SN74AVCAH164245
16-BIT DUAL-SUPPLY BUS TRANSCEIVER
WITH CONFIGURABLE VOLTAGE TRANSLATION AND 3-STATE OUTPUTS

SCES396A–JULY 2002–REVISED JUNE 2005

FEATURES

- **Member of the Texas Instruments Widebus™ Family**
- **DOC™ Circuitry Dynamically Changes Output Impedance, Resulting in Noise Reduction Without Speed Degradation**
- **Dynamic Drive Capability Is Equivalent to Standard Outputs With I_{OH} and I_{OL} of ±24 mA at 2.5-V V_{CC}**
- **Control Inputs V_{IH}/V_{IL} Levels Are Referenced to V_{CCA} Voltage**
- **If Either V_{CC} Input Is at GND, Both Ports Are in the High-Impedance State**
- **Overvoltage-Tolerant Inputs/Outputs Allow Mixed-Voltage-Mode Data Communications**

- **I_{off} Supports Partial-Power-Down Mode Operation**
- **Fully Configurable Dual-Rail Design Allows Each Port to Operate Over the Full 1.4-V to 3.6-V Power-Supply Range**
- **Bus Hold on Data Inputs Eliminates the Need for External Pullup/Pulldown Resistors**
- **Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II**
- **ESD Protection Exceeds JESD 22**
  - **2000-V Human-Body Model (A114-A)**
  - **200-V Machine Model (A115-A)**
  - **1000-V Charged-Device Model (C101)**

DESCRIPTION/ORDERING INFORMATION

This 16-bit (dual-octal) noninverting bus transceiver uses two separate configurable power-supply rails. The A port is designed to track V_{CCA}. V_{CCA} accepts any supply voltage from 1.4 V to 3.6 V. The B port is designed to track V_{CCB}. V_{CCB} accepts any supply voltage from 1.4 V to 3.6 V. This allows for universal low-voltage bidirectional translation between any of the 1.5-V, 1.8-V, 2.5-V, and 3.3-V voltage nodes.

The SN74AVCAH164245 is designed for asynchronous communication between data buses. The device transmits data from the A bus to the B bus or from the B bus to the A bus, depending on the logic level at the direction-control (DIR) input. The output-enable ($\overline{OE}$) input can be used to disable the outputs so the buses are effectively isolated.

The SN74AVCAH164245 is designed so that the control pins (1DIR, 2DIR, 1$\overline{OE}$, and 2$\overline{OE}$) are supplied by V_{CCA}.

Active bus-hold circuitry is provided to hold unused or floating data inputs at a valid logic level. Use of pullup or pulldown resistors with the bus-hold circuitry is not recommended.

To ensure the high-impedance state during power up or power down, $\overline{OE}$ should be tied to V_{CCA} through a pullup resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver.

This device is fully specified for partial-power-down applications using I_{off}. The I_{off} circuitry disables the outputs, preventing damaging current backflow through the device when it is powered down. If either V_{CC} input is at GND, then both ports are in the high-impedance state.

ORDERING INFORMATION

T_A	PACKAGE[(1)]		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 85°C	TSSOP – DGG	Tape and reel	SN74AVCAH164245GR	AVCAH164245
	TVSOP – DGV	Tape and reel	SN74AVCAH164245VR	WAH4245
	VFBGA – GQL	Tape and reel	SN74AVCAH164245KR	WAH4245

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

TEXAS INSTRUMENTS
www.ti.com

TERMINAL ASSIGNMENTS

DGG OR DGV PACKAGE
(TOP VIEW)

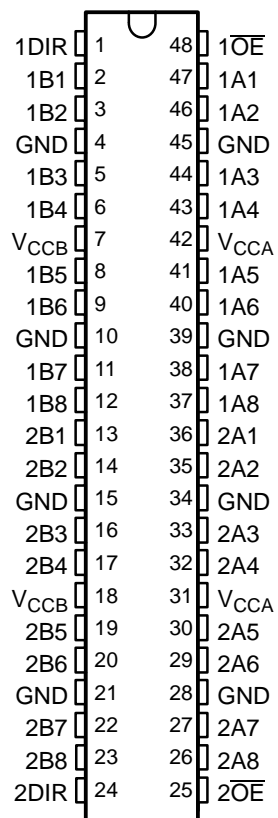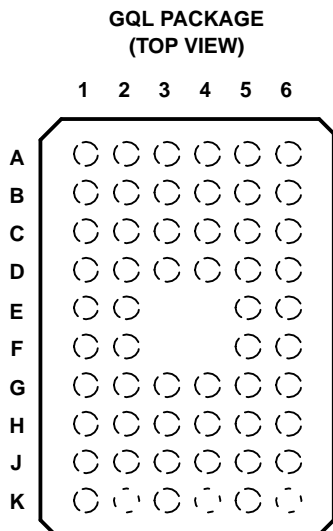|			
1DIR	1	48	1$\overline{OE}$
1B1	2	47	1A1
1B2	3	46	1A2
GND	4	45	GND
1B3	5	44	1A3
1B4	6	43	1A4
V_{CCB}	7	42	V_{CCA}
1B5	8	41	1A5
1B6	9	40	1A6
GND	10	39	GND
1B7	11	38	1A7
1B8	12	37	1A8
2B1	13	36	2A1
2B2	14	35	2A2
GND	15	34	GND
2B3	16	33	2A3
2B4	17	32	2A4
V_{CCB}	18	31	V_{CCA}
2B5	19	30	2A5
2B6	20	29	2A6
GND	21	28	GND
2B7	22	27	2A7
2B8	23	26	2A8
2DIR	24	25	2$\overline{OE}$

