

Power MOSFET

| PRODUCT SUMMARY | | |
|---------------------------|------------------------|-------|
| V_{DS} (V) | 60 | |
| $R_{DS(on)}$ (Ω) | $V_{GS} = 10\text{ V}$ | 0.028 |
| Q_g (Max.) (nC) | 67 | |
| Q_{gs} (nC) | 18 | |
| Q_{gd} (nC) | 25 | |
| Configuration | Single | |

FEATURES

- Dynamic dV/dt Rating
- 175 °C Operating Temperature
- Fast Switching
- Ease of Paralleling
- Simple Drive Requirements
- Compliant to RoHS Directive 2002/95/EC

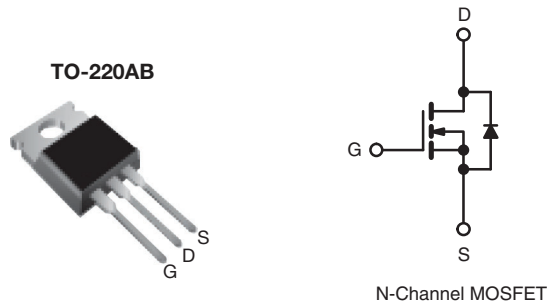


Available
RoHS*
COMPLIANT

DESCRIPTION

Third generation Power MOSFETs from Vishay provide the designer with the best combination of fast switching, ruggedized device design, low on-resistance and cost-effectiveness.

The TO-220AB package is universally preferred for commercial-industrial applications at power dissipation levels to approximately 50 W. The low thermal resistance and low package cost of the TO-220AB contribute to its wide acceptance throughout the industry.



| ORDERING INFORMATION | |
|----------------------|------------|
| Package | TO-220AB |
| Lead (Pb)-free | IRFZ40PbF |
| | SiHFZ40-E3 |
| SnPb | IRFZ40 |
| | SiHFZ40 |

| ABSOLUTE MAXIMUM RATINGS ($T_C = 25\text{ }^\circ\text{C}$, unless otherwise noted) | | | | |
|---|----------------------------------|-----------------------------------|---------------------|----------|
| PARAMETER | SYMBOL | LIMIT | UNIT | |
| Drain-Source Voltage | V_{DS} | 60 | V | |
| Gate-Source Voltage | V_{GS} | ± 20 | | |
| Continuous Drain Current ^e | V_{GS} at 10 V | $T_C = 25\text{ }^\circ\text{C}$ | A | |
| Continuous Drain Current | | $T_C = 100\text{ }^\circ\text{C}$ | | |
| Pulsed Drain Current ^a | I_{DM} | 200 | | |
| Linear Derating Factor | | 1.0 | W/ $^\circ\text{C}$ | |
| Single Pulse Avalanche Energy ^b | E_{AS} | 100 | mJ | |
| Maximum Power Dissipation | $T_C = 25\text{ }^\circ\text{C}$ | P_D | 150 | W |
| Peak Diode Recovery dV/dt ^c | | dV/dt | 4.5 | V/ns |
| Operating Junction and Storage Temperature Range | T_J, T_{stg} | - 55 to + 175 | $^\circ\text{C}$ | |
| Soldering Recommendations (Peak Temperature) ^d | for 10 s | | | |
| Mounting Torque | 6-32 or M3 screw | | 10 | lbf · in |
| | | | 1.1 | N · m |



Notes

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- $V_{DD} = 25\text{ V}$, starting $T_J = 25\text{ }^\circ\text{C}$, $L = 44\text{ }\mu\text{H}$, $R_g = 25\text{ }\Omega$, $I_{AS} = 51\text{ A}$ (see fig. 12).
- $I_{SD} \leq 51\text{ A}$, $dI/dt \leq 250\text{ A}/\mu\text{s}$, $V_{DD} \leq V_{DS}$, $T_J \leq 175\text{ }^\circ\text{C}$.
- 1.6 mm from case.
- Current limited by the package, (die current = 51 A).

