

## Autonomous Audio Headset Switch with Reduced GND Switch $R_{ON}$ and FM Capability

Check for Samples: [TS3A226AE](#)

### FEATURES

- Ground FET Switches (60m $\Omega$  typical)
- Autonomous Detection of Headset Types: 3-Poles or 4-Poles (with MIC on SLEEVE or RING2)
- Microphone Line Switches
- Supports FM Signal Transmission Through the Ground FETs
- Reduction of Click/Pop Noise
- VDD Range: 2.6 V – 4.7 V
- THD (Mic): 0.002% Typical
- Low Current Consumption: 6.5- $\mu$ A Typical
- $\pm$ 8kV Contract Discharge (IEC 61000-4-2) ESD Performance on SLEEVE and RING2 Pins

### APPLICATIONS

- Mobile Phones / Tablet PCs
- Notebook/Ultrabook Computers

### DESCRIPTION

The TS3A226AE is an audio headset switch that detects 3- or 4-pole 3.5mm accessories. For a 4-pole accessory with a microphone, the TS3A226AE also detects the MIC location and routes the microphone and ground signals automatically. The ground signal is routed through a pair of low-impedance ground FETs (60m $\Omega$  typical), resulting minimal impact on audio cross-talk performance. The autonomous detection feature allows end users to plug in accessories with different audio pole configurations into the mobile device and have them operate properly with no added software control and complexity. The ground FETs of the device are designed to allow FM signal pass-through, making it possible to use the ground line of the headset as an FM antenna in mobile audio application.

The TS3A226AE is packaged within a 1.2mm x 1.2mm WCSP package, making it suitable for use in mobile application.

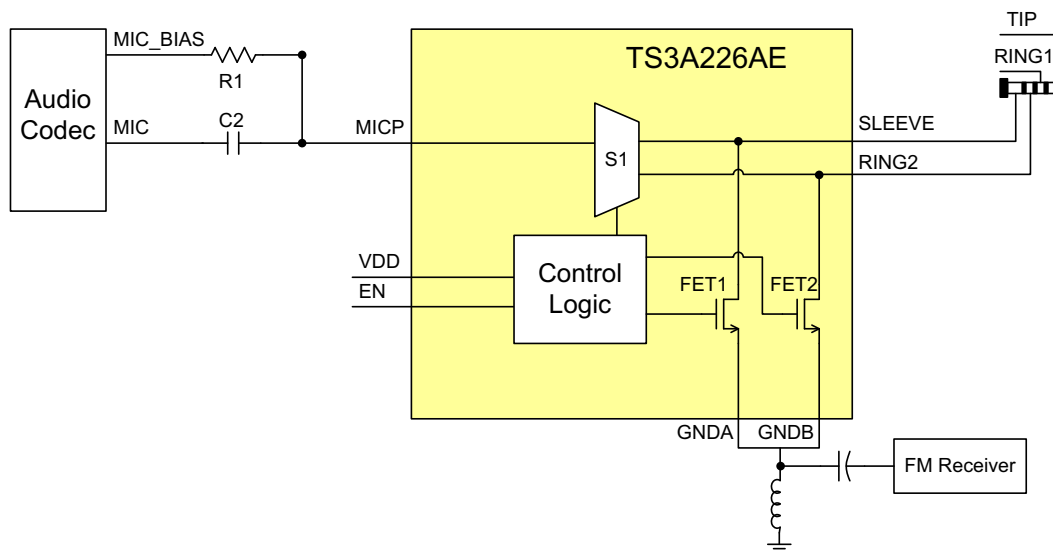


Figure 1. Typical Application Diagram

### ORDERING INFORMATION

For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI web site at [www.ti.com](http://www.ti.com)



