SY6287L

2A Adjustable Current Limit Load Switch with Latch Off Function

General Description

The SY6287L is an ultra-low $R_{DS(ON)}$ power distribution switch with 2A adjustable current limit to protect the power source from over current and short circuit conditions. It incorporates latch off function under over temperature protection or over current protection. And it has reverse blocking function to prevent reverse current flow from OUT to IN.

The device has a 150Ω pull-down resistor for quick output discharge when the switch is turned off.

Ordering Information

SY6287 □(□□)□
- Temperature Code
- Package Code
- Optional Spec Code

Ordering Number	Package Type	Note
SY6287LABC	SOT23-6	

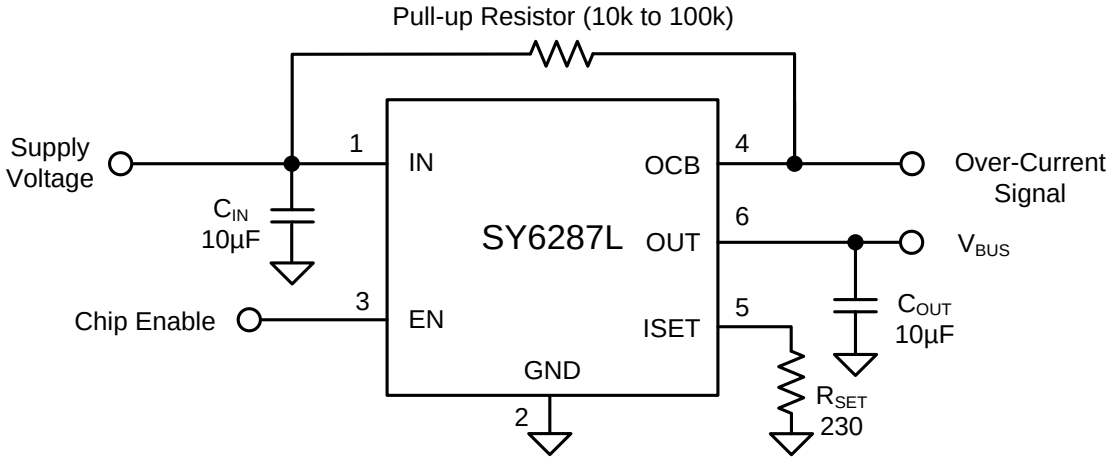
Features

- Input Voltage: 2.5V to 5.5V
- Extremely Low Power Path Resistance: 65mΩ (typ.)
- Adjustable Current Limit up to 2.0A
- Over Current/Temperature Protection with Latch Off Function
- Reverse Blocking (No Body Diode)
- Fault Flag (OCB) Output for Over Current and Fault Conditions
- At Shutdown, OUT Can be Forced Higher than IN
- Built-in Soft-start
- RoHS Compliant and Halogen Free
- Compact Package Minimizes the Board Space: SOT23-6

Applications

- USB 3.1 Application
- USB 3G Datacard
- USB Dongle
- MiniPCI Accessories
- USB Charger
- Public Place Multi-USB Charger
- PC Card Hot Swap Applications

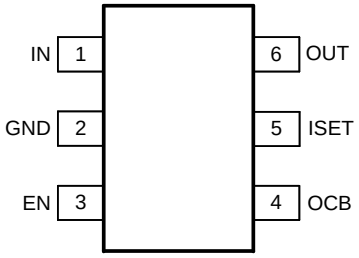
Typical Application Circuit



Note: If 0.1µF input cap will lead to large V_{IN} voltage spike, it is strongly recommended to add additional 10µF ceramic capacitor.

Figure1. Schematic Diagram

Pinout (Top view)



(SOT23-6)

Top Mark: N8*xyz* (device code: N8, ***x=year code, y=week code, z= lot number code)***

Pin Name	Pin number	Pin Description
IN	1	Input pin, decoupled with a 10μF capacitor to GND.
GND	2	Ground pin.
EN	3	ON/OFF control, active high. Do not leave it floating..
OCB	4	Open drain fault flag.
ISET	5	Current limit programming pin. Connect a resistor R_{SET} from this pin to ground to program the current limit: I_{LIM} (A)=230/R_{SET} (Ω)
OUT	6	Output pin, decoupled with a 10μF capacitor to GND.

