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*Consult Motorola if a direct replacement is necessary.

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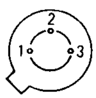
TABLE 1 — METAL TO-204, TO-204AE (continued)

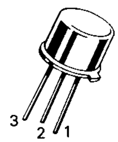
I_CCont Amps Max	$V_{CEO(sus)}$ Volts Min	Device Type NPN	Device Type PNP	h_{FE} Min/Max	@ I_C Amp	Resistive Switching t_s μs Max	Resistive Switching t_f μs Max	Resistive Switching @ I_C Amp	f_T MHz Min	P_D (Case) Watts @ 25°C
50	200	BUS51•		15 min	50					350
	400	MJ10015•##		10 min	40	2.5	1	20		250
	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)



CASE 79-04 (TO-205AD)

I_CCont Amps Max	$V_{CEO(sus)}$ Volts Min	*Device Type* NPN	*Device Type* PNP	h_{FE} Min/Max	@ I_C Amp	Resistive Switching t_s μs Max	Resistive Switching t_f μs Max	Resistive Switching @ I_C Amp	f_T MHz Min	P_D (Case) Watts @ 25°C
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
4	60	2N4877		20/100	4	1.5	0.5	4	4	10
5	80	2N5336 2N5337	2N6190 2N6191	30/120 60/240	2 2	2 2	0.2 0.2	2 2	30 30	6 6
	100	2N5338 2N5339	 2N6193	30/120 60/240	2 2	2 2	0.2 0.2	2 2	30 30	10 6

*t_{off}

(shaded) JAN, JTX, JTXV Available

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			$\|h_{fe}\|$ @ 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	50					300	TO-204/197
	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• MJ10016•		15 min 10 min	32 40	3 2.5	1.5 0.5	32 20	 10	250 250	TO-204/197 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

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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	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-U45#	MPS-U51A MPS-U95#	50 min 4k min	1 1				50 100	10 10	—/152 —/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
	100	MPS-U07	MPS-U57	60 min	0.25				50	10	—/152
3	40		2N3719 2N3867	25/180 40/200	2 2	0.4* 0.4*		1 1	60 60	6 6	TO-205AA/31 TO-205AA/31
	60		2N3720 2N3868	25/180 30/150	2 2	0.4* 0.4*		1 1	60 60	6 6	TO-205AA/31 TO-205AA/31
	80		2N6303	30/150	2	0.4*		1	60	6	TO-205AA/31

Darlington * t_{off} @ 1 MHz

(continued)

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

SILICON PNP POWER TRANSISTORS

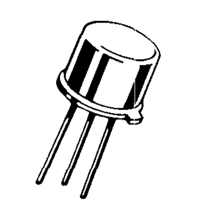
. . . designed for high-speed, medium-current switching and high-frequency amplifier applications.

- Collector-Emitter Sustaining Voltage –
  $V_{CEO(sus)}$ = 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

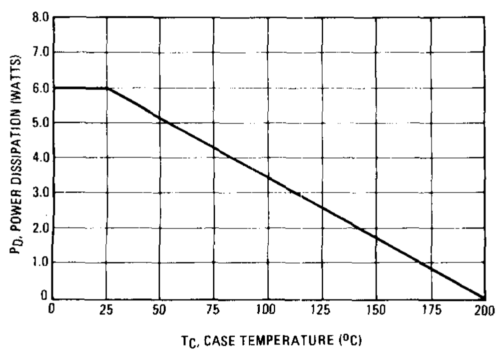
Rating	Symbol	2N3719 2N3867	2N3720 2N3868	2N6303	Unit
Collector-Emitter Voltage	V_{CEO}	40	60	80	Vdc
Collector-Base Voltage	V_{CB}	40	60	80	Vdc
Emitter-Base Voltage	V_{EB}	4.0			Vdc
Collector Current – Continuous Peak	I_C	3.0 10			Adc
Base Current	I_B	0.5			Adc
Total Device Dissipation @ T_C = 25°C Derate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

