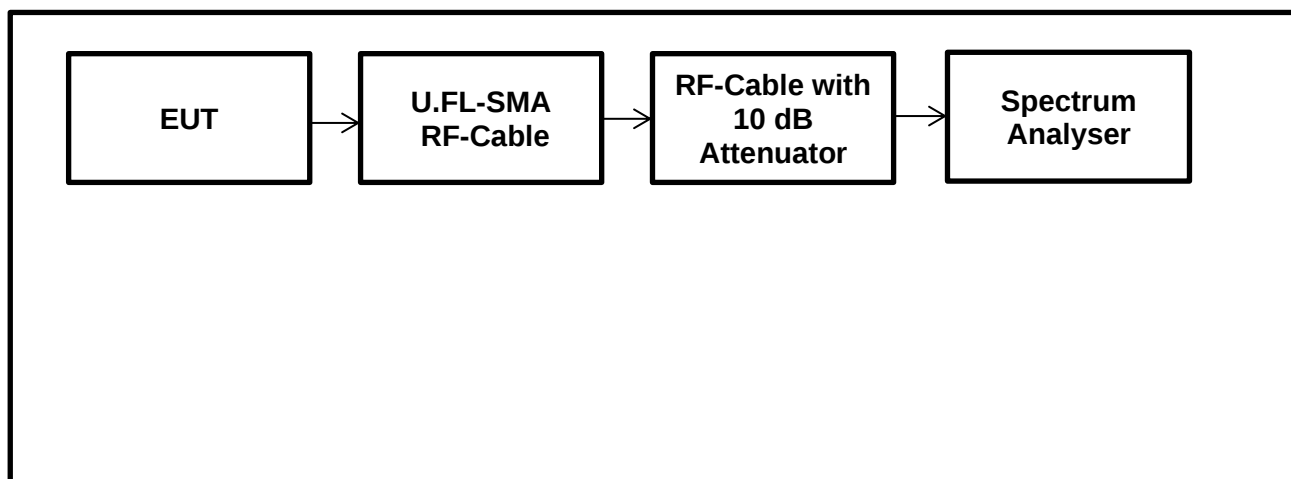
Temperature (°C):	21.7
Relative Humidity (%):	48.1

Notes:

1. The test receiver resolution bandwidth was set to 200 kHz and video bandwidth of 1 MHz. A peak detector was used, sweep time was set to auto and trace mode was Max Hold. The span was set to . 677.3 kHz (5 times the 20 dB BW). A marker was placed at the peak of the signal and the results recorded in the tables below.
2. 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 SMA (Female) RF Cable with maximum attenuation of 0.2 dB at the tested frequencies.
 - The RF cable attenuation maximum 0.2 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 10.40 dB was added to each of the at the tested frequencies conducted plots. The declared antenna gains were added to conducted power to obtain the EIRP.

Test Setup :



Transmitter Maximum Peak Output Power (continued)

Results: LoRa / TX / PWR 14 / SF7

Channel	Conducted Peak Power (dBm)	Conducted Power Limit (dBm)	Margin (dB)	Result
Bottom	11.76	30.00	18.24	Complied
Middle	11.71	30.00	18.29	Complied
Top	11.61	30.00	18.39	Complied

De Facto EIRP Results: LoRa / TX / PWR 14 / SF7

Channel	Conducted Peak Power (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
Bottom	11.76	1	12.76	36.00	23.24	Complied
Middle	11.71	1	12.71	36.00	23.29	Complied
Top	11.61	1	12.61	36.00	23.39	Complied

Result: **Pass**

Transmitter Maximum Peak Output Power (continued)

Results: LoRa / TX / PWR 14 / SF8

Channel	Conducted Peak Power (dBm)	Conducted Power Limit (dBm)	Margin (dB)	Result
Bottom	11.79	30.00	18.21	Complied
Middle	11.68	30.00	18.32	Complied
Top	11.62	30.00	18.38	Complied

De Facto EIRP Results: LoRa / TX / PWR 14 / SF8

Channel	Conducted Peak Power (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
Bottom	11.79	1	12.79	36.00	23.21	Complied
Middle	11.68	1	12.68	36.00	23.32	Complied
Top	11.62	1	12.62	36.00	23.38	Complied

Result: **Pass**

Transmitter Maximum Peak Output Power (continued)

Results: LoRa / TX / PWR 14 / SF9

Channel	Conducted Peak Power (dBm)	Conducted Power Limit (dBm)	Margin (dB)	Result
Bottom	11.79	30.00	18.21	Complied
Middle	11.68	30.00	18.32	Complied
Top	11.61	30.00	18.39	Complied

De Facto EIRP Results: LoRa / TX / PWR 14 / SF9

Channel	Conducted Peak Power (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
Bottom	11.79	1	12.79	36.00	23.21	Complied
Middle	11.68	1	12.68	36.00	23.32	Complied
Top	11.61	1	12.61	36.00	23.39	Complied

