

# 2N6515, 2N6517, 2N6520

## High Voltage Transistors

### NPN and PNP

#### Features

- Voltage and Current are Negative for PNP Transistors
- Pb-Free Package is Available\*

#### MAXIMUM RATINGS

Rating	Symbol	2N6515	2N6517 2N6520	Unit
Collector – Emitter Voltage	$V_{CEO}$	250	350	Vdc
Collector – Base Voltage	$V_{CBO}$	250	350	Vdc
Emitter – Base Voltage 2N6515, 2N6516, 2N6517 2N6519, 2N6520	$V_{EBO}$	6.0 5.0		Vdc
Base Current	$I_B$	250		mAdc
Collector Current – Continuous	$I_C$	500		mAdc
Total Device Dissipation @ $T_A = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	625 5.0		mW mW/ $^\circ\text{C}$
Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	1.5 12		Watts mW/ $^\circ\text{C}$
Operating and Storage Junction 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.

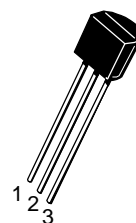
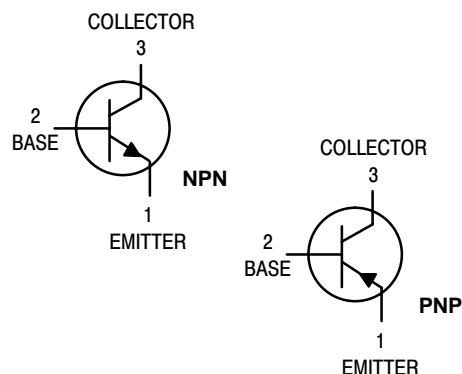
#### THERMAL CHARACTERISTICS

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



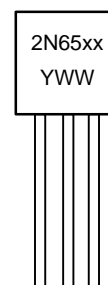
ON Semiconductor®

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TO-92  
CASE 29  
STYLE 1

#### MARKING DIAGRAM



Y = Year  
WW = Work Week

#### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 3 of this data sheet.

\*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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## ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Max	Unit
<b>OFF CHARACTERISTICS</b>				
Collector–Emitter Breakdown Voltage (Note 1) (I <sub>C</sub> = 1.0 mA <sub>dc</sub> , I <sub>B</sub> = 0)	V <sub>(BR)CEO</sub>	250 350	– –	V <sub>dc</sub>
Collector–Base Breakdown Voltage (I <sub>C</sub> = 100 μA <sub>dc</sub> , I <sub>E</sub> = 0)	V <sub>(BR)CBO</sub>	250 350	– –	V <sub>dc</sub>
Emitter–Base Breakdown Voltage (I <sub>E</sub> = 10 μA <sub>dc</sub> , I <sub>C</sub> = 0)	V <sub>(BR)EBO</sub>	6.0 5.0	– –	V <sub>dc</sub>
Collector Cutoff Current (V <sub>CB</sub> = 150 V <sub>dc</sub> , I <sub>E</sub> = 0) (V <sub>CB</sub> = 250 V <sub>dc</sub> , I <sub>E</sub> = 0)	I <sub>CBO</sub>	– –	50 50	nA <sub>dc</sub>
Emitter Cutoff Current (V <sub>EB</sub> = 5.0 V <sub>dc</sub> , I <sub>C</sub> = 0) (V <sub>EB</sub> = 4.0 V <sub>dc</sub> , I <sub>C</sub> = 0)	I <sub>EBO</sub>	– –	50 50	nA <sub>dc</sub>
<b>ON CHARACTERISTICS (Note 1)</b>				
DC Current Gain (I <sub>C</sub> = 1.0 mA <sub>dc</sub> , V <sub>CE</sub> = 10 V <sub>dc</sub> )  (I <sub>C</sub> = 10 mA <sub>dc</sub> , V <sub>CE</sub> = 10 V <sub>dc</sub> )  (I <sub>C</sub> = 30 mA <sub>dc</sub> , V <sub>CE</sub> = 10 V <sub>dc</sub> )  (I <sub>C</sub> = 50 mA <sub>dc</sub> , V <sub>CE</sub> = 10 V <sub>dc</sub> )  (I <sub>C</sub> = 100 mA <sub>dc</sub> , V <sub>CE</sub> = 10 V <sub>dc</sub> )	h <sub>FE</sub>	35 20  50 30  50 30  45 20  25 15	– –  – –  300 200  220 200  – –	–
Collector–Emitter Saturation Voltage (I <sub>C</sub> = 10 mA <sub>dc</sub> , I <sub>B</sub> = 1.0 mA <sub>dc</sub> ) (I <sub>C</sub> = 20 mA <sub>dc</sub> , I <sub>B</sub> = 2.0 mA <sub>dc</sub> ) (I <sub>C</sub> = 30 mA <sub>dc</sub> , I <sub>B</sub> = 3.0 mA <sub>dc</sub> ) (I <sub>C</sub> = 50 mA <sub>dc</sub> , I <sub>B</sub> = 5.0 mA <sub>dc</sub> )	V <sub>CE(sat)</sub>	– – – –	0.30 0.35 0.50 1.0	V <sub>dc</sub>
Base–Emitter Saturation Voltage (I <sub>C</sub> = 10 mA <sub>dc</sub> , I <sub>B</sub> = 1.0 mA <sub>dc</sub> ) (I <sub>C</sub> = 20 mA <sub>dc</sub> , I <sub>B</sub> = 2.0 mA <sub>dc</sub> ) (I <sub>C</sub> = 30 mA <sub>dc</sub> , I <sub>B</sub> = 3.0 mA <sub>dc</sub> )	V <sub>BE(sat)</sub>	– – –	0.75 0.85 0.90	V <sub>dc</sub>
Base–Emitter On Voltage (I <sub>C</sub> = 100 mA <sub>dc</sub> , V <sub>CE</sub> = 10 V <sub>dc</sub> )	V <sub>BE(on)</sub>	–	2.0	V <sub>dc</sub>

1. Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%.

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### SMALL-SIGNAL CHARACTERISTICS

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

### SWITCHING CHARACTERISTICS

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

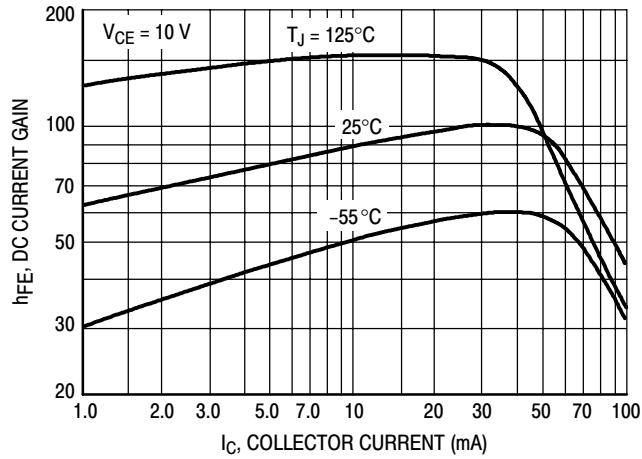
1. Pulse Test: Pulse Width  $\leq 300 \mu\text{s}$ , Duty Cycle  $\leq 2.0\%$ .

### ORDERING INFORMATION

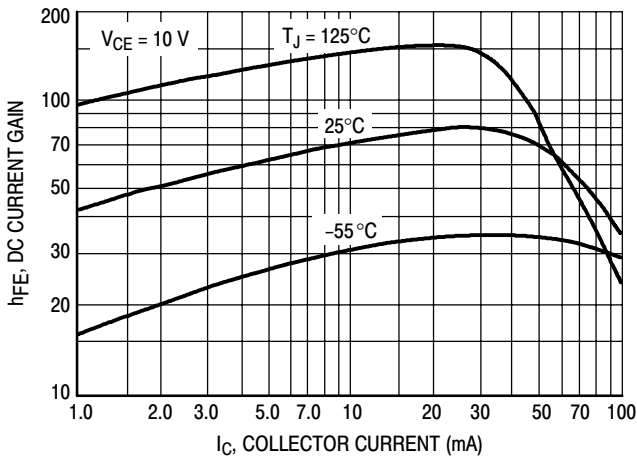
Device	Package	Shipping <sup>†</sup>
2N6515	TO-92	5000 Unit / Bulk
2N6515RLRM	TO-92	2000 Tape & Ammo Box
2N6517	TO-92	5000 Unit / Bulk
2N6517RLRA	TO-92	2000 Tape & Reel
2N6517RLRP	TO-92	2000 Tape & Ammo Box
2N6520RLRA	TO-92	2000 Tape & Reel
2N6520RLRAG	TO-92 (Pb-Free)	2000 Tape & Reel

<sup>†</sup>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.

