

# NSS60201LT1G

## 60 V, 4.0 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.

- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

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

Rating	Symbol	Max	Unit
Collector-Emitter Voltage	$V_{CEO}$	60	Vdc
Collector-Base Voltage	$V_{CBO}$	140	Vdc
Emitter-Base Voltage	$V_{EBO}$	8.0	Vdc
Collector Current - Continuous	$I_C$	2.0	A
Collector Current - Peak	$I_{CM}$	4.0	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)	460	mW
Thermal Resistance, Junction-to-Ambient	$R_{\theta JA}$ (Note 1)	270	$^\circ\text{C}/\text{W}$
Total Device Dissipation $T_A = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$ (Note 2)	540	mW
Thermal Resistance, Junction-to-Ambient	$R_{\theta JA}$ (Note 2)	230	$^\circ\text{C}/\text{W}$
Total Device Dissipation (Single Pulse < 10 sec.)	$P_{Dsingle}$ (Note 3)	710	mW
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.

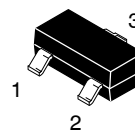
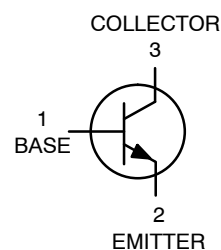
1. FR-4 @ 100 mm<sup>2</sup>, 1 oz. copper traces.
2. FR-4 @ 500 mm<sup>2</sup>, 1 oz. copper traces.
3. Thermal response.



**ON Semiconductor**®

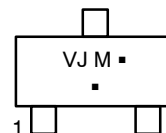
<http://onsemi.com>

## 60 VOLTS, 4.0 AMPS NPN LOW $V_{CE(sat)}$ TRANSISTOR EQUIVALENT $R_{DS(on)}$ 70 m $\Omega$



SOT-23 (TO-236)  
CASE 318  
STYLE 6

### MARKING DIAGRAM



VJ = Specific Device Code  
M = Date Code\*  
▪ = Pb-Free Package

(Note: Microdot may be in either location)

\*Date Code orientation and/or overbar may vary depending upon manufacturing location.

### ORDERING INFORMATION

Device	Package	Shipping <sup>†</sup>
NSS60201LT1G	SOT-23 (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 Specification Brochure, BRD8011/D.

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

Characteristic	Symbol	Min	Typ	Max	Unit
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### OFF CHARACTERISTICS

Collector – Emitter Breakdown Voltage (I <sub>C</sub> = 10 mA, I <sub>B</sub> = 0)	V <sub>(BR)CEO</sub>	60	–	–	Vdc
Collector – Base Breakdown Voltage (I <sub>C</sub> = 0.1 mA, I <sub>E</sub> = 0)	V <sub>(BR)CBO</sub>	140	–	–	Vdc
Emitter – Base Breakdown Voltage (I <sub>E</sub> = 0.1 mA, I <sub>C</sub> = 0)	V <sub>(BR)EBO</sub>	8.0	–	–	Vdc
Collector Cutoff Current (V <sub>CB</sub> = 60 Vdc, I <sub>E</sub> = 0)	I <sub>CBO</sub>	–	–	0.1	μA <sub>dc</sub>
Emitter Cutoff Current (V <sub>EB</sub> = 6.0 Vdc)	I <sub>EBO</sub>	–	–	0.1	μA <sub>dc</sub>

### ON CHARACTERISTICS

DC Current Gain (Note 4) (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)	h <sub>FE</sub>	160 160 150 100	– – – –	– – 350 –	
Collector – Emitter Saturation Voltage (Note 4) (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> = 2.0 A, I <sub>B</sub> = 0.200 A)	V <sub>CE(sat)</sub>	– – –	– – –	0.020 0.075 0.140	V
Base – Emitter Saturation Voltage (Note 4) (I <sub>C</sub> = 1.0 A, I <sub>B</sub> = 10 mA)	V <sub>BE(sat)</sub>	–	0.790	0.900	V
Base – Emitter Turn-on Voltage (Note 4) (I <sub>C</sub> = 1.0 A, V <sub>CE</sub> = 2.0 V)	V <sub>BE(on)</sub>	–	0.760	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>	100	–	–	MHz
Input Capacitance (V <sub>EB</sub> = 0.5 V, f = 1.0 MHz)	C <sub>ibo</sub>	–	–	380	pF
Output Capacitance (V <sub>CB</sub> = 3.0 V, f = 1.0 MHz)	C <sub>obo</sub>	–	–	45	pF

