

# NSS60201LT1G

## Low $V_{CE(sat)}$ Transistor, NPN, 60 V, 4.0 A

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.

- NSV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q101 Qualified and PPAP Capable
- 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<br>MM Class C |      |

### THERMAL CHARACTERISTICS

| Characteristic  | Symbol                           | Max            | Unit                      |
|---|----------------------------------|----------------|---------------------------|
| Total Device Dissipation<br>$T_A = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$ | $P_D$ (Note 1)                   | 460            | mW                        |
|   |                                  | 3.7            | mW/ $^\circ\text{C}$      |
| Thermal Resistance,<br>Junction-to-Ambient  | $R_{\theta JA}$ (Note 1)         | 270            | $^\circ\text{C}/\text{W}$ |
| Total Device Dissipation<br>$T_A = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$ | $P_D$ (Note 2)                   | 540            | mW                        |
|   |                                  | 4.3            | mW/ $^\circ\text{C}$      |
| Thermal Resistance,<br>Junction-to-Ambient  | $R_{\theta JA}$ (Note 2)         | 230            | $^\circ\text{C}/\text{W}$ |
| Total Device Dissipation<br>(Single Pulse < 10 sec.)                                    | $P_{D\text{single}}$<br>(Note 3) | 710            | mW                        |
| Junction and Storage<br>Temperature Range   | $T_J, T_{\text{stg}}$            | -55 to<br>+150 | $^\circ\text{C}$          |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

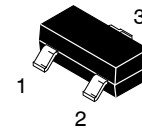
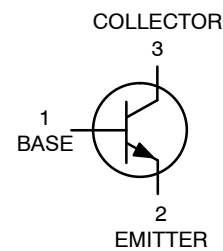
1. FR-4 @ 100 mm<sup>2</sup>, 1 oz. copper traces.
2. FR-4 @ 500 mm<sup>2</sup>, 1 oz. copper traces.
3. Thermal response.



ON Semiconductor®

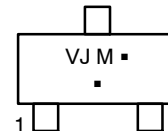
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**60 VOLTS, 4.0 AMPS**  
**NPN LOW  $V_{CE(sat)}$  TRANSISTOR**  
**EQUIVALENT  $R_{DS(on)}$  70 mΩ**



**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†        |
|--------------|---------------------|------------------|
| NSS60201LT1G | SOT-23<br>(Pb-Free) | 3000/Tape & Reel |
| NSV60201LT1G | SOT-23<br>(Pb-Free) | 3000/Tape & Reel |

†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.

# NSS60201LT1G

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

| Characteristic  | Symbol               | Min | Typ | Max | Unit             |
|---|----------------------|-----|-----|-----|------------------|
| <b>OFF CHARACTERISTICS</b>  |                      |     |     |     |                  |
| Collector – Emitter Breakdown Voltage<br>(I <sub>C</sub> = 10 mA, I <sub>B</sub> = 0) | V <sub>(BR)CEO</sub> | 60  | –   | –   | Vdc              |
| Collector – Base Breakdown Voltage<br>(I <sub>C</sub> = 0.1 mA, I <sub>E</sub> = 0)   | V <sub>(BR)CBO</sub> | 140 | –   | –   | Vdc              |
| Emitter – Base Breakdown Voltage<br>(I <sub>E</sub> = 0.1 mA, I <sub>C</sub> = 0)     | V <sub>(BR)EBO</sub> | 8.0 | –   | –   | Vdc              |
| Collector Cutoff Current<br>(V <sub>CB</sub> = 60 Vdc, I <sub>E</sub> = 0)            | I <sub>CBO</sub>     | –   | –   | 0.1 | μA <sub>dc</sub> |
| Emitter Cutoff Current<br>(V <sub>EB</sub> = 6.0 Vdc)                                 | I <sub>EBO</sub>     | –   | –   | 0.1 | μA <sub>dc</sub> |

## ON CHARACTERISTICS

|   |                      |                          |                  |                         |     |
|---|----------------------|--------------------------|------------------|-------------------------|-----|
| DC Current Gain (Note 4)<br>(I <sub>C</sub> = 10 mA, V <sub>CE</sub> = 2.0 V)<br>(I <sub>C</sub> = 500 mA, V <sub>CE</sub> = 2.0 V)<br>(I <sub>C</sub> = 1.0 A, V <sub>CE</sub> = 2.0 V)<br>(I <sub>C</sub> = 2.0 A, V <sub>CE</sub> = 2.0 V) | h <sub>FE</sub>      | 160<br>160<br>150<br>100 | –<br>–<br>–<br>– | –<br>–<br>350<br>–      |     |
| Collector – Emitter Saturation Voltage (Note 4)<br>(I <sub>C</sub> = 0.1 A, I <sub>B</sub> = 0.010 A)<br>(I <sub>C</sub> = 1.0 A, I <sub>B</sub> = 0.100 A)<br>(I <sub>C</sub> = 2.0 A, I <sub>B</sub> = 0.200 A)                             | V <sub>CE(sat)</sub> | –<br>–<br>–              | –<br>–<br>–      | 0.020<br>0.075<br>0.140 | V   |
| Base – Emitter Saturation Voltage (Note 4)<br>(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)<br>(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<br>(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 |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

