

Power MOSFET

| PRODUCT SUMMARY | | |
|---------------------------|-------------------|------|
| V_{DS} (V) | - 200 | |
| $R_{DS(on)}$ (Ω) | $V_{GS} = - 10$ V | 0.50 |
| Q_g (Max.) (nC) | 44 | |
| Q_{gs} (nC) | 7.1 | |
| Q_{gd} (nC) | 27 | |
| Configuration | Single | |

FEATURES

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

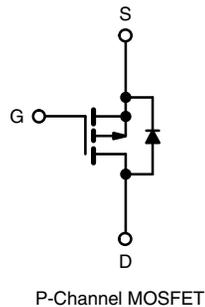
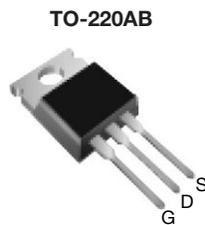


Available
RoHS*
COMPLIANT

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 all 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 | IRF9640PbF SiHF9640-E3 |
| SnPb | IRF9640 SiHF9640 |

| ABSOLUTE MAXIMUM RATINGS ($T_C = 25$ °C, unless otherwise noted) | | | | | |
|---|--------------------|----------------|------------------|-------|----------|
| PARAMETER | | SYMBOL | LIMIT | UNIT | |
| Drain-Source Voltage | | V_{DS} | - 200 | V | |
| Gate-Source Voltage | | V_{GS} | ± 20 | V | |
| Continuous Drain Current | V_{GS} at - 10 V | I_D | $T_C = 25$ °C | - 11 | A |
| | | | $T_C = 100$ °C | - 6.8 | |
| Pulsed Drain Current ^a | | I_{DM} | - 44 | | |
| Linear Derating Factor | | | 1.0 | W/°C | |
| Single Pulse Avalanche Energy ^b | | E_{AS} | 700 | mJ | |
| Repetitive Avalanche Current ^a | | I_{AR} | - 11 | 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

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- $V_{DD} = - 50$ V, starting $T_J = 25$ °C, $L = 8.7$ mH, $R_g = 25$ Ω , $I_{AS} = - 11$ A (see fig. 12).
- $I_{SD} \leq - 11$ A, $dI/dt \leq 150$ A/ μ s, $V_{DD} \leq V_{DS}$, $T_J \leq 150$ °C.
- 1.6 mm from case.

