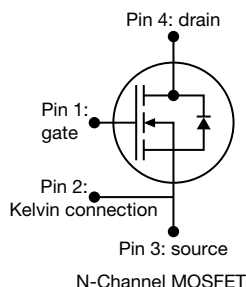
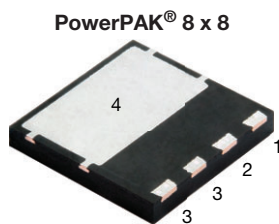


## E Series Power MOSFET



### FEATURES

- Completely lead (Pb)-free device
- Low figure-of-merit (FOM)  $R_{DS(on)} \times Q_g$
- Low input capacitance ( $C_{iss}$ )
- Reduced switching and conduction losses
- Ultra low gate charge ( $Q_g$ )
- Avalanche energy rated (UIS)
- Kelvin connection for reduced gate noise
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**  
**GREEN**  
(5-2008)

### PRODUCT SUMMARY

|                                         |                 |       |
|-----------------------------------------|-----------------|-------|
| $V_{DS}$ (V) at $T_J$ max.              | 700             |       |
| $R_{DS(on)}$ typ. ( $\Omega$ ) at 25 °C | $V_{GS} = 10$ V | 0.225 |
| $Q_g$ max. (nC)                         | 96              |       |
| $Q_{gs}$ (nC)                           | 12              |       |
| $Q_{gd}$ (nC)                           | 21              |       |
| Configuration                           | Single          |       |

### 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
  - Renewable energy
  - Solar (PV inverters)

### ORDERING INFORMATION

|                                 |                   |
|---------------------------------|-------------------|
| Package                         | PowerPAK 8 x 8    |
| Lead (Pb)-free and Halogen-free | SiHH14N65E-T1-GE3 |

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

| PARAMETER                                        | SYMBOL           | LIMIT          | UNIT |
|--------------------------------------------------|------------------|----------------|------|
| Drain-Source Voltage                             | $V_{DS}$         | 650            | 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>                | $I_{DM}$         | 38             |      |
| Linear Derating Factor                           |                  | 1.25           | W/°C |
| Single Pulse Avalanche Energy <sup>b</sup>       | $E_{AS}$         | 226            | 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                       | $dV/dt$          | 70             | V/ns |
| Reverse Diode $dV/dt$ <sup>c</sup>               |                  | 19             |      |

#### Notes

- Repetitive rating; pulse width limited by maximum junction temperature.
- $V_{DD} = 50$  V, starting  $T_J = 25$  °C,  $L = 28.2$  mH,  $R_g = 25$   $\Omega$ ,  $I_{AS} = 4$  A.
- $I_{SD} \leq I_D$ ,  $dI/dt = 100$  A/ $\mu$ s, starting  $T_J = 25$  °C.

