

# FDI040N06

## N-Channel PowerTrench® MOSFET

60V, 168A, 4.0mΩ

### Features

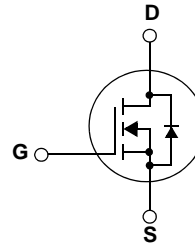
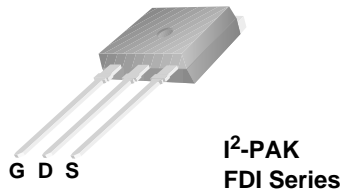
- $R_{DS(on)} = 3.2m\Omega$  (Typ.) @  $V_{GS} = 10V, I_D = 75A$
- Fast Switching Speed
- Low Gate Charge
- High Performance Trench Technology for Extremely Low  $R_{DS(on)}$
- High Power and Current Handling Capability
- RoHS Compliant

### 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	FDI040N06	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 $25^\circ\text{C}$	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	FDI040N06	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
FDI040N06	FDI040N06	TO-262	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

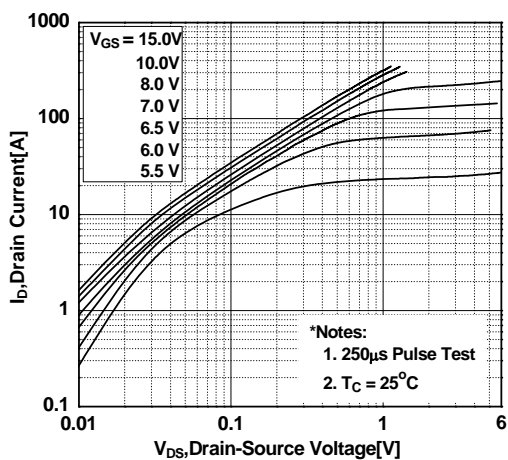
$I_S$	Maximum Continuous Drain to Source Diode Forward Current	-	-	168	A	
$I_{SM}$	Maximum Pulsed Drain to Source Diode Forward Current	-	-	672	A	
$V_{SD}$	Drain to Source Diode Forward Voltage	$V_{GS} = 0\text{V}$ , $I_{SD} = 75\text{A}$	-	-	1.3	V
$t_{rr}$	Reverse Recovery Time	$V_{GS} = 0\text{V}$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

#### Notes:

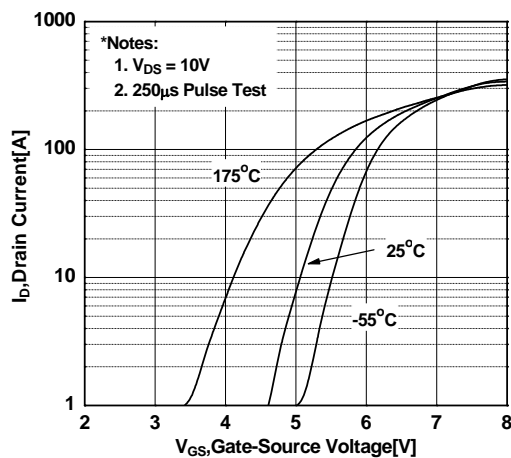
- 1: Repetitive Rating: Pulse width limited by maximum junction temperature
- 2:  $L = 0.31\text{mH}$ ,  $I_{AS} = 75\text{A}$ ,  $V_{DD} = 50\text{V}$ ,  $R_G = 25\Omega$ , Starting  $T_J = 25^\circ\text{C}$
- 3:  $I_{SD} \leq 75\text{A}$ ,  $di/dt \leq 200\text{A}/\mu\text{s}$ ,  $V_{DD} \leq BV_{DSS}$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

