

# FQD12N20L / FQU12N20L

## 200V LOGIC N-Channel MOSFET

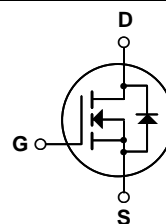
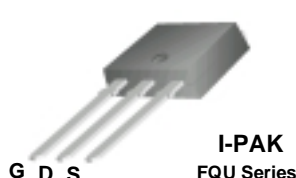
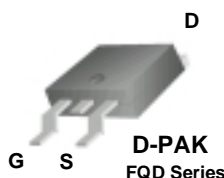
### General Description

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 high efficiency switching DC/DC converters, switch mode power supply, motor control.

### Features

- 9.0A, 200V,  $R_{DS(on)} = 0.28\Omega @ V_{GS} = 10V$
- Low gate charge ( typical 16 nC)
- Low Crss ( typical 17 pF)
- Fast switching
- 100% avalanche tested
- Improved dv/dt capability
- Low level gate drive requirement allowing direct operation from logic drivers
- RoHS Compliant



### Absolute Maximum Ratings T<sub>C</sub> = 25°C unless otherwise noted

Symbol	Parameter	FQD12N20L / FQU12N20L	Units
V <sub>DSS</sub>	Drain-Source Voltage	200	V
I <sub>D</sub>	Drain Current - Continuous (T <sub>C</sub> = 25°C) - Continuous (T <sub>C</sub> = 100°C)	9.0	A
		5.7	A
I <sub>DM</sub>	Drain Current - Pulsed (Note 1)	36	A
V <sub>GSS</sub>	Gate-Source Voltage	± 20	V
E <sub>AS</sub>	Single Pulsed Avalanche Energy (Note 2)	210	mJ
I <sub>AR</sub>	Avalanche Current (Note 1)	9.0	A
E <sub>AR</sub>	Repetitive Avalanche Energy (Note 1)	5.5	mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)	5.5	V/ns
P <sub>D</sub>	Power Dissipation (T <sub>A</sub> = 25°C) *	2.5	W
	Power Dissipation (T <sub>C</sub> = 25°C) - Derate above 25°C	55	W
		0.44	W/°C
T <sub>J</sub> , T <sub>STG</sub>	Operating and Storage Temperature Range	-55 to +150	°C
T <sub>L</sub>	Maximum lead temperature for soldering purposes, 1/8" from case for 5 seconds	300	°C

### Thermal Characteristics

Symbol	Parameter	Typ	Max	Units
R <sub>θJC</sub>	Thermal Resistance, Junction-to-Case	--	2.27	°C/W
R <sub>θJA</sub>	Thermal Resistance, Junction-to-Ambient *	--	50	°C/W
R <sub>θJA</sub>	Thermal Resistance, Junction-to-Ambient	--	110	°C/W

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

## Electrical Characteristics

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

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
<b>Off Characteristics</b>						
$BV_{DSS}$	Drain-Source Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$	200	--	--	V
$\Delta BV_{DSS} / \Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 250\ \mu\text{A}$ , Referenced to $25^\circ\text{C}$	--	0.14	--	V/ $^\circ\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 200\text{ V}, V_{GS} = 0\text{ V}$	--	--	1	$\mu\text{A}$
		$V_{DS} = 160\text{ V}, T_C = 125^\circ\text{C}$	--	--	10	$\mu\text{A}$
$I_{GSSF}$	Gate-Body Leakage Current, Forward	$V_{GS} = 20\text{ V}, V_{DS} = 0\text{ V}$	--	--	100	nA
$I_{GSSR}$	Gate-Body Leakage Current, Reverse	$V_{GS} = -20\text{ V}, V_{DS} = 0\text{ V}$	--	--	-100	nA

### On Characteristics

$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 250\ \mu\text{A}$	1.0	--	2.0	V
$R_{DS(on)}$	Static Drain-Source On-Resistance	$V_{GS} = 10\text{ V}, I_D = 4.5\text{ A}$	--	0.22	0.28	$\Omega$
		$V_{GS} = 5\text{ V}, I_D = 4.5\text{ A}$	--	0.25	0.32	$\Omega$
$g_{FS}$	Forward Transconductance	$V_{DS} = 30\text{ V}, I_D = 4.5\text{ A}$ (Note 4)	--	11.6	--	S

