

General Description

The SY20736 is a precise LDO (Low Dropout Regulator) with a 150mA output current capability. This device offers a resistor adjustable output voltage with an accuracy of $\pm 2\%$ at room temperature. Its ultra-low dropout voltage, wide input voltage range, and low ground current are ideal for USB and portable electronics that require varying input sources. Additionally, it features internal compensation for stable operation with low ESR ceramic capacitors, logic-enabled control, thermal shutdown, and current limit protection.

The SY20736 is available in a DFN 2mmx2mm-6pin package.

Features

- Wide Input Voltage Range: 2.5V to 30V
- Low Dropout Voltage: 150mV at 150mA
- 150mA Output Current Capability
- Low Ground Current
- Ultra-Low Shutdown Current (1 μ A Typ.)
- Output Current Limitation
- High Output Accuracy: $\pm 2\%$ at Room Temperature
- Stable with Small Ceramic Capacitors
- Excellent Load and Line Regulation
- TTL Logic Enable Input
- Thermal Shutdown
- RoHS Compliant and Halogen Free
- Compact DFN2x2-6 Package

Applications

- Battery Powered Applications
- Consumer and Portable Products
- Notebooks
- Smartphones
- SMPS Post-Regulators/ DC/DC Modules

Typical Application

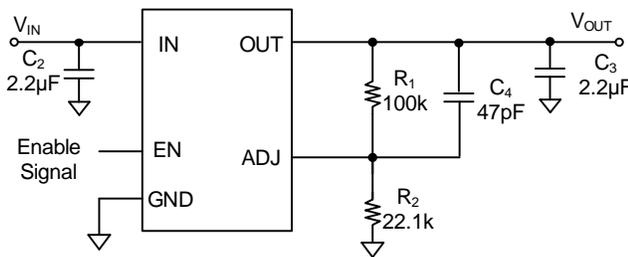


Figure 1. Schematic Diagram

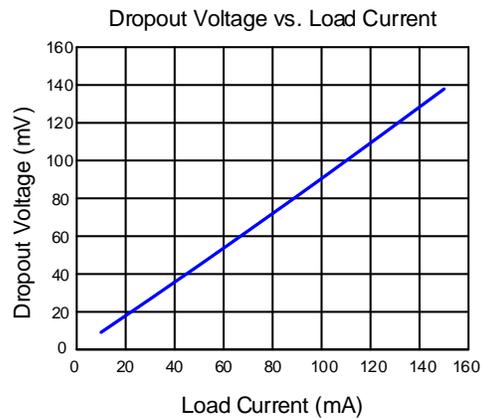


Figure 2. Dropout Characteristics

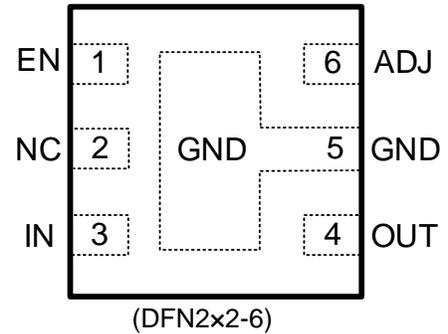
Ordering Information

SY20736 □(□□□)
 └── Package Code
 └── Optional Spec Code

Ordering Number	Package Type	Top Mark
SY20736DED	DFN2x2-6	r5xyz

Device code: **r5**
x=year code, y=week code, z=lot number code

Pinout (top view)



Pin Name	DFN2x2-6	Pin Description
EN	1	Enable pin. Pull it low to shut down the device or pull it high to enable it. Do not leave it floating.
IN	3	Supply input pin.
OUT	4	LDO output pin.
GND	5	Ground pin.
ADJ	6	Output voltage adjustment pin. Feedback the output voltage through the resistor voltage divider network. $V_o = 0.6 \times (1 + \frac{R1}{R2})$

