GL39100 SERIES

1A ULTRA LOW - DROPOUT REGULATOR

Description

The GL39100 series is 1.0A low-dropout linear voltage regulators that provide a low-voltage, high-current output from an extremely small package.

The GL39100 series offers extremely low dropout (typically 410mV at 1.0A) and low ground current (typically 12mA at 1.0A).

The GL39100 is a fixed output regulator offered in the SOT-223 and TO-252 package.

The GL39101 and GL39102 are fixed and adjustable regulators, respectively, in a thermally enhanced power 8-lead SOP (small outline package).

The GL39100 series is ideal for PC add-in cards that need to convert from standard 5V to 3.3V, 3.3V to 2.5V or 2.5V to 1.8V. A guaranteed maximum dropout voltage of 630mV over all operating conditions allows the GL39100 series to provide 2.5V from a supply as low as 3.13V and 1.8V from a supply as low as 2.43V.

The GL39100 series is fully protected with overcurrent limiting, thermal shutdown, and reversed-battery protection.

Fixed voltages of 5.0V, 3.3V, 2.5V, 1.8 and 1.5V are available on GL39100/1 with adjustable output voltages to 1.24V on GL39102.

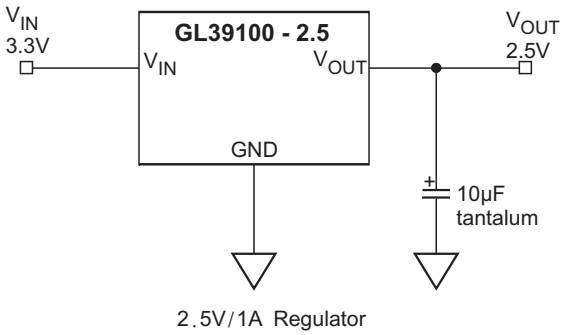
Features

- Fixed and adjustable output voltages to 1.24V
- 410mV typical dropout at 1A
  - Ideal for 3.0V to 2.5V conversion
  - Ideal for 2.5V to 1.8V conversion
- 1.0A minimum guaranteed output current
- 1% initial accuracy
- Low ground current
- Current limiting and Thermal shutdown
- Reversed-battery protection
- Reversed-leakage protection
- Fast transient response

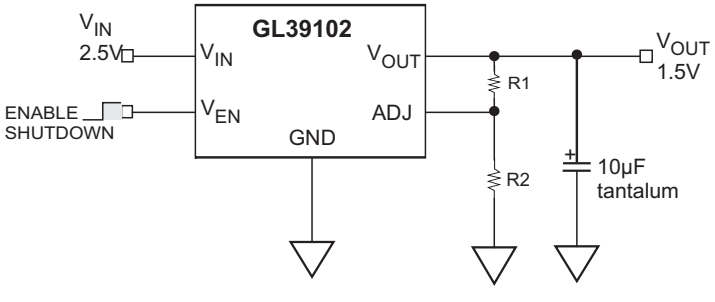
Application

- LDO linear regulator for PC add-in cards
- PowerPC™ power supplies
- High-efficiency linear power supplies
- SMPS post regulator
- Multimedia and PC processor supplies
- Battery chargers
- Low-voltage microcontrollers and digital logic

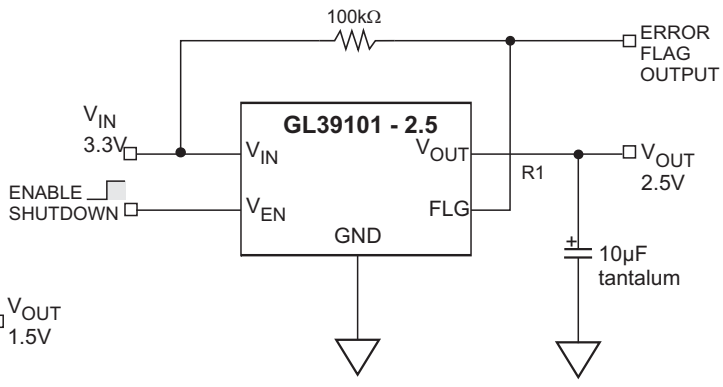
TYPICAL APPLICATION CIRCUITS



2.5V/1A Regulator



1.5/1A Adjustable Regulator



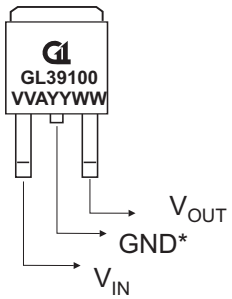
2.5V/1A Regulator with Error Flag

GL39100 SERIES

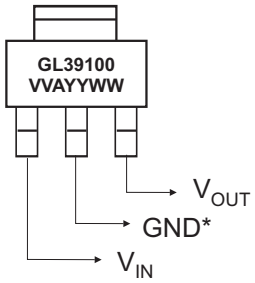
1A ULTRA LOW - DROPOUT REGULATOR

◆ MARKING INFORMATION & PIN CONFIGURATIONS (TOP VIEW)

