

# High Voltage Transistors

## MAXIMUM RATINGS

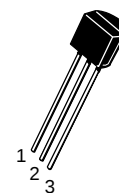
| Rating                                                                                    | Symbol         | 2N6515      | 2N6517<br>2N6520 | Unit                          |
|-------------------------------------------------------------------------------------------|----------------|-------------|------------------|-------------------------------|
| Collector–Emitter Voltage                                                                 | $V_{CEO}$      | 250         | 350              | Vdc                           |
| Collector–Base Voltage                                                                    | $V_{CBO}$      | 250         | 350              | Vdc                           |
| Emitter–Base Voltage<br>2N6515, 2N6516, 2N6517<br>2N6519, 2N6520                          | $V_{EBO}$      | 6.0<br>5.0  |                  | Vdc                           |
| Base Current                                                                              | $I_B$          | 250         |                  | mAdc                          |
| Collector Current –<br>Continuous                                                         | $I_C$          | 500         |                  | 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   |                  | Watts<br>mW/ $^\circ\text{C}$ |
| Operating and Storage<br>Junction<br>Temperature Range                                    | $T_J, T_{stg}$ | –55 to +150 |                  | $^\circ\text{C}$              |

## THERMAL CHARACTERISTICS

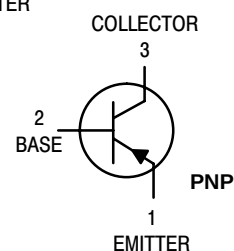
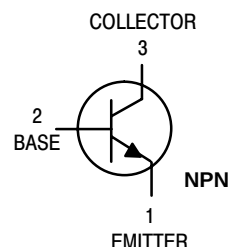
| Characteristic                          | Symbol          | Max  | Unit               |
|-----------------------------------------|-----------------|------|--------------------|
| Thermal Resistance, Junction to Ambient | $R_{\theta JA}$ | 200  | $^\circ\text{C/W}$ |
| Thermal Resistance, Junction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

**NPN**  
**2N6515**  
**2N6517**  
**PNP**  
**2N6520**

Voltage and current are negative  
for PNP transistors



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



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

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

## OFF CHARACTERISTICS

|                                                                                               |                          |               |            |        |     |
|-----------------------------------------------------------------------------------------------|--------------------------|---------------|------------|--------|-----|
| Collector–Emitter Breakdown Voltage <sup>(1)</sup><br>( $I_C = 1.0\text{ mAdc}$ , $I_B = 0$ ) | 2N6515<br>2N6517, 2N6520 | $V_{(BR)CEO}$ | 250<br>350 | –<br>– | Vdc |
| Collector–Base Breakdown Voltage<br>( $I_C = 100\text{ }\mu\text{Adc}$ , $I_E = 0$ )          | 2N6515<br>2N6517, 2N6520 | $V_{(BR)CBO}$ | 250<br>350 | –<br>– | Vdc |
| Emitter–Base Breakdown Voltage<br>( $I_E = 10\text{ }\mu\text{Adc}$ , $I_C = 0$ )             | 2N6515, 2N6517<br>2N6520 | $V_{(BR)EBO}$ | 6.0<br>5.0 | –<br>– | Vdc |

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

# NPN 2N6515 2N6517 PNP 2N6520

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

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

### OFF CHARACTERISTICS (Continued)

|                                                                                                                    |                          |           |        |          |      |
|--------------------------------------------------------------------------------------------------------------------|--------------------------|-----------|--------|----------|------|
| Collector Cutoff Current<br>( $V_{CB} = 150\text{ Vdc}$ , $I_E = 0$ )<br>( $V_{CB} = 250\text{ Vdc}$ , $I_E = 0$ ) | 2N6515<br>2N6517, 2N6520 | $I_{CBO}$ | –<br>– | 50<br>50 | nAdc |
| Emitter Cutoff Current<br>( $V_{EB} = 5.0\text{ Vdc}$ , $I_C = 0$ )<br>( $V_{EB} = 4.0\text{ Vdc}$ , $I_C = 0$ )   | 2N6515, 2N6517<br>2N6520 | $I_{EBO}$ | –<br>– | 50<br>50 | nAdc |

