

4P04L06-VB TO220 Datasheet

P-Channel 40-V (D-S) MOSFET

PRODUCT SUMMARY

| V_{DS} (V) | $r_{DS(on)}$ (Ω) | I_D (A) ^a | Q_g (Typ.) |
|--------------|-----------------------------|------------------------|--------------|
| - 40 | 0.0041 at $V_{GS} = - 10$ V | - 110 | 185 nC |

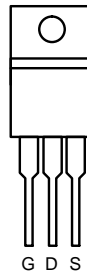
FEATURES

- Trench Power MOSFET

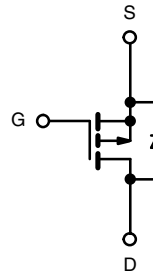


RoHS
COMPLIANT

TO-220AB



Top View



P-Channel MOSFET

ABSOLUTE MAXIMUM RATINGS $T_A = 25^\circ\text{C}$, unless otherwise noted

| Parameter | Symbol | Limit | Unit |
|--|--------------------------|----------------------|------------------|
| Drain-Source Voltage | V_{DS} | - 40 | V |
| Gate-Source Voltage | V_{GS} | ± 20 | |
| Continuous Drain Current ($T_J = 175^\circ\text{C}$) | $T_C = 25^\circ\text{C}$ | - 110 ^a | A |
| | $T_C = 70^\circ\text{C}$ | - 110 ^a | |
| | $T_A = 25^\circ\text{C}$ | 39 ^{b, c} | |
| | $T_A = 70^\circ\text{C}$ | 33 ^{b, c} | |
| Pulsed Drain Current | I_{DM} | 240 | mJ |
| Continuous Source-Drain Diode Current | $T_C = 25^\circ\text{C}$ | 110 | |
| | $T_A = 25^\circ\text{C}$ | 10 ^{b, c} | |
| Avalanche Current | $L = 0.1$ mH | 75 | |
| Single-Pulse Avalanche Energy | E_{AS} | 281 | W |
| Maximum Power Dissipation | $T_C = 25^\circ\text{C}$ | 375 | |
| | $T_C = 70^\circ\text{C}$ | 262 | |
| | $T_A = 25^\circ\text{C}$ | 15 ^{b, c} | |
| | $T_A = 70^\circ\text{C}$ | 10.5 ^{b, c} | |
| Operating Junction and Storage Temperature Range | T_J, T_{stg} | - 55 to 175 | $^\circ\text{C}$ |
| Soldering Recommendations (Peak Temperature) ^{d, e} | | 260 | |

THERMAL RESISTANCE RATINGS

| Parameter | Symbol | Typical | Maximum | Unit |
|---|------------|---------|---------|--------------------|
| Maximum Junction-to-Ambient ^{b, d} | R_{thJA} | 8 | 10 | $^\circ\text{C/W}$ |
| Maximum Junction-to-Case (Drain) | R_{thJC} | 0.33 | 0.4 | |

Notes:

a. Package limited.

b. Surface Mounted on 1" x 1" FR4 board.

c. $t = 10$ s.

d. Maximum under Steady State conditions is 40°C/W .

