FAIRCHILD SEMICONDUCTOR®

January 2009
QFET®

# FQD30N06 / FQU30N06

## 60V N-Channel MOSFET

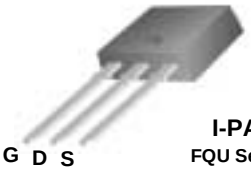
### General Description

These N-Channel enhancement mode power field effect transistors are produced using Fairchild's proprietary, planar stripe, DMOS technology.
This advanced technology has been especially tailored to minimize on-state resistance, provide superior switching performance, and withstand high energy pulse in the avalanche and commutation mode. These devices are well suited for low voltage applications such as automotive, DC/DC converters, and high efficiency switching for power management in portable and battery operated products.

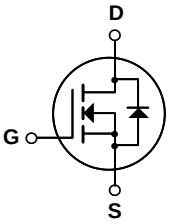
### Features

- 22.7A, 60V, $R_{DS(on)}$ = 0.045Ω @ $V_{GS}$ = 10V
- Low gate charge ( typical 19 nC)
- Low Crss ( typical 40 pF)
- Fast switching
- 100% avalanche tested
- Improved dv/dt capability
- 150°C maximum junction temperature rating
- RoHS Compliant


D-PAK
FQD Series




I-PAK
FQU Series




## Absolute Maximum Ratings

$T_C$ = 25°C unless otherwise noted

| Symbol | Parameter | | FQD30N06 / FQU30N06 | Units |
|---|---|---|---|---|
| $V_{DSS}$ | Drain-Source Voltage | | 60 | V |
| $I_D$ | Drain Current - Continuous ($T_C$ = 25°C) | | 22.7 | A |
| | - Continuous ($T_C$ = 100°C) | | 14.3 | A |
| $I_{DM}$ | Drain Current - Pulsed | (Note 1) | 90.8 | A |
| $V_{GSS}$ | Gate-Source Voltage | | ± 25 | V |
| $E_{AS}$ | Single Pulsed Avalanche Energy | (Note 2) | 280 | mJ |
| $I_{AR}$ | Avalanche Current | (Note 1) | 22.7 | A |
| $E_{AR}$ | Repetitive Avalanche Energy | (Note 1) | 4.4 | mJ |
| dv/dt | Peak Diode Recovery dv/dt | (Note 3) | 7.0 | V/ns |
| $P_D$ | Power Dissipation ($T_A$ = 25°C) * | | 2.5 | W |
| | Power Dissipation ($T_C$ = 25°C) | | 44 | W |
| | - Derate above 25°C | | 0.35 | W/°C |
| $T_J$, $T_{STG}$ | Operating and Storage Temperature Range | | -55 to +150 | °C |
| $T_L$ | Maximum lead temperature for soldering purposes, 1/8" from case for 5 seconds | | 300 | °C |

## Thermal Characteristics

| Symbol | Parameter | Typ | Max | Units |
|---|---|---|---|---|
| $R_{\theta JC}$ | Thermal Resistance, Junction-to-Case | -- | 2.85 | °C/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient * | -- | 50 | °C/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient | -- | 110 | °C/W |

* When mounted on the minimum pad size recommended (PCB Mount)

