

6.5V 5A Current Limit Switch with OVP Clamp

General Description

The SY20855A is a current limit switch with input voltage range selection and output voltage clamping. Extremely low $R_{DS(ON)}$ of the integrated protection N-channel MOSFET helps to reduce power loss during normal operation. The programmable soft-start time controls the slew rate of the output voltage during start-up.

The SY20855A uses an enable control for system sequencing. The device integrates short-circuit and over-temperature protections.

The SY20855A is available in a compact DFN 3mmx3mm-10 pin package.

Features

- Input Voltage Range: 2.5V to 6.5V with Surge Up to 12V
- 5A Fixed Current Limit
- Ultra Low Bias Current: 50uA (typ.)
- Extremely Low $R_{DS(ON)}$ for the Integrated Protection Switch: 40 mΩ
- Programmable Soft-Start Time
- Short-Circuit Protection
- Selectable Input Range and Output Clamping Voltage
- Enable Interface Pin
- Thermal Shutdown Protection & Auto Recovery
- RoHS Compliant and Halogen Free
- Compact package: DFN3X3-10

Applications

- Notebook PCs
- Servers
- Service PCs

Typical Application Circuit

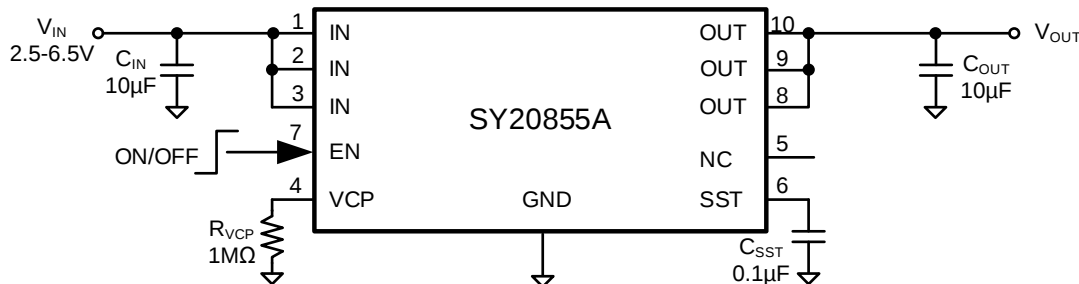
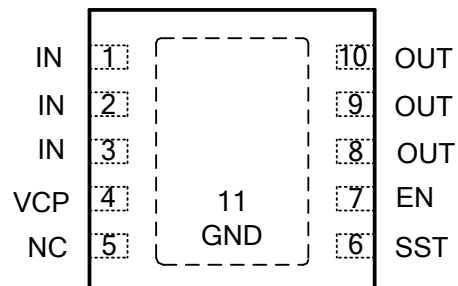


Figure 1. Schematic Diagram



Pinout (top view)

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



Pinout (Top View)

Pin Name	Pin Number	Pin Description					
IN	1,2,3	Power input pins. Decouple high frequency noise by connecting at least a 0.1uF MLCC to the ground.					
VCP	4	Output clamp voltage selection based on the input voltage. Pull the VCP pin high by connecting a resistor to IN, or pull the VCP pin low by connecting a resistor to ground. It's recommended to decouple this pin with 0.1uF capacitor.					
		VCP	IN		Clamping Threshold		
					Min	Typ	Max
		Low	3.3V	Over 4V	3.6V	3.8V	4.0V
		High	5V	Over 6V	5.4V	5.7V	6.0V
NC	5	No connection.					
SST	6	Soft-start time program pin. Connect a capacitor to the ground to program the soft start time.					
EN	7	Enable control input. Pull it High to enable the IC.					
OUT	8,9,10	Power output pins.					
GND	11 (exposed pad)	Ground pin.					

