

# NSS20501UW3

## 20 V, 7.0 A, Low $V_{CE(sat)}$ NPN Transistor

ON Semiconductor's e<sup>2</sup>PowerEdge family of low  $V_{CE(sat)}$  transistors are miniature surface mount devices featuring ultra low saturation voltage ( $V_{CE(sat)}$ ) and high current gain capability. These are designed for use in low voltage, high speed switching applications where affordable efficient energy control is important.

Typical applications are DC-DC converters and power management in portable and battery powered products such as cellular and cordless phones, PDAs, computers, printers, digital cameras and MP3 players. Other applications are low voltage motor controls in mass storage products such as disc drives and tape drives. In the automotive industry they can be used in air bag deployment and in the instrument cluster. The high current gain allows e<sup>2</sup>PowerEdge devices to be driven directly from PMU's control outputs, and the Linear Gain (Beta) makes them ideal components in analog amplifiers.

### Features

- This is a Pb-Free Device

### MAXIMUM RATINGS ( $T_A = 25^\circ\text{C}$ )

Rating	Symbol	Max	Unit
Collector-Emitter Voltage	$V_{CEO}$	20	Vdc
Collector-Base Voltage	$V_{CBO}$	20	Vdc
Emitter-Base Voltage	$V_{EBO}$	6.0	Vdc
Collector Current – Continuous	$I_C$	5.0	Adc
Collector Current – Peak	$I_{CM}$	7.0	A
Electrostatic Discharge	ESD	HBM Class 3B MM Class C	

### THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation, $T_A = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$ (Note 1)	875 7.0	mW mW/ $^\circ\text{C}$
Thermal Resistance, Junction-to-Ambient	$R_{\theta JA}$ (Note 1)	143	$^\circ\text{C}/\text{W}$
Total Device Dissipation, $T_A = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$ (Note 2)	1.5 11.8	W mW/ $^\circ\text{C}$
Thermal Resistance, Junction-to-Ambient	$R_{\theta JA}$ (Note 2)	85	$^\circ\text{C}/\text{W}$
Thermal Resistance, Junction-to-Lead #3	$R_{\theta JL}$ (Note 2)	23	$^\circ\text{C}/\text{W}$
Junction and Storage Temperature Range	$T_J, T_{stg}$	-55 to +150	$^\circ\text{C}$

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.

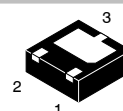
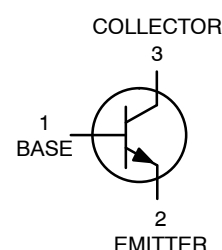
1. FR-4 @ 100 mm<sup>2</sup>, 1 oz copper traces.
2. FR-4 @ 500 mm<sup>2</sup>, 1 oz copper traces.



ON Semiconductor®

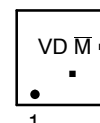
<http://onsemi.com>

**20 VOLTS, 7.0 AMPS  
NPN LOW  $V_{CE(sat)}$  TRANSISTOR  
EQUIVALENT  $R_{DS(on)}$  31 m $\Omega$**



WDFN3  
CASE 506AU

### MARKING DIAGRAM



VD = Specific Device Code

M = Date Code

■ = Pb-Free Package

(Note: Microdot may be in either location)

### ORDERING INFORMATION

Device	Package	Shipping <sup>†</sup>
NSS20501UW3T2G	WDFN3 (Pb-Free)	3000/ Tape & Reel
NSS20501UW3TBG	WDFN3 (Pb-Free)	3000/ 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.

# NSS20501UW3

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

Characteristic	Symbol	Min	Typical	Max	Unit
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### OFF CHARACTERISTICS

Collector – Emitter Breakdown Voltage (I <sub>C</sub> = 10 mAdc, I <sub>B</sub> = 0)	V <sub>(BR)CEO</sub>	20	–	–	Vdc
Collector – Base Breakdown Voltage (I <sub>C</sub> = 0.1 mAdc, I <sub>E</sub> = 0)	V <sub>(BR)CBO</sub>	20	–	–	Vdc
Emitter – Base Breakdown Voltage (I <sub>E</sub> = 0.1 mAdc, I <sub>C</sub> = 0)	V <sub>(BR)EBO</sub>	6.0	–	–	Vdc
Collector Cutoff Current (V <sub>CB</sub> = 20 Vdc, I <sub>E</sub> = 0)	I <sub>CBO</sub>	–	–	0.1	μAdc
Emitter Cutoff Current (V <sub>EB</sub> = 6.0 Vdc)	I <sub>EBO</sub>	–	–	0.1	μAdc

