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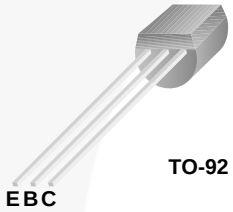
April 2014

# 2N3906 / MMBT3906 / PZT3906
# PNP General-Purpose Amplifier

## Description

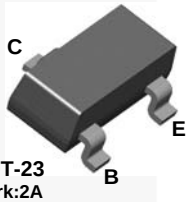
This device is designed for general-purpose amplifier and switching applications at collector currents of 10 mA to 100 mA.

**2N3906**



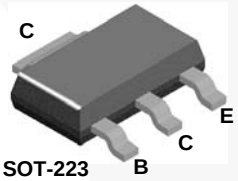

TO-92

**MMBT3906**




SOT-23
Mark:2A

**PZT3906**




SOT-223

## Ordering Information

| Part Number | Marking | Package | Packing Method | Pack Quantity |
|---|---|---|---|---|
| 2N3906BU | 2N3906 | TO-92 3L | Bulk | 10000 |
| 2N3906TA | 2N3906 | TO-92 3L | Ammo | 2000 |
| 2N3906TAR | 2N3906 | TO-92 3L | Ammo | 2000 |
| 2N3906TF | 2N3906 | TO-92 3L | Tape and Reel | 2000 |
| 2N3906TFR | 2N3906 | TO-92 3L | Tape and Reel | 2000 |
| MMBT3906 | 2A | SOT-23 3L | Tape and Reel | 3000 |
| PZT3906 | 3906 | SOT-223 4L | Tape and Reel | 2500 |

## Absolute Maximum Ratings(1)

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only. Values are at $T_A$ = 25°C unless otherwise noted.

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_{CEO}$ | Collector-Emitter Voltage | -40 | V |
| $V_{CBO}$ | Collector-Base Voltage | -40 | V |
| $V_{EBO}$ | Emitter-Base Voltage | -5.0 | V |
| $I_C$ | Collector Current - Continuous | -200 | mA |
| $T_{J,}$ $T_{STG}$ | Operating and Storage Junction Temperature Range | -55 to +150 | °C |

**Note:**

1. These ratings are based on a maximum junction temperature of 150°C.
   These are steady-state limits. Fairchild Semiconductor should be consulted on applications involving pulsed or low-duty cycle operations.

## Thermal Characteristics

Values are at $T_A$ = 25°C unless otherwise noted.

| Symbol | Parameter | Maximum | | | Unit |
|---|---|---|---|---|---|
| | | **2N3906**(3) | **MMBT3906**(2) | **PZT3906**(3) | |
| $P_D$ | Total Device Dissipation | 625 | 350 | 1,000 | mW |
| | Derate Above 25°C | 5.0 | 2.8 | 8.0 | mW/°C |
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case | 83.3 | | | °C/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient | 200 | 357 | 125 | °C/W |

**Notes:**

2. Device is mounted on FR-4 PCB 1.6 inch X 1.6 inch X 0.06 inch.
3. PCB size: FR-4, 76 mm x 114 mm x 1.57 mm (3.0 inch x 4.5 inch x 0.062 inch) with minimum land pattern size.

## Electrical Characteristics

Values are at $T_A$ = 25°C unless otherwise noted.

