GM78L00 SERIES

POSITIVE VOLTAGE REGULATORS

Description

The GM78L00 series in positive voltage regulators are low-cost devices providing a simple solution for a wide variety of applications, which requires a regulated supply of up to 100mA.

These virtually indestructible positive voltage regulators are protected by thermal shutdown and internal current-limiting. Most applications require no external components.

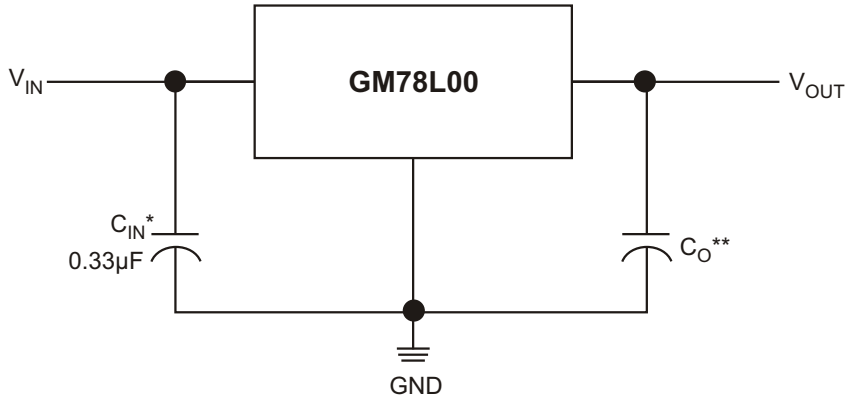
The GM78L00 is very versatile. To use them as fixed voltage regulators in a wide range of applications, including both local and on-card regulation for elimination of noise and distribution problems associated with single-point regulation. They can also be used with power pass elements to make high current voltage regulators.

The GM78L00 offers impressive performance advantages over old-fashioned zener diode-resistor combinations, providing lower output impedance and reduced quiescent cur-

Features

- **Output Current up to 100mA**
- **Output Voltages 5V, 6V, 8V, 9V, 10V, 12V, 15V, 18V and24V**
- **3- Terminal Regulators**
- **No External Components Required**
- **Internal Thermal Overload Protection**
- **Internal Short Circuit Current-Limiting**
- **Available in TO-92, SOT-89 and SOP-8 packages**

TYPIC APPLICATION CIRCUITS



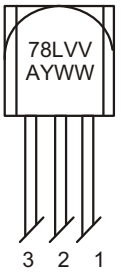
A common ground is required between the input and the output voltages. The input voltage must remain typically 2.0V above, the output voltage even during the low point on the input ripple voltage.

* C_{IN} is required if regulator is located an appreciable distance from power supply filter.

** C_O is not needed for stability; however, it does improve transient response.

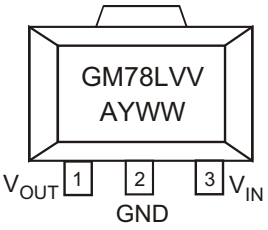
◆ MARKING INFORMATION & PIN CONFIGURATIONS (TOP VIEW)