### Dynamic Characteristics

$C_{iss}$	Input Capacitance	$V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V},$ $f = 1.0\text{ MHz}$	--	830	1080	pF
$C_{oss}$	Output Capacitance		--	120	155	pF
$C_{rss}$	Reverse Transfer Capacitance		--	17	22	pF

### Switching Characteristics

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 100\text{ V}, I_D = 11.6\text{ A},$ $R_G = 25\ \Omega$  (Note 4, 5)	--	15	40	ns
$t_r$	Turn-On Rise Time		--	190	390	ns
$t_{d(off)}$	Turn-Off Delay Time		--	60	130	ns
$t_f$	Turn-Off Fall Time		--	120	250	ns
$Q_g$	Total Gate Charge	$V_{DS} = 160\text{ V}, I_D = 11.6\text{ A},$ $V_{GS} = 5\text{ V}$  (Note 4, 5)	--	16	21	nC
$Q_{gs}$	Gate-Source Charge		--	2.8	--	nC
$Q_{gd}$	Gate-Drain Charge		--	7.6	--	nC

### Drain-Source Diode Characteristics and Maximum Ratings

$I_S$	Maximum Continuous Drain-Source Diode Forward Current	--	--	9.0	A	
$I_{SM}$	Maximum Pulsed Drain-Source Diode Forward Current	--	--	36	A	
$V_{SD}$	Drain-Source Diode Forward Voltage	$V_{GS} = 0\text{ V}, I_S = 9.0\text{ A}$	--	--	1.5	V
$t_{rr}$	Reverse Recovery Time	$V_{GS} = 0\text{ V}, I_S = 11.6\text{ A},$ $di_F / dt = 100\text{ A}/\mu\text{s}$ (Note 4)	--	128	--	ns
$Q_{rr}$	Reverse Recovery Charge		--	0.56	--	$\mu\text{C}$

#### Notes:

1. Repetitive Rating : Pulse width limited by maximum junction temperature
2.  $L = 3.9\text{ mH}, I_{AS} = 9.0\text{ A}, V_{DD} = 50\text{ V}, R_G = 25\ \Omega$ , Starting  $T_J = 25^\circ\text{C}$
3.  $I_{SD} \leq 11.6\text{ A}, di/dt \leq 300\text{ A}/\mu\text{s}, V_{DD} \leq BV_{DSS}$ , Starting  $T_J = 25^\circ\text{C}$
4. Pulse Test : Pulse width  $\leq 300\ \mu\text{s}$ , Duty cycle  $\leq 2\%$
5. Essentially independent of operating temperature

