

## Description

GM6250 combine high accuracy with very low power consumption, and provides high output current even when the application requires extremely low input-output voltage differential.

GM6250 includes a precision voltage reference, an error correction circuit, over-temperature protection, and a current limited output driver. Fast transient response to load variations provides excellent stability under dynamic load conditions.

GM6250 comes in SOT-23 (150mW), SOT-89 (500mW) and TO-92 packages.

## Features

- ◆ **Maximum output current 250mA (within maximum power dissipation)**
- ◆ **Output voltage: from 1.8 V to 5.0V in 0.1V increments**
- ◆ **Output voltage  $\pm 2\%$**
- ◆ **CMOS low power consumption, typically 1.0 $\mu$ A at  $V_{OUT} = 5.0V$**
- ◆ **Input stability typically 0.2%/V**
- ◆ **Ultra-low dropout voltage 0.38V @  $I_{OUT} = 200mA$  at  $V_{OUT} = 5.0V$**
- ◆ **Small input/ output differential: 0.4V at 160mA ( $V_{OUT} = 3.3V$ )**
- ◆ **SOT-23 (150mW), SOT-89 (500mW) and TO-92 packages**

## Application

Palmtops

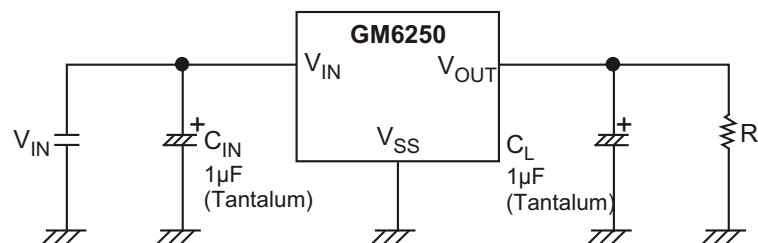
Portable Cameras

Video Recorders

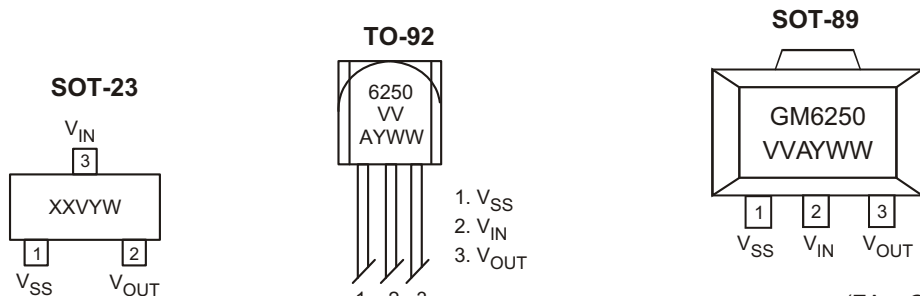
Battery Powered Equipment

Reference Voltage Sources

## TYPICAL APPLICATION CIRCUITS



◆ MARKING INFORMATION & PIN CONFIGURATIONS (TOP VIEW)



XX = Marking Code(EA = GM6250)  
 V = Voltage Code  
 VV = Voltage Suffix (18=1.8V, 50=5.0V)  
 A = Assembly Location  
 Y = Year  
 WW, W= Weekly

◆ ORDERING INFORMATION (Continued)

Ordering Number	Output Voltage	Voltage Code	Package	Shipping
GM6250-1.5T92B	1.5V		TO-92	1,000 Units/ ESD Bag
GM6250-1.5T92RL	1.5V		TO-92	2,000 Units/ Ammo Pack (Tape)
GM6250-1.5ST23R	1.5V	C	SOT-23	3,000 Units/ Tape and Reel
GM6250-1.5ST89R	1.5V		SOT-89	1,000 Units/ Tape and Reel
GM6250-1.8T92B	1.8V		TO-92	1,000 Units/ ESD Bag
GM6250-1.8T92RL	1.8V		TO-92	2,000 Units/ Ammo Pack (Tape)
GM6250-1.8ST23R	1.8V	E	SOT-23	3,000 Units/ Tape and Reel
GM6250-1.8ST89R	1.8V		SOT-89	1,000 Units/ Tape and Reel
GM6250-2.5T92B	2.5V		TO-92	1,000 Units/ ESD Bag
GM6250-2.5T92RL	2.5V		TO-92	2,000 Units/ Ammo Pack (Tape)
GM6250-2.5ST23R	2.5V	G	SOT-23	3,000 Units/ Tape and Reel
GM6250-2.5ST89R	2.5V		SOT-89	1,000 Units/ Tape and Reel
GM6250-2.7T92B	2.7V		TO-92	1,000 Units/ ESD Bag
GM6250-2.7T92RL	2.7V		TO-92	2,000 Units/ Ammo Pack (Tape)
GM6250-2.7ST23R	2.7V	T	SOT-23	3,000 Units/ Tape and Reel
GM6250-2.7ST89R	2.7V		SOT-89	1,000 Units/ Tape and Reel
GM6250-2.8T92B	2.8V		TO-92	1,000 Units/ ESD Bag
GM6250-2.8T92RL	2.8V		TO-92	2,000 Units/ Ammo Pack (Tape)
GM6250-2.8ST23R	2.8V	H	SOT-23	3,000 Units/ Tape and Reel
GM6250-2.8ST89R	2.8V		SOT-89	1,000 Units/ Tape and Reel
GM6250-2.85T92B	2.85V		TO-92	1,000 Units/ ESD Bag
GM6250-2.85T92RL	2.85V		TO-92	2,000 Units/ Ammo Pack (Tape)
GM6250-2.85ST23R	2.85V	I	SOT-23	3,000 Units/ Tape and Reel
GM6250-2.85ST89R	2.85V		SOT-89	1,000 Units/ Tape and Reel
GM6250-3.0T92B	3.0V		TO-92	1,000 Units/ ESD Bag
GM6250-3.0T92RL	3.0V		TO-92	2,000 Units/ Ammo Pack (Tape)
GM6250-3.0ST23R	3.0V	J	SOT-23	3,000 Units/ Tape and Reel
GM6250-3.0ST89R	3.0V		SOT-89	1,000 Units/ Tape and Reel

