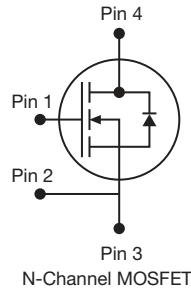


E Series Power MOSFET with Fast Body Diode

| PRODUCT SUMMARY | |
|-----------------------------------------|-------------------------|
| V_{DS} (V) at T_J max. | 650 |
| $R_{DS(on)}$ typ. (Ω) at 25 °C | $V_{GS} = 10$ V 0.161 |
| Q_g max. (nC) | 86 |
| Q_{gs} (nC) | 13 |
| Q_{gd} (nC) | 23 |
| Configuration | Single |



FEATURES

- Completely lead (Pb)-free device
- Low figure-of-merit (FOM) $R_{on} \times Q_g$
- 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



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
 - Renewable energy
 - Solar (PV inverters)

| ORDERING INFORMATION | |
|---------------------------------|--------------------|
| Package | PowerPAK 8 x 8 |
| Lead (Pb)-free and Halogen-free | SiHH21N60EF-T1-GE3 |


| 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} | ± 30 | |
| Continuous Drain Current ($T_J = 150$ °C) | V_{GS} at 10 V | $T_C = 25$ °C | 19 |
| | | $T_C = 100$ °C | 12 |
| Pulsed Drain Current ^a | I_{DM} | 47 | A |
| Linear Derating Factor | | 1.4 | W/°C |
| Single Pulse Avalanche Energy ^b | E_{AS} | 226 | mJ |
| Maximum Power Dissipation | P_D | 174 | 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 | 70 |
| Reverse Diode dV/dt ^c | | 20 | |

Notes

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



| THERMAL RESISTANCE RATINGS | | | | |
|----------------------------------|-------------------|------|------|------|
| PARAMETER | SYMBOL | TYP. | MAX. | UNIT |
| Maximum Junction-to-Ambient | R _{thJA} | 40 | 52 | °C/W |
| Maximum Junction-to-Case (Drain) | R _{thJC} | 0.55 | 0.72 | |

| SPECIFICATIONS (T _J = 25 °C, unless otherwise noted) | | | | | | | |
|-----------------------------------------------------------------|----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|-----------------------|-------|-------|------|
| PARAMETER | SYMBOL | TEST CONDITIONS | | MIN. | TYP. | MAX. | UNIT |
| Static | | | | | | | |
| Drain-Source Breakdown Voltage | V _{DS} | V _{GS} = 0 V, I _D = 250 μA | | 600 | - | - | V |
| V _{DS} Temperature Coefficient | ΔV _{DS} /T _J | Reference to 25 °C, I _D = 10 mA | | - | 0.63 | - | V/°C |
| Gate-Source Threshold Voltage (N) | V _{GS(th)} | V _{DS} = V _{GS} , I _D = 250 μA | | 2.0 | - | 4.0 | V |
| Gate-Source Leakage | I _{GSS} | V _{GS} = ± 20 V | | - | - | ± 100 | nA |
| | | V _{GS} = ± 30 V | | - | - | ± 1 | μA |
| Zero Gate Voltage Drain Current | I _{DSS} | V _{DS} = 480 V, V _{GS} = 0 V | | - | - | 1 | μA |
| | | V _{DS} = 480 V, V _{GS} = 0 V, T _J = 125 °C | | - | - | 100 | |
| Drain-Source On-State Resistance | R _{DS(on)} | V _{GS} = 10 V | I _D = 11 A | - | 0.161 | 0.185 | Ω |
| Forward Transconductance | g _{fs} | V _{DS} = 30 V, I _D = 11 A | | - | 7.3 | - | S |
| Dynamic | | | | | | | |
| Input Capacitance | C _{iss} | V _{GS} = 0 V, V _{DS} = 100 V, f = 1 MHz | | - | 2035 | - | pF |
| Output Capacitance | C _{oss} | | | - | 96 | - | |
| Reverse Transfer Capacitance | C _{rss} | | | - | 6 | - | |
| Effective Output Capacitance, Energy Related ^a | C _{o(er)} | | | - | 60 | - | |
| Effective Output Capacitance, Time Related ^b | C _{o(tr)} | V _{DS} = 0 V to 480 V, V _{GS} = 0 V | | - | 257 | - | |
| Total Gate Charge | Q _g | V _{GS} = 10 V | I _D = 11 A, V _{DS} = 480 V | - | 57 | 86 | nC |
| Gate-Source Charge | Q _{gs} | | | - | 13 | - | |
| Gate-Drain Charge | Q _{gd} | | | - | 23 | - | |
| Turn-On Delay Time | t _{d(on)} | V _{DD} = 480 V, I _D = 11 A, V _{GS} = 10 V, R _g = 9.1 Ω | | - | 20 | 40 | ns |
| Rise Time | t _r | | | - | 43 | 86 | |
| Turn-Off Delay Time | t _{d(off)} | | | - | 65 | 98 | |
| Fall Time | t _f | | | - | 43 | 86 | |
| Gate Input Resistance | R _g | | | f = 1 MHz, open drain | | 0.25 | |
| Drain-Source Body Diode Characteristics | | | | | | | |
| Continuous Source-Drain Diode Current | I _S | MOSFET symbol showing the integral reverse p - n junction diode  | | - | - | 19 | A |
| Pulsed Diode Forward Current | I _{SM} | | | - | - | 47 | |
| Diode Forward Voltage | V _{SD} | T _J = 25 °C, I _S = 11 A, V _{GS} = 0 V | | - | 0.9 | 1.2 | V |
| Reverse Recovery Time | t _{rr} | T _J = 25 °C, I _F = I _S = 11 A, dI/dt = 100 A/μs, V _R = 25 V | | - | 137 | 274 | ns |
| Reverse Recovery Charge | Q _{rr} | | | - | 0.8 | 1.6 | μC |
| Reverse Recovery Current | I _{RRM} | | | - | 12 | - | 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)

