FAIRCHILD
SEMICONDUCTOR™

December 2000
PRELIMINARY

FDZ204P

P-Channel 2.5V Specified PowerTrench$^{\text{â}}$ BGA MOSFET

General Description

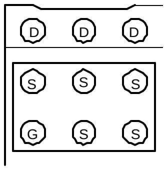
Combining Fairchild's advanced 2.5V specified PowerTrench process with state of the art BGA packaging, the FDZ204P minimizes both PCB space and $R_{DS(ON)}$. This BGA MOSFET embodies a breakthrough in packaging technology which enables the device to combine excellent thermal transfer characteristics, high current handling capability, ultra-low profile packaging, low gate charge, and low $R_{DS(ON)}$.

Applications

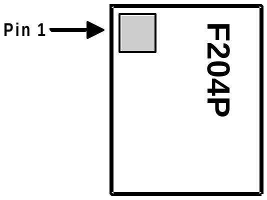
- Battery management
- Load switch
- Battery protection

Features

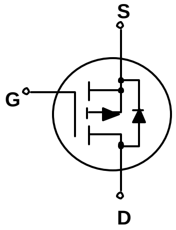
- –4.5 A, –20 V. $R_{DS(ON)}$ = 45 mΩ @ V_{GS} = –4.5 V
  $R_{DS(ON)}$ = 75 mΩ @ V_{GS} = –2.5 V
- Occupies only 3.7 mm^2 of PCB area.
  Less than 40% of the area of a SSOT-6
- Ultra-thin package: less than 0.70 mm height when mounted to PCB
- Ultra-low Q_g x $R_{DS(ON)}$ figure-of-merit.
- High power and current handling capability.



Bottom



Top



Absolute Maximum Ratings
T_A=25°C unless otherwise noted

Symbol	Parameter		Ratings	Units
V_{DSS}	Drain-Source Voltage		–20	V
V_{GSS}	Gate-Source Voltage		±12	V
I_D	Drain Current – Continuous	(Note 1a)	–4.5	A
	– Pulsed		–20	
P_D	Power Dissipation (Steady State)	(Note 1a)	1.6	W
T_J, T_{STG}	Operating and Storage Junction Temperature Range		–55 to +175	°C

Thermal Characteristics

$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	(Note 1a)	96	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	(Note 1b)	155	°C/W
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	(Note 1)	8	°C/W

Package Marking and Ordering Information

Device Marking	Device	Reel Size	Tape width	Quantity
204	FDZ204P	7"	8mm	3000 units

Electrical Characteristics

T_A = 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	–20			V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	I_D = –250 µA, Referenced to 25°C		–15		mV/°C
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = –16 V, V_{GS} = 0 V			–1	µA
I_{GSSF}	Gate–Body Leakage, Forward	V_{GS} = –12 V, V_{DS} = 0 V			–100	nA
I_{GSSR}	Gate–Body Leakage, Reverse	V_{GS} = 12 V, V_{DS} = 0 V			100	nA
On Characteristics (Note 2)						
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS} = V_{GS}, I_D = –250 µA	–0.6	–1.0	–1.5	V
$\frac{\Delta V_{GS(th)}}{\Delta T_J}$	Gate Threshold Voltage Temperature Coefficient	I_D = –250 µA, Referenced to 25°C		3		mV/°C
$R_{DS(on)}$	Static Drain–Source On–Resistance	V_{GS} = –4.5 V, I_D = –4.5 A V_{GS} = –2.5 V, I_D = –3.5 A V_{GS} = –4.5 V, I_D = –4.5A, T_J=125°C		38 62 40	45 75 77	mΩ
$I_{D(on)}$	On–State Drain Current	V_{GS} = –4.5 V, V_{DS} = –5 .0 V	–20			A
g_{FS}	Forward Transconductance	V_{DS} = –5 V, I_D = –4.5 A		15		S
Dynamic Characteristics						
C_{iss}	Input Capacitance	V_{DS} = –10 V, V_{GS} = 0 V, f = 1.0 MHz		987		pF
C_{oss}	Output Capacitance			278		pF
C_{rss}	Reverse Transfer Capacitance			111		pF
Switching Characteristics (Note 2)						
$t_{d(on)}$	Turn–On Delay Time	V_{DD} = –6 V, I_D = –1 A, V_{GS} = –4.5 V, R_{GEN} = 6 Ω		10	20	ns
t_r	Turn–On Rise Time			10	19	ns
$t_{d(off)}$	Turn–Off Delay Time			35	56	ns
t_f	Turn–Off Fall Time			34	54	ns
Q_g	Total Gate Charge	V_{DS} = –10 V, I_D = –4.5 A, V_{GS} = –4.5 V		9	14	nC
Q_{gs}	Gate–Source Charge			2		nC
Q_{gd}	Gate–Drain Charge			3		nC
Drain–Source Diode Characteristics and Maximum Ratings						
I_S	Maximum Continuous Drain–Source Diode Forward Current				–1.3	A
V_{SD}	Drain–Source Diode Forward Voltage	V_{GS} = 0 V, I_S = –1.3 A (Note 2)		–0.7	–1.2	V

