FAIRCHILD SEMICONDUCTOR®

May 2009

FAN5902
800mA Buck Converter for 3G RFPAs

Features

- 92% Efficient Synchronous Operation
- 2.7V to 5.5V Input Voltage Range
- V_{OUT} Range from 0.4V to 3.4V (or V_{IN})
- Up to 800mA Output Current
- 20µs Step Response
- 30µs Bypass Transition Time
- 50mΩ Integrated Bypass FET with Controlled Slew Rate for Low Battery Voltage Operation
- 6MHz PWM Operation Allows 470nH Small Form Factor Inductor
- 100% Duty Cycle for Low Dropout Operation
- Thermal Shutdown
- Input Under-Voltage Lockout
- 12-Lead MLP (0.8mm Maximum)
- 12-Bump WLCSP

Applications

- Battery-Powered 3G RFPAs
- Multiband/Multimode WCDMA/CDMA Handset RF Transceivers
- RF PC Cards
- Pocket PC and PDAs with Communication Capabilities

Description

The FAN5902 is a high-efficiency, low-noise, synchronous, step-down DC-to-DC converter designed for powering the radio frequency power amplifiers (RFPA) in 3G mobile handsets and other mobile applications. It provides up to 800mA of output current over an input voltage range of 2.7V to 5.5V. The output voltage can be dynamically adjusted from 0.4V up to 3.4V, proportional to an analog input voltage ranging from 0.2V to 1.7V provided by an external DAC. This allows supplying the RFPA with the voltage level that provides optimum Power Added Efficiency (PAE).

An integrated bypass FET automatically switches on when the battery voltage drops too close to the output voltage (when $V_{OUT}=V_{BAT}-250mV$). The bypass transition is controlled by a slew rate controller to limit the inrush current and reduce the RFPA gain deviation.

The FAN5902 offers fast transition times, allowing changes to the output voltage in less than 20µs.

The FAN5902 operates at 6MHz, enabling the use of a small, low-value inductor of 470nH. A current-mode control loop with fast transient response ensures excellent line and load regulation.

The FAN5902 improves the RFPA power efficiency and increases the talk/connection time in 3G handsets.

The FAN5902 is available in a 12-lead MLP package and 12-bump WLCSP.

Important

For complete performance specifications and datasheet, please contact a Fairchild Semiconductor sales representative.

Ordering Information

Part Number	Operating Temperature Range	Package	Eco Status	Packing Method
FAN5902MPX	-40 to +85°C	12-Lead, 3x3.5mm, Molded Leadless Package (MLP)	RoHS	Tape and Reel
FAN5902UCX	-40 to +85°C	12-Bump, Wafer-Level Chip-Scale Package (WLCSP)	RoHS	Tape and Reel

For Fairchild's definition of Eco Status, please visit: http://www.fairchildsemi.com/company/green/rohs_green.html.

