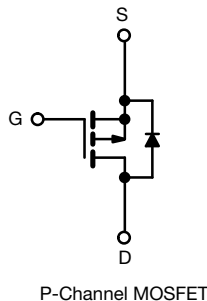
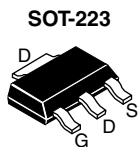


## Power MOSFET



P-Channel MOSFET

### FEATURES

- Surface-mount
- Available in tape and reel
- Dynamic dV/dt rating
- Repetitive avalanche rated
- P-channel
- Fast switching
- Ease of paralleling
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**  
Available

### DESCRIPTION

Third generation power MOSFETs from Vishay provide the designer with the best combination of fast switching, ruggedized device design, low on-resistance, and cost-effectiveness.

The SOT-223 package is designed for surface-mounting using vapor phase, infrared, or wave soldering techniques. Its unique package design allows for easy automatic pick-and-place as with other SOT or SOIC packages but has the added advantage of improved thermal performance due to an enlarged tab for heatsinking. Power dissipation of greater than 1.25 W is possible in a typical surface mount application.

Marking code: FE

PRODUCT SUMMARY		
V <sub>DS</sub> (V)	-60	
R <sub>DS(on)</sub> (Ω)	V <sub>GS</sub> = -10 V	0.50
Q <sub>g</sub> (Max.) (nC)	12	
Q <sub>gs</sub> (nC)	3.8	
Q <sub>gd</sub> (nC)	5.1	
Configuration	Single	

ORDERING INFORMATION	
Package	SOT-223
Lead (Pb)-free and halogen-free	SiHFL9014TR-GE3 IRFL9014TRPbF-BE3 <sup>a, b</sup>
Lead (Pb)-free	IRFL9014TRPbF <sup>a</sup>

#### Notes

- See device orientation
- "-BE3" denotes alternate manufacturing location

ABSOLUTE MAXIMUM RATINGS (T <sub>C</sub> = 25 °C, unless otherwise noted)				
PARAMETER	SYMBOL		LIMIT	UNIT
Drain-source voltage	V <sub>DS</sub>		-60	V
Gate-source voltage	V <sub>GS</sub>		± 20	
Continuous drain current	V <sub>GS</sub> at -10 V	T <sub>C</sub> = 25 °C	-1.8	A
		T <sub>C</sub> = 100 °C	-1.1	
Pulsed drain current <sup>a</sup>	I <sub>DM</sub>		-14	
Linear derating factor			0.025	W/°C
Linear derating factor (PCB mount) <sup>e</sup>			0.017	
Single pulse avalanche energy <sup>b</sup>	E <sub>AS</sub>		140	mJ
Avalanche current <sup>a</sup>	I <sub>AR</sub>		-1.8	A
Repetitive avalanche energy <sup>a</sup>	E <sub>AR</sub>		0.31	mJ
Maximum power dissipation	T <sub>C</sub> = 25 °C		3.1	W
Maximum power dissipation (PCB mount) <sup>e</sup>	T <sub>A</sub> = 25 °C		2.0	
Peak diode recovery dv/dt <sup>c</sup>	dV/dt		-4.5	V/ns
Operating junction and storage temperature range	T <sub>J</sub> , T <sub>stg</sub>		-55 to +150	°C
Soldering recommendations (peak temperature) <sup>d</sup>	For 10 s		300	

#### Notes

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11)
- V<sub>DD</sub> = - 25 V, starting T<sub>J</sub> = 25 °C, L = 50 mH, R<sub>g</sub> = 25 Ω, I<sub>AS</sub> = - 1.8 A (see fig. 12)
- I<sub>SP</sub> ≤ - 6.7 A, dI/dt ≤ 90 A/μs, V<sub>DD</sub> ≤ V<sub>DS</sub>, T<sub>J</sub> ≤ 150 °C
- 1.6 mm from case
- When mounted on 1" square PCB (FR-4 or G-10 material)

