SY20737H

36V, 500mA LDO Regulator

General Description

The SY20737H is a high-voltage input Linear Voltage Regulator (LDO) operating with input voltages from 4V to 36V and capable of delivering 500mA to a load, with ultra-low ground current and low dropout voltage.

The SY20737H has an adjustable output that can be configured using two external resistors. The device offers protection features, including an over-current limit, output short and over-temperature protections.

The Enable input allows disabling the part to reduce power consumption.

The High-Power Supply Rejection Ratio (PSRR) and low noise makes this part suitable for many applications in industrial and consumer products.

The SY20737H is available in a compact DFN 2mm×3mm-8pin package.

Features

- Input Voltage Range: 4V to 36V
- V_{ABS} = 40V
- V_{FB}: 1.235V (±1%)
- Output Voltage Tolerance: ±1%
- Line Regulation: 0.2%/V
- Load Regulation: 0.25%
- PSRR: 60dB
- Noise Level: 150μVRMS
- Operating T_J: -40℃ to 125℃
- Auto Retry-During Fault Conditions
- Compact Package: DFN2×3-8

Applications

- Portable Consumer Equipment
- Portable Instrumentation
- Industrial Equipment
- SMPS Post Regulators

Typical Application

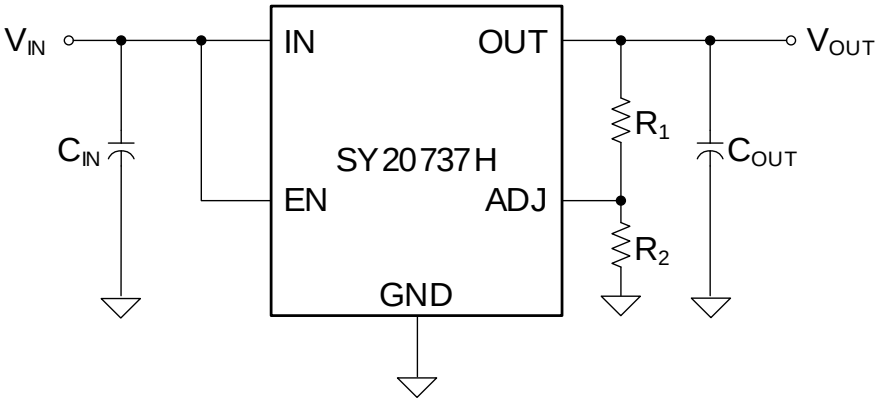


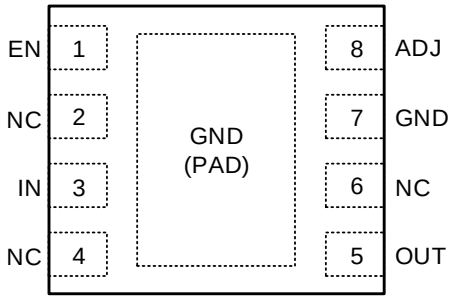
Figure 1. Schematic Diagram

Ordering Information

Ordering Part Number	Package Type	Top Mark
SY20737HDGD	DFN2×3-8 RoHS Compliant and Halogen Free	***4Axyz***

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

Pinout (top view)



Pin Description

Pin Name	Pin Number	Pin Description
EN	1	Enable. CMOS-compatible control input. Logic high = enable. Logic low or open = shutdown.
NC	2, 4, 6	No connection.
IN	3	Supply input.
OUT	5	Regulator output.
GND	7	Ground.
ADJ	8	Adjustable part only. Feedback input. Connect to resistive voltage-divider network.

