

ALPHANUMERIC INDEX — CROSS-REFERENCE (Continued)

Industry Part Number	Motorola Direct Replacement	Motorola Similar Replacement	Page Number	Industry Part Number	Motorola Direct Replacement	Motorola Similar Replacement	Page Number
MJ13090	MJ13090		3-688	MJ2802		2N5881	3-123
MJ13091		MJ16010	3-758	MJ2840		2N5877	3-120
MJ13100		MJ16016	3-774	MJ2841		2N5878	3-120
MJ13101		MJ16016	3-774	MJ2901		MJ15016	3-9
MJ13330	MJ13330		3-694	MJ2940		2N5875	3-120
MJ13331	MJ13331		3-694	MJ2955	MJ2955		3-6
MJ13332		MJ13333	3-700	MJ2955A	MJ2955A		3-9
MJ13333	MJ13333		3-700	MJ3000	MJ3000		3-530
MJ13334		MJ13335	3-700	MJ3001	MJ3001		3-530
MJ13335	MJ13335		3-700	MJ3029	MJ3029		3-532
MJ14000	MJ14000		3-706	MJ3030	2N6545		3-221
MJ14001	MJ14001		3-706	MJ3040	MJ3041		3-534
MJ14002	MJ14002		3-706	MJ3041	MJ3041		3-534
MJ14003	MJ14003		3-706	MJ3042	MJ3042		3-534
MJ15001	MJ15001		3-710	MJ3055	2N3055		3-6
MJ15002	MJ15002		3-710	MJ3055A	2N3055A		3-9
MJ15003	MJ15003		3-713	MJ3237	MJE15031		3-972
MJ15004	MJ15004		3-713	MJ3238	MJE15031		3-972
MJ15011	MJ15011		3-716	MJ3247	MJE15030		3-972
MJ15012	MJ15012		3-716	MJ3248	MJE15030		3-972
MJ15015	MJ15015		3-9	MJ400		2N3739	3-37
MJ15016	MJ15016		3-9	MJ4030	2N6285		3-172
MJ15018	MJ15018		3-718	MJ4031	2N6286		3-172
MJ15019	MJ15019		3-718	MJ4032	2N6287		3-172
MJ15020	MJ15020		3-718	MJ4033	2N6282		3-172
MJ15021	MJ15021		3-718	MJ4034	2N6283		3-172
MJ15022	MJ15022		3-720	MJ4035	2N6284		3-172
MJ15023	MJ15023		3-723	MJ410	MJ410		3-522
MJ15024	MJ15024		3-720	MJ411	MJ411		3-522
MJ15025	MJ15025		3-723	MJ413	MJ413		3-524
MJ15026		MJ15024	3-720	MJ423	MJ423		3-524
MJ15027		MJ15025	3-723	MJ4237		MJ15012	3-716
MJ16002	MJ16002		3-726	MJ4238		MJ15012	3-716
MJ16002A	MJ16002A		3-734	MJ424		2N6308	3-181
MJ16004	MJ16004		3-726	MJ4247		MJ15011	3-716
MJ16006	MJ16006		3-742	MJ4248		MJ15011	3-716
MJ16006A	MJ16006A		3-750	MJ425		2N6545	3-221
MJ16008	MJ16008		3-742	MJ431	MJ431		3-524
MJ16010	MJ16010		3-758	MJ4360		MJE130C2	3-938
MJ16010A	MJ16010A		3-766	MJ4361		MJE130C3	3-938
MJ16012	MJ16012		3-758	MJ4380		MJE130C4	3-944
MJ16014	MJ16014		3-774	MJ4381		MJE130C5	3-944
MJ16016	MJ16016		3-774	MJ4400		MJE130C4	3-944
MJ16018	MJ16018		3-782	MJ4401		MJE130C5	3-944
MJ16020	MJ16020		—	MJ450		2N4398	3-68
MJ16022	MJ16022		—	MJ4502	MJ4502		3-536
MJ205		MJ12003	3-642	MJ4645	MJ4646		3-538
MJ2249		2N3766	3-44	MJ4646	MJ4646		3-538
MJ2250		2N3767	3-44	MJ4647	MJ4647		3-538
MJ2251		2N3738	3-37	MJ480		2N3055	3-6
MJ2252		2N3739	3-37	MJ481		2N3055	3-6
MJ2253		2N3740	3-41	MJ490		2N3789	3-56
MJ2254		2N3741	3-41	MJ491		2N3789	3-56
MJ2267		MJ15016	3-9	MJ6502	MJ6503		3-540
MJ2268		MJ2955	3-6	MJ6503	MJ6503		3-540
MJ2300		MJE270	3-874	MJ6700		2N6193	3-158
MJ2305		MJE271	3-874	MJ701		MJ12002	3-637
MJ2500	MJ2500		3-530	MJ702		MJ12002	3-637
MJ2501	MJ2501		3-530	MJ704		MJ12002	3-637
MJ2801		2N3055	3-6	MJ721		MJ12002	3-637

