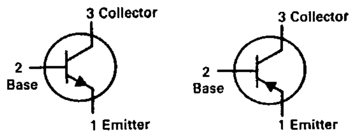
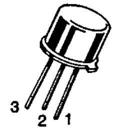
T-29-23

NPN 2N3439 2N3440 / PNP 2N5415 2N5416



JAN, JTX, JTXV AVAILABLE
CASE 79-04, STYLE 1
TO-39 (TO-205AD)



HIGH VOLTAGE AMPLIFIERS

Boca Semiconductor Corp.

http://www.bocasemi.com

3

MAXIMUM RATINGS

Rating	Symbol	PNP 2N5415	PNP 2N5416	NPN 2N3439	NPN 2N3440	Unit
Collector-Emitter Voltage	V_{CEO}	200	300	350	250	Vdc
Collector-Base Voltage	V_{CBO}	200	350	450	300	Vdc
Emitter-Base Voltage	V_{EBO}	4.0	6.0	7.0	7.0	Vdc
Base Current	I_B	0.5				Adc
Collector Current — Continuous	I_C	1.0				Adc
Total Device Dissipation @ T_A = 25°C Derate above 25°C	P_D	— —		1.0 5.7		Watts mW/°C
Total Device Dissipation @ T_C = 25°C Derate above 25°C	P_D	10 57		5.0 28.6		Watts mW/°C
Total Device Dissipation @ T_A = 50°C Derate above 50°C	P_D	1.0 6.7		— —		Watts mW/°C
Operating and Storage Junction Temperature Range	T_J, T_{stg}	−65 to +200				°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	2N5415 2N5416	2N3439 2N3440	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	17.5	35	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	150	175	°C/W

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

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Sustaining Voltage(1) (I_C = 50 mAdc, I_B = 0)	2N5415 2N5416 2N3439 2N3440	$V_{CEO(sus)}$	200 300 350 250	— — — —	Vdc
*Collector Cutoff Current (V_{CE} = 300 Vdc, I_B = 0) (V_{CE} = 200 Vdc, I_B = 0)	2N3439 2N3440	I_{CEO}	— —	20 50	μAdc
*Collector Cutoff Current (V_{CE} = 450 Vdc, V_{BE} = 1.5 Vdc) (V_{CE} = 300 Vdc, V_{BE} = 1.5 Vdc)	2N3439 2N3440	I_{CEX}	— —	500 500	μAdc
Collector Cutoff Current (V_{CB} = 175 Vdc, I_E = 0) (V_{CB} = 280 Vdc, I_E = 0) (V_{CB} = 360 Vdc, I_E = 0) (V_{CB} = 250 Vdc, I_E = 0)	2N5415 2N5416 2N3439 2N3440	I_{CBO}	— — — —	50 50 20 20	μAdc
Emitter Cutoff Current (V_{EB} = 4.0 Vdc, I_C = 0) (V_{EB} = 6.0 Vdc, I_C = 0)	2N5415 2N5416, 2N3439, 2N3440	I_{EBO}	— —	20 20	μAdc
ON CHARACTERISTICS(1)					
DC Current Gain (I_C = 2.0 mAdc, V_{CE} = 10 Vdc) *(I_C = 20 mAdc, V_{CE} = 10 Vdc) *(I_C = 50 mAdc, V_{CE} = 10 Vdc)	2N3439 2N3439, 2N3440 2N5415 2N5416	h_{FE}	30 40 30 30	— 160 150 120	—
Collector-Emitter Saturation Voltage (I_C = 50 mAdc, I_B = 4.0 mAdc)	2N3439, 2N3440	$V_{CE(sat)}$	—	0.5	Vdc
Base-Emitter Saturation Voltage (I_C = 50 mAdc, I_B = 4.0 mAdc)	2N3439, 2N3440	$V_{BE(sat)}$	—	1.3	Vdc

*Indicates Data in Addition to JEDEC Requirements.

