# SY20736DED

## 30V Max 150mA LDO

## 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 ±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 2mm×2mm-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 µA Typ.)
- Output Current Limitation
- High Output Accuracy: ±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 DFN2×2-6 Package

## Applications

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

## Typical Application

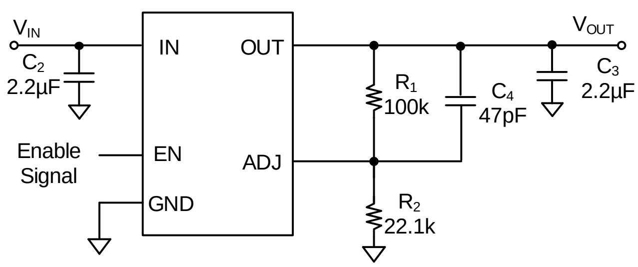



*Figure 1. Schematic Diagram*

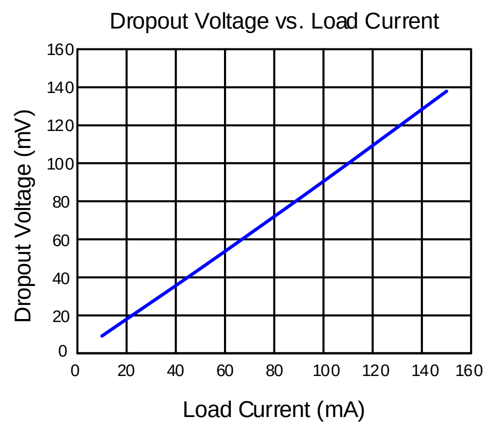



*Figure 2. Dropout Characteristics*

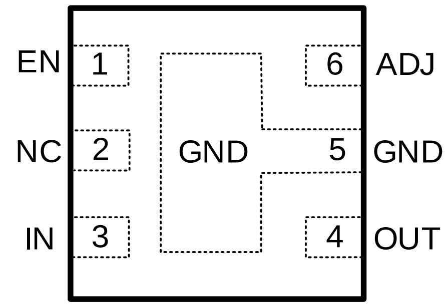
## Ordering Information

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

| Ordering Number | Package Type | Top Mark |
|---|---|---|
| SY20736DED | DFN2×2-6 | **r5*xyz*** |

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

## Pinout (top view)




(DFN2×2-6)

| Pin Name | DFN2×2-6 | 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

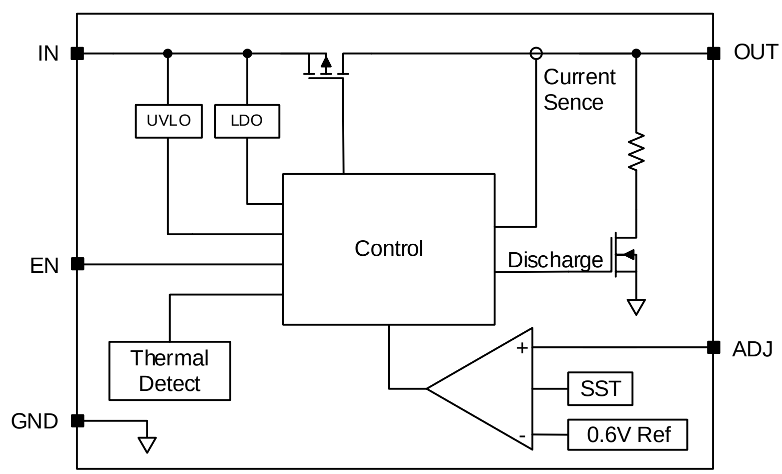



*Figure 2. Block Diagram*

## Absolute Maximum Ratings

| Parameter (Note 1) | Min | Max | Unit |
|---|---|---|---|
| IN | -0.3 | 36 | V |
| OUT | | 0.3+$V_{IN}$ | V |
| EN | -0.3 | 0.3+$V_{IN}$ | V |
| ADJ | 0 | 3.6 | V |
| Lead Temperature (Soldering, 10s) | | 260 | °C |
| Junction Temperature, Operating | -40 | 150 | °C |
| Storage Temperature | -65 | 150 | °C |

