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DATA SHEET

GTLPH16612

18-bit GTLP to LVTTL/TTL bidirectional universal translator (3-State)

Product data

2001 Sep 28

File under Integrated Ciruits ICL03

Philips
Semiconductors

PHILIPS

18-bit GTLP to LVTTL/TTL bidirectional universal translator (3-State)

GTLPH16612

FEATURES

- 18-bit bidirectional bus interface
- Translates between GTLP logic levels (B ports) and LVTTL/TTL logic levels (A ports)
- Edge rate control circuitry on the Bn outputs rising/falling edges to minimize system noise in a multipoint backplane environment
- 5 V I/O tolerant on the LVTTL side
- No bus current loading when LVTTL output is tied to 5 V bus
- 3-State buffers
- Output capability: +64 mA/-32 mA on the LVTTL side; +40 mA on the GTLP side
- LVTTL input levels on control pins
- Power-up reset
- Power-up 3-State
- Positive edge triggered clock inputs
- Latch-up protection exceeds 500 mA per JESD78
- ESD protection exceeds 2000 V HBM per JESD22-A114, 200 V MM per JESD22-A115 and 750 V (Bn I/O exceeds 1000 V) CDM per JESD22-C101

DESCRIPTION

The GTLPH16612 is a high-performance BiCMOS product designed for V_{CC} operation at 3.3V with I/O compatibility up to 5 V.

The GTLPH16612 is unique in that pin 50 is a no connect and this device can be used as a replacement device in sockets where pin 50 is 3.3/5 V V_{CC} or 3.3 V BIAS V_{CC}.

This device is an 18-bit universal transceiver featuring non-inverting 3-State bus compatible outputs in both send and receive directions. Data flow in each direction is controlled by output enable ($\overline{OEAB}$ and $\overline{OEBA}$), latch enable (LEAB and LEBA), and clock (CPAB and CPBA) inputs. For A-to-B data flow, the device operates in the transparent mode when LEAB is High. When LEAB is Low, the A data is latched if CPAB is held at a High or Low logic level. If LEAB is Low, the A-bus data is stored in the latch/flip-flop on the Low-to-High transition of CPAB. When $\overline{OEAB}$ is Low, the outputs are active. When $\overline{OEAB}$ is High, the outputs are in the high-impedance state. The clocks can be controlled with the clock-enable inputs ($\overline{CEBA}$/$\overline{CEAB}$).

Data flow for B-to-A is similar to that of A-to-B but uses $\overline{OEBA}$, LEBA and CPBA.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS T_{amb} = 25 °C	TYPICAL	UNIT
			3.3 V	
t_{PLH} t_{PHL}	Propagation delay An to Bn or Bn to An	C_L = 50 pF	1.9	ns
C_{IN}	Input capacitance (Control pins)	V_I = 0 V or V_{CC}	4	pF
$C_{I/O}$	An I/O pin capacitance	$V_{I/O}$ = 0 V or V_{CC}	9	pF
$C_{I/O}$	Bn I/O pin capacitance	$V_{I/O}$ = 0 V or 1.5 V	5.3	pF
I_{CCZ}	Total supply current	Outputs disabled	12	mA

ORDERING INFORMATION

PACKAGES	TEMPERATURE RANGE	ORDER CODE	DWG NUMBER
56-Pin Plastic SSOP	–40 to +85 °C	GTLPH16612DL	SOT371-1
56-Pin Plastic TSSOP	–40 to +85 °C	GTLPH16612DGG	SOT364-1

NOTE:
1. Standard packing quantities and other packaging data is available at **www.philipslogic.com/support/packages**.

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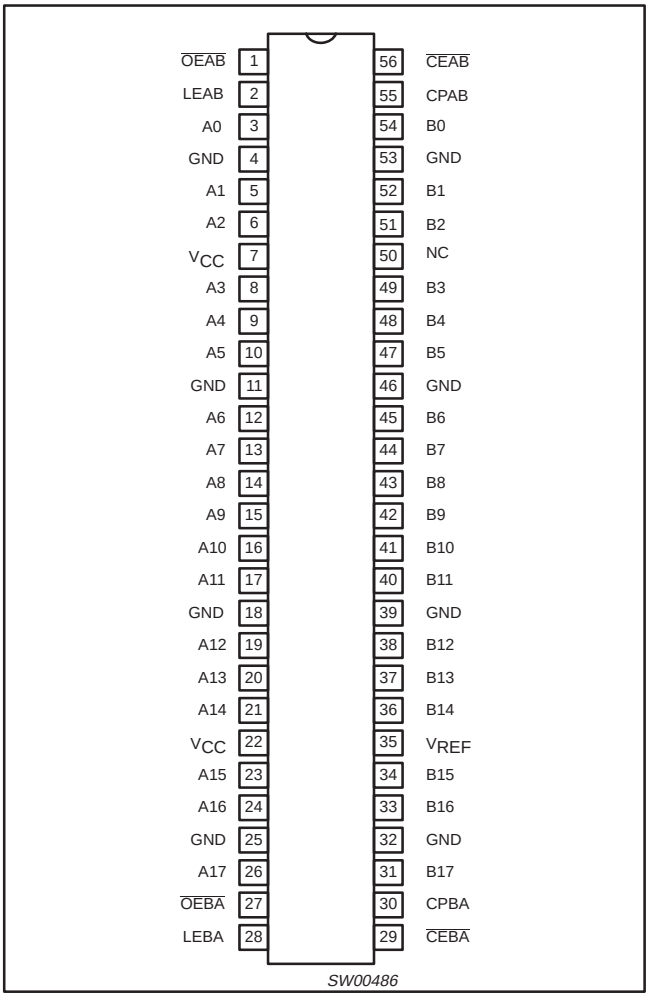
PIN CONFIGURATION



