SY20731

Low Dropout 1A LDO Regulator

General Description

The SY20731 is a low-dropout voltage regulator with an input voltage range of 1.6V to 5.5V, and capable of sourcing up to 1A to a load. Protection features like fold-back current limit and overtemperature protection enable the use of the part in demanding applications. The output voltage can be configured using a resistor network.

The SY20731 is available in an industry standard DFN 3mmx3mm-6pin package, which offers low thermal resistance.

Features

- Input Voltage Range: 1.6-5.5V
- Up to 1A Output Current
- Output Voltage Accuracy: ±3%
- Low Dropout Voltage:
  Typ. 0.32V at I_{OUT}=1A, V_{OUT}=1.5V
  Typ. 0.18V at I_{OUT}=1A, V_{OUT}=2.8V
- Current Limiting Protection
- Thermal Shutdown Protection
- Quiescent Current: 60μA
- Output Auto-discharge Function
- Over Temperature Protection
- RoHS Compliant and Halogen Free
- Compact Package: DFN3×3-6

Applications

- Portable Communication Equipment
- Hand-Held Instruments, Notebook PCs
- Camcorders and Cameras

Typical Applications

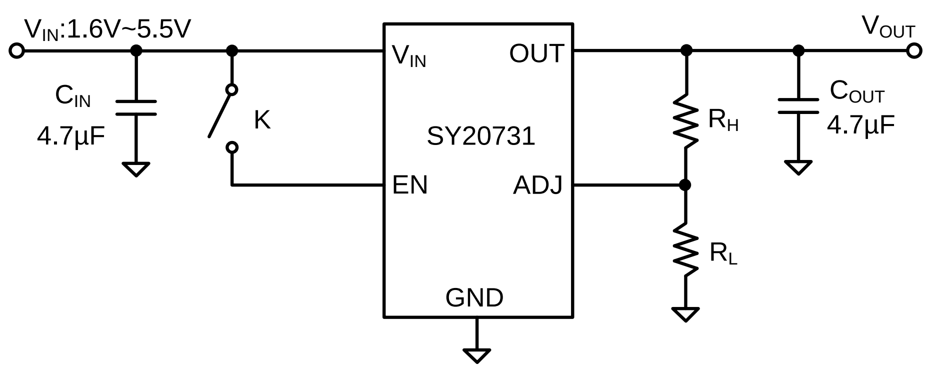


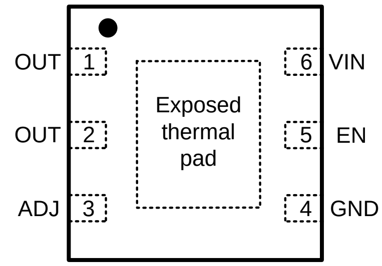
Figure 1. Schematic diagram

Ordering Information

Ordering Part Number	Package Type	Top Mark
SY20731DSC	DFN3×3-6 RoHS Compliant and Halogen Free	**RB*xyz***

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

Pinout (top view)



Pin Description

Pin No	Pin Name	Pin Description
OUT	1, 2	Output pin. Decouple this pin to the GND pin with at least a 4.7μF ceramic capacitor.
ADJ	3	Output voltage programming pin. Connect this pin to the center point of the output resistor divider (as shown in Figure 1) to program the output voltage: $V_{OUT}=1.0V\times(1+R_H/R_L)$.
GND	4	Ground pin.
EN	5	Enable control pin. A 5MΩ pull-down resistor is integrated.
VIN	6	Input pin. Decouple this pin to the GND pin with at least a 4.7μF ceramic capacitor.

