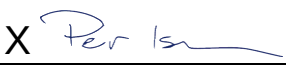


Prüfbericht-Nr.: Test report no.:	60448572-002	Auftrags-Nr.: Order no.:	23870393 030	Seite 1 von 56 Page 1 of 56
Kunden-Referenz-Nr.: Client reference no.:	-	Auftragsdatum: Order date:	2021.06.24	
Auftraggeber: Client:	Sensitive AB			
Prüfgegenstand: Test item:	Multi sensors strip			
Bezeichnung / Typ-Nr.: Identification / Type no.:	FCC ID: 2AHIR-004			
Auftrags-Inhalt: Order content:	Accredited testing			
Prüfgrundlage: Test specification:	FCC 47 CFR Part 15.247 with parts 15.207 & 15.209 ANSI C63.10: 2013			
Wareneingangsdatum: Date of sample receipt:	2020.06.24			
Prüfmuster-Nr.: Test sample no.:	See chapter 2.3			
Prüfzeitraum: Testing period:	2021.02.18 – 2021.08.31			
Ort der Prüfung: Place of testing:	Lund, Sweden			
Prüflaboratorium: Testing laboratory:	TÜV Rheinland Sweden			
Prüfergebnis*: Test result*:	Pass			
überprüft von: reviewed by:	X 	genehmigt von: authorized by:	X 	
Datum: 2021.09.29 Date:	Signed by: Sam Ebadeh	Datum: 2021.09.29 Date:	Signed by: Per Isacson	
Stellung / Position:	Technical Expert	Stellung / Position:	Managing Director	
Sonstiges / Other:				
Zustand des Prüfgegenstandes bei Anlieferung: Condition of the test item at delivery:		Prüfmuster vollständig und unbeschädigt Test item complete and undamaged		
* Legende:	1 = sehr gut P(ass) = entspricht o.g. Prüfgrundlage(n)	2 = gut F(ail) = entspricht nicht o.g. Prüfgrundlage(n)	3 = befriedigend N/A = nicht anwendbar	4 = ausreichend N/T = nicht getestet
* Legend:	1 = very good P(ass) = passed a.m. test specification(s)	2 = good F(ail) = failed a.m. test specification(s)	3 = satisfactory N/A = not applicable	4 = sufficient N/T = not tested
Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens. <i>This test report only relates to the a. m. test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts.</i>				

Revision History60448572-00260448572-002

REVISION	DATE	REMARKS	AUTHOR
001	2021.08.31	First release	Sam Ebadeh
002	2021.09.29	Corrected highest frequency and FCC ID	Sam Ebadeh
Note: Latest revision report will replace all previous reports			
This report based on FCC Part 15.247 Template version 1.2			

Summary of Test Results

FCC 47 CFR Rule Part	Test Description	Applicability	Report Section	RESULT	REMARKS
15.207	AC Power Line Conducted Emissions (Intentional Radiators)	NO	4.1	N/A	No AC power input
15.209	Radiated Emissions (Intentional Radiators)	YES	4.2	PASS	
15.247 (d)	Antenna conducted emissions	YES	4.3	N/A	Radiated Emissions performed instead
15.247 (d)	Band Edge Compliance (Authorized Band)	YES	4.4	PASS	
15.247 (d)	Band Edge Compliance (Restricted Band)	YES	4.5	PASS	
15.247 (a)(1)	20dB Bandwidth	YES	4.6	PASS	
15.247 (a)(1)	Carrier (Hopping Channel) Separation	YES	4.7	PASS	
15.247 (a)(1)	Number of Hopping Channels	YES	4.8	PASS	
15.247 (a)(1)	Time of Occupancy (Dwell Time)	YES	4.9	PASS	
15.247 (a)(2)	6dB Bandwidth	YES	4.10	PASS	
15.247 (b)	Peak Conducted Output Power	YES	4.11	PASS	
15.247 (e)	Power Spectral Density	YES	4.12	PASS	

Possible test case verdicts:

- | | |
|--|-----------------------|
| - Test case does not apply to the test object: | N/A |
| - Test object complies with the requirement: | PASS or COMPLIANT |
| - Test object does not meet the requirement: | FAIL or NOT COMPLIANT |
| - Test case not performed on the test object: | N.P. |

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1. GENERAL INFORMATION

1.1 Test Site

Test Facility:	TÜV Rheinland Sweden AB
Address:	Mobilvägen 10
	223 62 Lund
	Sweden
Swedac Registration Number:	10325
FCC Test Firm Registration Number:	517458
ISED Test Site Registration Number:	24753

1.2 Client Information

Company Name:	Sensitive AB
Address:	Mobilvägen 10
	223 62 Lund
	Sweden
Contact Person:	Lars Jonsson
Contact e-Mail / Telephone	Lars.Jonsson@sensitive.com / +46 70 302 37 67

2. PRODUCT INFORMATION

2.1 General Description

Model name:	Multi sensor strip
Manufacturer:	Sensitive AB
Model number / Marketing name:	1300002, 1301002, 1302002, 1303002, 1304002, 1305002, 1306002
FCC ID:	2AHIR-004
Description:	Multi sensors using LoRa radio technology
Ancillary Equipment:	See section 2.7

2.2 Device Characteristics

Type of Power Supply	External
Nominal Supply Voltage	DC
Supply Voltage Range	1.71 V to 3.6 V
Operating Temperature Range	-20°C to +60°C
Operating Air Humidity Range	0-80% RH
Highest Internal Frequency Source	914.9 MHz

2.3 Test Samples

EUT #	EUT ID	Description	Used For:
1	A003003480-001	Standard test sample	Radiated Emissions
2	A003003480-002	Conducted sample	All other tests

2.4 Wireless Technologies and Bands Supported by the EUT

Technology	Band	Frequency Range (Tx)	Evaluation Performed*
LoRa	900 MHz	902.3 MHz – 914.9 MHz	YES

*This statement refers only to this report. Other wireless technologies may be covered by other reports.

2.5 Antenna Information

Technology	Band	Number of Antennas	Antenna Type(s)	Gain (dBi)
LoRa	900 MHz	1	PCB Antenna	+2.3 dBi

2.6 Wireless Technology Details

Technology	Band	Rated Pwr (dBm)	Modulation Type(s)	No. of Channels	Channel Spacing	Adaptivity
LoRa (DTS)	900 MHz	14.9	CSS	8	1.6 MHz	N/A
LoRa (FHSS)	900 MHz	15.1	CSS	64	200 kHz	N/A

2.7 Ancillary Equipment

None

2.8 EUT Diagrams

N/A

3. TEST METHODS

3.1 Test Standards

Testing was performed according to the following standards / references

Standard	Version	Description
FCC 47 CFR 15.247	-	Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.
FCC 47 CFR 15.207	-	Conducted limits
FCC 47 CFR 15.209	-	Radiated emission limits; general requirements

3.2 Additional references

The following standards / references were also considered for the testing

Standard	Version	Description
ANSI C63.10	2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

3.3 Limits

FCC 47 CFR Rule Part	Test Description	Limit Reference (FCC 47 CFR Reference)
15.207	AC Power Line Conducted Emissions (Intentional Radiators)	15.207 (a)
15.209	Radiated Emissions (Intentional Radiators)	15.209 (a) *See Note 1
15.247 (d)	Out of Band Emissions	15.247 (d)
15.247 (d)	Band Edge Compliance (Authorized Band)	15.247 (d)
15.247 (d)	Band Edge Compliance (Restricted Band)	15.247 (d)
15.247 (a)(1)	20dB Bandwidth	15.247 (a)(1)
15.247 (a)(1)	Carrier (Hopping Channel) Separation	15.247 (a)(1)
15.247 (a)(1)	Number of Hopping Channels	15.247 (a)(1)
15.247 (a)(1)	Time of Occupancy (Dwell Time)	15.247 (a)(1)
15.247 (a)(2)	6dB Bandwidth	15.247 (a)(2)
15.247 (b)	Peak Conducted Output Power	§15.247 (b)(1) [Hopping] §15.247 (b)(3) [Non-Hopping]
15.247 (e)	Power Spectral Density	15.247 (e)

Interpretation of the measurement results has been performed in accordance with ANSI C63.10 section 1.3

Compliance with the requirements has been based on the results of the measurements compared to the specified limits, not taking into account measurement instrumentation uncertainty.

Measurement Uncertainty figures are stated in section 6

Note 1

Radiated Emissions limits in the tables from 47 CFR sections 15.109 & 15.209 are presented in $\mu\text{V/m}$. Measurements on the test system are made in $\text{dB}\mu\text{V/m}$. To convert between these, the following adjustment is used:

$$\text{New Limit} = 20 \log \left(\frac{\text{Original Limit}}{10^6} \right) + 120$$

Example: from 15.209(a) the limit for 30MHz – 88MHz is $100\mu\text{V/m}$ at 3m. This gives:

$$\text{New Limit} = 20 \log \left(\frac{100}{10^6} \right) + 120 = 40\text{dB}\mu\text{V/m at 3m}$$

Additionally, in some cases testing has been performed at distances other than those specified in the tables. When this has occurred, the limits have been adjusted in accordance with the requirements in 47 CFR 15.31, using an extrapolation factor of 40dB/decade at frequencies below 30MHz and 20dB/decade at or above 30MHz

Example: from 15.209(a) the limit for 1.705MHz – 30MHz is $30\mu\text{V/m}$ (=29.54 $\text{dB}\mu\text{V/m}$) at 30m

$$\text{Limit@3m} = \text{Limit@30m} + 40 \log \left(\frac{30}{3} \right) = 29.54 + 40.00 = 69.54 \text{ dB}\mu\text{V/m at 3m}$$

Example: from 15.209(a) the limit for 1GHz – 18GHz is $500\mu\text{V/m}$ (=53.98 $\text{dB}\mu\text{V/m}$) at 3m

$$\text{Limit@1m} = \text{Limit@3m} + 20 \log \left(\frac{3}{1} \right) = 53.98 + 9.54 = 63.52 \text{ dB}\mu\text{V/m at 1m}$$

3.4 Description of Test Methods and Equipment Setup

3.4.1 General Description

Testing was performed in accordance with the various requirements of ANSI C63.4 and ANSI C63.10. Any deviations from the test methods are described in section 3.7

Where different arrangements of equipment were used for different types of measurements, these are tabulated in section 3.4.2 and details of each arrangement are included in subsequent sections

3.4.2 Test Equipment Setup Used by Test Type

FCC 47 CFR Rule Part	Test Description	Test Equipment Used
15.207	AC Power Line Conducted Emissions (Intentional Radiators)	Conducted Emissions
15.209	Radiated Emissions (Intentional Radiators)	SAC5
15.247 (d)	Antenna conducted emissions	Conducted radio
15.247 (d)	Band Edge Compliance (Authorized band)	Conducted radio
15.247 (d)	Band Edge Compliance (Restricted band)	SAC 5
15.247 (a)(1)	20dB Bandwidth	Conducted radio
15.247 (a)(1)	Carrier (Hopping Channel) Separation	Conducted radio
15.247 (a)(1)	Number of Hopping Channels	Conducted radio
15.247 (a)(1)	Time of Occupancy (Dwell Time)	Conducted radio
15.247 (a)(2)	6dB Bandwidth	Conducted radio
15.247 (b)	Peak Conducted Output Power	Conducted radio
15.247 (e)	Power Spectral Density	Conducted radio

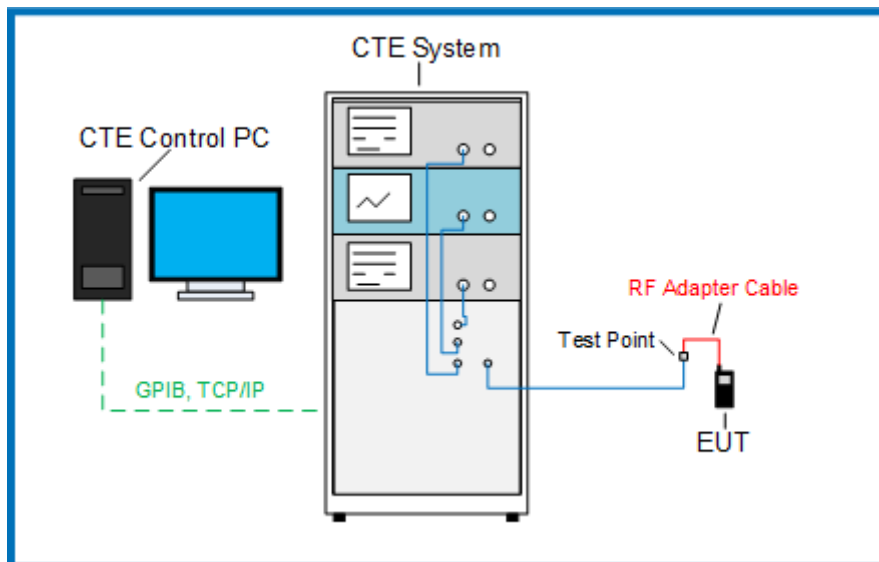
3.4.3 Test Equipment Setup – CTE System

The Comprehensive Test Environment (CTE) system consists of a number of instruments (see section 5.1.1) mounted in a rack together with automated relays and interconnecting hardware. The instruments and other equipment are controlled from a standard PC running software provided by the manufacturer. The RF output of the EUT is connected to the test system via a coaxial cable.

Tests are in the form of pre-defined scripts that can be loaded on the PC. The scripts, as well as the hardware setup, have been verified for conformance with the relevant test specifications.

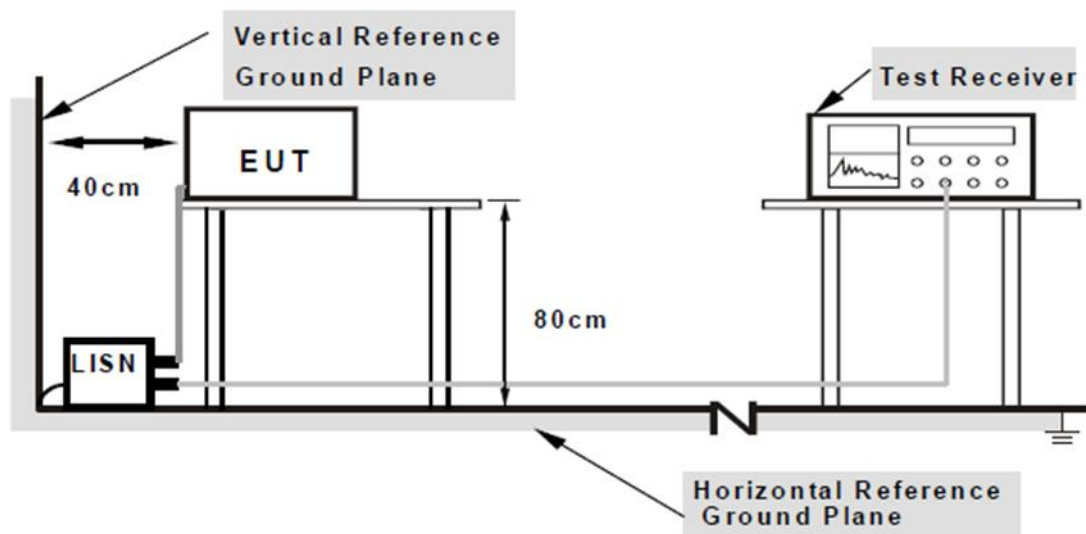
Losses in the cables and interconnects have been measured using the system's own automated routines and are compensated for automatically. Any additional loss in RF adapter cables supplied together with the EUT can be compensated for using the known characteristics of that adapter.

CTE Block Diagram



3.4.4 Test Equipment Setup – Conducted Emissions

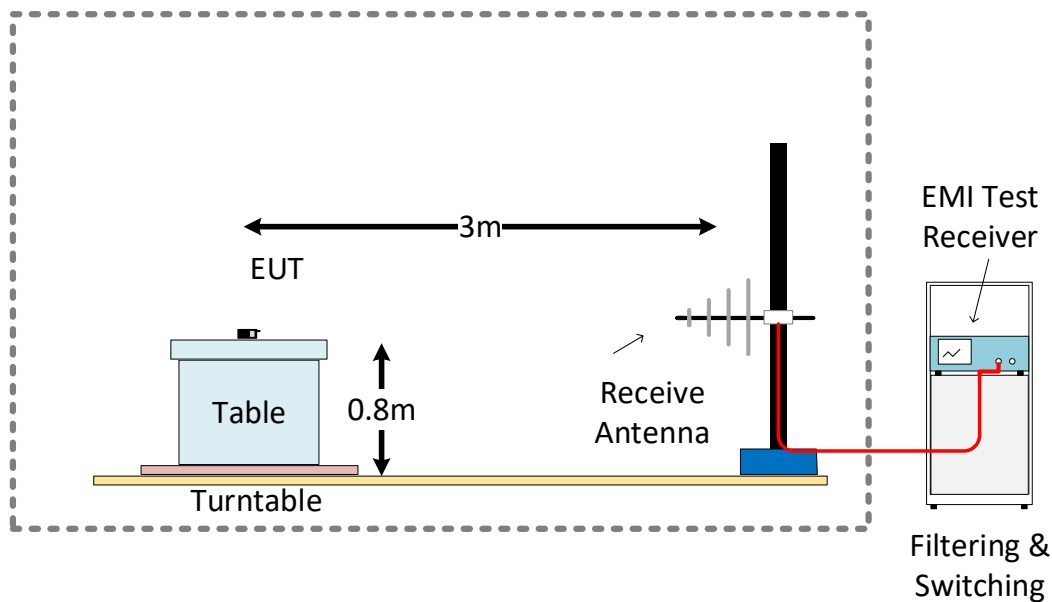
- The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The LISNs provide 50Ω/ 50μH of coupling impedance for the measuring instrument.
- The lines of the power mains connected to the EUT were checked for maximum conducted interference.
- The frequency range from 150 kHz to 30 MHz was searched. Emission levels over 10 dB under the prescribed limits could not be reported.