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

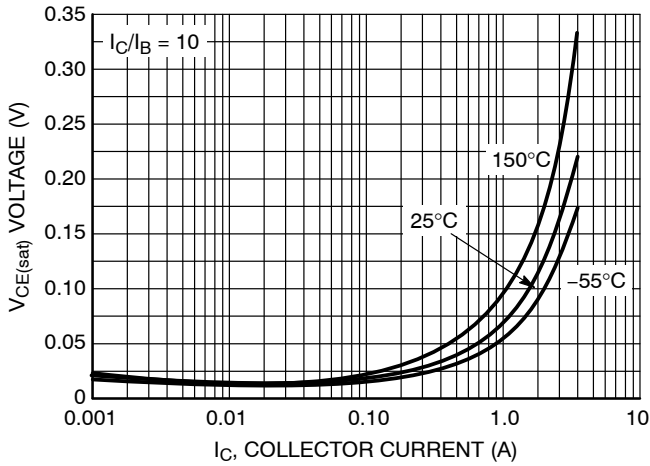


Figure 1. Collector-Emitter Saturation Voltage

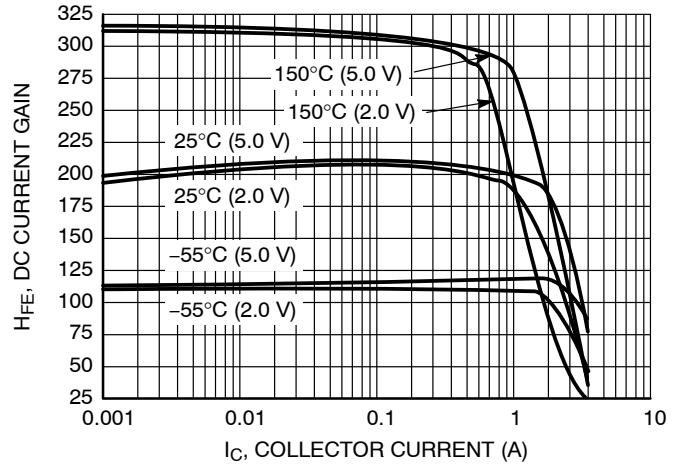


Figure 2. DC Current versus Collector Current

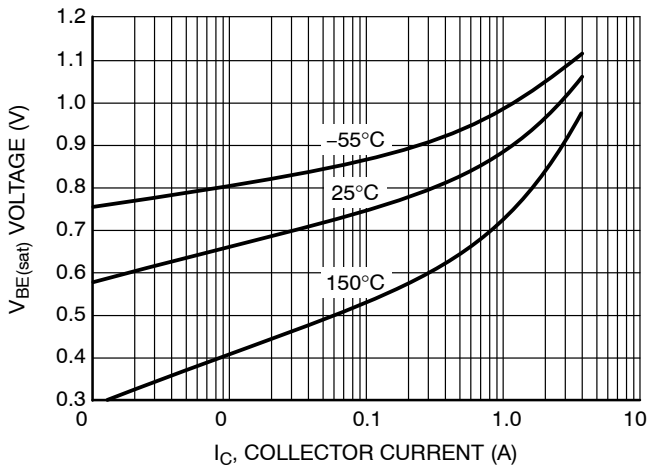


