# AOTF409-VB Datasheet

## P-Channel 60 V (D-S) MOSFET

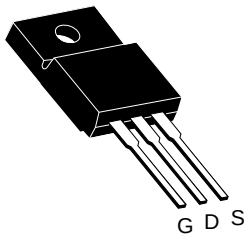
| PRODUCT SUMMARY | | | |
|---|---|---|---|
| $V_{DS}$ (V) | $R_{DS(on)}$ (Ω) Max. | $I_D$ (A) | $Q_g$ (Typ.) |
| - 60 | 0.050 at $V_{GS}$ = - 10 V | - 30 | 67 |
| | 0.060 at $V_{GS}$ = - 4.5 V | - 24 | |

### FEATURES

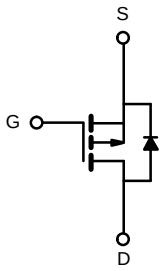
- **Halogen-free According to IEC 61249-2-21 Definition**
- Trench Power MOSFET
- 100 % $R_g$ and UIS Tested
- Compliant to RoHS Directive 2002/95/EC

RoHS COMPLIANT

**TO-220 FULLPAK**




Top View




P-Channel MOSFET

| ABSOLUTE MAXIMUM RATINGS ($T_C$ = 25 °C, unless otherwise noted) | | | | |
|---|---|---|---|---|
| **Parameter** | | **Symbol** | **Limit** | **Unit** |
| Drain-Source Voltage | | $V_{DS}$ | - 60 | V |
| Gate-Source Voltage | | $V_{GS}$ | ± 20 | |
| Continuous Drain Current ($T_J$ = 150 °C) | $T_C$ = 25 °C | $I_D$ | - 30 | A |
| | $T_C$ = 70 °C | | - 29 | |
| Pulsed Drain Current (t = 300 µs) | | $I_{DM}$ | - 100 | |
| Avalanche Current | | $I_{AS}$ | - 32 | |
| Single Avalanche Energy[a] | L = 0.1 mH | $E_{AS}$ | 51 | mJ |
| Maximum Power Dissipation[a] | $T_C$ = 25 °C | $P_D$ | 41.7[b] | W |
| | $T_A$ = 25 °C[c] | | 2.1 | |
| 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)[c] | $R_{thJA}$ | 60 | °C/W |
| Junction-to-Case (Drain) | $R_{thJC}$ | 3 | |

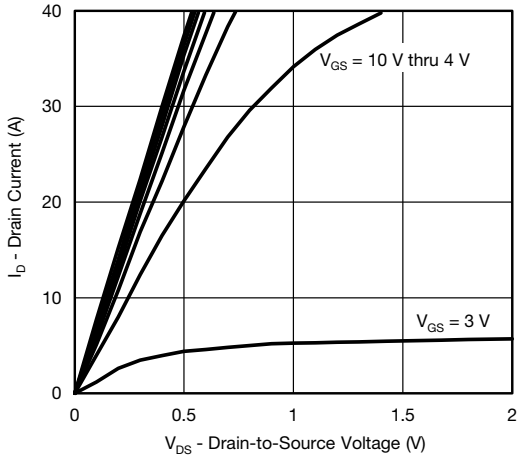
Notes:
a. Duty cycle ≤ 1 %.
b. See SOA curve for voltage derating.
c. When mounted on 1" square PCB (FR-4 material).

