

# 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 –  $h_{FE} = 25 \text{ Min @ } I_C = 8 \text{ Adc}$
- 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.

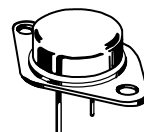


ON Semiconductor®

<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  $\leq 2\%$

PNP MJ21193

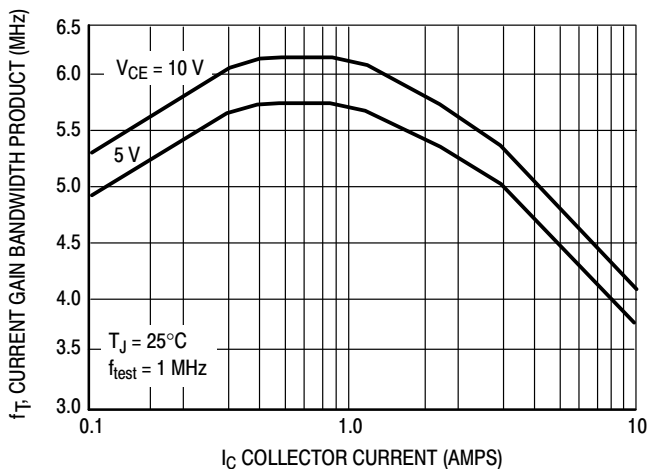


Figure 1. Typical Current Gain Bandwidth Product

NPN MJ21194

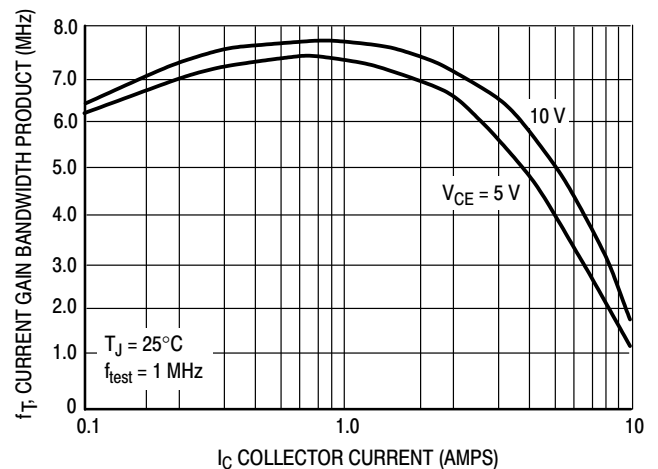


Figure 2. Typical Current Gain Bandwidth Product

TYPICAL CHARACTERISTICS

PNP MJ21193

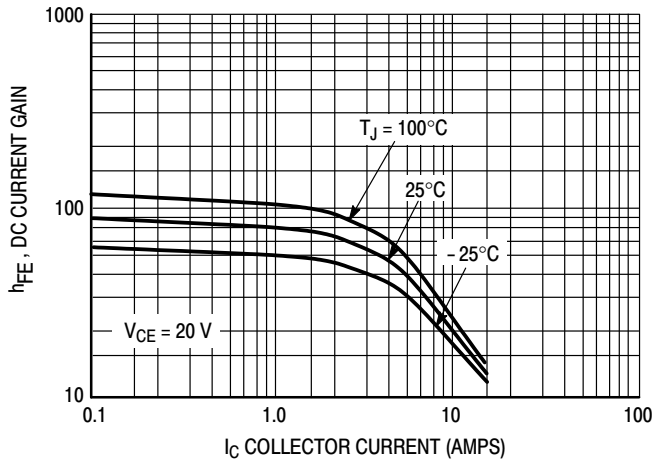


Figure 3. DC Current Gain,  $V_{CE} = 20\text{ V}$

NPN MJ21194

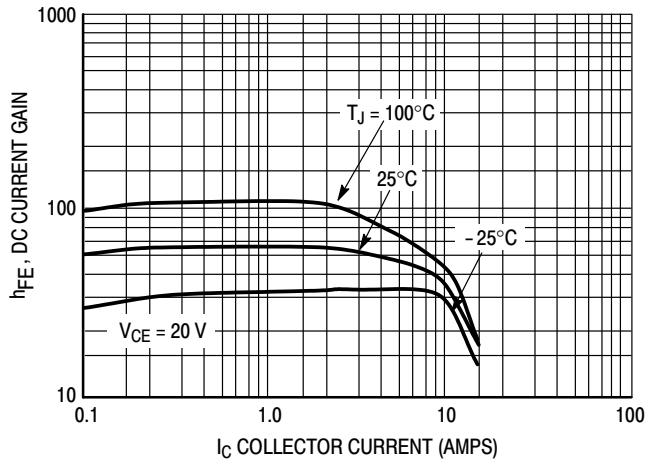


Figure 4. DC Current Gain,  $V_{CE} = 20\text{ V}$

PNP MJ21193

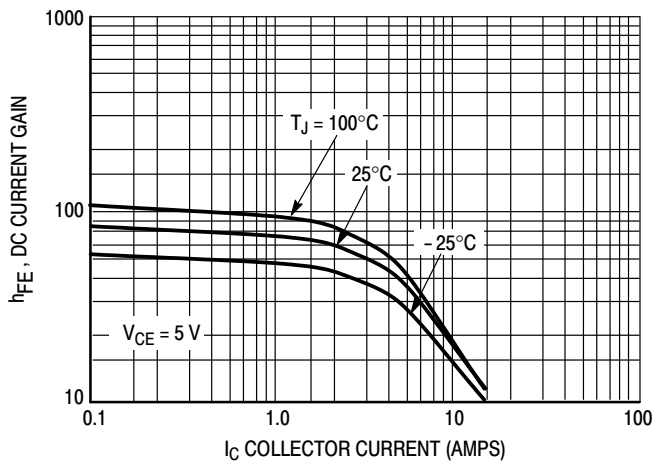


Figure 5. DC Current Gain,  $V_{CE} = 5\text{ V}$

NPN MJ21194

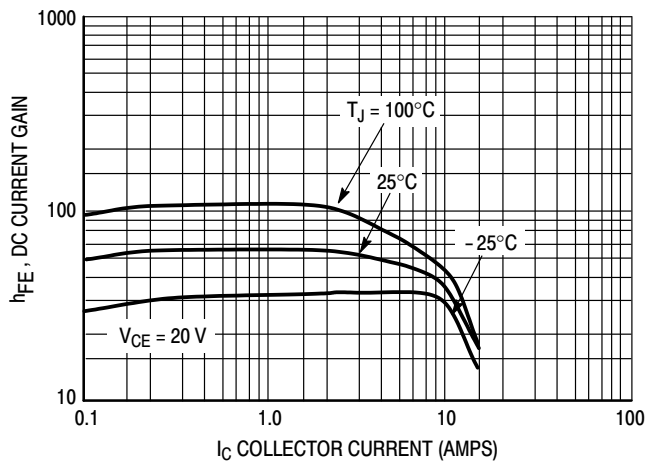


Figure 6. DC Current Gain,  $V_{CE} = 5\text{ V}$

PNP MJ21193

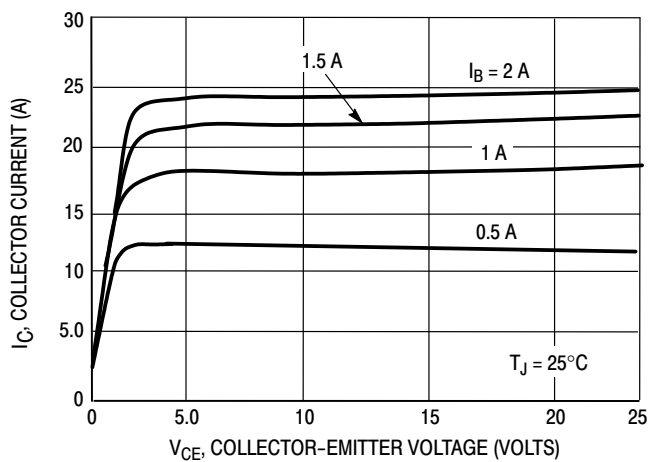


