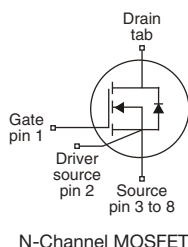
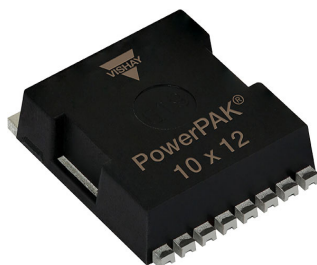


## EF Series Power MOSFET With Fast Body Diode



### FEATURES

- 4<sup>th</sup> generation E series technology
- Low figure-of-merit (FOM)  $R_{on} \times Q_g$
- Low effective capacitance ( $C_{o(er)}$ )
- Reduced switching and conduction losses
- Avalanche energy rated (UIS)
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



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

### APPLICATIONS

- Server and telecom power supplies
- Switch mode power supplies (SMPS)
- Power factor correction power supplies (PFC)
- Lighting
  - High-intensity discharge (HID)
  - Fluorescent ballast lighting
- Industrial
  - Welding
  - Induction heating
  - Motor drives
  - Battery chargers
  - Solar (PV inverters)

### PRODUCT SUMMARY

|   |                 |       |
|---|-----------------|-------|
| $V_{DS}$ (V) at $T_J$ max.              | 650             |       |
| $R_{DS(on)}$ typ. ( $\Omega$ ) at 25 °C | $V_{GS} = 10$ V | 0.137 |
| $Q_g$ max. (nC)                         | 38              |       |
| $Q_{gs}$ (nC)                           | 10              |       |
| $Q_{gd}$ (nC)                           | 6               |       |
| Configuration                           | Single          |       |

### ORDERING INFORMATION

|                                 |                    |
|---------------------------------|--------------------|
| Package                         | PowerPAK 10 x 12   |
| Lead (Pb)-free and halogen-free | SiHK155N60EF-T1GE3 |

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

| PARAMETER  | SYMBOL           | LIMIT          | UNIT |
|--|------------------|----------------|------|
| Drain-source voltage                             | $V_{DS}$         | 600            | V    |
| Gate-source voltage                              | $V_{GS}$         | $\pm 30$       |      |
| Continuous drain current ( $T_J = 150$ °C)       | $V_{GS}$ at 10 V | $T_C = 25$ °C  | A    |
|  |                  | $T_C = 100$ °C |      |
| Pulsed drain current <sup>a</sup>                | $I_{DM}$         | 43             |      |
| Linear derating factor                           |                  | 1.04           | W/°C |
| Single pulse avalanche energy <sup>b</sup>       | $E_{AS}$         | 179            | mJ   |
| Maximum power dissipation                        | $P_D$            | 156            | W    |
| Operating junction and storage temperature range | $T_J, T_{stg}$   | -55 to +150    | °C   |
| Drain-source voltage slope                       | $dv/dt$          | $T_J = 125$ °C | V/ns |
| Reverse diode $dv/dt$ <sup>d</sup>               |                  |                |      |


