

SN74AVCA406L

#### **FEATURES**

- **Transceiver for Memory Card Interface** [MultiMediaCard (MMC), Secure Digital (SD), Memory Stick™ Compliant Products]
- Configurable I/O Switching Levels With **Dual-Supply Pins Operating Over Full 1.2-V to** 3.6-V Power-Supply Range
- For Low-Power Operation, A and B Ports Are Placed in High-Impedance State When Either Supply Voltage Is Switched Off
- Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II
- **ESD Protection Exceeds JESD 22** 
  - 6000-V Human-Body Model (A114-A)
  - 200-V Machine Model (A115-A)
  - 1000-V Charged-Device Model (C101)

#### DESCRIPTION/ORDERING INFORMATION

The SN74AVCA406L is a transceiver for interfacing microprocessors with MultiMediaCards (MMCs), secure digital (SD) cards, and Memory Stick™ compliant products.

Two supply-voltage pins allow the A-port and B-port input switching thresholds to be configured separately. The A port is designed to track  $V_{CCA}$ , while the B port is designed to track  $V_{CCB}$ .  $V_{CCA}$  and  $V_{CCB}$  can accept any supply voltage from 1.2 V to 3.6 V.

If either V<sub>CC</sub> is switched off (V<sub>CCA</sub> = 0 V and/or V<sub>CCB</sub> = 0 V), all outputs are placed in the high-impedance state to conserve power.

The SN74AVCA406L enables system designers to easily interface low-voltage microprocessors to different memory cards operating at higher voltages.

The SN74AVCA406L is available in two 0.5-mm-pitch ball grid array (BGA) packages. The 20-ball package has dimensions of 3 mm × 2.5 mm, and the 24-ball package measures 3 mm × 3 mm. Memory cards are widely used in mobile phones, PDAs, digital cameras, personal media players, camcorders, set-top boxes, etc. Low static power consumption and small package size make the SN74AVCA406L an ideal choice for these applications.

#### ORDERING INFORMATION

T <sub>A</sub>	PACKAGE <sup>(1)</sup>		ORDERABLE PART NUMBER	TOP-SIDE MARKING
	UFBGA – GXY	Reel of 2500	SN74AVCA406LGXYR	WV406
	UFBGA – ZXY (Pb-Free)	Reel of 2500	SN74AVCA406LZXYR	WV406
-40°C to 85°C	MicroStar Junior™ BGA – GQS	Reel of 2500	SN74AVCA406LGQSR	WM406L
	MicroStar Junior™ BGA – ZQS (Pb-Free)	Reel of 2500	SN74AVCA406LZQSR	WM406L

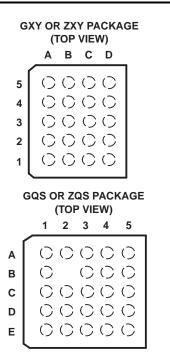
(1) Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.



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# TERMINAL ASSIGNMENTS (20-Ball GXY/ZXY Package)

	Α	В	С	D
5	$V_{CCA}$	CMD-dir	DAT0-dir	$V_{CCB}$
4	4 DAT3A DAT2A		DAT2B	DAT3B
3	CLKA	GND	GND	CLKB
2	DAT1A	DAT0A	CMDB	DAT0B
1	CLK-f	CMDA	DAT123-dir	DAT1B

# TERMINAL ASSIGNMENTS (24-Ball GQS/ZQS Package)

	1	2	3	4	5
Α	DAT2A	CMD-dir	DAT0-dir	RSV	DAT2B
В	DAT3A		$V_{CCA}$	$V_{CCB}$	DAT3B
С	CLKA	RSV	GND	GND	CLKB
D	DAT0A	CMDA	RSV	CMDB	DAT0B
E	DAT1A	CLK-f	DAT123-dir	RSV	DAT1B

#### REFERENCE DESIGN

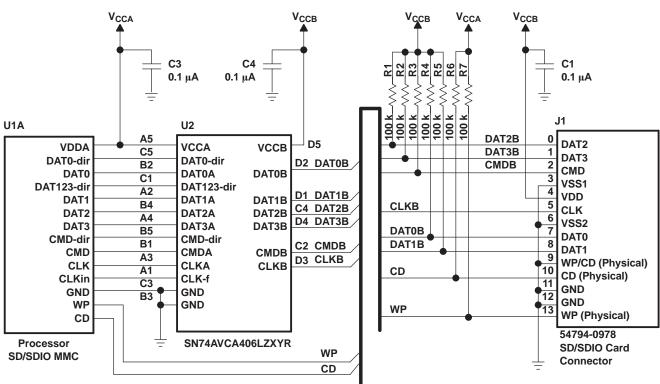


Figure 1. Interfacing With SD/SDIO Card

# SN74AVCA406L MMC, SD CARD, Memory Stick™ VOLTAGE-TRANSLATION TRANSCEIVER

SCES634B-JANUARY 2006-REVISED JUNE 2006

#### **PIN DESCRIPTION**

GXY/ZXY NO.	GQS/ZQS NO.	NAME	FUNCTION	TYPE
A1	E2	CLK-f	Clock feedback to host for resynchronizing data. Used in OMAP processors. Leave unconnected if not used.	Output
A2	E1	DAT1A	Data bit 2 connected to host. Referenced to V <sub>CCA</sub> .	I/O
A3	C1	CLKA	Clock signal connected to host. Referenced to V <sub>CCA</sub> .	Input
A4	B1	DAT3A	Data bit 4 connected to host. Referenced to V <sub>CCA</sub> .	I/O
A5	В3	V <sub>CCA</sub>	A-port supply voltage. V <sub>CCA</sub> powers all A-port I/Os and control inputs.	Power
B1	D2	CMDA	Command bit connected to host. Referenced to V <sub>CCA</sub> .	I/O
B2	D1	DAT0A	Data bit 1 connected to host. Referenced to V <sub>CCA</sub> .	I/O
В3	C4	GND	Ground	
B4	A1	DAT2A	Data bit 3 connected to host. Referenced to V <sub>CCA</sub> .	I/O
B5	A2	CMD-dir	Direction control for command bit (CMDA/CMDB)	Input
C1	E3	DAT123-dir	Direction control for DAT1A/B, DAT2A/B, and DAT3A/B	Input
C2	D4	CMDB	Command bit connected to memory card. Referenced to V <sub>CCB</sub> .	I/O
C3	C3	GND	Ground	
C4	A5	DAT2B	Data bit 3 connected to memory card. Referenced to V <sub>CCB</sub>	I/O
C5	А3	DAT0-dir	Direction control for DAT0A/DAT0B	Input
D1	E5	DAT1B	Data bit 2 connected to memory card. Referenced to V <sub>CCB</sub> .	I/O
D2	D5	DAT0B	Data bit 1 connected to memory card. Referenced to V <sub>CCB</sub> .	I/O
D3	C5	CLKB	Clock signal connected to memory card. Referenced to V <sub>CCB</sub> .	Output
D4	B5	DAT3B	Data bit 4 connected to memory card. Referenced to V <sub>CCB</sub> .	I/O
D5	B4	V <sub>CCB</sub>	B-port supply voltage. V <sub>CCB</sub> powers all B-port I/Os.	Power
NA	B2		Depopulated ball	
NA	A4, C2, D3, E4	RSV	Reserved (for possible future functionality). Leave unconnected.	





