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_{CC} is switched off (V_{CCA} = 0 V and/or V_{CCB} = 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.

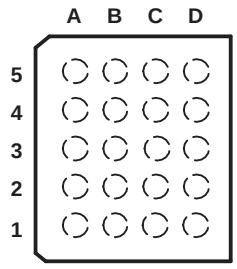
The SN74AVCA406L is available in two 0.5-mm-pitch ball grid array (BGA) packages. The 20-ball package has dimensions of 3 mm × 2.5 mm, and the 24-ball package measures 3 mm × 3 mm. Memory cards are widely used in mobile phones, PDAs, digital cameras, personal media players, camcorders, set-top boxes,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

ORDERING INFORMATION

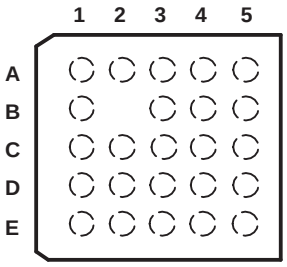
T_A	PACKAGE(1)		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 85°C	UFBGA – GXY	Reel of 2500	SN74AVCA406LGXYR	WV406
	UFBGA – ZXY (Pb-Free)	Reel of 2500	SN74AVCA406LZXYR	WV406
	MicroStar Junior™ BGA – GQS	Reel of 2500	SN74AVCA406LGQSR	WM406L
	MicroStar Junior™ BGA – ZQS (Pb-Free)	Reel of 2500	SN74AVCA406LZQSR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

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

GXY OR ZXY PACKAGE
(TOP VIEW)



GQS OR ZQS PACKAGE
(TOP VIEW)



TERMINAL ASSIGNMENTS
(20-Ball GXY/ZXY Package)

	A	B	C	D
5	V_{CCA}	CMD-dir	DAT0-dir	V_{CCB}
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
A	DAT2A	CMD-dir	DAT0-dir	RSV	DAT2B
B	DAT3A		V_{CCA}	V_{CCB}	DAT3B
C	CLKA	RSV	GND	GND	CLKB
D	DAT0A	CMDA	RSV	CMDB	DAT0B
E	DAT1A	CLK-f	DAT123-dir	RSV	DAT1B

REFERENCE DESIGN

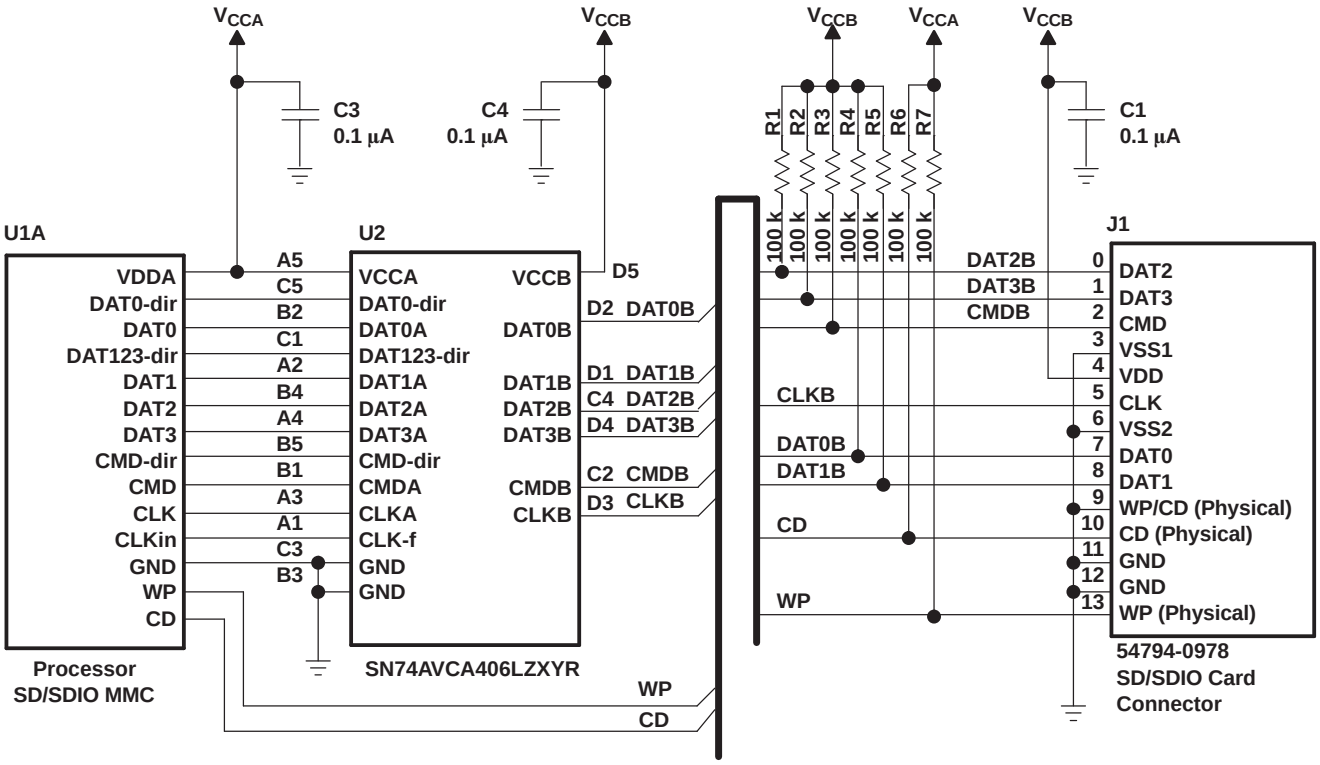


Figure 1. Interfacing With SD/SDIO Card

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_{CCA}.	I/O
A3	C1	CLKA	Clock signal connected to host. Referenced to V_{CCA}.	Input
A4	B1	DAT3A	Data bit 4 connected to host. Referenced to V_{CCA}.	I/O
A5	B3	V_{CCA}	A-port supply voltage. V_{CCA} powers all A-port I/Os and control inputs.	Power
B1	D2	CMDA	Command bit connected to host. Referenced to V_{CCA}.	I/O
B2	D1	DAT0A	Data bit 1 connected to host. Referenced to V_{CCA}.	I/O
B3	C4	GND	Ground	
B4	A1	DAT2A	Data bit 3 connected to host. Referenced to V_{CCA}.	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_{CCB}.	I/O
C3	C3	GND	Ground	
C4	A5	DAT2B	Data bit 3 connected to memory card. Referenced to V_{CCB}	I/O
C5	A3	DAT0-dir	Direction control for DAT0A/DAT0B	Input
D1	E5	DAT1B	Data bit 2 connected to memory card. Referenced to V_{CCB}.	I/O
D2	D5	DAT0B	Data bit 1 connected to memory card. Referenced to V_{CCB}.	I/O
D3	C5	CLKB	Clock signal connected to memory card. Referenced to V_{CCB}.	Output
D4	B5	DAT3B	Data bit 4 connected to memory card. Referenced to V_{CCB}.	I/O
D5	B4	V_{CCB}	B-port supply voltage. V_{CCB} powers all B-port I/Os.	Power
NA	B2		Depopulated ball	
NA	A4, C2, D3, E4	RSV	Reserved (for possible future functionality). Leave unconnected.	

