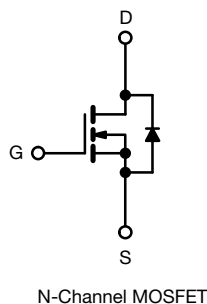
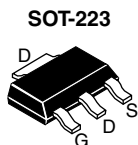


## Power MOSFET



### FEATURES

- Surface-mount
- Available in tape and reel
- Dynamic dV/dt rating
- Logic-level gate drive
- $R_{DS(on)}$  specified at  $V_{GS} = 4\text{ V}$  and  $5\text{ V}$
- 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

Marking code: LA

| PRODUCT SUMMARY           |                         |      |
|---------------------------|-------------------------|------|
| $V_{DS}$ (V)              | 60                      |      |
| $R_{DS(on)}$ ( $\Omega$ ) | $V_{GS} = 5.0\text{ V}$ | 0.20 |
| $Q_g$ max. (nC)           | 8.4                     |      |
| $Q_{gs}$ (nC)             | 3.5                     |      |
| $Q_{gd}$ (nC)             | 6.0                     |      |
| Configuration             | Single                  |      |

### 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.

| ORDERING INFORMATION            |                       |
|---------------------------------|-----------------------|
| Package                         | SOT-223               |
| Lead (Pb)-free and halogen-free | SiHLL014TR-GE3        |
|                                 | IRLL014TRPbF-BE3 a, b |
| Lead (Pb)-free                  | IRLL014TRPbF a        |

### Notes

- a. See device orientation  
b. "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>                   | ± 10        |      |
| Continuous drain current                                                  | V <sub>GS</sub> at 10 V | T <sub>C</sub> = 25 °C  | I <sub>D</sub>                    | 2.7         | A    |
|                                                                           |                         | T <sub>C</sub> = 100 °C |                                   | 1.7         |      |
| Pulsed drain current <sup>a</sup>                                         |                         |                         | I <sub>DM</sub>                   | 22          |      |
| 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>                   | 100         | mJ   |
| Avalanche current <sup>a</sup>                                            |                         |                         | I <sub>AR</sub>                   | 2.7         | A    |
| Repetitive avalanche energy <sup>a</sup>                                  |                         |                         | E <sub>AR</sub>                   | 0.31        | mJ   |
| Maximum power dissipation                                                 | T <sub>C</sub> = 25 °C  |                         | P <sub>D</sub>                    | 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

- a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11)  
b.  $V_{DD} = 25\text{ V}$ , starting  $T_J = 25\text{ }^\circ\text{C}$ ,  $L = 16\text{ mH}$ ,  $R_g = 25\text{ }\Omega$ ,  $I_{AS} = 2.7\text{ A}$  (see fig. 12)  
c.  $I_{SD} \leq 10\text{ A}$ ,  $dI/dt \leq 90\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq V_{DS}$ ,  $T_J \leq 150\text{ }^\circ\text{C}$   
d. 1.6 mm from case  
e. When mounted on 1" square PCB (FR-4 or G-10 material)

**THERMAL RESISTANCE RATINGS**

| PARAMETER                                            | SYMBOL     | MIN. | 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)