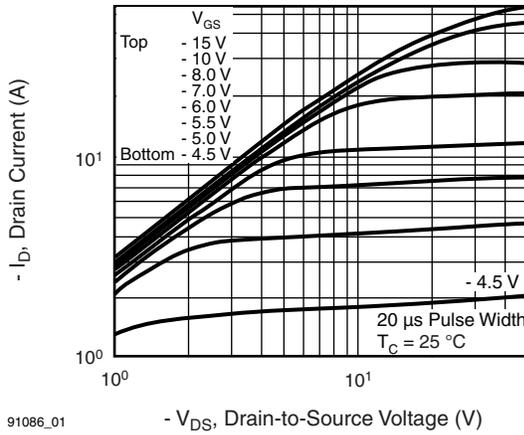
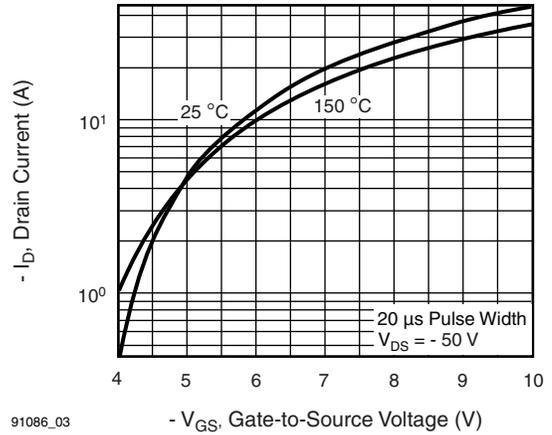
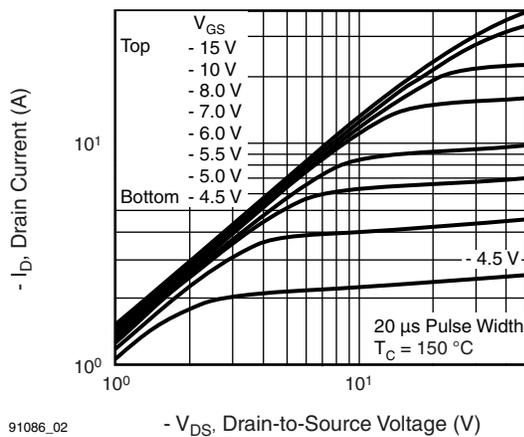
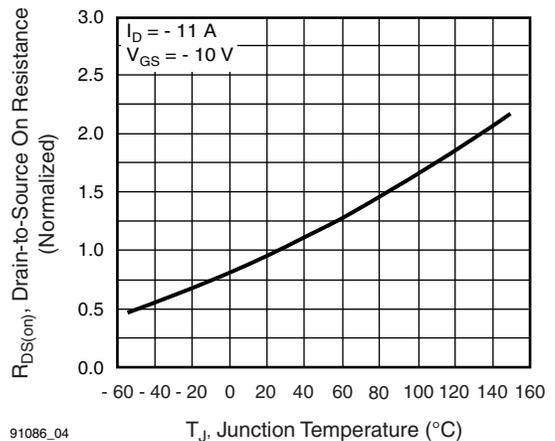
* Pb containing terminations are not RoHS compliant, exemptions may apply

| THERMAL RESISTANCE RATINGS | | | | |
|-------------------------------------|------------|------|------|------|
| PARAMETER | SYMBOL | TYP. | MAX. | UNIT |
| Maximum Junction-to-Ambient | R_{thJA} | - | 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} | $V_{GS} = 0\text{ V}, I_D = -250\text{ }\mu\text{A}$ | -200 | - | - | V |
| V_{DS} Temperature Coefficient | $\Delta V_{DS}/T_J$ | Reference to $25\text{ }^\circ\text{C}$, $I_D = -1\text{ mA}$ | - | -0.2 | - | 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} | $V_{DS} = -200\text{ V}, V_{GS} = 0\text{ V}$ | - | - | -100 | μA |
| | | $V_{DS} = -160\text{ V}, V_{GS} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$ | - | - | -500 | |
| Drain-Source On-State Resistance | $R_{DS(on)}$ | $V_{GS} = -10\text{ V}, I_D = -6.6\text{ A}^b$ | - | - | 0.50 | Ω |
| Forward Transconductance | g_{fs} | $V_{DS} = -50\text{ V}, I_D = -6.6\text{ A}^b$ | 4.1 | - | - | S |
| Dynamic | | | | | | |
| Input Capacitance | C_{iss} | $V_{GS} = 0\text{ V},$ $V_{DS} = -25\text{ V},$ $f = 1.0\text{ MHz}$, see fig. 5 | - | 1200 | - | μF |
| Output Capacitance | C_{oss} | | - | 370 | - | |
| Reverse Transfer Capacitance | C_{rss} | | - | 81 | - | |
| Total Gate Charge | Q_g | $V_{GS} = -10\text{ V},$ $I_D = -11\text{ A}, V_{DS} = -160\text{ V},$ see fig. 6 and 13 ^b | - | - | 44 | nC |
| Gate-Source Charge | Q_{gs} | | - | - | 7.1 | |
| Gate-Drain Charge | Q_{gd} | | - | - | 27 | |
| Turn-On Delay Time | $t_{d(on)}$ | $V_{DD} = -100\text{ V}, I_D = -11\text{ A}$ $R_g = 9.1\text{ }\Omega, R_D = 8.6\text{ }\Omega$, see fig. 10 ^b | - | 14 | - | ns |
| Rise Time | t_r | | - | 43 | - | |
| Turn-Off Delay Time | $t_{d(off)}$ | | - | 39 | - | |
| Fall Time | t_f | | - | 38 | - | |
| 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  | - | - | -11 | A |
| Pulsed Diode Forward Current ^a | I_{SM} | | - | - | -44 | |
| Body Diode Voltage | V_{SD} | $T_J = 25\text{ }^\circ\text{C}, I_S = -11\text{ A}, V_{GS} = 0\text{ V}^b$ | - | - | -5 | V |
| Body Diode Reverse Recovery Time | t_{rr} | $T_J = 25\text{ }^\circ\text{C}, I_F = -11\text{ A}, dI/dt = 100\text{ A}/\mu\text{s}^b$ | - | 250 | 300 | ns |
| Body Diode Reverse Recovery Charge | Q_{rr} | | - | 2.9 | 3.6 | 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 $\leq 300\text{ }\mu\text{s}$; duty cycle $\leq 2\%$.

TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

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

Fig. 3 - Typical Transfer Characteristics

Fig. 2 - Typical Output Characteristics, $T_C = 150^\circ\text{C}$

Fig. 4 - Normalized On-Resistance vs. Temperature

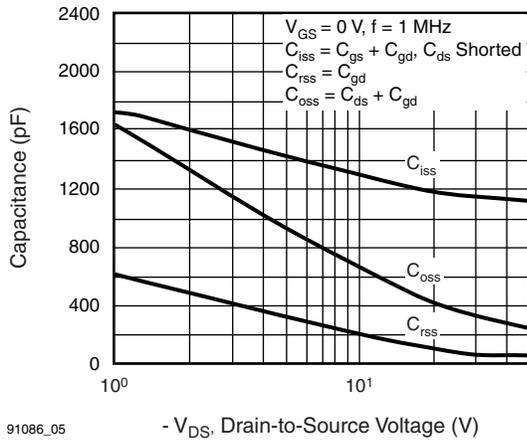


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

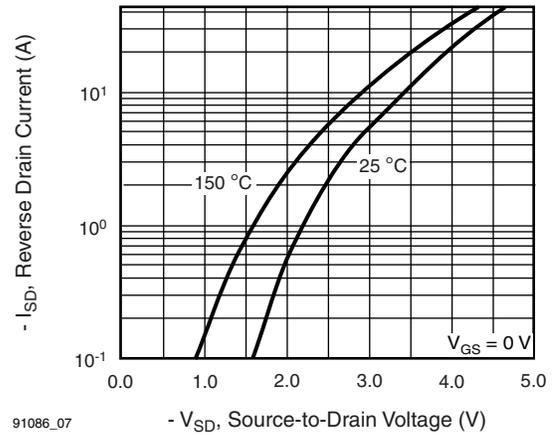


Fig. 7 - Typical Source-Drain Diode Forward Voltage

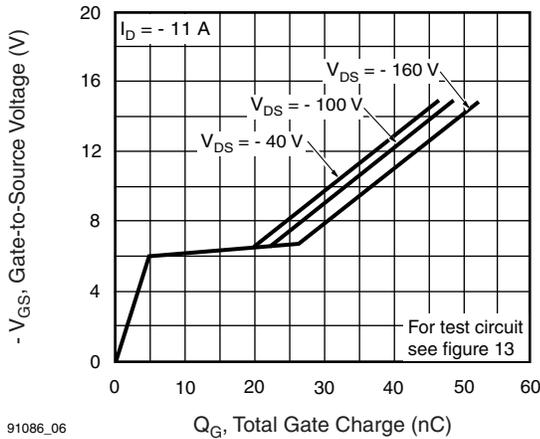