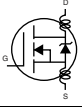

**THERMAL RESISTANCE RATINGS**

PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum junction-to-ambient (PCB mount) <sup>a</sup>	$R_{thJA}$	-	60	°C/W
Maximum junction-to-case (drain)	$R_{thJC}$	-	40	

**Note**

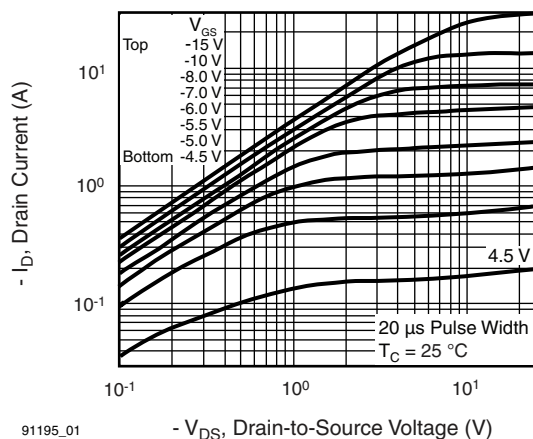
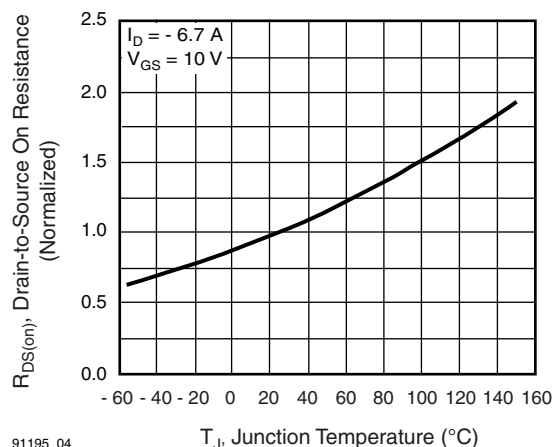
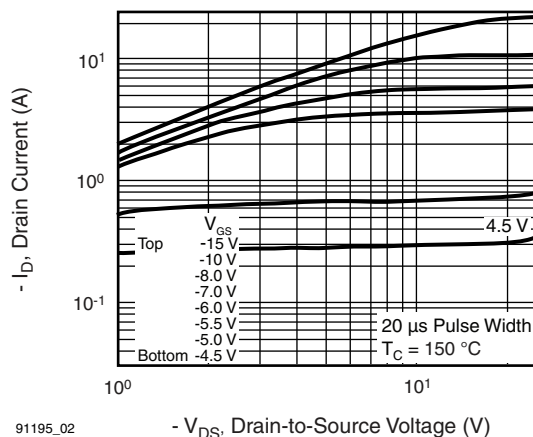
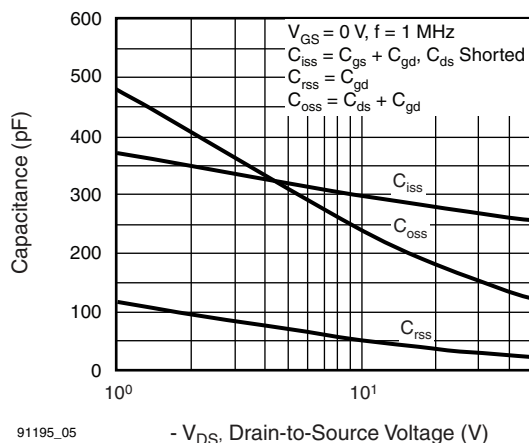
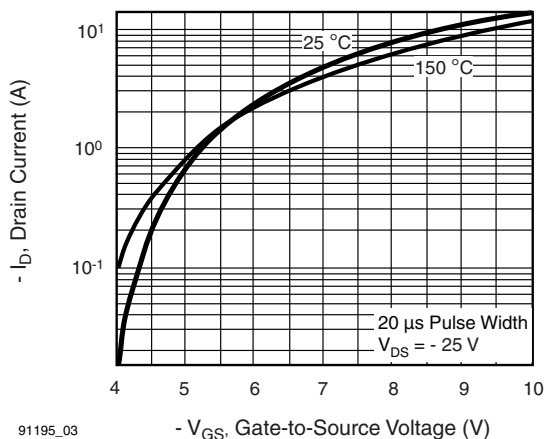
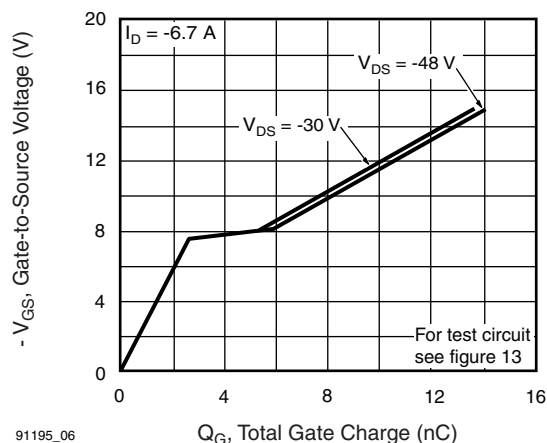
a. When mounted on 1" square PCB (FR-4 or G-10 material)

