



March 1995  
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## GTL16612 CMOS 18-Bit TTL/GTL Universal Bus Transceiver

### General Description

The GTL16612 is an 18-bit universal bus transceiver which provides TTL to GTLP signal level translation. The device is designed to provide a high speed interface between cards operating at TTL logic levels and a back-plane operating at GTLP logic levels. High speed back-plane operation is a direct result of GTLP's reduced output swing (<1V), reduced input threshold levels and output edge rate control which minimizes signal settling times. GTLP is a Fairchild Semiconductor derivative of the Gunning Transceiver Logic (GTL) JEDEC standard JESD8-3.

Fairchild's GTLP has internal edge-rate control and is Process, Voltage, and Temperature (PVT) compensated. Its function is similar to BTL or GTL but with different driver output levels and receiver threshold. GTLP output low voltage is typically less than 0.5V, the output high is 1.5V and the receiver threshold is 1.0V.

### Features

- Bidirectional interface between GTLP and TTL logic levels
- Designed with Edge Rate Control Circuit to reduce output noise
- VREF pin provides external supply reference voltage for receiver threshold
- Submicron Core CMOS technology for low power dissipation
- Special PVT Compensation circuitry to provide consistent performance over variations of process, supply voltage and temperature
- 5V tolerant inputs and outputs on A-Port
- Bus-Hold data inputs on A-Port to eliminate the need for external pull-up resistors for unused inputs
- Power up/down high impedance
- TTL compatible Driver and Control inputs
- A-Port outputs source/sink -32 mA/+32 mA
- Flow-through architecture optimizes PCB layout
- Open drain on GTLP to support wired-or connection

### Ordering Code:

Order Number	Package Number	Package Description
GTL16612MEA	MS56A	56-Lead Shrink Small Outline Package (SSOP), JEDEC MO-118 0.300" Wide
GTL16612MTD	MTD56	56-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 6.1mm Wide

Device also available in Tape and Reel. Specify by appending suffix letter "X" to the ordering code.

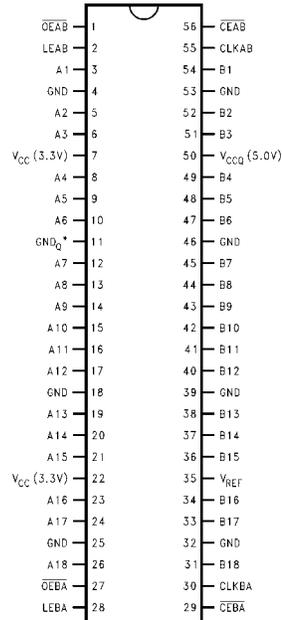
GTL16612 CMOS 18-Bit TTL/GTL Universal Bus Transceiver



## Pin Descriptions

Pin Names	Description
$\overline{OEAB}$	A-to-B Output Enable (Active LOW)
$\overline{OEBA}$	B-to-A Output Enable (Active LOW)
$\overline{CEAB}$	A-to-B Clock Enable (Active LOW)
$\overline{CEBA}$	B-to-A Clock Enable (Active LOW)
LEAB	A-to-B Latch Enable (Transparent HIGH)
LEBA	B-to-A Latch Enable (Transparent HIGH)
CLKAB	A-to-B Clock Pulse
CLKBA	B-to-A Clock Pulse
$V_{REF}$	GTLP Input Reference Voltage
A1–A18	A-to-B TTL Data Inputs or B-to-A 3-STATE Outputs
B1–B18	B-to-A GTLP Data Inputs or A-to-B Open Drain Outputs

## Connection Diagram



## Functional Description

The GTLP16612 combines a universal transceiver function with a TTL to GTLP translation. The A-Port and control pins operate at LVTTTL or 5V TTL levels while the B-Port operates at GTLP levels. The transceiver logic includes D-type latches and D-type flip-flops to allow data flow in transparent, latched and clock mode.

The functional operation is described in the truth table below.

