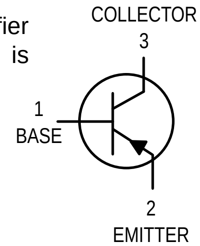
General Purpose Transistors

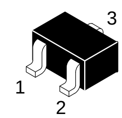
PNP Silicon

These transistors are designed for general purpose amplifier applications. They are housed in the SOT–323/SC–70 which is designed for low power surface mount applications.



BC856AWT1,BWT1
BC857AWT1,BWT1
BC858AWT1,BWT1,
CWT1

Motorola Preferred Devices



CASE 419–02, STYLE 3
SOT–323/SC–70

MAXIMUM RATINGS

Rating	Symbol	BC856	BC857	BC858	Unit
Collector – Emitter Voltage	V_{CEO}	–65	–45	–30	V
Collector – Base Voltage	V_{CBO}	–80	–50	–30	V
Emitter – Base Voltage	V_{EBO}	–5.0	–5.0	–5.0	V
Collector Current — Continuous	I_C	–100	–100	–100	mAdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR– 5 Board, (1) $T_A = 25°C$	P_D	150	mW
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	833	°C/W
Junction and Storage Temperature	T_J, T_{stg}	– 55 to +150	°C

DEVICE MARKING

BC856AWT1 = 3A; BC856BWT1 = 3B; BC857AWT1 = 3E; BC857BWT1 = 3F;
BC858AWT1 = 3J; BC858BWT1 = 3K; BC858CWT1 = 3L

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

Characteristic		Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS						
Collector – Emitter Breakdown Voltage (I_C = –10 mA)	BC856 Series BC857 Series BC858 Series	$V_{(BR)CEO}$	–65 –45 –30	— — —	— — —	V
Collector – Emitter Breakdown Voltage (I_C = –10 µA, V_{EB} = 0)	BC856 Series BC857 Series BC858 Series	$V_{(BR)CES}$	–80 –50 –30	— — —	— — —	V
Collector – Base Breakdown Voltage (I_C = –10 µA)	BC856 Series BC857 Series BC858 Series	$V_{(BR)CBO}$	–80 –50 –30	— — —	— — —	V
Emitter – Base Breakdown Voltage (I_E = –1.0 µA)	BC856 Series BC857 Series BC858 Series	$V_{(BR)EBO}$	–5.0 –5.0 –5.0	— — —	— — —	V
Collector Cutoff Current (V_{CB} = –30 V) (V_{CB} = –30 V, T_A = 150°C)		I_{CBO}	— —	— —	–15 –4.0	nA µA

1. FR–5 = 1.0 x 0.75 x 0.062 in

Thermal Clad is a registered trademark of the Bergquist Company.

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

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

Characteristic		Symbol	Min	Typ	Max	Unit
ON CHARACTERISTICS						
DC Current Gain	BC856A, BC857A, BC585A	h_{FE}	—	90	—	—
(I_C = –10 µA, V_{CE} = –5.0 V)	BC856A, BC857A, BC858A		—	150	—	
	BC858C		—	270	—	
(I_C = –2.0 mA, V_{CE} = –5.0 V)	BC856A, BC857A, BC858A		125	180	250	
	BC856B, BC857B, BC858B		220	290	475	
	BC858C		420	520	800	
Collector–Emitter Saturation Voltage		$V_{CE(sat)}$				V
(I_C = –10 mA, I_B = –0.5 mA)			—	—	–0.3	
(I_C = –100 mA, I_B = –5.0 mA)			—	—	–0.65	
Base–Emitter Saturation Voltage		$V_{BE(sat)}$				V
(I_C = –10 mA, I_B = –0.5 mA)			—	–0.7	—	
(I_C = –100 mA, I_B = –5.0 mA)			—	–0.9	—	
Base–Emitter On Voltage		$V_{BE(on)}$				V
(I_C = –2.0 mA, V_{CE} = –5.0 V)			–0.6	—	–0.75	
(I_C = –10 mA, V_{CE} = –5.0 V)			—	—	–0.82	
SMALL–SIGNAL CHARACTERISTICS						
Current–Gain — Bandwidth Product (I_C = –10 mA, V_{CE} = –5.0 Vdc, f = 100 MHz)		f_T	100	—	—	MHz
Output Capacitance (V_{CB} = –10 V, f = 1.0 MHz)		C_{ob}	—	—	4.5	pF
Noise Figure (I_C = –0.2 mA, V_{CE} = –5.0 Vdc, R_S = 2.0 kΩ, f = 1.0 kHz, BW = 200 Hz)		NF	—	—	10	dB