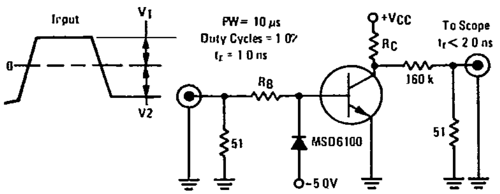
T-29-23

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

Characteristic		Symbol	Min	Max	Unit
SMALL-SIGNAL CHARACTERISTICS					
Current-Gain — Bandwidth Product (I_C = 10 mAdc, V_{CE} = 10 Vdc, f = 5.0 MHz)	2N3439, 2N3440	f_T	15	—	MHz
Output Capacitance (V_{CB} = 10 Vdc, I_E = 0, f = 1.0 MHz)	2N5415, 2N5416	C_{obo}	—	15	pF
	2N3439, 2N3440		—	10	
Input Capacitance (V_{EB} = 5.0 Vdc, I_C = 0, f = 1.0 MHz)		C_{ibo}	—	75	pF
Small-Signal Current Gain (I_C = 5.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz) (I_C = 10.0 mAdc, V_{CE} = 10 Vdc, f = 5.0 MHz)	2N5415, 2N5416	h_{fe}	25	—	—
Real Part of Input Impedance (V_{CE} = 10 Vdc, I_C = 5.0 mAdc, f = 1.0 MHz)		$Re(h_{ie})$	—	300	Ohms

(1) Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%.
CAUTION: The sustaining voltage *must not* be measured on a curve tracer. (See Fig. 15.)

FIGURE 1 — SWITCHING TIMES TEST CIRCUIT



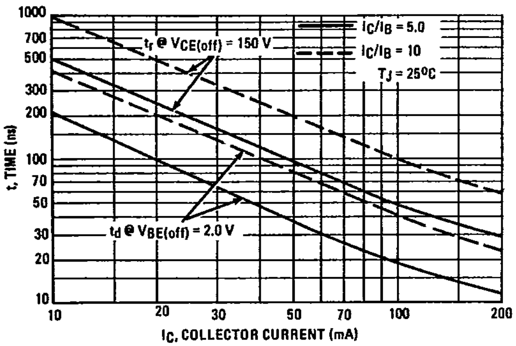
NOTE: V_{CC} and R_C adjusted for $V_{CE(off)}$ = 150 V and I_C as desired, R_B chosen for desired I_{B1}. $V_1 \approx 10$ V, $V_2 \approx 8.0$ V

For t_d and t_r, D1 is disconnected and V_2 = 2.0 V

For PNP test circuit, reverse all polarities.

FIGURE 2 — TURN-ON TIME

PNP 2N5415, 2N5416



NPN 2N3439, 2N3440

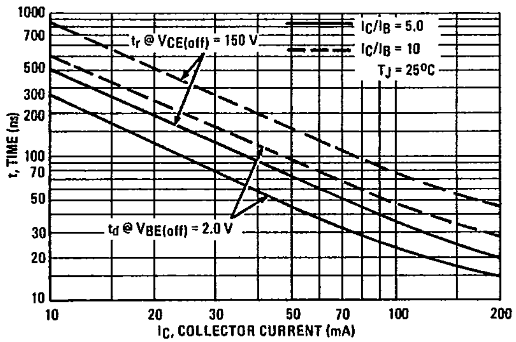
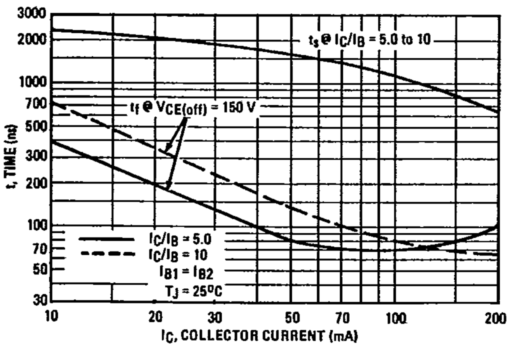
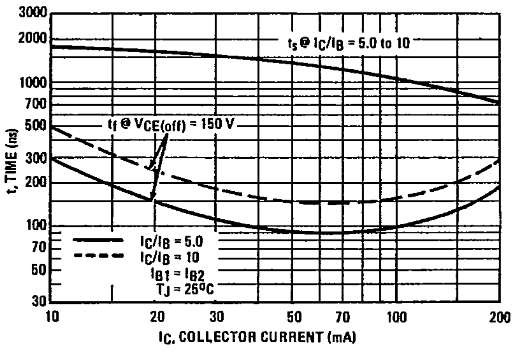


