ALPHANUMERIC INDEX — CROSS-REFERENCE (Continued)

Industry Part Number	Motorola Direct Replacement	Motorola Similar Replacement	Page Number
BU806	BU806		3-380
BU807	BU807		3-380
BUS11		MJE16002	3-976
BUS12	BUX47		3-499
BUS12A	BUX47A		3-499
BUS13	BUX48		3-506
BUS13A	BUX48A		3-506
BUS14	BUX98		—
BUS14A	BUX98A		—
BUS46P		MJE16002	3-976
BUS47	BUX47		3-499
BUS47A	BUX47A		3-499
BUS47AP	BUV47A		3-462
BUS47P	BUV47		3-462
BUS48	BUX48		3-506
BUS48A	BUX48A		3-506
BUS48AP	BUV48A		3-469
BUS48P	BUV48		3-469
BUS50	BUS50		3-382
BUS51	BUS51		3-384
BUS52		BUS51	3-384
BUS97	MJ16010		3-758
BUS97A	MJ16010A		3-766
BUS98	BUX98		—
BUS98A	BUX98A		—
BUT13	BUT13		3-393
BUT14	BUT14		3-399
BUT15	BUT15		3-405
BUT33	BUT33		3-411
BUT34	BUT34		3-417
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BUT50P	BUT50P		3-429
BUT51P	BUT51P		3-431
BUT90	BUS50		3-382
BUT91	BUS51		3-384
BUT92		BUS51	3-384
BUV10		BUV10N	3-432
BUV10N	BUV10N		3-432
BUV11	BUV11		3-435
BUV11N		BUV11	3-435
BUV12	BUV12		3-441
BUV18		BUS50	3-382
BUV19		BUS50	3-382
BUV20	BUV20		3-444
BUV21	BUV21		3-447
BUV21N		BUV21	3-447
BUV22	BUV22		3-453
BUV23	BUV23		3-456
BUV24		BUS98	3-386
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BUV44	BUX47		3-499
BUV45	BUX47A		3-499
BUV46	2N6543		3-215
BUV47	BUV47		3-462
BUV47A	BUV47A		3-462
BUV48	BUV48		3-469
BUV48A	BUV48A		3-469
BUW11	BUW11		3-476
BUW11A	BUW11A		3-476
BUW12	BUW12		3-476

Industry Part Number	Motorola Direct Replacement	Motorola Similar Replacement	Page Number
BUW12A	BUW12A		3-476
BUW13	BUV48P		3-469
BUW13A	BUV48A		3-469
BUW24	BU326A		3-363
BUW25	BU326A		3-363
BUW26	BUS326A		—
BUW34	BUX47		3-499
BUW35	BUX47		3-499
BUW36	BUX47A		3-499
BUW44	BUX48		3-506
BUW45	BUX48		3-506
BUW46	BUX48A		3-506
BUW72		MJE13008	3-950
BUW74	BUX47		3-499
BUW75	BUX47		3-499
BUW76	BUX47		3-499
BUW77	BUX47		3-499
BUW81	MJ10014		3-600
BUW81A	MJ10014		3-600
BUW84	MJE13003		3-938
BUW85	MJE13003		3-938
BUX13	BUX13		3-484
BUX14	BUX14		—
BUX14CECCF	BUX14		—
BUX14CECCL	BUX14		—
BUX15	BUX47A		3-499
BUX15CECCF	BUX47A		3-499
BUX15CECCL	BUX47A		3-499
BUX16	2N6543		3-215
BUX16A	2N6543		3-215
BUX16B	2N6543		3-215
BUX16C	2N6543		3-215
BUX17	BUX48		3-506
BUX17A	BUX48		3-506
BUX17B	BUX48		3-506
BUX17C	BUX48		3-506
BUX18	2N6545		3-221
BUX18A	2N6545		3-221
BUX18B	2N6545		3-221
BUX18C	2N6545		3-221
BUX39	BUX39		3-487
BUX40	BUX40		3-490
BUX41	BUX41		3-493
BUX41N		BUX41	3-493
BUX42		BUX13	3-484
BUX43		BUX13	3-484
BUX47	BUX47		3-499
BUX47A	BUX47A		3-499
BUX48	BUX48		3-506
BUX48A	BUX48A		3-506
BUX48S	BUX48		3-506
BUX66	2N6211		3-161
BUX66A	2N6212		3-161
BUX66B	2N6212		3-161
BUX66C	2N6213		3-161
BUX67	2N3584		3-20
BUX67A	2N3584		3-20
BUX67B	2N3585		3-20
BUX67C	2N4240		3-20
BUX81		MJ13335	3-700

*Consult Motorola if a direct replacement is necessary.

