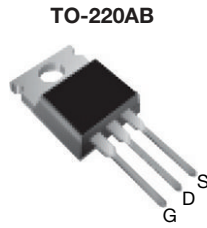


E Series Power MOSFET



N-Channel MOSFET

FEATURES

- 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)
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912



RoHS
COMPLIANT
HALOGEN
FREE
Available

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)

PRODUCT SUMMARY

| | | |
|---|-----------------|-------|
| V_{DS} (V) at T_J max. | 650 | |
| $R_{DS(on)}$ typ. (Ω) at 25 °C | $V_{GS} = 10$ V | 0.156 |
| Q_g max. (nC) | 96 | |
| Q_{gs} (nC) | 12 | |
| Q_{gd} (nC) | 25 | |
| Configuration | Single | |

ORDERING INFORMATION

| | |
|---------------------------------|------------------------------|
| Package | TO-220AB |
| Lead (Pb)-free and halogen-free | SiHP22N60AE-BE3 ^a |
| | SiHP22N60AE-GE3 |

Note

a. "-BE3" denotes alternate manufacturing location

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 | A |
| | | $T_C = 100$ °C | |
| Pulsed drain current ^a | I_{DM} | 49 | |
| Linear derating factor | | 1.4 | W/°C |
| Single pulse avalanche energy ^b | E_{AS} | 204 | mJ |
| Maximum power dissipation | P_D | 179 | 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 ^d | | 70 | |
| Soldering recommendations (peak temperature) ^c | For 10 s | | 31 |
| | | | 300 |

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 , $I_{AS} = 3.8$ A
- 1.6 mm from case
- $I_{SD} \leq I_D$, $dI/dt = 100$ A/ μ s, starting $T_J = 25$ °C



| THERMAL RESISTANCE RATINGS | | | | |
|----------------------------------|-------------------|------|------|------|
| PARAMETER | SYMBOL | TYP. | MAX. | UNIT |
| Maximum junction-to-ambient | R _{thJA} | - | 62 | °C/W |
| Maximum junction-to-case (drain) | R _{thJC} | - | 0.7 | |

| 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 = 250 μA | | - | 0.72 | - | V/°C |
| Gate-source threshold voltage (N) | V _{GS(th)} | V _{DS} = V _{GS} , I _D = 250 μA | | 2 | - | 4 | 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} = 600 V, V _{GS} = 0 V | | - | - | 1 | μA |
| | | V _{DS} = 480 V, V _{GS} = 0 V, T _J = 125 °C | | - | - | 10 | |
| Drain-source on-state resistance | R _{DS(on)} | V _{GS} = 10 V | I _D = 11 A | - | 0.156 | 0.180 | Ω |
| Forward transconductance | g _{fs} | V _{DS} = 30 V, I _D = 11 A | | - | 4.8 | - | S |
| Dynamic | | | | | | | |
| Input capacitance | C _{iss} | V _{GS} = 0 V, V _{DS} = 100 V, f = 1 MHz | | - | 1451 | - | pF |
| Output capacitance | C _{oss} | | | - | 73 | - | |
| Reverse transfer capacitance | C _{rss} | | | - | 5 | - | |
| Effective output capacitance, energy related ^a | C _{o(er)} | | | - | 50 | - | |
| Effective output capacitance, time related ^b | C _{o(tr)} | V _{DS} = 0 V to 480 V, V _{GS} = 0 V | | - | 258 | - | |
| Total gate charge | Q _g | V _{GS} = 10 V | I _D = 11 A, V _{DS} = 480 V | - | 48 | 96 | nC |
| Gate-source charge | Q _{gs} | | | - | 12 | - | |
| Gate-drain charge | Q _{gd} | | | - | 25 | - | |
| Turn-on delay time | t _{d(on)} | V _{DD} = 480 V, I _D = 11 A, V _{GS} = 10 V, R _g = 9.1 Ω | | - | 19 | 38 | ns |
| Rise time | t _r | | | - | 33 | 66 | |
| Turn-off delay time | t _{d(off)} | | | - | 45 | 90 | |
| Fall time | t _f | | | - | 21 | 42 | |
| Gate input resistance | R _g | | | f = 1 MHz, open drain | | 0.3 | |
| Drain-Source Body Diode Characteristics | | | | | | | |
| Continuous source-drain diode current | I _S | MOSFET symbol showing the integral reverse p - n junction diode  | | - | - | 20 | A |
| Pulsed diode forward current | I _{SM} | | | - | - | 49 | |
| Diode forward voltage | V _{SD} | T _J = 25 °C, I _S = 11 A, V _{GS} = 0 V | | - | - | 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 | | - | 319 | 638 | ns |
| Reverse recovery charge | Q _{rr} | | | - | 4.9 | 9.8 | μC |
| Reverse recovery current | I _{RRM} | | | - | 28 | - | 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)

