BD 195
BD 197
BD 199

PLASTIC HIGH POWER
SILICON NPN TRANSISTOR

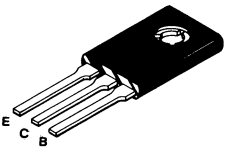
. . . designed for use up to 30 Watt audio amplifiers utilizing complementary or quasi complementary circuits.

- DC Current Gain—h_{FE} = 30 (Min) @ I_C = 1.15 Adc
- BD 195, 197, 199 are complementary with BD 196, 198, 200

6 AMPERE
POWER TRANSISTOR

NPN SILICON

30, 45, 60 VOLTS
65 WATTS



HARDWARE AVAILABLE:
1. MICA WASHER—14B 52 600 F03
2. LOCK WASHER—04A 52 200 F02

MAXIMUM RATINGS

Rating	Symbol	Type	Value	Unit
Collector-Emitter Voltage	V_{CEO}	BD 195 BD 197 BD 199	30 45 60	Vdc
Collector-Base Voltage	V_{CBO}	BD 195 BD 197 BD 199	40 55 70	Vdc
Emitter-Base Voltage	V_{EBO}		5	Vdc
Collector Current	I_C		6.0	Adc
Base Current	I_B		2.5	Adc
Total Device Dissipation T_C=25°C Derate above 25°C	P_D		65 522	Watts mW/°C
Operating and Storage Junction Temperature Range	T_J, T_{stg}		—55 to +150	°C

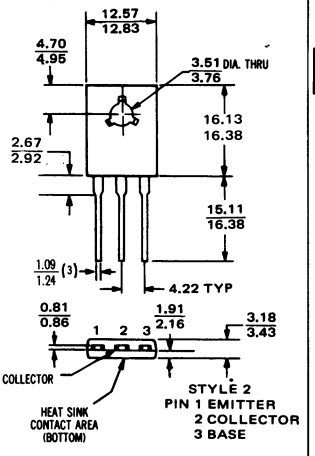
THERMAL CHARACTERISTICS

Characteristic	Symbol		Max	Unit
Thermal Resistance, Junction to Case	θ_{JC}		1.92	° C/W

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

Characteristic	Symbol	Type	Min	Max	Unit
Collector-Emitter Sustaining Voltage* (I_C = 0.1 Adc, I_B = 0)	BV_{CEO}*	BD 195 BD 197 BD 199	30 45 60	— — —	Vdc
Collector Cutoff Current (V_{CB} = 40 Vdc, I_E = 0) (V_{CB} = 55 Vdc, I_E = 0) (V_{CB} = 70 Vdc, I_E = 0)	I_{CBO}	BD 195 BD 197 BD 199	— — —	0.1 0.1 0.1	mAdc
Emitter Cutoff Current (V_{BE} = 5.0 Vdc, I_C = 0)	I_{EBO}		—	1.0	mAdc
DC current Gain (I_C = 1 A, V_{CE} = 2 V) (I_C = 3 A, V_{CE} = 2 V)	h_{FE}*		30 15	— —	
Collector-Emitter Saturation Voltage* (I_C = 3 Adc, I_B = 0.3 Adc)	$V_{CE(sat)}$*		—	1.0	Vdc
Base-Emitter On Voltage* (I_C = 3 Adc, V_{CE} = 2.0 Vdc)	$V_{BE(on)}$*		—	1.6	Vdc
Current-Gain-Bandwidth Product (I_C = 1.0 Adc, V_{CE} = 10 Vdc, f = 1.0 MHz)	f_T		2.0	—	MHz

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



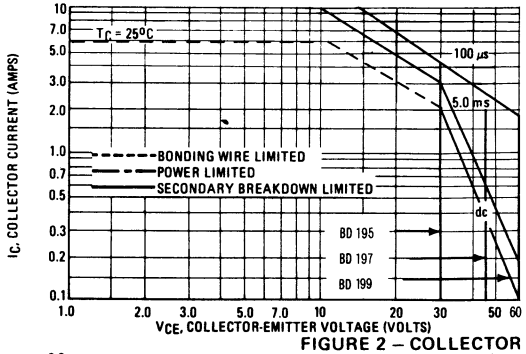
When mounting the device, torque not to exceed 0.09 m-kg.

If lead bending is required, use suitable clamps or other supports between transistor case and point of bend

CASE 90 - 05 (2)

Dimensions in millimeters

FIGURE 1 – ACTIVE-REGION SAFE OPERATING AREA



The Safe Operating Area Curves indicate I_C–V_{CE} limits below which the device will not enter secondary breakdown. Collector load lines for specific circuits must fall within the applicable Safe Area to avoid causing a catastrophic failure. To insure operation below the maximum T_J, power-temperature derating must be observed for both steady state and pulse power conditions.

FIGURE 2 – COLLECTOR SATURATION REGION

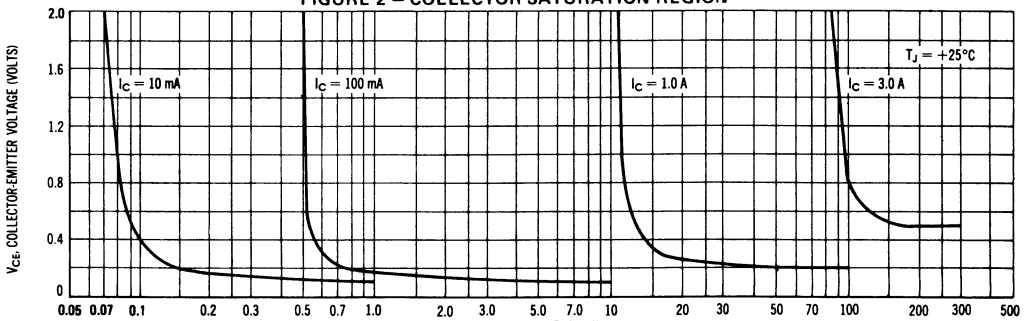


FIGURE 3—NORMALIZED DC CURRENT GAIN

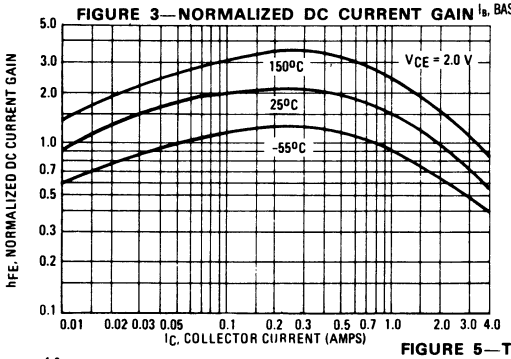


FIGURE 4—"ON" VOLTAGE

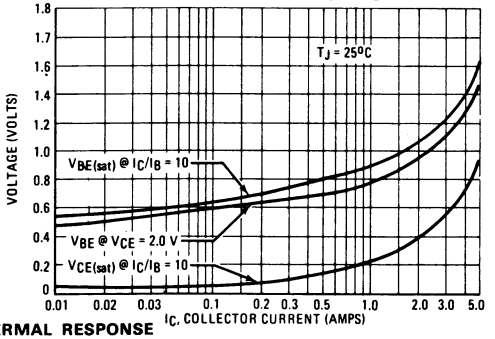
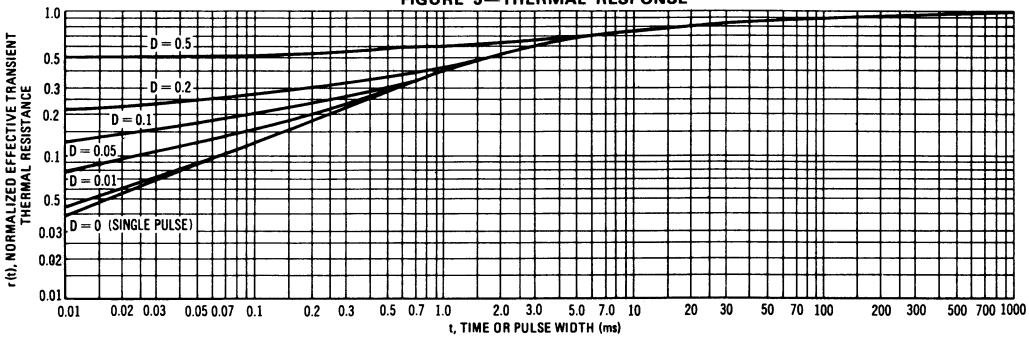


FIGURE 5—THERMAL RESPONSE



BD 196
BD 198
BD 200

PLASTIC HIGH POWER
SILICON PNP TRANSISTOR

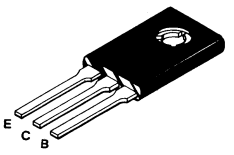
. . . designed for use up to 30 Watt audio amplifiers utilizing complementary or quasi complementary circuits.

- DC Current—h_{FE} = 30 (Min) @ I_C = 1 Adc
- BD 196, 198, 200 are complementary with BD 195, 197, 199

6 AMPERE
POWER TRANSISTOR

PNP SILICON

30, 45, 60 VOLTS
65 WATTS



HARDWARE AVAILABLE:
1. MICA WASHER—14B 52 600 F03
2. LOCK WASHER—04A 52 200 F02

MAXIMUM RATINGS

Rating	Symbol	Type	Value	Unit
Collector-Emitter Voltage	V_{CEO}	BD 196 BD 198 BD 200	30 45 60	Vdc
Collector-Base Voltage	V_{CBO}	BD 196 BD 198 BD 200	40 55 70	Vdc
Emitter-Base Voltage	V_{EBO}		5	Vdc
Collector Current	I_C		6.0	Adc
Base Current	I_B		2.5	Adc
Total Device Dissipation T_C=25°C Derate above 25°C	P_D		65 522	Watts mW/°C
Operating and Storage Junction Temperature Range	T_J, T_{stg}		—55 to +150	°C

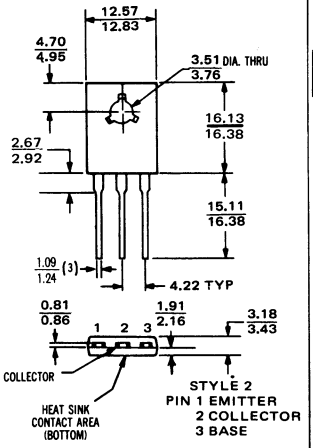
THERMAL CHARACTERISTICS

Characteristic	Symbol		Max	Unit
Thermal Resistance, Junction to Case	θ_{JC}		1.92	° C/W

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

Characteristic	Symbol	Type	Min	Max	Unit
Collector-Emitter Sustaining Voltage* (I_C = 0.1 Adc, I_B = 0)	BV_{CEO}*	BD 196 BD 198 BD 200	30 45 60	— — —	Vdc
Collector Cutoff Current (V_{CB} = 40 Vdc, I_E = 0) (V_{CB} = 55 Vdc, I_E = 0) (V_{CB} = 70 Vdc, I_E = 0)	I_{CBO}	BD 196 BD 198 BD 200	— — —	0.1 0.1 0.1	mAdc
Emitter Cutoff Current (V_{BE} = 5.0 Vdc, I_C = 0)	I_{EBO}		—	1.0	mAdc
DC current Gain (I_C = 1 A, V_{CE} = 2 V) (I_C = 3 A, V_{CE} = 2 V)	h_{FE}*		30 15	— —	
Collector-Emitter Saturation Voltage* (I_C = 3.0 Adc, I_B = 0.3 Adc)	$V_{CE(sat)}$*		—	1.0	Vdc
Base-Emitter On Voltage* (I_C = 3.0 Adc, V_{CE} = 2.0 Vdc)	$V_{BE(on)}$*		—	1.6	Vdc
Current-Gain-Bandwidth Product (I_C = 1.0 Adc, V_{CE} = 10 Vdc, f = 1.0 MHz)	f_T		2.0	—	MHz

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



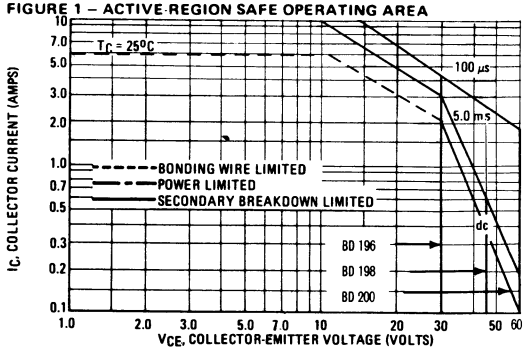
When mounting the device, torque not to exceed 0.09 m-kg.