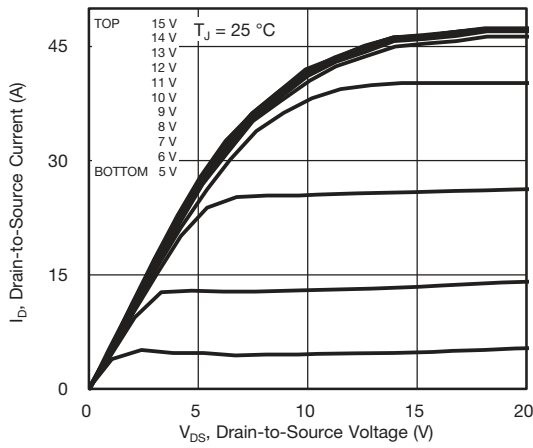


Fig. 1 - Typical Output Characteristics

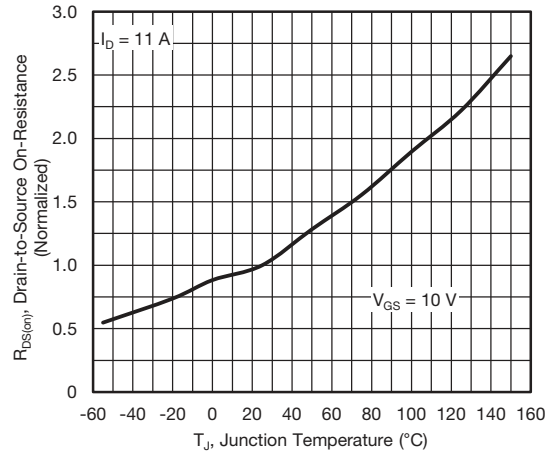


Fig. 4 - Normalized On-Resistance vs. Temperature

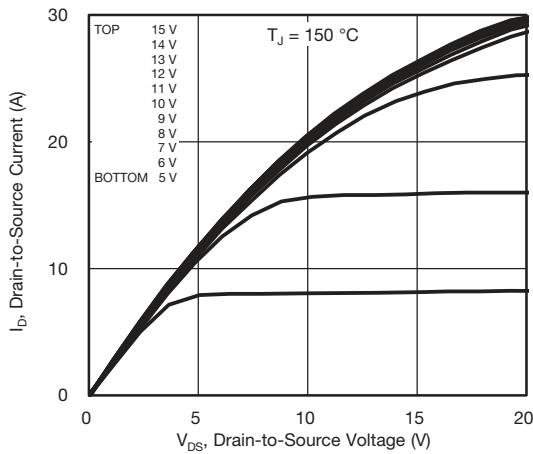


Fig. 2 - Typical Output Characteristics

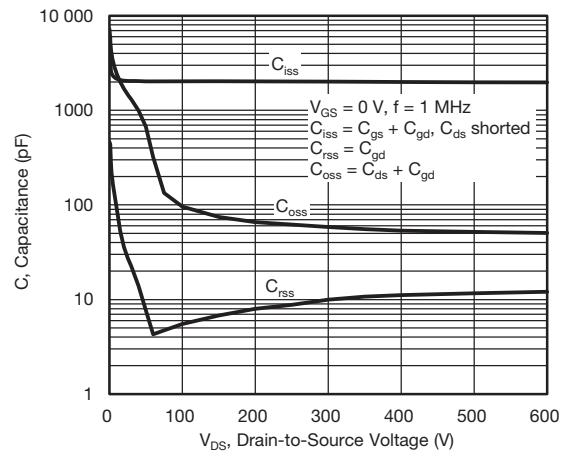


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

