GL1086

1.5A LOW DROPOUT PRECISION LINEAR REGULATORS

Description

GL1086 of positive adjustable and fixed regulators is designed to provide 1.5A output with low dropout voltage performance. On-chip trimming adjusts the reference voltage to 2%. Put them to work in post regulators or microprocessor power supplies, where low voltage operation and fast transient response are required.

Pin-to-pin compatible with LT1086 family of regulators, GL1086 is available in TO-252, TO-263, and surface-mount TO-223 packages.

Features

- **Adjustable or Fixed Output**
- **Output Current of 1.5A**
- **Dropout Voltage (Typical) 1.3V @ 1.5A**
- **Line Regulation 0.2% max.**
- **Load Regulation 0.4% max.**
- **Fast Transient Response**
- **Current Limit Protection**
- **Thermal Shutdown Protection**

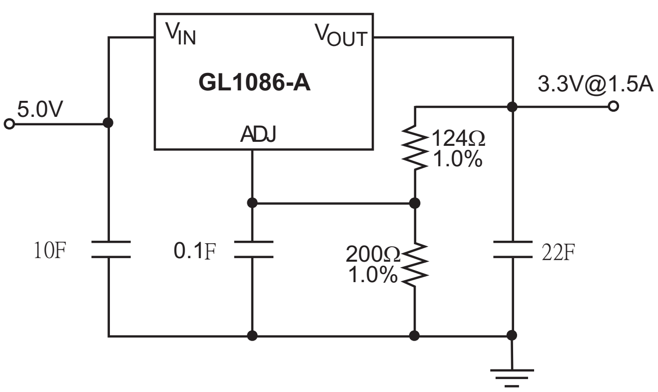
Application

High Efficiency Linear Regulators

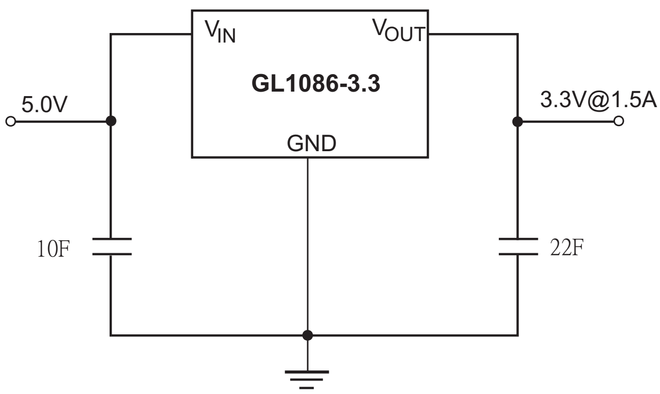
Post Regulators for Switching Supplies

Battery Chargers

TYPICAL APPLICATION CIRCUITS



(Adjustable Version)

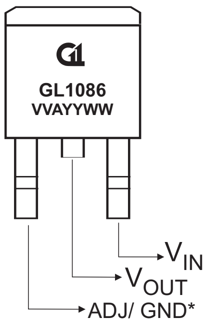


(Fixed Version)

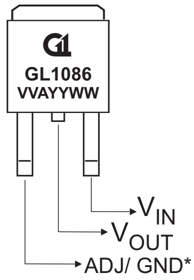
1.5A LOW DROPOUT PRECISION LINEAR REGULATORS

◆ MARKING INFORMATION & PIN CONFIGURATIONS (Top View)

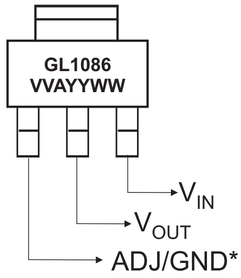
TO-263-2 (D²PAK)



TO-252-2 (DPAK)



SOT-223



V V, V = Output Voltage (50 = 5.0V, 18= 1.8V ,A =Adj)
A = Assembly Location
YY = Year
W W = Weekly