| 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} | $V_{GS} = 0\text{ V}, I_D = -250\text{ }\mu\text{A}$ | - 40 | | | V |
| V_{DS} Temperature Coefficient | $\Delta V_{DS}/T_J$ | $I_D = -250\text{ }\mu\text{A}$ | | - 40 | | mV/ $^{\circ}\text{C}$ |
| $V_{GS(th)}$ Temperature Coefficient | $\Delta V_{GS(th)}/T_J$ | | | - 5.5 | | |
| Gate-Source Threshold Voltage | $V_{GS(th)}$ | $V_{DS} = V_{GS}, I_D = -250\text{ }\mu\text{A}$ | - 2 | - 3 | - 4 | V |
| Gate-Source Leakage | I_{GSS} | $V_{DS} = 0\text{ V}, V_{GS} = \pm 20\text{ V}$ | | | ± 100 | nA |
| Zero Gate Voltage Drain Current | I_{DSS} | $V_{DS} = -40\text{ V}, V_{GS} = 0\text{ V}$ | | | - 1 | μA |
| | | $V_{DS} = -40\text{ V}, V_{GS} = 0\text{ V}, T_J = 55\text{ }^{\circ}\text{C}$ | | | - 10 | |
| On-State Drain Current ^a | $I_{D(on)}$ | $V_{DS} \geq 5\text{ V}, V_{GS} = -10\text{ V}$ | - 120 | | | A |
| Drain-Source On-State Resistance ^a | $r_{DS(on)}$ | $V_{GS} = -10\text{ V}, I_D = -20\text{ A}$ | | 0.0041 | | Ω |
| Forward Transconductance ^a | g_{fs} | $V_{DS} = -15\text{ V}, I_D = -20\text{ A}$ | | 75 | | S |
| Dynamic ^b | | | | | | |
| Input Capacitance | C_{iss} | $V_{DS} = -25\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$ | | 11300 | | pF |
| Output Capacitance | C_{oss} | | | 1510 | | |
| Reverse Transfer Capacitance | C_{rss} | | | 1000 | | |
| Total Gate Charge | Q_g | $V_{DS} = -20\text{ V}, V_{GS} = -10\text{ V}, I_D = -110\text{ A}$ | | 185 | 280 | nC |
| Gate-Source Charge | Q_{gs} | | | 48 | | |
| Gate-Drain Charge | Q_{gd} | | | 42 | | |
| Gate Resistance | R_g | $f = 1\text{ MHz}$ | | 4.0 | | Ω |
| Turn-On Delay Time | $t_{d(on)}$ | $V_{DD} = -20\text{ V}, R_L = 0.18\text{ }\Omega$ $I_D \cong -110\text{ A}, V_{GEN} = -10\text{ V}, R_g = 1\text{ }\Omega$ | | 25 | 40 | ns |
| Rise Time | t_r | | | 290 | 440 | |
| Turn-Off Delay Time | $t_{d(off)}$ | | | 110 | 165 | |
| Fall Time | t_f | | | 35 | 55 | |
| Drain-Source Body Diode Characteristics | | | | | | |
| Continuous Source-Drain Diode Current | I_S | $T_C = 25\text{ }^{\circ}\text{C}$ | | | - 110 | A |
| Pulse Diode Forward Current ^a | I_{SM} | | | | - 240 | |
| Body Diode Voltage | V_{SD} | $I_S = -20\text{ A}$ | | - 0.8 | - 1.5 | V |
| Body Diode Reverse Recovery Time | t_{rr} | $I_F = -20\text{ A}, di/dt = 100\text{ A}/\mu\text{s}, T_J = 25\text{ }^{\circ}\text{C}$ | | 70 | 105 | ns |
| Body Diode Reverse Recovery Charge | Q_{rr} | | | 130 | 200 | nC |
| Reverse Recovery Fall Time | t_a | | | 37 | | ns |
| Reverse Recovery Rise Time | t_b | | | 33 | | |

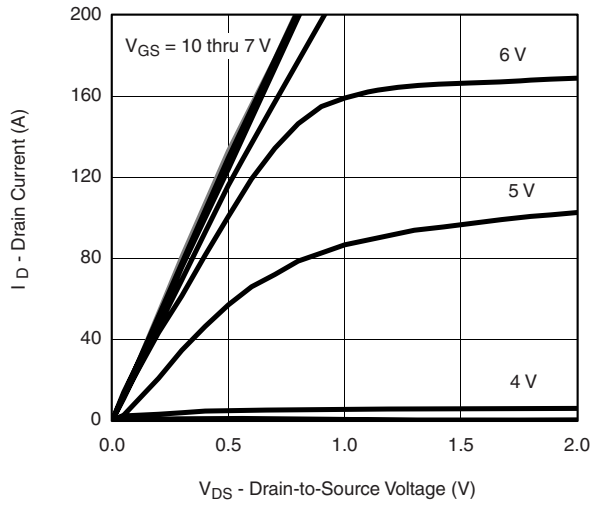
Notes:

a. Pulse test; pulse width $\leq 300\text{ }\mu\text{s}$, duty cycle $\leq 2\%$.