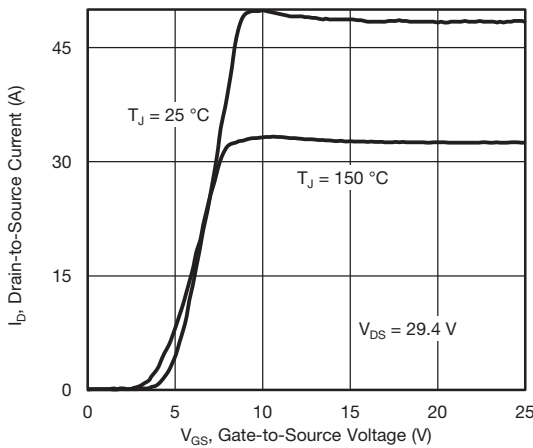


Fig. 3 - Typical Transfer Characteristics

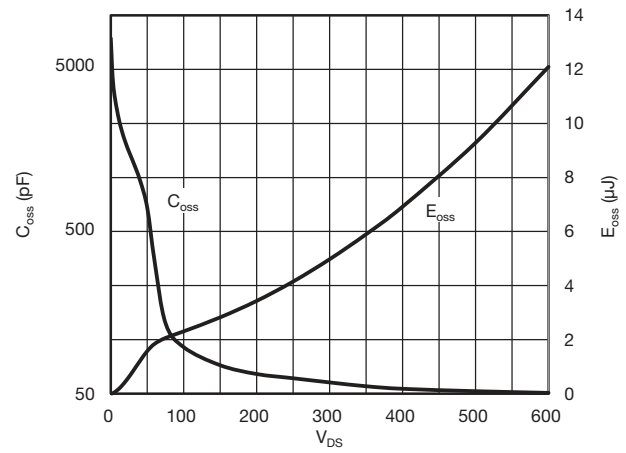


Fig. 6 - Coss and Eoss vs. Vds

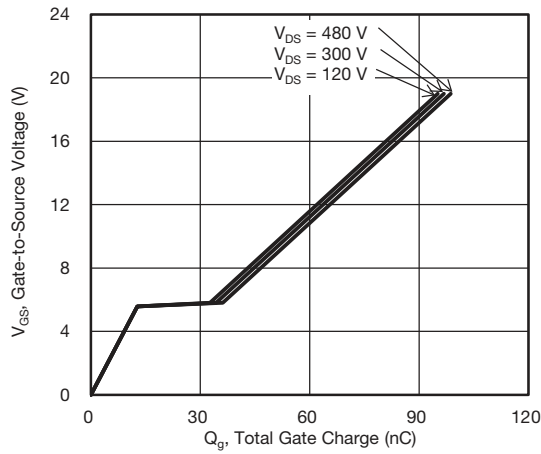


Fig. 7 - Typical Gate Charge vs. Gate-to-Source Voltage

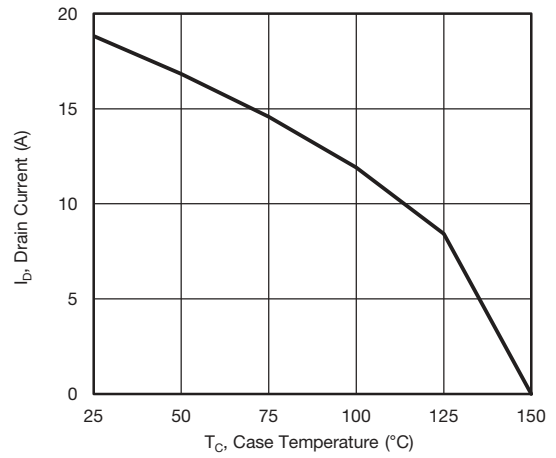


Fig. 10 - Maximum Drain Current vs. Case Temperature