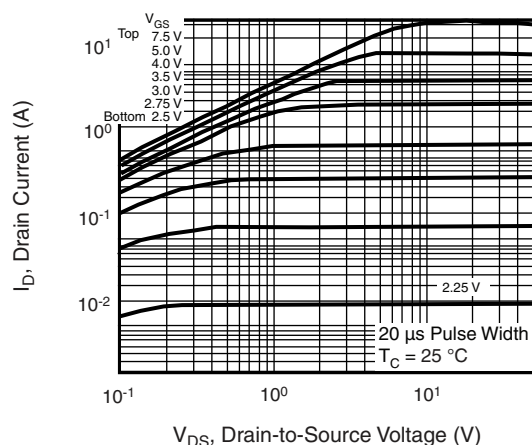
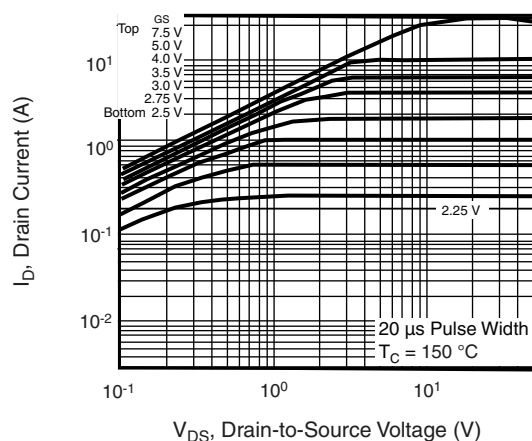
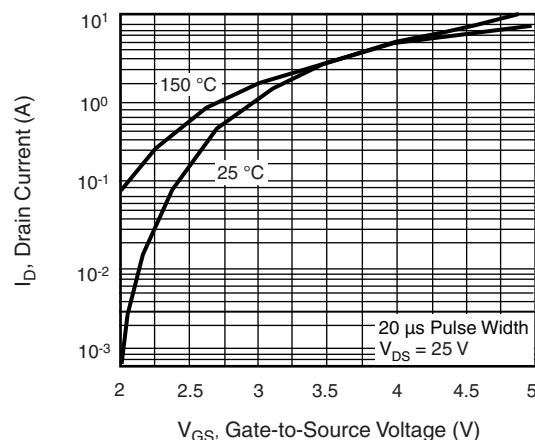
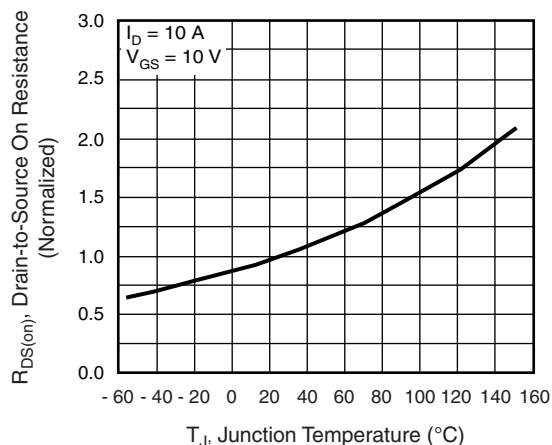
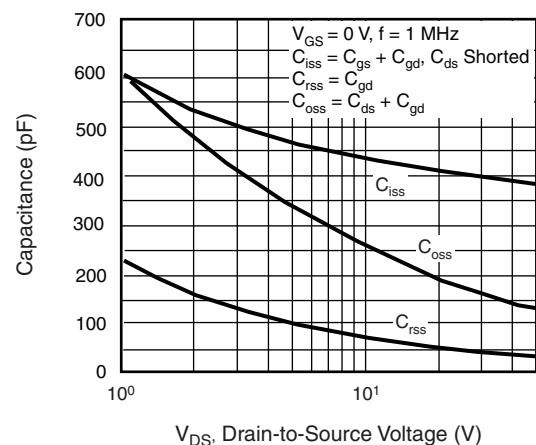
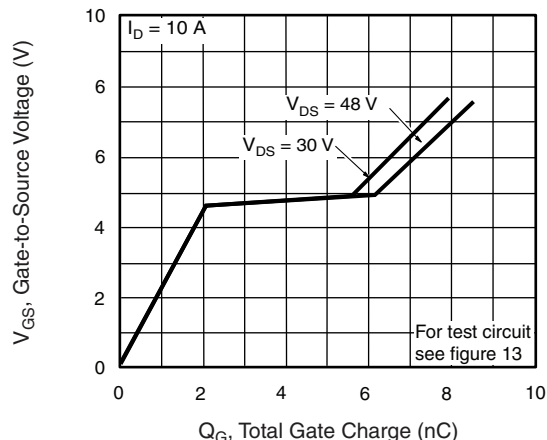
**SPECIFICATIONS** ( $T_J = 25\text{ }^{\circ}\text{C}$ , unless otherwise noted)