## Typical Characteristics

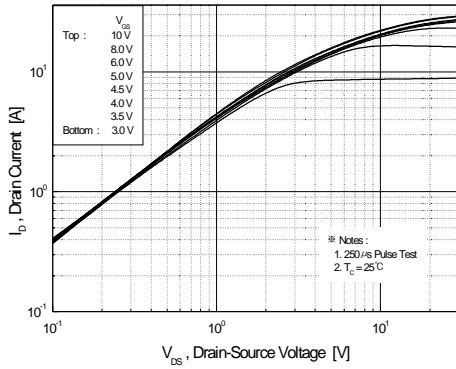


Figure 1. On-Region Characteristics

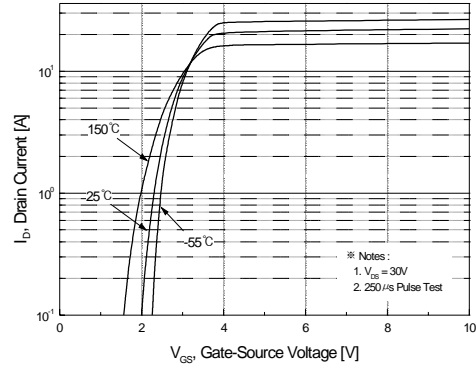


Figure 2. Transfer Characteristics

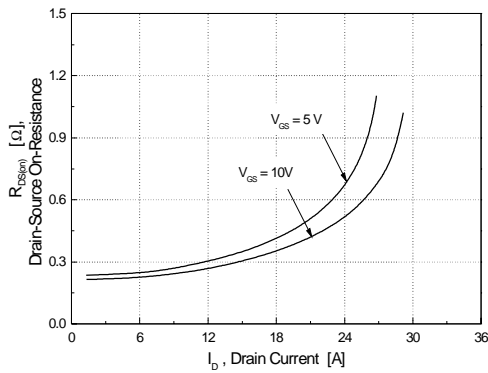


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

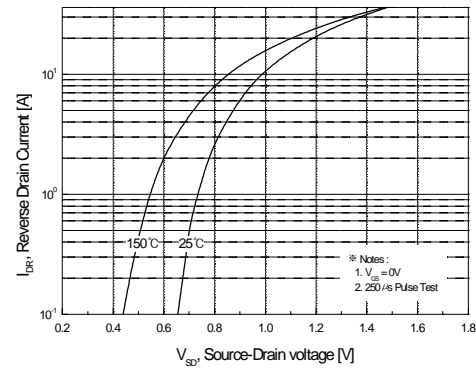


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

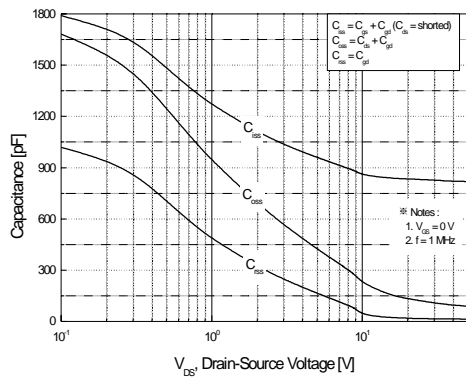


Figure 5. Capacitance Characteristics

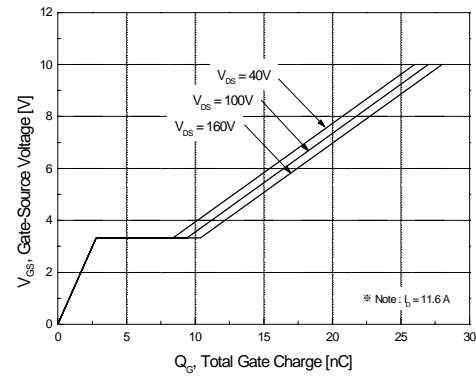
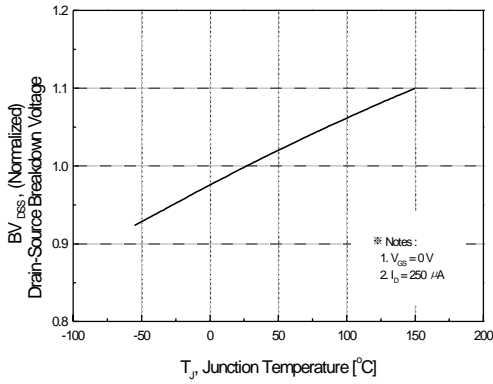
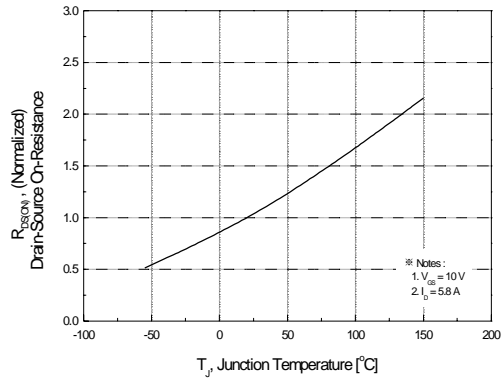


Figure 6. Gate Charge Characteristics

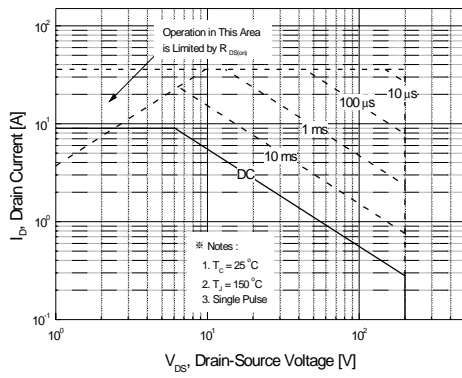
**Typical Characteristics** (Continued)



