

MOTOROLA

SEMICONDUCTOR TECHNICAL DATA

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by MJ21193/D

Silicon Power Transistors

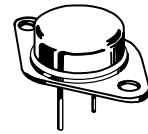
The MJ21193 and MJ21194 utilize Perforated Emitter technology and are specifically designed for high power audio output, disk head positioners and linear applications.

- Total Harmonic Distortion Characterized
- High DC Current Gain – $h_{FE} = 25$ Min @ $I_C = 8$ Adc
- Excellent Gain Linearity
- High SOA: 2.5 A, 80 V, 1 Second

PNP
MJ21193*
NPN
MJ21194*

*Motorola Preferred Device

**16 AMPERE
COMPLEMENTARY
SILICON POWER
TRANSISTORS
250 VOLTS
250 WATTS**



**CASE 1-07
TO-204AA
(TO-3)**

MAXIMUM RATINGS

| Rating | Symbol | Value | Unit |
|---|----------------|--------------|------------------------------|
| Collector–Emitter Voltage | V_{CEO} | 250 | Vdc |
| Collector–Base Voltage | V_{CBO} | 400 | Vdc |
| Emitter–Base Voltage | V_{EBO} | 5 | Vdc |
| Collector–Emitter Voltage – 1.5 V | V_{CEX} | 400 | Vdc |
| Collector Current — Continuous Peak (1) | I_C | 16 30 | Adc |
| Base Current — Continuous | I_B | 5 | 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 | $R_{\theta JC}$ | 0.7 | $^\circ\text{C}/\text{W}$ |

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

| Characteristic | Symbol | Min | Typical | Max | Unit |
|----------------|--------|-----|---------|-----|------|
|----------------|--------|-----|---------|-----|------|

OFF CHARACTERISTICS

| | | | | | |
|---|----------------|-----|---|-----|-----------------|
| Collector–Emitter Sustaining Voltage ($I_C = 100$ mAdc, $I_B = 0$) | $V_{CEO(sus)}$ | 250 | — | — | Vdc |
| Collector Cutoff Current ($V_{CE} = 200$ Vdc, $I_B = 0$) | I_{CEO} | — | — | 100 | μAdc |

(1) Pulse Test: Pulse Width = 5 μs , Duty Cycle $\leq 10\%$.

(continued)

Preferred devices are Motorola recommended choices for future use and best overall value.

REV 1



MJ21193 MJ21194**ELECTRICAL CHARACTERISTICS** ($T_C = 25^\circ\text{C}$ unless otherwise noted)

| Characteristic | Symbol | Min | Typical | Max | Unit |
|----------------|--------|-----|---------|-----|------|
|----------------|--------|-----|---------|-----|------|

OFF CHARACTERISTICS

| | | | | | |
|---|-----------|---|---|-----|-----------------|
| Emitter Cutoff Current ($V_{CE} = 5\text{ Vdc}$, $I_C = 0$) | I_{EBO} | — | — | 100 | μAdc |
| Collector Cutoff Current ($V_{CE} = 250\text{ Vdc}$, $V_{BE(\text{off})} = 1.5\text{ Vdc}$) | I_{CEX} | — | — | 100 | μAdc |

