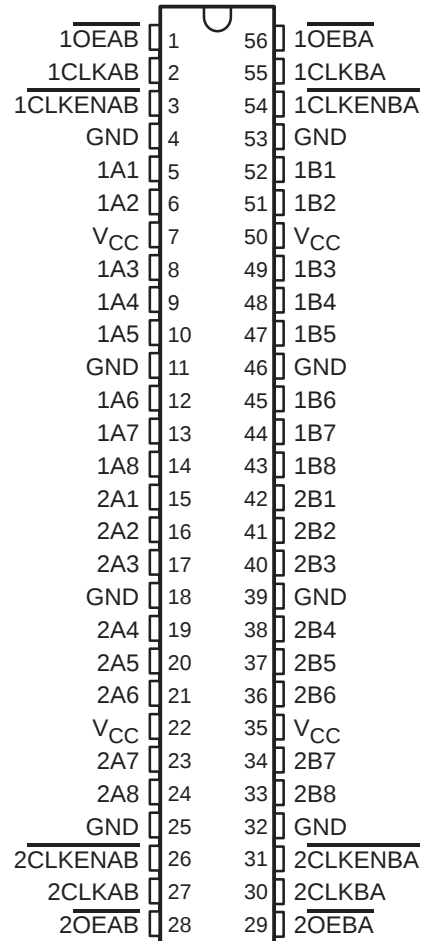


SN54LVTH16952, SN74LVTH16952 3.3-V ABT 16-BIT REGISTERED TRANSCEIVERS WITH 3-STATE OUTPUTS

SCBS697G – JULY 1997 – REVISED APRIL 2000

- Members of the Texas Instruments *Widebus™* Family
- State-of-the-Art Advanced BiCMOS Technology (ABT) Design for 3.3-V Operation and Low Static-Power Dissipation
- Support Mixed-Mode Signal Operation (5-V Input and Output Voltages With 3.3-V V_{CC})
- Support Unregulated Battery Operation Down to 2.7 V
- Typical V_{OLP} (Output Ground Bounce) < 0.8 V at $V_{CC} = 3.3$ V, $T_A = 25^\circ\text{C}$
- I_{off} and Power-Up 3-State Support Hot Insertion
- Bus Hold on Data Inputs Eliminates the Need for External Pullup/Pulldown Resistors
- Distributed V_{CC} and GND Pins Minimize High-Speed Switching Noise
- Flow-Through Architecture Optimizes PCB Layout
- Latch-Up Performance Exceeds 500 mA Per JESD 17
- ESD Protection Exceeds 2000 V Per MIL-STD-883, Method 3015; Exceeds 200 V Using Machine Model ($C = 200$ pF, $R = 0$)
- Package Options Include Plastic Shrink Small-Outline (DL) and Thin Shrink Small-Outline (DGG) Packages and 380-mil Fine-Pitch Ceramic Flat (WD) Package

SN54LVTH16952 . . . WD PACKAGE
SN74LVTH16952 . . . DGG OR DL PACKAGE
(TOP VIEW)



description

The 'LVTH16952 devices are 16-bit registered transceivers designed for low-voltage (3.3-V) V_{CC} operation, but with the capability to provide a TTL interface to a 5-V system environment.

These devices can be used as two 8-bit transceivers or one 16-bit transceiver. Data on the A or B bus is stored in the registers on the low-to-high transition of the clock (CLKAB or CLKBA) input, provided that the clock-enable (CLKENAB or CLKENBA) input is low. Taking the output-enable (OEAB or OEBA) input low accesses the data on either port.

Active bus-hold circuitry is provided to hold unused or floating data inputs at a valid logic level.

When V_{CC} is between 0 and 1.5 V, the devices are in the high-impedance state during power up or power down. However, to ensure the high-impedance state above 1.5 V, $\overline{OE}$ should be tied to V_{CC} through a pullup resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver.



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

Widebus is a trademark of Texas Instruments.

PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.



POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

Copyright © 2000, Texas Instruments Incorporated
On products compliant to MIL-PRF-38535, all parameters are tested unless otherwise noted. On all other products, production processing does not necessarily include testing of all parameters.

SN54LVTH16952, SN74LVTH16952

3.3-V ABT 16-BIT REGISTERED TRANSCEIVERS

WITH 3-STATE OUTPUTS

SCBS697G – JULY 1997 – REVISED APRIL 2000

description (continued)

These devices are fully specified for hot-insertion applications using I_{OFF} and power-up 3-state. The I_{OFF} circuitry disables the outputs, preventing damaging current backflow through the devices when they are powered down. The power-up 3-state circuitry places the outputs in the high-impedance state during power up and power down, which prevents driver conflict.

The SN54LVTH16952 is characterized for operation over the full military temperature range of -55°C to 125°C . The SN74LVTH16952 is characterized for operation from -40°C to 85°C .

