

BC847BPDW1T1, BC847CPDW1T1, BC848BPDW1T1, BC848CPDW1T1



ON Semiconductor

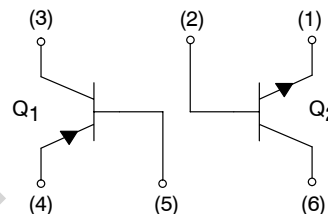
<http://onsemi.com>

Dual General Purpose Transistors

NPN/PNP 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:
BC847BPDW1T1 = 13F
BC847CPDW1T1 = 13G
BC848BPDW1T1 = 13K
BC848CPDW1T1 = 13L



MAXIMUM RATINGS – NPN

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

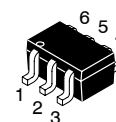
MAXIMUM RATINGS – PNP

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

THERMAL CHARACTERISTICS

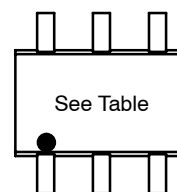
| Characteristic | Symbol | Max | Unit |
|---|-----------------|-------------------|--------------------------------|
| Total Device Dissipation Per Device FR-5 Board (1) $T_A = 25^\circ\text{C}$ Derate Above 25°C | P_D | 380 250 3.0 | mW mW/ $^\circ\text{C}$ |
| Thermal Resistance, Junction to Ambient | $R_{\theta JA}$ | 328 | $^\circ\text{C}/\text{W}$ |
| 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



SOT-363/SC-88
CASE 419B
STYLE 1

DEVICE MARKING



ORDERING INFORMATION

| Device | Package | Shipping |
|--------------|---------|-----------------|
| BC847BPDW1T1 | SOT-363 | 3000 Units/Reel |
| BC847CPDW1T1 | SOT-363 | 3000 Units/Reel |
| BC848BPDW1T1 | SOT-363 | 3000 Units/Reel |
| BC848CPDW1T1 | SOT-363 | 3000 Units/Reel |

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

| Characteristic | Symbol | Min | Typ | Max | Unit |
|---|---------------|------------|--------|-----------|---------------------|
| OFF CHARACTERISTICS | | | | | |
| Collector – Emitter Breakdown Voltage ($I_C = 10\text{ mA}$) | $V_{(BR)CEO}$ | 45 30 | — — | — — | V |
| Collector – Emitter Breakdown Voltage ($I_C = 10\ \mu\text{A}$, $V_{EB} = 0$) | $V_{(BR)CES}$ | 50 30 | — — | — — | V |
| Collector – Base Breakdown Voltage ($I_C = 10\ \mu\text{A}$) | $V_{(BR)CBO}$ | 50 30 | — — | — — | V |
| Emitter – Base Breakdown Voltage ($I_E = 1.0\ \mu\text{A}$) | $V_{(BR)EBO}$ | 6.0 5.0 | — — | — — | V |
| Collector Cutoff Current ($V_{CB} = 30\text{ V}$) ($V_{CB} = 30\text{ V}$, $T_A = 150^\circ\text{C}$) | I_{CBO} | — — | — — | 15 5.0 | nA μA |

ON CHARACTERISTICS

| | | | | | | |
|--|----------------------------------|---------------|------------|------------|-------------|----|
| DC Current Gain ($I_C = 10\ \mu\text{A}$, $V_{CE} = 5.0\text{ V}$) | BC847B, BC848B BC847C, BC848C | h_{FE} | — — | 150 270 | — — | — |
| ($I_C = 2.0\text{ mA}$, $V_{CE} = 5.0\text{ V}$) | BC847B, BC848B BC847C, BC848C | | 200 420 | 290 520 | 475 800 | |
| Collector – Emitter Saturation Voltage ($I_C = 10\text{ mA}$, $I_B = 0.5\text{ mA}$) ($I_C = 100\text{ mA}$, $I_B = 5.0\text{ mA}$) | | $V_{CE(sat)}$ | — — | — — | 0.25 0.6 | V |
| Base – Emitter Saturation Voltage ($I_C = 10\text{ mA}$, $I_B = 0.5\text{ mA}$) ($I_C = 100\text{ mA}$, $I_B = 5.0\text{ mA}$) | | $V_{BE(sat)}$ | — — | 0.7 0.9 | — — | V |
| Base – Emitter Voltage ($I_C = 2.0\text{ mA}$, $V_{CE} = 5.0\text{ V}$) ($I_C = 10\text{ mA}$, $V_{CE} = 5.0\text{ V}$) | | $V_{BE(on)}$ | 580 — | 660 — | 700 770 | mV |

