

# FDD390N15ALZ

## N-Channel PowerTrench® MOSFET 150V, 26A, 42mΩ

### Features

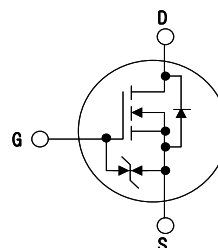
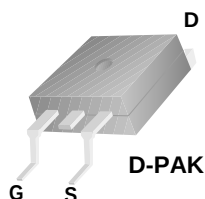
- $R_{DS(on)} = 33.4m\Omega$  (Typ.) @  $V_{GS} = 10V$ ,  $I_D = 26A$
- $R_{DS(on)} = 42.2m\Omega$  (Typ.) @  $V_{GS} = 4.5V$ ,  $I_D = 20A$
- Fast Switching Speed
- Low gate charge
- High Performance Trench Technology for Extremely Low  $R_{DS(on)}$
- High Power and Current Handling Capability
- RoHS Compliant

### 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 for Telecommunication PSU
- Battery Charger
- AC motor drives and Uninterruptible Power Supplies



### MOSFET Maximum Ratings $T_C = 25^\circ C$ unless otherwise noted\*

| Symbol         | Parameter                                                                    | Rating                               | Units        |
|----------------|------------------------------------------------------------------------------|--------------------------------------|--------------|
| $V_{DSS}$      | Drain to Source Voltage                                                      | 150                                  | V            |
| $V_{GSS}$      | Gate to Source Voltage                                                       | $\pm 20$                             | V            |
| $I_D$          | Drain Current                                                                | - Continuous ( $T_C = 25^\circ C$ )  | A            |
|                |                                                                              | - Continuous ( $T_C = 100^\circ C$ ) |              |
| $I_{DM}$       | Drain Current                                                                | - Pulsed (Note 1)                    | A            |
| $E_{AS}$       | Single Pulsed Avalanche Energy                                               | (Note 2)                             | mJ           |
| $dv/dt$        | Peak Diode Recovery $dv/dt$                                                  | (Note 3)                             | V/ns         |
| $P_D$          | Power Dissipation                                                            | ( $T_C = 25^\circ C$ )               | W            |
|                |                                                                              | - Derate above $25^\circ C$          | $W/^\circ C$ |
| $T_J, T_{STG}$ | Operating and Storage Temperature Range                                      | -55 to +150                          | $^\circ C$   |
| $T_L$          | Maximum Lead Temperature for Soldering Purpose, 1/8" from Case for 5 Seconds | 300                                  | $^\circ C$   |

### Thermal Characteristics

| Symbol          | Parameter                               | Min. | Max. | Units        |
|-----------------|-----------------------------------------|------|------|--------------|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case    | -    | 2.0  | $^\circ C/W$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient | -    | 87   |              |

## Package Marking and Ordering Information

| Device Marking | Device       | Package | Reel Size | Tape Width | Quantity |
|----------------|--------------|---------|-----------|------------|----------|
| FDD390N15ALZ   | FDD390N15ALZ | D-PAK   | 380mm     | 16mm       | 2500     |

## 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         | $I_D = 250\mu\text{A}$ , $V_{GS} = 0\text{V}$                                                       | 150 | -    | -        | V                         |
| $\frac{\Delta BV_{DSS}}{\Delta T_J}$ | Breakdown Voltage Temperature Coefficient | $I_D = 250\mu\text{A}$ , Referenced to $25^\circ\text{C}$                                           | -   | 0.15 | -        | $\text{V}/^\circ\text{C}$ |
| $I_{DSS}$                            | Zero Gate Voltage Drain Current           | $V_{DS} = 120\text{V}$ , $V_{GS} = 0\text{V}$<br>$V_{DS} = 120\text{V}$ , $T_C = 125^\circ\text{C}$ | -   | -    | 1<br>500 | $\mu\text{A}$             |
| $I_{GSS}$                            | Gate to Body Leakage Current              | $V_{GS} = \pm 20\text{V}$ , $V_{DS} = 0\text{V}$                                                    | -   | -    | $\pm 10$ | $\mu\text{A}$             |