## Electrical Characteristics

$T_C$ = 25°C unless otherwise noted

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| **Off Characteristics** | | | | | | |
| $BV_{DSS}$ | Drain-Source Breakdown Voltage | $V_{GS}$ = 0 V, $I_D$ = 250 μA | 60 | -- | -- | V |
| $\Delta BV_{DSS}$ / $\Delta T_J$ | Breakdown Voltage Temperature Coefficient | $I_D$ = 250 μA, Referenced to 25°C | -- | 0.06 | -- | V/°C |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ = 60 V, $V_{GS}$ = 0 V | -- | -- | 1 | μA |
| | | $V_{DS}$ = 48 V, $T_C$ = 125°C | -- | -- | 10 | μA |
| $I_{GSSF}$ | Gate-Body Leakage Current, Forward | $V_{GS}$ = 25 V, $V_{DS}$ = 0 V | -- | -- | 100 | nA |
| $I_{GSSR}$ | Gate-Body Leakage Current, Reverse | $V_{GS}$ = -25 V, $V_{DS}$ = 0 V | -- | -- | -100 | nA |
| **On Characteristics** | | | | | | |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = 250 μA | 2.0 | -- | 4.0 | V |
| $R_{DS(on)}$ | Static Drain-Source On-Resistance | $V_{GS}$ = 10 V, $I_D$ = 11.4 A | -- -- | 0.036 | 0.045 | Ω |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$ = 25 V, $I_D$ = 11.4 A (Note 4) | -- | 15 | -- | S |
| **Dynamic Characteristics** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{DS}$ = 25 V, $V_{GS}$ = 0 V, f = 1.0 MHz | -- | 725 | 945 | pF |
| $C_{oss}$ | Output Capacitance | | -- | 270 | 350 | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | -- | 40 | 52 | pF |
| **Switching Characteristics** | | | | | | |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{DD}$ = 30 V, $I_D$ = 15 A, $R_G$ = 25 Ω (Note 4, 5) | -- | 10 | 30 | ns |
| $t_r$ | Turn-On Rise Time | | -- | 85 | 180 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | -- | 35 | 80 | ns |
| $t_f$ | Turn-Off Fall Time | | -- | 40 | 90 | ns |
| $Q_g$ | Total Gate Charge | $V_{DS}$ = 48 V, $I_D$ = 30 A, $V_{GS}$ = 10 V (Note 4, 5) | -- | 19 | 25 | nC |
| $Q_{gs}$ | Gate-Source Charge | | -- | 5.4 | -- | nC |
| $Q_{gd}$ | Gate-Drain Charge | | -- | 8.5 | -- | nC |
| **Drain-Source Diode Characteristics and Maximum Ratings** | | | | | | |
| $I_S$ | Maximum Continuous Drain-Source Diode Forward Current | | -- | -- | 22.7 | A |
| $I_{SM}$ | Maximum Pulsed Drain-Source Diode Forward Current | | -- | -- | 90.8 | A |
| $V_{SD}$ | Drain-Source Diode Forward Voltage | $V_{GS}$ = 0 V, $I_S$ = 22.7 A | -- | -- | 1.5 | V |
| $t_{rr}$ | Reverse Recovery Time | $V_{GS}$ = 0 V, $I_F$ = 30 A, $dI_F$ / dt = 100 A/μs (Note 4) | -- | 45 | -- | ns |
| $Q_{rr}$ | Reverse Recovery Charge | | -- | 65 | -- | nC |

**Notes:**
1. Repetitive Rating : Pulse width limited by maximum junction temperature
2. L = 630μH, $I_{AS}$ = 22.7A, $V_{DD}$ = 25V, $R_G$ = 25 Ω, Starting $T_J$ = 25°C
3. $I_{SD}$ ≤ 30A, di/dt ≤ 300A/μs, $V_{DD}$ ≤ $BV_{DSS}$, Starting $T_J$ = 25°C
4. Pulse Test : Pulse width ≤ 300μs, Duty cycle ≤ 2%
5. Essentially independent of operating temperature