**THERMAL RESISTANCE RATINGS**

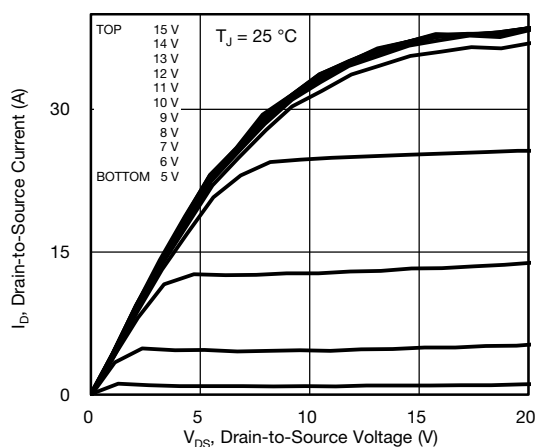
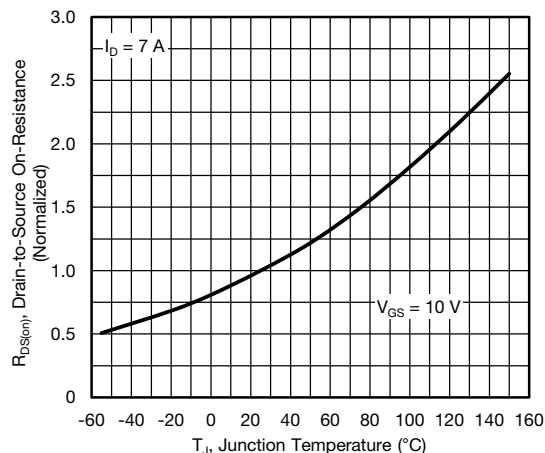
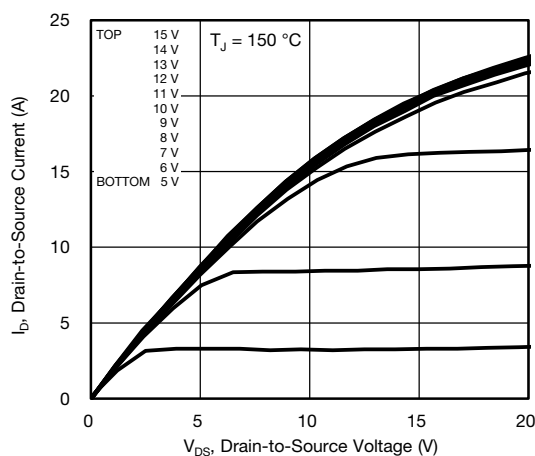
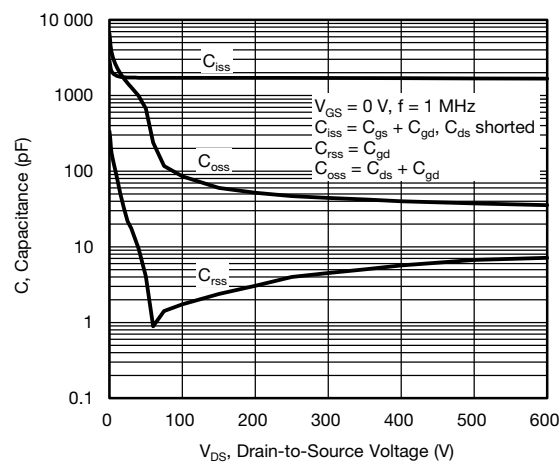
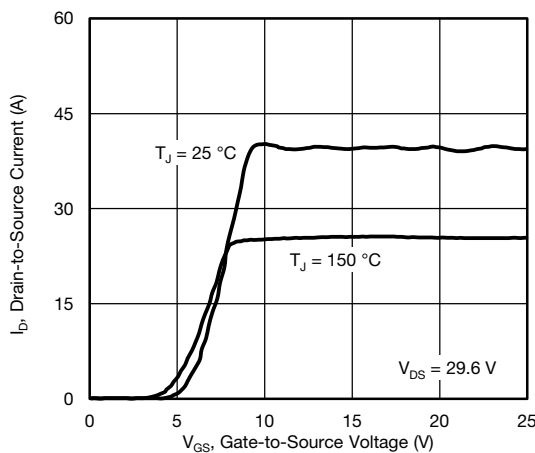
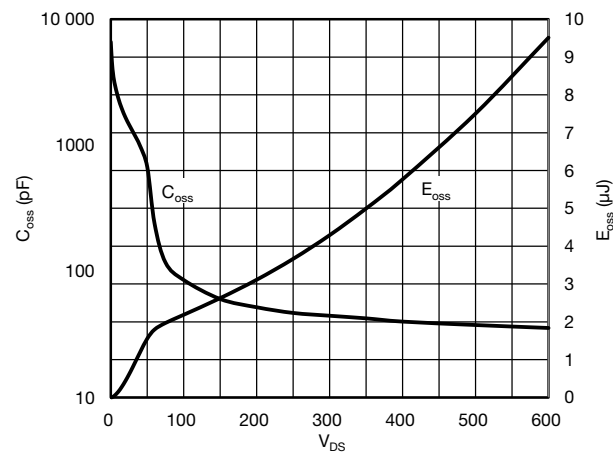
| PARAMETER                        | SYMBOL     | TYP. | MAX. | UNIT |
|----------------------------------|------------|------|------|------|
| Maximum Junction-to-Ambient      | $R_{thJA}$ | 42   | 55   | °C/W |
| Maximum Junction-to-Case (Drain) | $R_{thJC}$ | 0.57 | 0.80 |      |