Block Diagram

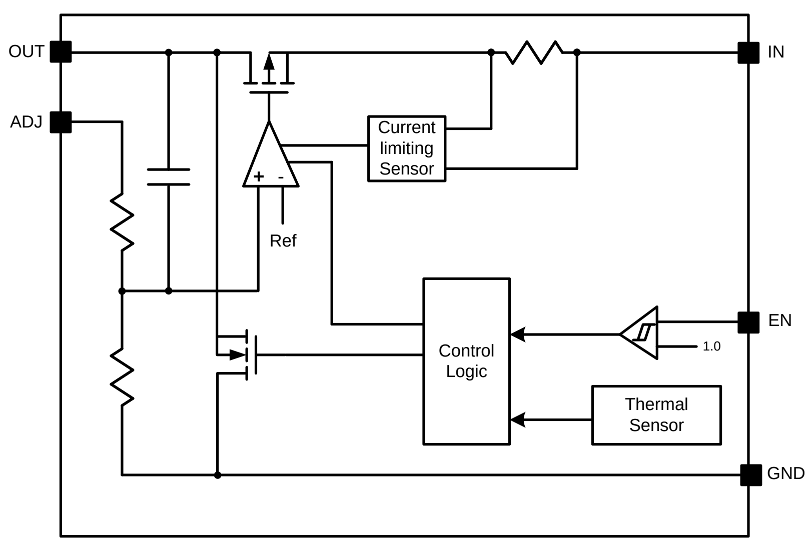


Figure 2. Block diagram

Absolute Maximum Ratings

Parameter (Note 1)	Min	Max	Unit
IN, 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	50	°C/W
θ_{JC} Junction-to-Case Thermal Resistance	15	
P_D Power Dissipation TA = 25°C	2	W

Recommended Operating Conditions

Parameter (Note 3)	Min	Max	Unit
IN	1.6	5.5	V
OUT	1	V_{IN}	
Junction Temperature, Operating	-40	125	°C
Ambient Temperature	-40	85	

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 Silergy test board.

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

Electrical Characteristics

(V_{IN} = 5V, C_{IN}=4.7μF, C_{OUT}=4.7μF, T_A = 25°C unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ.	Max	Unit
Input Voltage Range	V_{IN}		1.6		5.5	V
Supply Current	I_{SS}	V_{EN}=V_{IN}=2V, V_{OUT}=V_{ADJ}, I_{OUT}=0A		60	100	μA
Shutdown Current	I_{SD}	V_{IN}=6.0V, V_{EN}=0		0.1	1	μA
Output Voltage Accuracy	$\triangle V_{OUT}$	V_{OUT}=V_{ADJ}, V_{IN}=2.0V, I_{OUT}=100mA	0.970		1.030	V
Output Voltage Range			1.0		V_{IN}	V
Current Limit	I_{LIM}		1.0			A
Load Regulation	$\triangle V_{OUT}/\triangle I_{OUT}$	V_{OUT}=V_{ADJ}, V_{IN}=2.0V 1mA≤I_{OUT}≤1A		-3		mV/A
Line Regulation	$\triangle V_{OUT}/$ $\triangle V_{IN}$	V_{OUT}=V_{ADJ}, I_{OUT}=100mA 2.0≤V_{IN}≤5.5V		0.05	0.2	%/V
EN Pull-down Resistance	R_{EN}			5		MΩ
Ripple Rejection	RR	f=1kHz, Ripple 0.5V_{P-P} V_{OUT}=V_{ADJ}, V_{IN}=2.5V, I_{OUT}=100mA		-60		dB

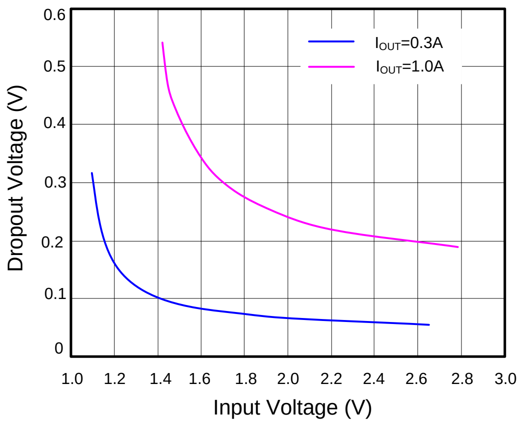
Parameter	Symbol	Test Conditions	Min	Typ.	Max	Unit
Output Voltage Temperature Coefficient	$\triangle V_{OUT}/\triangle T$	I_{OUT}=100mA -40℃≤T≤85℃		±100		ppm/°C
Short Current Limit	I_{SHORT}	V_{OUT}=0V		250		mA
Discharge Resistor	R_{DISCHG}			100		Ω
EN Rising Threshold	V_{ENH}		1.0			V
EN Falling Threshold	V_{ENL}				0.4	V
Thermal Shutdown Temperature	T_{SD}			150		°C
Thermal Shutdown Hysteresis	T_{HYS}			20		°C
Dropout Voltage	V_{DROP}	Refer to following table				

Dropout Voltage by output Voltage T_A = 25°C

Output Voltage(V) V_{OUT}	Dropout Voltage V_{DROP} (V)		
	I=300mA		I=1A
	Typ.	Max	Typ
1.0V≤V_{OUT} < 1.5V	0.18	0.32	0.50
1.5V≤ V_{OUT} < 2.6V	0.10	0.15	0.28
2.6V≤V_{OUT}	0.05	0.10	0.18

