SY6353

3A, 55V Fast-Response LDO Regulator

General Description

The SY6353 is a 3A current capacity and low drop out voltage regulator, which features very fast transient recovery from input voltage surges and output load current changes. The SY6353 has an adjustable output which can be set by two external resistors to a voltage between 1.24V to 29.6V. The SY6353 with fully protection includes over current limit, output short protection, over input voltage protection and over temperature operation.

Ordering Information

SY6353 □(□□)□
- └ Temperature Code
- Package Code
- Optional Spec Code

Ordering Number	Package type	Note
SY6353MAC	TO263-5	----

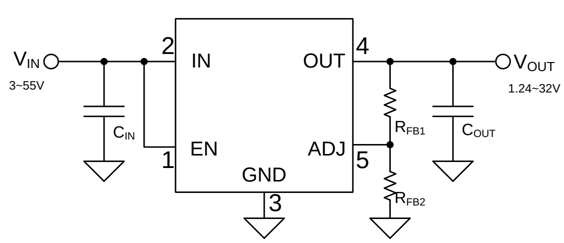
Features

- High Current Capability:3A over Full Temperature Range
- Low Dropout Voltage of 450mV at Full Load 3A
- Extremely-fast Transient Response
- Zero-current Shutdown Mode
- Adjustable Output Voltage
- Low Ground Current
- Protection：
  1) Over Current Limit ,
  2) Output Short Circuit Protection,
  3) Over Input Voltage Protection,
  4) Over Temperature Protection.
- Packages: TO263-5
- RoHS Compliant and Halogen Free

Application

- Industry Application
- Medical Imaging
- Smart Metering

Typical Application



$$V_{OUT} = 1.24 \times (\frac{R_{FB1} + R_{FB2}}{R_{FB2}})$$

Figure1. Adjustable Output Regulator

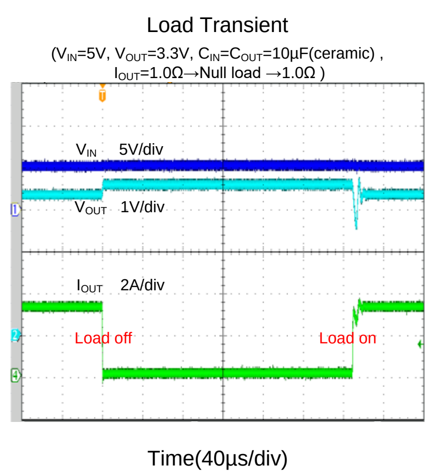
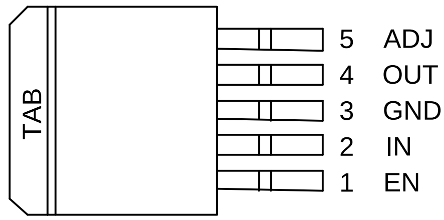


Figure2. Load Transient

Pinout (top view)



TO263-5 (D^2 Pak)

Top Mark: **BII*xyz*** for SY6353MAC **(**Device code: BII; ***x=year code, y=week code, z= lot number code*****)**

Pin Name	Pin Number	Pin Description
EN	1	Enable (Input): Active-high CMOS compatible control input. Do not leave it floating.
IN	2	INPUT: Unregulated input, +3V to +55V maximum. A 10μF capacitor connected from this pin to GND is recommended.
GND	3, TAB	GND: Ground pin.
OUT	4	OUTPUT: The regulator output voltage. A 10μF capacitor connected from this pin to GND is recommended.
ADJ	5	Feedback voltage: 1.24V feedback from external resistor divider.

