

# NPN Multi-Chip General-Purpose Amplifier

## FMB3904, MMPQ3904

### Description

This device is designed as a general-purpose amplifier and switch. The useful dynamic range extends to 100 mA as a switch and to 100 MHz as an amplifier. Sourced from Process 23.

### ABSOLUTE MAXIMUM RATINGS (Note 1)

| Symbol         | Parameter                                        | Value       | Unit |
|----------------|--------------------------------------------------|-------------|------|
| $V_{CEO}$      | Collector-Emitter Voltage                        | 40          | V    |
| $V_{CBO}$      | Collector-Base Voltage                           | 60          | V    |
| $V_{EBO}$      | Emitter-Base Voltage                             | 6.0         | V    |
| $I_C$          | Collector Current – Continuous                   | 200         | mA   |
| $T_J, T_{STG}$ | Operating and Storage Junction Temperature Range | –55 to +150 | °C   |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

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

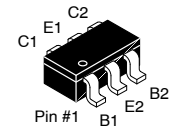
### THERMAL CHARACTERISTICS (Note 2)

(Values are at  $T_A = 25^\circ\text{C}$ , unless otherwise noted.)

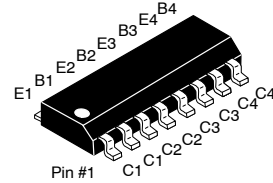
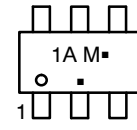
| Symbol          | Parameter                                                | Max     |          | Unit  |
|-----------------|----------------------------------------------------------|---------|----------|-------|
|                 |                                                          | FMB3904 | MMPQ3904 |       |
| $P_D$           | Total Device Dissipation                                 | 700     | 1,000    | mW    |
|                 | Derate Above 25°C                                        | 5.6     | 8.0      | mW/°C |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient                  | 180     | –        | °C/W  |
|                 | Thermal Resistance, Junction to Ambient, Effective 4 Die | –       | 125      |       |
|                 | Thermal Resistance, Junction to Ambient, Each Die        | –       | 240      |       |

2. PCB size: FR-4 76 x 114 x 0.6T mm<sup>3</sup> (3.0 inch x 4.5 inch x 0.062 inch) with minimum land pattern size.

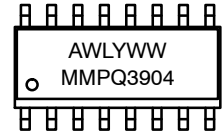
### MARKING DIAGRAM



TSOT23 6-Lead  
CASE 419BL



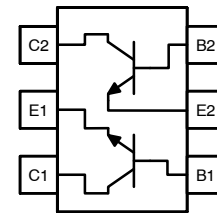
SOIC-16  
CASE 751BG



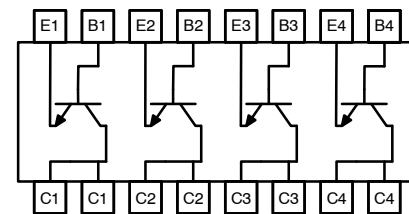
1A, MMPQ3904 = Specific Device Code  
M = Date Code  
▪ = Pb-Free Package  
A = Assembly Site  
WL = Wafer Lot Number  
Y = Year of Production  
WW = Work Week Number

(Note: Microdot may be in either location)

### INTERNAL CONNECTIONS



FMB3904



MMPQ3904

### ORDERING INFORMATION

| Device   | Package                           | Shipping†          |
|----------|-----------------------------------|--------------------|
| FMB3904  | TSOT23<br>(Pb-Free, Halide Free)  | 3000 / Tape & Reel |
| MMPQ3904 | SOIC-16<br>(Pb-Free, Halide Free) | 2500 / Tape & Reel |

†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](http://BRD8011/D).

