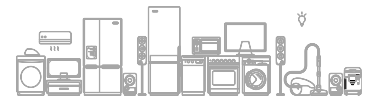


# Shelly MOD1U datasheet

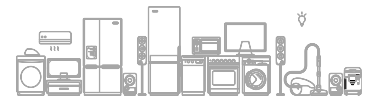
Datasheet version 5

Hardware revision V1.2



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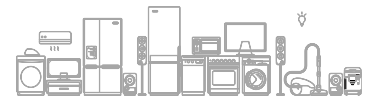
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## Features

### CPU and On-Chip Memory

- ESP32-C3FH4 embedded, 32-bit RISC-V single-core processor, up to 160 MHz
- 384 KB ROM
- 400 KB SRAM (16 KB for cache)
- 8 KB SRAM in RTC
- 4 MB flash in chip package

*The flash is integrated into the chip's package.  
Flash supports more than 100,000  
program/erase cycles and more than 20 years  
data retention time.*

### Wi-Fi

- IEEE 802.11 b/g/n-compliant
- Center frequency range of operating channel:  
2412 ~ 2484 MHz
- Supports 20 MHz, 40 MHz bandwidth in 2.4 GHz  
band
- 1T1R mode with data rate up to 150 Mbps
- Wi-Fi Multimedia (WMM)
- TX/RX A-MPDU, TX/RX A-MSDU
- Immediate Block ACK
- Fragmentation and defragmentation
- Transmit opportunity (TXOP)
- Automatic Beacon monitoring (hardware TSF)
- 4 × virtual Wi-Fi interfaces
- Simultaneous support for Infrastructure BSS in  
Station mode, SoftAP mode, Station + SoftAP  
mode, and promiscuous mode

*Note that when the chip scans in Station mode,  
the SoftAP channel will change along with the  
Station channel*

### Bluetooth®

- Bluetooth LE: Bluetooth 5
- Speed: 125 Kbps, 500 Kbps, 1 Mbps, 2 Mbps
- Advertising extensions
- Multiple advertisement sets
- Channel selection algorithm #2
- Internal co-existence mechanism between Wi-Fi  
and Bluetooth to share the same antenna

### Peripherals

- Up to 8 digital inputs or outputs, usable by the  
firmware platform
- Support for UART communication via JS  
interface, more protocols will be supported in  
the future
- Temperature & humidity sensor support -  
DS18B20 & DHT22

### Integrated Components on Module

- 40 MHz crystal oscillator

### Antenna

- External antenna via a connector:
  - W.FL Series connector from Hirose
  - MHF III connector from I-PEX
  - AMC connector from Amphenol

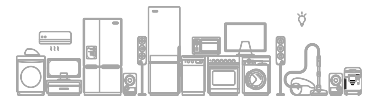
### Operating conditions

- Operating voltage/Power supply: 3.0 ~ 3.6 V
- Operating ambient temperature: -40 ~ 105 °C

*Ambient temperature specifies the  
recommended temperature range of the  
environment immediately outside the module.*

