| THERMAL RESISTANCE RATINGS | | | | |
|---|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **TYP.** | **MAX.** | **UNIT** |
| Typical Socket Mount, Junction-to-Ambient | $R_{thJA}$ | - | 80 | °C/W |
| Case-to-Sink, Mounting Surface Flat, Smooth, and Greased | $R_{thCS}$ | 1.0 | - | |
| Junction-to-Case | $R_{thJC}$ | - | 3.12 | |

| ELECTRICAL CHARACTERISTICS ($T_J$ = 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 | | 50 | - | - | V |
| Gate-Source Threshold Voltage | $V_{GS(th)}$ | $V_{DS}$ = $V_{GS}$, $I_D$ = 250 µA | | 2.0 | - | 4.0 | V |
| Gate-Source Leakage | $I_{GSS}$ | $V_{GS}$ = ± 20 V | | - | - | ± 500 | nA |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{DS}$ > Max. Rating, $V_{GS}$ = 0 V | | - | - | 250 | µA |
| | | $V_{DS}$ = Max. Rating x 0.8, $V_{GS}$ = 0 V, $T_C$ = 125 °C | | - | - | 1000 | |
| On-State Drain Current | $I_{D(on)}$ | $V_{GS}$ = 10 V | $V_{DS}$ > $I_{D(on)}$ x $R_{DS(on)}$ max. | - | - | 15 | A |
| Drain-Source On-State Resistance[b] | $R_{DS(on)}$ | $V_{GS}$ = 10 V | $I_D$ = 10 A | - | 0.080 | 0.10 | Ω |
| Forward Transconductance[b] | $g_{fs}$ | $V_{DS}$ > $I_{D(on)}$ x $R_{DS(on)}$ max., $I_D$ = 9.0 A | | 5.0 | 6.0 | - | S |
| **Dynamic** | | | | | | | |
| Input Capacitance | $C_{iss}$ | $V_{GS}$ = 0 V, $V_{DS}$ = 25 V, f = 1.0 MHz, see fig. 11 | | - | 560 | 860 | pF |
| Output Capacitance | $C_{oss}$ | | | - | 250 | 350 | |
| Reverse Transfer Capacitance | $C_{rss}$ | | | - | 60 | 100 | |
| Total Gate Charge | $Q_g$ | $V_{GS}$ = 10 V | $I_D$ = 20 A, $V_{DS}$ = 0.8 max. rating, see fig. 18 for test circuit (Gate charge is essentially independent of operating temperature) | - | 12 | 17 | nC |
| Gate-Source Charge | $Q_{gs}$ | | | - | 9.0 | - | |
| Gate-Drain Charge | $Q_{gd}$ | | | - | 3.0 | - | |
| Turn-On Delay Time | $t_{d(on)}$ | $V_{DD}$ = 25 V, $I_D$ = 9.0 A, $Z_0$ = 50 Ω, see fig. 5[b] | | - | 15 | 30 | ns |
| Rise Time | $t_r$ | | | - | 45 | 90 | |
| Turn-Off Delay Time | $t_{d(off)}$ | | | - | 20 | 40 | |
| Fall Time | $t_f$ | | | - | 15 | 30 | |
| Internal Drain Inductance | $L_D$ | Modified MOSFET symbol showing the internal device inductances  | | - | 3.5 | - | nH |
| Internal Source Inductance | $L_S$ | | | - | 4.5 | - | |
| **Drain-Source Body Diode Characteristics** | | | | | | | |
| Continuous Source-Drain Diode Current | $I_S$ | MOSFET symbol showing the integral reverse p - n junction rectifier  | | - | - | 15 | A |
| Pulsed Diode Forward Current[a] | $I_{SM}$ | | | - | - | 60 | |
| Body Diode Voltage[b] | $V_{SD}$ | $T_C$ = 25 °C, $I_S$ = 15 A, $V_{GS}$ = 0 V | | - | - | 1.5 | V |
| Body Diode Reverse Recovery Time | $t_{rr}$ | $T_J$ = 150 °C, $I_F$ = 15 A, $dI_F/dt$ = 100 A/µs | | - | 100 | - | ns |
| Body Diode Reverse Recovery Charge | $Q_{rr}$ | | | - | 0.4 | - | 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. Repeditive rating: Pulse width limited by max. junction temperature. See transient temperature impedance curve (see fig. 5).

b. Pulse test: Pulse width ≤ 300 µs; duty cycle ≤ 2 %.

