

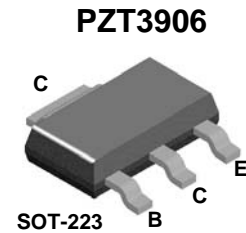
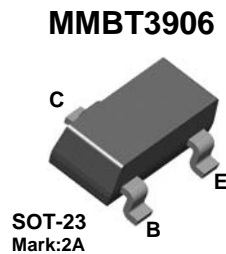
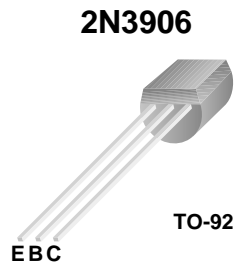


ON Semiconductor®

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.



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 |

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

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 $T_A = 25^\circ\text{C}$ 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 | $^\circ\text{C}$ |

Note:

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

Thermal Characteristics

Values are at $T_A = 25^\circ\text{C}$ 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 | $\text{mW}/^\circ\text{C}$ |
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case | 83.3 | | | $^\circ\text{C}/\text{W}$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient | 200 | 357 | 125 | $^\circ\text{C}/\text{W}$ |

Notes:

- Device is mounted on FR-4 PCB 1.6 inch X 1.6 inch X 0.06 inch.
- 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 $T_A = 25^\circ\text{C}$ unless otherwise noted.

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

Note:

4. Pulse test: pulse width $\leq 300\ \mu\text{s}$, duty cycle $\leq 2.0\%$.

Typical Performance Characteristics

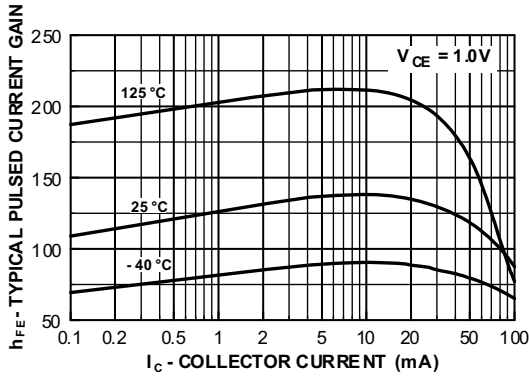


Figure 1. Typical Pulsed Current Gain vs. Collector Current

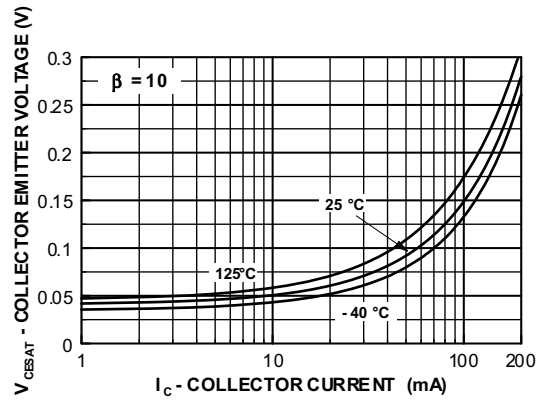


Figure 2. Collector-Emitter Saturation Voltage vs. Collector Current

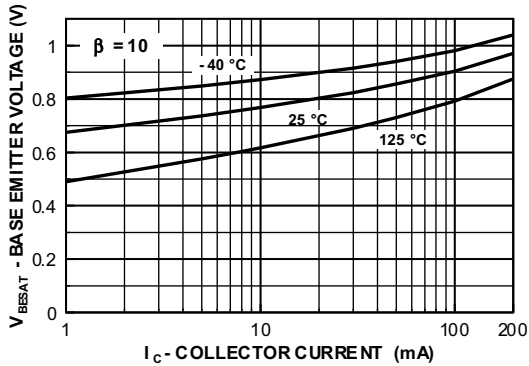


Figure 3. Base-Emitter Saturation Voltage vs. Collector Current

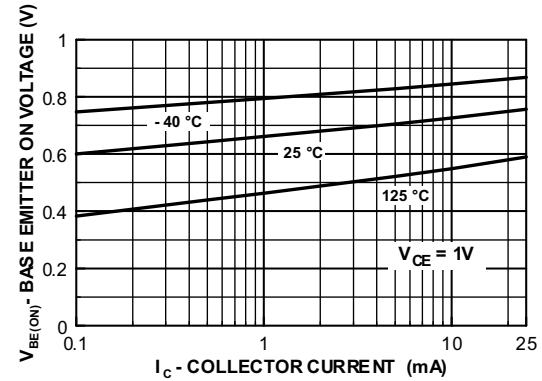


Figure 4. Base-Emitter On Voltage vs. Collector Current

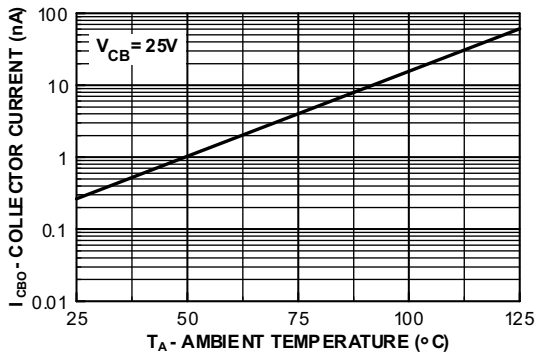


Figure 5. Collector Cut-Off Current vs. Ambient Temperature

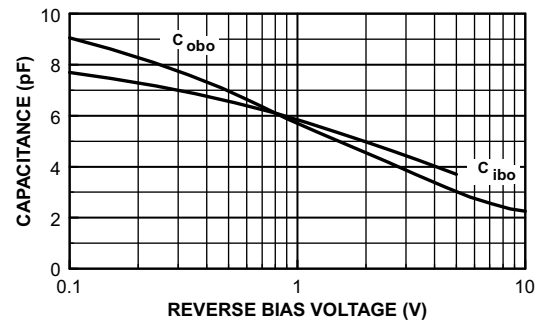


Figure 6. Common-Base Open Circuit Input and Output Capacitance vs. Reverse Bias Voltage

Typical Performance Characteristics (Continued)