## Typical Performance Characteristics

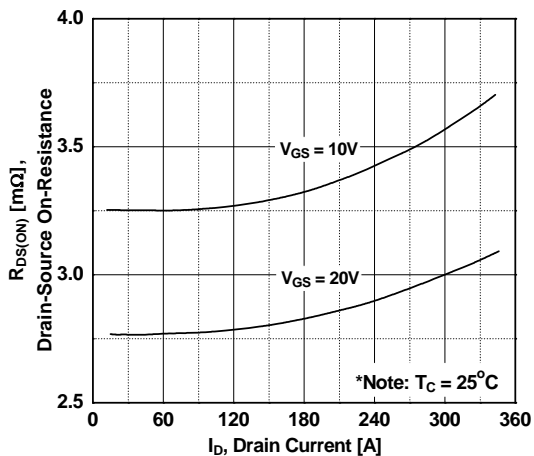
**Figure 1. On-Region Characteristics**



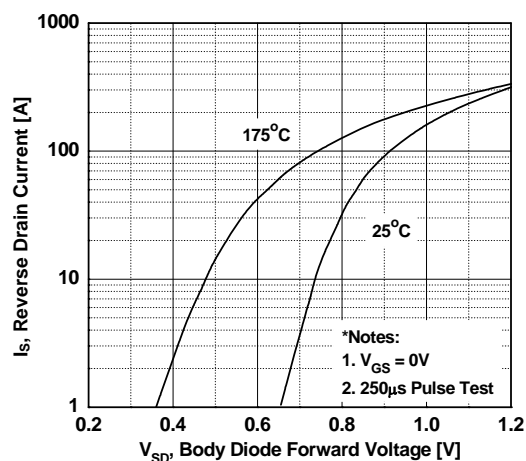
**Figure 2. Transfer Characteristics**



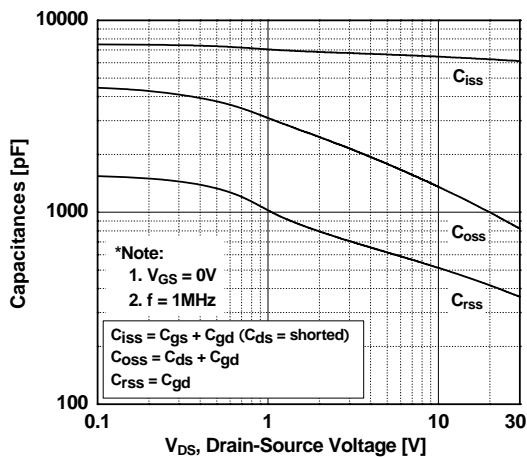
**Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage**



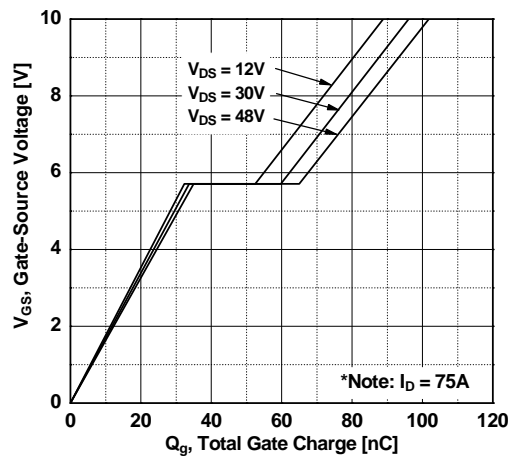
**Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature**



