MBT3906DW1T1

Dual General Purpose Transistor

The MBT3906DW1T1 device is a spin–off of our popular SOT–23/SOT–323 three–leaded device. It is designed for general purpose amplifier applications and is housed in the SOT–363 six–leaded surface mount package. By putting two discrete devices in one package, this device is ideal for low–power surface mount applications where board space is at a premium.

- h_{FE}, 100–300
- Low $V_{CE(sat)}$, ≤ 0.4 V
- Simplifies Circuit Design
- Reduces Board Space
- Reduces Component Count
- Available in 8 mm, 7–inch/3,000 Unit Tape and Reel
- Device Marking: MBT3906DW1T1 = A2

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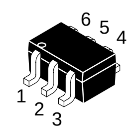
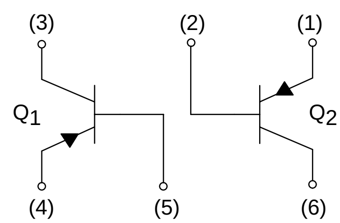


SOT–363/SC–88
CASE 419B
STYLE 1



MBT3906DW1T1

ORDERING INFORMATION

Device	Package	Shipping
MBT3906DW1T1	SOT–363	3000 Units/Reel

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector–Emitter Voltage	V_{CEO}	–40	Vdc
Collector–Base Voltage	V_{CBO}	–40	Vdc
Emitter–Base Voltage	V_{EBO}	–5.0	Vdc
Collector Current – Continuous	I_C	–200	mAdc
Electrostatic Discharge	ESD	HBM>16000, MM>2000	V

THERMAL CHARACTERISTICS

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

1. Device mounted on FR4 glass epoxy printed circuit board using the minimum recommended footprint.

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

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector–Emitter Breakdown Voltage(2)	$V_{(BR)CEO}$	–40	–	Vdc
Collector–Base Breakdown Voltage	$V_{(BR)CBO}$	–40	–	Vdc
Emitter–Base Breakdown Voltage	$V_{(BR)EBO}$	–5.0	–	Vdc
Base Cutoff Current	I_{BL}	–	–50	nAdc
Collector Cutoff Current	I_{CEX}	–	–50	nAdc
ON CHARACTERISTICS (2)				
DC Current Gain	h_{FE}			–
(I_C = –0.1 mAdc, V_{CE} = –1.0 Vdc)		60	–	
(I_C = –1.0 mAdc, V_{CE} = –1.0 Vdc)		80	–	
(I_C = –10 mAdc, V_{CE} = –1.0 Vdc)		100	300	
(I_C = –50 mAdc, V_{CE} = –1.0 Vdc)		60	–	
(I_C = –100 mAdc, V_{CE} = –1.0 Vdc)		30	–	
Collector–Emitter Saturation Voltage	$V_{CE(sat)}$			Vdc
(I_C = –10 mAdc, I_B = –1.0 mAdc)		–	–0.25	
(I_C = –50 mAdc, I_B = –5.0 mAdc)		–	–0.4	
Base–Emitter Saturation Voltage	$V_{BE(sat)}$			Vdc
(I_C = –10 mAdc, I_B = –1.0 mAdc)		–0.65	–0.85	
(I_C = –50 mAdc, I_B = –5.0 mAdc)		–	–0.95	
SMALL–SIGNAL CHARACTERISTICS				
Current–Gain – Bandwidth Product	f_T	250	–	MHz
Output Capacitance	C_{obo}	–	4.5	pF
Input Capacitance	C_{ibo}	–	10.0	pF

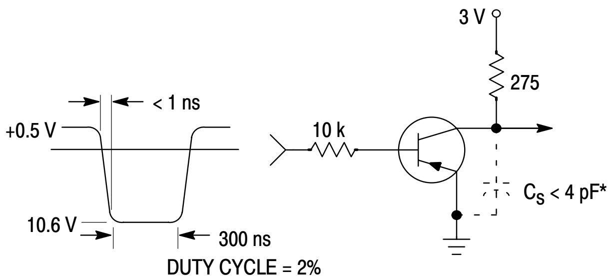
2. Pulse Test: Pulse Width ≤ 300 μs; Duty Cycle ≤2.0%.