#### **FUNCTION TABLES**

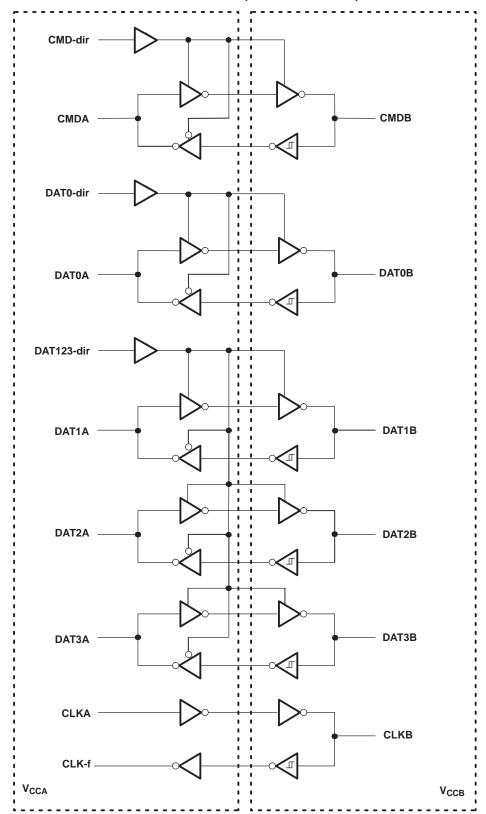
CONTROL INPUT	OUTPUT	OPERATION	
CMD-dir	CMDA	CMDB	OPERATION
High	Hi-Z	Enabled	CMDA to CMDB
Low	Enabled	Hi-Z	CMDB to CMDA

CONTROL INPUT DAT0-dir	OUTPUT	FUNCTION		
	DAT0A	DAT0B	FUNCTION	
High	Hi-Z	Enabled	DAT0A to DAT0B	
Low	Enabled	Hi-Z	DAT0B to DAT0A	

	OUTPUT		
CONTROL INPUT DAT123-dir	DAT1A, DAT2A, DAT3A	DAT1B, DAT2B, DAT3B	FUNCTION
			DAT1A to DAT1B
High	Hi-Z	Enabled	DAT2A to DAT2B
			DAT3A to DAT3B
			DAT1B to DAT1A
Low	Enabled	Hi-Z	DAT2B to DAT2A
			DAT3B to DAT3A



#### **LOGIC DIAGRAM (POSITIVE LOGIC)**



### SN74AVCA406L MMC, SD CARD, Memory Stick™ VOLTAGE-TRANSLATION TRANSCEIVER

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SCES634B-JANUARY 2006-REVISED JUNE 2006

#### Absolute Maximum Ratings (1)

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

			MIN	MAX	UNIT
V <sub>CCA</sub>	Supply voltage range		-0.5	4.6	V
		I/O ports (A port)	-0.5	4.6	
$V_{I}$	Input voltage range <sup>(2)</sup>	I/O ports (B port)	-0.5	4.6	V
	put voltage range (2)  Oltage range applied to any output the high-impedance or power-off state (2)  Oltage range applied to any output in the high or low state (2)(3)  put clamp current output clamp current continuous output current continuous current through V <sub>CCA</sub> , V <sub>CCB</sub> , or GND  ackage thermal impedance (4)	Control inputs	-0.5	4.6	
M	Voltage range applied to any output	A port	-0.5	4.6	V
Vo	in the high-impedance or power-off state <sup>(2)</sup>	B port	-0.5	4.6	V
M	Voltage range applied to any output in the high or low state (2)(3)	A port	-0.5	V <sub>CCA</sub> + 0.5	V
Vo		B port	-0.5	V <sub>CCB</sub> + 0.5	V
I <sub>IK</sub>	Input clamp current	V <sub>1</sub> < 0		-50	mA
I <sub>OK</sub>	Output clamp current	V <sub>O</sub> < 0		-50	mA
Io	Continuous output current			±50	mA
	Continuous current through V <sub>CCA</sub> , V <sub>CCB</sub> , or GND			±100	mA
0	Dealers the small investigation (4)	GQS/ZQS package		171.6	0000
$\theta_{JA}$	Package thermal impedance (*)	GXY/ZXY package		193	°C/W
T <sub>stg</sub>	Storage temperature range	·	-65	150	°C

<sup>(1)</sup> 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.

<sup>(2)</sup> The input voltage and output negative-voltage ratings may be exceeded if the input and output current ratings are observed.

 <sup>(3)</sup> The output positive-voltage rating may be exceeded up to 4.6 V maximum if the output current rating is observed.
 (4) The package thermal impedance is calculated in accordance with JESD 51-7.