## Thermal Information

| Parameter (Note 2) | Typ | Unit |
|---|---|---|
| $\theta_{JA}$ Junction-to-Ambient Thermal Resistance | 62 | °C/W |
| $\theta_{JC}$ Junction-to-Case Thermal Resistance | 8.5 | °C/W |
| $P_D$ 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+$V_{IN}$ | V |
| EN | 0 | 0.3+$V_{IN}$ | V |
| 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℃~125℃, typical values are at $T_J$=25℃, 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 | $V_{OUT}$ | $I_O$=100μA, $T_A$=25℃ | -2 | | 2 | % |
| Line Regulation | $\Delta V_{LNR}$ | $V_{IN}$=($V_{OUT}$+0.3) to 30V, $I_O$=100μA | | 0.04 | 0.5 | % |
| Load Regulation | $\Delta V_{LDR}$ | $I_O$=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×$V_{OUT}$ (normal) | | 350 | 500 | mA |
| Power-supply Rejection Ratio | PSRR | f=1kHz, $C_{OUT}$=10μF | | 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 | | °C |
| Thermal Shutdown Hysteresis | $T_{HYS}$ | | | 20 | | °C |

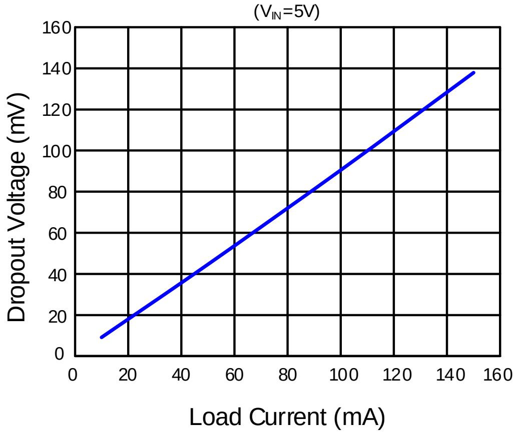
**Note 1**: Stresses beyond the "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specification is not implied. Exposure to absolute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

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

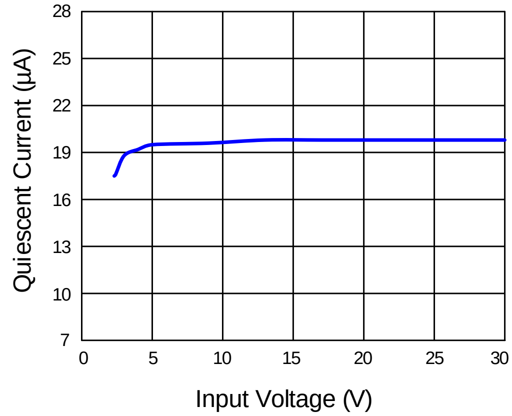
**Note 3**: The device is not guaranteed to function outside its operating conditions.

# Typical Performance Characteristics

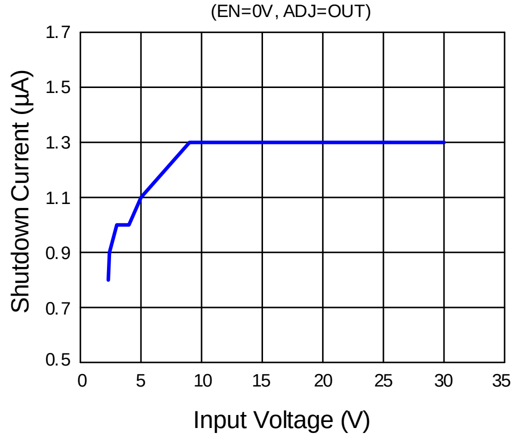
Dropout Voltage vs. Load Current
($V_{IN}$=5V)



