

## Tiny Over Voltage and Over Current Protection Switch

### Features

- Input voltage range: 2.5V ~ 28V
- Both IN and ISNS may supply the chip
- Low Quiescent current: 20uA
- Low on-resistance: typical 80mΩ (WLP Only)
- Over voltage protection: Default 6V
- Programmable Over Current Protection
- 10Mbps bit rate communication
- Output Discharge
- Thermal Shutdown
- Robust ESD capability  
HBM > ±6500V  
CDM > ±2000V
- Tiny 4-bumps WLCSP 0.83mm x 0.67mm  
or 2mm x 2mm 8-pin DFN

### Applications

- TWS, AR/VR Device, Smart Band/Watch, Smart IOT etc.

### General Description

YHM2019 over-voltage and over current protection device features a low 80mΩ (TYP) on-resistance integrated MOSFET which actively protect low-voltage systems against voltage supply faults up to +29VDC. An input voltage exceeding the over-voltage threshold will cause the internal MOSFET to turn off, preventing excessive voltage from damaging downstream devices.

The over-voltage protection threshold is default 6V. There are other versions for 2.3V/3.6V/11V/16V/23V OVP and no OVP. YHM2019 device enters hiccup mode when the output load exceeds the over current threshold. The over current threshold is programed by  $R_{SNS}$ .

The device also features 10Mbps bit rate and it supports digital signal communication when the chip is powered by ISNS pin.

YHM2019 is available in tiny 4-bumps WLCSP 0.83mm x 0.67mm with 0.35 pitch or 2mm x 2mm 8-pin DFN with 0.5 pitch, and operates over an ambient temperature range of -40°C to +85°C.