Block Diagram

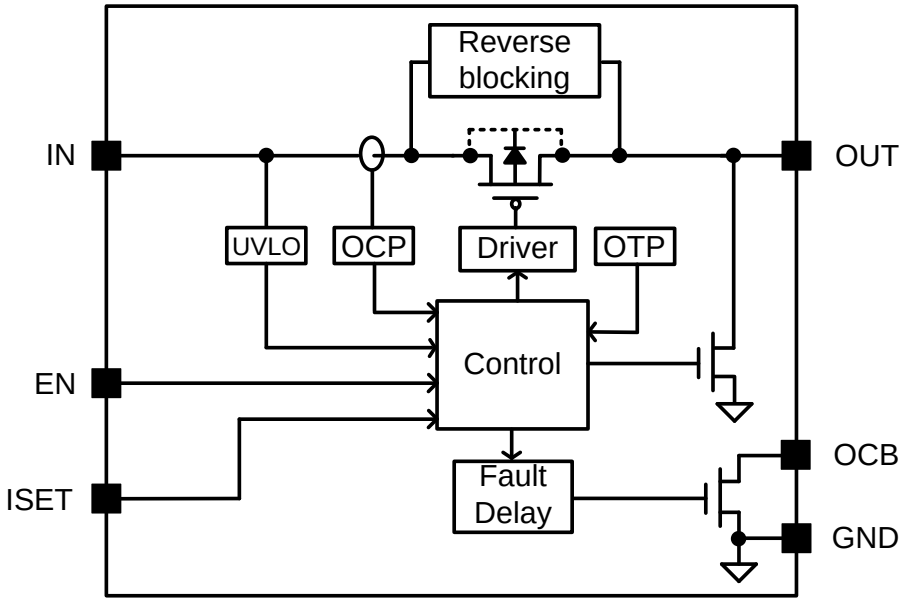


Figure2. Block Diagram

Absolute Maximum Ratings (Note 1)

IN, OUT ---------- -0.3V to 7V
ISET, OCB, EN---------- -0.3V to 7V
Power Dissipation, P_D @ T_A = 25°C SOT23-6, ---------- 0.94W
Package Thermal Resistance (Note 2)
θ_{JA} ---------- 106.4°C/W
θ_{JC} ---------- 41.7°C/W
Junction Temperature---------- 150°C
Lead Temperature (Soldering, 10 sec.) ---------- 260°C
Storage Temperature Range ---------- -65°C to 150°C

Recommended Operating Conditions (Note 3)

IN, OUT ---------- 2.5V to 5.5V
ISET, OCB, EN---------- 0V to 5.5V
Junction Temperature Range ---------- -40°C to 125°C
Ambient Temperature Range ---------- -40°C to 85°C

Electrical Characteristics

(V_{IN} = 5V, C_{OUT}=10μF, T_A = 25°C unless otherwise specified)

Parameter		Symbol	Test Conditions	Min	Typ	Max	Unit
Input Voltage Range		V_{IN}		2.5		5.5	V
IN UVLO Threshold		$V_{IN,UVLO}$				2.45	V
IN UVLO Hysteresis		$V_{IN,HYS}$			0.1		V
Shutdown Input Current		I_{SHDN}	Open load, switch off		0.1	5	μA
			Output grounded, switch off		0.1	5	μA
Reverse Leakage Current			IN tied to GND, V_{OUT}=5V		0.1	5	μA
Reverse Blocking Threshold		V_{RBT}	V_{OUT}-V_{IN}		100		mV
Reverse Blocking Recovery Threshold		V_{RBT_REC}	V_{OUT}-V_{IN}		-30		mV
Quiescent Supply Current		I_Q	Open load, switch on		45	100	μA
FET $R_{DS(ON)}$		$R_{DS(ON)}$	V_{IN}=5V, I_{OUT}=0.5A		65	100	mΩ
Current Limit		I_{LIM}	V_{OUT}=4V, R_{SET}=460Ω (Note5)	0.425	0.5	0.575	A
			V_{OUT}=4V, R_{SET}=153.3Ω(Note5)	1.382	1.5	1.617	A
EN	Logic-low Voltage	V_{IL}				0.4	V
	Logic-high Voltage	V_{IH}		1.0			V
EN Input Capacitor		C_{EN}	(Note 4)		1		pF
EN Leakage Current		I_{ENLK}				1	μA
Output Turn On Time		t_{ON}	R_L=10Ω, C_L=1μF. Measure from EN ON to V_{OUT} reach V_{IN}×90%	1	2	5	ms
Output Turn On Rise Time		t_R	R_L=10Ω, C_L=1μF. Measure from V_{OUT}=10% of V_{IN} to 90% of V_{IN}	1	2	5	ms

