SY20812C

Low Loss Power Distribution Switch with Programmable Current Limit

General Description

The SY20812C, ultra-low $R_{DS(ON)}$ switch with a resistor programmable current limit operates over an input voltage range of 2.5V to 5.5V. The device can be used to protect a power source from overcurrent and short-circuit conditions. It incorporates overtemperature protection and reverse blocking functions.

The SY20812C is available in a SOT23-5 package.

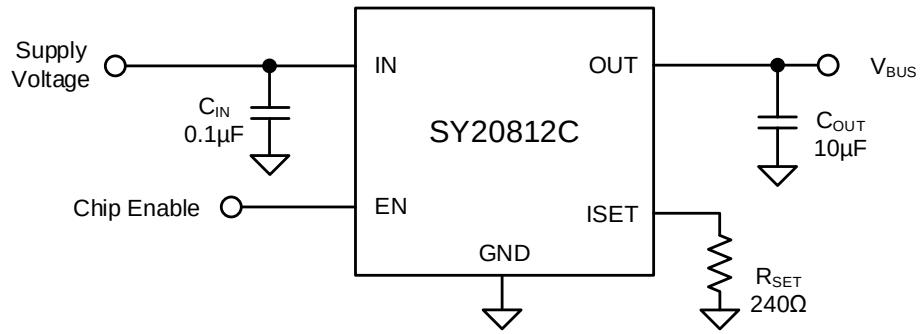
Features

- Input Voltage: 2.5V to 5.5V
- Low Power Path Resistance: 65mΩ (typ.)
- Quiescent Current I_Q 45 μA (typ.)
- Shutdown Current I_{SHDN} 0.1 μA (typ.)
- Adjustable Current Limit from 100mA to 2.5A
- Overtemperature Shutdown and Automatic Retry
- Reverse Blocking (No Body Diode)
- Output Capacitor Auto-Discharge
- Built-in Soft-Start
- RoHS Compliant and Halogen Free
- Compact Package: SOT23-5

Applications

- USB 3.1 Applications
- USB Dongles
- PC Accessories
- USB Chargers
- Public Place Multi-USB Chargers
- PC Card Hotswap Applications

Typical Application Circuit



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

Figure 1. Schematic Diagram

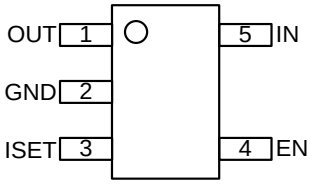
Ordering Information

SY20812 □(□□□)
- Package Code
- Optional Spec Code

Ordering Number	Package Type	Top Mark
SY20812CAAT	SOT23-5	**2Rxyz**

Device code: 2R
x=year code, y=week code, z= lot number code

Pinout (Top View)



(SOT23-5)

Pin Name	Pin Number	Pin Description
OUT	1	Output pin, Decouple with a 10μF capacitor to GND.
GND	2	Ground pin.
ISET	3	Current limit programming pin. Connect a resistor R_{SET} from this pin to the ground to program the current limit: I_{LIM} (A)=240/R_{SET} (Ω)
EN	4	ON/OFF control. Pull high to enable. Do not leave it floating.
IN	5	Input pin. Decoupled with a 0.1μF capacitor to GND.

Absolute Maximum Ratings

Parameter (Note 1)	Min	Max	Unit
IN, OUT, ISET, EN	-0.3	6	V
Lead Temperature (Soldering, 10s)		260	°C
Junction Temperature, Operating	-40	150	
Storage Temperature	-65	150	

Thermal Information

Parameter (Note 2)	Typ	Unit
θ_{JA} Junction-to-Ambient Thermal Resistance	106.4	°C/W
θ_{JC} Junction-to-Case Thermal Resistance	41.7	
P_D Power Dissipation T_A = 25°C	0.94	W

Recommended Operating Conditions

Parameter (Note 3)	Min	Max	Unit
IN, OUT	2.5	5.5	V
ISET, EN	0	5.5	
Junction Temperature, Operating	-40	125	°C
Ambient Temperature	-40	85	

