

# MMBT5088L, MMBT5089L

## Low Noise Transistors

### NPN Silicon

#### Features

- S and NSV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q101 Qualified and PPAP Capable
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

#### MAXIMUM RATINGS

| Rating  | Symbol    | Value    | Unit |
|---|-----------|----------|------|
| Collector–Emitter Voltage<br>MMBT5088L<br>MMBT5089L | $V_{CEO}$ | 30<br>25 | Vdc  |
| Collector–Base Voltage<br>MMBT5088L<br>MMBT5089L    | $V_{CBO}$ | 35<br>30 | Vdc  |
| Emitter–Base Voltage                                | $V_{EBO}$ | 4.5      | Vdc  |
| Collector Current – Continuous                      | $I_C$     | 50       | mA   |

#### THERMAL CHARACTERISTICS

| Characteristic  | Symbol          | Max         | Unit                       |
|---|-----------------|-------------|----------------------------|
| Total Device Dissipation FR-5 Board,<br>(Note 1) $T_A = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$        | $P_D$           | 225<br>1.8  | mW<br>mW/ $^\circ\text{C}$ |
| Thermal Resistance, Junction-to-Ambient   | $R_{\theta JA}$ | 556         | $^\circ\text{C}/\text{W}$  |
| Total Device Dissipation Alumina<br>Substrate, (Note 2) $T_A = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$ | $P_D$           | 300<br>2.4  | mW<br>mW/ $^\circ\text{C}$ |
| Thermal Resistance, Junction-to-Ambient   | $R_{\theta JA}$ | 417         | $^\circ\text{C}/\text{W}$  |
| Junction and Storage Temperature  | $T_J, T_{stg}$  | -55 to +150 | $^\circ\text{C}$           |

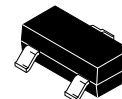
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. FR-5 = 1.0 x 0.75 x 0.062 in.
2. Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

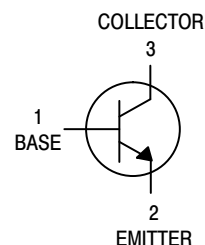


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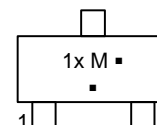
[www.onsemi.com](http://www.onsemi.com)



SOT-23 (TO-236)  
CASE 318  
STYLE 6



#### MARKING DIAGRAM



- 1x = Device Code  
 x = Q for MMBT5088L  
     SMMBT5088L  
 x = R for MMBT5089L  
     SMMBT5089L  
 M = Date Code\*  
 ■ = Pb-Free Package

(Note: Microdot may be in either location)

\*Date Code orientation and/or overbar may vary depending upon manufacturing location.

#### ORDERING INFORMATION

| Device                         | Package             | Shipping†               |
|--------------------------------|---------------------|-------------------------|
| MMBT5088LT1G,<br>SMMBT5088LT1G | SOT-23<br>(Pb-Free) | 3,000 / Tape &<br>Reel  |
| NSVMMBT5088LT3G                | SOT-23<br>(Pb-Free) | 10,000 / Tape &<br>Reel |
| MMBT5089LT1G,<br>SMMBT5089LT1G | SOT-23<br>(Pb-Free) | 3,000 / Tape &<br>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.

