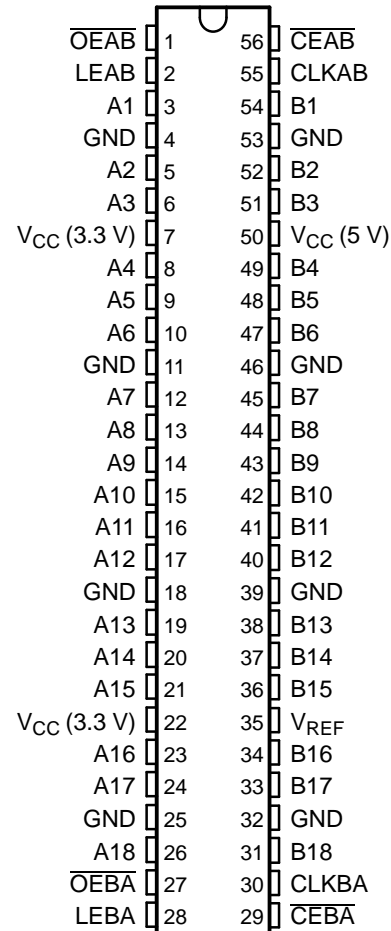


FEATURES

- Members of Texas Instruments Widebus™ Family
- UBT™ Transceivers Combine D-Type Latches and D-Type Flip-Flops for Operation in Transparent, Latched, Clocked, or Clock-Enabled Modes
- OEC™ Circuitry Improves Signal Integrity and Reduces Electromagnetic Interference
- Translate Between GTL/GTL+ Signal Levels and LVTTL Logic Levels
- Support Mixed-Mode (3.3 V and 5 V) Signal Operation on A-Port and Control Inputs
- Identical to '16601 Function
- I_{off} Supports Partial-Power-Down Mode Operation
- Bus Hold on Data Inputs Eliminates the Need for External Pullup/Pulldown Resistors on A Port
- Distributed V_{CC} and GND Pins Minimize High-Speed Switching Noise
- Latch-Up Performance Exceeds 500 mA Per JESD 17

SN54GTL16612... WD PACKAGE
SN74GTL16612... DGG OR DL PACKAGE
(TOP VIEW)



DESCRIPTION/ORDERING INFORMATION

The 'GTL16612 devices are 18-bit UBT™ transceivers that provide LVTTL-to-GTL/GTL+ and GTL/GTL+-to-LVTTL signal-level translation. They combine D-type flip-flops and D-type latches to allow for transparent, latched, clocked, and clock-enabled modes of data transfer identical to the '16601 function. The devices provide an interface between cards operating at LVTTL logic levels and a backplane operating at GTL/GTL+ signal levels. Higher-speed operation is a direct result of the reduced output swing (<1 V), reduced input threshold levels, and OEC™ circuitry.

The user has the flexibility of using these devices at either GTL ($V_{TT} = 1.2$ V and $V_{REF} = 0.8$ V) or the preferred higher noise margin GTL+ ($V_{TT} = 1.5$ V and $V_{REF} = 1$ V) signal levels. GTL+ is the Texas Instruments derivative of the Gunning Transceiver Logic (GTL) JEDEC standard JESD 8-3. The B port normally operates at GTL or GTL+ signal levels, while the A-port and control inputs are compatible with LVTTL logic levels and are 5-V tolerant. V_{REF} is the reference input voltage for the B port.

V_{CC} (5 V) supplies the internal and GTL circuitry while V_{CC} (3.3 V) supplies the LVTTL output buffers.



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.

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SN54GTL16612, SN74GTL16612

18-BIT LVTTTL-TO-GTL/GTL+ UNIVERSAL BUS TRANSCEIVERS

SCBS480K–JUNE 1994–REVISED JULY 2005



DESCRIPTION/ORDERING INFORMATION (CONTINUED)

Data flow in each direction is controlled by output-enable (\overline{OEAB} and \overline{OEBA}), latch-enable (LEAB and LEBA), and clock (CLKAB and CLKBA) inputs. The clock can be controlled by the clock-enable (\overline{CEAB} and \overline{CEBA}) inputs. For A-to-B data flow, the devices operate in the transparent mode when LEAB is high. When LEAB is low, the A data is latched if \overline{CEAB} is low and CLKAB is held at a high or low logic level. If LEAB is low, the A data is stored in the latch/flip-flop on the low-to-high transition of CLKAB if \overline{CEAB} also 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} , LEBA, CLKBA, and \overline{CEBA} .