BC857/BC858

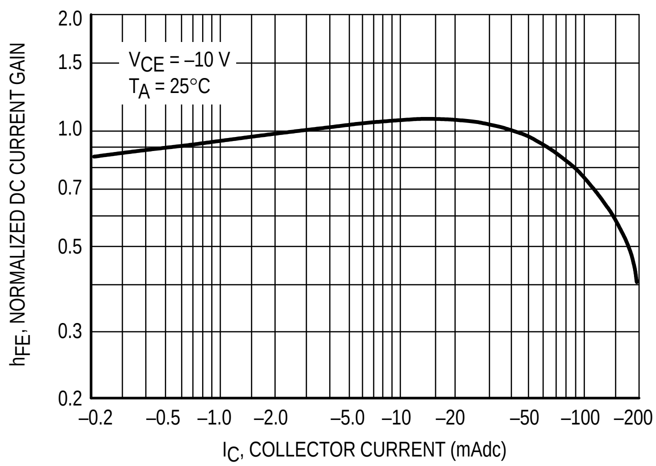


Figure 1. Normalized DC Current Gain

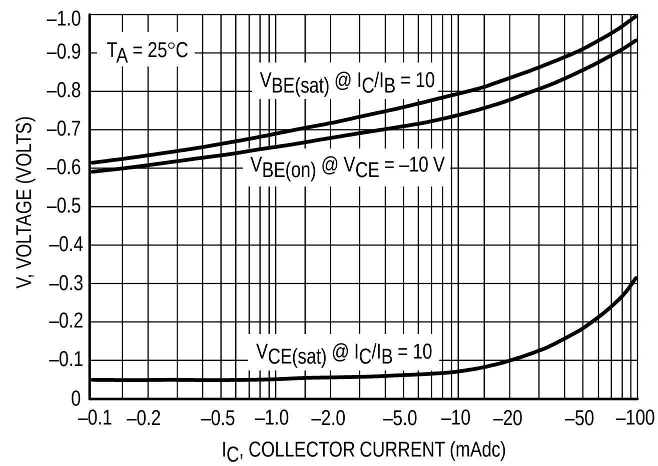


Figure 2. "Saturation" and "On" Voltages

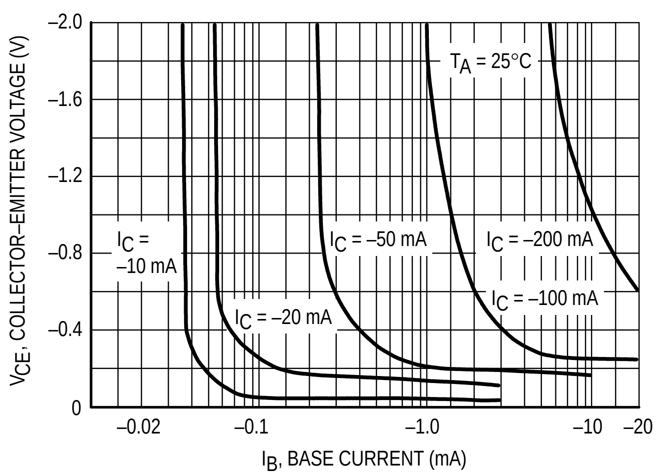


Figure 3. Collector Saturation Region

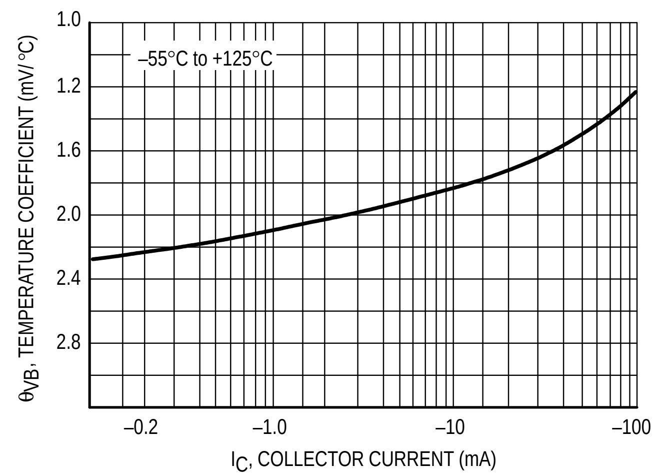


Figure 4. Base–Emitter Temperature Coefficient

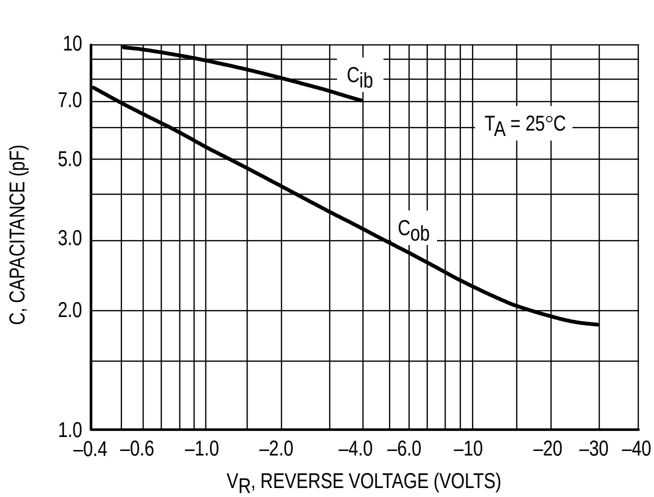


Figure 5. Capacitances