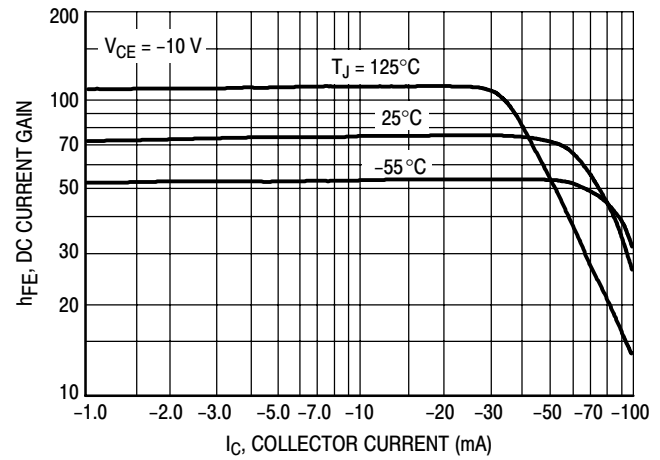
## 2N6515, 2N6517, 2N6520



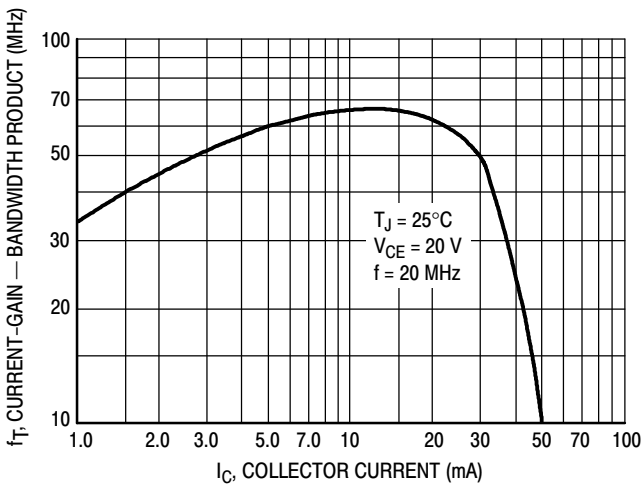
**Figure 1. DC Current Gain  
NPN 2N6515**



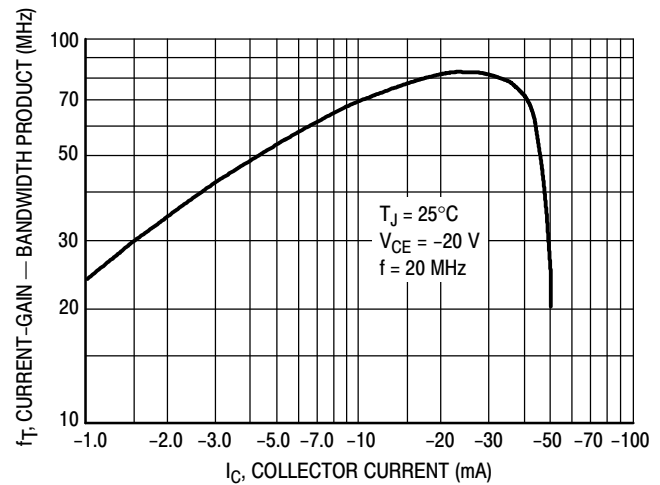
**Figure 2. DC Current Gain  
NPN 2N6517**



