

# Low $V_{CE(sat)}$ NPN Transistors, 60 V, 1 A

## NSS60101DMR6

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 LED lighting, power management...etc. 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

- 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	$V_{CBO}$	80	Vdc
Emitter-Base Voltage	$V_{EBO}$	6	Vdc
Collector Current - Continuous	$I_C$	1	A
Collector Current - Peak	$I_{CM}$	2	A

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.

### THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance Junction-to-Ambient (Notes 1 and 2)	$R_{\theta JA}$	234	$^\circ\text{C}/\text{W}$
Total Power Dissipation per Package @ $T_A = 25^\circ\text{C}$ (Note 2)	$P_D$	0.53	W
Thermal Resistance Junction-to-Ambient (Note 3)	$R_{\theta JA}$	300	$^\circ\text{C}/\text{W}$
Power Dissipation per Transistor @ $T_A = 25^\circ\text{C}$ (Note 3)	$P_D$	0.40	W
Junction and Storage Temperature Range	$T_J, T_{stg}$	-55 to +150	$^\circ\text{C}$

1. Per JESD51-7 with 100 mm<sup>2</sup> pad area and 2 oz. Cu (Dual Operation).
2.  $P_D$  per Transistor when both are turned on is one half of Total  $P_D$  or 0.53 Watts.
3. Per JESD51-7 with 100 mm<sup>2</sup> pad area and 2 oz. Cu (Single-Operation).



ON Semiconductor®

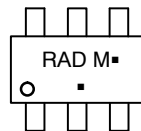
[www.onsemi.com](http://www.onsemi.com)

60 Volt, 1 Amp  
NPN Low  $V_{CE(sat)}$  Transistors



SC-74  
CASE 318F

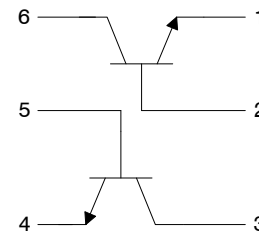
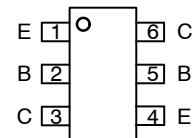
### MARKING DIAGRAM



RAD = Specific Device Code  
M = Date Code  
▪ = Pb-Free Package

(Note: Microdot may be in either location)

### PIN CONNECTIONS



### ORDERING INFORMATION

Device	Package	Shipping†
NSS60101DMR6T1G	SC-74 (Pb-Free)	3000/Tape & Reel
NSS60101DMR6T2G		
NSV60101DMR6T1G		
NSV60101DMR6T2G		

†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.

# NSS60101DMR6

**Table 1. ELECTRICAL CHARACTERISTICS** ( $T_A = 25^\circ\text{C}$  unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
<b>OFF CHARACTERISTICS</b>					
Collector–Emitter Breakdown Voltage ( $I_C = 10\text{ mA}$ , $I_B = 0$ )	$V_{(BR)CEO}$	60			V
Collector–Base Breakdown Voltage ( $I_C = 0.1\text{ mA}$ , $I_E = 0$ )	$V_{(BR)CBO}$	80			V
Emitter–Base Breakdown Voltage ( $I_E = 0.1\text{ mA}$ , $I_C = 0$ )	$V_{(BR)EBO}$	6			V
Collector Cutoff Current ( $V_{CB} = 60\text{ V}$ , $I_E = 0$ )	$I_{CBO}$			100	nA
Emitter Cutoff Current ( $V_{BE} = 5.0\text{ V}$ )	$I_{EBO}$			100	nA