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

I_{C}Cont 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
25	60	2N5885	2N5883	20/100	10	1	0.8	10	4	200
	80	2N5886	2N5884 2N6436	20/100 30/120	10 10	1 1	0.8 0.25	10 10	4 40	200 200
	100	2N6338	2N6437	30/120	10	1	0.25	10	40	200
	120	2N6339	2N6438	30/120	10	1	0.25	10	40	200
	125	BUV10 BUV10N		10 min 10 min	20 20	1.2 1.55	0.25 0.45	20 15	8 10	150 175
	140	2N6340		30/120	10	1	0.25	10	40	200
	150	2N6341		30/120	10	1	0.25	10	40	200
	500	BUT14##		15 min	16	2.8	0.8	16		175
28	400	BUT13##		20 min	20	2.6	0.8	18		175
30	40	2N3771 2N5301	 2N4398	15/60 15/60	15 15	 2	 1	 10	2 2	150 200
	60	2N5302 MJ11012##	2N4399 MJ11011##	15/60 1k min	15 20	2	1	10	2 4#	200 200
	90	BUX39 MJ11014##	 MJ11013##	8 min 1k min	20 20	1	0.25	20	8 4#	120 200
	100	2N6328 MJ802	 MJ4502	6/30 25/100	30 7.5				3 2	200 200
	120	MJ11016##	MJ11015##	1k min	20				4#	200
	325	BUV23•		8 min	16	1.8	0.4	16	8	250
	400	BUS98• BUX98		8 min	20	2.3 3	0.4 0.8	20 20		250 250
	450	BUS98A• BUX98A MJ16020• MJ16022•		8 min 5 min 7 min	16 30 30	2.3 3 1.8 1.5	0.4 0.8 0.2 0.15	16 16 20 20		250 250 250 250
40	160	BUV21N•		10 min	40	1	0.2	40	8	250
	200	BUV21•		10 min	25	1.8	0.4	25	8	150
	250	BUS52• BUV22•		15 min 10 min	40 20	 1.1	 0.35	 20	 8	350 250
	350	MJ10022•##		50/600	120	2.5	0.9	20		250
	400	MJ10023•##		50/600	10	2.5	0.9	20		250
	700	BUT35•##		15 min	24	4	1.2	24		250
50	60	2N5685• MJ11028•##	2N5683• MJ11029•##	15/60 400 min	25 50	0.5 typ	0.3 typ	25	2	300 300
	80	2N5686•	2N5684• 2N6377•	15/60 30/120	25 20	0.5 typ 0.8	0.3 typ 0.25	25 20	2 30	300 250
	90	MJ11030•##	MJ11031•##	400 min	50					300
	100	2N6274•	2N6378•	30/120	20	0.8	0.25	20	30	250
	120	2N6275• MJ11032•##	2N6379• MJ11033•##	30/120 400 min	20 50	0.8	0.25	20	30	250 300
	125	BUV20•		10 min	50	1.2	0.25	50	8	250
	150	2N6277•		30/120	20	0.8	0.25	20	30	250

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

(continued)

☐ JAN, JTX, JTXV Available

TABLE 14 — SWITCHMODE POWER TRANSISTORS (continued)