Output Turn Off Time	t_{OFF}	R_L=10Ω, C_L=1μF. Measure from EN OFF to V_{OUT} reach V_{IN}×10%		22		μs
Output Turn Off Fall Time	t_F	R_L=10Ω, C_L=1μF. Measure from V_{OUT}=90% of V_{IN} to 10% of V_{IN}		21		μs
OCB Low Resistance	R_{OCB}	V_{IN}=5V, I_L=10μA		9		Ω
		V_{IN}=3.3V, I_L=10μA		12		Ω
OCB Leakage Current	I_{LKG_OCB}	V_{OCB}=5V		0.01	1	μA
OUT Shutdown Discharge Resistance	R_{DSG}	EN=0, V_{OUT}=0.1V		150		Ω
Current Limit Latch Off Time	t_{OC_OFF}	I_{LOAD}=1.2I_{LIMIT} (Note 5). Measure from I_{OUT}>I_{LMT} to Power FET shutdown		2		ms
Current Limit Response Time	t_{OC_RES}	I_{LOAD}=1.2I_{LIMIT}(Note 4; Note 5)		25		μs
Over Current Flag Response Time	t_{OCB}	I_{LOAD}=1.2I_{LIMIT}(Note 5)		2		ms
Reverse Blocking Response Time	t_{RBT}	(Note 4)		800		ns
Thermal Shutdown Temperature	T_{SD}	(Note 4)		150		°C
Thermal Shutdown Hysteresis	T_{HYS}	(Note 4)		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 Silergy EVB test board of JEDEC 51-3 thermal measurement standard.

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

Note 4: Guaranteed by design but not production tested.

Note 5: Current limit threshold is determined by I_{LIM}=230V/R_{SET}, where R_{SET} is in Ω.

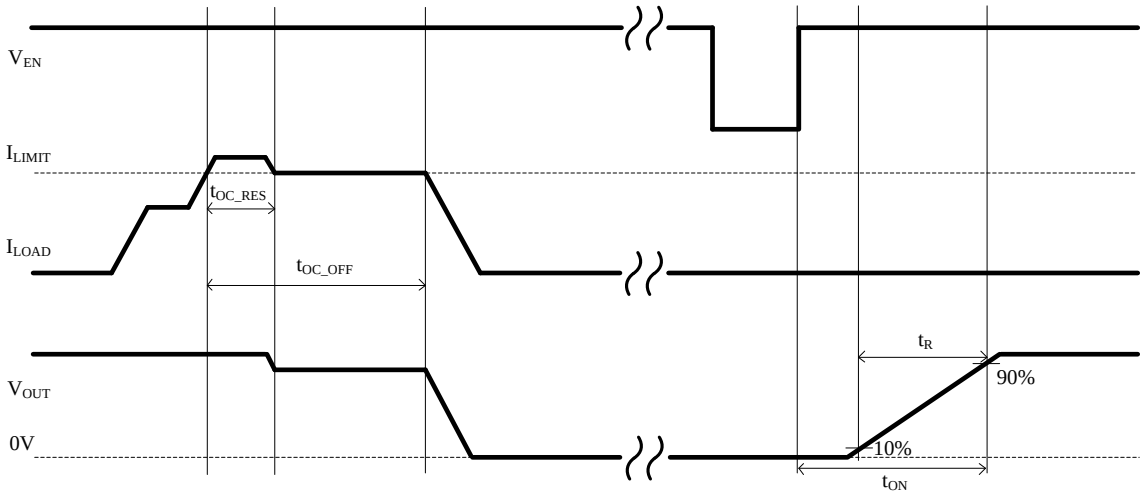
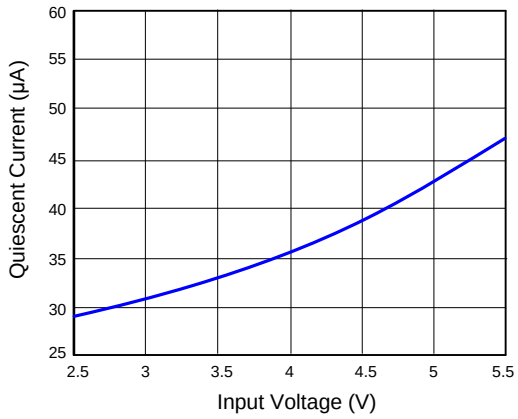