Notes:

1. $R_{\theta JA}$ is a function of the junction-to-case ($R_{\theta JC}$), case-to-ambient ($R_{\theta CA}$) and the PC Board ($R_{\theta BA}$) thermal resistance where the case thermal reference is defined the top surface of the package. $R_{\theta JC}$ is guaranteed by design while $R_{\theta CA}$ and $R_{\theta BA}$ are determined by the user's design.

(a). $R_{\theta JA}$ = 96°C/W (steady-state) when mounted on 1 in^2 of 2 oz. copper.

(b). $R_{\theta JA}$ = 155°C/W (steady-state) when mounted on a minimum pad of 2 oz. copper.

2. Pulse Test: Pulse Width < 300µs, Duty Cycle < 2.0%

Typical Characteristics

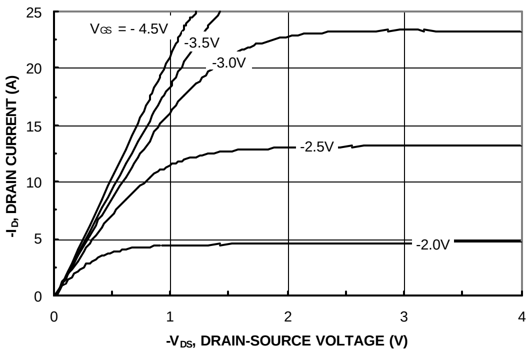


Figure 1. On-Region Characteristics.

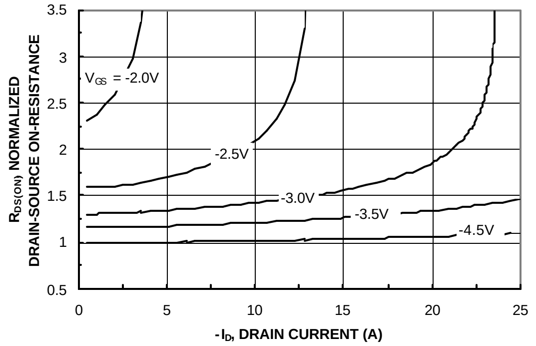


Figure 2. On-Resistance Variation with Drain Current and Gate Voltage.

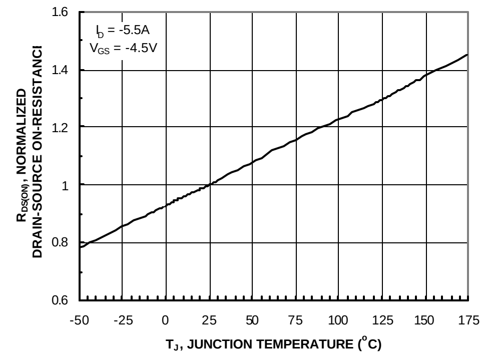


Figure 3. On-Resistance Variation with Temperature.

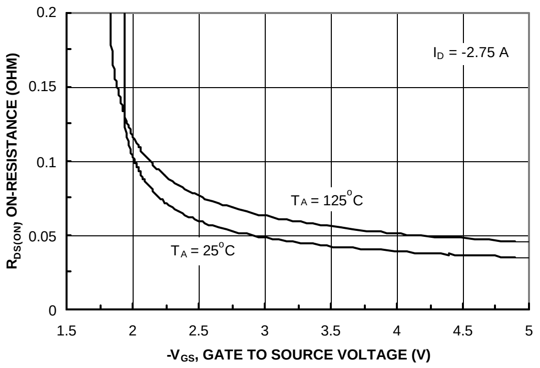


Figure 4. On-Resistance Variation with Gate-to-Source Voltage.