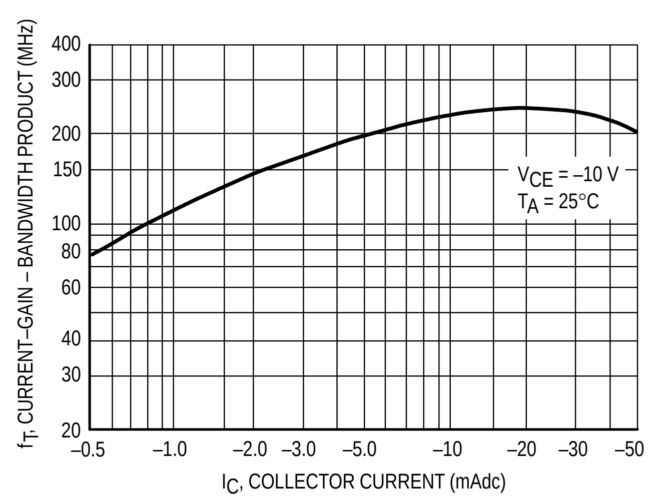


Figure 6. Current–Gain – Bandwidth Product

BC856

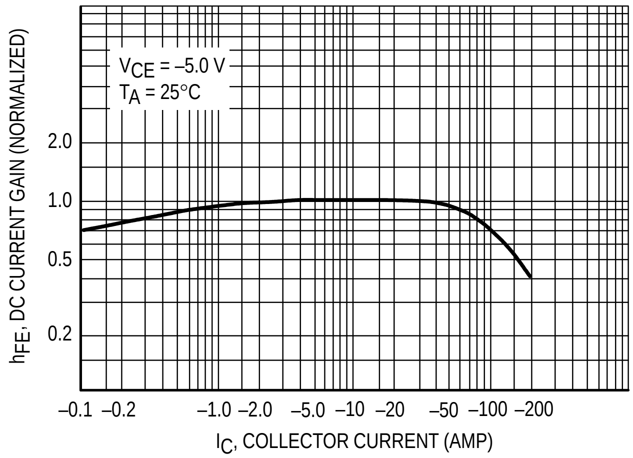


Figure 7. DC Current Gain

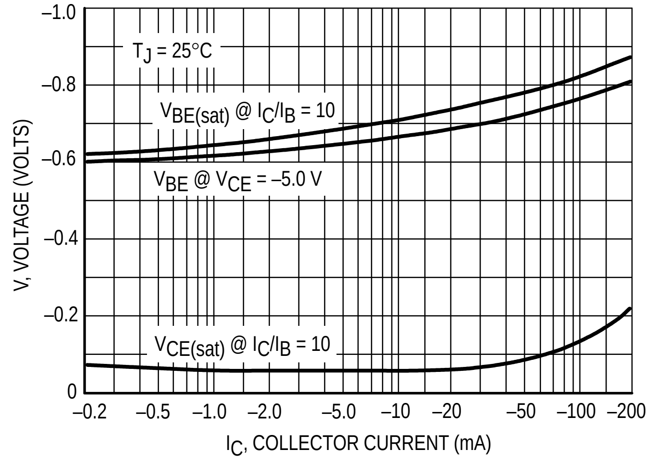


Figure 8. "On" Voltage

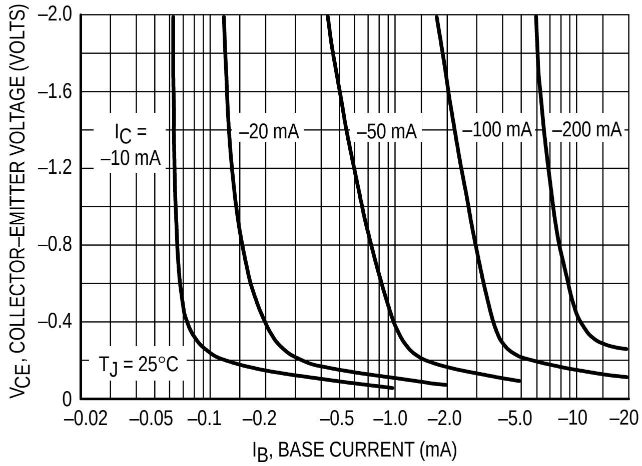


Figure 9. Collector Saturation Region

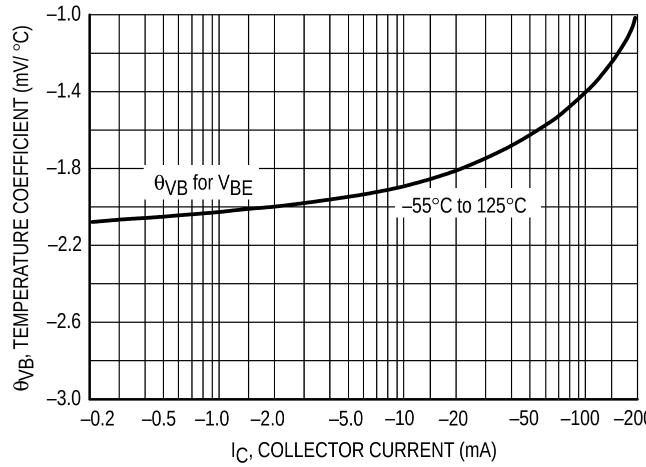


Figure 10. Base–Emitter Temperature Coefficient

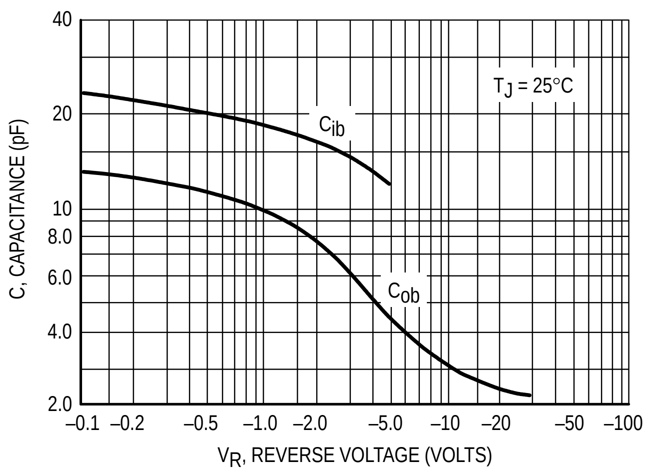


Figure 11. Capacitance

