

NPN - 2N6515, 2N6517; PNP - 2N6520

High Voltage Transistors

NPN and PNP

Features

- Voltage and Current are Negative for PNP Transistors
- These are Pb-Free Devices*

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector – Emitter Voltage 2N6515 2N6517, 2N6520	V_{CEO}	250 350	Vdc
Collector – Base Voltage 2N6515 2N6517, 2N6520	V_{CBO}	250 350	Vdc
Emitter – Base Voltage 2N6515, 2N6517 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°C	P_D	625 5.0	mW mW/ $^\circ\text{C}$
Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above 25°C	P_D	1.5 12	W mW/ $^\circ\text{C}$
Operating and Storage Junction 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	$^\circ\text{C/W}$

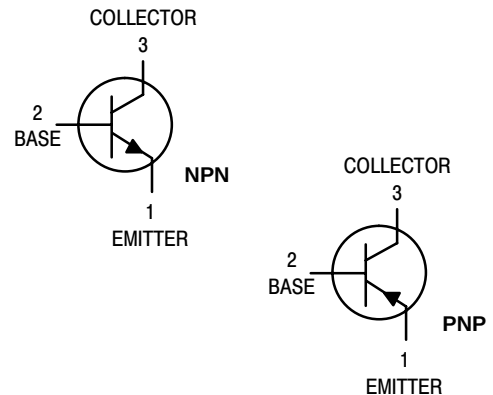
Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERM/D.

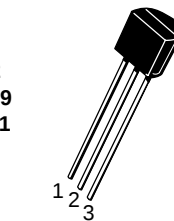


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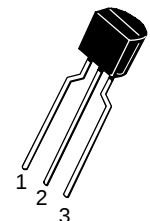
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TO-92
CASE 29
STYLE 1

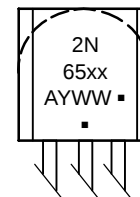


STRAIGHT LEAD
BULK PACK



BENT LEAD
TAPE & REEL
AMMO PACK

MARKING DIAGRAM



xx = 15, 17, or 20
A = Assembly Location
Y = Year
WW = Work Week
▪ = Pb-Free Package

(Note: Microdot may be in either location)

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 6 of this data sheet.

NPN – 2N6515, 2N6517; PNP – 2N6520

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 mA _{dc} , I _B = 0)	V _{(BR)CEO}	250 350	– –	V _{dc}
Collector–Base Breakdown Voltage (I _C = 100 μA _{dc} , I _E = 0)	V _{(BR)CBO}	250 350	– –	V _{dc}
Emitter–Base Breakdown Voltage (I _E = 10 μA _{dc} , I _C = 0)	V _{(BR)EBO}	6.0 5.0	– –	V _{dc}
Collector Cutoff Current (V _{CB} = 150 V _{dc} , I _E = 0) (V _{CB} = 250 V _{dc} , I _E = 0)	I _{CBO}	– –	50 50	nA _{dc}
Emitter Cutoff Current (V _{EB} = 5.0 V _{dc} , I _C = 0) (V _{EB} = 4.0 V _{dc} , I _C = 0)	I _{EBO}	– –	50 50	nA _{dc}

ON CHARACTERISTICS (Note 1)

DC Current Gain (I _C = 1.0 mA _{dc} , V _{CE} = 10 V _{dc})	h _{FE}	35 20	– –	–
(I _C = 10 mA _{dc} , V _{CE} = 10 V _{dc})		50 30	– –	
(I _C = 30 mA _{dc} , V _{CE} = 10 V _{dc})		50 30	300 200	
(I _C = 50 mA _{dc} , V _{CE} = 10 V _{dc})		45 20	220 200	
(I _C = 100 mA _{dc} , V _{CE} = 10 V _{dc})		25 15	– –	
Collector–Emitter Saturation Voltage (I _C = 10 mA _{dc} , I _B = 1.0 mA _{dc}) (I _C = 20 mA _{dc} , I _B = 2.0 mA _{dc}) (I _C = 30 mA _{dc} , I _B = 3.0 mA _{dc}) (I _C = 50 mA _{dc} , I _B = 5.0 mA _{dc})	V _{CE(sat)}	– – – –	0.30 0.35 0.50 1.0	V _{dc}
Base–Emitter Saturation Voltage (I _C = 10 mA _{dc} , I _B = 1.0 mA _{dc}) (I _C = 20 mA _{dc} , I _B = 2.0 mA _{dc}) (I _C = 30 mA _{dc} , I _B = 3.0 mA _{dc})	V _{BE(sat)}	– – –	0.75 0.85 0.90	V _{dc}
Base–Emitter On Voltage (I _C = 100 mA _{dc} , V _{CE} = 10 V _{dc})	V _{BE(on)}	–	2.0	V _{dc}

