

## IRF9540PBF-VB Datasheet

### P-Channel 100 V (D-S) MOSFET

| PRODUCT SUMMARY               |        |           |
|-------------------------------|--------|-----------|
| $V_{DS}$                      | -100   | V         |
| $R_{DS(on)}$ $V_{GS} = 10$ V  | 167    | $m\Omega$ |
| $R_{DS(on)}$ $V_{GS} = 4.5$ V | 178    | $m\Omega$ |
| $I_D$                         | -18    | A         |
| Configuration                 | Single |           |

#### FEATURES

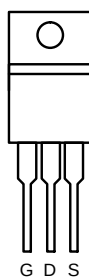
- Halogen-free According to IEC 61249-2-21 Definition
- Trench Power MOSFET
- 100 %  $R_g$  and UIS Tested
- Compliant to RoHS Directive 2002/95/EC


**RoHS**  
 COMPLIANT

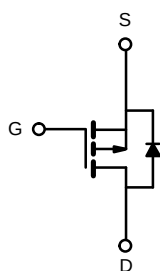
#### APPLICATIONS

- Power Switch
- Load Switch in High Current Applications
- DC/DC Converters

TO-220AB



G D S



P-Channel MOSFET

| ABSOLUTE MAXIMUM RATINGS ( $T_C = 25$ °C, unless otherwise noted) |                            |                |                   |      |
|-------------------------------------------------------------------|----------------------------|----------------|-------------------|------|
| Parameter                                                         |                            | Symbol         | Limit             | Unit |
| Drain-Source Voltage                                              |                            | $V_{DS}$       | - 100             | V    |
| Gate-Source Voltage                                               |                            | $V_{GS}$       | $\pm 20$          |      |
| Continuous Drain Current ( $T_J = 150$ °C)                        | $T_C = 25$ °C              | $I_D$          | - 18              | A    |
|                                                                   | $T_C = 70$ °C              |                | - 13              |      |
| Pulsed Drain Current ( $t = 300$ $\mu$ s)                         |                            | $I_{DM}$       | - 100             |      |
| Avalanche Current                                                 |                            | $I_{AS}$       | - 10              |      |
| Single Avalanche Energy <sup>a</sup>                              | $L = 0.1$ mH               | $E_{AS}$       | 31                | mJ   |
|                                                                   |                            |                |                   |      |
| Maximum Power Dissipation <sup>a</sup>                            | $T_C = 25$ °C              | $P_D$          | 11.7 <sup>b</sup> | W    |
|                                                                   | $T_A = 25$ °C <sup>c</sup> |                | 1.1               |      |
| Operating Junction and Storage Temperature Range                  |                            | $T_J, T_{stg}$ | - 55 to 150       | °C   |

| THERMAL RESISTANCE RATINGS                   |            |       |      |
|----------------------------------------------|------------|-------|------|
| Parameter                                    | Symbol     | Limit | Unit |
| Junction-to-Ambient (PCB Mount) <sup>c</sup> | $R_{thJA}$ | 60    | °C/W |
| Junction-to-Case (Drain)                     | $R_{thJC}$ | 9     |      |

Notes:

a. Duty cycle  $\leq 1$  %.

b. See SOA curve for voltage derating.

c. When mounted on 1" square PCB (FR-4 material).

