

# BC846BDW1T1, BC847BDW1T1 Series, BC848BDW1T1 Series

## Dual General Purpose Transistors

### NPN Duals

These transistors are designed for general purpose amplifier applications. They are housed in the SOT-363/SC-88 which is designed for low power surface mount applications.

- Device Marking:  
BC846BDW1T1 = 1B  
BC847BDW1T1 = 1F  
BC847CDW1T1 = 1G  
BC848BDW1T1 = 1K  
BC848CDW1T1 = 1L

#### MAXIMUM RATINGS

| Rating                         | Symbol    | BC846 | BC847 | BC848 | Unit |
|--------------------------------|-----------|-------|-------|-------|------|
| Collector-Emitter Voltage      | $V_{CEO}$ | 65    | 45    | 30    | V    |
| Collector-Base Voltage         | $V_{CBO}$ | 80    | 50    | 30    | V    |
| Emitter-Base Voltage           | $V_{EBO}$ | 6.0   | 6.0   | 5.0   | V    |
| Collector Current – Continuous | $I_C$     | 100   | 100   | 100   | mAdc |

#### THERMAL CHARACTERISTICS

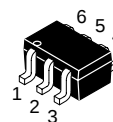
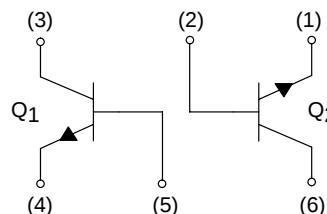
| Characteristic                                                                                                             | Symbol          | Max                   | Unit                           |
|----------------------------------------------------------------------------------------------------------------------------|-----------------|-----------------------|--------------------------------|
| Total Device Dissipation Per Device<br>FR-5 Board (Note 1.)<br>$T_A = 25^\circ\text{C}$<br>Derate Above $25^\circ\text{C}$ | $P_D$           | 380<br>250<br><br>3.0 | mW<br><br>mW/ $^\circ\text{C}$ |
| Thermal Resistance, Junction to Ambient                                                                                    | $R_{\theta JA}$ | 328                   | $^\circ\text{C/W}$             |
| Junction and Storage Temperature Range                                                                                     | $T_J, T_{stg}$  | -55 to +150           | $^\circ\text{C}$               |

1. FR-5 = 1.0 x 0.75 x 0.062 in



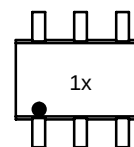
ON Semiconductor™

<http://onsemi.com>



SOT-363  
CASE 419B  
STYLE 1

#### DEVICE MARKING



1x = Specific Device Code  
x = B, F, G, K, L

#### ORDERING INFORMATION

| Device      | Package | Shipping        |
|-------------|---------|-----------------|
| BC846BDW1T1 | SOT-363 | 3000 Units/Reel |
| BC847BDW1T1 | SOT-363 | 3000 Units/Reel |
| BC847CDW1T1 | SOT-363 | 3000 Units/Reel |
| BC848BDW1T1 | SOT-363 | 3000 Units/Reel |
| BC848CDW1T1 | SOT-363 | 3000 Units/Reel |

# BC846BDW1T1, BC847BDW1T1 Series, BC848BDW1T1 Series

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

| Characteristic | Symbol | Min | Typ | Max | Unit |
|----------------|--------|-----|-----|-----|------|
|----------------|--------|-----|-----|-----|------|