## ON CHARACTERISTICS

DC Current Gain (Note 4) ( $I_C = 100\text{ mA}$ , $V_{CE} = 2\text{ V}$ ) ( $I_C = 500\text{ mA}$ , $V_{CE} = 2\text{ V}$ ) ( $I_C = 1\text{ A}$ , $V_{CE} = 2\text{ V}$ ) ( $I_C = 1\text{ mA}$ , $V_{CE} = 5\text{ V}$ ) ( $I_C = 100\text{ mA}$ , $V_{CE} = 5\text{ V}$ ) ( $I_C = 500\text{ mA}$ , $V_{CE} = 5\text{ V}$ ) ( $I_C = 1\text{ A}$ , $V_{CE} = 5\text{ V}$ )	$h_{FE}$	200 150 70 250 250 200 100	320 290 110 335 335 310 295		
Collector–Emitter Saturation Voltage (Note 4) ( $I_C = 100\text{ mA}$ , $I_B = 1\text{ mA}$ ) ( $I_C = 500\text{ mA}$ , $I_B = 50\text{ mA}$ ) ( $I_C = 1\text{ A}$ , $I_B = 50\text{ mA}$ ) ( $I_C = 1\text{ A}$ , $I_B = 100\text{ mA}$ )	$V_{CE(sat)}$		0.080 0.078 0.170 0.143	0.200 0.150 0.250 0.200	V
Base–Emitter Saturation Voltage (Note 4) ( $I_C = 500\text{ mA}$ , $I_B = 50\text{ mA}$ ) ( $I_C = 1\text{ A}$ , $I_B = 50\text{ mA}$ ) ( $I_C = 1\text{ A}$ , $I_B = 100\text{ mA}$ )	$V_{BE(sat)}$		0.87 0.91 0.94	1.50 1.50 1.60	V
Base–Emitter Turn–on Voltage (Note 4) ( $I_C = 1\text{ mA}$ , $V_{CE} = 1\text{ V}$ ) ( $I_C = 500\text{ mA}$ , $V_{CE} = 2\text{ V}$ )	$V_{BE(on)}$	0.27	0.57 0.76	0.90	V

## DYNAMIC CHARACTERISTICS

Input Capacitance ( $V_{EB} = 1\text{ V}$ , $f = 1.0\text{ MHz}$ )	$C_{ibo}$		100		pF
Output Capacitance ( $V_{CB} = 10\text{ V}$ , $f = 1.0\text{ MHz}$ )	$C_{obo}$		8.0		pF
Cutoff Frequency ( $I_C = 50\text{ mA}$ , $V_{CE} = 2.0\text{ V}$ , $f = 100\text{ MHz}$ )	$f_T$		200		MHz

## SWITCHING TIMES

Delay Time ( $V_{CC} = 10\text{ V}$ , $I_C = 0.5\text{ A}$ , $I_{B1} = 25\text{ mA}$ , $I_{B2} = -25\text{ mA}$ )	$t_d$		10		ns
ON Time ( $V_{CC} = 10\text{ V}$ , $I_C = 0.5\text{ A}$ , $I_{B1} = 25\text{ mA}$ , $I_{B2} = -25\text{ mA}$ )	$t_{on}$		28		ns
Rise Time ( $V_{CC} = 10\text{ V}$ , $I_C = 0.5\text{ A}$ , $I_{B1} = 25\text{ mA}$ , $I_{B2} = -25\text{ mA}$ )	$t_r$		18		ns
Storage Time ( $V_{CC} = 10\text{ V}$ , $I_C = 0.5\text{ A}$ , $I_{B1} = 25\text{ mA}$ , $I_{B2} = -25\text{ mA}$ )	$t_s$		622		ns
OFF Time ( $V_{CC} = 10\text{ V}$ , $I_C = 0.5\text{ A}$ , $I_{B1} = 25\text{ mA}$ , $I_{B2} = -25\text{ mA}$ )	$t_{off}$		709		ns
Fall Time ( $V_{CC} = 10\text{ V}$ , $I_C = 0.5\text{ A}$ , $I_{B1} = 25\text{ mA}$ , $I_{B2} = -25\text{ mA}$ )	$t_f$		87		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. Pulse Condition: Pulse Width = 300  $\mu\text{sec}$ , Duty Cycle  $\leq 2\%$ .