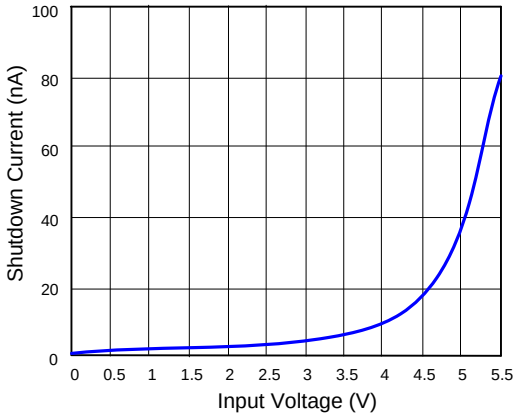
Figure3. Switching Time Waveform

Typical Performance Characteristic

Quiescent Current vs. Input Voltage

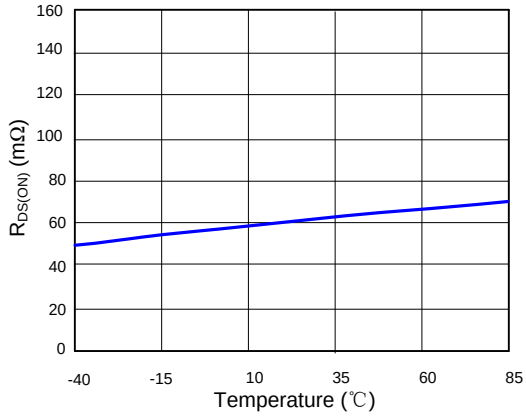


Shutdown Current vs. Input Voltage



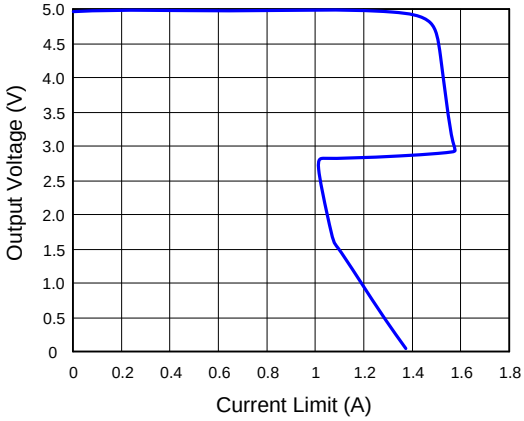
$R_{DS(ON)}$ vs. Temperature

(V_{IN}=5V, I_{OUT}=0.5A)



