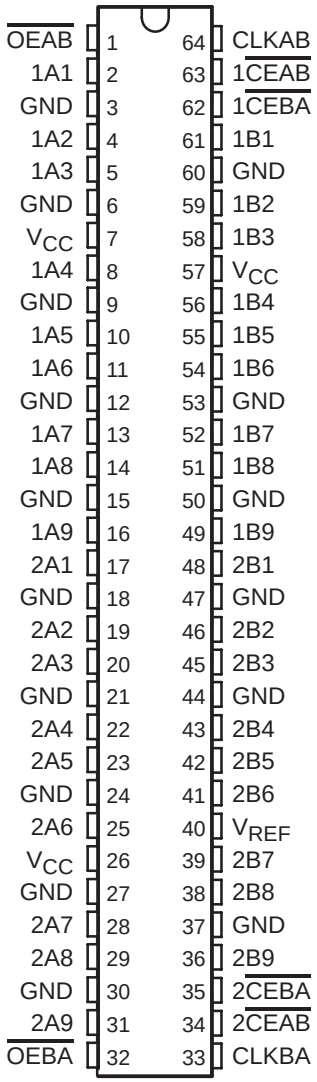
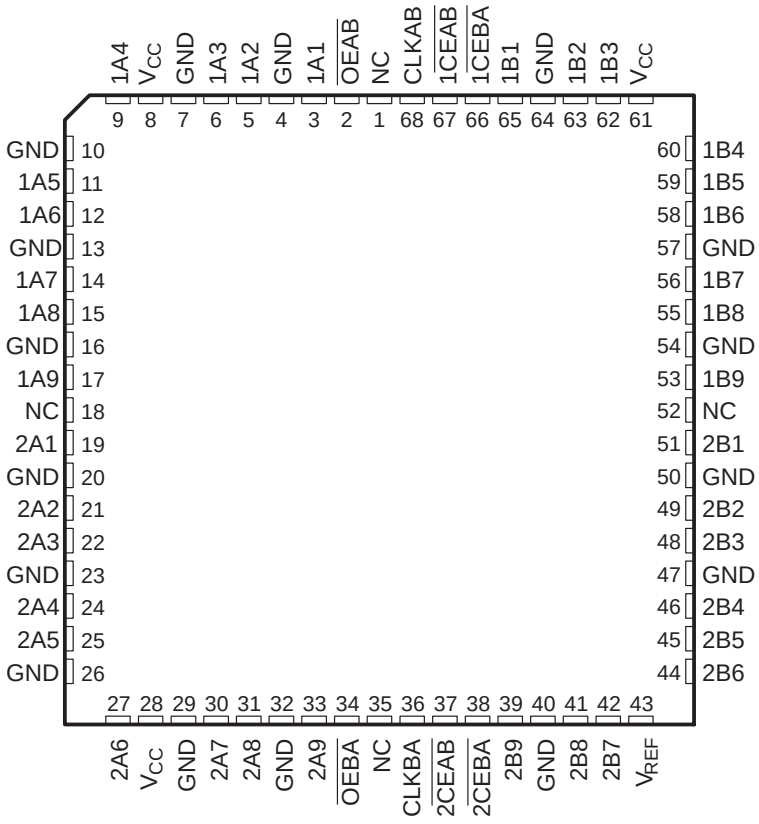
- **Translate Between GTL/GTL+ Signal Levels and LVTTL**
- **Members of the Texas Instruments *Widebus*™ Family**
- **Support GTL/GTL+ Signal Operation on B Port**
- **D-Type Flip-Flops With Qualified Storage Enable**
- **Bus-Hold Data Inputs Eliminate the Need for External Pullup or Pulldown Resistors on A Port**
- **Flow-Through Architecture Facilitates Printed-Circuit-Board Layout**
- **Package Options Include Plastic Thin-Shrink Small-Outline (DGG) and Ceramic Quad Flat (HV) Packages**

SN74GTL16622 . . . DGG PACKAGE
(TOP VIEW)



SN54GTL16622 . . . HV PACKAGE
(TOP VIEW)



NC − No internal connection

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 Incorporated.

description

These 18-bit registered bus transceivers contain two sets of D-type flip-flops for temporary storage of data flowing in either direction.