Application Diagrams

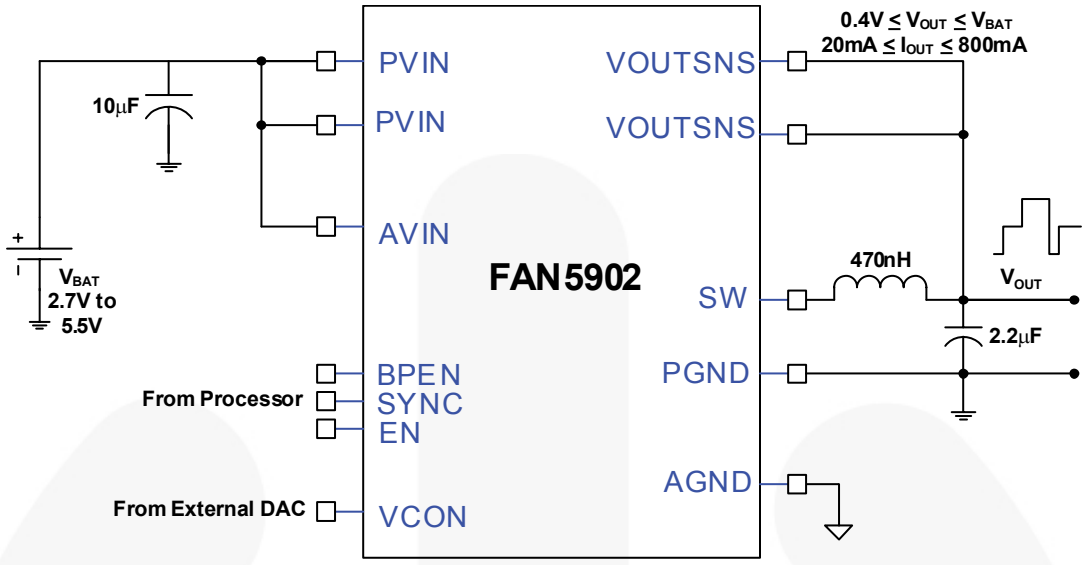


Figure 1. FAN5902 Circuit

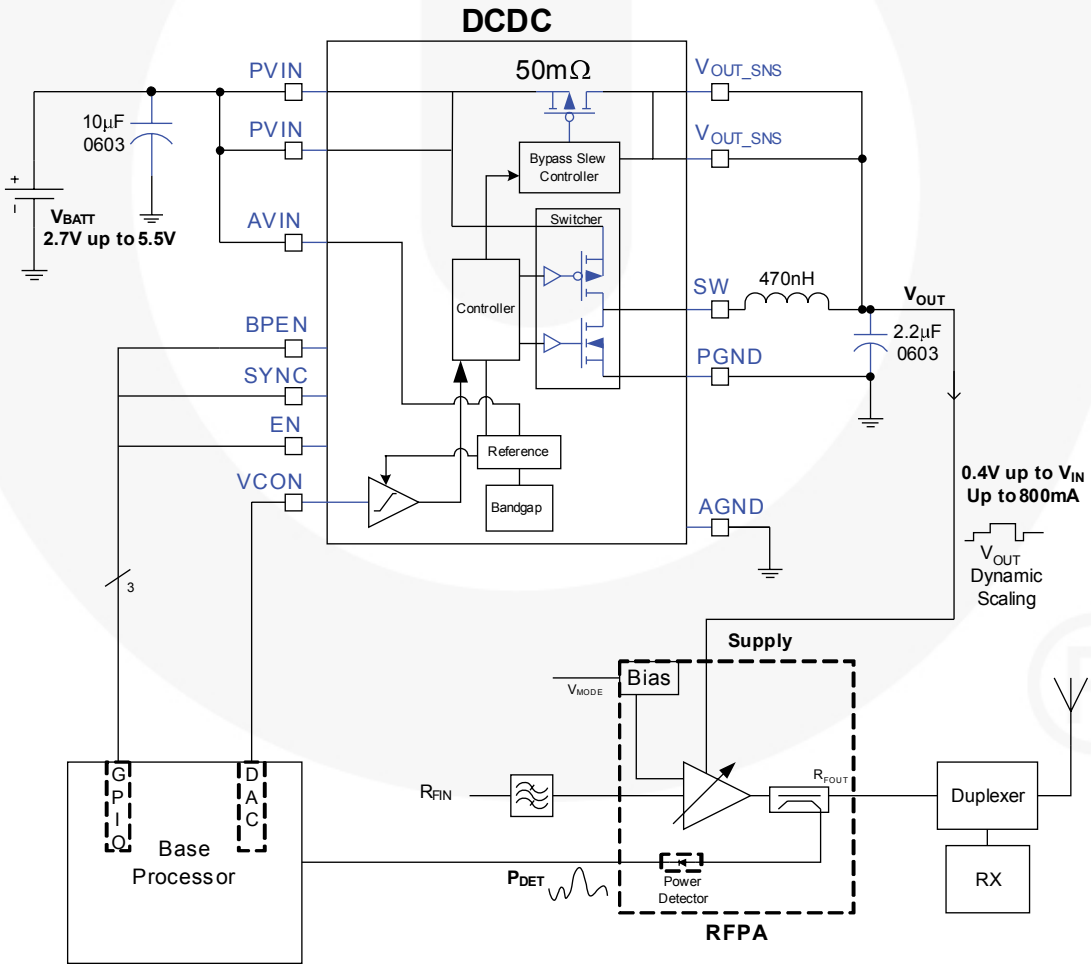


Figure 2. Typical Application

Pin Configurations

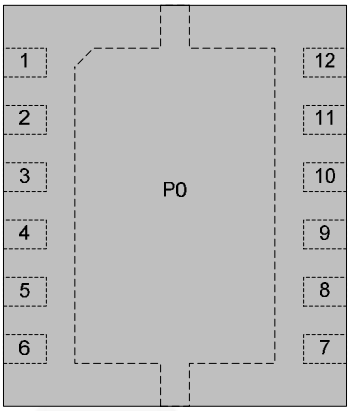


Figure 3. 12-Lead MLP (Top View)