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

#### ◆ ORDERING INFORMATION (Continued)

Ordering Number	Output Voltage	Voltage Code	Package	Shipping
GM6250-3.2T92B	3.2V		TO-92	1,000 Units/ ESD Bag
GM6250-3.2T92RL	3.2V		TO-92	2,000 Units/ Ammo Pack (Tape)
GM6250-3.2ST23R	3.2V	U	SOT-23	3,000 Units/ Tape and Reel
GM6250-3.2ST89R	3.2V		SOT-89	1,000 Units/ Tape and Reel
GM6250-3.3T92B	3.3V		TO-92	1,000 Units/ ESD Bag
GM6250-3.3T92RL	3.3V		TO-92	2,000 Units/ Ammo Pack (Tape)
GM6250-3.3ST23R	3.3V	K	SOT-23	3,000 Units/ Tape and Reel
GM6250-3.3ST89R	3.3V		SOT-89	1,000 Units/ Tape and Reel
GM6250-3.5T92B	3.5V		TO-92	1,000 Units/ ESD Bag
GM6250-3.5T92RL	3.5V		TO-92	2,000 Units/ Ammo Pack (Tape)
GM6250-3.5ST23R	3.5V	V	SOT-23	3,000 Units/ Tape and Reel
GM6250-3.5ST89R	3.5V		SOT-89	1,000 Units/ Tape and Reel
GM6250-3.6T92B	3.6V		TO-92	1,000 Units/ ESD Bag
GM6250-3.6T92RL	3.6V		TO-92	2,000 Units/ Ammo Pack (Tape)
GM6250-3.6ST23R	3.6V	L	SOT-23	3,000 Units/ Tape and Reel
GM6250-3.6ST89R	3.6V		SOT-89	1,000 Units/ Tape and Reel
GM6250-4.0T92B	4.0V		TO-92	1,000 Units/ ESD Bag
GM6250-4.0T92RL	4.0V		TO-92	2,000 Units/ Ammo Pack (Tape)
GM6250-4.0ST23R	4.0V	M	SOT-23	3,000 Units/ Tape and Reel
GM6250-4.0ST89R	4.0V		SOT-89	1,000 Units/ Tape and Reel
GM6250-4.4T92B	4.4V		TO-92	1,000 Units/ ESD Bag
GM6250-4.4T92RL	4.4V		TO-92	2,000 Units/ Ammo Pack (Tape)
GM6250-4.4ST23R	4.4V	W	SOT-23	3,000 Units/ Tape and Reel
GM6250-4.4ST89R	4.4V		SOT-89	1,000 Units/ Tape and Reel
GM6250-4.5T92B	4.5V		TO-92	1,000 Units/ ESD Bag
GM6250-4.5T92RL	4.5V		TO-92	2,000 Units/ Ammo Pack (Tape)
GM6250-4.5ST23R	4.5V	N	SOT-23	3,000 Units/ Tape and Reel
GM6250-4.5ST89R	4.5V		SOT-89	1,000 Units/ Tape and Reel
GM6250-5.0T92B	5.0V		TO-92	1,000 Units/ ESD Bag
GM6250-5.0T92RL	5.0V		TO-92	2,000 Units/ Ammo Pack (Tape)
GM6250-5.0ST23R	5.0V	Q	SOT-23	3,000 Units/ Tape and Reel
GM6250-5.0ST89R	5.0V		SOT-89	1,000 Units/ Tape and Reel