Figure 7. Typical Output Characteristics

NPN MJ21194

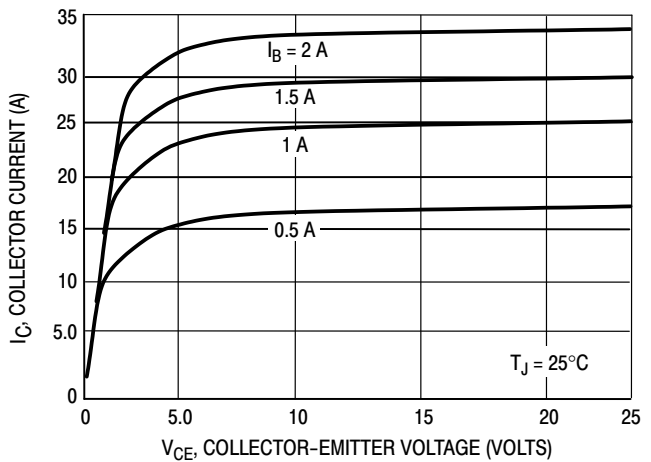


Figure 8. Typical Output Characteristics

TYPICAL CHARACTERISTICS

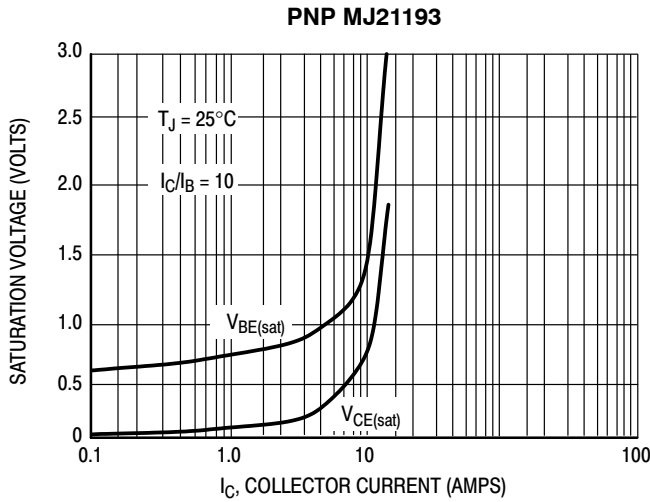


Figure 9. Typical Saturation Voltages

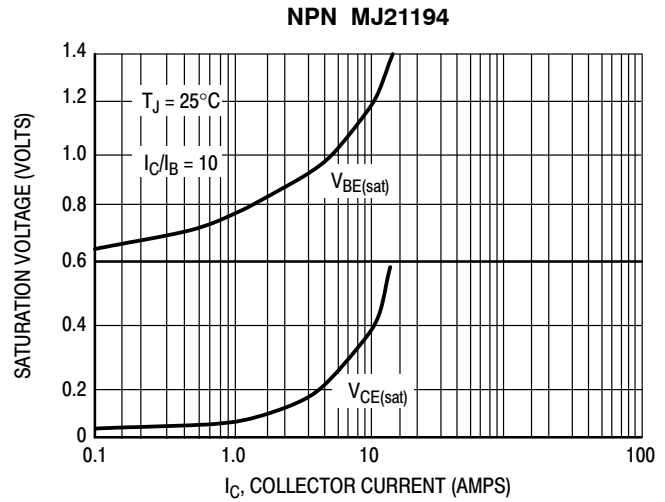


Figure 10. Typical Saturation Voltages

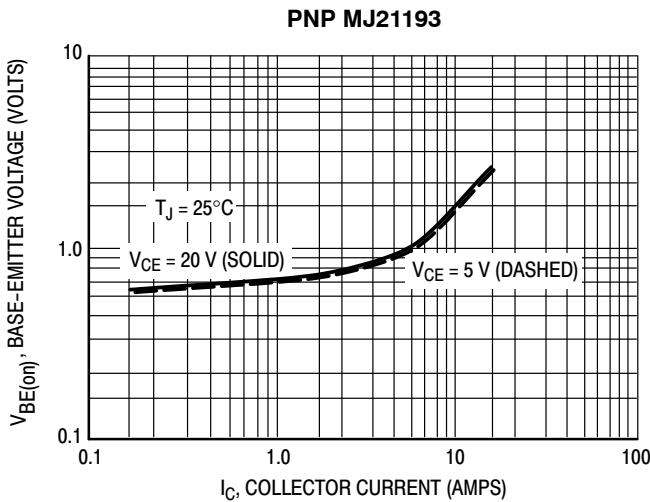


Figure 11. Typical Base-Emitter Voltage

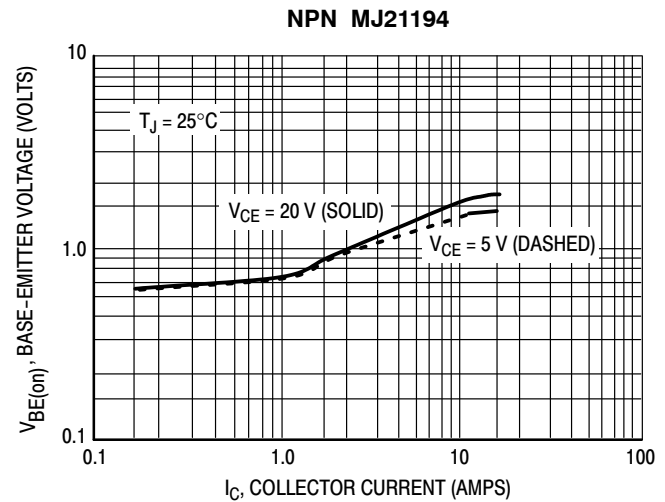


Figure 12. Typical Base-Emitter Voltage

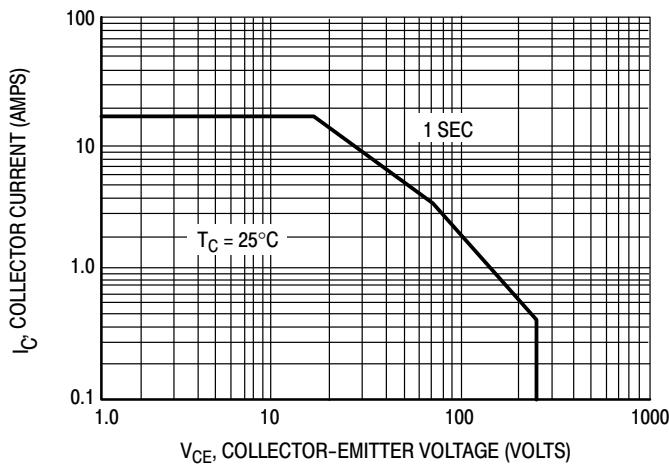


Figure 13. Active Region Safe Operating Area

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

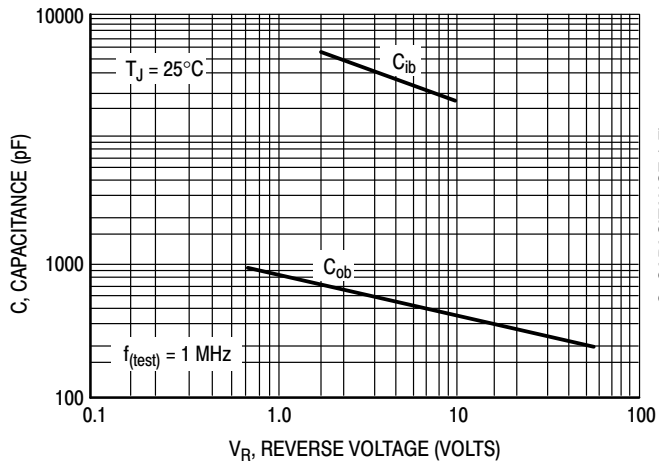


Figure 14. MJ21193 Typical Capacitance

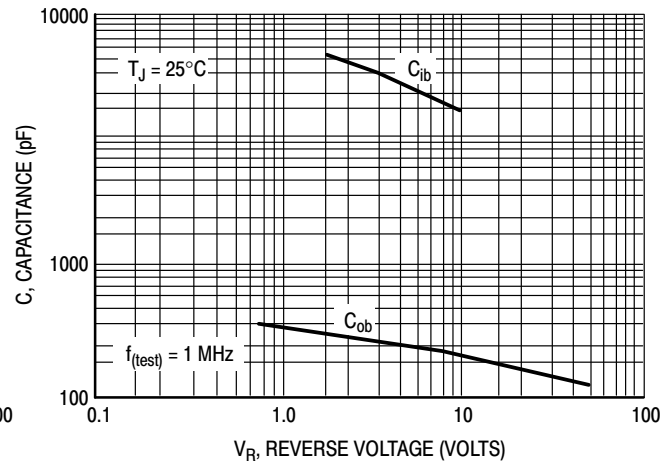


Figure 15. MJ21194 Typical Capacitance

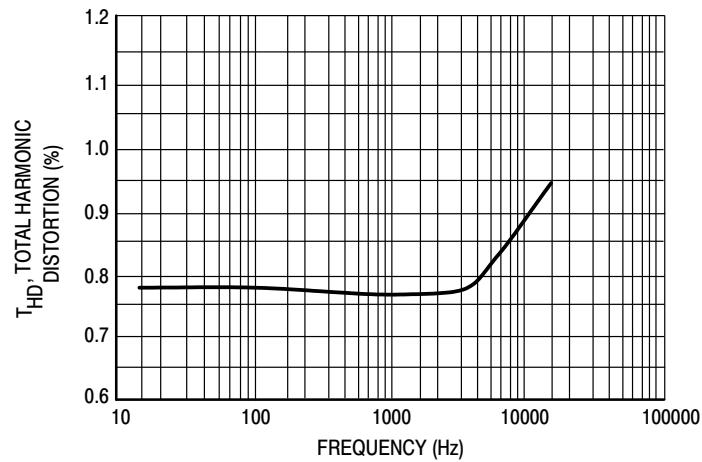


Figure 16. Typical Total Harmonic Distortion

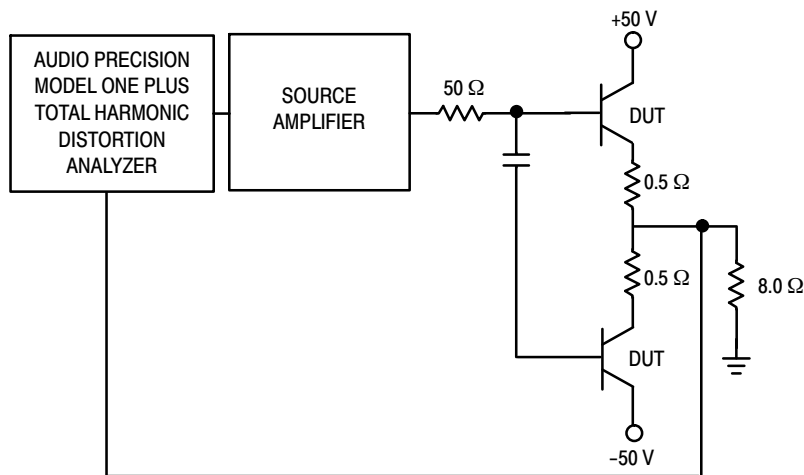


Figure 17. Total Harmonic Distortion Test Circuit

