SY20809

6V, 3A Low Loss Power Distribution Switch

General Description

The SY20809 is an ultra-low $R_{DS(ON)}$ power distribution switch. It uses a resistor programmable current limit to protect the power source from overcurrent and short-circuit conditions.

The device incorporates short-circuit, overtemperature protection and a reverse blocking function to ensure reliable operation.

Its low quiescent and very low shutdown currents make this part attractive for battery powered applications.

The SY20809 is available in a TSOT23-5 package.

Features

- Input Voltage: 2.4V to 6V
- 3A Load Current Capability
- Quiescent Current I_Q 38μA (typ.)
- Shutdown Current I_{SHDN} 0.2μA (typ.)
- Programmable Current Limit
- Overtemperature Protection
- Reverse Blocking (No Body Diode)
- OUT Can be Forced Higher than IN During Shutdown
- Compact Package: TSOT23-5
- RoHS Compliant and Halogen Free

Applications

- Battery Operated Products
- USB Dongles
- Mini PCI Accessories
- USB Chargers
- Public Place Multi-USB Chargers

Typical Application Circuit

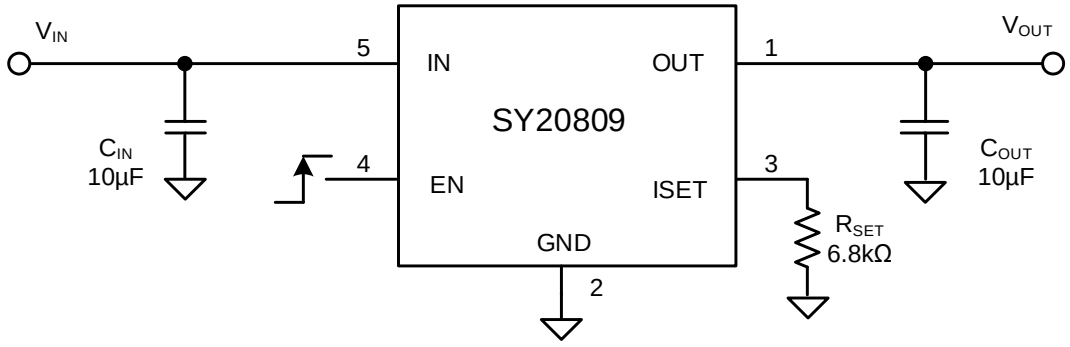


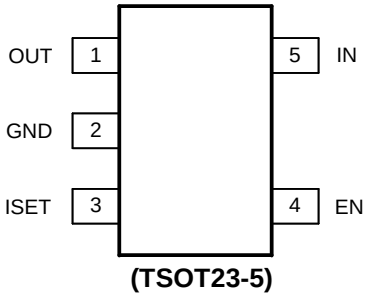
Figure 1. Schematic Diagram

Ordering Information

Ordering Number	Package Type	Top Mark
SY20809ACC	TSOT23-5 RoHS Compliant and Halogen Free	**Ln*xyz***

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

Pinout (Top View)



(TSOT23-5)

Pin Name	Pin Number	Pin Description
OUT	1	Output pin, decoupled 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)=6800/R_{SET} (Ω)
EN	4	ON/OFF control. Pull high to enable the device. Do not leave it floating.
IN	5	Input pin, decoupled with a 10μF capacitor to GND.