TYPICAL CHARACTERISTICS

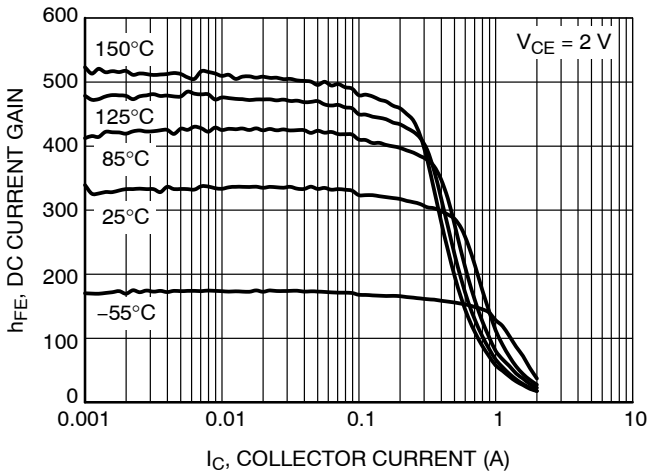


Figure 1. DC Current Gain

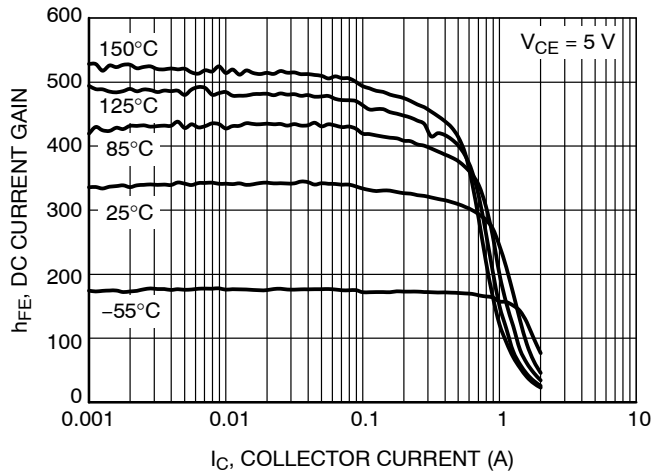


Figure 2. DC Current Gain

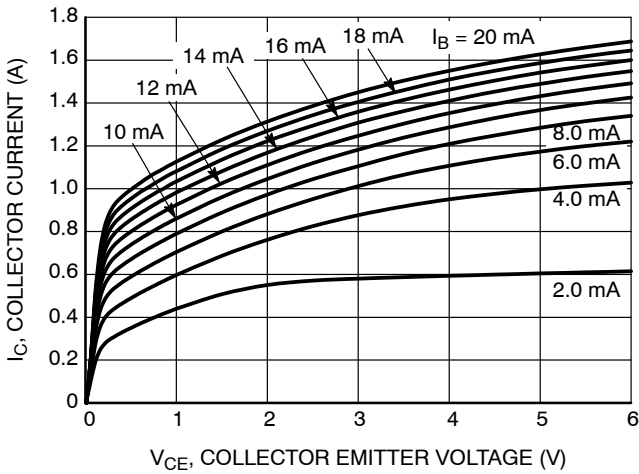


Figure 3. Collector Current as a Function of Collector Emitter Voltage

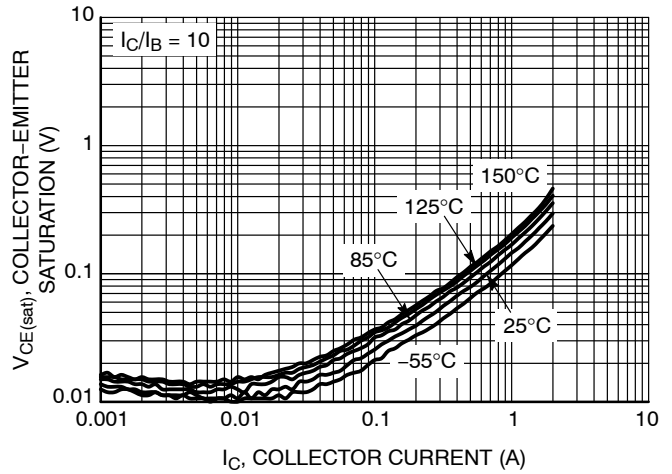


