

General Description

The SY20787 is a low-dropout LDO regulator with a wide input voltage range of 3V to 18V and 3A current capability. It features fast recovery from input voltage surges and output load current changes.

The Enable input can be used to disable the operation and reduce current consumption in the system.

The SY20787 offers protection features, including an over-current limit, output short protection, input over-voltage protection, and over-temperature protection. It also offers an adjustable output, which can be set by two external resistors.

The SY20787 is available in a compact TO263-5 package.

Features

- Input Voltage Range: 3V to 18V
- High Current Capability: 3A Over Full Temperature Range
- Adjustable Output Voltage
- Low Dropout Voltage: 480mV at Full Load 3A
- Fast Transient Response
- Zero-Current Shutdown Mode
- Low Ground Current
- Current Limiting Protection
- Over Temperature Protection
- Output Short Circuit Protection
- Package: TO263-5

Applications

- High Efficiency Linear Low Power Supply Applications
- Battery-Powered Equipment
- Hand-Held Instruments
- Notebook PCs

Typical Applications

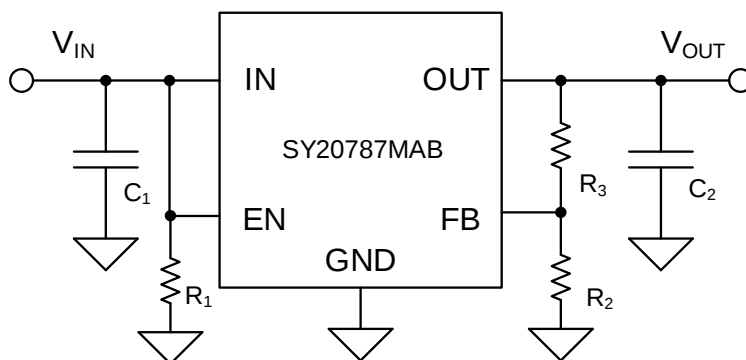


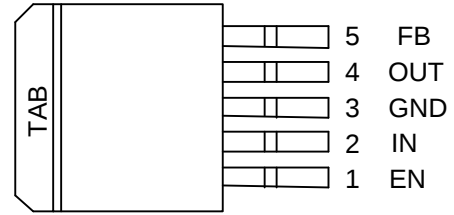
Figure 1. Adjustable Output Regulator

Ordering Information

Ordering Part Number	Package Type	Top Mark
SY20787MAB	TO263-5 RoHS Compliant and Halogen Free	EAGxyz

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

Pinout (top view)



Pin Description

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 +18V maximum.
GND	3, TAB	GND: TAB is also connected internally to the device ground.
OUT	4	OUTPUT: The regulator output voltage.
FB	5	Feedback Voltage: 1.24V feedback from external resistor divider. $V_{OUT} = 1.24 \times (\frac{R_1 + R_2}{R_2})$

Block Diagram

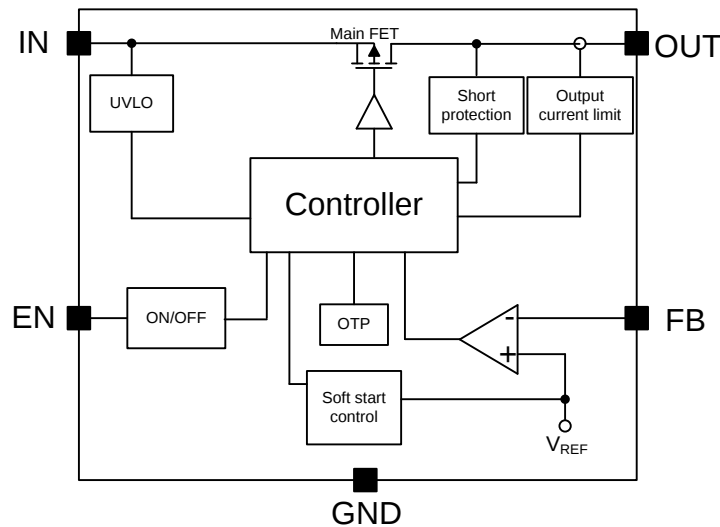


Figure 2. Block Diagram

Absolute Maximum Ratings

Parameter (Note1)	Min	Max	Unit
IN, EN, OUT, FB	-0.3	19	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	24.5	°C/W
θ_{JC} Junction-to-case Thermal Resistance	1.4	

Recommended Operating Conditions

Parameter (Note 3)	Min	Max	Unit
IN	3	18	V
EN, OUT, FB	0	18	
Junction Temperature, Operating	-40	125	°C
Ambient Temperature	-40	85	

Electrical Characteristics

($V_{IN} = 5V$, $V_{OUT} = 3.3V$, $I_{OUT} = 100mA$, $T_J = -40^{\circ}C$ to $+125^{\circ}C$, unless otherwise specified. The values are guaranteed by test, design or statistical correlation.)