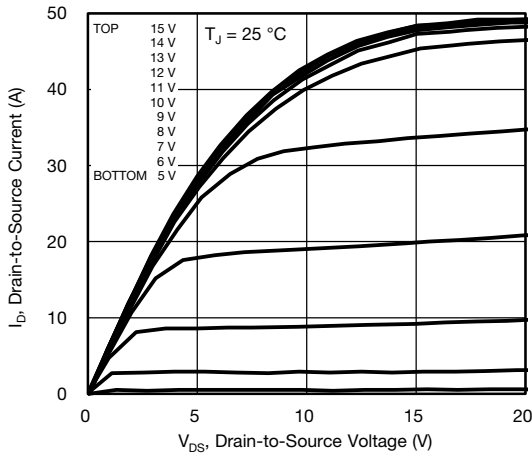


Fig. 1 - Typical Output Characteristics

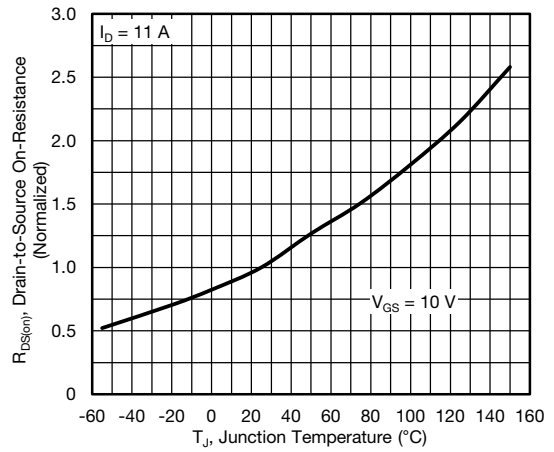


Fig. 4 - Normalized On-Resistance vs. Temperature

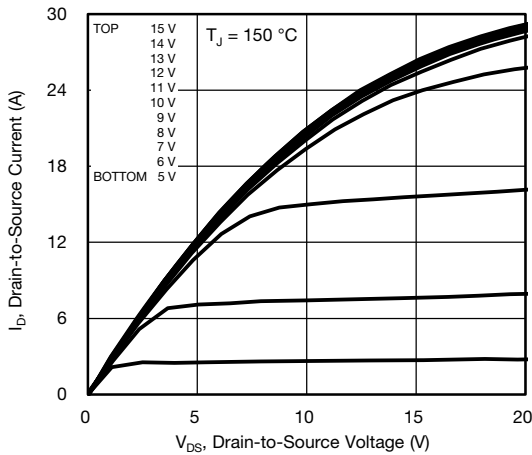


Fig. 2 - Typical Output Characteristics

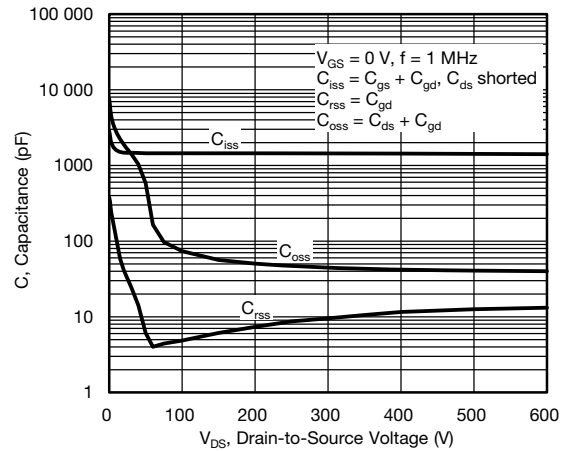


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

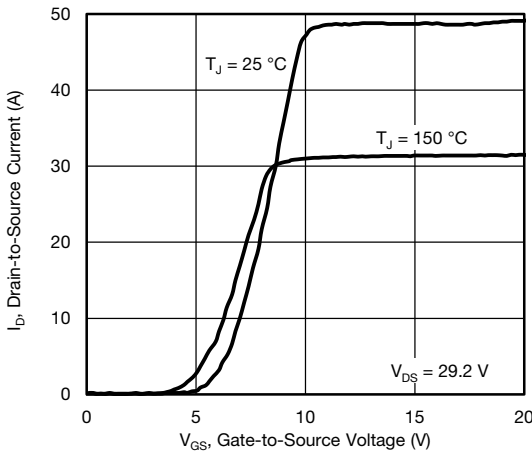


Fig. 3 - Typical Transfer Characteristics