* 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 ($T_J = 25\text{ }^\circ\text{C}$, unless otherwise noted)

| PARAMETER | SYMBOL | TEST CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|--|---------------------|---|------|-------|-----------|---------------|
| Static | | | | | | |
| Drain-Source Breakdown Voltage | V_{DS} | $V_{GS} = 0\text{ V}$, $I_D = 250\text{ }\mu\text{A}$ | 60 | - | - | V |
| V_{DS} Temperature Coefficient | $\Delta V_{DS}/T_J$ | Reference to $25\text{ }^\circ\text{C}$, $I_D = 1\text{ mA}$ | - | 0.060 | - | V/°C |
| Gate-Source Threshold Voltage | $V_{GS(th)}$ | $V_{DS} = V_{GS}$, $I_D = 250\text{ }\mu\text{A}$ | 2.0 | - | 4.0 | V |
| Gate-Source Leakage | I_{GSS} | $V_{GS} = \pm 20\text{ V}$ | - | - | ± 100 | nA |
| Zero Gate Voltage Drain Current | I_{DSS} | $V_{DS} = 60\text{ V}$, $V_{GS} = 0\text{ V}$ | - | - | 25 | μA |
| | | $V_{DS} = 48\text{ V}$, $V_{GS} = 0\text{ V}$, $T_J = 125\text{ }^\circ\text{C}$ | - | - | 250 | |
| Drain-Source On-State Resistance | $R_{DS(on)}$ | $V_{GS} = 10\text{ V}$ $I_D = 31\text{ A}^b$ | - | - | 0.028 | Ω |
| Forward Transconductance | g_{fs} | $V_{DS} = 25\text{ V}$, $I_D = 31\text{ A}$ | 15 | - | - | S |
| Dynamic | | | | | | |
| Input Capacitance | C_{iss} | $V_{GS} = 0\text{ V}$, $V_{DS} = 25\text{ V}$, $f = 1.0\text{ MHz}$, see fig. 5 | - | 1900 | - | pF |
| Output Capacitance | C_{oss} | | - | 920 | - | |
| Reverse Transfer Capacitance | C_{rss} | | - | 170 | - | |
| Total Gate Charge | Q_g | $V_{GS} = 10\text{ V}$ $I_D = 51\text{ A}$, $V_{DS} = 48\text{ V}$, see fig. 6 and 13 ^b | - | - | 67 | nC |
| Gate-Source Charge | Q_{gs} | | - | - | 18 | |
| Gate-Drain Charge | Q_{gd} | | - | - | 25 | |
| Turn-On Delay Time | $t_{d(on)}$ | $V_{DD} = 30\text{ V}$, $I_D = 51\text{ A}$, $R_g = 9.1\text{ }\Omega$, $R_D = 0.55\text{ }\Omega$, see fig. 10 ^b | - | 14 | - | ns |
| Rise Time | t_r | | - | 110 | - | |
| Turn-Off Delay Time | $t_{d(off)}$ | | - | 45 | - | |
| Fall Time | t_f | | - | 92 | - | |
| 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  | - | - | 50 | A |
| Pulsed Diode Forward Current ^a | I_{SM} | | - | - | 200 | |
| Body Diode Voltage | V_{SD} | $T_J = 25\text{ }^\circ\text{C}$, $I_S = 51\text{ A}$, $V_{GS} = 0\text{ V}^b$ | - | - | 2.5 | V |
| Body Diode Reverse Recovery Time | t_{rr} | $T_J = 25\text{ }^\circ\text{C}$, $I_F = 51\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ | - | 120 | 180 | ns |
| Body Diode Reverse Recovery Charge | Q_{rr} | | - | 0.53 | 0.80 | nC |
| Forward Turn-On Time | t_{on} | Intrinsic turn-on time is negligible (turn-on is dominated by L_S and L_D) | | | | |