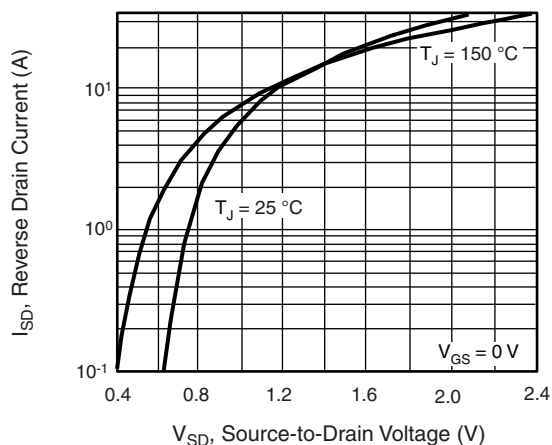
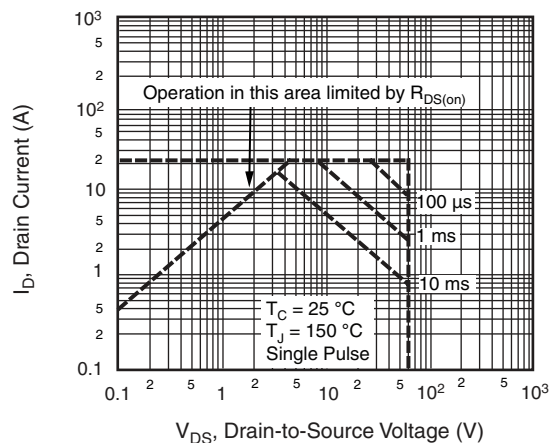
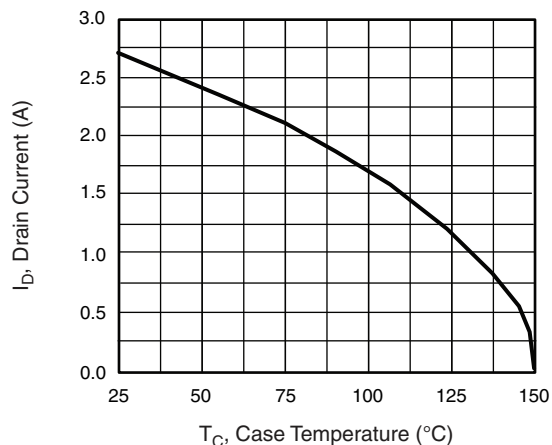
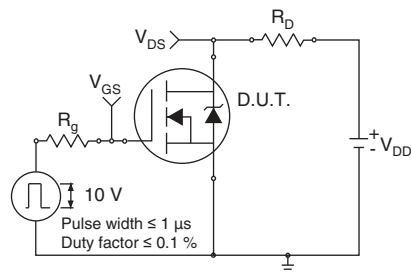
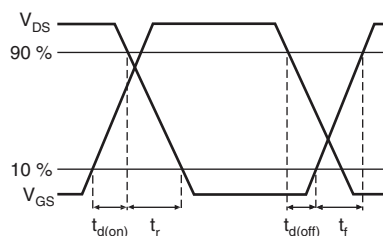
| PARAMETER                                 | SYMBOL              | TEST CONDITIONS                                                                                                                   |                                                                                  | MIN. | TYP.  | MAX.      | UNIT                |
|-------------------------------------------|---------------------|-----------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|------|-------|-----------|---------------------|
| Static                                    |                     |                                                                                                                                   |                                                                                  |      |       |           |                     |
| Drain-source breakdown voltage            | $V_{DS}$            | $V_{GS} = 0\text{ V}$ , $I_D = 250\text{ }\mu\text{A}$                                                                            |                                                                                  | 60   | -     | -         | V                   |
| $V_{DS}$ temperature coefficient          | $\Delta V_{DS}/T_J$ | Reference to $25\text{ }^\circ\text{C}$ , $I_D = 1\text{ mA}$                                                                     |                                                                                  | -    | 0.073 | -         | V/ $^\circ\text{C}$ |
| Gate-source threshold voltage             | $V_{GS(th)}$        | $V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{A}$                                                                                |                                                                                  | 1.0  | -     | 2.0       | V                   |
| Gate-source leakage                       | $I_{GSS}$           | $V_{GS} = \pm 10\text{ V}$                                                                                                        |                                                                                  | -    | -     | $\pm 100$ | nA                  |
| Zero gate voltage drain current           | $I_{DSS}$           | $V_{DS} = 60\text{ V}$ , $V_{GS} = 0\text{ V}$                                                                                    |                                                                                  | -    | -     | 25        | $\mu\text{A}$       |
|                                           |                     | $V_{DS} = 48\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_J = 125\text{ }^\circ\text{C}$                                                |                                                                                  | -    | -     | 250       |                     |
| Drain-source on-state resistance          | $R_{DS(on)}$        | $V_{GS} = 5.0\text{ V}$                                                                                                           | $I_D = 1.6\text{ A}^b$                                                           | -    | -     | 0.20      | $\Omega$            |
|                                           |                     | $V_{GS} = 4.0\text{ V}$                                                                                                           | $I_D = 1.4\text{ A}^b$                                                           | -    | -     | 0.28      |                     |
| Forward transconductance                  | $g_{fs}$            | $V_{DS} = 25\text{ V}$ , $I_D = 1.6\text{ A}$                                                                                     |                                                                                  | 3.2  | -     | -         | S                   |
| Dynamic                                   |                     |                                                                                                                                   |                                                                                  |      |       |           |                     |
| Input capacitance                         | $C_{iss}$           | $V_{GS} = 0\text{ V}$ ,<br>$V_{DS} = 25\text{ V}$ ,<br>$f = 1.0\text{ MHz}$ , see fig. 5                                          |                                                                                  | -    | 400   | -         | pF                  |
| Output capacitance                        | $C_{oss}$           |                                                                                                                                   |                                                                                  | -    | 170   | -         |                     |
| Reverse transfer capacitance              | $C_{rss}$           |                                                                                                                                   |                                                                                  | -    | 42    | -         |                     |
| Total gate charge                         | $Q_g$               | $V_{GS} = 5.0\text{ V}$                                                                                                           | $I_D = 10\text{ A}$ , $V_{DS} = 48\text{ V}$ ,<br>see fig. 6 and 13 <sup>b</sup> | -    | -     | 8.4       | nC                  |
| Gate-source charge                        | $Q_{gs}$            |                                                                                                                                   |                                                                                  | -    | -     | 3.5       |                     |
| Gate-drain charge                         | $Q_{gd}$            |                                                                                                                                   |                                                                                  | -    | -     | 6.0       |                     |
| Turn-on delay time                        | $t_{d(on)}$         | $V_{DD} = 30\text{ V}$ , $I_D = 10\text{ A}$ ,<br>$R_g = 12\text{ }\Omega$ , $R_D = 2.8\text{ }\Omega$ , see fig. 10 <sup>b</sup> |                                                                                  | -    | 9.3   | -         | ns                  |
| Rise time                                 | $t_r$               |                                                                                                                                   |                                                                                  | -    | 110   | -         |                     |
| Turn-off delay time                       | $t_{d(off)}$        |                                                                                                                                   |                                                                                  | -    | 17    | -         |                     |
| Fall time                                 | $t_f$               |                                                                                                                                   |                                                                                  | -    | 26    | -         |                     |
| Internal drain inductance                 | $L_D$               | Between lead,<br>6 mm (0.25") from<br>package and center of<br>die contact                                                        |                                                                                  | -    | 4.0   | -         | nH                  |
| Internal source inductance                | $L_S$               |                                                                                                                                   |                                                                                  | -    | 6.0   | -         |                     |
| Drain-Source Body Diode Characteristics   |                     |                                                                                                                                   |                                                                                  |      |       |           |                     |
| Continuous source-drain diode current     | $I_S$               | MOSFET symbol<br>showing the<br>integral reverse<br>p - n junction diode                                                          |                                                                                  | -    | -     | 2.7       | A                   |
| Pulsed diode forward current <sup>a</sup> | $I_{SM}$            |                                                                                                                                   |                                                                                  | -    | -     | 22        |                     |
| Body diode voltage                        | $V_{SD}$            | $T_J = 25\text{ }^\circ\text{C}$ , $I_S = 2.7\text{ A}$ , $V_{GS} = 0\text{ V}^b$                                                 |                                                                                  | -    | -     | 1.6       | V                   |
| Body diode reverse recovery time          | $t_{rr}$            | $T_J = 25\text{ }^\circ\text{C}$ , $I_F = 10\text{ A}$ , $dI/dt = 100\text{ A}/\mu\text{s}^b$                                     |                                                                                  | -    | 65    | 130       | ns                  |
| Body diode reverse recovery charge        | $Q_{rr}$            |                                                                                                                                   |                                                                                  | -    | 0.33  | 0.65      | $\mu\text{C}$       |
| Forward turn-on time                      | $t_{on}$            | Intrinsic turn-on time is negligible (turn-on is dominated by $L_S$ and $L_D$ )                                                   |                                                                                  |      |       |           |                     |