*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		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		
15		MJ16012 2N6836		7 min 10/30	15 10	0.9 typ 3	0.15 typ 0.35	10 10	10	175 175
	500	MJ16010A		5 min	15	3	0.4	10		175
	850*	MJ12022		5 min	15		0.1 typ	10		175
16	100	2N5629	BD318 2N6029	25 min 25/100	5 8	1.2 typ	1.2 typ	8	1 1	200 200
	120	2N5630	2N6030	20/80	8	1.2 typ	1.2 typ	8	1	200
	140	2N3773 2N5631	2N6609 2N6031	15/60 15/60	8 8	1.1 typ 1.2 typ	1.5 typ 1.2 typ	8 8	4 1	150 200
	200	MJ15022	MJ15023	15/60	8				5	250
	250	MJ15024	MJ15025	15/60	8				5	250
18	160	BUX41N		8 min	12	1.2	0.25	12	8	120
20	60	2N3772 2N6282##	2N6285##	15/60 750/18k	10 10	2.5 typ	2.5 typ	10	2 4#	150 160
	75	2N5039		20/100	10	1.5	0.5	10	60	140
	80	2N5303 2N6283##	2N5745 2N6286##	15/60 750/18k	10 10	2 2.5 typ	1 2.5 typ	10 10	2 4#	200 160
	90	2N5038		20/100	12	1.5	0.5	12	60	140
	100	2N6284##	2N6287##	750/18k	10	2.5 typ	2.5 typ	10	4#	160
	125	BUX40		8 min	15	1	0.25	15	8	120
	140	MJ15003	MJ15004	25/150	5				2	250
	160	BUV11N		10 min	15	1.2	0.25	15	8	150
	200	BUV11 MJ13330		10 min 8/40	12 10	1.8 3.5	0.4 0.7	12 10	8 5 to 40	150 175
	250	BUV12 MJ13331		10 min 8/40	10 10	1.5 3.5	0.5 0.7	10 10	8 5 to 40	150 175
	350	MJ10000## MJ10004##		40/400 40/400	10 10	3 1.5	1.8 0.5	10 10	10# 10#	175 175
	400	MJ10001## MJ10005## MJ13333		40/400 40/400 10/60	10 10 5	3 1.5 4	1.8 0.5 0.7	10 10 10	10# 10# 10#	175 175 175
	450	MJ10008## MJ16014 MJ16016 2N6837		30/300 5 min 7 min 10/30	10 20 20 15	2 2.7 2.2 2.5	0.6 0.35 0.25 0.25	10 20 20 15	8#	175 250 250 250
	500	MJ10009## MJ13335		30/300 10/60	10 5	2 4	0.6 0.7	10 10	8#	175 175
	700	BUT15##		15 min	12	2.5	0.8	12		175
	750	MJ10024##		50/600	20	5	1.8	10		250
	850	MJ10025##		50/600	20	5	1.8	10		250

* V_{I(BR)CEX}, # I_{hfeI} @ 1 MHz, ## Darlington

(continued)

 JAN, JTX, JTXV Available

NPN
MJ15003
PNP
MJ15004

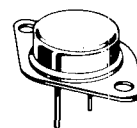
COMPLEMENTARY SILICON POWER TRANSISTORS

The MJ15003 and MJ15004 are PowerBase power transistors designed for high power audio, disk head positioners and other linear applications.

