

Prüfbericht-Nr.: Test report no.:	60440947-003	Auftrags-Nr.: Order no.:	23870482 030	Seite 1 von 55 Page 1 of 55	
Kunden-Referenz-Nr.: Client reference no.:	2311184	Auftragsdatum: Order date:	2020.12.09		
Auftraggeber: Client:	Wittra Sweden AB				
Prüfgegenstand: Test item:	Gateway 1.0 US				
Bezeichnung / Typ-Nr.: Identification / Type no.:	Gateway 1.0 / FCC ID:2AYHX00347				
Auftrags-Inhalt: Order content:	Accredited test according to FCC Part 15C				
Prüfgrundlage: Test specification:	FCC 47 CFR Part 15.247 with parts 15.207 & 15.209 ANSI C63.10: 2013				
Wareneingangsdatum: Date of sample receipt:	2020.12.09				
Prüfmuster-Nr.: Test sample no.:	See section 2.3				
Prüfzeitraum: Testing period:	2021.01.22 – 2021.06.24				
Ort der Prüfung: Place of testing:	Lund, Sweden				
Prüflaboratorium: Testing laboratory:	TÜV Rheinland Sweden				
Prüfergebnis*: Test result*:	Pass				
überprüft von: reviewed by:			genehmigt von: authorized by:		
Datum: 2021.06.24 Date:	Signed by: Niall Forrester		Datum: 2021.06.24 Date:	X	
Stellung / Position:	Senior Technical Expert		Stellung / Position:	Lab Manager	
Sonstiges / Other:	Note: This report contains information for IEEE 802.15.4 measurement only. Conducted RF testing was performed on "Sensor tag 1.0" devices (FCC ID 2AYHX00348) which are functionally and electronically identical to the hardware contained in the Gateway device for the purposes of the testing in this report.				
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 F(ail) = entspricht nicht o.g. Prüfgrundlage(n)	4 = ausreichend N/A = nicht anwendbar	5 = mangelhaft 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 F(ail) = failed a.m. test specification(s)	4 = sufficient N/A = not applicable	5 = poor 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 History60440947-00360440947-003

REVISION	DATE	REMARKS	AUTHOR
001	2021.04.16	First release	Niall Forrester
002	2021.05.12	Corrected table in 4.7.1 image in 4.7.2 & added plots to section 4.11.2	Niall Forrester
003	2021.06.24	Corrected gain figures, 20dB BW and typos	Niall Forrester
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)	YES	4.1	PASS	
15.209	Radiated Emissions (Intentional Radiators)	YES	4.2	PASS	
15.247 (d)	Antenna Conducted Emissions	NO	4.3	N/A	Radiated testing performed
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	NO	4.10	N/A	Frequency Hopping Device
15.247 (b)	Peak Conducted Output Power	YES	4.11	PASS	
15.247 (e)	Power Spectral Density	NO	4.12	N/A	Frequency Hopping Device

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.

Note 1: the device includes pre-certified modules as described in section 2.1 below

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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:	Wittra Sweden AB
Address:	Rosenlundsgatan 40 OTR
	Stockholm 118 53
	Sweden
Contact Person:	Warwick Taws
Contact e-Mail / Telephone	wat@wittra.se

2. PRODUCT INFORMATION

2.1 General Description

Model name:	Gateway 1.0 US
Manufacturer:	TT Electronics PLC
Model number / Marketing name:	Gateway 1.0 US
FCC ID:	2AYHX00347
Description:	Gateway acting as a bridge between the wireless sensor network and the internet
Ancillary Equipment:	See section 2.8

The device incorporates the following pre-certified module:

- Raspberry Pi 4 Model B FCC ID: 2ABCB-RPI4B

The Raspberry Pi includes Bluetooth Low Energy. Other RF transmitters (IEEE 802.15.4 “Sub-GHz” and a second Bluetooth Low Energy transmitter) are implemented on an internal component of the Gateway, described below as “Border Router”.

2.2 Device Characteristics

Type of Power Supply	AC/DC Adapter
Nominal Supply Voltage	12V DC
Supply Voltage Range	10 – 16 VDC
Operating Temperature Range	0°C to +50°C
Operating Air Humidity Range	Environment rating IP64
Highest Internal Frequency Source	5850.0 MHz

2.3 Test Samples

EUT #	EUT ID	Description	Used For:
1	A002972080-026	Gateway 1.0	Conducted emission
2	A002972080-027	Gateway 1.0	Radiated emission
3	A003002493-001	Gateway 1.0	Radiated emission
4	A002965790-011	Sensor Tag 1.0 Modified with RF connector and	Conducted RF
5	A003002493-001	Sensor Tag 1.0 Modified with RF connector	Conducted RF

Note that conducted RF testing was performed on “Sensor tag 1.0” devices (FCC ID 2AYHX00348) which are functionally and electronically identical to the hardware contained in the Gateway device for the purposes of the testing in this report.

2.4 Wireless Technologies and Bands Supported by the EUT

Technology	Band	Frequency Range (Tx)	Evaluation Performed*
IEEE 802.15.4g (Border Router)	902-928 MHz	902.0 MHz – 928.0 MHz	YES
Bluetooth LE (Border Router)	2.4 GHz	2400.0 MHz – 2483.5 MHz	NO
Bluetooth LE (Raspberry Pi)	2.4 GHz	2400.0 MHz – 2483.5 MHz	NO

*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
IEEE 802.15.4g (Border Router)	902-928 MHz	1	Printed foil 50Ω	2.20 dBi
Bluetooth LE (Border Router)	2.4 GHz	1	Printed foil 50Ω	1.40 dBi
Bluetooth LE (Raspberry Pi)	2.4 GHz	1	PCB trace antenna	3.50 dBi

2.6 Simultaneous Transmission Capabilities

The device supports no simultaneous transmission capabilities

The Bluetooth Low Energy and IEEE 802.15.4 transmitters in the “Border Router” cannot transmit simultaneously.

The Bluetooth Low Energy transmitter in the Raspberry Pi is active only during firmware updates of the device and cannot transmit simultaneously with either of the transmitters in the Border Router

2.7 Wireless Technology Details

Technology	Band	Rated Power (dBm)	Modulation Type(s)	No. of Channels	Channel Spacing	Adaptivity
IEEE 802.15.4g (Border Router)	902-928 MHz	12	2-GFSK	129	0.2 MHz	N/A
Bluetooth LE (Border Router)	2.4 GHz	5	GFSK	40	2 MHz	N/A
Bluetooth LE (Raspberry Pi)	2.4 GHz	5	GFSK	40	2 MHz	N/A

2.8 Ancillary Equipment

ID	Description	Manufacturer / Model	Hardware & Software Versions
A002972080-010	AC/DC Power Supply	-	-
A002972080-013	Case	Wittra Sweden AB	-
A002972080-033	External Antenna	-	-

2.9 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

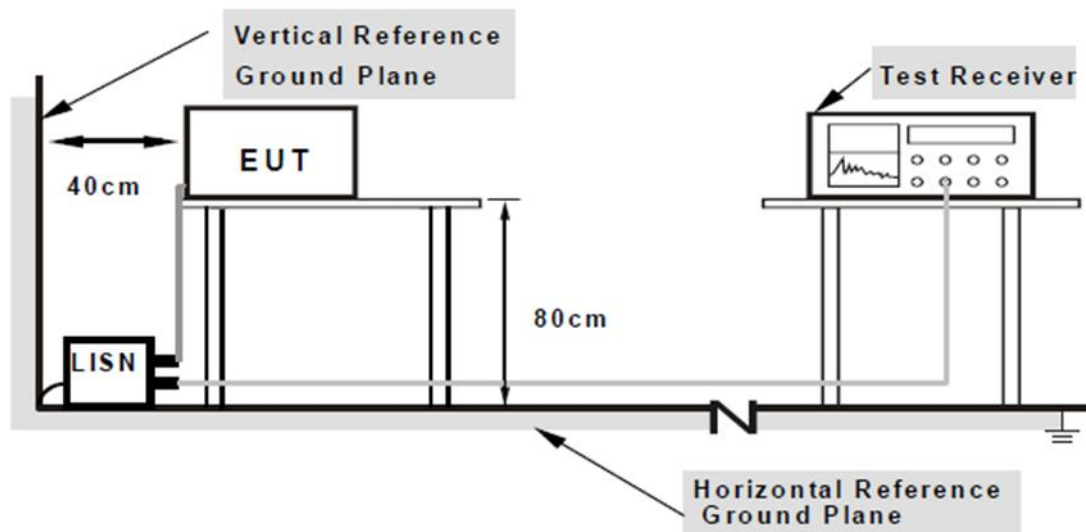
FCC 47 CFR Rule Part	Test Description	Test Equipment Used
15.207	AC Power Line Conducted Emissions (Intentional Radiators)	Conducted Emissions
15.209	Radiated Emissions (Intentional Radiators)	SAC5
15.247 (d)	Out of Band Emissions	Conducted RF
15.247 (d)	Band Edge Compliance (Authorized band)	Conducted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

3.4.3 Test Equipment Setup – Conducted RF

For the purposes of the testing in the report, the conducted RF system consists of a Spectrum Analyzer with suitable cabling and a controller PC. The DUT is connected to the Spectrum analyser RF input and the loss in the connecting cable is compensate for in the reported results. The tests are either script based (using dedicated software on the controller PC), or in some cases manual measurements are made directly using the spectrum analyser interface.

3.4.4 Test Equipment Setup – Conducted Emissions

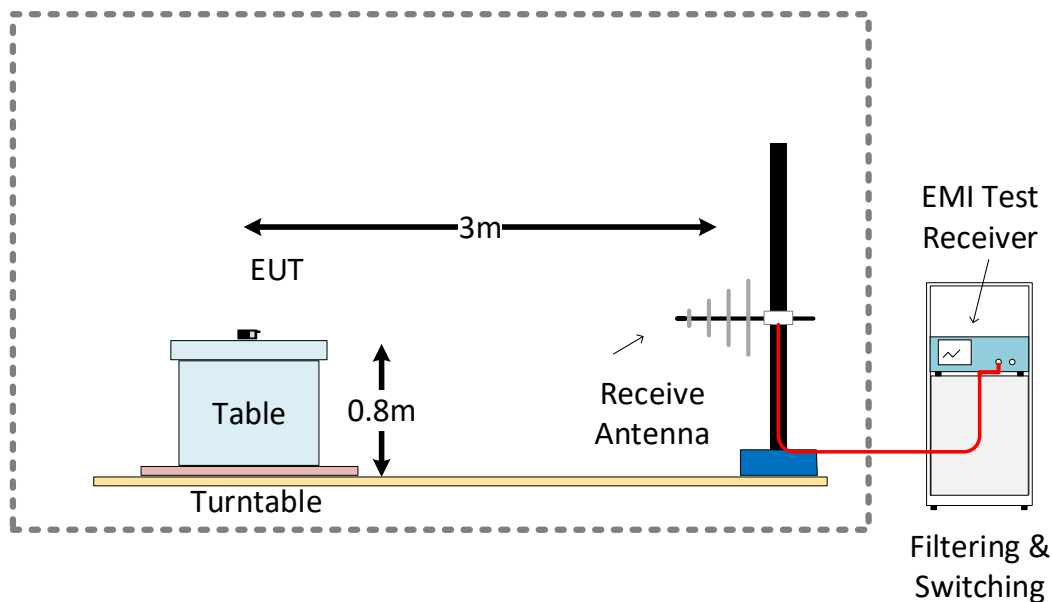
- The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The LISNs provide 50Ω/ 50μH of coupling impedance 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.



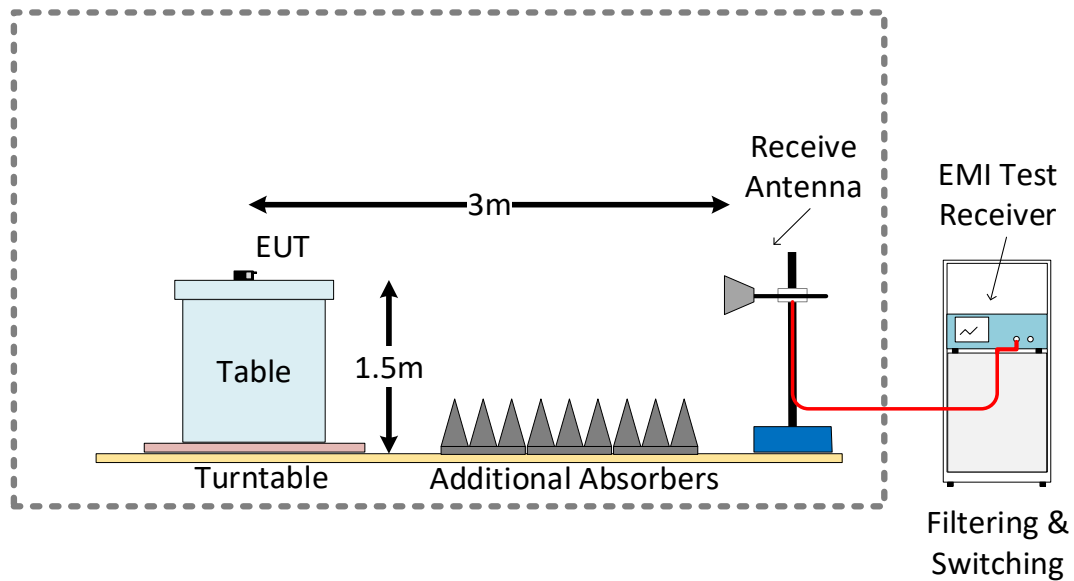
3.4.5 Test Equipment Setup – SAC 5 (Radiated Emissions and Restricted Band Edge)

- 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.

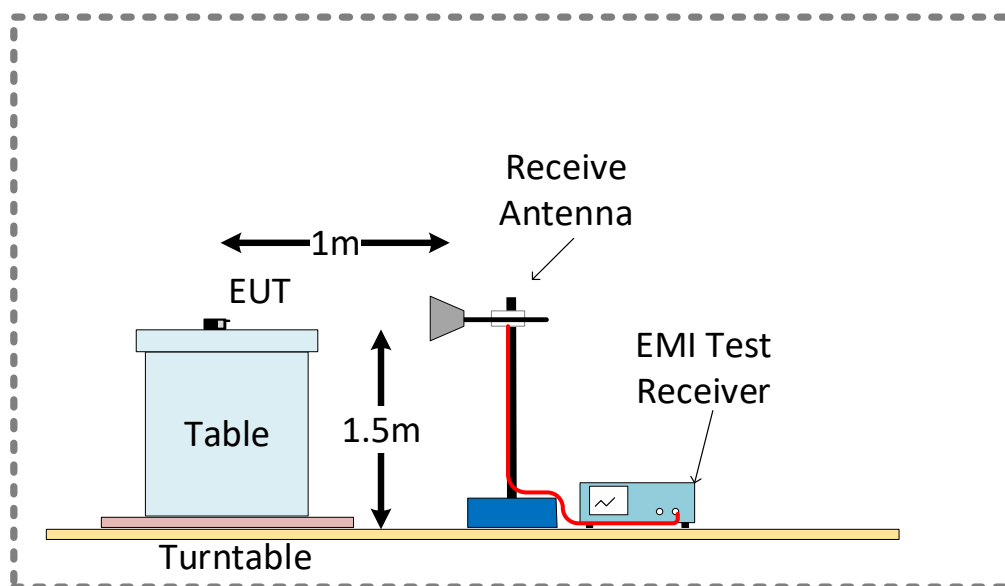
SAC 5 Test Setup Configuration 30MHz – 1GHz



SAC 5 Test Setup Configuration 1GHz – 18GHz



SAC 5 Test Setup Configuration 18GHz – 40GHz



3.5 EUT Configuration During Test

AC Power Line Conducted Emissions

For AC power line conducted emissions testing, the device was connected to the AC/DC Power Supply and set to continuous transmit mode on the mid channel. Conducted emissions tests were run on the Mains AC connection to the ac/dc Power Supply. See test setup photographs for more detail.

Radiated Emissions

For radiated emissions testing, the device was operated from the AC/DC Power Supply and set to continuous transit mode on an appropriate channel. See test setup photographs for more detail.

Conducted RF

For conducted RF testing for a fixed channel, power to the Sensor Tag device was supplied from a DC power supply to simulate the various battery levels. The device was modified with an RF connector in place of the antenna to allow for conducted RF measurements.

For conducted testing in hopping mode, power to the Sensor Tag device was supplied from a USB charger. The device was modified with an RF connector in place of the antenna to allow for conducted RF measurements.

3.6 EUT Operation Modes

Operation mode	Description
Continuous TX	The device was set to transmit a continuous modulated signal with the appropriate frequency.
Continuous Hopping	The device was set to transmit a modulated signal with the standard frequency-hopping parameters

3.7 Deviations from the Test Standard

None.