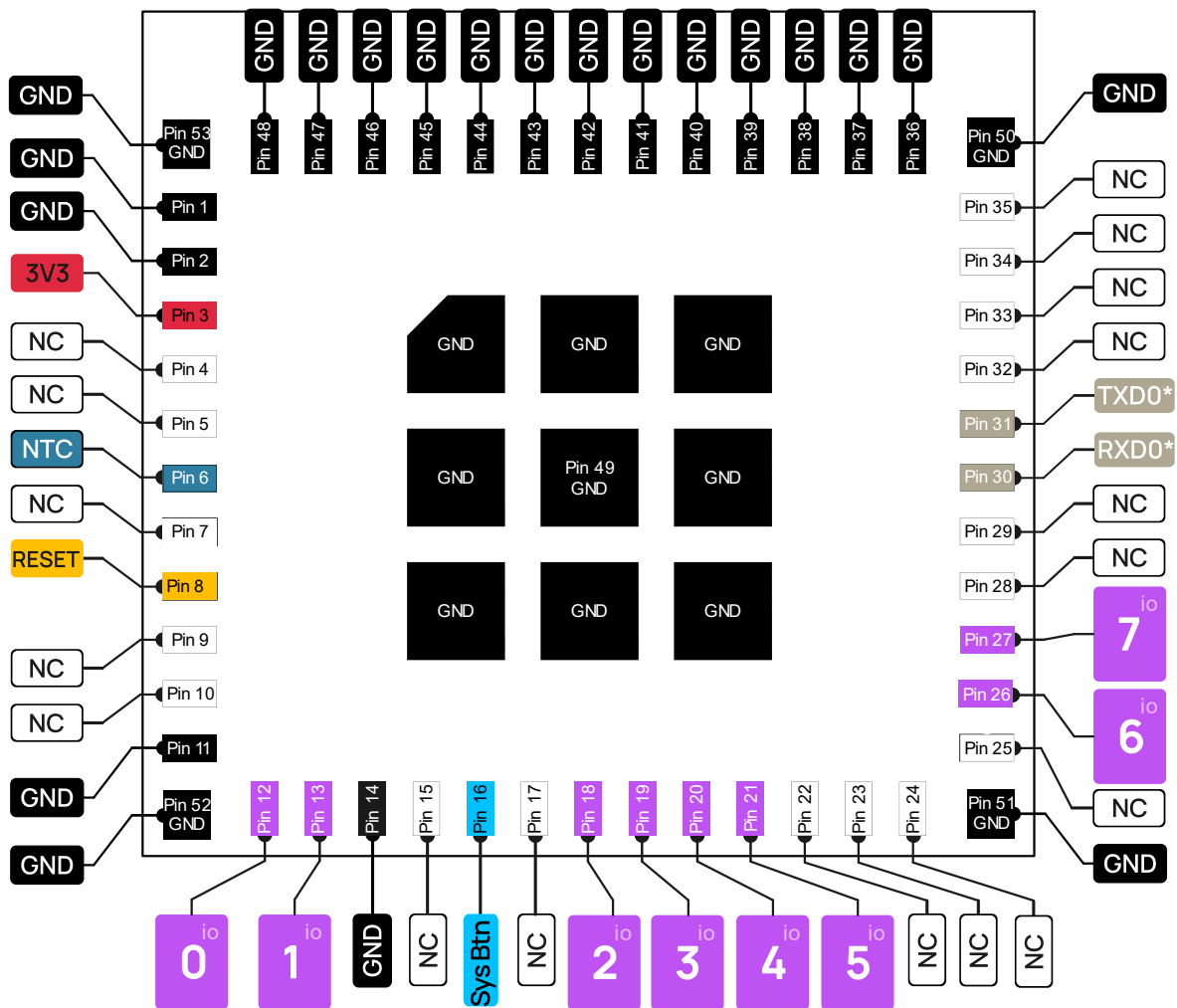
### Certificates

- RoHS



# Module overview

## IO layout

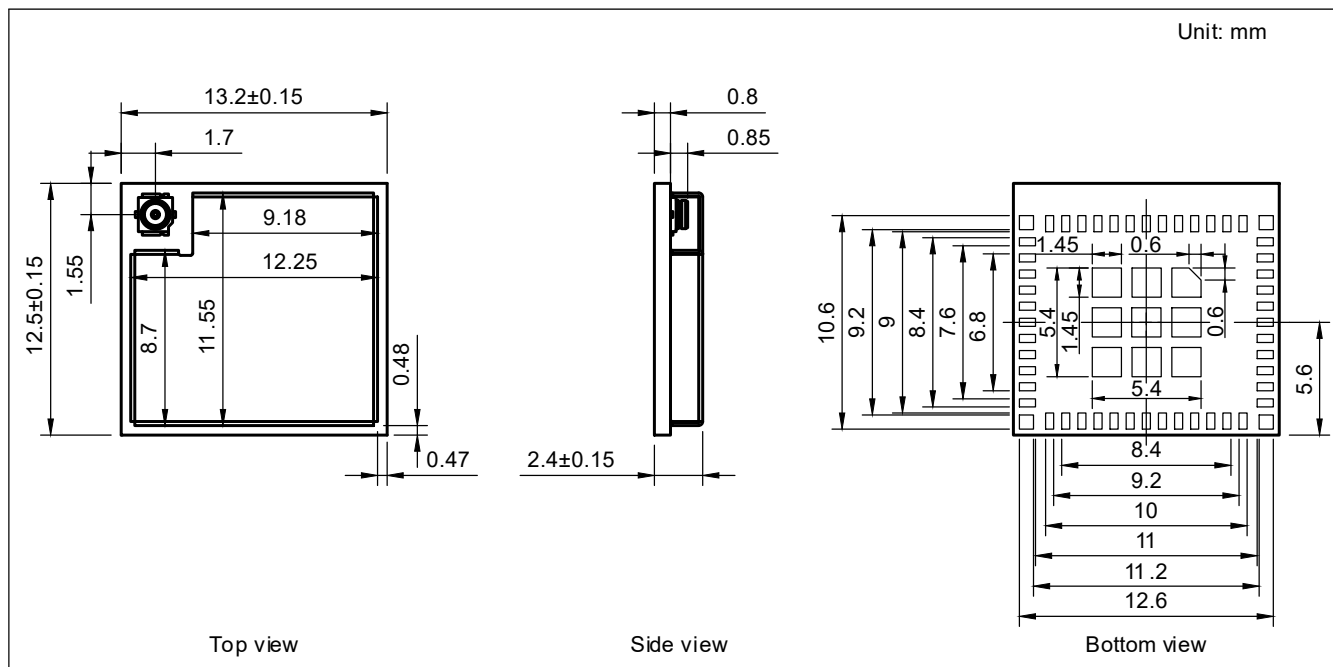


### Special purpose IOs

The U0RXD and the U0TXD are service IOs for system diagnostics and communication, and should not be used for any other purposes.



## Module dimensions





# Electrical Characteristics

## Absolute Maximum Ratings

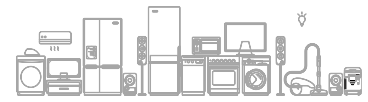
| Symbol             | Parameter            | Min  | Max | Unit |
|--------------------|----------------------|------|-----|------|
| VDD33              | Power supply voltage | -0.3 | 3.6 | V    |
| T <sub>STORE</sub> | Storage temperature  | -40  | 105 | °C   |

Table 1: Absolute Maximum Ratings

## Recommended Operating Conditions

| Symbol           | Parameter                                  | Min | Typ. | Max | Unit |
|------------------|--------------------------------------------|-----|------|-----|------|
| VDD33            | Power supply voltage                       | 3.0 | 3.3  | 3.6 | V    |
| I <sub>VDD</sub> | Current delivered by external power supply | 0.5 | —    | —   | A    |
| T <sub>A</sub>   | Operating ambient temperature              | -40 | —    | 105 | °C   |