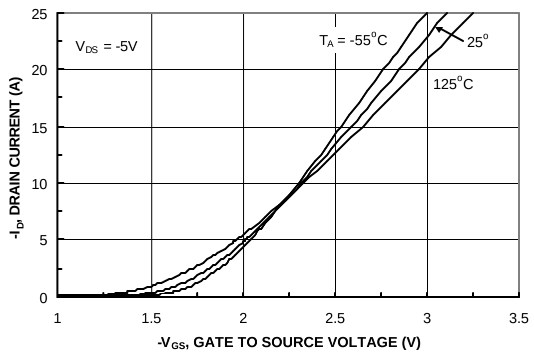


Figure 5. Transfer Characteristics.

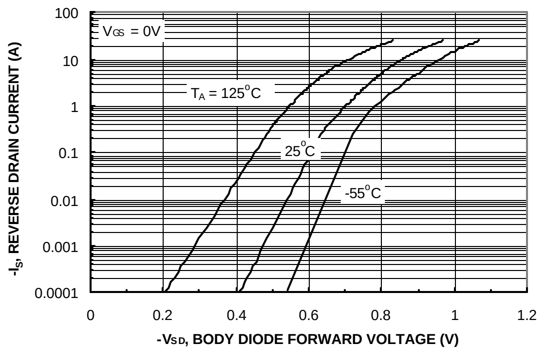


Figure 6. Body Diode Forward Voltage Variation with Source Current and Temperature.

Typical Characteristics

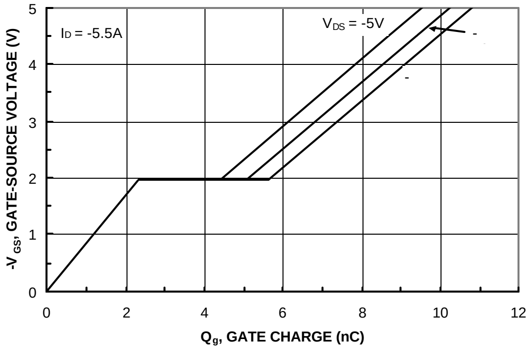


Figure 7. Gate Charge Characteristics.

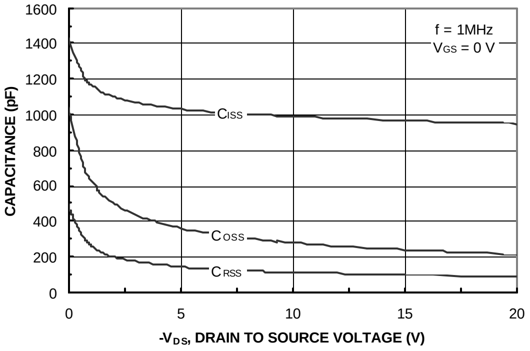


Figure 8. Capacitance Characteristics.

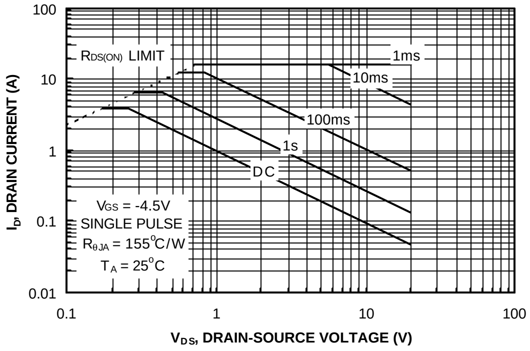


Figure 9. Maximum Safe Operating Area.

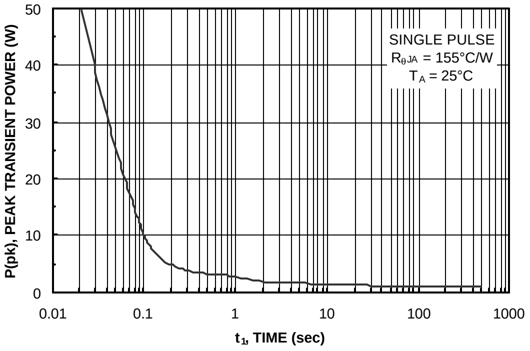


Figure 10. Single Pulse Maximum Power Dissipation.

