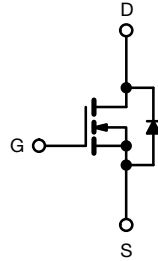
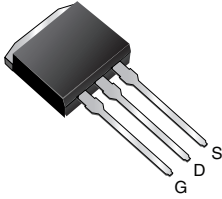


## Power MOSFET

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


N-Channel MOSFET

### FEATURES

- Dynamic dV/dt rating
- Repetitive avalanche rated
- Fast switching
- Ease of paralleling
- Simple drive requirements
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)


**RoHS\***  
Available

### Note

\* This datasheet provides information about parts that are RoHS-compliant and / or parts that are non RoHS-compliant. For example, parts with lead (Pb) terminations are not RoHS-compliant. Please see the information / tables in this datasheet for details

### 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.

### PRODUCT SUMMARY

|                            |                        |      |
|----------------------------|------------------------|------|
| V <sub>DS</sub> (V)        | 500                    |      |
| R <sub>DS(on)</sub> (Ω)    | V <sub>GS</sub> = 10 V | 0.55 |
| Q <sub>g</sub> (Max.) (nC) | 51                     |      |
| Q <sub>gs</sub> (nC)       | 12                     |      |
| Q <sub>gd</sub> (nC)       | 23                     |      |
| Configuration              | Single                 |      |

### ORDERING INFORMATION

|                |                             |
|----------------|-----------------------------|
| Package        | I <sup>2</sup> PAK (TO-262) |
| Lead (Pb)-free | IRFSL11N50APbF              |

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

| PARAMETER  | SYMBOL                            | LIMIT                   | UNIT |
|--|-----------------------------------|-------------------------|------|
| Drain-Source Voltage                             | V <sub>DS</sub>                   | 500                     | V    |
| Gate-Source Voltage                              | V <sub>GS</sub>                   | ± 30                    |      |
| Continuous Drain Current                         | I <sub>D</sub>                    | T <sub>C</sub> = 25 °C  | A    |
|  |                                   | T <sub>C</sub> = 100 °C |      |
| Pulsed Drain Current <sup>a</sup>                | I <sub>DM</sub>                   | 44                      |      |
| Linear Derating Factor                           |                                   | 1.3                     | W/°C |
| Single Pulse Avalanche Energy <sup>b</sup>       | E <sub>AS</sub>                   | 390                     | mJ   |
| Repetitive Avalanche Current <sup>a</sup>        | I <sub>AR</sub>                   | 11                      | A    |
| Repetitive Avalanche Energy <sup>a</sup>         | E <sub>AR</sub>                   | 19                      | mJ   |
| Maximum Power Dissipation                        | P <sub>D</sub>                    | 190                     | W    |
| Peak Diode Recovery dV/dt <sup>c</sup>           | dV/dt                             | 4.1                     | V/ns |
| Operating Junction and Storage Temperature Range | T <sub>J</sub> , T <sub>stg</sub> | - 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)
- Starting T<sub>J</sub> = 25 °C, L = 6.4 mH, R<sub>G</sub> = 25 Ω, I<sub>AS</sub> = 11 A (see fig. 12)
- I<sub>SD</sub> ≤ 11 A, dI/dt ≤ 185 A/μs, V<sub>DD</sub> ≤ V<sub>DS</sub>, T<sub>J</sub> ≤ 175 °C
- 1.6 mm from case

**THERMAL RESISTANCE RATINGS**

| PARAMETER                        | SYMBOL     | TYP. | MAX. | UNIT |
|----------------------------------|------------|------|------|------|
| Maximum Junction-to-Ambient      | $R_{thJA}$ | -    | 40   | °C/W |
| Maximum Junction-to-Case (Drain) | $R_{thJC}$ | -    | 0.75 |      |