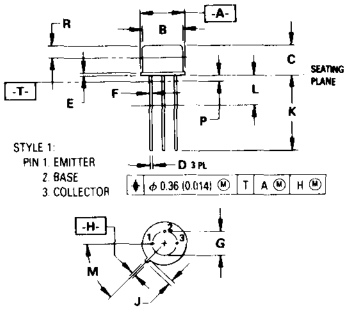
THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	θ_{JC}	29	°C/W
Thermal Resistance, Junction to Ambient	θ_{JA}	175	°C/W

*Indicates JEDEC Registered Data

FIGURE 1 – POWER DERATING





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

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES 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-39)

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

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Sustaining Voltage (1) (I_C = 20 mAdc, I_B = 0)	2N3867	$V_{CEO(sus)}$	40	–	Vdc
	2N3868		60	–	
	2N6303		80	–	
Collector-Base Breakdown Voltage (I_C = 100 μAdc, I_E = 0)	2N3867	$V_{(BR)CBO}$	40	–	Vdc
	2N3868		60	–	
	2N6303		80	–	
Emitter-Base Breakdown Voltage (I_E = 100 μAdc, I_C = 0)		$V_{(BR)EBO}$	4.0	–	Vdc
Collector Cutoff Current (V_{CE} = Rated V_{CB}, $V_{BE(off)}$ = 2.0 Vdc)		I_{CEX}	–	1.0	μAdc
Collector Cutoff Current (V_{CB} = Rated V_{CB}, I_E = 0, T_C = 150°C)		I_{CBO}	–	150	μAdc
ON CHARACTERISTICS (1)					
DC Current Gain (I_C = 500 mAdc, V_{CE} = 1.0 Vdc)	2N3867	h_{FE}	50	–	–
	2N3868, 2N6303		35	–	
(I_C = 1.5 Adc, V_{CE} = 2.0 Vdc)	2N3867		40	200	
	2N3868, 2N6303		30	150	
(I_C = 2.5 Adc, V_{CE} = 3.0 Vdc)	2N3867		25	–	
	2N3868, 2N6303		20	–	
(I_C = 3.0 Adc, V_{CE} = 5.0 Vdc)	2N3867		20	–	
	2N3868, 2N6303				
Collector-Emitter Saturation Voltage (I_C = 500 mAdc, I_B = 50 mAdc)		$V_{CE(sat)}$	–	0.5	Vdc
(I_C = 1.5 Adc, I_B = 150 mAdc)			–	0.75	
(I_C = 2.5 Adc, I_B = 250 mAdc)			–	1.3	
Base-Emitter Saturation Voltage (I_C = 500 mAdc, I_B = 50 mAdc)		$V_{BE(sat)}$	–	1.0	Vdc
(I_C = 1.5 Adc, I_B = 150 mAdc)			0.9	1.4	
(I_C = 2.5 Adc, I_B = 250 mAdc)			–	2.0	
DYNAMIC CHARACTERISTICS					
Current-Gain – Bandwidth Product (2) (I_C = 100 mAdc, V_{CE} = 5.0 Vdc, f_{test} = 20 MHz)		f_T	60	–	MHz
Output Capacitance (V_{CB} = 10 Vdc, I_E = 0, f = 0.1 MHz)		C_{ob}	–	120	pF
Input Capacitance (V_{EB} = 3.0 Vdc, I_C = 0, f = 0.1 MHz)		C_{ib}	–	1000	pF
SWITCHING CHARACTERISTICS					
Delay Time	(V_{CC} = 30 Vdc, $V_{BE(off)}$ = 0, I_C = 1.5 Adc, I_{B1} = 150 mAdc)	t_d	–	35	ns
Rise Time		t_r	–	65	ns
Storage Time	(V_{CC} = 30 Vdc, I_C = 1.5 Adc, I_{B1} = I_{B2} = 150 mAdc)	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) $f_T = |h_{fe}| \cdot f_{test}$.

