

# FDZ4670S

## N-Channel PowerTrench® SyncFET™

30V, 25A, 2.4mΩ

### Features

- Max  $r_{DS(on)}$  = 2.4mΩ at  $V_{GS} = 10V$ ,  $I_D = 25A$
- Max  $r_{DS(on)}$  = 4.0mΩ at  $V_{GS} = 4.5V$ ,  $I_D = 19A$
- Ultra-thin package: less than 0.85mm height when mounted to PCB
- Outstanding thermal transfer characteristics
- Ultra-low gate charge x  $r_{DS(on)}$  product
- RoHS Compliant



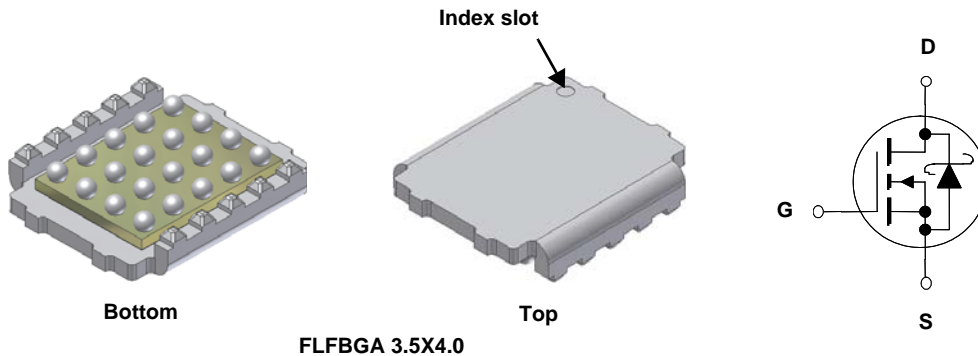
### General Description

Combining Fairchild's 30V PowerTrench® process with state-of-the-art BGA packaging, the FDZ4670S minimizes both PCB space and  $r_{DS(on)}$ . This BGA MOSFET embodies a breakthrough in packaging technology which enables the device to combine excellent thermal transfer characteristics, high current handling capacity, ultra-low profile packaging, low gate charge and low  $r_{DS(on)}$  incorporating SyncFET technology. This device has the added benefit of an efficient monolithic Schottky body diode to reduce  $T_{rr}$  and diode forward voltage.

This MOSFET feature faster switching and lower gate charge than other MOSFETs with comparable  $r_{DS(on)}$  specifications resulting in DC/DC power supply designs and POL converters with higher overall efficiency.

### Applications

- DC - DC Conversion
- POL converters



### MOSFET Maximum Ratings $T_A = 25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	Ratings	Units
$V_{DS}$	Drain to Source Voltage	30	V
$V_{GS}$	Gate to Source Voltage	±20	V
$I_D$	Drain Current -Continuous	$T_A = 25^\circ\text{C}$ (Note 1a)	25
	-Pulsed		107
$P_D$	Power Dissipation	$T_A = 25^\circ\text{C}$ (Note 1a)	2.5
	Power Dissipation	$T_A = 25^\circ\text{C}$ (Note 1b)	1.25
$T_J, T_{STG}$	Operating and Storage Junction Temperature Range	-55 to +150	$^\circ\text{C}$

### Thermal Characteristics

$R_{\theta JC}$	Thermal Resistance, Junction to Case	0.85	$^\circ\text{C/W}$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient (Note 1a)	50	
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient (Note 1b)	100	

### Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
4670S	FDZ4670S	FLFBGA 3.5X4.0	13"	12mm	3000 units

## Electrical Characteristics $T_J = 25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
--------	-----------	-----------------	-----	-----	-----	-------

### Off Characteristics

$BV_{DSS}$	Drain to Source Breakdown Voltage	$I_D = 1\text{mA}, V_{GS} = 0\text{V}$	30			V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = 1\text{mA}$ , referenced to $25^\circ\text{C}$		25		mV/ $^\circ\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{GS} = 0\text{V}, V_{DS} = 24\text{V}$ ,			500	$\mu\text{A}$
$I_{GSS}$	Gate to Source Leakage Current	$V_{GS} = \pm 20\text{V}, V_{DS} = 0\text{V}$			$\pm 100$	nA