### On Characteristics

|              |                                      |                                                                                           |     |              |          |                  |
|--------------|--------------------------------------|-------------------------------------------------------------------------------------------|-----|--------------|----------|------------------|
| $V_{GS(th)}$ | Gate Threshold Voltage               | $V_{GS} = V_{DS}$ , $I_D = 250\mu\text{A}$                                                | 1.4 | -            | 2.8      | V                |
| $R_{DS(on)}$ | Static Drain to Source On Resistance | $V_{GS} = 10\text{V}$ , $I_D = 26\text{A}$<br>$V_{GS} = 4.5\text{V}$ , $I_D = 20\text{A}$ | -   | 33.4<br>42.2 | 42<br>64 | $\text{m}\Omega$ |
| $g_{FS}$     | Forward Transconductance             | $V_{DS} = 10\text{V}$ , $I_D = 26\text{A}$                                                | -   | 50           | -        | S                |

### Dynamic Characteristics

|                      |                                    |                                                         |                                               |   |      |      |    |
|----------------------|------------------------------------|---------------------------------------------------------|-----------------------------------------------|---|------|------|----|
| C <sub>iss</sub>     | Input Capacitance                  | V <sub>DS</sub> = 75V, V <sub>GS</sub> = 0V<br>f = 1MHz |                                               | - | 1323 | 1760 | pF |
| C <sub>oss</sub>     | Output Capacitance                 |                                                         |                                               | - | 93   | 120  | pF |
| C <sub>rss</sub>     | Reverse Transfer Capacitance       |                                                         |                                               | - | 4    | 6    | pF |
| C <sub>oss(er)</sub> | Energy Related Output Capacitance  | V <sub>DS</sub> = 75V, V <sub>GS</sub> = 0V             |                                               | - | 165  | -    | pF |
| Q <sub>g(tot)</sub>  | Total Gate Charge at 10V           | V <sub>GS</sub> = 10V                                   | V <sub>DS</sub> = 75V<br>I <sub>D</sub> = 26A | - | 17.6 | 39   | nC |
| Q <sub>g(tot)</sub>  | Total Gate Charge at 5V            | V <sub>GS</sub> = 4.5V                                  |                                               | - | 8.1  | 10.5 | nC |
| Q <sub>gs</sub>      | Gate to Source Gate Charge         | (Note 4)                                                |                                               | - | 4.7  | -    | nC |
| Q <sub>gd</sub>      | Gate to Drain "Miller" Charge      |                                                         |                                               | - | 2.3  | -    | nC |
| ESR                  | Equivalent Series Resistance (G-S) | Drain shorted to Source, f = 1MHz                       |                                               | - | 1.48 | -    | Ω  |

### Switching Characteristics

|              |                     |                                                                                                         |   |      |      |    |
|--------------|---------------------|---------------------------------------------------------------------------------------------------------|---|------|------|----|
| $t_{d(on)}$  | Turn-On Delay Time  | $V_{DD} = 75\text{V}$ , $I_D = 26\text{A}$<br>$V_{GS} = 10\text{V}$ , $R_{GEN} = 4.7\Omega$<br>(Note 4) | - | 12.8 | 35.6 | ns |
| $t_r$        | Turn-On Rise Time   |                                                                                                         | - | 9.3  | 28.6 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time |                                                                                                         | - | 26.9 | 63.8 | ns |
| $t_f$        | Turn-Off Fall Time  |                                                                                                         | - | 3.2  | 16.4 | ns |

### Drain-Source Diode Characteristics

|                 |                                                          |                                             |   |     |      |    |
|-----------------|----------------------------------------------------------|---------------------------------------------|---|-----|------|----|
| I <sub>S</sub>  | Maximum Continuous Drain to Source Diode Forward Current | -                                           | - | 26  | A    |    |
| I <sub>SM</sub> | Maximum Pulsed Drain to Source Diode Forward Current     | -                                           | - | 104 | A    |    |
| V <sub>SD</sub> | Drain to Source Diode Forward Voltage                    | V <sub>GS</sub> = 0V, I <sub>SD</sub> = 26A | - | -   | 1.25 | V  |
| t <sub>rr</sub> | Reverse Recovery Time                                    | V <sub>GS</sub> = 0V, I <sub>SD</sub> = 26A | - | 70  | -    | ns |
| Q <sub>rr</sub> | Reverse Recovery Charge                                  | dI <sub>F</sub> /dt = 100A/μs               | - | 169 | -    | nC |

#### Notes:

1. Repetitive Rating: Pulse width limited by maximum junction temperature
2.  $L = 3\text{mH}$ ,  $I_{AS} = 6.75\text{A}$ , Starting  $T_J = 25^\circ\text{C}$
3.  $I_{SD} \leq 26\text{A}$ ,  $di/dt \leq 200\text{A}/\mu\text{s}$ ,  $V_{DD} \leq BV_{DSS}$ , Starting  $T_J = 25^\circ\text{C}$
4. Essentially Independent of Operating Temperature Typical Characteristics

