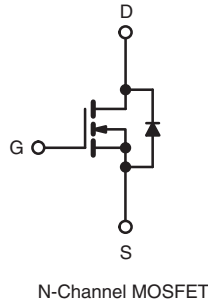
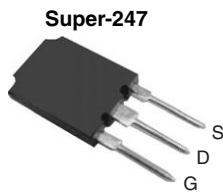


Power MOSFET

| PRODUCT SUMMARY | | |
|---------------------------|-----------------|-------|
| V_{DS} (V) | 600 | |
| $R_{DS(on)}$ (Ω) | $V_{GS} = 10$ V | 0.110 |
| Q_g (Max.) (nC) | 330 | |
| Q_{gs} (nC) | 84 | |
| Q_{gd} (nC) | 150 | |
| Configuration | Single | |



FEATURES

- Low Gate Charge Q_g Results in Simple Drive Requirement
- Improved Gate, Avalanche and Dynamic dV/dt Ruggedness
- Fully Characterized Capacitance and Avalanche Voltage and Current
- Enhanced Body Diode dV/dt Capability
- Compliant to RoHS Directive 2002/95/EC



RoHS*
COMPLIANT

APPLICATIONS

- Hard Switching Primary or PFC Switch
- Switch Mode Power Supply (SMPS)
- Uninterruptible Power Supply
- High Speed Power Switching
- Motor Drive

| ORDERING INFORMATION | |
|----------------------|-----------------|
| Package | Super-247 |
| Lead (Pb)-free | IRFPS40N60KPbF |
| | SiHFPS40N60K-E3 |
| SnPb | IRFPS40N60K |
| | SiHFPS40N60K |


| ABSOLUTE MAXIMUM RATINGS ($T_C = 25^\circ\text{C}$, unless otherwise noted) | | | | |
|---|--------------------------|----------------|---------------------------|---------------------|
| PARAMETER | | SYMBOL | LIMIT | UNIT |
| Drain-Source Voltage | | V_{DS} | 600 | V |
| Gate-Source Voltage | | V_{GS} | ± 30 | |
| Continuous Drain Current | V_{GS} at 10 V | I_D | $T_C = 25^\circ\text{C}$ | 40 |
| | | | $T_C = 100^\circ\text{C}$ | |
| Pulsed Drain Current ^a | | I_{DM} | 160 | A |
| Linear Derating Factor | | | 4.5 | W/ $^\circ\text{C}$ |
| Single Pulse Avalanche Energy ^b | | E_{AS} | 600 | mJ |
| Repetitive Avalanche Current ^a | | I_{AR} | 40 | A |
| Repetitive Avalanche Energy ^a | | E_{AR} | 57 | mJ |
| Maximum Power Dissipation | $T_C = 25^\circ\text{C}$ | P_D | 570 | W |
| Peak Diode Recovery dV/dt^c | | dV/dt | 7.5 | V/ns |
| Operating Junction and Storage Temperature Range | | T_J, T_{stg} | - 55 to + 150 | $^\circ\text{C}$ |
| Soldering Recommendations (Peak Temperature) | for 10 s | | 300 ^d | |

Notes

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- Starting $T_J = 25^\circ\text{C}$, $L = 0.84$ mH, $R_g = 25 \Omega$, $I_{AS} = 38$ A, $dV/dt = 5.5$ V/ns (see fig. 12a).
- $I_{SD} \leq 38$ A, $dI/dt \leq 150$ A/ μs , $V_{DD} \leq V_{DS}$, $T_J \leq 150^\circ\text{C}$.
- 1.6 mm from case.

* Pb containing terminations are not RoHS compliant, exemptions may apply

| THERMAL RESISTANCE RATINGS | | | | |
|-------------------------------------|------------|------|------|------|
| PARAMETER | SYMBOL | TYP. | MAX. | UNIT |
| Maximum Junction-to-Ambient | R_{thJA} | - | 40 | °C/W |
| Case-to-Sink, Flat, Greased Surface | R_{thCS} | 0.24 | - | |
| Maximum Junction-to-Case (Drain) | R_{thJC} | - | 0.22 | |