FUNCTION TABLE[†]

INPUTS				OUTPUT B
$\overline{\text{CLKENAB}}$	CLKAB	$\overline{\text{OEAB}}$	A	
H	X	L	X	$B_0^{\ddagger}$
X	L	L	X	$B_0^{\ddagger}$
L	$\uparrow$	L	L	L
L	$\uparrow$	L	H	H
X	X	H	X	Z

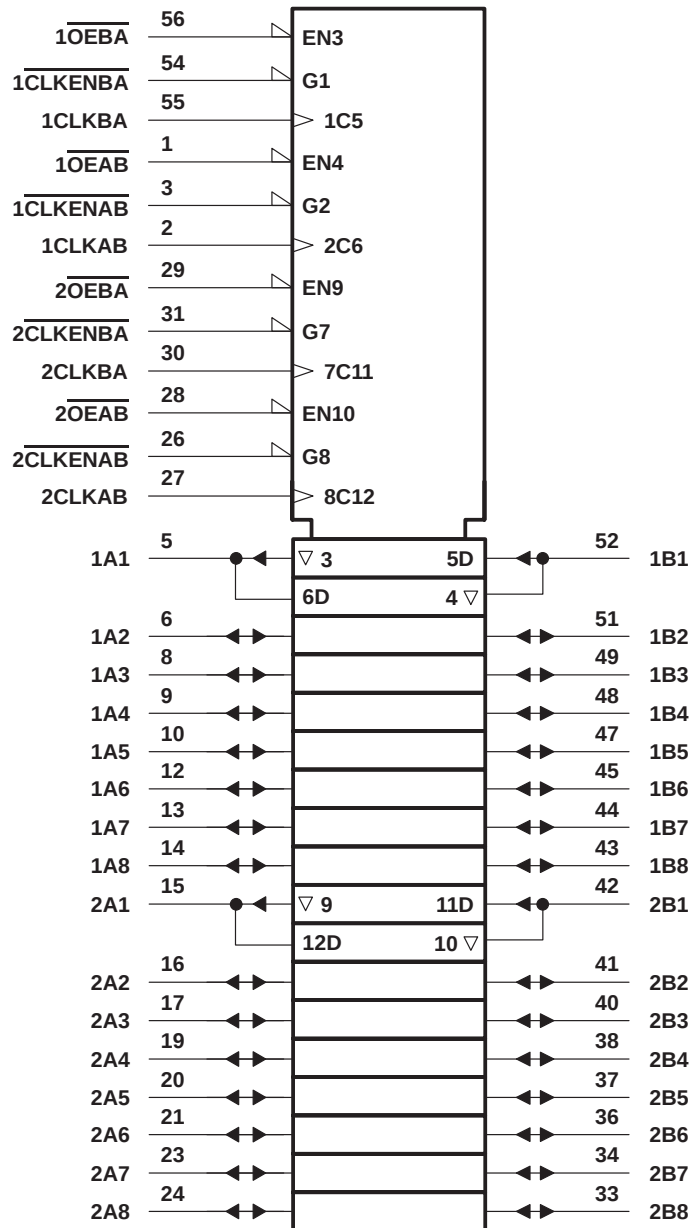
[†] A-to-B data flow is shown; B-to-A data flow is similar, but uses $\overline{\text{CLKENBA}}$, CLKBA , and $\overline{\text{OEBA}}$.

[‡] Level of B before the indicated steady-state input conditions were established

SN54LVTH16952, SN74LVTH16952
3.3-V ABT 16-BIT REGISTERED TRANSCEIVERS
WITH 3-STATE OUTPUTS

SCBS697G – JULY 1997 – REVISED APRIL 2000

logic symbol[†]