## Truth Table

(Note 1)

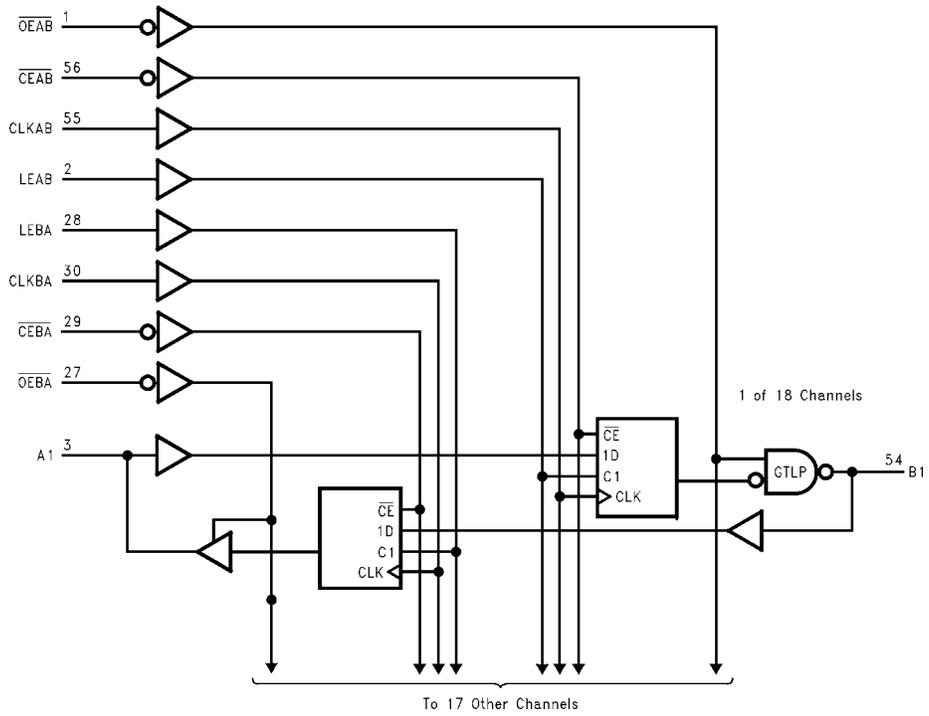
Inputs					Output B	Mode
$\overline{CEAB}$	$\overline{OEAB}$	LEAB	CLKAB	A		
X	H	X	X	X	Z	Latched storage
L	L	L	H	X	$B_0$ (Note 2)	of A data
L	L	L	L	X	$B_0$ (Note 3)	
X	L	H	X	L	L	Transparent
X	L	H	X	H	H	
L	L	L	↑	L	L	Clocked storage
L	L	L	↑	H	H	of A data
H	L	L	X	X	$B_0$ (Note 3)	Clock inhibit

**Note 1:** A-to-B data flow is shown. B-to-A data flow is similar but uses  $\overline{OEBA}$ , LEBA, CLKBA, and  $\overline{CEBA}$ .

**Note 2:** Output level before the indicated steady-state input conditions were established, provided that CLKAB was high before LEAB went low.

**Note 3:** Output level before the indicated steady-state input conditions were established.

### Logic Diagram



### Absolute Maximum Ratings (Note 4)

Supply Voltage ( $V_{CC}$ , $V_{CCQ}$ )	-0.5V to +7.0V
DC Input Voltage ( $V_I$ )	-0.5V to +7.0V
DC Output Voltage ( $V_O$ )	
Outputs 3-STATE	-0.5V to +7.0V
Outputs Active (Note 5)	-0.5V to $V_{CC} + 0.5V$
DC Output Sink Current into A-Port $I_{OL}$	64 mA
DC Output Source Current from A-Port $I_{OH}$	-64 mA
DC Output Sink Current into B-Port in the LOW State, $I_{OL}$	80 mA
DC Input Diode Current ( $I_{IK}$ ) $V_I < 0V$	-50 mA
DC Output Diode Current ( $I_{OK}$ ) $V_O < 0V$	-50 mA
$V_O > V_{CC}$	+50 mA
Storage Temperature ( $T_{STG}$ )	-65°C to +150°C
ESD Performance	>2000V