## Typical Performance Characteristics

Figure 1. On-Region Characteristics

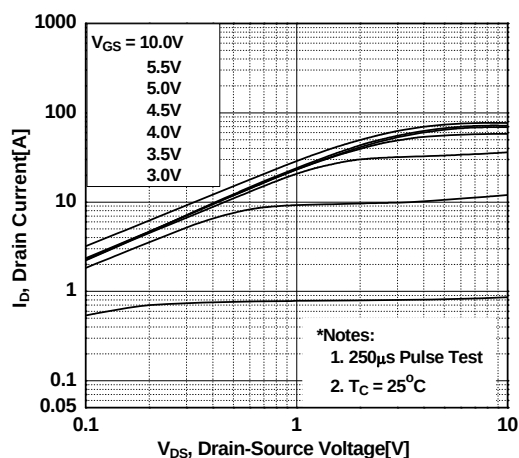


Figure 2. Transfer Characteristics

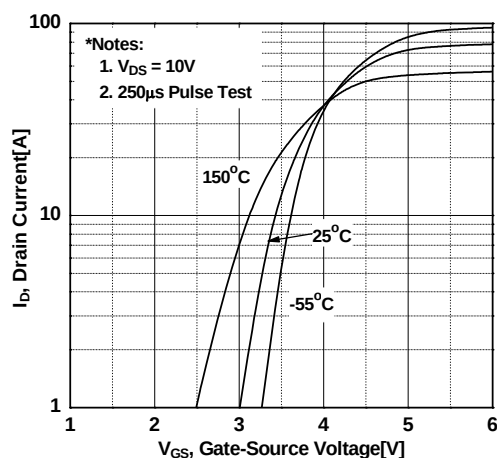


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

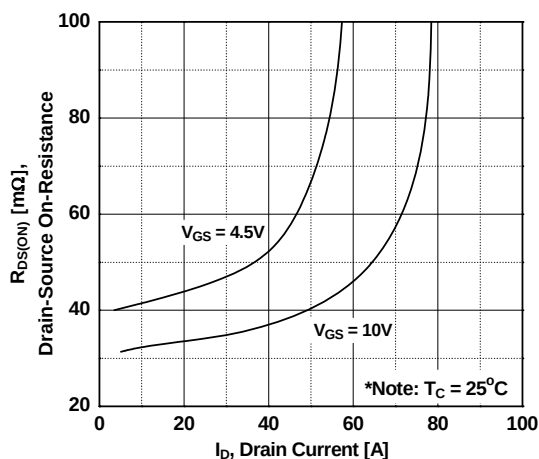


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

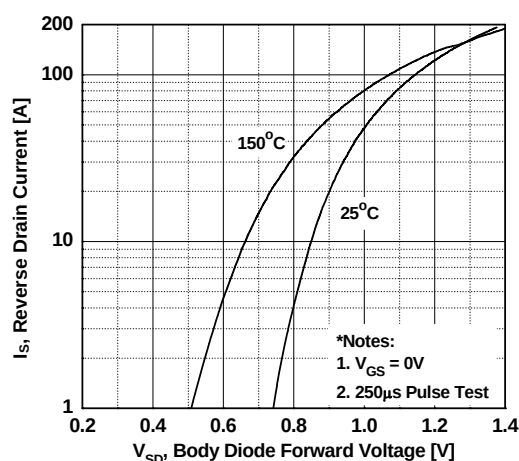


Figure 5. Capacitance Characteristics

