Application Note: SY6818

High Current Overvoltage Protection Switch With Integrated Reverse Blocking FET

General Description

SY6818 is an over voltage protection switch with high current capability to prevent damage to the downstream system with low voltage rating. It achieves wide input voltage range from $2.5V_{DC}$ to $30V_{DC}$. Programmable OVP is available with simple external resistor divider. Integrated reverse blocking FET up to $20V$ rating prevents the leakage current from output side to input side when the input power supply is removed, but without output discharging. Extremely low power path resistance R_{PWPT} helps to reduce power loss during the normal operation. Enable control is available to cut off the energy path. High accuracy current indicator is employed internally. It integrates the over-temperature protection shutdown and auto-recovery with hysteresis to protect against over temperature events. It has a default over current protection up to 5A internally and auto-recovery. Each auto-recovery process is composed of deglitch time T_{DG} and switch turn-on time T_{ON}. This IC along with CSP-12, 1.73mmx1.73mm footprint provides small PCB area application.

Features

. V_{IN}=2.5V to 30V
. Integrated reverse blocking FET up to 20V rating for high voltage charging mode
. Extremely Low Power Path Resistance RPWPT
  ✍ R_{PWPT}=53mΩ typ.
. Programmable OVP thru external resistor divider, accuracy up to +/-3%
. Internal Soft Start to Prevent In-rush Current
. Thermal Shutdown Protection & Auto Recovery
. Current Indicator with High Accuracy up to +/-5%
. RoHS Compliant and Halogen Free
. Compact package: CSP-12 (1.73mmx1.73mm)

Applications

. Smart Phone
. Tablet PCs
. Mobile Device

Ordering Information

SY6818 ☐(☐☐)☐
└ Temperature Code
  Package Code
  Optional Spec Code
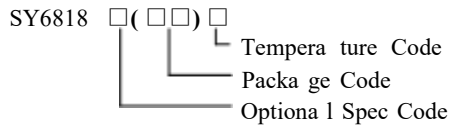
Ordering Number	Package Type	Note
SY6818PLC	CSP1.73x1.73-12	

Typical Applications
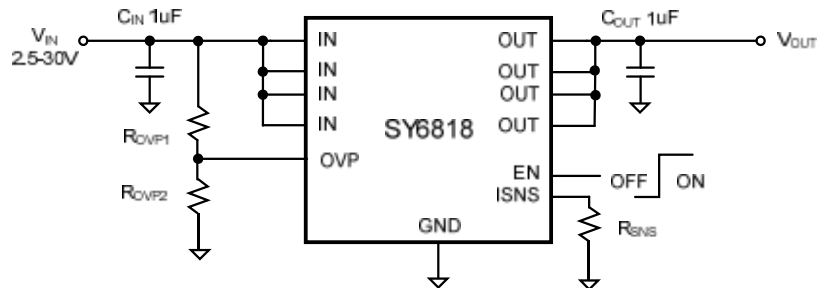
Figure 1. Schematic Diagram

Pinout (top view)
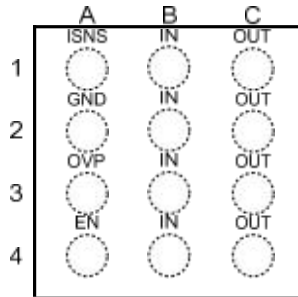
Part Number	Package type	Top Mark[①]
SY6818PLC	CSP1.73x1.73- 12	**ZQ***xyz*

Note①: x=year code, y=week code, z= lot number code.

| Pin Name	Pin Number	Pin Description
IN	B1,B2,B3,B4	Power input pin. Connect IN pin together. Decouple high frequency noise by connecting at least 0. 1uF MLCC to ground.
OUT	C1,C2,C3,C4	Output voltage pin. Connect OUT pins together for normal operation.
ISNS	A1	Current indicator pin. Connect a resister R_{SNS} from this pin to ground. The current flow is mirrored internally to charge R_{SNS} for the indication. The ratio of power current to mirrored current is 2.5k. The voltage on ISNS pin equals to $V_{ISNS}=(I_{OUT}/2.5k)*R_{SNS}$.
EN	A4	EN control pin. High logic enables all the internal circuit; low logic disables the internal energy flow path.
OVP	A3	External OVP program pin. Connect resistor divider to this pin to program the OVP threshold. The internal reference is at 1.26V. Pull down this pin to ground to disable external program function.
GND	A2	Power ground pin.

