ALPHANUMERIC INDEX — CROSS-REFERENCE

The following table represents an index and cross-reference guide for all low-frequency power transistors which are either manufactured directly by Motorola or for which Motorola manufactures a suitable equivalent. Where the Motorola part number differs from the industry part number, the Motorola device is a "form, fit and function" replacement for the industry type number — however, subtle differences in characteristics and/or specifications may exist.

1

Industry Part Number	Motorola Direct Replacement	Motorola Similar Replacement	Page Number
1SI10A-100		MJ16018	3-782
2N1487		2N5877	3-120
2N1488		2N5878	3-120
2N1489		2N5877	3-120
2N1490		2N5878	3-120
2N1702		2N5877	3-120
2N3016		2N5337	3-97
2N3021		2N3789	3-56
2N3022		2N3789	3-56
2N3023		2N3789	3-56
2N3024		2N3791	3-56
2N3025		2N3791	3-56
2N3026		2N3791	3-56
2N3054	2N3054		3-2
2N3054A	2N3054A		3-2
2N3055	2N3055		3-6
2N3055A	2N3055A		3-9
2N3055H		2N3055A	3-9
2N3055JAN		2N5302JAN	3-93
2N3055SD		2N3055A	3-9
2N3055UB		2N3055A	3-9
2N3076		2N6249	3-164
2N3079		2N6308	3-181
2N3080		2N6543	3-215
2N3171		2N3789	3-56
2N3172		2N3789	3-56
2N3173		2N3790	3-56
2N3174		MJ15016	3-9
2N3183		2N3789	3-56
2N3184		2N3789	3-56
2N3185		2N3790	3-56
2N3186		MJ15016	3-9
2N3195		2N3789	3-56
2N3196		2N3790	3-56
2N3198		MJ15016	3-9
2N3202		2N3719	3-32
2N3203		2N3720	3-32
2N3204		2N6303	3-32
2N3232		2N5877	3-120
2N3233		2N5882	3-123
2N3234		2N5760	3-116
2N3235		2N3055	3-6
2N3236		2N5882	3-123
2N3237		2N5302	3-93
2N3238		2N5882	3-123
2N3239		2N5882	3-123
2N3240		2N5882	3-123
2N3419		2N5336	3-97
2N3420		2N5336	3-97
2N3421		2N5336	3-97

Industry Part Number	Motorola Direct Replacement	Motorola Similar Replacement	Page Number
2N3441	2N3441		3-13
2N3442	2N3442		3-15
2N3445	2N3447		3-18
2N3446	2N3448		3-18
2N3447	2N3447		3-18
2N3448	2N3448		3-18
2N3583	2N3583		3-20
2N3584	2N3584		3-20
2N3585	2N3585		3-20
2N3667		2N5881	3-123
2N3713		2N5881	3-123
2N3714	2N3714		3-26
2N3715	2N3715		3-26
2N3715JAN	2N3715JAN		3-26
2N3715JTX	2N3715JTX		3-26
2N3715JTXV	2N3715JTXV		3-26
2N3716	2N3716		3-26
2N3716JAN	2N3716JAN		3-26
2N3716JTX	2N3716JTX		3-26
2N3716JTXV	2N3716JTXV		3-26
2N3719	2N3719		3-32
2N3720	2N3720		3-32
2N3738	2N3738		3-37
2N3739	2N3739		3-37
2N3739JAN	2N3739JAN		3-37
2N3739JTX	2N3739JTX		3-37
2N3739JTXV	2N3739JTXV		3-37
2N3740	2N3740		3-41
2N3740A		2N3740	3-41
2N3740JAN	2N3740JAN		3-41
2N3740JTX	2N3740JTX		3-41
2N3740JTXV	2N3740JTXV		3-41
2N3741	2N3741		3-41
2N3741A	2N3741A		3-41
2N3741JAN	2N3741JAN		3-41
2N3741JTX	2N3741JTX		3-41
2N3741JTXV	2N3741JTXV		3-41
2N3766	2N3766		3-44
2N3766JAN	2N3766JAN		3-44
2N3766JTX	2N3766JTX		3-44
2N3766JTXV	2N3766JTXV		3-44
2N3767	2N3767		3-44
2N3767JAN	2N3767JAN		3-44
2N3767JTX	2N3767JTX		3-44
2N3767JTXV	2N3767JTXV		3-44
2N3771	2N3771		3-48
2N3772	2N3772		3-48
2N3773	2N3773		3-52
2N3788		2N6543	3-215
2N3789	2N3789		3-56