# FMB3904, MMPQ3904

## ELECTRICAL CHARACTERISTICS (Values are at $T_A = 25^\circ\text{C}$ unless otherwise noted.)

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|--------|-----------|------------|-----|-----|-----|------|
|--------|-----------|------------|-----|-----|-----|------|

### OFF CHARACTERISTICS

|               |                                     |                                              |     |   |    |    |
|---------------|-------------------------------------|----------------------------------------------|-----|---|----|----|
| $V_{(BR)CEO}$ | Collector-Emitter Breakdown Voltage | $I_C = 1.0\text{ mA}, I_B = 0$               | 40  | – | –  | V  |
| $V_{(BR)CBO}$ | Collector-Base Breakdown Voltage    | $I_C = 10\text{ }\mu\text{A}, I_E = 0$       | 60  | – | –  | V  |
| $V_{(BR)EBO}$ | Emitter-Base Breakdown Voltage      | $I_E = 10\text{ }\mu\text{A}, I_C = 0$       | 6.0 | – | –  | V  |
| $I_{BL}$      | Base Cut-Off Current                | $V_{CE} = 30\text{ V}, V_{BE} = -3\text{ V}$ | –   | – | 50 | nA |
| $I_{CEX}$     | Collector Cut-Off Current           | $V_{CE} = 30\text{ V}, V_{BE} = -3\text{ V}$ | –   | – | 50 | nA |

### ON CHARACTERISTICS (Note 3)

|               |                                      |             |                                              |      |   |      |   |
|---------------|--------------------------------------|-------------|----------------------------------------------|------|---|------|---|
| $h_{FE}$      | DC Current Gain                      | FMB3904     | $I_C = 0.1\text{ mA}, V_{CE} = 1.0\text{ V}$ | 40   | – | –    |   |
|               |                                      | MMPQ3904    |                                              | 30   | – | –    |   |
|               |                                      | FMB3904     | $I_C = 1.0\text{ mA}, V_{CE} = 1.0\text{ V}$ | 70   | – | –    |   |
|               |                                      | MMPQ3904    |                                              | 50   | – | –    |   |
|               |                                      | FMB3904     | $I_C = 10\text{ mA}, V_{CE} = 1.0\text{ V}$  | 100  | – | 300  |   |
|               |                                      | MMPQ3904    |                                              | 75   | – | –    |   |
|               |                                      | All Devices | $I_C = 50\text{ mA}, V_{CE} = 1.0\text{ V}$  | 60   | – | –    |   |
|               |                                      | All Devices | $I_C = 100\text{ mA}, V_{CE} = 1.0\text{ V}$ | 30   | – | –    |   |
| $V_{CE(sat)}$ | Collector-Emitter Saturation Voltage |             | $I_C = 10\text{ mA}, I_B = 1.0\text{ mA}$    | –    | – | 0.2  | V |
|               |                                      |             | $I_C = 50\text{ mA}, I_B = 5.0\text{ mA}$    | –    | – | 0.3  |   |
| $V_{BE(sat)}$ | 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 (MMPQ3904 ONLY)

|          |                                |                                                                |   |     |   |     |
|----------|--------------------------------|----------------------------------------------------------------|---|-----|---|-----|
| $f_T$    | Current Gain-Bandwidth Product | $I_C = 10\text{ mA}, V_{CE} = 20\text{ V}, f = 100\text{ MHz}$ | – | 200 | – | MHz |
| $C_{ob}$ | Output Capacitance             | $V_{CB} = 5.0\text{ V}, I_E = 0, f = 140\text{ kHz}$           | – | 4.0 | – | pF  |
| $C_{ib}$ | Input Capacitance              | $V_{EB} = 0.5\text{ V}, I_C = 0, f = 140\text{ kHz}$           | – | 8.0 | – | pF  |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

