

## N-CHANNEL ENHANCEMENT MODE POWER MOSFET

# SI60N03

### Product Summary

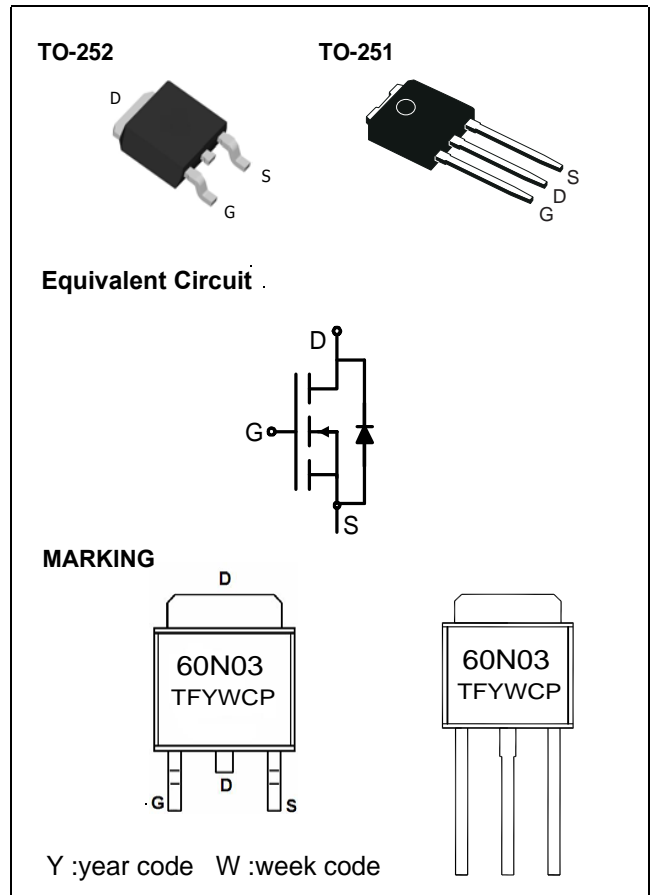
$V_{DS}$	30	V
$R_{DS(on),max}$ SMDversion	9	m $\Omega$
$I_D$	60	A

### Features

- For fast switching converters and sync. rectification
- N-channel enhancement - normal level
- Avalanche rated
- Pb-free lead plating, RoHS compliant

### Typical Applications

- Power Supplies
- Converters
- Power Motor Controls
- Bridge Circuits



**Maximum ratings, at  $T_j=25\text{ }^\circ\text{C}$ , unless otherwise specified**

Parameter	Symbol	Conditions	Value	Unit
Continuous drain current	$I_D$	$T_a = 25\text{ }^\circ\text{C}$	60	A
Pulsed drain current	$I_{D,pulse}$	$t_p = 10\mu\text{s}$	120	
Avalanche energy, single pulse	$E_{AS}$	$I_D = 60\text{A}$ $R_{GS} = 25\ \Omega$	733	mJ
Gate source voltage	$V_{GS}$		$\pm 20$	V
Power dissipation	$P_{tot}$	$T_C = 25\text{ }^\circ\text{C}$	75	W
Operating and storage temperature	$T_j, T_{stg}$		-55-150	$^\circ\text{C}$
Maximum Lead Temperature for Soldering Purposes, 1/8" from case for 10 seconds	$T_L$		260	$^\circ\text{C}$
Thermal Resistance				$^\circ\text{C/W}$
- Junction-to-Case	$R_{\theta JC}$		1.65	
- Junction-to-Ambient (Note 1)	$R_{\theta JA}$		67	
- Junction-to-Ambient (Note 2)	$R_{\theta JA}$		120	

1. When surface mounted to an FR4 board using 1" pad size, (Cu Area 1.127 in<sup>2</sup>).
2. When surface mounted to an FR4 board using the minimum recommended pad size, (Cu Area 0.412 in<sup>2</sup>).

\*Chip current capability limited by package.