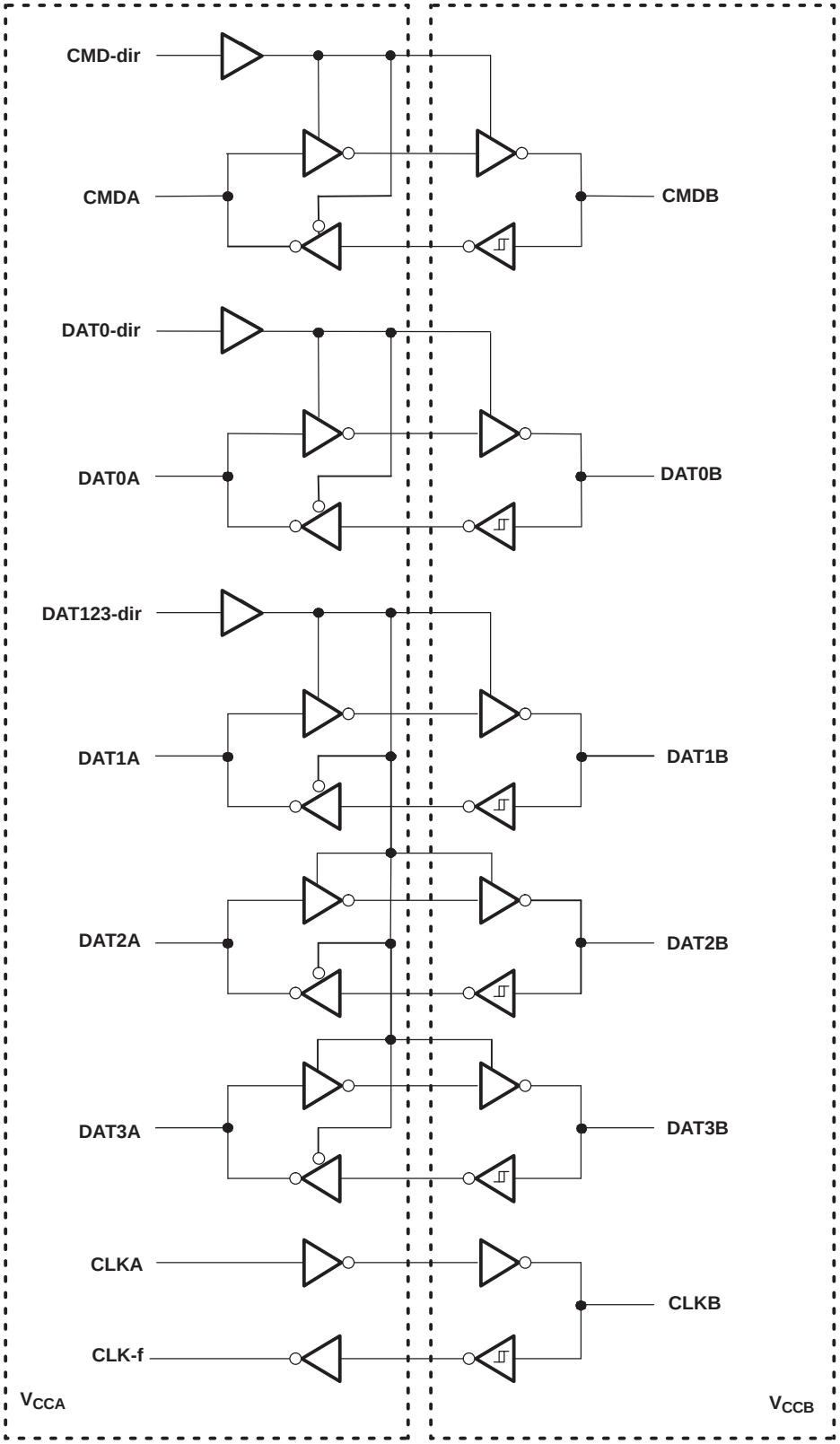
FUNCTION TABLES

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

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

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

LOGIC DIAGRAM (POSITIVE LOGIC)



Absolute Maximum Ratings(1)

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

			MIN	MAX	UNIT
V_{CCA} V_{CCB}	Supply voltage range		–0.5	4.6	V
V_I	Input voltage range(2)	I/O ports (A port)	–0.5	4.6	V
		I/O ports (B port)	–0.5	4.6	
		Control inputs	–0.5	4.6	
V_O	Voltage range applied to any output in the high-impedance or power-off state(2)	A port	–0.5	4.6	V
		B port	–0.5	4.6	
V_O	Voltage range applied to any output in the high or low state(2)(3)	A port	–0.5	V_{CCA} + 0.5	V
		B port	–0.5	V_{CCB} + 0.5	
I_{IK}	Input clamp current	V_I < 0		–50	mA
I_{OK}	Output clamp current	V_O < 0		–50	mA
I_O	Continuous output current			±50	mA
	Continuous current through V_{CCA}, V_{CCB}, or GND			±100	mA
θ_{JA}	Package thermal impedance(4)	GQS/ZQS package		171.6	°C/W
		GXY/ZXY package		193	
T_{stg}	Storage temperature range		–65	150	°C

(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) The input voltage and output negative-voltage ratings may be exceeded if the input and output current ratings are observed.
(3) 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.

