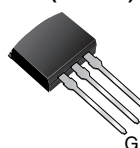
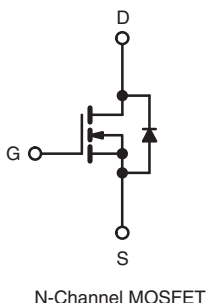
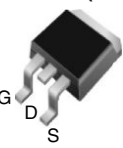


## Power MOSFET

### PRODUCT SUMMARY

|                           |                       |      |
|---------------------------|-----------------------|------|
| $V_{DS}$ (V)              | 60                    |      |
| $R_{DS(on)}$ ( $\Omega$ ) | $V_{GS} = 5\text{ V}$ | 0.20 |
| $Q_g$ (Max.) (nC)         | 8.4                   |      |
| $Q_{gs}$ (nC)             | 3.5                   |      |
| $Q_{gd}$ (nC)             | 6.0                   |      |
| Configuration             | Single                |      |

I<sup>2</sup>PAK (TO-262)

D<sup>2</sup>PAK (TO-263)


### FEATURES

- Halogen-free According to IEC 61249-2-21 Definition
- Advanced Process Technology
- Surface Mount (IRLZ14S, SiHLZ14S)
- Low-Profile Through-Hole (IRLZ14L, SiHLZ14L)
- 175 °C Operating Temperature
- Fast Switching
- Compliant to RoHS Directive 2002/95/EC



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

### DESCRIPTION

Third generation Power MOSFETs from Vishay utilize advanced processing techniques to achieve extremely low on-resistance per silicon area. This benefit, combined with the fast switching speed and ruggedized device design that Power MOSFETs are well known for, provides the designer with an extremely efficient reliable device for use in a wide variety of applications.

The D<sup>2</sup>PAK is a surface mount power package capable of accommodating die sizes up to HEX-4. It provides the highest power capability and lowest possible on-resistance in any existing surface mount package. The D<sup>2</sup>PAK is suitable for high current applications because of its low internal connection resistance and can dissipate up to 2.0 W in a typical surface mount application.

The through-hole version (IRLZ44L, SiHLZ44L) is available for low-profile applications.

### ORDERING INFORMATION

| Package                         | D <sup>2</sup> PAK (TO-263) | D <sup>2</sup> PAK (TO-263)  | D <sup>2</sup> PAK (TO-263)  | I <sup>2</sup> PAK (TO-262) |
|---------------------------------|-----------------------------|------------------------------|------------------------------|-----------------------------|
| Lead (Pb)-free and Halogen-free | SiHLZ14S-GE3                | SiHLZ14STRL-GE3 <sup>a</sup> | SiHLZ14STRR-GE3 <sup>a</sup> | -                           |
| Lead (Pb)-free                  | IRLZ14SPbF                  | -                            | IRLZ14STRRPbF <sup>a</sup>   | IRLZ14LPbF                  |
|                                 | SiHLZ14S-E3                 | -                            | SiHLZ14STR-E3                | SiHLZ14L-E3                 |

#### Note

a. See device orientation.

### ABSOLUTE MAXIMUM RATINGS ( $T_C = 25\text{ °C}$ , unless otherwise noted)

| PARAMETER                                        | SYMBOL          | LIMIT                 | UNIT |
|--------------------------------------------------|-----------------|-----------------------|------|
| Drain-Source Voltage <sup>e</sup>                | $V_{DS}$        | 60                    | V    |
| Gate-Source Voltage                              | $V_{GS}$        | $\pm 10$              |      |
| Continuous Drain Current                         | $V_{GS}$ at 5 V | $T_C = 25\text{ °C}$  | A    |
|                                                  |                 | $T_C = 100\text{ °C}$ |      |
| Pulsed Drain Current <sup>a, e</sup>             | $I_{DM}$        | 40                    |      |
| Linear Derating Factor                           |                 | 0.29                  | W/°C |
| Single Pulse Avalanche Energy <sup>b, e</sup>    | $E_{AS}$        | 68                    | mJ   |
| Maximum Power Dissipation                        |                 | $T_C = 25\text{ °C}$  | W    |
|                                                  |                 | $T_A = 25\text{ °C}$  |      |
| Peak Diode Recovery $dV/dt$ <sup>c, e</sup>      | $dV/dt$         | 4.5                   | V/ns |
| Operating Junction and Storage Temperature Range | $T_J, T_{stg}$  | - 55 to + 175         | °C   |
| Soldering Recommendations (Peak Temperature)     | for 10 s        | 300 <sup>d</sup>      |      |

#### Notes

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- $V_{DD} = 25\text{ V}$ , starting  $T_J = 25\text{ °C}$ ,  $L = 790\text{ }\mu\text{H}$ ,  $R_g = 25\text{ }\Omega$ ,  $I_{AS} = 10\text{ A}$  (see fig. 12).
- $I_{SD} \leq 10\text{ A}$ ,  $dI/dt \leq 90\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq V_{DS}$ ,  $T_J \leq 175\text{ °C}$ .
- 1.6 mm from case.
- Uses IRLZ14, SiHLZ14 data and test conditions.