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}	$V_{OUT} = 0.9 \times V_{OUT_normal}$	3.5	4.5	5.5	A
Thermal Shutdown Temperature	T_{SD}			150		°C
Thermal Shutdown Hysteresis	T_{HYS}			20		°C
Output Short Protection Threshold	$V_{FB,SHORT}$		40	50	60	% V_{REF}
Output Short Off Time	t_{short_off}			24		ms
IN Pin to OUT Pin Leakage Current	$I_{Leakage}$	$EN=0, V_{IN-OUT}=18V$		10	600	nA
Line Regulation	ΔV_{LNR}	$I_{OUT} = 100mA$, $(V_{OUT} + 1V) \leq V_{IN} \leq 16V$		0.1	0.5	%
Load Regulation	ΔV_{LDR}	$V_{IN} = V_{OUT} + 1V$, $100mA \leq I_{OUT} \leq 3A$		0.2	1	%

Electrical Characteristics (Cont.)

($V_{IN} = 5V$, $V_{OUT} = 3.3V$, $I_{OUT} = 100mA$, $T_J = -40^{\circ}C$ to $125^{\circ}C$ unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typical	Max	Unit
Dropout Voltage	ΔV_{DROP}	$V_{\text{FB}}=1\text{V}$, $I_{\text{OUT}} = 100\text{mA}$		16	24	mV
		$V_{\text{FB}}=1\text{V}$, $I_{\text{OUT}} = 750\text{mA}$		120	175	
		$V_{\text{FB}}=1\text{V}$, $I_{\text{OUT}} = 1.5\text{A}$		240	350	
		$V_{\text{FB}}=1\text{V}$, $I_{\text{OUT}} = 3\text{A}$		480	730	
Power Supply Rejection	PSRR	Frequency=100Hz, $C_{\text{OUT}}=10\mu\text{F}$ (Note 4)		70		dB
		Frequency=100kHz, $C_{\text{OUT}}=10\mu\text{F}$ (Note 4)		30		
Ground Current						
Ground Current	I_{GND}	IC shutdown		1	5	μA
		$I_{\text{OUT}} = 0$, $V_{\text{IN}}=V_{\text{OUT}}+1\text{V}$		120	165	μA
		$I_{\text{OUT}} = 1.5\text{A}$, $V_{\text{IN}}=V_{\text{OUT}}+1\text{V}$ (Note 4)		2.75	5.5	mA
		$I_{\text{OUT}} = 3\text{A}$, $V_{\text{IN}}=V_{\text{OUT}}+1\text{V}$ (Note 4)		5.2	10.4	mA
Reference Voltage						
Reference Voltage	V_{REF}		1.215	1.24	1.265	V
FB Pin Bias Current	$I_{\text{FB_Bias}}$	EN=0, FB pin floating			50	nA