The B port operates at GTL (V_{TT} = 1.2 V and V_{REF} = 0.8 V) and GTL+ (V_{TT} = 1.5 V and V_{REF} = 1 V) levels, while the A port and control inputs are compatible with LVTTL logic levels.

Data flow in each direction is controlled by output-enable ($\overline{OEAB}$ and $\overline{OEBA}$) and clock (CLKAB and CLKBA) inputs. The clock-enable ($\overline{CEAB}$ and $\overline{CEBA}$) inputs are designed to control each 9-bit transceiver independently, which makes the device more versatile.

For A-to-B data flow, the devices operate on the low-to-high transition of CLKAB if $\overline{CEAB}$ is low. When $\overline{OEAB}$ is low, the outputs are active. When $\overline{OEAB}$ is high, the outputs are in the high-impedance state. Data flow for B to A is similar to that for A to B, but uses $\overline{OEBA}$, CLKBA, and $\overline{CEBA}$.

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

To ensure the high-impedance state during power up or power down, $\overline{OE}$ 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.

The SN54GTL16622 is characterized for operation over the full military temperature range of −55°C to 125°C. The SN74GTL16622 is characterized for operation from −40°C to 85°C.

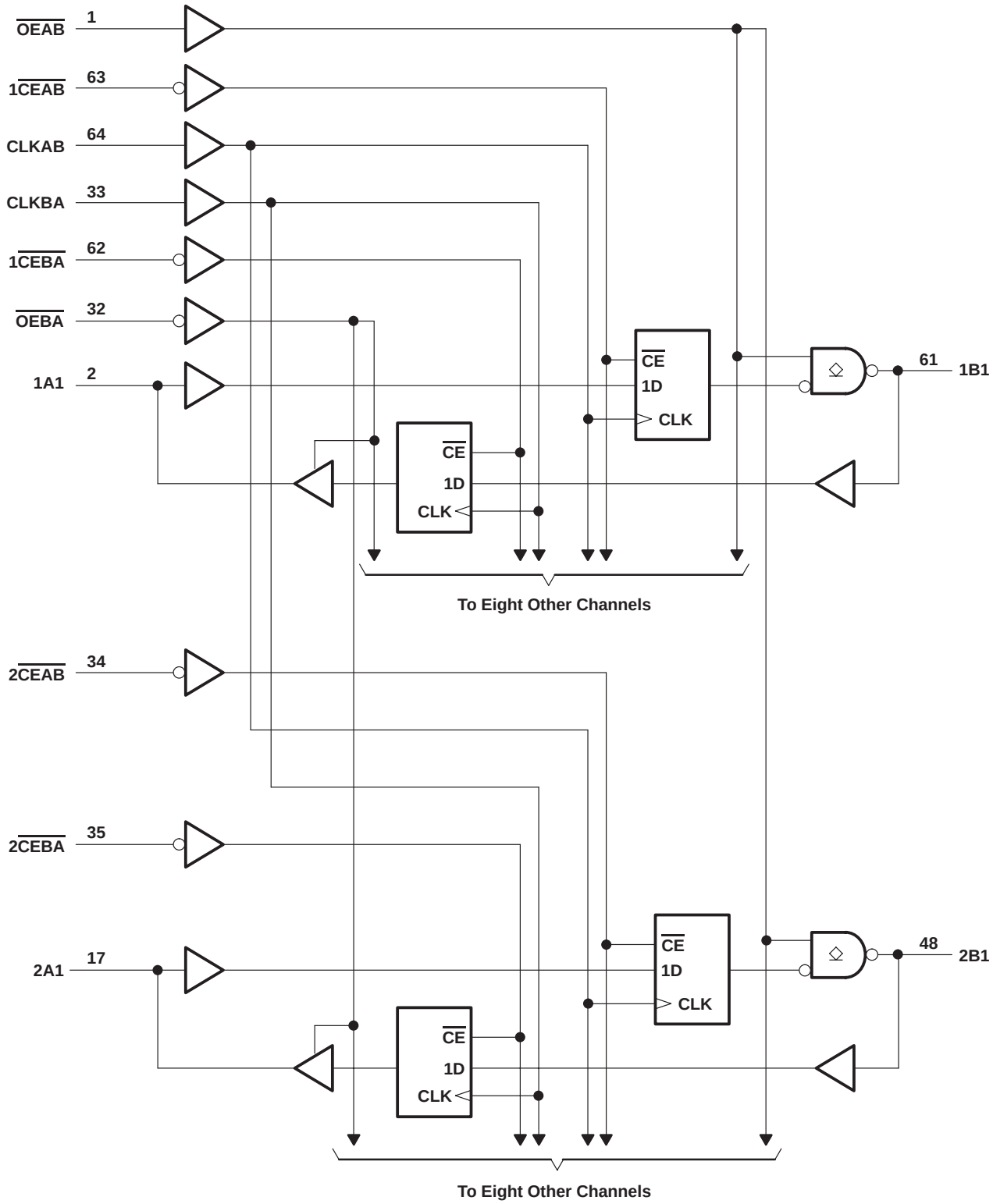
FUNCTION TABLE†

INPUTS				OUTPUT B	MODE
$\overline{CEAB}$	$\overline{OEAB}$	CLKAB	A		
X	H	X	X	Z	
H	L	X	X	B_0‡	Latched storage of A data
X	L	H or L	X	B_0‡	
L	L	↑	L	L	Clocked storage of A data
L	L	↑	H	H	

† A-to-B data flow is shown: B-to-A data flow is similar but uses $\overline{OEBA}$, CLKBA, and $\overline{CEBA}$.

‡ Output level before the indicated steady-state input conditions are established

logic diagram (positive logic)



Pin numbers shown are for the DGG package.

