GS1117A

1A Low Dropout Voltage Regulator

Product Description

The GS1117A is a low dropout three-terminal regulator with 1A output current capability. In order to obtain lower dropout voltage and fast transient response , which is critical for low voltage applications.

The GS1117A has been optimized. The device is available in an adjustable version and fixed output voltage of 1.2V, 1.5V, 1.8V, 2.5V, 3.3V and 5V. Dropout voltage is guaranteed at a maximum of 1.3V at 1A.

Current limit is trimmed to ensure specified output current and controlled short circuit current. On-chip thermal limiting provides protection against any combination of overload that would create excessive junction temperatures.

The GS1117A is available in the three leads SOT-89, SOT-223 and TO-252 surface mount packages.
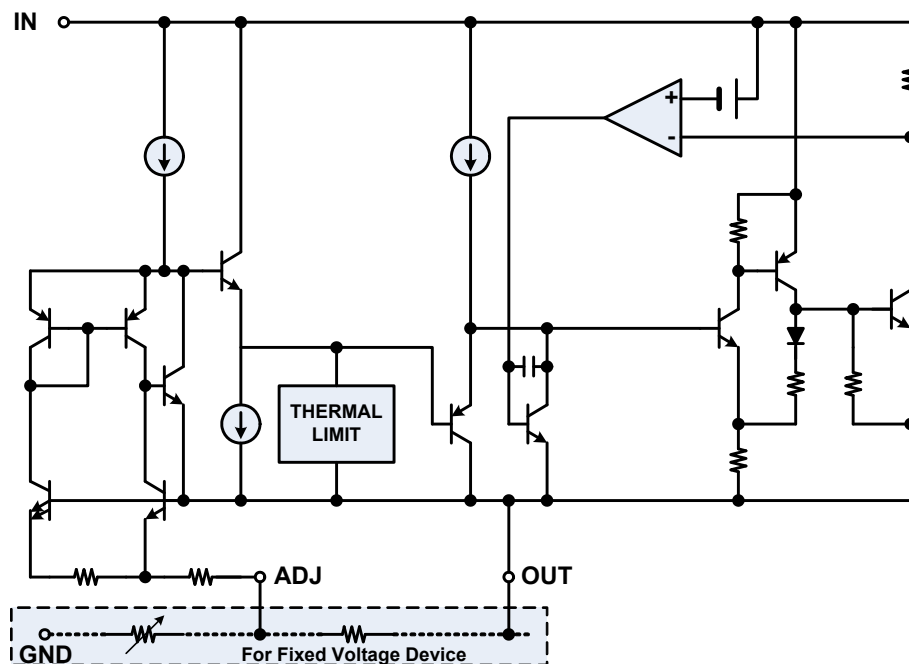
Features

■ Adjustable or Fixed Output
■ Current Limit and Thermal Protection
■ Output Current of 1A
■ 1.3V Dropout Voltage
■ Line Regulation typically at 0.04% Max.
■ Load Regulation typically at 0.2% Max.
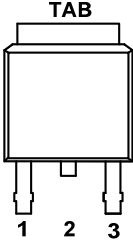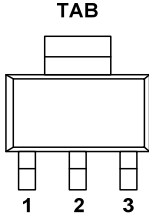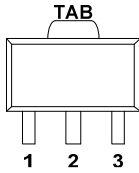■ RoHS Compliant, 100%Pb & Halogen Free

Applications

■ Battery-Power Circuitry
■ Post Regulator for Switching Power Supply
■ Low Voltage Logic Suppliers

Block Diagram

Packages & Pin Assignments

TO-252			SOT-223			SOT-89		
TAB			**TAB**			**TAB**		
1 2 3			1 2 3			1 2 3		
Pin	**GS1117AD**	**GS1117ARD**	**Pin**	**GS1117AX**	**GS1117ARX**	**Pin**	**GS1117AY**	**GS1117ARY**
1	GND/ADJ	V_{IN}	1	GND/ADJ	V_{IN}	1	GND/ADJ	V_{IN}
2	V_{OUT}	GND/ADJ	2	V_{OUT}	GND/ADJ	2	V_{OUT}	GND/ADJ
3	V_{IN}	V_{OUT}	3	V_{IN}	V_{OUT}	3	V_{IN}	V_{OUT}

Ordering Information

➤ GS Brand Name
➤ Part Number

GS 1117A P XX F

◄ Package Code
◄ Voltage Code
◄ Halogen Free/
Pb Free Code
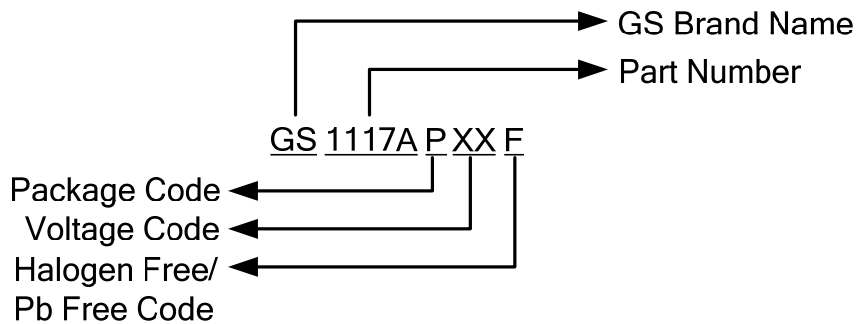
GS1117A			GS1117AR			
TO-252	**SOT-223**	**SOT-89**	**TO-252**	**SOT-223**	**SOT-89**	**Output**
GS1117ADF	GS1117AXF	GS1117AYF	GS1117ARDF	GS1117ARXF	GS1117ARYF	ADJ
GS1117AD12F	GS1117AX12F	GS1117AY12F	GS1117ARD12F	GS1117ARX12F	GS1117ARY12F	1.2V
GS1117AD15F	GS1117AX15F	GS1117AY15F	GS1117ARD15F	GS1117ARX15F	GS1117ARY15F	1.5V
GS1117AD18F	GS1117AX18F	GS1117AY18F	GS1117ARD18F	GS1117ARX18F	GS1117ARY18F	1.8V
GS1117AD25F	GS1117AX25F	GS1117AY25F	GS1117ARD25F	GS1117ARX25F	GS1117ARY25F	2.5V
GS1117AD33F	GS1117AX33F	GS1117AY33F	GS1117ARD33F	GS1117ARX33F	GS1117ARY33F	3.3V
GS1117AD50F	GS1117AX50F	GS1117AY50F	GS1117ARD50F	GS1117ARX50F	GS1117ARY50F	5.0V

*GS1117AXF or GS1117ARXF, X means package type and F means Lead Free part.
*For other voltages, please contact factory.
*Adjustable Version does not need Voltage Code.

