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MJD31	MJD31		3-797	MJE15030	MJE15030		3-972
MJD31-1	MJD31-1		3-797	MJE15031	MJE15031		3-972
MJD31C	MJD31C		3-797	MJE16002	MJE16002		3-976
MJD31C1	MJD31C1		3-797	MJE16004	MJE16004		3-976
MJD32	MJD32		3-797	MJE16032	MJE16032		3-984
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\*Consult Motorola if a direct replacement is necessary.



**TABLE 7 — PLASTIC TO-225 Type (continued)**

I <sub>C</sub> Cont Amps Max	V <sub>CEO(sus)</sub> Volts Min	Device Type		h <sub>FE</sub> Min/Max	@ I <sub>C</sub> Amp	Resistive Switching			f <sub>T</sub> MHz Min	P <sub>D</sub> (Case) Watts @ 25°C				
		NPN	PNP			t <sub>s</sub> μs Max	t <sub>f</sub> μs Max	@ I <sub>C</sub> Amp						
3	45		BD176 BD176.6 BD176.10 BD176.16	40/250 40/100 63/160 100/250	0.15 0.15 0.15 0.15				3 3 3 3	30 30 30 30				
		60	MJE181	MJE171	50/250	0.1	0.6 typ	0.12 typ	0.1	50	12.5			
		80	BD179 BD179.6 BD179.10 BD179.16 MJE182	BD180 BD180.6 BD180.10 BD180.16 MJE172	40/250 40/100 63/160 100/250 50/250	0.15 0.15 0.15 0.15 0.1					3 3 3 3 50	30 30 30 30 12.5		
			200	BUY49P		30 min	0.5				25	20		
4	30	BD185		15 min	2				20	40				
	40	2N5190 MJE521 2N6037##	2N5193 MJE371 2N6034##	25/100 40 min 750/18k	1.5 1 2	0.4 typ 1.7 typ	0.4 typ 1.2 typ	1.5 2	2 25	2 40 40	40 40 40			
		45	BD437 BD675## BD675A## BD785	BD438 BD676## BD676A## BD786 BD776##	40 min 750 min 750 min 20 min 750 min	2 1.5 2 2 2				3 50 20	36 40 40 15 15			
			60	BD189  BD677## BD677A## BD787 BD777## 2N5191 MJE800## MJE801## 2N6038##	BD440 BD678## BD678A## BD788 BD778## 2N5194 MJE700## MJE701## 2N6035##	15 min 25 min 750 min 20 min 750 min 25/100 750 min 750 min 750/18k	2 2 1.5 2 2 1.5 1.5 2 2	0.4 typ 1.7 typ	0.4 typ 1.2 typ	1.5 2	2 3 40 20 40 40 1# 1# 25	40 36 40 40 15 15 40 40 40		
	80			2N5192 BD441 BD679## BD679A## BD789 BD779## MJE240 MJE241 MJE802## MJE803## 2N6039##	2N5195 BD442 BD680## BD680A## BD790 BD780## MJE250 MJE251 MJE702## MJE703## 2N6036##	25/100 15 min 750 min 750 min 10 min 750 min 40/200 40/120 750 min 750 min 750/18k	1.5 2 1.5 2 2 2 0.2 0.2 1.5 2 2	0.4 typ 0.15 typ 0.15 typ	0.4 typ 0.07 typ 0.07 typ	1.5 2 2	2 3 40 20 40 40 1# 1# 25	40 36 40 40 15 15 15 40 40 40		
				100	BD681## BD791 MJE243 MJE244	BD682## BD792 MJE253 MJE254	750 min 10 min 40/120 25 min	1.5 2 0.2 0.2	0.13 typ 0.15 typ 0.15 typ	0.035 typ 0.07 typ 0.07 typ	2 2 2	40 40 40	40 15 15 15	
		5			25	MJE200	MJE210	45/180	2	0.13 typ	0.035 typ	2	65	15

• Case 77 (Style 3), # |h<sub>FE</sub>| @ 1 MHz, ## Darlington

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**NPN**  
**MJE200**  
**PNP**  
**MJE210**

**COMPLEMENTARY SILICON POWER PLASTIC TRANSISTORS**

... designed for low voltage, low-power, high-gain audio amplifier applications.

