

MAXIMUM RATINGS

Rating	Symbol	PNP		NPN		Unit
		2N5415	2N5416	2N3439	2N3440	
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		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 _{θJC}	17.5	35	°C/W
Thermal Resistance, Junction to Ambient	R _{θJA}	150	175	°C/W

NPN
2N3439
2N3440

PNP
2N5415
2N5416

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

HIGH VOLTAGE AMPLIFIERS

T-29-23

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

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector-Emitter Sustaining Voltage(1) (I _C = 50 mA, I _B = 0)	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)	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)	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)	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)	I _{EBO}	— —	20 20	μAdc
ON CHARACTERISTICS(1)				
DC Current Gain (I _C = 2.0 mA, V _{CE} = 10 Vdc) *(I _C = 20 mA, V _{CE} = 10 Vdc) *(I _C = 50 mA, V _{CE} = 10 Vdc)	h _{FE}	30 40 30 30	— 160 150 120	—
Collector-Emitter Saturation Voltage (I _C = 50 mA, I _B = 4.0 mA)	V _{CE(sat)}	—	0.5	Vdc
Base-Emitter Saturation Voltage (I _C = 50 mA, I _B = 4.0 mA)	V _{BE(sat)}	—	1.3	Vdc

*Indicates Data in Addition to JEDEC Requirements.

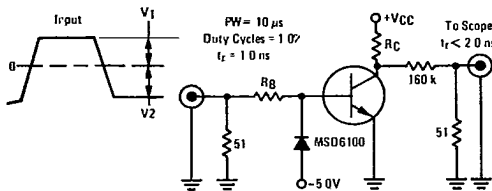
ELECTRICAL CHARACTERISTICS (continued) ($T_A = 25^\circ\text{C}$ unless otherwise noted.)

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

(1) Pulse Test: Pulse Width $\leq 300\ \mu\text{s}$, Duty Cycle $\leq 2.0\%$.

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

For t_d and t_r , D1 is disconnected and $V_2 = 2.0\text{ V}$

For PNP test circuit, reverse all polarities.

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PNP
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FIGURE 2 — TURN-ON TIME

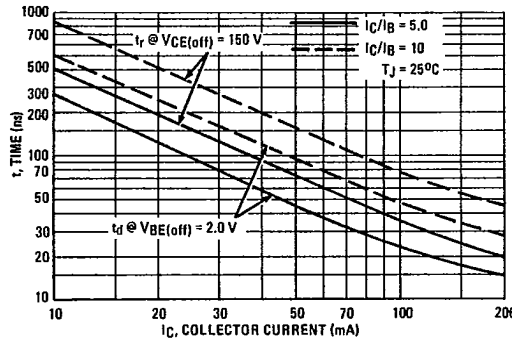
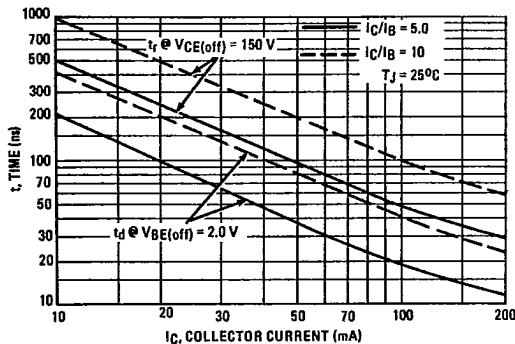


FIGURE 3 — TURN-OFF TIME

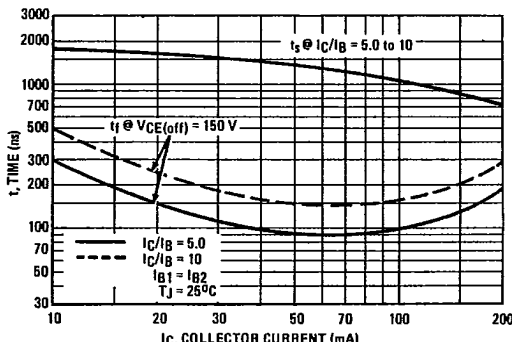
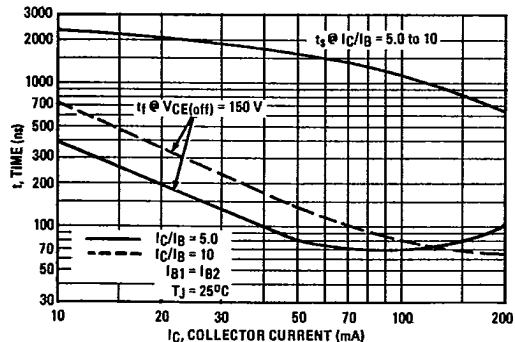