Fig. 6 - Typical Gate Charge vs. Drain-to-Source Voltage

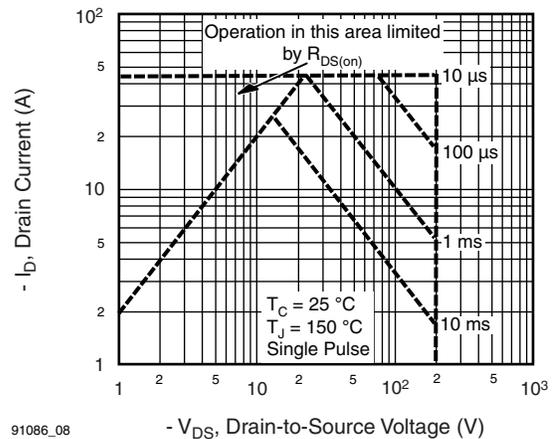


Fig. 8 - Maximum Safe Operating Area

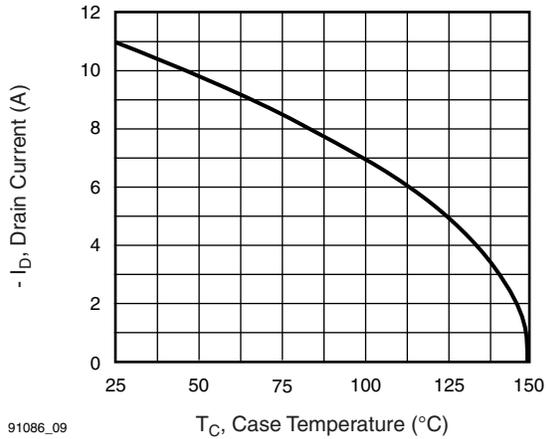


Fig. 9 - Maximum Drain Current vs. Case Temperature

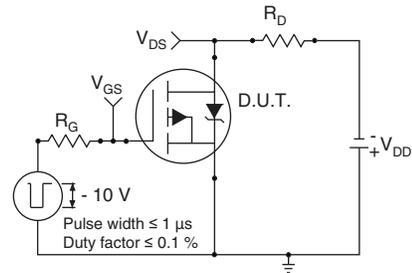


Fig. 10a - Switching Time Test Circuit

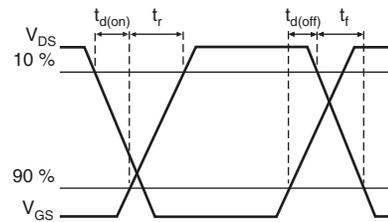


Fig. 10b - Switching Time Waveforms

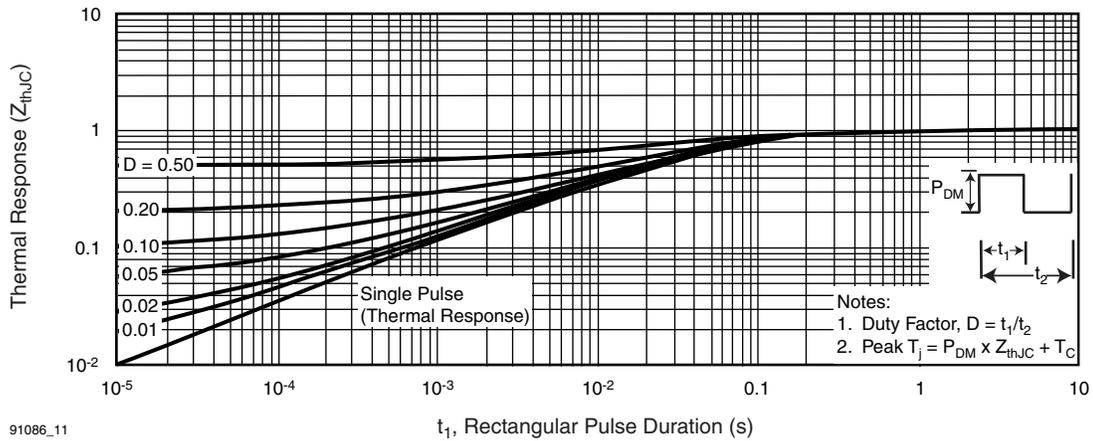


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