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

TYPICAL PERFORMANCE CHARACTERISTICS

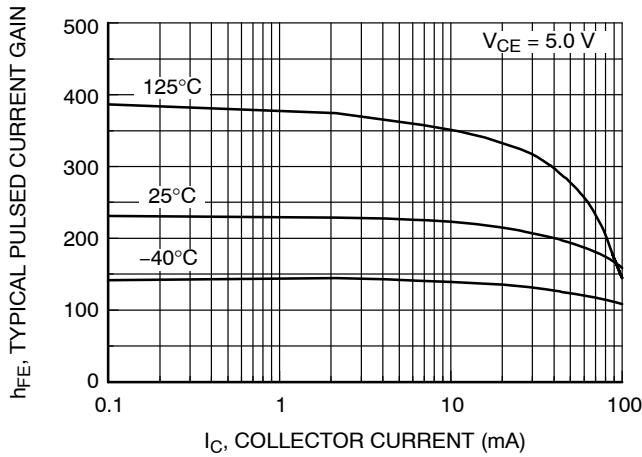


Figure 1. Typical Pulsed Current Gain vs. Collector Current

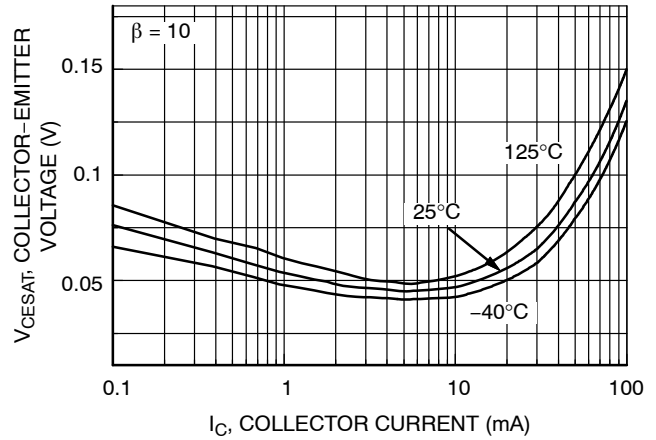


Figure 2. Collector-Emitter Saturation Voltage vs. Collector Current

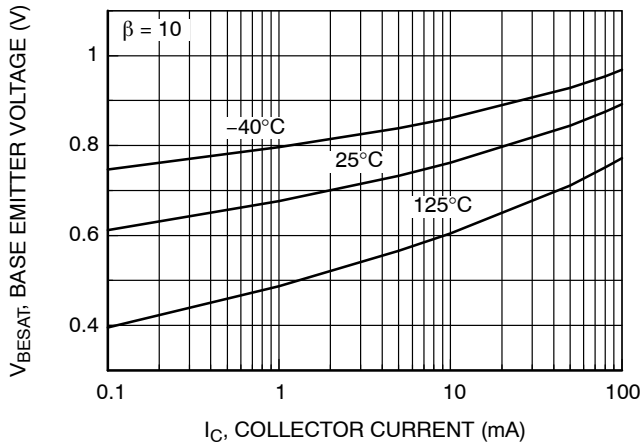


