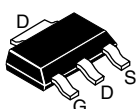


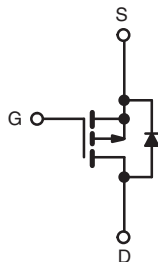
## Power MOSFET

### PRODUCT SUMMARY

|                            |                         |     |
|----------------------------|-------------------------|-----|
| V <sub>DS</sub> (V)        | -100                    |     |
| R <sub>DS(on)</sub> (Ω)    | V <sub>GS</sub> = -10 V | 1.2 |
| Q <sub>g</sub> (Max.) (nC) | 8.7                     |     |
| Q <sub>gs</sub> (nC)       | 2.2                     |     |
| Q <sub>gd</sub> (nC)       | 4.1                     |     |
| Configuration              | Single                  |     |

**SOT-223**


Marking code: FF



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-mount 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       | SOT-223                      |
| Lead (Pb)-free and Halogen-free | SiHFL9110-GE3 | SiHFL9110TR-GE3 <sup>a</sup> |
| Lead (Pb)-free                  | IRFL9110PbF   | IRFL9110TRPbF <sup>a</sup>   |
|                                 | SiHFL9110-E3  | SiHFL9110T-E3 <sup>a</sup>   |

#### Note

a. See device orientation.

### ABSOLUTE MAXIMUM RATINGS (T<sub>C</sub> = 25 °C, unless otherwise noted)

| PARAMETER                                                 | SYMBOL                            | LIMIT                   | UNIT |
|-----------------------------------------------------------|-----------------------------------|-------------------------|------|
| Drain-Source Voltage                                      | V <sub>DS</sub>                   | -100                    | 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  | A    |
|                                                           |                                   | T <sub>C</sub> = 100 °C |      |
| Pulsed Drain Current <sup>a</sup>                         | I <sub>DM</sub>                   | -8.8                    |      |
| 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>                   | -1.1                    | A    |
| Repetitive Avalanche Energy <sup>a</sup>                  | E <sub>AR</sub>                   | 0.31                    | mJ   |
| Maximum Power Dissipation                                 | P <sub>D</sub>                    | T <sub>C</sub> = 25 °C  | W    |
| Maximum Power Dissipation (PCB Mount) <sup>e</sup>        |                                   | T <sub>A</sub> = 25 °C  |      |
| Peak Diode Recovery dV/dt <sup>c</sup>                    | dV/dt                             | -5.5                    | 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 = 7.7 mH, R<sub>g</sub> = 25 Ω, I<sub>AS</sub> = -4.4 A (see fig. 12).
- I<sub>SD</sub> ≤ -4.4 A, dI/dt ≤ -75 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     | 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 <sub>DS</sub>                  | V <sub>GS</sub> = 0 V, I <sub>D</sub> = -250 μA                                                                             |                                                                                     | -100 | -      | -     | 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                                                                                  |                                                                                     | -    | -0.091 | -     | 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> = -100 V, V <sub>GS</sub> = 0 V                                                                             |                                                                                     | -    | -      | -100  | μA   |
|                                           |                                  | V <sub>DS</sub> = -80 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> = -0.66 A <sup>b</sup>                                               | -    | -      | 1.2   | Ω    |
| Forward Transconductance                  | g <sub>fs</sub>                  | V <sub>DS</sub> = -50 V, I <sub>D</sub> = -0.66 A                                                                           |                                                                                     | 0.82 | -      | -     | S    |
| Dynamic                                   |                                  |                                                                                                                             |                                                                                     |      |        |       |      |
| Input Capacitance                         | C <sub>iss</sub>                 | V <sub>GS</sub> = 0 V,<br>V <sub>DS</sub> = - 25 V,<br>f = 1.0 MHz, see fig. 5                                              |                                                                                     | -    | 200    | -     | pF   |
| Output Capacitance                        | C <sub>oss</sub>                 |                                                                                                                             |                                                                                     | -    | 94     | -     |      |
| Reverse Transfer Capacitance              | C <sub>rss</sub>                 |                                                                                                                             |                                                                                     | -    | 18     | -     |      |
| Total Gate Charge                         | Q <sub>g</sub>                   | V <sub>GS</sub> = -10 V                                                                                                     | I <sub>D</sub> = -4.0 A, V <sub>DS</sub> = -80 V,<br>see fig. 6 and 13 <sup>b</sup> | -    | -      | 8.7   | nC   |
| Gate-Source Charge                        | Q <sub>gs</sub>                  |                                                                                                                             |                                                                                     | -    | -      | 2.2   |      |
| Gate-Drain Charge                         | Q <sub>gd</sub>                  |                                                                                                                             |                                                                                     | -    | -      | 4.1   |      |
| Turn-On Delay Time                        | t <sub>d(on)</sub>               | V <sub>DD</sub> = -50 V, I <sub>D</sub> = -4.0 A,<br>R <sub>G</sub> = 24 Ω, R <sub>D</sub> = 11 Ω, see fig. 10 <sup>b</sup> |                                                                                     | -    | 10     | -     | ns   |
| Rise Time                                 | t <sub>r</sub>                   |                                                                                                                             |                                                                                     | -    | 27     | -     |      |
| Turn-Off Delay Time                       | t <sub>d(off)</sub>              |                                                                                                                             |                                                                                     | -    | 15     | -     |      |
| Fall Time                                 | t <sub>f</sub>                   |                                                                                                                             |                                                                                     | -    | 17     | -     |      |
| Internal Drain Inductance                 | L <sub>D</sub>                   | Between lead,<br>6 mm (0.25") from<br>package and center of<br>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<br>showing the<br>integral reverse<br>p - n junction diode                                                    |                                                                                     | -    | -      | -1.1  | A    |
| Pulsed Diode Forward Current <sup>a</sup> | I <sub>SM</sub>                  |                                                                                                                             |                                                                                     | -    | -      | -8.8  |      |
| Body Diode Voltage                        | V <sub>SD</sub>                  | T <sub>J</sub> = 25 °C, I <sub>S</sub> = -1.1 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> = -4.0 A, dI/dt = 100 A/μs <sup>b</sup>                                              |                                                                                     | -    | 80     | 160   | ns   |
| Body Diode Reverse Recovery Charge        | Q <sub>rr</sub>                  |                                                                                                                             |                                                                                     | -    | 0.15   | 0.30  | 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)