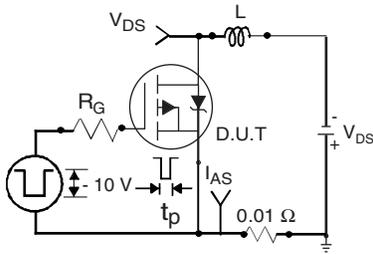


Fig. 12a - Unclamped Inductive Test Circuit

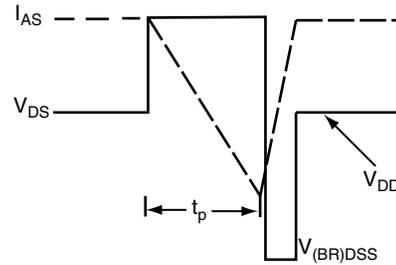


Fig. 12b - Unclamped Inductive Waveforms

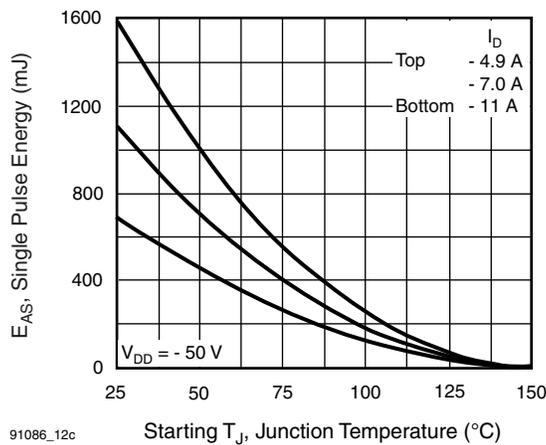


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

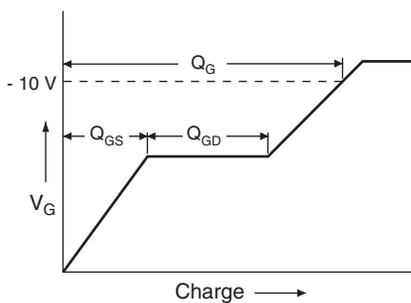


Fig. 13a - Basic Gate Charge Waveform

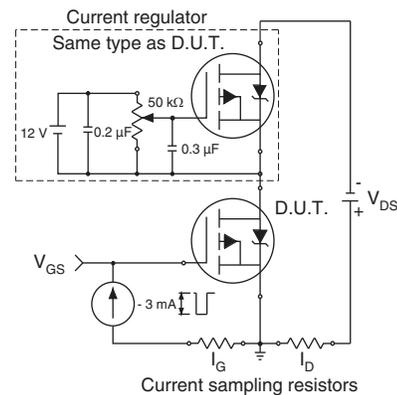
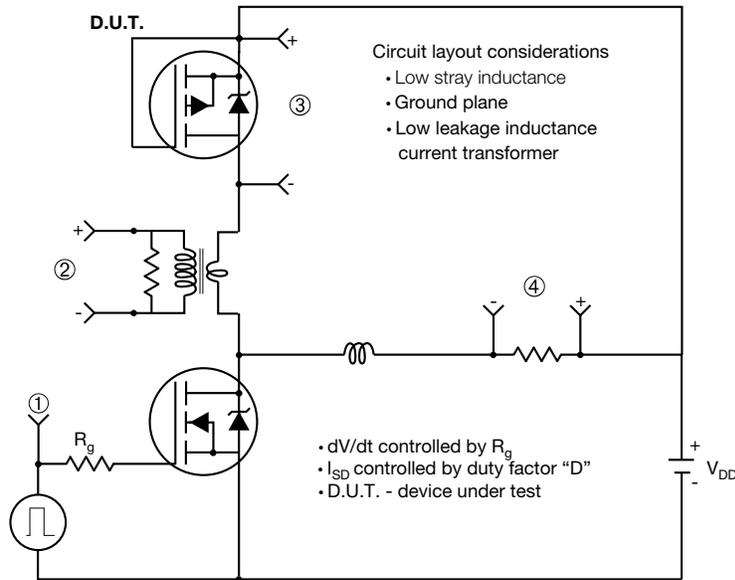
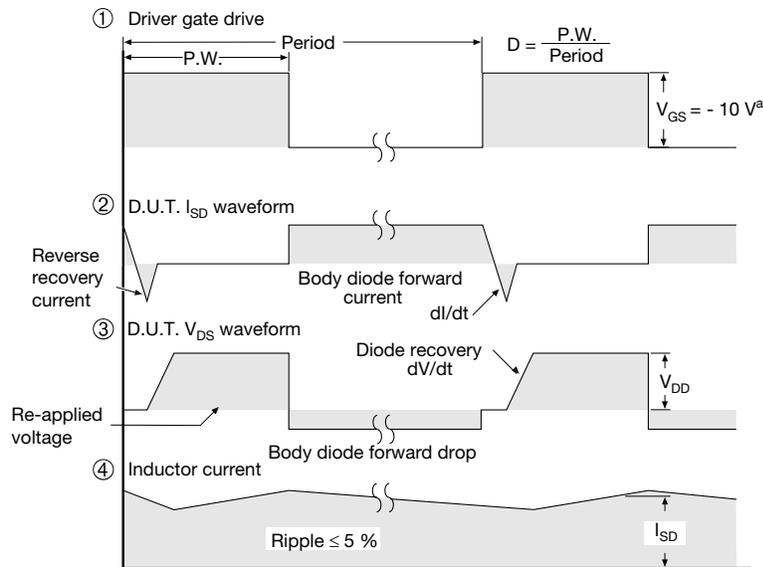


Fig. 13b - Gate Charge Test Circuit