Absolute Maximum Ratings (Note 1)

IN, EN, OVP, -- 30V
OUT, --- 20V
ISNS, -- 6V
Continues IN, OUT current, -- 3A
Peak IN, OUT current (10ms), --- 5A
Power Dissipation, PD @ TA = 25°C CSP, -- TBD W
Package Thermal Resistance (Note 2)

        θ JA --- TBD °C/W

        θ JC --- TBD °C/W
Junction Temperature Range -- 150°C
Lead Temperature (Soldering, 10 sec.) --- 260°C
Storage Temperature Range ---65°C to 150°C

Recommended Operating Conditions (Note 3)

IN, EN, OVP, -- less than 30V
OUT, -- less than 20V
ISNS, --- less than 6V
Continues IN, OUT current, -- less than 3A
Peak IN, OUT current (10ms), --- less than 5A
Junction Temperature Range --- 40°C to 125°C
Ambient Temperature Range --- -40°C to 85°C

Block Diagram
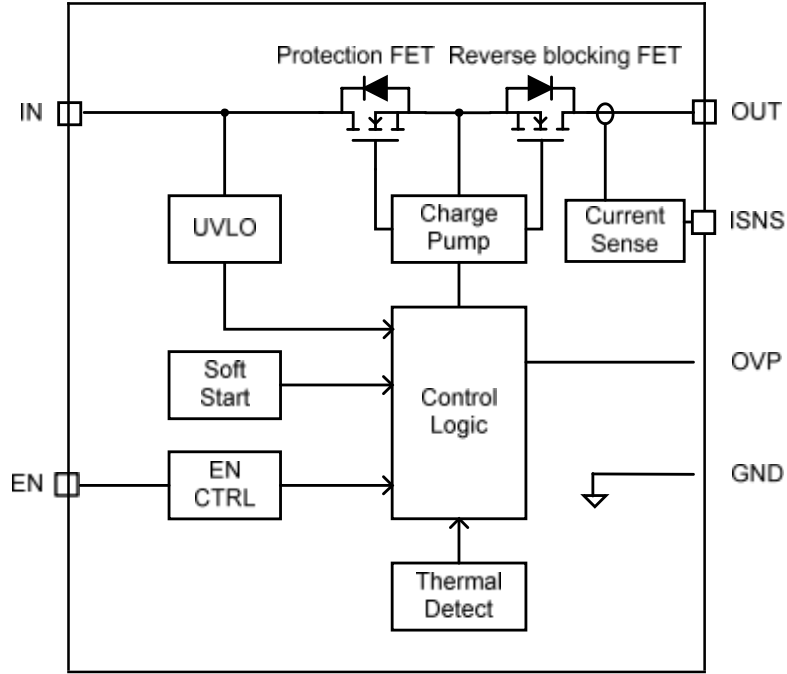
Electrical Characteristics

(V_{IN} = 2.5V to 30V, R_{ISNS}=1k, C_{IN}=1uF, C_{OUT}=1uF, T_A = 25°C, unless otherwise specified)