Block Diagram

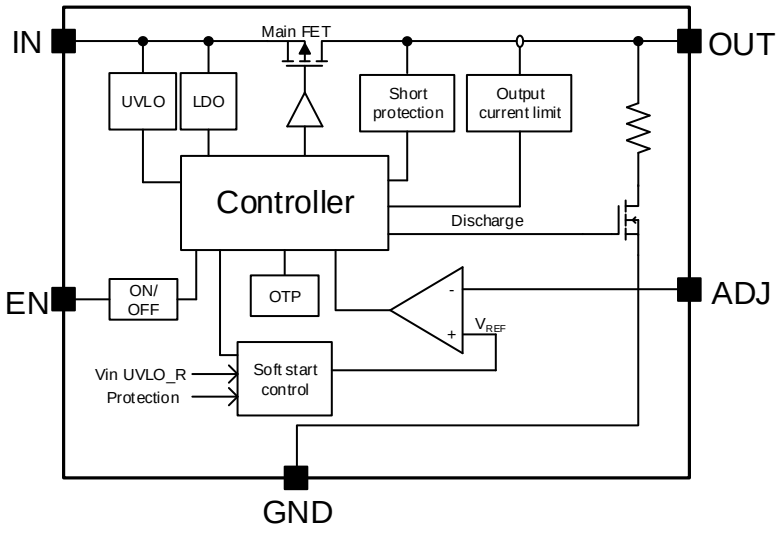


Figure 2. Block Diagram

Absolute Maximum Ratings

Parameter (Note1)	Min	Max	Unit
IN, EN, OUT, ADJ	-0.3	40	V
Lead Temperature (Soldering, 10 sec.)		260	°C
Junction Temperature, Operating	-40	150	
Storage Temperature	-65	150	

Thermal Information

Parameter (Note2)	Typ	Unit
θ_{JA} Junction-to-ambient Thermal Resistance	46	°C/W
θ_{JB} Junction-to-Board Thermal Resistance	22.5	
θ_{JC} Junction-to-case Thermal Resistance	28	
P_D Power Dissipation T_A = 25°C	2.17	W

Recommended Operating Conditions

Parameter (Note 3)	Min	Max	Unit
IN	4	36	V
EN, OUT, ADJ	0	36	
Junction Temperature, Operating	-40	125	°C

Electrical Characteristics

(V_{IN} = V_{EN}=12V, T_J = -40°C~125°C, typical values are at T_J=25°C, unless otherwise specified, the values are guaranteed by test, design, or statistical correlation.)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Input Voltage	V_{IN}		4		36	V
Reference Voltage	V_{REF}	T_A= 25°C	1.223	1.235	1.247	V
		T_J= -40°C ~125°C	1.210	1.235	1.260	V
Line Regulation	ΔV_{LNR}	I_{OUT} = 10mA, 4V ≤ V_{IN} ≤36V		1	1.5	mV/V
Load Regulation	ΔV_{LDR}	V_{IN} = 5V, 10mA ≤ I_{OUT} ≤ 0.5A,		0.25	1.0	%
Dropout Voltage	ΔV_{DROP}	I_{OUT} = 10mA		10	20	mV
		I_{OUT} = 300mA		300	540	mV
		I_{OUT} = 500mA		500	750	mV
Shutdown Current	I_{SHDN}	V_{EN}=0V, V_{IN}=24V			5	μA
Ground Pin Current	I_{GND}	No Load		7	14	μA
		I_L=0.1mA		90	190	μA
		I_L=50mA		250	900	
		I_L=150mA		1.0	2.5	mA
		I_L=500mA		6.5	30.0	
Output Current	I_O	V_{IN}=V_{OUT}+1V	0		500	mA
Current Limit	I_{LIMIT}	V_{OUT}=0.9×V_{OUT}(normal)	600	900	1200	mA
Input Voltage UVLO Threshold	V_{UVLO}	V_{IN} rising			3.9	V
UVLO Hysteresis	$V_{UVLO,HYS}$			200		mV
Shutdown Discharge Resistance	R_{DIS}			600		Ω
Ripple Rejection	PSRR			60		dB
Output Noise	e_{NO}	I_L = 10mA, C_L = 1.0μF, C_{IN} = 1μF, (10Hz – 100kHz)		150		μV_{RMS}
Enable Input Logic-low Voltage	V_{IL}	OFF			0.4	V
Enable Input Logic-high Voltage	V_{IH}	ON	1.5			V
Thermal Shutdown Temperature	T_{SD}			150		°C
Thermal Shutdown Hysteresis	T_{HYS}			20		°C

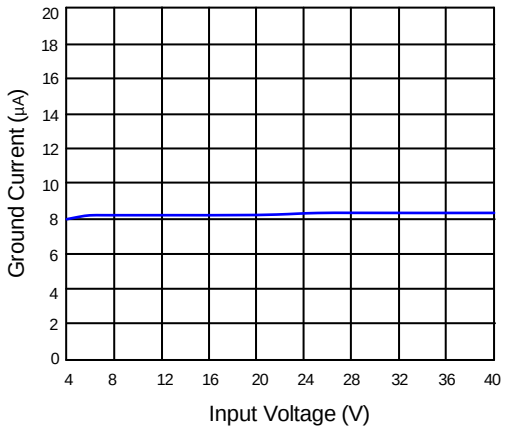
Note 1: Stresses beyond the “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specification is not implied. Exposure to absolute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

Note 2: θ_{JA} is measured in the natural convection at T_A = 25°C on a high effective single layer thermal conductivity test board of JESD51-2, -5, -7, -8, -14 thermal measurement standard.