Block Diagram

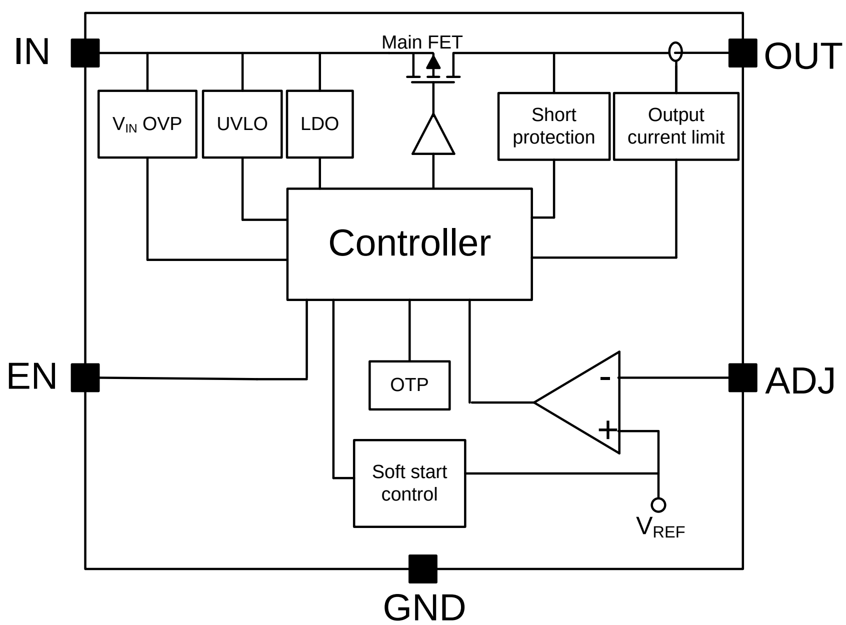


Figure3. Block Diagram

Absolute Maximum Ratings (Note 1)

IN, EN, OUT, ADJ-- -0.3V to 55V
Power Dissipation, P_D @ T_A = 25°C TO263-5 -- 3.8W
Package Thermal Resistance (Note 2)
θ_{JA} -- 26.5°C/W
θ_{JC} -- 24.1°C/W
Junction Temperature Range -- -40°C to 150°C
Lead Temperature (Soldering, 10 sec.) --- 260°C
Storage Temperature Range --- -65°C to 150°C

Recommended Operating Conditions (Note 3)

Supply Input Voltage --- 3V to 55V
EN, OUT, ADJ--- 0V to 55V
Junction Temperature Range --- -40°C to 125°C
Ambient Temperature Range --- -40°C to 85°C

Electrical Characteristics

V_{IN} = 5V, V_{OUT}=3.3V, I_{OUT} = 100mA, Tj = -40°C ~85°C

Parameter	Symbol	Test Conditions	Min	Typical	Max	Unit
Input Voltage	V_{IN}		3		55	V
Input Voltage UVLO Threshold	V_{UVLO}	V_{IN} rising		2.6	2.8	V
Input OVP Threshold			30	34	38	V
UVLO Hysteresis	V_{UVLO_th}			200		mV
Soft-start Time	t_{SS}		1	2	4	ms
Enable Input Logic-high Voltage	$V_{EN,H}$	V_{IN}= V_{OUT}+1V	2.4			V
Enable Input Logic-low Voltage	$V_{EN,L}$				0.8	V
Current Limit	I_{limit}		3.7	4.5	5.4	A
Thermal Shutdown Temperature	T_{SD}			150		°C
Thermal Shutdown Hysteresis	T_{HYS}			20		°C
Output Short Protection Threshold	$V_{ADJ,SHORT}$	V_{FB} falling	40	50	60	%V_{REF}
Output Short off Time	t_{short_off}			15		ms
IN Pin to OUT pin Leakage Current	$I_{Leakage}$	EN=0,V_{IN-OUT}=55V			1.2	μA
Line Regulation	ΔV_{LNR}	I_{OUT} = 10mA, (V_{OUT} + 1V) ≦ V_{IN} ≦ 55V, T_A=25°C		0.1	0.5	%
Load Regulation	ΔV_{LDR}	V_{IN} = V_{OUT} + 1V, 10mA ≦ I_{OUT} ≦ 3A, T_A=25°C		0.2	1	%
Dropout Voltage	ΔV_{DROP}	I_{OUT} = 100mA		15	29	mV
		I_{OUT} = 750mA		115	213	mV
		I_{OUT} = 1.5A		225	432	mV
		I_{OUT} = 3A		450	863	mV
Power Supply Rejection	PSRR	Frequency=100Hz, C_{OUT}=10μF，T_A=25°C		70		dB
		Frequency=100kHz, C_{OUT}=10μF，T_A=25°C		40		
Ground Current						
Ground Current	I_{GND}	IC shut down		1	5	μA
		I_{OUT} = 0, V_{IN}=V_{OUT}+1V		80	120	μA
		I_{OUT} = 1.5A, V_{IN}=V_{OUT}+1V		0.73	5	mA
		I_{OUT} = 3A V_{IN}=V_{OUT}+1V		5	8	mA
Reference Voltage						
Reference Voltage	V_{REF}		1.215	1.24	1.265	V
ADJ Pin Bias Current	I_{ADJ_Bias}	EN=0, ADJ pin floating			50	nA