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# TS3A226AE

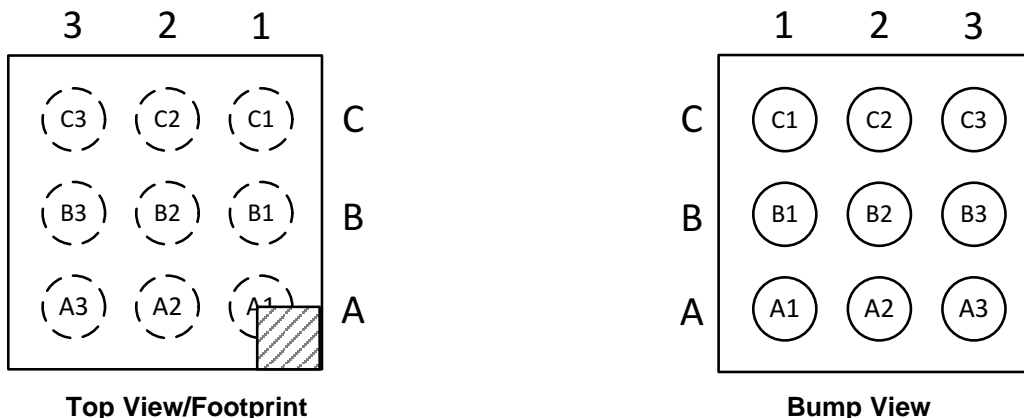
SCDS346A – JUNE 2013 – REVISED JULY 2013

www.ti.com



These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

## PACKAGE; YFF-WCSP



Die Size: 1.2mm x 1.2mm  
 Bump Size: 0.25mm  
 Bump Pitch: 0.4mm

TS3A226AE Pin Mapping (Top View)

	3	2	1
C	GND	TIP	EN
B	SLEEVE	GNDA	MICp
A	RING2	GNDB	VDD

## PIN FUNCTIONS

NUMBER	PIN		DESCRIPTION
	NAME	TYPE	
A1	VDD	Supply	Power supply for the chip.
A2	GNDB	Ground	FET2 ground reference.
A3	RING2	I/O	Connected to the RING2 segment of the jack. The pin will be routed automatically by TS3A226AE to either MICp or GNDB depending on the type of accessory.
B1	MICp	I/O	Microphone signal connection to codec. Microphone bias should be fed into this pin.
B2	GNDA	Ground	FET1 ground reference.
B3	SLEEVE	I/O	Connected to the SLEEVE segment of the jack. The pin will be routed automatically by TS3A226AE to either MICp or GNDA depending on the type of accessory.
C1	EN	Input	A rising edge triggers the detection sequence. This pin can be connected to the headset jack to allow automatic pull-up to supply after headset insertion.
C2	TIP	I/O	Connected to the TIP segment of the headphone jack.
C3	GND	Ground	Chip ground reference.

S1 MUX DETAIL

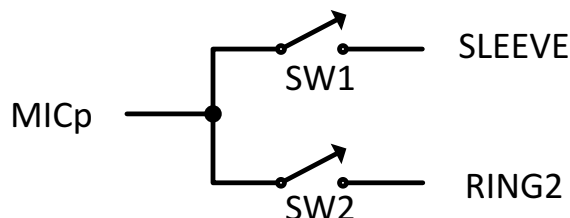


Figure 2. S1 Mux Detail

FUNCTIONAL TABLES: INTERNAL SWITCHES

EN	Accessory Type	Accessory Configuration	SW1	SW2	FET1	FET2
0	N/A	—	High Z	High Z	High Z	High Z
1	TRS 3-pole Headphone or Speaker	TIP = Audio Left Ring = Audio Right Sleeve = <b>Ground</b>	On	On	On	On
1	TRRS 4-pole Headphone	TIP = Audio Left Ring1 = Audio Right Ring2 = <b>Ground</b> Sleeve = <b>Microphone</b>	On	High Z	High Z	On
1	TRRS 4-pole Headphone	TIP = Audio Left Ring1 = Audio Right Ring2 = <b>Microphone</b> Sleeve = <b>Ground</b>	High Z	On	On	High Z
1	N/A	—	On	On	On	On

