YHM2019

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.

Typical Application

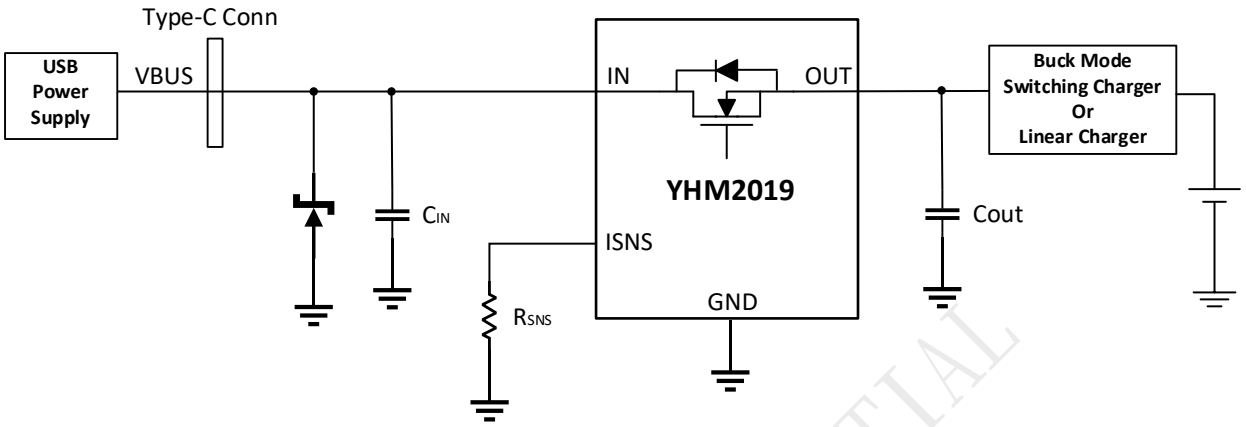


Fig 1. VBUS OVP/OCP Application Diagram

Internal Block Diagram

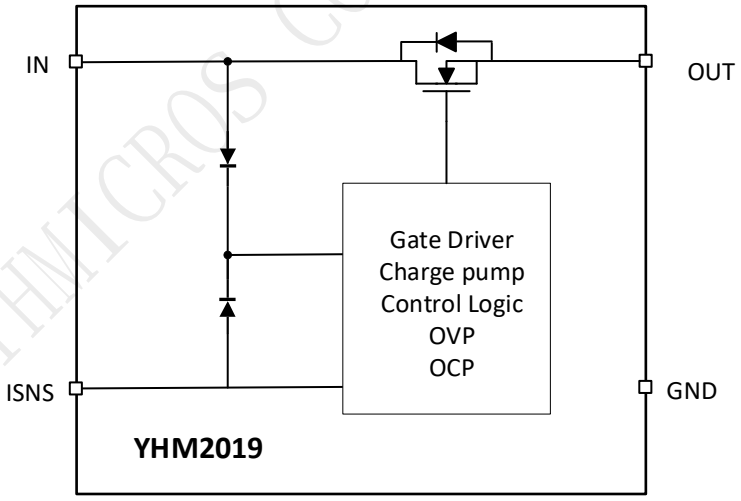


Fig 2. YHM2019 Functional Block Diagram

Pin Configurations

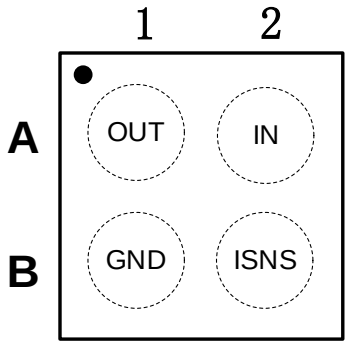


Fig 3. YHM2019 WLP-4 Pin Assignment (Top Through View）

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.

Pin Configurations

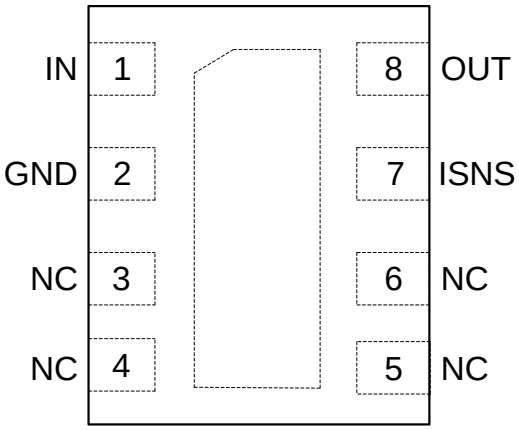


Fig 4. YHM2019 DFN-8 Pin Assignment (Top Through View）

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.

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
θ_{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

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		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 28V, C_{IN} = 0.1μF, T_A = -40°C to +85°C, typical values are at V_{IN} = 5V, I_{IN} ≤ 2A, T_A = +25°C, unless otherwise noted.