Notes

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

TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

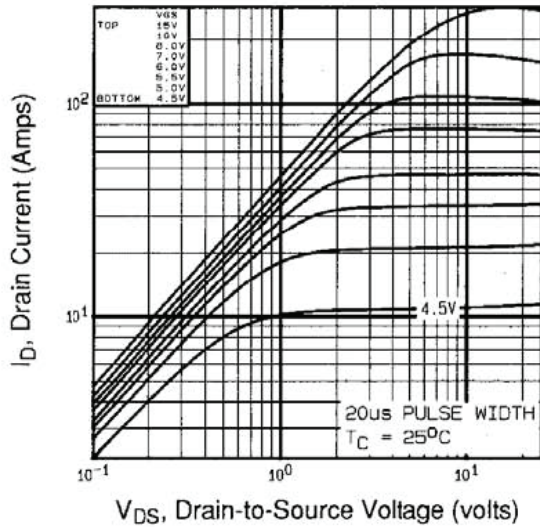


Fig. 1 - Typical Output Characteristics, $T_C = 25\text{ }^\circ\text{C}$

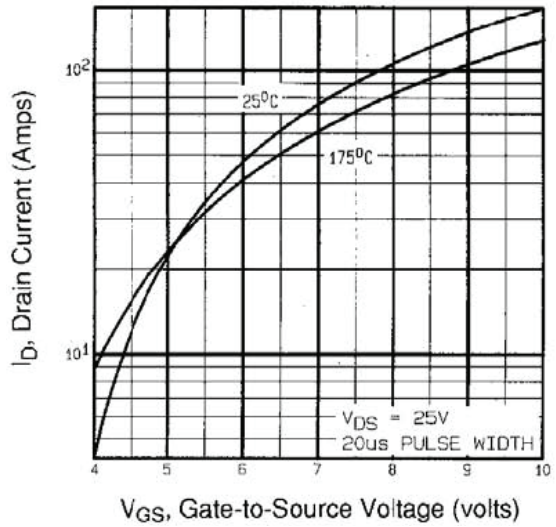


Fig. 1 - Typical Transfer Characteristics

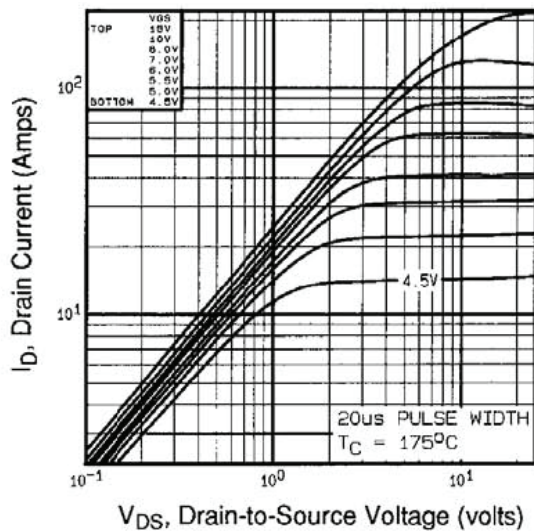


Fig. 2 - Typical Output Characteristics, $T_C = 175\text{ }^\circ\text{C}$

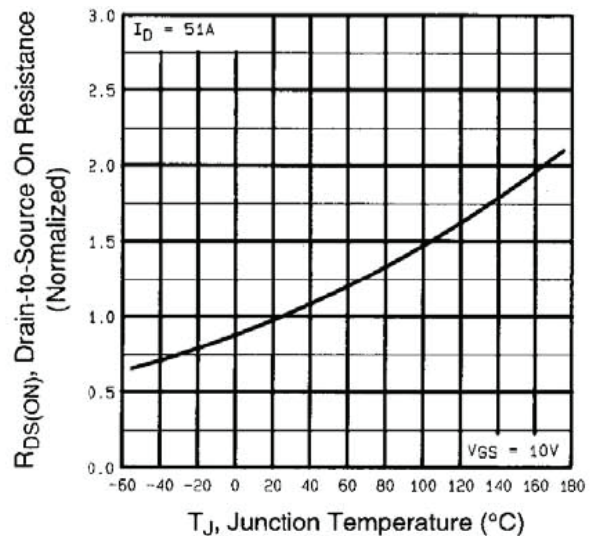


Fig. 2 - Normalized On-Resistance vs. Temperature



Fig. 3 - Typical Capacitance vs. Drain-to-Source Voltage

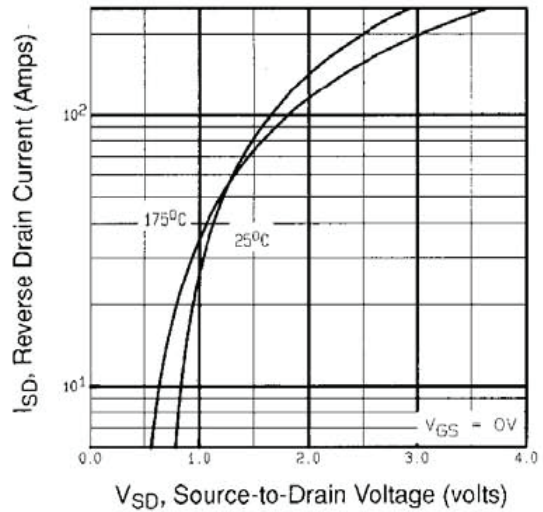


Fig. 5 - Typical Source-Drain Diode Forward Voltage