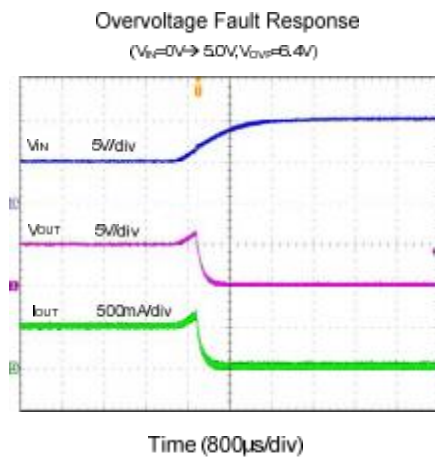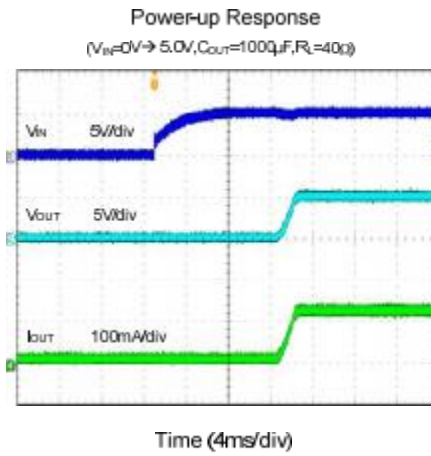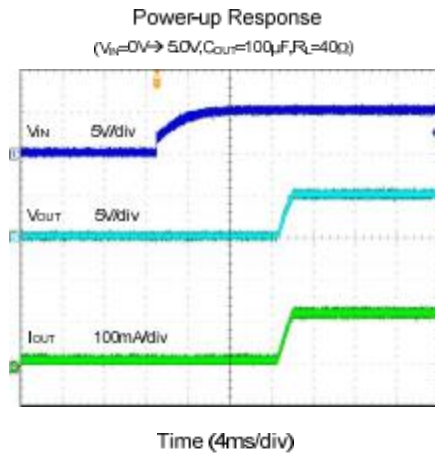| Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Input Voltage Range	V_{IN}		2.5		30	V
Input UVLO Threshold	V_{UVLO}				2.4	V
UVLO Hysteresis	V_{HYS}			0.1		V
Reverse Blocking Range	V_{RB}				20	V
Bias Current	I_{BIAS}	V_{IN}=5V		100		μA
Reverse Blocking Current	I_{RB}	V_{IN}=0V, V_{OUT}=16V, EN=0V		2	5	μA
Shutdown Current	I_{SD}	V_{IN}=5V, EN=0V		6	10	μA
		V_{IN}=30V, EN=0V		9	15	μA
Enable Threshold	V_{EN}	Rising	1.2			V
		Falling			0.5	V
OVP Program Threshold	V_{OVP}		1.22	1.26	1.30	V
Resistance of Power Path	R_{PWPT}	V_{IN}=5V, I_{OUT}=200mA, from IN to OUT	30	53	70	mΩ
Current Indicator Accuracy	V_{ISNS}	I_{OUT}=0.5A, R_{SNS}=1k	186	200	214	mV
		I_{OUT}=1.0A, R_{SNS}=1k	380	400	420	mV
Maximum Current Capability Note[4]	I_{MAX}			5		A
Output Load Capacitance	C_{OUT}	V_{IN}=5V			1000	μF
Deglitch Time	T_{DG}	Time from 2.5V<V_{IN}<V_{OVP} to V_{OUT}=10% of V_{IN}	6	11	16	ms
Switch Turn-On Time	T_{ON}	V_{IN}=5V, V_{OUT}=10% of V_{IN} to 90% V_{IN}	0.7	1.2	1.7	ms
Thermal Shutdown Temperature	T_{SD}			150		°C
Thermal Shutdown Hysteresis	T_{HYS}			20		°C

