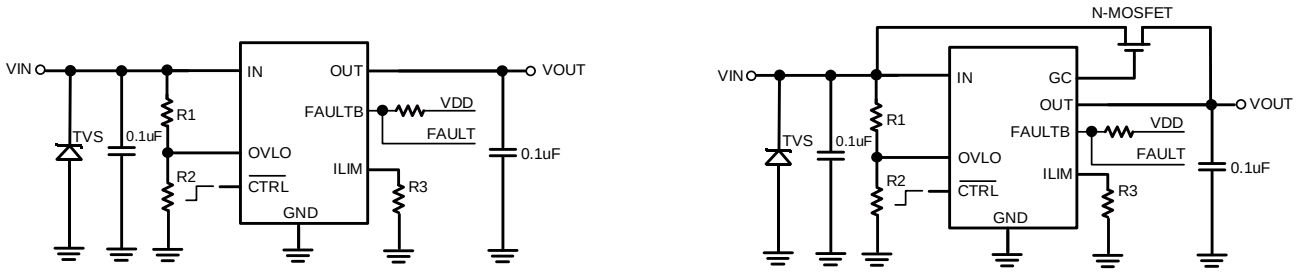
Over voltage and over current protector

Description

The P14C3N is an Over-Voltage-Protection (OVP) load switch with adjustable OVLO threshold voltage. The device will switch off internal MOSFET to disconnect IN to OUT to protect load when any of input voltage over the threshold.

When the OVLO input set below the external OVLO select voltage, the P14C3N automatically chooses the internal fixed OVLO threshold voltage. The over voltage protection threshold voltage can be adjusted with external resistor divider and the OVLO threshold voltage range is 4.0V~16V. The Over temperature protection (OTP) function monitors chip temperature to protect the device.

The P14C3ND is available in DFN2x2-8L package and the P14C3NS/P14C3NT is available in SOT23-6L package.



w/o external N-MOSFET application

w/i external N-MOSFET application

Figure 1: Typical Application

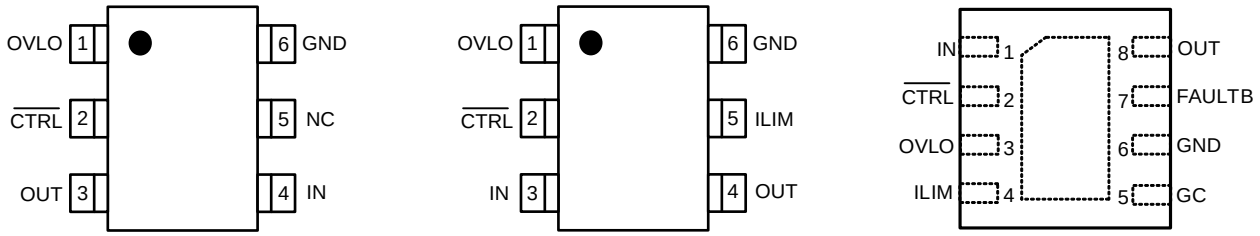


Figure 2: Pin order (Top view)

Feature

- Maximum input voltage: 40V
- Switch ON resistance: 79mΩ Typ.(DFN2x2-8L)
  85mΩ Typ.(SOT23-6L)
- Ultra fast OVP response time: 50ns Typ.
- Programmed over-current protection:
  200mA-3A
- Adjustable OVLO threshold voltage**:** 4.0V-16V,±3%
- Fixed internal OVLO threshold voltage: 6.0V, ±3%
- Over temperature protection