#### Notes

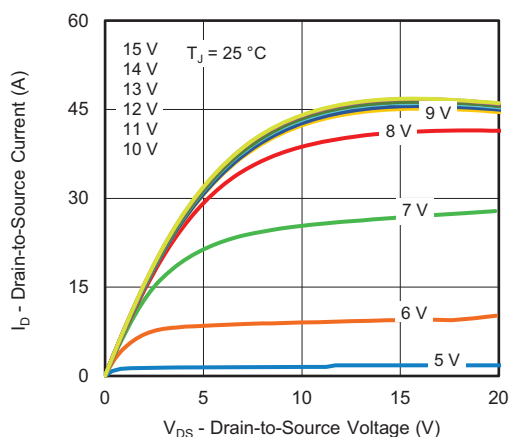
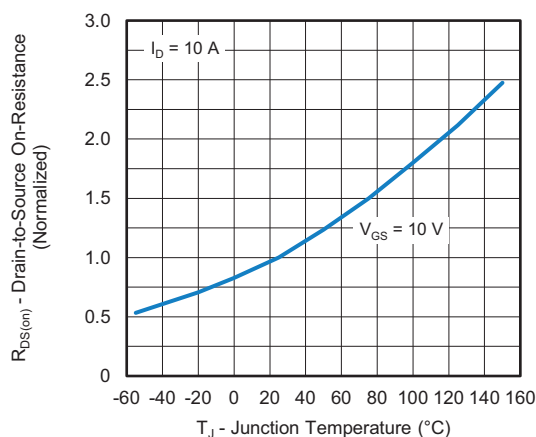
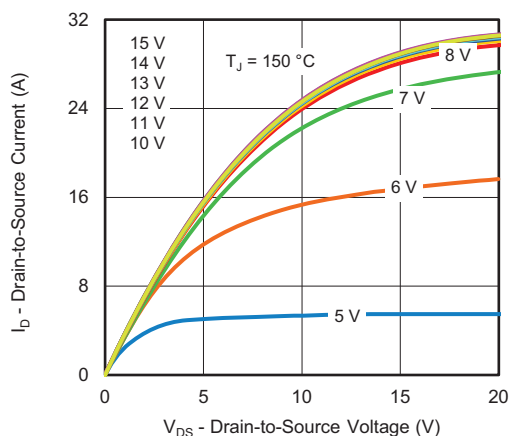
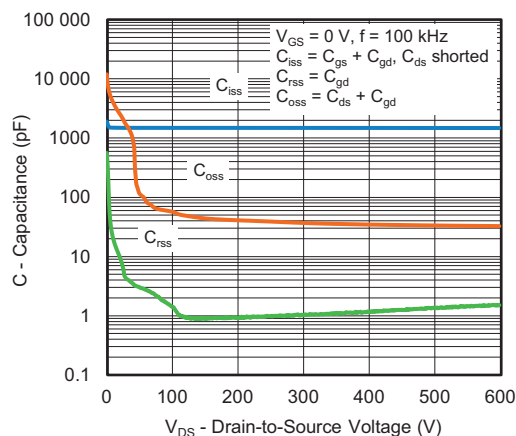
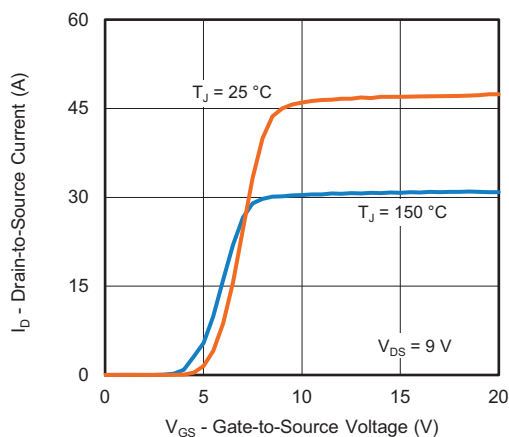
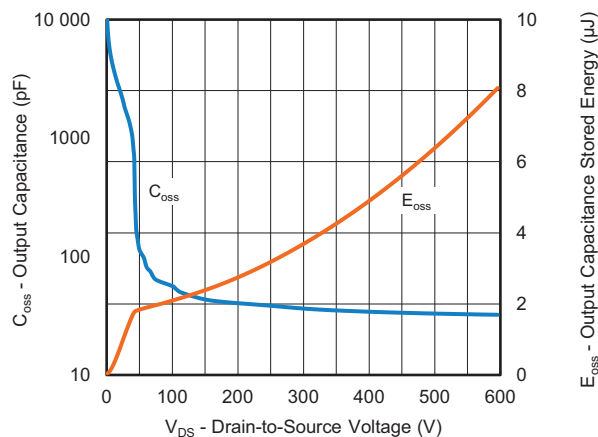
- a. Repetitive rating; pulse width limited by maximum junction temperature  
 b.  $V_{DD} = 120$  V, starting  $T_J = 25$  °C,  $L = 28.2$  mH,  $R_g = 25$   $\Omega$ ,  $I_{AS} = 2.8$  A  
 c.  $I_{SD} \leq I_D$ ,  $di/dt = 100$  A/ $\mu$ s, starting  $T_J = 25$  °C