3.8 Environmental Conditions

3.8.1 Environmental Conditions – Conducted RF System

Environmental Conditions Log – Conducted RF

Date	Time	Temperature (°C)	Relative Humidity (%)
2021.02.22	09:03	19.3	34
2021.03.09	14:16	22.8	16
2021.04.12	16:50	18.7	25
2021.06.24	13:16	23.1	53

3.8.2 Environmental Conditions – SAC5 (Radiated Emissions)

Environmental Conditions Log – SAC5

Date	Time	Temperature (°C)	Relative Humidity (%)
2021.01.24	12:00	20.1	32
2021.03.11	14:23	19.6	28
2021.03.12	06:59	18.3	32
2021.04.13	10:10	19.2	21
2021.04.14	08:20	20.0	28

4. TEST RESULTS

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

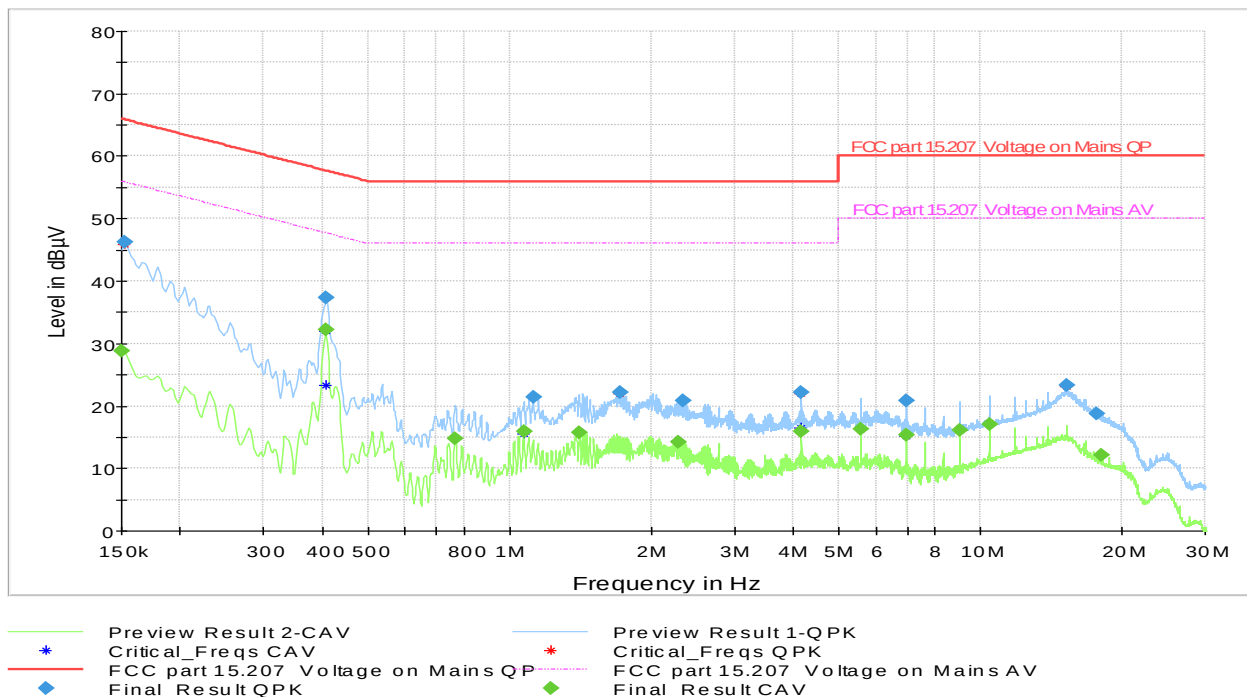
4.1.1 AC Power Line Conducted Emissions (Intentional) – Test Summary

Test Specification	FCC 47 CFR 15.207 (Part 15 Subpart C)		
Test Engineer & Date	Fariborz Abasi	2021.01.22	
EUT and Ancillary Equipment IDs	A002972080-026	A002972080-013 A002972080-010	
EUT Operation Mode(s)	Continuous Tx		
EUT Wireless Configuration(s)	See below		
EUT Hardware Configuration(s)	N/A		
Overall Result	PASS		
Test Parameter	Wireless Configuration	Frequency Range	Result*
AC Conducted Power Line Emissions – “N” Line & “L1” Line	915 MHz IEEE 802.15.4g	150 kHz – 30 MHz	PASS

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

4.1.2 AC Power Line Conducted Emissions (Intentional Bluetooth LE in mid channel) – Test Details

Test mode condition	Conducted Emissions	
Sweep frequency	150 kHz – 30 MHz	
Standard	FCC 47 Part 15.207	
EUT	A002972080-026	
Ancillary Equipment	A002972080-013 A002972080-010	
Test Engineer	Fariborz Abasi	Date: 2021.01.22



Frequency (MHz)	QuasiPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
0.150000	---	28.85	56.00	27.15	1000.0	9.000	N	ON	9.7
0.152250	46.31	---	65.88	19.57	1000.0	9.000	N	ON	9.7
0.406500	---	32.15	47.72	15.57	1000.0	9.000	L1	ON	9.6
0.408750	37.31	---	57.67	20.37	1000.0	9.000	L1	ON	9.6
0.766500	---	14.70	46.00	31.30	1000.0	9.000	N	ON	9.6
1.070250	---	15.86	46.00	30.14	1000.0	9.000	N	ON	9.7
1.126500	21.51	---	56.00	34.49	1000.0	9.000	N	ON	9.7
1.407750	---	15.68	46.00	30.32	1000.0	9.000	N	ON	9.7
1.713750	22.21	---	56.00	33.79	1000.0	9.000	N	ON	9.7
2.274000	---	14.15	46.00	31.85	1000.0	9.000	N	ON	9.7
2.328000	20.91	---	56.00	35.09	1000.0	9.000	N	ON	9.7
4.170750	---	15.84	46.00	30.16	1000.0	9.000	N	ON	9.8
4.170750	22.12	---	56.00	33.88	1000.0	9.000	N	ON	9.8
5.561250	---	16.30	50.00	33.70	1000.0	9.000	N	ON	9.8
6.951750	20.82	---	60.00	39.18	1000.0	9.000	N	ON	9.8
6.951750	---	15.32	50.00	34.68	1000.0	9.000	N	ON	9.8
9.037500	---	16.12	50.00	33.88	1000.0	9.000	N	ON	9.9
10.428000	---	17.08	50.00	32.92	1000.0	9.000	N	ON	9.9
15.294750	23.26	---	60.00	36.74	1000.0	9.000	N	ON	10.0
17.657250	18.70	---	60.00	41.30	1000.0	9.000	N	ON	10.1
18.073500	---	12.07	50.00	37.93	1000.0	9.000	N	ON	10.1

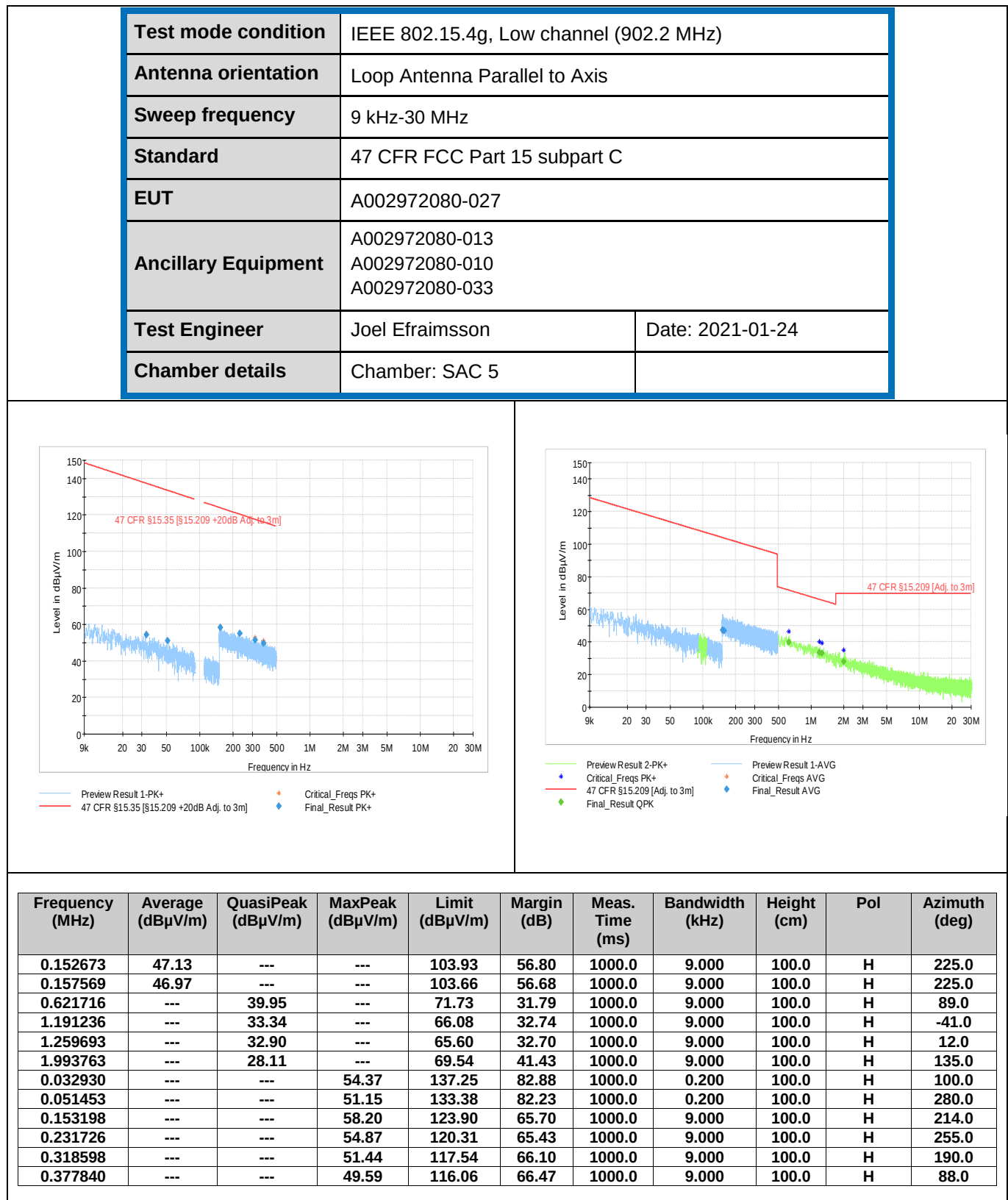
4.2 Test Results – Radiated Emissions (Intentional Transmitter)

4.2.1 Radiated Emissions (Intentional) – Test Summary

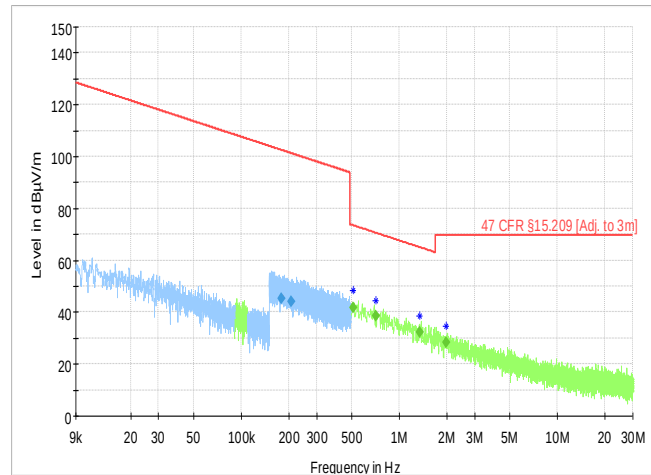
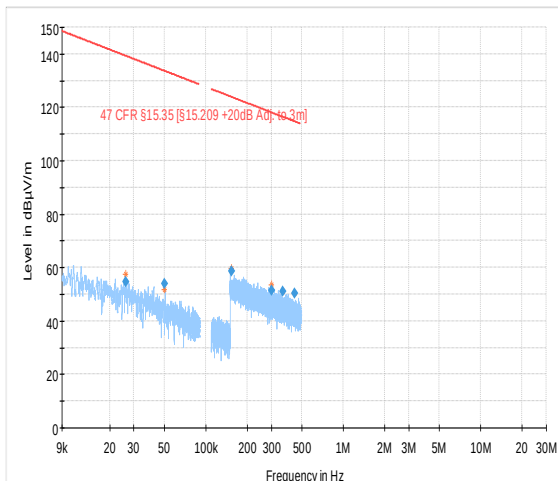
Test Specification		FCC 47 CFR 15.209 (Part 15 Subpart C)	
Test Engineer & Date		Niall Forrester Joel Efraimsson	2021.01.22 – 2021.03.12
EUT and Ancillary Equipment IDs		A002972080-027 A003002493-001	A002972080-013 A002972080-010 A002972080-033
EUT Operation Mode(s)		Continuous TX	
EUT Wireless Configuration(s)		See below	
EUT Hardware Configuration(s)		N/A	
Overall Result		PASS	
Test Parameter	Wireless Configuration	Frequency Range	Result
Radiated Emissions	902.2 MHz IEEE 802.15.4g	9 kHz – 30 MHz	PASS
Radiated Emissions	902.2 MHz IEEE 802.15.4g	30 MHz – 1 GHz	PASS
Radiated Emissions	902.2 MHz IEEE 802.15.4g	1 GHz – 18 GHz	PASS
Radiated Emissions	915 MHz IEEE 802.15.4g	9 kHz – 30 MHz	PASS
Radiated Emissions	915 MHz IEEE 802.15.4g	30 MHz – 1 GHz	PASS
Radiated Emissions	915 MHz IEEE 802.15.4g	1 GHz – 18 GHz	PASS
Radiated Emissions	927.8 MHz IEEE 802.15.4g	9 kHz – 30 MHz	PASS
Radiated Emissions	927.8 MHz IEEE 802.15.4g	30 MHz – 1 GHz	PASS
Radiated Emissions	927.8 MHz IEEE 802.15.4g	1 GHz – 18 GHz	PASS

4.2.2 Radiated Emissions (Intentional) – Test Details

Low Channel

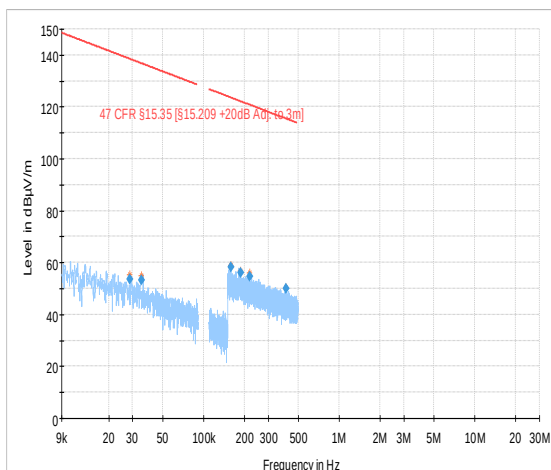


Test mode condition	IEEE 802.15.4g, Low channel (902.2 MHz)	
Antenna orientation	Loop Antenna Perpendicular to Axis	
Sweep frequency	9 kHz-30 MHz	
Standard	47 CFR FCC Part 15 subpart C	
EUT	A002972080-027	
Ancillary Equipment	A002972080-013 A002972080-010 A002972080-033	
Test Engineer	Joel Efraimsson	Date: 2021-01-24
Chamber details	Chamber: SAC 5	

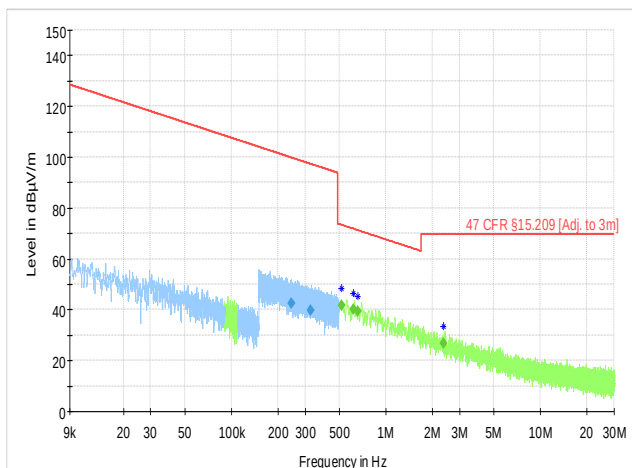


Frequency (MHz)	Average (dBµV/m)	QuasiPeak (dBµV/m)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
0.180094	45.37	---	---	102.49	57.12	1000.0	9.000	100.0	H	167.0
0.208136	44.21	---	---	101.24	57.02	1000.0	9.000	100.0	H	166.0
0.511967	---	41.82	---	73.42	31.60	1000.0	9.000	100.0	H	25.0
0.713086	---	38.57	---	70.54	31.97	1000.0	9.000	100.0	H	135.0
1.344972	---	32.14	---	65.03	32.89	1000.0	9.000	100.0	H	281.0
1.979354	---	28.39	---	69.54	41.15	1000.0	9.000	100.0	H	168.0
0.026086	---	---	54.73	139.28	84.55	1000.0	0.200	100.0	H	-2.0
0.050363	---	---	53.80	133.56	79.77	1000.0	0.200	100.0	H	135.0
0.154380	---	---	58.67	123.83	65.16	1000.0	9.000	100.0	H	270.0
0.301618	---	---	51.50	118.02	66.52	1000.0	9.000	100.0	H	315.0
0.361584	---	---	51.03	116.44	65.41	1000.0	9.000	100.0	H	153.0
0.445318	---	---	50.26	114.63	64.37	1000.0	9.000	100.0	H	216.0

Test mode condition	IEEE 802.15.4g, Low channel (902.2 MHz)	
Antenna orientation	Loop Antenna Parallel to floor	
Sweep frequency	9 kHz-30 MHz	
Standard	47 CFR FCC Part 15 subpart C	
EUT	A002972080-027	
Ancillary Equipment	A002972080-013 A002972080-010 A002972080-033	
Test Engineer	Joel Efraimsson	Date: 2021-01-24
Chamber details	Chamber: SAC 5	