TO-92



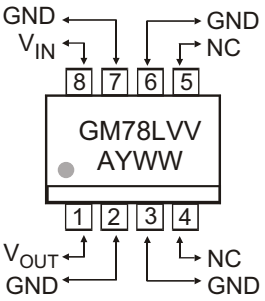
1. INPUT
2. GROUND
3. OUTPUT

SOT-89



V V =Output Voltage (05:5.0V, 12:12V)
A =Assembly Location
Y =Year
W W =Weekly

SOP-8



◆ ORDERING INFORMATION

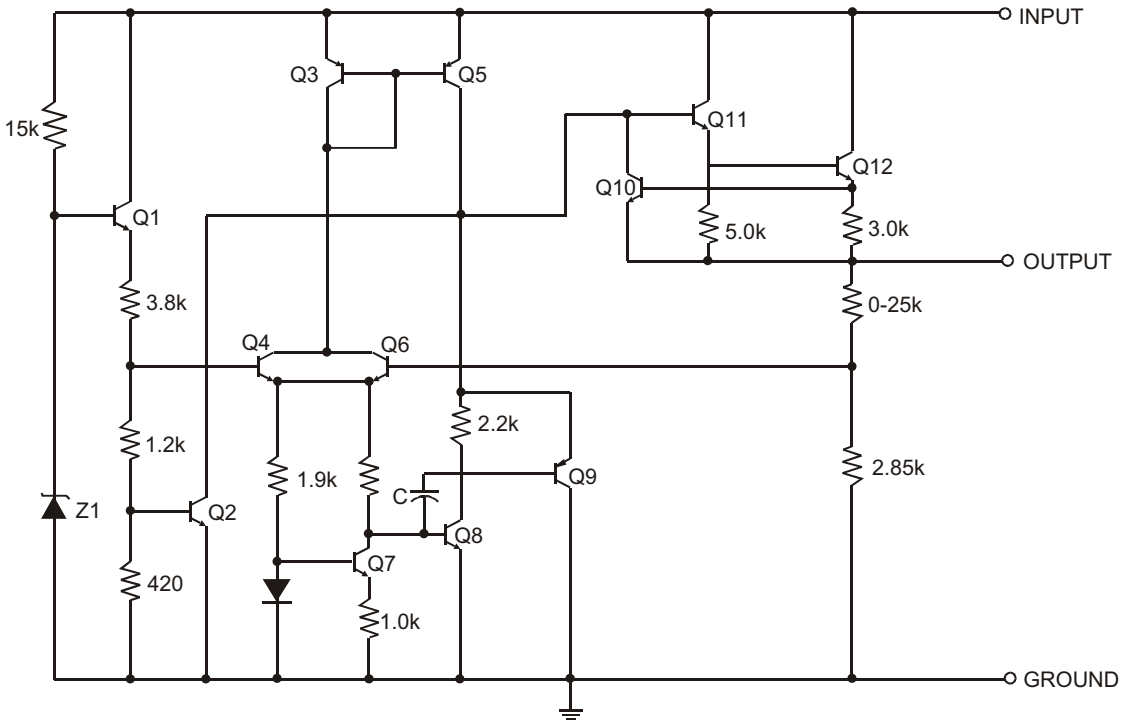
Pro Number	V_{OUT}	Package
GM78L05	5.0V	TO-92, SOT-89, SOP-8
GM78L06	6.0V	TO-92, SOT-89, SOP-8
GM78L08	8.0V	TO-92, SOT-89, SOP-8
GM78L09	9.0V	TO-92, SOT-89, SOP-8
GM78L10	10V	TO-92, SOT-89, SOP-8
GM78L12	12V	TO-92, SOT-89, SOP-8
GM78L15	15V	TO-92, SOT-89, SOP-8
GM78L18	18V	TO-92, SOT-89, SOP-8
GM78L24	24V	TO-92, SOT-89, SOP-8

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

◆ RECOMMENDED OPERATING CONDITIONS (I_O= 1.5A)

PARAMETER		MIN	MAX	UNIT
Input Voltage V_I	GM78L05	7	20	V
	GM78L06	8	20	
	GM78L08	10.5	23	
	GM78L09	11.5	24	
	GM78L10	12.5	25	
	GM78L12	14.5	27	
	GM78L15	17.5	30	
	GM78L18	21	33	
	GM78L24	27	39	
Output Current, I_O			100	mA
Operating virtual junction temperature, T_J		0	125	°C

◆ BLOCK DIAGRAM



◆ ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	VALUE	UNITS
Input Voltage GM78L05 to GM78L10 GM78L12 to GM78L18 GM78L24	V_I	30 35 40	V
Power Dissipation	P_D	Internally limited	W
Operating Junction Temperature Range	T_J	0 to +150	°C
Storage Temperature Range	T_{stg}	-65 to +150	°C
Lead Temperature 1.6mm (1/16 inch) from case for 10 sec.	T_L	260	°C

◆ ELECTRICAL CHARACTERISTICS at specified Junction Temperature

GM78L05: V_I= 10V, I_O= 40mA, (unless otherwise noted)