### OFF CHARACTERISTICS

|                                                                                                               |                                              |               |                   |             |             |                     |
|---------------------------------------------------------------------------------------------------------------|----------------------------------------------|---------------|-------------------|-------------|-------------|---------------------|
| Collector–Emitter Breakdown Voltage<br>( $I_C = 10\text{ mA}$ )                                               | BC846 Series<br>BC847 Series<br>BC848 Series | $V_{(BR)CEO}$ | 65<br>45<br>30    | –<br>–<br>– | –<br>–<br>– | V                   |
| Collector–Emitter Breakdown Voltage<br>( $I_C = 10\text{ }\mu\text{A}$ , $V_{EB} = 0$ )                       | BC846 Series<br>BC847 Series<br>BC848 Series | $V_{(BR)CES}$ | 80<br>50<br>30    | –<br>–<br>– | –<br>–<br>– | V                   |
| Collector–Base Breakdown Voltage<br>( $I_C = 10\text{ }\mu\text{A}$ )                                         | BC846 Series<br>BC847 Series<br>BC848 Series | $V_{(BR)CBO}$ | 80<br>50<br>30    | –<br>–<br>– | –<br>–<br>– | V                   |
| Emitter–Base Breakdown Voltage<br>( $I_E = 1.0\text{ }\mu\text{A}$ )                                          | BC846 Series<br>BC847 Series<br>BC848 Series | $V_{(BR)EBO}$ | 6.0<br>6.0<br>5.0 | –<br>–<br>– | –<br>–<br>– | V                   |
| Collector Cutoff Current ( $V_{CB} = 30\text{ V}$ )<br>( $V_{CB} = 30\text{ V}$ , $T_A = 150^\circ\text{C}$ ) |                                              | $I_{CBO}$     | –<br>–            | –<br>–      | 15<br>5.0   | nA<br>$\mu\text{A}$ |

### ON CHARACTERISTICS

|                                                                                                                                            |                                          |               |            |            |             |    |
|--------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|---------------|------------|------------|-------------|----|
| DC Current Gain<br>( $I_C = 10\text{ }\mu\text{A}$ , $V_{CE} = 5.0\text{ V}$ )                                                             | BC846B, BC847B, BC848B<br>BC847C, BC848C | $h_{FE}$      | –<br>–     | 150<br>270 | –<br>–      | –  |
| ( $I_C = 2.0\text{ mA}$ , $V_{CE} = 5.0\text{ V}$ )                                                                                        | BC846B, BC847B, BC848B<br>BC847C, BC848C |               | 200<br>420 | 290<br>520 | 450<br>800  |    |
| Collector–Emitter Saturation Voltage ( $I_C = 10\text{ mA}$ , $I_B = 0.5\text{ mA}$ )<br>( $I_C = 100\text{ mA}$ , $I_B = 5.0\text{ mA}$ ) |                                          | $V_{CE(sat)}$ | –<br>–     | –<br>–     | 0.25<br>0.6 | V  |
| Base–Emitter Saturation Voltage ( $I_C = 10\text{ mA}$ , $I_B = 0.5\text{ mA}$ )<br>( $I_C = 100\text{ mA}$ , $I_B = 5.0\text{ mA}$ )      |                                          | $V_{BE(sat)}$ | –<br>–     | 0.7<br>0.9 | –<br>–      | V  |
| Base–Emitter Voltage ( $I_C = 2.0\text{ mA}$ , $V_{CE} = 5.0\text{ V}$ )<br>( $I_C = 10\text{ mA}$ , $V_{CE} = 5.0\text{ V}$ )             |                                          | $V_{BE(on)}$  | 580<br>–   | 660<br>–   | 700<br>770  | mV |

### SMALL-SIGNAL CHARACTERISTICS

|                                                                                                                                                  |           |     |   |     |     |
|--------------------------------------------------------------------------------------------------------------------------------------------------|-----------|-----|---|-----|-----|
| Current–Gain – Bandwidth Product<br>( $I_C = 10\text{ mA}$ , $V_{CE} = 5.0\text{ Vdc}$ , $f = 100\text{ MHz}$ )                                  | $f_T$     | 100 | – | –   | MHz |
| Output Capacitance ( $V_{CB} = 10\text{ V}$ , $f = 1.0\text{ MHz}$ )                                                                             | $C_{obo}$ | –   | – | 4.5 | pF  |
| Noise Figure<br>( $I_C = 0.2\text{ mA}$ , $V_{CE} = 5.0\text{ Vdc}$ , $R_S = 2.0\text{ k}\Omega$ , $f = 1.0\text{ kHz}$ , $BW = 200\text{ Hz}$ ) | NF        | –   | – | 10  | dB  |