- High Safe Operating Area (100% Tested) —
250 W @ 50 V
- For Low Distortion Complementary Designs
- High DC Current Gain —
 $h_{FE} = 25$ (Min) @ $I_C = 5$ Adc

20 AMPERE POWER TRANSISTORS COMPLEMENTARY SILICON

140 VOLTS
250 WATTS

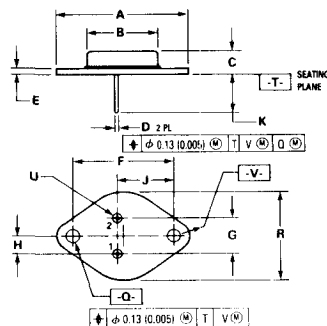


MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	140	Vdc
Collector-Base Voltage	V_{CBO}	140	Vdc
Emitter-Base Voltage	V_{EBO}	5	Vdc
Collector Current — Continuous	I_C	20	Adc
Base Current — Continuous	I_B	5	Adc
Emitter Current — Continuous	I_E	25	Adc
Total Power Dissipation @ $T_C = 25^\circ\text{C}$ Derate above 25°C	P_D	250 1.43	Watts W/ $^\circ\text{C}$
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	$R_{\theta JC}$	0.70	$^\circ\text{C/W}$
Maximum Lead Temperature for Soldering Purposes: 1/16" from Case for ≤ 10 s.	T_L	265	$^\circ\text{C}$



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. ALL RULES AND NOTES ASSOCIATED WITH REFERENCED TO 204AA OUTLINE SHALL APPLY.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	—	39.37	—	1.550
B	—	21.08	—	0.830
C	6.35	8.25	0.250	0.325
D	0.97	1.09	0.038	0.043
E	1.40	1.77	0.055	0.070
F	30.15 BSC	—	1.187 BSC	—
G	10.92 BSC	—	0.430 BSC	—
H	5.46 BSC	—	0.215 BSC	—
J	16.89 BSC	—	0.665 BSC	—
K	11.18	12.19	0.440	0.480
Q	3.84	4.19	0.151	0.165
R	—	26.67	—	1.050
U	4.83	5.33	0.190	0.210
V	3.84	4.19	0.151	0.165

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

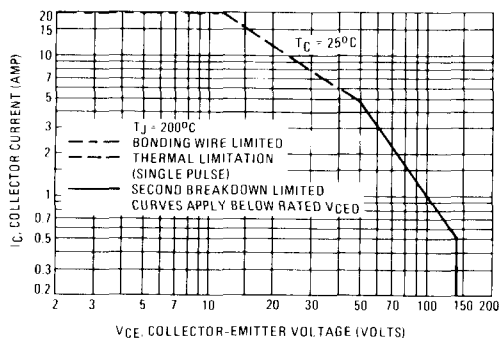
CASE 1-06
TO-204AA
(TO-3)

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

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector-Emitter Sustaining Voltage (1) ($I_C = 200\text{ mAdc}$, $I_B = 0$)	$V_{CE(sus)}$	140		Vdc
Collector Cutoff Current ($V_{CE} = 140\text{ Vdc}$, $V_{BE(off)} = 1.5\text{ Vdc}$) ($V_{CE} = 140\text{ Vdc}$, $V_{BE(off)} = 1.5\text{ Vdc}$, $T_C = 150^\circ\text{C}$)	I_{CEX}		100 2	μAdc mAdc
Collector Cutoff Current ($V_{CE} = 140\text{ Vdc}$, $I_B = 0$)	I_{CEO}		250	μAdc
Emitter Cutoff Current ($V_{EB} = 5\text{ Vdc}$, $I_C = 0$)	I_{EBO}		100	μAdc
SECOND BREAKDOWN				
Second Breakdown Collector Current with Base Forward Biased ($V_{CE} = 50\text{ Vdc}$, $t = 1\text{ s}$ (non-repetitive)) ($V_{CE} = 100\text{ Vdc}$, $t = 1\text{ s}$ (non-repetitive))	$I_{S/b}$	5 1		A _{dc}
ON CHARACTERISTICS				
DC Current Gain ($I_C = 5\text{ Adc}$, $V_{CE} = 2\text{ Vdc}$)	h_{FE}	25	150	
Collector-Emitter Saturation Voltage ($I_C = 5\text{ Adc}$, $I_B = 0.5\text{ Adc}$)	$V_{CE(sat)}$		1	Vdc
Base-Emitter On Voltage ($I_C = 5\text{ Adc}$, $V_{CE} = 2\text{ Vdc}$)	$V_{BE(on)}$		2	Vdc
DYNAMIC CHARACTERISTICS				
Current Gain Bandwidth Product ($I_C = 0.5\text{ Adc}$, $V_{CE} = 10\text{ Vdc}$, $f_{test} = 0.5\text{ MHz}$)	f_T	2		MHz
Output Capacitance ($V_{CB} = 10\text{ Vdc}$, $I_E = 0$, $f_{test} = 1\text{ MHz}$)	C_{ob}	-	1000	pF

