

TABLE 1 — METAL TO-204, TO-204AE (continued)

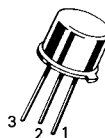
I _C Cont Amps Max	V _{CEO} (sus) Volts Min	Device Type		h _{FE} Min/Max	@ I _C Amp	Resistive Switching			f _T MHz Min	P _D (Case) Watts @ 25°C
		NPN	PNP			t _s μs Max	t _f μs Max	@ I _C Amp		
50	200	BUS51•		15 min	50					350
	400	MJ10015•##		10 min	40	2.5	1	20		250
	500	BUT34•## MJ10016•##		15 min 10 min	32 40	3 2.5	1.5 1	32 20		250 250
56	400	BUT33•##		20 min	36	3.3	1.6	36		250
60	60	MJ14000•	MJ14001•	15/100	50					300
	80	MJ14002•	MJ14003•	15/100	50					300
	200	MJ10020•##		75 min	15	3.5	0.5	30		250
	250	MJ10021•##		75 min	15	3.5	0.5	30		250
70	125	BUS50•		15 min	50					350

• Modified TO-3, 60 mil pins, # h_{FE} @ 1 MHz, ## Darlington

TABLE 2 — METAL TO-205 (Formerly TO-39)



STYLE 1:
PIN 1. EMITTER
2. BASE
3. COLLECTOR
(Pin 3 connected to case)



2

CASE 79-04 (TO-205AD)

I _C Cont Amps Max	V _{CEO} (sus) Volts Min	Device Type		h _{FE} Min/Max	@ I _C Amp	Resistive Switching			f _T MHz Min	P _D (Case) Watts @ 25°C
		NPN	PNP			t _s μs Max	t _f μs Max	@ I _C Amp		
0.5	300		MJ4646	20 min	0.5	0.72*		0.05	40	5
	400		MJ4647	20 min	0.5	0.72*		0.05	30	5
3	40		2N3719 2N3867	25/180 40/200	1 1.5	0.4* 0.4*		1 1.5	60 60	6 6
		60	2N3720 2N3868	25/180 30/150	1 1.5	0.4* 0.4*		1 1.5	60 60	6 6
	80		2N6303	30/150	1.5	0.4*		1.5	60	6
		60	2N4877		20/100	4	1.5	0.5	4	4
5	80	2N5336	2N6190	30/120	2	2	0.2	2	30	6
		2N5337	2N6191	60/240	2	2	0.2	2	30	6
	100	2N5338		30/120	2	2	0.2	2	30	10
		2N5339	2N6193	60/240	2	2	0.2	2	30	6

JAN, JTX, JTXV Available

*t_{off}

TABLE 12 — POWER DARLINGTONS (continued)

I _C Cont Amps Max	V _{CEO(sus)} Volts Min	Device Type		h _{FE} Min/Max	@ I _C Amp	Resistive Switching			h _{f_e} @ 1 MHz Min	P _D (Case) Watts @ 25°C	Case JEDEC/MOT
		NPN	PNP			t _s μs Max	t _f μs Max	@ I _C Amp			
		50	90			MJ11030	MJ11031	400 min			
	120	MJ11032	MJ11033	400 min	50					300	TO-204/197
	400	MJ10015*		10 min	40	2.5	0.5	20	10	250	TO-204/197
	500	BUT34*		15 min	32	3	1.5	32		250	TO-204/197
		MJ10016*		10 min	40	2.5	0.5	20	10	250	TO-204/197
56	400	BUT33*		20 min	36	3.3	1.6	36		250	TO-204/197
60	200	MJ10020*		75/1k min	15	3.5	0.5	30		250	TO-204/197
	250	MJ10021*		75/1k min	15	3.5	0.5	30		250	TO-204/197

* Darlington with speed-up diode.