\* Pb containing terminations are not RoHS compliant, exemptions may apply

| THERMAL RESISTANCE RATINGS                           |            |      |      |      |
|------------------------------------------------------|------------|------|------|------|
| PARAMETER                                            | SYMBOL     | TYP. | MAX. | UNIT |
| Maximum Junction-to-Ambient (PCB Mount) <sup>a</sup> | $R_{thJA}$ | -    | 40   | °C/W |
| Maximum Junction-to-Case (Drain)                     | $R_{thJC}$ | -    | 3.5  |      |

**Note**

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

| SPECIFICATIONS (T <sub>J</sub> = 25 °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, 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                                                                                                               |                                                                                  | -    | 0.07 | -     | 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                                                                                             |                                                                                  | 1.0  | -    | 2.0   | V    |
| Gate-Source Leakage                                             | I <sub>GSS</sub>                 | V <sub>GS</sub> = ± 10 V                                                                                                                                |                                                                                  | -    | -    | ± 100 | nA   |
| Zero Gate Voltage Drain Current                                 | I <sub>DSS</sub>                 | V <sub>DS</sub> = 60 V, V <sub>GS</sub> = 0 V                                                                                                           |                                                                                  | -    | -    | 25    | μA   |
|                                                                 |                                  | V <sub>DS</sub> = 48 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 150 °C                                                                                  |                                                                                  | -    | -    | 250   |      |
| Drain-Source On-State Resistance                                | R <sub>DS(on)</sub>              | V <sub>GS</sub> = 5 V                                                                                                                                   | I <sub>D</sub> = 6.0 A <sup>b</sup>                                              | -    | -    | 0.2   | Ω    |
|                                                                 |                                  | V <sub>GS</sub> = 4 V                                                                                                                                   | I <sub>D</sub> = 5.0 A <sup>b</sup>                                              | -    | -    | 0.28  |      |
| Forward Transconductance                                        | g <sub>fs</sub>                  | V <sub>DS</sub> = 25 V, I <sub>D</sub> = 6.0 A                                                                                                          |                                                                                  | 3.5  | -    | -     | 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                                                                            |                                                                                  | -    | 400  | -     | pF   |
| Output Capacitance                                              | C <sub>oss</sub>                 |                                                                                                                                                         |                                                                                  | -    | 170  | -     |      |
| Reverse Transfer Capacitance                                    | C <sub>rss</sub>                 |                                                                                                                                                         |                                                                                  | -    | 42   | -     |      |
| Total Gate Charge                                               | Q <sub>g</sub>                   | V <sub>GS</sub> = 5 V                                                                                                                                   | I <sub>D</sub> = 10 A, V <sub>DS</sub> = 48 V,<br>see fig. 6 and 13 <sup>b</sup> | -    | -    | 8.4   | nC   |
| Gate-Source Charge                                              | Q <sub>gs</sub>                  |                                                                                                                                                         |                                                                                  | -    | -    | 3.5   |      |
| Gate-Drain Charge                                               | Q <sub>gd</sub>                  |                                                                                                                                                         |                                                                                  | -    | -    | 6.0   |      |
| Turn-On Delay Time                                              | t <sub>d(on)</sub>               | V <sub>DD</sub> = 30 V, I <sub>D</sub> = 10 A,<br>R <sub>g</sub> = 12 Ω, R <sub>D</sub> = 2.8 Ω, see fig. 10 <sup>b</sup>                               |                                                                                  | -    | 9.3  | -     | ns   |
| Rise Time                                                       | t <sub>r</sub>                   |                                                                                                                                                         |                                                                                  | -    | 110  | -     |      |
| Turn-Off Delay Time                                             | t <sub>d(off)</sub>              |                                                                                                                                                         |                                                                                  | -    | 17   | -     |      |
| Fall Time                                                       | t <sub>f</sub>                   |                                                                                                                                                         |                                                                                  | -    | 26   | -     |      |
| Internal Source Inductance                                      | L <sub>S</sub>                   | Between lead, and center of die contact                                                                                                                 |                                                                                  | -    | 7.5  | -     | nH   |
| Drain-Source Body Diode Characteristics                         |                                  |                                                                                                                                                         |                                                                                  |      |      |       |      |
| Continuous Source-Drain Diode Current                           | I <sub>S</sub>                   | MOSFET symbol showing the integral reverse p - n junction diode<br> |                                                                                  | -    | -    | 10    | A    |
| Pulsed Diode Forward Current <sup>a</sup>                       | I <sub>SM</sub>                  |                                                                                                                                                         |                                                                                  | -    | -    | 40    |      |
| Body Diode Voltage                                              | V <sub>SD</sub>                  | T <sub>J</sub> = 25 °C, I <sub>S</sub> = 10 A, V <sub>GS</sub> = 0 V <sup>b</sup>                                                                       |                                                                                  | -    | -    | 1.6   | V    |
| Body Diode Reverse Recovery Time                                | t <sub>rr</sub>                  | T <sub>J</sub> = 25 °C, I <sub>F</sub> = 10 A, dI/dt = 100 A/μs <sup>b</sup>                                                                            |                                                                                  | -    | 93   | 130   | ns   |
| Body Diode Reverse Recovery Charge                              | Q <sub>rr</sub>                  |                                                                                                                                                         |                                                                                  | -    | 340  | 650   | nC   |
| 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)