#### SCES634B-JANUARY 2006-REVISED JUNE 2006

# Recommended Operating Conditions (1)(2)(3)

			V <sub>CCI</sub>	V <sub>cco</sub>	MIN	MAX	UNIT
$V_{CCA}$	Supply voltage				1.2	3.6	V
$V_{CCB}$	Supply voltage				1.2	3.6	V
			1.2 V to 1.95 V		V <sub>CCI</sub> × 0.65		
$V_{IH}$	High-level input voltage	All inputs (4)	1.95 V to 2.7 V		1.7		V
			2.7 V to 3.6 V		2		
			1.2 V to 1.95 V			$V_{CCI} \times 0.35$	
$V_{IL}$	Low-level input voltage	All inputs (4)	1.95 V to 2.7 V			0.7	V
			2.7 V to 3.6 V			0.8	
VI	Input voltage	Control inputs			0	3.6	V
		Active state			0	V <sub>CCO</sub>	
$V_{I/O}$	Input/output voltage	3-state			0	3.6	V
		-1		1.2 V		-1	
				1.4 V to 1.6 V		-1	
I <sub>OH</sub>	High-level output current	(A port)		1.65 V to 1.95 V		-2	mA
				2.3 V to 2.7 V		-4	
				3 V to 3.6 V		-8	
				1.2 V		1	
				1.4 V to 1.6 V		1	
$I_{OL}$	High-level input voltage  All inputs (4)  Low-level input voltage  All inputs (4)  Input voltage  Control inputs  Active state		1.65 V to 1.95 V		2	mA	
				2.3 V to 2.7 V		4	
				3 V to 3.6 V		8	
				1.2 V		-1	
				1.4 V to 1.6 V		-2	
I <sub>OH</sub>	High-level output current	(B port)		1.65 V to 1.95 V		-4	mA
				2.3 V to 2.7 V		-8	
				3 V to 3.6 V		-16	
				1.2 V		1	
				1.4 V to 1.6 V		2	
$I_{OL}$	Low-level output current (	voltage All inputs (4)  2.2 V to 1.95 V 2.7 V to 3.6 V  1.2 V to 1.95 V 2.7 V to 3.6 V  1.2 V to 1.95 V 2.7 V to 3.6 V  1.2 V to 1.95 V 2.7 V to 3.6 V  1.2 V 1.4 V to 1.6 V 1.65 V to 1.95 V 2.3 V to 2.7 V 3 V to 3.6 V  1.2 V 1.4 V to 1.6 V 1.65 V to 1.95 V 2.3 V to 2.7 V 3 V to 3.6 V  1.2 V 1.4 V to 1.6 V 1.65 V to 1.95 V 2.3 V to 2.7 V 3 V to 3.6 V  1.2 V 1.4 V to 1.6 V 1.65 V to 1.95 V 2.3 V to 2.7 V 3 V to 3.6 V  1.2 V 1.4 V to 1.6 V 1.65 V to 1.95 V 2.3 V to 2.7 V 3 V to 3.6 V  1.2 V 1.4 V to 1.6 V 1.65 V to 1.95 V 2.3 V to 2.7 V 3 V to 3.6 V  1.2 V 1.4 V to 1.6 V 1.65 V to 1.95 V 2.3 V to 2.7 V 3 V to 3.6 V  1.2 V 1.4 V to 1.6 V 1.65 V to 1.95 V 2.3 V to 2.7 V 3 V to 3.6 V  1.2 V 1.4 V to 1.6 V 1.65 V to 1.95 V 2.3 V to 2.7 V 3 V to 3.6 V  1.2 V 1.4 V to 1.6 V 1.65 V to 1.95 V 2.3 V to 2.7 V 3 V to 3.6 V	4	mA			
				2.3 V to 2.7 V		8	
			the state that the st	16			
Δt/Δν	Input transition rise or fall	rate				5	ns/V
T <sub>A</sub>	Operating free-air temper	ature			-40	85	°C

V<sub>CCI</sub> is the V<sub>CC</sub> associated with the input port.
 V<sub>CCO</sub> is the V<sub>CC</sub> associated with the output port.
 All unused data inputs of the device must be held at V<sub>CCI</sub> or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.
 CMD-dir, DAT0-dir, and DAT123-dir are referenced to V<sub>CCA</sub>.

## SN74AVCA406L MMC, SD CARD, Memory Stick™ VOLTAGE-TRANSLATION TRANSCEIVER





## Electrical Characteristics (1)(2)

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

DΛ	RAMETER	TEST CON	IDITIONS	V	V	T <sub>A</sub> =	= 25°C		UNIT
FA	RAIVIETER	TEST CON	IDITIONS	V <sub>CCA</sub>	V <sub>CCB</sub>	MIN	TYP(3)	MAX	UNIT
		$I_{OH} = -100 \mu A$		1.2 V to 3.6 V	1.2 V to 3.6 V	V <sub>CCO</sub> - 0.2			
		1 1 m 1		1.2 V	1.2 V		1.1		
	A t	$I_{OH} = -1 \text{ mA}$	\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	1.4 V	1.4 V	1.05			
$V_{OH}$	A port	$I_{OH} = -2 \text{ mA}$	$V_{I} = V_{IH}$	1.65 V	1.65 V	1.2			V
		$I_{OH} = -4 \text{ mA}$		2.3 V	2.3 V	1.75			
		$I_{OH} = -8 \text{ mA}$		3 V	3 V	2.3			
		$I_{OL} = 100  \mu A$		1.2 V to 3.6 V	1.2 V to 3.6 V			0.2	
				1.2 V	1.2 V		0.07		
		I <sub>OL</sub> = 1 mA	., .,	1.4 V	1.4 V			0.35	
$V_{OL}$	A port	I <sub>OL</sub> = 2 mA	$V_I = V_{IL}$	1.65 V	1.65 V			0.45	V
		I <sub>OL</sub> = 4 mA		2.3 V	2.3 V			0.55	
		I <sub>OL</sub> = 8 mA		3 V	3 V			0.7	
		$I_{OH} = -100  \mu A$		1.2 V to 3.6 V	1.2 V to 3.6 V	V <sub>CCO</sub> - 0.2			
		$I_{OH} = -1 \text{ mA}$		1.2 V	1.2 V		1.1		
		$I_{OH} = -2 \text{ mA}$	1	1.4 V	1.4 V	1.05			
$V_{OH}$	B port	I <sub>OH</sub> = -4 mA	$V_{I} = V_{IH}$	1.65 V	1.65 V	1.2			V
		I <sub>OH</sub> = -8 mA	_	2.3 V	2.3 V	1.75			
		I <sub>OH</sub> = -16 mA	_	3 V	3 V	2.3			
		I <sub>OL</sub> = 100 μA		1.2 V to 3.6 V	1.2 V to 3.6 V			0.2	
		I <sub>OL</sub> = 1 mA	_	1.2 V	1.2 V		0.07		
		I <sub>OL</sub> = 2 mA	_	1.4 V	1.4 V			0.35	
$V_{OL}$	B port	I <sub>OL</sub> = 4 mA	$V_I = V_{IL}$	1.65 V	1.65 V			0.45	V
		I <sub>OL</sub> = 8 mA	1	2.3 V	2.3 V				
		I <sub>OL</sub> = 16 mA		3 V	3 V			0.7	
I <sub>1</sub>	Control inputs	$V_I = V_{CCA}$ or GND		1.2 V to 3.6 V	1.2 V to 3.6 V			±1	μΑ
				0 V	0 V to 3.6 V			±5	
l <sub>off</sub>	A or B port	$V_I$ or $V_O = 0$ to 3.6 \	/	0 V to 3.6 V	0 V			±5	μΑ
I <sub>OZ</sub> <sup>(4)</sup>	A or B port	$V_O = V_{CCO}$ or GND, $V_I = V_{CCI}$ or GND	See function table for input states when outputs are Hi Z	3.6 V	3.6 V			±5	μΑ
			1	1.2 V to 3.6 V	1.2 V to 3.6 V			10	
I <sub>CCA</sub>		$V_I = V_{CCI}$ or GND,	$I_{O} = 0$	3.6 V	0 V			10	μΑ
00/1			· ·	0 V	3.6 V			0.2 0.35 0.45 0.55 0.7 0.2 0.35 0.45 0.55 0.7 ±1 ±5 ±5	
				1.2 V to 3.6 V	1.2 V to 3.6 V			10	
I <sub>CCB</sub>		$V_I = V_{CCI}$ or GND,	$I_{O} = 0$	3.6 V	0 V			-1	μΑ
			-	0 V	3.6 V				•
I <sub>CCA</sub> +	I <sub>CCB</sub>	$V_I = V_{CCI}$ or GND,	I <sub>O</sub> = 0	1.2 V to 3.6 V	1.2 V to 3.6 V				μΑ
C <sub>i</sub>	Control inputs	$V_{I} = V_{CCA}$ or GND	<del>-</del>	1.8 V	3 V		1.5		pF
1	Clock input	_ / COA = 1.12				2		2.5	1.5
^	A port	$V_O = V_{CCA}$ or GND		4.6.17	0.17		2.5		
$C_{io}$	B port	$V_O = V_{CCB}$ or GND		1.8 V	3 V		2.5		pF

