ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted)

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector–Emitter Breakdown Voltage (Note 1) (I_C = 1.0 mAdc, I_B = 0) 2N6515 2N6517, 2N6520		$V_{(BR)CEO}$	250 350	– –	Vdc
Collector–Base Breakdown Voltage (I_C = 100 μAdc, I_E = 0) 2N6515 2N6517, 2N6520		$V_{(BR)CBO}$	250 350	– –	Vdc
Emitter–Base Breakdown Voltage (I_E = 10 μAdc, I_C = 0) 2N6515, 2N6517 2N6520		$V_{(BR)EBO}$	6.0 5.0	– –	Vdc
Collector Cutoff Current (V_{CB} = 150 Vdc, I_E = 0) 2N6515 (V_{CB} = 250 Vdc, I_E = 0) 2N6517, 2N6520		I_{CBO}	– –	50 50	nAdc
Emitter Cutoff Current (V_{EB} = 5.0 Vdc, I_C = 0) 2N6515, 2N6517 (V_{EB} = 4.0 Vdc, I_C = 0) 2N6520		I_{EBO}	– –	50 50	nAdc
ON CHARACTERISTICS (Note 1)					

DC Current Gain
(I_C = 1.0 mAdc, V_{CE} = 10 Vdc)   2N6515
           2N6517, 2N6520
 	
(I_C = 10 mAdc, V_{CE} = 10 Vdc)   2N6515
           2N6517, 2N6520
 	
(I_C = 30 mAdc, V_{CE} = 10 Vdc)   2N6515
           2N6517, 2N6520
 	
(I_C = 50 mAdc, V_{CE} = 10 Vdc)   2N6515
           2N6517, 2N6520
 	
(I_C = 100 mAdc, V_{CE} = 10 Vdc)   2N6515
           2N6517, 2N6520
		h_{FE}	35
			20
			
			50
			30
			
			50
			30
			
			45
			20
			
			25
			15
				–
				–
				
				–
				–
				
				300
				200
				
				220
				200
				
				–
				–
					–

Collector–Emitter Saturation Voltage (I_C = 10 mAdc, I_B = 1.0 mAdc) (I_C = 20 mAdc, I_B = 2.0 mAdc) (I_C = 30 mAdc, I_B = 3.0 mAdc) (I_C = 50 mAdc, I_B = 5.0 mAdc)		$V_{CE(sat)}$	– – – –	0.30 0.35 0.50 1.0	Vdc
Base–Emitter Saturation Voltage (I_C = 10 mAdc, I_B = 1.0 mAdc) (I_C = 20 mAdc, I_B = 2.0 mAdc) (I_C = 30 mAdc, I_B = 3.0 mAdc)		$V_{BE(sat)}$	– – –	0.75 0.85 0.90	Vdc
Base–Emitter On Voltage (I_C = 100 mAdc, V_{CE} = 10 Vdc)		$V_{BE(on)}$	–	2.0	Vdc
SMALL–SIGNAL CHARACTERISTICS					
Current–Gain – Bandwidth Product (Note 1) (I_C = 10 mAdc, V_{CE} = 20 Vdc, f = 20 MHz)		f_T	40	200	MHz
Collector–Base Capacitance (V_{CB} = 20 Vdc, I_E = 0, f = 1.0 MHz)		C_{cb}	–	6.0	pF
Emitter–Base Capacitance (V_{EB} = 0.5 Vdc, I_C = 0, f = 1.0 MHz) 2N6515, 2N6517 2N6520		C_{eb}	– –	80 100	pF
SWITCHING CHARACTERISTICS					
Turn–On Time (V_{CC} = 100 Vdc, $V_{BE(off)}$ = 2.0 Vdc, I_C = 50 mAdc, I_{B1} = 10 mAdc)		t_{on}	–	200	μs
Turn–Off Time (V_{CC} = 100 Vdc, I_C = 50 mAdc, I_{B1} = I_{B2} = 10 mAdc)		t_{off}	–	3.5	μs