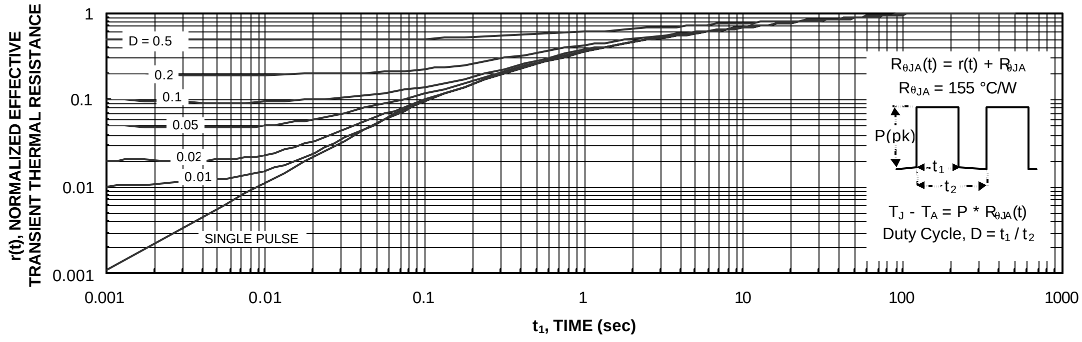


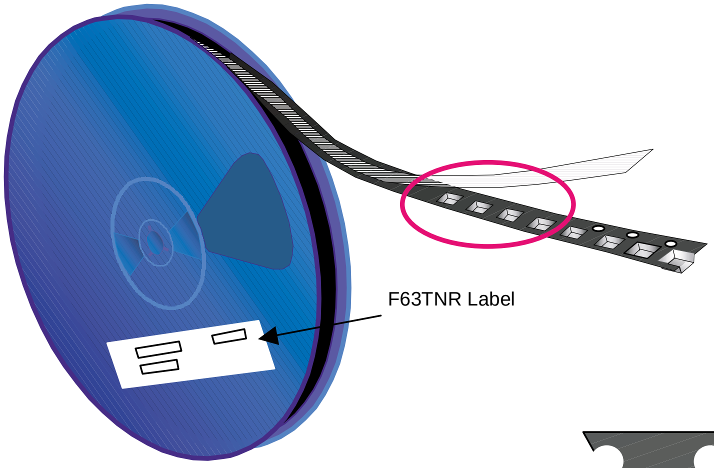
Figure 11. Transient Thermal Response Curve.

Thermal characterization performed using the conditions described in Note 1b.
Transient thermal response will change depending on the circuit board design.

FC-09A 2 x 2 mm MOSFET BGA Tape and Reel Dimensions

FC-09A MOSFET BGA Packaging Configuration:

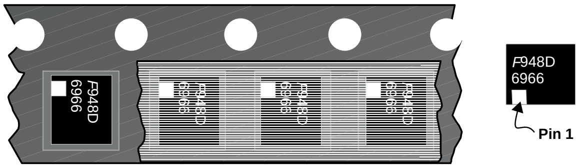
Figure 1



Packaging Description:

FC-09A MOSFET BGA parts are shipped in tape and reel. The carrier tape is made from a dissipative (carbon filled) polycarbonate resin. The cover tape is a multilayer film (Heat Activated Adhesive in nature) primarily composed of polyester film, adhesive layer, sealant, and anti-static sprayed agent. These reeled parts in standard option are shipped with 3,000 units per 7" or 177cm diameter reel. The reels are dark blue in color and is made of polystyrene plastic (anti-static coated).

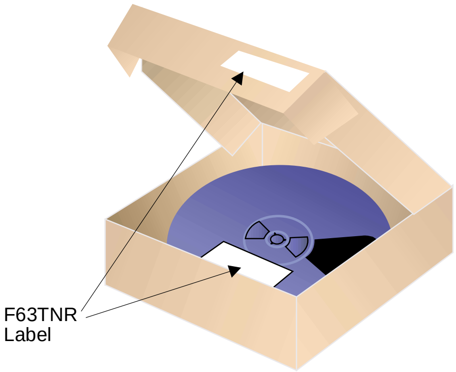
These full reels are individually labeled and placed inside a standard intermediate made of recyclable corrugated brown paper with a Fairchild logo printing. One pizza box contains five reels maximum. These intermediate boxes are placed inside a labeled shipping box which comes in different sizes depending on the number of parts shipped.