### ON CHARACTERISTICS(1)

|                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                          |               |                                                                          |                                                                        |     |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|--------------------------------------------------------------------------|------------------------------------------------------------------------|-----|
| DC Current Gain<br>( $I_C = 1.0\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ )<br><br>( $I_C = 10\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ )<br><br>( $I_C = 30\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ )<br><br>( $I_C = 50\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ )<br><br>( $I_C = 100\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ ) | 2N6515<br>2N6517, 2N6520<br><br>2N6515<br>2N6517, 2N6520<br><br>2N6515<br>2N6517, 2N6520<br><br>2N6515<br>2N6517, 2N6520<br><br>2N6515<br>2N6517, 2N6520 | $h_{FE}$      | 35<br>20<br><br>50<br>30<br><br>50<br>30<br><br>45<br>20<br><br>25<br>15 | –<br>–<br><br>–<br>–<br><br>300<br>200<br><br>220<br>200<br><br>–<br>– | –   |
| Collector–Emitter Saturation Voltage<br>( $I_C = 10\text{ mAdc}$ , $I_B = 1.0\text{ mAdc}$ )<br>( $I_C = 20\text{ mAdc}$ , $I_B = 2.0\text{ mAdc}$ )<br>( $I_C = 30\text{ mAdc}$ , $I_B = 3.0\text{ mAdc}$ )<br>( $I_C = 50\text{ mAdc}$ , $I_B = 5.0\text{ mAdc}$ )                                                           |                                                                                                                                                          | $V_{CE(sat)}$ | –<br>–<br>–<br>–                                                         | 0.30<br>0.35<br>0.50<br>1.0                                            | Vdc |
| Base–Emitter Saturation Voltage<br>( $I_C = 10\text{ mAdc}$ , $I_B = 1.0\text{ mAdc}$ )<br>( $I_C = 20\text{ mAdc}$ , $I_B = 2.0\text{ mAdc}$ )<br>( $I_C = 30\text{ mAdc}$ , $I_B = 3.0\text{ mAdc}$ )                                                                                                                        |                                                                                                                                                          | $V_{BE(sat)}$ | –<br>–<br>–                                                              | 0.75<br>0.85<br>0.90                                                   | Vdc |
| Base–Emitter On Voltage<br>( $I_C = 100\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ )                                                                                                                                                                                                                                              |                                                                                                                                                          | $V_{BE(on)}$  | –                                                                        | 2.0                                                                    | Vdc |

### SMALL–SIGNAL CHARACTERISTICS

|                                                                                                                    |                          |          |        |           |     |
|--------------------------------------------------------------------------------------------------------------------|--------------------------|----------|--------|-----------|-----|
| Current–Gain – Bandwidth Product(1)<br>( $I_C = 10\text{ mAdc}$ , $V_{CE} = 20\text{ Vdc}$ , $f = 20\text{ MHz}$ ) |                          | $f_T$    | 40     | 200       | MHz |
| Collector–Base Capacitance<br>( $V_{CB} = 20\text{ Vdc}$ , $I_E = 0$ , $f = 1.0\text{ MHz}$ )                      |                          | $C_{cb}$ | –      | 6.0       | pF  |
| Emitter–Base Capacitance<br>( $V_{EB} = 0.5\text{ Vdc}$ , $I_C = 0$ , $f = 1.0\text{ MHz}$ )                       | 2N6515, 2N6517<br>2N6520 | $C_{eb}$ | –<br>– | 80<br>100 | pF  |

