GS1117

800mA Low Dropout Voltage Regulator

Product Description

The GS1117/R series of adjustable and fixed voltage regulators are designed to provide 800mA output current and to operate down to 1V input-to-output differential.

The dropout voltage of the device is guaranteed maximum 1.3V at maximum output current, decreasing at lower load currents.

On-chip trimming adjusts the reference voltage to 1%. Current limit is also trimmed, minimizing the stress under overload conditions on both the regulator and power source circuitry.

The GS1117/R devices are pin compatible with other three-terminal SCSI regulators and are offered in the low profile surface mount SOT-223 and SOT-89 packages.

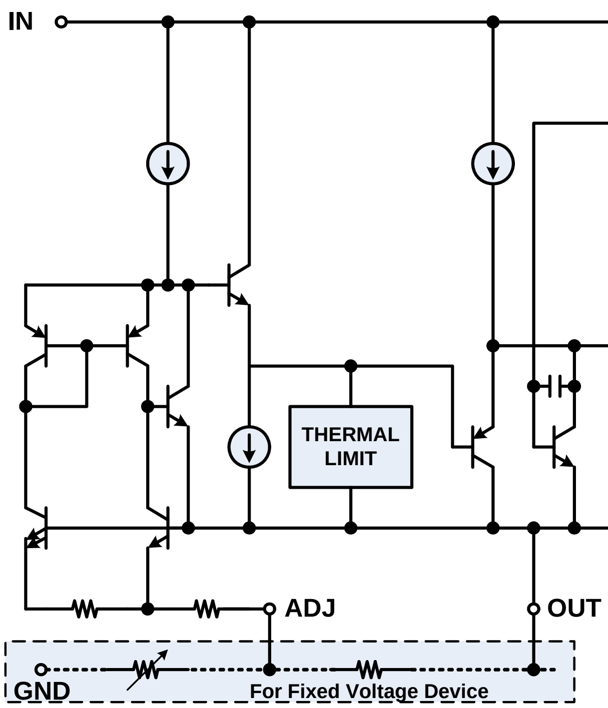
Features

- Three Terminal Adjustable or Fixed Voltages
  * 1.5V, 1.8V, 2.5V, 2.85V, 3.3V and 5.0V.
- Output Current of 800mA
- Operates Down to 1V Dropout
- Line Regulation: 0.2% Max.
- Load Regulation: 0.4% Max.
- RoHS Compliant, 100%Pb & Halogen Free

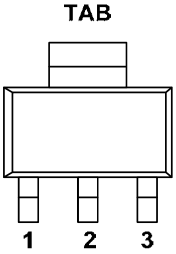
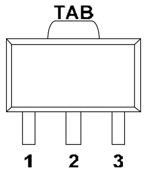
Applications

- High Efficiency Linear Regulators
- Post Regulators for Switching Supplies.
- Battery Chargers
- Active SCSI Terminators (Sound Cards)
- Power Management for Notebook
- Battery Powered Instrumentation

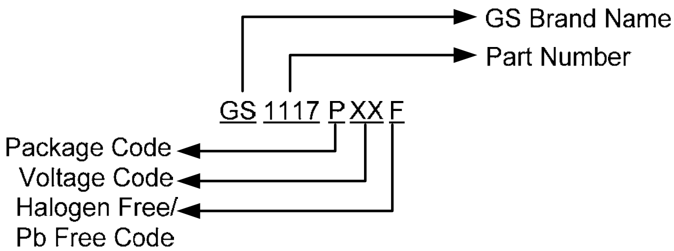
Block Diagram



Packages & Pin Assignments

SOT-223			SOT-89		
					
Pin No.	**GS1117X**	**GS1117RX**	**Pin No.**	**GS1117Y**	**GS1117RY**
1	GND/ADJ	V_{IN}	1	GND/ADJ	V_{IN}
2	V_{OUT}	GND/ADJ	2	V_{OUT}	GND/ADJ
3	V_{IN}	V_{OUT}	3	V_{IN}	V_{OUT}