FC-09A MOSFET BGA Unit Orientation

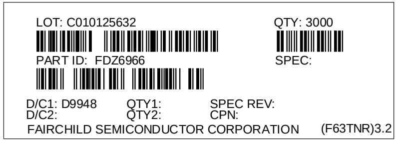
FC-09A MOSFET BGA Packaging Information

Packaging Option	Standard (no flow code)
Packaging type	TNR
Qty per Reel/Tube/Bag	3,000
Reel Size	7" Dia
Box Dimension (mm)	193x183x80
Max qty per Box	15,000
Weight per unit (gm)	0.0180
Weight per Reel (kg)	0.4448
Note/Comments	



193mm x 183mm x 80mm
Pizza Box for Standard Option

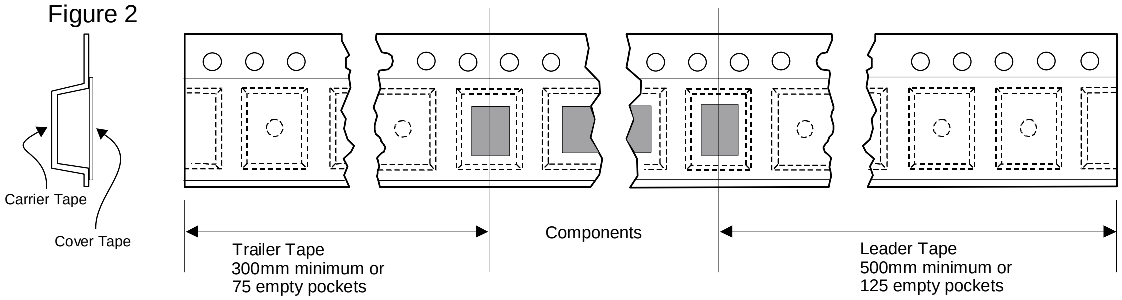
F63TNR Label Sample



LOT: C010125632 QTY: 3000
PART ID: FDZ6966 SPEC:
D/C1: D9948 QTY1: SPEC REV:
D/C2: QTY2: CPN:
FAIRCHILD SEMICONDUCTOR CORPORATION (F63TNR)3.2

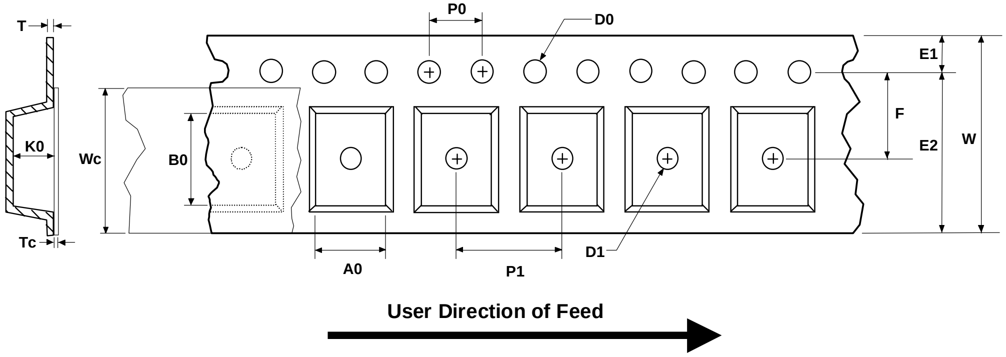
FC-09A MOSFET BGA Tape Leader and Trailer Configuration:

Figure 2



FC-09A 2 x 2 mm MOSFET BGA Tape and Reel Dimensions

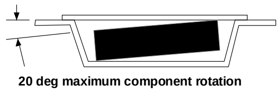
FC-09A MOSFET BGA
Embossed Carrier Tape Configuration: Figure 3



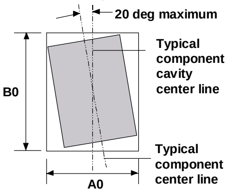
Dimensions are in millimeters

Pkg type	A0	B0	W	D0	D1	E1	E2	F	P1	P0	K0	T	Wc	Tc
FC-09A MOSFET BGA (8mm)	2.40 +/-0.10	2.40 +/-0.10	8.0 +0.30/ -0.00	1.50 +0.10/ -0.00	1.00 +0.25/ -0.00	1.75 +/-0.10	6.25 min	3.50 +/-0.05	4.0 +/-0.1	4.0 +/-0.1	1.25 +/-0.10	0.279 +/-0.02	5.2 +/-0.3	0.06 +/-0.02

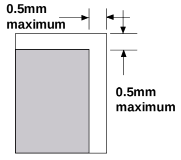
Notes: A0, B0, and K0 dimensions are determined with respect to the EIA/Jedec RS-481 rotational and lateral movement requirements (see sketches A, B, and C).