# BC846BDW1T1, BC847BDW1T1 Series, BC848BDW1T1 Series

## TYPICAL CHARACTERISTICS – BC847 SERIES & BC848 SERIES

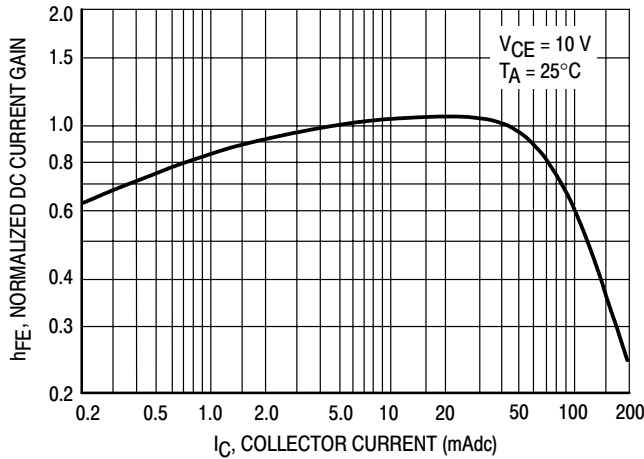


Figure 1. Normalized DC Current Gain

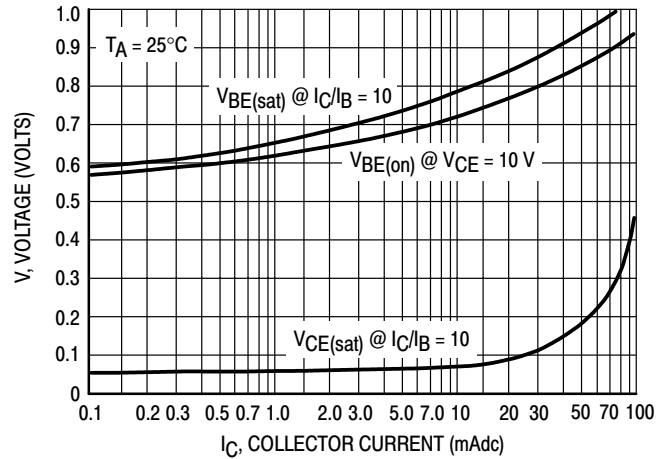


Figure 2. "Saturation" and "On" Voltages

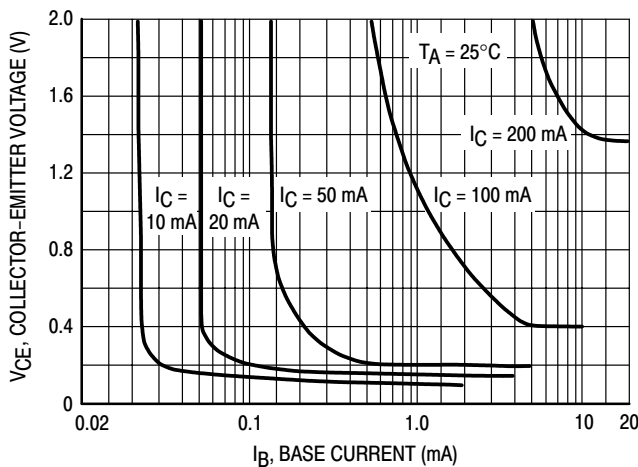


Figure 3. Collector Saturation Region

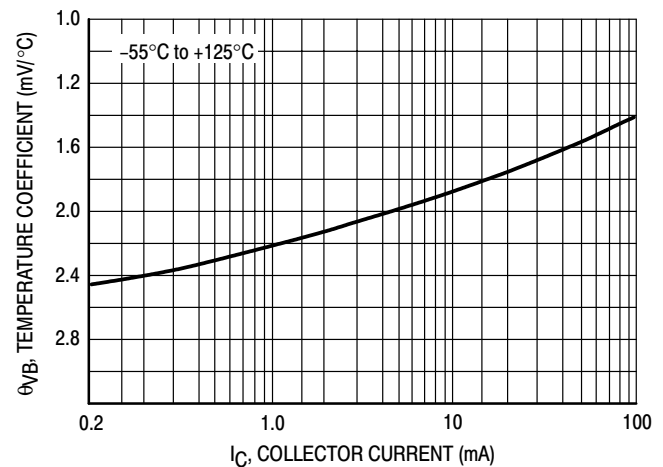


Figure 4. Base-Emitter Temperature Coefficient

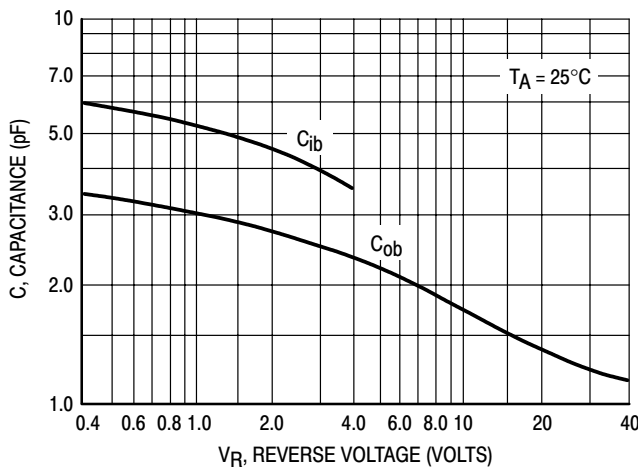


Figure 5. Capacitances

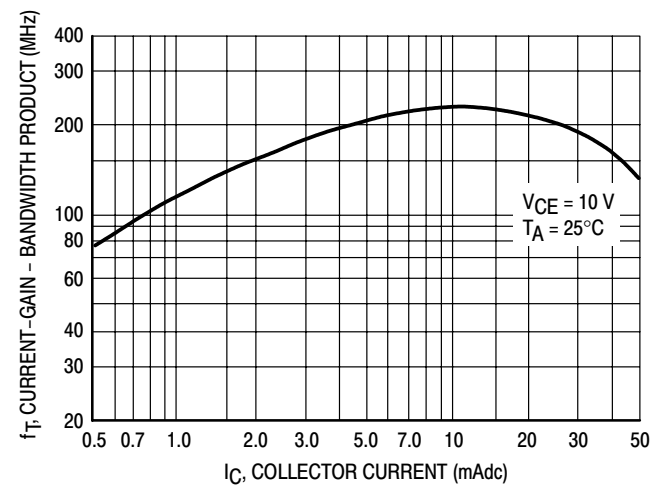


Figure 6. Current-Gain – Bandwidth Product