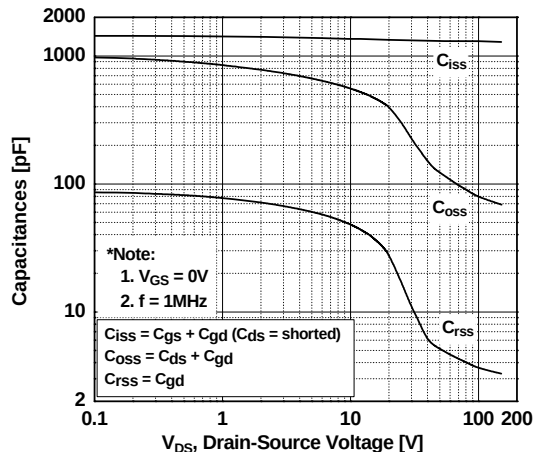
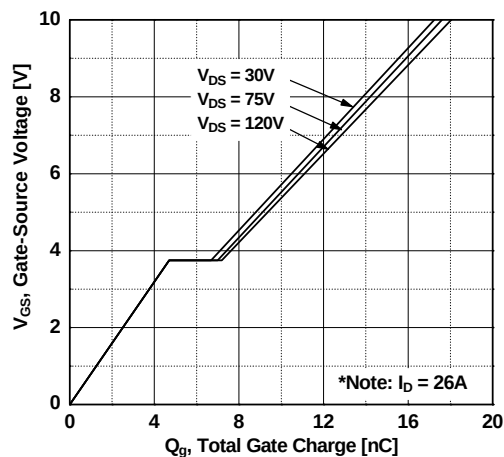
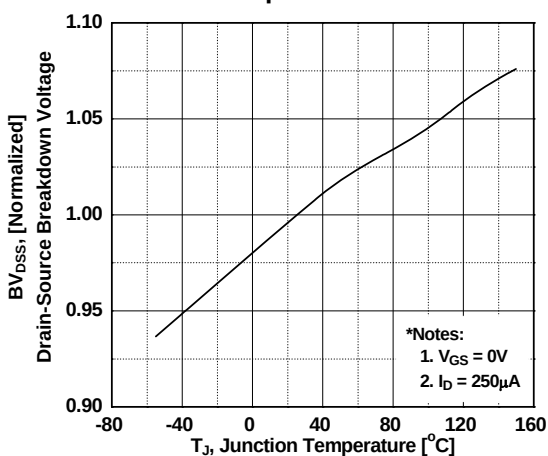


Figure 6. Gate Charge Characteristics

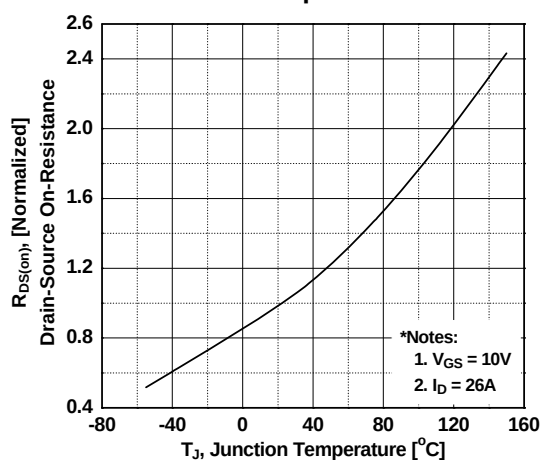


# Typical Performance Characteristics (Continued)

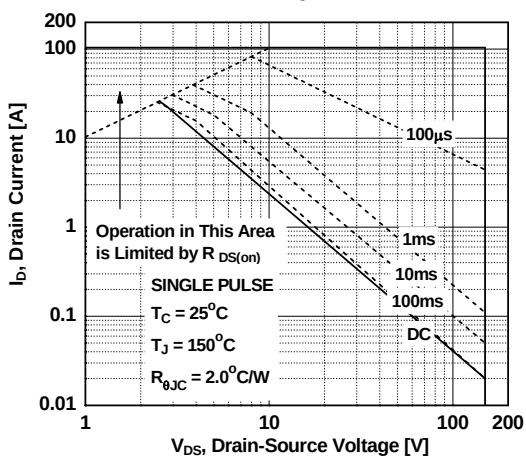
**Figure 7. Breakdown Voltage Variation vs. Temperature**



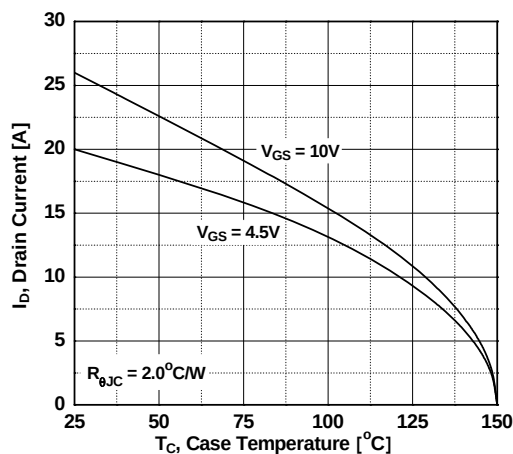
**Figure 8. On-Resistance Variation vs. Temperature**



