

FDP040N06

N-Channel PowerTrench® MOSFET

60V, 168A, 4.0mΩ

Features

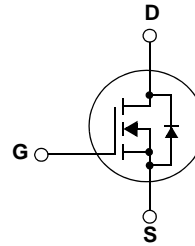
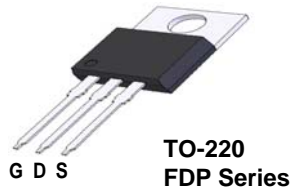
- $R_{DS(on)} = 3.2m\Omega$ (Typ.) @ $V_{GS} = 10V, I_D = 75A$
- Fast Switching Speed
- Low Gate Charge
- High Performance Trench Technology for Extremely Low $R_{DS(on)}$
- High Power and Current Handling Capability
- RoHS Compliant

General Description

This N-Channel MOSFET is produced using Fairchild Semiconductor's advanced PowerTrench process that has been especially tailored to minimize the on-state resistance and yet maintain superior switching performance.

Application

- DC to DC converters / Synchronous Rectification



MOSFET Maximum Ratings $T_C = 25^\circ\text{C}$ unless otherwise noted

| Symbol | Parameter | FDP040N06 | Units |
|----------------|--|---|------------------|
| V_{DSS} | Drain to Source Voltage | 60 | V |
| V_{GSS} | Gate to Source Voltage | ± 20 | V |
| I_D | Drain Current | -Continuous ($T_C = 25^\circ\text{C}$, Silicion Limited) | 168* |
| | | -Continuous ($T_C = 100^\circ\text{C}$, Silicion Limited) | 118* |
| | | -Continuous ($T_C = 25^\circ\text{C}$, Package Limited) | 120 |
| I_{DM} | Drain Current | - Pulsed (Note 1) | 672 |
| E_{AS} | Single Pulsed Avalanche Energy | (Note 2) | 872 |
| dv/dt | Peak Diode Recovery dv/dt | (Note 3) | 7.0 |
| P_D | Power Dissipation | ($T_C = 25^\circ\text{C}$) | 231 |
| | | - Derate above 25°C | 1.54 |
| T_J, T_{STG} | Operating and Storage Temperature Range | -55 to +175 | $^\circ\text{C}$ |
| T_L | Maximum Lead Temperature for Soldering Purpose, 1/8" from Case for 5 Seconds | 300 | $^\circ\text{C}$ |

*Calculated continuous current based on maximum allowable junction temperature. Package limitation current is 120A.

Thermal Characteristics

| Symbol | Parameter | FDP040N06 | Units |
|-----------------|--|-----------|---------------------------|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case, Max | 0.65 | $^\circ\text{C}/\text{W}$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient, Max | 62.5 | |

Package Marking and Ordering Information

| Device Marking | Device | Package | Reel Size | Tape Width | Quantity |
|----------------|-----------|---------|-----------|------------|----------|
| FDP040N06 | FDP040N06 | TO-220 | Tube | - | 50 |

Electrical Characteristics $T_C = 25^\circ\text{C}$ unless otherwise noted

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Units |
|--------|-----------|-----------------|------|------|------|-------|
|--------|-----------|-----------------|------|------|------|-------|

Off Characteristics

| | | | | | | |
|--------------------------------------|---|--|----|------|-----------|---------------------------|
| BV_{DSS} | Drain to Source Breakdown Voltage | $I_D = 250\mu\text{A}, V_{GS} = 0\text{V}, T_C = 25^\circ\text{C}$ | 60 | - | - | V |
| $\frac{\Delta BV_{DSS}}{\Delta T_J}$ | Breakdown Voltage Temperature Coefficient | $I_D = 250\mu\text{A}$, Referenced to 25°C | - | 0.04 | - | $\text{V}/^\circ\text{C}$ |
| I_{DSS} | Zero Gate Voltage Drain Current | $V_{DS} = 60\text{V}, V_{GS} = 0\text{V}$ | - | - | 1 | μA |
| | | $V_{DS} = 60\text{V}, V_{GS} = 0\text{V}, T_C = 150^\circ\text{C}$ | - | - | 500 | |
| I_{GSS} | Gate to Body Leakage Current | $V_{GS} = \pm 20\text{V}, V_{DS} = 0\text{V}$ | - | - | ± 100 | nA |