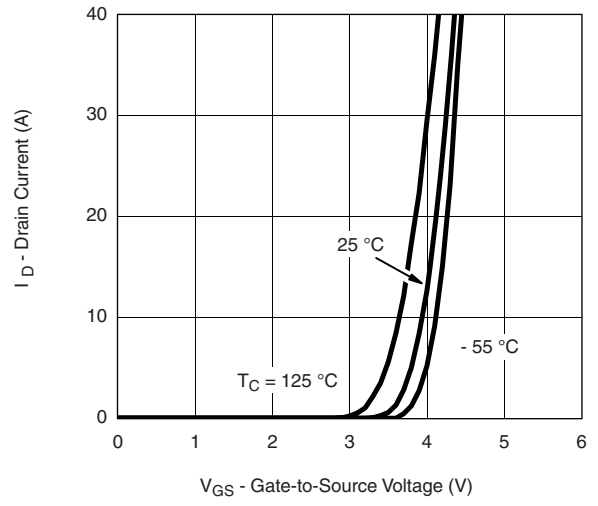
b. Guaranteed by design, not subject to production testing.

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

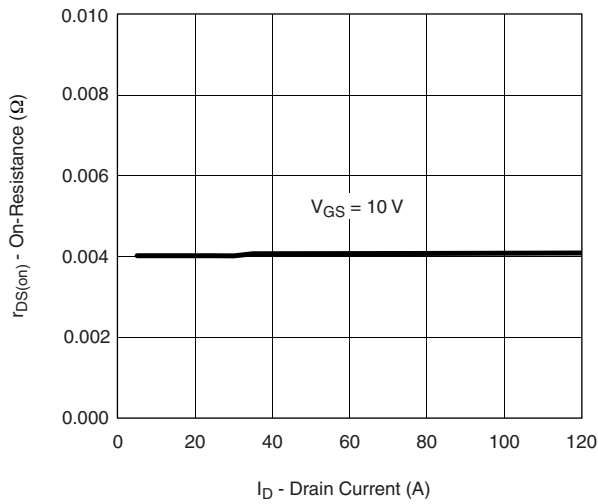
TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