Result: **Pass**

Transmitter Maximum Peak Output Power (continued)

Results: LoRa / TX / PWR 14 / SF10

Channel	Conducted Peak Power (dBm)	Conducted Power Limit (dBm)	Margin (dB)	Result
Bottom	11.79	30.00	18.21	Complied
Middle	11.68	30.00	18.32	Complied
Top	11.60	30.00	18.40	Complied

De Facto EIRP Results: LoRa / TX / PWR 14 / SF9

Channel	Conducted Peak Power (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
Bottom	11.79	1	12.79	36.00	23.21	Complied
Middle	11.68	1	12.68	36.00	23.32	Complied
Top	11.60	1	12.60	36.00	23.40	Complied

Result: **Pass**

Transmitter Maximum Peak Output Power (continued)

Results: LoRa / TX / PWR 14 / SF11

Channel	Conducted Peak Power (dBm)	Conducted Power Limit (dBm)	Margin (dB)	Result
Bottom	11.79	30.00	18.21	Complied
Middle	11.68	30.00	18.32	Complied
Top	11.60	30.00	18.40	Complied

De Facto EIRP Results: LoRa / TX / PWR 14 / SF11

Channel	Conducted Peak Power (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
Bottom	11.79	1	12.79	36.00	23.21	Complied
Middle	11.68	1	12.68	36.00	23.32	Complied
Top	11.60	1	12.60	36.00	23.40	Complied

Result: **Pass**

Transmitter Maximum Peak Output Power (continued)

Results: LoRa / TX / PWR 14 / SF12

Channel	Conducted Peak Power (dBm)	Conducted Power Limit (dBm)	Margin (dB)	Result
Bottom	11.83	30.00	18.17	Complied
Middle	11.68	30.00	18.32	Complied
Top	11.57	30.00	18.43	Complied

De Facto EIRP Results: LoRa / TX / PWR 14 / SF12

Channel	Conducted Peak Power (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
Bottom	11.83	1	12.83	36.00	23.17	Complied
Middle	11.68	1	12.68	36.00	23.32	Complied
Top	11.57	1	12.57	36.00	23.43	Complied

Result: **Pass**

5.2.6. Transmitter Radiated Emissions

Test Summary:

Test Engineer:	Muhammad Faiq Khan	Test Date:	16 February 2023
Test Sample Serial Number:	eWB LR0015 (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:

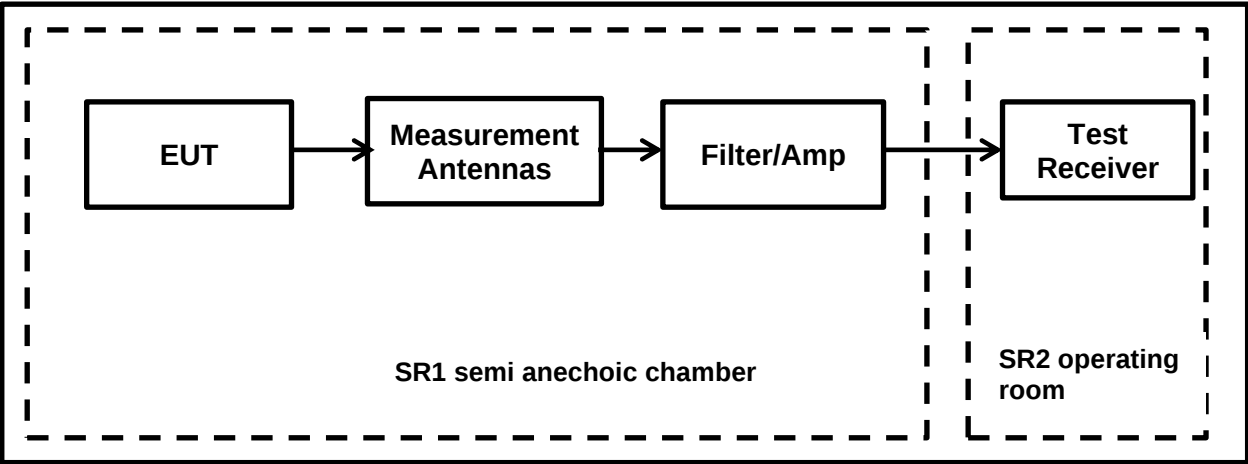
Temperature (°C):	21
Relative Humidity (%):	38

Note(s):

1. 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).
2. 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.
3. 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.
4. The radiated emission measurements were performed with the EUT set to the following worst case mode:
 - LoRa / PWR 14 / Bottom Channel / SF12
5. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
6. 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.
7. 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:

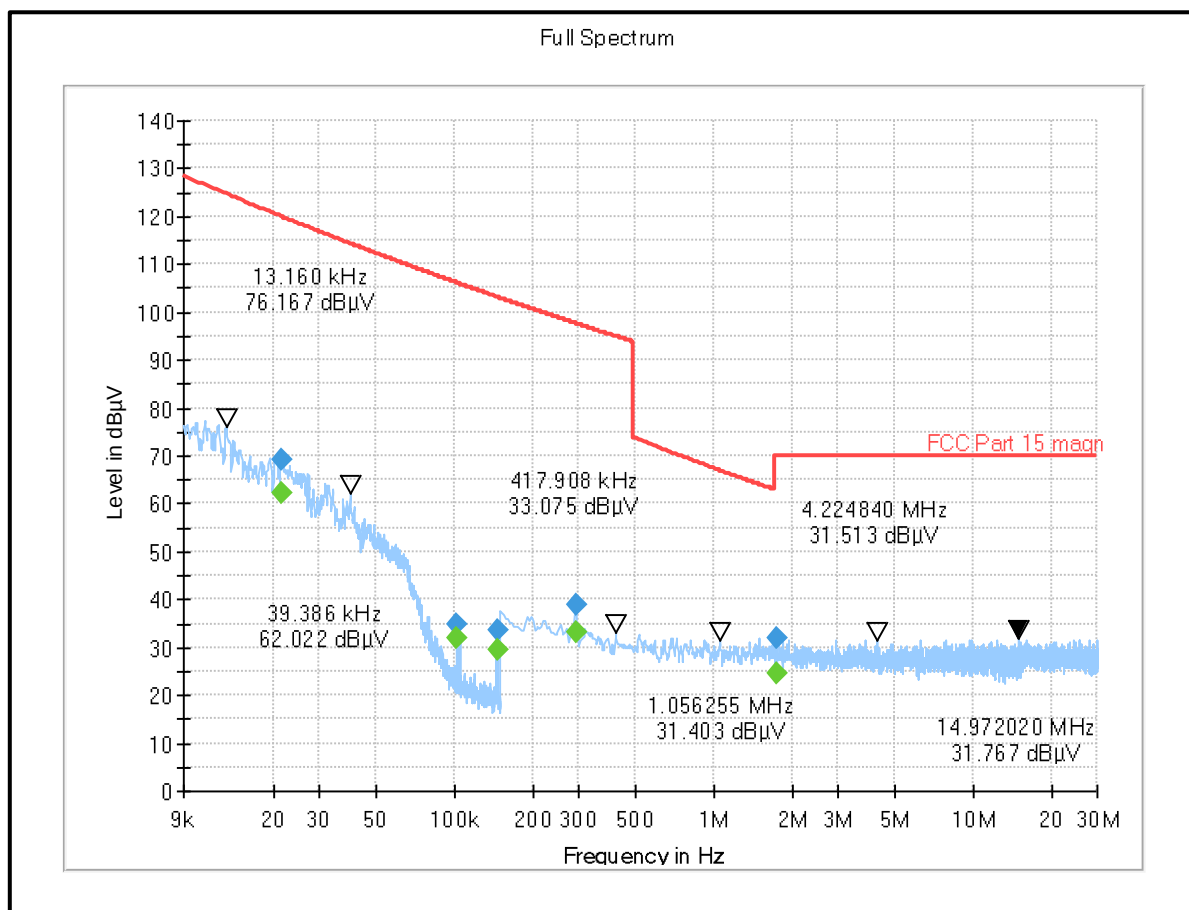


Transmitter Radiated Emissions (continued)

Results: LoRa / Bottom Channel / PWR 14 / SF12

Frequency (MHz)	Loop Antenna orientation	MaxPeak Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
0.021620	90° to EUT	69.02	119.93	50.91	Complied
0.102060	0° to EUT	34.72	106.13	71.41	Complied
0.145700	0° to EUT	33.69	103.20	69.51	Complied
0.292223	0° to EUT	38.94	97.70	58.76	Complied
1.760753	90° to EUT	32.13	70.00	37.87	Complied

Plot 9 kHz – 30 MHz: LoRa / Bottom Channel / PWR 14 / SF12



Result: Pass

Transmitter Radiated Emissions (continued)

Test Summary:

Test Engineer:	Muhammad Faiq Khan	Test Date:	17 February 2023
Test Sample Serial Number:	eWB LR0015 (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

