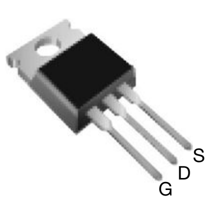
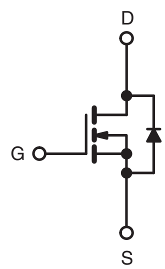
# Power MOSFET

| PRODUCT SUMMARY | | |
|---|---|---|
| $V_{DS}$ (V) | 500 | |
| $R_{DS(on)}$ (Ω) | $V_{GS}$ = 10 V | 0.85 |
| $Q_g$ (Max.) (nC) | 38 | |
| $Q_{gs}$ (nC) | 9.0 | |
| $Q_{gd}$ (nC) | 18 | |
| Configuration | Single | |

TO-220AB




N-Channel MOSFET

## 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
- Effective $C_{oss}$ Specified
- Compliant to RoHS Directive 2002/95/EC

Pb Available

RoHS* COMPLIANT

## APPLICATIONS

- Switch Mode Power Supply (SMPS)
- Uninterruptable Power Supply
- High Speed Power Switching

## TYPICAL SMPS TOPOLOGIES

- Two Transistor Forward
- Half Bridge
- Full Bridge

| ORDERING INFORMATION | |
|---|---|
| Package | TO-220AB |
| Lead (Pb)-free | IRF840APbF |
| | SiHF840A-E3 |
| SnPb | IRF840A |
| | SiHF840A |

**ABSOLUTE MAXIMUM RATINGS** ($T_C$ = 25 °C, unless otherwise noted)

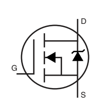
| PARAMETER | | | SYMBOL | LIMIT | UNIT |
|---|---|---|---|---|---|
| Drain-Source Voltage | | | $V_{DS}$ | 500 | V |
| Gate-Source Voltage | | | $V_{GS}$ | ± 30 | |
| Continuous Drain Current | $V_{GS}$ at 10 V | $T_C$ = 25 °C | $I_D$ | 8.0 | A |
| | | $T_C$ = 100 °C | | 5.1 | |
| Pulsed Drain Current[a] | | | $I_{DM}$ | 32 | |
| Linear Derating Factor | | | | 1.0 | W/°C |
| Single Pulse Avalanche Energy[b] | | | $E_{AS}$ | 510 | mJ |
| Repetitive Avalanche Current[a] | | | $I_{AR}$ | 8.0 | A |
| Repetitive Avalanche Energy[a] | | | $E_{AR}$ | 13 | mJ |
| Maximum Power Dissipation | $T_C$ = 25 °C | | $P_D$ | 125 | W |
| Peak Diode Recovery dV/dt[c] | | | dV/dt | 5.0 | 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 = 16 mH, $R_g$ = 25 Ω, $I_{AS}$ = 8.0 A (see fig. 12).
c. $I_{SD} \leq$ 8.0 A, dI/dt $\leq$ 100 A/μs, $V_{DD} \leq V_{DS}$, $T_J \leq$ 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 | $R_{thJA}$ | - | 62 | °C/W |
| Case-to-Sink, Flat, Greased Surface | $R_{thCS}$ | 0.50 | - | |
| Maximum Junction-to-Case (Drain) | $R_{thJC}$ | - | 1.0 | |