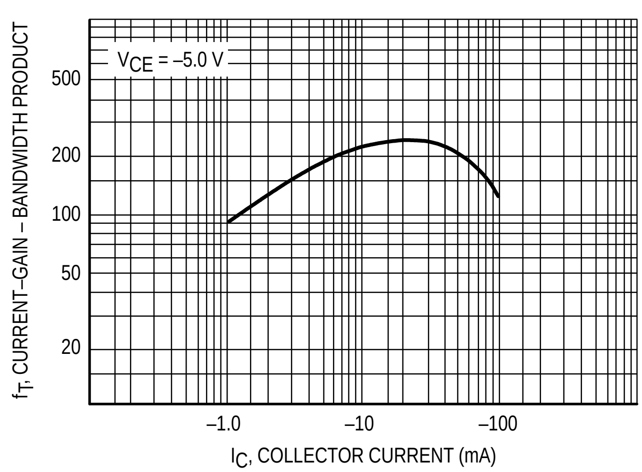


Figure 12. Current–Gain – Bandwidth Product

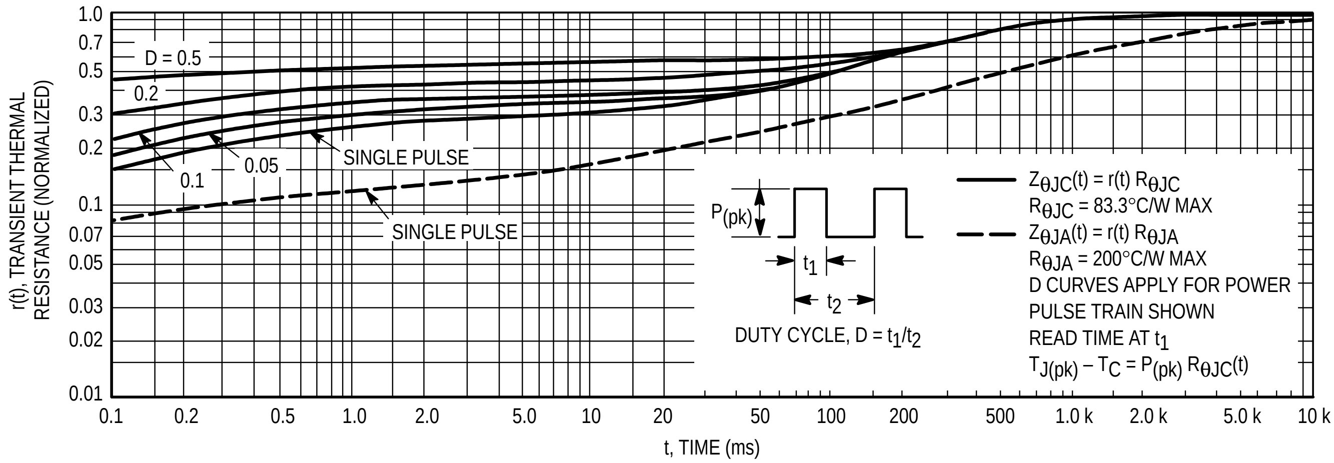


Figure 13. Thermal Response

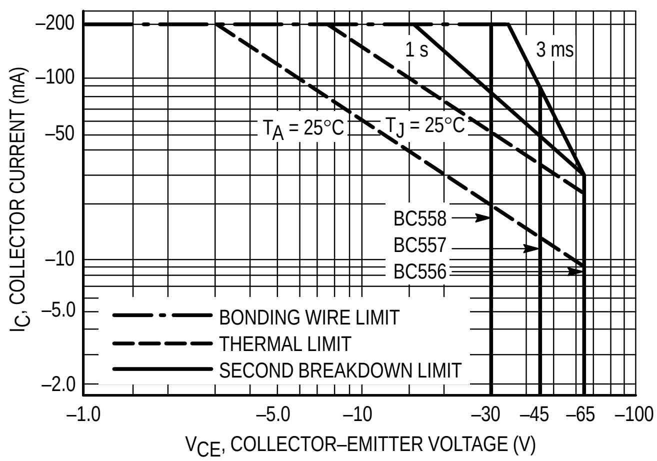


Figure 14. Active Region Safe Operating Area

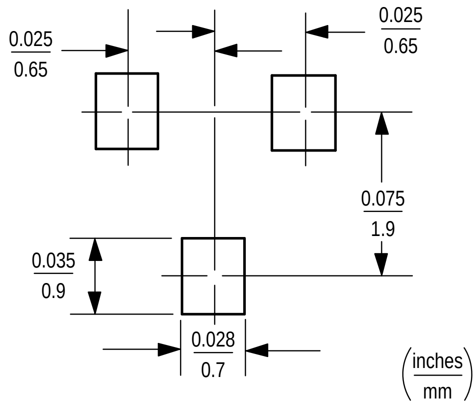
The safe operating area curves indicate I_C–V_{CE} limits of the transistor that must be observed for reliable operation. Collector load lines for specific circuits must fall below the limits indicated by the applicable curve.

The data of Figure 14 is based upon $T_{J(pk)}$ = 150°C; T_C or T_A is variable depending upon conditions. Pulse curves are valid for duty cycles to 10% provided $T_{J(pk)} \leq$ 150°C. $T_{J(pk)}$ may be calculated from the data in Figure 13. At high case or ambient temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by the secondary breakdown.

