ALPHANUMERIC INDEX — CROSS-REFERENCE (Continued)

Industry Part Number	Motorola Direct Replacement	Motorola Similar Replacement	Page Number
MJ13090	MJ13090		3-688
MJ13091		MJ16010	3-758
MJ13100		MJ16016	3-774
MJ13101		MJ16016	3-774
MJ13330	MJ13330		3-694
MJ13331	MJ13331		3-694
MJ13332		MJ13333	3-700
MJ13333	MJ13333		3-700
MJ13334		MJ13335	3-700
MJ13335	MJ13335		3-700
MJ14000	MJ14000		3-706
MJ14001	MJ14001		3-706
MJ14002	MJ14002		3-706
MJ14003	MJ14003		3-706
MJ15001	MJ15001		3-710
MJ15002	MJ15002		3-710
MJ15003	MJ15003		3-713
MJ15004	MJ15004		3-713
MJ15011	MJ15011		3-716
MJ15012	MJ15012		3-716
MJ15015	MJ15015		3-9
MJ15016	MJ15016		3-9
MJ15018	MJ15018		3-718
MJ15019	MJ15019		3-718
MJ15020	MJ15020		3-718
MJ15021	MJ15021		3-718
MJ15022	MJ15022		3-720
MJ15023	MJ15023		3-723
MJ15024	MJ15024		3-720
MJ15025	MJ15025		3-723
MJ15026		MJ15024	3-720
MJ15027		MJ15025	3-723
MJ16002	MJ16002		3-726
MJ16002A	MJ16002A		3-734
MJ16004	MJ16004		3-726
MJ16006	MJ16006		3-742
MJ16006A	MJ16006A		3-750
MJ16008	MJ16008		3-742
MJ16010	MJ16010		3-758
MJ16010A	MJ16010A		3-766
MJ16012	MJ16012		3-758
MJ16014	MJ16014		3-774
MJ16016	MJ16016		3-774
MJ16018	MJ16018		3-782
MJ16020	MJ16020		—
MJ16022	MJ16022		—
MJ205		MJ12003	3-642
MJ2249		2N3766	3-44
MJ2250		2N3767	3-44
MJ2251		2N3738	3-37
MJ2252		2N3739	3-37
MJ2253		2N3740	3-41
MJ2254		2N3741	3-41
MJ2267		MJ15016	3-9
MJ2268		MJ2955	3-6
MJ2300		MJE270	3-874
MJ2305		MJE271	3-874
MJ2500	MJ2500		3-530
MJ2501	MJ2501		3-530
MJ2801		2N3055	3-6

Industry Part Number	Motorola Direct Replacement	Motorola Similar Replacement	Page Number
MJ2802		2N5881	3-123
MJ2840		2N5877	3-120
MJ2841		2N5878	3-120
MJ2901		MJ15016	3-9
MJ2940		2N5875	3-120
MJ2955	MJ2955		3-6
MJ2955A	MJ2955A		3-9
MJ3000	MJ3000		3-530
MJ3001	MJ3001		3-530
MJ3029	MJ3029		3-532
MJ3030	2N6545		3-221
MJ3040	MJ3041		3-534
MJ3041	MJ3041		3-534
MJ3042	MJ3042		3-534
MJ3055	2N3055		3-6
MJ3055A	2N3055A		3-9
MJ3237	MJE15031		3-972
MJ3238	MJE15031		3-972
MJ3247	MJE15030		3-972
MJ3248	MJE15030		3-972
MJ400		2N3739	3-37
MJ4030	2N6285		3-172
MJ4031	2N6286		3-172
MJ4032	2N6287		3-172
MJ4033	2N6282		3-172
MJ4034	2N6283		3-172
MJ4035	2N6284		3-172
MJ410	MJ410		3-522
MJ411	MJ411		3-522
MJ413	MJ413		3-524
MJ423	MJ423		3-524
MJ4237		MJ15012	3-716
MJ4238		MJ15012	3-716
MJ424		2N6308	3-181
MJ4247		MJ15011	3-716
MJ4248		MJ15011	3-716
MJ425		2N6545	3-221
MJ431	MJ431		3-524
MJ4360		MJE13002	3-938
MJ4361		MJE13003	3-938
MJ4380		MJE13004	3-944
MJ4381		MJE13005	3-944
MJ4400		MJE13004	3-944
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MJ450		2N4398	3-68
MJ4502	MJ4502		3-536
MJ4645	MJ4646		3-538
MJ4646	MJ4646		3-538
MJ4647	MJ4647		3-538
MJ480		2N3055	3-6
MJ481		2N3055	3-6
MJ490		2N3789	3-56
MJ491		2N3789	3-56
MJ6502	MJ6503		3-540
MJ6503	MJ6503		3-540
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MJ702		MJ12002	3-637
MJ704		MJ12002	3-637
MJ721		MJ12002	3-637

*Consult Motorola if a direct replacement is necessary.