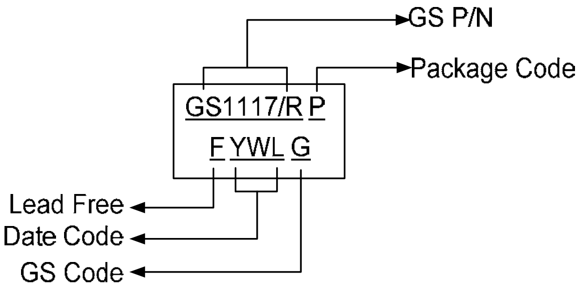
Ordering Information

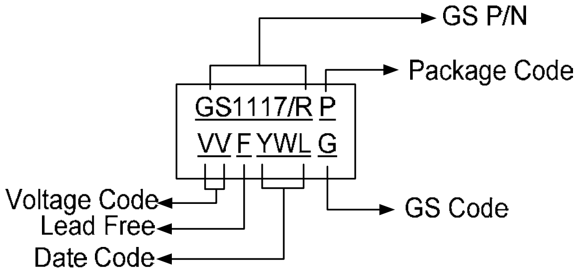


GS1117		GS1117R		Output
SOT-223	**SOT-89**	**SOT-223**	**SOT-89**	
GS1117X	GS1117Y	GS1117RX	GS1117RY	ADJ
GS1117X15	GS1117Y15	GS1117RX15	GS1117RY15	1.5V
GS1117X18	GS1117Y18	GS1117RX18	GS1117RY18	1.8V
GS1117X25	GS1117Y25	GS1117RX25	GS1117RY25	2.5V
GS1117X285	GS1117Y285	GS1117RX285	GS1117RY285	2.85V
GS1117X33	GS1117Y33	GS1117RX33	GS1117RY33	3.3V
GS1117X50	GS1117Y50	GS1117RX50	GS1117RY50	5.0V

For other voltages, please contact factory.
*Adjustable Version does not need Voltage Code.

Marking Information





Absolute Maximum Ratings

Symbol	Parameter	Maximum		Unit
V_{IN}	Input Voltage	15		V
P_D	Power Dissipation(Internally Limited)	SOT-223	0.9	W
		SOT-89	0.5	
T_J	Operating Junction Temperature	-40 to 125		ºC
T_{STG}	Storage temperature Range	-65 to 150		ºC
T_{LEAD}	Lead Temperature (Soldering, 10 sec)	300		ºC
θ_{JA}	Thermal Resistance Junction to Ambient	SOT-223	135	ºC/W
		SOT-89	175	
θ_{JC}	Thermal Resistance Junction to Case	SOT-223	19	ºC/W
		SOT-89	100	

Electrical Characteristics

I_{OUT}=0mA, and T_J=+25 ºC unless otherwise specified.

Parameter	Device	Conditions	Min	Typ	Max	Units
Reference Voltage (Note 2)	GS1117/R	I_{OUT}=10mA 10mA ≤ I_{OUT} ≤800mA, 1.5V ≤ (V_{IN}-V_{OUT}) ≤12V	1.238 1.225	1.250 1.250	1.262 1.270	V
Output Voltage (Note 2)	GS1117/R-1.5	0 ≤ I_{OUT} ≤800mA, 3.0V ≤V_{IN}≤12V	1.485 1.476	1.500 1.500	1.515 1.524	V
	GS1117/R-1.8	0 ≤ I_{OUT} ≤800mA, 3.3V ≤V_{IN}≤12V	1.782 1.773	1.800 1.800	1.818 1.827	
	GS1117/R-2.5	0 ≤ I_{OUT} ≤800mA, 4.0V ≤V_{IN}≤12V	2.475 2.460	2.500 2.500	2.525 2.560	
	GS1117/R-2.85	0 ≤ I_{OUT} ≤800mA, 4.35V ≤V_{IN}≤12V	2.82 2.79	2.850 2.850	2.88 2.91	
	GS1117/R-3.3	0 ≤ I_{OUT} ≤800mA, 4.75V ≤V_{IN}≤12V	3.267 3.235	3.300 3.300	3.333 3.365	
	GS1117/R-5.0	0 ≤ I_{OUT} ≤800mA, 6.5V ≤V_{IN}≤12V	4.950 4.900	5.000 5.000	5.050 5.100	
Line Regulation	GS1117/R	I_{LOAD}=10mA, 1.5V ≤ (V_{IN}-V_{OUT}) ≤12V		0.015 0.035	0.2 0.2	%
	GS1117/R-1.5	3.0V ≤V_{IN}≤12V		0.3 0.6	5 6	mV
	GS1117/R-1.8	3.3V ≤V_{IN}≤12V		0.3 0.6	5 6	
	GS1117/R-2.5	4.0V ≤V_{IN}≤12V		0.3 0.6	6 6	
	GS1117/R-2.85	4.35V ≤V_{IN}≤12V		0.3 0.6	6 6	
	GS1117/R-3.3	4.75V ≤VIN≤12V		0.5 1.0	10 10	
	GS1117/R-5.0	6.5V ≤VIN≤12V		0.5 1.0	10 10	