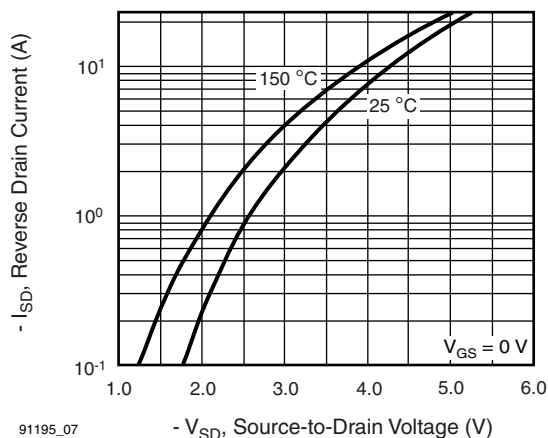
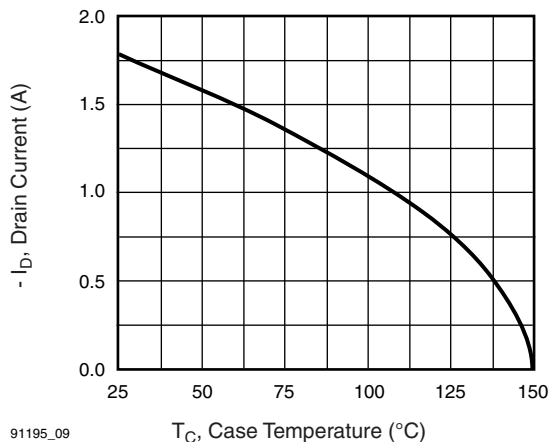
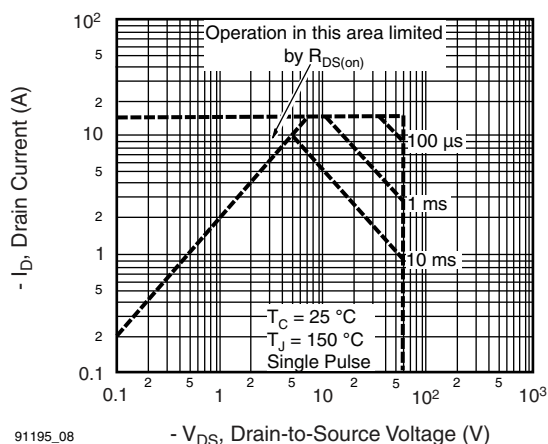
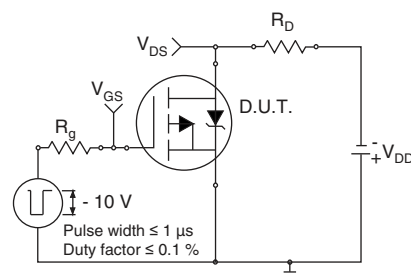
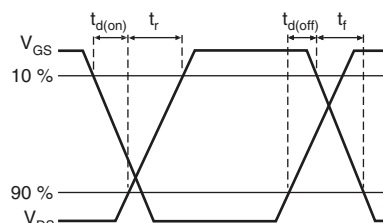
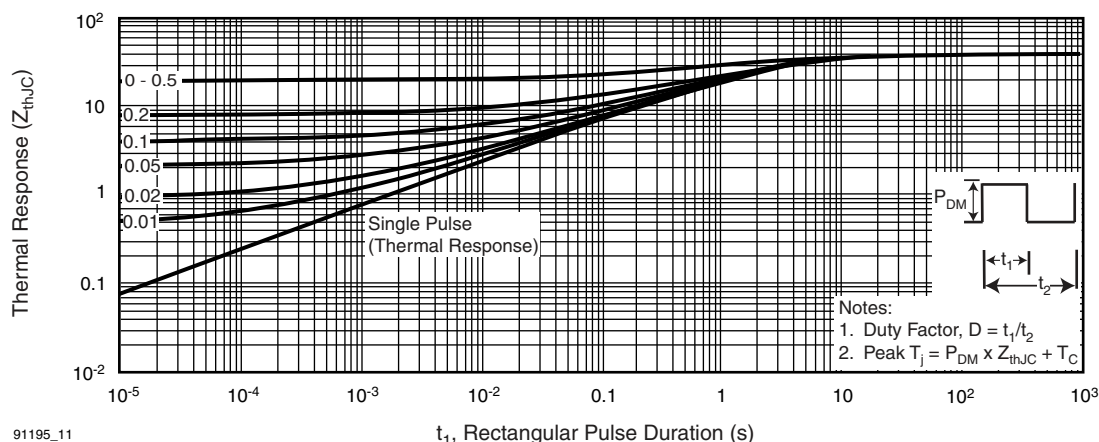
**SPECIFICATIONS** ( $T_J = 25^\circ\text{C}$ , unless otherwise noted)