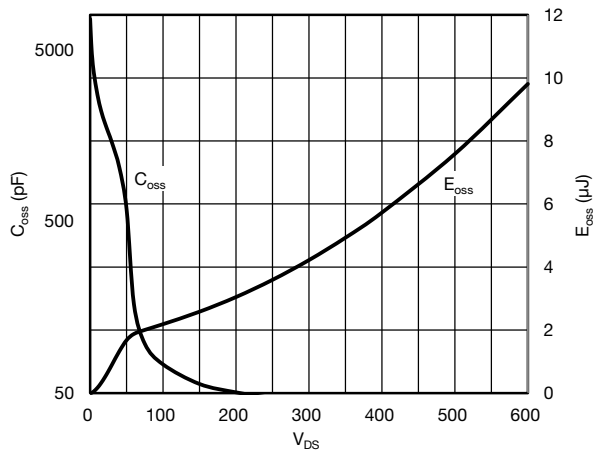


Fig. 6 - C_{oss} and E_{oss} vs. V_{ds}

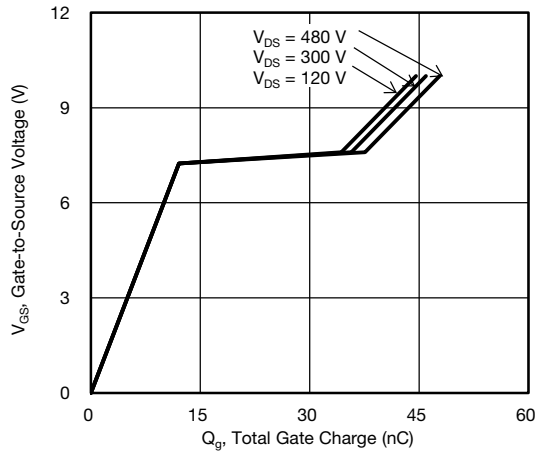


Fig. 7 - Typical Gate Charge vs. Gate-to-Source Voltage

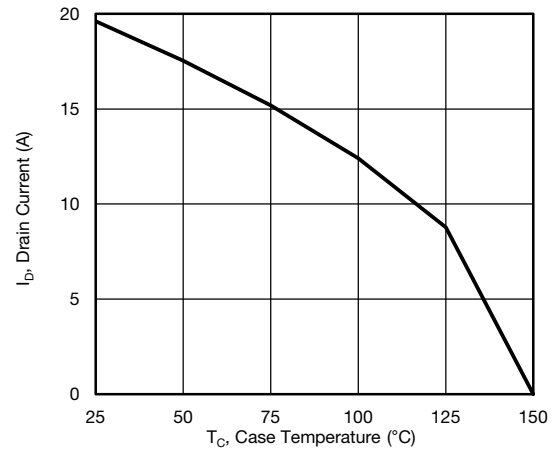


Fig. 10 - Maximum Drain Current vs. Case Temperature

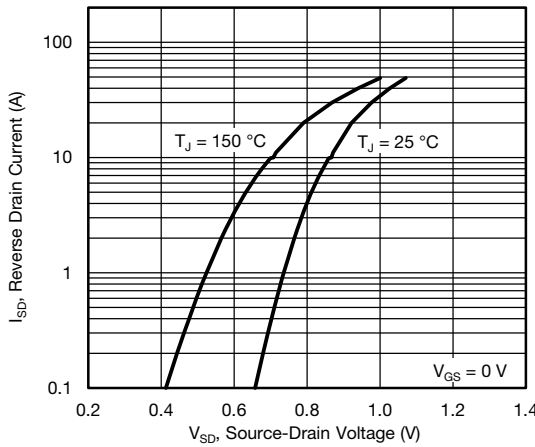


Fig. 8 - Typical Source-Drain Diode Forward Voltage

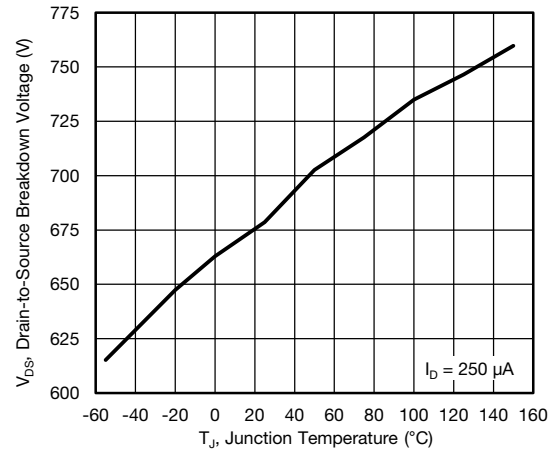