### Recommended Operating Conditions (Note 6)

Supply Voltage $V_{CC}$	3.15V to 3.45V
$V_{CC}$	3.15V to 3.45V
$V_{CCQ}$	4.75V to 5.25V
Bus Termination Voltage ( $V_{TT}$ )	1.35V to 1.65V
Input Voltage ( $V_I$ ) on A-Port and Control Pins	0.0V to 5.5V
HIGH Level Output Current ( $I_{OH}$ ) A-Port	-32 mA
LOW Level Output Current ( $I_{OL}$ ) A-Port	+32 mA
B-Port	+34 mA
Operating Temperature ( $T_A$ )	-40°C to +85°C

**Note 4:** The Absolute Maximum Ratings are those values beyond which the safety of the device cannot be guaranteed. The device should not be operated at these limits. The parametric values defined in the Electrical Characteristic tables are not guaranteed at the absolute maximum rating. The "Recommended Operating Conditions" table will define the conditions for actual device operation.

**Note 5:**  $I_O$  Absolute Maximum Rating must be observed.

**Note 6:** Unused inputs must be held high or low.

DC Electrical Characteristics							
Over Recommended Operating Free-Air Temperature Range, $V_{REF} = 1.0V$ (Unless Otherwise Noted).							
Symbol		Test Conditions		Min	Typ (Note 7)	Max	Units
$V_{IH}$	B-Port			$V_{REF} + 0.1$		$V_{TT}$	V
	Others			2.0			V
$V_{IL}$	B-Port			0.0		$V_{REF} - 0.1$	V
	Others					0.8	
$V_{REF}$					1.0		V
$V_{IK}$		$V_{CC} = 3.15V$ , $V_{CCQ} = 4.75V$	$I_I = -18\text{ mA}$			-1.2	V
$V_{OH}$	A-Port	$V_{CC}, V_{CCQ} = \text{Min to Max (Note 8)}$		$I_{OH} = -100\ \mu A$	$V_{CC} - 0.2$		V
		$V_{CC} = 3.15V$	$I_{OH} = -8\text{ mA}$	2.4			
		$V_{CCQ} = 4.75V$	$I_{OH} = -32\text{ mA}$	2.0			
$V_{OL}$	A-Port	$V_{CC}, V_{CCQ} = \text{Min to Max (Note 8)}$		$I_{OL} = 100\ \mu A$		0.2	V
		$V_{CC} = 3.15V$	$I_{OL} = 32\text{ mA}$		0.5		
	B-Port	$V_{CC} = 3.15V, V_{CCQ} = 4.75V$		$I_{OL} = 34\text{ mA}$		0.65	V
$I_I$	Control Pins	$V_{CC}, V_{CCQ} = 0\text{ or Max}$		$V_I = 5.5V\text{ or }0V$		$\pm 10$	$\mu A$
	A-Port	$V_{CC} = 3.45V$ $V_{CCQ} = 5.25V$	$V_I = 5.5V$		20	$\mu A$	
			$V_I = V_{CC}$		1		
			$V_I = 0$			-30	
B-Port	$V_{CC} = 3.45V$ $V_{CCQ} = 5.25V$	$V_I = V_{CCQ}$			5	$\mu A$	
			$V_I = 0$			-5	
$I_{OFF}$	A-Port	$V_{CC} = V_{CCQ} = 0$		$V_I\text{ or }V_O = 0\text{ to }4.5V$		100	$\mu A$
$I_{I(\text{hold})}$	A-Port	$V_{CC} = 3.15V$ , $V_{CCQ} = 4.75V$		$V_I = 0.8V$	75		$\mu A$
				$V_I = 2.0V$	-20		
$I_{OZH}$	A-Port	$V_{CC} = 3.45V$ , $V_{CCQ} = 5.25V$		$V_O = 3.45V$		1	$\mu A$
	B-Port			$V_O = 1.5V$		5	
$I_{OZL}$	A-Port	$V_{CC} = 3.45V$ , $V_{CCQ} = 5.25V$		$V_O = 0$		-20	$\mu A$
	B-Port			$V_O = 0.65V$		-10	
$I_{CCQ}$ ( $V_{CCQ}$ )	A or B Ports	$V_{CC} = 3.45V$ , $V_{CCQ} = 5.25V$ , $I_O = 0$ , $V_I = V_{CCQ}\text{ or GND}$		Outputs HIGH	30	40	mA
				Outputs LOW	30	40	
				Outputs Disabled	30	40	
$I_{CC}$ ( $V_{CC}$ )	A or B Ports	$V_{CC} = 3.45V$ , $V_{CCQ} = 5.25V$ , $I_O = 0$ , $V_I = V_{CCQ}\text{ or GND}$		Outputs HIGH	0	1	mA
				Outputs LOW	0	1	
				Outputs Disabled	0	1	
$\Delta I_{CC}$ (Note 9)	A-Port and Control Pins	$V_{CC} = 3.45V$ , $V_{CCQ} = 5.25V$ , A or Control Inputs at $V_{CC}\text{ or GND}$		One Input at 2.7V	0	1	mA
$C_{IN}$	Control Pins			$V_I = V_{CCQ}\text{ or }0$	8		pF
$C_{I/O}$	A-Port			$V_I = V_{CCQ}\text{ or }0$	9		
$C_{I/O}$	B-Port			$V_I = V_{CCQ}\text{ or }0$	6		