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

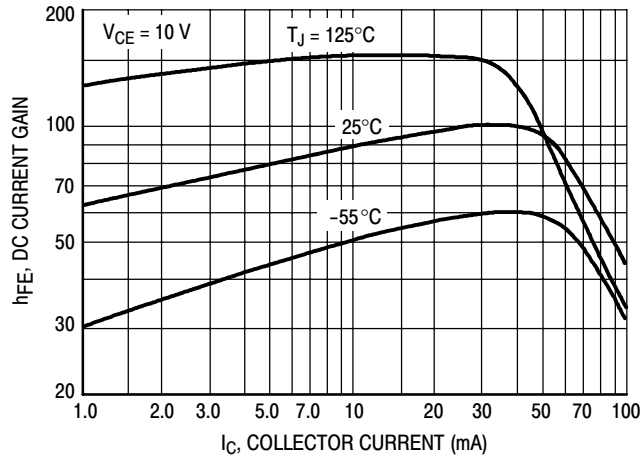## NPN – 2N6515, 2N6517; PNP – 2N6520

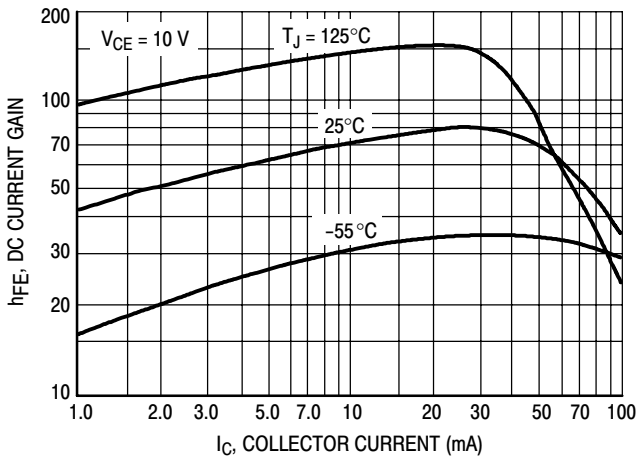**Figure 1. DC Current Gain**
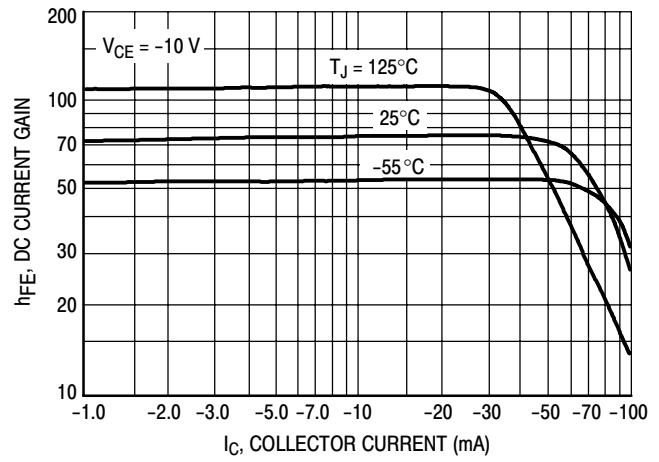**NPN 2N6515**