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

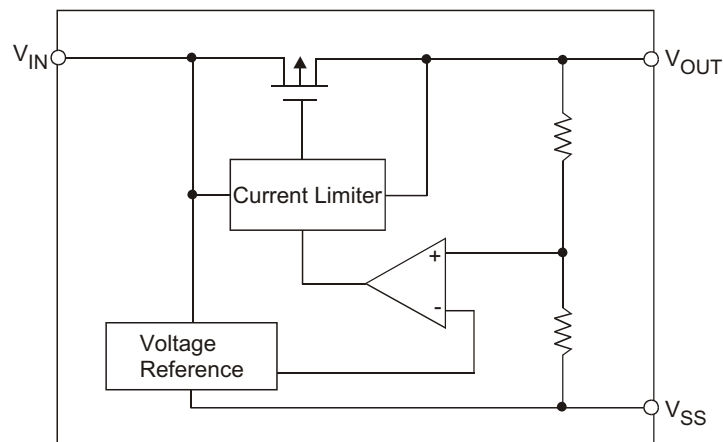
### ◆ ABSOLUTE MAXIMUM RATINGS

PARAMETER		SYMBOL	RATINGS	UNITS
Input Voltage		$V_{IN}$	12	V
Output Current		$I_{OUT}$	500	mA
Output Voltage		$V_{OUT}$	$V_{SS} - 0.3 \sim V_{IN} + 0.3$	V
Continuous Total Power Dissipation	SOT - 23	$P_D$	150	mW
	SOT - 89		500	
	TO - 92		300	
Operating Ambient Temperature		$T_{opr}$	-30 ~ +80	°C
Storage Temperature		$T_{stg}$	-40 ~ +125	°C

### ◆ Thermal Information

PARAMETER		Maximum	Unit
Thermal Resistance $R_{\theta jc}$	SOT-89	100	°C/W
Thermal Resistance $R_{\theta ja}$		300	°C/W

### ◆ BLOCK DIAGRAM



◆ **ELECTRICAL CHARACTERISTICS** ( $T_A = 25^\circ\text{C}$  unless otherwise noted)

Parameter		Symbol	Condition	Min	Typ	Max	Unit	Circuit
Output Voltage	GM6250-1.5V	$V_{OUT(E)}$ <sup>(Note 2)</sup>	$I_{OUT}=40\text{mA}$ , $V_{IN} > V_{Drop} + V_{OUT}$	1.470	1.500	1.530	V	1
	GM6250-1.8V			1.764	1.800	1.836		
	GM6250-2.5V			2.450	2.500	2.550		
	GM6250-2.7V			2.646	2.700	2.754		
	GM6250-2.8V			2.744	2.800	2.856		
	GM6250-3.0V			2.940	3.000	3.060		
	GM6250-3.2V			3.136	3.200	3.264		
	GM6250-3.3V			3.234	3.300	3.366		
	GM6250-3.5V			3.430	3.500	3.570		
	GM6250-3.6V			3.528	3.600	3.672		
	GM6250-4.0V			3.920	4.000	4.080		
	GM6250-4.4V			4.312	4.400	4.488		
	GM6250-4.5V			4.410	4.500	4.590		
	GM6250-5.0V			4.900	5.000	5.100		
Maximum Output Current	GM6250-1.5V	$I_{OUT\ max}$	$V_{IN}=3.0\text{V}$ , $V_{OUT(E)} \geq 1.35\text{V}$	250			mA	1
	GM6250-1.8V		$V_{IN}=3.0\text{V}$ , $V_{OUT(E)} \geq 1.62\text{V}$					
	GM6250-2.5V		$V_{IN}=4.0\text{V}$ , $V_{OUT(E)} \geq 2.3\text{V}$					
	GM6250-2.7V		$V_{IN}=4.0\text{V}$ , $V_{OUT(E)} \geq 2.43\text{V}$					
	GM6250-2.8V		$V_{IN}=4.0\text{V}$ , $V_{OUT(E)} \geq 2.52\text{V}$					
	GM6250-3.0V		$V_{IN}=4.0\text{V}$ , $V_{OUT(E)} \geq 2.7\text{V}$					
	GM6250-3.2V		$V_{IN}=4.0\text{V}$ , $V_{OUT(E)} \geq 2.88\text{V}$					
	GM6250-3.3V		$V_{IN}=4.0\text{V}$ , $V_{OUT(E)} \geq 2.97\text{V}$					
	GM6250-3.5V		$V_{IN}=5.0\text{V}$ , $V_{OUT(E)} \geq 3.15\text{V}$					
	GM6250-3.6V		$V_{IN}=5.0\text{V}$ , $V_{OUT(E)} \geq 3.24\text{V}$					
	GM6250-4.0V		$V_{IN}=5.0\text{V}$ , $V_{OUT(E)} \geq 3.6\text{V}$					
	GM6250-4.4V		$V_{IN}=6.0\text{V}$ , $V_{OUT(E)} \geq 3.96\text{V}$					
	GM6250-4.5V		$V_{IN}=6.0\text{V}$ , $V_{OUT(E)} \geq 4.05\text{V}$					
	GM6250-5.0V		$V_{IN}=6.0\text{V}$ , $V_{OUT(E)} \geq 4.5\text{V}$					

◆ ELECTRICAL CHARACTERISTICS ( $T_A = 25^\circ\text{C}$  unless otherwise noted)