| 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 $25\text{ }^\circ\text{C}$, $I_D = 1\text{ mA}$ | - | 0.63 | - | V/°C | |
| Gate-Source Threshold Voltage | $V_{GS(th)}$ | $V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$ | 3.0 | - | 5.0 | V | |
| Gate-Source Leakage | I_{GSS} | $V_{GS} = \pm 30\text{ V}$ | - | - | ± 100 | nA | |
| Zero Gate Voltage Drain Current | I_{DSS} | $V_{DS} = 600\text{ V}, V_{GS} = 0\text{ V}$ | - | - | 50 | μA | |
| | | $V_{DS} = 480\text{ V}, V_{GS} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$ | - | - | 250 | | |
| Drain-Source On-State Resistance | $R_{DS(on)}$ | $V_{GS} = 10\text{ V}, I_D = 24\text{ A}^b$ | - | 0.110 | 0.130 | Ω | |
| Forward Transconductance | g_{fs} | $V_{DS} = 50\text{ V}, I_D = 24\text{ A}^b$ | 21 | - | - | S | |
| Dynamic | | | | | | | |
| Input Capacitance | C_{iss} | $V_{GS} = 0\text{ V}, V_{DS} = 25\text{ V}, f = 1.0\text{ MHz}$, see fig. 5 | - | 7970 | - | pF | |
| Output Capacitance | C_{oss} | | - | 750 | - | | |
| Reverse Transfer Capacitance | C_{rss} | | - | 75 | - | | |
| Output Capacitance | C_{oss} | $V_{GS} = 0\text{ V}$ | $V_{DS} = 1.0\text{ V}, f = 1.0\text{ MHz}$ | - | 9440 | - | |
| Effective Output Capacitance | $C_{oss\text{ eff.}}$ | | $V_{DS} = 480\text{ V}, f = 1.0\text{ MHz}$ | - | 200 | - | |
| Total Gate Charge | Q_g | $V_{GS} = 10\text{ V}$ | $V_{DS} = 0\text{ V to } 480\text{ V}^c$ | - | 260 | - | |
| Gate-Source Charge | Q_{gs} | | $I_D = 38\text{ A}, V_{DS} = 480\text{ V}$, see fig. 6 and 13 ^b | - | - | 330 | nC |
| Gate-Drain Charge | Q_{gd} | | | - | - | 84 | |
| Turn-On Delay Time | $t_{d(on)}$ | | | - | - | 150 | |
| Rise Time | t_r | | $V_{DD} = 300\text{ V}, I_D = 38\text{ A}, R_G = 4.3\text{ }\Omega$, see fig. 10 ^b | - | 47 | - | ns |
| Turn-Off Delay Time | $t_{d(off)}$ | - | | 110 | - | | |
| Fall Time | t_f | - | | 97 | - | | |
| Drain-Source Body Diode Characteristics | | | | | | | |
| Continuous Source-Drain Diode Current | I_S | MOSFET symbol showing the integral reverse p - n junction diode  | - | - | 40 | A | |
| Pulsed Diode Forward Current ^a | I_{SM} | | - | - | 160 | | |
| Body Diode Voltage | V_{SD} | $T_J = 25\text{ }^\circ\text{C}, I_S = 38\text{ A}, V_{GS} = 0\text{ V}^b$ | - | - | 1.5 | V | |
| Body Diode Reverse Recovery Time | t_{rr} | $T_J = 25\text{ }^\circ\text{C}$ | $I_F = 38\text{ A}, di/dt = 100\text{ A}/\mu\text{s}$ | - | 630 | 950 | ns |
| | | $T_J = 125\text{ }^\circ\text{C}$ | | - | 730 | 1090 | |
| Body Diode Reverse Recovery Charge | Q_{rr} | $T_J = 25\text{ }^\circ\text{C}$ | | - | 14 | 20 | μC |
| | | $T_J = 125\text{ }^\circ\text{C}$ | | - | 17 | 25 | |
| Body Diode Recovery Current | I_{RRM} | $T_J = 25\text{ }^\circ\text{C}$ | - | 39 | 58 | A | |
| Forward Turn-On Time | t_{on} | Intrinsic turn-on time is negligible (turn-on is dominated by L_S and L_D) | | | | | |