## Tiny Over Voltage and Over Current Protection Switch

### Typical Application

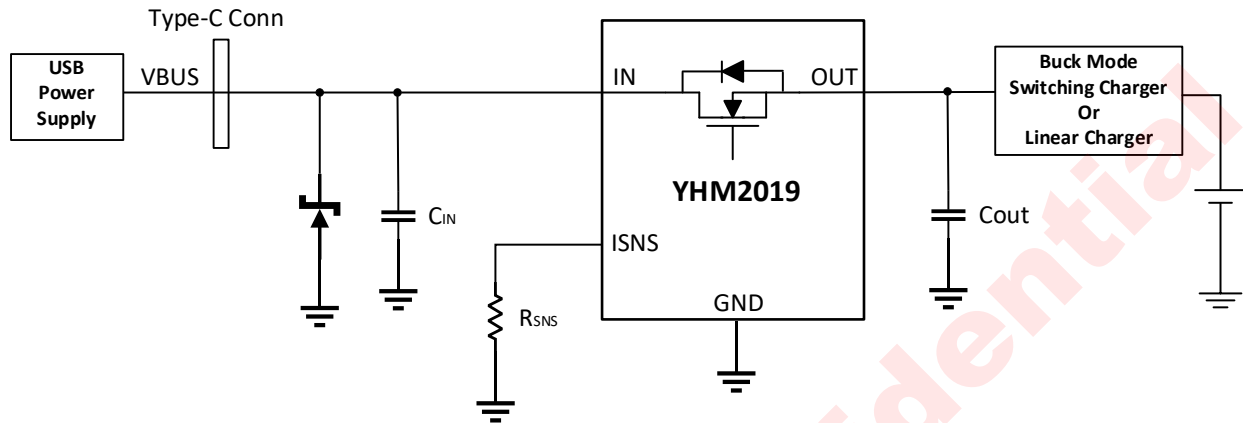


Fig 1. VBUS OVP/OCP Application Diagram

### Internal Block Diagram

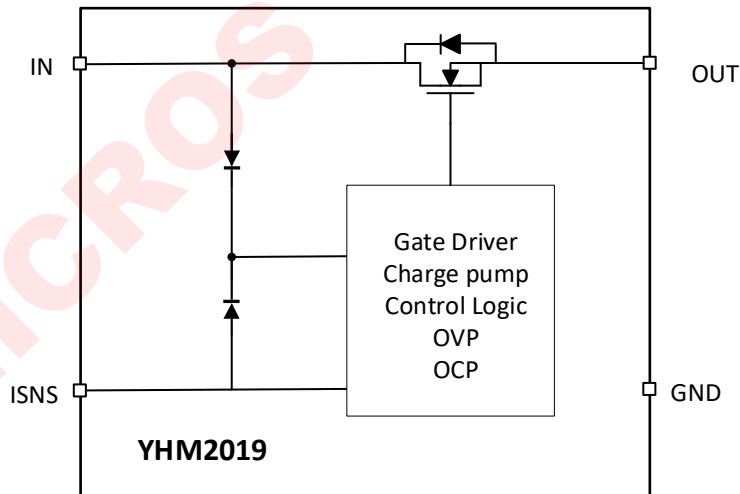


Fig 2. YHM2019 Functional Block Diagram

## Tiny Over Voltage and Over Current Protection Switch

### Pin Configurations

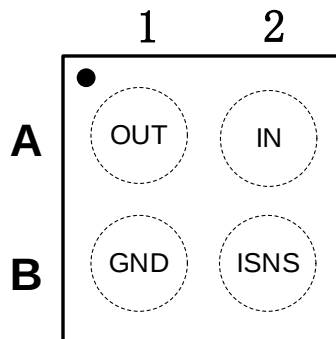


Fig 3. YHM2019 WLP-4 Pin Assignment (Top Through View)

### YHM2019 WLP Pin Descriptions

| Bump | Name | Description                                                                                                |
|------|------|------------------------------------------------------------------------------------------------------------|
| A1   | OUT  | Power Output.                                                                                              |
| A2   | IN   | Power Input.                                                                                               |
| B1   | GND  | Device Ground.                                                                                             |
| B2   | ISNS | Resistor connected to program over current threshold. Or connect to >1.6V GPIO for communication function. |

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### Pin Configurations

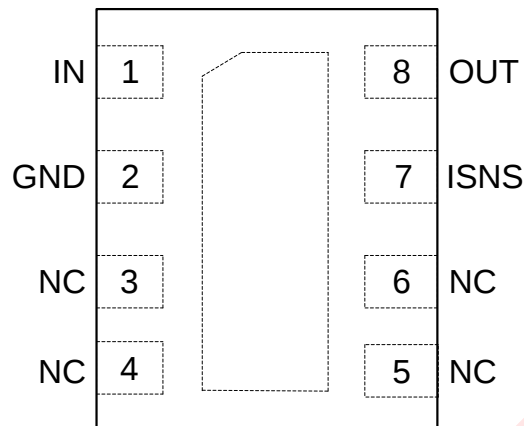


Fig 4. YHM2019 DFN-8 Pin Assignment (Top Through View)

### YHM2019 DFN Pin Descriptions

| Bump | Name | Description                                                                                                |
|------|------|------------------------------------------------------------------------------------------------------------|
| 1    | IN   | Power Input.                                                                                               |
| 2    | GND  | Device Ground.                                                                                             |
| 3    | NC   | Floating or connect to ground.                                                                             |
| 4    | NC   | Floating or connect to ground.                                                                             |
| 5    | NC   | Floating or connect to ground.                                                                             |
| 6    | NC   | Floating or connect to ground.                                                                             |
| 7    | ISNS | Resistor connected to program over current threshold. Or connect to >1.6V GPIO for communication function. |
| 8    | OUT  | Power Output.                                                                                              |

## Tiny Over Voltage and Over Current Protection Switch

### 1. Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

| Symbol        | Parameter                                                           |          | Min. | Max.         | Unit |
|---------------|---------------------------------------------------------------------|----------|------|--------------|------|
| $V_{IN}$      | IN to GND                                                           |          | -0.3 | 29           | V    |
| $V_{OUT}$     | OUT to GND                                                          |          | -0.3 | $V_{IN}+0.3$ | V    |
| $V_{ISNS}$    | ISNS to GND                                                         |          | -0.3 | 6.0          | V    |
| $I_{IN}$      | Input Current (Continuous)                                          |          |      | 2.0          | A    |
| $I_{OUT}$     | Output Current                                                      |          |      | 2.0          | A    |
| $T_{STG}$     | Storage Temperature Range                                           |          | -65  | +150         | °C   |
| $T_J$         | Maximum Junction Temperature                                        |          |      | +150         | °C   |
| $T_L$         | Lead Temperature (Soldering, 10 Seconds)                            |          |      | +260         | °C   |
| $\theta_{JA}$ | Thermal Resistance, Junction-to-Ambient (1-in. Pad of 2-oz. Copper) |          |      | TBD          | °C/W |
| ESD           | Human Body Model, ANSI/ESDA/JEDEC JS-001-2012                       | All Pins | 6.5  |              | kV   |
|               | Charged Device Model, JESD22-C101                                   | All Pins | 2.0  |              |      |

