SY20728B

3A Fast-Response LDO Regulator

General Description

The SY20728B is a 3A high current capacity and low drop out voltage regulator, which features very fast transient recovery from input voltage surges and output load current changes. The SY20728B has an adjustable output which can be set by two external resistors to a voltage between 1.24V to 18V. SY20728B with fully protection includes over current limit, and over temperature operation.

Features

- High-current Capability:3A Over Full Temperature Range
- Low-dropout Voltage of 480m**V** at Full Load 3A.
- Extremely-fast Transient Response
- Zero-current Shutdown Mode
- Adjustable Output Voltage
- Low Ground Current
- Over Current Limit
- Over Temperature Protection.
- Packages: TO263-5
- RoHS Compliant and Halogen Free

Ordering Information

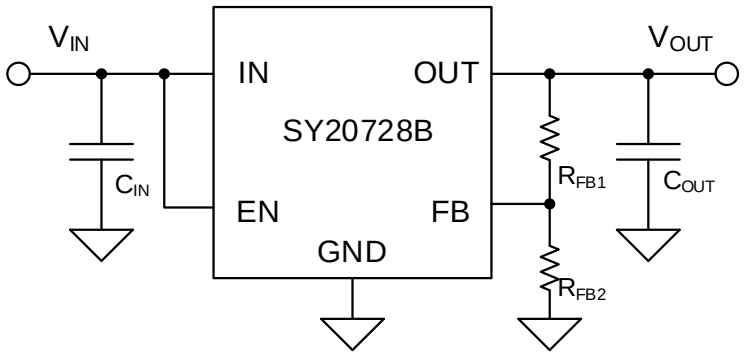
SY20728 □(□□□)

Package Code

Optional Spec Code

Ordering Number	Package type	Note
SY20728BMAB	TO263-5	----

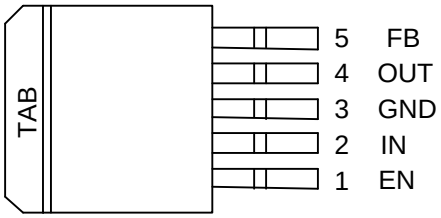
Typical Applications



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

Figure1. Adjustable Output Regulator

Pinout (top view)



TO263-5 (D^2 Pak)

Top Mark: EDE*xyz* (device code: EDE, ***x=year code, y=week code, z= lot number code)***

Pin Name	Pin Number	Pin Description
1	EN	Enable (Input): Active-high CMOS compatible control input. Do not leave it floating.
2	IN	INPUT: Unregulated input, +3V to +18V maximum.
3, TAB	GND	GND: TAB is also connected internally to the IC's ground.
4	OUT	OUTPUT: The regulator output voltage.
5	FB	Feedback Voltage: 1.24V feedback from external resistor divider $V_{OUT} = 1.24 \times (\frac{R_{FB1} + R_{FB2}}{R_{FB2}})$

Block Diagram

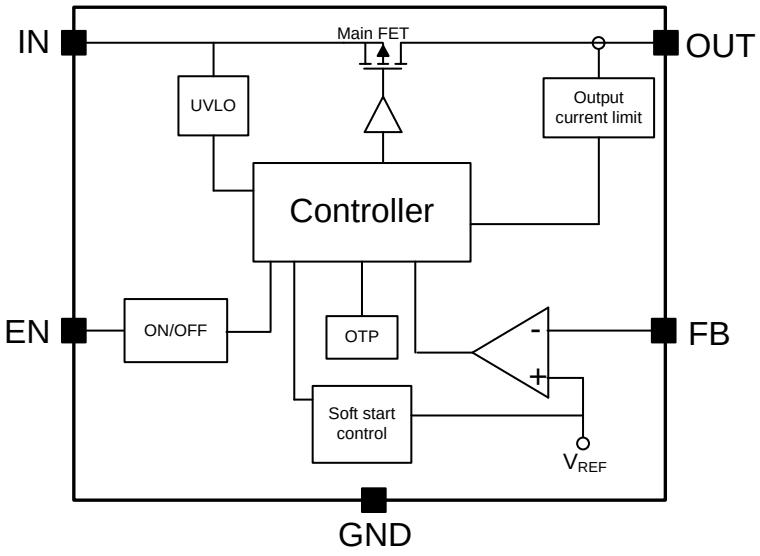


Figure2. Block Diagram

Absolute Maximum Ratings (Note 1)

IN, EN, OUT, FB---------- 19V
Power Dissipation, PD @ TA = 25°C TO-263---------- 71.4W
Package Thermal Resistance (Note 2)
θ JA ---------- 24.5°C/W
θ JC ---------- 1.4 C/W
Junction Temperature Range ---------- 150°C
Lead Temperature (Soldering, 10 sec.) ---------- 260°C
Storage Temperature Range ---------- -65°C to 150°C

Recommended Operating Conditions (Note 3)

IN ---------- 3V to 18V
EN, OUT, FB---------- 0V to 18V
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; T_A = -40°C ~85°C, unless otherwise specified.)