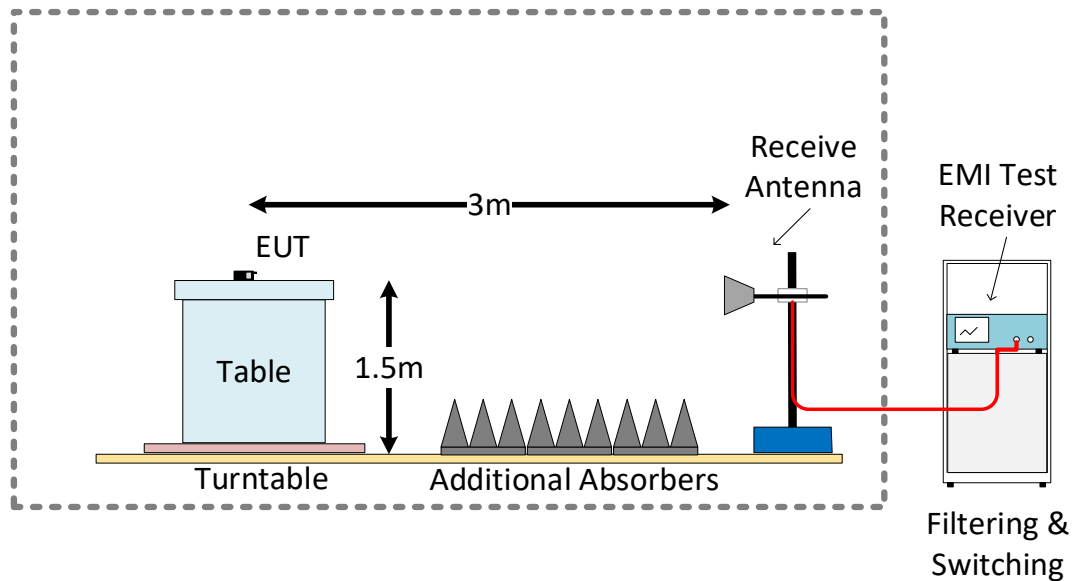
3.4.5 Test Equipment Setup – SAC 5 (Radiated Emissions and Restricted Band Edge)

- For frequency range 30MHz-1GHz Log-Periodic Antenna was used. Antenna elevated from 100 cm from floor to 400 cm from floor, and was placed at 3 m from center of turntable in tilted position. The equipment under test (EUT) was placed at the middle of the turntable at 150 cm height from floor. The antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations. Repeat the measurement steps until the maximum emissions were obtained.
- For frequency range 1GHz-18GHz horn Antenna was used. Antenna elevated from 100 cm from floor to 200 cm from floor, and was placed at 3 m from center of turntable. The equipment under test (EUT) was placed at the middle of the turntable at 150 cm height from floor. The antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations. Repeat the measurement steps until the maximum emissions were obtained.
- For frequency range 18GHz-40GHz double horn Antenna was used. Antenna's height was adjusted to 150 cm from floor, and 1 m distance to center of turntable. The equipment under test (EUT) was placed at the middle of the turntable on at 150 cm height from floor.
- For all frequency ranges the turntable was rotated 360° for obtaining the maximum emission.

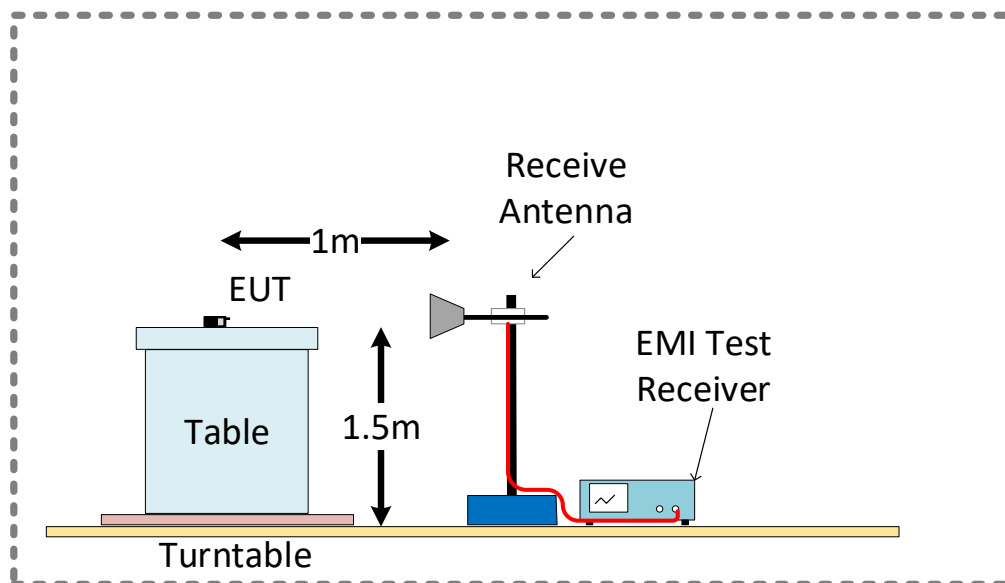
SAC 5 Test Setup Configuration 30MHz – 1GHz



SAC 5 Test Setup Configuration 1GHz – 18GHz



SAC 5 Test Setup Configuration 18GHz – 40GHz



3.5 EUT Configuration During Test

N/A

3.6 EUT Operation Modes

Operation mode	Description
Default DTS	Unit is powered up and transmitting with a 100% duty cycle on a specific channel.
Default FHSS	Unit is powered up and set in a frequency hopping mode. Hopping between 64 channels.

3.7 Deviations from the Test Standard

None.

3.8 Environmental Conditions

3.8.1 Environmental Conditions – Conducted radio

Environmental Conditions Log – Conducted radio

Date	Time	Temperature (°C)	Relative Humidity (%)
2021.06.22	13:31	22.9	52
2021.08.10	09:48	19.4	67
2021.08.16	07:52	19.4	63
2021.08.31	11:45	20.2	54

3.8.2 Environmental Conditions – SAC5 (Radiated Emissions)

Environmental Conditions Log – SAC5

Date	Time	Temperature (°C)	Relative Humidity (%)
2021.02.18	08:25	18.3	28
2021.02.23	08:19	18.4	35
2021.03.04	08:39	18.4	34
2021.03.05	07:25	18.3	33
2021.03.10	08:45	18.6	27
2021.03.17	08:20	18.4	33
2021.05.31	11:02	18.6	50
2021.06.14	14:06	18.5	60
2021.06.15	10:05	18.6	57

4. TEST RESULTS

4.1 Test Results – AC Power Line Conducted Emissions (Intentional Transmitter)

4.1.1 AC Power Line Conducted Emissions (Intentional) – Test Summary

Requirement not applicable as the device have no AC Mains input.

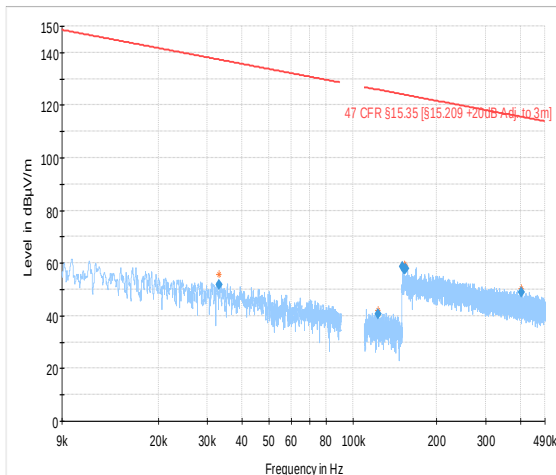
4.2 Test Results – Radiated Emissions (Intentional Transmitter)

4.2.1 Radiated Emissions (Intentional) – Test Summary

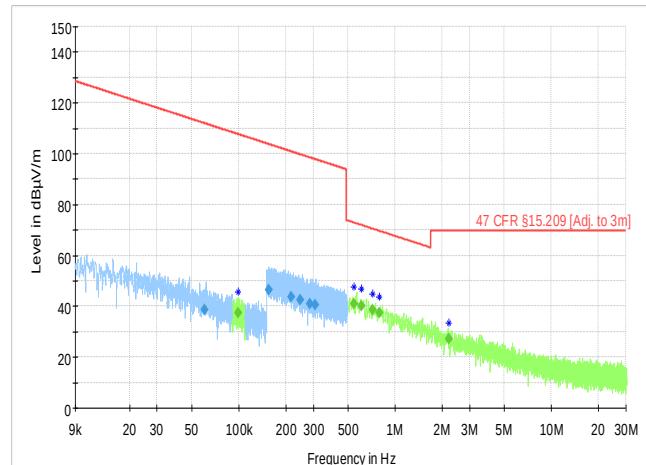
Test Specification		FCC 47 CFR 15.209 (Part 15 Subpart C)	
Test Engineer & Date		Simon Palmhager Niall Forrester Sam Ebadeh	2021.02.18 – 2021.03.17
EUT and Ancillary Equipment IDs		A003003480-001	None
EUT Operation Mode(s)		Default	
EUT Wireless Configuration(s)		See below	
EUT Hardware Configuration(s)		N/A	
Overall Result		PASS	
Test Parameter	Wireless Configuration	Frequency Range	Result
Radiated Emissions	LoRa Low channel – 902.3 MHz	9 kHz – 30 MHz	PASS
Radiated Emissions	LoRa Low channel – 902.3 MHz	30 MHz – 1 GHz	PASS
Radiated Emissions	LoRa Low channel – 902.3 MHz	1 GHz – 18 GHz	PASS
Radiated Emissions	LoRa Mid channel – 908.7 MHz	9 kHz – 30 MHz	PASS
Radiated Emissions	LoRa Mid channel – 908.7 MHz	30 MHz – 1 GHz	PASS
Radiated Emissions	LoRa Mid channel – 908.7 MHz	1 GHz – 18 GHz	PASS
Radiated Emissions	LoRa High channel – 914.9 MHz	9 kHz – 30 MHz	PASS
Radiated Emissions	LoRa High channel – 914.9 MHz	30 MHz – 1 GHz	PASS
Radiated Emissions	LoRa High channel – 914.9 MHz	1 GHz – 18 GHz	PASS

4.2.2 Radiated Emissions (Details) – Test Details

Test mode condition	LoRa – low channel 902.3 MHz	
Antenna orientation	Parallel to floor	
Sweep frequency	9 kHz – 30 MHz	
Standard	47 CFR FCC Part 15 subpart C	
EUT	A003003480-001	
Ancillary Equipment	None	
Test Engineer	Simon Palmhager	Date: 2021.03.17
Chamber details	Chamber: SAC 5	



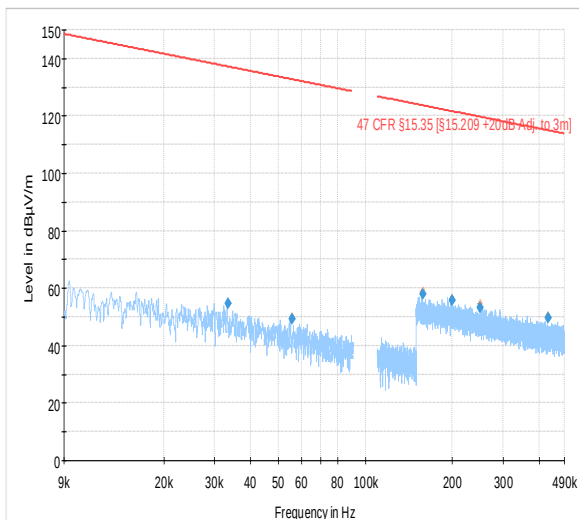
Preview Result 1-PK+ Critical_Freqs PK+
47 CFR §15.35 [§15.209 +20dB Adj. to 3m] Final_Result PK+



Preview Result 2-PK+ Preview Result 1-AVG
Critical_Freqs PK+ Critical_Freqs AVG
47 CFR §15.209 [Adj. to 3m] Final_Result AVG
Final_Result QPK

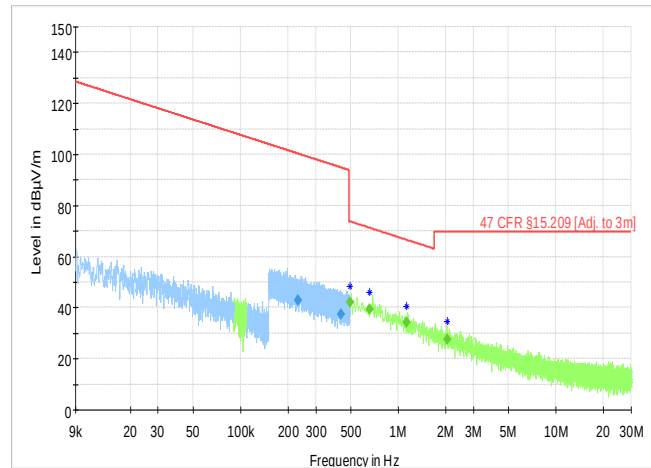
Frequency (MHz)	Average (dBµV/m)	QuasiPeak (dBµV/m)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
0.032952	---	---	51.97	137.25	85.27	1000.0	0.200	100.0	H	225.0
0.122975	---	---	40.73	125.81	85.08	1000.0	0.200	100.0	H	229.0
0.150570	---	---	58.77	124.05	65.28	1000.0	9.000	100.0	H	177.0
0.153345	---	---	57.59	123.89	66.30	1000.0	9.000	100.0	H	-41.0
0.154617	---	---	57.78	123.82	66.04	1000.0	9.000	100.0	H	75.0
0.403470	---	---	48.82	115.49	66.67	1000.0	9.000	100.0	H	225.0
0.060724	38.45	---	---	111.94	73.49	1000.0	0.200	100.0	H	139.0
0.099105	---	37.39	---	107.68	70.29	1000.0	0.200	100.0	H	205.0
0.155905	46.49	---	---	103.75	57.26	1000.0	9.000	100.0	H	179.0
0.216227	43.79	---	---	100.91	57.11	1000.0	9.000	100.0	H	225.0
0.248172	42.33	---	---	99.71	57.38	1000.0	9.000	100.0	H	135.0
0.284335	41.00	---	---	98.53	57.53	1000.0	9.000	100.0	H	225.0
0.306587	40.38	---	56.34	97.87	57.50	1000.0	9.000	100.0	H	244.0
0.546106	---	41.10	53.02	72.86	31.75	1000.0	9.000	100.0	H	135.0
0.607755	---	40.14	48.97	71.93	31.79	1000.0	9.000	100.0	H	102.0
0.720042	---	38.45	57.16	70.46	32.00	1000.0	9.000	100.0	H	115.0
0.791420	---	37.52	55.43	69.64	32.12	1000.0	9.000	100.0	H	180.0
2.210412	---	27.03	51.99	69.54	42.51	1000.0	9.000	100.0	H	192.0

Test mode condition	LoRa – low channel 902.3 MHz	
Antenna orientation	Perpendicular to axis	
Sweep frequency	9 kHz – 30 MHz	
Standard	47 CFR FCC Part 15 subpart C	
EUT	A003003480-001	
Ancillary Equipment	None	
Test Engineer	Simon Palmhager	Date: 2021.03.17
Chamber details	Chamber: SAC 5	



— Preview Result 1-PK+
— 47 CFR §15.35 [§15.209 +20dB Adj. to 3m]

★ Critical_Freqs PK+
◆ Final_Result PK+

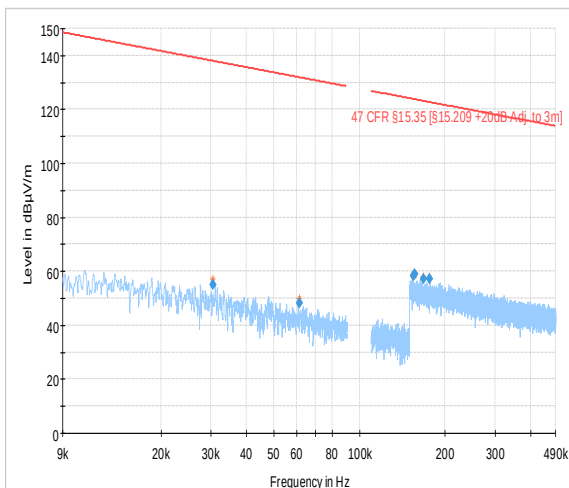


— Preview Result 2-PK+
★ Critical_Freqs PK+
— 47 CFR §15.209 [Adj. to 3m]
◆ Final_Result QPK

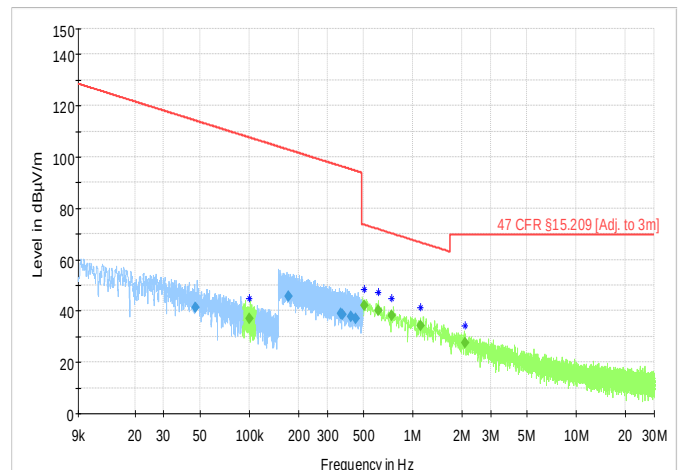
— Preview Result 1-AVG
★ Critical_Freqs AVG
◆ Final_Result AVG

Frequency (MHz)	Average (dBµV/m)	QuasiPeak (dBµV/m)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
0.033449	---	---	54.61	137.12	82.50	1000.0	0.200	100.0	H	153.0
0.055678	---	---	49.18	132.69	83.51	1000.0	0.200	100.0	H	165.0
0.158179	---	---	58.03	123.62	65.60	1000.0	9.000	100.0	H	45.0
0.199464	---	---	55.60	121.61	66.00	1000.0	9.000	100.0	H	315.0
0.249592	---	---	53.36	119.66	66.30	1000.0	9.000	100.0	H	202.0
0.429622	---	---	49.73	114.94	65.21	1000.0	9.000	100.0	H	-45.0
0.231274	43.08	---	---	100.32	57.24	1000.0	9.000	100.0	H	244.0
0.433748	37.47	---	---	94.86	57.39	1000.0	9.000	100.0	H	-13.0
0.492581	---	42.24	---	73.76	31.51	1000.0	9.000	100.0	H	179.0
0.657485	---	39.31	---	71.25	31.93	1000.0	9.000	100.0	H	225.0
1.129877	---	34.10	---	66.54	32.45	1000.0	9.000	100.0	H	135.0
2.038801	---	27.74	---	69.54	41.80	1000.0	9.000	100.0	H	179.0

