MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

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By MUN2111/D

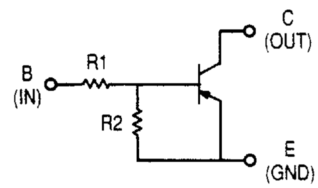
MUN2111
MUN2112
MUN2113

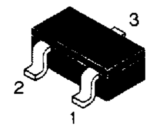
Motorola preferred devices

Bias Resistor Transistor

PNP Silicon Surface Mount Transistor With Monolithic Bias Resistor Network

PNP SILICON BIAS RESISTOR TRANSISTOR





CASE 318D-03, STYLE 1 (SC-59)

This new series of digital transistors is designed to replace a single device and its external resistor bias network. The BRT (Bias Resistor Transistor) contains a single transistor with a monolithic bias network consisting of two resistors; a series base resistor and a base-emitter resistor. The BRT eliminates these individual components by integrating them into a single device. The use of a BRT can reduce both system cost and board space. The device is housed in the SC-59 package which is designed for low power surface mount applications.

- Simplifies Circuit Design
- Reduces Board Space
- Reduces Component Count
- Power dissipation of 200 milliwatts on standard FR5/G10 glass epoxy printed circuit board and up to 400 milliwatts on ceramic or Thermal Clad™ substrates using recommended footprint
- The SC-59 package can be soldered using wave or reflow. The modified gull-winged leads absorb thermal stress during soldering eliminating the possibility of damage to the die.
- Available in 8 mm embossed tape and reel
  Add a "T1" suffix to the part number to order the 7 inch/3000 unit reel.
  Add a "T3" suffix to the part number to order the 13 inch/10,000 unit reel.

MAXIMUM RATINGS (T_A = 25°C unless otherwise noted)

Rating	Symbol	Value	Unit
Collector-Base Voltage	V_{CBO}	50	Vdc
Collector-Emitter Voltage	V_{CEO}	50	Vdc
Collector Current	I_C	100	mAdc
Total Power Dissipation @ T_A = 25°C Derate above 25°C	P_D	200* 1.6	mW mW/°C
Thermal Resistance — Junction to Ambient	$R_{\theta JA}$	625	°C/W
Operating and Storage Temperature Range	T_J, T_{stg}	–65 to +150	°C

DEVICE MARKING AND RESISTOR VALUES

Device	Marking	R1 (K)	R2 (K)
MUN2111	6A	10	10
MUN2112	6B	22	22
MUN2113	6C	47	47

* Device mounted on a glass epoxy printed circuit board using the minimum recommended footprint shown on page 6

Thermal Clad is a registered trademark of the Bergquist Company

Preferred devices are Motorola recommended choices for future use and best overall value

MOTOROLA

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted)

Characteristic		Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS						
Collector-Base Cutoff Current (V_{CB} = 50 V, I_E = 0)		I_{CBO}	—	—	100	nAdc
Collector-Emitter Cutoff Voltage (V_{CE} = 50 V, I_B = 0)		I_{CEO}	—	—	500	nAdc
Emitter-Base Cutoff Current (V_{EB} = 6.0 V, I_C = 0)	MUN2111 MUN2112 MUN2113	I_{EBO}	— — —	— — —	0.5 0.2 0.1	mAdc
Collector-Base Breakdown Voltage (I_C = 10 µA, I_E = 0)		$V_{(BR)CBO}$	50	—	—	Vdc
Collector-Emitter Breakdown Voltage* (I_C = 2.0 mA, I_B = 0)		$V_{(BR)CEO}$	50	—	—	Vdc
ON CHARACTERISTICS*						
DC Current Gain (V_{CE} = 10 V, I_C = 5.0 mA)	MUN2111 MUN2112 MUN2113	h_{FE}	35 60 80	60 100 140	— — —	—
Collector-Emitter Saturation Voltage (I_C = 10 mA, I_E = 3.0 mA)		$V_{CE(sat)}$	—	—	0.25	Vdc
Input Voltage (on) (V_{CC} = 5.0 V, V_B = 2.5 V, R_L = 1.0 kΩ)	MUN2111 MUN2112	V_{OL}	— —	— —	0.2 0.2	Vdc
(V_{CC} = 5.0 V, V_B = 3.5 V, R_L = 1.0 kΩ)	MUN2113		—	—	0.2	
Input Voltage (off) (V_{CC} = 5.0 V, V_B = 0.5 V, R_L = 1.0 kΩ)		V_{OH}	4.9	—	—	Vdc
Input Resistor	MUN2111 MUN2112 MUN2113	R1	7.0 15.4 32.9	10 22 47	13 28.6 61.1	k ohms
Resistor Ratio		R_1/R_2	0.9	1.0	1.1	—