SMALL–SIGNAL CHARACTERISTICS

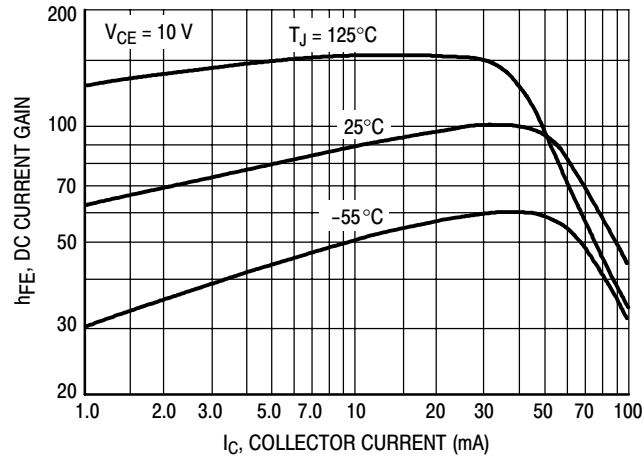
Current–Gain – Bandwidth Product (Note 1) (I _C = 10 mA _{dc} , V _{CE} = 20 V _{dc} , f = 20 MHz)	f _T	40	200	MHz
Collector–Base Capacitance (V _{CB} = 20 V _{dc} , I _E = 0, f = 1.0 MHz)	C _{cb}	–	6.0	pF
Emitter–Base Capacitance (V _{EB} = 0.5 V _{dc} , I _C = 0, f = 1.0 MHz)	C _{eb}	– –	80 100	pF

SWITCHING CHARACTERISTICS

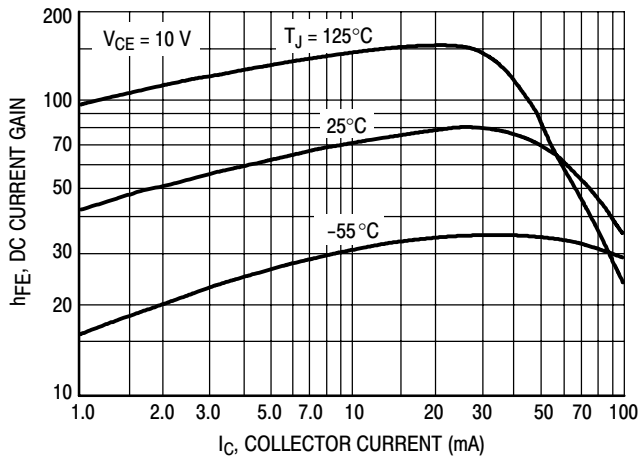
Turn–On Time (V _{CC} = 100 V _{dc} , V _{BE(off)} = 2.0 V _{dc} , I _C = 50 mA _{dc} , I _{B1} = 10 mA _{dc})	t _{on}	–	200	μs
Turn–Off Time (V _{CC} = 100 V _{dc} , I _C = 50 mA _{dc} , I _{B1} = I _{B2} = 10 mA _{dc})	t _{off}	–	3.5	μs