Test mode condition	LoRa – low channel 902.3 MHz	
Antenna orientation	Parallel to axis	
Sweep frequency	9 kHz – 30 MHz	
Standard	47 CFR FCC Part 15 subpart C	
EUT	A003003480-001	
Ancillary Equipment	None	
Test Engineer	Simon Palmhager	Date: 2021.03.10
Chamber details	Chamber: SAC 5	



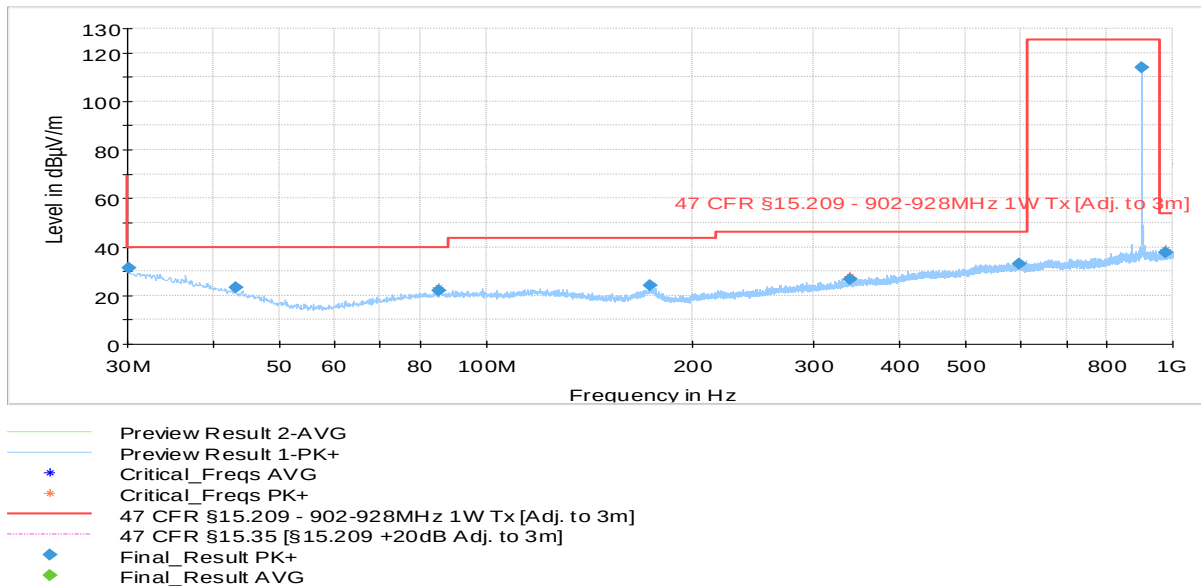
— Preview Result 1-PK+
— 47 CFR §15.35 [§15.209 +20dB Adj. to 3m]
★ Critical_Freqs PK+
◆ Final_Result PK+



— Preview Result 2-PK+
★ Critical_Freqs PK+
— 47 CFR §15.209 [Adj. to 3m]
◆ Final_Result QPK
— Preview Result 1-AVG
★ Critical_Freqs AVG
◆ Final_Result AVG

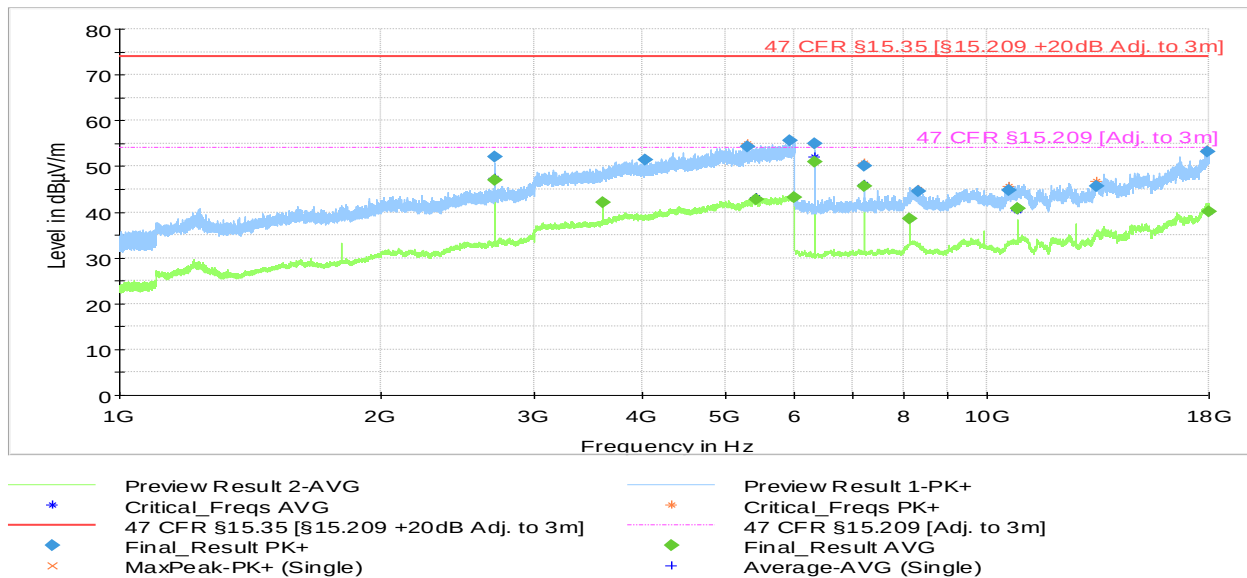
Frequency (MHz)	Average (dBµV/m)	QuasiPeak (dBµV/m)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
0.030486	---	---	55.05	137.92	82.88	1000.0	0.200	100.0	H	202.0
0.061396	---	---	48.22	131.84	83.63	1000.0	0.200	100.0	H	63.0
0.154979	---	---	58.37	123.80	65.43	1000.0	9.000	100.0	H	223.0
0.156626	---	---	58.83	123.71	64.87	1000.0	9.000	100.0	H	45.0
0.168288	---	---	57.26	123.08	65.82	1000.0	9.000	100.0	H	315.0
0.176251	---	---	57.24	122.68	65.44	1000.0	9.000	100.0	H	279.0
0.046951	41.44	---	---	114.17	72.74	1000.0	0.200	100.0	H	216.0
0.100782	---	36.82	---	107.54	70.71	1000.0	0.200	100.0	H	-1.0
0.173742	45.61	---	---	102.81	57.19	1000.0	9.000	100.0	H	-41.0
0.364383	38.93	---	---	96.37	57.45	1000.0	9.000	100.0	H	64.0
0.369667	38.76	---	---	96.25	57.49	1000.0	9.000	100.0	H	24.0
0.419715	37.76	---	---	95.15	57.39	1000.0	9.000	100.0	H	-45.0
0.448551	37.18	---	---	94.57	57.39	1000.0	9.000	100.0	H	294.0
0.505845	---	41.94	---	73.52	31.58	1000.0	9.000	100.0	H	114.0
0.615057	---	40.14	---	71.83	31.69	1000.0	9.000	100.0	H	135.0
0.739748	---	38.29	---	70.22	31.93	1000.0	9.000	100.0	H	45.0
1.116866	---	34.39	---	66.64	32.26	1000.0	9.000	100.0	H	-14.0
2.096941	---	27.60	---	69.54	41.94	1000.0	9.000	100.0	H	215.0

Test mode condition	LoRa – low channel 902.3 MHz	
Antenna orientation	Horizontal and Vertical	
Sweep frequency	30 MHz – 1 GHz	
Standard	47 CFR FCC Part 15 subpart C	
EUT	A003003480-001	
Ancillary Equipment	None	
Test Engineer	Niall Forrester	Date: 2021.03.04
Chamber details	Chamber: SAC 5	



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
30.092422	31.49	40.00	8.51	1000.0	120.000	183.0	H	130.0
43.132480	23.40	40.00	16.60	1000.0	120.000	225.0	V	99.0
85.290120	21.94	40.00	18.06	1000.0	120.000	175.0	V	232.0
172.939400	24.25	43.52	19.27	1000.0	120.000	220.0	V	142.0
338.084240	26.60	46.02	19.43	1000.0	120.000	100.0	V	40.0
598.301640	33.08	46.02	12.94	1000.0	120.000	225.0	V	244.0
902.241120	113.98	125.23	11.25	1000.0	120.000	100.0	H	220.0
978.510320	37.87	53.98	16.11	1000.0	120.000	404.0	V	19.0

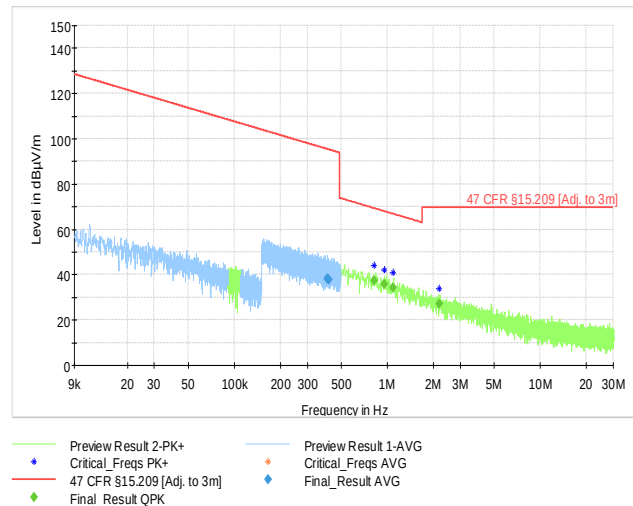
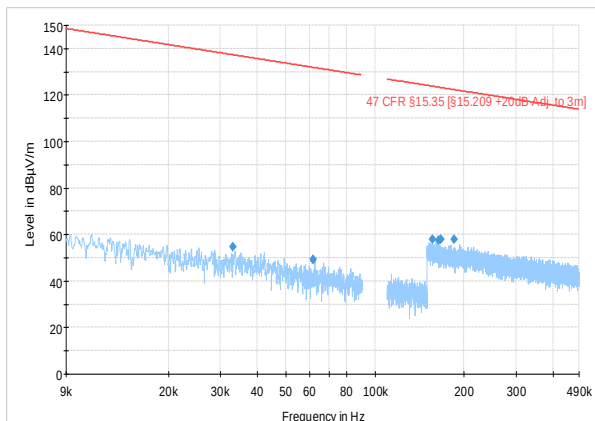
Test mode condition	LoRa – low channel 902.3 MHz	
Antenna orientation	Horizontal and Vertical	
Sweep frequency	1 GHz – 18 GHz	
Standard	47 CFR FCC Part 15 subpart C	
EUT	A003003480-001	
Ancillary Equipment	None	
Test Engineer	Niall Forrester	Date: 2021.02.18
Chamber details	Chamber: SAC 5	



Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
2706.871000	---	47.09	53.98	6.89	1000.0	1000.000	198.0	H	267.0
2706.952000	51.97	---	73.98	22.01	1000.0	1000.000	198.0	H	267.0
3609.153000	---	42.18	53.98	11.80	1000.0	1000.000	125.0	H	88.0
4035.225000	51.34	---	73.98	22.64	1000.0	1000.000	185.0	H	116.0
5287.232000	54.28	---	73.98	19.70	1000.0	1000.000	100.0	H	221.0
5413.979000	---	42.74	53.98	11.24	1000.0	1000.000	136.0	H	221.0
5920.937000	55.54	---	73.98	18.44	1000.0	1000.000	198.0	H	162.0
5979.728000	---	43.14	53.98	10.84	1000.0	1000.000	125.0	V	158.0
6316.120000	---	51.06	53.98	2.92	1000.0	1000.000	100.0	V	309.0
6316.167000	55.03	---	73.98	18.95	1000.0	1000.000	101.0	V	313.0
7218.412000	---	45.69	53.98	8.29	1000.0	1000.000	110.0	V	296.0
7218.535000	50.06	---	73.98	23.92	1000.0	1000.000	111.0	V	296.0
8120.758000	---	38.45	53.98	15.53	1000.0	1000.000	125.0	V	248.0
8310.886000	44.58	---	73.98	29.40	1000.0	1000.000	136.0	H	289.0
10592.860000	44.67	---	73.98	29.31	1000.0	1000.000	175.0	H	-22.0
10827.577000	---	40.70	53.98	13.28	1000.0	1000.000	100.0	V	175.0
10827.632000	---	40.79	53.98	13.18	1000.0	1000.000	100.0	V	175.0
13339.955000	45.76	---	73.98	28.21	1000.0	1000.000	175.0	V	175.0
17958.045000	53.20	---	73.98	20.78	1000.0	1000.000	126.0	V	85.0
17993.975700	---	40.09	53.98	13.89	1000.0	1000.000	100.0	V	98.0

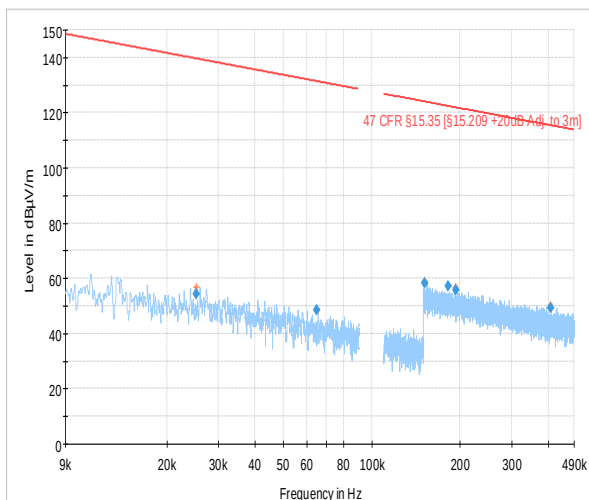
Mid Channel

Test mode condition	LoRa – mid channel 908.7 MHz	
Antenna orientation	Parallel to floor	
Sweep frequency	9 kHz – 30 MHz	
Standard	47 CFR FCC Part 15 subpart C	
EUT	A003003480-001	
Ancillary Equipment	None	
Test Engineer	Simon Palmhager	Date: 2021.03.17
Chamber details	Chamber: SAC 5	

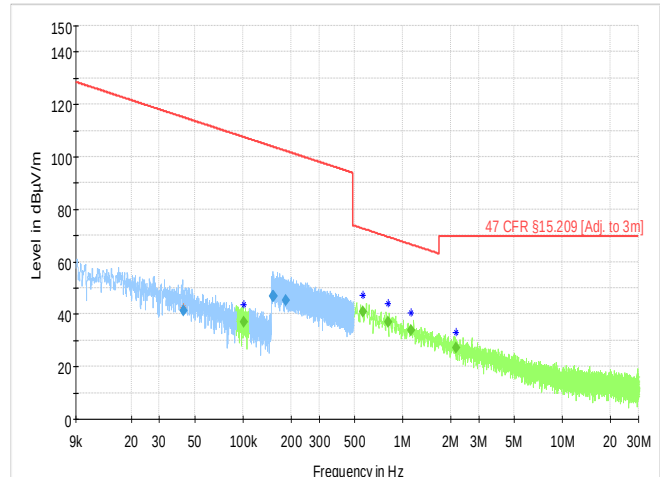


Frequency (MHz)	Average (dBµV/m)	QuasiPeak (dBµV/m)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
0.033071	---	---	54.76	137.22	82.45	1000.0	0.200	100.0	H	315.0
0.061616	---	---	49.22	131.81	82.59	1000.0	0.200	100.0	H	225.0
0.156591	---	---	58.04	123.71	65.67	1000.0	9.000	100.0	H	87.0
0.164279	---	---	57.54	123.29	65.75	1000.0	9.000	100.0	H	63.0
0.166510	---	---	57.84	123.18	65.33	1000.0	9.000	100.0	H	229.0
0.185124	---	---	57.74	122.26	64.51	1000.0	9.000	100.0	H	125.0
0.404154	38.05	---	---	95.47	57.42	1000.0	9.000	100.0	H	315.0
0.413516	37.76	---	---	95.27	57.51	1000.0	9.000	100.0	H	-14.0
0.819020	---	37.21	---	69.34	32.12	1000.0	9.000	100.0	H	154.0
0.958963	---	35.81	---	67.97	32.16	1000.0	9.000	100.0	H	295.0
1.095394	---	34.43	---	66.81	32.38	1000.0	9.000	100.0	H	244.0
2.174054	---	27.17	---	69.54	42.37	1000.0	9.000	100.0	H	11.0

Test mode condition	LoRa – mid channel 908.7 MHz	
Antenna orientation	Perpendicular to axis	
Sweep frequency	9 kHz – 30 MHz	
Standard	47 CFR FCC Part 15 subpart C	
EUT	A003003480-001	
Ancillary Equipment	None	
Test Engineer	Simon Palmhager	Date: 2021.03.17
Chamber details	Chamber: SAC 5	



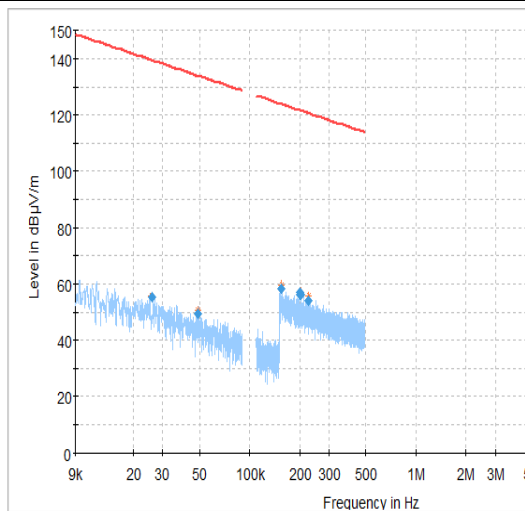
— Preview Result 1-PK+
— 47 CFR §15.35 [§15.209 +20dB Adj. to 3m]
★ Critical_Freqs PK+
◆ Final_Result PK+



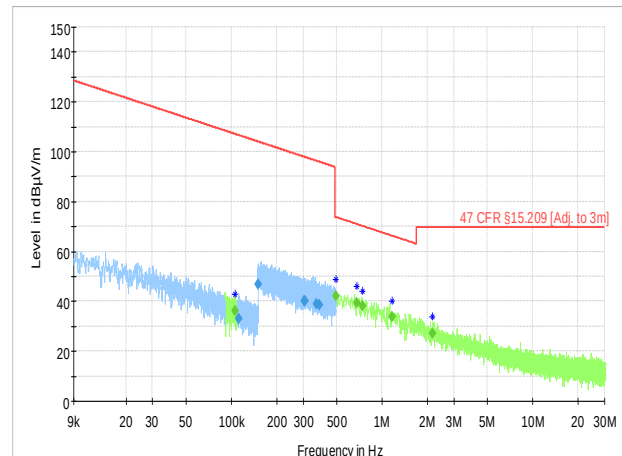
— Preview Result 2-PK+
★ Critical_Freqs PK+
— 47 CFR §15.209 [Adj. to 3m]
◆ Final_Result QPK
— Preview Result 1-AVG
★ Critical_Freqs AVG
◆ Final_Result AVG