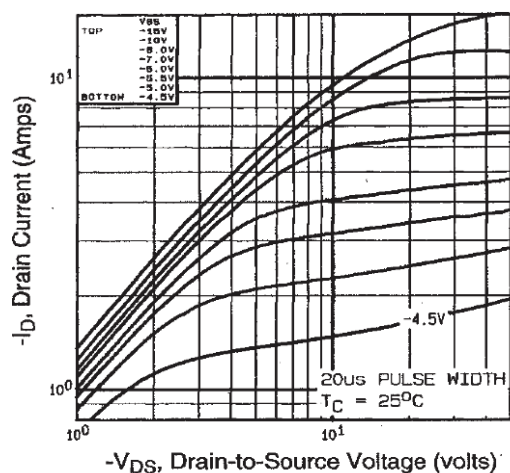


Fig. 1 - Typical Output Characteristics

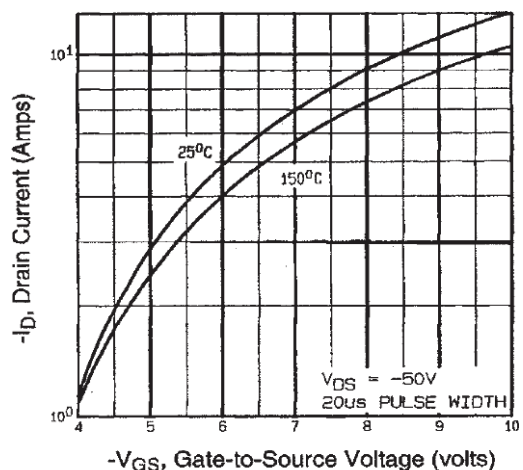


Fig. 3 - Typical Transfer Characteristics

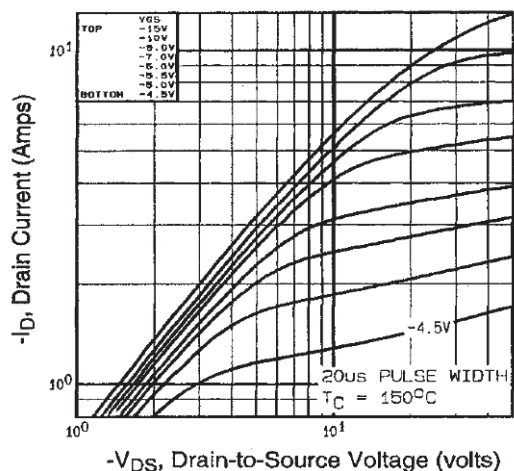


Fig. 2 - Typical Output Characteristics

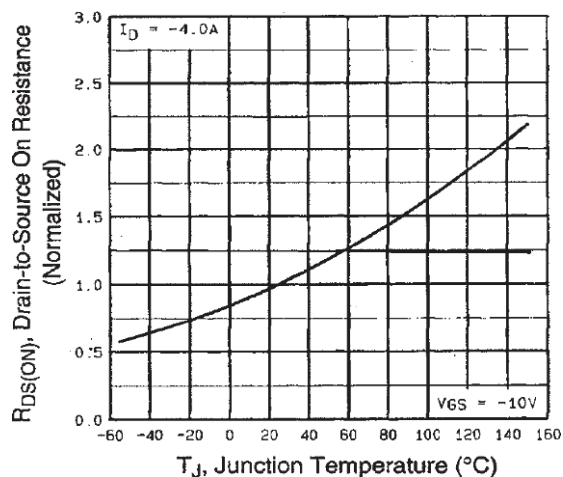