### SWITCHING CHARACTERISTICS

|                                                                                                                                     |           |   |     |               |
|-------------------------------------------------------------------------------------------------------------------------------------|-----------|---|-----|---------------|
| Turn–On Time<br>( $V_{CC} = 100\text{ Vdc}$ , $V_{BE(off)} = 2.0\text{ Vdc}$ , $I_C = 50\text{ mAdc}$ , $I_{B1} = 10\text{ mAdc}$ ) | $t_{on}$  | – | 200 | $\mu\text{s}$ |
| Turn–Off Time<br>( $V_{CC} = 100\text{ Vdc}$ , $I_C = 50\text{ mAdc}$ , $I_{B1} = I_{B2} = 10\text{ mAdc}$ )                        | $t_{off}$ | – | 3.5 | $\mu\text{s}$ |

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

# NPN 2N6515 2N6517 PNP 2N6520

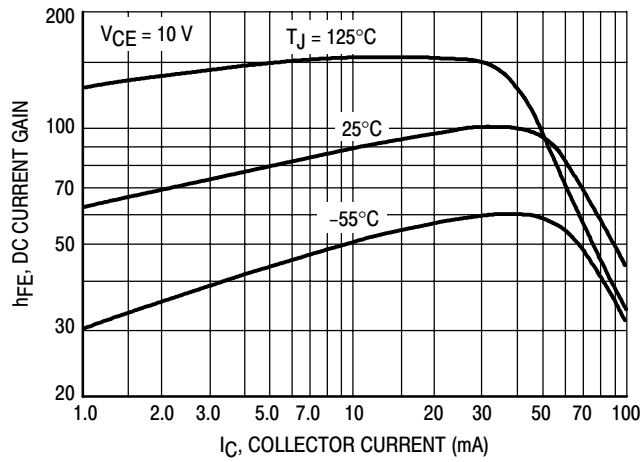


Figure 1. DC Current Gain – NPN 2N6515

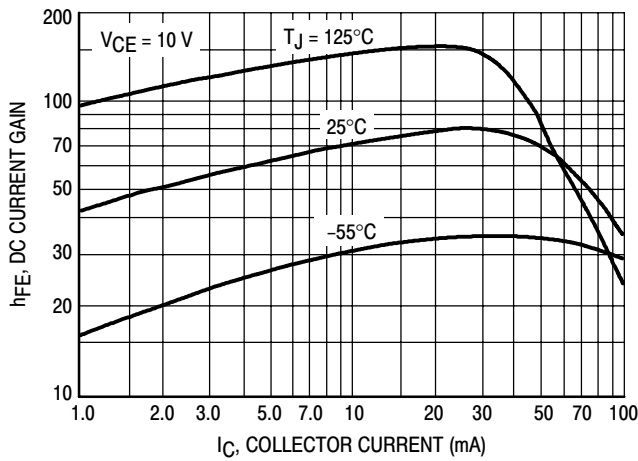