If lead bending is required, use suitable clamps or other supports between transistor case and point of bend

CASE 90 - 05 (2)

Dimensions in millimeters

FIGURE 1 – ACTIVE-REGION SAFE OPERATING AREA



The Safe Operating Area Curves indicate I_C–V_{CE} limits below which the device will not enter secondary breakdown. Collector load lines for specific circuits must fall within the applicable Safe Area to avoid causing a catastrophic failure. To insure operation below the maximum T_J, power-temperature derating must be observed for both steady state and pulse power conditions.

FIGURE 2 – COLLECTOR SATURATION REGION

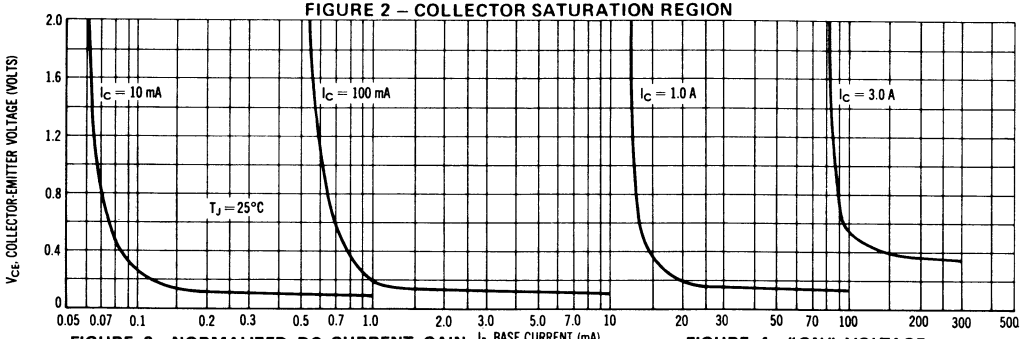


FIGURE 3—NORMALIZED DC CURRENT GAIN

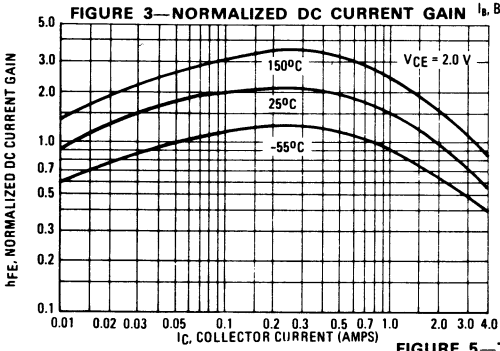


FIGURE 4—"ON" VOLTAGE

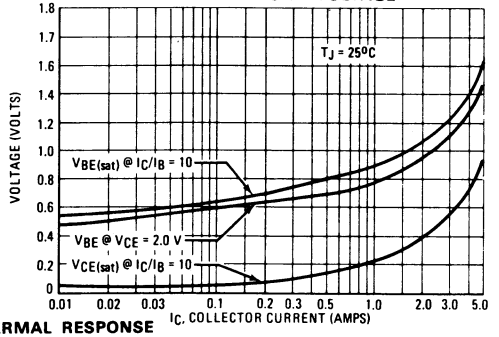
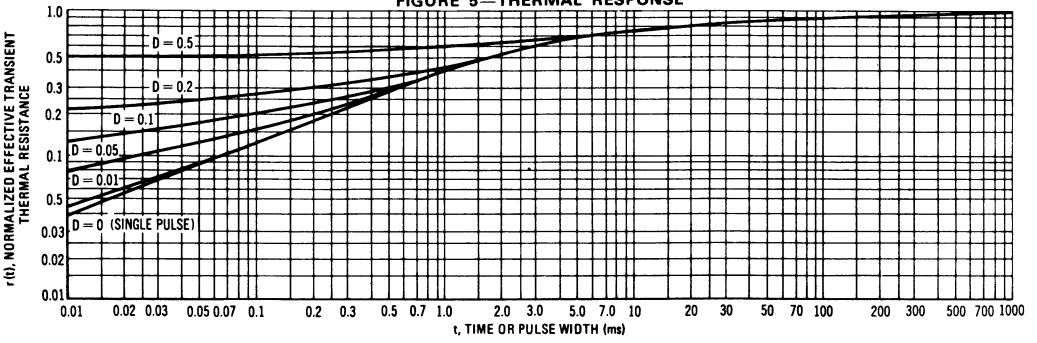


FIGURE 5—THERMAL RESPONSE



BD 205
BD 207

PLASTIC HIGH POWER
SILICON NPN TRANSISTOR

. . . designed for use in high power audio amplifiers utilizing complementary or quasi complementary circuits.

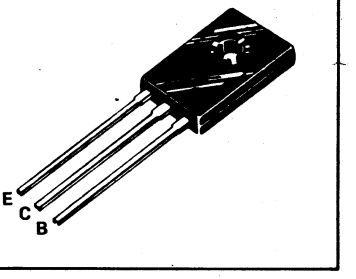
- DC Current Gain—h_{FE} = 30 (Min) @ I_C = 2.0 Adc
- BD 205, 207 are complementary with BD 206, 208

10 AMPERE
POWER TRANSISTOR

NPN SILICON

45, 60 VOLTS
90 WATTS

APRIL 1970—E-013



MAXIMUM RATINGS

Rating	Symbol	Type	Value	Unit
Collector-Emitter Voltage	V_{CEO}	BD 205 BD 207	45 60	Vdc
Collector-Base Voltage	V_{CBO}	BD 205 BD 207	55 70	Vdc
Emitter-Base Voltage	V_{EBO}		5	Vdc
Collector Current	I_C		10.0	Adc
Base Current	I_B		6.0	Adc
Total Device Dissipation T_C=25°C Derate above 25°C	P_D		90 720	Watts mW/°C
Operating and Storage Junction Temperature Range	T_J, T_{stg}		—55 to +150	°C

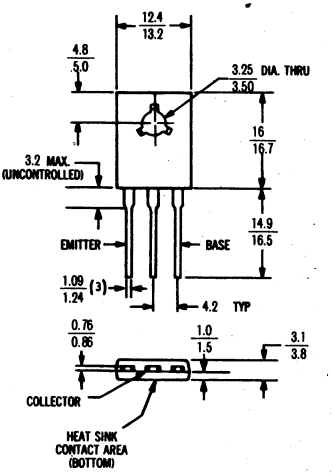
THERMAL CHARACTERISTICS

Characteristic	Symbol		Max	Unit
Thermal Resistance, Junction to Case	θ_{JC}		1.39	° C/W

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

Characteristic	Symbol	Type	Min	Max	Unit
Collector-Emitter Sustaining Voltage* (I_C = 0.2 Adc, I_B = 0)	BV_{CEO}*	BD 205 BD 207	45 60	— —	Vdc
Collector Cutoff Current (V_{CB} = 55 Vdc, I_E = 0) (V_{CB} = 70 Vdc, I_E = 0)	I_{CBO}	BD 205 BD 207	— —	1.0 1.0	mAdc
Emitter Cutoff Current (V_{BE} = 5.0 Vdc, I_C = 0)	I_{EBO}		—	2.0	mAdc
DC current Gain (I_C = 2A, V_{CE} = 2 V) (I_C = 4A, V_{CE} = 2 V)	h_{FE}*		30 15	— —	
Collector-Emitter Saturation Voltage* (I_C = 4 Adc, I_B = 0.4 Adc)	$V_{CE(sat)}$*		—	1.1	Vdc
Base-Emitter On Voltage* (I_C = 4 Adc, V_{CE} = 2.0 Vdc)	$V_{BE(on)}$*		—	1.6	Vdc
Current-Gain-Bandwidth Product (I_C = 1.0 Adc, V_{CE} = 10 Vdc, f = 1.0 MHz)	f_T		1.5	—	MHz

* Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%.



When mounting the device, torque not to exceed 0.09 m-kg.

If lead bending is required, use suitable clamps or other supports between transistor case and point of bend.

All dimensions in millimeters

CASE 90

FIGURE 1 — ACTIVE REGION DC SAFE OPERATING AREA

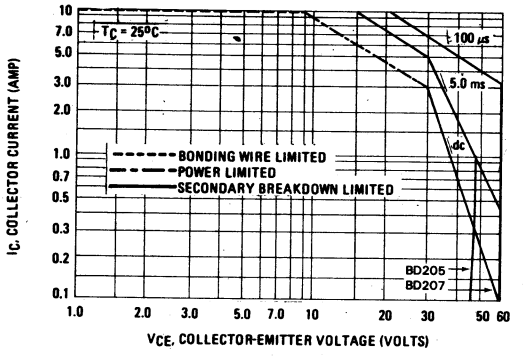


FIGURE 2 — POWER-TEMPERATURE DERATING CURVE

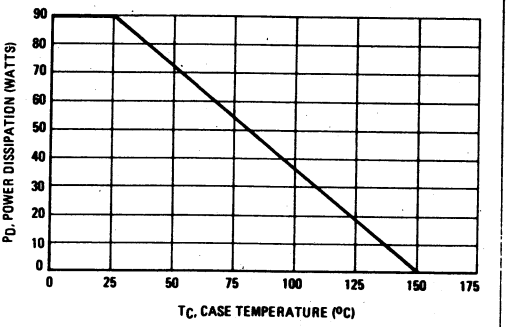


FIGURE 3 — "ON" VOLTAGES

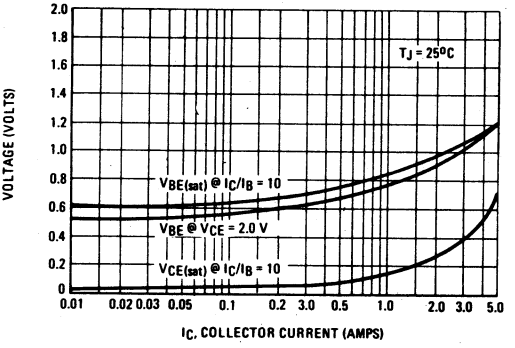


FIGURE 4 — CURRENT GAIN

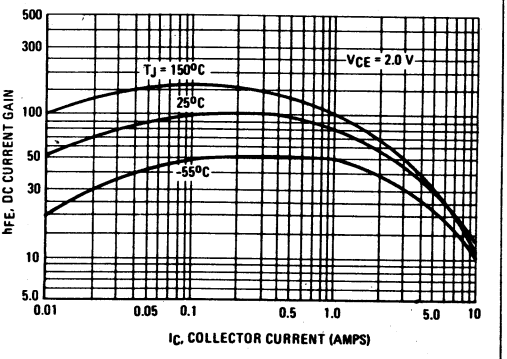
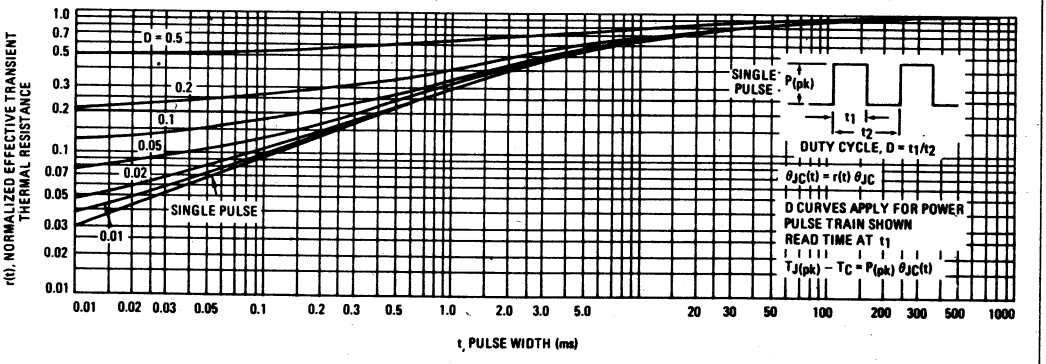


FIGURE 5 — THERMAL RESPONSE



BD 206
BD 208

PLASTIC HIGH POWER SILICON PNP TRANSISTOR

. . . designed for use in high power audio amplifiers utilizing complementary or quasi complementary circuits.