Table 2: Recommended Operating Conditions



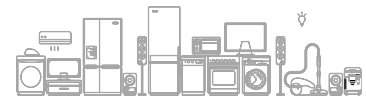
## DC Characteristics (3.3 V, 25 °C)

| Symbol         | Parameter                                                                       | Min                 | Typ. | Max                 | Unit       |
|----------------|---------------------------------------------------------------------------------|---------------------|------|---------------------|------------|
| $C_{IN}$       | Pin capacitance                                                                 | —                   | 2    | —                   | pF         |
| $V_{IH}$       | High-level input voltage                                                        | $0.75 \times VDD^1$ | —    | $VDD^1 + 0.3$       | V          |
| $V_{IL}$       | Low-level input voltage                                                         | -0.3                | —    | $0.25 \times VDD^1$ | V          |
| $I_{IH}$       | High-level input current                                                        | —                   | —    | 50                  | nA         |
| $I_{IL}$       | Low-level input current                                                         | —                   | —    | 50                  | nA         |
| $V_{OH}^2$     | High-level output voltage                                                       | $0.8 \times VDD^1$  | —    | —                   | V          |
| $V_{OL}^2$     | Low-level output voltage                                                        | —                   | —    | $0.1 \times VDD^1$  | V          |
| $I_{OH}$       | High-level source current ( $VDD^1 = 3.3$ V, $V_{OH} > 2.64$ V, PAD_DRIVER = 3) | —                   | 40   | —                   | mA         |
| $I_{OL}$       | Low-level sink current ( $VDD^1 = 3.3$ V, $V_{OL} = 0.495$ V, PAD_DRIVER = 3)   | —                   | 28   | —                   | mA         |
| $R_{PU}$       | Pull-up resistor                                                                | —                   | 45   | —                   | k $\Omega$ |
| $R_{PD}$       | Pull-down resistor                                                              | —                   | 45   | —                   | k $\Omega$ |
| $V_{IH\_nRST}$ | Chip reset release voltage (CHIP_EN voltage is within the specified range)      | $0.75 \times VDD^1$ | —    | $VDD^1 + 0.3$       | V          |
| $V_{IL\_nRST}$ | Chip reset voltage (CHIP_EN voltage is within the specified range)              | -0.3                | —    | $0.25 \times VDD^1$ | V          |

Table 3: DC Characteristics (3.3 V, 25 °C)

<sup>1</sup> VDD - voltage from a power pin of a respective power domain.

<sup>2</sup>  $V_{OH}$  and  $V_{OL}$  are measured using high-impedance load.



# Current Consumption Characteristics

## Current Consumption in Active Mode

The current consumption measurements are taken with a 3.3 V supply at 25 °C ambient temperature.

TX current consumption is rated at a 100% duty cycle.

RX current consumption is rated when the peripherals are disabled and the CPU idle.

### Wi-Fi (2.4 GHz) in Active Mode

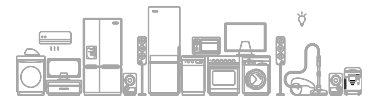
| Work mode           | Description |                                | Peak (mA) |
|---------------------|-------------|--------------------------------|-----------|
| Active (RF working) | TX          | 802.11b, 1 Mbps, @20.5 dBm     | 350       |
|                     |             | 802.11g, 54 Mbps, @18 dBm      | 295       |
|                     |             | 802.11n, HT20, MCS7, @17.5 dBm | 290       |
|                     |             | 802.11n, HT40, MCS7, @17 dBm   | 290       |
|                     | RX          | 802.11b/g/n, HT20              | 82        |
|                     |             | 802.11n, HT40                  | 84        |

Table 4: Current Consumption for Wi-Fi (2.4 GHz) in Active Mode

### Bluetooth LE in Active Mode

| Work Mode           | RF Condition | Description              | Peak (mA) |
|---------------------|--------------|--------------------------|-----------|
| Active (RF working) | TX           | Bluetooth LE @ 20.0 dBm  | 340       |
|                     |              | Bluetooth LE @ 9.0 dBm   | 190       |
|                     |              | Bluetooth LE 0 dBm       | 170       |
|                     |              | Bluetooth LE @ -15.0 dBm | 100       |
|                     | RX           | Bluetooth LE             | 86        |

Table 5: Current Consumption for Bluetooth LE in Active Mode



## Current Consumption in Other Modes

### Modem-sleep mode

| Mode                       | CPU Frequency (MHz) | Description    | Typ                                  |                                                  |
|----------------------------|---------------------|----------------|--------------------------------------|--------------------------------------------------|
|                            |                     |                | All Peripherals Clocks Disabled (mA) | All Peripherals Clocks Enabled (mA) <sup>1</sup> |
| Modem-sleep <sup>2,3</sup> | 160                 | CPU is idle    | 16                                   | 21                                               |
|                            |                     | CPU is running | 23                                   | 28                                               |
|                            | 80                  | CPU is idle    | 13                                   | 18                                               |
|                            |                     | CPU is running | 17                                   | 22                                               |

Table 6: Current Consumption in Modem-sleep mode

<sup>1</sup> In practice, the current consumption might be different depending on which peripherals are enabled.

<sup>2</sup> In Modem-sleep mode, Wi-Fi is clock gated.

<sup>3</sup> In Modem-sleep mode, the consumption might be higher when accessing flash. For a flash rated at 80 Mbit/s, in SPI 2-line mode the consumption is 10 mA.

### Low-power modes

| Mode        | Description                                                          | Typ (µA) |
|-------------|----------------------------------------------------------------------|----------|
| Light-sleep | VDD_SPI and Wi-Fi are powered down, and all GPIOs are high-impedance | 130      |
| Deep-sleep  | RTC timer + RTC memory                                               | 5        |
| Power off   | CHIP_EN is set to low level, the chip is powered off                 | 1        |

Table 7: Current Consumption in Low-power Modes



## RF Characteristics

The RF data is measured at the antenna port, where RF cable is connected, including the front-end loss. The external antennas used for the tests on the modules with external antenna connectors have an impedance of 50  $\Omega$ .

Devices should operate in the center frequency range allocated by regional regulatory authorities.

Unless otherwise stated, the RF tests are conducted with a 3.3 V ( $\pm 5\%$ ) supply at 25 °C ambient temperature.