| **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 | | 500 | - | - | V |
| $V_{DS}$ Temperature Coefficient | $\Delta V_{DS}/T_J$ | Reference to 25 °C, $I_D$ = 1 mA | | - | 0.58 | - | 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 | $I_{GSS}$ | $V_{GS}$ = ± 30 V | | - | - | ± 100 | nA |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{DS}$ = 500 V, $V_{GS}$ = 0 V | | - | - | 25 | μA |
| | | $V_{DS}$ = 400 V, $V_{GS}$ = 0 V, $T_J$ = 125 °C | | - | - | 250 | |
| Drain-Source On-State Resistance | $R_{DS(on)}$ | $V_{GS}$ = 10 V | $I_D$ = 4.8 A[b] | - | - | 0.85 | Ω |
| Forward Transconductance | $g_{fs}$ | $V_{DS}$ = 50 V, $I_D$ = 4.8 A[b] | | 3.7 | - | - | S |
| **Dynamic** | | | | | | | |
| Input Capacitance | $C_{iss}$ | $V_{GS}$ = 0 V, $V_{DS}$ = 25 V, f = 1.0 MHz, see fig. 5 | | - | 1018 | - | pF |
| Output Capacitance | $C_{oss}$ | | | - | 155 | - | |
| Reverse Transfer Capacitance | $C_{rss}$ | | | - | 8.0 | - | |
| Output Capacitance | $C_{oss}$ | $V_{GS}$ = 0 V; $V_{DS}$ = 1.0 V, f = 1.0 MHz | | | 1490 | | |
| Output Capacitance | $C_{oss}$ | $V_{GS}$ = 0 V; $V_{DS}$ = 400 V, f = 1.0 MHz | | | 42 | | |
| Effective Output Capacitance | $C_{oss}$ eff. | $V_{GS}$ = 0 V; $V_{DS}$ = 0 V to 400 V[c] | | | 56 | | |
| Total Gate Charge | $Q_g$ | $V_{GS}$ = 10 V | $I_D$ = 8 A, $V_{DS}$ = 400 V, see fig. 6 and 13[b] | - | - | 38 | nC |
| Gate-Source Charge | $Q_{gs}$ | | | - | - | 9.0 | |
| Gate-Drain Charge | $Q_{gd}$ | | | - | - | 18 | |
| Turn-On Delay Time | $t_{d(on)}$ | $V_{DD}$ = 250 V, $I_D$ = 8 A, $R_g$ = 9.1 Ω, $R_D$ = 31 Ω, see fig. 10[b] | | - | 11 | - | ns |
| Rise Time | $t_r$ | | | - | 23 | - | |
| Turn-Off Delay Time | $t_{d(off)}$ | | | - | 26 | - | |
| Fall Time | $t_f$ | | | - | 19 | - | |
| **Drain-Source Body Diode Characteristics** | | | | | | | |
| Continuous Source-Drain Diode Current | $I_S$ | MOSFET symbol showing the integral reverse p - n junction diode |  | - | - | 8.0 | A |
| Pulsed Diode Forward Current[a] | $I_{SM}$ | | | - | - | 32 | |
| Body Diode Voltage | $V_{SD}$ | $T_J$ = 25 °C, $I_S$ = 8 A, $V_{GS}$ = 0 V[b] | | - | - | 2.0 | V |
| Body Diode Reverse Recovery Time | $t_{rr}$ | $T_J$ = 25 °C, $I_F$ = 8 A, dI/dt = 100 A/μs[b] | | - | 422 | 633 | ns |
| Body Diode Reverse Recovery Charge | $Q_{rr}$ | | | - | 2.16 | 3.24 | 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 %.
c. $C_{oss}$ 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)

