



<b>Prüfbericht-Nr.:</b> <i>Test report no.:</i>	<b>60431065-003</b>	<b>Auftrags-Nr.:</b> <i>Order no.:</i>	23870469 030	Seite 1 von 24 Page 1 of 24
<b>Kunden-Referenz-Nr.:</b> <i>Client reference no.:</i>	1288983	<b>Auftragsdatum:</b> <i>Order date:</i>	2020.11.29	
<b>Auftraggeber:</b> <i>Client:</i>	IKEA of Sweden AB			
<b>Prüfgegenstand:</b> <i>Test item:</i>	Hub for smart products			
<b>Bezeichnung / Typ-Nr.:</b> <i>Identification / Type no.:</i>	DIRIGERA / E2003 / FCC ID: FHO-E2003			
<b>Auftrags-Inhalt:</b> <i>Order content:</i>	Accredited testing			
<b>Prüfgrundlage:</b> <i>Test specification:</i>	FCC 47 CFR Part 15B with parts 15.107 & 15.109 ANSI C63.4: 2014			
<b>Wareneingangsdatum:</b> <i>Date of sample receipt:</i>	2020.11.30			
<b>Prüfmuster-Nr.:</b> <i>Test sample no.:</i>	See chapter 2.3			
<b>Prüfzeitraum:</b> <i>Testing period:</i>	2020.12.10 – 2020.12.21			
<b>Ort der Prüfung:</b> <i>Place of testing:</i>	Lund, Sweden			
<b>Prüflaboratorium:</b> <i>Testing laboratory:</i>	TÜV Rheinland Sweden			
<b>Prüfergebnis*:</b> <i>Test result*:</i>	Pass			
<b>überprüft von:</b> <i>reviewed by:</i>		<b>genehmigt von:</b> <i>authorized by:</i>		
<b>Datum: 2021.12.06</b> <i>Date:</i>	Signed by: Niall Forrester	<b>Datum: 2021.12.06</b> <i>Date:</i>	Signed by: Hakan Ahlberg	
<b>Stellung / Position:</b>	Senior Technical Expert	<b>Stellung / Position:</b>	Lab Manager	
<b>Sonstiges / Other:</b>				
<b>Zustand des Prüfgegenstandes bei Anlieferung:</b> <i>Condition of the test item at delivery:</i>		Prüfmuster vollständig und unbeschädigt <i>Test item complete and undamaged</i>		
* Legende:	1 = sehr gut P(ass) = entspricht o.g. Prüfgrundlage(n)	2 = gut F(ail) = entspricht nicht o.g. Prüfgrundlage(n)	3 = befriedigend N/A = nicht anwendbar	4 = ausreichend N/T = nicht getestet
* Legend:	1 = very good P(ass) = passed a.m. test specification(s)	2 = good F(ail) = failed a.m. test specification(s)	3 = satisfactory N/A = not applicable	4 = sufficient N/T = not tested
<p><b>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.</b> <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></p>				

## Revision History<sup>60431065-00360431065-003</sup>

REVISION	DATE	REMARKS	AUTHOR
001	2021.05.03	First release	Sam Ebadeh
002	2021.09.28	Corrected gain figures, updated module name. Fixed 18-40GHz graph.	Niall Forrester
003	2021.12.06	Replaced gain with module figure	Niall Forrester

Note: Latest revision report will replace all previous reports

This report based on FCC Part 15B no JBP Template version 1.2

## Summary of Test Results

FCC 47 CFR Rule Part	Test Description	Applicability	Report Section	RESULT	REMARKS
15.107	AC Power Line Conducted Emissions (Unintentional Radiators)	YES	4.1	PASS	
15.109	Radiated Emissions (Unintentional Radiators)	YES	4.2	PASS	

Possible test case verdicts:

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

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## 1. GENERAL INFORMATION

### 1.1 Test Site

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

### 1.2 Client Information

Company Name:	IKEA
Address:	Tulpanvägen 8
	343 34 Älmhult
	Sverige
Contact Person:	Jeton Salihu
Contact e-Mail / Telephone	<a href="mailto:Jeton.salihu@ikea.com">Jeton.salihu@ikea.com</a> +46 701 443 175

## 2. PRODUCT INFORMATION

### 2.1 General Description

<b>Model name:</b>	DIRIGERA
<b>Manufacturer:</b>	IKEA of Sweden AB, SE-343 81 Älmhult
<b>Model number / Marketing name:</b>	E2003
<b>FCC ID:</b>	FHO-E2003
<b>Description:</b>	Hub for smart products
<b>Ancillary Equipment:</b>	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