Parameter	Symbol	Test Conditions	Min	Typical	Max	Unit
General						
Input Voltage	V_{IN}		3		18	V
Input Voltage UVLO Threshold	V_{UVLO}	V_{IN} rising	2.3	2.5	2.7	V
UVLO Hysteresis	V_{UVLO_HYS}			200		mV
Soft-start Time	t_{SS}			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}	V_{OUT}=0.9×V_{OUT_normal}	3.5	4.5	5.5	A
Thermal Shutdown Temperature	T_{SD}		130	150	170	°C
Thermal Shutdown Hysteresis	T_{HYS}			20		°C
IN pin to OUT pin Leakage Current	$I_{LEAKAGE}$	EN=0,V_{IN-OUT}=18V		10	600	nA
Line Regulation	ΔV_{LNR}	I_{OUT} = 100mA, (V_{OUT} + 1V) ≦ V_{IN} ≦16V		0.1	0.5	%
Load Regulation	ΔV_{LDR}	V_{IN} = V_{OUT} + 1V, 100mA ≦ I_{OUT} ≦ 3A		0.2	1	%
Dropout Voltage	ΔV_{DROP}	I_{OUT} = 100mA		16	24	mV
		I_{OUT} = 750mA		120	175	mV
		I_{OUT} = 1.5A		240	350	mV
		I_{OUT} = 3A		480	700	mV
Power Supply Rejection	PSRR	Frequency=100Hz, C_{OUT}=10μF		70		dB
		Frequency=100kHz, C_{OUT}=10μF		30		

Parameter	Symbol	Test Conditions	Min	Typical	Max	Unit
Ground Current						
Ground Current	I_{GND}	IC shutdown		1	5	μA
		I_{OUT} = 0, V_{IN}=V_{OUT}+1V		120	150	μA
		I_{OUT} = 1.5A V_{IN}=V_{OUT}+1V		2	4	mA
		I_{OUT} = 3A V_{IN}=V_{OUT}+1V		4	8	mA
Reference Voltage						
Reference Voltage	V_{REF}		1.215	1.24	1.265	V
FB pin Bias Current	I_{FB_BIAS}	EN=0, FB pin floating			50	nA

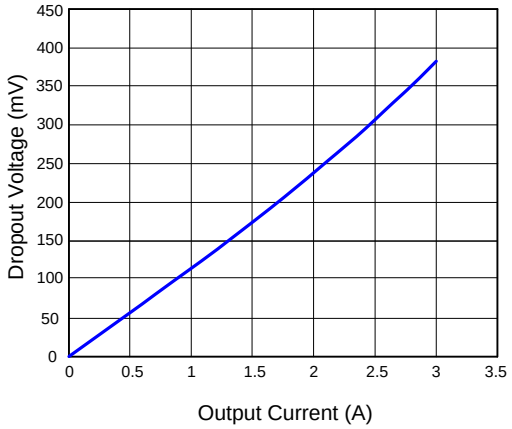
Note 1: Stresses beyond "Absolute Maximum Ratings" may cause permanent damage to the device. These are for stress ratings. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute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

Note 2: θ_{JA} is measured according to JEDEC 51-2 and chip mounted on Silergy PCB. Exposed paddle of TO263-5 is the case position for θ_{JC} measurement.

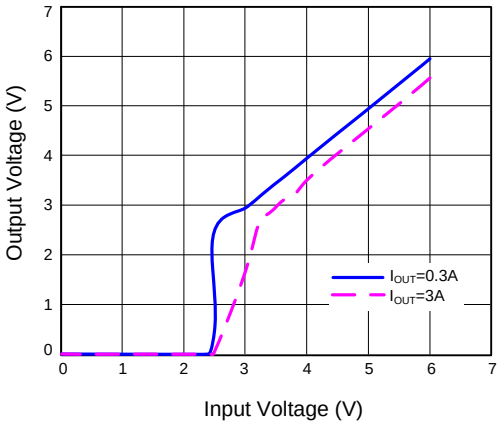
Note 3: The device is not guaranteed to function outside its operating conditions.