Note 1. Refer to JEDEC JESD51-7, use a 4-layerboard

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### 2. Recommended Operating Conditions

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance.

| Parameters                                                         | Min. | Max. | Unit    |
|--------------------------------------------------------------------|------|------|---------|
| Supply Voltage: $V_{IN}$                                           | 2.5  | 28   | V       |
| Supply Voltage: $V_{ISNS}$                                         | 1.6  | 5.5  | V       |
| Ambient Operating Temperature, $T_A$                               | -40  | 85   | °C      |
| $V_{IN}$ Capacitor (No capacitor for communication function)       | 0.1  |      | $\mu F$ |
| $V_{OUT}$ Load Capacitor (No capacitor for communication function) | 1    | 100  | $\mu F$ |
| Operating Temperature Range                                        | -40  | 85   | °C      |

### 3. Detailed Electrical Characteristics

$V_{IN} = 2.5V$  to  $28V$ ,  $C_{IN} = 0.1\mu F$ ,  $T_A = -40^\circ C$  to  $+85^\circ C$ , typical values are at  $V_{IN} = 5V$ ,  $I_{IN} \leq 2A$ ,  $T_A = +25^\circ C$ , unless otherwise noted.

| PARAMETER                        | SYMBOL         | CONDITION                                                                                                             | MIN  | TYP  | MAX | UNIT       |
|----------------------------------|----------------|-----------------------------------------------------------------------------------------------------------------------|------|------|-----|------------|
| <b>INPUT OPERATION</b>           |                |                                                                                                                       |      |      |     |            |
| Input Voltage Range              | $V_{IN}$       |                                                                                                                       | 2.5  |      | 28  | V          |
| Input Supply Current             | $I_{INQ}$      | $V_{IN} = 5V$ , ISNS Floating                                                                                         |      | 20   |     | $\mu A$    |
| Under-Voltage Lockout            | $V_{IN\_UVLO}$ | $V_{IN}$ rising                                                                                                       |      | 2.35 |     | V          |
| Under-Voltage Lockout Hysteresis | $V_{IN\_HYS}$  |                                                                                                                       |      | 0.1  |     | V          |
| <b>OVER-VOLTAGE PROTECTION</b>   |                |                                                                                                                       |      |      |     |            |
| OVLO Threshold                   | $V_{IN\_OVLO}$ |                                                                                                                       |      | 6    |     | V          |
| Switch On-Resistance (WLP Only)  | $R_{ON}$       | $V_{IN} = 5V$ , $I_{OUT} = 0.2A$ , $T_A = 25^\circ C$                                                                 |      | 80   |     | m $\Omega$ |
|                                  |                | $V_{IN} = 3.3V$ , $I_{OUT} = 0.2A$ , $T_A = 25^\circ C$                                                               |      | 85   |     |            |
|                                  |                | $V_{IN} = 2.5V$ , $I_{OUT} = 0.2A$ , $T_A = 25^\circ C$                                                               |      | 90   |     |            |
| Switch On-Resistance             | $R_{ON}$       | $V_{IN} = 5V$ , $I_{OUT} = 0.2A$ , $T_A = 25^\circ C$                                                                 |      | 120  |     | m $\Omega$ |
| ISNS Supply Current              | $I_{VDDQ}$     | $V_{ISNS} = 1.8V$                                                                                                     |      | 15   |     | $\mu A$    |
| <b>OVER-CURRENT PROTECTION</b>   |                |                                                                                                                       |      |      |     |            |
| OCP Threshold                    | $I_{OCP}$      | $R_{SNS}=25K\Omega$ (DFN Package), $T_A= 25^\circ C$                                                                  |      | 1    |     | A          |
|                                  |                | $R_{SNS}=600\Omega$ (WLP Package), $T_A= 25^\circ C$                                                                  |      | 1    |     | A          |
|                                  |                | Accuracy, $T_A = 0^\circ C$ to $+65^\circ C$                                                                          | -10% |      | 10% |            |
| OCP Response Time                | $t_{OCP}$      |                                                                                                                       |      | 45   |     | $\mu s$    |
| OCP Auto-restart Time            | $t_{OCP\_RST}$ |                                                                                                                       |      | 130  |     | ms         |
| <b>TIMING CHARACTERISTICS</b>    |                |                                                                                                                       |      |      |     |            |
| Debounce Time                    | $t_{DEB}$      | Time from $V_{IN} > V_{IN\_UVLO}$ to the time $V_{OUT}$ starts rising                                                 |      | 10   |     | ms         |
| Switch Turn-On Time              | $t_{ON}$       | $V_{IN} = 5V$ , $R_L = 100\Omega$ , $C_{LOAD} = 100\mu F$ , $V_{OUT}$ from $0.1 \times V_{IN}$ to $0.9 \times V_{IN}$ |      | 0.5  |     | ms         |
| Switch Turn-Off Time             | $t_{OFF}$      | $V_{IN} > V_{IN\_OVLO}$ to $V_{OUT} = 0.1 \times V_{IN}$ , $R_L = 100\Omega$ , $V_{IN}$ rising at $2V/\mu s$          |      | 50   |     | ns         |