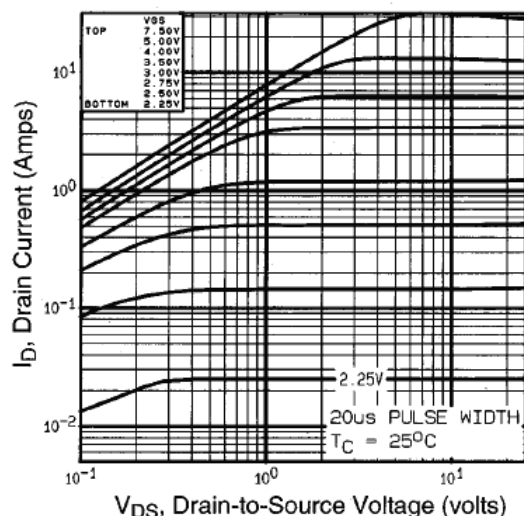


Fig. 1 - Typical Output Characteristics

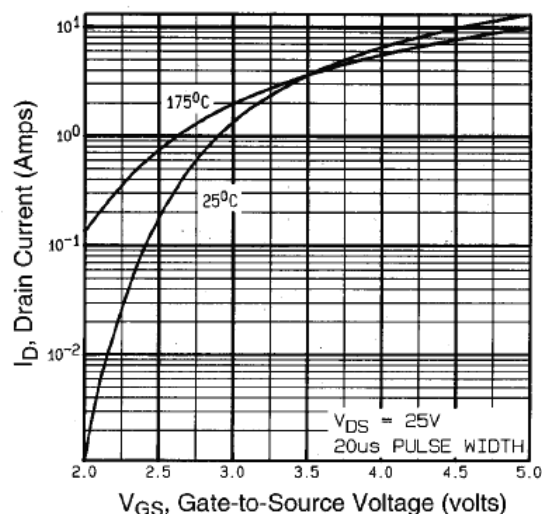


Fig. 3 - Typical Transfer Characteristics

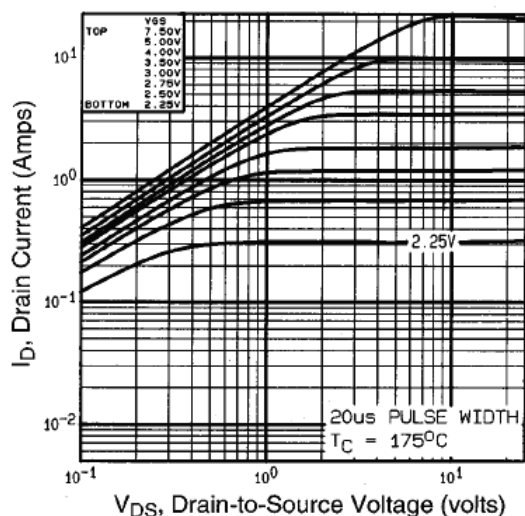


Fig. 2 - Typical Output Characteristics

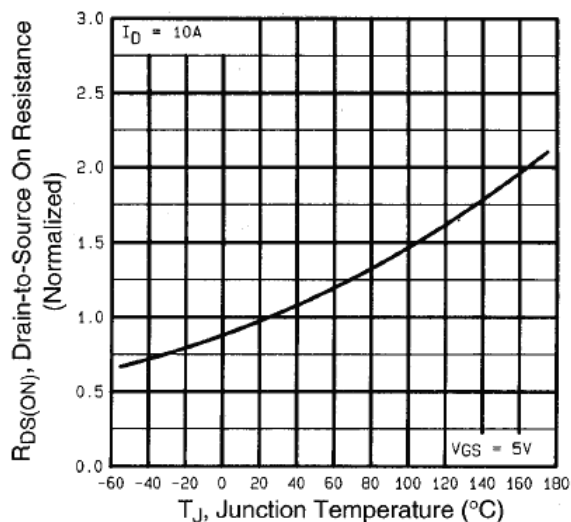


Fig. 4 - Normalized On-Resistance vs. Temperature