Note 1: Stresses beyond the "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.
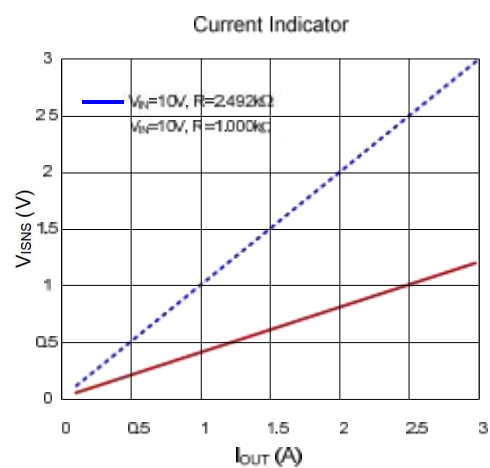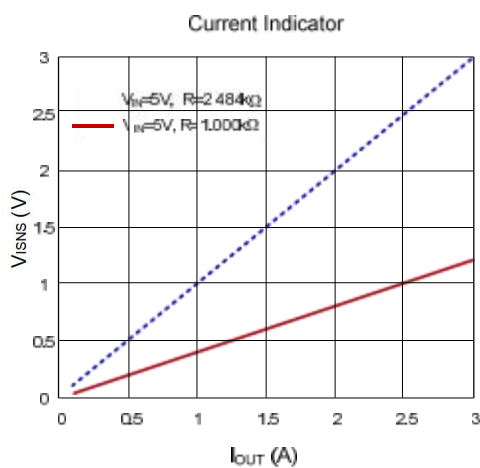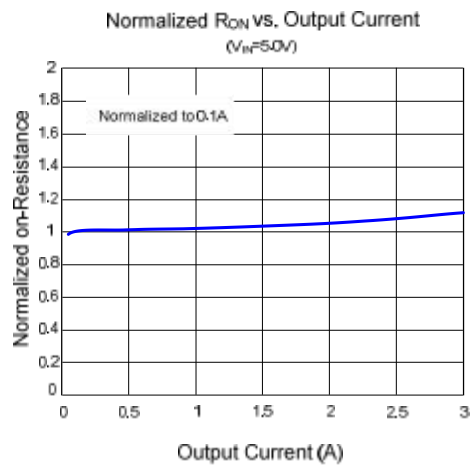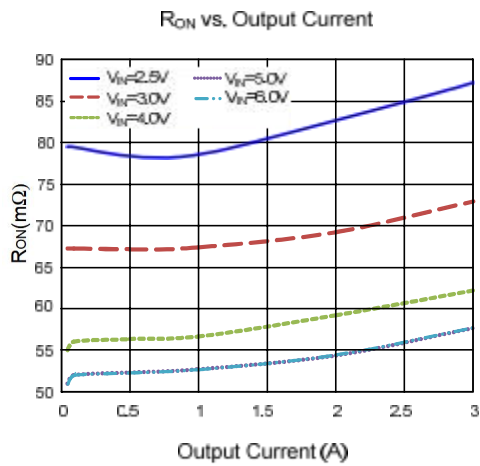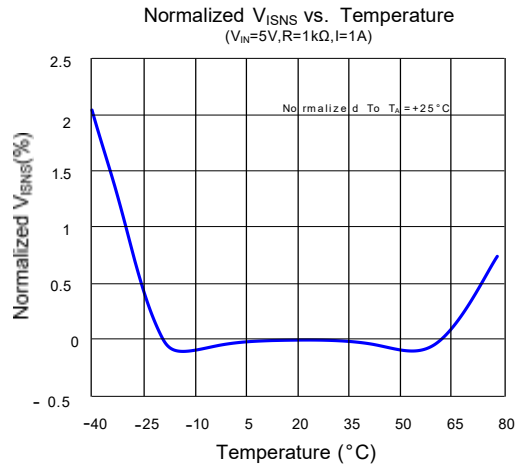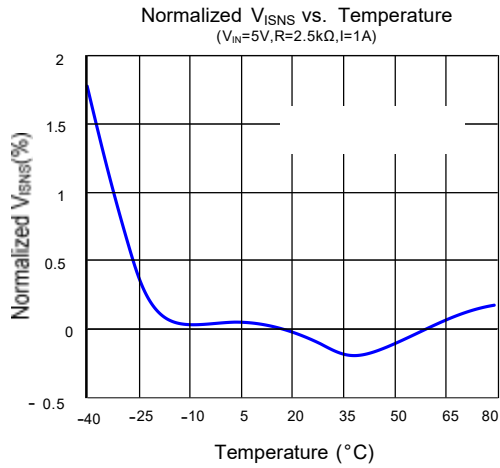
Note 2: θ_{JA} is measured in the natural convection at T_A = 25°C on a low effective single layer thermal conductivity test board of JEDEC 51-3 thermal measurement standard.

Note 3: The device is not guaranteed to function outside its operating conditions.

Note 4: These characteristics are design guaranteed, not test items.

Typical Operating Characteristics

Power-up Response
(V_{IN}=0V→ 5.0V,C_{OUT}=100µF,R_L=40Ω)

V_{IN} 5V/div

V_{OUT} 5V/div

I_{OUT} 100mA/div

Time (4ms/div)

Power-up Response
(V_{IN}=0V→ 5.0V,C_{OUT}=1000µF,R_L=40Ω)

V_{IN} 5V/div

V_{OUT} 5V/div

I_{OUT} 100mA/div

Time (4ms/div)

Overvoltage Fault Response
(V_{IN}=0V→ 5.0V,V_{OVP}=6.4V)

V_{IN} 5V/div

V_{OUT} 5V/div

I_{OUT} 500mA/div

Time (800µs/div)

Normalized R_{ON} vs. Temperature
(V_{IN}=5.0V,R_L=100Ω)

Normalized To T_A= +25°C

Normalized on-Resistance

Temperature (°C)

Normalized V_{ISNS} vs. Temperature
(V_{IN}=5V,R=2.5kΩ,I=3A)

Normalized V_{ISNS}(%)

Temperature (°C)

Normalized V_{ISNS} vs. Temperature
(V_{IN}=5V,R=1kΩ,I=3A)

Normalized To T_A=+25°C

Normalized V_{ISNS}(%)