SECOND BREAKDOWN

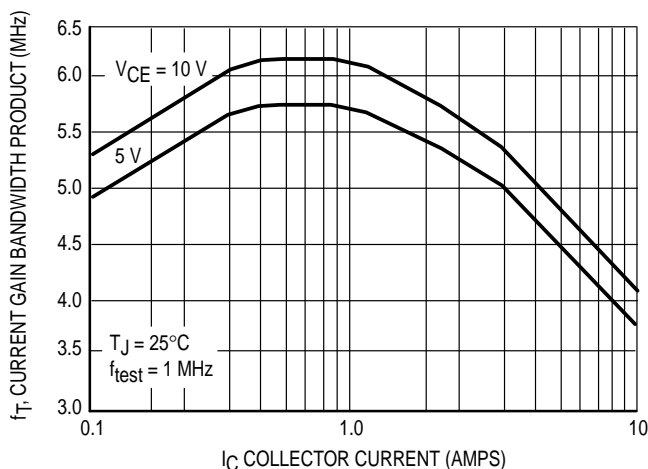
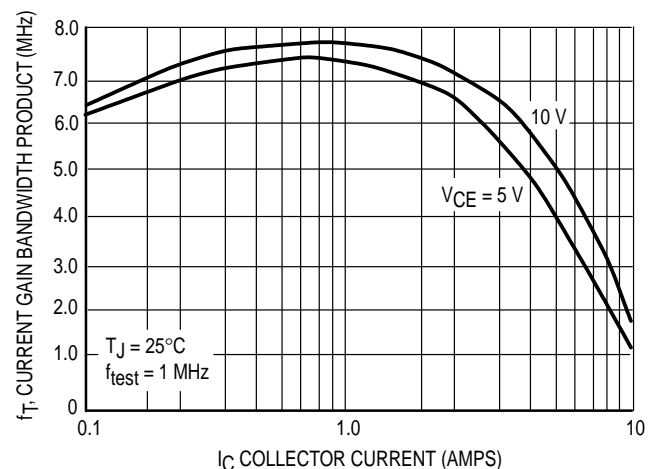
| | | | | | |
|--|-----------|----------|--------|--------|--------------|
| Second Breakdown Collector Current with Base Forward Biased ($V_{CE} = 50\text{ Vdc}$, $t = 1\text{ s}$ (non-repetitive) ($V_{CE} = 80\text{ Vdc}$, $t = 1\text{ s}$ (non-repetitive)) | $I_{S/b}$ | 5 2.5 | — — | — — | Adc |
|--|-----------|----------|--------|--------|--------------|