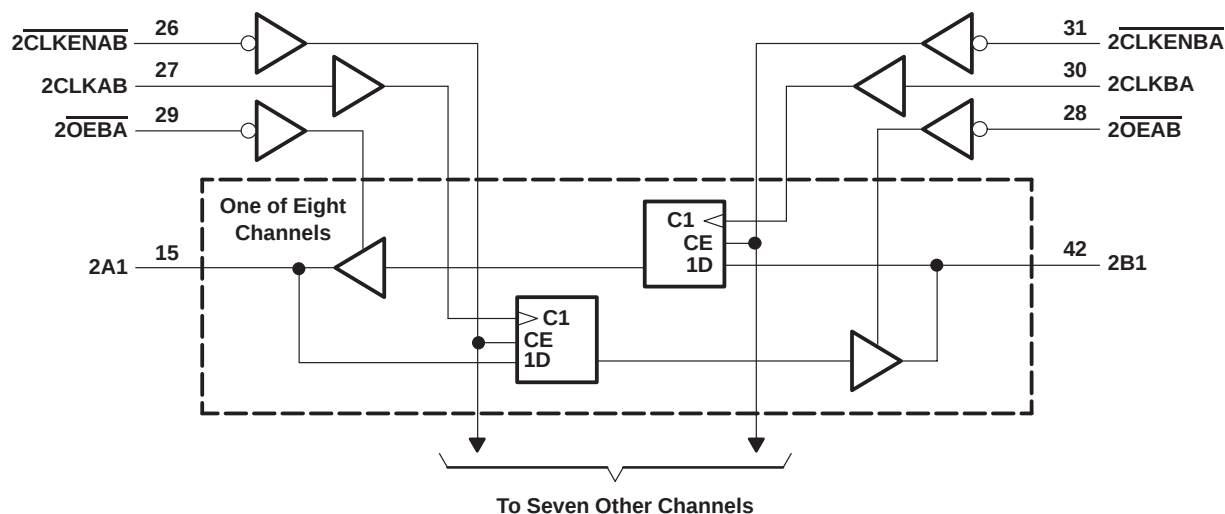
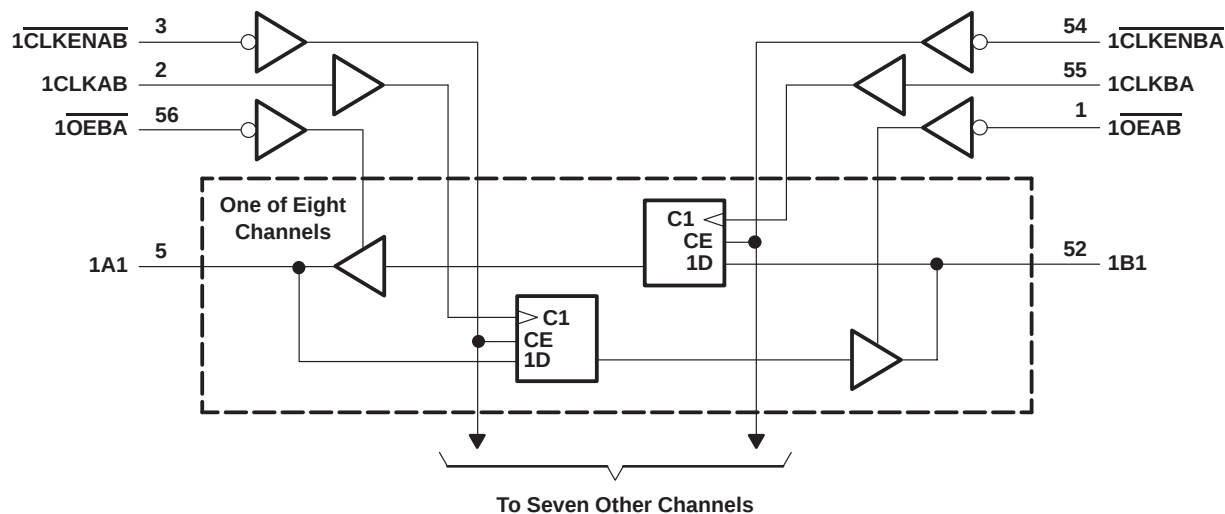
[†] This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

SN54LVTH16952, SN74LVTH16952

3.3-V ABT 16-BIT REGISTERED TRANSCIEVERS WITH 3-STATE OUTPUTS

SCBS697G – JULY 1997 – REVISED APRIL 2000

logic diagram (positive logic)



SN54LVTH16952, SN74LVTH16952

3.3-V ABT 16-BIT REGISTERED TRANSCEIVERS

WITH 3-STATE OUTPUTS

SCBS697G – JULY 1997 – REVISED APRIL 2000

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)[†]

Supply voltage range, V_{CC}	–0.5 V to 4.6 V
Input voltage range, V_I (see Note 1)	–0.5 V to 7 V
Voltage range applied to any output in the high-impedance or power-off state, V_O (see Note 1)	–0.5 V to 7 V
Voltage range applied to any output in the high state, V_O (see Note 1)	–0.5 V to $V_{CC} + 0.5$ V
Current into any output in the low state, I_O : SN54LVTH16952	96 mA
SN74LVTH16952	128 mA
Current into any output in the high state, I_O (see Note 2): SN54LVTH16952	48 mA
SN74LVTH16952	64 mA
Input clamp current, I_{IK} ($V_I < 0$)	–50 mA
Output clamp current, I_{OK} ($V_O < 0$)	–50 mA
Package thermal impedance, θ_{JA} (see Note 3): DGG package	64°C/W
DL package	56°C/W
Storage temperature range, T_{stg}	–65°C to 150°C

[†] 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.