Block Diagram

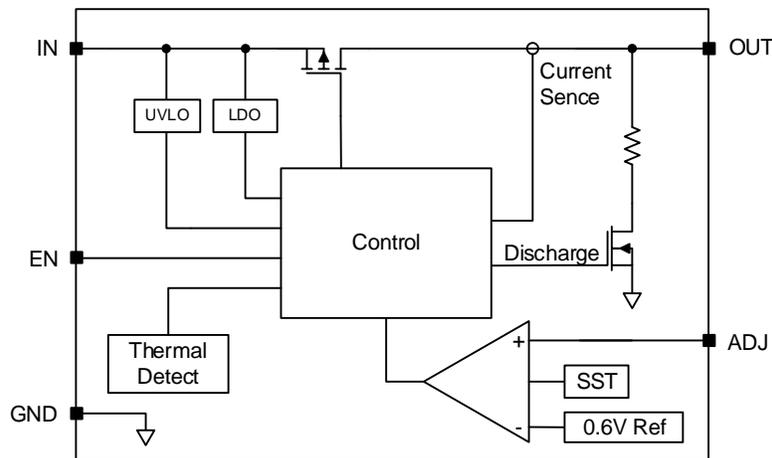


Figure 2. Block Diagram

Absolute Maximum Ratings

Parameter (Note 1)	Min	Max	Unit
IN	-0.3	36	V
OUT		0.3+V _{IN}	
EN	-0.3	0.3+V _{IN}	
ADJ	0	3.6	
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	62	°C/W
θ _{JC} Junction-to-Case Thermal Resistance	8.5	
P _D Power Dissipation T _A = 25°C	1.6	W

Recommended Operating Conditions

Parameter (Note 3)	Min	Max	Unit
IN	2.5	30	V
OUT		0.3+V _{IN}	
EN	0	0.3+V _{IN}	
Junction Temperature, Operating	-40	125	°C

Electrical Characteristics

($V_{IN}=V_{OUT}+1V$, or $V_{IN}=2.5V$, $V_{EN}=V_{IN}$, $T_J = -40^{\circ}C\sim 125^{\circ}C$, typical values are at $T_J=25^{\circ}C$, unless otherwise specified. The min/max values are guaranteed by test, design, or statistical correlation.)