* Pulse Test Pulse Width < 300 µs, Duty Cycle < 2.0%

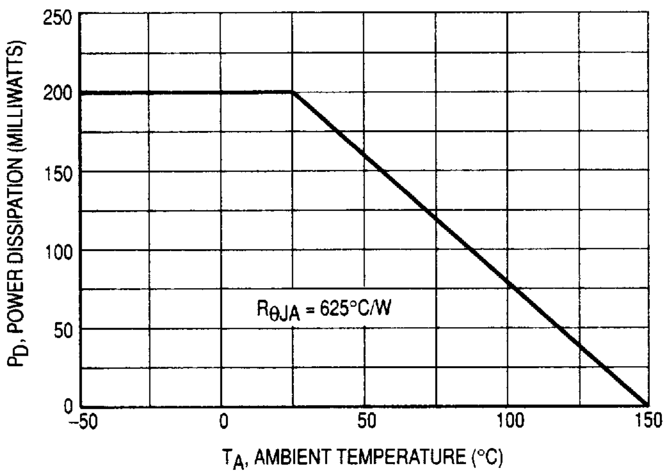


Figure 1. Derating Curve

TYPICAL ELECTRICAL CHARACTERISTICS — MUN2111

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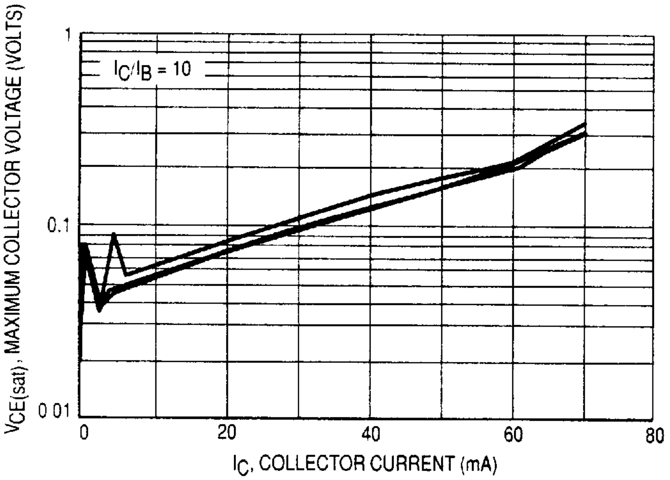