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Marking Information
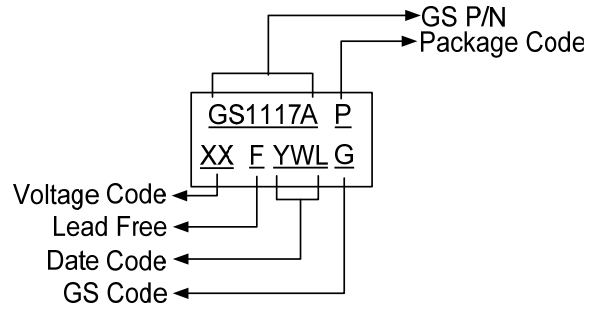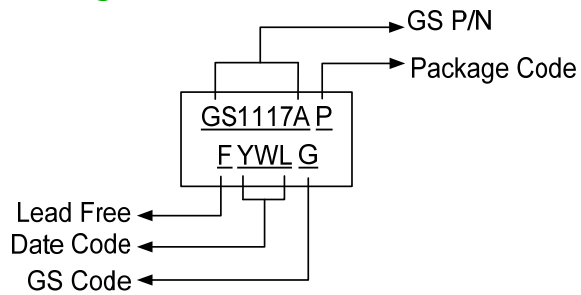
Absolute Maximum Ratings

Symbol	Parameter	Maximum		Unit
V_{IN}	Input Voltage	15		V
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 SOT-89 TO-252	135 175 68	ºC/W
θ_{JC}	Thermal Resistance Junction to Case	SOT-223 SOT-89 TO-252	19 100 7.5	ºC/W
P_D	Power Dissipation	SOT-223 SOT-89 TO-252	0.9 0.5 1.2	W

Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions above those indicated in the operation sections of the specifications is not implied.
Exposure to Absolute Maximum Ratings conditions for extended periods may affect device reliability.

GS1117A

Electrical Characteristics

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

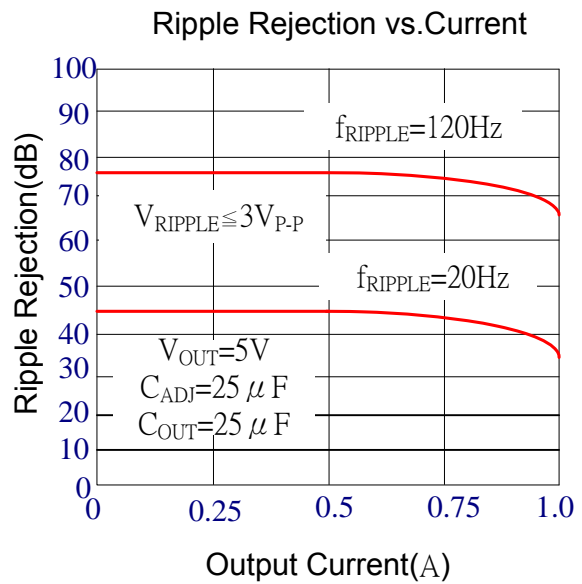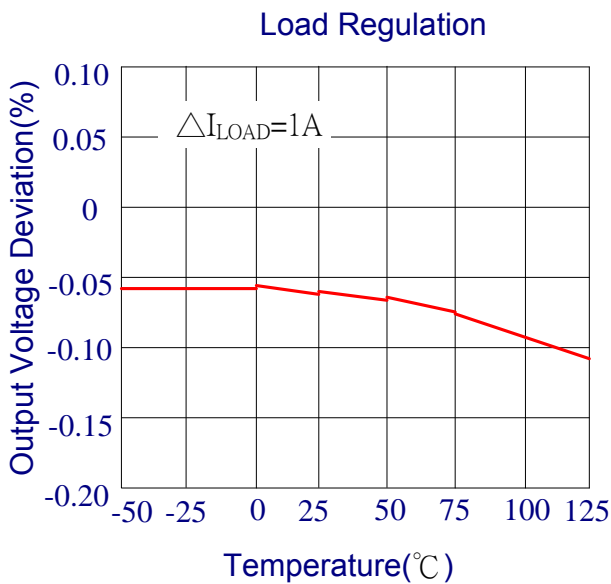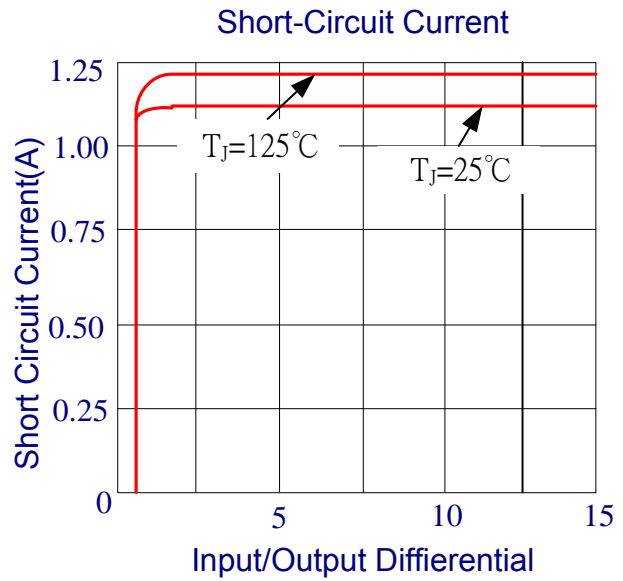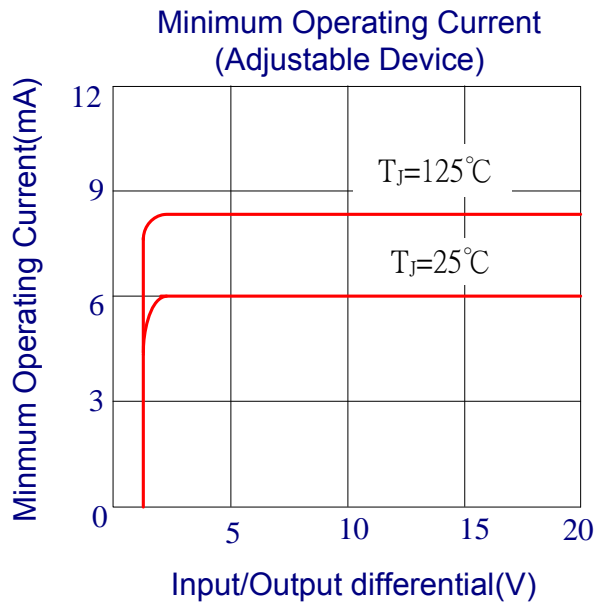| Parameter	Device	Conditions	MIN	TYP	MAX	Unit
Reference Voltage (Note)	GS1117A-Adj	V_{IN} =2.75V, I_{LOAD} =10mA	1.238	1.250	1.262	V
		*V_{IN} =2.7V to 12V, I_{LOAD} =10mA to 1A	1.225	1.250	1.275	
Output Voltage	GS1117A-1.2	V_{IN} =3.7V	1.176	1.200	1.224	V
		*V_{IN} =3.0V, I_{LOAD} =10mA to 1A	1.140	1.200	1.248	V
	GS1117A-1.5	V_{IN} =4.0V	1.485	1.500	1.515	V
		*V_{IN} =3.0V, I_{LOAD} =10mA to 1A	1.476	1.500	1.524	V
	GS1117A-1.8	V_{IN} =4.3V	1.782	1.800	1.818	V
		*V_{IN} =3.3V, I_{LOAD} =10mA to 1A	1.771	1.800	1.829	V
	GS1117A-2.5	V_{IN} =5.0V	2.475	2.500	2.525	V
		*V_{IN} =4.0V, I_{LOAD} =10mA to 1A	2.460	2.500	2.540	V
	GS1117A-3.3	V_{IN} =5.8V	3.267	3.300	3.333	V
		*V_{IN} =4.8V, I_{LOAD} =10mA to 1A	3.247	3.300	3.353	V
	GS1117A-5.0	V_{IN} =7.5V	4.950	5.000	5.050	V
		*V_{IN} =6.5V, I_{LOAD} =10mA to 1A	4.900	5.000	5.100	V
Line Regulation (Note1)	GS1117A-1.2	*I_{LOAD} =10mA, 3.0V ≤ V_{IN} ≤ 12V		10	15	mV
	All	*I_{LOAD} =10mA, (1.5V+V_{OUT}) ≤ V_{IN} ≤ 12V		0.04	0.2	%
Load Regulation (Note1)	GS1117A-1.2	V_{IN}=3.0V, 0 ≤ I_{OUT} ≤ 1A		8	20	mV
	All	*V_{IN} = V_{OUT}+1.5V, I_{LOAD} =10mA to 1A		0.2	0.4	%
Minimum Load Current	GS1117A-Adj	*V_{IN} =5V, V_{ADJ} =0V		3	7	mA
Ground Pin Current	GS1117A-XX	*V_{IN} = V_{OUT}+1.5V, I_{LOAD} =10mA to 1A		7	13	mA
Adjust Pin Current	GS1117A-Adj	*V_{IN} =2.65V to 12V, I_{LOAD} =10mA		55	90	µA
Current Limit	All	*V_{IN}- V_{OUT}=1.5V	1			A
Ripple Rejection (Note 2)	All	V_{IN} = V_{OUT}+1.5V,	60	72		dB
Dropout Voltage (Note 1,3)	All	I_{LOAD} =10mA		1.00	1.15	V
		*V_{IN} ≥ 2.65V, I_{LOAD} =1A		1.15	1.3	V
Temperature Coefficient	All	*V_{IN} =V_{OUT}=1.5V, I_{LOAD} =10mA		0.005		%/ºC
OTP			130	150	170	ºC