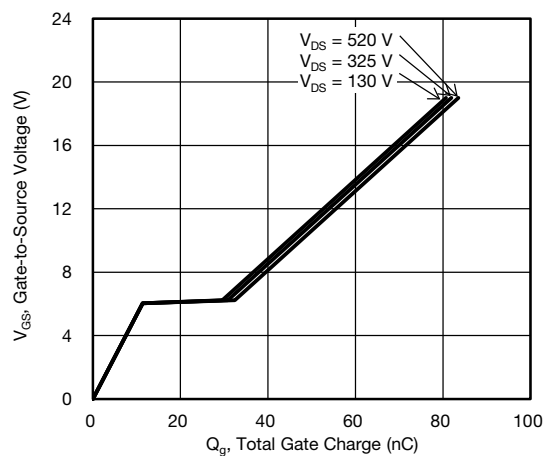
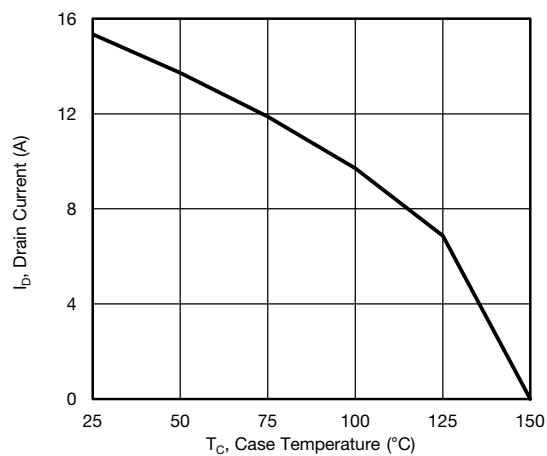
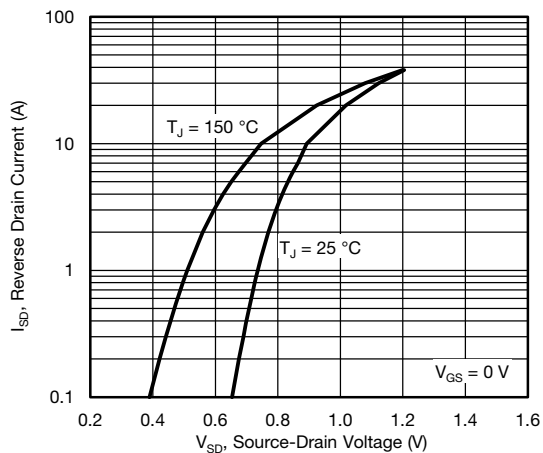
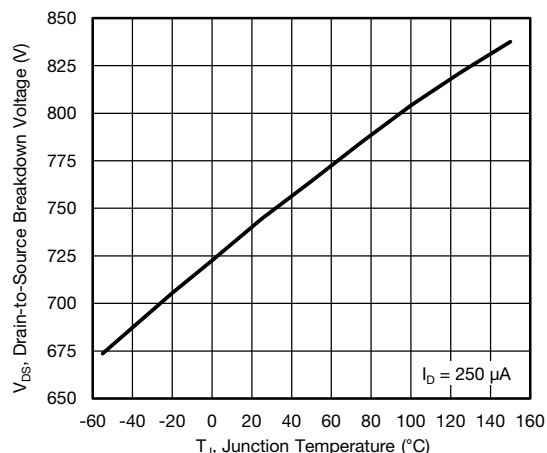
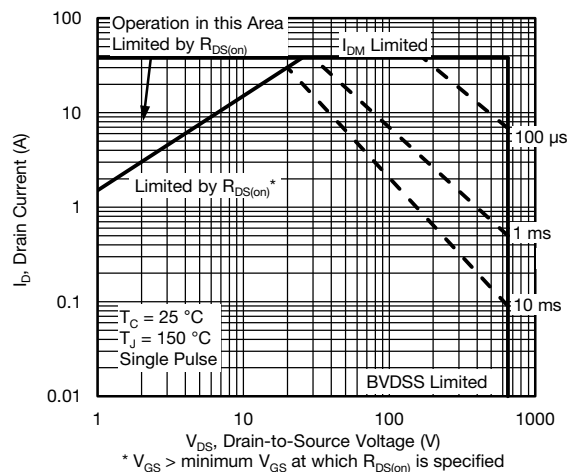
**SPECIFICATIONS** ( $T_J = 25\text{ °C}$ , unless otherwise noted)

