

# Darlington Transistors

## NPN Silicon

### MAXIMUM RATINGS

| Rating                                                                                 | Symbol         | Value       | Unit                          |
|----------------------------------------------------------------------------------------|----------------|-------------|-------------------------------|
| Collector–Emitter Voltage                                                              | $V_{CES}$      | 30          | Vdc                           |
| Collector–Base Voltage                                                                 | $V_{CBO}$      | 30          | Vdc                           |
| Emitter–Base Voltage                                                                   | $V_{EBO}$      | 10          | Vdc                           |
| Collector Current — Continuous                                                         | $I_C$          | 500         | mA <sub>dc</sub>              |
| Total Device Dissipation @ $T_A = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$ | $P_D$          | 625<br>5.0  | mW<br>mW/ $^\circ\text{C}$    |
| Total Device Dissipation @ $T_C = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$ | $P_D$          | 1.5<br>12   | Watts<br>mW/ $^\circ\text{C}$ |
| Operating and Storage Junction<br>Temperature Range                                    | $T_J, T_{stg}$ | –55 to +150 | $^\circ\text{C}$              |

### THERMAL CHARACTERISTICS

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

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

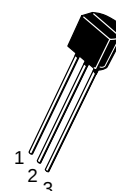
| Characteristic | Symbol | Min | Max | Unit |
|----------------|--------|-----|-----|------|
|----------------|--------|-----|-----|------|

### OFF CHARACTERISTICS

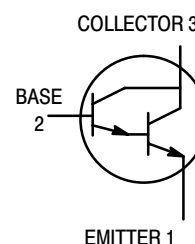
|                                                                                     |               |    |     |                  |
|-------------------------------------------------------------------------------------|---------------|----|-----|------------------|
| Collector–Emitter Breakdown Voltage<br>( $I_C = 100 \mu\text{A}_{dc}$ , $I_B = 0$ ) | $V_{(BR)CES}$ | 30 | —   | Vdc              |
| Collector Cutoff Current<br>( $V_{CB} = 30 \text{ Vdc}$ , $I_E = 0$ )               | $I_{CBO}$     | —  | 100 | nA <sub>dc</sub> |
| Emitter Cutoff Current<br>( $V_{EB} = 10 \text{ Vdc}$ , $I_C = 0$ )                 | $I_{EBO}$     | —  | 100 | nA <sub>dc</sub> |

**MPSA13**  
**MPSA14\***

\*ON Semiconductor Preferred Device



CASE 29–04, STYLE 1  
TO–92 (TO–226AA)



Preferred devices are ON Semiconductor recommended choices for future use and best overall value.

# MPSA13 MPSA14

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

| Characteristic | Symbol | Min | Max | Unit |
|----------------|--------|-----|-----|------|
|----------------|--------|-----|-----|------|

### ON CHARACTERISTICS<sup>(1)</sup>

|                                                                                           |        |               |        |     |     |
|-------------------------------------------------------------------------------------------|--------|---------------|--------|-----|-----|
| DC Current Gain<br>( $I_C = 10\text{ mA}$ , $V_{CE} = 5.0\text{ Vdc}$ )                   | MPSA13 | $h_{FE}$      | 5,000  | —   | —   |
|                                                                                           | MPSA14 |               | 10,000 | —   |     |
| ( $I_C = 100\text{ mA}$ , $V_{CE} = 5.0\text{ Vdc}$ )                                     | MPSA13 |               | 10,000 | —   |     |
|                                                                                           | MPSA14 |               | 20,000 | —   |     |
| Collector–Emitter Saturation Voltage<br>( $I_C = 100\text{ mA}$ , $I_B = 0.1\text{ mA}$ ) |        | $V_{CE(sat)}$ | —      | 1.5 | Vdc |
| Base–Emitter On Voltage<br>( $I_C = 100\text{ mA}$ , $V_{CE} = 5.0\text{ Vdc}$ )          |        | $V_{BE(on)}$  | —      | 2.0 | Vdc |

### SMALL–SIGNAL CHARACTERISTICS

|                                                                                                                                |       |     |   |     |
|--------------------------------------------------------------------------------------------------------------------------------|-------|-----|---|-----|
| Current–Gain – Bandwidth Product <sup>(2)</sup><br>( $I_C = 10\text{ mA}$ , $V_{CE} = 5.0\text{ Vdc}$ , $f = 100\text{ MHz}$ ) | $f_T$ | 125 | — | MHz |
|--------------------------------------------------------------------------------------------------------------------------------|-------|-----|---|-----|

1. Pulse Test: Pulse Width  $\leq 300\text{ }\mu\text{s}$ ; Duty Cycle  $\leq 2.0\%$ .
2.  $f_T = |h_{fe}| \cdot f_{test}$ .