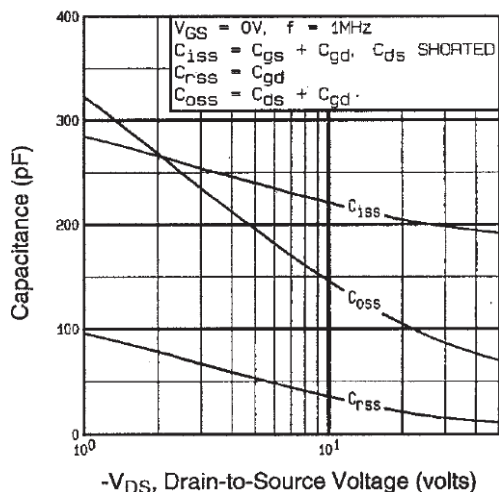
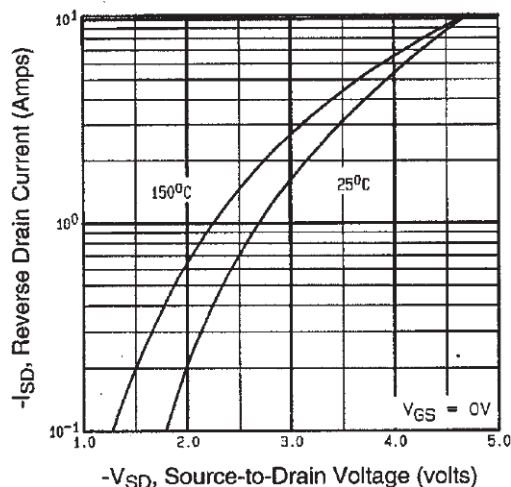
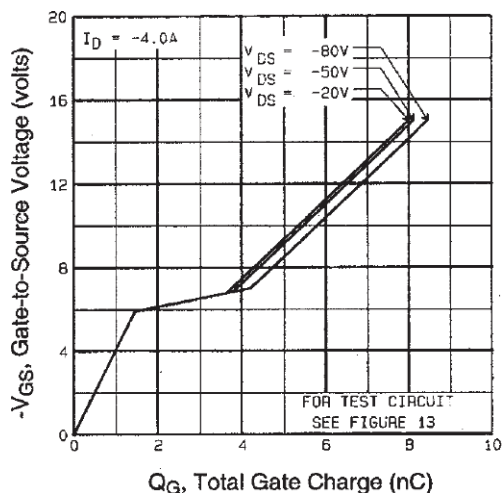
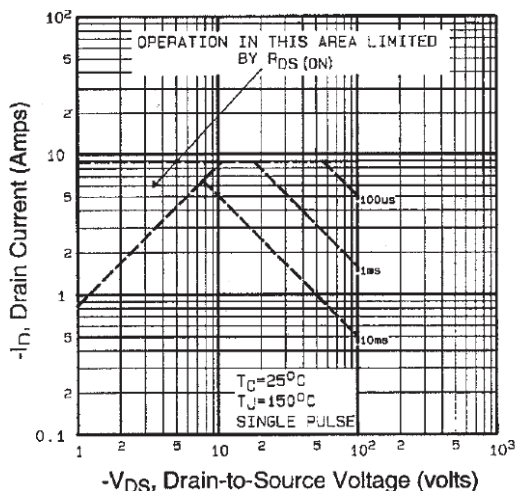
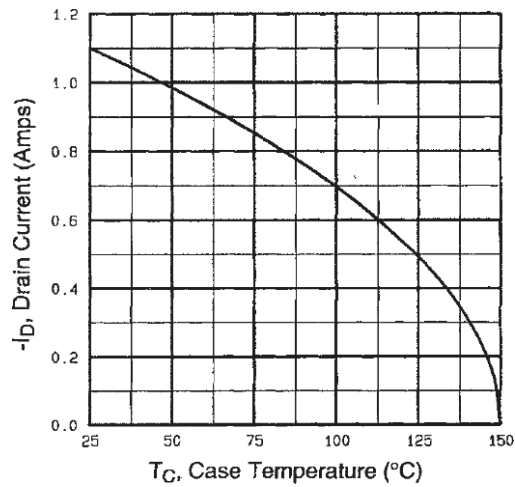
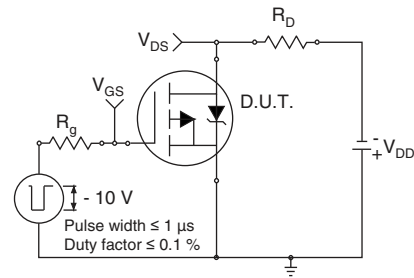
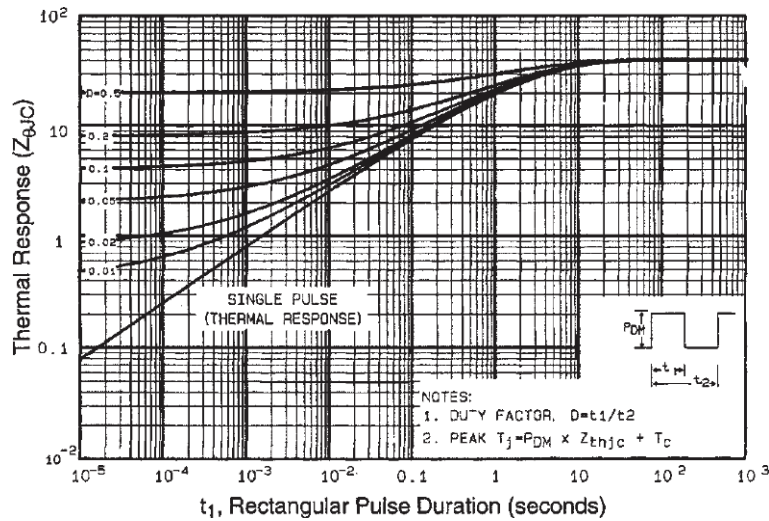
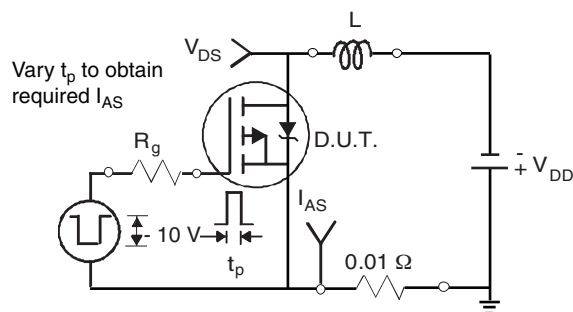