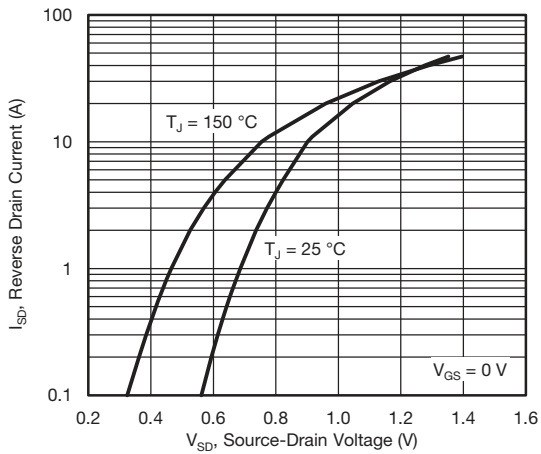


Fig. 8 - Typical Source-Drain Diode Forward Voltage

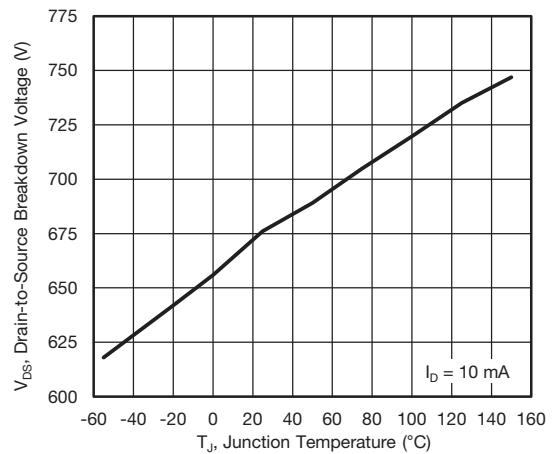


Fig. 11 - Temperature vs. Drain-to-Source Voltage

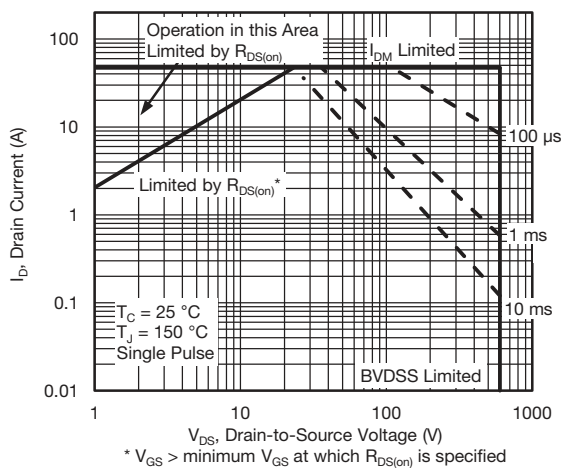


Fig. 9 - Maximum Safe Operating Area

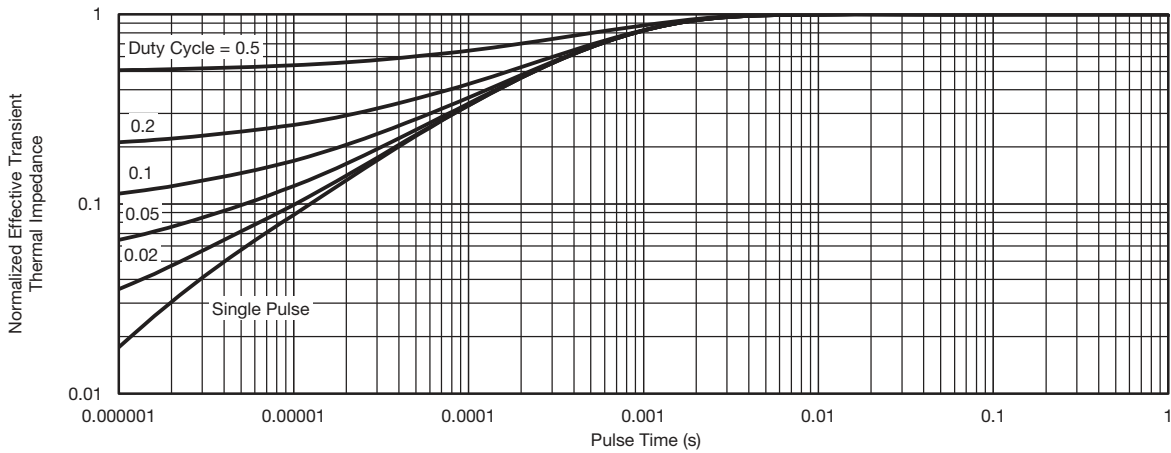