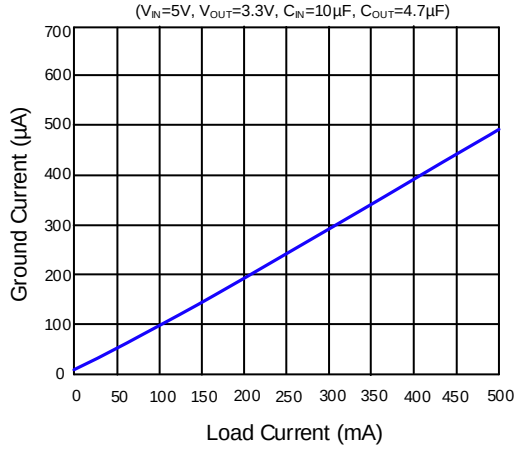
Note 3: The device is not guaranteed to function outside its operating conditions.

Typical Performance Characteristics

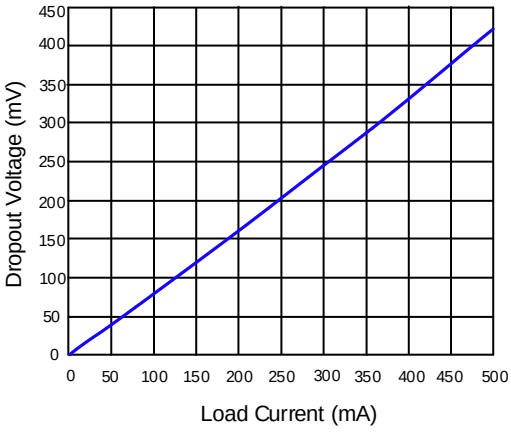
Ground Current vs. Input Voltage
(C_{IN}=10μF, C_{OUT}=4.7μF, Null Load)



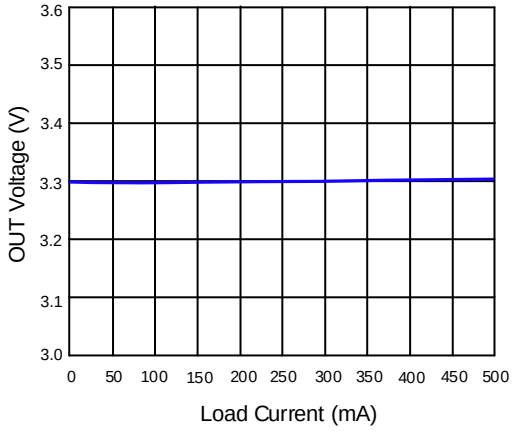
Ground Current vs. Load Current
(V_{IN}=5V, V_{OUT}=3.3V, C_{IN}=10μF, C_{OUT}=4.7μF)



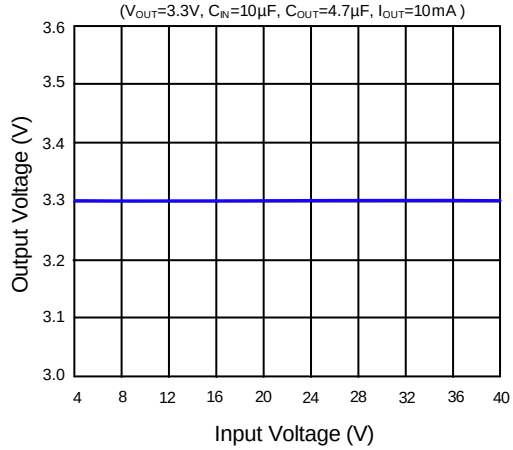
Dropout Voltage vs. Load Current
(V_{IN}=3.3V, C_{IN}=10μF, C_{OUT}=4.7μF, I_{OUT}=10mA)