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

Characteristic	Symbol	Min	Typ	Max	Unit
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#### OFF CHARACTERISTICS

Drain-to-Source Breakdown Voltage (Note 3) (V <sub>GS</sub> = 0 Vdc, I <sub>D</sub> = 250 μAdc) Temperature Coefficient (Positive)	V <sub>(BR)DSS</sub>	30		-	Vdc
Zero Gate Voltage Drain Current (V <sub>GS</sub> = 0 Vdc, V <sub>DS</sub> = 24 Vdc)	I <sub>DSS</sub>	-	-	50	nAdc
Gate-Body Leakage Current (V <sub>GS</sub> = ±20 Vdc, V <sub>DS</sub> = 0 Vdc)	I <sub>GSS</sub>	-	-	±100	nAdc

#### ON CHARACTERISTICS (Note 3)

Gate Threshold Voltage (Note 3) (V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μAdc) Threshold Temperature Coefficient (Negative)	V <sub>GS(th)</sub>	1.0	1.9	2.0	Vdc mV/°C
Static Drain-to-Source On-Resistance (Note 3) (V <sub>GS</sub> = 10 Vdc, I <sub>D</sub> = 35 Adc) (V <sub>GS</sub> = 4.5 Vdc, I <sub>D</sub> = 20 Adc)	R <sub>DS(on)</sub>			9.0 15.0	mΩ
Forward Transconductance (V <sub>DS</sub> = 15 Vdc, I <sub>D</sub> = 10 Adc) (Note 3)	g <sub>FS</sub>	-	20	-	Mhos

#### DYNAMIC CHARACTERISTICS

Input Capacitance	(V <sub>DS</sub> = 24 Vdc, V <sub>GS</sub> = 0 Vdc, f = 1.0 MHz)	C <sub>iss</sub>	-	2150	-	pF
Output Capacitance		C <sub>oss</sub>	-	680	-	
Transfer Capacitance		C <sub>rss</sub>	-	260	-	

#### SWITCHING CHARACTERISTICS (Note 4)

Turn-On Delay Time	(V <sub>DD</sub> = 15 Vdc, I <sub>D</sub> = 15 Adc, V <sub>GS</sub> = 10 Vdc, R <sub>G</sub> = 3.3 Ω)	t <sub>d(on)</sub>	-	10	-	ns
Rise Time		t <sub>r</sub>	-	18	-	
Turn-Off Delay Time		t <sub>d(off)</sub>	-	32	-	
Fall Time		t <sub>f</sub>	-	15	-	
Gate Charge	(V <sub>DS</sub> = 24 Vdc, I <sub>D</sub> = 15 Adc, V <sub>GS</sub> = 4.5 Vdc) (Note 3)	Q <sub>T</sub>	-	30	-	nC
		Q <sub>1</sub>	-	6.5	-	
		Q <sub>2</sub>	-	18.4	-	

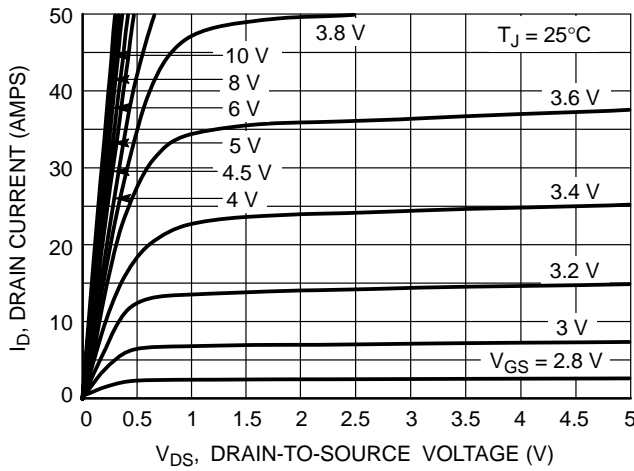
#### SOURCE-DRAIN DIODE CHARACTERISTICS

Forward On-Voltage (I <sub>S</sub> = 2.3 Adc, V <sub>GS</sub> = 0 Vdc) (Note 3) (I <sub>S</sub> = 30 Adc, V <sub>GS</sub> = 0 Vdc) (I <sub>S</sub> = 2.3 Adc, V <sub>GS</sub> = 0 Vdc, T <sub>J</sub> = 150°C)	V <sub>SD</sub>	-	0.75	1.0	Vdc	
Reverse Recovery Time	(I <sub>S</sub> = 2.3 Adc, V <sub>GS</sub> = 0 Vdc, dI <sub>S</sub> /dt = 100 A/μs) (Note 3)	t <sub>rr</sub>	-	39	-	ns
		t <sub>a</sub>	-	21	-	
		t <sub>b</sub>	-	18	-	
Reverse Recovery Stored Charge	Q <sub>rr</sub>	-	0.043	-	μC	

