SY6875A

Programmable Current Limit Switch

General Description

The SY6875A is a programmable current limit switch with input voltage range selection and output voltage clamping. Extremely low $R_{DS(ON)}$ of the integrated protection N-channel FET helps to reduce power loss during the normal operation. Programmable soft-start time controls the slew rate of the output voltage during the start-up time. Independent enable control allows the complicated system sequencing control. It integrates the over-temperature protection shutdown and auto-recovery with hysteresis. This IC along with small DFN3×3-10 footprint provides small PCB area application.

Features

- Wide Input Voltage Range from 2.5V to 15V with Surge up to 30V
- Extremely Low $R_{DS(ON)}$ for the Integrated Protection Switch: 40 mΩ
- Programmable Soft-Start Time
- Programmable Current Limit
- Short-circuit Protection
- Selectable Input Range and Clamping Output Voltage Threshold.
- Enable Interface Pin
- Thermal Shutdown Protection & Auto Recovery
- RoHS Compliant and Halogen Free
- Compact Package: DFN3×3-10

Ordering Information

SY6875 □(□□)□
- Temperature Code
- Package Code
- Optional Spec Code

Ordering Number	Package type	Note
SY6875ADBC	DFN3×3-10	----

Applications

- Notebook PC
- I-pad Mini
- Server
- Service PC

Typical Application

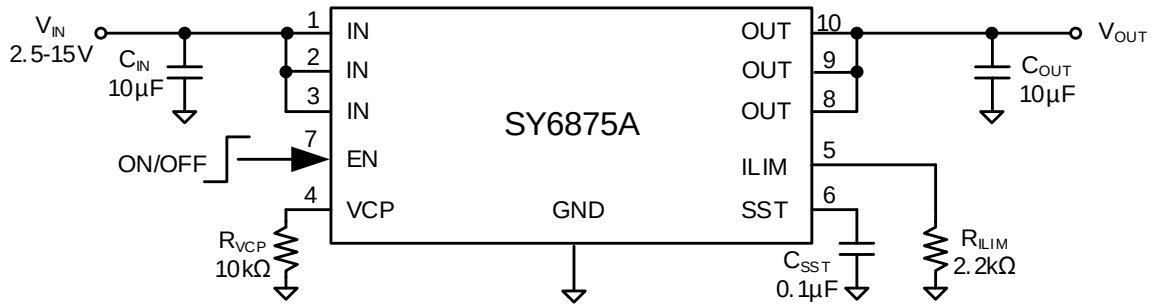
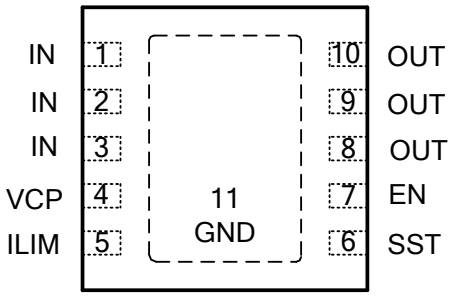


Figure1. Schematic Diagram

Pinout (top view)



(DFN3×3-10)

Top mark: **FN*xyz*** for SY6875A (Device code: FN, ***x=year code, y=week code, z= lot number code***)

Pin Name	Pin Number	Pin Description
IN	1,2,3	Power input pin. Decouple high frequency noise by connecting at least a 0.1μF MLCC to ground.
GND	11(exposed paddle)	Ground pin.
OUT	8,9,10	Power output pin.
ILIM	5	Current limit program pin. Program the current limit by connecting a resister to ground.
SST	6	Soft-start time program pin. Connect a capacitor to ground to program the soft start time.
EN	7	Enable interface pin. Pull it High to enable the IC.
VCP	4	Output clamp voltage selection based on the input voltage. Pull VCP pin to High by connecting a resistor ≤ 10kΩ to IN, or pull VCP pin to Low by connecting a resistor ≤ 10kΩ to ground, or float VCP Pin to select different output clamping thresholds. Recommend to decoupling 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
Open	12V	Over 14V	12.6V	13.3V	14V