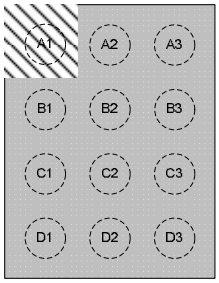


Figure 4. 12-Bump WLCSP (Top View)

Pin Definitions

MLP Pin #	WLCSP Pin #	Name	Description
(*)	(*)	AGND	Analog ground, reference ground for the IC. Follow PCB routing notes for connecting this pin.
		VOUTSNS	Output voltage sense pin. Connect to V_{OUT} to establish feedback path for regulation.
		EN	Enables switcher when HIGH, shutdown mode when LOW. This pin should not be left floating.
		VCON	Analog control input from an external D-to-A converter.
		AVIN	Analog bias supply voltage input. Connect to PVIN.
		AGND	Connect to analog ground.
		BPEN	Force bypass transistor when HIGH; auto-bypass when LOW. This pin should not be left floating
		SYNC	External clock synchronization input and PFM lockout. When SYNC remains HIGH, the DC-to-DC does not allow PFM mode. Tie SYNC to AGND if not used.
		PGND	Power ground of the internal MOSFET switches. Follow routing notes for connections between PGND and AGND.
		SW	Switching node of the internal MOSFET switches. Connect to output inductor.
		PVIN	Supply voltage input to the internal MOSFET switches. Connect to input power source.

(*) Pinout available upon request

Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

Symbol	Parameter		Min.	Max.	Unit
V_{IN}	AVIN, PVIN		-0.3	6.0	V
	Voltage On Any Other Pin		-0.3	AV_{IN}+0.3	
T_J	Junction Temperature		-40	+125	°C
T_{STG}	Storage Temperature		-65	+150	°C
T_L	Lead Soldering Temperature (10 Seconds)			+260	°C
θ_{JC}	Thermal Resistance, Junction to Tab(1)	MLP Package		5	°C/W
θ_{JC}	Thermal Resistance, Junction to Case(1)	WLCSP Package		30	°C/W

1. Refer to θ_{JA} data below.

Recommended Operating Conditions

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications. Fairchild does not recommend exceeding them or designing to Absolute Maximum Ratings.

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{CC}	Supply Voltage Range	2.7		5.5	V
V_{OUT}	Output Voltage Range	0.4		V_{IN}	V
I_{OUT}	Output Current	20		800	mA
L	Inductor		0.47		µH
C_{IN}	Input Capacitor(2)	10			µF
C_{OUT}	Output Capacitor(2)	2.2	4.7	10.0	µF
T_A	Operating Ambient Temperature Range	-40		+85	°C
T_J	Operating Junction Temperature Range	-40		+125	°C

Notes:

2. A high input capacitor value is required for limiting input voltage drop during bypass transitions or during large output voltage transitions. Ensure the input capacitor value is greater than the output capacitor's. *See the inrush current specifications below.*
3. *Refer to application note AN-6087 for more details.*

Dissipation Ratings(4)

Package	θ_{JA}(4)	Power Rating at $T_A \le 25°C$(5)	Derating Factor > T_A=25ºC
Molded Leadless Package (MLP)	49ºC/W(5)	2050mW	21mW/ºC
Wafer-Level Chip-Scale Package (WLCSP)	110ºC/W(5)	900mW	9mW/ºC

Notes:

4. Thermal Resistance, Junction-to-Ambient, measured according to JEDEC 2S2P PCB (and zero air flow). θ_{JA} for JEDEC 1S0P PCB (and zero air flow) = 210°C/W.
5. Maximum power dissipation is a function of $T_{J(max)}$, θ_{JA}, and T_A. The maximum allowable power dissipation at any allowable ambient temperature is $P_D=[T_{J(max)} - T_A] / \theta_{JA}$.

Typical Performance Characteristics

Typical performance at 25°C.