Frequency (MHz)	Average (dBµV/m)	QuasiPeak (dBµV/m)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
0.025222	---	---	54.27	139.57	85.30	1000.0	0.200	100.0	H	215.0
0.064715	---	---	48.63	131.38	82.75	1000.0	0.200	100.0	H	45.0
0.151357	---	---	58.40	124.00	65.60	1000.0	9.000	100.0	H	315.0
0.181984	---	---	57.13	122.40	65.27	1000.0	9.000	100.0	H	153.0
0.193748	---	---	55.65	121.86	66.21	1000.0	9.000	100.0	H	-45.0
0.407091	---	---	49.30	115.41	66.11	1000.0	9.000	100.0	H	22.0
0.042273	41.47	---	---	115.08	73.61	1000.0	0.200	100.0	H	64.0
0.100823	---	36.89	---	107.53	70.64	1000.0	0.200	100.0	H	45.0
0.154331	46.70	---	---	103.84	57.13	1000.0	9.000	100.0	H	89.0
0.155483	46.66	---	---	103.77	57.11	1000.0	9.000	100.0	H	257.0
0.184980	45.16	---	---	102.26	57.11	1000.0	9.000	100.0	H	-1.0
0.563046	---	40.83	---	72.59	31.76	1000.0	9.000	100.0	H	269.0
0.810530	---	37.14	---	69.43	32.28	1000.0	9.000	100.0	H	12.0
1.126780	---	34.02	---	66.57	32.55	1000.0	9.000	100.0	H	270.0
2.159828	---	27.19	---	69.54	42.35	1000.0	9.000	100.0	H	64.0

Test mode condition	LoRa – mid channel 908.7 MHz	
Antenna orientation	Parallel to axis	
Sweep frequency	9 kHz – 30 MHz	
Standard	47 CFR FCC Part 15 subpart C	
EUT	A003003480-001	
Ancillary Equipment	None	
Test Engineer	Simon Palmhager	Date: 2021.03.10
Chamber details	Chamber: SAC 5	



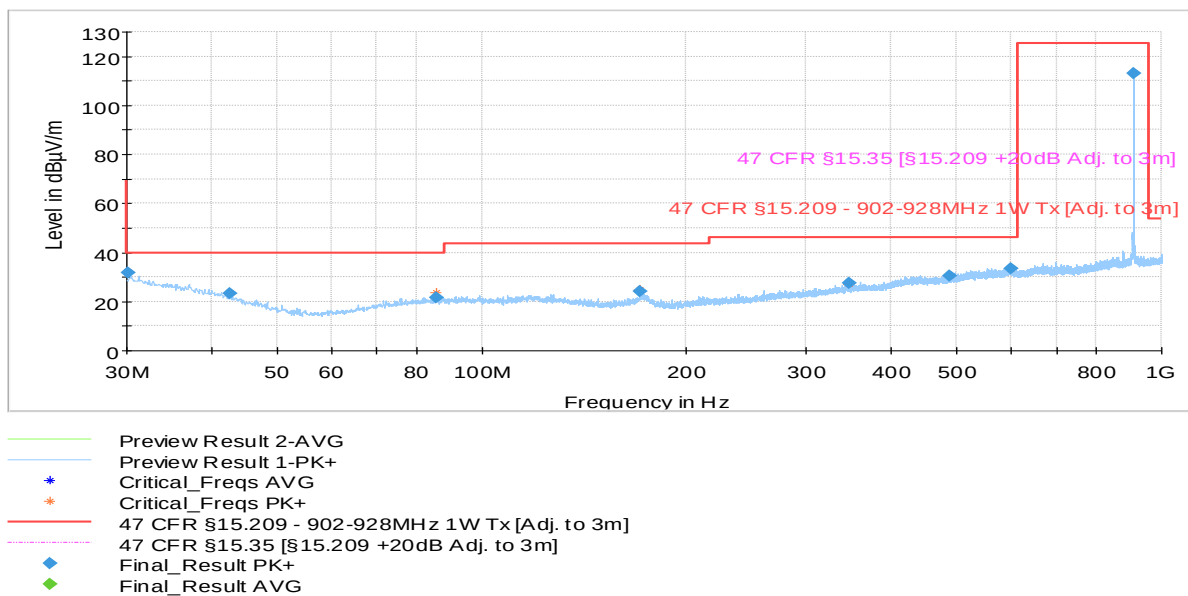
Preview Result 1-PK+
47 CFR §15.35 [§15.209 +20dB Adj. to 3m]
Critical_Freqs PK+
Final_Result PK+



Preview Result 2-PK+
Critical_Freqs PK+
47 CFR §15.209 [Adj. to 3m]
Final_Result QPK
Preview Result 1-AVG
Critical_Freqs AVG
Final_Result AVG

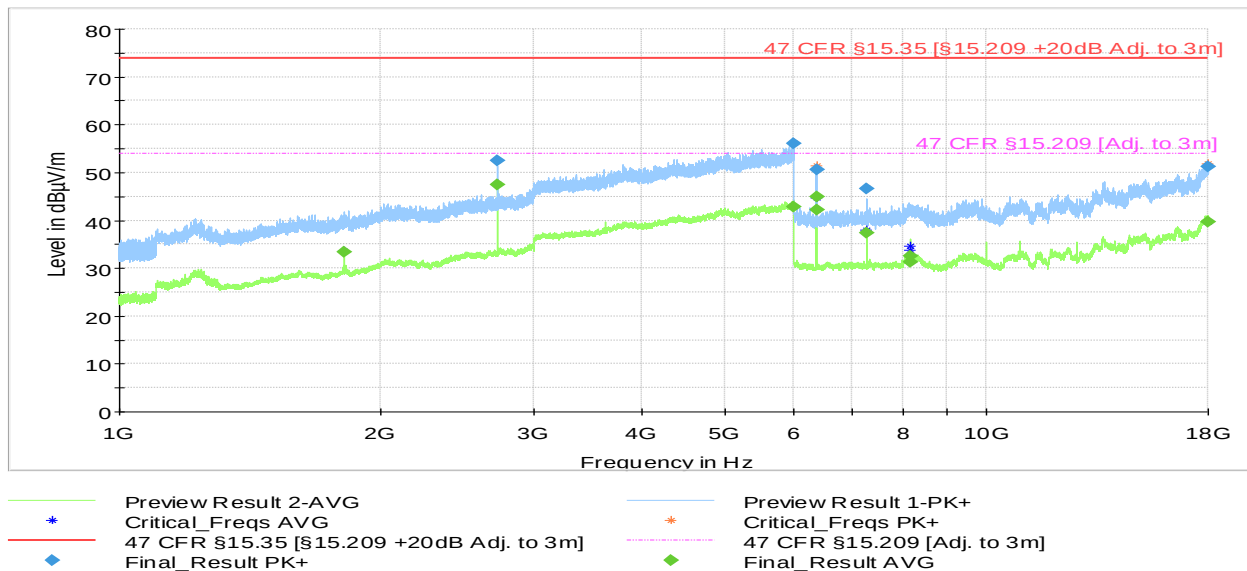
Frequency (MHz)	Average (dBµV/m)	QuasiPeak (dBµV/m)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
0.025796	---	---	55.55	139.37	83.82	1000.0	0.200	100.0	H	305.0
0.049021	---	---	49.33	133.80	84.47	1000.0	0.200	100.0	H	-45.0
0.155129	---	---	58.17	123.79	65.62	1000.0	9.000	100.0	H	280.0
0.200441	---	---	56.77	121.57	64.80	1000.0	9.000	100.0	H	87.0
0.201743	---	---	56.16	121.51	65.35	1000.0	9.000	100.0	H	-15.0
0.225344	---	---	54.05	120.55	66.50	1000.0	9.000	100.0	H	124.0
0.105428	---	36.11	---	107.15	71.03	1000.0	0.200	100.0	H	49.0
0.112178	33.09	---	---	106.61	73.51	1000.0	0.200	100.0	H	244.0
0.150197	46.73	---	---	104.07	57.34	1000.0	9.000	100.0	H	37.0
0.305913	40.32	---	---	97.89	57.58	1000.0	9.000	100.0	H	307.0
0.306835	40.30	---	---	97.87	57.56	1000.0	9.000	100.0	H	139.0
0.367877	38.80	---	---	96.29	57.49	1000.0	9.000	100.0	H	315.0
0.382419	38.42	---	---	95.95	57.54	1000.0	9.000	100.0	H	25.0
0.492084	---	42.18	---	73.76	31.58	1000.0	9.000	100.0	H	126.0
0.682966	---	39.18	---	70.92	31.74	1000.0	9.000	100.0	H	225.0
0.739010	---	38.31	---	70.23	31.92	1000.0	9.000	100.0	H	102.0
1.163704	---	33.85	---	66.29	32.44	1000.0	9.000	100.0	H	90.0
2.164508	---	27.26	---	69.54	42.28	1000.0	9.000	100.0	H	135.0

Test mode condition	LoRa – mid channel 908.7 MHz	
Antenna orientation	Horizontal and Vertical	
Sweep frequency	30 MHz – 1 GHz	
Standard	47 CFR FCC Part 15 subpart C	
EUT	A003003480-001	
Ancillary Equipment	None	
Test Engineer	Sam Ebadeh	Date: 2021.03.05
Chamber details	Chamber: SAC 5	



Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
30.109802	31.59	40.00	8.41	1000.0	120.000	100.0	H	220.0
42.490480	23.21	40.00	16.79	1000.0	120.000	125.0	H	88.0
85.537480	21.51	40.00	18.49	1000.0	120.000	125.0	H	248.0
170.546240	23.97	43.52	19.55	1000.0	120.000	303.0	H	68.0
347.080640	27.33	46.02	18.69	1000.0	120.000	133.0	H	72.0
486.653600	30.50	46.02	15.52	1000.0	120.000	325.0	V	248.0
600.085280	33.29	46.02	12.73	1000.0	120.000	175.0	H	22.0
908.643320	113.06	125.23	12.17	1000.0	120.000	100.0	H	220.0

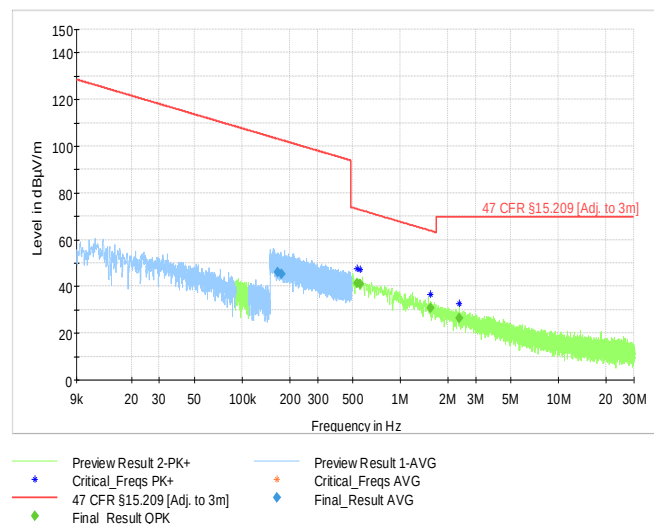
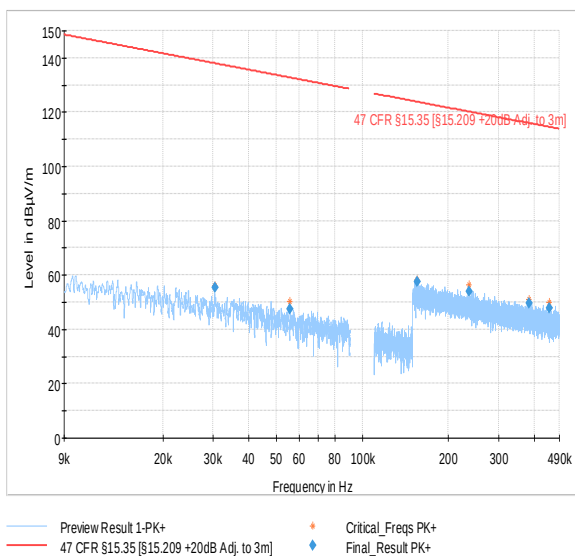
Test mode condition	LoRa – mid channel 908.7 MHz	
Antenna orientation	Horizontal and Vertical	
Sweep frequency	1 GHz – 18 GHz	
Standard	47 CFR FCC Part 15 subpart C	
EUT	A003003480-001	
Ancillary Equipment	None	
Test Engineer	Niall Forrester	Date: 2021.02.18
Chamber details	Chamber: SAC 5	



Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
1817.435000	---	33.48	53.98	20.50	1000.0	1000.000	169.0	H	177.0
2725.886000	52.52	---	73.98	21.46	1000.0	1000.000	137.0	H	267.0
2725.995000	---	47.47	53.98	6.51	1000.0	1000.000	137.0	H	267.0
5981.962000	56.15	---	73.98	17.83	1000.0	1000.000	125.0	V	221.0
5988.493000	---	42.85	53.98	11.13	1000.0	1000.000	137.0	H	338.0
6360.494000	---	42.24	53.98	11.74	1000.0	1000.000	110.0	V	309.0
6360.835000	50.59	---	73.98	23.39	1000.0	1000.000	120.0	V	309.0
6360.948000	---	44.96	53.98	9.02	1000.0	1000.000	119.0	V	309.0
7269.397000	---	37.32	53.98	16.66	1000.0	1000.000	175.0	V	158.0
7269.710000	46.66	---	73.98	27.32	1000.0	1000.000	110.0	H	85.0
8178.255000	---	32.45	53.98	21.52	1000.0	1000.000	149.0	V	252.0
8178.524000	---	31.25	53.98	22.73	1000.0	1000.000	135.0	V	252.0
17979.429000	---	39.77	53.98	14.21	1000.0	1000.000	100.0	H	232.0
17995.426520	51.28	---	73.98	22.70	1000.0	1000.000	126.0	H	112.0

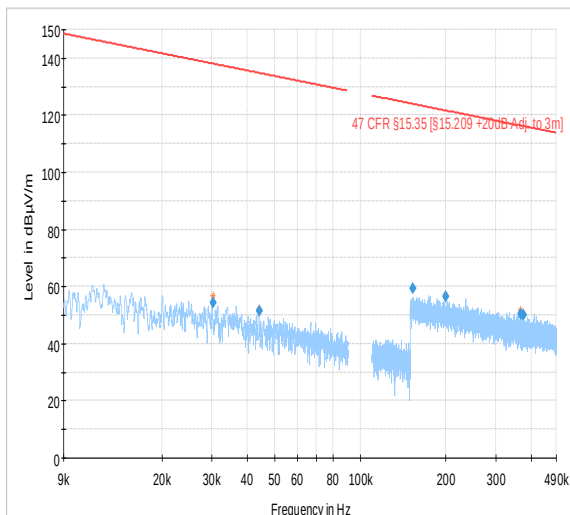
High Channel

Test mode condition	LoRa – high channel 914.9 MHz	
Antenna orientation	Parallel to floor	
Sweep frequency	9 kHz – 30 MHz	
Standard	47 CFR FCC Part 15 subpart C	
EUT	A003003480-001	
Ancillary Equipment	None	
Test Engineer	Simon Palmhager	Date: 2021.03.17
Chamber details	Chamber: SAC 5	

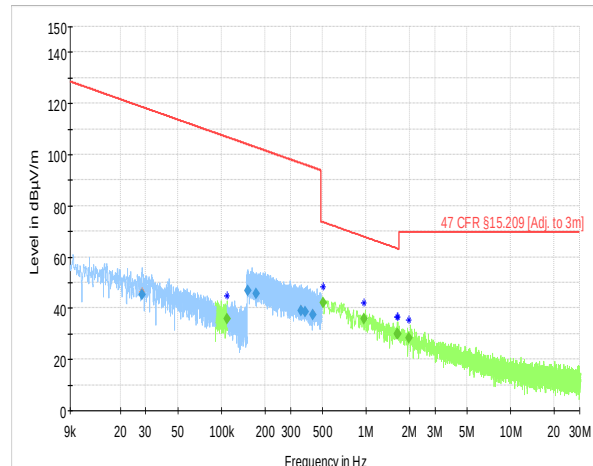


Frequency (MHz)	Average (dBµV/m)	QuasiPeak (dBµV/m)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
0.030358	---	---	55.22	137.96	82.74	1000.0	0.200	100.0	H	135.0
0.055581	---	---	47.45	132.71	85.26	1000.0	0.200	100.0	H	293.0
0.155357	---	---	57.60	123.78	66.18	1000.0	9.000	100.0	H	243.0
0.236876	---	---	53.82	120.11	66.29	1000.0	9.000	100.0	H	215.0
0.384024	---	---	49.51	115.92	66.41	1000.0	9.000	100.0	H	10.0
0.452668	---	---	47.75	114.49	66.74	1000.0	9.000	100.0	H	35.0
0.167324	46.02	---	---	103.13	57.12	1000.0	9.000	100.0	H	-26.0
0.177882	45.43	---	---	102.60	57.17	1000.0	9.000	100.0	H	269.0
0.534603	---	41.47	---	73.04	31.57	1000.0	9.000	100.0	H	64.0
0.559442	---	41.09	---	72.65	31.56	1000.0	9.000	100.0	H	25.0
1.550908	---	30.67	---	63.79	33.12	1000.0	9.000	100.0	H	89.0
2.370071	---	26.48	---	69.54	43.07	1000.0	9.000	100.0	H	-26.0

Test mode condition	LoRa – high channel 914.9 MHz	
Antenna orientation	Perpendicular to axis	
Sweep frequency	9 kHz – 30 MHz	
Standard	47 CFR FCC Part 15 subpart C	
EUT	A003003480-001	
Ancillary Equipment	None	
Test Engineer	Simon Palmhager	Date: 2021.03.17
Chamber details	Chamber: SAC 5	