ABSOLUTE MAXIMUM RATINGS

over operating free-air temperature range (unless otherwise noted)<sup>(1)</sup>

		VALUE	UNIT
V <sub>I</sub>	Voltage range on VDD <sup>(2)</sup>	-0.3 to 5	V
	Voltage range on EN, MICP, RING2, SLEEVE, TIP <sup>(2)</sup>	-0.3 to V <sub>DD</sub> +0.5	V
T <sub>A</sub>	Operating ambient temperature range <sup>(3)</sup>	-40 to 85	°C
T <sub>J (MAX)</sub>	Maximum operating junction temperature	125	°C
T <sub>stg</sub>	Storage temperature range	-65 to 150	°C
ESD rating	Charge device model (JEDEC 22 C101)	500	V
	Human body model (JEDEC 22 A114)	2	kV
	Contact discharge on RING2, SLEEVE, TIP (IEC 61000-4-2)	8	kV

- (1) Stresses beyond those listed under absolute maximum ratings may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under recommended operating conditions is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- (2) All voltage values are with respect to network ground terminal.
- (3) In applications where high power dissipation and/or poor package thermal resistance is present, the maximum ambient temperature may have to be derated. Maximum ambient temperature [T<sub>A(max)</sub>] is dependent on the maximum operating junction temperature [T<sub>J(max)</sub>], the maximum power dissipation of the device in the application [P<sub>D(max)</sub>], and the junction-to-ambient thermal resistance of the part/package in the application (θ<sub>JA</sub>), as given by the following equation: T<sub>A(max)</sub> = T<sub>J(max)</sub> - (θ<sub>JA</sub> × P<sub>D(max)</sub>)

## RECOMMENDED OPERATING CONDITIONS

over operating free-air temperature range (unless otherwise noted)

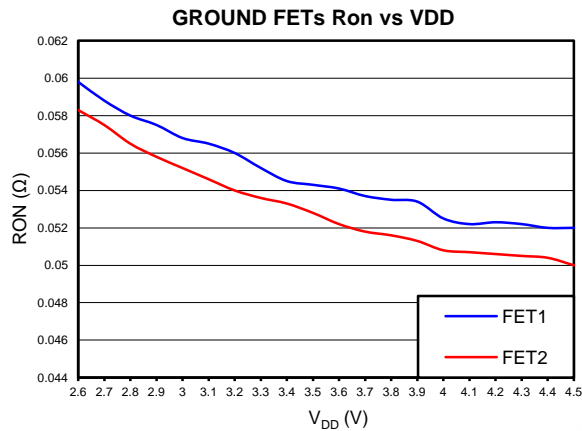
		MIN	MAX	UNIT	
V <sub>DD</sub>	Supply voltage range	2.6	4.5	V	
V <sub>IO</sub>	Input/Output voltage range (EN, MICP, RING2, SLEEVE, TIP)	0	V <sub>DD</sub>	V	
V <sub>IO(TIP)</sub>	Input/Output voltage range for TIP	-2.0	V <sub>DD</sub>	V	
V <sub>IH</sub>	Input Logic High for EN	V <sub>DD</sub> = 2.6 V	1.16	V <sub>DD</sub>	V
		V <sub>DD</sub> = 3.3 V	1.24	V <sub>DD</sub>	
		V <sub>DD</sub> = 4.5 V	1.48	V <sub>DD</sub>	
V <sub>IL</sub>	Input Logic Low for EN	V <sub>DD</sub> = 2.6 V	0	0.19	V
		V <sub>DD</sub> = 3.3 V	0	0.3	
		V <sub>DD</sub> = 4.5 V	0	0.5	
T <sub>A</sub>	Operating temperature range	-40	85	°C	

## KEY ELECTRICAL CHARACTERISTICS

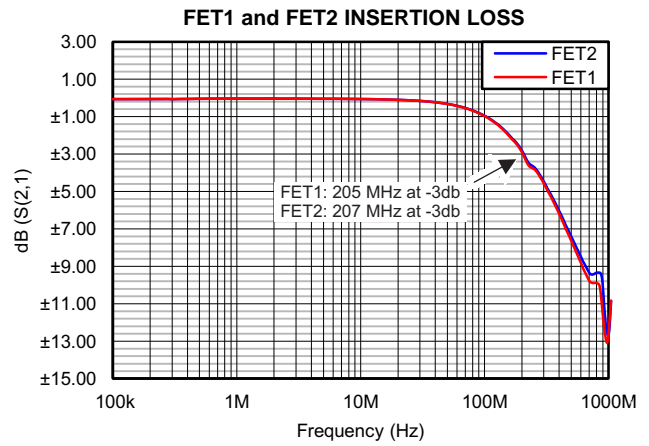
 Unless otherwise noted the specification applies over the V<sub>DD</sub> range and operating junction temperature  $-40^{\circ}\text{C} \leq T_A \leq 70^{\circ}\text{C}$ . Typical values are for V<sub>DD</sub> = 3.3V and T<sub>J</sub> = 25°C.