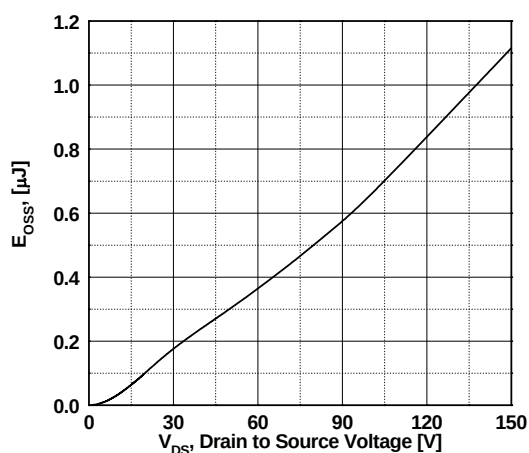
**Figure 9. Maximum Safe Operating Area vs. Case Temperature**



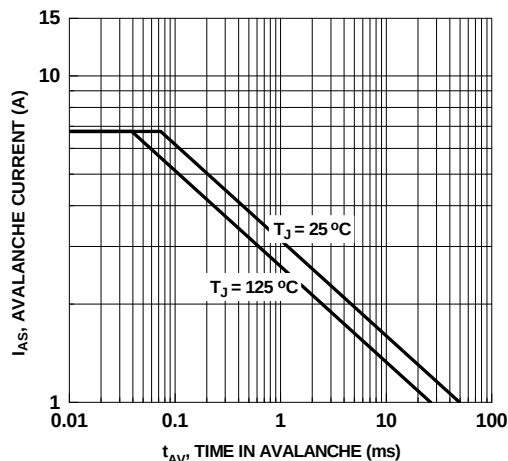
**Figure 10. Maximum Drain Current**



**Figure 11. Eoss vs. Drain to Source Voltage**

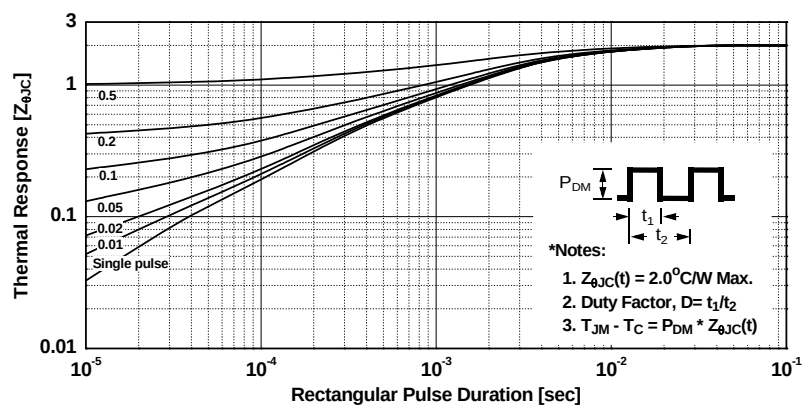


**Figure 12. Unclamped Inductive Switching Capability**

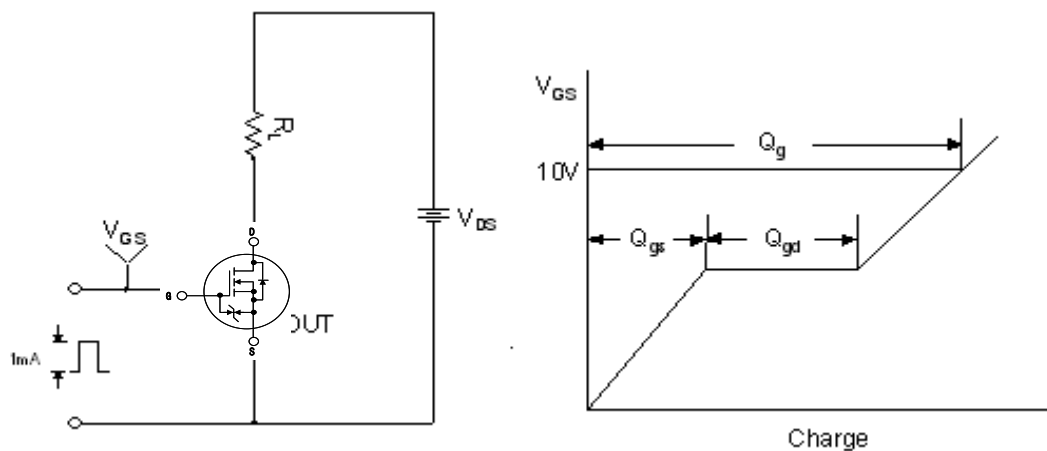


## Typical Performance Characteristics (Continued)

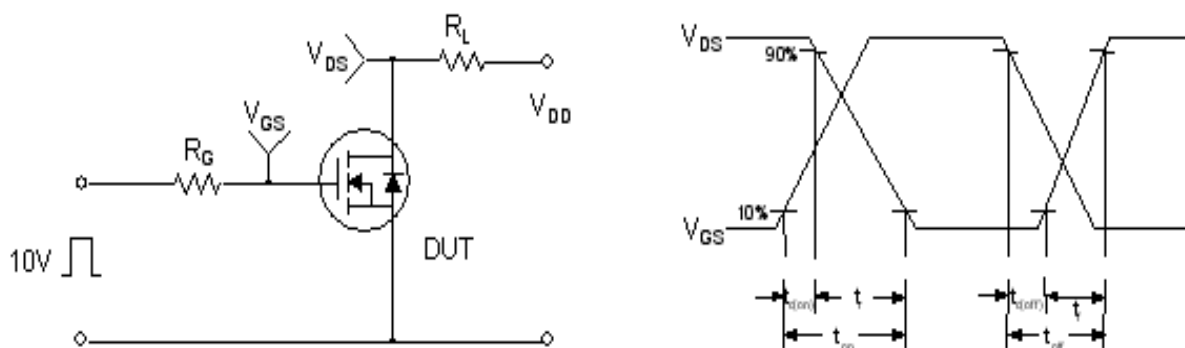
Figure 13. Transient Thermal Response Curve