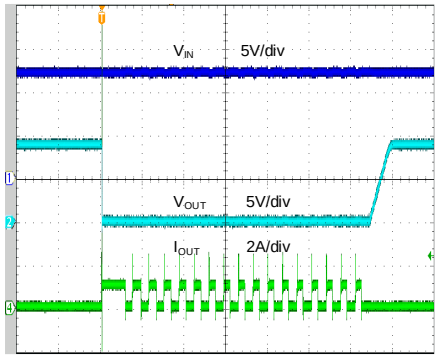
OUT Voltage vs. Load Current
(V_{IN}=5V, V_{OUT}=3.3V, C_{IN}=10μF, C_{OUT}=4.7μF)



Output Voltage vs. Input Voltage
(V_{OUT}=3.3V, C_{IN}=10μF, C_{OUT}=4.7μF, I_{OUT}=10mA)



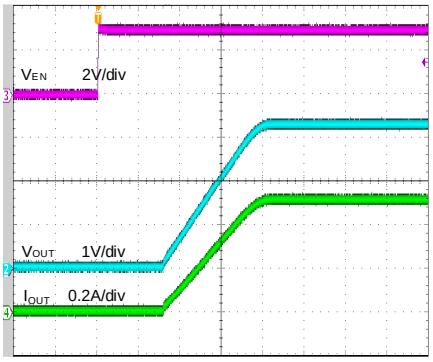
Short Protect
(V_{IN}=12V, V_{OUT}=9V, C_{IN}=10μF,C_{OUT}=4.7μF,
I_{OUT}=Null~ Short Circuit~ Null)



Time (2ms/div)

Startup from Enable

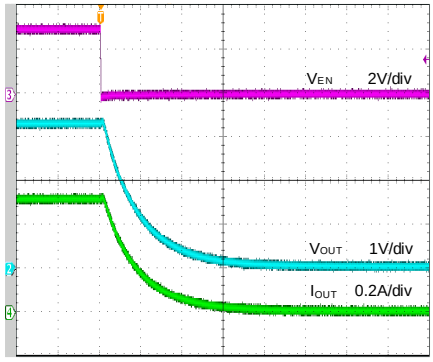
(V_{IN}=5V, V_{OUT}=3.3V, C_{IN}=10μF, C_{OUT}=4.7μF, I_{OUT}=500mA)



Time (400μs/div)

Shutdown from Enable

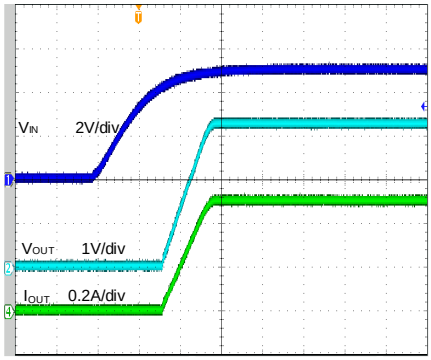
(V_{IN}=5V, V_{OUT}=3.3V, C_{IN}=10μF, C_{OUT}=4.7μF, I_{OUT}=500mA)



Time (40μs/div)

Startup from V_{IN}

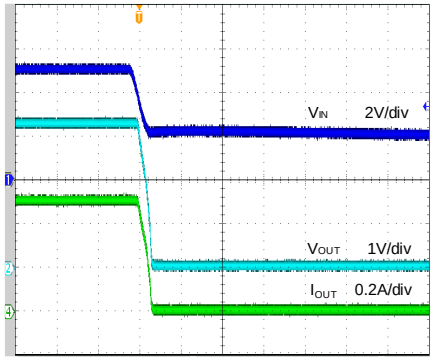
(V_{IN}=5V, V_{OUT}=3.3V, C_{IN}=10μF, C_{OUT}=4.7μF, I_{OUT}=500mA)



Time (800μs/div)

Shutdown from V_{IN}

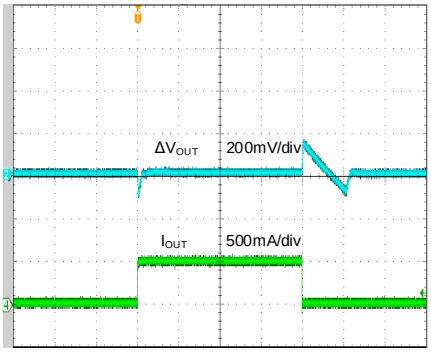
(V_{IN}=5V, V_{OUT}=3.3V, C_{IN}=10μF, C_{OUT}=4.7μF, I_{OUT}=500mA)



