

# MJ21193, MJ21194

Preferred Device

## Silicon Power Transistors

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

### Features

- Total Harmonic Distortion Characterized
- High DC Current Gain –  $h_{FE} = 25 \text{ Min @ } I_C = 8 \text{ A dc}$
- Excellent Gain Linearity
- High SOA: 2.5 A, 80 V, 1 Second
- Pb-Free Packages are Available\*

### 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<br>Peak (Note 1)                                       | $I_C$          | 16<br>30     | Adc                      |
| Base Current – Continuous                                                             | $I_B$          | 5            | Adc                      |
| Total Power Dissipation @ $T_C = 25^\circ\text{C}$<br>Derate Above $25^\circ\text{C}$ | $P_D$          | 250<br>1.43  | W<br>W/ $^\circ\text{C}$ |
| Operating and Storage Junction<br>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 | $^\circ\text{C/W}$ |

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

1. Pulse Test: Pulse Width = 5  $\mu\text{s}$ , Duty Cycle  $\leq 10\%$ . (continued)

\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

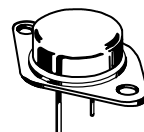


ON Semiconductor®

<http://onsemi.com>

## 16 AMP COMPLEMENTARY SILICON POWER TRANSISTORS 250 VOLTS, 250 WATTS

### MARKING DIAGRAM



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



MJ2119x = Device Code  
          x = 3 or 4  
G      = Pb-Free Package  
A      = Assembly Location  
YY     = Year  
WW     = Work Week  
MEX    = Country of Origin

### ORDERING INFORMATION

| Device   | Package           | Shipping†        |
|----------|-------------------|------------------|
| MJ21193  | TO-3              | 100 Units / Tray |
| MJ21193G | TO-3<br>(Pb-Free) | 100 Units / Tray |
| MJ21194  | TO-3              | 100 Units / Tray |
| MJ21194G | TO-3<br>(Pb-Free) | 100 Units / Tray |

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

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

# MJ21193, MJ21194

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

| Characteristic | Symbol | Min | Typ | Max | Unit |
|----------------|--------|-----|-----|-----|------|
|----------------|--------|-----|-----|-----|------|

### OFF CHARACTERISTICS

|                                                                                              |                |     |   |     |                 |
|----------------------------------------------------------------------------------------------|----------------|-----|---|-----|-----------------|
| Collector-Emitter Sustaining Voltage<br>( $I_C = 100 \text{ mAdc}$ , $I_B = 0$ )             | $V_{CEO(sus)}$ | 250 | – | –   | Vdc             |
| Collector Cutoff Current<br>( $V_{CE} = 200 \text{ Vdc}$ , $I_B = 0$ )                       | $I_{CEO}$      | –   | – | 100 | $\mu\text{Adc}$ |
| Emitter Cutoff Current<br>( $V_{CE} = 5 \text{ Vdc}$ , $I_C = 0$ )                           | $I_{EBO}$      | –   | – | 100 | $\mu\text{Adc}$ |
| Collector Cutoff Current<br>( $V_{CE} = 250 \text{ Vdc}$ , $V_{BE(off)} = 1.5 \text{ Vdc}$ ) | $I_{CEX}$      | –   | – | 100 | $\mu\text{Adc}$ |