**Note 7:** All typical values are at  $V_{CC} = 3.3V$ ,  $V_{CCQ} = 5.0V$ , and  $T_A = 25^\circ C$ .

**Note 8:** For conditions shown as Min or Max, use the appropriate value specified under recommended operating conditions.

**Note 9:** This is the increase in supply current for each input that is at the specified TTL voltage level rather than  $V_{CC}$  or GND.

AC Operating Requirements						
Over recommended ranges of supply voltage and operating free-air temperature, $V_{REF} = 1.0V$ (unless otherwise noted).						
Symbol		Min	Max	Unit		
$f_{CLOCK}$	Max Clock Frequency	175		MHz		
$t_W$	Pulse Duration	LEAB or LEBA HIGH	3.0		ns	
		CLKAB or CLKBA HIGH or LOW	3.2			
$t_S$	Setup Time	A before CLKAB $\uparrow$	0.5		ns	
		B before CLKBA $\uparrow$	3.1			
		A before LEAB $\downarrow$	1.3			
		B before LEBA $\downarrow$	3.7			
		$\overline{CEAB}$ before CLKAB $\uparrow$	0.4			
		$\overline{CEBA}$ before CLKBA $\uparrow$	1.0			
$t_H$	Hold Time	A after CLKAB $\uparrow$	1.5		ns	
		B after CLKBA $\uparrow$	0.0			
		A after LEAB $\downarrow$	0.5			
		B after LEBA $\downarrow$	0.0			
		$\overline{CEAB}$ after CLKAB $\uparrow$	1.5			
		$\overline{CEBA}$ after CLKBA $\uparrow$	1.7			

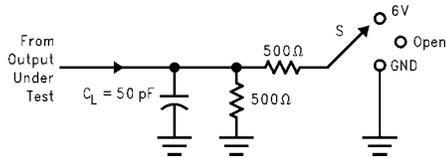
  

AC Electrical Characteristics						
Over recommended range of supply voltage and operating free-air temperature, $V_{REF} = 1.0V$ (unless otherwise noted).						
$C_L = 30$ pF for B-Port and $C_L = 50$ pF for A-Port.						
Symbol	From (Input)	To (Output)	Min	Typ (Note 10)	Max	Unit
$t_{PLH}$	A	B	1.0	4.3	6.5	ns
$t_{PHL}$			1.0	5.0	8.2	
$t_{PLH}$	LEAB	B	1.8	4.5	6.7	ns
$t_{PHL}$			1.5	5.3	8.6	
$t_{PLH}$	CLKAB	B	1.8	4.6	6.7	ns
$t_{PHL}$			1.5	5.4	8.7	
$t_{PLH}$	$\overline{OEAB}$	B	1.6	4.4	6.2	ns
$t_{PHL}$			1.3	6.1	9.8	
$t_{RISE}$	Transition time, B outputs (20% to 80%)			2.6		ns
$t_{FALL}$	Transition time, B outputs (20% to 80%)			2.6		
$t_{PLH}$	B	A	2.0	5.6	8.2	ns
$t_{PHL}$			1.4	5.0	7.2	
$t_{PLH}$	LEBA	A	2.1	4.2	6.3	ns
$t_{PHL}$			1.9	3.3	5.0	
$t_{PLH}$	CLKBA	A	2.3	4.4	6.8	ns
$t_{PHL}$			2.2	3.5	5.2	
$t_{PZH}, t_{PZL}$	$\overline{OEBA}$	A	1.5	5.0	6.2	ns
$t_{PHZ}, t_{PLZ}$			1.9	3.9	7.9	