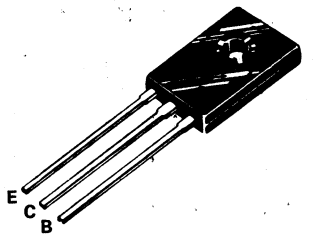
- DC Current—h_{FE} = 30 (Min) @ I_C = 2.0 Adc
- BD 206, 208 are complementary with BD 205, 207

10 AMPERE POWER TRANSISTOR

PNP SILICON

45, 60 VOLTS
90 WATTS

APRIL 1970—E-012



MAXIMUM RATINGS

Rating	Symbol	Type	Value	Unit
Collector-Emitter Voltage	V_{CEO}	BD 206 BD 208	45 60	Vdc
Collector-Base Voltage	V_{CBO}	BD 206 BD 208	55 70	Vdc
Emitter-Base Voltage	V_{EBO}		5	Vdc
Collector Current	I_C		10.0	Adc
Base Current	I_B		6.0	Adc
Total Device Dissipation T_C=25°C Derate above 25°C	P_D		90 720	Watts mW/°C
Operating and Storage Junction Temperature Range	T_J, T_{stg}		—55 to +150	°C

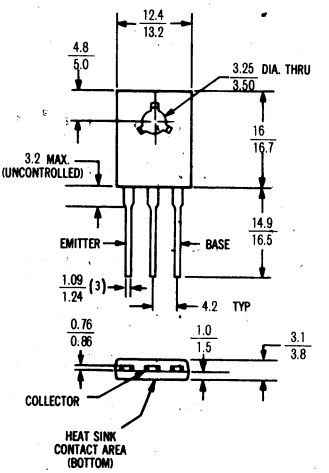
THERMAL CHARACTERISTICS

Characteristic	Symbol		Max	Unit
Thermal Resistance, Junction to Case	θ_{JC}		1.39	° C/W

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

Characteristic	Symbol	Type	Min	Max	Unit
Collector-Emitter Sustaining Voltage* (I_C = 0.2 Adc, I_B = 0)	BV_{CEO}*	BD 206 BD 208	45 60	— —	Vdc
Collector Cutoff Current (V_{CB} = 55 Vdc, I_E = 0) (V_{CB} = 70 Vdc, I_E = 0)	I_{CBO}	BD 206 BD 208	— —	1.0 1.0	mAdc
Emitter Cutoff Current (V_{BE} = 5.0 Vdc, I_C = 0)	I_{EBO}		—	2.0	mAdc
DC current Gain (I_C = 2A, V_{CE} = 2 V) (I_C = 4A, V_{CE} = 2 V)	h_{FE}*		30 15	— —	
Collector-Emitter Saturation Voltage* (I_C = 4 Adc, I_B = 0.4 Adc)	$V_{CE(sat)}$*		—	1.1	Vdc
Base-Emitter On Voltage* (I_C = 4 Adc, V_{CE} = 2.0 Vdc)	$V_{BE(on)}$*		—	1.6	Vdc
Current-Gain-Bandwidth Product (I_C = 1.0 Adc, V_{CE} = 10 Vdc, f = 1.0 MHz)	f_T		1.5	—	MHz

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



When mounting the device, torque not to exceed 0.09 m-kg.

If lead bending is required, use suitable clamps or other supports between transistor case and point of bend.

All dimensions in millimeters

CASE 90

FIGURE 1 — ACTIVE REGION DC SAFE OPERATING AREA

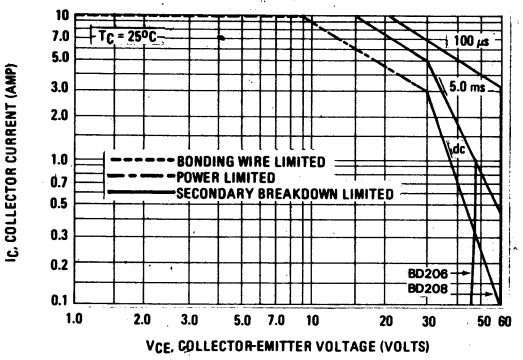


FIGURE 2 — POWER-TEMPERATURE DERATING CURVE

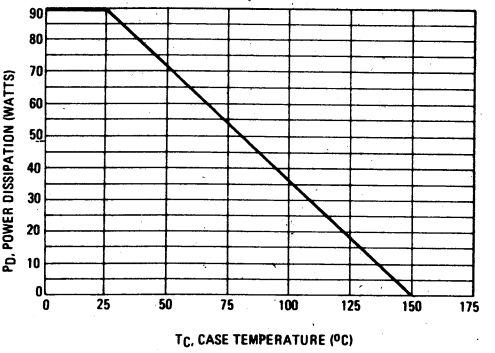


FIGURE 3 — "ON" VOLTAGES

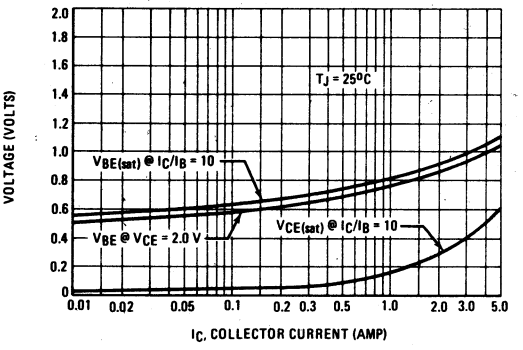


FIGURE 4 — CURRENT GAIN

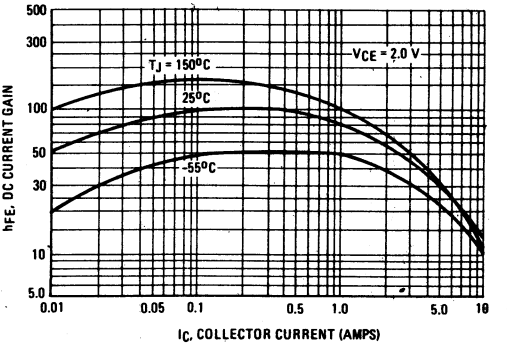
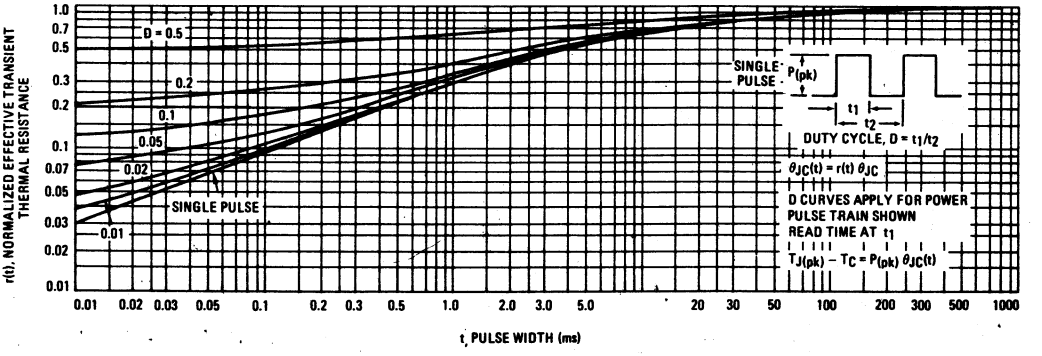


FIGURE 5 — THERMAL RESPONSE



NPN

BD311

PNP

BD312

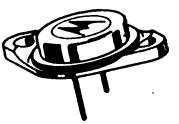
COMPLEMENTARY SILICON HIGH-POWER TRANSISTORS

. . . designed for high quality amplifiers operating up to 60 Watts into 4 ohm load.

- High DC Current Gain
- Excellent Safe Operating Area
- High Current Gain – Bandwidth Product – Typical
  f_T = 4.0 MHz @ I_C = 0.5 A

10 AMPERE COMPLEMENTARY SILICON POWER TRANSISTORS

60 VOLTS 115 WATTS



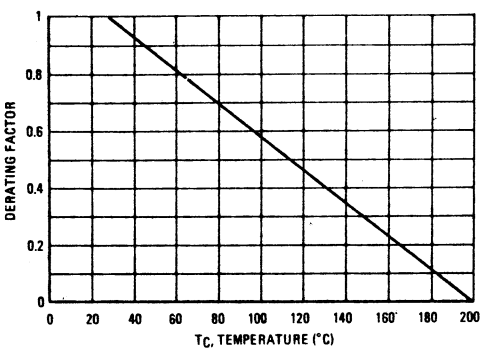
MAXIMUM RATINGS

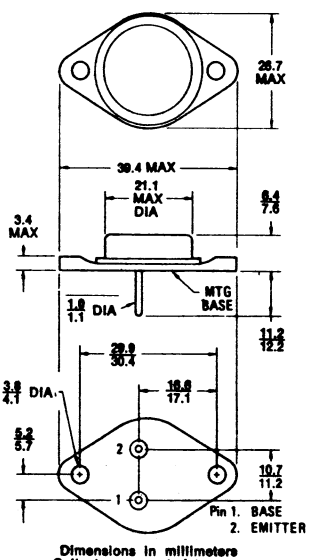
Rating	Symbol	BD311/312	Unit
Collector-Emitter Voltage	V_{CEO}	60	Vdc
Collector-Base Voltage	V_{CB}	60	Vdc
Emitter-Base Voltage	V_{EB}	5.0	Vdc
Collector Current — Continuous Peak	I_C	10 20	Adc
Base Current	I_B	4.0	Adc
Total Device Dissipation @ T_C = 25 °C Derate above 25 °C	P_D	115 0.658	Watts W/°C
Operating and Storage Junction Temperature Range	T_J, T_{stg}	−65 to +200	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max.	Unit.
Thermal Resistance, Junction to Case	θ_{JC}	1.52	°C/W

FIGURE 1 – POWER DERATING





Dimensions in millimeters
Collector connected to case

CASE 11
TO-3

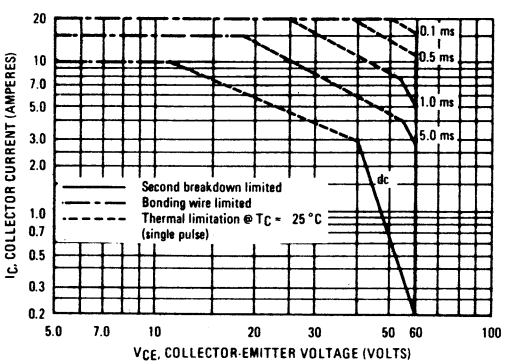
ELECTIRCAL CHARACTERISTICS* (T_C = 25 °C unless otherwise noted)

