YHM2011

OVP/OCP Switch with Over Temperature Protection

Features

- Input voltage range: 3.6V ~ 28V
- Low on-resistance for IN-OUT
  - WLP: typical 40mΩ
  - DFN: typical 50mΩ
- Over voltage protection: Default 6V
- Super-fast OVP response time: typical 50ns
- Programmable Over Current Protection
- Over Temperature Protection with external NTC
- Short Circuit Protection
- Tiny 6-bumps WLCSP 1.17mm x 0.815mm
- 2mm x 2mm 8-pin DFN

Applications

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

General Description

YHM2011 over-voltage protection devices feature a low 40mΩ (TYP) on-resistance high current integrated MOSFET which actively protects 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. YHM2011 device enters hiccup mode when the output load exceeds the over current threshold. The over current threshold is programed by R_{SNS}.

YHM2011 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 temperature recover.

YHM2011 is available in tiny 6-bumps WLCSP 1.17mm x 0.815mm, 0.4mm pitch, or 2mm x 2mm DFN-8 and operates over an ambient temperature range of -40°C to +85°C.

Typical Application

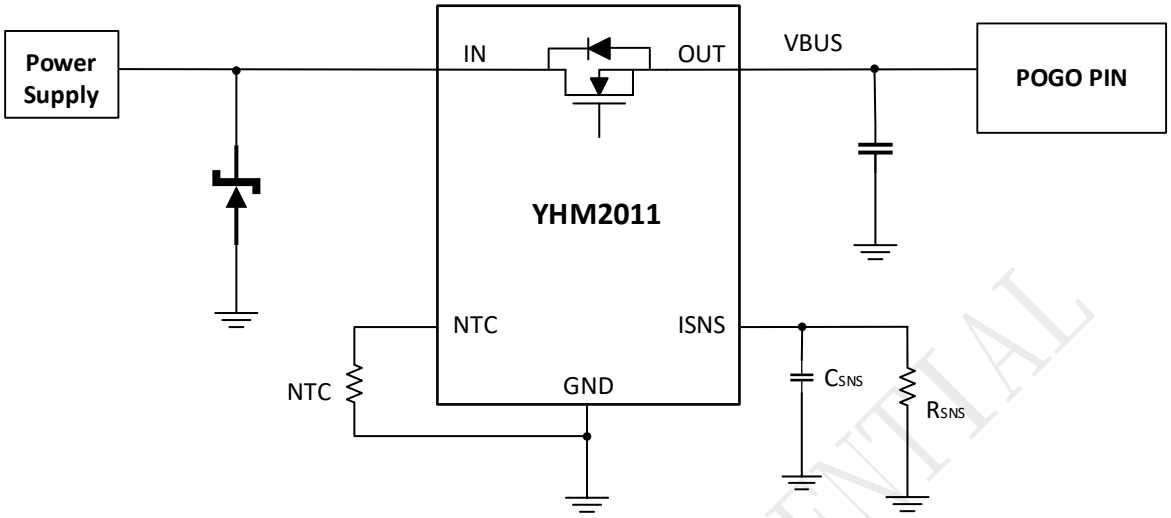


Fig 1. Cable OVP/OCP/OTP Application Diagram

Internal Block Diagram

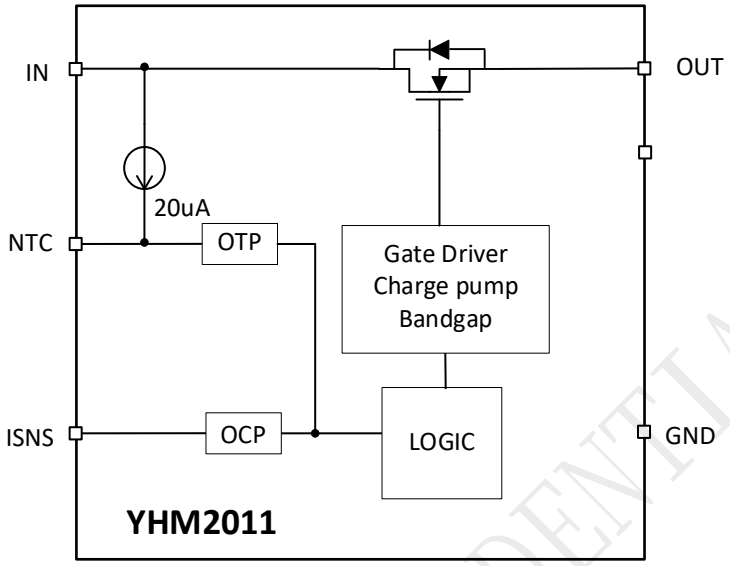


Fig 2. YHM2011 Functional Block Diagram

YHM2011 Pin Configurations

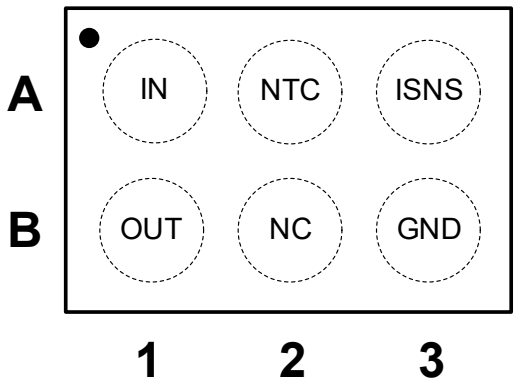


Fig 3. YHM2011 WLP-6 Pin Assignment (Top Through View）

YHM2011 WLP Pin Descriptions

Bump	Name	Description
A1	IN	Power Input.
A2	NTC	Connect NTC for temperature protection or connect a 100KΩ resistor if not use this function.
A3	ISNS	Resistor connected to program OCP threshold.
B1	OUT	Power Output.
B2	NC	Not connected.
B3	GND	Device Ground.

YHM2011 DFN Pin Configurations

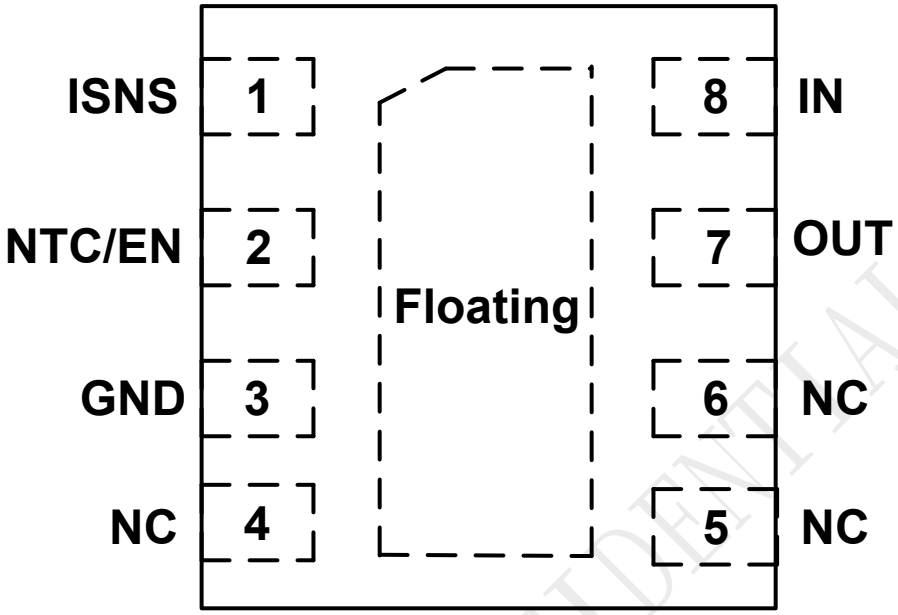


Fig 4. YHM2011 DFN-8 Pin Assignment (Top Through View）