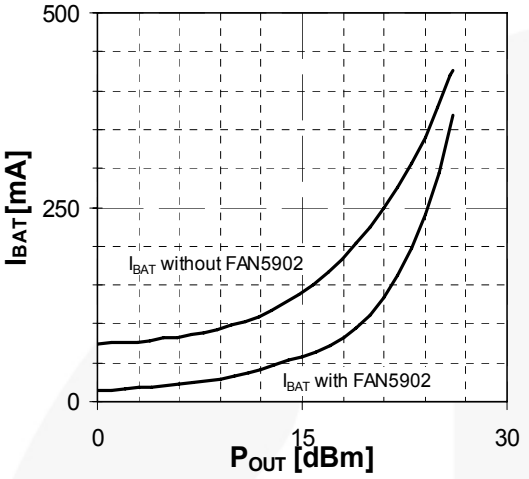


Figure 5. Comparison of RF PA Current Consumption with and without FAN5902

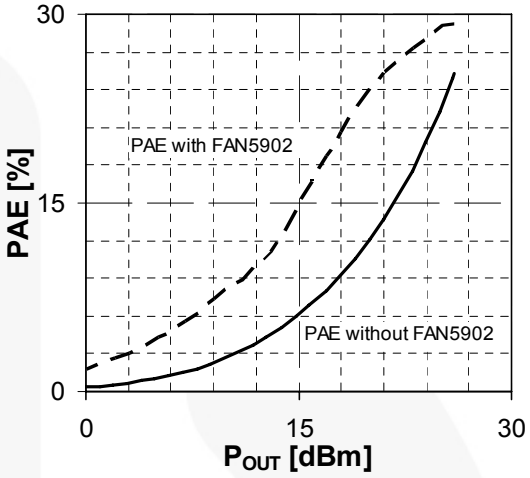


Figure 6. Comparison of RFPA Power Added Efficiency with and without FAN5902

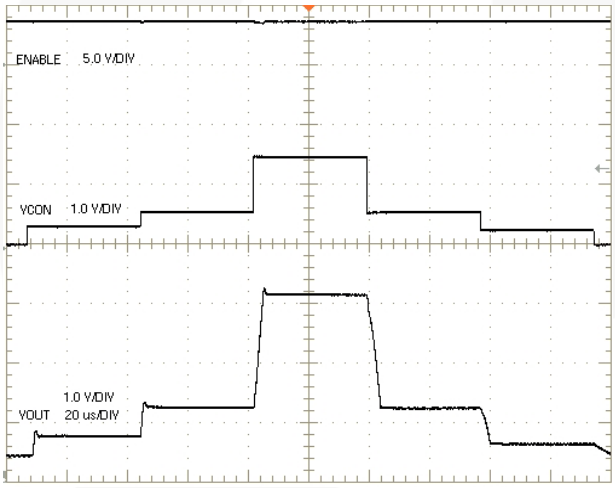


Figure 7. Rise Times for 300mV, 500mV, and 2V ΔV_{OUT} C_{OUT} = 2.2µF (V_{IN}=3.7V)