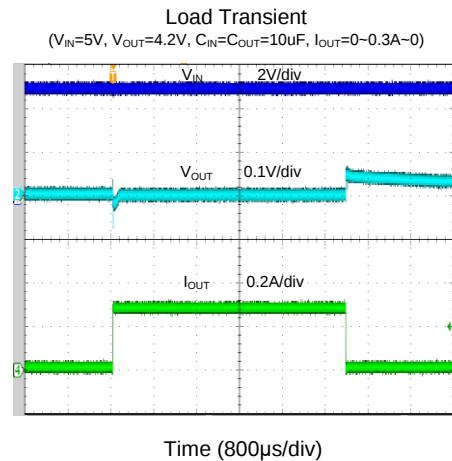
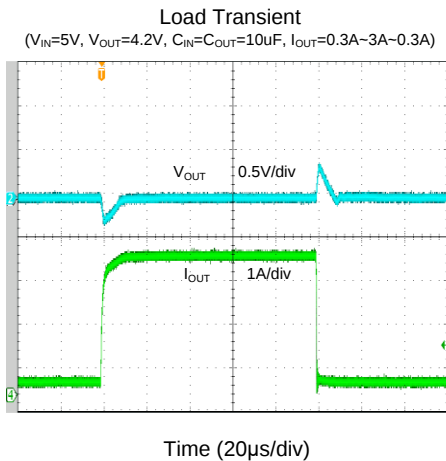
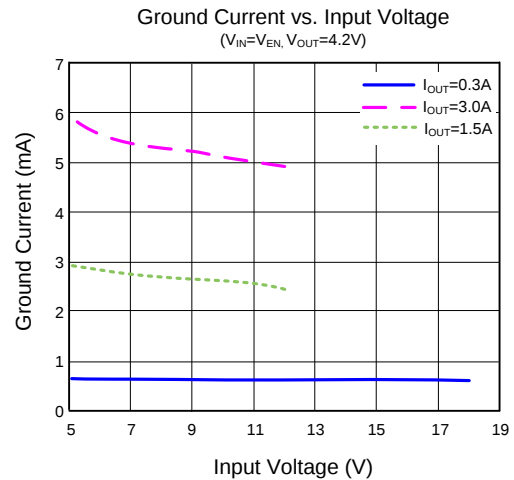
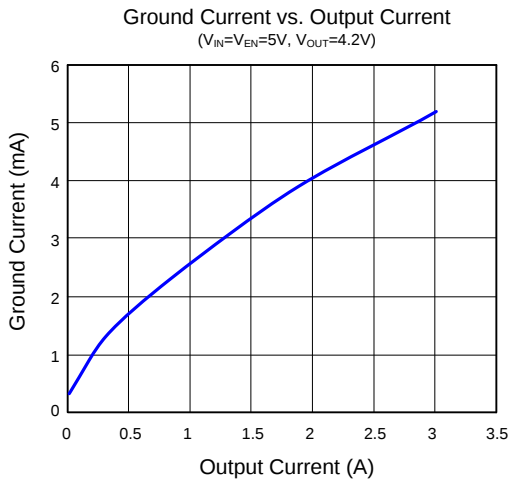
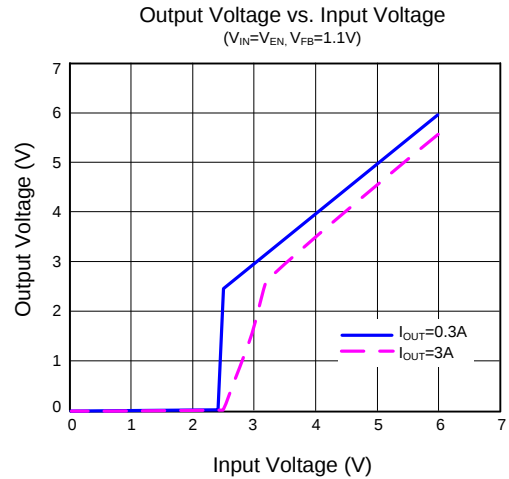
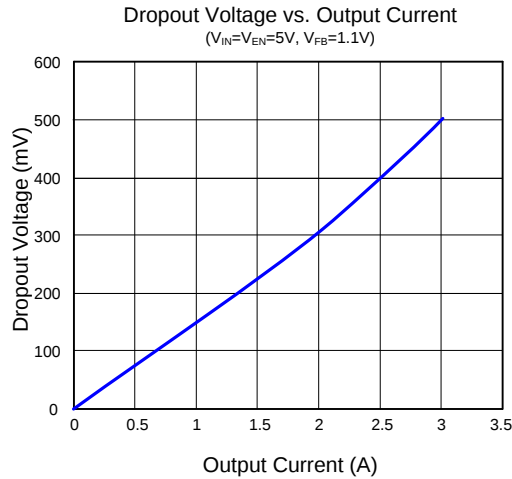
Note 1: Stresses beyond "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute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