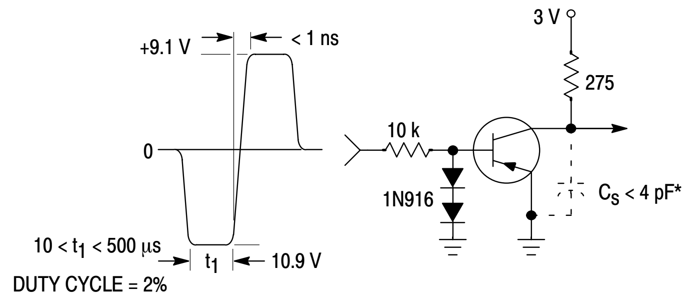
ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted) (Continued)

Characteristic	Symbol	Min	Max	Unit
Input Impedance (V_{CE} = –10 Vdc, I_C = –1.0 mAdc, f = 1.0 kHz)	h_{ie}	2.0	12	k Ω
Voltage Feedback Ratio (V_{CE} = –10 Vdc, I_C = –1.0 mAdc, f = 1.0 kHz)	h_{re}	0.1	10	X 10^{-4}
Small–Signal Current Gain (V_{CE} = –10 Vdc, I_C = –1.0 mAdc, f = 1.0 kHz)	h_{fe}	100	400	–
Output Admittance (V_{CE} = –10 Vdc, I_C = –1.0 mAdc, f = 1.0 kHz)	h_{oe}	3.0	60	μmhos
Noise Figure (V_{CE} = –5.0 Vdc, I_C = –100 μAdc, R_S = 1.0 k Ω, f = 1.0 kHz)	NF	–	4.0	dB

SWITCHING CHARACTERISTICS

Characteristic	Conditions	Symbol	Min	Max	Unit
Delay Time	(V_{CC} = –3.0 Vdc, V_{BE} = 0.5 Vdc)	t_d	–	35	ns
Rise Time	(I_C = –10 mAdc, I_{B1} = –1.0 mAdc)	t_r	–	35	
Storage Time	(V_{CC} = –3.0 Vdc, I_C = –10 mAdc)	t_s	–	225	ns
Fall Time	(I_{B1} = I_{B2} = –1.0 mAdc)	t_f	–	75	