### SECOND BREAKDOWN

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

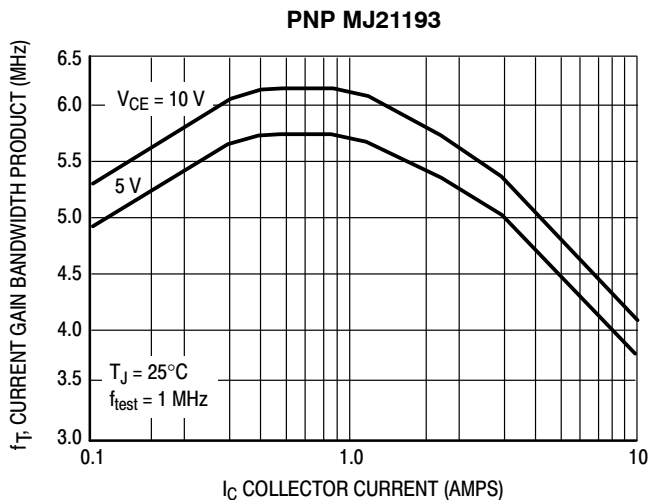
### ON CHARACTERISTICS

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

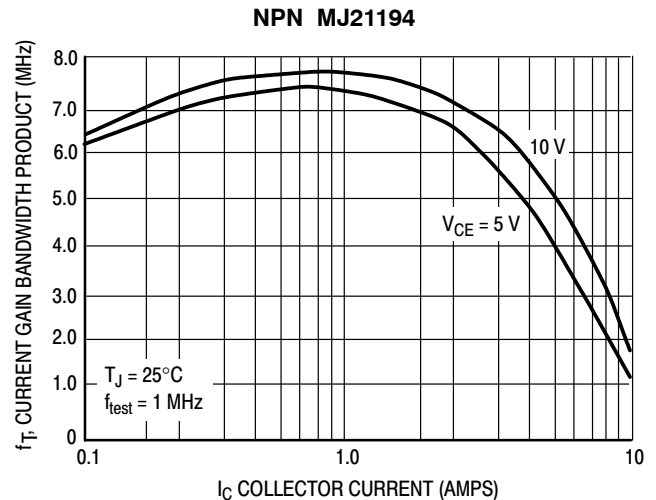
### DYNAMIC CHARACTERISTICS

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

NOTE: Pulse Test: Pulse Width = 300  $\mu\text{s}$ , Duty Cycle  $\leq 2\%$