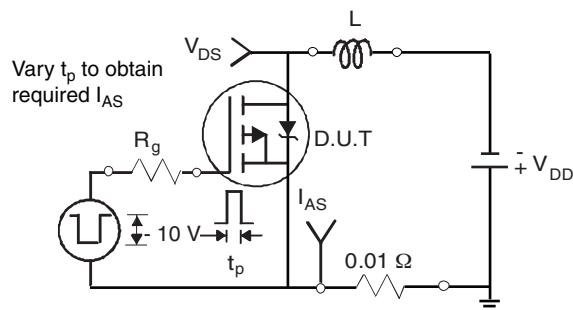
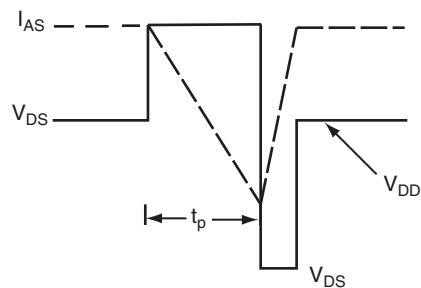
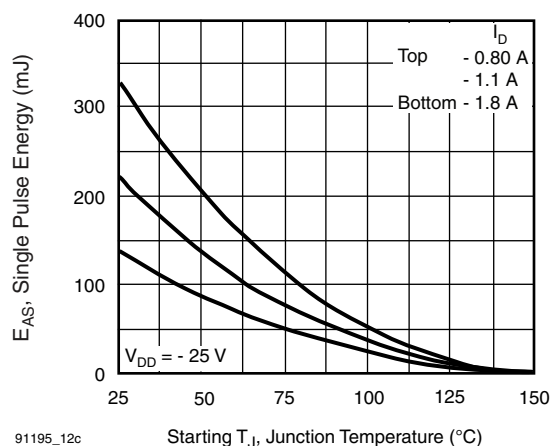
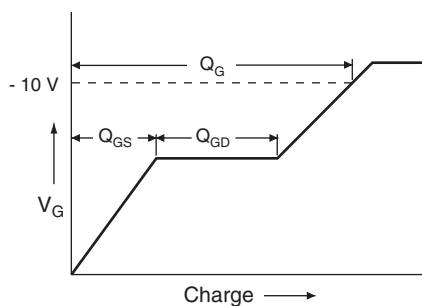
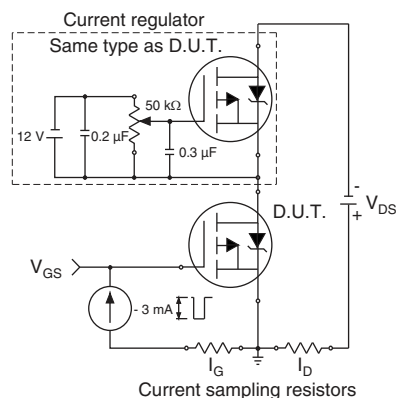
PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT		
Static									
Drain-source breakdown voltage	V <sub>DS</sub>	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA		-60	-	-	V		
V <sub>DS</sub> temperature coefficient	ΔV <sub>DS</sub> /T <sub>J</sub>	Reference to 25 °C, I <sub>D</sub> = 1 mA		-	-0.059	-	V/°C		
Gate-source threshold voltage	V <sub>GS(th)</sub>	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA		-2.0	-	-4.0	V		
Gate-source leakage	I <sub>GSS</sub>	V <sub>GS</sub> = ± 20 V		-	-	± 100	nA		
Zero gate voltage drain current	I <sub>DSS</sub>	V <sub>DS</sub> = -60 V, V <sub>GS</sub> = 0 V		-	-	- 100	μA		
		V <sub>DS</sub> = -48 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 125 °C		-	-	-500			
Drain-source on-state resistance	R <sub>DS(on)</sub>	V <sub>GS</sub> = -10 V	I <sub>D</sub> = 1.1 A <sup>b</sup>	-	-	0.50	Ω		
Forward transconductance	g <sub>fs</sub>	V <sub>DS</sub> = - 25 V, I <sub>D</sub> = 1.1 A <sup>b</sup>		1.3	-	-	S		
Dynamic									
Input capacitance	C <sub>iss</sub>	V <sub>GS</sub> = 0 V, V <sub>DS</sub> = 25 V, f = 1.0 MHz, see fig. 5		-	270	-	pF		
Output capacitance	C <sub>oss</sub>			-	170	-			
Reverse transfer capacitance	C <sub>rss</sub>			-	31	-			