Block Diagram

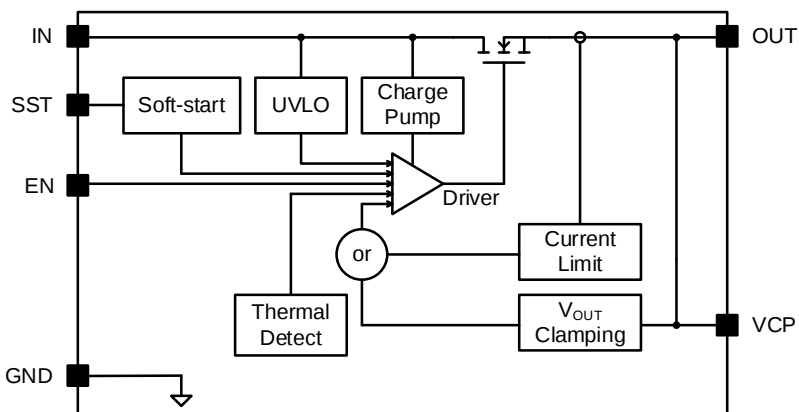


Figure 2. Block Diagram

Absolute Maximum Ratings

Parameter (Note 1)	Min	Max	Unit
IN, EN, VCP		12	V
Lead Temperature (Soldering, 10s)		260	
Junction Temperature, Operating	-40	150	°C
Storage Temperature	-65	150	

Thermal Information

Parameter (Note 2)	Typ	Unit
θ_{JA} Junction-to-Ambient Thermal Resistance	38	°C/W
θ_{JC} Junction-to-Case Thermal Resistance	8	
P_D Power Dissipation $T_A = 25^\circ\text{C}$	2.6	W

Recommended Operating Conditions

Parameter (Note 3)	Min	Max	Unit
IN	2.5	6.5	V
Junction Temperature, Operating	-40	125	°C
Ambient Temperature	-40	85	

Electrical Characteristics

($V_{IN} = 5V$, $C_{SST}=100nF$, $C_{IN} = 10\mu F$, $C_{OUT} = 10\mu F$, $T_A = 25^\circ\text{C}$, unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Input Voltage Range	V_{IN}		2.5		6.5	V
Input UVLO Threshold	V_{UVLO}	VCP=LOW	Falling	2.05	2.35	V
			Rising	2.2	2.4	
		VCP=HIGH	Falling	3.25	3.75	V
			Rising	3.4	3.8	
Bias Current	I_{BIAS}			50	65	μA
Shutdown Current	I_{SHDN}	EN=0		10		μA
Protection FET RON	$R_{DS(ON)}$			40	60	m Ω
Current Limit Threshold	I_{LIM}		3.5	5	6.5	A
Clamping Output Voltage	V_{CLP}	VCP=LOW	3.6	3.8	4.0	V
		VCP=HIGH	5.4	5.7	6.0	V
Soft-start Time	T_{SST}	$C_{SST}=100nF$ (Note 4)		23		ms
Soft-start Time Accuracy				$\pm 30\%$		T_{SST}
EN Turn-on Threshold	V_{EN_ON}		2			V
EN Turn-off Threshold	V_{EN_OFF}				0.4	V
Thermal Shutdown Temperature	T_{SD}			140		°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 $T_A = 25^\circ\text{C}$ on a low effective single layer thermal conductivity test board of JEDEC 51-3 thermal measurement standard. The exposed pad of DFN3x3-10 packages is used for θ_{JC} measurement.

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

Note 4. Recommended Soft-Start Time Program Table:

SST cap (nF)	None	10	47	100
Rise time (ms)	0.6	2.3	10.8	23

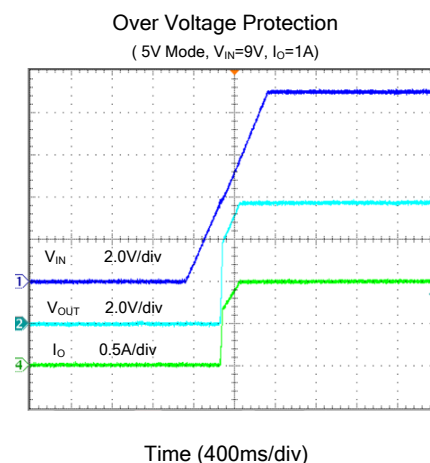
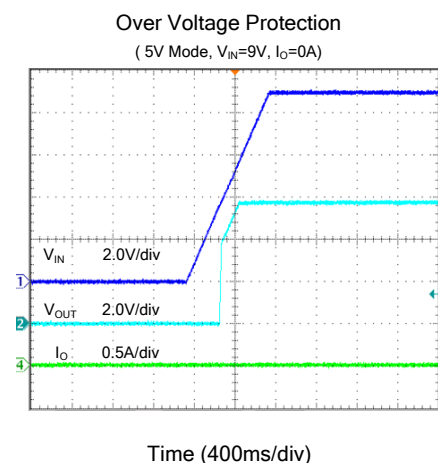
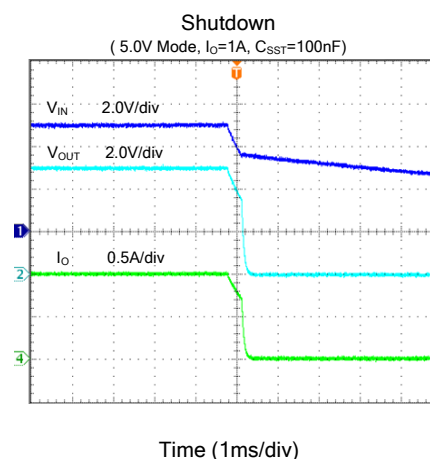
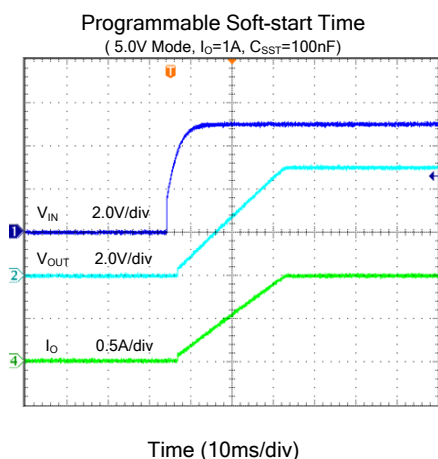
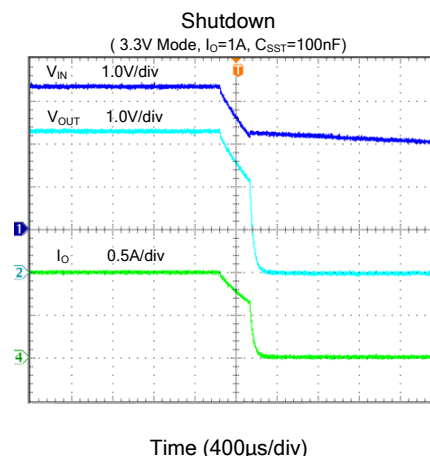
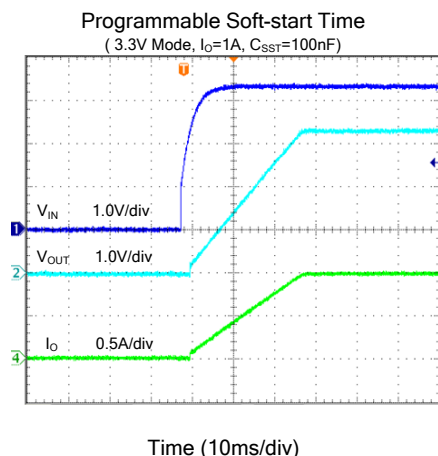
Recommended formula for C_{SST} and soft-start time calculation:

$$T_{SS} = \begin{cases} T_{SS_DLT}, & \text{No external } C_{SST} \\ \frac{0.85 \times C_{SST}}{I_{INT}}, & T_{SS} > T_{SS_DLT} \end{cases},$$

Where, T_{SS_DLT} is the internally fixed default soft-start time of 0.6ms (typ.);

I_{INT} is the internal current source with a value of 3.7 μA (typ.).

Typical Performance Characteristics



Functional Description

The SY20855A is a current limit N-channel MOSFET power switch designed for high-side load-switching applications. It incorporates extremely low $R_{DS(ON)}$.

N-channel MOSFET to reduce power loss during normal operation. The programmable soft-start time controls the slew rate of the output voltage during the start-up time.

Over Current Protection

The SY20855A supports 5A fixed current limit. When the over-current condition is sensed, the gate of the pass switch is controlled to achieve constant output current. If the over current condition persists for a long time, the junction temperature may exceed 150°C, and over-temperature protection will shut down the part. Once the chip temperature drops below 130°C, the part will restart.

Over Voltage Protection

SY20855A integrates an over voltage protection controlled using the VCP input pin. The output voltage is clamped to 5.7V(typ.) when $V_{VCP} = \text{High}$ or 3.8V(typ.) when $V_{VCP} = \text{Low}$.

Soft Start Time Program

To avoid thermal shutdown during start-up because of large inrush currents caused by the downstream system capacitance, it is important to set an appropriate start-up time.