On Characteristics

| | | | | | | |
|--------------|--------------------------------------|---|-----|-----|-----|------------------|
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{GS} = V_{DS}, I_D = 250\mu\text{A}$ | 2.5 | 3.5 | 4.5 | V |
| $R_{DS(on)}$ | Static Drain to Source On Resistance | $V_{GS} = 10\text{V}, I_D = 75\text{A}$ | - | 3.2 | 4.0 | $\text{m}\Omega$ |
| g_{FS} | Forward Transconductance | $V_{DS} = 10\text{V}, I_D = 75\text{A}$ | - | 169 | - | S |

Dynamic Characteristics

| | | | | | | |
|--------------|-------------------------------|--|---|------|------|----|
| C_{iss} | Input Capacitance | $V_{DS} = 25\text{V}, V_{GS} = 0\text{V}$ $f = 1\text{MHz}$ | - | 6190 | 8235 | pF |
| C_{oss} | Output Capacitance | | - | 900 | 1195 | pF |
| C_{rss} | Reverse Transfer Capacitance | | - | 385 | 580 | pF |
| $Q_{g(tot)}$ | Total Gate Charge at 10V | $V_{DS} = 48\text{V}, I_D = 75\text{A}$ | - | 102 | 133 | nC |
| Q_{gs} | Gate to Source Gate Charge | $V_{GS} = 10\text{V}$ | - | 32 | - | nC |
| Q_{gd} | Gate to Drain "Miller" Charge | (Note 4) | - | 32 | - | nC |

Switching Characteristics

| | | | | | | |
|--------------|---------------------|---|----------|----|-----|----|
| $t_{d(on)}$ | Turn-On Delay Time | $V_{DD} = 30\text{V}, I_D = 75\text{A}$ $V_{GS} = 10\text{V}, R_{GEN} = 4.7\Omega$ | - | 30 | 70 | ns |
| t_r | Turn-On Rise Time | | - | 40 | 90 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | - | 55 | 120 | ns |
| t_f | Turn-Off Fall Time | | (Note 4) | - | 24 | 58 |

Drain-Source Diode Characteristics

| | | | | | | |
|----------|--|---|---|-----|-----|----|
| I_S | Maximum Continuous Drain to Source Diode Forward Current | - | - | 168 | A | |
| I_{SM} | Maximum Pulsed Drain to Source Diode Forward Current | - | - | 672 | A | |
| V_{SD} | Drain to Source Diode Forward Voltage | $V_{GS} = 0\text{V}, I_{SD} = 75\text{A}$ | - | - | 1.3 | V |
| t_{rr} | Reverse Recovery Time | $V_{GS} = 0\text{V}, I_{SD} = 75\text{A}$ | - | 41 | - | ns |
| Q_{rr} | Reverse Recovery Charge | $di_F/dt = 100\text{A}/\mu\text{s}$ | - | 47 | - | nC |

Notes:

- 1: Repetitive Rating: Pulse width limited by maximum junction temperature
- 2: $L = 0.31\text{mH}, I_{AS} = 75\text{A}, V_{DD} = 50\text{V}, R_G = 25\Omega$, Starting $T_J = 25^\circ\text{C}$
- 3: $I_{SD} \leq 75\text{A}, di/dt \leq 200\text{A}/\mu\text{s}, V_{DD} \leq BV_{DSS}$, Starting $T_J = 25^\circ\text{C}$
- 4: Essentially Independent of Operating Temperature Typical Characteristics

