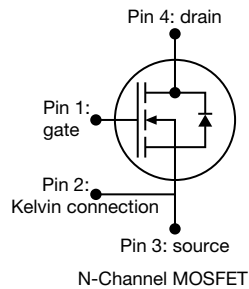
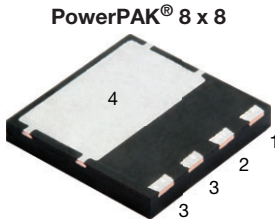


EF Series Power MOSFET With Fast Body Diode



FEATURES

- 4th 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



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. (Ω) at 25 °C | $V_{GS} = 10$ V | 0.061 |
| Q_g max. (nC) | 75 | |
| Q_{gs} (nC) | 20 | |
| Q_{gd} (nC) | 17 | |
| Configuration | Single | |

ORDERING INFORMATION

| | |
|---------------------------------|--------------------|
| Package | PowerPAK 8 x 8 |
| Lead (Pb)-free and halogen-free | SiHH070N60EF-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} | ± 30 | | |
| Continuous drain current ($T_J = 150$ °C) | V_{GS} at 10 V | $T_C = 25$ °C | 36 | A |
| | | $T_C = 100$ °C | 23 | |
| Pulsed drain current ^a | I_{DM} | 93 | | |
| Linear derating factor | | 1.6 | W/°C | |
| Single pulse avalanche energy ^b | E_{AS} | 226 | mJ | |
| Maximum power dissipation | P_D | 202 | 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 | 100 | V/ns |
| Reverse diode dv/dt ^d | | 50 | | |

Notes

- Repetitive rating; pulse width limited by maximum junction temperature
- $V_{DD} = 140$ V, starting $T_J = 25$ °C, $L = 28.2$ mH, $R_g = 25$ Ω , $I_{AS} = 4$ A
- 1.6 mm from case
- $I_{SD} \leq I_D$, $di/dt = 900$ A/ μ s, starting $T_J = 25$ °C



| THERMAL RESISTANCE RATINGS | | | | |
|----------------------------------|------------|------|------|------|
| PARAMETER | SYMBOL | TYP. | MAX. | UNIT |
| Maximum junction-to-ambient | R_{thJA} | 38 | 50 | °C/W |
| Maximum junction-to-case (drain) | R_{thJC} | 0.48 | 0.62 | |

| SPECIFICATIONS ($T_J = 25\text{ }^\circ\text{C}$, 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 $25\text{ }^\circ\text{C}, I_D = 20\text{ mA}$ | | - | 0.51 | - | V/°C |
| Gate-source threshold voltage (N) | $V_{GS(th)}$ | $V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$ | | 3 | - | 5 | V |
| Gate-source leakage | I_{GSS} | $V_{GS} = \pm 20\text{ V}$ | | - | - | ± 100 | nA |
| | | $V_{GS} = \pm 30\text{ V}$ | | - | - | ± 1 | μA |
| Zero gate voltage drain current | I_{DSS} | $V_{DS} = 480\text{ V}, V_{GS} = 0\text{ V}$ | | - | - | 1 | μA |
| | | $V_{DS} = 480\text{ V}, V_{GS} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$ | | - | - | 2 | mA |
| Drain-source on-state resistance | $R_{DS(on)}$ | $V_{GS} = 10\text{ V}$ | $I_D = 15\text{ A}$ | - | 0.061 | 0.071 | Ω |
| Forward transconductance ^a | g_{fs} | $V_{DS} = 20\text{ V}, I_D = 15\text{ A}$ | | - | 10.5 | - | S |
| Dynamic | | | | | | | |
| Input capacitance | C_{iss} | $V_{GS} = 0\text{ V}, V_{DS} = 100\text{ V}, f = 1\text{ MHz}$ | | - | 2647 | - | pF |
| Output capacitance | C_{oss} | | | - | 122 | - | |
| Reverse transfer capacitance | C_{rss} | | | - | 6 | - | |
| Effective output capacitance, energy related ^a | $C_{o(er)}$ | | | - | 90 | - | |
| Effective output capacitance, time related ^b | $C_{o(tr)}$ | $V_{DS} = 0\text{ V to } 480\text{ V}, V_{GS} = 0\text{ V}$ | | - | 560 | - | |
| Total gate charge | Q_g | $V_{GS} = 10\text{ V}$ | $I_D = 15\text{ A}, V_{DS} = 480\text{ V}$ | - | 50 | 75 | nC |
| Gate-source charge | Q_{gs} | | | - | 20 | - | |
| Gate-drain charge | Q_{gd} | | | - | 17 | - | |
| Turn-on delay time | $t_{d(on)}$ | $V_{DD} = 480\text{ V}, I_D = 15\text{ A}, V_{GS} = 10\text{ V}, R_g = 9.1\text{ }\Omega$ | | - | 36 | 72 | ns |
| Rise time | t_r | | | - | 79 | 119 | |
| Turn-off delay time | $t_{d(off)}$ | | | - | 55 | 83 | |
| Fall time | t_f | | | - | 38 | 76 | |
| Gate input resistance | R_g | $f = 1\text{ MHz}$ | | 0.3 | 0.7 | 1.4 | Ω |
| Drain-Source Body Diode Characteristics | | | | | | | |
| Continuous source-drain diode current | I_S | MOSFET symbol showing the integral reverse p - n junction diode  | | - | - | 36 | A |
| Pulsed diode forward current | I_{SM} | | | - | - | 93 | |
| Diode forward voltage | V_{SD} | $T_J = 25\text{ }^\circ\text{C}, I_S = 15\text{ A}, V_{GS} = 0\text{ V}$ | | - | - | 1.2 | V |
| Reverse recovery time | t_{rr} | $T_J = 25\text{ }^\circ\text{C}, I_F = I_S = 15\text{ A}, di/dt = 100\text{ A}/\mu\text{s}, V_R = 400\text{ V}$ | | - | 136 | 272 | ns |
| Reverse recovery charge | Q_{rr} | | | - | 0.9 | 1.8 | 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_{DSS}
- 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_{DSS}

TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

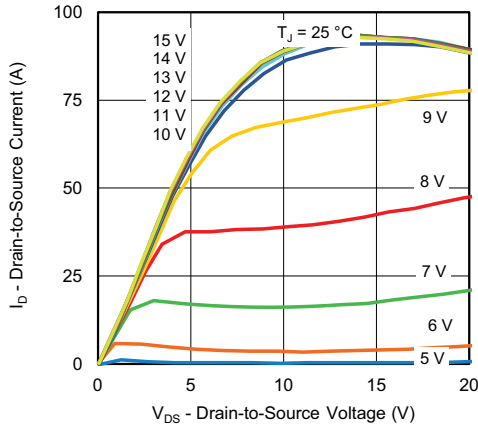


Fig. 1 - Typical Output Characteristics

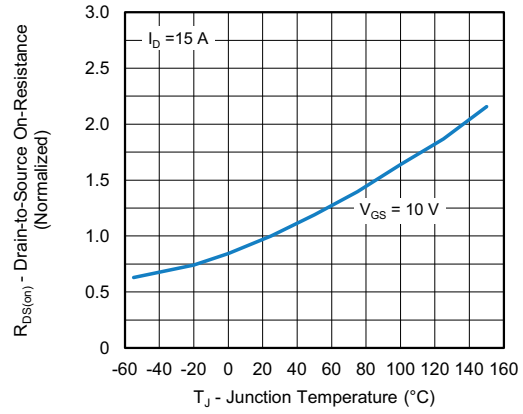


Fig. 4 - Normalized On-Resistance vs. Temperature

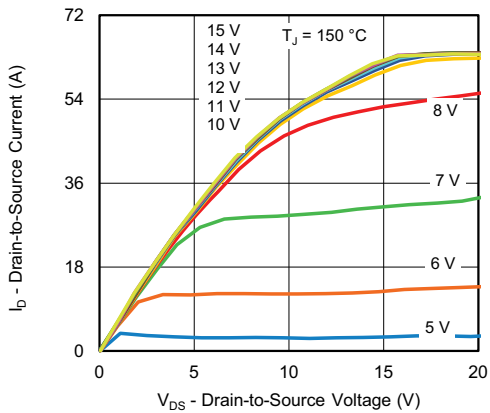


Fig. 2 - Typical Output Characteristics

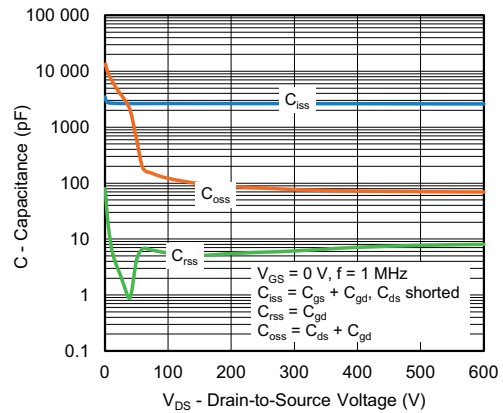


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

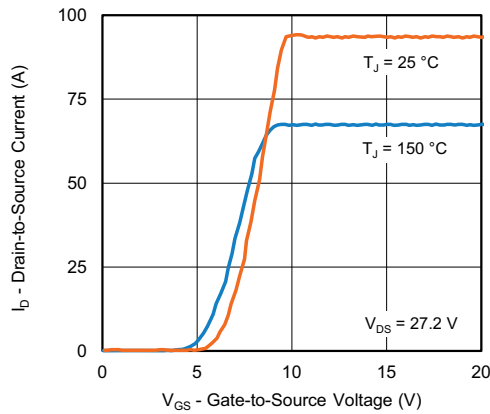


Fig. 3 - Typical Transfer Characteristics