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

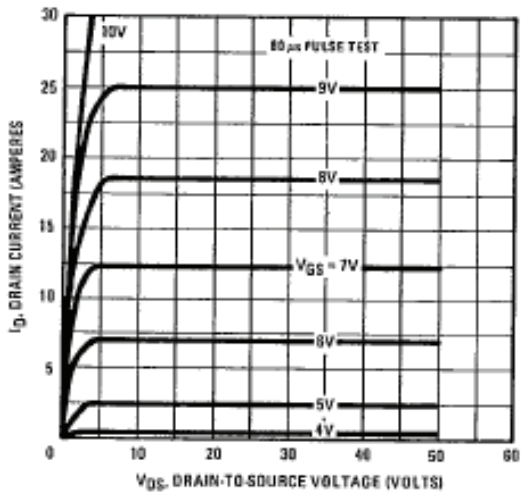



Fig. 1 - Typical Output Characteristics

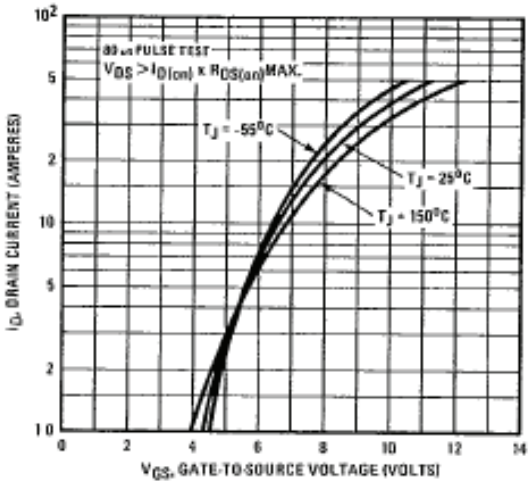



Fig. 3 - Typical Transfer Characteristics

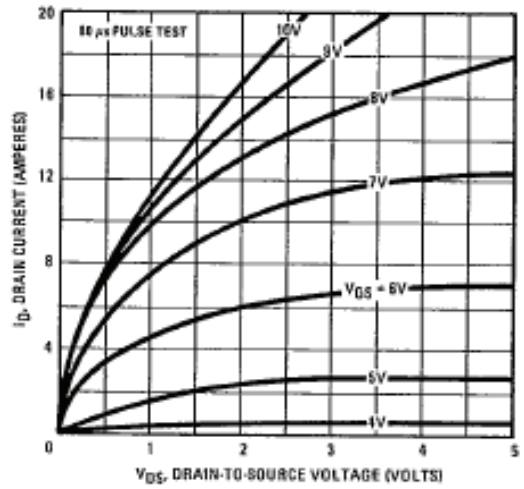



Fig. 2 - Typical Saturation Characteristics

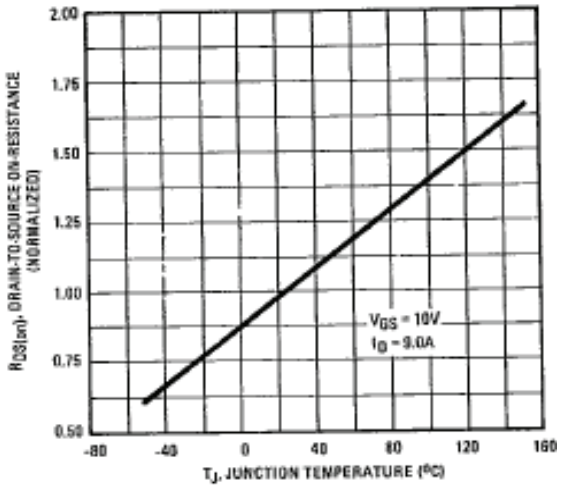