The * denotes the specifications which apply over the full temperature range.
Note 1: Low duty pulse testing with Kelvin connections required.
Note 2: 120Hz input ripple (C_{ADJ} for ADJ=25µF)
Note 3: ΔV_{OUT}, ΔV_{REF}=1%
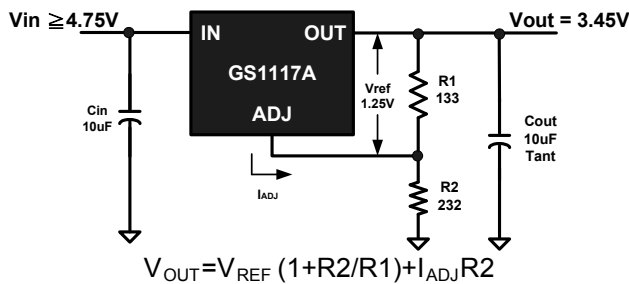
Typical Performance Characteristics

Minimum Operating Current (Adjustable Device)

X-axis: Input/Output differential(V)
Y-axis: Minmum Operating Current(mA)

$T_J=125°C$
$T_J=25°C$

Short-Circuit Current

X-axis: Input/Output Diffierential
Y-axis: Short Circuit Current(A)

$T_J=125°C$
$T_J=25°C$

Load Regulation

X-axis: Temperature(°C)
Y-axis: Output Voltage Deviation(%)

$\triangle I_{LOAD}=1A$

Ripple Rejection vs.Current

X-axis: Output Current(A)
Y-axis: Ripple Rejection(dB)

$f_{RIPPLE}=120Hz$
$V_{RIPPLE}\leqq 3V_{P-P}$
$f_{RIPPLE}=20Hz$
$V_{OUT}=5V$
$C_{ADJ}=25\mu F$
$C_{OUT}=25\mu F$

Typical Applications

Vin ≧4.75V
IN   OUT
GS1117A
ADJ
Vref 1.25V
R1 133
R2 232
Cin 10uF
Cout 10uF Tant
Vout = 3.45V
I_{ADJ}

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

Figure 1. Adjustable Voltage Regulator

Vin
IN   OUT
GS1117A-xx
GND
Cin 10uF/Tantalum
Cout 10uF/Tantalum
Vout
I_{GND}
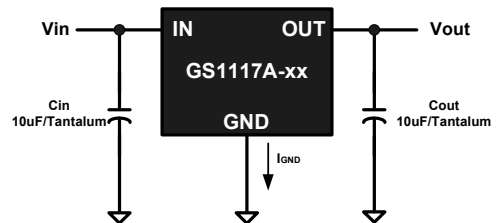
Figure 2. Fixed Voltage Regulator

GS1117A

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Application Hints

The GS1117A 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 three 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 GS1117A series requires the use of an output capacitor as part of the device frequency compensation. The addition of 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 covers all cases of bypassing the adjustment terminal. Without bypassing the adjustment terminal smaller capacitors can be used with equally good results.