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): A port/B port . . . . . −0.5 V to 4.6 V
Voltage range applied to any output in the high or power-off state, V_O
(see Note 1): A port/B port . . . . . −0.5 V to 4.6 V
Current into any output in the low state, I_O: A port . . . . . 48 mA
B port . . . . . 100 mA
Input clamp current, I_{IK} (V_I < 0) . . . . . −50 mA
Output clamp current, I_{OK} (V_O < 0) . . . . . −50 mA
Maximum power dissipation at T_A = 55°C (in still air) (see Note 2): DGG package . . . . . 1.3 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. The maximum package power dissipation is calculated using a junction temperature of 150°C and a board trace length of 1000 mils. For more information, refer to the *Package Thermal Considerations* application note in the *ABT Advanced BiCMOS Technology Data Book*.

recommended operating conditions (see Note 3)

			SN54GTL16622			SN74GTL16622			UNIT
			MIN	NOM	MAX	MIN	NOM	MAX	
V_{CC}	Supply voltage		3.15	3.3	3.45	3.15	3.3	3.45	V
V_{TT}	Termination voltage	GTL	1.14	1.2	1.26	1.14	1.2	1.26	V
		GTL+	1.35	1.5	1.65	1.35	1.5	1.65	
V_{REF}	Supply voltage	GTL	0.74	0.8	0.87	0.74	0.8	0.87	V
		GTL+	0.87	1	1.1	0.87	1	1.1	
V_I	Input voltage	B port	0		V_{TT}	0		V_{TT}	V
		Except B port	0		V_{CC}	0		V_{CC}	
V_{IH}	High-level input voltage	B port	V_{REF}+50 mV			V_{REF}+50 mV			V
		Except B port	2			2			
V_{IL}	Low-level input voltage	B port			V_{REF}−50 mV			V_{REF}−50 mV	V
		Except B port			0.8			0.8	
I_{IK}	Input clamp current				−18			−18	mA
I_{OH}	High-level output current	A port			−24			−24	mA
I_{OL}	Low-level output current	A port			24			24	mA
		B port			50			50	
T_A	Operating free-air temperature		−55		125	−40		85	°C

NOTE 3: Unused control inputs must be held high or low to prevent them from floating.