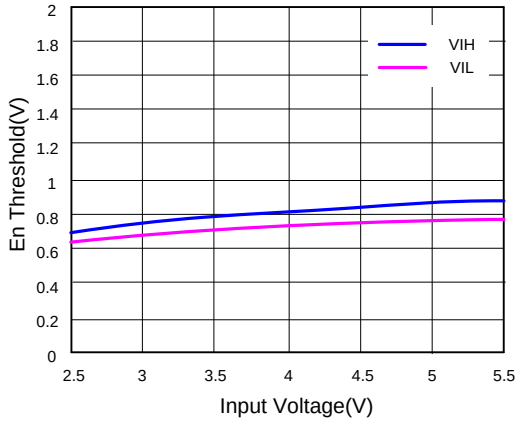
Current Limit vs. Output Voltage

(V_{IN}=5V, R_{SET}=154Ω)



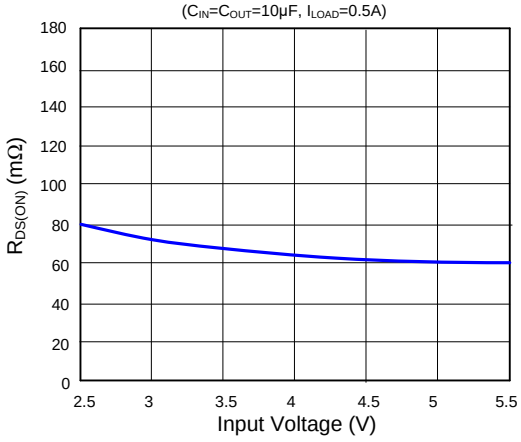
En Threshold vs. Input Voltage

(C_{IN}=C_{OUT}=10μF)



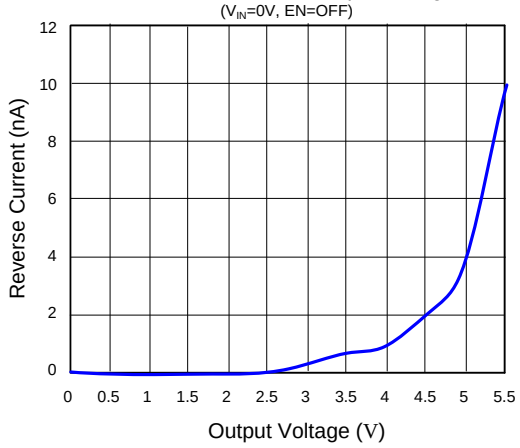
$R_{DS(ON)}$ vs. Input Voltage

(C_{IN}=C_{OUT}=10μF, I_{LOAD}=0.5A)



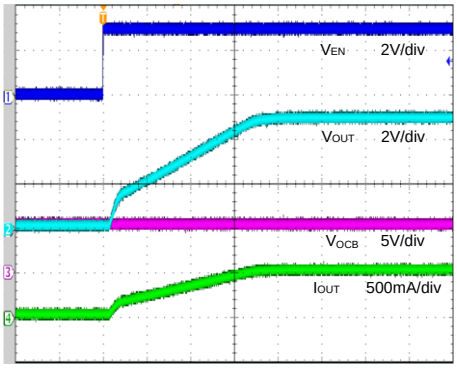
Reverse Current vs. Output Voltage

(V_{IN}=0V, EN=OFF)



Startup From Enable

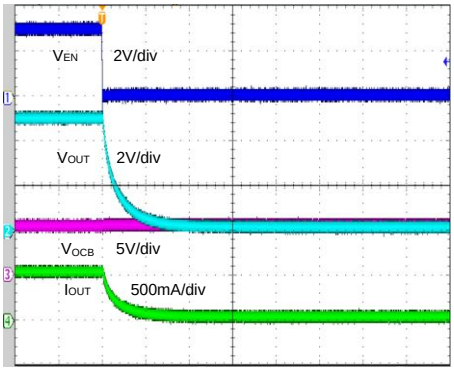
(V_{IN}=5V, C_{IN}= C_{OUT}=10μF, R_{SET}=154Ω, 10Ω Load)



Time (800μs/div)