Parameter	Symbol	Condition	Min	Typ	Max	Unit	Circuit	
Load Stability	GM6250-1.5V	$V_{OUT}$	$V_{IN}=2.5\text{V}, 1\text{mA} \leq I_{OUT} \leq 60\text{mA}$		45	90	mV	1
	GM6250-1.8V		$V_{IN}=2.8\text{V}, 1\text{mA} \leq I_{OUT} \leq 60\text{mA}$		45	90		
	GM6250-2.5V		$V_{IN}=3.5\text{V}, 1\text{mA} \leq I_{OUT} \leq 80\text{mA}$		45	90		
	GM6250-2.7V		$V_{IN}=3.7\text{V}, 1\text{mA} \leq I_{OUT} \leq 80\text{mA}$		45	90		
	GM6250-2.8V		$V_{IN}=3.8\text{V}, 1\text{mA} \leq I_{OUT} \leq 80\text{mA}$		45	90		
	GM6250-3.0V		$V_{IN}=4.0\text{V}, 1\text{mA} \leq I_{OUT} \leq 80\text{mA}$		45	90		
	GM6250-3.2V		$V_{IN}=4.2\text{V}, 1\text{mA} \leq I_{OUT} \leq 80\text{mA}$		45	90		
	GM6250-3.3V		$V_{IN}=4.3\text{V}, 1\text{mA} \leq I_{OUT} \leq 100\text{mA}$		45	90		
	GM6250-3.5V		$V_{IN}=4.5\text{V}, 1\text{mA} \leq I_{OUT} \leq 100\text{mA}$		45	90		
	GM6250-3.6V		$V_{IN}=4.6\text{V}, 1\text{mA} \leq I_{OUT} \leq 100\text{mA}$		45	90		
	GM6250-4.0V		$V_{IN}=5.0\text{V}, 1\text{mA} \leq I_{OUT} \leq 100\text{mA}$		40	80		
	GM6250-4.4V		$V_{IN}=5.4\text{V}, 1\text{mA} \leq I_{OUT} \leq 100\text{mA}$		40	80		
	GM6250-4.5V		$V_{IN}=4.5\text{V}, 1\text{mA} \leq I_{OUT} \leq 100\text{mA}$		40	80		
	GM6250-5.0V		$V_{IN}=6.0\text{V}, 1\text{mA} \leq I_{OUT} \leq 100\text{mA}$		40	80		
Input - Output Voltage Differential (Note 3)	GM6250-1.5V	Vdif1	$I_{OUT} = 40\text{mA}$		180	360	mV	1
		Vdif2	$I_{OUT} = 160\text{mA}$		900	1300		
	GM6250-1.8V	Vdif1	$I_{OUT} = 60\text{mA}$		180	360		
		Vdif2	$I_{OUT} = 160\text{mA}$		900	1300		
	GM6250-2.5V	Vdif1	$I_{OUT} = 80\text{mA}$		180	360		
		Vdif2	$I_{OUT} = 160\text{mA}$		550	850		
	GM6250-2.7V	Vdif1	$I_{OUT} = 80\text{mA}$		180	360		
		Vdif2	$I_{OUT} = 160\text{mA}$		400	700		
	GM6250-2.8V	Vdif1	$I_{OUT} = 80\text{mA}$		180	360		
		Vdif2	$I_{OUT} = 160\text{mA}$		400	700		
	GM6250-3.0V	Vdif1	$I_{OUT} = 80\text{mA}$		180	360		
		Vdif2	$I_{OUT} = 160\text{mA}$		400	700		
	GM6250-3.2V	Vdif1	$I_{OUT} = 80\text{mA}$		180	360		
		Vdif2	$I_{OUT} = 160\text{mA}$		400	700		
	GM6250-3.3V	Vdif1	$I_{OUT} = 100\text{mA}$		170	330		
		Vdif2	$I_{OUT} = 200\text{mA}$		400	630		
	GM6250-3.5V	Vdif1	$I_{OUT} = 100\text{mA}$		120	300		
		Vdif2	$I_{OUT} = 200\text{mA}$		380	600		
	GM6250-3.6V	Vdif1	$I_{OUT} = 100\text{mA}$		120	300		
		Vdif2	$I_{OUT} = 200\text{mA}$		380	600		
	GM6250-4.0V	Vdif1	$I_{OUT} = 100\text{mA}$		170	330		
		Vdif2	$I_{OUT} = 200\text{mA}$		400	630		
	GM6250-4.4V	Vdif1	$I_{OUT} = 100\text{mA}$		120	300		
		Vdif2	$I_{OUT} = 200\text{mA}$		380	600		
GM6250-4.5V	Vdif1	$I_{OUT} = 100\text{mA}$		120	300			
	Vdif2	$I_{OUT} = 200\text{mA}$		380	600			
GM6250-5.0V	Vdif1	$I_{OUT} = 100\text{mA}$		120	300			
	Vdif2	$I_{OUT} = 200\text{mA}$		380	600			

◆ **ELECTRICAL CHARACTERISTICS** ( $T_A = 25^\circ\text{C}$  unless otherwise noted)