**Figure 1. Typical Current Gain Bandwidth Product**



**Figure 2. Typical Current Gain Bandwidth Product**

TYPICAL CHARACTERISTICS

PNP MJ21193

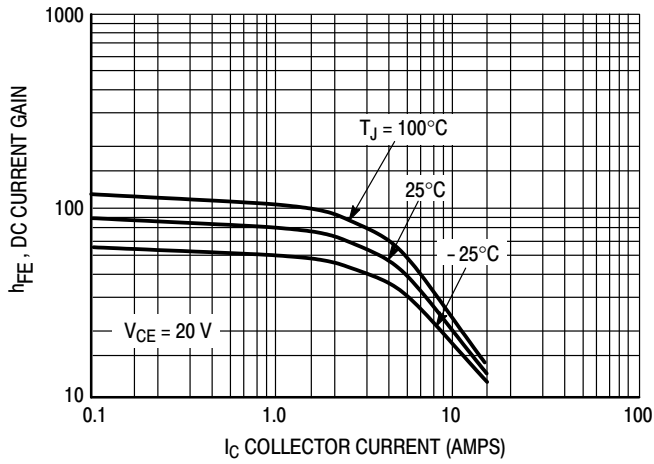


Figure 3. DC Current Gain,  $V_{CE} = 20\text{ V}$

NPN MJ21194

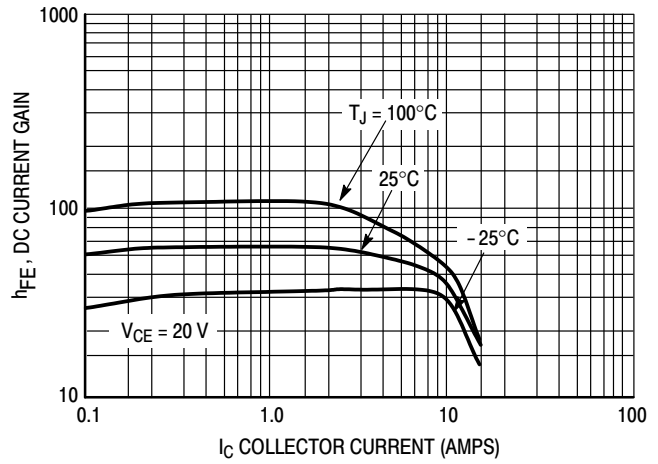


Figure 4. DC Current Gain,  $V_{CE} = 20\text{ V}$

PNP MJ21193

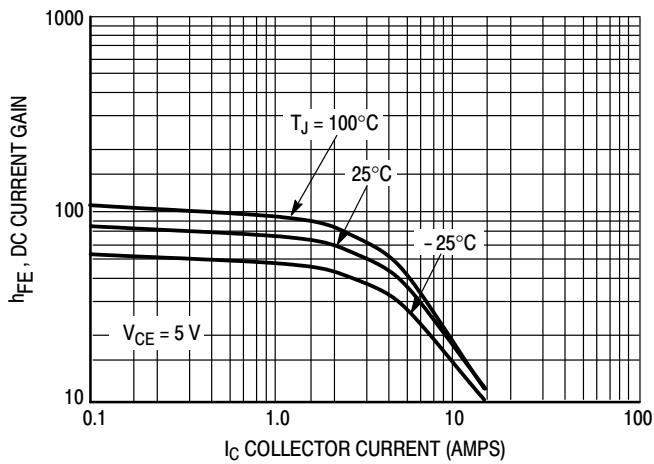


Figure 5. DC Current Gain,  $V_{CE} = 5\text{ V}$

NPN MJ21194

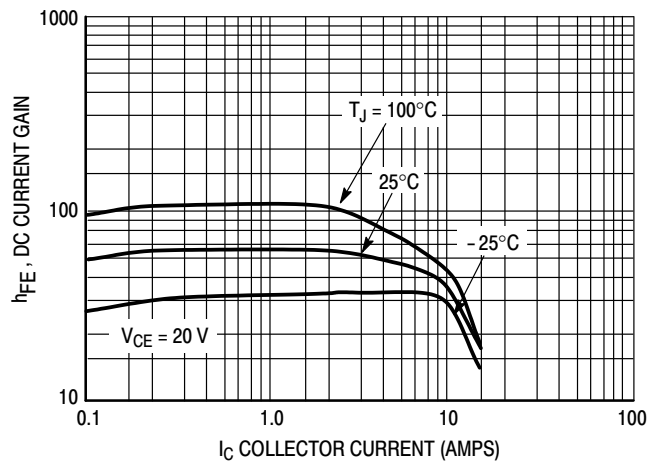