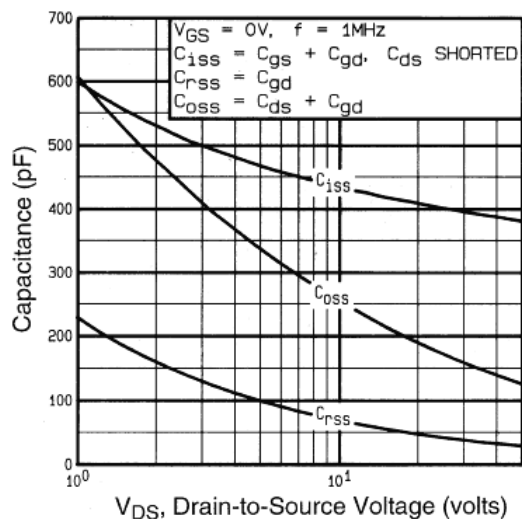


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

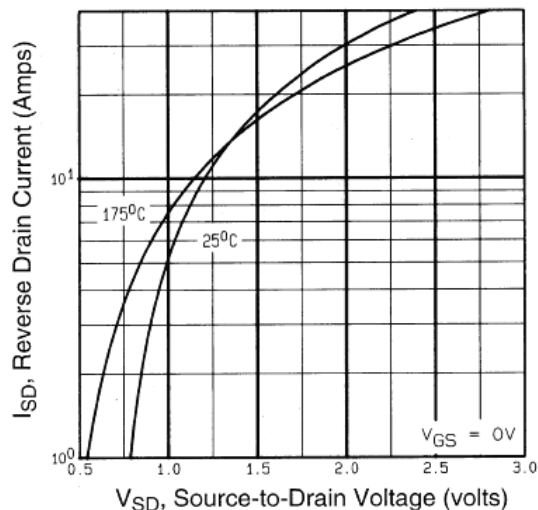


Fig. 7 - Typical Source-Drain Diode Forward Voltage

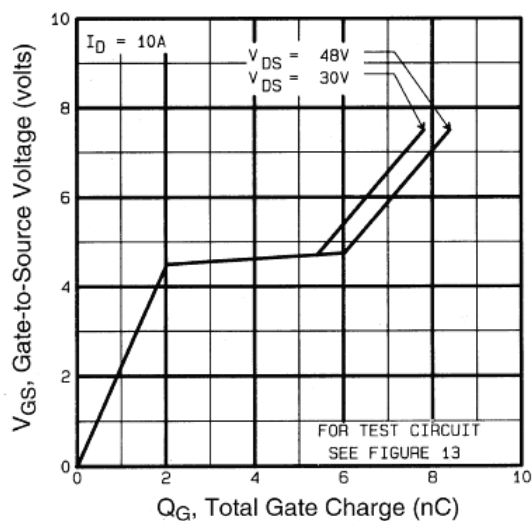


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

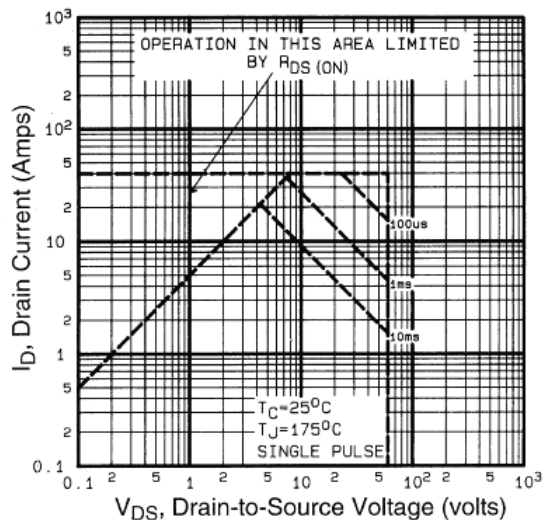