| **SPECIFICATIONS** ($T_J$ = 25 °C, unless otherwise noted) | | | | | | |
|---|---|---|---|---|---|---|
| **Parameter** | **Symbol** | **Test Conditions** | **Min.** | **Typ.** | **Max.** | **Unit** |
| **Static** | | | | | | |
| Drain-Source Breakdown Voltage | $V_{DS}$ | $V_{DS}$ = 0 V, $I_D$ = - 250 µA | - 60 | | | V |
| Gate Threshold Voltage | $V_{GS(th)}$ | $V_{DS}$ = $V_{GS}$, $I_D$ = - 250 µA | - 1 | | - 2.5 | |
| Gate-Body Leakage | $I_{GSS}$ | $V_{DS}$ = 0 V, $V_{GS}$ = ± 20 V | | | ± 250 | nA |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{DS}$ = - 60 V, $V_{GS}$ = 0 V | | | - 1 | µA |
| | | $V_{DS}$ = - 60 V, $V_{GS}$ = 0 V, $T_J$ = 125 °C | | | - 50 | |
| | | $V_{DS}$ = - 60 V, $V_{GS}$ = 0 V, $T_J$ = 150 °C | | | - 250 | |
| On-State Drain Current[a] | $I_{D(on)}$ | $V_{DS} \leq$ - 10 V, $V_{GS}$ = - 10 V | - 30 | | | A |
| Drain-Source On-State Resistance[a] | $R_{DS(on)}$ | $V_{GS}$ = - 10 V, $I_D$ = - 14 A | | 0.050 | | Ω |
| | | $V_{GS}$ = - 4.5 V, $I_D$ = - 12 A | | 0.060 | | |
| Forward Transconductance[a] | $g_{fs}$ | $V_{DS}$ = - 20 V, $I_D$ = - 14 A | | 40 | | S |
| **Dynamic[b]** | | | | | | |
| Input Capacitance | $C_{iss}$ | $V_{GS}$ = 0 V, $V_{DS}$ = - 20 V, f = 1 MHz | | 1765 | | pF |
| Output Capacitance | $C_{oss}$ | | | 230 | | |
| Reverse Transfer Capacitance | $C_{rss}$ | | | 180 | | |
| Total Gate Charge[c] | $Q_g$ | $V_{DS}$ = - 20 V, $V_{GS}$ = - 10 V, $I_D$ = - 14 A | | 67 | | nC |
| Gate-Source Charge[c] | $Q_{gs}$ | | | 13.5 | | |
| Gate-Drain Charge[c] | $Q_{gd}$ | | | 14 | | |
| Gate Resistance | $R_g$ | f = 1 MHz | 0.5 | 2.5 | 5 | Ω |
| Turn-On Delay Time[c] | $t_{d(on)}$ | $V_{DD}$ = - 20 V, $R_L$ = 2 Ω<br>$I_D \cong$ - 10 A, $V_{GEN}$ = - 10 V, $R_g$ = 1 Ω | | 10 | 20 | ns |
| Rise Time[c] | $t_r$ | | | 11 | 20 | |
| Turn-Off Delay Time[c] | $t_{d(off)}$ | | | 42 | 63 | |
| Fall Time[c] | $t_f$ | | | 12 | 20 | |
| **Drain-Source Body Diode Ratings and Characteristics** $T_C$ = 25 °C[b] | | | | | | |
| Continuous Current | $I_S$ | | | | - 36 | A |
| Pulsed Current | $I_{SM}$ | | | | - 100 | |
| Forward Voltage[a] | $V_{SD}$ | $I_F$ = - 10 A, $V_{GS}$ = 0 V | | - 0.8 | - 1.5 | V |
| Reverse Recovery Time | $t_{rr}$ | $I_F$ = - 10 A, dI/dt = 100 A/µs | | 38 | 57 | ns |
| Peak Reverse Recovery Current | $I_{RM(REC)}$ | | | 2.3 | 3.5 | A |
| Reverse Recovery Charge | $Q_{rr}$ | | | 40 | 60 | nC |

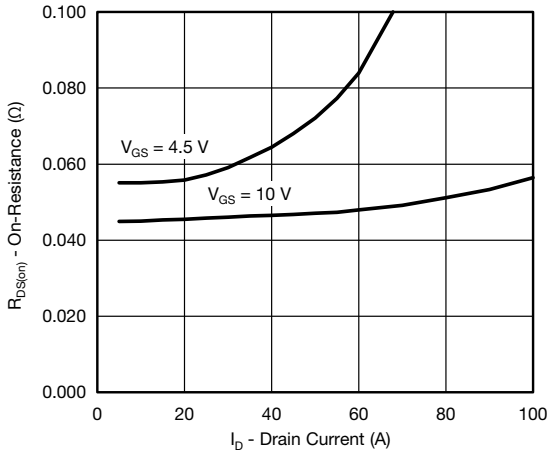
Notes:
a. Pulse test; pulse width ≤ 300 µs, duty cycle ≤ 2 %.
b. Guaranteed by design, not subject to production testing.
c. Independent of operating temperature.