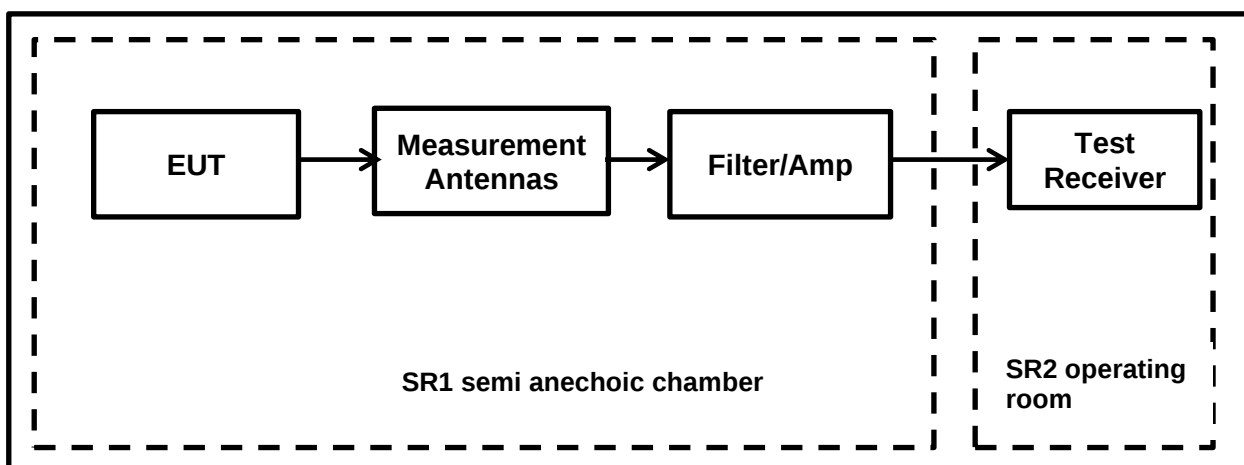
Environmental Conditions:

Temperature (°C):	22.6
Relative Humidity (%):	40.5

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 902 MHz on the 30 MHz to 1 GHz plots s 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 radiated emission measurements were performed with the EUT set to the following worst case mode:
 - LoRa / PWR 14 / Bottom Channel / SF12
- The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.

Test Setup:

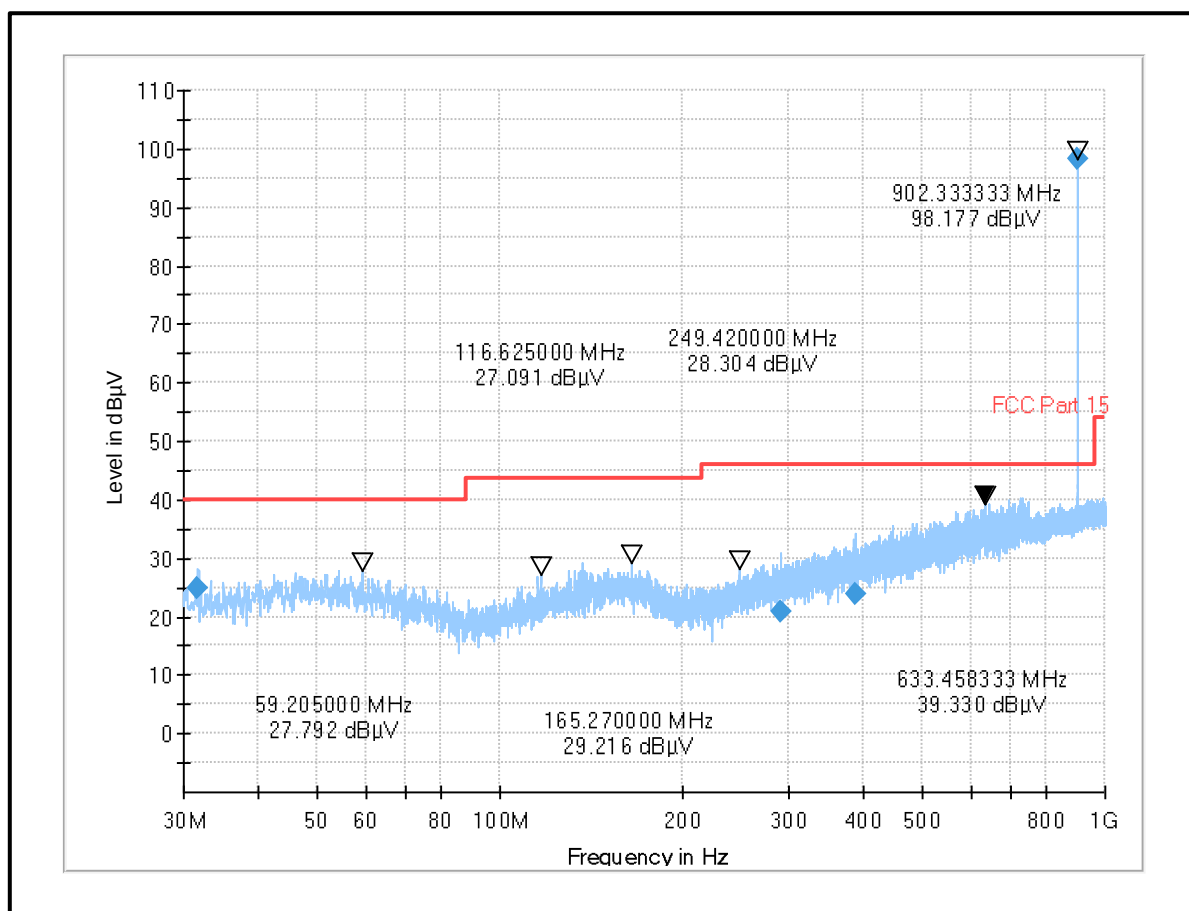


Transmitter Radiated Emissions (continued)