* Total shunt capacitance of test jig and connectors

Figure 1. Delay and Rise Time Equivalent Test Circuit

Figure 2. Storage and Fall Time Equivalent Test Circuit

TYPICAL TRANSIENT CHARACTERISTICS

—— T_J = 25°C
– – T_J = 125°C

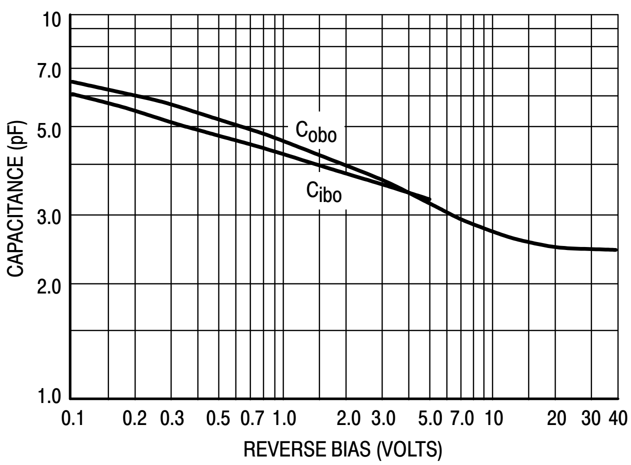


Figure 3. Capacitance

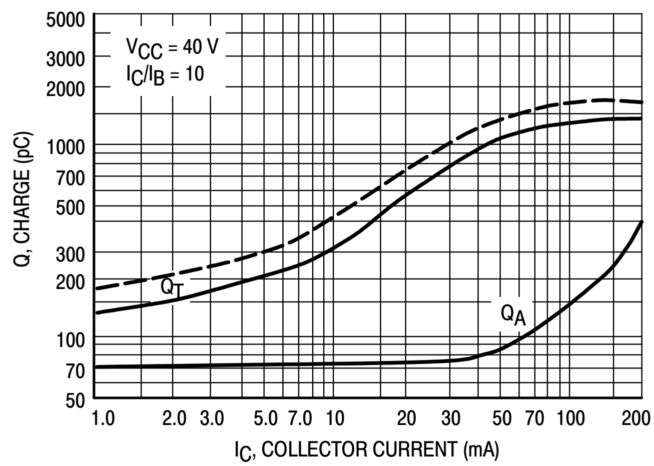


Figure 4. Charge Data

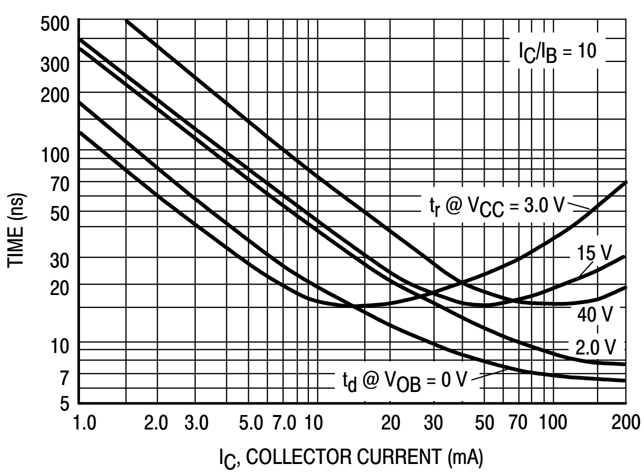


Figure 5. Turn−On Time

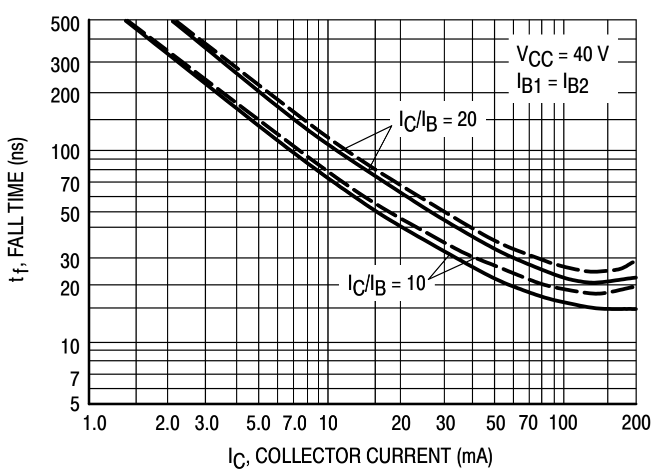


Figure 6. Fall Time

TYPICAL AUDIO SMALL–SIGNAL CHARACTERISTICS
NOISE FIGURE VARIATIONS

(V_{CE} = –5.0 Vdc, T_A = 25°C, Bandwidth = 1.0 Hz)

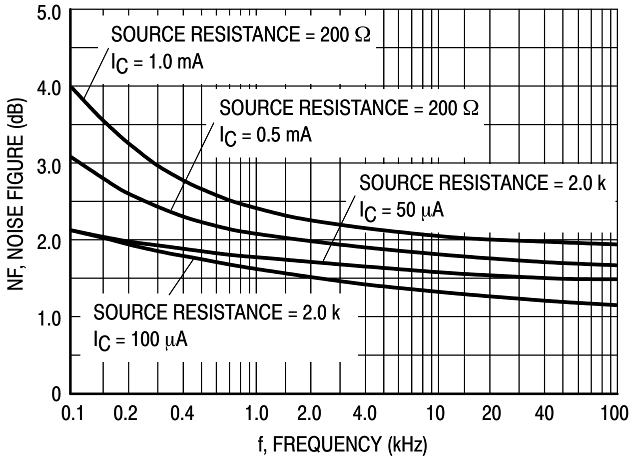


Figure 7.

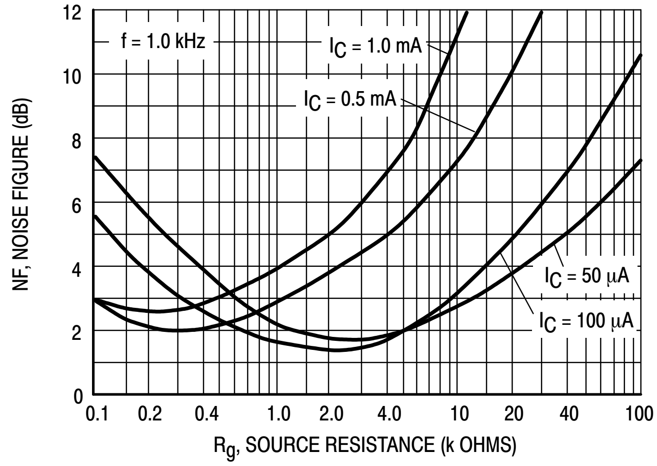


Figure 8.

h PARAMETERS

(V_{CE} = –10 Vdc, f = 1.0 kHz, T_A = 25°C)