(1) Pulse Test. Pulse Width = 300 μs , Duty Cycle = 2%.

FIGURE 1 – ACTIVE-REGION SAFE OPERATING AREA



There are two limitations on the powerhandling 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 1 is based on $T_{J(pk)} = 200^\circ\text{C}$; T_C is variable depending on conditions. At high case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by second breakdown.

NPN MJ15003, PNP MJ15004

TYPICAL CHARACTERISTICS

FIGURE 2 – CAPACITANCES

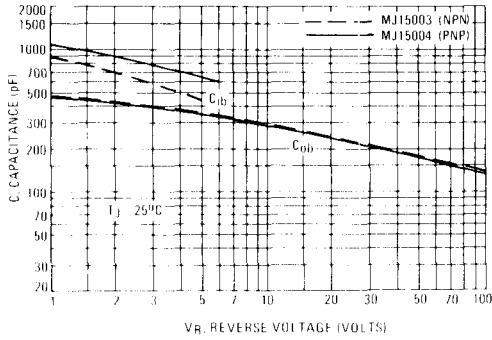


FIGURE 3 – CURRENT GAIN – BANDWIDTH PRODUCT

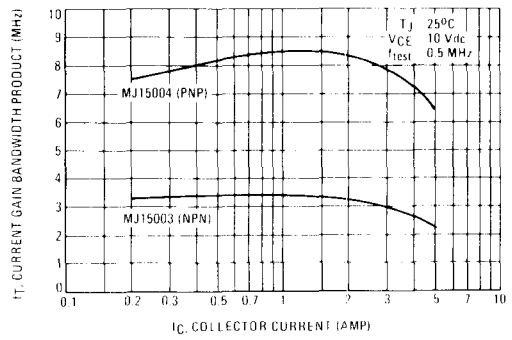


FIGURE 4 – DC CURRENT GAIN

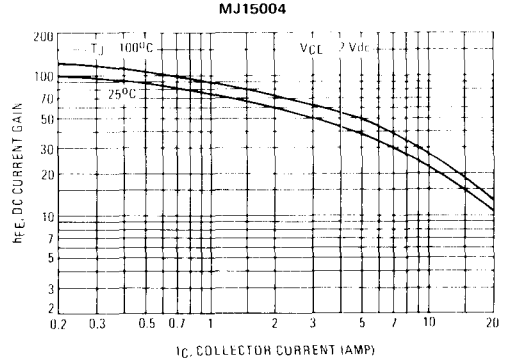
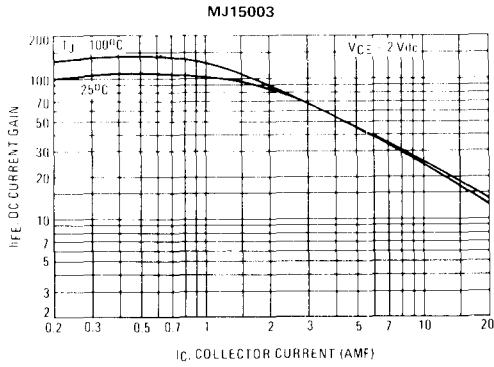
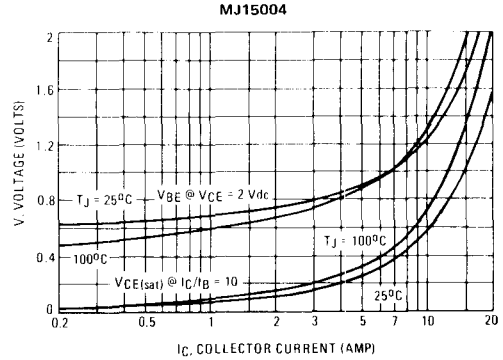
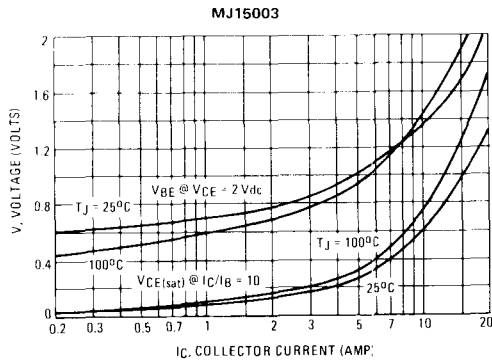
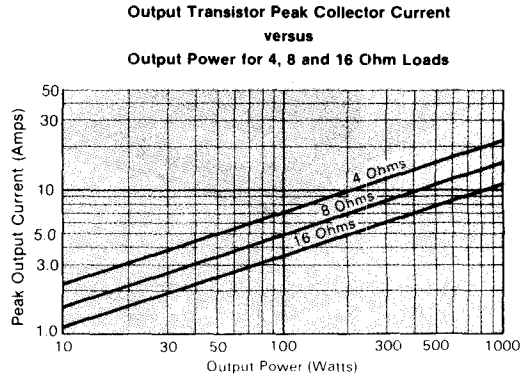
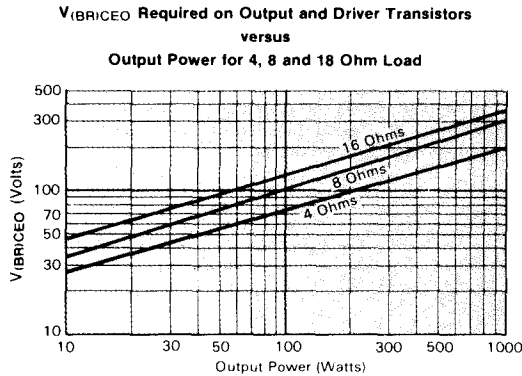


FIGURE 5 – “ON” VOLTAGE



Audio

GENERAL DESIGN CURVES FOR POWER AUDIO OUTPUT STAGES