- NOTES:
1. The input and output negative-voltage ratings may be exceeded if the input and output clamp-current ratings are observed.
 2. This current flows only when the output is in the high state and $V_O > V_{CC}$.
 3. The package thermal impedance is calculated in accordance with JESD 51.

recommended operating conditions (see Note 4)

		SN54LVTH16952		SN74LVTH16952		UNIT
		MIN	MAX	MIN	MAX	
V_{CC}	Supply voltage	2.7	3.6	2.7	3.6	V
V_{IH}	High-level input voltage	2		2		V
V_{IL}	Low-level input voltage		0.8		0.8	V
V_I	Input voltage		5.5		5.5	V
I_{OH}	High-level output current		–24		–32	mA
I_{OL}	Low-level output current		48		64	mA
$\Delta t/\Delta v$	Input transition rise or fall rate	Outputs enabled			10	ns/V
$\Delta t/\Delta V_{CC}$	Power-up ramp rate	200		200		μs/V
T_A	Operating free-air temperature	–55	125	–40	85	°C

NOTE 4: All unused control inputs of the device must be held at V_{CC} or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.



SN54LVTH16952, SN74LVTH16952

3.3-V ABT 16-BIT REGISTERED TRANSCEIVERS

WITH 3-STATE OUTPUTS

SCBS697G – JULY 1997 – REVISED APRIL 2000

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

PARAMETER		TEST CONDITIONS		SN54LVTH16952			SN74LVTH16952			UNIT	
				MIN	TYP†	MAX	MIN	TYP†	MAX		
V _{IK}		V _{CC} = 2.7 V, I _I = −18 mA		−1.2			−1.2			V	
V _{OH}		V _{CC} = 2.7 V to 3.6 V, I _{OH} = −100 μA		V _{CC} −0.2			V _{CC} −0.2			V	
		V _{CC} = 2.7 V, I _{OH} = −8 mA		2.4			2.4				
		V _{CC} = 3 V	I _{OH} = −24 mA	2							
			I _{OH} = −32 mA				2				
V _{OL}		V _{CC} = 2.7 V	I _{OL} = 100 μA	0.2			0.2			V	
			I _{OL} = 24 mA	0.5			0.5				
		V _{CC} = 3 V	I _{OL} = 16 mA	0.4			0.4				
			I _{OL} = 32 mA	0.5			0.5				
			I _{OL} = 48 mA	0.55							
			I _{OL} = 64 mA				0.55				
I _I	Control inputs	V _{CC} = 3.6 V, V _I = V _{CC} or GND		±1			±1			μA	
		V _{CC} = 0 or 3.6 V, V _I = 5.5 V		10			10				
	A or B ports‡	V _{CC} = 3.6 V	V _I = 5.5 V	20			20				
			V _I = V _{CC}	1			1				
			V _I = 0	−5			−5				
I _{off}			V _{CC} = 0, V _I or V _O = 0 to 4.5 V					±100			μA
I _I (hold)	A or B ports	V _{CC} = 3 V	V _I = 0.8 V	75			75			μA	
			V _I = 2 V	−75			−75				
		V _{CC} = 3.6 V§, V _I = 0 to 3.6 V					±500				
I _{OZPU}		V _{CC} = 0 to 1.5 V, V _O = 0.5 V to 3 V, OE = don't care		±100			±100			μA	
I _{OZPD}		V _{CC} = 1.5 V to 0, V _O = 0.5 V to 3 V, OE = don't care		±100			±100			μA	
I _{CC}		V _{CC} = 3.6 V, I _O = 0, V _I = V _{CC} or GND	Outputs high		0.19			0.19			mA
			Outputs low		5			5			
			Outputs disabled		0.19			0.19			
ΔI _{CC} ¶		V _{CC} = 3 V to 3.6 V, One input at V _{CC} − 0.6 V, Other inputs at V _{CC} or GND		0.2			0.2			mA	
C _i		V _I = 3 V or 0		4			4			pF	
C _{i0}		V _O = 3 V or 0		10			10			pF	

[†] All typical values are at $V_{CC} = 3.3\text{ V}$, $T_A = 25^\circ\text{C}$.

[‡] Unused pins at $V_{CC}\text{ or GND}$

[§] This is the bus-hold maximum dynamic current. It is the minimum overdrive current required to switch the input from one state to another.

^{||} This is the increase in supply current for each input that is at the specified TTL voltage level rather than $V_{CC}\text{ or GND}$.

