# Power MOSFET

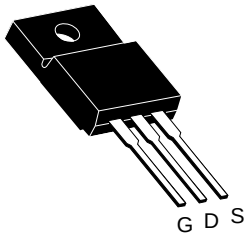
| PRODUCT SUMMARY | | |
|---|---|---|
| $V_{DS}$ (V) | 600 | |
| $R_{DS(on)}$ (Ω) | $V_{GS}$ = 10 V | 4.4 |
| $Q_g$ (Max.) (nC) | 18 | |
| $Q_{gs}$ (nC) | 3.0 | |
| $Q_{gd}$ (nC) | 8.9 | |
| Configuration | Single | |

## FEATURES

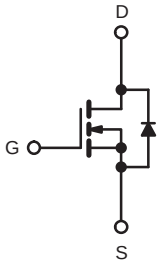
- **Halogen-free According to IEC 61249-2-21 Definition**
- Dynamic dV/dt Rating
- Repetitive Avalanche Rated
- Surface Mount (IRFRC20, SiHFRC20)
- Straight Lead (IRFUC20, SiHFUC20)
- Available in Tape and Reel
- Fast Switching
- Ease of Paralleling
- Compliant to RoHS Directive 2002/95/EC

Pb Available
RoHS* COMPLIANT
HALOGEN FREE Available

**TO-220 FULLPAK**




Top View




N-Channel MOSFET

| ABSOLUTE MAXIMUM RATINGS $T_C$ = 25 °C, unless otherwise noted | | | | | |
|---|---|---|---|---|---|
| **PARAMETER** | | | **SYMBOL** | **LIMIT** | **UNIT** |
| Drain-Source Voltage | | | $V_{DS}$ | 600 | V |
| Gate-Source Voltage | | | $V_{GS}$ | ± 20 | |
| Continuous Drain Current | $V_{GS}$ at 10 V | $T_C$ = 25 °C | $I_D$ | 2.0 | A |
| | | $T_C$ = 100 °C | | 1.3 | |
| Pulsed Drain Current[a] | | | $I_{DM}$ | 8.0 | |
| Linear Derating Factor | | | | 0.33 | W/°C |
| Linear Derating Factor (PCB Mount)[e] | | | | 0.020 | |
| Single Pulse Avalanche Energy[b] | | | $E_{AS}$ | 74 | mJ |
| Repetitive Avalanche Current[a] | | | $I_{AR}$ | 2.0 | A |
| Repetitive Avalanche Energy[a] | | | $E_{AR}$ | 4.2 | mJ |
| Maximum Power Dissipation | $T_C$ = 25 °C | | $P_D$ | 42 | W |
| Maximum Power Dissipation (PCB Mount)[e] | $T_A$ = 25 °C | | | 2.5 | |
| Peak Diode Recovery dV/dt[c] | | | dV/dt | 3.0 | V/ns |
| Operating Junction and Storage Temperature Range | | | $T_J$, $T_{stg}$ | - 55 to + 150 | °C |
| Soldering Recommendations (Peak Temperature) | for 10 s | | | 260[d] | |

**Notes**

a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
b. $V_{DD}$ = 50 V, starting $T_J$ = 25 °C, L = 37 mH, $R_g$ = 25 Ω, $I_{AS}$ = 2.0 A (see fig. 12).
c. $I_{SD} \leq$ 2.0 A, dI/dt ≤ 40 A/μs, $V_{DD} \leq V_{DS}$, $T_J \leq$ 150 °C.
d. 1.6 mm from case.
e. When mounted on 1" square PCB (FR-4 or G-10 material).