The slew rate (SR) needed to achieve the desired output rise time can be calculated as:

$$T_{SS} = \begin{cases} T_{SS_DLT}, & \text{No external } C_{SST} \\ \frac{0.85 \times C_{SST}}{I_{INT}}, & T_{SS} > T_{SS_DLT} \end{cases}$$

Where, T_{SS_DLT} is the internally fixed default soft-start time of 0.6ms (typ.) and I_{INT} is the internal current source with a value of 3.7uA (typ.).

Supply Filter Capacitor

In order to prevent the input voltage spike which could destroy the internal circuitry when the input transient voltage exceeds the absolute maximum supply voltage during output short or other load transient situations, a 1μF ceramic capacitor connected between VIN and GND is strongly recommended. Higher capacitor values could reduce the voltage spike on the input further. In application with long wiring the capacitor voltage rating must be at least twice the input supply voltage to be able to withstand the positive voltage transients caused by inductive ringing.

Output Filter Capacitor

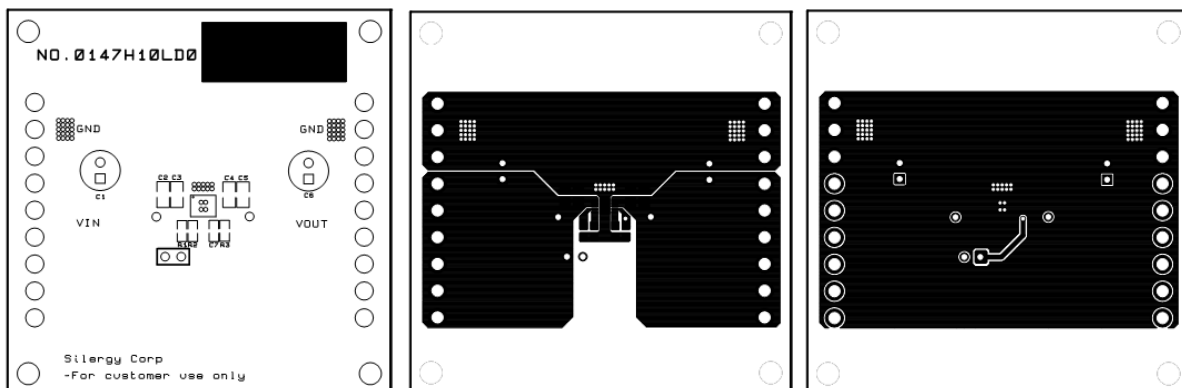
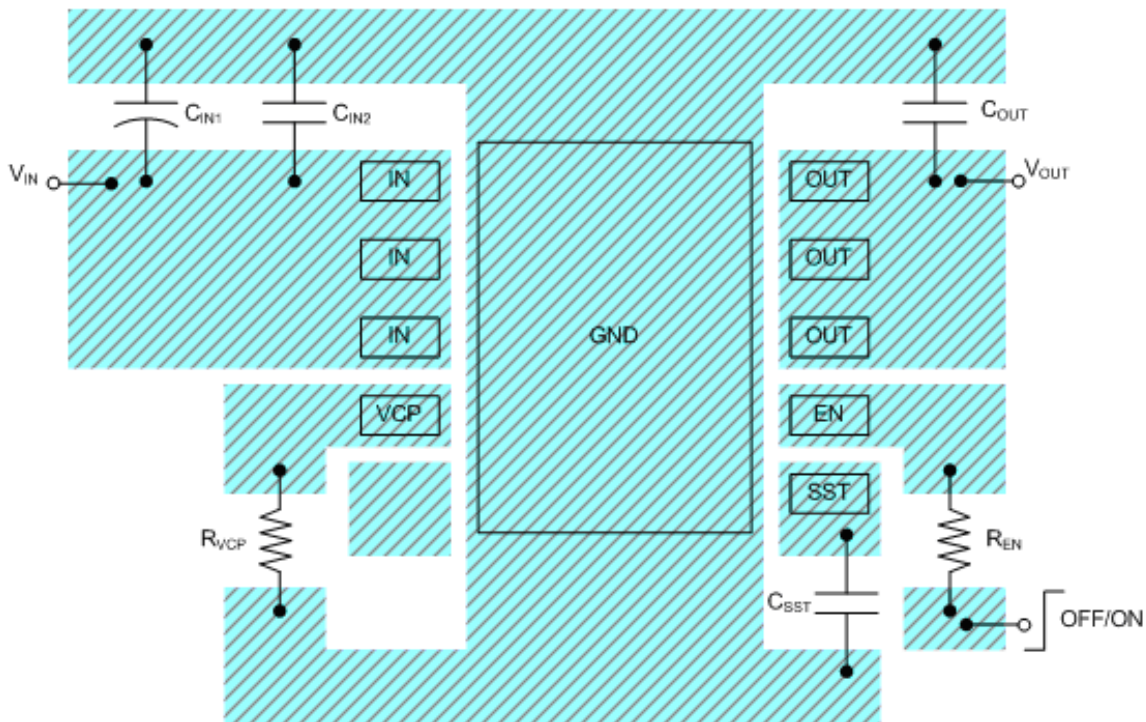
A 10uF output ceramic capacitor is recommended to be placed close to the IC and output connector to reduce voltage drop during high load steps. Higher values of output capacitor can be used to further reduce the voltage drop during operation.