**SPECIFICATIONS** ( $T_J = 25\text{ °C}$ , 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, I <sub>D</sub> = 250 μA  |  | 500  | -    | -     | 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   |  | -    | 0.57 | -     | 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> = ± 30 V  |  | -    | -    | ± 100 | nA   |
| Zero Gate Voltage Drain Current           | I <sub>DSS</sub>                 | V <sub>DS</sub> = 500 V, V <sub>GS</sub> = 0 V  |  | -    | -    | 25    | μA   |
|   |                                  | V <sub>DS</sub> = 400 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> = 10 V  | I <sub>D</sub> = 6.6 A <sup>b</sup>  | -    | -    | 0.55  | Ω    |
| Forward Transconductance                  | g <sub>fs</sub>                  | V <sub>DS</sub> = 50 V, I <sub>D</sub> = 6.6 A <sup>b</sup>   |  | 6.0  | -    | -     | 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  |  | -    | 1426 | -     | pF   |
| Output Capacitance                        | C <sub>oss</sub>                 |   |  | -    | 208  | -     |      |
| Reverse Transfer Capacitance              | C <sub>rss</sub>                 |   |  | -    | 9.6  | -     |      |
| Output Capacitance                        | C <sub>oss</sub>                 | V <sub>GS</sub> = 0 V   | V <sub>DS</sub> = 1.0 V, f = 1.0 MHz   | -    | 1954 | -     | pF   |
|   |                                  |   | V <sub>DS</sub> = 400 V, f = 1.0 MHz   | -    | 53   | -     |      |
| Effective Output Capacitance              | C <sub>oss eff.</sub>            |   | V <sub>DS</sub> = 0 V to 400 V <sup>c</sup>                                      | -    | 110  | -     |      |
| Total Gate Charge                         | Q <sub>g</sub>                   | V <sub>GS</sub> = 10 V  | I <sub>D</sub> = 11 A, V <sub>DS</sub> = 400 V<br>see fig. 6 and 13 <sup>b</sup> | -    | -    | 51    | nC   |
| Gate-Source Charge                        | Q <sub>gs</sub>                  |   |  | -    | -    | 12    |      |
| Gate-Drain Charge                         | Q <sub>gd</sub>                  |   |  | -    | -    | 23    |      |
| Turn-On Delay Time                        | t <sub>d(on)</sub>               | V <sub>DD</sub> = 250 V, I <sub>D</sub> = 11 A<br>R <sub>G</sub> = 9.1 Ω, R <sub>D</sub> = 22 Ω, see fig. 10 <sup>b</sup> |  | -    | 14   | -     | ns   |
| Rise Time                                 | t <sub>r</sub>                   |   |  | -    | 34   | -     |      |
| Turn-Off Delay Time                       | t <sub>d(off)</sub>              |   |  | -    | 32   | -     |      |
| Fall Time                                 | t <sub>f</sub>                   |   |  | -    | 27   | -     |      |
| Internal Drain Inductance                 | L <sub>D</sub>                   | Between lead,<br>6 mm (0.25") from<br>package and center of<br>die contact  |  | -    | 4.5  | -     | nH   |
| Internal Source Inductance                | L <sub>S</sub>                   |   |  | -    | 7.5  | -     |      |
| 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  |  | -    | -    | 11    | A    |
| Pulsed Diode Forward Current <sup>a</sup> | I <sub>SM</sub>                  |   |  | -    | -    | 44    |      |
| Body Diode Voltage                        | V <sub>SD</sub>                  | T <sub>J</sub> = 25 °C, I <sub>S</sub> = 11 A, V <sub>GS</sub> = 0 V <sup>b</sup>   |  | -    | -    | 1.5   | V    |
| Body Diode Reverse Recovery Time          | t <sub>rr</sub>                  | T <sub>J</sub> = 25 °C, I <sub>F</sub> = 11 A, dI/dt = 100 A/μs <sup>b</sup>  |  | -    | 530  | 790   | ns   |
| Body Diode Reverse Recovery Charge        | Q <sub>rr</sub>                  |   |  | -    | 3.4  | 5.1   | 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  $\leq 2\%$ c.  $C_{oss\text{ eff.}}$  is a fixed capacitance that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 % to 80 %  $V_{DS}$