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

| THERMAL RESISTANCE RATINGS | | | | | |
|---|---|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **MIN.** | **TYP.** | **MAX.** | **UNIT** |
| Maximum Junction-to-Ambient | $R_{thJA}$ | - | - | 110 | °C/W |
| Maximum Junction-to-Ambient (PCB Mount)[a] | $R_{thJA}$ | - | - | 50 | |
| Maximum Junction-to-Case (Drain) | $R_{thJC}$ | - | - | 3.0 | |

**Note**

a. When mounted on 1" square PCB (FR-4 or G-10 material).

| **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 | $\Delta V_{DS}/T_J$ | Reference to 25 °C, $I_D$ = 1 mA | - | 0.88 | - | V/°C |
| Gate-Source Threshold Voltage | $V_{GS(th)}$ | $V_{DS}$ = $V_{GS}$, $I_D$ = 250 µA | 2.0 | - | 4.0 | V |
| Gate-Source Leakage | $I_{GSS}$ | $V_{GS}$ = ± 20 V | - | - | ± 100 | nA |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{DS}$ = 600 V, $V_{GS}$ = 0 V | - | - | 100 | µA |
| | | $V_{DS}$ = 480 V, $V_{GS}$ = 0 V, $T_J$ = 125 °C | - | - | 500 | |
| Drain-Source On-State Resistance | $R_{DS(on)}$ | $V_{GS}$ = 10 V, $I_D$ = 1.2 A[b] | – | 4.4 | - | Ω |
| Forward Transconductance | $g_{fs}$ | $V_{DS}$ = 50 V, $I_D$ = 1.2 A | 1.4 | - | - | S |
| **Dynamic** | | | | | | |
| Input Capacitance | $C_{iss}$ | $V_{GS}$ = 0 V, $V_{DS}$ = - 25 V, f = 1.0 MHz, see fig. 5 | - | 350 | - | pF |
| Output Capacitance | $C_{oss}$ | | - | 48 | - | |
| Reverse Transfer Capacitance | $C_{rss}$ | | - | 8.6 | - | |
| Total Gate Charge | $Q_g$ | $V_{GS}$ = 10 V, $I_D$ = 2.0 A, $V_{DS}$ = 360 V, see fig. 6 and 13[b] | - | - | 18 | nC |
| Gate-Source Charge | $Q_{gs}$ | | - | - | 3.0 | |
| Gate-Drain Charge | $Q_{gd}$ | | - | - | 8.9 | |
| Turn-On Delay Time | $t_{d(on)}$ | $V_{DD}$ = 300 V, $I_D$ = 2.0 A, $R_g$ = 18 Ω, $R_D$ = 135 Ω, see fig. 10[b] | - | 10 | - | ns |
| Rise Time | $t_r$ | | - | 23 | - | |
| Turn-Off Delay Time | $t_{d(off)}$ | | - | 30 | - | |
| Fall Time | $t_f$ | | - | 25 | - | |
| Internal Drain Inductance | $L_D$ | Between lead, 6 mm (0.25") from package and center of die contact  | - | 4.5 | - | nH |
| Internal Source Inductance | $L_S$ | | - | 7.5 | - | |
| **Drain-Source Body Diode Characteristics** | | | | | | |
| Continuous Source-Drain Diode Current | $I_S$ | MOSFET symbol showing the integral reverse p - n junction diode  | - | - | 2.0 | A |
| Pulsed Diode Forward Current[a] | $I_{SM}$ | | - | - | 8.0 | |
| Body Diode Voltage | $V_{SD}$ | $T_J$ = 25 °C, $I_S$ = 2.0 A, $V_{GS}$ = 0 V[b] | - | - | 1.6 | V |
| Body Diode Reverse Recovery Time | $t_{rr}$ | $T_J$ = 25 °C, $I_F$ = 2.0 A, dI/dt = 100 A/µs[b] | - | 290 | 580 | ns |
| Body Diode Reverse Recovery Charge | $Q_{rr}$ | | - | 0.67 | 1.3 | µC |
| 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 ≤ 300 µs; duty cycle ≤ 2 %.

