Prüfbericht-Nr.: *Test report no.:*	**60431076-004**	**Auftrags-Nr.:** *Order no.*:	23870469 030	Seite 1 von 36 *Page 1 of 36*
Kunden-Referenz-Nr.: *Client reference no.:*	1288983	**Auftragsdatum:** *Order date:*	2020.11.29	
Auftraggeber: *Client:*	IKEA of Sweden AB			
Prüfgegenstand: *Test item:*	Hub for smart products			
Bezeichnung / Typ-Nr.: *Identification / Type no.:*	DIRIGERA / E2003 / FCC ID: FHO-E2003			
Auftrags-Inhalt: *Order content*:	Accredited testing 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:*	2020.11.30
Prüfmuster-Nr.: *Test sample no:*	See section 2.3
Prüfzeitraum: *Testing period:*	2021.02.08 – 2021.03.04
Ort der Prüfung: *Place of testing:*	Lund, Sweden
Prüflaboratorium: *Testing laboratory:*	TÜV Rheinland Sweden
Prüfergebnis*: *Test result*:*	Pass

überprüft von: reviewed by:	X Signed by: Niall Forrester	**genehmigt von:** authorized by:	X Signed by: Hakan Ahlberg
Datum: 2022.02.16 *Date:*		**Datum: 2022.02.16** *Date:*	
Stellung / *Position:*	Senior Technical Expert	**Stellung** / *Position:*	Lab Manager

Sonstiges / *Other:* This report contains measurements for the Thread radio interface only

Zustand des Prüfgegenstandes bei Anlieferung: Prüfmuster vollständig und unbeschädigt
Condition of the test item at delivery: *Test item complete and undamaged*

* Legende:	1 = sehr gut	2 = gut	3 = befriedigend	4 = ausreichend	5 = mangelhaft
	P(ass) = entspricht o.g. Prüfgrundlage(n)		F(ail) = entspricht nicht o.g. Prüfgrundlage(n)	N/A = nicht anwendbar	N/T = nicht getestet
** Legend:*	*1 = very good*	*2 = good*	*3 = satisfactory*	*4 = sufficient*	*5 = poor*
	P(ass) = passed a.m. test specification(s)		*F(ail) = failed a.m. test specification(s)*	*N/A = not applicable*	*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.
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.

V05

Revision History60431076-00460431076-004

REVISION	DATE	REMARKS	AUTHOR
001	2021.04.27	First Release	Niall Forrester
002	2021.09.28	Corrected gain figures, updated module name.	Niall Forrester
003	2021.12.06	Replaced gain with module figure	Niall Forrester
004	2022.02.16	Corrected label - peak output power	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	N.P.	See Note 1
15.247 (d)	Band Edge Compliance (Restricted Band)	YES	4.5	PASS	
15.247 (a)(1)	20dB Bandwidth	NO	4.6	N/A	Thread is non-hopping
15.247 (a)(1)	Carrier (Hopping Channel) Separation	NO	4.7	N/A	Thread is non-hopping
15.247 (a)(1)	Number of Hopping Channels	NO	4.8	N/A	Thread is non-hopping
15.247 (a)(1)	Time of Occupancy (Dwell Time)	NO	4.9	N/A	Thread is non-hopping
15.247 (a)(2)	6dB Bandwidth	YES	4.10	N.P.	See Note 1
15.247 (b)	Peak Conducted Output Power	YES	4.11	N.P.	See Note 1
15.247 (e)	Power Spectral Density	YES	4.12	N.P.	See Note 1
-	Conducted Power Comparison	YES	4.13	Comparison Only	Comparing with certified module

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

Table of Contents

1. GENERAL INFORMATION

1.1 Test Site

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

1.2 Client Information

Company Name:	**IKEA**
Address:	**Tulpanvägen 8**
	343 34 Älmhult
	Sweden
Contact Person:	**Jeton Salihu**
Contact e-Mail / Telephone	**Jeton.salihu@inter.ikea.com** **+46 701443175**

2. PRODUCT INFORMATION

2.1 General Description

Model name:	DIRIGERA
Manufacturer:	IKEA of Sweden AB, SE-343 81 Älmhult
Model number / Marketing name:	E2003
FCC ID:	FHO-E2003
Description:	Electronic product acting as central hub for IKEAs Home Smart products.
Ancillary Equipment:	See section 2.8

The device incorporates three separate pre-certified modules:

- Murata LBEE5ZZ2AW (FCC ID: VPYLBEE5HY1MW) for WLAN 2.4 GHz 802.11 b/g/n, WLAN 5GHz 802.11 a/n/ac and Bluetooth Low Energy
- Silicon Labs MGM210L “No. 1” (FCC ID: QOQMGM210L) for ZigBee 802.15.4
- Silicon Labs MGM210L “No. 2” (FCC ID: QOQMGM210L) for Thread 802.15.4

Each module uses its own built-in antenna

2.2 Device Characteristics

Type of Power Supply	USB Power Supply (via AC/DC Adapter)
Nominal Supply Voltage	120V or 230V AC (Adapter) / 5V DC (USB)
Supply Voltage Range	100-240V AC
Operating Temperature Range	0ºC - 40 ºC
Operating Air Humidity Range	-
Highest Internal Frequency Source	5825 MHz

2.3 Test Samples

EUT #	EUT ID	Description	Used For:
1	A002959287-026	Standard Sample	Radiated Emissions
2	A002959287-027	Standard Sample	Conducted Emissions
3	A002959287-036	Modified with semi-rigid cable in place of each antenna	Conducted Power Measurements

2.4 Wireless Technologies and Bands Supported by the EUT

Technology	Band	Frequency Range (Tx)	Evaluation Performed*
WiFi 802.11 b/g/n (LBEE5ZZ2AW)	2.4 GHz	2412 MHz - 2462 MHz	NO
WiFi 802.11 a/n/ac (LBEE5ZZ2AW)	5 GHz	5180 MHz - 5240 MHz 5260 MHz - 5320 MHz 5500 MHz - 5720 MHz 5745 MHz - 5825 MHz	NO
BlueTooth Low Energy (LBEE5ZZ2AW)	2.4 GHz	2402 MHz – 2480 MHz	NO
ZigBee 802.15.4 (MGM210L No.1)	2.4 GHz	2400 MHz – 2483.5 MHz	NO
Thread 802.15.4 (MGM210L No.2)	2.4 GHz	2400 MHz – 2483.5 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
WiFi 802.11 a/b/g/n/ac BlueTooth Low Energy (LBEE5ZZ2AW)	2.4 GHz 5 GHz	1	Monopole	0.10 -0.40
ZigBee 802.15.4 (MGM210L No.1)	2.4 GHz	1	Inverted F PCB Trace	0.50
Thread 802.15.4 (MGM210L No.2)	2.4 GHz	1	Inverted F PCB Trace	0.50

2.6 Simultaneous Transmission Capabilities

Active Technologies	Bands	Active Modules
WiFi 802.11 a/n/ac + ZigBee 802.15.4	5 GHz 2.4 GHz	(LBEE5ZZ2AW) + (MGM210L No.1)
WiFi 802.11 a/n/ac + Thread 802.15.4	5 GHz 2.4 GHz	(LBEE5ZZ2AW) + (MGM210L No.2)

Except for the two cases listed above, no other simultaneous transmission capabilities are supported by the device. It is not possible for the device to send on any two 2.4GHz technologies simultaneously, and there is no situation where all three modules are active simultaneously. The LBEE5ZZ2AW module cannot transmit for Bluetooth simultaneously with any WLAN configuration.

2.7 Wireless Technology Details

Technology	Band	Modulation Type(s)	No. of Channels	Channel Spacing	Adaptivity
WiFi 802.11 b/g/n (LBEE5ZZ2AW)	2.4 GHz	CCK / BPSK / QPSK / 16-QAM / 64-QAM	11	5 MHz	N/A
WiFi 802.11 a/n/ac (LBEE5ZZ2AW)	5 GHz	BPSK / QPSK / 16-QAM / 64-QAM	As per 802.11	5 MHz	N/A
BlueTooth Low Energy (LBEE5ZZ2AW)	2.4 GHz	GFSK	40	2 MHz	N/A
ZigBee 802.15.4 (MGM210L No.1)	2.4 GHz	O-QPSK	16	5 MHz	N/A
Thread 802.15.4 (MGM210L No.2)	2.4 GHz	O-QPSK	16	5 MHz	N/A

2.8 Ancillary Equipment

ID	Description	Manufacturer / Model	Hardware & Software Versions
A002959287-014	AC/DC Power Supply	IKEA ICPWS5	-
A002959287-015	USB Cable	-	-
A002959287-017	AC/DC Power Supply	IKEA ICPWS5	-
A002959287-018	USB Cable	-	-
A002959287-020	LAN Cable (UTP)	-	-
A002959287-023	LAN Cable (UTP)	-	-

2.9 EUT Diagrams

-

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)	Antenna Conducted 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 µV/m. Measurements on the test system are made in dBµV/m. To convert between these, the following adjustment is used:

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

Example: from 15.209(a) the limit for 30MHz – 88MHz is 100µV/m at 3m. This gives:

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

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 30µV/m (=29.54 dBµV/m) at 30m

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

Example: from 15.209(a) the limit for 1GHz – 18GHz is 500µV/m (=53.98 dBµV/m) at 3m

$Limit@1m = Limit@3m + 20\log\left(\frac{3}{1}\right)$ = 53.98 +9.54 = 63.52 dBµV/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	N/A
15.247 (d)	Band Edge Compliance (Authorized band)	N.P.
15.247 (d)	Band Edge Compliance (Restricted band)	SAC 5
15.247 (a)(1)	20dB Bandwidth	N.P.
15.247 (a)(1)	Carrier (Hopping Channel) Separation	N.P.
15.247 (a)(1)	Number of Hopping Channels	N.P.
15.247 (a)(1)	Time of Occupancy (Dwell Time)	N.P.
15.247 (a)(2)	6dB Bandwidth	N.P.
15.247 (b)	Peak Conducted Output Power	N.P.
15.247 (e)	Power Spectral Density	N.P.

