iT56051

Three Phases Intelligent Power Module

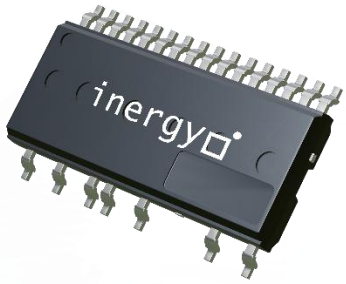
Preliminary Datasheet Rev. 0.1

1. Description

The iT56051 is a three-phase, intelligence power module. It is composed of temperature sensor, MOSFET, gate driver and control logic which can provide minimal components of total BOM to save the total cost. The iT56051 embedded 600V HVIC gate driver with bootstrap diode. Built-in 5A/600V fast recovery MOSFET to reduce switching loss. The gate driver sourcing / sinking current is fine tuned to lower the EMI. The iT56051 is equipped TS (temperature sensor), UVLO (under voltage lockout) protections. Three independent low side MOSFET source paths for the current sensing application.

2. Features

- 5A/600V Fast Recovery MOSFET
- Floating Channel Designed for Bootstrap Operation to +600V
- Under Voltage (UVLO) Protection
- Bootstrap Diodes Built-in with Current Limiting Resistor
- Input interface: 3.3V, 5V Line
- 3-Phase Independent Current Detection
- Temperature Sensor
- Soft Driving for Low EMI
- Insulation Voltage Standing: 1500Vrms
- SOP-23H Package
- UL 94V-0 Compound Material



3. Applications

- Air Conditioner Out Door Unit
- Refrigerator Compressor
- Pumps
- Exhausted Fan

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4. Pin Assignments

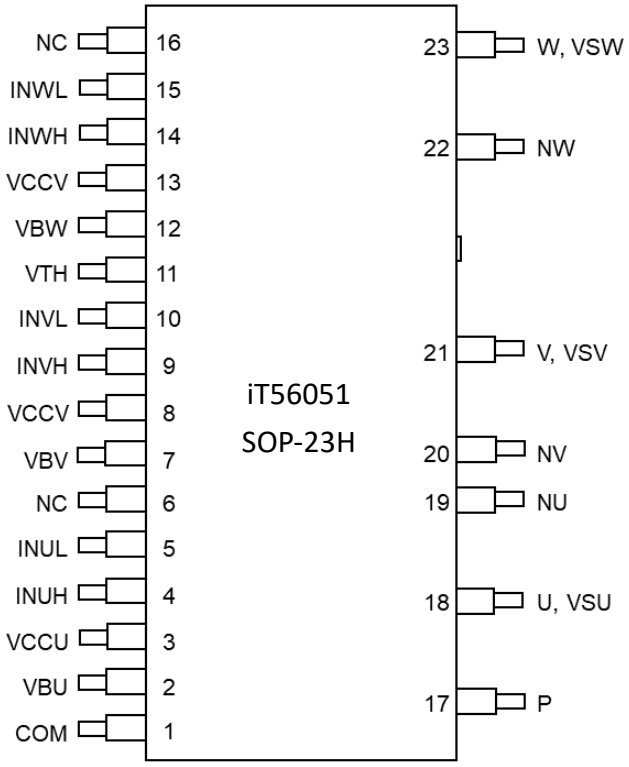


Fig.1 Pin Assignments (Top View)