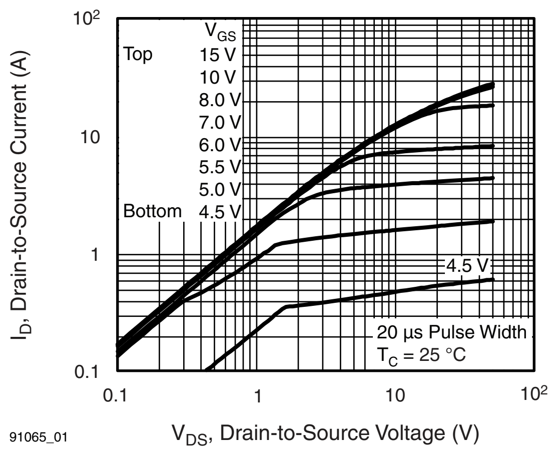



**Fig. 1 - Typical Output Characteristics, $T_C$ = 25 °C**

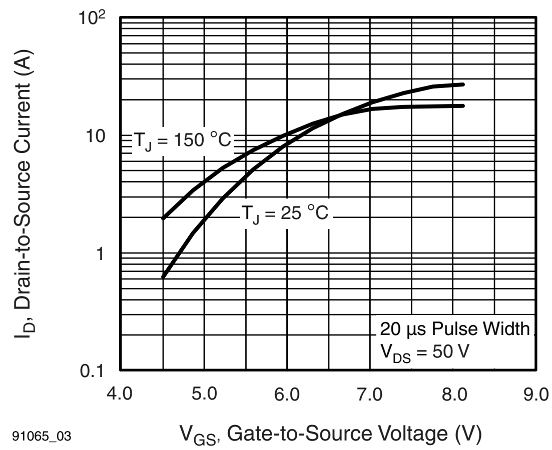



**Fig. 3 - Typical Transfer Characteristics**

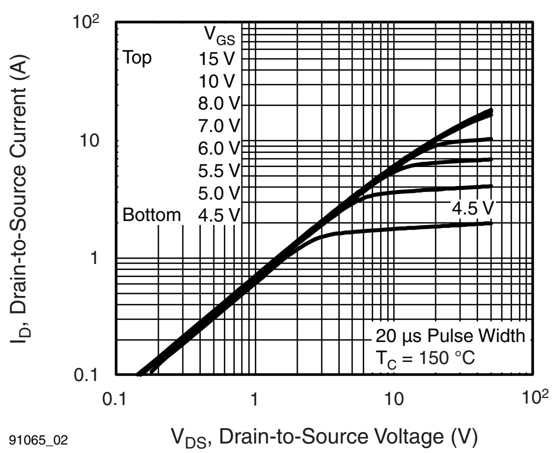



**Fig. 2 - Typical Output Characteristics, $T_C$ = 150 °C**

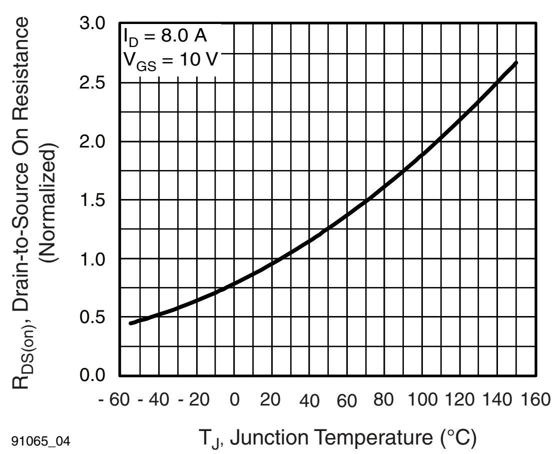



**Fig. 4 - Normalized On-Resistance vs. Temperature**

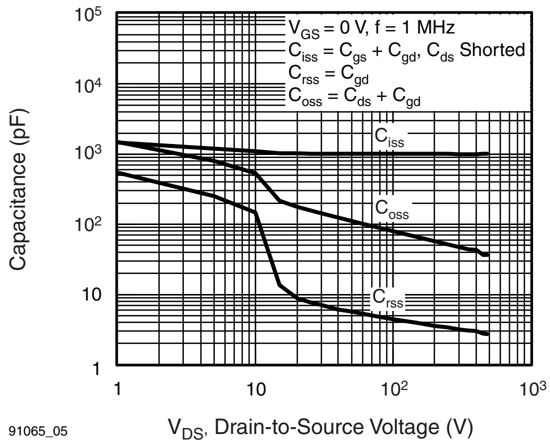



**Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage**

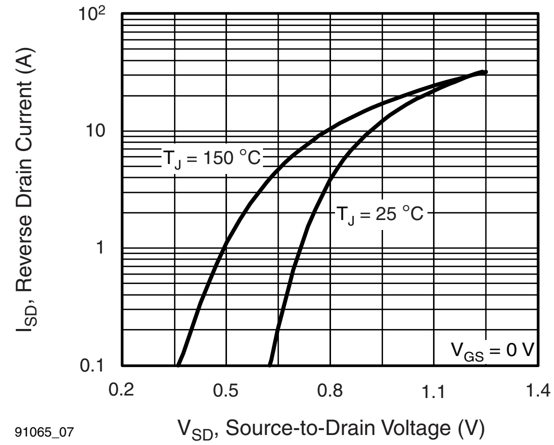



**Fig. 7 - Typical Source-Drain Diode Forward Voltage**

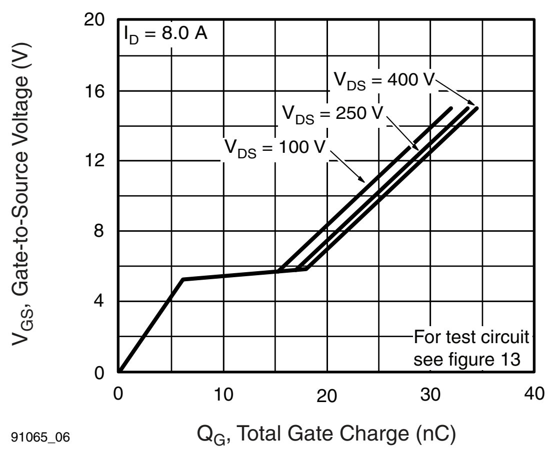



**Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage**

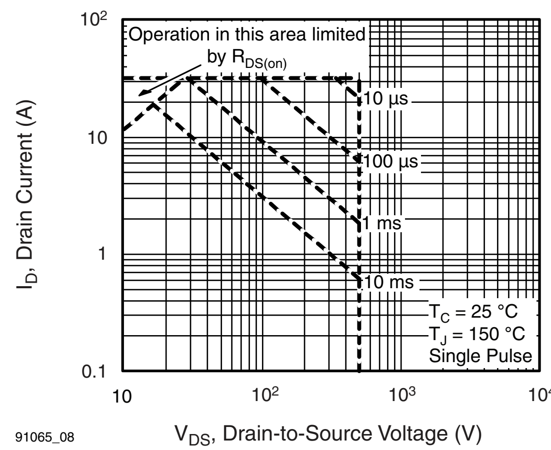



**Fig. 8 - Maximum Safe Operating Area**

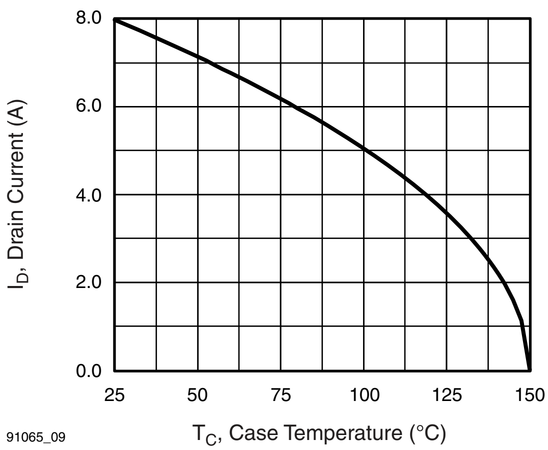



Fig. 9 - Maximum Drain Current vs. Case Temperature

