YHM2009
Over Voltage Protection Switch with Digital Signal Transmission

YHMICROS
炎火微电子

Features

- Input voltage range: 2.5V ~ 29V
- Both IN and OVLO/VDD may supply the chip
- Low on-resistance: typical 23mΩ
- Programmable over voltage protection (OVP) threshold
- Super-fast OVP response time: typical 100ns
- Support 10Mbps communication
- Over temperature protection (OTP)
- Robust ESD and surge immunity capability
  - HBM > ±2KV
  - CDM > ±1kV
- Tiny 6-bumps WLCSP 1.19mm x 0.87mm

Applications

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

General Description

YHM2009 over-voltage protection devices feature a low 23mΩ (TYP) on-resistance high current 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 can be 5.8V, 11V, 16V and 23V configurable by single external resistor at OVLO/VDD pin.

Additionally, YHM2009 internal switch supports 10Mbps digital signal communication when powered by OVLO/VDD pin.

YHM2009 is available in tiny 6-bumps WLCSP 1.19mm x 0.87mm, and operates over an ambient temperature range of -40°C to +85°C.

YHMICROS
炎火微电子

Typical Application
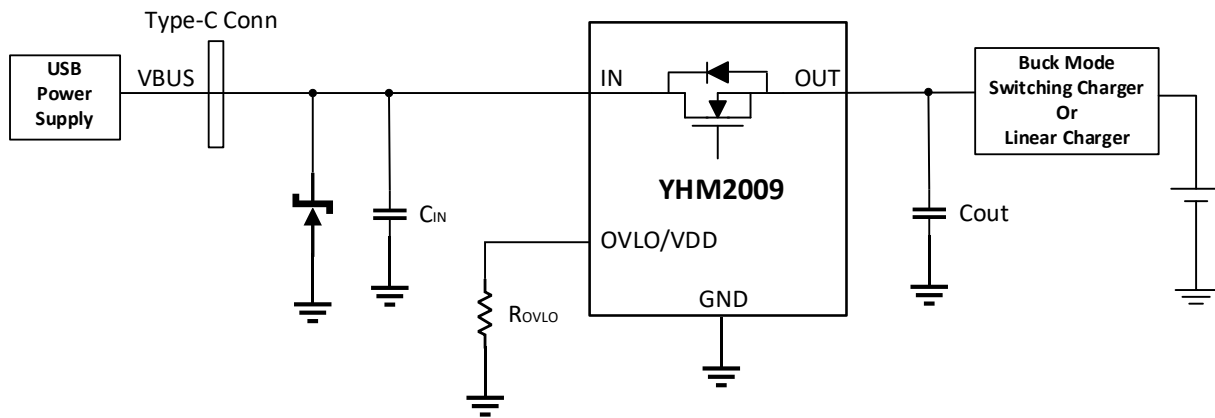
Fig 1. VBUS OVP Application Diagram
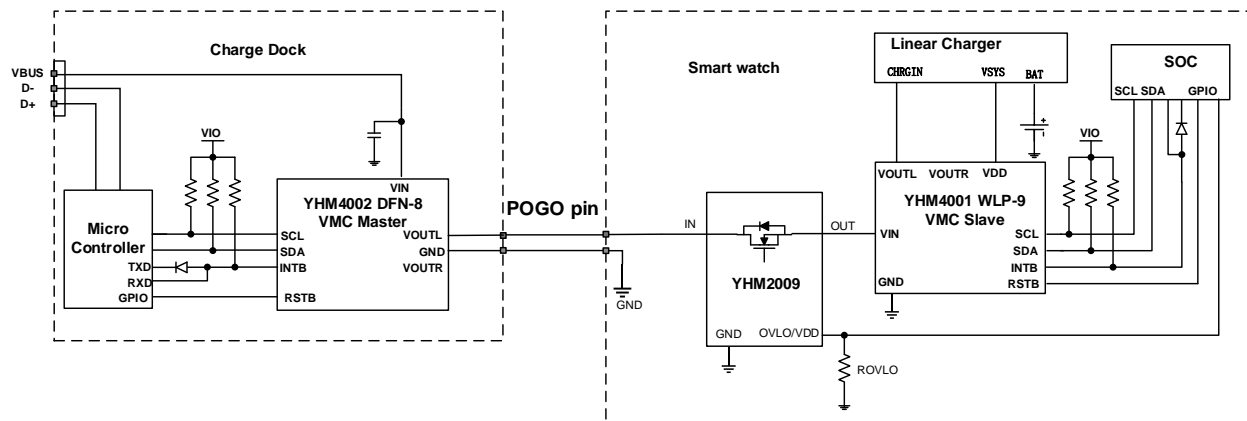
Fig 2. POGO Pin Communication and OVP Application Diagram with YHM2009