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

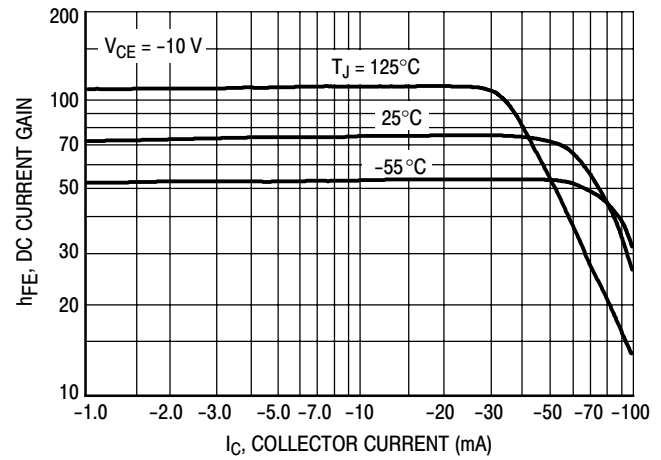
NPN – 2N6515, 2N6517; PNP – 2N6520



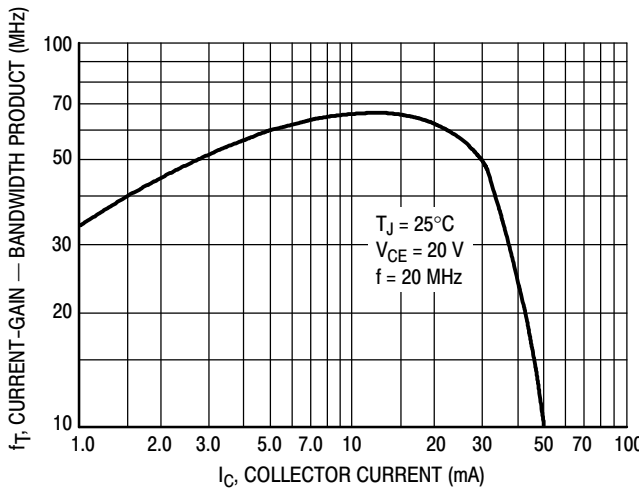
**Figure 1. DC Current Gain
NPN 2N6515**



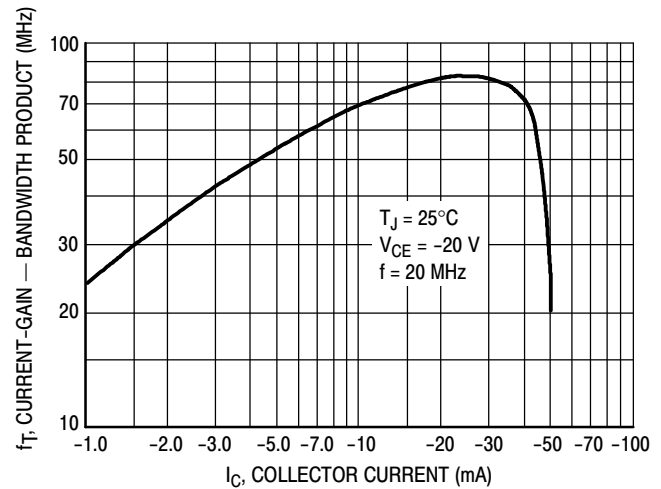
**Figure 2. DC Current Gain
NPN 2N6517**