Block Diagram

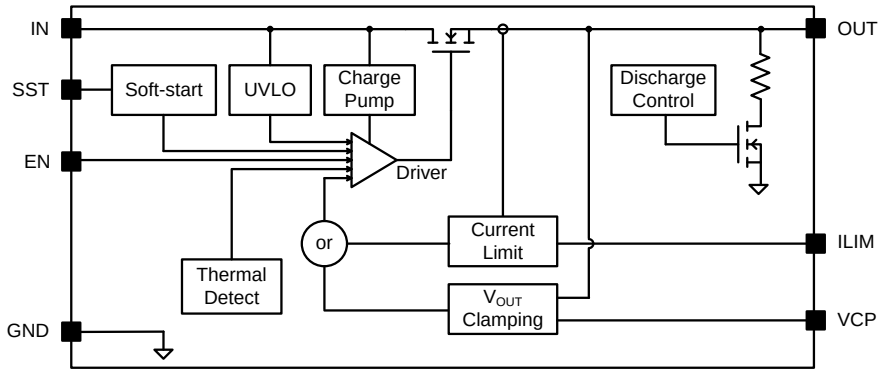


Figure2. Block Diagram

Absolute Maximum Ratings (Note 1)

Supply Input Voltage ---------- 30V
EN Pin, VCP Pin ---------- 30V
Power Dissipation, P_D @ T_A = 25°C DFN3×3-10 ---------- 2.6W
Package Thermal Resistance (Note 2)
θ_{JA} ---------- 38°C/W
θ_{JC} ---------- 8°C/W
Junction Temperature Range ---------- 125°C
Lead Temperature (Soldering, 10 sec.) ---------- 260°C
Storage Temperature Range ---------- -65°C to 150°C

Recommended Operating Conditions (Note 3)

Supply Input Voltage ---------- 2.5V to 15V
Junction Temperature Range ---------- -40°C to 125°C
Ambient Temperature Range ---------- -40°C to 85°C

Electrical Characteristics

(V_{IN} = 5V, R_{LIM}=10kΩ, C_{SST}=105nF, C_{IN} = 10μF, 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		30	V
Input UVLO Threshold	V_{UVLO}	VCP=LOW	2.2		2.4	V
		VCP=HIGH	3.4		3.8	V
		VCP=OPEN	8.1		9.0	V
UVLO Hysteresis	V_{HYS}	VCP=LOW	0.05	0.085	0.13	V
		VCP=HIGH	0.06	0.095	0.15	
		VCP=OPEN	0.1	0.19	0.29	
Bias Current	I_{BIAS}			200		μA
Shutdown Current	I_{SHDN}	EN=0		10		μA
Protection FET RON	$R_{DS(ON)}$			40	70	mΩ
Current Limit Accuracy				±30%I_{LIM}		
Current Limit Program Range	I_{LIM}	(Note 5)	1		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
		VCP=OPEN	12.6	13.3	14.0	V
Soft-start Time	t_{SST}	C_{SST}=105nF(Note 4)		29.4		ms
Soft-start Time Accuracy				±30%t_{SST}		
EN Turn-on Threshold	V_{EN_ON}		2			V
EN Turn-off Threshold	V_{EN_OFF}				0.4	V
Output Discharge Resistor	R_{DIS}	EN='0'		30		Ω
Thermal Shutdown Temperature	T_{SD}			140		°C
Thermal Shutdown Hysteresis	T_{HYS}			20		°C

Note 1: Stresses beyond "Absolute Maximum Ratings" may cause permanent damage to the device. These are for stress ratings. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions may affect device reliability.

Note 2: θ_{JA} is measured in the natural convection at T_A = 25°C on a low effective single layer thermal conductivity test board of JEDEC 51-3 thermal measurement standard. Test condition: Device mounted on 2" x 2" FR-4 substrate PCB, 2oz copper, with minimum recommended pad on top layer and thermal vias to bottom layer ground plane.

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

Note4: Recommended Soft-start Time Program Table

SST cap (nF)	None	10	55	105
Rise time (ms)	1.4	2.8	15.4	29.4

Recommended Formula for C_{SST} & Soft-start Time Calculation

$$T_{SS} = \begin{cases} T_{SS\_DLT}, & \text{No external } C_{SST} \\ \dfrac{C_{SST}}{I_{INT}}, & T_{SS} > T_{SS\_DLT} \end{cases},$$

Where, TSS_DLT is the internally fixed default soft-start time, about 1.4ms, which means there's no any external C_{SST}; I_{INT} is the internal current source, about 3.6uA.