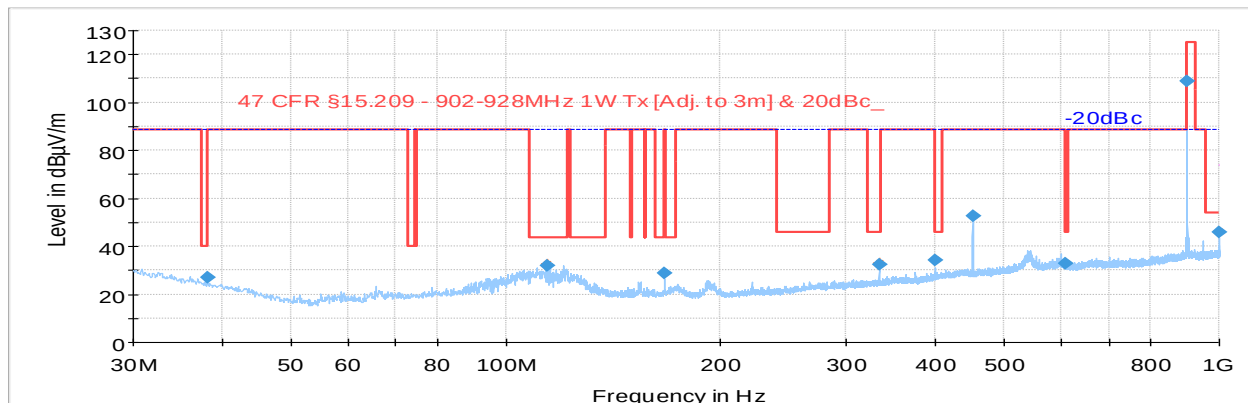
— Preview Result 1-PK+ * Critical_Freqs PK+
— 47 CFR §15.35 [§15.209 +20dB Adj. to 3m] ♦ Final_Result PK+



— 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)
0.245113	42.50	---	---	99.82	57.32	1000.0	9.000	100.0	H	257.0
0.326918	39.75	---	---	97.32	57.57	1000.0	9.000	100.0	H	135.0
0.516292	---	41.81	---	73.35	31.54	1000.0	9.000	100.0	H	45.0
0.616719	---	39.98	---	71.80	31.82	1000.0	9.000	100.0	H	179.0
0.659661	---	39.30	---	71.22	31.92	1000.0	9.000	100.0	H	307.0
2.362332	---	26.58	---	69.54	42.97	1000.0	9.000	100.0	H	-14.0
0.028633	---	---	53.64	138.47	84.83	1000.0	0.200	100.0	H	135.0
0.034923	---	---	53.33	136.74	83.41	1000.0	0.200	100.0	H	225.0
0.158298	---	---	58.15	123.62	65.47	1000.0	9.000	100.0	H	45.0
0.187656	---	---	56.13	122.14	66.01	1000.0	9.000	100.0	H	203.0
0.218777	---	---	54.60	120.80	66.20	1000.0	9.000	100.0	H	45.0
0.405762	---	---	49.89	115.44	65.55	1000.0	9.000	100.0	H	-15.0

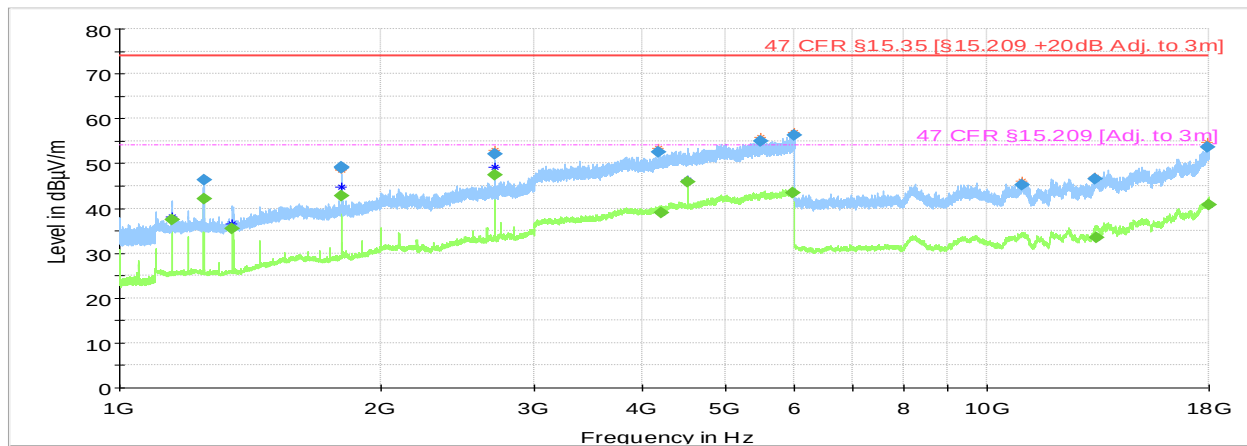
Test mode condition	IEEE 802.15.4g, Low channel (902.2 MHz)	
Antenna orientation	Horizontal and Vertical	
Sweep frequency	30 MHz – 1 GHz	
Standard	47 CFR FCC Part 15 subpart C	
EUT	A003002493-001	
Ancillary Equipment	A002972080-013 A002972080-010 A002972080-033	
Test Engineer	Niall Forrester	Date: 2021-03-12
Chamber details	Chamber: SAC 5	



Preview Result 2-AVG
 Preview Result 1-PK+
 Critical_Freqs AVG
 Critical_Freqs PK+
 47 CFR §15.209 - 902-928MHz 1W Tx [Adj. to 3m] & 20dBc
 47 CFR §15.35 [§15.209 +20dB Adj. to 3m]
 Final_Result PK+
 Final_Result AVG
 -20dBc

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
38.234880	27.09	---	40.00	12.91	1000.0	120.000	206.0	V	8.0
114.090000	32.09	---	43.52	11.43	1000.0	120.000	175.0	V	233.0
166.657640	28.56	---	43.52	14.96	1000.0	120.000	270.0	H	86.0
333.360760	32.32	---	46.02	13.70	1000.0	120.000	125.0	H	278.0
399.991840	34.11	---	46.02	11.91	1000.0	120.000	100.0	H	266.0
451.101840	52.45	---	88.64	36.19	1000.0	120.000	254.0	H	40.0
609.591520	32.76	---	46.02	13.26	1000.0	120.000	383.0	V	158.0
902.204200	108.75	---	125.23	16.48	1000.0	120.000	100.0	V	162.0
998.213440	45.86	---	53.98	8.12	1000.0	120.000	125.0	V	252.0

Test mode condition	IEEE 802.15.4g, Low channel (902.2 MHz)	
Antenna orientation	Horizontal and Vertical	
Sweep frequency	1 GHz – 18 GHz	
Standard	47 CFR FCC Part 15 subpart C	
EUT	A003002493-001	
Ancillary Equipment	A002972080-013 A002972080-010 A002972080-033	
Test Engineer	Niall Forrester	Date: 2021-03-11
Chamber details	Chamber: SAC 5	

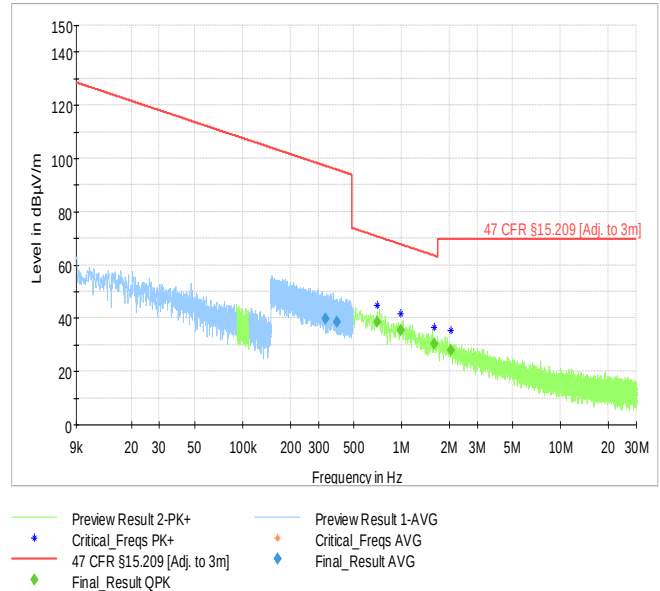
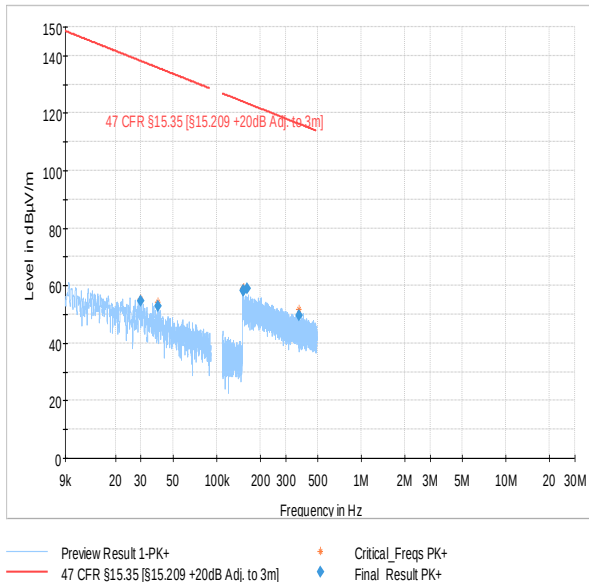


Preview Result 2-AVG	Preview Result 1-PK+
Critical_Freqs AVG	Critical_Freqs PK+
47 CFR §15.35 [§15.209 +20dB Adj. to 3m]	47 CFR §15.209 [Adj. to 3m]
Final_Result PK+	Final_Result AVG
MaxPeak-PK+ (Single)	Average-AVG (Single)

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
1150.044000	---	37.49	53.98	16.49	1000.0	1000.000	178.0	V	41.0
1249.981000	46.24	---	73.98	27.74	1000.0	1000.000	210.0	V	41.0
1250.106000	---	42.02	53.98	11.96	1000.0	1000.000	175.0	V	41.0
1350.052000	---	35.39	53.98	18.59	1000.0	1000.000	121.0	H	177.0
1804.391000	49.19	---	73.98	24.79	1000.0	1000.000	147.0	H	177.0
1804.432000	---	42.67	53.98	11.31	1000.0	1000.000	147.0	H	162.0
1804.450000	48.93	---	73.98	25.05	1000.0	1000.000	158.0	H	177.0
2706.563000	52.16	---	73.98	21.82	1000.0	1000.000	102.0	V	296.0
2706.626000	---	47.42	53.98	6.56	1000.0	1000.000	103.0	V	296.0
4181.504000	52.53	---	73.98	21.45	1000.0	1000.000	137.0	V	41.0
4207.226000	---	39.06	53.98	14.92	1000.0	1000.000	137.0	H	248.0
4511.064000	---	45.83	53.98	8.15	1000.0	1000.000	111.0	V	177.0
5479.227000	55.03	---	73.98	18.95	1000.0	1000.000	121.0	H	199.0
5974.288000	---	43.45	53.98	10.53	1000.0	1000.000	175.0	H	323.0
5988.312000	56.33	---	73.98	17.65	1000.0	1000.000	120.0	V	100.0
10977.621000	45.26	---	73.98	28.72	1000.0	1000.000	210.0	V	158.0
13325.711000	46.60	---	73.98	27.38	1000.0	1000.000	136.0	H	116.0
13364.859000	---	33.49	53.98	20.49	1000.0	1000.000	125.0	H	109.0
17901.107000	53.61	---	73.98	20.37	1000.0	1000.000	146.0	V	202.0
17969.787000	---	40.70	53.98	13.28	1000.0	1000.000	101.0	V	232.0

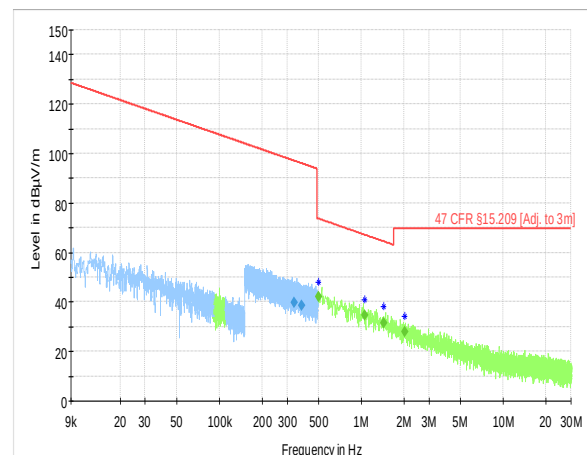
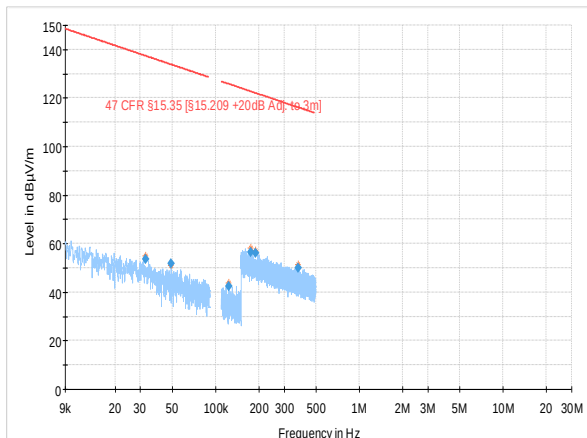
Mid Channel

Test mode condition	IEEE 802.15.4g, Mid channel (915 MHz)	
Antenna orientation	Loop Antenna Parallel to Axis	
Sweep frequency	9 kHz-30 MHz	
Standard	47 CFR FCC Part 15 subpart C	
EUT	A002972080-027	
Ancillary Equipment	A002972080-013 A002972080-010 A002972080-033	
Test Engineer	Joel Efraimsson	Date: 2021-01-24
Chamber details	Chamber: SAC 5	



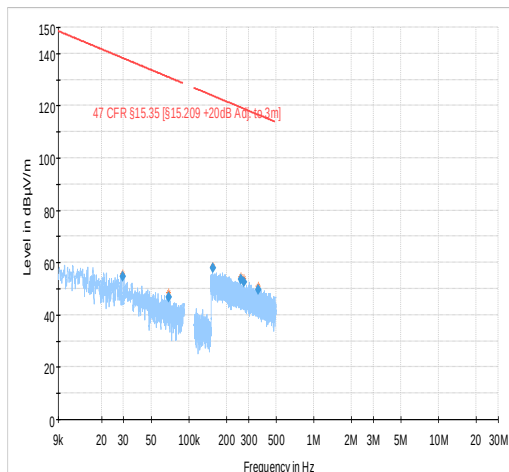
Frequency (MHz)	Average (dBµV/m)	QuasiPeak (dBµV/m)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
0.331187	39.80	---	---	97.20	57.41	1000.0	9.000	100.0	H	37.0
0.392951	38.43	---	---	95.72	57.29	1000.0	9.000	100.0	H	229.0
0.705875	---	38.53	---	70.63	32.10	1000.0	9.000	100.0	H	168.0
0.987942	---	35.53	---	67.71	32.17	1000.0	9.000	100.0	H	135.0
1.609990	---	30.16	---	63.47	33.31	1000.0	9.000	100.0	H	154.0
2.040863	---	27.91	---	69.54	41.63	1000.0	9.000	100.0	H	-41.0
0.030024	---	---	54.58	138.06	83.48	1000.0	0.200	100.0	H	225.0
0.039125	---	---	53.03	135.76	82.73	1000.0	0.200	100.0	H	214.0
0.152291	---	---	58.22	123.95	65.73	1000.0	9.000	100.0	H	256.0
0.154768	---	---	58.43	123.81	65.38	1000.0	9.000	100.0	H	-2.0
0.162619	---	---	58.97	123.38	64.41	1000.0	9.000	100.0	H	229.0
0.370988	---	---	49.58	116.22	66.64	1000.0	9.000	100.0	H	307.0

Test mode condition	IEEE 802.15.4g, Mid channel (915 MHz)	
Antenna orientation	Loop Antenna Perpendicular to axis	
Sweep frequency	9 kHz-30 MHz	
Standard	47 CFR FCC Part 15 subpart C	
EUT	A002972080-027	
Ancillary Equipment	A002972080-013 A002972080-010 A002972080-033	
Test Engineer	Joel Efraimsson	Date: 2021-01-24
Chamber details	Chamber: SAC 5	

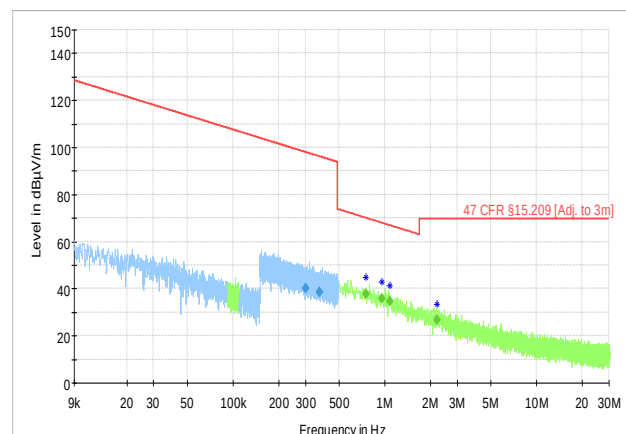


Frequency (MHz)	Average (dBµV/m)	QuasiPeak (dBµV/m)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
0.337971	39.57	---	---	97.03	57.46	1000.0	9.000	100.0	H	154.0
0.378005	38.57	---	---	96.05	57.49	1000.0	9.000	100.0	H	315.0
0.499111	---	42.05	---	73.64	31.59	1000.0	9.000	100.0	H	135.0
1.053072	---	34.80	---	67.16	32.35	1000.0	9.000	100.0	H	-45.0
1.445654	---	31.36	---	64.40	33.05	1000.0	9.000	100.0	H	139.0
2.018214	---	27.95	---	69.54	41.59	1000.0	9.000	100.0	H	256.0
0.032468	---	---	53.68	137.38	83.69	1000.0	0.200	100.0	H	189.0
0.049018	---	---	51.79	133.80	82.01	1000.0	0.200	100.0	H	153.0
0.123793	---	---	42.54	125.75	83.21	1000.0	0.200	100.0	H	281.0
0.175164	---	---	56.52	122.74	66.22	1000.0	9.000	100.0	H	-27.0
0.190185	---	---	55.95	122.02	66.07	1000.0	9.000	100.0	H	178.0
0.374143	---	---	50.12	116.14	66.02	1000.0	9.000	100.0	H	243.0