| Symbol | Parameter | Conditions | Min. | Max. | Unit |
|---|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | | |
| $V_{(BR)CEO}$ | Collector-Emitter Breakdown Voltage[4] | $I_C$ = -1.0 mA, $I_B$ = 0 | -40 | | V |
| $V_{(BR)CBO}$ | Collector-Base Breakdown Voltage | $I_C$ = -10 μA, $I_E$ = 0 | -40 | | V |
| $V_{(BR)EBO}$ | Emitter-Base Breakdown Voltage | $I_E$ = -10 μA, $I_C$ = 0 | -5.0 | | V |
| $I_{BL}$ | Base Cut-Off Current | $V_{CE}$ = -30 V, $V_{BE}$ = 3.0 V | | -50 | nA |
| $I_{CEX}$ | Collector Cut-Off Current | $V_{CE}$ = -30 V, $V_{BE}$ = 3.0 V | | -50 | nA |
| **ON CHARACTERISTICS** | | | | | |
| $h_{FE}$ | DC Current Gain[4] | $I_C$ = -0.1 mA, $V_{CE}$ = -1.0 V | 60 | | |
| | | $I_C$ = -1.0 mA, $V_{CE}$ = -1.0 V | 80 | | |
| | | $I_C$ = -10 mA, $V_{CE}$ = -1.0 V | 100 | 300 | |
| | | $I_C$ = -50 mA, $V_{CE}$ = -1.0 V | 60 | | |
| | | $I_C$ = -100 mA, $V_{CE}$ = -1.0V | 30 | | |
| $V_{CE}$(sat) | Collector-Emitter Saturation Voltage | $I_C$ = -10 mA, $I_B$ = -1.0 mA | | -0.25 | V |
| | | $I_C$ = -50 mA, $I_B$ = -5.0 mA | | -0.40 | |
| $V_{BE}$(sat) | Base-Emitter Saturation Voltage | $I_C$ = -10 mA, $I_B$ = -1.0 mA | -0.65 | -0.85 | V |
| | | $I_C$ = -50 mA, $I_B$ = -5.0 mA | | -0.95 | |
| **SMALL SIGNAL CHARACTERISTICS** | | | | | |
| $f_T$ | Current Gain - Bandwidth Product | $I_C$ = -10 mA, $V_{CE}$ = -20 V, f = 100 MHz | 250 | | MHz |
| $C_{obo}$ | Output Capacitance | $V_{CB}$ = -5.0 V, $I_E$ = 0, f = 100 kHz | | 4.5 | pF |
| $C_{ibo}$ | Input Capacitance | $V_{EB}$ = -0.5 V, $I_C$ = 0, f = 100 kHz | | 10.0 | pF |
| NF | Noise Figure | $I_C$ = -100 μA, $V_{CE}$ = -5.0 V, $R_S$ = 1.0 kΩ, f = 10 Hz to 15.7 kHz | | 4.0 | dB |
| **SWITCHING CHARACTERISTICS** | | | | | |
| $t_d$ | Delay Time | $V_{CC}$ = -3.0 V, $V_{BE}$ = -0.5 V $I_C$ = -10 mA, $I_{B1}$ = -1.0 mA | | 35 | ns |
| $t_r$ | Rise Time | | | 35 | ns |
| $t_s$ | Storage Time | $V_{CC}$ = -3.0 V, $I_C$ = -10 mA, $I_{B1}$ = $I_{B2}$ = -1.0 mA | | 225 | ns |
| $t_f$ | Fall Time | | | 75 | ns |