**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

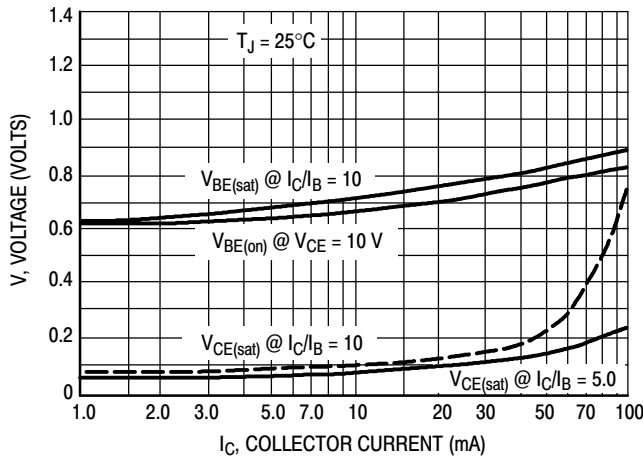


Figure 6. "On" Voltages
NPN 2N6515, 2N6517

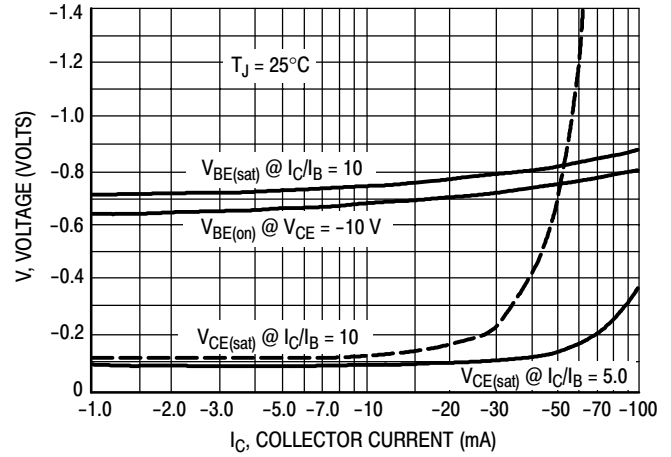


Figure 7. "On" Voltages
PNP 2N6520

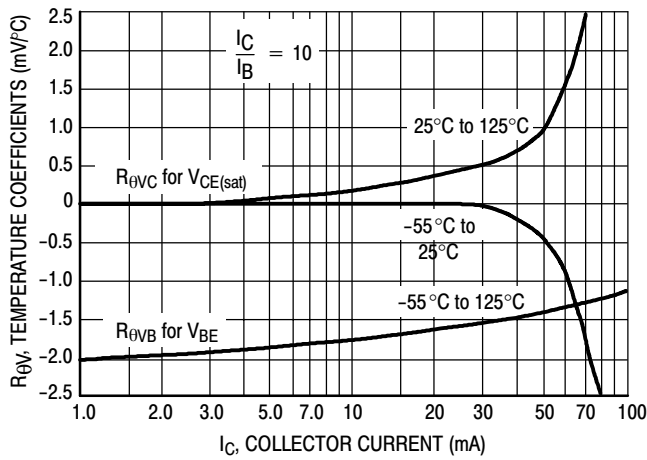


Figure 8. Temperature Coefficients
NPN 2N6515, 2N6517

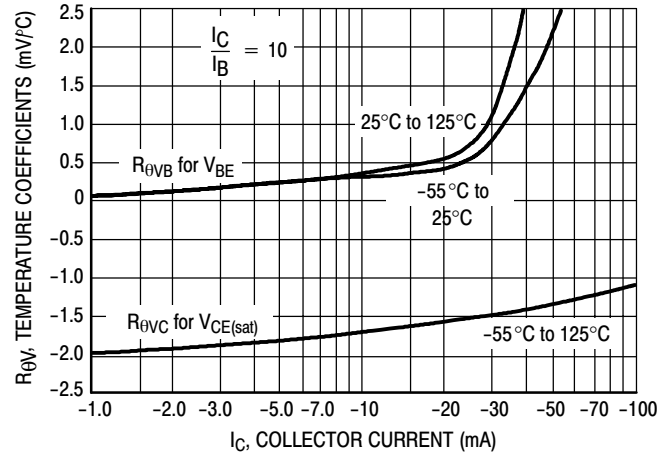


Figure 9. Temperature Coefficients
PNP 2N6520

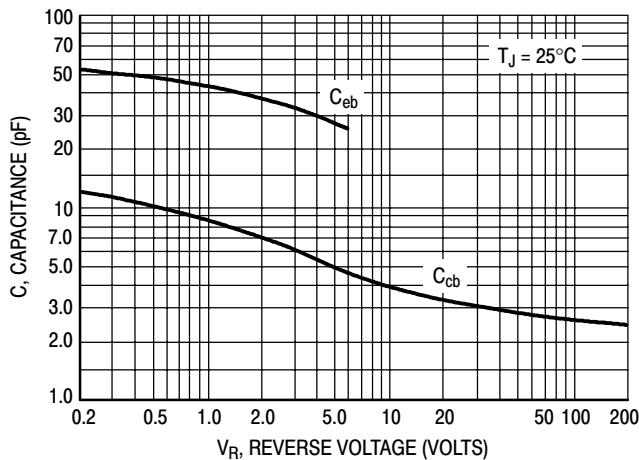


Figure 10. Capacitance
NPN 2N6515, 2N6517

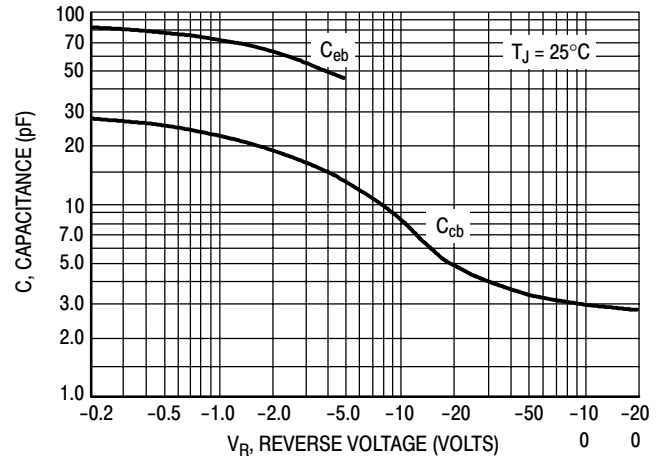


