

# 2N5088, 2N5089

## Amplifier Transistors

### NPN Silicon

#### Features

- Pb-Free Packages are Available\*

#### MAXIMUM RATINGS

| Rating                                                                                    | Symbol         | Value       | Unit                       |
|-------------------------------------------------------------------------------------------|----------------|-------------|----------------------------|
| Collector – Emitter Voltage<br>2N5088<br>2N5089                                           | $V_{CEO}$      | 30<br>25    | Vdc                        |
| Collector – Base Voltage<br>2N5088<br>2N5089                                              | $V_{CBO}$      | 35<br>30    | Vdc                        |
| Emitter – Base Voltage                                                                    | $V_{EBO}$      | 3.0         | Vdc                        |
| Collector Current – Continuous                                                            | $I_C$          | 50          | mAdc                       |
| Total Device Dissipation<br>@ $T_A = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$ | $P_D$          | 625<br>5.0  | mW<br>mW/ $^\circ\text{C}$ |
| Total Device Dissipation<br>@ $T_C = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$ | $P_D$          | 1.5<br>12   | W<br>mW/ $^\circ\text{C}$  |
| Operating and Storage Junction<br>Temperature Range                                       | $T_J, T_{stg}$ | -55 to +150 | $^\circ\text{C}$           |

Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.

#### THERMAL CHARACTERISTICS

| Characteristic                                      | Symbol          | Max  | Unit               |
|-----------------------------------------------------|-----------------|------|--------------------|
| Thermal Resistance, (Note 1)<br>Junction-to-Ambient | $R_{\theta JA}$ | 200  | $^\circ\text{C/W}$ |
| Thermal Resistance,<br>Junction-to-Case             | $R_{\theta JC}$ | 83.3 | $^\circ\text{C/W}$ |

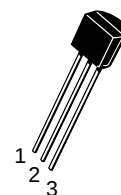
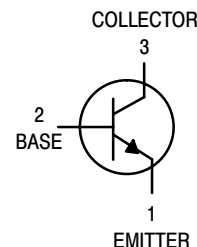
1.  $R_{\theta JA}$  is measured with the device soldered into a typical printed circuit board.

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



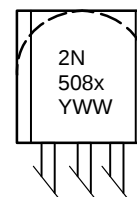
ON Semiconductor®

<http://onsemi.com>



TO-92  
CASE 29  
STYLE 1

#### MARKING DIAGRAM



x      8 or 9  
Y      = Year  
WW    = Work Week

#### ORDERING INFORMATION

| Device      | Package            | Shipping†        |
|-------------|--------------------|------------------|
| 2N5088      | TO-92              | 5000 Units/Box   |
| 2N5088RLRA  | TO-92              | 5000 Units/Box   |
| 2N5089      | TO-92              | 5000 Units/Box   |
| 2N5089G     | TO-92<br>(Pb-Free) | 5000 Units/Box   |
| 2N2089RLRA  | TO-92              | 2000/Tape & Reel |
| 2N2089RLRAG | TO-92<br>(Pb-Free) | 2000/Tape & Reel |
| 2N2089RLRE  | TO-92              | 2000/Tape & Reel |
| 2N2089RLREG | TO-92<br>(Pb-Free) | 2000/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.

## 2N5088, 2N5089

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

| Characteristic                                                                                                             | Symbol        | Min      | Max       | Unit |
|----------------------------------------------------------------------------------------------------------------------------|---------------|----------|-----------|------|
| <b>OFF CHARACTERISTICS</b>                                                                                                 |               |          |           |      |
| Collector–Emitter Breakdown Voltage (Note 2)<br>( $I_C = 1.0\text{ mA}$ , $I_E = 0$ )                                      | $V_{(BR)CEO}$ | 30<br>25 | –<br>–    | Vdc  |
| Collector–Base Breakdown Voltage<br>( $I_C = 100\text{ }\mu\text{A}$ , $I_E = 0$ )                                         | $V_{(BR)CBO}$ | 35<br>30 | –<br>–    | Vdc  |
| Collector Cutoff Current<br>( $V_{CB} = 20\text{ Vdc}$ , $I_E = 0$ )<br>( $V_{CB} = 15\text{ Vdc}$ , $I_E = 0$ )           | $I_{CBO}$     | –<br>–   | 50<br>50  | nAdc |
| Emitter Cutoff Current<br>( $V_{EB(off)} = 3.0\text{ Vdc}$ , $I_C = 0$ )<br>( $V_{EB(off)} = 4.5\text{ Vdc}$ , $I_C = 0$ ) | $I_{EBO}$     | –<br>–   | 50<br>100 | nAdc |