Test mode condition	IEEE 802.15.4g, Mid channel (915 MHz)	
Antenna orientation	Loop Antenna Parallel to floor	
Sweep frequency	9 kHz-30 MHz	
Standard	47 CFR FCC Part 15 subpart C	
EUT	A002972080-027	
Ancillary Equipment	A002972080-013 A002972080-010 A002972080-033	
Test Engineer	Joel Efraimsson	Date: 2021-01-24
Chamber details	Chamber: SAC 5	



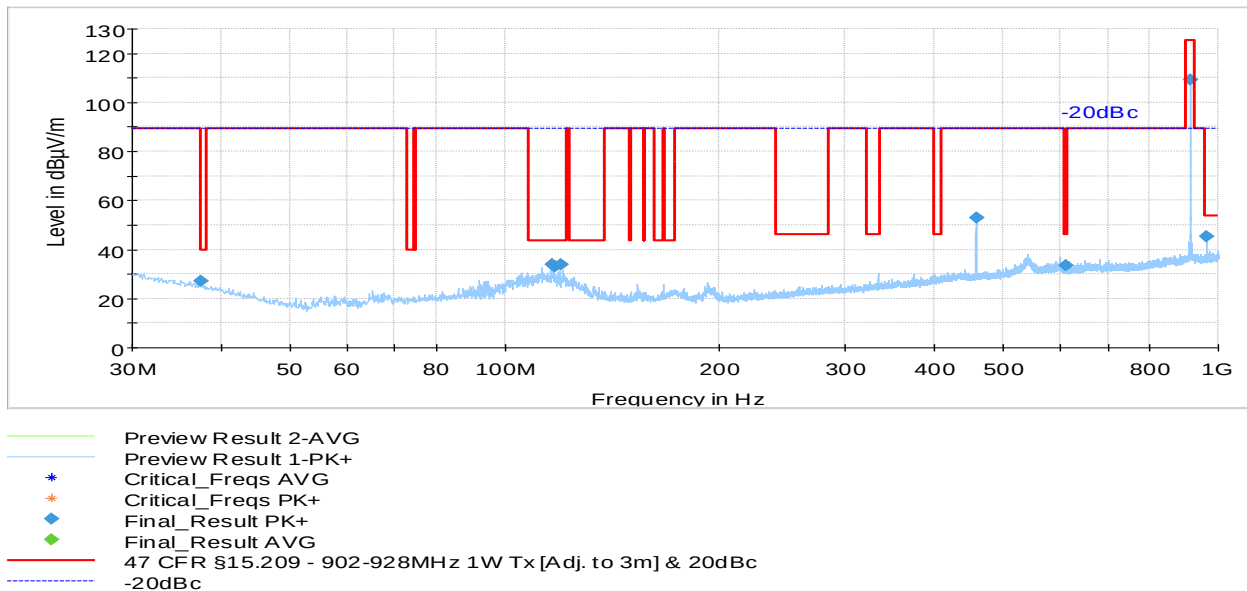
Preview Result 1-PK+ Critical_Freqs PK+
47 CFR §15.35 [§15.209 +20dB Adj. to 3m] Final_Result PK+



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

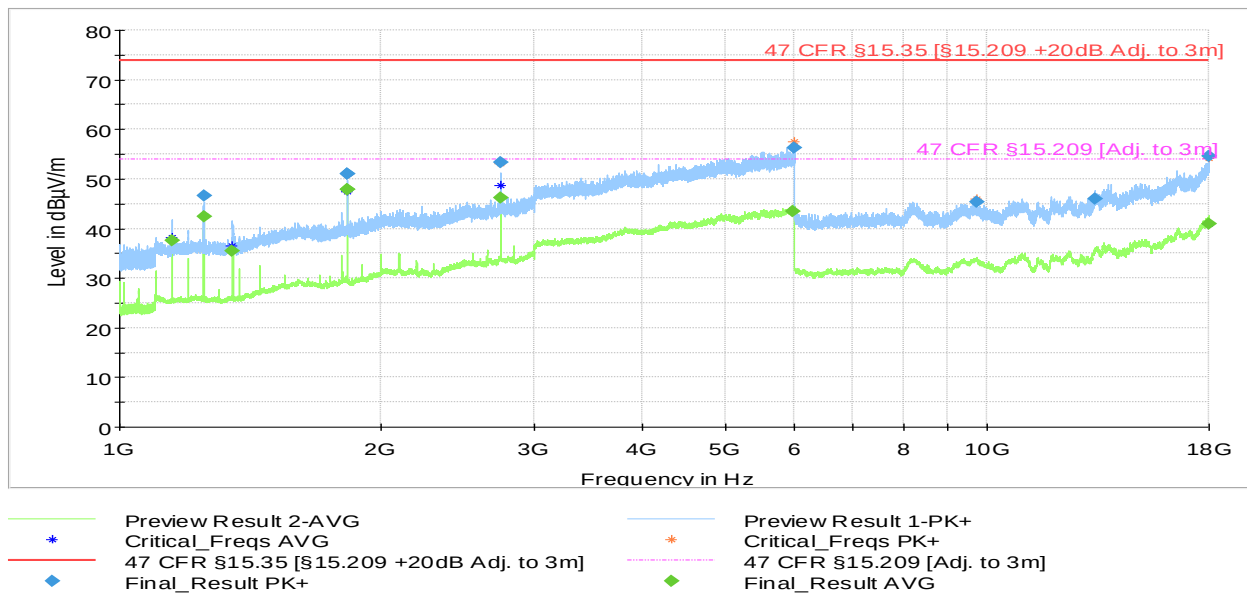
Frequency (MHz)	Average (dBµV/m)	QuasiPeak (dBµV/m)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
0.301417	40.33	---	---	98.02	57.69	1000.0	9.000	100.0	H	102.0
0.370734	38.77	---	---	96.22	57.45	1000.0	9.000	100.0	H	135.0
0.754920	---	37.93	---	70.05	32.12	1000.0	9.000	100.0	H	139.0
0.962073	---	35.82	---	67.94	32.12	1000.0	9.000	100.0	H	295.0
1.081871	---	34.58	---	66.92	32.34	1000.0	9.000	100.0	H	45.0
2.219105	---	26.95	---	69.54	42.59	1000.0	9.000	100.0	H	-41.0
0.029559	---	---	54.72	138.19	83.47	1000.0	0.200	100.0	H	190.0
0.069108	---	---	46.78	130.81	84.04	1000.0	0.200	100.0	H	-3.0
0.155012	---	---	58.09	123.80	65.71	1000.0	9.000	100.0	H	178.0
0.260835	---	---	53.63	119.28	65.64	1000.0	9.000	100.0	H	225.0
0.274686	---	---	52.63	118.83	66.20	1000.0	9.000	100.0	H	315.0
0.359752	---	---	49.78	116.48	66.70	1000.0	9.000	100.0	H	165.0

Test mode condition	IEEE 802.15.4g, Mid channel (915 MHz)	
Antenna orientation	Horizontal and Vertical	
Sweep frequency	30 MHz – 1 GHz	
Standard	47 CFR FCC Part 15 subpart C	
EUT	A003002493-001	
Ancillary Equipment	A002972080-013 A002972080-010 A002972080-033	
Test Engineer	Niall Forrester	Date: 2021-03-12
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)
37.500560	27.30	---	40.00	12.70	1000.0	120.000	333.0	V	26.0
116.534280	34.00	---	43.52	9.52	1000.0	120.000	100.0	V	220.0
117.598680	33.08	---	43.52	10.45	1000.0	120.000	100.0	V	206.0
120.083480	33.74	---	43.52	9.78	1000.0	120.000	108.0	V	220.0
457.507320	53.02	---	89.49	36.47	1000.0	120.000	254.0	H	40.0
611.248600	33.27	---	46.02	12.75	1000.0	120.000	233.0	V	19.0
915.003640	109.36	---	125.23	15.87	1000.0	120.000	220.0	V	220.0
963.008440	45.38	---	53.98	8.60	1000.0	120.000	100.0	V	233.0

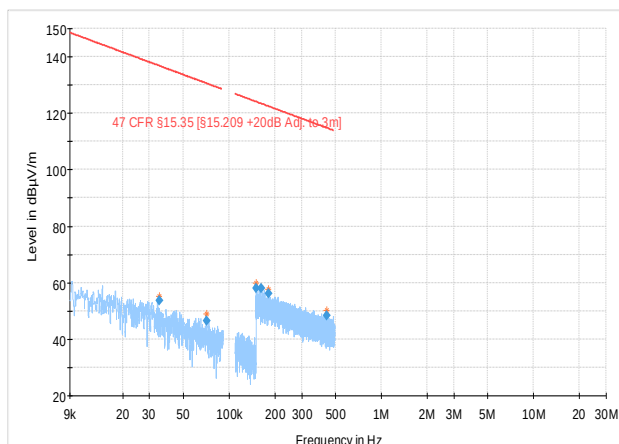
Test mode condition	IEEE 802.15.4g, Mid channel (915 MHz)	
Antenna orientation	Horizontal and Vertical	
Sweep frequency	1 GHz – 18 GHz	
Standard	47 CFR FCC Part 15 subpart C	
EUT	A002972080-020	
Ancillary Equipment	A002972080-013 A002972080-010 A002972080-033	
Test Engineer	Niall Forrester	Date: 2021-03-12
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)
1150.045000	---	37.64	53.98	16.34	1000.0	1000.000	177.0	V	41.0
1249.904000	46.64	---	73.98	27.34	1000.0	1000.000	206.0	V	54.0
1249.980000	---	42.49	53.98	11.49	1000.0	1000.000	198.0	V	41.0
1350.066000	---	35.47	53.98	18.51	1000.0	1000.000	120.0	H	177.0
1830.001000	50.93	---	73.98	23.05	1000.0	1000.000	148.0	H	177.0
1830.007000	---	47.83	53.98	6.15	1000.0	1000.000	147.0	H	177.0
1830.010000	---	47.90	53.98	6.08	1000.0	1000.000	148.0	H	177.0
1830.018000	50.96	---	73.98	23.02	1000.0	1000.000	148.0	H	177.0
2744.963000	---	46.25	53.98	7.73	1000.0	1000.000	120.0	V	296.0
2745.030000	53.41	---	73.98	20.57	1000.0	1000.000	125.0	V	311.0
5971.180000	---	43.52	53.98	10.46	1000.0	1000.000	112.0	V	199.0
5979.173000	56.34	---	73.98	17.64	1000.0	1000.000	125.0	V	-3.0
9705.366000	45.37	---	73.98	28.61	1000.0	1000.000	100.0	H	278.0
13320.594000	45.91	---	73.98	28.07	1000.0	1000.000	196.0	V	-22.0
17988.889000	54.69	---	73.98	19.29	1000.0	1000.000	101.0	V	22.0
17990.543000	---	40.93	53.98	13.05	1000.0	1000.000	100.0	V	39.0

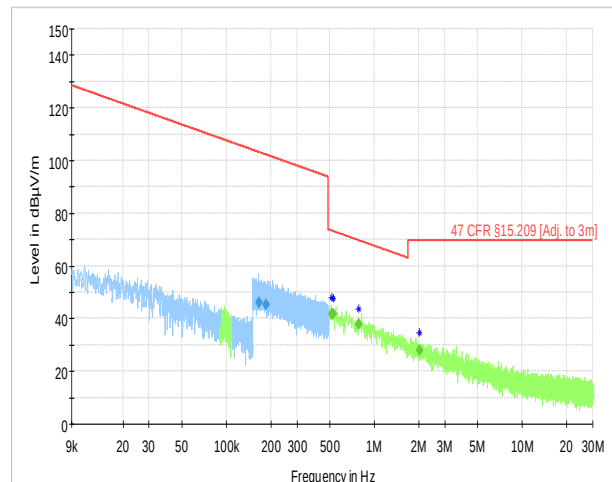
High Channel

Test mode condition	IEEE 802.15.4g, High channel (927.8 MHz)	
Antenna orientation	Loop Antenna Parallel to Axis	
Sweep frequency	9 kHz-30 MHz	
Standard	47 CFR FCC Part 15 subpart C	
EUT	A002972080-027	
Ancillary Equipment	A002972080-013 A002972080-010 A002972080-033	
Test Engineer	Joel Efraimsson	Date: 2021-01-24
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+

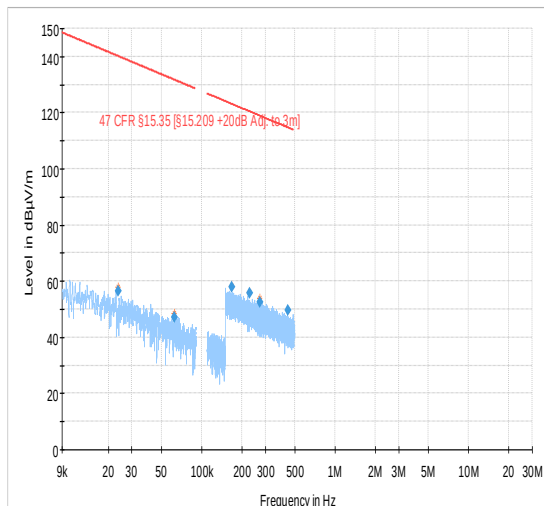


Preview Result 2-PK+
Critical_Freqs PK+
47 CFR §15.209 [Adj. to 3m]
Final_Result QPK

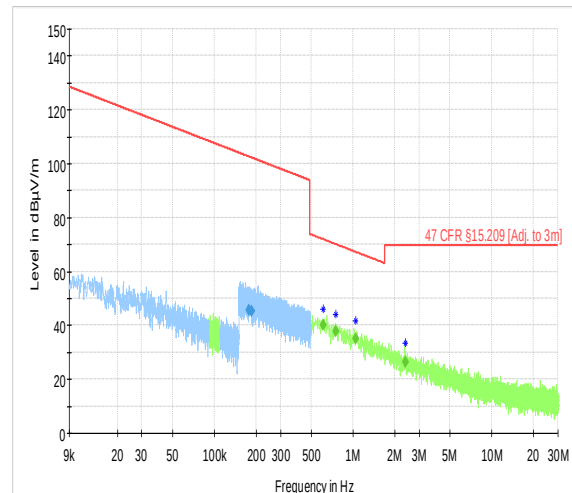
Preview Result 1-AVG
Critical_Freqs AVG
Final_Result AVG

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)
0.167133	46.18	---	---	103.14	56.96	1000.0	9.000	100.0	H	154.0
0.185586	45.21	---	---	102.23	57.02	1000.0	9.000	100.0	H	135.0
0.517958	---	41.66	---	73.32	31.65	1000.0	9.000	100.0	H	45.0
0.529778	---	41.57	---	73.12	31.55	1000.0	9.000	100.0	H	225.0
0.784646	---	37.65	---	69.71	32.06	1000.0	9.000	100.0	H	191.0
2.028880	---	27.97	---	69.54	41.57	1000.0	9.000	100.0	H	225.0
0.034774	---	---	53.72	136.78	83.06	1000.0	0.200	100.0	H	229.0
0.071468	---	---	46.65	130.52	83.87	1000.0	0.200	100.0	H	165.0
0.150457	---	---	58.07	124.06	65.99	1000.0	9.000	100.0	H	256.0
0.161887	---	---	57.96	123.42	65.46	1000.0	9.000	100.0	H	88.0
0.182568	---	---	56.12	122.38	66.25	1000.0	9.000	100.0	H	45.0
0.437961	---	---	48.50	114.78	66.28	1000.0	9.000	100.0	H	-39.0

Test mode condition	IEEE 802.15.4g, High channel (927.8 MHz)	
Antenna orientation	Loop Antenna Parallel to Axis	
Sweep frequency	9 kHz-30 MHz	
Standard	47 CFR FCC Part 15 subpart C	
EUT	A002972080-027	
Ancillary Equipment	A002972080-013 A002972080-010 A002972080-033	
Test Engineer	Joel Efraimsson	Date: 2021-01-24
Chamber details	Chamber: SAC 5	



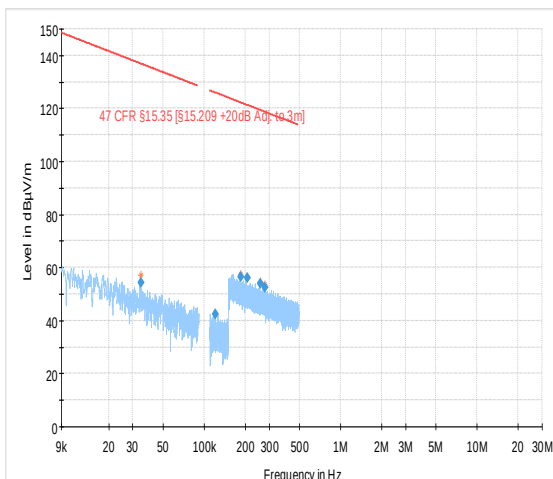
Preview Result 1-PK+ Critical_Freqs PK+
47 CFR §15.35 [§15.209 +20dB Adj. to 3m] Final_Result PK+