Figure 2. DC Current Gain – NPN 2N6517

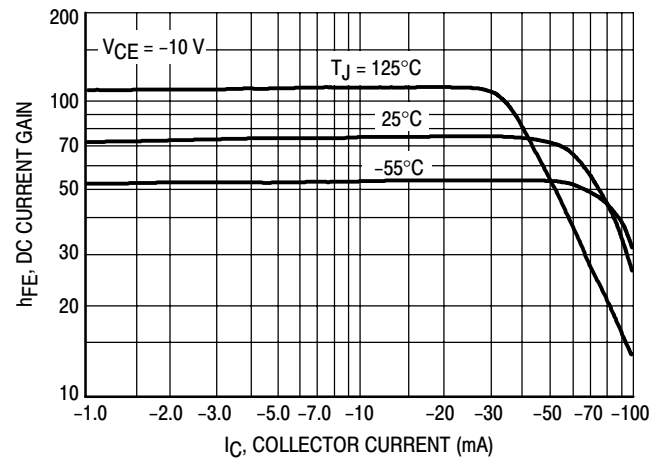


Figure 3. DC Current Gain – PNP 2N6520

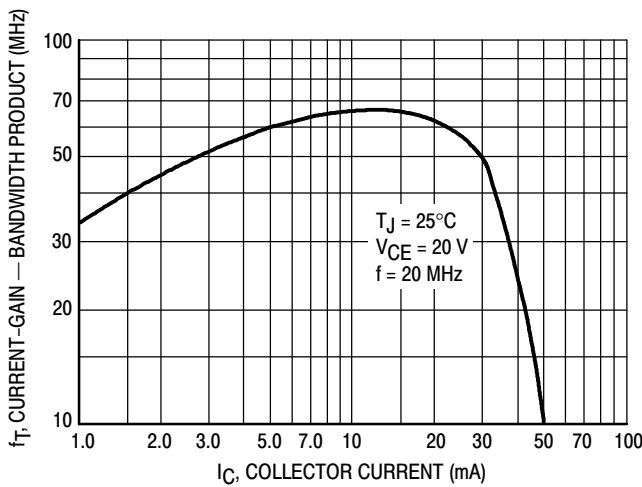


Figure 4. Current-Gain – Bandwidth Product – NPN 2N6515, 2N6517

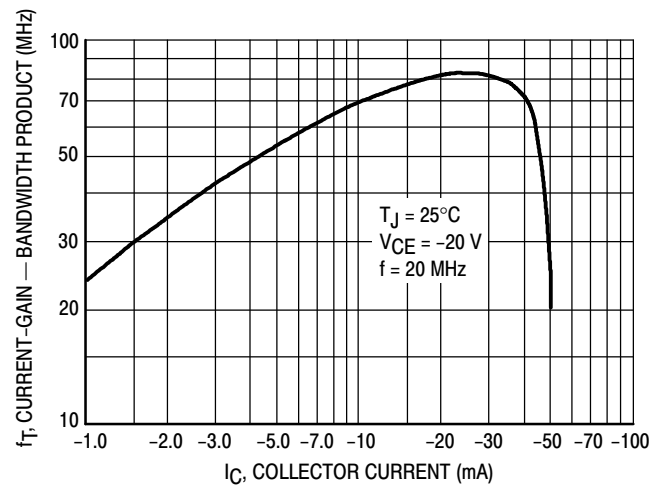


Figure 5. Current-Gain – Bandwidth Product – PNP 2N6520

# NPN 2N6515 2N6517 PNP 2N6520

## NPN

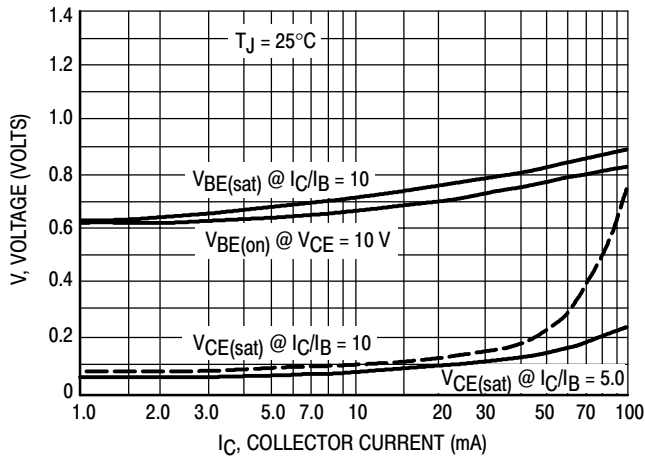


Figure 6. "On" Voltages – NPN 2N6515, 2N6517

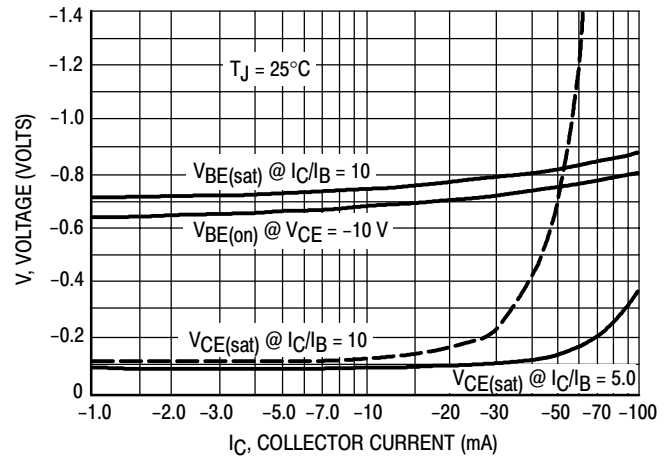