Application

- Mobile Handsets and Tablets
- Portable Media Players
- Peripherals

Pin Definitions

Pin No.			Symbol	Descriptions
P14C3ND	P14C3NS	P14C3NT		
1	4	3	IN	Switch Input and Device Power Supply.
2	2	2	$\overline{\text{CTRL}}$	OUTPUT power path is enabled when CTRL is logic low or floating.
3	1	1	OVLO	External OVLO adjustment. Connect a resistor-divider to set different OVLO threshold, V_{OVLO}=1.2x(1+R1/R2) as shown typical application diagram. Connect OVLO to GND when using the internal fixed threshold voltage. R2=120kohm is recommended.
4	NC	5	ILIM	Current limit adjustment. Connect a resistor to GND to set over current threshold. I_{Lim} = 5.6÷R3 (current in A, resistance in kΩ). For example, ILim = 1.0A if R3 =5.6kΩ. Short ILIM to GND will disable current limitation. An optional capacitor to GND for OCP response time setting.
5	—	—	GC	Gate control pin.
6	6	6	GND	Ground.
7	—	—	FAULTB	Fault indication, Open drain output, active-low at OTP, OCP, Chip disable and short status.
8	3	4	OUT	Switch Output to Load.

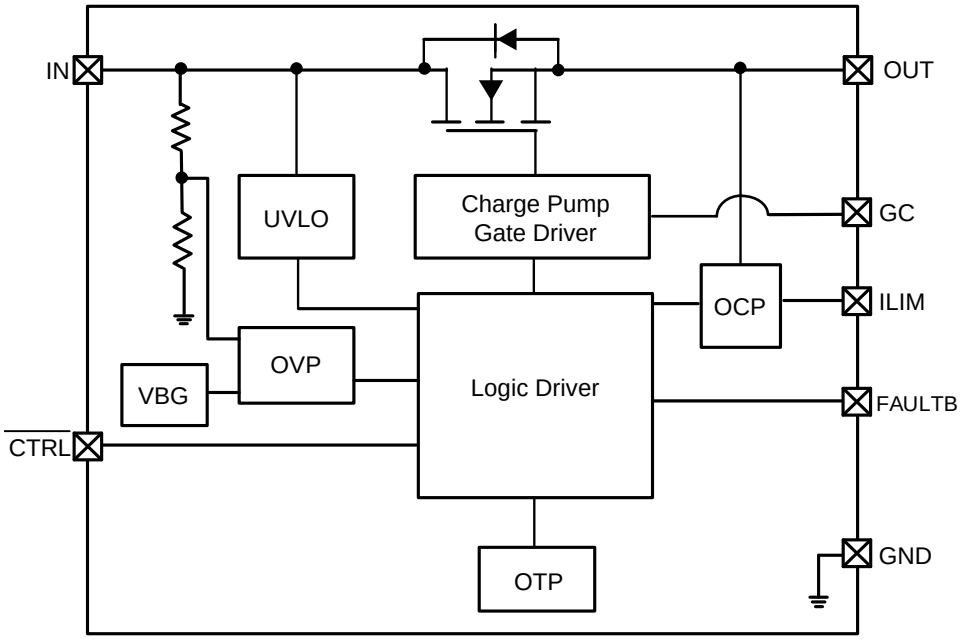


Figure 3: IC Block Diagram

Absolute Maximum Rating

Parameter(Note1)	Symbol	Value	Units
Input voltage (IN pin)	V_{IN}	-0.3 ~ 40	V
Output voltage (OUT pin)	V_{OUT}	-0.3 ~ 22	V
Input voltage (CTRL, OVLO pin)	V_{CTRL}, V_{OVLO}	-0.3 ~ 6.0	V
Junction temperature	T_J	150	℃
Lead temperature(10s)	T_L	260	℃
Storage temperature	Tstg	-55~150	℃
ESD Ratings	HBM	±2000	V
	CDM	±500	V

Note 1: Stresses greater than those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "Recommended Operating Conditions" is not implied. Exposure to "Absolute Maximum Ratings" for extended periods may affect device reliability.

