

Prüfbericht-Nr.: <i>Test report no.:</i>	60431098-004	Auftrags-Nr.: <i>Order no.:</i>	23870469 030	Seite 1 von 8 <i>Page 1 of 8</i>
Kunden-Referenz-Nr.: <i>Client reference no.:</i>	1288983	Auftragsdatum: <i>Order date:</i>	2020.11.29	
Auftraggeber: <i>Client:</i>	IKEA of Sweden AB			
Prüfgegenstand: <i>Test item:</i>	Hub for smart products			
Bezeichnung / Typ-Nr.: <i>Identification / Type no.:</i>	DIRIGERA / E2003 / FCC ID: FHO-E2003			
Auftrags-Inhalt: <i>Order content:</i>	RF Exposure Evaluation			
Prüfgrundlage: <i>Test specification:</i>	FCC 47 CFR 2.1091 IEEE Std. C95.1:2005			
Wareneingangsdatum: <i>Date of sample receipt:</i>	N/A			
Prüfmuster-Nr.: <i>Test sample no.:</i>	N/A			
Prüfzeitraum: <i>Testing period:</i>	N/A -			
Ort der Prüfung: <i>Place of testing:</i>	Lund, Sweden			
Prüflaboratorium: <i>Testing laboratory:</i>	TÜV Rheinland Sweden			
Prüfergebnis*: <i>Test result*:</i>	Siehe Sonstiges / See Other			
überprüft von: <i>reviewed by:</i>		genehmigt von: <i>authorized by:</i>		
Datum: 2022.02.16 <i>Date:</i>	Signed by: Niall Forrester	Datum: 2022.02.16 <i>Date:</i>	Signed by: Hakan Ahlberg	
Stellung / Position:	Senior Technical Expert	Stellung / Position:	Lab Manager	
Sonstiges / Other:	See details below			
Zustand des Prüfgegenstandes bei Anlieferung: <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>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></p>				

Revision History⁶⁰⁴³¹⁰⁹⁸⁻⁰⁰⁴⁶⁰⁴³¹⁰⁹⁸⁻⁰⁰⁴

Revision	Date	Remarks	Author
001	2021.04.23	First Release	Niall Forrester
002	2021.09.28	Corrected gain & power figures, updated data, updated module name.	Niall Forrester
003	2021.12.06	Replaced gain with module figures & recalculated	Niall Forrester
004	2022.02.16	Updated with peak power from module reports	Niall Forrester
Note: Latest revision report will replace all previous reports			
This report based on RF Exposure FCC 47CFR 2-1091 IEEE C95 Template version 1.1			

Statement of Compliance

Evaluation was performed based on FCC 47 CFR 2.1091 and IEEE C95.1:2005, together with the “General Population / Uncontrolled” requirements set out in FCC 47 CFR 1.1310 Table 1 (B)

The calculations below show that the DIRIGERA / E2003 / FCC ID: FHO-E2003 is compliant with these requirements at a distance of 20cm for all supported combinations of wireless transmitter technologies.

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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
Contact Person:	Jeton Salihu
Contact e-Mail / Telephone	Jeton.salihu@inter.ikea.com +46 701443175

2. PRODUCT INFORMATION

2.1 General Description

Model name:	Gateway
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:	N/A

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 Usage and Evaluation Distance

The device is an “Electronic product acting as central hub for IKEAs Home Smart products”. An evaluation distance of 20cm has been selected.

2.3 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 - 2472 MHz	YES
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	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

2.4 Simultaneous Transmission Configurations

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.

2.5 Conducted Power and Antenna Gain

Technology	Band	Max. Conducted Output Power (dBm)	Max. Time-Averaged Output Power (dBm)*	Antenna Gain (dBi)
WiFi 802.11 b/g/n (LBEE5ZZ2AW)	2.4 GHz	23.83	23.83	0.10
WiFi 802.11 a/n/ac (LBEE5ZZ2AW)	5 GHz	14.82	14.82	-0.40
BlueTooth Low Energy (LBEE5ZZ2AW)	2.4 GHz	5.11	5.11	0.10
ZigBee 802.15.4 (MGM210L No.1)	2.4 GHz	13.30	13.30	0.50
Thread 802.15.4 (MGM210L No.2)	2.4 GHz	13.30	13.30	0.50

3. TEST METHODS

3.1 Test Standards

Testing was performed according to the following standards / references

Standard	Version	Description
47 CFR 2.1091	-	Radiofrequency radiation exposure evaluation: mobile devices.