Electrical Characteristics

(V_{IN} = 5V, C_{OUT}=10μF, T_A = 25°C, BOLD values indicate -40°C to 85°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		$I_{RVS, LKG}$	IN ties 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 (Note 5)	0.44	0.52	0.60	A
			V_{OUT}=4V, R_{SET}=153.3Ω (Note 5)	1.43	1.56	1.69	A
EN Threshold	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
Output Turn-on Time		t_{ON}	R_L=10Ω, C_L=1μF. Measure from EN ON to V_{OUT} reaches 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} reaches 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
OUT Shutdown Discharge Resistance		R_{DIS}	EN=0, V_{OUT}=0.1V		120		Ω
Thermal Shutdown Temperature		T_{SD}			150		°C
Thermal Shutdown Hysteresis		T_{HYS}			20		°C
Current Limit Response Time		$t_{OC,RES}$	I_{LOAD}=1.2×I_{LIMIT}		25		μs
Short Circuit Response Time		t_{OC}	I_{LOAD}=1.5×I_{LIMIT}		2		μs
Reverse Blocking Response Time		t_{RBT}	Note 4		800		ns

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 Silergy’s test board. Pin 2 of the SOT23-5 package is the case position for θ_{JC} measurement.

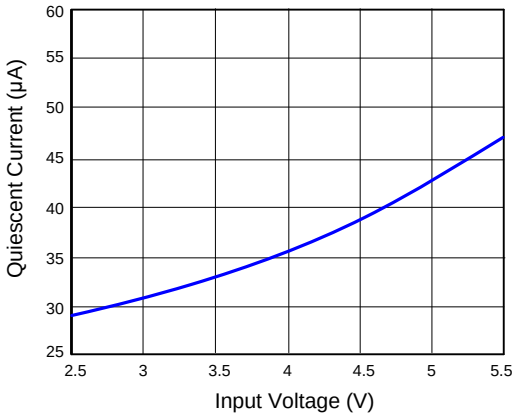
Note 3: The device is not guaranteed to function outside its operating conditions.

Note 4: Guaranteed by design but not production tested.

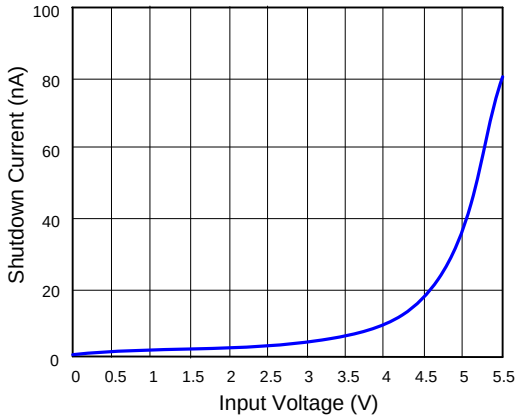
Note 5: The current limit threshold is determined by I_{LIMIT}=240V/R_{SET}, where R_{SET} is in Ω.