*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.*

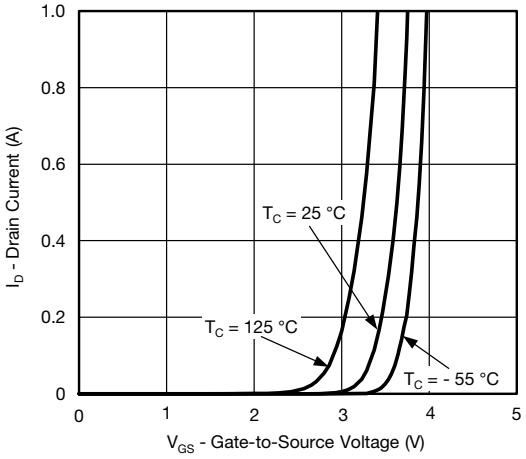
## TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



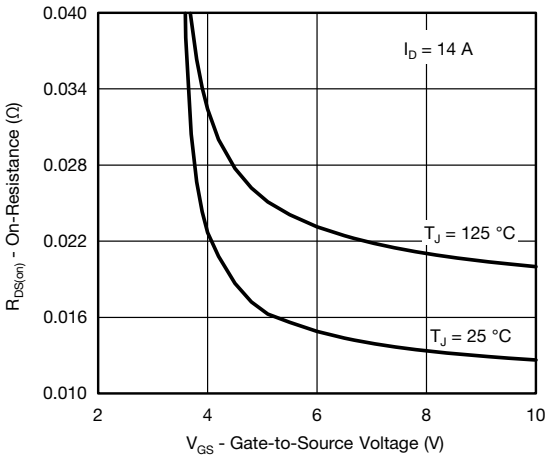

**Output Characteristics**



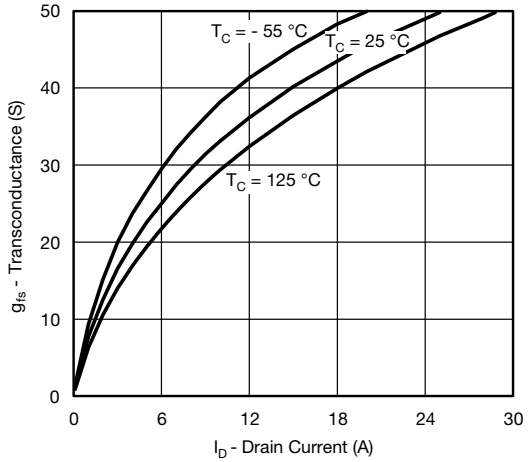

**On-Resistance vs. Drain Current**



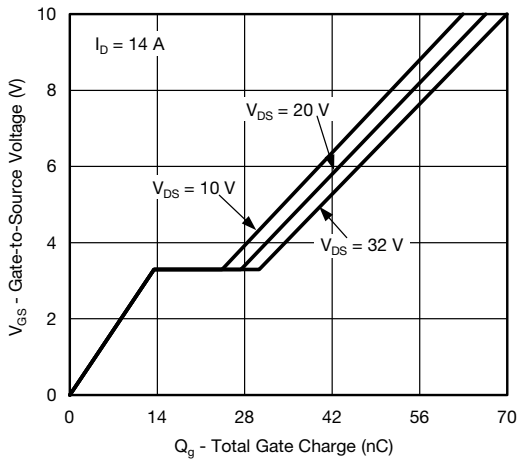

**Transfer Characteristics**




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

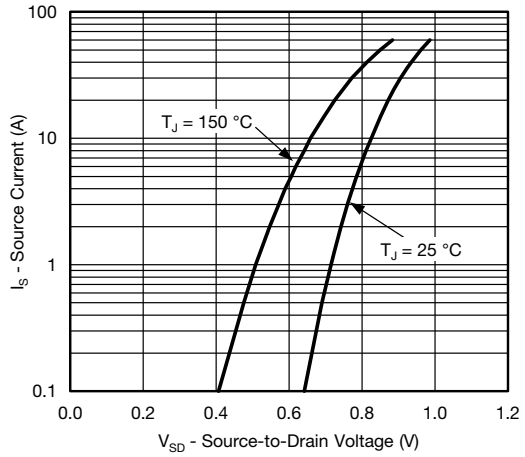



**Transconductance**

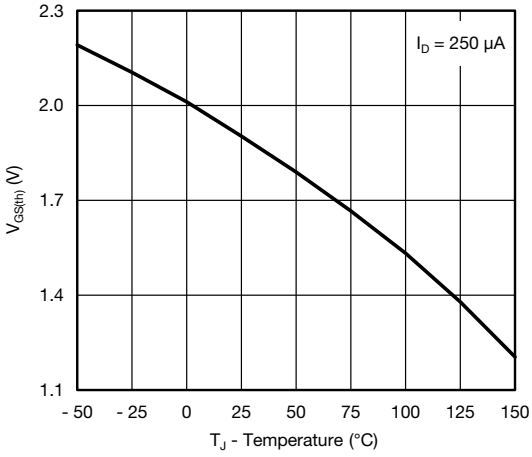



**Gate Charge**

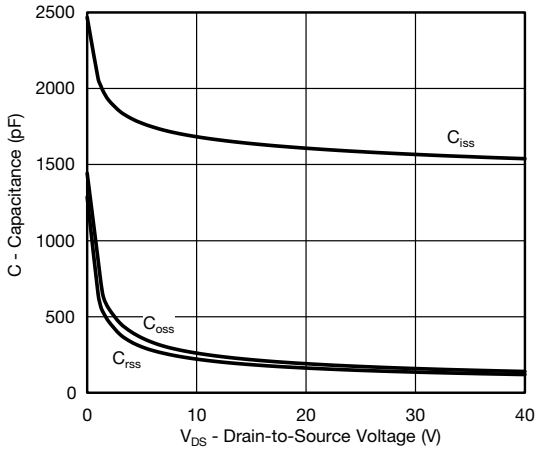
## TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