Results: LoRa / Bottom Channel / PWR 14 / SF12

Frequency (MHz)	Antenna Polarization	MaxPeak Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
31.710000	Vertical	24.94	40.00	15.06	Complied
291.315000	Horizontal	20.87	46.00	25.13	Complied
387.633333	Horizontal	23.77	46.00	22.23	Complied

Plot 30 MHz – 1 GHz :LoRa / Bottom Channel / PWR 14 / SF12



Result: Pass

Transmitter Radiated Emissions (continued)

Test Summary:

Test Engineer:	Muhammad Faiq Khan	Test Date:	16 February 2023
Test Sample Serial Number:	eWB LR0015 (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:

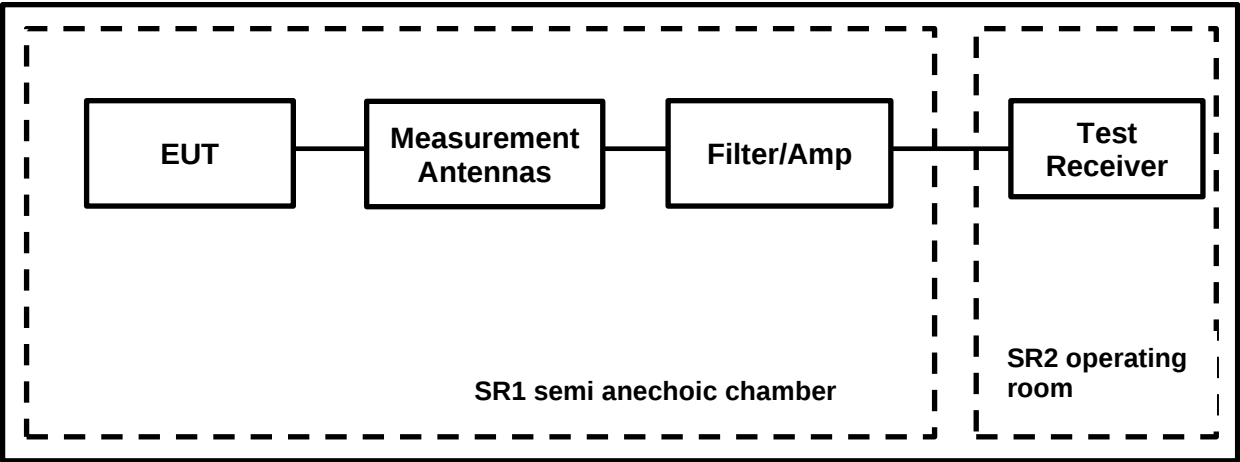
Temperature (°C):	21
Relative Humidity (%):	38

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 radiated emission measurements were performed with the EUT set to the following worst case mode:
 - LoRa / PWR 14 / Bottom Channel / SF12
4. For frequency range between 1 GHz and 10 GHz, the final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
5. All other emissions shown on the pre-scans were investigated and found to be below the noise floor of the measurement system.
6. 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."
7. The Restricted Band Emissions were performed in accordance with ANSI C63.10 Section 11.12.2.4 & 11.12.2.5.1.
8. As the EUT continuous transmission of the EUT ($D \geq 98\%$) can be achieved and EUT was transmitting continuously with a constant Duty Cycle of 99 % (duty cycle variations are less than $\pm 2\%$). Therefore, a Duty Cycle Correction Factor isn't applicable to the measured average values of the emissions.

Transmitter Radiated Emissions (continued)

Test Setup:



Transmitter Radiated Emissions (continued)