## Typical Characteristics

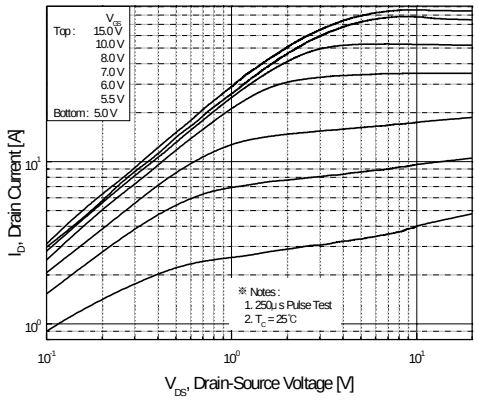



**Figure 1. On-Region Characteristics**

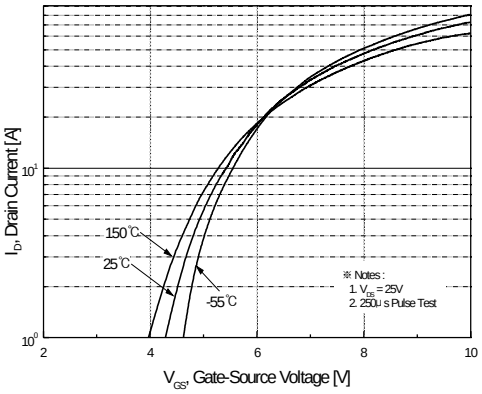



**Figure 2. Transfer Characteristics**

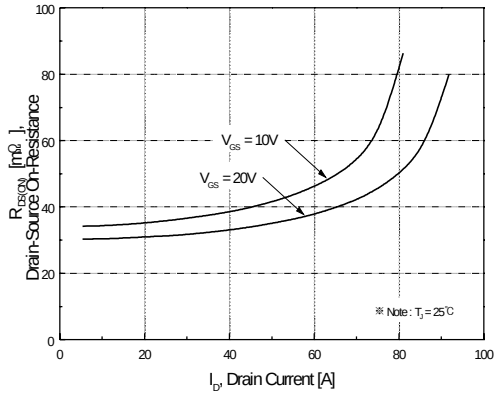



**Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage**

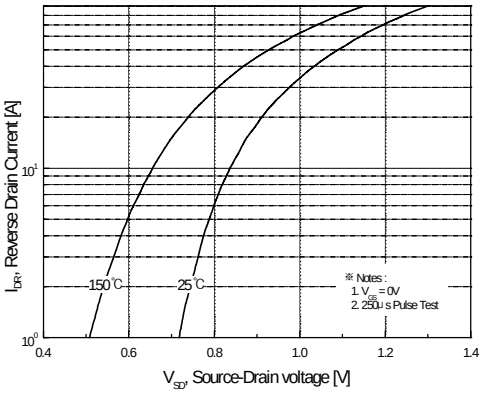



**Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature**

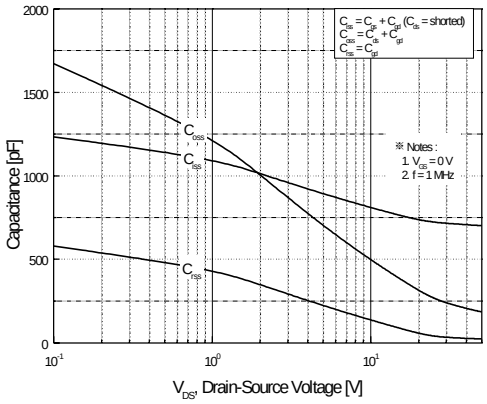



**Figure 5. Capacitance Characteristics**

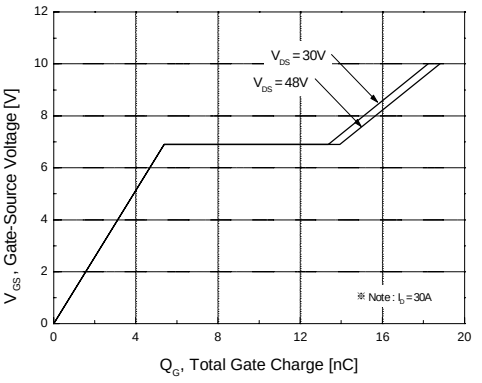