Fig. 12 - Normalized Thermal Transient Impedance, Junction-to-Case

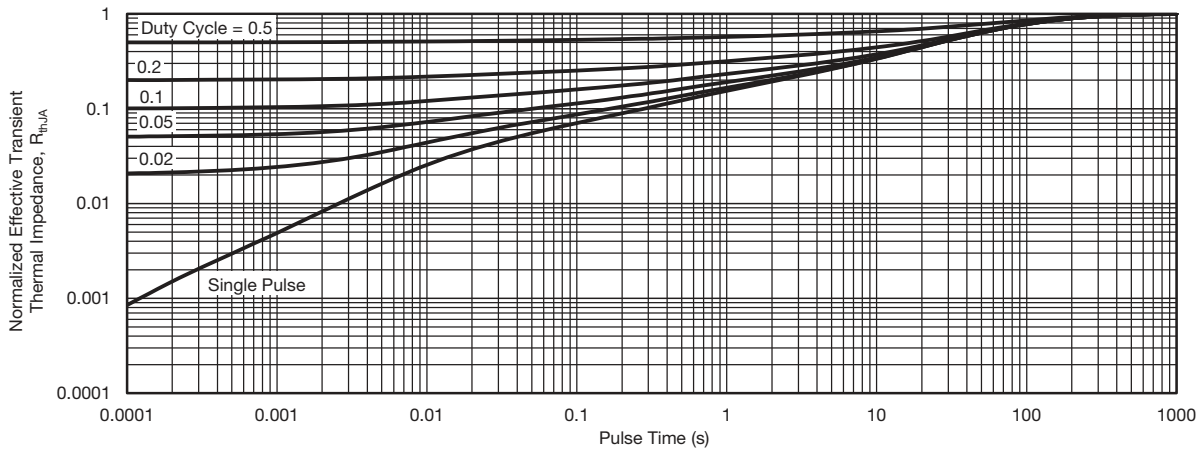


Fig. 13 - Normalized Thermal Transient Impedance, Junction-to-Ambient

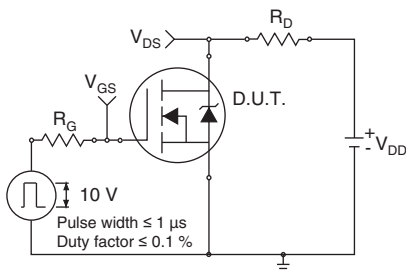


Fig. 14 - Switching Time Test Circuit

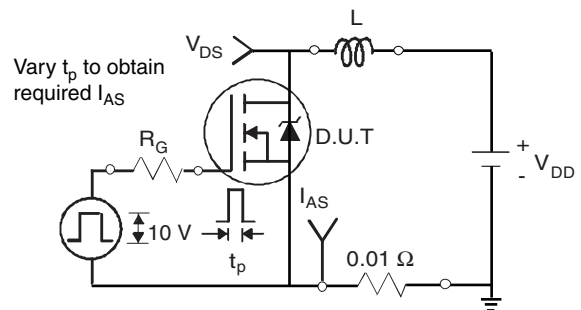


Fig. 16 - Unclamped Inductive Test Circuit

