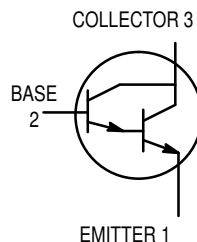


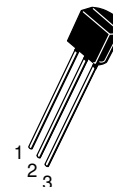
# Darlington Transistors

## NPN Silicon



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

\*Motorola Preferred Device



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

### 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> |

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

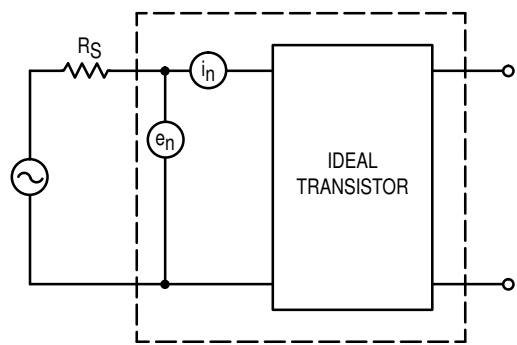


**MPSA13 MPSA14**

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

| Characteristic                                                                                                         | Symbol        | Min    | Max | Unit |
|------------------------------------------------------------------------------------------------------------------------|---------------|--------|-----|------|
| <b>ON CHARACTERISTICS(1)</b>                                                                                           |               |        |     |      |
| DC Current Gain<br>( $I_C = 10\text{ mA dc}$ , $V_{CE} = 5.0\text{ V dc}$ )                                            | $h_{FE}$      | 5,000  | —   | —    |
| MPSA13                                                                                                                 |               | 10,000 | —   | —    |
| ( $I_C = 100\text{ mA dc}$ , $V_{CE} = 5.0\text{ V dc}$ )                                                              |               | 10,000 | —   | —    |
| MPSA14                                                                                                                 |               | 20,000 | —   | —    |
| Collector–Emitter Saturation Voltage<br>( $I_C = 100\text{ mA dc}$ , $I_B = 0.1\text{ mA dc}$ )                        | $V_{CE(sat)}$ | —      | 1.5 | Vdc  |
| Base–Emitter On Voltage<br>( $I_C = 100\text{ mA dc}$ , $V_{CE} = 5.0\text{ V dc}$ )                                   | $V_{BE(on)}$  | —      | 2.0 | Vdc  |
| <b>SMALL–SIGNAL CHARACTERISTICS</b>                                                                                    |               |        |     |      |
| Current–Gain – Bandwidth Product(2)<br>( $I_C = 10\text{ mA dc}$ , $V_{CE} = 5.0\text{ V dc}$ , $f = 100\text{ MHz}$ ) | $f_T$         | 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**