Temperature (°C)

Normalized V_{ISNS} vs. Temperature
(V_{IN}=5V,R=2.5kΩ,I=1A)

Normalized V_{ISNS} vs. Temperature
(V_{IN}=5V,R=1kΩ,I=1A)

R_{ON} vs. Output Current

Normalized R_{ON} vs. Output Current
(V_{IN}=5.0V)

Current Indicator

Current Indicator

General Operation Description

SY6818 is an over voltage protection switch with high current capability to prevent damage to the downstream system with low voltage rating. It is designed for the applications of smart phone, PC tablets and other mobile devices especially. It operates with wide input voltage range from $2.5V_{DC}$ to $30V_{DC}$. The programmable OVP is available with simple external resistor divider. The integrated reverse blocking Power MOSFET up to 20V rating prevents the leakage current from output side to input side when the input power supply is removed or shorted suddenly, but without internal discharging circuit at the output side. Extremely low power path resistance R_{PWPT} is achieved to reduce the power loss during the normal operation. It is good for the overall system thermal design and the heat dissipation. Enable control is available to cut off the energy path to meet the requirement of startup sequence. Very high accuracy current indicator is employed internally. It is convenient to monitor the current flowing through the switch by reading the indicator voltage directly. It integrates the over-temperature protection shutdown and the auto-recovery with hysteresis to protect against over temperature events. It has a default over current protection up to 5A internally and auto-recovery. Each auto-recovery process is composed of deglitch time T_{DG} and switch turn-on time T_{ON}.

- Over Voltage Protection

SY6818 has an internal OVP threshold at 1.26V with around 20mV hysteresis. When the voltage on OVP pin is higher than the OVP threshold, the OVP is triggered and the internal power switch is turned off; when the voltage on OVP pin is lower than the OVP threshold minus the voltage hysteresis, the OVP recovers and the power switch is turned on again. Employing an external resistor divider, R_{OVP1} and R_{OVP2}, can program the input OVP point easily, as shown in (1).

$$V_{INOVP}= (R_{OVP1}+R_{OVP2})*1.26/R_{OVP2} \qquad (1)$$

- Leakage Current Reverse Blocking

SY6818 integrates back-to-back Power MOSFET to achieve leakage current reverse blocking. The reverse blocking function is implemented by switching off the back-to-back FET when the input side voltage drops lower than the output side voltage around 80mV. In this way, SY6818 can block the reverse energy flowing from the output side to the input side when the input power source is plugged out or the input side is shorted to ground. It is useful to protect the downstream battery powered system and prolong the battery lifetime. When the input side voltage rises higher than the output

voltage minus 50mV, the reverse blocking is relieved and the power MOSFET is able to switch on again.

- High Accuracy Current Indicator

SY6818 has a current indicator pin ISNS with very high accuracy. It is easily to monitor the current flowing through the power switch by reading the voltage on ISNS directly. The indication function is shown in (2). The voltage rating of this pin is 6V and SY6818 has a default current limit around 5A internally. Therefore, it is recommended strongly not to use an indication resistor too large, as shown in (3). When the current exceeds the default current limit, the power FET switches off and restarts automatically. The accuracy higher than 5% is achieved at 1A output current and that higher than 7% is achieved at 0.5A output current, as shown in Fig. 1 and Fig.2 respectively.

$$V_{ISNS}=(I_{OUT}/2.5k)*R_{SNS} \qquad (2)$$
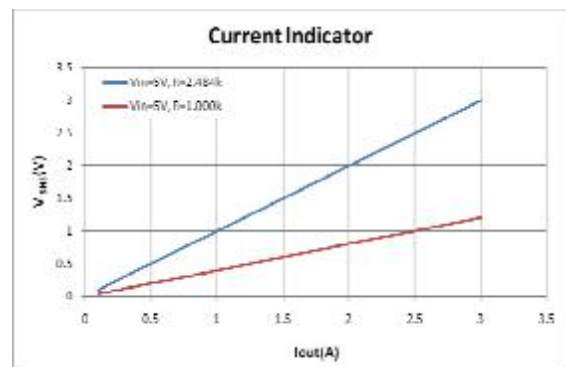
$$R_{SNS}<(V_{ISNS\_MAX}/I_{MAX})*2.5k \qquad (3)$$