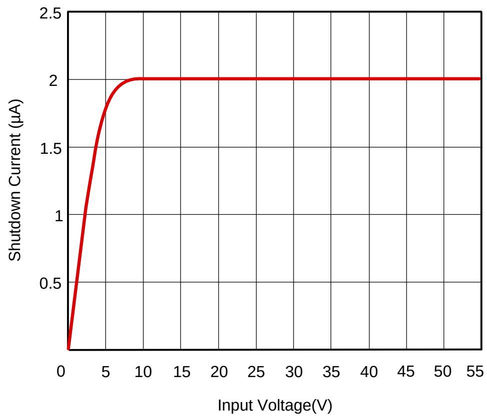
Note 1: Stresses beyond "Absolute Maximum Ratings" may cause permanent damage to the device. These are for stress ratings. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute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

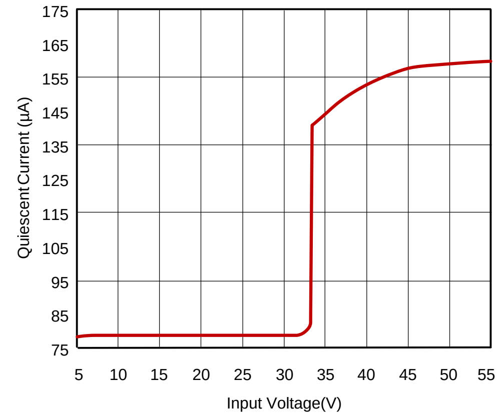
Note 3: The device is not guaranteed to function outside its operating conditions.

Typical Operating Characteristics

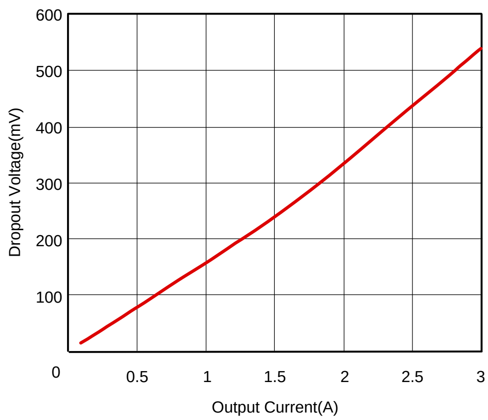
Shutdown Current vs. Input Voltage
(EN OFF, Output to Ground)



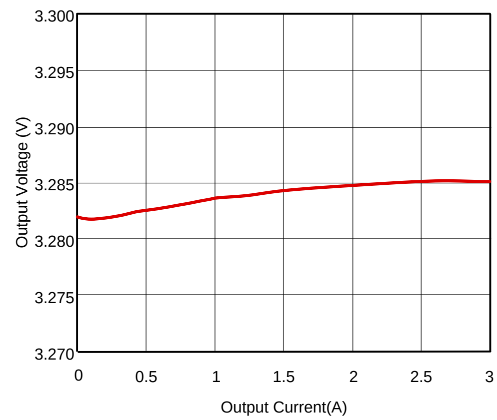
Quiescent Current vs. Input Voltage
(V_{ADJ}=1.5V, V_{EN}=3V, Null Load)