Time (2ms/div)

Load Transient

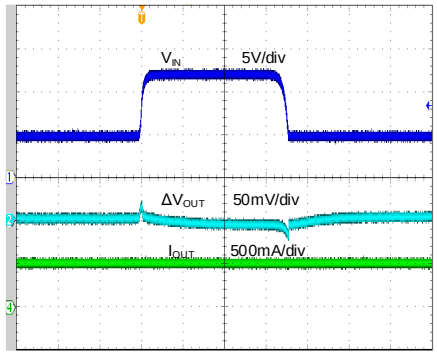
(V_{IN}=5V, V_{OUT}=3.3V, C_{IN}=10μF, C_{OUT}=4.7μF,
I_{OUT}=10mA～500mA～10mA)



Time (100μs/div)

Line Transient

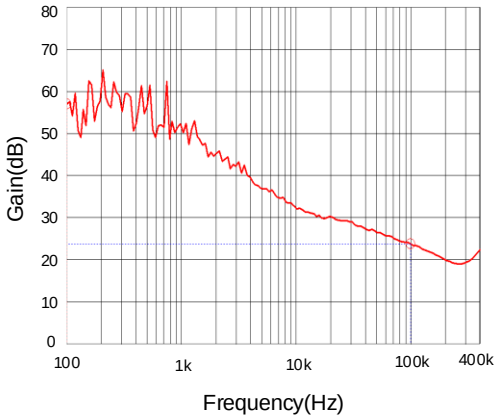
(V_{IN}=5V～12V～5V, V_{OUT}=3.3V, C_{IN}=10μF, C_{OUT}=4.7μF,
I_{OUT}=500mA)



Time (2ms/div)

PSRR

(V_{IN}=12V, V_{OUT}=3.3V, C_{IN} null, C_{OUT}=4.7μF, I_{OUT}=500mA)



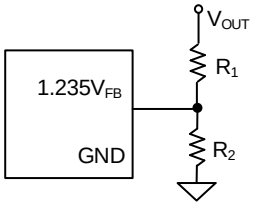
Application Information

The SY20737H is a 500mA high-current capacity linear regulator with ultra-low ground current and low dropout voltage. The SY20737H has an adjustable output that can be set by two external resistors. The device provides protection features, including over-current limit, output short and over-temperature protections.

Feedback Resistor Dividers 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, choosing large resistance values for both R1 and R2 is recommended. A value of between 10kΩ and 10MΩ is recommended for both resistors. As an example, for a V_{OUT} of 3.3V, if R_1=50.1kΩ is chosen, then using the following equation, R_2 can be calculated to be 30kΩ:

$$R_2 = \frac{1.235V}{V_{OUT} - 1.235V} \times R_1$$



Input Capacitor C_{IN}:

An input capacitor of about 10μF between the device input and ground pin is required. A typical X5R or better grade ceramic capacitor is recommended for most applications. Place the input capacitor as close as practical to the device to minimize the input noise.

Output Capacitor C_{OUT}:

The SY20737H is designed specifically to work with very small ceramic output capacitors for transient stability. A 4.7μF output capacitance 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 phase lead which is required for loop stability.

Dropout Voltage:

The SY20737H has a very low dropout voltage due to its extra low $R_{DS(ON)}$ of the main PMOS, which determines the lowest usable supply.

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

Over-Current and Short-Circuit Protection:

The device includes over-current and short-circuit protection. The current limiting circuit regulates the output current to its limit threshold to protect the device from damage. Under over-current or short-circuit conditions, the dissipated power on device can be high, which may trigger thermal protection.

Thermal Considerations:

The SY20737H can deliver a current of up to 500mA over the full operating temperature range. However, the maximum output current must be derated at a higher ambient temperature. Under all operating conditions the junction temperature must be within the range specified. The LDO power dissipation can be calculated based on the output current and the voltage drop across the regulator.