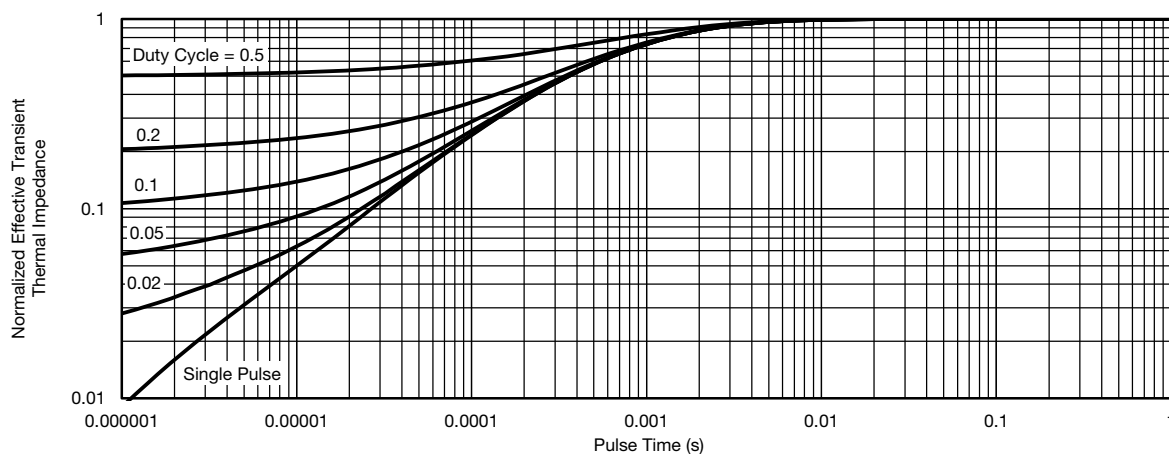
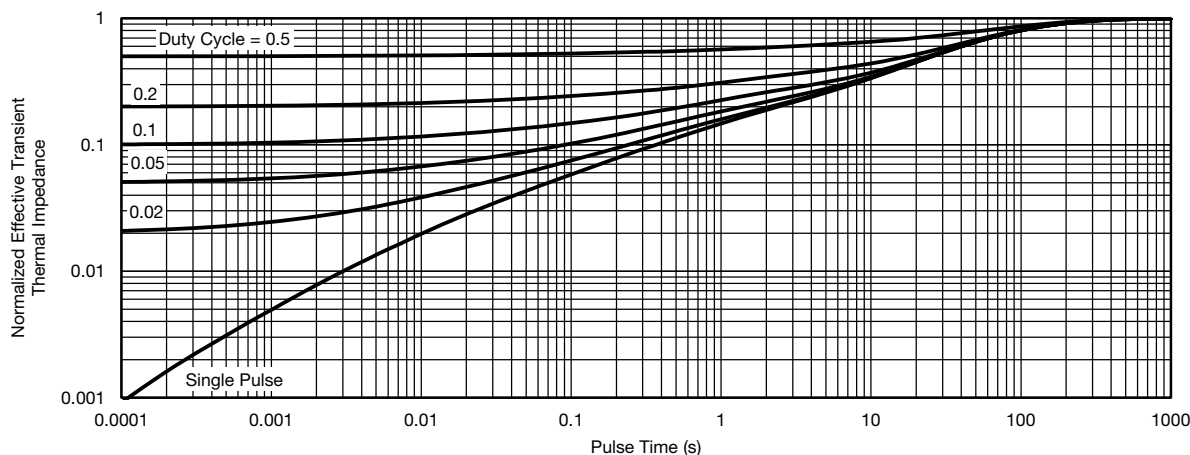
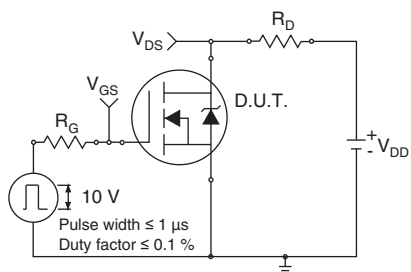
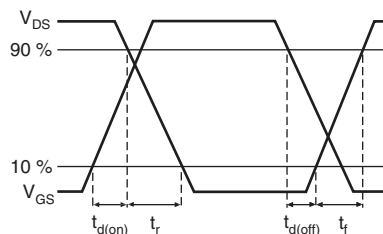
| PARAMETER                                                 | SYMBOL                           | TEST CONDITIONS                                                                                                                                          |                                               | MIN. | TYP.  | MAX.  | UNIT |
|-----------------------------------------------------------|----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|------|-------|-------|------|
| Static                                                    |                                  |                                                                                                                                                          |                                               |      |       |       |      |
| Drain-Source Breakdown Voltage                            | V <sub>DS</sub>                  | V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA                                                                                                           |                                               | 650  | -     | -     | 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                                                                                                                |                                               | -    | 0.81  | -     | V/°C |
| Gate-Source Threshold Voltage (N)                         | 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   |
|                                                           |                                  | V <sub>GS</sub> = ± 30 V                                                                                                                                 |                                               | -    | -     | ± 1   | μA   |
| Zero Gate Voltage Drain Current                           | I <sub>DSS</sub>                 | V <sub>DS</sub> = 650 V, V <sub>GS</sub> = 0 V                                                                                                           |                                               | -    | -     | 1     | μA   |
|                                                           |                                  | V <sub>DS</sub> = 520 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 125 °C                                                                                  |                                               | -    | -     | 50    |      |
| Drain-Source On-State Resistance                          | R <sub>DS(on)</sub>              | V <sub>GS</sub> = 10 V                                                                                                                                   | I <sub>D</sub> = 7 A                          | -    | 0.225 | 0.260 | Ω    |
| Forward Transconductance                                  | g <sub>fs</sub>                  | V <sub>DS</sub> = 30 V, I <sub>D</sub> = 7 A                                                                                                             |                                               | -    | 5.4   | -     | S    |
| Dynamic                                                   |                                  |                                                                                                                                                          |                                               |      |       |       |      |
| Input Capacitance                                         | C <sub>iss</sub>                 | V <sub>GS</sub> = 0 V,<br>V <sub>DS</sub> = 100 V,<br>f = 1 MHz                                                                                          |                                               | -    | 1712  | -     | pF   |
| Output Capacitance                                        | C <sub>oss</sub>                 |                                                                                                                                                          |                                               | -    | 85    | -     |      |
| Reverse Transfer Capacitance                              | C <sub>rss</sub>                 |                                                                                                                                                          |                                               | -    | 2     | -     |      |
| Effective Output Capacitance, Energy Related <sup>a</sup> | C <sub>o(er)</sub>               | V <sub>DS</sub> = 0 V to 520 V, V <sub>GS</sub> = 0 V                                                                                                    |                                               | -    | 56    | -     |      |
| Effective Output Capacitance, Time Related <sup>b</sup>   | C <sub>o(tr)</sub>               |                                                                                                                                                          |                                               | -    | 229   | -     |      |
| Total Gate Charge                                         | Q <sub>g</sub>                   | V <sub>GS</sub> = 10 V                                                                                                                                   | I <sub>D</sub> = 7 A, V <sub>DS</sub> = 520 V | -    | 48    | 96    | nC   |
| Gate-Source Charge                                        | Q <sub>gs</sub>                  |                                                                                                                                                          |                                               | -    | 12    | -     |      |
| Gate-Drain Charge                                         | Q <sub>gd</sub>                  |                                                                                                                                                          |                                               | -    | 21    | -     |      |
| Turn-On Delay Time                                        | t <sub>d(on)</sub>               | V <sub>DD</sub> = 520 V, I <sub>D</sub> = 7 A,<br>V <sub>GS</sub> = 10 V, R <sub>g</sub> = 9.1 Ω                                                         |                                               | -    | 22    | 44    | ns   |
| Rise Time                                                 | t <sub>r</sub>                   |                                                                                                                                                          |                                               | -    | 30    | 60    |      |
| Turn-Off Delay Time                                       | t <sub>d(off)</sub>              |                                                                                                                                                          |                                               | -    | 53    | 80    |      |
| Fall Time                                                 | t <sub>f</sub>                   |                                                                                                                                                          |                                               | -    | 31    | 62    |      |
| Gate Input Resistance                                     | R <sub>g</sub>                   | f = 1 MHz, open drain                                                                                                                                    |                                               | 0.35 | 0.70  | 1.4   | Ω    |
| 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> |                                               | -    | -     | 15    | A    |
| Pulsed Diode Forward Current                              | I <sub>SM</sub>                  |                                                                                                                                                          |                                               | -    | -     | 38    |      |
| Diode Forward Voltage                                     | V <sub>SD</sub>                  | T <sub>J</sub> = 25 °C, I <sub>S</sub> = 7 A, V <sub>GS</sub> = 0 V                                                                                      |                                               | -    | 0.9   | 1.2   | V    |
| Reverse Recovery Time                                     | t <sub>rr</sub>                  | T <sub>J</sub> = 25 °C, I <sub>F</sub> = I <sub>S</sub> = 7 A,<br>dI/dt = 100 A/μs, V <sub>R</sub> = 25 V                                                |                                               | -    | 349   | 698   | ns   |
| Reverse Recovery Charge                                   | Q <sub>rr</sub>                  |                                                                                                                                                          |                                               | -    | 4.4   | 8.8   | μC   |
| Reverse Recovery Current                                  | I <sub>RRM</sub>                 |                                                                                                                                                          |                                               | -    | 20    | -     | A    |