CHARACTERISTICS	TEST CONDITIONS *		MIN	TYP	MAX	UNIT
Output Voltage **		25°C	4.8	5.0	5.2	V
	I_O= 1mA to 40mA V_I=7V to 20V	0°C to 125°C	4.75	5.0	5.25	
	I_O= 1mA to 70mA		4.75	5.0	5.25	
Input Regulation	V_I=7V to 20V	25°C		32	150	mV
	V_I=8V to 20V			26	100	
Ripple Rejection	V_I=8V to 18V, f = 120Hz	25°C	41	49		dB
Output Regulation	I_O=1mA to 100mA	25°C		15	60	mV
	I_O=1mA to 40mA			8	30	
Output Resistance	f = 10Hz to 100kHz	25°C		42		µV
Dropout Voltage		25°C		1.7		V
Bias Current		25°C		3.8	6	mA
		125°C			5.5	
Bias Current	V_I=8V to 20V	0°C to 125°C			1.5	mA
	I_O=1mA to 40mA				0.1	

GM78L06: V_I= 11V, I_O= 40mA, (unless otherwise noted)

CHARACTERISTICS	TEST CONDITIONS *		MIN	TYP	MAX	UNIT
Output Voltage **		25°C	5.75	6.0	6.25	V
	I_O= 1mA to 40mA V_I=8V to 20V	0°C to 125°C	5.7	6.0	6.3	
	I_O= 1mA to 70mA		5.7	6.0	6.3	
Input Regulation	V_I=8V to 20V	25°C		35	175	mV
	V_I=9V to 20V			29	125	
Ripple Rejection	V_I=9V to 19V, f = 120Hz	25°C	40	48		dB
Output Regulation	I_O=1mA to 100mA	25°C		16	80	mV
	I_O=1mA to 40mA			9	40	
Output Resistance	f = 10Hz to 100kHz	25°C		46		µV
Dropout Voltage		25°C		1.7		V
Bias Current		25°C		3.9	6	mA
		125°C			5.5	
Bias Current	V_I=9V to 20V	0°C to 125°C			1.5	mA
	I_O=1mA to 40mA				0.1	

*Pulse testing tehniques are used to maintain the junction temperature as close to the ambient temperature as possible.
Thermal effects must be taken into account.
** The specification applies only for DC power dissipation permitted by absolute maximum ratings

◆ ELECTRICAL CHARACTERISTICS at specified Junction Temperature

GM78L08: V_I= 14V, I_O= 40mA, (unless otherwise noted)

CHARACTERISTICS	TEST CONDITIONS *		MIN	TYP	MAX	UNIT
Output Voltage **		25°C	7.7	8.0	8.3	V
	I_O= 1mA to 40mA V_I=10.5V to 23V	0°C to 125°C	7.6	8.0	8.4	
	I_O= 1mA to 70mA		7.6	8.0	8.4	
Input Regulation	V_I=10.5V to 23V	25°C		42	175	mV
	V_I=11V to 23V			36	125	
Ripple Rejection	V_I=13V to 23V, f = 120Hz	0°C to 125°C	37	46		dB
Output Regulation	I_O=1mA to 100mA	25°C		18	80	mV
	I_O=1mA to 40mA			10	40	
Output Resistance	f = 10Hz to 100kHz	25°C		54		µV
Dropout Voltage		25°C		1.7		V
Bias Current		25°C		4	6	mA
		125°C			5.5	
Bias Current	V_I=11V to 23V	0°C to 125°C			1.5	mA
	I_O=1mA to 40mA				0.1	

GM78L09: V_I= 16V, I_O= 40mA, (unless otherwise noted)

CHARACTERISTICS	TEST CONDITIONS *		MIN	TYP	MAX	UNIT
Output Voltage **		25°C	8.6	9.0	9.4	V
	I_O= 1mA to 40mA V_I=12V to 24V	0°C to 125°C	8.55	9.0	9.45	
	I_O= 1mA to 70mA		8.55	9.0	9.45	
Input Regulation	V_I=12V to 24V	25°C		45	175	mV
	V_I=13V to 24V			40	125	
Ripple Rejection	V_I=15V to 25V, f = 120Hz	25°C	38	45		dB
Output Regulation	I_O=1mA to 100mA	25°C		19	90	mV
	I_O=1mA to 40mA			11	40	
Output Resistance	f = 10Hz to 100kHz	25°C		58		µV
Dropout Voltage		25°C		1.7		V
Bias Current		25°C		4.1	6	mA
		125°C			5.5	
Bias Current	V_I=13V to 20V	0°C to 125°C			1.5	mA
	I_O=1mA to 40mA				0.1	

