GL39300 SERIES

3A ULTRA LOW - DROPOUT REGULATOR

Description

The GL39300 series is 3.0A low-dropout linear voltage regulators that provide a low-voltage, and high-current output with a minimum of external components.

The GL39300 series offers extremely low dropout (typically 400mV at 3.0A) and low ground current (typically 36mA at 3.0A).

The GL39300 series is ideal for PC add-in cards that need to convert from standard 3.0V to 2.5V and 2.5V to 1.8V, down to new, lower core voltage. A guaranteed maximum dropout voltage of 500mV over all operating conditions allows the GL39300 series to provide 2.5V from a supply as low as 3V or 1.8V. The GL39300 series also has fast transient response. for heavy switching applications to maintain stability and achieve fast response.

The GL39300 series is fully protected with overcurrent limiting, thermal shutdown, reversed-battery protection, reversed-lead insertion protection, and reversed-leakage protection.

The GL39300 series offers a TTL-logic-compatible enable pin, and an error flag that indicates under voltage and over current conditions. Offered in a fixed voltages, 1.8V and 2.5V, the GL39300 series comes in the TO-263 and TO-252 packages. and is an ideal upgrade to older, NPN-based linear voltage regulators.

The GL39302 is adjustable version. And the GL39300/01 is fixed version.

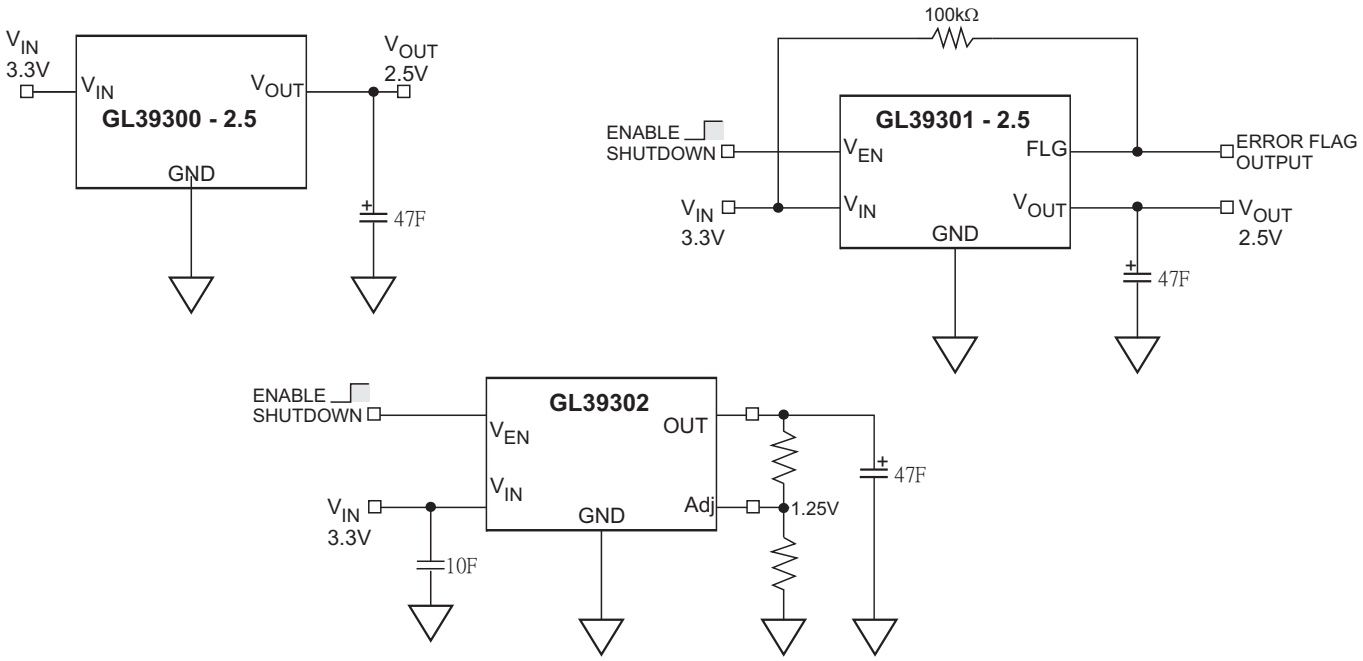
Features

- **3.0A minimum guaranteed output current**
- **500mV dropout voltage**
  Ideal for 3.0V to 2.5V conversion
  Ideal for 2.5V to 1.8V conversion
- **1% initial accuracy**
- **Low ground current**
- **Current limiting and Thermal shutdown**
- **Reversed-battery protection**
- **Reversed-leakage protection**
- **Fast transient response**
- **TO-263 and TO-252 packages**
- **TTL/CMOS compatible enable pin (GL39301 only)**
- **Error flag output (GL39301 only)**
- **Adjustable version (GL39302 only)**