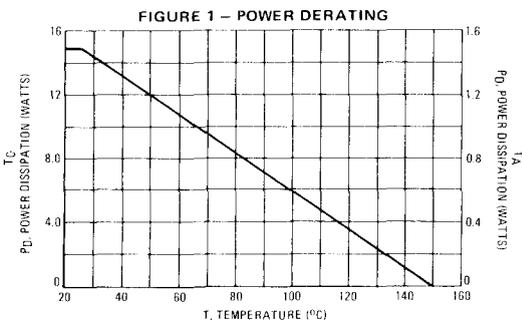
- Collector-Emitter Sustaining Voltage –  $V_{CE(sus)} = 25 \text{ Vdc (Min) @ } I_C = 10 \text{ mAdc}$
- High DC Current Gain –  $h_{FE} = 70 \text{ (Min) @ } I_C = 500 \text{ mAdc}$   
= 45 (Min) @  $I_C = 2.0 \text{ Adc}$   
= 10 (Min) @  $I_C = 5.0 \text{ Adc}$
- Low Collector-Emitter Saturation Voltage  
 $V_{CE(sat)} = 0.3 \text{ Vdc (Max) @ } I_C = 500 \text{ mAdc}$   
= 0.75 Vdc (Max) @  $I_C = 2.0 \text{ Adc}$
- High Current-Gain · Bandwidth Product  
 $f_T = 65 \text{ MHz (Min) @ } I_C = 100 \text{ mAdc}$
- Annular Construction for Low Leakage –  $I_{CBO} = 100 \text{ nAdc @ Rated } V_{CB}$

**MAXIMUM RATINGS**

Rating	Symbol	Value	Unit
Collector-Base Voltage	$V_{CB}$	40	Vdc
Collector-Emitter Voltage	$V_{CEO}$	25	Vdc
Emitter-Base Voltage	$V_{EB}$	8.0	Vdc
Collector Current Continuous Peak	$I_C$	5.0 10	Adc
Base Current	$I_B$	1.0	Adc
Total Power Dissipation @ $T_C = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	15 0.12	Watts W/ $^\circ\text{C}$
Total Power Dissipation @ $T_A = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	1.5 0.012	Watts W/ $^\circ\text{C}$
Operating and Storage Junction Temperature Range	$T_J, T_{stg}$	-65 to +150	$^\circ\text{C}$

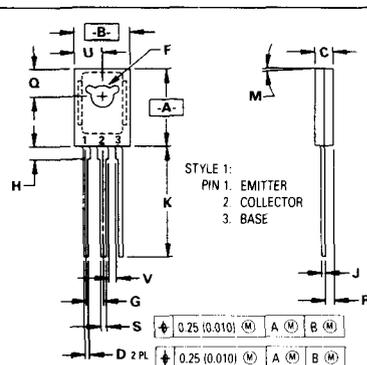
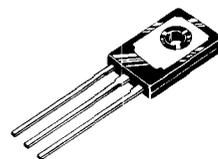
**THERMAL CHARACTERISTICS**

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$\theta_{JC}$	8.34	$^\circ\text{C/W}$
Thermal Resistance, Junction to Ambient	$\theta_{JA}$	83.4	$^\circ\text{C/W}$



**5 AMPERE  
POWER TRANSISTORS  
COMPLEMENTARY SILICON**

**25 VOLTS  
15 WATTS**



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

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	10.80	11.04	0.425	0.435
B	7.50	7.74	0.295	0.305
C	2.42	2.66	0.095	0.105
D	0.51	0.66	0.020	0.026
F	2.93	3.17	0.115	0.125
G	2.39 BSC		0.094 BSC	
H	1.27	2.41	0.050	0.095
J	0.39	0.63	0.015	0.025
K	14.61	16.63	0.575	0.655
M	3 TYP		3 TYP	
Q	3.76	4.01	0.148	0.158
R	1.15	1.39	0.045	0.055
S	0.64	0.88	0.025	0.035
U	3.69	3.93	0.145	0.155
V	1.02	—	0.040	—