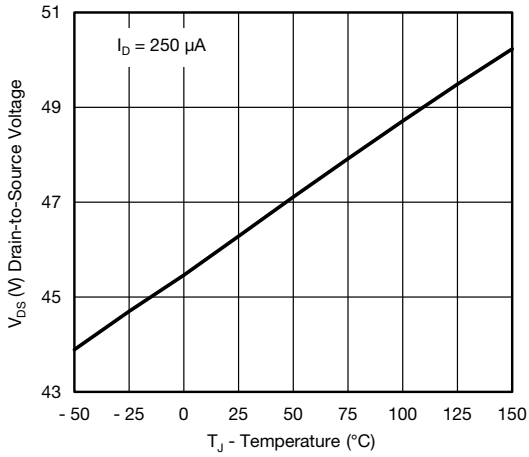

**Source-Drain Diode Forward Voltage**



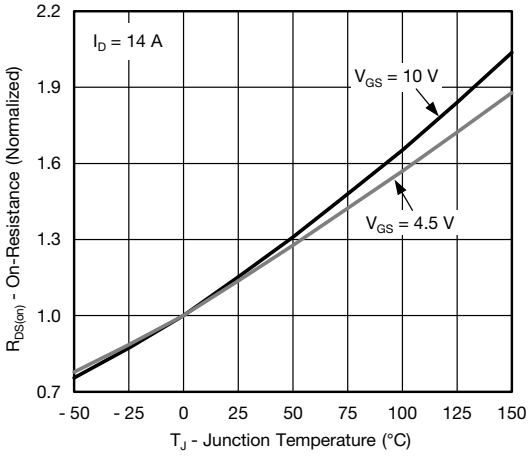

**Threshold Voltage**



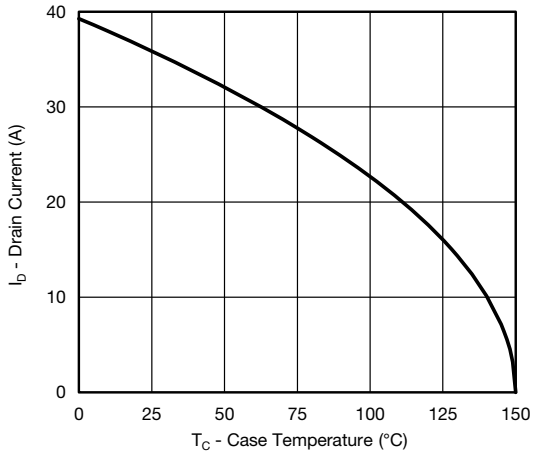

**Capacitance**




**Drain Source Breakdown vs. Junction Temperature**