3.4.3 Test Equipment Setup – Conducted Power measurements for comparison

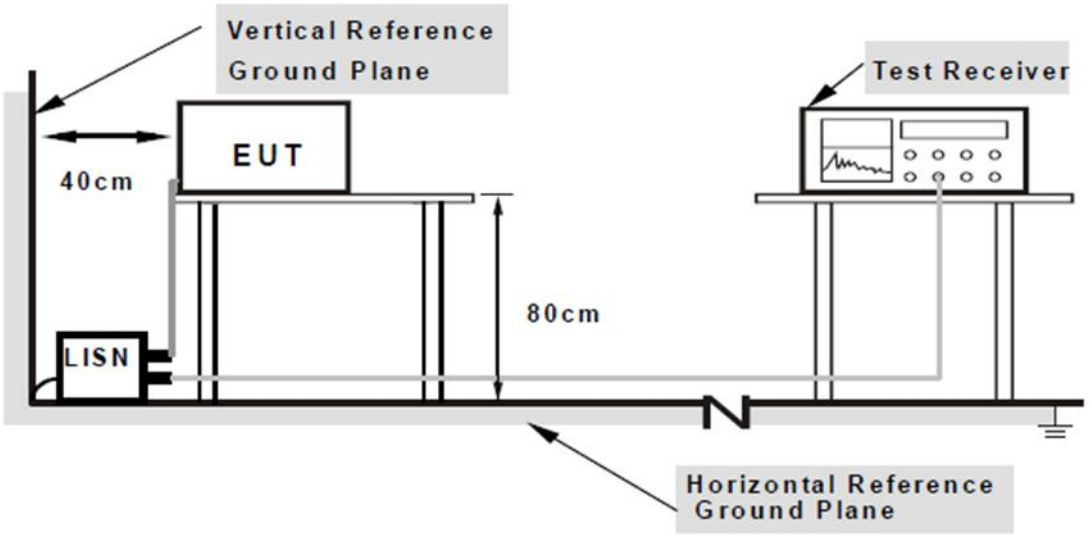
Measurements were performed with the DUT connected via an RF cable to the input of a spectrum analyser. The loss in the cable was compensated for in the measurement results.

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)

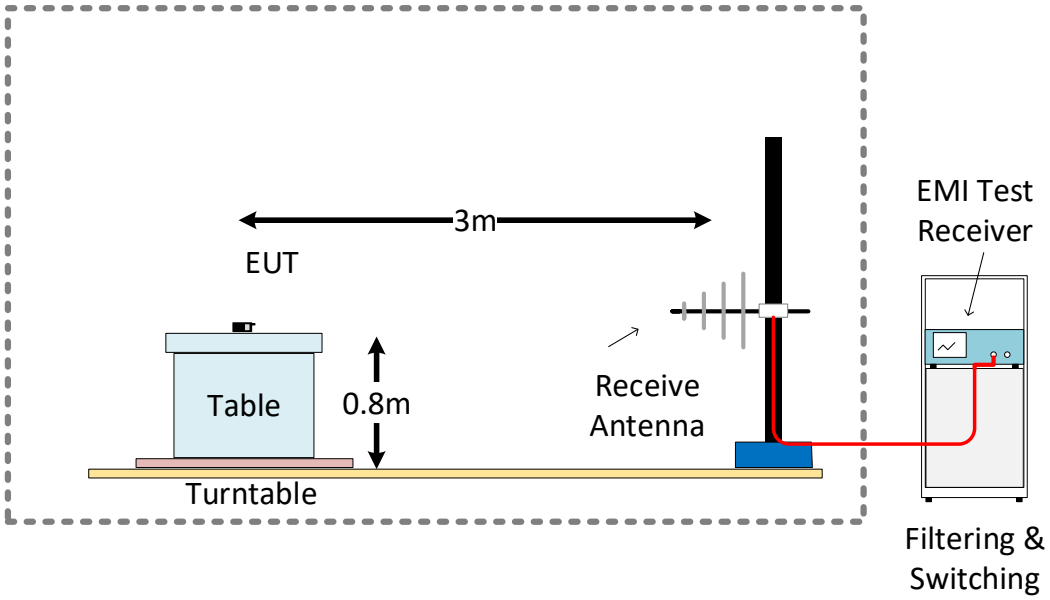
- For frequency range 30MHz-1GHz Log-Periodic Antenna was used. Antenna elevated from 100 cm from floor to 400 cm from floor, and was placed at 3 m from center of turntable in tilted position. The equipment under test (EUT) was placed at the middle of the turntable at 150 cm height from floor. The antenna 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.

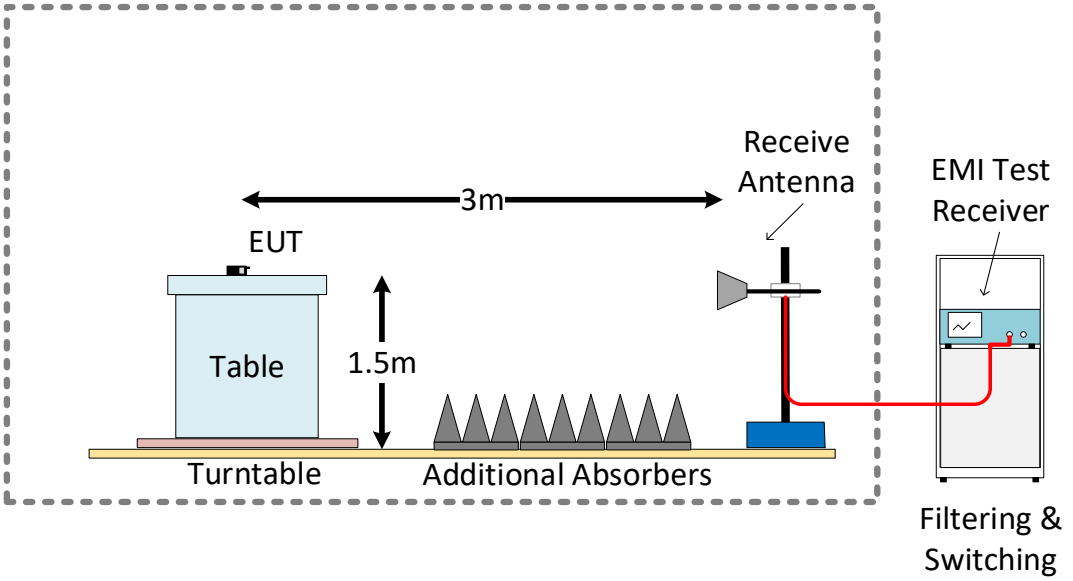
- For frequency range 18GHz-40GHz double horn Antenna was used. Antenna's height was adjusted to150 cm from floor, and 1 m distance to center of turntable. The equipment under test (EUT) was placed at the middle of the turntable on at 150 cm height from floor.

- For all frequency ranges the turntable was rotated 360˚ for obtaining the maximum emission.

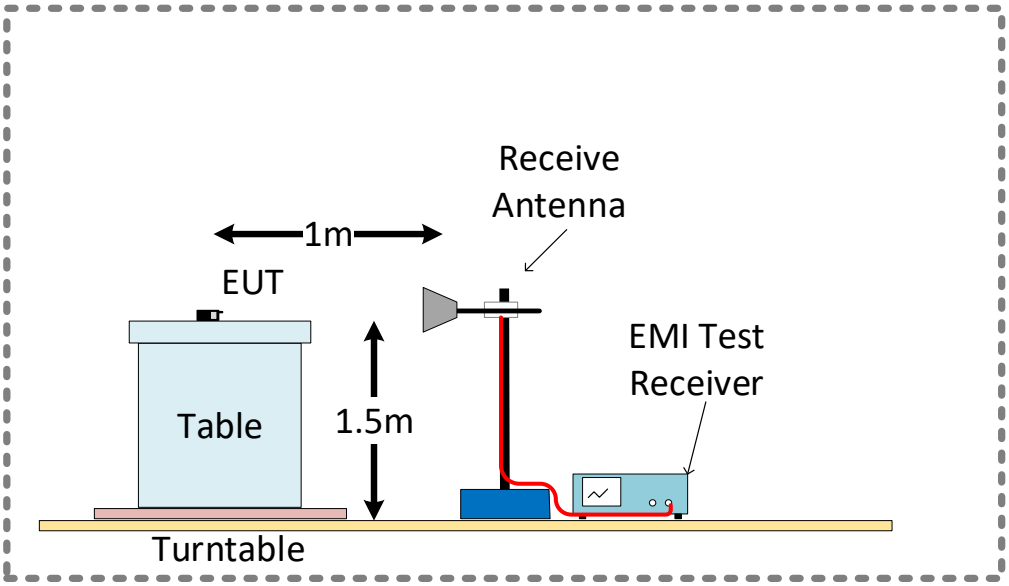
SAC 5 Test Setup Configuration 30MHz – 1GHz



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 USB Charger and set to continuous transmit mode on the mid channel with appropriate modulation. A LAN cable was connected between the device and a laptop PC placed outside of the test area. Conducted emissions tests were run on the Mains AC connection to the charger. See test setup photographs for more detail.

Radiated Emissions

For radiated emissions testing, the device was connected to the USB Charger and set to continuous transmit mode on an appropriate channel, with appropriate modulation. A LAN cable was connected between the device and a laptop PC placed outside of the test area.

Conducted Power Measurements

For conducted power measurements, the RF output of the device was connected to the test equipment via an RF cable. The device was connected to the USB Charger and set to continuous transmit mode on an appropriate channel, with appropriate modulation. A LAN cable was connected between the device and a laptop PC placed outside of the test area.

3.6 EUT Operation Modes

Operation mode	Description
Continuous Tx	The device was set to transmit continuously with an appropriate frequency and modulation.

3.7 Deviations from the Test Standard

This product is based on pre-certified modules as described in section 2.1, hence a limited test scope has been verified.