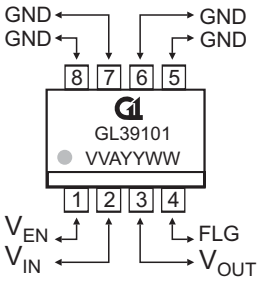
TO-252-2 (DPAK)



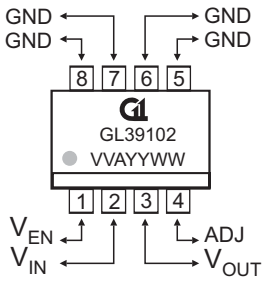
SOT-223



SOP- 8



SOP- 8



V V = Output Voltage (18=1.8V , 25=2.5V)
A = Assembly Location
YY = Year
W W = Weekly

◆ ORDERING INFORMATION (Green Package Products are available now!)

ORDERING NUMBER	OUTPUT VOLTAGE	PACKAGE	SHIPPING
GL39100			
GL39100-1.5ST3T	1.5V	SOT-223	80 Units/ Tube
GL39100-1.5ST3R	1.5V	SOT-223	2,500 Units/ Tape & Reel
GL39100-1.5TC3R	1.5V	TO-252-2	2,500 Units/ Tape & Reel
GL39100-1.8ST3T	1.8V	SOT-223	80 Units/ Tube
GL39100-1.8ST3R	1.8V	SOT-223	2,500 Units/ Tape & Reel
GL39100-1.8TC3R	1.8V	TO-252-2	2,500 Units/ Tape & Reel
GL39100-2.5ST3T	2.5V	SOT-223	80 Units/ Tube
GL39100-2.5ST3R	2.5V	SOT-223	2,500 Units/ Tape & Reel
GL39100-2.5TC3R	2.5V	TO-252-2	2,500 Units/ Tape & Reel
GL39100-3.3ST3T	3.3V	SOT-223	80 Units/ Tube
GL39100-3.3ST3R	3.3V	SOT-223	2,500 Units/ Tape & Reel
GL39100-3.3TC3R	3.3V	TO-252-2	2,500 Units/ Tape & Reel
GL39100-5.0ST3T	5.0V	SOT-223	80 Units/ Tube
GL39100-5.0ST3R	5.0V	SOT-223	2,500 Units/ Tape & Reel
GL39100-5.0TC3R	5.0V	TO-252-2	2,500 Units/ Tape & Reel
GL39101			
GL39101-1.5S8R	1.5V	SOP-8	2,500 Units/ Tape & Reel
GL39101-1.8S8R	1.8V	SOP-8	2,500 Units/ Tape & Reel
GL39101-2.5S8R	2.5V	SOP-8	2,500 Units/ Tape & Reel
GL39101-3.3S8R	3.3V	SOP-8	2,500 Units/ Tape & Reel
GL39101-5.0S8R	5.0V	SOP-8	2,500 Units/ Tape & Reel
GL39102			
GL39102-S8R	Adj	SOP-8	2,500 Units/ Tape & Reel

* For detail Ordering Number identification, please see last page.

PIN DESCRIPTION

PIN number GL39100	PIN Number GL39101	PIN Number GL39102	PIN Name	PIN Function
1	1	1	V_{EN}	Enable (Input): CMOS compatible control input. Logic high=enable; logic low or open=shutdown.
	2	2	V_{IN}	Supply(Input)
3	3	3	V_{OUT}	Regulator Output.
	4		FLG	Flag (Output): Open collector error flag output. Active low = output under-voltage.
		4	ADJ	Adjustment Input: Feedback input. Connect to resistive voltage-divider network.
2, TAB	5-8	5-8	GND	Ground