Figure 7. "On" Voltages – PNP 2N6520

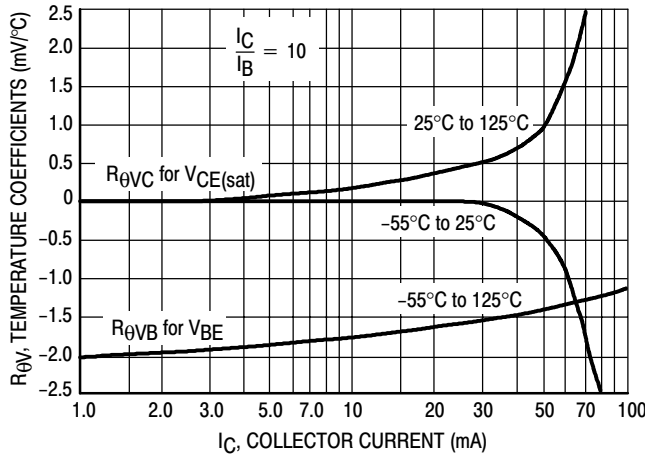


Figure 8. Temperature Coefficients – NPN 2N6515, 2N6517

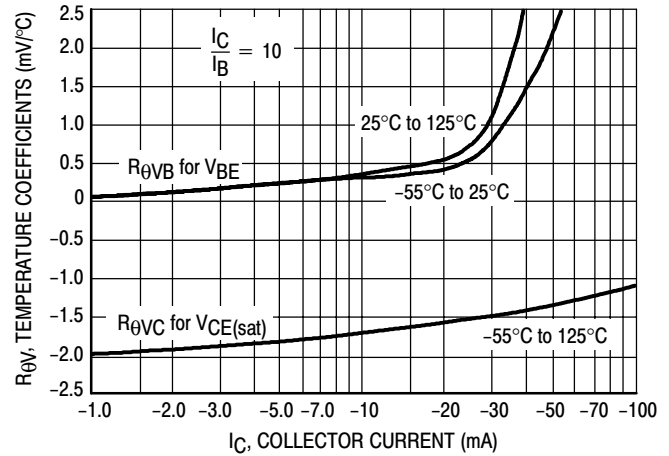


Figure 9. Temperature Coefficients – PNP 2N6520

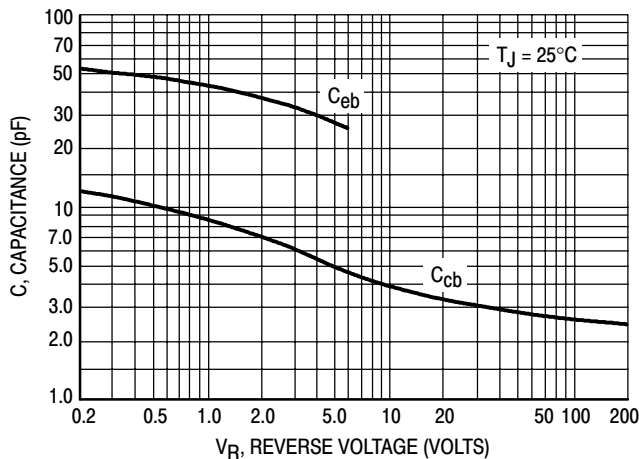


Figure 10. Capacitance – NPN 2N6515, 2N6517

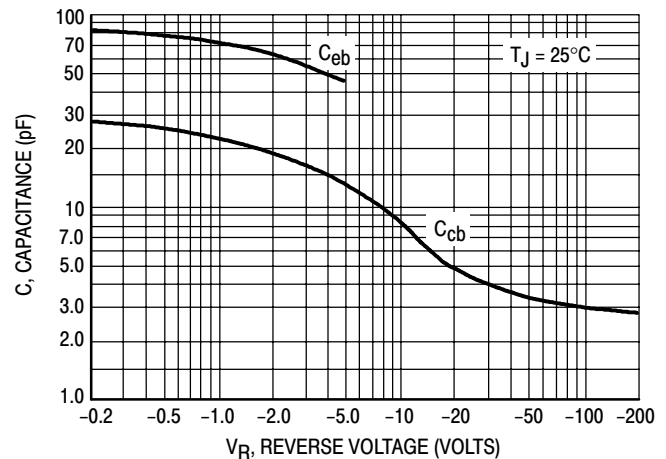


Figure 11. Capacitance – PNP 2N6520

# NPN 2N6515 2N6517 PNP 2N6520

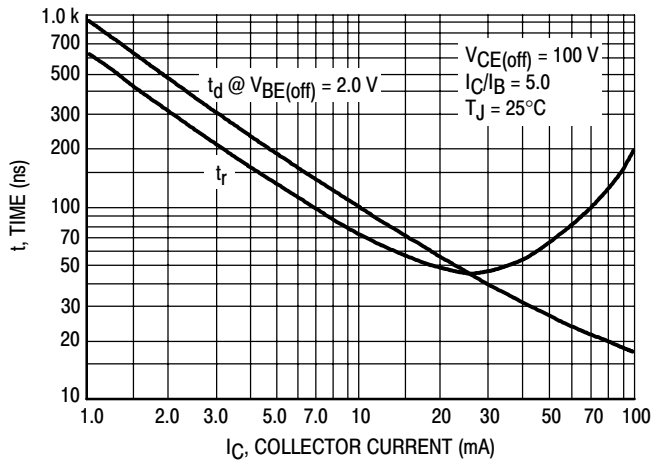