TEXAS INSTRUMENTS
www.ti.com

SN74AVCAH164245
16-BIT DUAL-SUPPLY BUS TRANSCEIVER
WITH CONFIGURABLE VOLTAGE TRANSLATION AND 3-STATE OUTPUTS
SCES396A−JULY 2002−REVISED JUNE 2005

GQL PACKAGE
(TOP VIEW)

TERMINAL ASSIGNMENTS[1]

	1	2	3	4	5	6
A	1DIR	NC	NC	NC	NC	1$\overline{\text{OE}}$
B	1B2	1B1	GND	GND	1A1	1A2
C	1B4	1B3	V_{CCB}	V_{CCA}	1A3	1A4
D	1B6	1B5	GND	GND	1A5	1A6
E	1B8	1B7			1A7	1A8
F	2B1	2B2			2A2	2A1
G	2B3	2B4	GND	GND	2A4	2A3
H	2B5	2B6	V_{CCB}	V_{CCA}	2A6	2A5
J	2B7	2B8	GND	GND	2A8	2A7
K	2DIR	NC	NC	NC	NC	2$\overline{\text{OE}}$

(1) NC – No internal connection

FUNCTION TABLE
(EACH 8-BIT SECTION)

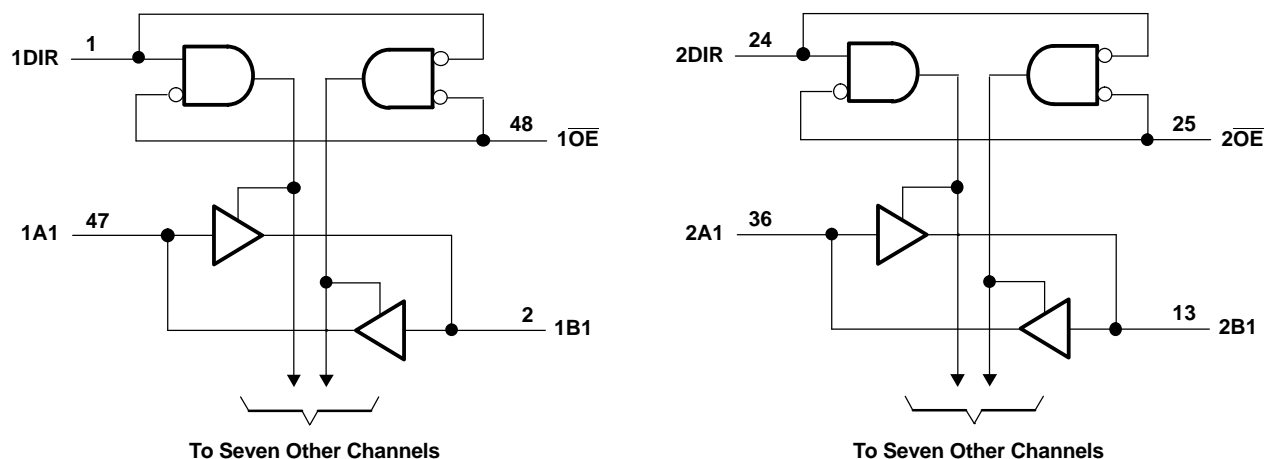| INPUTS		OPERATION
$\overline{\text{OE}}$	DIR	
L	L	B data to A bus
L	H	A data to B bus
H	X	Isolation

SN74AVCAH164245
16-BIT DUAL-SUPPLY BUS TRANSCEIVER
WITH CONFIGURABLE VOLTAGE TRANSLATION AND 3-STATE OUTPUTS
SCES396A – JULY 2002 – REVISED JUNE 2005

TEXAS INSTRUMENTS
www.ti.com

LOGIC DIAGRAM (POSITIVE LOGIC)

To Seven Other Channels   To Seven Other Channels

Pin numbers shown are for the DGG and DGV packages.

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]	DGG package		70	°C/W
		DGV package		58	
		GQL package		28	
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 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.

Texas Instruments
www.ti.com

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

			V_{CCI}	V_{CCO}	MIN	MAX	UNIT
V_{CCA}	Supply voltage				1.4	3.6	V
V_{CCB}	Supply voltage				1.4	3.6	V
V_{IH}	High-level input voltage	Data inputs	1.4 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	Data inputs	1.4 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_{IH}	High-level input voltage	Control inputs (referenced to V_{CCA})	1.4 V to 1.95 V		$V_{CCA} \times 0.65$		V
			1.95 V to 2.7 V		1.7		
			2.7 V to 3.6 V		2		
V_{IL}	Low-level input voltage	Control inputs (referenced to V_{CCA})	1.4 V to 1.95 V			$V_{CCA} \times 0.35$	V
			1.95 V to 2.7 V			0.7	
			2.7 V to 3.6 V			0.8	
V_I	Input voltage				0	3.6	V
V_O	Output voltage	Active state			0	V_{CCO}	V
		3-state			0	3.6	
I_{OH}	High-level output current			1.4 V to 1.6 V		−2	mA
				1.65 V to 1.95 V		−4	
				2.3 V to 2.7 V		−8	
				3 V to 3.6 V		−12	
I_{OL}	Low-level output current			1.4 V to 1.6 V		2	mA
				1.65 V to 1.95 V		4	
				2.3 V to 2.7 V		8	
				3 V to 3.6 V		12	
$\Delta t/\Delta v$	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 data 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.