The dissipated power, P_D, can be calculated using the following equation:

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

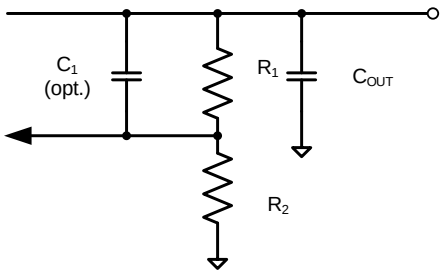
The operating junction temperature can be estimated by the following thermal formula:

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

Where $T_{J(MAX)}$ is the maximum junction temperature of die (125°C), T_A is the maximum ambient temperature and θ_{JA} is the junction to ambient thermal resistance for the package (46°C/W).

Load Transient Considerations:

The SY20737H integrates the compensation components to achieve stability and fast transient response. In some applications, adding a small ceramic capacitor in parallel with R1 may further speed up the load transient responses and is thus recommended for applications with large load transient step requirements.



PCB Layout Guide:

For the best performance of the SY20737H, the following guidelines must be followed:

1. Keep all power traces as short and wide as possible. A 2-layer- or 4-layer board is recommended for improved thermal performance and current flow capability.
2. Place the input/output capacitor close to the IC for better transient performance.
3. Maximize the copper area connected to GND and the exposed pad of the package to improve heat dissipation.

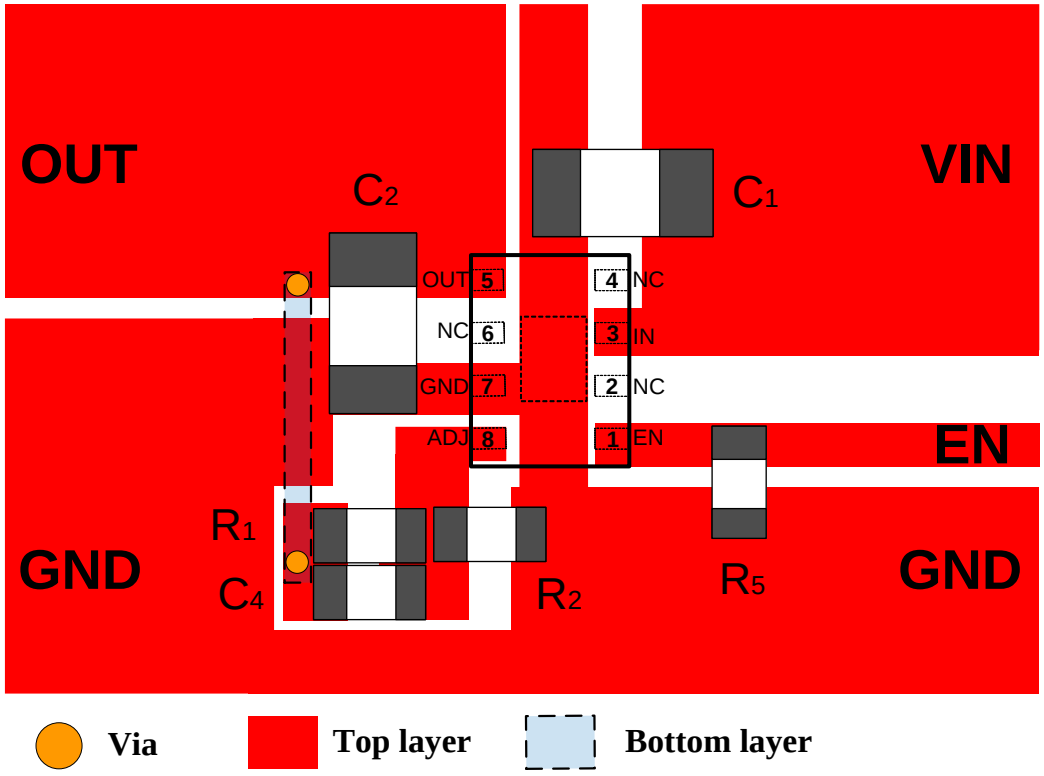
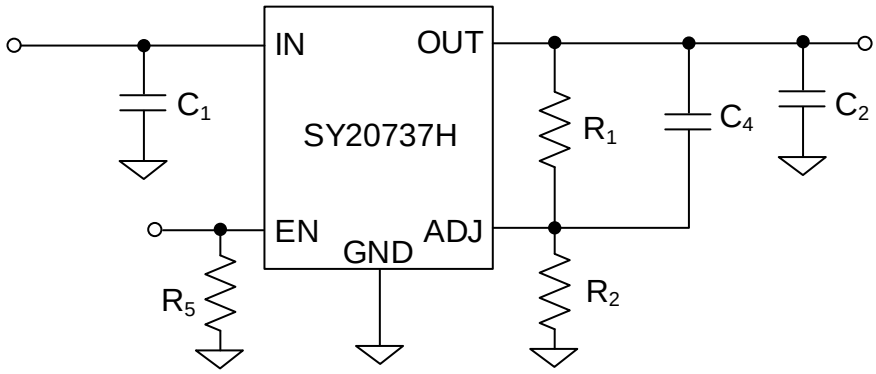