Figure 12. Turn-On Time – NPN 2N6515, 2N6517

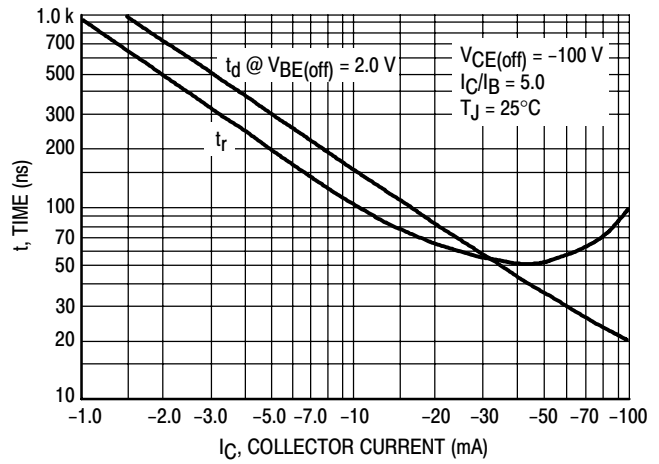


Figure 13. Turn-On Time – PNP 2N6520

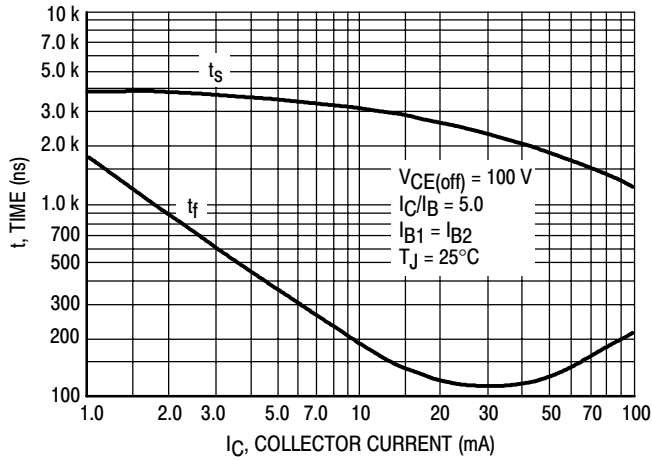


Figure 14. Turn-Off Time – NPN 2N6515, 2N6517

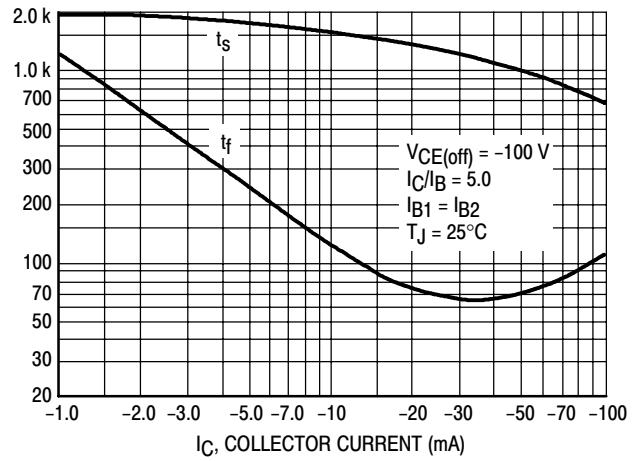


Figure 15. Turn-Off Time – PNP 2N6520

# NPN 2N6515 2N6517 PNP 2N6520

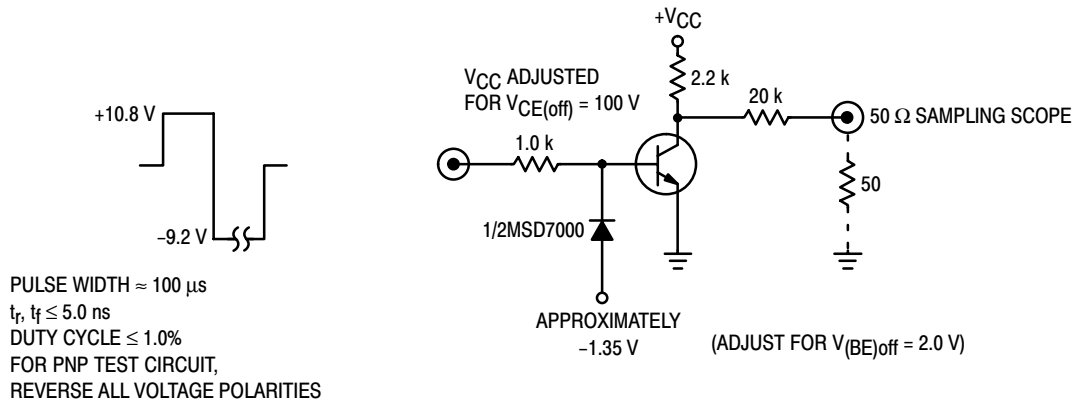


Figure 16. Switching Time Test Circuit

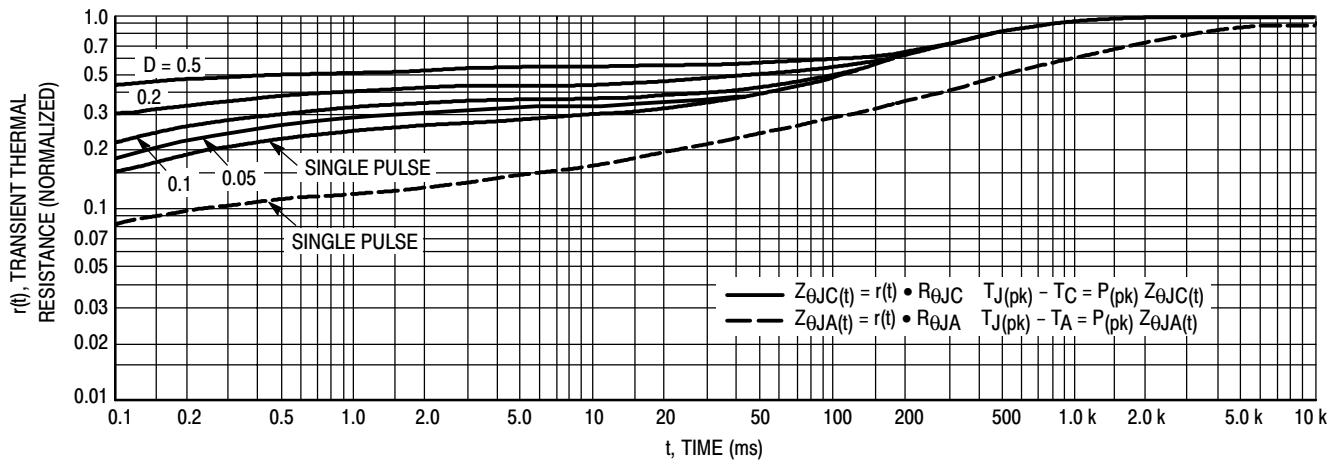