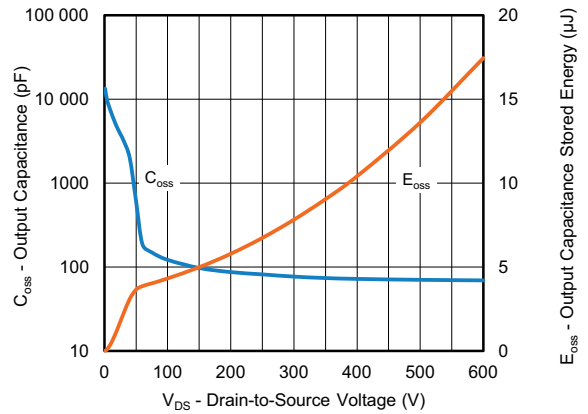


Fig. 6 - C_{oss} and E_{oss} vs. V_{DS}

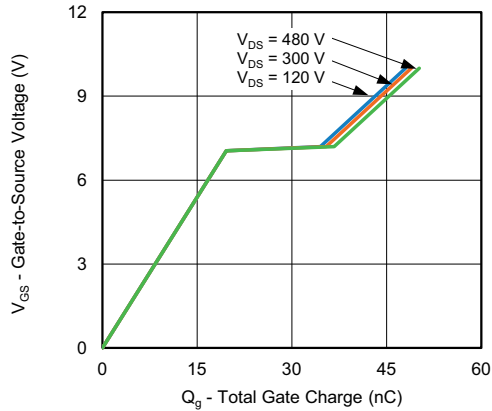


Fig. 7 - Typical Gate Charge vs. Gate-to-Source Voltage

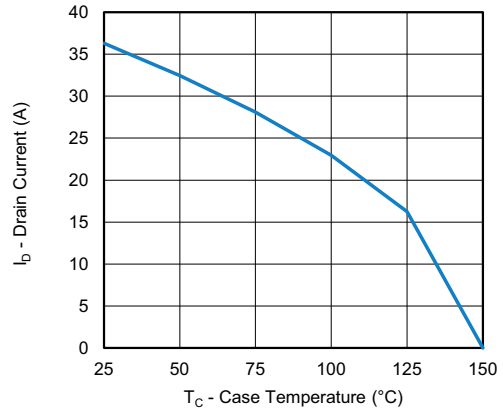


Fig. 10 - Maximum Drain Current vs. Case Temperature

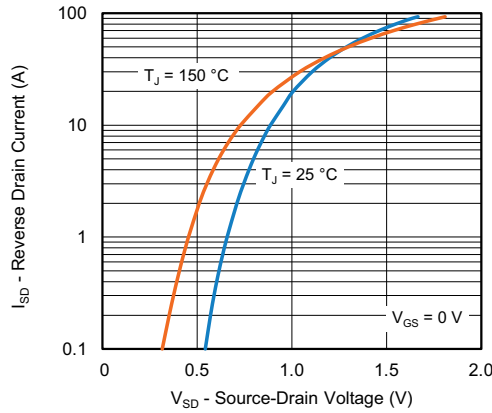


Fig. 8 - Typical Source-Drain Diode Forward Voltage

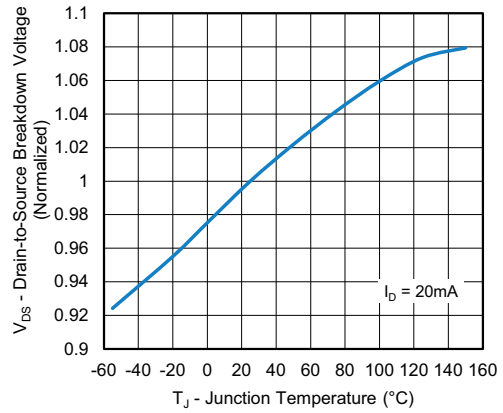


Fig. 11 - Temperature vs. Drain-to-Source Voltage

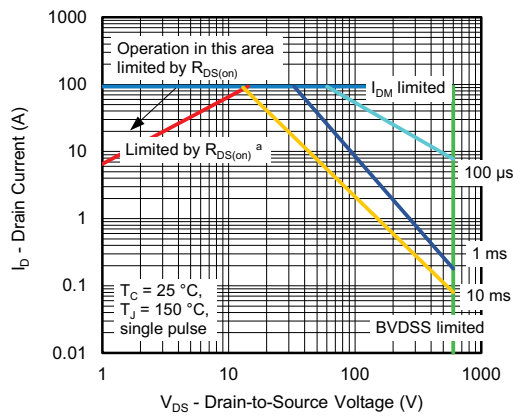