$V_{CEO(sus)}$ Volts Min	I_C Cont Amps Max	V_{CEV} Volts Min	Device Type NPN unless otherwise noted	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	Case JEDEC/MOT
400	8	850	2N6545★	7/35	5	4	1	5	6		TO-204/1
		800	MJE5742#	200/400	4	8 typ	2 typ	6			TO-220/221A
		800	MJE16080	5 min	8	2	0.5	5		80	TO-220/221A
		850	BUW12	6 min	6	4	0.8	5		125	TO-218/340
		850	BUX84	30 min	0.1	3.5	1.4	1	4	50	TO-220/221A
		700	MJE13007★	6/30	5	3	0.7	5	4		TO-220/221A
		650	MJ13080★	8 min	5	1.5	0.5	5			TO-204/1
		650	MJE16106	6/25	8	2 typ	0.1 typ	5		100	TO-220/221A
		650	MJH16106	6/25	8	2 typ	0.1 typ	5		125	TO-218/340
		450	MJ6503-PNP★	15 min	2	2	0.5	4			TO-204/1
		450	MJE5852-PNP★	15 min	2	2	0.5	4			TO-220/221A
	6	900	BU326A	30 typ	0.6	3.5	1**	2.5	6	90	TO-204/1
		900	BU426A	30 typ	0.6	2 typ	0.5 typ	2.5	6 typ	113	TO-218/340D
	5	850	2N6543★	7/35	3	4	0.8	3	6		TO-204/1
		850	BUW11	6 min	3	4	0.8	3		125	TO-218/340
		650	MJ13070★	8 min	3	1.5	0.5	3			TO-204/1
		650	MJE13070★	8 min	3	1.5	0.5	3			TO-220/221A
	4	700	MJE13005★	6/30	3	3	0.7	3	4		TO-220/221A
	1.5	700	MJE13003★	5/25	1	4	0.7	1	5		TO-225AA/77R
	0.5	400	MJ4647-PNP	20 min	0.5	0.72*		0.05	40		TO-205AD/79
375	6	800	BU326	30 typ	0.6	3.5	1**	2.5	6	90	TO-204/1
		800	BU426	30 typ	0.6	2 typ	0.5 typ	2.5	6 typ	113	TO-218/340D
350	40	450	MJ10022##★	50/600	10	2.5	0.9	20			TO-204/197
	20	450	MJ10000#★	40/400	10	3	1.8	10	10**		TO-204/1
		450	MJ10004##★	40/400	10	1.5	0.5	10	10**		TO-204/1
	15	375	2N6251	6/50	10	3.5	1	10	2.5		TO-204/1
	10	450	MJ10002#★	30/300	5	2.5	1	5	10**		TO-204/1
		450	MJ10006##★	30/300	5	1.5	0.5	5	10**		TO-204/1
		400	MJ13014★	8/20	5	2	0.5	5			TO-204/1
	8	700	2N6308	12/60	3	1.6	0.4	5	5		TO-204/1
		700	MJE5741#	200/400	4	8 typ	2 typ	6			TO-220/221A
		400	MJE5851-PNP	15 min	2	2	0.5	4			TO-220/221A
	2	400	2N6213-PNP	10/100	1	2.5	0.6	1	4		TO-213AA/80
325	30	400	BUV23	8 min	16	1.8	0.4	16	8	250	TO-204/197
	15	400	BUX13	8 min	8	2.5	0.8	8	8	150	TO-204/1
	5	350	2N6235	25/125	1	3.5	0.5	1	20		TO-213AA/80
300	15	650	2N6546★	6/30	10	4	0.7	10	6 to 24		TO-204/1
	12	600	MJE13008★	6/30	8	3	0.7	8	4**		TO-220/221A
	8	600	2N6307	15/75	3	1.6	0.4	3	5		TO-204/1
		600	MJE13006★	6/30	5	3	0.7	5	4		TO-220/221A
		600	MJE5740	200/400	4	8 typ	2 typ	6			TO-220/221A
		350	MJE5850-PNP★	15 min	2	2	0.5	4			TO-220/221A
	5	400	2N6498	10/75	2.5	1.8	0.8	2.5	5		TO-220/221A
	4	600	MJE13004★	6/30	3	3	0.7	3	4		TO-220/221A
	2	500	2N3585	25/100	1	4	3	1	10		TO-213AA/80
		500	2N6422-PNP	25/100	1	4	3	1	10		TO-213AA/80
		350	2N6212-PNP	10/100	1	2.5	0.6	1	4		TO-213AA/80
	1.5	600	MJE13002★	5/25	1	4	0.7	1	5		TO-225AA/77R

★ Designers Data Sheet characterization
Darlington ## Darlington with speed-up diode * t_{off} ** $|h_{fe}|$ @ 1 MHz

(continued)

BUV23

SWITCHMODE▲ SERIES
NPN SILICON POWER TRANSISTOR

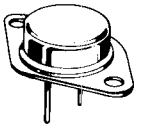
. . . designed for high current, high speed, high power applications.