Figure 11. Capacitance
PNP 2N6520

NPN – 2N6515, 2N6517; PNP – 2N6520

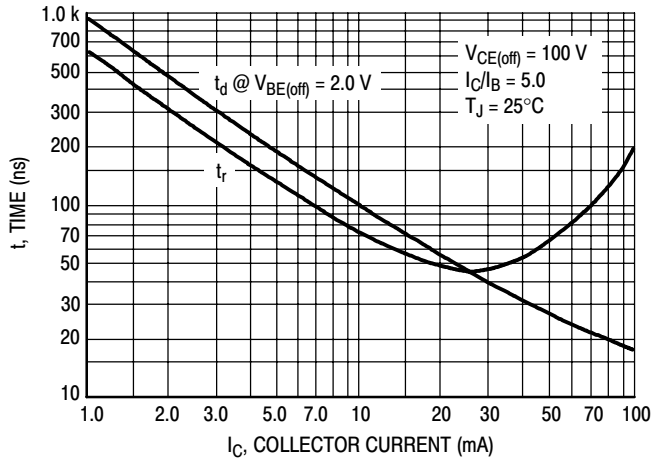


Figure 12. Turn-On Time
NPN 2N6515, 2N6517

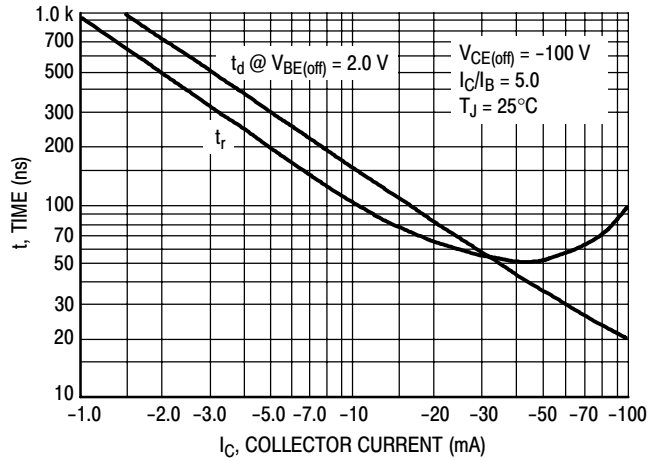


Figure 13. Turn-On Time
PNP 2N6520

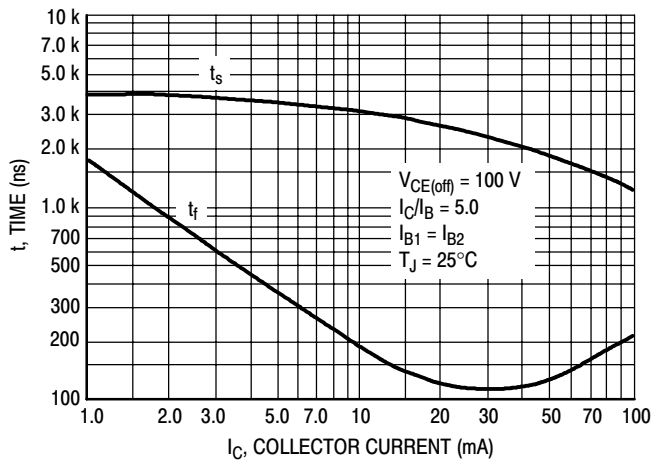


Figure 14. Turn-Off Time
NPN 2N6515, 2N6517

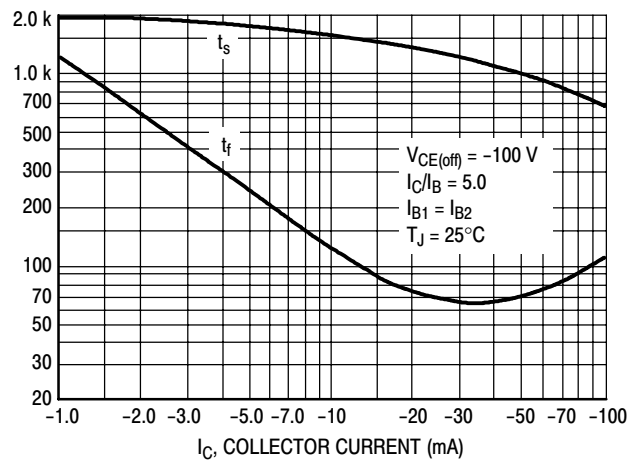


Figure 15. Turn-Off Time
PNP 2N6520

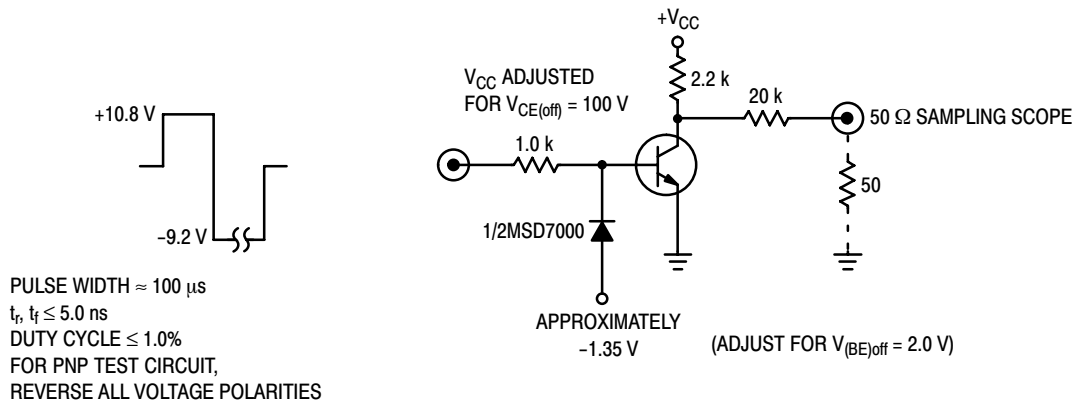


Figure 16. Switching Time Test Circuit

NPN – 2N6515, 2N6517; PNP – 2N6520