Results: LoRa / Bottom Channel / PWR 14 / SF12

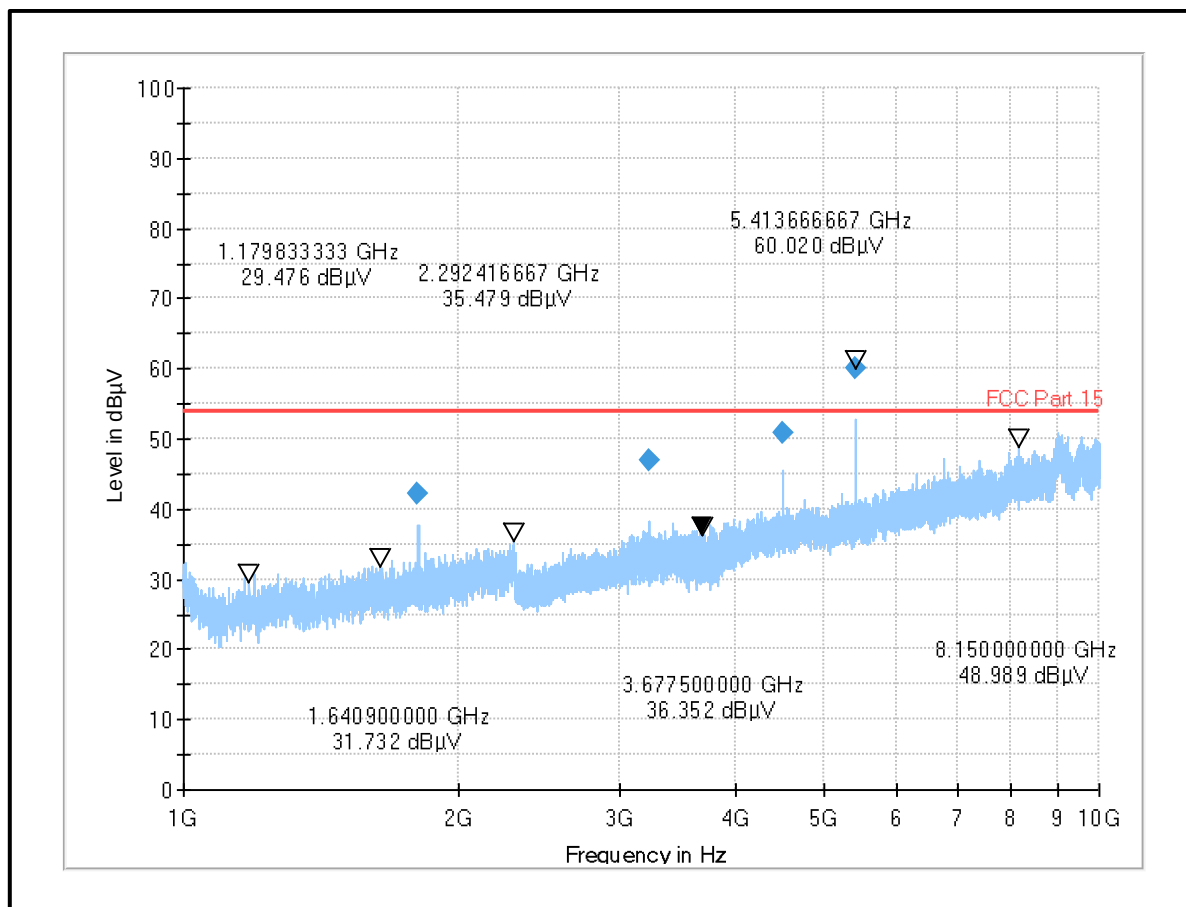
Frequency (MHz)	Antenna Polarization	MaxPeak Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
1804.700000	Vertical	42.31	54.00	11.69	Complied
3220.333333	Vertical	46.99	54.00	7.01	Complied
4511.666667	Vertical	50.75	54.00	3.25	Complied

Restricted Band Emission:

Frequency (MHz)	Antenna Orientation	MaxPeak Level (dB μ V/m)	20 dBc Peak Limit (dB μ V/m)	Margin (dB)	Result
5413.52050	Horizontal	57.71	79.61	21.90	Complied

Frequency (MHz)	Antenna Orientation	Average Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
5413.52050	Horizontal	53.40	54.00	0.6	Complied

Plot 1 GHz – 10 GHz :LoRa / Bottom Channel / PWR 14 / SF12



Result: Pass

5.2.7. Transmitter Band Edge Radiated Emissions

Test Summary:

Test Engineer:	Muhammad Faiq Khan	Test Date:	17 & 28 February 2023
Test Sample Serial Number:	eWB LR0015 (Radiated Test Sample)		
Test Site Identification	SR 1/2		

FCC Reference:	Parts 15.247(d), 15.209(a) & 15.205(a)
Test Method Used:	ANSI C63.10:2013 Section 7.8.6 referencing Section 6.10
	Emissions in Authorized-band / non-restricted frequency bands: ANSI C63.10:2013 Section 6.10.4
	Emissions in restricted frequency bands: ANSI C63.10:2013 Section 6.10.5

Environmental Conditions:

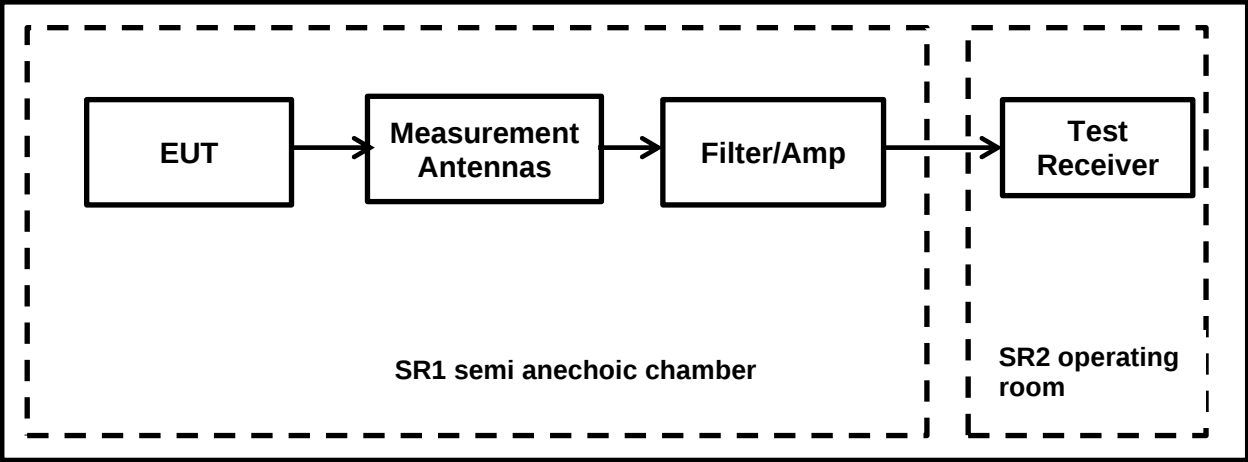
Temperature (°C):	21 to 23
Relative Humidity (%):	31 to 39

