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# FDP040N06

## N-Channel PowerTrench® MOSFET

60V, 168A, 4.0mΩ

### Features

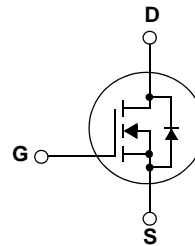
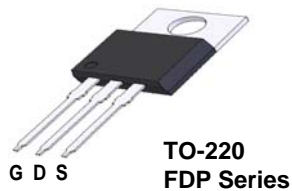
- $R_{DS(on)} = 3.2m\Omega$  (Typ.) @  $V_{GS} = 10V, I_D = 75A$
- Fast Switching Speed
- Low Gate Charge
- High Performance Trench Technology for Extremely Low  $R_{DS(on)}$
- High Power and Current Handling Capability
- RoHS Compliant

### 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	$\pm 20$	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 $25^\circ\text{C}$	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
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### 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 $25^\circ\text{C}$	-	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	$\mu\text{A}$
		$V_{DS} = 60\text{V}, V_{GS} = 0\text{V}, T_C = 150^\circ\text{C}$	-	-	500	
$I_{GSS}$	Gate to Body Leakage Current	$V_{GS} = \pm 20\text{V}, V_{DS} = 0\text{V}$	-	-	$\pm 100$	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

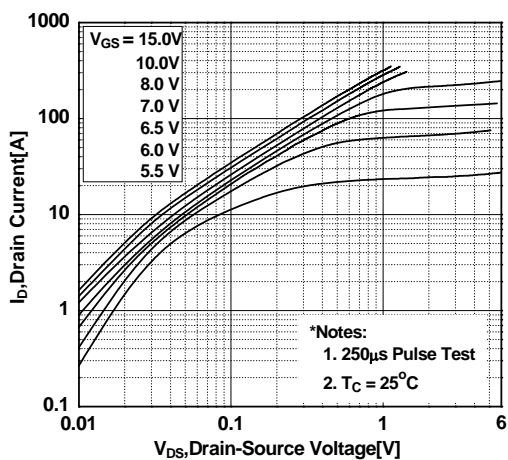
$I_S$	Maximum Continuous Drain to Source Diode Forward Current	-	-	168	A	
$I_{SM}$	Maximum Pulsed Drain to Source Diode Forward Current	-	-	672	A	
$V_{SD}$	Drain to Source Diode Forward Voltage	$V_{GS} = 0\text{V}, I_{SD} = 75\text{A}$	-	-	1.3	V
$t_{rr}$	Reverse Recovery Time	$V_{GS} = 0\text{V}, I_{SD}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

#### Notes:

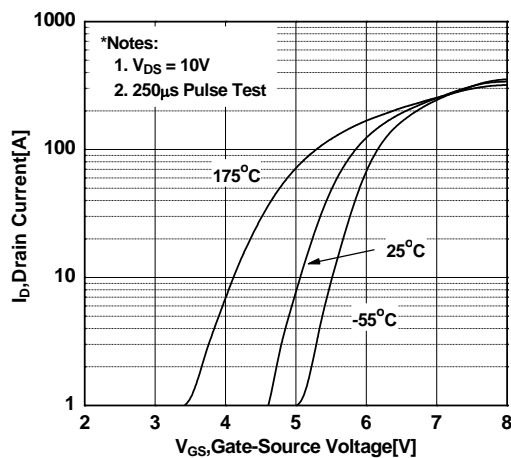
- 1: Repetitive Rating: Pulse width limited by maximum junction temperature
- 2:  $L = 0.31\text{mH}, I_{AS} = 75\text{A}, V_{DD} = 50\text{V}, R_G = 25\Omega$ , Starting  $T_J = 25^\circ\text{C}$
- 3:  $I_{SD} \leq 75\text{A}, di/dt \leq 200\text{A}/\mu\text{s}, V_{DD} \leq BV_{DSS}$ , Starting  $T_J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