SN54LVTH16952, SN74LVTH16952
3.3-V ABT 16-BIT REGISTERED TRANSCEIVERS
WITH 3-STATE OUTPUTS

SCBS697G – JULY 1997 – REVISED APRIL 2000

timing requirements over recommended operating free-air temperature range (unless otherwise noted) (see Figure 1)

			SN54LVTH16952				SN74LVTH16952				UNIT
			V _{CC} = 3.3 V ± 0.3 V		V _{CC} = 2.7 V		V _{CC} = 3.3 V ± 0.3 V		V _{CC} = 2.7 V		
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
f _{clock}	Clock frequency		150		150		150		150		MHz
t _w	Pulse duration	CLK high or low	3.3		3.3		3.3		3.3		ns
t _{su}	Setup time	A or B before CLK	2.6		3.3		1.7		2.5		ns
		CLKEN before CLK	2.2		2.8		2		2.8		
t _h	Hold time	A or B after CLK	1		1		0.8		0		ns
		CLKEN after CLK	1.4		1.5		0.4		0		

switching characteristics over recommended operating free-air temperature range, $C_L = 50\text{ pF}$ (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	SN54LVTH16952				SN74LVTH16952				UNIT	
			V _{CC} = 3.3 V ± 0.3 V		V _{CC} = 2.7 V		V _{CC} = 3.3 V ± 0.3 V		V _{CC} = 2.7 V			
			MIN	MAX	MIN	MAX	MIN	TYP†	MAX	MIN		MAX
f _{max}			150		150		150		150		MHz	
t _{PLH}	CLKBA or CLKAB	A or B	1.6	5.7	7.4		1.3	2.7	4	4.4		ns
t _{PHL}			1.7	6	7		1.3	2.7	4	4.4		
t _{PZH}	OEBA or OEAB	A or B	0.9	5	7.3		1	2.3	4	4.9		ns
t _{PZL}			1.1	5.2	5.9		1	2.4	4	4.9		
t _{PHZ}	OEBA or OEAB	A or B	1.7	6.7	7.3		2.1	3.9	5.7	6.2		ns
t _{PLZ}			1.1	5.8	6		2.1	3.5	5.1	5.3		

[†] All typical values are at $V_{CC} = 3.3\text{ V}$, $T_A = 25^\circ\text{C}$.

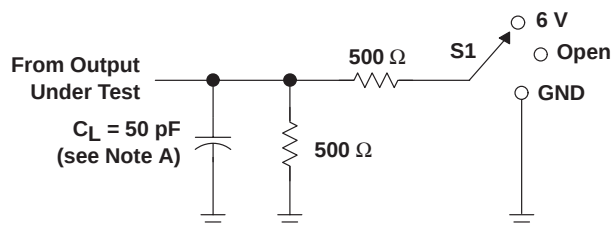
SN54LVTH16952, SN74LVTH16952

3.3-V ABT 16-BIT REGISTERED TRANSCEIVERS

WITH 3-STATE OUTPUTS

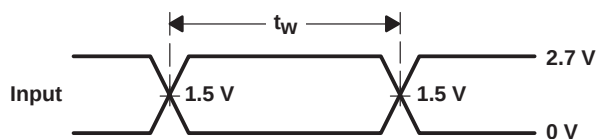
SCBS697G – JULY 1997 – REVISED APRIL 2000

PARAMETER MEASUREMENT INFORMATION

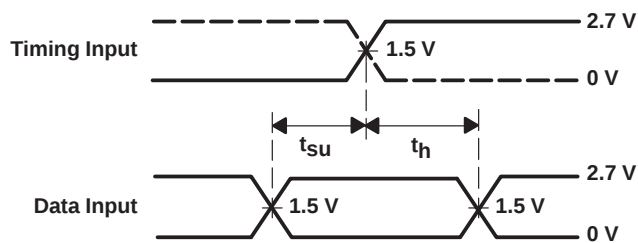


LOAD CIRCUIT

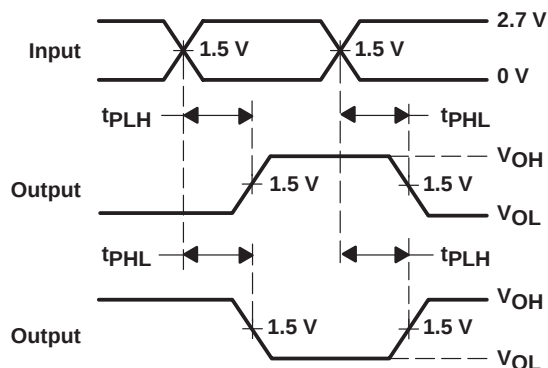
TEST	S1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	6 V
t_{PHZ}/t_{PZH}	GND



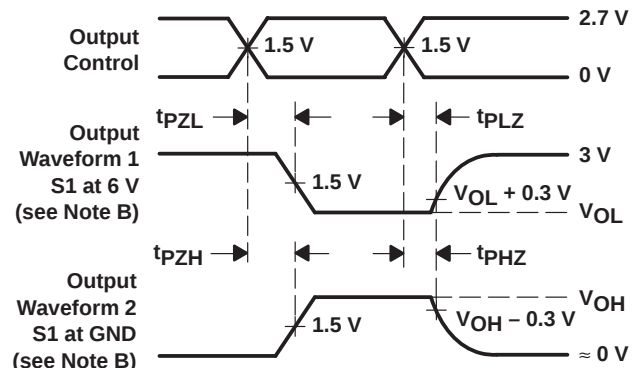
VOLTAGE WAVEFORMS
PULSE DURATION



VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES
INVERTING AND NONINVERTING OUTPUTS



VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES
LOW- AND HIGH-LEVEL ENABLING

- 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: $PRR \leq 10 \text{ MHz}$, $Z_O = 50 \Omega$, $t_r \leq 2.5 \text{ ns}$, $t_f \leq 2.5 \text{ ns}$.
- D. The outputs are measured one at a time with one transition per measurement.