<b>Device Class for 47 CFR Part 15 B</b>	Class B
<b>Type of Power Supply</b>	USB Power Supply (via AC/DC Adapter)
<b>Nominal Supply Voltage</b>	120V or 230V AC (Adapter) / 5V DC (USB)
<b>Supply Voltage Range</b>	100-240V AC
<b>Operating Temperature Range</b>	0°C - 40 °C
<b>Operating Air Humidity Range</b>	-
<b>Highest Internal Frequency Source</b>	5825 MHz

## 2.3 Test Samples

EUT #	EUT ID	Description	Used For:
1	A002959287-010	Standard test sample	Conducted emissions Radiated emissions
2	A002959287-013	Standard test sample	Radiated emissions

## 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	YES
WiFi 802.11 a/n/ac (LBEE5ZZ2AW)	5 GHz	5180 MHz - 5240 MHz 5260 MHz - 5320 MHz	YES
BlueTooth Low Energy (LBEE5ZZ2AW)	2.4 GHz	2402 MHz – 2480 MHz	YES
ZigBee 802.15.4 (MGM210L No.1)	2.4 GHz	2400 MHz – 2483.5 MHz	YES
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	1	Monopole	0.10
	5 GHz			-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
A002959287-017	AC/DC Power Supply	IKEA ICPWS5	-
A002959287-018	USB Cable	-	-
A002959287-020	LAN Cable (UTP)	-	-
A002959287-011	AC/DC Power Supply	IKEA ICPWS5	-
A002959287-012	USB Cable	-	-
A002959287-025	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 15.107	-	Conducted limits
FCC 47 CFR 15.109	-	Radiated emission limits

#### 3.2 Additional references

The following standards / references were also considered for the testing

Standard	Version	Description
ANSI C63.4	2014	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

### 3.3 Limits

FCC 47 CFR Rule Part	Test Description	Limit Reference (FCC 47 CFR Reference)
15.107	AC Power Line Conducted Emissions (Unintentional Radiators)	15.107 (a) for Class B Devices
15.109	Radiated Emissions (Unintentional Radiators)	15.109 (a) for Class B Devices *See Note 1

Interpretation of the measurement results has been performed in accordance with ANSI C63.4 section 10.2.8.2

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 are presented in  $\mu\text{V}/\text{m}$ . Measurements on the test system are made in  $\text{dB}\mu\text{V}/\text{m}$ . 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  $100\mu\text{V}/\text{m}$  at 3m. This gives:

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

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  $30\mu\text{V}/\text{m}$  (=29.54  $\text{dB}\mu\text{V}/\text{m}$ ) at 30m

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

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

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

### 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

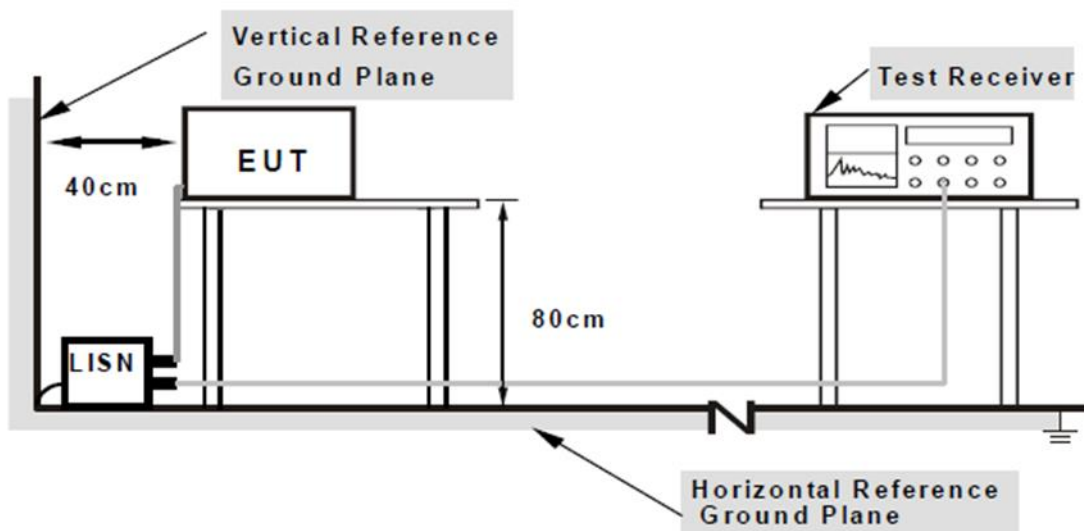
Where different arrangements of equipment were used for different types of measurements, these are tabulated in section 3.4.2 and details of each arrangement are included in subsequent sections

#### 3.4.2 Test Equipment Setup Used by Test Type

FCC 47 CFR Rule Part	Test Description	Test Equipment Used
15.107	AC Power Line Conducted Emissions (Unintentional Radiators)	Conducted Emissions
15.109	Radiated Emissions (Unintentional Radiators)	SAC5