Figure 3. Base-Emitter Saturation Voltage vs. Collector Current

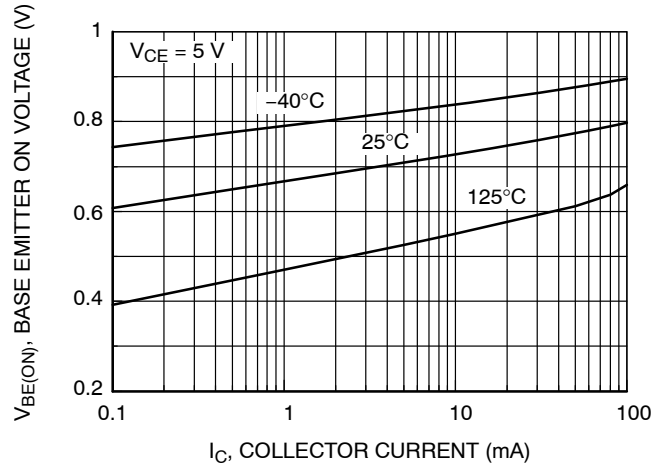


Figure 4. Base-Emitter On Voltage vs. Collector Current

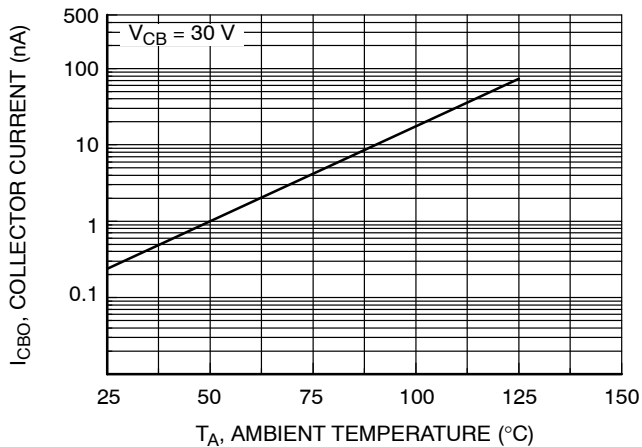


Figure 5. Collector Cut-Off Current vs. Ambient Temperature

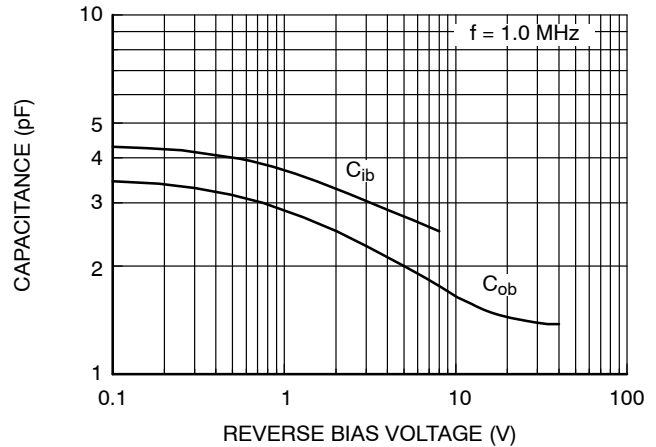


Figure 6. Capacitance vs. Reverse Bias Voltage

TYPICAL PERFORMANCE CHARACTERISTICS (CONTINUED)