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

Protection Diodes

Unlike older regulators, the GS1117A 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 GS1117A adjustment pin, therefore even with capacitors 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 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 GS1117A is used (Figure 6).
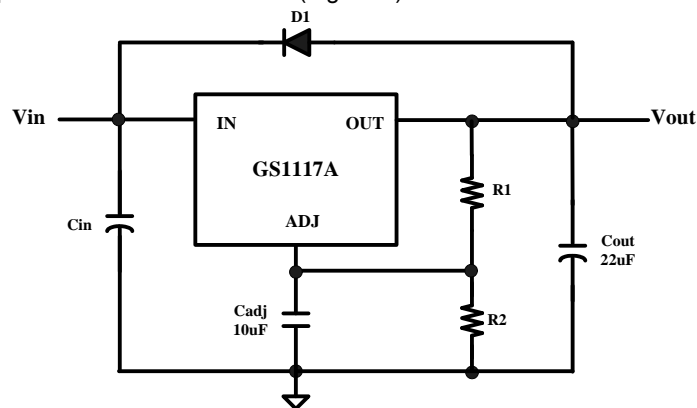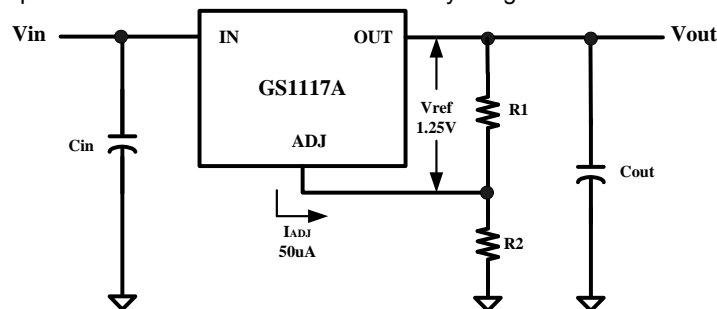

Figure 6.

Output Voltage

The GS1117A series develops a 1.25V reference voltage between the output and the adjust terminal. Placing a resistor between these two terminals causes a constant current 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 7.

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Application Hints (Continues)

Load Regulation

True remote load sensing it is not possible to provide, because the GS1117A 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
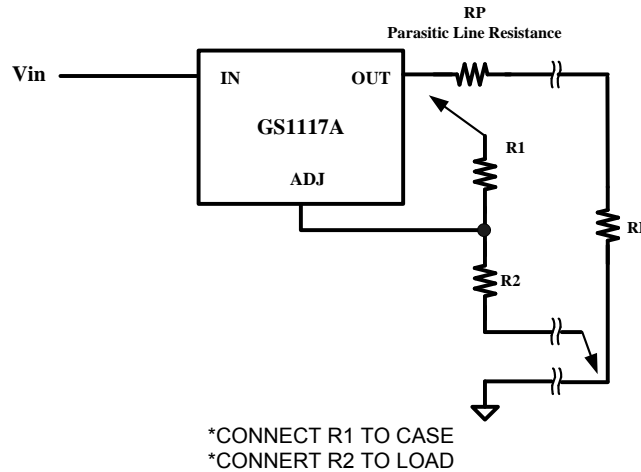
*CONNECT R1 TO CASE
*CONNERT R2 TO LOAD
Figure 8.

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.

Thermal Considerations

The GS1117A series have internal power and thermal limiting circuitry designed to protect the device under overload conditions. However maximum junction temperature ratings of 125℃ 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 GS1117A is 15 ºC/W. Thermal resistance from tab to ambient can be as low as 30 ºC/W.

The total thermal resistance from junction to ambient can be as low as 45 ºC/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 GS1117A 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

Application Hints (Continues)

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}).

Application Hints (Continues)

The ripple of the output Capacitors is a MLCC Test
condition:V_{IN}=5V,V_{OUT}=3.3V,C_{IN}=1uF(Ceramic,X7R,6.3V,0603),CH1:V_{OUT}.CH4:I_{OUT}

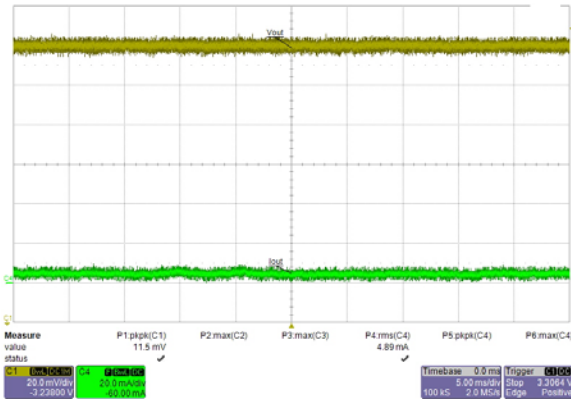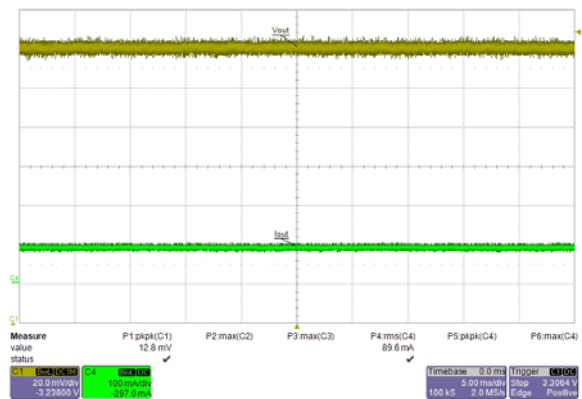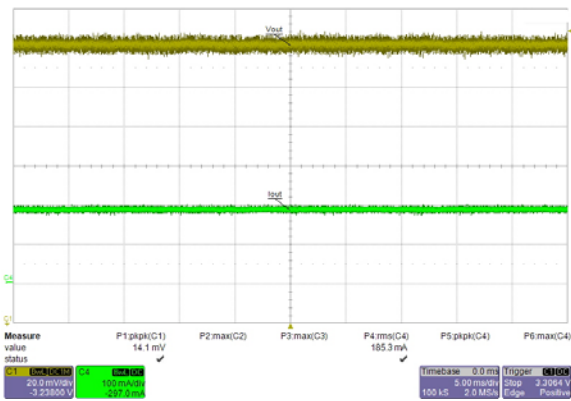**Fig 1. I_{OUT} = 10mA**
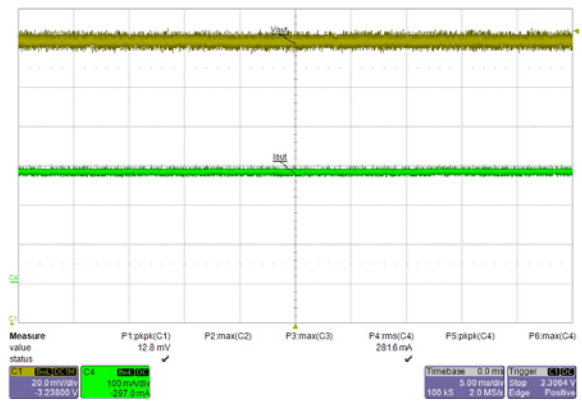