Typical Performance Characteristics

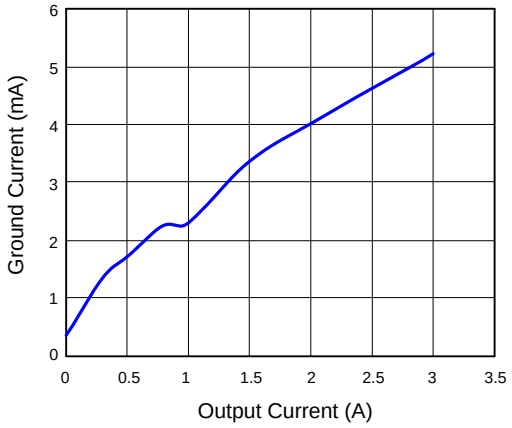
Dropout Voltage vs. Output Current
(V_{IN}=V_{EN}=5V, V_{FB}=1.1V)



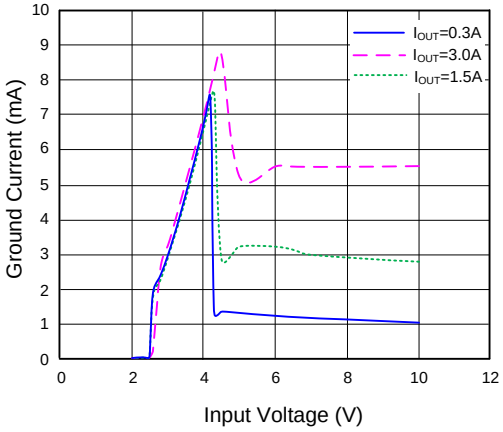
Output Voltage vs. Input Voltage
(V_{IN}=V_{EN}, V_{FB}=1.1V)



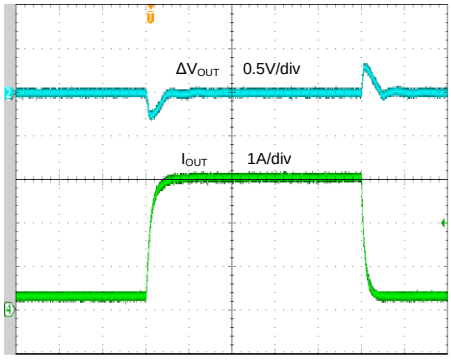
Ground Current vs. Output Current
(V_{IN}=V_{EN}=5V, V_{OUT}=4.2V)



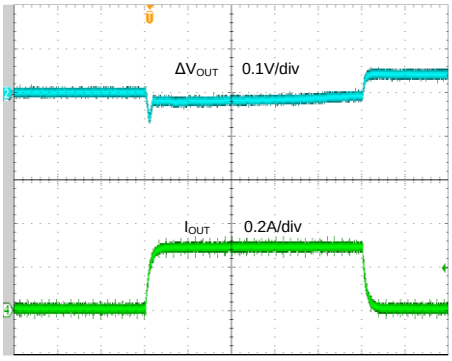
Ground Current vs. Input Voltage
(V_{IN}=V_{EN}, V_{OUT}=4.2V)



Load Transient
(V_{IN}=6V, V_{OUT}=4.2V, C_{IN}=C_{OUT}=10μF, I_{OUT}=0.3A~3A)

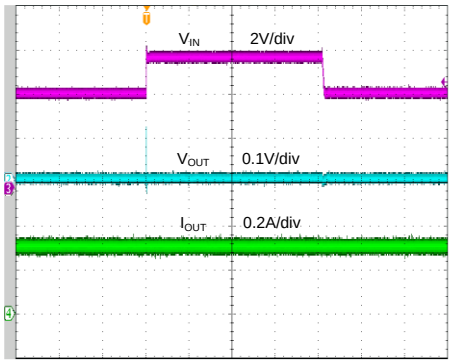


Load Transient
(V_{IN}=6V, V_{OUT}=4.2V, C_{IN}=C_{OUT}=10μF, I_{OUT}=0A~0.3A)



Line Transient

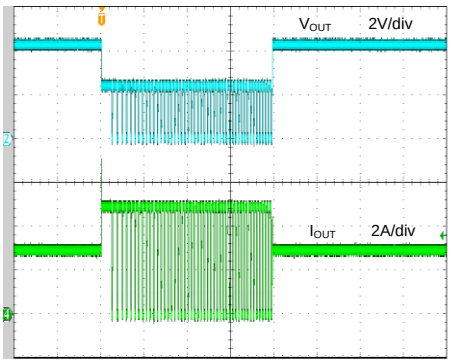
(V_{IN}=5V~6V, C_{IN}=C_{OUT}=10μF, I_{OUT}=0.3A)



Time (800μs/div)

Over Current

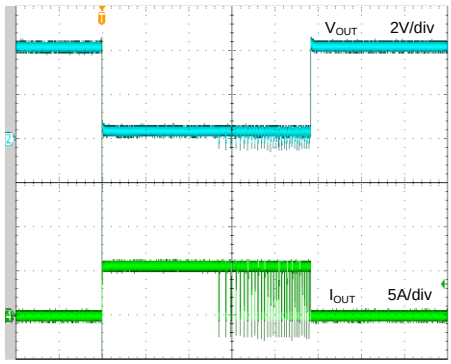
(V_{IN}=6V, C_{IN}=C_{OUT}=10μF, OUT=1.4Ω to 0.42Ω to1.4Ω)