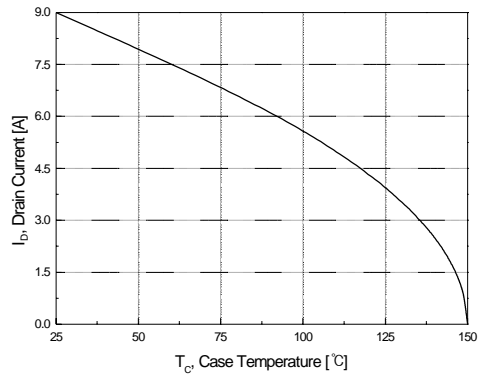
**Figure 7. Breakdown Voltage Variation vs. Temperature**



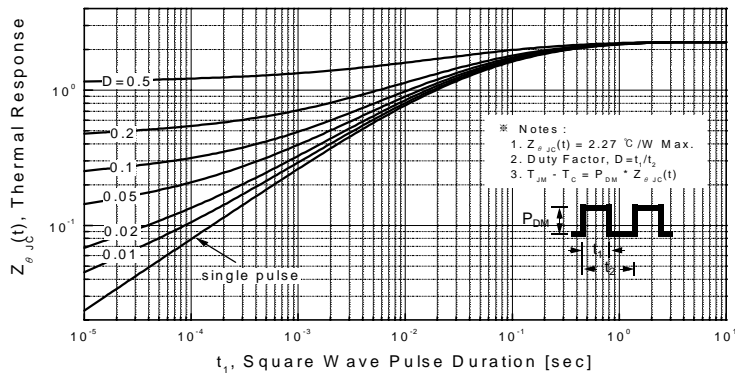
**Figure 8. On-Resistance Variation vs. Temperature**