Figure 2. $V_{CE(sat)}$ versus I_C

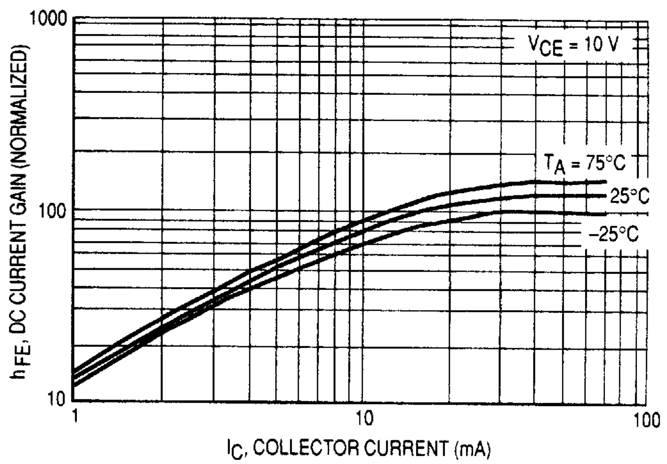

Figure 3. DC Current Gain

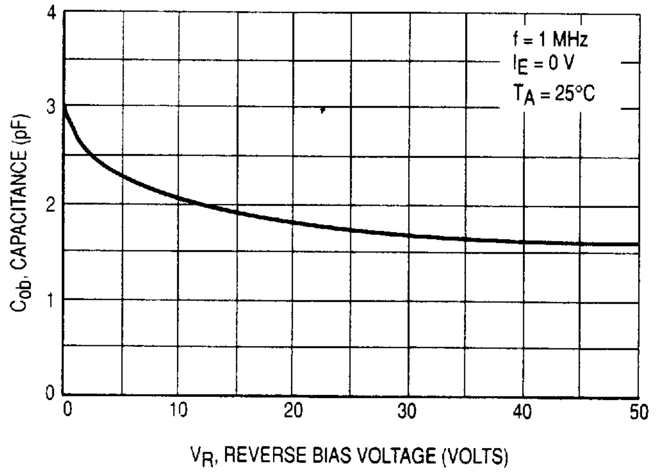

Figure 4. Output Capacitance

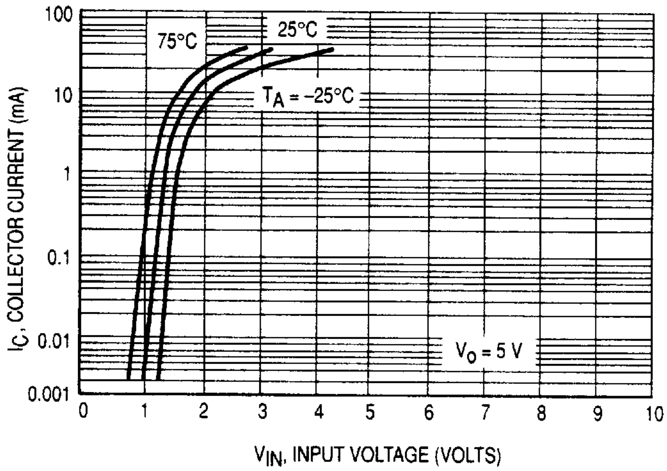

Figure 5. Output Current versus Input Voltage

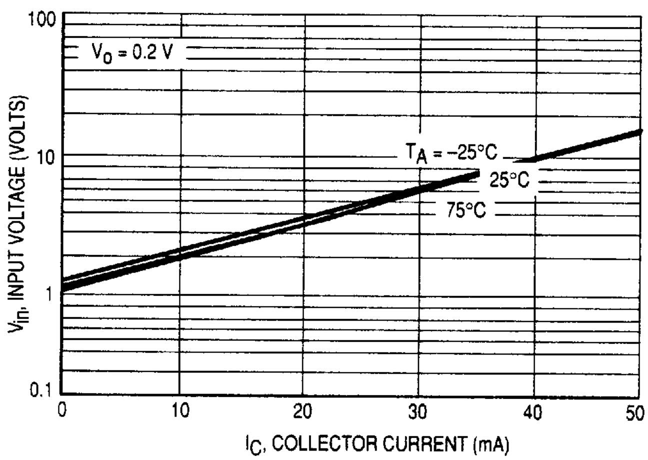