Figure 4. Collector-Emitter Saturation Voltage

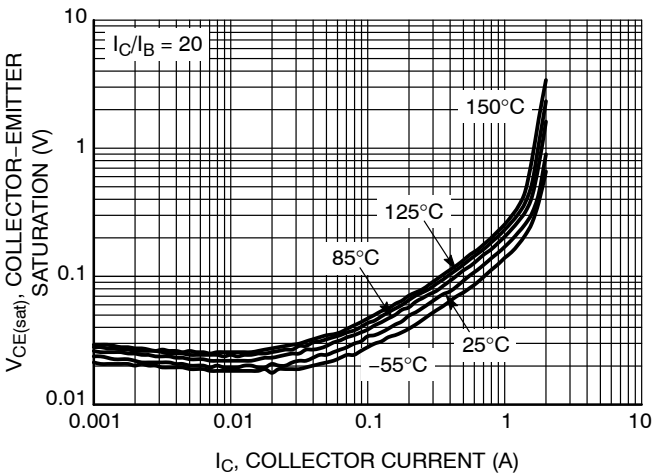


Figure 5. Collector-Emitter Saturation Voltage

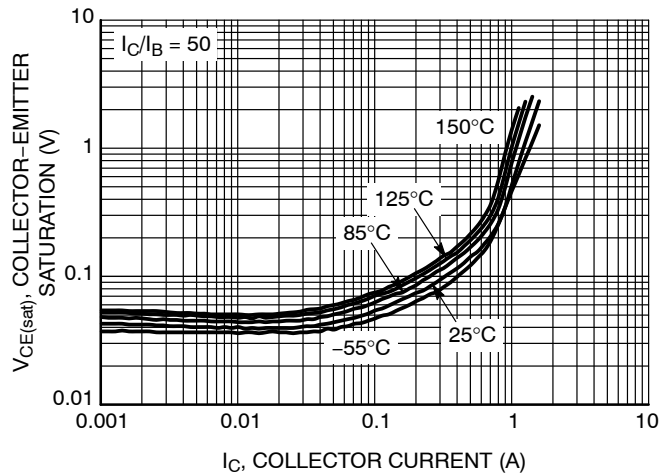


Figure 6. Collector-Emitter Saturation Voltage

TYPICAL CHARACTERISTICS

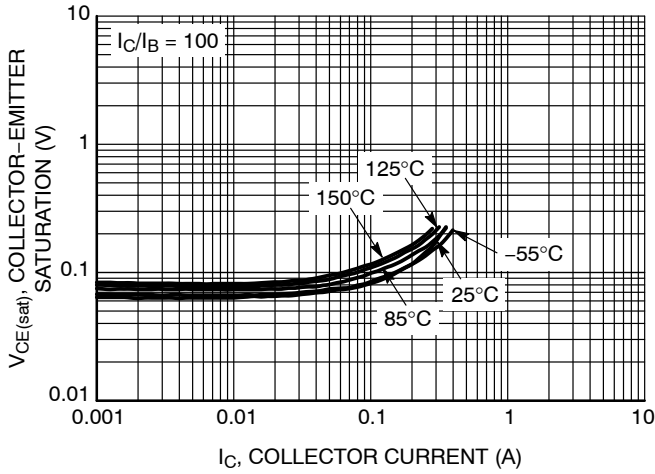


Figure 7. Collector-Emitter Saturation Voltage