**Note:**

4. Pulse test: pulse width ≤ 300 μs, duty cycle ≤ 2.0%.

## Typical Performance Characteristics

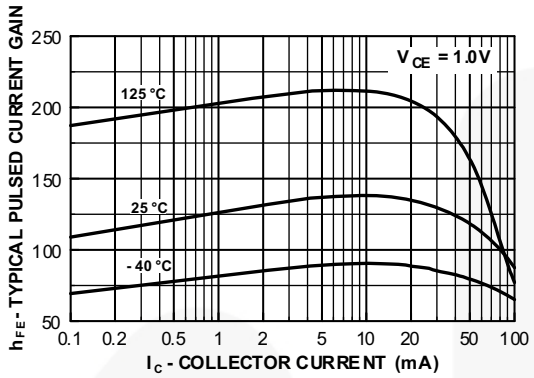



**Figure 1. Typical Pulsed Current Gain vs. Collector Current**

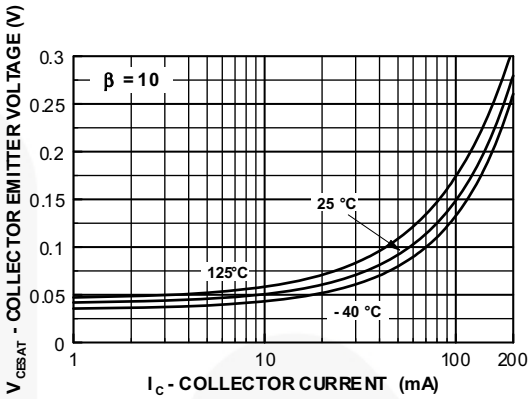



**Figure 2. Collector-Emitter Saturation Voltage vs. Collector Current**

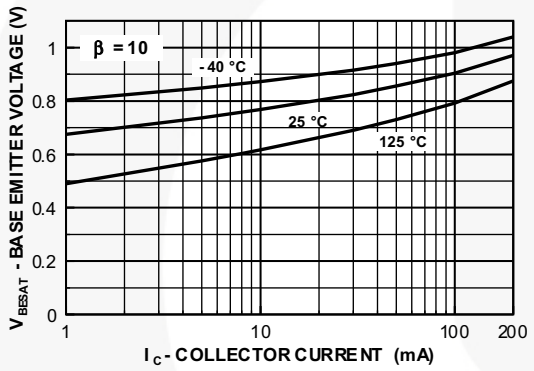



**Figure 3. Base-Emitter Saturation Voltage vs. Collector Current**

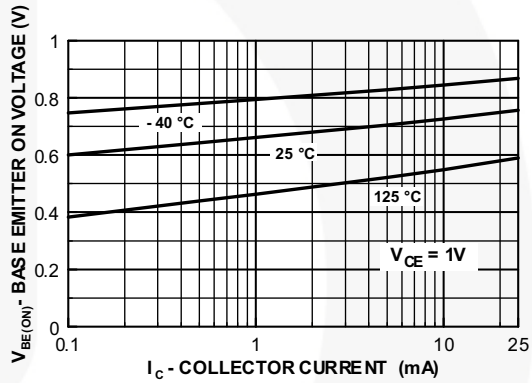



**Figure 4. Base-Emitter On Voltage vs. Collector Current**

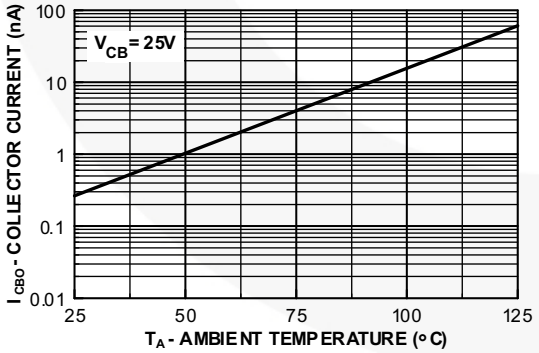