TABLE 13 — POWER SWITCHING TRANSISTORS

V_{CEO} < 200 V

I _C Cont Amps Max	V _{CEO(sus)} Volts Min	Device Type		h _{FE} Min/Max	@ I _C Amp	Resistive Switching			t _f MHz Min	P _D (Case) Watts @ 25°C	Case JEDEC/MOT
		NPN	PNP			t _s μs Max	t _f μs Max	@ I _C Amp			
0.8	40	MPS-U02	MPS-U52	30 min	0.5				150	10	—/152
1	120	MPS-U03		40 min	0.1				100	10	—/152
	180	MPS-U04		40 min	0.1				100	10	—/152
2	30	MPS-U01	MPS-U51	50 min	1				50	10	—/152
	40	MPS-U01A	MPS-U51A	50 min	1				50	10	—/152
		MPS-U45#	MPS-U95#	4k min	1				100	10	—/152
	60	MPS-U05	MPS-U55	60 min	0.25				50	10	—/152
	80	MPS-U06	MPS-U56	60 min	0.25				50	10	—/152
3	40		2N3719	25/180	2	0.4*		1	60	6	TO-205AA/31
			2N3867	40/200	2	0.4*		1	60	6	TO-205AA/31
	60		2N3720	25/180	2	0.4*		1	60	6	TO-205AA/31
			2N3868	30/150	2	0.4*		1	60	6	TO-205AA/31
	80		2N6303	30/150	2	0.4*		1	60	6	TO-205AA/31

Darlington

* t_{off} @ 1 MHz

(continued)

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

2N3719, 2N3720
2N3867, 2N3868
2N6303

SILICON PNP POWER TRANSISTORS

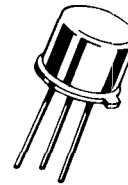
... designed for high-speed, medium-current switching and high-frequency amplifier applications.

- Collector-Emitter Sustaining Voltage –
 $V_{CE(sus)}$ = 40 Vdc (Min) – 2N3719, 2N3867
 = 60 Vdc (Min) – 2N3720, 2N3868
 = 80 Vdc (Min) – 2N6303
- DC Current Gain –
 h_{FE} = 25-180 @ $I_C = 1.0$ Adc – 2N3719, 2N3720
 = 40-200 @ $I_C = 1.5$ Adc – 2N3867
 = 30-150 @ $I_C = 1.5$ Adc – 2N3868, 2N6303
- Low Collector-Emitter Saturation Voltage –
 $V_{CE(sat)}$ = 0.75 Vdc @ $I_C = 1.0$ Adc – 2N3719, 2N3720
 = 0.75 Vdc @ $I_C = 1.5$ Adc – 2N3867, 2N3868, 2N6303
- High Current-Gain – Bandwidth Product –
 $f_T = 90$ MHz (Typ)
- 2N3867 JAN and 2N3868 JAN also Available

3 AMPERE

POWER TRANSISTORS
PNP SILICON

40, 60, 80 VOLTS
6 WATTS



***MAXIMUM RATINGS**

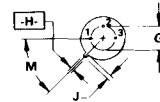
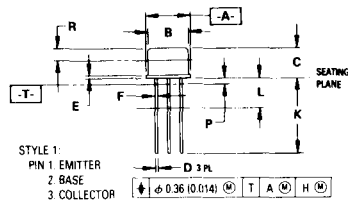
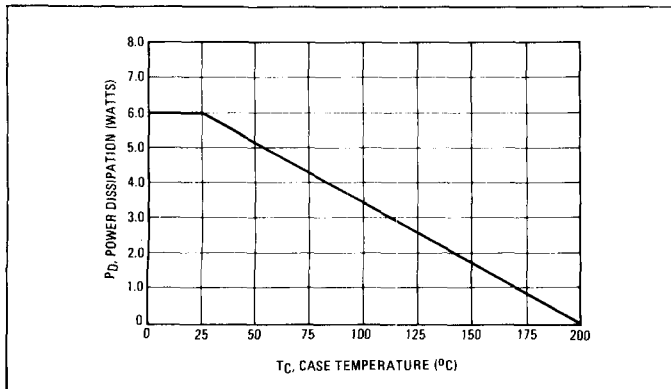
Rating	Symbol	2N3719 2N3867	2N3720 2N3868	2N6303	Unit
Collector-Emitter Voltage	V_{CEO}	40	60	80	Vdc
Collector-Base Voltage	V_{CB}	40	60	80	Vdc
Emitter-Base Voltage	V_{EB}	4.0			Vdc
Collector Current – Continuous	I_C	3.0			Adc
Collector Current – Peak		10			Adc
Base Current	I_B	0.5			Adc
Total Device Dissipation @ $T_C = 25^\circ\text{C}$	P_D	6.0			Watts
Derate above 25°C		34.3			mW/ $^\circ\text{C}$
Total Device Dissipation @ $T_A = 25^\circ\text{C}$	P_D	1.0			Watt
Derate above 25°C		5.71			mW/ $^\circ\text{C}$
Operating and Storage Junction Temperature Range	T_J, T_{stg}	65 to +200			$^\circ\text{C}$