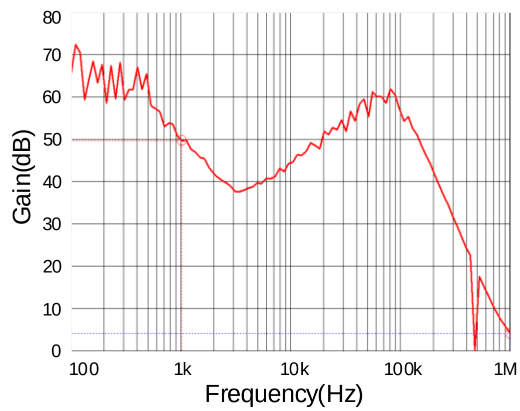

Quiescent Current vs. Input Voltage
(EN=3V, ADJ=OUT, $I_O$=0.1mA )



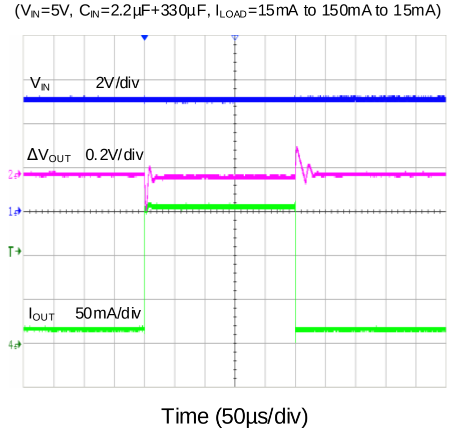

Shutdown Current vs. Input Voltage
(EN=0V, ADJ=OUT)



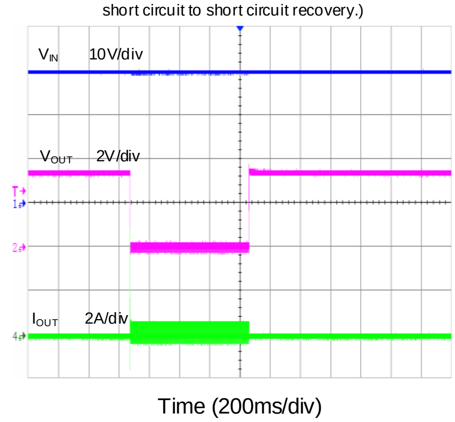

PSRR
($V_{IN}$=5V, $V_{OUT}$=3.3V, $C_{OUT}$=10μF, $I_{OUT}$=0.1mA, $C_{ADJ}$=47pF)



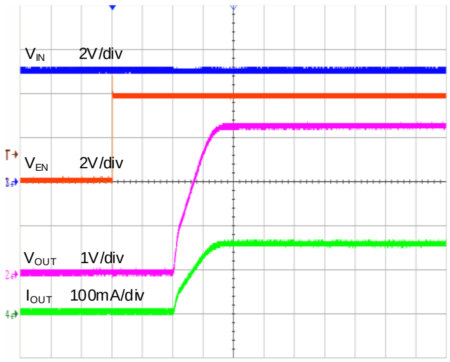

Load Transient
($V_{IN}$=5V, $C_{IN}$=2.2μF+330μF, $I_{LOAD}$=15mA to 150mA to 15mA)




Hard Short
($V_{IN}$=30V, EN=3V, $C_{IN}$=2.2μF+330μF, $V_{OUT}$=3.3V,
short circuit to short circuit recovery.)

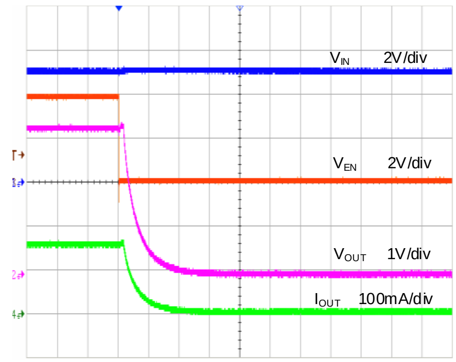


Turn ON with Enable
($V_{IN}$=5V, EN=0V to 4V, $V_{OUT}$=3.3V, $I_{LOAD}$=150mA)