**Figure 6. Gate Charge Characteristics**

## Typical Characteristics (Continued)

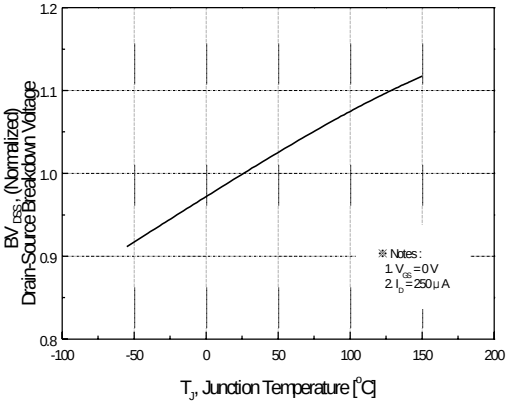



**Figure 7. Breakdown Voltage Variation vs. Temperature**

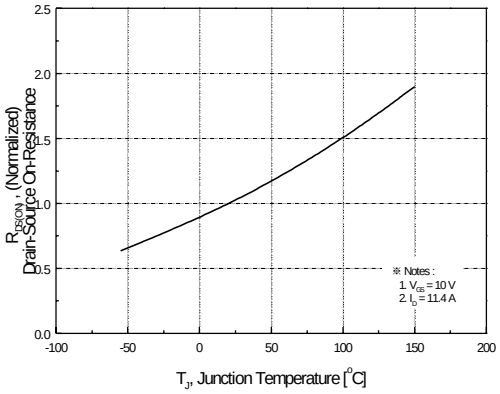



**Figure 8. On-Resistance Variation vs. Temperature**

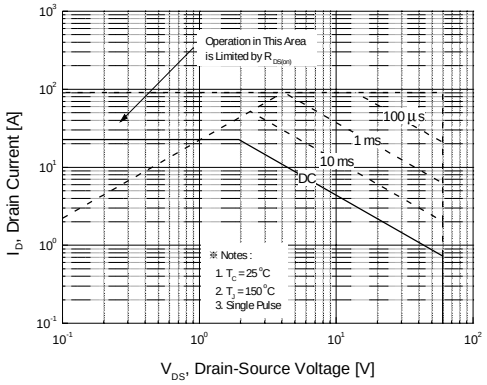



**Figure 9. Maximum Safe Operating Area**

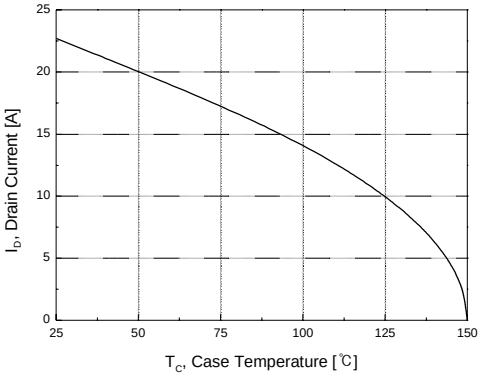



**Figure 10. Maximum Drain Current vs. Case Temperature**

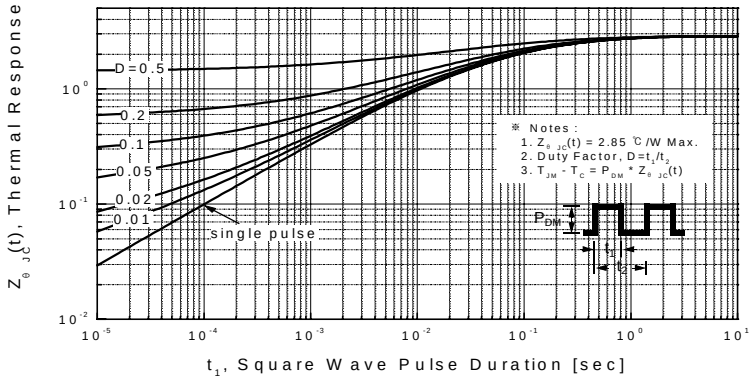
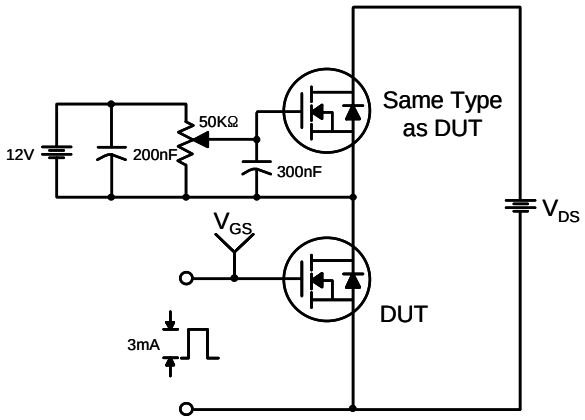
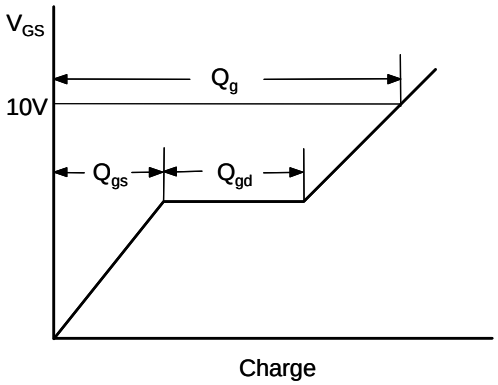