3

FIGURE 4 – THERMAL RESISTANCE

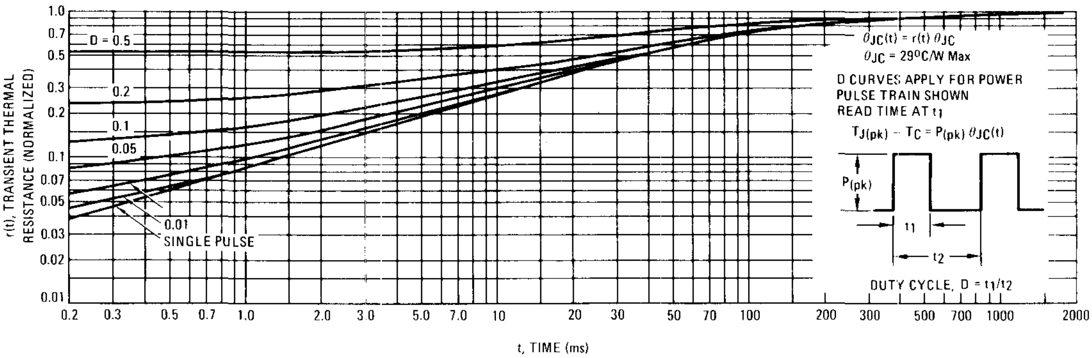
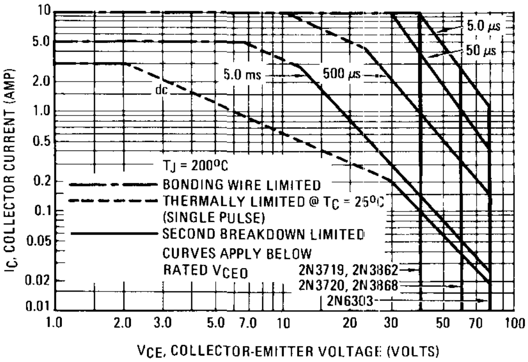