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

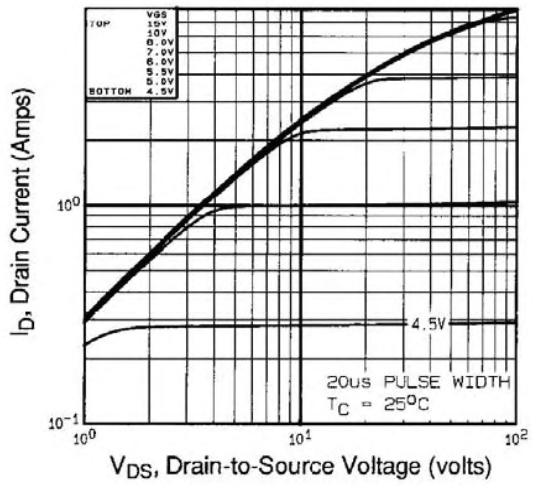



**Fig. 1 - Typical Output Characteristics, $T_C$ = 25 °C**

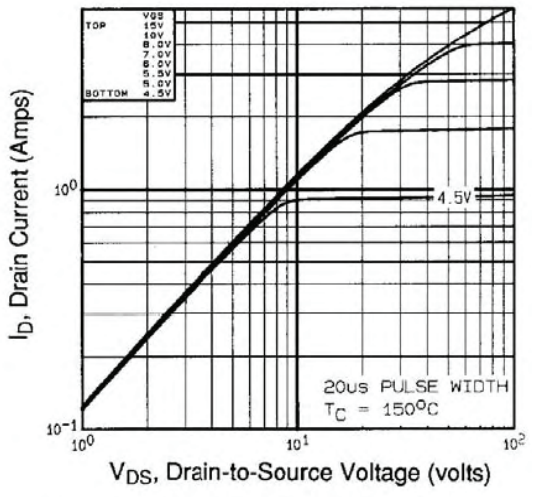



**Fig. 2 - Typical Output Characteristics, $T_C$ = 150 °C**

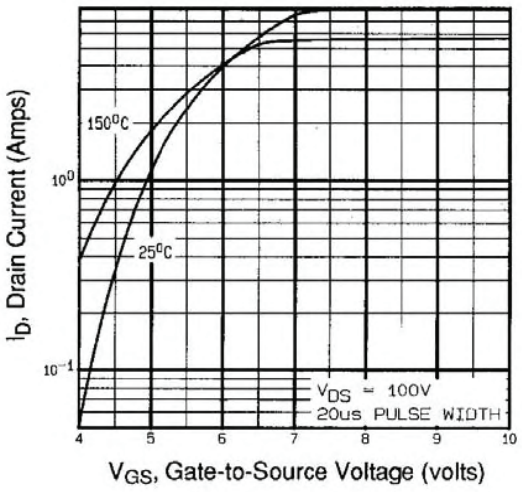



**Fig. 3 - Typical Transfer Characteristics**

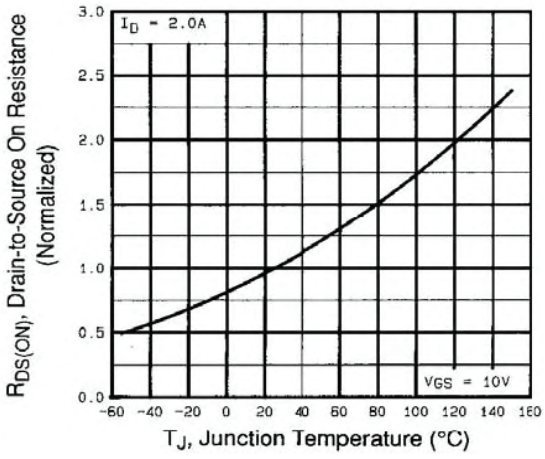