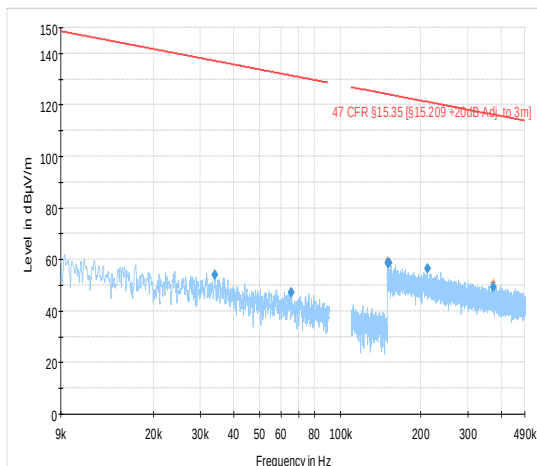
Preview Result 1-PK+
47 CFR §15.35 [§15.209 +20dB Adj. to 3m]
Critical_Freqs PK+
Final_Result PK+



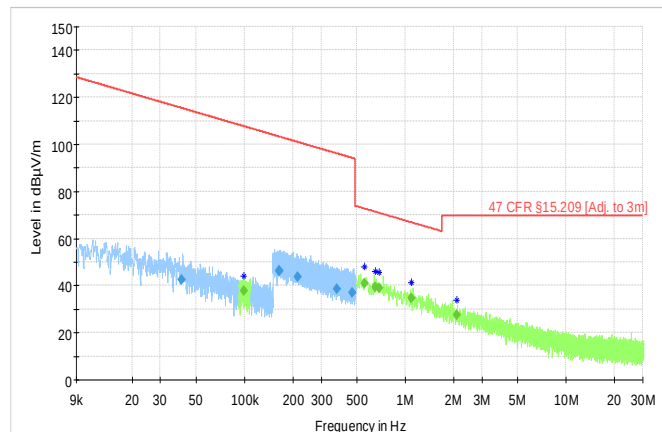
Preview Result 2-PK+
Critical_Freqs PK+
47 CFR §15.209 [Adj. to 3m]
Final_Result QPK
Preview Result 1-AVG
Critical_Freqs AVG
Final_Result AVG

Frequency (MHz)	Average (dBµV/m)	QuasiPeak (dBµV/m)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
0.030283	---	---	54.42	137.98	83.56	1000.0	0.200	100.0	H	225.0
0.044163	---	---	51.49	134.70	83.21	1000.0	0.200	100.0	H	99.0
0.152941	---	---	59.25	123.91	64.66	1000.0	9.000	100.0	H	292.0
0.200197	---	---	56.47	121.58	65.11	1000.0	9.000	100.0	H	88.0
0.367572	---	---	50.45	116.30	65.85	1000.0	9.000	100.0	H	216.0
0.376090	---	---	50.17	116.10	65.93	1000.0	9.000	100.0	H	165.0
0.028253	45.45	---	---	118.58	73.13	1000.0	0.200	100.0	H	101.0
0.109340	---	35.99	---	106.83	70.84	1000.0	0.200	100.0	H	37.0
0.152167	46.67	---	---	103.96	57.29	1000.0	9.000	100.0	H	229.0
0.174379	45.56	---	---	102.77	57.21	1000.0	9.000	100.0	H	45.0
0.354696	39.17	---	---	96.61	57.44	1000.0	9.000	100.0	H	225.0
0.380710	38.56	---	---	95.99	57.43	1000.0	9.000	100.0	H	306.0
0.430337	37.55	---	---	94.93	57.38	1000.0	9.000	100.0	H	244.0
0.505377	---	42.03	---	73.53	31.50	1000.0	9.000	100.0	H	166.0
0.963880	---	35.86	---	67.92	32.07	1000.0	9.000	100.0	H	225.0
1.641915	---	30.05	---	63.30	33.25	1000.0	9.000	100.0	H	100.0
1.653700	---	30.12	---	63.24	33.12	1000.0	9.000	100.0	H	225.0
1.989879	---	28.18	---	69.54	41.36	1000.0	9.000	100.0	H	166.0

Test mode condition	LoRa – high channel 914.9 MHz	
Antenna orientation	Parallel to axis	
Sweep frequency	9 kHz – 30 MHz	
Standard	47 CFR FCC Part 15 subpart C	
EUT	A003003480-001	
Ancillary Equipment	None	
Test Engineer	Simon Palmhager	Date: 2021.03.10
Chamber details	Chamber: SAC 5	



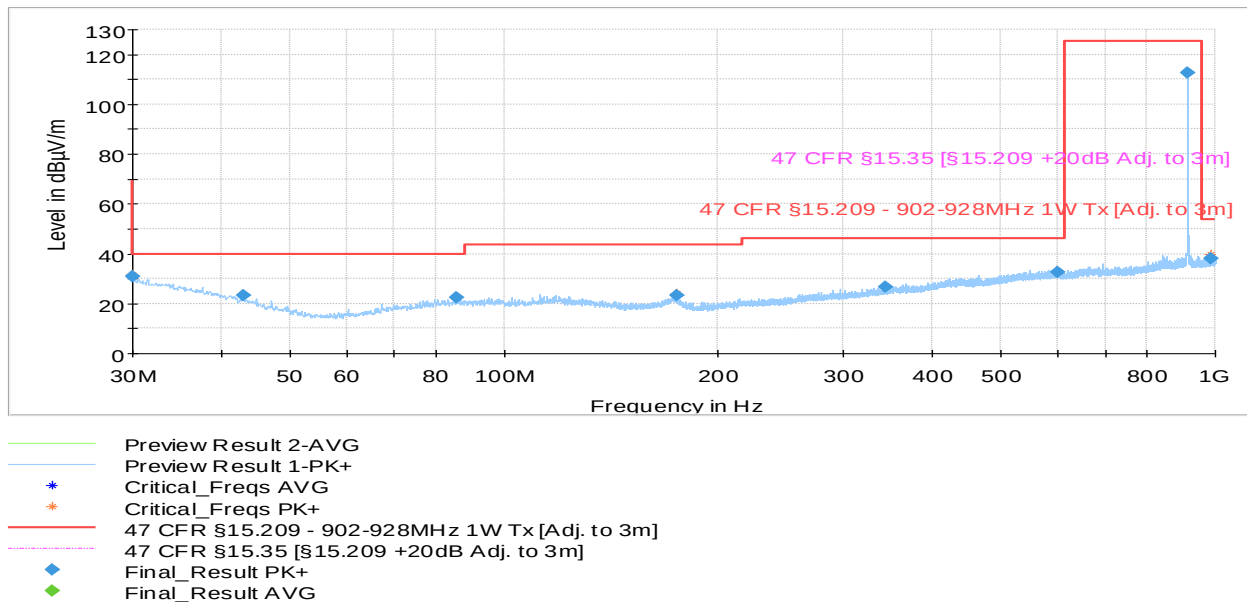
Preview Result 1-PK+ Critical_Freqs PK+
47 CFR §15.35 [§15.209 +20dB Adj. to 3m] Final_Result PK+



Preview Result 2-PK+ Preview Result 1-AVG
Critical_Freqs PK+ Critical_Freqs AVG
47 CFR §15.209 [Adj. to 3m] Final_Result AVG
Final_Result QPK

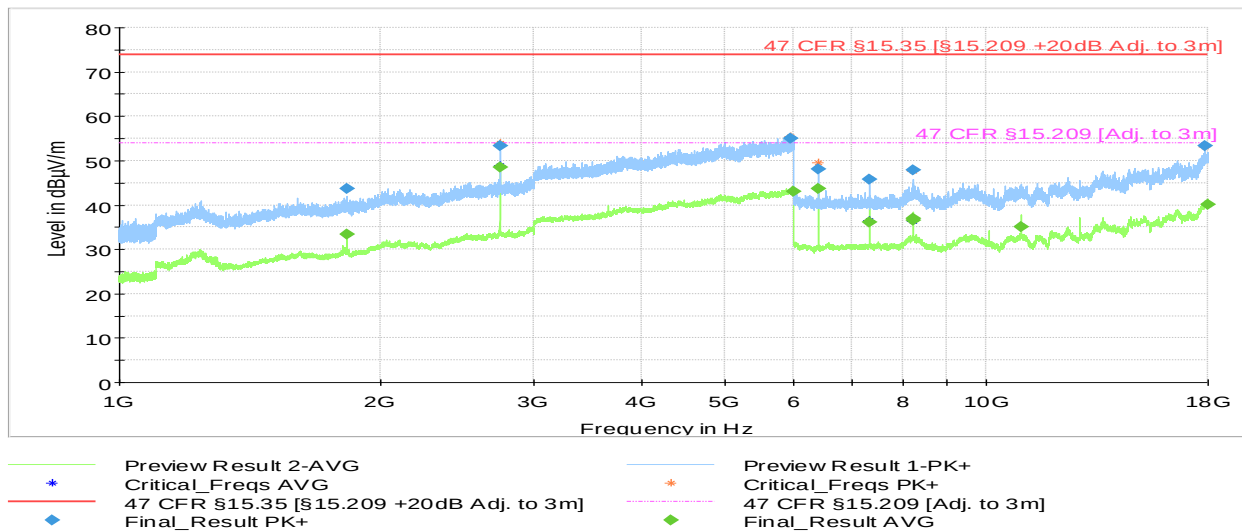
Frequency (MHz)	Average (dBµV/m)	QuasiPeak (dBµV/m)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
0.033876	---	---	54.10	137.01	82.90	1000.0	0.200	100.0	H	225.0
0.065393	---	---	47.25	131.29	84.04	1000.0	0.200	100.0	H	294.0
0.150836	---	---	58.72	124.03	65.31	1000.0	9.000	100.0	H	49.0
0.152389	---	---	58.51	123.95	65.44	1000.0	9.000	100.0	H	305.0
0.212255	---	---	56.30	121.07	64.77	1000.0	9.000	100.0	H	10.0
0.372467	---	---	49.30	116.18	66.88	1000.0	9.000	100.0	H	223.0
0.040602	42.34	---	---	115.43	73.09	1000.0	0.200	100.0	H	283.0
0.099329	---	37.60	---	107.66	70.06	1000.0	0.200	100.0	H	-27.0
0.163600	46.34	---	---	103.33	56.99	1000.0	9.000	100.0	H	268.0
0.164721	46.16	---	---	103.27	57.10	1000.0	9.000	100.0	H	225.0
0.214511	43.84	---	---	100.98	57.13	1000.0	9.000	100.0	H	88.0
0.377446	38.63	---	---	96.07	57.44	1000.0	9.000	100.0	H	229.0
0.467101	36.83	---	---	94.22	57.39	1000.0	9.000	100.0	H	101.0
0.556340	---	41.03	---	72.70	31.67	1000.0	9.000	100.0	H	45.0
0.653011	---	39.54	---	71.31	31.76	1000.0	9.000	100.0	H	315.0
0.685714	---	39.01	---	70.88	31.87	1000.0	9.000	100.0	H	76.0
1.093147	---	34.61	---	66.83	32.22	1000.0	9.000	100.0	H	11.0
2.087502	---	27.69	---	69.54	41.85	1000.0	9.000	100.0	H	-45.0

Test mode condition	LoRa – high channel 914.9 MHz	
Antenna orientation	Horizontal and Vertical	
Sweep frequency	30 MHz – 1 GHz	
Standard	47 CFR FCC Part 15 subpart C	
EUT	A003003480-001	
Ancillary Equipment	None	
Test Engineer	Sam Ebadeh	Date: 2021.03.05
Chamber details	Chamber: SAC 5	



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
30.011116	31.01	40.00	8.99	1000.0	120.000	125.0	V	-4.0
43.059680	23.16	40.00	16.84	1000.0	120.000	410.0	V	86.0
85.855040	22.54	40.00	17.46	1000.0	120.000	175.0	H	158.0
174.834760	23.19	43.52	20.33	1000.0	120.000	125.0	V	243.0
344.176200	26.51	46.02	19.51	1000.0	120.000	233.0	V	-18.0
600.449480	32.55	46.02	13.47	1000.0	120.000	275.0	V	26.0
914.840440	112.73	125.23	12.50	1000.0	120.000	100.0	H	220.0
985.185800	37.92	53.98	16.06	1000.0	120.000	125.0	H	338.0

Test mode condition	LoRa – high channel 914.9 MHz	
Antenna orientation	Horizontal and Vertical	
Sweep frequency	1 GHz – 18 GHz	
Standard	47 CFR FCC Part 15 subpart C	
EUT	A003003480-001	
Ancillary Equipment	None	
Test Engineer	Niall Forrester	Date: 2021.02.23
Chamber details	Chamber: SAC 5	



Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
1829.815000	---	33.29	53.98	20.69	1000.0	1000.000	102.0	H	-3.0
1829.982000	43.59	---	73.98	30.39	1000.0	1000.000	125.0	H	-3.0
2744.559000	53.37	---	73.98	20.61	1000.0	1000.000	148.0	H	267.0
2744.828000	---	48.55	53.98	5.43	1000.0	1000.000	185.0	H	267.0
5944.273000	54.95	---	73.98	19.03	1000.0	1000.000	175.0	H	158.0
5980.476000	---	42.99	53.98	10.99	1000.0	1000.000	125.0	V	292.0
6404.317000	48.17	---	73.98	25.81	1000.0	1000.000	120.0	V	310.0
6404.505000	---	43.73	53.98	10.25	1000.0	1000.000	175.0	V	292.0
7318.788000	45.86	---	73.98	28.12	1000.0	1000.000	125.0	V	162.0
7318.997000	---	36.11	53.98	17.87	1000.0	1000.000	125.0	V	175.0
8234.047000	47.84	---	73.98	26.14	1000.0	1000.000	100.0	H	248.0
8234.061000	---	36.87	53.98	17.11	1000.0	1000.000	125.0	H	248.0
8234.350000	---	36.43	53.98	17.55	1000.0	1000.000	125.0	H	219.0
10979.488000	---	35.13	53.98	18.85	1000.0	1000.000	120.0	V	68.0
17850.097000	53.40	---	73.98	20.58	1000.0	1000.000	210.0	V	72.0
17995.715180	---	40.19	53.98	13.79	1000.0	1000.000	175.0	V	154.0

4.3 Test Results – Out of Band Emissions

4.3.1 Out of Band Emissions – Test Summary

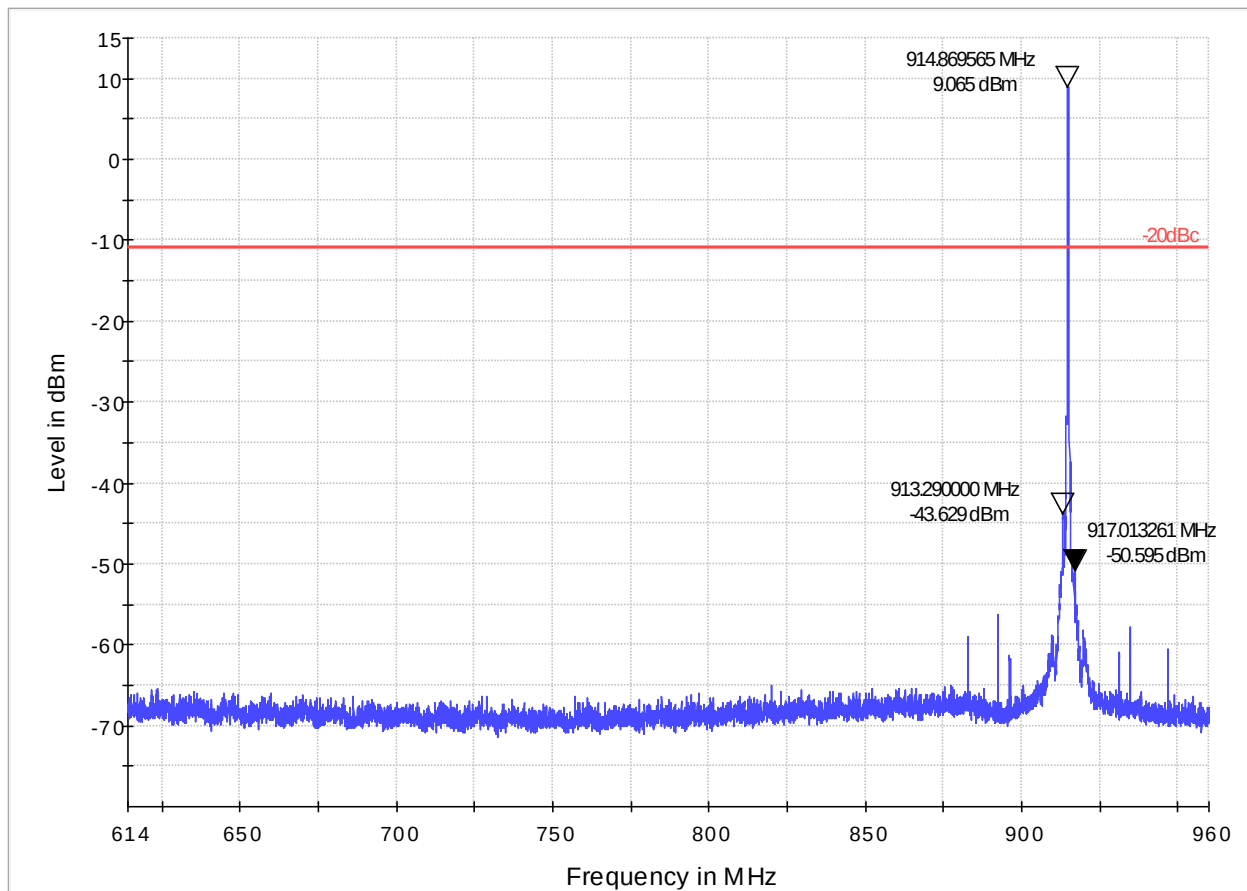
Emissions measurements have been performed as radiated test (see section 4.2)

4.4 Test Results – Band Edge Compliance (Authorized Band)

4.4.1 Band Edge Compliance (Authorized Band) – Test Summary

Test Specification	47 CFR 15.247 (d)			
Test Engineer & Date	Sam Ebadeh		2021.08.31	
EUT and Ancillary Equipment IDs	A003003480-002		None	
EUT Operation Mode(s)	Default DTS			
EUT Wireless Configuration(s)	LoRa			
EUT Hardware Configuration(s)	N/A			
Overall Result	PASS			
Test Parameter	Wireless Configuration	Measured Level (dBm)	Limit (dBm)	Result
Emissions at Band Edge (Auth. Band – Low Edge)	902.3 MHz Low channel	-55.403	-11.138	PASS
Emissions at Band Edge (Auth. Band – High Edge)	914.9 High channel	-43.629	-10.935	PASS