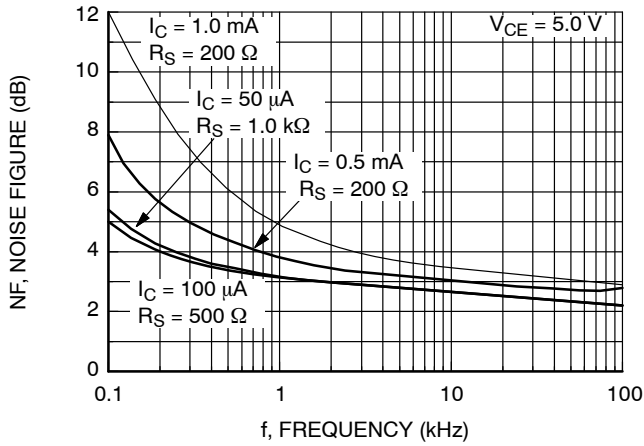


Figure 7. Noise Figure vs. Frequency

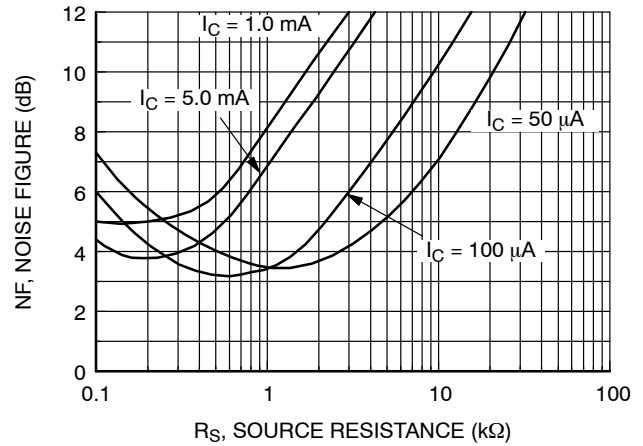


Figure 8. Noise Figure vs. Source Resistance

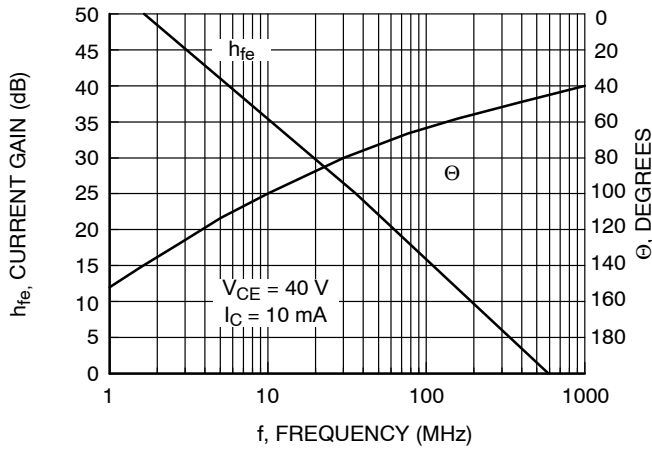


Figure 9. Current Gain and Phase Angle vs. Frequency

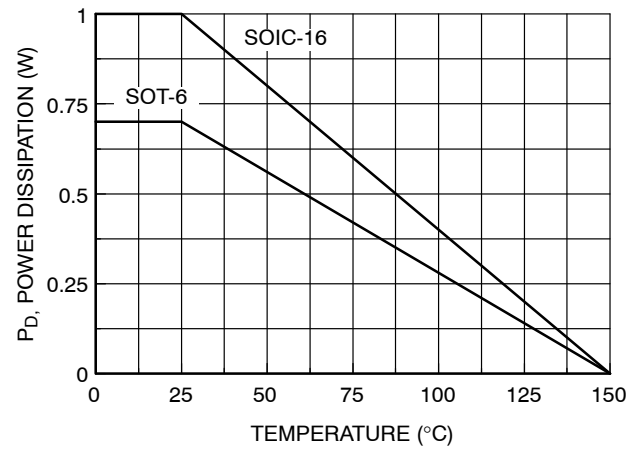


Figure 10. Power Dissipation vs. Ambient Temperature

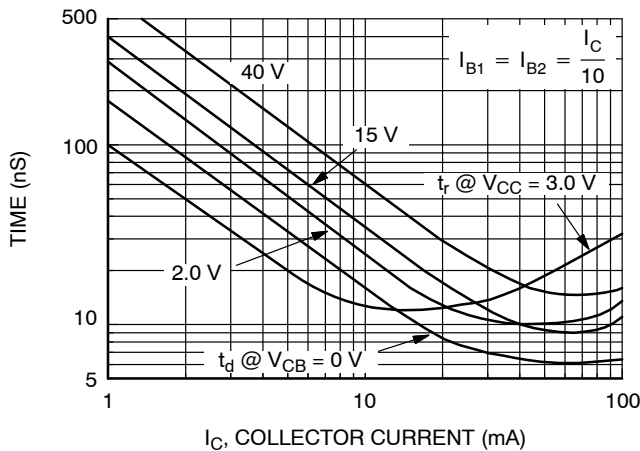


Figure 11. Turn-On Time vs. Collector Current

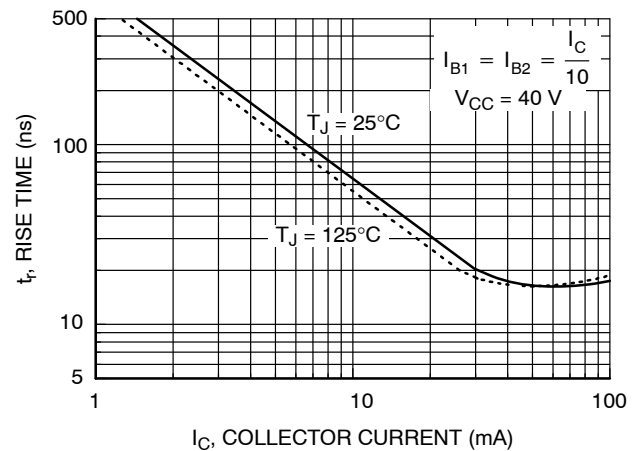


Figure 12. Rise Time vs. Collector Current

TYPICAL PERFORMANCE CHARACTERISTICS (CONTINUED)