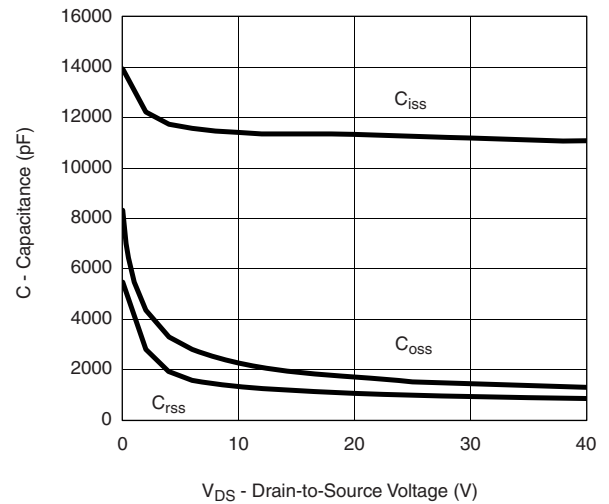
Output Characteristics



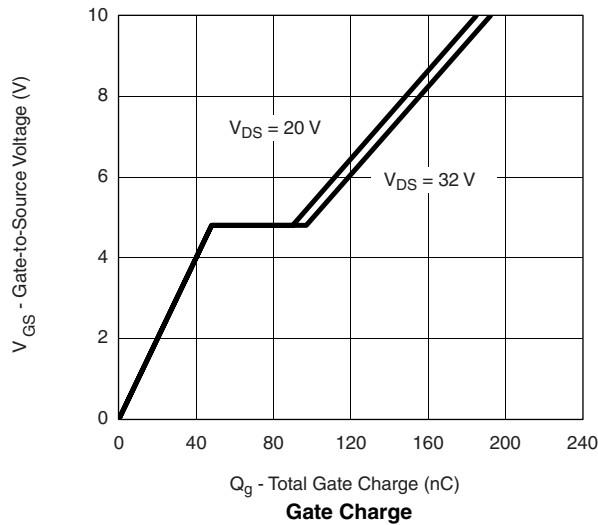
Transfer Characteristics



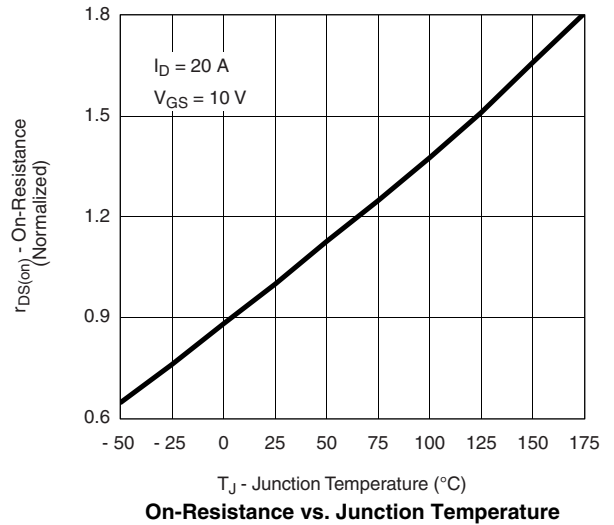
On-Resistance vs. Drain Current



Capacitance

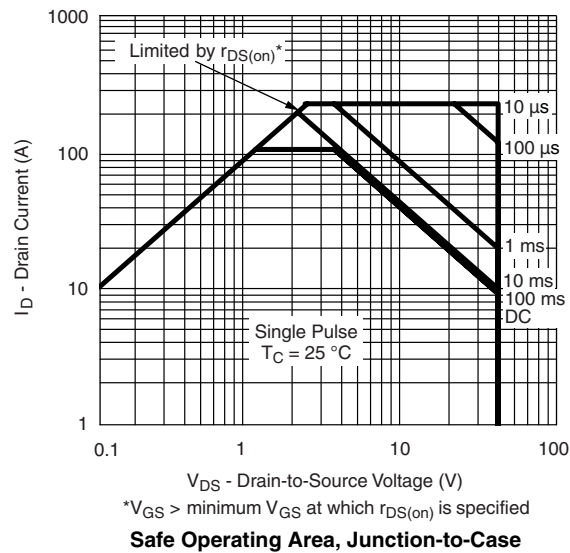
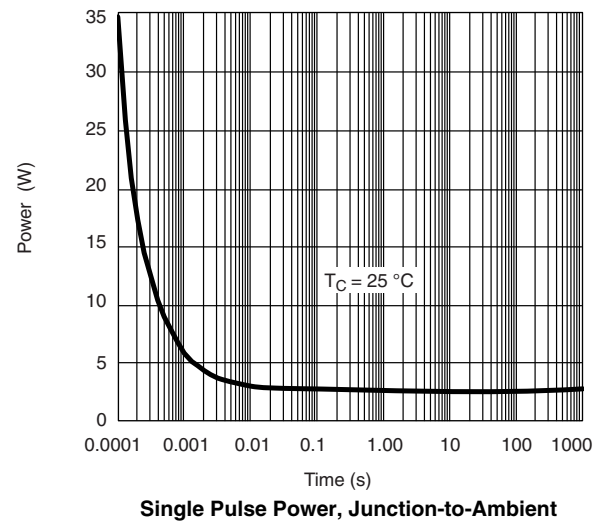
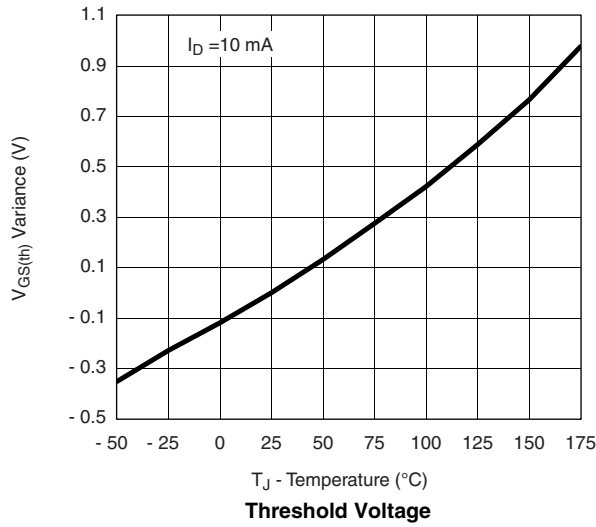
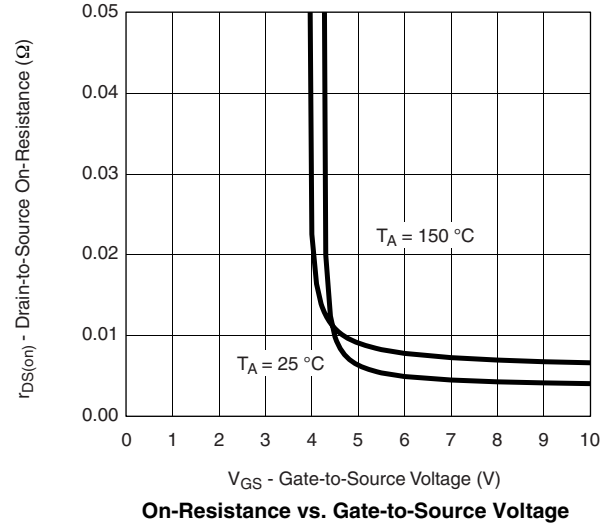
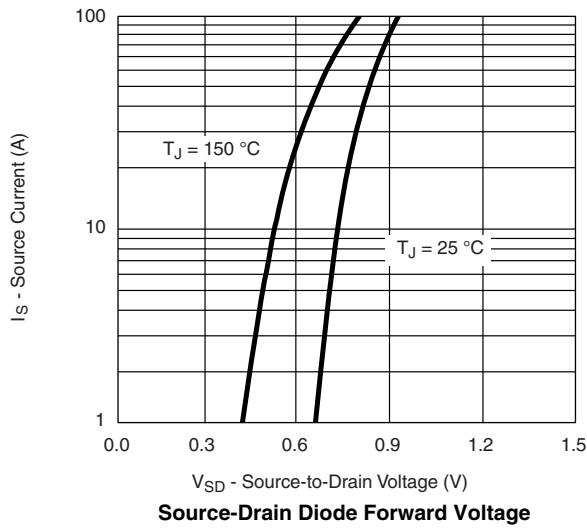