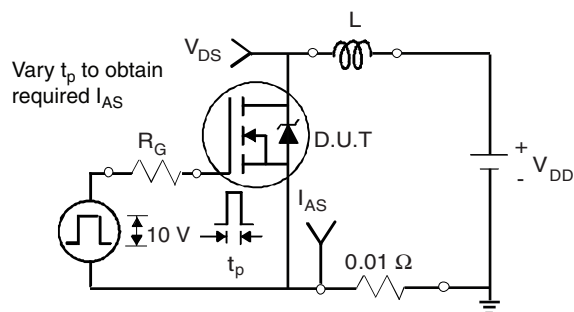
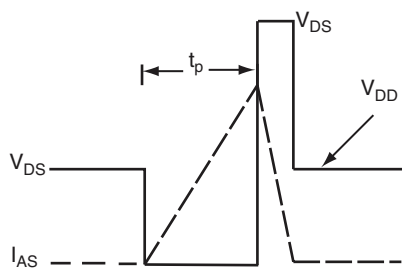
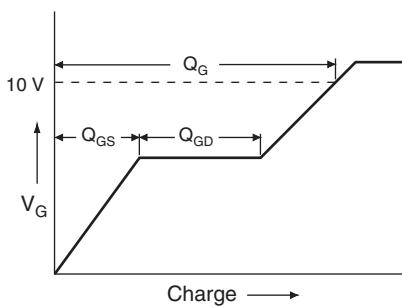
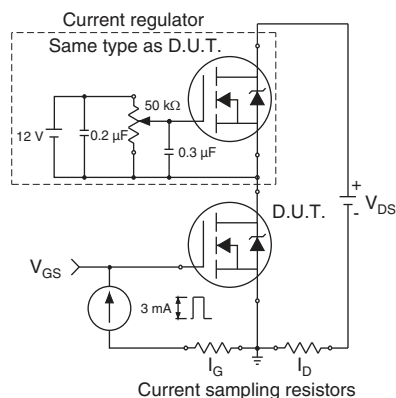
**Notes**