**Figure 5. Collector Cut-Off Current vs. Ambient Temperature**

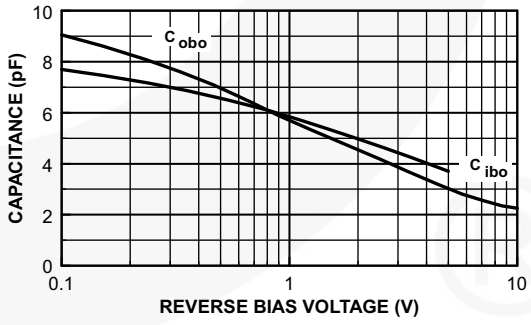



**Figure 6. Common-Base Open Circuit Input and Output Capacitance vs. Reverse Bias Voltage**

## Typical Performance Characteristics (Continued)

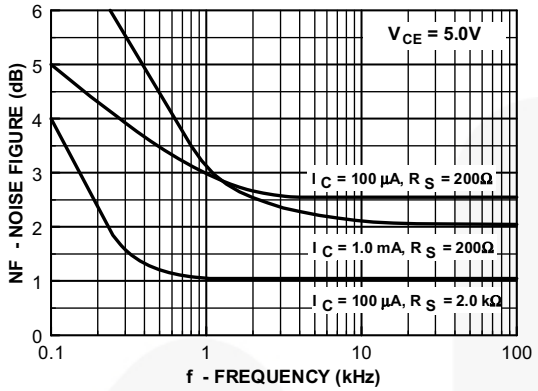



**Figure 7. Noise Figure vs. Frequency**

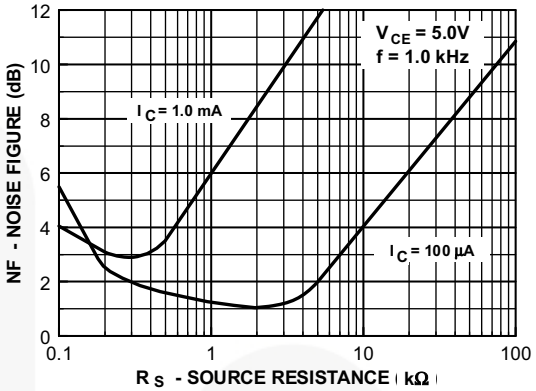



**Figure 8. Noise Figure vs. Source Resistance**

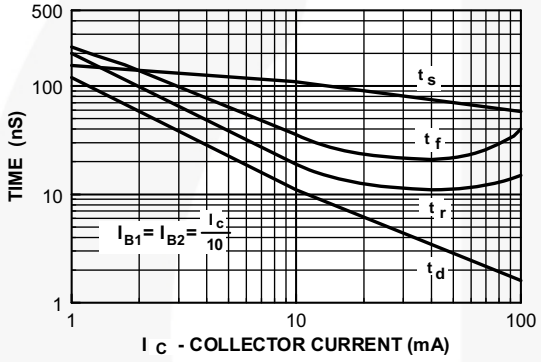



**Figure 9. Switching Times vs. Collector Current**

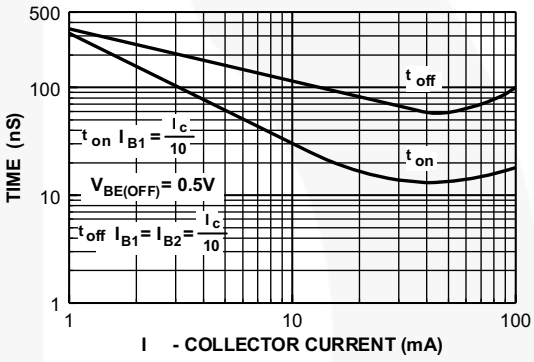