Block Diagram

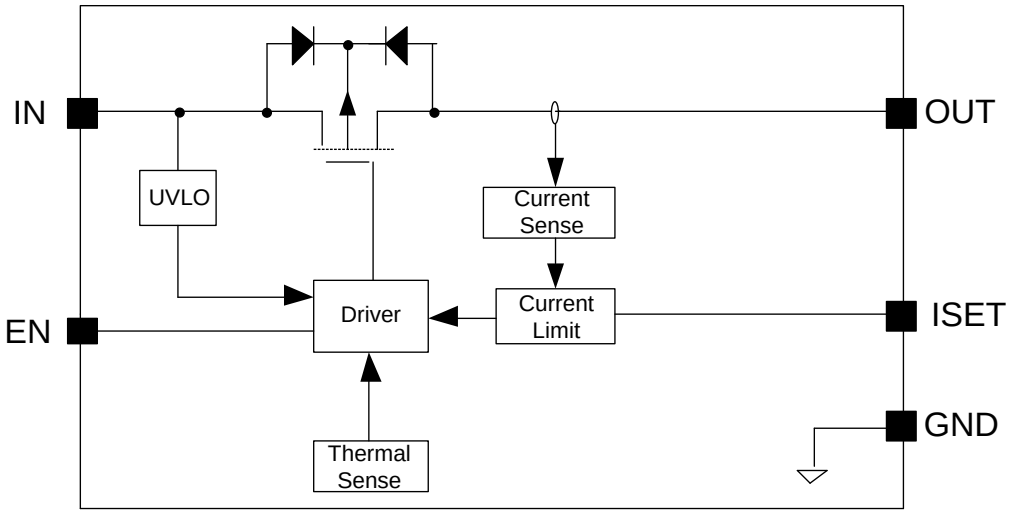


Figure 2. Block Diagram

Absolute Maximum Ratings

Parameter (Note 1)	Min	Max	Unit
IN, OUT, EN, ISET	-0.3	7	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	68.5	°C/W
θ_{JC} Junction-to-Case Thermal Resistance	10.9	
P_D Power Dissipation T_A = 25°C	1.46	W

Recommended Operating Conditions

Parameter (Note 3)	Min	Max	Unit
IN	2.4	6	V
OUT, ISET	0	6	
EN	0	V_{IN}	
Junction Temperature, Operating	-40	125	°C
Ambient Temperature	-40	85	

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}		2.4		6	V
Shutdown Input Current	I_{SHDN}	Open load, IC disabled		0.2	1	μA
Quiescent Supply Current	I_Q	Open load, IC enabled		38		μA
FET R_{ON}	$R_{DS(ON)}$			50		mΩ
EN Rising Threshold	$V_{EN(H)}$		2			V
EN Falling Threshold	$V_{EN(L)}$				0.8	V
EN Leakage Current	I_{EN}	V_{EN}=5.0V			1	μA
IN UVLO Threshold	V_{IN_UVLO}				2.3	V
IN UVLO Hysteresis	V_{IN_HYS}			0.1		V
Over Current Limit	I_{LIM}	R_{SET}=6.8kΩ	0.75	1	1.25	A
Programmable Current Limit Range	I_{RANGE}		0.4		3.5	A
Turn-on Time	t_{ON}	R_L=10Ω, C_{OUT}=1μF		130		μs
Turn-off Time	t_{OFF}	R_L=10Ω, C_{OUT}=1μF		20		μs
Thermal Shutdown Temperature	T_{SD}			150		℃
Thermal Shutdown Hysteresis	T_{SD_HYS}			20		℃

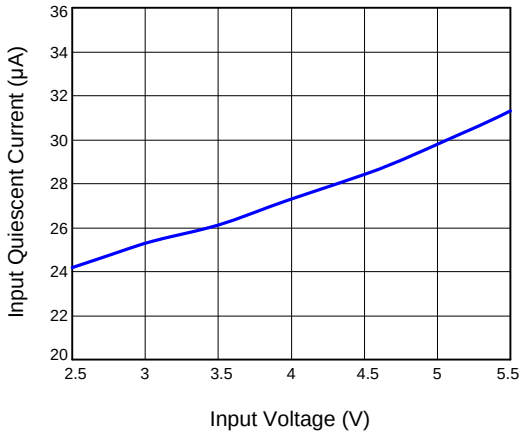
Note 1: Stresses beyond the "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specification is not implied. Exposure to absolute 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 test board. Pin 2 of TSOT23-5 package is the case position for θ_{JC} measurement.

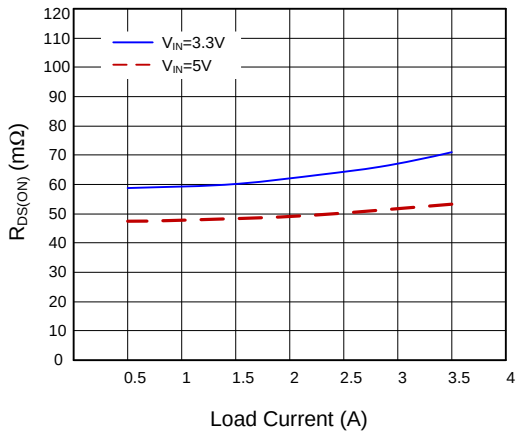
Note 3: The device is not guaranteed to function outside its operating conditions.