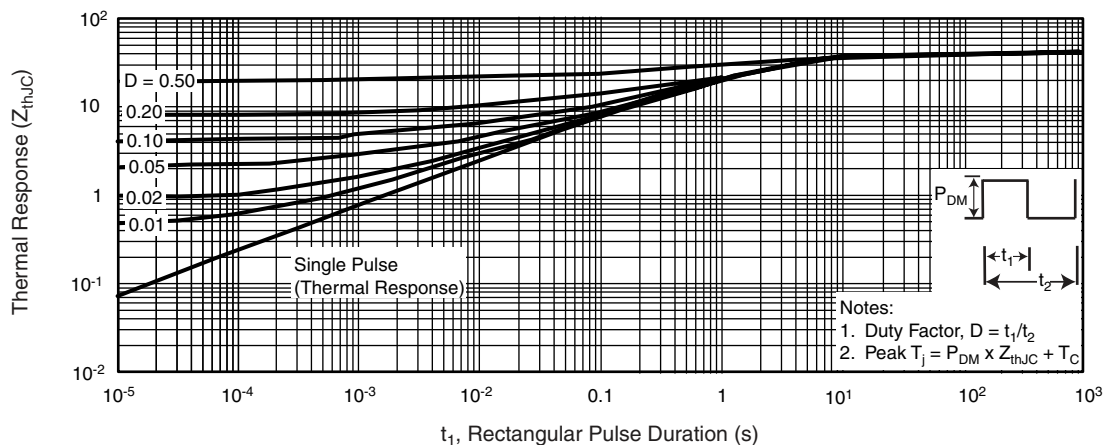
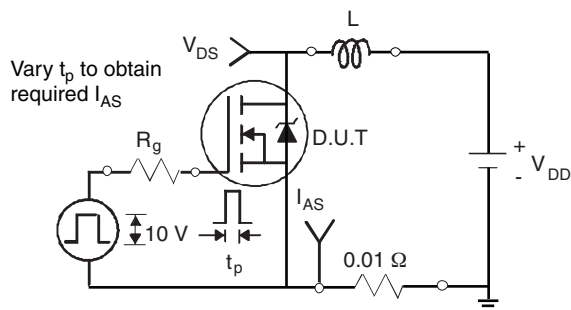
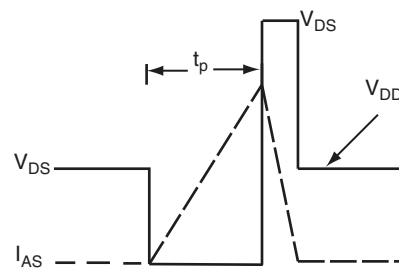
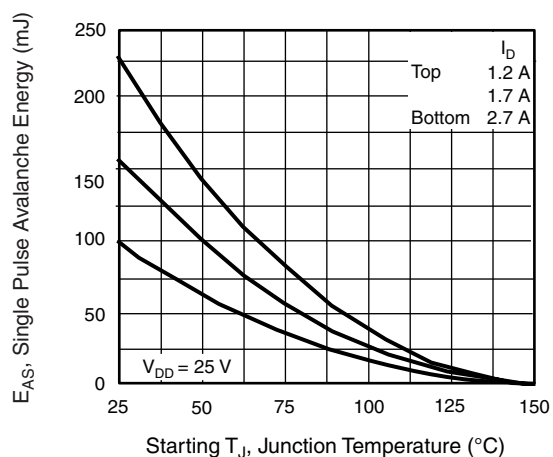
**Notes**