Time (100ms/div)

Short Current

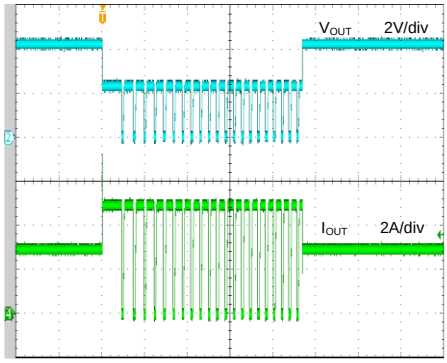
(V_{IN}=6V, C_{IN}=C_{OUT}=10μF, I_{OUT}=0A to short to 0A)



Time (100ms/div)

Short Current

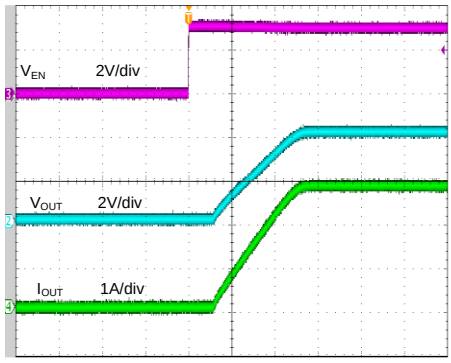
(V_{IN}=6V, C_{IN}=C_{OUT}=10μF, I_{OUT}=3A to short to 3A)



Time (40ms/div)

Startup from EN

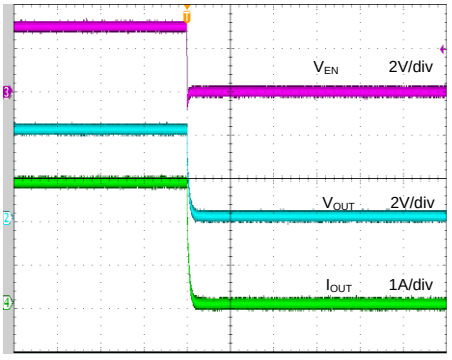
(V_{IN}=5V, C_{IN}=C_{OUT}=10μF, I_{OUT}=3A)



Time (800μs/div)

Shutdown from EN

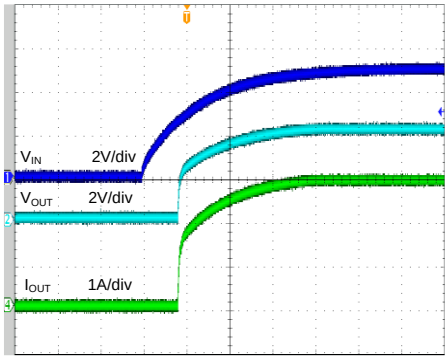
(V_{IN}=5V, C_{IN}=C_{OUT}=10μF, I_{OUT}=3A)



Time (400μs/div)

Startup from V_{IN}

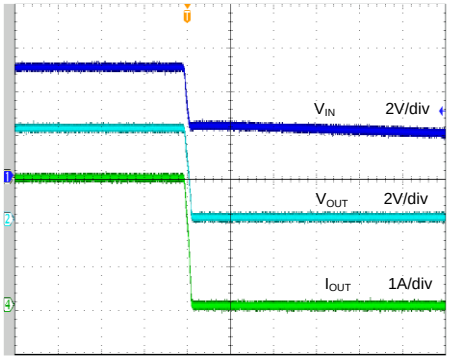
(V_{IN}=5V, C_{IN}=C_{OUT}=10μF, I_{OUT}=3A)



Time (20ms/div)

Shutdown from V_{IN}

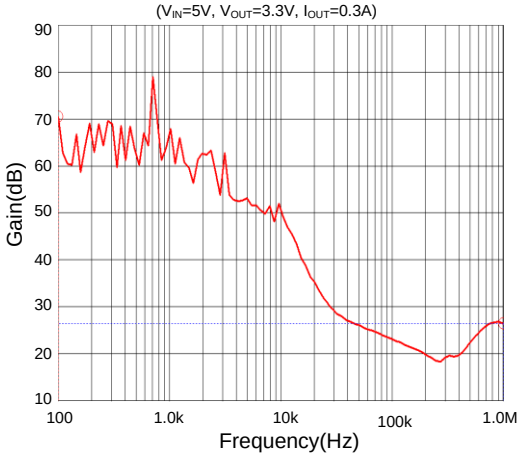
(V_{IN}=5V, C_{IN}=C_{OUT}=10μF, I_{OUT}=3A)