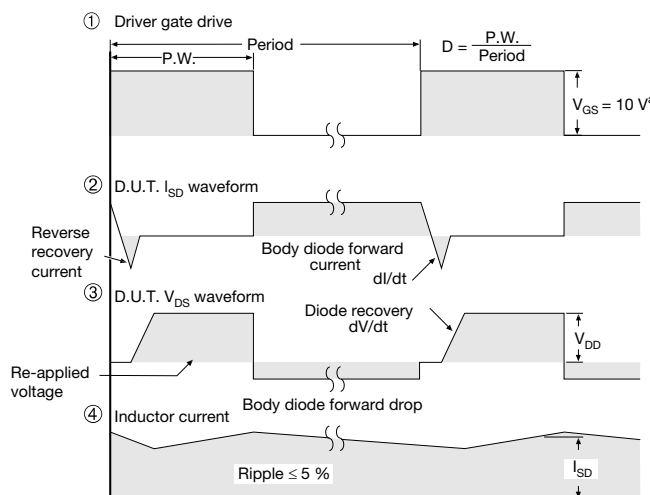
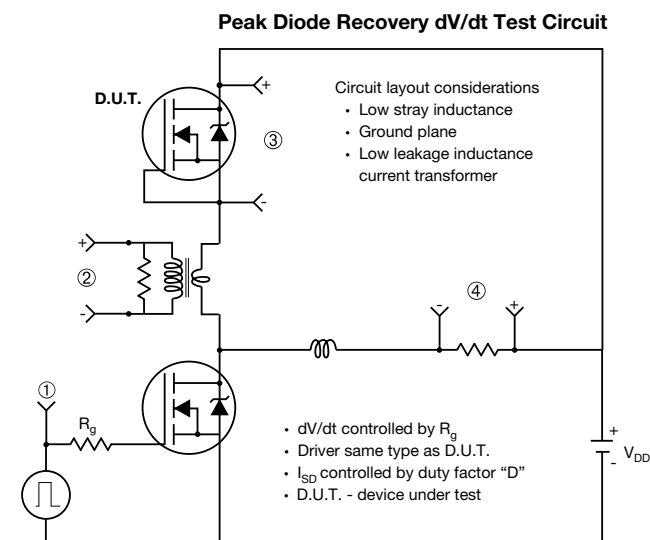
- a.  $C_{oss(er)}$  is a fixed capacitance that gives the same energy as  $C_{oss}$  while  $V_{DS}$  is rising from 0 % to 80 %  $V_{DS}$ .  
b.  $C_{oss(tr)}$  is a fixed capacitance that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 % to 80 %  $V_{DS}$ .