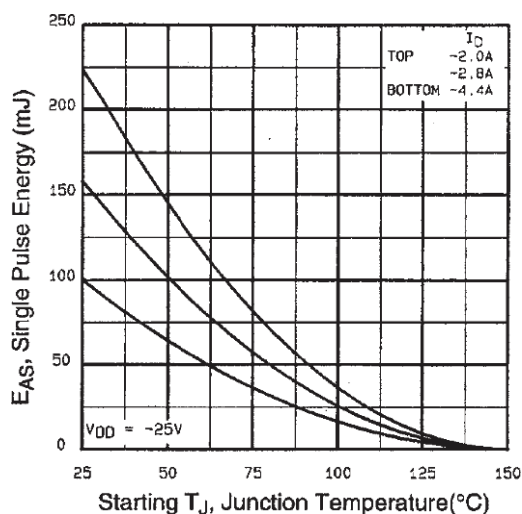
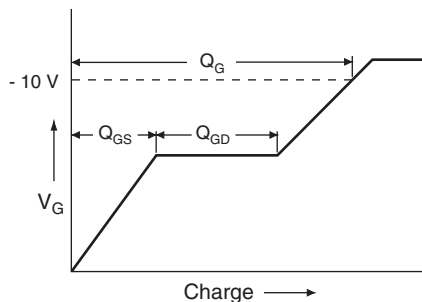
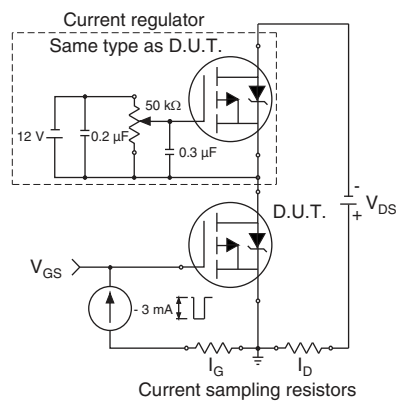
Fig. 4 - Normalized On-Resistance vs. Temperature