* On fixed versions Pin 1 = GND,
on adjustable versions Pin 1 = ADJ

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

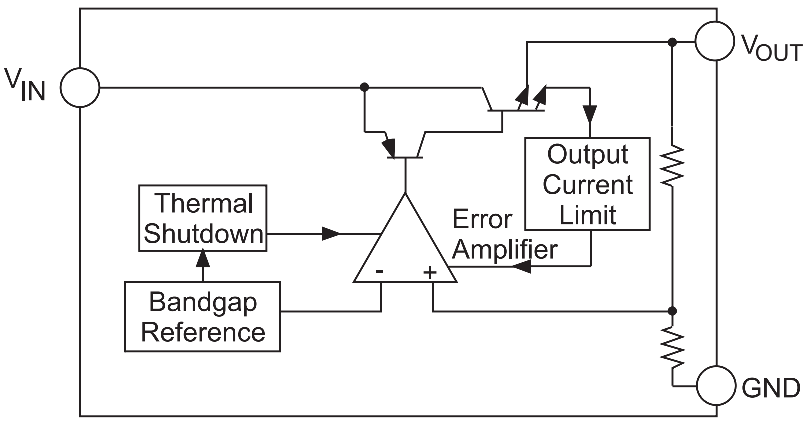
Ordering Number	Output Voltage	Package	Shipping
GL1086-ATA3R	Adj	TO-263-2	800 Units / Tape & Reel
GL1086-ATC3R	Adj	TO-252-2	2,500 Units / Tape & Reel
GL1086-AST3R	Adj	TO-223	2,500 Units / Tape & Reel
GL1086-1.5TA3R	1.5	TO-263-2	800 Units / Tape & Reel
GL1086-1.5TC3R	1.5	TO-252-2	2,500 Units / Tape & Reel
GL1086-1.5ST3R	1.5	TO-223	2,500 Units / Tape & Reel
GL1086-1.8TA3R	1.8	TO-263-2	800 Units / Tape & Reel
GL1086-1.8TC3R	1.8	TO-252-2	2,500 Units / Tape & Reel
GL1086-1.8ST3R	1.8	TO-223	2,500 Units / Tape & Reel
GL1086-2.5TA3R	2.5	TO-263-2	800 Units / Tape & Reel
GL1086-2.5TC3R	2.5	TO-252-2	2,500 Units / Tape & Reel
GL1086-2.5ST3R	2.5	TO-223	2,500 Units / Tape & Reel
GL1086-3.3TA3R	3.3	TO-263-2	800 Units / Tape & Reel
GL1086-3.3TC3R	3.3	TO-252-2	2,500 Units / Tape & Reel
GL1086-3.3ST3R	3.3	TO-223	2,500 Units / Tape & Reel
GL1086-5.0TA3R	5.0	TO-263-2	800 Units / Tape & Reel
GL1086-5.0TC3R	5.0	TO-252-2	2,500 Units / Tape & Reel
GL1086-5.0ST3R	5.0	TO-223	2,500 Units / Tape & Reel

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

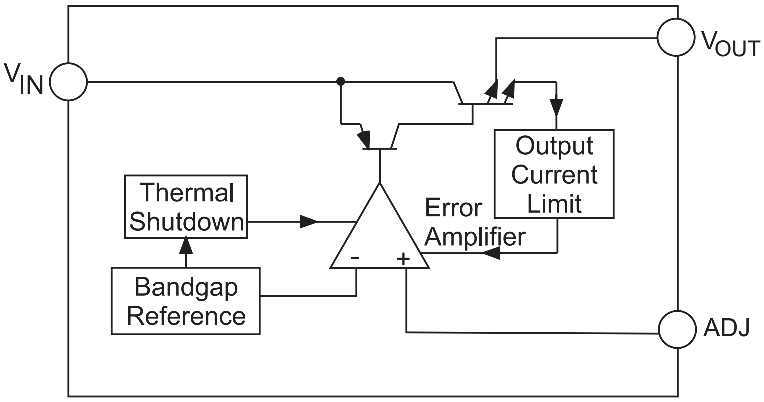
ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	VALUE	UNIT
Power Dissipation	P_D	Internally limited	W
Input Voltage	V_{IN}	15	V
Junction Temperature	T_J	150	C
Lead Temperature(Soldering, 10sec)	T_{LEAD}	300	C
Storage Temperature Range	T_{STG}	-65 to 150	C
ESD Damage Threshold	ESD	2.0	kV

BLOCK DIAGRAM



(Fixed Version)



(Adjustable Version)

ELECTRICAL CHARACTERISTICS

(Typicals and limits appearing in normal type apply for T_J = 25C)

