# Power MOSFET

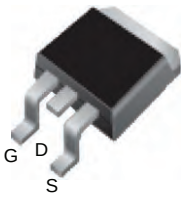
| PRODUCT SUMMARY | | |
|---|---|---|
| $V_{DS}$ (V) | 600 | |
| $R_{DS(on)}$ (Ω) | $V_{GS}$ = 10 V | 0.5 |
| $Q_g$ (Max.) (nC) | 200 | |
| $Q_{gs}$ (nC) | 24 | |
| $Q_{gd}$ (nC) | 110 | |
| Configuration | Single | |

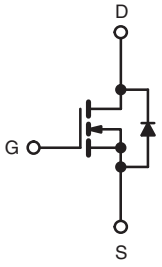
## FEATURES

- Dynamic dV/dt Rating
- Repetitive Avalanche Rated
- Isolated Central Mounting Hole
- Fast Switching
- Ease of Paralleling
- Simple Drive Requirements
- Compliant to RoHS Directive 2002/95/EC

Available
RoHS* COMPLIANT

**D²PAK (TO-263)**




N-Channel MOSFET

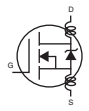
| ABSOLUTE MAXIMUM RATINGS ($T_C$ = 25 °C, unless otherwise noted) | | | | | |
|---|---|---|---|---|---|
| **PARAMETER** | | | **SYMBOL** | **LIMIT** | **UNIT** |
| Drain-Source Voltage | | | $V_{DS}$ | 600 | V |
| Gate-Source Voltage | | | $V_{GS}$ | ± 20 | |
| Continuous Drain Current | $V_{GS}$ at 10 V | $T_C$ = 25 °C | $I_D$ | 12 | A |
| | | $T_C$ = 100 °C | | 9 | |
| Pulsed Drain Current[a] | | | $I_{DM}$ | 36 | |
| Linear Derating Factor | | | | 1.5 | W/°C |
| Single Pulse Avalanche Energy[b] | | | $E_{AS}$ | 880 | mJ |
| Repetitive Avalanche Current[a] | | | $I_{AR}$ | 8.7 | A |
| Repetitive Avalanche Energy[a] | | | $E_{AR}$ | 19 | mJ |
| Maximum Power Dissipation | $T_C$ = 25 °C | | $P_D$ | 190 | W |
| Peak Diode Recovery dV/dt[c] | | | dV/dt | 1.5 | V/ns |
| Operating Junction and Storage Temperature Range | | | $T_J$, $T_{stg}$ | - 55 to + 150 | °C |
| Soldering Recommendations (Peak Temperature) | for 10 s | | | 300[d] | |
| Mounting Torque | 6-32 or M3 screw | | | 10 | lbf · in |
| | | | | 1.1 | N · m |

**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, $I_{AS}$ = 6.7 A (see fig. 12).
c. $I_{SD}$ ≤ 6.7 A, dI/dt ≤ 130 A/μs, $V_{DD}$ ≤ 600, $T_J$ ≤ 150 °C.
d. 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) | $R_{thJC}$ | - | 0.65 | |

