SY20808C7/D7

Low Loss Power Distribution Switch

General Description

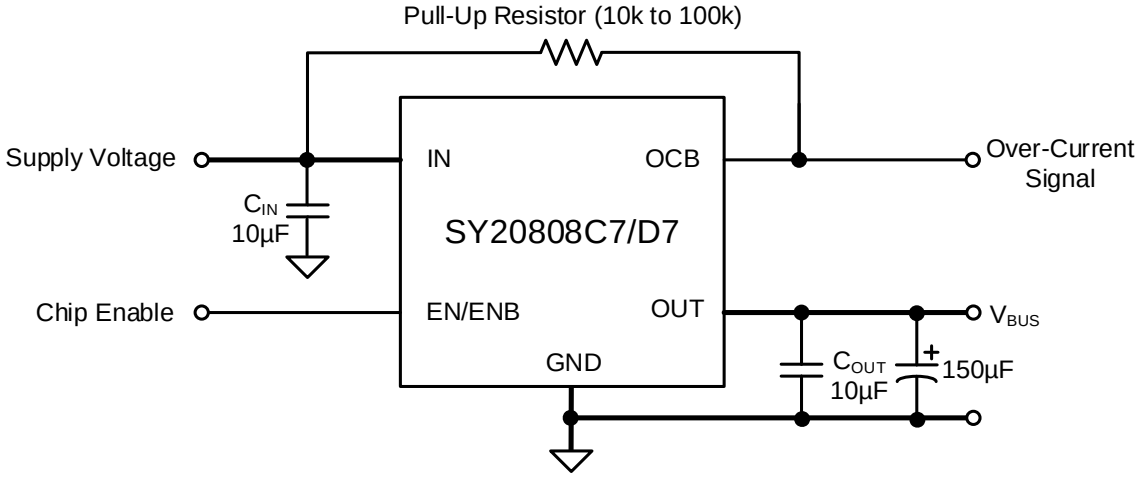
The SY20808C7/D7 protection switch is an ultra-low resistance, compact, current limiting device. It incorporates soft start, short circuit protection, over-temperature protection, and reverse blocking functions. The device provides a fault flag output for fault conditions, including over-current events, thermal shutdown, and reverse blocking.

The SY20808C7/D7 operates across a voltage range of 2.5V to 5.5V and is available in the industry standard SOT23-5 package.

Features

- Voltage Range: 2.5V to 5.5V
- Maximum current: 2.5A
- Low shutdown I_Q : 0.1 µA (typ.)
- Over-temperature Shutdown and Automatic Retry
- Reverse Blocking Function (No Body Diode)
- Automatic Output Discharge at Shutdown
- Built-in Soft Start
- 0.4ms Rise Time
- Two Enable Polarities
  - SY20808C7: Active High/2.5A
  - SY20808D7: Active Low/2.5A
- Compact Package: SOT23-5
- At shutdown, OUT can be forced higher than IN
- Fault Flag (OCB) Output if An Over-Current Event, Thermal Shutdown, or Reverse Blocking Occurs.

Typical Application Circuit



Note: If 1µF input cap will lead to large Vin voltage spike, it is strongly recommended to add additional 10µF ceramic cap.

Figure 1. Schematic Diagram

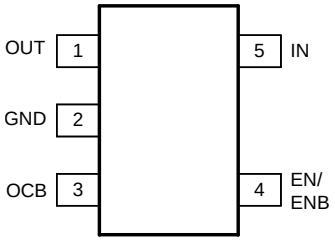
Note: Using low-ESR 150µF aluminum electrolytic or tantalum capacitor between the OUT and the GND pins is recommended.

Ordering Information

Ordering Part Number	Package Type	Top Mark
SY20808C7AAC	SOT23-5 RoHS Compliant and Halogen Free	**Pt***xyz*
SY20808D7AAC	SOT23-5 RoHS Compliant and Halogen Free	**Pw***xyz*

x=year code, y=week code, z= lot number code

Pinout (top view)



Pin Description

Pin Name	Pin Number	Pin Description
OUT	1	Output pin.
GND	2	Ground pin.
OCB	3	Open drain fault flag.
EN- SY20808C7 ENB- SY20808D7	4	ON/OFF control. Do not leave it floating. EN: high enable. ENB: low enable.
IN	5	Input pin.