**Fig. 4 - Normalized On-Resistance vs. Temperature**

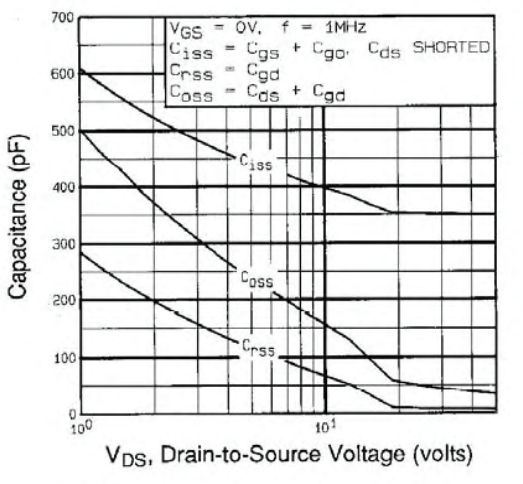



Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

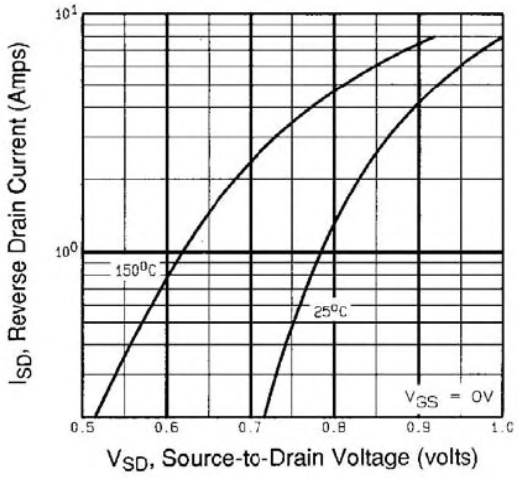



Fig. 7 - Typical Source-Drain Diode Forward Voltage

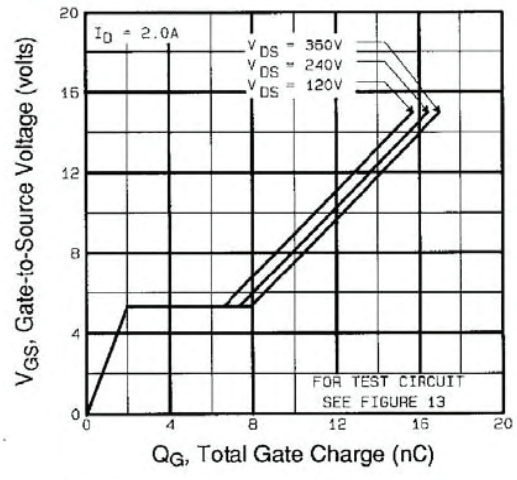



Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

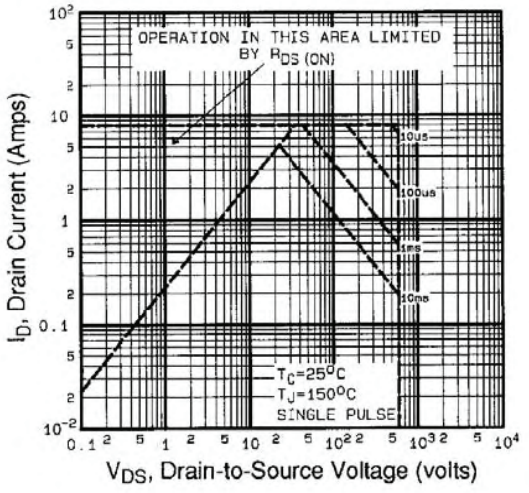



Fig. 8 - Maximum Safe Operating Area