Electrical Characteristics (Continue)

Parameter	Device	Conditions	Min	Typ	Max	Units
Load Regulation (Notes 2, 3)	GS1117/R	$(V_{IN}-V_{OUT})=3V$ $10mA \le I_{OUT} \le 800mA$		0.1 0.2	0.3 0.4	%
	GS1117/R-1.5	$V_{IN}=5V$, $0 \le I_{OUT} \le 800mA$		3 6	10 20	mV
	GS1117/R-1.8	$V_{IN}=5V$, $0 \le I_{OUT} \le 800mA$		3 6	10 20	
	GS1117/R-2.5	$V_{IN}=5V$, $0 \le I_{OUT} \le 800mA$		3 6	12 20	
	GS1117/R-2.85	$V_{IN}=5V$, $0 \le I_{OUT} \le 800mA$		3 6	12 20	
	GS1117/R-3.3	$V_{IN}=5V$, $0 \le I_{OUT} \le 800mA$		3 7	15 25	
	GS1117/R-5.0	$V_{IN}=8V$, $0 \le I_{OUT} \le 800mA$		5 10	20 35	
Dropout Voltage $(V_{IN}-V_{OUT})$	GS1117/R-1.5/ 1.8/2.5/2.85/3.3/5.0	ΔV_{OUT}, $\Delta VREF$ =1%, I_{OUT} =800mA (Note4)		1.1	1.3	V
Current Limit	GS1117/R-1.5/ 1.8/2.5/2.85/3.3/5.0	$(V_{IN}-V_{OUT})=5V$	700	800	1,000	mA
Minimum Load Current	GS1117/R	$(V_{IN}-V_{OUT})=12V$ (Note5)		5	10	mA
Quiescent Current	GS1117/R-1.5/1.8/2.5/2.85 / 3.3 /5.0	$V_{IN} \le 12V$		5	10	mA
Ripple Rejection	GS1117/R	f=120Hz, C_{OUT} =22µF Tantalum, I_{OUT} =800mA $(V_{IN}-V_{OUT})=3V$, C_{ADJ}=10µF	60	75		dB
	GS1117/R-1.5/ 1.8/2.5/2.85	f=120Hz, C_{OUT} =22µF Tantalum, I_{OUT} =800Ma,V_{IN}=6V	60	72		
	GS1117/R-3.3	f=120Hz, C_{OUT}=22µF Tantalum, I_{OUT}=800mA, V_{IN} =6.3V	60	72		
	GS1117/R-5.0	f=120Hz,C_{OUT}=22µF Tantalum, I_{OUT}=800mA, V_{IN}=8V	60	68		
Thermal Regulation	GS1117/R	T_A=25 ºC,30ms pulse		0.008	0.04	%W
Adjust Pin Current	GS1117/R	$10mA \le I_{OUT} \le 800mA$, $1.5V \le (V_{IN}-V_{OUT}) \le 12V$		55	120	µA
Adjust Pin Current Chang	GS1117/R	$10mA \le I_{OUT} \le 800mA$, $1.5V \le (V_{IN}-V_{OUT}) \le 12V$		0.2	5	µA
Temperature Stability				0.5		%
Long Term Stability		T_A=125 ºC, 1000Hrs		0.3	1	%
RMS Out Noise (% of V_{OUT})		T_A=25 ºC, $10Hz \le f \le 10kHz$		0.003		%
OTP			130	150	170	ºC

Parameters identified with **boldface type** apply over the full operating temperature range.

Note 1: Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. For guaranteed specifications and test conditions, see the Electrical Characteristics. The guaranteed specifications apply only for the test conditions listed.

Note 2: Line and load regulation are guaranteed up to the maximum power dissipation of 1.2W for SOT-223 package and 0.9W for SOT-89 package. Power dissipation is determined by the input/ output differential and the output current. Guaranteed maximum power dissipation will not be available over the full input/output range.