### Wi-Fi Radio

| Name                                        | Description      |
|---------------------------------------------|------------------|
| Center frequency range of operating channel | 2412 ~ 2484 MHz  |
| Wi-Fi wireless standard                     | IEEE 802.11b/g/n |

Table 8: Wi-Fi RF Characteristics



## Wi-Fi RF Transmitter (TX) Characteristics

### TX Power with Spectral Mask and EVM Meeting 802.11 Standards

| Rate                | Min (dBm) | Typ (dBm) | Max (dBm) |
|---------------------|-----------|-----------|-----------|
| 802.11b, 1 Mbps     | —         | 20.5      | —         |
| 802.11b, 11 Mbps    | —         | 20.5      | —         |
| 802.11g, 6 Mbps     | —         | 20.0      | —         |
| 802.11g, 54 Mbps    | —         | 18.0      | —         |
| 802.11n, HT20, MCS0 | —         | 19.0      | —         |
| 802.11n, HT20, MCS7 | —         | 17.5      | —         |
| 802.11n, HT40, MCS0 | —         | 18.5      | —         |
| 802.11n, HT40, MCS7 | —         | 17.0      | —         |

Table 9: TX Power with Spectral Mask and EVM Meeting 802.11 Standards

### TX EVM Test

| Rate                           | Min (dB) | Typ (dB) | Limit (dB) |
|--------------------------------|----------|----------|------------|
| 802.11b, 1 Mbps, 20.5 dBm      | —        | -24.5    | -10        |
| 802.11b, 11 Mbps, @20.5 dBm    | —        | -25.0    | -10        |
| 802.11g, 6 Mbps, @20 dBm       | —        | -23.0    | -5         |
| 802.11g, 54 Mbps, 18 dBm       | —        | -28.0    | -25        |
| 802.11n, HT20, MCS0, @19 dBm   | —        | -23.5    | -5         |
| 802.11n, HT20, MCS7, @17.5 dBm | —        | -30.5    | -27        |
| 802.11n, HT40, MCS0, 18.5 dBm  | —        | -26.5    | -5         |
| 802.11n, HT40, MCS7, @17 dBm   | —        | -30.5    | -27        |

Table 10: TX EVM Test<sup>†</sup>

<sup>†</sup> EVM is measured at the corresponding typical TX power provided in table TX Power with Spectral Mask and EVM Meeting 802.11 Standards above.



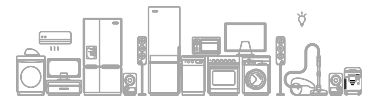
## Wi-Fi RF Receiver (RX) Characteristics

For RX tests, the PER (packet error rate) limit is 8% for 802.11b, and 10% for 802.11g/n.

### RX Sensitivity

| Rate                | Min (dBm) | Typ (dBm) | Max (dBm) |
|---------------------|-----------|-----------|-----------|
| 802.11b, 1 Mbps     | —         | -98.0     | —         |
| 802.11b, 2 Mbps     | —         | -96.0     | —         |
| 802.11b, 5.5 Mbps   | —         | -93.0     | —         |
| 802.11b, 11 Mbps    | —         | -88.6     | —         |
| 802.11g, 6 Mbps     | —         | -92.8     | —         |
| 802.11g, 9 Mbps     | —         | -91.8     | —         |
| 802.11g, 12 Mbps    | —         | -90.8     | —         |
| 802.11g, 18 Mbps    | —         | -88.4     | —         |
| 802.11g, 24 Mbps    | —         | -85.4     | —         |
| 802.11g, 36 Mbps    | —         | -82.0     | —         |
| 802.11g, 48 Mbps    | —         | -77.8     | —         |
| 802.11g, 54 Mbps    | —         | -76.2     | —         |
| 802.11n, HT20, MCS0 | —         | -92.6     | —         |
| 802.11n, HT20, MCS1 | —         | -90.6     | —         |
| 802.11n, HT20, MCS2 | —         | -88.0     | —         |
| 802.11n, HT20, MCS3 | —         | -84.8     | —         |
| 802.11n, HT20, MCS4 | —         | -81.6     | —         |
| 802.11n, HT20, MCS5 | —         | -77.4     | —         |
| 802.11n, HT20, MCS6 | —         | -75.6     | —         |
| 802.11n, HT20, MCS7 | —         | -74.4     | —         |
| 802.11n, HT40, MCS0 | —         | -90.0     | —         |
| 802.11n, HT40, MCS1 | —         | -87.6     | —         |
| 802.11n, HT40, MCS2 | —         | -84.8     | —         |
| 802.11n, HT40, MCS3 | —         | -81.8     | —         |
| 802.11n, HT40, MCS4 | —         | -78.4     | —         |
| 802.11n, HT40, MCS5 | —         | -74.2     | —         |
| 802.11n, HT40, MCS6 | —         | -72.6     | —         |
| 802.11n, HT40, MCS7 | —         | -71.2     | —         |

Table 11: RX Sensitivity



## Maximum RX level

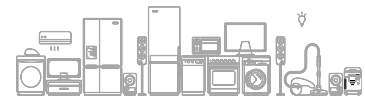
| Rate                | Min (dBm) | Typ (dBm) | Max (dBm) |
|---------------------|-----------|-----------|-----------|
| 802.11b, 1 Mbps     | —         | 5         | —         |
| 802.11b, 11 Mbps    | —         | 5         | —         |
| 802.11g, 6 Mbps     | —         | 5         | —         |
| 802.11g, 54 Mbps    | —         | 0         | —         |
| 802.11n, HT20, MCS0 | —         | 5         | —         |
| 802.11n, HT20, MCS7 | —         | 0         | —         |
| 802.11n, HT40, MCS0 | —         | 5         | —         |
| 802.11n, HT40, MCS7 | —         | 0         | —         |