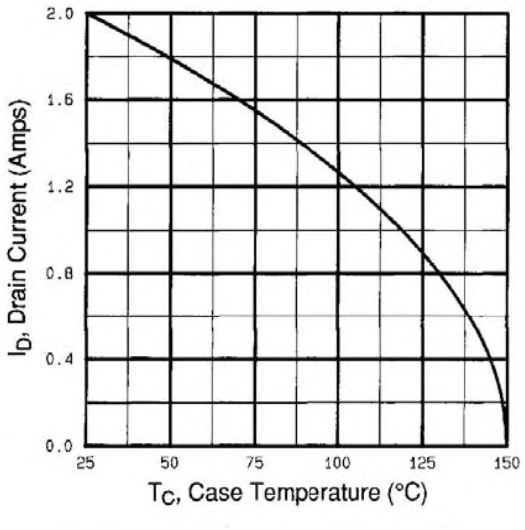



Fig. 9 - Maximum Drain Current vs. Case Temperature

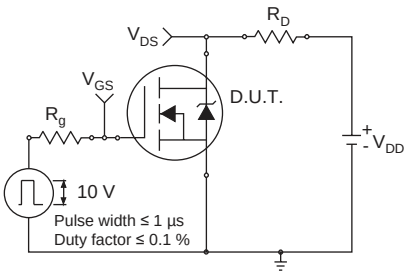



Fig. 10a - Switching Time Test Circuit

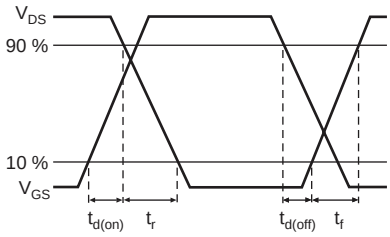



Fig. 10b - Switching Time Waveforms

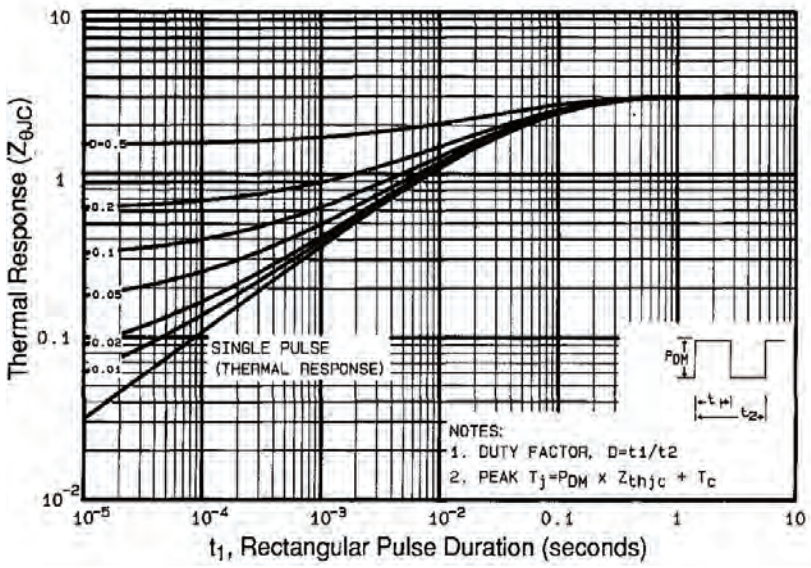



Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

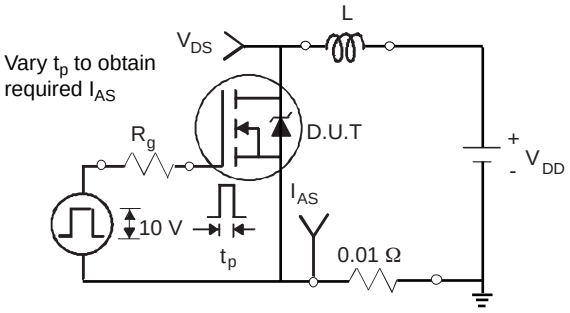