| **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 | | - | 1.2 | - | 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 |
| | | $V_{DS}$ = 560 V, $V_{GS}$ = 0 V, $T_J$ = 125 °C | | - | - | 500 | |
| Drain-Source On-State Resistance | $R_{DS(on)}$ | $V_{GS}$ = 10 V | $I_D$ = 4.0 A[b] | - | 0.5 | - | Ω |
| Forward Transconductance | $g_{fs}$ | $V_{DS}$ = 100 V, $I_D$ = 4.0 A[b] | | 4.9 | - | - | S |
| **Dynamic** | | | | | | | |
| Input Capacitance | $C_{iss}$ | $V_{GS}$ = 0 V, $V_{DS}$ = 25 V, f = 1.0 MHz, see fig. 5 | | - | 2900 | - | pF |
| Output Capacitance | $C_{oss}$ | | | - | 270 | - | |
| Reverse Transfer Capacitance | $C_{rss}$ | | | - | 92 | - | |
| Total Gate Charge | $Q_g$ | $V_{GS}$ = 10 V | $I_D$ = 6.7 A, $V_{DS}$ = 360 V, see fig. 6 and 13[b] | - | - | 200 | nC |
| Gate-Source Charge | $Q_{gs}$ | | | - | - | 24 | |
| Gate-Drain Charge | $Q_{gd}$ | | | - | - | 110 | |
| Turn-On Delay Time | $t_{d(on)}$ | $V_{DD}$ = 475 V, $I_D$ = 6.7 A , $R_G$ = 6.2 Ω, $R_D$ = 67 Ω, see fig. 10[b] | | - | 20 | - | ns |
| Rise Time | $t_r$ | | | - | 34 | - | |
| Turn-Off Delay Time | $t_{d(off)}$ | | | - | 130 | - | |
| Fall Time | $t_f$ | | | - | 37 | - | |
| Internal Drain Inductance | $L_D$ | Between lead, 6 mm (0.25") from package and center of die contact  | | - | 5.0 | - | nH |
| Internal Source Inductance | $L_S$ | | | - | 13 | - | |
| **Drain-Source Body Diode Characteristics** | | | | | | | |
| Continuous Source-Drain Diode Current | $I_S$ | MOSFET symbol showing the integral reverse p - n junction diode  | | - | - | 9 | A |
| Pulsed Diode Forward Current[a] | $I_{SM}$ | | | - | - | 1 8 | |
| Body Diode Voltage | $V_{SD}$ | $T_J$ = 25 °C, $I_S$ = 6.7 A, $V_{GS}$ = 0 V[b] | | - | - | 1.8 | V |
| Body Diode Reverse Recovery Time | $t_{rr}$ | $T_J$ = 25 °C, $I_F$ = 6.7 A, dI/dt = 100 A/µs[b] | | - | 610 | 920 | ns |
| Body Diode Reverse Recovery Charge | $Q_{rr}$ | | | - | 3.2 | 4.8 | 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)