Industry Part Number	Motorola Direct Replacement	Motorola Similar Replacement	Page Number
BDT63A	BDW41		3-328
BDT63B	BDW42		3-328
BDT63C	BDW43		3-328
BDT64	BDW44		3-328
BDT64A	BDW45		3-328
BDT64B	BDW46		3-328
BDT64C	BDW47		3-328
BDT65	BDW40		3-328
BDT65A	BDW41		3-328
BDT65B	BDW42		3-328
BDT65C	BDW43		3-328
BDT91	BD807		3-316
BDT92	BD808		3-318
BDT93	BD809		3-316
BDT94	BD810		3-318
BDV64	BDV64		3-324
BDV64A	BDV64A		3-324
BDV64B	BDV64B		3-324
BDV64C		BDV64B	3-324
BDV65	BDV65		3-324
BDV65A	BDV65A		3-324
BDV65B	BDV65B		3-324
BDV65C		BDV65B	3-324
BDV66C	MJH11018		3-1034
BDV66C	MJH11017		3-1034
BDV66D	MJH11019		3-1034
BDV67D	MJH11020		3-1034
BDV91	MJE3055T		3-904
BDV92	TIP34B		3-1077
BDV93	TIP34C		3-1077
BDV94	TIP2955		3-1108
BDV95	TIP33B		3-1077
BDV96	TIP33C		3-1077
BDW21	2N3714		3-26
BDW21A	2N3714		3-26
BDW21B	2N3714		3-26
BDW21C		2N5882	3-123
BDW22	2N3789		3-56
BDW22A	2N3789		3-56
BDW22B	2N3790		3-56
BDW22C	2N5880		3-123
BDW23	BDX53		3-338
BDW23A	BDX53A		3-338
BDW23B	BDX53B		3-338
BDW23C	BDX53C		3-338
BDW24	BDX54		3-338
BDW24A	BDX54A		3-338
BDW24B	BDX54B		3-338
BDW24C	BDX54C		3-338
BDW39	BDW39		3-328
BDW40	BDW40		3-328
BDW41	BDW41		3-328
BDW42	BDW42		3-328
BDW44	BDW44		3-328
BDW45	BDW45		3-328
BDW46	BDW46		3-328
BDW47	BDW47		3-328
BDW51	2N3715		3-26
BDW51A	2N3715		3-26
BDW51B	2N3716		3-26

Industry Part Number	Motorola Direct Replacement	Motorola Similar Replacement	Page Number
BDW51C	2N5882		3-123
BDW52	2N3791		3-56
BDW52A	2N3792		3-56
BDW52B	2N3792		3-56
BDW52C	2N5880		3-123
BDW53	TIP120		3-1098
BDW53A	TIP120		3-1098
BDW53B	TIP121		3-1098
BDW53C	BDX53C		3-338
BDW53D	BDX53D		3-338
BDW54	TIP125		3-1098
BDW54A	TIP125		3-1098
BDW54B	TIP126		3-1098
BDW54C	BDX54C		3-338
BDW54D	BDX54D		3-338
BDW55	BD135		3-258
BDW56	BD136		3-260
BDW57	BD137		3-258
BDW58	BD138		3-260
BDW59	BD139		3-258
BDW60	BD140		3-260
BDW63	BDX53		3-338
BDW63A	BDX53A		3-338
BDW63B	BDX53B		3-338
BDW63C	BDX53C		3-338
BDW63D	BDX53D		3-338
BDW64	BDX54		3-338
BDW64A	BDX54A		3-338
BDW64B	BDX54B		3-338
BDW64C	BDX54C		3-338
BDW73	BD895		3-320
BDW73A	BD897		3-320
BDW73B	BD899		3-320
BDW73C	BD901		3-320
BDW73D	BDX33D		3-334
BDW74	BD896		3-322
BDW74A	BD898		3-322
BDW74B	BD900		3-322
BDW74C	BD902		3-322
BDW74D	BDX34D		3-334
BDW83	BDV65		3-324
BDW83A	BDV65		3-324
BDW83B	BDV65A		3-324
BDW83C	BDV65B		3-324
BDW84	BDV64		3-324
BDW84A	BDV64		3-324
BDW84B	BDV64A		3-324
BDW84C	BDV64B		3-324
BDW93	BDW39		3-328
BDW93A	BDW40		3-328
BDW93B	BDW41		3-328
BDW93C	BDW42		3-328
BDW94	BDW44		3-328
BDW94A	BDW45		3-328
BDW94B	BDW46		3-328
BDW94C	BDW47		3-328
BDX10	2N3055A		3-9
BDX10-4	2N3055A		3-9
BDX10-6	2N3055A		3-9
BDX10-7	2N3055A		3-9