Figure 3.  $V_{BE(sat)}$

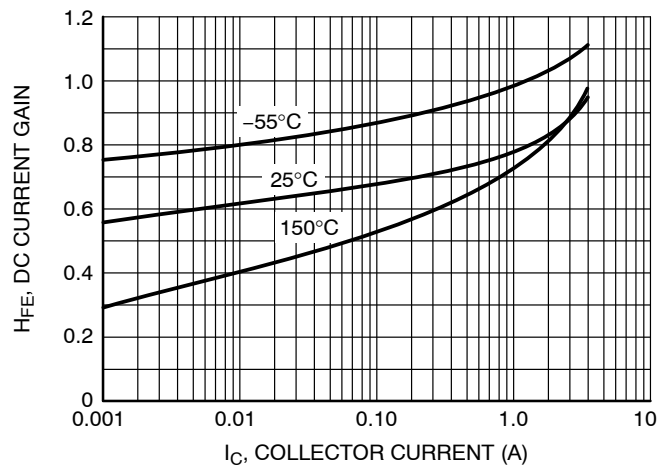


Figure 4.  $V_{BE(on)}$

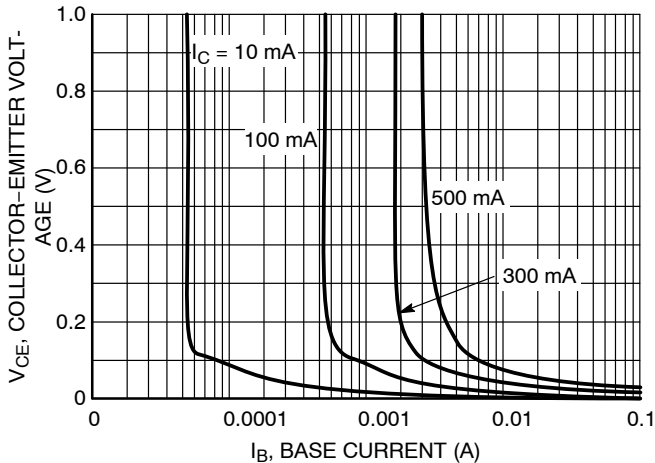


Figure 5. Saturation Region

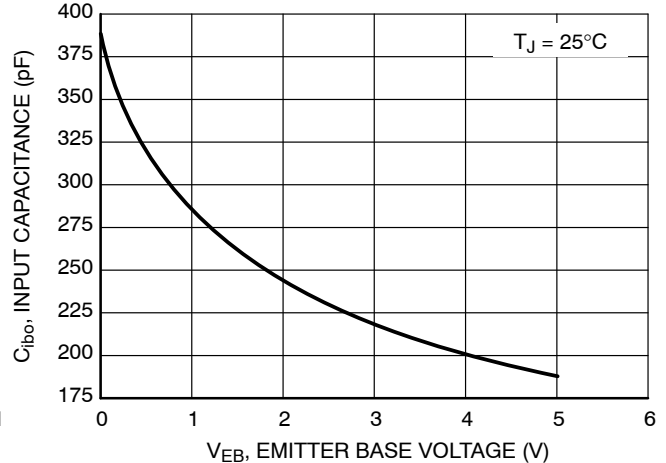
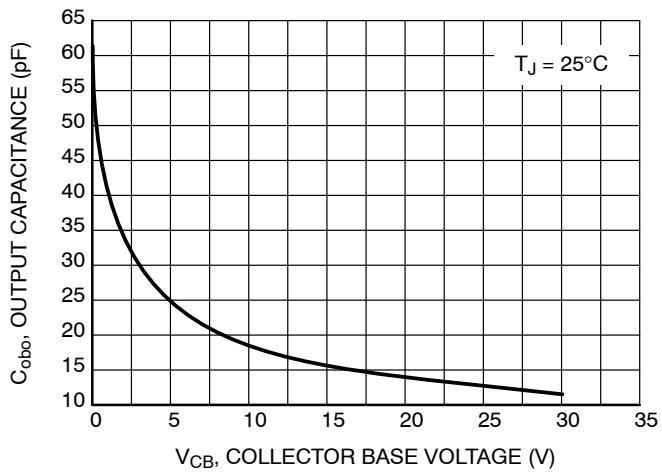
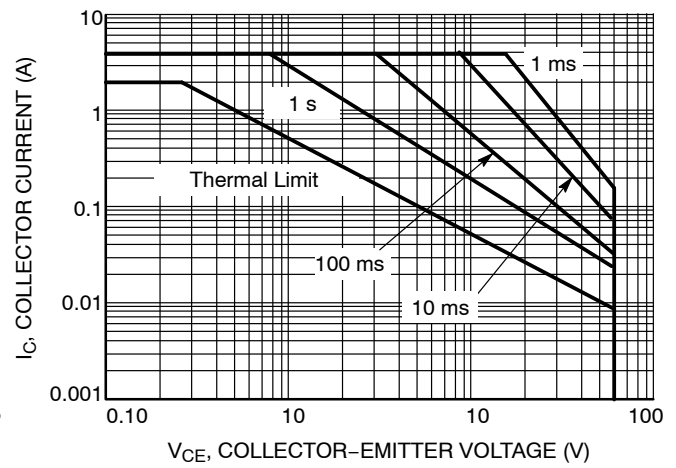