SMALL-SIGNAL CHARACTERISTICS

| | | | | | | |
|---|----------------------------------|-----------|--------|--------|-----------|-----|
| Current – Gain — Bandwidth Product ($I_C = 10\text{ mA}$, $V_{CE} = 5.0\text{ Vdc}$, $f = 100\text{ MHz}$) | | f_T | 100 | — | — | MHz |
| Output Capacitance ($V_{CB} = 10\text{ V}$, $f = 1.0\text{ MHz}$) | | C_{obo} | — | — | 4.5 | pF |
| Noise Figure ($I_C = 0.2\text{ mA}$, $V_{CE} = 5.0\text{ Vdc}$, $R_S = 2.0\text{ k}\Omega$, $f = 1.0\text{ kHz}$, $BW = 200\text{ Hz}$) | BC847B, BC848B BC847C, BC848C | NF | — — | — — | 10 4.0 | dB |

BC847BPDW1T1, BC847CPDW1T1, BC848BPDW1T1, BC848CPDW1T1

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

| Characteristic | Symbol | Min | Typ | Max | Unit |
|---|---------------|--------------|--------------|----------------|---------------------|
| OFF CHARACTERISTICS | | | | | |
| Collector–Emitter Breakdown Voltage ($I_C = -10\text{ mA}$) | $V_{(BR)CEO}$ | -45 -30 | — — | — — | V |
| Collector–Emitter Breakdown Voltage ($I_C = -10\text{ }\mu\text{A}$, $V_{EB} = 0$) | $V_{(BR)CES}$ | -50 -30 | — — | — — | V |
| Collector–Base Breakdown Voltage ($I_C = -10\text{ }\mu\text{A}$) | $V_{(BR)CBO}$ | -50 -30 | — — | — — | V |
| Emitter–Base Breakdown Voltage ($I_E = -1.0\text{ }\mu\text{A}$) | $V_{(BR)EBO}$ | -5.0 -5.0 | — — | — — | V |
| Collector Cutoff Current ($V_{CB} = -30\text{ V}$) ($V_{CB} = -30\text{ V}$, $T_A = 150^\circ\text{C}$) | I_{CBO} | — — | — — | -15 -4.0 | nA μA |
| ON CHARACTERISTICS | | | | | |
| DC Current Gain ($I_C = -10\text{ }\mu\text{A}$, $V_{CE} = -5.0\text{ V}$) | h_{FE} | — — | 150 270 | — — | — |
| ($I_C = -2.0\text{ mA}$, $V_{CE} = -5.0\text{ V}$) | | 200 420 | 290 520 | 475 800 | |
| Collector–Emitter Saturation Voltage ($I_C = -10\text{ mA}$, $I_B = -0.5\text{ mA}$) ($I_C = -100\text{ mA}$, $I_B = -5.0\text{ mA}$) | $V_{CE(sat)}$ | — — | — — | -0.3 -0.65 | V |
| Base–Emitter Saturation Voltage ($I_C = -10\text{ mA}$, $I_B = -0.5\text{ mA}$) ($I_C = -100\text{ mA}$, $I_B = -5.0\text{ mA}$) | $V_{BE(sat)}$ | — — | -0.7 -0.9 | — — | V |
| Base–Emitter On Voltage ($I_C = -2.0\text{ mA}$, $V_{CE} = -5.0\text{ V}$) ($I_C = -10\text{ mA}$, $V_{CE} = -5.0\text{ V}$) | $V_{BE(on)}$ | -0.6 — | — — | -0.75 -0.82 | V |
| SMALL-SIGNAL CHARACTERISTICS | | | | | |
| Current–Gain — Bandwidth Product ($I_C = -10\text{ mA}$, $V_{CE} = -5.0\text{ Vdc}$, $f = 100\text{ MHz}$) | f_T | 100 | — | — | MHz |
| Output Capacitance ($V_{CB} = -10\text{ V}$, $f = 1.0\text{ MHz}$) | C_{ob} | — | — | 4.5 | pF |
| Noise Figure ($I_C = -0.2\text{ mA}$, $V_{CE} = -5.0\text{ Vdc}$, $R_S = 2.0\text{ k}\Omega$, $f = 1.0\text{ kHz}$, $BW = 200\text{ Hz}$) | NF | — | — | 10 | dB |