| SPECIFICATIONS ( $T_J = 25\text{ }^{\circ}\text{C}$ , unless otherwise noted)                       |               |                                                                                                                                    |       |       |           |               |
|-----------------------------------------------------------------------------------------------------|---------------|------------------------------------------------------------------------------------------------------------------------------------|-------|-------|-----------|---------------|
| Parameter                                                                                           | Symbol        | Test Conditions                                                                                                                    | Min.  | Typ.  | Max.      | Unit          |
| Static                                                                                              |               |                                                                                                                                    |       |       |           |               |
| Drain-Source Breakdown Voltage                                                                      | $V_{DS}$      | $V_{DS} = 0\text{ V}$ , $I_D = -250\text{ }\mu\text{A}$                                                                            | - 100 |       |           | V             |
| Gate Threshold Voltage                                                                              | $V_{GS(th)}$  | $V_{DS} = V_{GS}$ , $I_D = -250\text{ }\mu\text{A}$                                                                                | - 1   |       | - 2.5     |               |
| Gate-Body Leakage                                                                                   | $I_{GSS}$     | $V_{DS} = 0\text{ V}$ , $V_{GS} = \pm 20\text{ V}$                                                                                 |       |       | $\pm 250$ | nA            |
| Zero Gate Voltage Drain Current                                                                     | $I_{DSS}$     | $V_{DS} = -60\text{ V}$ , $V_{GS} = 0\text{ V}$                                                                                    |       |       | - 1       | $\mu\text{A}$ |
|                                                                                                     |               | $V_{DS} = -100\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_J = 125\text{ }^{\circ}\text{C}$                                             |       |       | - 50      |               |
|                                                                                                     |               | $V_{DS} = -100\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_J = 150\text{ }^{\circ}\text{C}$                                             |       |       | - 250     |               |
| On-State Drain Current <sup>a</sup>                                                                 | $I_{D(on)}$   | $V_{DS} \leq -10\text{ V}$ , $V_{GS} = -10\text{ V}$                                                                               | - 18  |       |           | A             |
| Drain-Source On-State Resistance <sup>a</sup>                                                       | $R_{DS(on)}$  | $V_{GS} = -10\text{ V}$ , $I_D = -14\text{ A}$                                                                                     |       | 167   |           | m $\Omega$    |
|                                                                                                     |               | $V_{GS} = -4.5\text{ V}$ , $I_D = -12\text{ A}$                                                                                    |       | 178   |           |               |
| Forward Transconductance <sup>a</sup>                                                               | $g_{fs}$      | $V_{DS} = -20\text{ V}$ , $I_D = -14\text{ A}$                                                                                     |       | 20    |           | S             |
| Dynamic <sup>b</sup>                                                                                |               |                                                                                                                                    |       |       |           |               |
| Input Capacitance                                                                                   | $C_{iss}$     | $V_{GS} = 0\text{ V}$ , $V_{DS} = -20\text{ V}$ , $f = 1\text{ MHz}$                                                               |       | 1460  |           | pF            |
| Output Capacitance                                                                                  | $C_{oss}$     |                                                                                                                                    |       | 330   |           |               |
| Reverse Transfer Capacitance                                                                        | $C_{rss}$     |                                                                                                                                    |       | 280   |           |               |
| Total Gate Charge <sup>c</sup>                                                                      | $Q_g$         | $V_{DS} = -20\text{ V}$ , $V_{GS} = -10\text{ V}$ , $I_D = -14\text{ A}$                                                           |       | 67    | 100       | nC            |
| Gate-Source Charge <sup>c</sup>                                                                     | $Q_{gs}$      |                                                                                                                                    |       | 13.5  |           |               |
| Gate-Drain Charge <sup>c</sup>                                                                      | $Q_{gd}$      |                                                                                                                                    |       | 14    |           |               |
| Gate Resistance                                                                                     | $R_g$         | $f = 1\text{ MHz}$                                                                                                                 | 0.5   | 2.5   | 5         | $\Omega$      |
| Turn-On Delay Time <sup>c</sup>                                                                     | $t_{d(on)}$   | $V_{DD} = -20\text{ V}$ , $R_L = 2\text{ }\Omega$<br>$I_D \cong -10\text{ A}$ , $V_{GEN} = -10\text{ V}$ , $R_g = 1\text{ }\Omega$ |       | 10    | 20        | ns            |
| Rise Time <sup>c</sup>                                                                              | $t_r$         |                                                                                                                                    |       | 11    | 20        |               |
| Turn-Off Delay Time <sup>c</sup>                                                                    | $t_{d(off)}$  |                                                                                                                                    |       | 42    | 63        |               |
| Fall Time <sup>c</sup>                                                                              | $t_f$         |                                                                                                                                    |       | 12    | 20        |               |
| Drain-Source Body Diode Ratings and Characteristics $T_C = 25\text{ }^{\circ}\text{C}$ <sup>b</sup> |               |                                                                                                                                    |       |       |           |               |
| Continuous Current                                                                                  | $I_S$         |                                                                                                                                    |       |       | - 18      | A             |
| Pulsed Current                                                                                      | $I_{SM}$      |                                                                                                                                    |       |       | - 100     |               |
| Forward Voltage <sup>a</sup>                                                                        | $V_{SD}$      | $I_F = -10\text{ A}$ , $V_{GS} = 0\text{ V}$                                                                                       |       | - 0.8 | - 1.5     | V             |
| Reverse Recovery Time                                                                               | $t_{rr}$      | $I_F = -10\text{ A}$ , $dI/dt = 100\text{ A}/\mu\text{s}$                                                                          |       | 38    | 57        | ns            |
| Peak Reverse Recovery Current                                                                       | $I_{RM(REC)}$ |                                                                                                                                    |       | 2.3   | 3.5       | A             |
| Reverse Recovery Charge                                                                             | $Q_{rr}$      |                                                                                                                                    |       | 40    | 60        | nC            |