Figure 6. Input Voltage versus Output Current

TYPICAL ELECTRICAL CHARACTERISTICS — MUN2112

T-27-90

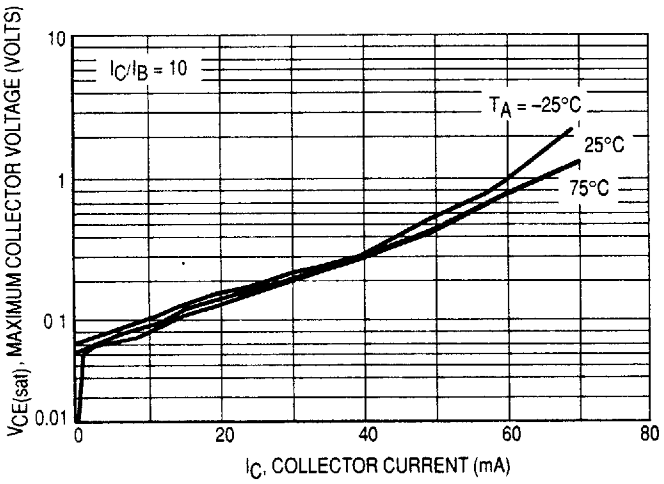

Figure 7. $V_{CE(sat)}$ versus I_C

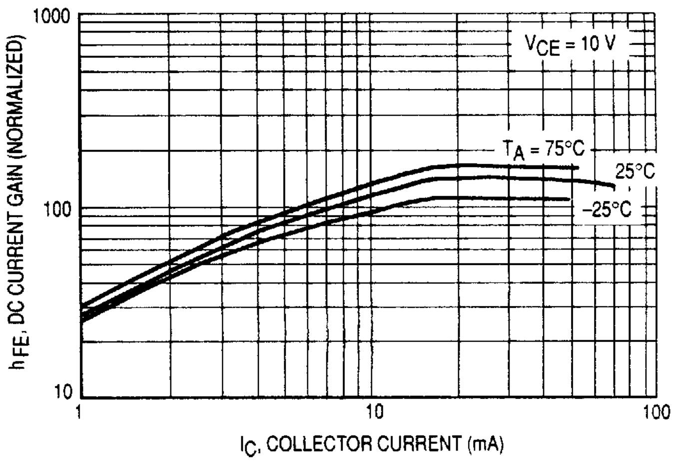

Figure 8. DC Current Gain

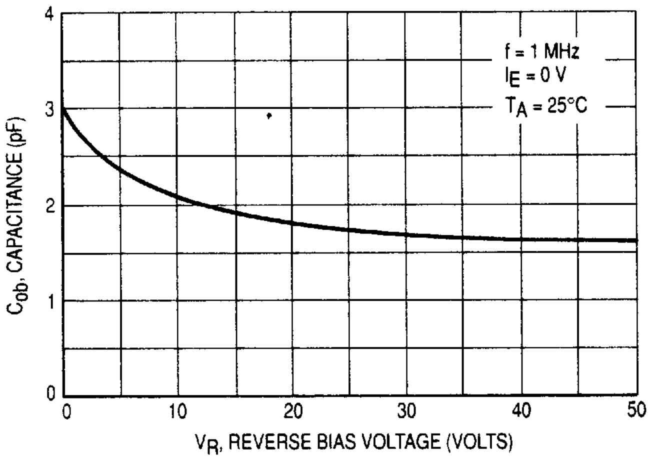

Figure 9. Output Capacitance