### SWITCHING CHARACTERISTICS

Delay (V <sub>CC</sub> = 30 V, I <sub>C</sub> = 750 mA, I <sub>B1</sub> = 15 mA)	t <sub>d</sub>	–	–	55	ns
Rise (V <sub>CC</sub> = 30 V, I <sub>C</sub> = 750 mA, I <sub>B1</sub> = 15 mA)	t <sub>r</sub>	–	–	100	ns
Storage (V <sub>CC</sub> = 30 V, I <sub>C</sub> = 750 mA, I <sub>B1</sub> = 15 mA)	t <sub>s</sub>	–	–	1100	ns
Fall (V <sub>CC</sub> = 30 V, I <sub>C</sub> = 750 mA, I <sub>B1</sub> = 15 mA)	t <sub>f</sub>	–	–	120	ns

4. Pulsed Condition: Pulse Width = 300 msec, Duty Cycle ≤ 2%.

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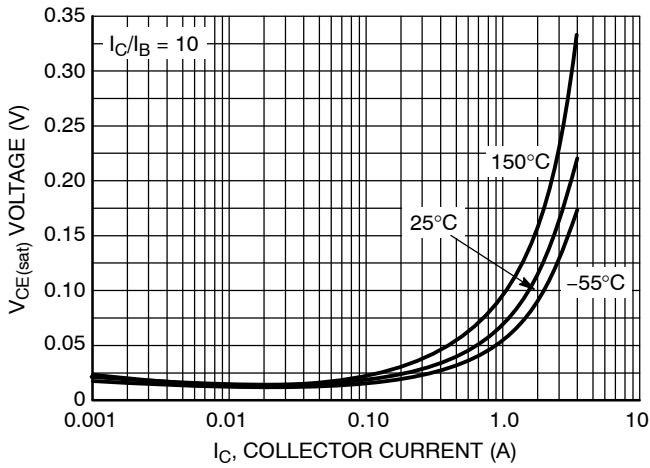