Notes

- a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- b. Pulse width $\leq 300\text{ }\mu\text{s}$; duty cycle $\leq 2\%$.
- c. $C_{oss\text{ eff.}}$ 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)

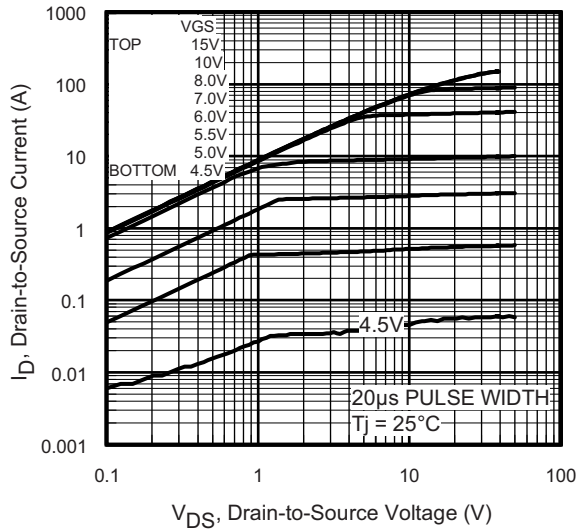


Fig. 1 - Typical Output Characteristics

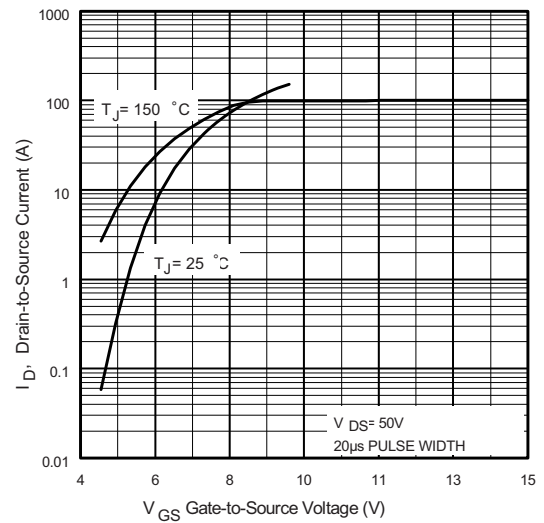


Fig. 3 - Typical Transfer Characteristics

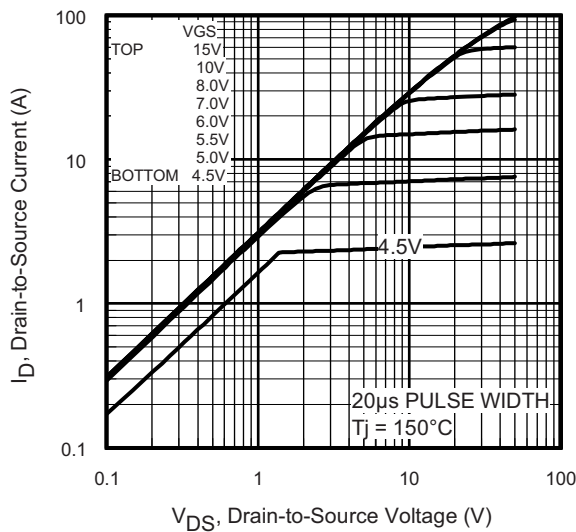


Fig. 2 - Typical Output Characteristics

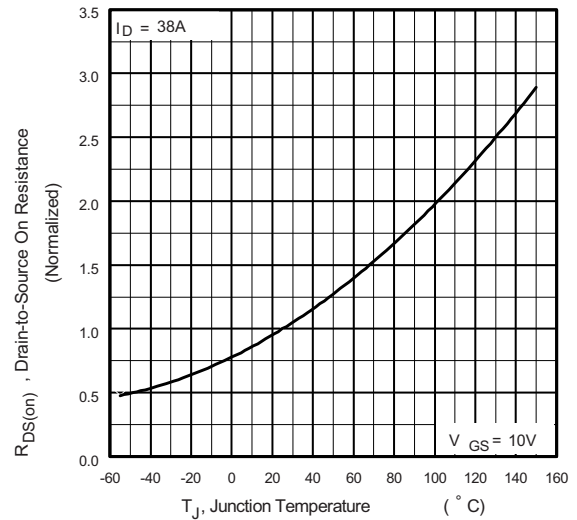


Fig. 4 - Normalized On-Resistance vs. Temperature

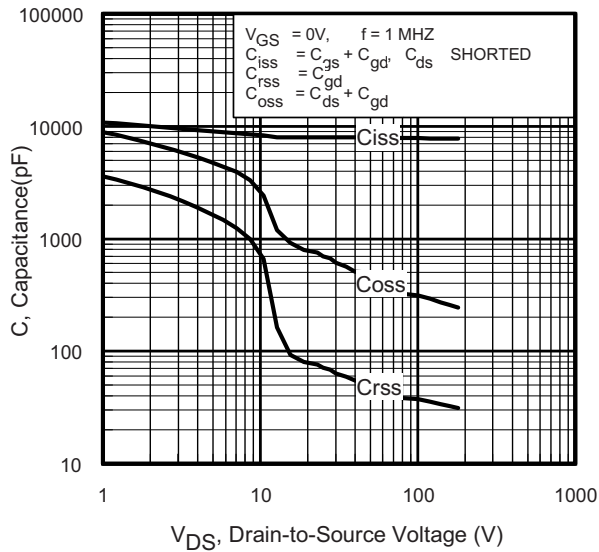


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