**Figure 10. Turn-On and Turn-Off Times vs. Collector Current**

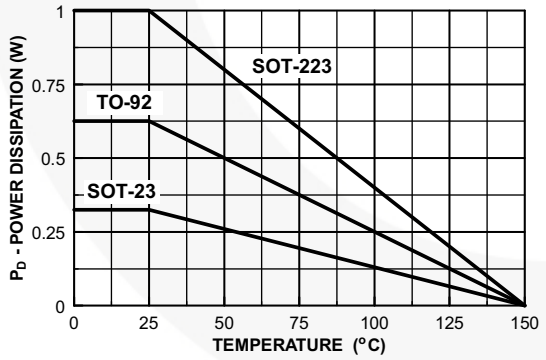



**Figure 11. Power Dissipation vs. Ambient Temperature**

## Typical Performance Characteristics (Continued)

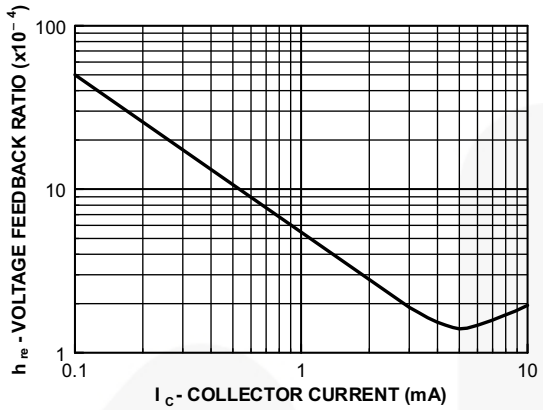



**Figure 12. Voltage Feedback Ratio**

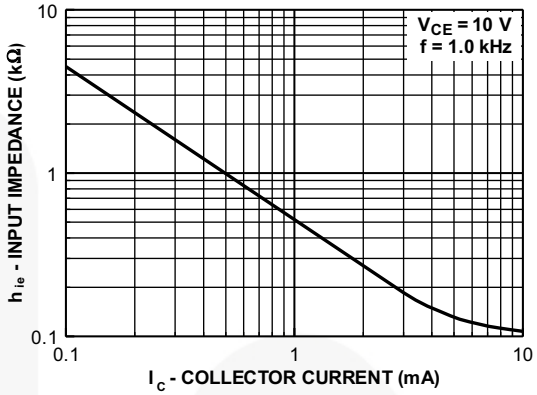



**Figure 13. Input Impedance**

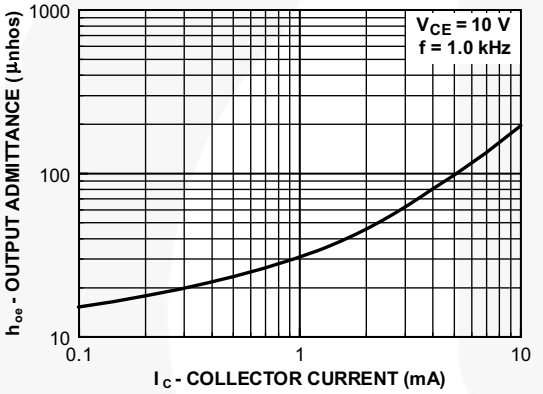



**Figure 14. Output Admittance**

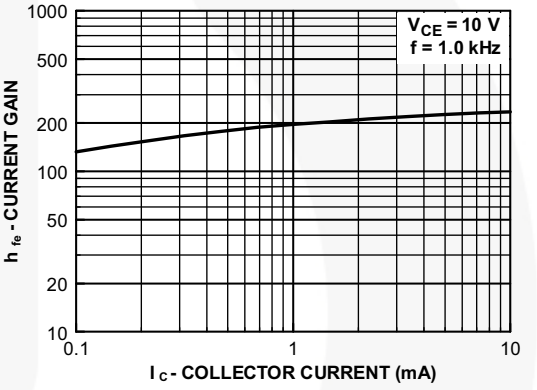
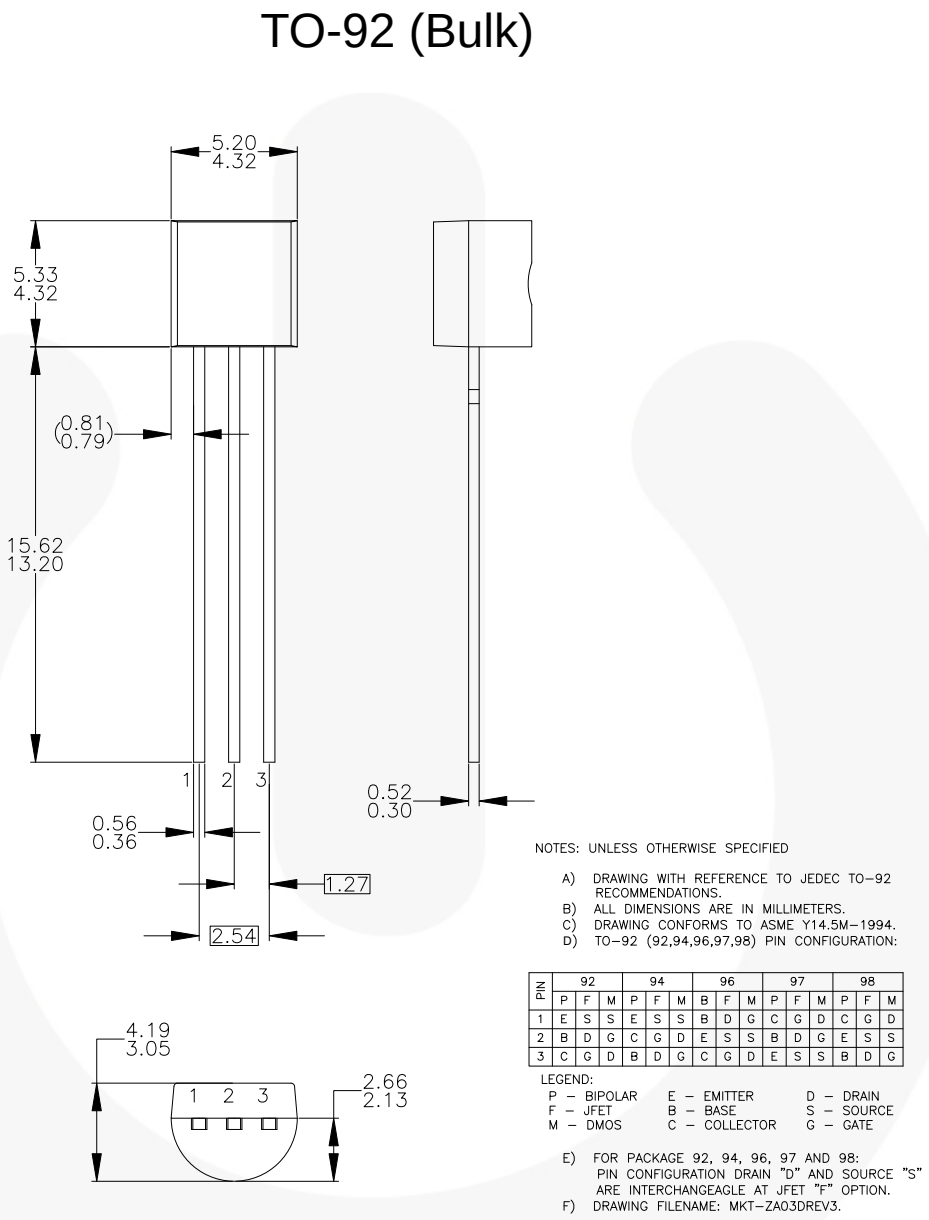