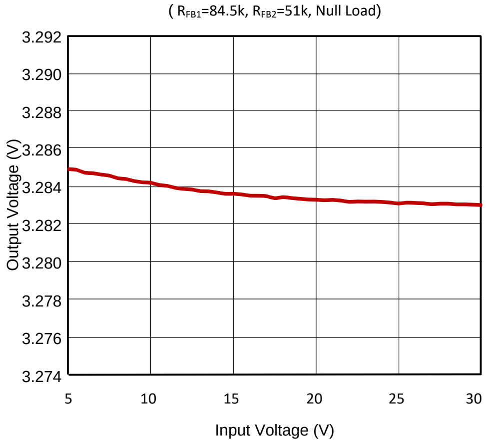
Dropout Voltage vs. Output Current
(V_{IN}=5V, V_{ADJ}=1V)



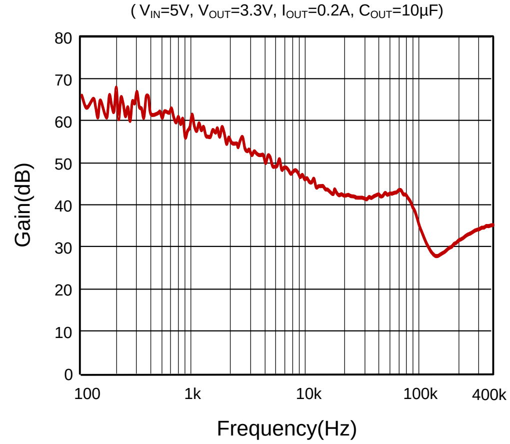
Load Regulation
(V_{IN}=5V, R_{FB1}=84.5k, R_{FB2}=51k)



Line Regulation
(R_{FB1}=84.5k, R_{FB2}=51k, Null Load)

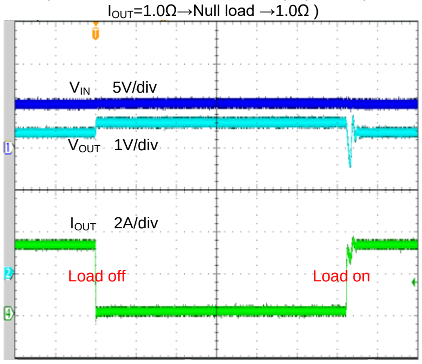


PSRR
(V_{IN}=5V, V_{OUT}=3.3V, I_{OUT}=0.2A, C_{OUT}=10μF)



Load Transient

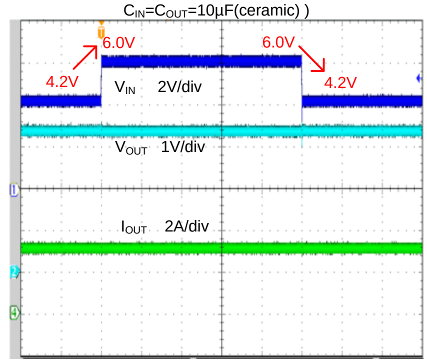
(V_{IN}=5V, V_{OUT}=3.3V, C_{IN}=C_{OUT}=10µF(ceramic) , I_{OUT}=1.0Ω→Null load →1.0Ω)



Time(40µs/div)

Line Transient

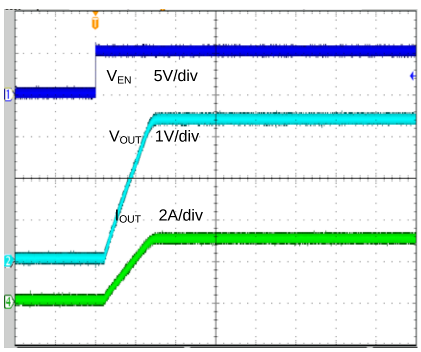
(V_{IN}=4.2V→6V→4.2V, V_{OUT}=3.3V, I_O=1.1Ω load, C_{IN}=C_{OUT}=10µF(ceramic))



Time(2ms/div)

Startup From Enable

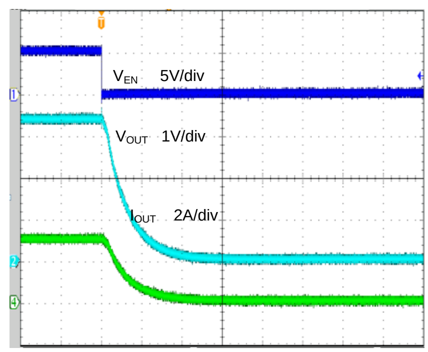
(V_{IN}=5V, V_{OUT}=3.3V, C_{IN}=C_{OUT}=10µF, I_{OUT}=1.1Ω)