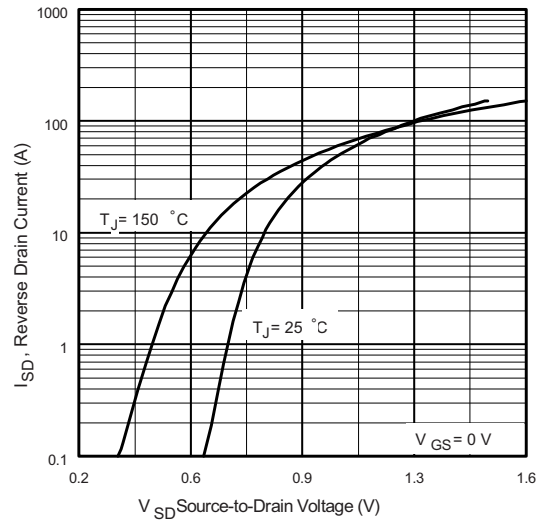


Fig. 7 - Typical Source-Drain Diode Forward Voltage

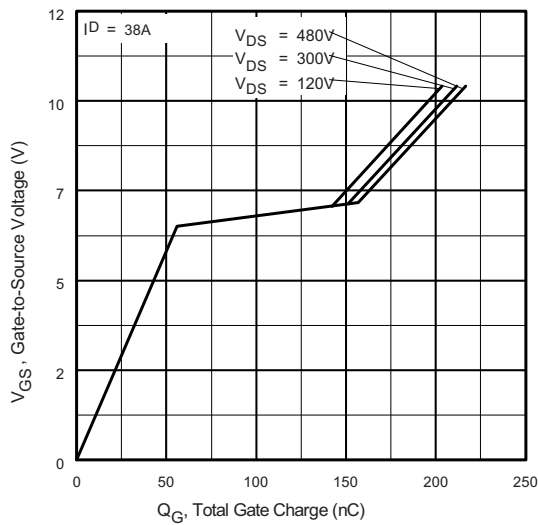


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

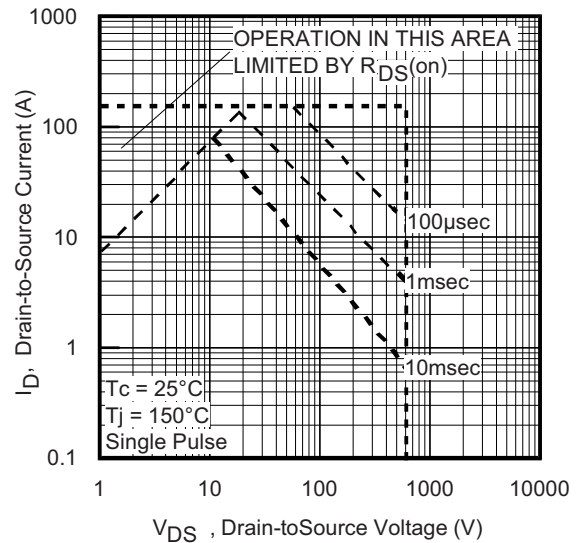


Fig. 8 - Maximum Safe Operating Area

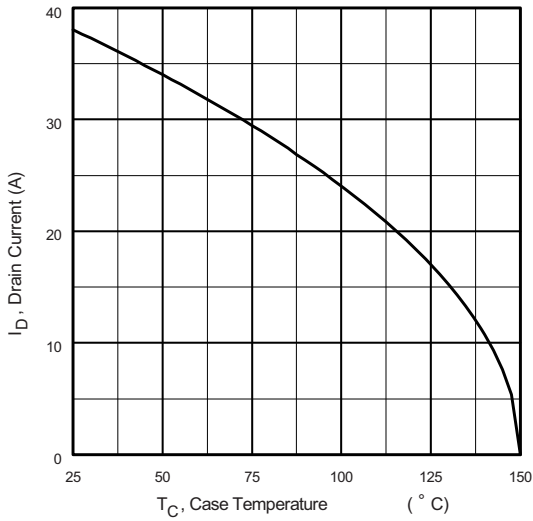


Fig. 9 - Maximum Drain Current vs. Case Temperature



Fig. 10a - Switching Time Test Circuit



Fig. 10b - Switching Time Waveforms

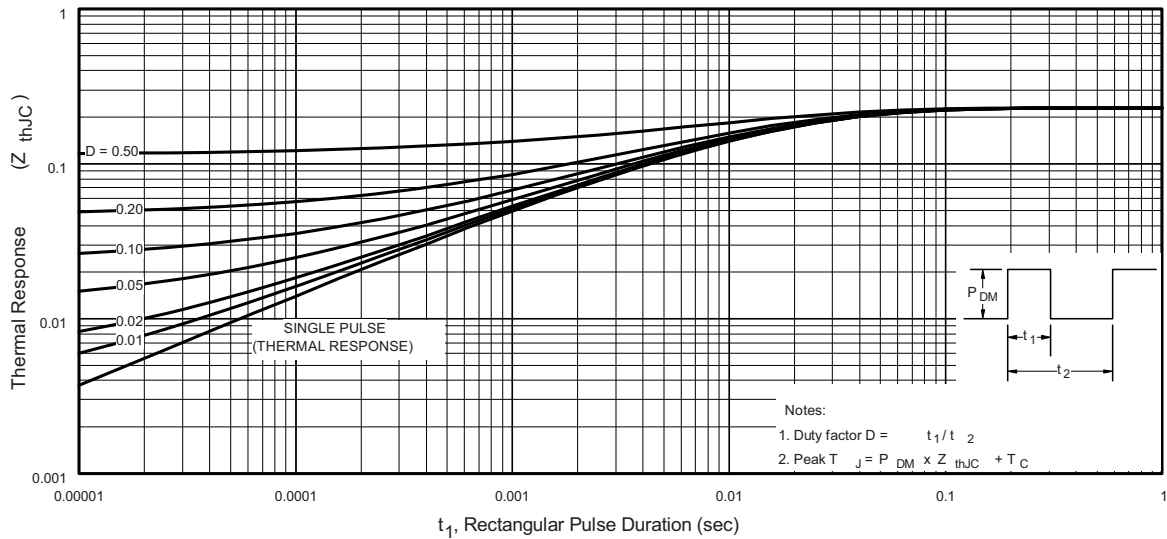


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

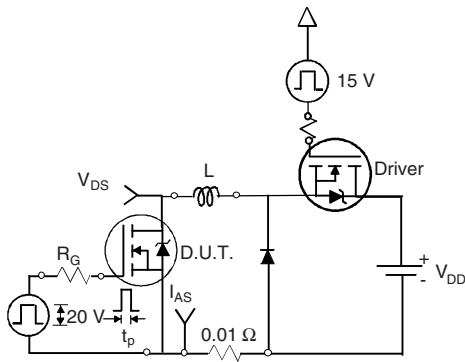


Fig. 12a - Unclamped Inductive Test Circuit

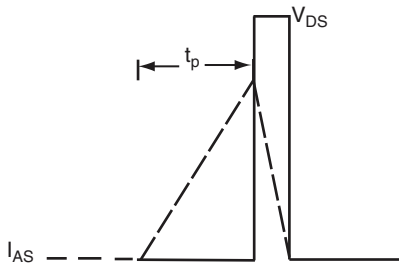


Fig. 12b - Unclamped Inductive Waveforms