Recommended Operating Conditions[1][2][3]

			V_{CCI}	V_{CCO}	MIN	MAX	UNIT
V_{CCA}	Supply voltage				1.2	3.6	V
V_{CCB}	Supply voltage				1.2	3.6	V
V_{IH}	High-level input voltage	All inputs[4]	1.2 V to 1.95 V		$V_{CCI} \times 0.65$		V
			1.95 V to 2.7 V		1.7		
			2.7 V to 3.6 V		2		
V_{IL}	Low-level input voltage	All inputs[4]	1.2 V to 1.95 V			$V_{CCI} \times 0.35$	V
			1.95 V to 2.7 V			0.7	
			2.7 V to 3.6 V			0.8	
V_I	Input voltage	Control inputs			0	3.6	V
$V_{I/O}$	Input/output voltage	Active state			0	V_{CCO}	V
		3-state			0	3.6	
I_{OH}	High-level output current (A port)			1.2 V		–1	mA
				1.4 V to 1.6 V		–1	
				1.65 V to 1.95 V		–2	
				2.3 V to 2.7 V		–4	
				3 V to 3.6 V		–8	
I_{OL}	Low-level output current (A port)			1.2 V		1	mA
				1.4 V to 1.6 V		1	
				1.65 V to 1.95 V		2	
				2.3 V to 2.7 V		4	
				3 V to 3.6 V		8	
I_{OH}	High-level output current (B port)			1.2 V		–1	mA
				1.4 V to 1.6 V		–2	
				1.65 V to 1.95 V		–4	
				2.3 V to 2.7 V		–8	
				3 V to 3.6 V		–16	
I_{OL}	Low-level output current (B port)			1.2 V		1	mA
				1.4 V to 1.6 V		2	
				1.65 V to 1.95 V		4	
				2.3 V to 2.7 V		8	
				3 V to 3.6 V		16	
$\Delta t/\Delta v$	Input transition rise or fall rate					5	ns/V
T_A	Operating free-air temperature				–40	85	°C

(1) V_{CCI} is the V_{CC} associated with the input port.
(2) V_{CCO} is the V_{CC} associated with the output port.
(3) All unused data inputs of the device must be held at V_{CCI} or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.
(4) CMD-dir, DAT0-dir, and DAT123-dir are referenced to V_{CCA}.

Electrical Characteristics[1][2]

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

PARAMETER		TEST CONDITIONS		V_{CCA}	V_{CCB}	T_A = 25°C			UNIT
						MIN	TYP[3]	MAX	
V_{OH}	A port	I_{OH} = –100 µA	$V_I = V_{IH}$	1.2 V to 3.6 V	1.2 V to 3.6 V	V_{CCO} – 0.2			V
		I_{OH} = –1 mA		1.2 V	1.2 V		1.1		
				1.4 V	1.4 V	1.05			
		I_{OH} = –2 mA		1.65 V	1.65 V	1.2			
		I_{OH} = –4 mA		2.3 V	2.3 V	1.75			
		I_{OH} = –8 mA		3 V	3 V	2.3			
V_{OL}	A port	I_{OL} = 100 µA	$V_I = V_{IL}$	1.2 V to 3.6 V	1.2 V to 3.6 V			0.2	V
		I_{OL} = 1 mA		1.2 V	1.2 V		0.07		
				1.4 V	1.4 V			0.35	
		I_{OL} = 2 mA		1.65 V	1.65 V			0.45	
		I_{OL} = 4 mA		2.3 V	2.3 V			0.55	
		I_{OL} = 8 mA		3 V	3 V			0.7	
V_{OH}	B port	I_{OH} = –100 µA	$V_I = V_{IH}$	1.2 V to 3.6 V	1.2 V to 3.6 V	V_{CCO} – 0.2			V
		I_{OH} = –1 mA		1.2 V	1.2 V		1.1		
		I_{OH} = –2 mA		1.4 V	1.4 V	1.05			
		I_{OH} = –4 mA		1.65 V	1.65 V	1.2			
		I_{OH} = –8 mA		2.3 V	2.3 V	1.75			
		I_{OH} = –16 mA		3 V	3 V	2.3			
V_{OL}	B port	I_{OL} = 100 µA	$V_I = V_{IL}$	1.2 V to 3.6 V	1.2 V to 3.6 V			0.2	V
		I_{OL} = 1 mA		1.2 V	1.2 V		0.07		
		I_{OL} = 2 mA		1.4 V	1.4 V			0.35	
		I_{OL} = 4 mA		1.65 V	1.65 V			0.45	
		I_{OL} = 8 mA		2.3 V	2.3 V			0.55	
		I_{OL} = 16 mA		3 V	3 V			0.7	
I_I	Control inputs	$V_I = V_{CCA}$ or GND		1.2 V to 3.6 V	1.2 V to 3.6 V			±1	µA
I_{off}	A or B port	V_I or V_O = 0 to 3.6 V		0 V	0 V to 3.6 V			±5	µA
				0 V to 3.6 V	0 V			±5	
I_{OZ}[4]	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	µA
I_{CCA}		$V_I = V_{CCI}$ or GND,	I_O = 0	1.2 V to 3.6 V	1.2 V to 3.6 V			10	µA
				3.6 V	0 V			10	
				0 V	3.6 V			–1	
I_{CCB}		$V_I = V_{CCI}$ or GND,	I_O = 0	1.2 V to 3.6 V	1.2 V to 3.6 V			10	µA
				3.6 V	0 V			–1	
				0 V	3.6 V			10	
$I_{CCA} + I_{CCB}$		$V_I = V_{CCI}$ or GND,	I_O = 0	1.2 V to 3.6 V	1.2 V to 3.6 V			15	µA
C_i	Control inputs	$V_I = V_{CCA}$ or GND		1.8 V	3 V		1.5	2	pF
	Clock input						2	2.5	
C_{io}	A port	$V_O = V_{CCA}$ or GND		1.8 V	3 V		2.5	3	pF
	B port	$V_O = V_{CCB}$ or GND					2.5	3	

(1) V_{CCO} is the V_{CC} associated with the output port.
(2) V_{CCI} is the V_{CC} associated with the input port.
(3) All typical values are at T_A = 25°C.
(4) For I/O ports, the parameter I_{OZ} includes the input leakage current.

Output Slew Rates(1)

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

PARAMETER	FROM	TO	V_{CCA} = 1.8 V ± 0.15 V, V_{CCB} = 3 V ± 0.3 V		UNIT
			MIN	MAX	
t_r	10%	90%		3(2)	ns
t_f	90%	10%		3(2)	ns

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

Typical Switching Characteristics

T_A = 25°C, V_{CCA} = 1.2 V (see Figure 2)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CCB} = 1.2 V	V_{CCB} = 1.5 V	V_{CCB} = 1.8 V	V_{CCB} = 2.5 V	V_{CCB} = 3 V	V_{CCB} = 3.3 V	UNIT
			TYP	TYP	TYP	TYP	TYP	TYP	
t_{pd}	A	B	3.8	3	2.6	2.5	2.5	2.6	ns
	B	A	4.6	4.2	4	3.9	3.9	3.8	
	CLKA	CLKB	3.8	3	2.6	2.5	2.5	2.6	
		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	
t_{en}(1)	DIR	B	4.8	4	3.7	3.4	3.4	3.4	ns
		A	4.5	4.4	5	5.4	5.4	5.4	
t_{dis}(1)	DIR	B	6.3	5.2	5.6	4.8	4.8	6.1	ns
		A	4.8	4.6	5.3	5.4	5.4	5.3	

(1) DIR refers to CMD-dir, DAT0-dir, and DAT123-dir.