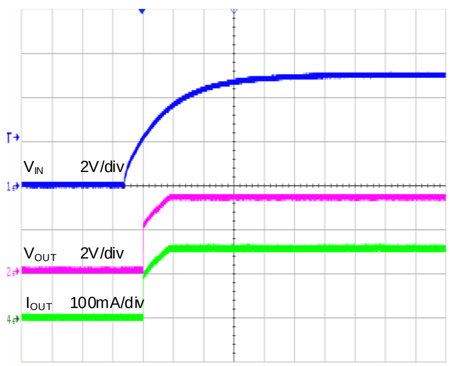

Time (100µs/div)

Turn OFF with Enable
($V_{IN}$=5V, EN=4V to 0V, $V_{OUT}$=3.3V, $I_{LOAD}$=150mA)



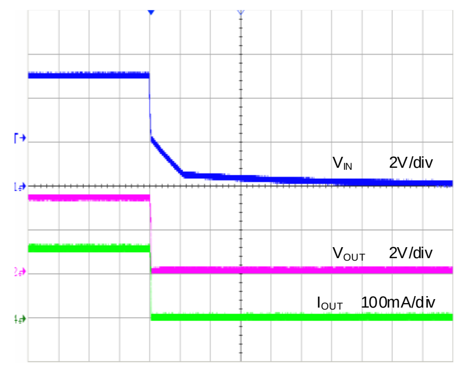

Time (100µs/div)

Turn ON with VIN
($V_{IN}$=0V to 5V, EN=4V, $V_{OUT}$=3.3V, $I_{LOAD}$=150mA)




Time (20ms/div)

Turn OFF with VIN
($V_{IN}$=5V to 0V, EN=4V, $V_{OUT}$=3.3V, $I_{LOAD}$=150mA)




Time (50ms/div)

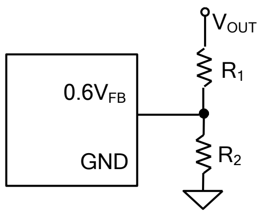
## Application information

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 $R_1$ and $R_2$:**

Choose $R_1$ and $R_2$ to program the proper output voltage. To minimize the power consumption under light loads, it is recommended to choose large resistance values for both $R_1$ and $R_2$. A value of between 10kΩ and 1MΩ is recommended for these resistors. For instance, if $V_{OUT}$ is 3.3V, and $R_1$=100k is chosen, then $R_2$ 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:

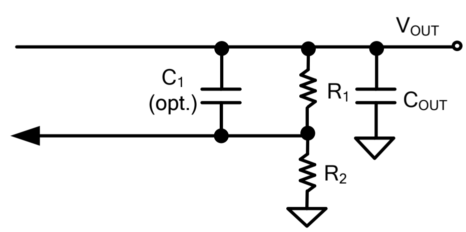
$$P_{D(MAX)} = (T_{J(MAX)} - T_A)/\theta_{JA}$$

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 ($\theta_{JA}$) footprint is 62°C/W for the DFN2×2-6 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 $R_1$ 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