These devices are 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.

Active bus-hold circuitry holds unused or undriven LVTTTL inputs at a valid logic state. Use of pullup or pulldown resistors with the bus-hold circuitry is not recommended.

ORDERING INFORMATION

T_A	PACKAGE ⁽¹⁾		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 85°C	SSOP – DL	Tube	SN74GTL16612DL	GTL16612
		Tape and reel	SN74GTL16612DLR	
	TSSOP – DGG	Tape and reel	SN74GTL16612DGGR	GTL16612
–55°C to 125°C	CFP – WD	Tube	SNJ54GTL16612WD	SNJ54GTL16612WD

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

FUNCTION TABLE⁽¹⁾

INPUTS					OUTPUT B	MODE
\overline{CEAB}	\overline{OEAB}	LEAB	CLKAB	A		
X	H	X	X	X	Z	Isolation
L	L	L	H	X	$B_0^{(2)}$	Latched storage of A data
L	L	L	L	X	$B_0^{(3)}$	
X	L	H	X	L	L	Transparent
X	L	H	X	H	H	
L	L	L	↑	L	L	Clocked storage of A data
L	L	L	↑	H	H	
H	L	L	X	X	$B_0^{(3)}$	Clock inhibit

(1) A-to-B data flow is shown. B-to-A data flow is similar, but uses \overline{OEBA} , LEBA, CLKBA, and \overline{CEBA} .

(2) Output level before the indicated steady-state input conditions were established, provided that CLKAB was high before LEAB went low

(3) Output level before the indicated steady-state input conditions were established

SN54GTL16612, SN74GTL16612

18-BIT LVTTTL-TO-GTL/GTL+ UNIVERSAL BUS TRANSCEIVERS

SCBS480K–JUNE 1994–REVISED JULY 2005



Absolute Maximum Ratings⁽¹⁾

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

			MIN	MAX	UNIT
V_{CC}	Supply voltage range	3.3 V	–0.5	4.6	V
		5 V	–0.5	7	
V_I	Input voltage range ⁽²⁾	A-port and control inputs	–0.5	7	V
		B port and V_{REF}	–0.5	4.6	
V_O	Voltage range applied to any output in the high or power-off state ⁽²⁾	A port	–0.5	7	V
		B port	–0.5	4.6	
I_O	Current into any output in the low state	A port		128	mA
		B port		80	
I_O	Current into any A-port output in the high state ⁽³⁾			64	mA
	Continuous current through each V_{CC} or GND			±100	mA
I_{IK}	Input clamp current	$V_I < 0$		–50	mA
I_{OK}	Output clamp current	$V_O < 0$		–50	mA
θ_{JA}	Package thermal impedance ⁽⁴⁾	DGG package		64	°C/W
		DL package		56	
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 clamp-current ratings are observed.
- (3) This current flows only when the output is in the high state and $V_O > V_{CC}$.
- (4) The package thermal impedance is calculated in accordance with JESD 51-7.

Recommended Operating Conditions⁽¹⁾⁽²⁾⁽³⁾⁽⁴⁾

			SN54GTL16612			SN74GTL16612			UNIT
			MIN	NOM	MAX	MIN	NOM	MAX	
V _{CC}	Supply voltage	3.3 V	3.15	3.3	3.45	3.15	3.3	3.45	V
		5 V	4.75	5	5.25	4.75	5	5.25	
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}	Reference 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	V _{TT}			V _{TT}			V
		Except B port	5.5			5.5			
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	–32			–32			mA
I _{OL}	Low-level output current	A port	64			64			mA
		B port	40			40			
T _A	Operating free-air temperature		–55	125		–40	85		°C

- (1) All unused 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.
- (2) Normal connection sequence is GND first, $V_{CC} = 5$ V second, and $V_{CC} = 3.3$ V, I/O, control inputs, V_{TT} and V_{REF} (any order) last.
- (3) V_{TT} and R_{TT} can be adjusted to accommodate backplane impedances if the dc recommended I_{OL} ratings are not exceeded.
- (4) V_{REF} can be adjusted to optimize noise margins, but normally is two-thirds V_{TT} .