Fig 2. Iout = 100mA
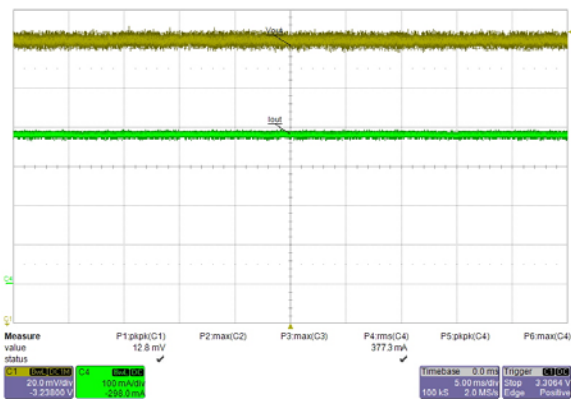

Fig 3. I_{OUT} = 200mA
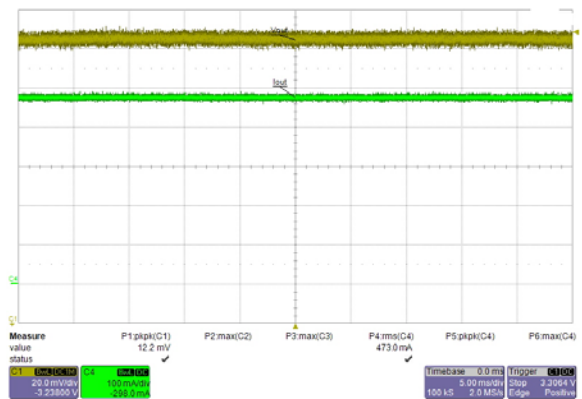

Fig 4. I_{OUT} = 300mA

Fig 5. I_{OUT} = 400mA

Fig 6. I_{OUT} = 500mA

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Application Hints (Continues)
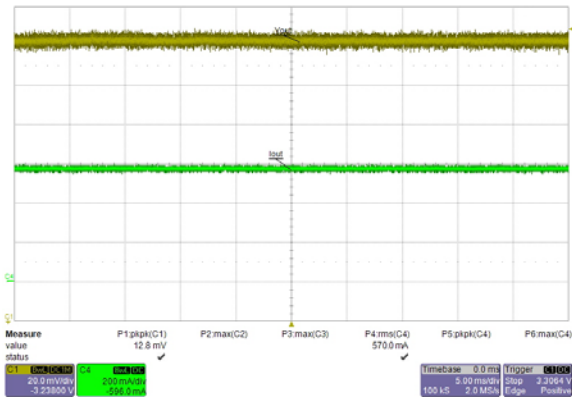
Fig 7. I_{OUT} = 600mA
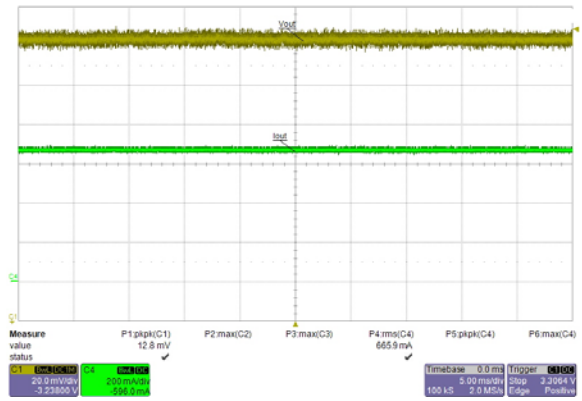
Fig 8. I_{OUT} = 700mA
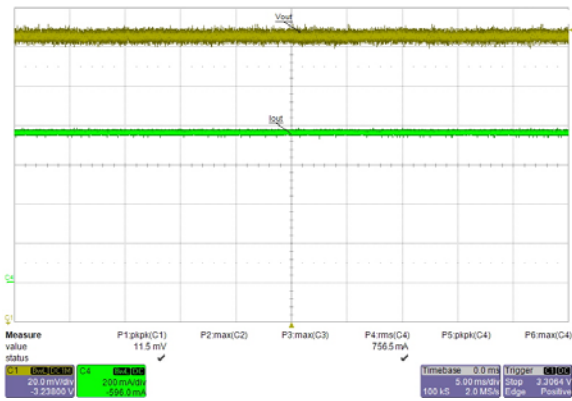
Fig 9. I_{OUT} = 800mA
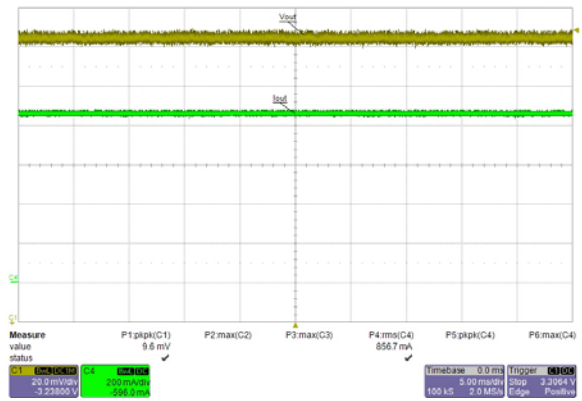
Fig 10. I_{OUT} = 900mA