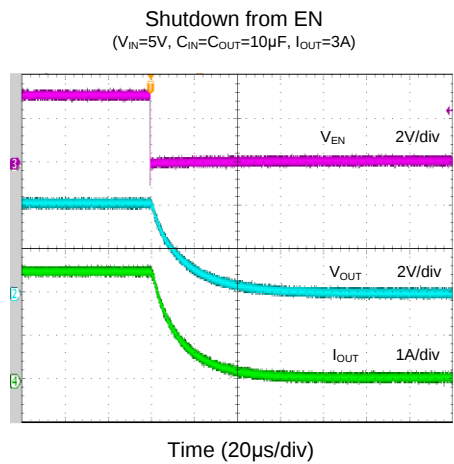
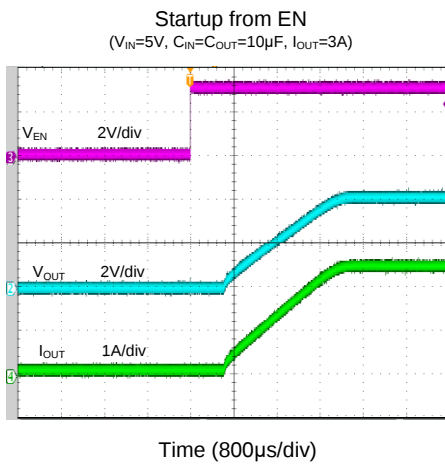
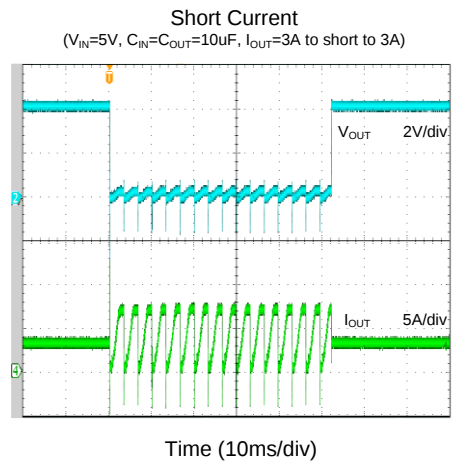
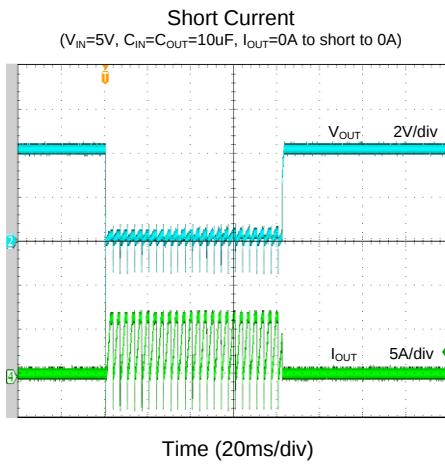
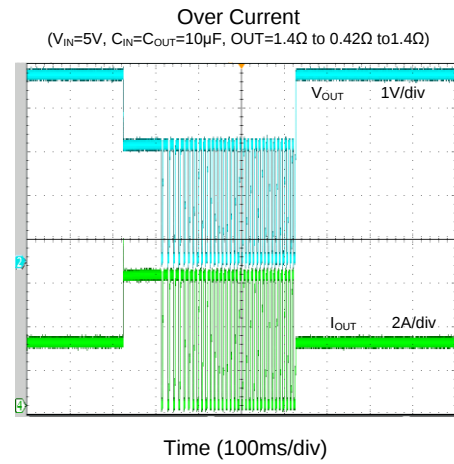
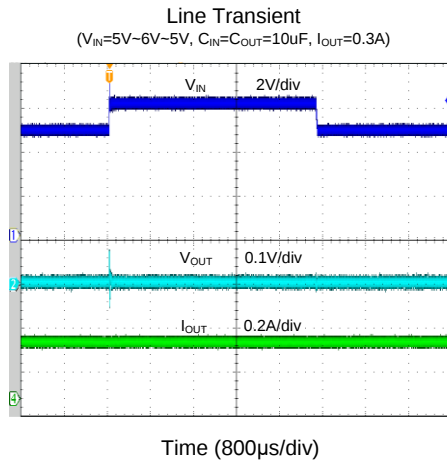
Note 2: θ_{JA} was measured according to JESD51-2 and chip mounted on Silergy PCB. Exposed paddle of TO263-5 is the case position for θ_{JC} measurement.

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

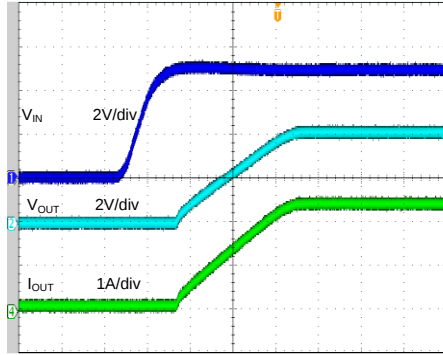
Note 4: Guaranteed by design.

Typical Performance Characteristics



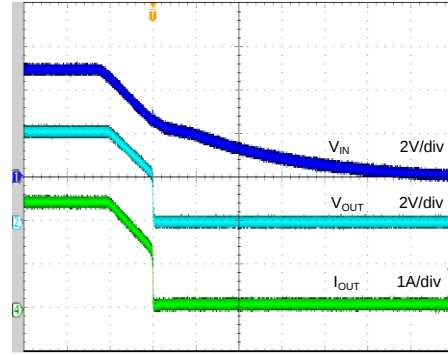


Startup from V_{IN}
($V_{IN}=5V$, $C_{IN}=C_{OUT}=10\mu F$, $I_{OUT}=3A$)



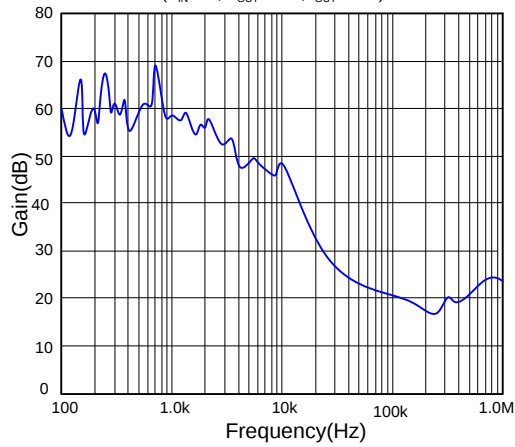
Time (800µs/div)