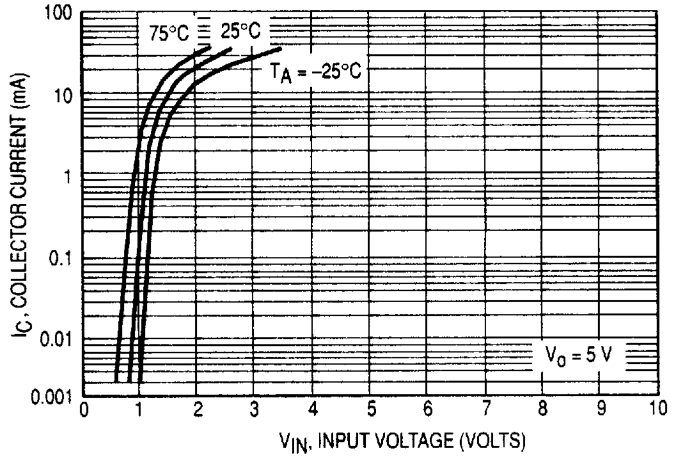

Figure 10. Output Current versus Input Voltage

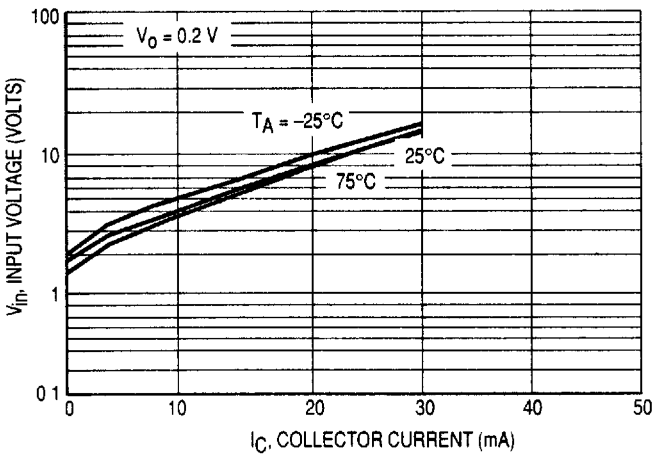

Figure 11. Input Voltage versus Output Current

TYPICAL ELECTRICAL CHARACTERISTICS — MUN2113

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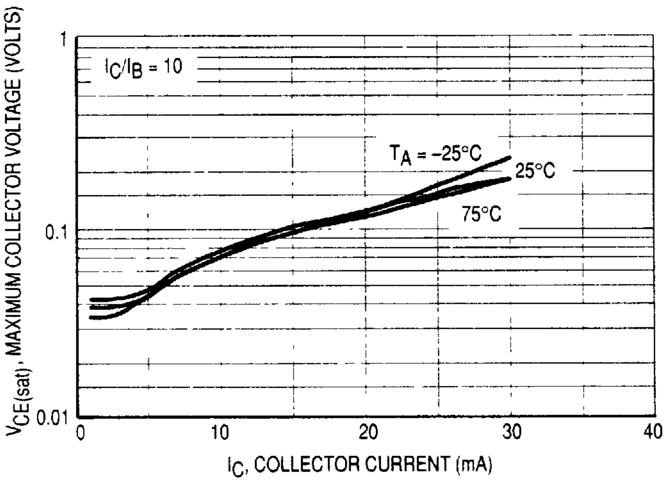