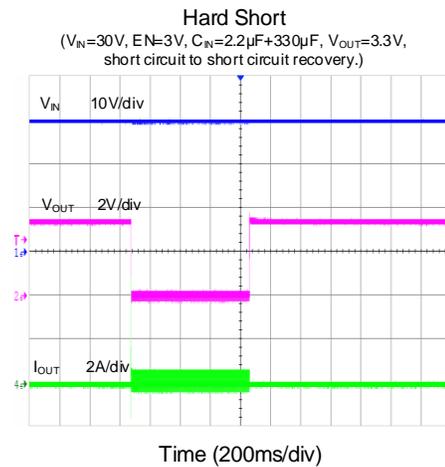
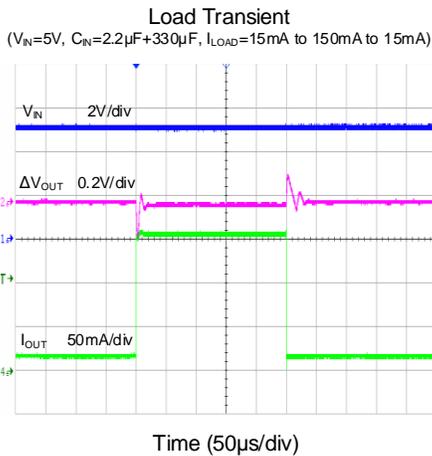
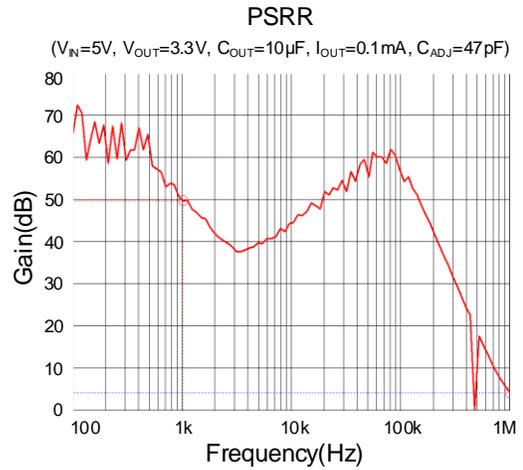
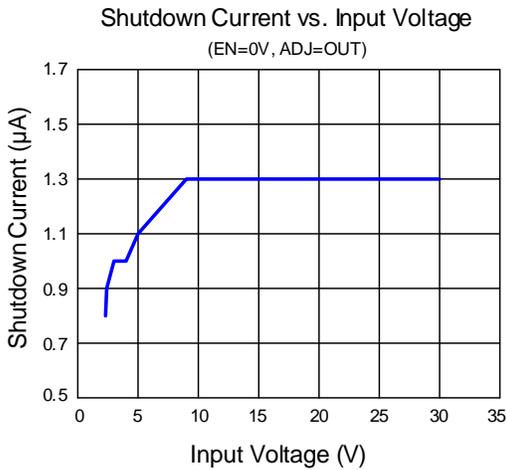
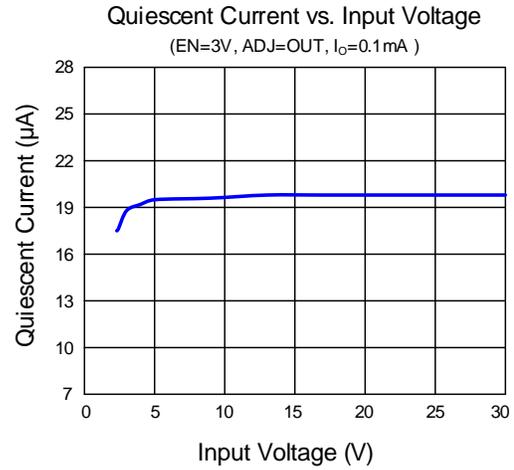
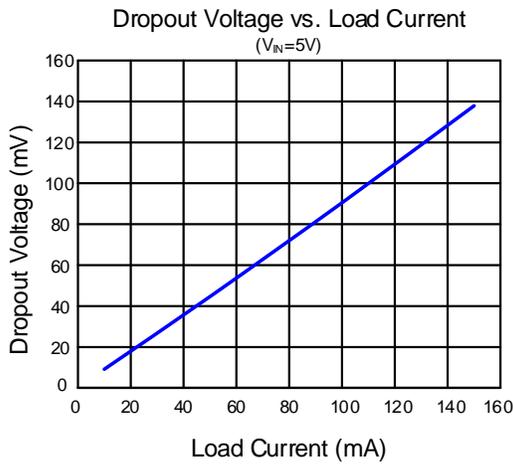
Parameter	Symbol	Test Conditions	Min	Typical	Max	Unit
Input Voltage	V_{IN}		2.5		30	V
Output Voltage Accuracy	V_{OUT}	$I_O=100\mu A$, $T_A=25^{\circ}C$	-2		2	%
Line Regulation	ΔV_{LNR}	$V_{IN}=(V_{OUT}+0.3)$ to 30V, $I_O=100\mu A$		0.04	0.5	%
Load Regulation	ΔV_{LDR}	$I_O=0.1mA$ to 150mA		0.25	2	%
Dropout Voltage	$V_{IN}-V_{OUT}$	$I_O=10mA$		10	20	mV
		$I_O=50mA$		50	100	mV
		$I_O=100mA$		100	200	mV
		$I_O=150mA$		150	300	mV
Shutdown Current	I_{SHDN}	$V_{EN}=0V$, $V_{IN}=4V$		1	5	μA
		$V_{EN}=0V$, $V_{IN}=24V$		1	5	μA
Quiescent Current	I_Q	$I_O=0.1mA$		18	40	μA
		$I_O=150mA$		450		μA
Current Limit	I_{LIM}	$V_{OUT}=0.9\times V_{OUT}$ (normal)		350	500	mA
Power-supply Rejection Ratio	PSRR	$f=1kHz$, $C_{OUT}=10\mu F$		50		dB
Input UVLO Threshold	V_{UVLO}	V_{IN} rising			2.5	V
UVLO Hysteresis	V_{UVLO_TH}			100		mV
Shutdown discharge Resistor			400	500	800	Ω
Enable Input logic High Voltage	V_{EN_H}	$V_{IN}=2.8$ to 5.5V	1.7			V
Enable Input logic Low Voltage	V_{EN_L}	$V_{IN}=2.8$ to 5.5V			0.6	V
Thermal Shutdown Temperature	T_{SD}			150		$^{\circ}C$
Thermal Shutdown Hysteresis	T_{HYS}			20		$^{\circ}C$