Notes:

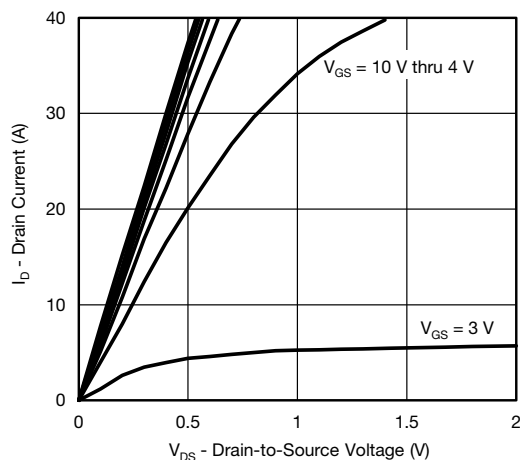
a. Pulse test; pulse width  $\leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$ .

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

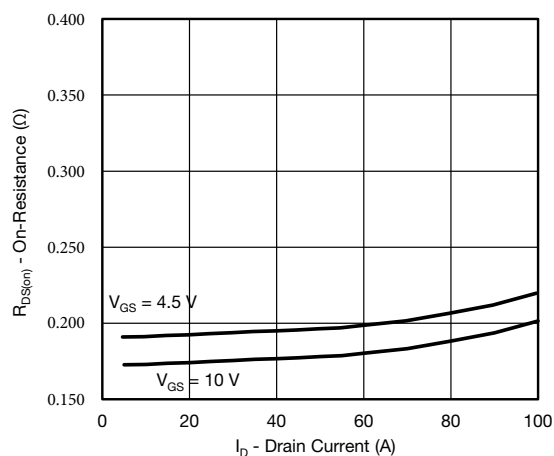
c. Independent of operating temperature.

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.

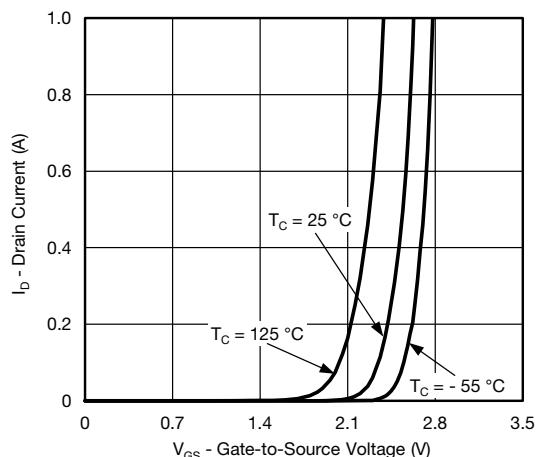
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