Fig. 8 - Maximum Safe Operating Area

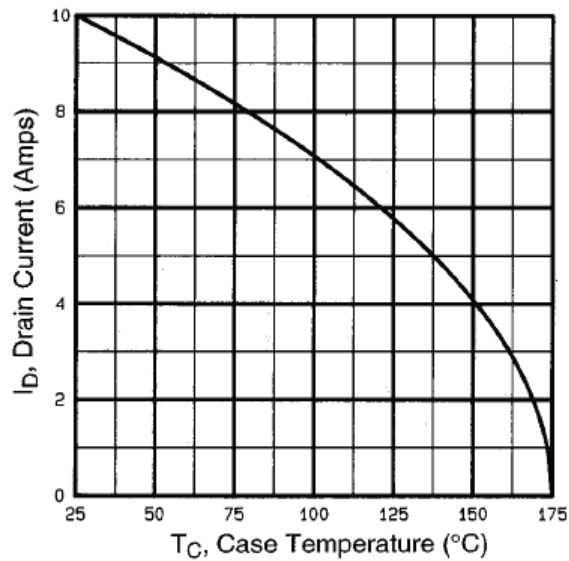


Fig. 9 - Maximum Drain Current vs. Case Temperature

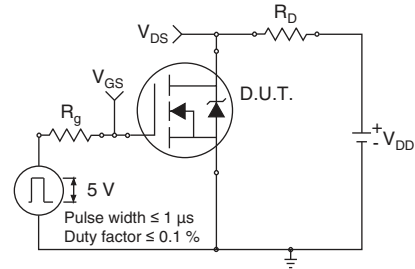


Fig. 10a - Switching Time Test Circuit



Fig. 10b - Switching Time Waveforms

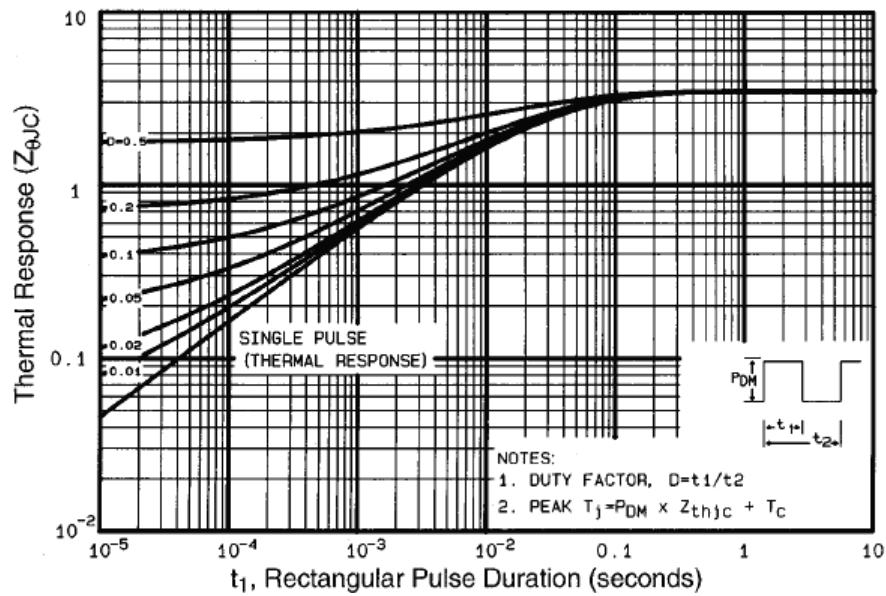


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