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

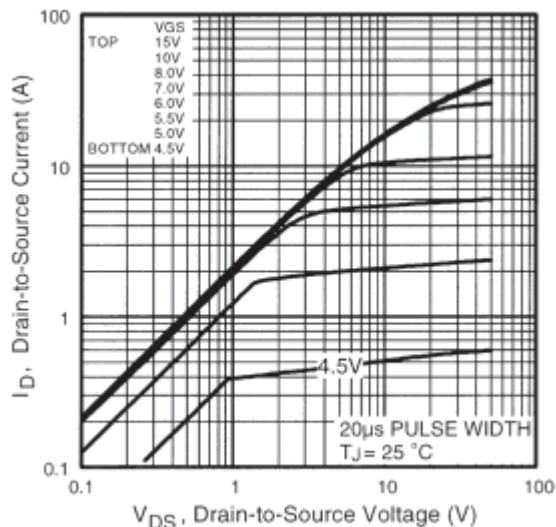


Fig. 1 - Typical Output Characteristics

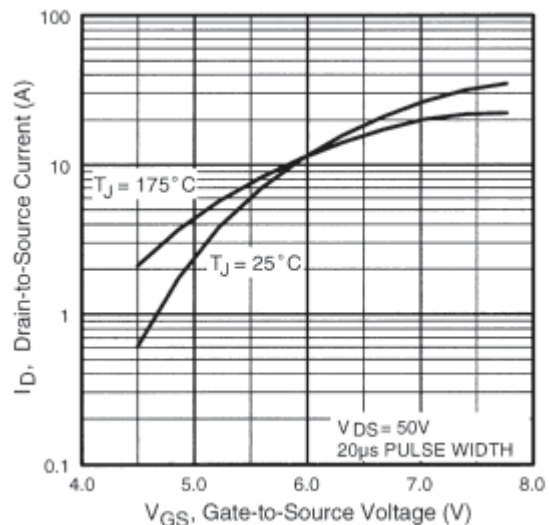


Fig. 3 - Typical Transfer Characteristics