Recommended Operating Conditions

Parameter	Symbol	Value	Units
Input voltage	V_{IN}	3.5~40	V
MAX Continuous Output current	I_{OUT}	2.5	A
Ambient operating temperature	Topr	-40~85	℃

Electrical Characteristic

（T_A=25℃，V_{IN}=5V，C_{IN}=0.1uF，C_{OUT}=0.1uF，unless otherwise specified.）

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
General Function						
Input voltage range	V_{IN}		3.5		40	V
Quiescent current	I_Q	No Load，CTRL=GND，OVLO=GND，V_{IN}=5V		100		uA
Over voltage quiescent current	I_{Q_OVP}	No Load，CTRL=GND，OVLO=GND，V_{IN}=30V		120		uA
Disable OVP quiescent current	I_{Q_DIS}	No Load，CTRL=5V，OVLO=GND V_{IN}=5V		4		uA
ON resistance	$R_{DS(ON)}$	V_{IN}=5V, I_{OUT}=1A, P14C3ND		79		mΩ
		V_{IN}=5V, I_{OUT}=1A, P14C3NT,P14C3NS		85		mΩ
Power on delay time	T_{ON_DELAY}	V_{IN}=0V to 5V		5		ms
Turn On Time	T_{ON}	V_{OUT}=V_{IN}*10% to V_{OUT}=V_{IN}*90%		150		us
CTRL high threshold voltage	V_{CTRL_H}	V_{CTRL} Rising	1.4			V
CTRL low threshold voltage	V_{CTRL_L}	V_{CTRL} Falling			0.4	V
UVLO threshold voltage	V_{UVLO}	V_{IN} Rising		2.07		V
UVLO hysteresis voltage	V_{UVLO_HYS}	V_{IN} Falling		40		mV
OVP Function						
OVP response time	T_{OVP}	V_{IN} Rising, C_{IN}=C_L=0pF		50		ns
OVP set threshold voltage	V_{OVLO_TH}			1.1		V
Adjust OVP voltage range	V_{OVP_EXTSEL}	V_{IN} Rising	4.0		16	V
	V_{OVP_INTSEL}		5.82	6.0	6.18	V
OVP hysteresis voltage	V_{OVP_HYS}			0.2		V
Output discharge resistance	R_{DCHG}	V_{IN}=5V		220		Ω
OCP Function						
OCP current	I_{OCP}	Current Rising	200		3000	mA
OCP accuracy	$A_{CCURACY\_IOCP}$	I_{OCP} < 1A	－15		＋15	%
		I_{OCP} ≥ 1A	－10		＋10	%
OCP deglitch time	$T_{DEGLITCH\_OCP}$			1.4		ms
OCP detect delay time at start-up	T_{OCP}	V_{IN}=0V to 5V		10		ms
Over current recover delay time	T_{OCR}			9		s
Start-up Protection Function						
Load capability at start-up	I_{LOAD_ON}		1			A
Output voltage at start-up	V_{OUT_OVP}	V_{IN}=0 to 15V		0		mV
SCP Function						
Current Limit at SCP	I_{SHORT_LIMIT}			0.7		A
SCP deglitch time	T_{DELAY_SHORT}			1.4		ms
Short recover delay time	T_{SCR}			9		s
OTP Function						
OTP threshold temperature	T_{OTP}	V_{IN}=5V		150		℃
OTP hysteresis temperature	T_{HYS}	V_{IN}=5V		30		℃