Fig 11. I_{OUT} = 1A

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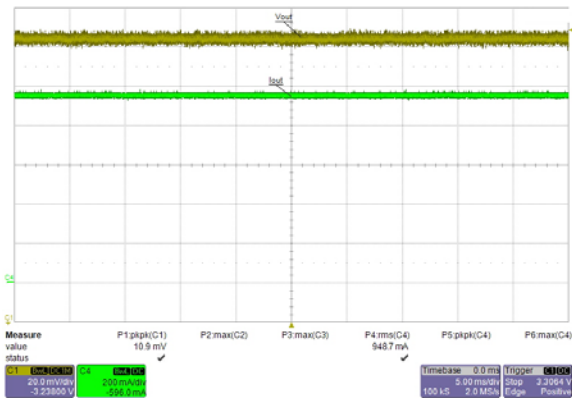
Application Hints (Continues)
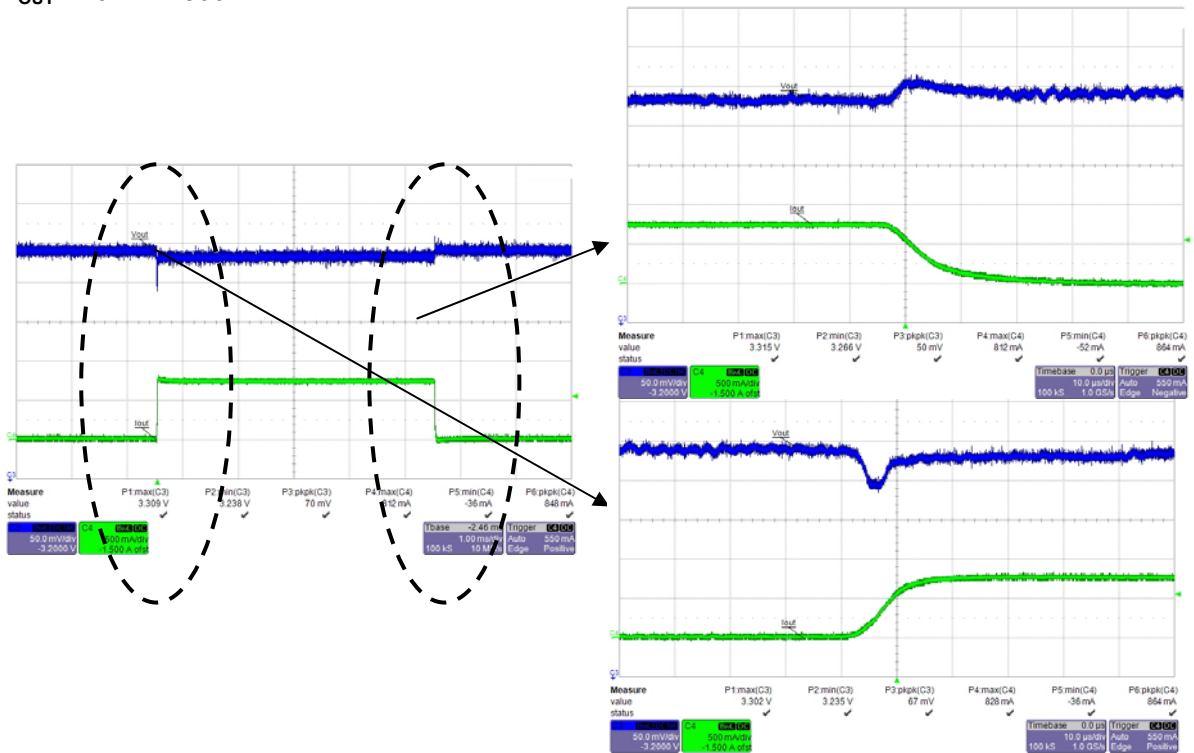
b.Load Transient Response
Test condition:V_{IN}=5V,V_{OUT}=3.3V,C_{IN}=1uF(Ceramic,X7R,6.3V,0603),
C_{OUT}=10uF(Ceramic,X7R,6.3V,0603,ESR=50m OHM) CH1:V_{OUT}.CH4:I_{OUT}
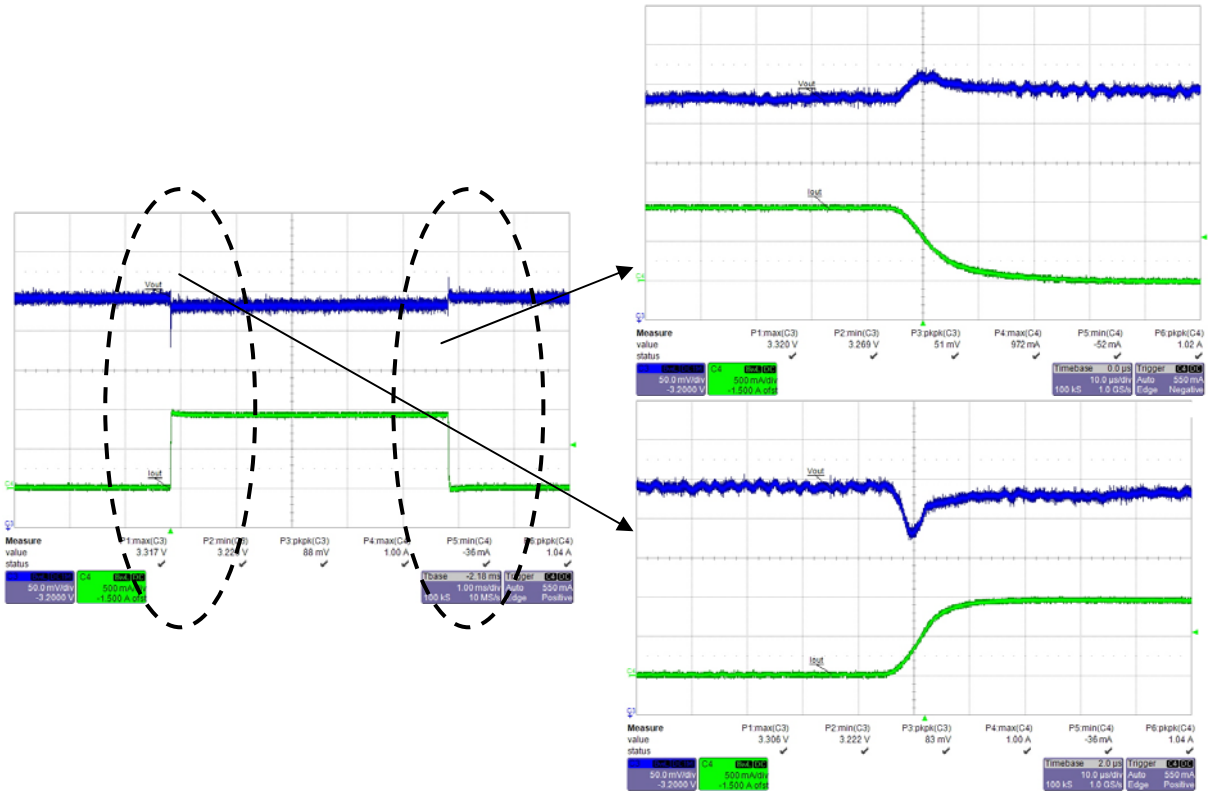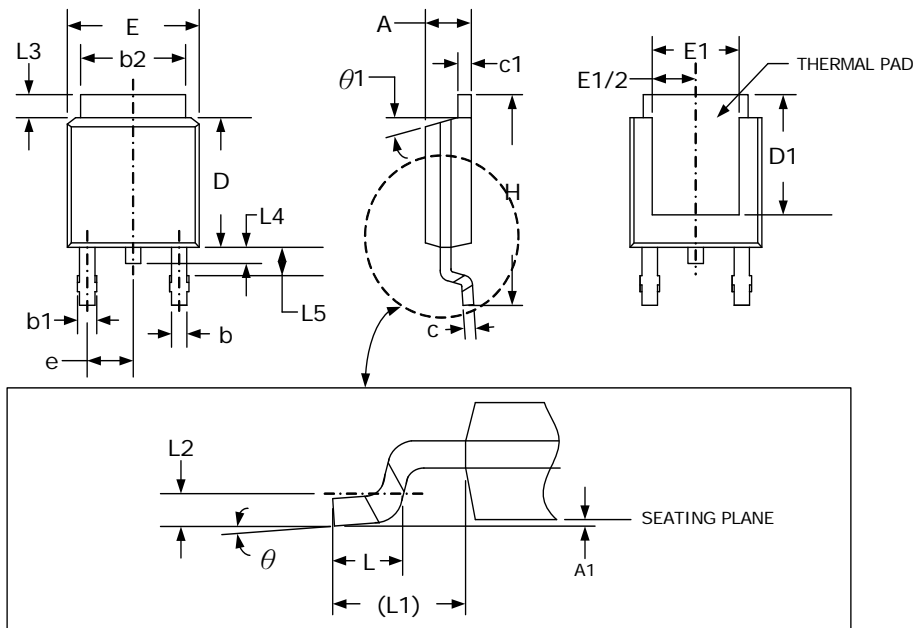
I_{OUT} : 10mA ~ 500mA