Characteristic	Symbol	Min.	Max.	Unit.
OFF CHARACTERISTICS				
Collector-Emitter Sustaining Voltage[1] (I_C = 200 mAdc, I_B = 0)	$V_{CEO(sus)}$	60		Vdc
Collector-Base Cutoff Current (V_{CB} = Rated V_{CB}, I_E = 0)	I_{CBO}		1.0	mAdc
Emitter-Base Cutoff Current (V_{BE} = 7.0 Vdc, I_C = 0)	I_{EBO}		1.0	mAdc
ON CHARACTERISTICS[1]				
DC Current Gain (I_C = 5.0 Vdc, V_{CE} = 4.0 Vdc) (I_C = 10 Adc, V_{CE} = 4.0 Vdc)	H_{FE}	25 5		–
Collector-Emitter Saturation Voltage (I_C = 5.0 Adc, I_B = 0.5 Adc)	$V_{CE(sat)}$		1.0	Vdc
Base-Emitter Saturation Voltage (I_C = 5.0 Adc, I_B = 0.5 Adc)	$V_{BE(sat)}$		1.8	Vdc
Base-Emitter On Voltage (I_C = 5.0 Adc, V_{CE} = 4.0 Vdc)	$V_{BE(on)}$		1.5	Vdc
DYNAMIC CHARACTERISTICS[1]				
Current-Gain – Bandwidth Product[2] (I_C = 0.5 Adc, V_{CE} = 10 Vdc, f_{test} = 1.0 MHz)	f_T	4.0		MHz
SECOND BREAKDOWN				
Second Breakdown Collector Current (V_{CE} = 39 Vdc, t = 0.5 sec.) (V_{CE} = 50 Vdc, t = 0.5 sec.)	$I_{S/B}$	2.95 0.60		Adc

[1] Pulse test: Pulse width ≤ 300 μs, Duty Cycle ≥ 2%

[2] $f_T = |h_{fe}| \cdot f_{test}$

FIGURE 2 – ACTIVE REGION SAFE OPERATING AREA



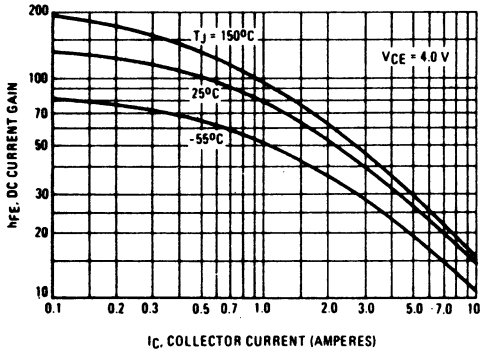
There are two limitations on the power handling ability of a transistor: average junction temperature and second breakdown. Safe operating area curves indicate I_C – V_{CE} limits of the transistor that must be observed for reliable operation, i.e., the transistor must not be subjected to greater dissipation than the curves indicate.
Second breakdown pulse limits are valid for duty cycles to 10%.

At high case temperatures, thermal limitation may reduce the power that can be handled to values less than the limitations imposed by second breakdown.

PNP DEVICE
BD312

NPN DEVICE
BD311

FIGURE 3 – DC CURRENT GAIN



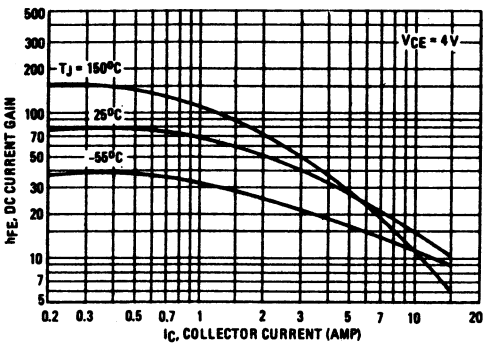
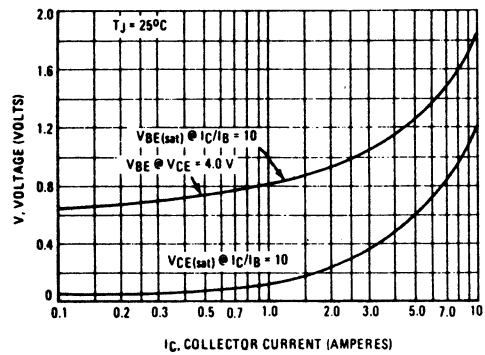
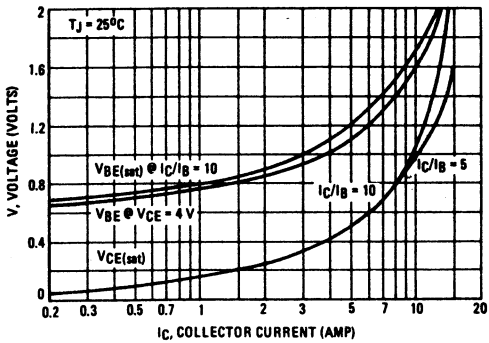


FIGURE 4 – "ON" VOLTAGES





NPN

BD313

PNP

BD314

COMPLEMENTARY SILICON HIGH-POWER TRANSISTORS

. . . designed for high quality amplifiers operating up to 60 Watts into 8 ohm load.

- High DC Current Gain
- Excellent Safe Operating Area
- High Current Gain – Bandwidth Product – Typical
  f_T = 4.0 MHz @ I_C = 0.5 A

10 AMPERE COMPLEMENTARY SILICON POWER TRANSISTORS

80 VOLTS 150 WATTS

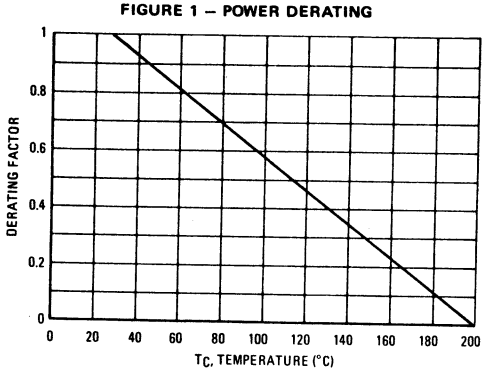
MAXIMUM RATINGS

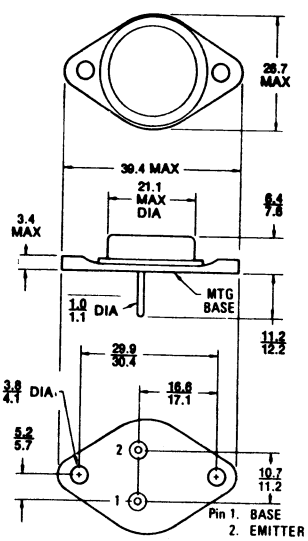
Rating	Symbol	BD313/314	Unit
Collector-Emitter Voltage	V_{CEO}	80	Vdc
Collector-Base Voltage	V_{CB}	80	Vdc
Emitter-Base Voltage	V_{EB}	5.0	Vdc
Collector Current – Continuous Peak	I_C	10 20	Adc
Base Current	I_B	4.0	Adc
Total Device Dissipation @ T_C = 25°C Derate above 25°C	P_D	150 0.857	Watts W/°C
Operating and Storage Junction Temperature Range	T_J, T_{stg}	−65 to +200	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max.	Unit.
Thermal Resistance, Junction to Case	θ_{JC}	1.17	°C/W

FIGURE 1 – POWER DERATING





Dimensions in millimeters
Collector connected to case

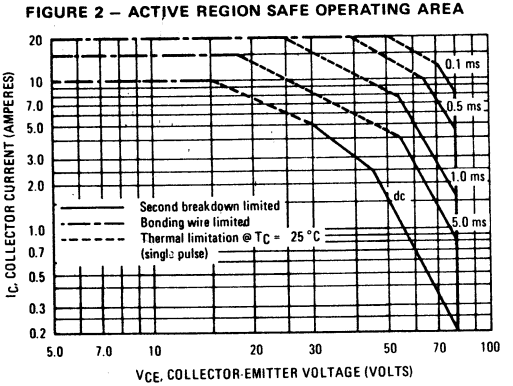
CASE 11
TO-3

ELECTIRCAL CHARACTERISTICS* (T_C = 25 °C unless otherwise noted)

Characteristic	Symbol	Min.	Max.	Unit.
OFF CHARACTERISTICS				
Collector-Emitter Sustaining Voltage[1] (I_C = 200 mAdc, I_B = 0)	$V_{CEO(sus)}$	80		Vdc
Collector-Base Cutoff Current (V_{CB} = Rated V_{CB}, I_E = 0)	I_{CBO}		1.0	mAdc
Emitter-Base Cutoff Current (V_{BE} = 7.0 Vdc, I_C = 0)	I_{EBO}		1.0	mAdc
ON CHARACTERISTICS[1]				
DC Current Gain (I_C = 4.0 Adc, V_{CE} = 4.0 Vdc) (I_C = 10 Adc, V_{CE} = 4.0 Vdc)	H_{FE}	25 5		–
Collector-Emitter Saturation Voltage (I_C = 5.0 Adc, I_B = 0.5 Adc)	$V_{CE(sat)}$		1.0	Vdc
Base-Emitter Saturation Voltage (I_C = 5.0 Adc, I_B = 0.5 Adc)	$V_{BE(sat)}$		1.8	Vdc
Base-Emitter On Voltage (I_C = 5.0 Adc, V_{CE} = 4.0 Vdc)	$V_{BE(on)}$		1.5	Vdc
DYNAMIC CHARACTERISTICS[1]				
Current-Gain – Bandwidth Product[2] (I_C = 0.5 Adc, V_{CE} = 10 Vdc, f_{test} = 1.0 MHz)	f_T	4.0		MHz
SECOND BREAKDOWN				
Second Breakdown Collector Current (V_{CE} = 30 Vdc, t = 0.5 sec.) (V_{CE} = 50 Vdc, t = 0.e sec.)	$I_{S/B}$	5 1.5		Adc

[1] Pulse test: Pulse width ≤ 300 μs, Duty Cycle ≥2%
[2] $f_T = |h_{fe}| \cdot f_{test}$

FIGURE 2 – ACTJVE REGION SAFE OPERATING AREA



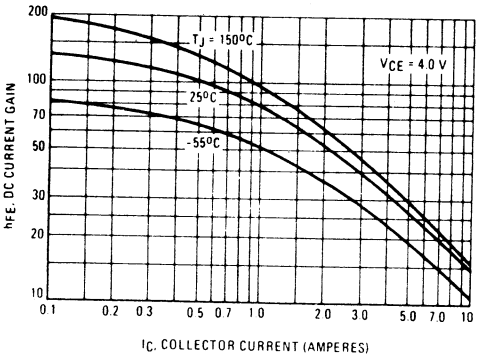
There are two limitations on the power handling ability of a transistor: average junction temperature and second breakdown. Safe operating area curves indicate I_C – V_{CE} limits of the transistor that must be observed for reliable operation, i.e., the transistor must not be subjected to greater dissipation than the curves indicate.
Second breakdown pulse limits are valid for duty cycles to 10%.

At high case temperatures, thermal limitation may reduce the power that can be handled to values less than the limitations imposed by second breakdown.