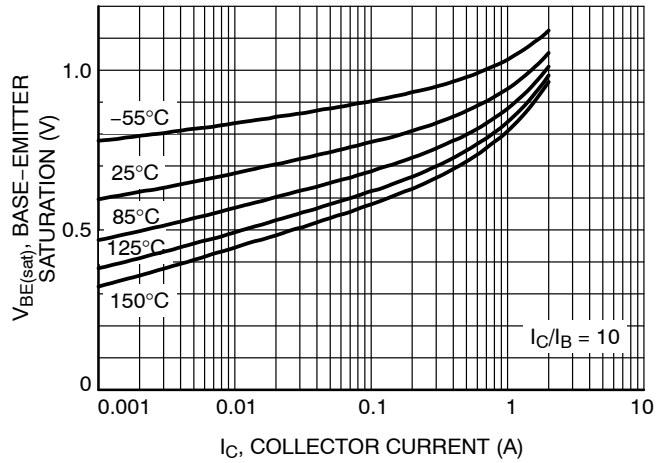


Figure 8. Base-Emitter Saturation Voltage

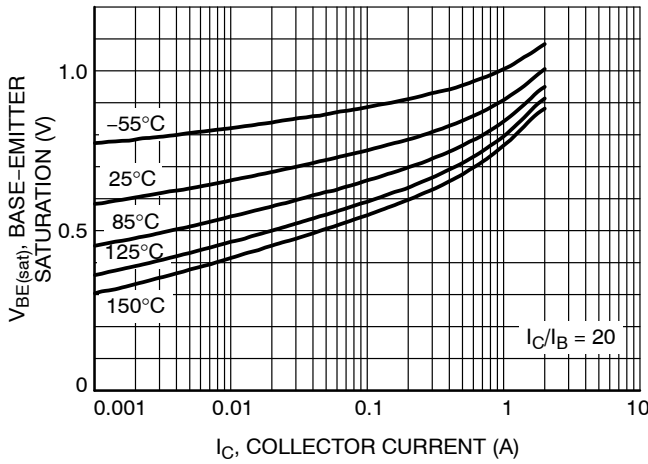


Figure 9. Base-Emitter Saturation Voltage

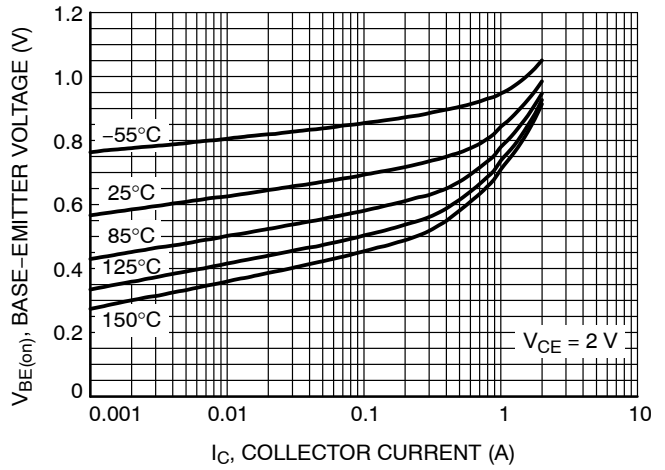


Figure 10. Base-Emitter "ON" Voltage

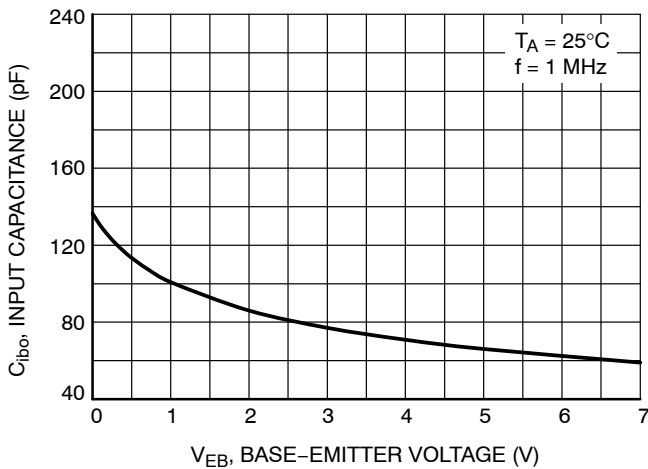