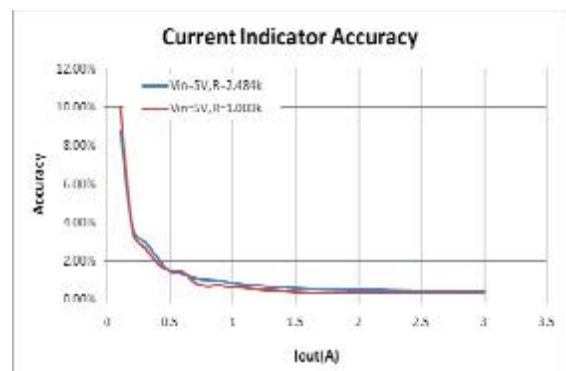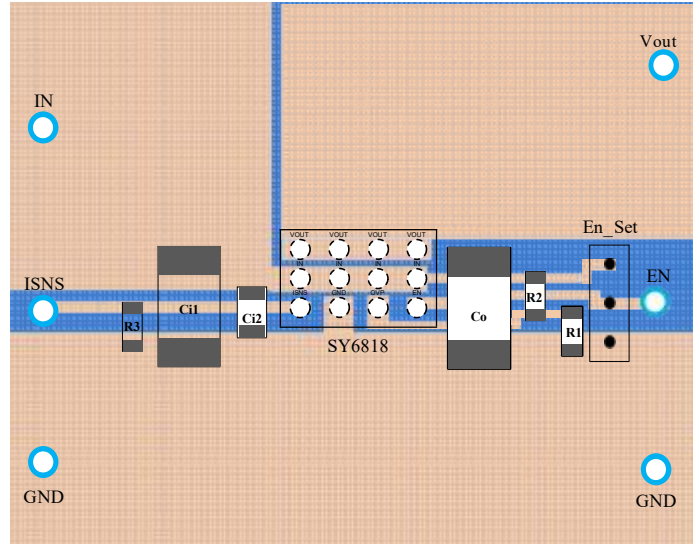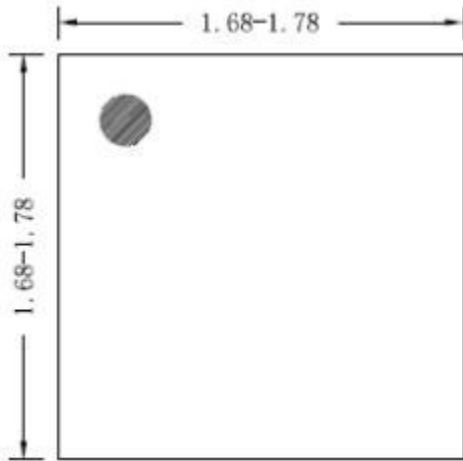Fig. 1 Relationship between V_{ISNS} and I_{OUT} with different R_{SNS}

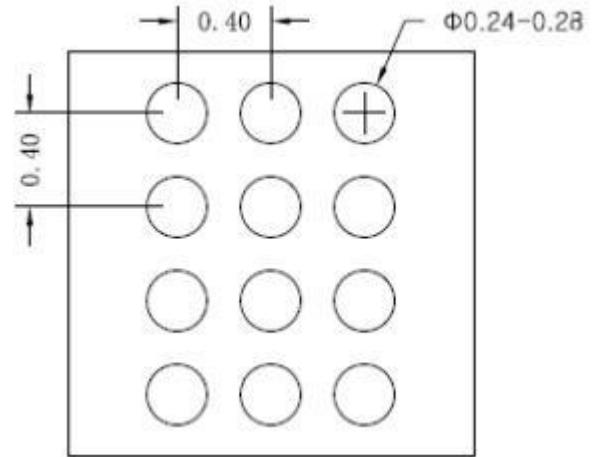Fig. 2 Accuracy of current indicator with different R_{SNS}