Time (2ms/div)

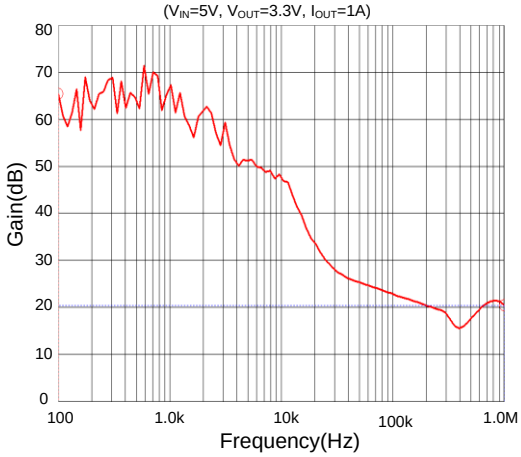
Power Supply Rejection Ratio

(V_{IN}=5V, V_{OUT}=3.3V, I_{OUT}=0.3A)



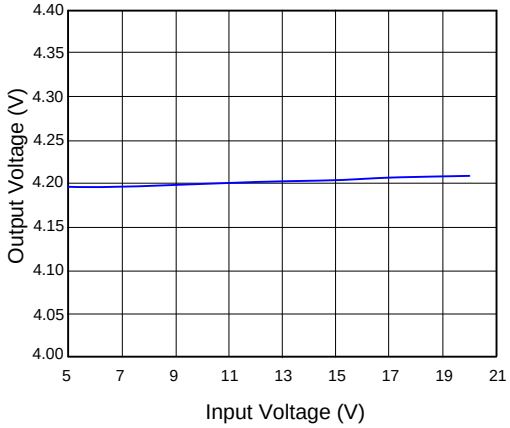
Power Supply Rejection Ratio

(V_{IN}=5V, V_{OUT}=3.3V, I_{OUT}=1A)



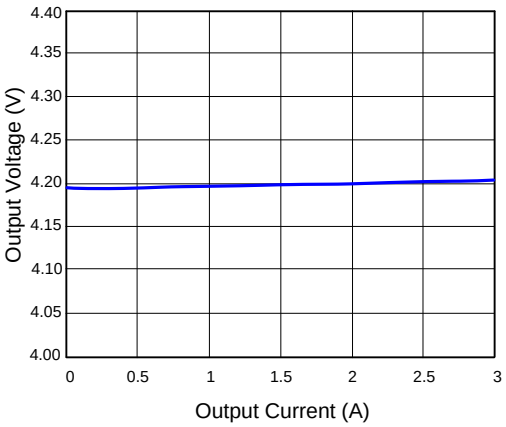
Line Regulation

(V_{OUT}=4.2V, C_{IN}=C_{OUT}=10μF, I_{OUT}=0.15A)

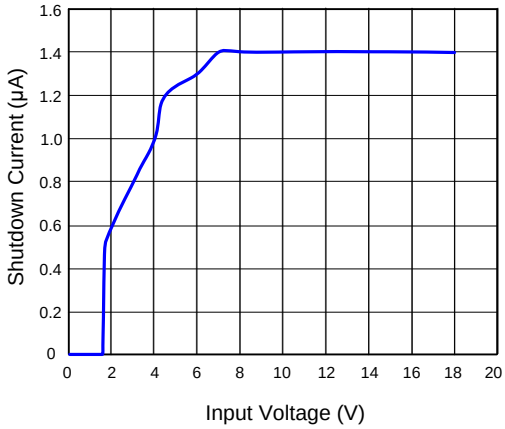


Load Regulation

(V_{IN}=5V, C_{IN}=C_{OUT}=10μF)

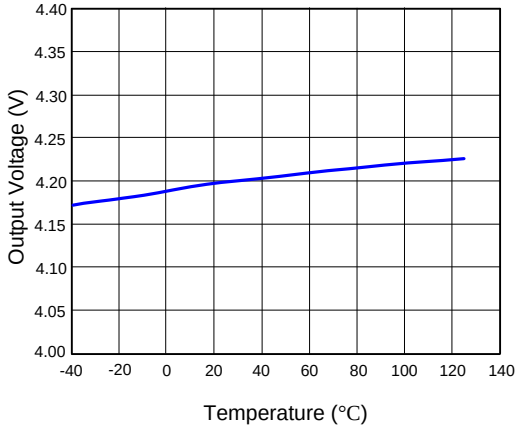


Shutdown Current vs. Input Voltage



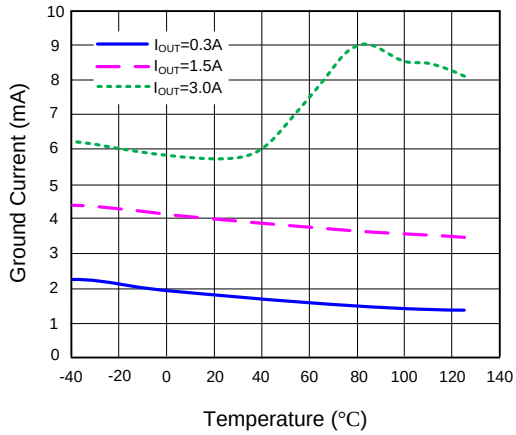
Output Voltage vs. Temperature

(V_{IN}=5V, C_{IN}=C_{OUT}=10μF)