Typical Performance Characteristics

Figure 1. On-Region Characteristics

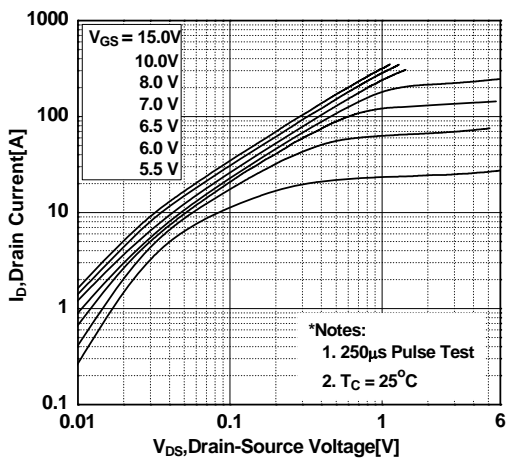


Figure 2. Transfer Characteristics

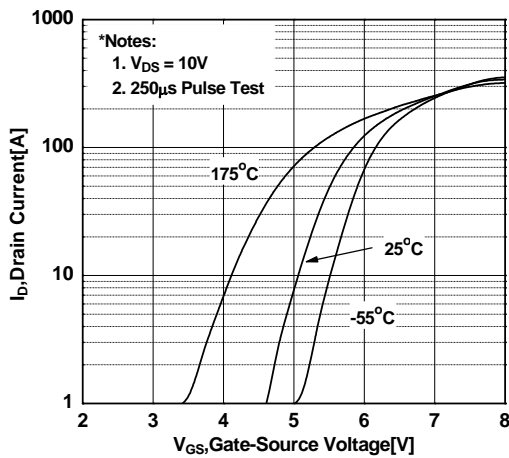


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

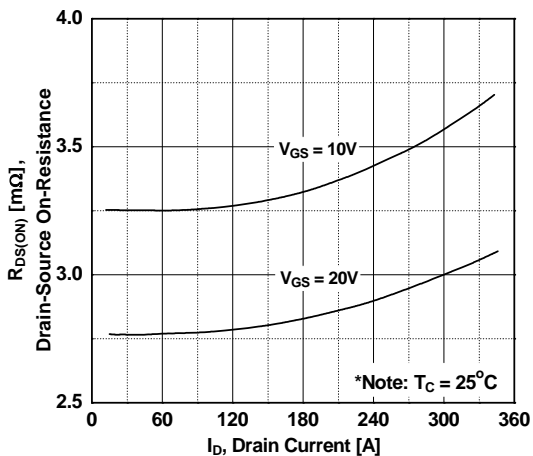


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

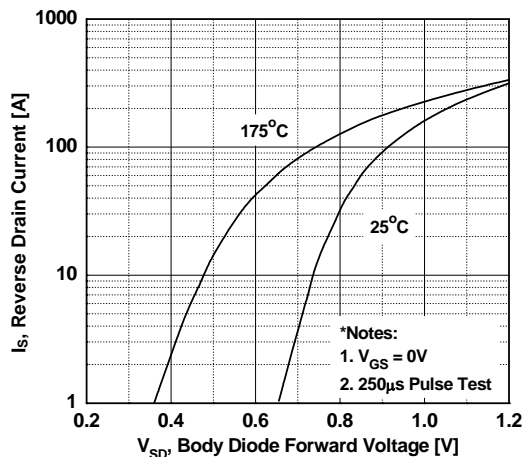


Figure 5. Capacitance Characteristics

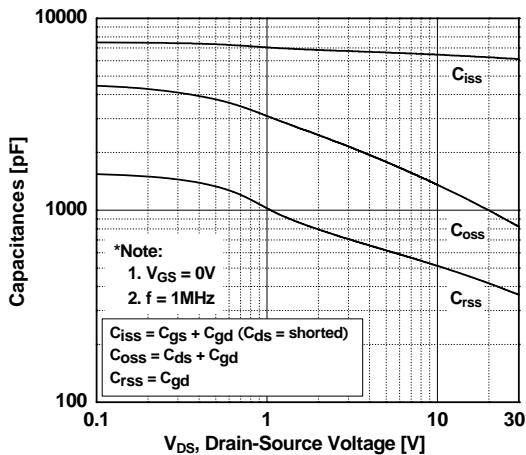
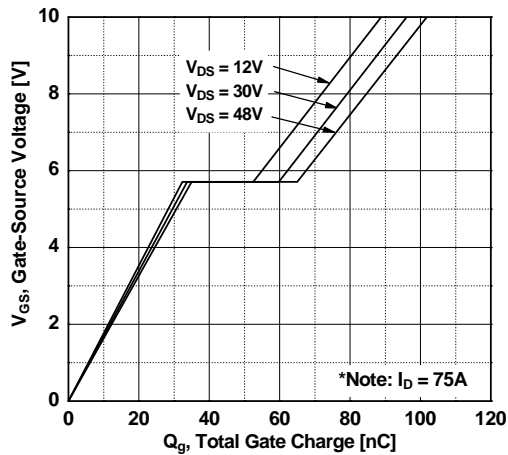