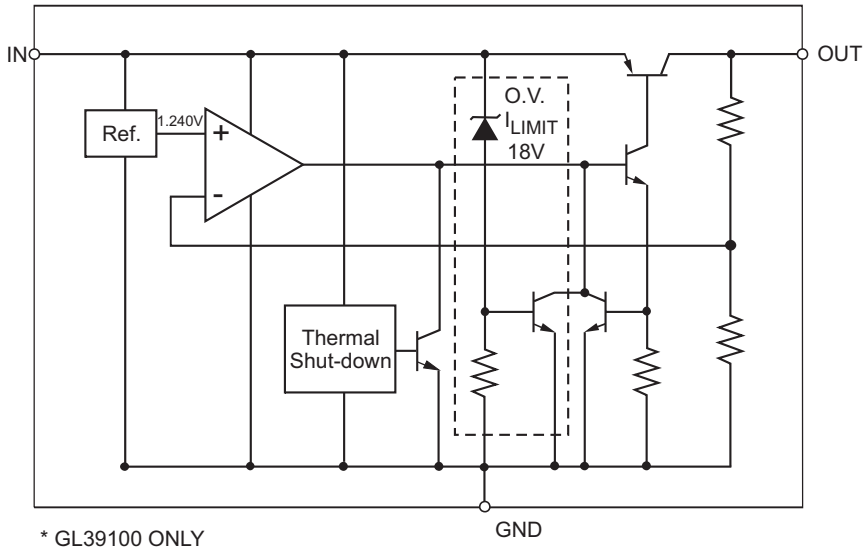
ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Value	Unit
Input Supply Voltage	V_{IN}	-20 to +20	V
Enable Voltage	V_{EN}	+20	V
Storage Temperature Range	T_{STG}	-65 to +150	°C
Lead Temperature (Soldering, 5 sec)	T_{LEAD}	260	°C
EDS, (**Note 3**)			

OPERATING RATINGS

Parameter	Symbol	Value	Unit
Supply Voltage	V_{IN}	+ 2.25 to +16	V
Enable Voltage	V_{EN}	+ 2.25 to +16	V
Operating junction Temperature Range	T_J	-20 to +125	°C
Thermal Resistance SOT-223 (θ_{JC}) SOP-8(θ_{JC})	θ_{JC}	15 20	°C/W
Maximum Power Dissipation($P_{D\ max}$) , (**Note 4**)			