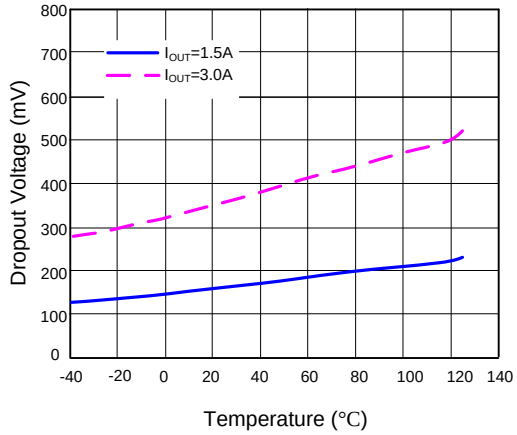
Ground Current vs. Temperature

(V_{IN}=5V, C_{IN}=C_{OUT}=10μF)



Dropout Voltage vs. Temperature

(V_{IN}=5V, C_{IN}=C_{OUT}=10μF)



Operation Information

The SY20728B is a 3A high current capacity and low drop out voltage regulator, which features very fast transient recovery from input voltage surges and output load current changes. The SY20728B has an adjustable output which can be set by two external resistors to a voltage between 1.24V to 18V. The SY20728B with fully protection includes over current limit, and over temperature operation.

Input Capacitor C_{IN}

An input capacitance about 10μF is required between the device input pin and ground pin. A typical X5R or better grade ceramic capacitor with 25V rating is recommended in this application. This input capacitor must be located close to the device to assure input stability. A lower ESR capacitor allows the use of less capacitance, while higher ESR type requires more capacitance.

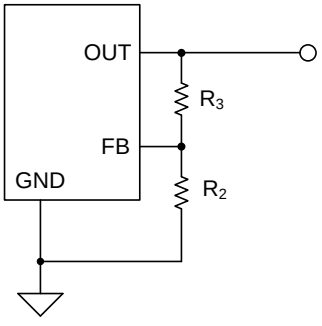
Output Capacitor C_{OUT}

For transient stability, the SY20728B is designed specifically to work with very small ceramic output capacitors. 2.2μF output capacitance can be used in this application. Higher capacitance values help to improve transient. The output capacitor' ESR is critical because it forms a zero to provide phase lead which is required for loop stability.

Output Voltage Setting

Choose R_2 and R_3 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_2 and R_3. A value of between 1kΩ and 1MΩ is highly recommended for both resistors. The complete equation for the output voltage is described as follows;

$$V_{OUT}=1.24\times\frac{R_3+R_2}{R_2}$$



No Load Stability

The device will remain stable and in regulation with no external load. This is especially important in CMOS RAM keep-alive applications.

Dropout Voltage

The SY20728B 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 Protection

The minimum current limit of the SY20728B is 3.5A. The device includes over current protection. The current limitation circuit regulates the output current to its limitation threshold to the output current to its limitation threshold to protect IC from damage. Under over current condition, the power loss of the IC is relative high. And that may trigger the thermal protection.

Load Transient Considerations

The SY20728B integrates the compensation components to achieve good stability and fast transient responses. In some applications, adding a small ceramic capacitor in parallel with R_3 may further speed up the load transient responses and is thus recommended for applications with large load transient step requirements.

Thermal Considerations

The SY20728B 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 conditions 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.