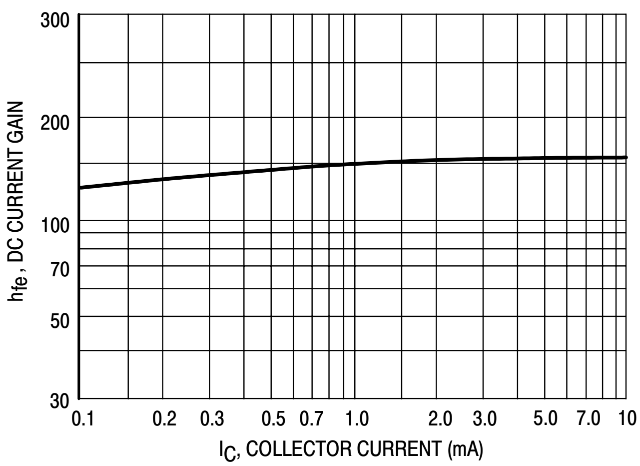


Figure 9. Current Gain

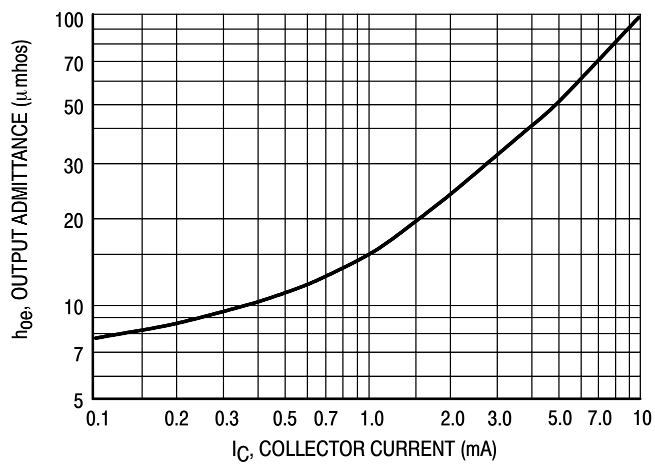


Figure 10. Output Admittance

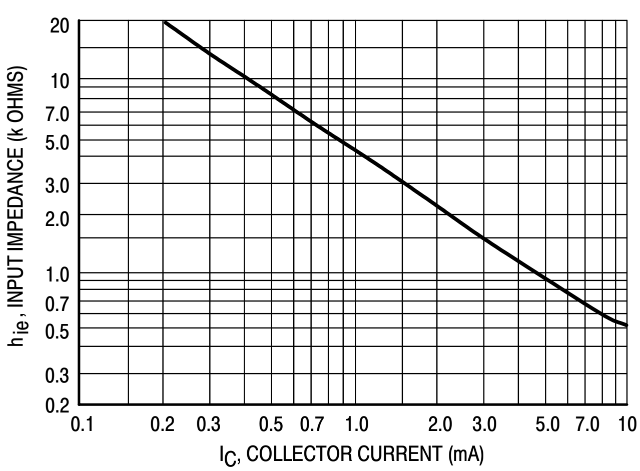


Figure 11. Input Impedance

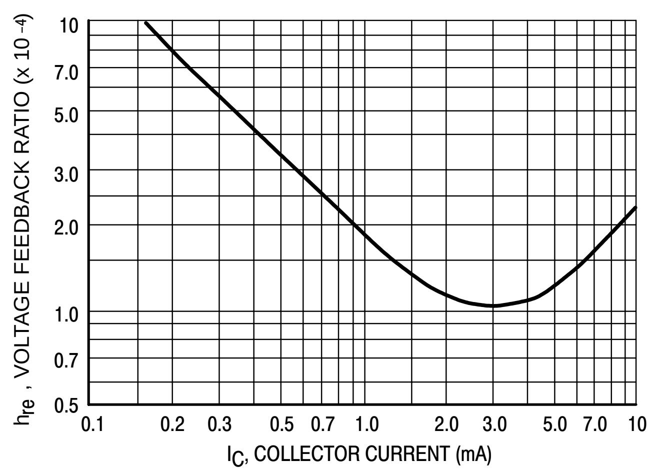


Figure 12. Voltage Feedback Ratio

TYPICAL STATIC CHARACTERISTICS

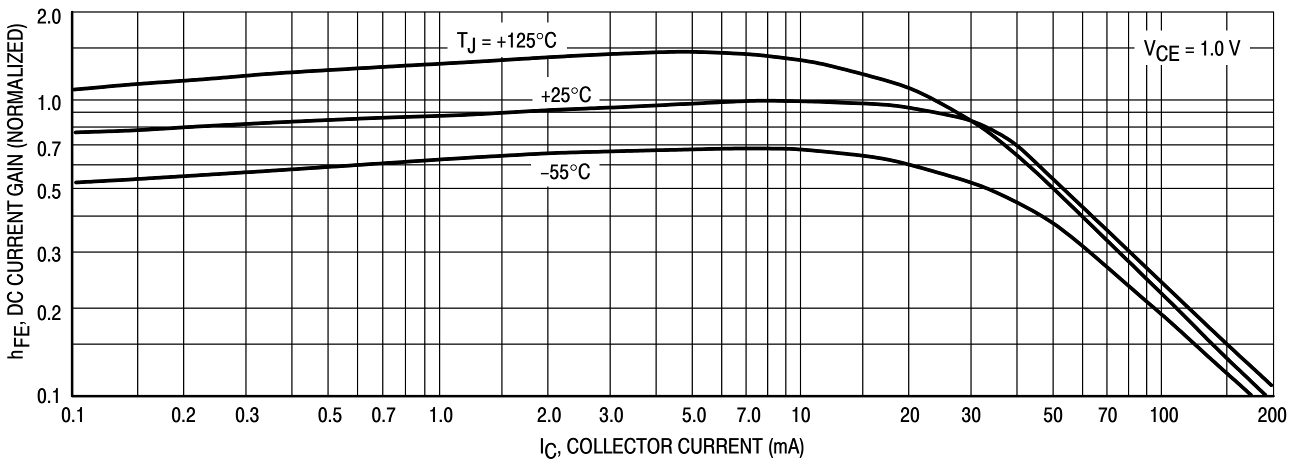


Figure 13. DC Current Gain

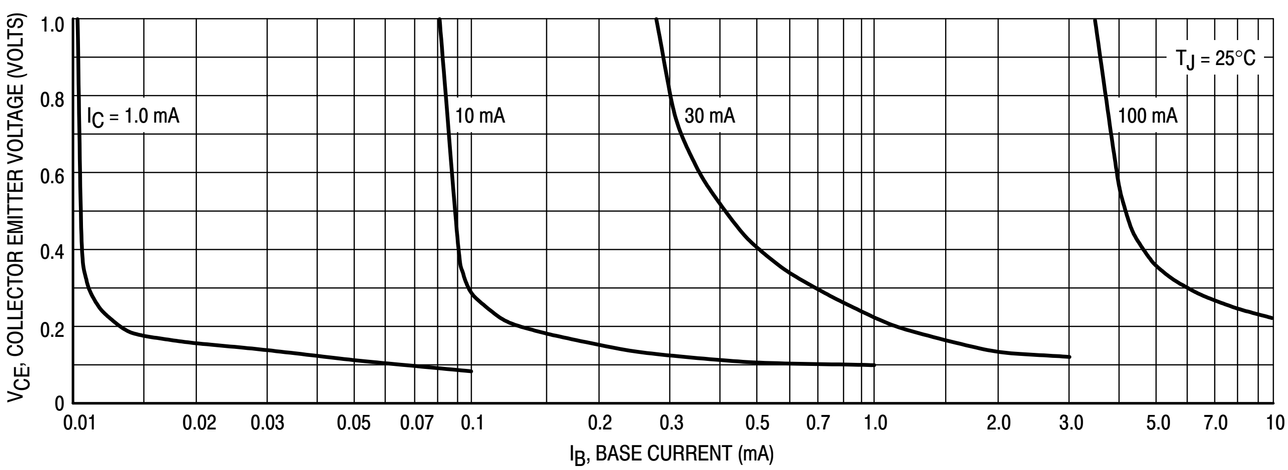


Figure 14. Collector Saturation Region

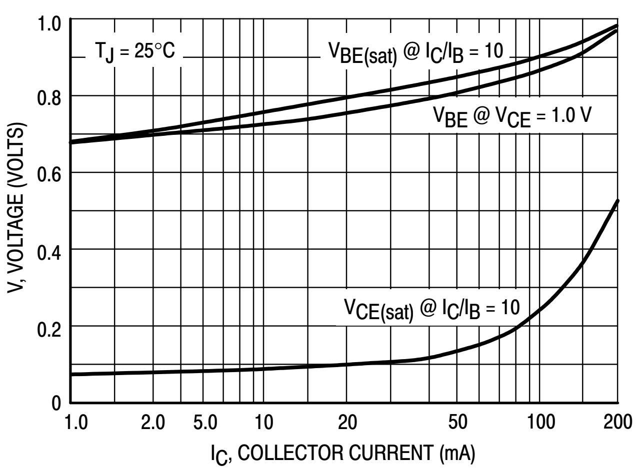


Figure 15. "ON" Voltages

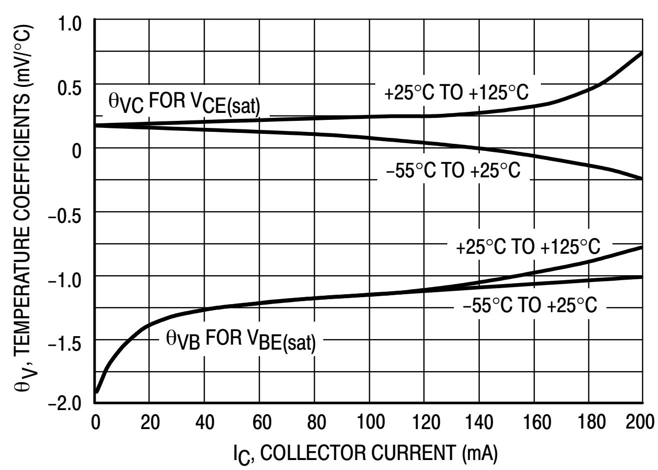
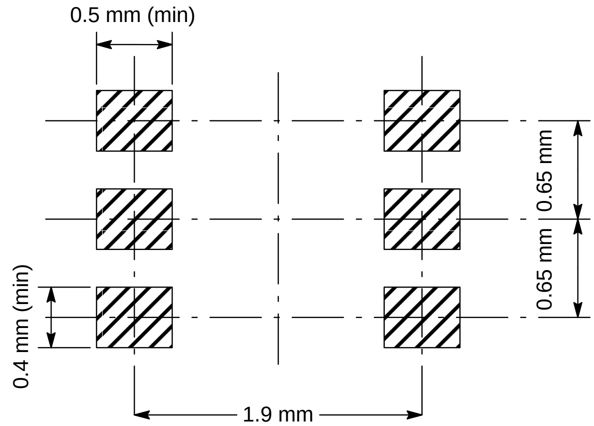


Figure 16. Temperature Coefficients