Typical Operating Performance

（T_A=25℃，V_{IN}=5V，V_{CTRL}=5V，unless otherwise specified.）

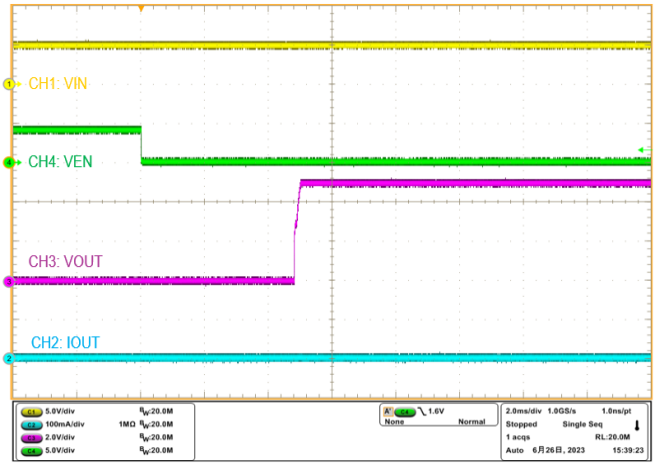


Figure 4. Enable，No Load

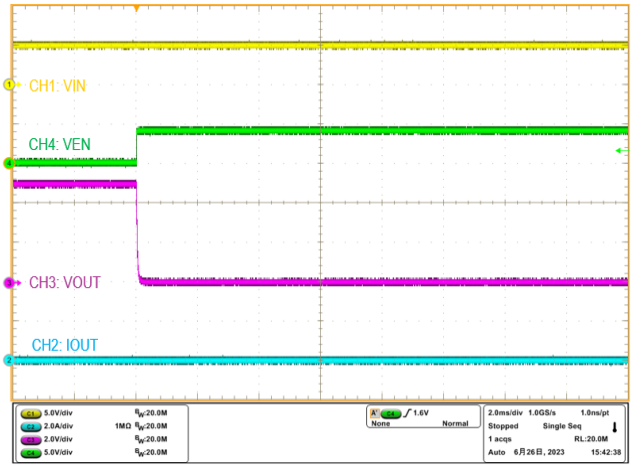


Figure 5. Disable，No Load

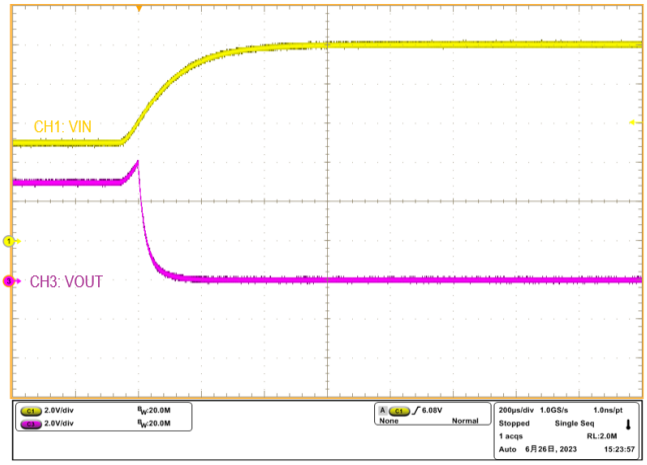


Figure 6. OVP Response