*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

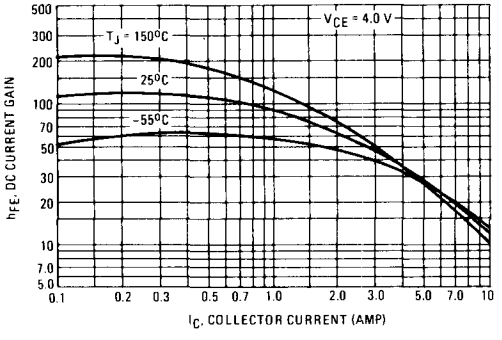
(continued)

☐ JAN, JTX, JTXV Available

NPN
2N3055

PNP
MJ2955

FIGURE 3 – DC CURRENT GAIN



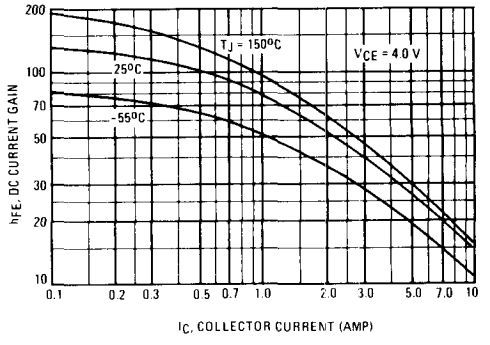
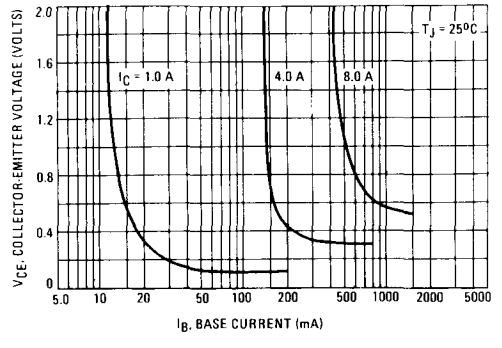
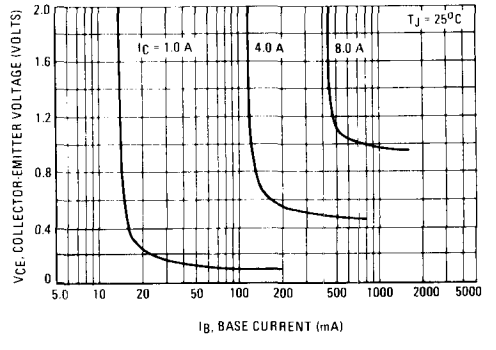