Electrical Characteristics

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

PARAMETER		TEST CONDITIONS		SN54GTL16612			SN74GTL16612			UNIT	
				MIN	TYP ⁽¹⁾	MAX	MIN	TYP ⁽¹⁾	MAX		
V _{IK}		V _{CC} (3.3 V) = 3.15 V, V _{CC} (5 V) = 4.75 V	I _I = −18 mA			−1.2			−1.2	V	
V _{OH}	A port	V _{CC} (3.3 V) = 3.15 V to 3.45 V, V _{CC} (5 V) = 4.75 V to 5.25 V	I _{OH} = −100 μA	V _{CC} (3.3 V) − 0.2			V _{CC} (3.3 V) − 0.2			V	
			I _{OH} = −8 mA	2.4			2.4				
		V _{CC} (3.3 V) = 3.15 V, V _{CC} (5 V) = 4.75 V	I _{OH} = −32 mA	2			2				
V _{OL}	A port	V _{CC} (3.3 V) = 3.15 V, V _{CC} (5 V) = 4.75 V	I _{OL} = 100 μA				0.2			V	
			I _{OL} = 16 mA				0.4				
			I _{OL} = 32 mA				0.5				
			I _{OL} = 64 mA				0.6				
	B port	V _{CC} (3.3 V) = 3.15 V, V _{CC} (5 V) = 4.75 V, I _{OL} = 40 mA				0.5			0.4		
I _I	Control inputs	V _{CC} (3.3 V) = 0 or 3.45 V, V _{CC} (5 V) = 0 or 5.25 V	V _I = 5.5 V				10			μA	
	A port	V _{CC} (3.3 V) = 3.45 V, V _{CC} (5 V) = 5.25 V	V _I = 5.5 V				1000				
			V _I = V _{CC} (3.3 V)				1				
			V _I = 0				−30				
	B port	V _{CC} (3.3 V) = 3.45 V, V _{CC} (5 V) = 5.25 V	V _I = V _{CC} (3.3 V)				5				
			V _I = 0				−5				
I _{off}		V _{CC} = 0,	V _I or V _O = 0 to 4.5 V				1000			μA	
I _{I(hold)}	A port	V _{CC} (3.3 V) = 3.15 V, V _{CC} (5 V) = 4.75 V	V _I = 0.8 V	75			75			μA	
			V _I = 2 V	−75			−75				
			V _I = 0 to V _{CC} (3.3 V) ⁽²⁾	±500			±500				
I _{OZH}	A port	V _{CC} (3.3 V) = 3.45 V, V _{CC} (5 V) = 5.25 V, V _O = 3 V		1			1			μA	
	B port	V _{CC} (3.3 V) = 3.45 V, V _{CC} (5 V) = 5.25 V, V _O = 1.2 V		10			10				
I _{OZL}	A port	V _{CC} (3.3 V) = 3.45 V, V _{CC} (5 V) = 5.25 V, V _O = 0.5 V		−1			−1			μA	
	B port	V _{CC} (3.3 V) = 3.45 V, V _{CC} (5 V) = 5.25 V, V _O = 0.4 V		−10			−10				
I _{CC} (3.3 V)	A or B port	V _{CC} (3.3 V) = 3.45 V, V _{CC} (5 V) = 5.25 V, I _O = 0, V _I = V _{CC} (3.3 V) or GND	Outputs high	1			1			mA	
			Outputs low	5			5				
			Outputs disabled	1			1				
I _{CC} (5 V)	A or B port	V _{CC} (3.3 V) = 3.45 V, V _{CC} (5 V) = 5.25 V, I _O = 0, V _I = V _{CC} (3.3 V) or GND	Outputs high	120			120			mA	
			Outputs low	120			120				
			Outputs disabled	120			120				
ΔI _{CC} ⁽³⁾		V _{CC} (3.3 V) = 3.45 V, V _{CC} (5 V) = 5.25 V, A-port or control inputs at V _{CC} (3.3 V) or GND, One input at 2.7 V		1			1			mA	
C _i	Control inputs	V _I = 3.15 V or 0		3.5 12			3.5			pF	
C _{io}	A port	V _O = 3.15 V or 0		12 18			12			pF	
	B port			10			5				

(1) All typical values are at V_{CC} (3.3 V) = 3.3 V, V_{CC} (5 V) = 5 V, $T_A = 25^\circ\text{C}$.