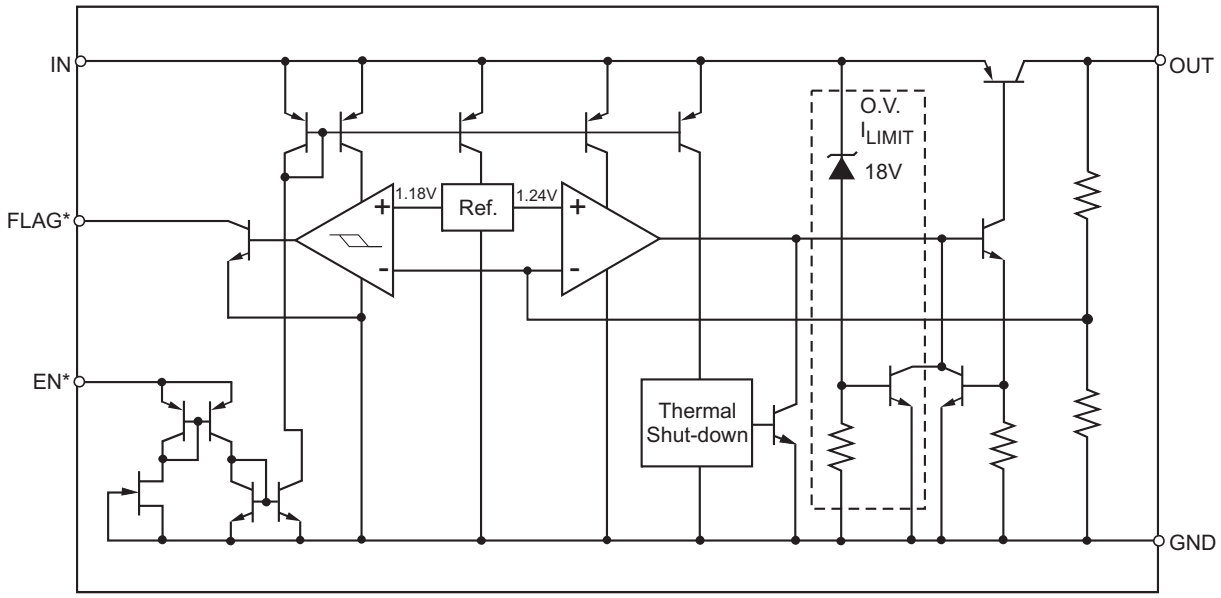
FUNCTIONAL DIAGRAM



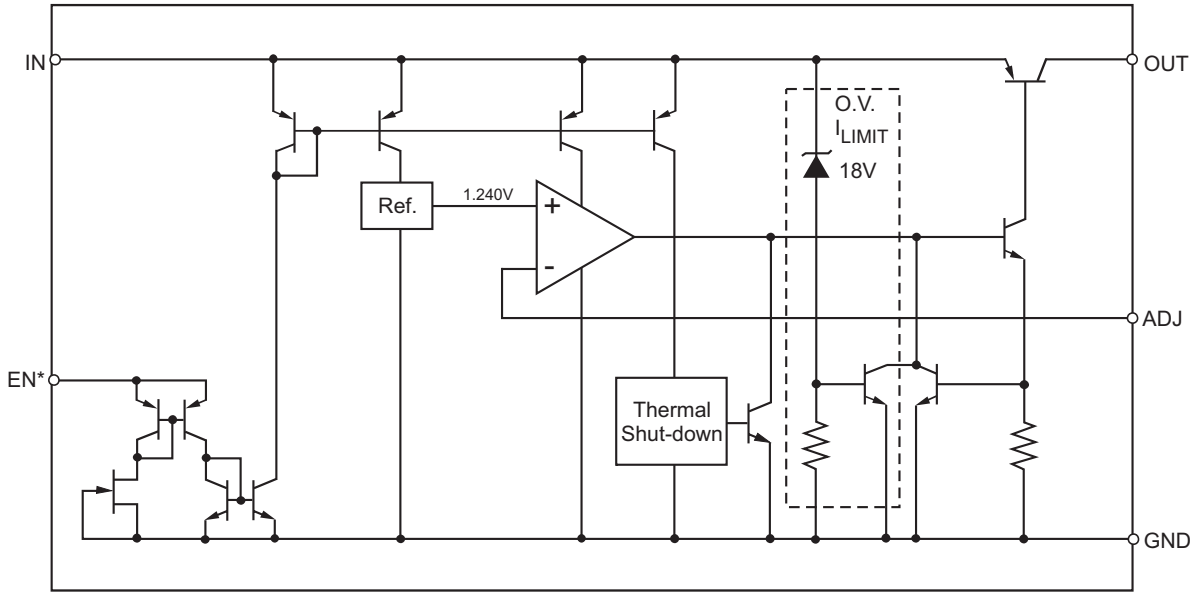
* GL39100 ONLY

GL39100 SERIES

1A ULTRA LOW - DROPOUT REGULATOR



* GL39101 ONLY



* GL39102 ONLY

ELECTRICAL CHARACTERISTICS

V_{IN}= V_{OUT} +1V; V_{EN} = 2.25V; T_J = 25°C, **bold** values indicate -20°C ≤ T_J ≤ +125°C; unless noted

Parameter	Conditions	Min	Typ	Max	Unit
Output Voltage	I_O = 10 mA	-1		1	%
	10mA ≤ I_{OUT} ≤ 1A, V_{OUT} + 1V ≤ V_{IN} ≤8V	**-2**		**2**	%
Line Regulation	I_{OUT} = 10mA, V_{OUT} + 1V ≤ V_{IN} ≤ 16V		0.06	0.5	%
Load Regulation	V_{IN} = V_{OUT} + 1V, 10mA ≤ I_{OUT} ≤ 1A		0.20	1.0	%
Output Voltage change with Temperature Coef., (**Note 5**)	$\Delta V_{OUT} / \Delta T$		**40**	**100**	ppm/°C
Dropout Voltage, (**Note 6**)	I_{OUT} = 100mA, ΔV_{OUT} = -1%		150	200 **250**	mV
	I_{OUT} = 500mA, ΔV_{OUT} = -1%		275		
	I_{OUT} = 750mA, ΔV_{OUT} = -1%		330	**500**	
	I_{OUT} = 1A, ΔV_{OUT} = -1%		410	550 **630**	
Ground Current, (**Note 7**)	I_{OUT} = 100mA, V_{IN} = V_{OUT} + 1V		700		µA
	I_{OUT} = 500mA, V_{IN} = V_{OUT} + 1V		4		mA
	I_{OUT} = 750mA, V_{IN} = V_{OUT} + 1V		7		
	I_{OUT} = 1A, V_{IN} = V_{OUT} + 1V		12	**20**	
Current Limit	V_{OUT} = 0V, V_{IN} = V_{OUT} + 1V		1.8	2.5	A
Enable Input					
Enable Input Voltage	Logic Low (off)			**0.8**	V
	Logic high (on)	**2.25**			V
Enable Input Current	V_{EN} = 2,25V	1	15	30 **75**	µA
	V_{EN} = 0.8V			2 **4**	µA
Flag Output					
Output Leakage Current	V_{OH} =16V		0.01	1 **2**	µA
Output Low Voltage,(**Note 8**)	V_{IN} =0.9∗V_{OUT} NOMINAL, I_{OL}=250µA		240	300 **400**	mV
Low Threshold	1% of V_{OUT}	93			%
High Threshold	1% of V_{OUT}			99.2	%
Hysteresis			1		%
GL39102 Only					
Reference Voltage		1.228 **1.215**	1.240	1.252 **1.265**	V
	Note 9	**1.203**		**1.277**	
Adjust Pin Bias Current			40	80 **120**	nA
Reference Voltage Temp. Coefficient, (**Note 5**)			20		ppm/°C
Adjust Pin Bias Current Temp. Coefficient			0.1	99.2	nA/°C