Block Diagram

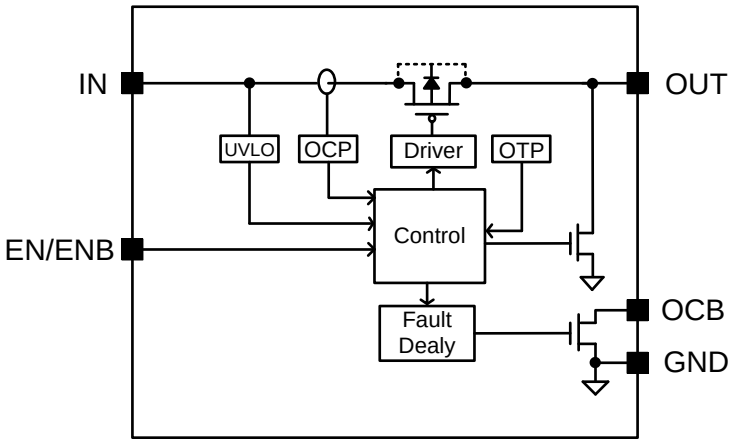


Figure 2. Block Diagram

Absolute Maximum Ratings

Parameter (Note 1)	Min	Max	Unit
IN, OUT, OCB	-0.3	6	V
EN/ENB	-0.3	V_{IN}+0.3	
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	100	°C/W
θ_{JC} Junction-to-Case Thermal Resistance	30	
P_D Power Dissipation T_A = 25°C	0.6	W

Recommended Operating Conditions

Parameter (Note 3)	Min	Max	Unit
IN	2.5	5.5	V
EN/ENB	0	V_{IN}	
OUT, OCB	0	5.5	
Junction Temperature, Operating	-40	125	°C
Ambient Temperature	-40	85	

Electrical Characteristics

(V_{IN} = 5V, C_L=1μF, per channel, 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
Shutdown Input Current		I_{SHDN}	Open load, switch off		0.1	1	μA
			Output grounded, switch off		0.1	1	μA
Quiescent Supply Current		I_Q	Open load, switch on		32		μA
MOSFET RON		$R_{DS(ON)}$		50	63	75	mΩ
Current Limit		I_{LIM}		2.7	3.55	4.4	A
Short Circuit Output Current		I_{OS}	SY20808C7/D7, OUT connected to GND device enabled	1.2	1.8	2.4	A
EN/$\overline{EN}$ Threshold	Logic-Low Voltage	V_{IL}				0.8	V
	Logic-High Voltage	V_{IH}		1.75			V
IN UVLO Threshold		$V_{IN, UVLO}$				2.4	V
IN UVLO Hysteresis		$V_{IN, HYS}$			0.1		V
Turn-ON Time		t_{ON}	R_L=5 Ω, C_L=1μF		400		μs
OCB Low Resistance		R_{OCB}			10		Ω
OCB Delay Time		t_{OCB_Delay}			10		ms

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
OUT Shutdown Discharge Resistance	R_{DIS}			10		Ω
Thermal Shutdown Temperature	T_{SD}			150		°C
Thermal Shutdown Hysteresis				20		°C

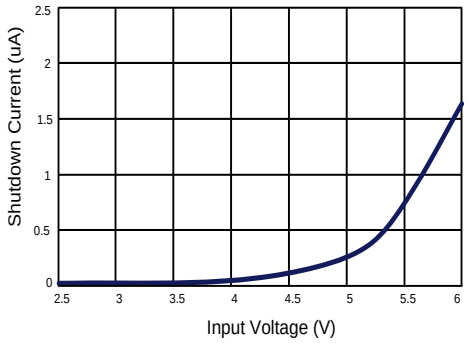
Note 1: Stresses beyond the “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specification is not implied. Exposure to absolute 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 the Silergy evaluation board.

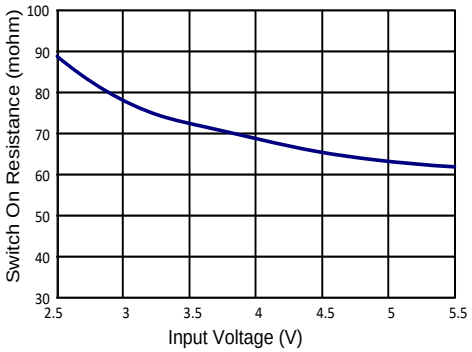
Note 3: The device is not guaranteed to function outside its operating conditions.