**Figure 3. DC Current Gain  
PNP 2N6520**

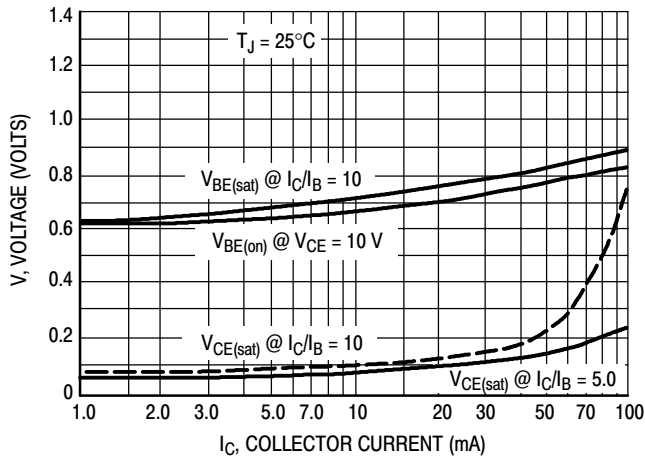


**Figure 4. Current-Gain – Bandwidth Product  
NPN 2N6515, 2N6517**

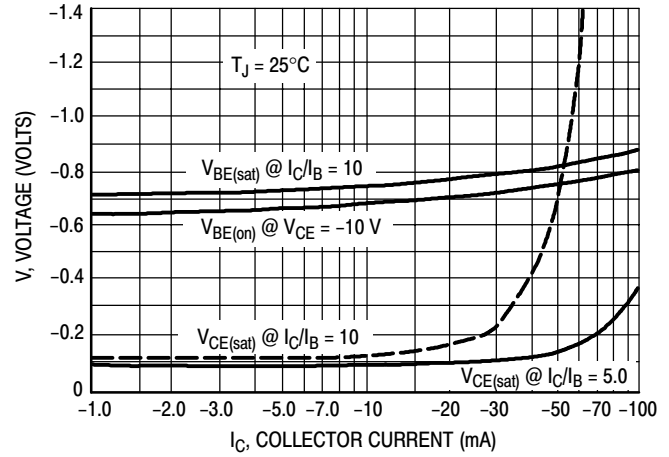


**Figure 5. Current-Gain – Bandwidth Product  
PNP 2N6520**

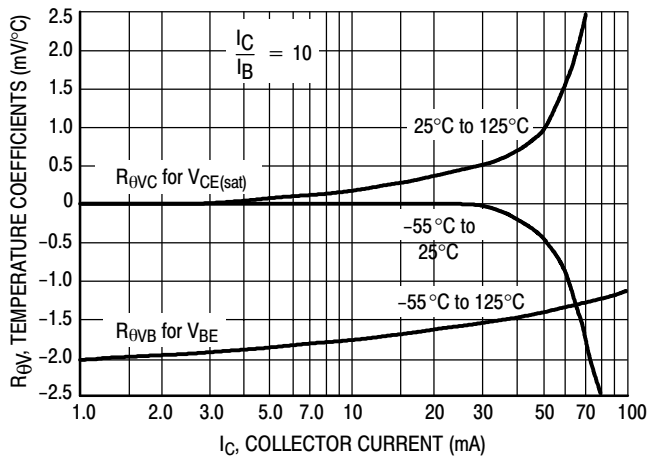
## 2N6515, 2N6517, 2N6520



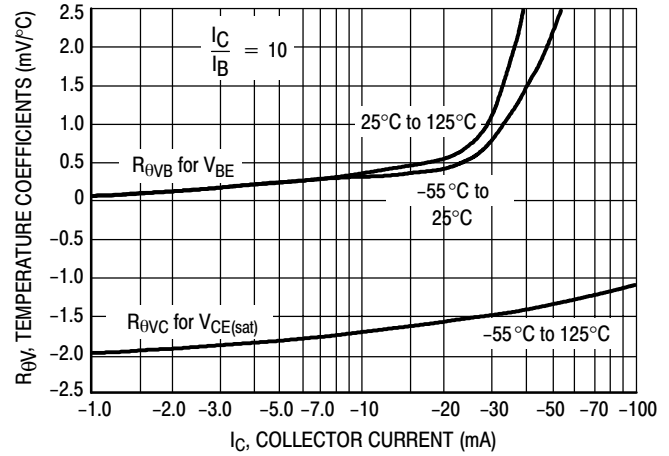
**Figure 6. "On" Voltages**  
NPN 2N6515, 2N6517