 $<sup>\</sup>begin{array}{ll} \hbox{(1)} & V_{CCO} \text{ is the } V_{CC} \text{ associated with the output port.} \\ \hbox{(2)} & V_{CCI} \text{ is the } V_{CC} \text{ associated with the input port.} \\ \hbox{(3)} & \text{All typical values are at } T_A = 25^{\circ}\text{C.} \\ \hbox{(4)} & \text{For I/O ports, the parameter } I_{OZ} \text{ includes the input leakage current.} \\ \end{array}$ 

#### SCES634B-JANUARY 2006-REVISED JUNE 2006

## Output Slew Rates<sup>(1)</sup>

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

PARAMETER	FROM	то	$\begin{array}{c} \textrm{V}_{\textrm{CCA}} = \textrm{1.8 V} \pm \textrm{0.15 V}, \\ \textrm{V}_{\textrm{CCB}} = \textrm{3 V} \pm \textrm{0.3 V} \end{array}$		UNIT
			MIN	MAX	
t <sub>r</sub>	10%	90%		3(2)	ns
t <sub>f</sub>	90%	10%		3(2)	ns

- (1) Values are characterized, but not production tested.
- (2) Using  $C_L = 15 \text{ pF}$  on the B side and  $C_L = 7 \text{ pF}$  on the A side

#### **Typical Switching Characteristics**

 $T_A = 25^{\circ}C$ ,  $V_{CCA} = 1.2 \text{ V (see Figure 2)}$ 

PARAMETER	FROM		TO (OUTPUT)	V <sub>CCB</sub> = 1.2 V	V <sub>CCB</sub> = 1.5 V	V <sub>CCB</sub> = 1.8 V	V <sub>CCB</sub> = 2.5 V	V <sub>CCB</sub> = 3 V	V <sub>CCB</sub> = 3.3 V	UNIT
	(INPUT)	(OUTPUT)	TYP	TYP	TYP	TYP	TYP	TYP		
	А	В	3.8	3	2.6	2.5	2.5	2.6		
	В	Α	4.6	4.2	4	3.9	3.9	3.8		
	CLKA	CLKB	3.8	3	2.6	2.5	2.5	2.6	ns	
$t_{pd}$		CLK-f	8.4	7.2	6.6	6.4	6.4	6.4		
	CMDA	CMDB	3.8	3	2.6	2.5	2.5	2.6		
	CMDB	CMDA	4.6	4.2	4	3.9	3.9	3.8		
. (1)	20	В	4.8	4	3.7	3.4	3.4	3.4		
t <sub>en</sub> <sup>(1)</sup>	DIR	Α	4.5	4.4	5	5.4	5.4	5.4	ns	
t <sub>dis</sub> (1)	CID	В	6.3	5.2	5.6	4.8	4.8	6.1		
	DIR	Α	4.8	4.6	5.3	5.4	5.4	5.3	ns	

<sup>(1)</sup> DIR refers to CMD-dir, DAT0-dir, and DAT123-dir.

#### **Switching Characteristics**

over recommended operating free-air temperature range,  $V_{CCA}$  = 1.5 V  $\pm$  0.1 V (see Figure 2)

PARAMETER	FROM	TO (OUTPUT)	V <sub>CCB</sub> = 1.2 V	V <sub>CCB</sub> = ± 0.		V <sub>CCB</sub> = ± 0.1		V <sub>CCB</sub> = ± 0.2		V <sub>CCB</sub> : ± 0.3		V <sub>CCB</sub> = ± 0.3		UNIT
	(INPUT)	(001701)	TYP	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
	Α	В	3.4	1.1	5.6	1	4.8	1	3.9	0.9	3.9	0.9	3.8	
	В	Α	3.8	1.4	6	1.3	5.6	1.3	5.2	0.5	5.2	0.3	5.2	
	CLKV	CLKB	3.4	1.1	5.6	1	4.8	1	3.9	0.9	3.9	0.9	3.8	no
<sup>L</sup> pd	t <sub>pd</sub> CLKA	CLK-f	7.2	2.6	11.6	2.3	10.4	2.3	9.1	1.3	9.1	1.2	9	ns
	CMDA	CMDB	3.4	1.1	5.6	1	4.8	1	3.9	0.9	3.9	0.9	3.8	
	CMDB	CMDA	3.8	1.4	6	1.3	5.6	1.3	5.2	0.5	5.2	0.3	5.2	
+ (1)	DIB	В	4	1.3	7.7	1.1	6.9	0.8	6.1	0.8	6	0.8	5.9	no
len'''	t <sub>en</sub> <sup>(1)</sup> DIR	Α	3.5	1.4	7	1.5	7.4	1.7	8.2	1.7	8.2	1.7	7.7	ns
t <sub>dis</sub> <sup>(1)</sup> DIR	В	5.7	1.9	8.9	2.1	10.4	1.8	8.7	1.7	8.5	2.4	11.4	ns	
'dis` '	DIK	Α	3.4	1.2	7	1.2	6.8	1.2	6.9	1.2	6.5	1.2	6.6	113

<sup>(1)</sup> DIR refers to CMD-dir, DAT0-dir, and DAT123-dir.