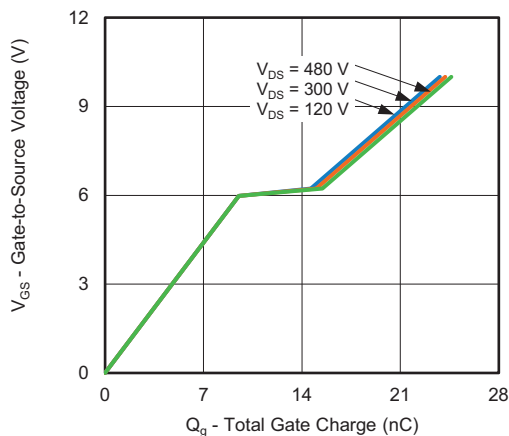
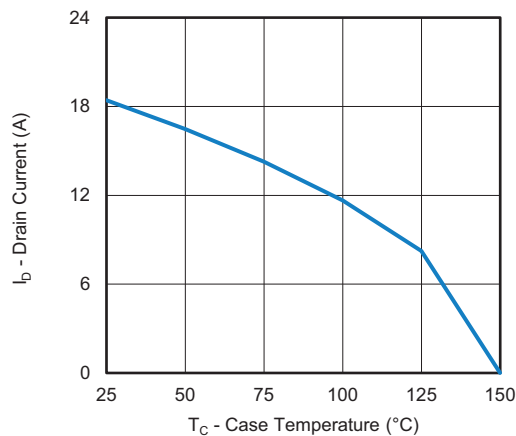
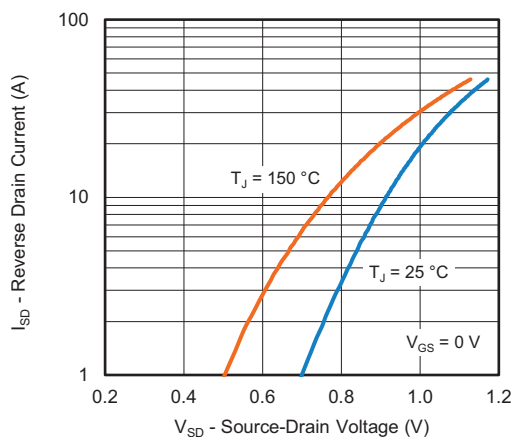
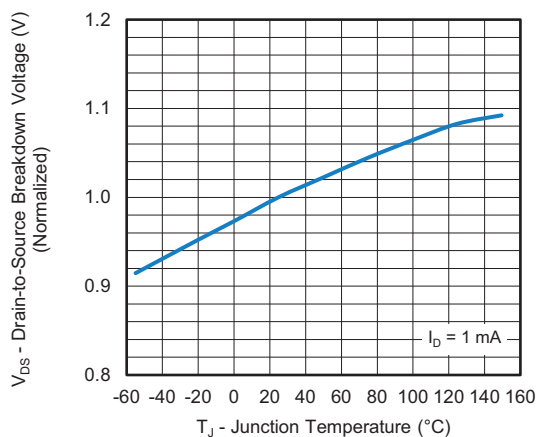
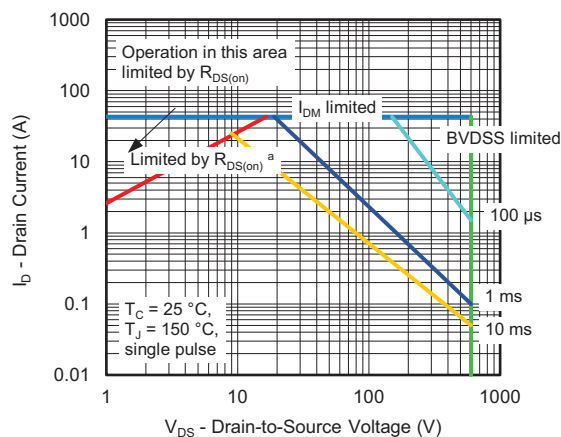
**THERMAL RESISTANCE RATINGS**

| PARAMETER                        | SYMBOL     | TYP. | MAX. | UNIT |
|----------------------------------|------------|------|------|------|
| Maximum junction-to-ambient      | $R_{thJA}$ | -    | 50   | °C/W |
| Maximum junction-to-case (drain) | $R_{thJC}$ | -    | 0.96 |      |