PNP DEVICE
BD314

NPN DEVICE
BD313

FIGURE 3 – DC CURRENT GAIN



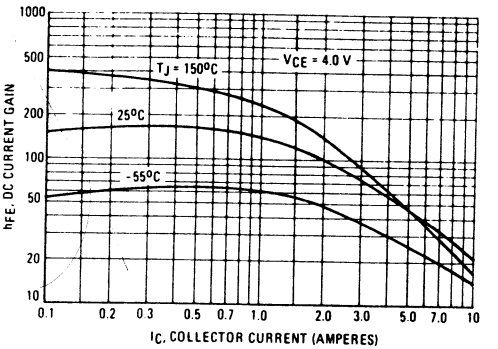
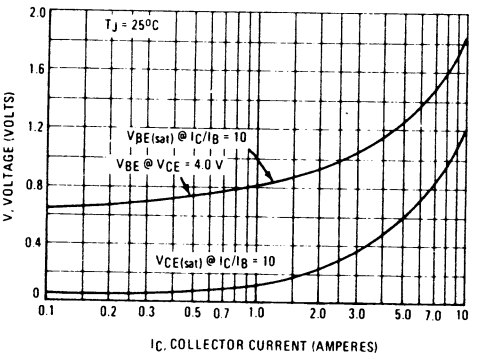
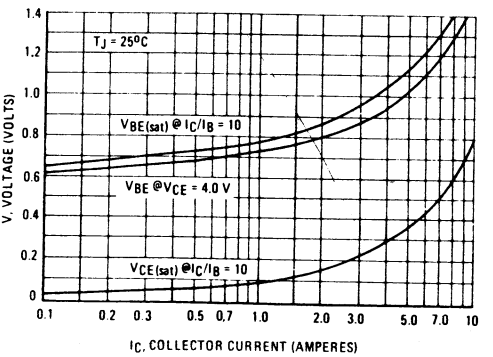


FIGURE 4 – "ON" VOLTAGES





BD315 • BD316
BD317 • BD318

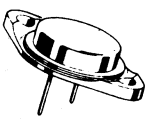
COMPLEMENTARY SILICON HIGH-POWER TRANSISTORS

... designed for high quality amplifiers operating up to 100 Watts into 4 ohm load with BD315, BD316 and into 8 ohm load with BD317, BD318.

- High DC Current Gain
- Excellent Safe Operating Area
- High Current Gain — Bandwidth Product — Typical f_T = 2.0 MHz @ I_C = 1.0 A

16 AMPERE COMPLEMENTARY SILICON POWER TRANSISTORS

80-100 VOLTS 200 WATTS



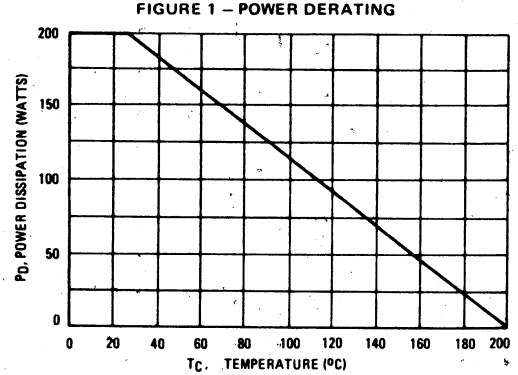
MAXIMUM RATINGS

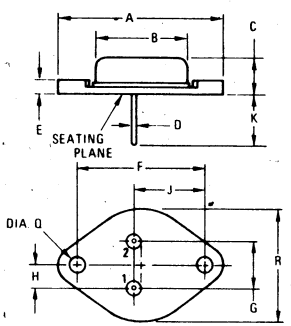
Rating	Symbol	BD315 BD316	BD317 BD318	Unit
Collector-Emitter Voltage	V_{CEO}	80	100	Vdc
Collector-Base Voltage	V_{CB}	80	100	Vdc
Emitter-Base Voltage	V_{EB}	7.0		Vdc
Collector Current — Continuous Peak	I_C	16 20		Adc
Base Current — Continuous	I_B	5.0		Adc
Total Device Dissipation @ T_C = 25°C Derate above 25°C	P_D	200 1.14		Watts W/°C
Operating and Storage Junction Temperature Range	T_J, T_{stg}	-65 to +200		°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	θ_{JC}	0.875	°C/W

FIGURE 1 – POWER DERATING





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

NOTE:
1. DIM "Q" IS DIA

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	–	39.37	–	1.550
B	–	21.08	–	0.830
C	6.35	7.62	0.250	0.300
D	0.99	1.09	0.039	0.043
E	–	3.43	–	0.135
F	29.90	30.40	1.177	1.197
G	10.67	11.18	0.420	0.440
H	5.33	5.59	0.210	0.220
J	16.64	17.15	0.655	0.675
K	11.18	12.19	0.440	0.480
Q	3.84	4.09	0.151	0.161
R	–	26.67	–	1.050

Collector connected to case

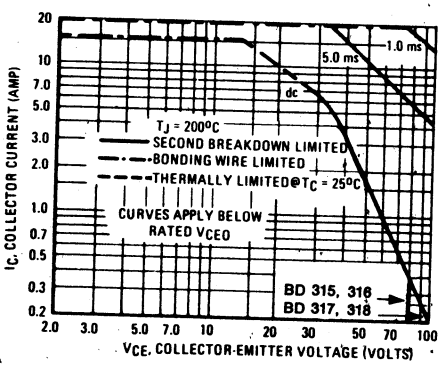
CASE 11 (TO-3)

*** ELECTRICAL CHARACTERISTICS** (T_C = 25°C unless otherwise noted)

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Sustaining Voltage (1) (I_C = 200 mAdc, I_B = 0)	BD315, BD316 BD317, BD318	$V_{CEO(sus)}$	80 100	— —	Vdc
Collector-Base Cutoff Current (V_{CB} = Rated V_{CB}, I_E = 0)		I_{CBO}	—	1.0	mAdc
Emitter-Base Cutoff Current (V_{BE} = 7.0 Vdc, I_C = 0)		I_{EBO}	—	1.0	mAdc
ON CHARACTERISTICS (1)					
DC Current Gain I_C = 5.0 Adc, V_{CE} = 4.0 Vdc I_C = 8.0 Adc, V_{CE} = 4.0 Vdc I_C = 10 Adc, V_{CE} = 4.0 Vdc	BD317, BD318 BD315, BD316 All Types	h_{FE}	25 25 15		—
Collector-Emitter Saturation Voltage I_C = 8.0 Adc, I_B = 0.8 Adc		$V_{CE(sat)}$	—	1.0	Vdc
Base-Emitter Saturation Voltage I_C = 8.0 Adc, I_B = 0.8 Adc		$V_{BE(sat)}$	—	1.8	Vdc
Base-Emitter On Voltage (I_C = 8.0 Adc, V_{CE} = 2.0 Vdc)		$V_{BE(on)}$	—	1.5	Vdc
DYNAMIC CHARACTERISTICS					
Current-Gain—Bandwidth Product (2) (I_C = 1.0 Adc, V_{CE} = 20 Vdc, f_{test} = 0.5 MHz)		f_T	1.0	—	MHz

(1) Pulse Test: Pulse Width $\leq$ 300 μs, Duty Cycle $\geq$ 2.0%.
(2) $f_T = |h_{fe}| \bullet f_{test}$.

FIGURE 2 — ACTIVE REGION SAFE OPERATING AREA



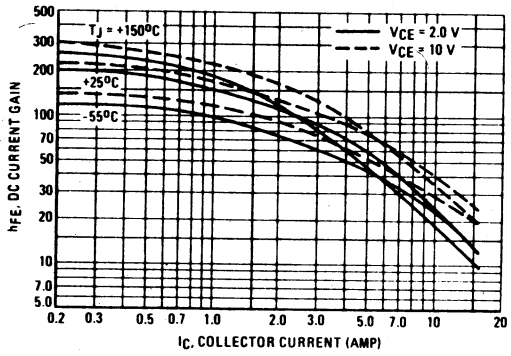
There are two limitations on the power handling ability of a transistor: average junction temperature and second breakdown. Safe operating area curves indicate I_C — V_{CE} limits of the transistor that must be observed for reliable operation, i.e., the transistor must not be subjected to greater dissipation than the curves indicate.

The data of Figure 2 is based on $T_{J(pk)}$ = 200°C; T_C is variable depending on conditions. Second breakdown pulse limits are valid for duty cycles to 10% provided $T_{J(pk)}$ <200°C. At high case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by second breakdown. (See AN-415).

PNP DEVICES
BD316 and BD318

NPN DEVICES
BD315 and BD317

FIGURE 3 — DC CURRENT GAIN



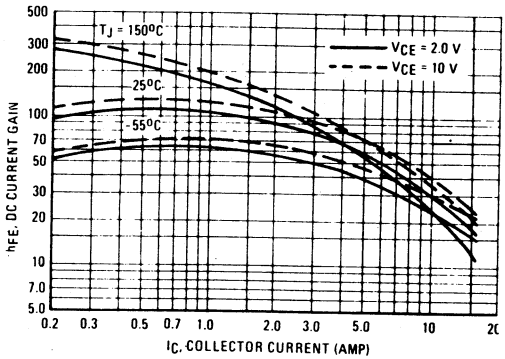
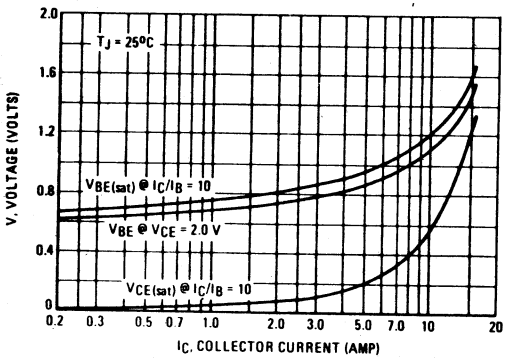
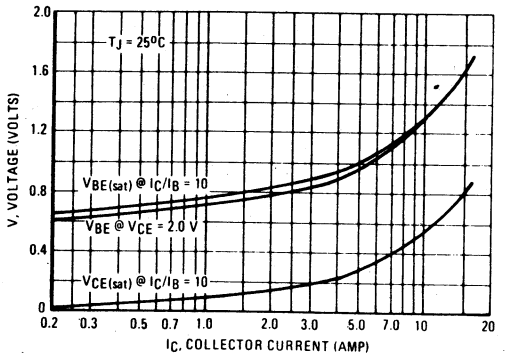


FIGURE 4 — "ON" VOLTAGES





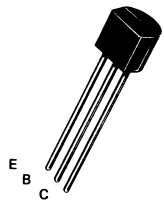
BC 347
BC 348
BC 349

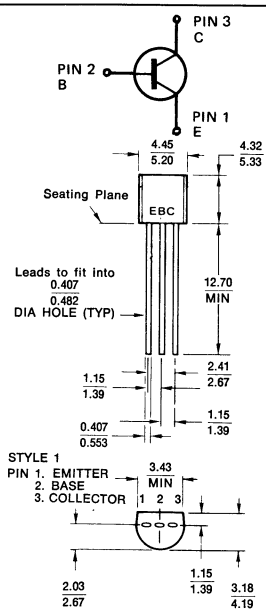
NPN SILICON ANNULAR* TRANSISTORS

. . . designed for general-purpose use in audio, radio, and television applications.

- High Breakdown Voltage—
  BV_{CEO} = 20, 30, 45 Vdc (Min) @ I_C = 1.0 mAdc
- Low Collector-Emitter Saturation Voltage—
  $V_{CE(sat)}$ = 0.25 Vdc (Max) @ I_C = 10 mAdc
- Low Output Capacitance—
  C_{ob} = 4.0 pF (Max) @ V_{CB} = 10 Vdc
- Complementary to PNP BC 350, BC 351, BC 352
- One-Piece, Injection-Molded Unibloc† Package

NPN SILICON AMPLIFIER TRANSISTORS





CASE 29-02 (1)
(TO92)
PLASTIC

Dimensions in millimeters

MAXIMUM RATINGS

Rating	Symbol	Type	Value	Unit
Collector-Emitter Voltage	V_{CEO}	BC 347 BC 348 BC 349	45 30 20	Vdc
Emitter-Base Voltage	V_{EB}		5.0	Vdc
Collector Current - Continuous	I_C		100	mAdc
Total Device Dissipation @T_A = 25°C Derate above 25°C	P_D		350 2.81	mW mW/°C
Operating and Storage Junction Temperature range	T_J, T_{stg}		—55 to +135	°C

THERMAL CHARACTERISTICS

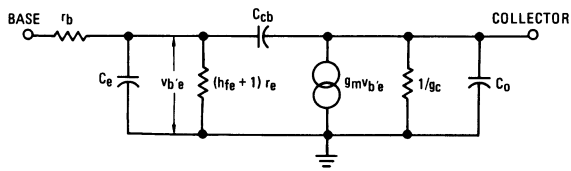
Characteristic	Symbol		Max	Unit
Thermal Resistance, Junction to Ambient	θ_{JA}		357	°C/W

*Annular Semiconductors Patented by Motorola Inc.
†Trademark of Motorola Inc.