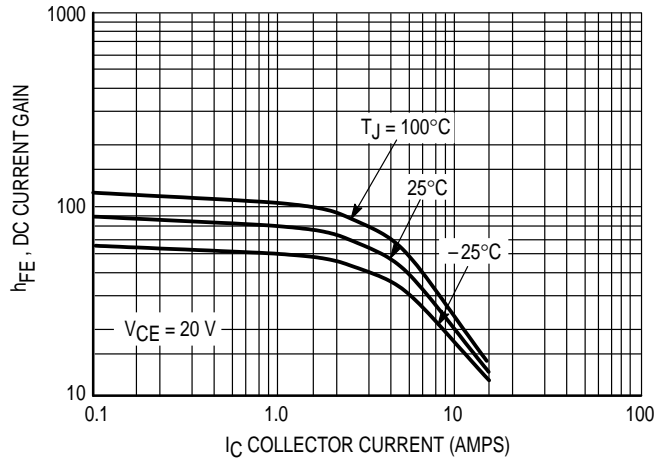
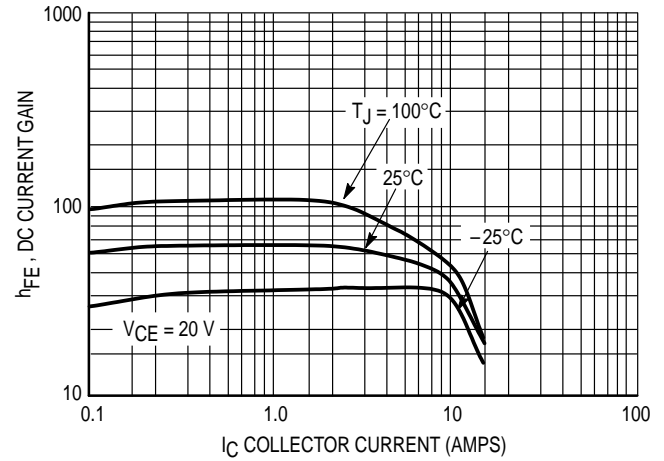
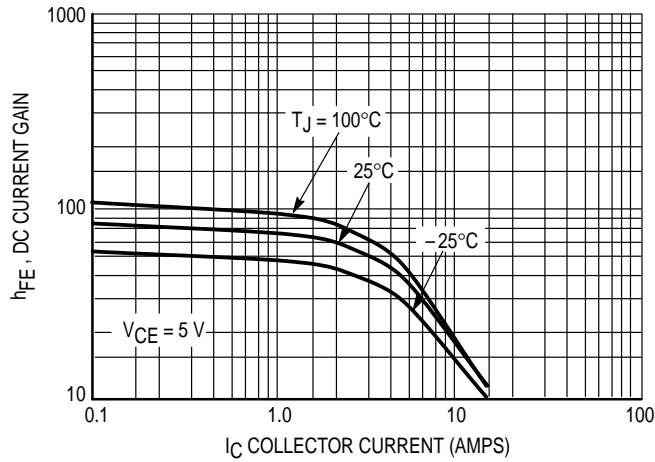
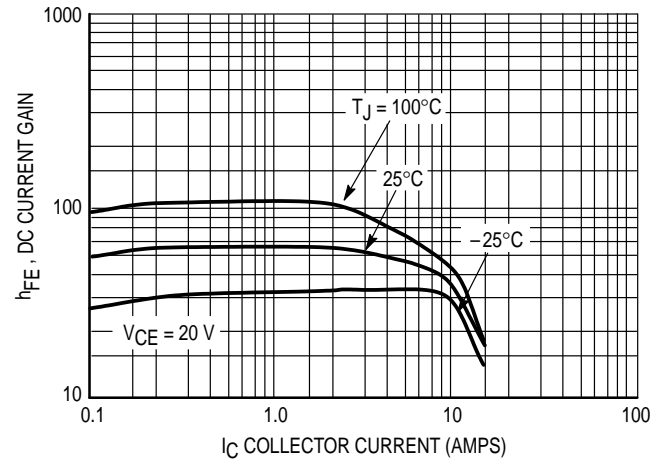
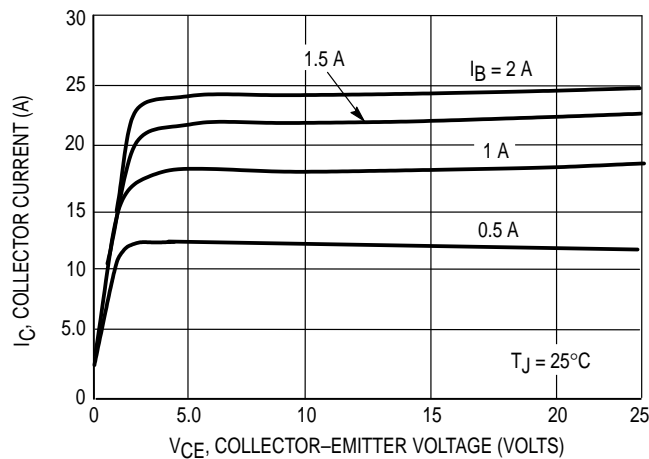
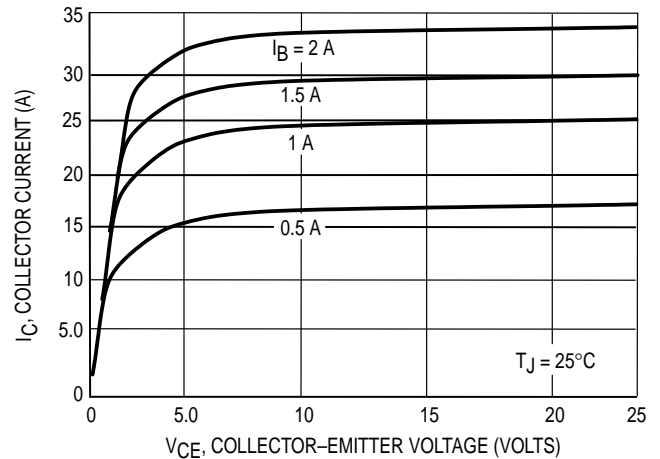
ON CHARACTERISTICS