Application

LDO linear regulator for PC add-in cards
High-efficiency linear power supplies
SMPS post regulator
Multimedia and PC processor supplies
Low-voltage microcontrollers
Strong ARM™ processor supply

TYPICAL APPLICATION CIRCUITS

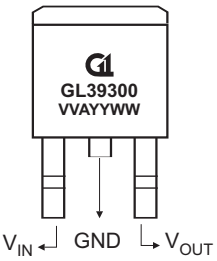


GL39300 SERIES

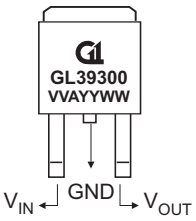
3A ULTRA LOW - DROPOUT REGULATOR

◆ MARKING INFORMATION & PIN CONFIGURATIONS

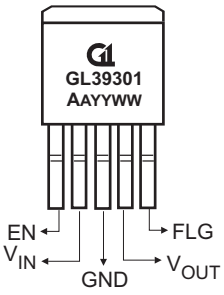
TO-263-2 (D²PAK)



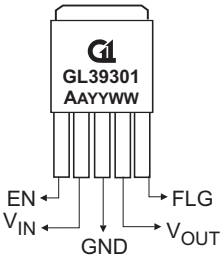
TO-252-2 (DPAK)



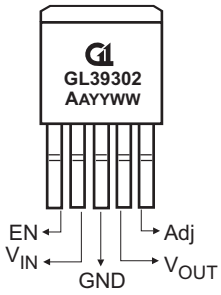
TO-263-5(D²PAK)



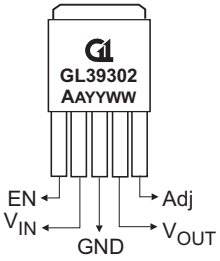
TO-252-5 (DPAK)



TO-263-5(D²PAK)



TO-252-5 (DPAK)



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

Pinout On all devices, the Tab is grounded.

GL39300/ Three Terminal

Pin 1 = Input, 2 = Ground, 3 = Output

GL39301/ Five Terminal (Fixed Voltage Devices)

Pin 1 = Enable, 2 = Input, 3 = Ground,
4 = Output, 5 = Flag

GL39302/ Adjustable with ON/ OFF Control

Pin 1 = Enable, 2 = Input, 3 = Ground,
4 = Output, 5 = Adjust

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

Ordering Number	Output Voltage	Package	Shipping
GL39300			
GL39300-1.8TA3T	1.8V	TO-263-2	50 Units/ Tube
GL39300-1.8TA3R	1.8V	TO-263-2	800 Units/ Tape & Reel
GL39300-1.8TC3R	1.8V	TO-252-2	2,500 Units / Tape & Reel
GL39300-2.5TA3T	2.5V	TO-263-2	50 Units/ Tube
GL39300-2.5TA3R	2.5V	TO-263-2	800 Units/ Tape & Reel
GL39300-2.5TC3R	2.5V	TO-252-2	2,500 Units / Tape & Reel
GL39301			
GL39301-1.8TA5T	1.8V	TO-263-5	50 Units/ Tube
GL39301-1.8TA5R	1.8V	TO-263-5	800 Units/ Tape & Reel
GL39301-1.8TC5R	1.8V	TO-252-5	2,500 Units / Tape & Reel
GL39301-2.5TA5T	2.5V	TO-263-5	50 Units/ Tube
GL39301-2.5TA5R	2.5V	TO-263-5	800 Units/ Tape & Reel
GL39301-2.5TC5R	2.5V	TO-252-5	2,500 Units / Tape & Reel
GL39302			
GL39302-TA5T	Adj	TO-263-5	50 Units/ Tube
GL39302-TA5R	Adj	TO-263-5	800 Units/ Tape & Reel
GL39302-TC5R	Adj	TO-252-5	2,500 Units / Tape & Reel

* For detail ordering number identification, please see last page.