Table 12: Maximum RX level

## RX Adjacent channel rejection

| Rate                | Min (dB) | Typ (dB) | Max (dB) |
|---------------------|----------|----------|----------|
| 802.11b, 1 Mbps     | —        | 35       | —        |
| 802.11b, 11 Mbps    | —        | 35       | —        |
| 802.11g, 6 Mbps     | —        | 31       | —        |
| 802.11g, 54 Mbps    | —        | 14       | —        |
| 802.11n, HT20, MCS0 | —        | 31       | —        |
| 802.11n, HT20, MCS7 | —        | 13       | —        |
| 802.11n, HT40, MCS0 | —        | 19       | —        |
| 802.11n, HT40, MCS7 | —        | 8        | —        |

Table 13: RX Adjacent Channel Rejection



# Bluetooth 5 (LE) Radio

## Bluetooth LE RF Transmitter (TX) Characteristics

### Bluetooth LE RF Characteristics

| Name                                        | Description      |
|---------------------------------------------|------------------|
| Center frequency range of operating channel | 2402 ~ 2480 MHz  |
| RF transmit power range                     | -24.0 ~ 20.0 dBm |

Table 14: Bluetooth LE RF characteristics

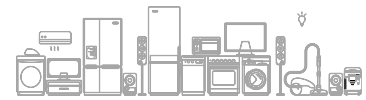
### Bluetooth LE - Transmitter Characteristics - 1 Mbps

| Parameter                  | Description                                       | Min | Typ    | Max | Unit |
|----------------------------|---------------------------------------------------|-----|--------|-----|------|
| In-band emissions          | $F = F_0 \pm 2 \text{ MHz}$                       | —   | -37.62 | —   | dBm  |
|                            | $F = F_0 \pm 3 \text{ MHz}$                       | —   | -41.95 | —   | dBm  |
|                            | $F = F_0 \pm > 3 \text{ MHz}$                     | —   | -44.48 | —   | dBm  |
| Modulation characteristics | $\Delta f_{1\text{avg}}$                          | —   | 245.00 | —   | kHz  |
|                            | $\Delta f_{2\text{max}}$                          | —   | 208.00 | —   | kHz  |
|                            | $\Delta f_{2\text{avg}} / \Delta f_{1\text{avg}}$ | —   | 0.93   | —   | —    |
| Carrier frequency offset   | —                                                 | —   | -9.00  | —   | kHz  |
| Carrier frequency drift    | $ f_0 - f_n _{n=2,3,4,\dots,k}$                   | —   | 1.17   | —   | kHz  |
|                            | $ f_1 - f_0 $                                     | —   | 0.30   | —   | kHz  |
|                            | $ f_n - f_{n-5} _{n=6,7,8,\dots,k}$               | —   | 4.90   | —   | kHz  |

Table 15: Bluetooth LE - Transmitter Characteristics - 1 Mbps

### Bluetooth LE - Transmitter Characteristics - 2 Mbps

| Parameter                  | Description                                       | Min | Typ    | Max | Unit |
|----------------------------|---------------------------------------------------|-----|--------|-----|------|
| In-band emissions          | $F = F_0 \pm 4 \text{ MHz}$                       | —   | -43.55 | —   | dBm  |
|                            | $F = F_0 \pm 5 \text{ MHz}$                       | —   | -45.26 | —   | dBm  |
|                            | $F = F_0 \pm > 5 \text{ MHz}$                     | —   | -47.00 | —   | dBm  |
| Modulation characteristics | $\Delta f_{1\text{avg}}$                          | —   | 497.00 | —   | kHz  |
|                            | $\Delta f_{2\text{max}}$                          | —   | 398.00 | —   | kHz  |
|                            | $\Delta f_{2\text{avg}} / \Delta f_{1\text{avg}}$ | —   | 0.95   | —   | —    |
| Carrier frequency offset   | —                                                 | —   | -9.00  | —   | kHz  |



|                         |                                  |   |      |   |     |
|-------------------------|----------------------------------|---|------|---|-----|
| Carrier frequency drift | $ f_0 - f_n _{n=2,3,4,...k}$     | — | 0.46 | — | kHz |
|                         | $ f_1 - f_0 $                    | — | 0.70 | — | kHz |
|                         | $ f_n - f_{n-5} _{n=6,7,8,...k}$ | — | 6.80 | — | kHz |

Table 16: Bluetooth LE - Transmitter Characteristics - 2 Mbps

## Bluetooth LE - Transmitter Characteristics - 125 Kbps

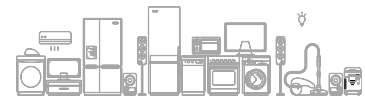
| Parameter                  | Description                      | Min | Typ    | Max | Unit |
|----------------------------|----------------------------------|-----|--------|-----|------|
| In-band emissions          | $F = F_0 \pm 2 \text{ MHz}$      | —   | -37.90 | —   | dBm  |
|                            | $F = F_0 \pm 3 \text{ MHz}$      | —   | -41.00 | —   | dBm  |
|                            | $F = F_0 \pm > 3 \text{ MHz}$    | —   | -42.50 | —   | dBm  |
| Modulation characteristics | $\Delta f_{1\text{avg}}$         | —   | 252.00 | —   | kHz  |
|                            | $\Delta f_{1\text{max}}$         | —   | 200.00 | —   | kHz  |
| Carrier frequency offset   | —                                | —   | -13.70 | —   | kHz  |
| Carrier frequency drift    | $ f_0 - f_n _{n=1,2,3,...k}$     | —   | 1.52   | —   | kHz  |
|                            | $ f_0 - f_3 $                    | —   | 0.65   | —   | kHz  |
|                            | $ f_n - f_{n-3} _{n=7,8,9,...k}$ | —   | 0.70   | —   | kHz  |