Switching Characteristics

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

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CCB} = 1.2 V	V_{CCB} = 1.5 V ± 0.1 V		V_{CCB} = 1.8 V ± 0.15 V		V_{CCB} = 2.5 V ± 0.2 V		V_{CCB} = 3 V ± 0.3 V		V_{CCB} = 3.3 V ± 0.3 V		UNIT
			TYP	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t_{pd}	A	B	3.4	1.1	5.6	1	4.8	1	3.9	0.9	3.9	0.9	3.8	ns
	B	A	3.8	1.4	6	1.3	5.6	1.3	5.2	0.5	5.2	0.3	5.2	
	CLKA	CLKB	3.4	1.1	5.6	1	4.8	1	3.9	0.9	3.9	0.9	3.8	
		CLK-f	7.2	2.6	11.6	2.3	10.4	2.3	9.1	1.3	9.1	1.2	9	
	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	
t_{en}(1)	DIR	B	4	1.3	7.7	1.1	6.9	0.8	6.1	0.8	6	0.8	5.9	ns
		A	3.5	1.4	7	1.5	7.4	1.7	8.2	1.7	8.2	1.7	7.7	
t_{dis}(1)	DIR	B	5.7	1.9	8.9	2.1	10.4	1.8	8.7	1.7	8.5	2.4	11.4	ns
		A	3.4	1.2	7	1.2	6.8	1.2	6.9	1.2	6.5	1.2	6.6	

(1) DIR refers to CMD-dir, DAT0-dir, and DAT123-dir.

Switching Characteristics

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

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CCB} = 1.2 V	V_{CCB} = 1.5 V ± 0.1 V		V_{CCB} = 1.8 V ± 0.15 V		V_{CCB} = 2.5 V ± 0.2 V		V_{CCB} = 3 V ± 0.3 V		V_{CCB} = 3.3 V ± 0.3 V		UNIT
			TYP	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t_{pd}	A	B	3.2	1	5.2	0.8	4.4	0.7	3.5	0.6	3.4	0.7	3.1	ns
	B	A	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	
		CLK-f	6.5	2.1	10.4	1.8	9.1	1.7	7.8	0.9	7.7	0.9	7.4	
	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	
t_{en} (1)	DIR	B	3.5	1.2	6.8	0.9	6	0.7	5.1	0.7	5	0.7	4.8	ns
		A	2.9	1.1	4.7	1.1	5.2	1.4	5.1	1.4	5.1	1.4	5.3	
t_{dis} (1)	DIR	B	5.3	1.6	8.4	2	9.5	1.6	8.2	1.4	8.1	2.2	8.2	ns
		A	3.6	1.3	7.7	1.2	7.9	1.3	7.5	1.3	7.5	1.3	7.6	

(1) DIR refers to CMD-dir, DAT0-dir, and DAT123-dir.

Switching Characteristics

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

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CCB} = 1.2 V	V_{CCB} = 1.5 V ± 0.1 V		V_{CCB} = 1.8 V ± 0.15 V		V_{CCB} = 2.5 V ± 0.2 V		V_{CCB} = 3 V ± 0.3 V		V_{CCB} = 3.3 V ± 0.3 V		UNIT
			TYP	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t_{pd}	A	B	3	0.8	4.7	0.7	3.8	0.6	2.9	0.4	2.7	0.5	2.5	ns
	B	A	3	0.9	4.4	0.7	3.9	0.6	3.3	0.3	3.2	0.3	3.2	
	CLKA	CLKB	3	0.8	4.7	0.7	3.8	0.6	2.9	0.4	2.7	0.5	2.5	
		CLK-f	6	1.7	9.1	1.4	7.7	1.1	6.2	0.7	5.9	0.8	5.7	
	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	
t_{en} (1)	DIR	B	3.1	1	5.7	0.8	4.8	0.5	3.9	0.5	3.7	0.5	3.6	ns
		A	2.2	0.7	3.5	0.6	4.3	1.2	4.4	0.7	4.6	0.4	4.7	
t_{dis}	DIR	B	4.6	1.4	7.6	1.8	8.4	1.3	7.2	1.3	7.1	2	7.5	ns
		A	2.6	0.9	5.6	0.9	5.4	1	5.5	0.9	5.5	0.9	5.8	

(1) DIR refers to CMD-dir, DAT0-dir, and DAT123-dir.

Switching Characteristics

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

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CCB} = 1.2 V	V_{CCB} = 1.5 V ± 0.1 V		V_{CCB} = 1.8 V ± 0.15 V		V_{CCB} = 2.5 V ± 0.2 V		V_{CCB} = 3 V ± 0.3 V		V_{CCB} = 3.3 V ± 0.3 V		UNIT
			TYP	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t_{pd}	A	B	2.8	0.8	4.5	0.6	3.6	0.4	2.7	0.4	2.7	0.3	2.3	ns
	B	A	2.9	0.8	4.3	0.6	3.7	0.5	3	0.5	3	0.1	2.7	
	CLKA	CLKB	2.8	0.8	4.5	0.6	3.6	0.4	2.7	0.4	2.7	0.3	2.3	
		CLK-f	5.7	1.6	8.8	1.2	7.3	0.9	5.7	0.9	5.7	0.4	5	
	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	
t_{en} (1)	DIR	B	3	1	5.1	0.6	4.3	0.5	3.4	0.5	3.4	0.4	3	ns
		A	2	0.6	3.1	0.6	5.4	0.7	5.4	0.7	5.4	0.5	5.4	
t_{dis} (1)	DIR	B	4.4	1.4	7.4	1.8	8.3	1.2	7	1.2	7	2	7.3	ns
		A	3.7	1.5	8.1	1.5	7.9	1.5	7.9	1.5	7.9	1.5	8	

(1) DIR refers to CMD-dir, DAT0-dir, and DAT123-dir.