Shutdown From Enable

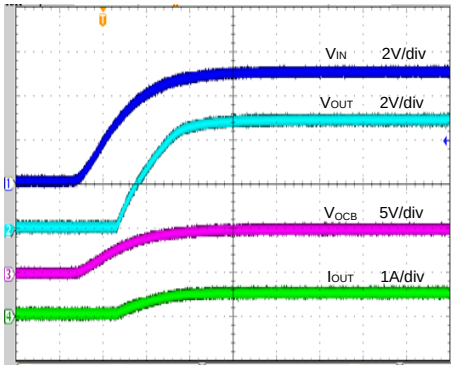
(V_{IN}=5V, C_{IN}= C_{OUT}=10μF, R_{SET}=154Ω, 10Ω Load)



Time (200μs/div)

Startup From V_{IN}

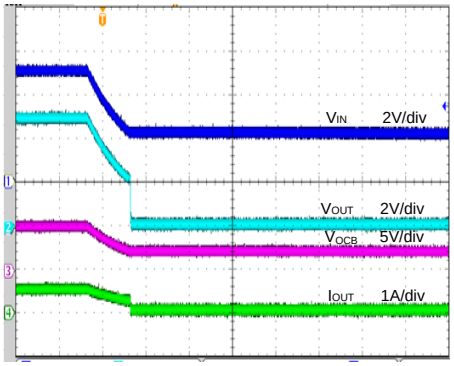
(V_{IN}=5V, C_{IN}= C_{OUT}=10μF, R_{SET}=154Ω, 10Ω Load)



Time (800μs/div)

Shutdown From V_{IN}

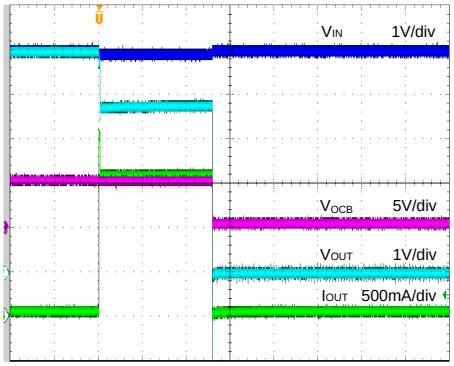
(V_{IN}=5V, C_{IN}= C_{OUT}=10μF, R_{SET}=154Ω, 10Ω Load)



Time (10ms/div)

Over Current Response

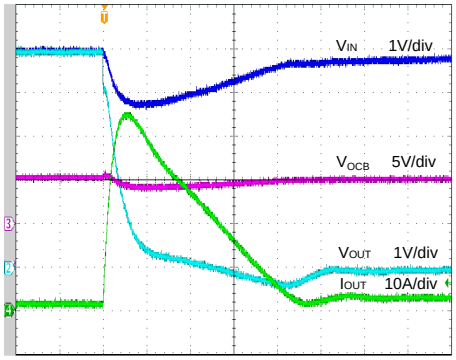
(V_{IN}=5V, C_{IN}=10μF, C_{OUT}=0μF, R_{SET}=154Ω, 2.5Ω Load)



Time (800μs/div)

Short Circuit Response

(V_{IN}=5V, C_{IN}=C_{OUT}=10μF)



Time (4μs/div)

Operation

The SY6287L is a current limited P-channel MOSFET power switch designed for USB load-switching or hot plug applications. It incorporates the over temperature protection and reverse blocking function, so the IC prevents current flow from OUT to IN when out being externally forced to a higher voltage than IN.

Over Current Protection

The SY6287L supports Current limit programming. Connect a resistor R_{SET} from the ISET pin to ground to program the current limit:

$$I_{LIM}(A) = 230 / R_{SET}(\Omega)$$

The minimum current limit is 0.2A. Current limit beyond 2.0A is not recommended.

When the over current condition is sensed, the gate of the pass switch is modulated to achieve constant output current. And the SY6287L will enter latch off mode when thermal shutdown protection is triggered or over current condition persists for 2ms. EN OFF then ON can reset the IC.

Table1. Current Limit vs. R_{SET}

$R_{SET}(\Omega)$	Current Limit Threshold(mA)		
	MIN	TYP	MAX
460.0	425	500	575
153.3	1380	1500	1620

The current limit of the device will be folded back at about 60%×I_{LIM} to decrease power dissipation when VOUT<50% ×V_{IN}.