### On Characteristics

$V_{GS(th)}$	Gate to Source Threshold Voltage	$V_{GS} = V_{DS}, I_D = 1\text{mA}$	1.0	1.8	3.0	V
$\frac{\Delta V_{GS(th)}}{\Delta T_J}$	Gate to Source Threshold Voltage Temperature Coefficient	$I_D = 1\text{mA}$ , referenced to $25^\circ\text{C}$		-3.6		mV/ $^\circ\text{C}$
$r_{DS(on)}$	Static Drain to Source On Resistance	$V_{GS} = 10\text{V}, I_D = 25\text{A}$		1.7	2.4	m $\Omega$
		$V_{GS} = 4.5\text{V}, I_D = 19\text{A}$		2.8	4.0	
		$V_{GS} = 10\text{V}, I_D = 25\text{A}, T_J = 125^\circ\text{C}$		2.7	3.6	
$g_{FS}$	Forward Transconductance	$V_{DD} = 10\text{V}, I_D = 25\text{A}$		118		S

### Dynamic Characteristics

$C_{iss}$	Input Capacitance	$V_{DS} = 15\text{V}, V_{GS} = 0\text{V}$ , $f = 1\text{MHz}$		2890	3845	pF
$C_{oss}$	Output Capacitance			1610	2145	pF
$C_{rss}$	Reverse Transfer Capacitance			160	240	pF
$R_g$	Gate Resistance	$f = 1\text{MHz}$		1.0		$\Omega$

### Switching Characteristics

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 15\text{V}, I_D = 25\text{A}$ , $V_{GS} = 10\text{V}, R_{GEN} = 6\Omega$		13	23	ns
$t_r$	Rise Time			4.5	10	ns
$t_{d(off)}$	Turn-Off Delay Time			31	50	ns
$t_f$	Fall Time			3.1	10	ns
$Q_g$	Total Gate Charge		$V_{GS} = 10\text{V}$		49	69
$Q_{gs}$	Gate to Source Charge	$V_{DD} = 15\text{V}$		9.1		nC
$Q_{gd}$	Gate to Drain "Miller" Charge	$I_D = 25\text{A}$		7.6		nC

### Drain-Source Diode Characteristics

$V_{SD}$	Source to Drain Diode Forward Voltage	$V_{GS} = 0\text{V}, I_S = 3.5\text{A}$ (Note 2)		0.4	0.7	V
$t_{rr}$	Reverse Recovery Time	$I_F = 25\text{A}, di/dt = 300\text{A}/\mu\text{s}$		37		ns
$Q_{rr}$	Reverse Recovery Charge			46		nC

#### NOTES:

- $R_{\theta JA}$  is determined with the device mounted on a  $1\text{in}^2$  pad 2 oz copper pad on a  $1.5 \times 1.5\text{in.}$  board of FR-4 material.  $R_{\theta JC}$  is guaranteed by design while  $R_{\theta CA}$  is determined by the user's board design.



a.  $50^\circ\text{C}/\text{W}$  when mounted on a  $1\text{in}^2$  pad of 2 oz copper.



b.  $100^\circ\text{C}/\text{W}$  when mounted on a minimum pad of 2 oz copper.

- Pulse Test: Pulse Width  $< 300\mu\text{s}$ , Duty cycle  $< 2.0\%$ .