# MMBT5088L, MMBT5089L

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

| Characteristic   | Symbol   | Min        | Max  | Unit                                    |
|--|--|------------|--|---|
| <b>OFF CHARACTERISTICS</b>   |  |            |  |   |
| Collector–Emitter Breakdown Voltage<br>( $I_C = 1.0\text{ mA}$ , $I_B = 0$ )   | MMBT5088L<br>MMBT5089L<br>$V_{(BR)CEO}$  | 30<br>25   | –<br>–   | Vdc                                     |
| Collector–Base Breakdown Voltage<br>( $I_C = 100\text{ }\mu\text{A}$ , $I_E = 0$ )   | MMBT5088L<br>MMBT5089L<br>$V_{(BR)CBO}$  | 35<br>30   | –<br>–   | Vdc                                     |
| Collector Cutoff Current<br>( $V_{CB} = 20\text{ Vdc}$ , $I_E = 0$ )<br>( $V_{CB} = 15\text{ Vdc}$ , $I_E = 0$ )   | MMBT5088L<br>MMBT5089L<br>$I_{CBO}$  | –<br>–     | 50<br>50                                       | nA                                      |
| Emitter Cutoff Current<br>( $V_{EB(off)} = 3.0\text{ Vdc}$ , $I_C = 0$ )<br>( $V_{EB(off)} = 4.5\text{ Vdc}$ , $I_C = 0$ )   | MMBT5088L<br>MMBT5089L<br>$I_{EBO}$  | –<br>–     | 50<br>100                                      | nA                                      |
| <b>ON CHARACTERISTICS</b>  |  |            |  |   |
| DC Current Gain<br>( $I_C = 100\text{ }\mu\text{A}$ , $V_{CE} = 5.0\text{ Vdc}$ )<br><br>( $I_C = 1.0\text{ mA}$ , $V_{CE} = 5.0\text{ Vdc}$ )<br><br>( $I_C = 10\text{ mA}$ , $V_{CE} = 5.0\text{ Vdc}$ ) | MMBT5088L<br>MMBT5089L<br><br>MMBT5088L<br>MMBT5089L<br><br>MMBT5088L<br>MMBT5089L | $h_{FE}$   | 300<br>400<br><br>350<br>450<br><br>300<br>400 | 900<br>1200<br><br>–<br>–<br><br>–<br>– |
| Collector–Emitter Saturation Voltage<br>( $I_C = 10\text{ mA}$ , $I_B = 1.0\text{ mA}$ )   | $V_{CE(sat)}$  | –          | 0.5  | Vdc                                     |
| Base–Emitter Saturation Voltage<br>( $I_C = 10\text{ mA}$ , $I_B = 1.0\text{ mA}$ )  | $V_{BE(sat)}$  | –          | 0.8  | Vdc                                     |
| <b>SMALL–SIGNAL CHARACTERISTICS</b>  |  |            |  |   |
| Current–Gain — Bandwidth Product<br>( $I_C = 500\text{ }\mu\text{A}$ , $V_{CE} = 5.0\text{ Vdc}$ , $f = 20\text{ MHz}$ )   | $f_T$  | 50         | –  | MHz                                     |
| Collector–Base Capacitance<br>( $V_{CB} = 5.0\text{ Vdc}$ , $I_E = 0$ , $f = 1.0\text{ MHz}$ emitter guarded)  | $C_{cb}$   | –          | 4.0  | pF                                      |
| Emitter–Base Capacitance<br>( $V_{EB} = 0.5\text{ Vdc}$ , $I_C = 0$ , $f = 1.0\text{ MHz}$ collector guarded)  | $C_{eb}$   | –          | 10   | pF                                      |
| Small Signal Current Gain<br>( $I_C = 1.0\text{ mA}$ , $V_{CE} = 5.0\text{ Vdc}$ , $f = 1.0\text{ kHz}$ )  | MMBT5088L<br>MMBT5089L<br>$h_{fe}$   | 350<br>450 | 1400<br>1800                                   | –                                       |
| Noise Figure<br>( $I_C = 100\text{ }\mu\text{A}$ , $V_{CE} = 5.0\text{ Vdc}$ , $R_S = 10\text{ k}\Omega$ , $f = 1.0\text{ kHz}$ )  | MMBT5088L<br>MMBT5089L<br>NF   | –<br>–     | 3.0<br>2.0                                     | dB                                      |

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.