#### 3.4.3 Test Equipment Setup – Conducted Emissions

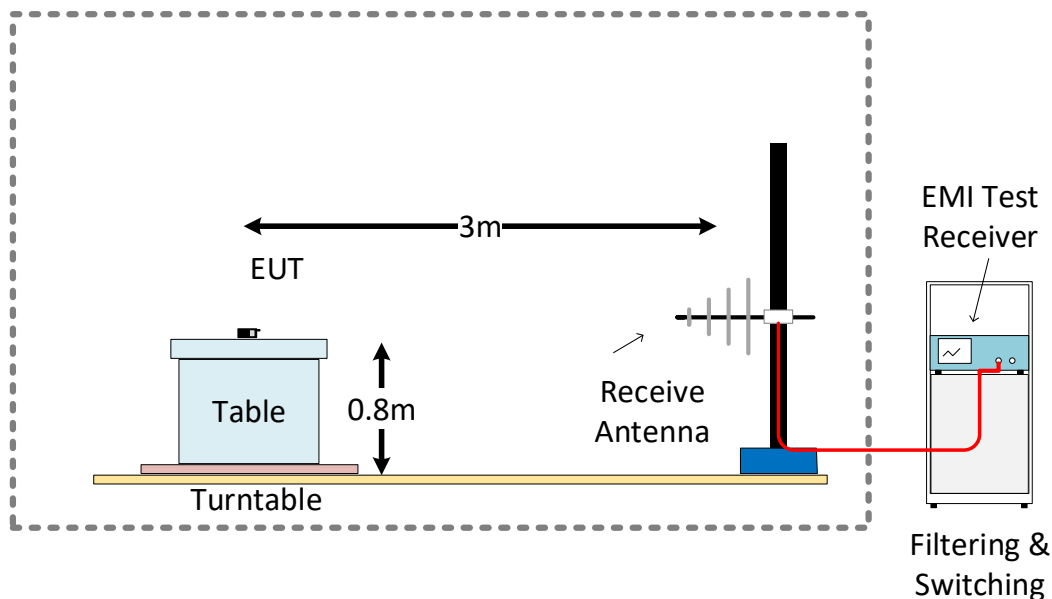
- The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The LISNs provide 50Ω/ 50μH of coupling impedance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



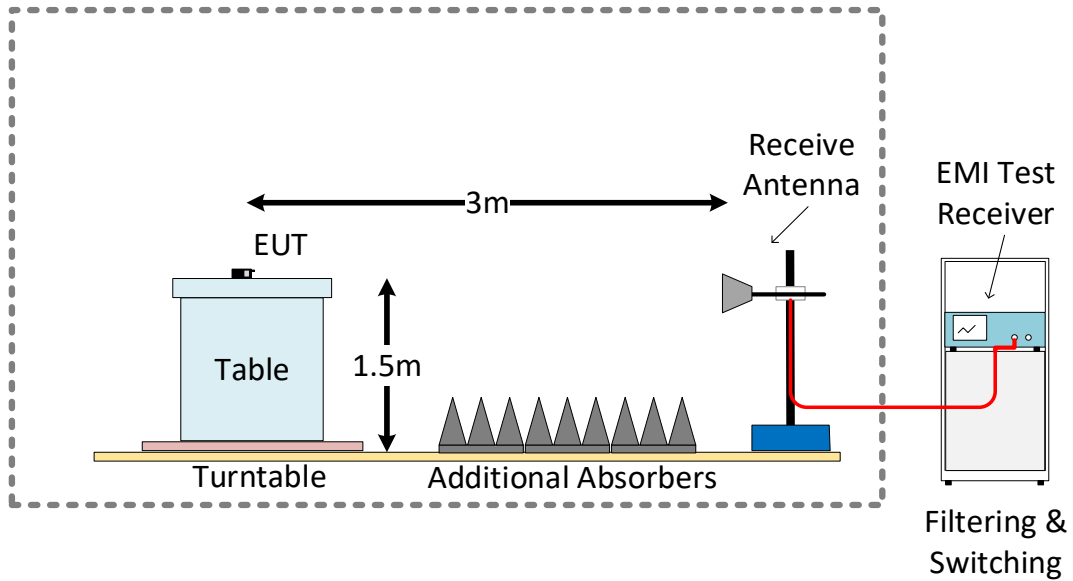
#### 3.4.4 Test Equipment Setup – SAC 5 (Radiated Emissions)

- 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.