#### **Switching Characteristics**

over recommended operating free-air temperature range,  $V_{CCA}$  = 1.8 V  $\pm$  0.15 V (see Figure 2)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V <sub>CCB</sub> = 1.2 V	V <sub>CCB</sub> = ± 0.	= 1.5 V 1 V	V <sub>CCB</sub> = ± 0.1		V <sub>CCB</sub> = ± 0.2		V <sub>CCB</sub> = ± 0.3		V <sub>CCB</sub> = ± 0.		UNIT
	(INFOT)	(OUTFUT)	TYP	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
	Α	В	3.2	1	5.2	0.8	4.4	0.7	3.5	0.6	3.4	0.7	3.1	
	В	Α	3.4	1.1	5.2	1	4.8	0.9	4.3	0.3	4.3	0.2	4.3	
	CLKA	CLKB	3.2	1	5.2	0.8	4.4	0.7	3.5	0.6	3.4	0.7	3.1	no
t <sub>pd</sub>	CLKA	CLK-f	6.5	2.1	10.4	1.8	9.1	1.7	7.8	0.9	7.7	0.9	7.4	ns
	CMDA	CMDB	3.2	1	5.2	0.8	4.4	0.7	3.5	0.6	3.4	0.7	3.1	
	CMDB	CMDA	3.4	1.1	5.2	1	4.8	0.9	4.3	0.3	4.3	0.2	4.3	
<b>.</b> (1)	DID	В	3.5	1.2	6.8	0.9	6	0.7	5.1	0.7	5	0.7	4.8	
t <sub>en</sub> <sup>(1)</sup> DIR	Α	2.9	1.1	4.7	1.1	5.2	1.4	5.1	1.4	5.1	1.4	5.3	ns	
+ (1)	t <sub>dis</sub> <sup>(1)</sup> DIR	В	5.3	1.6	8.4	2	9.5	1.6	8.2	1.4	8.1	2.2	8.2	no
<sup>t</sup> dis <sup>(1)</sup>	DIK	Α	3.6	1.3	7.7	1.2	7.9	1.3	7.5	1.3	7.5	1.3	7.6	ns

<sup>(1)</sup> DIR refers to CMD-dir, DAT0-dir, and DAT123-dir.

#### **Switching Characteristics**

over recommended operating free-air temperature range, V  $_{\text{CCA}}$  = 2.5 V  $\pm$  0.2 V (see Figure 2)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V <sub>CCB</sub> = 1.2 V	V <sub>CCB</sub> = ± 0.1	1.5 V I V	V <sub>CCB</sub> = ± 0.1	1.8 V 5 V	V <sub>CCB</sub> = ± 0.2		V <sub>CCB</sub> :		V <sub>CCB</sub> = ± 0.3		UNIT
	(INFUT)	(OUIFUI)	TYP	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
	Α	В	3	0.8	4.7	0.7	3.8	0.6	2.9	0.4	2.7	0.5	2.5	
	В	Α	3	0.9	4.4	0.7	3.9	0.6	3.3	0.3	3.2	0.3	3.2	
t <sub>pd</sub> CLKA	CLKA	CLKB	3	0.8	4.7	0.7	3.8	0.6	2.9	0.4	2.7	0.5	2.5	no
<sup>L</sup> pd	CLNA	CLK-f	6	1.7	9.1	1.4	7.7	1.1	6.2	0.7	5.9	0.8	5.7	ns
	CMDA	CMDB	3	0.8	4.7	0.7	3.8	0.6	2.9	0.4	2.7	0.5	2.5	
	CMDB	CMDA	3	0.9	4.4	0.7	3.9	0.6	3.3	0.3	3.2	0.3	3.2	
+ (1)	DIR	В	3.1	1	5.7	0.8	4.8	0.5	3.9	0.5	3.7	0.5	3.6	200
t <sub>en</sub> <sup>(1)</sup>	DIK	Α	2.2	0.7	3.5	0.6	4.3	1.2	4.4	0.7	4.6	0.4	4.7	ns
	DID	В	4.6	1.4	7.6	1.8	8.4	1.3	7.2	1.3	7.1	2	7.5	20
t <sub>dis</sub>	DIR	Α	2.6	0.9	5.6	0.9	5.4	1	5.5	0.9	5.5	0.9	5.8	ns

<sup>(1)</sup> DIR refers to CMD-dir, DAT0-dir, and DAT123-dir.



#### **Switching Characteristics**

over recommended operating free-air temperature range,  $V_{CCA}$  = 3.3 V  $\pm$  0.3 V (see Figure 2)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V <sub>CCB</sub> = 1.2 V	V <sub>CCB</sub> = ± 0.7		V <sub>CCB</sub> = ± 0.1		V <sub>CCB</sub> = ± 0.2		V <sub>CCB</sub> :		V <sub>CCB</sub> = ± 0.3		UNIT
	(INFO1)	(OUTFUT)	TYP	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
	Α	В	2.8	0.8	4.5	0.6	3.6	0.4	2.7	0.4	2.7	0.3	2.3	
	В	Α	2.9	0.8	4.3	0.6	3.7	0.5	3	0.5	3	0.1	2.7	
	CLKV	CLKB	2.8	0.8	4.5	0.6	3.6	0.4	2.7	0.4	2.7	0.3	2.3	no
<sup>L</sup> pd	t <sub>pd</sub> CLKA	CLK-f	5.7	1.6	8.8	1.2	7.3	0.9	5.7	0.9	5.7	0.4	5	ns
	CMDA	CMDB	2.8	0.8	4.5	0.6	3.6	0.4	2.7	0.4	2.7	0.3	2.3	
	CMDB	CMDA	2.9	0.8	4.3	0.6	3.7	0.5	3	0.5	3	0.1	2.7	
. (1)	DID	В	3	1	5.1	0.6	4.3	0.5	3.4	0.5	3.4	0.4	3	
l <sub>en</sub> (''/	t <sub>en</sub> <sup>(1)</sup> DIR	Α	2	0.6	3.1	0.6	5.4	0.7	5.4	0.7	5.4	0.5	5.4	ns
t <sub>dis</sub> <sup>(1)</sup> DIR	DID	В	4.4	1.4	7.4	1.8	8.3	1.2	7	1.2	7	2	7.3	20
ldis (1)	אוט	Α	3.7	1.5	8.1	1.5	7.9	1.5	7.9	1.5	7.9	1.5	8	ns

<sup>(1)</sup> DIR refers to CMD-dir, DAT0-dir, and DAT123-dir.