**Figure 15. Current Gain**

## Physical Dimensions




| PIN | 92 | | | 94 | | | 96 | | | 97 | | | 98 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | P | F | M | P | F | M | B | F | M | P | F | M | P | F | M |
| 1 | E | S | S | E | S | S | B | D | G | C | G | D | C | G | D |
| 2 | B | D | G | C | G | D | E | S | S | B | D | G | E | S | S |
| 3 | C | G | D | B | D | G | C | G | D | E | S | S | B | D | G |

**Figure 16. 3-LEAD, TO92, JEDEC TO-92 COMPLIANT STRAIGHT LEAD CONFIGURATION (OLD TO92AM3)**

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## Physical Dimensions (Continued)

# TO-92 (Ammo, Tape and Reel)

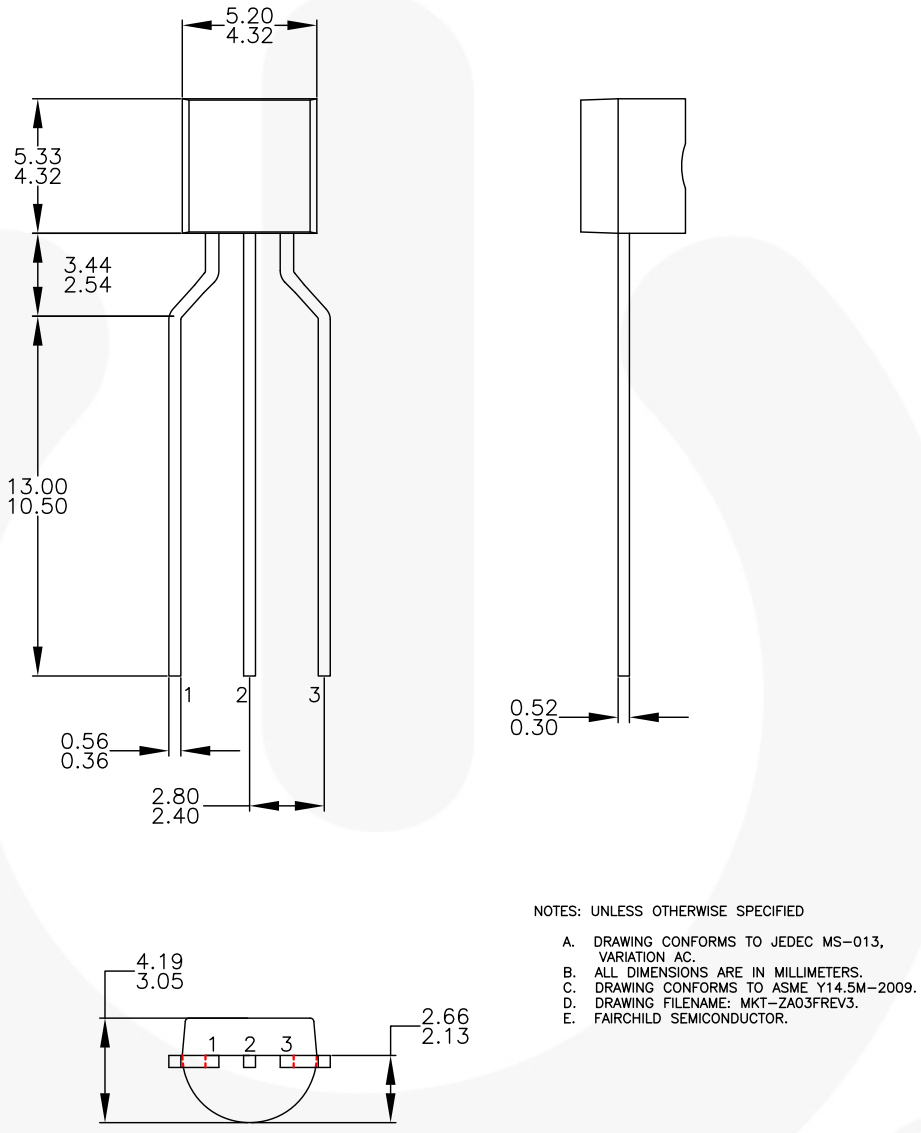


**Figure 17. 3-LEAD, TO92, MOLDED 0.200 IN LINE SPACING LEAD FORM (J61Z OPTION)**

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## Physical Dimensions (Continued)