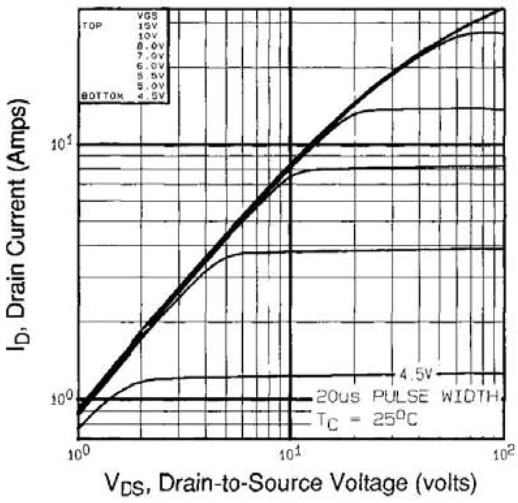



Fig. 1 - Typical Output Characteristics, $T_C$ = 25 °C

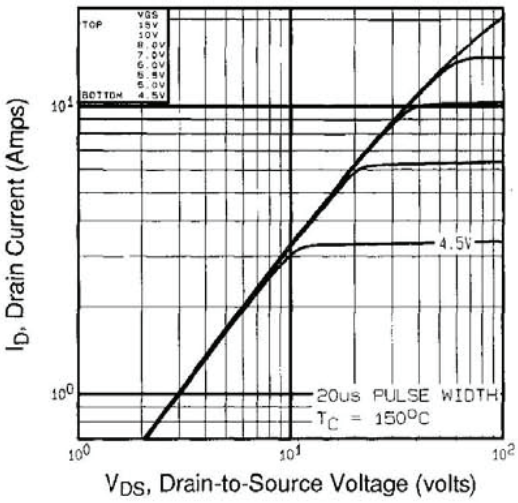



Fig. 2 - Typical Output Characteristics, $T_C$ = 150 °C

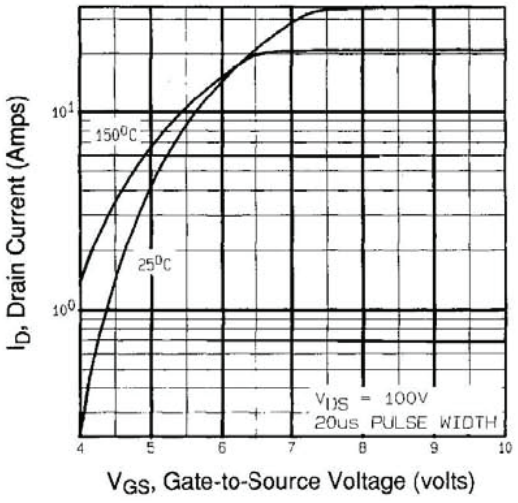



Fig. 3 - Typical Transfer Characteristics

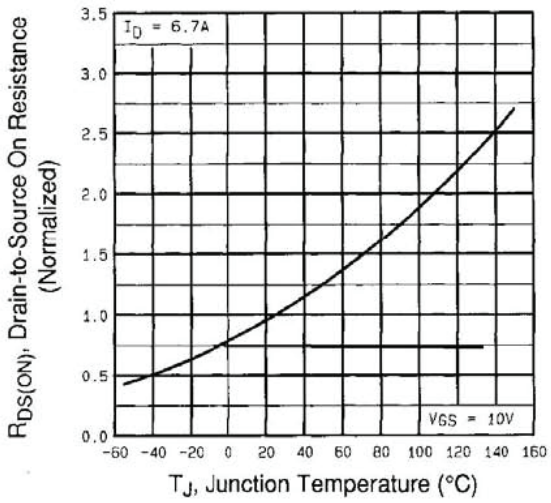



Fig. 4 - Normalized On-Resistance vs. Temperature