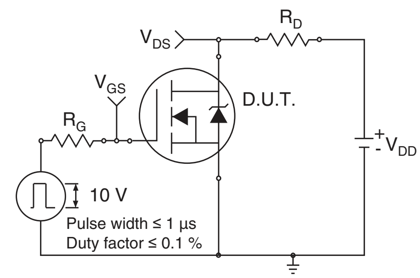



Fig. 10a - Switching Time Test Circuit

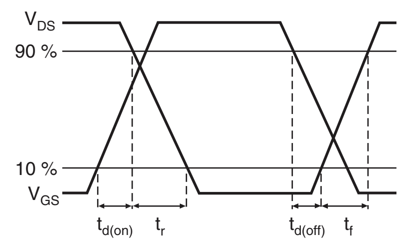



Fig. 10b - Switching Time Waveforms

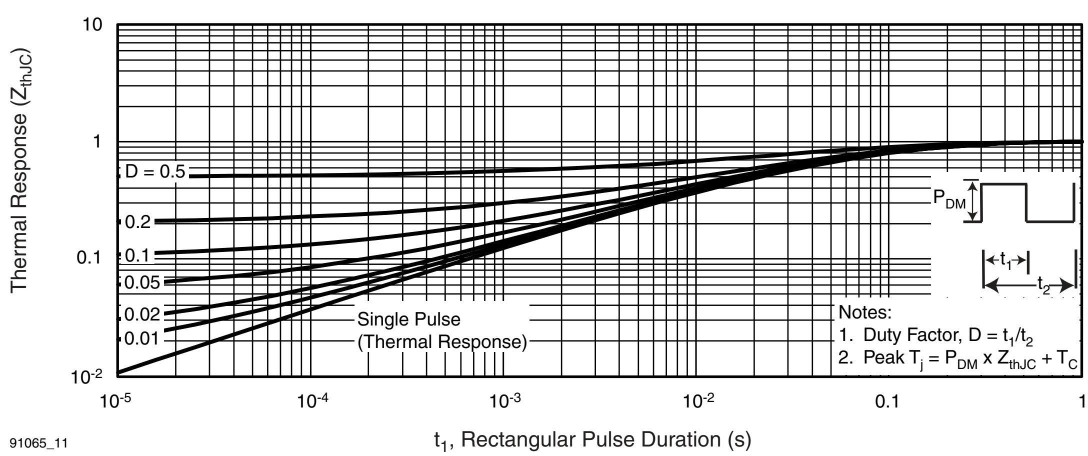



Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

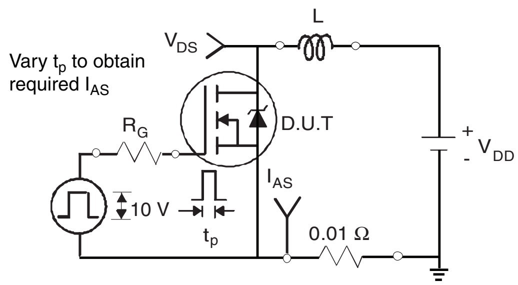



Fig. 12a - Unclamped Inductive Test Circuit

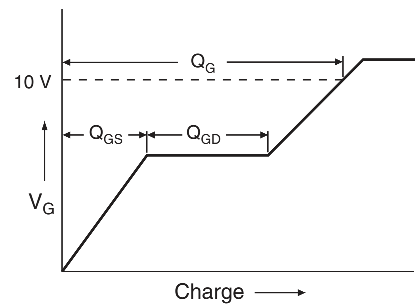



Fig. 12d - Basic Gate Charge Waveform