**Typical Characteristics**  $T_J = 25^\circ\text{C}$  unless otherwise noted

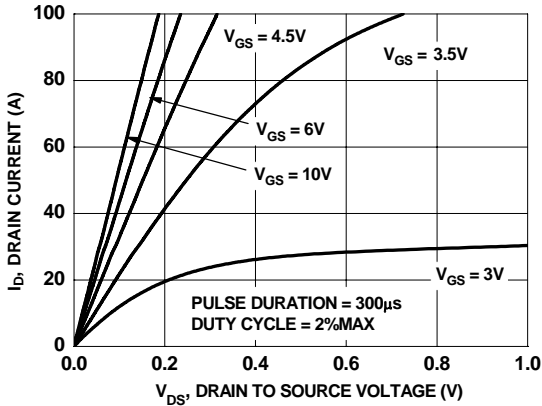


Figure 1. On-Region Characteristics

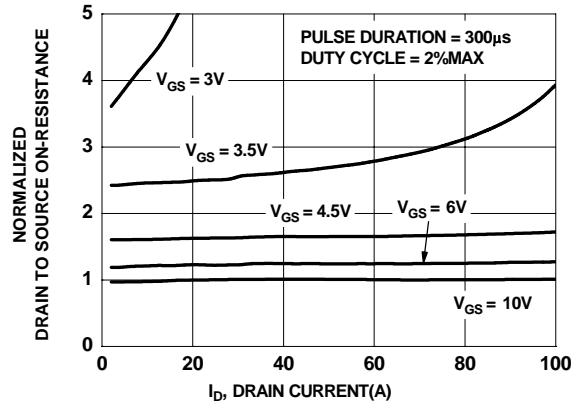


Figure 2. Normalized On-Resistance vs Drain Current and Gate Voltage

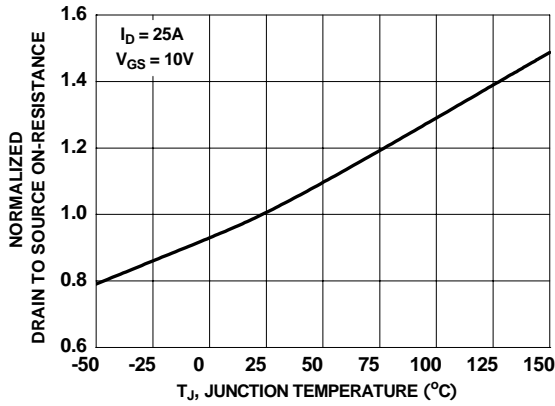


Figure 3. Normalized On-Resistance vs Junction Temperature

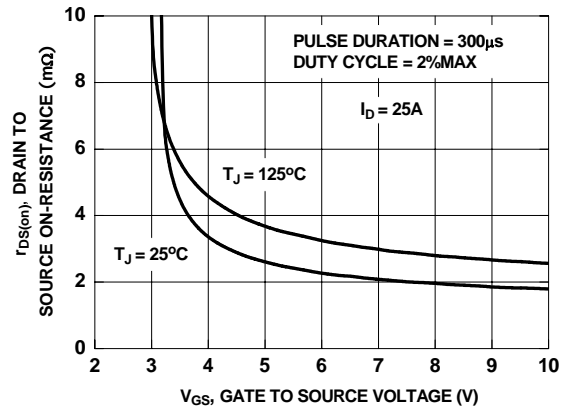


Figure 4. On-Resistance vs Gate to Source Voltage

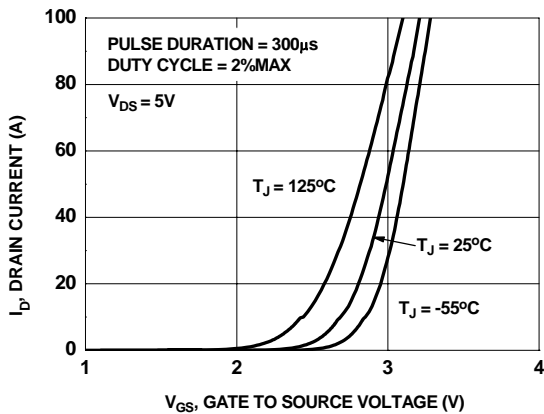


