

# BC847BPD XV6T1, BC847BPD XV6T5

## Dual General Purpose Transistor

### NPN/PNP Dual (Complimentary)

This transistor is designed for general purpose amplifier applications. It is housed in the SOT-563 which is designed for low power surface mount applications.

- Lead-Free Solder Plating

#### MAXIMUM RATINGS - NPN

Rating	Symbol	Value	Unit
Collector - Emitter Voltage	$V_{CEO}$	45	V
Collector - Base Voltage	$V_{CBO}$	50	V
Emitter - Base Voltage	$V_{EBO}$	6.0	V
Collector Current - Continuous	$I_C$	100	mAdc

#### MAXIMUM RATINGS - PNP

Rating	Symbol	Value	Unit
Collector - Emitter Voltage	$V_{CEO}$	-45	V
Collector - Base Voltage	$V_{CBO}$	-50	V
Emitter - Base Voltage	$V_{EBO}$	-5.0	V
Collector Current - Continuous	$I_C$	-100	mAdc

#### THERMAL CHARACTERISTICS

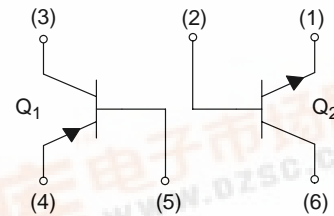
Characteristic (One Junction Heated)	Symbol	Max	Unit
Total Device Dissipation $T_A = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	357 (Note 1) 2.9 (Note 1)	mW mW/ $^\circ\text{C}$
Thermal Resistance - Junction-to-Ambient	$R_{\theta JA}$	350 (Note 1)	$^\circ\text{C}/\text{W}$
Characteristic (Both Junctions Heated)	Symbol	Max	Unit
Total Device Dissipation $T_A = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	500 (Note 1) 4.0 (Note 1)	mW mW/ $^\circ\text{C}$
Thermal Resistance - Junction-to-Ambient	$R_{\theta JA}$	250 (Note 1)	$^\circ\text{C}/\text{W}$
Junction and Storage Temperature Range	$T_J, T_{stg}$	- 55 to +150	$^\circ\text{C}$

1. FR-4 @ Minimum Pad

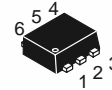


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BC847BPD XV6T1



SOT-563  
CASE 463A  
PLASTIC

#### MARKING DIAGRAM



4F = Specific Device Code  
D = Date Code

#### ORDERING INFORMATION

Device	Package	Shipping
BC847BPD XV6T1	SOT-563	4 mm pitch 4000/Tape & Reel
BC847BPD XV6T5	SOT-563	2 mm pitch 8000/Tape & Reel



## BC847BPD XV6T1, BC847BPD XV6T5

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

Characteristic	Symbol	Min	Typ	Max	Unit
<b>OFF CHARACTERISTICS</b>					
Collector - Emitter Breakdown Voltage ( $I_C = 10\text{ mA}$ )	$V_{(BR)CEO}$	45	-	-	V
Collector - Emitter Breakdown Voltage ( $I_C = 10\ \mu\text{A}$ , $V_{EB} = 0$ )	$V_{(BR)CES}$	50	-	-	V
Collector - Base Breakdown Voltage ( $I_C = 10\ \mu\text{A}$ )	$V_{(BR)CBO}$	50	-	-	V
Emitter - Base Breakdown Voltage ( $I_E = 1.0\ \mu\text{A}$ )	$V_{(BR)EBO}$	6.0	-	-	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 $\mu\text{A}$

### ON CHARACTERISTICS

DC Current Gain ( $I_C = 10\ \mu\text{A}$ , $V_{CE} = 5.0\text{ V}$ ) ( $I_C = 2.0\text{ mA}$ , $V_{CE} = 5.0\text{ V}$ )	$h_{FE}$	- 200	150 290	- 475	-
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 ( $I_C = 0.2\text{ mA}$ , $V_{CE} = 5.0\text{ Vdc}$ , $R_S = 2.0\text{ k}\Omega$ , $f = 1.0\text{ kHz}$ , $BW = 200\text{ Hz}$ )	NF	-	-	10	dB