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

**Fig. 1 - Typical Output Characteristics**

**Fig. 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. 10 - Maximum Drain Current vs. Case Temperature**

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

**Fig. 11 - Temperature vs. Drain-to-Source Voltage**

**Fig. 9 - Maximum Safe Operating Area**


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

**Fig. 13 - Normalized Thermal Transient Impedance, Junction-to-Ambient**

**Fig. 14 - Switching Time Test Circuit**

**Fig. 15 - Switching Time Waveforms**


**Fig. 16 - Unclamped Inductive Test Circuit**

**Fig. 17 - Unclamped Inductive Waveforms**

**Fig. 18 - Basic Gate Charge Waveform**

**Fig. 19 - Gate Charge Test Circuit**

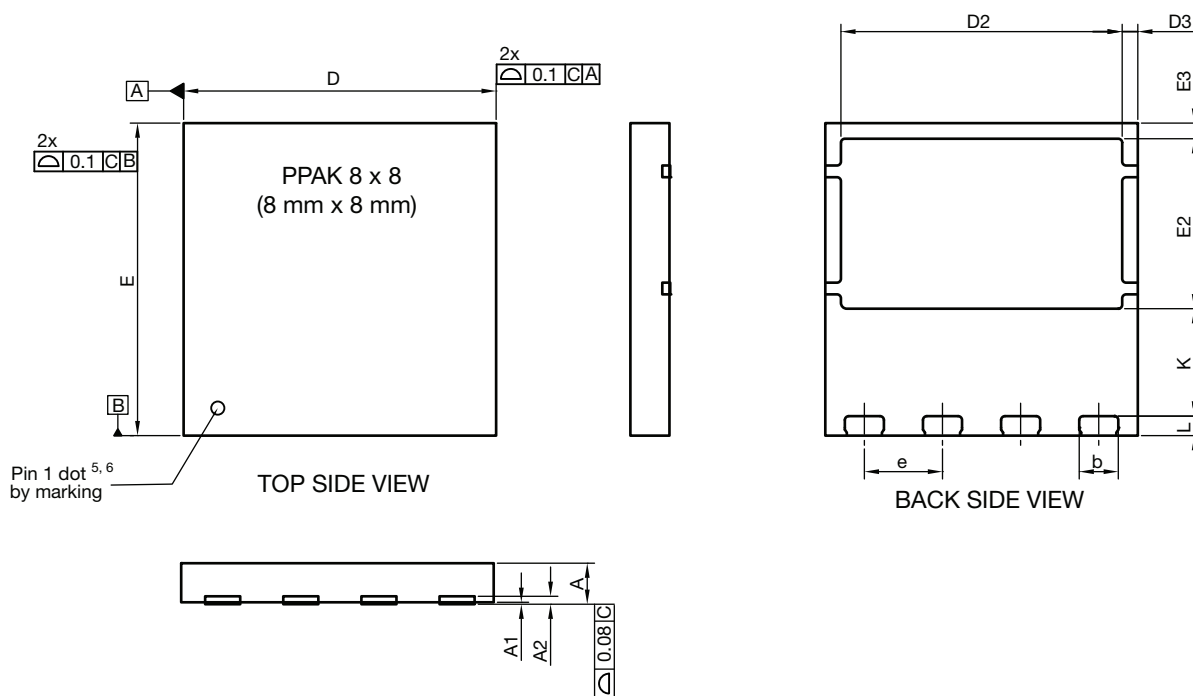

**Note**

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

**Fig. 20 - For N-Channel**

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## PowerPAK® 8 x 8 Case Outline