### ON CHARACTERISTICS

|                                                                                          |               |            |             |     |
|------------------------------------------------------------------------------------------|---------------|------------|-------------|-----|
| DC Current Gain<br>( $I_C = 100\text{ }\mu\text{A}$ , $V_{CE} = 5.0\text{ Vdc}$ )        | $h_{FE}$      | 300<br>400 | 900<br>1200 | –   |
| ( $I_C = 1.0\text{ mA}$ , $V_{CE} = 5.0\text{ Vdc}$ )                                    |               | 350<br>450 | –<br>–      |     |
| ( $I_C = 10\text{ mA}$ , $V_{CE} = 5.0\text{ Vdc}$ ) (Note 2)                            |               | 300<br>400 | –<br>–      |     |
| Collector–Emitter Saturation Voltage<br>( $I_C = 10\text{ mA}$ , $I_E = 1.0\text{ mA}$ ) | $V_{CE(sat)}$ | –          | 0.5         | Vdc |
| Base–Emitter On Voltage<br>( $I_C = 10\text{ mA}$ , $V_{CE} = 5.0\text{ Vdc}$ ) (Note 2) | $V_{BE(on)}$  | –          | 0.8         | Vdc |

### SMALL–SIGNAL CHARACTERISTICS

|                                                                                                                                       |          |            |              |     |
|---------------------------------------------------------------------------------------------------------------------------------------|----------|------------|--------------|-----|
| 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>( $V_{CB} = 5.0\text{ Vdc}$ , $I_E = 0$ , $f = 1.0\text{ MHz}$ )                                        | $C_{cb}$ | –          | 4.0          | pF  |
| Emitter–Base Capacitance<br>( $V_{EB} = 0.5\text{ Vdc}$ , $I_C = 0$ , $f = 1.0\text{ MHz}$ )                                          | $C_{eb}$ | –          | 10           | pF  |
| Small–Signal Current Gain<br>( $I_C = 1.0\text{ mA}$ , $V_{CE} = 5.0\text{ Vdc}$ , $f = 1.0\text{ kHz}$ )                             | $h_{fe}$ | 350<br>450 | 1400<br>1800 | –   |
| Noise Figure<br>( $I_C = 100\text{ }\mu\text{A}$ , $V_{CE} = 5.0\text{ Vdc}$ , $R_S = 1.0\text{ k}\Omega$ ,<br>$f = 1.0\text{ kHz}$ ) | NF       | –<br>–     | 3.0<br>2.0   | dB  |