**Figure 9. Maximum Safe Operating Area**

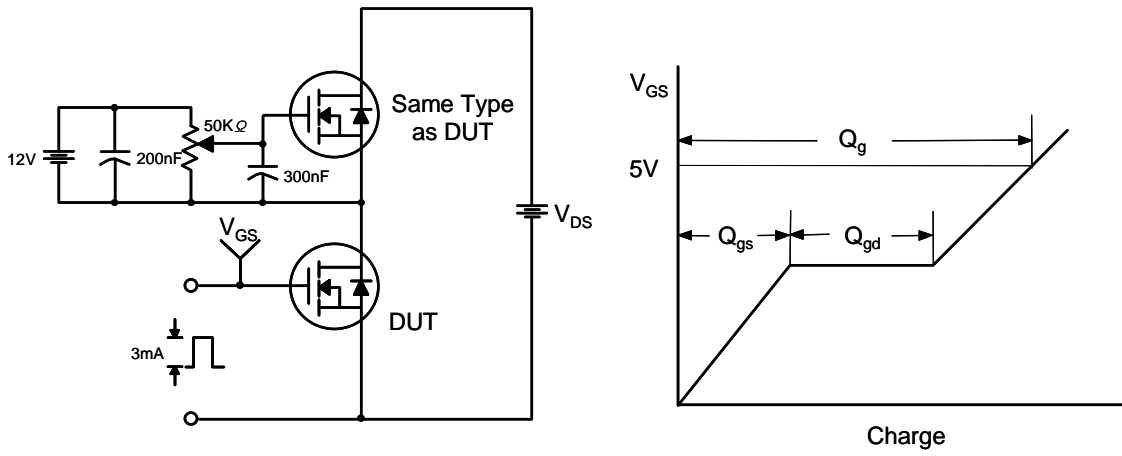


**Figure 10. Maximum Drain Current vs. Case Temperature**

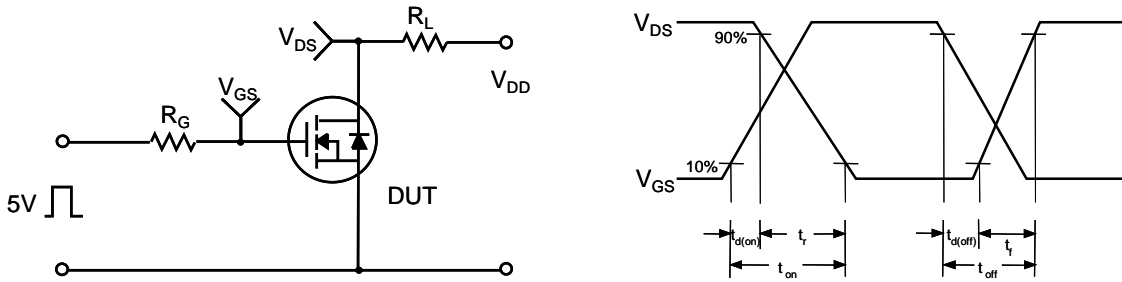


**Figure 11. Transient Thermal Response Curve**

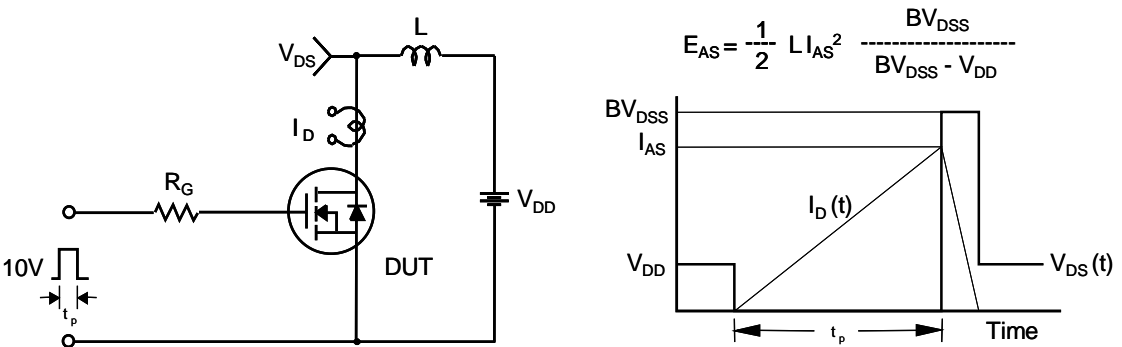
**Gate Charge Test Circuit & Waveform**



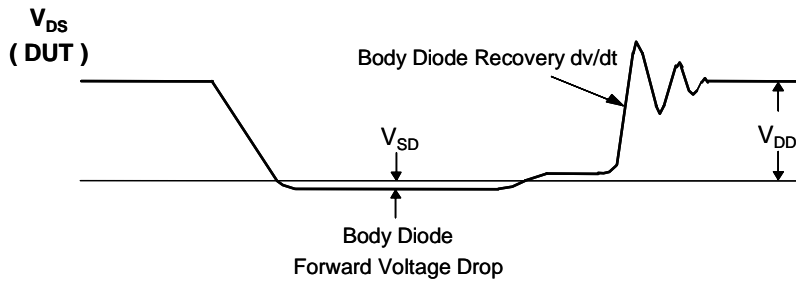
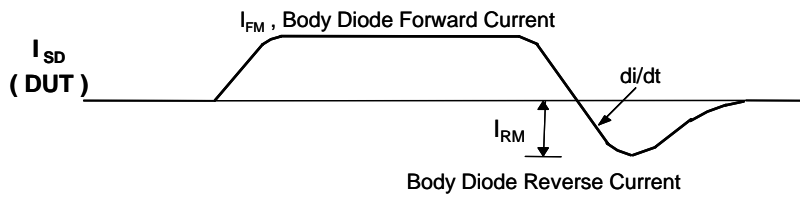
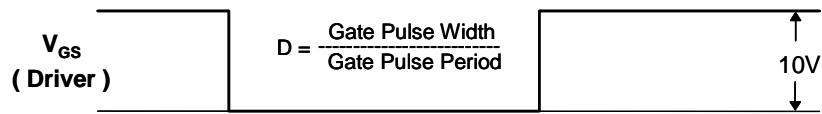
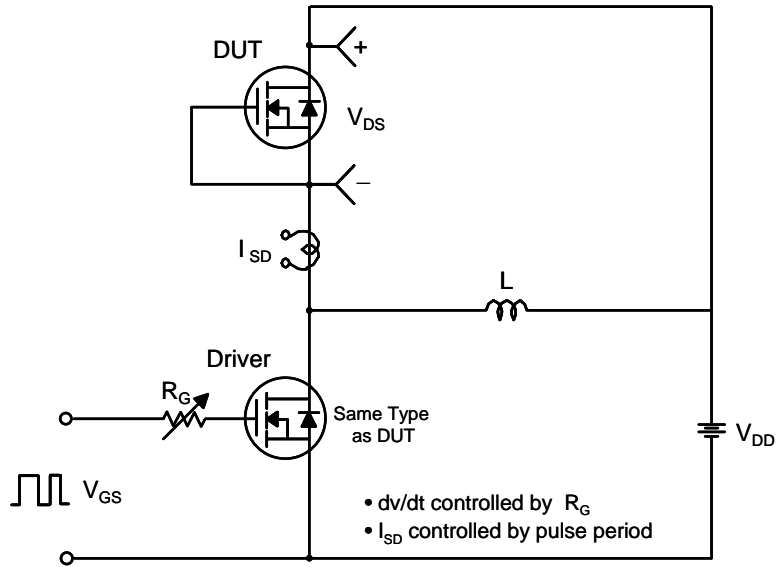
**Resistive Switching Test Circuit & Waveforms**