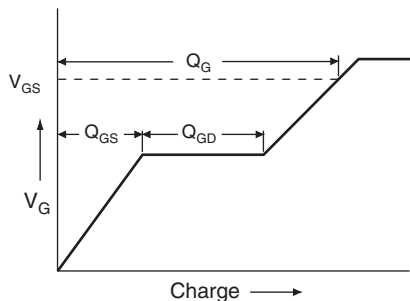
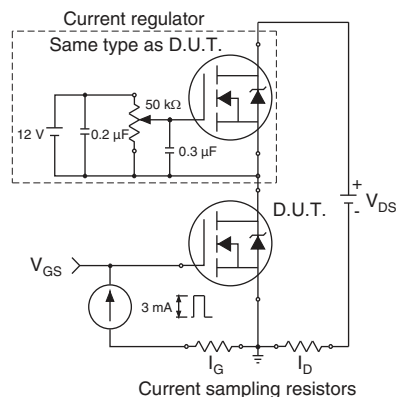
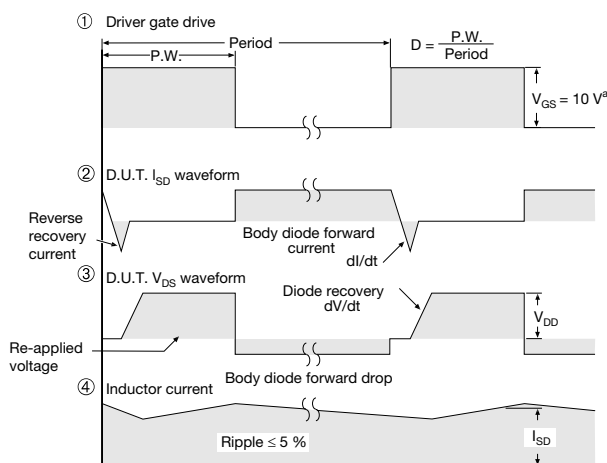
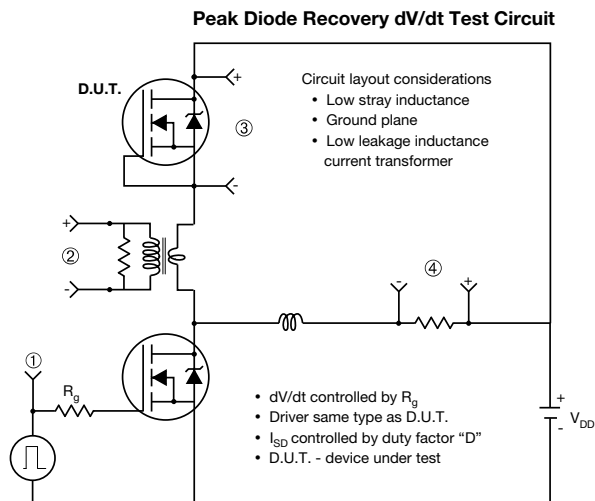
a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11)