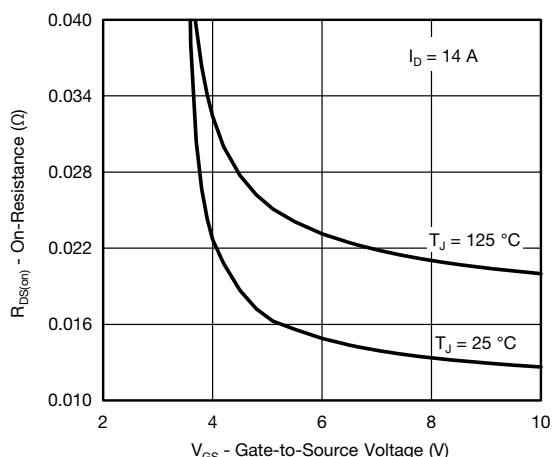
**Output Characteristics**



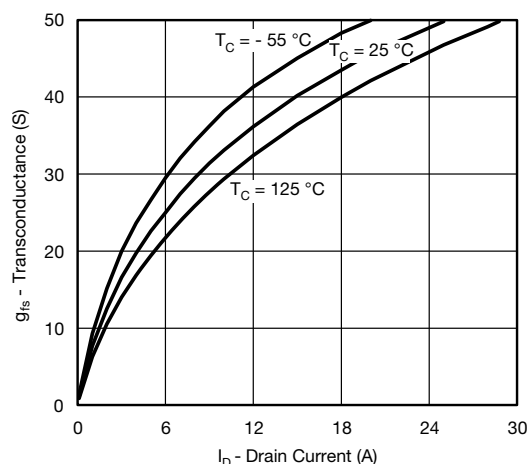
**On-Resistance vs. Drain Current**



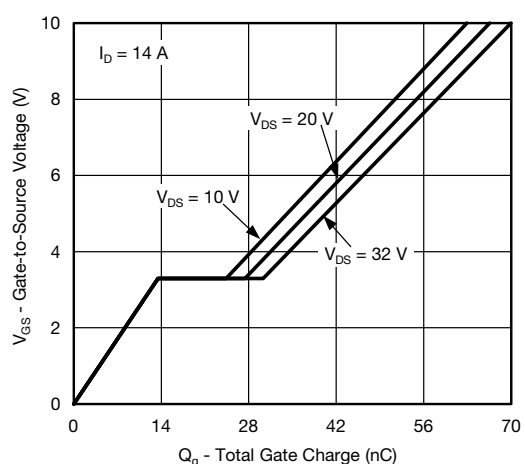
**Transfer Characteristics**



**On-Resistance vs. Gate-to-Source Voltage**

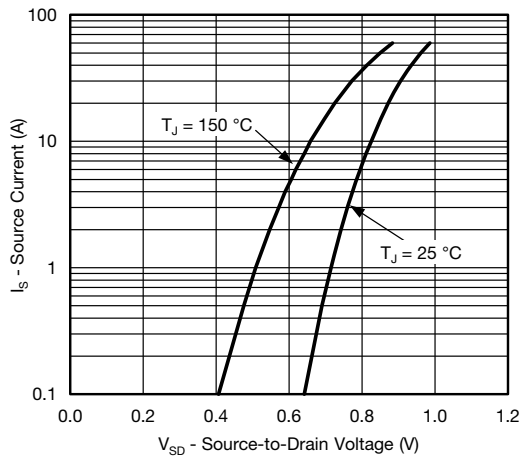


**Transconductance**

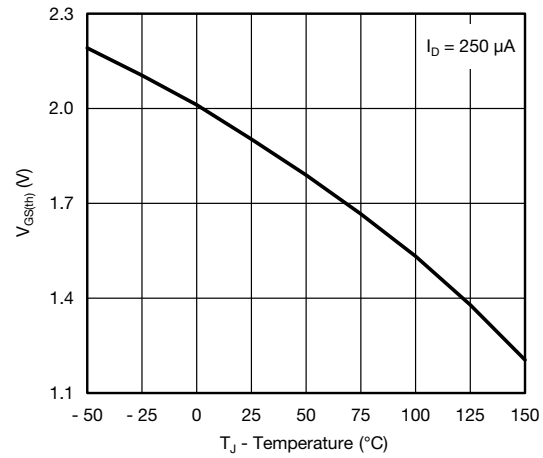


**Gate Charge**

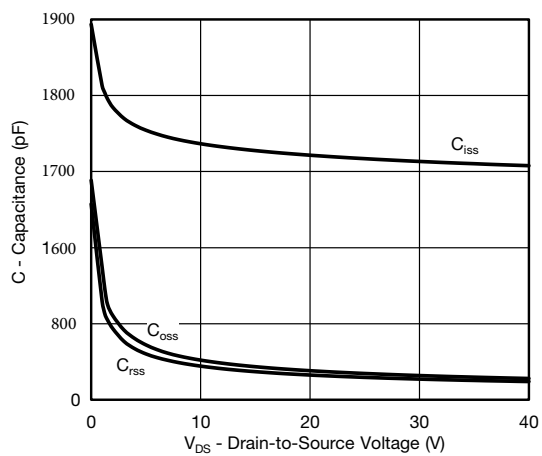
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