### ON CHARACTERISTICS

DC Current Gain (Note 3) (I <sub>C</sub> = 10 mA, V <sub>CE</sub> = 2.0 V) (I <sub>C</sub> = 500 mA, V <sub>CE</sub> = 2.0 V) (I <sub>C</sub> = 1.0 A, V <sub>CE</sub> = 2.0 V) (I <sub>C</sub> = 2.0 A, V <sub>CE</sub> = 2.0 V) (I <sub>C</sub> = 3.0 A, V <sub>CE</sub> = 2.0 V)	h <sub>FE</sub>	200 200 200 200 180	– – 325 310 300	– – – – –	
Collector – Emitter Saturation Voltage (Note 3) (I <sub>C</sub> = 0.1 A, I <sub>B</sub> = 0.010 A) (I <sub>C</sub> = 1.0 A, I <sub>B</sub> = 0.100 A) (I <sub>C</sub> = 1.0 A, I <sub>B</sub> = 0.010 A) (I <sub>C</sub> = 2.0 A, I <sub>B</sub> = 0.020 A) (I <sub>C</sub> = 3.0 A, I <sub>B</sub> = 0.030 A) (I <sub>C</sub> = 4.0 A, I <sub>B</sub> = 0.400 A)	V <sub>CE(sat)</sub>	– – – – – –	0.007 0.031 0.045 0.070 0.120 0.110	0.008 0.040 0.075 0.100 0.135 0.125	V
Base – Emitter Saturation Voltage (Note 3) (I <sub>C</sub> = 1.0 A, I <sub>B</sub> = 0.01 A)	V <sub>BE(sat)</sub>	–	0.760	0.900	V
Base – Emitter Turn-on Voltage (Note 3) (I <sub>C</sub> = 2.0 A, V <sub>CE</sub> = 2.0 V)	V <sub>BE(on)</sub>	–	0.730	0.900	V
Cutoff Frequency (I <sub>C</sub> = 100 mA, V <sub>CE</sub> = 5.0 V, f = 100 MHz)	f <sub>T</sub>	150	–	–	MHz
Input Capacitance (V <sub>EB</sub> = 0.5 V, f = 1.0 MHz)	C <sub>ibo</sub>	–		650	pF
Output Capacitance (V <sub>CB</sub> = 3.0 V, f = 1.0 MHz)	C <sub>obo</sub>	–		70	pF

### SWITCHING CHARACTERISTICS

Delay (V <sub>CC</sub> = 15 V, I <sub>C</sub> = 750 mA, I <sub>B1</sub> = 15 mA)	t <sub>d</sub>	–	–	90	ns
Rise (V <sub>CC</sub> = 15 V, I <sub>C</sub> = 750 mA, I <sub>B1</sub> = 15 mA)	t <sub>r</sub>	–	–	100	ns
Storage (V <sub>CC</sub> = 15 V, I <sub>C</sub> = 750 mA, I <sub>B1</sub> = 15 mA)	t <sub>s</sub>	–	–	500	ns
Fall (V <sub>CC</sub> = 15 V, I <sub>C</sub> = 750 mA, I <sub>B1</sub> = 15 mA)	t <sub>f</sub>	–	–	100	ns