FIGURE 3 — TURN-OFF TIME





T-29-23

FIGURE 4 — CURRENT-GAIN — BANDWIDTH PRODUCT

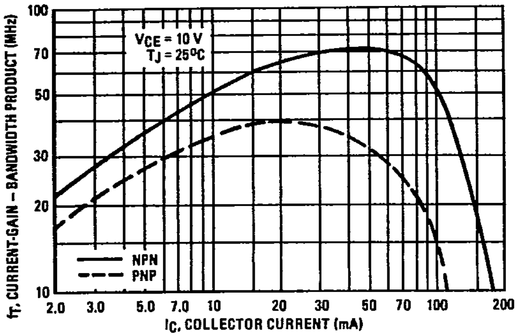


FIGURE 5 — CAPACITANCE

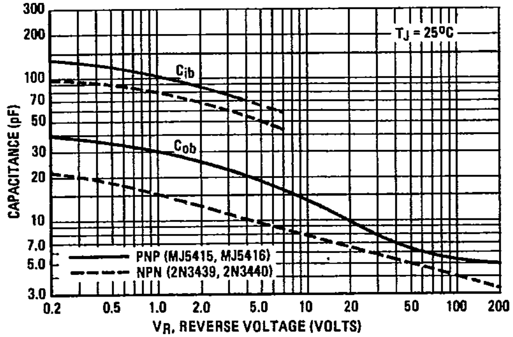


FIGURE 6 — THERMAL RESPONSE

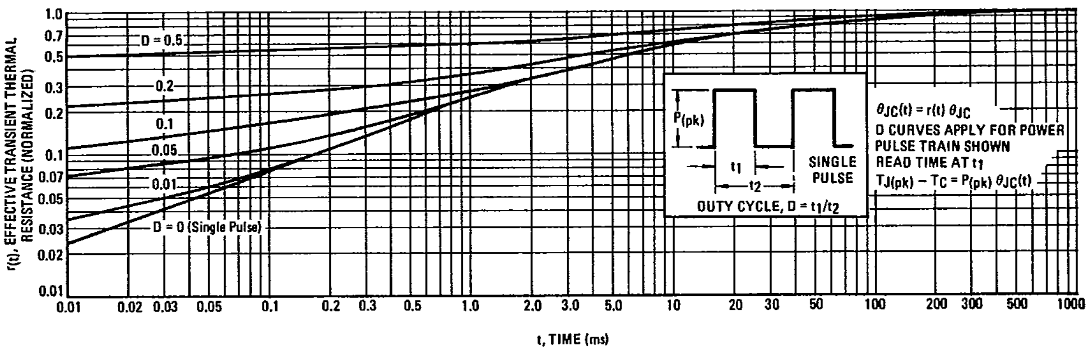
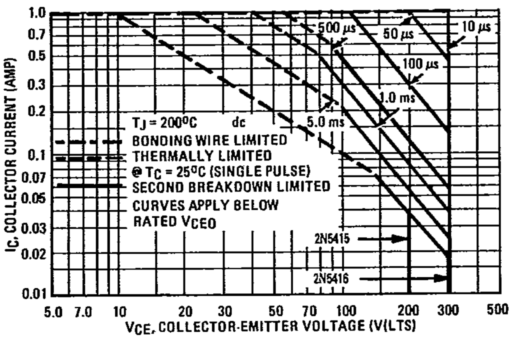
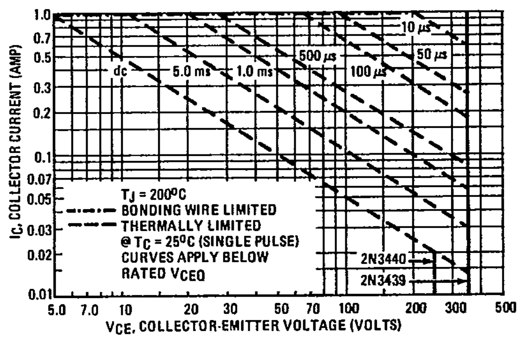