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
10	250	MJ15011	MJ15012	20/100	2					200
	300	MJ3041##		250 min	2.5					175
	325	MJ413		20/80	0.5				2.5	125
		MJ423		30/90	1				2.5	125
		MJ431		15/35	2.5				2.5	125
	350	BU323##		150 min	6	7.5 typ	5.2 typ	6		175
		MJ3042##		250 min	2.5					175
		MJ13014		8/20	5	2	0.5	5		150
		MJ10002##		3/300	5	2.5	1	5	10#	150
		MJ10006##		30/300	5	1.5	0.5	5	10#	150
	400	BU323A##		150 min	6	7.5 typ	5.2 typ	6		175
		MJ10007##		30/300	5	1.5	0.5	5	10#	150
		MJ10012##		100/2k	6	15	15	6		175
		MJ13015		8/20	5	2	0.5	5		150
	600	MJ10014##		10/250	10	2.5	0.8	10		175
	700	MJ8504		7.5 min	1.5	4	2	5		175
	800	MJ8505		7.5 min	1.5	4	2	5		175
		MJ16018		4 min	5	4.5 typ	0.2 typ	5		150
	950*	MJ12010		4.2 min	5		1	5		100
12	60	2N6057##	2N6050##	750/18k	6	1.6 typ	1.5 typ	6	4#	150
	80	2N6058##	2N6051##	750/18k	6	1.6 typ	1.5 typ	6	4#	150
	100	2N6059##	2N6052##	750/18k	6	1.6 typ	1.5 typ	6	4#	150
15	60	2N3055	MJ2955	20/70	4	0.7 typ	0.3 typ	4	2.5	115
		2N3055A	MJ2955A	20/70	4				0.8	115
		2N6576##		2k/20k	4	2	7	10	10–200#	120
		2N5881	2N5879	20/100	6	1	0.8	6	4	160
	80	2N5882	2N5880	20/100	6	1	0.8	6	4	160
	90	2N6577##		2k/20k	4	2	7	10	10-200#	120
	120	MJ15015	MJ15016	20/70	4				1	180
		2N6578##		2k/20k	4	2	7	10	10-200#	120
	140	MJ15001	MJ15002	25/150	4				2	200
	150	MJ11018##	MJ11017##	100 min	15				3#	175
	200	BUX41		8 min	8	1.5	0.4	8	8	120
		2N6249		10/50	10	3.5	1	10	2.5	175
		MJ11020##	MJ11019##	100 min	15				3#	175
	250	MJ11022##	MJ11021##	100 min	15				3#	175
	275	2N6250		8/50	10	3.5	1	10	2.5	175
	300	2N6546		6/30	10	4	0.7	10	6 to 24	175
	325	BUX13		8 min	8	2.5	0.8	8	8	150
	400	BUX48		8 min	10	2	0.4	10		175
		2N6547		6/30	10	4	0.7	10	6 to 24	175
		MJ13090		8 min	10	2.5	0.5	10		175
		MJ16110		6/20	15	0.8 typ	0.1 typ	10		175
	450	BUX48A		8 min	8	2	0.4	10		175
		MJ16010		5 min	15	1.2 typ	0.2 typ	10		175

* $V_{(BR)CEX}$, # $|h_{fe}|$ @ 1 MHz, ## Darlington

(continued)

☐ JAN, JTX, JTXV Available

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

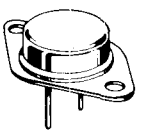
NPN MJ15001 PNP MJ15002

COMPLEMENTARY SILICON POWER TRANSISTORS

The MJ15001 and MJ15002 are EpiBase power transistors designed for high power audio, disk head positioners and other linear applications.