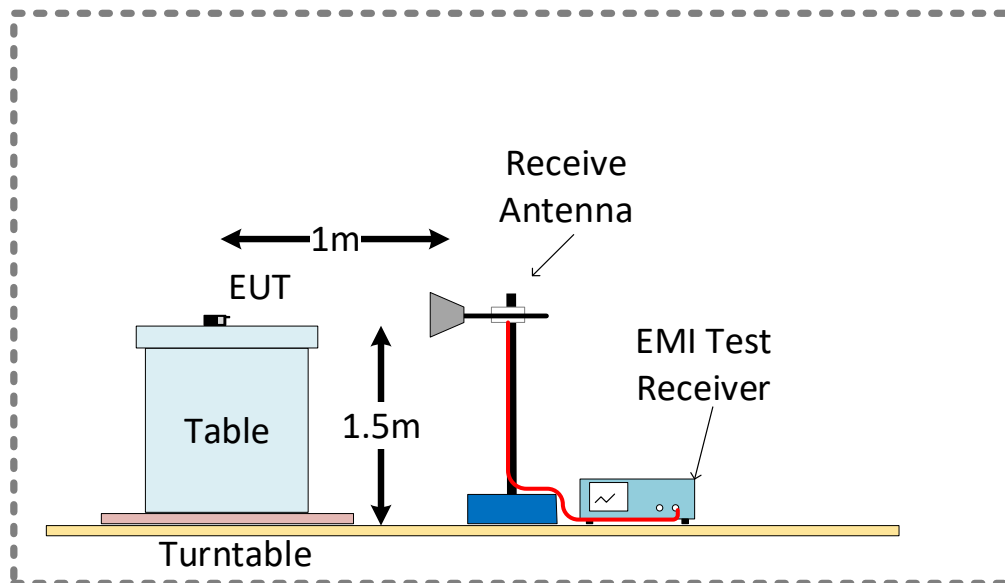
SAC 5 Test Setup Configuration 30MHz – 1GHz



### 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 USB Charger and set to in idle mode. 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 idle mode. 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
Idle mode	EUT radio is on RX mode.

### 3.7 Deviations from the Test Standard

None

### 3.8 Environmental Conditions

#### 3.8.1 Environmental Conditions – Conducted Emissions System

##### Environmental Conditions Log – Conducted Emissions

Date	Time	Temperature (°C)	Relative Humidity (%)
2020.12.21	09:00	18.3	44

#### 3.8.2 Environmental Conditions – SAC5 (Radiated Emissions)

##### Environmental Conditions Log – SAC5

Date	Time	Temperature (°C)	Relative Humidity (%)
2020.12.10	07:38	18.3	39
2020.12.17	08:32	18.7	43

## 4. TEST RESULTS

### 4.1 Test Results – AC Power Line Conducted Emissions (Unintentional Trans.)

#### 4.1.1 AC Power Line Conducted Emissions (Unintentional) – Test Summary

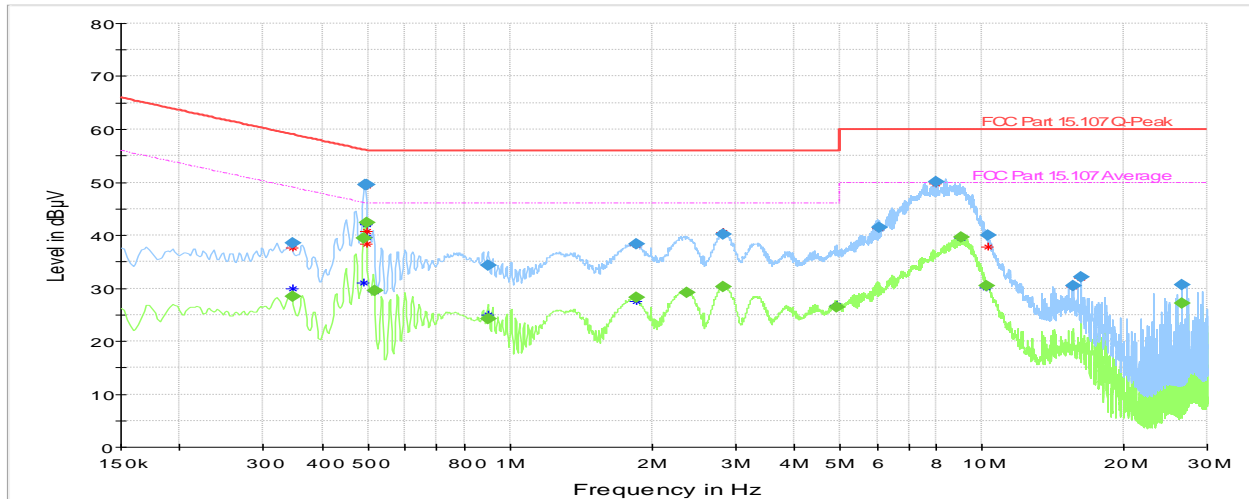
<b>Test Specification</b>	FCC 47 CFR 15.107 (Part 15 Subpart B)	
<b>Test Engineer &amp; Date</b>	Fariborz Abasi	2020.12.21
<b>EUT and Ancillary Equipment IDs</b>	A002959287-010	A002959287-020 A002959287-018 A002959287-017
<b>EUT Operation Mode(s)</b>	1	
<b>EUT Wireless Configuration(s)</b>	RX mode	
<b>EUT Hardware Configuration(s)</b>	-	
<b>Overall Result</b>	PASS	
<b>Test Parameter</b>	<b>Frequency Range</b>	<b>Result*</b>
AC Power Line Emissions - Idle Mode	150 kHz – 30 MHz	PASS