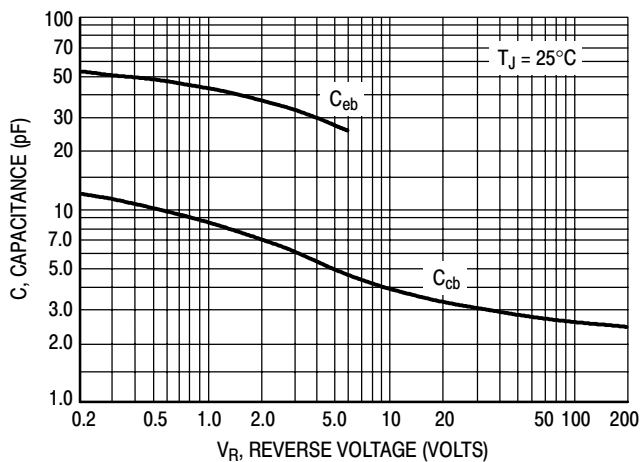
**Figure 7. "On" Voltages**  
PNP 2N6520



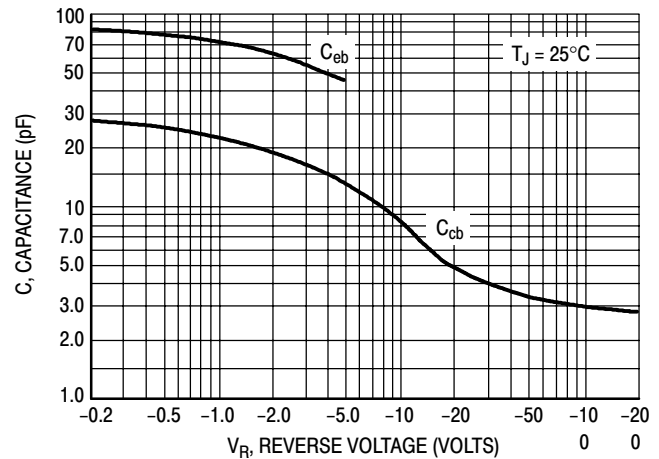
**Figure 8. Temperature Coefficients**  
NPN 2N6515, 2N6517