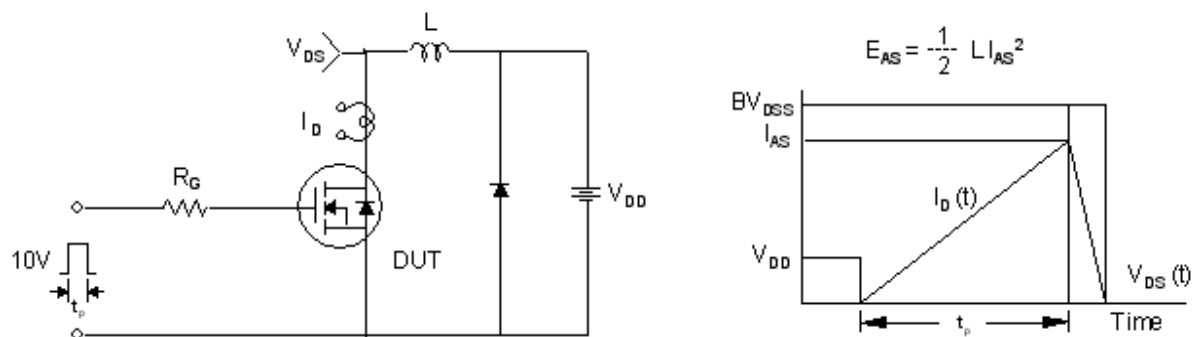
Gate Charge Test Circuit & Waveform



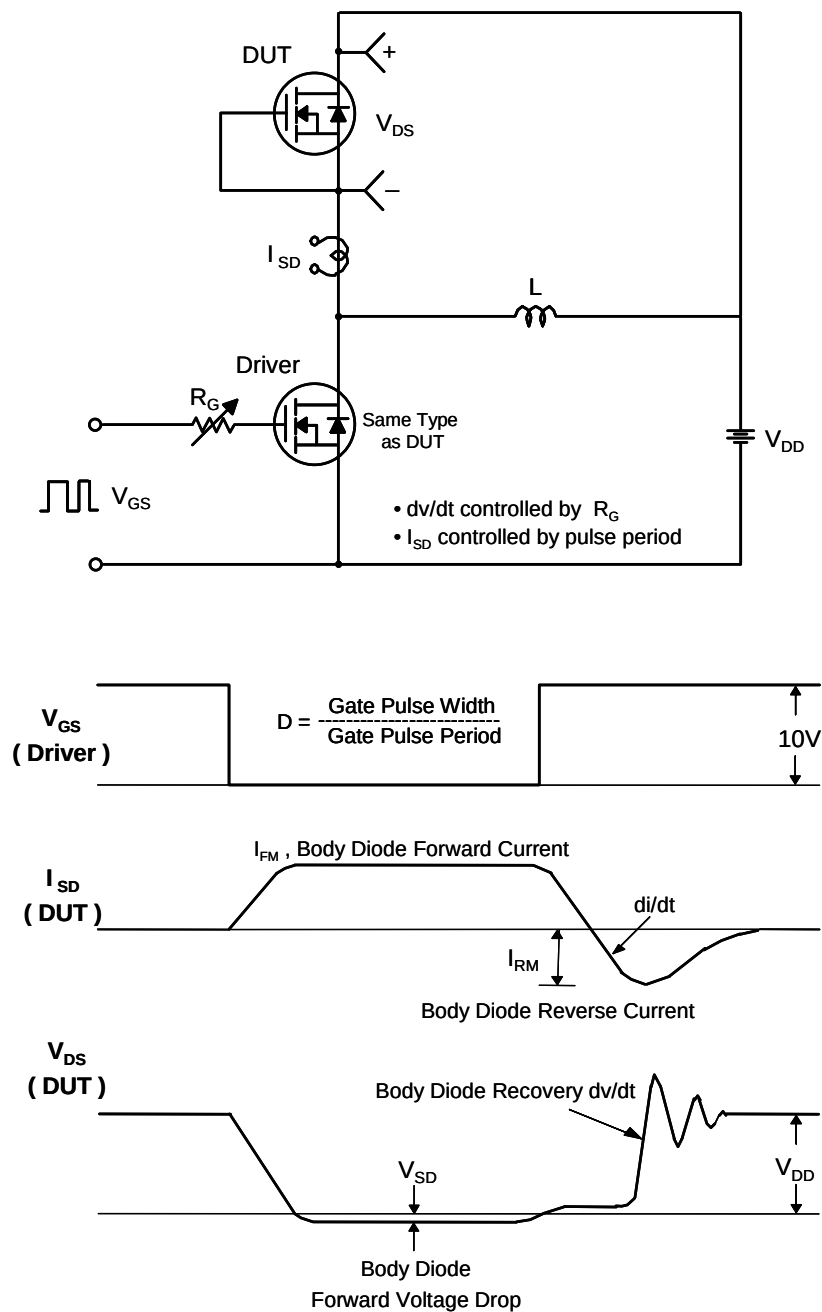
Resistive Switching Test Circuit & Waveforms



Unclamped Inductive Switching Test Circuit & Waveforms