**CASE 77-06  
TO-225AA TYPE**

# MJE200, NPN, MJE210, PNP

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

Characteristic	Symbol	Min	Max	Unit
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### OFF CHARACTERISTICS

Collector-Emitter Sustaining Voltage (1) ( $I_C = 10 \text{ mAdc}, I_B = 0$ )	$V_{CE(sus)}$	25	—	Vdc
Collector Cutoff Current ( $V_{CB} = 40 \text{ Vdc}, I_E = 0$ ) ( $V_{CB} = 40 \text{ Vdc}, I_E = 0, T_J = 125^\circ\text{C}$ )	$I_{CBO}$	—	100 100	nAdc $\mu\text{Adc}$
Emitter Cutoff Current ( $V_{BE} = 8.0 \text{ Vdc}, I_C = 0$ )	$I_{EBO}$	—	100	nAdc

### ON CHARACTERISTICS

DC Current Gain (1) ( $I_C = 500 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc}$ ) ( $I_C = 2.0 \text{ Adc}, V_{CE} = 1.0 \text{ Vdc}$ ) ( $I_C = 5.0 \text{ Adc}, V_{CE} = 2.0 \text{ Vdc}$ )	$h_{FE}$	70 45 10	— 180 —	—
Collector-Emitter Saturation Voltage (1) ( $I_C = 500 \text{ mAdc}, I_B = 50 \text{ mAdc}$ ) ( $I_C = 2.0 \text{ Adc}, I_B = 200 \text{ mAdc}$ ) ( $I_C = 5.0 \text{ Adc}, I_B = 1.0 \text{ Adc}$ )	$V_{CE(sat)}$	— — —	0.3 0.75 1.8	Vdc
Base-Emitter Saturation Voltage (1) ( $I_C = 5.0 \text{ Adc}, I_B = 1.0 \text{ Adc}$ )	$V_{BE(sat)}$	—	2.5	Vdc
Base-Emitter On Voltage (1) ( $I_C = 2.0 \text{ Adc}, V_{CE} = 1.0 \text{ Vdc}$ )	$V_{BE(on)}$	—	1.6	Vdc

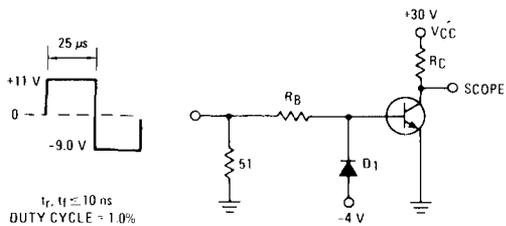
### DYNAMIC CHARACTERISTICS

Current-Gain — Bandwidth Product (2) ( $I_C = 100 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f_{test} = 10 \text{ MHz}$ )	$f_T$	65	—	MHz
Output Capacitance ( $V_{CB} = 10 \text{ Vdc}, I_E = 0, f = 0.1 \text{ MHz}$ )	$C_{ob}$	— —	80 120	pF
		MJE200 MJE210		

(1) Pulse test: Pulse Width = 300  $\mu\text{s}$ , Duty Cycle  $\approx 2.0\%$ .