Typical Operating Characteristics

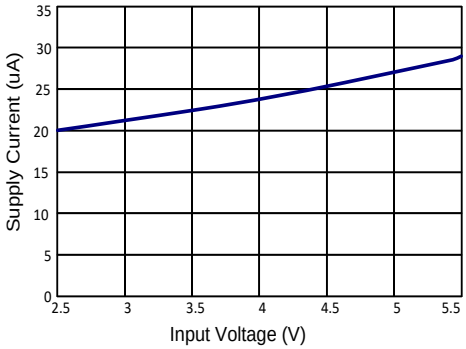
Shutdown Current vs. Input Voltage
(R_{LOAD}=Open, EN OFFC_{IN}=10uF C_{OUT}=4.7uF)



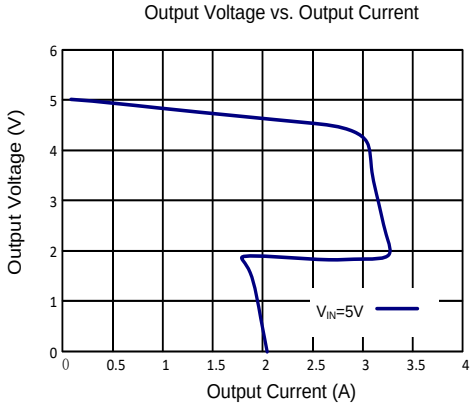
Switch on Resistance vs. Input Voltage
(R_{LOAD}=10Ω C_{IN}=10uF C_{OUT}=4.7uF)



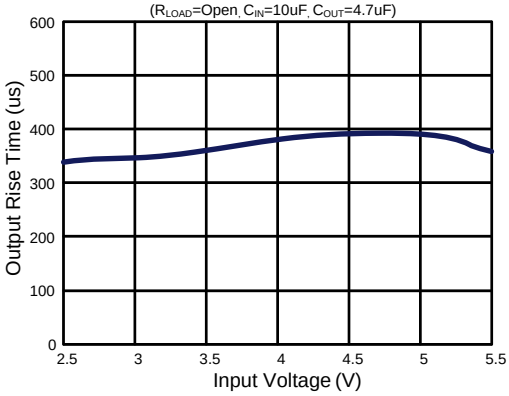
Supply Current vs. Input Voltage
(R_{LOAD}=10Ω C_{IN}=10uF C_{OUT}=4.7uF)



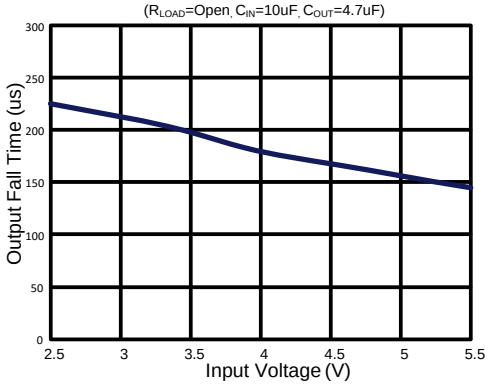
Output Voltage vs. Output Current



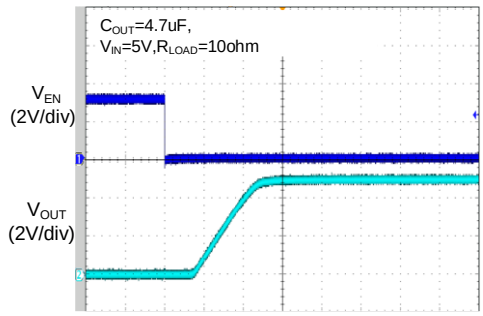
Output Rise Time vs. Input Voltage
(R_{LOAD}=Open, C_{IN}=10uF, C_{OUT}=4.7uF)



Output Fall Time vs. Input Voltage
(R_{LOAD}=Open, C_{IN}=10uF, C_{OUT}=4.7uF)

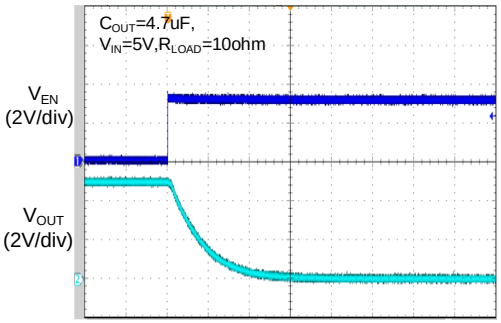


Turn ON Response



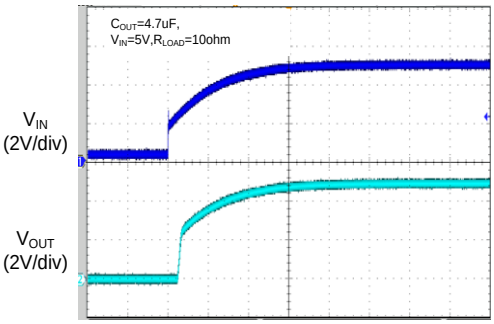
Time (200μs/div)