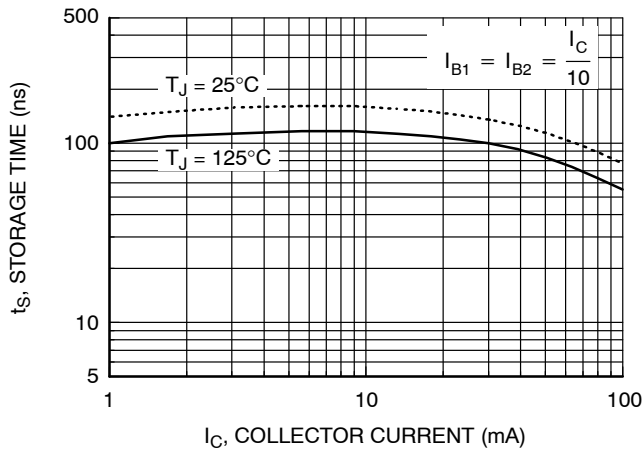


Figure 13. Storage Time vs. Collector Current

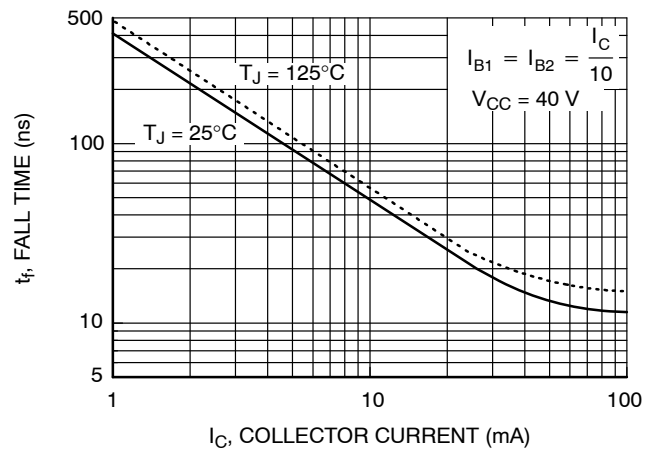


Figure 14. Fall Time vs. Collector Current

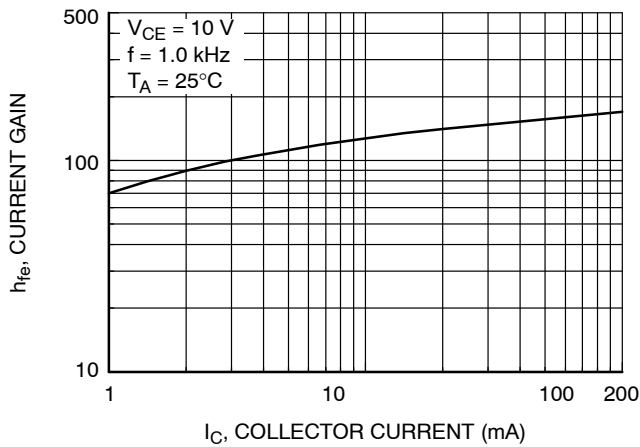


Figure 15. Current Gain

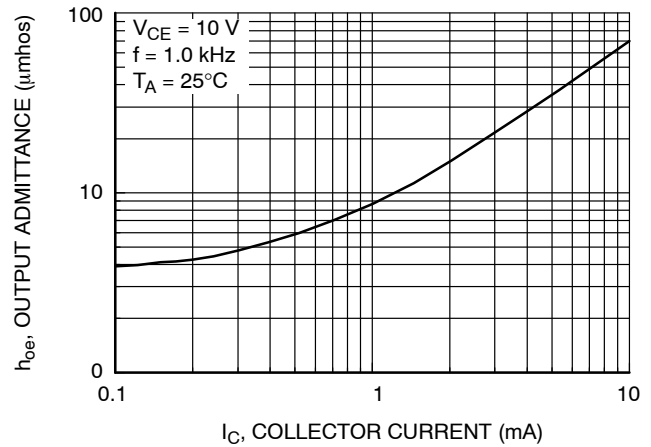


Figure 16. Output Admittance

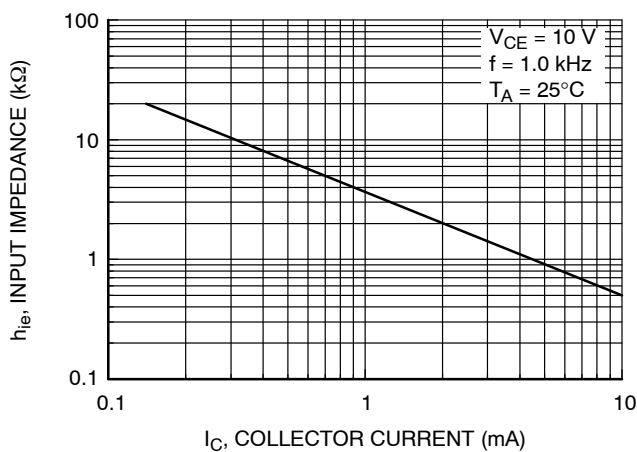


Figure 17. Input Impedance

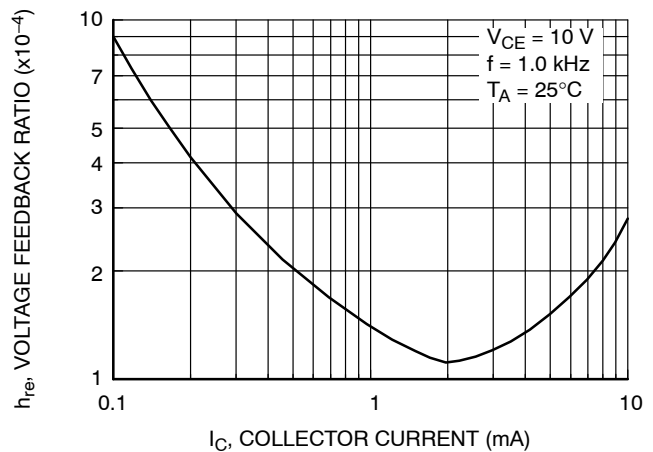


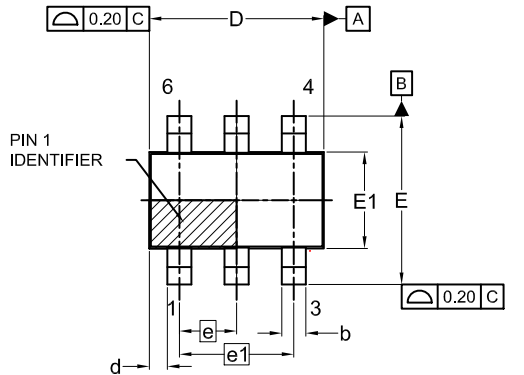
Figure 18. Voltage Feedback Ratio



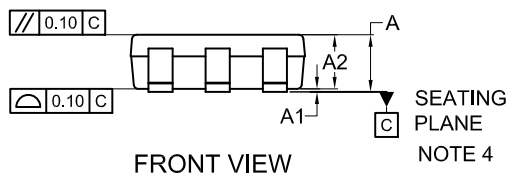
SCALE 2:1

**TSOT23 6-Lead**  
**CASE 419BL**  
**ISSUE A**

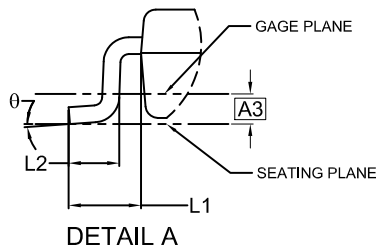
DATE 31 AUG 2020



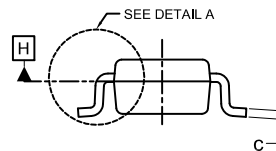
TOP VIEW



FRONT VIEW

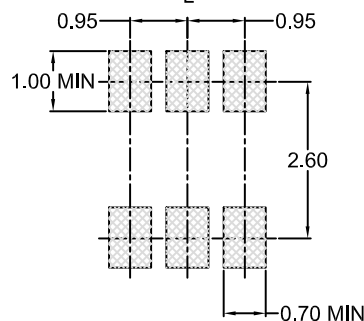


DETAIL A



SIDE VIEW

SYMM

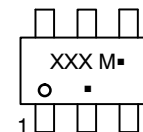

LAND PATTERN  
RECOMMENDATION

\*FOR ADDITIONAL INFORMATION ON OUR  
Pb-FREE STRATEGY AND SOLDERING DETAILS,  
PLEASE DOWNLOAD THE ON SEMICONDUCTOR  
SOLDERING AND MOUNTING TECHNIQUES  
REFERENCE MANUAL, SOLDERRM/D.

## NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
2. CONTROLLING DIMENSION: MILLIMETERS
3. DIMENSIONS D AND E1 DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS. MOLD FLASH, PROTRUSIONS OR GATE BURRS SHALL NOT EXCEED 0.25MM PER END. DIMENSIONS D AND E1 ARE DETERMINED AT DATUM H.
4. SEATING PLANE IS DEFINED BY THE TERMINALS. "A1" IS DEFINED AS THE DISTANCE FROM THE SEATING PLANE TO THE LOWEST POINT ON THE PACKAGE BODY.

| DIM | MILLIMETERS |      |      |
|-----|-------------|------|------|
|     | MIN.        | NOM. | MAX. |
| A   | 0.90        | 1.00 | 1.10 |
| A1  | 0.00        | 0.05 | 0.10 |
| A2  | 0.70        | 0.85 | 1.00 |
| A3  | 0.25 BSC    |      |      |
| b   | 0.25        | 0.38 | 0.50 |
| c   | 0.10        | 0.18 | 0.26 |
| D   | 2.80        | 2.95 | 3.10 |
| d   | 0.30 REF    |      |      |
| E   | 2.50        | 2.75 | 3.00 |
| E1  | 1.30        | 1.50 | 1.70 |
| e   | 0.95 BSC    |      |      |
| e1  | 1.90 BSC    |      |      |
| L1  | 0.60 REF    |      |      |
| L2  | 0.20        | 0.40 | 0.60 |
| Θ   | 0°          | —    | 10°  |