INFORMATION FOR USING THE SOT–363 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–363

SOT–363 POWER DISSIPATION

The power dissipation of the SOT–363 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–363 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–363 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–363 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

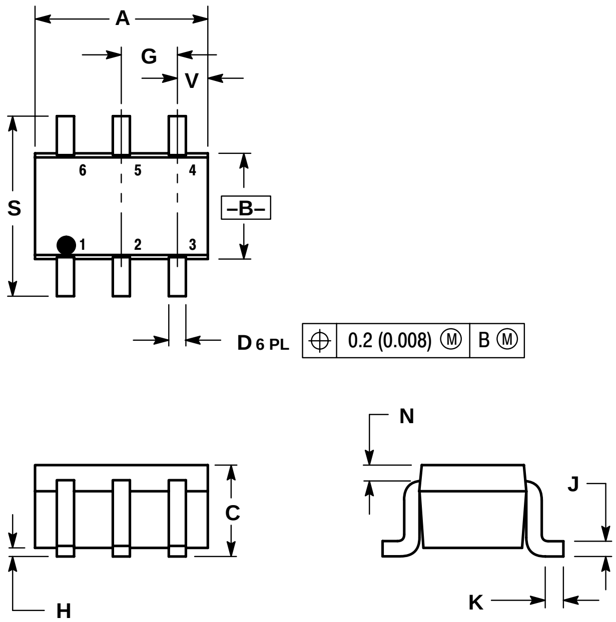
The melting temperature of solder is higher than the rated temperature of the device. When the entire device is heated to a high temperature, failure to complete soldering within a short time could result in device failure. Therefore, the following items should always be observed in order to minimize 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

SOT–363/SC–88
CASE 419B–01
ISSUE G



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

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.071	0.087	1.80	2.20
B	0.045	0.053	1.15	1.35
C	0.031	0.043	0.80	1.10
D	0.004	0.012	0.10	0.30
G	0.026 BSC		0.65 BSC	
H	---	0.004	---	0.10
J	0.004	0.010	0.10	0.25
K	0.004	0.012	0.10	0.30
N	0.008 REF		0.20 REF	
S	0.079	0.087	2.00	2.20
V	0.012	0.016	0.30	0.40

STYLE 1:
PIN 1. EMITTER 2
2. BASE 2
3. COLLECTOR 1
4. EMITTER 1
5. BASE 1
6. COLLECTOR 2

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