Fig. 11 - Temperature vs. Drain-to-Source Voltage

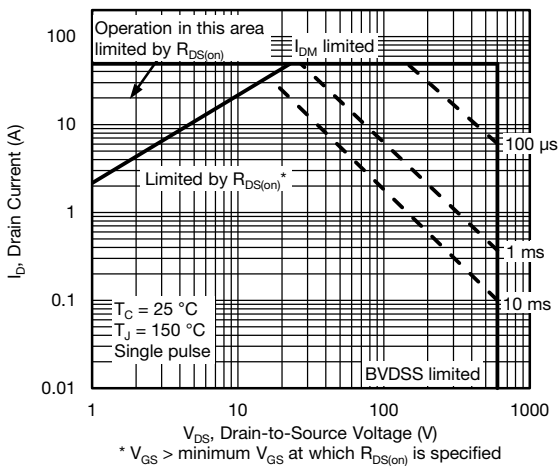


Fig. 9 - Maximum Safe Operating Area

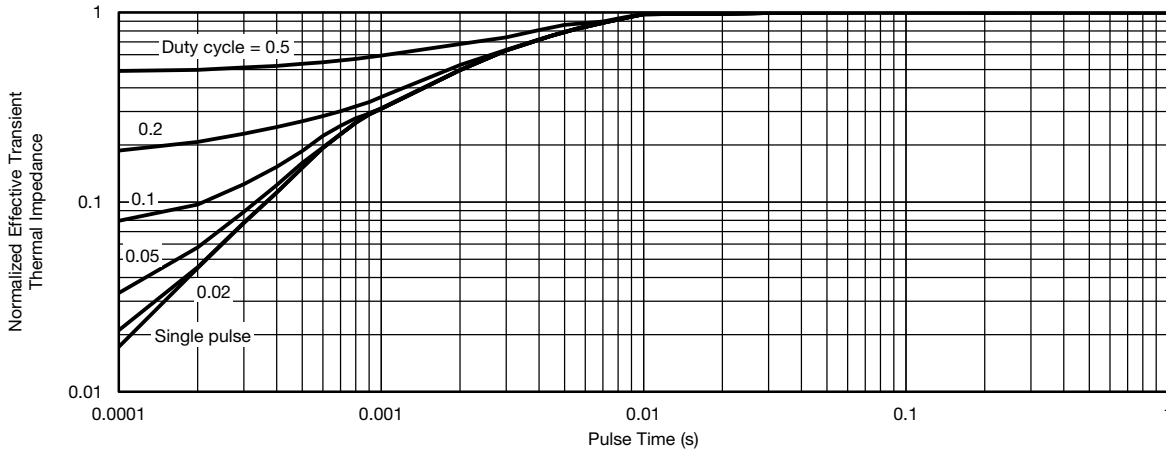


Fig. 12 - Normalized Thermal Transient Impedance, Junction-to-Case



Fig. 13 - Switching Time Test Circuit

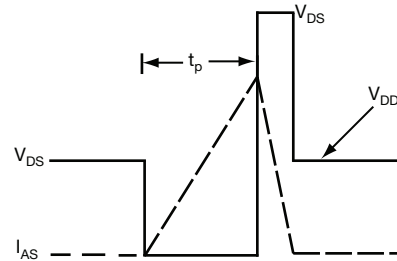


Fig. 16 - Unclamped Inductive Waveforms

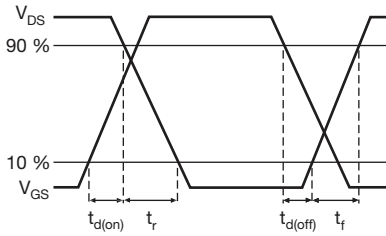