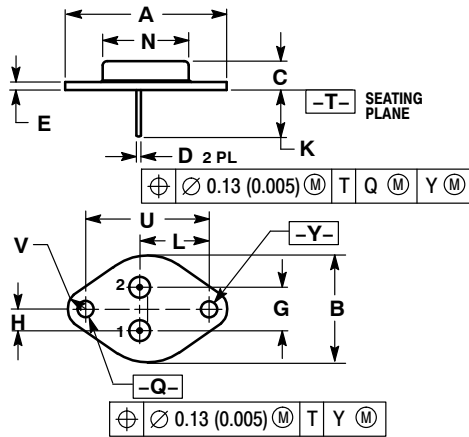
# MJ21193, MJ21194

## 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  
2: EMITTER  
CASE: COLLECTOR

ON Semiconductor and  are registered trademarks of Semiconductor Components Industries, LLC (SCILLC). SCILLC reserves the right to make changes without further notice to any products herein. SCILLC makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does SCILLC assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. "Typical" parameters which may be provided in SCILLC data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. SCILLC does not convey any license under its patent rights nor the rights of others. SCILLC products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the SCILLC product could create a situation where personal injury or death may occur. Should Buyer purchase or use SCILLC products for any such unintended or unauthorized application, Buyer shall indemnify and hold SCILLC and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that SCILLC was negligent regarding the design or manufacture of the part. SCILLC is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