Sketch A (Side or Front Sectional View)
Component Rotation

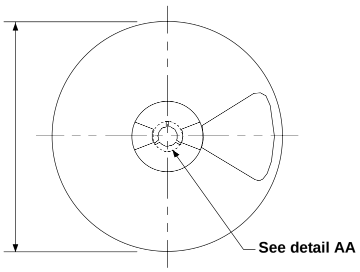


Sketch B (Top View)
Component Rotation

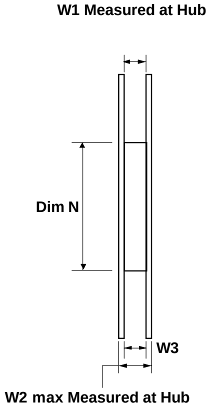


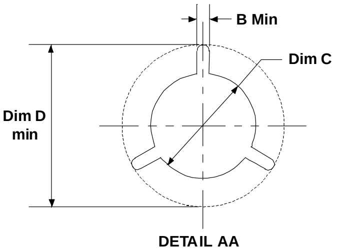
Sketch C (Top View)
Component Lateral Movement

FC-09A MOSFET BGA
Reel Configuration: Figure 4



7" Diameter Reel



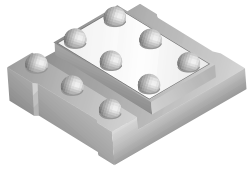


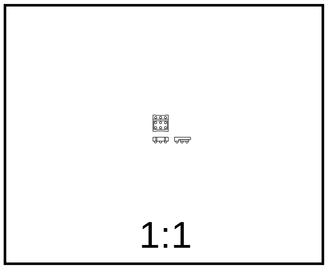
Dimensions are in inches and millimeters

Tape Size	Reel Option	Dim A	Dim B	Dim C	Dim D	Dim N	Dim W1	Dim W2	Dim W3 (LSL-USL)
8mm	7" Dia	7.00 177.8	0.059 1.5	512 +0.020/-0.008 13 +0.5/-0.2	0.795 20.2	2.165 55	0.331 +0.059/-0.000 8.4 +1.5/0	0.567 14.4	0.311 – 0.429 7.9 – 10.9

2 x 2 mm MOSFET BGA Package Dimensions

2 x 2 mm (FS PKG Code Z6)

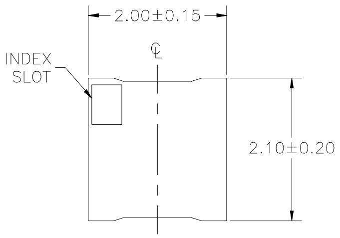




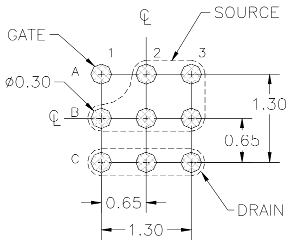
Scale 1:1 on letter size paper

Dimensions shown below are in:
inches [millimeters]

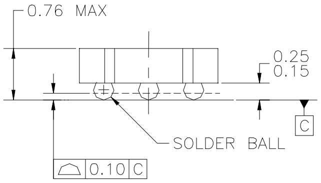
Part Weight per unit (gram): 0.0180



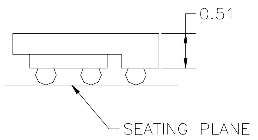
TOP VIEW



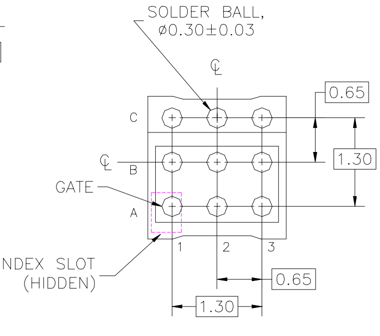
LAND PATTERN RECOMMENDATION



FRONT VIEW



SIDE VIEW



BOTTOM VIEW

NOTES: UNLESS OTHERWISE SPECIFIED

A) ALL DIMENSIONS ARE IN MILLIMETERS.
B) NO JEDEC REGISTRATION REFERENCE AS OF JULY 1999.
C) BALL CONFIGURATION TABLE.

BALL TERMINAL	DESIGNATION
C1,C2,C3	DRAIN
A1	GATE
A2,A3,B1,B2,B3	SOURCE

BGA09BREVA

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PACMAN™
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PowerTrench ®
QFET™
QS™
QT Optoelectronics™
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SuperSOT™-6
SuperSOT™-8
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2. A critical component is 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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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, and supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice in order 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 in order 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. H1