Fig. 4 - Normalized On-Resistance vs. Temperature

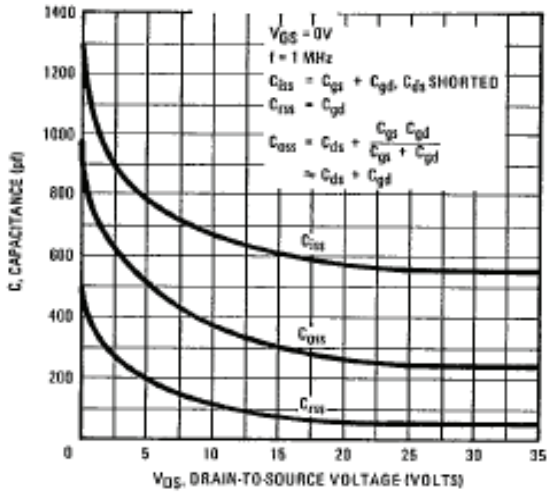



Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

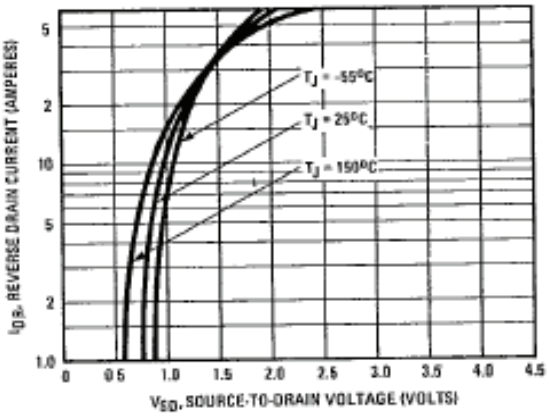



Fig. 7 - Typical Source-Drain Diode Forward Voltage

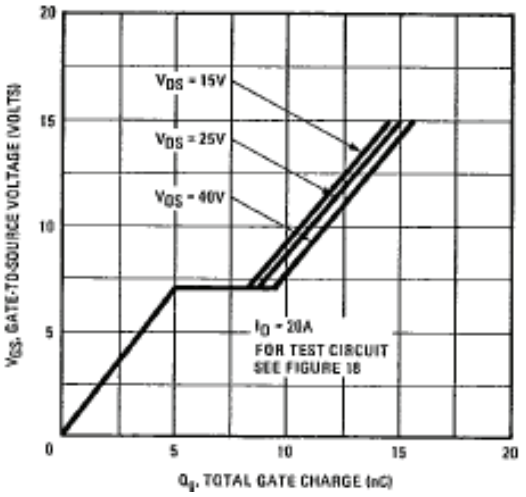



Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

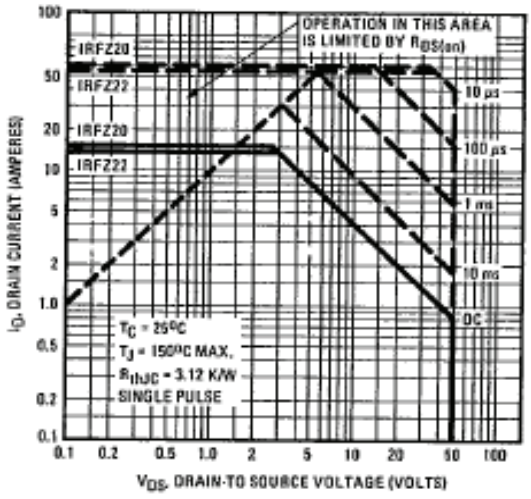