Fig. 9 - Maximum Safe Operating Area

Note

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

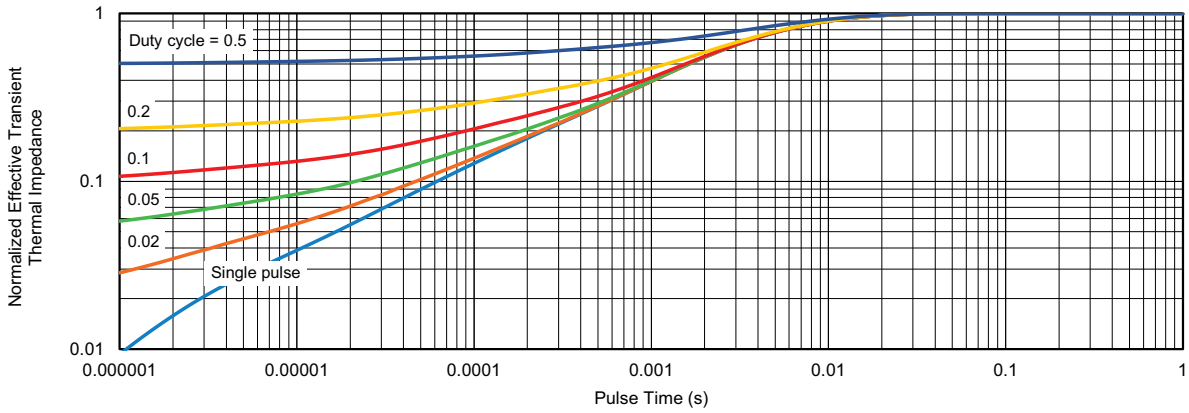


Fig. 12 - Normalized Transient Thermal Impedance, Junction-to-Case

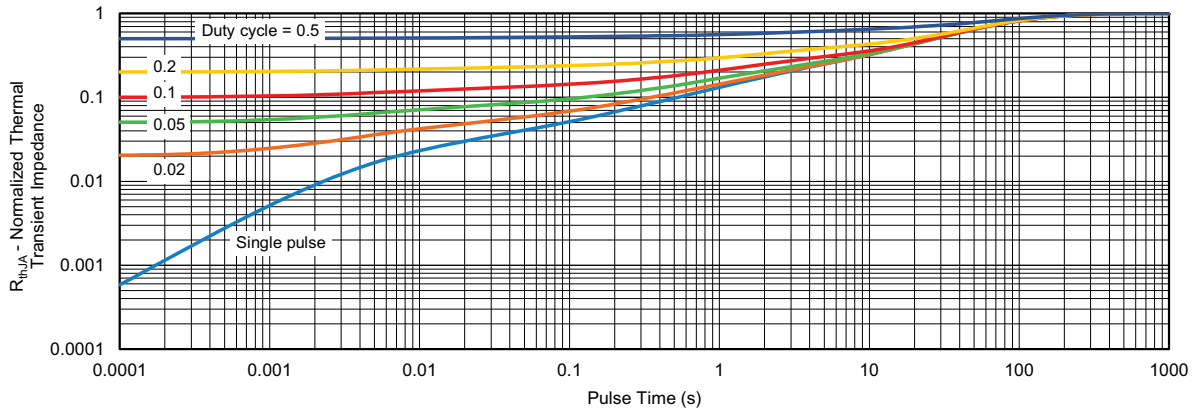


Fig. 13 - Normalized Transient Thermal Impedance, Junction-to-Ambient

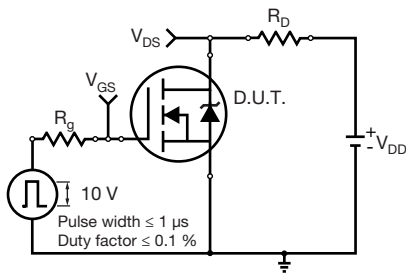


Fig. 14 - Switching Time Test Circuit

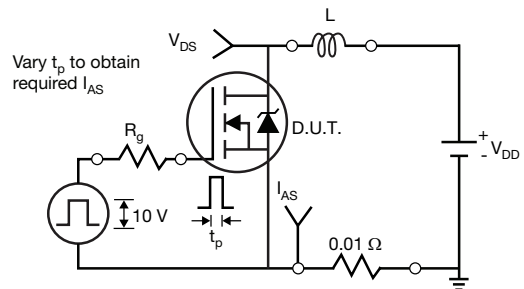


Fig. 16 - Unclamped Inductive Test Circuit

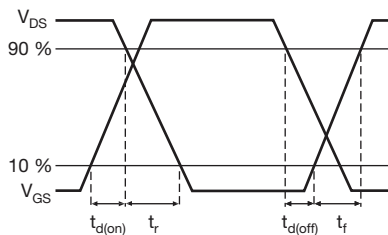