Figure 1. 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⁾
5962-9684901QXA	ACTIVE	CFP	WD	56	1	TBD	Call TI	Level-NC-NC-NC
74LVTH16952DGGRE4	ACTIVE	TSSOP	DGG	56	2000	Pb-Free (RoHS)	CU NIPDAU	Level-1-250C-UNLIM
74LVTH16952DLRG4	ACTIVE	SSOP	DL	56	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVTH16952DGGR	ACTIVE	TSSOP	DGG	56	2000	Pb-Free (RoHS)	CU NIPDAU	Level-1-250C-UNLIM
SN74LVTH16952DL	ACTIVE	SSOP	DL	56	20	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVTH16952DLR	ACTIVE	SSOP	DL	56	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SNJ54LVTH16952WD	ACTIVE	CFP	WD	56	1	TBD	Call TI	Level-NC-NC-NC

⁽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) 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.

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.

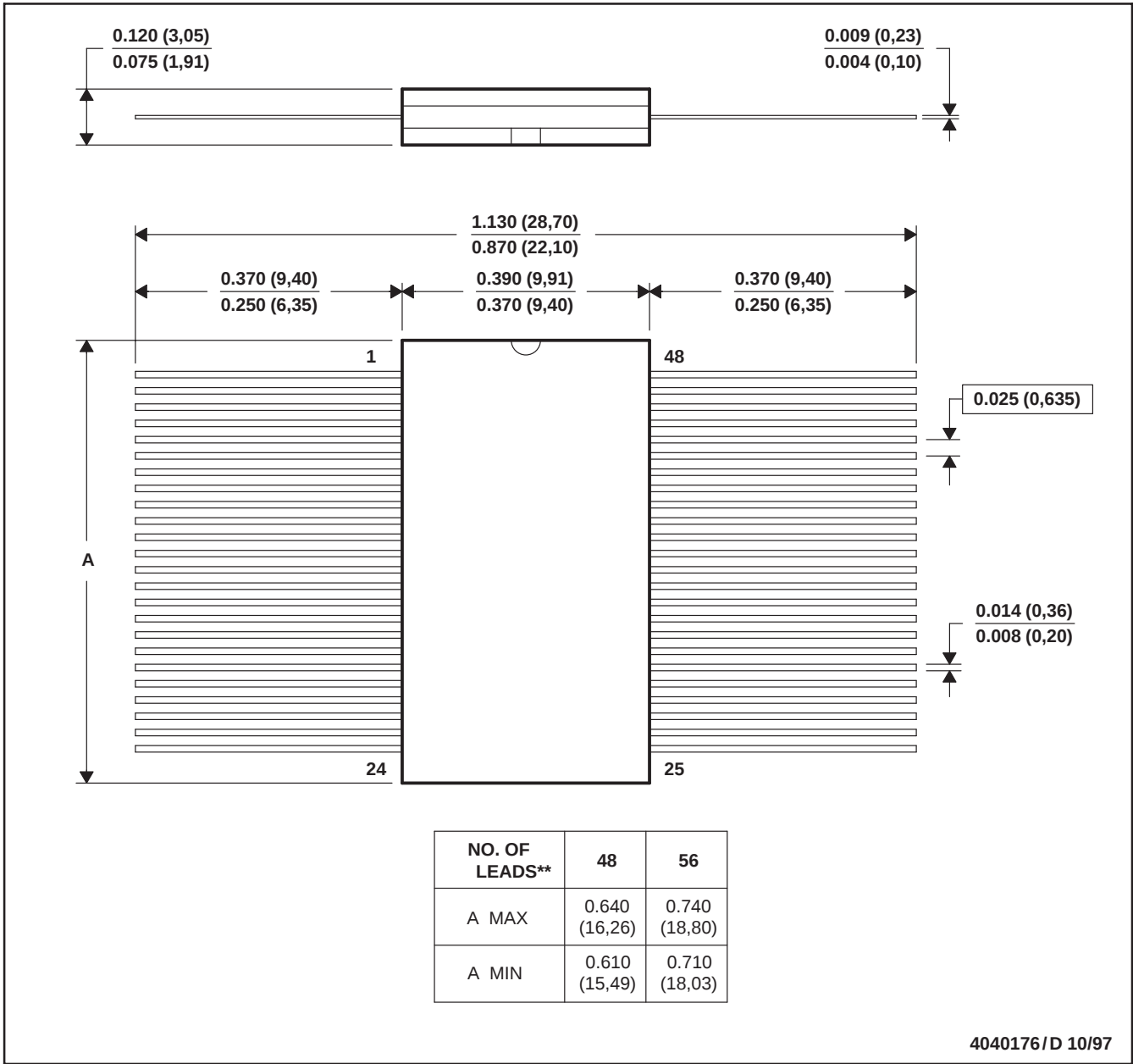
Important Information and Disclaimer: The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. 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.

