# YHM2010
## Hybrid Switch for OVP/OCP and Communication

## Features

- Input voltage range: 3.6V ~ 28V
- Both IN and ISNS may supply the chip
- Low on-resistance for IN-OUT: typical 40mΩ
- IN-COM for 10Mbps bit rate Communication
- Over voltage protection: Default 6V
- Super-fast OVP response time: typical 50ns
- Programmable Over Current Protection
- Short Circuit Protection
- Over Temperature Protection with external NTC
- Tiny 6-bumps WLCSP 1.17mm x 0.815mm

## Applications

- Smart Phone, AR/VR Device, Tablet PC, Wearable etc.

## General Description

YHM2010 over-voltage protection devices feature a low 40mΩ (TYP) on-resistance high current integrated MOSFET which actively protect low-voltage systems against voltage supply faults up to +28VDC. 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 trim versions for 11V/16V /22V OVP and no OVP. YHM2010 device enters hiccup mode when the output load exceeds the over current threshold. The over current threshold is programed by $R_{SNS}$.

YHM2010 has two outputs, OUT supports 2A current for power supply, COM supports 10Mbps digital signal communication when the chip is powered by ISNS pin.

YHM2010 has an NTC pin to support over Temperature Protection. It turns off when detected ambient temperature via external NTC resistor exceeds a pre-programmed threshold. Once turned off, it cannot be turned on until VIN is disconnected and reconnected again.

YHM2010 is available in tiny 6-bumps WLCSP 1.17mm x 0.815mm, 0.4mm pitch, and operates over an ambient temperature range of -40°C to +85°C.