3. Pulsed Condition: Pulse Width = 300 μsec, Duty Cycle ≤ 2%.

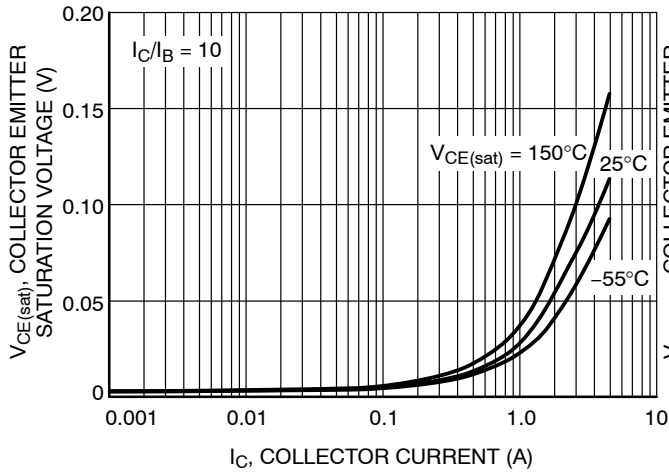


Figure 1. Collector Emitter Saturation Voltage vs. Collector Current

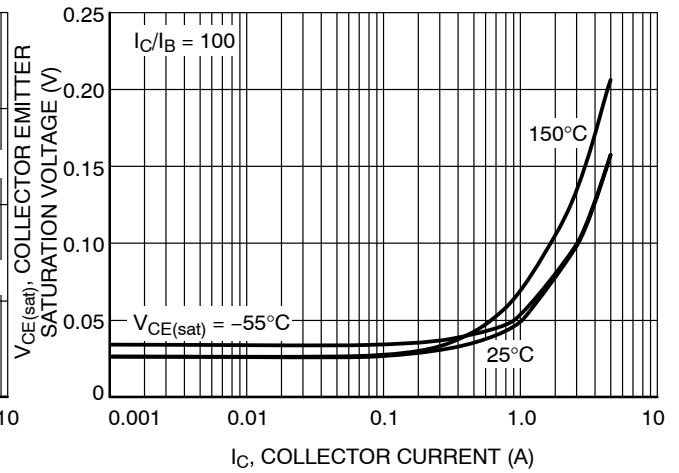


Figure 2. Collector Emitter Saturation Voltage vs. Collector Current

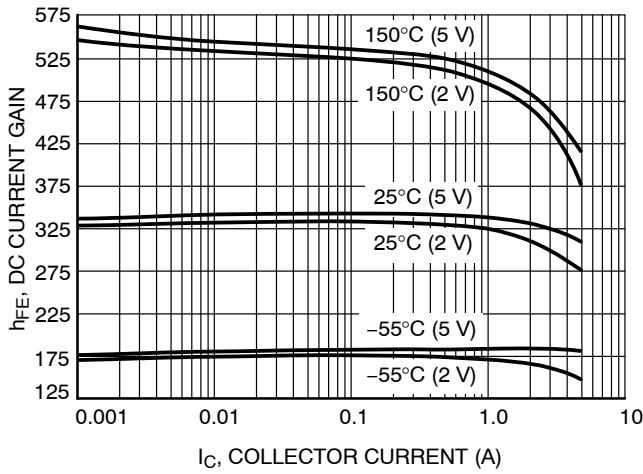


Figure 3. DC Current Gain vs. Collector Current

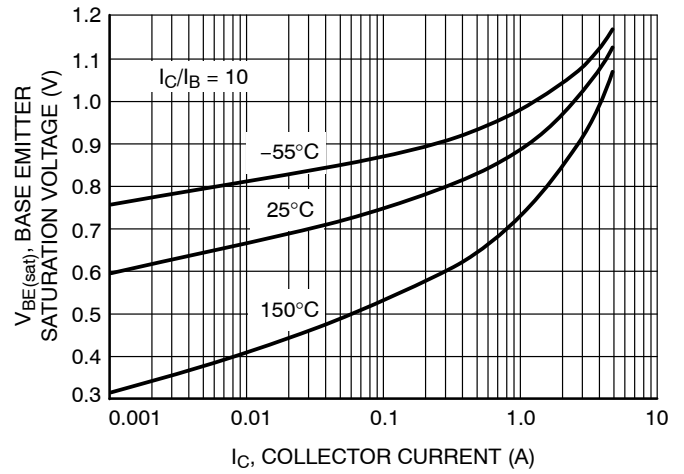


Figure 4. Base Emitter Saturation Voltage vs. Collector Current