Fault Flag(OCB)

The OCB output is asserted (active low) when thermal shutdown protection is triggered or over current condition persists for 2ms. The output remains asserted until fault condition is removed.

Supply Filter Capacitor

In order to prevent the input voltage drooping during hot-plug events, a 10μF ceramic capacitor from VIN to GND is strongly recommended. However, higher capacitor values could reduce the voltage droop on the input further. Furthermore, an output short will cause ringing on the input without the input capacitor. It could destroy the internal circuitry when the input transient exceeds the absolute maximum supply voltage even for a short duration.

Output Filter Capacitor

A 10μF output ceramic capacitor is recommended to be placed close to the IC and output connector to reduce voltage drop during load transient. Higher values of output capacitor can be used to further reduce the drop during high current application.

Reverse Block Function:

The SY6287L integrates reverse block function. Once the deviation voltage of OUT-IN exceeds 100mV, the reverse block function is triggered. The power FET will be shutdown in 800ns block the reverse current flow from OUT to IN.

PCB Layout Guide

For best performance of the SY6287L, the following guidelines must be strictly followed:

1) Keep all power traces as short and wide as possible and use at least 2 ounce copper for all power traces.

2) Locate the output capacitor as close to the connectors as possible to lower impedance (mainly inductance) between the port and the capacitor and improve transient performance.

3) Input and output capacitors should be placed closed to the IC and connected to ground plane to reduce noise coupling.

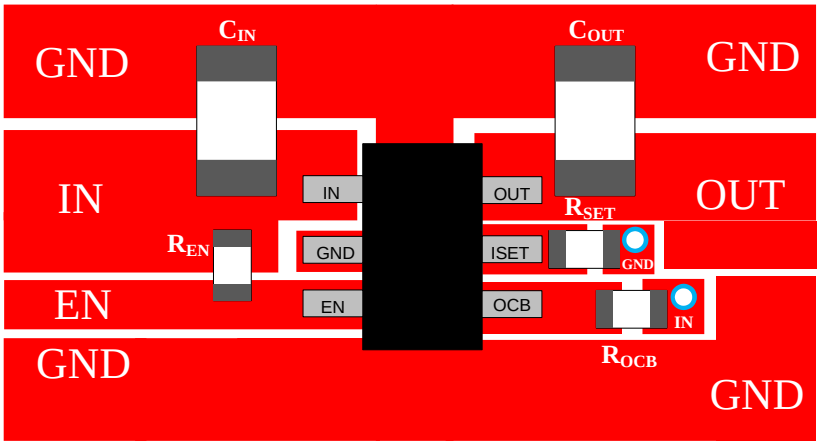
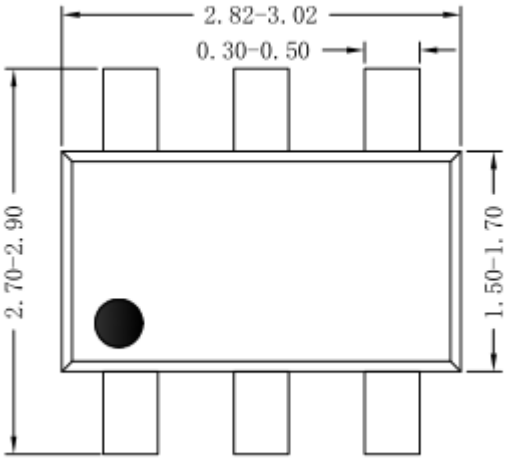
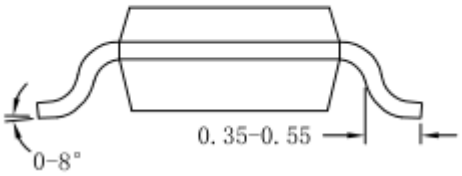