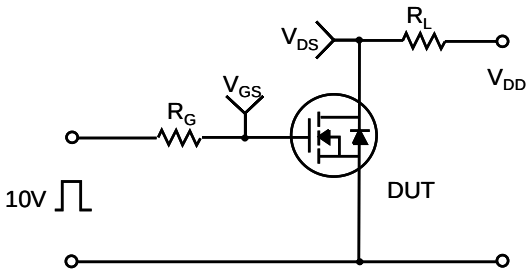

**Figure 11. Transient Thermal Response Curve**

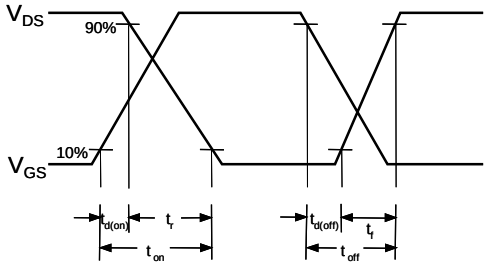
### Gate Charge Test Circuit & Waveform



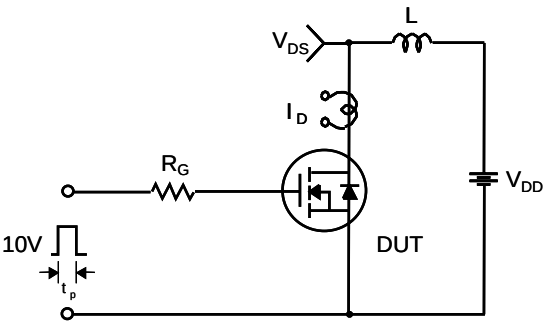




### Resistive Switching Test Circuit & Waveforms

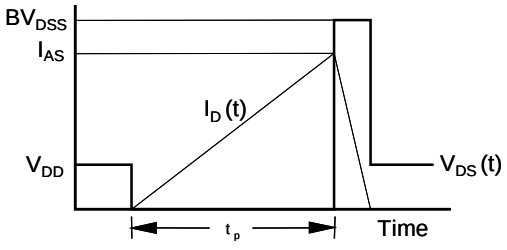