Figure 2. DC Current Gain
NPN 2N6517

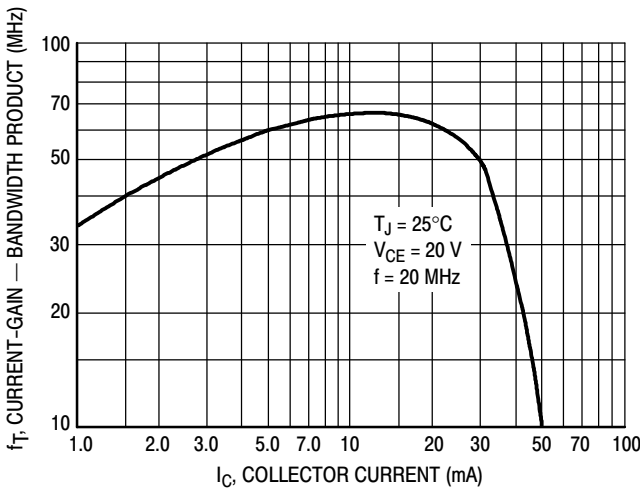**Figure 3. DC Current Gain**
PNP 2N6520

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

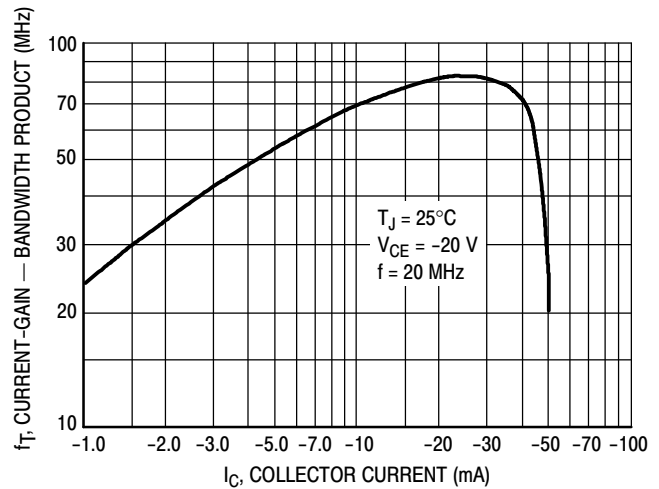**Figure 5. Current–Gain – Bandwidth Product**
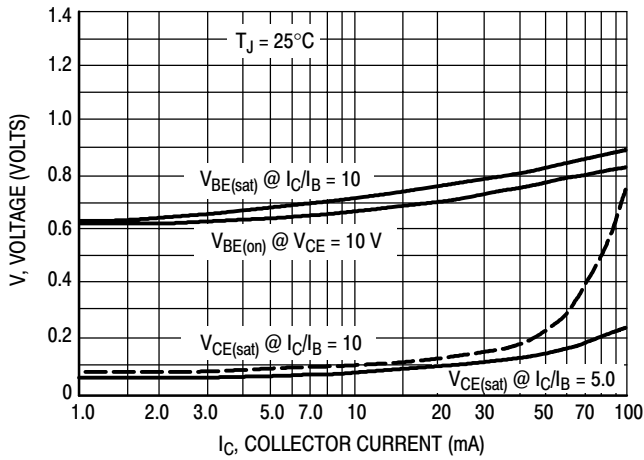**PNP 2N6520**

NPN − 2N6515, 2N6517; PNP − 2N6520

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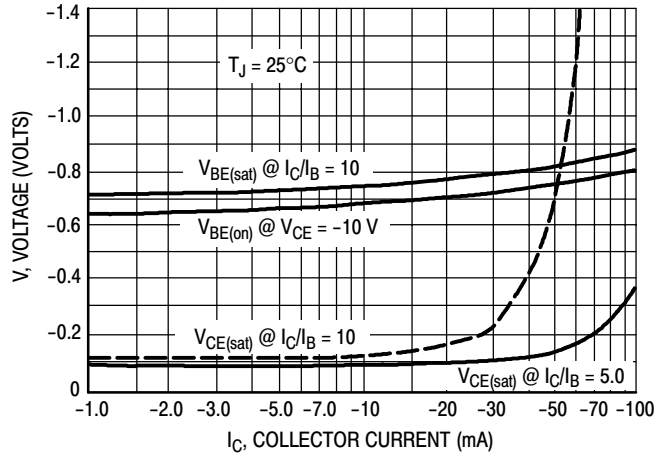**NPN 2N6515, 2N6517**
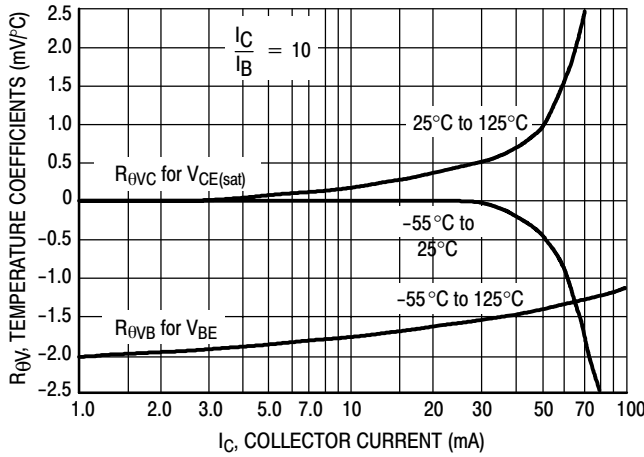