FIGURE 4 — CURRENT-GAIN — BANDWIDTH PRODUCT

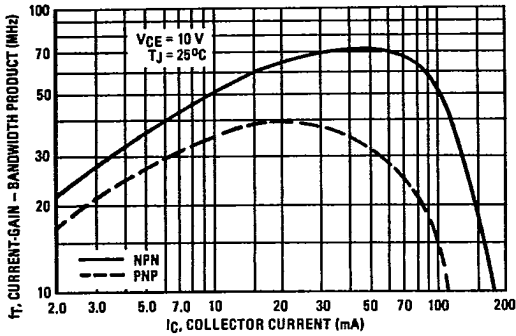


FIGURE 5 — CAPACITANCE

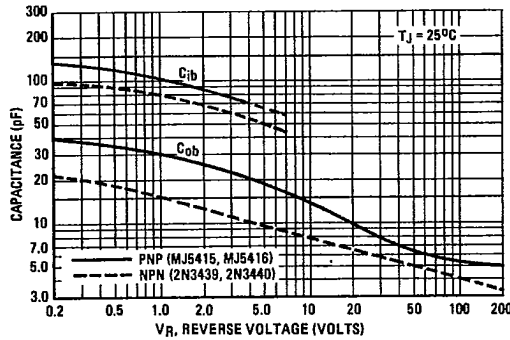
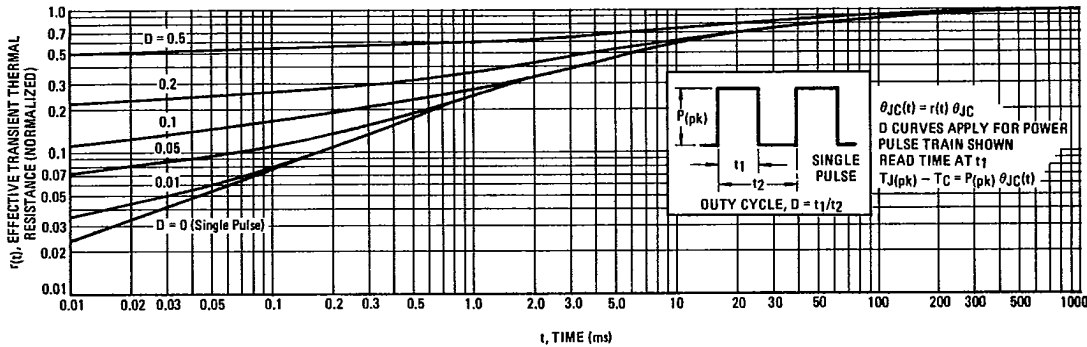


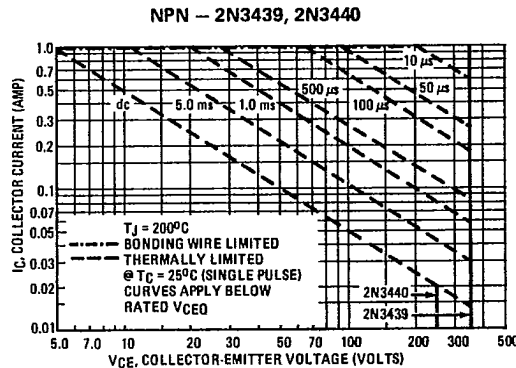
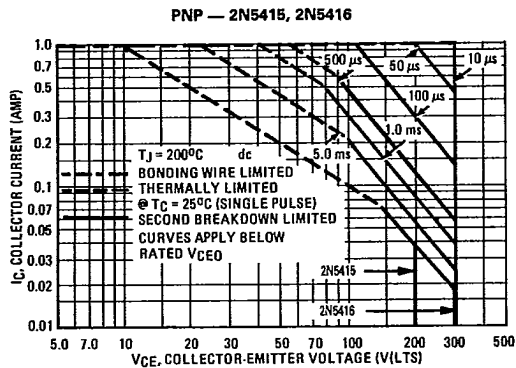
FIGURE 6 — THERMAL RESPONSE