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



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

Test mode condition	Conducted Emissions	
Sweep frequency	150 kHz – 30 MHz	
Standard	FCC 47 Part 15.107	
EUT	A002959287-010	
Ancillary Equipment	A002959287-020 A002959287-018 A002959287-017	
Test Engineer	Fariborz Abasi	Date: 2020.12.21



Frequency (MHz)	QuasiPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.345750	38.45	---	59.06	20.61	1000.0	9.000	L1	ON	9.6
0.348000	---	28.41	49.01	20.60	1000.0	9.000	L1	ON	9.6
0.492000	---	39.47	46.13	6.66	1000.0	9.000	L1	ON	9.6
0.494250	49.47	---	56.10	6.63	1000.0	9.000	L1	ON	9.6
0.496500	49.61	---	56.06	6.45	1000.0	9.000	L1	ON	9.6
0.496500	---	42.40	46.06	3.66	1000.0	9.000	L1	ON	9.6
0.516750	---	29.56	46.00	16.45	1000.0	9.000	L1	ON	9.6
0.899250	34.38	---	56.00	21.62	1000.0	9.000	L1	ON	9.6
0.901500	---	24.18	46.00	21.82	1000.0	9.000	L1	ON	9.6
1.855500	---	28.18	46.00	17.82	1000.0	9.000	L1	ON	9.7
1.855500	38.40	---	56.00	17.60	1000.0	9.000	L1	ON	9.7
2.364000	---	29.12	46.00	16.88	1000.0	9.000	L1	ON	9.8
2.838750	---	30.32	46.00	15.68	1000.0	9.000	L1	ON	9.8
2.841000	40.15	---	56.00	15.85	1000.0	9.000	L1	ON	9.8
4.924500	---	26.49	46.00	19.51	1000.0	9.000	L1	ON	9.8
6.058500	41.46	---	60.00	18.54	1000.0	9.000	N	ON	9.8
7.973250	50.05	---	60.00	9.95	1000.0	9.000	N	ON	9.8
9.046500	---	39.58	50.00	10.42	1000.0	9.000	L1	ON	9.9
10.227750	---	30.40	50.00	19.60	1000.0	9.000	L1	ON	9.9
10.279500	39.93	---	60.00	20.07	1000.0	9.000	L1	ON	9.9
15.616500	30.49	---	60.00	29.51	1000.0	9.000	N	ON	10.0
16.228500	32.03	---	60.00	27.97	1000.0	9.000	N	ON	10.0
26.610000	---	27.24	50.00	22.76	1000.0	9.000	N	ON	10.1
26.610000	30.61	---	60.00	29.39	1000.0	9.000	N	ON	10.1

## 4.2 Test Results – Radiated Emissions (Unintentional Transmitter)

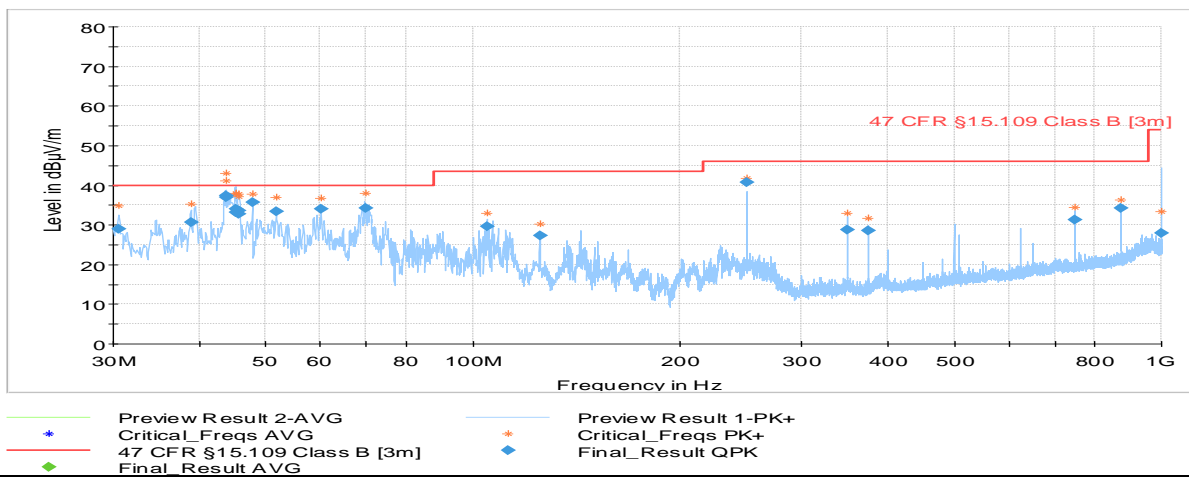
### 4.2.1 Radiated Emissions (Unintentional) – Test Summary