TYPICAL NPN CHARACTERISTICS

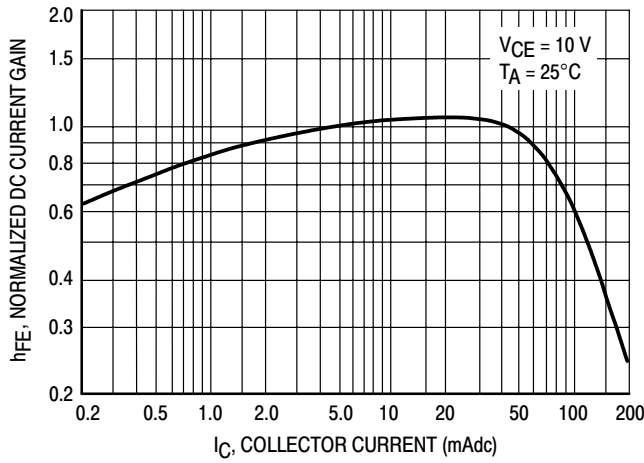


Figure 1. Normalized DC Current Gain

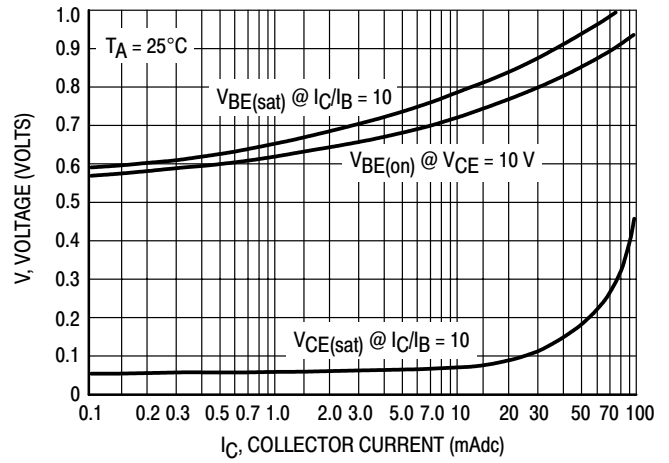


Figure 2. "Saturation" and "On" Voltages

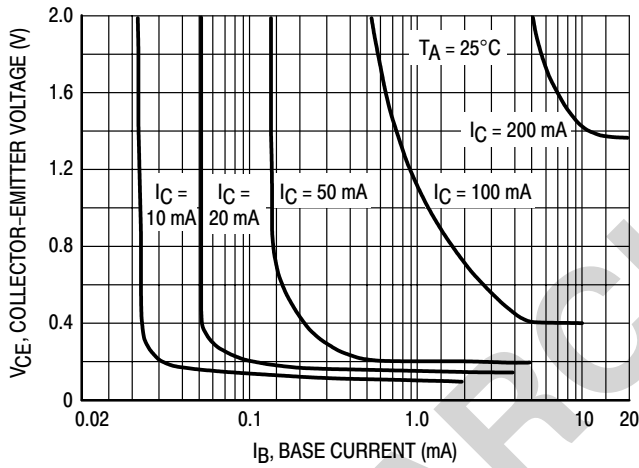


Figure 3. Collector Saturation Region

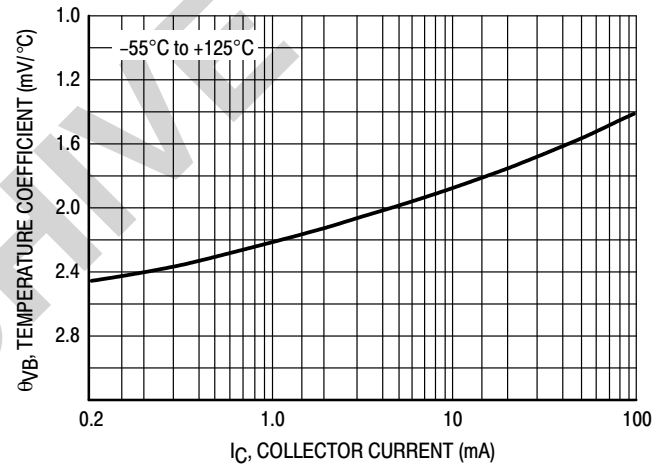


Figure 4. Base-Emitter Temperature Coefficient

TYPICAL NPN CHARACTERISTICS

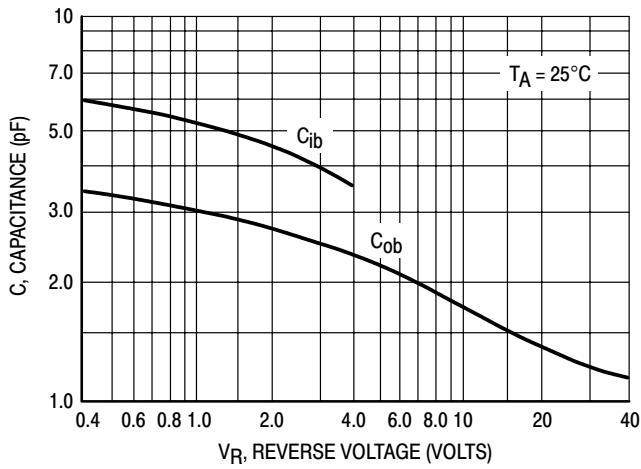