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	θ_{JC}	29	$^\circ\text{C/W}$
Thermal Resistance, Junction to Ambient	θ_{JA}	175	$^\circ\text{C/W}$

*Indicates JEDEC Registered Data

FIGURE 1 – POWER DERATING



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	8.51	9.39	0.335	0.370
B	7.75	8.50	0.305	0.335
C	6.10	6.60	0.240	0.260
D	0.41	0.53	0.016	0.021
E	0.23	1.04	0.009	0.041
F	0.41	0.48	0.016	0.019
G	5.08 BSC		0.200 BSC	
H	0.72	0.86	0.028	0.034
J	0.74	1.14	0.029	0.045
K	12.70	19.05	0.500	0.750
L	6.35	—	0.250	—
M	45° BSC		45° BSC	
P	—	1.27	—	0.050
R	2.54	—	0.100	—

CASE 79-04
TO-205AD
(TO-33)

2N3719, 2N3720, 2N3867, 2N3868, 2N6303

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

Characteristic	Symbol	Min	Max	Unit	
OFF CHARACTERISTICS					
Collector-Emitter Sustaining Voltage (1) (I _C = 20 mA _{dc} , I _B = 0)	V _{CEO(sus)}	40 60 80	— — —	V _{dc}	
Collector-Base Breakdown Voltage (I _C = 100 μA _{dc} , I _E = 0)	V _{(BR)CBO}	40 60 80	— — —	V _{dc}	
Emitter-Base Breakdown Voltage (I _E = 100 μA _{dc} , I _C = 0)	V _{(BR)EBO}	4.0	—	V _{dc}	
Collector Cutoff Current (V _{CE} = Rated V _{CB} , V _{BE(off)} = 2.0 V _{dc})	I _{CEx}	—	1.0	μA _{dc}	
Collector Cutoff Current (V _{CB} = Rated V _{CB} , I _E = 0, T _C = 150°C)	I _{CBO}	—	150	μA _{dc}	
ON CHARACTERISTICS (1)					
DC Current Gain (I _C = 500 mA _{dc} , V _{CE} = 1.0 V _{dc})	h _{FE}	50	—	—	
(I _C = 1.5 A _{dc} , V _{CE} = 2.0 V _{dc})		35	—		
(I _C = 2.5 A _{dc} , V _{CE} = 3.0 V _{dc})		40	200		
(I _C = 3.0 A _{dc} , V _{CE} = 5.0 V _{dc})		30	150		
		25	—		
		20	—		
Collector-Emitter Saturation Voltage (I _C = 500 mA _{dc} , I _B = 50 mA _{dc})	V _{CE(sat)}	—	0.5	V _{dc}	
(I _C = 1.5 A _{dc} , I _B = 150 mA _{dc})		—	0.75		
(I _C = 2.5 A _{dc} , I _B = 250 mA _{dc})		—	1.3		
Base-Emitter Saturation Voltage (I _C = 500 mA _{dc} , I _B = 50 mA _{dc})	V _{BE(sat)}	—	1.0	V _{dc}	
(I _C = 1.5 A _{dc} , I _B = 150 mA _{dc})		0.9	1.4		
(I _C = 2.5 A _{dc} , I _B = 250 mA _{dc})		—	2.0		
DYNAMIC CHARACTERISTICS					
Current-Gain ~ Bandwidth Product (2) (I _C = 100 mA _{dc} , V _{CE} = 5.0 V _{dc} , f _{test} = 20 MHz)	f _T	60	—	MHz	
Output Capacitance (V _{CB} = 10 V _{dc} , I _E = 0, f = 0.1 MHz)	C _{ob}	—	120	pF	
Input Capacitance (V _{EB} = 3.0 V _{dc} , I _C = 0, f = 0.1 MHz)	C _{ib}	—	1000	pF	
SWITCHING CHARACTERISTICS					
Delay Time	(V _{CC} = 30 V _{dc} , V _{BE(off)} = 0, I _C = 1.5 A _{dc} , I _{B1} = 150 mA _{dc})	t _d	—	35	ns
Rise Time		t _r	—	65	ns
Storage Time	(V _{CC} = 30 V _{dc} , I _C = 1.5 A _{dc} , I _{B1} = I _{B2} = 150 mA _{dc})	t _s	—	325	ns
Fall Time		t _f	—	75	ns