Note5: Recommended Current Limit Program Table

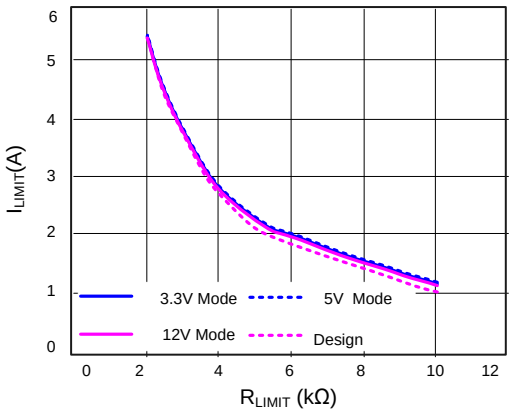
Current Limit Resistance (kΩ)	11	5.5	4.4	3.7	3.1	2.8	2.4	2.2
Current Limit (A)	1.0	2.0	2.5	3.0	3.5	4.0	4.5	5.0

Recommended Formula for R_{LIM} & Current Limit Calculation

$$R_{LIM} = \frac{11k}{I_{LIM}}(\Omega).$$

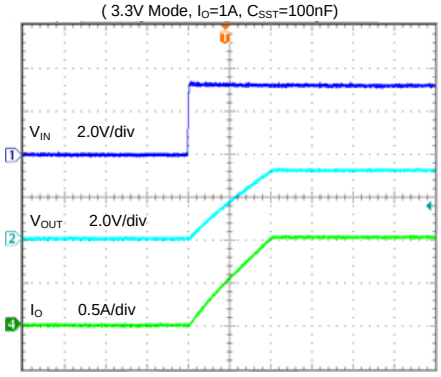
Typical Performance Characteristics

Programmable Current Limit



Programmable Soft-start Time

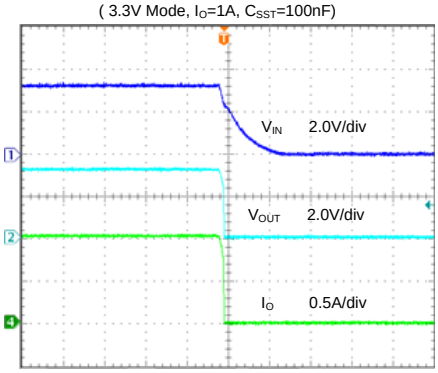
(3.3V Mode, I_O=1A, C_{SST}=100nF)



Time (20ms/div)

Shutdown

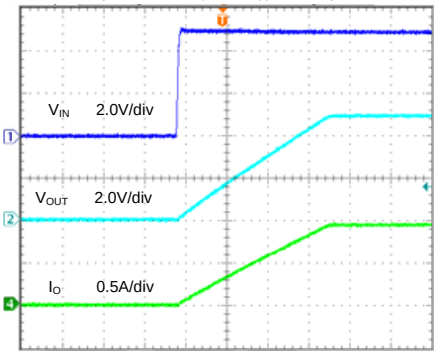
(3.3V Mode, I_O=1A, C_{SST}=100nF)



Time (10ms/div)

Programmable Soft-start Time

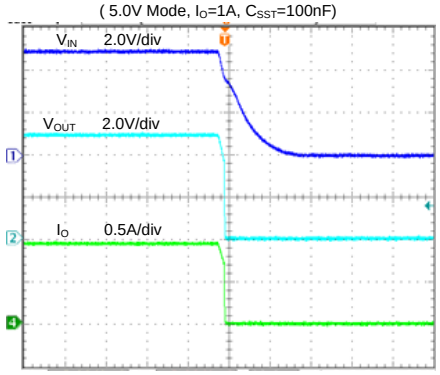
(5.0V Mode, I_O=1A, C_{SST}=100nF)



Time (10ms/div)