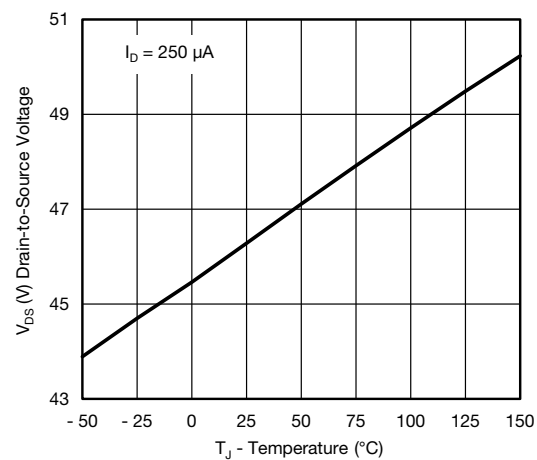
Source-Drain Diode Forward Voltage



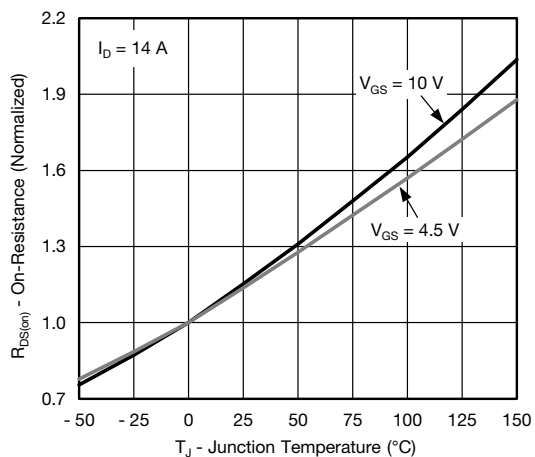
Threshold Voltage



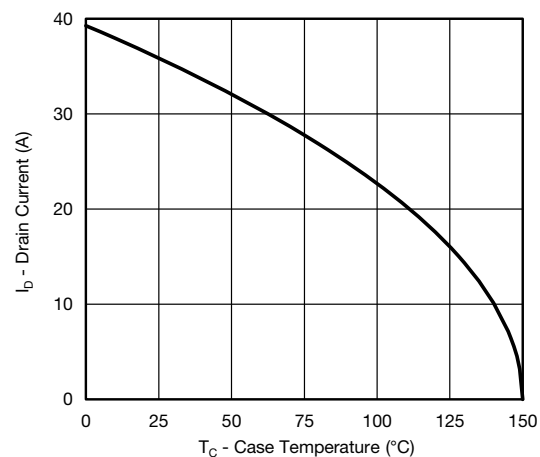
Capacitance



Drain Source Breakdown vs. Junction Temperature

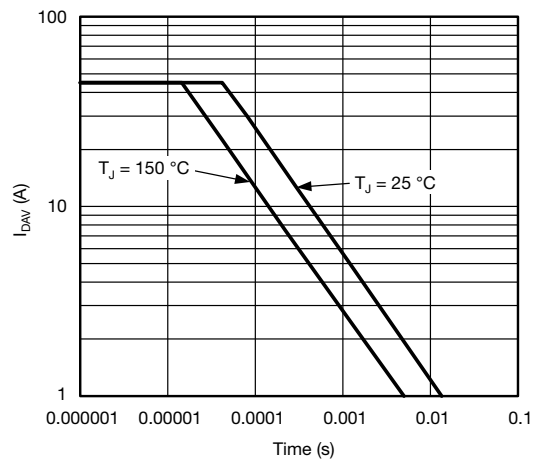


On-Resistance vs. Junction Temperature

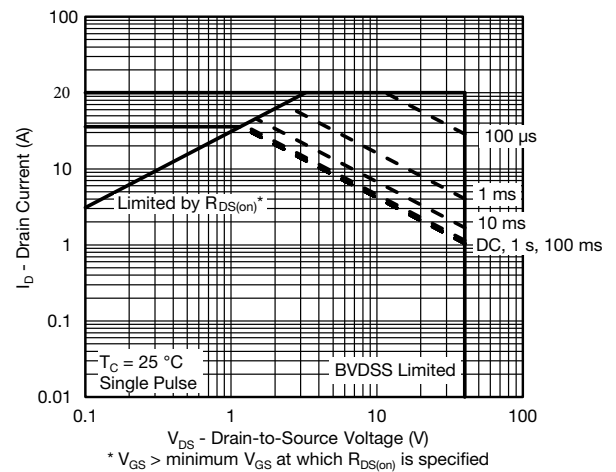


Current Derating

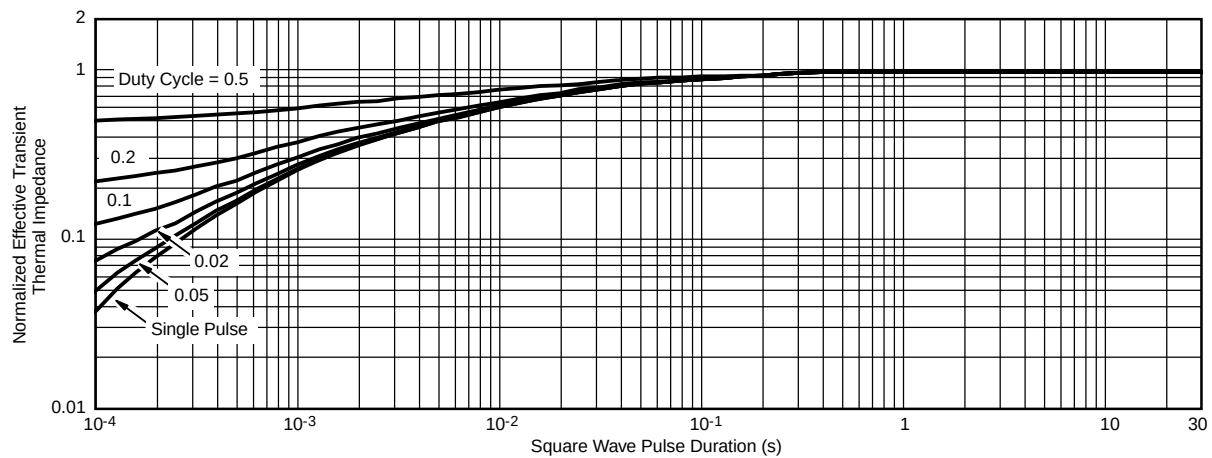
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