Parameter		Symbol	Condition	Min	Typ	Max	Unit
Reference Voltage (Note 1)	GL1086-Adj	V_{REF}	I_{OUT}=10mA, V_{IN}-V_{OUT}=1.5V	1.238	1.250	1.262	V
			V_{IN}-V_{OUT} = 1.5V to 10V I_{OUT} = 10mA to 1.5A	1.225	1.250	1.275	
Output Voltage (Note 1)	All Fixed Versions	V_{OUT}	I_{OUT}=10mA, V_{IN}-V_{OUT}=1.5V	-1	-	+1	%
			V_{IN}-V_{OUT} = 1.5V to 10V I_{OUT} = 10mA to 1.5A	-2	-	+2	
Line Regulation	All	REG_{LINE}	V_{IN}-V_{OUT} = 1.5V to 10V I_{OUT} = 10mA		0.04	0.20	%
Load Regulation	All	REG_{LOAD}	V_{IN}-V_{OUT} = 1.5V I_{OUT} = 10mA to 1.5A		0.20	0.40	%
Dropout Voltage(Note 1,3)		V_D	I_{OUT}=1.5A		1.3	1.5	V
Current Limit		I_{CL}	V_{IN}-V_{OUT}=1.5V	1.5	2.2		A
Minimum Load Current	GL1086-Adj	$I_{O\ MIN}$	V_{IN}=5V, V_{ADJ}=0V		3	7	mA
Quiescent Current	All Fixed Versions	I_Q	V_{IN}-V_{OUT} = 1.5V I_{OUT} = 10mA to 1.5A		7	10	mA
Adjust Pin Current	GL1086-Adj	I_{ADJ}	V_{IN}-V_{OUT} = 1.5V to 10V I_{OUT} = 10mA		40	90	uA
Temperature Coefficient		T_C	V_{IN}-V_{OUT}=1.5V, I_{OUT}=10mA		0.005		%/C
Ripple Rejection(Note 2)		R_A	V_{IN}-V_{OUT}=3V, I_{OUT}=1.5A	60	65		dB

Notes:

1: Low duty pluse testing with Kelvin connections required.

2: 120Hz input ripple (C_{ADJ} for ADJ = 25uF, C_{OUT}=25uF)

3: $\triangle V_{OUT}$, $\triangle V_{REF}$ = 1%

APPLICATION INFORMATION

GL1086 series linear regulators provide fixed and adjustable output voltages at currents up to 1.5A. These regulators are protected against over-current conditions and include thermal shutdown protection. GL1086 has a composite PNP-NPN output transistor and require an output capacitor for stability.

A detailed procedure for selecting this capacitor is a followed.

Stability Considerations

The output compensation capacitor helps to determine three main characteristics of a linear regulator's performance: start-up delay, load transient response, and loop stability. The capacitor value and type is based on cost, availability, size, and temperature constraints. A tantalum or aluminum electrolytic capacitor is preferred, as a film or ceramic capacitor with almost zero ESR can cause instability. An aluminum electrolytic capacitor is the least expensive type. But when the circuit operates at low temperatures, both the value and ESR of the capacitor will vary widely. For optimum performance over the full operating temperature range, a tantalum capacitor is the best. A 22uF tantalum capacitor will work fine in most applications. But with high current regulators, such as GL1086, higher capacitance values will improve the transient response and stability. Most applications for the GL1086 involve large changes in load current, so the output capacitor must supply instantaneous load current. The ESR of the output capacitor causes an immediate drop in output voltage given by:

$$\Delta V = \Delta I \times ESD$$

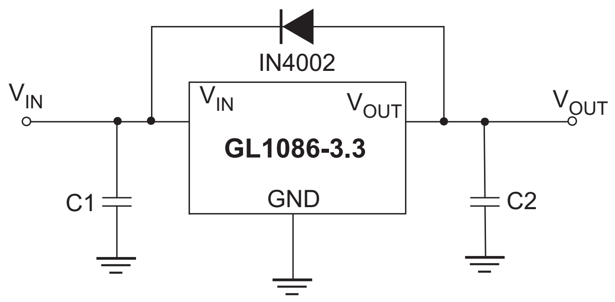
In microprocessor applications, an output capacitor network of several tantalum and ceramic capacitors in parallel is commonly used. This reduces overall ESR and minimizes the instantaneous output voltage drop under transient load conditions. The output capacitor network should be placed as close to the load as possible for the best results.