#### **Typical Frequency and Output Skew**

 $T_A = 25^{\circ}C$ ,  $V_{CCA} = 1.2 \text{ V (see Figure 2)}$ 

DAD	AMETER	FROM	то	V <sub>CCB</sub> = 1.2 V	V <sub>CCB</sub> = 1.5 V	V <sub>CCB</sub> = 1.8 V	$V_{CCB} = 2.5 V$	$V_{CCB} = 3 V$	V <sub>CCB</sub> = 3.3 V	UNIT
FARA	AIVIETER	(INPUT)	(OUTPUT)	TYP	TYP	TYP	TYP	TYP	TYP	UNIT
	Clock	CLKA	CLKB	95	95	95	95	95	95	
	Clock	CLKA	CLK-f	95	95	95	95	95	95	MHz
lmax	Data	Α	В	95	95	95	95	95	95	IVITIZ
	Dala	В	Α	95	95	95	95	95	95	
t <sub>sk(o)</sub>	Channel to channel	А	В	0.5	0.4	0.4	0.3	0.5	0.5	ns

#### **Maximum Frequency and Output Skew**

over recommended operating free-air temperature range,  $V_{CCA}$  = 1.5 V  $\pm$  0.1 V (see Figure 2)

PAF	RAMETER	FROM (INPUT)	TO (OUTPUT)	V <sub>CCB</sub> = 1.2 V	V <sub>CCB</sub> = ± 0.1		V <sub>CCB</sub> = ± 0.1		V <sub>CCB</sub> = ± 0.2		V <sub>CCB</sub> ± 0.	= 3 V .3 V	V <sub>CCB</sub> = ± 0.	: 3.3 V 3 V	UNIT
		(INFOI)	(OUTFUT)	TYP	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	•
	Clock	CLKA	CLKB	95	95		95		95		95		95		
_	Clock	CLNA	CLK-f	95	95		95		95		95		95		MHz
f <sub>max</sub>	Doto	Α	В	95	95		95		95		95		95		IVITZ
	Data	В	Α	95	95		95		95		95		95		
t <sub>sk(o)</sub>	Channel to channel	DIR	В	0.3		0.3		0.3		0.3		0.5		0.4	ns

# SN74AVCA406L MMC, SD CARD, Memory Stick™ VOLTAGE-TRANSLATION TRANSCEIVER





#### **Maximum Frequency and Output Skew**

over recommended operating free-air temperature range,  $V_{\text{CCA}}$  = 1.8 V  $\pm$  0.15 V (see Figure 2)

PAF	RAMETER	FROM (INPUT)	TO (OUTPUT)	V <sub>CCB</sub> = 1.2 V	V <sub>CCB</sub> = ± <b>0.</b> 1		V <sub>CCB</sub> = ± <b>0.1</b>		V <sub>CCB</sub> = ± 0.2			= 3 V .3 V	V <sub>CCB</sub> = ± 0.	3.3 V 3 V	UNIT
		(INFUT)	(OUTFUT)	TYP	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
	Clock	CLKA	CLKB	95	95		95		95		95		95		
£	CIOCK	CLNA	CLK-f	95	95		95		95		95		95		MHz
f <sub>max</sub>	Data	Α	В	95	95		95		95		95		95		IVI⊓∠ 
	Data	В	Α	95	95		95		95		95		95		
t <sub>sk(o)</sub>	Channel to channel	DIR	В	0.3		0.3		0.3		0.3		0.5		0.3	ns

#### **Maximum Frequency and Output Skew**

over recommended operating free-air temperature range,  $V_{CCA}$  = 2.5 V  $\pm$  0.2 V (see Figure 2)

PAR	RAMETER	FROM (INPUT)	TO	V <sub>CCB</sub> = 1.2 V	V <sub>CCB</sub> = ± <b>0.</b> 1		V <sub>CCB</sub> = ± 0.1		V <sub>CCB</sub> = ± 0.2		V <sub>CCB</sub> ± 0.	= 3 V .3 V	V <sub>CCB</sub> = ± 0.		UNIT
		(INPUT)	(OUTPUT)	TYP	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
	Clock	CLKA	CLKB	95	95		95		95		95		95		
_	Clock	CLNA	CLK-f	95	95		95		95		95		95		NAL I-
f <sub>max</sub>	Doto	Α	В	95	95		95		95		95		95		MHz
	Data	В	Α	95	95		95		95		95		95		
t <sub>sk(o)</sub>	Channel to channel	DIR	В	0.3		0.3		0.3		0.2		0.6		0.3	ns

#### **Maximum Frequency and Output Skew**

over recommended operating free-air temperature range,  $V_{CCA}$  = 3.3 V  $\pm$  0.3 V (see Figure 2)

PAF	PARAMETER FROM (INPUT)	_	TO (OUTPUT)	V <sub>CCB</sub> = 1.2 V	V <sub>CCB</sub> = ± <b>0.</b> 1		V <sub>CCB</sub> = ± 0.1		V <sub>CCB</sub> = ± 0.2		V <sub>CCB</sub> ± 0.	= 3 V .3 V	V <sub>CCB</sub> = ± 0.	: 3.3 V 3 V	UNIT
		(INPUT)	(OUTPUT)	TYP	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
	Clock	CLKA	CLKB	95	95		95		95		95		95		
£	Clock	CLKA	CLK-f	95	95		95		95		95		95		MHz
Imax	Data	Α	В	95	95		95		95		95		95		IVI⊓∠
	Dala	В	Α	95	95		95		95		95		95		
t <sub>sk(o)</sub>	Channel to channel	DIR	В	0.3		0.3		0.4		0.3		0.6		0.4	ns