Typical Frequency and Output Skew

T_A = 25°C, V_{CCA} = 1.2 V (see Figure 2)

PARAMETER		FROM (INPUT)	TO (OUTPUT)	V_{CCB} = 1.2 V	V_{CCB} = 1.5 V	V_{CCB} = 1.8 V	V_{CCB} = 2.5 V	V_{CCB} = 3 V	V_{CCB} = 3.3 V	UNIT
				TYP	TYP	TYP	TYP	TYP	TYP	
t_{max}	Clock	CLKA	CLKB	95	95	95	95	95	95	MHz
			CLK-f	95	95	95	95	95	95	
	Data	A	B	95	95	95	95	95	95	
		B	A	95	95	95	95	95	95	
$t_{sk(o)}$	Channel to channel	A	B	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 ± 0.1 V (see Figure 2)

PARAMETER		FROM (INPUT)	TO (OUTPUT)	V_{CCB} = 1.2 V	V_{CCB} = 1.5 V ± 0.1 V		V_{CCB} = 1.8 V ± 0.15 V		V_{CCB} = 2.5 V ± 0.2 V		V_{CCB} = 3 V ± 0.3 V		V_{CCB} = 3.3 V ± 0.3 V		UNIT
				TYP	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
f_{max}	Clock	CLKA	CLKB	95	95		95		95		95		95		MHz
			CLK-f	95	95		95		95		95		95		
	Data	A	B	95	95		95		95		95		95		
		B	A	95	95		95		95		95		95		
$t_{sk(o)}$	Channel to channel	DIR	B	0.3		0.3		0.3		0.3		0.5		0.4	ns

Maximum Frequency and Output Skew

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

PARAMETER		FROM (INPUT)	TO (OUTPUT)	V_{CCB} = 1.2 V	V_{CCB} = 1.5 V ± 0.1 V		V_{CCB} = 1.8 V ± 0.15 V		V_{CCB} = 2.5 V ± 0.2 V		V_{CCB} = 3 V ± 0.3 V		V_{CCB} = 3.3 V ± 0.3 V		UNIT
				TYP	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
f_{max}	Clock	CLKA	CLKB	95	95		95		95		95		95		MHz
			CLK-f	95	95		95		95		95		95		
	Data	A	B	95	95		95		95		95		95		
		B	A	95	95		95		95		95		95		
$t_{sk(o)}$	Channel to channel	DIR	B	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 ± 0.2 V (see Figure 2)

PARAMETER		FROM (INPUT)	TO (OUTPUT)	V_{CCB} = 1.2 V	V_{CCB} = 1.5 V ± 0.1 V		V_{CCB} = 1.8 V ± 0.15 V		V_{CCB} = 2.5 V ± 0.2 V		V_{CCB} = 3 V ± 0.3 V		V_{CCB} = 3.3 V ± 0.3 V		UNIT
				TYP	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
f_{max}	Clock	CLKA	CLKB	95	95		95		95		95		95		MHz
			CLK-f	95	95		95		95		95		95		
	Data	A	B	95	95		95		95		95		95		
		B	A	95	95		95		95		95		95		
$t_{sk(o)}$	Channel to channel	DIR	B	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 ± 0.3 V (see Figure 2)

PARAMETER		FROM (INPUT)	TO (OUTPUT)	V_{CCB} = 1.2 V	V_{CCB} = 1.5 V ± 0.1 V		V_{CCB} = 1.8 V ± 0.15 V		V_{CCB} = 2.5 V ± 0.2 V		V_{CCB} = 3 V ± 0.3 V		V_{CCB} = 3.3 V ± 0.3 V		UNIT
				TYP	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
f_{max}	Clock	CLKA	CLKB	95	95		95		95		95		95		MHz
			CLK-f	95	95		95		95		95		95		
	Data	A	B	95	95		95		95		95		95		
		B	A	95	95		95		95		95		95		
$t_{sk(o)}$	Channel to channel	DIR	B	0.3		0.3		0.4		0.3		0.6		0.4	ns

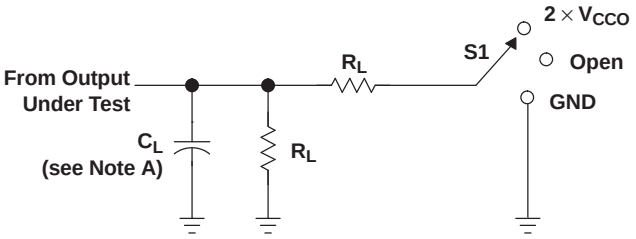
Operating Characteristics

T_A = 25°C

PARAMETER		TEST CONDITIONS	V_{CCA} = V_{CCB} = 1.2 V	V_{CCA} = V_{CCB} = 1.5 V	V_{CCA} = V_{CCB} = 1.8 V	V_{CCA} = V_{CCB} = 2.5 V	V_{CCA} = V_{CCB} = 3 V	V_{CCA} = V_{CCB} = 3.3 V	UNIT
			TYP	TYP	TYP	TYP	TYP	TYP	
C_{pdA} (1)	A-port input, B-port output	C_L = 0, f = 10 MHz, t_r = t_f = 1 ns	1.9	2	2.1	2.4	2.7	2.9	pF
	B-port input, A-port output		4.4	4.5	4.6	4.7	4.8	4.9	
C_{pdB} (1)	A-port input, B-port output	C_L = 0, f = 10 MHz, t_r = t_f = 1 ns	5.3	5.4	5.4	5.7	5.8	5.9	pF
	B-port input, A-port output		0.3	0.3	0.4	0.5	0.6	0.6	

(1) Power dissipation capacitance per transceiver

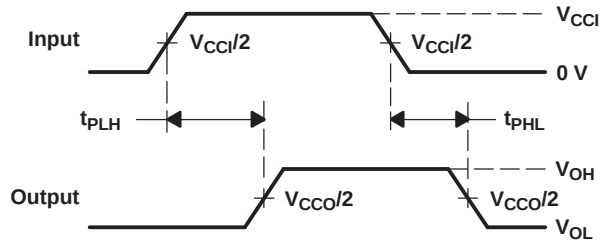
PARAMETER MEASUREMENT INFORMATION



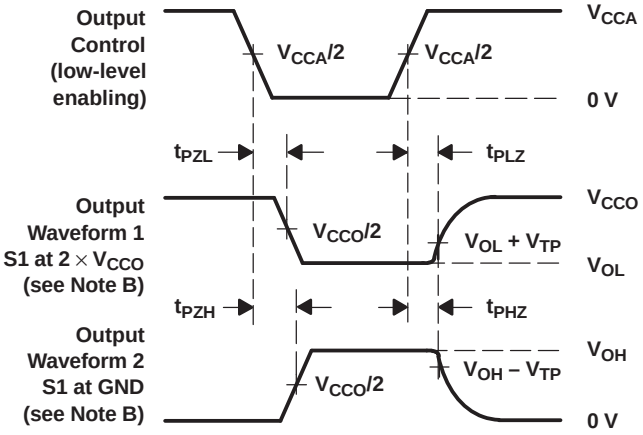
LOAD CIRCUIT

TEST	S1
t_{pd}	Open
t_{PLZ}/t_{PZL}	$2 \times V_{CCO}$
t_{PHZ}/t_{PZH}	GND

V_{CCO}	C_L	R_L	V_{TP}
1.5 V ± 0.1 V	15 pF	2 kΩ	0.1 V
1.8 V ± 0.15 V	15 pF	2 kΩ	0.15 V
2.5 V ± 0.2 V	15 pF	2 kΩ	0.15 V
3.3 V ± 0.3 V	15 pF	2 kΩ	0.3 V



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES



VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES

NOTES: A. C_L 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 ≤ 10 MHz, Z_O = 50 Ω, dv/dt ≥ 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_{CCI} is the V_{CC} associated with the input port.
I. V_{CCO} is the V_{CC} associated with the output port.