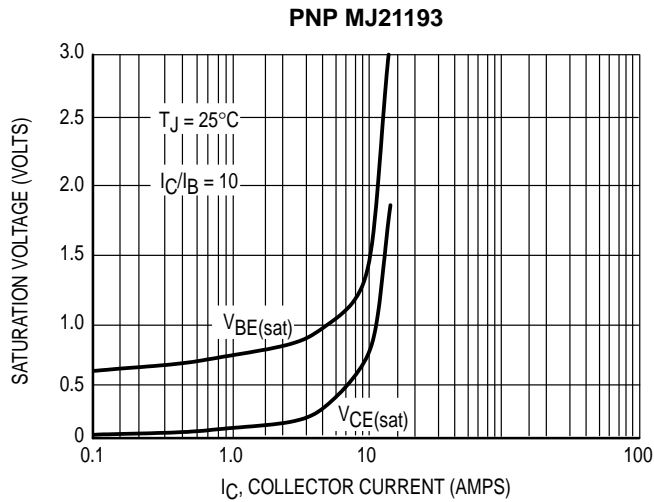
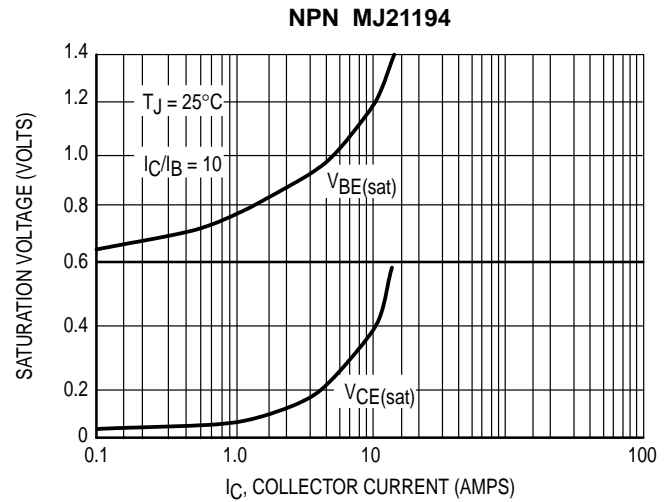
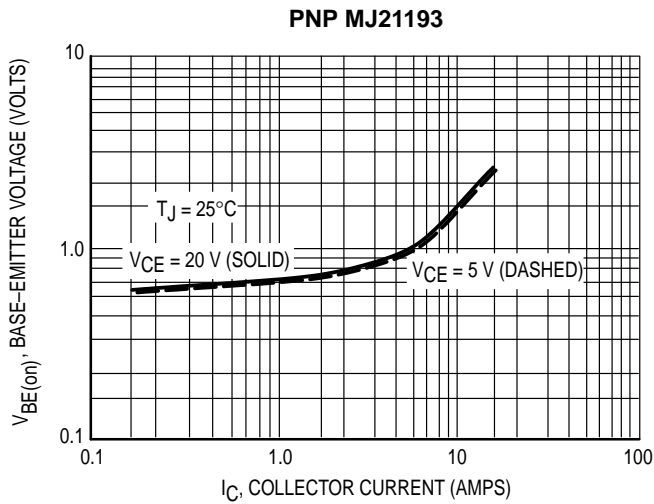
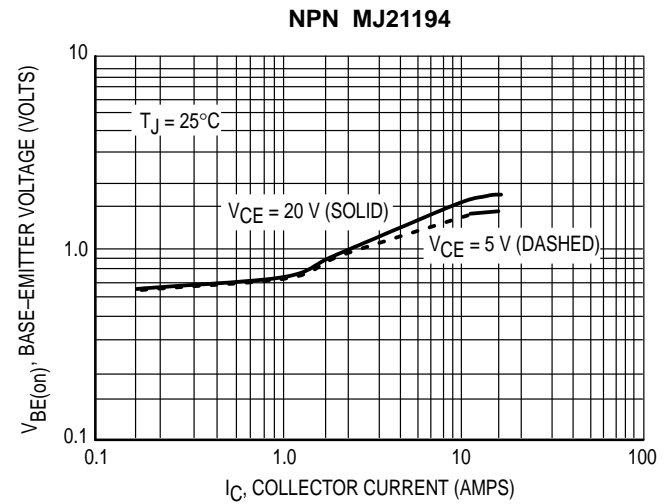
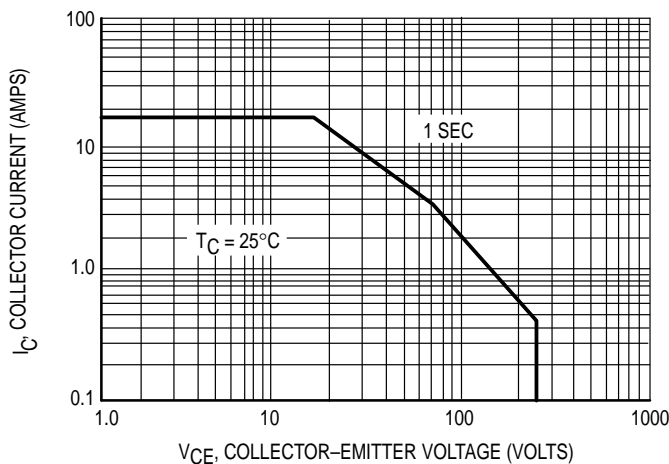
| | | | | | |
|---|----------------------|---------|--------|----------|--------------|
| DC Current Gain ($I_C = 8\text{ Adc}$, $V_{CE} = 5\text{ Vdc}$) ($I_C = 16\text{ Adc}$, $I_B = 5\text{ Adc}$) | h_{FE} | 25 8 | — — | 75 | |
| Base-Emitter On Voltage ($I_C = 8\text{ Adc}$, $V_{CE} = 5\text{ Vdc}$) | $V_{BE(\text{on})}$ | — | — | 2.2 | Vdc |
| Collector-Emitter Saturation Voltage ($I_C = 8\text{ Adc}$, $I_B = 0.8\text{ Adc}$) ($I_C = 16\text{ Adc}$, $I_B = 3.2\text{ Adc}$) | $V_{CE(\text{sat})}$ | — — | — — | 1.4 4 | Vdc |