I_{OUT} : 10mA ~ 800mA

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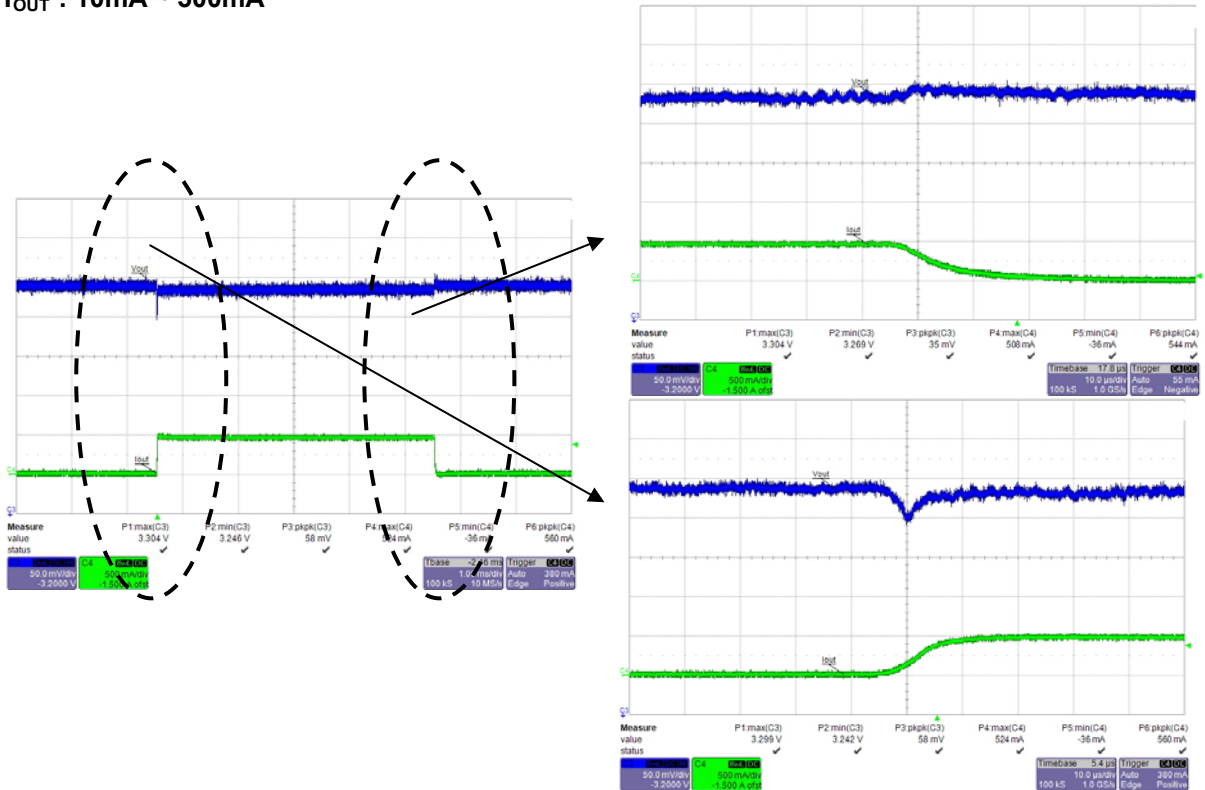
I_{OUT} : 10mA ~ 1A