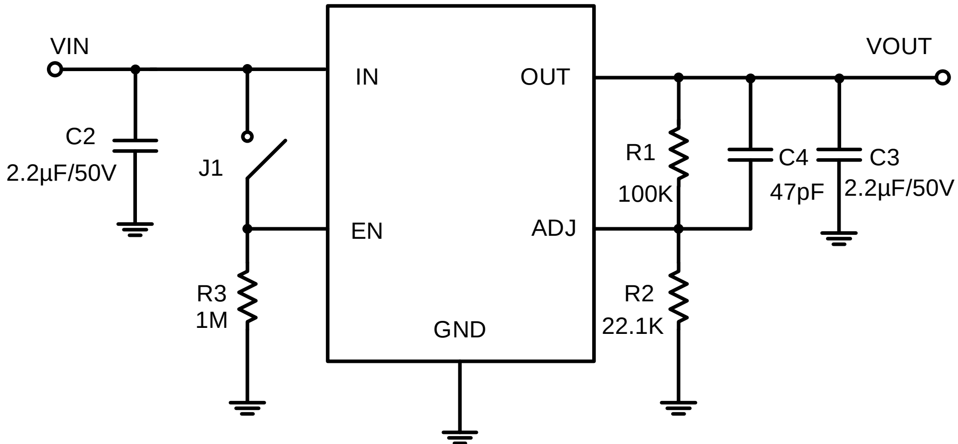



*Figure 3. Schematic Diagram*

## 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, 2×1, 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:

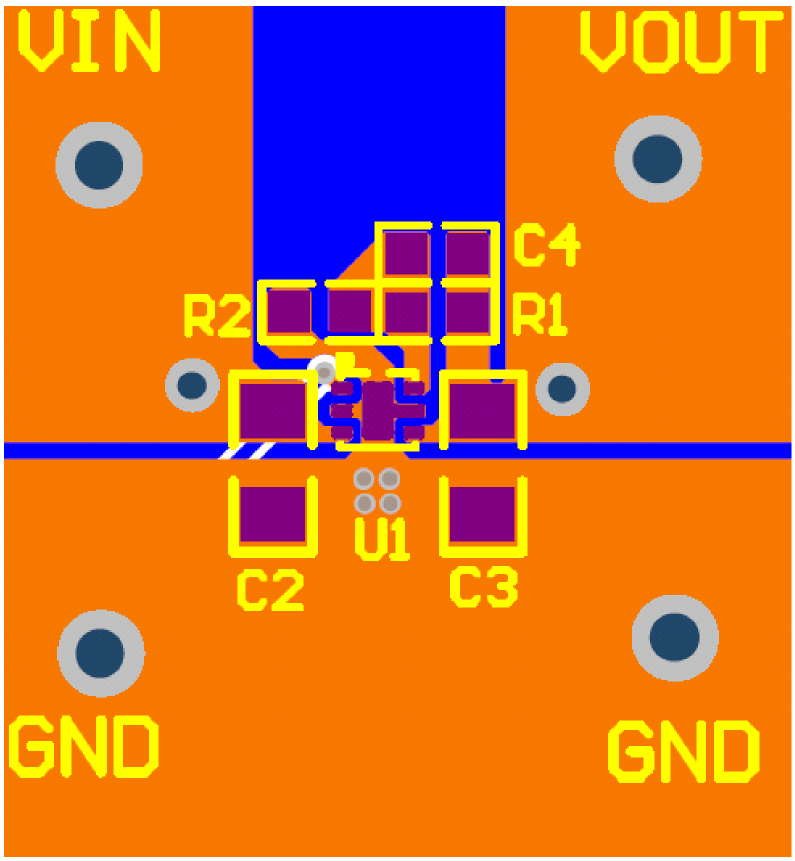
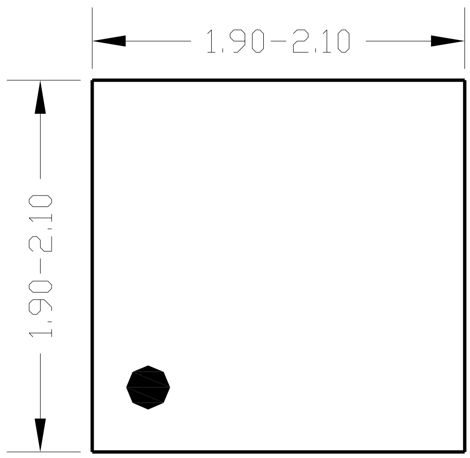
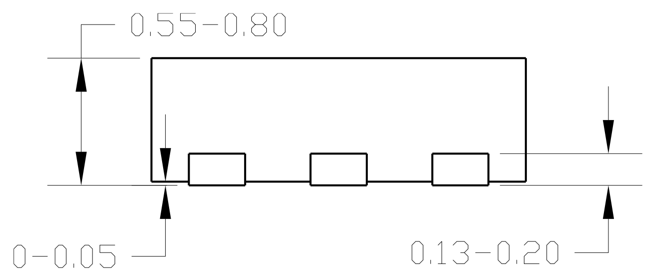