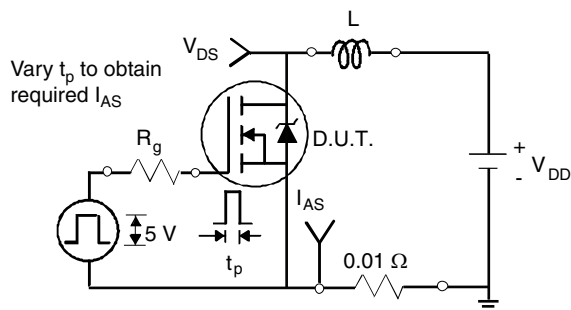


Fig. 12a - Unclamped Inductive Test Circuit



Fig. 12b - Unclamped Inductive Waveforms

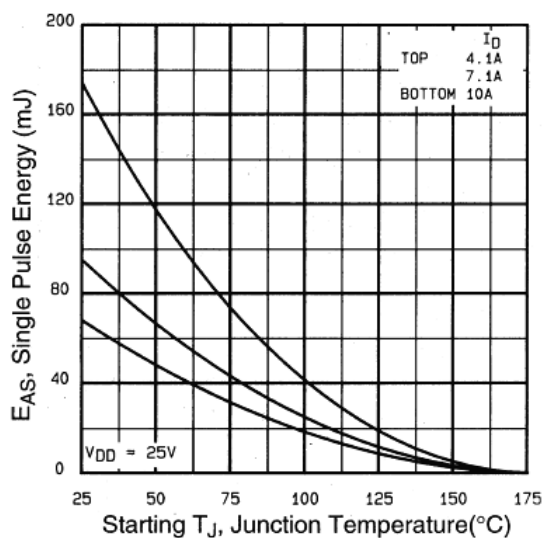


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

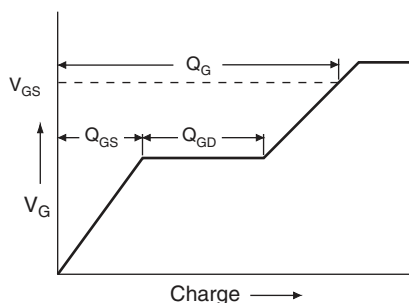
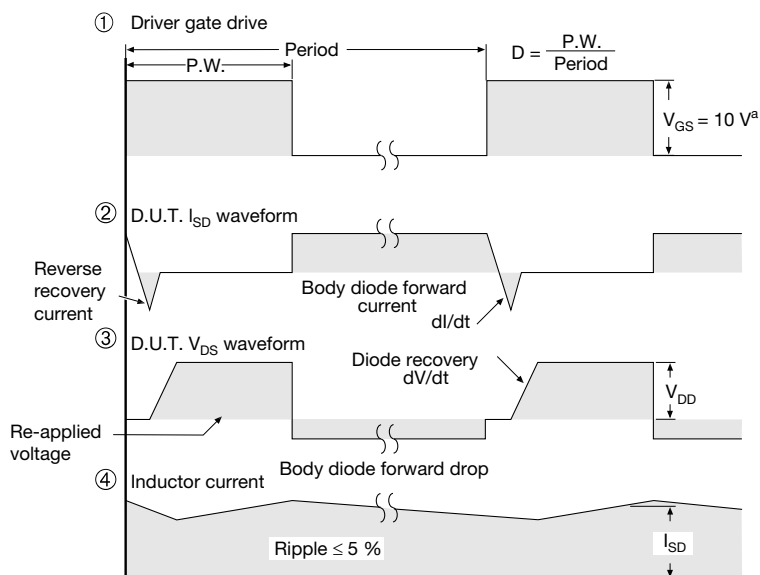
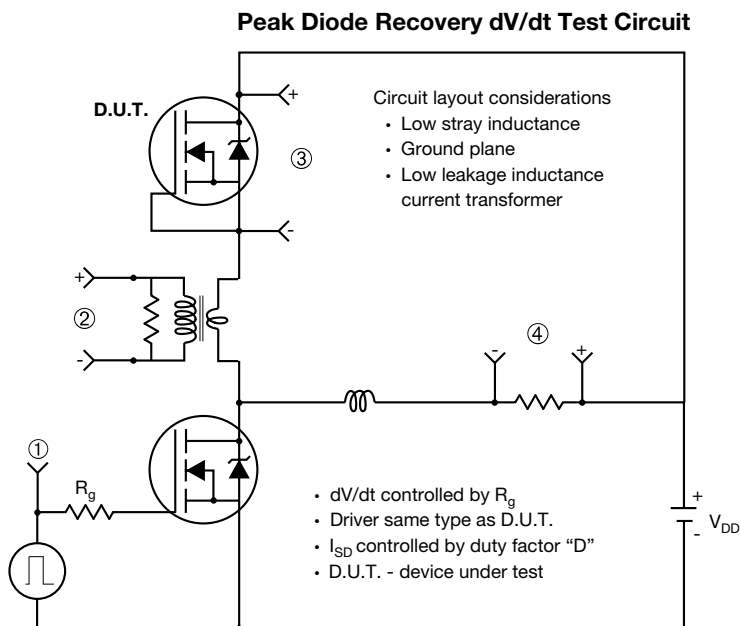