**Unclamped Inductive Switching Test Circuit & Waveforms**

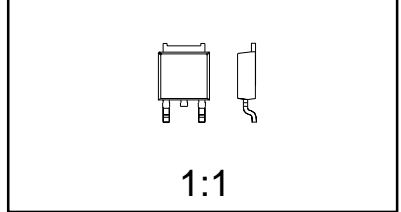
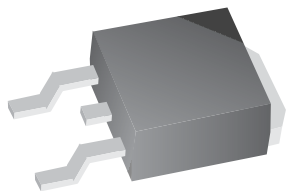


Peak Diode Recovery dv/dt Test Circuit & Waveforms



**Mechanical Dimensions**

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

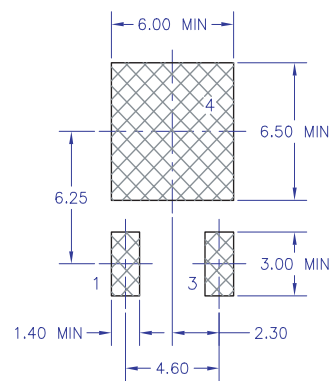
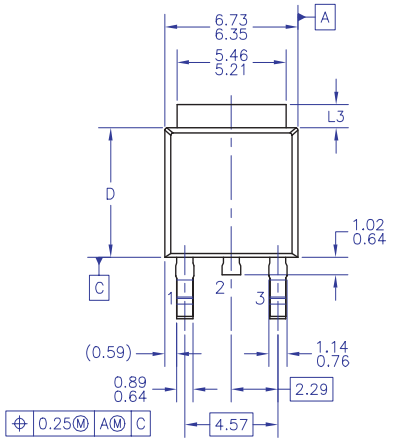


1:1

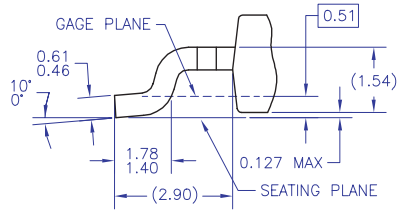
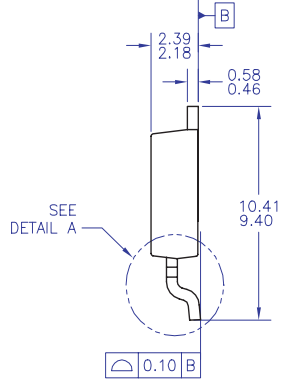
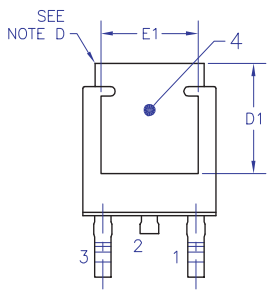
Scale 1:1 on letter size paper