Protection Diodes

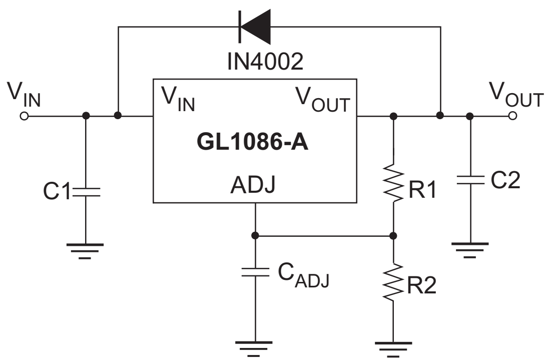
When large external capacitors are used with most linear regulator, it is wise to add protection diodes. If the input voltage of the regulator is shorted, the output capacitor will discharge into the output of the regulator. The discharge current depends on the value of capacitor, output voltage, and rate at which V_{IN} drops.

Figure 1 [(a),(b)] Protection Diode Scheme for Large Output Capacitors

(a) Fixed Version



(b) Adjustable Version



In GL1086 linear regulators, the discharge path is through a large junction, and protection diodes are normally not needed. However, if the regulator is used with large output capacitance values and the input voltage is instantaneously shorted to ground, damage can occur. In this case, a diode connected as shown above in Figure 1.

Output Voltage Sensing

GL1086 series is three terminal regulator, so they cannot provide true remote load sensing. Load regulation is limited by the resistance of the conductors connecting the regulator to the load. For best results, GM66015 should be connected as shown in Figure 2.

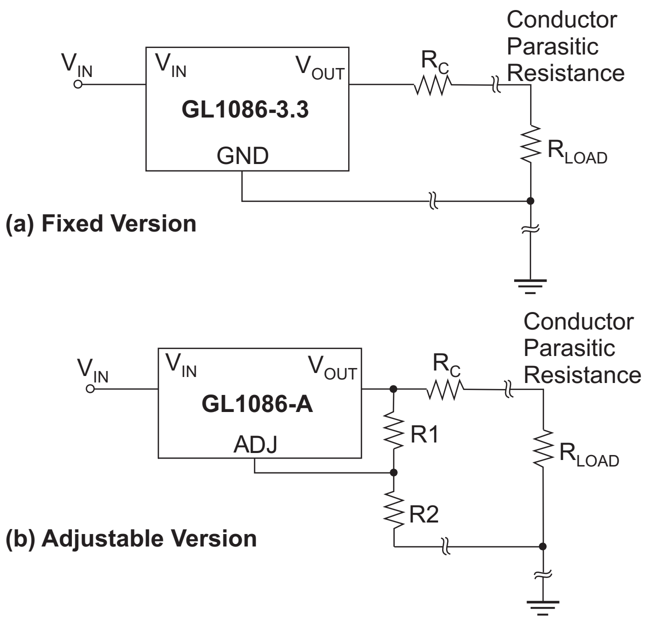


Figure 2 (a),(b) Conductor Parasitic Resistance Effects are Minimized by this Grounding Scheme For Fixed and Adjustable Output Regulators

Calculating Power Dissipation and Heat Sink Requirements

GL1086 series precision linear regulators include thermal shutdown and current limit circuitry to protect the devices. However, high power regulators normally operate at high junction temperatures so it is important to calculate the power dissipation and junction temperatures accurately to be sure that you use and adequate heat sink. The case is connected to V_{OUT} on GL1086 so electrical isolation may be required for some applications. Thermal compound should always be used with high current regulators like GL1086.

The thermal characteristics of an IC depend on four factors:

1. Maximum Ambient Temperature T_A (C)
2. Power Dissipation P_D (Watts)
3. Maximum Junction Temperature T_J(C)
4. Thermal Resistance Junction to ambient R_{QJA} (C/W)

These relationship of these four factors is expressed by equation (1):

$$T_J = T_A + P_D \times R_{\Theta JA} \text{ ....(1)}$$

Maximum ambient temperature and power dissipation are determined by the design while the maximum junction temperature and thermal resistance depend on the manufacturer and the package type.

The maximum power dissipation for a regulator is expressed by equation (2):

$$P_{D(max)} = \{ V_{IN(max)} - V_{OUT(min)} \} I_{OUT(max)} + V_{IN(max)} I_Q \text{ ....(2)}$$

where:

$V_{IN(max)}$ is the maximum input voltage,
$V_{OUT(min)}$ is the minimum output voltage,
$I_{OUT(max)}$ is the maximum output current
I_Q is the maximum quiescent current at $I_{OUT(max)}$.