- High Safe Operating Area (100% Tested) –
  200 W @ 40 V
  50 W @ 100 V
- For Low Distortion Complementary Designs
- High DC Current Gain –
  h_{FE} = 25 (Min) @ I_C = 4 Adc

15 AMPERE
POWER TRANSISTORS
COMPLEMENTARY SILICON
140 VOLTS
200 WATTS



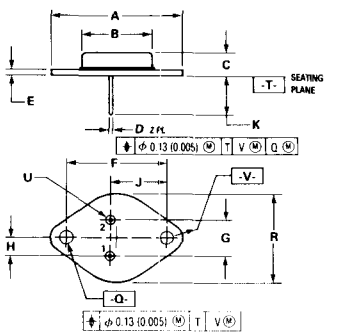
3

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	15	Adc
Base Current – Continuous	I_B	5	Adc
Emitter Current – Continuous	I_E	20	Adc
Total Power Dissipation @ T_C = 25°C Derate above 25°C	P_D	200 1.14	Watts W/°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	$R_{\theta JC}$	0.875	°C/W
Maximum Lead Temperature for Soldering Purposes: 1/16" from Case for ≤10s.	T_L	265	°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 MIN	MILLIMETERS MAX	INCHES MIN	INCHES 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)

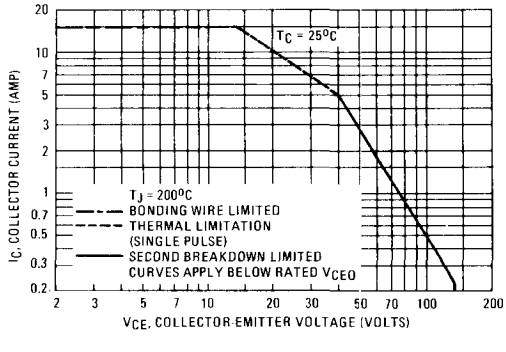
ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector-Emitter Sustaining Voltage (1) (I_C = 200 mAdc, I_B = 0)	$V_{CEO(sus)}$	140	–	Vdc
Collector Cutoff Current (V_{CE} = 140 Vdc, $V_{BE(off)}$ = 1.5 Vdc)	I_{CEX}	–	100	μAdc
(V_{CE} = 140 Vdc, $V_{BE(off)}$ = 1.5 Vdc, T_C = 150°C)			2	mAdc
Collector Cutoff Current (V_{CE} = 140 Vdc, I_B = 0)	I_{CEO}	–	250	μAdc
Emitter Cutoff Current (V_{EB} = 5 Vdc, I_C = 0)	I_{EBO}	–	100	μAdc
SECOND BREAKDOWN				
Second Breakdown Collector Current with Base Forward Biased (V_{CE} = 40 Vdc, t = 1 s (non-repetitive))	$I_{S/b}$	5	–	Adc
(V_{CE} = 100 Vdc, t = 1 s (non-repetitive)		0.5	–	
ON CHARACTERISTICS				
DC Current Gain (I_C = 4 Adc, V_{CE} = 2 Vdc)	h_{FE}	25	150	–
Collector-Emitter Saturation Voltage (I_C = 4 Adc, I_B = 0.4 Adc)	$V_{CE(sat)}$	–	1	Vdc
Base-Emitter On Voltage (I_C = 4 Adc, V_{CE} = 2 Vdc)	$V_{BE(on)}$	–	2	Vdc
DYNAMIC CHARACTERISTICS				
Current-Gain – Bandwidth Product (I_C = 0.5 Adc, V_{CE} = 10 Vdc, f_{test} = 0.5 MHz)	f_T	2	–	MHz
Output Capacitance (V_{CB} = 10 Vdc, I_E = 0, f_{test} = 1 MHz)	C_{ob}	–	1000	pF

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

3

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°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.

TYPICAL CHARACTERISTICS

FIGURE 2 – CAPACITANCES

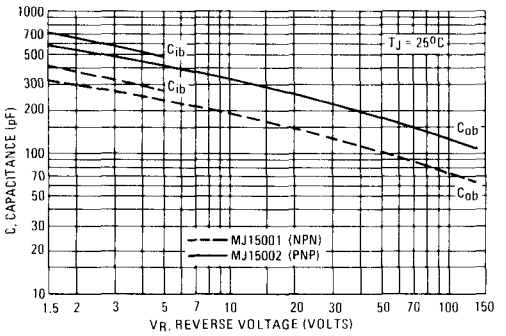


FIGURE 3 – CURRENT-GAIN – BANDWIDTH PRODUCT

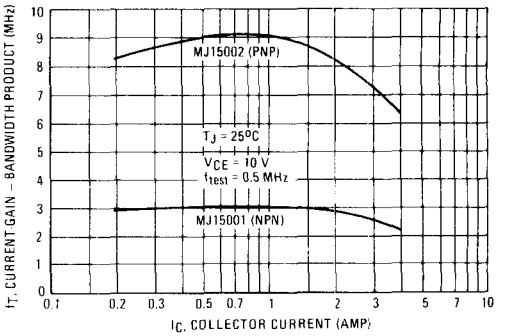
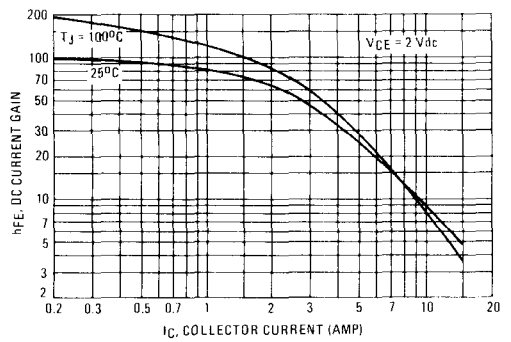