Figure 2. Load Circuit and Voltage Waveforms

PACKAGING INFORMATION

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

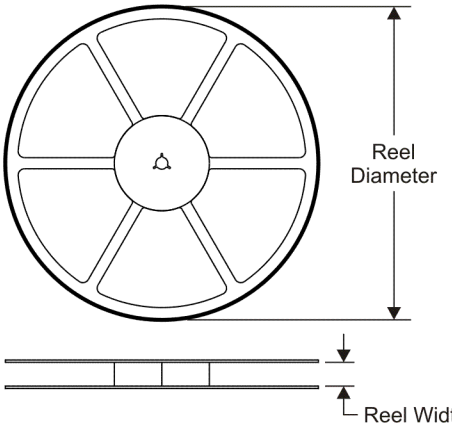
(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, 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) 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)

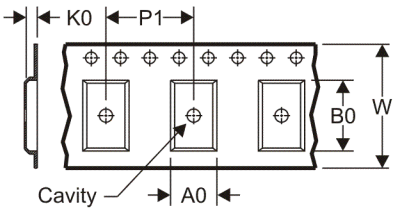
(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

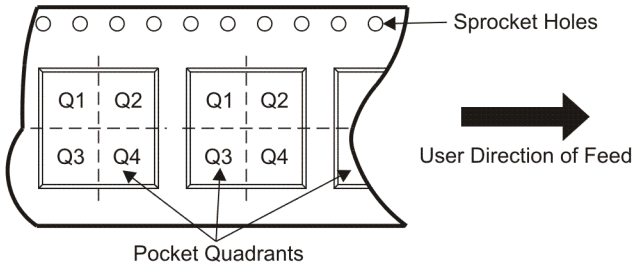


TAPE DIMENSIONS



A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

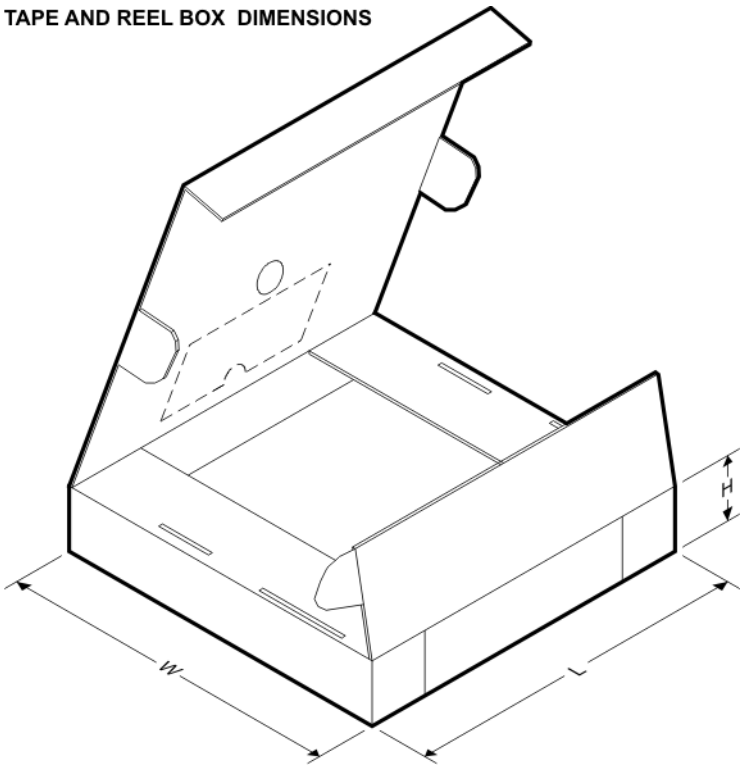
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

Device	Package 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 MICROSTAR JUNIOR	GQS	24	2500	330.0	12.4	3.3	3.3	1.6	8.0	12.0	Q1
SN74AVCA406LGXYR	BGA MICROSTAR JUNIOR	GXY	20	2500	330.0	12.4	2.8	3.3	1.0	4.0	12.0	Q2
SN74AVCA406LZQSR	BGA MICROSTAR JUNIOR	ZQS	24	2500	330.0	12.4	3.3	3.3	1.6	8.0	12.0	Q1
SN74AVCA406LZXYR	BGA MICROSTAR JUNIOR	ZXY	20	2500	330.0	12.4	2.8	3.3	1.0	4.0	12.0	Q2