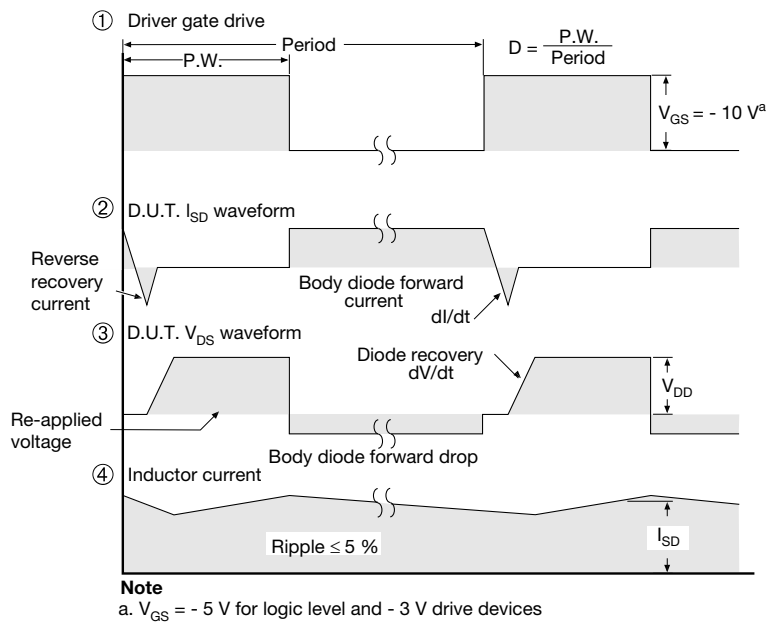
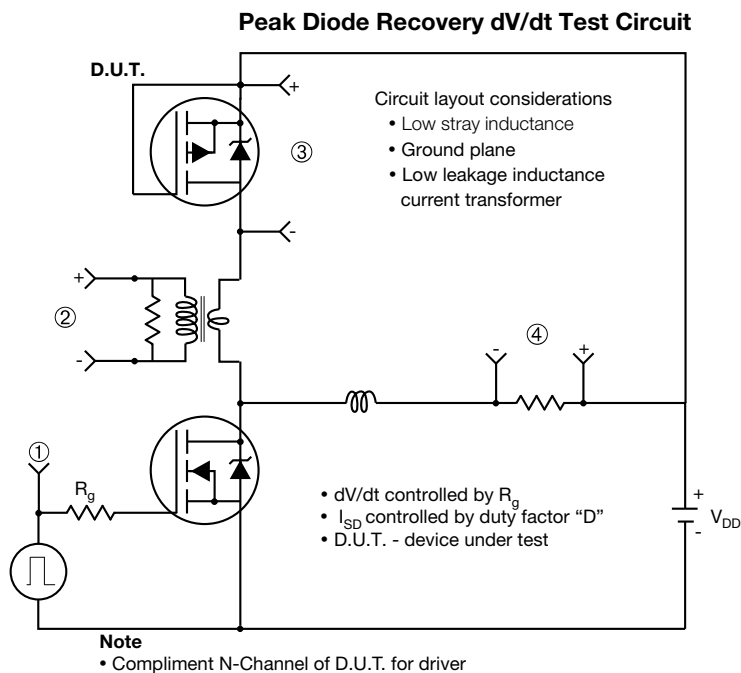

**Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage**

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

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



**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 |       |
| $\theta$                                    | -           | 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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**Please note that some Vishay documentation may still make reference to RoHS Directive 2002/95/EC. We confirm that all the products identified as being compliant to Directive 2002/95/EC conform to Directive 2011/65/EU.**

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