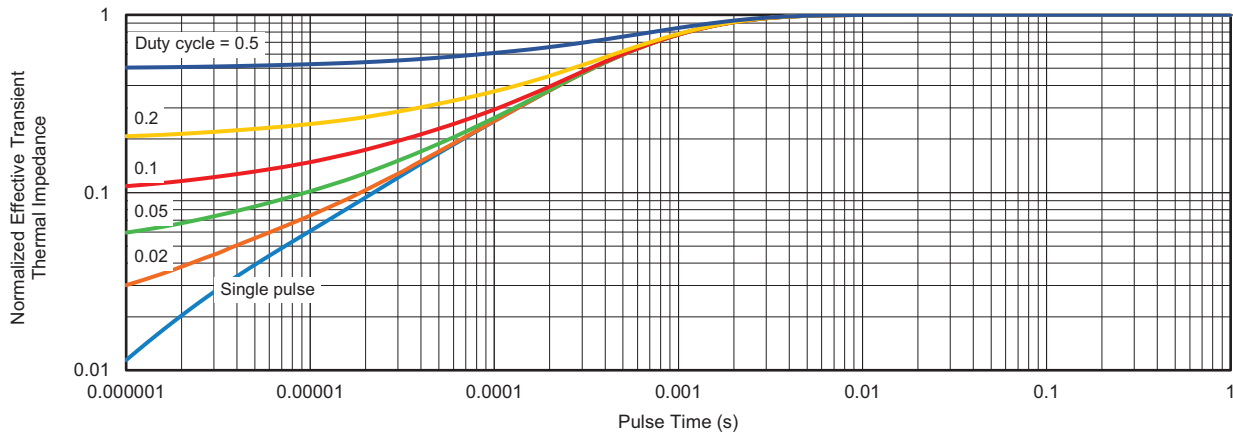
**SPECIFICATIONS** ( $T_J = 25\text{ °C}$ , unless otherwise noted)

| PARAMETER                                    | SYMBOL              | TEST CONDITIONS  |   | MIN. | TYP.  | MAX.      | UNIT                |
|--|---------------------|--|---|------|-------|-----------|---------------------|
| Static                                       |                     |  |   |      |       |           |                     |
| Drain-source breakdown voltage               | $V_{DS}$            | $V_{GS} = 0\text{ V}$ , $I_D = 250\text{ }\mu\text{A}$   |   | 600  | -     | -         | V                   |
| $V_{DS}$ temperature coefficient             | $\Delta V_{DS}/T_J$ | Reference to $25\text{ }^\circ\text{C}$ , $I_D = 1\text{ mA}$  |   | -    | 0.62  | -         | V/ $^\circ\text{C}$ |
| Gate-source threshold voltage (N)            | $V_{GS(th)}$        | $V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{A}$   |   | 3.0  | -     | 5.0       | V                   |
| Gate-source leakage                          | $I_{GSS}$           | $V_{GS} = \pm 20\text{ V}$   |   | -    | -     | $\pm 100$ | nA                  |
|  |                     | $V_{GS} = \pm 30\text{ V}$   |   | -    | -     | $\pm 1$   | $\mu\text{A}$       |
| Zero gate voltage drain current              | $I_{DSS}$           | $V_{DS} = 480\text{ V}$ , $V_{GS} = 0\text{ V}$  |   | -    | -     | 1         | $\mu\text{A}$       |
|  |                     | $V_{DS} = 480\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_J = 125\text{ }^\circ\text{C}$  |   | -    | -     | 2         | mA                  |
| Drain-source on-state resistance             | $R_{DS(on)}$        | $V_{GS} = 10\text{ V}$   | $I_D = 10\text{ A}$                           | -    | 0.137 | 0.159     | $\Omega$            |
| Forward transconductance <sup>a</sup>        | $g_{fs}$            | $V_{DS} = 10\text{ V}$ , $I_D = 10\text{ A}$   |   | -    | 9.2   | -         | S                   |
| Dynamic                                      |                     |  |   |      |       |           |                     |
| Input capacitance                            | $C_{iss}$           | $V_{GS} = 0\text{ V}$ ,<br>$V_{DS} = 100\text{ V}$ ,<br>$f = 100\text{ KHz}$   |   | -    | 1465  | -         | pF                  |
| Output capacitance                           | $C_{oss}$           |  |   | -    | 56    | -         |                     |
| Reverse transfer capacitance                 | $C_{rss}$           |  |   | -    | 1     | -         |                     |
| Effective output capacitance, energy related | $C_{o(er)}$         | $V_{DS} = 0\text{ V to } 400\text{ V}$ , $V_{GS} = 0\text{ V}$   |   | -    | 61    | -         |                     |
| Effective output capacitance, time related   | $C_{o(tr)}$         |  |   | -    | 356   | -         |                     |
| Total gate charge                            | $Q_g$               | $V_{GS} = 10\text{ V}$   | $I_D = 10\text{ A}$ , $V_{DS} = 480\text{ V}$ | -    | 25    | 38        | nC                  |
| Gate-source charge                           | $Q_{gs}$            |  |   | -    | 10    | -         |                     |
| Gate-drain charge                            | $Q_{gd}$            |  |   | -    | 6     | -         |                     |
| Turn-on delay time                           | $t_{d(on)}$         | $V_{DD} = 480\text{ V}$ , $I_D = 10\text{ A}$ ,<br>$V_{GS} = 10\text{ V}$ , $R_g = 9.1\text{ }\Omega$  |   | -    | 20    | 40        | ns                  |
| Rise time                                    | $t_r$               |  |   | -    | 27    | 54        |                     |
| Turn-off delay time                          | $t_{d(off)}$        |  |   | -    | 28    | 56        |                     |
| Fall time                                    | $t_f$               |  |   | -    | 17    | 34        |                     |
| Gate input resistance                        | $R_g$               | $f = 1\text{ MHz}$   |   | 0.4  | 0.9   | 1.8       | $\Omega$            |
| Drain-Source Body Diode Characteristics      |                     |  |   |      |       |           |                     |
| Continuous source-drain diode current        | $I_S$               | MOSFET symbol showing the integral reverse p - n junction diode<br> |   | -    | -     | 18        | A                   |
| Pulsed diode forward current                 | $I_{SM}$            |  |   | -    | -     | 43        |                     |
| Diode forward voltage                        | $V_{SD}$            | $T_J = 25\text{ }^\circ\text{C}$ , $I_S = 10\text{ A}$ , $V_{GS} = 0\text{ V}$   |   | -    | -     | 1.2       | V                   |
| Reverse recovery time                        | $t_{rr}$            | $T_J = 25\text{ }^\circ\text{C}$ , $I_F = I_S = 10\text{ A}$ ,<br>$di/dt = 100\text{ A}/\mu\text{s}$ , $V_R = 400\text{ V}$                              |   | -    | 95    | 190       | ns                  |
| Reverse recovery charge                      | $Q_{rr}$            |  |   | -    | 0.5   | 1.0       | $\mu\text{C}$       |
| Reverse recovery current                     | $I_{RRM}$           |  |   | -    | 12    | -         | A                   |