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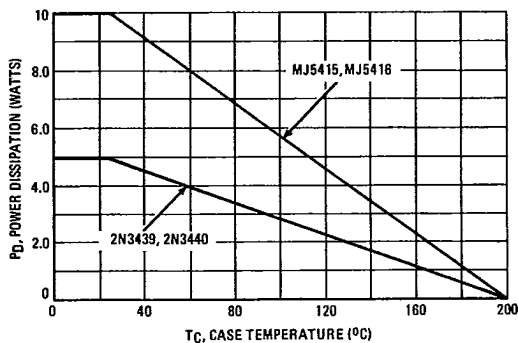
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FIGURE 7 — ACTIVE-REGION SAFE OPERATING AREA



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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 $T_{J(pk)} = 200^\circ\text{C}$; T_C is variable depending on conditions. Second breakdown pulse limits are valid for duty cycles to 10% provided $T_{J(pk)} \leq 200^\circ\text{C}$. $T_{J(pk)}$ 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).

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2N3439 2N3440

FIGURE 9 — DC CURRENT GAIN

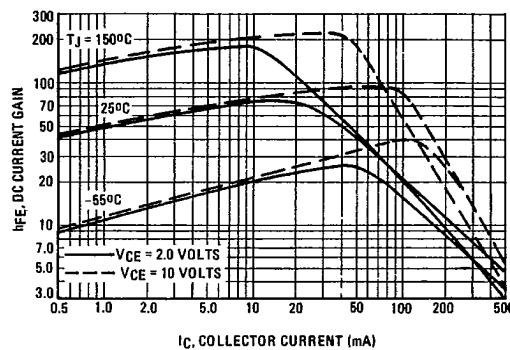
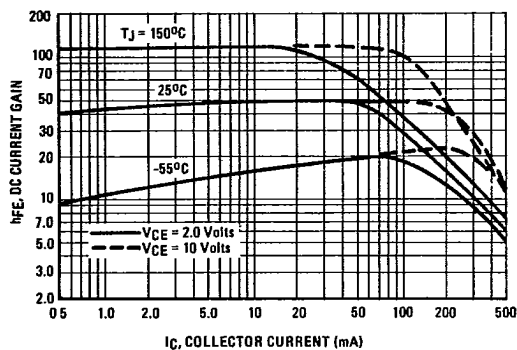
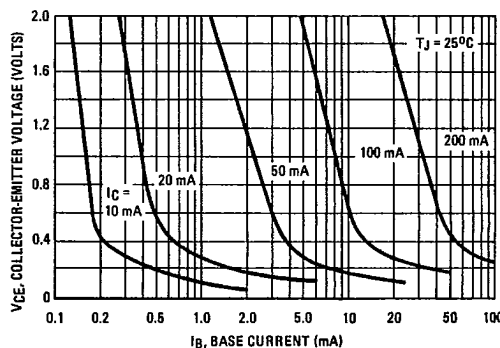
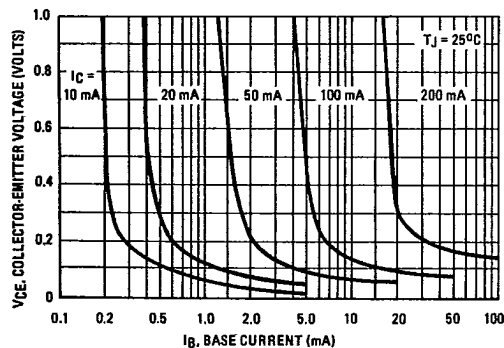
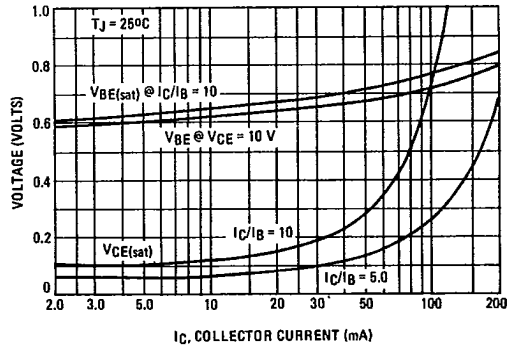
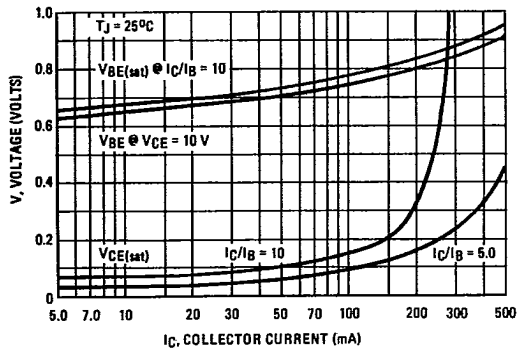