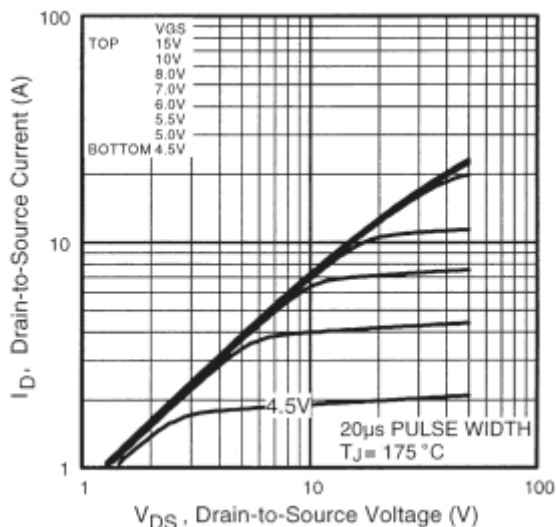


Fig. 2 - Typical Output Characteristics

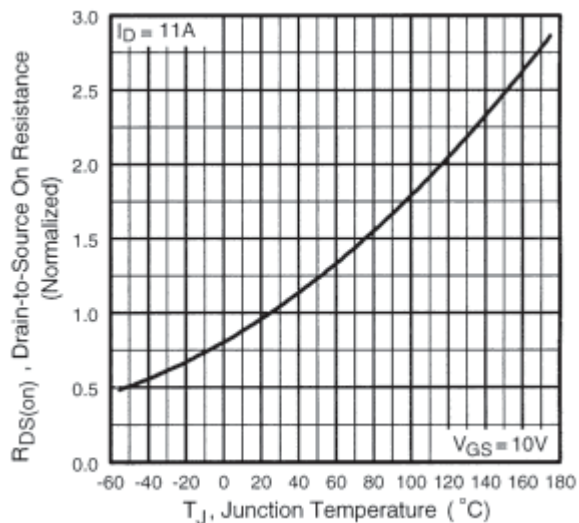
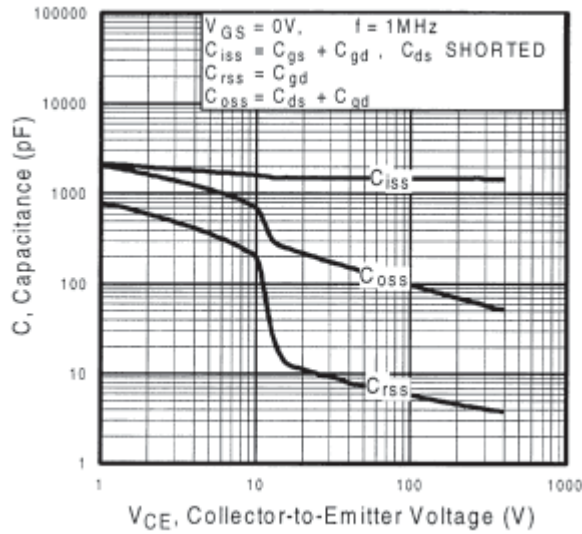
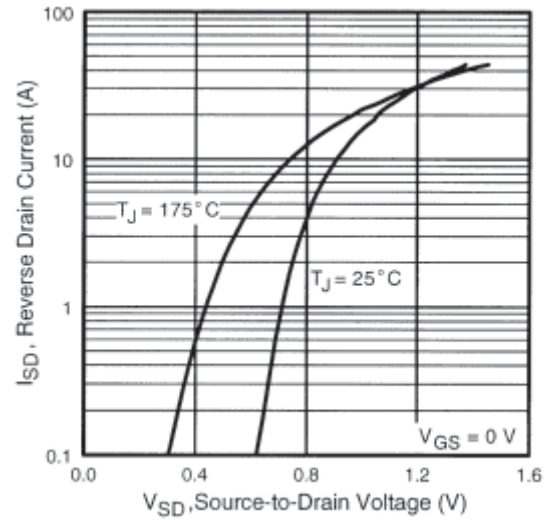
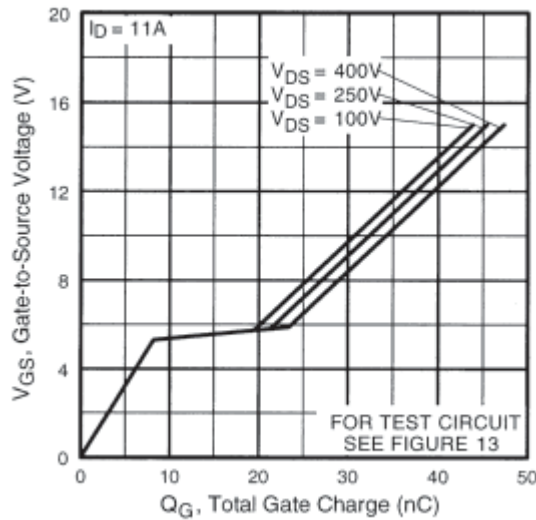