Note 1. Exceeding the absolute maximum ratings may damage the device.
Note 2. The device is not guaranteed to function outside its operating rating.
Note 3. Devices are ESD sensitive. Handling precautions recommended.
Note 4. $P_{D(max)}=(T_{J(max)}-T_A) \div \theta_{JA}$, where θ_{JA} -junction-to-ambient thermal resistance.
Note 5. Output voltage temperature coefficient is $\Delta V_{OUT(worst\ case)} \div (T_{J(max)} - T_{J(min)})$ where $T_{J(max)}$ is +125°C and $T_{J(min)}$ is 0°C.
Note 6. $V_{DO}=V_{IN}-V_{OUT}$ when V_{OUT} decreases to 99% of its nominal output voltage with $V_{IN}=V_{OUT}+1V$. For output voltages below 2.25V, dropout voltage is the input-to-output voltage differential with the minimum input voltage being 2.25V. Minimum input operating voltage is 2.25V.
Note 7. I_{GND} is the quiescent current. $I_{IN} = I_{GND} + I_{OUT}$
Note 8. For adjustable device and fixed device with V_{OUT}≥2.5V
Note 9. $V_{REF} \le V_{OUT} \le (V_{IN} - 1V)$, $2.25V \le V_{IN} \le 16V$, $10mA \le I_L \le 1A$.