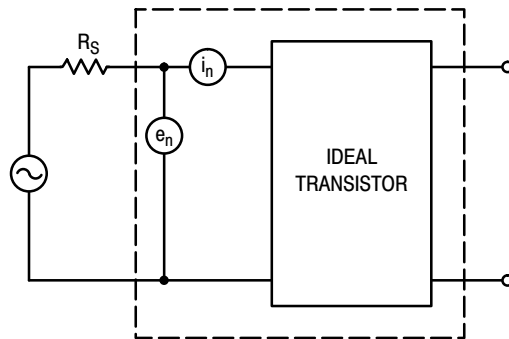


Figure 1. Transistor Noise Model

# MPSA13 MPSA14

## NOISE CHARACTERISTICS

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

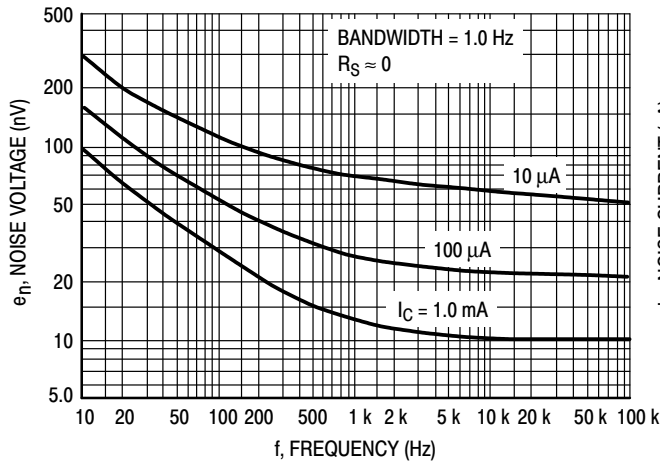


Figure 2. Noise Voltage

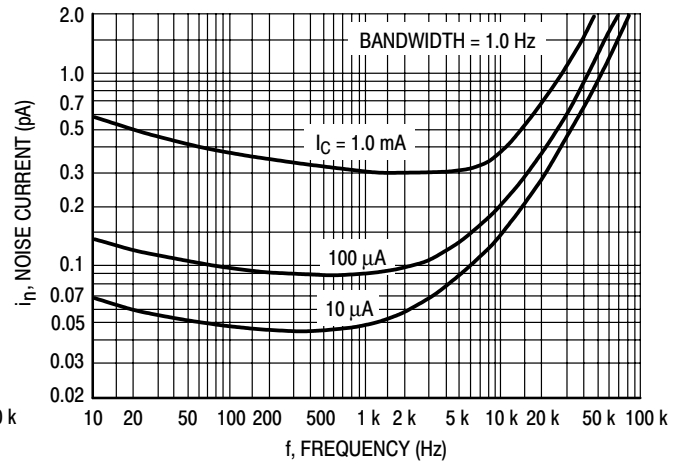


Figure 3. Noise Current

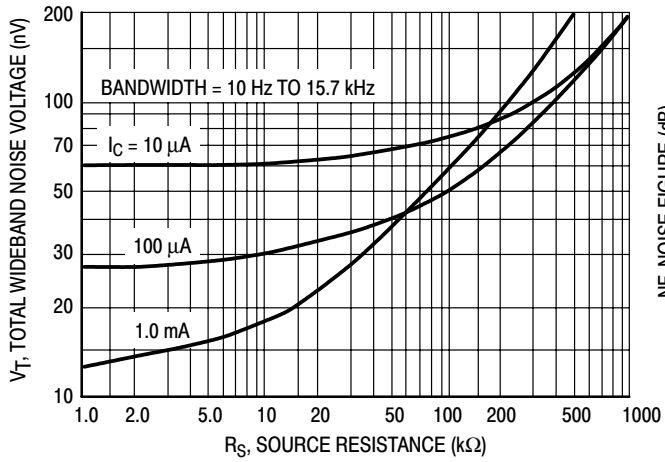


Figure 4. Total Wideband Noise Voltage

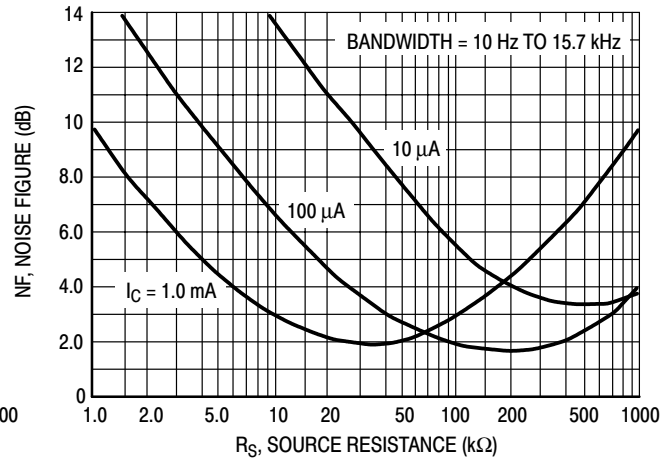


Figure 5. Wideband Noise Figure