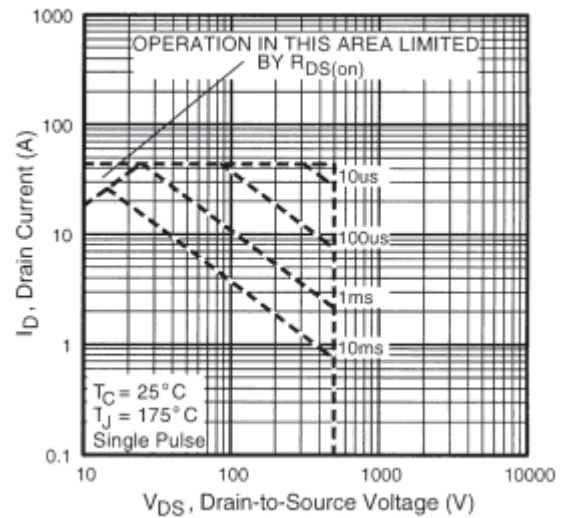
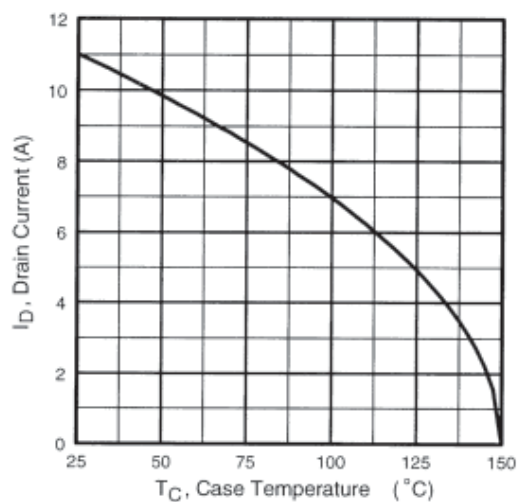
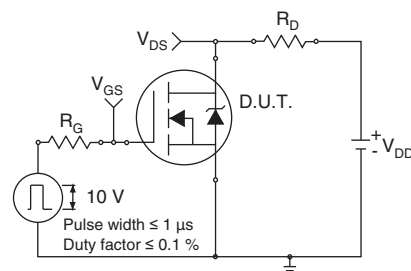
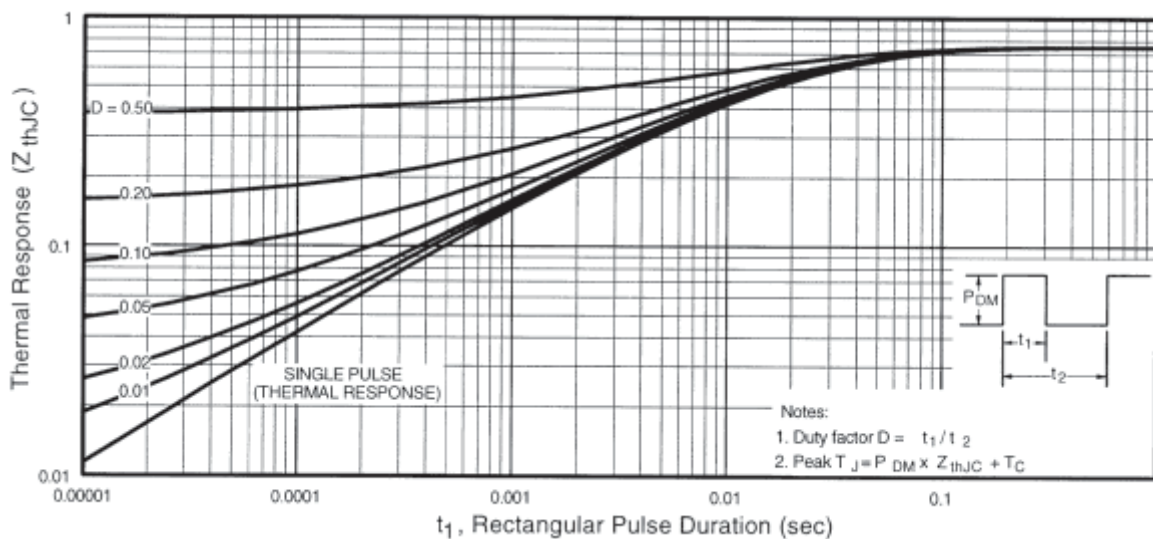
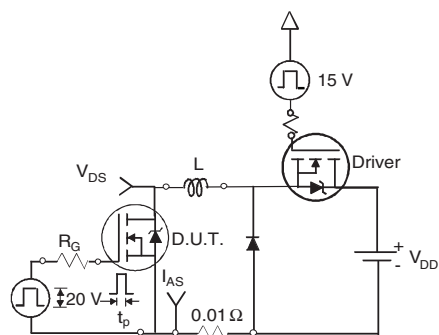