Figure 6. DC Current Gain,  $V_{CE} = 5\text{ V}$

PNP MJ21193

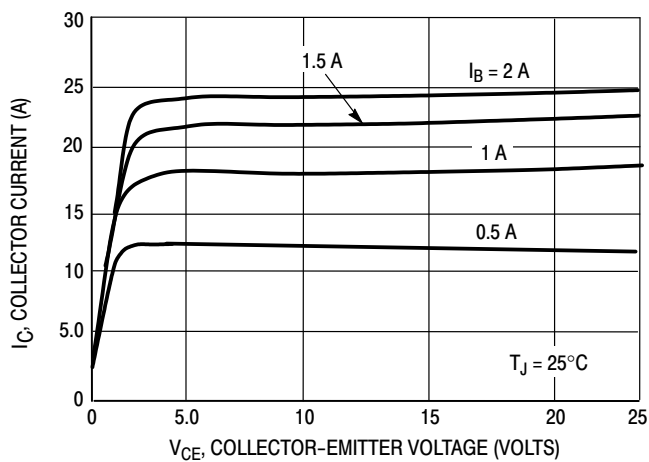


Figure 7. Typical Output Characteristics

NPN MJ21194

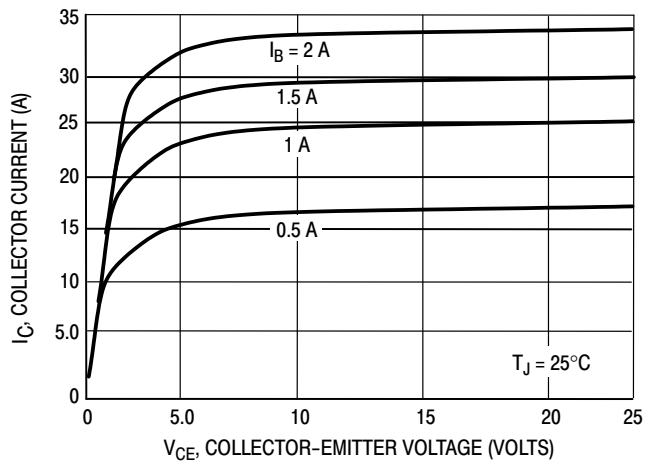


Figure 8. Typical Output Characteristics

TYPICAL CHARACTERISTICS

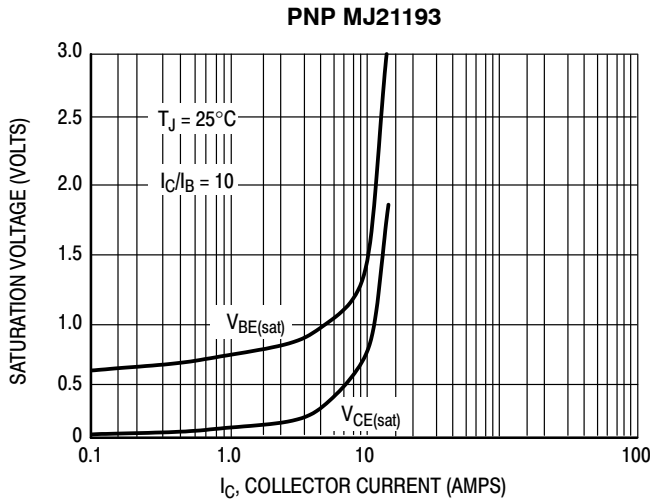


Figure 9. Typical Saturation Voltages

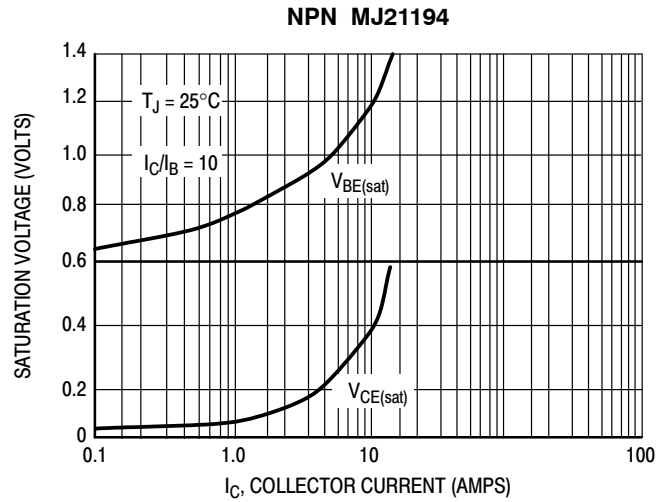


Figure 10. Typical Saturation Voltages

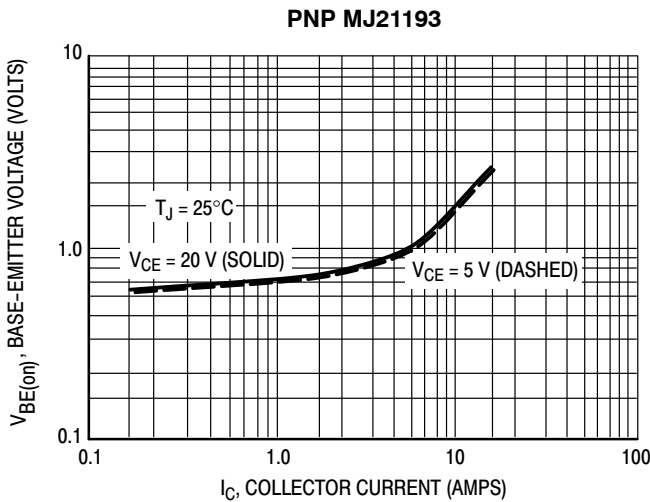