Figure 5. Transfer Characteristics

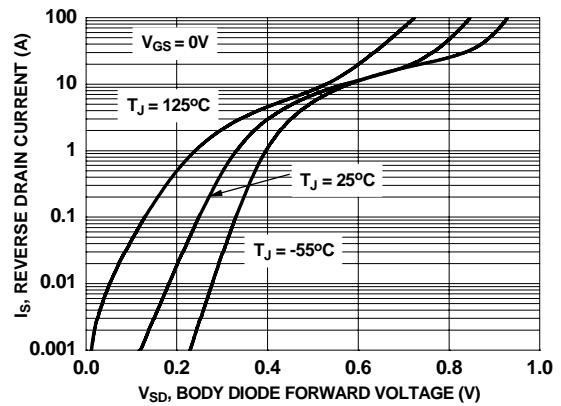
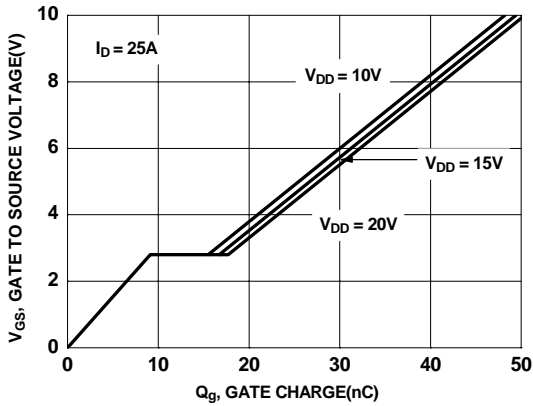
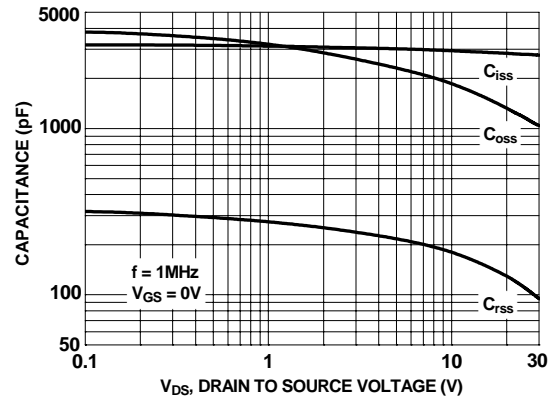


Figure 6. Source to Drain Diode Forward Voltage vs Source Current

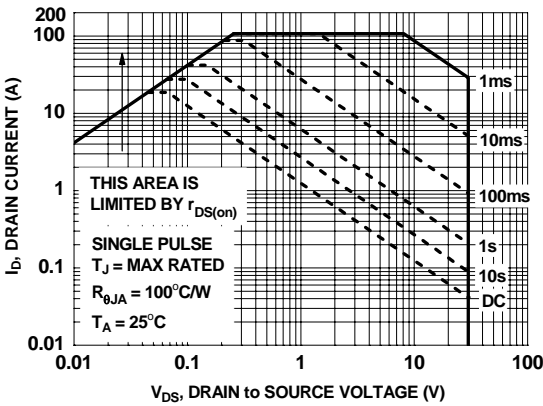
**Typical Characteristics**  $T_J = 25^\circ\text{C}$  unless otherwise noted



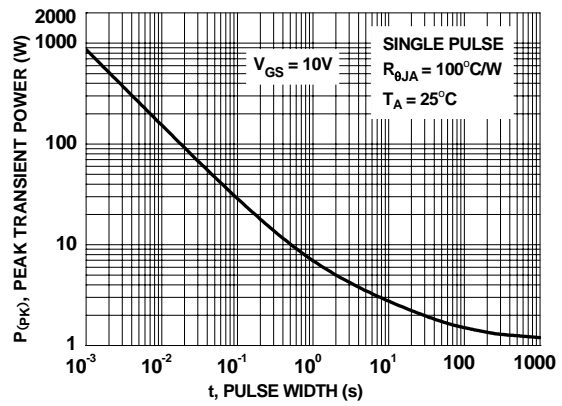
**Figure 7. Gate Charge Characteristics**



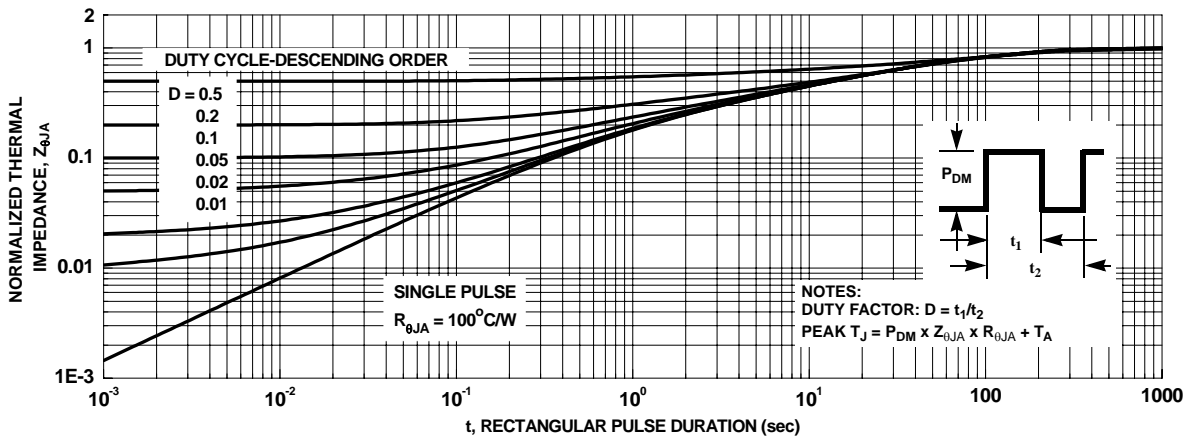
**Figure 8. Capacitance vs Drain to Source Voltage**