Shutdown from V_{IN}
($V_{IN}=5V$, $C_{IN}=C_{OUT}=10\mu F$, $I_{OUT}=3A$)

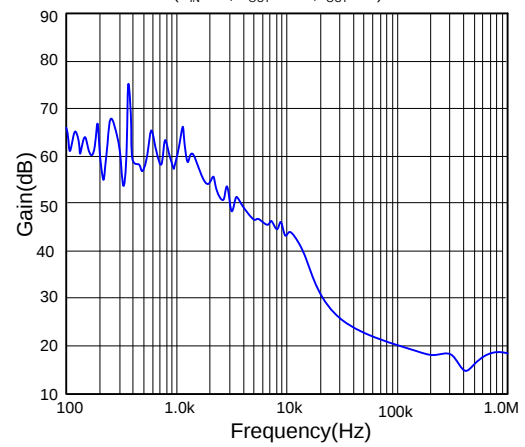


Time (2ms/div)

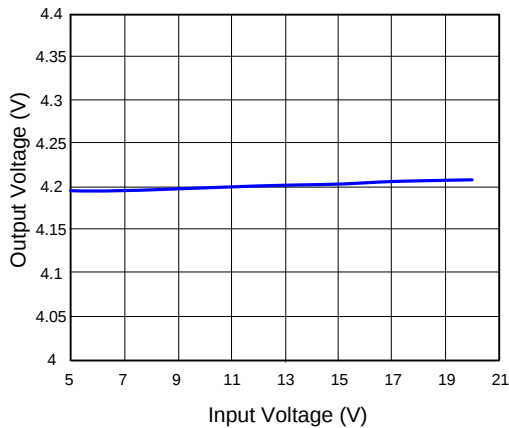
Power Supply Rejection Ratio
($V_{IN}=5V$, $V_{OUT}=4.2V$, $I_{OUT}=0.3A$)



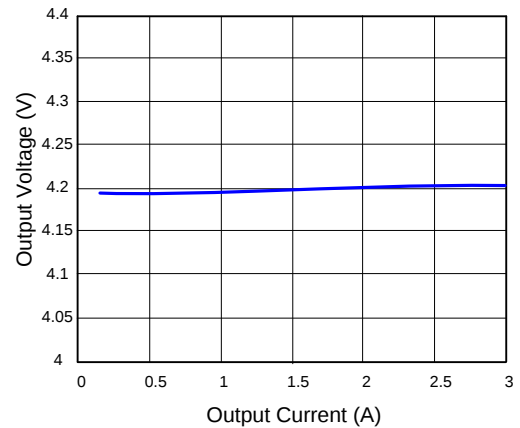
Power Supply Rejection Ratio
($V_{IN}=5V$, $V_{OUT}=4.2V$, $I_{OUT}=1A$)



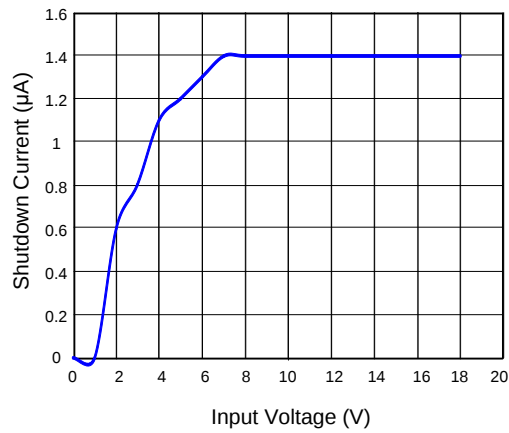
Line Regulation
($V_{OUT}=4.2V$, $C_{IN}=C_{OUT}=10\mu F$, $I_{OUT}=0.15A$)



Load Regulation
($V_{IN}=5V$, $V_{OUT}=4.2V$, $C_{IN}=C_{OUT}=10\mu F$)