electrical characteristics over recommended operating free-air temperature range, V_{REF} = 1 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS		SN54GTL16622			SN74GTL16622			UNIT
				MIN	TYP†	MAX	MIN	TYP†	MAX	
V_{IK}		V_{CC} = 3.15 V,	I_I = −18 mA			−1.2			−1.2	V
V_{OH}	A port	V_{CC} = 3.15 V to 3.45 V,	I_{OH} = −100 μA	V_{CC}−0.2			V_{CC}−0.2			V
		V_{CC} = 3.15 V	I_{OH} = −12 mA	2.4			2.4			
			I_{OH} = −24 mA	2			2			
V_{OL}	A port	V_{CC} = 3.15 V to 3.45 V,	I_{OL} = 100 μA			0.2			0.2	V
		V_{CC} = 3.15 V	I_{OL} = 12 mA			0.4			0.4	
			I_{OL} = 24 mA			0.5			0.5	
	B port	V_{CC} = 3.15 V to 3.45 V,	I_{OL} = 100 μA			0.2			0.2	
		V_{CC} = 3.15 V	I_{OL} = 10 mA			0.2			0.2	
			I_{OL} = 40 mA			0.4			0.4	
			I_{OL} = 50 mA			0.55			0.55	
I_I	Control inputs	V_{CC} = 3.45 V,	V_I = V_{CC} or GND			±5			±5	μA
	B port	V_{CC} = 3.45 V,	V_I = V_{TT} or GND			±5			±5	
I_{off}	A port	V_{CC} = 0, V_I or V_O = 0 to 3.45 V				100			100	μA
$I_{I(hold)}$	A port	V_{CC} = 3.15 V	V_I = 0.8 V	75			75			μA
			V_I = 2 V	−75			−75			
		V_{CC} = 3.45 V‡,	V_I = 0.8 V to 2 V			±500			±500	
I_{OZH}	B port	V_{CC} = 3.45 V,	V_O = 1.5 V			10			10	μA
I_{OZ}§	A port	V_{CC} = 3.45 V,	V_O = V_{CC} or GND			±10			±10	μA
I_{CC}	A or B port	V_{CC} = 3.45 V, I_O = 0,	V_I = V_{CC} or GND			60			60	mA
ΔI_{CC}¶	A port or control inputs	V_{CC} = 3.45 V, A port or control inputs at V_{CC} or GND, One input at V_{CC} − 0.6 V				500			500	μA
C_i	Control inputs	V_I = 3.15 V or 0			3			3		pF
C_{io}	A port	V_O = 3.15 V or 0			10			10		pF
	B port	Per IEEE 1194.1			8.5			8.5		

† All typical values are at V_{CC} = 3.3 V, T_A = 25°C.
‡ This is the bus-hold maximum dynamic current required to switch the input from one state to another.
§ For I/O ports, the parameter I_{OZ} includes the input leakage current.
¶ This is the increase in supply current for each input that is at the specified TTL voltage level rather than V_{CC} or GND.

timing requirements over recommended ranges of supply voltage and operating free-air temperature for GTL (unless otherwise noted)†

			SN54GTL16622		SN74GTL16622		UNIT
			MIN	MAX	MIN	MAX	
f_{clock}	Clock frequency		0	200	0	200	MHz
t_w	Pulse duration, CLK high or low		2.5		2.5		ns
t_{su}	Setup time	Data before CLK↑	3.1		3		ns
		$\overline{CE}$ before CLK↑	2.8		2.7		
t_h	Hold time	Data after CLK↑	0.7		0.6		ns
		$\overline{CE}$ after CLK↑	0.4		0.3		

† These parameters are warranted but not production tested.

switching characteristics over recommended ranges of supply voltage and operating free-air temperature for GTL (see Figure 1)†