*Figure 4. PCB Layout Suggestion*

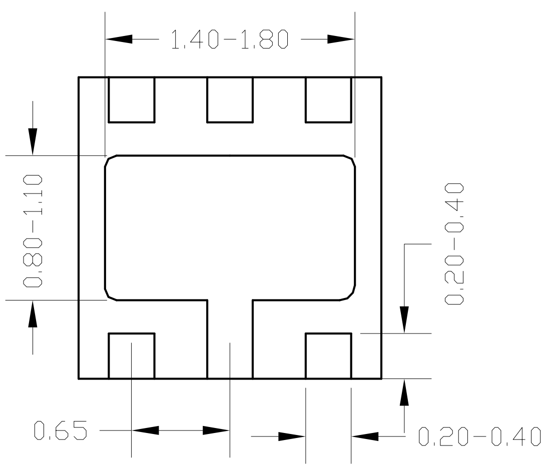
# DFN2×2-6 Package Outline



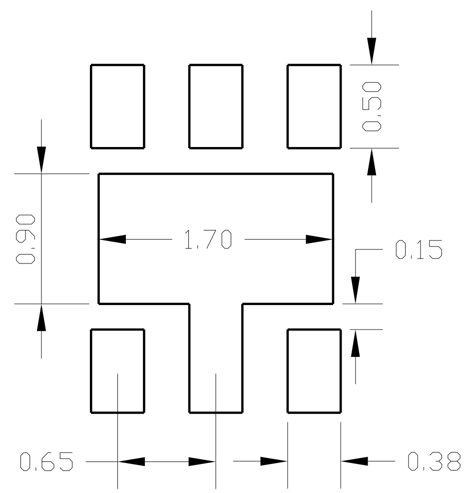

**Top View**




**Side View**




**Bottom View**

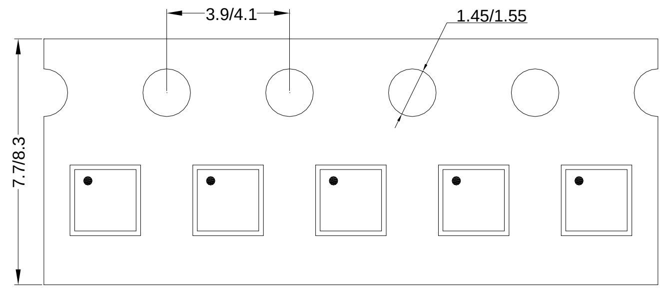



**Recommended PCB Layout**

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

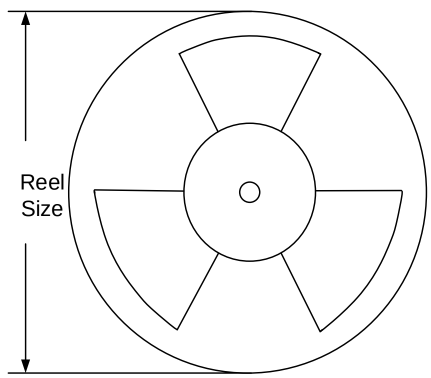
# Tape and Reel Specification

## Tape dimensions and pin 1 orientation




**Feeding direction** →

## Reel dimensions




| Package type | Tape width (mm) | Pocket pitch (mm) | Reel size (Inch) | Trailer length (mm) | Leader length (mm) | Qty per reel |
|---|---|---|---|---|---|---|
| DFN2×2 | 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):<br>1. Add Max. value for Dropout Voltage and Shutdown Current;<br>2. Add Min./Max. Value for Shutdown Discharge Resistor. |
| June 30, 2022 | Revision 0.9 | Initial Release |

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