Figure 7. "On" Voltages
PNP 2N6520

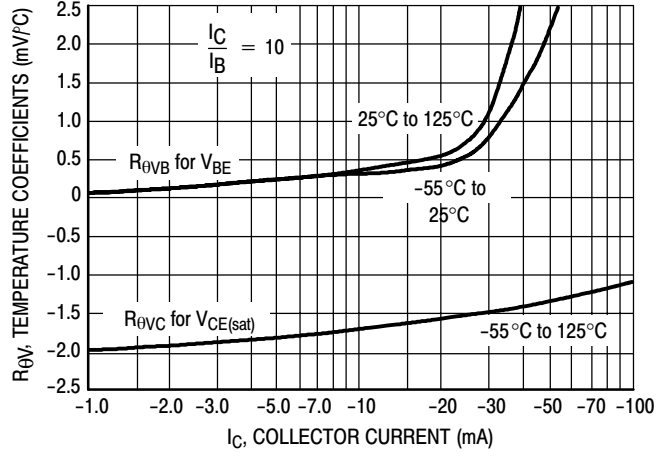**Figure 8. Temperature Coefficients**
NPN 2N6515, 2N6517
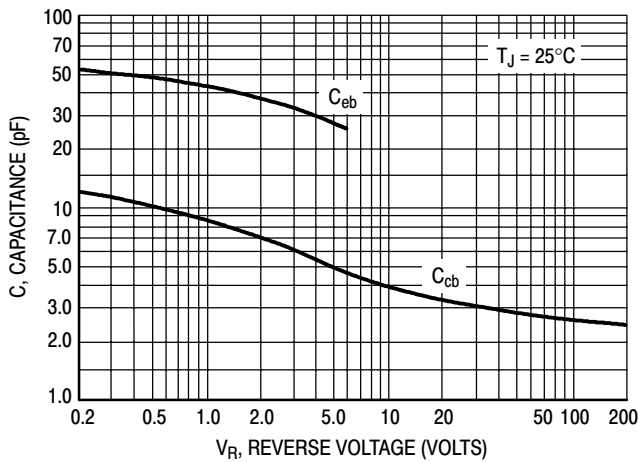

Figure 9. Temperature Coefficients
PNP 2N6520
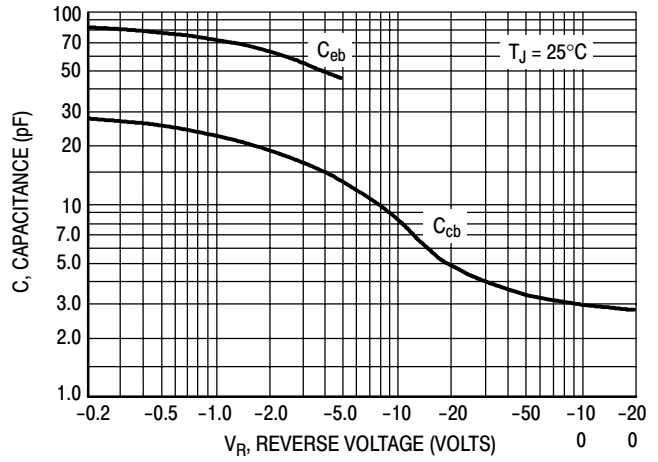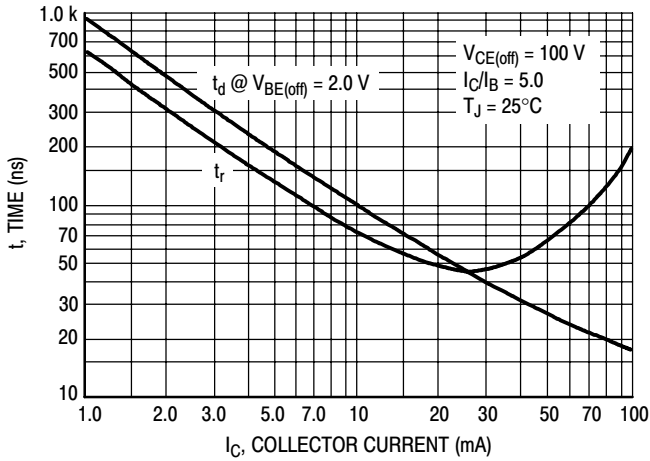