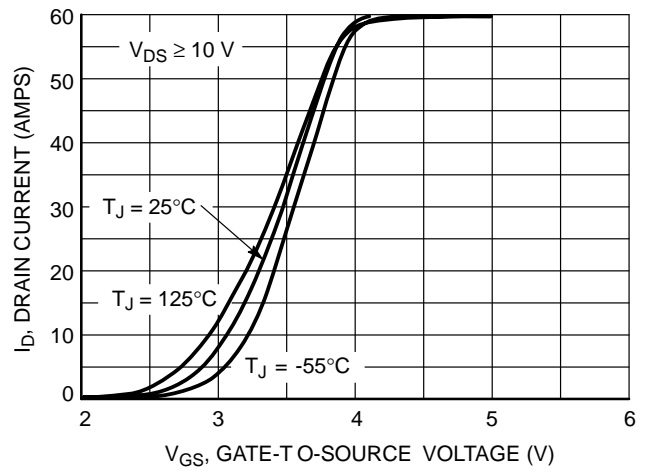
3. Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2%.
4. Switching characteristics are independent of operating junction temperatures.

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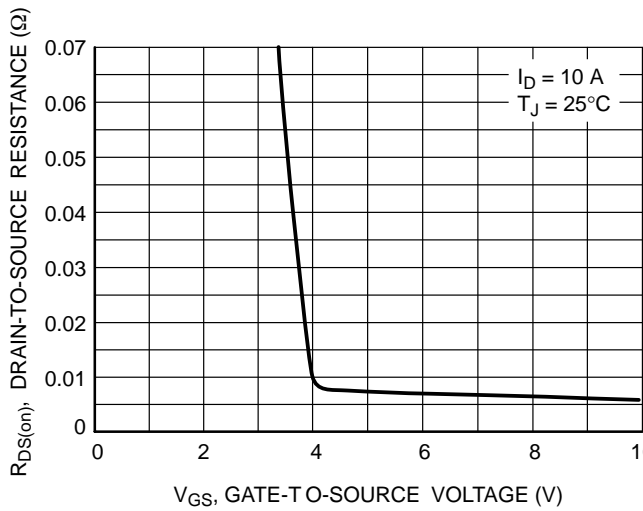
## SI60N03