(2) This is the bus-hold maximum dynamic current. It is the minimum overdrive current required to switch the input from one state to another.

(3) This is the increase in supply current for each input that is at the specified TTL voltage level, rather than V_{CC} or GND.

SN54GTL16612, SN74GTL16612

18-BIT LVTTTL-TO-GTL/GTL+ UNIVERSAL BUS TRANSCEIVERS

SCBS480K–JUNE 1994–REVISED JULY 2005

Timing Requirements

over recommended ranges of supply voltage and operating free-air temperature,
 $V_{TT} = 1.2\text{ V}$ and $V_{REF} = 0.8\text{ V}$ for GTL (unless otherwise noted) (see [Figure 1](#))

			SN54GTL16612		SN74GTL16612		UNIT
			MIN	MAX	MIN	MAX	
f _{clock}	Clock frequency		95		95		MHz
t _w	Pulse duration	LEAB or LEBA high	3.3		3.3		ns
		CLKAB or CLKBA high or low	5.6		5.6		
t _{su}	Setup time	A before CLKAB↑	1.3		1.3		ns
		B before CLKBA↑	3.4		2.5		
		A before LEAB↓	1.2		0		
		B before LEBA↓	1		1		
		$\overline{\text{CEAB}}$ before CLKAB↑	2.1		2		
		$\overline{\text{CEBA}}$ before CLKBA↑	2.6		2.2		
t _h	Hold time	A after CLKAB↑	2.9		1.6		ns
		B after CLKBA↑	4.1		0.3		
		A after LEAB↓	4.5		4		
		B after LEBA↓	4.3		3.6		
		$\overline{\text{CEAB}}$ after CLKAB↑	2		0.8		
		$\overline{\text{CEBA}}$ after CLKBA↑	1.1		1.1		

Switching Characteristics

over recommended ranges of supply voltage and operating free-air temperature,
 $V_{TT} = 1.2\text{ V}$ and $V_{REF} = 0.8\text{ V}$ for GTL (see [Figure 1](#))

PARAMETER	FROM (INPUT)	TO (OUTPUT)	SN54GTL16612			SN74GTL16612			UNIT
			MIN	TYP ⁽¹⁾	MAX	MIN	TYP ⁽¹⁾	MAX	
f _{max}			95			95			MHz
t _{PLH}	A	B	1	2.8	4.5	1.5	2.8	4.1	ns
t _{PHL}			1	2.5	4.5	1.3	2.5	4	
t _{PLH}	LEAB	B	1	3.6	5.5	2	3.6	5.3	ns
t _{PHL}			1	3.5	6	1.9	3.5	5.4	
t _{PLH}	CLKAB	B	1	3.7	5.5	2.3	3.7	5.3	ns
t _{PHL}			1	3.4	5.5	1.9	3.4	5.4	
t _{en}	$\overline{\text{OEAB}}$	B	1	3.3	5.5	2	3.3	5.5	ns
t _{dis}			1	3.4	5.5	2	3.4	5.1	
t _r	Transition time, B outputs (0.5 V to 1 V)		1.3			1.3			ns
t _f	Transition time, B outputs (1 V to 0.5 V)		0.5			0.5			ns
t _{PLH}	B	A	2	4.1	6.9	2.1	4.1	6.3	ns
t _{PHL}			1	2.9	5.1	1.2	2.9	4.6	
t _{PLH}	LEBA	A	2	3.7	6.1	2.3	3.7	5.7	ns
t _{PHL}			1	3	5.1	1.8	3	4.8	
t _{PLH}	CLKBA	A	2	3.8	6.4	2.5	3.8	6.1	ns
t _{PHL}			2	3.3	5.6	2.3	3.3	5.2	
t _{en}	$\overline{\text{OEBA}}$	A	1	5	7.5	2.3	5	7.4	ns
t _{dis}			2	4.3	6.9	2.5	4.3	6.4	

(1) All typical values are at V_{CC} (3.3 V) = 3.3 V, V_{CC} (5 V) = 5 V, $T_A = 25^\circ\text{C}$.

