

1. RF Exposure Requirements

1.1 General Information

Client Information

Applicant: Shelly Europe Ltd.
Address of applicant: 51 Cherni Vrah Blvd., building 3, floor 2 and 3, Lozenetz Region, Sofia 1407, Republic of Bulgaria
Manufacturer: Shelly Europe Ltd.
Address of manufacturer: 51 Cherni Vrah Blvd., building 3, floor 2 and 3, Lozenetz Region, Sofia 1407, Republic of Bulgaria

General Description of EUT:

Product Name: Smart BLE ultrasonic sensor for distance and level measurement
Trade Name 
Model No.: Shelly BLU Distance
Adding Model(s): SBDI-003E
Rated Voltage: DC 3.6V
Battery capacity: 2700mAh with "AA" battery inside
FCC ID: 2BDC6-DISTANCE
Equipment Type: Portable device

Technical Characteristics of EUT:

Bluetooth

Bluetooth Version: V5.0 (BLE mode)
Frequency Range: 2402-2480MHz
RF Output Power: 1Mbps: -5.45dBm (Conducted)
2Mbps: -5.27dBm (Conducted)
Data Rate: 1Mbps, 2Mbps
Modulation: GFSK
Quantity of Channels: 40
Channel Separation: 2MHz
Type of Antenna: PCB Antenna
Antenna Gain: 4.67dBi

1.2 RF Exposure Exemption

According to §1.1307(b)(3) and KDB 447498 D04 Interim General RF Exposure Guidance v01, system operating under the provisions of this section shall be operating in a manner that the public is not exposed to radio frequency energy level in excess limit for maximum permissible exposure.

Option A: FCC Rule Part 1.1307 (b)(3)(i)(A): The available maximum time-averaged power is no more than 1mW, regardless of separation distance.

Option B: FCC Rule Part 1.1307 (b)(3)(i)(B): The available maximum time-averaged power or effective radiated power (ERP), whichever is greater, is less than or equal to the threshold P_{th} (mW) described in the following formula. P_{th} is given by:

$$P_{th} \text{ (mW)} = \begin{cases} ERP_{20 \text{ cm}}(d/20 \text{ cm})^x & d \leq 20 \text{ cm} \\ ERP_{20 \text{ cm}} & 20 \text{ cm} < d \leq 40 \text{ cm} \end{cases}$$

Where

$$x = -\log_{10} \left(\frac{60}{ERP_{20 \text{ cm}} \sqrt{f}} \right) \text{ and } f \text{ is in GHz;}$$

and

$$ERP_{20 \text{ cm}} \text{ (mW)} = \begin{cases} 2040f & 0.3 \text{ GHz} \leq f < 1.5 \text{ GHz} \\ 3060 & 1.5 \text{ GHz} \leq f \leq 6 \text{ GHz} \end{cases}$$

d = the separation distance (cm);

Option C: FCC Rule Part 1.1307 (b)(3)(i)(C): The minimum separation distance (R in meters) from the body of a nearby person for the frequency (f in MHz) at which the source operates, the ERP (watts) is no more than the calculated value prescribed for that frequency. R must be at least $\lambda/2\pi$, where λ is the free-space operating wavelength in meters.

Single RF Sources Subject to Routine Environmental Evaluation	
RF Source frequency (MHz)	Threshold ERP (watts)
0.3-1.34	$1,920 R^2$
1.34-30	$3,450 R^2/f^2$
30-300	$3.83 R^2$
300-1,500	$0.0128 R^2 f$
1,500-100,000	$19.2R^2$

For Multiple RF sources: FCC Rule Part 1.1307(b)(3)(ii):

(A) The available maximum time-averaged power of each source is no more than 1 mW and there is a separation distance of two centimeters between any portion of a radiating structure operating and the nearest portion of any other radiating structure in the same device, except if the sum of multiple sources is less than 1 mW during the time-averaging period, in which case they may be treated as a single source (separation is not required).

(B) In the case of fixed RF sources operating in the same time-averaging period, or of multiple mobile or portable RF sources within a device operating in the same time averaging period, if the sum of the fractional contributions to the applicable thresholds is less than or equal to 1 as indicated in the following equation.

$$\sum_{i=1}^a \frac{P_i}{P_{th,i}} + \sum_{j=1}^b \frac{ERP_j}{ERP_{th,j}} + \sum_{k=1}^c \frac{Evaluated_k}{Exposure\ Limit_k} \leq 1$$

1.3 Calculated Result

Radio Access Technology	Prediction Frequency (MHz)	Output Power (dBm)	Antenna Gain (dBi)	Duty Cycle (%)	Tune-Up Time-Averaged Power (dBm)	ERP (dBm)
Bluetooth	2402	20	4.67	100	21.00	23.52

Frequency (MHz)	Option	Min. Distance (cm)	Max. Power (dBm)		Exposure Limit (mW)	Ratio	Result
			(dBm)	(mW)			
2402	C	20.00	23.52	224.91	768.00	0.29	Pass

Note: 1. Time-Averaged Power=Output Power * Duty Cycle; ERP= Time-Averaged Power+ Antenna gain-2.15dB

2. Option A, B and C refers as clause 1.2.
3. For option B, Max (time-averaged power, effective radiated power (ERP)) converts to Max. Power. For option C, ERP converts to Max. Power;
4. For option B, P_{th} (mW) converts to Exposure Limit (mW); For option C, ERP (W) converts to Exposure Limit (mW).
5. Ratio= Tune-Up ERP (mW)/ Exposure Limit (mW)

Mode for Simultaneous Multi-band Transmission:

Radio Access Technology	Ratio 1	Ratio 2	Simultaneous Ratio	Limit	Result
					Pass/Fail
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Result: Pass