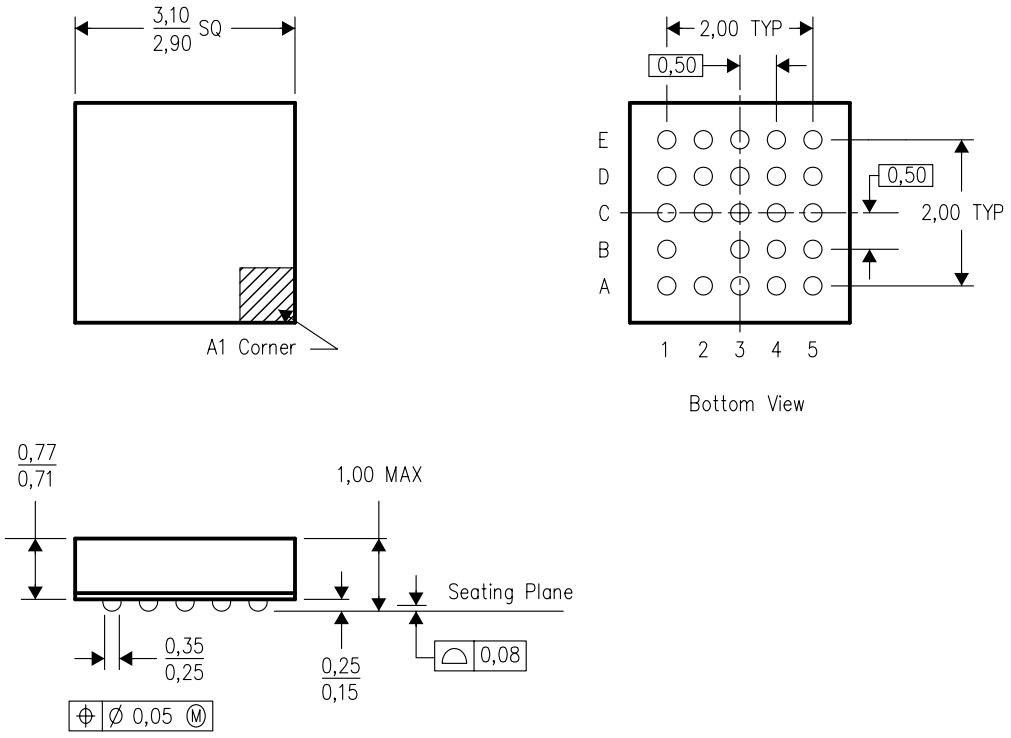
TAPE AND REEL BOX DIMENSIONS



*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

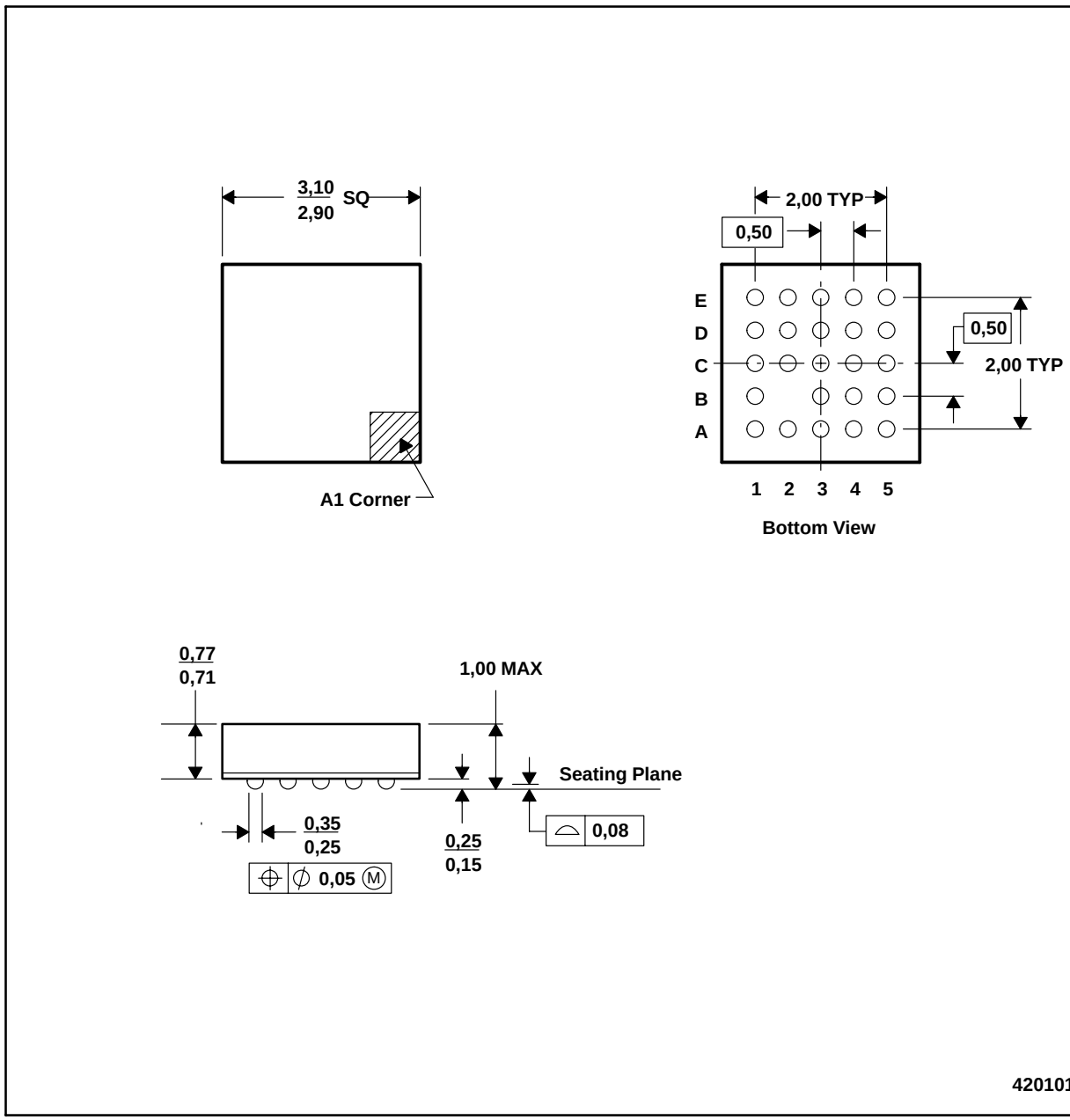


4206374/A 09/04

NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Falls within JEDEC MO–225
D. This package is lead–free.