PARAMETER	SYMBO	CONDITION	MIN	TYP	MAX	UNIT
INPUT OPERATION						
Input Voltage Range	V_{IN}		2.5		28	V
Input Supply Current	I_{INQ}	V_{IN} = 5V, ISNS Floating		20		μA
Under-Voltage Lockout	V_{IN_UVLO}	V_{IN} rising		2.35		V
Under-Voltage Lockout Hysteresis	V_{IN_HYS}			0.1		V
OVER-VOLTAGE PROTECTION						
OVLO Threshold	V_{IN_OVLO}			6		V
Switch On-Resistance (WLP Only)	R_{ON}	V_{IN} = 5V, I_{OUT} = 0.2A, T_A = 25°C		80		mΩ
		V_{IN} = 3.3V, I_{OUT} = 0.2A, T_A = 25°C		85		
		V_{IN} = 2.5V, I_{OUT} = 0.2A, T_A = 25°C		90		
Switch On-Resistance	R_{ON}	V_{IN} = 5V, I_{OUT} = 0.2A, T_A = 25°C		120		mΩ
ISNS Supply Current	I_{VDDQ}	V_{ISNS} = 1.8V		15		μA
OVER-CURRENT PROTECTION						
OCP Threshold	I_{OCP}	R_{SNS}=25KΩ(DFN Package), T_A= 25°C		1		A
		R_{SNS}=600Ω(WLP Package), 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}			130		ms
TIMING CHARACTERISTICS						
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 = 100Ω, C_{LOAD} = 100uF, V_{OUT} from 0.1 × V_{IN} to 0.9 × V_{IN}		0.5		ms
Switch Turn-Off Time	t_{OFF}	V_{IN} > V_{IN_OVLO} to V_{OUT} = 0.1 × V_{IN}, R_L = 100Ω, V_{IN} rising at 2V/μs		50		ns

THERMAL SHUTDOWN(1)						
Thermal Shutdown				150		°C
Thermal Shutdown Hysteresis				20		°C

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

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 programed by R_{SNS}.

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 IN voltage 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.

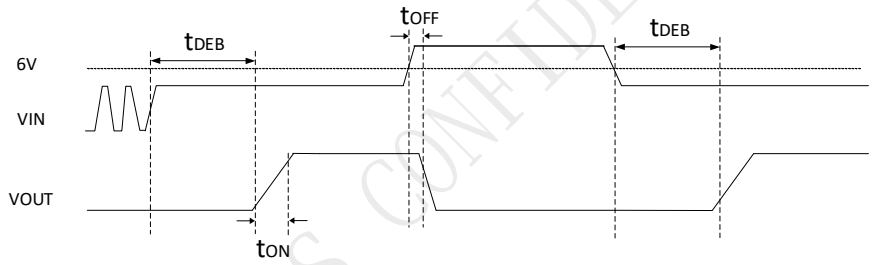


Fig 5. Timing for OVLO trip

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 resister 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.

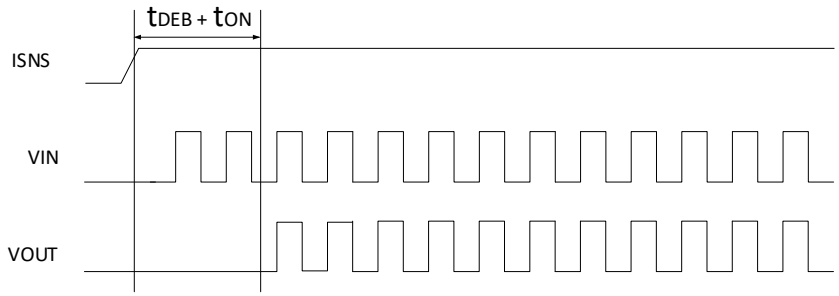


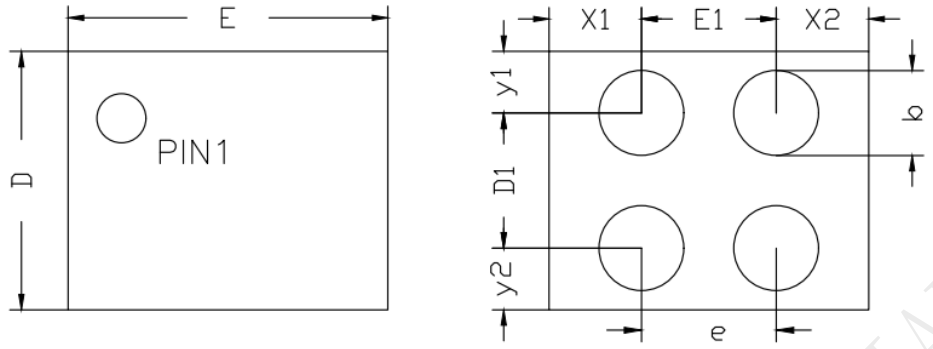
Fig 6. Timing for VIN communication

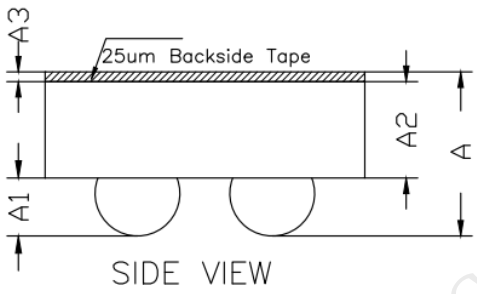
4.6 Thermal Protection

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).

Package Dimensions

WLCSP-4 0.83mm x 0.67mm x 0.425mm





COMMON DIMENSIONS
(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	

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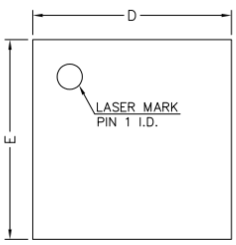
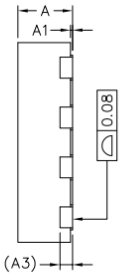
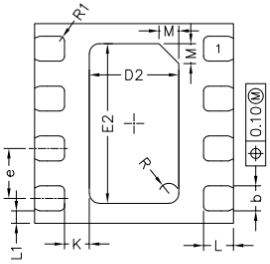
DFN-8　2mm x 2mm x 0.55mm



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	0.20	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	

SIDE VIEW

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

Ordering Information

Part Number	Temp Range	Pin Package	RSNS 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 YYWW	4000

Top Mark
T: YHM2019.
x: Data Code.
Y2019: YHM2019
YYWW: Date Code. YY = year, WW = week.

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