PCB Layout Guide

For best performance of the SY20855A, the following guidelines must be strictly followed:

1. Keep all VBUS traces as short and wide as possible and use at least 2-ounce copper for all VBUS 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 device and connected to ground plane to reduce noise coupling.

PCB Layout Guideline

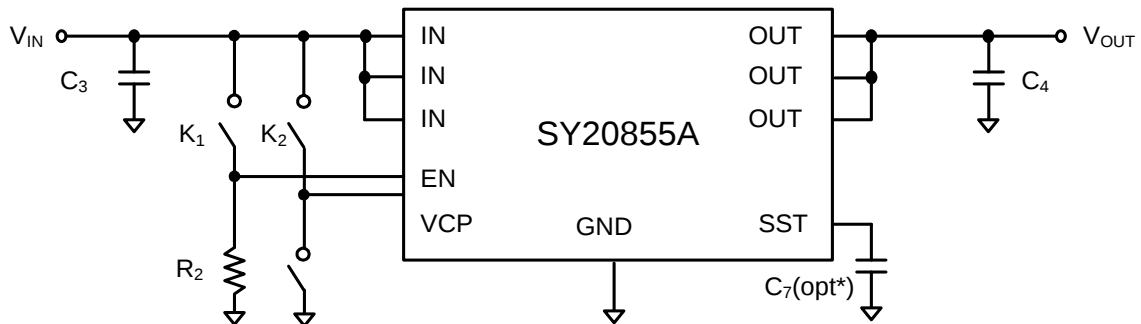


Top Silkscreen

Top Layer

Bottom Layer

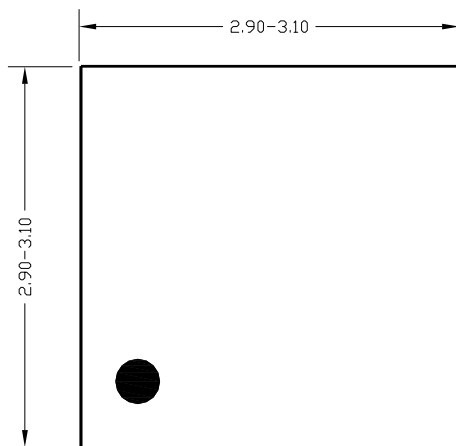
Application Schematic



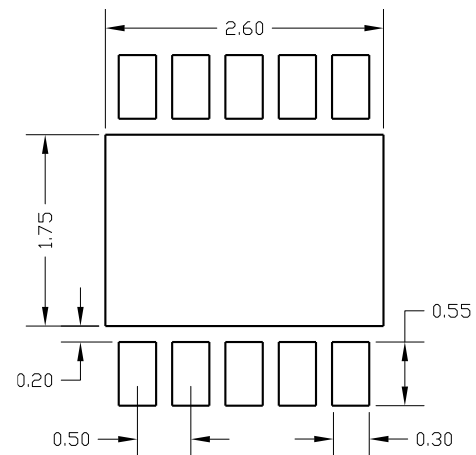
BOM List

Reference Designator	Description	Part Number	Manufacturer
U1		SY20855ADBC	Silergy
C_3, C_4	10 μ F/25V/X7R,1206	C3225X7R1E106M	TDK
R_2	1M Ω , 0603, 1%		
C_7	0.1 μ F, 0603		