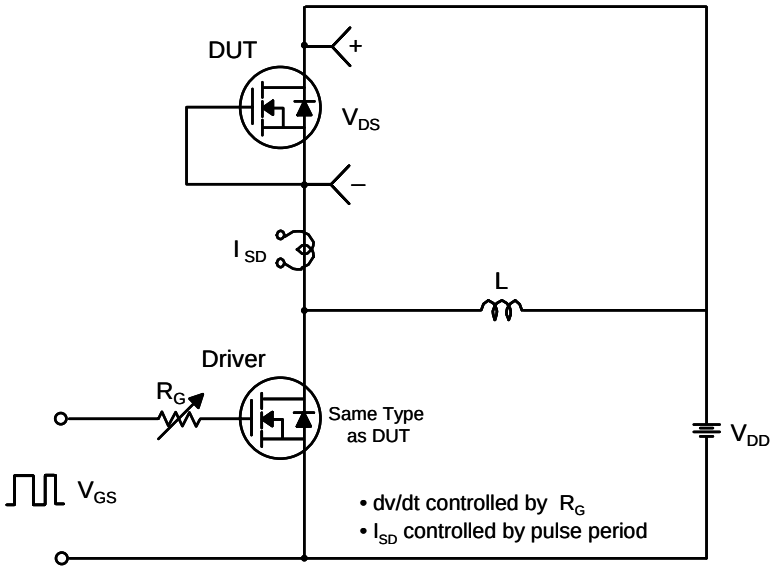

### Unclamped Inductive Switching Test Circuit & Waveforms

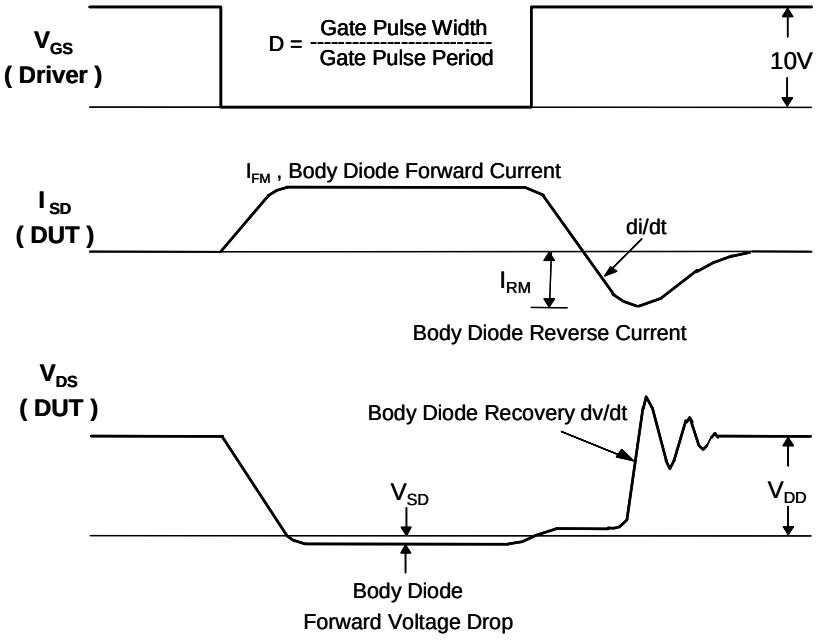



$$E_{AS} = \frac{1}{2} L I_{AS}^2 \frac{BV_{DSS}}{BV_{DSS} - V_{DD}}$$



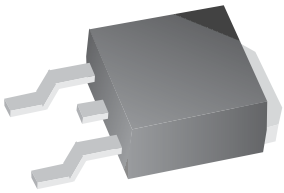
**Peak Diode Recovery dv/dt Test Circuit & Waveforms**