**Figure 9. Forward Bias Safe Operating Area**



**Figure 10. Single Pulse Maximum Power Dissipation**

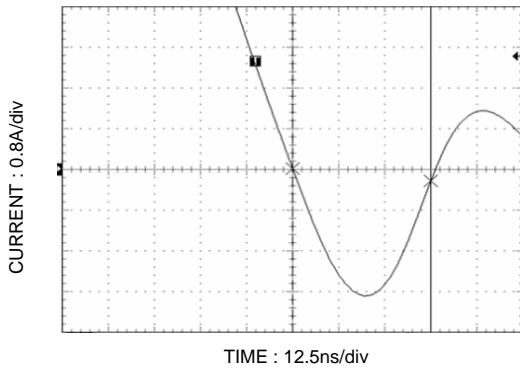


**Figure 11. Transient Thermal Response Curve**

## Typical Characteristics (continued)

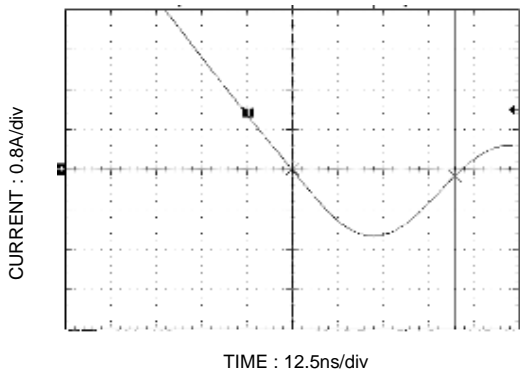
### SyncFET Schottky Body Diode Characteristics

Fairchild's SyncFET process embeds a Schottky diode in parallel with PowerTrench MOSFET. This diode exhibits similar characteristics to a discrete external Schottky diode in parallel with a MOSFET. Figure 22 shows the reverse recovery characteristic of the FDZ4670S.



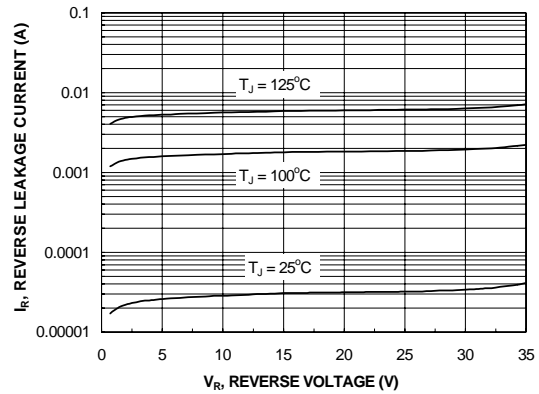
**Figure 22. FDZ4670S SyncFET body diode reverse recovery characteristic**

For comparison purposes, Figure 23 shows the reverse recovery characteristics of the body diode of an equivalent size MOSFET produced without SyncFET (FDZ4670).