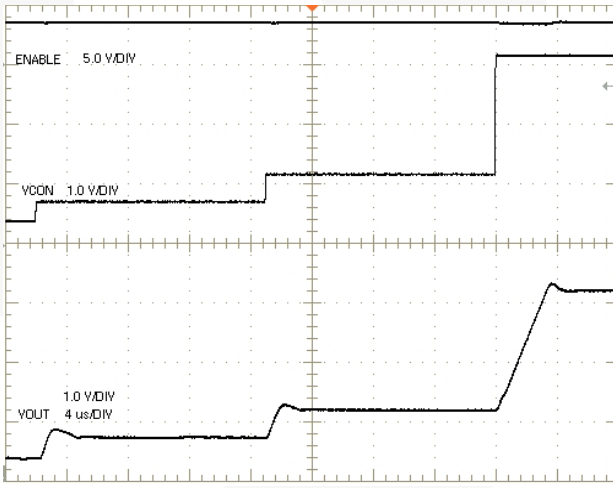
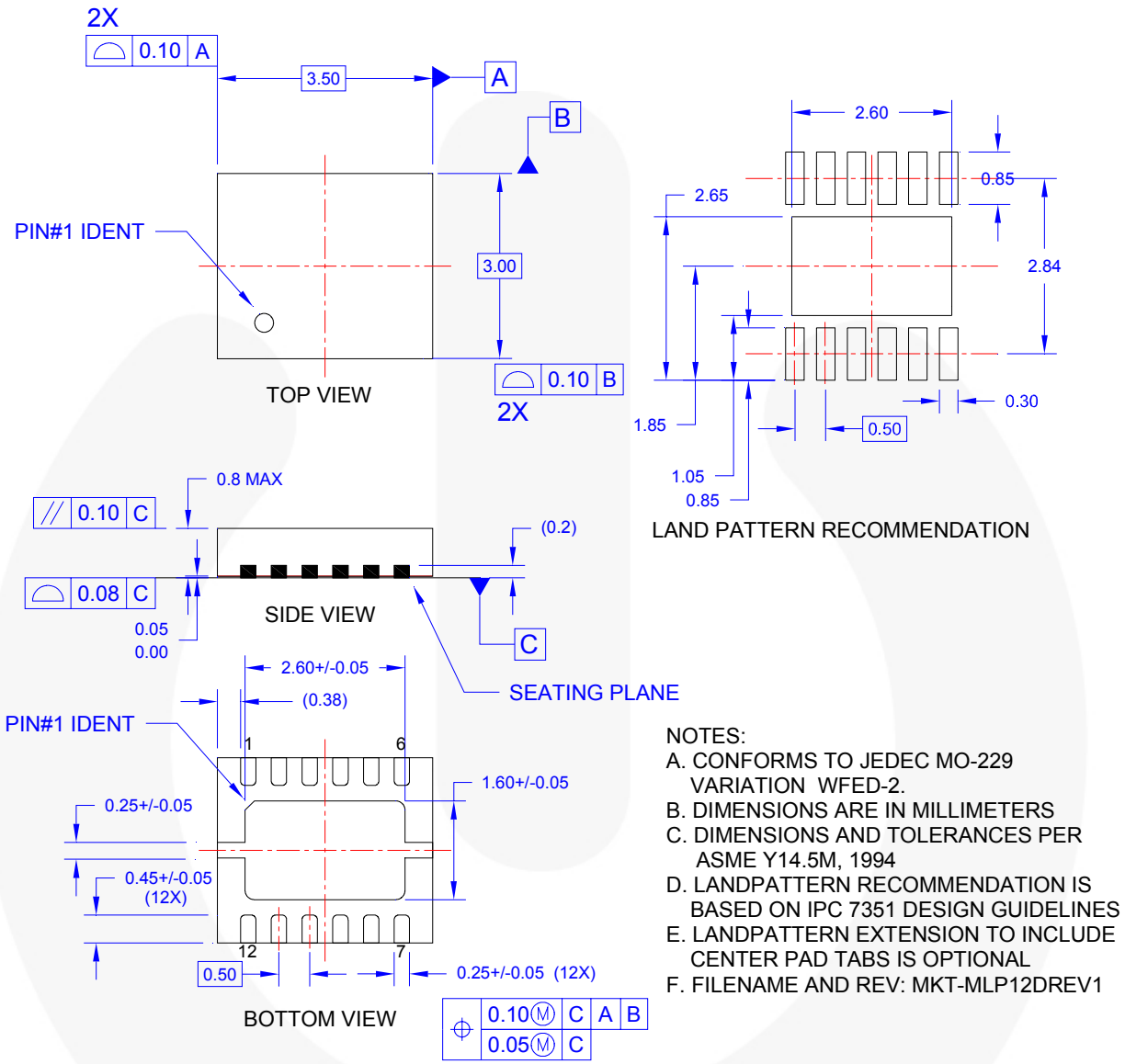


Figure 8. Rise Times for 300mV, 500mV, and 2V ΔV_{OUT} C_{OUT} = 2.2µF (V_{IN}=3.7V)

Physical Dimensions



NOTES:
A. CONFORMS TO JEDEC MO-229 VARIATION WFED-2.
B. DIMENSIONS ARE IN MILLIMETERS
C. DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994
D. LANDPATTERN RECOMMENDATION IS BASED ON IPC 7351 DESIGN GUIDELINES
E. LANDPATTERN EXTENSION TO INCLUDE CENTER PAD TABS IS OPTIONAL
F. FILENAME AND REV: MKT-MLP12DREV1

