

# 1. RF Exposure Requirements

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## 1.1 General Information

### Client Information

|                          |                                             |
|--------------------------|---------------------------------------------|
| Applicant:               | Shelly Europe Ltd.                          |
| Address of applicant:    | 103 Cherni Vrah Blvd., 1407 Sofia, Bulgaria |
| Manufacturer:            | Shelly Europe Ltd.                          |
| Address of manufacturer: | 103 Cherni Vrah Blvd., 1407 Sofia, Bulgaria |

### General Description of EUT:

|                   |                                                                                   |
|-------------------|-----------------------------------------------------------------------------------|
| Product Name:     | Smart energy measurement instrument                                               |
| Trade Name        |  |
| Model No.:        | Shelly Pro 3EM-400                                                                |
| Adding Model(s):  | Shelly Pro 3EM                                                                    |
| Rated Voltage:    | AC100-260V                                                                        |
| Battery Capacity: | /                                                                                 |
| FCC ID:           | 2BDC6-SHELLYPRO3EMS                                                               |
| Equipment Type:   | Mobile device                                                                     |

### Technical Characteristics of EUT:

#### Bluetooth

|                       |                     |
|-----------------------|---------------------|
| Bluetooth Version:    | V4.2 (BLE mode)     |
| Frequency Range:      | 2402-2480MHz        |
| RF Output Power:      | 4.54dBm (Conducted) |
| Data Rate:            | 1Mbps               |
| Modulation:           | GFSK                |
| Quantity of Channels: | 40                  |
| Channel Separation:   | 2MHz                |
| Type of Antenna:      | PCB antenna         |
| Antenna Gain:         | 2.14dBi             |

#### Wi-Fi

|                       |                                                                      |
|-----------------------|----------------------------------------------------------------------|
| Support Standards:    | 802.11b, 802.11g, 802.11n                                            |
| Frequency Range:      | 2412-2462MHz for 802.11b/g/n(HT20)<br>2422-2452MHz for 802.11n(HT40) |
| RF Output Power:      | 18.28dBm (Conducted)                                                 |
| Type of Modulation:   | CCK, OFDM, QPSK, BPSK, 16QAM, 64QAM                                  |
| Quantity of Channels: | 11 for 802.11b/g/n(HT20); 7 for 802.11n(HT40)                        |
| Channel Separation:   | 5MHz                                                                 |
| Type of Antenna:      | PCB Antenna                                                          |
| Antenna Gain:         | 2.13dBi                                                              |

## 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  $\lambda$  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                                                      | $1,920 R^2$           |
| 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                                                 | $19.2 R^2$            |

**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                       | 4.54               | 2.14               | 100            | 5.00                              | 4.99      |
| Wi-Fi                   | 2412                       | 18.28              | 2.13               | 100            | 19.00                             | 18.98     |

| Frequency (MHz) | Option | Min. Distance (cm) | Max. Power (dBm) (mW) |       | Exposure Limit (mW) | Ratio | Result Pass/Fail |
|-----------------|--------|--------------------|-----------------------|-------|---------------------|-------|------------------|
| 2402            | C      | 20.00              | 4.99                  | 3.16  | 768.00              | 0.01  | Pass             |
| 2412            | C      | 20.00              | 18.98                 | 79.07 | 768.00              | 0.10  | 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 |
|-------------------------|---------|---------|--------------------|-------|------------------|
| --                      | --      | --      | --                 | --    | --               |

WIFI and BT is the use the same antenna cannot simultaneous transmission.

Result: Pass