Typical Performance Characteristics

Quiescent Current vs. Input Voltage

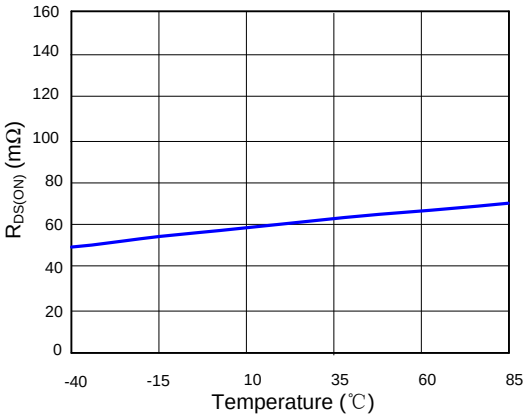


Shutdown Current vs. Input Voltage



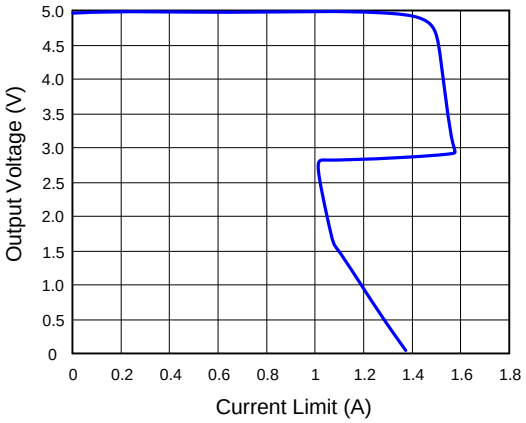
$R_{DS(ON)}$ vs. Temperature

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



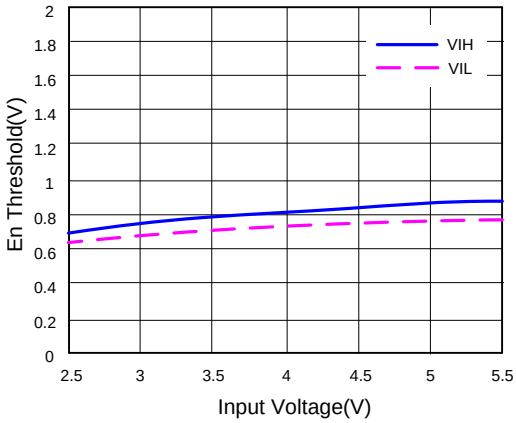
Current Limit vs. Output Voltage

(V_{IN}=5V, R_{SET}=154Ω)



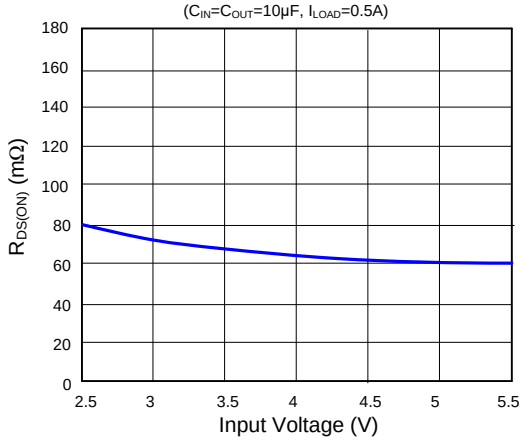
En Threshold vs. Input Voltage

(C_{IN}=C_{OUT}=10μF)



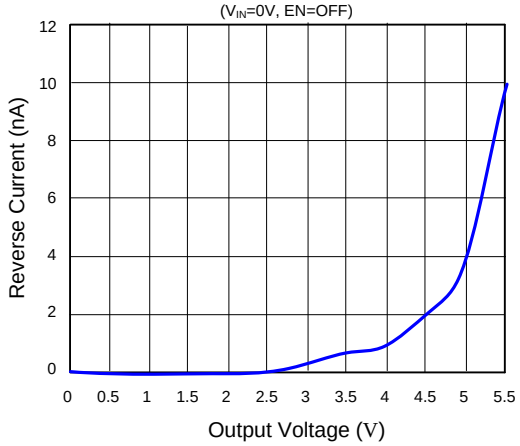
$R_{DS(ON)}$ vs. Input Voltage

(C_{IN}=C_{OUT}=10μF, I_{LOAD}=0.5A)



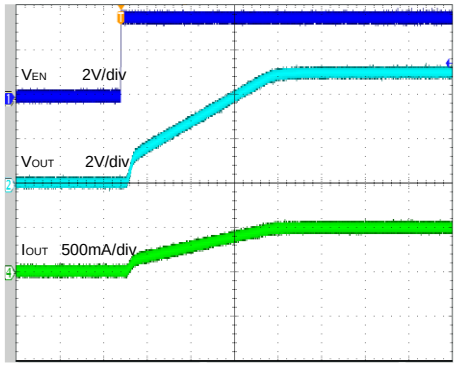
Reverse Current vs. Output Voltage

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



Startup from Enable

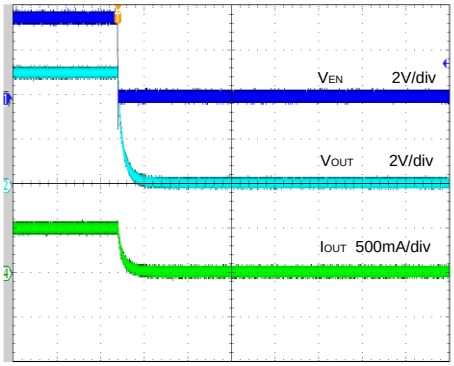
(V_{IN}=5V, C_{IN}= C_{OUT}=10μF, R_{SET}=154Ω, 10Ω Load)