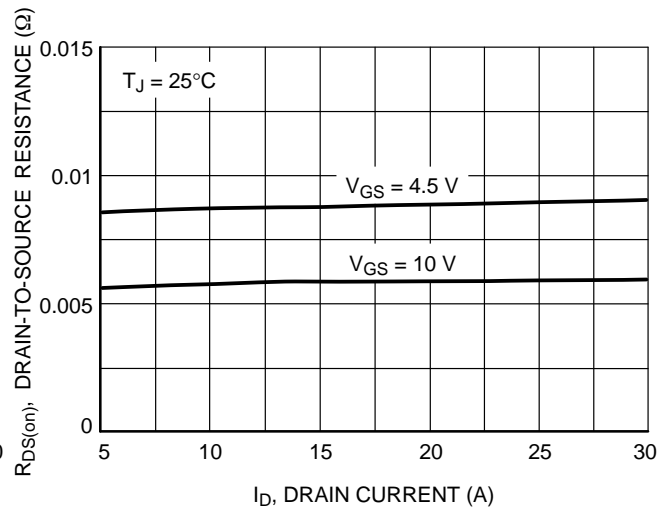
**Figure 1. On-Region Characteristics**



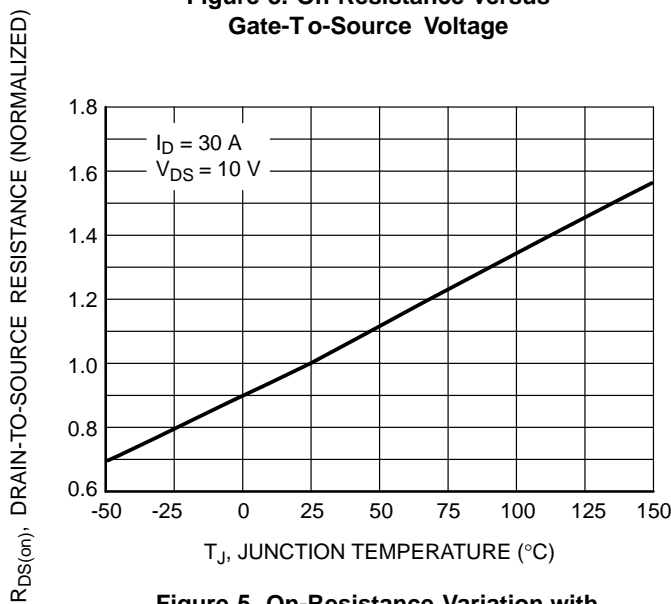
**Figure 2. Transfer Characteristics**



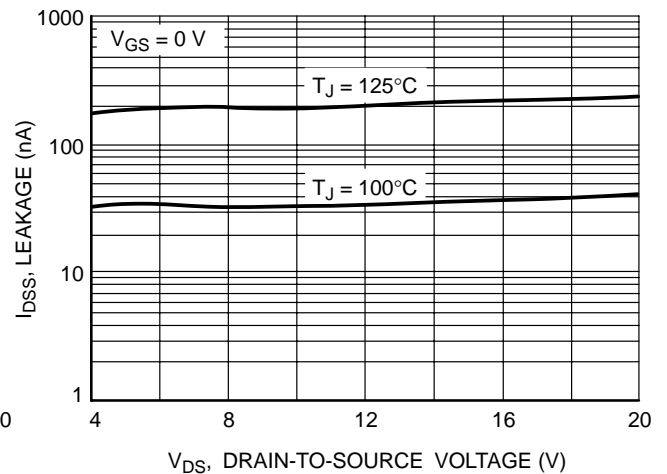
**Figure 3. On-Resistance versus Gate-to-Source Voltage**



**Figure 4. On-Resistance versus Drain Current and Gate Voltage**



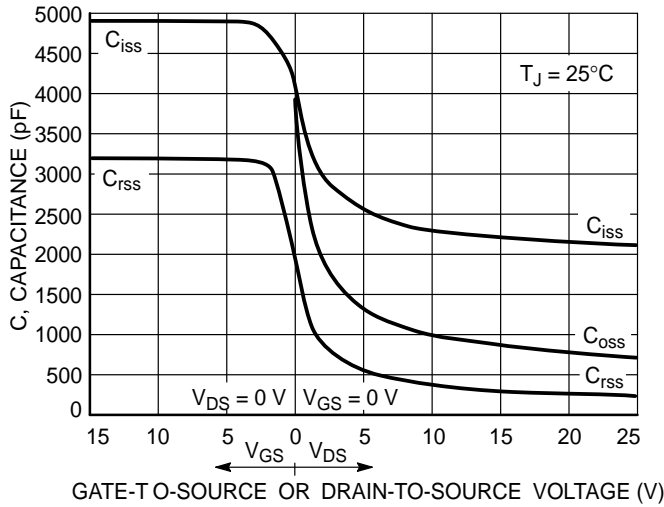
**Figure 5. On-Resistance Variation with Temperature**



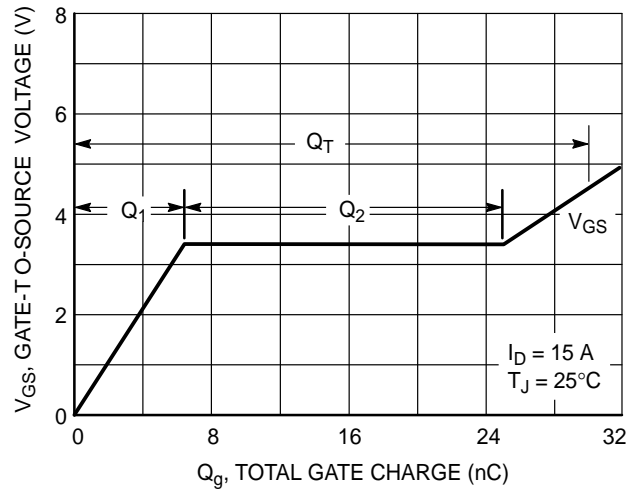
**Figure 6. Drain-to-Source Leakage Current versus Voltage**