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

Characteristic	Symbol	Type	Min.	Max.	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (I_C = 1.0 mAdc, I_B = 0)	BV_{CEO}	BC347 BC348 BC349	45 30 20	—	Vdc
Collector-Base Breakdown Voltage (I_C = 100 μAdc, I_E = 0)	BV_{CBO}	BC347 BC348 BC349	50 40 30	—	Vdc
Emitter-Base Breakdown Voltage (I_E = 100 μAdc, I_C = 0)	BV_{EBO}		5	—	Vdc
Collector Cutoff Current (V_{CB} = 20 Vdc, I_E = 0)	I_{CBO}		—	100	nAdc
ON CHARACTERISTICS					
DC Current Gain (I_C = 2.0 mAdc, V_{CE} = 5 Vdc)	h_{FE}		40	450	—
Collector-Emitter Saturation Voltage (I_C = 10 mAdc, I_B = 1.0 mAdc)	$V_{CE(sat)}$		—	0.25	Vdc
DYNAMIC CHARACTERISTICS					
Current-Gain–Bandwidth Product (I_C = 5.0 mAdc, V_{CE} = 10 Vdc, f = 100MHz)	f_T		125		MHz
Output Capacitance (V_{CB} = 10 Vdc, I_E = 0, f = 100 kHz)	C_{ob}			4.0	pF

FIGURE 1 – SIMPLIFIED AC EQUIVALENT CIRCUIT (Common Emitter)



Note:

Data is presented in terms of the equivalent circuit shown in Figure 1. Values for its components may be found or calculated as follows:

r_b' – See Figure 8 $\quad C_{cb} = C_{ob} - 0.2$ pF (See Figure 6)

$r_e = 26\ mV/I_E \quad g_m = 1/r_e$

$C_e = \dfrac{1}{2\pi f_t r_e} \quad g_c = (h_{fe}+1)\,h_{ob}$ (See Figures 2 & 7)

$C_o = 0.2$ pF

Low frequency h parameters may be found from:

$h_{ie} = r_b' + (h_{fe}+1)\,r_e$

h_{fe} = See Figure 2

h_{re} = Negligible

$h_{oe} = (h_{fe}+1)\,h_{ob}$

FIGURE 2 – SMALL SIGNAL CURRENT GAIN

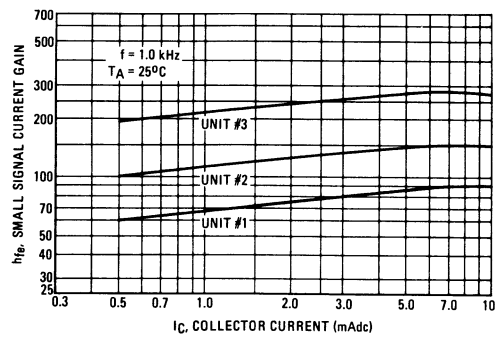


FIGURE 3 – NORMALIZED QC CURRENT GAIN

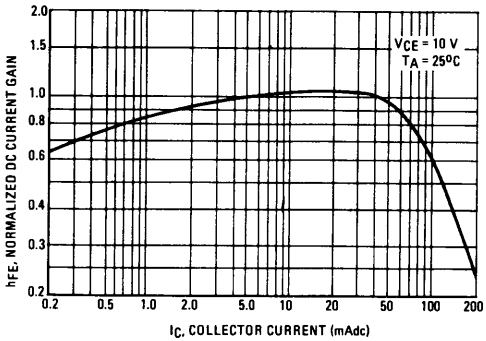


FIGURE 4 – "SATURATION" AND "ON" VOLTAGES

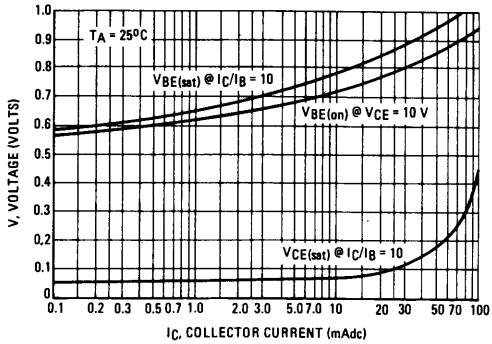


FIGURE 5 – CURRENT-GAIN–BANDWIDTH PRODUCT

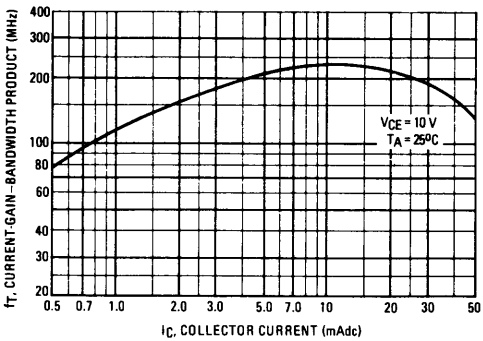


FIGURE 6 – CAPACITANCES

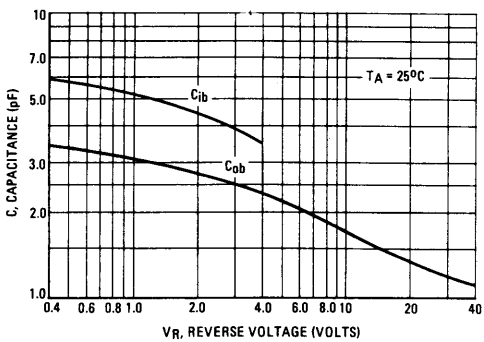


FIGURE 7 – OUTPUT ADMITTANCE

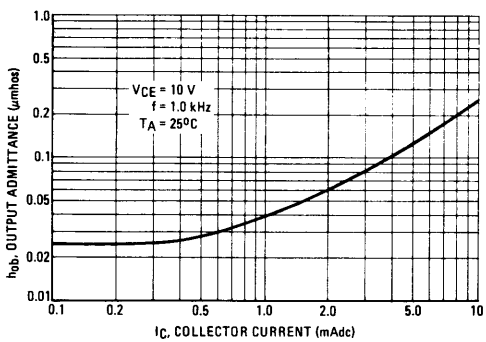
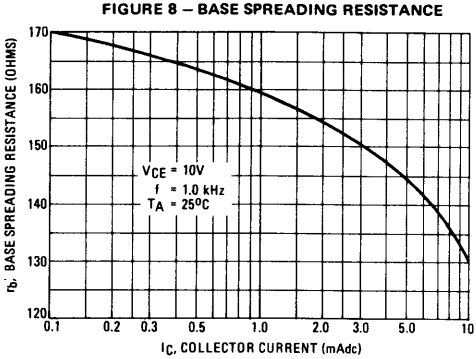


FIGURE 8 – BASE SPREADING RESISTANCE



BC 347, BC 348, BC 349
can be supplied in 4 different h_{FE} ranges as follows

Characteristic	Symbol	Type	Min	Max	Unit
DC Current Gain (I_C = 2 mA, V_{CE} = 5 V)	h_{FE}	BC347 BC348 BC349	40	450	—
		BC347L BC348L BC349L	40	120	—
		BC347A BC348A BC349A	110	220	—
		BC347B BC348B BC349B	200	450	—

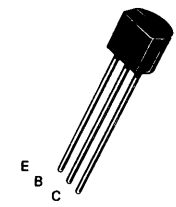
BC 350
BC 351
BC 352

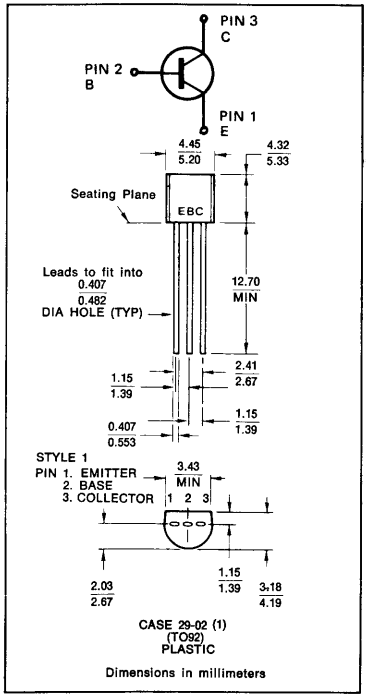
PNP SILICON ANNULAR* TRANSISTORS

. . . designed for general purpose use in audio, radio, and television applications.

- High Breakdown Voltage—
  BV_{CEO} = 20, 30, 45 Vdc (Min) @ I_C = 1.0 mAdc
- Low Collector-Emitter Saturation Voltage—
  $V_{CE(sat)}$ = 0.25 Vdc (Max) @ I_C = 10 mAdc
- Low Output Capacitance—
  C_{ob} = 4.0 pF (Max) @ V_{CB} = 10 Vdc
- Complementary to NPN BC 347, BC 348, BC 349
- One-Piece, Injection-Molded Unibloc† Package

PNP SILICON AMPLIFIER TRANSISTORS





CASE 29-02 (1)
(TO92)
PLASTIC

Dimensions in millimeters

MAXIMUM RATINGS

Rating	Symbol	Type	Value	Unit
Collector-Emitter Voltage	V_{CEO}	BC 350 BC 351 BC 352	45 30 20	Vdc
Emitter-Base Voltage	V_{EB}		5.0	Vdc
Collector Current - Continuous	I_C		100	mAdc
Total Device Dissipation @ T_A = 25°C Derate above 25°C	P_D		350 2.81	mW mW/°C
Operating and Storage Junction Temperature Range	T_J, T_{stg}		—55 to +150	°C

THERMAL CHARACTERISTICS

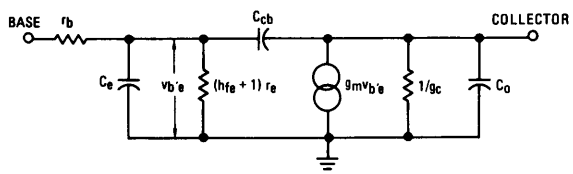
Characteristic	Symbol		Max	Unit
Thermal Resistance, Junction to Ambient	θ_{JA}		357	°C/W

*Annular Semiconductors Patented by Motorola Inc.
†Trademark of Motorola Inc.