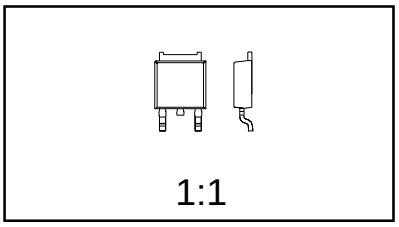


## Mechanical Dimensions

# TO-252 (DPAK) (FS PKG Code 36)

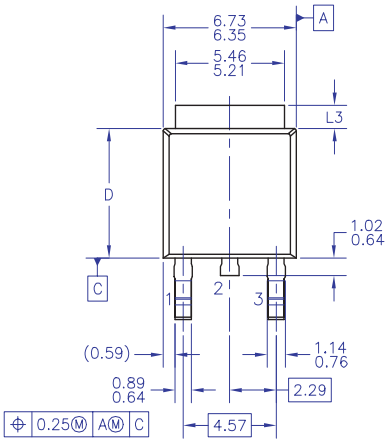


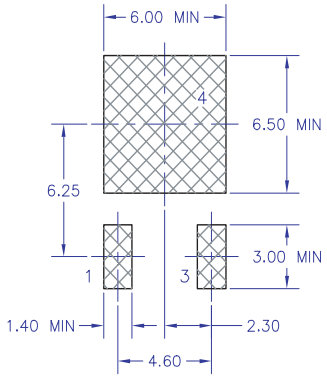



Scale 1:1 on letter size paper

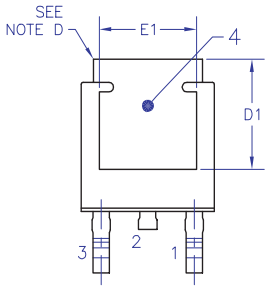
Dimensions shown below are in:
millimeters

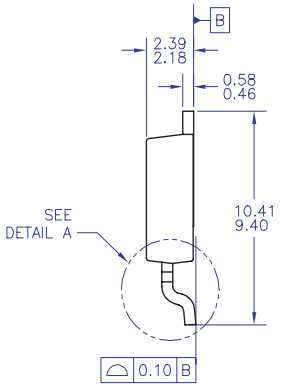
Part Weight per unit (gram): 0.33

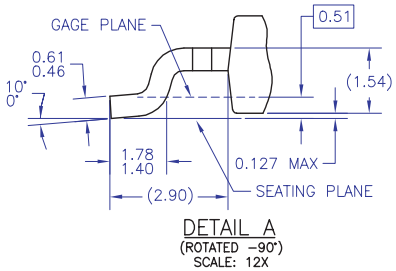



LAND PATTERN RECOMMENDATION




DETAIL A
(ROTATED −90°)
SCALE: 12X

NOTES: UNLESS OTHERWISE SPECIFIED

A) ALL DIMENSIONS ARE IN MILLIMETERS.

B) THIS PACKAGE CONFORMS TO JEDEC, TO−252, ISSUE C, VARIATION AA & AB, DATED NOV. 1999.

C) DIMENSIONING AND TOLERANCING PER ASME Y14.5M−1994.