- High DC current gain: HFE min. = 15 at Ic = 8 A
- Low $V_{CE(sat)}$, $V_{CE(sat)}$ max. = 0.8 V at Ic = 8 A
- Very fast switching times:
  T_F = 0.4 μs at Ic = 16 A

30 AMPERES

NPN SILICON POWER METAL TRANSISTOR

325 VOLTS
250 WATTS



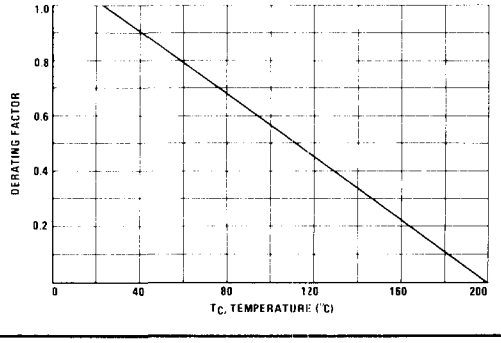
MAXIMUM RATINGS

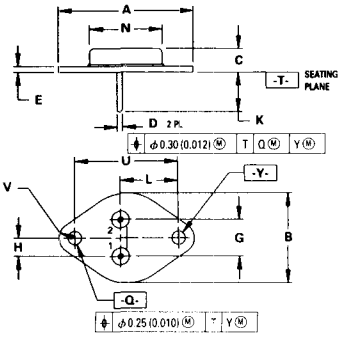
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	$V_{CEO(sus)}$	325	Vdc
Collector-Base Voltage	V_{CBO}	400	Vdc
Emitter-Base Voltage	V_{EBO}	7	Vdc
Collector-Emitter Voltage (V_{BE} = −1.5 V)	V_{CEX}	400	Vdc
Collector-Emitter Voltage (R_{BE} = 100Ω)	V_{CER}	390	Vdc
Collector-Current — continuous — peak (pw ≤ 10 ms)	I_C I_{CM}	30 40	Adc Apk
Base-Current continuous	I_B	6	Adc
Total Power Dissipation @ T_C = 25°C	P_D	250	Watts
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}	0.7	°C/W

FIGURE 1 - POWER DERATING





NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	38.86 REF		1.530 REF	
B	25.15	26.67	0.990	1.050
C	6.35	8.25	0.250	0.325
D	1.45	1.60	0.057	0.063
E	1.53	1.77	0.060	0.070
G	10.92 BSC		0.430 BSC	
H	5.46 BSC		0.215 BSC	
K	11.18	12.19	0.440	0.480
L	16.89 BSC		0.665 BSC	
N	19.31	21.08	0.760	0.830
Q	3.84	4.19	0.151	0.165
U	30.15 BSC		1.187 BSC	
V	3.33	4.77	0.131	0.188

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

CASE 197A-02
TO-204AE
(TO-3)

3

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

Characteristic	Symbol	Min.	Max.	Unit
OFF CHARACTERISTICS[1]				
Collector-Emitter Sustaining Voltage (I_C = 200 mA, I_B = 0, L = 25 mH)	$V_{CEO(sus)}$	325		Vdc
Collector Cutoff Current at Reverse Biais: (V_{CE} = 400 V, V_{BE} = −1.5 V) (V_{CE} = 400 V, V_{BE} = −1.5 V, T_C = 125°C)	I_{CEX}		3.0 12	mAdc
Collector-Emitter Cutoff Current (V_{CE} = 260 V)	I_{CEO}		3.0	mAdc
Emitter-Base Reverse Voltage (I_E = 50 mA)	V_{EBO}	7		V
Emitter-Cutoff Current (V_{EB} = 5 V)	I_{EBO}		1.0	mAdc
SECOND BREAKDOWN				
Second Breakdown Collector Current with base forward biased (V_{CE} = 20 V, t = 1 s) (V_{CE} = 140 V, t = 1 s)	$I_{S/b}$	12 0.15		Adc
ON CHARACTERISTICS[1]				
DC Current Gain (I_C = 8 A, V_{CE} = 4 V) (I_C = 16 A, V_{CE} = 4 V)	h_{FE}	15 8	60	
Collector-Emitter Saturation Voltage (I_C = 8 A, I_B = 1.6 A) (I_C = 16 A, I_B = 3.2 A)	$V_{CE(sat)}$		0.8 1.0	Vdc
Base-Emitter Saturation Voltage (I_C = 16 A, I_B = 3.2 A)	$V_{BE(sat)}$		1.5	Vdc
DYNAMIC CHARACTERISTICS				
Current Gain – Bandwidth Product (V_{CE} = 15 V, I_C = 2 A, f = 4 MHz)	f_T	8.0		MHz