TYPICAL CHARACTERISTICS

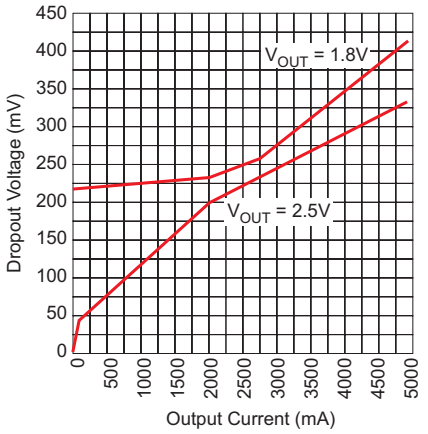


Figure 1. Dropout Voltage vs. Output Current

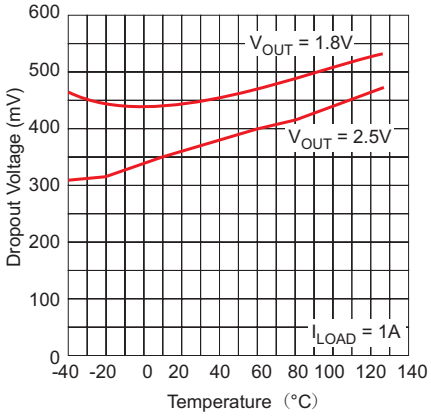


Figure 2. Dropout Voltage vs. Temperature

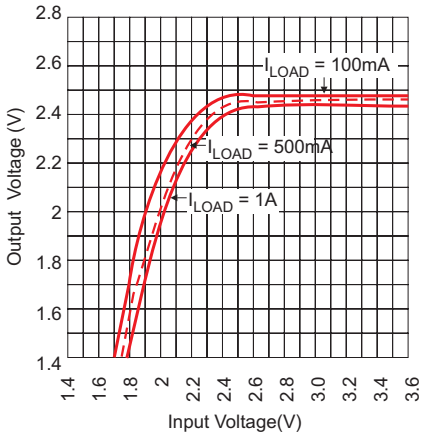


Figure 3. Dropout Characteristics

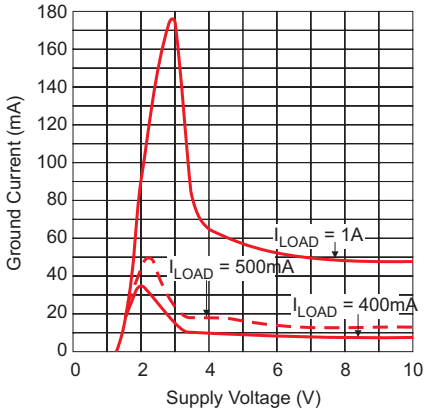


Figure 4. Ground Current vs. Supply Voltage

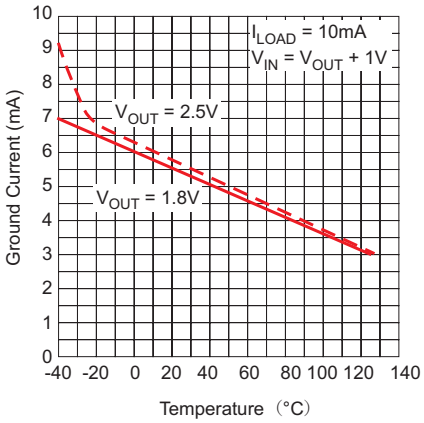


Figure 5. Ground Current vs. Temperature

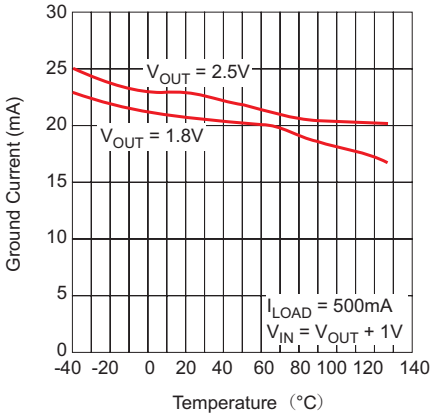


Figure 6. Ground Current vs. Temperature

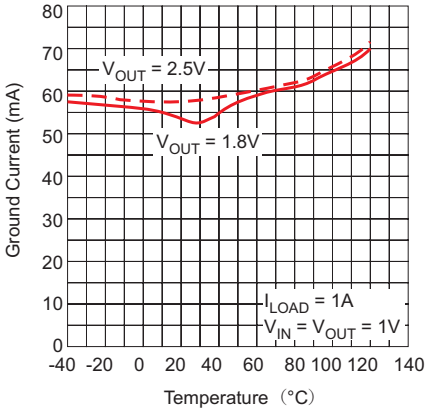


Figure 7. Ground Current vs. Temperature

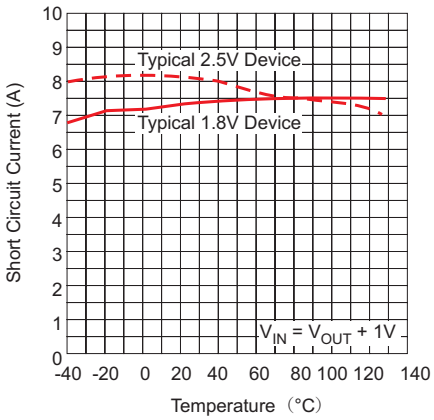


Figure 8. Short Circuit Current vs. Temperature

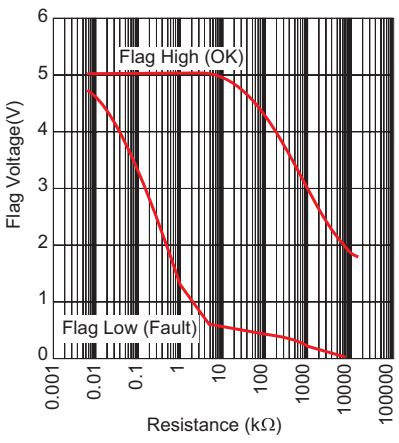


Figure 9. Error Flag Pull-up Resistor

APPLICATION INFORMATION

The GL39100 series is a high-performance low-dropout voltage regulator, suitable for moderate to high-current voltage regulator applications. Its 630mV dropout voltage at full load and over temperature makes it especially valuable in battery-powered systems and as high-efficiency noise filters in post-regulator applications.

Unlike older NPN-pass transistor designs, where the minimum dropout voltage is limited by the base-to-emitter voltage drop and collector-to-emitter saturation voltage, dropout performance of the PNP output of these devices is limited only by the low V_{CE} saturation voltage.

The GL39100 series regulator is fully protected from damage due to fault conditions. Linear current limiting is provided. Output current during overload conditions is constant. Thermal shutdown disables the device when the die temperature exceeds the maximum safe operating temperature. Transient protection allows device (and load) survival even when the input voltage spikes above and below nominal. The output structure of these regulators allows voltages in excess of the desired output voltage to be applied without reverse current flow.

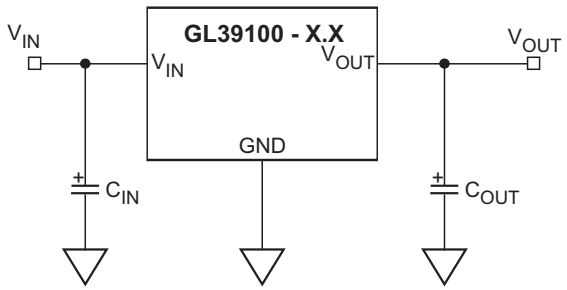


Figure 10. Capacitor Requirements

Output Capacitor

The GL39100 series requires an output capacitor to maintain stability and improve transient response. Proper capacitor selection is important to ensure proper operation.

The GL39100 series output capacitor selection is dependent upon the ESR (equivalent series resistance) of the output capacitor to maintain stability.

When the output capacitor is 10μF or greater, the output capacitor should have an ESR less than 2Ω. This will improve transient response as well as promote stability.

Ultra-low-ESR capacitors(<100mΩ), such as ceramic chip capacitors, may promote instability. These very low ESR levels may cause an oscillation and/or under damped transient response. A low-ESR solid tantalum capacitor works extremely well and provides good transient response and stability over temperature. Aluminum electrolytics can also be used, as long as the ESR of the capacitor is <2Ω .