Timing Requirements

over recommended ranges of supply voltage and operating free-air temperature,
 $V_{TT} = 1.5\text{ V}$ and $V_{REF} = 1\text{ V}$ for GTL+ (unless otherwise noted) (see [Figure 1](#))

			SN54GTL16612		SN74GTL16612		UNIT
			MIN	MAX	MIN	MAX	
f _{clock}	Clock frequency		95		95		MHz
t _w	Pulse duration	LEAB or LEBA high	3.3		3.3		ns
		CLKAB or CLKBA high or low	5.6		5.6		
t _{su}	Setup time	A before CLKAB↑	1.3		1.3		ns
		B before CLKBA↑	3.2		2.3		
		A before LEAB↓	1.2		0		
		B before LEBA↓	1.3		1.3		
		$\overline{\text{CEAB}}$ before CLKAB↑	2.1		2		
		$\overline{\text{CEBA}}$ before CLKBA↑	2.6		2.2		
t _h	Hold time	A after CLKAB↑	2.9		1.6		ns
		B after CLKBA↑	4.4		0.3		
		A after LEAB↓	4.5		4		
		B after LEBA↓	4.3		3.6		
		$\overline{\text{CEAB}}$ after CLKAB↑	2		0.8		
		$\overline{\text{CEBA}}$ after CLKBA↑	1.1		1.1		

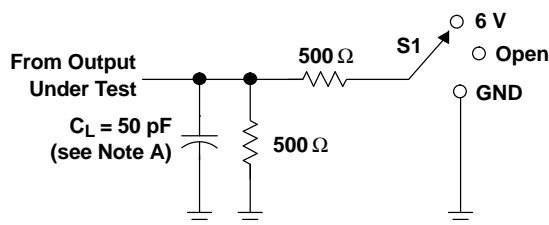
Switching Characteristics

over recommended ranges of supply voltage and operating free-air temperature,
 $V_{TT} = 1.5\text{ V}$ and $V_{REF} = 1\text{ V}$ for GTL+ (see [Figure 1](#))

PARAMETER	FROM (INPUT)	TO (OUTPUT)	SN54GTL16612			SN74GTL16612			UNIT
			MIN	TYP ⁽¹⁾	MAX	MIN	TYP ⁽¹⁾	MAX	
f _{max}			95			95			MHz
t _{PLH}	A	B	1	2.8	4.5	1.5	2.8	4.1	ns
t _{PHL}			1	2.5	4.6	1.3	2.5	4.1	
t _{PLH}	LEAB	B	1	3.6	5.5	2	3.6	5.3	ns
t _{PHL}			1	3.5	6.1	1.9	3.5	5.5	
t _{PLH}	CLKAB	B	1	3.7	5.5	2.3	3.7	5.3	ns
t _{PHL}			1	3.4	5.6	1.9	3.4	5.5	
t _{PLH}	$\overline{\text{OEAB}}$	B	1	3.4	5.5	2	3.4	5.1	ns
t _{PHL}			1	3.3	5.6	2	3.3	5.6	
t _r	Transition time, B outputs (0.5 V to 1 V)		1.5			1.5			ns
t _f	Transition time, B outputs (1 V to 0.5 V)		0.8			0.8			ns
t _{PLH}	B	A	1.9	4	6.9	2	4	6.3	ns
t _{PHL}			0.9	2.8	4.9	1.1	2.8	4.4	
t _{PLH}	LEBA	A	2	3.7	6.1	2.3	3.7	5.7	ns
t _{PHL}			1	3	5.1	1.8	3	4.8	
t _{PLH}	CLKBA	A	2	3.8	6.4	2.5	3.8	6.1	ns
t _{PHL}			2	3.3	5.6	2.3	3.3	5.2	
t _{en}	$\overline{\text{OEBA}}$	A	1	5	7.5	2.3	5	7.4	ns
t _{dis}			2	4.3	6.9	2.5	4.3	6.4	

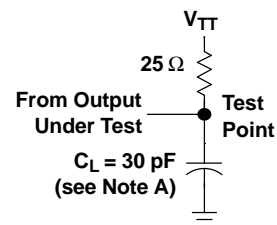
(1) All typical values are at V_{CC} (3.3 V) = 3.3 V, V_{CC} (5 V) = 5 V, $T_A = 25^\circ\text{C}$.