YHM2011 DFN Pin Descriptions

Pin	Name	Description
1	ISNS	Resistor connected to program constant current threshold.
2	NTC/EN	NTC pin and switch enable pin. When used as NTC pin, Connect NTC for temperature protection. Or when used as switch enable pin, connect to GPIO to control switch ON/OFF and a 100kΩ to ground. Pull GPIO to Hi-Zi to turn on the switch, pull GPIO to ground to turn off the switch.
3	GND	Device Ground.
4	NC	No connect.
5	NC	No connect.
6	NC	No connect.
7	OUT	Power Output.
8	IN	Power Input.

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
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		V
	Charged Device Model, JESD22-C101	All Pins	±2000		

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

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}	3.7	28	V
Ambient Operating Temperature, T_A	-40	85	°C
V_{IN} Capacitor	0.1		μF
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
OUT Switch On-Resistance	R_{ON_WLP}	V_{IN} = 5V, I_{OUT} = 0.5A, T_A = +25°C		40		mΩ
OUT Switch On-Resistance	R_{ON_DFN}	V_{IN} = 5V, I_{OUT} = 0.5A, T_A = +25°C		50		mΩ
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_{ON}	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_{OFF}	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

YHM2011 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. YHM2011 device enters hiccup mode when the output load exceeds the over current threshold. The over current threshold is programed by R_{SNS}.

YHM2011 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 temperature recover.

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 OTP versions for 11V/16V and 22V OVP.

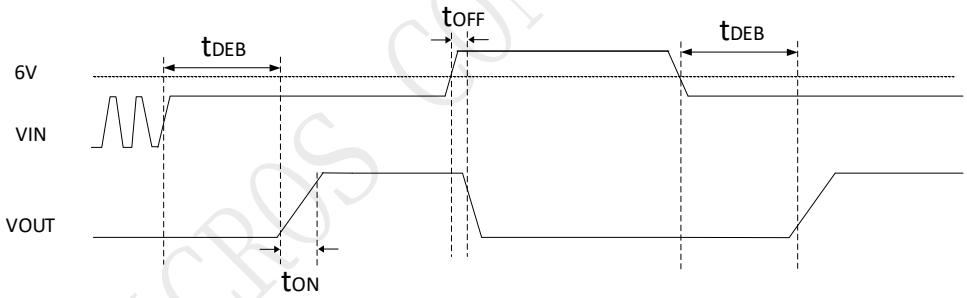


Fig 5. Timing for OVLO trip

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 resister R_{SNS} connected between ISNS and GND.