Parameter	Symbol	Condition	Min	Typ	Max	Unit	Circuit
Supply Current	$I_{SS}$	$V_{IN} = 1.5\text{V}$					
		$V_{IN} = 2.8\text{V}$					
		$V_{IN} = 3.5\text{V}$					
		$V_{IN} = 3.7\text{V}$					
		$V_{IN} = 3.8\text{V}$					
		$V_{IN} = 4.0\text{V}$					
		$V_{IN} = 4.2\text{V}$					
		$V_{IN} = 4.3\text{V}$		1.0	2.9	$\mu\text{A}$	2
		$V_{IN} = 4.5\text{V}$					
		$V_{IN} = 4.6\text{V}$					
		$V_{IN} = 5.0\text{V}$					
		$V_{IN} = 5.4\text{V}$					
		$V_{IN} = 5.5\text{V}$					
		$V_{IN} = 6.0\text{V}$					
Output Current Limit				500		mA	-
Input Stability	$\frac{V_{OUT}}{V_{IN} \cdot V_{OUT}}$	$I_{OUT} = 40\text{mA}$ $2.5\text{V} \leq V_{IN} \leq 10.0\text{V}$					
		$I_{OUT} = 40\text{mA}$ $2.8\text{V} \leq V_{IN} \leq 10.0\text{V}$					
		$I_{OUT} = 40\text{mA}$ $3.5\text{V} \leq V_{IN} \leq 10.0\text{V}$					
		$I_{OUT} = 40\text{mA}$ $3.7\text{V} \leq V_{IN} \leq 10.0\text{V}$					
		$I_{OUT} = 40\text{mA}$ $3.8\text{V} \leq V_{IN} \leq 10.0\text{V}$					
		$I_{OUT} = 40\text{mA}$ $4.0\text{V} \leq V_{IN} \leq 10.0\text{V}$					
		$I_{OUT} = 40\text{mA}$ $4.2\text{V} \leq V_{IN} \leq 10.0\text{V}$					
		$I_{OUT} = 40\text{mA}$ $4.3\text{V} \leq V_{IN} \leq 10.0\text{V}$		0.2	0.3	%/V	1
		$I_{OUT} = 40\text{mA}$ $4.5\text{V} \leq V_{IN} \leq 10.0\text{V}$					
		$I_{OUT} = 40\text{mA}$ $4.6\text{V} \leq V_{IN} \leq 10.0\text{V}$					
		$I_{OUT} = 40\text{mA}$ $5.0\text{V} \leq V_{IN} \leq 10.0\text{V}$					
		$I_{OUT} = 40\text{mA}$ $5.4\text{V} \leq V_{IN} \leq 10.0\text{V}$					
		$I_{OUT} = 40\text{mA}$ $5.5\text{V} \leq V_{IN} \leq 10.0\text{V}$					
		$I_{OUT} = 40\text{mA}$ $6.0\text{V} \leq V_{IN} \leq 10.0\text{V}$					
Input Voltage	$V_{IN}$				10	V	-
Output Voltage Temperature Characteristics	$\frac{V_{OUT}}{T_{opr} \cdot V_{OUT}}$	$I_{OUT} = 10\text{mA}$ $-30^\circ\text{C} \leq T_{opr} \leq 80^\circ\text{C}$		$\pm 100$		ppm/ $^\circ\text{C}$	1

- Note:**
- $V_{OUT}(T)$  = Specified Output Voltage
  - $V_{OUT}(E)$  = Effective Output Voltage (the output voltage when " $V_{OUT}(T) + 1.0\text{V}$ " is provided at the  $V_{IN}$  pin while maintaining a certain  $I_{OUT}$  value)
  - $V_{dif} = \{ V_{IN1} (\text{Note 4}) - V_{OUT}(E) \}$
  - $V_{IN1}$  = The input voltage at the time 98% of  $V_{OUT}(E)$  is output (input voltage has been gradually reduced).
- \* Output Voltage from 1.8V to 6.0V in 0.1V increments are available