FIGURE 7 — ACTIVE-REGION SAFE OPERATING AREA

PNP — 2N5415, 2N5416

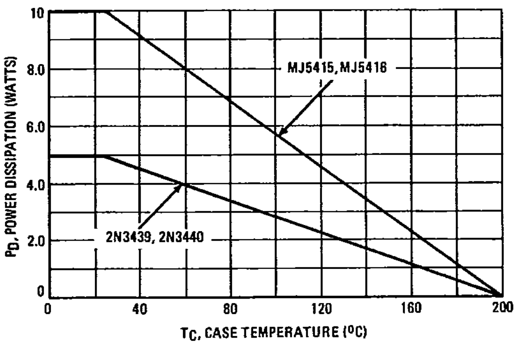


NPN — 2N3439, 2N3440



T-29-23

FIGURE 8 — POWER DERATING



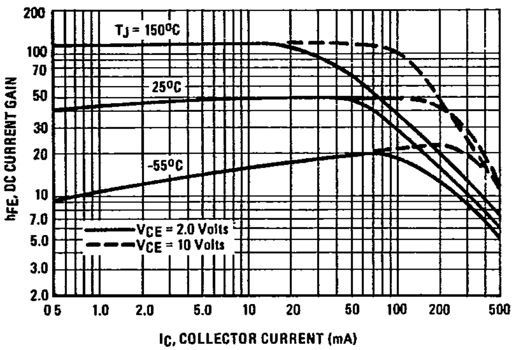
There are two limitations on the power handling ability of a transistor, average junction temperature and second breakdown. Safe operating area curves indicate I_C-V_{CE} limits of the transistor that must be observed for reliable operation; i.e., the transistor must not be subjected to greater dissipation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

The data of Figure 7 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 $T_{J(pk)} \leq 200°C$. $T_{J(pk)}$ may be calculated from the data in Figure 6. 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).

3

FIGURE 9 — DC CURRENT GAIN

PNP 2N5415, 2N5416



NPN 2N3439 2N3440

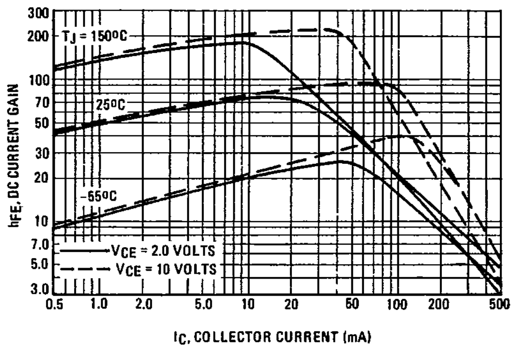
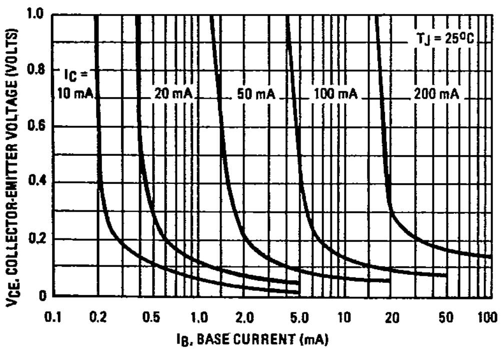
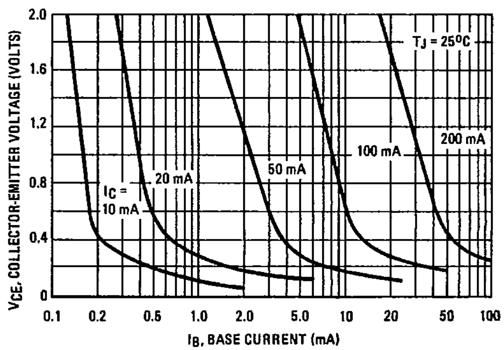