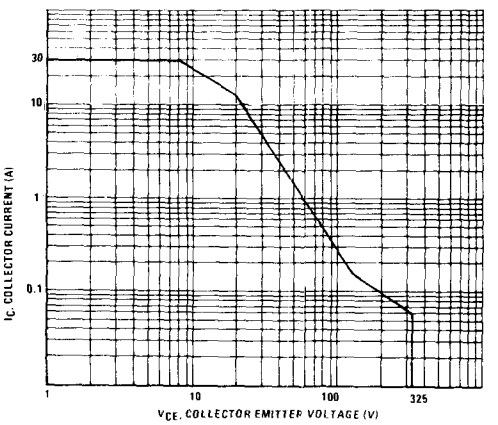
SWITCHING CHARACTERISTICS (Resistive Load)

Turn on Time	I_C = 16 A, I_{B1} = I_{B2} = 3.2 A, (V_{CC} = 100 V, RC = 6.25 Ω)	t_{on}		0.8	μs
Storage Time		t_s		2.5	
Fall Time		t_f		0.4	

[1] Pulse Test: Pulse Width ≤300 μs, Duty Cycle ≤2%.

3

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_C = 25°C; $T_{J(pk)}$ is variable depending on power level. Second breakdown limitations do not derate the same as thermal limitations. At high case temperatures, thermal limitations will reduce the power that can handled to values less than the limitations imposed by second breakdown. (See AN415A)

FIGURE 3 – "ON" VOLTAGES

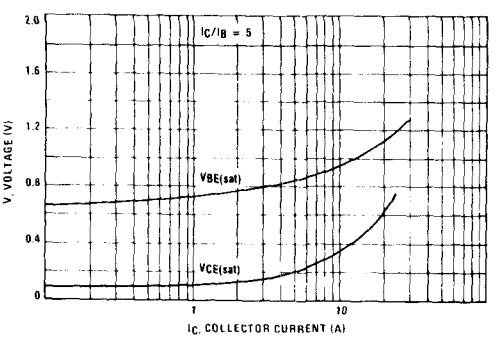


FIGURE 4 – DC CURRENT GAIN

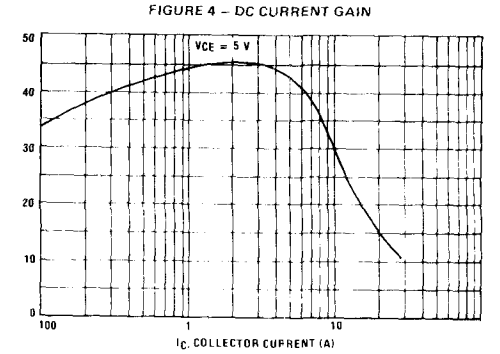


FIGURE 5 – RESISTIVE SWITCHING PERFORMANCE

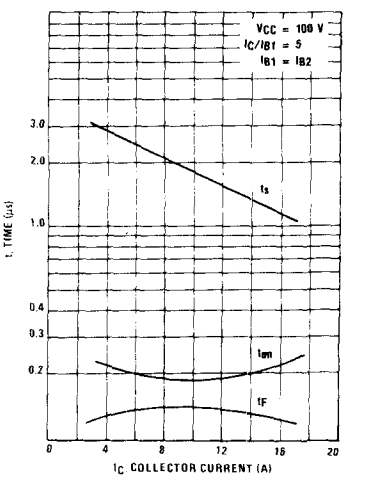
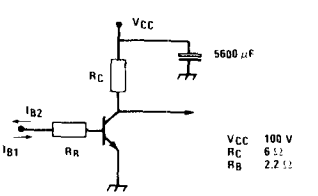


FIGURE 6 – SWITCHING TIMES TEST CIRCUIT



RC – RB : Non inductive resistances

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