Figure 1. Collector-Emitter Saturation Voltage

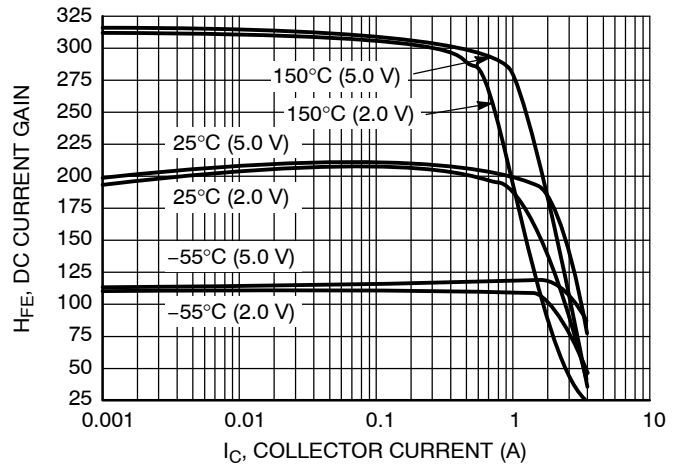


Figure 2. DC Current versus Collector Current

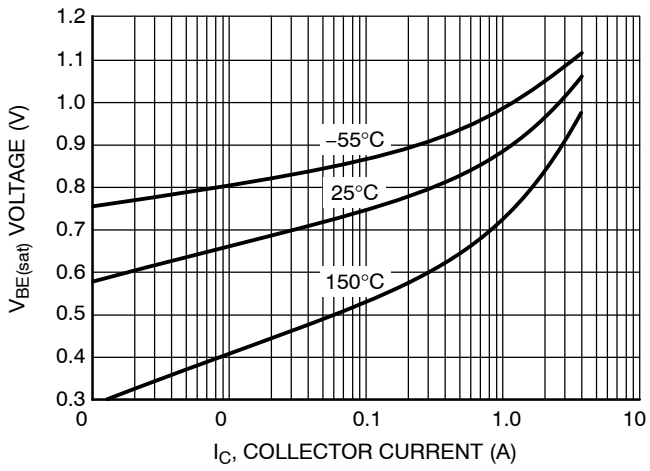


Figure 3.  $V_{BE(sat)}$

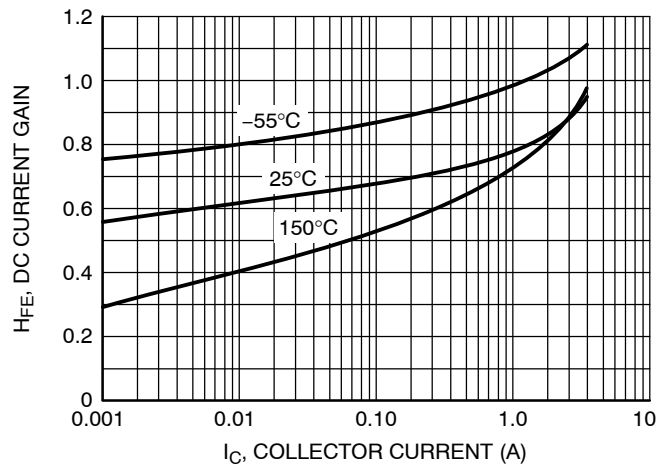


Figure 4.  $V_{BE(on)}$

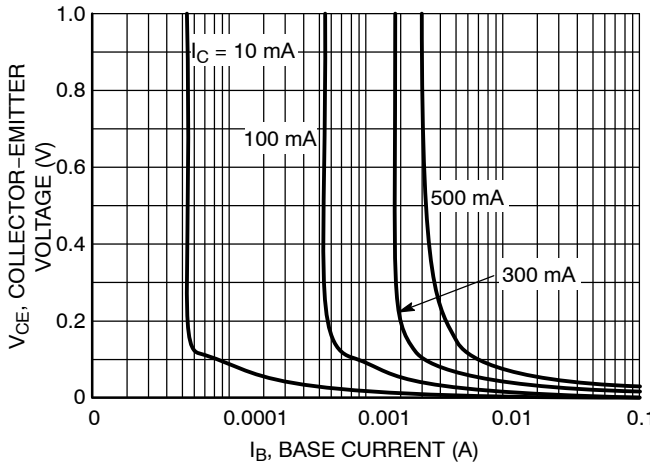


Figure 5. Saturation Region

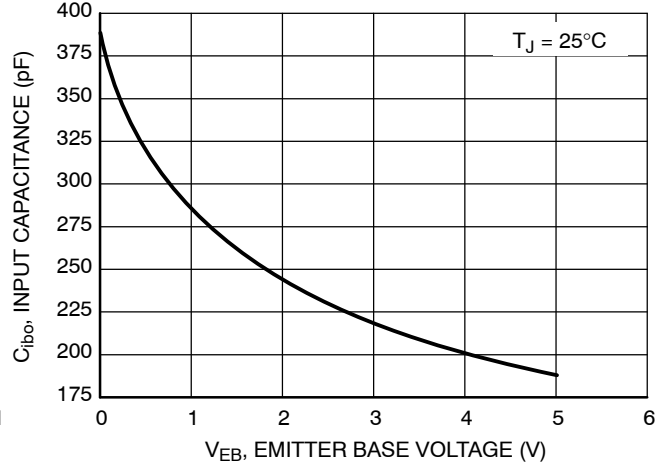
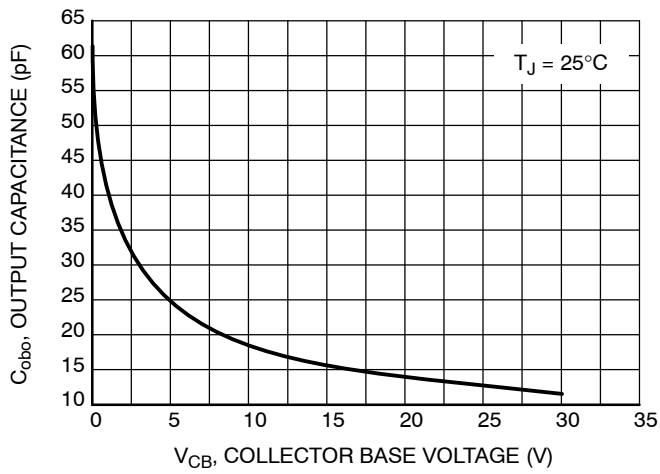
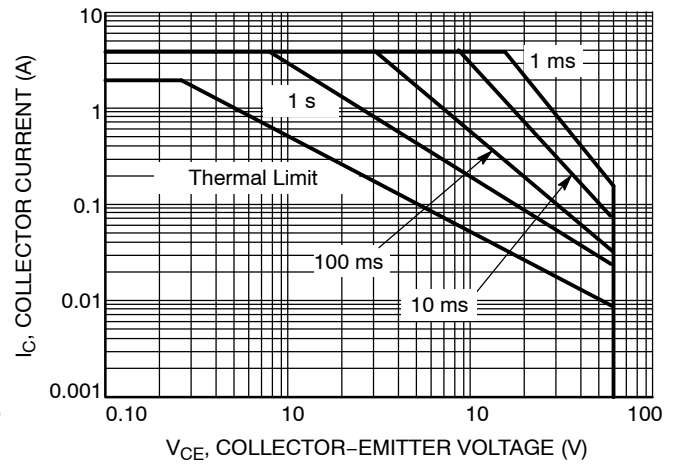