Figure 6. Gate Charge Characteristics



Typical Performance Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

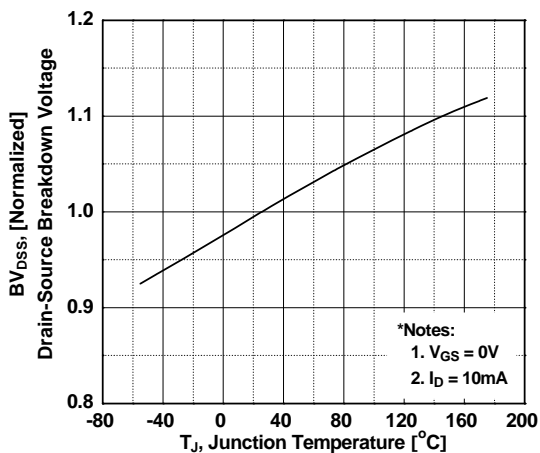


Figure 8. On-Resistance Variation vs. Temperature

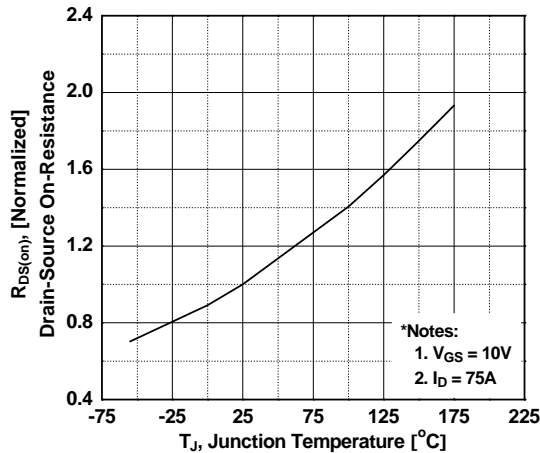


Figure 9. Maximum Safe Operating Area