A heat sink effectively increases the surface area of the package to improve the flow of heat away from the IC into the air. Each material in the heat flow path between the IC and the environment has a thermal resistance. Like series electrical resistances, these resistance are summed to determine R_{QJA}, the total thermal resistance between the junction and the air. This is expressed by equation (3):

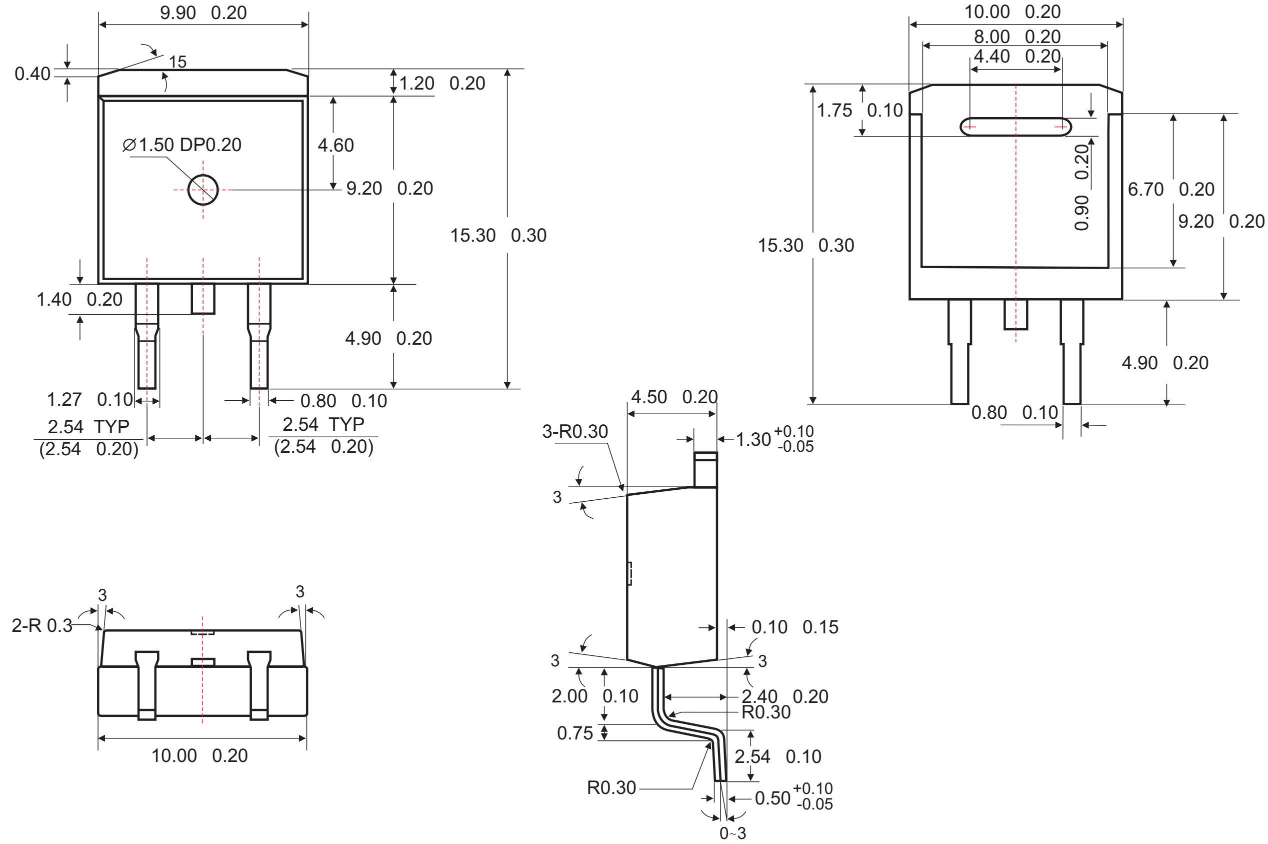
$$R_{\Theta JA} = R_{\Theta JC} + R_{\Theta CS} + R_{\Theta SA} \text{ ....(3)}$$

Where all of the following are in C/W:

R_{QJC} is thermal resistance of junction to case,
R_{QCS} is thermal resistance of case to heat sink,
R_{QSA} is thermal resistance of heat sink to ambient air