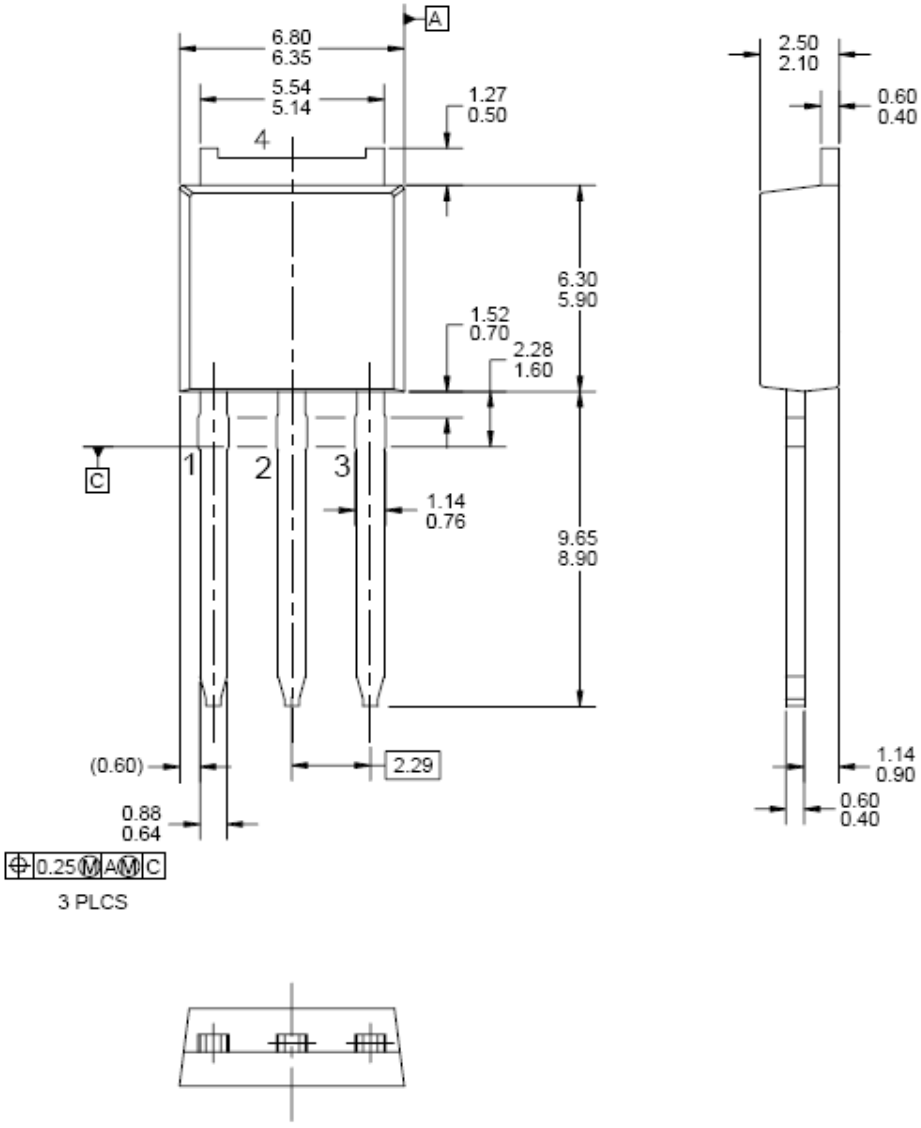
D) HEAT SINK TOP EDGE COULD BE IN CHAMFERED CORNERS OR EDGE PROTRUSION.

E) DIMENSIONS L3,D,E1&D1 TABLE:

| | OPTION AA | OPTION AB |
|---|---|---|
| L3 | 0.89−1.27 | 1.52−2.03 |
| D | 5.97−6.22 | 5.33−5.59 |
| E1 | 4.32 MIN | 3.81 MIN |
| D1 | 5.21 MIN | 4.57 MIN |

## Mechanical Dimensions

### I - PAK




Dimensions in Millimeters

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FAST®
FastvCore™
FlashWriter® *
FPS™
F-PFS™
FRFET®
Global Power Resource℠
Green FPS™
Green FPS™ e-Series™
GTO™
IntelliMAX™
ISOPLANAR™
MegaBuck™
MICROCOUPLER™
MicroFET™
MicroPak™
MillerDrive™
MotionMax™
Motion-SPM™
OPTOLOGIC®
OPTOPLANAR®
®
PDP SPM™
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PowerTrench®
PowerXS™
Programmable Active Droop™
QFET®
QS™
Quiet Series™
RapidConfigure™
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Saving our world, 1mW /W /kW at a time™
SmartMax™
SMART START™
SPM®
STEALTH™
SuperFET™
SuperSOT™-3
SuperSOT™-6
SuperSOT™-8
SupreMOS™
SyncFET™
SYSTEM ® GENERAL
The Power Franchise®
the power franchise
TinyBoost™
TinyBuck™
TinyLogic®
TINYOPTO™
TinyPower™
TinyPWM™
TinyWire™
μSerDes™
SerDes™
UHC®
Ultra FRFET™
UniFET™
VCX™
VisualMax™
XS™

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2. A critical component in any component of a life support, device, or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

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**PRODUCT STATUS DEFINITIONS**

**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. |
| Obsolete | Not In Production | Datasheet contains specifications on a product that is discontinued by Fairchild Semiconductor. The datasheet is for reference information only. |

Rev. I37