**Tiny Over Voltage and Over Current Protection Switch**

| THERMAL SHUTDOWN            |  |  |  |     |  |    |
|-----------------------------|--|--|--|-----|--|----|
| Thermal Shutdown            |  |  |  | 150 |  | °C |
| Thermal Shutdown Hysteresis |  |  |  | 20  |  | °C |

**Note 1:** This parameter is guaranteed by design and characterization; not production tested.

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## Tiny Over Voltage and Over Current Protection Switch

### 4. Detailed Description

#### 4.1 General Introduction

YHM2019 is an over-voltage and over-current protection device with 80mΩ (TYP) on-resistance path, which can actively protect low-voltage systems against voltage supply faults up to +29VDC. An input voltage exceeding the over-voltage threshold will cause the internal MOSFET to turn off, preventing excessive voltage from damaging downstream devices. The over-voltage protection threshold is default 6V.

YHM2019 device enters hiccup mode when the output load exceeds the over current threshold. The over current threshold is programmed by  $R_{SNS}$ .

#### 4.2 UVLO (Under-Voltage Lockout)

The device has a built-in under-voltage lockout (UVLO) circuit. When  $V_{IN}$  is rising, the output remains disconnected from the input until  $V_{IN}$  is above 2.35V (TYP). This circuit has a 100mV hysteresis to provide noise immunity to transient conditions.

#### 4.3 OVLO (Over-Voltage Lockout)

When the voltage at the input exceeds OVLO threshold, the device immediately turns off the internal switch disconnecting the load from the abnormal voltage, preventing damage to downstream components. The OVLO threshold is default 6V, and there are other version for 2.3V, 3.6V, 11V, 16V and 23V OVP.

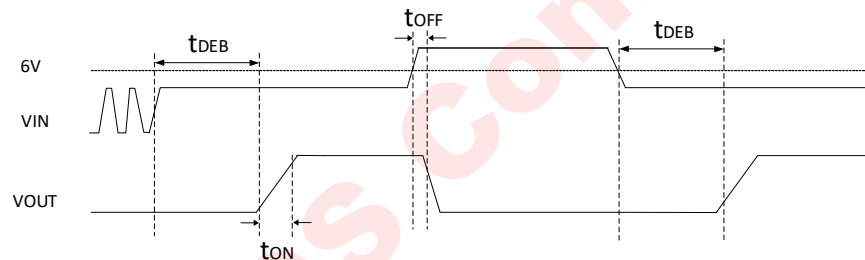


Fig 5. Timing for OVLO trip

#### 4.4 OCP (Over Current Protection)

The chip enters hiccup mode when the output load exceeds the over current threshold. The OCP threshold could be adjusted by single external resistor  $R_{SNS}$  connected between  $ISNS$  and GND using the following equations:

For DFN package,  $R_{SNS} = 25K/I_{OCP}$

For WLP package,  $R_{SNS} = 600/I_{OCP}$

Connect an ADC to  $ISNS$  pin to measure the voltage on  $R_{SNS}$  can get the current flow through the switch. When the output is short to ground, the chip limit the short current to protect the system from damage.

#### 4.5 Communication Functionality

Both  $IN$  and  $ISNS$  may supply YHM2019. YHM2019 would compare the voltage between  $IN$  and  $ISNS$ , and select the higher voltage to power the IC. By this, YHM2019 supports digital signal transmission through  $IN$  and  $OUT$  when the device is powered by  $ISNS$ . Typically,  $ISNS$  is recommended to be driven by GPIO typically. For example,  $V_{ISNS} = 1.8V$  would power YHM2019 even when  $V_{IN} = 0$ . It is necessary to remove input and output capacitor when communication is required.

## Tiny Over Voltage and Over Current Protection Switch

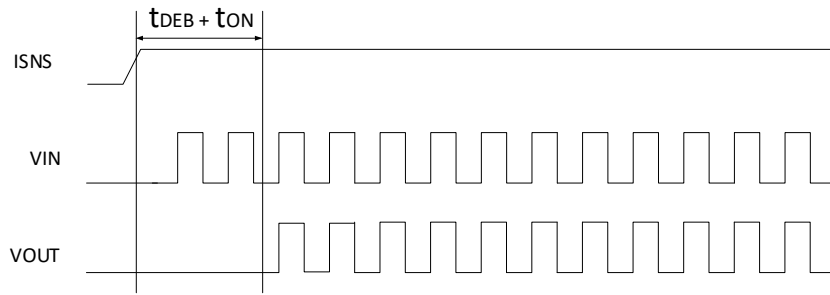


Fig 6. Timing for VIN communication

### 4.6 Thermal Protection

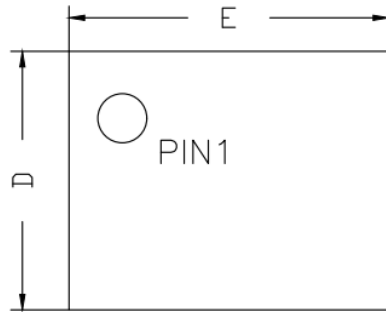
The internal FET turns off when the junction temperature exceeds +150°C (TYP). The device exits thermal shutdown after the junction temperature cools down by 20°C (TYP).

# YHM2019

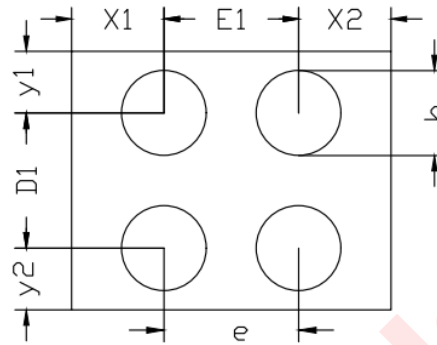
## Tiny Over Voltage and Over Current Protection Switch

### Package Dimensions

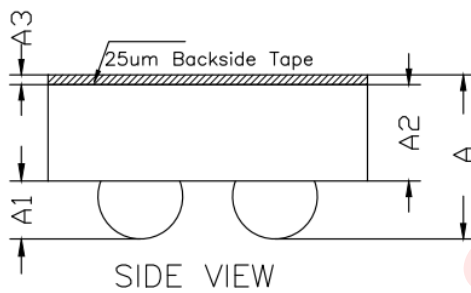
WLCSP-4 0.83mm x 0.67mm x 0.425mm



TOP VIEW  
(MARK SIDE)



BOTTOM VIEW  
(BALL SIDE)