Measurement data from certification reports for the modules was used in determining which tests to include or exclude from the scope. A comparison of conducted output power between the module and the device covered by this report is included in section 4.13

3.8 Environmental Conditions

3.8.1 Environmental Conditions – Conducted power Measurements

Date	Time	Temperature (°C)	Relative Humidity (%)
2021.03.04	08:45	20.6	23

3.8.2 Environmental Conditions – Conducted Emissions System

Date	Time	Temperature (°C)	Relative Humidity (%)
2021.02.09	10:40	23.4	25

3.8.3 Environmental Conditions – SAC5 (Radiated Emissions)

Date	Time	Temperature (°C)	Relative Humidity (%)
2021.02.08	08:43	18.3	23
2021.02.09	08:32	18.2	22
2021.02.11	08:02	18.4	22
2021.02.15	07:55	18.5	24

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

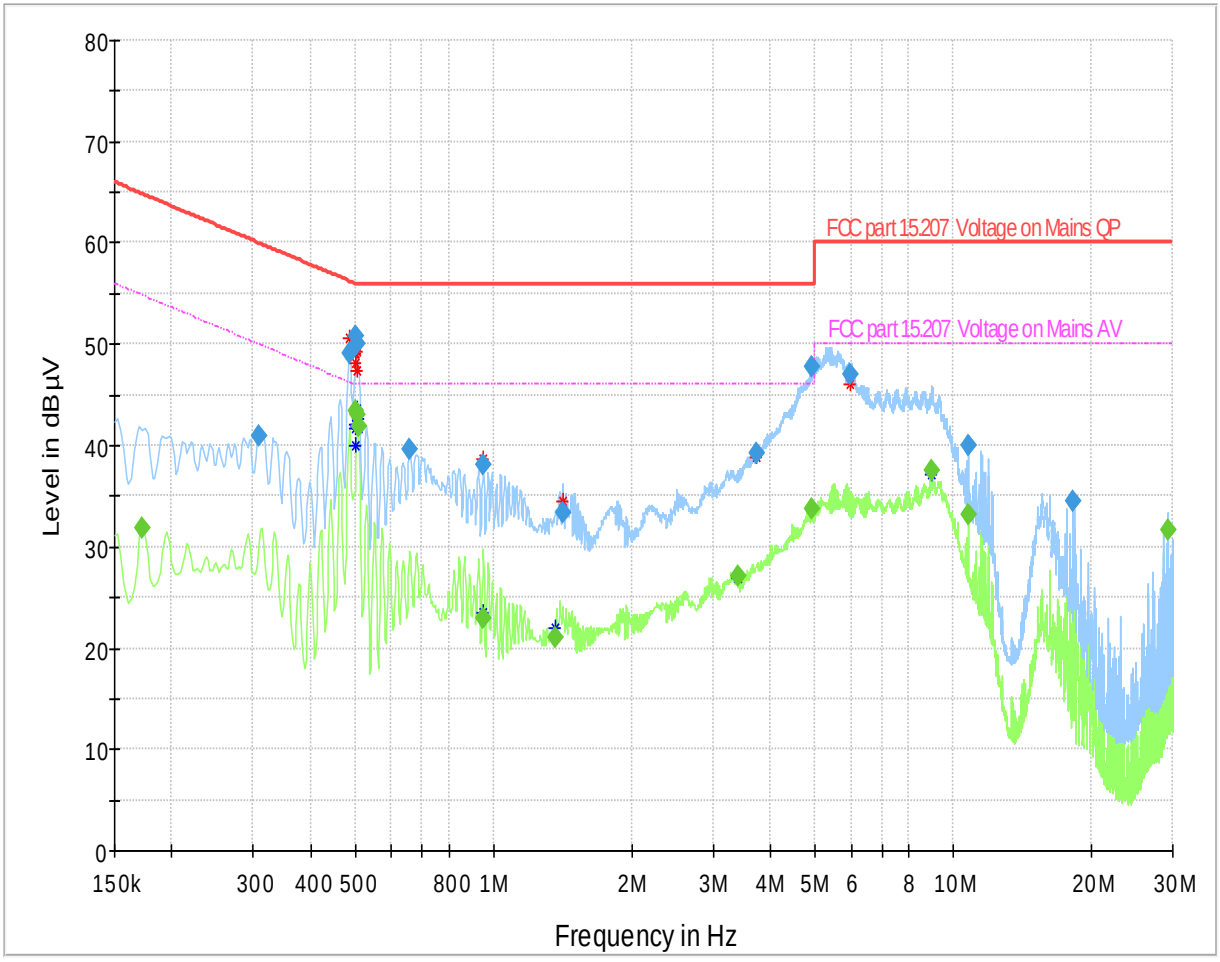
Test Specification	FCC 47 CFR 15.207 (Part 15 Subpart C)	
Test Engineer & Date	Fariborz Abasi	2021.02.09
EUT and Ancillary Equipment IDs	A002959287-027	A002959287-017 A002959287-018 A002959287-020
EUT Operation Mode(s)	Continuous Tx	
EUT Wireless Configuration(s)	Thread 802.15.4 (see below for details)	
EUT Hardware Configuration(s)	Power from AC Adapter	
Overall Result	PASS	

Test Parameter	Wireless Configuration	Frequency Range	Result*
AC Conducted Power Line Emissions – “N” Line	Thread Mid Channel (OQPSK 2445 MHz)	150 kHz – 30 MHz	PASS
AC Conducted Power Line Emissions – “L1” Line	Thread Mid Channel (OQPSK 2445 MHz)	150 kHz – 30 MHz	PASS

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

4.1.2 AC Power Line Conducted Emissions (Intentional) – Test Details

Test	Conducted Emission	
Test mode condition	Thread Mid Channel (2445 MHz)	
Standard	47 CFR Part 15.247 Class A	
EUT	A002959287-027	
Ancillary Equipment	A002959287-020 Ethernet cable A002959287-018 USB cable A002959287-017 AC / DC power supply	
Test Engineer	Fariborz Abasi	Date: 2021-02-09



Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.172500	---	31.81	54.84	23.03	1000.0	9.000	L1	ON	9.7
0.309750	41.04	---	59.98	18.94	1000.0	9.000	L1	ON	9.6
0.485250	49.11	---	56.25	7.14	1000.0	9.000	L1	ON	9.6
0.503250	50.73	---	56.00	5.27	1000.0	9.000	L1	ON	9.6
0.503250	---	43.35	46.00	2.65	1000.0	9.000	L1	ON	9.6
0.505500	---	43.03	46.00	2.97	1000.0	9.000	L1	ON	9.6
0.505500	50.00	---	56.00	6.00	1000.0	9.000	L1	ON	9.6
0.507750	---	41.95	46.00	4.05	1000.0	9.000	L1	ON	9.6
0.656250	39.54	---	56.00	16.46	1000.0	9.000	L1	ON	9.6
0.948750	38.15	---	56.00	17.85	1000.0	9.000	L1	ON	9.7
0.951000	---	22.99	46.00	23.01	1000.0	9.000	L1	ON	9.7
1.360500	---	20.96	46.00	25.04	1000.0	9.000	L1	ON	9.7
1.416750	33.45	---	56.00	22.55	1000.0	9.000	L1	ON	9.7
3.399000	---	27.12	46.00	18.88	1000.0	9.000	L1	ON	9.8
3.729750	39.20	---	56.00	16.80	1000.0	9.000	N	ON	9.8
4.924500	47.68	---	56.00	8.32	1000.0	9.000	N	ON	9.8
4.940250	---	33.74	46.00	12.26	1000.0	9.000	L1	ON	9.8
5.970750	47.08	---	60.00	12.92	1000.0	9.000	N	ON	9.8
8.938500	---	37.48	50.00	12.52	1000.0	9.000	L1	ON	9.9
10.792500	40.03	---	60.00	19.97	1000.0	9.000	N	ON	9.9
10.792500	---	33.26	50.00	16.74	1000.0	9.000	N	ON	9.9
18.242250	34.52	---	60.00	25.48	1000.0	9.000	N	ON	10.1
29.235750	---	31.75	50.00	18.25	1000.0	9.000	N	ON	10.1

4.2 Test Results – Radiated Emissions (Intentional Transmitter)

4.2.1 Radiated Emissions (Intentional) – Test Summary

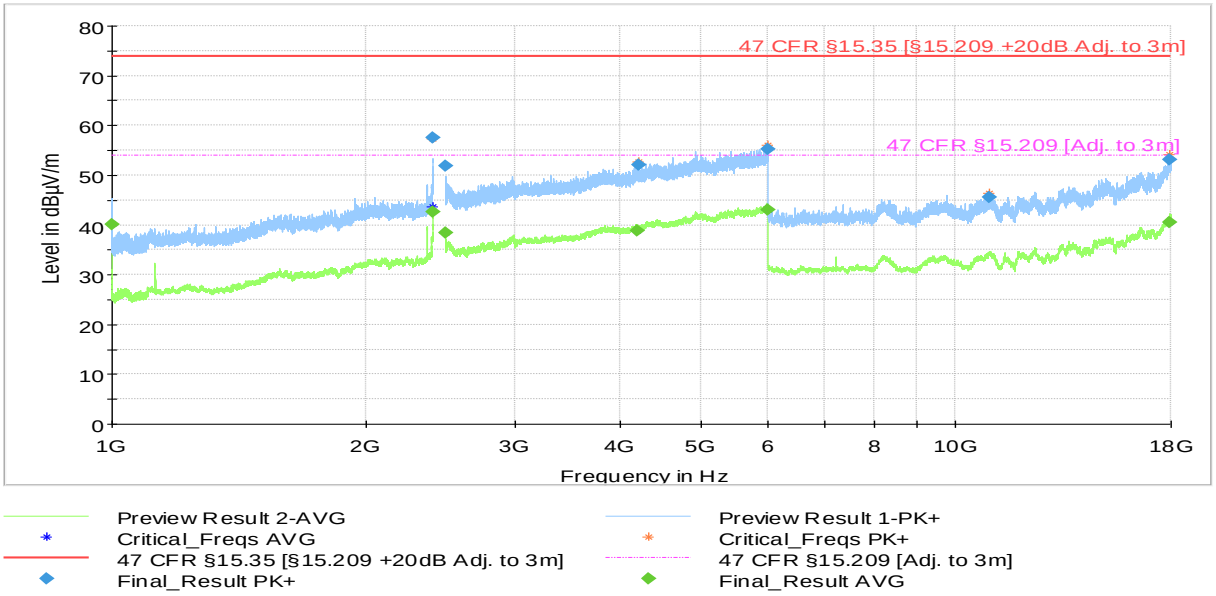
Test Specification	FCC 47 CFR 15.209 (Part 15 Subpart C)	
Test Engineer & Date	Niall Forrester Sam Ebadeh Simon Palmhager	2021.02.08 – 2021.02.15
EUT and Ancillary Equipment IDs	A002959287-026	A002959287-014 A002959287-015 A002959287-023
EUT Operation Mode(s)	Continuous Tx	
EUT Wireless Configuration(s)	Thread 802.15.4 (see below for details)	
EUT Hardware Configuration(s)	Power from USB Power Supply	
Overall Result	PASS	