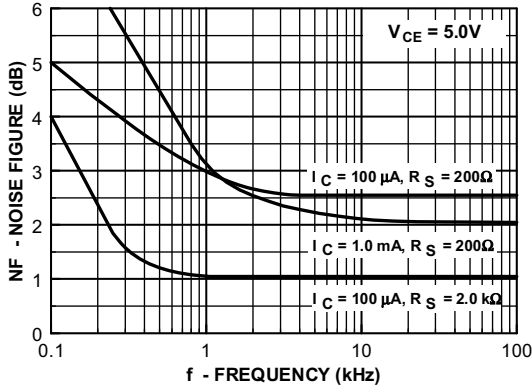


Figure 7. Noise Figure vs. Frequency

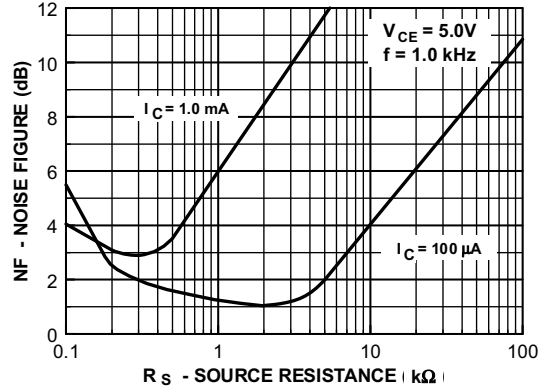


Figure 8. Noise Figure vs. Source Resistance

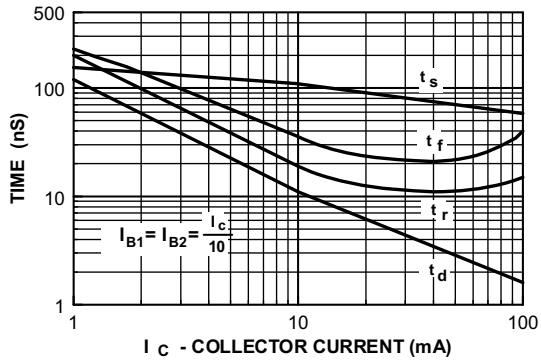


Figure 9. Switching Times vs. Collector Current

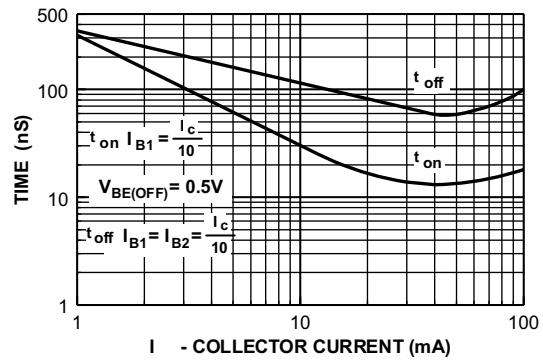


Figure 10. Turn-On and Turn-Off Times vs. Collector Current

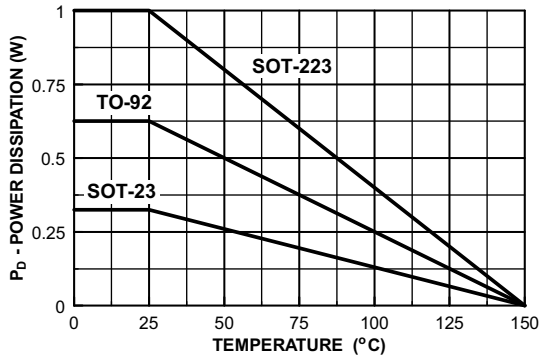


Figure 11. Power Dissipation vs. Ambient Temperature

Typical Performance Characteristics (Continued)