*Pulse testing tehniques are used to maintain the junction temperature as close to the ambient temperature as possible.
Thermal effects must be taken into account.
** The specification applies only for DC power dissipation permitted by absolute maximum ratings

◆ ELECTRICAL CHARACTERISTICS at specified Junction Temperature

GM78L10: V_I= 17V, I_O= 40mA, (unless otherwise noted)

CHARACTERISTICS	TEST CONDITIONS *		MIN	TYP	MAX	UNIT
Output Voltage **		25°C	9.6	10	10.4	V
	I_O= 1mA to 40mA V_I=13V to 25V	0°C to 125°C	9.5	10	10.5	
	I_O= 1mA to 70mA		9.5	10	10.5	
Input Regulation	V_I=13V to 25V	25°C		51	175	mV
	V_I=14V to 25V			42	125	
Ripple Rejection	V_I=15V to 25V, f = 120Hz	0°C to 125°C	37	44		dB
Output Regulation	I_O=1mA to 100mA	25°C		20	90	mV
	I_O=1mA to 40mA			11	40	
Output Resistance	f = 10Hz to 100kHz	25°C		62		μV
Dropout Voltage		25°C		1.7		V
Bias Current		25°C		4	6	mA
		125°C			5.5	
Bias Current	V_I=14V to 25V	0°C to 125°C			1.5	mA
	I_O=1mA to 40mA				0.1	

GM78L12: V_I= 19V, I_O= 40mA, (unless otherwise noted)

CHARACTERISTICS	TEST CONDITIONS *		MIN	TYP	MAX	UNIT
Output Voltage **		25°C	11.5	12	12.5	V
	I_O= 1mA to 40mA V_I=14.5V to 27V	0°C to 125°C	11.4	12	12.6	
	I_O= 1mA to 70mA		11.4	12	12.6	
Input Regulation	V_I=14.5V to 27V	25°C		55	250	mV
	V_I=16V to 27V			49	200	
Ripple Rejection	V_I=15V to 25V, f = 120Hz	25°C	37	42		dB
Output Regulation	I_O=1mA to 100mA	25°C		22	100	mV
	I_O=1mA to 40mA			13	50	
Output Resistance	f = 10Hz to 100kHz	25°C		70		μV
Dropout Voltage		25°C		1.7		V
Bias Current		25°C		4.3	6.5	mA
		125°C			6.0	
Bias Current	V_I=16V to 27V	0°C to 125°C			1.5	mA
	I_O=1mA to 40mA				0.1	

*Pulse testing tehniques are used to maintain the junction temperature as close to the ambient temperature as possible.
Thermal effects must be taken into account.
** The specification applies only for DC power dissipation permitted by absolute maximum ratings

◆ ELECTRICAL CHARACTERISTICS at specified Junction Temperature

GM78L15: V_I= 23V, I_O= 40mA, (unless otherwise noted)

CHARACTERISTICS	TEST CONDITIONS *		MIN	TYP	MAX	UNIT
Output Voltage **		25°C	14.4	15	15.6	V
	I_O= 1mA to 40mA V_I=17.5V to 30V	0°C to 125°C	14.25	15	15.75	
	I_O= 1mA to 70mA		14.25	15	15.75	
Input Regulation	V_I=17.5V to30V	25°C		65	300	mV
	V_I=19V to 30V			58	250	
Ripple Rejection	V_I=18.5V to 28.5V, f = 120Hz	0°C to 125°C	34	39		dB
Output Regulation	I_O=1mA to 100mA	25°C		25	150	mV
	I_O=1mA to 40mA			15	75	
Output Resistance	f = 10Hz to 100kHz	25°C		82		µV
Dropout Voltage		25°C		1.7		V
Bias Current		25°C		4.6	6.5	mA
		125°C			6.0	
Bias Current	V_I=14V to 25V	0°C to 125°C			1.5	mA
	I_O=1mA to 40mA				0.1	

GM78L18: V_I= 26V, I_O= 40mA, (unless otherwise noted)