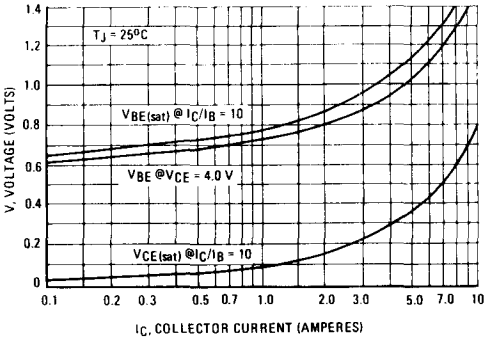
FIGURE 4 – COLLECTOR SATURATION REGION

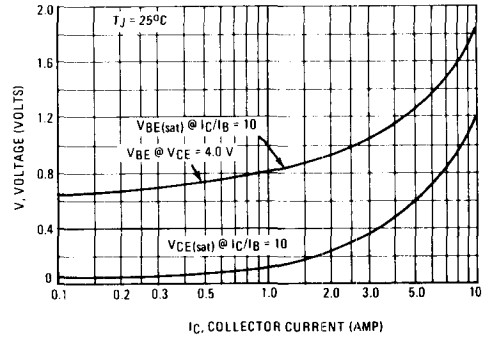




3

FIGURE 5 – "ON" VOLTAGES





NPN **PNP**
2N3055A **MJ2955A**
MJ15015 **MJ15016**

COMPLEMENTARY SILICON HIGH-POWER TRANSISTORS

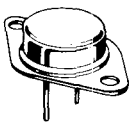
. . . PowerBase complementary transistors designed for high power audio, stepping motor and other linear applications. These devices can also be used in power switching circuits such as relay or solenoid drivers, dc-to-dc converters, inverters, or for inductive loads requiring higher safe operating area than the 2N3055 and MJ2955.

- Current-Gain — Bandwidth-Product @ I_C = 1.0 Adc
  f_T = 0.8 MHz (Min) — NPN
  = 2.2 MHz (Min) — PNP
- Safe Operating Area — Rated to 60 V and 120 V, Respectively

15 AMPERE

COMPLEMENTARY SILICON POWER TRANSISTORS

60, 120 VOLTS
115, 180 WATTS



*MAXIMUM RATINGS

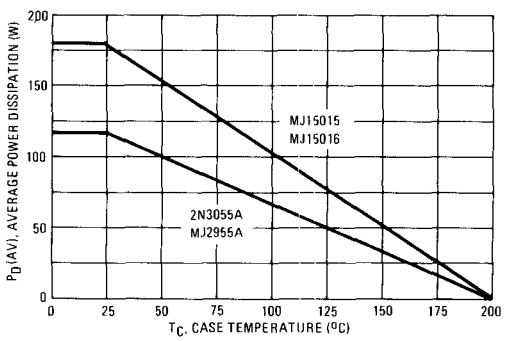
Rating	Symbol	2N3055A MJ2955A	MJ15015 MJ15016	Unit
Collector-Emitter Voltage	V_{CEO}	60	120	Vdc
Collector-Base Voltage	V_{CBO}	100	200	Vdc
Collector-Emitter Voltage Base Reversed Biased	V_{CEV}	100	200	Vdc
Emitter-Base Voltage	V_{EBO}	7.0		Vdc
Collector Current — Continuous	I_C	15		Adc
Base Current	I_B	7.0		Adc
Total Device Dissipation @ T_C = 25°C Derate above 25°C	P_D	115 0.65	180 1.03	Watts W/°C
Operating and Storage Junction Temperature Range	T_J, T_{stg}	−65 to +200		°C

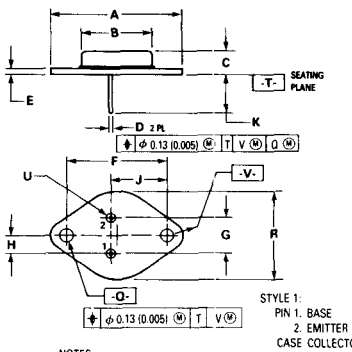
THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Max	Unit
Thermal Resistance, Junction to Case	θ_{JC}	1.52	0.98	°C/W

*Indicates JEDEC Registered Data (2N3055A)