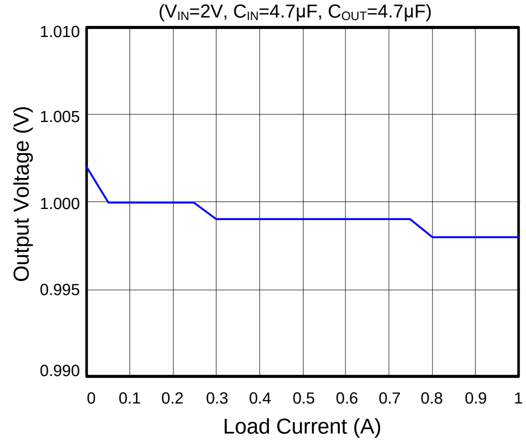
Typical Operating Characteristics

Dropout Voltage vs. Input Voltage



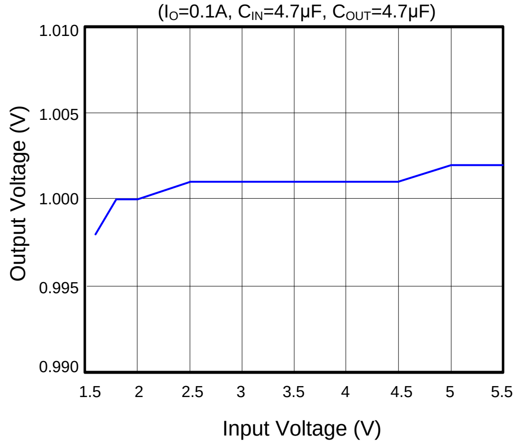
Load Regulation

(V_{IN}=2V, C_{IN}=4.7μF, C_{OUT}=4.7μF)



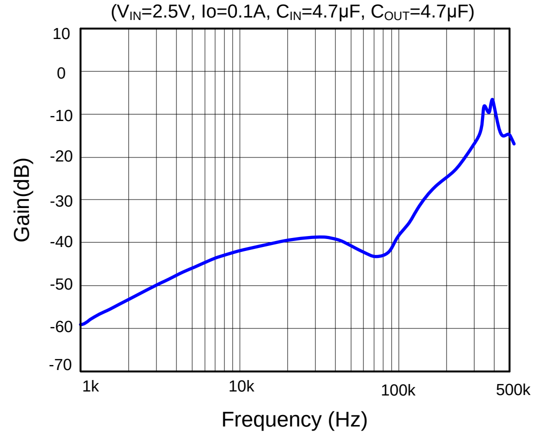
Line Regulation

(I_O=0.1A, C_{IN}=4.7μF, C_{OUT}=4.7μF)



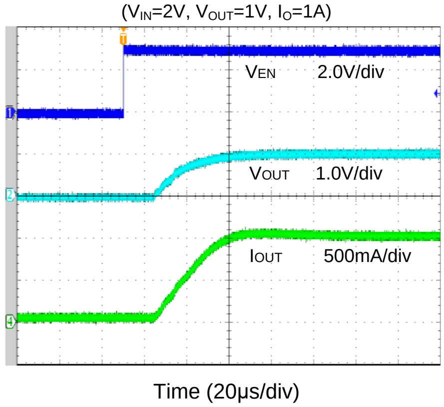
Power Supply Rejection Ratio

(V_{IN}=2.5V, Io=0.1A, C_{IN}=4.7μF, C_{OUT}=4.7μF)



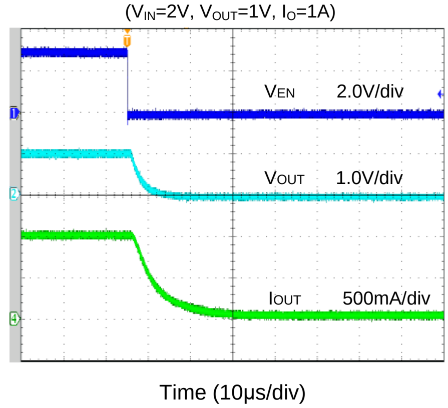
Startup from EN

(V_{IN}=2V, V_{OUT}=1V, I_O=1A)