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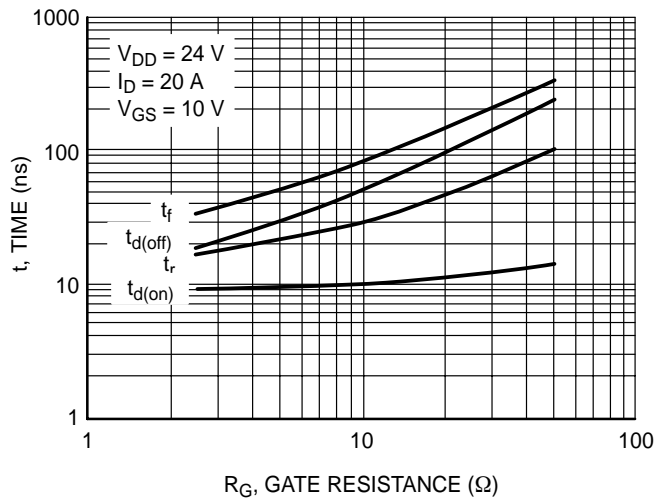
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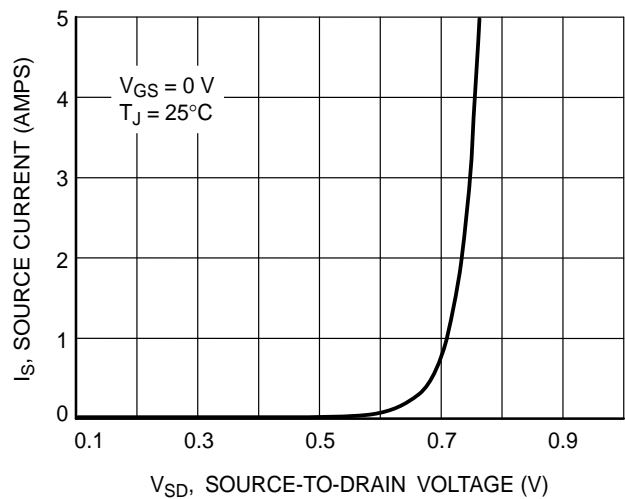
**Figure 7. Capacitance Variation**



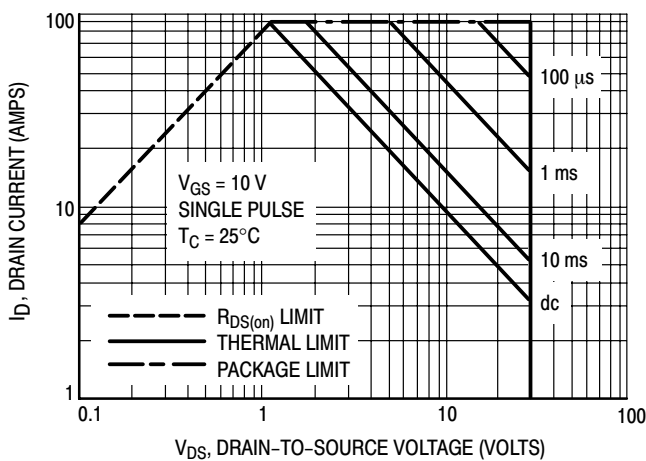
**Figure 8. Gate-to-Source and Drain-to-Source Voltage versus Total Charge**



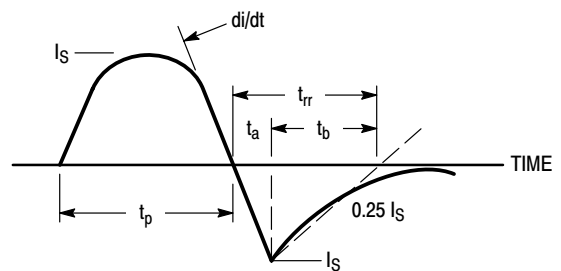
**Figure 9. Resistive Switching Time Variation versus Gate Resistance**