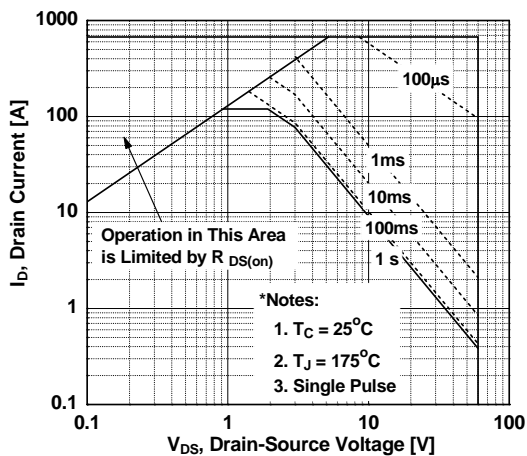


Figure 10. Maximum Drain Current vs. Case Temperature

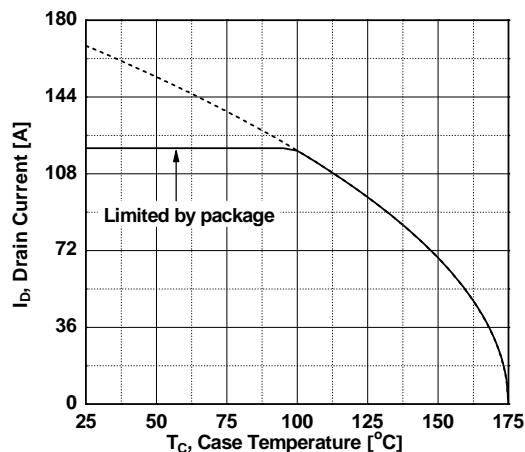
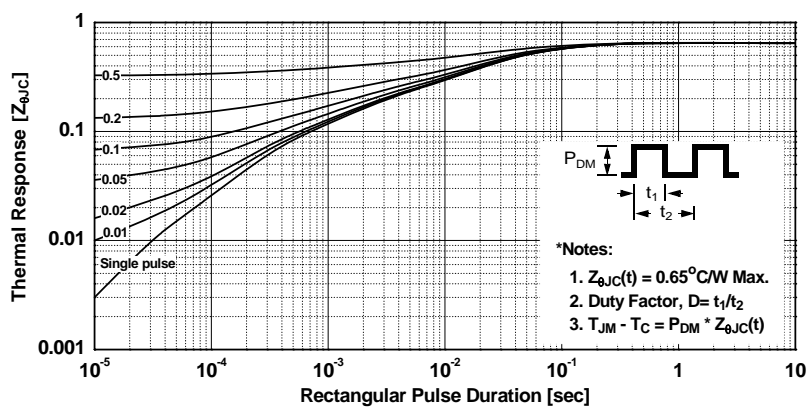
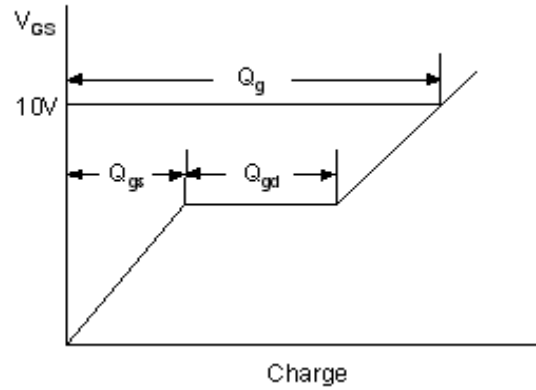
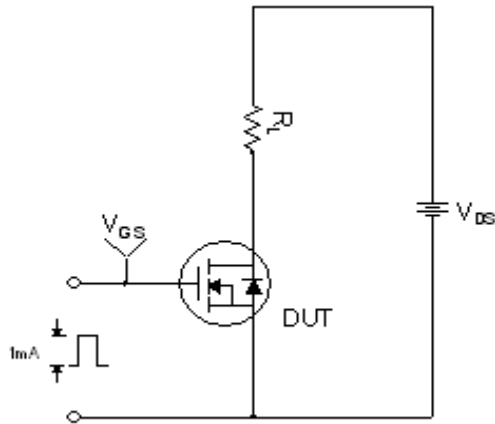


