# 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: Z-wave switch

Trade Name:

Model No.: Wave 1PM

Adding Model:

Rated Voltage: AC120V

Battery capacity: /
Power Adaptor: /

FCC ID: 2BDC6-WAVE1PM

Equipment Type: Mobile device

**Technical Characteristics of EUT:** 

Frequency Range: 908.42MHz, 912MHz, 920MHz

Max. Field Strength: 94.49dBuV/m

Modulation: FSK, DSSS OQPSK

Quantity of Channels: 3
Channel Separation: /

Antenna Type: Integral Antenna

Antenna Gain: -4.28dBi

## 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:

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

Where

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

and

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

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  $\lambda$  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 <sup>2</sup>			
1.34-30	3,450 R <sup>2</sup> /f <sup>2</sup>			
30-300	3.83 R <sup>2</sup>			
300-1,500	0.0128 R <sup>2</sup> f			
1,500-100,000	19.2R <sup>2</sup>			

### 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.

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

### 1.3 Calculated Result

Radio	Prediction	Max. Field	Antenna	Output	Tune-Up	ERP	
Access	Frequency	Strength	Gain	Power	Power	ERP	
Technology	(MHz)	(dBuV/m)	(dBi)	(dBm)	(dBm)	(dBm)	
SRD	908.42	94.49	-4.28	3.51	4.00	-2.43	

	Frequency	Option	Min. Distance	Max.	Power	Exposure Limit	Ratio	Result
	(MHz)	Option	(cm)	(dBm)	(mW)	(mW)	Kallo	Pass/Fail
Ī	908.42	В	0.5	4.00	2.51	8.22	0.31	Pass

Note: 1. EIRP= E-104.8+20logD; Output Power=EIRP- Antenna Gain; ERP=EIRP-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	Ratio 1	Ratio 2	Ratio 3	Simultaneous	Limit	Result	
Technology				Ratio		Pass/Fail	
1	/	1	1	1	/	1	

Result: Pass