# MPSA13 MPSA14

## SMALL-SIGNAL CHARACTERISTICS

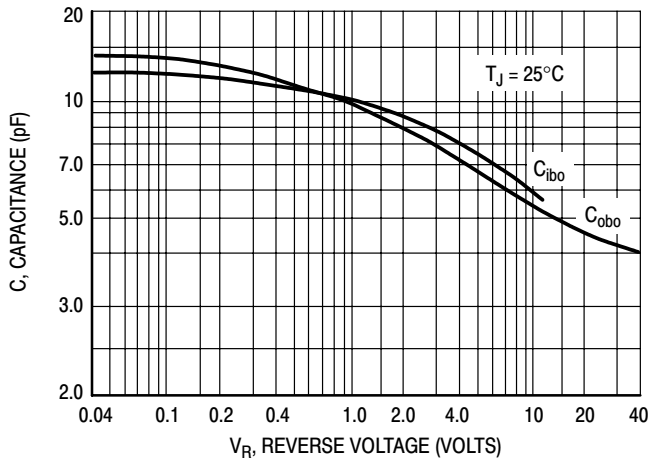


Figure 6. Capacitance

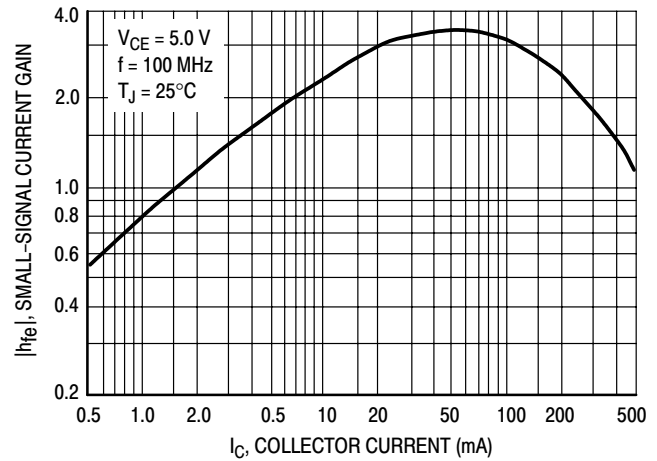


Figure 7. High Frequency Current Gain

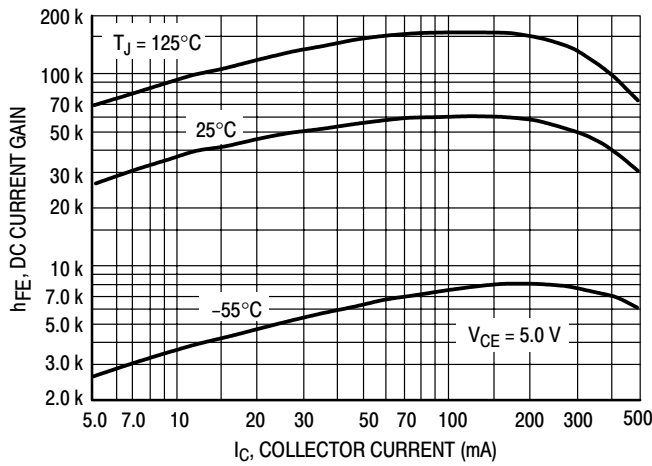


Figure 8. DC Current Gain

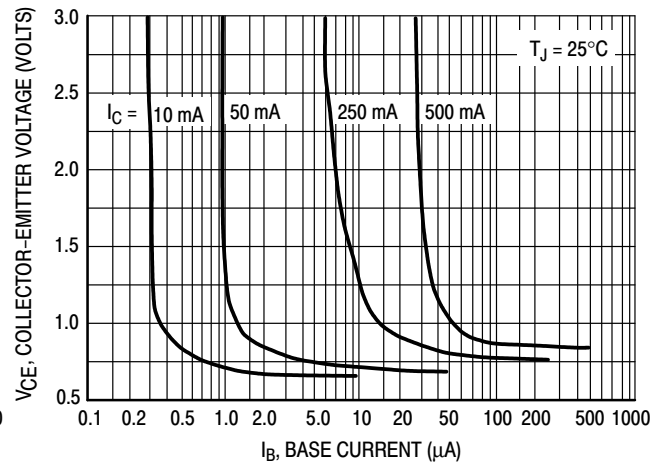


Figure 9. Collector Saturation Region

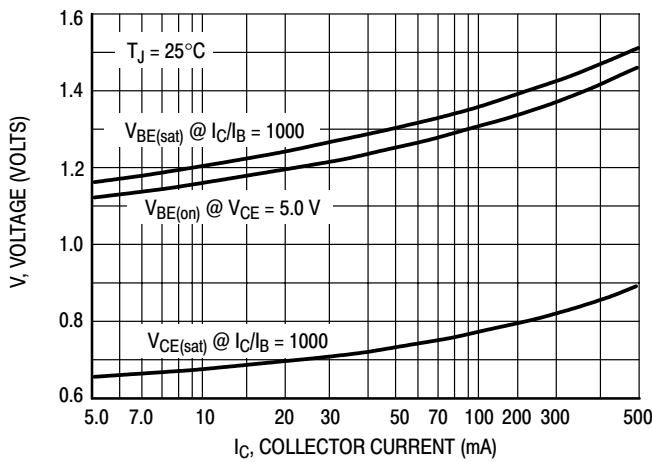


Figure 10. "On" Voltages

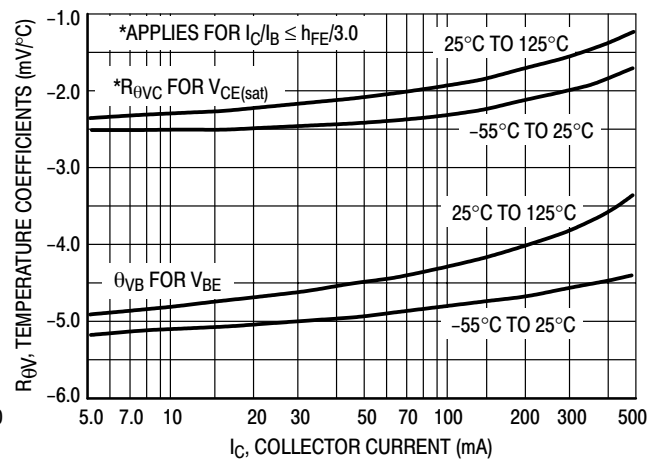