CHARACTERISTICS	TEST CONDITIONS *		MIN	TYP	MAX	UNIT
Output Voltage **		25°C	17.3	18	18.7	V
	I_O= 1mA to 40mA V_I=20.5V to 33V	0°C to 125°C	17.1	18	18.9	
	I_O= 1mA to 70mA		17.1	18	18.9	
Input Regulation	V_I=20.5V to 33V	25°C		70	360	mV
	V_I=22V to 33V			64	300	
Ripple Rejection	V_I=21.5V to 31.5V, f = 120Hz	25°C	32	36		dB
Output Regulation	I_O=1mA to 100mA	25°C		27	180	mV
	I_O=1mA to 40mA			19	90	
Output Resistance	f = 10Hz to 100kHz	25°C		89		µV
Dropout Voltage		25°C		1.7		V
Bias Current		25°C		4.7	6.5	mA
		125°C			6.0	
Bias Current	V_I=22V to 33V	0°C to 125°C			1.5	mA
	I_O=1mA to 40mA				0.1	

*Pulse testing tehniques are used to maintain the junction temperature as close to the ambient temperature as possible.
Thermal effects must be taken into account.
** The specification applies only for DC power dissipation permitted by absolute maximum ratings

◆ ELECTRICAL CHARACTERISTICS at specified Junction Temperature

GM78L24: V_I= 32V, I_O= 40mA, (unless otherwise noted)

CHARACTERISTICS	TEST CONDITIONS *		MIN	TYP	MAX	UNIT
Output Voltage **		25°C	23	24	25	V
	I_O= 1mA to 40mA V_I=26.5V to 39V	0°C to 125°C	22.8	24	25.2	
	I_O= 1mA to 70mA		22.8	24	25.2	
Input Regulation	V_I=26.5V to39V	25°C		95	480	mV
	V_I=29V to 39V			78	400	
Ripple Rejection	V_I=27.5V to 37.5V, f = 120Hz	0°C to 125°C	30	33		dB
Output Regulation	I_O=1mA to 100mA	25°C		41	240	mV
	I_O=1mA to 40mA			28	120	
Output Resistance	f = 10Hz to 100kHz	25°C		97		μV
Dropout Voltage		25°C		1.7		V
Bias Current		25°C		4.8	6.5	mA
		125°C			6.0	
Bias Current	V_I=28V to 39V	0°C to 125°C			1.5	mA
	I_O=1mA to 40mA				0.1	

*Pulse testing tehniques are used to maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account.
** The specification applies only for DC power dissipation permitted by absolute maximum ratings