## PUBLICATION ORDERING INFORMATION

### LITERATURE FULFILLMENT:

Literature Distribution Center for ON Semiconductor  
P.O. Box 5163, Denver, Colorado 80217 USA  
Phone: 303-675-2175 or 800-344-3860 Toll Free USA/Canada  
Fax: 303-675-2176 or 800-344-3867 Toll Free USA/Canada  
Email: [orderlit@onsemi.com](mailto:orderlit@onsemi.com)

N. American Technical Support: 800-282-9855 Toll Free  
USA/Canada  
Europe, Middle East and Africa Technical Support:  
Phone: 421 33 790 2910  
Japan Customer Focus Center  
Phone: 81-3-5773-3850

ON Semiconductor Website: [www.onsemi.com](http://www.onsemi.com)

Order Literature: <http://www.onsemi.com/orderlit>

For additional information, please contact your local Sales Representative

Компания «Океан Электроники» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Поставка оригинальных импортных электронных компонентов напрямую с производств Америки, Европы и Азии, а так же с крупнейших складов мира;
- Широкая линейка поставок активных и пассивных импортных электронных компонентов (более 30 млн. наименований);
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Помощь Конструкторского Отдела и консультации квалифицированных инженеров;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Поставка электронных компонентов под контролем ВП;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- При необходимости вся продукция военного и аэрокосмического назначения проходит испытания и сертификацию в лаборатории (по согласованию с заказчиком);
- Поставка специализированных компонентов военного и аэрокосмического уровня качества (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Actel, Aeroflex, Peregrine, VPT, Syfer, Eurofarad, Texas Instruments, MS Kennedy, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Компания «Океан Электроники» является официальным дистрибьютором и эксклюзивным представителем в России одного из крупнейших производителей разъемов военного и аэрокосмического назначения «JONHON», а так же официальным дистрибьютором и эксклюзивным представителем в России производителя высокотехнологичных и надежных решений для передачи СВЧ сигналов «FORSTAR».



## JONHON

«JONHON» (основан в 1970 г.)

Разъемы специального, военного и аэрокосмического назначения:

(Применяются в военной, авиационной, аэрокосмической, морской, железнодорожной, горно- и нефтедобывающей отраслях промышленности)

«FORSTAR» (основан в 1998 г.)

ВЧ соединители, коаксиальные кабели,  
кабельные сборки и микроволновые компоненты:

(Применяются в телекоммуникациях гражданского и специального назначения, в средствах связи, РЛС, а так же военной, авиационной и аэрокосмической отраслях промышленности).



Телефон: 8 (812) 309-75-97 (многоканальный)

Факс: 8 (812) 320-03-32

Электронная почта: [ocean@oceanchips.ru](mailto:ocean@oceanchips.ru)

Web: <http://oceanchips.ru/>

Адрес: 198099, г. Санкт-Петербург, ул. Калинина, д. 2, корп. 4, лит. А