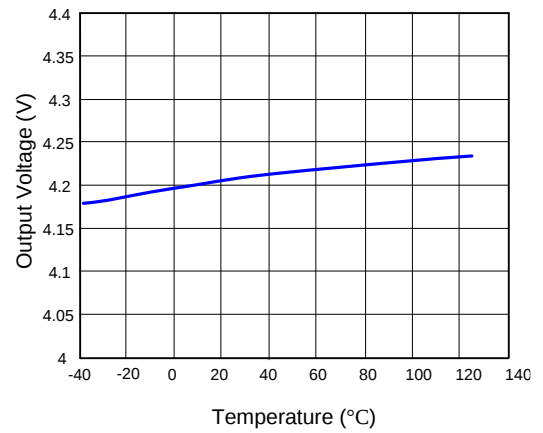


Shutdown Current vs. Input Voltage



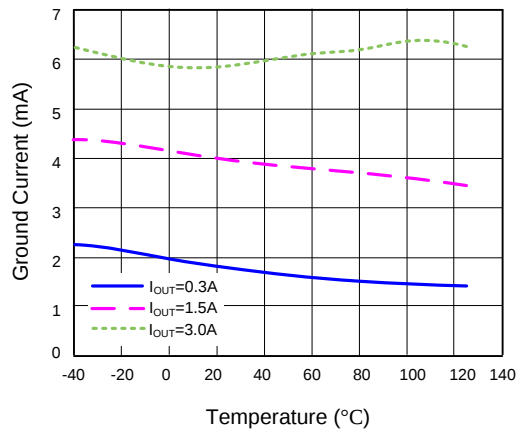
Output Voltage vs. Temperature

($V_{IN}=5V$, $C_{IN}=C_{OUT}=10\mu F$, $I_{OUT}=no\ load$)



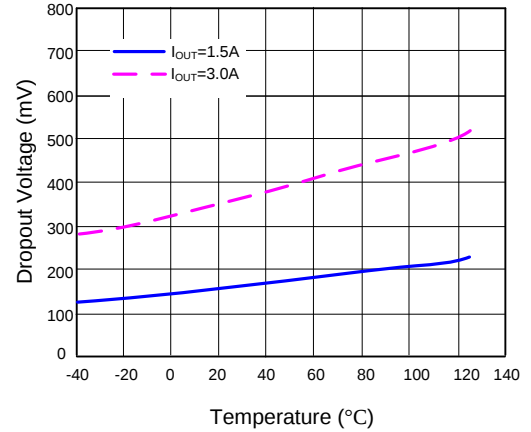
Ground Current vs. Temperature

($V_{IN}=5V$, $V_{OUT}=4.2V$, $C_{IN}=C_{OUT}=10\mu F$)



Dropout Voltage vs. Temperature

($V_{IN}=5V$, $V_{FB}=1.1V$, $C_{IN}=C_{OUT}=10\mu F$)



Application Information

The SY20787 is a low-dropout LDO regulator with a wide input voltage range of 3V to 18V and 3A current capability. It features fast recovery from input voltage surges and output load current changes.

The Enable input can be used to disable the operation and reduce current consumption in the system.

Protection features, including an over-current limit, output short protection, input over-voltage protection, and over-temperature protection ensure reliable operation across different demanding applications.

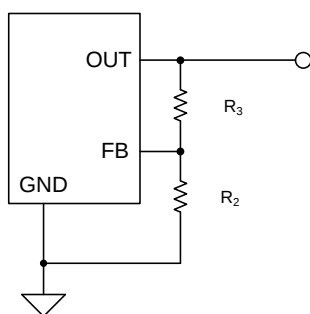
Input Capacitor C_{IN}:

An input capacitance of about 10μF is required between the device input and ground pins. A typical X5R or better grade ceramic capacitor with a 25V rating is recommended for most applications. Place the input capacitor as close to the device as practical to ensure stable operation.

Output Capacitor C_{OUT}:

The SY20787 is designed to operate using very small ceramic output capacitors. A 2.2μF output capacitance can be used in this application. The output capacitor's ESR is critical because it forms a zero to provide phase lead which is required for loop stability. Higher capacitance values help to improve transient response.

Output Voltage Setting:



Choose R2 and R3 to program the proper output voltage. Choosing large resistance values for both R2 and R3 is recommended to minimize power consumption under light loads. A value of between 10kΩ and 1MΩ is recommended for both resistors.

The output voltage can be calculated using the following equation:

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

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 SY20787 has a very low dropout voltage due to the 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 minimum current limit of the SY20787 is 4A. 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 the device is high, which may trigger thermal protection.

Load Transient Considerations:

The SY20787 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.

Thermal Considerations:

The SY20787 can source a current of up to 3A over the full operating junction temperature range. However, the maximum output current must be derated at a higher ambient temperature to limit junction temperature to a maximum 125°C. The junction temperature must be within the operating range specified under all operating conditions. 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 using the following 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 package junction-to-ambient thermal resistance.

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 device's input, output, and ground pins using traces with no other currents flowing through them. The feedback loop formed by R_1 ,

R_2 , and the trace connecting to the FB pin and OUT must be minimized.