**Figure 5. Capacitance Characteristics**



**Figure 6. Gate Charge Characteristics**



Typical Performance Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

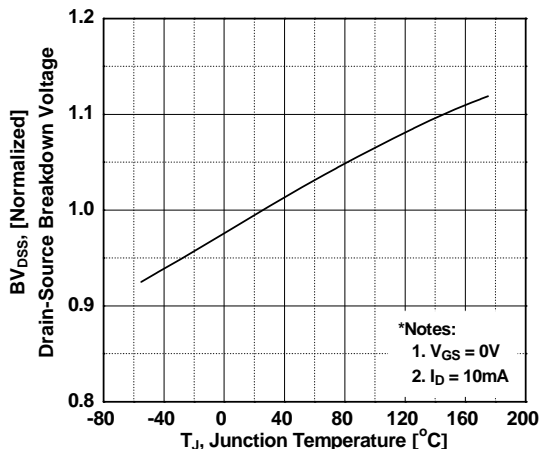


Figure 8. On-Resistance Variation vs. Temperature

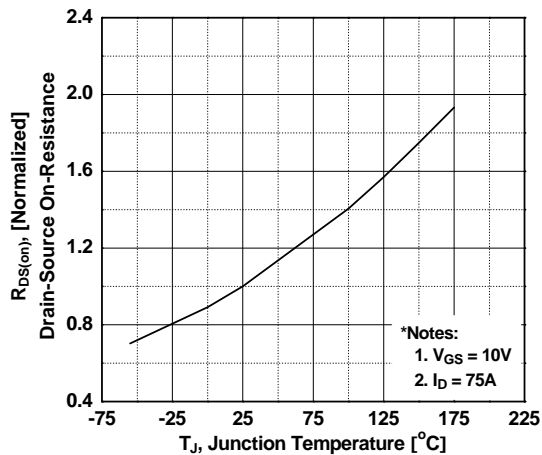


Figure 9. Maximum Safe Operating Area

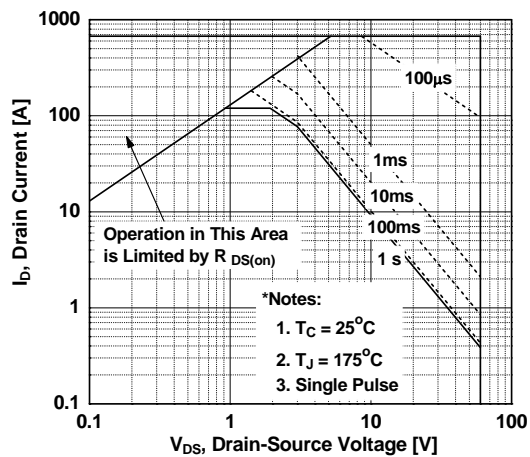


Figure 10. Maximum Drain Current vs. Case Temperature

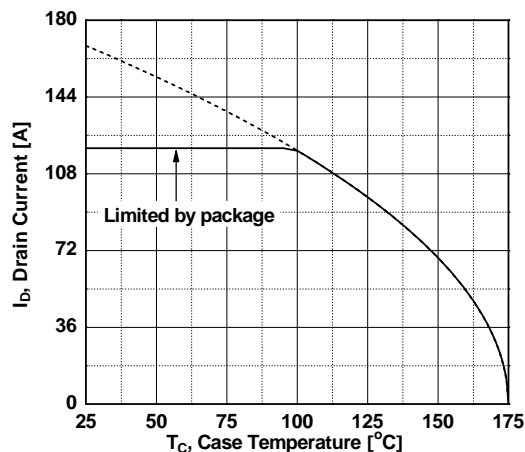
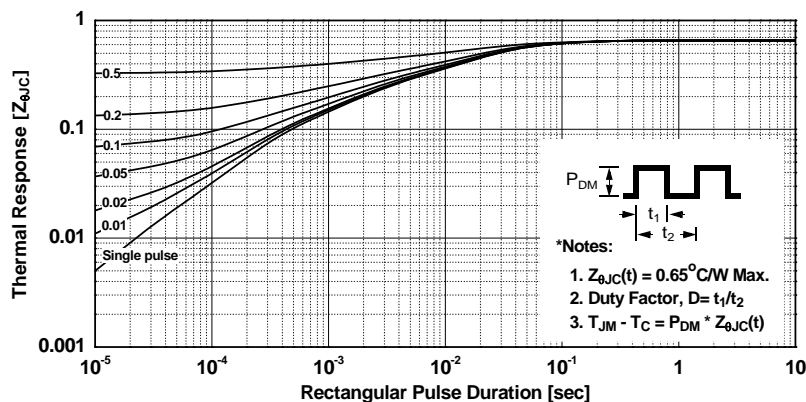
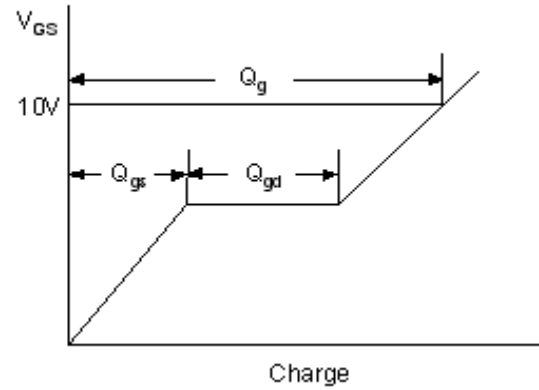
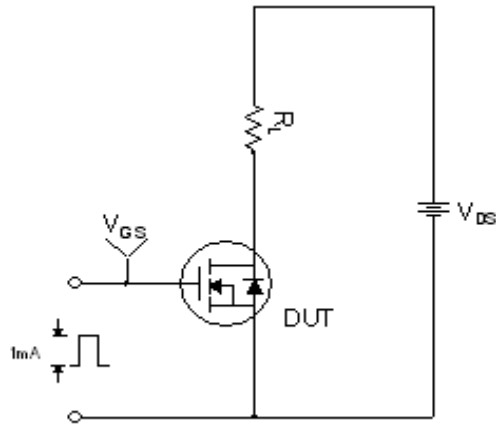