Fig. 15 - Switching Time Waveforms

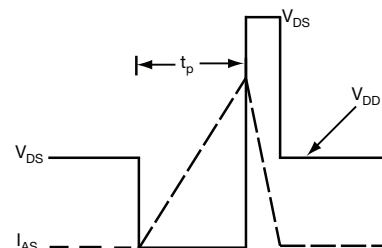


Fig. 17 - Unclamped Inductive Waveforms

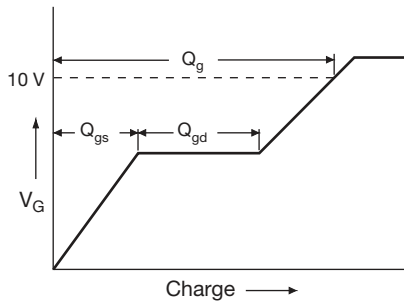


Fig. 18 - Basic Gate Charge Waveform

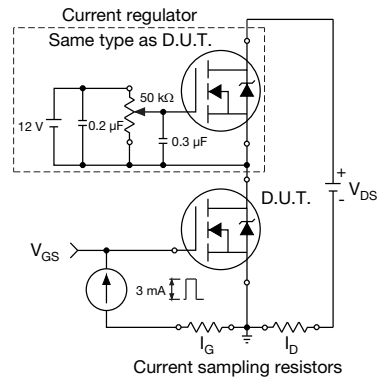
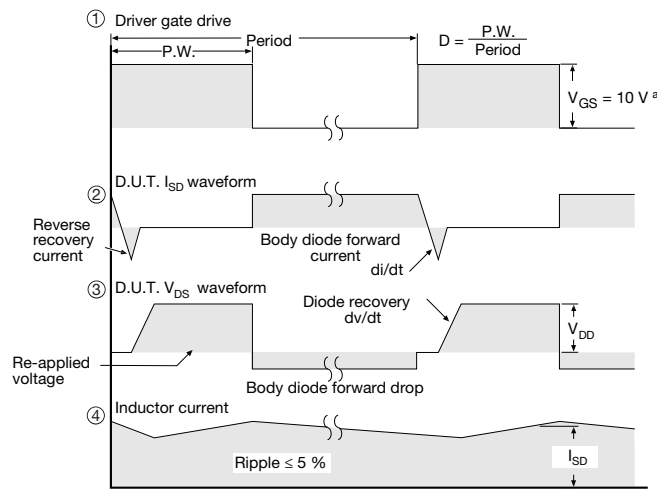
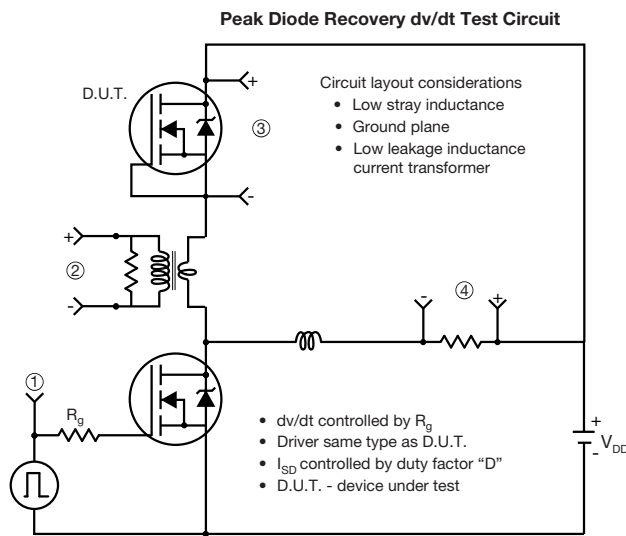


Fig. 19 - Gate Charge Test Circuit



Note
a. $V_{GS} = 5V$ 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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