Note 3: See thermal regulation specifications for changes in output voltage due to heating effects. Line and load regulation are measured at a constant junction temperature by low duty cycle pulse testing. Load regulation is measured at the output lead~1/8'' from the package.

Note 4: Dropout voltage is specified over the full output current range of the device.

Note 5: Minimum lode current is defined as the minimum output current required maintaining regulation. When 1.5V ≤ (V_{IN}-V_{OUT}) ≤12V the device is guaranteed to regulate if the output current is greater than 10mA.

Application Hints

The GS1117/R series of adjustable and fixed regulators are easy to use and are protected against short circuit and thermal overloads. Thermal protection circuitry will shut-down the regulator should the junction temperature exceed 165℃ at the sense point.

Pin compatible with older terminal adjustable regulators, these devices offer the advantage of a lower dropout voltage, more precise reference tolerance and improved reference stability with temperature.

Stability

The circuit design used in the GS1117/R series requires the use of an output capacitor as part of the device frequency compensation. The addition of 150µF aluminum electrolytic or a 22µF solid tantalum on the output will ensure stability for all operating conditions.

When the adjustment terminal is bypassed with a capacitor to improve the ripple rejection, the requirement for an output capacitor increases. The value of 22µF tantalum or 150µF aluminum covers all cases of bypassing the adjustment terminal. Without bypassing the adjustment terminal smaller capacitors can be uses with equally good results.

To further improve stability and transient response of these devices larger of output capacitor can be used.

Protection Diodes

Unlike older regulators, the GS1117/R family does not need any protection diodes between the adjustment pin and the output and from the output to the input to prevent over-stressing the die. Internal resistors are limiting the internal current paths on the adjustment pin no protection diode is needed to ensure device safety under short-circuit conditions.

Diodes between the input and output are not usually needed. Microsecond surge currents of 50A to 100A can be handled by the internal diode between the input and output pins of the devices. In normal diode between the input and output pins of the device. In normal operations it is difficult to get those values of surge currents even with the use of large output capacitances. If high value output capacitors are used, such as 1000µF to 5000µF and the input pin is instantaneously shorted to ground, damage can occur. A diode from output to input is recommended, when a crowbar circuit at the input of the GS1117/R is used (Figure 1).

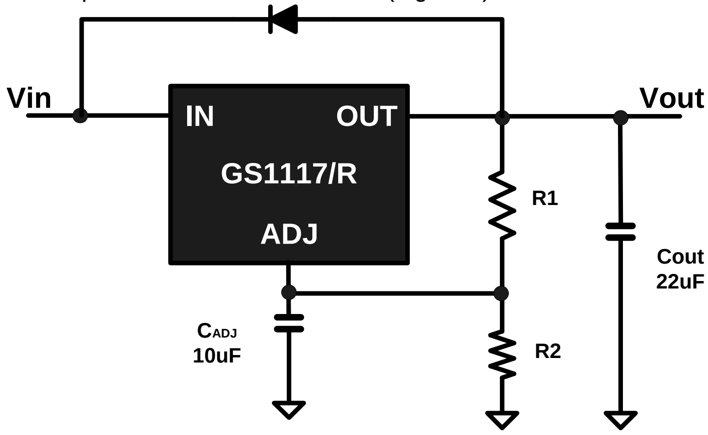
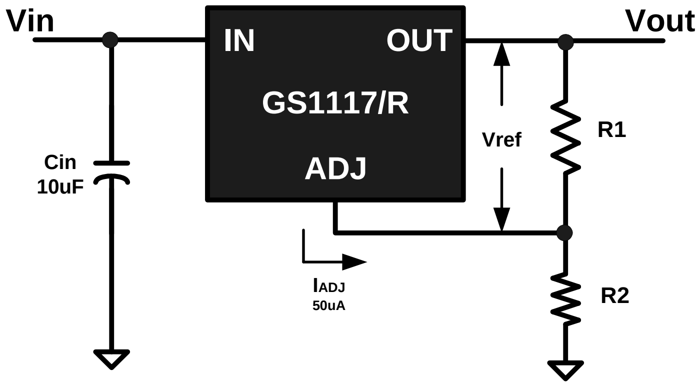


Figure 1.

Application Hints (Continue)

Output Voltage

The GS1117/R series develops a 1.25V reference voltage between the output and the adjust terminal. Placing a resistor between these two terminals causes a constant to flow through R1 and down through R2 to set the overall output voltage. This current is normally the specified minimum load current of 10mA. Because I_{ADJ} is very small and constant it represents a small error and it can usually be ignored.