PIN DESCRIPTION

PIN Number GM66300	PIN Number GM66301	PIN NUMBER GM66302	PIN Name	PIN Function
	1	1	V_{EN}	Enable (Input): TTL/CMOS compatible input. Logic high=enable; logic low or open=shutdown.
1	2	2	V_{IN}	Unregulated Input: +16V maximum supply.
2, TAB	3, TAB	3, TAB	GND	Ground: Ground pin and TAB are internally connected.
3	4	4	V_{OUT}	Regulator Output.
	5		FLG	Error Flag (Output): Open collector output. Active low indicates an output fault condition.
		5	Adj	Adjustable

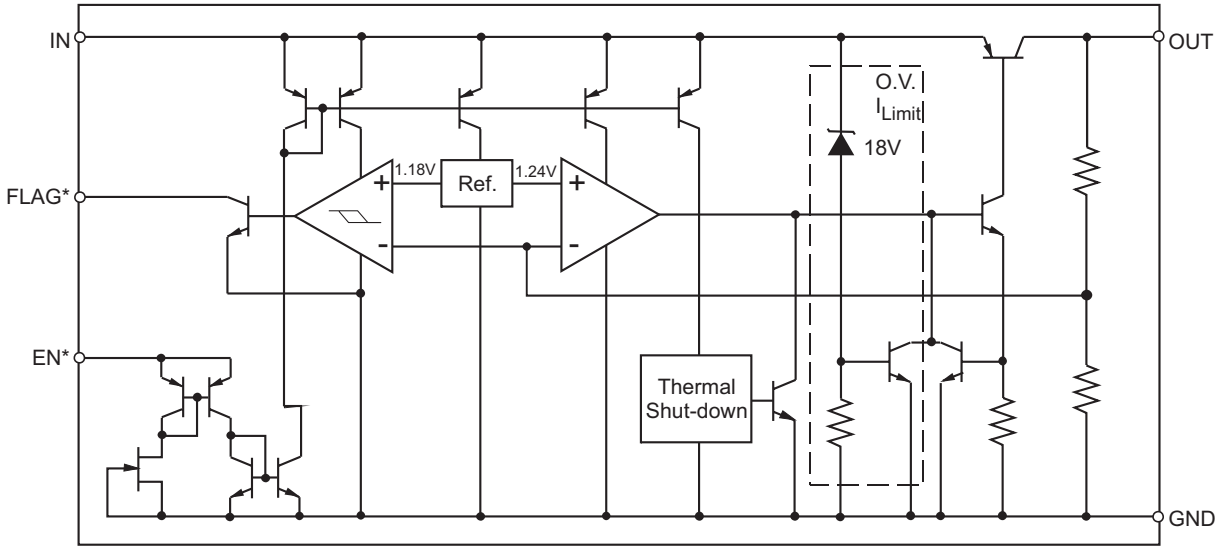
ABSOLUTE MAXIMUM RATINGS (Note 1)

Parameter	Symbol	Value	Unit
Power Dissipation	P_D	Internally limited	W
Supply Voltage	V_{IN}	-20 to +20	V
Lead Temperature (Soldering, 5 sec)	T_{LEAD}	260	C
Storage Temperature Range	T_{STG}	-65 to +150	C
ESD, **Note 3**			

OPERATING RATINGS (Note 2)

Parameter	Symbol	Value	Unit
Supply Voltage	V_{IN}	+ 2.5 to +16	V
Enable Voltage	V_{EN}	+16	V
Operating junction Temperature Range	T_J	-40 to +125	C
Thermal Resistance (TO-263-2)	θ_{JC}	2.0	C/W
Maximum Power Dissipation, **Note 4**			