2. Pulse Test: Pulse Width  $\leq 300\text{ }\mu\text{s}$ , Duty Cycle  $\leq 2.0\%$ .

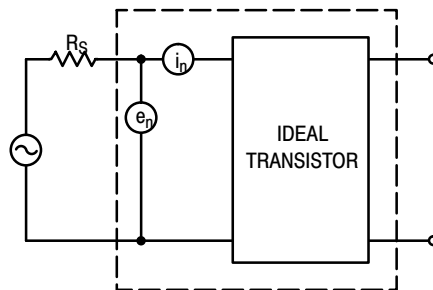


Figure 1. Transistor Noise Model

# NOISE CHARACTERISTICS

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

## NOISE VOLTAGE

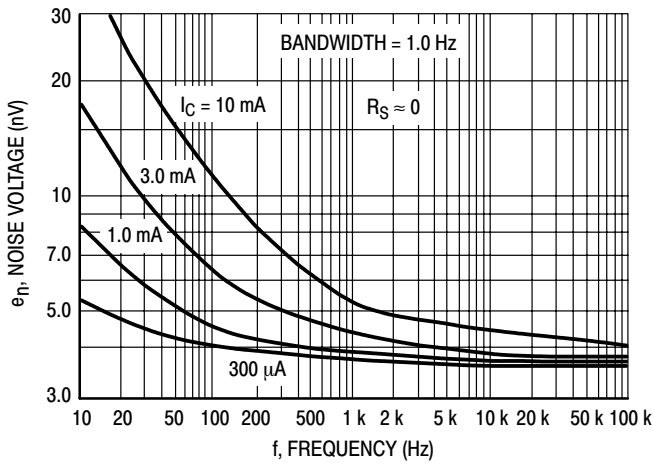


Figure 2. Effects of Frequency

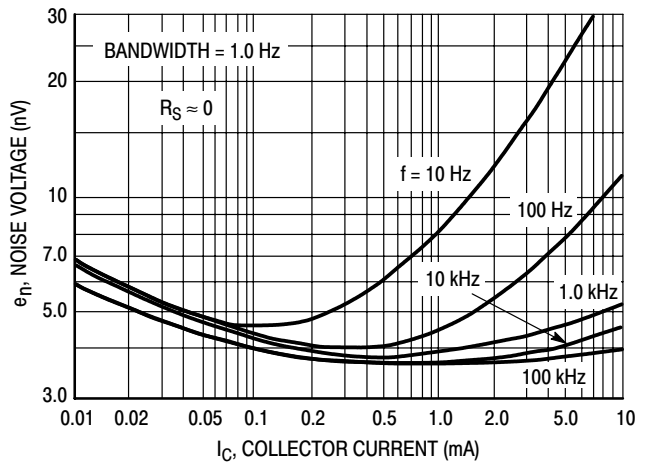


Figure 3. Effects of Collector Current

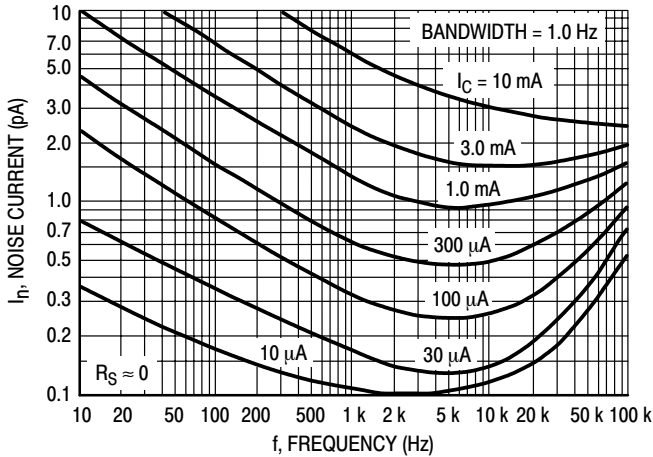


Figure 4. Noise Current

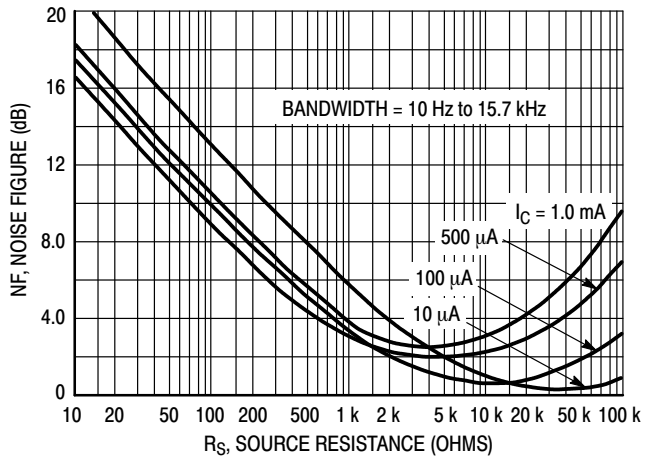


Figure 5. Wideband Noise Figure

## 100 Hz NOISE DATA

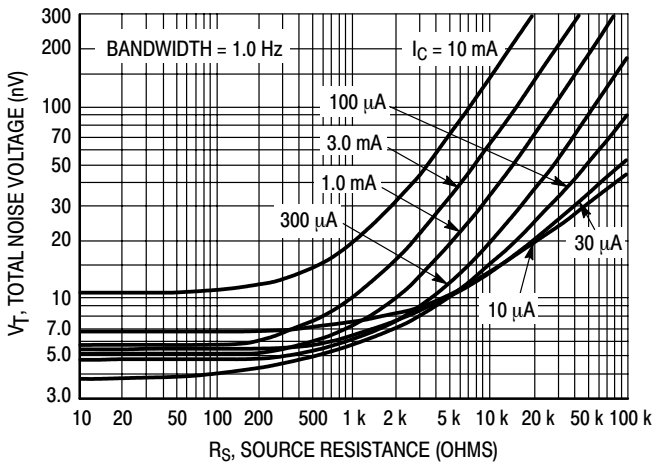


Figure 6. Total Noise Voltage

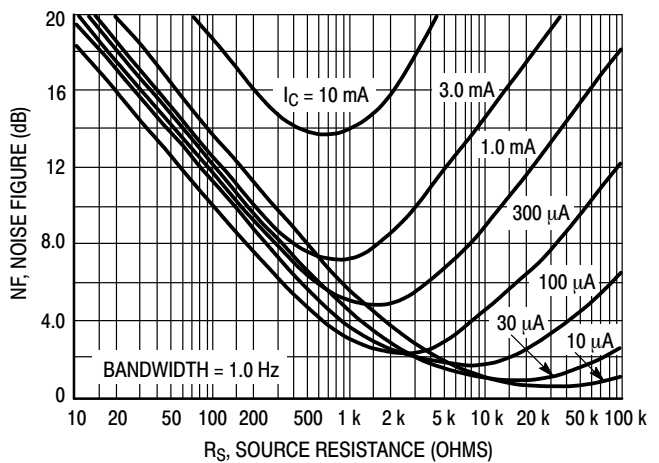


Figure 7. Noise Figure

## 2N5088, 2N5089

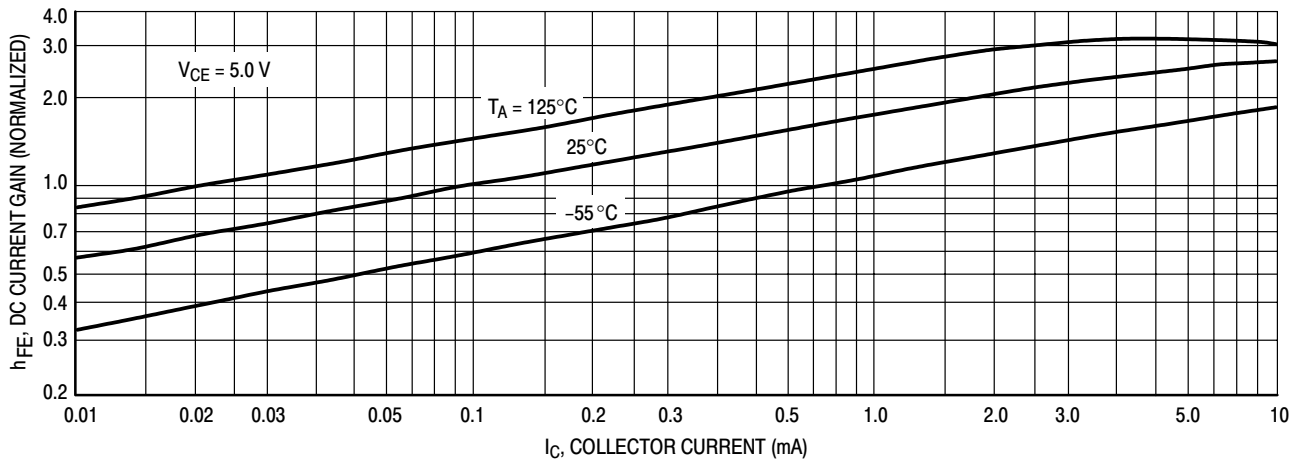