Figure 11. Typical Base-Emitter Voltage

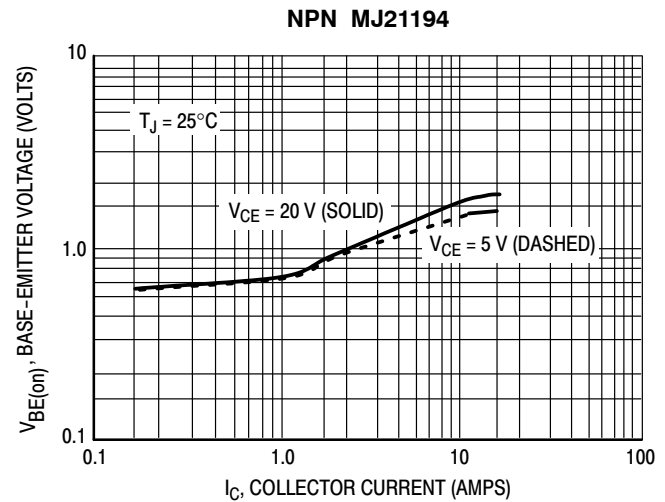


Figure 12. Typical Base-Emitter Voltage

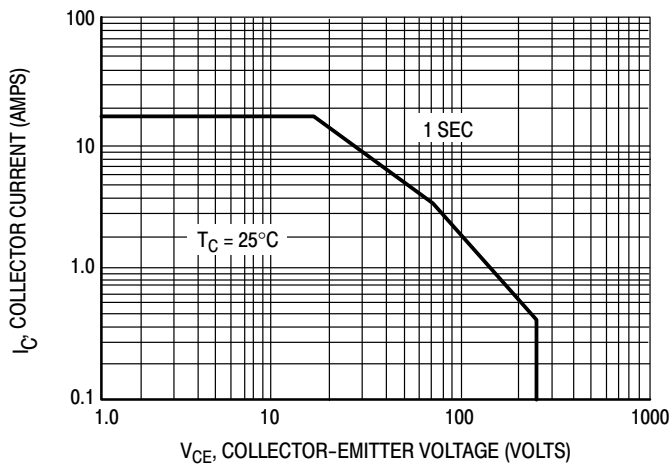


Figure 13. Active Region Safe Operating Area

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

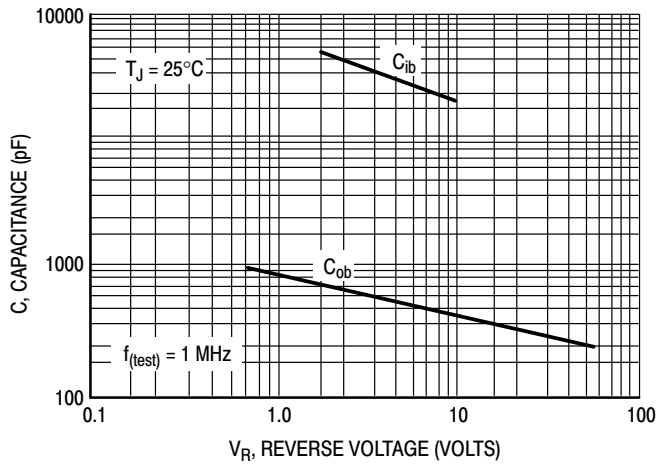


Figure 14. MJ21193 Typical Capacitance

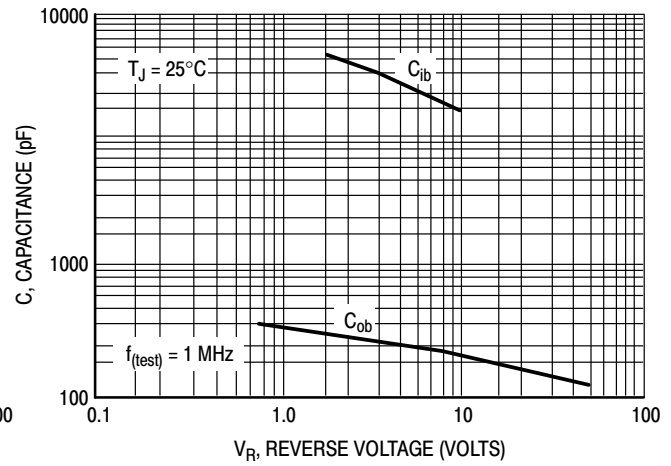


Figure 15. MJ21194 Typical Capacitance