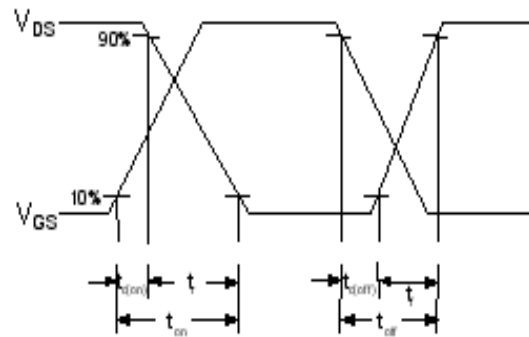
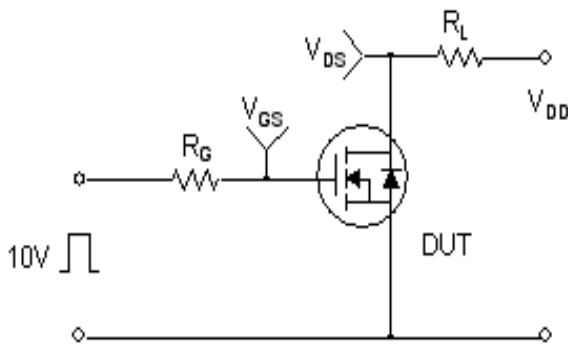
Figure 11. Transient Thermal Response Curve



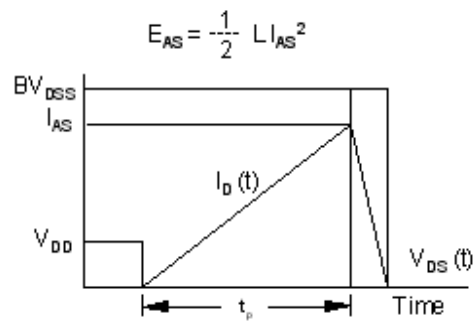
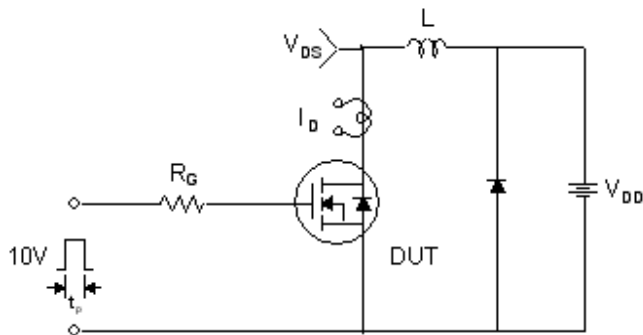
Gate Charge Test Circuit & Waveform



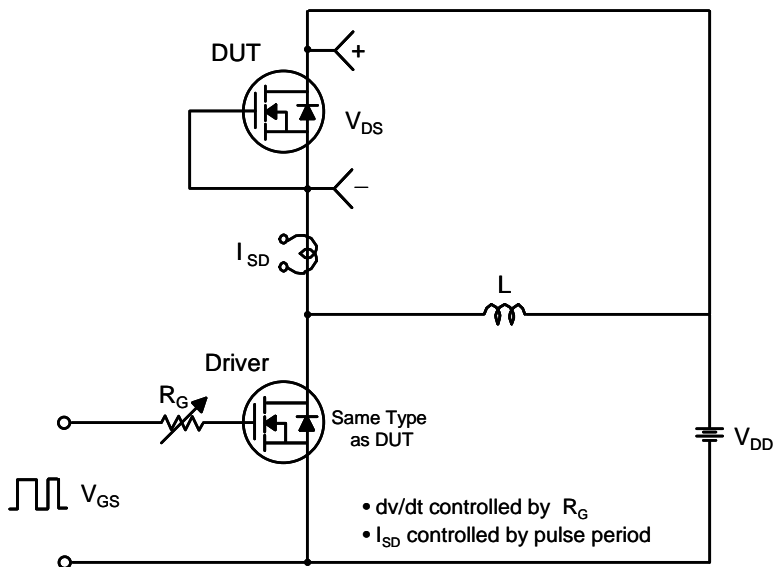
Resistive Switching Test Circuit & Waveforms