Typical Performance Characteristics

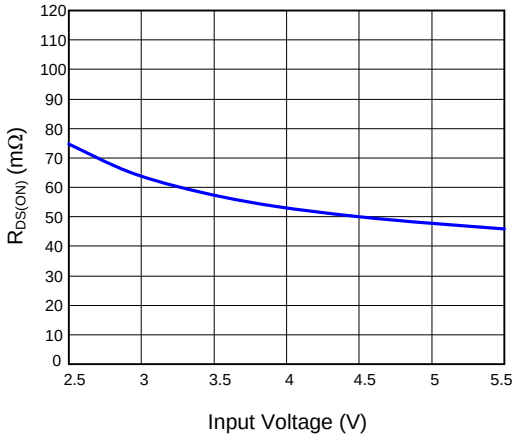
Input Quiescent Current vs. Input Voltage



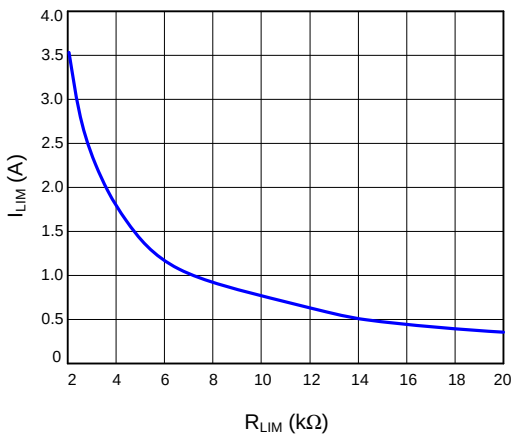
$R_{DS(ON)}$ vs. Load Current



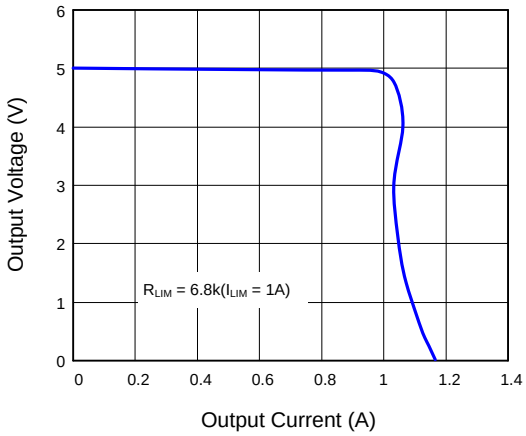
$R_{DS(ON)}$ vs. Input Voltage



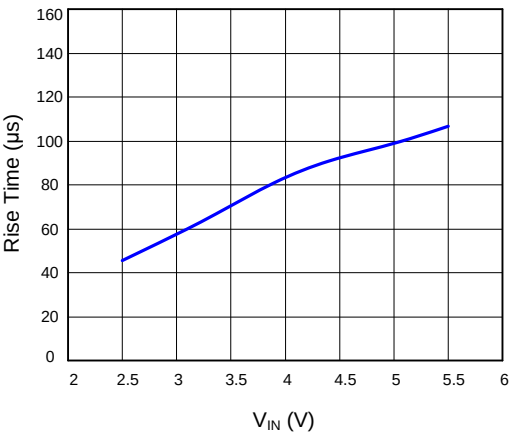
R_{LIM} vs. I_{LIM}



Output Voltage vs. Output Current

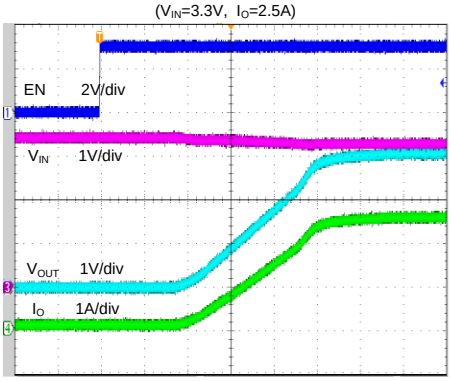


Rise Time vs. V_{IN}



Startup from Enable

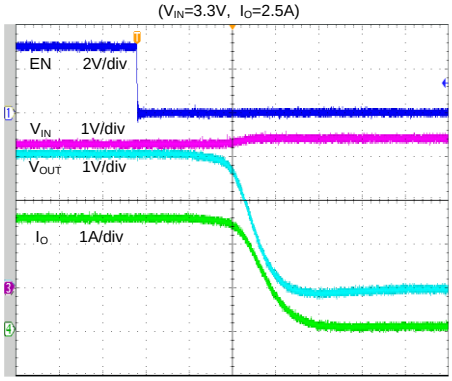
(V_{IN}=3.3V, I_O=2.5A)