**GENERIC  
MARKING DIAGRAM\***


XXX = Specific Device Code

M = Date Code

▪ = Pb-Free Package

(Note: Microdot may be in either location)

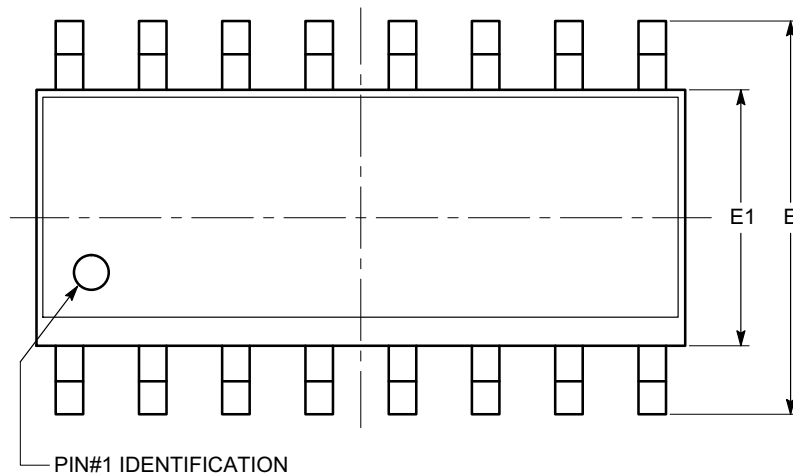
\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

|                         |                      |                                                                                                                                                                                  |
|-------------------------|----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
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| <b>DESCRIPTION:</b>     | <b>TSOT23 6-Lead</b> | <b>PAGE 1 OF 1</b>                                                                                                                                                               |

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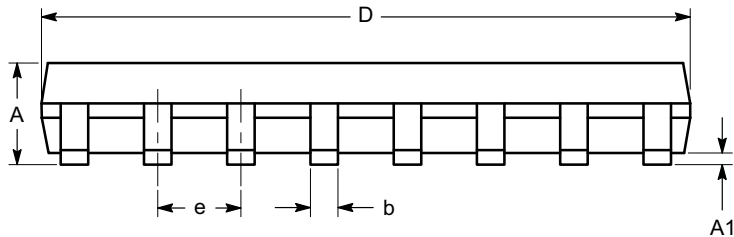
**SOIC-16, 150 mils**  
CASE 751BG  
ISSUE O

DATE 19 DEC 2008

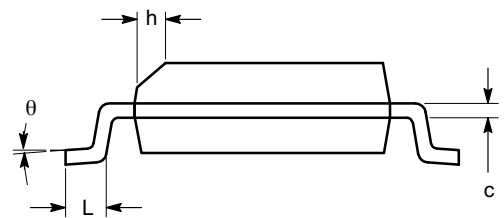


| SYMBOL | MIN      | NOM  | MAX   |
|--------|----------|------|-------|
| A      | 1.35     |      | 1.75  |
| A1     | 0.10     |      | 0.25  |
| b      | 0.33     |      | 0.51  |
| c      | 0.19     |      | 0.25  |
| D      | 9.80     | 9.90 | 10.00 |
| E      | 5.80     | 6.00 | 6.20  |
| E1     | 3.80     | 3.90 | 4.00  |
| e      | 1.27 BSC |      |       |
| h      | 0.25     |      | 0.50  |
| L      | 0.40     |      | 1.27  |
| θ      | 0°       |      | 8°    |

**TOP VIEW**



**SIDE VIEW**



**END VIEW**

**Notes:**

- (1) All dimensions are in millimeters. Angles in degrees.
- (2) Complies with JEDEC MS-012.

|                         |                          |                                                                                                                                                                                     |
|-------------------------|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
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| <b>DESCRIPTION:</b>     | <b>SOIC-16, 150 mils</b> | <b>PAGE 1 OF 1</b>                                                                                                                                                                  |

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