Gate Charge

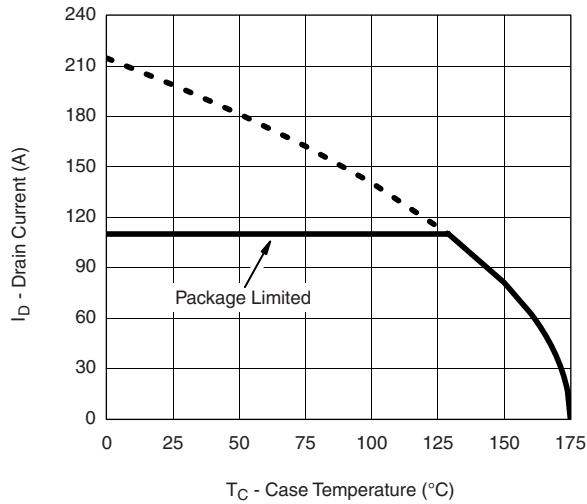


On-Resistance vs. Junction Temperature

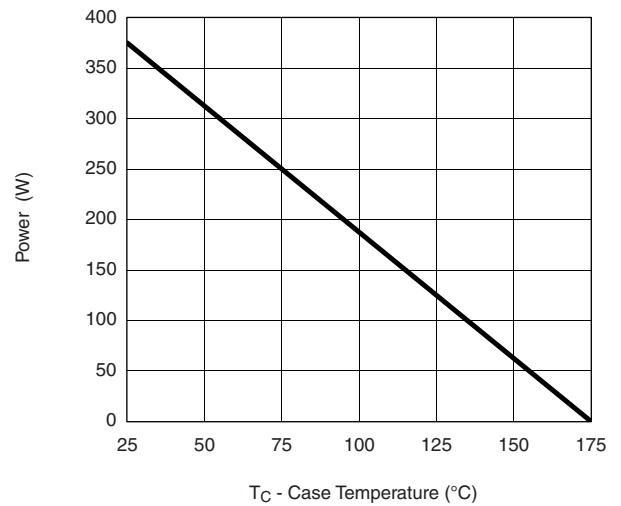
TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