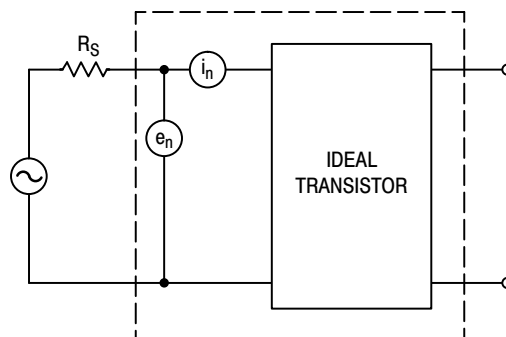


Figure 1. Transistor Noise Model

# MMBT5088L, MMBT5089L

## NOISE CHARACTERISTICS

( $V_{CE} = 5.0 \text{ Vdc}$ ,  $T_A = 25^\circ\text{C}$ )

### NOISE VOLTAGE



Figure 2. Effects of Frequency

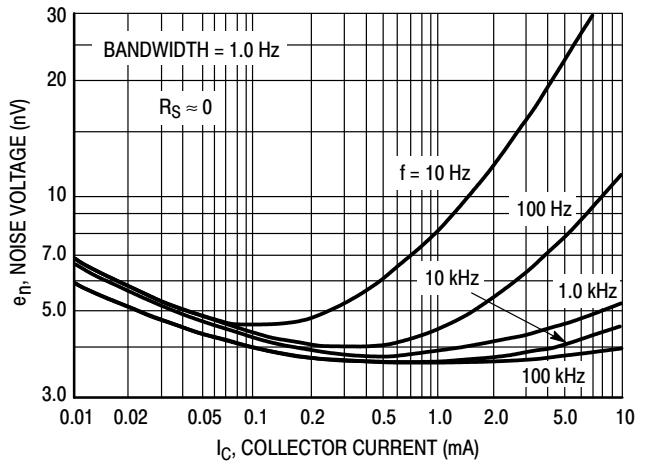


Figure 3. Effects of Collector Current

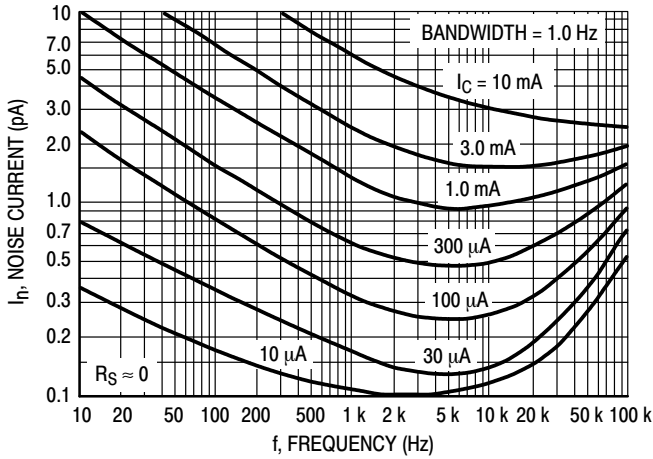


Figure 4. Noise Current

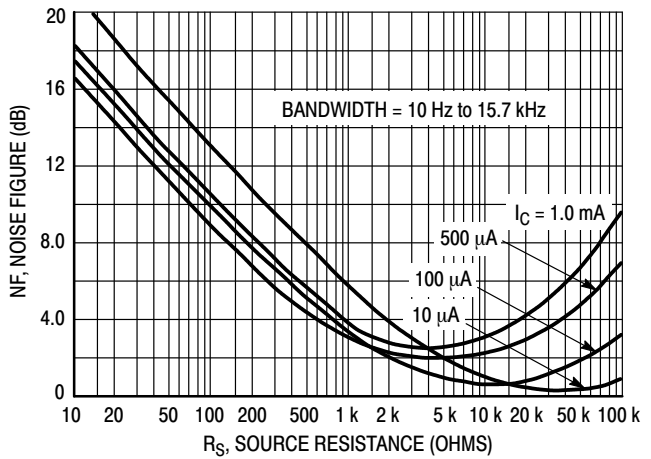


Figure 5. Wideband Noise Figure

### 100 Hz NOISE DATA

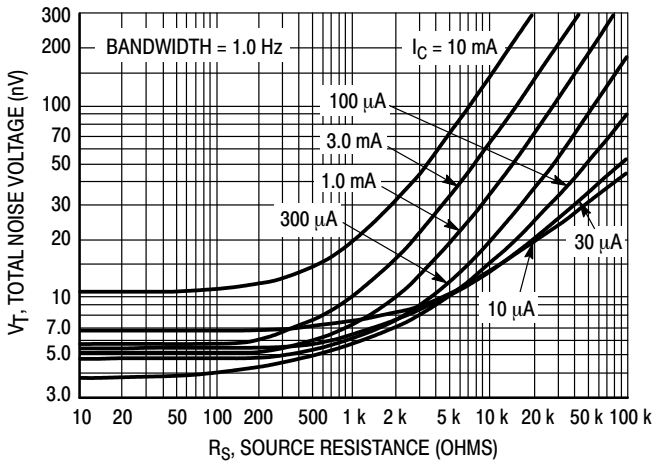


Figure 6. Total Noise Voltage

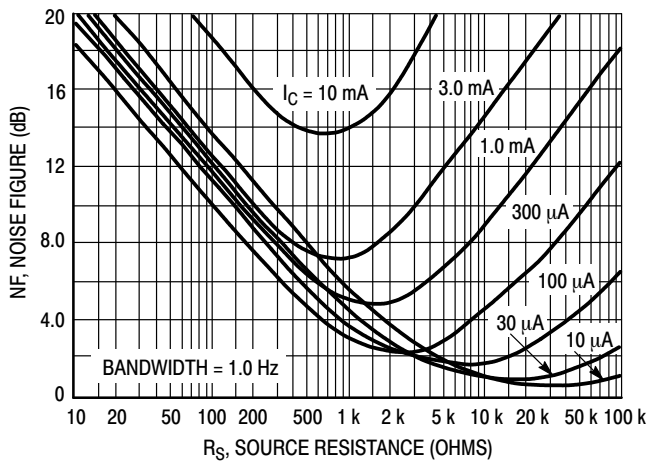