# BC846BDW1T1, BC847BDW1T1 Series, BC848BDW1T1 Series

## TYPICAL CHARACTERISTICS – BC846 SERIES

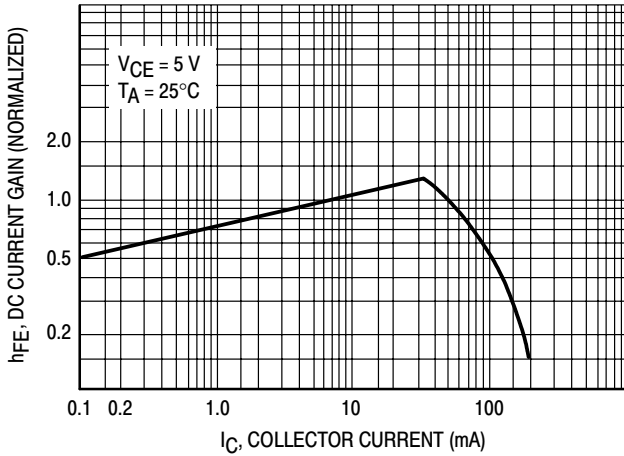


Figure 7. Normalized DC Current Gain

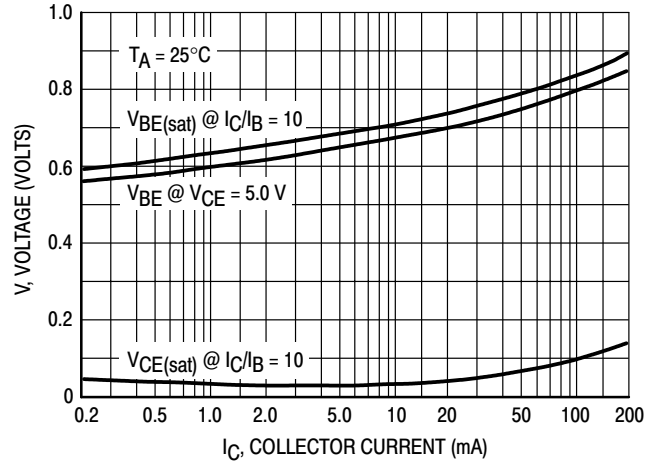


Figure 8. "On" Voltage

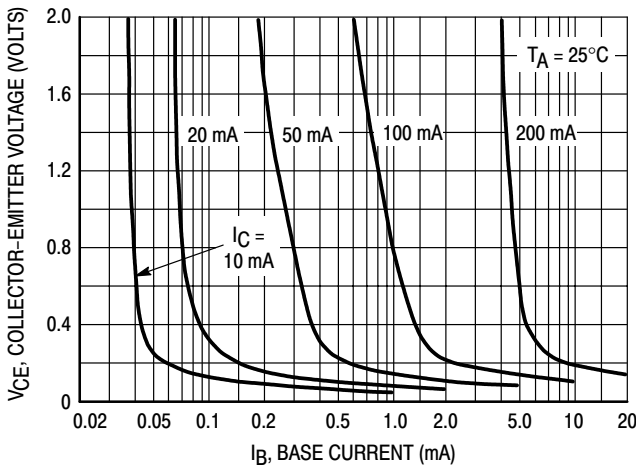


Figure 9. Collector Saturation Region

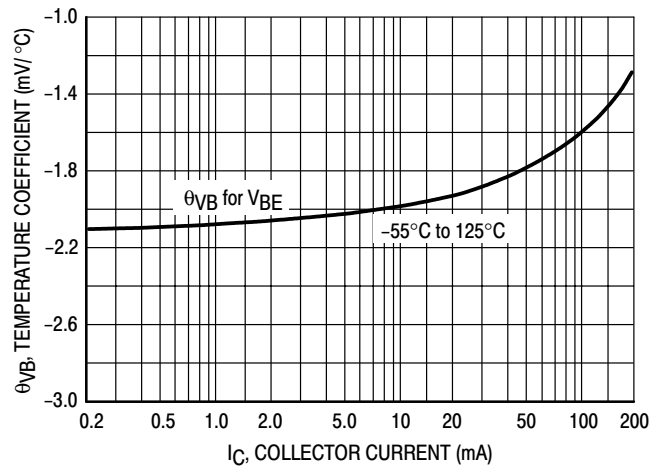


Figure 10. Base-Emitter Temperature Coefficient

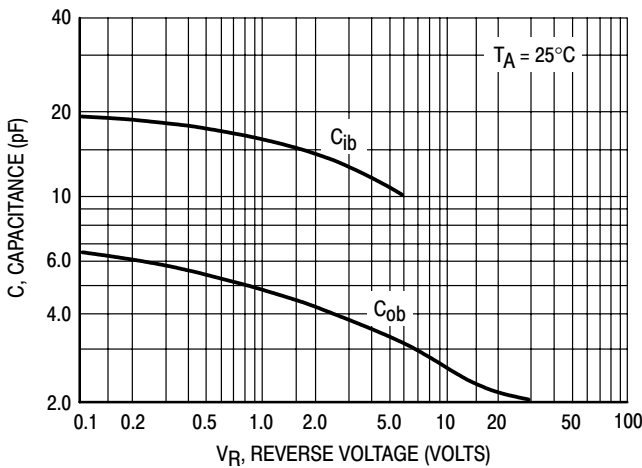


Figure 11. Capacitance

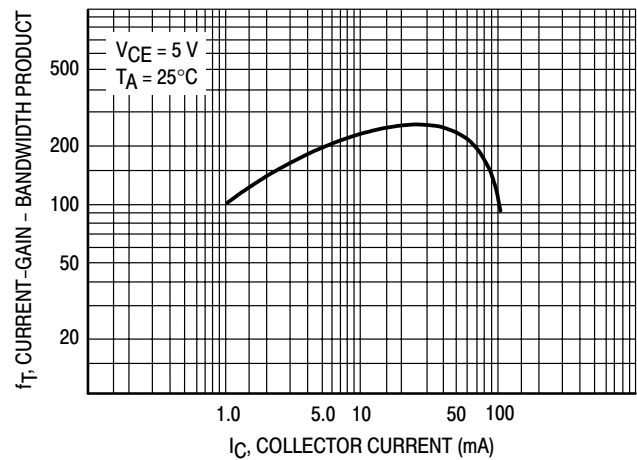


Figure 12. Current-Gain - Bandwidth Product