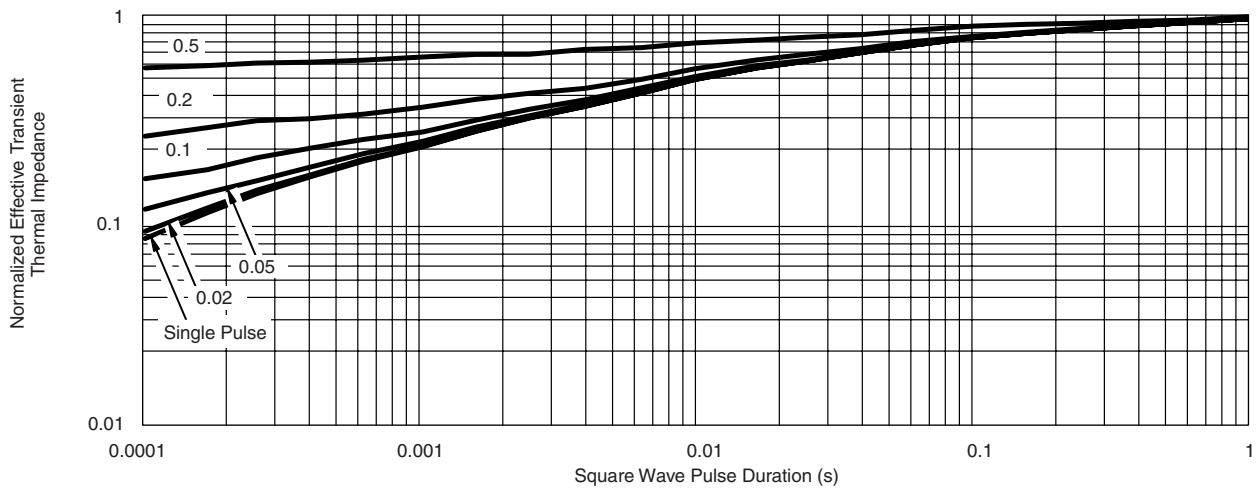
TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



Max. Avalanche and Drain Current vs. Case Temperature*



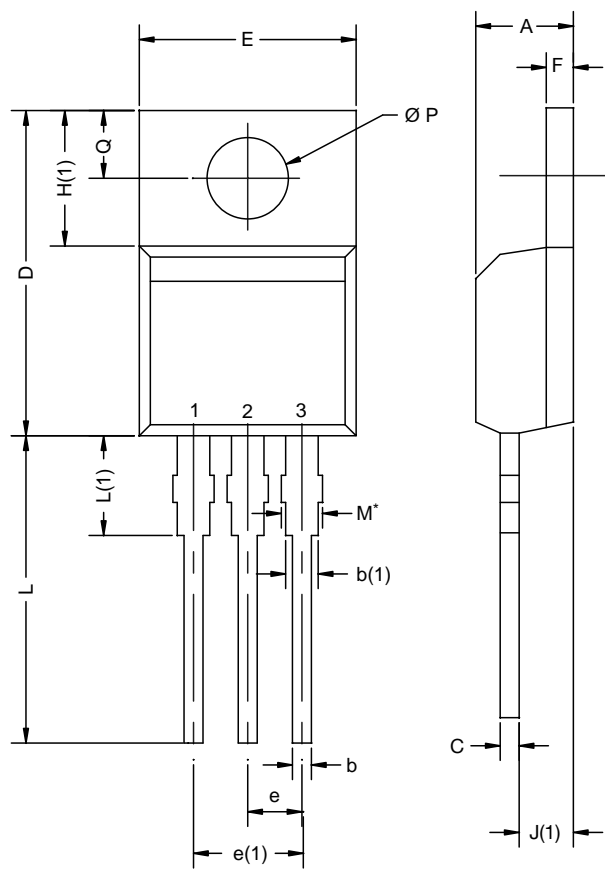
Power Derating, Junction-to-Case



Normalized Thermal Transient Impedance, Junction-to-Case

* The power dissipation P_D is based on $T_{J(max)} = 175\text{ }^{\circ}\text{C}$, using junction-to-case thermal resistance, and is more useful in settling the upper dissipation limit for cases where additional heatsinking is used. It is used to determine the current rating, when this rating falls below the package limit.

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: X12-0208-Rev. N, 08-Oct-12
DWG: 5471

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

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