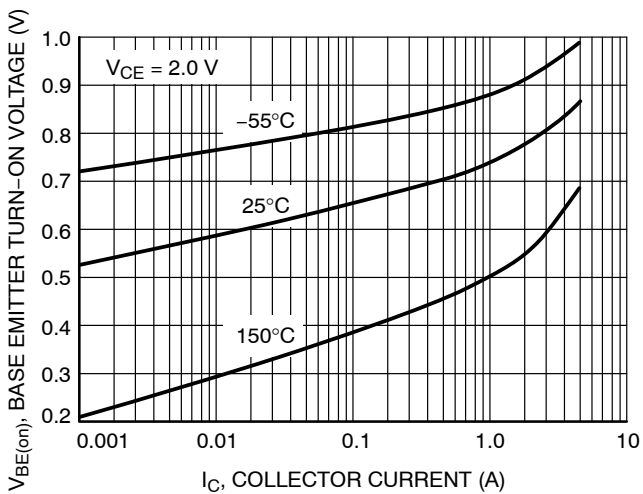


Figure 5. Base Emitter Turn-On Voltage vs. Collector Current

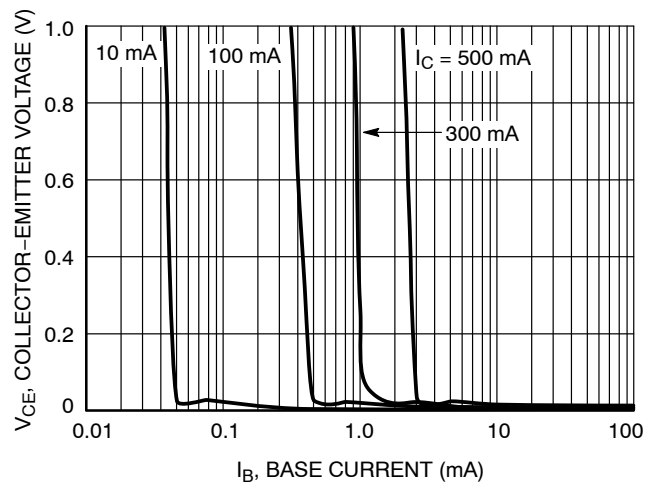


Figure 6. Saturation Region

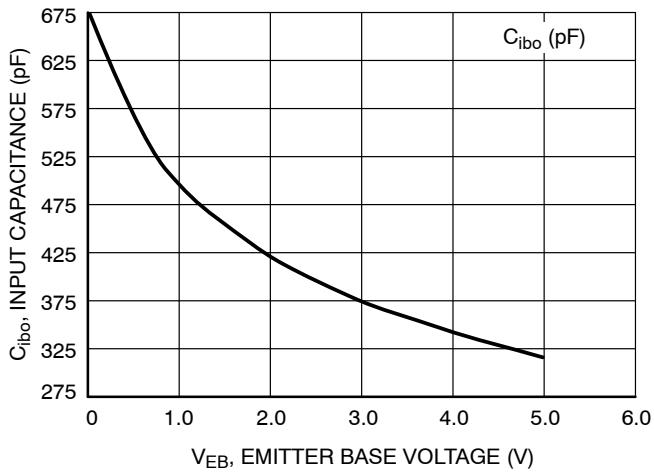


Figure 7. Input Capacitance

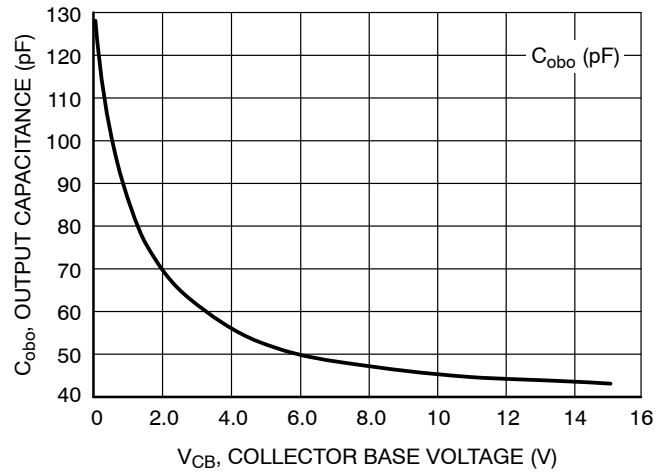


Figure 8. Output Capacitance

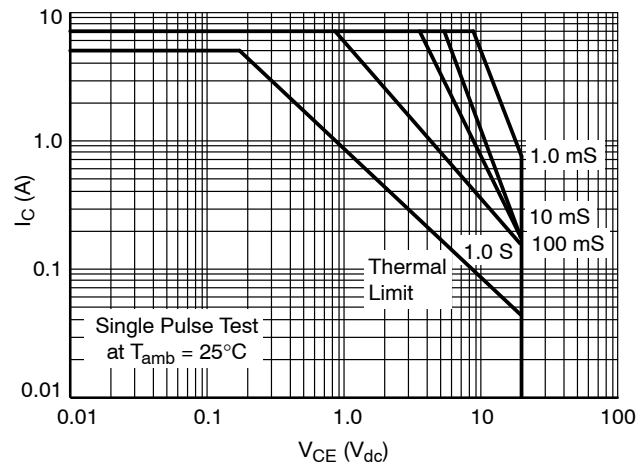


Figure 9. Safe Operating Area



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