Turn OFF Response



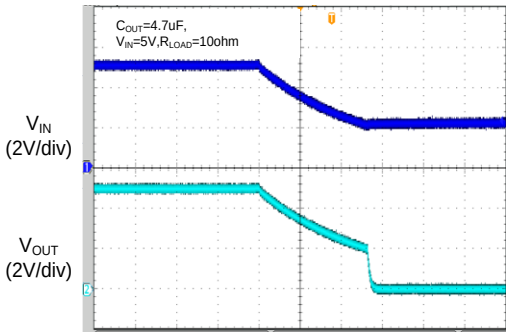
Time (40μs/div)

UVLO at Rising



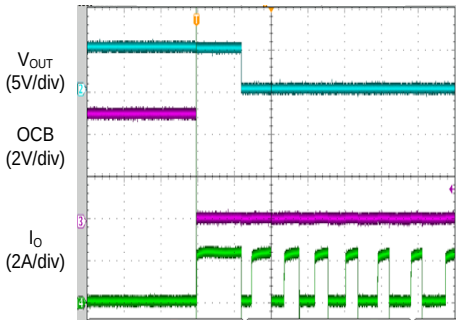
Time (2ms/div)

UVLO at Falling



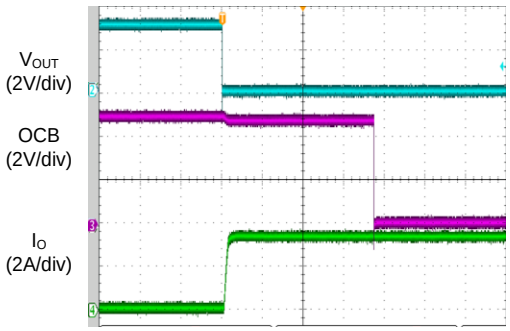
Time (800us/div)

OCB Response during Short Circuit



Time (10ms/div)

OCB Response during Over Load

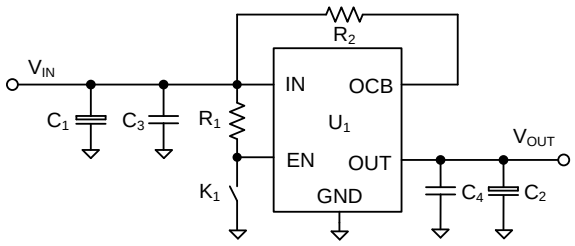


Time (4ms/div)

Operation

The SY20808C7/D7 power switch integrates a P-channel MOSFET. It incorporates the over-temperature protection and current limit functions. There is no parasitic body diode between the drain and the source of the MOSFET. This prevents the current from flowing from OUT to IN when OUT is externally forced to a higher voltage than IN when the chip is disabled. The device is ideal for high-side load-switching applications.

Application Schematic



BOM List

Reference Designator	Description	Part Number	Manufacturer
C3	10μF/10V,0805,X5R	C2012X5R1A106M	TDK
C4	4.7μF/16V,0805,X5R	C1608X5R1C475M	TDK
R1	510kΩ,0603		
R2	100kΩ		

Over Current Protection

The internal current-limit amplifier regulates the output current to I_{LIM} for overload conditions, and the current limit value folds back to 50% to reduce power dissipation during the output short circuit conditions—the output voltage drops during the current regulation. If the over-current condition persists for a long time, the junction temperature may exceed 150°C, and over-temperature protection shuts down the part. Once the chip temperature drops below 130°C, the part restarts.

Short Circuit

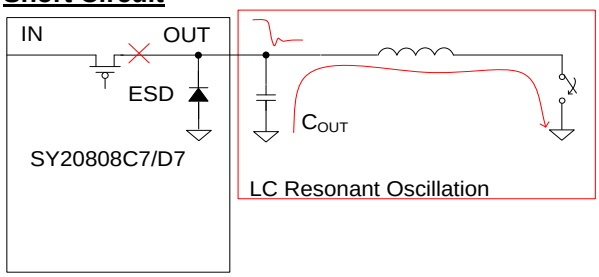


Figure 3. Equivalent Circuit

In the case of a short circuit, the parasitic inductance of the short wire and the output capacitor causes LC resonant oscillation. The output inductance generates a negative voltage spike on the output, and the current flows through the internal ESD diode on the output. The internal ESD diode can handle a maximum forward current of 600mA.