DYNAMIC CHARACTERISTICS

| | | | | | |
|--|----------|--------|-------------|--------|--------------|
| Total Harmonic Distortion at the Output $V_{RMS} = 28.3\text{ V}$, $f = 1\text{ kHz}$, $P_{LOAD} = 100\text{ W}_{RMS}$ (Matched pair $h_{FE} = 50$ @ $5\text{ A}/5\text{ V}$) h_{FE} unmatched h_{FE} matched | T_{HD} | — — | 0.8 0.08 | — — | % |
| Current Gain Bandwidth Product ($I_C = 1\text{ Adc}$, $V_{CE} = 10\text{ Vdc}$, $f_{\text{test}} = 1\text{ MHz}$) | f_T | 4 | — | — | MHz |
| Output Capacitance ($V_{CB} = 10\text{ Vdc}$, $I_E = 0$, $f_{\text{test}} = 1\text{ MHz}$) | C_{ob} | — | — | 500 | pF |

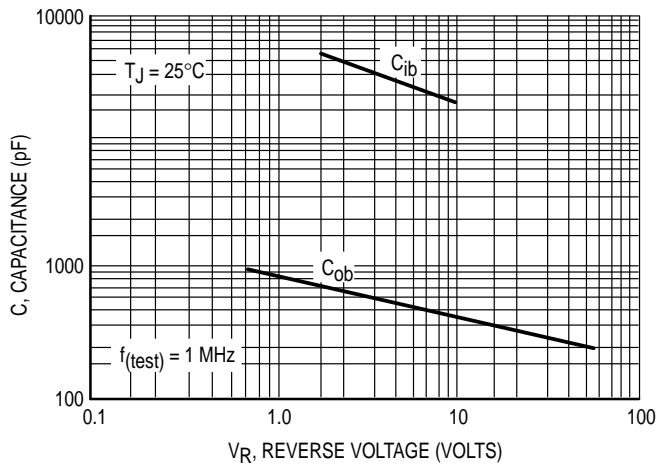
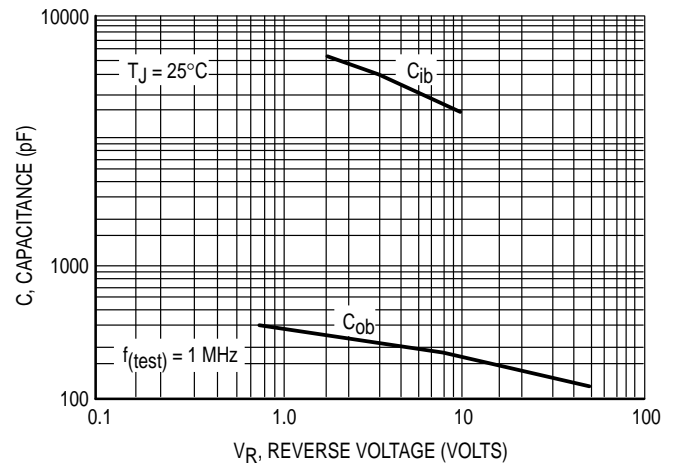
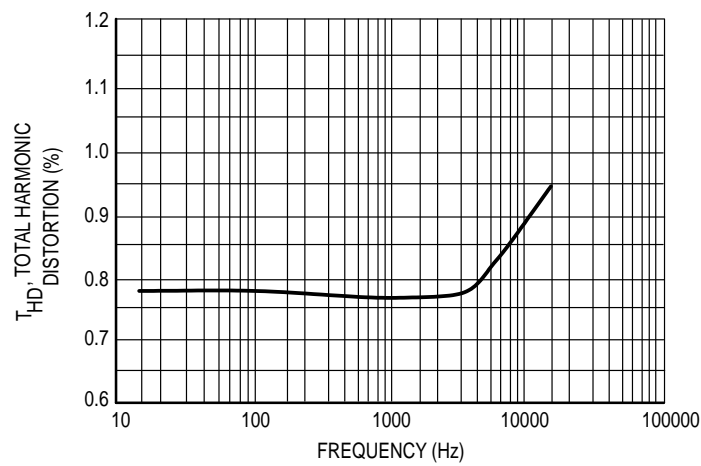
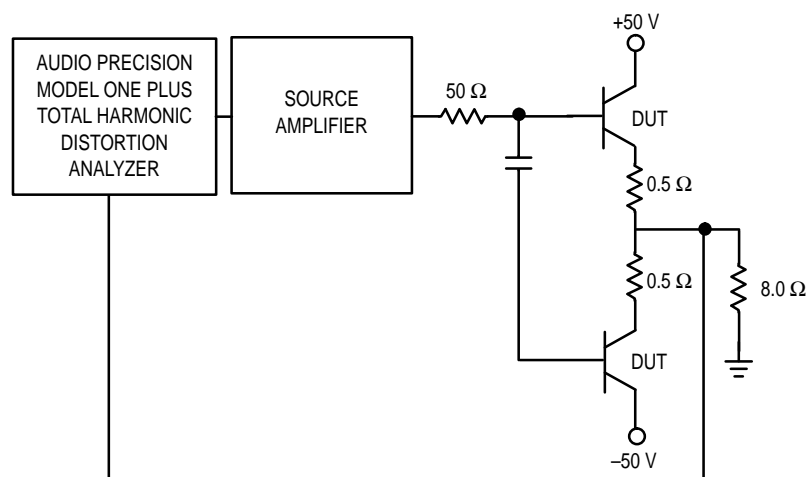
(1) Pulse Test: Pulse Width = $300\text{ }\mu\text{s}$, Duty Cycle $\leq 2\%$ **PNP MJ21193****Figure 1. Typical Current Gain Bandwidth Product****NPN MJ21194****Figure 2. Typical Current Gain Bandwidth Product**