Time (40μs/div)

Shutdown from Enable

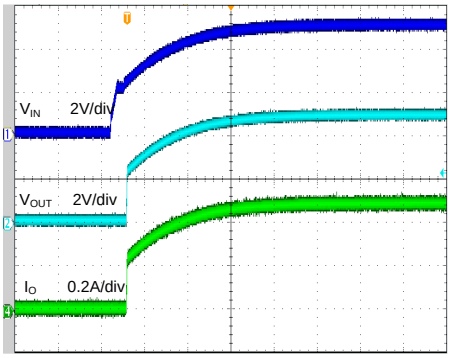
(V_{IN}=3.3V, I_O=2.5A)



Time (2μs/div)

Startup from V_{IN}

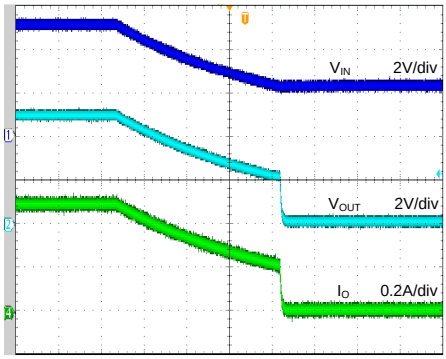
(V_{IN}=3.3V, I_O=0.5A)



Time(2ms/div)

Shutdown from V_{IN}

(V_{IN}=3.3V, I_O=0.5A)



Time (2ms/div)

Application Information

The SY20809 is a current limited P-channel MOSFET power switch with overcurrent and overtemperature protections. There is no body diode between the drain and the source of the MOSFET. It prevents the current flow from the output to the input when the chip is disabled.

Overcurrent Protection:

When the overcurrent condition is sensed, the gate of the pass switch is controlled by internal circuitry to achieve a constant output current. Under output short-circuit conditions, the normal current limit will fold back by 50%. If the overcurrent condition persists, the junction temperature may exceed 150°C, and the over-temperature protection will shut down the device. When the temperature drops below 130°C, the device will restart.

Supply Filter Capacitor:

To prevent an input voltage drop during hotplug events, connecting a 10μF ceramic capacitor from VIN to GND 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.

Current Limit Setting:

The current limit can be programmed to protect the power source from overcurrent and short-circuit conditions. Connect a resistor R_{SET} from the ISET pin to GND to program the current limit:

$$I_{LIM}\ (A) = 6800 / R_{SET}\ (\Omega)$$

The minimum current limit is 0.4A. A current limit beyond 3A is not recommended.

Maximum Input Voltage Consideration:

For any application, the input voltage for the SY20809 should not be allowed to exceed the maximum recommended value (6V).

Below is a typical application circuit for the SY20809. The front stage is a non-synchronous boost stage, and the input power supply can be a battery or an adapter.

Some adapters may have poor output voltage tolerance or significant output voltage overshoot if the adapter is hot-plugged directly. A voltage overshoot higher than the maximum input operating voltage value (6V) will significantly reduce the reliability of the SY20809 and may lead to electrical overstress and failure of the device.

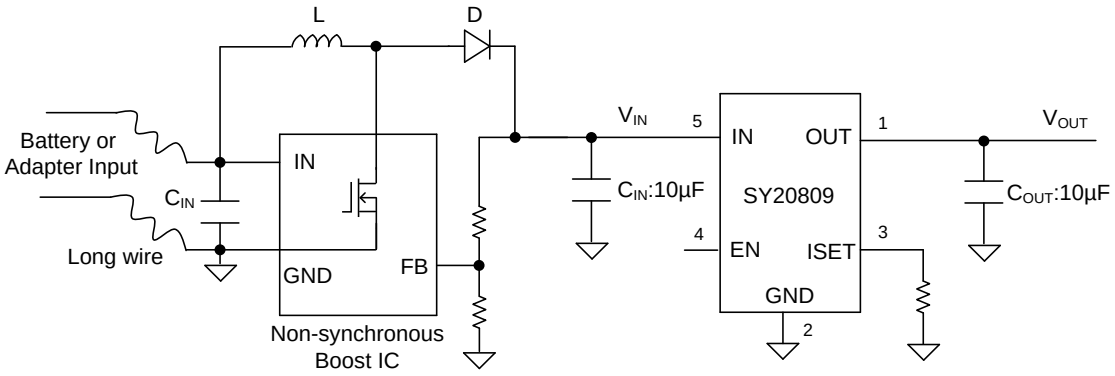


Figure 3. USB Host Application

PCB Layout Guide:

For the best performance of the SY20809, the following guidelines must be followed:

1. Keep all power traces as short and wide as possible and use at least 2 ounce copper for all power traces.
2. Place a ground plane under all circuitry to lower resistance and inductance and improve DC and transient performance.
3. Place the output capacitors as close to the connectors as possible to lower the impedance (mainly inductance) between the port and the capacitor and improve transient performance.
4. Input and output capacitors should be placed close to the device and connected to the ground plane to reduce noise coupling.
5. Place the ceramic bypass capacitors as close as possible to the IN and OUT pins.

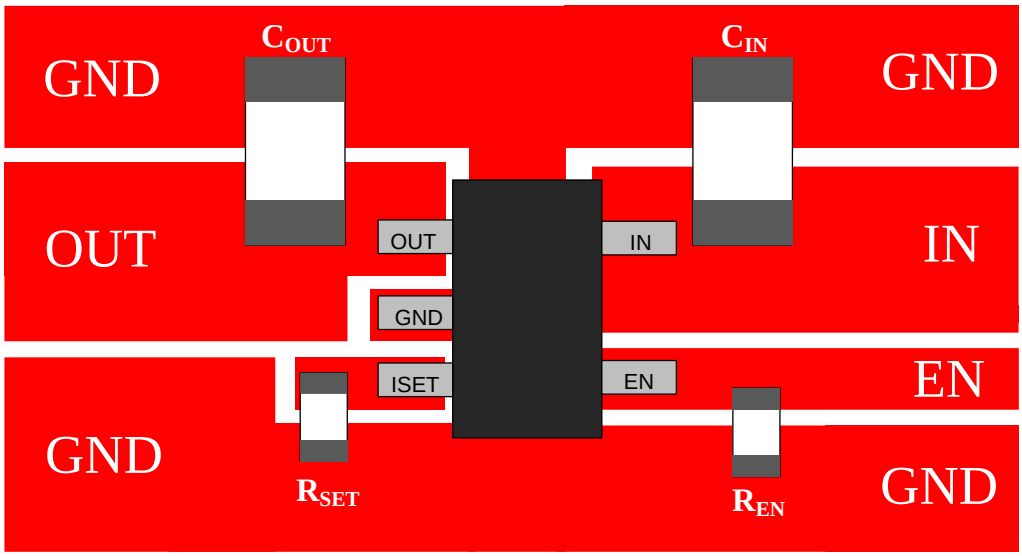
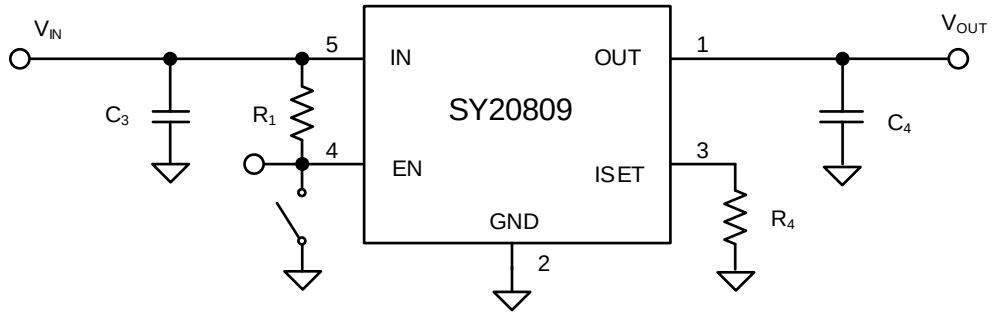