Fig. 8 - Maximum Safe Operating Area

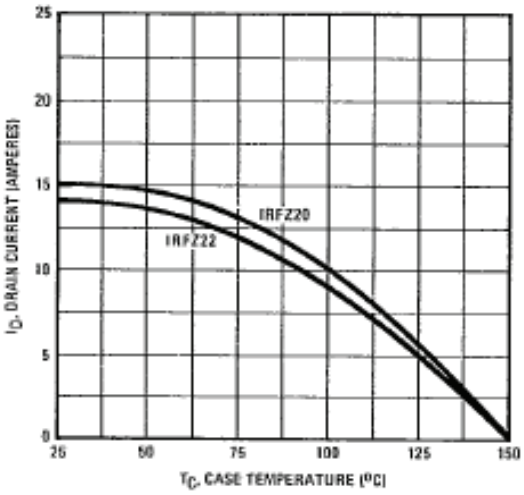



Fig. 9 - Maximum Drain Current vs. Case Temperature

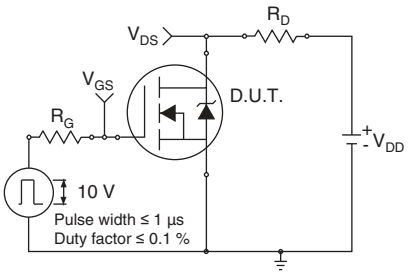



Fig. 10a - Switching Time Test Circuit

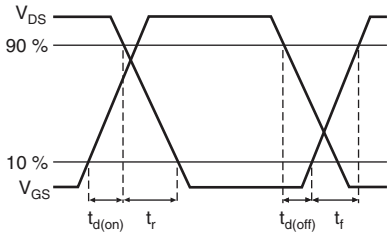



Fig. 10b - Switching Time Waveforms

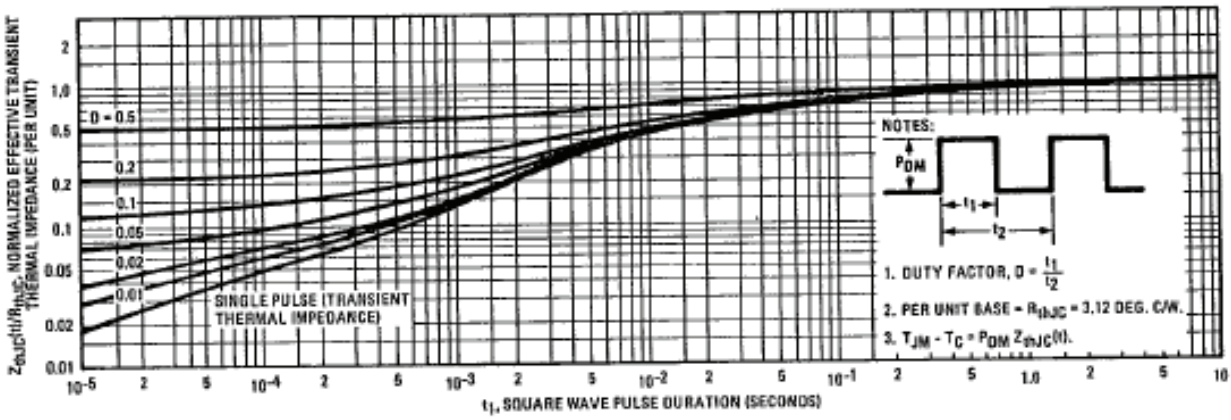



Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case vs. Pulse Duration

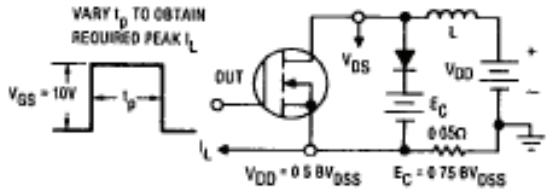



Fig. 12a - Clamped Inductive Test Circuit

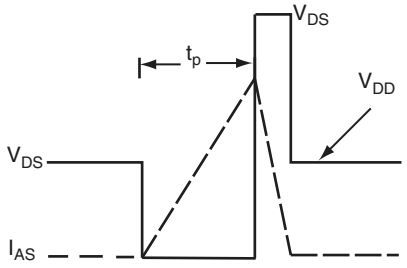



Fig. 12b - Unclamped Inductive Waveforms

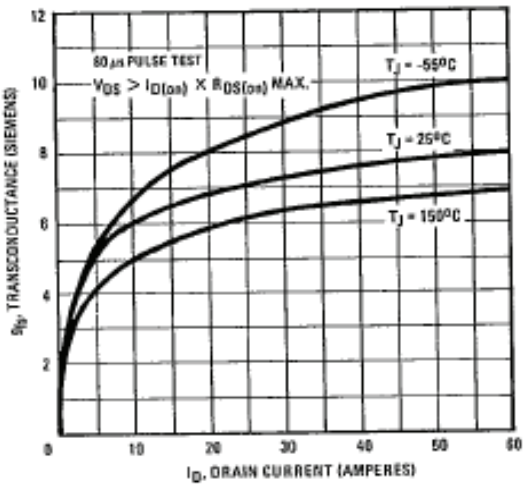



**Fig. 13 - Typical Transconductance vs. Drain Current**

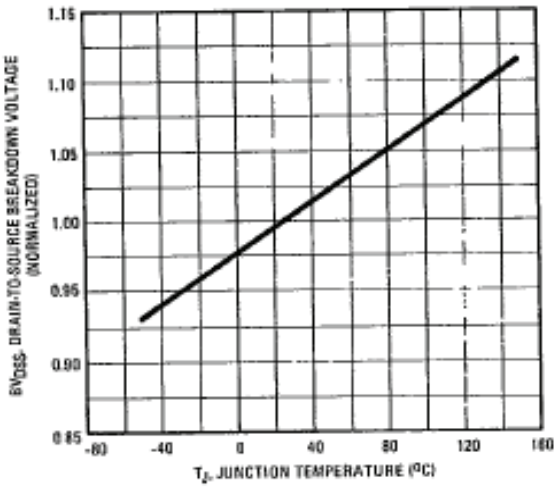