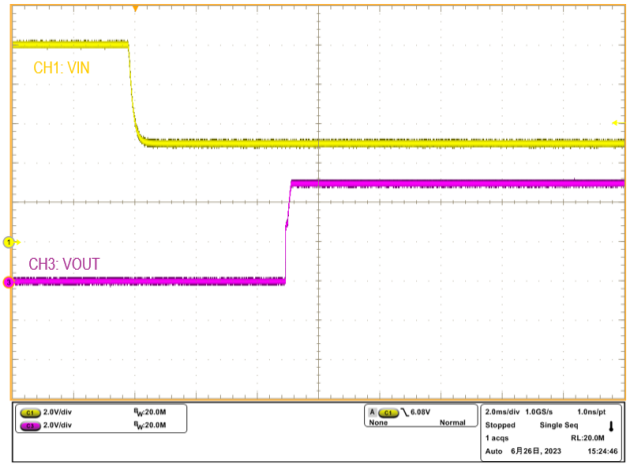


Figure 7. OVP Recovery Response

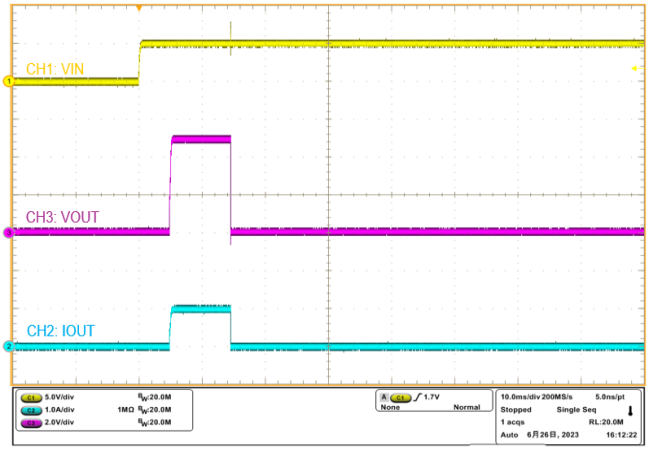


Figure 8. OCP Response at Start-up

（Rload=4Ω, Rlim=5.6kΩ）

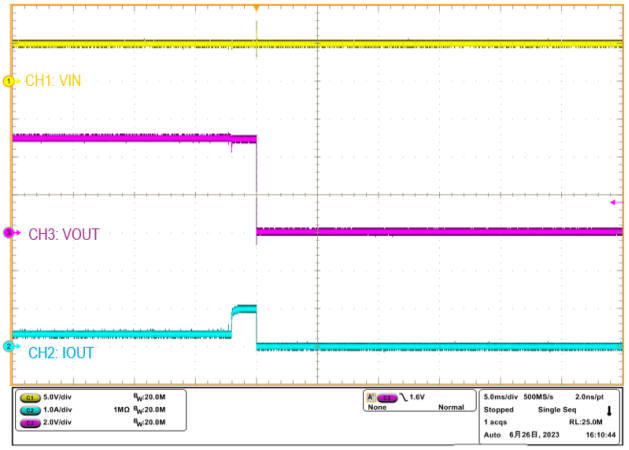


Figure 9. OCP Response after Start-up

（Rload=14Ω to 4Ω, Rlim=5.6kΩ）

Typical Operating Performance (continued)