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:

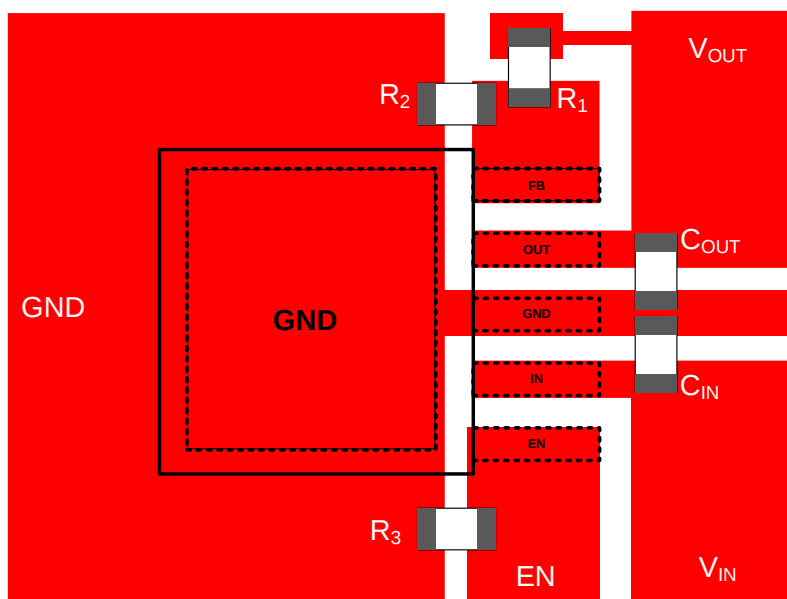
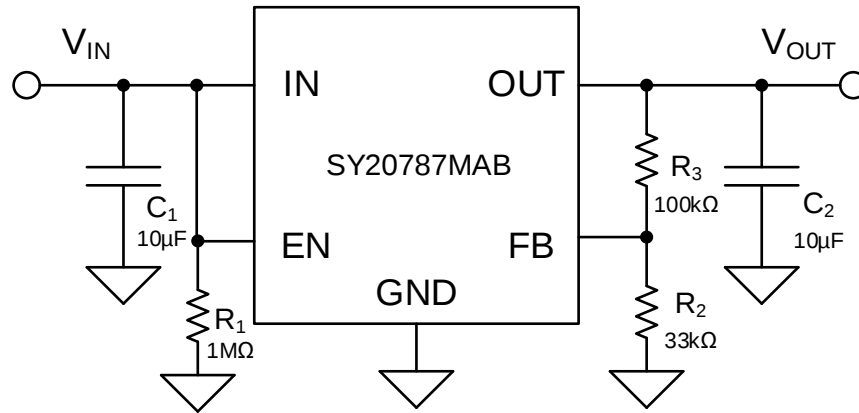


Figure 3. PCB Layout Suggestion

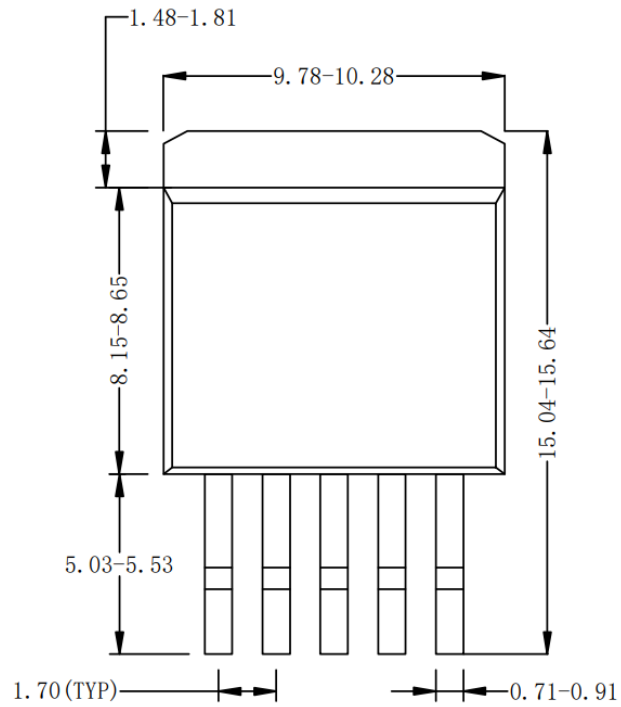
Application Schematic ($V_{OUT}=5V$)



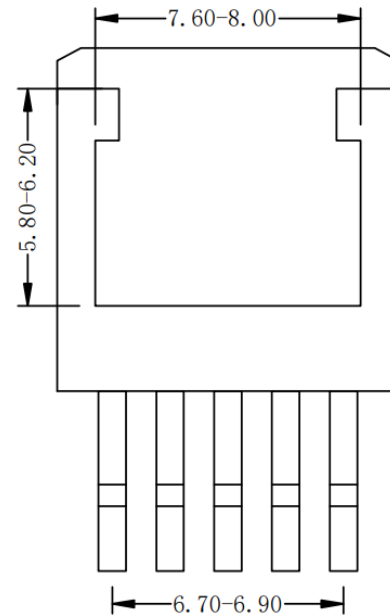
BOM List

Reference Designator	Description	Part Number	Manufacturer
C ₁	10 μ F/50V,1206	C3216X5R1H106K	TDK
C ₂	10 μ F/16V,1206	C3216X7R1C106K	TDK
R ₁	1M Ω ,1%, 0603	RC0603FR-071ML	YAGEO
R ₂	33k,1%,0603	RC0603FR-0733K2L	YAGEO
R ₃	100k,1%,0603	RC0603FR-07100KL	YAGEO