Fig. 13a - Basic Gate Charge Waveform



Fig. 13b - Gate Charge Test Circuit



**Note**

a.  $V_{GS} = 5\text{ V}$  for logic level devices

**Fig. 14 - For N-Channel**

Vishay Siliconix maintains worldwide manufacturing capability. Products may be manufactured at one of several qualified locations. Reliability data for Silicon Technology and Package Reliability represent a composite of all qualified locations. For related documents such as package/tape drawings, part marking, and reliability data, see [www.vishay.com/ppg?90414](http://www.vishay.com/ppg?90414).

### TO-263AB (HIGH VOLTAGE)



| DIM. | MILLIMETERS |      | INCHES |       |
|------|-------------|------|--------|-------|
|      | MIN.        | MAX. | MIN.   | MAX.  |
| A    | 4.06        | 4.83 | 0.160  | 0.190 |
| A1   | 0.00        | 0.25 | 0.000  | 0.010 |
| b    | 0.51        | 0.99 | 0.020  | 0.039 |
| b1   | 0.51        | 0.89 | 0.020  | 0.035 |
| b2   | 1.14        | 1.78 | 0.045  | 0.070 |
| b3   | 1.14        | 1.73 | 0.045  | 0.068 |
| c    | 0.38        | 0.74 | 0.015  | 0.029 |
| c1   | 0.38        | 0.58 | 0.015  | 0.023 |
| c2   | 1.14        | 1.65 | 0.045  | 0.065 |
| D    | 8.38        | 9.65 | 0.330  | 0.380 |

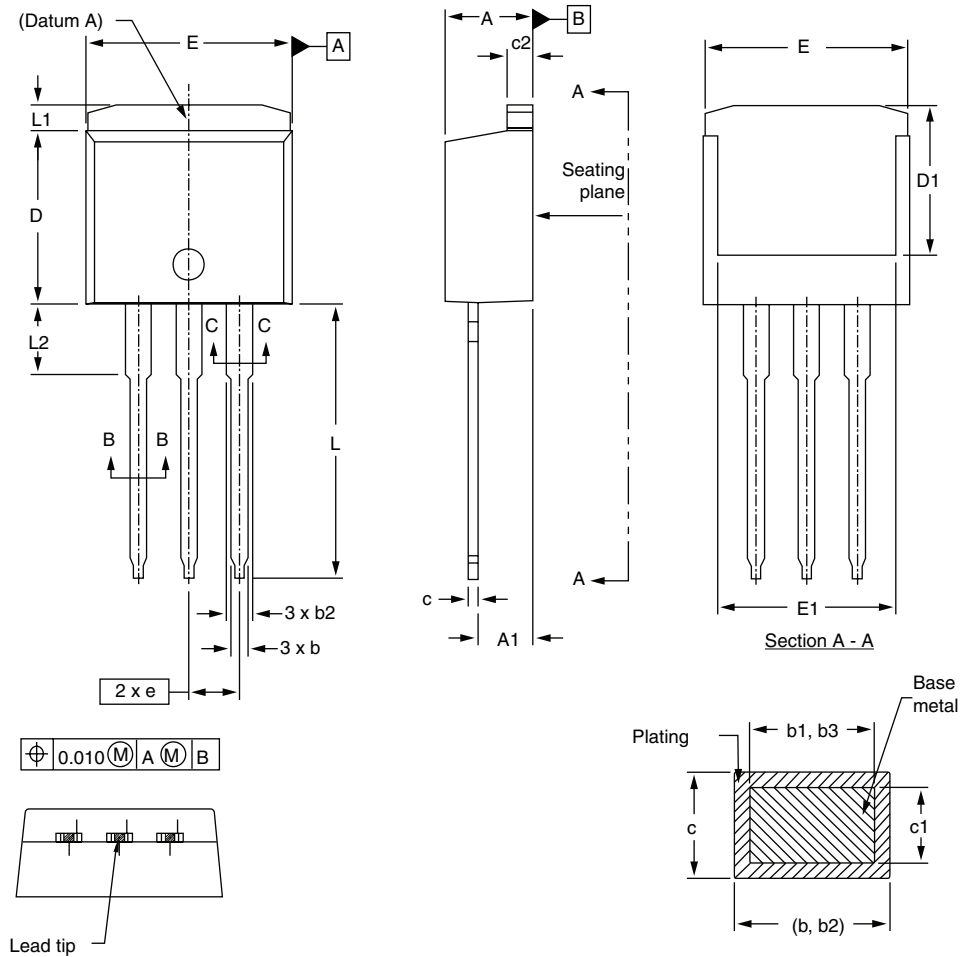
| DIM. | MILLIMETERS |       | INCHES    |       |
|------|-------------|-------|-----------|-------|
|      | MIN.        | MAX.  | MIN.      | MAX.  |
| D1   | 6.86        | -     | 0.270     | -     |
| E    | 9.65        | 10.67 | 0.380     | 0.420 |
| E1   | 6.22        | -     | 0.245     | -     |
| e    | 2.54 BSC    |       | 0.100 BSC |       |
| H    | 14.61       | 15.88 | 0.575     | 0.625 |
| L    | 1.78        | 2.79  | 0.070     | 0.110 |
| L1   | -           | 1.65  | -         | 0.066 |
| L2   | -           | 1.78  | -         | 0.070 |
| L3   | 0.25 BSC    |       | 0.010 BSC |       |
| L4   | 4.78        | 5.28  | 0.188     | 0.208 |