（T_A=25℃，V_{IN}=5V，V_{CTRL}=5V，unless otherwise specified.）

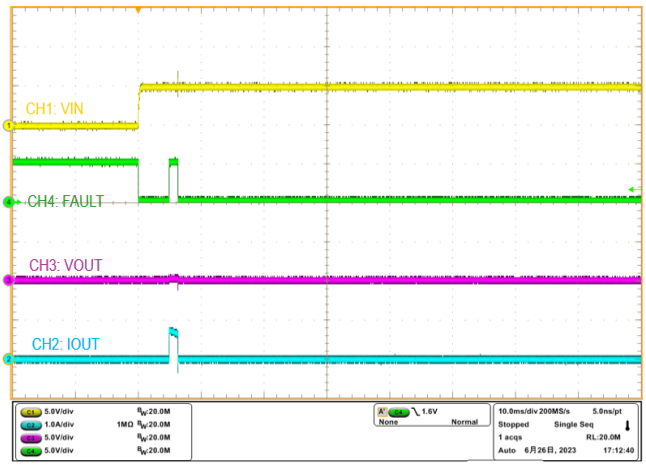


Figure 10. Fault Indication at SCP

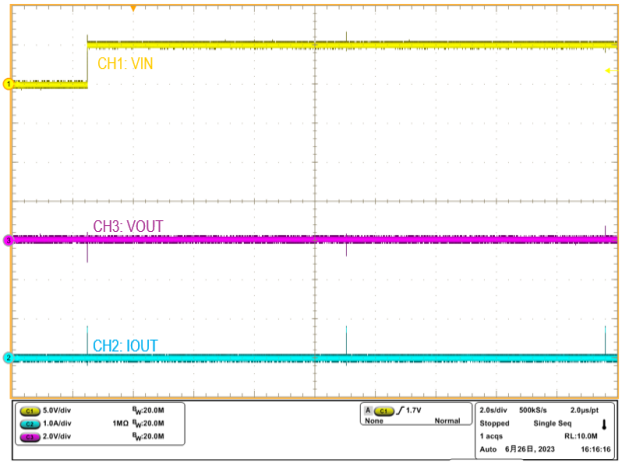


Figure 11. Short recover delay time

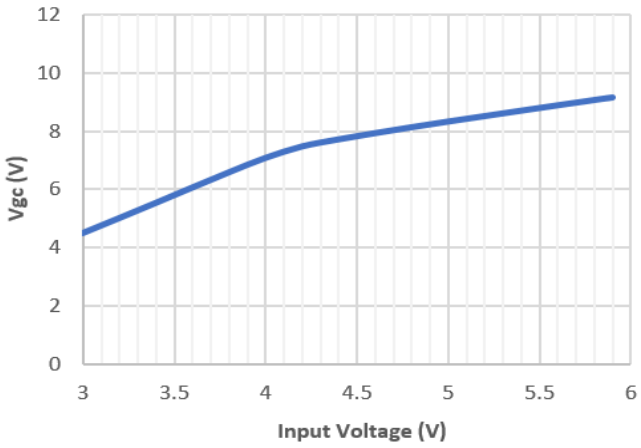


Figure 12. Gate Control Voltage vs. Input Voltage

Function Descriptions

Over Current Protection (OCP)

The Over Current threshold can adjustable by a external resistor connected from the ILIM pin to GND. In the application without external NMOS, the OCP threshold is calculated by the following formula:

I_{OCP}=5.6÷R3 (current in A, resistance in kΩ)

If the output current exceed the I_{OCP} threshold, the device limits the current for a blanking duration of T_{OCP}. If the over current situation exceeds the T_{OCP}, the switch will turned off, and the Fault pin is go low. The switch will re-soft start again after T_{OCR}.

In other applications of P14C3ND, an NMOS can be connected in parallel between the input and output of P14C3ND to reduce the on-resistance(see Figure1). The I_{OCP} setting in this application can be calculated by the following formula:

$$I_{OCP} = \left(\frac{RON_{NMOS}+RON_{P14C3N}}{RON_{NMOS}}\right) * \frac{5.6}{R3}$$, (current in A, resistance in kΩ)

RON_{NMOS}: On resistance of NMOS

RON_{P14C3N}: On resisntance of P14C3ND

Input Over Voltage Protection (OVP)

The P14C3N Input has an over voltage protection to protect system. When the V_{IN} voltage rises above V_{OVP_INTSEL} (fix 6.0V) or V_{OVP_EXTSEL} (set by external divider resistance), the system will turn the switch off. The external OVP threshold is calculated by the equation:

V_{OVP_EXTSEL} =1.2x(1+R1/R2). R2=120kΩ is recommended.

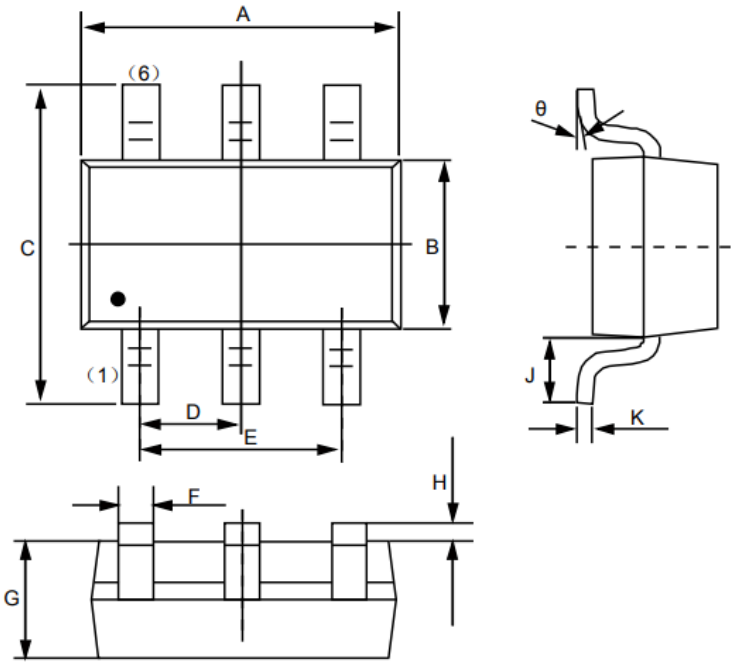
Under Voltage Lockout (UVLO)

The P14C3N had an UVLO internal circuit that enable the device once the V_{IN} voltage exceeds the UVLO threshold voltage.