Time (800μs/div)

Shutdown from Enable

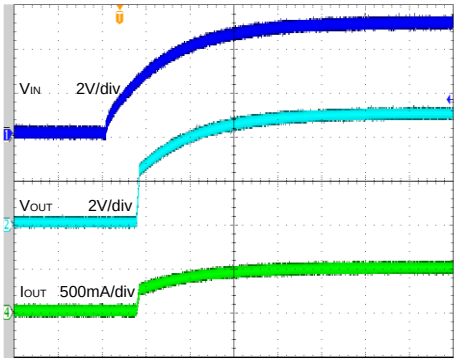
(V_{IN}=5V, C_{IN}= C_{OUT}=10μF, R_{SET}=154Ω, 10Ω Load)



Time (800μs/div)

Startup from V_{IN}

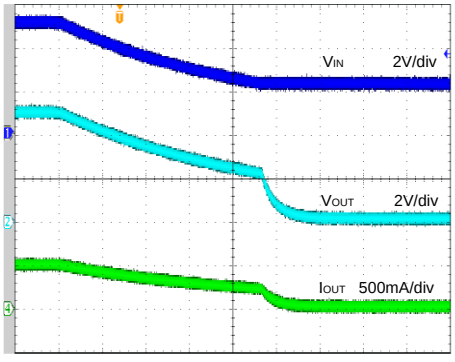
(V_{IN}=5V, C_{IN}= C_{OUT}=10μF, R_{SET}=154Ω, 10Ω Load)



Time (20ms/div)

Shutdown from V_{IN}

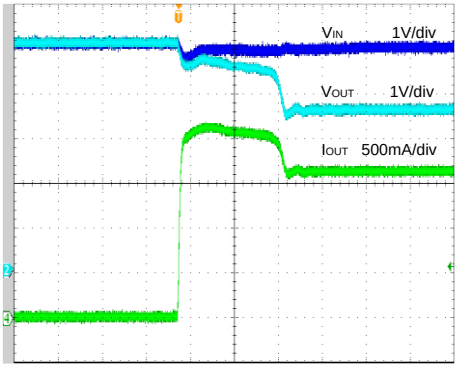
(V_{IN}=5V, C_{IN}= C_{OUT}=10μF, R_{SET}=154Ω, 10Ω Load)



Time (400μs/div)

Over Current Response

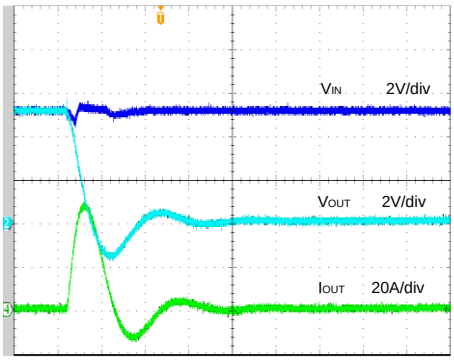
(V_{IN}=5V, C_{IN}= 10μF, C_{OUT}=0μF, R_{SET}=154Ω, 2.5Ω Load)



Time (10μs/div)

Short Circuit Response

(V_{IN}=5V, C_{IN}=C_{OUT}=10μF)



Time (10μs/div)

Application Information

The SY20812C is a current limited P-channel MOSFET power switch designed for USB load-switching or hotplug applications. It incorporates a reverse blocking function, which prevents current flow from OUT to IN when OUT is externally forced to a higher voltage than IN.