Test Parameter	Wireless Configuration	Frequency Range	Result
Radiated Emissions	Thread Low Channel (OQPSK 2405 MHz)	1 GHz – 18 GHz	PASS
Radiated Emissions	Thread Low Channel (OQPSK 2405 MHz)	18 GHz – 40 GHz	PASS
Radiated Emissions	Thread Mid Channel (OQPSK 2445 MHz)	9 kHz – 30 MHz	PASS
Radiated Emissions	Thread Mid Channel (OQPSK 2445 MHz)	30 MHz – 1 GHz	PASS
Radiated Emissions	Thread Mid Channel (OQPSK 2445 MHz)	1 GHz – 18 GHz	PASS
Radiated Emissions	Thread Mid Channel (OQPSK 2445 MHz)	18 GHz – 40 GHz	PASS
Radiated Emissions	Thread High Channel (OQPSK 2480 MHz)	1 GHz – 18 GHz	PASS
Radiated Emissions	Thread High Channel (OQPSK 2480 MHz)	18 GHz – 40 GHz	PASS

4.2.2 Radiated Emissions (Intentional) – Test Details

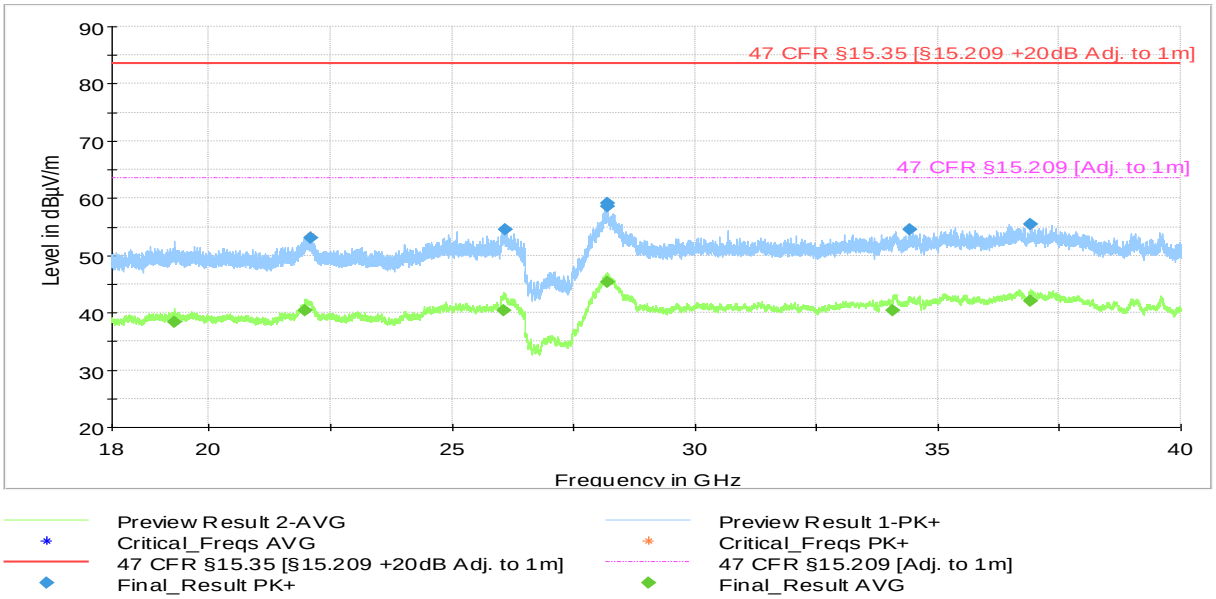
Low Channel

Test mode condition	Thread, Low channel (2405 MHz)	
Antenna orientation	Horizontal and Vertical	
Sweep frequency	1 GHz – 18 GHz	
Standard	47 CFR FCC Part 15 subpart C	
EUT	A002959287-026	
Ancillary Equipment	A002959287-014, A002959287-015, A002959287-023	
Test Engineer	Simon Palmhager	Date: 2021-02-08
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)
1000.011110	---	40.18	53.98	13.80	1000.0	1000.000	187.0	H	92.0
2399.948000	---	42.53	53.98	11.45	1000.0	1000.000	121.0	H	312.0
2399.988681	57.47	---	73.98	16.51	1000.0	1000.000	125.0	H	324.0
2483.505258	51.80	---	73.98	22.18	1000.0	1000.000	210.0	H	292.0
2483.595500	---	38.44	53.98	15.54	1000.0	1000.000	125.0	H	326.0
4198.272000	---	38.90	53.98	15.08	1000.0	1000.000	159.0	H	-2.0
4217.094000	52.10	---	73.98	21.88	1000.0	1000.000	175.0	H	248.0
5988.192000	---	42.95	53.98	11.03	1000.0	1000.000	175.0	V	290.0
5998.840800	55.25	---	73.98	18.73	1000.0	1000.000	175.0	V	324.0
10967.343000	45.59	---	73.98	28.39	1000.0	1000.000	100.0	H	248.0
17919.922000	53.14	---	73.98	20.84	1000.0	1000.000	101.0	V	278.0
17922.815000	---	40.53	53.98	13.45	1000.0	1000.000	125.0	V	72.0

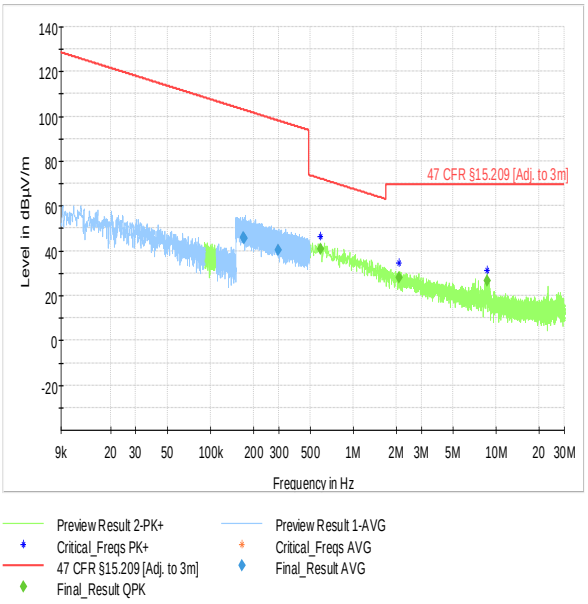
Test mode condition	Thread, Low channel (2405 MHz)	
Antenna orientation	Horizontal and Vertical	
Sweep frequency	18 GHz – 40 GHz	
Standard	47 CFR FCC Part 15 subpart C	
EUT	A002959287-026	
Ancillary Equipment	A002959287-014, A002959287-015, A002959287-023	
Test Engineer	Simon Palmhager	Date: 2021-02-15
Chamber details	Chamber: SAC 5	

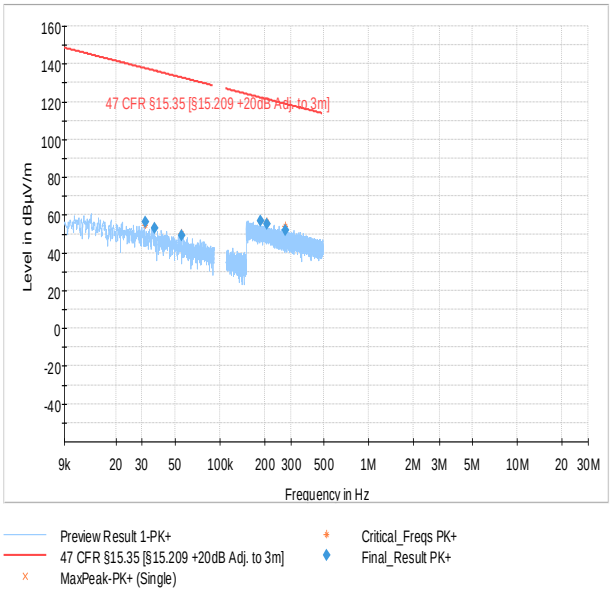


Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
19291.311000	---	38.31	63.52	25.21	1000.0	1000.000	155.0	V	26.0
21986.011000	---	40.36	63.52	23.16	1000.0	1000.000	155.0	V	52.0
22099.127000	53.16	---	83.52	30.37	1000.0	1000.000	155.0	H	86.0
26067.780000	---	40.45	63.52	23.07	1000.0	1000.000	155.0	V	322.0
26080.558000	54.61	---	83.52	28.92	1000.0	1000.000	155.0	H	202.0
28187.244000	59.07	---	83.52	24.45	1000.0	1000.000	155.0	V	-4.0
28189.686000	58.53	---	83.52	24.99	1000.0	1000.000	155.0	V	-4.0
28203.271000	---	45.35	63.52	18.18	1000.0	1000.000	155.0	V	52.0
34081.647000	---	40.47	63.52	23.05	1000.0	1000.000	155.0	H	68.0
34427.055000	54.57	---	83.52	28.95	1000.0	1000.000	155.0	V	86.0
36911.167000	---	42.14	63.52	21.39	1000.0	1000.000	155.0	V	172.0
36916.225000	55.39	---	83.52	28.13	1000.0	1000.000	155.0	H	22.0