Single Pulse Avalanche Current Capability vs. Time

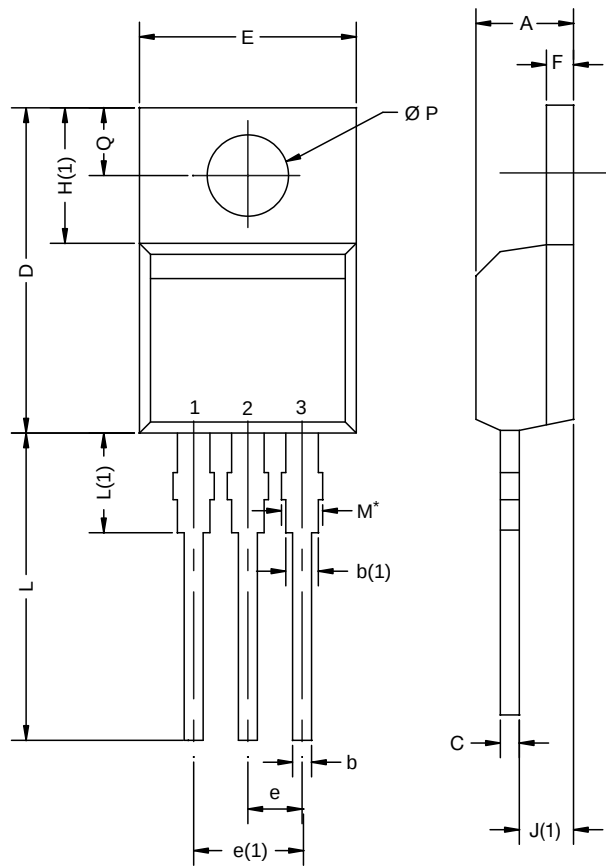


Safe Operating Area



Normalized Thermal Transient Impedance, Junction-to-Case

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 |
| $\varnothing P$                              | 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<br>DWG: 5471 |             |       |        |       |

Notes

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

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