# YHM2010
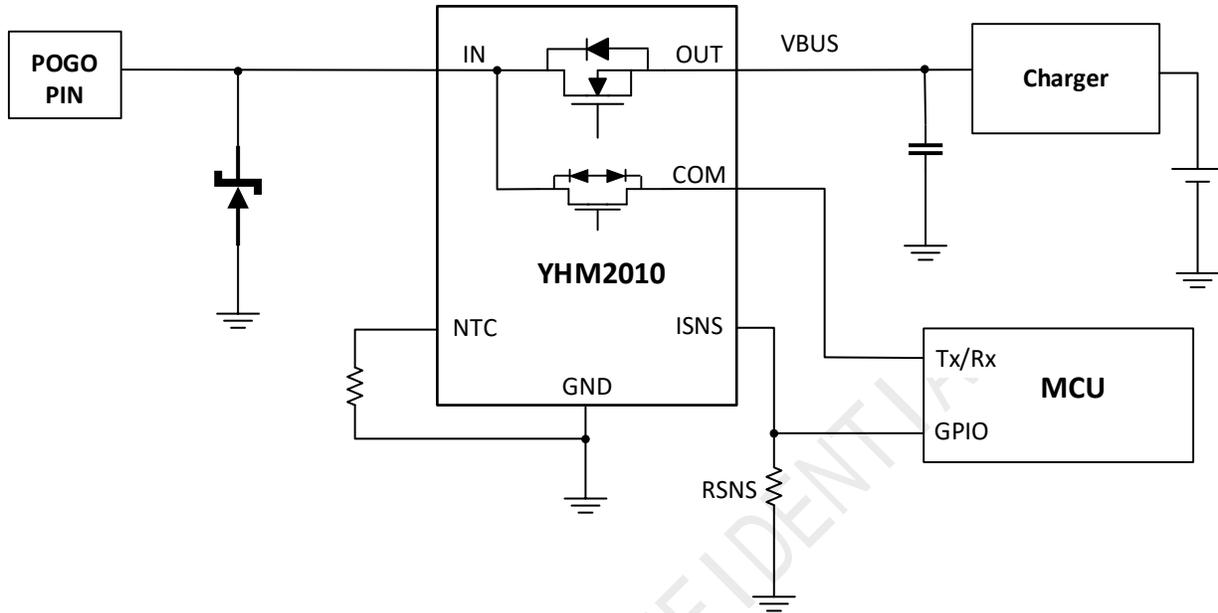## Hybrid Switch for OVP/OCP and Communication

## Typical Application



**Fig 1. POGO Pin Communication and OVP Application Diagram**

## Internal Block Diagram



**Fig 2. YHM2010 Functional Block Diagram**

### YHM2010 Pin Configurations
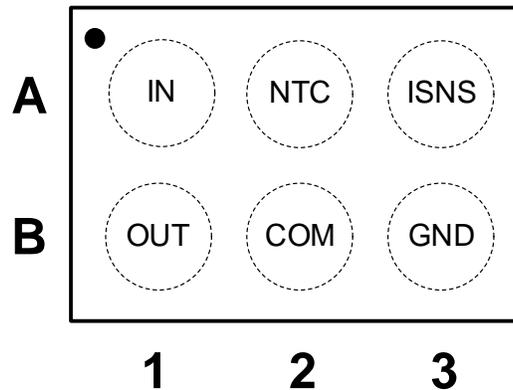


**Fig 3. YHM2010 WLP-6 Pin Assignment (Top Through View）**

### YHM2010 WLP Pin Descriptions

| Bump | Name | Description |
|------|------|-------------|
| A1 | IN | Power Input. |
| A2 | NTC | Connect NTC for temperature protection or keep floating if not use this function. |
| A3 | ISNS | Connect to system GPIO for communication function. |
| B1 | OUT | Power Output. |
| B2 | COM | Communication Output. |
| B3 | GND | Device Ground. |

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### 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) | | | 2.2 | A |
| $I_{OUT}$ | OUT Current | | | 2.2 | A |
| $I_{COM}$ | COM Current | | | 0.1 | A |
| $t_{PD}$ | Total Power Dissipation at $T_A$ = 25°C | | | TBD | W |
| $T_{STG}$ | Storage Temperature Range | | -65 | +150 | °C |
| $T_J$ | Maximum Junction Temperature | | | +150 | °C |
| $T_L$ | Lead Temperature (Soldering, 10 Seconds) | | | +260 | °C |
| ESD | Human Body Model, ANSI/ESDA/JEDEC JS-001-2012 | All Pins | | ±3500 | kV |
| | Charged Device Model, JESD22-C101 | All Pins | | ±2000 | |

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

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## Hybrid Switch for OVP/OCP and Communication

### 1. 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: $V_{IN}$ | 3.6 | 29 | V |
| Supply Voltage: $V_{ISNS}$ | 1.6 | 5.5 | V |
| Ambient Operating Temperature, $T_A$ | -40 | 85 | °C |
| $V_{OUT}$ Load Capacitor | 1 | 100 | µF |
| Operating Temperature Range | -40 | 85 | °C |

### 2. Detailed Electrical Characteristics

$V_{IN}$ = 3.6V to 28V, $C_{IN}$ = 0.1µF, $T_A$ = -40°C to +85°C, typical values are at $V_{IN}$ = 5V, $I_{IN}$ ≤ 3A, $T_A$ = +25°C, unless otherwise noted.