Total gate charge	Q <sub>g</sub>	V <sub>GS</sub> = - 10 V	I <sub>D</sub> = - 6.7 A, V <sub>DS</sub> = - 48 V, see fig. 6 and 13 <sup>b</sup>	-	-	12	nC		
Gate-source charge	Q <sub>gs</sub>			-	-	3.8			
Gate-drain charge	Q <sub>gd</sub>			-	-	5.1			
Turn-on delay time	t <sub>d(on)</sub>	V <sub>DD</sub> = - 30 V, I <sub>D</sub> = - 6.7 A, R <sub>g</sub> = 24 Ω, R <sub>D</sub> = 4.0 Ω, see fig. 10 <sup>b</sup>		-	11	-	ns		
Rise time	t <sub>r</sub>			-	63	-			
Turn-off delay time	t <sub>d(off)</sub>			-	9.6	-			
Fall time	t <sub>f</sub>			-	31	-			
Internal drain inductance	L <sub>D</sub>	Between lead, 6 mm (0.25") from package and center of die contact				-	4.0	-	nH
Internal source inductance	L <sub>S</sub>					-	6.0	-	
Drain-Source Body Diode Characteristics									
Continuous source-drain diode current	I <sub>S</sub>	MOSFET symbol showing the integral reverse p - n junction diode				-	-	- 1.8	A
Pulsed diode forward current <sup>a</sup>	I <sub>SM</sub>					-	-	- 14	
Body diode voltage	V <sub>SD</sub>	T <sub>J</sub> = 25 °C, I <sub>S</sub> = - 1.8 A, V <sub>GS</sub> = 0 V <sup>b</sup>		-	-	- 5.5	V		
Body diode reverse recovery time	t <sub>rr</sub>	T <sub>J</sub> = 25 °C, I <sub>F</sub> = - 6.7 A, dI/dt = 100 A/μs <sup>b</sup>		-	80	160	ns		
Body diode reverse recovery charge	Q <sub>rr</sub>			-	0.096	0.19	μC		
Forward turn-on time	t <sub>on</sub>	Intrinsic turn-on time is negligible (turn-on is dominated by L <sub>S</sub> and L <sub>D</sub> )							