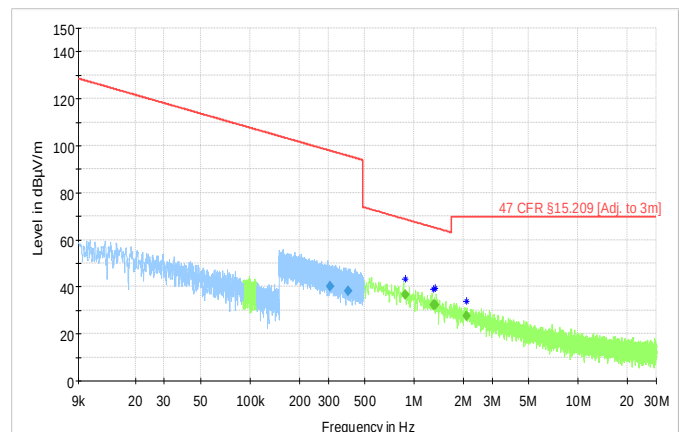
Preview Result 2-PK+ Preview Result 1-AVG
Critical_Freqs PK+ Critical_Freqs AVG
47 CFR §15.209 [Adj. to 3m] Final_Result AVG
Final_Result QPK

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)
0.178129	45.48	---	---	102.59	57.11	1000.0	9.000	100.0	H	-41.0
0.186382	45.11	---	---	102.20	57.08	1000.0	9.000	100.0	H	139.0
0.610546	---	40.06	---	71.89	31.83	1000.0	9.000	100.0	H	102.0
0.755278	---	37.78	---	70.04	32.26	1000.0	9.000	100.0	H	-41.0
1.040676	---	34.96	---	67.26	32.30	1000.0	9.000	100.0	H	135.0
2.373499	---	26.29	---	69.54	43.25	1000.0	9.000	100.0	H	45.0
0.023579	---	---	56.57	140.15	83.59	1000.0	0.200	100.0	H	135.0
0.062642	---	---	47.22	131.67	84.45	1000.0	0.200	100.0	H	76.0
0.168661	---	---	57.81	123.06	65.26	1000.0	9.000	100.0	H	267.0
0.228844	---	---	55.58	120.41	64.83	1000.0	9.000	100.0	H	315.0
0.272341	---	---	52.61	118.90	66.29	1000.0	9.000	100.0	H	292.0
0.441015	---	---	49.52	114.72	65.19	1000.0	9.000	100.0	H	135.0

Test mode condition	IEEE 802.15.4g, High channel (927.8 MHz)	
Antenna orientation	Loop Antenna Perpendicular to axis	
Sweep frequency	9 kHz-30 MHz	
Standard	47 CFR FCC Part 15 subpart C	
EUT	A002972080-027	
Ancillary Equipment	A002972080-013 A002972080-010 A002972080-033	
Test Engineer	Joel Efraimsson	Date: 2021-01-24
Chamber details	Chamber: SAC 5	



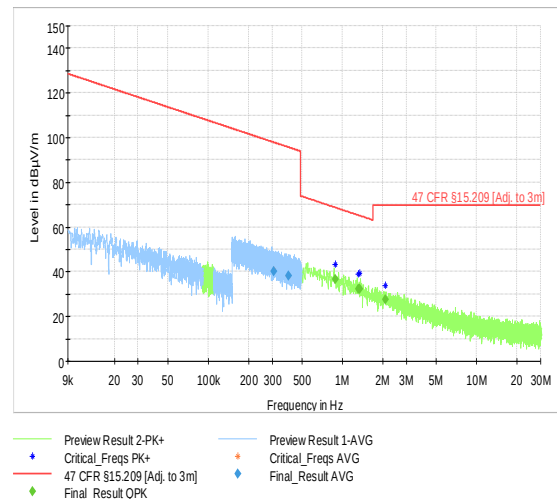
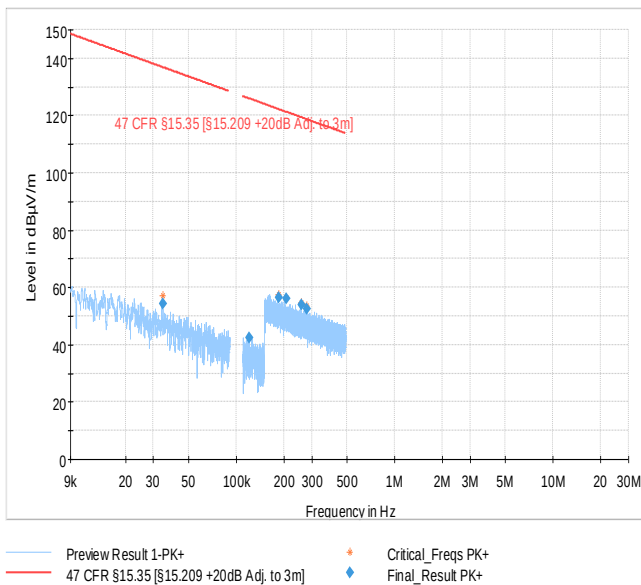
— Preview Result 1-PK+ ★ Critical_Freqs PK+
— 47 CFR §15.35 [§15.209 +20dB Adj. to 3m] ◆ Final_Result PK+



— 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

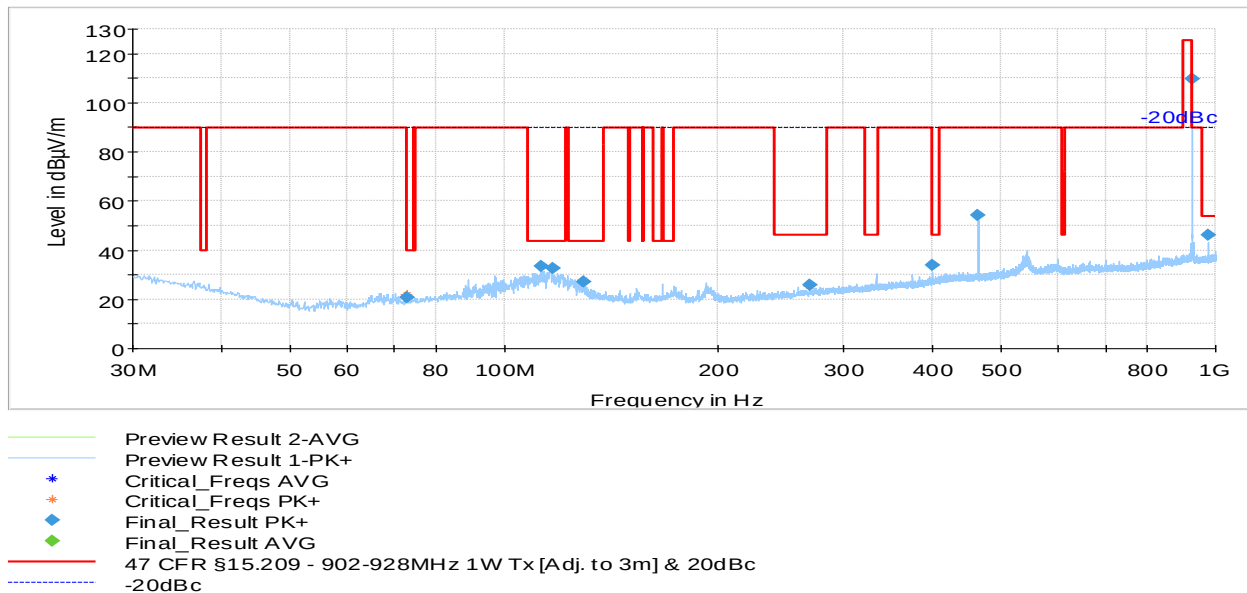
Frequency (MHz)	Average (dBµV/m)	QuasiPeak (dBµV/m)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
0.306572	40.22	---	---	97.87	57.65	1000.0	9.000	100.0	H	25.0
0.396069	38.15	---	---	95.65	57.50	1000.0	9.000	100.0	H	45.0
0.886142	---	36.49	---	68.65	32.17	1000.0	9.000	100.0	H	281.0
1.320304	---	32.46	---	65.19	32.73	1000.0	9.000	100.0	H	135.0
1.339456	---	32.39	---	65.07	32.68	1000.0	9.000	100.0	H	-1.0
2.081300	---	27.62	---	69.54	41.92	1000.0	9.000	100.0	H	218.0
0.034473	---	---	54.35	136.86	82.50	1000.0	0.200	100.0	H	225.0
0.120690	---	---	42.46	125.97	83.52	1000.0	0.200	100.0	H	225.0
0.185449	---	---	56.63	122.24	65.61	1000.0	9.000	100.0	H	255.0
0.206752	---	---	56.11	121.30	65.19	1000.0	9.000	100.0	H	189.0
0.257616	---	---	53.91	119.39	65.47	1000.0	9.000	100.0	H	-45.0
0.277594	---	---	52.41	118.74	66.33	1000.0	9.000	100.0	H	88.0

Test mode condition	IEEE 802.15.4g, High channel (927.8 MHz)	
Antenna orientation	Loop Antenna Parallel to floor	
Sweep frequency	9 kHz-30 MHz	
Standard	47 CFR FCC Part 15 subpart C	
EUT	A002972080-027	
Ancillary Equipment	A002972080-013 A002972080-010 A002972080-033	
Test Engineer	Joel Efraimsson	Date: 2021-01-24
Chamber details	Chamber: SAC 5	



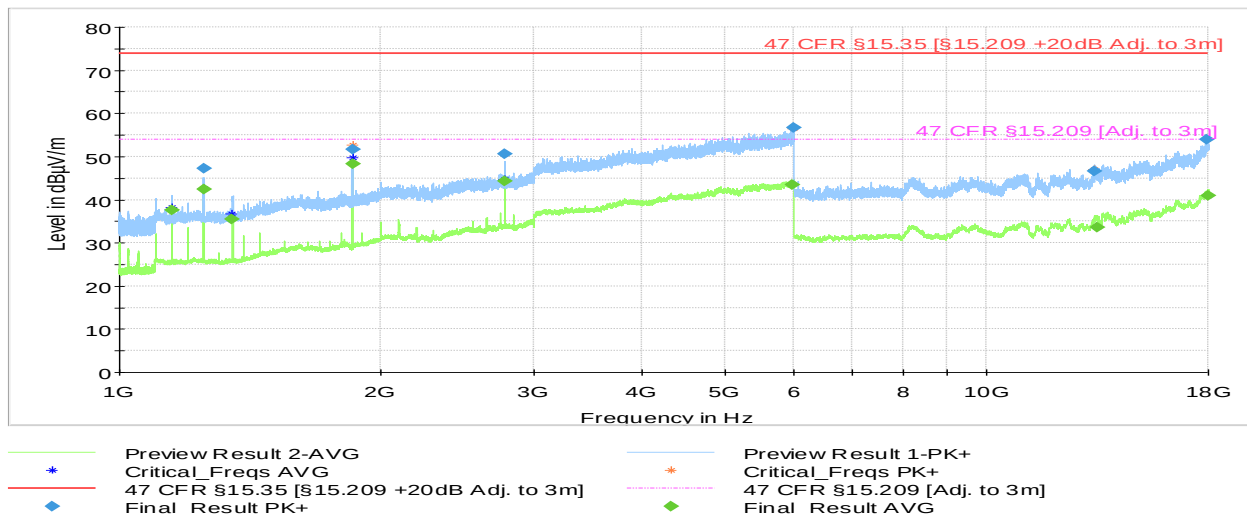
Frequency (MHz)	Average (dBµV/m)	QuasiPeak (dBµV/m)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
0.306572	40.22	---	---	97.87	57.65	1000.0	9.000	100.0	H	25.0
0.396069	38.15	---	---	95.65	57.50	1000.0	9.000	100.0	H	45.0
0.886142	---	36.49	---	68.65	32.17	1000.0	9.000	100.0	H	281.0
1.320304	---	32.46	---	65.19	32.73	1000.0	9.000	100.0	H	135.0
1.339456	---	32.39	---	65.07	32.68	1000.0	9.000	100.0	H	-1.0
2.081300	---	27.62	---	69.54	41.92	1000.0	9.000	100.0	H	218.0
0.034473	---	---	54.35	136.86	82.50	1000.0	0.200	100.0	H	225.0
0.120690	---	---	42.46	125.97	83.52	1000.0	0.200	100.0	H	225.0
0.185449	---	---	56.63	122.24	65.61	1000.0	9.000	100.0	H	255.0
0.206752	---	---	56.11	121.30	65.19	1000.0	9.000	100.0	H	189.0
0.257616	---	---	53.91	119.39	65.47	1000.0	9.000	100.0	H	-45.0
0.277594	---	---	52.41	118.74	66.33	1000.0	9.000	100.0	H	88.0

Test mode condition	IEEE 802.15.4g, High channel (927.8 MHz)	
Antenna orientation	Horizontal and Vertical	
Sweep frequency	30 MHz – 1 GHz	
Standard	47 CFR FCC Part 15 subpart C	
EUT	A002972080-027	
Ancillary Equipment	A002972080-013 A002972080-010 A002972080-033	
Test Engineer	Niall Forrester	Date: 2021-03-12
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)
72.770760	20.64	---	89.81	69.17	1000.0	120.000	383.0	V	199.0
112.799440	33.55	---	43.52	9.97	1000.0	120.000	133.0	V	-22.0
116.930640	32.42	---	43.52	11.10	1000.0	120.000	153.0	V	333.0
129.442560	27.28	---	43.52	16.24	1000.0	120.000	206.0	V	-22.0
269.057840	25.90	---	46.02	20.13	1000.0	120.000	270.0	H	40.0
400.024840	33.73	---	46.02	12.29	1000.0	120.000	325.0	H	266.0

Test mode condition	IEEE 802.15.4g, High channel (927.8 MHz)	
Antenna orientation	Horizontal and Vertical	
Sweep frequency	1 GHz – 18 GHz	
Standard	47 CFR FCC Part 15 subpart C	
EUT	A002972080-027	
Ancillary Equipment	A002972080-013 A002972080-010 A002972080-033	
Test Engineer	Niall Forrester	Date: 2021-03-12
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)
1150.022000	---	37.61	53.98	16.37	1000.0	1000.000	177.0	V	41.0
1249.838000	47.18	---	73.98	26.80	1000.0	1000.000	158.0	V	54.0
1249.974000	---	42.48	53.98	11.50	1000.0	1000.000	198.0	V	41.0
1350.019000	---	35.49	53.98	18.49	1000.0	1000.000	120.0	H	177.0
1855.616000	---	48.24	53.98	5.74	1000.0	1000.000	175.0	H	162.0
1855.705000	51.68	---	73.98	22.30	1000.0	1000.000	148.0	H	162.0
2783.329000	50.55	---	73.98	23.43	1000.0	1000.000	100.0	V	311.0
2783.403000	---	44.41	53.98	9.57	1000.0	1000.000	100.0	V	311.0
5977.810000	---	43.56	53.98	10.42	1000.0	1000.000	100.0	H	112.0
5992.587000	56.68	---	73.98	17.30	1000.0	1000.000	206.0	H	221.0
13328.413000	46.53	---	73.98	27.45	1000.0	1000.000	120.0	H	68.0
13401.472000	---	33.49	53.98	20.49	1000.0	1000.000	175.0	H	309.0
17927.129000	53.87	---	73.98	20.11	1000.0	1000.000	125.0	V	202.0
17990.523000	---	41.00	53.98	12.98	1000.0	1000.000	100.0	H	158.0

4.3 Test Results – Antenna Conducted Emissions

4.3.1 Antenna Conducted Emissions – Test Summary

Emissions measurements performed as radiated test (see section 4.2)

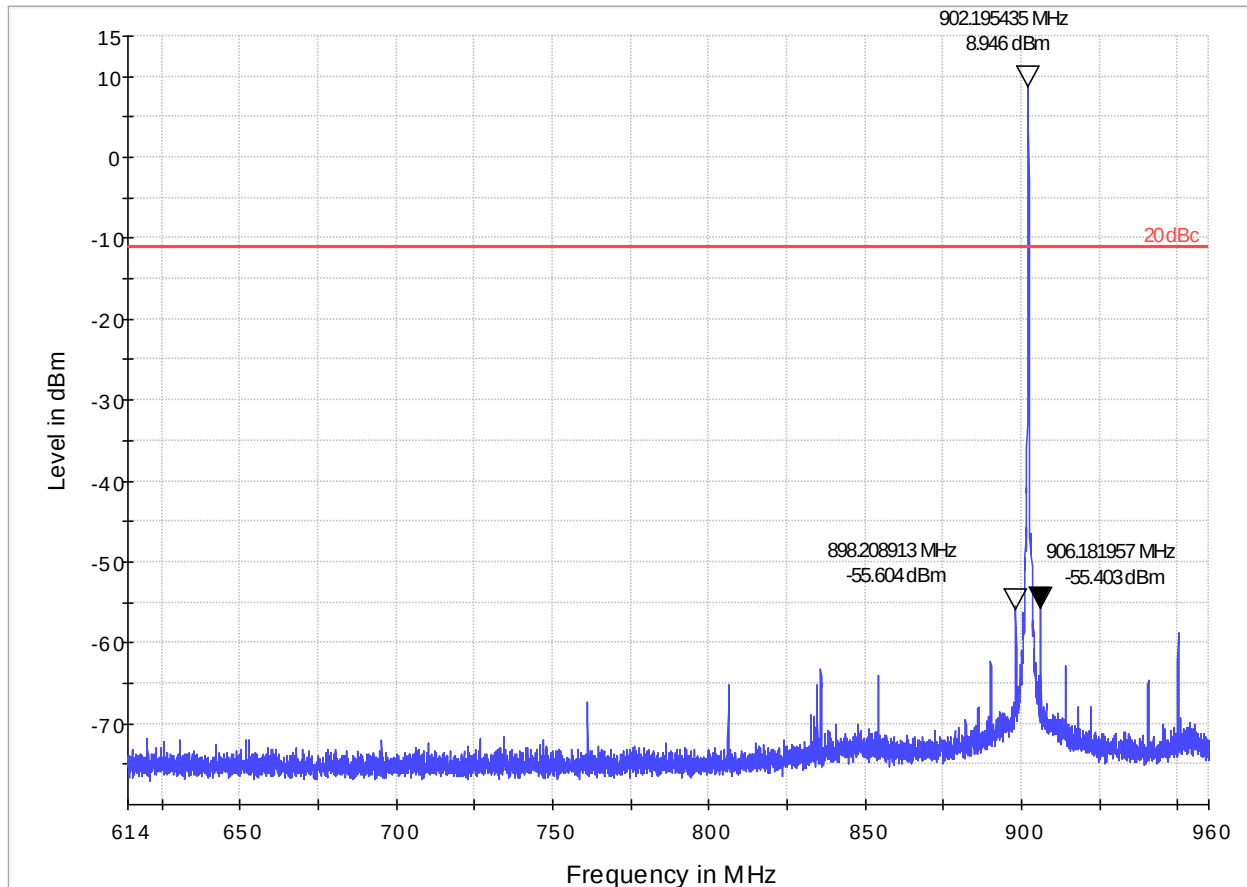
4.4 Test Results – Band Edge Compliance (Authorized Band)