Time(2ms/div)

Shutdown From Enable

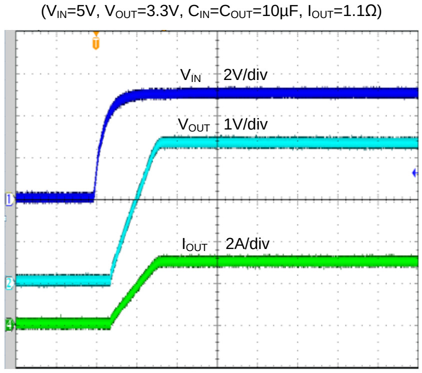
(V_{IN}=5V, V_{OUT}=3.3V, C_{IN}=C_{OUT}=10µF, I_{OUT}=1.1Ω)



Time(20µs/div)

Vin Start up

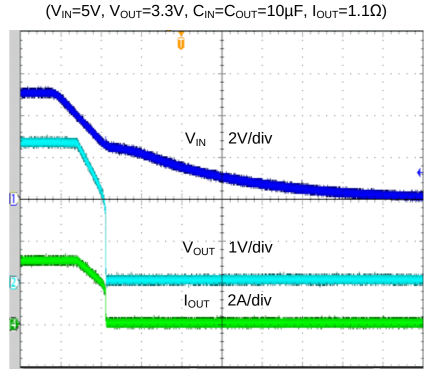
(V_{IN}=5V, V_{OUT}=3.3V, C_{IN}=C_{OUT}=10µF, I_{OUT}=1.1Ω)



Time(2ms/div)

Vin Shut Down

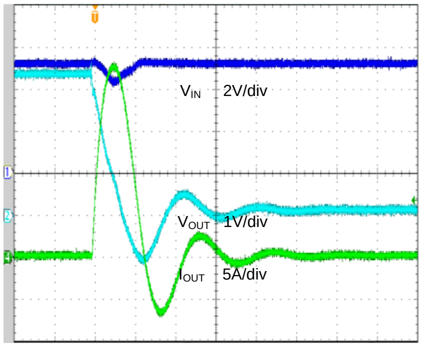
(V_{IN}=5V, V_{OUT}=3.3V, C_{IN}=C_{OUT}=10µF, I_{OUT}=1.1Ω)



Time(2ms/div)

Short Circuit Response

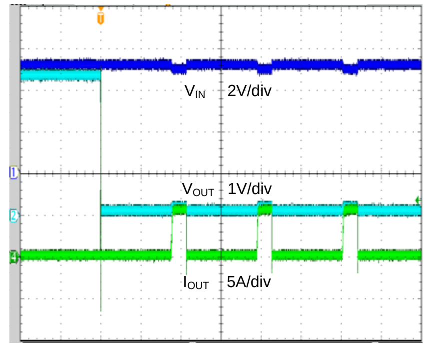
(V_{IN}=5V, V_{OUT}=3.3V, C_{IN}=C_{OUT}=10µF)



Time(4µs/div)

Output Short Off Time Test

(V_{IN}=5V, V_{OUT}=3.3V, C_{IN}=C_{OUT}=10µF)



Time(10ms/div)

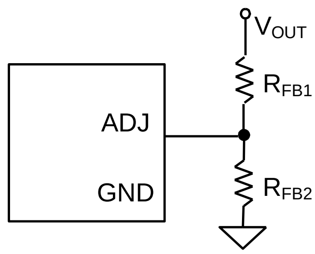
Application information

The SY6353 is a 3A linear regulator with a low drop out voltage. Like any low-dropout regulator, the SY6353 requires input and output decoupling capacitors.