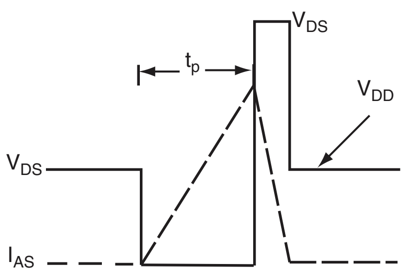



Fig. 12b - Unclamped Inductive Waveforms

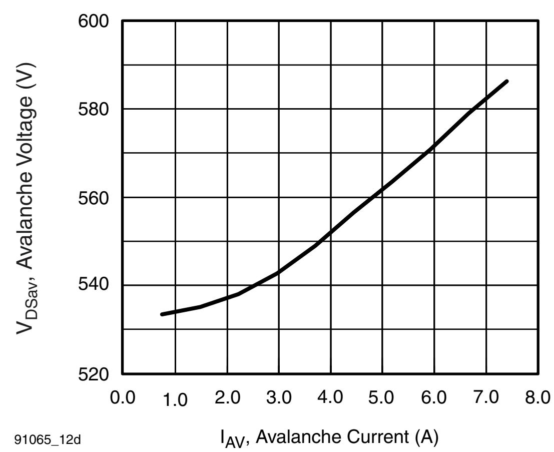



Fig. 13a - Typical Drain-to-Source Voltage vs. Avalanche Current

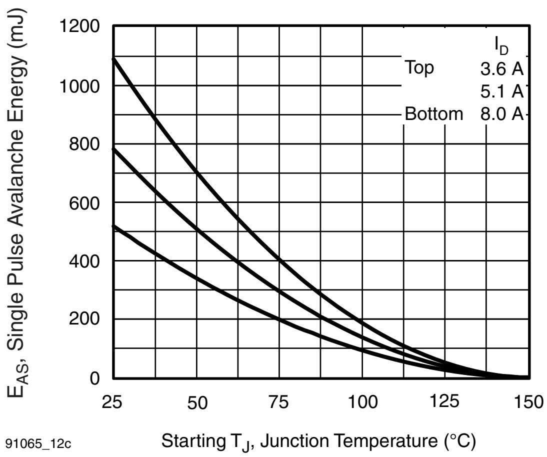



Fig. 12c - Maximum Avalanche Energy vs. Drain Current

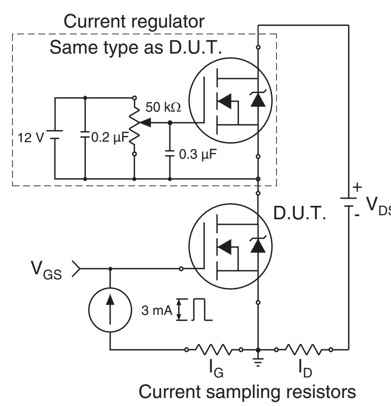
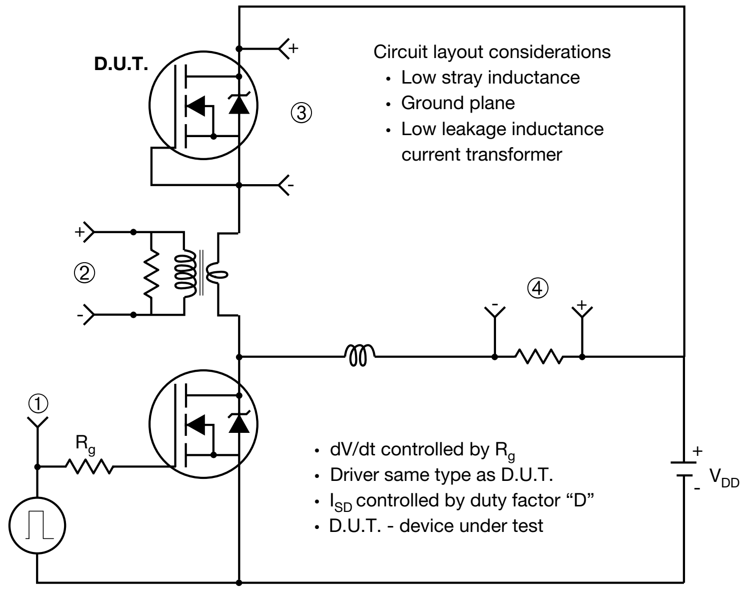
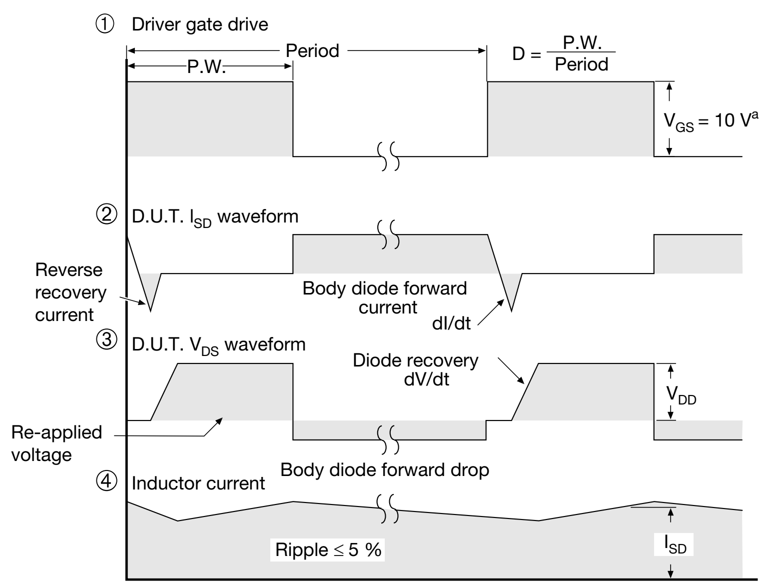