5. Marking Information

Product Name	Marking
iT56051	inergy iT56051 XXXXXXX X: Date code

6. Ordering Code

Ordering Code
iT56051

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7. Pin Definitions

Pin No.	Symbol	Description
1	COM	Common Ground Pin
2	VBU	U-Phase High Side Floating Power Supply
3	VCCU	U-Phase Analog/ Logic Power Supply
4	INUH	U-Phase Signal input High Active for High Side
5	INUL	U-Phase Signal input High Active for Low Side
6	NC	No Connection
7	VBV	V-Phase High Side Floating Power Supply
8	VCCV	V-Phase Analog/Logic Power Supply
9	INVH	V-Phase Signal input High Active for High Side
10	INVL	V-Phase Signal input High Active for Low Side
11	VTH	Temperature Sensor Output
12	VBW	W-Phase High Side Floating Power Supply
13	VCCW	W-Phase Analog/Logic Power Supply
14	INWH	W-Phase Signal input High Active for High Side
15	INWL	W-Phase Signal input High Active for Low Side
16	NC	No Connection
17	P	DC Bus Power Supply
18	VSU	U-Phase Output & Floating Ground
19	NU	U-Phase Low Side MOSFET Source
20	NV	V-Phase Low Side MOSFET Source
21	VSV	V-Phase Output & Floating Ground
22	NW	W-Phase Low Side MOSFET Source
23	VSW	W-Phase Output & Floating Ground

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8. Function Block

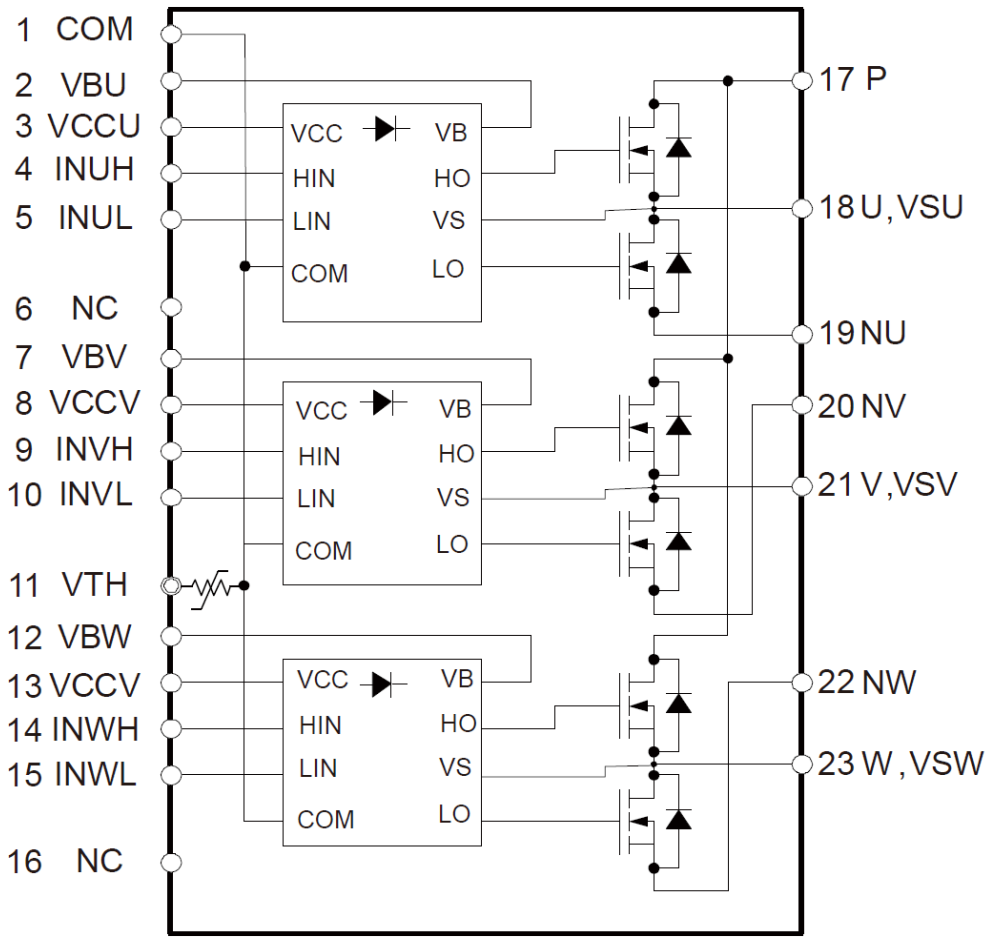


Fig.2 Pin Configuration and Internal Block Diagram

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9. Typical Application Circuit