Package Dimension

TO-252 PLASTIC PACKAGE

Dimensions

SYMBOL	Millimeters		Inches	
	MIN	MAX	MIN	MAX
A	2.18	2.39	.086	.094
A1	-	0.13	-	.005
b	0.64	0.89	.025	.035
b1	0.76	1.14	.030	.045
b2	4.95	5.46	.195	.215
C	0.46	0.61	.018	.024
C1	0.46	0.89	.018	.035
D	5.97	6.22	.235	.245
D1	5.21	-	.205	-
E	6.35	6.73	.250	.265
E1	4.32	-	.170	-
e	2.29 (TYP)		.090 (TYP)	
H	9.40	10.41	.370	.410
L	1.40	1.78	.055	.070
L1	2.74 (TYP)		.108 (TYP)	
L2	0.51 (TYP)		.020 (TYP)	
L3	0.89	1.27	.035	.050
L4	-	1.02	-	.040
L5	1.14	1.52	.045	.060
θ	0°	10°	0°	10°
θ1	0°	15°	0°	15°

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SOT-223 PLASTIC PACKAGE
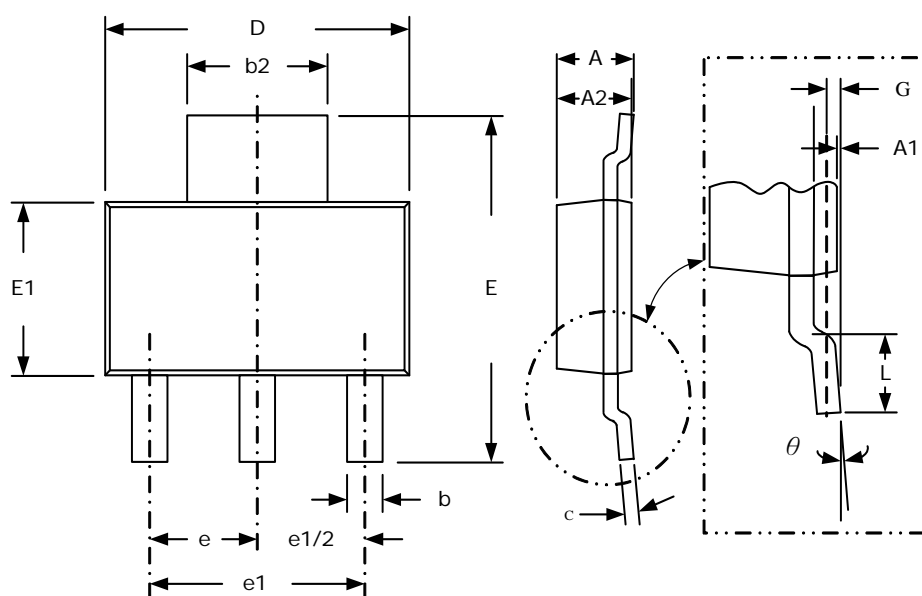
SYMBOL	Millimeters		Inches	
	MIN	MAX	MIN	MAX
A	-	1.80	-	.071
A1	0.02	0.10	.001	.004
A2	1.55	1.65	.061	.065
b	0.66	0.84	.026	.033
b2	2.90	3.10	.114	.122
c	0.23	0.33	.009	.013
D	6.30	6.70	.248	.264
E	6.70	7.30	.264	.288
E1	3.30	3.70	.130	.146
e	2.30 (TYP)		.091 (TYP)	
e1	4.60 (TYP)		.181 (TYP)	
L	0.90	-	.035	-
G	0.25 (TYP)		.010 (TYP)	
θ	0°	8°	0°	8°

Dimensions

GLOBALTECH
SEMICONDUCTOR

SOT-89 PLASTIC PACKAGE
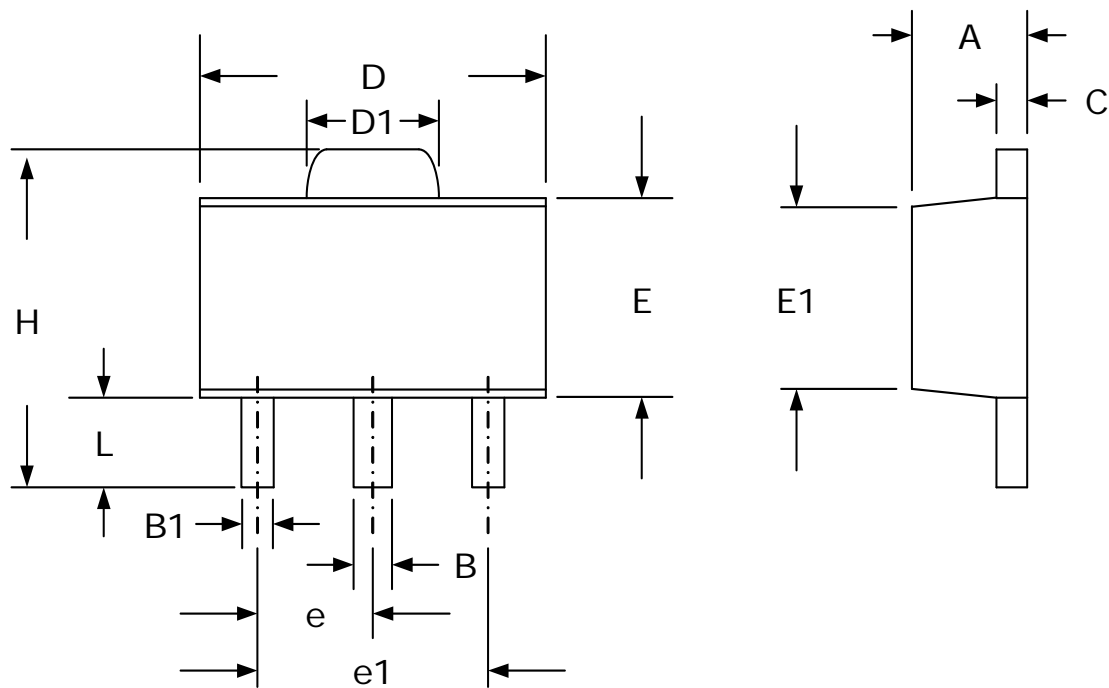
Dimensions

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

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