FUNCTIONAL DIAGRAM



* GL39301 ONLY

◆ ELECTRICAL CHARACTERISTICS

T_J = 25C, **bold** values indicate -40C ≤ T_J ≤ +125C; unless noted

Parameter	Conditions	Min	Typ	Max	Unit
Output Voltage	I_O = 10 mA	-1		1	%
	10mA ≤ I_{OUT} ≤ 3A, V_{OUT} + 1V ≤ V_{IN} ≤8V	**-2**		**2**	%
Line Regulation	I_{OUT} = 10mA, V_{OUT} + 1V ≤ V_{IN} ≤8V		0.06	0.5	%
Load Regulation	V_{IN} = V_{OUT} + 1V, 10mA ≤ I_{OUT} ≤ 3A		0.20	1.0	%
Output Voltage change with Temperature Coef. **Note 5**	ΔV_{OUT} / ΔT		**20**	**100**	ppm/C
Dropout Voltage **Note 6 & 9**	I_{OUT} = 100mA, ΔV_{OUT} = -1% I_{OUT} = 750mA, ΔV_{OUT} = -1% I_{OUT} = 1.5A, ΔV_{OUT} = -1% I_{OUT} = 3A, ΔV_{OUT} = -1%		65 185 250 385	**200** **550**	mV
Ground Current **Note 7**	I_{OUT} = 750mA, V_{IN} = V_{OUT} + 1V I_{OUT} = 1.5A, V_{IN} = V_{OUT} + 1V I_{OUT} = 3A, V_{IN} = V_{OUT} + 1V		10 17 45	**20**	mA
Dropout Ground Pin Current	V_{IN} ≤ $V_{OUT(nominal)}$ -0.5V, I_{OUT}=10mA		6		mA
Current Limit	V_{OUT}= 0V, V_{IN} = V_{OUT} + 1V		4.5		A
Enable Input (GI39301)					
Enable Input Voltage	Logic Low (off)			**0.8**	V
	Logic high (on)	**2.5**			V
Enable Input Current	V_{EN} = 2.5V		15	30 **75**	uA
	V_{EN} = 0.8V			2 **4**	uA
Shutdown Output Current	(Note 8)		10	**20**	uA
Flag Output (GI39301)					
Output Leakage Current	V_{OH} = 16V		0.01	1 **2**	uA
Output Low Voltage	V_{IN} = 2.5V, I_{OL}= 250uA **Note 9**		220	300 **400**	mV
Low Threshold	% of V_{OUT}	93			%
High Threshold	% of V_{OUT}			99.2	%
Hysteresis			1		%

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. Handing precautions recommended.
Note 4. $P_{D(max)}$=($T_{J(max)}$-T_A) θ_{JA}, where θ_{JA} depends upon the printed circuit layout. See "Applications Information".
Note 5. Output voltage temperature coefficient is $\Delta V_{OUT(worst\ case)}$ ($T_{J(max)}$- $T_{J(min)}$) where $T_{J(max)}$ is +125C and $T_{J(min)}$ is -40C.
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 voltages below 2.5V, dropout voltage is the input-to-output voltage differential with the minimum input voltage being 2.5V. Minimum input operating voltage is 2.5V.
Note 7. I_{GND} is the quiescent current. I_{IN} = I_{GND} + I_{OUT}
Note 8. V_{EN} ≤ 0.8V, V_{IN} ≤ 8V, and V_{OUT} = 0V
Note 9. For a 1.8V device, V_{IN} = 2.5V.