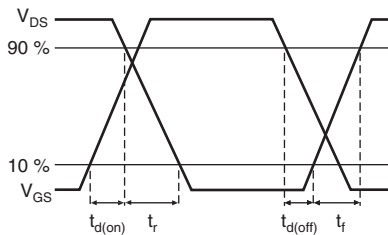


Fig. 15 - Switching Time Waveforms

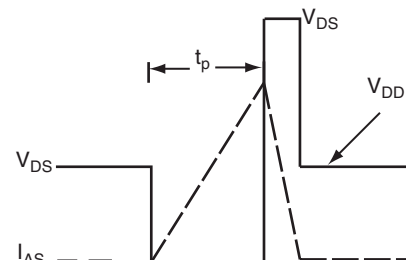


Fig. 17 - Unclamped Inductive Waveforms

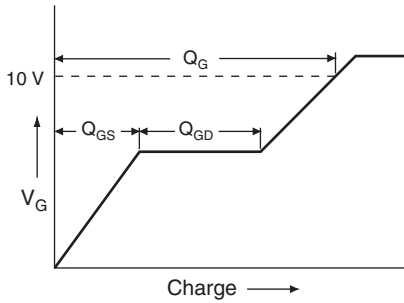


Fig. 18 - Basic Gate Charge Waveform

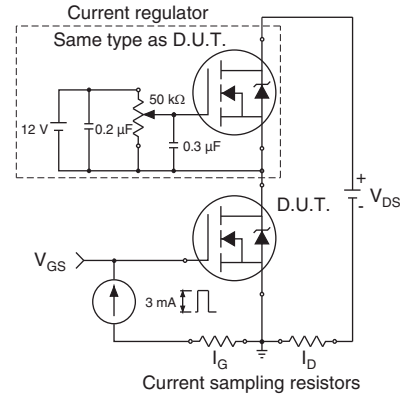
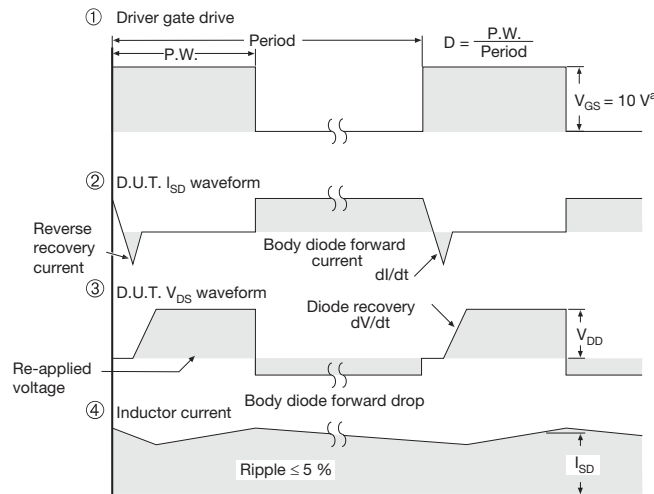
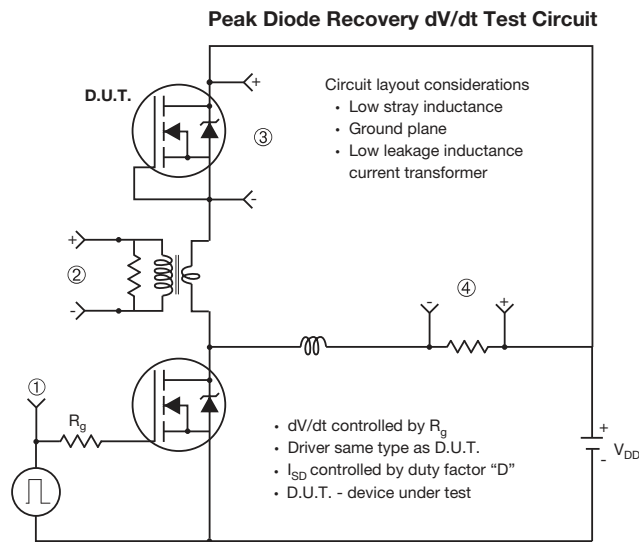