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
V <sub>DD</sub>	Input Voltage Range		2.6	3.3	4.5	V
I <sub>DD</sub>	Quiescent Current	V <sub>DD</sub> = 4.5 V, V <sub>MICP</sub> = 1.8 V to V <sub>DD</sub> , EN=L or EN=H (after detection)		6.5	14	μA
<b>SWITCH RESISTANCE</b>						
R <sub>F1</sub>	FET1 On Resistance	V <sub>DD</sub> = 2.6 V, V <sub>GND</sub> = 0 V, I <sub>GND</sub> = 10 mA		60	85	mΩ
R <sub>F2</sub>	FET2 On Resistance			60	85	
R <sub>SW1</sub>	SW1 On Resistance	V <sub>DD</sub> = 2.6 V, V <sub>SLEEVE/RING2</sub> = 0 V to 2.6 V, I <sub>MIC</sub> = ±10 mA		8.5	10.5	Ω
R <sub>SW2</sub>	SW2 On Resistance			8.5	10.5	
<b>SWITCH LEAKAGE CURRENT</b>						
I <sub>OFF-0.1</sub>	FET1 and FET2 off leakage	V <sub>IN</sub> = 0 V to 2.6 V, V <sub>OUT</sub> = 0 V, V <sub>DD</sub> = 4.5 V			1	μA
I <sub>OFF-10</sub>	SW1, SW2 off leakage				1	
I <sub>ON-10</sub>	SW1, SW2 on leakage				1	
<b>SWITCH DYNAMIC CHARACTERISTICS</b>						
BW <sub>F1</sub>	FET1 Bandwidth	V = 60 mV <sub>PP</sub> , I <sub>bias</sub> = 10 mA	160	200		MHz
BW <sub>F2</sub>	FET2 Bandwidth		160	200		
PSR <sub>217</sub>	Power Supply Rejection, R <sub>L</sub> = 50 Ω	V = 200 mV <sub>PP</sub> , f = 217 Hz		-110		dB
PSR <sub>1k</sub>		V = 200 mV <sub>PP</sub> , f = 1 kHz		-100		dB
PSR <sub>20k</sub>		V = 200 mV <sub>PP</sub> , f = 20 kHz		-85		dB
ISO <sub>S1</sub>	SLEEVE or RING2 to MICP Isolation	V = 200 mV <sub>PP</sub> , f = 20 kHz, R <sub>L</sub> = 50 Ω		-80		dB
SEP <sub>S1</sub>	SLEEVE to RING2 Separation	V = 200 mV <sub>PP</sub> , f = 20 kHz, R <sub>L</sub> = 50 Ω (see Figure 5)		-80		dB
THD <sub>10</sub>	Total Harmonic Distortion	V = 10 mV <sub>PP</sub> , f = 20-20 kHz, R <sub>S</sub> = 600 Ω		0.01%		
THD <sub>200</sub>		V = 200 mV <sub>PP</sub> , f = 20-20 kHz, R <sub>S</sub> = 600 Ω		0.002%		
<b>TIMING CHARACTERISTICS</b>						
t <sub>dect</sub>	Total detection time	From EN=H to S1 switch(es) closing		180		ms