SN74AVCAH164245
16-BIT DUAL-SUPPLY BUS TRANSCEIVER
WITH CONFIGURABLE VOLTAGE TRANSLATION AND 3-STATE OUTPUTS
SCES396A−JULY 2002−REVISED JUNE 2005

TEXAS INSTRUMENTS
www.ti.com

Electrical Characteristics[1][2]

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

PARAMETER		TEST CONDITIONS		V_{CCA}	V_{CCB}	MIN	TYP[3]	MAX	UNIT
V_{OH}		$I_{OH} = -100\ \mu A$,	$V_I = V_{IH}$	1.4 V to 3.6 V	1.4 V to 3.6 V	$V_{CCO} - 0.2$ V			V
		$I_{OH} = -2$ mA,	$V_I = V_{IH}$	1.4 V	1.4 V	1.05			
		$I_{OH} = -4$ mA,	$V_I = V_{IH}$	1.65 V	1.65 V	1.2			
		$I_{OH} = -8$ mA,	$V_I = V_{IH}$	2.3 V	2.3 V	1.75			
		$I_{OH} = -12$ mA,	$V_I = V_{IH}$	3 V	3 V	2.3			
V_{OL}		$I_{OH} = 100\ \mu A$,	$V_I = V_{IL}$	1.4 V to 3.6 V	1.4 V to 3.6 V			0.2	V
		$I_{OH} = 2$ mA,	$V_I = V_{IL}$	1.4 V	1.4 V			0.35	
		$I_{OH} = 4$ mA,	$V_I = V_{IL}$	1.65 V	1.65 V			0.45	
		$I_{OH} = 8$ mA,	$V_I = V_{IL}$	2.3 V	2.3 V			0.55	
		$I_{OH} = 12$ mA,	$V_I = V_{IL}$	3 V	3 V			0.7	
I_I	Control inputs	$V_I = V_{CCA}$ or GND		1.4 V to 3.6 V	3.6 V			±2.5	µA
I_{BHL}[4]		$V_I = 0.49$ V		1.4 V	1.4 V		11		µA
		$V_I = 0.57$ V		1.65 V	1.65 V		30		
		$V_I = 0.7$ V		2.3 V	2.3 V	45			
		$V_I = 0.8$ V		3 V	3 V	75			
I_{BHH}[5]		$V_I = 0.91$ V		1.4 V	1.4 V		−11		µA
		$V_I = 1.07$ V		1.65 V	1.65 V		−30		
		$V_I = 1.7$ V		2.3 V	2.3 V	−45			
		$V_I = 2$ V		3 V	3 V	−75			
I_{BHLO}[6]		$V_I = 0$ to V_{CC}		1.6 V	1.6 V	100			µA
				1.95 V	1.95 V	200			
				2.7 V	2.7 V	300			
				3.6 V	3.6 V	525			
I_{BHHO}[7]		$V_I = 0$ to V_{CC}		1.6 V	1.6 V	−100			µA
				1.95 V	1.95 V	−200			
				2.7 V	2.7 V	−300			
				3.6 V	3.6 V	−525			
I_{off}	A port	V_I or $V_O = 0$ to 3.6 V		0 V	0 to 3.6 V			±10	µA
	B port			0 to 3.6 V	0 V			±10	
I_{OZ}[8]	A or B ports	$V_O = V_{CCO}$ or GND, $V_I = V_{CCI}$ or GND	$\overline{OE} = V_{IH}$	3.6 V	3.6 V			±12.5	µA
	B port		$\overline{OE}$ = don't care	0 V	3.6 V			±12.5	
	A port			3.6 V	0 V			±12.5	

(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) The bus-hold circuit can sink at least the minimum low sustaining current at V_{IL} max. I_{BHL} should be measured after lowering V_{IN} to GND and then raising it to V_{IL} max.
(5) The bus-hold circuit can source at least the minimum high sustaining current at V_{IH} min. I_{BHH} should be measured after raising V_{IN} to V_{CC} and then lowering it to V_{IH} min.
(6) An external driver must source at least I_{BHLO} to switch this node from low to high.
(7) An external driver must sink at least I_{BHHO} to switch this node from high to low.
(8) For I/O ports, the parameter I_{OZ} includes the input leakage current.

Electrical Characteristics[1](continued)

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

PARAMETER		TEST CONDITIONS	V_{CCA}	V_{CCB}	MIN	TYP[2]	MAX	UNIT
I_{CCA}		$V_I = V_{CCI}$ or GND, $\quad I_O = 0$	1.6 V	1.6 V			20	μA
			1.95 V	1.95 V			20	
			2.7 V	2.7 V			30	
			0 V	3.6 V			−40	
			3.6 V	0 V			40	
			3.6 V	3.6 V			40	
I_{CCB}		$V_I = V_{CCI}$ or GND, $\quad I_O = 0$	1.6 V	1.6 V			20	μA
			1.95 V	1.95 V			20	
			2.7 V	2.7 V			30	
			0 V	3.6 V			40	
			3.6 V	0 V			−40	
			3.6 V	3.6 V			40	
C_i	Control inputs	V_I = 3.3 V or GND	3.3 V	3.3 V		4		pF
C_{io}	A or B ports	V_O = 3.3 V or GND	3.3 V	3.3 V		5		pF

(1) V_{CCI} is the V_{CC} associated with the input port.
(2) All typical values are at T_A = 25°C.