**Figure 10. Diode Forward Voltage versus Current**



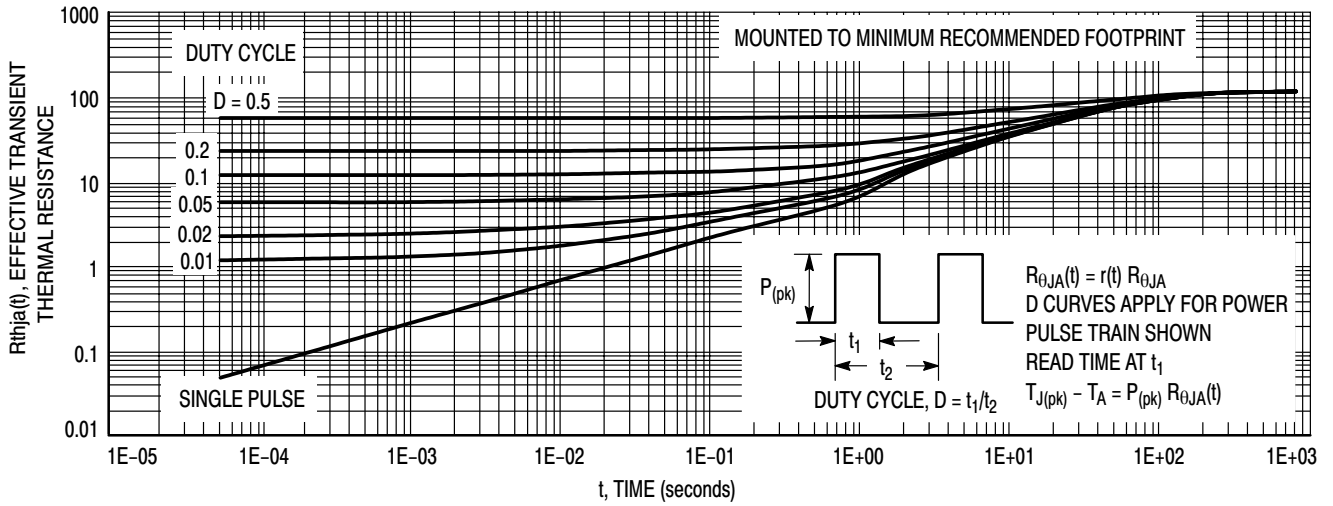
**Figure 11. Maximum Rated Forward Biased Safe Operating Area**



**Figure 12. Diode Reverse Recovery Waveform**

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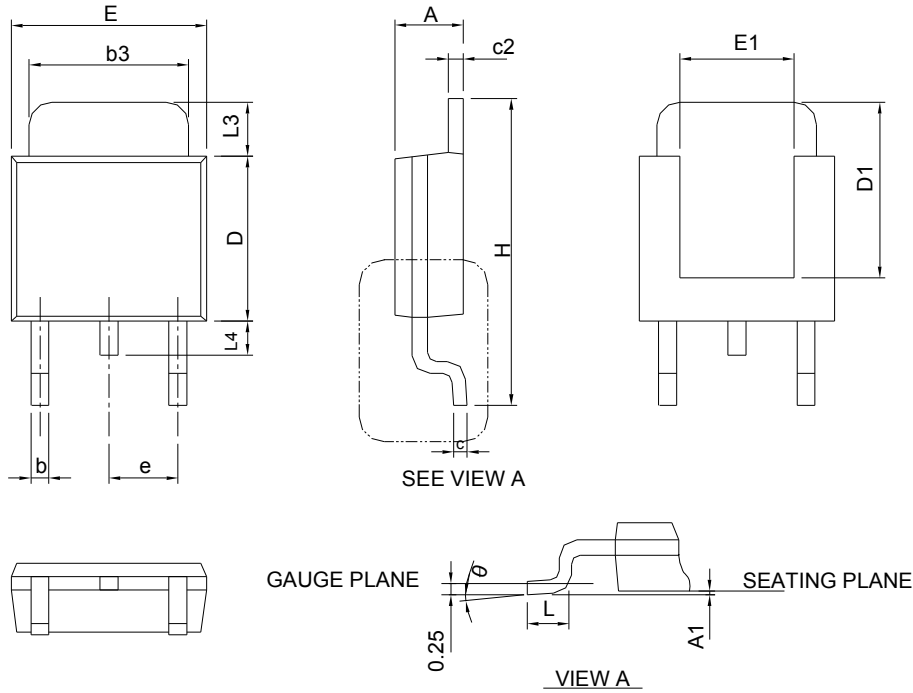
**Figure 13. Thermal Response - Various Duty Cycles**