<b>Test Specification</b>	FCC 47 CFR 15.109 (Part 15 Subpart B)	
<b>Test Engineer &amp; Date</b>	Simon Palmhager Fariborz Abasi	2020.12.10 – 2020.12.17
<b>EUT and Ancillary Equipment IDs</b>	A002959287-010 A002959287-013	A002959287-025 A002959287-011 A002959287-012
<b>EUT Operation Mode(s)</b>	1	
<b>EUT Wireless Configuration(s)</b>	Idle mode	
<b>EUT Hardware Configuration(s)</b>	-	
<b>Overall Result</b>	PASS	
<b>Test Parameter</b>	<b>Frequency Range</b>	<b>Result*</b>
Radiated Emissions - Idle Mode	30 MHz – 1 GHz	PASS
Radiated Emissions - Idle Mode	1 GHz – 18 GHz	PASS
Radiated Emissions – Idle mode	18 GHz – 40 GHz	PASS

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

4.2.2 Radiated Emissions (Unintentional) – Test Details  
30MHz – 1GHz

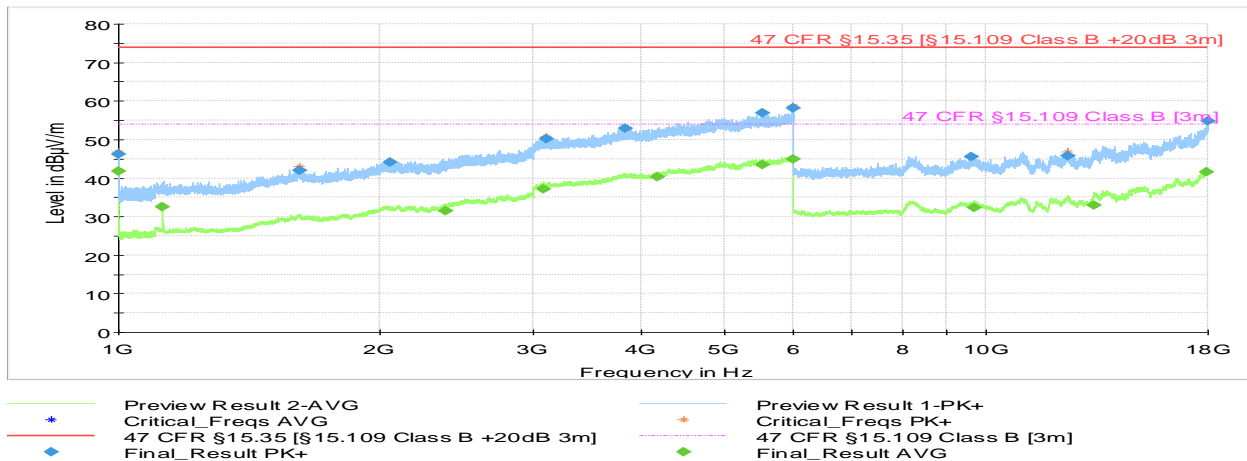
Test mode condition	Idle mode	
Antenna orientation	Horizontal and Vertical	
Sweep frequency	30 MHz – 1 GHz	
Standard	47 CFR FCC Part 15 subpart B	
EUT	A002959287-010	
Ancillary Equipment	A002959287-011, A002959287-012, A002959287-025	
Test Engineer	Simon Palmhager	Date: 2020.12.10
Chamber details	Chamber: SAC 5	



Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
30.605893	28.93	40.00	11.07	1000.0	120.000	100.0	V	292.0
38.946920	30.72	40.00	9.28	1000.0	120.000	100.0	V	206.0
43.813600	36.99	40.00	3.01	1000.0	120.000	100.0	V	296.0
43.826080	37.33	40.00	2.67	1000.0	120.000	125.0	V	9.0
45.240360	33.94	40.00	6.06	1000.0	120.000	100.0	V	-18.0
45.280800	33.17	40.00	6.83	1000.0	120.000	100.0	V	-4.0
45.704600	32.79	40.00	7.21	1000.0	120.000	100.0	V	-22.0
45.732520	33.62	40.00	6.38	1000.0	120.000	100.0	V	-22.0
47.799360	35.77	40.00	4.23	1000.0	120.000	100.0	V	292.0
51.808080	33.33	40.00	6.67	1000.0	120.000	125.0	V	292.0
60.212600	34.08	40.00	5.92	1000.0	120.000	225.0	V	8.0
69.705880	34.29	40.00	5.71	1000.0	120.000	100.0	V	334.0
104.727080	29.62	43.52	13.91	1000.0	120.000	100.0	V	-4.0
125.003320	27.22	43.52	16.30	1000.0	120.000	125.0	V	176.0
249.998400	40.69	46.02	5.33	1000.0	120.000	133.0	H	112.0
349.994600	28.69	46.02	17.33	1000.0	120.000	100.0	V	162.0
374.994640	28.56	46.02	17.46	1000.0	120.000	100.0	H	296.0
749.994160	31.20	46.02	14.82	1000.0	120.000	233.0	V	72.0
875.003400	34.14	46.02	11.88	1000.0	120.000	233.0	H	131.0
999.434140	27.96	53.98	26.02	1000.0	120.000	175.0	H	322.0

1GHz – 18GHz

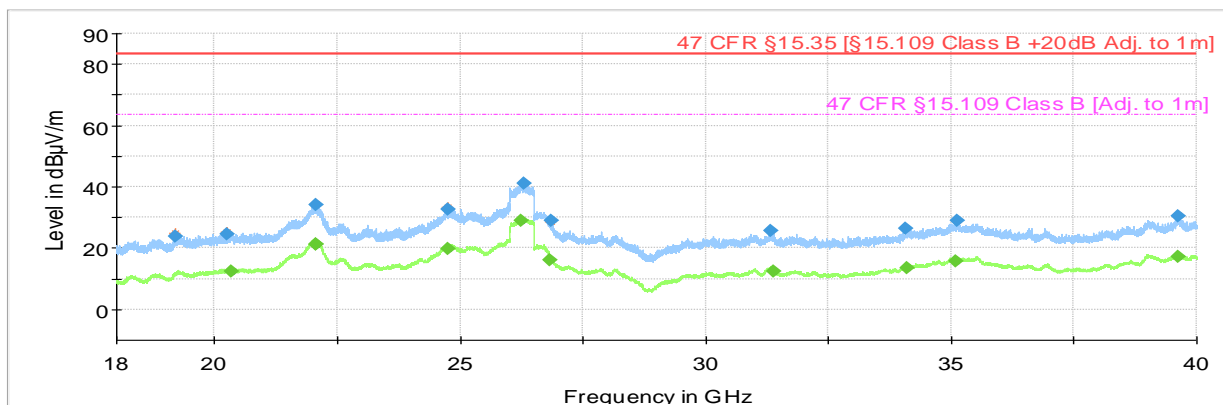
<b>Test mode condition</b>	Idle mode	
<b>Antenna orientation</b>	Horizontal and Vertical	
<b>Sweep frequency</b>	1 GHz – 18 GHz	
<b>Standard</b>	47 CFR FCC Part 15 subpart B	
<b>EUT</b>	A002959287-010	
<b>Ancillary Equipment</b>	A002959287-011, A002959287-012, A002959287-025	
<b>Test Engineer</b>	Simon Palmhager	Date: 2020.12.17
<b>Chamber details</b>	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)
1000.005500	---	41.87	53.98	12.11	1000.0	1000.000	108.0	V	218.0
1000.058696	46.15	---	73.98	27.83	1000.0	1000.000	100.0	V	218.0
1125.089000	---	32.50	53.98	21.48	1000.0	1000.000	215.0	V	308.0
1616.069000	42.03	---	73.98	31.95	1000.0	1000.000	393.0	H	278.0
2053.698000	44.11	---	73.98	29.87	1000.0	1000.000	293.0	V	8.0
2378.845000	---	31.54	53.98	22.43	1000.0	1000.000	185.0	V	82.0
3088.711000	---	37.23	53.98	16.75	1000.0	1000.000	265.0	H	232.0
3108.521000	50.20	---	73.98	23.78	1000.0	1000.000	265.0	H	52.0
3831.620000	52.92	---	73.98	21.06	1000.0	1000.000	365.0	V	132.0
4176.000000	---	40.27	53.98	13.71	1000.0	1000.000	215.0	H	-4.0
5518.782000	---	43.50	53.98	10.48	1000.0	1000.000	393.0	V	142.0
5528.408000	56.91	---	73.98	17.07	1000.0	1000.000	165.0	V	262.0
5979.090000	58.13	---	73.98	15.85	1000.0	1000.000	293.0	H	266.0
5982.749000	---	44.86	53.98	9.12	1000.0	1000.000	165.0	H	176.0
9598.492000	45.66	---	73.98	28.32	1000.0	1000.000	265.0	V	8.0
9691.185000	---	32.32	53.98	21.66	1000.0	1000.000	385.0	V	308.0
12397.627000	45.74	---	73.98	28.24	1000.0	1000.000	315.0	V	308.0
13316.908000	---	32.89	53.98	21.09	1000.0	1000.000	185.0	H	172.0
17939.000000	---	41.68	53.98	12.30	1000.0	1000.000	235.0	H	218.0
17986.624000	54.76	---	73.98	19.22	1000.0	1000.000	365.0	V	172.0