PARAMETER	FROM (INPUT)	TO (OUTPUT)	SN54GTL16622			SN74GTL16622			UNIT
			MIN	TYP‡	MAX	MIN	TYP‡	MAX	
f_{max}			200			200			MHz
t_{PLH}	CLKAB	B	2.7		6.5	2.8	4.3	6.1	ns
t_{PHL}			1.9		6.2	2	3.6	5.5	
t_{PLH}	$\overline{OEAB}$	B	2.5		6.4	2.6	4.2	6	ns
t_{PHL}			1.6		5.8	1.7	3.1	5.1	
Slew rate	Both transitions			0.5			0.5		V/ns
t_r	Transition time, B outputs (0.6 V to 1 V)		0.5		2.6	0.6	1.2	2.5	ns
t_f	Transition time, B outputs (1 V to 0.6 V)		0.3		2.3	0.4	0.8	2	ns
t_{PLH}	CLKBA	A	2.1		5.6	2.2	3.7	5.3	ns
t_{PHL}			2.2		5.6	2.3	3.8	5.2	
t_{en}	$\overline{OEBA}$	A	1.7		5.4	1.8	3.3	5	ns
t_{dis}			2.2		6.2	2.4	4.1	5.7	

† These parameters are warranted but not production tested.
‡ All typical values are at V_{CC} = 3.3 V, T_A = 25°C.

TEXAS INSTRUMENTS
POST OFFICE BOX 655303 • DALLAS, TEXAS 75265
POST OFFICE BOX 1443 • HOUSTON, TEXAS 77251−1443

timing requirements over recommended ranges of supply voltage and operating free-air temperature for GTL+ (unless otherwise noted)

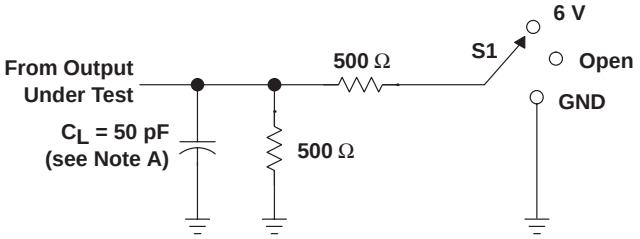
			SN54GTL16622		SN74GTL16622		UNIT
			MIN	MAX	MIN	MAX	
f_{clock}	Clock frequency		0	200	0	200	MHz
t_w	Pulse duration, CLK high or low		2.5		2.5		ns
t_{su}	Setup time	Data before CLK↑	2.8		2.5		ns
		$\overline{CE}$ before CLK↑	2.7		2.6		
t_h	Hold time	Data after CLK↑	0.6		0.5		ns
		$\overline{CE}$ after CLK↑	0.2		0.1		

switching characteristics over recommended ranges of supply voltage and operating free-air temperature for GTL+ (see Figure 1)

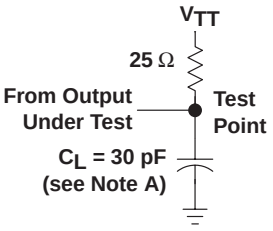
PARAMETER	FROM (INPUT)	TO (OUTPUT)	SN54GTL16622			SN74GTL16622			UNIT
			MIN	TYP†	MAX	MIN	TYP†	MAX	
f_{max}			200			200			MHz
t_{PLH}	CLKAB	B	2.8		6.6	2.9	4.2	6.1	ns
t_{PHL}			2		6.6	2.1	3.7	5.7	
t_{PLH}	$\overline{OEAB}$	B	2.6		6.4	2.7	4.1	5.9	ns
t_{PHL}			1.7		6.1	1.8	3.3	5.3	
Slew rate	Both transitions			0.5			0.5		V/ns
t_r	Transition time, B outputs (0.6 V to 1.3 V)		0.9		3.1	1	1.6	3	ns
t_f	Transition time, B outputs (1.3 V to 0.6 V)		0.6		4.3	0.7	1.4	3.3	ns
t_{PLH}	CLKBA	A	2.1		5.6	2.2	3.7	5.3	ns
t_{PHL}			2.2		5.6	2.3	3.8	5.2	
t_{en}	$\overline{OEBA}$	A	1.6		5.4	1.7	3.2	5	ns
t_{dis}			2.2		6.2	2.4	4.1	5.7	

† All typical values are at V_{CC} = 3.3 V, T_A = 25°C.