# NOISE CHARACTERISTICS

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

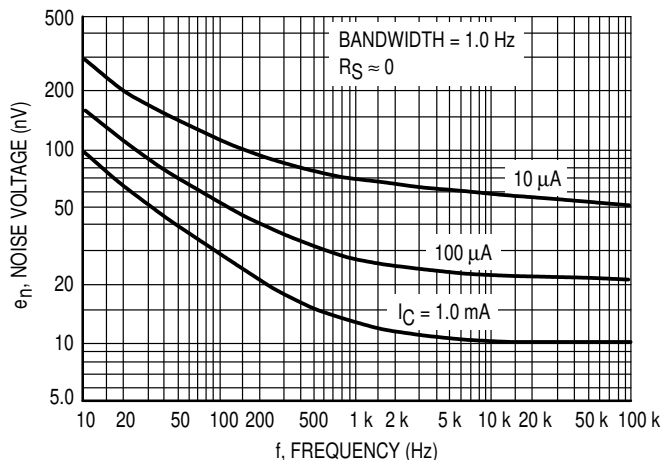


Figure 2. Noise Voltage

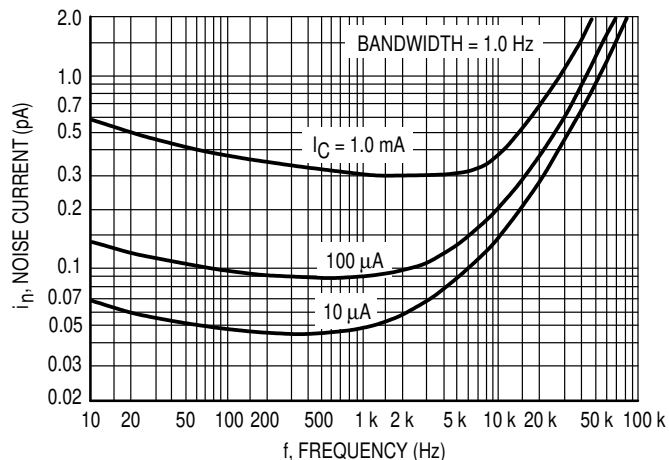


Figure 3. Noise Current

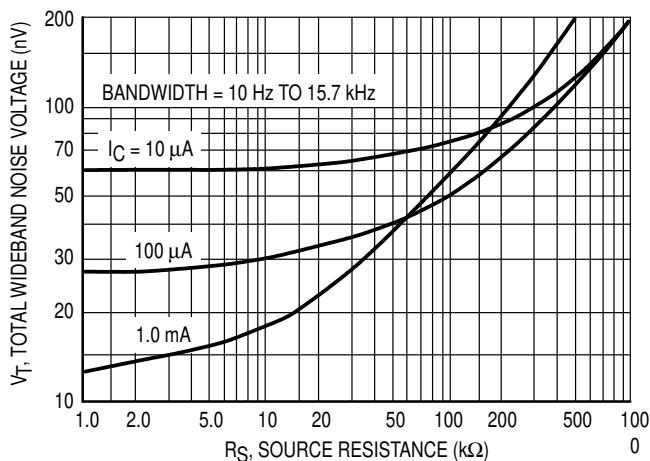


Figure 4. Total Wideband Noise Voltage

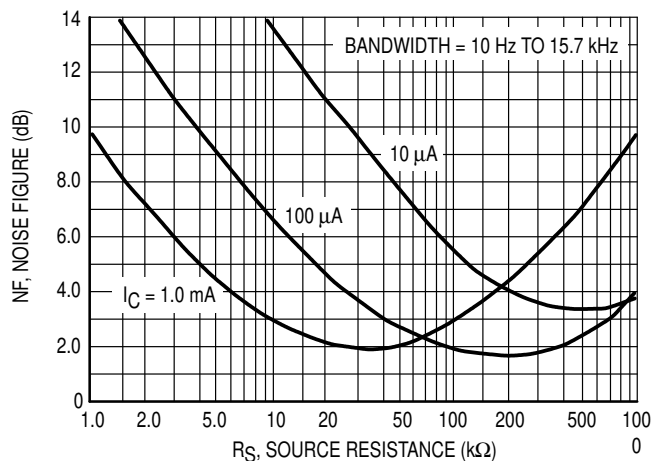


Figure 5. Wideband Noise Figure

## SMALL-SIGNAL CHARACTERISTICS

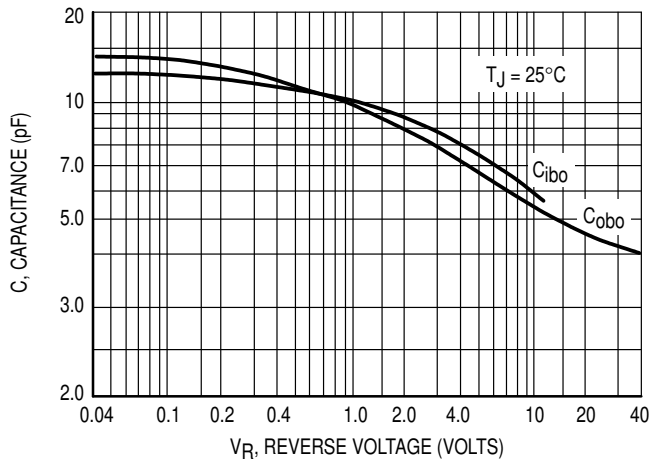