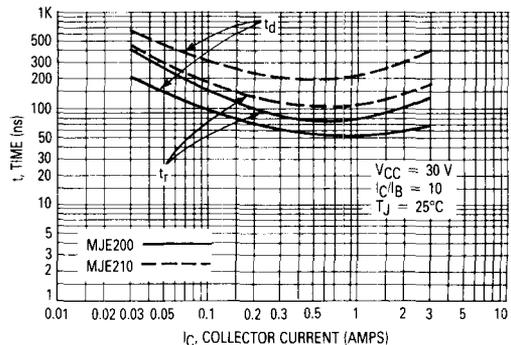
(2)  $f_T = |h_{fe}| \cdot f_{test}$

FIGURE 2 — SWITCHING TIME TEST CIRCUIT



FOR PNP TEST CIRCUIT, REVERSE ALL POLARITIES

FIGURE 3 — TURN-ON TIME



# MJE200, NPN, MJE210, PNP

FIGURE 4 – THERMAL RESPONSE

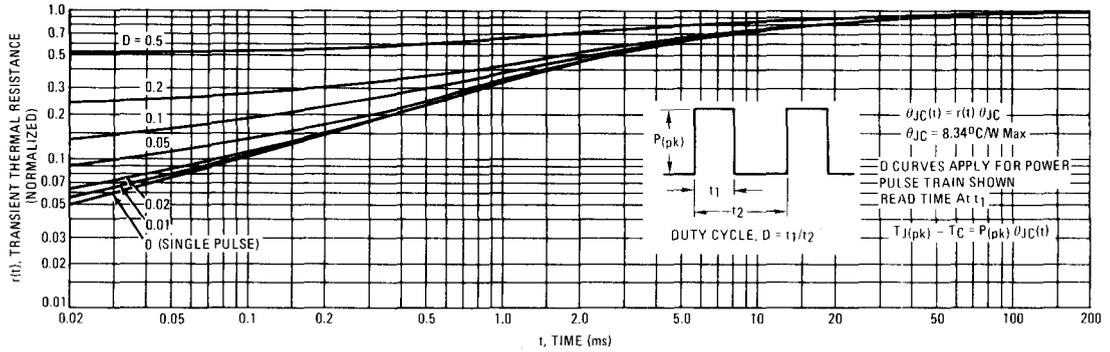
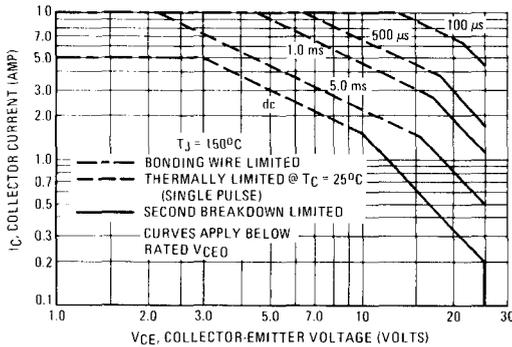


FIGURE 5 – ACTIVE REGION SAFE OPERATING AREA



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  $T_{J(pk)} = 150^\circ\text{C}$ ;  $T_C$  is variable depending on conditions. Second breakdown pulse limits are valid for duty cycles to 10% provided  $T_{J(pk)} \leq 150^\circ\text{C}$ .  $T_{J(pk)}$  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.

FIGURE 6 – TURN-OFF TIME

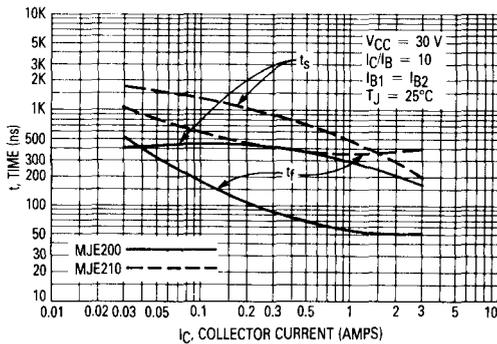
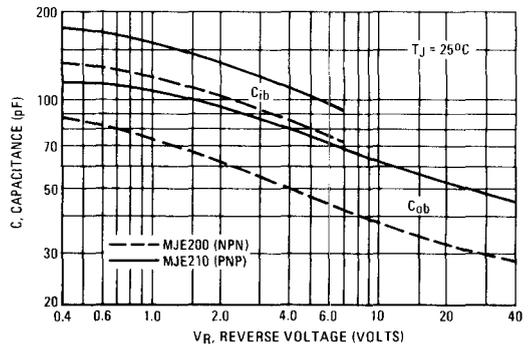