Figure 10. Capacitance
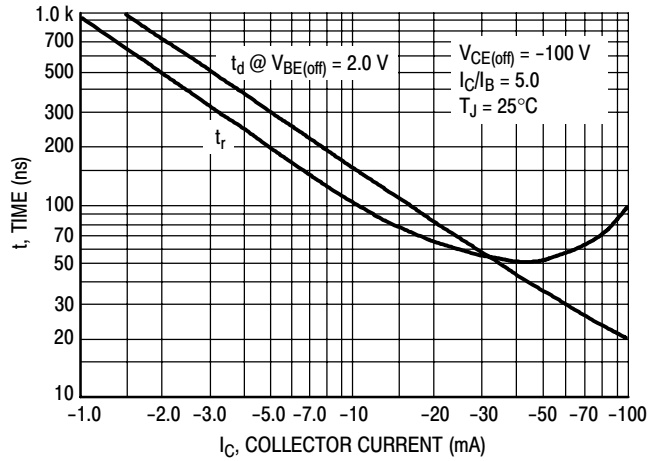**NPN 2N6515, 2N6517**

Figure 11. Capacitance
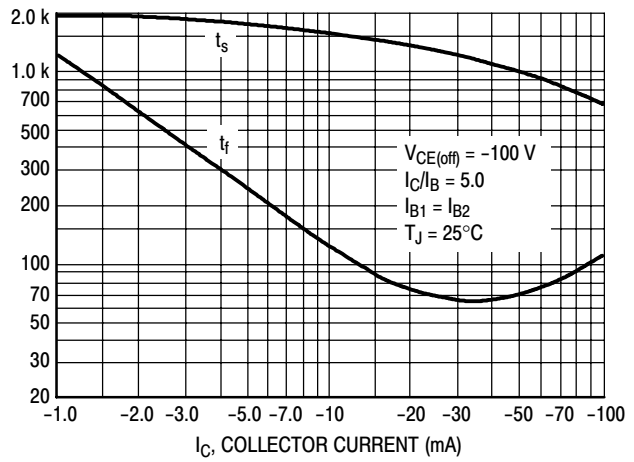**PNP 2N6520**

NPN – 2N6515, 2N6517; PNP – 2N6520

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

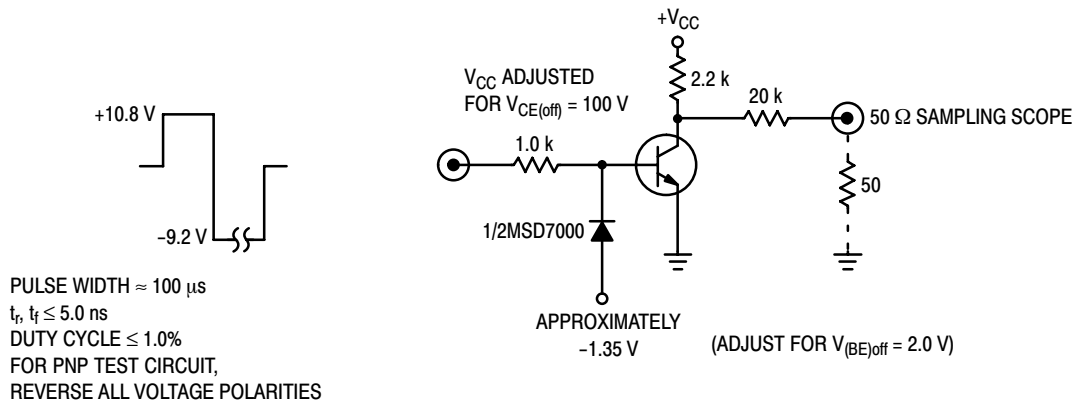t, TIME (ns) vs I$_C$, COLLECTOR CURRENT (mA)