$V_{OUT}=V_{REF}(1+R2/R1)+I_{ADJ}R2$

Figure 2.

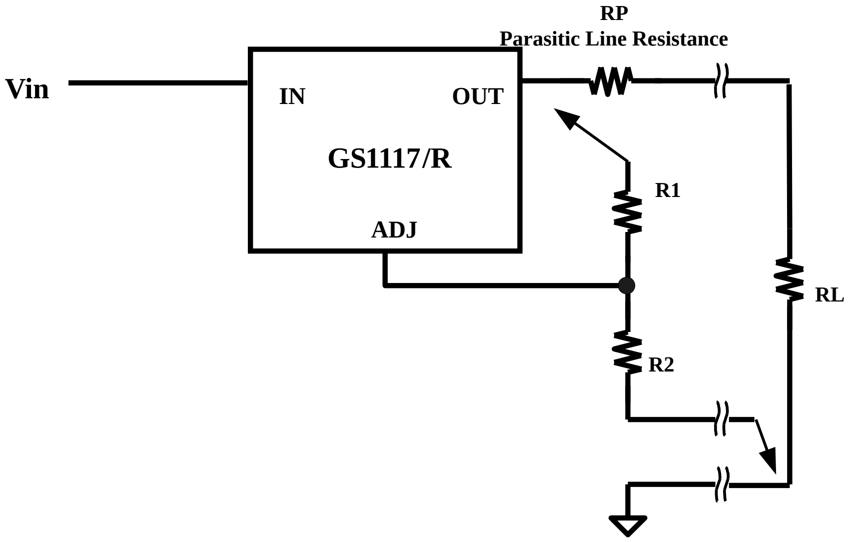
Load Regulation

True remote load sensing it is not possible to provide, because the GS1117/R is a three terminal device. The resistance of the wire connecting the regulator to the load will limit the load regulation. The data sheet specification for load regulation is measured at the bottom of the package. Negative side sensing is a true Kelvin connection, with the bottom of the output divider returned to the negative side of the load.

The best load regulation is obtained when the top of the resistor divider R1 is connected directly to the case not to the load. If R1 were connected to the load, the effective resistance between the regulator and the load would be:

Rp • (R2+R1) / R1 , Rp = Parasitic Line Resistance

Connected as shown, Rp is not multiplied by the divider ratio



*CONNECT R1 TO CASE
*CONNERT R2 TO LOAD

Figure 3.

In the case of fixed voltage devices the top of R1 is connected Kelvin internally, and the ground pin can be used for negative side sensing.

Application Hints (Continue)

Thermal Considerations

The GS1117/R series have internal power and thermal limiting circuitry designed to protect the device under overload conditions. However maximum junction temperature ratings of 125ºC should not be exceeded under continuous normal load conditions.

Careful consideration must be given to all sources of thermal resistance from junction to ambient. For the surface mount package SOT-223 additional heat sources mounted near the device must be considered. The heat dissipation capability of the PC board and its copper traces is used as a heat sink for the device. The thermal resistance from the junction to the tab for the GS1117/R is 15 ºC/W. Thermal resistance from tab to ambient can be as low as 30ºC/W.

The total thermal resistance from junction to ambient can be as low as 45ºC/W. This requires a reasonable sized PC board with at least on layer of copper to spread the heat across the board and couple it into the surrounding air. Experiments have shown that the heat spreading copper layer does not need to be electrically connected to the tab of the device. The PC material can be very effective at transmitting heat between the pad area, attached to the pad of the device, and a ground plane layer either inside or on the opposite side of the board. Although the actual thermal resistance of the PC material is high, the Length/Area ratio of the thermal resistance between layers is small. The data in Table 1, was taken using 1/16" FR-4 board with 1 oz. copper foil, and it can be used as a rough guideline for estimating thermal resistance.

For each application the thermal resistance will be affected by thermal interactions with other components on the board. To determine the actual value some experimentation will be necessary.

The power dissipation of the GS1117/R is equal to:

$$P_D = (V_{in} - V_{OUT}) \bullet (I_{OUT})$$

Maximum junction temperature will be equal to:

$$T_J = T_{A\,(MAX)} + P_D \text{ [Thermal Resistance (junction-to-ambient)]}$$

Maximum junction temperature must not exceed 125ºC.

Table 1.