Figure 6. Capacitance

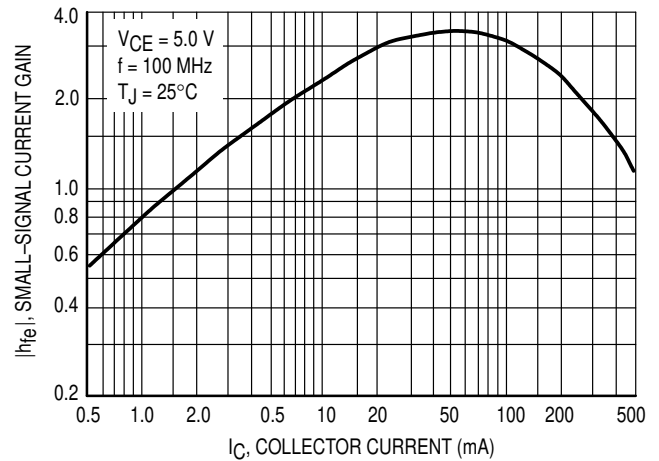


Figure 7. High Frequency Current Gain

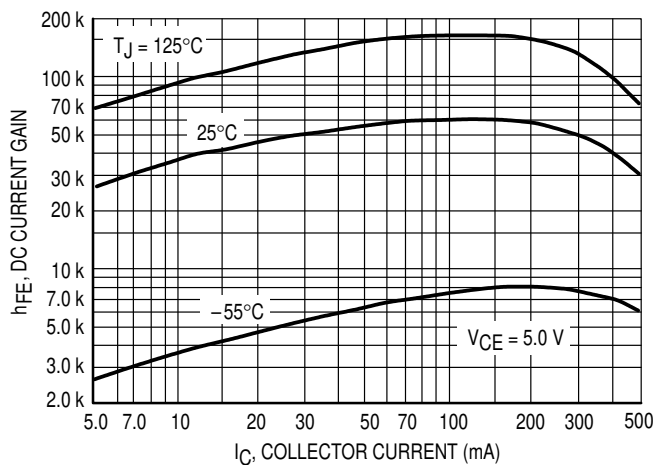


Figure 8. DC Current Gain

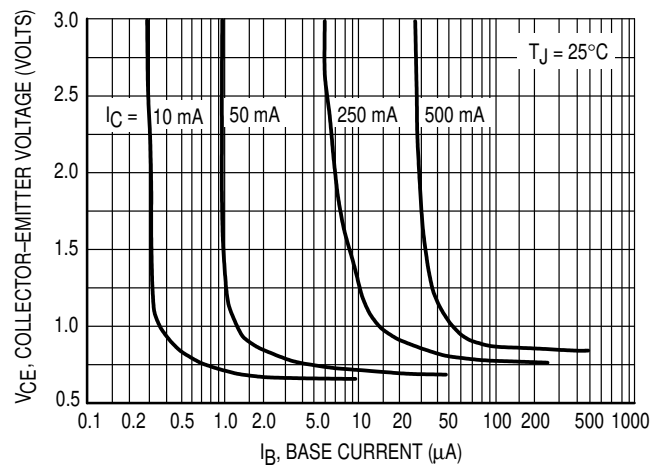


Figure 9. Collector Saturation Region

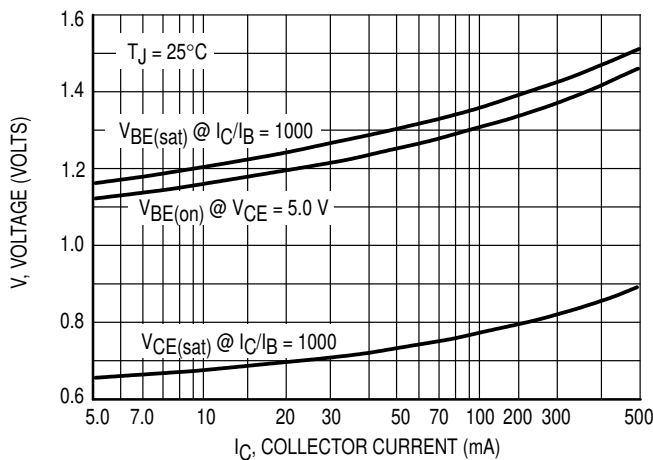


Figure 10. "On" Voltages

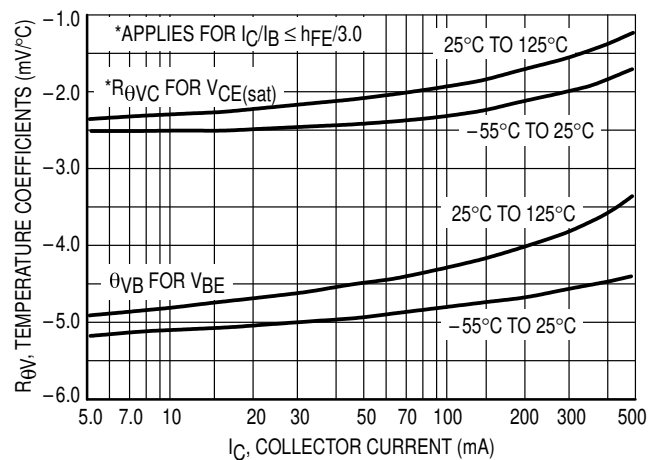


Figure 11. Temperature Coefficients