| PARAMETER | SYMBO | CONDITION | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| **INPUT OPERATION** | | | | | | |
| Input Voltage Range | $V_{IN}$ | | 3.7 | | 28 | V |
| Input Supply Current | $I_{IN}$ | $V_{IN}$ = 5V, NTC floating | | 32 | | µA |
| Under-Voltage Lockout | $V_{IN\_UVLO}$ | $V_{IN}$ falling | | 3.5 | | V |
| Under-Voltage Lockout Hysteresis | $V_{IN\_HYS}$ | | | 0.1 | | V |
| **OVER-VOLTAGE PROTECTION** | | | | | | |
| OUT OVLO threshold | $V_{IN\_OUT\_OVLO}$ | $V_{IN}$ rising | | 6 | | V |
| COM OVLO threshold | $V_{IN\_COM-OVLO}$ | $V_{IN}$ rising | | 3.65 | | V |
| OUT Switch On-Resistance | $R_{ON1}$ | $V_{IN}$ = 5V, $I_{OUT}$ = 0.5A, $T_A$ = +25°C | | 40 | | mΩ |
| COM Switch On-Resistance | $R_{ON2}$ | $V_{ISNS}$ = 1.8V, $I_{COM}$ = 5mA, $T_A$ = +25°C | | 60 | | Ω |
| ISNS Supply Current | $I_{VDD}$ | $V_{ISNS}$ = 1.8V, $V_{IN}$ = 1.8V, NTC floating | | 15 | | uA |
| **OVER-CURRENT PROTECTION** | | | | | | |
| OCP Threshold | $I_{OCP}$ | $R_{SNS}$=5.4kΩ, $T_A$= 25°C | | 1 | | A |
| | | Accuracy, $T_A$ = 0°C to +65°C | -10% | | 10% | |
| OCP Response Time | $t_{OCP}$ | | | 45 | | us |
| OCP Auto-restart Time | $t_{OCP\_RST}$ | | | 100 | | ms |
| **TIMING CHARACTERISTICS** | | | | | | |
| Debounce Time | $t_{DEB}$ | De-bounce Time for start rising | | 3 | | ms |
| Switch Turn-On Time | $t_{ON1}$ | $V_{IN}$ = 5V, $R_L$ = 100Ω, $C_{LOAD}$ = 100uF, $V_{OUT}$ from 0.1 × $V_{IN}$ to 0.9 × $V_{IN}$ | | 3 | | ms |
| Switch Turn-Off Time | $t_{OFF1}$ | $V_{IN}$ > $V_{IN\_OVLO}$ to $V_{OUT}$ = 0.8 × $V_{IN}$, $R_L$ = 100Ω, $V_{IN}$ rising at 2V/µs | | 50 | | ns |
| **THERMAL SHUTDOWN** | | | | | | |
| Thermal Shutdown | | | | 150 | | °C |

| Thermal Shutdown Hysteresis | | | 15 | | °C |
|---|---|---|---|---|---|

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

## 4. Detailed Description

### 4.1 General Introduction

YHM2010 is a dual output over-voltage protection device. One is a low 40mΩ (TYP) on-resistance high current path, the other is 60Ω (TYP) on-resistance communication path. Both the two output can actively protect low-voltage systems against voltage supply faults up to +28VDC. 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.

YHM2010 device enters hiccup mode when the output load exceeds the over current threshold. The over current threshold is programed by RSNS.

The communication path of COM features 10Mbps bandwidth which means the device support digital signal communication when powered by ISNS pin.

### 4.2 UVLO (Under-Voltage Lockout)

The device has a built-in under-voltage lockout (UVLO) circuit. When VIN is falling, the output remains connected from the input until IN voltage is below 3.5V (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 trim versions for 11V/16V and 22V OVP.
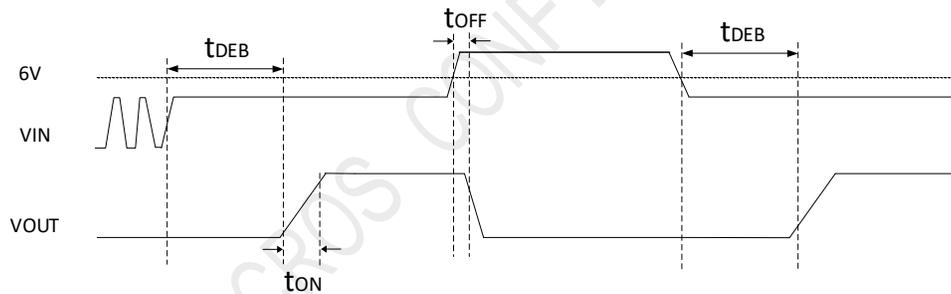


**Fig 4. Timing for OVLO trip**

### 4.4 OCP (Over Current Protection)

The chip enters hiccup mode when the output load exceeds the over current threshold. The OCP threshold is 2.35A when ISNS pin is above 1.5V or floating. It also could be adjusted by single external resister RSNS connected between ISNS and GND.

$$R_{SNS} = 5.4K/ I_{OCP}$$

### 4.5 Communication Functionality

Both IN and ISNS may supply YHM2010. YHM2010 would be powered by ISNS if ISNS voltage is higher than 1.5V. By this, YHM2010 supports digital signal transmission through IN and COM when the device is powered by ISNS. Typically, ISNS is recommended to be driven by GPIO typically. For example, ISNS=1.8V would power YHM2010 even when $V_{IN}$=0. It is necessary to remove input and output capacitor when communication is required.