◆ TYPICAL PERFORMANCE CHARACTERISTICS

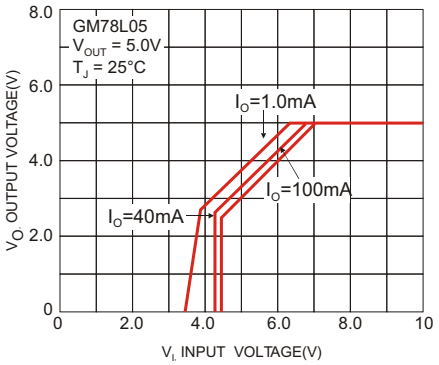


Figure 1. Dropout Characteristics

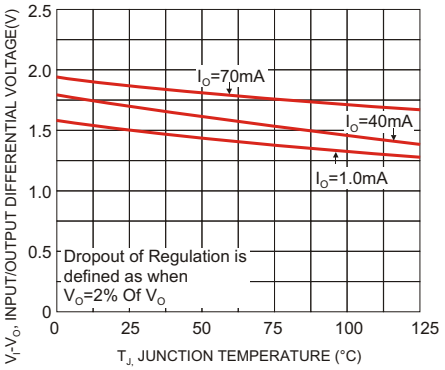


Figure 2. Dropout Voltage versus Junction Temperature

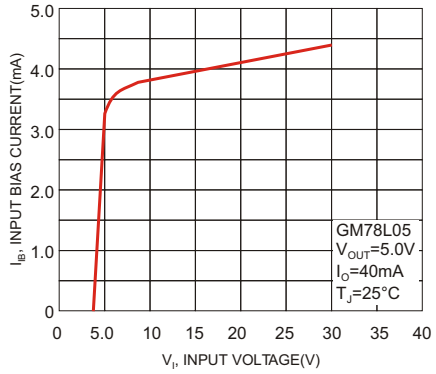


Figure 3. Input Bias Current versus Input Voltage

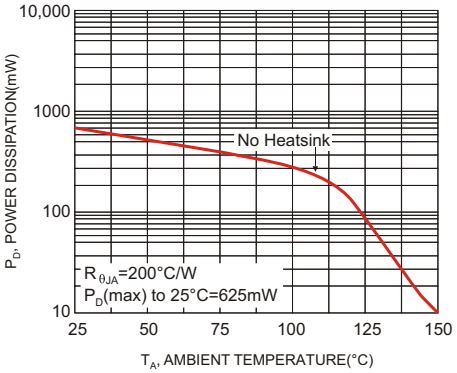


Figure 4. Maximum Average Power Dissipation versus Ambient Temperature-TO-92 Type Package

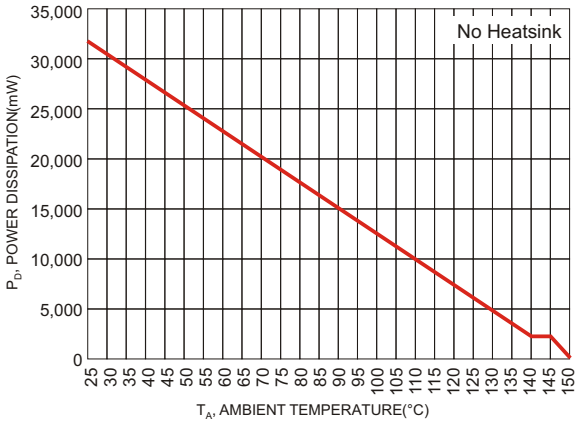


Figure 5. Maximum Average Power Dissipation versus Ambient Temperature SOT-89 Type Package

◆ APPLICATION INFORMATION

Design Considerations

The GM78L00 series regulators have thermal overload protection from excessive power, internal short-circuit protection limits each circuit's maximum current, and output transistor safe-area protection for reducing the output current as the voltage across each pass transistor is increased.

Although the internal power dissipation is limited, the junction temperature must be kept below the maximum specified temperature (125°C) in order to meet data sheet specifications.

Thermal Considerations

The TO-92 molded package is capable of unusual high power dissipation due to the lead frame design. However, its thermal capabilities are generally overlooked because of a lack of understanding of the thermal paths from the semiconductor junction to ambient temperature.

While thermal resistance is normally specified for the device mounted 1cm above an infinite heat sink, very little has been mentioned of the options available to improve the conservatively rated thermal capability. An explanation of the thermal paths of the TO-92 will allow the designer to determine the thermal stress which is applying in any given application.

The TO-92 Package

The TO-92 package thermal paths are complex. In addition to the path through the molding compound to ambient temperature, there is another path through the leads, in parallel with the case path, to ambient temperature, as shown in Figure 5.

The total thermal resistance in this model is then:

$$\theta_{JA}=\frac{(\theta_{JA}+\theta_{CA})(\theta_{JL}+\theta_{LA})}{\theta_{JA}+\theta_{CA}+\theta_{JL}+\theta_{LA}}$$

Where:

$_{JC}$ = thermal resistance of the case between the regulator die and a point on the case directly above the die location.

$_{CA}$ = thermal resistance between the case and air at ambient temperature.

$_{JL}$ = thermal resistance from regulator die through the input lead to a point 1/16 inch below the regulator case.

$_{LA}$ = total thermal resistance of the input/output ground leads to ambient temperature.

$_{JA}$ = junction to ambient thermal resistance.