V$_{CE(off)}$ = 100 V
I$_C$/I$_B$ = 5.0
T$_J$ = 25°C

t$_d$ @ V$_{BE(off)}$ = 2.0 V

t$_r$

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

t, TIME (ns) vs I$_C$, COLLECTOR CURRENT (mA)

V$_{CE(off)}$ = –100 V
I$_C$/I$_B$ = 5.0
T$_J$ = 25°C

t$_d$ @ V$_{BE(off)}$ = 2.0 V

t$_r$
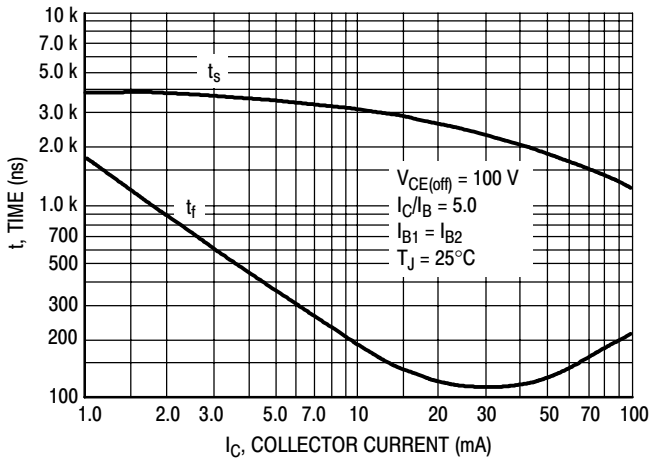
**Figure 14. Turn–Off Time
NPN 2N6515, 2N6517**

t, TIME (ns) vs I$_C$, COLLECTOR CURRENT (mA)

t$_s$

t$_f$

V$_{CE(off)}$ = 100 V
I$_C$/I$_B$ = 5.0
I$_{B1}$ = I$_{B2}$
T$_J$ = 25°C

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

t, TIME (ns) vs I$_C$, COLLECTOR CURRENT (mA)

t$_s$

t$_f$

V$_{CE(off)}$ = –100 V
I$_C$/I$_B$ = 5.0
I$_{B1}$ = I$_{B2}$
T$_J$ = 25°C

+10.8 V

–9.2 V

PULSE WIDTH ≈ 100 µs
t$_r$, t$_f$ ≤ 5.0 ns
DUTY CYCLE ≤ 1.0%
FOR PNP TEST CIRCUIT,
REVERSE ALL VOLTAGE POLARITIES

+V$_{CC}$

V$_{CC}$ ADJUSTED
FOR V$_{CE(off)}$ = 100 V

2.2 k

20 k

1.0 k

50 Ω SAMPLING SCOPE

50

1/2MSD7000

APPROXIMATELY
–1.35 V

(ADJUST FOR V$_{(BE)off}$ = 2.0 V)