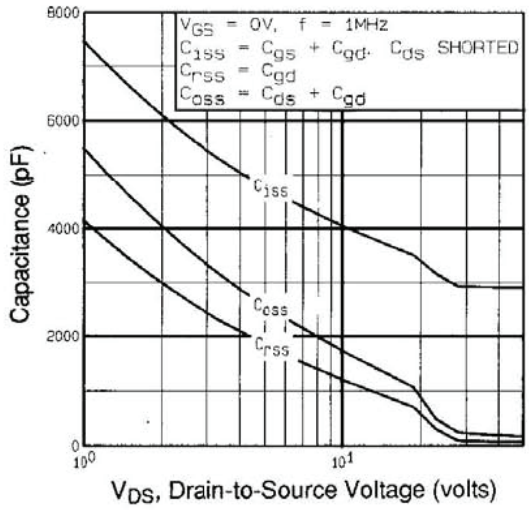



**Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage**

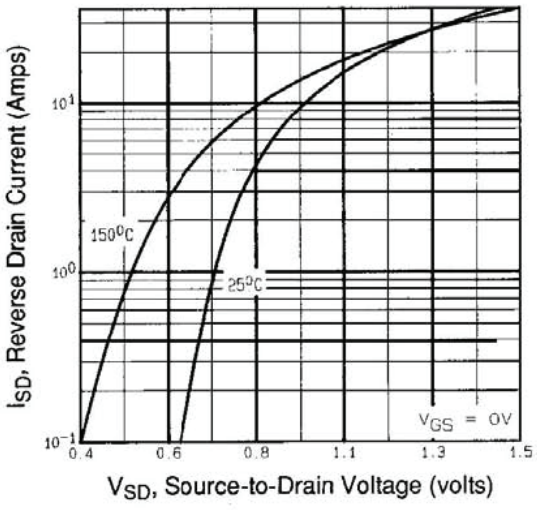



**Fig. 7 - Typical Source-Drain Diode Forward Voltage**

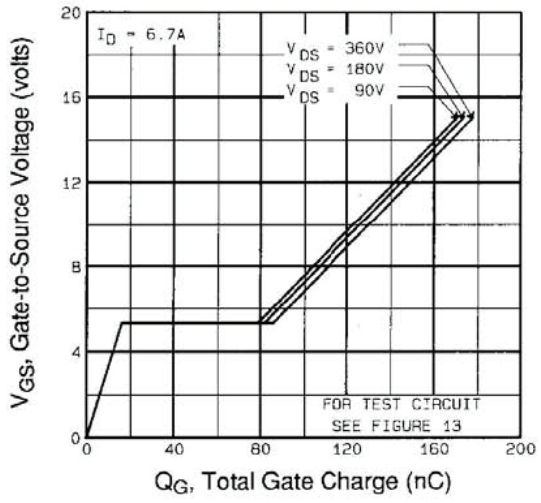



**Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage**

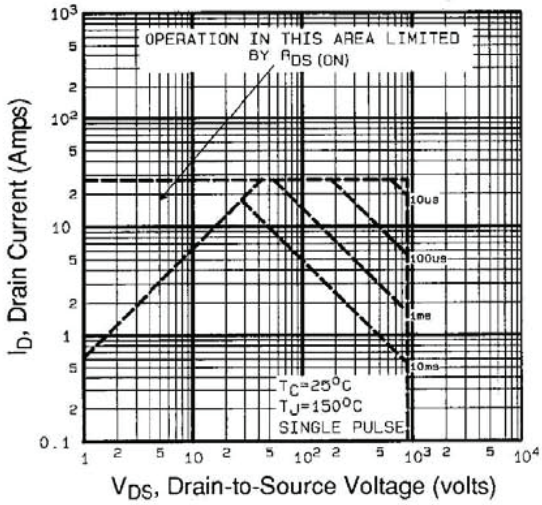



**Fig. 8 - Maximum Safe Operating Area**

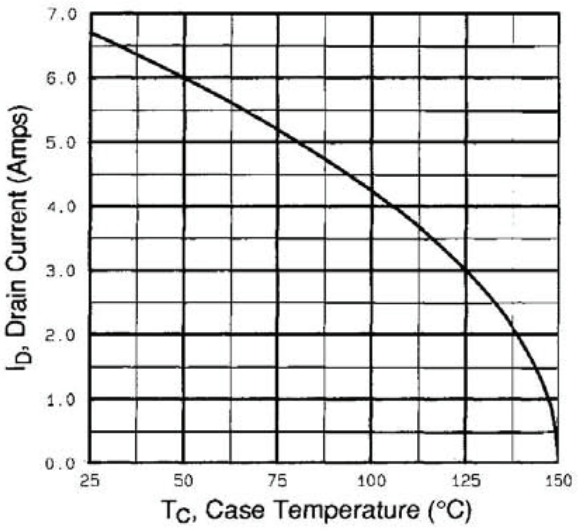