FIGURE 5 – ACTIVE REGION SAFE OPERATING AREA



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

3

FIGURE 6 – TURN-OFF TIME

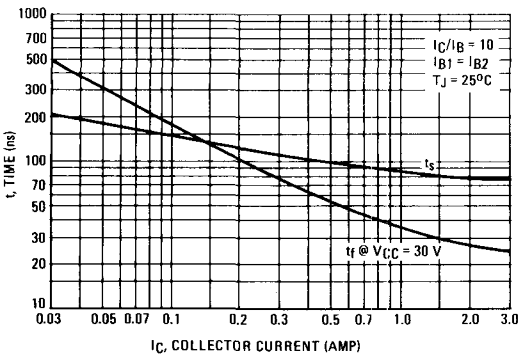


FIGURE 7 – CAPACITANCE

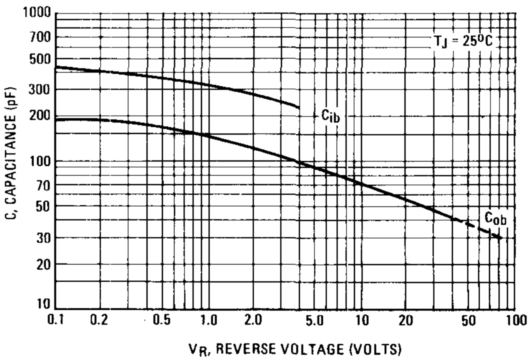


FIGURE 8 – DC CURRENT GAIN

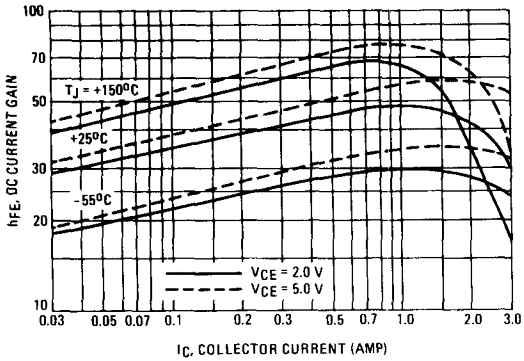


FIGURE 9 – COLLECTOR SATURATION REGION

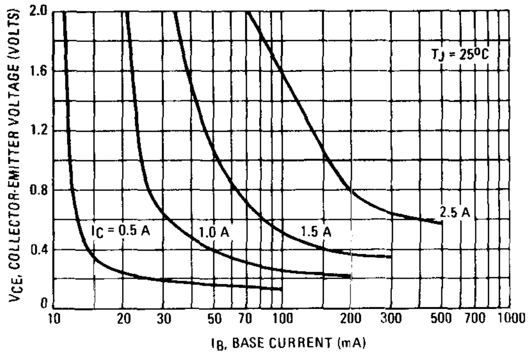


FIGURE 10 – "ON" VOLTAGES

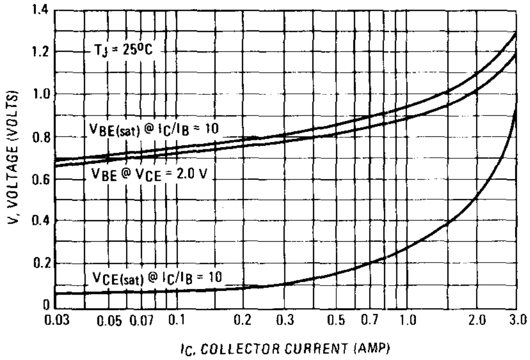


FIGURE 11 – TEMPERATURE COEFFICIENTS

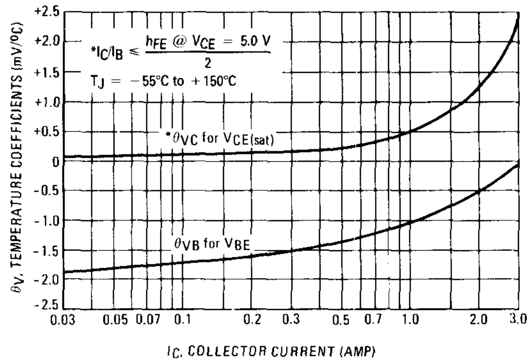


FIGURE 12 – COLLECTOR CUT-OFF REGION

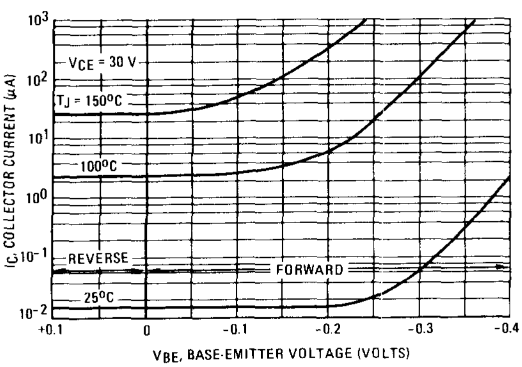
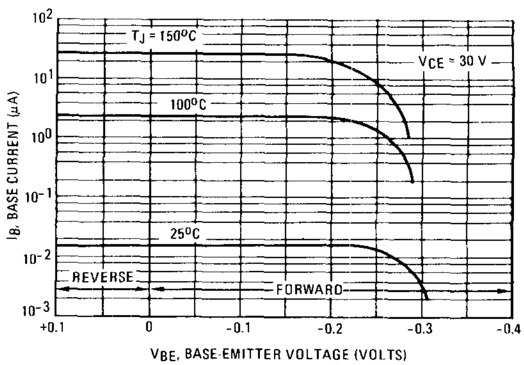


FIGURE 13 – BASE CUT-OFF REGION



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