Another important parameter that must be considered before selecting the output transistors is the safe-operating area these devices must withstand. For a complete discussion on these see Application Notes AN484A and AN485.

TABLE 1 — RECOMMENDED POWER TRANSISTORS FOR AUDIO/SERVO LOADS

RMS Power Output	NPN	PNP	Case	P _D Watts @ 25°C	V _{CEO}	h _{FE} @ Min/Max	I _C Amps	f _T MHz Typ	ISB Volts/Amps
To 25W	MJE15030	MJE15031	TO-220	50W	150 V	20 min	4A	70	14/3.6
25 to 50W	2N3055A MJ15001	MJ2955A MJ15002	TO-204	120W	120 V	20/70	4A	3	60/2
			TO-204	200W	140 V	25/150	4A	3	40/5
50 to 100W	MJ15015 MJ15003 MJ15018 MJ15020	MJ15016 MJ15004 MJ15019 MJ15020	TO-204	180W	120 V	20/70	4A	3	60/3
			TO-204	250W	140 V	25/150	5A	3	100/1
			TO-204	150W	200	30 min	1A	20	50/3
			TO-204	150W	250	30 min	1A	20	50/3
Over 100W	MJ15024	MJ15025	TO-204	250W	250 V	15/60	8A	8	80/2.2

The Power Transistors shown are provided for reference only and show device capability. The final choice of the Power Transistors used is left to the circuit designer and depends upon the particular safe-operating area required and the mounting and heat sinking configuration used.