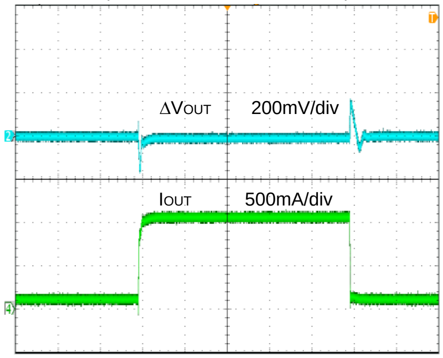
Shutdown from EN

(V_{IN}=2V, V_{OUT}=1V, I_O=1A)



Load Transient

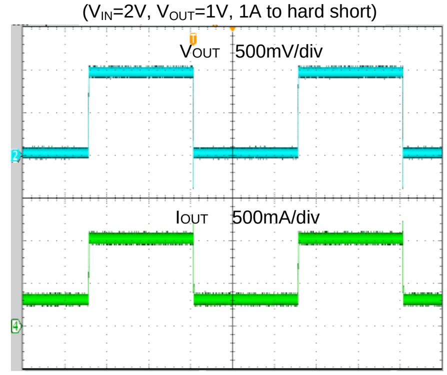
(V_{IN}=2V, V_{OUT}=1V, I_O=0.1~1A)



Time (40μs/div)

Short Circuit Protection

(V_{IN}=2V, V_{OUT}=1V, 1A to hard short)



Time (2ms/div)

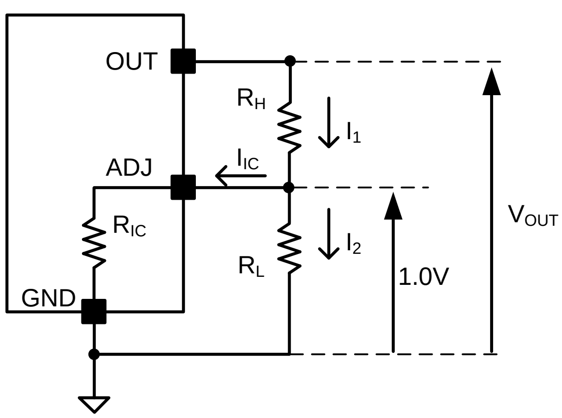
Application Information

The SY20731 is a low-dropout voltage regulator capable of sourcing up to 1A. It provides programmable output voltage with ±3% accuracy

Input Capacitor C_{IN}:
A 4.7μF decoupling capacitor is recommended between input pin and ground pin. A typical X5R or better grade ceramic capacitor with 6V rating is recommended for most applications. Place the input and output capacitors as close as practical to the input and output pins to ensure stable operation.

Output Capacitor C_{OUT}:
The SY20731 is designed to operate using low equivalent series resistance (ESR) ceramic output capacitors. This forms a zero to provide phase lead which is required for loop stability. A 4.7μF capacitor with 10mΩ to 50mΩ ESR range can be used in this application. Higher capacitance values help to improve transient response.

Output Voltage Setting:



The output voltage can be adjusted from 1.0V to V_{IN}-V_{DROP} by using a resistor divider. The output voltage can be calculated using the following equations:

$V_{OUT}=1.0+R_H(I_{IC}+1.0/R_L)$
$V_{OUT}=1.0(1+R_H/R_L)+R_H\times I_{IC}$;

When choosing $R_L<<R_{IC}$ (1.45MΩ) the term $R_H\times I_{IC}$ becomes negligible and the output voltage can be estimated using the simplified formula:
$V_{OUT}=1.0(1+R_H/R_L)$, ($R_L<<R_{IC}$).

Dropout Voltage:
The dropout voltage is determined by the $R_{DS(ON)}$ of the power MOSFET. The SY20731 features a low dropout voltage due to its extra low $R_{DS(ON)}$, which determines the lowest usable supply voltage.

$$V_{DROPOUT}=V_{IN}-V_{OUT}=R_{DS(ON)}\times I_{OUT}$$

Current Limit:
The internal current-limit circuit is used to protect the LDO against transient high-load current faults. The device is configured to operate with a minimum current limit of 1A.

Short-circuit Protection
The current through the device increases very rapidly during a short circuit event. When a short circuit is detected by comparing the current through the device with the current limit threshold, the current is reduced to approximately 0.25A. Operating in current limit can trigger the integrated thermal shutdown protection circuit. The output turns on and off when thermal shutdown is reached until power dissipation is reduced.