## BC847BPDXV6T1, BC847BPDXV6T5

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

Characteristic	Symbol	Min	Typ	Max	Unit
<b>OFF CHARACTERISTICS</b>					
Collector - Emitter Breakdown Voltage ( $I_C = -10\text{ mA}$ )	$V_{(BR)CEO}$	-45	-	-	V
Collector - Emitter Breakdown Voltage ( $I_C = -10\ \mu\text{A}$ , $V_{EB} = 0$ )	$V_{(BR)CES}$	-50	-	-	V
Collector - Base Breakdown Voltage ( $I_C = -10\ \mu\text{A}$ )	$V_{(BR)CBO}$	-50	-	-	V
Emitter - Base Breakdown Voltage ( $I_E = -1.0\ \mu\text{A}$ )	$V_{(BR)EBO}$	-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 $\mu\text{A}$

### ON CHARACTERISTICS

DC Current Gain ( $I_C = -10\ \mu\text{A}$ , $V_{CE} = -5.0\text{ V}$ ) ( $I_C = -2.0\text{ mA}$ , $V_{CE} = -5.0\text{ V}$ )	$h_{FE}$	- 200	150 290	- 475	-
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

# BC847BPD XV6T1, BC847BPD XV6T5

## TYPICAL NPN CHARACTERISTICS

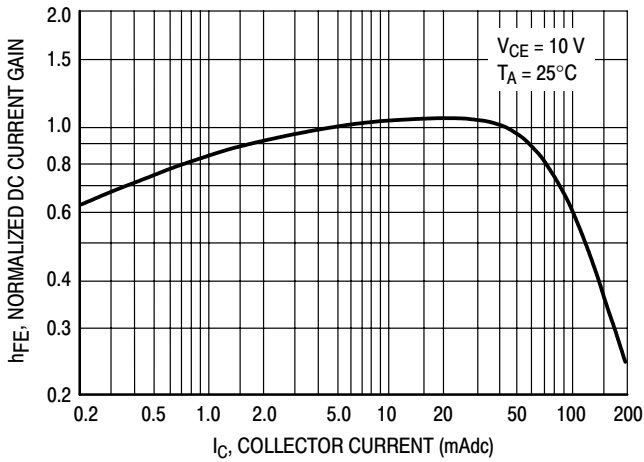