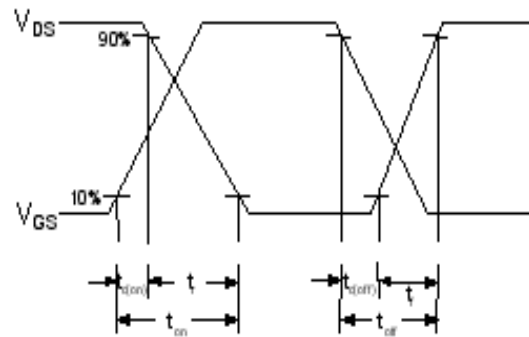
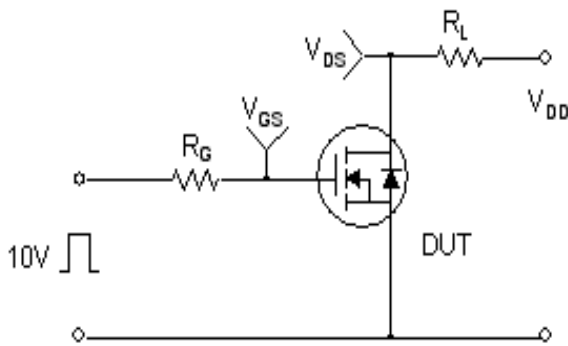
Figure 11. Transient Thermal Response Curve



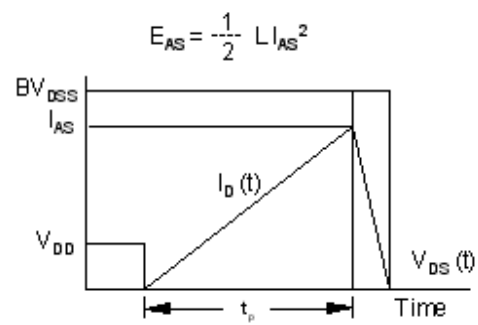
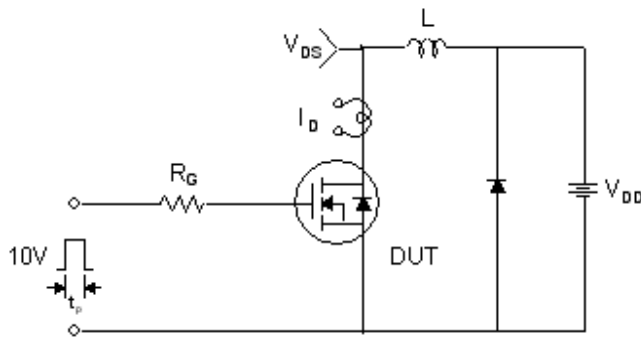
**Gate Charge Test Circuit & Waveform**



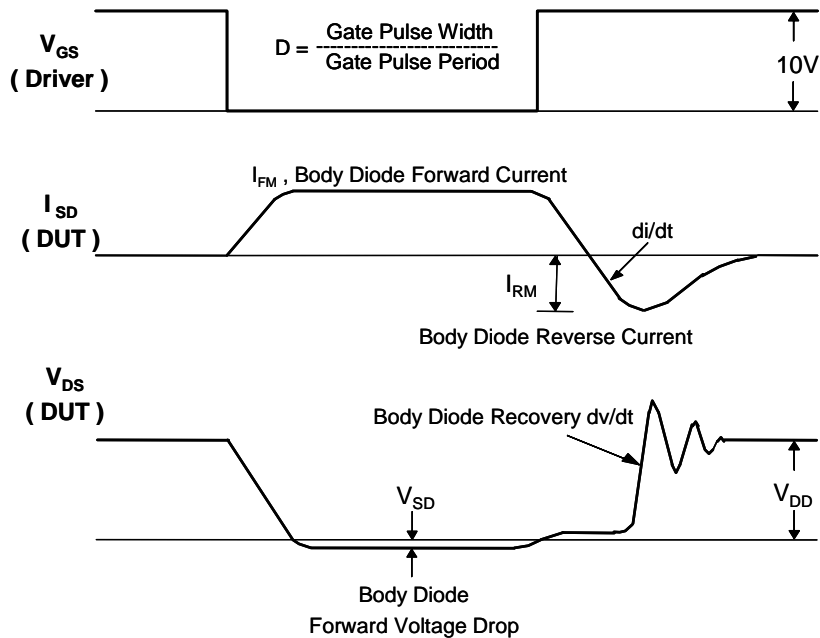
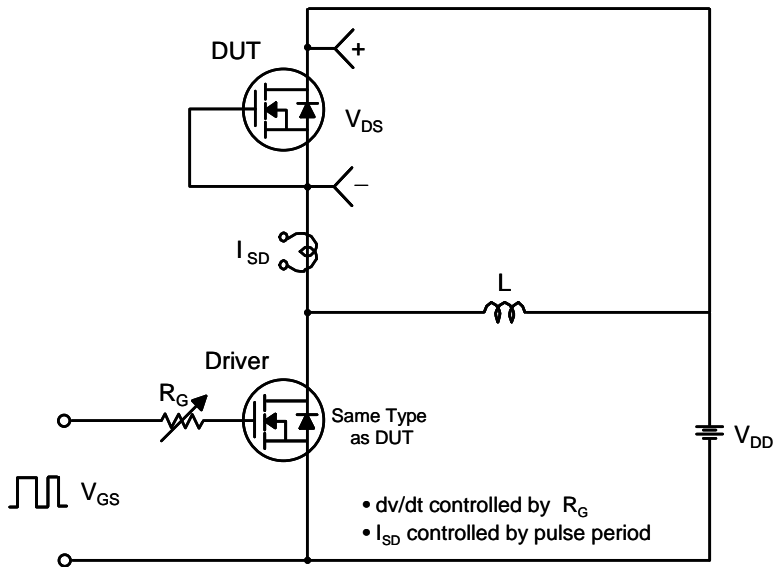
**Resistive Switching Test Circuit & Waveforms**