Mid Channel

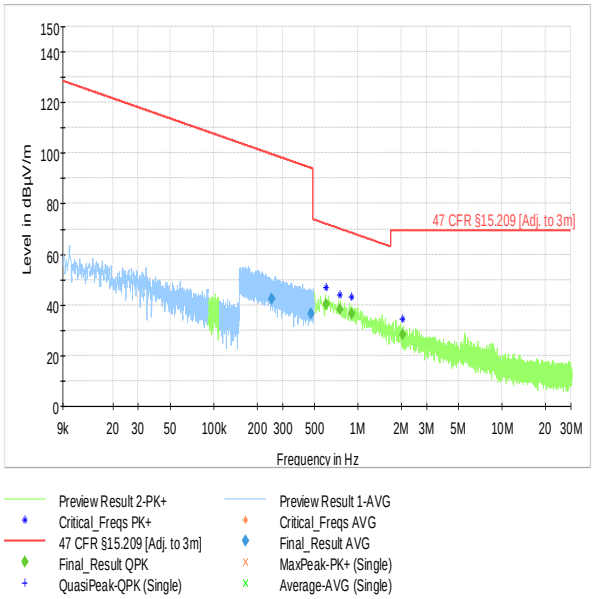
Test mode condition	Thread, Mid channel (2445 MHz)	
Antenna orientation	Loop Antenna Parallel to Axis	
Sweep frequency	9 kHz-30 MHz	
Standard	47 CFR FCC Part 15 subpart C	
EUT	A002959287-026	
Ancillary Equipment	A002959287-014, A002959287-015, A002959287-023	
Test Engineer	Sam Ebadeh	Date: 2021-02-11
Chamber details	Chamber: SAC 5	

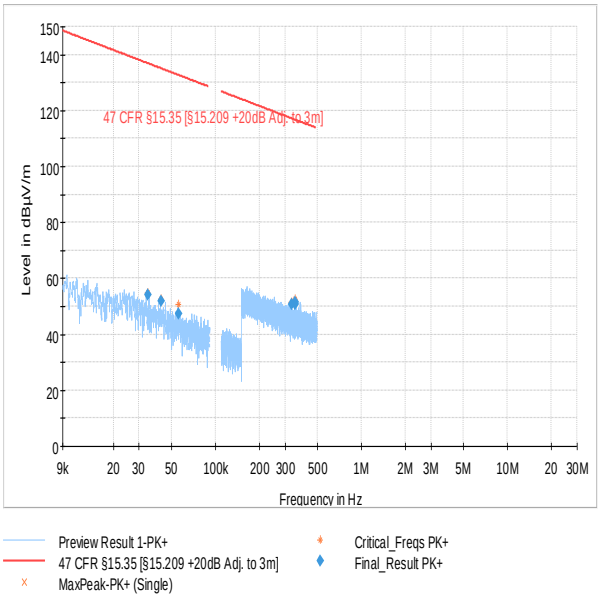




Frequency (MHz)	Average (dBµV/m)	QuasiPeak (dBµV/m)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
0.170436	45.81	---	---	102.97	57.16	1000.0	9.000	100.0	H	171.0
0.171699	45.70	---	---	102.91	57.21	1000.0	9.000	100.0	H	135.0
0.299330	40.53	---	---	98.08	57.55	1000.0	9.000	100.0	H	45.0
0.586919	---	40.55	---	72.23	31.68	1000.0	9.000	100.0	H	101.0
2.084472	---	27.84	---	69.54	41.70	1000.0	9.000	100.0	H	229.0
8.675260	---	26.48	---	69.54	43.06	1000.0	9.000	100.0	H	135.0
0.031713	---	---	56.34	137.58	81.24	1000.0	0.200	100.0	H	225.0
0.036286	---	---	53.02	136.41	83.39	1000.0	0.200	100.0	H	45.0
0.055611	---	---	48.97	132.70	83.73	1000.0	0.200	100.0	H	139.0
0.188662	---	---	57.16	122.09	64.93	1000.0	9.000	100.0	H	9.0
0.206323	---	---	55.43	121.31	65.89	1000.0	9.000	100.0	H	255.0
0.275897	---	---	51.99	118.79	66.80	1000.0	9.000	100.0	H	75.0

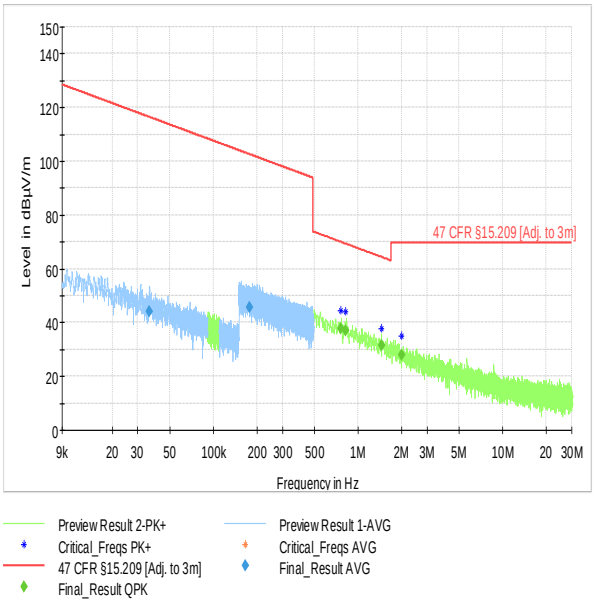
Test mode condition	Thread, Mid channel (2445 MHz)	
Antenna orientation	Loop Antenna Perpendicular to Axis	
Sweep frequency	9 kHz-30 MHz	
Standard	47 CFR FCC Part 15 subpart C	
EUT	A002959287-026	
Ancillary Equipment	A002959287-014, A002959287-015, A002959287-023	
Test Engineer	Sam Ebadeh	Date: 2021-02-11
Chamber details	Chamber: SAC 5	

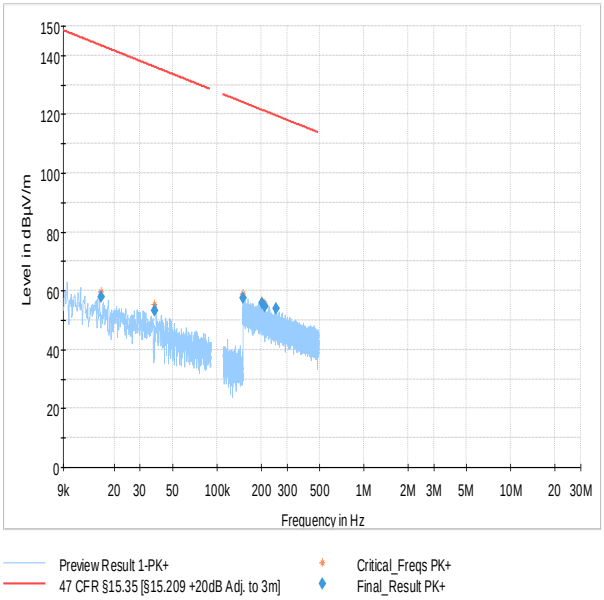




Frequency (MHz)	Average (dBµV/m)	QuasiPeak (dBµV/m)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
0.251617	42.25	---	---	99.59	57.34	1000.0	9.000	100.0	H	294.0
0.475517	36.60	---	---	94.06	57.46	1000.0	9.000	100.0	H	225.0
0.599908	---	40.20	---	72.04	31.84	1000.0	9.000	100.0	H	-1.0
0.754879	---	38.14	---	70.05	31.90	1000.0	9.000	100.0	H	77.0
0.903211	---	36.44	---	68.49	32.05	1000.0	9.000	100.0	H	89.0
2.036972	---	28.15	---	69.54	41.39	1000.0	9.000	100.0	H	102.0
0.034370	---	---	54.23	136.88	82.65	1000.0	0.200	100.0	H	225.0
0.042561	---	---	51.79	135.02	83.24	1000.0	0.200	100.0	H	124.0
0.055795	---	---	47.33	132.67	85.34	1000.0	0.200	100.0	H	315.0
0.331508	---	---	50.82	117.19	66.37	1000.0	9.000	100.0	H	-45.0
0.350714	---	---	51.67	116.71	65.04	1000.0	9.000	100.0	H	75.0
0.350840	---	---	50.72	116.70	65.98	1000.0	9.000	100.0	H	313.0