Internal Block Diagram
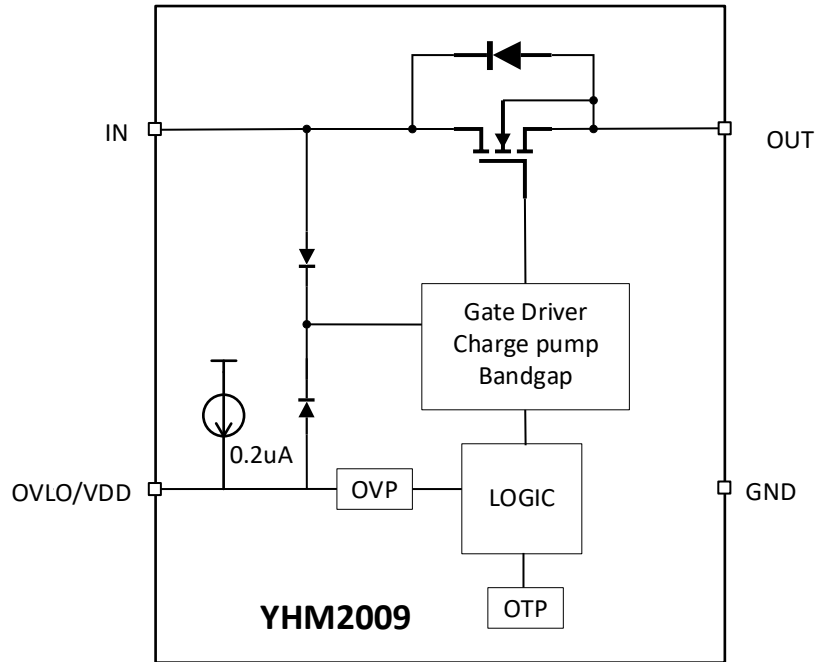
Fig 3. YHM2009 Functional Block Diagram

YHM2009
Over Voltage Protection Switch with Digital Signal Transmission

YHMICROS
炎火微电子

Pin Configurations
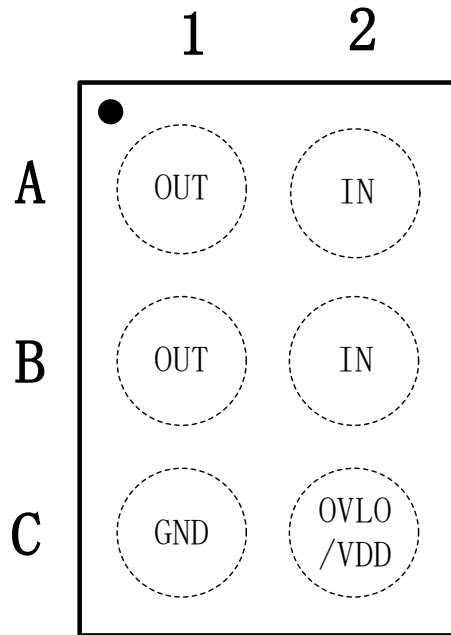
Fig 4. YHM2009 WLP-6 Pin Assignment (Top Through View）

YHM2009 WLP Pin Descriptions

Bump	Name	Description
A1, B1	OUT	Power output.
A2, B2	IN	Power Input.
C1	GND	Device Ground.
C2	OVLO/VDD	Connect resistor to program OVLO threshold. Or connect to system GPIO for communication function.

YHM2009
Over Voltage Protection Switch with Digital Signal Transmission

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_I	IN to GND		-0.3	31	V
V_{OUT}	OUT to GND		-0.3	V_{IN}+0.3	V
V_{OVLO}	OVLO/VDD to GND		-0.3	6.0	V
I_{IN}	Switch I/O Current (Continuous)			4.0	A
t_{PD}	Total Power Dissipation at T_A = 25°C				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
θ_{JA}	Thermal Resistance, Junction-to-Ambient (1-in. Pad of 2-oz. Copper)			100	°C/W
ESD	Human Body Model, ANSI/ESDA/JEDEC JS-001-2012	All Pins	2.0		kV
	Charged Device Model, JESD22-C101	All Pins	1.0		

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

Over Voltage Protection Switch with Digital Signal Transmission

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	29	V
Supply Voltage: $V_{OVLO/VDD}$	1.6	5.5	V
Ambient Operating Temperature, T_A	-40	85	°C
V_{IN} Capacitor (No capacitor for communication function)	0.1		µF
V_{OUT} Load Capacitor (No capacitor for communication function)	1	100	µF
Operating Temperature Range	-40	85	°C