TYPICAL CHARACTERISTICS

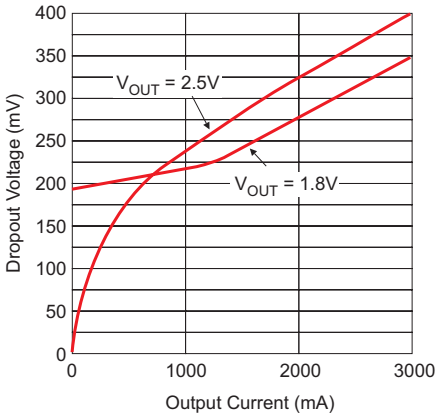


Figure 1. Dropout Voltage vs. Output Current

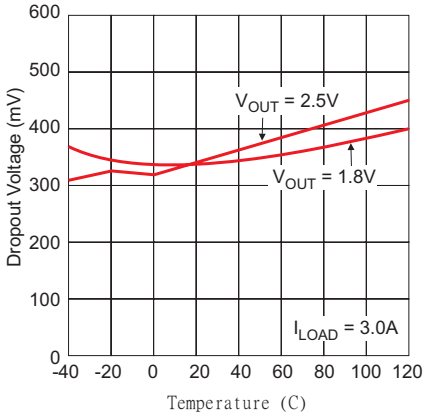


Figure 2. Dropout Voltage vs. Temperature

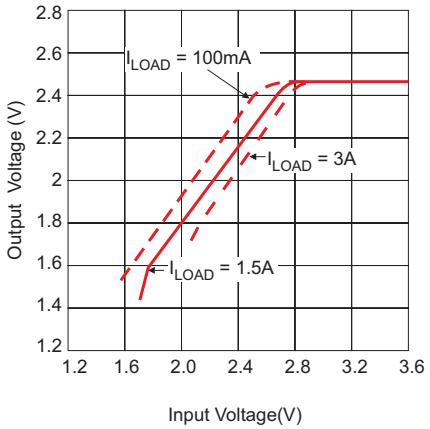


Figure 3. Dropout Characteristics

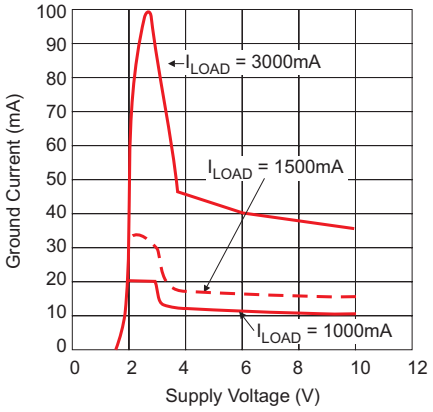


Figure 4. Ground Current vs. Supply Voltage

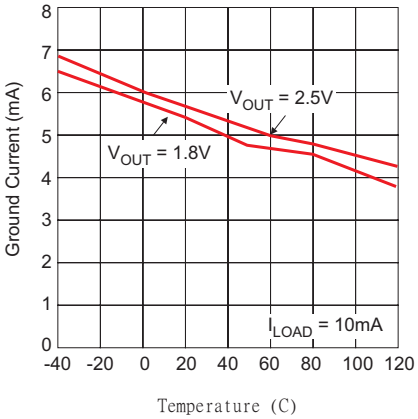


Figure 5. Ground Current vs. Temperature

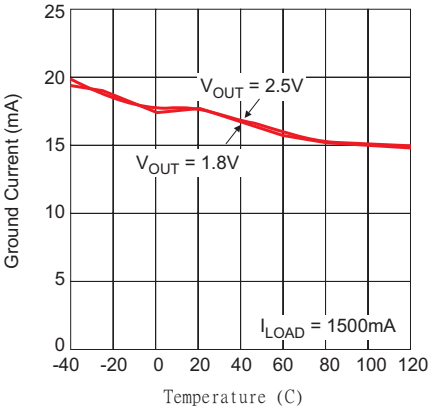


Figure 6. Ground Current vs. Temperature

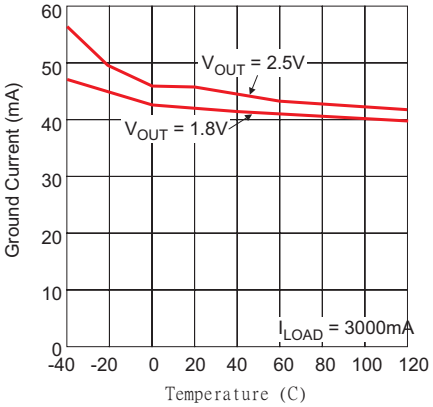


Figure 7. Ground Current vs. Temperature

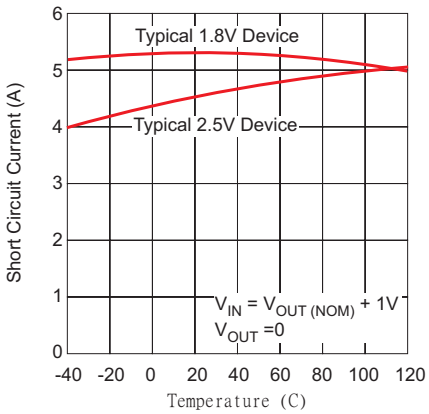


Figure 8. Short Circuit Current vs. Temperature

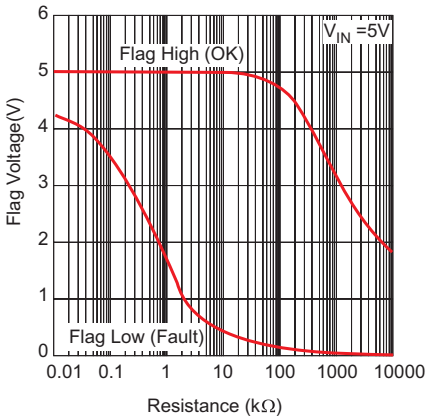


Figure 9. Error Flag Pull-up Resistor

APPLICATION INFORMATION

The GL39300 series is a high performance with low-dropout voltage regulator, suitable for moderate to high-current voltage regulator applications. Its 500mV dropout voltage at full load makes it especially valuable in battery-powered systems and as a high-efficiency noise filter 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 GL39300 series regulator is fully protected from damage due to fault conditions. Current limiting is provided. This limiting is linear, 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.