FIGURE 1 — POWER DERATING





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

CASE 1-06
TO-204AA
(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 mAdc, I_B = 0)	2N3055A, MJ2955A MJ15015, MJ15016	$V_{CEO(sus)}$	60 120	– –	Vdc
Collector Cutoff Current		I_{CEO}			mAdc
(V_{CE} = 30 Vdc, $V_{BE(off)}$ = 0 Vdc)	2N3055A, MJ2955A		–	0.7	
(V_{CE} = 60 Vdc, $V_{BE(off)}$ = 0 Vdc)	MJ15015, MJ15016		–	0.1	
*Collector Cutoff Current (V_{CEV} = Rated Value, $V_{BE(off)}$ = 1.5 Vdc)	2N3055A, MJ2955A MJ15015, MJ15016	I_{CEV}	– –	5.0 1.0	mAdc
Collector Cutoff Current (V_{CEV} = Rated Value, $V_{BE(off)}$ = 1.5 Vdc, T_C = 150°C)	2N3055A, MJ2955A MJ15015, MJ15016	I_{CEV}	– –	30 6.0	mAdc
*Emitter Cutoff Current (V_{EB} = 7.0 Vdc, I_C = 0)	2N3055A, MJ2955A MJ15015, MJ15016	I_{EBO}	– –	5.0 0.2	mAdc
***SECOND BREAKDOWN**					
Second Breakdown Collector Current with Base Forward Biased (t = 0.5 s non-repetitive) (V_{CE} = 60 Vdc)	2N3055A, MJ2955A MJ15015, MJ15016	$I_{S/b}$	1.95 3.0	– –	Adc
***ON CHARACTERISTICS (1)**					
DC Current Gain		h_{FE}			–
(I_C = 4.0 Adc, V_{CE} = 2.0 Vdc)			10	70	
(I_C = 4.0 Adc, V_{CE} = 4.0 Vdc)			20	70	
(I_C = 10 Adc, V_{CE} = 4.0 Vdc)			5.0	–	
Collector-Emitter Saturation Voltage		$V_{CE(sat)}$			Vdc
(I_C = 4.0 Adc, I_B = 400 mAdc)			–	1.1	
(I_C = 10 Adc, I_B = 3.3 Adc)			–	3.0	
(I_C = 15 Adc, I_B = 7.0 Adc)			–	5.0	
Base-Emitter On Voltage (I_C = 4.0 Adc, V_{CE} = 4.0 Vdc)		$V_{BE(on)}$	0.7	1.8	Vdc
***DYNAMIC CHARACTERISTICS**					
Current-Gain–Bandwidth Product (I_C = 1.0 Adc, V_{CE} = 4.0 Vdc, f = 1.0 MHz)	2N3055A, MJ15015 MJ2955A, MJ15016	f_T	0.8 2.2	6.0 18	MHz
Output Capacitance (V_{CB} = 10 Vdc, I_E = 0, f = 1.0 MHz)		C_{ob}	60	600	pF
***SWITCHING CHARACTERISTICS (2N3055A only)**					
RESISTIVE LOAD					
Delay Time	(V_{CC} = 30 Vdc, I_C = 4.0 Adc, I_{B1} = I_{B2} = 0.4 Adc, t_p = 25 μs Duty Cycle ≤ 2%)	t_d	–	0.5	μs
Rise Time		t_r	–	4.0	μs
Storage Time		t_s	–	3.0	μs
Fall Time		t_f	–	6.0	μs

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2%.
*Indicates JEDEC Registered Data (2N3055A)