Shutdown

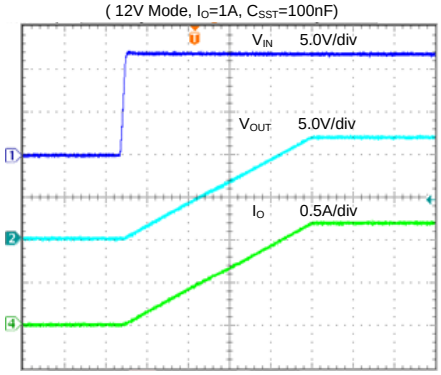
(5.0V Mode, I_O=1A, C_{SST}=100nF)



Time (10ms/div)

Programmable Soft-start Time

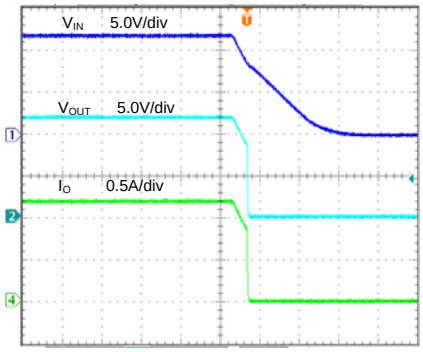
(12V Mode, I_O=1A, C_{SST}=100nF)



Time (10ms/div)

Shutdown

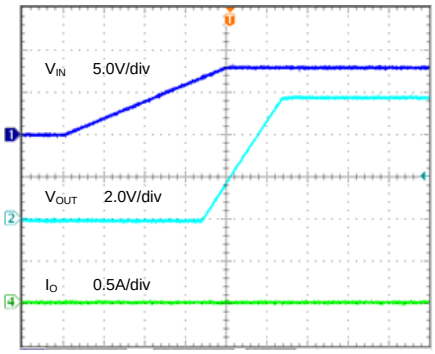
(12V Mode, I_O=1A, C_{SST}=100nF)



Time (10ms/div)

Over Voltage Protection

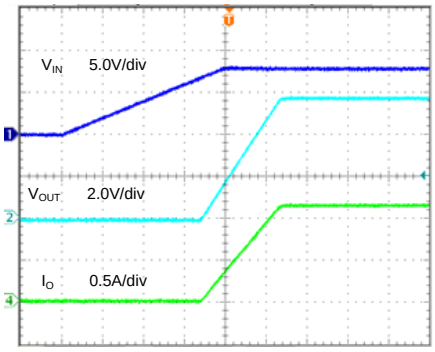
(5V Mode, V_{IN}=8V, I_O=0A)



Time (20ms/div)

Over Voltage Protection

(5V Mode, V_{IN}=8V, I_O=1A)



Time (20ms/div)