Fig. 9 - Maximum Drain Current vs. Case Temperature

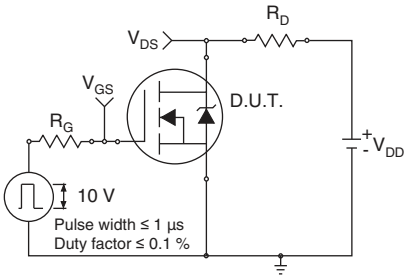



Fig. 10a - Switching Time Test Circuit

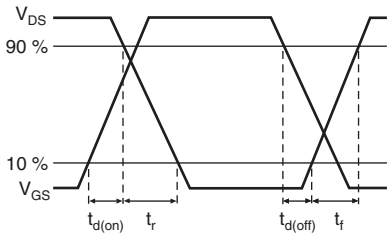



Fig. 10b - Switching Time Waveforms

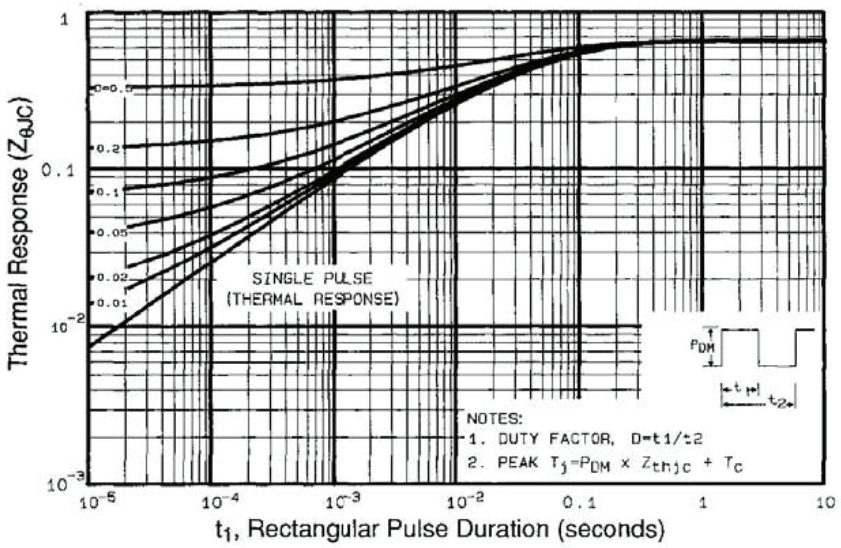



Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

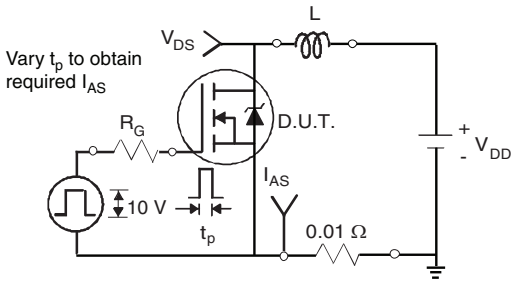