Figure 1. Normalized DC Current Gain

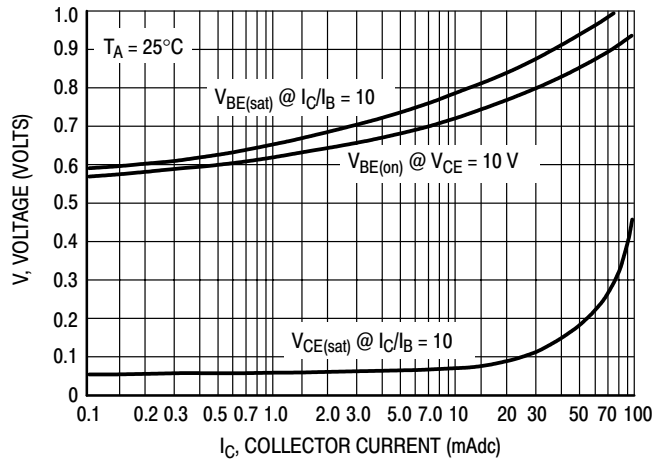


Figure 2. "Saturation" and "On" Voltages

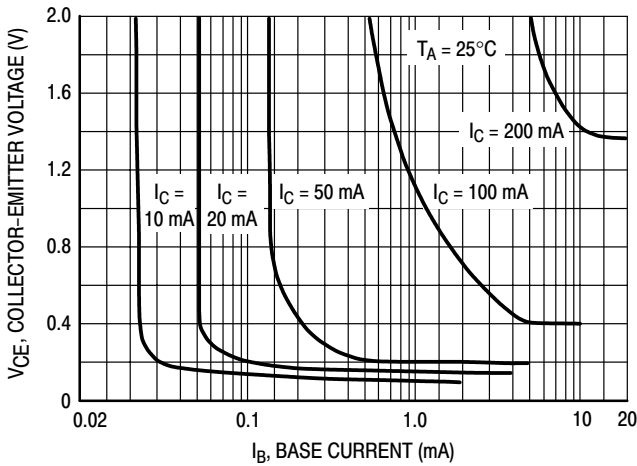


Figure 3. Collector Saturation Region

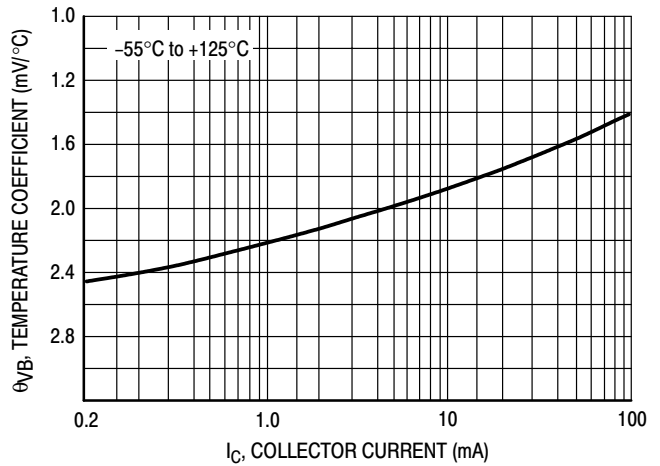


Figure 4. Base-Emitter Temperature Coefficient

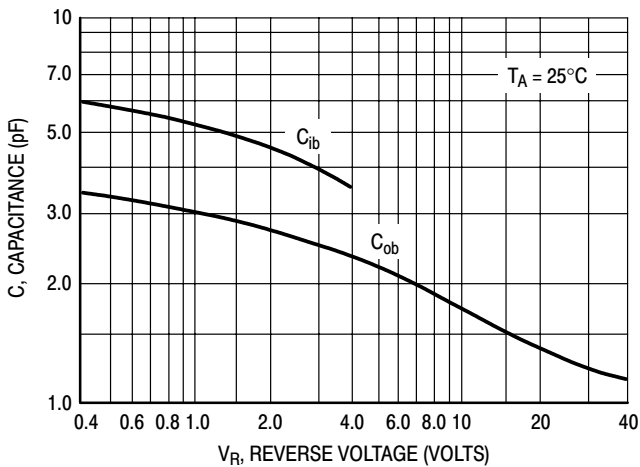


Figure 5. Capacitances

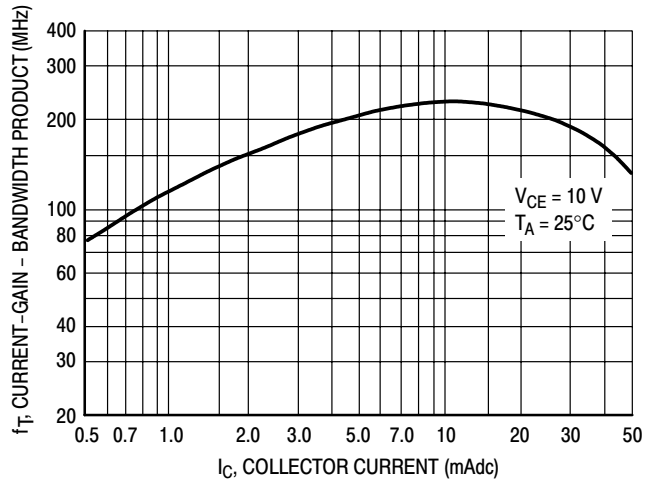


Figure 6. Current-Gain - Bandwidth Product

# BC847BPD XV6T1, BC847BPD XV6T5

## TYPICAL PNP CHARACTERISTICS

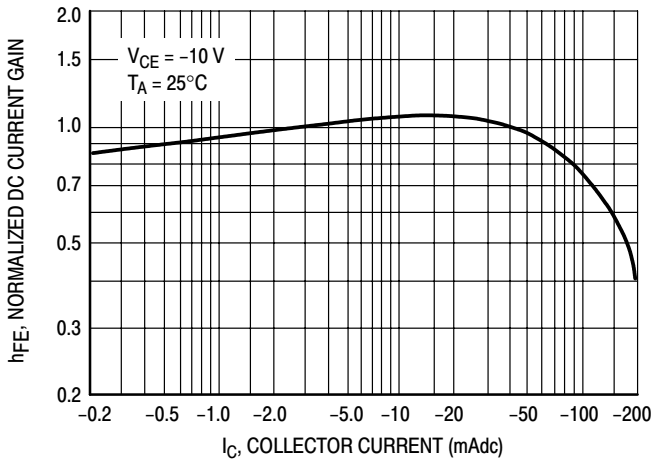


Figure 7. Normalized DC Current Gain

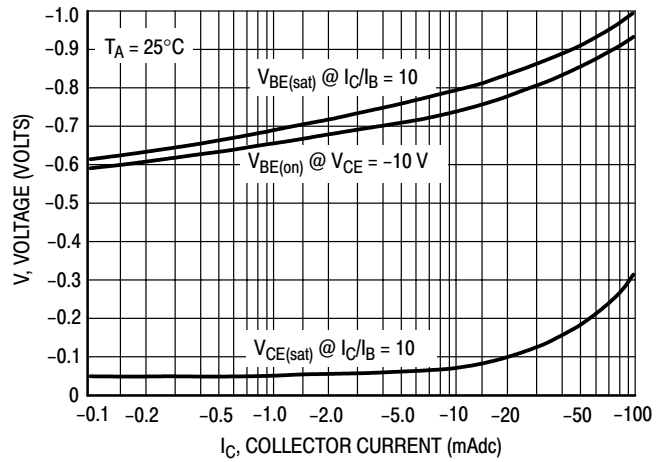


Figure 8. "Saturation" and "On" Voltages

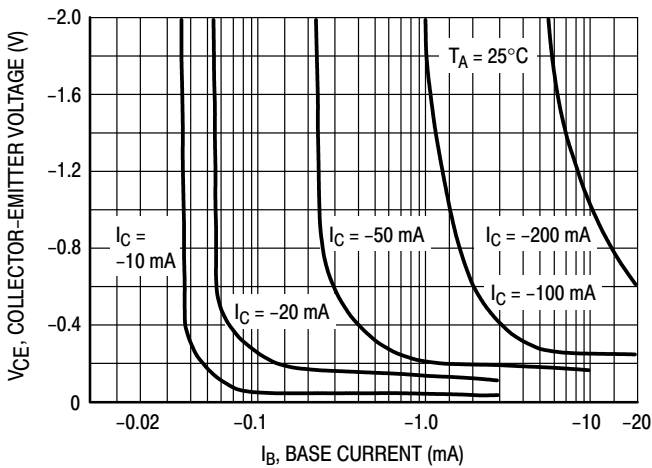


Figure 9. Collector Saturation Region

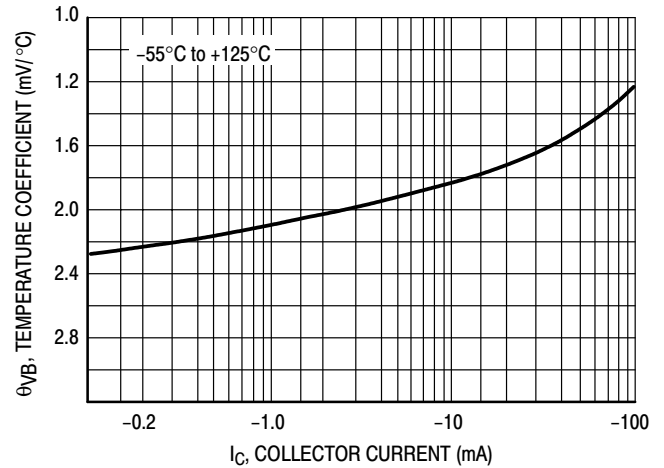


Figure 10. Base-Emitter Temperature Coefficient

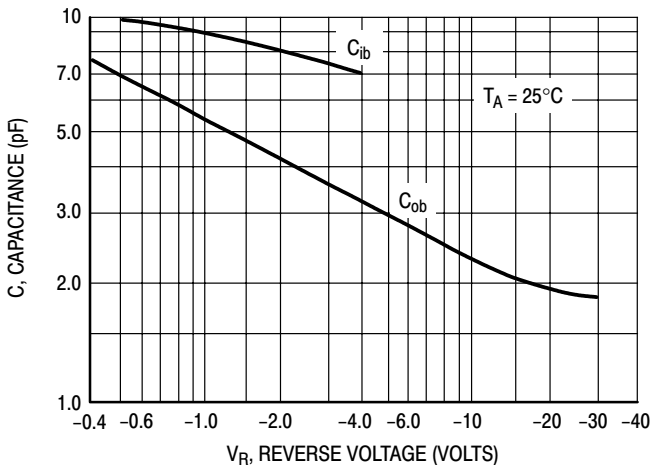


Figure 11. Capacitances

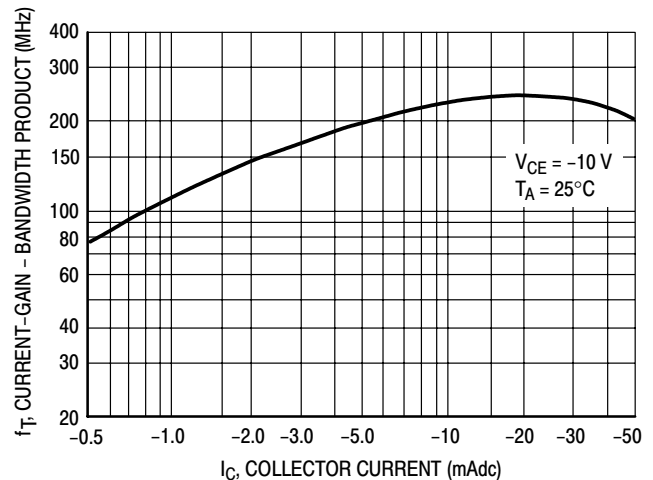