Figure 11. Input Capacitance

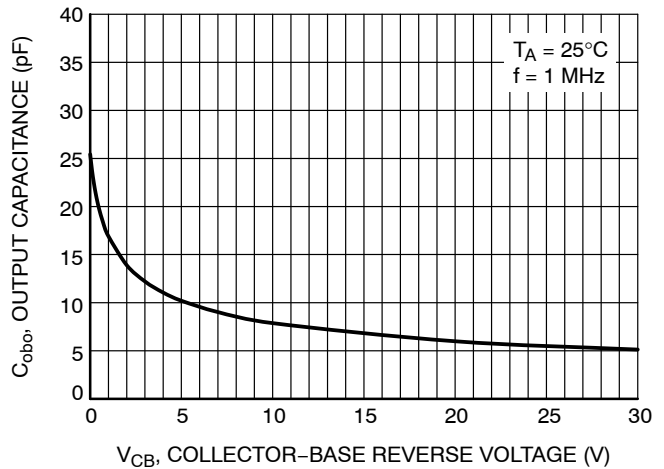


Figure 12. Output Capacitance

TYPICAL CHARACTERISTICS

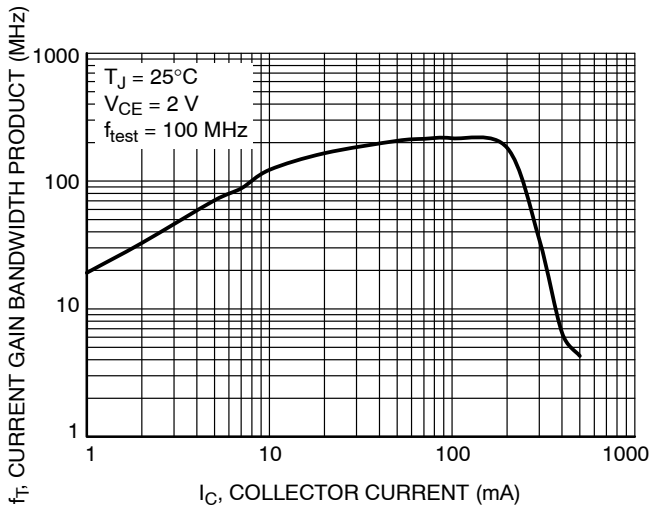


Figure 13.  $f_T$ , Current Gain Bandwidth Product

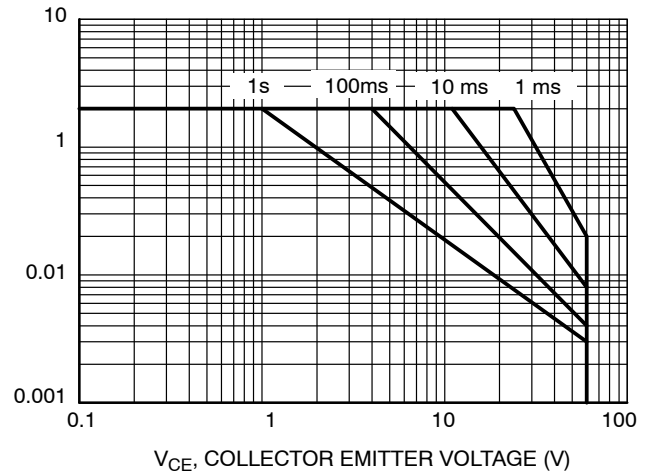


Figure 16. Safe Operating Area ( $T_A = 25^\circ\text{C}$ )