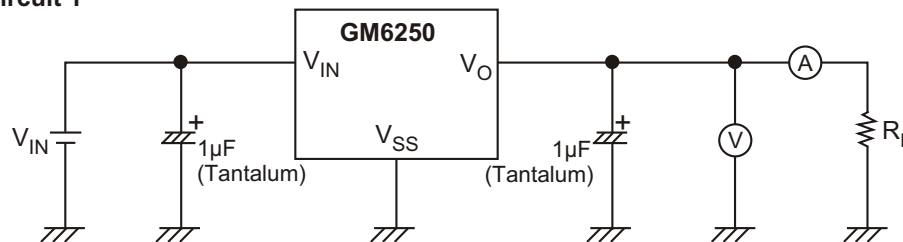
## ◆ DIRECTIONS FOR USAGE

### Notes on Usage

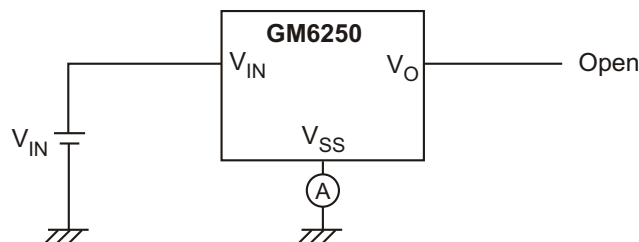
1. Please use this IC within the stipulated absolute maximum ratings as the IC is liable to malfunction outside of such parameters.
2. There is a possibility that, oscillation may occur as a result of the impedance present between the power supply and the IC's input. Where impedance is 10  $\Omega$  or more, please use a capacitor ( $C_{IN}$ ) of at least 1 $\mu$ F.  
With a large output current, operations can be stabilised by increasing capacitor size ( $C_{IN}$ ). If  $C_{IN}$  is small and capacitor size ( $C_L$ ) is increased, there is a possibility of oscillation due to input impedance. In such cases, operations can be stabilised by either increasing the size of  $C_{IN}$  or decreasing the size of  $C_L$ .
3. Please ensure the output current ( $I_{OUT}$ ) is less than  $P_d \div (V_{IN} - V_{OUT})$  and does not exceed the stipulated continuous total power dissipation value ( $P_d$ ) for the package.

## ◆ TEST CIRCUIT

Circuit 1



Circuit 2



## ◆ CALCULATING POWER DISSIPATION

The GM6250 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 an adequate heat sink.

The thermal characteristics of an IC depend on four factors:

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

These relationships of these four factors is expressed by equation (1):  $T_J = T_A + P_D \times R_{JA}$

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.