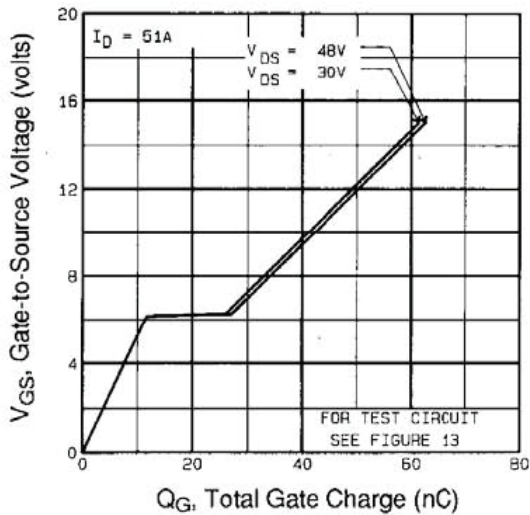


Fig. 4 - Typical Gate Charge vs. Gate-to-Source Voltage

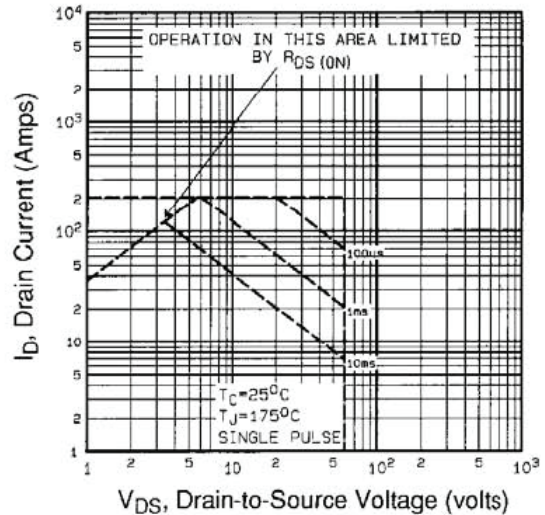


Fig. 3 - Maximum Safe Operating Area

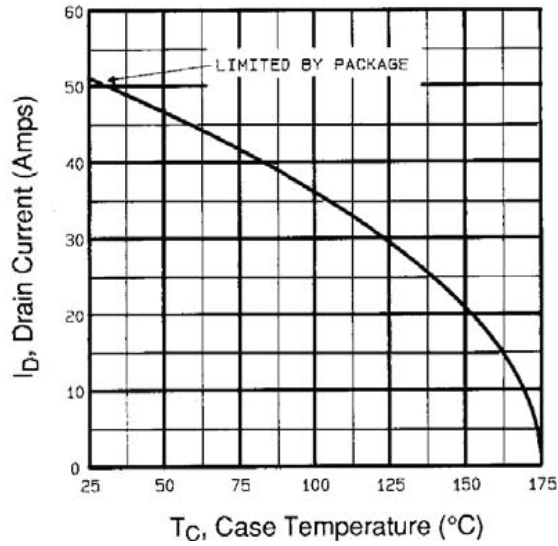


Fig. 9 - Maximum Drain Current vs. Case Temperature

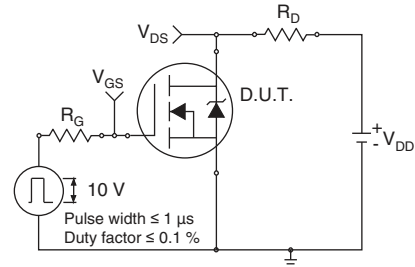


Fig. 10a - Switching Time Test Circuit

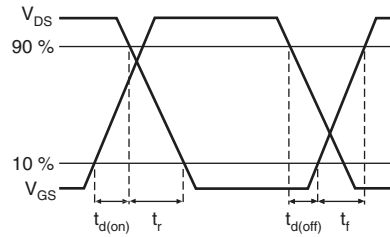


Fig. 10b - Switching Time Waveforms

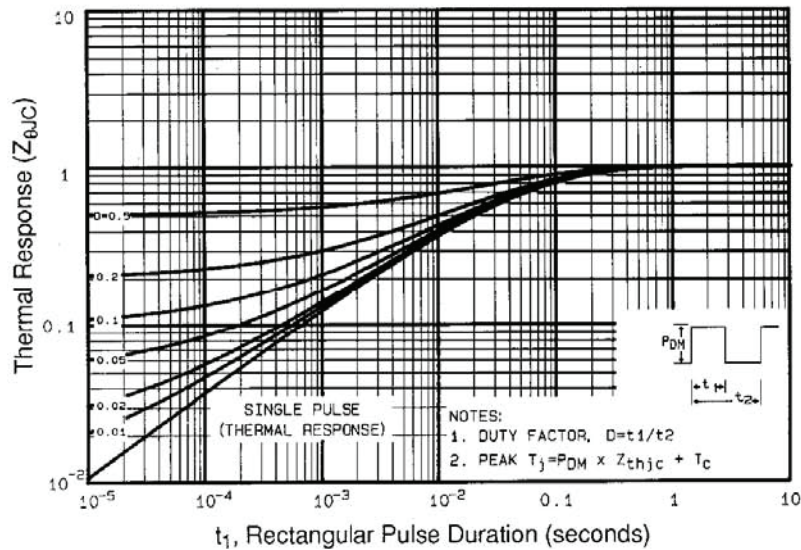


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

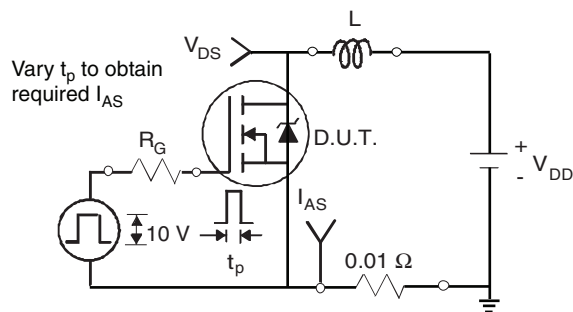


Fig. 12a - Unclamped Inductive Test Circuit

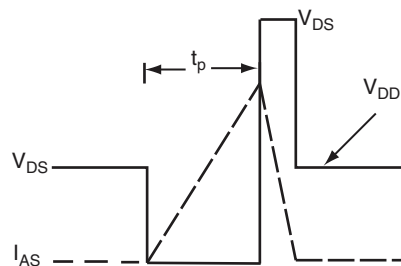