Figure 5. Capacitances

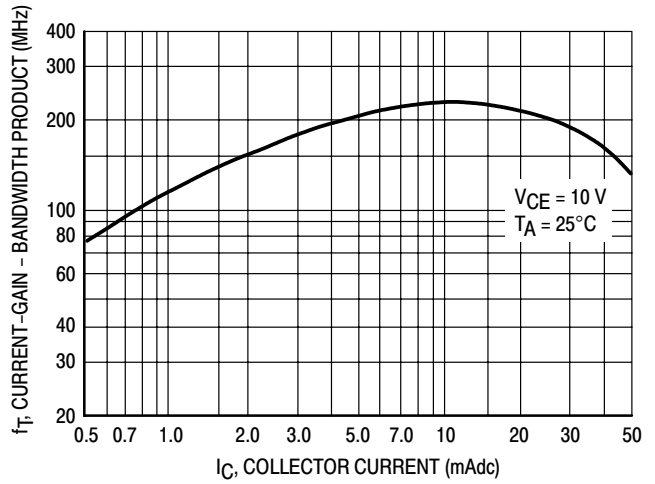


Figure 6. Current-Gain - Bandwidth Product

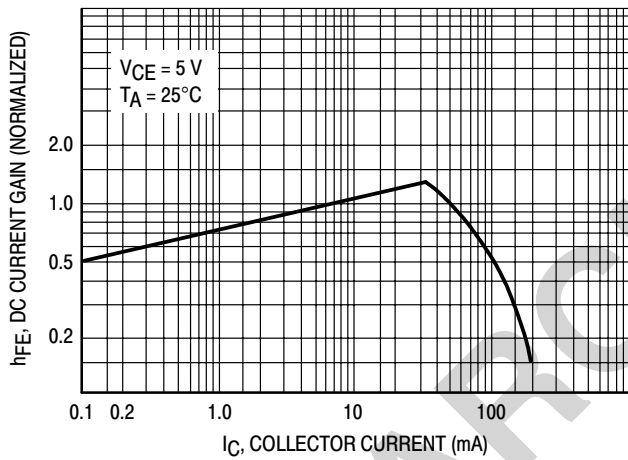


Figure 7. DC Current Gain

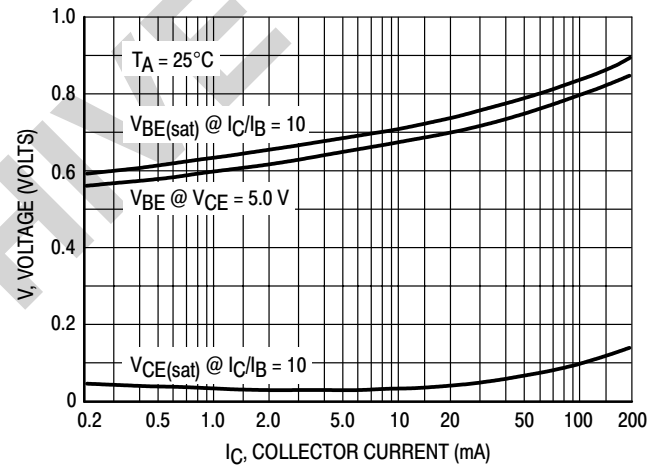


Figure 8. "On" Voltage

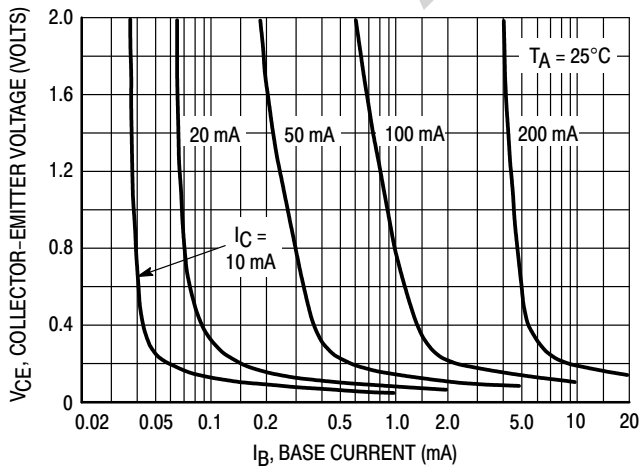


Figure 9. Collector Saturation Region

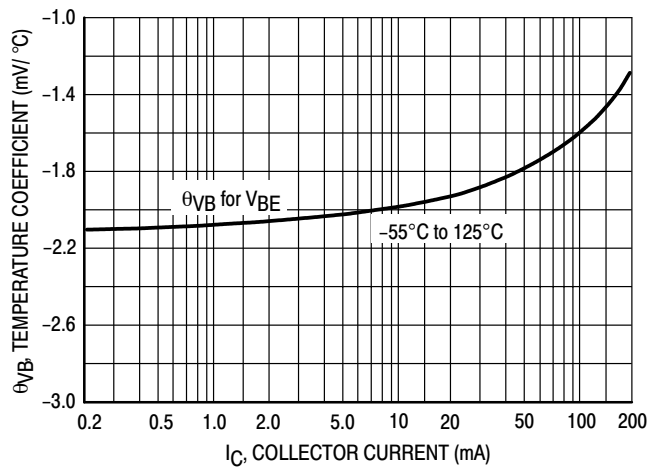


Figure 10. Base-Emitter Temperature Coefficient