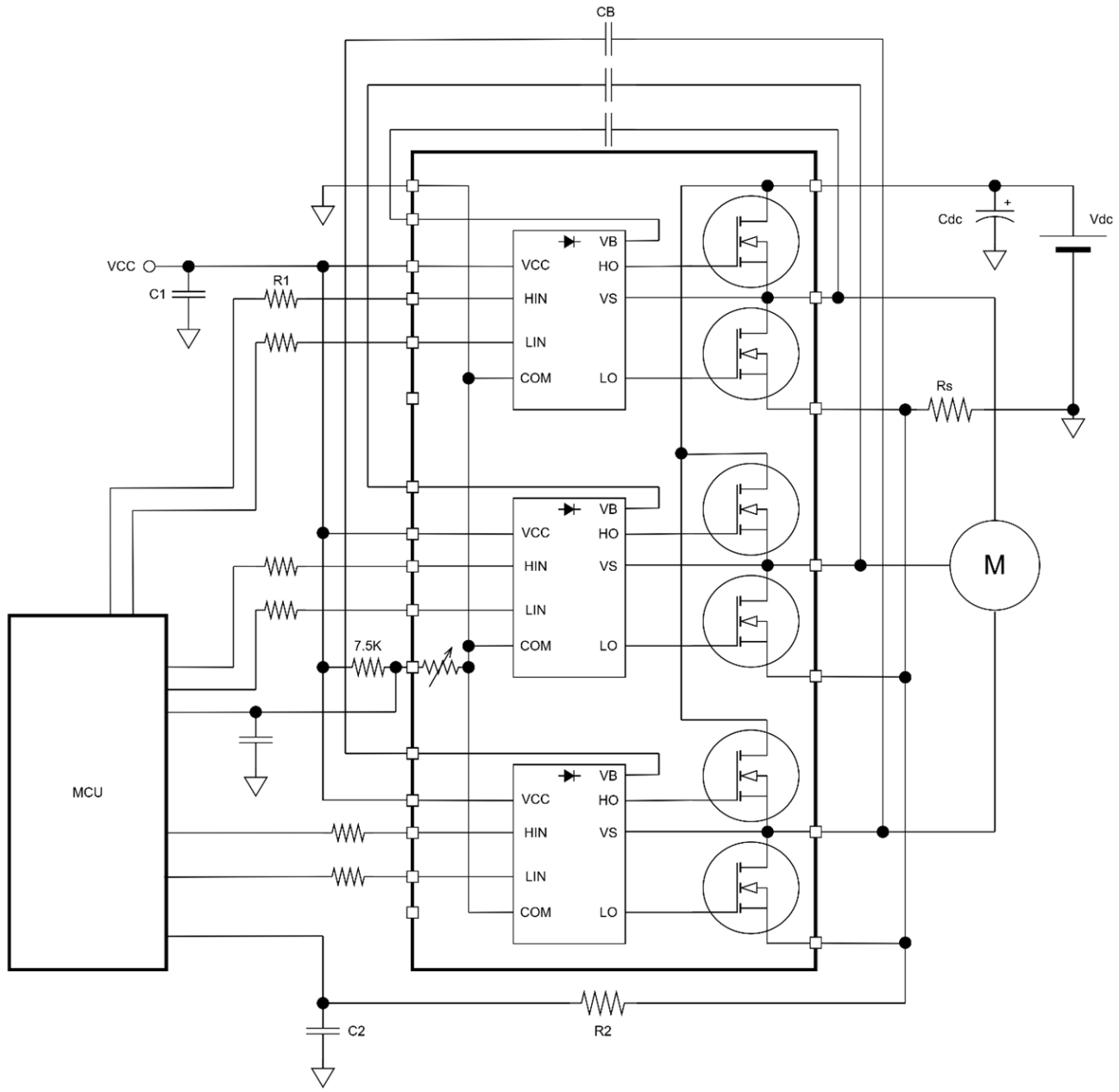


Fig.3 Application Circuit

Note 1：Suggest that the CB > 2.2uF and the C1 > 10*CB (22uF).

Note 2：PIN11 is the NTC output. If use the OTP function place a pull high resistor 7.5K to the Vcc.

Note 3：Rs's & Cdc's GND directly connected to the power supply Vdc negative end, keep the loop as small as possible.

Note 4：Between MCU & IPM, that could be placed the RC filter for the 6 PWM signal path. Suggest R1 is 100 Ohm to 1K Ohm.