Overcurrent Protection:

The SY20812C supports current limit programming. Connect a resistor R_{SET} from ISET pin to the ground to program the current limit:

$$I_{LIM}(A) = 240 / R_{SET}(\Omega)$$

The minimum current limit is 0.1A. A current limit beyond 2.5A is not recommended. When the overcurrent condition is sensed, the gate of the pass switch is controlled to achieve a constant output current. If the overcurrent condition persists for a long time, the junction temperature may exceed 150°C, and the overtemperature protection circuit will shut down the part. When the device temperature drops below 130°C, the part will restart.

Table 1. Current Limit vs. R_{SET}

$R_{SET}(\Omega)$	Current Limit Threshold(mA)		
	MIN	TYP	MAX
460.0	440	520	600
153.3	1430	1560	1690

To prevent significant power dissipation, the current limit of the device is folded back to 60%×I_{LIMIT} when V_{OUT}＜50%×V_{IN}.

Supply Filter Capacitor:

In order to prevent an input voltage drop during hotplug events, a 10μF ceramic capacitor between VIN and GND pins is strongly recommended. Higher capacitor values can further reduce input voltage drop. Without an input capacitor, an output short can cause ringing on the input, which 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 device and output connector to reduce voltage drop during load transients. Higher output capacitor values can further reduce the voltage drop during high-current applications.

Reverse Block Function:

The SY20812C integrates a reverse blocking function. Once the voltage difference between the OUT and IN pins exceeds 100mV, the reverse blocking function will be triggered. The power MOSFET will be shut down in 800ns, blocking the reverse current flow from OUT to IN.

PCB Layout Guide:

For the best performance of the SY20812C, the following guidelines must be followed:

1. Keep all VBUS traces as short and wide as possible, and use at least 2 ounce copper for all VBUS traces.
2. Place the output capacitor as close to the connectors as possible to lower the impedance and inductance between the port and the capacitor and improve transient performance.
3. Place the input and output capacitors close to the device and connect them to the ground plane to reduce noise coupling.

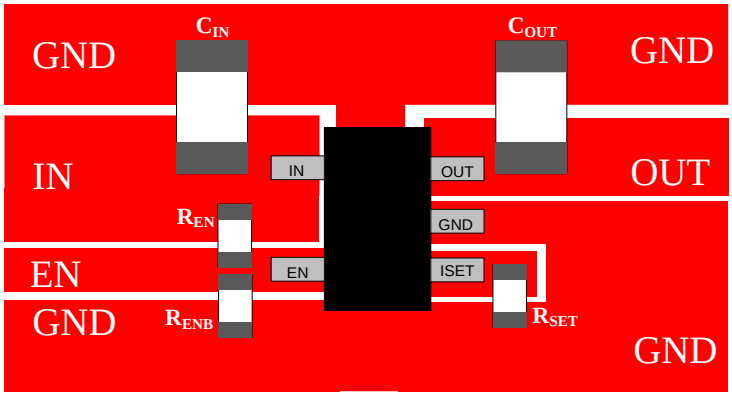
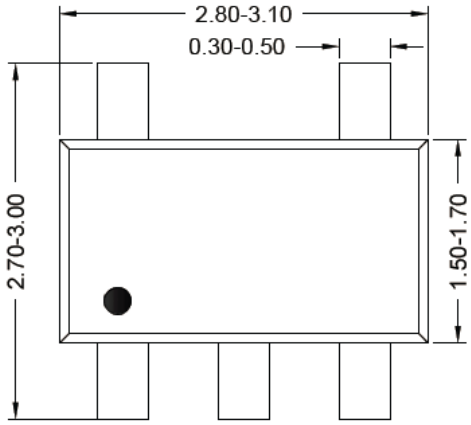
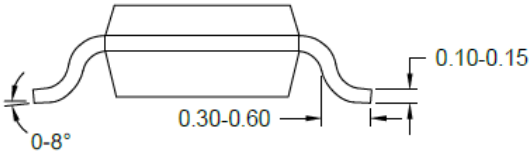