Figure 3. PCB Layout Suggestion

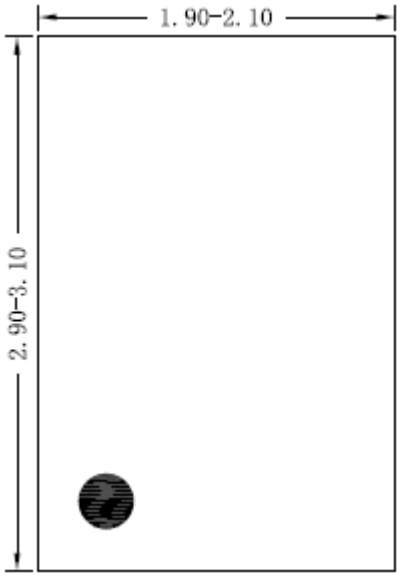
Application Schematic (V_{OUT}=3.3V)



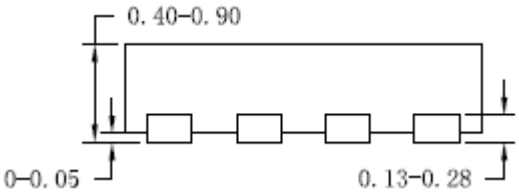
BOM List

Reference Designator	Description	Part Number	Manufacturer
C_1	10μF/50V/X5R,1206	GRM31CR61H106K	Murata
C_2	4.7μF/25V/X5R,1206	GRM31CR61E475K	Murata
R_1	50.1kΩ , 1%, 0603		
R_2	30kΩ, 1%, 0603		
R_5	1MΩ, 1%, 0603		