### 4.6 Over Temperature Protection

YHM2010 has an internal 20μA current source on NTC pin. When the voltage on NTC pin is below 300mV, the chip turns off. Once turned off, it cannot be turned on until VIN is disconnected and reconnected again. Choose a NTC to program the temperature protection threshold. Recommend 100Kohm NTC (Beta=3950) for 75°C protection. Keep floating if not use this function to save power.

### 4.7 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 15°C (TYP).

## Package Dimensions
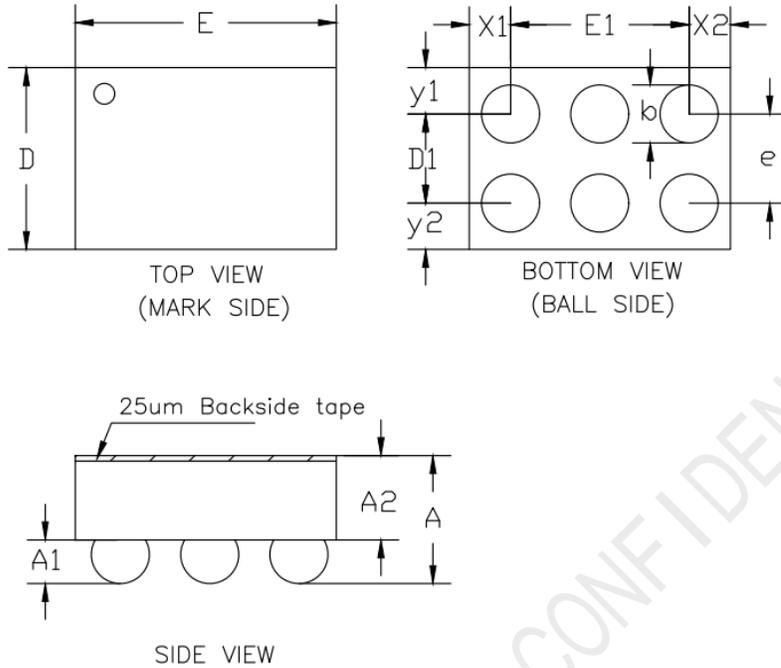
**WLCSP-6   1.17mm x 0.815mm x 0.574mm**



TOP VIEW
(MARK SIDE)

BOTTOM VIEW
(BALL SIDE)

25um Backside tape

SIDE VIEW

| COMMON DIMENSIONS (UNITS OF MEASURE=MILLIMETER) | | | |
|--------|-------|-------|-------|
| SYMBOL | MIN | NOM | MAX |
| A | 0.534 | 0.574 | 0.614 |
| A1 | 0.176 | 0.196 | 0.216 |
| A2 | 0.358 | 0.378 | 0.398 |
| D | 0.795 | 0.815 | 0.835 |
| D1 | 0.400BSC | | |
| E | 1.150 | 1.170 | 1.190 |
| E1 | 0.800BSC | | |
| b | 0.240 | 0.260 | 0.280 |
| e | 0.400BSC | | |
| x1 | 0.185 REF | | |
| x2 | 0.185 REF | | |
| y1 | 0.208 REF | | |
| y2 | 0.208 REF | | |

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## Ordering Information

| Part Number | Temp Range | Pin Package | Top Mark | MOQ |
|---|---|---|---|---|
| YHM2010W6T | -40°C to 85°C | 6 WLCSP | YWW<br>LOT | 3000 |

*T = Tape and reel.*
*YWW: Date Code. Y = year, WW = week.*
*LOT: The last three number of LOTID.*