PCB Layout Guideline

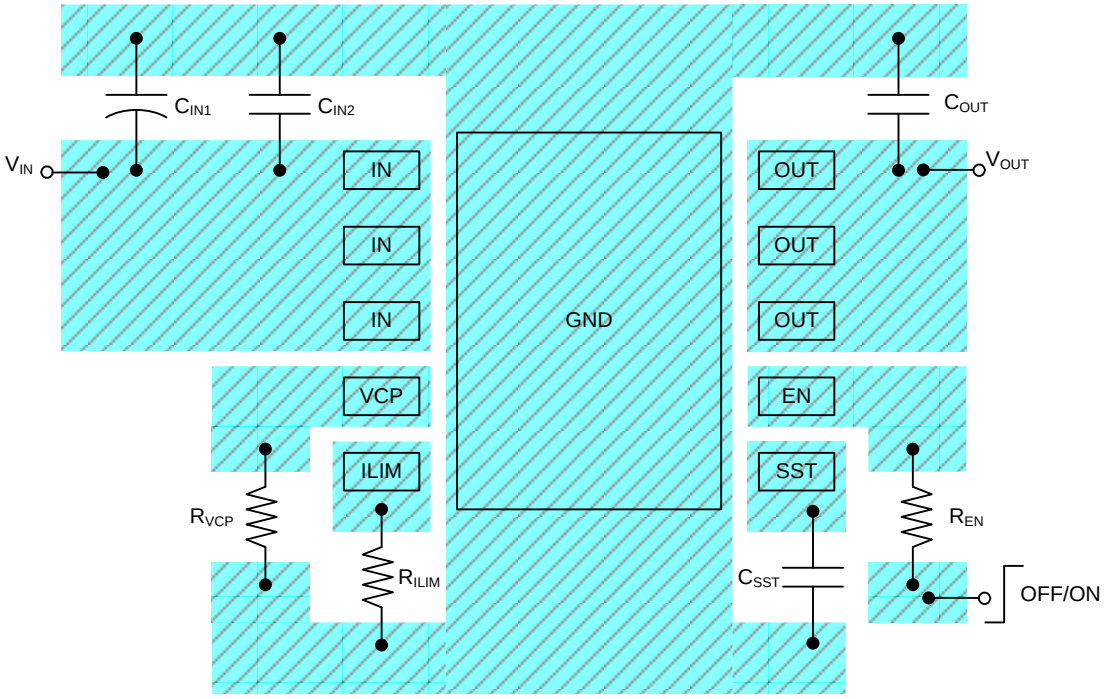
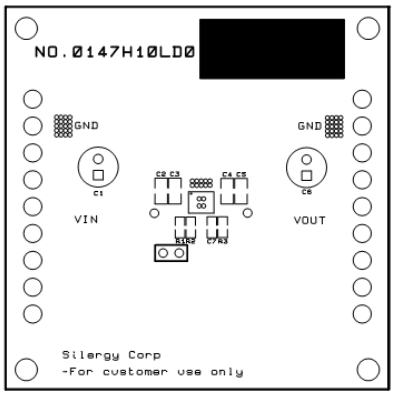
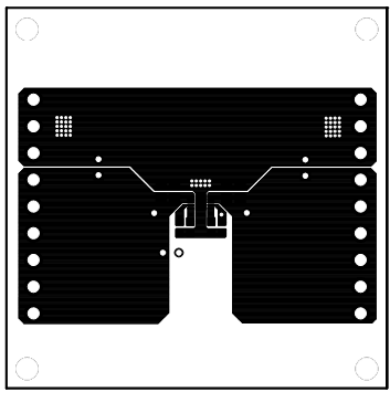