4.4.2 Band Edge Compliance (Authorized Band) – Test Details (Worst Case Plot)



4.5 Test Results – Band Edge Compliance (Restricted Band)

4.5.1 Band Edge Compliance (Restricted Band) – Test Summary

Test Specification	47 CFR 15.209 & 15.247 (d)	
Test Engineer & Date	Sam Ebadeh	2021.05.31 – 2021.06.15
EUT and Ancillary Equipment IDs	A003003480-001	None
EUT Operation Mode(s)	Default FHSS and Default DTS	
EUT Wireless Configuration(s)	LoRa	
EUT Hardware Configuration(s)	N/A	
Overall Result	PASS	

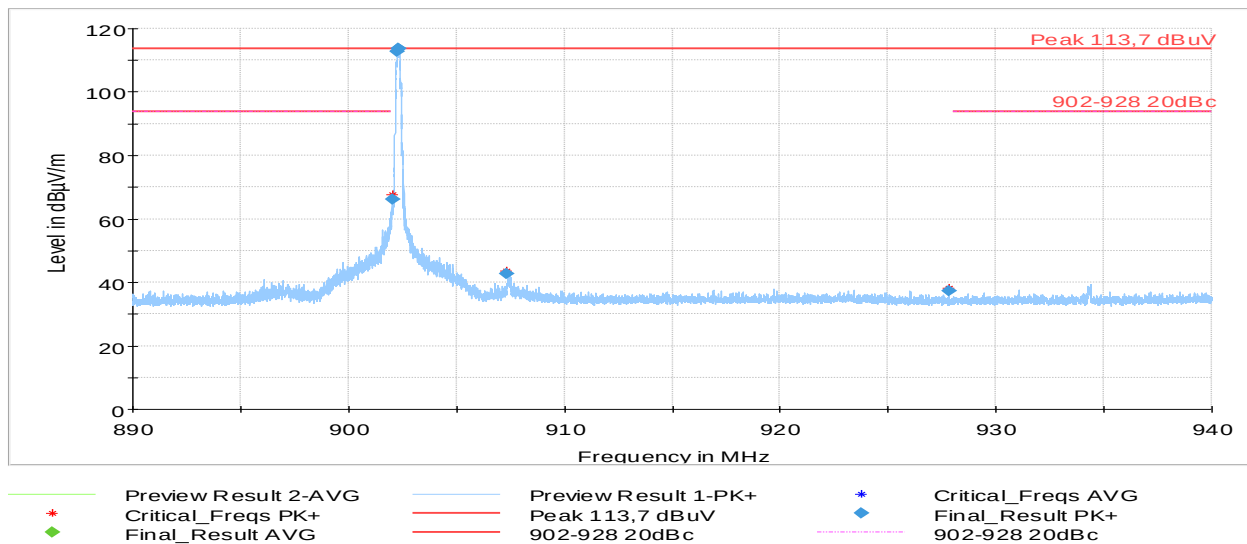
Test Parameter	Wireless Configuration	Result*
Emissions at Band Edge (Rest. Band – Low Edge)	Low channel - 902.3 MHz 125 kHz	PASS
Emissions at Band Edge (Rest. Band – High Edge)	High channel – 914.9 MHz 125 kHz	PASS
Emissions at Band Edge (Rest. Band – Low Edge)	Low channel – 903.0 MHz 500 kHz	PASS
Emissions at Band Edge (Rest. Band – High Edge)	High channel – 914.9 MHz 500 kHz	PASS

* For detailed measurements, see tables and graphs in sections below

4.5.2 Band Edge Compliance (Restricted Band) – Test Details

Restricted Band – Low Edge – 125 kHz BW

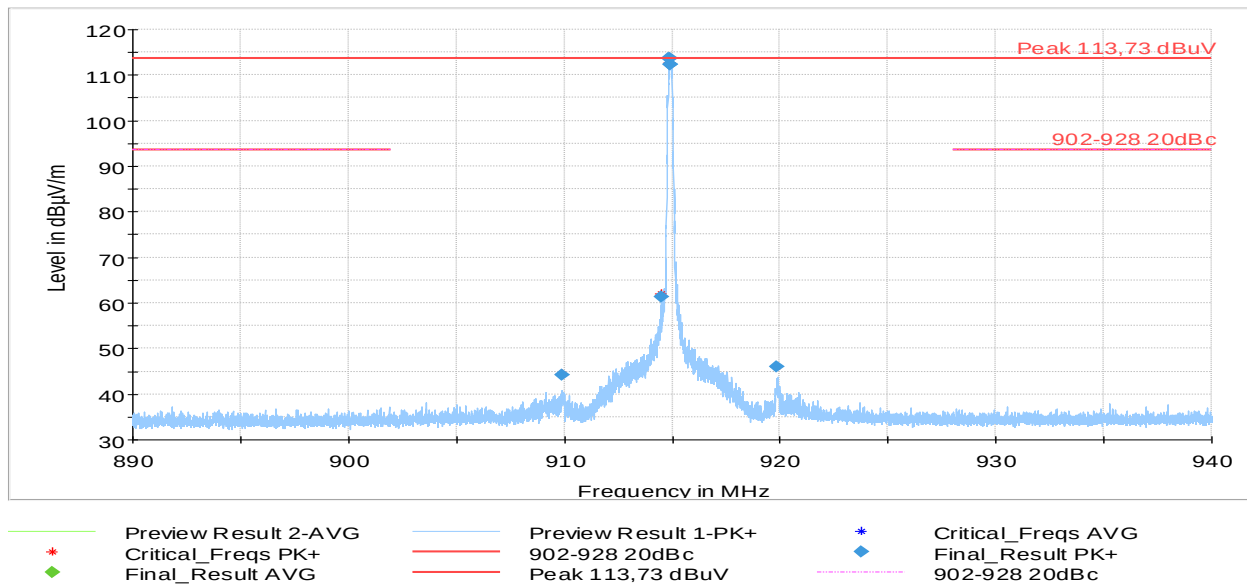
Test mode condition	LoRa - low channel 902.3 MHz: 125 kHz BW	
Antenna orientation	Horizontal and Vertical	
Sweep frequency	890 MHz – 940 MHz	
Standard	47 CFR FCC Part 15 subpart C	
EUT	A003003480-001	
Ancillary Equipment	None	
Test Engineer	Sam Ebadeh	Date: 2021-06-14
Chamber details	Chamber: SAC 5	



Frequency (MHz)	MaxPeak (dBuV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
902.039500	66.28	1000.0	100.000	410.0	V	98.0
902.249500	112.84	1000.0	100.000	100.0	H	40.0
902.296300	113.64	1000.0	100.000	100.0	H	162.0
902.342700	113.65	1000.0	100.000	100.0	H	162.0
907.334800	42.81	1000.0	100.000	100.0	H	158.0
927.827900	37.35	1000.0	100.000	375.0	H	26.0

Restricted Band – High Edge – 125 kHz BW

Test mode condition	LoRa - high channel 914.9 MHz: 125 kHz BW	
Antenna orientation	Horizontal and Vertical	
Sweep frequency	890 MHz – 940 MHz	
Standard	47 CFR FCC Part 15 subpart C	
EUT	A003003480-001	
Ancillary Equipment	None	
Test Engineer	Sam Ebadeh	Date: 2021-06-15
Chamber details	Chamber: SAC 5	

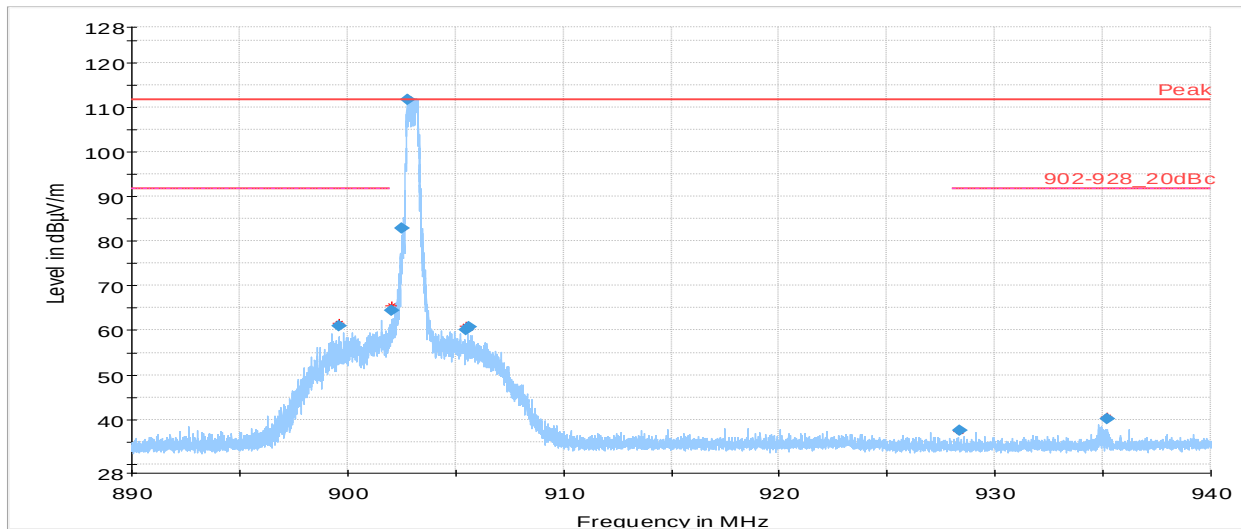


Frequency (MHz)	MaxPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
909.903600	44.20	1000.0	100.000	100.0	H	158.0
914.509600	61.24	1000.0	100.000	100.0	H	52.0
914.840500	113.73	1000.0	100.000	100.0	H	162.0
914.868100	112.31	1000.0	100.000	204.0	H	162.0
914.881600	113.73	1000.0	100.000	100.0	H	162.0
914.896000	112.38	1000.0	100.000	100.0	H	40.0
919.841800	46.09	1000.0	100.000	100.0	H	162.0

4.5.3 Band Edge Compliance (Restricted Band) – Test Details

Restricted Band – Low Edge – 500 kHz BW

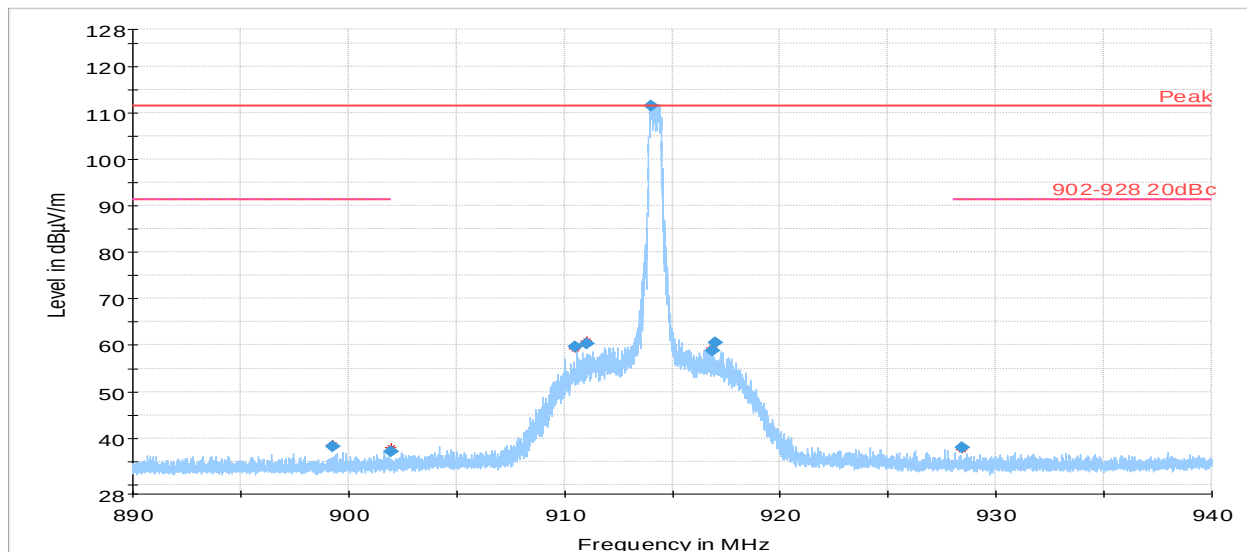
Test mode condition	LoRa - low channel 903.0 MHz: 500 kHz BW	
Antenna orientation	Horizontal and Vertical	
Sweep frequency	890 MHz – 940 MHz	
Standard	47 CFR FCC Part 15 subpart C	
EUT	A003003480-001	
Ancillary Equipment	None	
Test Engineer	Simon Palmhager	Date: 2021-05-31
Chamber details	Chamber: SAC 5	



Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
899.612400	60.91	1000.0	100.000	100.0	H	232.0
902.032500	64.53	1000.0	100.000	100.0	H	232.0
902.500000	82.83	1000.0	100.000	100.0	H	221.0
902.805600	111.70	1000.0	100.000	100.0	H	220.0
905.463400	60.05	1000.0	100.000	100.0	H	206.0
905.639600	60.67	1000.0	100.000	100.0	H	220.0
928.341100	37.65	1000.0	100.000	175.0	H	199.0
935.208500	40.13	1000.0	100.000	133.0	H	220.0

Restricted Band – High Edge – 500 kHz BW

Test mode condition	LoRa - high channel 914.9 MHz: 500 kHz BW	
Antenna orientation	Horizontal and Vertical	
Sweep frequency	890 MHz – 940 MHz	
Standard	47 CFR FCC Part 15 subpart C	
EUT	A003003480-001	
Ancillary Equipment	None	
Test Engineer	Simon Palmhager	Date: 2021-05-31
Chamber details	Chamber: SAC 5	



Frequency (MHz)	MaxPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
899.291400	38.29	1000.0	100.000	100.0	H	206.0
901.983600	37.08	1000.0	100.000	275.0	V	202.0
910.481600	59.76	1000.0	100.000	100.0	H	222.0
911.026100	60.25	1000.0	100.000	100.0	H	232.0
913.990500	111.44	1000.0	100.000	100.0	H	220.0
916.873700	58.77	1000.0	100.000	133.0	H	-18.0
916.964300	60.62	1000.0	100.000	100.0	H	232.0
928.424900	37.94	1000.0	100.000	333.0	V	153.0

4.6 Test Results – 20dB Bandwidth

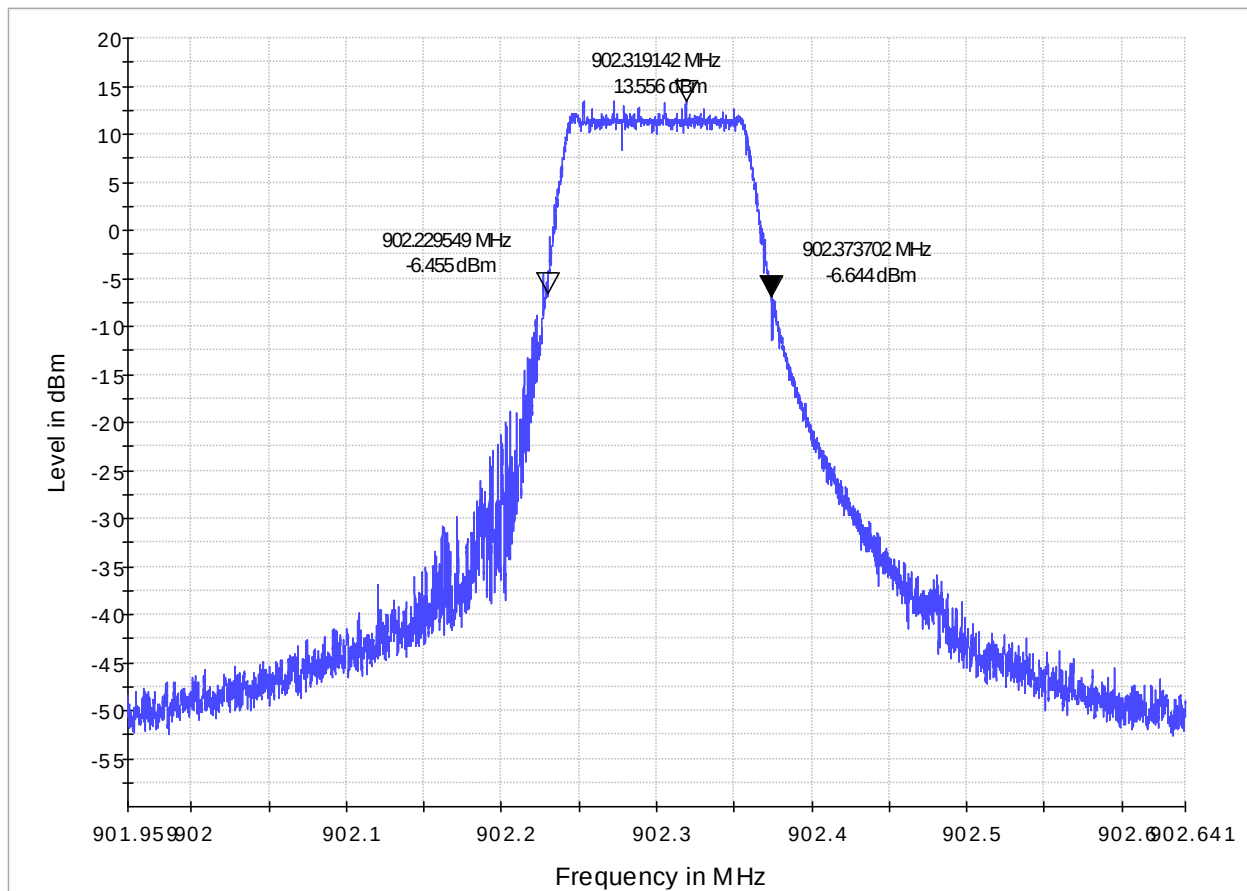
4.6.1 20dB Bandwidth – Test Summary

Test Specification	47 CFR 15.247 (a)(1)			
Test Engineer & Date	Sam Ebadeh	2021.06.22		
EUT and Ancillary Equipment IDs	A003003480-002	None		
EUT Operation Mode(s)	Default FHSS			
EUT Wireless Configuration(s)	LoRa			
EUT Hardware Configuration(s)	N/A			
Overall Result	PASS			

Test Parameter	Wireless Configuration	Bandwidth (kHz)	Limit (kHz)	Result
20dB Bandwidth FHSS	Low channel 902.3 MHz	144.2	See note	PASS
20dB Bandwidth FHSS	Mid channel 908.7 MHz	145.2	See note	PASS
20dB Bandwidth FHSS	High channel 914.9 MHz	144.9	See note	PASS

Note: For FHSS the 20dB bandwidth limits is based on following criteria: If the 20dB bandwidth of the hopping channel is less than 250 kHz the system shall use at least 50 hopping channels and the average time of occupancy on any channel shall not be greater than 0.4s within a 20-second period.