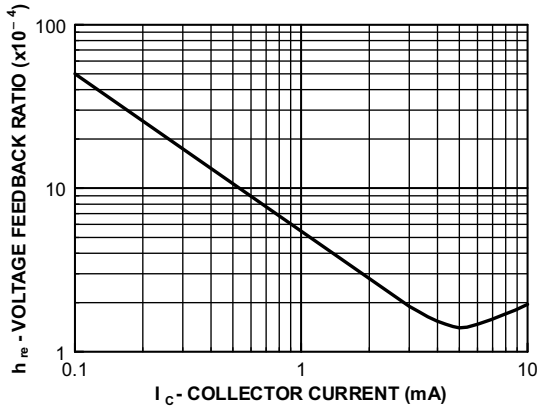


Figure 12. Voltage Feedback Ratio

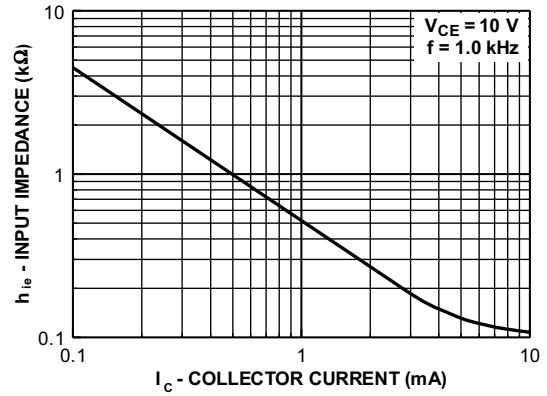


Figure 13. Input Impedance

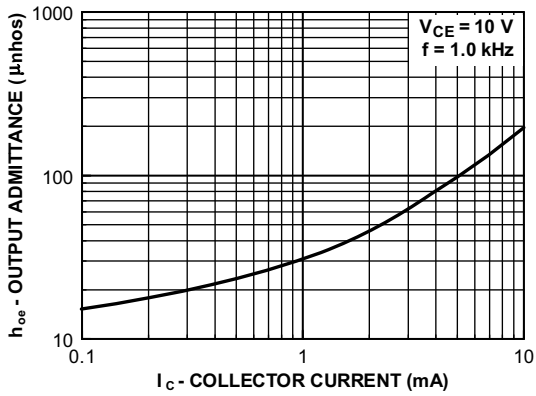


Figure 14. Output Admittance

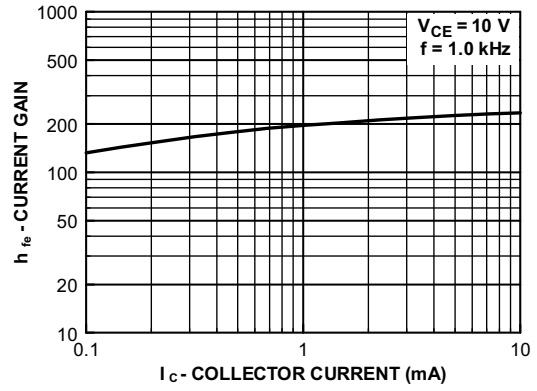
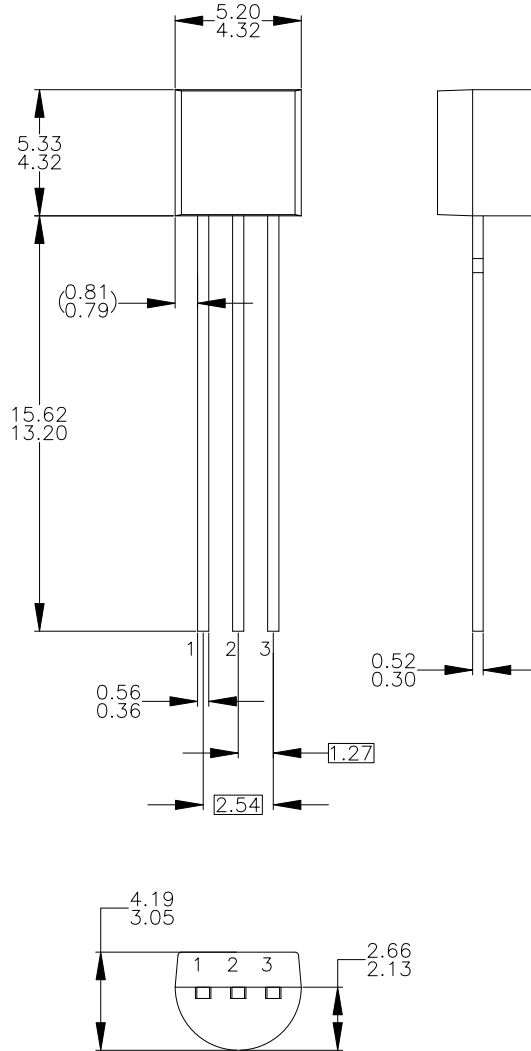


Figure 15. Current Gain

Physical Dimensions

TO-92 (Bulk)



NOTES: UNLESS OTHERWISE SPECIFIED

- A) DRAWING WITH REFERENCE TO JEDEC TO-92 RECOMMENDATIONS.
- B) ALL DIMENSIONS ARE IN MILLIMETERS.
- C) DRAWING CONFORMS TO ASME Y14.5M-1994.
- D) TO-92 (92,94,96,97,98) PIN CONFIGURATION:

| 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 |

LEGEND:

P - BIPOLAR E - EMITTER D - DRAIN
 F - JFET B - BASE S - SOURCE
 M - DMOS C - COLLECTOR G - GATE

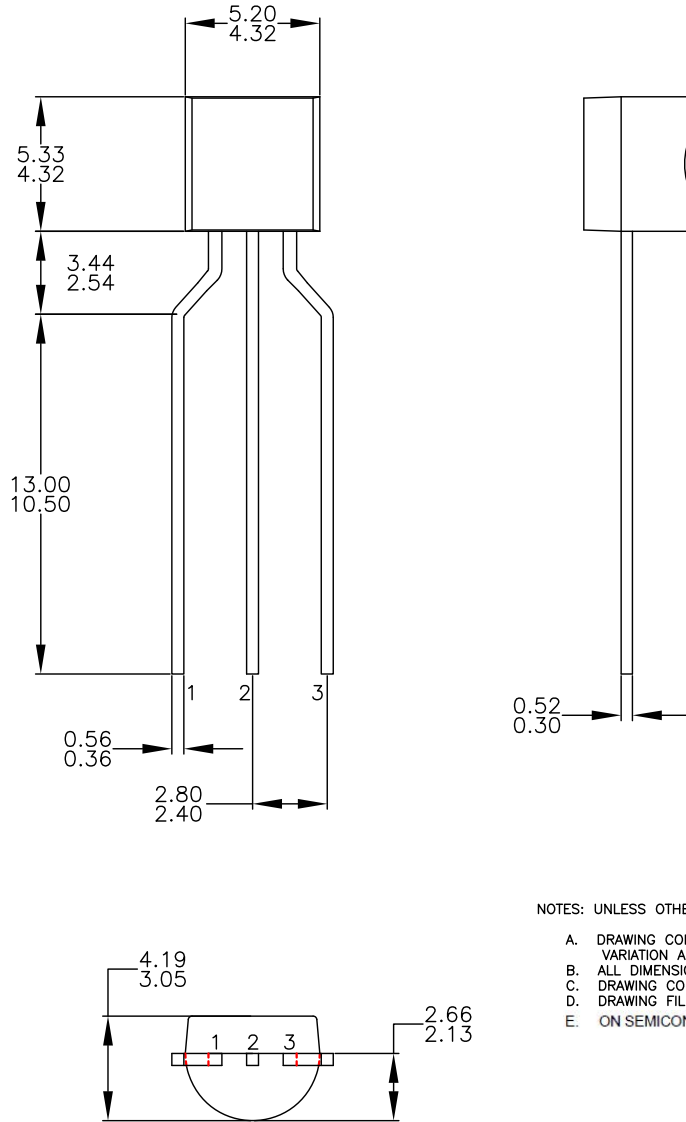
- E) FOR PACKAGE 92, 94, 96, 97 AND 98:
PIN CONFIGURATION DRAIN "D" AND SOURCE "S"
ARE INTERCHANGEABLE AT JFET "F" OPTION.
- F) DRAWING FILENAME: MKT-ZA03DREV3.

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)



NOTES: UNLESS OTHERWISE SPECIFIED

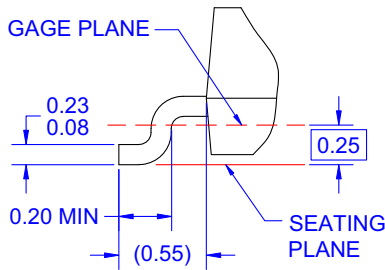
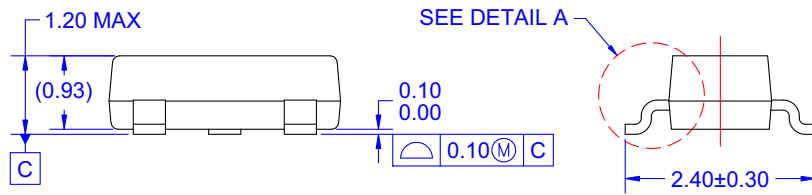
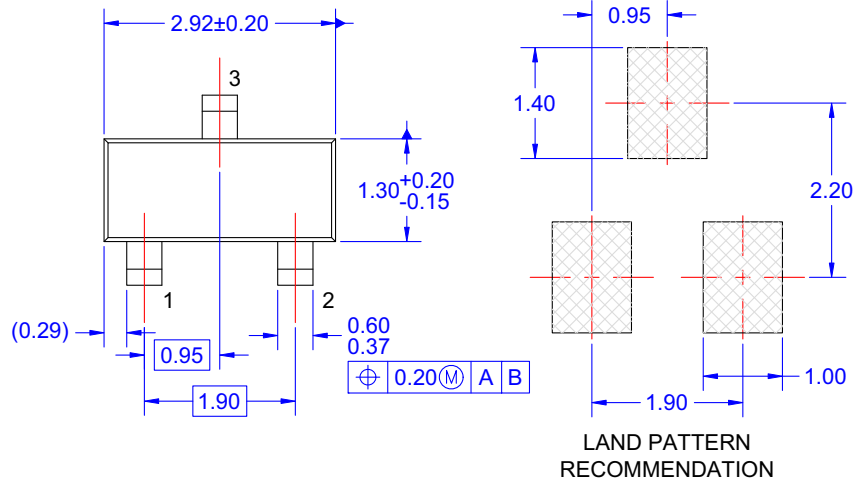
- A. DRAWING CONFORMS TO JEDEC MS-013, VARIATION AC.
- B. ALL DIMENSIONS ARE IN MILLIMETERS.
- C. DRAWING CONFORMS TO ASME Y14.5M-2009.
- D. DRAWING FILENAME: MKT-ZA03FREV3.
- E. ON SEMICONDUCTOR