Figure 16. Switching Time Test Circuit
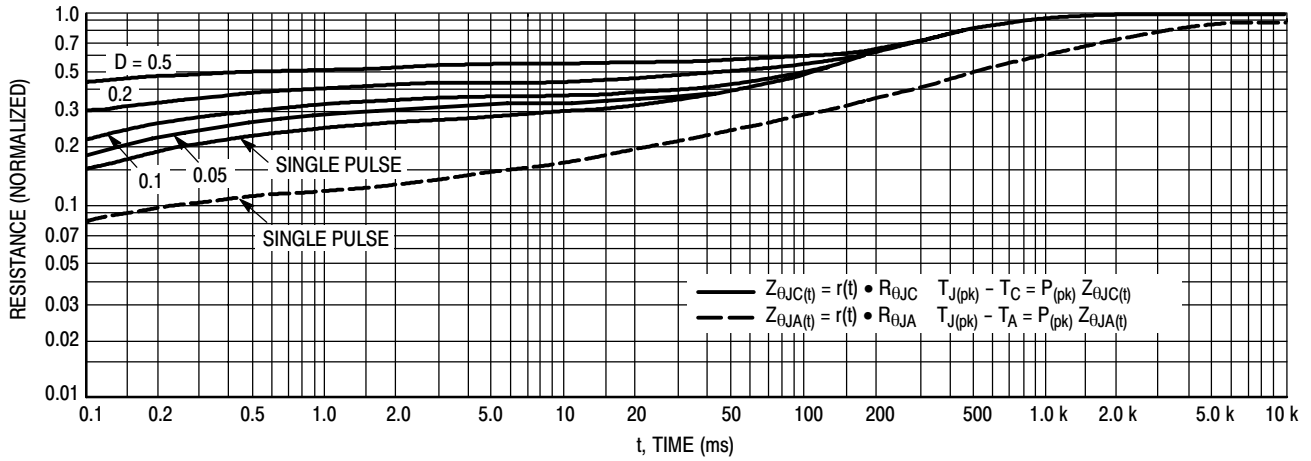
Figure 17. Thermal Response
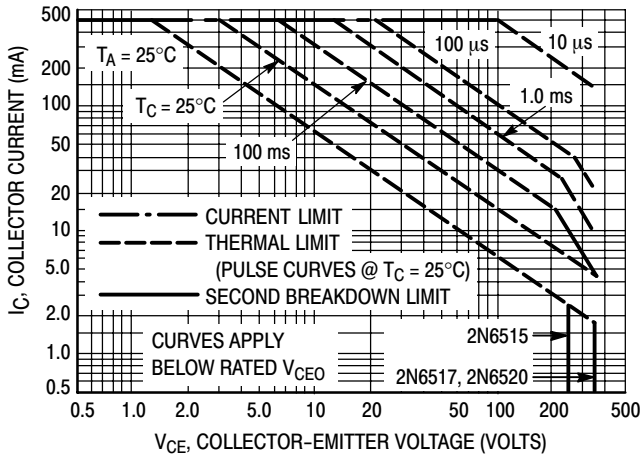
Figure 18. Active Region Safe Operating Area

FIGURE A

$$\text{DUTY CYCLE} = t_1 \, f = \frac{t_1}{t_P}$$

PEAK PULSE POWER $= P_P$
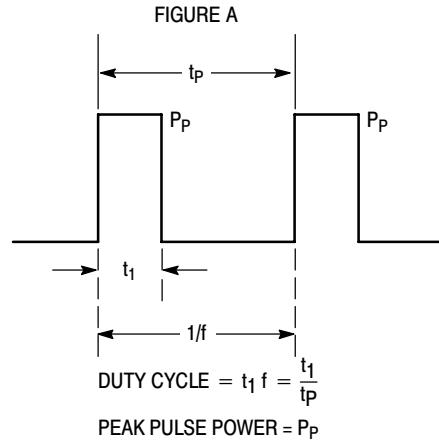
Design Note: Use of Transient Thermal Resistance Data

ORDERING INFORMATION

Device	Package	Shipping[†]
2N6515RLRMG	TO–92 (Pb–Free)	2000 Ammo Pack
2N6517G	TO–92 (Pb–Free)	5000 Unit / Bulk
2N6517RLRPG	TO–92 (Pb–Free)	2000 Ammo Pack
2N6520RLRAG	TO–92 (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.

TO–92 (TO–226)
CASE 29–11
ISSUE AM

DATE 09 MAR 2007

SCALE 1:1

STRAIGHT LEAD
BULK PACK

BENT LEAD
TAPE & REEL
AMMO PACK

STRAIGHT LEAD
BULK PACK

SECTION X–X

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	---

BENT LEAD
TAPE & REEL
AMMO PACK

SECTION X–X

NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. CONTOUR OF PACKAGE BEYOND DIMENSION R IS UNCONTROLLED.
4. LEAD DIMENSION IS UNCONTROLLED IN P AND BEYOND DIMENSION K MINIMUM.