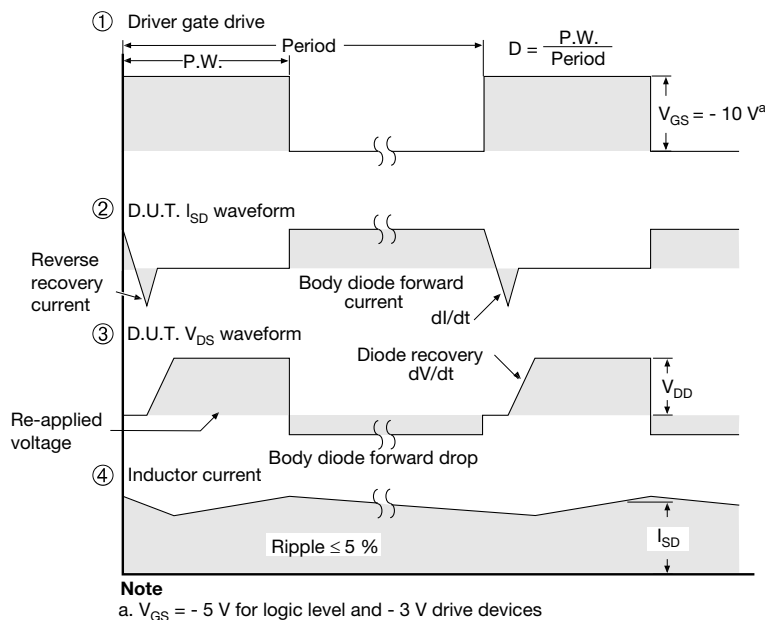
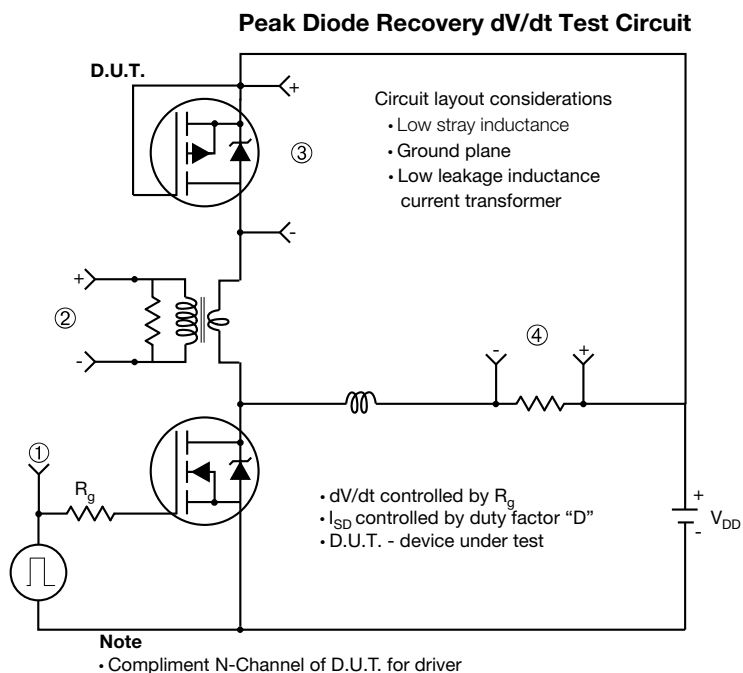
**Notes**