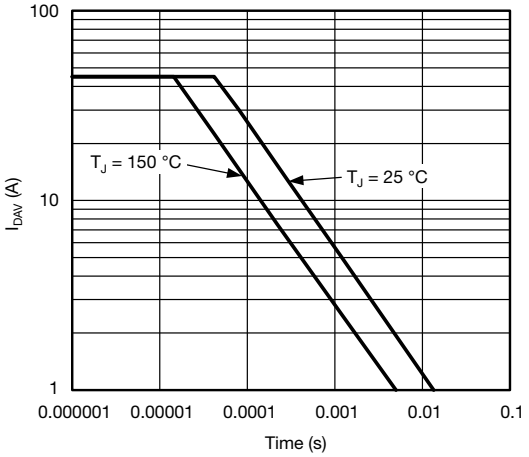



**On-Resistance vs. Junction Temperature**

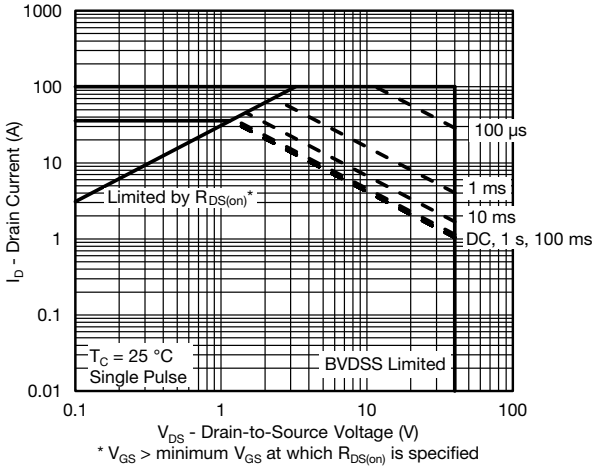



**Current Derating**

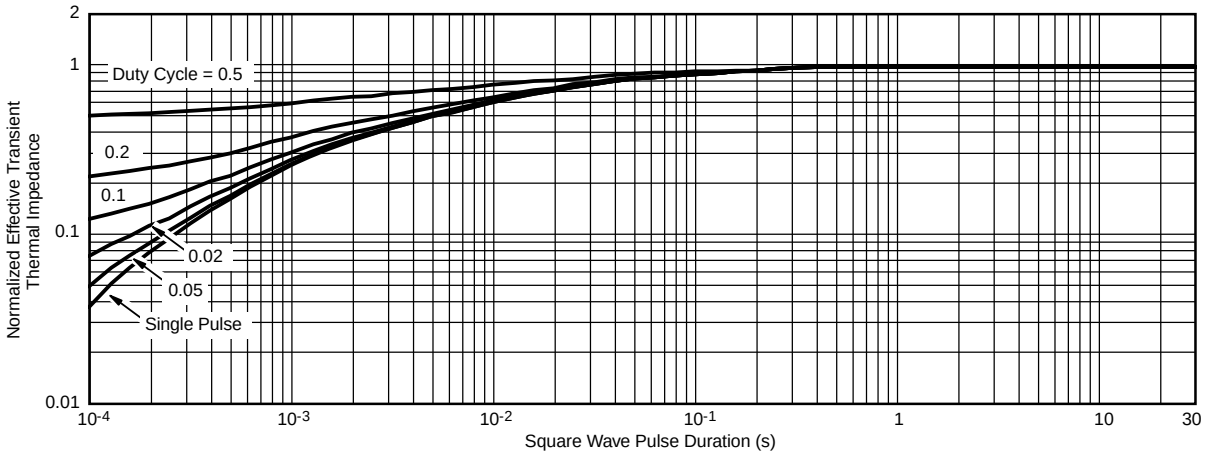
## TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)