FIGURE 7 – CAPACITANCE

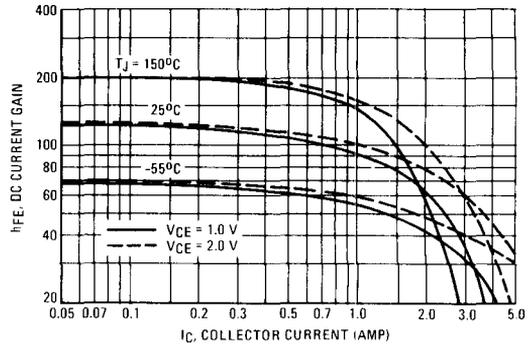
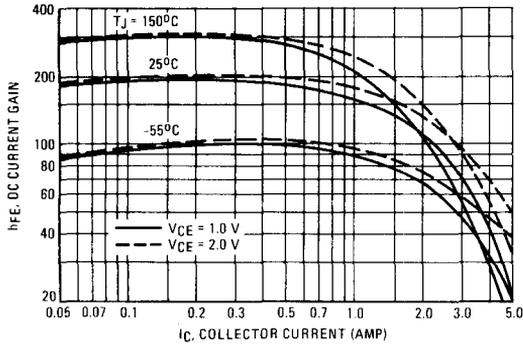


# MJE200, NPN, MJE210, PNP

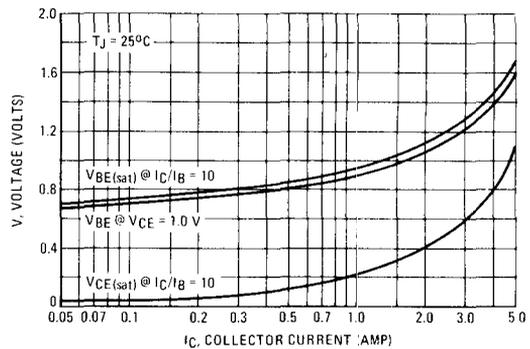
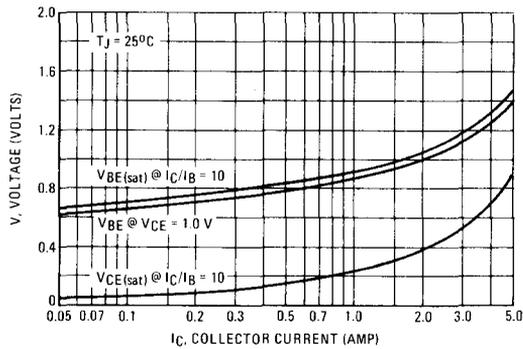
**NPN  
MJE200**

**PNP  
MJE210**

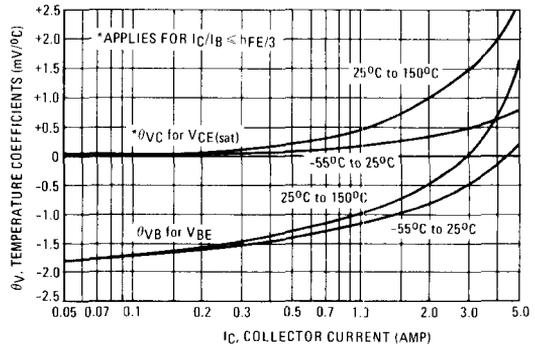
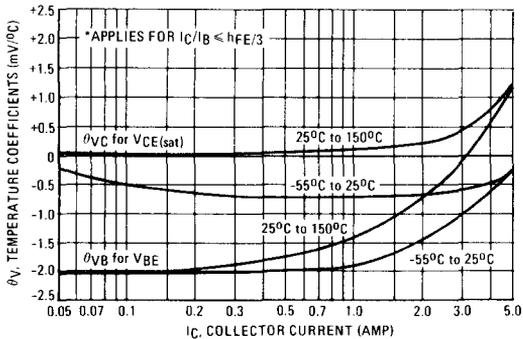
**FIGURE 8 – DC CURRENT GAIN**



**FIGURE 9 – "ON" VOLTAGE**



**FIGURE 10 – TEMPERATURE COEFFICIENTS**



**3**