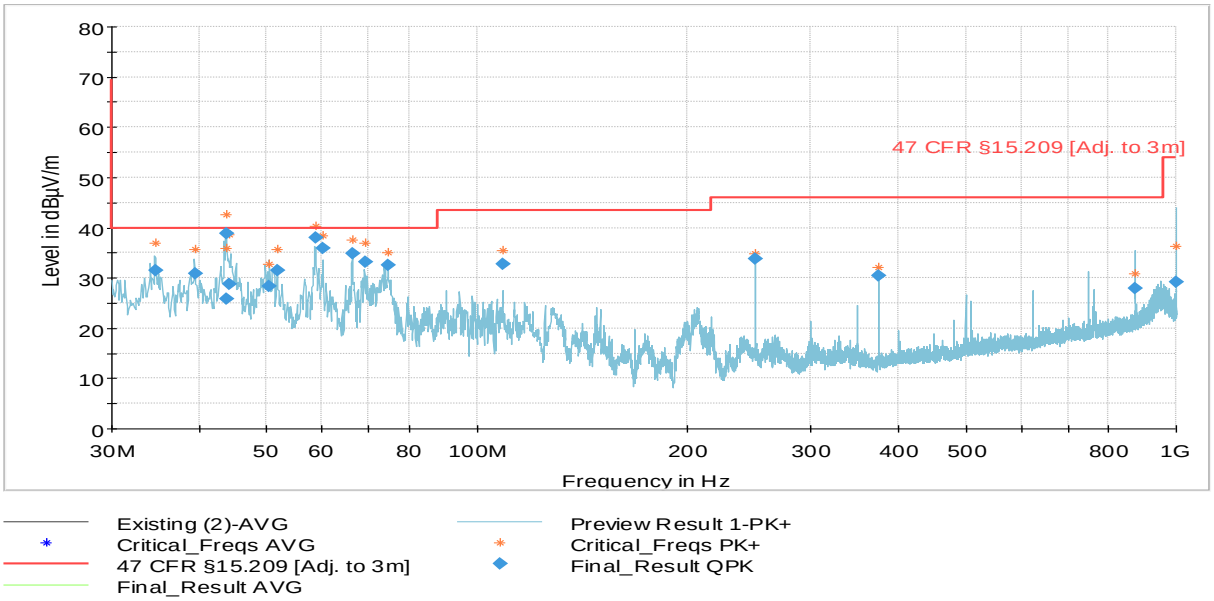
Test mode condition	Thread, Mid channel (2445 MHz)	
Antenna orientation	Loop Antenna Parallel to floor	
Sweep frequency	9 kHz-30 MHz	
Standard	47 CFR FCC Part 15 subpart C	
EUT	A002959287-026	
Ancillary Equipment	A002959287-014, A002959287-015, A002959287-023	
Test Engineer	Sam Ebadeh	Date: 2021-02-11
Chamber details	Chamber: SAC 5	





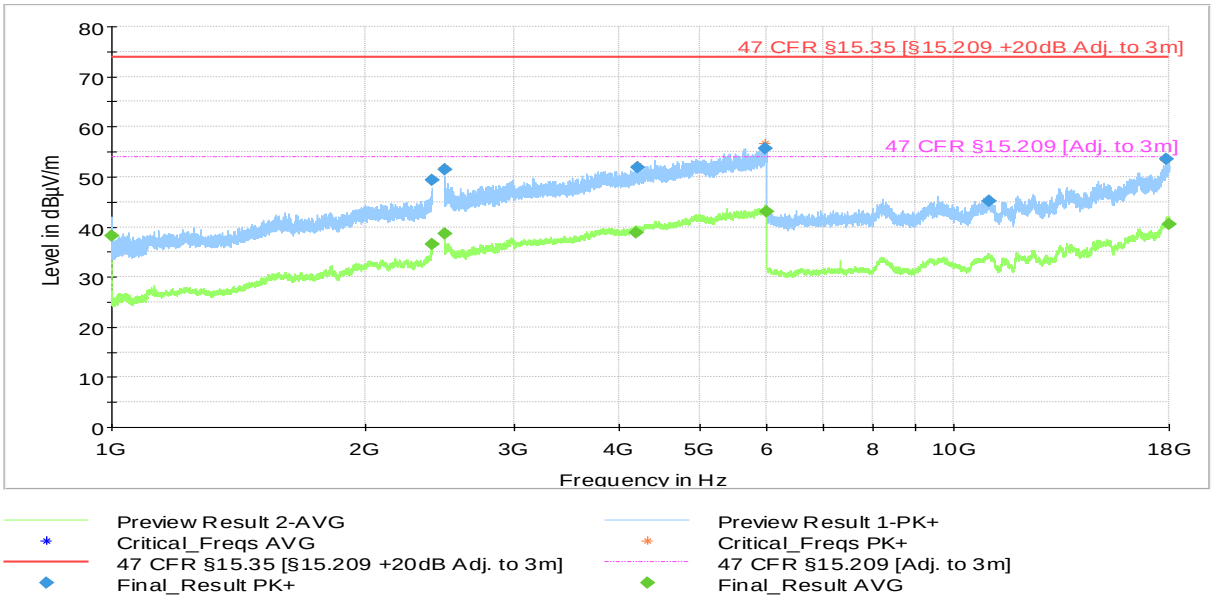
Frequency (MHz)	Average (dBµV/m)	QuasiPeak (dBµV/m)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
0.036019	43.91	---	---	116.47	72.57	1000.0	0.200	100.0	H	256.0
0.177665	45.48	---	---	102.61	57.13	1000.0	9.000	100.0	H	89.0
0.759086	---	37.91	---	70.00	32.09	1000.0	9.000	100.0	H	77.0
0.822434	---	37.18	---	69.30	32.12	1000.0	9.000	100.0	H	101.0
1.456219	---	31.51	---	64.34	32.83	1000.0	9.000	100.0	H	127.0
2.000493	---	28.13	---	69.54	41.41	1000.0	9.000	100.0	H	268.0
0.016320	---	---	57.81	143.35	85.54	1000.0	0.200	100.0	H	63.0
0.037838	---	---	53.07	136.05	82.98	1000.0	0.200	100.0	H	10.0
0.150077	---	---	57.58	124.08	66.50	1000.0	9.000	100.0	H	135.0
0.203011	---	---	55.64	121.45	65.81	1000.0	9.000	100.0	H	153.0
0.212588	---	---	54.73	121.05	66.32	1000.0	9.000	100.0	H	10.0
0.252000	---	---	53.83	119.58	65.75	1000.0	9.000	100.0	H	113.0

Test mode condition	Thread, Mid channel (2445 MHz)	
Antenna orientation	Horizontal and Vertical	
Sweep frequency	30 MHz – 1 GHz	
Standard	47 CFR FCC Part 15 subpart C	
EUT	A002959287-026	
Ancillary Equipment	A002959287-014, A002959287-015, A002959287-023	
Test Engineer	Niall Forrester	Date: 2021-02-09
Chamber details	Chamber: SAC 5	



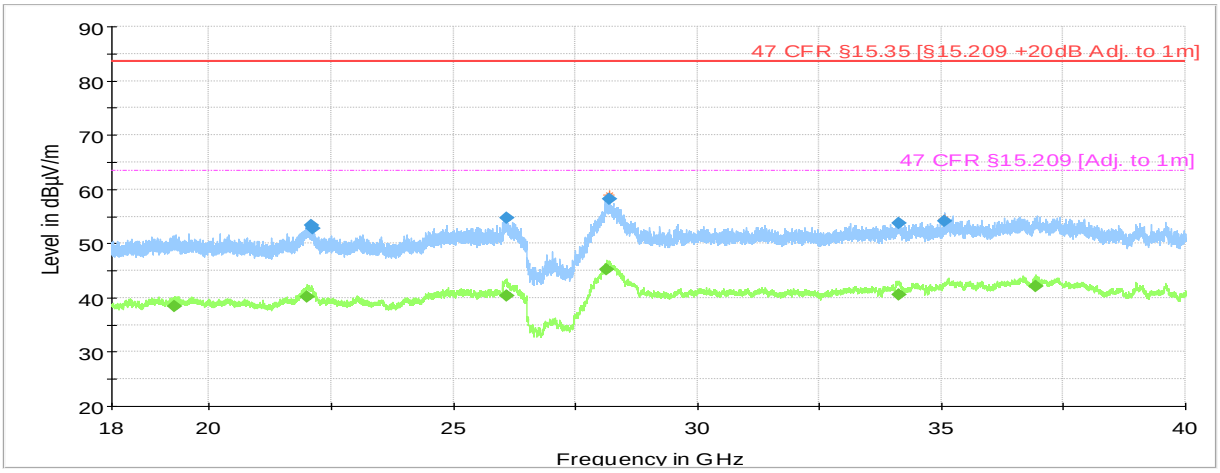
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
34.622840	31.45	40.00	8.55	1000.0	120.000	100.0	V	-4.0
39.483160	30.91	40.00	9.09	1000.0	120.000	100.0	V	289.0
43.770640	25.75	40.00	14.25	1000.0	120.000	125.0	V	296.0
43.799440	38.80	40.00	1.20	1000.0	120.000	108.0	V	26.0
44.233560	28.80	40.00	11.20	1000.0	120.000	100.0	V	296.0
50.444760	28.33	40.00	11.67	1000.0	120.000	100.0	V	244.0
51.807320	31.53	40.00	8.47	1000.0	120.000	100.0	V	252.0
58.719400	38.06	40.00	1.94	1000.0	120.000	225.0	V	292.0
60.222680	35.88	40.00	4.12	1000.0	120.000	225.0	V	220.0
66.290120	34.91	40.00	5.09	1000.0	120.000	175.0	V	202.0
69.122640	33.18	40.00	6.82	1000.0	120.000	133.0	V	112.0
74.543040	32.48	40.00	7.52	1000.0	120.000	108.0	V	292.0
108.804800	32.66	43.52	10.86	1000.0	120.000	100.0	V	289.0
249.995280	33.70	46.02	12.32	1000.0	120.000	100.0	V	158.0
374.995360	30.50	46.02	15.52	1000.0	120.000	125.0	V	22.0
874.978680	27.83	46.02	18.19	1000.0	120.000	410.0	H	52.0
999.578560	29.26	53.98	24.72	1000.0	120.000	100.0	V	-4.0

Test mode condition	Thread, Mid channel (2445 MHz)	
Antenna orientation	Horizontal and Vertical	
Sweep frequency	1 GHz – 18 GHz	
Standard	47 CFR FCC Part 15 subpart C	
EUT	A002959287-026	
Ancillary Equipment	A002959287-014, A002959287-015, A002959287-023	
Test Engineer	Simon Palmhager	Date: 2021-02-08
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)
1000.034272	---	38.25	53.98	15.73	1000.0	1000.000	102.0	V	100.0
2399.742000	49.31	---	73.98	24.67	1000.0	1000.000	125.0	V	41.0
2399.994000	---	36.45	53.98	17.53	1000.0	1000.000	175.0	V	26.0
2483.518744	51.38	---	73.98	22.60	1000.0	1000.000	125.0	H	162.0
2483.682000	---	38.63	53.98	15.35	1000.0	1000.000	148.0	V	116.0
4200.741000	---	38.90	53.98	15.08	1000.0	1000.000	135.0	H	190.0
4207.042000	51.93	---	73.98	22.05	1000.0	1000.000	137.0	H	55.0
5971.723000	55.68	---	73.98	18.30	1000.0	1000.000	121.0	H	145.0
5980.029000	---	43.10	53.98	10.88	1000.0	1000.000	101.0	V	248.0
10991.184000	45.25	---	73.98	28.73	1000.0	1000.000	146.0	V	85.0
17869.821000	53.56	---	73.98	20.42	1000.0	1000.000	100.0	H	334.0
17991.043000	---	40.59	53.98	13.38	1000.0	1000.000	125.0	H	292.0