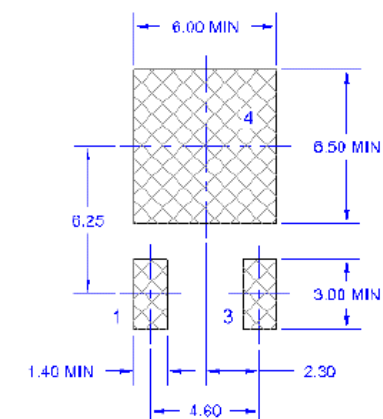
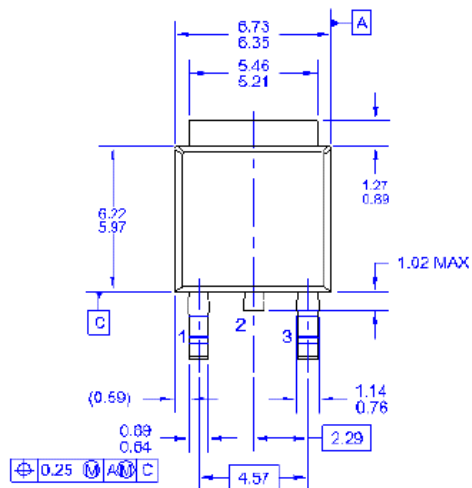


Peak Diode Recovery dv/dt Test Circuit & Waveforms

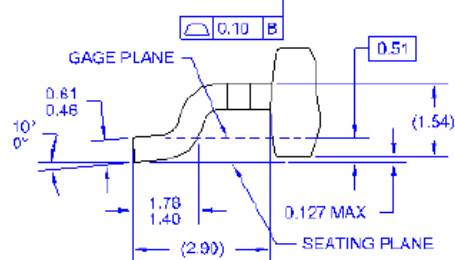
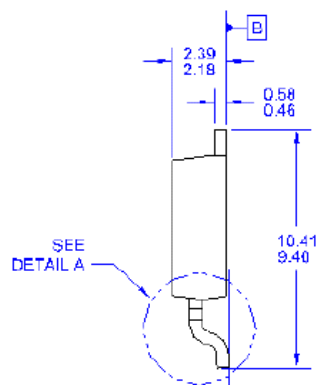
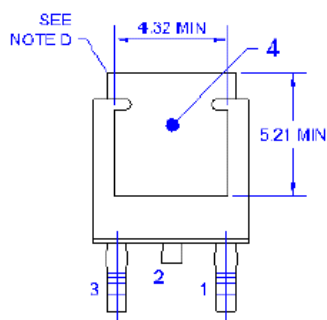