Fault Flag (OCB)

The OCB open-drain output is asserted (active low) when thermal shutdown protection is triggered, or an over-current condition persists for 15ms. The OCB signal remains asserted until the fault condition is removed. Connecting a heavy capacitance load to an enabled device can cause a momentary over-current condition. However, no false reporting on OCB occurs due to the 15ms deglitch circuit. Connect OCB with a pull-up resistor to the IN or OUT voltage rail.

Supply Filter Capacitor

To prevent the input voltage drop during hot-plug events, using a 1μF input ceramic bypass capacitor is recommended. Higher capacitor values can further reduce the voltage drop at the input. Shorting the output will generate a positive voltage spike on the input without the input capacitor. When such transients exceed the absolute maximum supply voltage, even for a short duration, the part can be permanently damaged.

Output Filter Capacitor

Using a low-ESR capacitor with a value of 4.7 μF is recommended. The capacitor should be placed close to the OUT pin to minimize inductance and resistance between the bypass capacitor and the downstream device in order to reduce EMI and improve the transient performance.

If the application has restrictions on the maximum voltage drip allowed during transient conditions, a larger low-ESR capacitor can be added. For example, a 150μF aluminum electrolytic or tantalum capacitor can be added in parallel to reduce the voltage drop to 300mV during transient conditions.

PCB Layout Guide

For the best performance of the SY20808C7/D7, the following guidelines must be followed:

- High current carrying power path connections should be as short and wide as possible and use at least 2-ounce copper for all these traces.
- Place a ground plane under all circuitry to lower resistance and inductance and improve direct current (DC) and transient performance.
- Place the output capacitor as close to the connectors as possible to lower the impedance (mainly inductance) between the port and the capacitor and improve transient performance.
- Place the input and output capacitors close to the device and connect to the ground plane to reduce noise coupling.
- Place the ceramic bypass capacitors as close as possible to the IN and OUT pins of SY20808C7/D7.

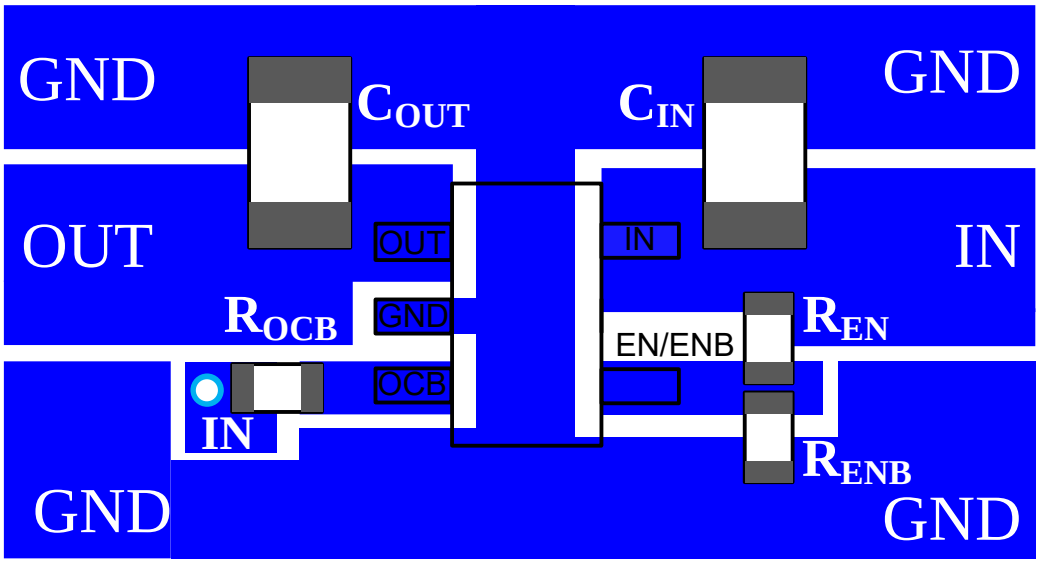
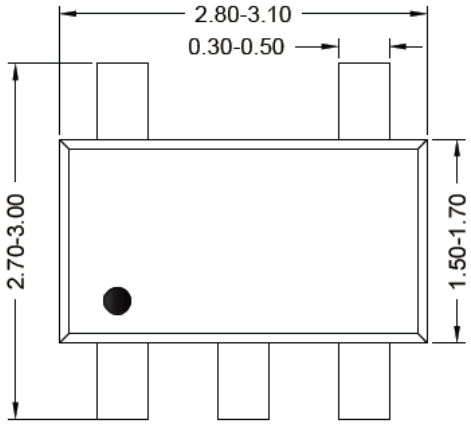
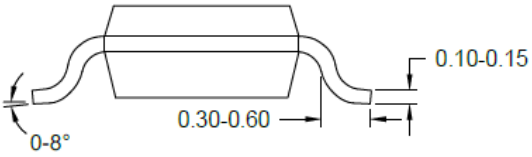