## Typical Performance Characteristics

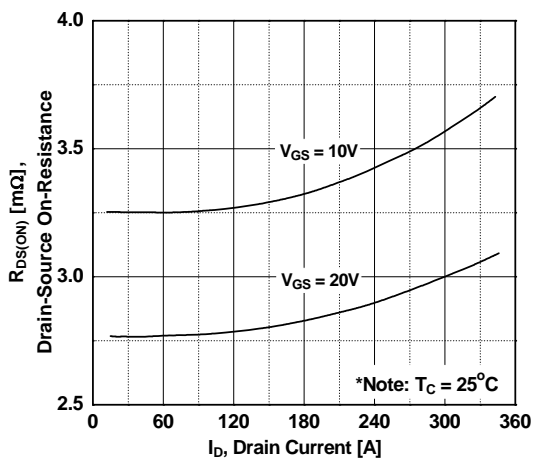
**Figure 1. On-Region Characteristics**



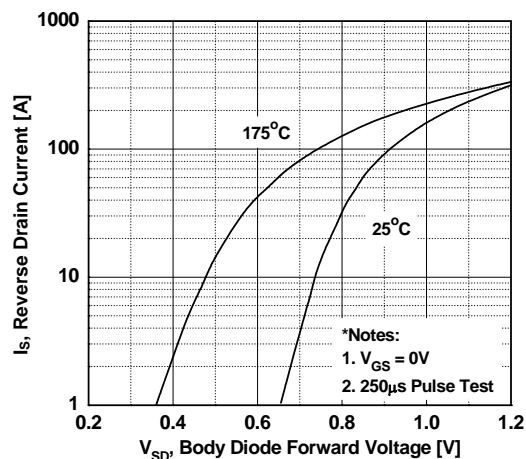
**Figure 2. Transfer Characteristics**



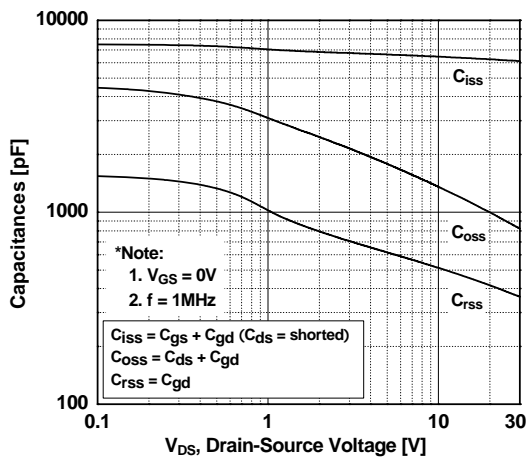
**Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage**



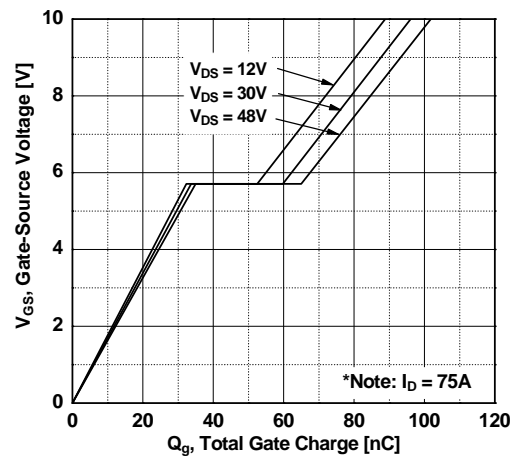
**Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature**