FIGURE 4 – DC CURRENT GAIN

MJ15001



MJ15002

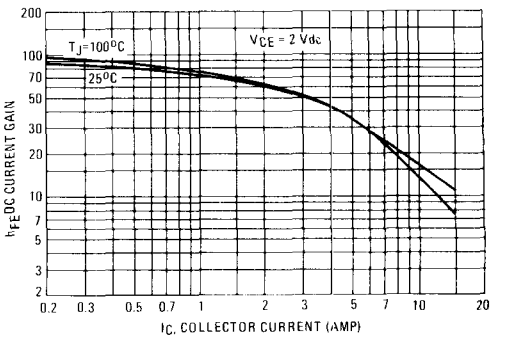
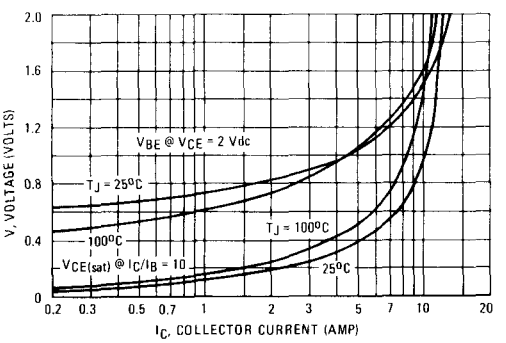
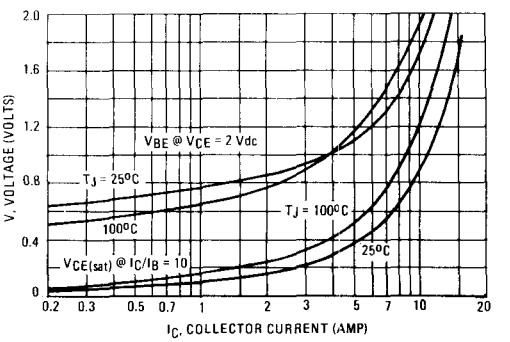


FIGURE 5 – "ON" VOLTAGE

MJ15001



MJ15002

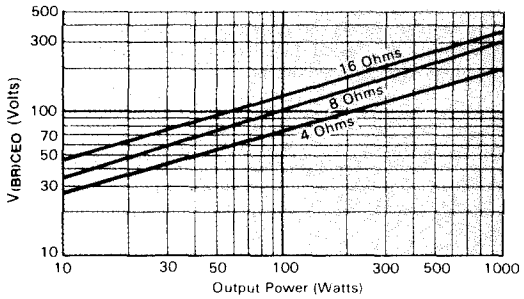


3

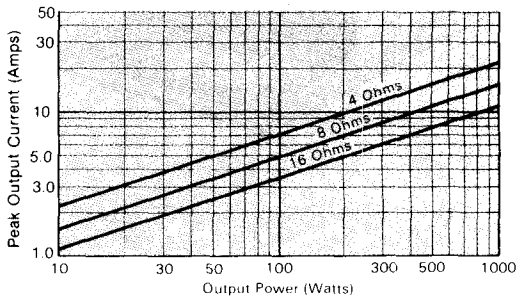
Audio

GENERAL DESIGN CURVES FOR POWER AUDIO OUTPUT STAGES

$V_{(BR)CEO}$ Required on Output and Driver Transistors versus Output Power for 4, 8 and 18 Ohm Load



Output Transistor Peak Collector Current versus Output Power for 4, 8 and 16 Ohm Loads



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	MJ2955A	TO-204	120W	120 V	20/70	4A	3	60/2
	MJ15001	MJ15002	TO-204	200W	140 V	25/150	4A	3	40/5
50 to 100W	MJ15015	MJ15016	TO-204	180W	120 V	20/70	4A	3	60/3
	MJ15003	MJ15004	TO-204	250W	140 V	25/150	5A	3	100/1
	MJ15018	MJ15019	TO-204	150W	200	30 min	1A	20	50/3
	MJ15020	MJ15020	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.