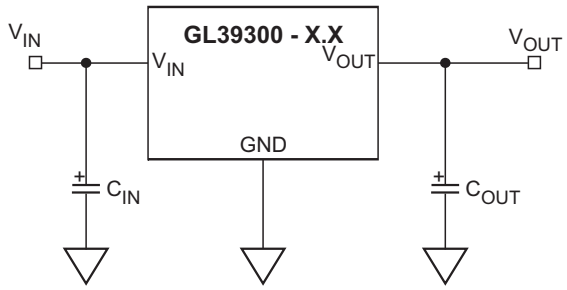


Figure 10. Capacitor Requirements

Thermal Design

Linear regulators are simple to use. The most complicated design parameters to consider are thermal characteristics.
Thermal design requires four application-specific parameters:

- Maximum ambient temperature (T_A)
- Output Current (I_{OUT})
- Output Voltage (V_{OUT})
- Input Voltage (V_{IN})
- Ground Current (I_{GND})

Calculate the power dissipation of the regulator from these numbers and the device parameters from this datasheet, where the ground current is taken from data sheet

$$P_D = (V_{IN} - V_{OUT})I_{OUT} + V_{IN} \bullet I_{GND}$$

The heat sink thermal resistance is determined by:

$$\theta_{SA} = \frac{T_{J(MAX)} - TA}{P_D} - (\theta_{JC} + \theta_{CS})$$

where $T_{J(max)}$ ≤125C and θ_{CS} is between 0C and 2 C/W.

The heat sink may be significantly reduced in applications where the minimum input voltage is known and is large compared with the dropout voltage. Use a series input resistor to drop excessive voltage and distribute the heat between this resistor and the regulator. The low dropout properties of Super βeta PNP regulators allow significant reductions in regulator power dissipation and the associated heat sink without compromising performance. When this technique is employed, a capacitor of at least 1.0uF is needed directly between the input and regulator ground.

Output Capacitor

The GL39300 series requires an output capacitor to maintain stability and improve transient response. Proper capacitor selection is important to ensure proper operation. The GL39300 series output capacitor selection is dependent upon the ESR (equivalent series resistance) of the output capacitor to maintain stability. When the output capacitor is 47uF or greater, the output capacitor should have less than 1Ω of ESR. This will improve transient response as well as promote stability. Ultra-low-ESR capacitors, such as ceramic chip capacitors may promote instability. These very low ESR levels may cause an oscillation and/or underdamped transient response. When larger capacitors are used, the ESR requirement approaches zero. A 100 uF ceramic capacitor can be used on the output while maintaining stability. A low-ESR 47uF 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 1Ω.

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

Input Capacitor

An input capacitor of 1uF 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 surfacemount 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.

Transient Response and 3.3V to 2.5V and 2.5V to 1.8V Conversions

The GL39300 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 47uF output capacitor, preferably tantalum, is all that is required. Larger values 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 without operating in dropout, NPN-based regulators require an input voltage of 3.7V at the very least.

The GL39300 series 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. A typical NPN regulator does not have the headroom to do this conversion.

Minimum Load Current

The GL39300 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.