Figure 12. $V_{CE(sat)}$ versus I_C

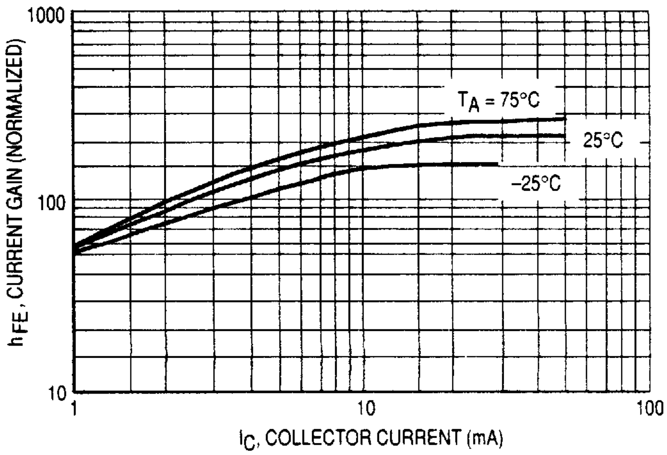

Figure 13. DC Current Gain

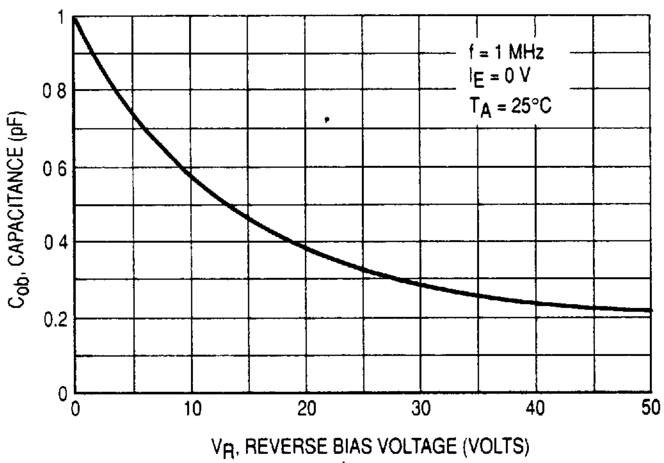

Figure 14. Output Capacitance

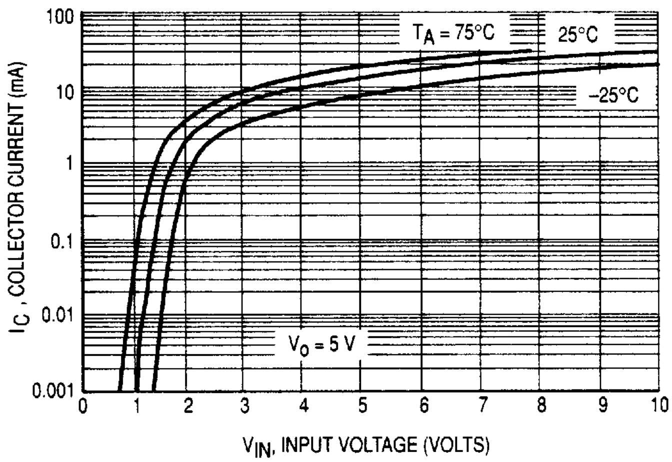

Figure 15. Output Current versus Input Voltage

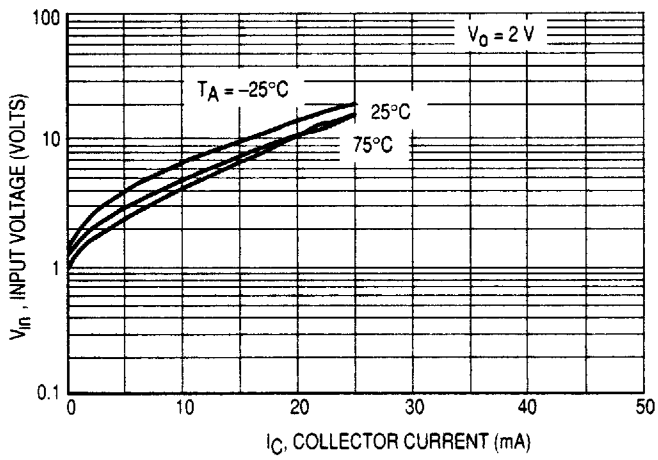

Figure 16. Input Voltage versus Output Current

MINIMUM RECOMMENDED FOOTPRINTS FOR SURFACE MOUNTED APPLICATIONS

Surface mount board layout is a critical portion of the total design. The footprint for the semiconductor packages must be the correct size to insure proper solder connection interface between the board and the package. With the correct pad geometry, the packages will self align when subjected to a solder reflow process.