◆ PERFORMANCE CHARACTERISTICS FOR GM6250 - 3.0

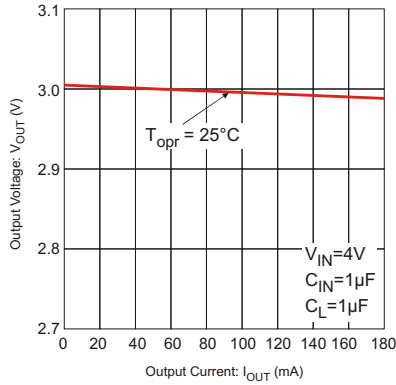


Figure 1: Output Voltage vs. Output Current

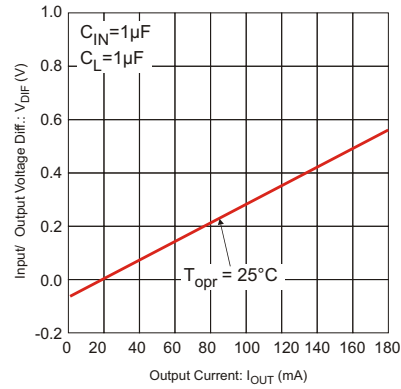


Figure 2: Input/ Output Voltage differential vs. Output Current

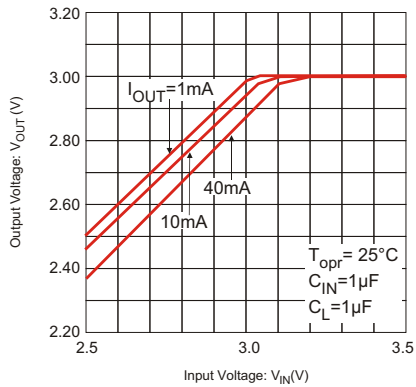


Figure 3: Output Voltage vs. Input voltage

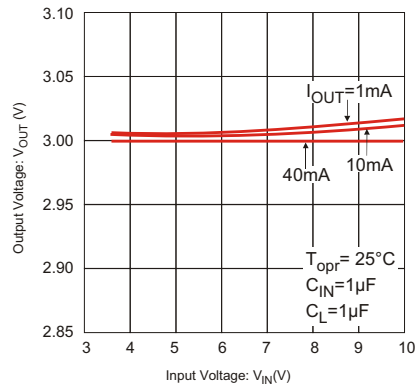


Figure 4: Output Voltage vs. Input voltage

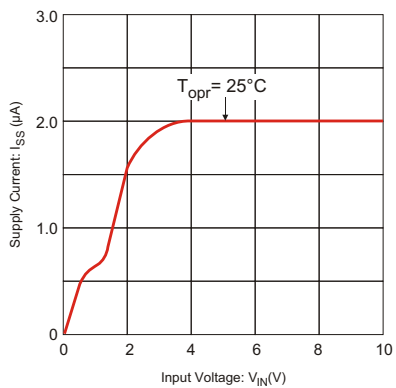


Figure 5: Supply Current vs. Input Voltage

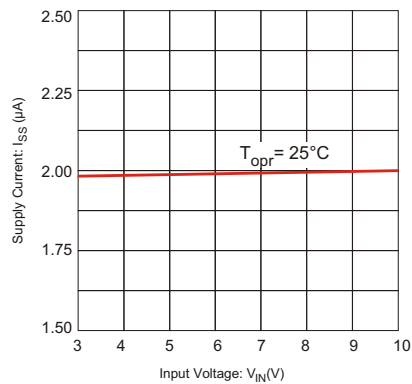


Figure 6: Supply Current vs. Input Voltage

◆ PERFORMANCE CHARACTERISTICS FOR GM6250 - 3.0

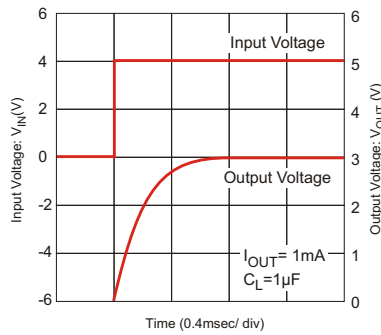


Figure 7: Input Transient Response 1

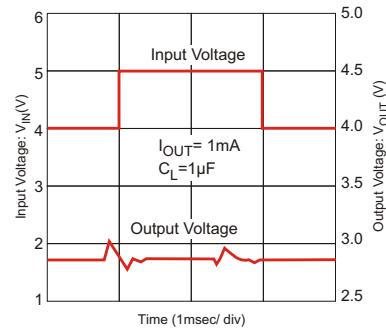


Figure 8: Input Transient Response 2

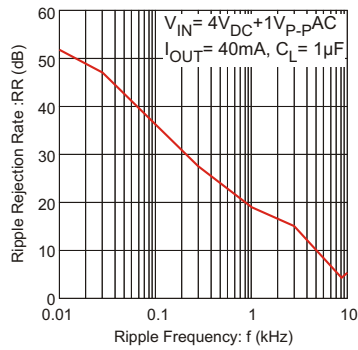
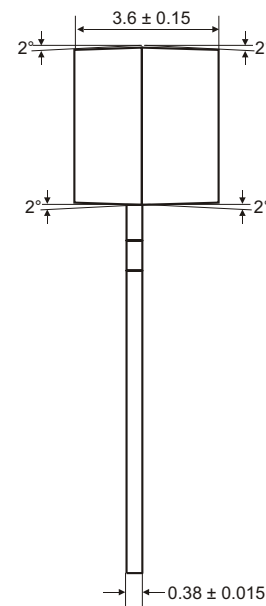
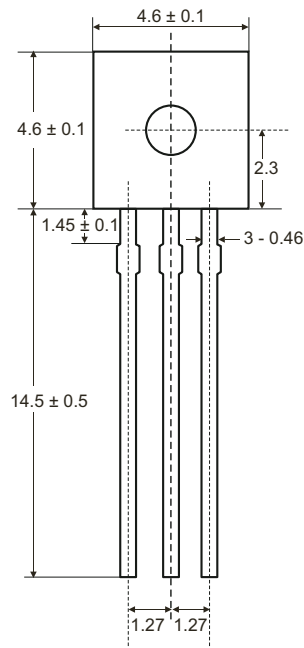
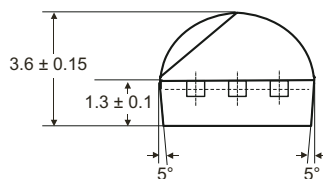