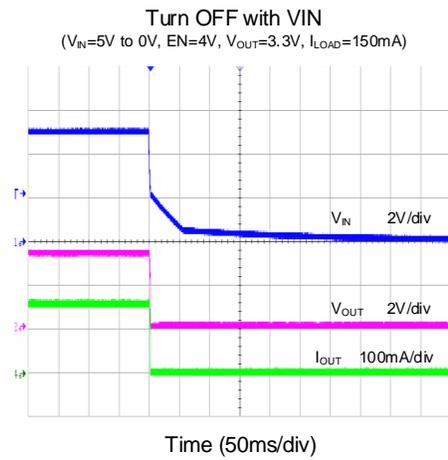
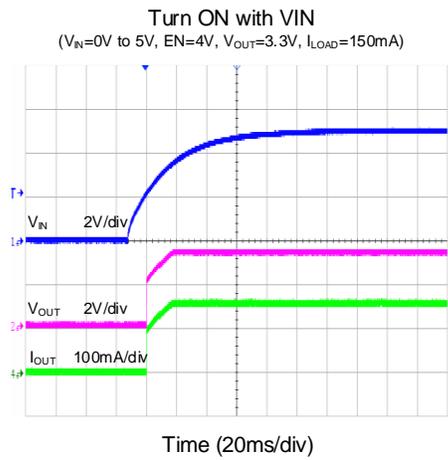
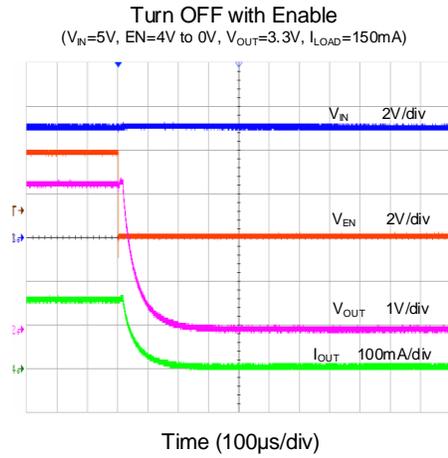
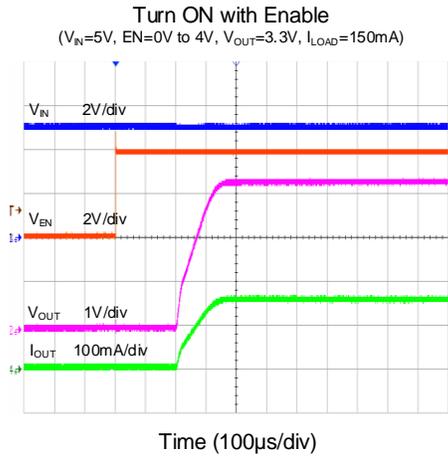
Note 1: Stresses beyond the “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specification is not implied. Exposure to absolute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

Note 2: θ_{JA} is measured with natural convection at $T_A = 25^{\circ}C$ on a two-layer Silergy Evaluation Board.

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

Typical Performance Characteristics



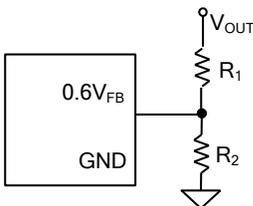


Application information

The SY20736 is a 150mA linear regulator with a low dropout voltage. Like any low dropout regulator, the SY20736 requires input and output decoupling capacitors.

Feedback Resistor R₁ and R₂:

Choose R₁ and R₂ to program the proper output voltage. To minimize the power consumption under light loads, it is recommended to choose large resistance values for both R₁ and R₂. A value of between 10kΩ and 1MΩ is recommended for these resistors. For instance, if V_{OUT} is 3.3V, and R₁=100k is chosen, then R₂ can be determined using the following equation to be approximately 22.1k:

$$R_2 = \frac{0.6V}{V_{OUT} - 0.6V} R_1$$


Input Capacitor C_{IN}:

A ceramic input capacitor with a capacitance larger than 2.2μF is required between the device input pin and ground pin. A typical X5R or better-grade ceramic capacitor is recommended for this application. This input capacitor must be located close to the device to minimize the input noise.