Note(s):

- 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
- The maximum conducted (peak) output power was previously measured. In accordance with FCC Part 15.247(d) for the band edge measurements -20 dBc limit has been applied.
- 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.
- As the both band edges falls within a non-restricted band, only peak measurements are required. 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 (1000 sweeps for hopping) 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.
- The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
- In accordance with ANSI C63.10 Section 6.10.4 the measurements were performed twice : once with the Fixed Channel Frequency Mode (Hopping OFF), repeated with Hopping Channels Frequency Mode (Hopping ON) with the worst-case mode.
 - LoRa / PWR 14 / Bottom Channel / SF12
 - LoRa / PWR 14 / Hopping Mode / SF12

Transmitter Band Edge Radiated Emissions (continued)

Test Setup:



Transmitter Band Edge Radiated Emissions (Continued)

Results: LoRa / PWR 14 / SF12

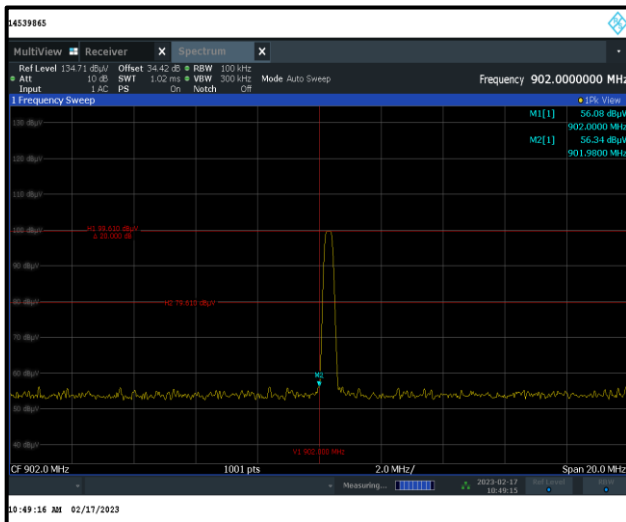
Results: Lower Band Edge / Peak

Frequency (MHz)	Peak Level (dBμV/m)	-20 dBc Limit (dBμV/m)	Margin (dB)	Result
902.00	56.08	79.61	23.53	Complied
901.98	56.34	79.61	23.27	Complied

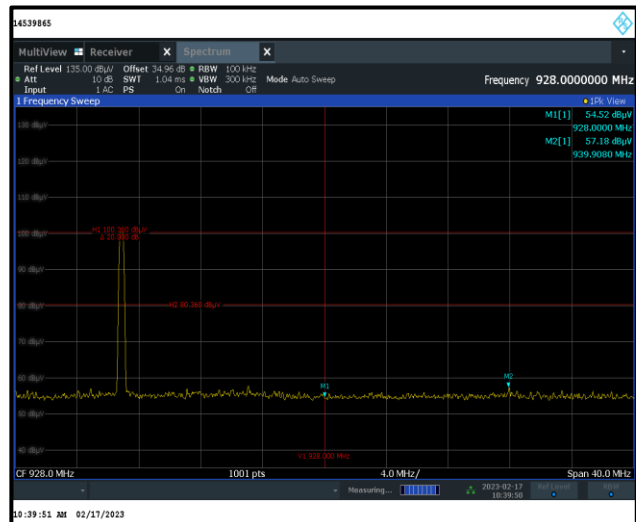
Results: Upper Band Edge / Peak

Frequency (MHz)	Peak Level (dBμV/m)	-20 dBc Limit (dBμV/m)	Margin (dB)	Result
928.00	54.52	80.36	25.84	Complied
939.90	57.18	80.36	23.18	Complied

Plots: LoRa / PWR 14 / SF12



Lower Band Edge Peak Measurement



Upper Band Edge Measurement

Result: **Pass**

Transmitter Band Edge Radiated Emissions (Continued)