COPPER AREA		BOARD AREA	THERMAL RESISTANCE (JUNCTION-TO-AMBIENT)
TOP SIDE*	BACK SIDE		
2500 Sq. mm	2500 Sq. mm	2500 Sq. mm	45 ºC/W
1000 Sq. mm	2500 Sq. mm	2500 Sq. mm	45 ºC/W
225 Sq. mm	2500 Sq. mm	2500 Sq. mm	53 ºC/W
100 Sq. mm	2500 Sq. mm	2500 Sq. mm	59 ºC/W
1000 Sq. mm	1000 Sq. mm	1000 Sq. mm	52 ºC/W
1000 Sq. mm	0	1000 Sq. mm	55 ºC/W

*Tab of device attached to topside copper.

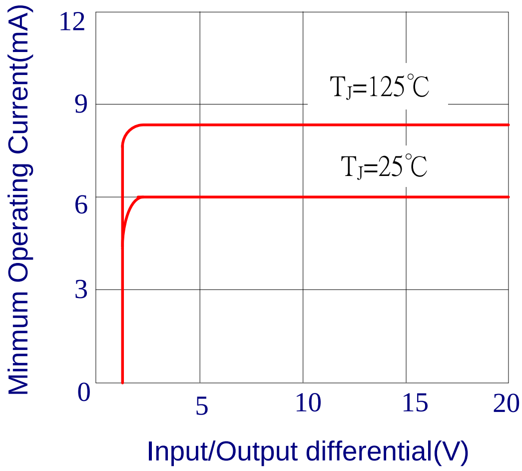
Ripple Rejection

The ripple rejection values are measured with the adjustment pin bypassed. The impedance of the adjust pin capacitor at the ripple frequency should be less than the value of R1 (normally 100Ω to 200Ω) for a proper bypassing and ripple rejection approaching the values shown. The size of the required adjust pin capacitor is a function of the input ripple frequency. If R1=100Ω at 120Hz the adjust pin capacitor should be ＞13μF. At 10kHz only 0.16μF is needed.

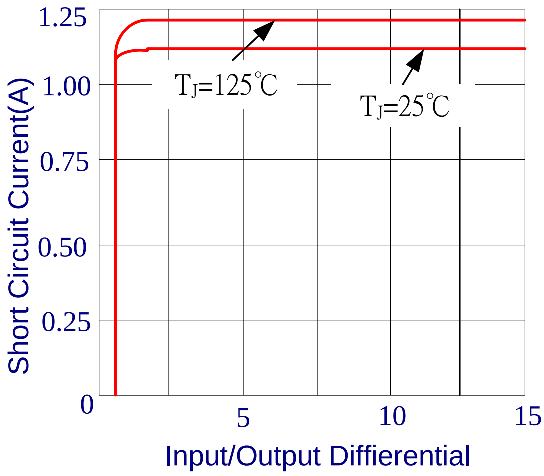
The ripple rejection will be a function of output voltage, in circuits without an adjust pin bypass capacitor. The output ripple will increase directly as a ratio of the output voltage to the reference voltage (V_{OUT} / V_{REF}).

Typical Performance Characteristics

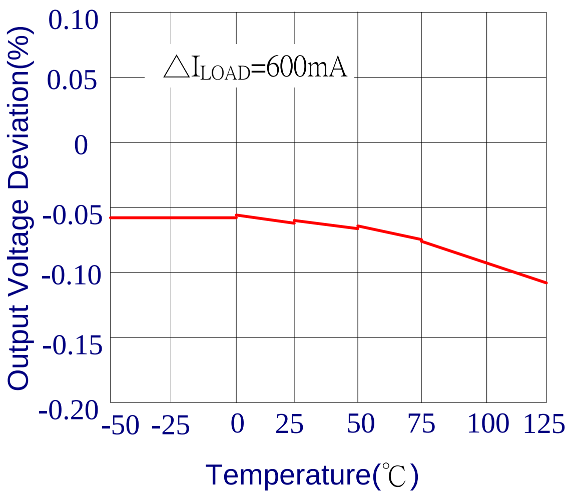
Minimum Operating Current (Adjustable Device)