Output Capacitor C_{OUT}:

For transient stability, the SY20736 is designed specifically to work with small ceramic output capacitors. An output capacitance of 2.2μF or higher can be used in this application. Higher capacitance values help to improve transient response. The output capacitor's ESR is critical because it forms a zero to provide the phase lead required for loop stability.

Dropout Voltage:

The SY20736 has a very low dropout voltage due to its extra low R_{DS(ON)} of the main PMOS, determining the lowest usable supply. The dropout voltage can be calculated using the following equation:

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

Overcurrent and Short-Circuit Protection:

The device includes overcurrent and short-circuit protection. The current limiting circuit regulates the output current to its threshold to protect the device from damage. During overcurrent or short-circuit events, the device experiences higher power loss, which could activate its thermal protection mechanism.

Thermal Considerations:

The SY20736 can deliver a current of up to 150mA over the full operating junction temperature range. However, the maximum output current must be derated at a higher ambient temperature to ensure the junction temperature does not exceed 125°C. Under all operating conditions, the junction temperature must be within the range specified under operating conditions.

Power dissipation can be calculated based on the output current and the voltage drop across the regulator, using the following equation:

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

The final operating junction temperature for any set of conditions can be estimated by using the following thermal equation:

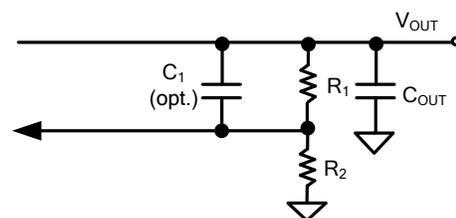
$$P_{D(MAX)} = (T_{J(MAX)} - T_A) / \theta_{JA}$$

Where:

- T_{J(MAX)} is the maximum junction temperature of die (125°C).
- T_A is the maximum ambient temperature.
- The junction to ambient thermal resistance (θ_{JA}) footprint is 62°C/W for the DFN2x2-6 package.

Load Transient Considerations:

The SY20736 integrates the compensation components to achieve good stability and fast transient responses. In some applications, adding a small ceramic cap in parallel with R₁ may further speed up the load transient responses and is thus recommended for applications with large load transient step requirements. A value of 47 pF is recommended for most applications.



Application Schematic

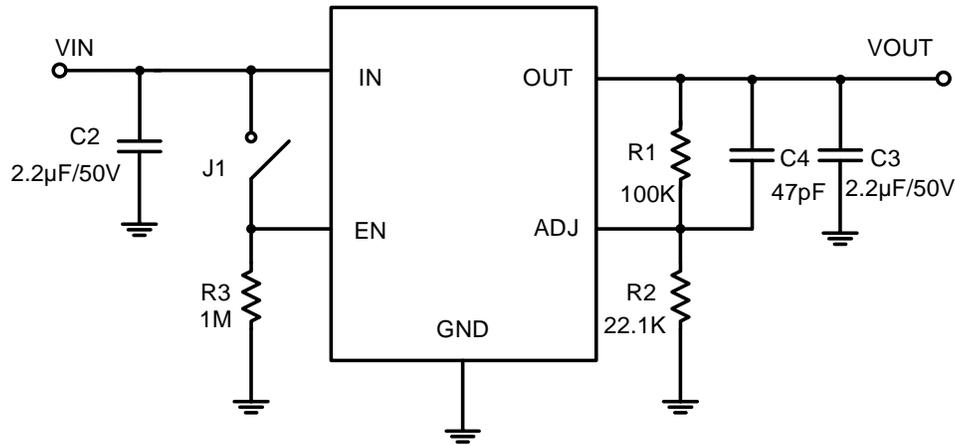


Figure 3. Schematic Diagram

BOM List

Reference Designator	Description	Part Number	Manufacturer
U1	30V, 150mA	SY20736DED	Silergy
C2, C3	2.2µF/50V/X7R,1206	C3216X7R1H225K	TDK
C4	47pF/50V/C0G,0603	C1608C0G1H470J	TDK
R1	100kΩ ,1% ,0.1W, 0603	RC0603FR-07100KL	YAGEO
R2	22.1kΩ ,1%, 0.1W 0603	RC0603FR-0722K2L	YAGEO
R3	1MΩ ,1% ,0.1W, 0603	RC0603FR-071ML	YAGEO
J1	Jumper, 2x1, Gold		Any