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} = 1.5 V ± 0.1 V		V_{CCB} = 1.8 V ± 0.15 V		V_{CCB} = 2.5 V ± 0.2 V		V_{CCB} = 3.3 V ± 0.3 V		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t_{pd}	A	B	1.7	6.7	1.9	6.3	1.8	5.5	1.7	5.8	ns
	B	A	1.8	6.8	2.2	7.4	2.1	7.6	2.1	7.3	
t_{en}	$\overline{OE}$	A	2.6	8.4	2.7	8.2	2.3	6.3	2.1	5.6	ns
	$\overline{OE}$	B	2.7	8.6	3.2	10.2	3.2	10.8	3.2	10.7	
t_{dis}	$\overline{OE}$	A	2.1	7	2.5	7	1.7	5.3	2	6.1	ns
	$\overline{OE}$	B	2.1	7.1	2.5	7.1	2.1	6.5	2.1	6.4	

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} = 1.5 V ± 0.1 V		V_{CCB} = 1.8 V ± 0.15 V		V_{CCB} = 2.5 V ± 0.2 V		V_{CCB} = 3.3 V ± 0.3 V		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t_{pd}	A	B	1.7	6.4	1.8	6	1.7	4.7	1.6	4.3	ns
	B	A	1.4	5.5	1.8	6	1.8	5.8	1.8	5.5	
t_{en}	$\overline{OE}$	A	2.5	8	2.7	7.8	2.2	5.8	2	5.1	ns
	$\overline{OE}$	B	1.8	6.7	2.7	7.8	2.7	8.1	2.7	8.1	
t_{dis}	$\overline{OE}$	A	2.1	6.4	2.5	6.4	1.5	4.5	1.8	5	ns
	$\overline{OE}$	B	2.1	6.6	2.5	6.4	2	5.5	2	5.5	

TEXAS INSTRUMENTS
www.ti.com

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} = 1.5 V ± 0.1 V		V_{CCB} = 1.8 V ± 0.15 V		V_{CCB} = 2.5 V ± 0.2 V		V_{CCB} = 3.3 V ± 0.3 V		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t_{pd}	A	B	1.6	6	1.8	5.6	1.5	4	1.4	3.4	ns
	B	A	1.3	4.6	1.7	4.4	1.5	4	1.4	3.7	
t_{en}	$\overline{OE}$	A	2.6	7.4	2.7	7.2	2.2	5.3	2	4.5	ns
		B	1.2	4.1	2.2	5.1	2.2	5.3	2.2	5.3	
t_{dis}	$\overline{OE}$	A	2	5.7	2.3	5.7	1.4	3.7	1.6	4	ns
		B	0.9	4.5	1.7	4.5	1.4	3.7	1.4	3.7	

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} = 1.5 V ± 0.1 V		V_{CCB} = 1.8 V ± 0.15 V		V_{CCB} = 2.5 V ± 0.2 V		V_{CCB} = 3.3 V ± 0.3 V		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t_{pd}	A	B	1.5	5.9	1.7	5.4	1.5	3.7	1.4	3.1	ns
	B	A	1.3	4.5	1.6	3.8	1.5	3.3	1.4	3.1	
t_{en}	$\overline{OE}$	A	2.5	7	2.6	6.9	2.1	5	1.9	4.1	ns
		B	0.8	2.6	1.9	4	2	4.1	1.9	4.1	
t_{dis}	$\overline{OE}$	A	1.2	5.4	2.2	5.2	1.2	3.3	1.5	3.6	ns
		B	1.2	5.4	1.7	4.4	1.5	3.6	1.5	3.6	

Operating Characteristics

V_{CCA} and V_{CCB} = 3.3 V, T_A = 25°C

PARAMETER			TEST CONDITIONS		TYP	UNIT
C_{pdA}	Power dissipation capacitance per transceiver, A-port input, B-port output	Outputs enabled	C_L = 0, f = 10 MHz		14	pF
		Outputs disabled			7	
	Power dissipation capacitance per transceiver, B-port input, A-port output	Outputs enabled			20	
		Outputs disabled			7	
C_{pdB}	Power dissipation capacitance per transceiver, A-port input, B-port output	Outputs enabled	C_L = 0, f = 10 MHz		14	pF
		Outputs disabled			7	
	Power dissipation capacitance per transceiver, B-port input, A-port output	Outputs enabled			20	
		Outputs disabled			7	