Fig. 4 - Normalized On-Resistance vs. Temperature

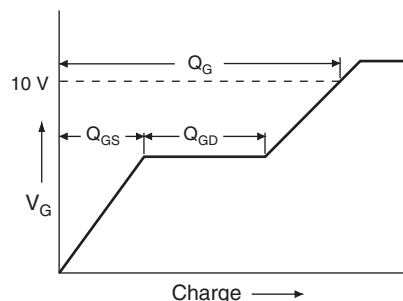

**Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage**

**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. 8 - Maximum Drain Current vs. Case Temperature**

**Fig. 9a - Switching Time Test Circuit**

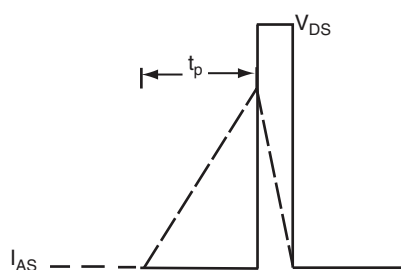
**Fig. 10b - Switching Time Waveforms**

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



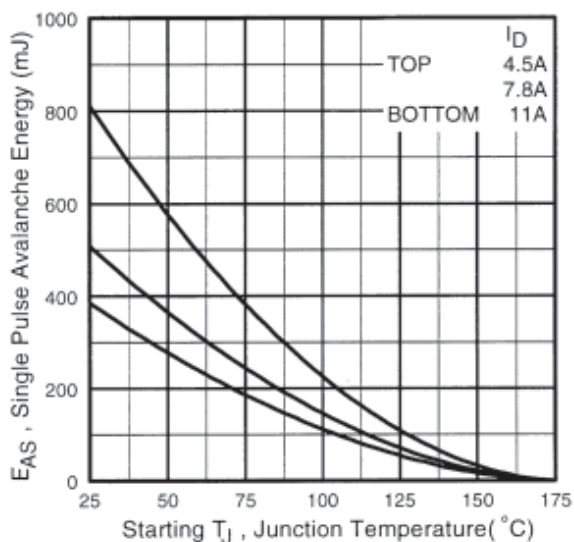
**Fig. 12a - Unclamped Inductive Test Circuit**



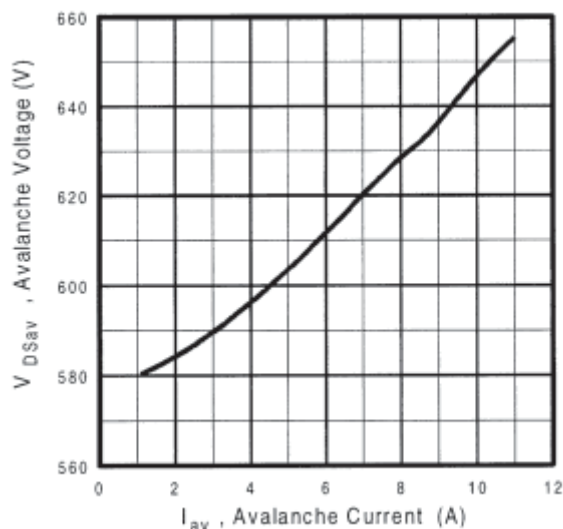
**Fig. 13a - Basic Gate Charge Waveform**



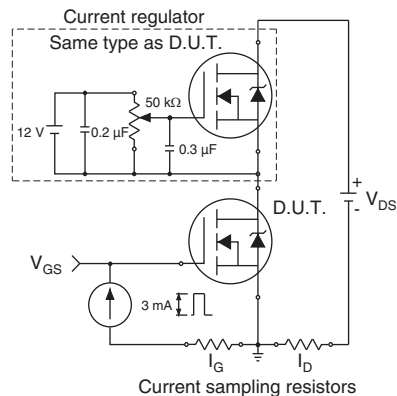
**Fig. 12b - Unclamped Inductive Waveforms**