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 feedback loop formed by R3, R2and the trace connecting to the FB pin and OUT must be minimize. The best way to do this is to layout CIN and COUT near the device with short traces to the VIN, VOUT, 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:

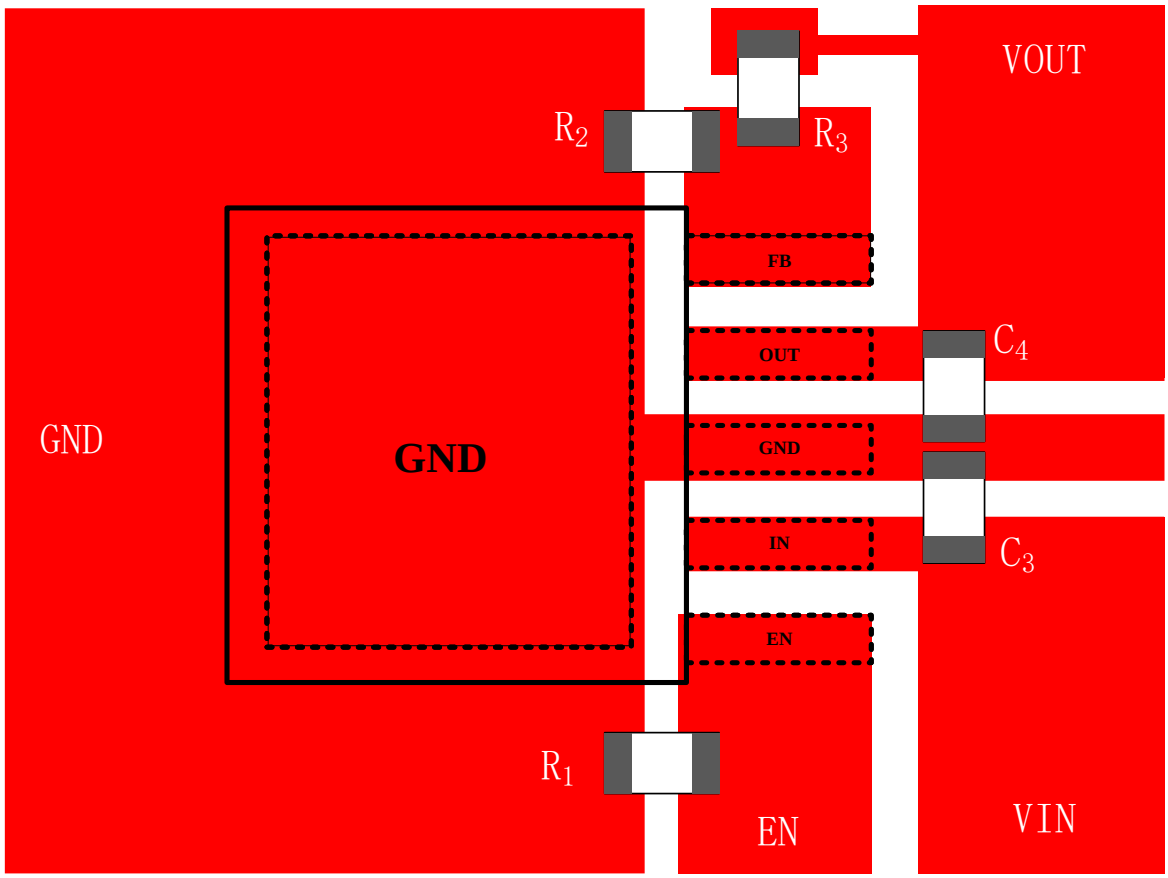
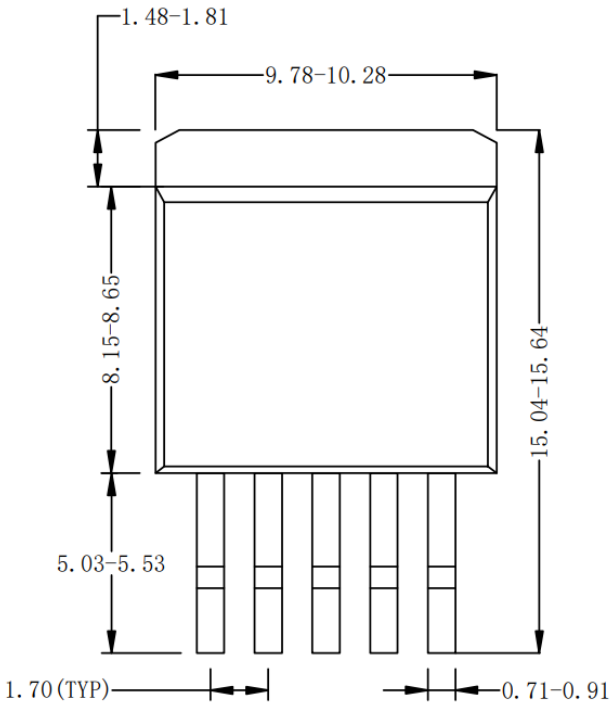
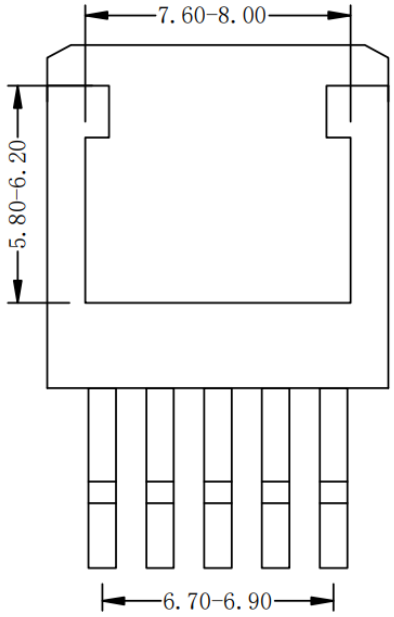