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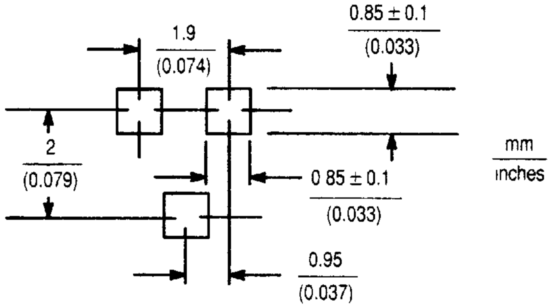


SC-59 POWER DISSIPATION

The power dissipation of the SC-59 is a function of the collector pad size. This can vary from the minimum pad size for soldering to the pad size given for maximum power dissipation. Power dissipation for a surface mount device is determined by $T_{J(max)}$, the maximum rated junction temperature of the die, $R_{\theta JA}$, the thermal resistance from the device junction to ambient; and the operating temperature, T_A. Using the values provided on the data sheet, P_D can be calculated as follows:

$$P_D = \frac{T_{J(max)} - T_A}{R_{\theta JA}}$$

The values for the equation are found in the maximum ratings table on the data sheet. Substituting these values into the equation for an ambient temperature T_A of 25°C, one can calculate the power dissipation of the device which in this case is 200 milliwatts.

$$P_D = \frac{150°C - 25°C}{0.625°C/mW} = 200 \text{ milliwatts}$$

The 0.625°C/mW assumes the recommended collector pad area of 37 mil^2 on a glass epoxy printed circuit board to achieve a power dissipation of 200 milliwatts using the footprint shown. Another alternative would be to use a ceramic substrate or an aluminum core board such as Thermal Clad. Using a board material such as Thermalclad, a power dissipation of 400 milliwatts can be achieved using the same footprint.

MOUNTING PRECAUTIONS

The melting temperature of solder is higher than the rated temperature of the device and the entire device is heated to a high temperature; therefore, failure to complete soldering within a short time could result in device failure. Therefore, the following items should always be observed in order to minimize the thermal stress to which the devices are subjected.

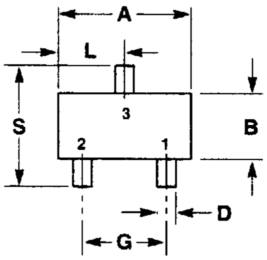
- Always preheat the device
- The delta temperature between the preheat and soldering should be 100°C or less*
- When preheating and soldering, the temperature of the leads and the case must not exceed the maximum temperature ratings as shown on the data sheet. When using infrared heating with the reflow soldering method, the difference in temperatures of the case and the leads shall be Δ10°C or less.
- The soldering temperature and time shall not exceed 260°C for more than 10 seconds.
- When shifting from preheating to soldering, the maximum temperature gradient shall be 5°C or less
- After soldering has been completed, the device should be allowed to cool naturally for three minutes or more. Gradual cooling should be used as the use of forced cooling will increase the temperature gradient and result in latent mechanical stress
- One should not apply mechanical stress or shock during cooling

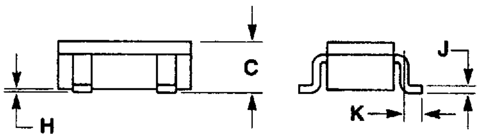
*Soldering a device without preheating can cause excessive thermal shock and stress which can result in damage to the device.

T-27-90

OUTLINE DIMENSIONS

STYLE 1
PIN 1 EMITTER
2 BASE
3 COLLECTOR





NOTES
1 DIMENSIONING AND TOLERANCING PER ANSI Y15 5M 1982.
2 CONTROLLING DIMENSION MILLIMETERS

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	2 70	3 10	0 1063	0 1220
B	1 30	1 70	0 0512	0 0669
C	1 00	1 30	0 0394	0 0511
D	0 35	0 50	0 0138	0 0196
G	1 70	2 10	0 0670	0 0826
H	0 013	0 100	0 0005	0 0040
J	0 10	0 26	0 0040	0 0102
K	0 20	0 60	0 0079	0 0236
L	1 25	1 65	0 0493	0 0649
S	2 50	3 00	0 0985	0 1181

CASE 318D-03
(SC-59)