Figure 4. PCB Layout Suggestion

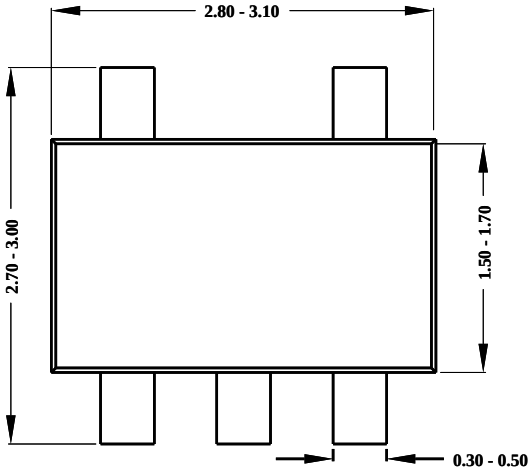
Schematic



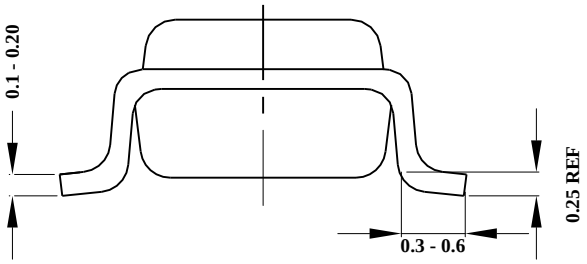
BOM List

Reference Designator	Description	Part Number	Manufacturer
C_3	10μF/25V, 0805, X5R	C2012X5R1E106K	TDK
C_4	10μF/25V, 0805, X5R	C2012X5R1E106K	TDK
R_1	1MΩ, 0603		
R_4	6.8kΩ, 0603		

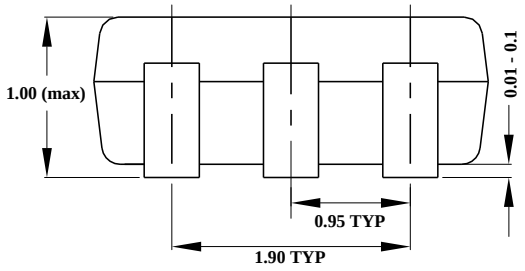
TSOT23-5 Package Outline & PCB Layout Design



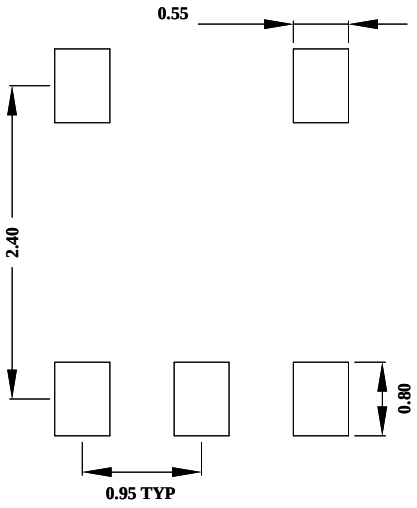
Top View



Side View



Front View

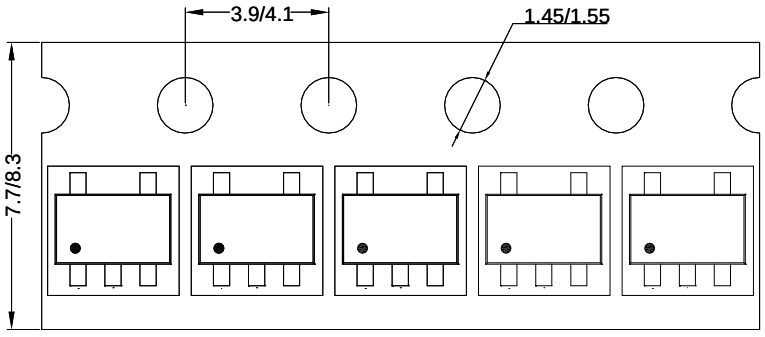


Recommended PAD Layout (Reference Only)

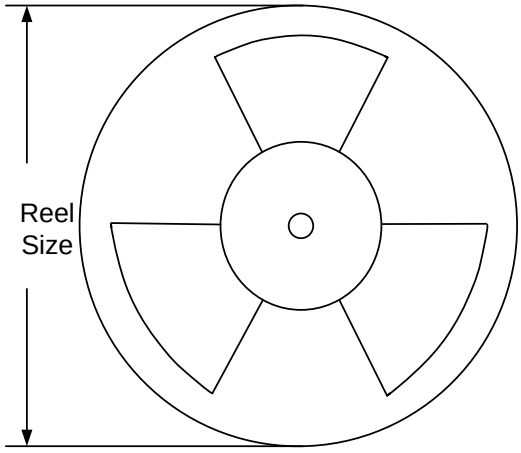
Note: All dimensions are in millimeters and exclude mold flash and metal burr.