WD (R-GDFP-F**)

CERAMIC DUAL FLATPACK

48 LEADS SHOWN

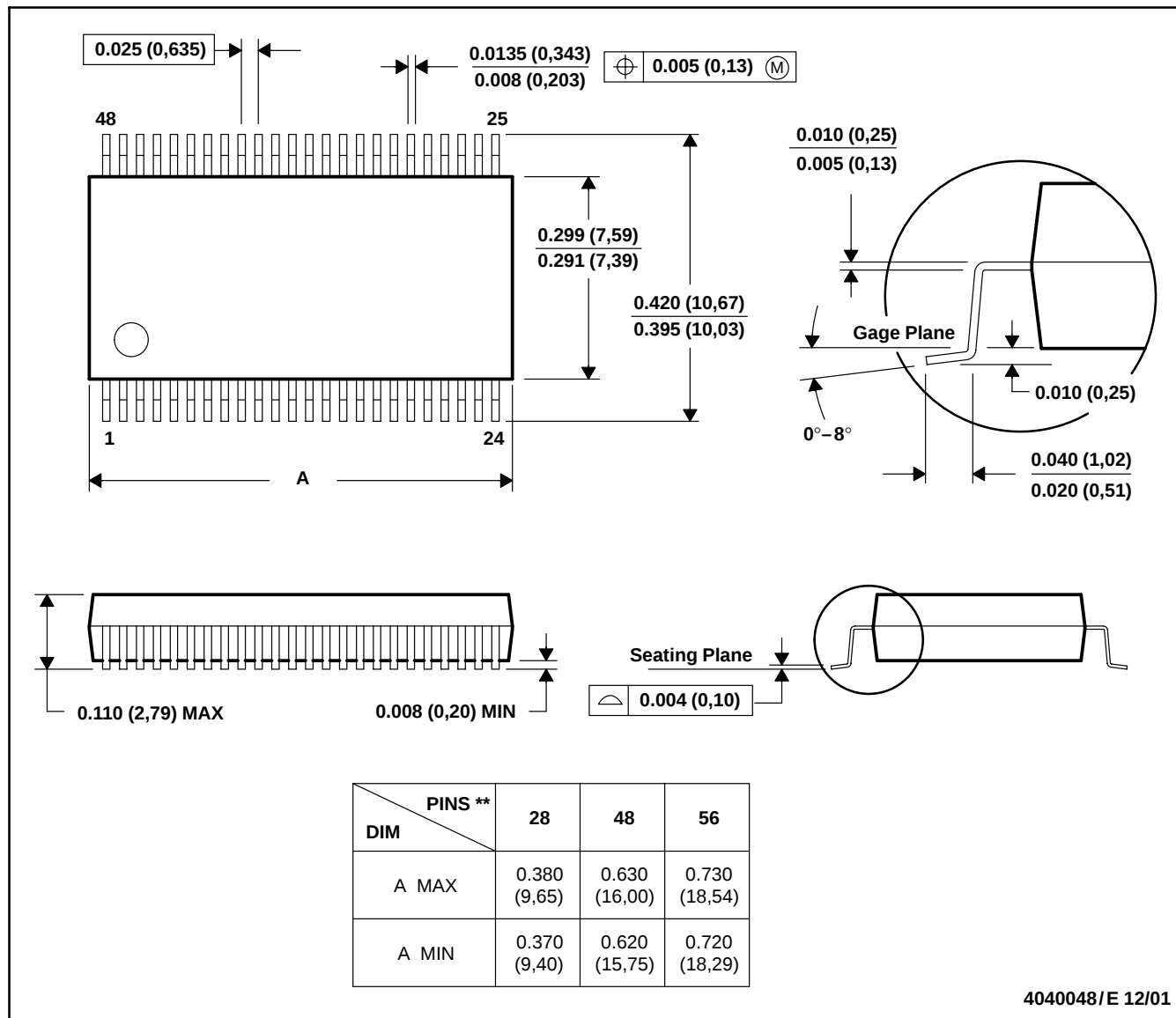


- NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. This package can be hermetically sealed with a ceramic lid using glass frit.
D. Index point is provided on cap for terminal identification only
E. Falls within MIL STD 1835: GDFP1-F48 and JEDEC MO-146AA
GDFP1-F56 and JEDEC MO-146AB