Layout Design:

Good board layout practices must be used for stable operation, and a large PCB copper area can improve thermal performance. The input and output capacitors must be directly connected to the input, output, and the device's ground pins using traces with no other currents flowing through them.

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:

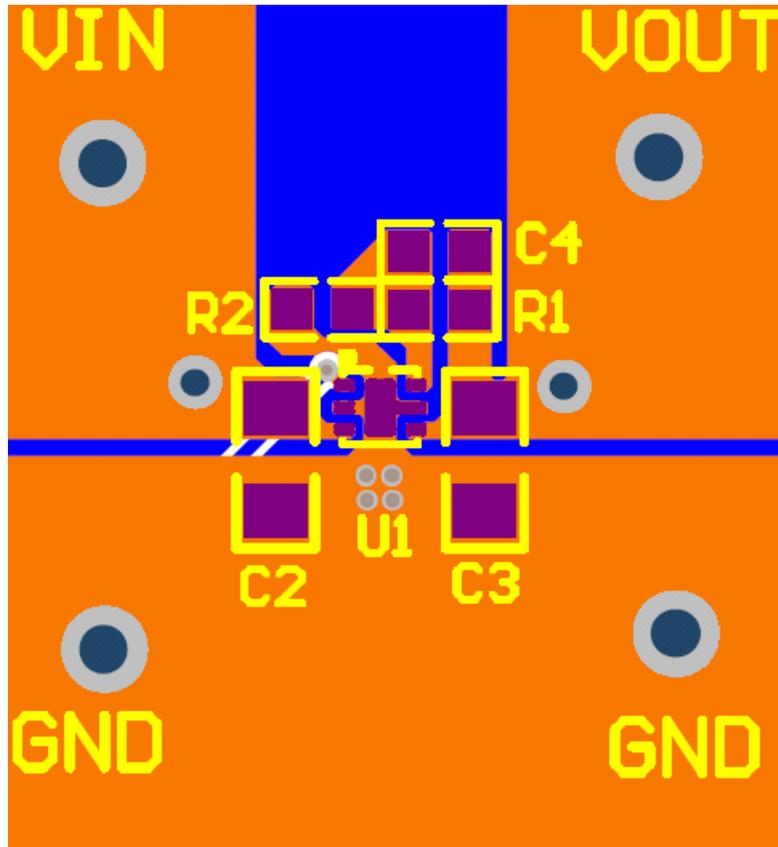
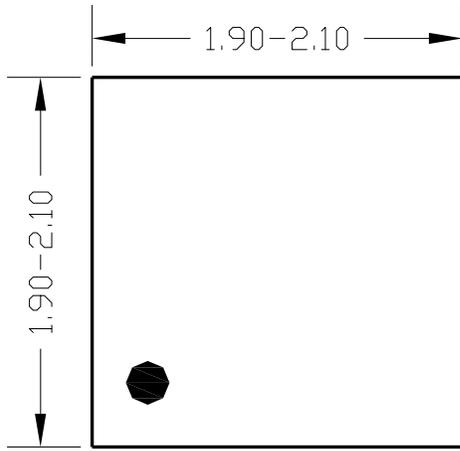
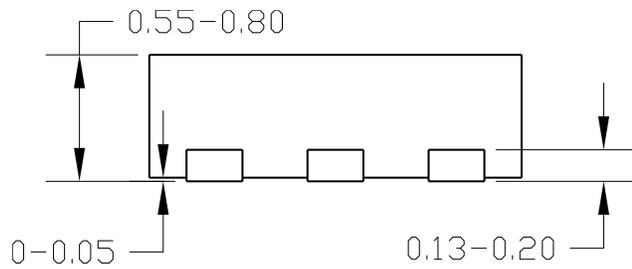