PARAMETER MEASUREMENT INFORMATION

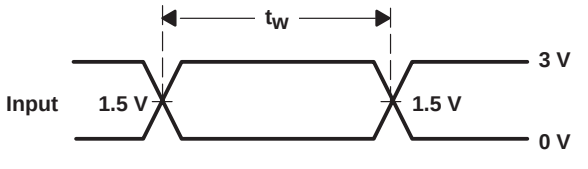


TEST	S1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	6 V
t_{PHZ}/t_{PZH}	GND

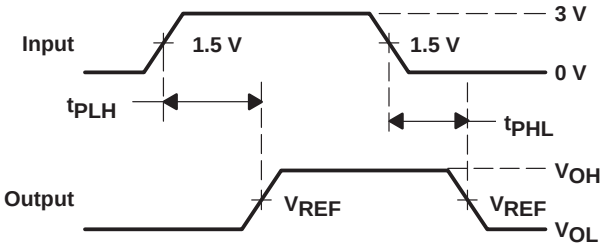


LOAD CIRCUIT FOR A OUTPUTS

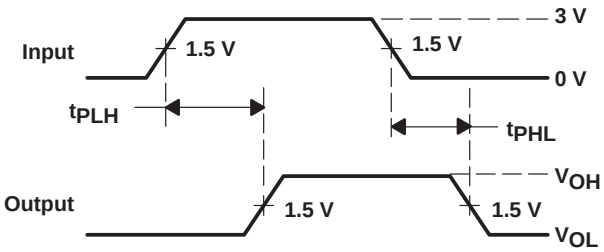
LOAD CIRCUIT FOR B OUTPUTS



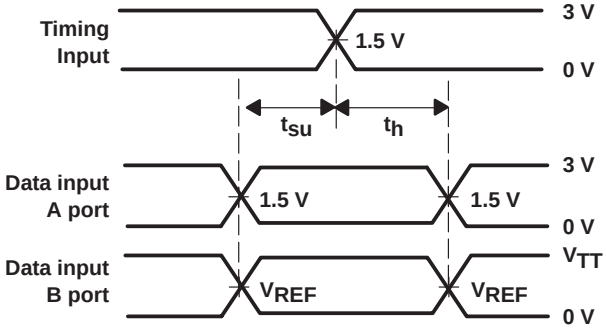
VOLTAGE WAVEFORMS
PULSE DURATION



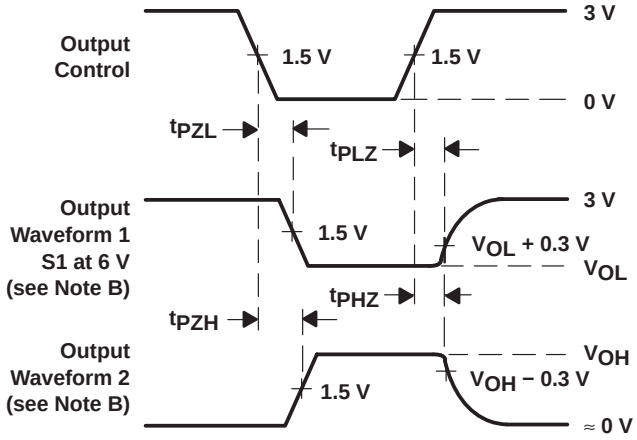
VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES
(CLKAB to B port)



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES
(CLKBA to A port)



VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES
(A port)

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, t_r ≤ 2.5 ns, t_f ≤ 2.5 ns.
D. The outputs are measured one at a time with one transition per measurement.