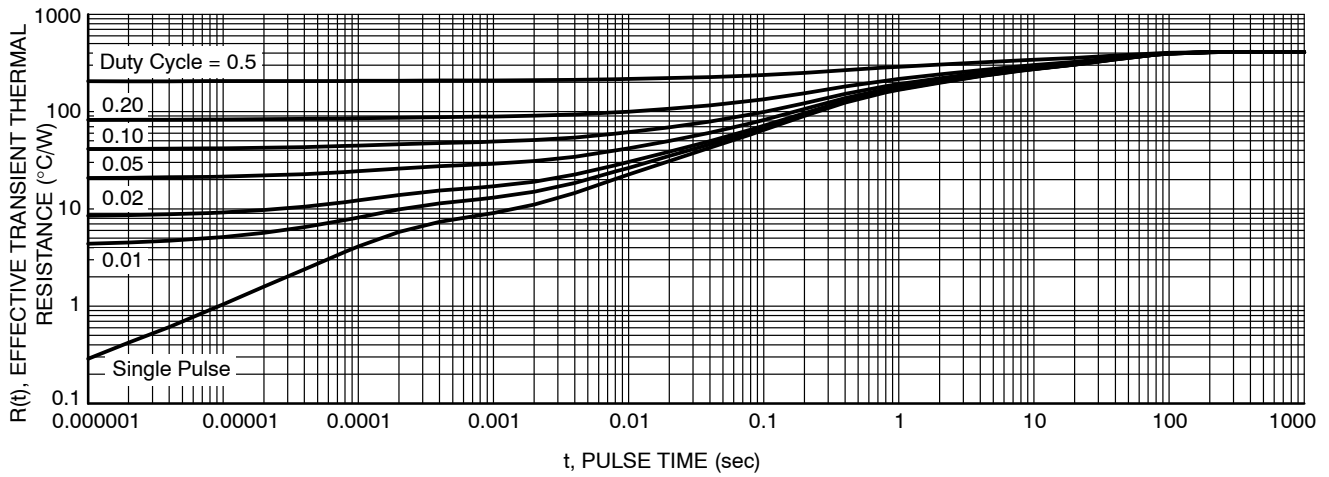


Figure 14. Thermal Resistance by Transistor

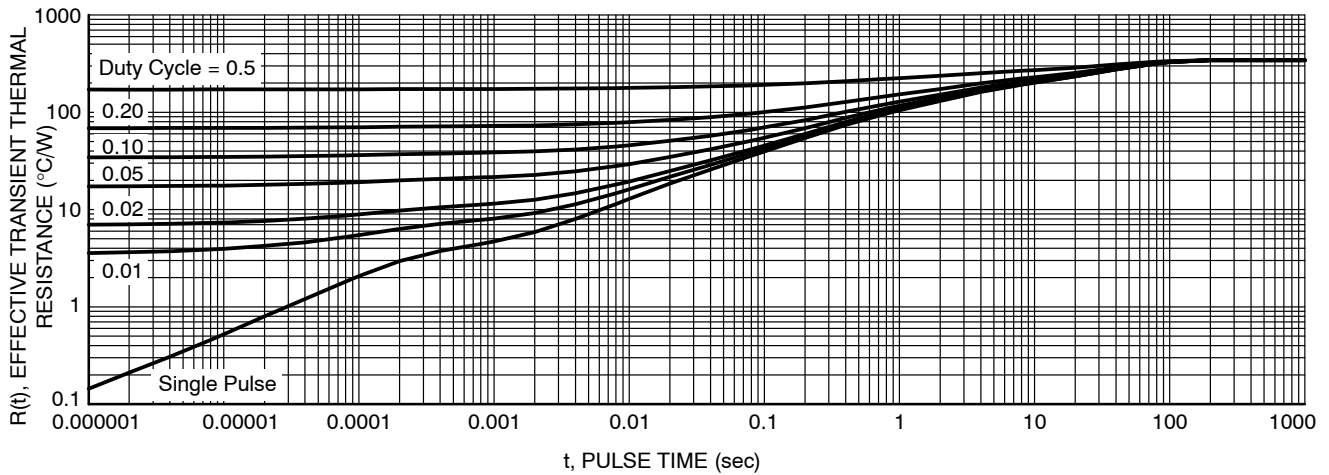


Figure 15. Thermal Resistance for Both Transistors

# 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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