Figure 7. Noise Figure

# MMBT5088L, MMBT5089L

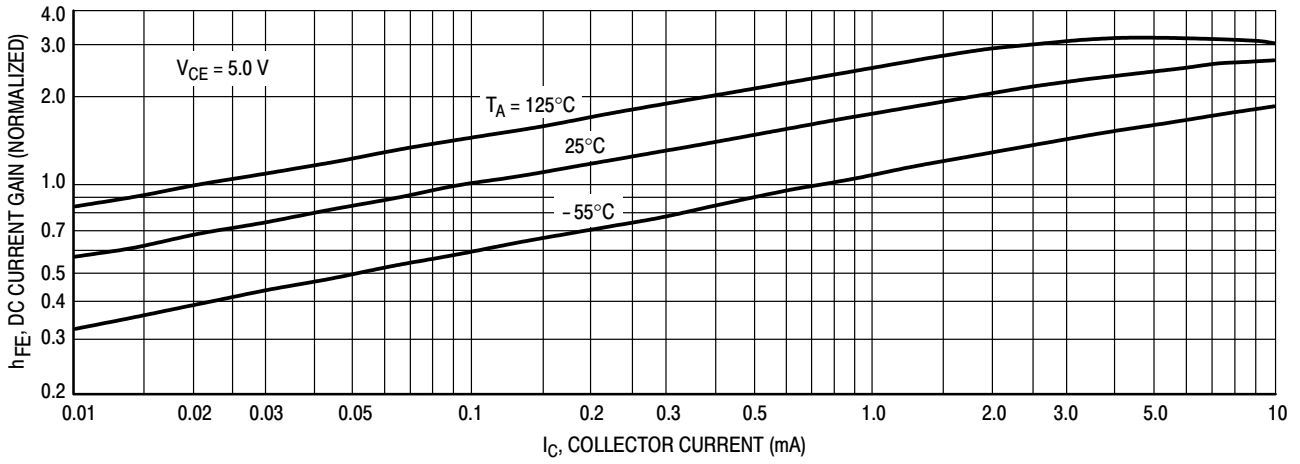


Figure 8. DC Current Gain

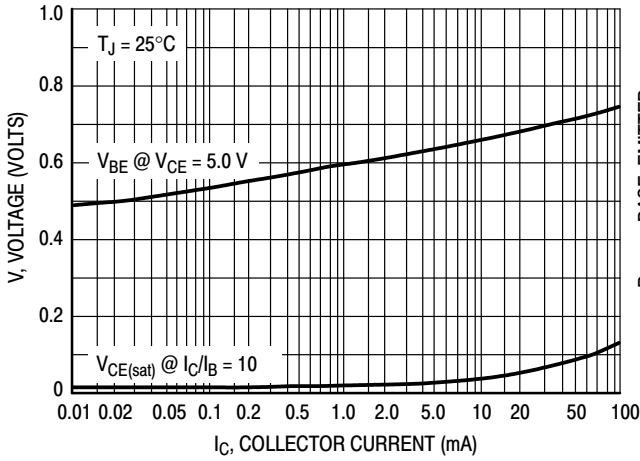


Figure 11. "On" Voltages

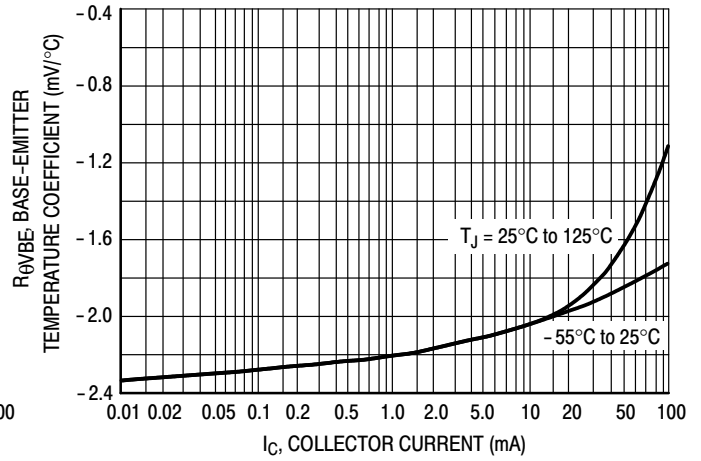


Figure 9. Temperature Coefficients

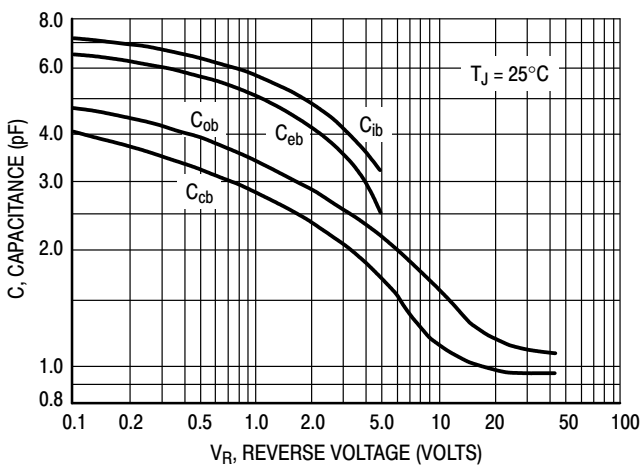


Figure 12. Capacitance

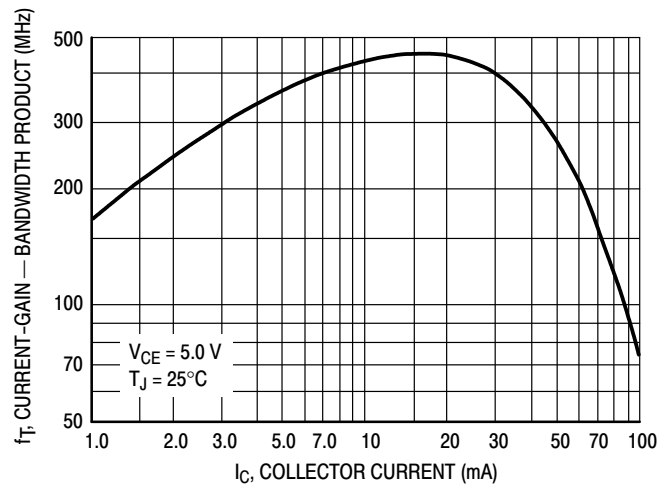
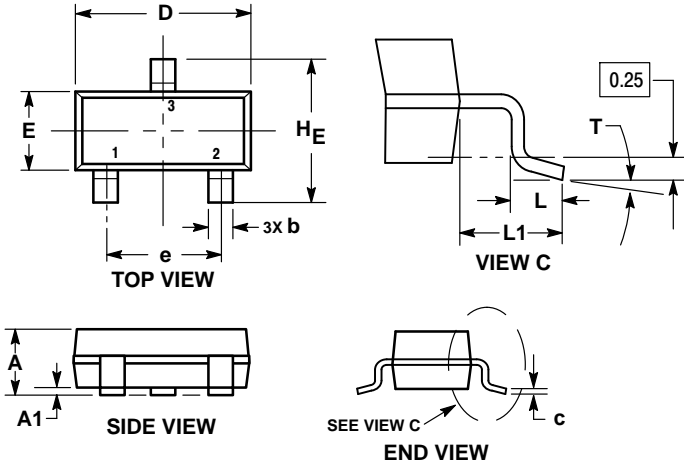


Figure 10. Current-Gain — Bandwidth Product

# MMBT5088L, MMBT5089L

## PACKAGE DIMENSIONS

SOT-23 (TO-236)  
CASE 318-08  
ISSUE AR



**NOTES:**

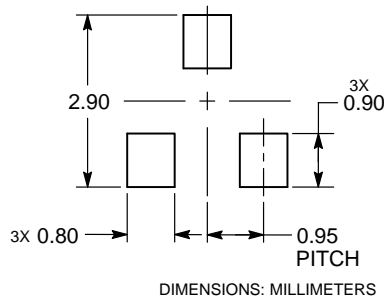