The value of the output capacitor can be increased without limit. Higher capacitance values help to improve transient response and ripple rejection and reduce output noise.

Input Capacitor

An input capacitor of 1μF or greater is recommended when the device is more than 4 inches away from the bulk as supply capacitance, or when the supply is a battery. Small surface mount ceramic chip capacitors can be used for the bypassing. Larger values will help to improve ripple rejection by bypassing the input to the regulator, further improving the integrity of the output voltage.

Error Flag

The GL39101 features an error flag (FLG), which monitors the output voltage and signals an error condition when this voltage drops 5% below its expected value.

The error flag is an open-collector output that pulls low under fault conditions and may sink up to 10mA. Low output voltage signifies a number of possible problems, including an over current fault (the device is in current limit) or low input voltage. The flag output is inoperative during over temperature conditions.

A pull-up resistor from FLG to either V_{IN} or V_{OUT} is required for proper operation. For information regarding the minimum and maximum values of pull-up resistance, refer to the graph in the typical characteristics section of the data sheet.

Enable Input

The GL39101 and GL39102 version features an active-high enable input (EN) that allows on-off control of the regulator. Current drain reduces to "zero" when the device is shutdown, with only microamperes of leakage current. The EN input has TTL/CMOS compatible thresholds for simple logic interfacing. EN may be directly tied to V_{IN} and pulled up to the maximum supply voltage.

Transient Response and 3.3V to 2.5V or 2.5V to 1.8V Conversion

The GL39100 series has excellent transient response to variations in input voltage and load current. The device has been designed to respond quickly to load current variations and input voltage variations. Large output capacitors are not required to obtain this performance. A standard 10μ F output capacitor, preferably tantalum, is all that is required. Larger values help to improve performance even further.

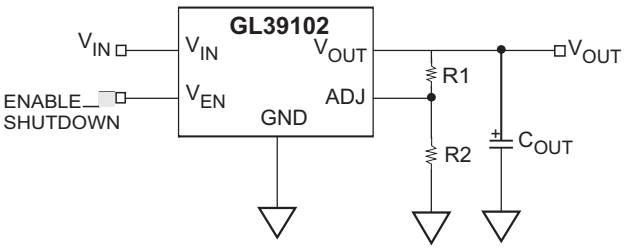
By virtue of its low-dropout voltage, this device does not saturate into dropout as readily as similar NPN-based designs. When converting from 3.3V to 2.5V or 2.5V to 1.8V, the NPN-based regulators are already operating in dropout, with typical dropout requirements of 1.2V or greater. To convert down to 2.5V or 1.8V without operating in dropout, NPN-based regulators require an input voltage of 3.7V at the very least.

The GL39100 regulator will provides excellent performance with an input as low as 3.0V or 2.5V respectively. This gives the PNP-based regulators a distinct advantage over older, NPN-based linear regulators.

Minimum Load Current

The GL39100 series regulator is specified between finite loads. If the output current is too small, leakage currents dominate and the output voltage rises. A 10mA minimum load current is necessary for proper regulation.

Adjustable Regulator Design



$$V_{OUT} = 1.240V \left(1 + \frac{R1}{R2} \right)$$

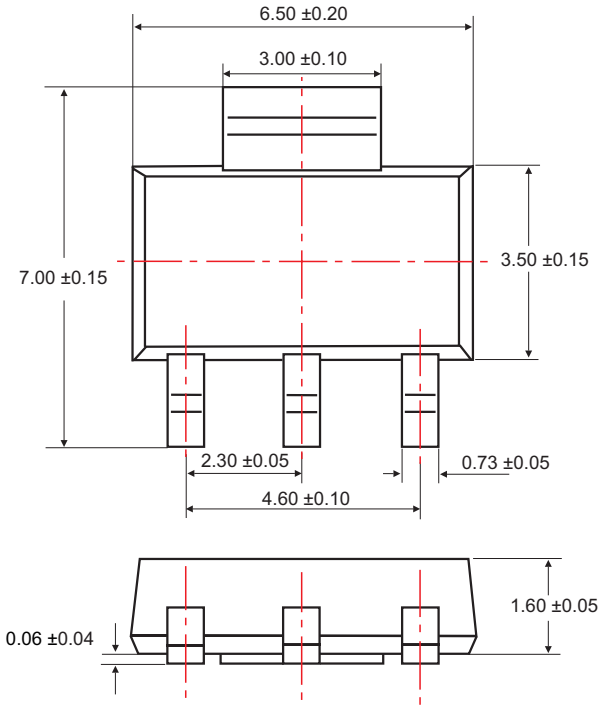
Figure 11. Adjustable Regulator with Resistors

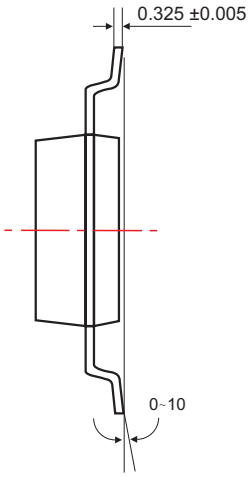
The GL39102 allows programming the output voltage anywhere between 1.24V and the 16V maximum operating rating of the family. Two resistors are used. The resistor values are calculated by:

$$R1_T = R2 \left(\frac{V_{OUT}}{1.240} - 1 \right)$$

Where V_{OUT} is the desired output voltage. Figure 2 shows component definition. Applications with widely varying load currents may scale the resistors to draw the minimum load current required for proper operation (see above).