PCB Layout Suggestion

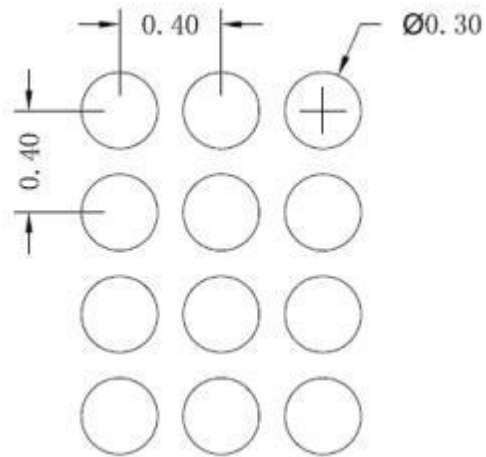## CSP1.73*1.73-12 Outline Drawing

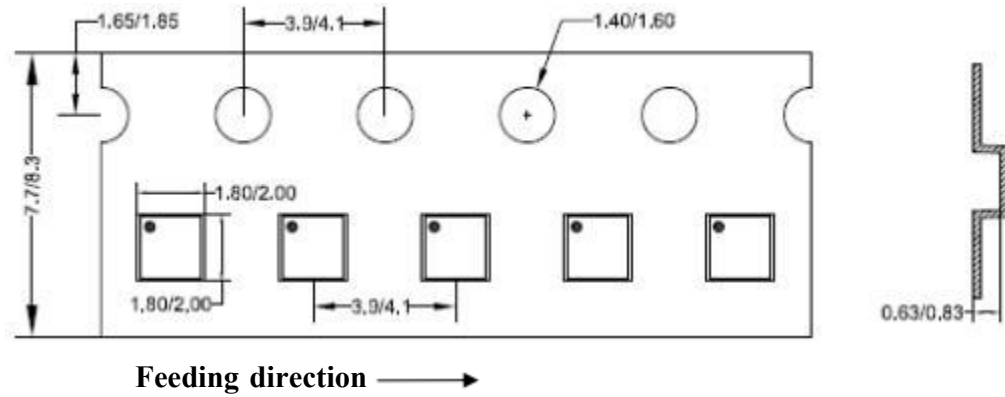**Top View**

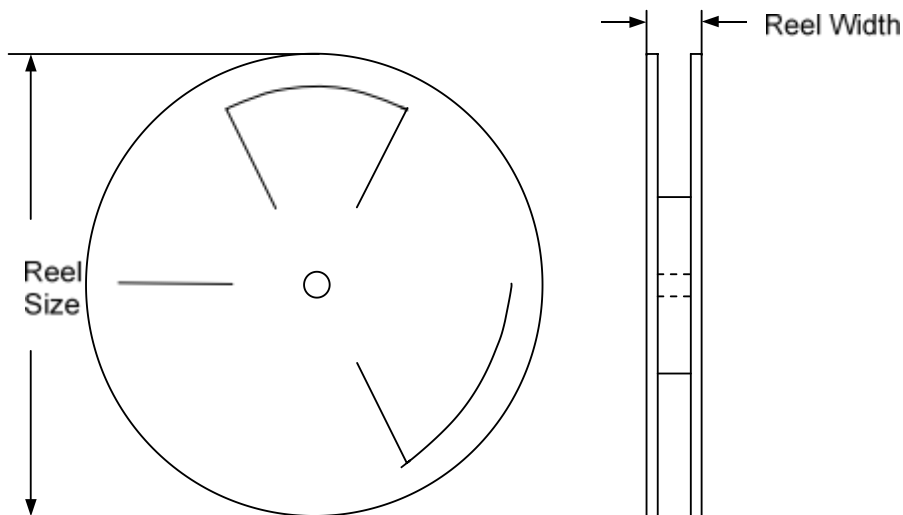**Bottom View**
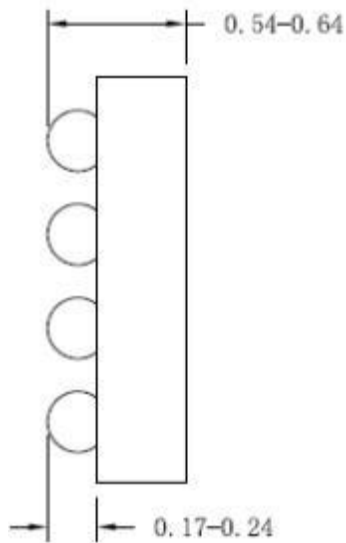
Side View

Recommended PCB layout

Notes: All dimension in MM and exclude mold flash & metal burr

Taping & Reel Specification

1. CSP1.73x1.73 taping orientation

Feeding direction ⟶

2. Carrier Tape & Reel specification for packages

Package types	Tape width (mm)	Pocket pitch(mm)	Reel size (Inch)	Reel width(mm)	Trailer length(mm)	Leader length (mm)	Qty per reel
CSP1.73*1.73	8	4	7"	8.4	400	400	3000

3. Others: NA