TYPICAL PNP CHARACTERISTICS

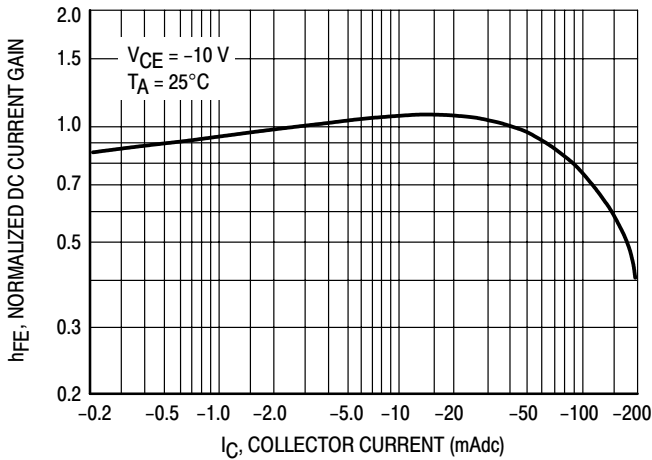


Figure 11. Normalized DC Current Gain

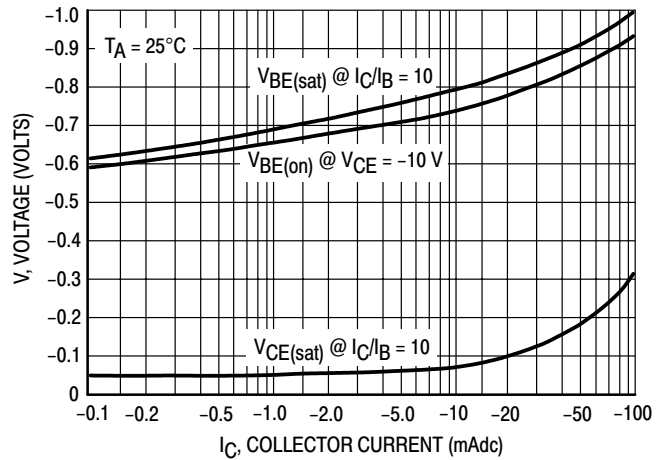


Figure 12. "Saturation" and "On" Voltages

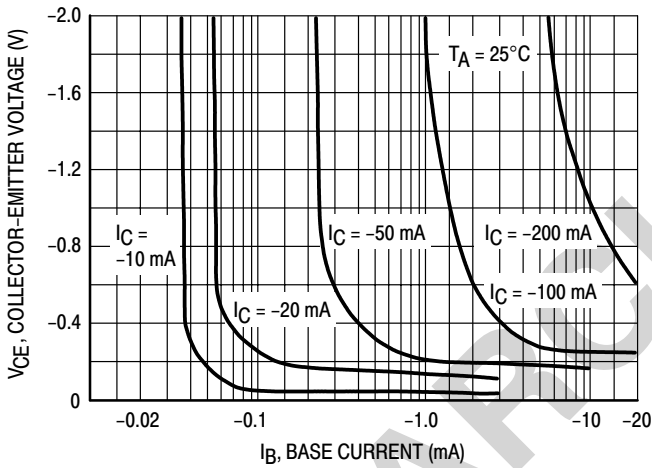


Figure 13. Collector Saturation Region

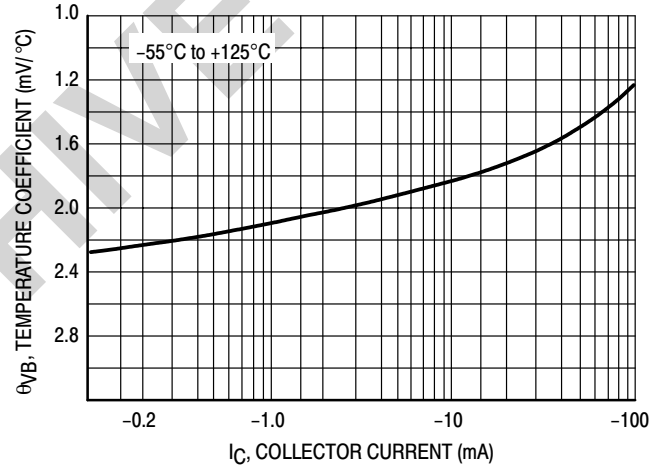


Figure 14. Base-Emitter Temperature Coefficient

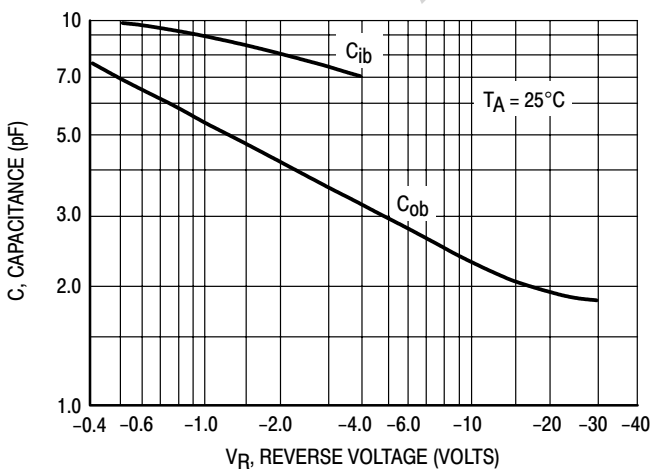