**Figure 5. Capacitance Characteristics**

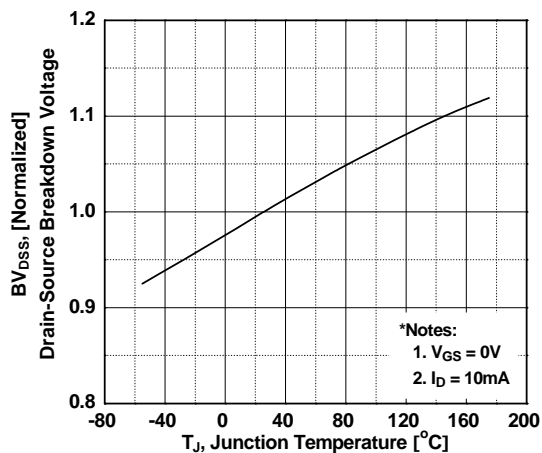


**Figure 6. Gate Charge Characteristics**

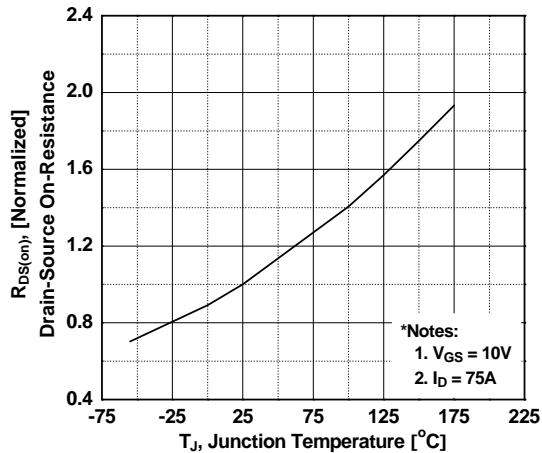


**Typical Performance Characteristics** (Continued)

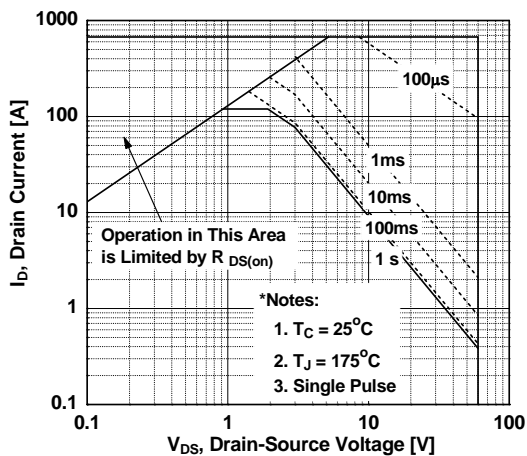
**Figure 7. Breakdown Voltage Variation vs. Temperature**



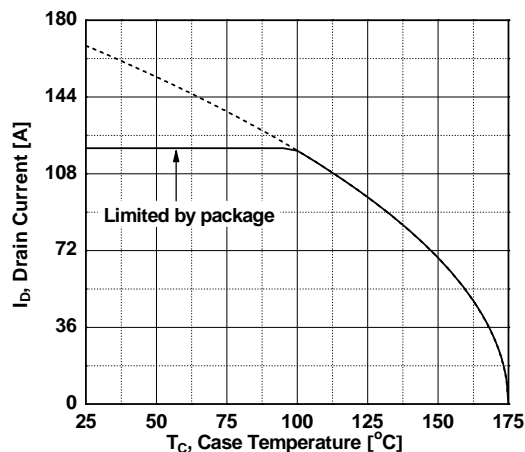
**Figure 8. On-Resistance Variation vs. Temperature**



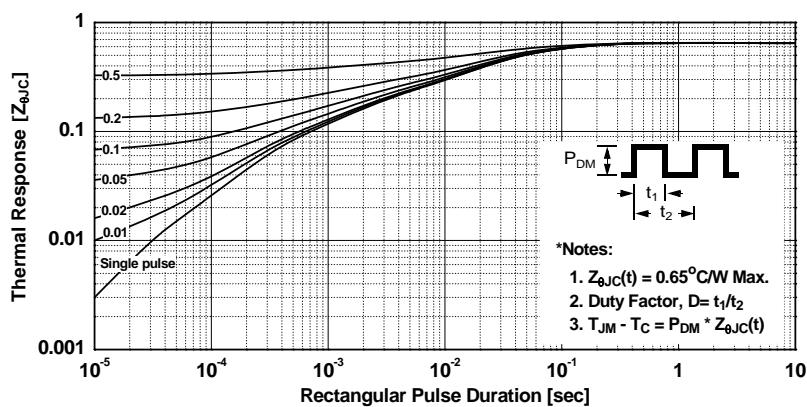
**Figure 9. Maximum Safe Operating Area**



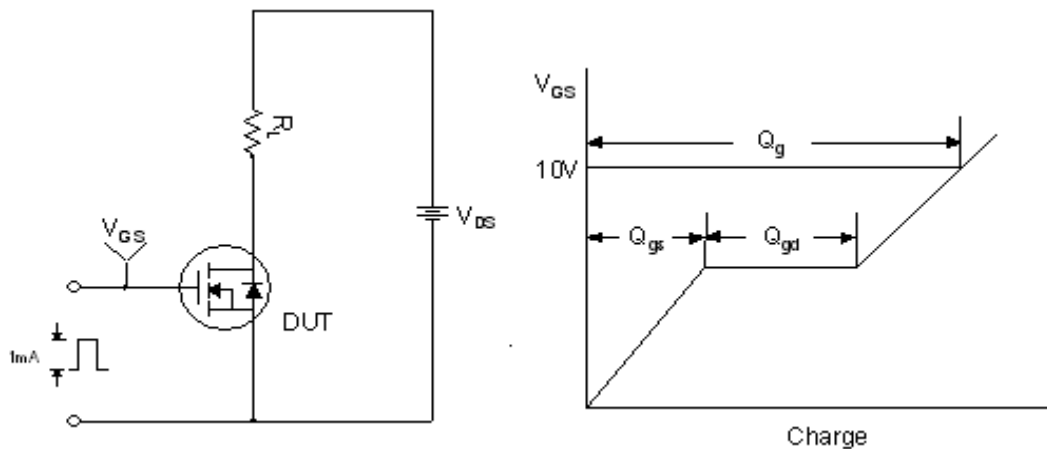
**Figure 10. Maximum Drain Current vs. Case Temperature**