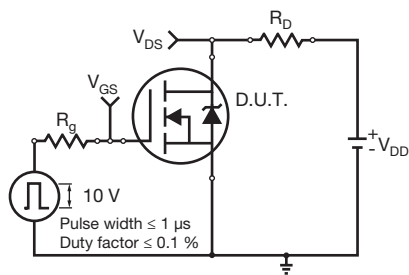
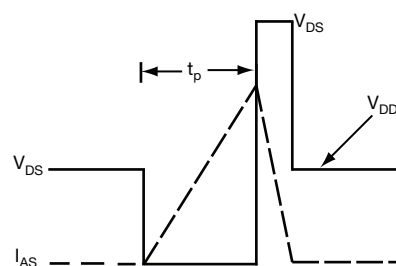
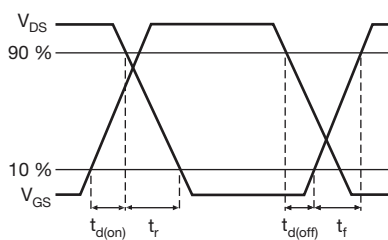
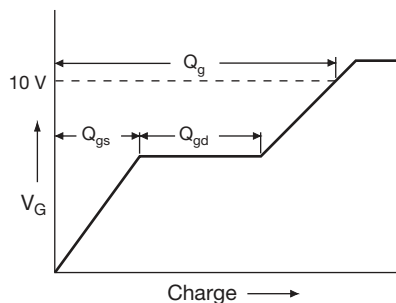
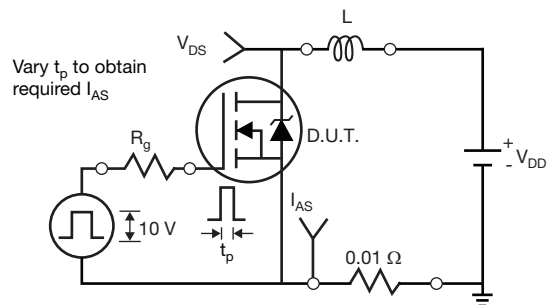
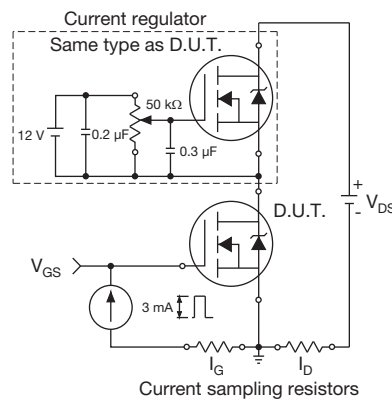
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)