Output Description

The DOC™ circuitry is implemented, which, during the transition, initially lowers the output impedance to effectively drive the load and, subsequently, raises the impedance to reduce noise. Figure 1 shows typical V_{OL} vs I_{OL} and V_{OH} vs I_{OH} curves to illustrate the output impedance and drive capability of the circuit. At the beginning of the signal transition, the DOC circuit provides a maximum dynamic drive that is equivalent to a high-drive standard-output device. For more information, refer to the TI application reports, *AVC Logic Family Technology and Applications*, literature number SCEA006, and *Dynamic Output Control (DOC™) Circuitry Technology and Applications*, literature number SCEA009.
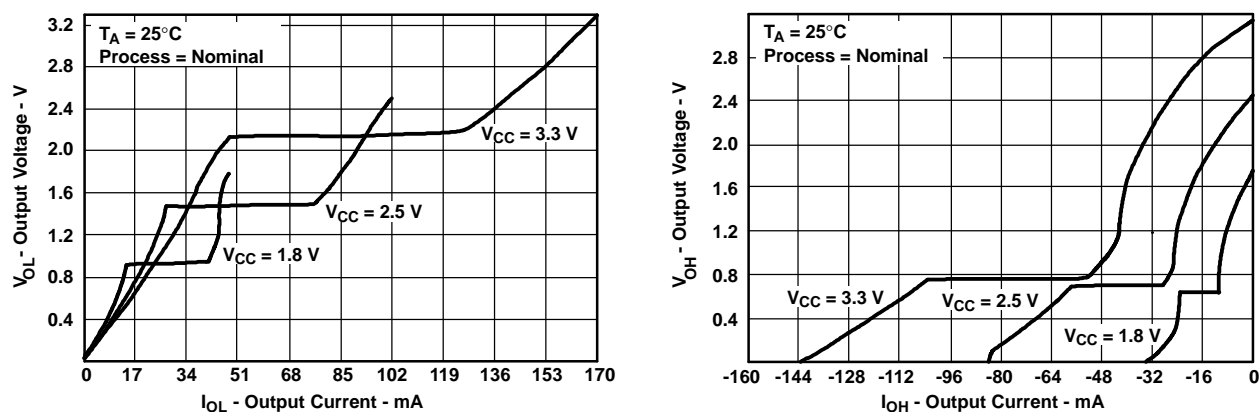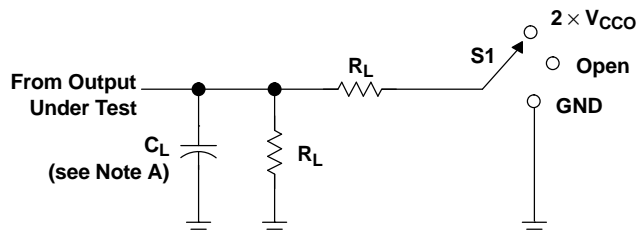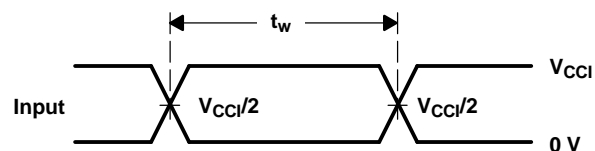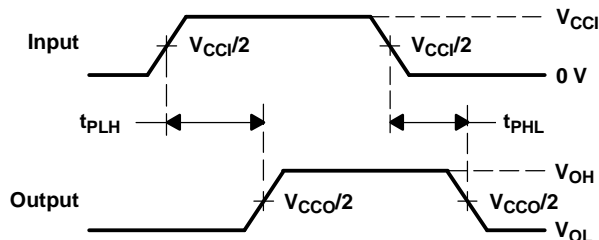

Figure 1. Output Voltage vs Output Current

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}
$1.5 V \pm 0.1 V$	15 pF	2 kΩ	0.1 V
$1.8 V \pm 0.15 V$	30 pF	1 kΩ	0.15 V
$2.5 V \pm 0.2 V$	30 pF	500 Ω	0.15 V
$3.3 V \pm 0.3 V$	30 pF	500 Ω	0.3 V

**VOLTAGE WAVEFORMS
PULSE DURATION**

**VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES**
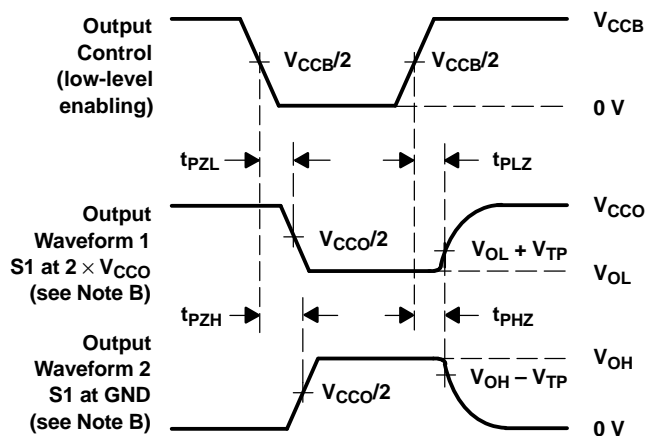
**VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES**

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

PACKAGE OPTION ADDENDUM

PACKAGING INFORMATION

Orderable Device	Status [1]	Package Type	Package Drawing	Pins	Package Qty	Eco Plan [2]	Lead/Ball Finish	MSL Peak Temp [3]
74AVCAH164245GRE4	ACTIVE	TSSOP	DGG	48	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
74AVCAH164245GRG4	ACTIVE	TSSOP	DGG	48	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
74AVCAH164245VRE4	ACTIVE	TVSOP	DGV	48	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
74AVCAH164245VRG4	ACTIVE	TVSOP	DGV	48	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
74AVCAH164245ZQLR	ACTIVE	BGA MI CROSTA R JUNI OR	ZQL	56	1000	Green (RoHS & no Sb/Br)	SNAGCU	Level-1-260C-UNLIM
SN74AVCAH164245GR	ACTIVE	TSSOP	DGG	48	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74AVCAH164245KR	ACTIVE	BGA MI CROSTA R JUNI OR	GQL	56	1000	TBD	SNPB	Level-1-240C-UNLIM
SN74AVCAH164245VR	ACTIVE	TVSOP	DGV	48	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	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.
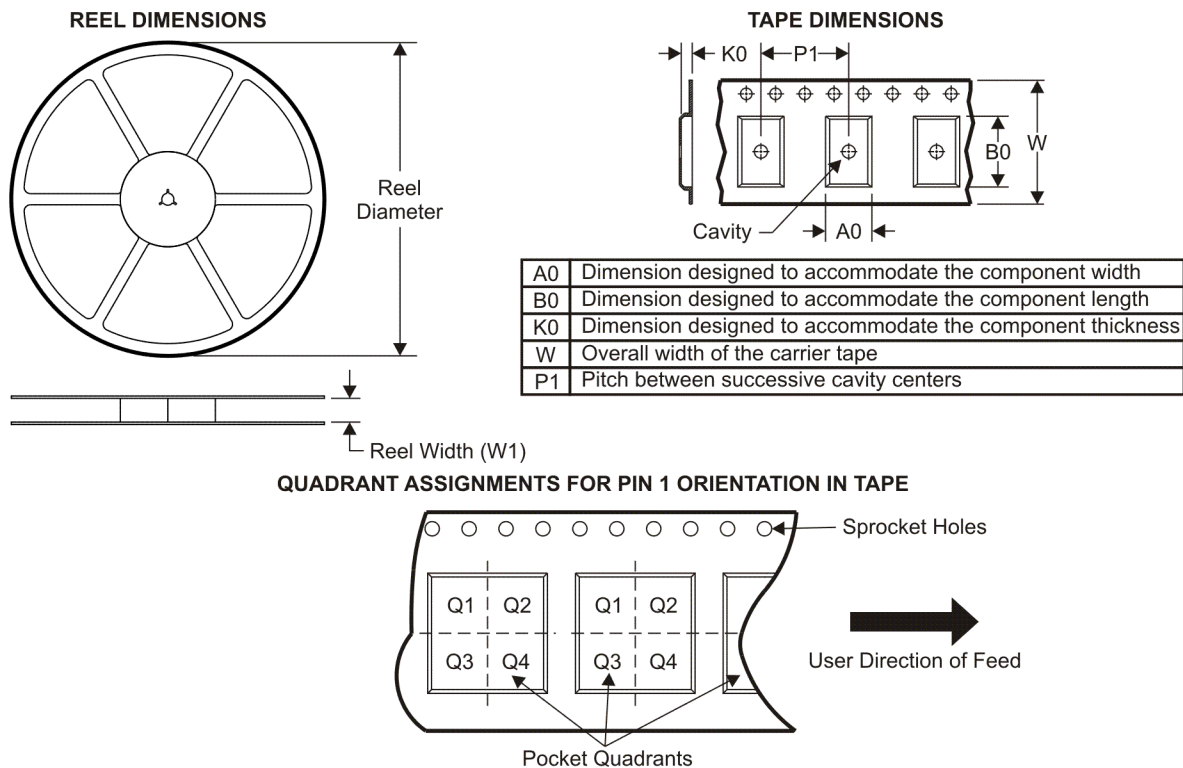**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
Green (RoHS & 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.