Figure 8. DC Current Gain

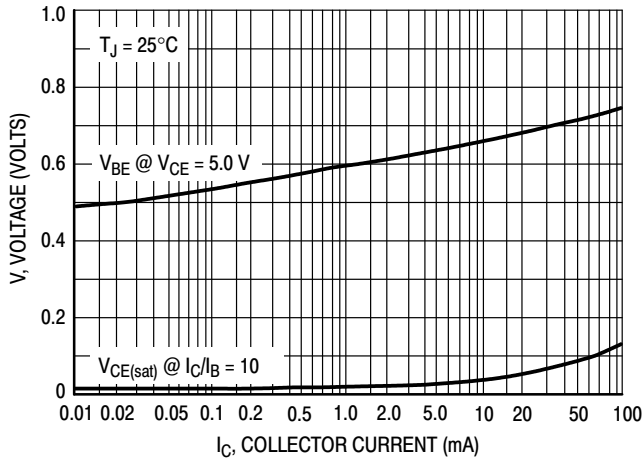


Figure 9. "On" Voltages

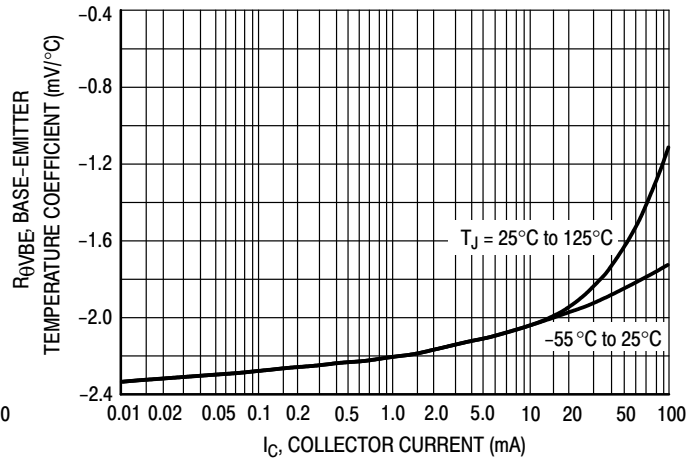


Figure 10. Temperature Coefficients

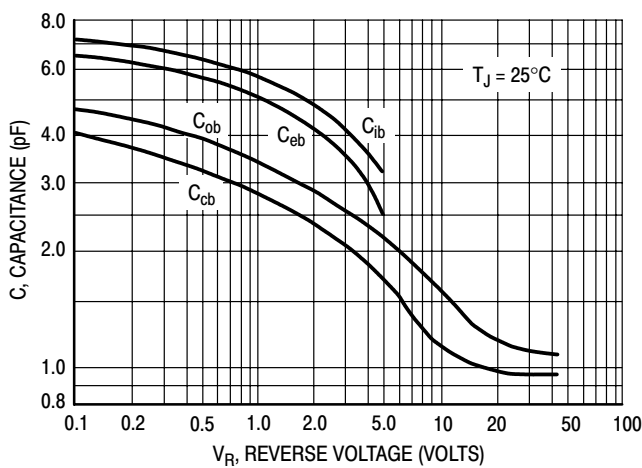


Figure 11. Capacitance

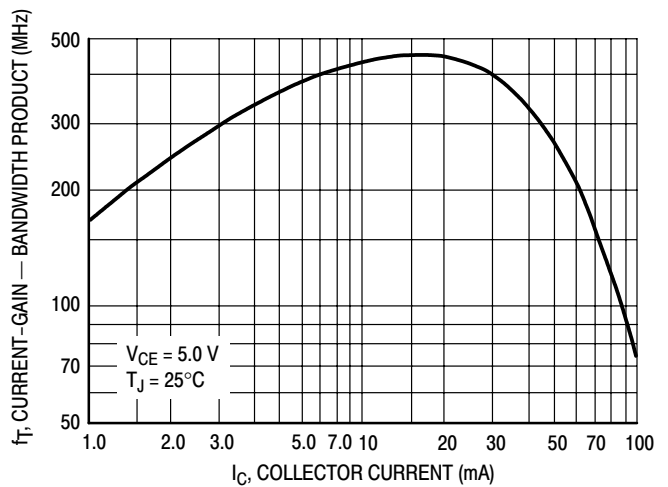
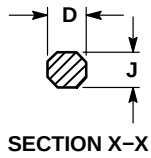
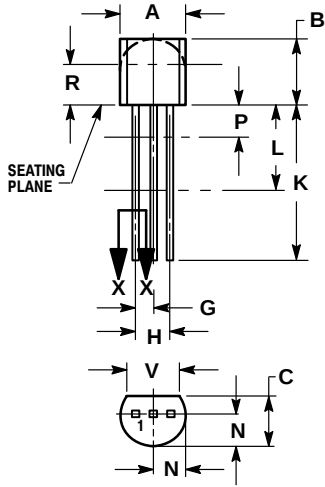


Figure 12. Current-Gain — Bandwidth Product

# 2N5088, 2N5089

## PACKAGE DIMENSIONS

TO-92  
TO-226AA  
CASE 29-11  
ISSUE AL



### NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. CONTOUR OF PACKAGE BEYOND DIMENSION R IS UNCONTROLLED.
4. LEAD DIMENSION IS UNCONTROLLED IN P AND BEYOND DIMENSION K MINIMUM.

| DIM | INCHES |       | MILLIMETERS |       |
|-----|--------|-------|-------------|-------|
|     | MIN    | MAX   | MIN         | MAX   |
| A   | 0.175  | 0.205 | 4.45        | 5.20  |
| B   | 0.170  | 0.210 | 4.32        | 5.33  |
| C   | 0.125  | 0.165 | 3.18        | 4.19  |
| D   | 0.016  | 0.021 | 0.407       | 0.533 |
| G   | 0.045  | 0.055 | 1.15        | 1.39  |
| H   | 0.095  | 0.105 | 2.42        | 2.66  |
| J   | 0.015  | 0.020 | 0.39        | 0.50  |
| K   | 0.500  | ---   | 12.70       | ---   |
| L   | 0.250  | ---   | 6.35        | ---   |
| N   | 0.080  | 0.105 | 2.04        | 2.66  |
| P   | ---    | 0.100 | ---         | 2.54  |
| R   | 0.115  | ---   | 2.93        | ---   |
| V   | 0.135  | ---   | 3.43        | ---   |

### STYLE 1:

1. PIN 1. EMITTER
2. BASE
3. COLLECTOR

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