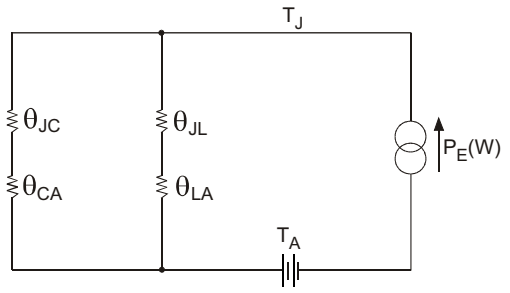
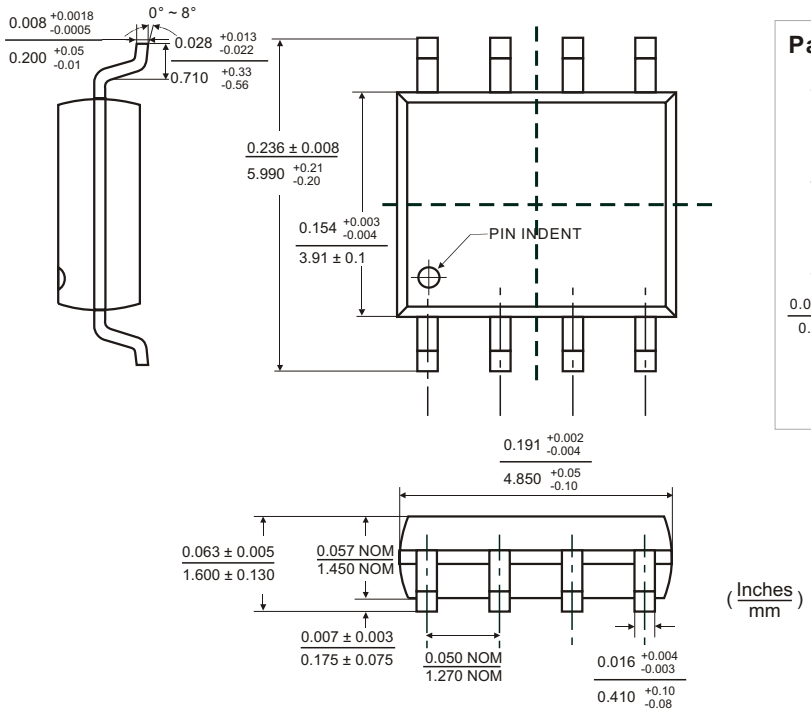
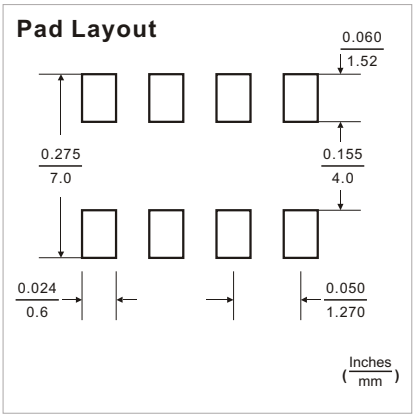


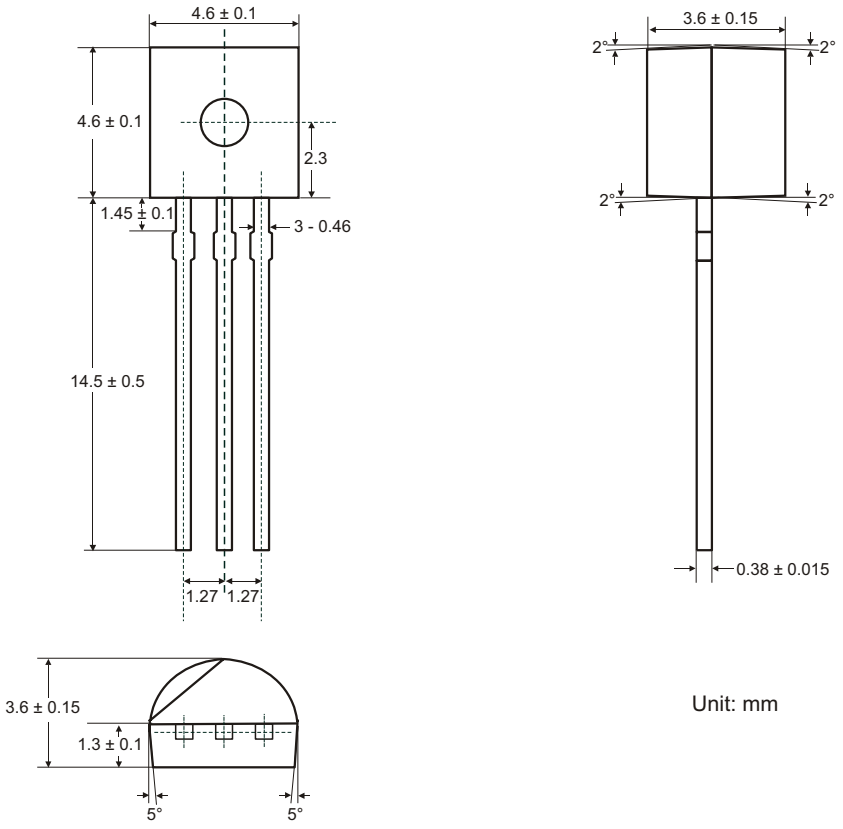
Figure 5. TO-92 Thermal Equivalent Circuit