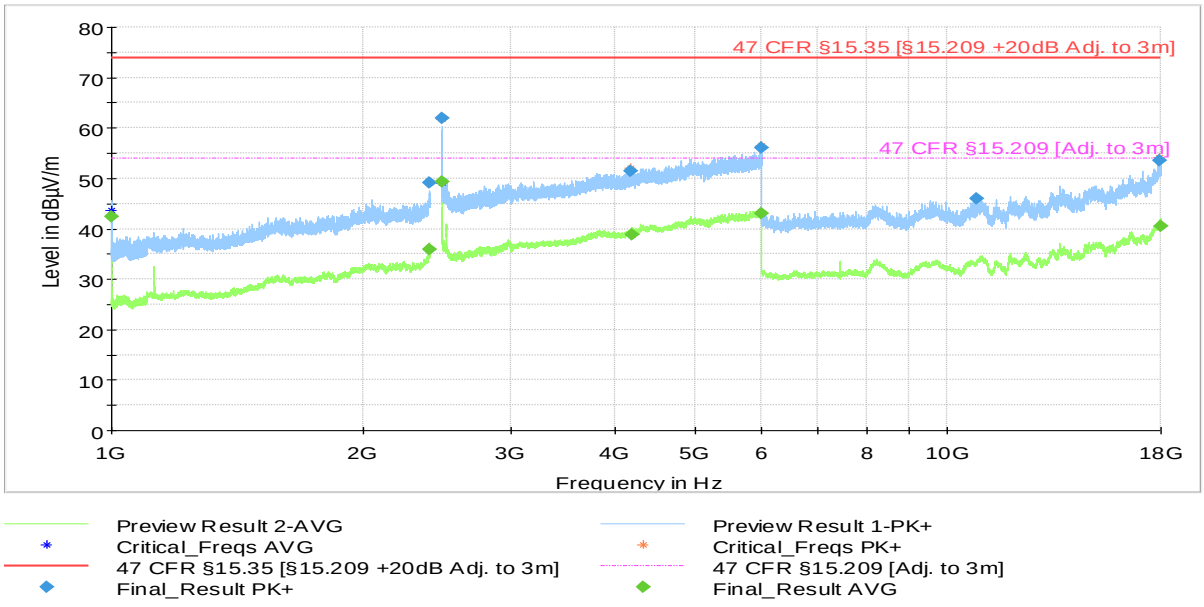
Test mode condition	Thread, Mid channel (2445 MHz)	
Antenna orientation	Horizontal and Vertical	
Sweep frequency	18 GHz – 40 GHz	
Standard	47 CFR FCC Part 15 subpart C	
EUT	A002959287-026	
Ancillary Equipment	A002959287-014, A002959287-015, A002959287-023	
Test Engineer	Simon Palmhager	Date: 2021-02-15
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)
19295.133000	---	38.48	63.52	25.05	1000.0	1000.000	155.0	H	322.0
21996.753000	---	40.14	63.52	23.39	1000.0	1000.000	155.0	H	292.0
22096.697000	53.27	---	83.52	30.26	1000.0	1000.000	155.0	H	266.0
22105.164000	52.81	---	83.52	30.72	1000.0	1000.000	155.0	H	278.0
26080.352000	54.62	---	83.52	28.90	1000.0	1000.000	155.0	V	188.0
26086.476000	---	40.44	63.52	23.08	1000.0	1000.000	155.0	V	98.0
28135.400000	---	45.17	63.52	18.35	1000.0	1000.000	155.0	V	202.0
28183.666000	58.19	---	83.52	25.33	1000.0	1000.000	155.0	V	296.0
34116.918000	53.80	---	83.52	29.73	1000.0	1000.000	155.0	H	232.0
34119.742000	---	40.65	63.52	22.87	1000.0	1000.000	155.0	H	322.0
35065.118000	54.16	---	83.52	29.36	1000.0	1000.000	155.0	H	206.0
36935.768000	---	42.17	63.52	21.36	1000.0	1000.000	155.0	H	172.0

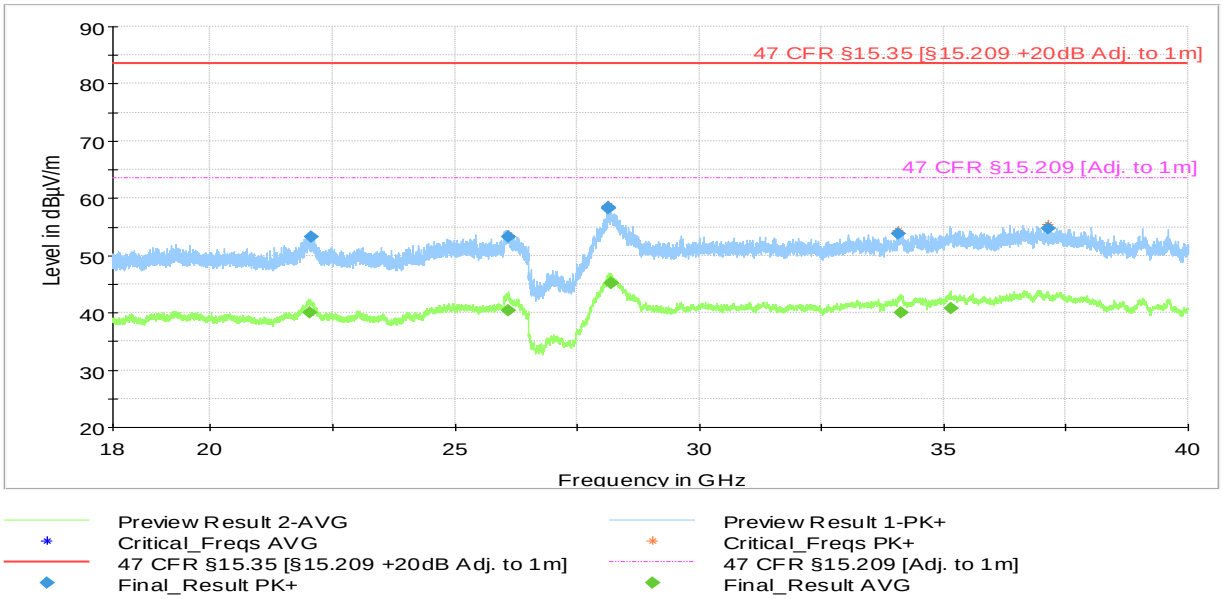
High Channel

Test mode condition	Thread, High channel (2480 MHz)	
Antenna orientation	Horizontal and Vertical	
Sweep frequency	1 GHz – 18 GHz	
Standard	47 CFR FCC Part 15 subpart C	
EUT	A002959287-026	
Ancillary Equipment	A002959287-014, A002959287-015, A002959287-023	
Test Engineer	Simon Palmhager	Date: 2021-02-08
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)
1000.008048	---	42.38	53.98	11.60	1000.0	1000.000	187.0	H	252.0
2399.840500	---	35.93	53.98	18.05	1000.0	1000.000	125.0	H	41.0
2399.914000	49.05	---	73.98	24.93	1000.0	1000.000	100.0	V	177.0
2483.567364	---	49.40	53.98	4.57	1000.0	1000.000	157.0	H	312.0
2483.578000	61.98	---	73.98	12.00	1000.0	1000.000	197.0	H	311.0
4179.301000	51.52	---	73.98	22.46	1000.0	1000.000	125.0	V	234.0
4200.391000	---	38.77	53.98	15.21	1000.0	1000.000	125.0	H	248.0
5982.389000	---	42.95	53.98	11.03	1000.0	1000.000	120.0	H	42.0
5987.941000	56.03	---	73.98	17.95	1000.0	1000.000	197.0	V	68.0
10847.919000	45.89	---	73.98	28.09	1000.0	1000.000	196.0	H	248.0
17936.115000	53.50	---	73.98	20.48	1000.0	1000.000	101.0	H	-22.0
17966.520000	---	40.54	53.98	13.44	1000.0	1000.000	125.0	H	68.0

Test mode condition	Thread, High channel (2480 MHz)	
Antenna orientation	Horizontal and Vertical	
Sweep frequency	18 GHz – 40 GHz	
Standard	47 CFR FCC Part 15 subpart C	
EUT	A002959287-026	
Ancillary Equipment	A002959287-014, A002959287-015, A002959287-023	
Test Engineer	Simon Palmhager	Date: 2021-02-15
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)
22041.231000	---	40.04	63.52	23.48	1000.0	1000.000	155.0	V	248.0
22051.262000	53.21	---	83.52	30.31	1000.0	1000.000	155.0	V	162.0
26082.241000	53.31	---	83.52	30.21	1000.0	1000.000	155.0	H	22.0
26090.429000	---	40.41	63.52	23.11	1000.0	1000.000	155.0	V	142.0
28128.101000	58.26	---	83.52	25.26	1000.0	1000.000	155.0	V	128.0
28132.286000	58.45	---	83.52	25.07	1000.0	1000.000	155.0	V	128.0
28200.863000	---	45.17	63.52	18.35	1000.0	1000.000	155.0	V	38.0
28202.028000	---	45.24	63.52	18.28	1000.0	1000.000	155.0	V	38.0
34079.208000	53.89	---	83.52	29.63	1000.0	1000.000	155.0	H	308.0
34125.224000	---	40.04	63.52	23.49	1000.0	1000.000	155.0	H	292.0
35135.958000	---	40.81	63.52	22.71	1000.0	1000.000	155.0	H	8.0
37122.191000	54.81	---	83.52	28.71	1000.0	1000.000	155.0	V	248.0