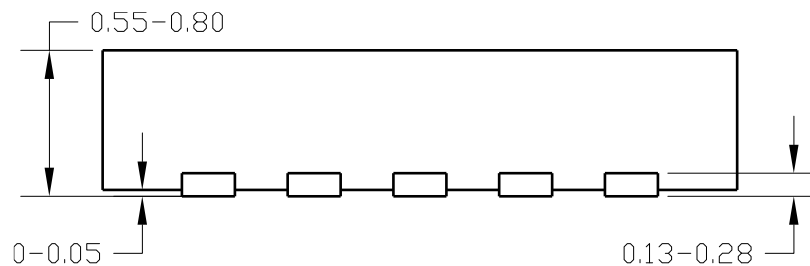
DFN3x3-10 Package Outline



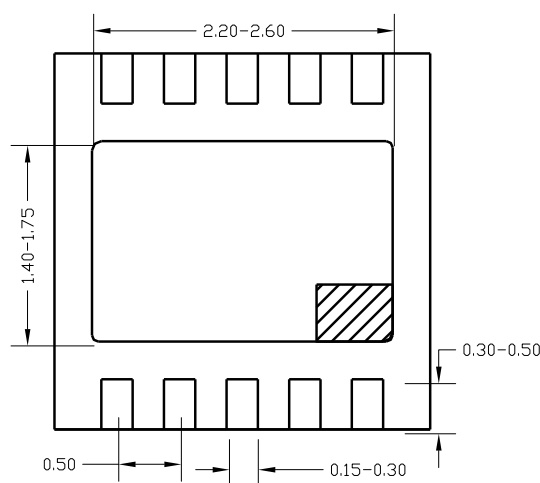
Top View



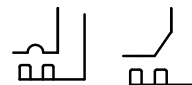
PCB Layout (Recommended)



Side View



Bottom View

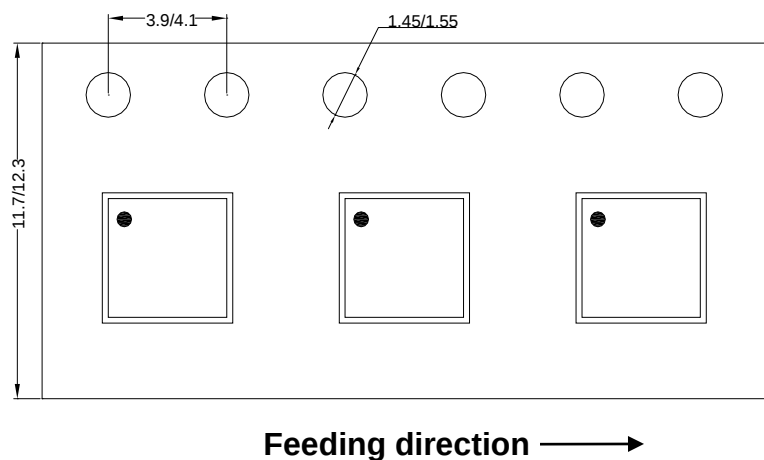


Detail A
Pin1 identifier: two options

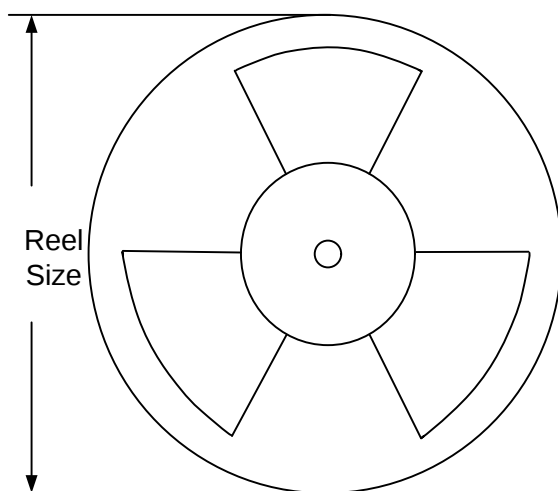
Note: All dimensions are in millimeters and exclude mold flash and metal burr.

Taping & Reel Specification

1. DFN3x3-10 Taping Orientation



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
DFN3x3	10	8	13"	400	400	5000

3. Others: NA



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

© 2018 Silergy Corp.

All Rights Reserved.