**Fig. 14 - Breakdown Voltage vs. Temperature**

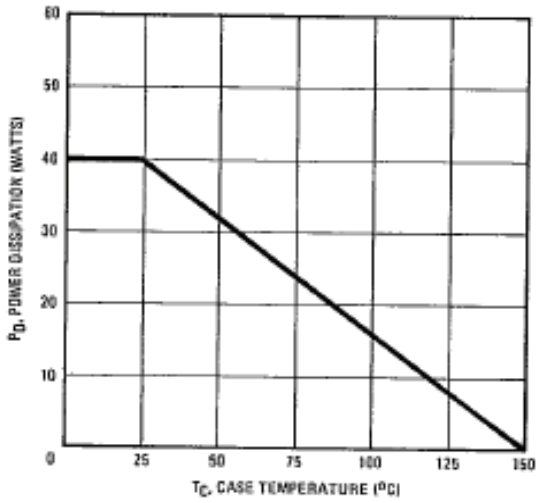



**Fig. 16 - Power vs. Temperature Derating Curve**

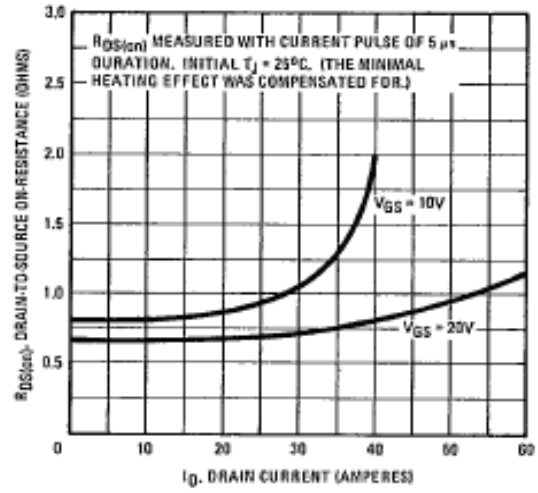



**Fig. 15 - Typical On-Resistance vs. Drain Current**

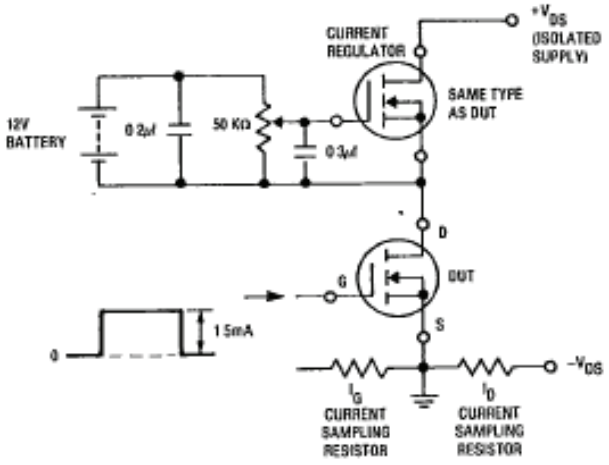
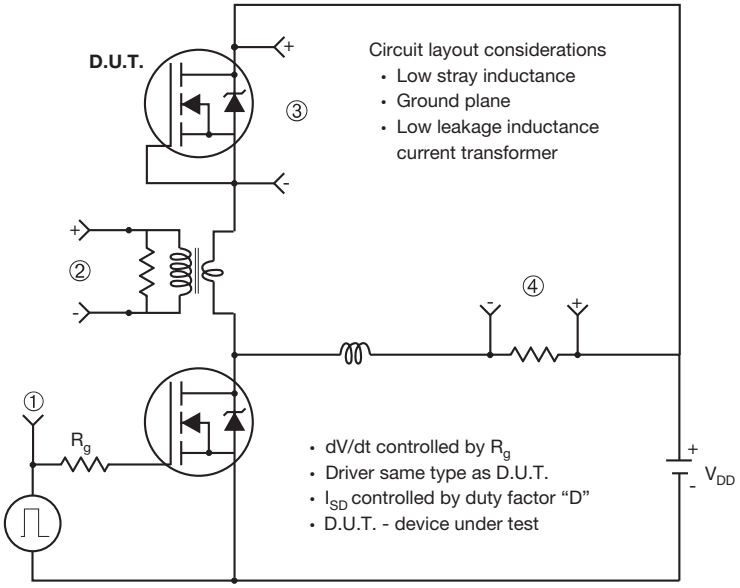
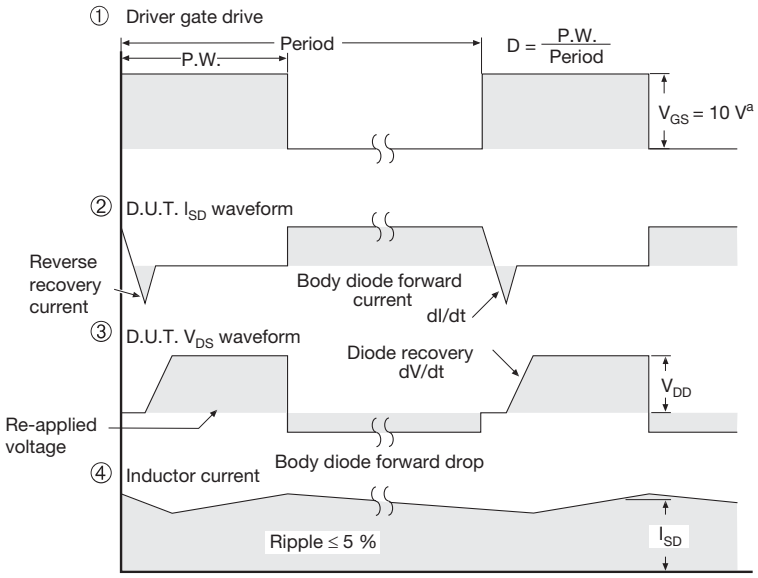