| DIM.             | MILLIMETERS |      |      | INCHES     |       |       |
|------------------|-------------|------|------|------------|-------|-------|
|                  | MIN.        | NOM. | MAX. | MIN.       | NOM.  | MAX.  |
| A                | 0.95        | 1.00 | 1.05 | 0.037      | 0.039 | 0.041 |
| A1               | 0.00        | -    | 0.05 | 0.000      | -     | 0.002 |
| A2               | 020 ref.    |      |      | 0.008 ref. |       |       |
| b                | 0.95        | 1.00 | 1.05 | 0.037      | 0.039 | 0.041 |
| D                | 7.90        | 8.00 | 8.10 | 0.311      | 0.315 | 0.319 |
| D2               | 7.10        | 7.20 | 7.30 | 0.280      | 0.283 | 0.287 |
| D3               | 0.40 BSC    |      |      | 0.016 BSC  |       |       |
| e                | 2.00 BSC    |      |      | 0.079 BSC  |       |       |
| E                | 7.90        | 8.00 | 8.10 | 0.311      | 0.315 | 0.319 |
| E2               | 4.30        | 4.35 | 4.40 | 0.169      | 0.171 | 0.173 |
| E3               | 0.40 BSC    |      |      | 0.016 BSC  |       |       |
| K                | 2.75 BSC    |      |      | 0.108 BSC  |       |       |
| L                | 0.45        | 0.50 | 0.55 | 0.018      | 0.020 | 0.022 |
| N <sup>(3)</sup> | 8           |      |      | 8          |       |       |

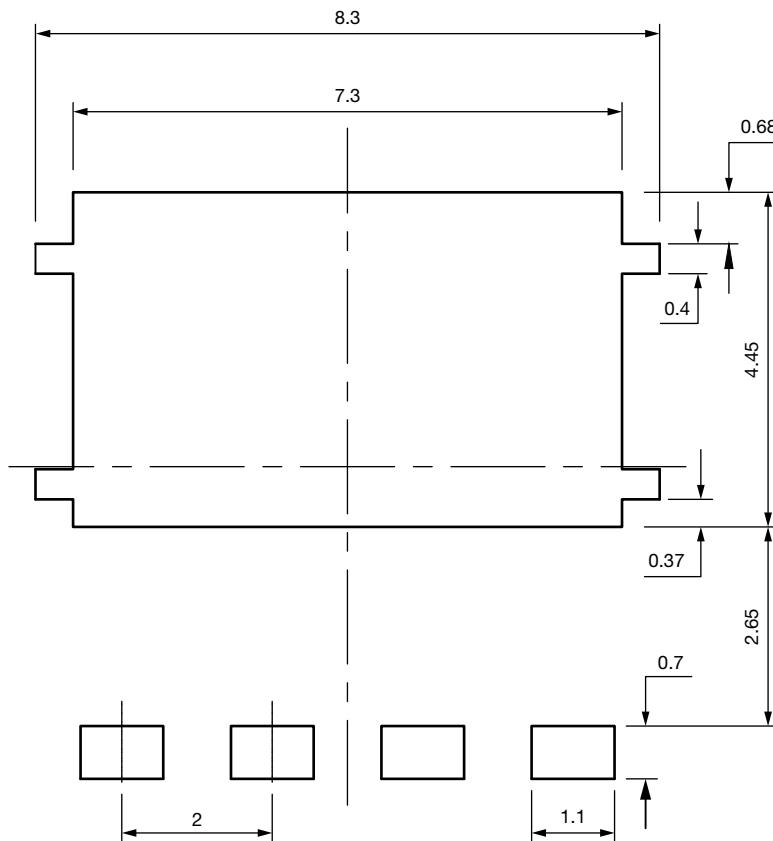
### Notes

- (1) Use millimeters as the primary measurement
- (2) Dimensioning and tolerances conform to ASME Y14.5 M - 1994
- (3) N is the number of terminals
- (4) The pin 1 identifier must be existed on the top surface of the package by using indentation mark or other feature of package body
- (5) Exact shape and size of this feature is optional

ECN: E20-0518-Rev. B, 28-Sep-2020  
DWG: 6041



## Recommended Minimum PADs for PowerPAK® 8 mm x 8 mm



Dimensions in millimeters



## Disclaimer

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