Error Flag

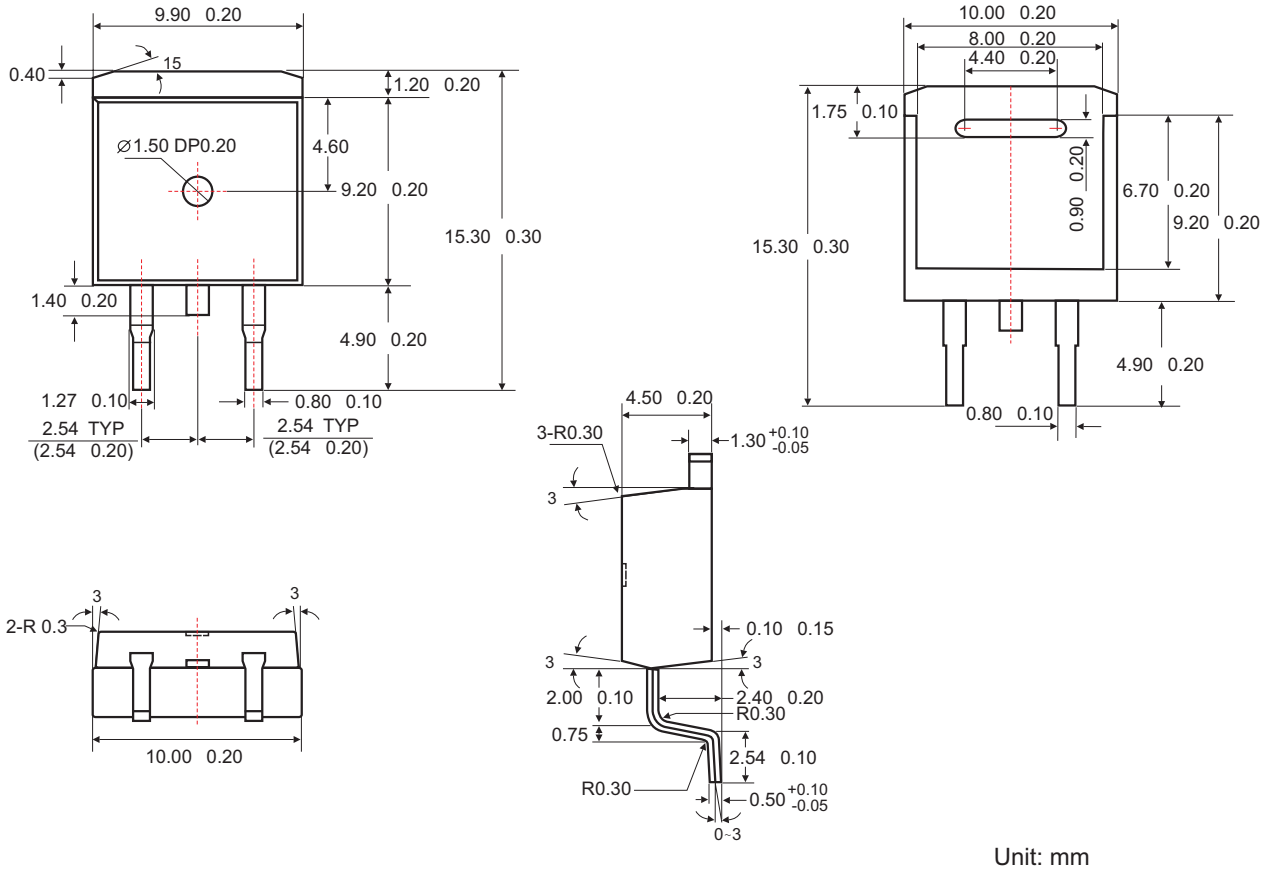
The Gl39300 series version features an error flag circuit which monitors the output voltage and signals an error condition when the voltage 5% below the nominal output voltage.

The error flag is an open-collector output that can sink 10mA during a fault condition. Low output voltage can be caused by a number of problems, including an overcurrent fault (device in current limit) or low input voltage. The flag is inoperative during overtemperature shutdown. When the error flag is not used, it is best to leave it open. The flag pin can be tied directly to pin 4, the output pin.

Enable Input

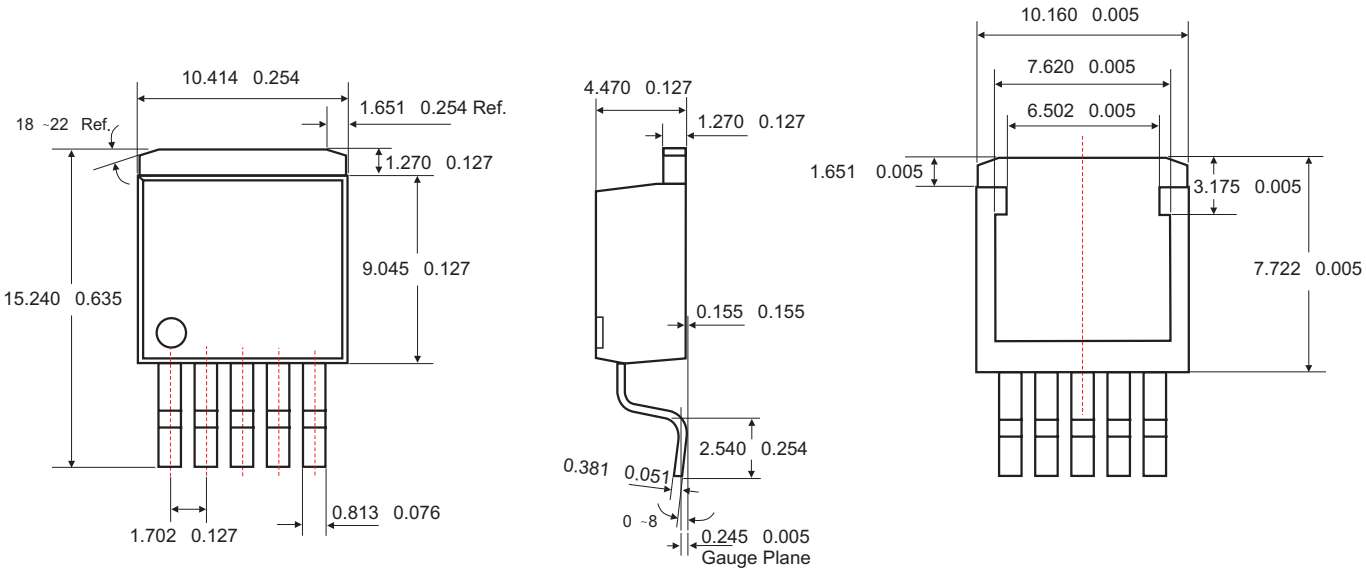
The GL39300 series version features an enable input for on/off control of the device. Its shutdown state draws “zero” current. The enable input is TTL/CMOS compatible for simple logic interface, but can be connected to up to 20V. When enabled, it draws approximately 15uA.