Fig. 14 - Switching Time Waveforms

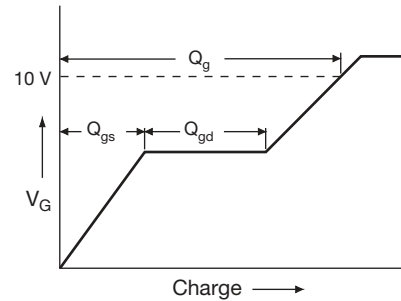


Fig. 17 - Basic Gate Charge Waveform

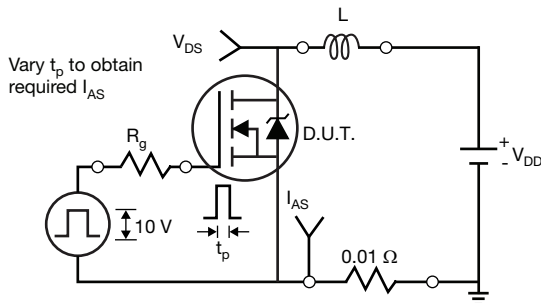


Fig. 15 - Unclamped Inductive Test Circuit

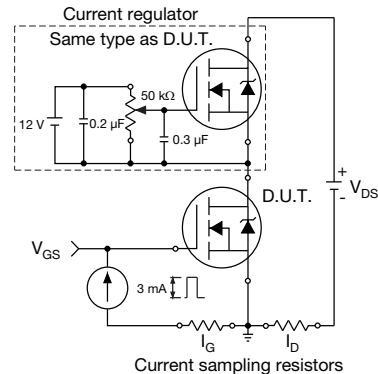


Fig. 18 - Gate Charge Test Circuit

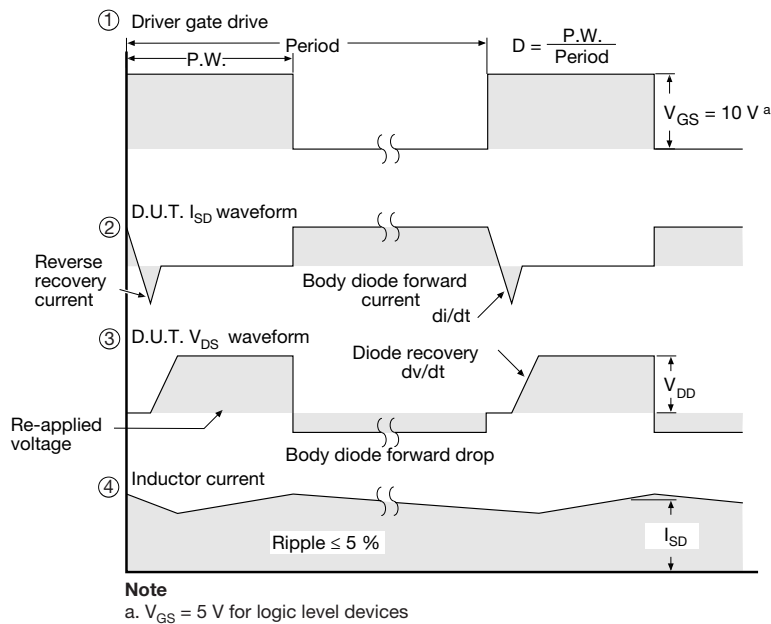
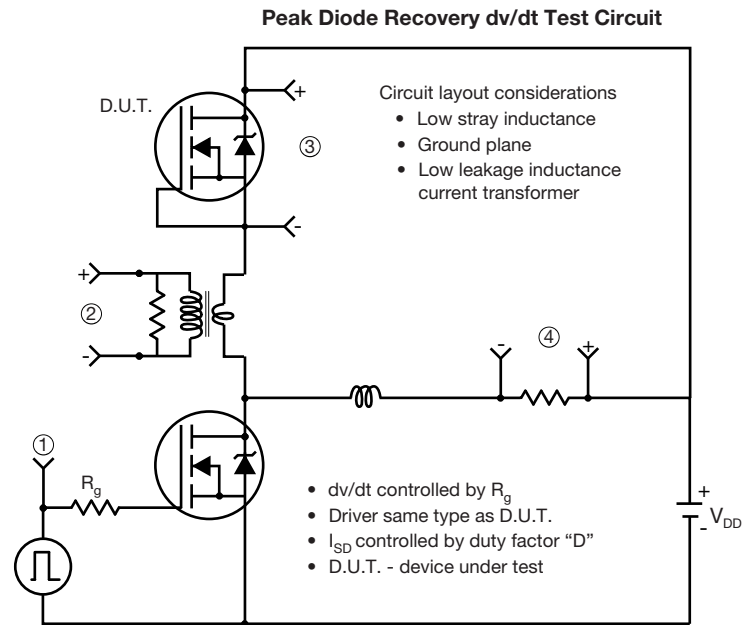


Fig. 19 - For N-Channel

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