ECN: S-82110-Rev. A, 15-Sep-08  
DWG: 5970

#### Notes

1. Dimensioning and tolerancing per ASME Y14.5M-1994.
2. Dimensions are shown in millimeters (inches).
3. Dimension D and E do not include mold flash. Mold flash shall not exceed 0.127 mm (0.005") per side. These dimensions are measured at the outmost extremes of the plastic body at datum A.
4. Thermal PAD contour optional within dimension E, L1, D1 and E1.
5. Dimension b1 and c1 apply to base metal only.
6. Datum A and B to be determined at datum plane H.
7. Outline conforms to JEDEC outline to TO-263AB.

## I<sup>2</sup>PAK (TO-262) (HIGH VOLTAGE)



|      | MILLIMETERS |      | INCHES |       |
|------|-------------|------|--------|-------|
| DIM. | MIN.        | MAX. | MIN.   | MAX.  |
| A    | 4.06        | 4.83 | 0.160  | 0.190 |
| A1   | 2.03        | 3.02 | 0.080  | 0.119 |
| b    | 0.51        | 0.99 | 0.020  | 0.039 |
| b1   | 0.51        | 0.89 | 0.020  | 0.035 |
| b2   | 1.14        | 1.78 | 0.045  | 0.070 |
| b3   | 1.14        | 1.73 | 0.045  | 0.068 |
| c    | 0.38        | 0.74 | 0.015  | 0.029 |
| c1   | 0.38        | 0.58 | 0.015  | 0.023 |
| c2   | 1.14        | 1.65 | 0.045  | 0.065 |

|      | MILLIMETERS |       | INCHES    |       |
|------|-------------|-------|-----------|-------|
| DIM. | MIN.        | MAX.  | MIN.      | MAX.  |
| D    | 8.38        | 9.65  | 0.330     | 0.380 |
| D1   | 6.86        | -     | 0.270     | -     |
| E    | 9.65        | 10.67 | 0.380     | 0.420 |
| E1   | 6.22        | -     | 0.245     | -     |
| e    | 2.54 BSC    |       | 0.100 BSC |       |
| L    | 13.46       | 14.10 | 0.530     | 0.555 |
| L1   | -           | 1.65  | -         | 0.065 |
| L2   | 3.56        | 3.71  | 0.140     | 0.146 |

ECN: S-82442-Rev. A, 27-Oct-08  
DWG: 5977

### Notes

1. Dimensioning and tolerancing per ASME Y14.5M-1994.
2. Dimension D and E do not include mold flash. Mold flash shall not exceed 0.127 mm per side. These dimensions are measured at the outmost extremes of the plastic body.
3. Thermal pad contour optional within dimension E, L1, D1, and E1.
4. Dimension b1 and c1 apply to base metal only.



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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.**

**Vishay Intertechnology, Inc. hereby certifies that all its products that are identified as Halogen-Free follow Halogen-Free requirements as per JEDEC JS709A standards. Please note that some Vishay documentation may still make reference to the IEC 61249-2-21 definition. We confirm that all the products identified as being compliant to IEC 61249-2-21 conform to JEDEC JS709A standards.**