**Note 10:** All typical values are at  $V_{CC} = 3.3V$ ,  $V_{CCQ} = 5.0V$ , and  $T_A = 25^\circ C$ .

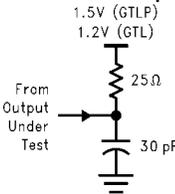
## Test Circuits and Timing Waveforms

**Test Circuit for A Outputs**



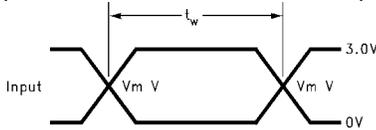
$C_L$  includes probes and jig capacitance.

**Test Circuit for B Outputs**

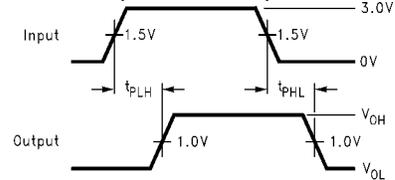


$C_L$  includes probes and jig capacitance. For B-Port outputs,  $C_L = 30$  pF is used for worst case edge rate.

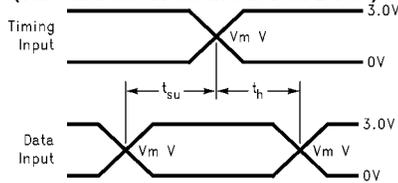
**Voltage Waveforms Pulse Duration**  
( $V_m = 1.5V$  for A-Port and  $1.0V$  for B-Port)



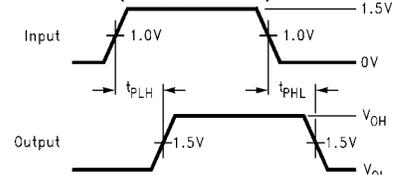
**Voltage Waveforms Propagation Delay Times**  
(A-Port to B-Port)



**Voltage Waveforms Setup and Hold Times**  
( $V_m = 1.5V$  for A-Port and  $1.0V$  for B-Port)

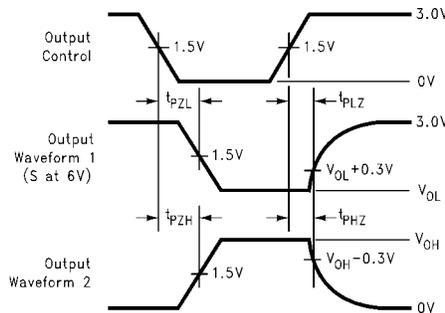


**Voltage Waveforms Propagation Delay Times**  
(B-Port to A-Port)



All input pulses have the following characteristics: frequency = 10 MHz,  $t_r = t_f = 2$  ns,  $Z_O = 50\Omega$ . The outputs are measured one at a time with one transition per measurement.