INFORMATION FOR USING THE SOT–323/SC–70 SURFACE MOUNT PACKAGE

MINIMUM RECOMMENDED FOOTPRINT 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.



SOT–323/SC–70

SOT–323/SC–70 POWER DISSIPATION

The power dissipation of the SOT–323/SC–70 is a function of the pad size. This can vary from the minimum pad size for soldering to a 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 for the SOT–323/SC–70 package, 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 150 milliwatts.

$$P_D = \frac{150°C - 25°C}{833°C/W} = 150 \text{ milliwatts}$$

The 833°C/W for the SOT–323/SC–70 package assumes the use of the recommended footprint on a glass epoxy printed circuit board to achieve a power dissipation of 150 milliwatts. There are other alternatives to achieving higher power dissipation from the SOT–323/SC–70 package. Another alternative would be to use a ceramic substrate or an aluminum core board such as Thermal Clad™. Using a board material such as Thermal Clad, an aluminum core board, the power dissipation can be doubled using the same footprint.

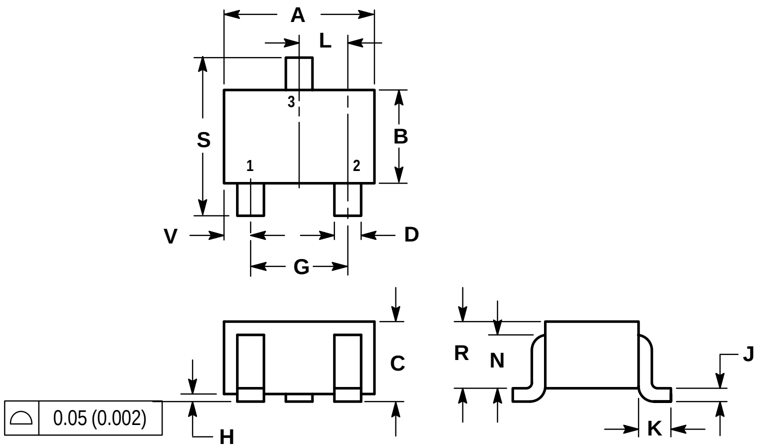
SOLDERING PRECAUTIONS

The melting temperature of solder is higher than the rated temperature of the device. When the entire device is heated to a high temperature, 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 shall be a maximum of 10°C.
- 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 at least three minutes. Gradual cooling should be used as the use of forced cooling will increase the temperature gradient and result in latent failure due to mechanical stress.
- Mechanical stress or shock should not be applied during cooling.

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

PACKAGE DIMENSIONS



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

DIM	INCHES MIN	INCHES MAX	MILLIMETERS MIN	MILLIMETERS MAX
A	0.071	0.087	1.80	2.20
B	0.045	0.053	1.15	1.35
C	0.035	0.049	0.90	1.25
D	0.012	0.016	0.30	0.40
G	0.047	0.055	1.20	1.40
H	0.000	0.004	0.00	0.10
J	0.004	0.010	0.10	0.25
K	0.017 REF		0.425 REF	
L	0.026 BSC		0.650 BSC	
N	0.028 REF		0.700 REF	
R	0.031	0.039	0.80	1.00
S	0.079	0.087	2.00	2.20
V	0.012	0.016	0.30	0.40

STYLE 3:
PIN 1. BASE
2. EMITTER
3. COLLECTOR

CASE 419–02
ISSUE G
SOT–323/SC–70

How to reach us:
USA / EUROPE: Motorola Literature Distribution;
P.O. Box 20912; Phoenix, Arizona 85036. 1–800–441–2447

MFAX: RMFAX0@email.sps.mot.com – TOUCHTONE (602) 244–6609
INTERNET: http://Design–NET.com

JAPAN: Nippon Motorola Ltd.; Tatsumi–SPD–JLDC, Toshikatsu Otsuki,
6F Seibu–Butsuryu–Center, 3–14–2 Tatsumi Koto–Ku, Tokyo 135, Japan. 03–3521–8315

HONG KONG: Motorola Semiconductors H.K. Ltd.; 8B Tai Ping Industrial Park,
51 Ting Kok Road, Tai Po, N.T., Hong Kong. 852–26629298