4.4.1 Band Edge Compliance (Authorized Band) – Test Summary

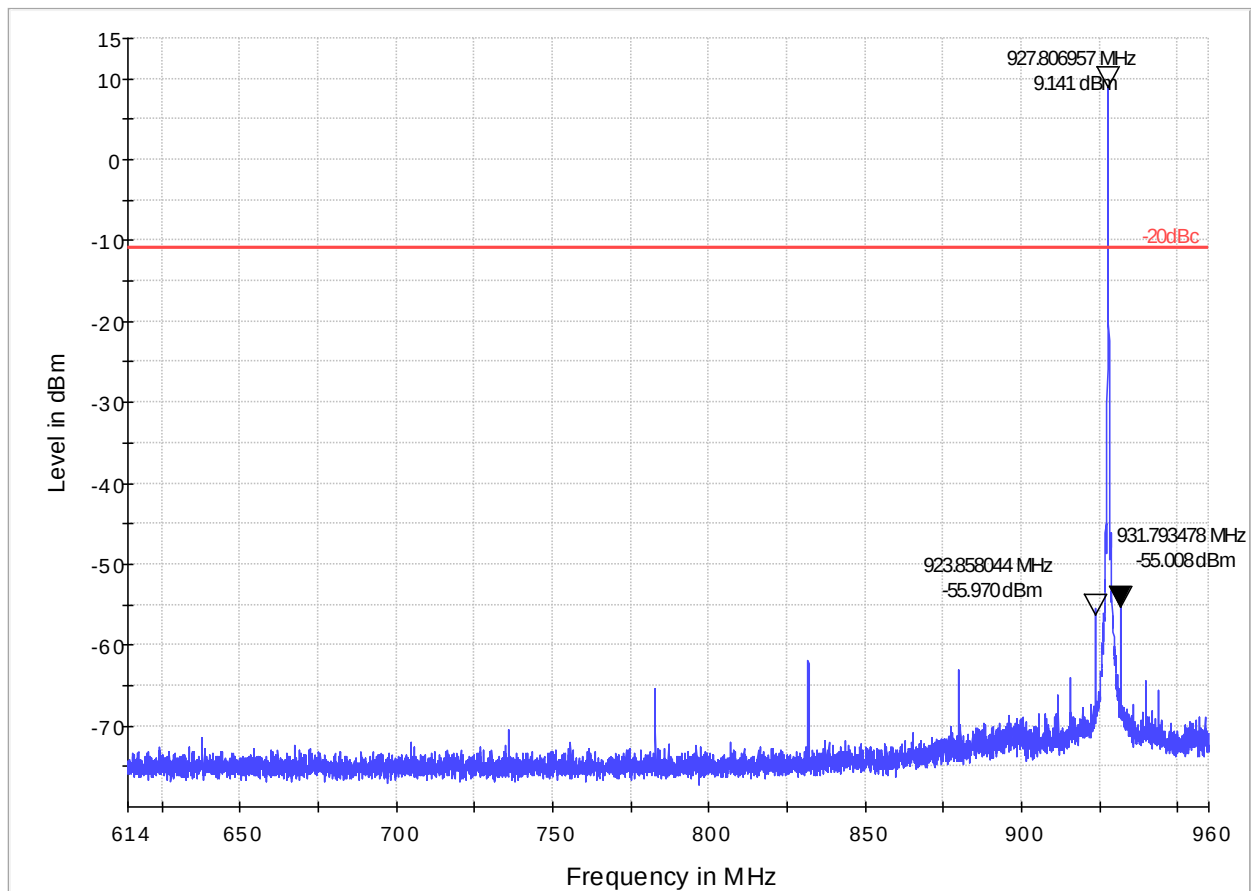
Test Specification	47 CFR 15.247 (d)			
Test Engineer & Date	Sam Ebadeh		2021.02.22 – 2021.04.12	
EUT and Ancillary Equipment IDs	A002965790-011 A003002493-001		A002972080-007	
EUT Operation Mode(s)	Continuous Tx / Continuous Hopping			
EUT Wireless Configuration(s)	IEEE 802.15.4g Sub-GHz US (see below for details)			
EUT Hardware Configuration(s)	Power from Lab Power Supply.			
Overall Result	PASS			
Test Parameter	Wireless Configuration	Measured Level (dBm)	Limit (dBm)	Result
Emissions at Band Edge (Auth. Band – Low Edge)	IEEE 802.15.4g Sub-GHz US Low Channel (2-GFSK 902.2 MHz)	-55.604	-11.054	PASS
Emissions at Band Edge (Auth. Band – Low Edge)	IEEE 802.15.4g Sub-GHz US Low Channel (2-GFSK 902.2 MHz)	-55.403	-11.054	PASS
Emissions at Band Edge (Auth. Band – Low Edge)	IEEE 802.15.4g Sub-GHz US Hopping (2-GFSK)	-40.965	-10.884	PASS
Emissions at Band Edge (Auth. Band – High Edge)	IEEE 802.15.4g Sub-GHz US High Channel (2-GFSK 927.8 MHz)	-55.970	-10.859	PASS
Emissions at Band Edge (Auth. Band – High Edge)	IEEE 802.15.4g Sub-GHz US High Channel (2-GFSK 927.8 MHz)	-55.008	-10.859	PASS
Emissions at Band Edge (Auth. Band – High Edge)	IEEE 802.15.4g Sub-GHz US Hopping (2-GFSK)	-55.230	-10.884	PASS

4.4.2 Band Edge Compliance (Authorized Band) – Test Details

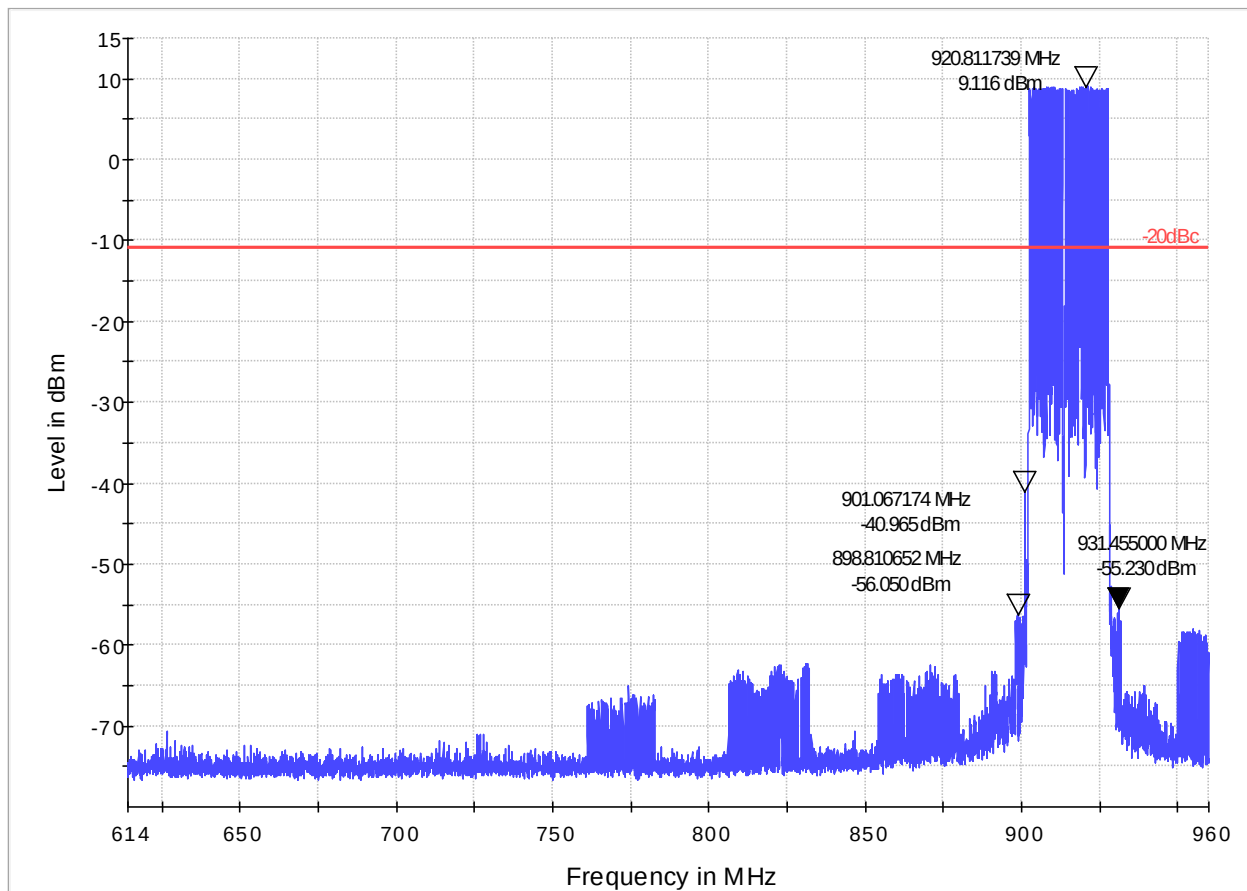
Low Channel



High Channel



Hopping



4.5 Test Results – Band Edge Compliance (Restricted Band)

4.5.1 Band Edge Compliance (Restricted Band) – Test Summary

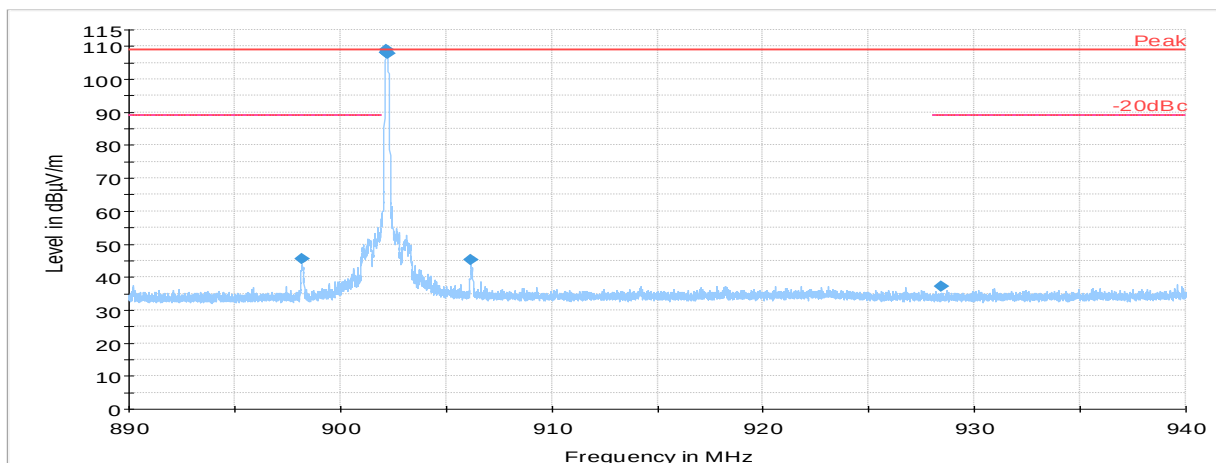
Test Specification	47 CFR 15.209 & 15.247 (d)	
Test Engineer & Date	Sam Ebadeh Niall Forrester	2021.04.13 – 2021.04.14
EUT and Ancillary Equipment IDs	A003002493-001	A002972080-013 A002972080-010 A002972080-033
EUT Operation Mode(s)	Continuous Tx	
EUT Wireless Configuration(s)	IEEE 802.15.4g Sub-GHz US (see below for details)	
EUT Hardware Configuration(s)	-	
Overall Result	PASS	
Test Parameter	Wireless Configuration	Result*
Emissions at Band Edge (Rest. Band – Low Edge)	IEEE 802.15.4g Sub-GHz US Low Channel (2-GFSK 902.2 MHz)	PASS
Emissions at Band Edge (Rest. Band – High Edge)	IEEE 802.15.4g Sub-GHz US High Channel (2-GFSK 927.8 MHz)	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

Test mode condition	IEEE 802.15.4g, Low channel (902.2 MHz)	
Antenna orientation	Horizontal and Vertical	
Sweep frequency	1 GHz – 18 GHz Lower Band Edge	
Standard	47 CFR FCC Part 15 subpart C	
EUT	A003002493-001	
Ancillary Equipment	A002972080-013	
	A002972080-010	
	A002972080-033	
Test Engineer	Niall Forrester	Date: 2021-04-13
Chamber details	Chamber: SAC 5	



* Preview Result 2-AVG
◆ Critical_Freqs PK+
◆ Final_Result AVG

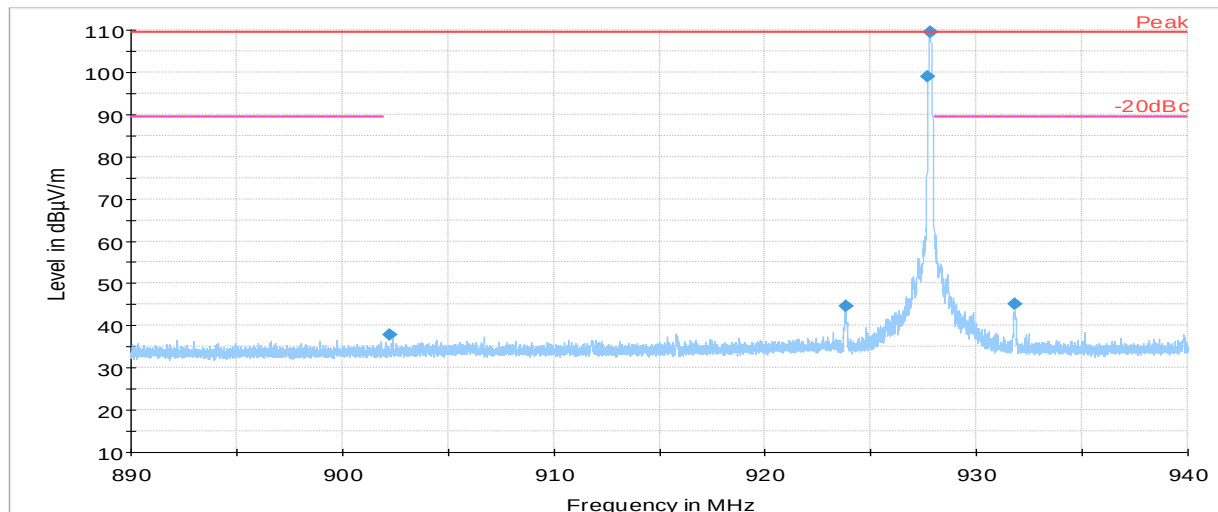
— Preview Result 1-PK+
— -20dBc
— -20dBc

* Critical_Freqs AVG
◆ Final_Result PK+
— Peak

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
898.182800	45.51	89.05	43.54	1000.0	100.000	100.0	V	-18.0
902.178600	109.05	---	---	1000.0	100.000	108.0	V	334.0
902.179400	107.95	---	---	1000.0	100.000	183.0	V	8.0
902.179900	107.94	---	---	1000.0	100.000	183.0	V	8.0
902.228700	107.93	---	---	1000.0	100.000	183.0	V	8.0
906.180500	45.22	---	---	1000.0	100.000	125.0	V	252.0
928.432400	37.15	89.05	51.90	1000.0	100.000	125.0	V	289.0

Restricted Band – High Edge

Test mode condition	IEEE 802.15.4g, High channel (927.8 MHz)	
Antenna orientation	Horizontal and Vertical	
Sweep frequency	1 GHz – 18 GHz Upper Band Edge	
Standard	47 CFR FCC Part 15 subpart C	
EUT	A003002493-001	
Ancillary Equipment	A002972080-013	
	A002972080-010	
	A002972080-033	
Test Engineer	Niall Forrester	Date: 2021.04.14
Chamber details	Chamber: SAC 5	



* Preview Result 2-AVG
◆ Critical_Freqs PK+ Final_Result AVG
 — Preview Result 1-PK+
— -20dBc
— -20dBc
* Critical_Freqs AVG
◆ Final_Result PK+ Peak

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
902.250200	37.73	---	---	1000.0	100.000	175.0	H	248.0
923.833500	44.61	---	---	1000.0	100.000	125.0	V	310.0
927.708900	98.93	---	---	1000.0	100.000	108.0	V	68.0
927.828900	109.56	---	---	1000.0	100.000	108.0	V	72.0
927.829600	109.57	---	---	1000.0	100.000	108.0	V	72.0
931.833500	45.04	89.57	44.53	1000.0	100.000	108.0	V	72.0