Unclamped Inductive Switching Test Circuit & Waveforms

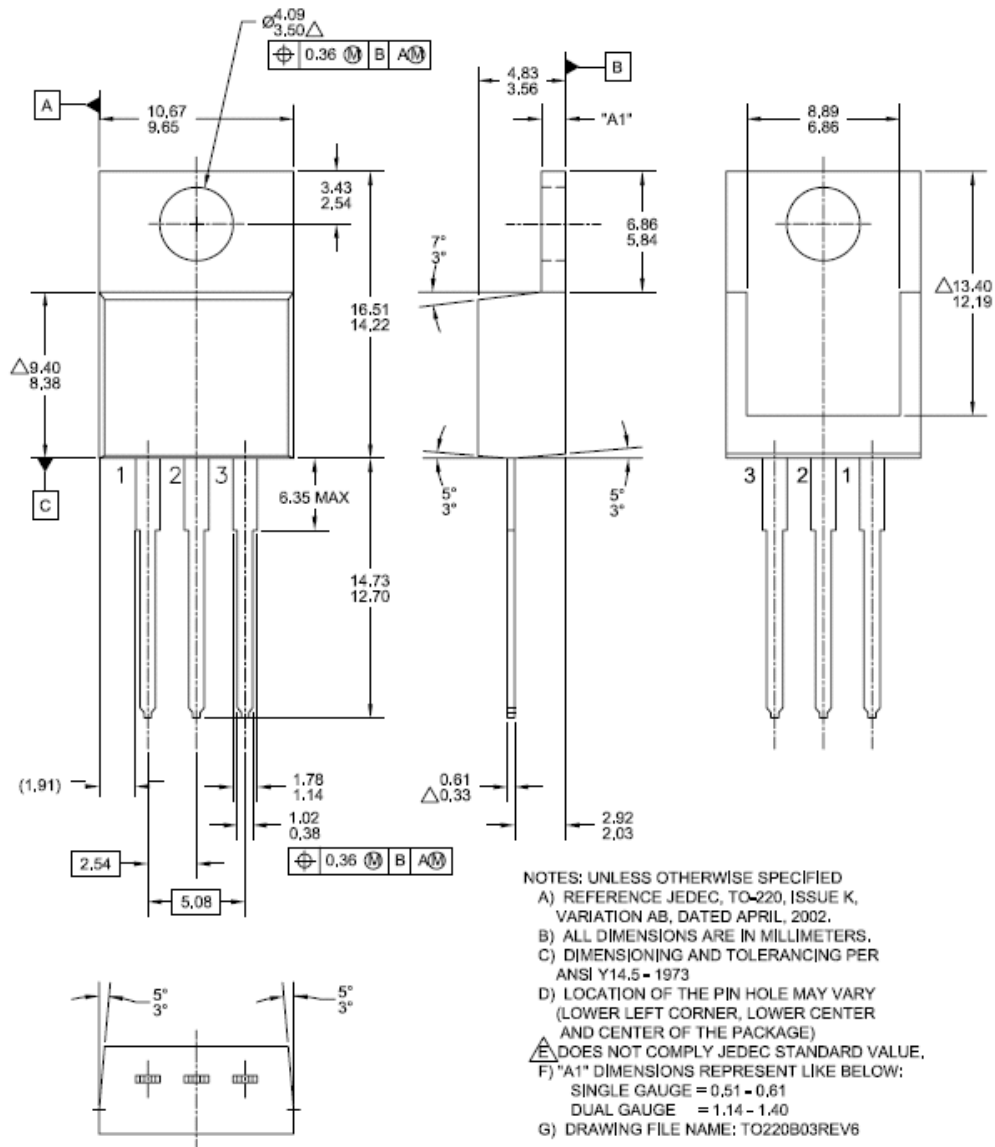


Peak Diode Recovery dv/dt Test Circuit & Waveforms



Mechanical Dimensions

TO-220AB




Dimensions in Millimeters



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