Results: LoRa / PWR 14 / SF12 / Hopping mode

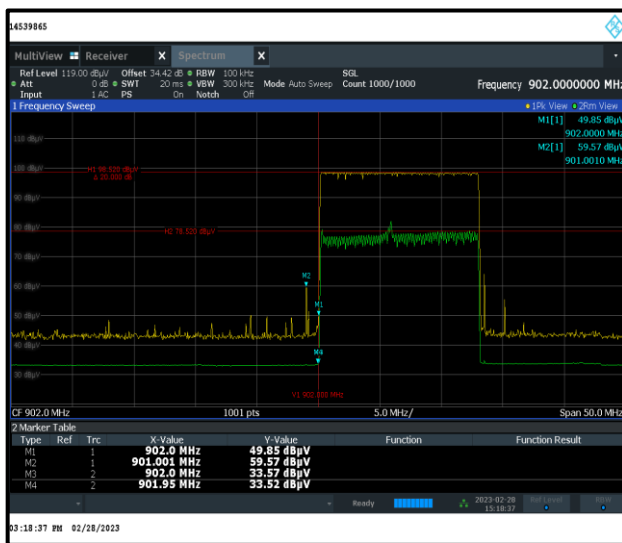
Results: Lower Band Edge / Peak

Frequency (MHz)	Peak Level (dB μ V/m)	-20 dBc Limit (dB μ V/m)	Margin (dB)	Result
902.00	49.85	78.52	28.67	Complied
901.98	59.57	78.52	18.95	Complied

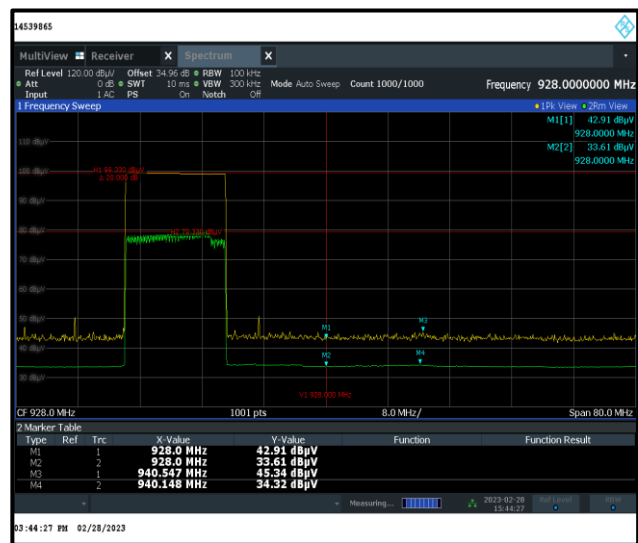
Results: Upper Band Edge / Peak

Frequency (MHz)	Peak Level (dB μ V/m)	-20 dBc Limit (dB μ V/m)	Margin (dB)	Result
928.00	42.91	79.33	36.42	Complied
940.54	45.34	79.33	33.99	Complied

Plots: LoRa / PWR 14 / SF12 / Hopping mode



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
Conducted Maximum Peak Output Power	95%	±0.59 dB
Radiated Spurious Emissions	95%	±3.10 dB
Band Edge Radiated Emissions	95%	±3.10 dB
Carrier Frequency Separation	95%	±92 Hz
Average Time of Occupancy	95%	±3.53 ns
20 dB Bandwidth	95%	±0.87 %

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
423	Bonn Elektronik	Amplifier, Low Noise Pre	BLMA 1840-1A	55929	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
495	Rohde & Schwarz	Antenna, log. - periodical	HL050	100296	06/08/2021	24
496	Rohde & Schwarz	Antenna, log. - periodical	HL050	100297	22/08/2022	24
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
591	Rohde & Schwarz	Receiver	ESU 40	100244/040	13/07/2022	12
669	Rohde & Schwarz	EMI Test Receiver	ESW 44	103087	03/02/2022	18
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
328	SPS	AC/DC power distribution system	PAS 5000	A2464 00/2 0200	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	12/07/2023	12
-/-	Testo	Thermo-Hygrometer	608-H1	07	lab verification	n/a
1603668	Siemens Matsushita Components	shielded room		B83117-B1422-T161	n/a	n/a

8. Report Revision History

Version Number	Revision Details		
	Page No(s)	Clause	Details
1.0	40	-	Initial Version
Test Report Version 1.1 supersede Version 1.0 with immediate effect Test Report No. UL-RPT-RP-14539865-416-FCC Version 1.1, Issue Date 02 AUGUST 2023 replaces Test Report No. UL-RPT-RP-14539865-416-FCC Version 1.0, Issue Date 05 JULY 2023, which is no longer valid.			
1.1	as below	as below	Current Version
	6	2.3	Methods and procedure updated
	12	5.2.1	Measurement results updated
	15-16	5.2.3	Measurements repeated, results and notes updated
	17-18	5.2.4	Measurements repeated and results updated
	19-25	5.2.5	Measurements repeated and results updated
	-	-	Test Method references updated
	39	7	Used equipment list updated

--- END OF REPORT ---