Peak Diode Recovery dV/dt Test Circuit



Note
• Compliment N-Channel of D.U.T. for driver



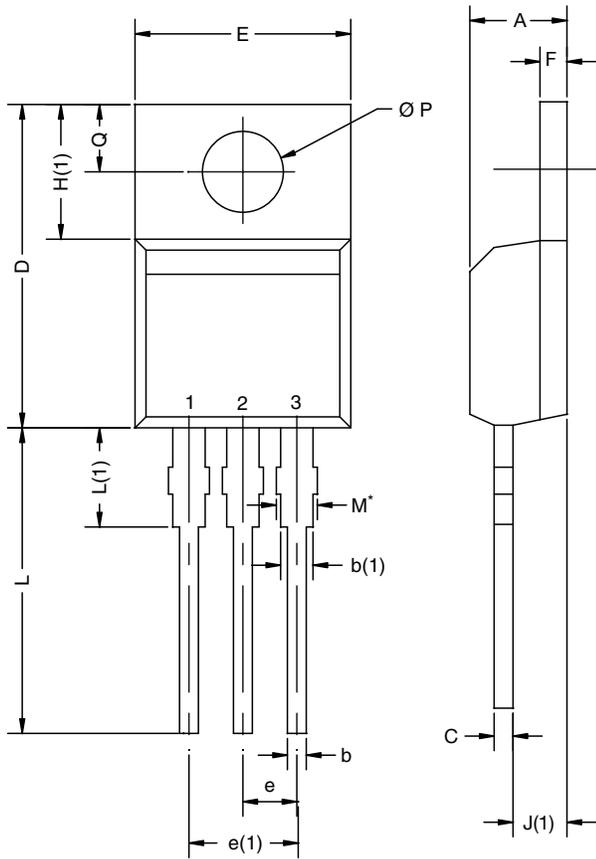
Note
a. $V_{GS} = -5\text{ V}$ for logic level and -3 V drive devices

Fig. 14 - For P-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 |
| 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: T13-0724-Rev. O, 14-Oct-13
DWG: 5471

Note

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



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