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF THE BASE MATERIAL.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.

| DIM | MILLIMETERS |      |      | INCHES |       |       |
|-----|-------------|------|------|--------|-------|-------|
|     | MIN         | NOM  | MAX  | MIN    | NOM   | MAX   |
| A   | 0.89        | 1.00 | 1.11 | 0.035  | 0.039 | 0.044 |
| A1  | 0.01        | 0.06 | 0.10 | 0.000  | 0.002 | 0.004 |
| b   | 0.37        | 0.44 | 0.50 | 0.015  | 0.017 | 0.020 |
| c   | 0.08        | 0.14 | 0.20 | 0.003  | 0.006 | 0.008 |
| D   | 2.80        | 2.90 | 3.04 | 0.110  | 0.114 | 0.120 |
| E   | 1.20        | 1.30 | 1.40 | 0.047  | 0.051 | 0.055 |
| e   | 1.78        | 1.90 | 2.04 | 0.070  | 0.075 | 0.080 |
| L   | 0.30        | 0.43 | 0.55 | 0.012  | 0.017 | 0.022 |
| L1  | 0.35        | 0.54 | 0.69 | 0.014  | 0.021 | 0.027 |
| HE  | 2.10        | 2.40 | 2.64 | 0.083  | 0.094 | 0.104 |
| T   | 0°          | ---  | 10°  | 0°     | ---   | 10°   |

**STYLE 6:**

- PIN 1. BASE
- EMITTER
- COLLECTOR

### RECOMMENDED SOLDERING FOOTPRINT\*



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

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