**Fig. 12a - Unclamped Inductive Test Circuit**

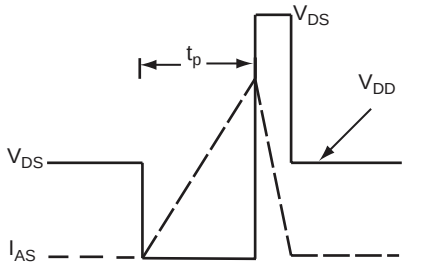



**Fig. 12b - Unclamped Inductive Waveforms**

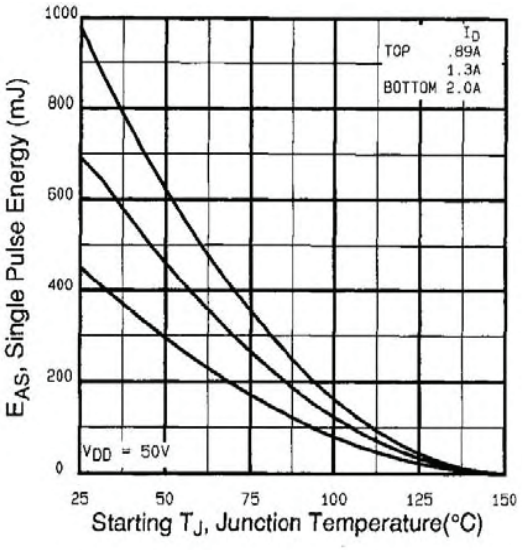



**Fig. 12c - Maximum Avalanche Energy vs. Drain Current**

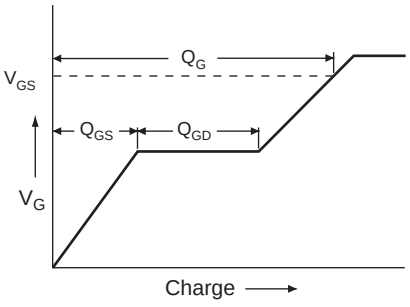



**Fig. 13a - Basic Gate Charge Waveform**

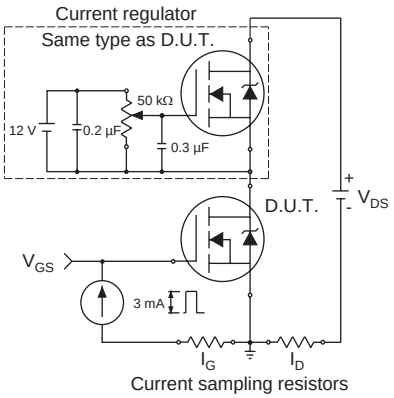
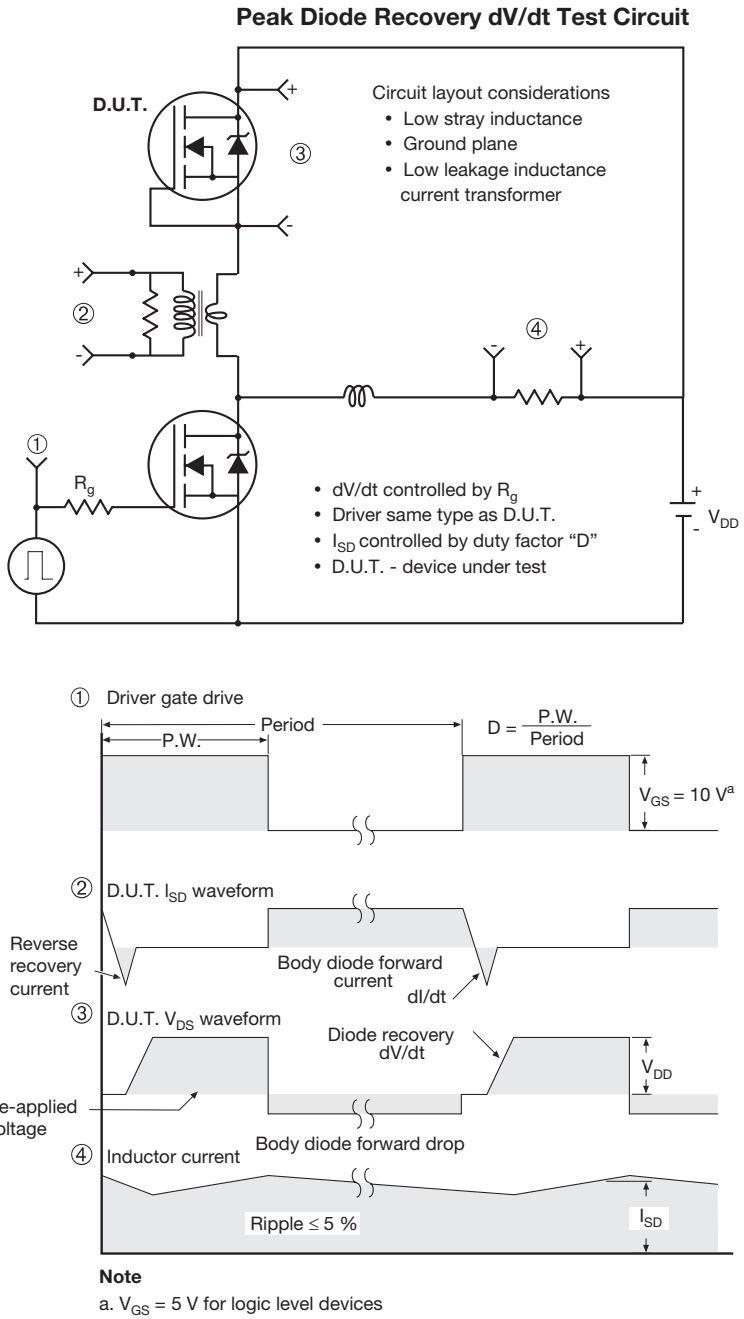