Important Information and Disclaimer: The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

PACKAGE MATERIALS INFORMATION

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
74AVCAH164245ZQLR	BGA MICROSTAR JUNIOR	ZQL	56	1000	330.0	16.4	4.8	7.3	1.45	8.0	16.0	Q1
SN74AVCAH164245GR	TSSOP	DGG	48	2000	330.0	24.4	8.6	15.8	1.8	12.0	24.0	Q1
SN74AVCAH164245KR	BGA MICROSTAR JUNIOR	GQL	56	1000	330.0	16.4	4.8	7.3	1.45	8.0	16.0	Q1
SN74AVCAH164245VR	TVSOP	DGV	48	2000	330.0	16.4	7.1	10.2	1.6	12.0	16.0	Q1

TAPE AND REEL BOX DIMENSIONS
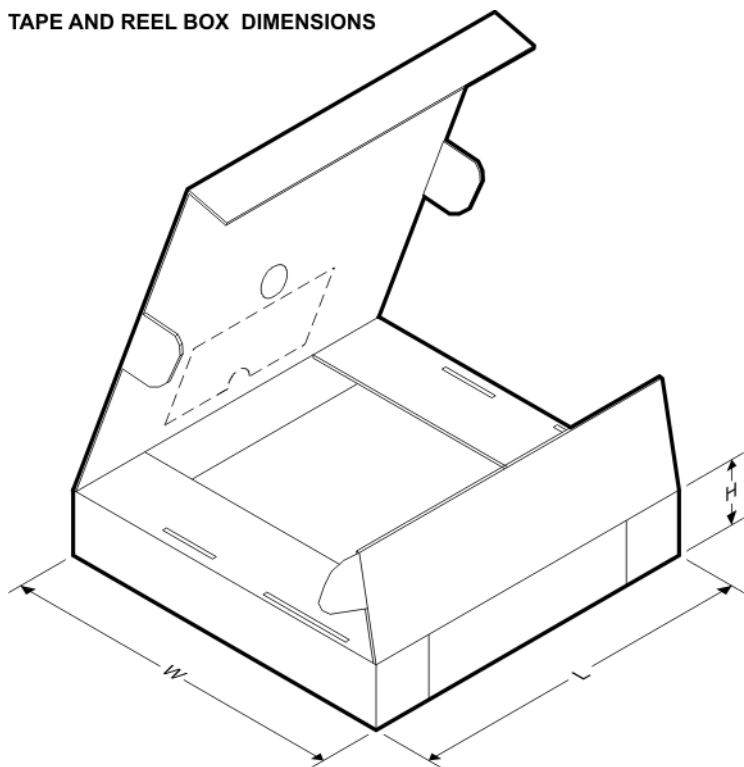
*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
74AVCAH164245ZQLR	BGA MICROSTAR JUNIOR	ZQL	56	1000	346.0	346.0	33.0
SN74AVCAH164245GR	TSSOP	DGG	48	2000	346.0	346.0	41.0
SN74AVCAH164245KR	BGA MICROSTAR JUNIOR	GQL	56	1000	346.0	346.0	33.0
SN74AVCAH164245VR	TVSOP	DGV	48	2000	346.0	346.0	33.0