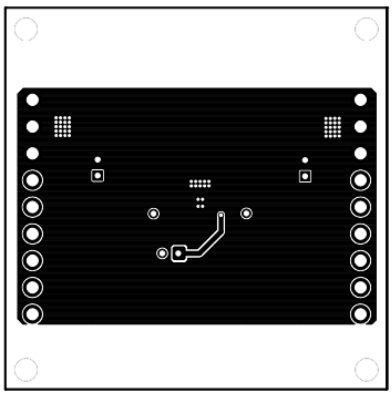
Figure3. PCB Layout Guideline



Top Silkscreen

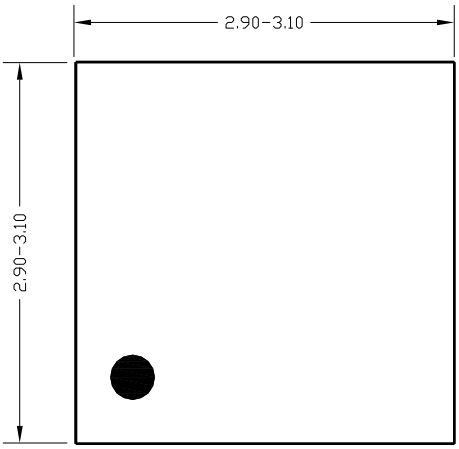


Top Layer

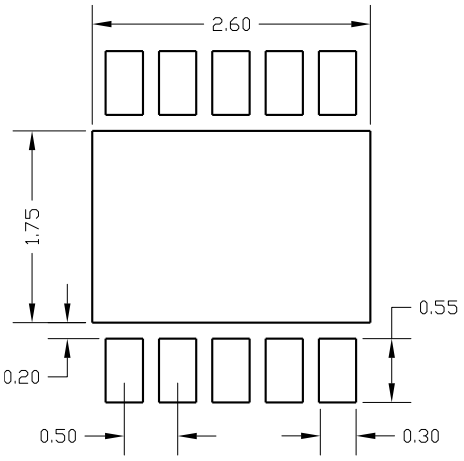


Bottom Layer

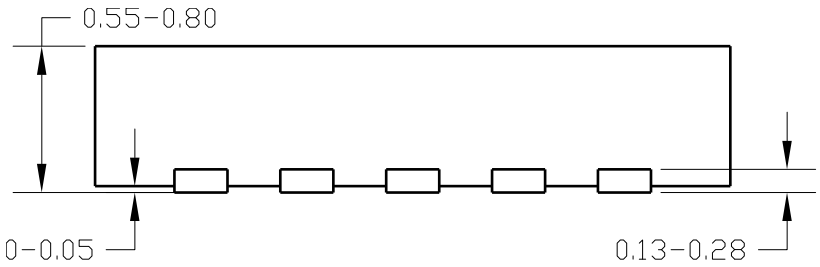
DFN3x3-10 Package outline



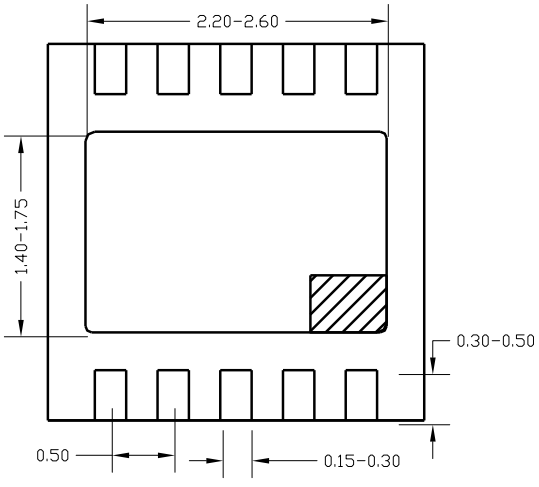
Top View

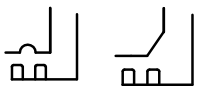


PCB layout (recommended)



Side View





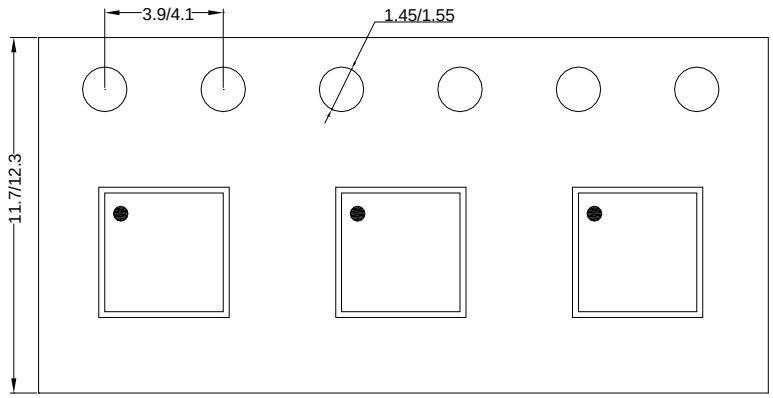
Detail A
Pin1 identifier: two options

Bottom View

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

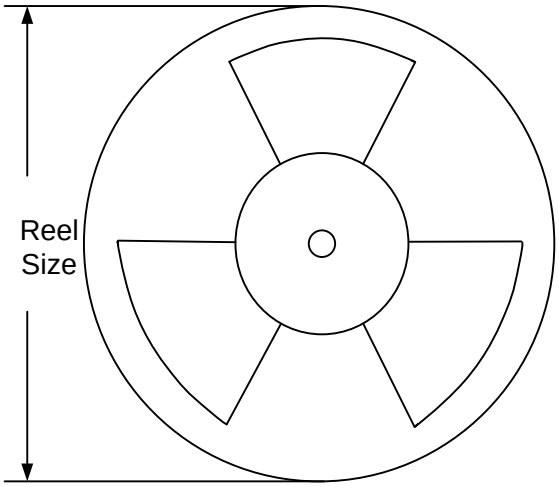
Taping & Reel Specification

1. DFN3×3-10 taping orientation



Feeding direction →

2. Carrier Tape & Reel specification for packages



Package types	Tape width (mm)	Pocket pitch(mm)	Reel size (Inch)	Reel width(mm)	Trailer length(mm)	Leader length (mm)	Qty per reel
DFN3×3	10	8	13"	12.4	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 an 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