SCES634B-JANUARY 2006-REVISED JUNE 2006

## **Operating Characteristics**

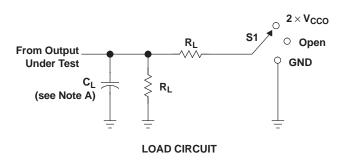
 $T_A = 25^{\circ}C$ 

PARA	METER	TEST CONDITIONS	V <sub>CCA</sub> = V <sub>CCB</sub> = 1.2 V	V <sub>CCA</sub> = V <sub>CCB</sub> = 1.5 V	$V_{CCA} = V_{CCB} = 1.8 V$	$V_{CCA} = V_{CCB} = 2.5 V$	V <sub>CCA</sub> = V <sub>CCB</sub> = 3 V	V <sub>CCA</sub> = V <sub>CCB</sub> = 3.3 V	UNIT
0 (1)	A-port input, B-port output	$C_L = 0$ ,	1.9	2	2.1	2.4	2.7	2.9	
C <sub>pdA</sub> <sup>(1)</sup> B-port input, A-port output	$f = 10 \text{ MHz},$ $t_r = t_f = 1 \text{ ns}$	4.4	4.5	4.6	4.7	4.8	4.9	pF	
C (1)	A-port input, B-port output	$C_L = 0$ ,	5.3	5.4	5.4	5.7	5.8	5.9	25
C <sub>pdB</sub> <sup>(1)</sup>	B-port input, A-port output	$f = 10 \text{ MHz},$ $t_r = t_f = 1 \text{ ns}$	0.3	0.3	0.4	0.5	0.6	0.6	pF

<sup>(1)</sup> Power dissipation capacitance per transceiver

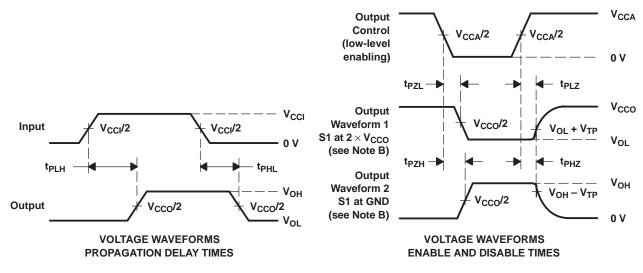


#### PARAMETER MEASUREMENT INFORMATION



TEST	S1
t <sub>pd</sub>	Open
t <sub>PLZ</sub> /t <sub>PZL</sub>	2×V <sub>CCO</sub>
t <sub>PHZ</sub> /t <sub>PZH</sub>	GND

V <sub>CCO</sub>	CL	R <sub>L</sub>	V <sub>TP</sub>
1.5 V ± 0.1 V	15 pF	<b>2 k</b> Ω	0.1 V
1.8 V $\pm$ 0.15 V	15 pF	<b>2 k</b> Ω	0.15 V
2.5 V $\pm$ 0.2 V	15 pF	<b>2 k</b> Ω	0.15 V
3.3 V $\pm$ 0.3 V	15 pF	<b>2 k</b> Ω	0.3 V



NOTES: A. C<sub>L</sub> includes probe and jig capacitance.

- B. Waveform 1 is for an output with internal conditions such that the output is low, except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high, except when disabled by the output control.
- C. All input pulses are supplied by generators having the following characteristics: PRR  $\leq$  10 MHz,  $Z_0 = 50 \Omega$ ,  $dv/dt \geq 1 V/ns$ .
- D. The outputs are measured one at a time, with one transition per measurement.
- E.  $t_{PLZ}$  and  $t_{PHZ}$  are the same as  $t_{dis}$ .
- F.  $t_{PZL}$  and  $t_{PZH}$  are the same as  $t_{en}$ .
- G.  $t_{PLH}$  and  $t_{PHL}$  are the same as  $t_{pd}$ .
- H. V<sub>CCI</sub> is the V<sub>CC</sub> associated with the input port.
- I. V<sub>CCO</sub> is the V<sub>CC</sub> associated with the output port.

Figure 2. Load Circuit and Voltage Waveforms

PACKAGE OPTION ADDENDUM

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#### **PACKAGING INFORMATION**

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
SN74AVCA406LGQSR	ACTIVE	BGA MI CROSTA R JUNI OR	GQS	24	2500	TBD	SNPB	Level-1-240C-UNLIM
SN74AVCA406LGXYR	ACTIVE	BGA MI CROSTA R JUNI OR	GXY	20	2500	TBD	SNPB	Level-1-240C-UNLIM
SN74AVCA406LZQSR	ACTIVE	BGA MI CROSTA R JUNI OR	ZQS	24	2500	Green (RoHS & no Sb/Br)	SNAGCU	Level-1-260C-UNLIM
SN74AVCA406LZXYR	ACTIVE	BGA MI CROSTA R JUNI OR	ZXY	20	2500	Green (RoHS & no Sb/Br)	SNAGCU	Level-1-260C-UNLIM

<sup>(1)</sup> 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) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.

TBD: The Pb-Free/Green conversion plan has not been defined.

**Pb-Free** (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

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

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## PACKAGE MATERIALS INFORMATION

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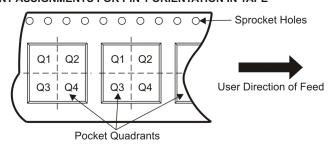
#### TAPE AND REEL INFORMATION





	Dimension designed to accommodate the component width
	Dimension designed to accommodate the component length
	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

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



#### \*All dimensions are nominal

Device Package Package Pins SPQ Reel Reel A0 B0 K0 P1 W Pin1										B: 4		
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
SN74AVCA406LGQSR	BGA MI CROSTA R JUNI OR	GQS	24	2500	330.0	12.4	3.3	3.3	1.6	8.0	12.0	Q1
SN74AVCA406LGXYR	BGA MI CROSTA R JUNI OR	GXY	20	2500	330.0	12.4	2.8	3.3	1.0	4.0	12.0	Q2
SN74AVCA406LZQSR	BGA MI CROSTA R JUNI OR	ZQS	24	2500	330.0	12.4	3.3	3.3	1.6	8.0	12.0	Q1
SN74AVCA406LZXYR	BGA MI CROSTA R JUNI OR	ZXY	20	2500	330.0	12.4	2.8	3.3	1.0	4.0	12.0	Q2