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

The normal OCP Response Time is 45μs. Recommend add 100nF capacitor C_{SNS} to increase OCP Response Time to 400μs.

Connect an ADC to ISNS pin to measure the voltage on R_{SNS} can get the current flow through the switch. The output current can be determined by ISNS pin voltage using the following equation:

$$I_{OUT} = V_{ISNS} \times 9000/R_{SNS}$$

4.5 Over Temperature Protection

YHM2011 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 the voltage on NTC pin is above 600mV. Choose a NTC to

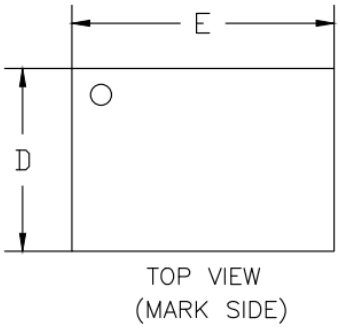
program the temperature protection threshold. Recommend 100Kohm NTC (Beta=3950) for 75°C protection. Connect a 100KΩ resistor to NTC pin if not use this function.

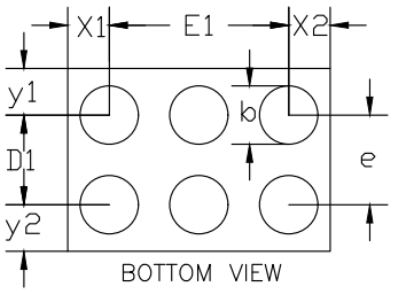
4.6 Thermal Protection

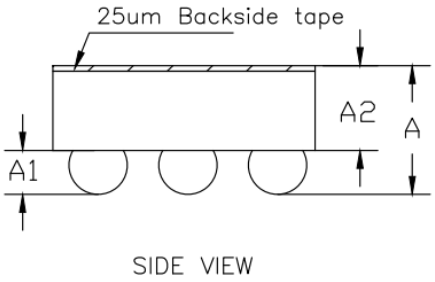
The internal FET turns off when the junction temperature exceeds +150°C (TYP). The device exits thermal shutdown after the junction temperature cools down by 15°C (TYP).

Package Dimensions

WLCSP-6 1.17mm x 0.815mm x 0.574mm



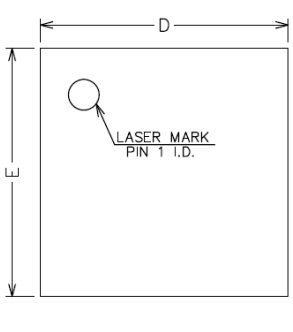




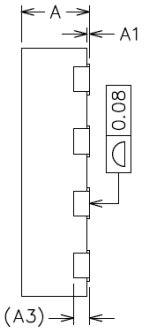
COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

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	

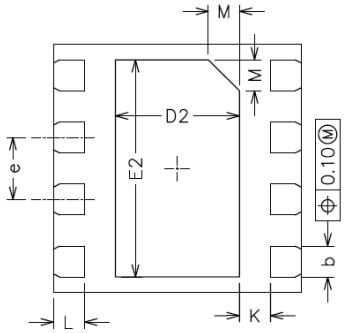
DFN-8 2mm x 2mm x 0.55mm



TOP VIEW



SIDE VIEW



BOTTOM VIEW

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	0.15	0.25	0.35
D	1.90	2.00	2.10
E	1.90	2.00	2.10
D2	0.90	1.00	1.10
E2	1.65	1.75	1.85
e	0.40	0.50	0.60
K		0.25REF	
L	0.15	0.25	0.35
M		0.25REF	

SIDE VIEW

Ordering Information

Part Number	Temp Range	Pin Package	Top Mark	OVP	MOQ
YHM2011W6T	-40°C to 85°C	6 WLCSP	YWW LO1	6V	3000
YHM2011AW6T	-40°C to 85°C	6 WLCSP	YWW LO1	22V	3000
YHM2011D8T	-40°C to 85°C	8 DFN	Y2011 YYWW	6V	4000
YHM2011AD8T	-40°C to 85°C	8 DFN	2011A YYWW	22V	4000
YHM2011BD8T	-40°C to 85°C	8 DFN	2011B YYWW	No OVP	4000
YHM2011CD8T	-40°C to 85°C	8 DFN	2011C YYWW	11V	4000

T = Tape and reel.
YWW: Date Code. Y = year, WW = week.
LO: The last two numbers of LOTID.
1：YHM2011