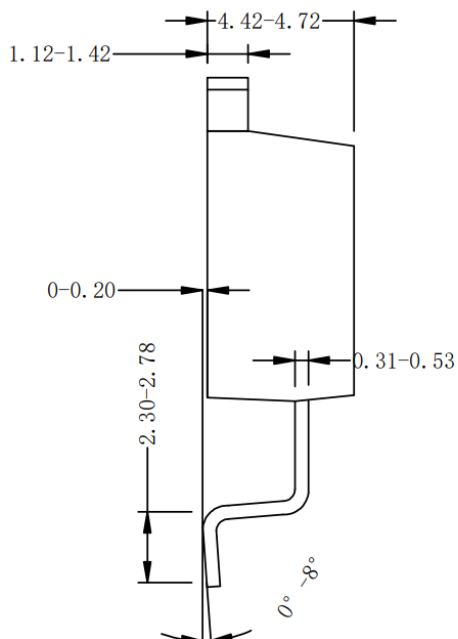
TO263-5 Package Outline Drawing



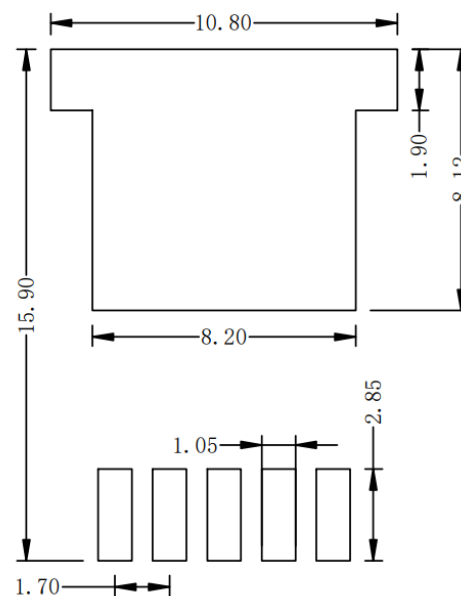
Top View



Bottom View



Side View

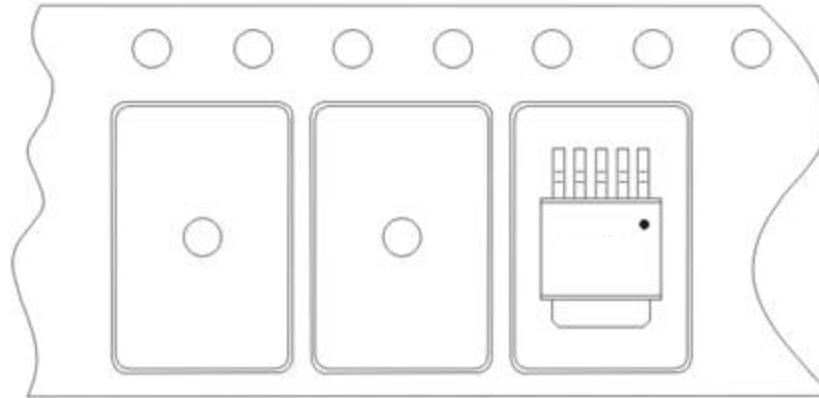


**Recommended PCB Layout
(Reference only)**

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

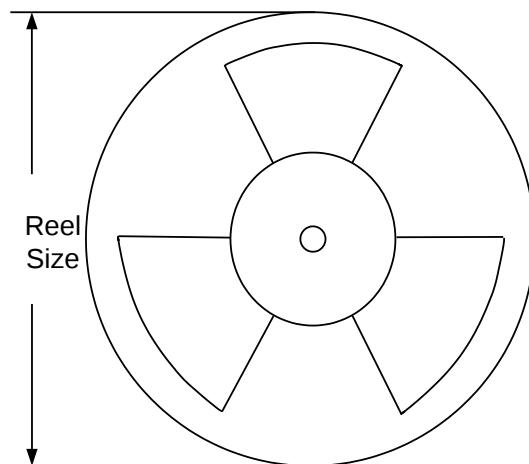
Taping & Reel Specification

1. TO263-5 Taping Orientation for Packages



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

Date	Revision	Change
Dec.04, 2024	Revision 1.0A	Update the package outline drawing (page12)
Apr.21, 2023	Revision 1.0	Language improvements for clarity.
Apr.08, 2021	Revision 0.9	Initial Release

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