MPBG127B – APRIL 2000 – REVISED FEBRUARY 2002

GQS (S-PBGA-N24) **PLASTIC BALL GRID ARRAY**

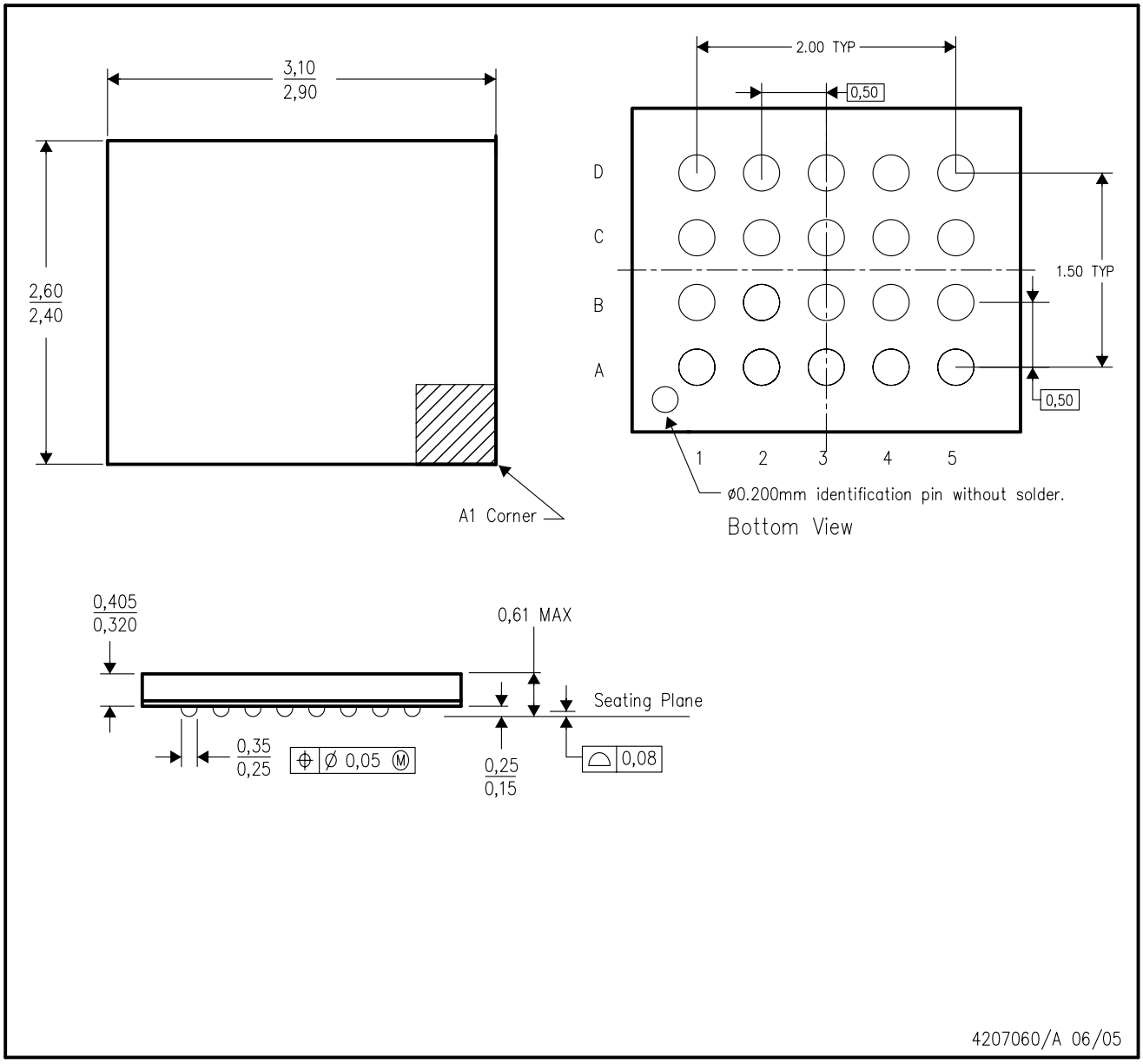


4201012/D 01/02

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

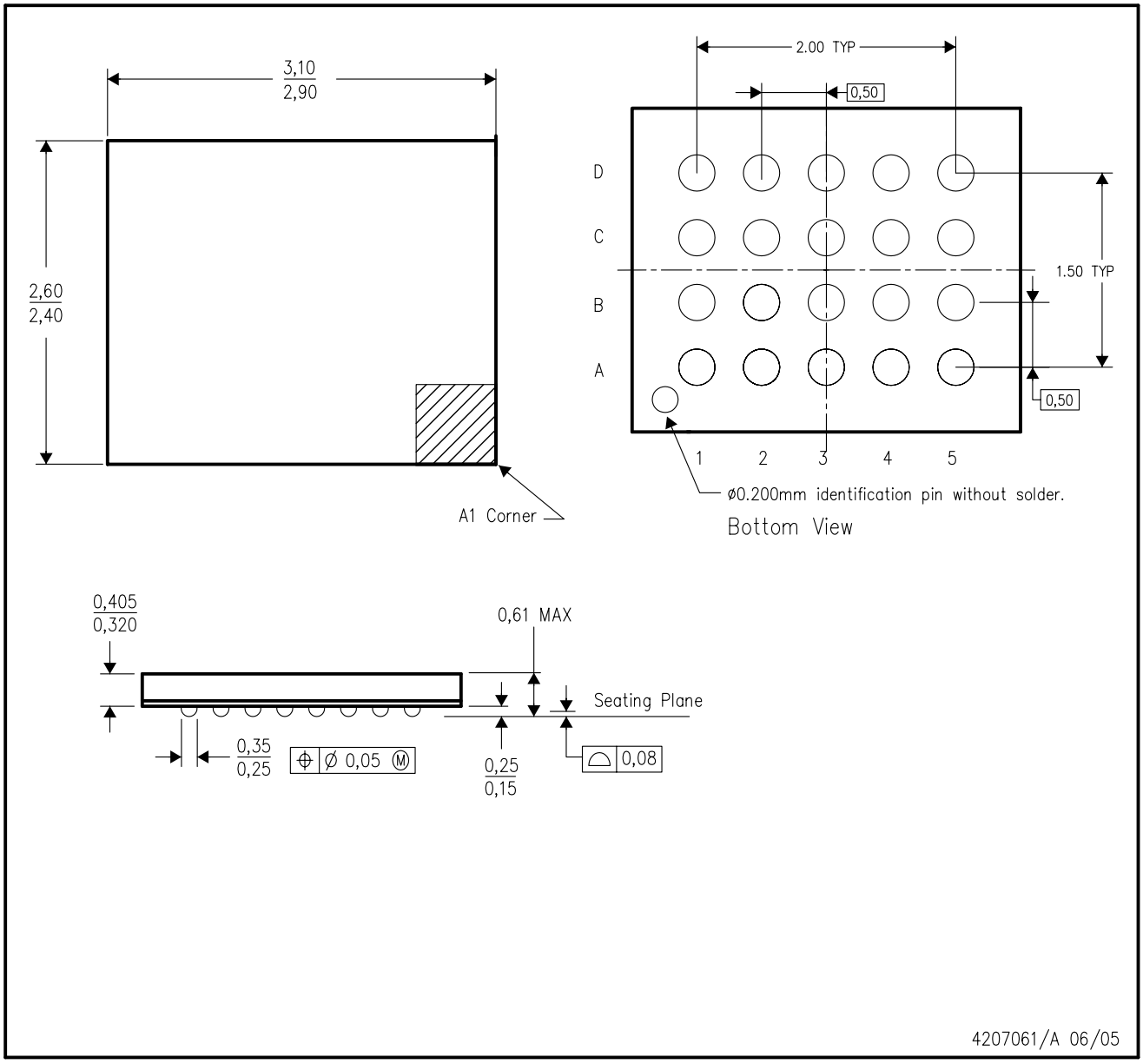
MicroStar Junior is a trademark of Texas Instruments.

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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