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10. Electrical Characteristics

10.1 Absolute Maximum Ratings

Absolute maximum ratings indicate sustained limits beyond which damage to the device may occur. All voltage parameters are absolute voltages referenced to COM, all currents are defined positive into any lead. The thermal resistance and power dissipation ratings are measured under board mounted and still air conditions. The ambient temperature is 25°C.

Symbol	Description	MIN	MAX	Unit
V_{CC}	Gate Driver Supply Voltage, V_{CCx}	-0.3	20	V
V_{BS}	Floating Supply Voltage from V_{Bx} to V_{Sx}	-0.3	20	V
V_{IN}	Signal Input Voltage, INxH & INxL	-0.3	Vcc+0.3	V
V_{PN}	DC Bus Supply Voltage from P to Nx	-0.6	600	V
I_O	Single MOSFET Output Current @ Tc = 25 ℃	-	5.0	A
V_{ISO}	Insulation Voltage from Heatsink to Pin (60Hz Sine AC 1min.)	-	1500	Vrms
$R_{th\ JC}$	Thermal Resistance, Junction to Case	-	7.8	℃ / W
T_J	Junction Temperature	-40	150	℃
T_S	Storage Temperature	-55	150	
T_L	Lead Temperature (Soldering 10 Seconds)	-	260	

10.2 Recommended Operating Conditions

For proper operation, the devices should be used under the following recommended conditions.

Symbol	Description	MIN	MAX	Unit
V_{CC}	Gate Driver Supply Voltage	12	18	V
V_{BS}	Floating Supply Voltage	11.5	16.5	V
V_{PN}	DC Bus Supply Voltage	-	400	V
V_{IN_H}	PWM Input Voltage Logic High	3.0	Vcc	V
V_{IN_L}	PWM Input Voltage Logic Low	0.0	0.6	V
t_{Dead}	Prevent High Side & Low Side Short through Dead Time	1	-	us
T_A	Ambient Temperature (*Note 1)	- 40	125	℃

*Note 1：T_A is limited by Tj max., don't exceed its limitation.

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10.3 D.C. and A.C. Characteristics

V_{CC} = V_B = 15V, V_S = COM = 0V, T_A = 25 ºC, unless otherwise specified.

10.3.1 Inverter Part

Symbol	Description	Condition	MIN	TYP	MAX	Unit
Inverter Part						
BV_{DSS}	D-S Breakdown Voltage	V_{IN} = 0V, I_D = 250uA	600	-	-	V
I_{DSS}	Drain Leakage Current	V_{IN} = 0V, V_{DS} = 500V	-	-	1	uA
$R_{DS(ON)}$	On State Resistance	V_{CC} = V_{BS} = 15V, V_{IN} = 5V, I_D = 1.2A	-	1.1	1.3	Ω
V_{SD}	Diode Forward Voltage	V_{CC} = V_{BS} = 15V, V_{IN} = 0V, I_D = -1.2A	-	-	1.5	V
T_{ON}	Turn on Propagation Delay	V_{PN} = 310V V_{CC} = V_{BS} = 15V I_D = 1.0A V_{IN} = 0V~5V	-	400	-	ns
T_{OFF}	Turn off Propagation Delay		-	400	-	ns
T_{RR}	Reverse Recovery Time		-	120	-	ns
E_{ON}	Turn on Power Loss		-	35	-	uJ
E_{OFF}	Turn off Power Loss		-	5	-	uJ

10.3.2 Control Part

Symbol	Description	Condition	MIN	TYP	MAX	Unit
Control Part						
V_{IH}	Input High Threshold Voltage	INHx / INLx to COM	2.0	-	-	V
V_{IL}	Input Low Threshold Voltage	INHx / INLx to COM	-	-	1.2	V
UV_{BSR}	VBS under Voltage Protection Reset	-	7.2	8.2	9.2	V
UV_{BSD}	VBS under Voltage Protection Detection	-	6.4	7.3	8.3	V
UV_{CCR}	VCC under Voltage Protection Reset	-	8.0	8.9	9.8	V
UV_{CCD}	VCC under Voltage Protection Detection	-	7.5	8.4	9.3	V
I_{QBS}	Quiescent V_{BO} Current	V_{BS} = 15V, V_{IN} = 0V $V_{B(U)-U}$, $V_{B(V)-V}$, $V_{B(W)-W}$	-	20	-	uA
I_{QCC}	Quiescent V_{CC} Current	V_{CC} = 15V, V_{IN} = 0V	-	50	-	uA
I_{IN+}	Logic High Input Bias Current	V_{IN} = 5V	1.7	-	70	uA
I_{IN-}	Logic Low Input Bias Current	V_{IN} = 0V	-	0	5	uA
R_{TH}	NTC Resistance	T_{TH} = 25℃	-	47	-	KΩ
		T_{TH} = 100℃	-	3.1	-	KΩ