Fig. 12a - Unclamped Inductive Test Circuit

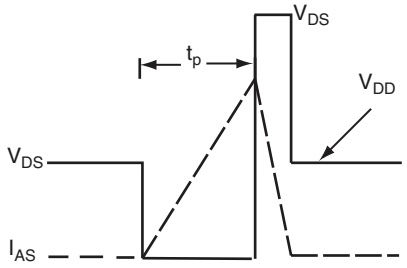



Fig. 12b - Unclamped Inductive Waveforms

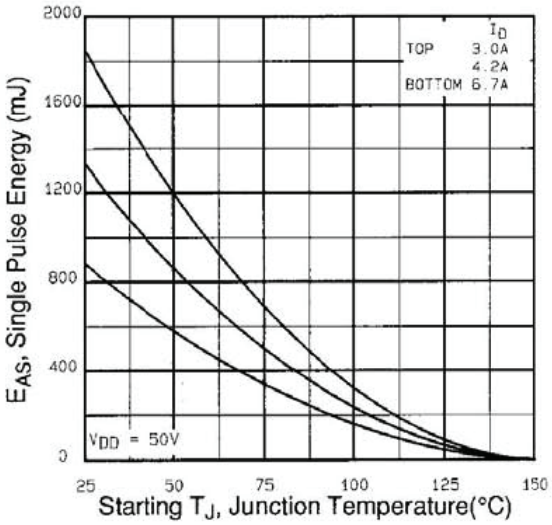



Fig. 12c - Maximum Avalanche Energy vs. Drain Current

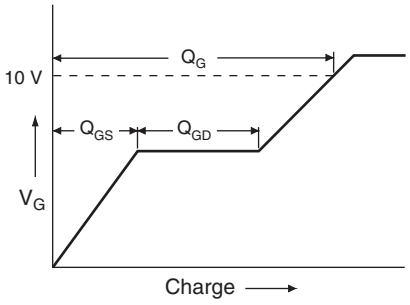



Fig. 13a - Basic Gate Charge Waveform

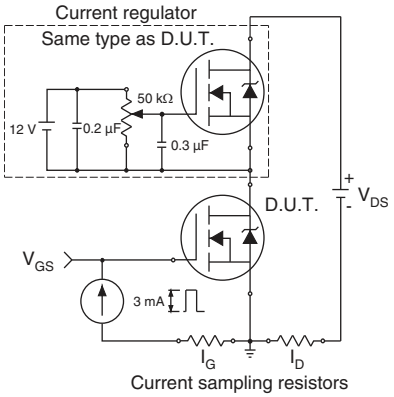
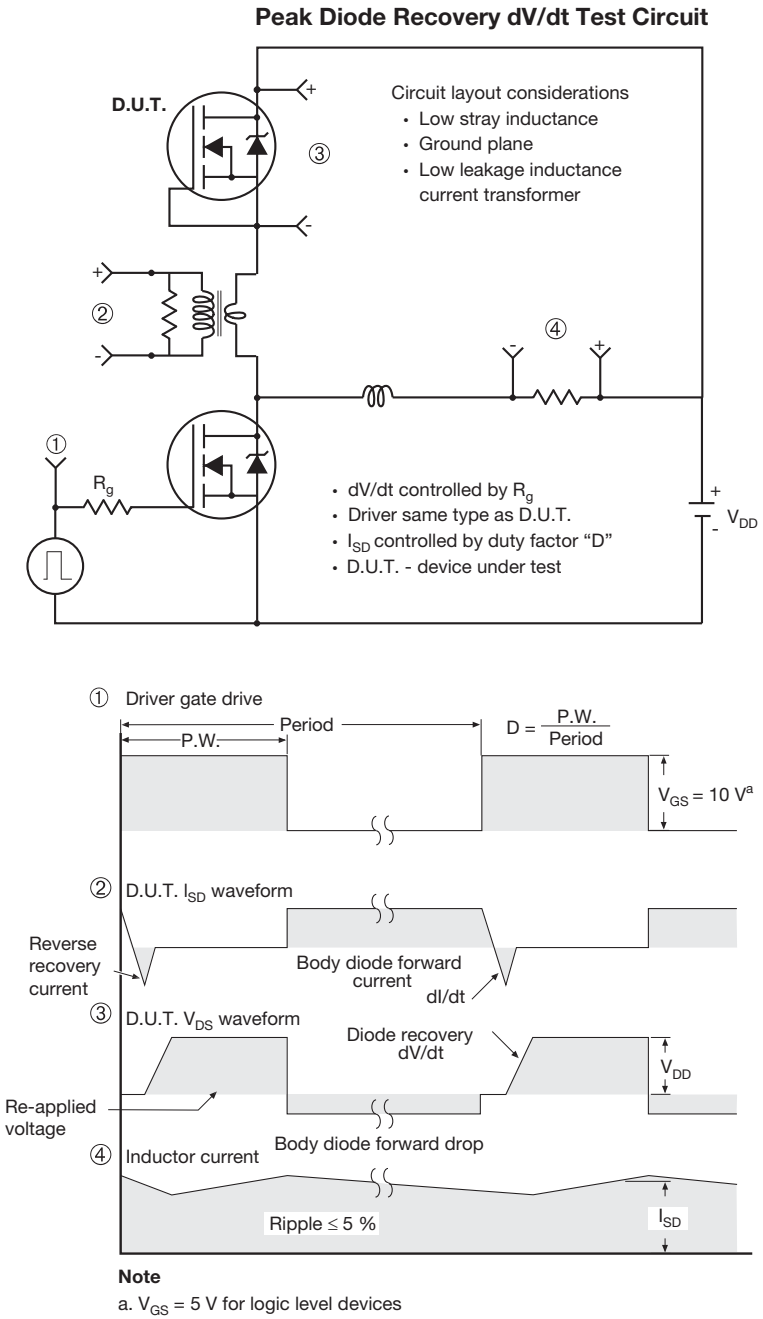