4.3 Test Results – Antenna Conducted Emissions

4.3.1 Antenna Conducted 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

This test has not been performed. The device is based on certified modules as described in section 2.1

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	Simon Palmhager	2021.02.09
EUT and Ancillary Equipment IDs	A002959287-026	A002959287-014 A002959287-015 A002959287-023
EUT Operation Mode(s)	Continuous Tx	
EUT Wireless Configuration(s)	Thread 802.15.4 (see below for details)	
EUT Hardware Configuration(s)	Power from USB Power Supply	
Overall Result	PASS	

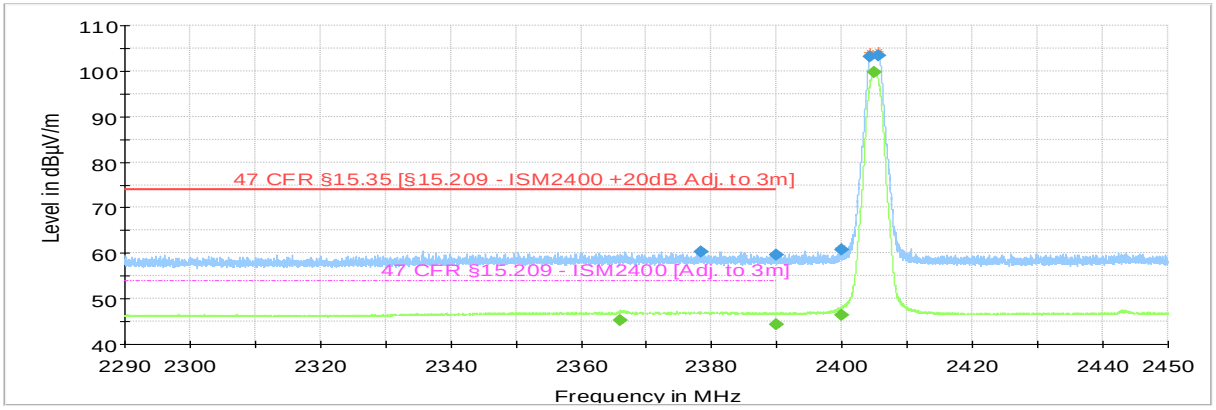
Test Parameter	Wireless Configuration	Result*
Emissions at Band Edge (Rest. Band – Low Edge)	Thread Low Channel (OQPSK 2405 MHz)	PASS
Emissions at Band Edge (Rest. Band – High Edge)	Thread High Channel (OQPSK 2480 MHz)	PASS

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

4.5.2 Band Edge Compliance (Restricted Band) – Test Details

Restricted Band – Low Edge

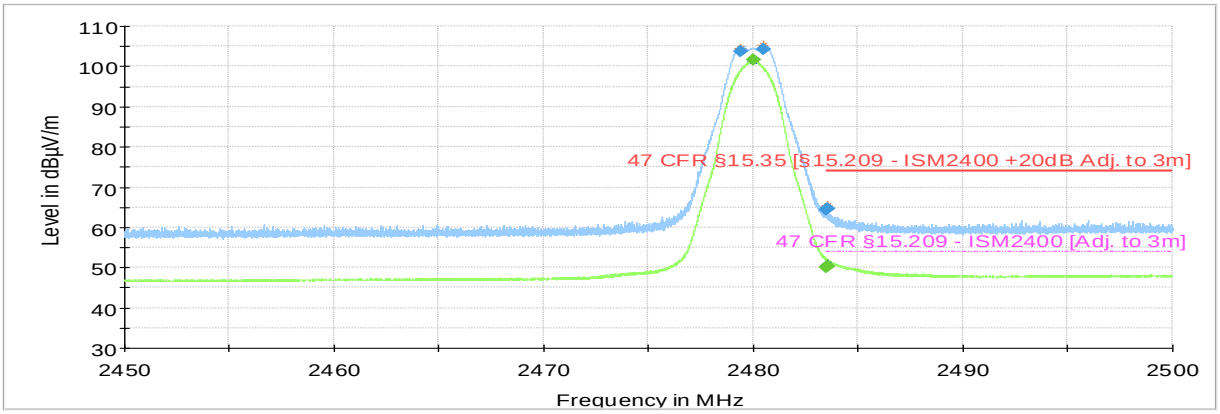
Test mode condition	Thread, Low channel (2405 MHz)	
Antenna orientation	Horizontal and Vertical	
Sweep frequency	1 GHz – 18 GHz Lower Band Edge	
Standard	47 CFR FCC Part 15 subpart C	
EUT	A002959287-026	
Ancillary Equipment	A002959287-014, A002959287-015, A002959287-023	
Test Engineer	Simon Palmhager	Date: 2021-02-09
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)
2366.064000	---	45.28	53.98	8.70	1000.0	1000.000	156.0	H	311.0
2378.432000	60.37	---	73.98	13.61	1000.0	1000.000	150.0	H	23.0
2390.000000	59.59	---	73.98	14.39	1000.0	1000.000	180.0	H	231.0
2390.000000	---	44.35	53.98	9.63	1000.0	1000.000	111.0	H	94.0
2400.000000	---	46.44	---	---	1000.0	1000.000	192.0	H	316.0
2400.000000	60.77	---	---	---	1000.0	1000.000	156.0	H	304.0
2404.352000	103.21	---	---	---	1000.0	1000.000	145.0	H	305.0
2404.944000	---	99.85	---	---	1000.0	1000.000	148.0	H	304.0
2405.584000	103.36	---	---	---	1000.0	1000.000	145.0	H	307.0

Restricted Band – High Edge

Test mode condition	Thread, High channel (2480 MHz)	
Antenna orientation	Horizontal and Vertical	
Sweep frequency	1 GHz – 18 GHz Lower Band Edge	
Standard	47 CFR FCC Part 15 subpart C	
EUT	A002959287-026	
Ancillary Equipment	A002959287-014, A002959287-015, A002959287-023	
Test Engineer	Simon Palmhager	Date: 2021-02-09
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 - ISM2400 +20dB Adj. to 3m]
47 CFR §15.209 - ISM2400 [Adj. to 3m]
Final_Result PK+
Final_Result AVG

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
2461.215000	109.16	---	---	---	1000.0	1000.000	132.0	H	336.0
2461.340000	---	99.65	---	---	1000.0	1000.000	133.0	H	326.0
2483.500000	---	45.81	53.98	8.17	1000.0	1000.000	134.0	H	0.0
2483.500000	60.37	---	73.98	13.61	1000.0	1000.000	210.0	V	0.0
2488.165000	60.44	---	73.98	13.54	1000.0	1000.000	168.0	V	179.0
2496.780000	---	45.64	53.98	8.34	1000.0	1000.000	110.0	V	202.0
2497.875000	60.64	---	73.98	13.34	1000.0	1000.000	210.0	V	4.0

4.6 Test Results – 20dB Bandwidth

4.6.1 20dB Bandwidth – Test Summary

This requirement is not applicable as the radio technology is non-hopping

4.7 Test Results – Carrier (Hopping Channel) Separation

4.7.1 Carrier (Hopping Channel) Separation – Test Summary

This requirement is not applicable as the radio technology is non-hopping

4.8 Test Results – Number of Hopping Channels

4.8.1 Number of Hopping Channels – Test Summary

This requirement is not applicable as the radio technology is non-hopping

4.9 Test Results – Time of Occupancy (Dwell Time)

4.9.1 Time of Occupancy (Dwell Time) – Test Summary

This requirement is not applicable as the radio technology is non-hopping

4.10 Test Results – 6dB Bandwidth

4.10.1 6dB Bandwidth – Test Summary

This test has not been performed. The device is based on certified modules as described in section 2.1

4.11 Test Results – Peak Conducted Output Power

4.11.1 Peak Conducted Output Power – Test Summary

This test has not been performed. The device is based on certified modules as described in section 2.1

4.12 Test Results – Power Spectral Density

4.12.1 Power Spectral Density – Test Summary

This test has not been performed. The device is based on certified modules as described in section 2.1

4.13 Test Results – Conducted Power Comparison

4.13.1 Conducted Power Comparison – Test Summary

Test Specification	ANSI C63.10 clause 11.9.1.1	
Test Engineer & Date	Niall Forrester	2021.03.04
EUT and Ancillary Equipment IDs	A002959287-036	A002959287-014 A002959287-015 A002959287-023
EUT Operation Mode(s)	Continuous Tx	
EUT Wireless Configuration(s)	Thread 802.15.4 (see below for details)	
EUT Hardware Configuration(s)	Power from USB Power Supply	
Overall Result	Measured power does not exceed the maximum measured power from the module by more than the measurement uncertainty listed in section 6.1	

Test Parameter	Wireless Configuration	Measured Level (dBm)	Reference Level (dBm) See Note 1
Peak Output Power	Thread Low Channel (OQPSK 2405 MHz)	11.81	13.3
Peak Output Power	Thread Mid Channel (OQPSK 2445 MHz)	11.81	
Peak Output Power	Thread High Channel (OQPSK 2480 MHz)	10.81	

Note 1: The reference level is the maximum measured power of a given configuration for the pre-certified module. This data is taken from Element report number TRA-043305-45-00B. As measurements for Thread modulation were not available, the conducted power data for ZigBee were used instead.

5. TEST EQUIPMENT STATUS

5.1 List of Hardware with Calibration Dates

5.1.1 Hardware List – Conducted Power Measurements

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

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	1236.0118.0802.033 2771042	2020.07.31	2022.07.31

5.2 Software / Firmware Versions

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

6. MEASUREMENT UNCERTAINTY

6.1 Measurement Uncertainty for Conducted Power Measurements

Parameter	Uncertainty (Coverage Factor k=2)
Conducted power	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, see Appendix 1