Fig. 12b - Unclamped Inductive Waveforms

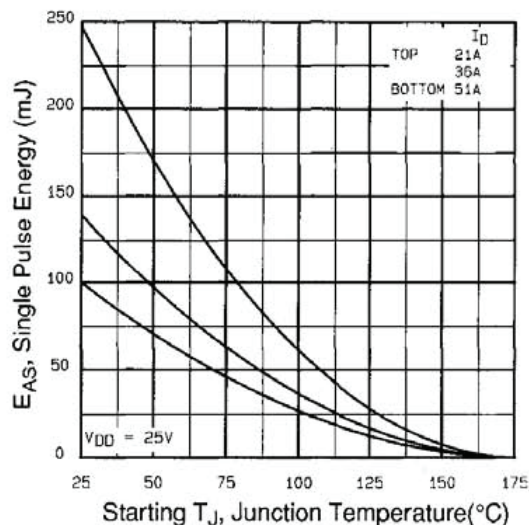


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

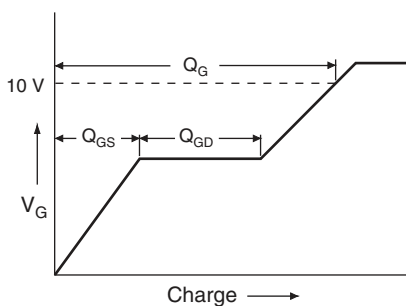


Fig. 13a - Basic Gate Charge Waveform

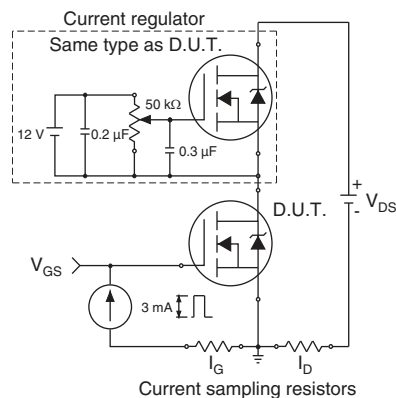
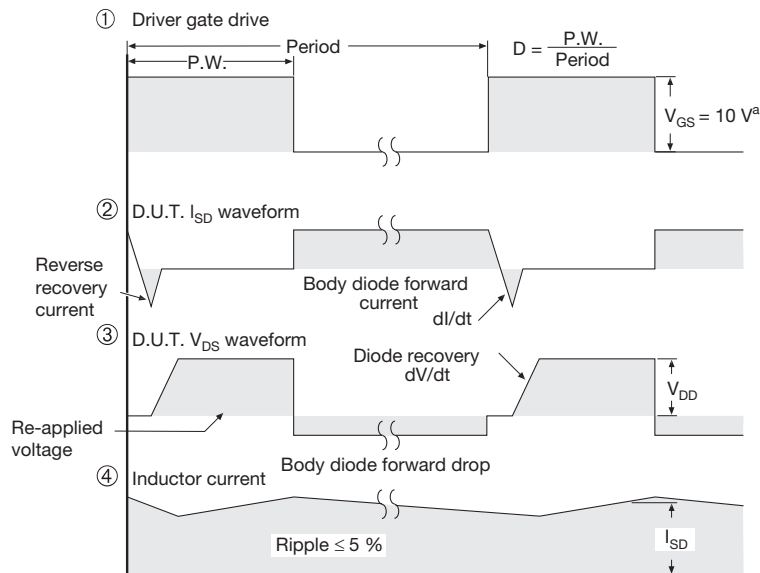
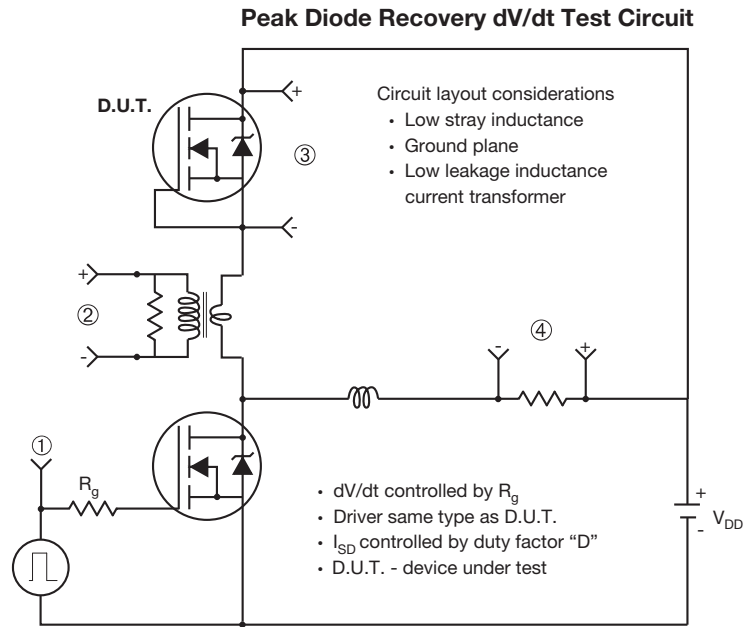


Fig. 13b - Gate Charge Test



Note

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

Fig. 14 - For N-Channel

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TO-220-1



| DIM. | MILLIMETERS | | INCHES | |
|------|-------------|-------|--------|-------|
| | MIN. | MAX. | MIN. | MAX. |
| A | 4.24 | 4.65 | 0.167 | 0.183 |
| b | 0.69 | 1.02 | 0.027 | 0.040 |
| b(1) | 1.14 | 1.78 | 0.045 | 0.070 |
| c | 0.36 | 0.61 | 0.014 | 0.024 |
| D | 14.33 | 15.85 | 0.564 | 0.624 |
| E | 9.96 | 10.52 | 0.392 | 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) | 6.10 | 6.71 | 0.240 | 0.264 |
| J(1) | 2.41 | 2.92 | 0.095 | 0.115 |
| L | 13.36 | 14.40 | 0.526 | 0.567 |
| L(1) | 3.33 | 4.04 | 0.131 | 0.159 |
| Ø P | 3.53 | 3.94 | 0.139 | 0.155 |
| Q | 2.54 | 3.00 | 0.100 | 0.118 |

ECN: X15-0364-Rev. C, 14-Dec-15
DWG: 6031

Note

- M* = 0.052 inches to 0.064 inches (dimension including protrusion), heatsink hole for HVM





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