* Indicates JEDEC Registered Data

(1) Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%.

(2) f_T = |h_{fe}| • f_{test}.

3

FIGURE 4 – THERMAL RESISTANCE

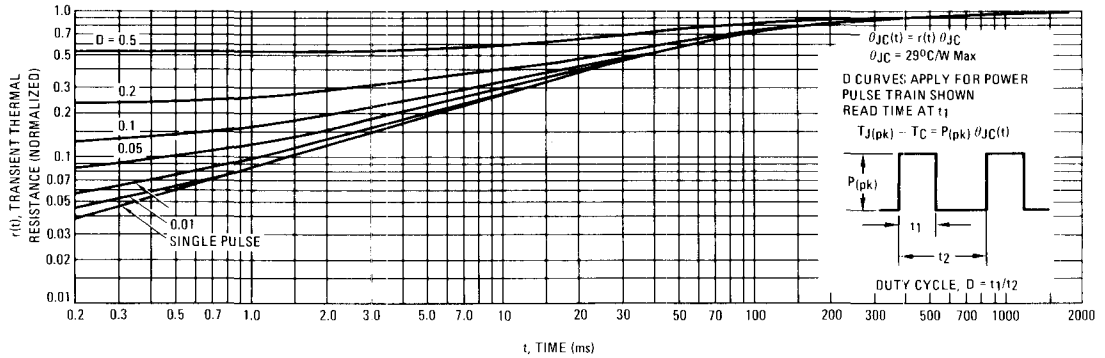
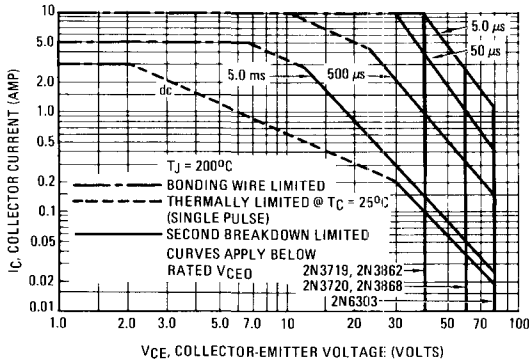