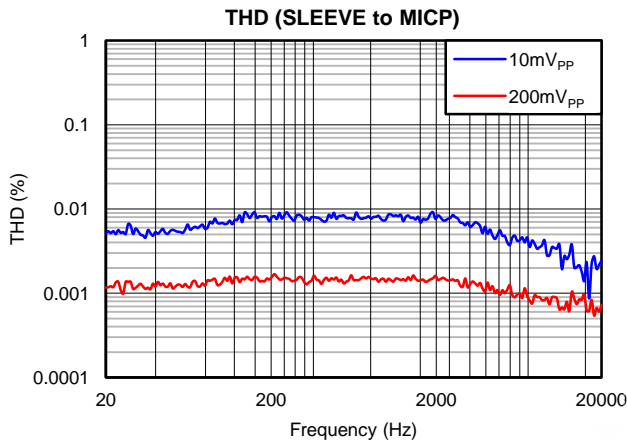
**TYPICAL CHARACTERISTICS**



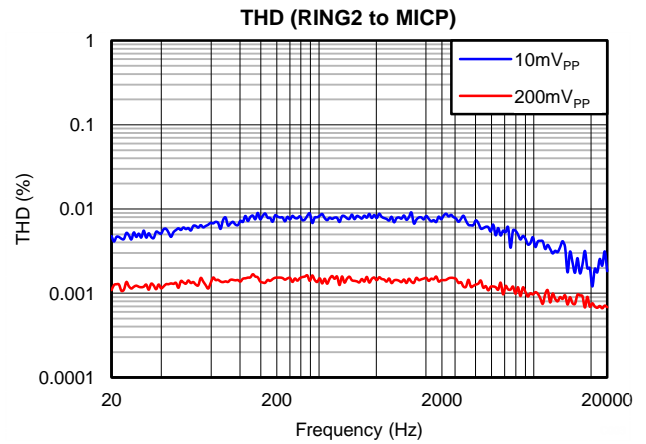
**Figure 3.**



**Figure 4.**



**Figure 5.**



**Figure 6.**

## REVISION HISTORY

Changes from Original (June 2013) to Revision A	Page
• Removed Machine Model ESD specification. ....	3
• Added EN=L or EN=H (after detection) to I <sub>DD</sub> TEST CONDITIONS. ....	4
• Added typical values to R <sub>SW1</sub> and R <sub>SW2</sub> . ....	4
• Added t <sub>dect</sub> PARAMETER to KEY ELECTRICAL CHARACTERISTICS table. ....	4

**PACKAGING INFORMATION**

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
TS3A226AEYFFR	ACTIVE	DSBGA	YFF	9	3000	RoHS & Green	SNAGCU	Level-1-260C-UNLIM	-40 to 85	YP2 26AE	<b>Samples</b>

(1) The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBsolete:** TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

**RoHS Exempt:** TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

**Green:** TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

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**TAPE AND REEL INFORMATION**

**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
TS3A226AEYFFR	DSBGA	YFF	9	3000	180.0	8.4	1.46	1.36	0.7	4.0	8.0	Q1



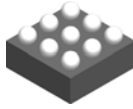
TAPE AND REEL BOX DIMENSIONS



\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TS3A226AEYFFR	DSBGA	YFF	9	3000	182.0	182.0	20.0

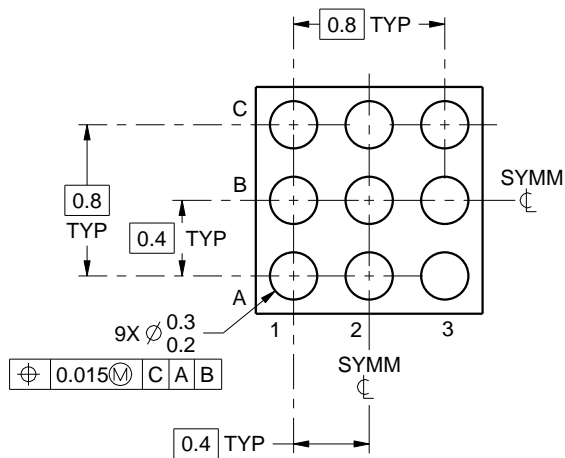
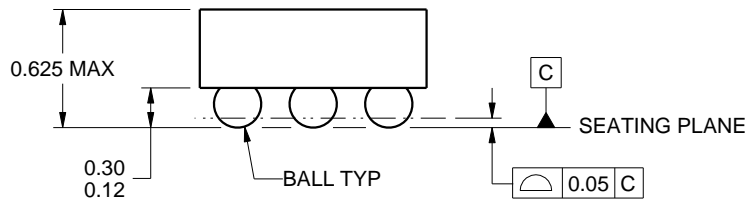
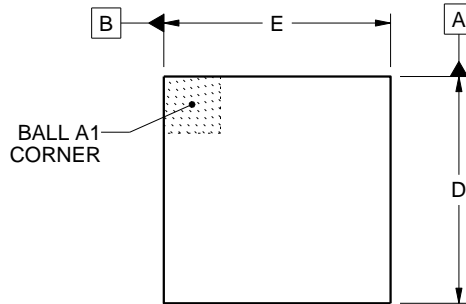
YFF0009