DL (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

48 PINS SHOWN

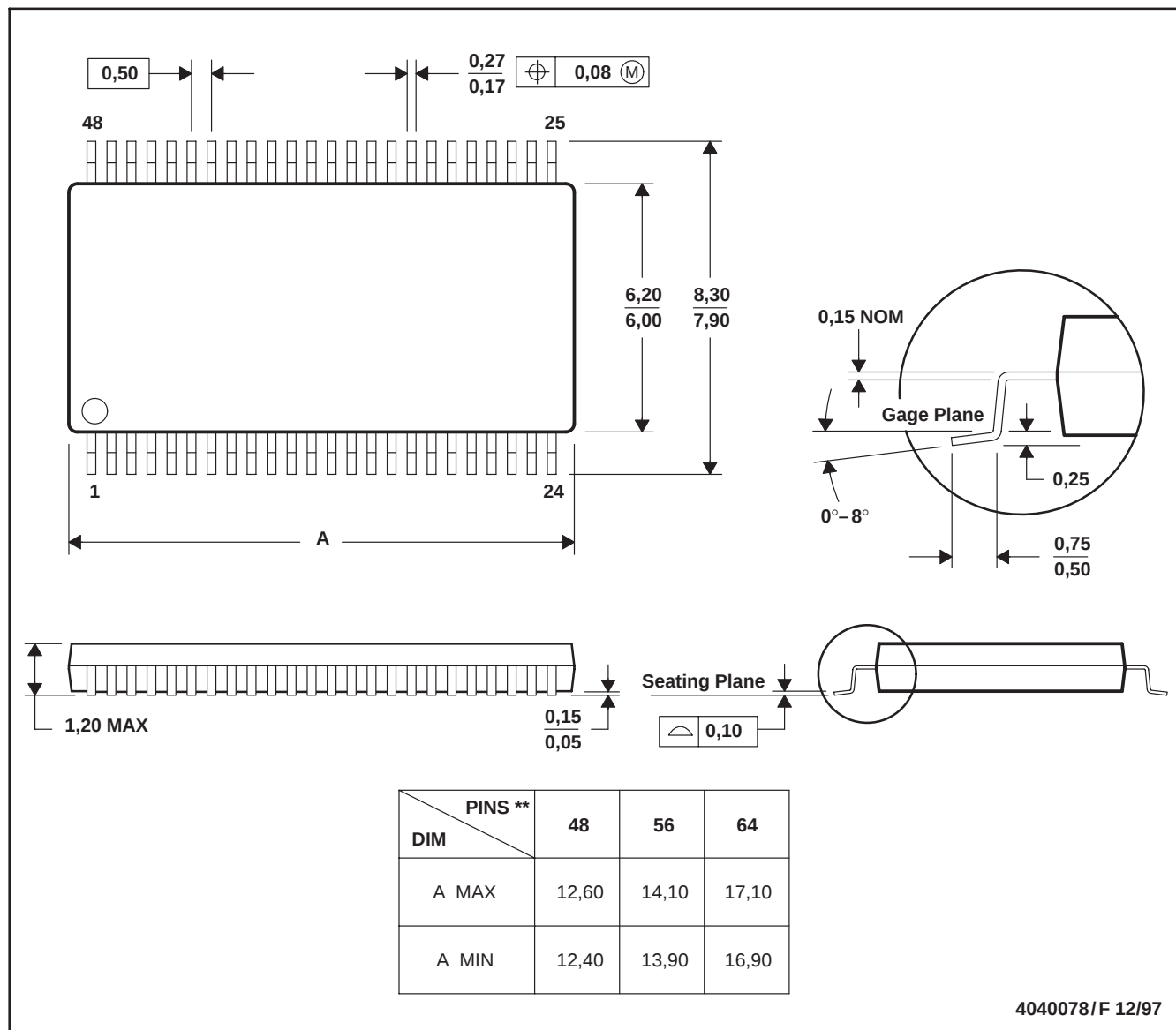


- NOTES: A. All linear dimensions are in inches (millimeters).
 B. This drawing is subject to change without notice.
 C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
 D. Falls within JEDEC MO-118

DGG (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

48 PINS SHOWN



- 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

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 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.

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.

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
DSP	dsp.ti.com	Broadband	www.ti.com/broadband
Interface	interface.ti.com	Digital Control	www.ti.com/digitalcontrol
Logic	logic.ti.com	Military	www.ti.com/military
Power Mgmt	power.ti.com	Optical Networking	www.ti.com/opticalnetwork
Microcontrollers	microcontroller.ti.com	Security	www.ti.com/security
		Telephony	www.ti.com/telephony
		Video & Imaging	www.ti.com/video
		Wireless	www.ti.com/wireless

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

Copyright © 2005, Texas Instruments Incorporated