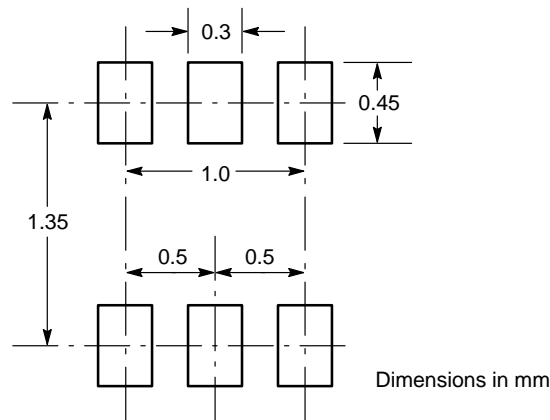
Figure 12. Current-Gain - Bandwidth Product

## BC847BPD XV6T1, BC847BPD XV6T5

### INFORMATION FOR USING THE SOT-563 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-563

#### SOT-563 POWER DISSIPATION

The power dissipation of the SOT-563 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-563 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-563 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-563 package. Another alternative would be to use a ceramic substrate or an aluminum core board such as Thermal Clad<sup>®</sup>. 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.

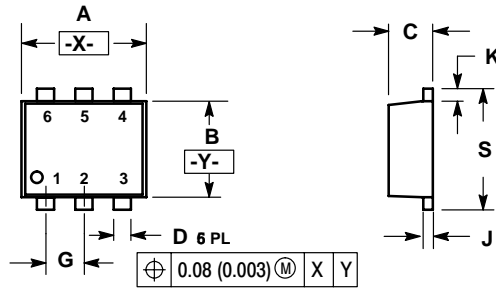
- Always preheat the device.
- The delta temperature between the preheat and soldering should be 100°C or less.\*
- When preheating and soldering, the temperature of the leads and the case must not exceed the maximum temperature ratings as shown on the data sheet. When using infrared heating with the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

# BC847BPD XV6T1, BC847BPD XV6T5

## PACKAGE DIMENSIONS

SOT-563, 6 LEAD  
CASE 463A-01  
ISSUE O



### NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETERS
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	1.50	1.70	0.059	0.067
B	1.10	1.30	0.043	0.051
C	0.50	0.60	0.020	0.024
D	0.17	0.27	0.007	0.011
G	0.50 BSC		0.020 BSC	
J	0.08	0.18	0.003	0.007
K	0.10	0.30	0.004	0.012
S	1.50	1.70	0.059	0.067

### STYLE 1:

- PIN 1. EMITTER 1
- BASE 1
- COLLECTOR 2
- EMITTER 2
- BASE 2
- COLLECTOR 1

### STYLE 2:

- PIN 1. EMITTER 1
- EMITTER 2
- BASE 2
- COLLECTOR 2
- BASE 1
- COLLECTOR 1

### STYLE 3:


- PIN 1. CATHODE 1
- CATHODE 1
- ANODE/ANODE 2
- CATHODE 2
- CATHODE 2
- ANODE/ANODE 1

### STYLE 4:

- PIN 1. COLLECTOR
- COLLECTOR
- BASE
- EMITTER
- COLLECTOR
- COLLECTOR

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