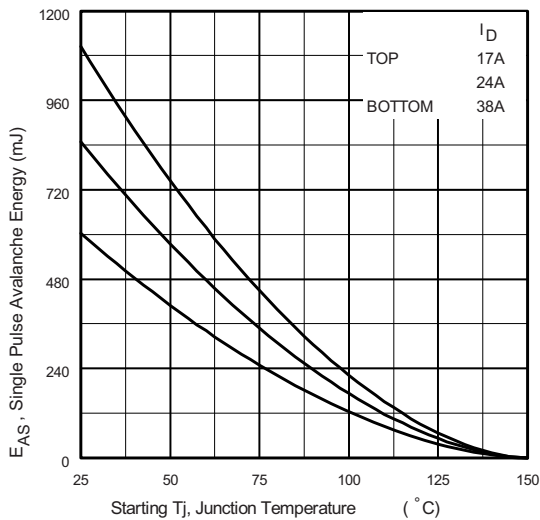


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

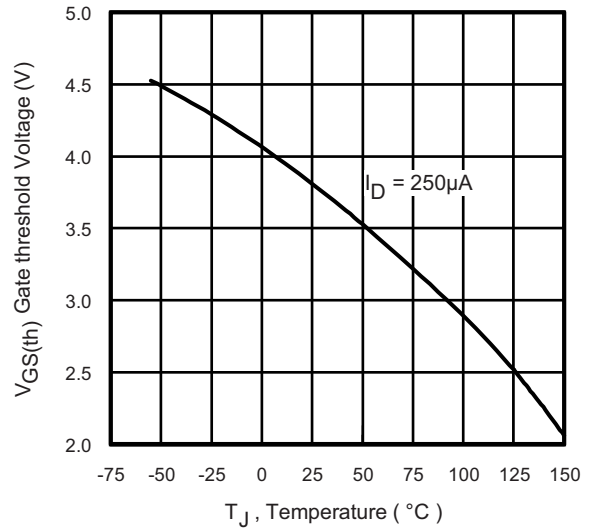


Fig. 12d - Threshold Voltage vs. Temperature

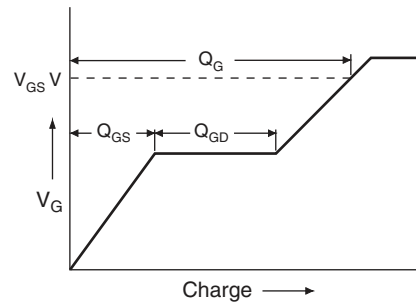


Fig. 13a - Basic Gate Charge Waveform

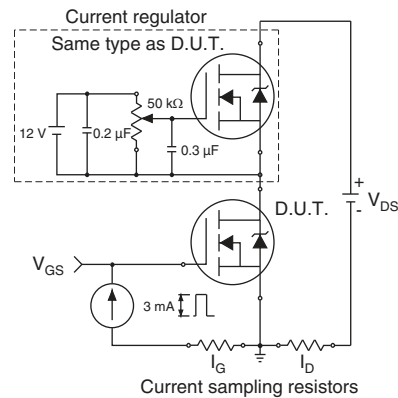


Fig. 13b - Gate Charge Test Circuit

Peak Diode Recovery dV/dt Test Circuit



Note

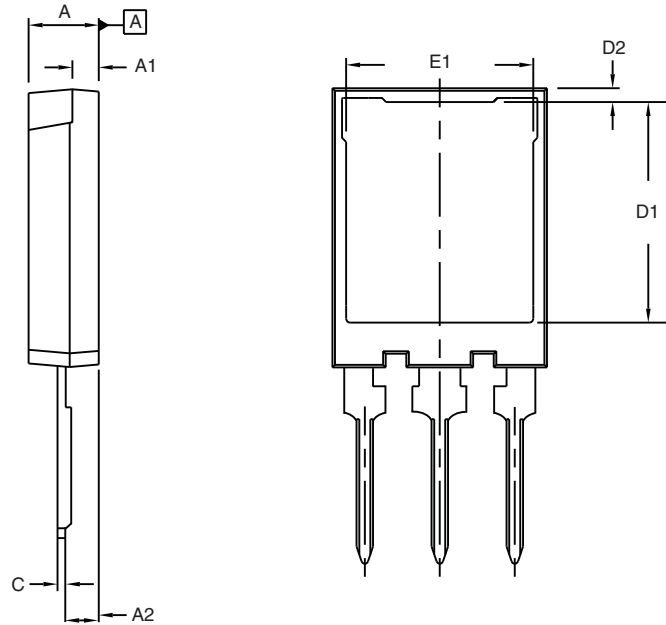
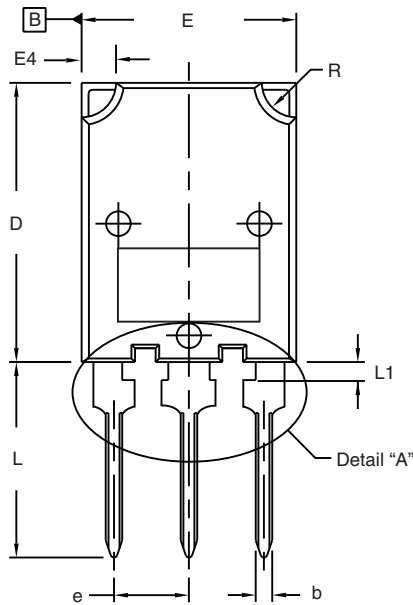
a. $V_{GS} = 5\text{ V}$ for logic level devices

Fig. 14 - For N-Channel

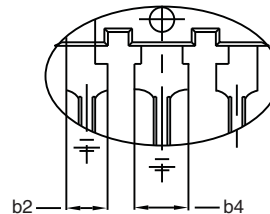
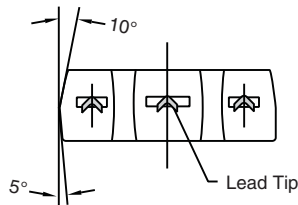