**Unclamped Inductive Switching Test Circuit & Waveforms**

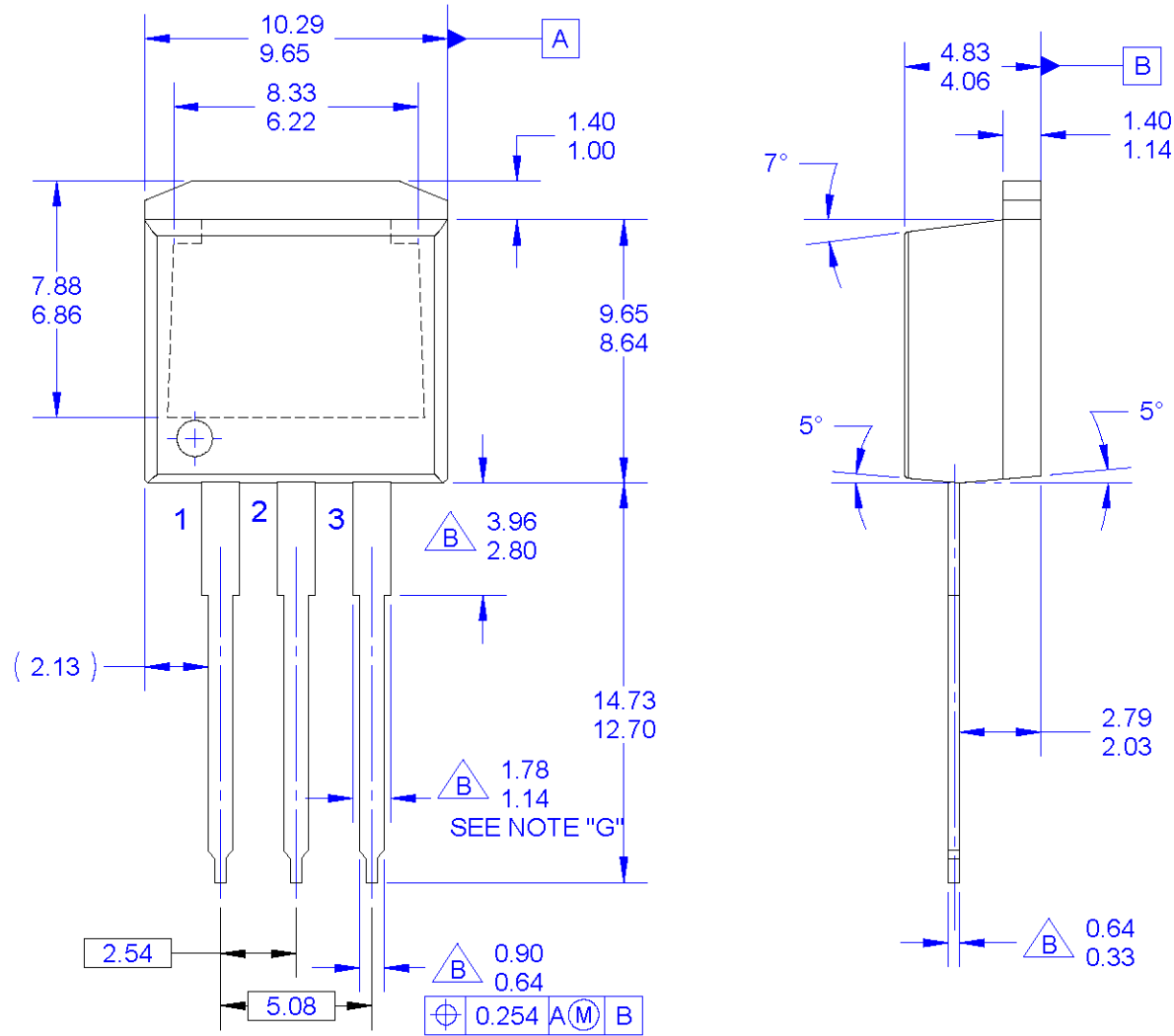


Peak Diode Recovery dv/dt Test Circuit & Waveforms



**Mechanical Dimensions**

**I<sup>2</sup>-PAK**




**NOTES:**

- A. EXCEPT WHERE NOTED CONFORMS TO TO262 JEDEC VARIATION AA.
- B. DOES NOT COMPLY JEDEC STD. VALUE.
- C. ALL DIMENSIONS ARE IN MILLIMETERS.
- D. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR PROTRUSIONS.
- E. DIMENSION AND TOLERANCE AS PER ANSI Y14.5-1994.
- F. LOCATION OF PIN HOLE MAY VARY (LOWER LEFT CORNER, LOWER CENTER AND CENTER OF PACKAGE)
- G. MAXIMUM WIDTH FOR F102 DEVICE = 1.35 MAX.
- H. DRAWING FILE NAME: TO262A03REV5



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|----------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|
| 2Cool™                                                                                       | F-PFST™                                                                           | PowerTrench®                                                                                                            | The Power Franchise®                                                                        |
| AccuPower™                                                                                   | FRFET®                                                                            | PowerXS™                                                                                                                | the <b>power</b> ®                                                                          |
| AX-CAP™*                                                                                     | Global Power Resource <sup>SM</sup>                                               | Programmable Active Droop™                                                                                              | franchise                                                                                   |
| BitSiC®                                                                                      | Green Bridge™                                                                     | QFET®                                                                                                                   | TinyBoost™                                                                                  |
| Build it Now™                                                                                | Green FPS™                                                                        | QS™                                                                                                                     | TinyBuck™                                                                                   |
| CorePLUS™                                                                                    | Green FPS™ e-Series™                                                              | Quiet Series™                                                                                                           | TinyCalc™                                                                                   |
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| CROSSVOLT™                                                                                   | GTO™                                                                              | ™                                                                                                                       | TINYOPTO™                                                                                   |
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| EfficientMax™                                                                                | MicroFET™                                                                         | SPM®                                                                                                                    | TRUECURRENT®*                                                                               |