- a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11)  
b. Pulse width  $\leq 300\text{ }\mu\text{s}$ ; duty cycle  $\leq 2\%$

**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)

**Fig. 1 - Typical Output Characteristics,  $T_C = 25^\circ\text{C}$** 

**Fig. 4 - Normalized On-Resistance vs. Temperature**

**Fig. 2 - Typical Output Characteristics,  $T_C = 150^\circ\text{C}$** 

**Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage**

**Fig. 3 - Typical Transfer Characteristics**

**Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage**


**Fig. 7 - Typical Source-Drain Diode Forward Voltage**

**Fig. 9 - Maximum Drain Current vs. Case Temperature**

**Fig. 8 - Maximum Safe Operating Area**

**Fig. 10a - Switching Time Test Circuit**

**Fig. 10b - Switching Time Waveforms**

**Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case**

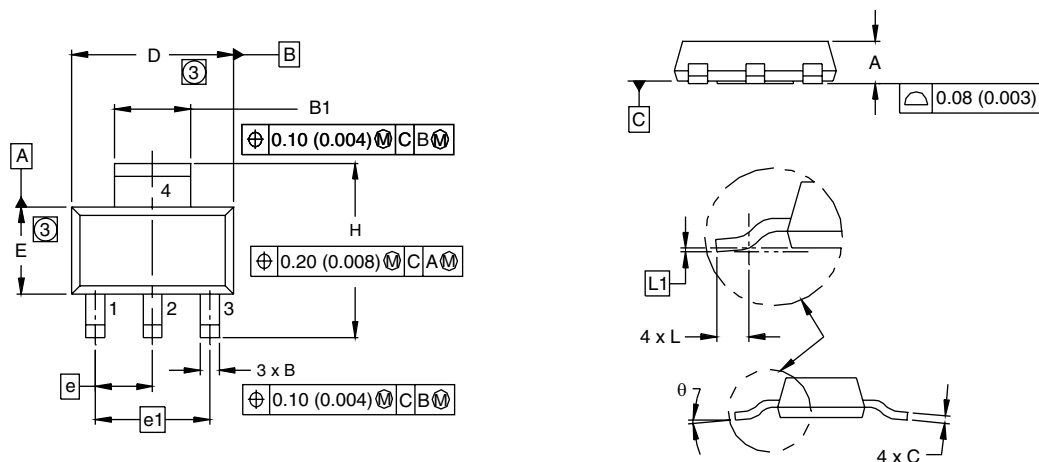

**Fig. 12a - Unclamped Inductive Test Circuit**

**Fig. 12b - Unclamped Inductive Waveforms**

**Fig. 12c - Maximum Avalanche Energy vs. Drain Current**

**Fig. 13a - Basic Gate Charge Waveform**

**Fig. 13b - Gate Charge Test Circuit**



**Fig. 14 - For P-Channel**

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## SOT-223 (HIGH VOLTAGE)



DIM.	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	1.55	1.80	0.061	0.071
B	0.65	0.85	0.026	0.033
B1	2.95	3.15	0.116	0.124
C	0.25	0.35	0.010	0.014
D	6.30	6.70	0.248	0.264
E	3.30	3.70	0.130	0.146
e	2.30 BSC		0.0905 BSC	
e1	4.60 BSC		0.181 BSC	
H	6.71	7.29	0.264	0.287
L	0.91	-	0.036	-
L1	0.061 BSC		0.0024 BSC	
θ	-	10°	-	10°
ECN: S-82109-Rev. A, 15-Sep-08 DWG: 5969				

### Notes

1. Dimensioning and tolerancing per ASME Y14.5M-1994.
2. Dimensions are shown in millimeters (inches).
3. Dimension do not include mold flash.
4. Outline conforms to JEDEC outline TO-261AA.



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