PARAMETER MEASUREMENT INFORMATION
 $V_{TT} = 1.2\text{ V}$, $V_{REF} = 0.8\text{ V}$ for GTL and $V_{TT} = 1.5\text{ V}$, $V_{REF} = 1\text{ V}$ for GTL+

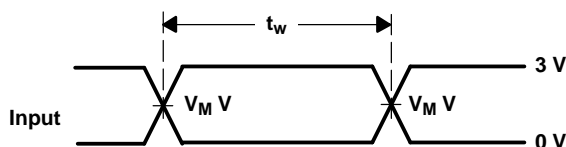


LOAD CIRCUIT FOR A OUTPUTS

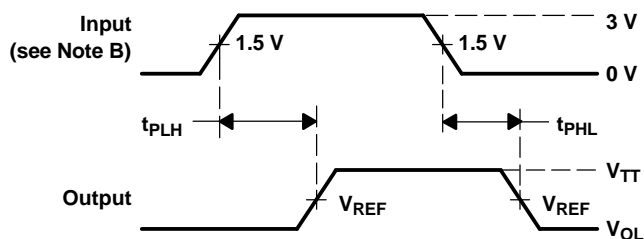
TEST	S1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	6 V
t_{PHZ}/t_{PZH}	GND



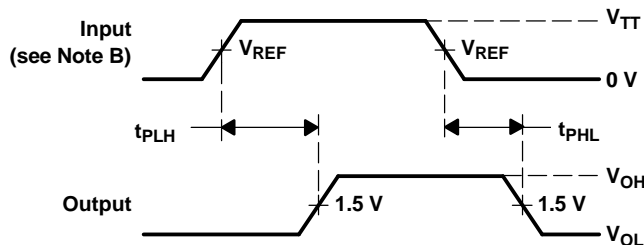
LOAD CIRCUIT FOR B OUTPUTS



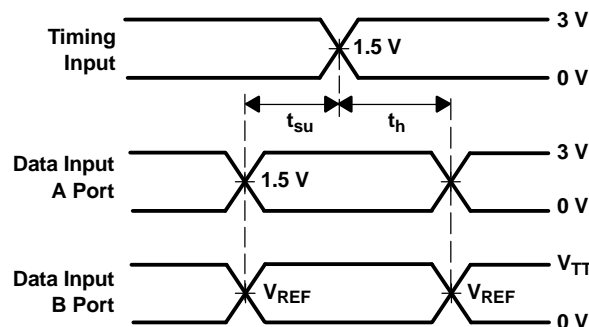
VOLTAGE WAVEFORMS PULSE DURATION
($V_M = 1.5\text{ V}$ for A port and V_{REF} for B port)⁽¹⁾



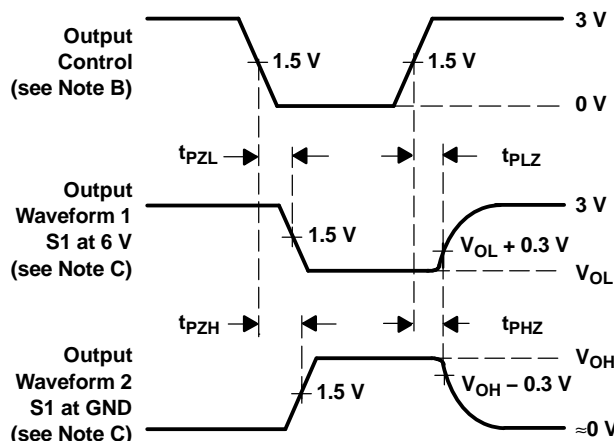
VOLTAGE WAVEFORMS PROPAGATION DELAY TIMES (A port to B port)⁽¹⁾



VOLTAGE WAVEFORMS PROPAGATION DELAY TIMES (B port to A port)⁽¹⁾



VOLTAGE WAVEFORMS SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS ENABLE AND DISABLE TIMES (A port)

⁽¹⁾ All control inputs are TTL levels.

NOTES: A. C_L includes probe and jig capacitance.

B. All input pulses are supplied by generators having the following characteristics: $PRR \leq 10\text{ MHz}$, $Z_O = 50\text{ }\Omega$, $t_r \leq 2.5\text{ ns}$, $t_f \leq 2.5\text{ ns}$.