GQL (R-PBGA-N56)   PLASTIC BALL GRID ARRAY

3,25

0,65

0,325

4,60
4,40   B

A

7,10
6,90

3X Via Hole
Without Ball

K
J
H
G
F
E
D
C
B
A

0,65

5,85

0,325

Missing Via Hole
Indicates Pin A1
Quadrant

A1 Corner

1 2 3 4 5 6

Bottom View

56X Ø 0,45
      0,35

⊕	Ø 0,15 Ⓜ	C	A	B
	Ø 0,08 Ⓜ	C		

1,00 Max

0,10 C

Seating Plane

0,35
0,15

C

4200583-3/K 06/2007

NOTES: A.   All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
         B.   This drawing is subject to change without notice.
         C.   Falls within JEDEC MO-285 variation BA-2.
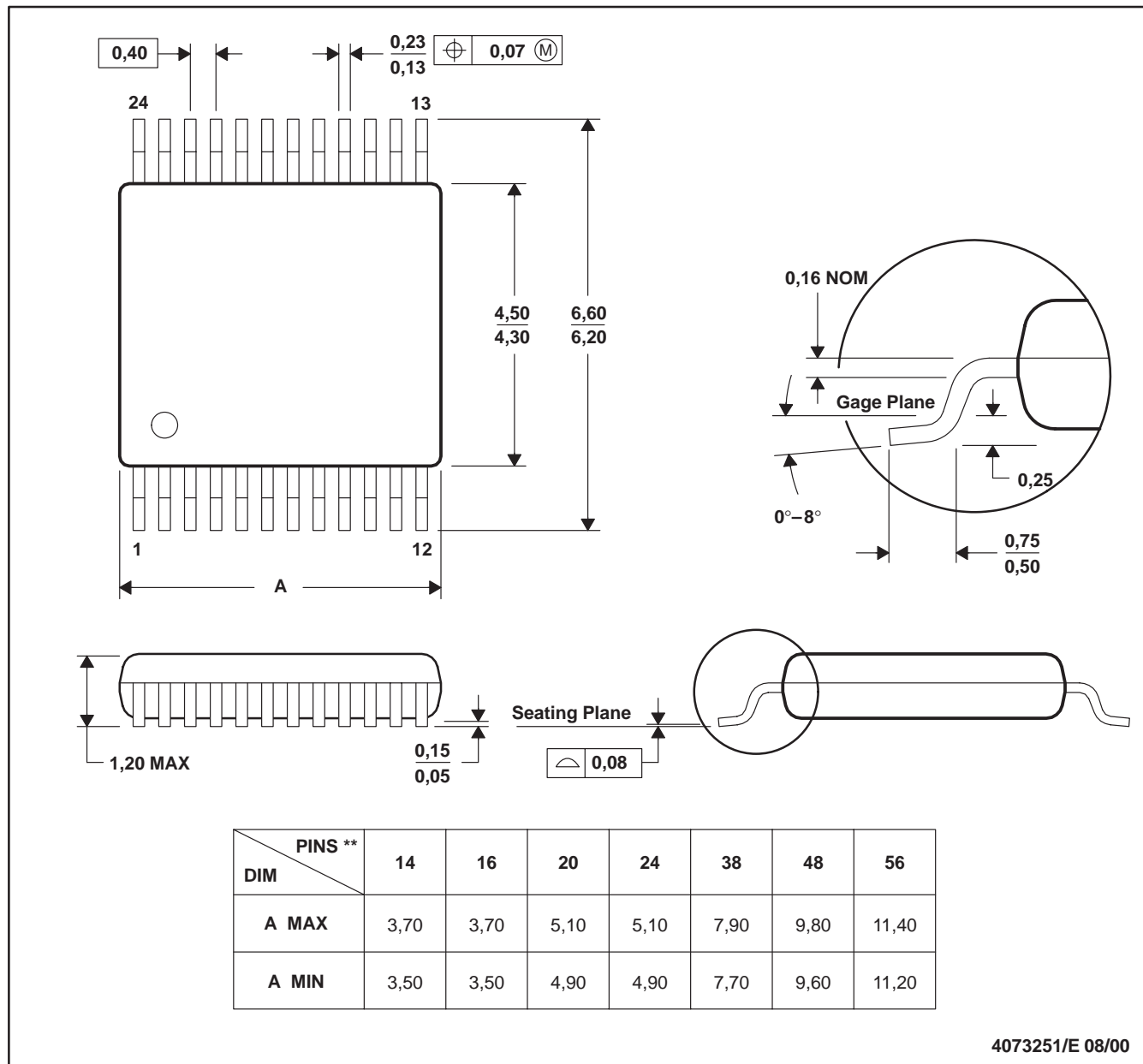   D.   This package is tin-lead (SnPb). Refer to the 56 ZQL package (drawing 4204437) for lead-free.

ZQL (R–PBGA–N56)　　　　PLASTIC BALL GRID ARRAY

4,60 / 4,40 ⟶ B

A

7,10 / 6,90

A1 Corner

1,00 Max

0,35 / 0,15

Seating Plane

0,10 C

C

3,25

0,65

0,325

3X Via Hole Without Ball

Missing Via Hole Indicates Pin A1 Quadrant

K J H G F E D C B A

1 2 3 4 5 6

Bottom View

0,65

5,85

0,325

56X Ø 0,45 / 0,35

| ⊕ | Ø 0,15 Ⓜ | C | A | B |
| | Ø 0,08 Ⓜ | C | | |

4204437–3/G　06/2007

NOTES: A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M–1994.
B. This drawing is subject to change without notice.
C. Falls within JEDEC MO–285 variation BA–2.
D. This package is lead–free. Refer to the 56 GQL package (drawing 4200583) for tin–lead (SnPb).