Figure3. PCB Layout Suggestion

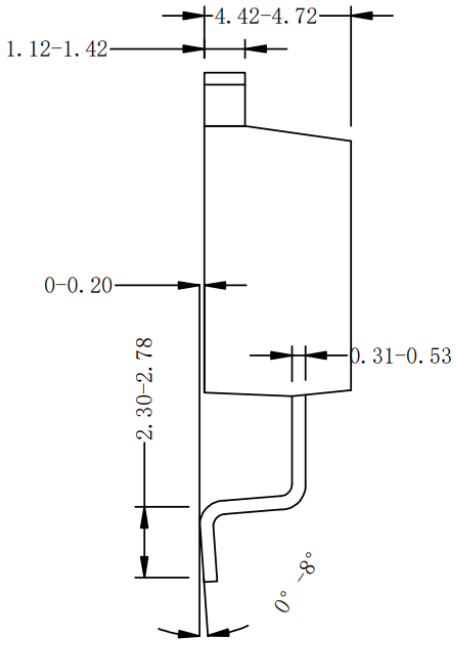
TO263-5 Package Outline Drawing



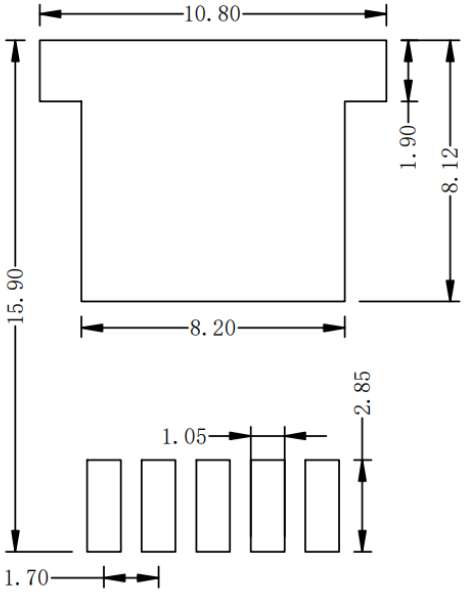
Top View



Bottom View



Side View



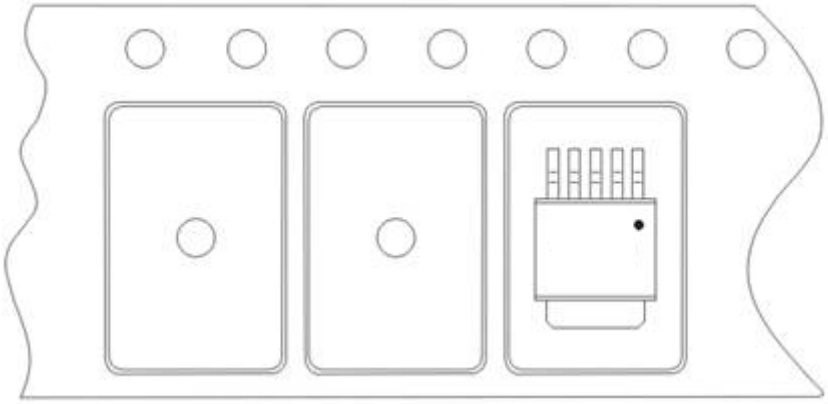
Recommended PCB Layout
(Reference only)

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

Taping & Reel Specification

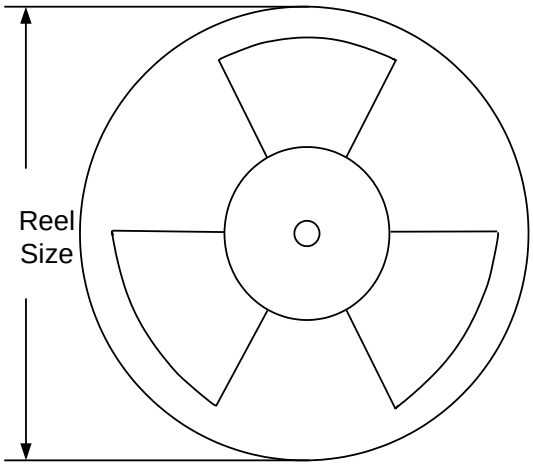
1. Taping Orientation for Packages

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)
Apr.16, 2021	Revision 0.9	Initial Release

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