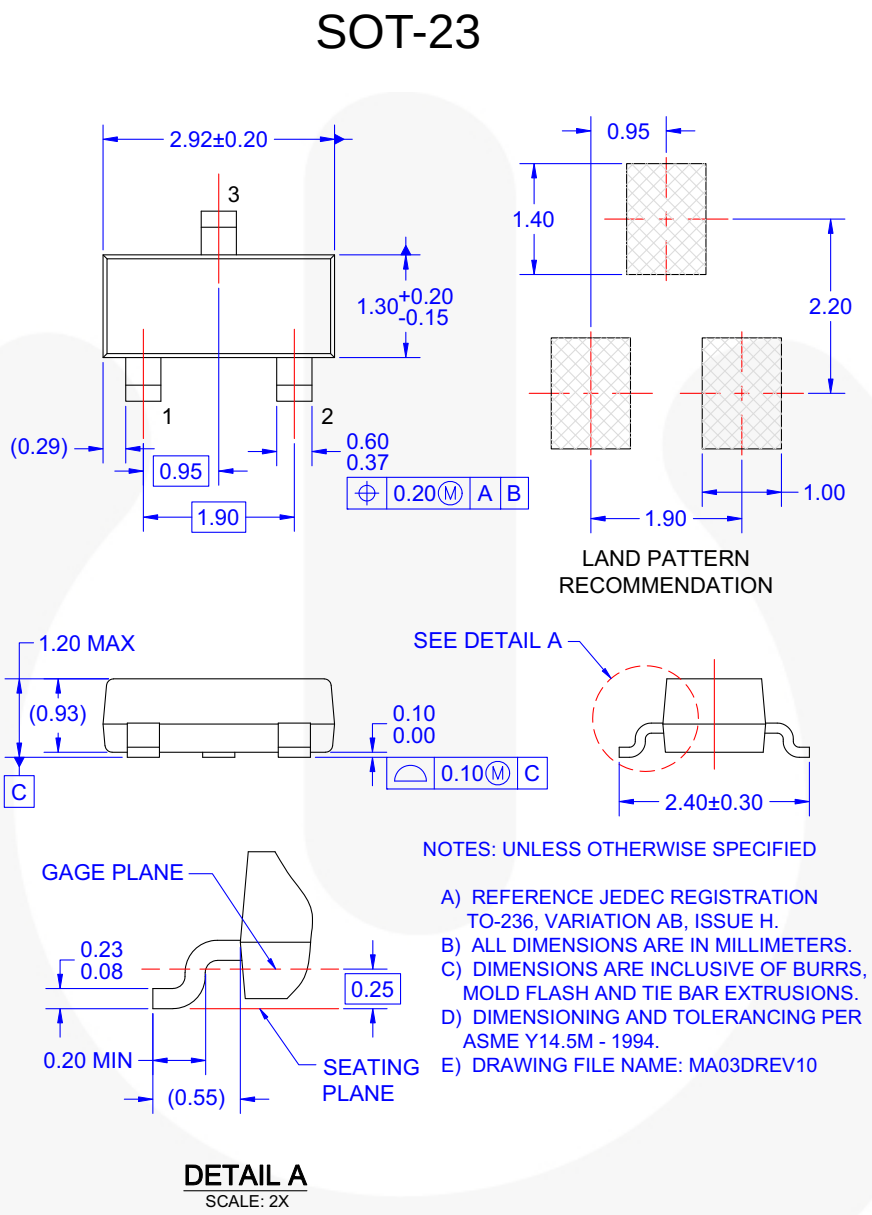


**Figure 18. 3-LEAD, SOT23, JEDEC TO-236, LOW PROFILE**

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## Physical Dimensions (Continued)