◆ SOP-8 PACKAGE OUTLINE DIMENSIONS



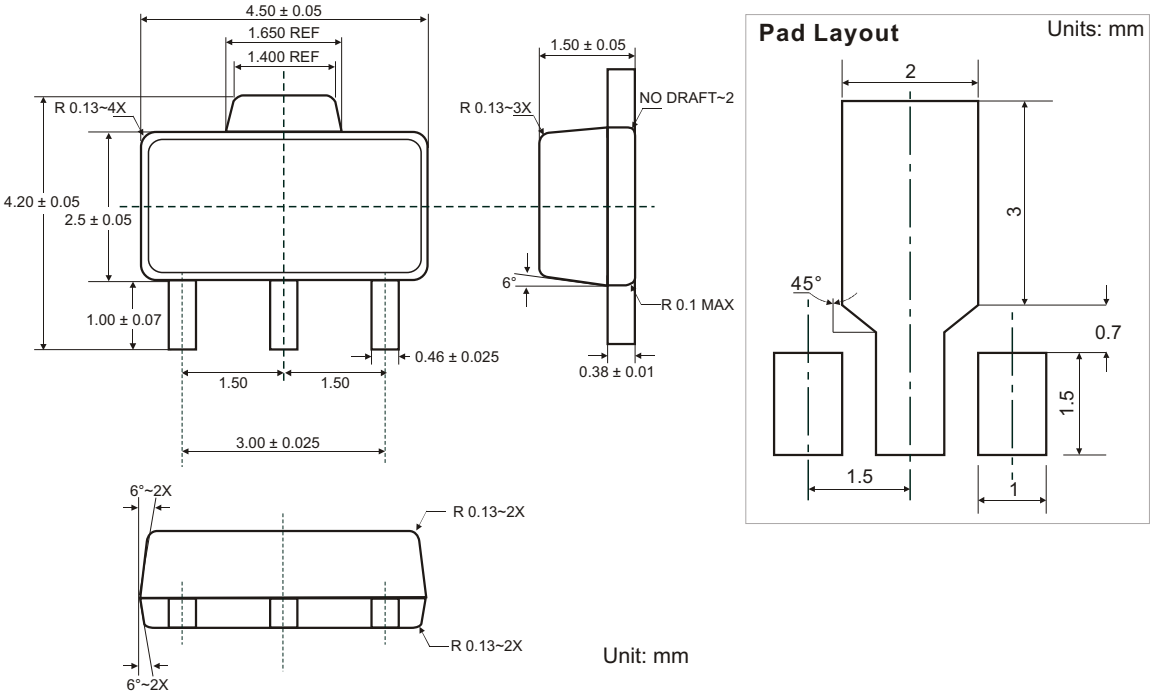


◆ TO-92 PACKAGE OUTLINE DIMENSIONS



Unit: mm

◆ SOT-89 PACKAGE OUTLINE DIMENSIONS



◆ ORDERING NUMBER

GM 78L 00 T92 B

Gamma Micro.

Circuit Type

Output Voltage
05: 5.0V, 06: 6.0V
08: 8.0V, 09: 9.0V
10: 10V, 12: 12V
15: 15V, 18: 18V
24: 24V

Package
T92: TO-92
1,000 Units/ ESD Bag
2,000 Units/ Ammo Pack (Tape)

S8: SOP-8
100 Units/ Tube
2,500 Units/ Tape & Reel

ST89: SOT-89
1,000 Units/ Tape & Reel

Shipping
B : ESD Bag
RL: Ammo Pack (Tape)
R: Tape & Reel
T: Tube