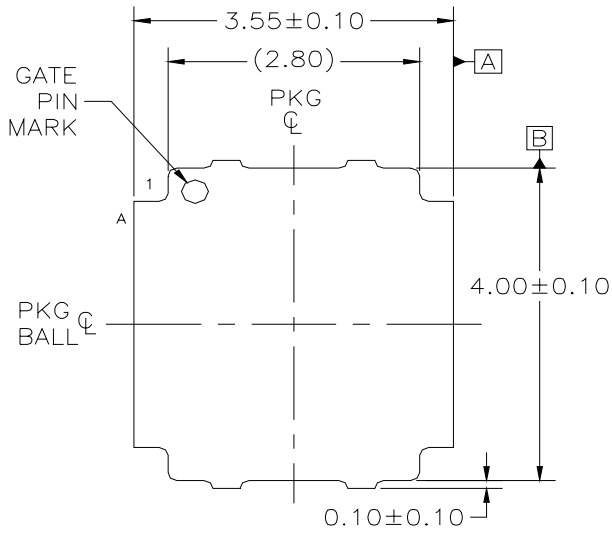
**Figure 23. Non-SyncFET (FDZ4670) body diode reverse recovery characteristic**

Schottky barrier diodes exhibit significant leakage at high temperature and high reverse voltage. This will increase the power in the device.

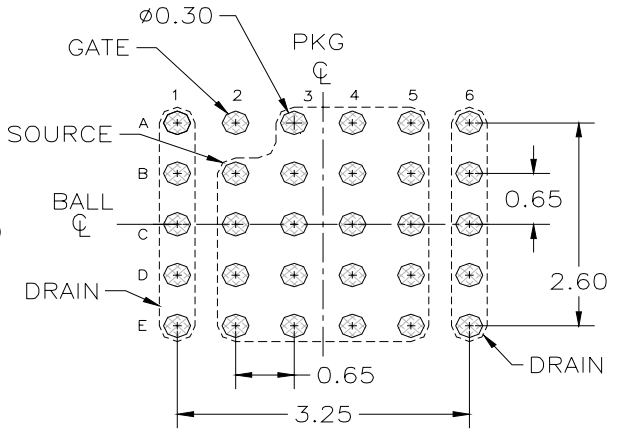


**Figure 24. SyncFET body diode reverse leakage versus drain-source voltage and temperature**

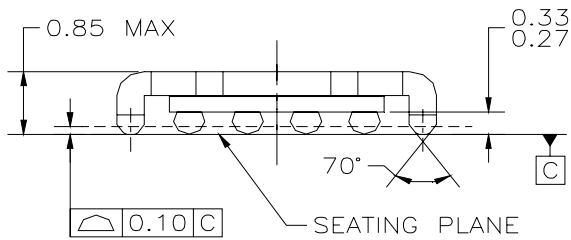
### Dimensional Outline and Pad Layout



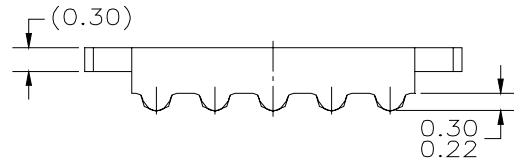
TOP VIEW



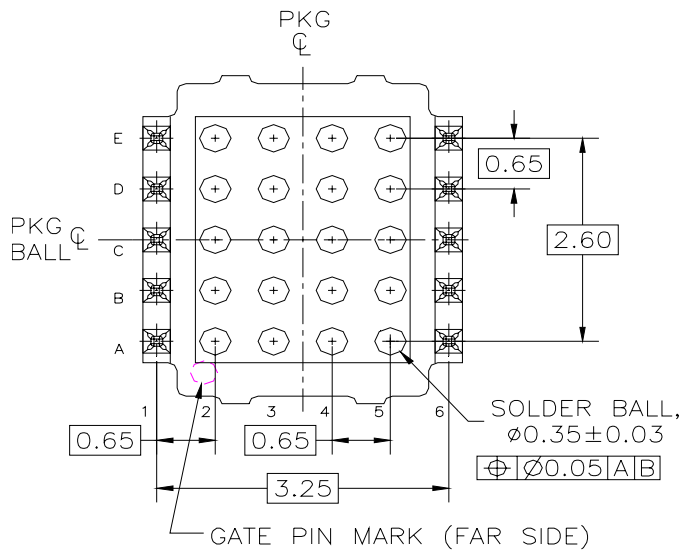
LAND PATTERN RECOMMENDATION



FRONT VIEW



SIDE VIEW



BOTTOM VIEW

BGA020CREVA

- NOTES: UNLESS OTHERWISE SPECIFIED  
 A) ALL DIMENSIONS ARE IN MILLIMETERS.  
 B) NO JEDEC REGISTRATION REFERENCE AS OF MARCH 2006.  
 C) TERMINAL CONFIGURATION TABLE