Figure4. PCB Layout Suggestion

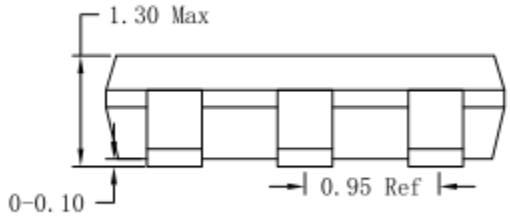
SOT23-6 Package Outline & PCB Layout



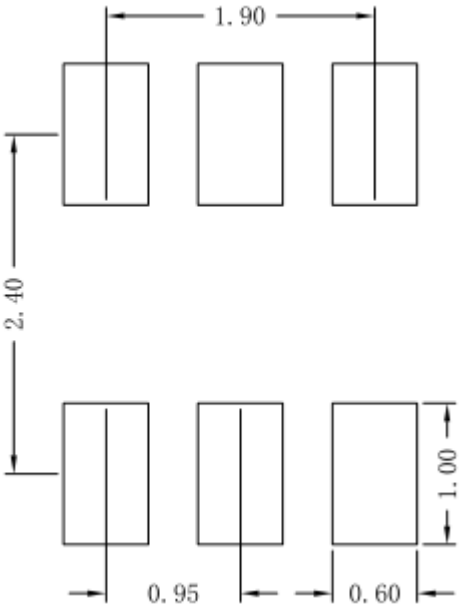
Top View



Side View



Side View



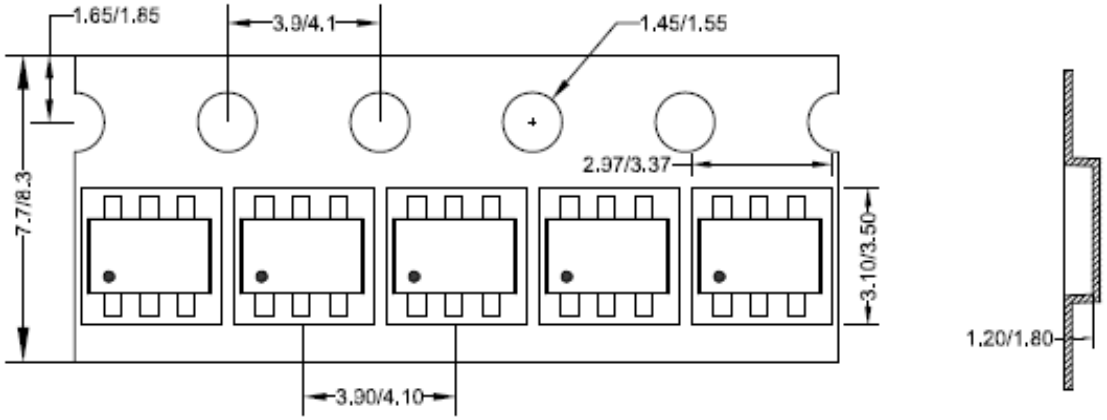
Recommended Pad Layout

Notes: **All dimension in millimeter and exclude mold flash & metal burr.**

Taping & Reel Specification

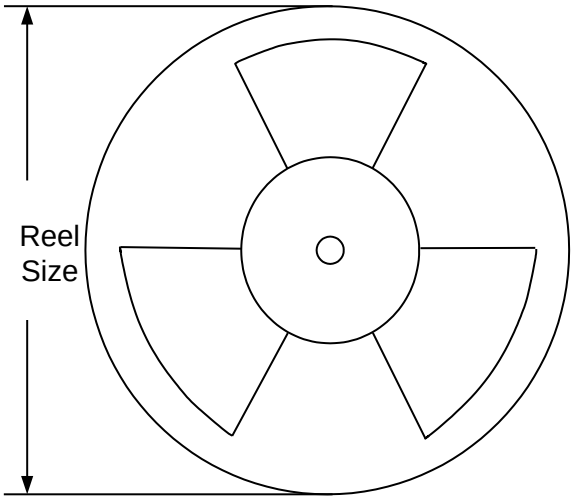
1. Taping Orientation

SOT23-6



Feeding direction ⟶

2. Carrier Tape & Reel Specification for Packages



Package types	Tape width (mm)	Pocket pitch(mm)	Reel size (Inch)	Trailer length(mm)	Leader length (mm)	Qty per reel
SOT23-6	8	4	7"	280	160	3000

3. Others: NA

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