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10.3.3 Bootstrap Diode

Symbol	Description	Condition	MIN	TYP	MAX	Unit
Bootstrap Diode						
R_{BS}	Bootstrap Current Limit Resistance	-	-	310	-	Ω
V_{BDF}	Bootstrap Diode forward Voltage	I_F=1mA	-	0.7	-	V
V_{BDR}	Bootstrap Diode Reverse Breakdown Voltage	I_R=10uA	600	-	-	V

The switching time definition and evaluation method are shown in the figures below.

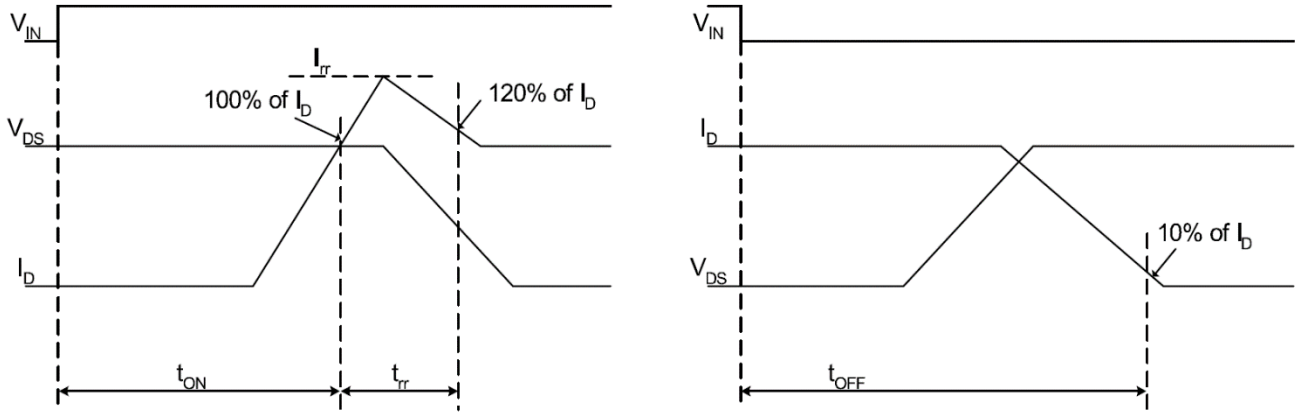


Fig.4 Switching Time Definitions

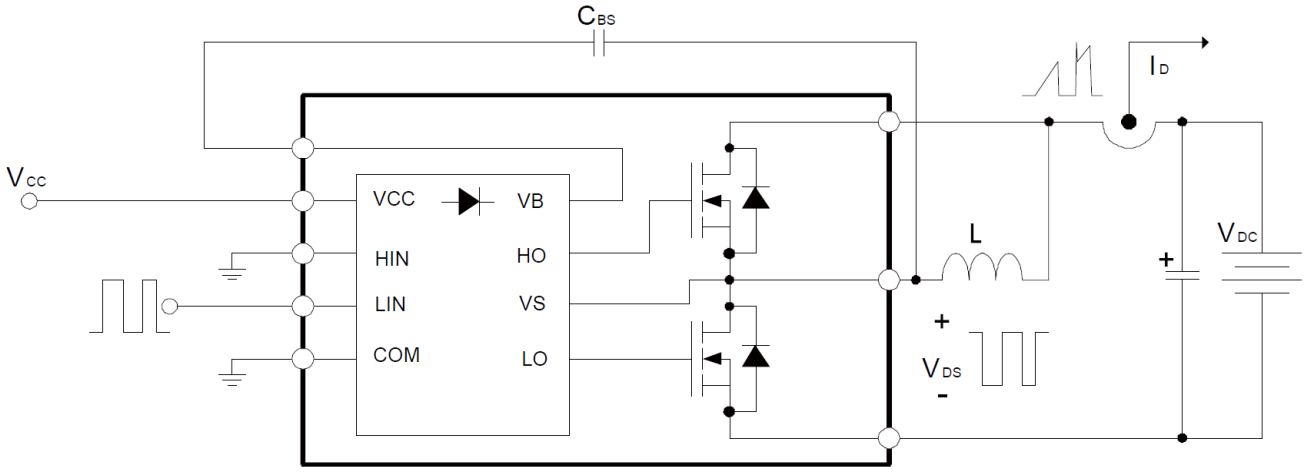


Fig.5 Switching Test Circuit (Low-side)

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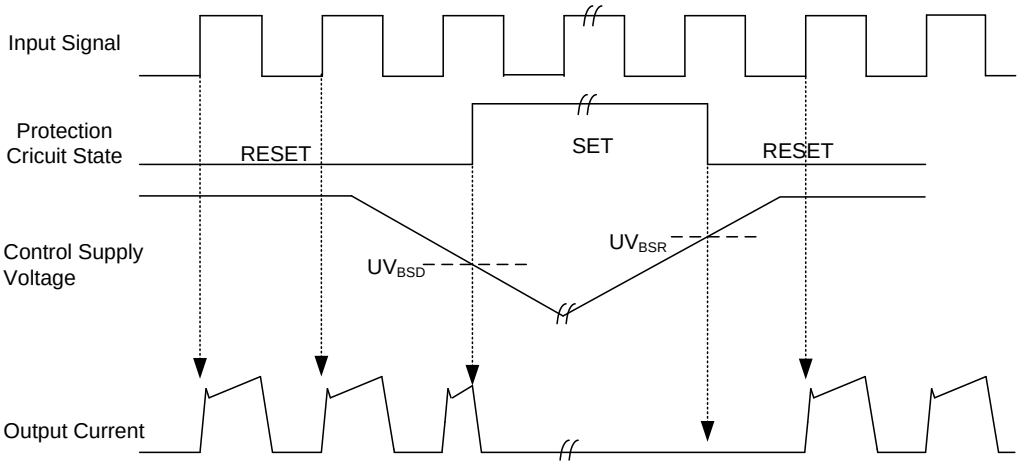


Fig.6 Under-Voltage Protection (Low-side)