FIGURE 2 – DC CURRENT GAIN

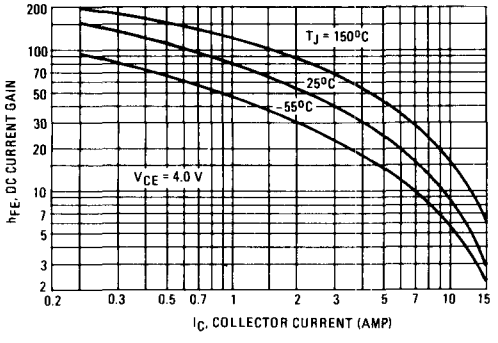


FIGURE 3 – COLLECTOR SATURATION REGION

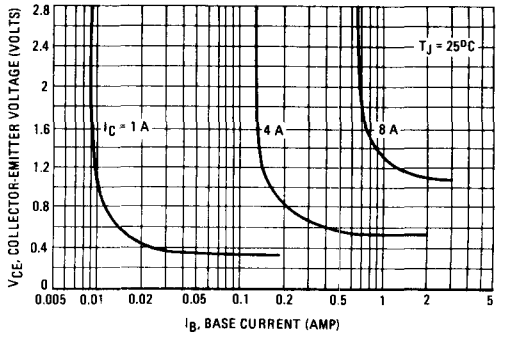


FIGURE 4 – "ON" VOLTAGES

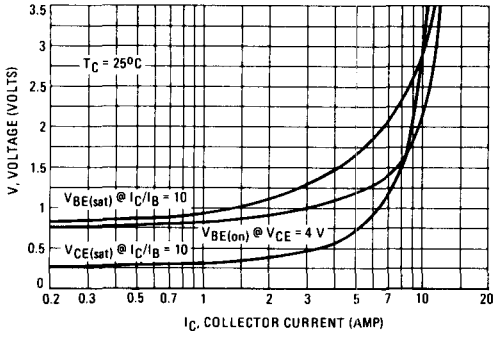


FIGURE 5 – CURRENT-GAIN–BANDWIDTH PRODUCT

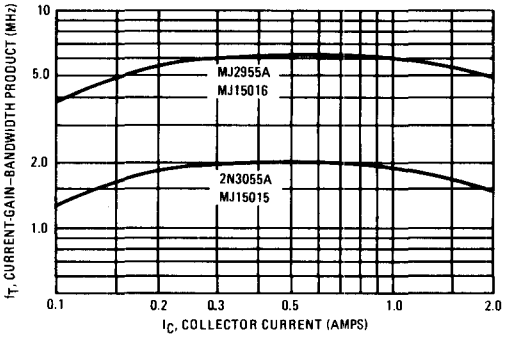


FIGURE 6 – SWITCHING TIMES TEST CIRCUIT
(Circuit shown is for NPN)

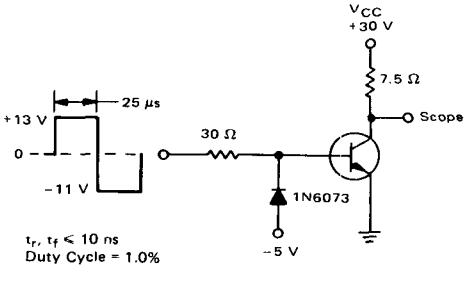
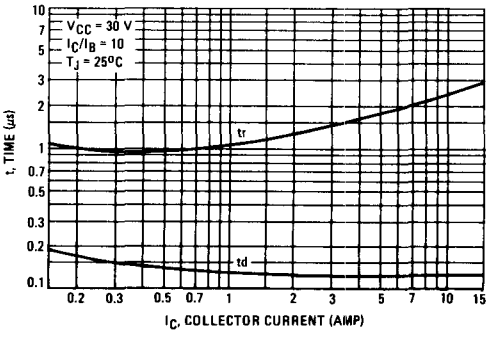


FIGURE 7 – TURN-ON TIME



3

FIGURE 8 – TURN-OFF TIMES

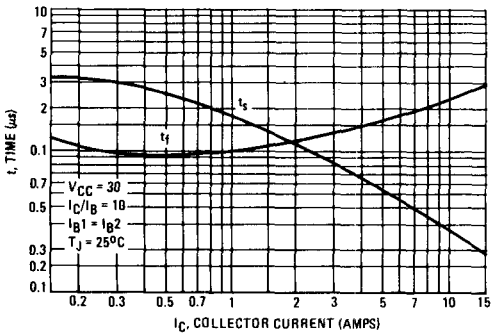
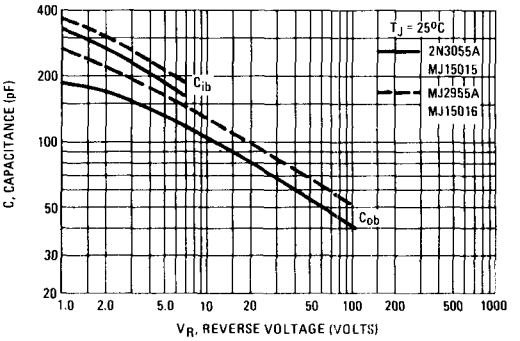