FIGURE 10 — COLLECTOR SATURATION REGION



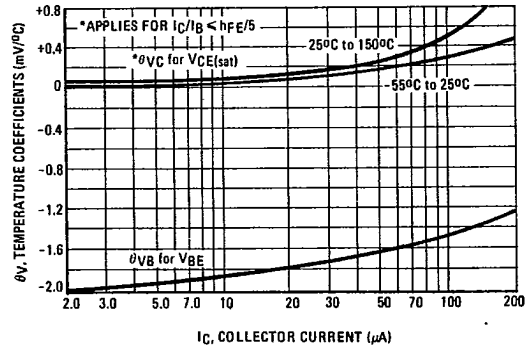
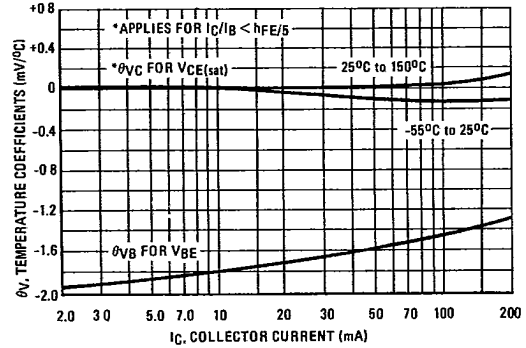
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FIGURE 11 — "ON" VOLTAGES



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FIGURE 12 — TEMPERATURE COEFFICIENTS



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FIGURE 13 — COLLECTOR CUTOFF REGION

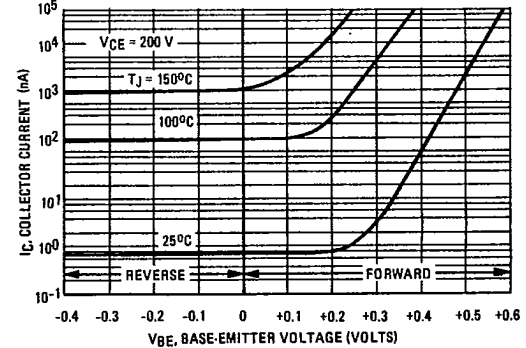
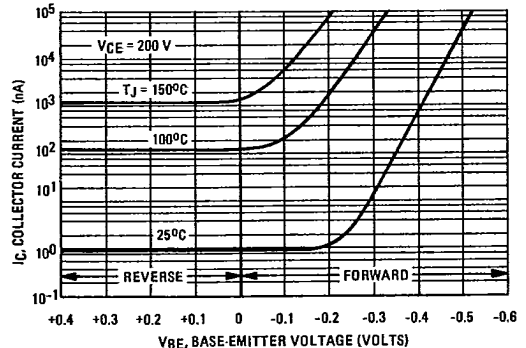


FIGURE 14 — BASE CUTOFF REGION

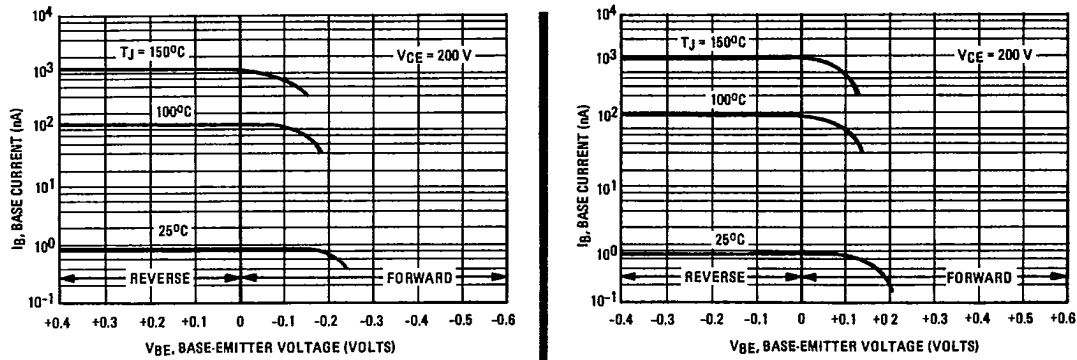


FIGURE 15 — CIRCUIT USED TO MEASURE SUSTAINING VOLTAGES