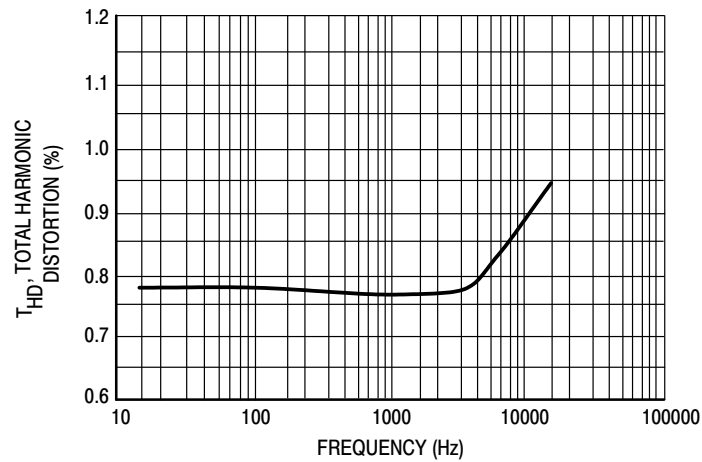


Figure 16. Typical Total Harmonic Distortion

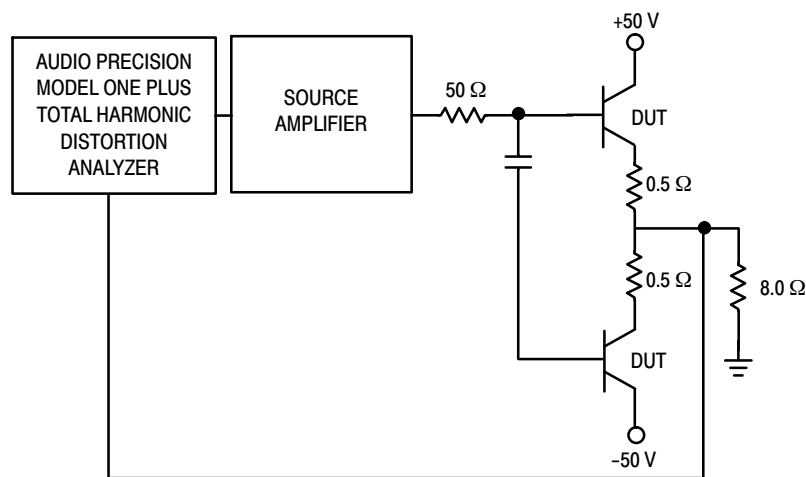


Figure 17. Total Harmonic Distortion Test Circuit

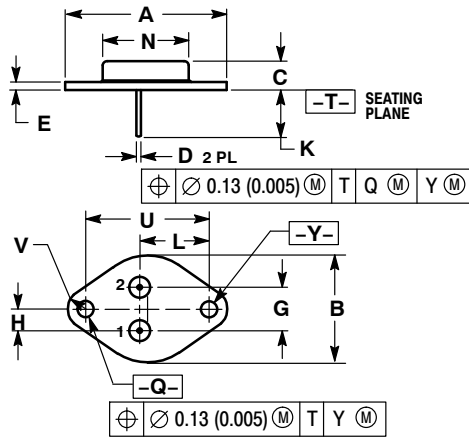
# MJ21193, MJ21194

## PACKAGE DIMENSIONS

TO-204AA (TO-3)

CASE 1-07

ISSUE Z



### 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:

- PIN 1. BASE
  - EMITTER
- CASE: COLLECTOR

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