| ESBC™                                                                                        | MicroPak™                                                                         | STEALTH™                                                                                                                | uSerDes™                                                                                    |
|  Fairchild® | MicroPak2™                                                                        | SuperFET®                                                                                                               |  SerDes™ |
| Fairchild Semiconductor®                                                                     | MillerDrive™                                                                      | SuperSOT™-3                                                                                                             | UHC®                                                                                        |
| FACT Quiet Series™                                                                           | MotionMax™                                                                        | SuperSOT™-6                                                                                                             | Ultra FRFET™                                                                                |
| FACT®                                                                                        | Motion-SPM™                                                                       | SuperSOT™-8                                                                                                             | UniFET™                                                                                     |
| FAST®                                                                                        | mWSaver™                                                                          | SupreMOS®                                                                                                               | VCX™                                                                                        |
| FastvCore™                                                                                   | OptoHiT™                                                                          | SyncFET™                                                                                                                | VisualMax™                                                                                  |
| FETBench™                                                                                    | OPTOLOGIC®                                                                        | Sync-Lock™                                                                                                              | VoltagePlus™                                                                                |
| FlashWriter®*                                                                                | OPTOPLANAR®                                                                       | SYSTEM GENERAL®*                                                                                                        | XST™                                                                                        |
| FPS™                                                                                         |  |                                                                                                                         |                                                                                             |

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**Definition of Terms**

Datasheet Identification	Product Status	Definition
Advance Information	Formative / In Design	Datasheet contains the design specifications for product development. Specifications may change in any manner without notice.
Preliminary	First Production	Datasheet contains preliminary data; supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design.
No Identification Needed	Full Production	Datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve the design.
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