Dimensions shown below are in millimeters

Part Weight per unit (gram): 0.33



LAND PATTERN RECOMMENDATION



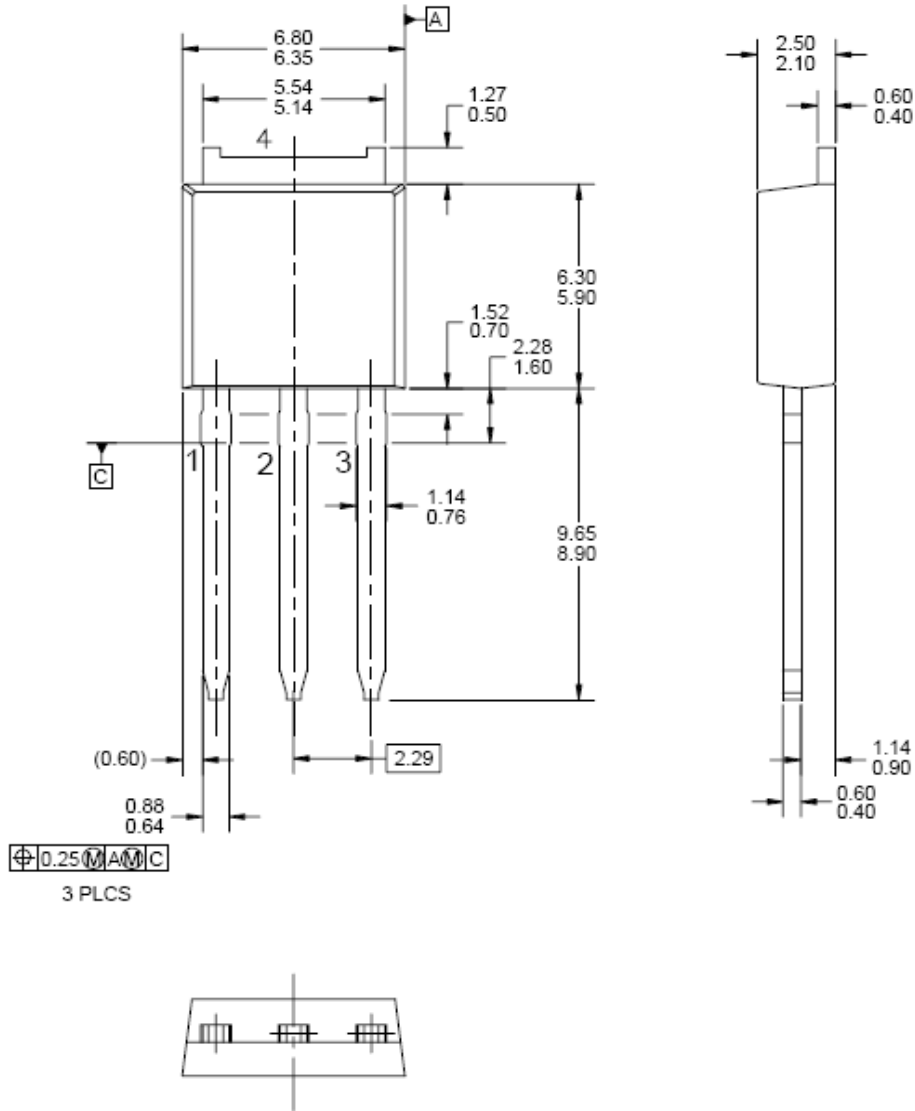
DETAIL A  
(ROTATED -90°)  
SCALE: 12X

- 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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| CorePOWER™                                                                          | Green FPS™                                                                          | QS™                                                                                 | TinyBuck™                                                                             |
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| FastvCore™                                                                          |  ™ | SyncFET™                                                                            |                                                                                       |
| FlashWriter® *                                                                      | PDP SPM™                                                                            |  ™ |                                                                                       |
| FPS™                                                                                | Power-SPM™                                                                          | The Power Franchise®                                                                |                                                                                       |
| F-PFS™                                                                              | PowerTrench®                                                                        |                                                                                     |                                                                                       |
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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.
Obsolete	Not In Production	Datasheet contains specifications on a product that is discontinued by Fairchild Semiconductor. The datasheet is for reference information only.

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