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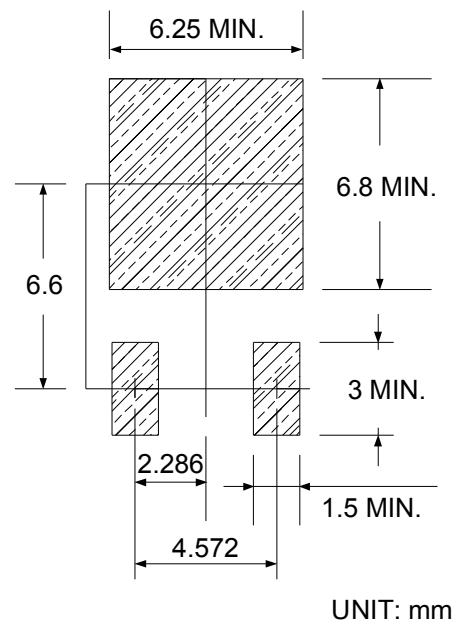
### Package Information

TO-252



DIMENSIONS	TO-252			
	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	2.18	2.39	0.086	0.094
A1		0.13		0.005
b	0.50	0.89	0.020	0.035
b3	4.95	5.46	0.195	0.215
c	0.46	0.61	0.018	0.024
c2	0.46	0.89	0.018	0.035
D	5.33	6.22	0.210	0.245
D1	4.57	6.00	0.180	0.236
E	6.35	6.73	0.250	0.265
E1	3.81	6.00	0.150	0.236
e	2.29 BSC		0.090 BSC	
H	9.40	10.41	0.370	0.410
L	0.90	1.78	0.035	0.070
L3	0.89	2.03	0.035	0.080
L4		1.02		0.040
θ	0°	8°	0°	8°

### RECOMMENDED LAND PATTERN

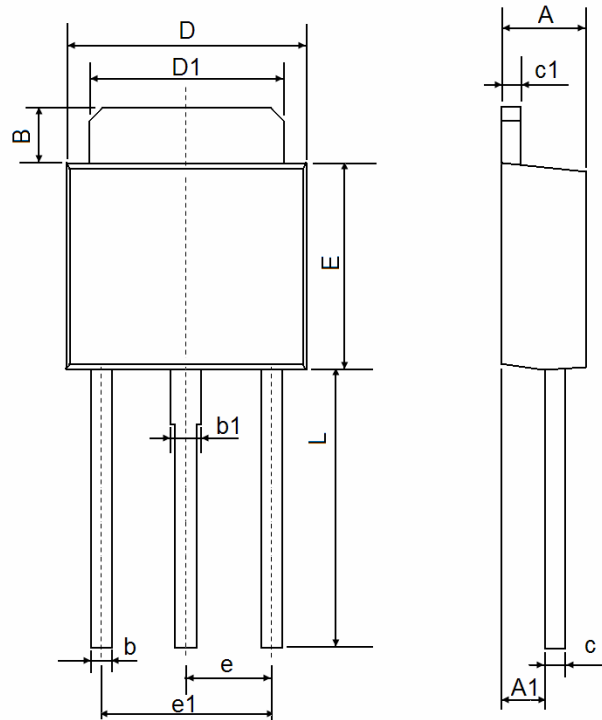


Note : Follow JEDEC TO-252 .

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### TO-251 Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	2.200	2.400	0.087	0.094
A1	1.050	1.350	0.042	0.054
B	0.700	1.000	0.028	0.040
b	0.500	0.700	0.020	0.028
b1	0.700	0.900	0.028	0.035
c	0.430	0.580	0.017	0.023
c1	0.430	0.580	0.017	0.023
D	6.350	6.650	0.250	0.262
D1	5.200	5.400	0.205	0.213
E	5.400	6.000	0.213	0.237
e	2.300 TYP.		0.091 TYP.	
e1	4.500	4.700	0.177	0.185
L	4.900	9.400	0.194	0.372

### Notes

1. All dimensions are in millimeters.
2. Tolerance  $\pm 0.10\text{mm}$  (4 mil) unless otherwise specified
3. Package body sizes exclude mold flash and gate burrs. Mold flash at the non-lead sides should be less than 5 mils.
4. Dimension L is measured in gauge plane.
5. Controlling dimension is millimeter, converted inch dimensions are not necessarily exact