POSITION	DESIGNATION	TYPE
A1,B1,C1,D1,E1, A6,B6,C6,D6,E6	DRAIN	COPPER STUD
A2	GATE	SOLDER BALL
A3,A4,A5,B2,B3, B4,B5,C2,C3,C4, C5,D2,D3,D4,D5, E2,E3,E4,E5	SOURCE	



**TRADEMARKS**

The following includes registered and unregistered trademarks and service marks, owned by Fairchild Semiconductor and/or its global subsidiaries, and is not intended to be an exhaustive list of all such trademarks.

- |   |   |                            |                      |
|---|---|----------------------------|----------------------|
| ACEx®   | FPS™  | PDP-SPM™                   | SupreMOS™            |
| Build it Now™   | FRFET®  | Power220®                  | SyncFET™             |
| CorePLUS™   | Global Power Resource <sup>SM</sup>   | POWEREDGE®                 | LS GENERAL®          |
| CROSSVOLT™  | Green FPS™  | Power-SPM™                 | The Power Franchise® |
| CTL™  | Green FPS™ e-Series™  | PowerTrench®               | the power franchise  |
| Current Transfer Logic™   | GTO™  | Programmable Active Droop™ | TinyBoost™           |
| EcoSPARK®   | i-Lo™   | QFET®                      | TinyBuck™            |
| EZSWITCH™ *   | IntelliMAX™   | QS™                        | TinyLogic®           |
|  | ISOPLANAR™  | QT Optoelectronics™        | TINYOPTO™            |
|  | MegaBuck™   | Quiet Series™              | TinyPower™           |
| Fairchild®  | MICROCOUPLER™   | RapidConfigure™            | TinyPWM™             |
| Fairchild Semiconductor®  | MicroFET™   | SMART START™               | TinyWire™            |
| FACT Quiet Series™  | MicroPak™   | SPM®                       | TinyWire™            |
| FACT®   | MillerDrive™  | STEALTH™                   | μSerDes™             |
| FAST®   | Motion-SPM™   | SuperFET™                  | UHC®                 |
| FastvCore™  | OPTOLOGIC®  | SuperSOT™-3                | Ultra FRFET™         |
| FlashWriter® *  | OPTOPLANAR®   | SuperSOT™-6                | UniFET™              |
|   |  | SuperSOT™-8                | VCX™                 |

\* EZSWITCH™ and FlashWriter® are trademarks of System General Corporation, used under license by Fairchild Semiconductor.

**DISCLAIMER**

FAIRCHILD SEMICONDUCTOR RESERVES THE RIGHT TO MAKE CHANGES WITHOUT NOTICE TO ANY PRODUCTS HEREIN TO IMPROVE RELIABILITY, FUNCTION, OR DESIGN. FAIRCHILD DOES NOT ASSUME ANY LIABILITY ARISING OUT OF THE APPLICATION OR USE OF ANY PRODUCT OR CIRCUIT DESCRIBED HEREIN; NEITHER DOES IT CONVEY ANY LICENSE UNDER ITS PATENT RIGHTS, NOR THE RIGHTS OF OTHERS. THESE SPECIFICATIONS DO NOT EXPAND THE TERMS OF FAIRCHILD'S WORLDWIDE TERMS AND CONDITIONS, SPECIFICALLY THE WARRANTY THEREIN, WHICH COVERS THESE PRODUCTS.

**LIFE SUPPORT POLICY**

FAIRCHILD'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF FAIRCHILD SEMICONDUCTOR CORPORATION.

As used herein:

- Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body or (b) support or sustain life, and (c) whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
- 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.

**PRODUCT STATUS DEFINITIONS**

**Definition of Terms**

Datasheet Identification	Product Status	Definition
Advance Information	Formative or In Design	This datasheet contains the design specifications for product development. Specifications may change in any manner without notice.
Preliminary	First Production	This 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	This datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design.
Obsolete	Not In Production	This datasheet contains specifications on a product that has been discontinued by Fairchild Semiconductor. The datasheet is printed for reference information only.

Rev. 133