Figure 15. Capacitances

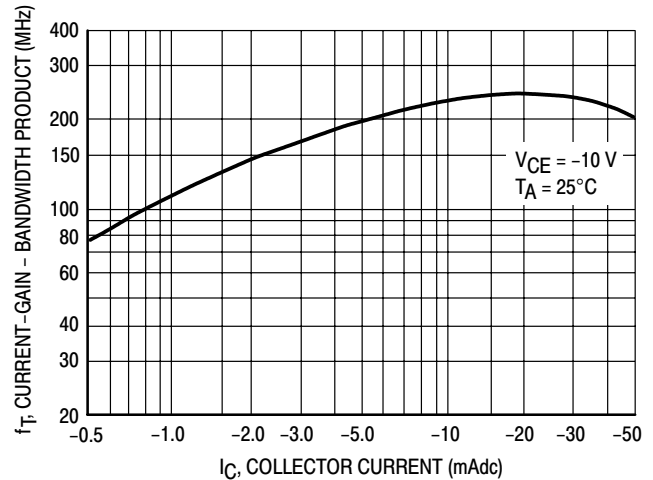


Figure 16. Current-Gain - Bandwidth Product

BC847BPDW1T1, BC847CPDW1T1, BC848BPDW1T1, BC848CPDW1T1

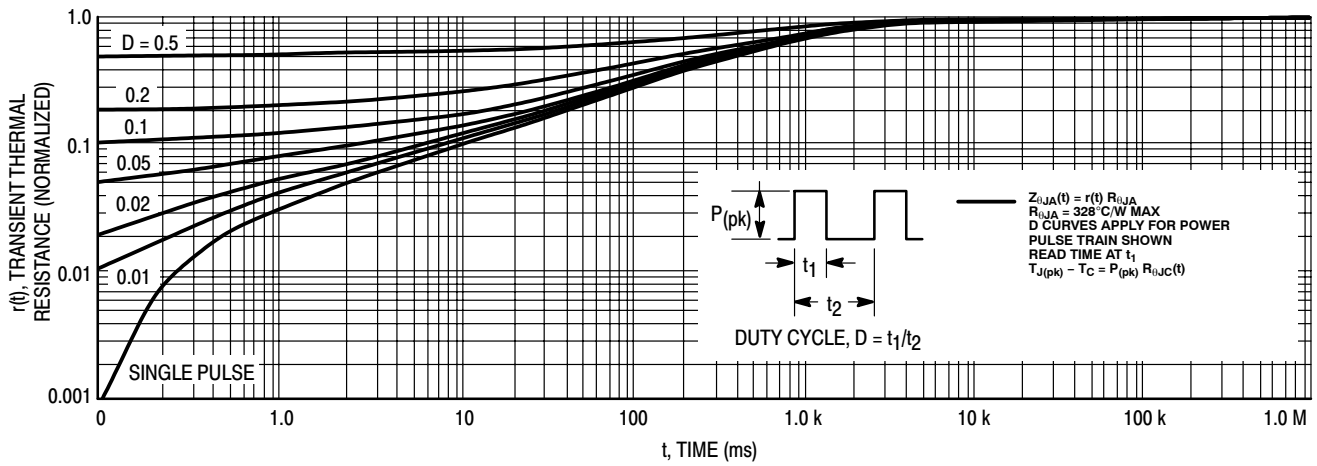


Figure 17. Thermal Response

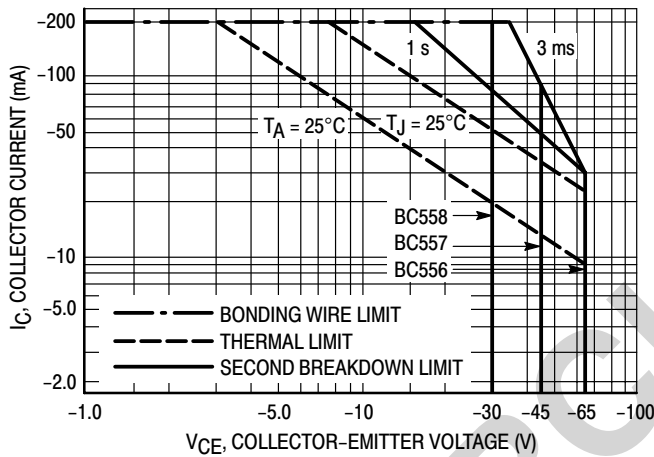


Figure 18. Active Region Safe Operating Area

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.

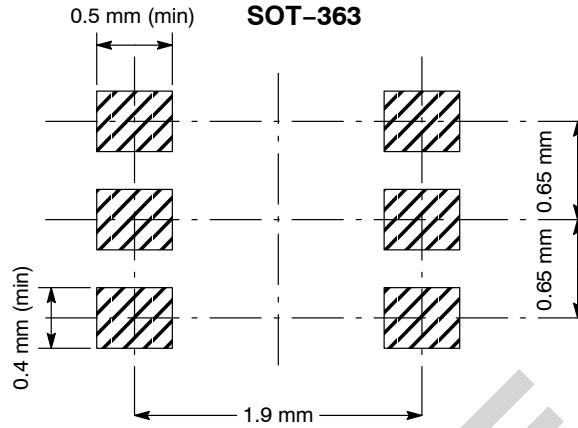
The data of Figure 14 is based upon $T_{J(pk)} = 150^\circ\text{C}$; T_C or T_A is variable depending upon conditions. Pulse curves are valid for duty cycles to 10% provided $T_{J(pk)} \leq 150^\circ\text{C}$. $T_{J(pk)}$ may be calculated from the data in Figure 13. At high case or ambient temperatures,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

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.

SOLDERING PRECAUTIONS