FIGURE 10 — COLLECTOR SATURATION REGION





T-29-23

FIGURE 11 — "ON" VOLTAGES

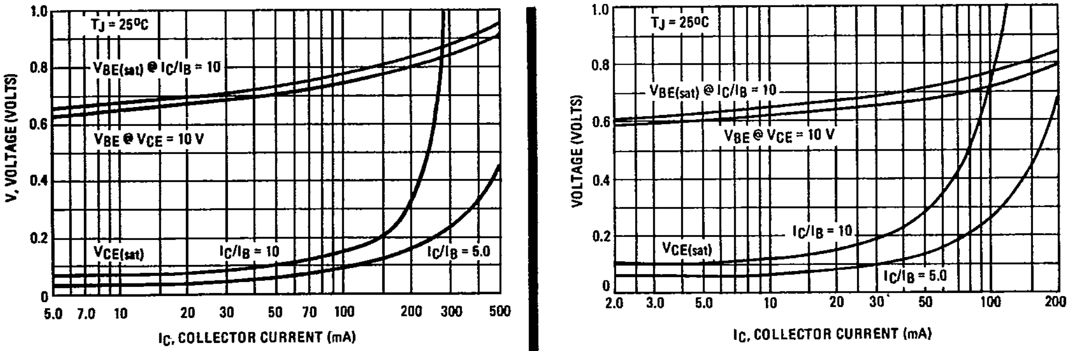


FIGURE 12 — TEMPERATURE COEFFICIENTS

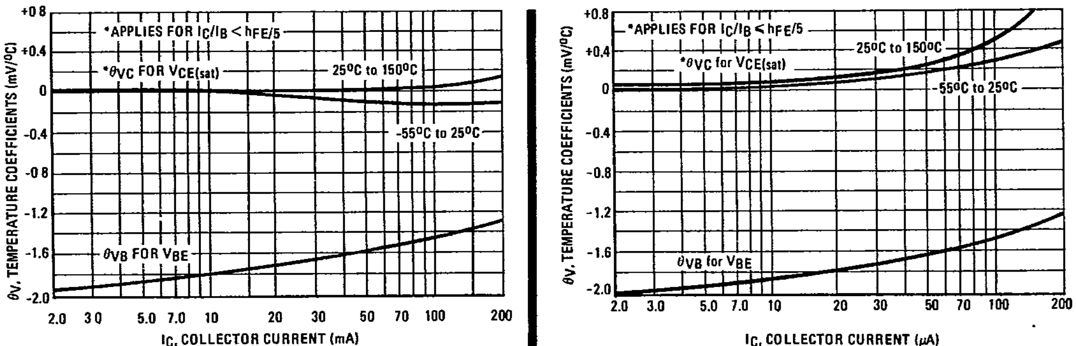
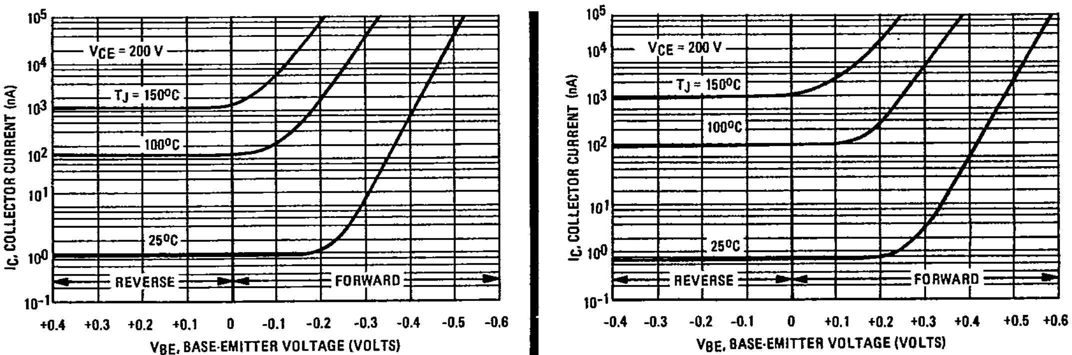
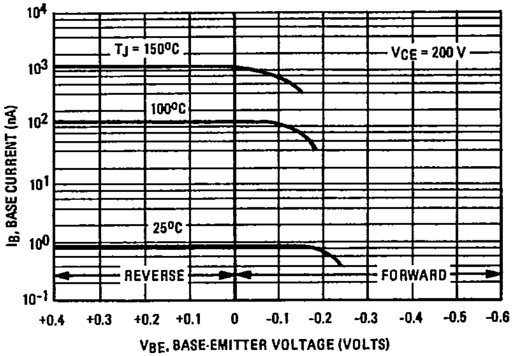


FIGURE 13 — COLLECTOR CUTOFF REGION



T-29-23

FIGURE 14 — BASE CUTOFF REGION



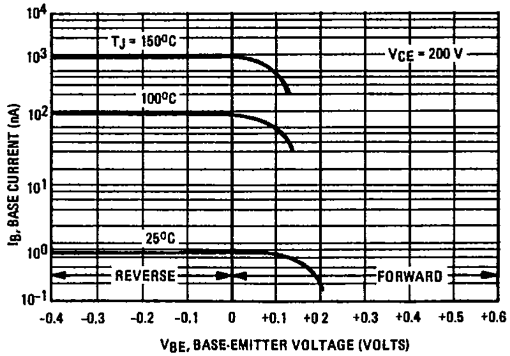


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FIGURE 15 — CIRCUIT USED TO MEASURE SUSTAINING VOLTAGES