Figure 17. Thermal Response

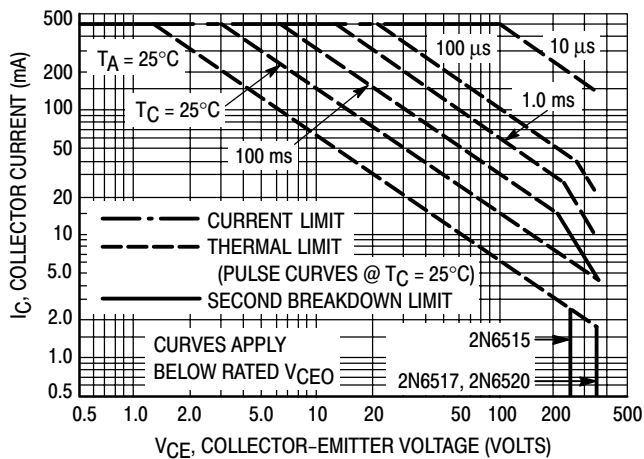
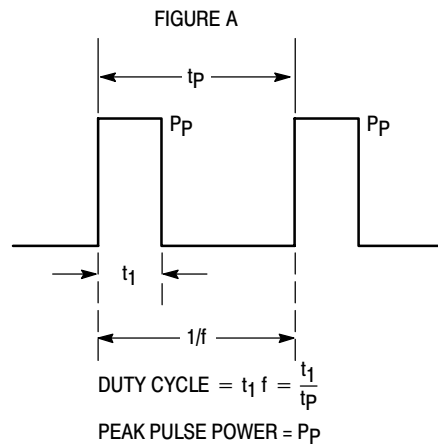


Figure 18. Active Region Safe Operating Area

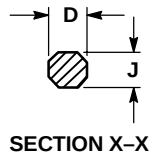
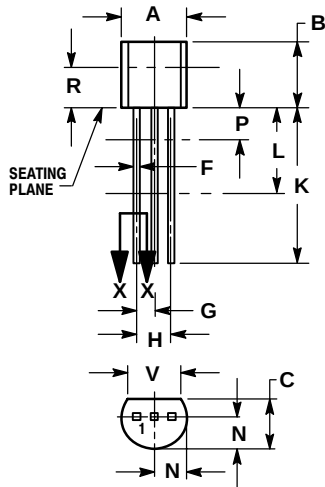


Design Note: Use of Transient Thermal Resistance Data

# NPN 2N6515 2N6517 PNP 2N6520

## 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

## NPN 2N6515 2N6517 PNP 2N6520

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