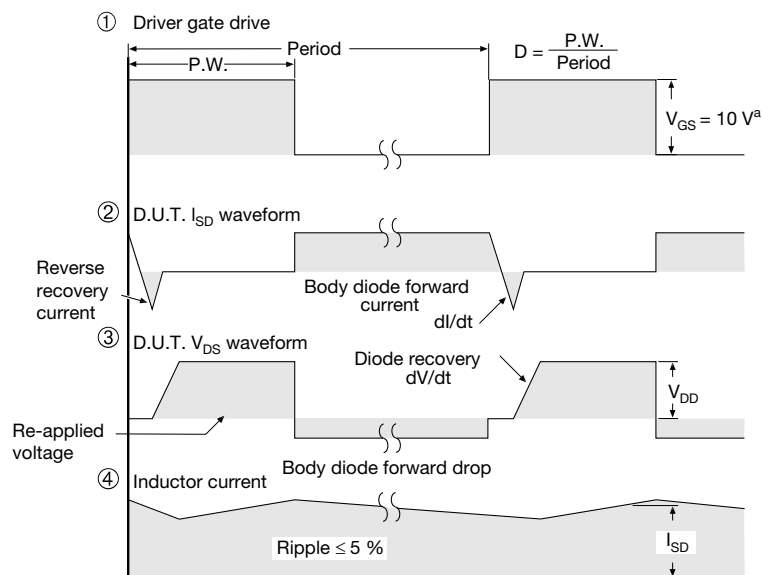
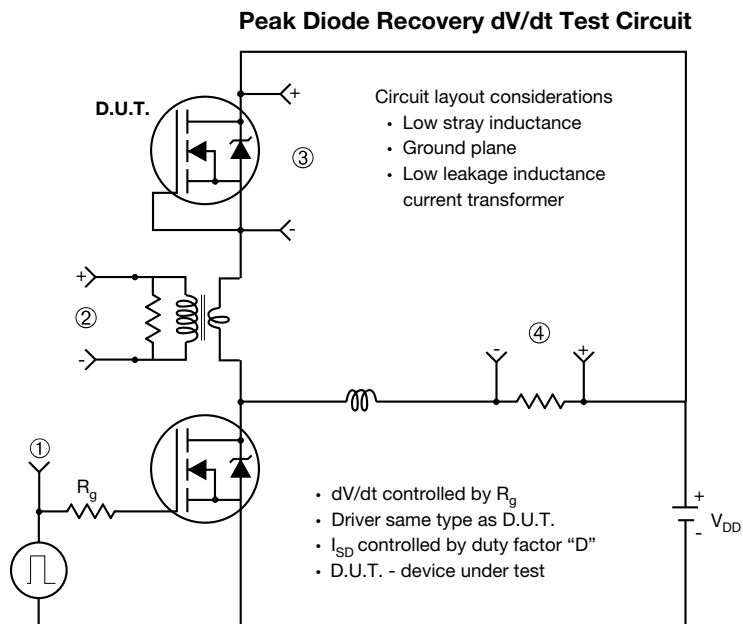
**Fig. 12c - Maximum Avalanche Energy vs. Drain Current**



**Fig. 12d - Typical Drain-to-Source Voltage vs. Avalanche Current**



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


**Note**

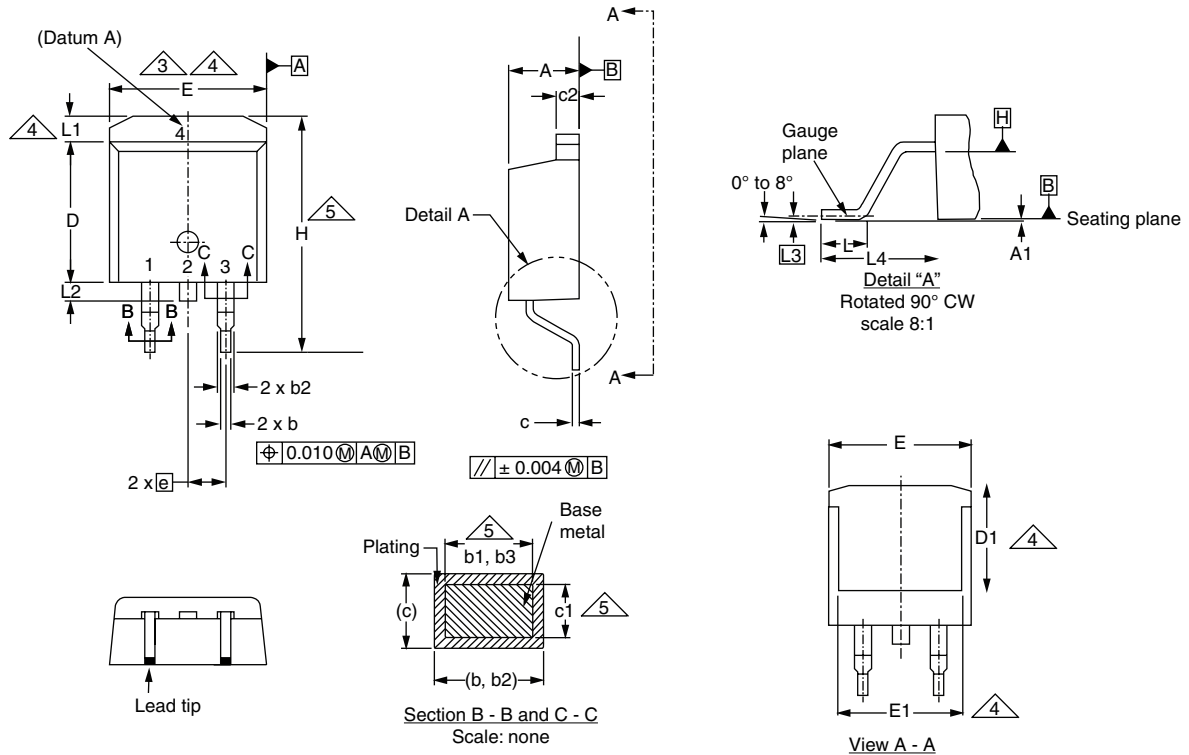
a.  $V_{GS} = 5\text{ V}$  for logic level devices