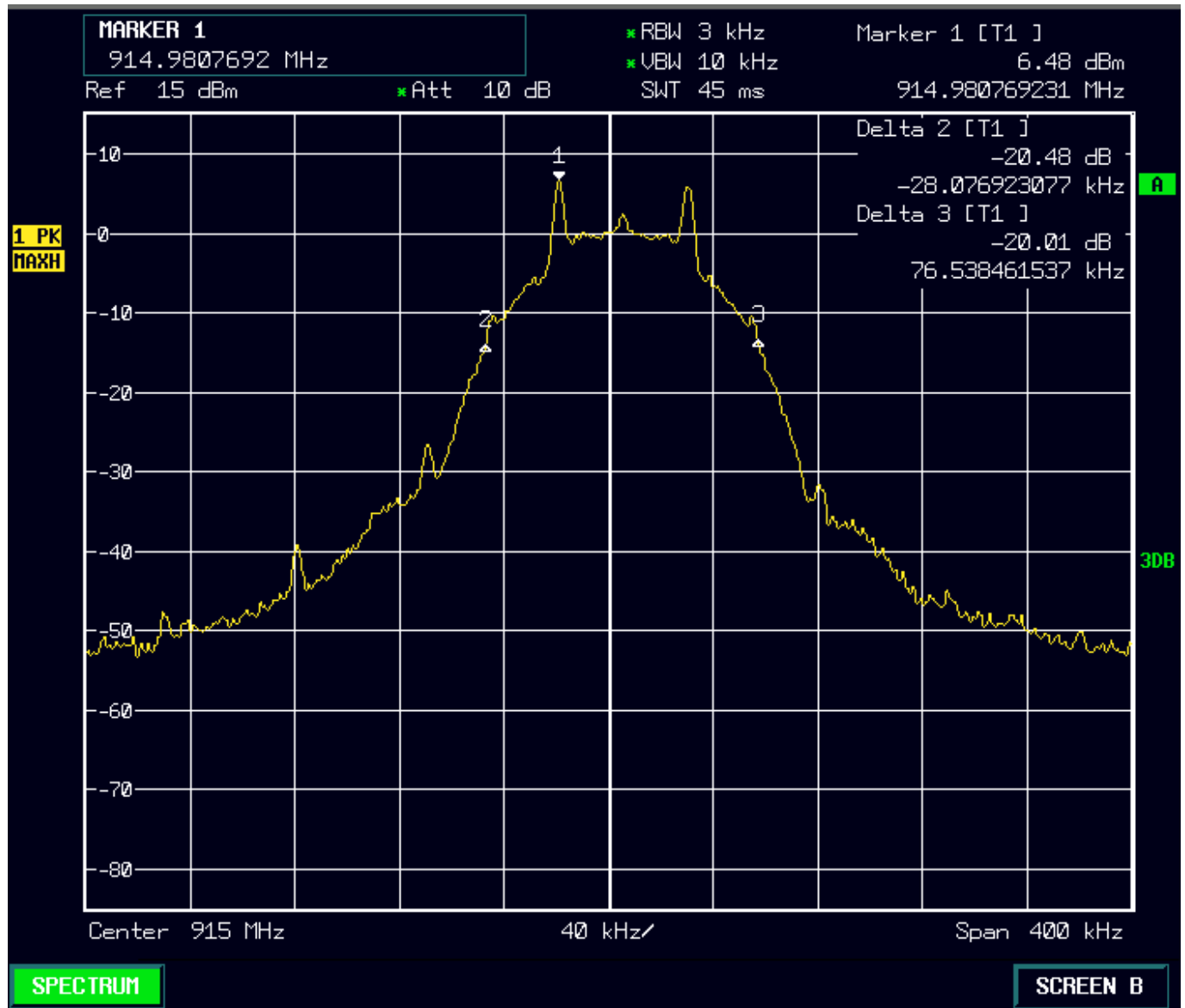
4.6 Test Results – 20dB Bandwidth

4.6.1 20dB Bandwidth – Test Summary

Test Specification		47 CFR 15.247 (a)(1)		
Test Engineer & Date		Sam Ebadeh	2021.06.24	
EUT and Ancillary Equipment IDs		A002965790-011	-	
EUT Operation Mode(s)		Continuous Tx		
EUT Wireless Configuration(s)		IEEE 802.15.4g Sub-GHz US (see below for details)		
EUT Hardware Configuration(s)		Power from Lab Power Supply.		
Overall Result		PASS		

Test Parameter	Wireless Configuration	Bandwidth (kHz)	Limit (kHz)	Result
20dB Bandwidth	IEEE 802.15.4g Sub-GHz US Low Channel (2-GFSK 902.2 MHz)	103.89	500	PASS
20dB Bandwidth	IEEE 802.15.4g Sub-GHz US Mid Channel (2-GFSK 915.0 MHz)	104.62	500	PASS
20dB Bandwidth	IEEE 802.15.4g Sub-GHz US High Channel (2-GFSK 927.8 MHz)	104.02	500	PASS

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

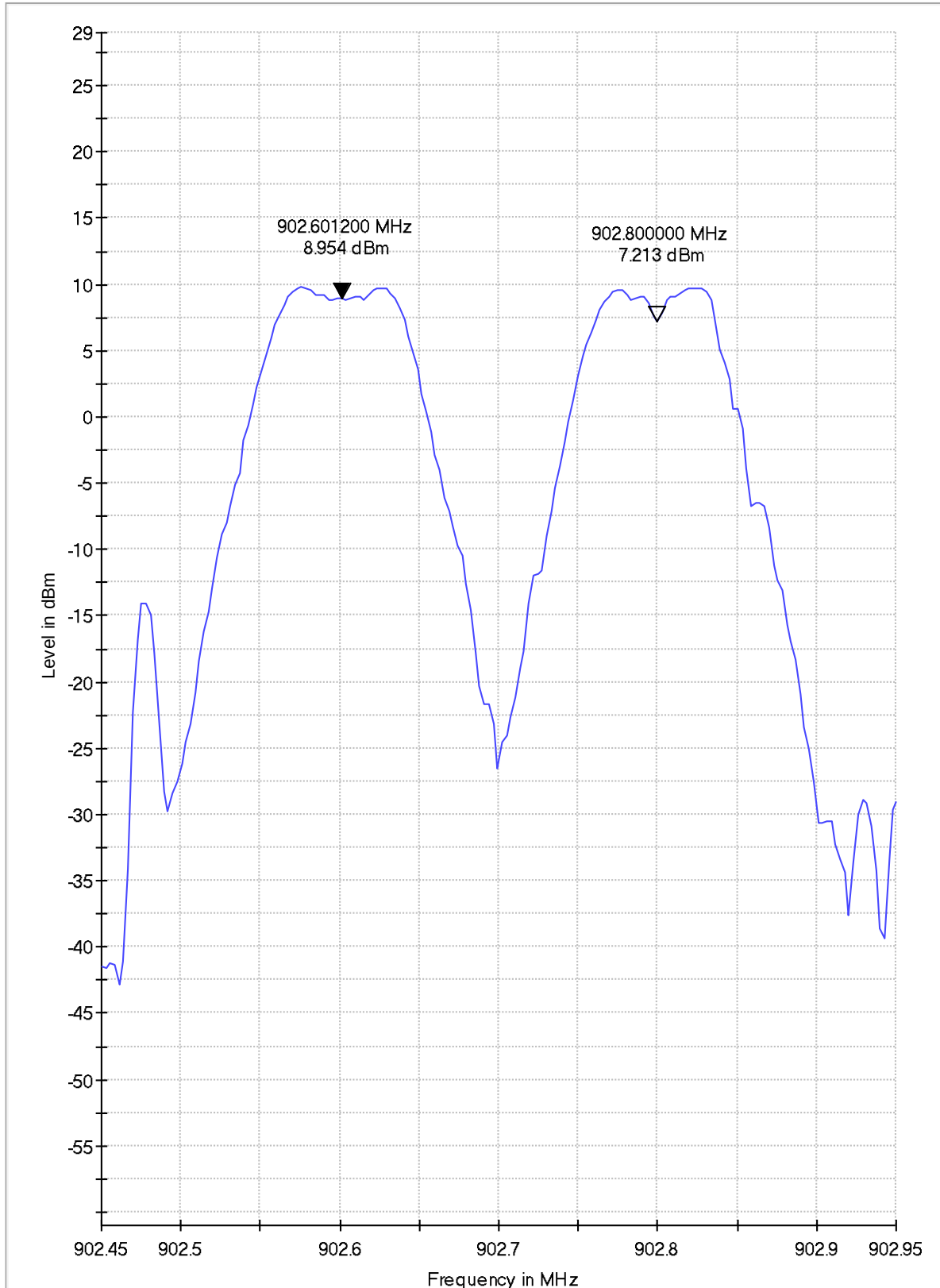


4.7 Test Results – Carrier (Hopping Channel) Separation

4.7.1 Carrier (Hopping Channel) Separation – Test Summary

Test Specification	47 CFR 15.247 (a)(1)				
Test Engineer & Date	Sam Ebadeh		2021.03.26		
EUT and Ancillary Equipment IDs	A003002493-001		-		
EUT Operation Mode(s)	Continuous Hopping				
EUT Wireless Configuration(s)	IEEE 802.15.4g Sub-GHz US (see below for details)				
EUT Hardware Configuration(s)	Power from USB Charger.				
Overall Result	PASS				
Test Parameter	Wireless Configuration		Separation (kHz)	Limit (kHz)	Result
Carrier Frequency Separation	IEEE 802.15.4g Sub-GHz US Hopping (2-GFSK)		198.80	<500	PASS

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



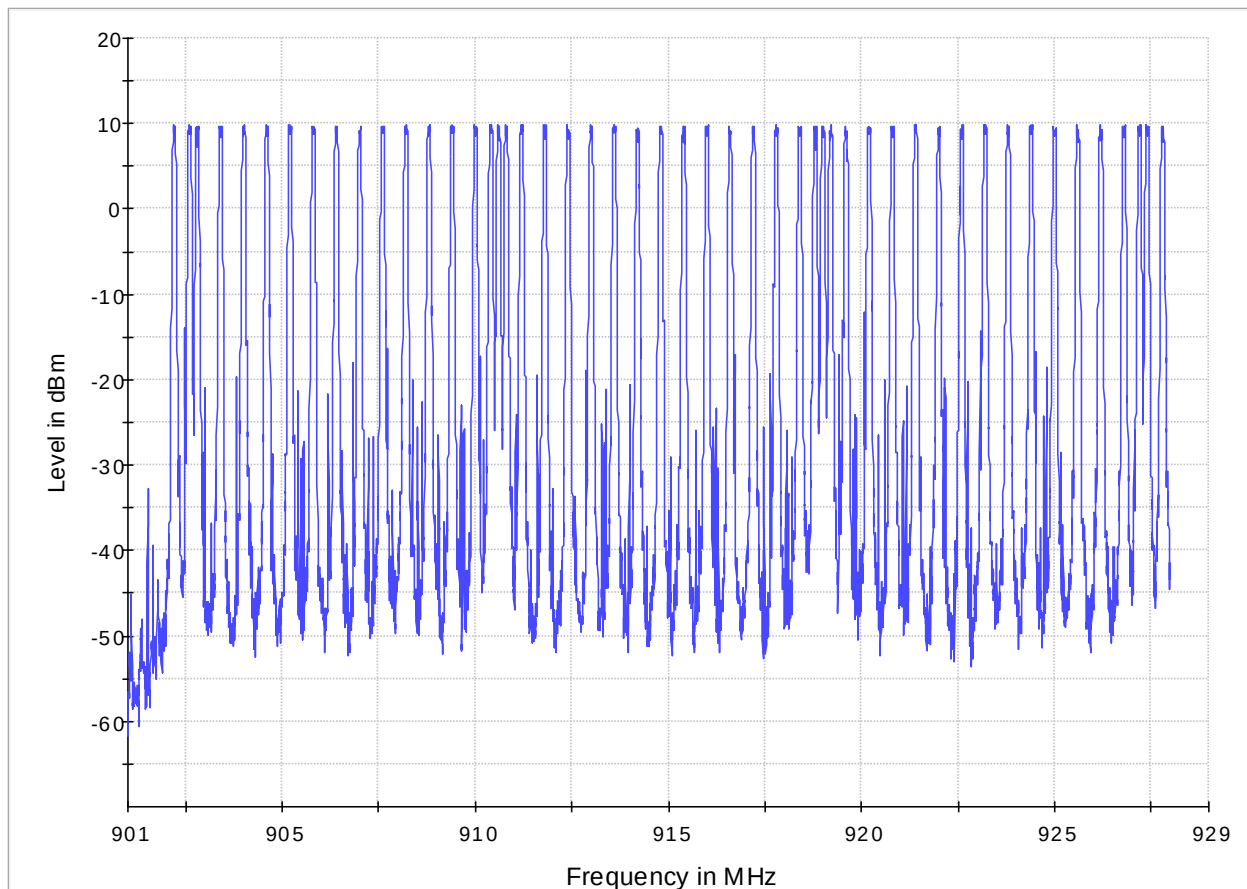
4.8 Test Results – Number of Hopping Channels

4.8.1 Number of Hopping Channels – Test Summary

Test Specification	47 CFR 15.247 (a)(1)			
Test Engineer & Date	Sam Ebadeh		2021.03.23	
EUT and Ancillary Equipment IDs	A003002493-001		-	
EUT Operation Mode(s)	Continuous Hopping			
EUT Wireless Configuration(s)	IEEE 802.15.4g Sub-GHz US (see below for details)			
EUT Hardware Configuration(s)	Power from USB Charger.			
Overall Result	PASS			

Test Parameter	Wireless Configuration	Measured Number	Limit (Min)	Result
Number of Hopping Channels	IEEE 802.15.4g Sub-GHz US Hopping (2-GFSK)	50	50	PASS

4.8.2 Number of Hopping Channels – Test Details



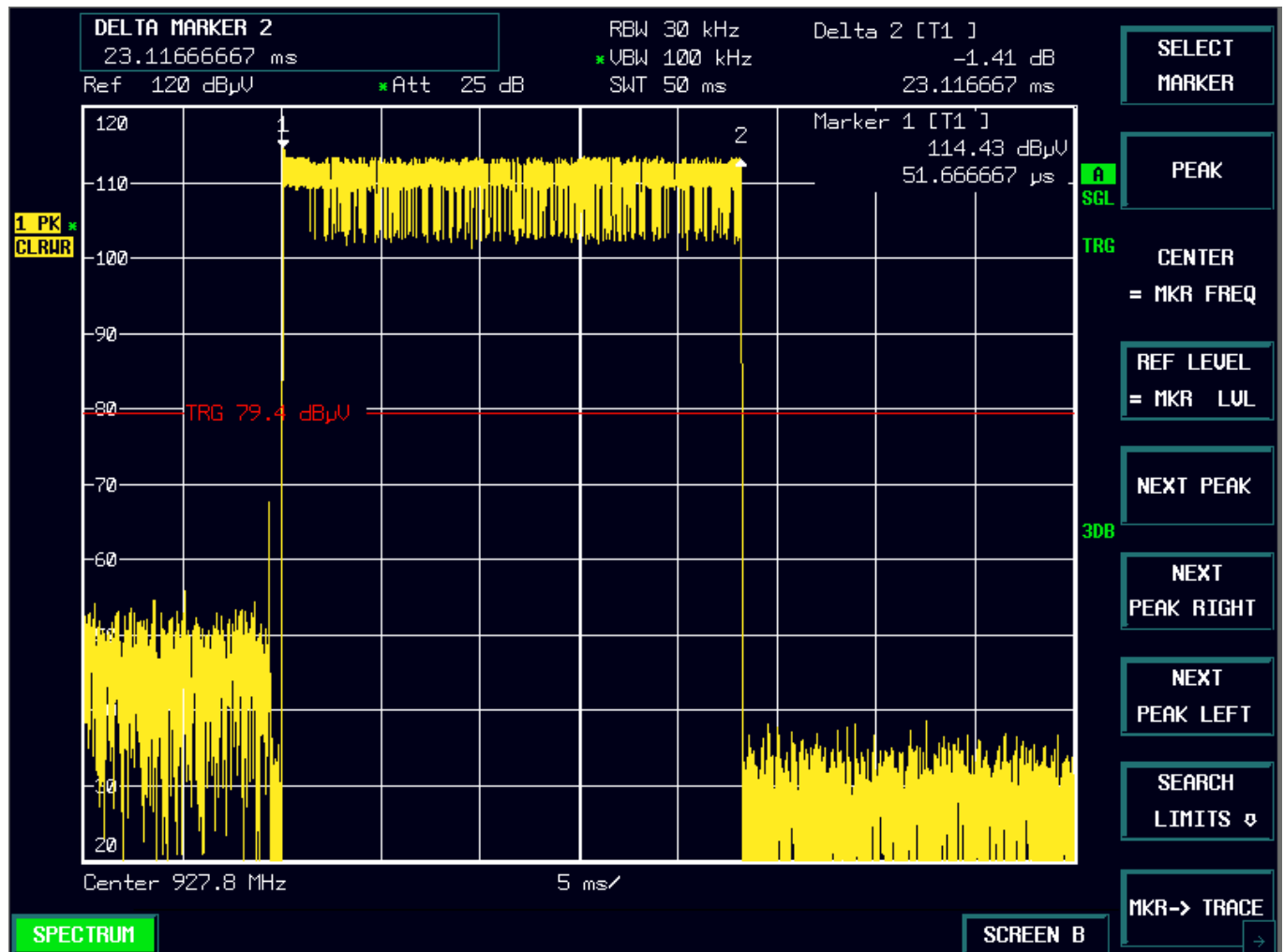
4.9 Test Results – Time of Occupancy (Dwell Time)

4.9.1 Time of Occupancy (Dwell Time) – Test Summary

Test Specification		47 CFR 15.247 (a)(1)		
Test Engineer & Date		Sam Ebadeh	2021.03.23	
EUT and Ancillary Equipment IDs		A003002493-001	-	
EUT Operation Mode(s)		Continuous Hopping		
EUT Wireless Configuration(s)		IEEE 802.15.4g Sub-GHz US (see below for details)		
EUT Hardware Configuration(s)		Power from USB Charger.		
Overall Result		PASS		