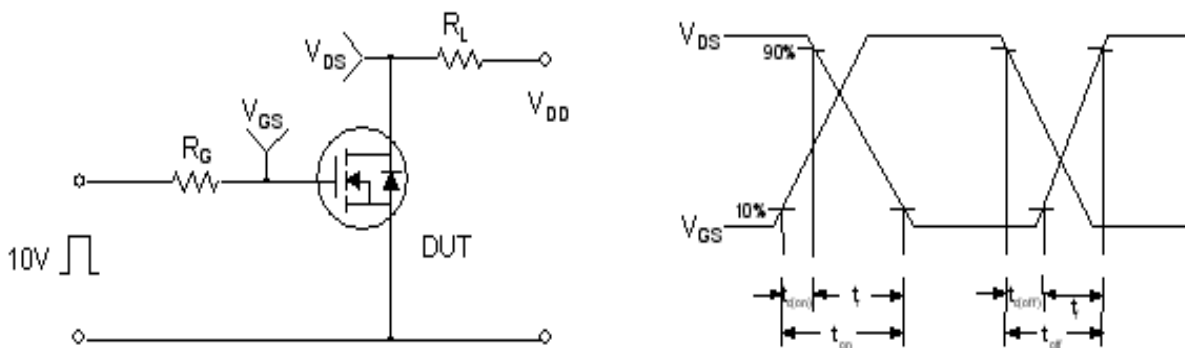
**Figure 11. Transient Thermal Response Curve**



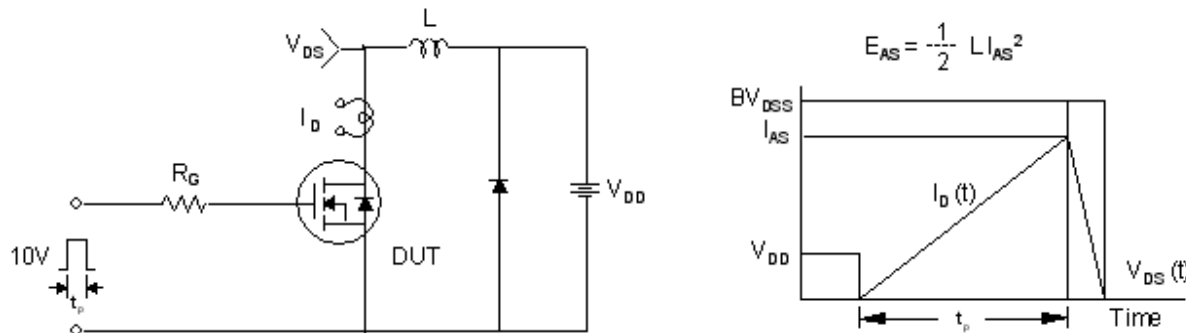
**Gate Charge Test Circuit & Waveform**



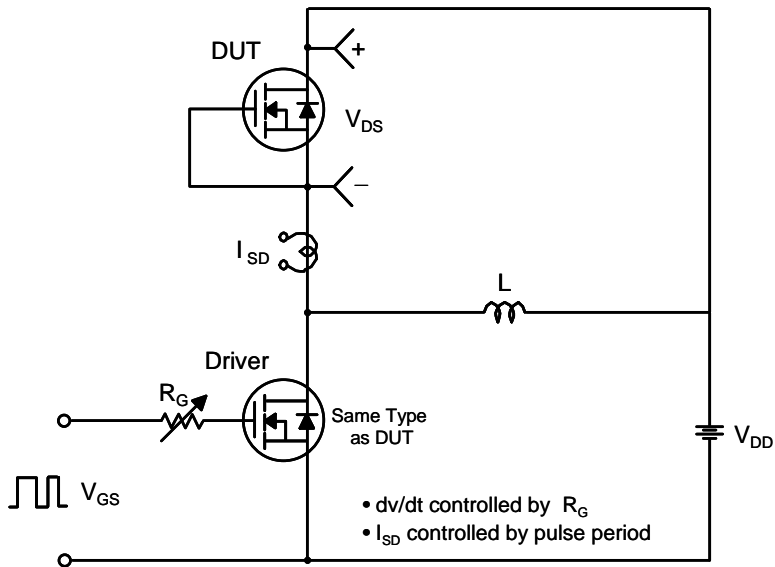
**Resistive Switching Test Circuit & Waveforms**