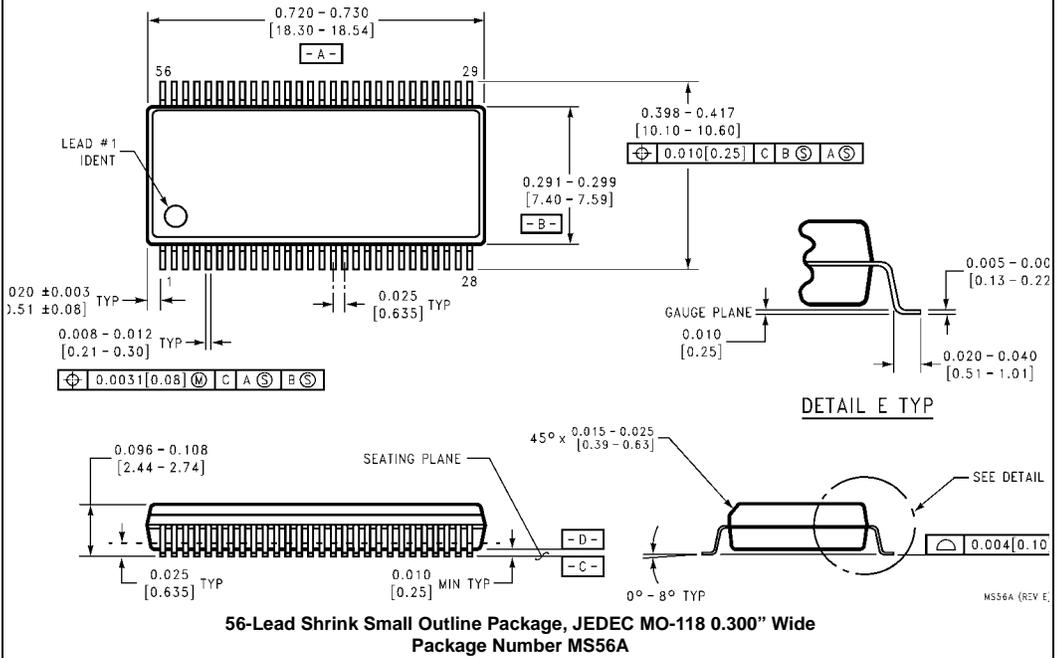
**Voltage Waveforms Enable and Disable Times (A-Port)**



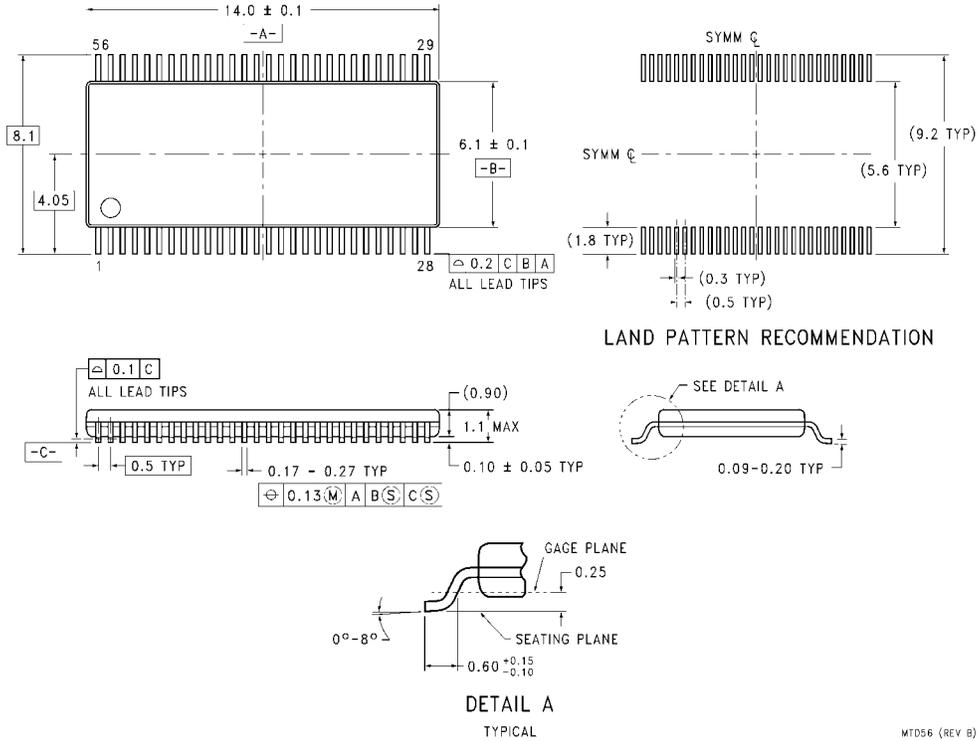
Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high except when disabled by the output control. All input pulses have the following characteristics: frequency = 10 MHz,  $t_r = t_f = 2$  ns,  $Z_O = 50\Omega$ . The outputs are measured one at a time with one transition per measurement.

GTLP16612

**Physical Dimensions** inches (millimeters) unless otherwise noted



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**56-Lead Thin Shrink Small Outline Package, JEDEC MO-153, 6.1mm Wide  
Package Number MTD56**

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