**Single Pulse Avalanche Current Capability vs. Time**

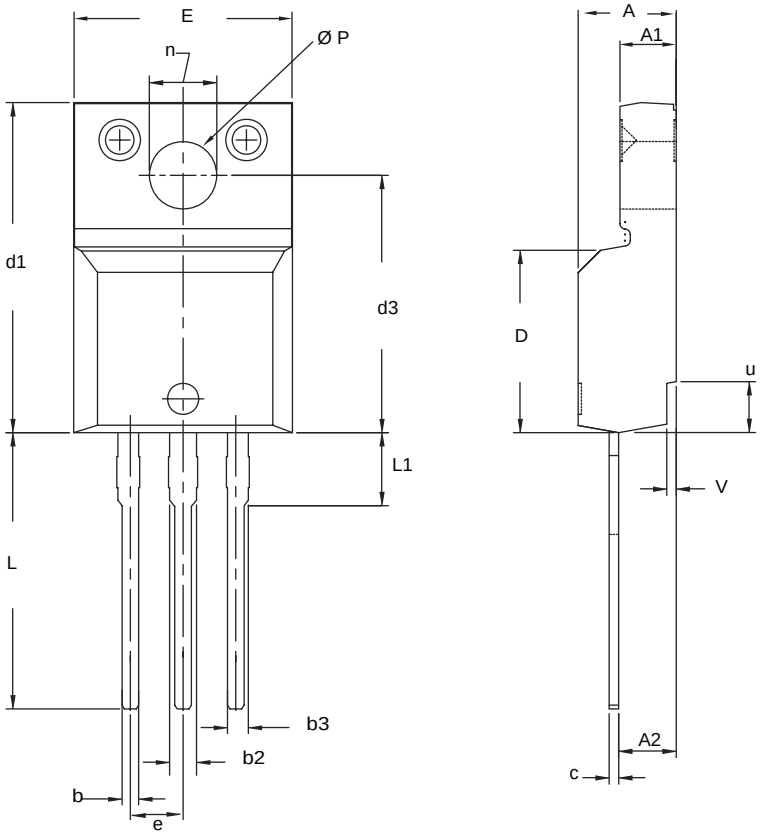



**Safe Operating Area**




**Normalized Thermal Transient Impedance, Junction-to-Case**

## TO-220 FULLPAK (HIGH VOLTAGE)




| | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| **DIM.** | **MIN.** | **MAX.** | **MIN.** | **MAX.** |
| A | 4.570 | 4.830 | 0.180 | 0.190 |
| A1 | 2.570 | 2.830 | 0.101 | 0.111 |
| A2 | 2.510 | 2.850 | 0.099 | 0.112 |
| b | 0.622 | 0.890 | 0.024 | 0.035 |
| b2 | 1.229 | 1.400 | 0.048 | 0.055 |
| b3 | 1.229 | 1.400 | 0.048 | 0.055 |
| c | 0.440 | 0.629 | 0.017 | 0.025 |
| D | 8.650 | 9.800 | 0.341 | 0.386 |
| d1 | 15.88 | 16.120 | 0.622 | 0.635 |
| d3 | 12.300 | 12.920 | 0.484 | 0.509 |
| E | 10.360 | 10.630 | 0.408 | 0.419 |
| e | 2.54 BSC | | 0.100 BSC | |
| L | 13.200 | 13.730 | 0.520 | 0.541 |
| L1 | 3.100 | 3.500 | 0.122 | 0.138 |
| n | 6.050 | 6.150 | 0.238 | 0.242 |
| Ø P | 3.050 | 3.450 | 0.120 | 0.136 |
| u | 2.400 | 2.500 | 0.094 | 0.098 |
| v | 0.400 | 0.500 | 0.016 | 0.020 |
| ECN: X09-0126-Rev. B, 26-Oct-09<br>DWG: 5972 | | | | |

**Notes**

1. To be used only for process drawing.
2. These dimensions apply to all TO-220, FULLPAK leadframe versions 3 leads.
3. All critical dimensions should C meet $C_{pk} > 1.33$.
4. All dimensions include burrs and plating thickness.
5. No chipping or package damage.

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