Taping & Reel Specification

1. TSOT23-5 Taping Orientation



2. Carrier Tape & Reel Specification for Packages



Package type	Tape width (mm)	Pocket pitch (mm)	Reel size (Inch)	Reel width (mm)	Trailer length (mm)	Leader length (mm)	Qty per reel
TSOT23-5	8	4	7"	8.4	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 warranted. Please make sure that you have the latest revision.

Date	Revision	Change
Jan.05, 2024	Revision 1.0	Language improvements for clarity.

IMPORTANT NOTICE

1. **Right to make changes.** Silergy and its subsidiaries (hereafter Silergy) reserve the right to change any information published in this document, including but not limited to circuitry, specification and/or product design, manufacturing or descriptions, at any time and without notice. This document supersedes and replaces all information supplied prior to the publication hereof. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products are sold subject to Silergy's standard terms and conditions of sale.

2. Applications. Application examples that are described herein for any of these products are for illustrative purposes only. Silergy makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification. Buyers are responsible for the design and operation of their applications and products using Silergy products. Silergy or its subsidiaries assume no liability for any application assistance or designs of customer products. It is customer's sole responsibility to determine whether the Silergy product is suitable and fit for the customer's applications and products planned. To minimize the risks associated with customer's products and applications, customer should provide adequate design and operating safeguards. Customer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Silergy assumes no liability related to any default, damage, costs or problem in the customer's applications or products, or the application or use by customer's third-party buyers. Customer will fully indemnify Silergy, its subsidiaries, and their representatives against any damages arising out of the use of any Silergy components in safety-critical applications. It is also buyers' sole responsibility to warrant and guarantee that any intellectual property rights of a third party are not infringed upon when integrating Silergy products into any application. Silergy assumes no responsibility for any said applications or for any use of any circuitry other than circuitry entirely embodied in a Silergy product.

3. **Limited warranty and liability.** Information furnished by Silergy in this document is believed to be accurate and reliable. However, Silergy makes no representation or warranty, expressed or implied, as to the accuracy or completeness of such information and shall have no liability for the consequences of use of such information. In no event shall Silergy be liable for any indirect, incidental, punitive, special or consequential damages, including but not limited to lost profits, lost savings, business interruption, costs related to the removal or replacement of any products or rework charges, whether or not such damages are based on tort or negligence, warranty, breach of contract or any other legal theory. Notwithstanding any damages that customer might incur for any reason whatsoever, Silergy' aggregate and cumulative liability towards customer for the products described herein shall be limited in accordance with the Standard Terms and Conditions of Sale of Silergy.

4. **Suitability for use.** Customer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of Silergy components in its applications, notwithstanding any applications-related information or support that may be provided by Silergy. Silergy products are not designed, authorized or warranted to be suitable for use in life support, life-critical or safety-critical systems or equipment, nor in applications where failure or malfunction of a Silergy product can reasonably be expected to result in personal injury, death or severe property or environmental damage. Silergy assumes no liability for inclusion and/or use of Silergy products in such equipment or applications and therefore such inclusion and/or use is at the customer's own risk.

5. **Terms and conditions of commercial sale**. Silergy products are sold subject to the standard terms and conditions of commercial sale, as published at http://www.silergy.com/stdterms, unless otherwise agreed in a valid written individual agreement specifically agreed to in writing by an authorized officer of Silergy. In case an individual agreement is concluded only the terms and conditions of the respective agreement shall apply. Silergy hereby expressly objects to and denies the application of any customer's general terms and conditions with regard to the purchase of Silergy products by the customer.

6. **No offer to sell or license**. Nothing in this document may be interpreted or construed as an offer to sell products that is open for acceptance or the grant, conveyance or implication of any license under any copyrights, patents or other industrial or intellectual property rights. Silergy makes no representation or warranty that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right. Information published by Silergy regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from Silergy under the patents or other intellectual property of Silergy.

For more information, please visit: www.silergy.com