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

Characteristic	Symbol	Type	Min.	Max.	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (I_C = 1.0 mAdc, I_B = 0)	BV_{CEO}	BC350 BC351 BC352	45 30 20	—	Vdc
Collector-Base Breakdown Voltage (I_C = 100 μAdc, I_E = 0)	BV_{CBO}	BC350 BC351 BC352	50 40 30	—	Vdc
Emitter-Base Breakdown Voltage (I_E = 100 μAdc, I_C = 0)	BV_{EBO}		5		Vdc
Collector Cutoff Current (V_{CB} = 20 V, I_E = 0)	I_{CBO}		—	100	nAdc
ON CHARACTERISTICS					
DC Current Gain (I_C = 2.0 mAdc, V_{CE} = 5 Vdc	h_{FE}		40	450	—
Collector-Emitter Saturation Voltage (I_C = 10 mAdc, I_B = 1.0 mAdc)	$V_{CE(sat)}$		—	0.25	Vdc
DYNAMIC CHARACTERISTICS					
Current-Gain–Bandwidth Product (I_C = 5.0 mAdc, V_{CE} = 10 Vdc, f = 100 MHz)	f_T		125	-	MHz
Output Capacitance (V_{CB} = 10 Vdc, I_E = 0, f = 100 kHz)	C_{ob}		-	4.0	pF

FIGURE 1 – SIMPLIFIED AC EQUIVALENT CIRCUIT (Common Emitter)



Note:

Data is presented in terms of the equivalent circuit shown in Figure 1. Values for its components may be found or calculated as follows:

r_b – See Figure 8 $\quad C_{cb} = C_{ob} - 0.2$ pF (See Figure 6)

$r_e = 26\ mV/I_E \quad g_m = 1/r_e$

$C_e = \dfrac{1}{2\pi f_t r_e} \quad g_c = (h_{fe} + 1)\, h_{ob}$ (See Figures 2 & 7)

$C_o = 0.2$ pF

Low frequency h parameters may be found from:

$h_{ie} = r_b' + (h_{fe} + 1)\, r_e$

h_{fe} = See Figure 2

h_{re} = Negligible

$h_{oe} = (h_{fe} + 1)\, h_{ob}$

FIGURE 2 – SMALL SIGNAL CURRENT GAIN

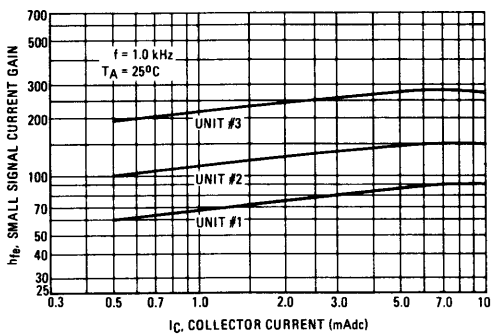


FIGURE 3 – NORMALIZED DC CURRENT GAIN

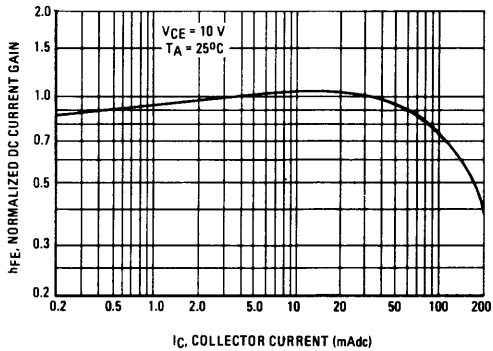


FIGURE 4 – "SATURATION" AND "ON" VOLTAGES

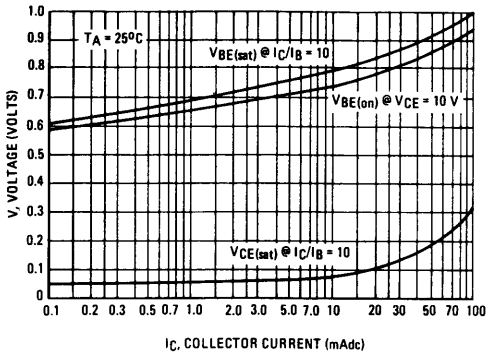


FIGURE 5 – CURRENT-GAIN–BANDWIDTH PRODUCT

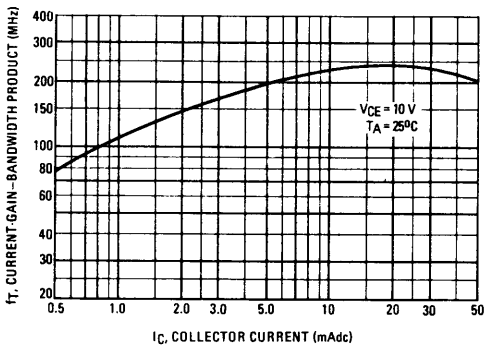


FIGURE 6 – CAPACITANCES

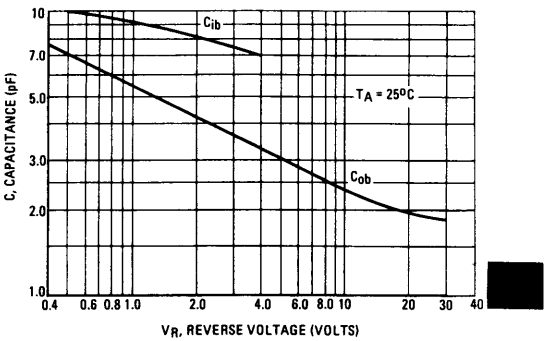


FIGURE 7 – OUTPUT ADMITTANCE

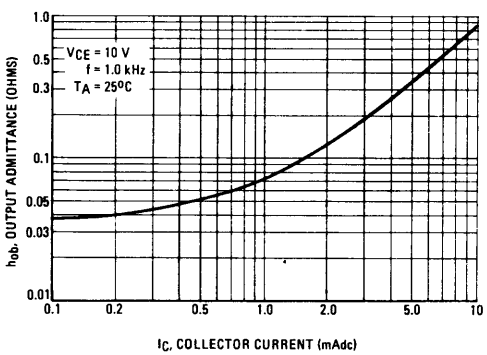
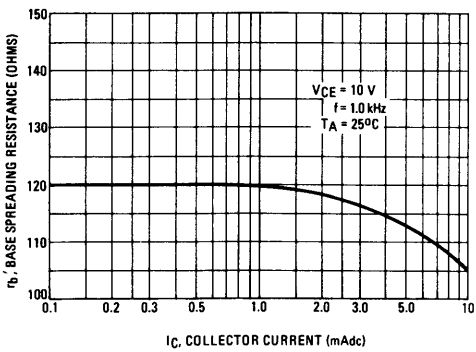


FIGURE 8 – BASE SPREADING RESISTANCE



BC 350, BC 351, BC 352
can be supplied in 4 different h_{FE} ranges as follows

Characteristic	Symbol	Type	Min	Max	
DC Current Gain (I_C = 2 mA, V_{CE} = 5 V)	h_{FE}	BC350 BC351 BC352	40	450	—
		BC350L BC351L BC352L	40	120	—
		BC350A BC351A BC352A	110	220	—
		BC350B BC351B BC352B	200	450	—

NPN PNP

BD361 BD362
BD361A BD362A

PLANAR SILICON MEDIUM-POWER TRANSISTORS

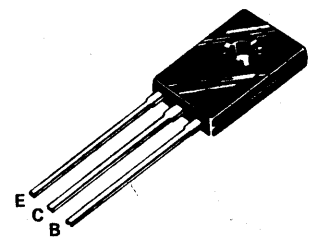
. . . designed for low power, high-gain audio amplifier, and low current high speed switching applications.

- P_D of 15 W with $T_C = 25^oC$
- F_T minimum 50 MHz
- High DC Current Gain
  I_C = 500 mAdc, h_{FE} = 80-320
- Very low Collector-Emitter Saturation Voltage
  $V_{CE(sat)}$ = 0.2 Vdc (Typ), I_C = 1 Adc

4 AMPERES

POWER TRANSISTOR COMPLEMENTARY SILICON

20 VOLTS
15 WATTS

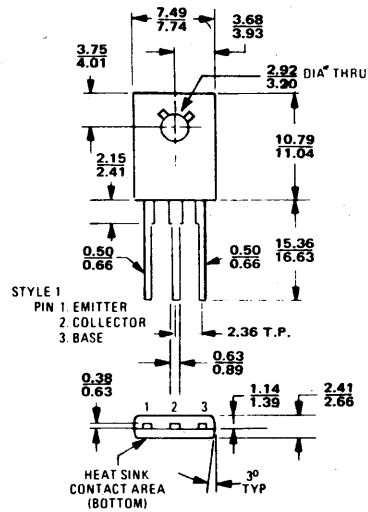


MAXIMUM RATINGS

Rating	Symbol	BD361 BD362	BD361A BD362A	Unit
Collector-Emitter Voltage	V_{CEO}	20	20	Vdc
Collector-Base Voltage	V_{CBO}	32	32	Vdc
Emitter-Base Voltage	V_{EBO}	8		Vdc
Collector Current	I_C	4.0		Adc
Base Current	I_B	1.0		Adc
Total Power Dissipation @ $T_C = 25^oC$ Derate above 25^oC	P_D	15 120		Watts $W/^oC$
Operating and Storage Junction Temperature Range	T_J, T_{stg}	-65 to +200		^oC

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	8.35	$^oC/W$



When mounting the device, torque not to exceed 0.07 m-kg

If lead bending is required, use suitable clamps or other supports between transistor case and point of bend

All dimensions in millimeters

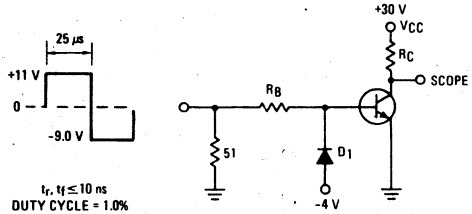
CASE 77-04

ELECTRICAL CHARACTERISTICS (T_C = 25°C unless othervise noted)

Characteristic	Symbol	Min.	Max.	Unit
Collector-Emitter Sustaining Voltage (I_C = 50 mAdc, I_B = 0)	$V_{CEO(sus)}$	20	—	Vdc
Collector Cutoff Current (V_{CB} = 32 V, I_E = 0) (V_{CB} = 32 V, I_E = 0, T_J = 150° C)	I_{CBO}	— —	0.2 1.0	μAdc mAdc
Emitter Cutoff Current (V_{EB} = 8 V, I_C = 0)	I_{EBO}	—	0.1	mAdc
DC Current Gain (I_C = 50 m A V_{CE} = 1 V)* ALL TYPES (I_C = 500 m A V_{CE} = 1 V)* ALL TYPES (I_C = 2.0 A V_{CE} = 1 V)* BD361, BD362 (I_C = 2.0 A V_{CE} = 1 V)* BD361A, BD362A	h_{FE}	 40 80 25 50	 — 300 320 — —	—
Collector-Emitter Saturation Voltage (I_C = 1.0 A, I_B = 20 m A)*	$V_{CE(sat)}$	—	0.6	Vdc
Base-Emitter On Voltage (I_C = 2.0 A V_{CE} = 1 V)*	$V_{BE(on)}$	—	1.5	Vdc
Current-Gain bandwidth product (I_C = 0.1 A, V_{CE} 10 V, f = 1MHz)	f_T	50		MHz

* Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%

FIGURE 1 – SWITCHING TIME TEST CIRCUIT



t_r, $t_f \leq 10$ ns
DUTY CYCLE = 1.0%

R_B and R_C VARIED TO OBTAIN DESIRED CURRENT LEVELS

D_1 MUST BE FAST RECOVERY TYPE, eg:
MBD5300 USED ABOVE $I_B \approx 100$ mA
MSD6100 USED BELOW $I_B \approx 100$ mA