Thermal Considerations:
The SY20731 can source a current of up to 1A over the full operating junction temperature range. However, the maximum output current must be derated at higher ambient temperature to limit junction temperature to a maximum of 125℃. The junction temperature must be within the operating range specified under all operating conditions. The LDO power dissipation depends on the input-to-output voltage difference and load current.
The dissipated power, P_D, can be calculated using the following equation:

$P_D=(V_{IN}-V_{OUT})\times I_{OUT}+V_{IN}\times I_{GND}$

The operating junction temperature can be estimated using the following formula:

$P_{D(MAX)}=(T_{J(MAX)}-T_A)/\theta_{JA}$

Where $T_{J(MAX)}$ is the maximum junction temperature of die (125℃) and T_A is the maximum ambient temperature.

Layout Design:

Good board layout practices must be used for stable operation, and a large PCB copper area can improve the thermal performance. The input and output capacitors must be directly connected to the input, the output, and the ground pins of the device using traces which have no other currents flowing through them. The feed back loop formed by R_L, R_H and the trace connecting to the ADJ pin and the OUT must be minimized.

Place C_{IN} and C_{OUT} near the device with short traces to the V_{IN}, V_{OUT}, and ground pins. The regulator ground pin should be connected to the external circuit ground so that the regulator and its capacitors have a "single point ground".

Below is the recommended PCB Layout diagram:

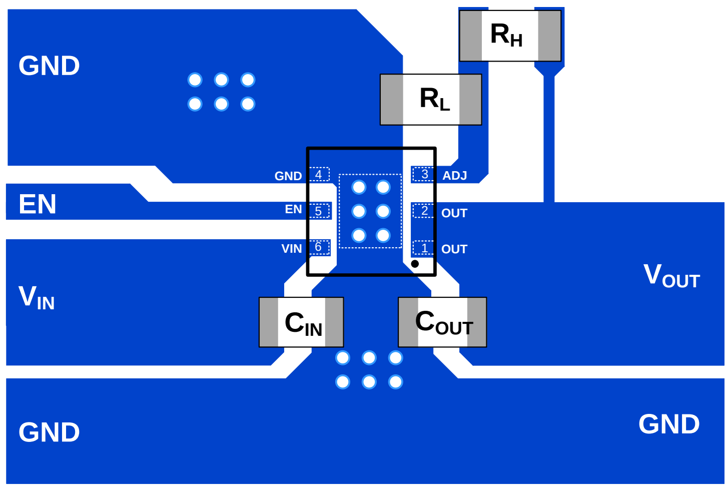
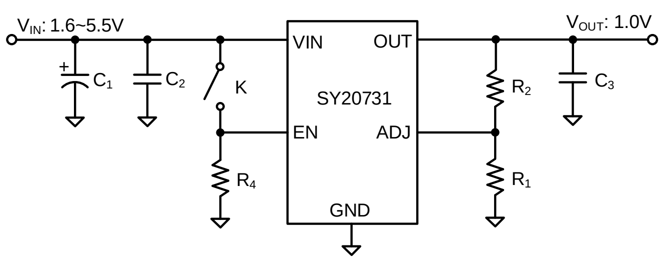


Figure3. PCB Layout Suggestion

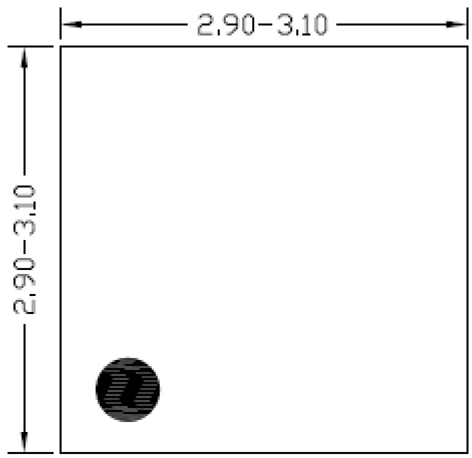
Application Schematic (V_{OUT} = 1.0V)



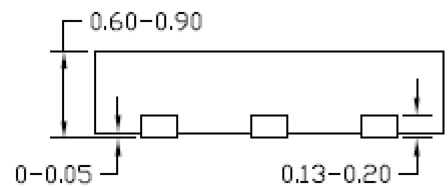
BOM List

Reference Designator	Description	Part Number	Manufacturer
C_1	100μF/16V (electrolytic capacitor)		
C_2	4.7μF/6.3V, 0603, X5R	C1005X5R1A475M	TDK
C_3	4.7μF/6.3V, 0603, X5R	C1005X5R1A475M	TDK
R_1	OPEN		
R_2	SHORT		
R_4	1MΩ, 0603		