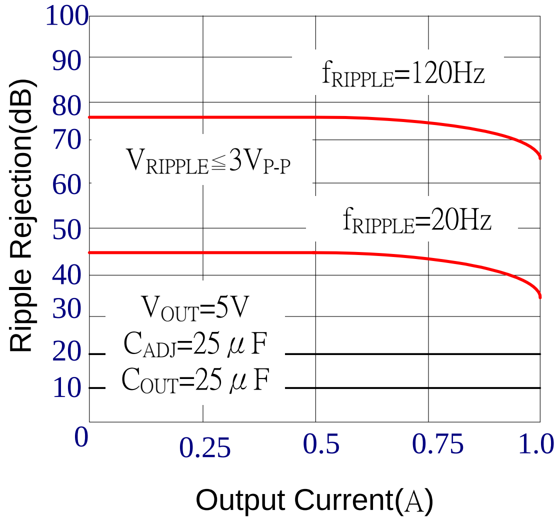
Short-Circuit Current



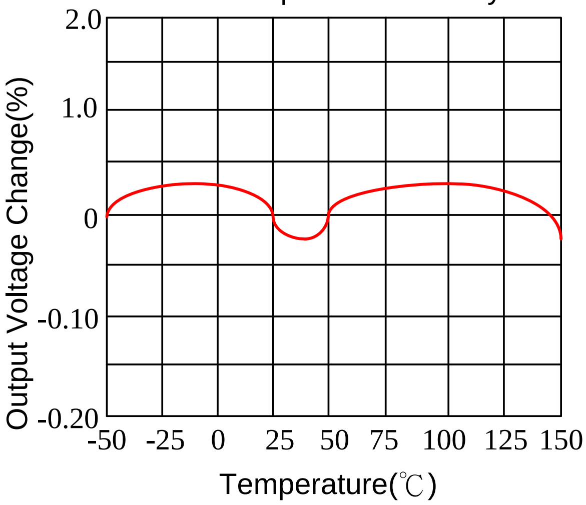
Load Regulation



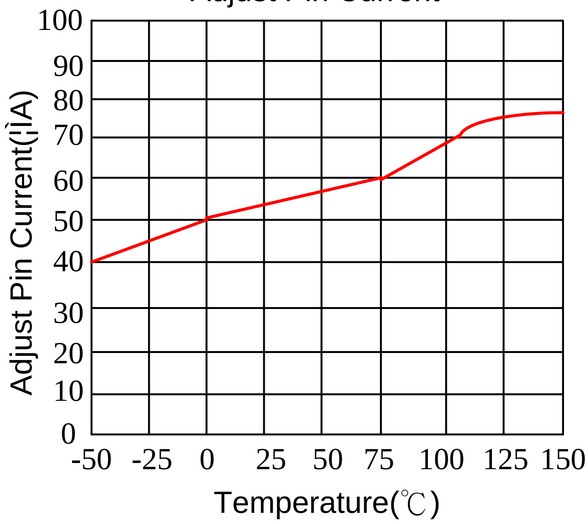
Ripple Rejection vs.Current



Temperature Stability

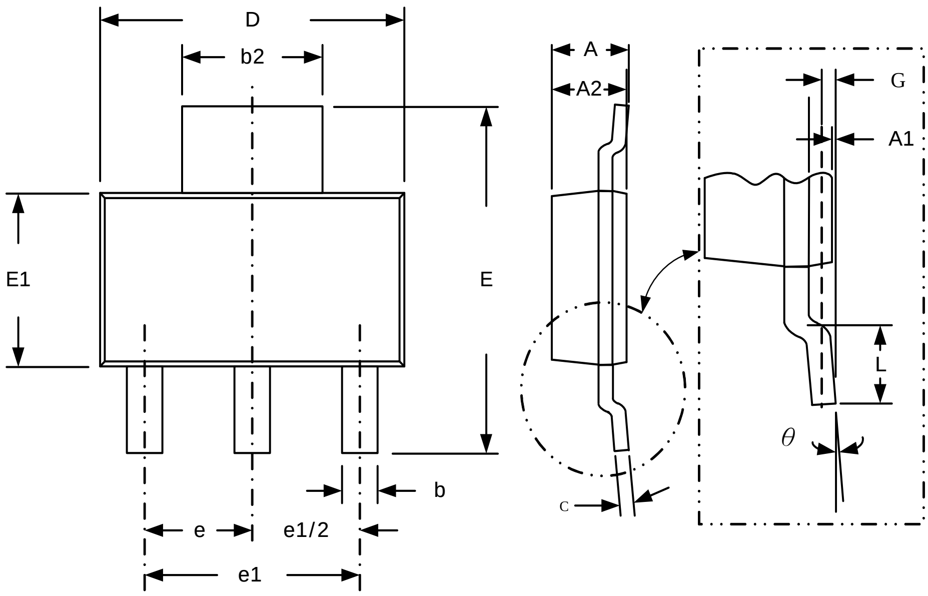


Adjust Pin Current



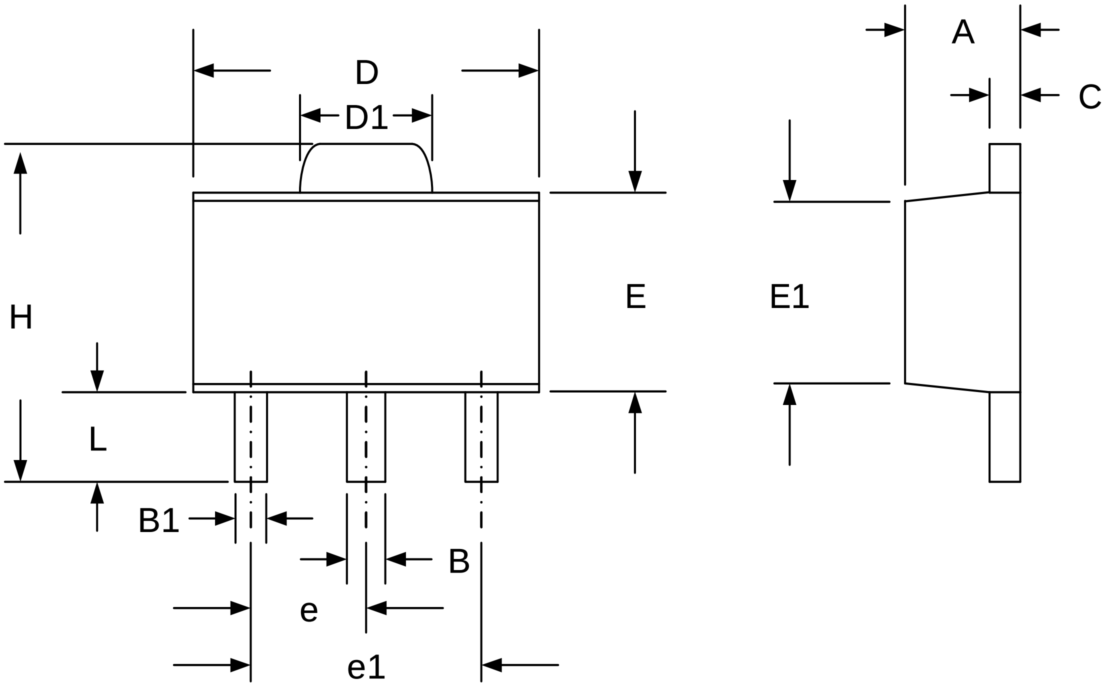
Package Dimension

SOT-223 PLASTIC PACKAGE



Dimensions				
SYMBOL	Millimeters		Inches	
	MIN	MAX	MIN	MAX
A	-	1.80	-	.071
A1	0.02	0.10	.001	.004
A2	1.55	1.65	.061	.065
b	0.66	0.84	.026	.033
b2	2.90	3.10	.114	.122
c	0.23	0.33	.009	.013
D	6.30	6.70	.248	.264
E	6.70	7.30	.264	.288
E1	3.30	3.70	.130	.146
e	2.30 (TYP)		.091 (TYP)	
e1	4.60 (TYP)		.181 (TYP)	
L	0.90	-	.035	-
G	0.25 (TYP)		.010 (TYP)	
θ	0°	8°	0°	8°

SOT-89 PLASTIC PACKAGE



Dimensions				
SYMBOL	Millimeters		Inches	
	MIN	MAX	MIN	MAX
A	1.40	1.60	.055	.063
B	0.44	0.56	.017	.022
B1	0.36	0.48	.014	.019
C	0.35	0.44	.014	.017
D	4.40	4.60	.173	.181
D1	1.62	1.83	.064	.072
E	2.29	2.60	.090	.102
E1	2.13	2.29	.084	.090
e	1.50 (TYP)		.059 (TYP)	
e1	3.00 (TYP)		.118 (TYP)	
H	3.94	4.25	.155	.167
L	0.89	1.20	.035	.047