4.6.2 20dB Bandwidth – Test Details (Worst Case Plot)



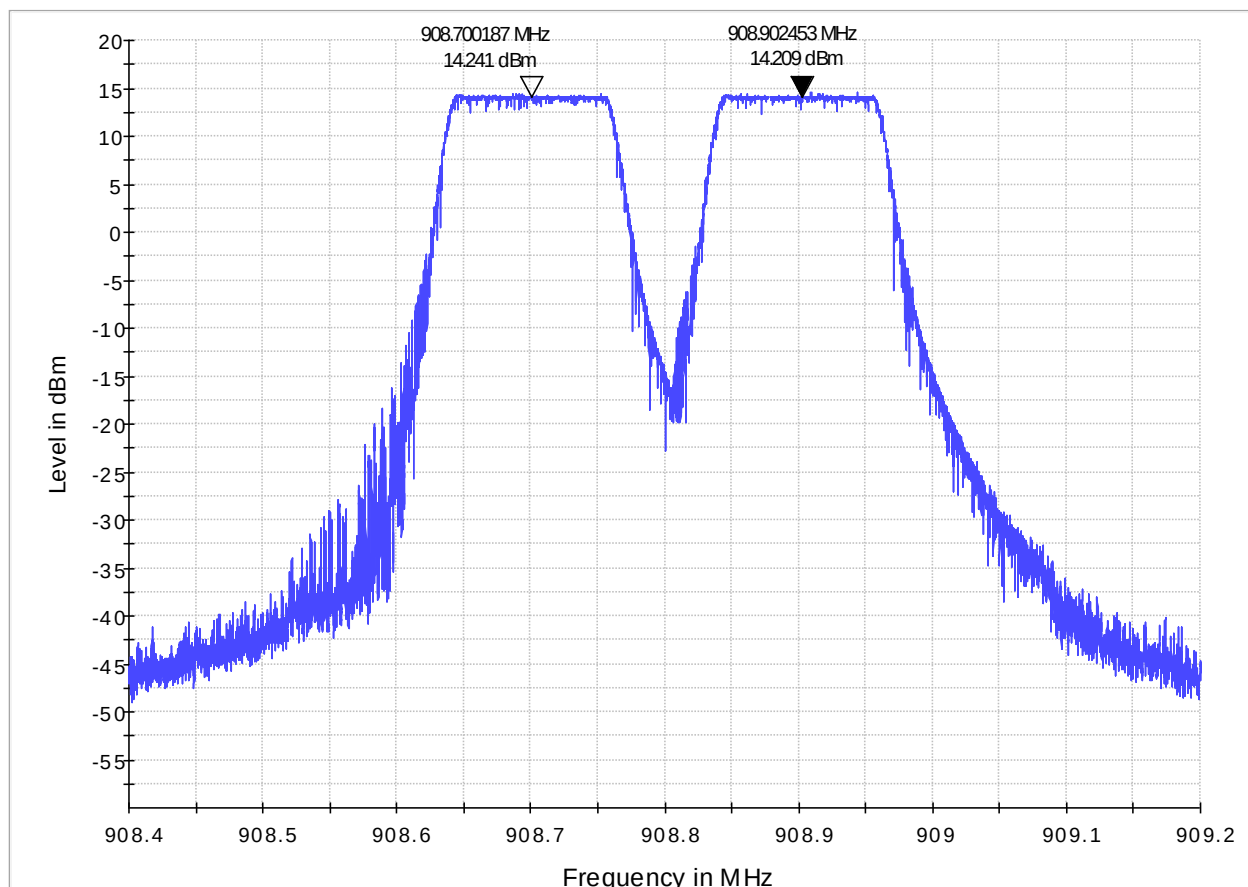
4.7 Test Results – Carrier (Hopping Channel) Separation

4.7.1 Carrier (Hopping Channel) Separation – Test Summary

Test Specification	47 CFR 15.247 (a)(1)			
Test Engineer & Date	Sam Ebadeh		2021.06.22	
EUT and Ancillary Equipment IDs	A003003480-002		None	
EUT Operation Mode(s)	Default FHSS			
EUT Wireless Configuration(s)	LoRa			
EUT Hardware Configuration(s)	N/A			
Overall Result	PASS			

Test Parameter	Wireless Configuration	Separation (kHz)	Minimum Limit (kHz)	Result
Carrier Frequency Separation	LoRa Two adjacent channels	200	25	PASS

4.7.2 Carrier (Hopping Channel) Separation – Test Details (Worst Case Plot)



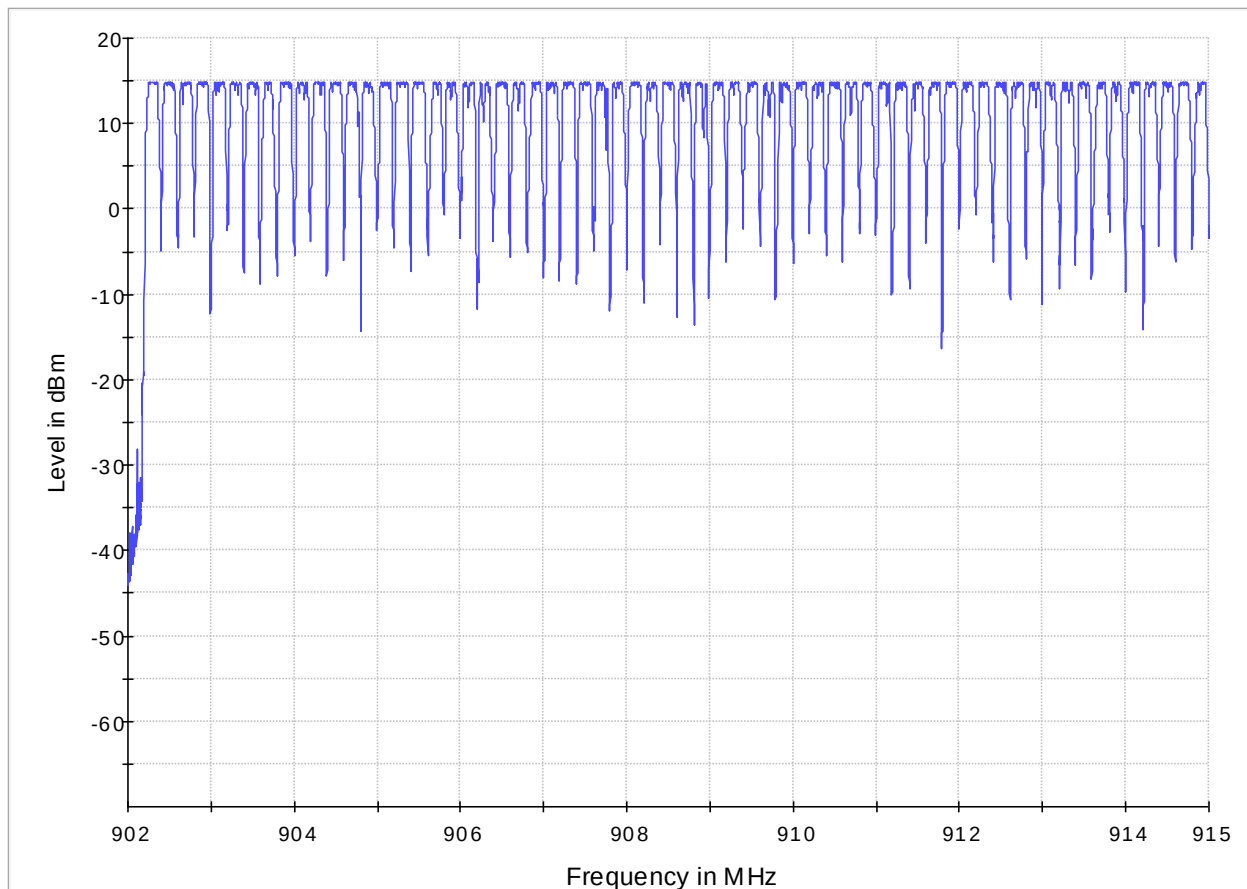
4.8 Test Results – Number of Hopping Channels

4.8.1 Number of Hopping Channels – Test Summary

Test Specification	47 CFR 15.247 (a)(1)			
Test Engineer & Date	Sam Ebadeh		2021.08.10	
EUT and Ancillary Equipment IDs	A003003480-002		None	
EUT Operation Mode(s)	Default FHSS			
EUT Wireless Configuration(s)	LoRa			
EUT Hardware Configuration(s)	N/A			
Overall Result	PASS			

Test Parameter	Wireless Configuration	Measured Number	Limit (Min)	Result
Number of Hopping Channels	LoRa 900 MHz	64	50	PASS

4.8.2 Number of Hopping Channels – Test Details

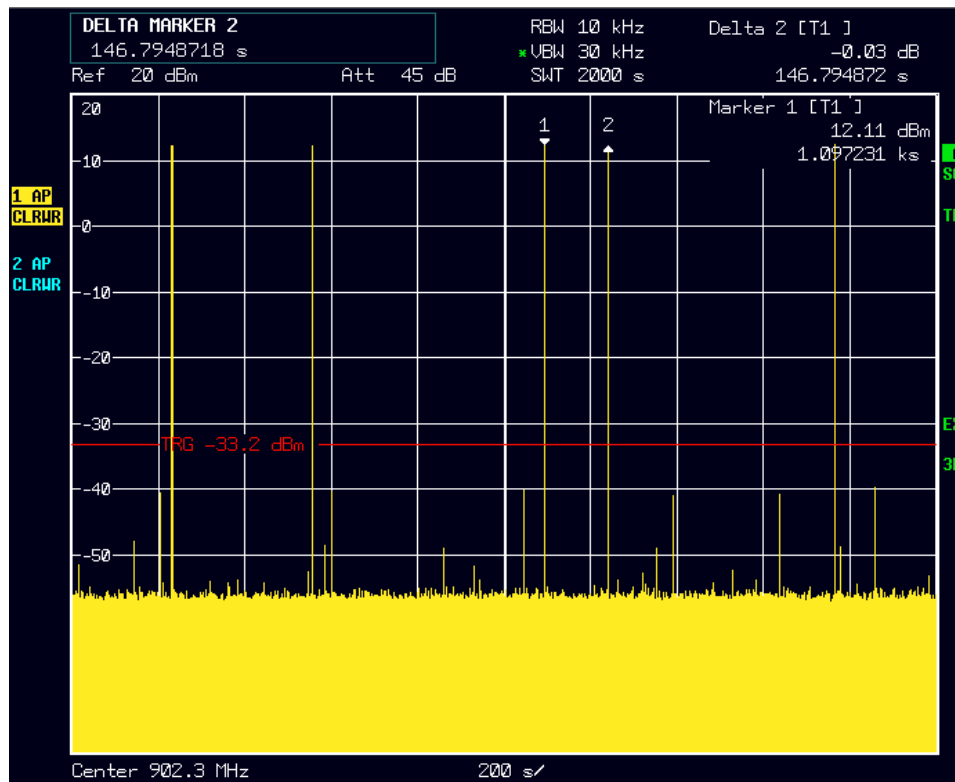


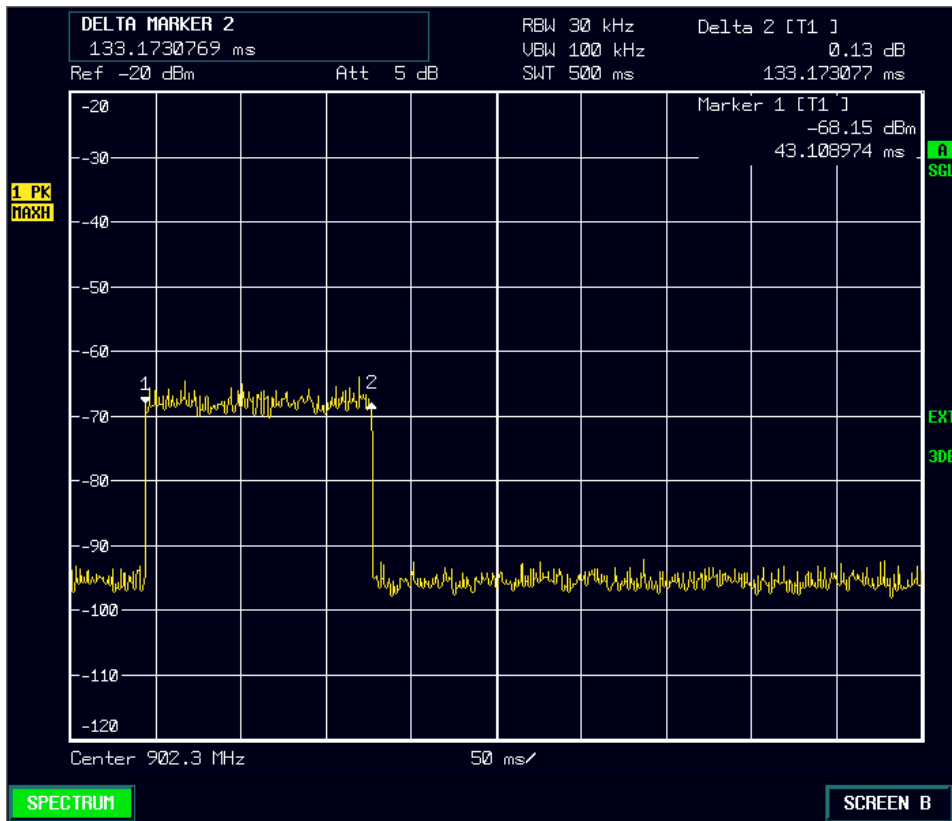
4.9 Test Results – Time of Occupancy (Dwell Time)

4.9.1 Time of Occupancy (Dwell Time) – Test Summary

Test Specification		15.247 (a)(1)			
Test Engineer & Date		Sam Ebadeh	2021.08.16		
EUT and Ancillary Equipment IDs		A003003480-002	None		
EUT Operation Mode(s)		Default FHSS			
EUT Wireless Configuration(s)		LoRa			
EUT Hardware Configuration(s)		N/A			
Overall Result		PASS			
Test Parameter	Wireless Configuration		Measured Time (ms)	Max Limit (ms)	Result
Dwell Time	LoRa 902.3 MHz		133	400	PASS

4.9.2 Time of Occupancy (Dwell Time) – Test Details



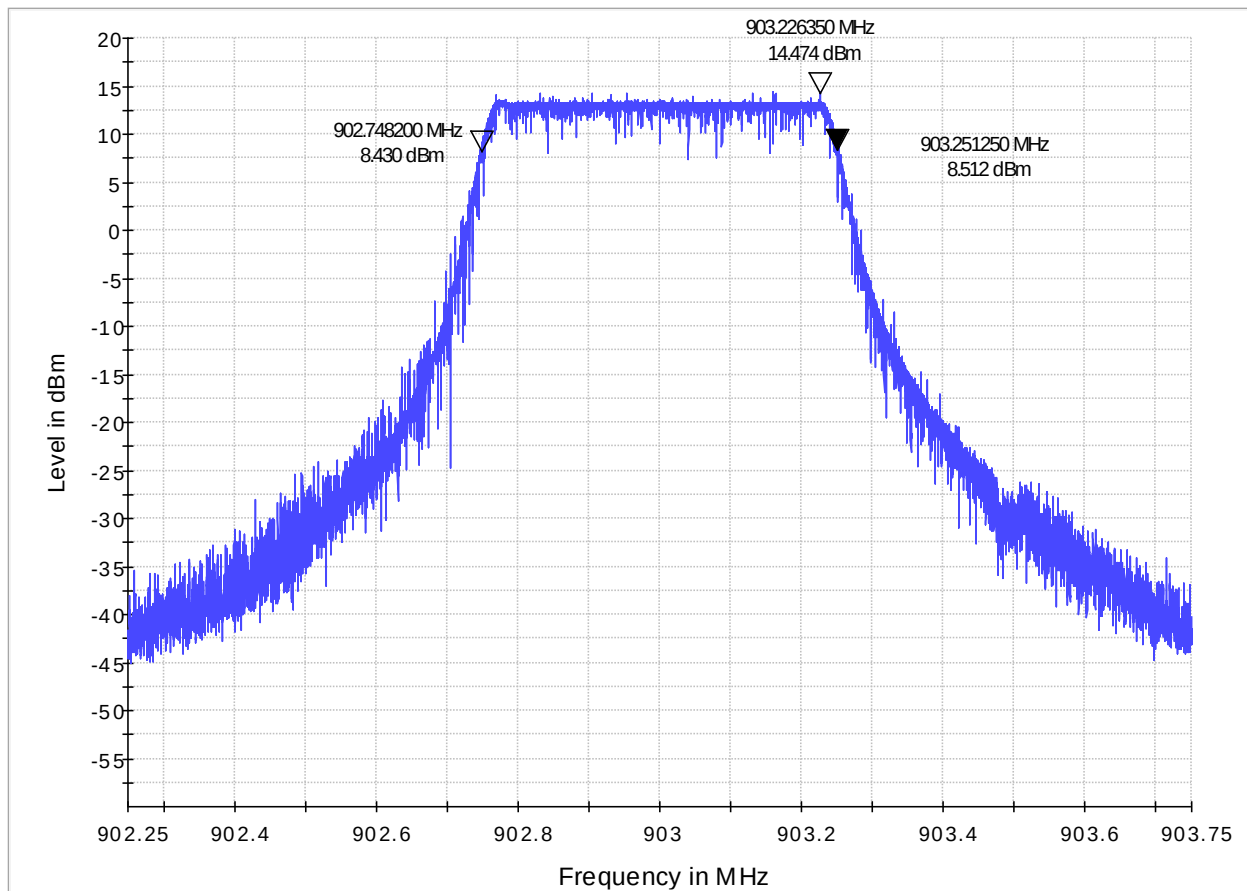


4.10 Test Results – 6dB and 99% Emission Bandwidth

4.10.1 6dB Bandwidth – Test Summary

Test Specification	15.247 (a)(2)			
Test Engineer & Date	Sam Ebadeh		2021.06.16	
EUT and Ancillary Equipment IDs	A003003480-002		None	
EUT Operation Mode(s)	Default DTS			
EUT Wireless Configuration(s)	LoRa			
EUT Hardware Configuration(s)	N/A			
Overall Result	PASS			
Test Parameter	Wireless Configuration	Measured Level (kHz)	Min Limit (kHz)	Result
6dB Bandwidth DTS	Low channel 903.0 MHz	503.05	500	PASS
6dB Bandwidth DTS	Mid channel 909.4 MHz	503.45	500	PASS
6dB Bandwidth DTS	High channel 914.2 MHz	503.35	500	PASS
99% Bandwidth DTS	Low channel 903.0 MHz	519.15	500	PASS
99% Bandwidth DTS	Mid channel 909.4 MHz	520.95	500	PASS
99% Bandwidth DTS	High channel 914.2 MHz	520.65	500	PASS