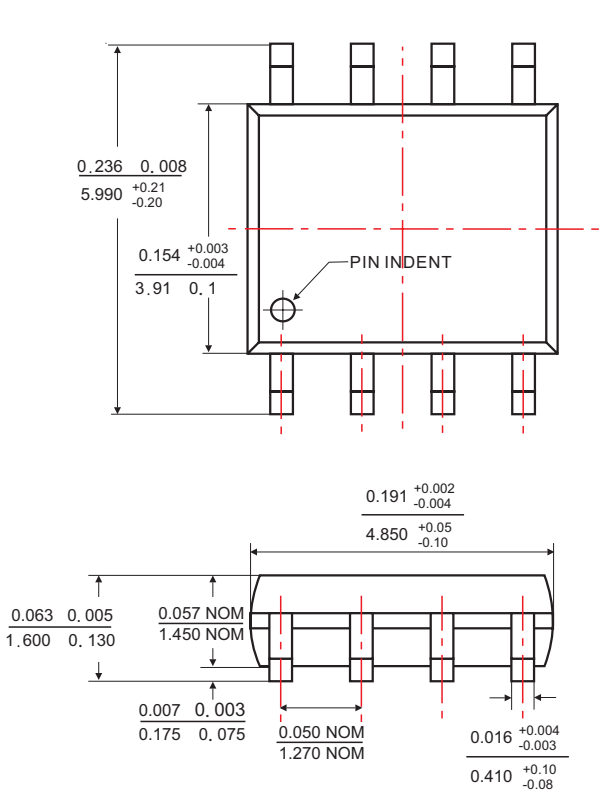
SOT- 223 PACKAGE OUTLINE DIMENSIONS

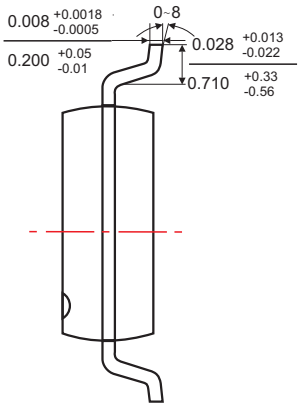




Unit: mm

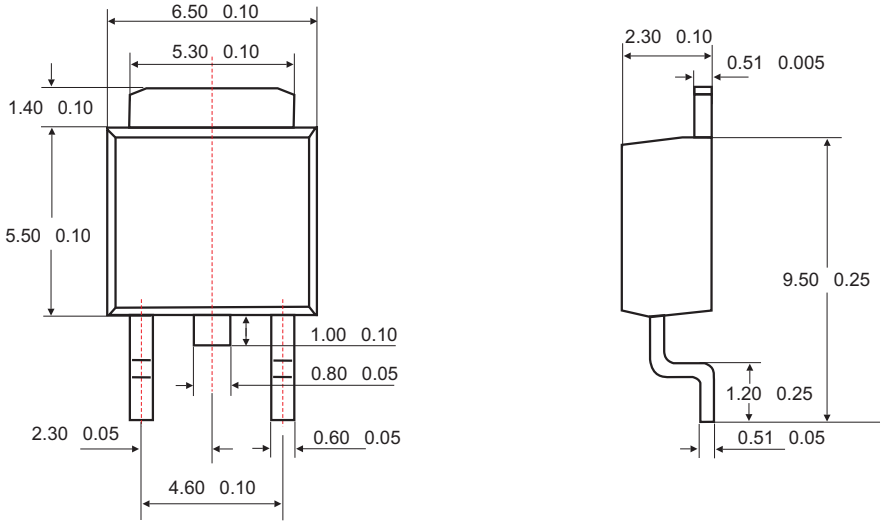
SOP-8 PACKAGE OUTLINE DIMENSIONS





(Inches / mm)

TO-252-3 PACKAGE OUTLINE DIMENSIONS



ORDERING NUMBER

Unit: mm

GL39100/ 39101/39102 1.8 ST3 T

Circuit Type

Output Voltage

Package
ST3: SOT-223
TC3: TO-252
S8: SOP-8

Shipping
R: Tape & Reel
T: Tube