C. 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.

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⁾
5962-9689001QXA	ACTIVE	CFP	WD	56	1	TBD	Call TI	Level-NC-NC-NC
74GTL16612DGGRE4	ACTIVE	TSSOP	DGG	56	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74GTL16612DGGR	ACTIVE	TSSOP	DGG	56	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74GTL16612DL	ACTIVE	SSOP	DL	56	20	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74GTL16612DLR	ACTIVE	SSOP	DL	56	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SNJ54GTL16612WD	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.

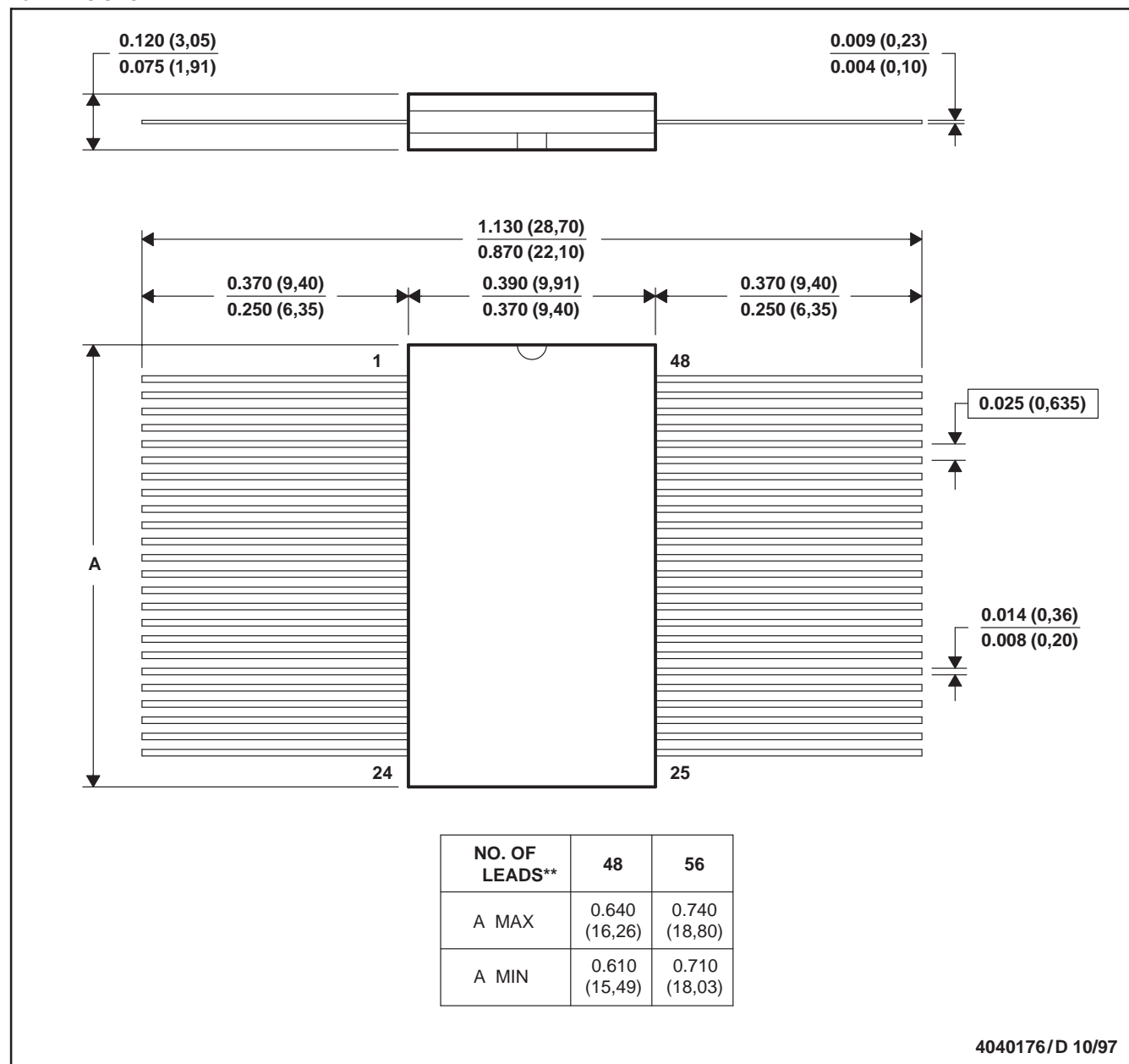
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WD (R-GDFP-F**)

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

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