3. Detailed Electrical Characteristics

V_{IN} = 2.5V to 29V, 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}		2.5		29	V
Input Supply Current	I_{IN}	V_{IN} = 5V		45		µA
VDD Supply Current	I_{VDD}	$V_{OVLO/VDD}$ =1.8V		40		uA
Under-Voltage Lockout	V_{IN_UVLO}	V_{IN} rising		2.35		V
Under-Voltage Lockout Hysteresis	V_{IN_HYS}			20		mV
OVER-VOLTAGE						
OVLO threshold	V_{IN_OVLO}	R_{OVLO} = 250kΩ		23		V
		R_{OVLO} = 500kΩ		16		
		R_{OVLO} = 1MΩ		11		
		R_{OVLO} = 2.5MΩ	5.6	5.8	6.0	
Switch On-Resistance	R_{ON}	V_{IN} = 5V, I_{OUT} = 0.5A, T_A = +25℃		23	40	mΩ
TIMING CHARACTERISTICS						
Debounce Time	t_{DEB}	Time from V_{IN} > 2.5V to the time V_{OUT} starts rising		16		ms
Switch Turn-On Time	t_{ON}	V_{IN} = 5V, R_L = 100Ω, C_{LOAD} = 100uF, V_{OUT} from 0.1 × V_{IN} to 0.9 × V_{IN}		0.4		ms
Switch Turn-Off Time	t_{OFF}	V_{IN} > V_{IN_OVLO} to V_{OUT} = 0.9 × V_{IN}, R_L = 100Ω, V_{IN} rising at 10V/µs OVLO/VDD connected 1.5MΩ to GND		100		ns
THERMAL SHUTDOWN						
Thermal Shutdown				150		°C
Thermal Shutdown Hysteresis				30		°C

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

4. Detailed Description

4.1 General Introduction

YHM2009 over-voltage protection devices feature a low 23mΩ (TYP) on-resistance high current 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 can be 5.8V, 11V, 16V and 23V configurable by single external resistor at OVLO/VDD pin.

YHM2009 internal switch features 10Mbps digital signal communication when powered by OVLO/VDD pin.

4.2 UVLO (Under-Voltage Lockout)

The device has a built-in under-voltage lockout (UVLO) circuit. When VIN is rising, the output remains disconnected from the input until VIN voltage is above 2.35V (TYP). This circuit has a 20mV hysteresis to provide noise immunity to transient conditions.

4.3 OVLO (Over-Voltage Lockout)

When the voltage at the input exceeds the programmed over-voltage trip point, the device immediately turns off the internal switch disconnecting the load from the abnormal voltage, preventing damage to downstream components. The OVLO threshold could be adjusted by single external resister connected between OVLO/VDD and GND.

Below are configurable OVLO thresholds based on different resistor connected to OVLO/VDD.

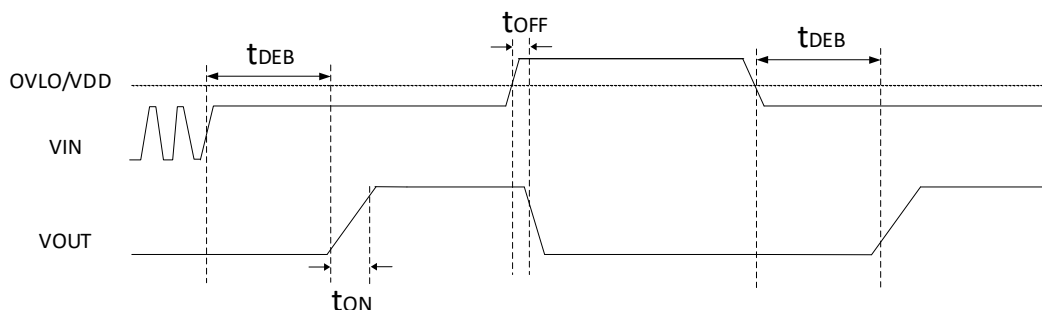| OVLO threshold	Typical resistor value
5.8V	2.5MΩ
11V	1MΩ
16V	500kΩ
23V	200kΩ

Fig 5. Timing for OVLO trip

4.4 USB On-The-Go (OTG) Operation

During OTG operation, the YHM2009 is initially disabled and the power FET's bulk diode is forward biased. The bulk diode represents ~0.7V drop across the device, which remains until the VIN voltage increase past 2.5 V, when the device is fully enabled. While the device is disabled and the body diode is forward biased, the max DC current through the diode is 1.8A. This current is limited by the thermal performance of the device (0.7V x 2.1A = 1.48W).