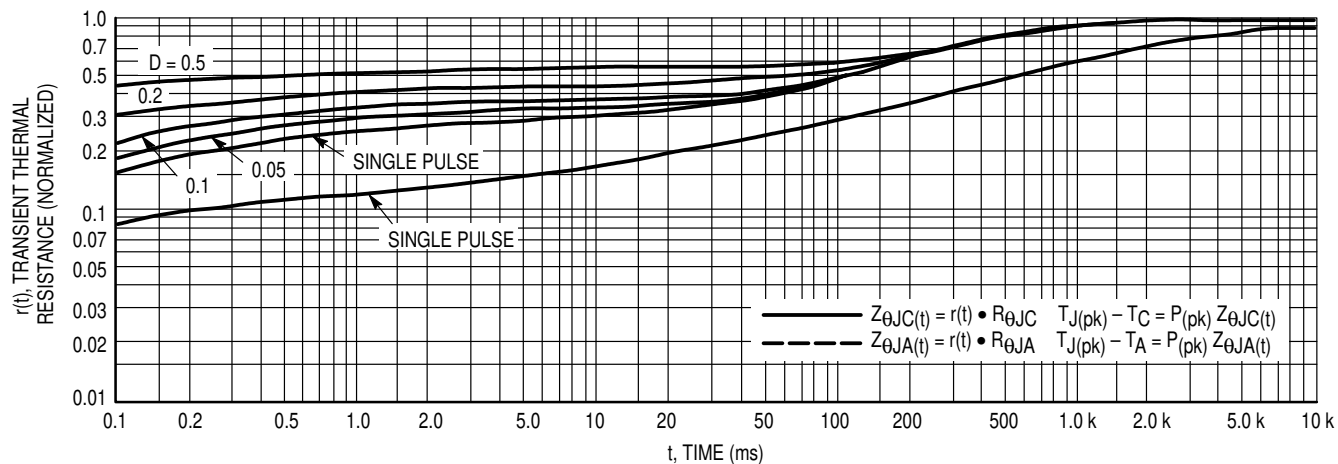


Figure 12. Thermal Response

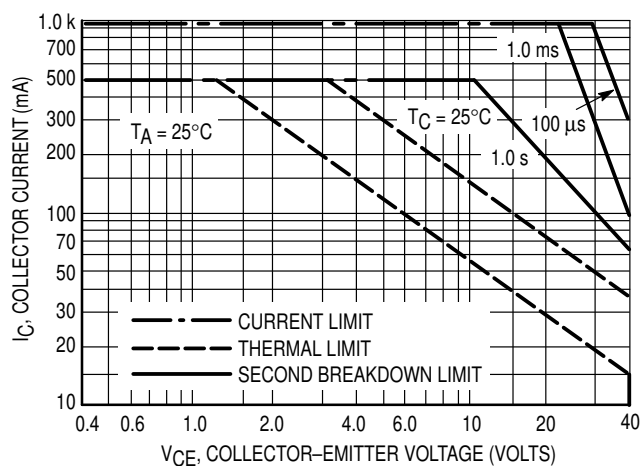
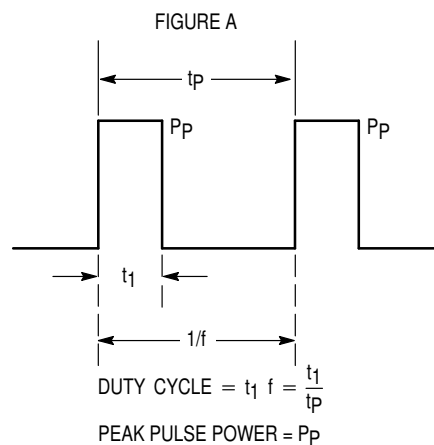
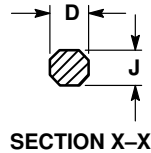
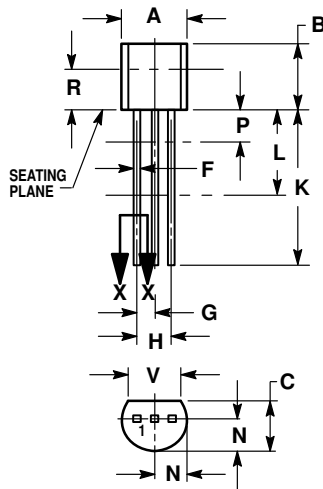


Figure 13. Active Region Safe Operating Area



Design Note: Use of Transient Thermal Resistance Data

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

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