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

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Physical Dimensions (Continued)

SOT-23



NOTES: UNLESS OTHERWISE SPECIFIED

- A) REFERENCE JEDEC REGISTRATION TO-236, VARIATION AB, ISSUE H.
- B) ALL DIMENSIONS ARE IN MILLIMETERS.
- C) DIMENSIONS ARE INCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR EXTRUSIONS.
- D) DIMENSIONING AND TOLERANCING PER ASME Y14.5M - 1994.
- E) DRAWING FILE NAME: MA03DREV10

DETAIL A
SCALE: 2X

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

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Physical Dimensions (Continued)

SOT-223 4L

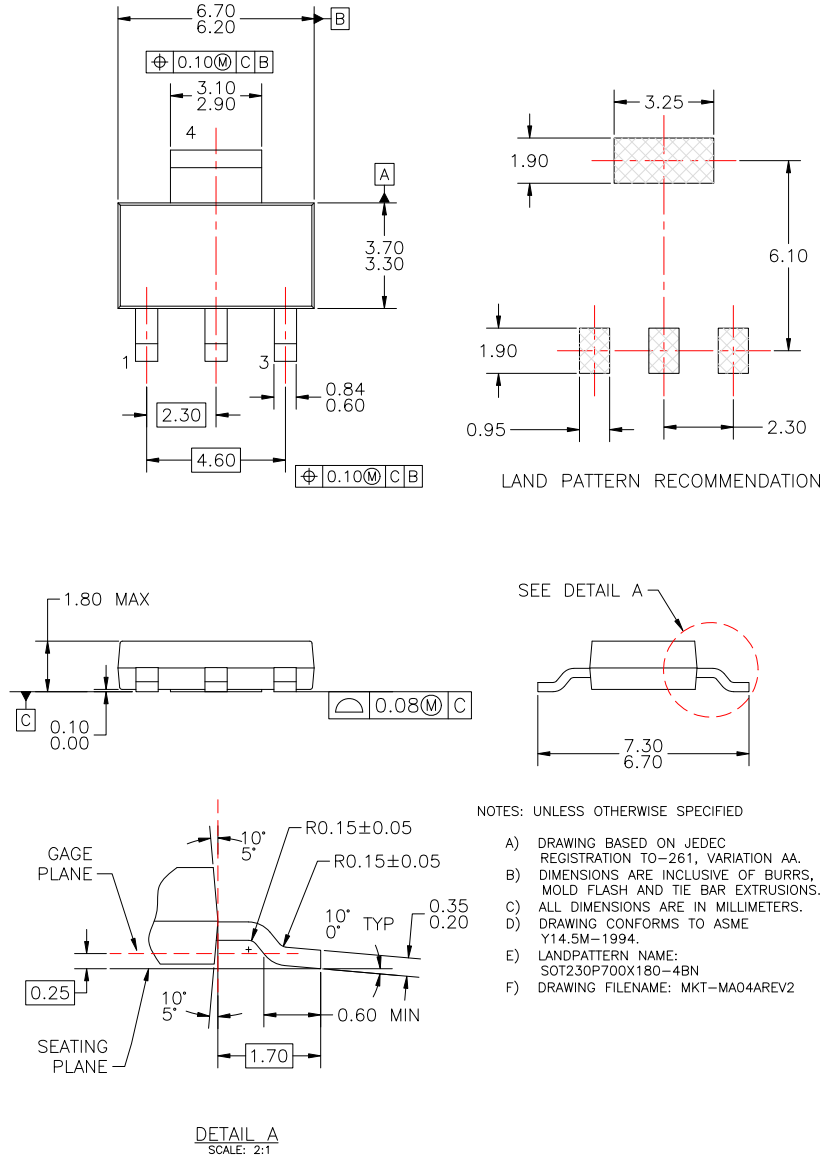


Figure 19. MOLDED PACKAGE, SOT-223, 4-LEAD

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