Over Temperature Protection (OTP)

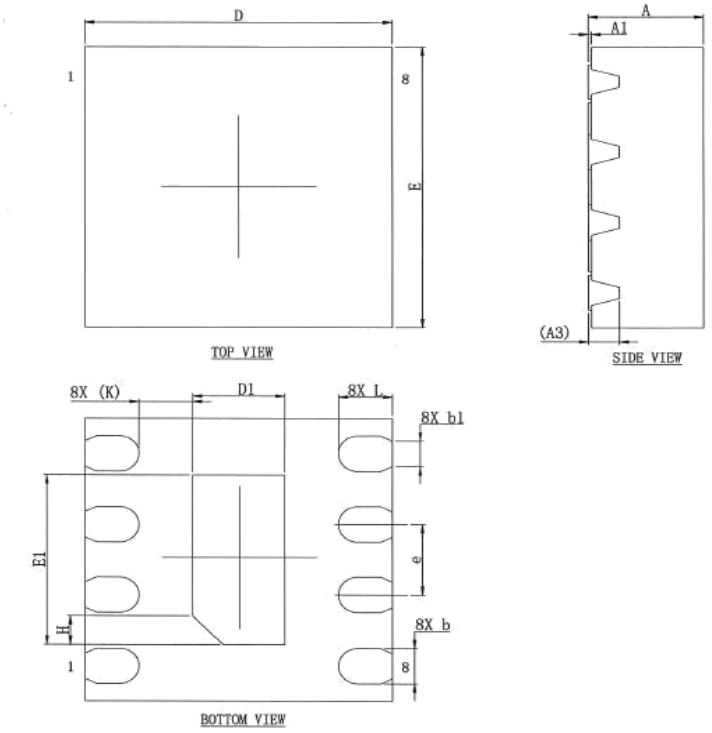
The device monitors the internal junction temperature to provide thermal shutdown. When IC junction temperature exceeds T_{OTP}(150 ºC), the switch is turned off. The output will restart when IC junction temperature is below T_{OTP}(150ºC) - T_{HYS} (30ºC).

Product Dimension (SOT23-6L)



Dim	Millimeters		
	MIN	NOM	MAX
A	2.87	2.92	2.97
B	1.55	1.60	1.65
C	2.72	2.80	2.88
D		0.95BSC	
E	1.80	1.90	2.00
F	0.30	0.35	0.45
G	1.06	1.15	1.24
H	0.01	0.05	0.09
J	0.55	0.60	0.65
K		0.127REF	
θ	0°	---	8°

Product Dimension (DFN2X2-8L)



Dim	Millimeters		
	MIN	Typ.	MAX
A	0.700	0.750	0.800
A1	0.000	0.020	0.050
A3	0.203REF		
b	0.200	0.250	0.300
b1	0.18REF		
D	1.900	2.000	2.100
E	1.900	2.000	2.100
e	0.500BSC		
D1	0.500	0.600	0.700
E1	1.100	1.200	1.300
L	0.300	0.350	0.400
K	0.350REF		
H	0.200REF		

IMPORTANT NOTICE

and Prisemi® are registered trademarks of **Prisemi Electronics Co., Ltd (**Prisemi**)** ,Prisemi reserves the right to make changes without further notice to any products herein. Prisemi makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does Prisemi assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. “Typical” parameters which may be provided in Prisemi data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including “Typical” must be validated for each customer application by customer’s technical experts. Prisemi does not convey any license under its patent rights nor the rights of others. The products listed in this document are designed to be used with ordinary electronic equipment or devices, Should you intend to use these products with equipment or devices which require an extremely high level of reliability and the malfunction of with would directly endanger human life (such as medical instruments, aerospace machinery, nuclear-reactor controllers, fuel controllers and other safety devices), please be sure to consult with our sales representative in advance.

Prisemi reserves the right to change the circuitry and/or specifications without notice at any time. Customers should obtain the latest relevant information and datasheets before placing orders and should verify that such information is current and complete.

Website: http://www.prisemi.com
For additional information, please contact your local Sales Representative.