Figure 1. Load Circuits 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]
SN74GTL16622DGGR	OBSOLETE	TSSOP	DGG	64		TBD	Call TI	Call TI

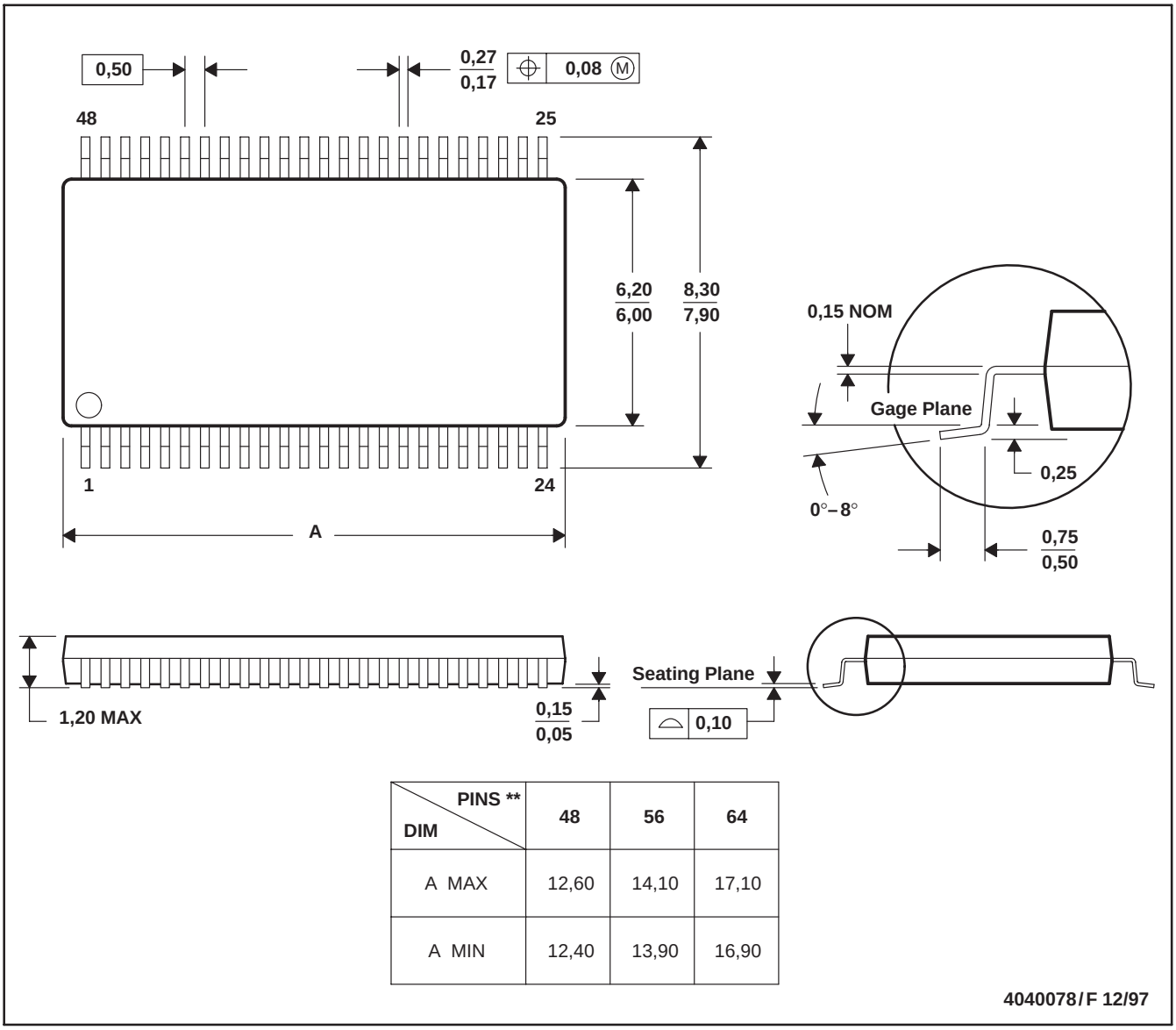
[1] The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers,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

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

48 PINS SHOWN



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

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 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
DSP	dsp.ti.com	Broadband	www.ti.com/broadband
Clocks and Timers	www.ti.com/clocks	Digital Control	www.ti.com/digitalcontrol
Interface	interface.ti.com	Medical	www.ti.com/medical
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
RFID	www.ti-rfid.com	Telephony	www.ti.com/telephony
RF/IF and ZigBee® Solutions	www.ti.com/lprf	Video & Imaging	www.ti.com/video
		Wireless	www.ti.com/wireless

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