Figure 4. PCB Layout Suggestion

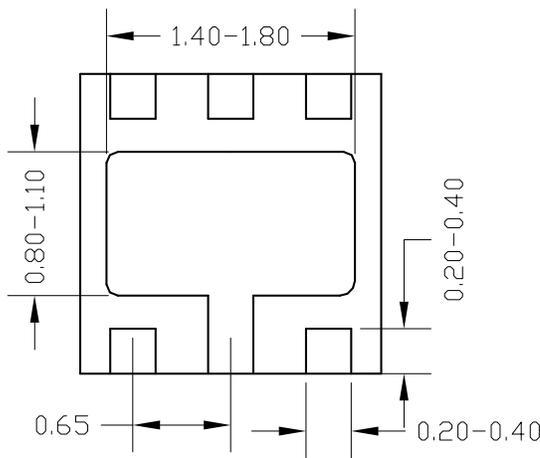
DFN2x2-6 Package Outline



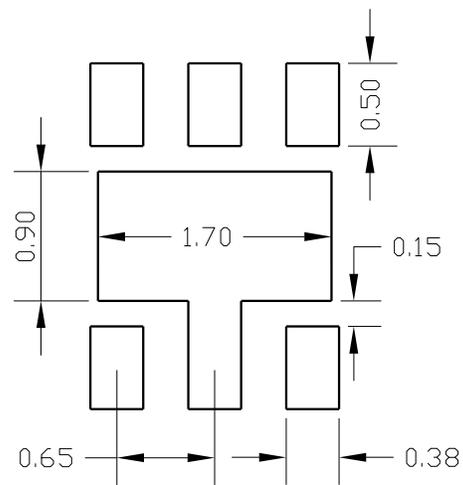
Top View



Side View



Bottom View

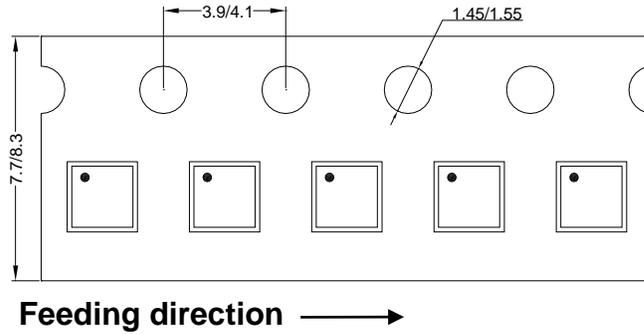


Recommended PCB Layout

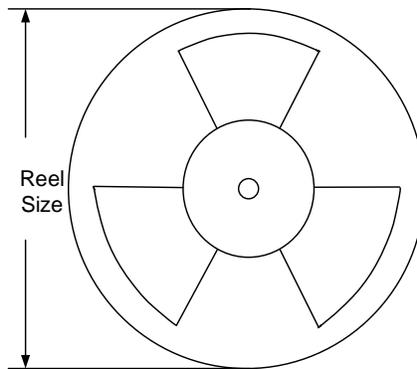
Note: All dimensions are in millimeters and exclude mold flash and metal burr.

Tape and Reel Specification

Tape dimensions and pin 1 orientation



Reel dimensions



Package type	Tape width (mm)	Pocket pitch (mm)	Reel size (Inch)	Trailer length (mm)	Leader length (mm)	Qty per reel
DFN2x2	8	4	7"	400	160	3000



Revision History

The revision history provided is for informational purposes only and is believed to be accurate, however, not warrantied. Please make sure that you have the latest revision.

Date	Revision	Change
Apr. 18, 2024	Revision 1.0	Language improvements for clarity.
July 27, 2022	Revision 0.9A	Update in EC table (page4): 1. Add Max. value for Dropout Voltage and Shutdown Current; 2. Add Min./Max. Value for Shutdown Discharge Resistor.
June 30, 2022	Revision 0.9	Initial Release



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

©2024 Silergy Corp.

All Rights Reserved.