# Mechanical Dimensions

## D-PAK



LAND PATTERN RECOMMENDATION



- NOTES: UNLESS OTHERWISE SPECIFIED:  
A) THIS PACKAGE CONFORMS TO JEDEC, TO-252.  
B) ALL DIMENSIONS ARE IN MILLIMETERS.  
C) DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994.  
D) HEAT SINK TOP EDGE COULD BE IN CHAMFERED CORNERS OR EDGE PROTRUSION.  
E) PRESENCE OF TRIMMED CENTER LEAD IS OPTIONAL.  
F) DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR PROTRUSIONS.  
G) LAND PATTERN RECOMMENDATION IS BASED ON IPC7351A STD TO220P1003X238-3N.  
H) DRAWING NUMBER AND REVISION: MKT-T0252A03REV B

Dimensions in Millimeters





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|                                                                                   |                                                 |                                                                                   |                                                                                     |
|-----------------------------------------------------------------------------------|-------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| 2Cool™                                                                            | F-PFET™                                         | PowerTrench®                                                                      | The Power Franchise®                                                                |
| AccuPower™                                                                        | FRFET®                                          | PowerXS™                                                                          | the power®                                                                          |
| AX-CAP™*                                                                          | Global Power ResourceSM                         | Programmable Active Droop™                                                        | franchise                                                                           |
| BitSiC®                                                                           | Green Bridge™                                   | QFET®                                                                             | TinyBoost™                                                                          |
| Build it Now™                                                                     | Green FPS™                                      | QS™                                                                               | TinyBuck™                                                                           |
| CorePLUS™                                                                         | Green FPS™ e-Series™                            | Quiet Series™                                                                     | TinyCalc™                                                                           |
| CorePOWER™                                                                        | Gmax™                                           | RapidConfigure™                                                                   | TinyLogic®                                                                          |
| CROSSVOLT™                                                                        | GTO™                                            | TM                                                                                | TINYOPTO™                                                                           |
| CTL™                                                                              | IntelliMAX™                                     |  | TinyPower™                                                                          |
| Current Transfer Logic™                                                           | ISOPLANAR™                                      | Saving our world, 1mW/W/kW at a time™                                             | TinyPWM™                                                                            |
| DEUXPEED®                                                                         | Marking Small Speakers Sound Louder and Better™ | SignalWise™                                                                       | TinyWire™                                                                           |
| Dual Cool™                                                                        | MegaBuck™                                       | SmartMax™                                                                         | TranSiC®                                                                            |
| EcoSPARK®                                                                         | MICROCOUPLER™                                   | SMART START™                                                                      | TriFault Detect™                                                                    |
| EfficientMax™                                                                     | MicroFET™                                       | Solutions for Your Success™                                                       | TRUECURRENT®*                                                                       |
| ESBC™                                                                             | MicroPak™                                       | SPM®                                                                              | uSerDes™                                                                            |
|  | MicroPak2™                                      | STEALTH™                                                                          |  |
| Fairchild®                                                                        | MillerDrive™                                    | SuperFET®                                                                         | SerDes™                                                                             |
| Fairchild Semiconductor®                                                          | MotionMax™                                      | SuperSOT™-3                                                                       | UHC®                                                                                |
| FACT Quiet Series™                                                                | Motion-SPM™                                     | SuperSOT™-6                                                                       | Ultra FRFET™                                                                        |
| FACT®                                                                             | mWSaver™                                        | SuperSOT™-8                                                                       | UniFET™                                                                             |
| FAST®                                                                             | OptoHiT™                                        | SupreMOS®                                                                         | VCX™                                                                                |
| FastvCore™                                                                        | OPTOLOGIC®                                      | SyncFET™                                                                          | VisualMax™                                                                          |
| FETBench™                                                                         | OPTOPLANAR®                                     | Sync-Lock™                                                                        | VoltagePlus™                                                                        |
| FlashWriter®*                                                                     |                                                 |  | XS™                                                                                 |
| FPS™                                                                              |                                                 |                                                                                   |                                                                                     |

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| 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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