FIGURE 5 – ACTIVE REGION SAFE OPERATING AREA



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

FIGURE 6 – TURN-OFF TIME

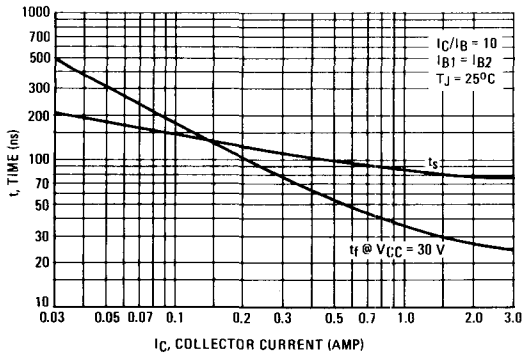


FIGURE 7 – CAPACITANCE

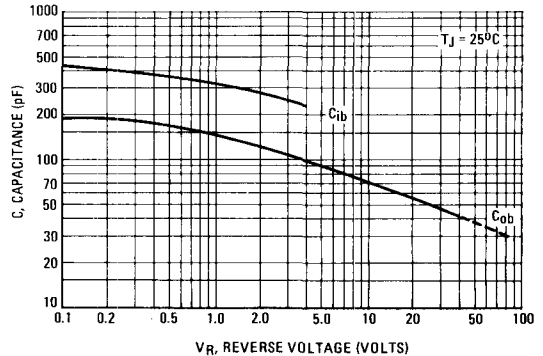


FIGURE 8 – DC CURRENT GAIN

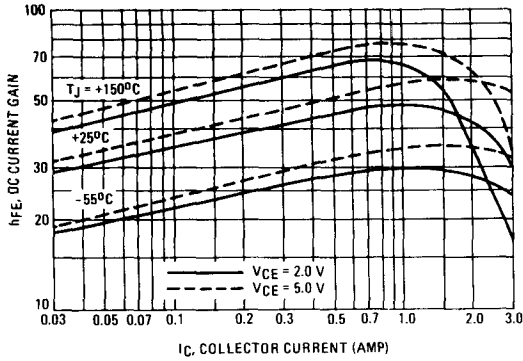


FIGURE 9 – COLLECTOR SATURATION REGION

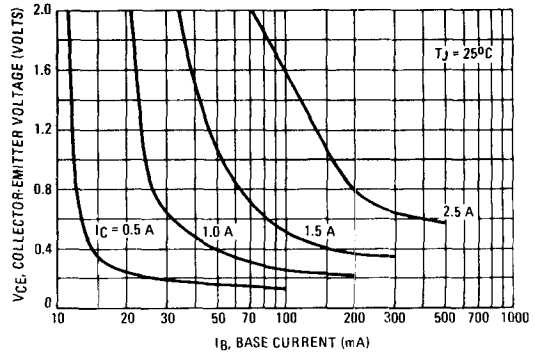


FIGURE 10 – "ON" VOLTAGES

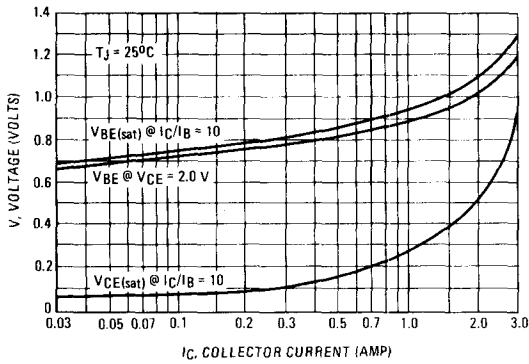


FIGURE 11 – TEMPERATURE COEFFICIENTS

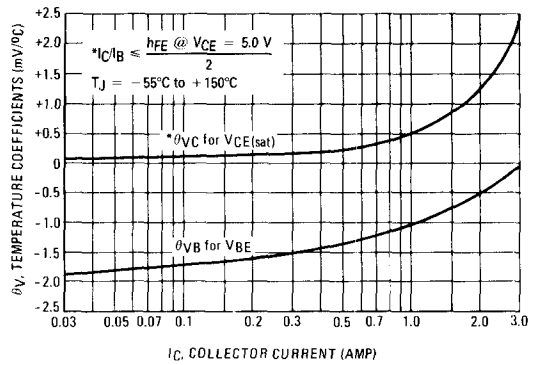


FIGURE 12 – COLLECTOR CUT-OFF REGION

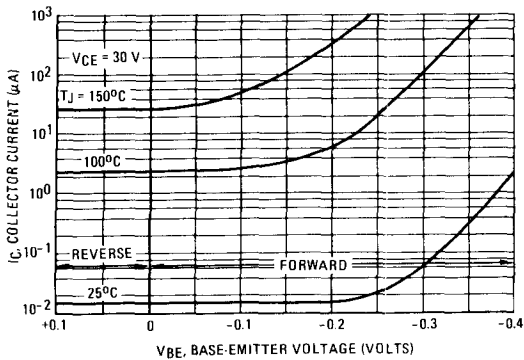


FIGURE 13 – BASE CUT-OFF REGION