3.2 Additional references

Standard	Version	Description
IEEE Std. C95.1	2005	IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz

3.3 Limits

Extract from 47 CFR 1.1310 - Radiofrequency radiation exposure limits

Table 1B

Limits for Maximum Permissible Exposure (MPE)
(Limits for general Population / Uncontrolled Exposure)

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field strength (A/m)	Power Density (mW/cm ²)	Averaging Time (minutes)
0.3 - 1.34	614	1.63	*100	30
1.34 - 30	824/f	2-19/f	*180/f ²	30
30 - 300	27.5	0.073	0.2	30
300 - 1500	-	-	f/1500	30
1500 - 10000	-	-	1.0	30

Notes:

1. f = frequency in MHz
2. * = Plane-wave equivalent power density

4. EVALUATION DETAILS

4.1 Power Density (S) at 20cm Distance for Each Band and Technology

The Power Density at 20cm separation distance has been calculated for each of the transmitter technologies supported by the device according to a re-arrangement of the Friis formula, as below:

$$S = \frac{P * G}{4\pi * r^2}$$

Where:

- “S” is power density in mW/cm²
- “P” is maximum avg. conducted power (incl. tolerances) in mW according to data from the manufacturer
- “G” is the peak antenna gain (numerical) according to data from the manufacturer
- “r” is the separation distance (20 cm)

Technology	Band	Freq* (MHz)	Power (dBm)	P (mW)	Gain (dBi)	G (Num.)	r (cm)	S (mW/cm ²)	Limit ** (mW/cm ²)
WiFi 802.11 b/g/n (LBEE5ZZ2AW)	2.4 GHz	2412	23.83	241.55	0.10	1.02	20.00	0.0492	1.00
WiFi 802.11 a/n/ac (LBEE5ZZ2AW)	5 GHz	5180	14.82	30.34	-0.40	0.91	20.00	0.0055	1.00
BlueTooth Low Energy (LBEE5ZZ2AW)	2.4 GHz	2402	5.11	3.24	0.10	1.02	20.00	0.0007	1.00
ZigBee 802.15.4 (MGM210L No.1)	2.4 GHz	2400	13.30	21.38	0.50	1.12	20.00	0.0048	1.00
Thread 802.15.4 (MGM210L No.2)	2.4 GHz	2400	13.30	21.38	0.50	1.12	20.00	0.0048	1.00

*The lowest frequency in each band has been chosen, to give the most conservative limit

**The limits listed are from FCC 47 CFR 1.1310 Table 1 (B): “Limits for General Population/Uncontrolled”

From 1500MHz to 100000MHz, the limit is 1.0 mW/cm²

4.2 Simultaneous Transmission Calculations

All relevant combinations of transmitters have been evaluated at 20cm distance below, using the following equation, rearranged from IEEE Std. C95.1:2005 Annex D.2:

$$\sum_{i=1}^n \left(\frac{S_i}{S_{L,i}} \right) = \text{"Evaluation Result"}$$

Where:

- S_i is the power density for transmitter 'i'
- $S_{L,i}$ is the power density MPE limit from Table 1(B) of 47 CFR 1.1310

If the evaluation result is ≤ 1 , the device is compliant with the limits even for the simultaneous transmission configuration.

Calculation of Ratio $S_i/S_{L,i}$ for Supported Transmitter Technologies and bands

Technology	Band	S_i (mW/cm ²)	Limit $S_{L,i}$ (mW/cm ²)	$S_i/S_{L,i}$
WiFi 802.11 a/n/ac (LBEE5ZZ2AW)	5 GHz	0.0055	1.00	0.0055
ZigBee 802.15.4 (MGM210L No.1)	2.4 GHz	0.0048	1.00	0.0048
Thread 802.15.4 (MGM210L No.2)	2.4 GHz	0.0048	1.00	0.0048

Evaluation of Compliance at 20cm for Supported Combinations of Transmitters

Tech. 1	Band 1	Tech 1 Band 1 $S_i/S_{L,i}$	Tech. 2	Band 2	Tech 2 Band 2 $S_i/S_{L,i}$	Sum $S_i/S_{L,i}$	Compliant?
WiFi 802.11 a/n/ac (LBEE5ZZ2AW)	5 GHz	0.0055	ZigBee 802.15.4 (MGM210L No.1)	2.4 GHz	0.0048	0.0103	YES
WiFi 802.11 a/n/ac (LBEE5ZZ2AW)	5 GHz	0.0055	Thread 802.15.4 (MGM210L No.2)	2.4 GHz	0.0048	0.0103	YES

The table above shows the compliance evaluation for all supported combinations of transmitters