Fig. 13b - Gate Charge Test Circuit

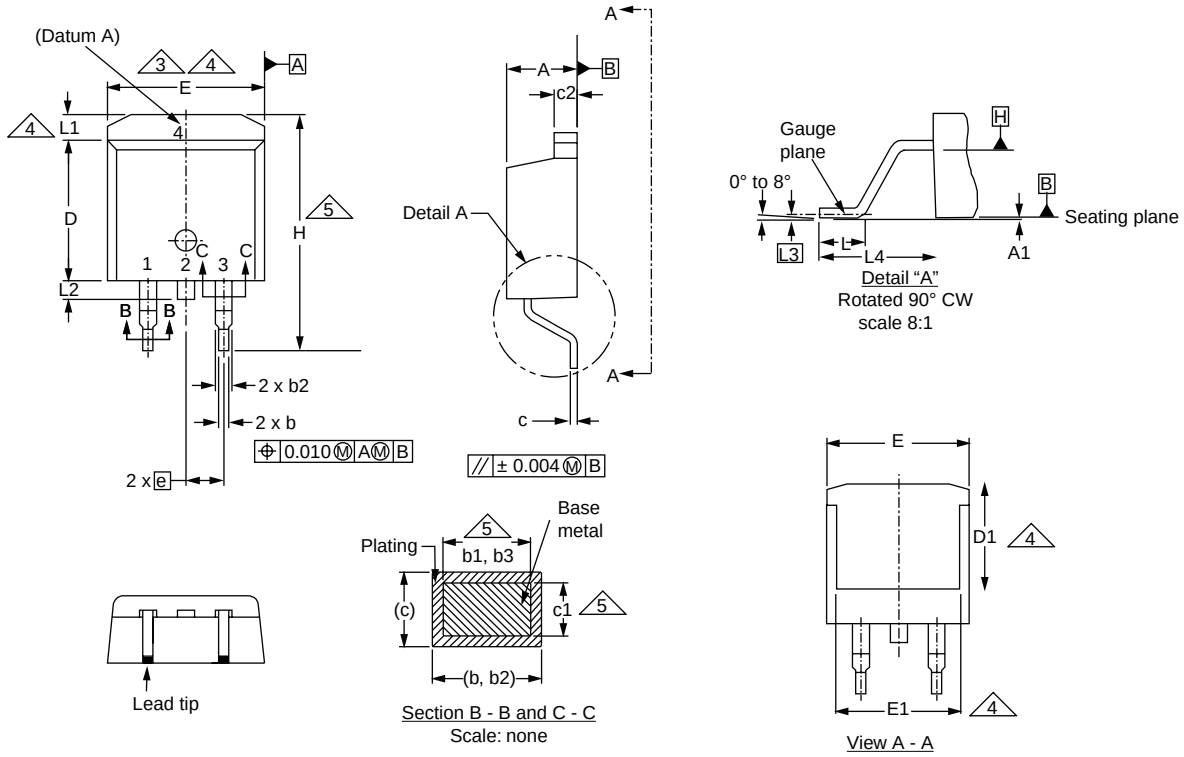



**Note**

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

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

## TO-263AB (HIGH VOLTAGE)




| | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| DIM. | MIN. | MAX. | MIN. | MAX. |
| A | 4.06 | 4.83 | 0.160 | 0.190 |
| A1 | 0.00 | 0.25 | 0.000 | 0.010 |
| b | 0.51 | 0.99 | 0.020 | 0.039 |
| b1 | 0.51 | 0.89 | 0.020 | 0.035 |
| b2 | 1.14 | 1.78 | 0.045 | 0.070 |
| b3 | 1.14 | 1.73 | 0.045 | 0.068 |
| c | 0.38 | 0.74 | 0.015 | 0.029 |
| c1 | 0.38 | 0.58 | 0.015 | 0.023 |
| c2 | 1.14 | 1.65 | 0.045 | 0.065 |
| D | 8.38 | 9.65 | 0.330 | 0.380 |

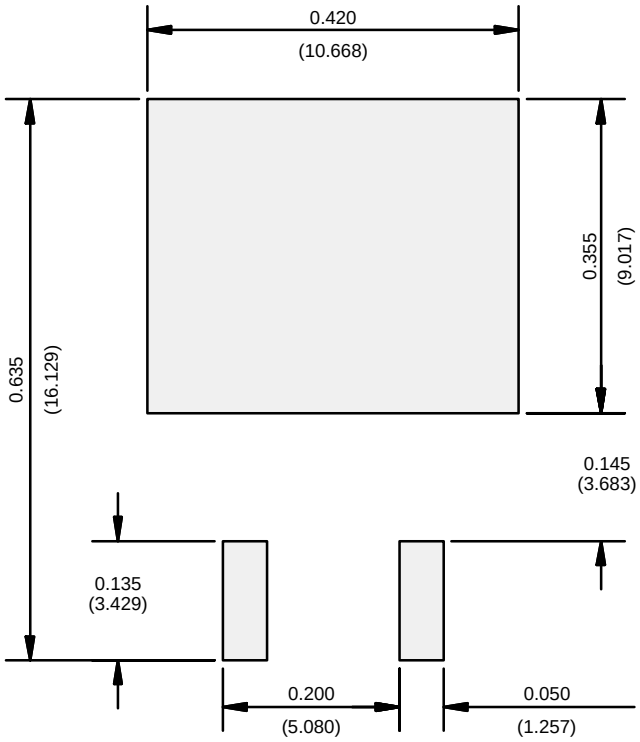
| | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| DIM. | MIN. | MAX. | MIN. | MAX. |
| D1 | 6.86 | - | 0.270 | - |
| E | 9.65 | 10.67 | 0.380 | 0.420 |
| E1 | 6.22 | - | 0.245 | - |
| e | 2.54 BSC | | 0.100 BSC | |
| H | 14.61 | 15.88 | 0.575 | 0.625 |
| L | 1.78 | 2.79 | 0.070 | 0.110 |
| L1 | - | 1.65 | - | 0.066 |
| L2 | - | 1.78 | - | 0.070 |
| L3 | 0.25 BSC | | 0.010 BSC | |
| L4 | 4.78 | 5.28 | 0.188 | 0.208 |

ECN: S-82110-Rev. A, 15-Sep-08
DWG: 5970

**Notes**

1. Dimensioning and tolerancing per ASME Y14.5M-1994.
2. Dimensions are shown in millimeters (inches).
3. 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 outmost extremes of the plastic body at datum A.
4. Thermal PAD contour optional within dimension E, L1, D1 and E1.
5. Dimension b1 and c1 apply to base metal only.
6. Datum A and B to be determined at datum plane H.
7. Outline conforms to JEDEC outline to TO-263AB.

## RECOMMENDED MINIMUM PADS FOR D²PAK: 3-Lead




Recommended Minimum Pads
Dimensions in Inches/(mm)

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