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TO-274AA (High Voltage)



⊕ 0.10 (0.25) Ⓜ B A Ⓜ



Detail "A"
Scale: 2:1

| DIM. | MILLIMETERS | | INCHES | |
|------------------|-------------|-------|--------|-------|
| | MIN. | MAX. | MIN. | MAX. |
| A | 4.70 | 5.30 | 0.185 | 0.209 |
| A1 | 1.50 | 2.50 | 0.059 | 0.098 |
| A2 | 2.25 | 2.65 | 0.089 | 0.104 |
| b | 1.30 | 1.60 | 0.051 | 0.063 |
| b2 | 1.80 | 2.20 | 0.071 | 0.087 |
| b4 | 3.00 | 3.25 | 0.118 | 0.128 |
| c ⁽¹⁾ | 0.38 | 0.89 | 0.015 | 0.035 |
| D | 19.80 | 20.80 | 0.780 | 0.819 |

| DIM. | MILLIMETERS | | INCHES | |
|------|-------------|-------|-----------|-------|
| | MIN. | MAX. | MIN. | MAX. |
| D1 | 15.50 | 16.10 | 0.610 | 0.634 |
| D2 | 0.70 | 1.30 | 0.028 | 0.051 |
| E | 15.10 | 16.10 | 0.594 | 0.634 |
| E1 | 13.30 | 13.90 | 0.524 | 0.547 |
| e | 5.45 BSC | | 0.215 BSC | |
| L | 13.70 | 14.70 | 0.539 | 0.579 |
| L1 | 1.00 | 1.60 | 0.039 | 0.063 |
| R | 2.00 | 3.00 | 0.079 | 0.118 |

ECN: X17-0056-Rev. B, 27-Mar-17
DWG: 5975

Notes

- Dimensioning and tolerancing per ASME Y14.5M-1994
- Dimension D and E do not include mold flash. Mold flash shall not exceed 0.127 mm (0.005") per side. These dimensions are measured at the outer extremes of the plastic body
- Outline conforms to JEDEC® outline to TO-274AA
- (1) Dimension measured at tip of lead



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