FOR PNP TEST CIRCUIT, REVERSE ALL POLARITIES

FIGURE 2 – TURN-ON TIME

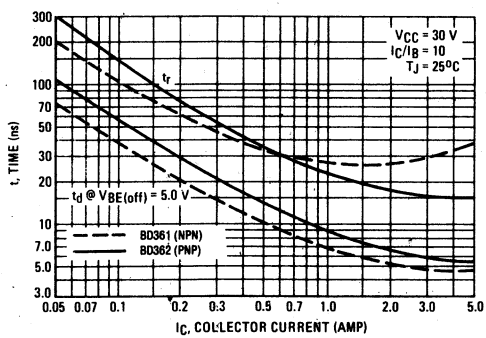


FIGURE 3 – THERMAL RESPONSE

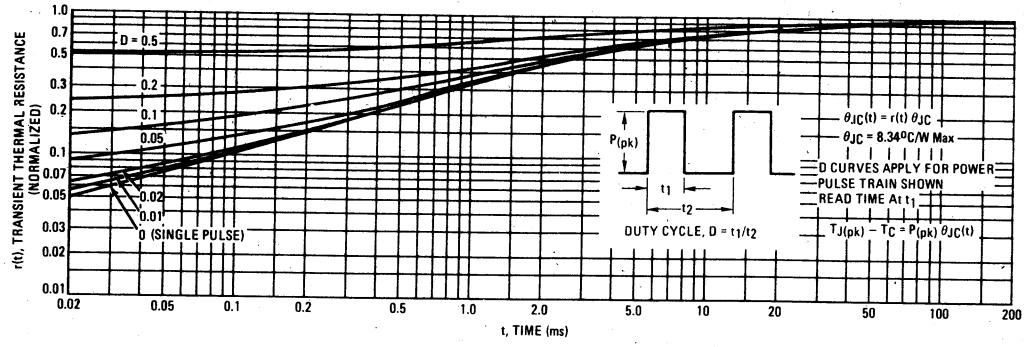
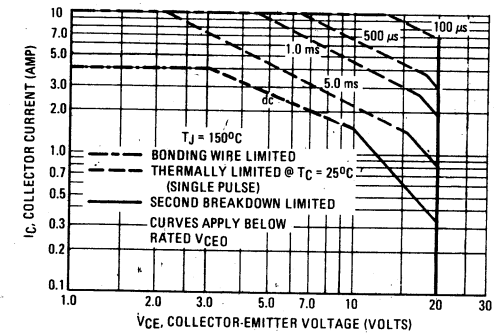


FIGURE 4 – ACTIVE REGION SAFE OPERATING AREA



There are two limitations on the power handling ability of a transistor: average junction temperature and second breakdown. Safe operating area curves indicate I_C-V_{CE} limits of the transistor that must be observed for reliable operation; i.e., the transistor must not be subjected to greater dissipation than the curves indicate.

The data of Figure 4 is based on $T_{J(pk)}$ = 150°C; T_C is variable depending on conditions. Second breakdown pulse limits 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 3. At high case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by second breakdown. (See AN-415)

FIGURE 5 – TURN-OFF TIME

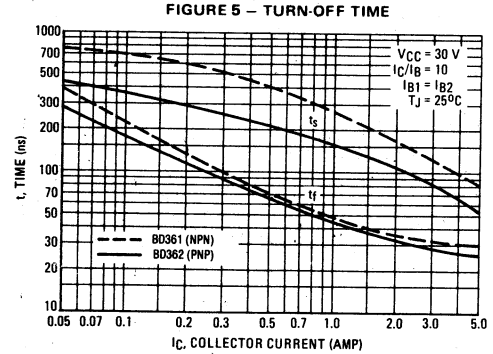
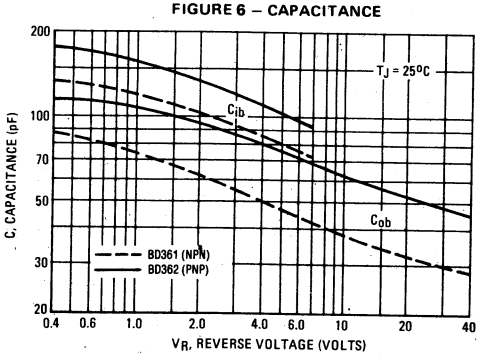


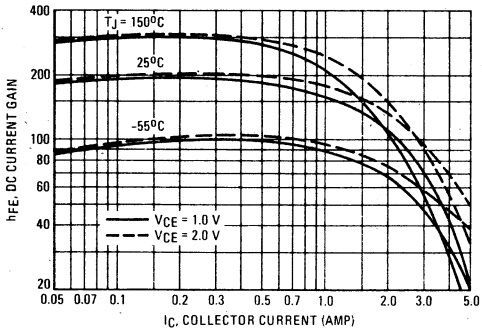
FIGURE 6 – CAPACITANCE



NPN
BD361, BD361A

PNP
BD362, BD362A

FIGURE 7 – DC CURRENT GAIN



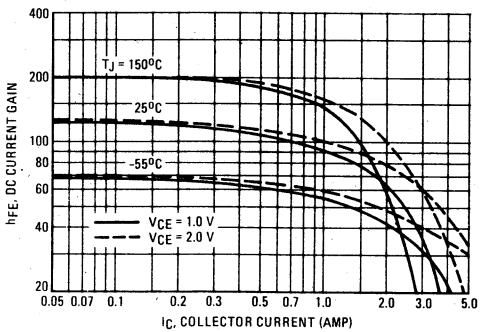
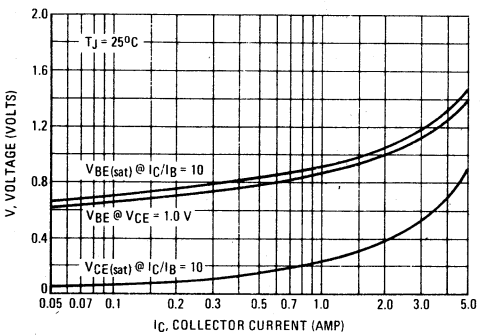


FIGURE 8 – "ON" VOLTAGE



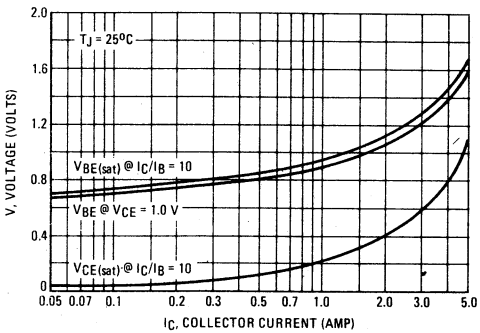
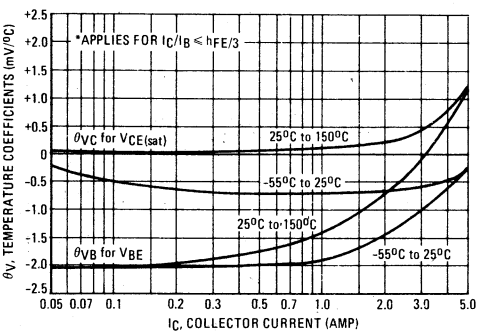
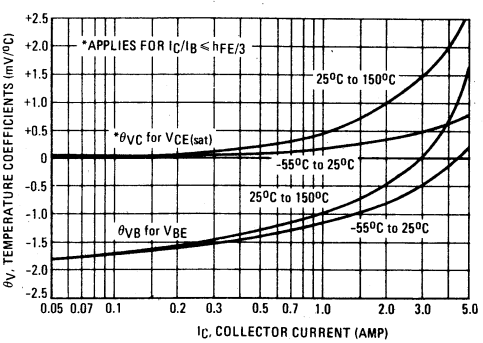


FIGURE 9 – TEMPERATURE COEFFICIENTS





BD364, BD366, BD368 (NPN)
BD365, BD367, BD369 (PNP)

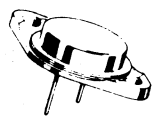
COMPLEMENTARY SILICON HIGH-POWER TRANSISTORS

. . . designed for high quality amplifiers operating up to 100 Watts into 4 ohm load in regular complementary operation or up to several hundred watts in 4 or 8 ohms in series connected mode

- High DC Current Gain $h_{FE\ min.} = 20$ @ $I_C = 10$ A
- Excellent Safe Operating Area
- High Current Gain – Bandwidth Product:
  $f_T = 4.0$ MHz @ $I_C = 1.0$ A
- Low Collector-Emitter Saturation Voltage:
  $V_{CE\ sat} = 1$ Vdc (max.) @ 10 A

20 AMPERES COMPLEMENTARY SILICON POWER TRANSISTORS

50, 60, 80 VOLTS
200 WATTS



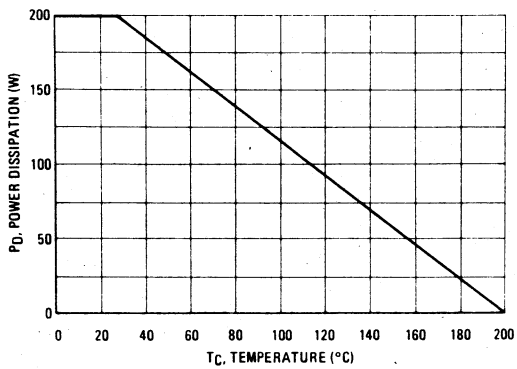
MAXIMUM RATINGS

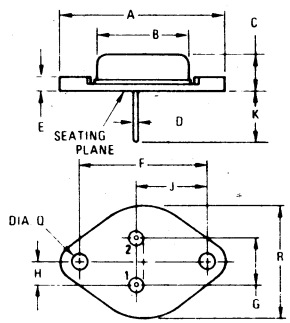
Rating	Symbol	BD364 BD365	BD366 BD367	BD368 BD369	Unit
Collector-Emitter Voltage	V_{CEO}	50	60	80	Vdc
Collector-Base Voltage	V_{CB}	50	60	80	Vdc
Emitter-Base Voltage	V_{EB}	5.0			Vdc
Collector Current – Continuous Peak	I_C	20 30			Adc
Base Current – Continuous	I_B	7.5			Adc
Total Device Dissipation @ $T_C = 25°C$ Derate above 25°C	P_D	200 1.14			Watts W/°C
Operating and Storage Junction Temperature Range	T_J, T_{stg}	−65 to +200			°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	θ_{JC}	0.875	°C/W

FIGURE 1 – POWER DERATING





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

NOTE:
1. DIM "Q" IS DIA

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A		39.37		1.550
B		21.08		0.830
C	6.35	7.62	0.250	0.300
D	0.99	1.09	0.039	0.043
E		3.43		0.135
F	29.90	30.40	1.177	1.197
G	10.67	11.18	0.420	0.440
H	5.33	5.59	0.210	0.220
J	16.64	17.15	0.655	0.675
K	11.18	12.19	0.440	0.480
Q	3.84	4.09	0.151	0.161
R		26.67		1.050

Collector connected to case

CASE 11 (TO-3)

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

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Sustaining Voltage (1) (I_C = 200 mAdc, I_B = 0)	BD364, BD365 BD366, BD367 BD368, BD369	V_{CEO} (sus)	50 60 80		Vdc
Collector-Base Cutoff Current (V_{CB} = Rated V_{CB}, I_E = 0)		I_{CBO}	–	1.0	mAdc
Emitter-Base Cutoff Current (V_{BE} = 5.0 Vdc, I_C = 0)		I_{EBO}	–	1.0	mAdc
ON CHARACTERISTIC (1)					
DC Current Gain I_C = 5.0 Adc, V_{CE} = 4.0 Vdc I_C = 8.0 Adc, V_{CE} = 4.0 Vdc I_C = 10 Adc, V_{CE} = 4.0 Vdc	All types	H_{FE}	25 25 20		–
Collector-Emitter Saturation Voltage (I_C = 10 Adc, I_B = 1 Adc)		V_{CE} (sat)	–	1.0	Vdc
Base-Emitter Saturation Voltage (I_C = 10 Adc, I_B = 1 Adc)		V_{BE} (sat)		1.8	Vdc
Base-Emitter On Voltage (I_C = 10 Adc, V_{CE} = 2.0 Vdc)		V_{BE} (on)	–	1.8	Vdc
DYNAMIC CHARACTERISTICS					
Current-Gain – Bandwidth Product (2) (I_C = 1.0 Adc, V_{CE} = 1 Vdc, f_{test} = 1 MHz)		f_T	4.0	–	MHz

(1) Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%.
(2) $f_T = |h_{fe}| \cdot f_{test}$.

FIGURE 2 – THERMAL RESPONSE