Test Parameter	Wireless Configuration	Measured Time (ms)	Limit (ms)	Result
Dwell Time	IEEE 802.15.4g Sub-GHz US Hopping (2-GFSK)	115.58	400	PASS

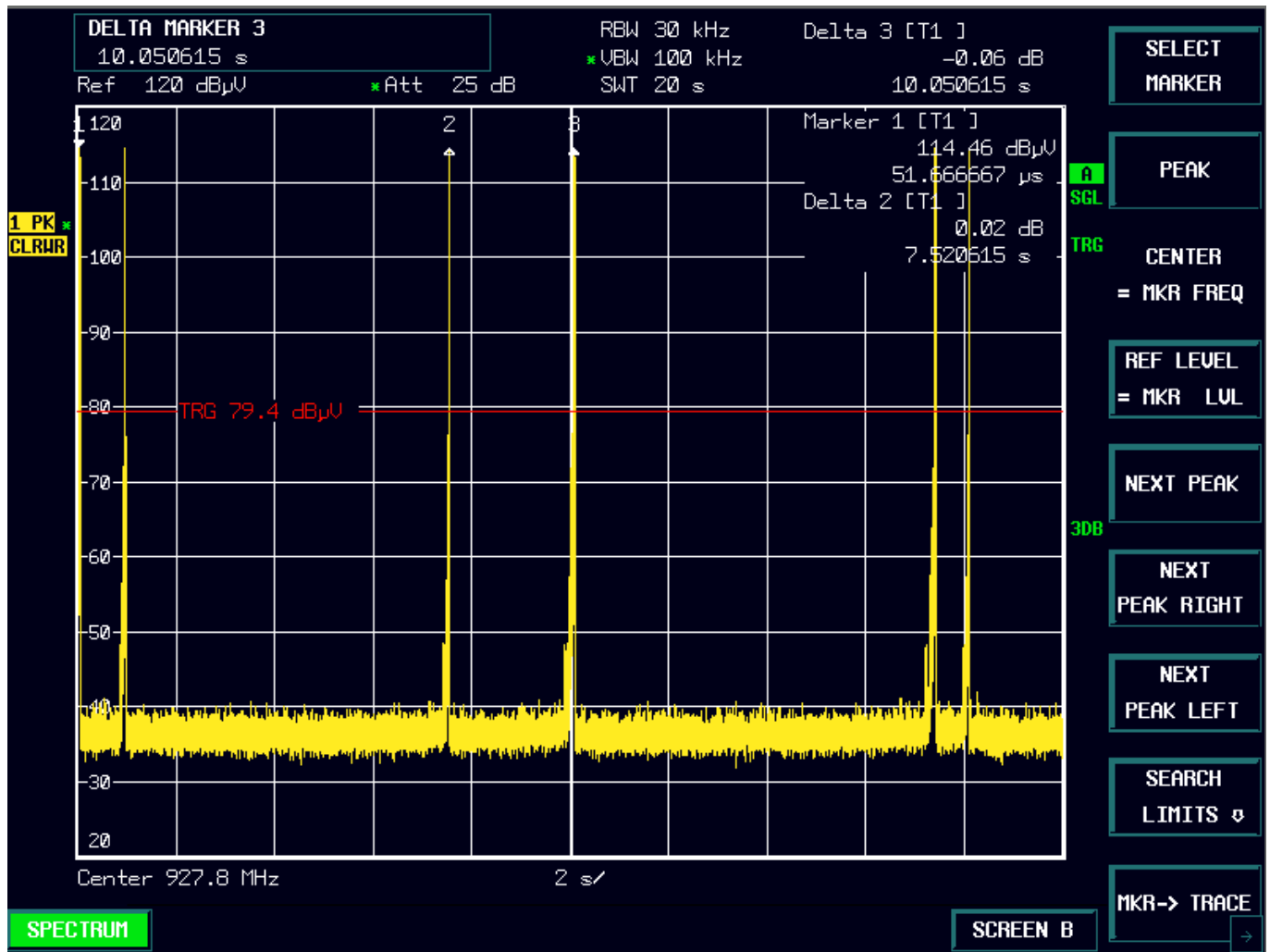
4.9.2 Time of Occupancy (Dwell Time) – Test Details



Time of occupancy (Single hop) = 23.116667 mS

Number of hops in 20s period = 5

Average Time of Occupancy = 5 x 23.11667 mS = 115.583335 mS



4.10 Test Results – 6dB Bandwidth

4.10.1 6dB Bandwidth – Test Summary

Requirement is not applicable as the device supports frequency hopping

4.11 Test Results – Peak Conducted Output Power

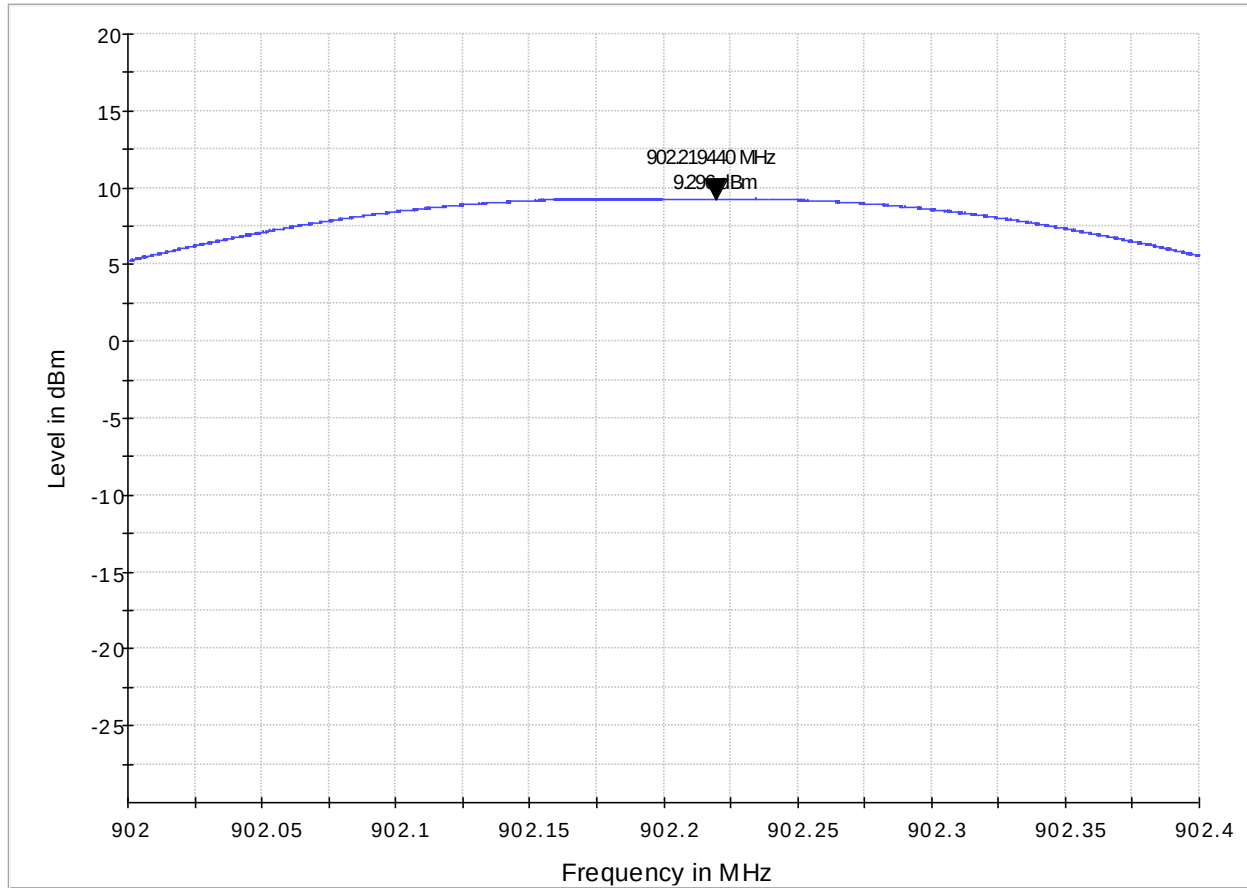
4.11.1 Peak Conducted Output Power – Test Summary

Test Specification	47 CFR 15.247(b)				
Test Engineer & Date	Sam Ebadeh		2021.03.15		
EUT and Ancillary Equipment IDs	A002965790-011		-		
EUT Operation Mode(s)	Continuous Tx				
EUT Wireless Configuration(s)	IEEE 802.15.4g Sub-GHz US (see below for details)				
EUT Hardware Configuration(s)	Power from Lab Power Supply.				
Overall Result	PASS				

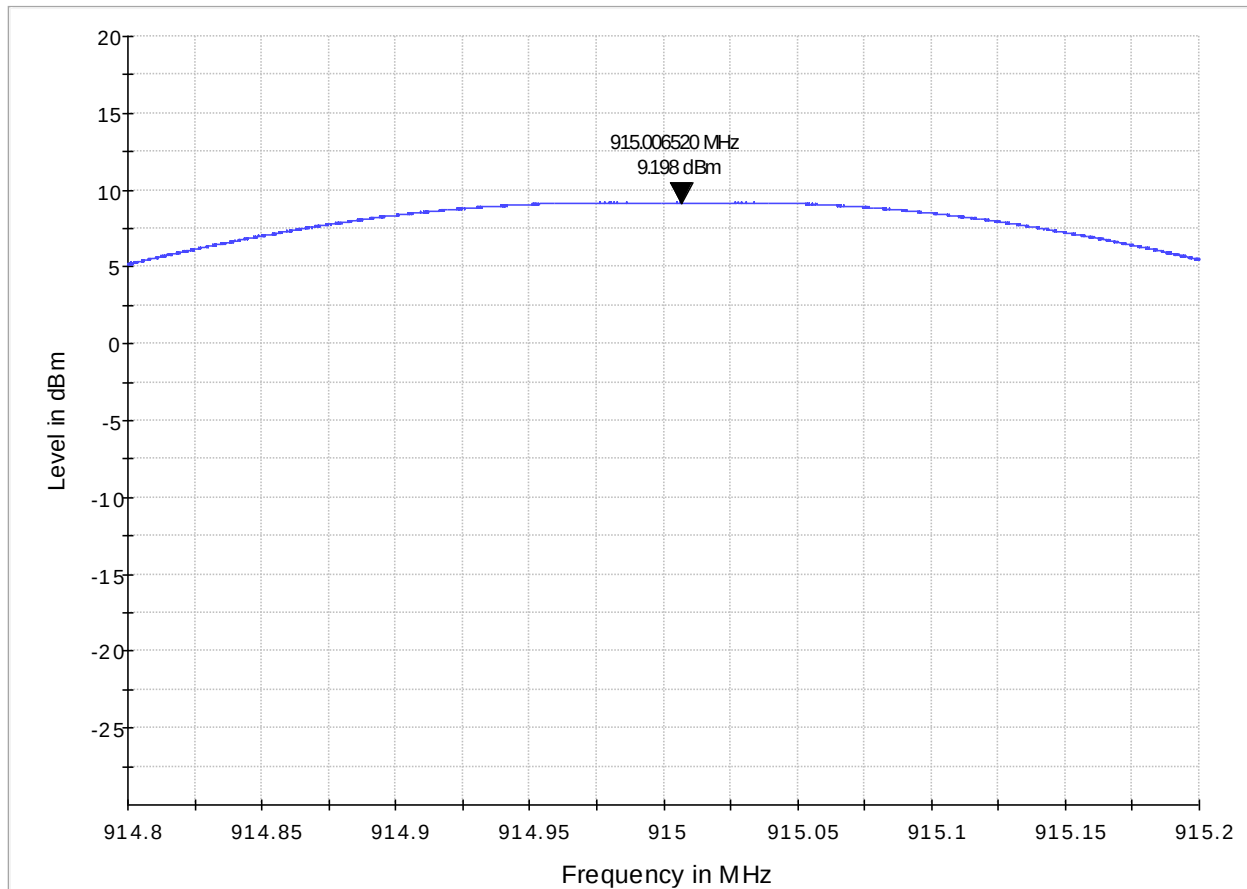
Test Parameter	Wireless Configuration	Measured Level (dBm)			Limit (dBm)	Result
		Low 2.40V	Nom 3.70V	High 5.50V		
Peak Conducted Output Power	IEEE 802.15.4g Sub-GHz US Low Channel (2-GFSK 902.2 MHz)	9.30	9.29	9.28	30	PASS
Peak Conducted Output Power	IEEE 802.15.4g Sub-GHz US Mid Channel (2-GFSK 915.0 MHz)	9.20	9.20	9.20	30	PASS
Peak Conducted Output Power	IEEE 802.15.4g Sub-GHz US High Channel (2-GFSK 927.8 MHz)	9.15	9.15	9.15	30	PASS

4.11.2 Peak Conducted Output Power – Test Details (Worst Case Plot)

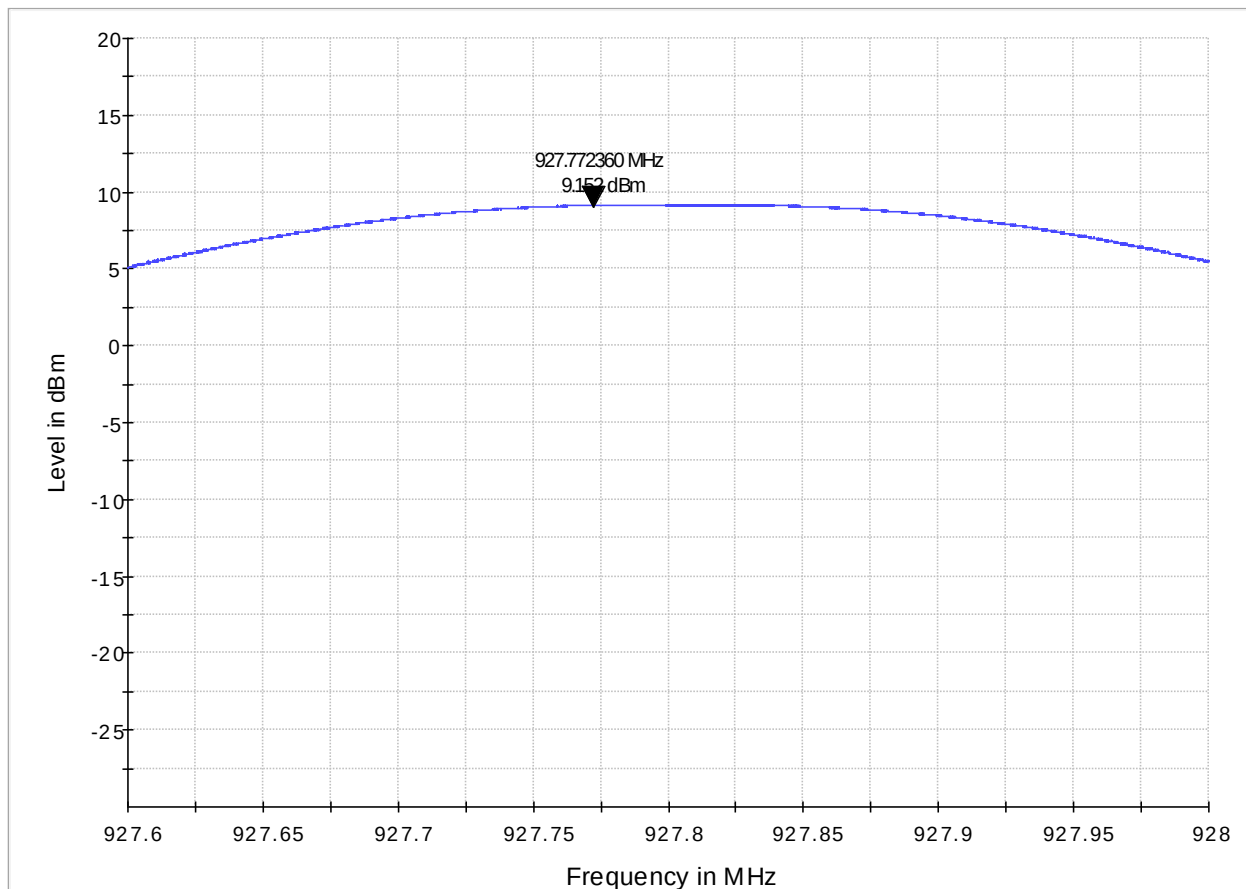
IEEE 802.15.4g – Low Channel – Low Voltage



IEEE 802.15.4g – Mid Channel – Low Voltage



IEEE 802.15.4g – High Channel – Low Voltage



4.12 Test Results – Power Spectral Density

4.12.1 Power Spectral Density – Test Summary

Requirement is not applicable as the device supports frequency hopping

5. TEST EQUIPMENT STATUS

5.1 List of Hardware with Calibration Dates

5.1.1 Hardware List – Conducted RF System

Type	Manufacturer	Model	Serial Number / ID	Calibration Date	Calibration Due
Spectrum Analyzer	Rohde & Schwarz	FSU26	100308 2704108	14.07.2020	14.07.2021
Temp. & Humidity Logger	Lufft	Opus 20	113.0118.0802.033 2771025	31.07.2020	31.07.2022

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

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	126.0118.0802.033 2771042	2020.07.31	2022.07.31

5.2 Software / Firmware Versions

Equipment	Software / Firmware Name	Version
Conducted RF	EMC 32	V10.60.10
Conducted Emissions System	EMC 32	V10.60.10
SAC 5	EMC 32	V10.60.10

6. MEASUREMENT UNCERTAINTY

6.1 Measurement Uncertainty for Conducted RF

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

For photographs of the test setup and EUT see appendix 1.