Figure 9: Ripple Rejection Rate

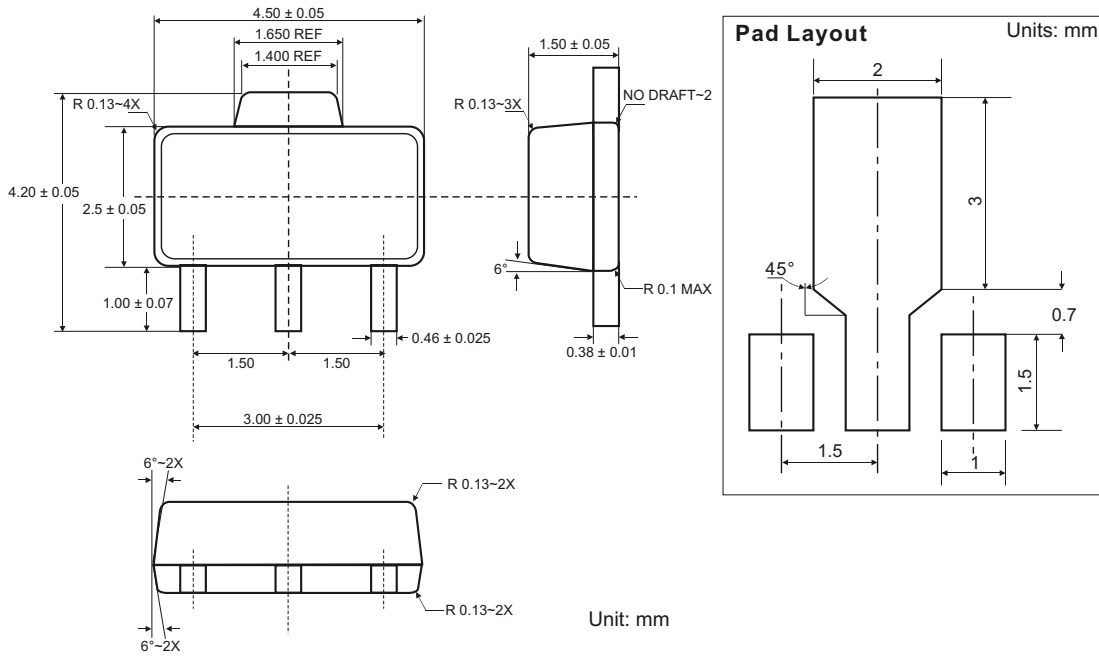
◆ TO-92 PACKAGE OUTLINE DIMENSIONS



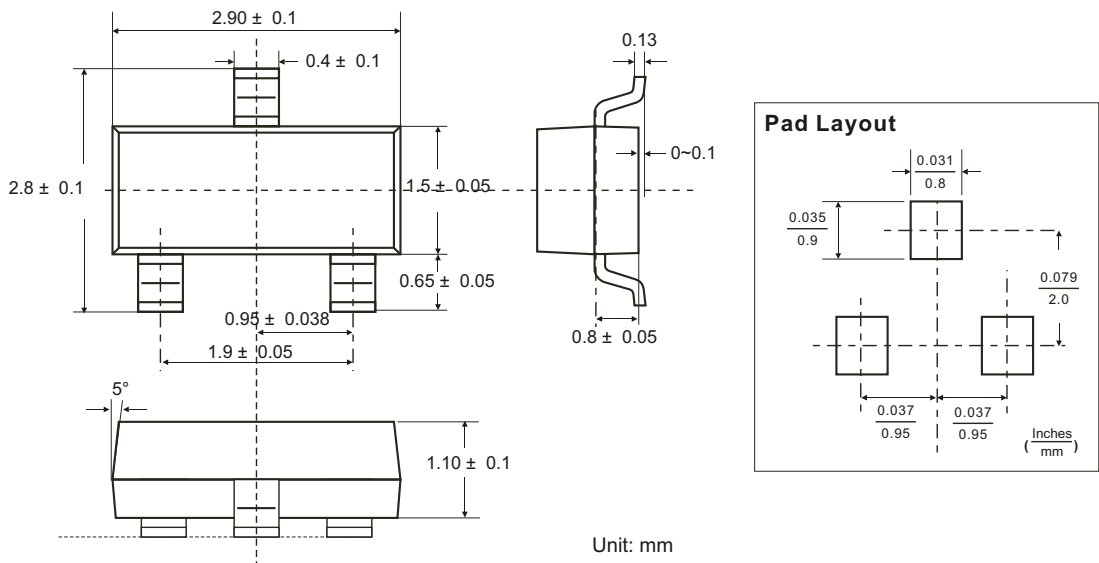
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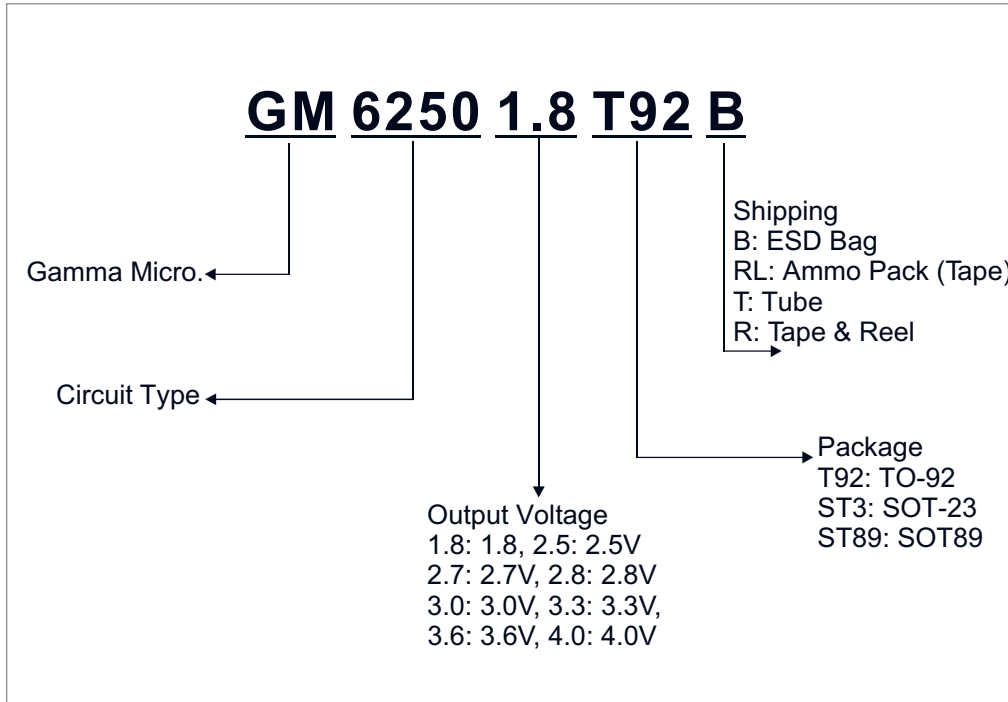
### ◆ SOT-89 PACKAGE OUTLINE DIMENSIONS





### ◆ SOT-23 PACKAGE OUTLINE DIMENSIONS



◆ ORDERING NUMBER



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