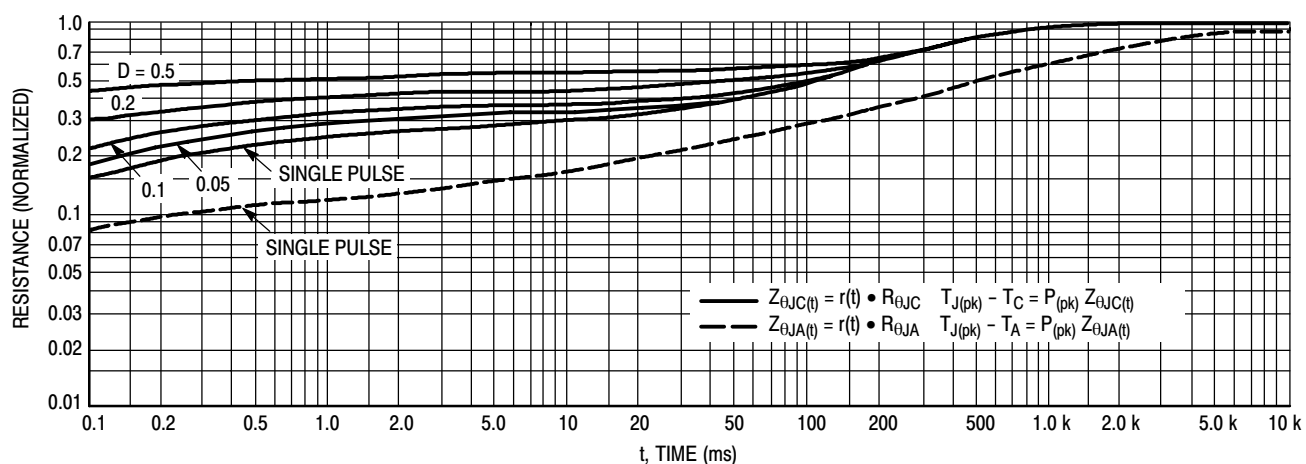


Figure 17. Thermal Response

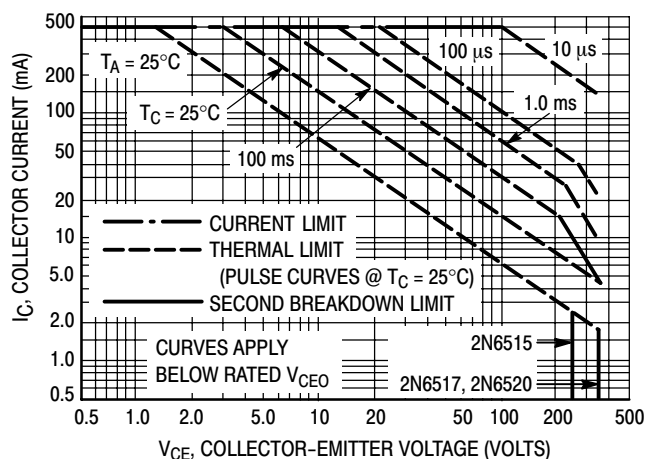
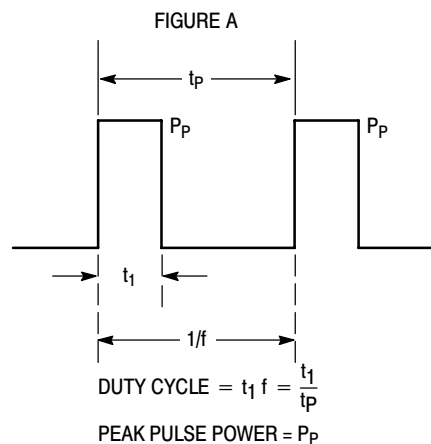


Figure 18. Active Region Safe Operating Area



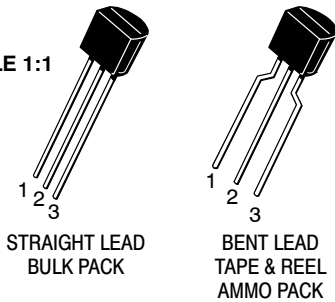
Design Note: Use of Transient Thermal Resistance Data

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

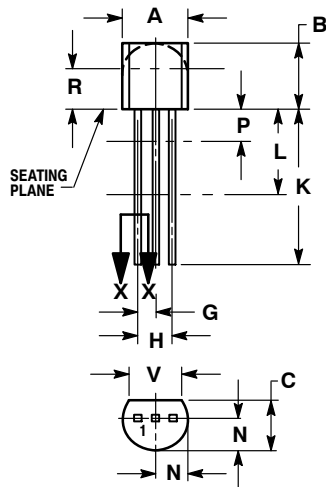
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

SCALE 1:1

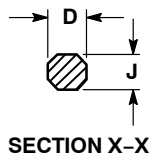


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ISSUE AM

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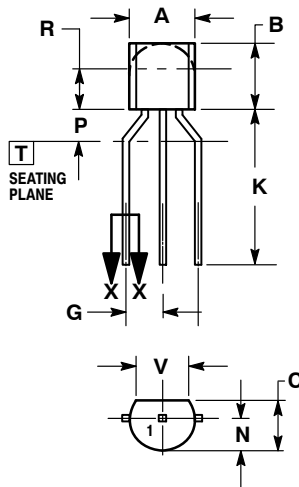
STRAIGHT LEAD
BULK PACK



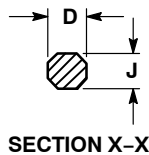
NOTES:

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



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

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CASE 29-11
ISSUE AM

DATE 09 MAR 2007

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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