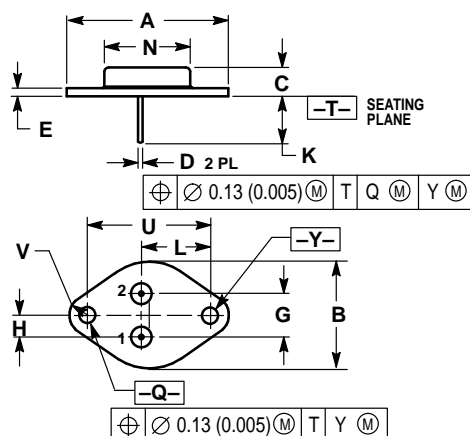
MJ21193 MJ21194**TYPICAL CHARACTERISTICS****PNP MJ21193****Figure 3. DC Current Gain, $V_{CE} = 20\text{ V}$** **NPN MJ21194****Figure 4. DC Current Gain, $V_{CE} = 20\text{ V}$** **PNP MJ21193****Figure 5. DC Current Gain, $V_{CE} = 5\text{ V}$** **NPN MJ21194****Figure 6. DC Current Gain, $V_{CE} = 5\text{ V}$** **PNP MJ21193****Figure 7. Typical Output Characteristics****NPN MJ21194****Figure 8. Typical Output Characteristics**

MJ21193 MJ21194**TYPICAL CHARACTERISTICS****Figure 9. Typical Saturation Voltages****Figure 10. Typical Saturation Voltages****Figure 11. Typical Base-Emitter Voltage****Figure 12. Typical Base-Emitter Voltage****Figure 13. Active Region Safe Operating Area**

There are two limitations on the power handling ability of a transistor; average junction temperature and secondary 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 13 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 than can be handled to values less than the limitations imposed by second breakdown.

MJ21193 MJ21194**Figure 14. MJ21193 Typical Capacitance****Figure 15. MJ21194 Typical Capacitance****Figure 16. Typical Total Harmonic Distortion****Figure 17. Total Harmonic Distortion Test Circuit**

MJ21193 MJ21194**PACKAGE DIMENSIONS****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 | INCHES | | MILLIMETERS | |
|-----|-----------|-------|-------------|-------|
| | MIN | MAX | MIN | MAX |
| A | 1.550 REF | | 39.37 REF | |
| B | — | 1.050 | — | 26.67 |
| C | 0.250 | 0.335 | 6.35 | 8.51 |
| D | 0.038 | 0.043 | 0.97 | 1.09 |
| E | 0.055 | 0.070 | 1.40 | 1.77 |
| G | 0.430 BSC | | 10.92 BSC | |
| H | 0.215 BSC | | 5.46 BSC | |
| K | 0.440 | 0.480 | 11.18 | 12.19 |
| L | 0.665 BSC | | 16.89 BSC | |
| N | — | 0.830 | — | 21.08 |
| Q | 0.151 | 0.165 | 3.84 | 4.19 |
| U | 1.187 BSC | | 30.15 BSC | |
| V | 0.131 | 0.188 | 3.33 | 4.77 |

STYLE 1:

1. BASE
 2. EMITTER
- CASE: COLLECTOR

CASE 1-07
TO-204AA (TO-3)
ISSUE Z

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