Figure 9: 3x3.5mm 12-Lead MLP

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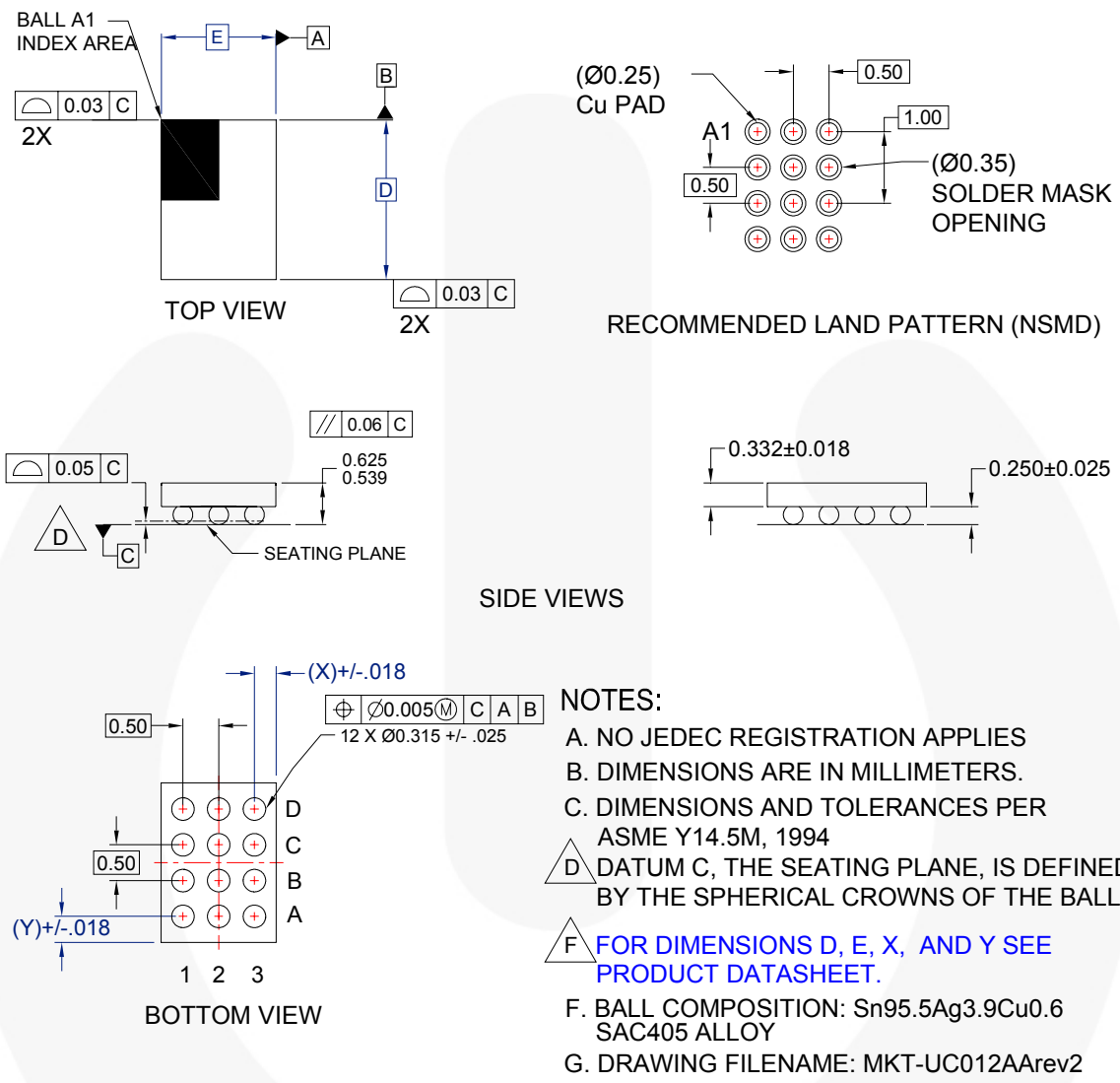
Physical Dimensions (Continued)



NOTES:

A. NO JEDEC REGISTRATION APPLIES

B. DIMENSIONS ARE IN MILLIMETERS.

C. DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994

D DATUM C, THE SEATING PLANE, IS DEFINED BY THE SPHERICAL CROWNS OF THE BALLS.

F FOR DIMENSIONS D, E, X, AND Y SEE PRODUCT DATASHEET.

F. BALL COMPOSITION: Sn95.5Ag3.9Cu0.6 SAC405 ALLOY

G. DRAWING FILENAME: MKT-UC012AArev2

Figure 10. 12-Bump WLCSP

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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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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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