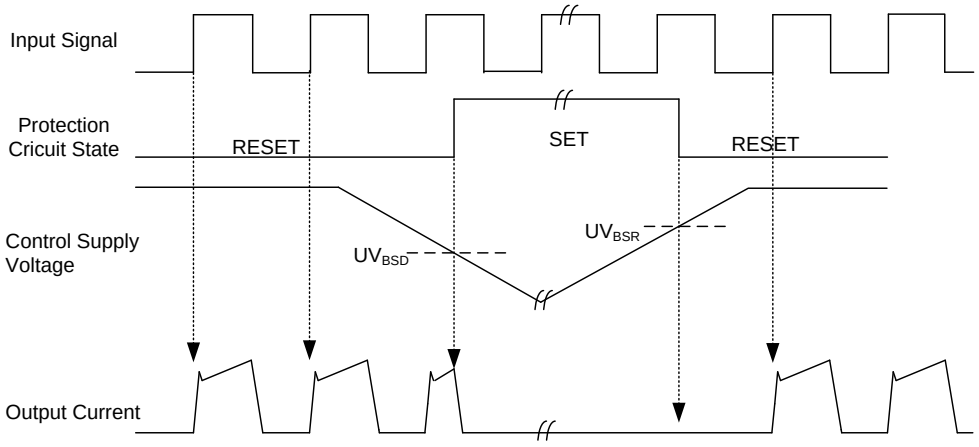
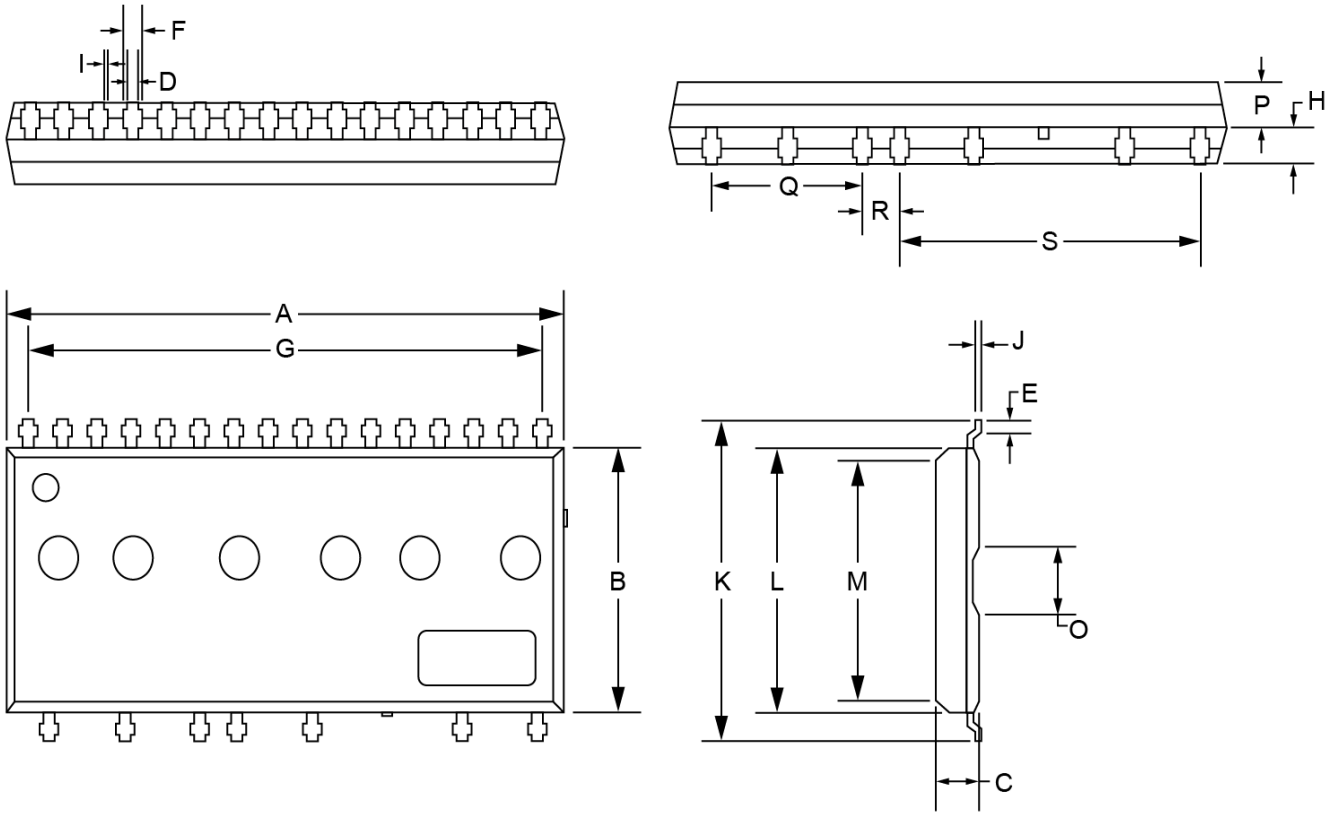


Fig.7 Under-Voltage Protection (High-side)

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11. Package Information

SOP-23H Outline Dimensions



SYMBOL	Dimensions in mm	
	MIN	MAX
A	28.80	29.20
B	11.80	12.20
C	3.05	3.25
D	0.50	0.70
E	1.05	1.75
F	0.75	1.05
G	26.37	26.97
H	1.15	1.45
I	0.00	0.15
J	0.40	0.60
K	16.70	17.30
L	10.80	11.20
M	9.90	10.30
O	2.58	2.78
P	1.70	2.00
Q	7.60	8.00
R	1.75	2.15
S	15.40	15.80

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