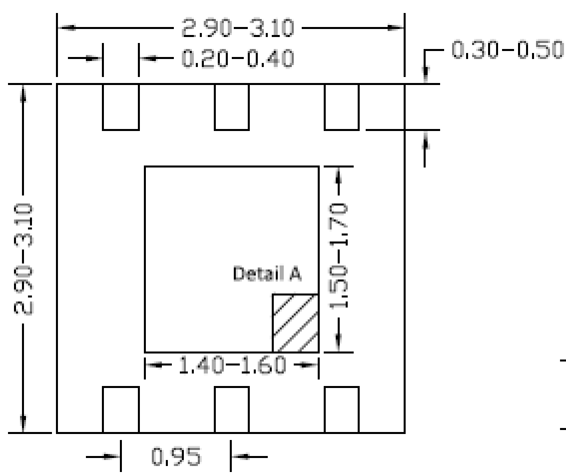
DFN3×3-6 Package Outline Drawing

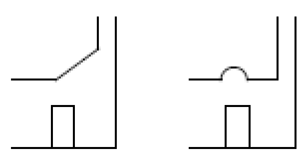


Top View



Side View





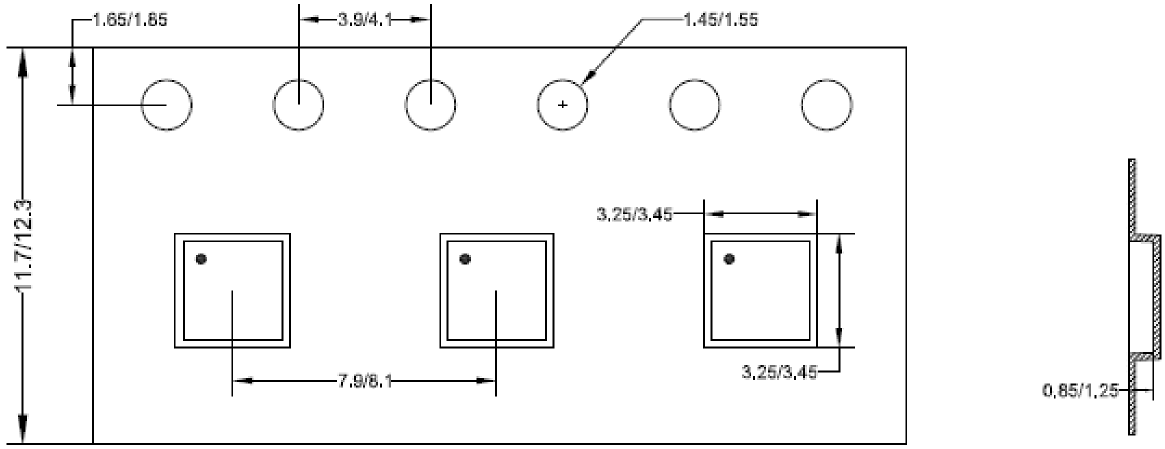
Detail A
Pin1 Identifier: two options

Bottom View

Notes: **All dimension in millimeter and exclude mold flash & metal burr**

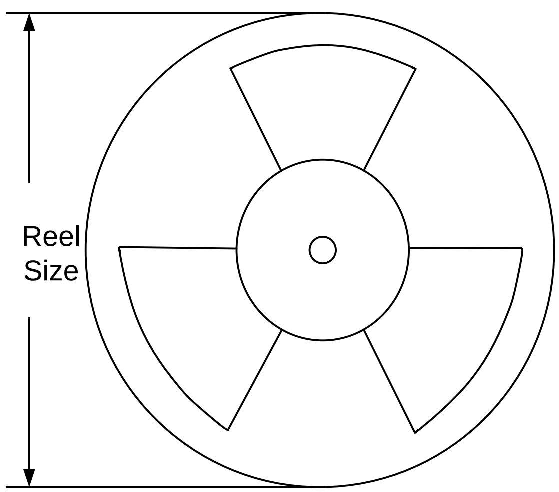
Taping & Reel Specification

1. DFN3×3 taping orientation



Feeding direction →

2. Carrier Tape & Reel specification for packages



Package type	Tape width (mm)	Pocket pitch(mm)	Reel size (Inch)	Trailer length(mm)	Leader length (mm)	Qty per reel
DFN3×3	12	8	13"	400	400	5000

3. Others: NA

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