Figure 2. PCB Layout Suggestion

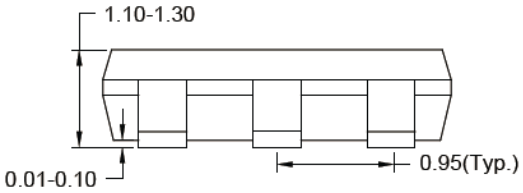
SOT23-5 Package Outline & PCB Layout



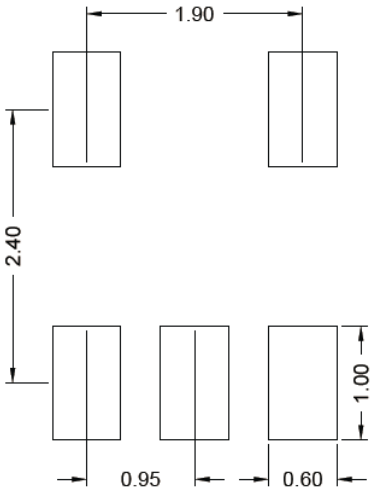
Top View



Side View



Front View

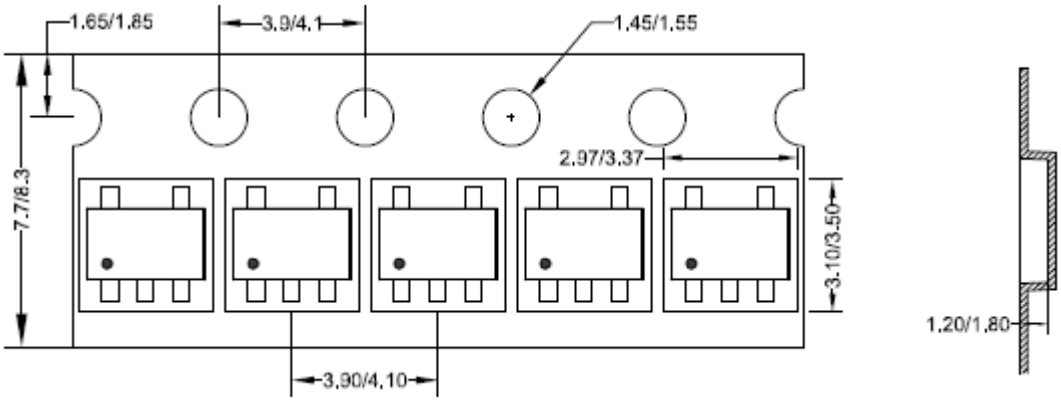


Recommended Pad Layout

Note: All dimensions are in millimeters and exclude mold flash and metal burr.

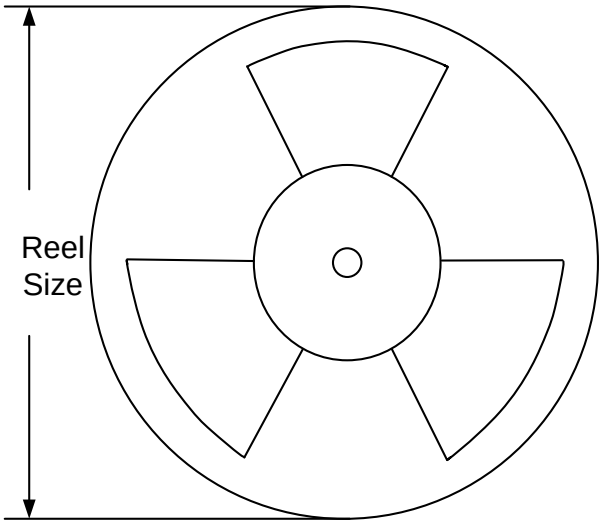
Tape and Reel Information

1. Tape Dimensions and Pin1 Orientation



Direction of Feed ⟶

2. Reel Dimensions



Package type	Tape width (mm)	Pocket pitch (mm)	Reel size (Inch)	Trailer length (mm)	Leader length (mm)	Qty per reel
SOT23-5	8	4	7"	280	160	3000

3. Others: NA

Revision History

The revision history provided is for informational purpose only and is believed to be accurate, however, not warrantied. Please make sure that you have the latest revision.

Date	Revision	Change
Mar.20, 2024	Revision 1.0	Language improvements for clarity.
Dec.18, 2020	Revision 0.9	Initial Release

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