**Fig. 1 - Typical Output Characteristics**

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

**Fig. 2 - Typical Output Characteristics**

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

**Fig. 3 - Typical Transfer Characteristics**

**Fig. 6 -  $C_{oss}$  and  $E_{oss}$  vs.  $V_{DS}$**

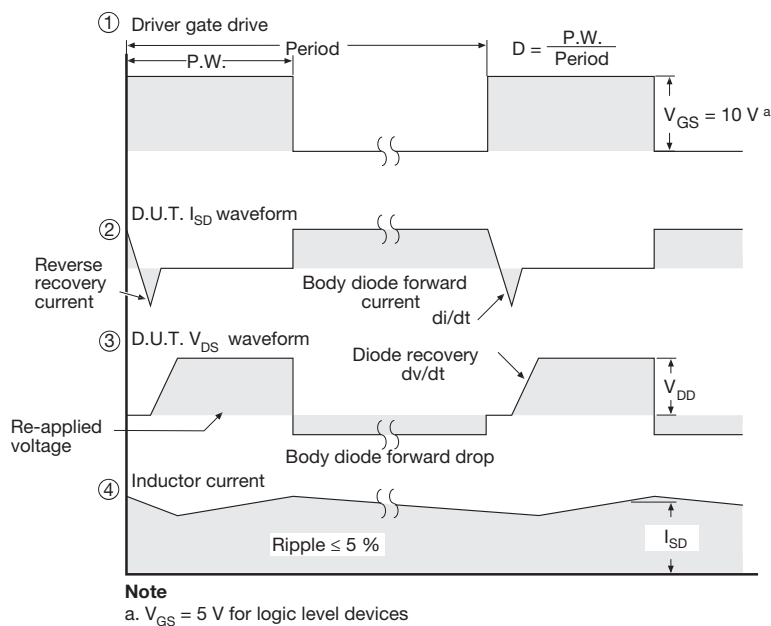
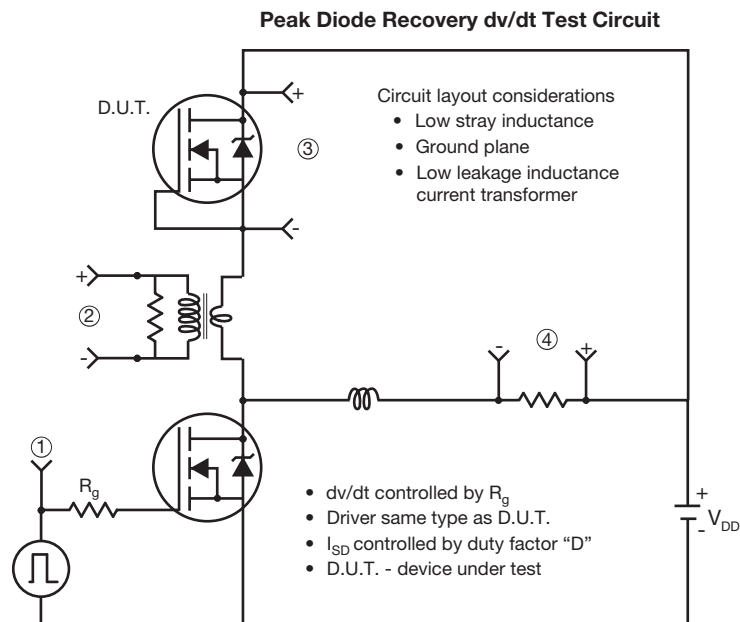