18 GHz – 26 GHz

Test mode condition	Idle mode	
Antenna orientation	Horizontal and Vertical	
Sweep frequency	18 GHz – 40 GHz	
Standard	47 CFR FCC Part 15 subpart B	
EUT	A002959287-013	
Ancillary Equipment	A002959287-011, A002959287-012, A002959287-025	
Test Engineer	Fariborz Abasi	Date: 2020.12.17
Chamber details	Chamber: SAC 5	



- Preview Result 2-AVG
- Preview Result 1-PK+
- \* Critical\_Freqs AVG
- \* Critical\_Freqs PK+
- 47 CFR §15.35 [§15.109 Class B +20dB Adj. to 1m]
- - - 47 CFR §15.109 Class B [Adj. to 1m]
- ◆ 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)
19198.358000	23.88	---	83.52	59.65	1000.0	1000.000	155.0	V	262.0
20239.335000	24.70	---	83.52	58.82	1000.0	1000.000	155.0	H	112.0
20342.904000	---	12.39	63.52	51.13	1000.0	1000.000	155.0	H	276.0
22052.858000	---	21.33	63.52	42.19	1000.0	1000.000	155.0	H	202.0
22055.015000	---	21.34	63.52	42.18	1000.0	1000.000	155.0	H	192.0
22058.765000	33.97	---	83.52	49.55	1000.0	1000.000	155.0	H	38.0
24745.765000	---	19.85	63.52	43.67	1000.0	1000.000	155.0	H	8.0
24754.436000	32.58	---	83.52	50.94	1000.0	1000.000	155.0	V	172.0
26253.116000	---	28.97	63.52	34.55	1000.0	1000.000	155.0	V	86.0
26297.654000	41.08	---	83.52	42.44	1000.0	1000.000	155.0	V	276.0
26837.136000	---	15.97	63.52	47.55	1000.0	1000.000	155.0	H	6.0
26838.505000	28.92	---	83.52	54.60	1000.0	1000.000	155.0	H	202.0
31326.834000	25.83	---	83.52	57.69	1000.0	1000.000	155.0	V	236.0
31375.393000	---	12.51	63.52	51.01	1000.0	1000.000	155.0	H	248.0
34066.139000	26.47	---	83.52	57.05	1000.0	1000.000	155.0	V	36.0
34098.128000	---	13.56	63.52	49.96	1000.0	1000.000	155.0	H	262.0
35084.715000	---	15.73	63.52	47.79	1000.0	1000.000	155.0	H	158.0
35130.833000	29.10	---	83.52	54.42	1000.0	1000.000	155.0	V	38.0
39615.629000	---	17.32	63.52	46.21	1000.0	1000.000	155.0	V	322.0
39622.856000	30.41	---	83.52	53.11	1000.0	1000.000	155.0	V	146.0

## 5. TEST EQUIPMENT STATUS

### 5.1 List of Hardware with Calibration Dates

#### 5.1.1 Hardware List – Conducted Emissions System

Type	Manufacturer	Model	Serial Number / ID	Calibration Date	Calibration Due
Two-Line V-network	Rohde & Schwarz	ENV216	101090 2704076	2020.07.16	2021.07.16
Test Receiver 9KHz to 3.5 GHz	Rohde & Schwarz	ESR3	101674 2704016	2020.07.17	2021.07.17
RF PROBE	Fischer Custom Communication	F-52	22 2902256	2019.04.09	2021.04.09
Humidity Temperature Probe	Lufft	OPUS 20	113.0118.0802.033 2771025	2020.07.31	2022.07.31

#### 5.1.2 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 Emissions System	EMC 32	V10.60.10
SAC 5	EMC 32	V10.60.10

## 6. MEASUREMENT UNCERTAINTY

### 6.1 Measurement Uncertainty for Conducted Emissions

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

### 6.2 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 60431065-001-Annex.