Feedback resistor dividers R_{FB1} and R_{FB2}

Choose R_{FB1} and R_{FB2} to program the proper output voltage. To minimize the power consumption under light loads, it is desirable to choose large resistance values for both R_{FB1} and R_{FB2}. A value of between 10kΩ and 1MΩ is highly recommended for both resistors. If V_{OUT} is 3.3V, R_{FB1} =84.5k is chosen, then using following equation, R_{FB2} can be calculated to be 50.8k:

$$R_{FB2} = \frac{1.24V}{V_{OUT} - 1.24V} R_{FB1}$$



Input Capacitor C_{IN}

An input capacitor about 10μF is required between the device input pin and ground pin. A typical X5R or better grade ceramic capacitor is recommended in 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 SY6353 is designed specifically to work with very small ceramic output capacitors. 10μF output capacitance can be used in this application. Higher capacitance values help to improve transient. 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 SY6353 has a very low dropout voltage due to its extra low $R_{DS(ON)}$ of the main PMOS 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 limitation circuit regulates the output current to its limitation threshold to protect IC from damage. Under over current or short circuit condition, the power loss of the IC is relative high. And that may trigger the thermal protection.

When short circuit protection is triggered, the device will reboot after about 15ms.

Thermal Considerations

The SY6353 can deliver a current of up to 3A over the full operating junction temperature range. However, the maximum output current must be derated at higher ambient temperature to ensure the junction temperature does not exceed 125°C. With all possible 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 regulator.

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

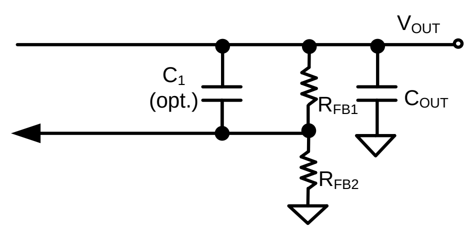
The final operating junction temperature for any set of condition can be estimated by the following thermal equation:

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

Where $T_{J(MAX)}$ is the maximum junction temperature of die (125°C) and T_A is the maximum ambient temperature. The junction to ambient thermal resistance (θ_{JA}) footprint is 26.5°C /W for TO263-5 package.

Load Transient Considerations

The SY6353 regulator IC integrates the compensation components to achieve good stability and fast transient responses. In some applications, adding a small ceramic capacitor in parallel with R_{FB1} may further speed up the load transient responses and is thus recommended for applications with large load transient step requirements.



Layout Design

Good board layout practices must be used or instability can be induced because of ground loops and voltage drops, and large PCB copper area can improve the thermal performance. The input and output capacitors MUST be directly connected to the input, output, and ground pins of the device using traces which have no other currents flowing through them.

The best way to do this is to layout 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:

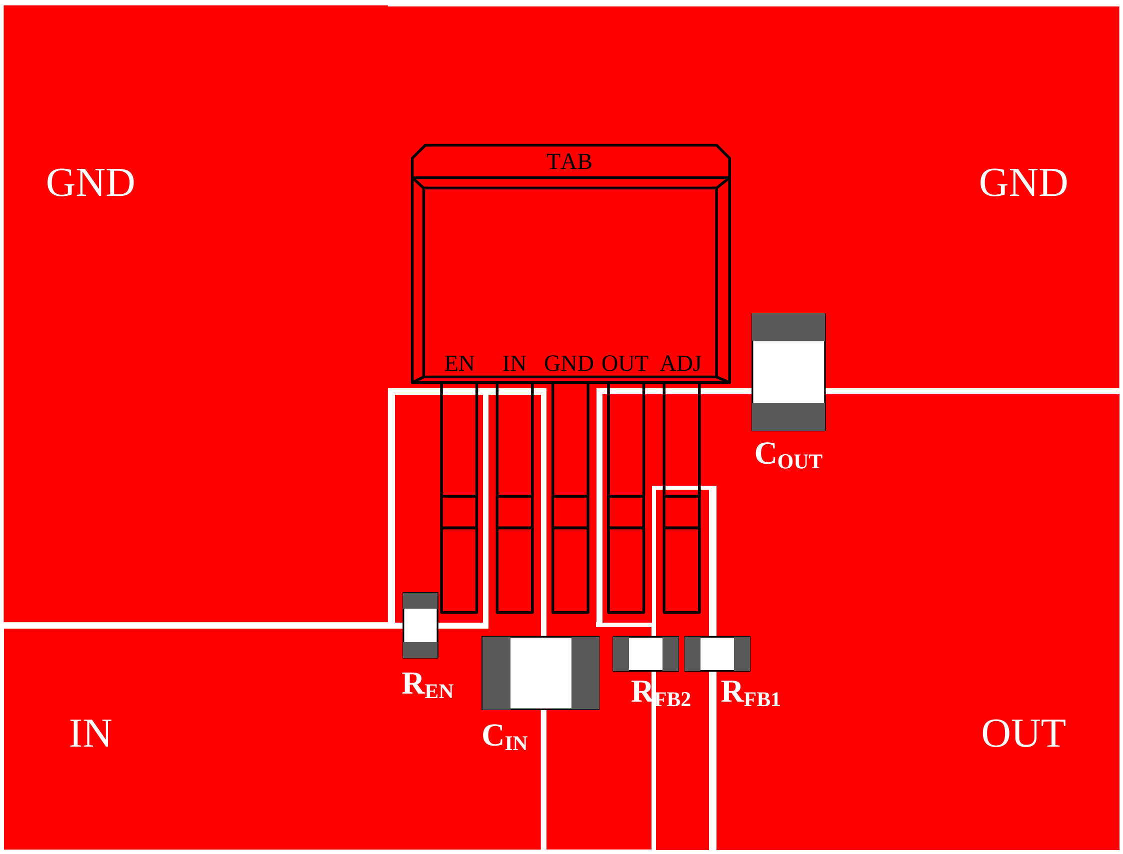
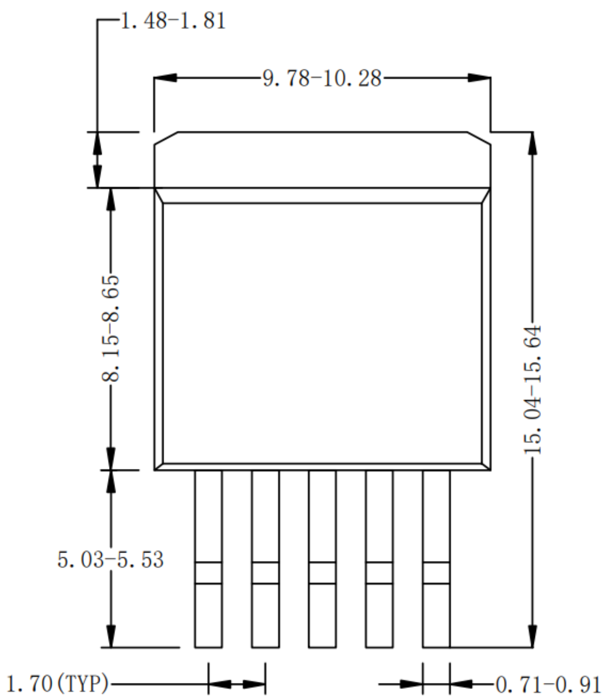
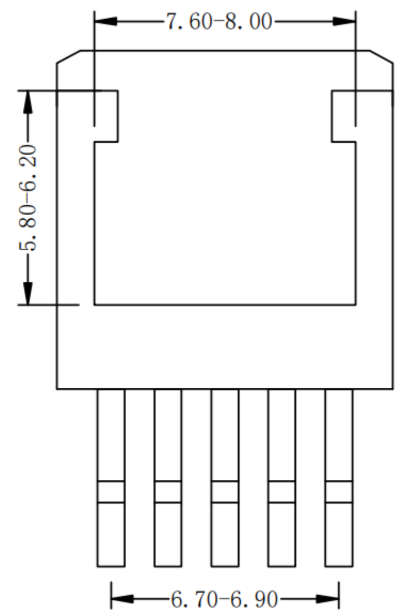