Table 17: Bluetooth LE - Transmitter Characteristics - 125 Kbps

## Bluetooth LE - Transmitter Characteristics - 500 Kbps

| Parameter                  | Description                      | Min | Typ    | Max | Unit |
|----------------------------|----------------------------------|-----|--------|-----|------|
| In-band emissions          | $F = F_0 \pm 2 \text{ MHz}$      | —   | -37.90 | —   | dBm  |
|                            | $F = F_0 \pm 3 \text{ MHz}$      | —   | -41.30 | —   | dBm  |
|                            | $F = F_0 \pm > 3 \text{ MHz}$    | —   | -42.80 | —   | dBm  |
| Modulation characteristics | $\Delta f_{2\text{avg}}$         | —   | 220.00 | —   | kHz  |
|                            | $\Delta f_{2\text{max}}$         | —   | 205.00 | —   | kHz  |
| Carrier frequency offset   | —                                | —   | -11.90 | —   | kHz  |
| Carrier frequency drift    | $ f_0 - f_n _{n=1,2,3,...k}$     | —   | 1.37   | —   | kHz  |
|                            | $ f_0 - f_3 $                    | —   | 1.09   | —   | kHz  |
|                            | $ f_n - f_{n-3} _{n=7,8,9,...k}$ | —   | 0.51   | —   | kHz  |

Table 18: Bluetooth LE - Transmitter Characteristics - 500 Kbps



## Bluetooth LE RF Receiver (RX) Characteristics

### Bluetooth LE - Receiver Characteristics - 1 Mbps

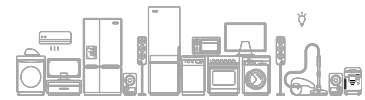
| Parameter                           | Description                            | Min | Typ | Max | Unit |
|-------------------------------------|----------------------------------------|-----|-----|-----|------|
| Sensitivity @30.8% PER              | —                                      | —   | -96 | —   | dBm  |
| Maximum received signal @30.8% PER  | —                                      | —   | 10  | —   | dBm  |
| Co-channel C/I                      | —                                      | —   | 8   | —   | dB   |
| Adjacent channel selectivity C/I    | $F = F_0 + 1 \text{ MHz}$              | —   | -4  | —   | dB   |
|                                     | $F = F_0 - 1 \text{ MHz}$              | —   | -3  | —   | dB   |
|                                     | $F = F_0 + 2 \text{ MHz}$              | —   | -32 | —   | dB   |
|                                     | $F = F_0 - 2 \text{ MHz}$              | —   | -36 | —   | dB   |
|                                     | $F \geq F_0 + 3 \text{ MHz}^{(1)}$     | —   | —   | —   | dB   |
|                                     | $F \leq F_0 - 3 \text{ MHz}$           | —   | -39 | —   | dB   |
| Image frequency                     | —                                      | —   | -29 | —   | dB   |
| Adjacent channel to image frequency | $F = F_{\text{image}} + 1 \text{ MHz}$ | —   | -38 | —   | dB   |
|                                     | $F = F_{\text{image}} - 1 \text{ MHz}$ | —   | -34 | —   | dB   |
| Out-of-band blocking performance    | 30 MHz ~ 2000 MHz                      | —   | -9  | —   | dBm  |
|                                     | 2003 MHz ~ 2399 MHz                    | —   | -18 | —   | dBm  |
|                                     | 2484 MHz ~ 2997 MHz                    | —   | -16 | —   | dBm  |
|                                     | 3000 MHz ~ 12.75 GHz                   | —   | -6  | —   | dBm  |
| Intermodulation                     | —                                      | —   | -44 | —   | dBm  |

Table 19: Bluetooth LE - Receiver Characteristics - 1 Mbps

<sup>1</sup> Refer to the value of Adjacent channel to image frequency when  $F = F_{\text{image}} - 1 \text{ MHz}$

### Bluetooth LE - Receiver Characteristics - 2 Mbps

| Parameter                          | Description                     | Min | Typ | Max | Unit |
|------------------------------------|---------------------------------|-----|-----|-----|------|
| Sensitivity @30.8% PER             | —                               | —   | -93 | —   | dBm  |
| Maximum received signal @30.8% PER | —                               | —   | 0   | —   | dBm  |
| Co-channel C/I                     | —                               | —   | 10  | —   | dB   |
| Adjacent channel selectivity C/I   | $F = F_0 + 2 \text{ MHz}$       | —   | -7  | —   | dB   |
|                                    | $F = F_0 - 2 \text{ MHz}$       | —   | -7  | —   | dB   |
|                                    | $F = F_0 + 4 \text{ MHz}^{(1)}$ | —   | —   | —   | dB   |
|                                    | $F = F_0 - 4 \text{ MHz}$       | —   | -34 | —   | dB   |
|                                    | $F \geq F_0 + 6 \text{ MHz}$    | —   | -39 | —   | dB   |



|                                     |                                       |   |     |   |     |
|-------------------------------------|---------------------------------------|---|-----|---|-----|
|                                     | $F \leq F_0 - 6 \text{ MHz}$          | — | -39 | — | dB  |
| Image frequency                     | —                                     | — | -27 | — | dB  |
| Adjacent channel to image frequency | $F = F_{image} + 2 \text{ MHz}$       | — | -39 | — | dB  |
|                                     | $F = F_{image} - 2 \text{ MHz}^{(2)}$ | — | —   | — | dB  |
| Out-of-band blocking performance    | 30 MHz ~ 2000 MHz                     | — | -17 | — | dBm |
|                                     | 2003 MHz ~ 2399 MHz                   | — | -19 | — | dBm |
|                                     | 2484 MHz ~ 2997 MHz                   | — | -16 | — | dBm |
|                                     | 3000 MHz ~ 12.75 GHz                  | — | -22 | — | dBm |
| Intermodulation                     | —                                     | — | -40 | — | dBm |

Table 20: Bluetooth LE - Receiver Characteristics - 2 Mbps

<sup>1</sup> Refer to the value of Image frequency.