**Fig. 13b - Gate Charge Test Circuit**

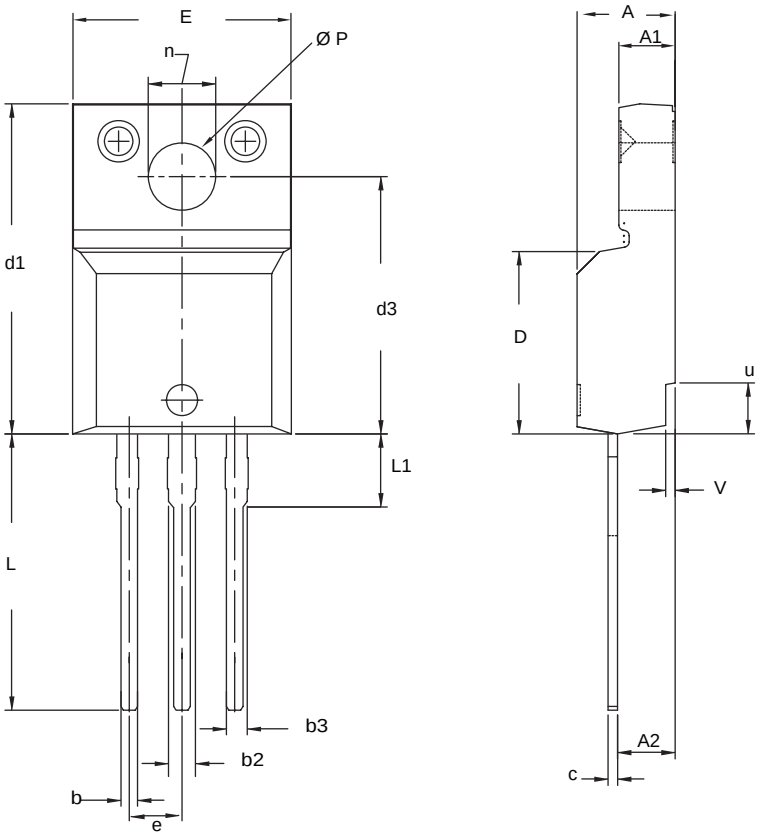



**Note**

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

**Fig. 14 - For N-Channel**

## TO-220 FULLPAK (HIGH VOLTAGE)




| | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| **DIM.** | **MIN.** | **MAX.** | **MIN.** | **MAX.** |
| A | 4.570 | 4.830 | 0.180 | 0.190 |
| A1 | 2.570 | 2.830 | 0.101 | 0.111 |
| A2 | 2.510 | 2.850 | 0.099 | 0.112 |
| b | 0.622 | 0.890 | 0.024 | 0.035 |
| b2 | 1.229 | 1.400 | 0.048 | 0.055 |
| b3 | 1.229 | 1.400 | 0.048 | 0.055 |
| c | 0.440 | 0.629 | 0.017 | 0.025 |
| D | 8.650 | 9.800 | 0.341 | 0.386 |
| d1 | 15.88 | 16.120 | 0.622 | 0.635 |
| d3 | 12.300 | 12.920 | 0.484 | 0.509 |
| E | 10.360 | 10.630 | 0.408 | 0.419 |
| e | 2.54 BSC | | 0.100 BSC | |
| L | 13.200 | 13.730 | 0.520 | 0.541 |
| L1 | 3.100 | 3.500 | 0.122 | 0.138 |
| n | 6.050 | 6.150 | 0.238 | 0.242 |
| Ø P | 3.050 | 3.450 | 0.120 | 0.136 |
| u | 2.400 | 2.500 | 0.094 | 0.098 |
| v | 0.400 | 0.500 | 0.016 | 0.020 |
| ECN: X09-0126-Rev. B, 26-Oct-09<br>DWG: 5972 | | | | |

**Notes**

1. To be used only for process drawing.
2. These dimensions apply to all TO-220, FULLPAK leadframe versions 3 leads.
3. All critical dimensions should C meet $C_{pk}$ > 1.33.
4. All dimensions include burrs and plating thickness.
5. No chipping or package damage.

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