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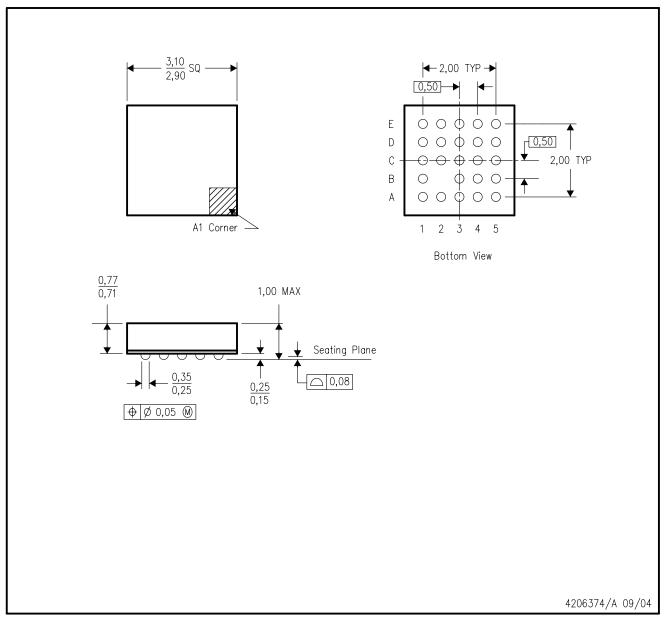


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74AVCA406LGQSR	BGA MICROSTAR JUNIOR	GQS	24	2500	340.5	338.1	20.6
SN74AVCA406LGXYR	BGA MICROSTAR JUNIOR	GXY	20	2500	340.5	338.1	20.6
SN74AVCA406LZQSR	BGA MICROSTAR JUNIOR	ZQS	24	2500	340.5	338.1	20.6
SN74AVCA406LZXYR	BGA MICROSTAR JUNIOR	ZXY	20	2500	340.5	338.1	20.6

## ZQS (S-PBGA-N24)

## PLASTIC BALL GRID ARRAY



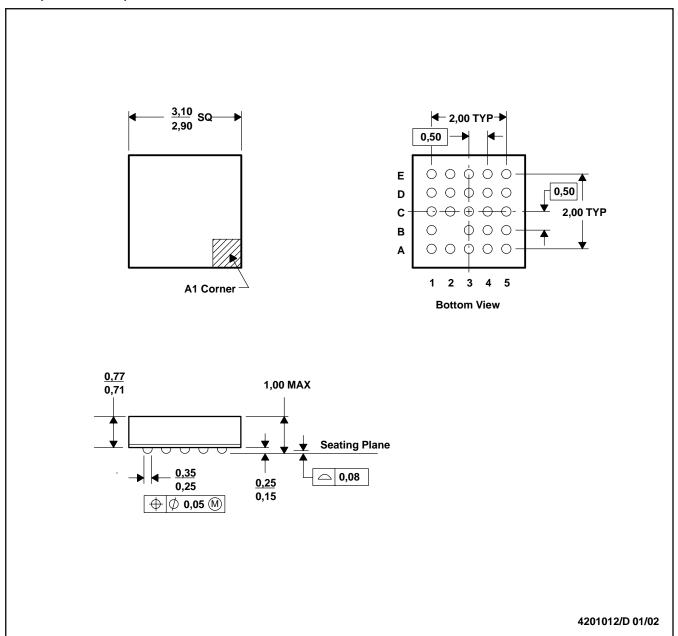
NOTES: All linear dimensions are in millimeters.

- This drawing is subject to change without notice.
- C. Falls within JEDEC MO-225
- D. This package is lead-free.



#### GQS (S-PBGA-N24)

#### **PLASTIC BALL GRID ARRAY**



NOTES: A. All linear dimensions are in millimeters.

B. This drawing is subject to change without notice.

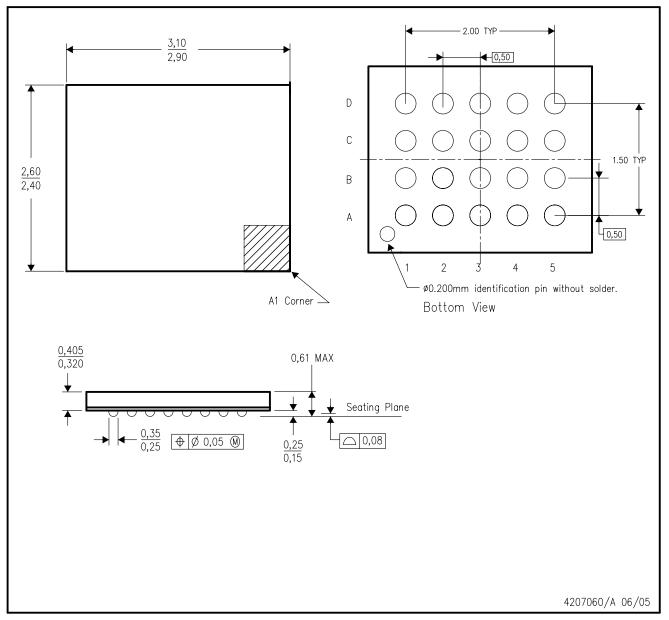
C. MicroStar Junior™BGA configuration

D. Falls within JEDEC MO-225

MicroStar Junior is a trademark of Texas Instruments.

# GXY (S-PBGA-N20)

## PLASTIC BALL GRID ARRAY

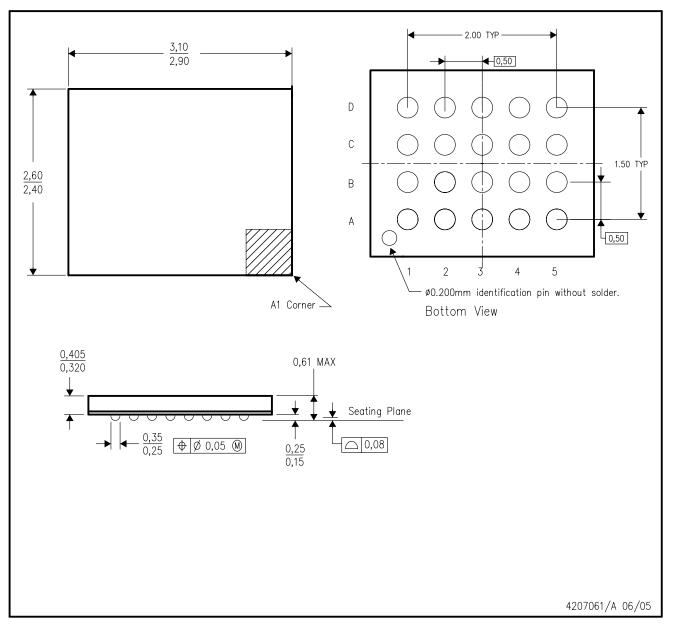


NOTES:

- A. All linear dimensions are in millimeters.
- B. This drawing is subject to change without notice.

# ZXY (S-PBGA-N20)

## PLASTIC BALL GRID ARRAY



NOTES:

- A. All linear dimensions are in millimeters.
- B. This drawing is subject to change without notice.
- C. This package is a lead-free solder ball design.



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