This is purely a transitionary condition as once the voltage at IN exceeds the UVLO voltage of 2.35V (TYP) and the debounce time of 15ms has elapsed, the main power switch will turn fully on, significantly reducing the voltage drop from OUT to IN.

4.5 Communication functionality

YHM2009
Over Voltage Protection Switch with Digital Signal Transmission

Both IN and OVLO/VDD may supply YHM2009. YHM2009 would powered by OVLO/VDD if OVLO/VDD voltage is higher than 1.5V. By this, YHM2009 supports digital signal transmission through IN and OUT when the device is powered by OVLO/VDD. Typically, OVLO/VDD is recommended to be driven by GPIO typically. It is necessary to remove input and output capacitor when communication is required.
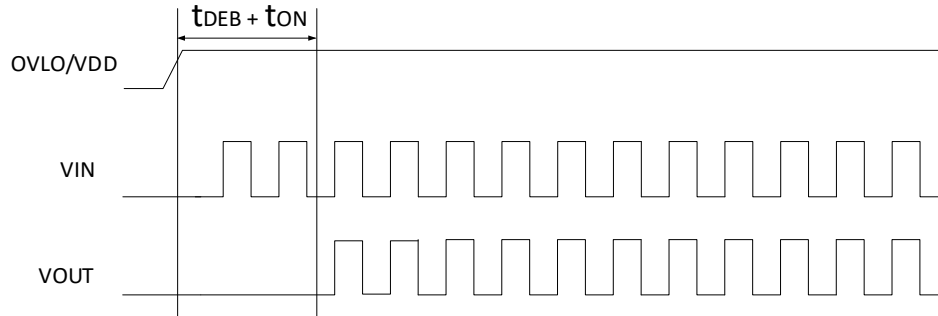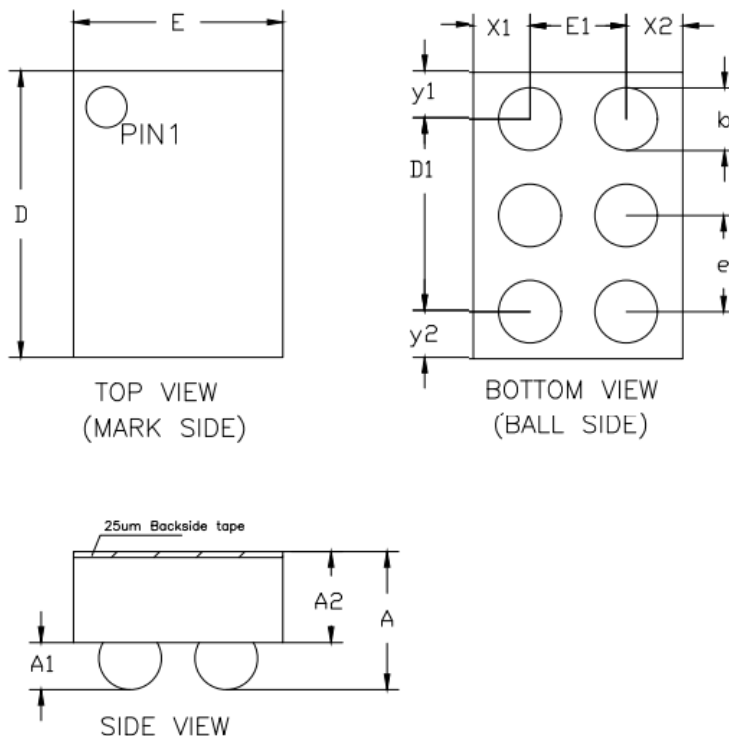

Fig 6. Timing for VIN communication

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 30°C (TYP).

Package Dimensions

WLCSP-6   1.19mm x 0.87mm x 0.574mm

TOP VIEW (MARK SIDE)

BOTTOM VIEW (BALL SIDE)

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	1.170	1.190	1.210
D1		0.800BSC	
E	0.850	0.870	0.890
E1		0.400BSC	
b	0.240	0.260	0.280
e		0.400BSC	
x1		0.235 REF	
x2		0.235 REF	
y1		0.195 REF	
y2		0.195 REF	

YHM2009
Over Voltage Protection Switch with Digital Signal Transmission

Ordering Information

Part Number	Temp Range	Pin Package	Top Mark	MOQ
YHM2009W6T	-40°C to 85°C	6 WLCSP	YWW LOT	3000

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

Email Requests to*: SALES@YHMICROS.COM*
YHMicros Website*: WWW.YHMICROS.COM*