**Fig. 17 - Gate Charge Test Circuit**

**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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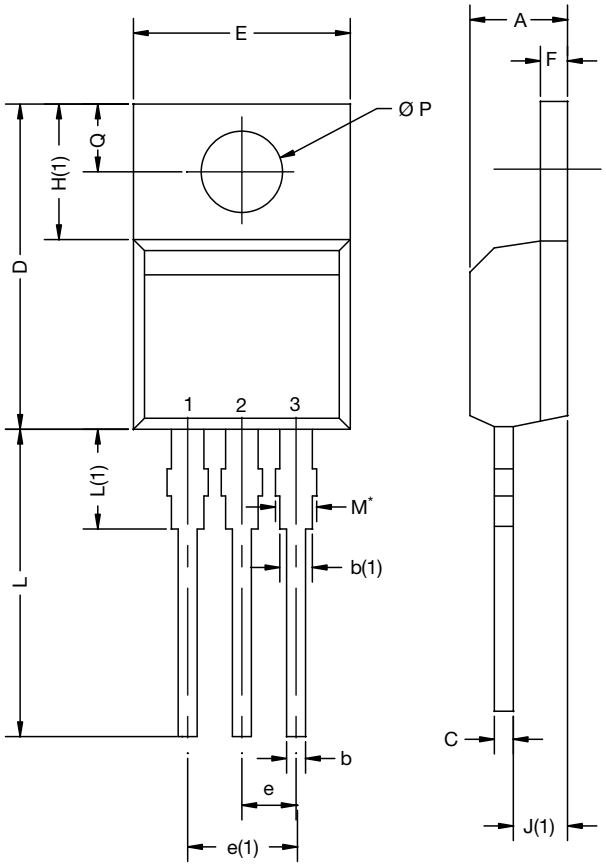
# TO-220-1

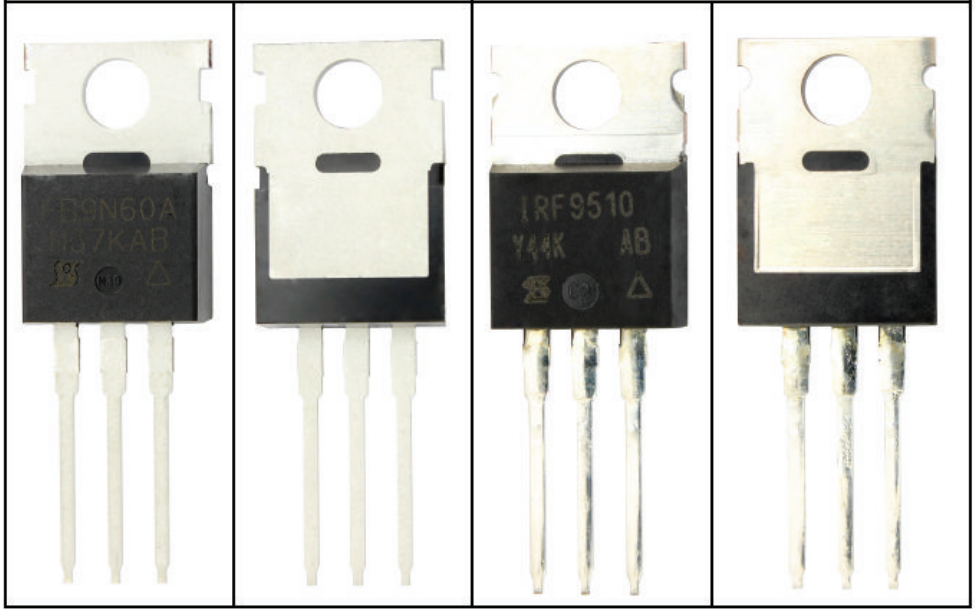



| DIM. | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| | MIN. | MAX. | MIN. | MAX. |
| A | 4.24 | 4.65 | 0.167 | 0.183 |
| b | 0.69 | 1.02 | 0.027 | 0.040 |
| b(1) | 1.14 | 1.78 | 0.045 | 0.070 |
| c | 0.36 | 0.61 | 0.014 | 0.024 |
| D | 14.33 | 15.85 | 0.564 | 0.624 |
| E | 9.96 | 10.52 | 0.392 | 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<br>DWG: 6031 | | | | |

**Note**

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

| Package Picture | |
|---|---|
| ASE | Xi'an |



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