**Fig. 7 - Typical Gate Charge vs. Gate-to-Source Voltage**

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

**Fig. 8 - Typical Source-Drain Diode Forward Voltage**

**Fig. 10 - Temperature vs. Drain-to-Source Voltage**

**Fig. 11 - Maximum Safe Operating Area**
**Note**

a.  $V_{GS} >$  minimum  $V_{GS}$  at which  $R_{DS(on)}$  is specified



**Fig. 12 - Normalized Transient Thermal Impedance, Junction-to-Case**

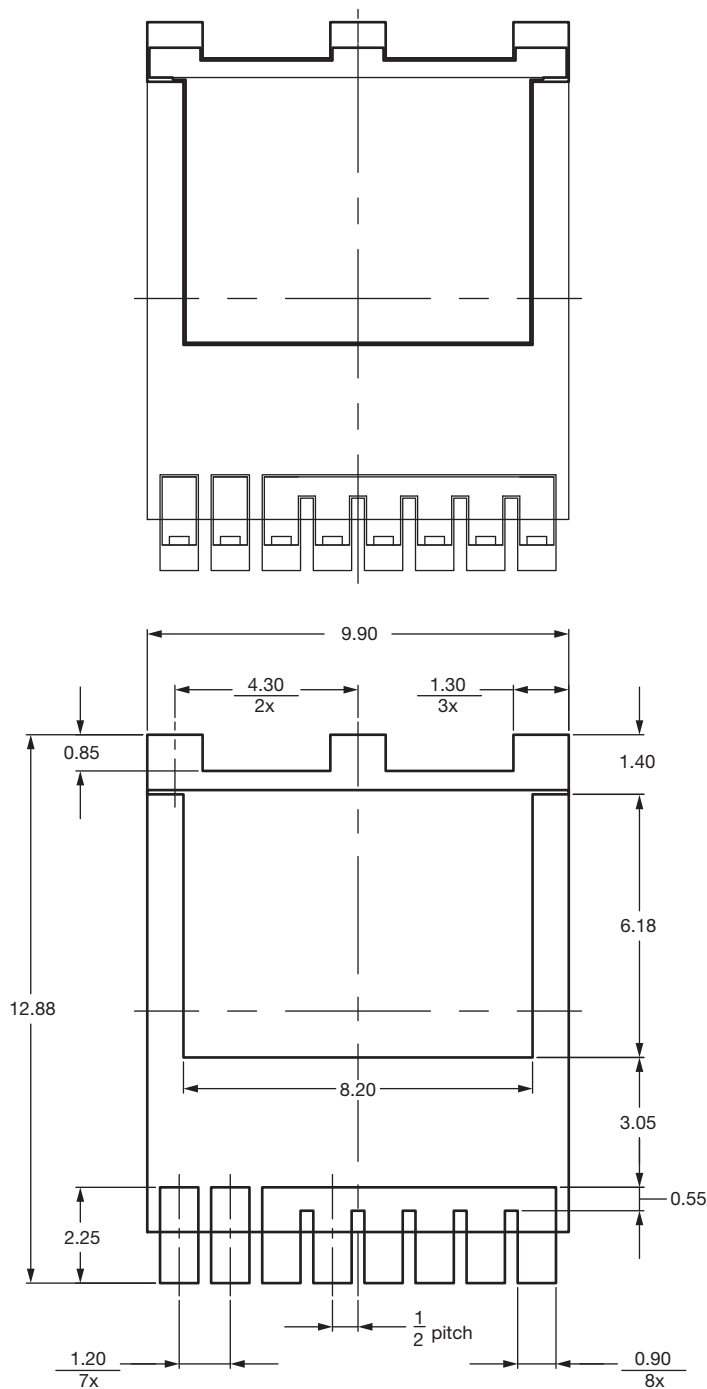

**Fig. 13 - Switching Time Test Circuit**

**Fig. 16 - Unclamped Inductive Waveforms**

**Fig. 14 - Switching Time Waveforms**

**Fig. 17 - Basic Gate Charge Waveform**

**Fig. 15 - Unclamped Inductive Test Circuit**

**Fig. 18 - Gate Charge Test Circuit**



**Fig. 19 - For N-Channel**

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## Recommended Land Pattern PowerPAK® 10 x 12 (TOLL) (High Voltage)


**Note**

- Dimensions in mm

ECN: S22-1061-Rev. C, 26-Dec-2022  
DWG: 3013





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