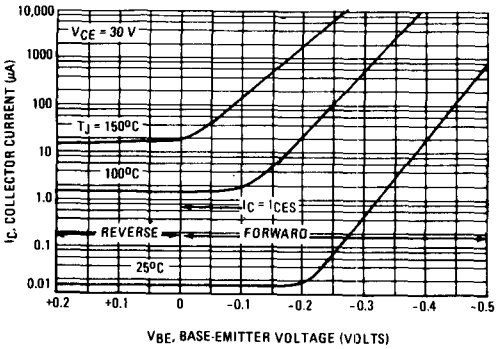
FIGURE 9 – CAPACITANCES



COLLECTOR CUT-OFF REGION

NPN

FIGURE 10 – 2N3055A, MJ15015



PNP

FIGURE 11 – MJ2955A, MJ15016

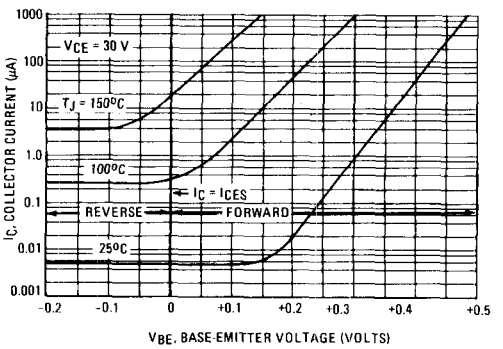


FIGURE 12 – FORWARD BIAS SAFE OPERATING AREA
2N3055A, MJ2955A

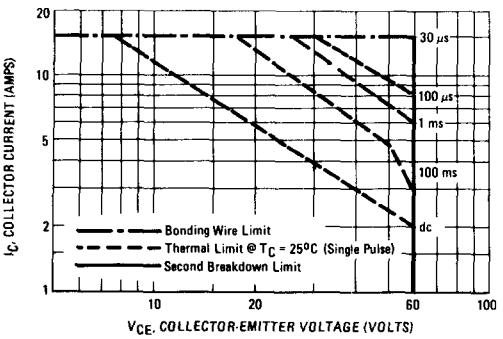
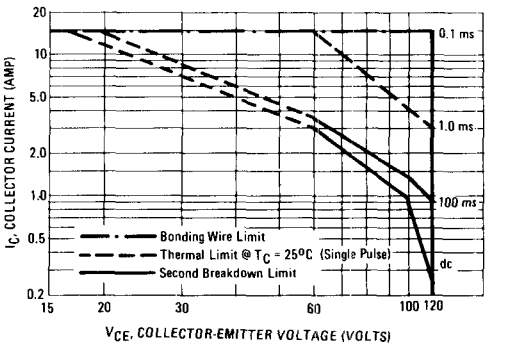


FIGURE 13 – FORWARD BIAS SAFE OPERATING AREA
MJ15015, MJ15016



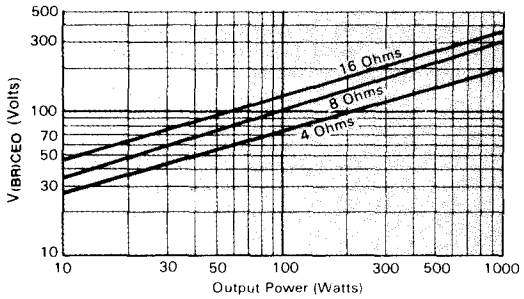
There are two limitations on the power handling ability of a transistor: average junction temperature and second breakdown. Safe Operating area curves indicate I_C-V_{CE} limits of the transistor that must be observed for reliable operation; i.e., the transistor must not be subjected to greater dissipation than the curves indicate.

The data of Figures 12 and 13 is based on T_C = 25°C; $T_{J(pk)}$ is variable depending on power level. Second breakdown pulse limits are valid for duty cycles to 10% but must be derated for temperature according to Figure 1.

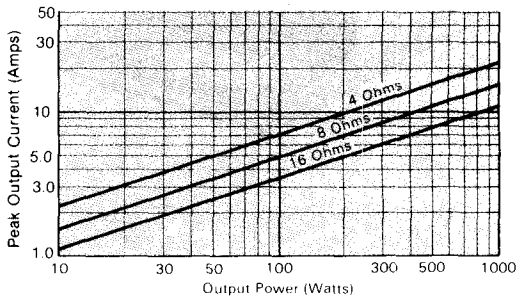
Audio

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.