**Figure 9. Temperature Coefficients**  
PNP 2N6520

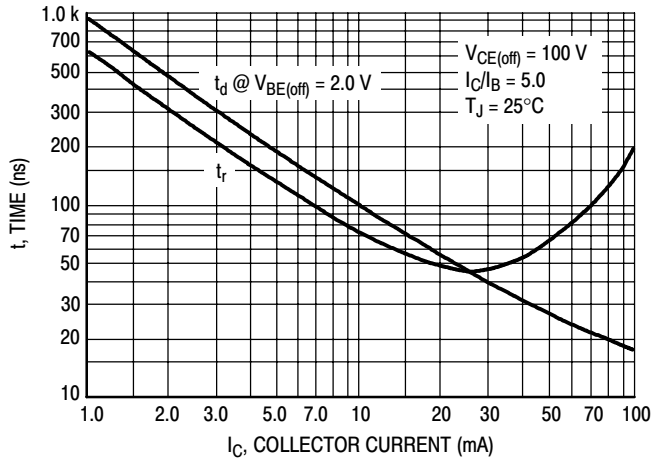


**Figure 10. Capacitance**  
NPN 2N6515, 2N6517

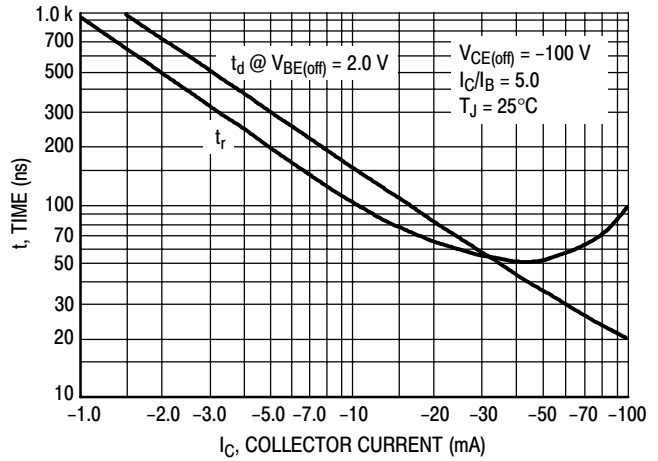


**Figure 11. Capacitance**  
PNP 2N6520

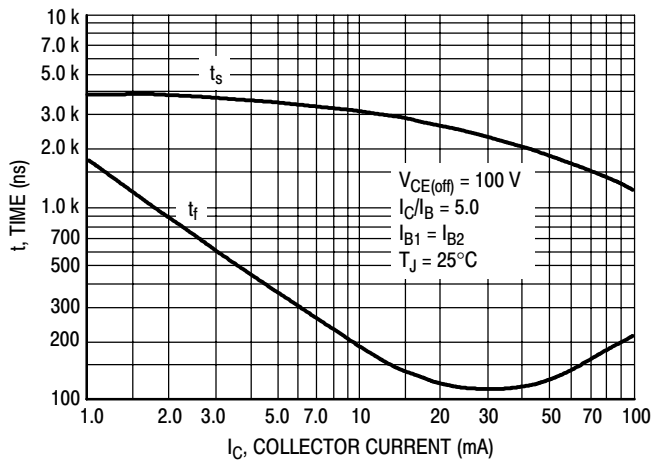
## 2N6515, 2N6517, 2N6520



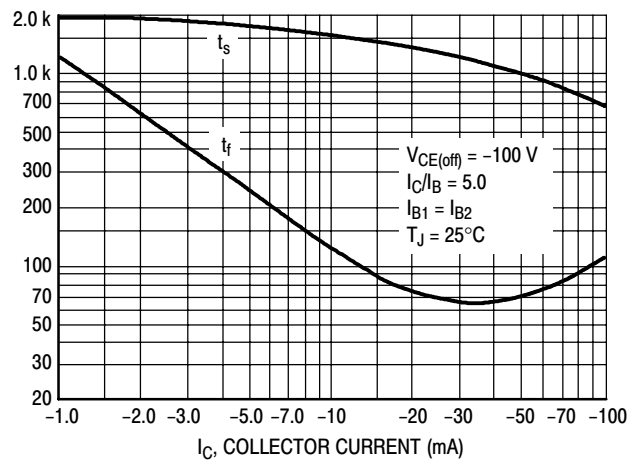
**Figure 12. Turn-On Time**  
NPN 2N6515, 2N6517