Figure 11. Temperature Coefficients

## MPSA13 MPSA14

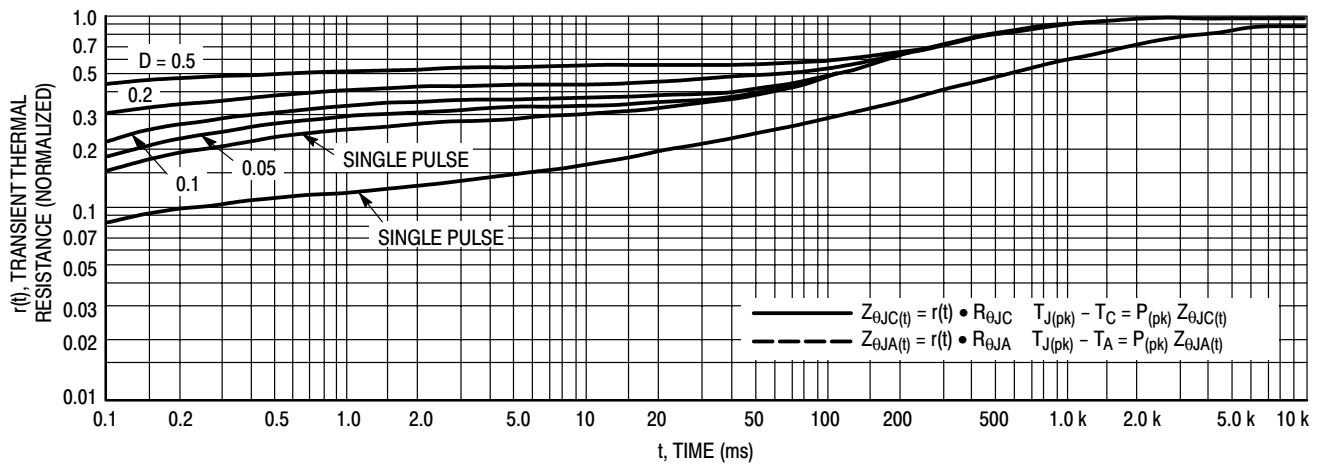


Figure 12. Thermal Response

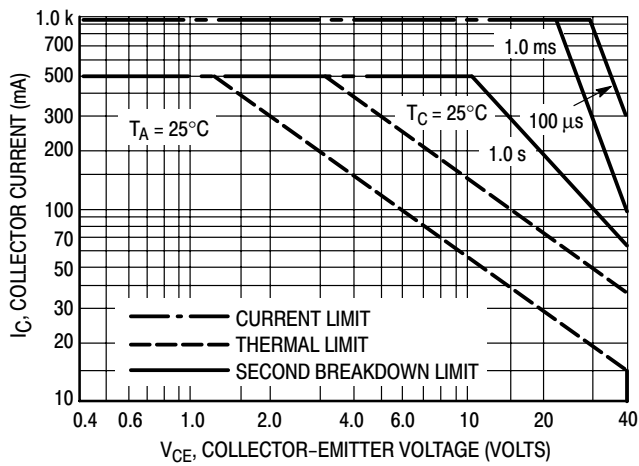
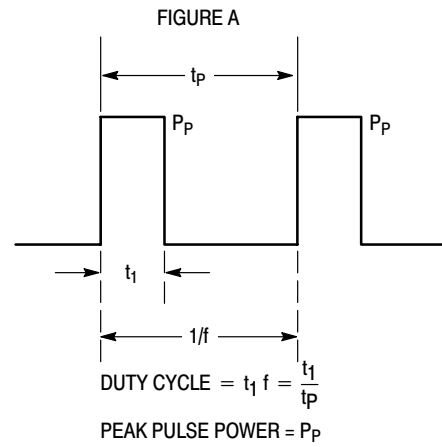


Figure 13. Active Region Safe Operating Area

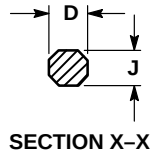
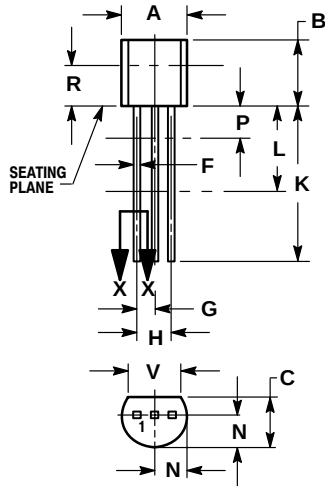


Design Note: Use of Transient Thermal Resistance Data

# MPSA13 MPSA14

## PACKAGE DIMENSIONS

CASE 029-04  
(TO-226AA)  
ISSUE AD



### NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. CONTOUR OF PACKAGE BEYOND DIMENSION R IS UNCONTROLLED.
4. DIMENSION F APPLIES BETWEEN P AND L. DIMENSION D AND J APPLY BETWEEN L AND K MINIMUM. 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  | 0.022 | 0.41        | 0.55 |
| F   | 0.016  | 0.019 | 0.41        | 0.48 |
| 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. EMITTER
2. BASE
3. COLLECTOR

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