Figure 6. Input Capacitance

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**Figure 7. Output Capacitance**

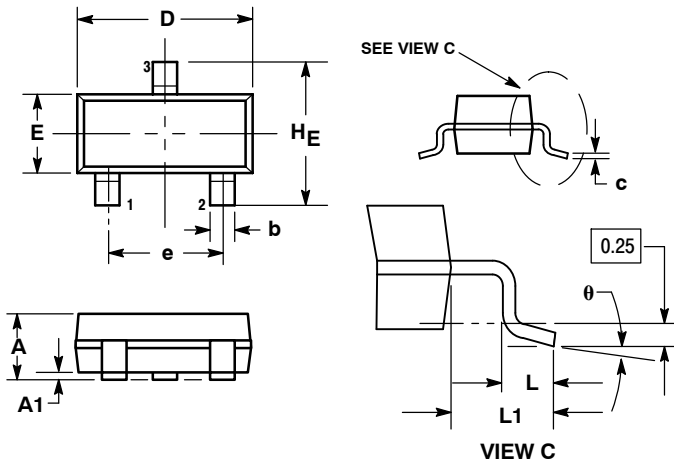


**Figure 8. Safe Operating Area  
Single Pulse Test @  $T_{amb} = 25^\circ\text{C}$**

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## PACKAGE DIMENSIONS

SOT-23 (TO-236)  
CASE 318-08  
ISSUE AN

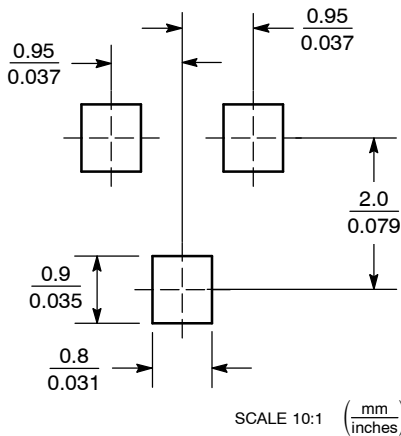


- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: INCH.
  3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
  4. 318-01 THRU -07 AND -09 OBSOLETE, NEW STANDARD 318-08.

DIM	MILLIMETERS			INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	0.89	1.00	1.11	0.035	0.040	0.044
A1	0.01	0.06	0.10	0.001	0.002	0.004
b	0.37	0.44	0.50	0.015	0.018	0.020
c	0.09	0.13	0.18	0.003	0.005	0.007
D	2.80	2.90	3.04	0.110	0.114	0.120
E	1.20	1.30	1.40	0.047	0.051	0.055
e	1.78	1.90	2.04	0.070	0.075	0.081
L	0.10	0.20	0.30	0.004	0.008	0.012
L1	0.35	0.54	0.69	0.014	0.021	0.029
HE	2.10	2.40	2.64	0.083	0.094	0.104

STYLE 6:  
PIN 1: BASE  
2: EMITTER  
3: COLLECTOR

### SOLDERING FOOTPRINT\*



\*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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