Figure 4. PCB Layout Suggestion

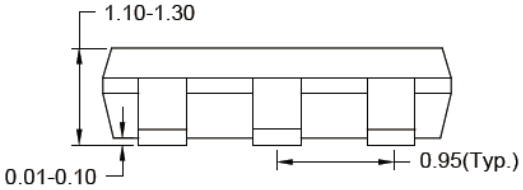
SOT23-5 Package Outline and PCB Layout



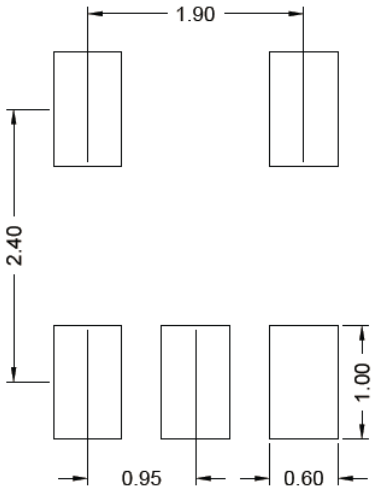
Top View



Side View



Front View

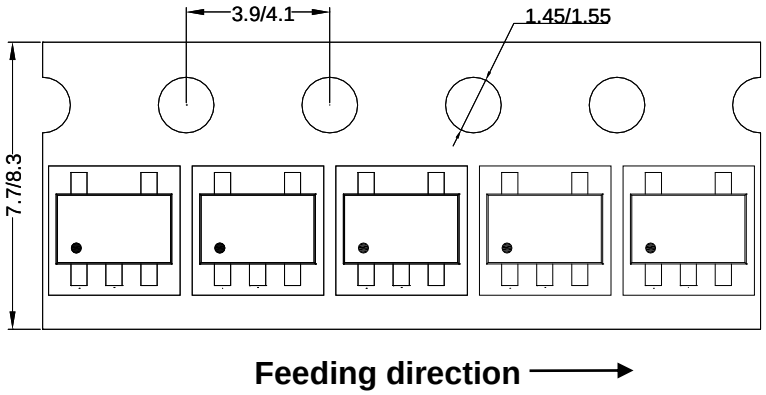


Recommended Pad Layout

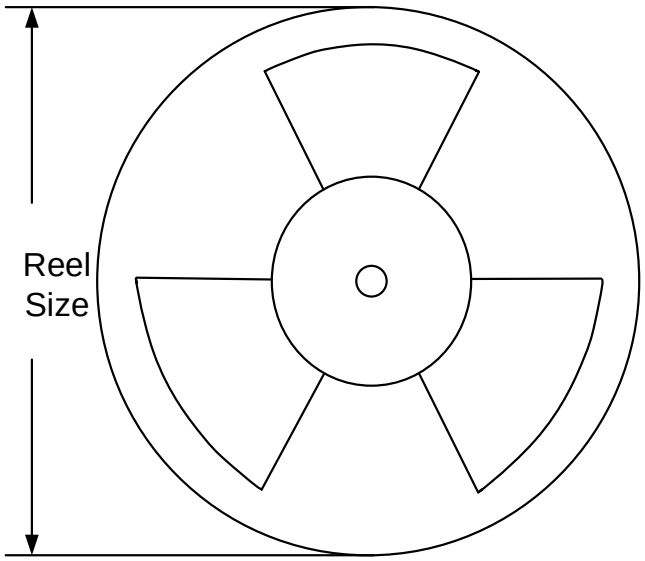
Note: All dimensions are in millimeters and exclude mold flash and metal burr.

Taping & Reel Specification

SOT23-5 Taping Orientation



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
SOT23-5	8	4	7"	280	160	3000

Others: NA

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