**Unclamped Inductive Switching Test Circuit & Waveforms**

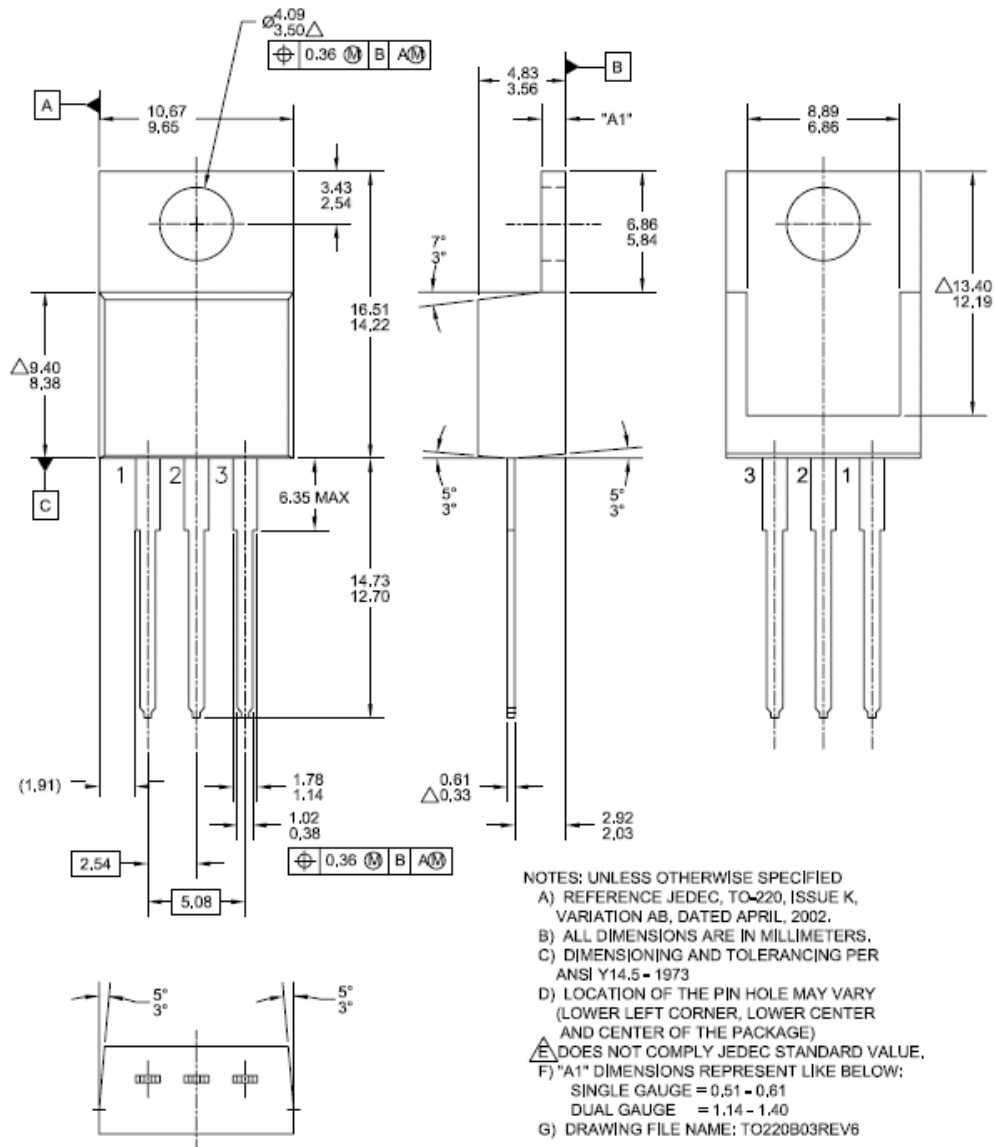


Peak Diode Recovery dv/dt Test Circuit & Waveforms



**Mechanical Dimensions**

**TO-220AB**



Dimensions in Millimeters





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