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

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### 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 |

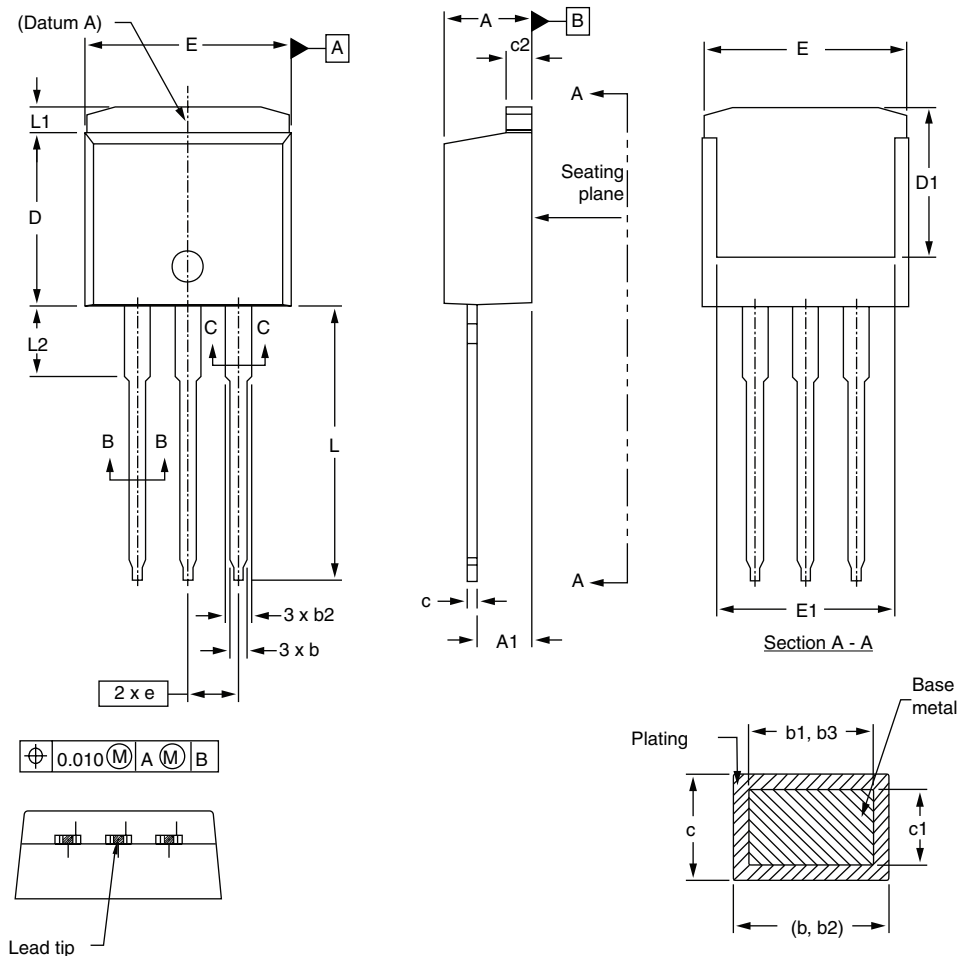
ECN: S-82110-Rev. A, 15-Sep-08  
DWG: 5970

#### 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.

**RECOMMENDED MINIMUM PADS FOR D<sup>2</sup>PAK: 3-Lead**



Recommended Minimum Pads  
Dimensions in Inches/(mm)

[Return to Index](#)



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