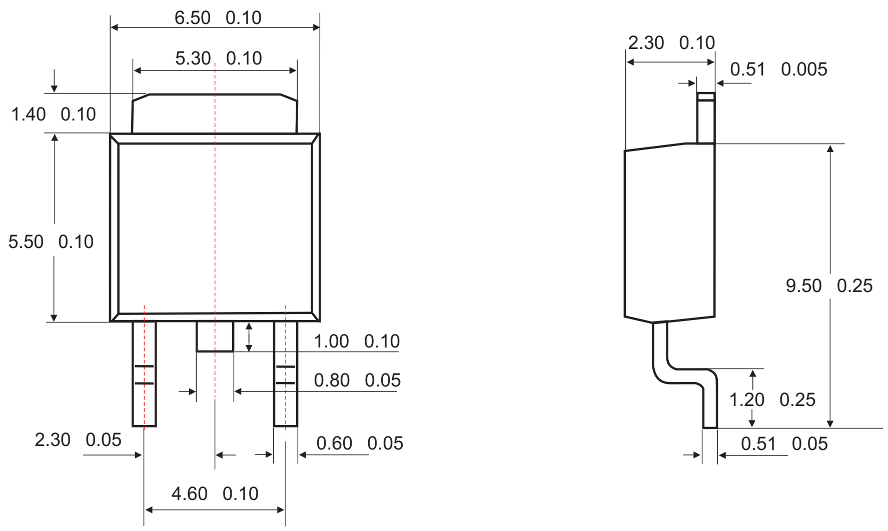
The value for R_{QJA} is calculated using equation (3) and the result can be substituted in equation (1). The value for R_{QJC} is 3.5C/W for a given package type based on an average die size. For a high current regulator such as GL1086, the majority of the heat is generated in the power transistor section.

TO-263-2 PACKAGE OUTLINE DIMENSIONS



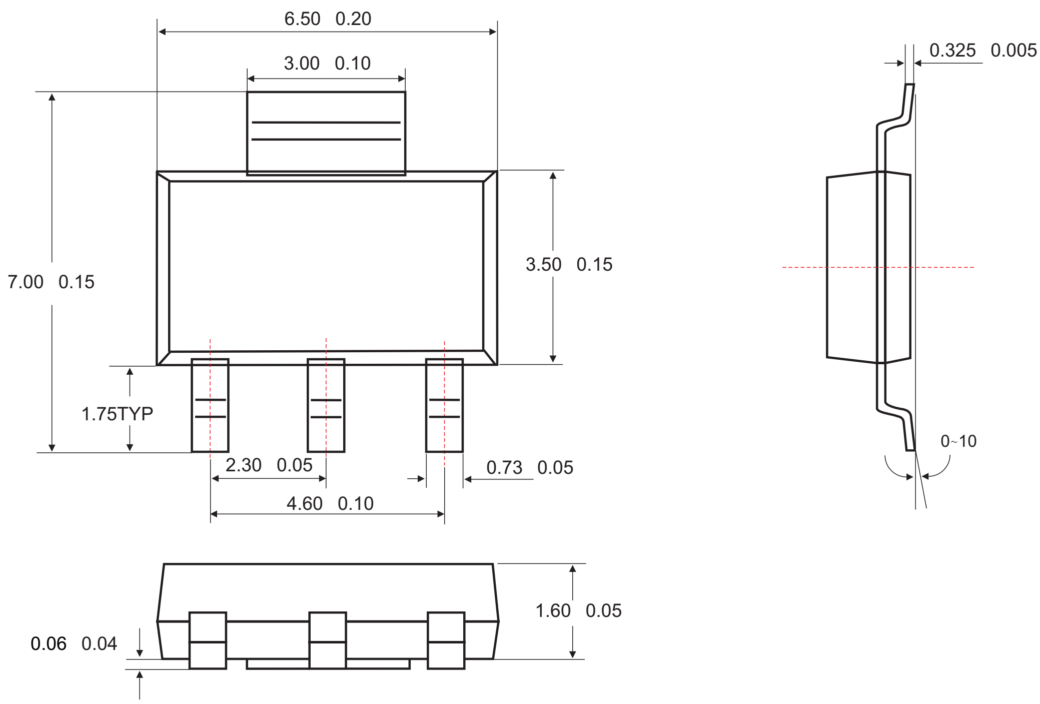
Unit: mm

TO-252-3 PACKAGE OUTLINE DIMENSIONS



Unit: mm

SOT- 223 PACKAGE OUTLINE DIMENSIONS



Unit: mm

ORDERING NUMBER