## BC846BDW1T1, BC847BDW1T1 Series, BC848BDW1T1 Series

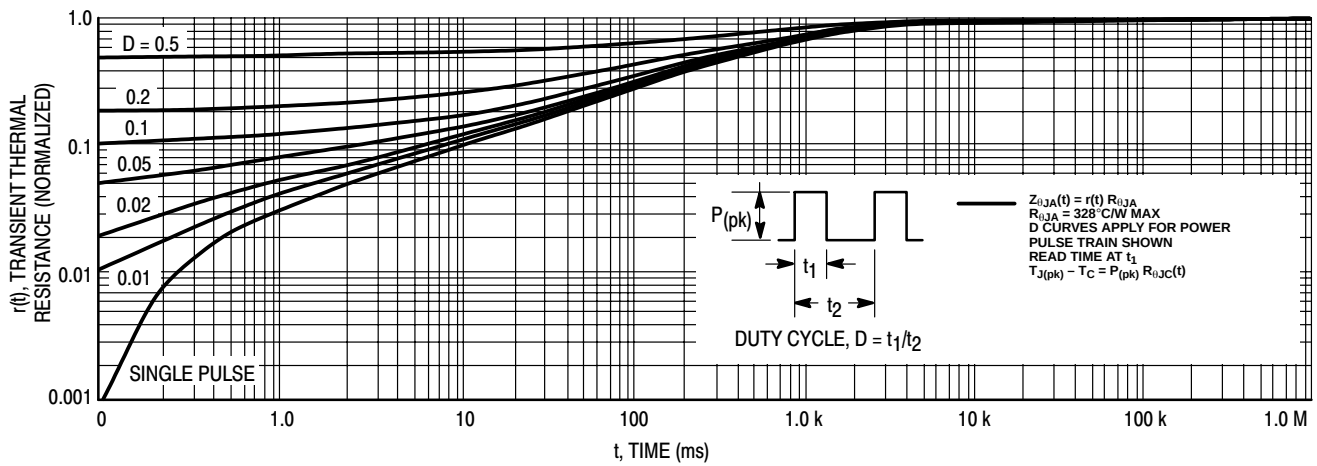


Figure 13. Thermal Response

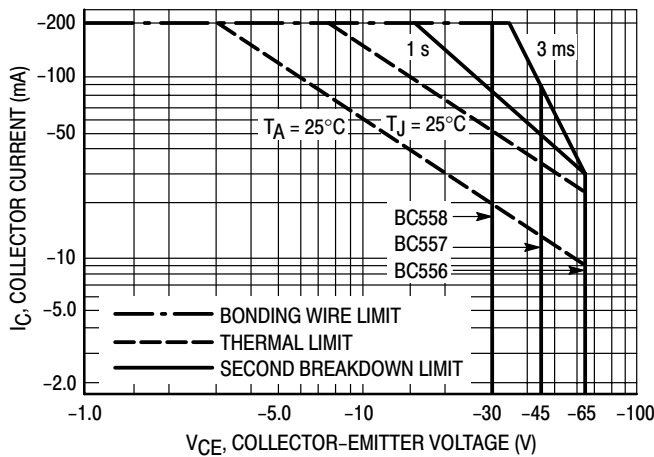


Figure 14. Active Region Safe Operating Area

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.

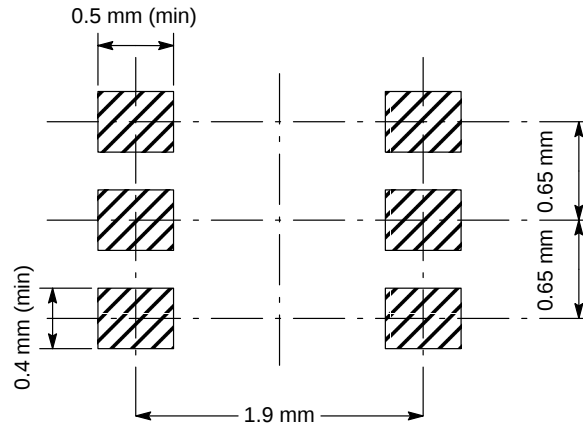
The data of Figure 14 is based upon  $T_{J(pk)} = 150^\circ\text{C}$ ;  $T_C$  or  $T_A$  is variable depending upon conditions. Pulse curves are valid for duty cycles to 10% provided  $T_{J(pk)} \leq 150^\circ\text{C}$ .  $T_{J(pk)}$  may be calculated from the data in Figure 13. At high case or ambient 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-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.

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

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.

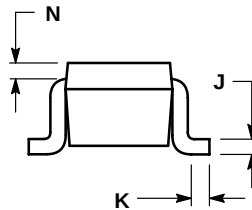
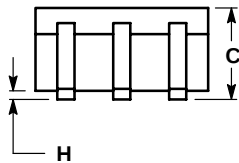
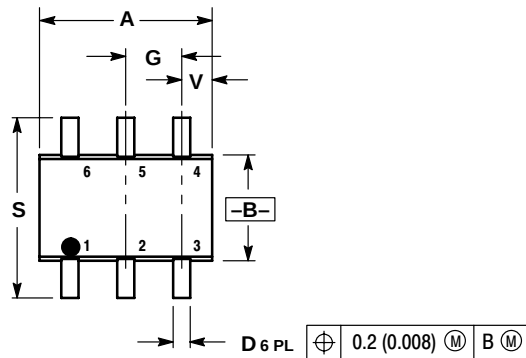
- Always preheat the device.
- The delta temperature between the preheat and soldering should be 100°C or less.\*
- When preheating and soldering, the temperature of the leads and the case must not exceed the maximum temperature ratings as shown on the data sheet. When using infrared heating with the 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.

# BC846BDW1T1, BC847BDW1T1 Series, BC848BDW1T1 Series

## PACKAGE DIMENSIONS

**SOT-363**  
CASE 419B-01  
ISSUE G



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

| DIM | INCHES    |       | MILLIMETERS |      |
|-----|-----------|-------|-------------|------|
|     | 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
  - BASE 2
  - COLLECTOR 1
  - EMITTER 1
  - BASE 1
  - COLLECTOR 2

## BC846BDW1T1, BC847BDW1T1 Series, BC848BDW1T1 Series

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