4.10.2 6dB Bandwidth – Test Details



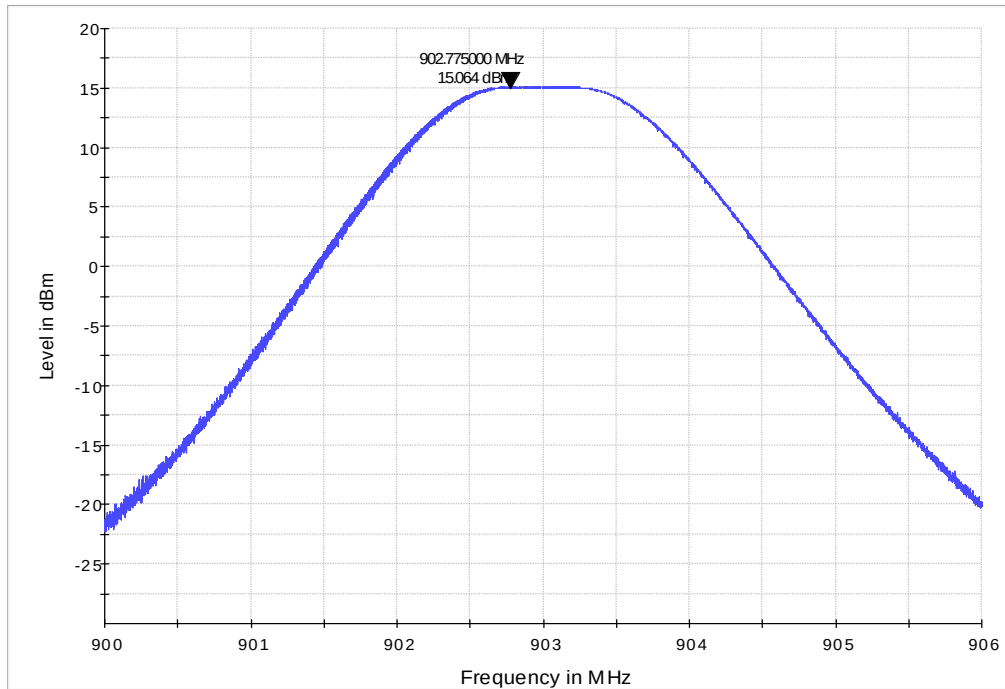
4.11 Test Results – Peak Conducted Output Power

4.11.1 Peak Conducted Output Power – Test Summary

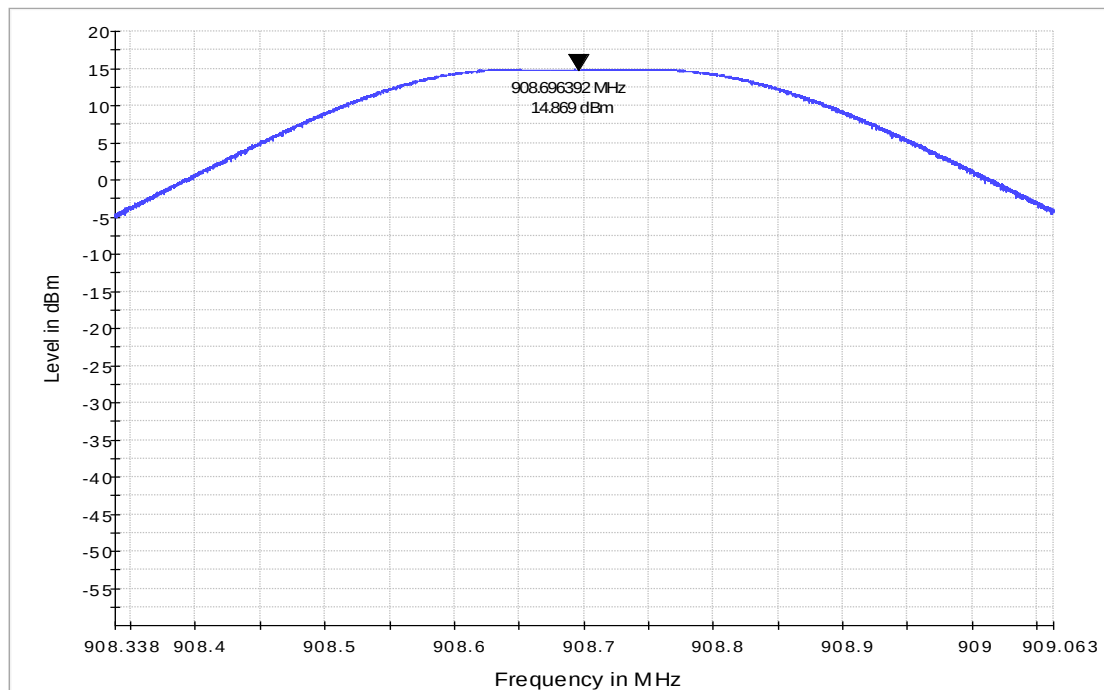
Test Specification		15.247 (b)				
Test Engineer & Date		Sam Ebadeh			2021.06.15 – 2021.06.22	
EUT and Ancillary Equipment IDs		A003003480-002			None	
EUT Operation Mode(s)		Default FHSS and default DTS				
EUT Wireless Configuration(s)		LoRa				
EUT Hardware Configuration(s)		N/A				
Overall Result		PASS				
Test Parameter	Wireless Configuration	Measured Level (dBm)			Limit (dBm)	Result
		Low 2.55V	Nom 3.0V	High 3.7V		
Peak Conducted Output Power	FHSS Low channel 902.3 MHz	14.9	14.9	14.9	30.0	PASS
Peak Conducted Output Power	FHSS Mid channel 908.7 MHz	14.8	14.9	14.9	30.0	PASS
Peak Conducted Output Power	FHSS High channel 914.9 MHz	14.8	14.8	14.9	30.0	PASS
Peak Conducted Output Power	DTS Low channel 903.0 MHz	14.4	14.7	15.1	30.0	PASS
Peak Conducted Output Power	DTS Mid channel 909.4 MHz	14.3	14.7	14.6	30.0	PASS
Peak Conducted Output Power	DTS High channel 914.9 MHz	14.4	14.4	15.0	30.0	PASS

4.11.2 Peak Conducted Output Power – Test Details

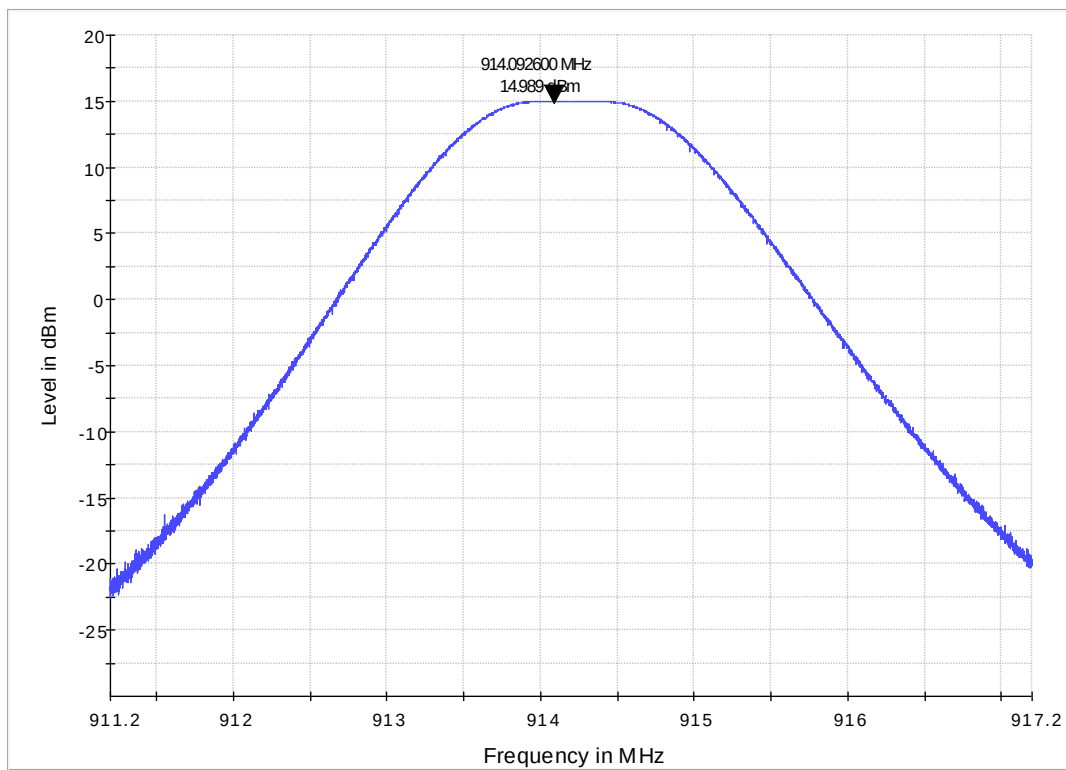
Minimum Voltage (2.55V)



Nominal Voltage (3.0V)



Maximum Voltage (3.7V)



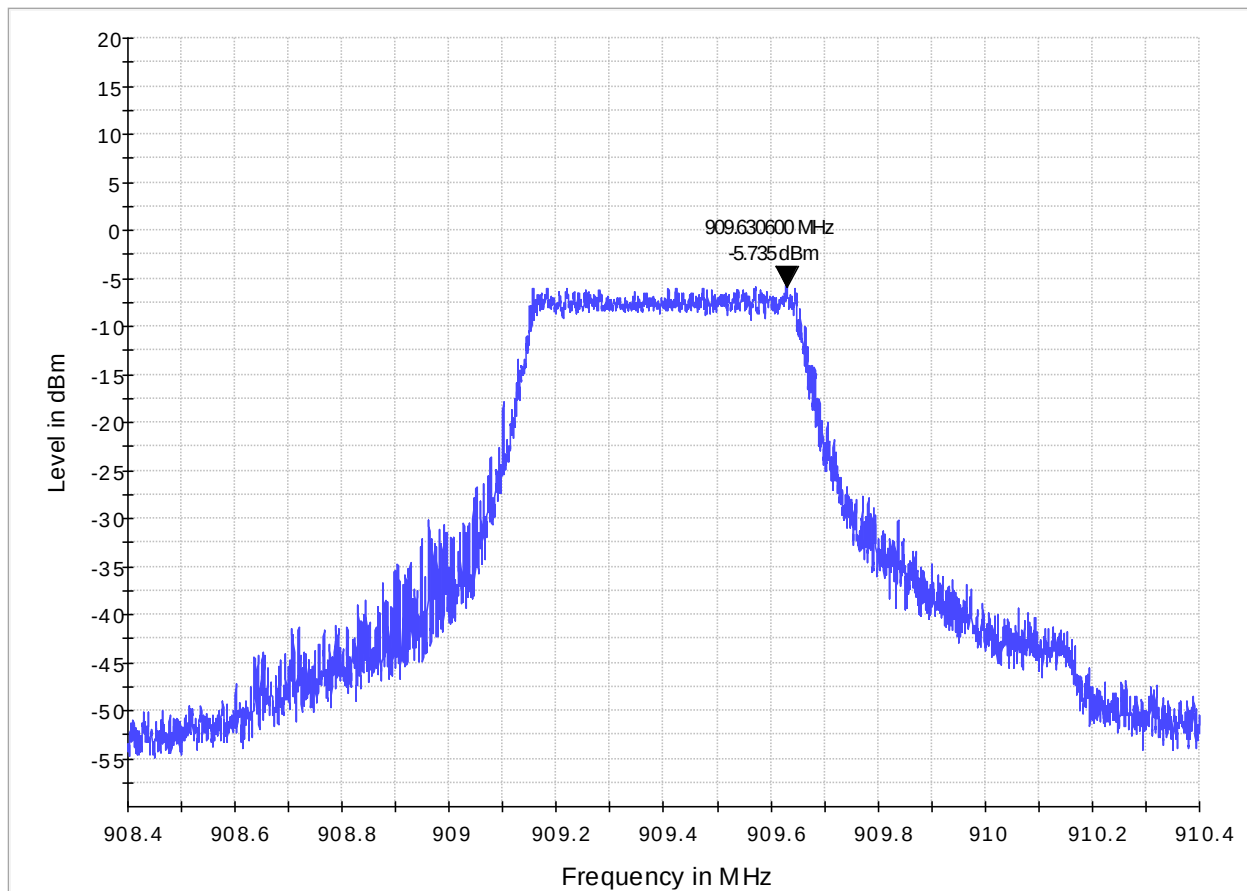
4.12 Test Results – Power Spectral Density

4.12.1 Power Spectral Density – Test Summary

Test Specification		15.247 (e)		
Test Engineer & Date		Sam Ebadeh	2021.06.16	
EUT and Ancillary Equipment IDs		A003003480-002	None	
EUT Operation Mode(s)		Default DTS		
EUT Wireless Configuration(s)		LoRa		
EUT Hardware Configuration(s)		N/A		
Overall Result		PASS		

Test Parameter	Wireless Configuration	Measured (dBm/3kHz)	High Limit (dBm/3kHz)	Result
Power Density	Low channel 903.0 MHz	-5.88	8	PASS
Power Density	Mid channel 909.4 MHz	-5.74	8	PASS
Power Density	High channel 914.9 MHz	-5.93	8	PASS

4.12.2 Power Spectral Density – Test Details (Worst case plot)



5. TEST EQUIPMENT STATUS

5.1 List of Hardware with Calibration Dates

5.1.1 Hardware List – Conducted Measurements

Type	Manufacturer	Model	Serial Number / ID	Calibration Date	Calibration Due
Spectrum Analyzer	Rohde & Schwarz	FSU26	100308 2704108	14.07.2020 / 20.07.2021	14.07.2021 / 20.07.2022

5.1.2 Hardware List – Conducted Emissions System

Type	Manufacturer	Model	Serial Number / ID	Calibration Date	Calibration Due
Two-Line V-network	Rohde & Schwarz	ENV216	101090 2704076	2020.07.16	2021.07.16
Test Receiver 9KHz to 3.5 GHz	Rohde & Schwarz	ESR3	101674 2704016	2020.07.17	2021.07.17
RF PROBE	Fischer Custom Communication	F-52	22 2902256	2020.07.16	2021.07.16

5.1.3 Hardware List – SAC5 System

Type	Manufacturer	Model	Serial Number / ID	Calibration Date	Calibration Due
EMI Test Receiver	Rohde & Schwarz	ESW44	101760 2881044	2020.07.17	2021.07.17
Ultra Broadband Antenna	Rohde & Schwarz	HL562E	100988 2823181	2019.07.23	2021.07.23
Double Ridged Waveguide Horn Antenna	Rohde & Schwarz	HF907	102678 2823164	2019.07.15	2021.07.15
Control Device	Maturo	NCD	NCD/393/2372.01	N/A	N/A
Open Switch & Control Unit	Rohde & Schwarz	OSP150	100081 2884198	2020.08.04	2021.08.04
Open Switch & Control Unit	Rohde & Schwarz	OSP120	100084 2761253	2020.08.04	2021.08.04
Shielded Filter Unit	Rohde & Schwarz	OSP-F Extension 1	101333 2761265	2020.08.04	2021.08.04
Shielded Filter Unit	Rohde & Schwarz	OSP-F Extension 2	101335 2761266	2020.08.04	2021.08.04
Shielded Filter Unit	Rohde & Schwarz	OSP-F Base Unit	101330 2761262	2020.08.04	2021.08.04
Humidity Temperature Probe	Lufft	OPUS 20	1236.0118.0802.033 2771042	2020.07.31	2022.07.31

5.2 Software / Firmware Versions

Equipment	Software / Firmware Name	Version
Conducted Measurements	EMC 32	V10.60.10 & V.10.60.20
Conducted Emissions System	EMC 32	V10.60.10
SAC 5	EMC 32	V10.60.10

6. MEASUREMENT UNCERTAINTY

6.1 Measurement Uncertainty for CTE

Parameter	Uncertainty (Coverage Factor k=2)
Maximum Output Power (15.247b)	±0.51 dB
6dB / 20dB Channel Bandwidth & 99% Occupied bandwidth (15.247a)	<5%
Carrier Frequency Separation (15.247a)	N/A
Number of Hopping Channels (15.247a)	N/A
Time of Occupancy – Dwell Time (15.247a)	N/A
Band Edge Compliance of Conducted Emissions (15.247a)	±1.04 dB
Conducted Spurious Emissions (15.247d)	±2.98 dB
Power Spectral Density (15.247e)	±0.51 dB

6.2 Measurement Uncertainty for Conducted Emissions

Parameter	Uncertainty (Coverage Factor k=2)
Conducted emissions with LISN 150KHz to 30 MHz	2.98 dB

6.3 Measurement Uncertainty for SAC 5 (Radiated Emissions & Band Edge)

Parameter	Uncertainty (Coverage Factor k=2)
Field Strength 10 Hz -9 kHz	3.38 dB
Field Strength 9 kHz -30 MHz	3.38 dB
Field Strength 30 MHz -1000 MHz	3.38 dB
Field Strength 1 GHz -18 GHz	4.88 dB
Field Strength 18 GHz - 40 GHz	5.14 dB

7. PHOTOGRAPHS

7.1 Photographs of the EUT

For photographs see appendix.