TO-263-2 PACKAGE OUTLINE DIMENSIONS



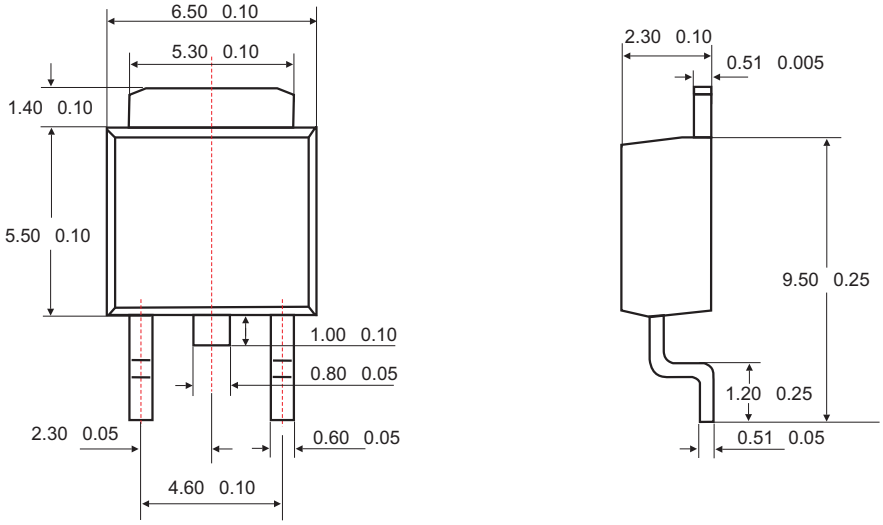
Unit: mm

TO-263-5 PACKAGE OUTLINE DIMENSIONS



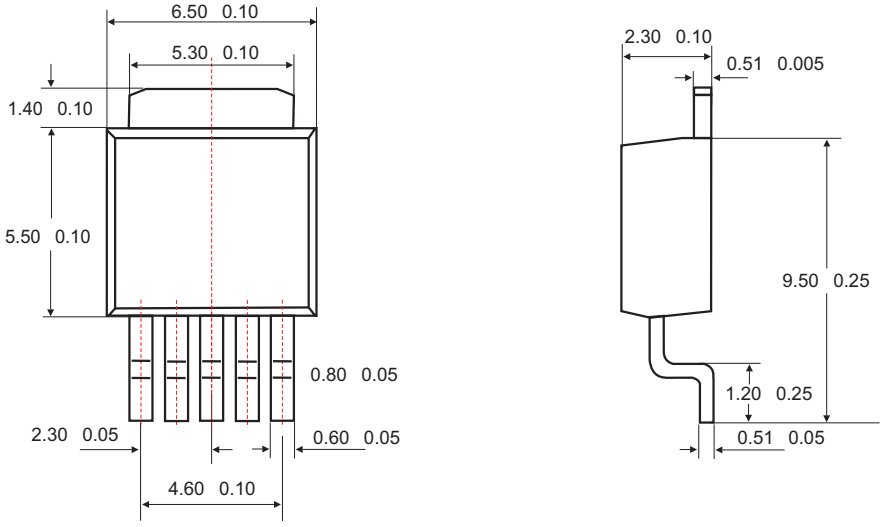
Unit: mm

TO-252-3 PACKAGE OUTLINE DIMENSIONS



Unit: mm

TO-252-5 PACKAGE OUTLINE DIMENSIONS



Unit: mm

◆ ORDERING NUMBER