Fig. 13b - Gate Charge Test Circuit

**Peak Diode Recovery dV/dt Test Circuit**




**Note**

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

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

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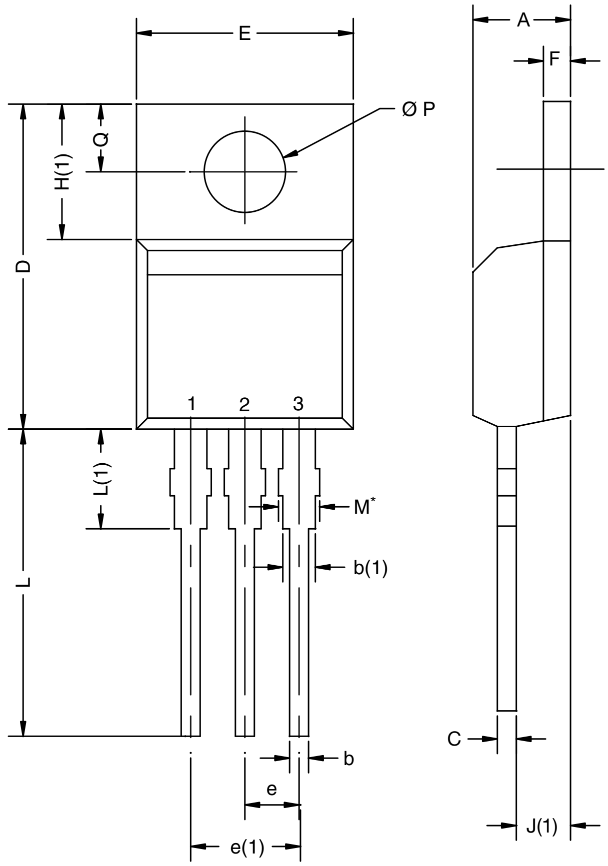
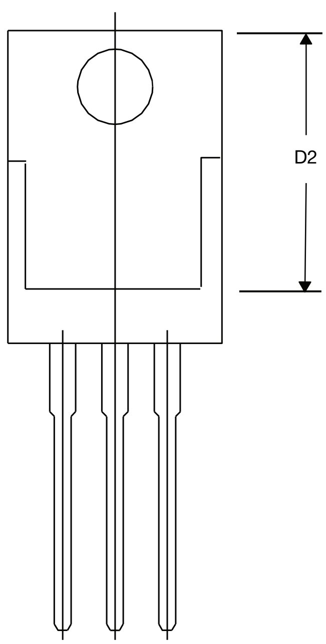
# TO-220AB




| DIM. | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| | MIN. | MAX. | MIN. | MAX. |
| A | 4.25 | 4.65 | 0.167 | 0.183 |
| b | 0.69 | 1.01 | 0.027 | 0.040 |
| b(1) | 1.20 | 1.73 | 0.047 | 0.068 |
| c | 0.36 | 0.61 | 0.014 | 0.024 |
| D | 14.85 | 15.49 | 0.585 | 0.610 |
| D2 | 12.19 | 12.70 | 0.480 | 0.500 |
| E | 10.04 | 10.51 | 0.395 | 0.414 |
| e | 2.41 | 2.67 | 0.095 | 0.105 |
| e(1) | 4.88 | 5.28 | 0.192 | 0.208 |
| F | 1.14 | 1.40 | 0.045 | 0.055 |
| H(1) | 6.09 | 6.48 | 0.240 | 0.255 |
| J(1) | 2.41 | 2.92 | 0.095 | 0.115 |
| L | 13.35 | 14.02 | 0.526 | 0.552 |
| L(1) | 3.32 | 3.82 | 0.131 | 0.150 |
| Ø P | 3.54 | 3.94 | 0.139 | 0.155 |
| Q | 2.60 | 3.00 | 0.102 | 0.118 |
| ECN: T14-0413-Rev. P, 16-Jun-14<br>DWG: 5471 | | | | |

**Note**

* M = 1.32 mm to 1.62 mm (dimension including protrusion)
Heatsink hole for HVM



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