# PACKAGE OUTLINE

DSBGA - 0.625 mm max height

DIE SIZE BALL GRID ARRAY



D: Max = 1.386 mm, Min = 1.326 mm

E: Max = 1.286 mm, Min = 1.226 mm

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NOTES:

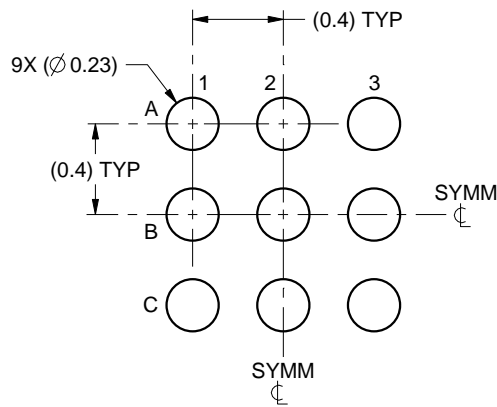
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.

# EXAMPLE BOARD LAYOUT

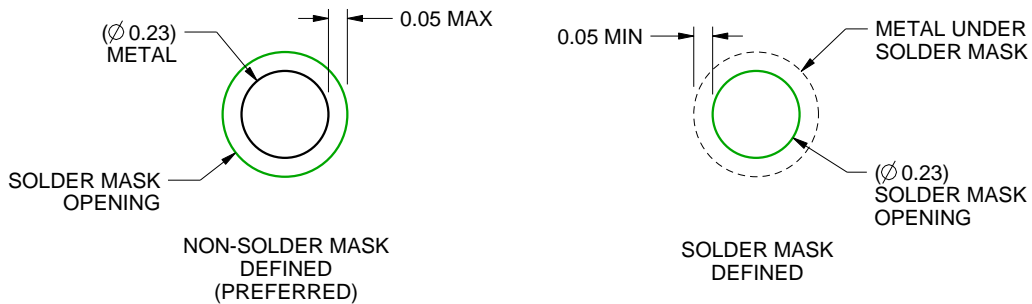
YFF0009

DSBGA - 0.625 mm max height

DIE SIZE BALL GRID ARRAY



LAND PATTERN EXAMPLE  
SCALE:30X



SOLDER MASK DETAILS  
NOT TO SCALE

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NOTES: (continued)

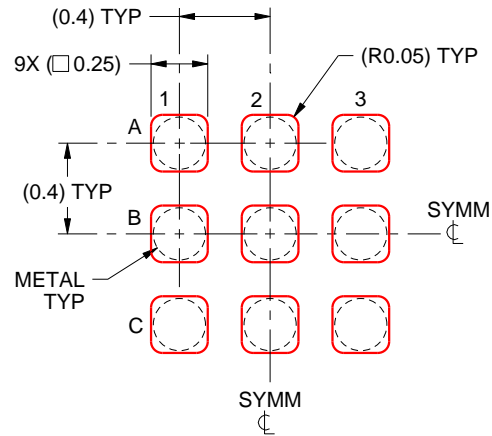
3. Final dimensions may vary due to manufacturing tolerance considerations and also routing constraints. For more information, see Texas Instruments literature number SNVA009 ([www.ti.com/lit/snva009](http://www.ti.com/lit/snva009)).

# EXAMPLE STENCIL DESIGN

YFF0009

DSBGA - 0.625 mm max height

DIE SIZE BALL GRID ARRAY



SOLDER PASTE EXAMPLE  
BASED ON 0.1 mm THICK STENCIL  
SCALE:30X

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NOTES: (continued)

4. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release.

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