TEXAS INSTRUMENTS
www.ti.com

DGG (R-PDSO-G****)**   PLASTIC SMALL-OUTLINE PACKAGE

48 PINS SHOWN
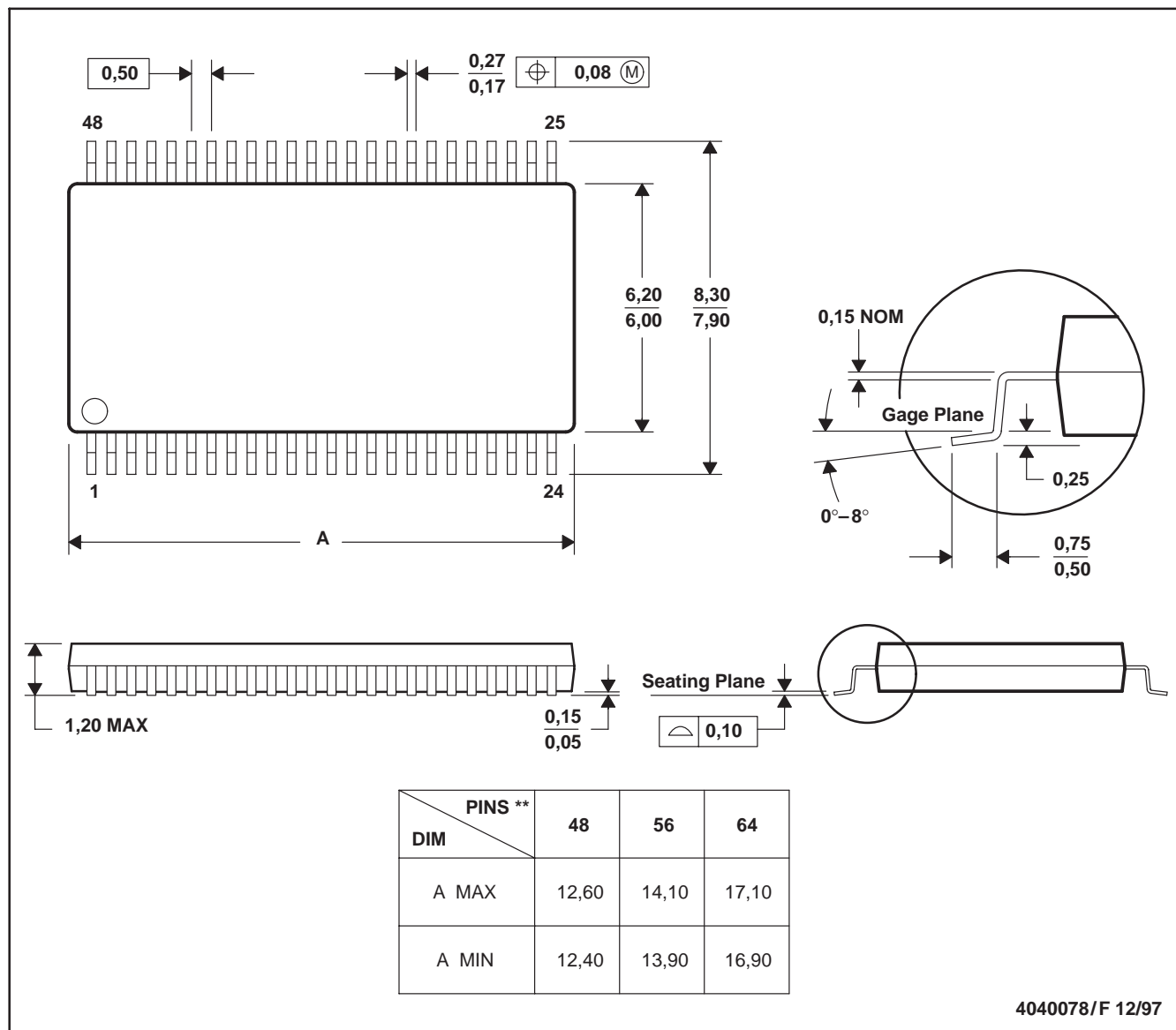
PINS ** DIM	48	56	64
A MAX	12,60	14,10	17,10
A MIN	12,40	13,90	16,90

4040078 / F 12/97

NOTES: A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold protrusion not to exceed 0,15.
D. Falls within JEDEC MO-153

TEXAS INSTRUMENTS
POST OFFICE BOX 655303 ● DALLAS, TEXAS 75265

DGV (R-PDSO-G**)   **PLASTIC SMALL-OUTLINE**

24 PINS SHOWN

PINS ** DIM	14	16	20	24	38	48	56
A MAX	3,70	3,70	5,10	5,10	7,90	9,80	11,40
A MIN	3,50	3,50	4,90	4,90	7,70	9,60	11,20

4073251/E 08/00

NOTES: A. All linear dimensions are in millimeters.
         B. This drawing is subject to change without notice.
         C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15 per side.
         D. Falls within JEDEC: 24/48 Pins – MO-153
                                  14/16/20/56 Pins – MO-194

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

Products		**Applications**	
Amplifiers	amplifier.ti.com	Audio	www.ti.com/audio
Data Converters	dataconverter.ti.com	Automotive	www.ti.com/automotive
DLP® Products	www.dlp.com	Broadband	www.ti.com/broadband
DSP	dsp.ti.com	Digital Control	www.ti.com/digitalcontrol
Clocks and Timers	www.ti.com/clocks	Medical	www.ti.com/medical
Interface	interface.ti.com	Military	www.ti.com/military
Logic	logic.ti.com	Optical Networking	www.ti.com/opticalnetwork
Power Mgmt	power.ti.com	Security	www.ti.com/security
Microcontrollers	microcontroller.ti.com	Telephony	www.ti.com/telephony
RFID	www.ti-rfid.com	Video & Imaging	www.ti.com/video
RF/IF and ZigBee® Solutions	www.ti.com/lprf	Wireless	www.ti.com/wireless

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265