SIDE VIEW

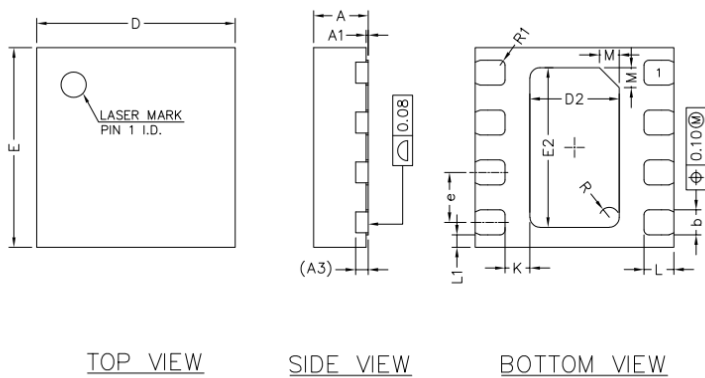
| COMMON DIMENSIONS<br>(UNITS OF MEASURE=MILLIMETER) |       |           |       |
|----------------------------------------------------|-------|-----------|-------|
| SYMBOL                                             | MIN   | NOM       | MAX   |
| A                                                  | 0.380 | 0.425     | 0.470 |
| A1                                                 | 0.130 | 0.150     | 0.170 |
| A2                                                 | 0.225 | 0.250     | 0.275 |
| A3                                                 |       | 0.025     |       |
| D                                                  | 0.650 | 0.670     | 0.690 |
| D1                                                 |       | 0.350BSC  |       |
| E                                                  | 0.810 | 0.830     | 0.850 |
| E1                                                 |       | 0.350BSC  |       |
| b                                                  | 0.200 | 0.220     | 0.240 |
| e                                                  |       | 0.350BSC  |       |
| x1                                                 |       | 0.240 REF |       |
| x2                                                 |       | 0.240 REF |       |
| y1                                                 |       | 0.160 REF |       |
| y2                                                 |       | 0.160 REF |       |

YHM2019

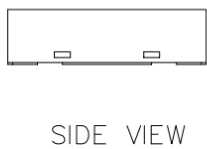
Tiny Over Voltage and Over Current Protection Switch



DFN-8 2mm x 2mm x 0.55mm



| COMMON DIMENSIONS             |          |       |       |
|-------------------------------|----------|-------|-------|
| (UNITS OF MEASURE=MILLIMETER) |          |       |       |
| SYMBOL                        | MIN      | NOM   | MAX   |
| A                             | 0.50     | 0.55  | 0.60  |
| A1                            | 0.00     | 0.02  | 0.05  |
| A3                            | 0.127REF |       |       |
| b                             | 0.20     | 0.25  | 0.30  |
| D                             | 1.95     | 2.00  | 2.05  |
| E                             | 1.95     | 2.00  | 2.05  |
| D2                            | 0.80     | 0.90  | 1.00  |
| E2                            | 1.50     | 1.60  | 1.70  |
| e                             | 0.45     | 0.50  | 0.55  |
| K                             | 0.15     | 0.25  | 0.35  |
| L                             | 0.25     | 0.30  | 0.35  |
| L1                            | 0.075    | 0.125 | 0.175 |
| M                             | 0.20REF  |       |       |
| R                             | 0.10REF  |       |       |
| R1                            | 0.05REF  |       |       |



NOTES:  
ALL DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSION.

# YHM2019



## Tiny Over Voltage and Over Current Protection Switch

### Ordering Information

| Part Number | Temp Range    | Pin Package | RSNS<br>Equation | OVP Threshold | Top Mark      | MOQ  |
|-------------|---------------|-------------|------------------|---------------|---------------|------|
| YHM2019W4T  | -40°C to 85°C | 4 WLCSP     | 600              | 6V            | Tx            | 5000 |
| YHM2019D8T  | -40°C to 85°C | 8 DFN       | 25K              | 6V            | Y2019<br>YYWW | 4000 |

Top Mark

T: YHM2019.

x: Data Code.

Y2019: YHM2019

YYWW: Date Code. YY = year, WW = week.

Email Requests to: [SALES@YHMICROS.COM](mailto:SALES@YHMICROS.COM)

# YHM2019



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