**Figure 13. Turn-On Time**  
PNP 2N6520



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



**Figure 15. Turn-Off Time**  
PNP 2N6520

## 2N6515, 2N6517, 2N6520

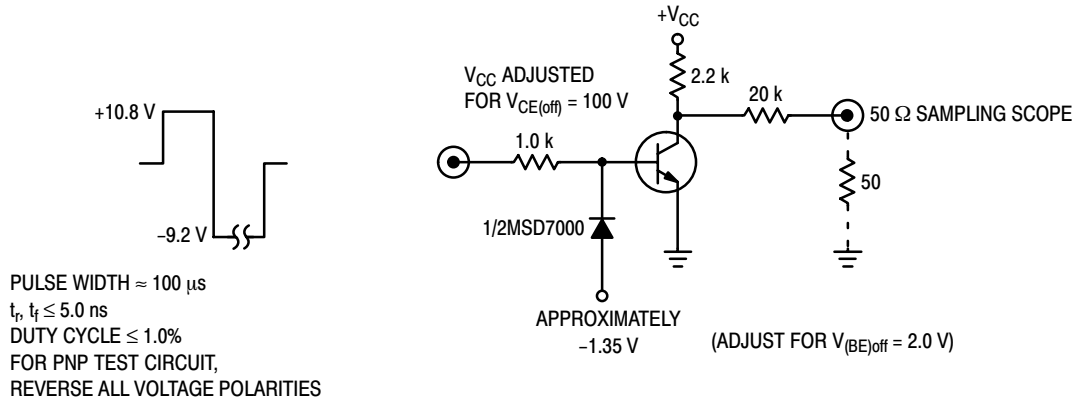


Figure 16. Switching Time Test Circuit

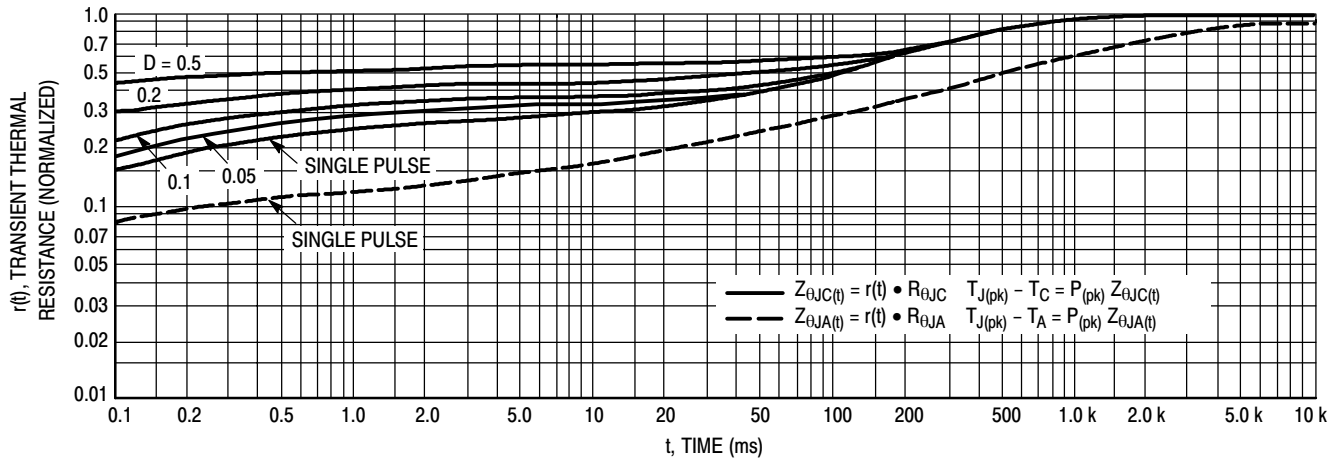


Figure 17. Thermal Response

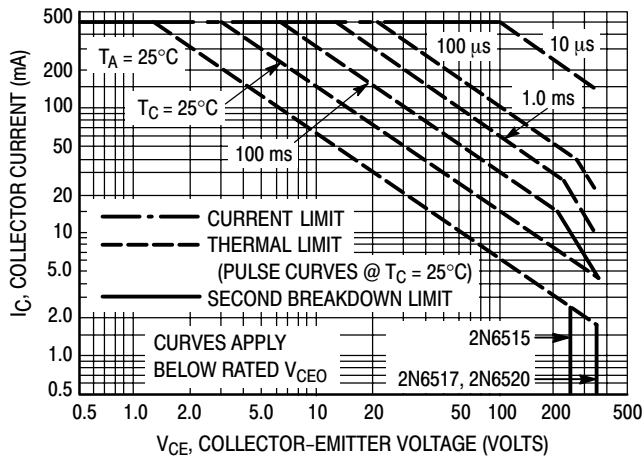
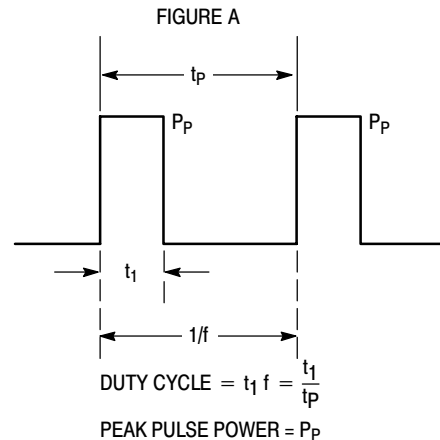


Figure 18. Active Region Safe Operating Area

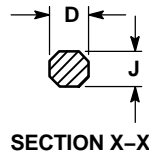
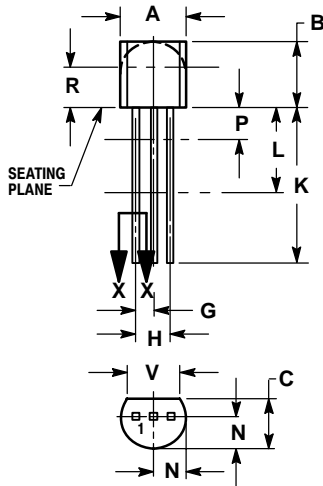


Design Note: Use of Transient Thermal Response Data

# 2N6515, 2N6517, 2N6520

## PACKAGE DIMENSIONS

TO-92  
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:

- PIN 1. EMITTER
- BASE
- COLLECTOR

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