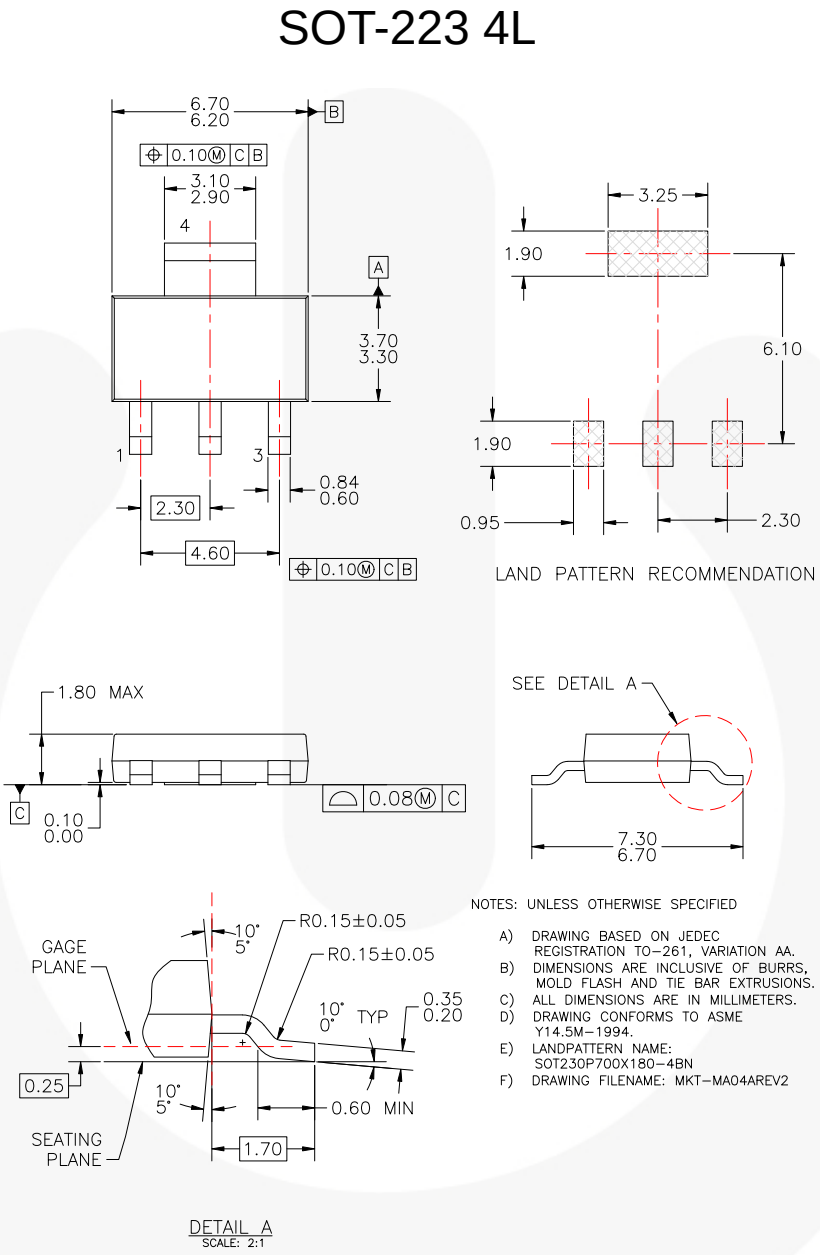


**Figure 19. MOLDED PACKAGE, SOT-223, 4-LEAD**

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**Definition of Terms**

| Datasheet Identification | Product Status | Definition |
|---|---|---|
| Advance Information | Formative / In Design | Datasheet contains the design specifications for product development. Specifications may change in any manner without notice. |
| Preliminary | First Production | Datasheet contains preliminary data; supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design. |
| No Identification Needed | Full Production | Datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve the design. |
| Obsolete | Not In Production | Datasheet contains specifications on a product that is discontinued by Fairchild Semiconductor. The datasheet is for reference information only. |

Rev. I68

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**Email**: orderlit@onsemi.com

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ON Semiconductor:

2N3906_J25Z 2N3906_D26Z 2N3906_D28Z 2N3906_D74Z 2N3906_D75Z 2N3906RA 2N3906TAM 2N3906TAR 2N3906_D81Z 2N3906TFR 2N3906TA 2N3906TF 2N3906BU 2N3906_J05Z 2N3906_J61Z 2N3906_J18Z 2N3906_D11Z 2N3906_D27ZS00Z 2N3906TF_Q 2N3906TFR_Q 2N3906_J05Z_Q