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

**Fig. 3 - Typical Transfer Characteristics**

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

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

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


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

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

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

**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**

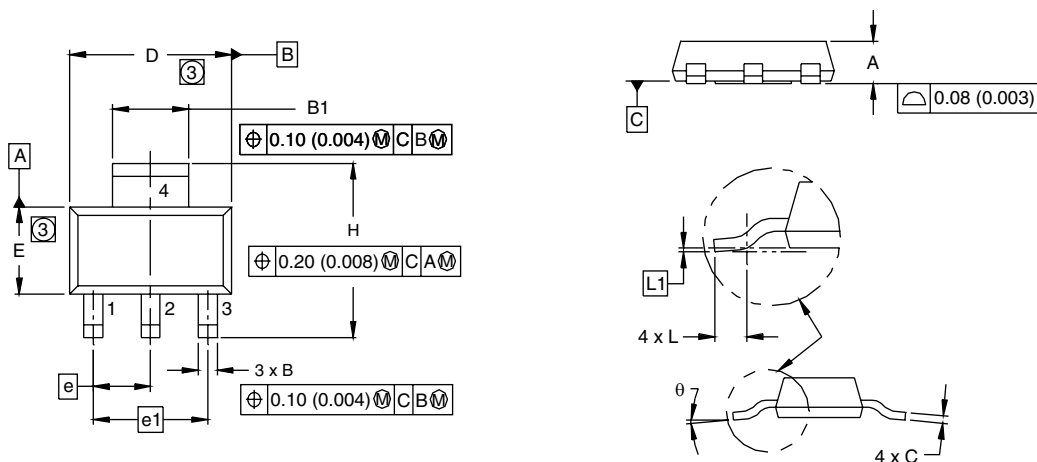

**Fig. 13a - Basic Gate Charge Waveform**

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


**Note**  
a.  $V_{GS} = 5V$  for logic level devices

**Fig. 14 - For N-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 |       |
| $\theta$                                    | -           | 10°  | -          | 10°   |
| ECN: S-82109-Rev. A, 15-Sep-08<br>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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