Fig. 19 - Gate Charge Test Circuit

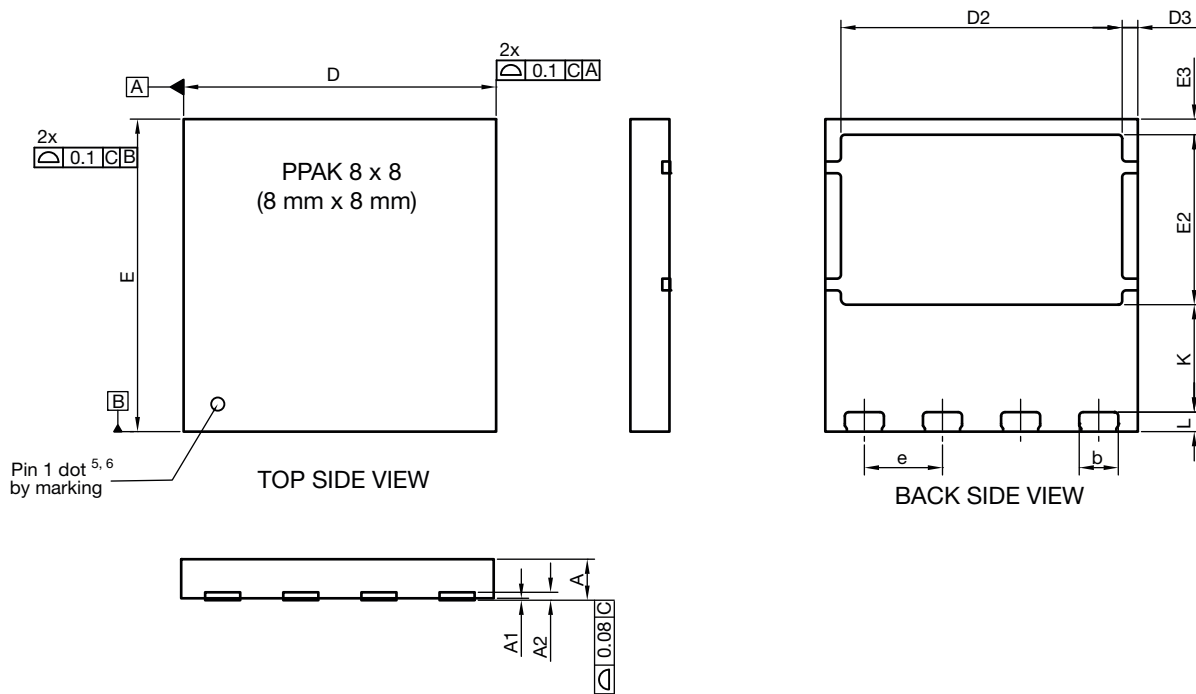


Note
a. $V_{GS} = 5 V$ for logic level devices

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 ⁽³⁾ | 8 | | | 8 | | |

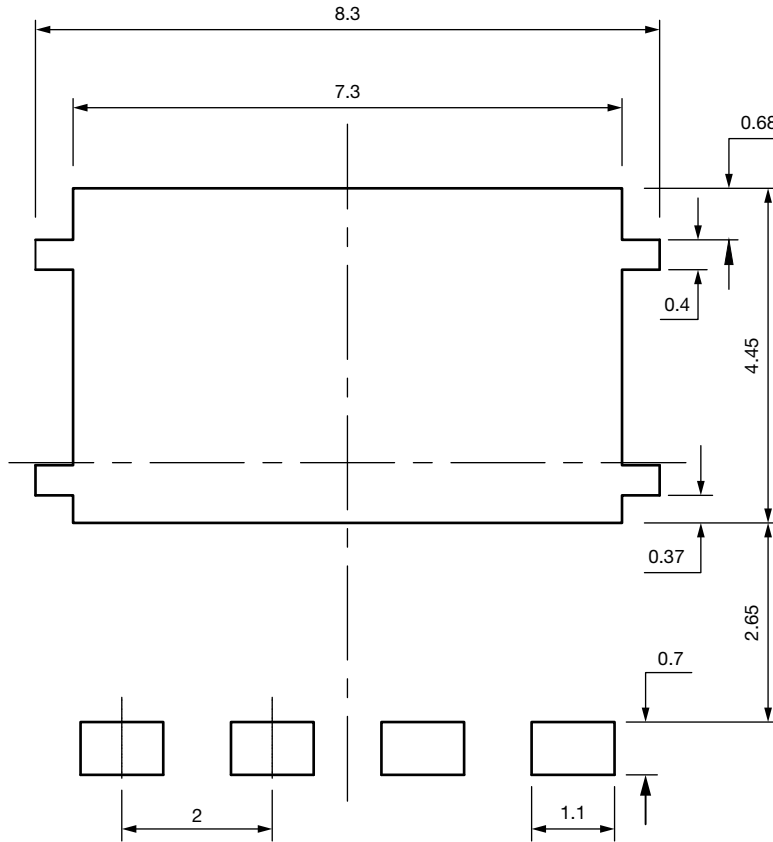
Notes

- (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



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