Figure4. SY6353MAC PCB Layout Suggestion

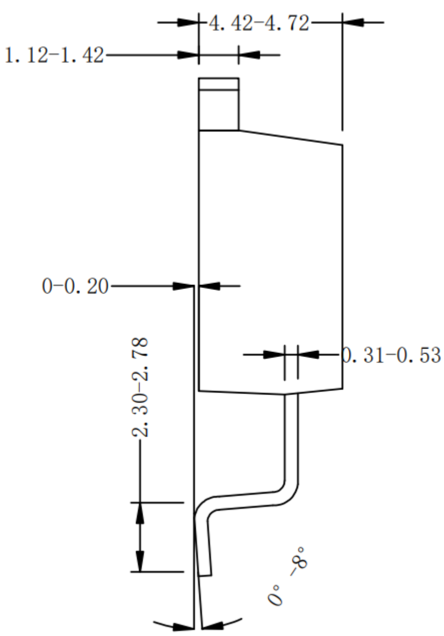
TO263-5 Package Outline Drawing



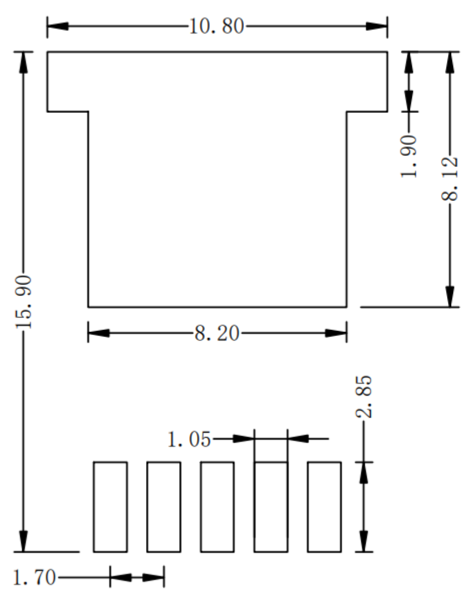
Top View



Bottom View



Side View



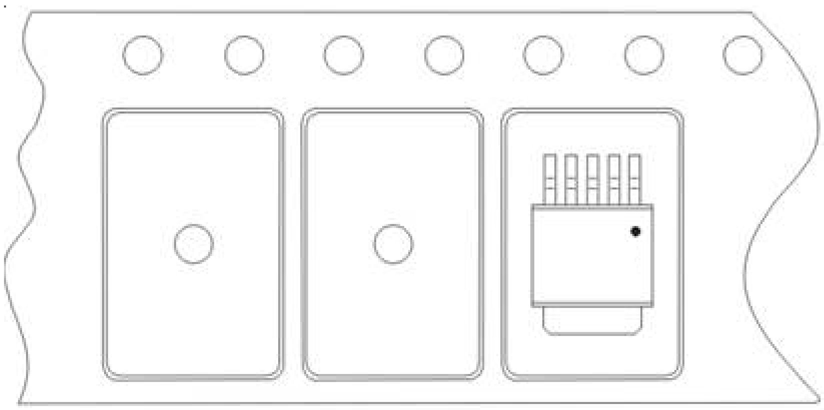
Recommended PCB Layout (Reference only)

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

Taping & Reel Specification

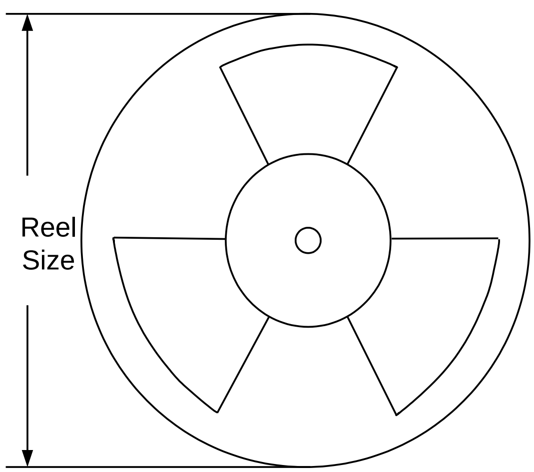
1. Taping Orientation for Packages

TO263-5



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(pcs)
TO263-5	12	8	13"	400	400	800

3. Others: NA

Revision History

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

Date	**Revision**	**Change**
Dec. 04, 2024	Revision 1.0A	Update the package outline drawing (page 11)
Aug.19, 2020	Revision 0.9A	Add taping and reel specification (page12).
Jan.08, 2020	Revision 0.9	Initial Release

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