Figure 6. Input Capacitance

# NSS60201LT1G



**Figure 7. Output Capacitance**



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

# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS



**SOT-23 (TO-236)**  
CASE 318  
ISSUE AT

DATE 01 MAR 2023

SCALE 4:1



**NOTES:**

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M,1994.
2. CONTROLLING DIMENSION: MILLIMETERS
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF THE BASE MATERIAL.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.

| DIM            | MILLIMETERS |      |      | INCHES |       |       |
|----------------|-------------|------|------|--------|-------|-------|
|                | MIN.        | NOM. | MAX. | MIN.   | NOM.  | MAX.  |
| A              | 0.89        | 1.00 | 1.11 | 0.035  | 0.039 | 0.044 |
| A1             | 0.01        | 0.06 | 0.10 | 0.000  | 0.002 | 0.004 |
| b              | 0.37        | 0.44 | 0.50 | 0.015  | 0.017 | 0.020 |
| c              | 0.08        | 0.14 | 0.20 | 0.003  | 0.006 | 0.008 |
| 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 | 0.080 |
| L              | 0.30        | 0.43 | 0.55 | 0.012  | 0.017 | 0.022 |
| L1             | 0.35        | 0.54 | 0.69 | 0.014  | 0.021 | 0.027 |
| H <sub>E</sub> | 2.10        | 2.40 | 2.64 | 0.083  | 0.094 | 0.104 |
| T              | 0°          | ---  | 10°  | 0°     | ---   | 10°   |

**GENERIC MARKING DIAGRAM\***



- XXX = Specific Device Code
- M = Date Code
- = Pb-Free Package

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.



**RECOMMENDED MOUNTING 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.

**STYLES ON PAGE 2**

|                         |                        |  |
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# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS



### SOT-23 (TO-236) CASE 318 ISSUE AT

DATE 01 MAR 2023

- |   |   |   |   |   |   |
|---|---|---|---|---|---|
| STYLE 1 THRU 5:<br>CANCELLED                            | STYLE 6:<br>PIN 1. BASE<br>2. EMITTER<br>3. COLLECTOR | STYLE 7:<br>PIN 1. EMITTER<br>2. BASE<br>3. COLLECTOR       | STYLE 8:<br>PIN 1. ANODE<br>2. NO CONNECTION<br>3. CATHODE  |   |   |
| STYLE 9:<br>PIN 1. ANODE<br>2. ANODE<br>3. CATHODE      | STYLE 10:<br>PIN 1. DRAIN<br>2. SOURCE<br>3. GATE     | STYLE 11:<br>PIN 1. ANODE<br>2. CATHODE<br>3. CATHODE-ANODE | STYLE 12:<br>PIN 1. CATHODE<br>2. CATHODE<br>3. ANODE       | STYLE 13:<br>PIN 1. SOURCE<br>2. DRAIN<br>3. GATE           | STYLE 14:<br>PIN 1. CATHODE<br>2. GATE<br>3. ANODE          |
| STYLE 15:<br>PIN 1. GATE<br>2. CATHODE<br>3. ANODE      | STYLE 16:<br>PIN 1. ANODE<br>2. CATHODE<br>3. CATHODE | STYLE 17:<br>PIN 1. NO CONNECTION<br>2. ANODE<br>3. CATHODE | STYLE 18:<br>PIN 1. NO CONNECTION<br>2. CATHODE<br>3. ANODE | STYLE 19:<br>PIN 1. CATHODE<br>2. ANODE<br>3. CATHODE-ANODE | STYLE 20:<br>PIN 1. CATHODE<br>2. ANODE<br>3. GATE          |
| STYLE 21:<br>PIN 1. GATE<br>2. SOURCE<br>3. DRAIN       | STYLE 22:<br>PIN 1. RETURN<br>2. OUTPUT<br>3. INPUT   | STYLE 23:<br>PIN 1. ANODE<br>2. ANODE<br>3. CATHODE         | STYLE 24:<br>PIN 1. GATE<br>2. DRAIN<br>3. SOURCE           | STYLE 25:<br>PIN 1. ANODE<br>2. CATHODE<br>3. GATE          | STYLE 26:<br>PIN 1. CATHODE<br>2. ANODE<br>3. NO CONNECTION |
| STYLE 27:<br>PIN 1. CATHODE<br>2. CATHODE<br>3. CATHODE | STYLE 28:<br>PIN 1. ANODE<br>2. ANODE<br>3. ANODE     |   |   |   |   |

|                         |                        |   |
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