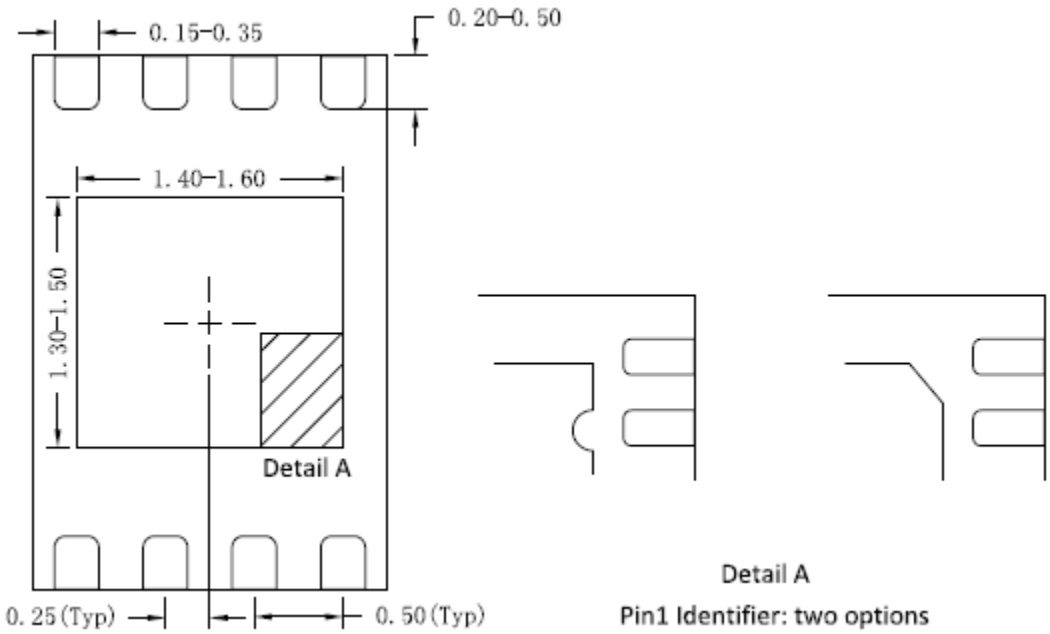
DFN2×3-8 Package Outline



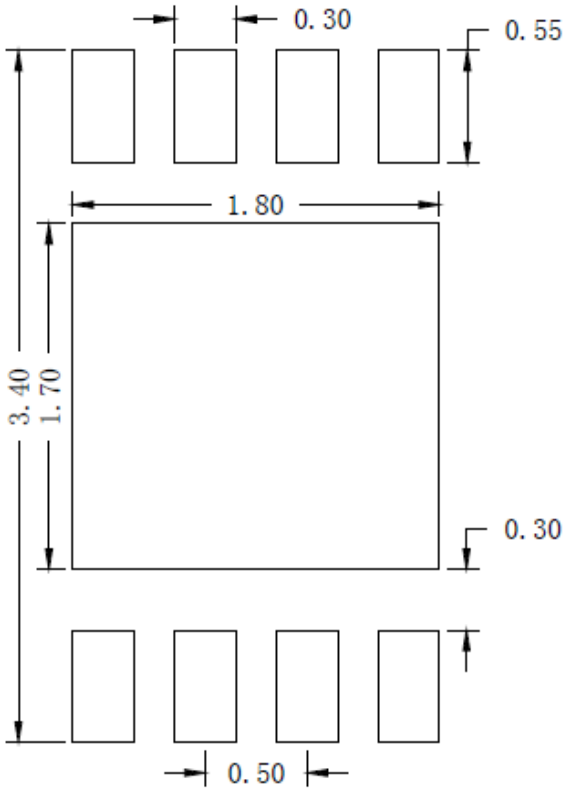
Top View



Side View



Bottom View

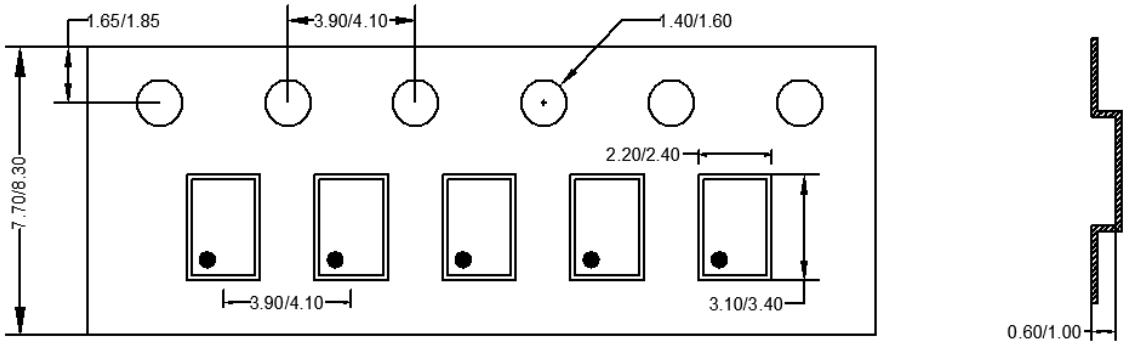


Recommended PCB Layout
(Reference Only)

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

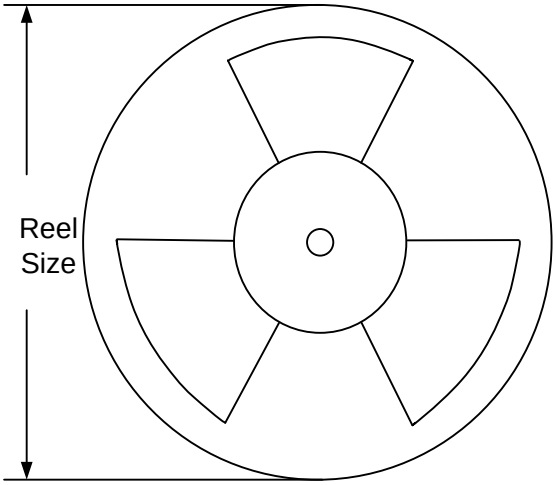
Taping & Reel Specification

1. DFN2×3-8 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
DFN2×3	8	4	7"	400	160	3000

3. Others: NA

Revision History

The revision history provided is for informational purposes only and is believed to be accurate; however, it is not warranted. Please reference the latest revision.

Date	Revision	Change
Sep.27, 2023	Revision 1.0	Language improvements for clarity.
Jul.28, 2020	Revision 0.9	Initial Release

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