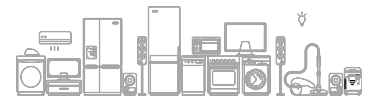
<sup>2</sup> Refer to the value of Adjacent channel selectivity C/I when  $F = F_0 + 2 \text{ MHz}$

## Bluetooth LE - Receiver Characteristics - 125 Kbps

| Parameter                           | Description                        | Min | Typ  | Max | Unit |
|-------------------------------------|------------------------------------|-----|------|-----|------|
| Sensitivity @30.8% PER              | —                                  | —   | -104 | —   | dBm  |
| Maximum received signal @30.8% PER  | —                                  | —   | 10   | —   | dBm  |
| Co-channel C/I                      | —                                  | —   | 2    | —   | dB   |
| Adjacent channel selectivity C/I    | $F = F_0 + 1 \text{ MHz}$          | —   | -6   | —   | dB   |
|                                     | $F = F_0 - 1 \text{ MHz}$          | —   | -5   | —   | dB   |
|                                     | $F = F_0 + 2 \text{ MHz}$          | —   | -40  | —   | dB   |
|                                     | $F = F_0 - 2 \text{ MHz}$          | —   | -42  | —   | dB   |
|                                     | $F \geq F_0 + 3 \text{ MHz}^{(1)}$ | —   | —    | —   | dB   |
|                                     | $F \leq F_0 - 3 \text{ MHz}$       | —   | -46  | —   | dB   |
| Image frequency                     | —                                  | —   | -34  | —   | dB   |
| Adjacent channel to image frequency | $F = F_{image} + 1 \text{ MHz}$    | —   | -44  | —   | dB   |
|                                     | $F = F_{image} - 1 \text{ MHz}$    | —   | -37  | —   | dB   |

Table 21: Bluetooth LE - Receiver Characteristics - 125 Kbps

<sup>1</sup> Refer to the value of Adjacent channel to image frequency when  $F = F_{image} - 1 \text{ MHz}$

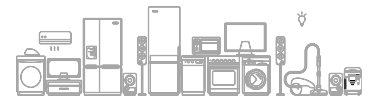


## Bluetooth LE - Receiver Characteristics - 500 Kbps

| Parameter                           | Description                            | Min | Typ | Max | Unit |
|-------------------------------------|----------------------------------------|-----|-----|-----|------|
| Sensitivity @30.8% PER              | —                                      | —   | -99 | —   | dBm  |
| Maximum received signal @30.8% PER  | —                                      | —   | 10  | —   | dBm  |
| Co-channel C/I                      | —                                      | —   | 3   | —   | dB   |
| Adjacent channel selectivity C/I    | $F = F_0 + 1 \text{ MHz}$              | —   | -5  | —   | dB   |
|                                     | $F = F_0 - 1 \text{ MHz}$              | —   | -7  | —   | dB   |
|                                     | $F = F_0 + 2 \text{ MHz}$              | —   | -39 | —   | dB   |
|                                     | $F = F_0 - 2 \text{ MHz}$              | —   | -40 | —   | dB   |
|                                     | $F \geq F_0 + 3 \text{ MHz}^{(1)}$     | —   | —   | —   | dB   |
|                                     | $F \leq F_0 - 3 \text{ MHz}$           | —   | -40 | —   | dB   |
| Image frequency                     | —                                      | —   | -34 | —   | dB   |
| Adjacent channel to image frequency | $F = F_{\text{image}} + 1 \text{ MHz}$ | —   | -43 | —   | dB   |
|                                     | $F = F_{\text{image}} - 1 \text{ MHz}$ | —   | -38 | —   | dB   |

Table 22: Bluetooth LE - Receiver Characteristics - 500 Kbps

<sup>1</sup> Refer to the value of Adjacent channel to image frequency when  $F = F_{\text{image}} - 1 \text{ MHz}$

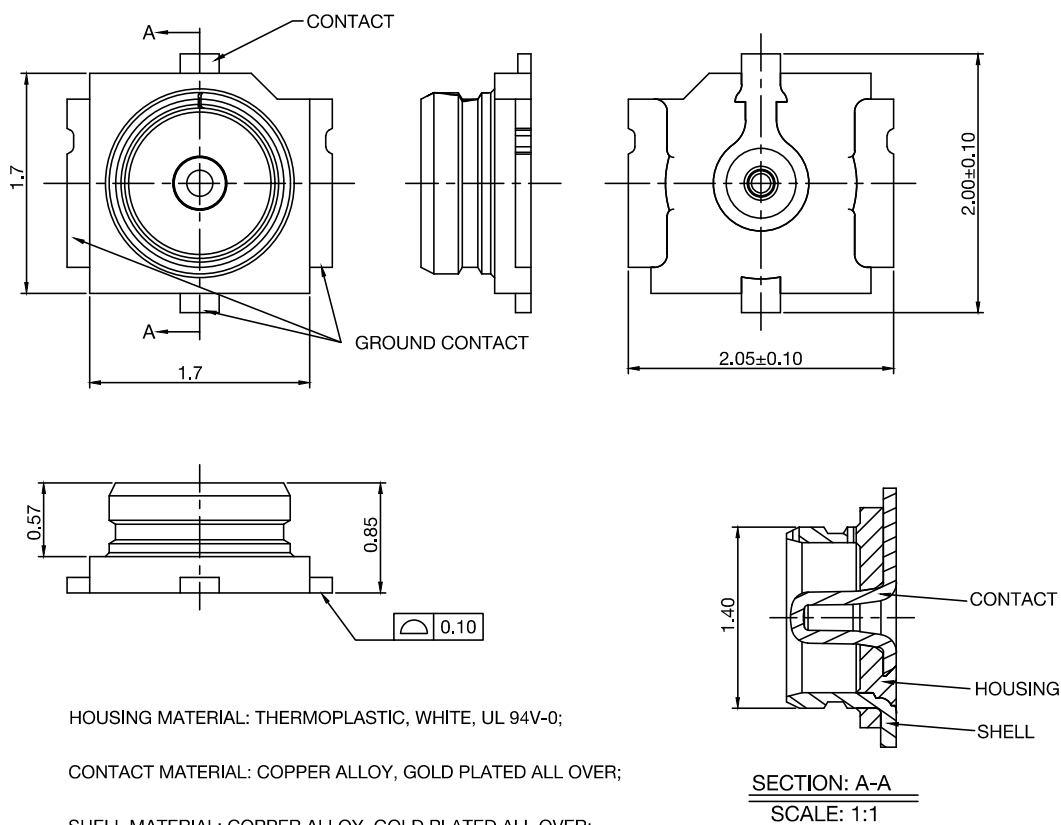


# External antenna connector dimensions

Shelly MOD1U uses the third-generation external antenna connector as shown in Dimensions of External Antenna Connector. This connector is compatible with the following connectors:

- W.FL Series connector from Hirose
- MHF III connector from I-PEX
- AMC connector from Amphenol

Unit: mm  
Tolerance:  $\pm 0.1$  mm



HOUSING MATERIAL: THERMOPLASTIC, WHITE, UL 94V-0;

CONTACT MATERIAL: COPPER ALLOY, GOLD PLATED ALL OVER;

SHELL MATERIAL: COPPER ALLOY, GOLD PLATED ALL OVER;

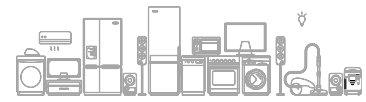
PERFORMANCE:

CONTACT RESISTANCE: 20mOHM Max.

DIELECTRIC WITHSTANDING VOLTAGE: 200V AC FOR 1MINUTE;

INSULATION RESISTANCE: 500MOHM Min.

Figure 1: External antenna connector dimensions.



# PCB Layout Recommendations

## PCB Land pattern

This section provides the following resources for your reference:

- Figures for recommended PCB land patterns with all the dimensions needed for PCB design.

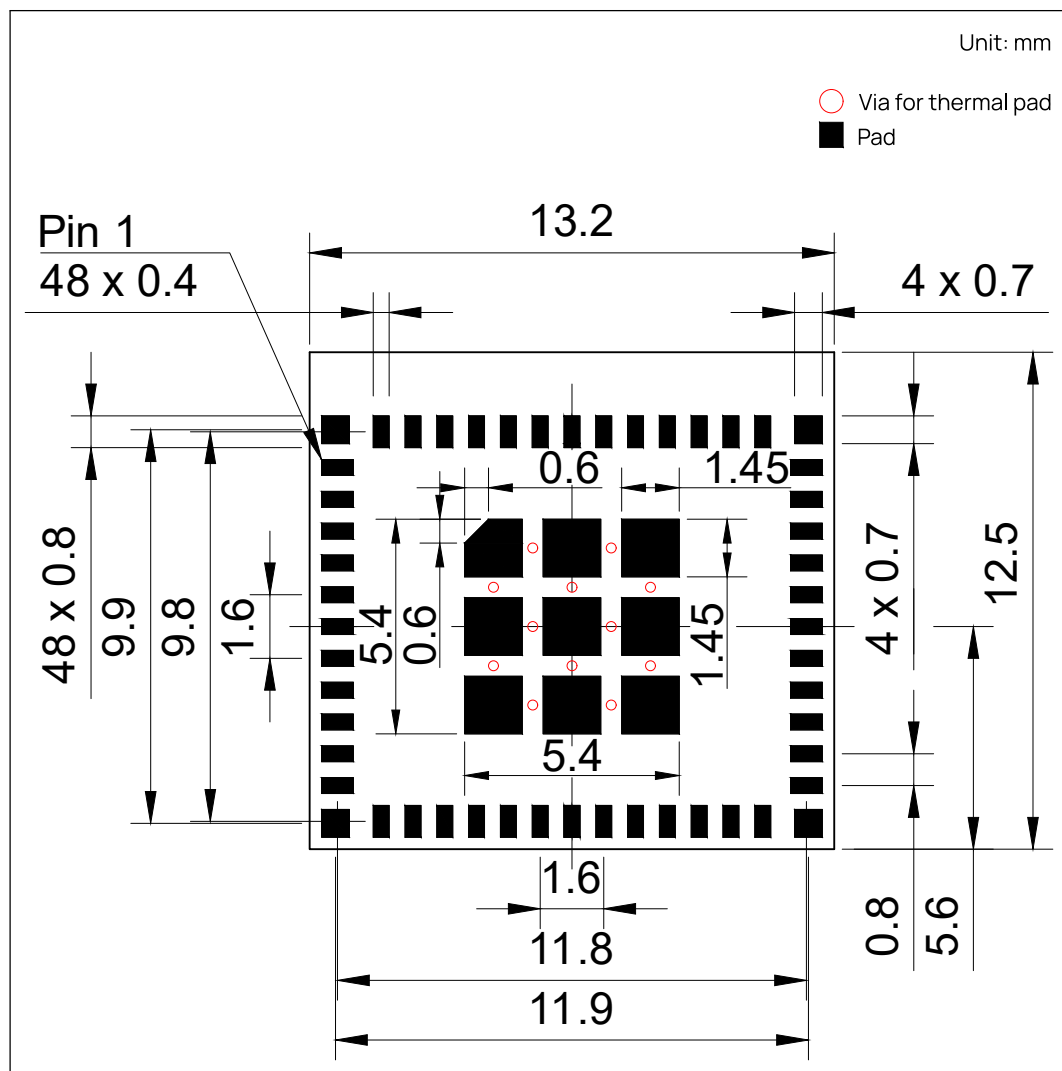


Figure 2: Shelly MOD1U Recommended PCB Land Pattern



## Revision history

| Date       | Version | Release notes                                                                                                                                     |
|------------|---------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| 2026-02-03 | v5      | <ol style="list-style-type: none"><li>1. Added Revision history table.</li><li>2. IOs layout updated to include NTC, and System button.</li></ol> |