DIM	MILLIMETERS	
	MIN	MAX
A	4.45	5.20
B	4.32	5.33
C	3.18	4.19
D	0.40	0.54
G	2.40	2.80
J	0.39	0.50
K	12.70	---
N	2.04	2.66
P	1.50	4.00
R	2.93	---
V	3.43	---

STYLES ON PAGE 2

DOCUMENT NUMBER:	**98ASB42022B**
STATUS:	**ON SEMICONDUCTOR STANDARD**
NEW STANDARD:	
DESCRIPTION:	**TO–92 (TO–226)**

PAGE 1 OF 3

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

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

STYLE 3:
PIN 1. ANODE
   2. ANODE
   3. CATHODE

STYLE 4:
PIN 1. CATHODE
   2. CATHODE
   3. ANODE

STYLE 5:
PIN 1. DRAIN
   2. SOURCE
   3. GATE

STYLE 6:
PIN 1. GATE
   2. SOURCE & SUBSTRATE
   3. DRAIN

STYLE 7:
PIN 1. SOURCE
   2. DRAIN
   3. GATE

STYLE 8:
PIN 1. DRAIN
   2. GATE
   3. SOURCE & SUBSTRATE

STYLE 9:
PIN 1. BASE 1
   2. EMITTER
   3. BASE 2

STYLE 10:
PIN 1. CATHODE
   2. GATE
   3. ANODE

STYLE 11:
PIN 1. ANODE
   2. CATHODE & ANODE
   3. CATHODE

STYLE 12:
PIN 1. MAIN TERMINAL 1
   2. GATE
   3. MAIN TERMINAL 2

STYLE 13:
PIN 1. ANODE 1
   2. GATE
   3. CATHODE 2

STYLE 14:
PIN 1. EMITTER
   2. COLLECTOR
   3. BASE

STYLE 15:
PIN 1. ANODE 1
   2. CATHODE
   3. ANODE 2

STYLE 16:
PIN 1. ANODE
   2. GATE
   3. CATHODE

STYLE 17:
PIN 1. COLLECTOR
   2. BASE
   3. EMITTER

STYLE 18:
PIN 1. ANODE
   2. CATHODE
   3. NOT CONNECTED

STYLE 19:
PIN 1. GATE
   2. ANODE
   3. CATHODE

STYLE 20:
PIN 1. NOT CONNECTED
   2. CATHODE
   3. ANODE

STYLE 21:
PIN 1. COLLECTOR
   2. EMITTER
   3. BASE

STYLE 22:
PIN 1. SOURCE
   2. GATE
   3. DRAIN

STYLE 23:
PIN 1. GATE
   2. SOURCE
   3. DRAIN

STYLE 24:
PIN 1. EMITTER
   2. COLLECTOR/ANODE
   3. CATHODE

STYLE 25:
PIN 1. MT 1
   2. GATE
   3. MT 2

STYLE 26:
PIN 1. V_{CC}
   2. GROUND 2
   3. OUTPUT

STYLE 27:
PIN 1. MT
   2. SUBSTRATE
   3. MT

STYLE 28:
PIN 1. CATHODE
   2. ANODE
   3. GATE

STYLE 29:
PIN 1. NOT CONNECTED
   2. ANODE
   3. CATHODE

STYLE 30:
PIN 1. DRAIN
   2. GATE
   3. SOURCE

STYLE 31:
PIN 1. GATE
   2. DRAIN
   3. SOURCE

STYLE 32:
PIN 1. BASE
   2. COLLECTOR
   3. EMITTER

STYLE 33:
PIN 1. RETURN
   2. INPUT
   3. OUTPUT

STYLE 34:
PIN 1. INPUT
   2. GROUND
   3. LOGIC

STYLE 35:
PIN 1. GATE
   2. COLLECTOR
   3. EMITTER

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STATUS:	**ON SEMICONDUCTOR STANDARD**	
NEW STANDARD:		
DESCRIPTION:	**TO−92 (TO−226)**	**PAGE 2 OF 3**

ISSUE	REVISION	DATE
AM	ADDED BENT–LEAD TAPE & REEL VERSION. REQ. BY J. SUPINA.	09 MAR 2007

PUBLICATION ORDERING INFORMATION

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Mouser Electronics

Authorized Distributor

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[2N6517RLRPG](#) [2N6520RLRA](#) [2N6520RLRAG](#) [2N6520BU](#)