PIN DESCRIPTION

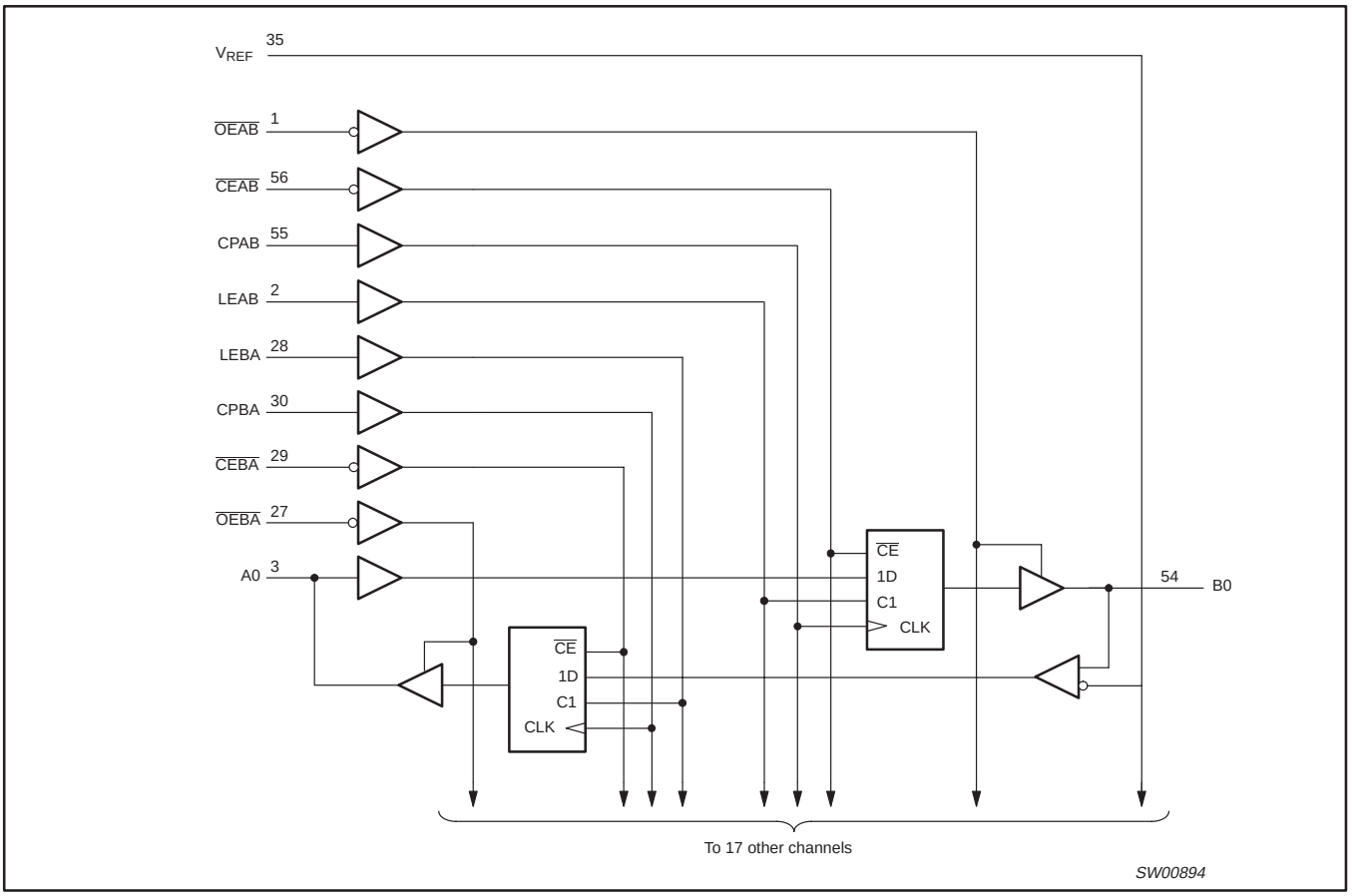
PIN NUMBER	SYMBOL	NAME AND FUNCTION
1, 27	$\overline{OEAB}/\overline{OEBA}$	A-to-B/ B-to-A Output enable input (active Low)
29, 56	$\overline{CEBA}/\overline{CEAB}$	B-to-A/A-to-B clock enable
2, 28	LEAB/LEBA	A-to-B/B-to-A Latch enable input
55, 30	CPAB/CPBA	A-to-B/B-to-A Clock input (active rising edge)
3, 5, 6, 8, 9, 10, 12, 13, 14, 15, 16, 17, 19, 20, 21, 23, 24, 26	A0-A17	Data inputs/outputs (A side)
54, 52, 51, 49, 48, 47, 45, 44, 43, 42, 41, 40, 38, 37, 36, 34, 33, 31	B0-B17	Data inputs/outputs (B side)
4, 11, 18, 25, 32, 39, 46, 53	GND	Ground (0V)
7, 22	V_{CC}	Positive supply voltage
35	V_{REF}	GTLP reference voltage
50	NC	No connect

FUNCTION TABLE

INPUTS					OUTPUT	
$\overline{CEAB}$	$\overline{OEAB}$	LEAB	CPAB	A	B	MODE
X	H	X	X	X	Z	Isolation
L	L	L	↑	L	L	Clocked storage of A data
L	L	L	↑	H	H	
X	L	H	X	L	L	Transparent
X	L	H	X	H	H	
L	L	L	H	X	B_O‡	Latched storage of A data
L	L	L	L	X	B_O§	
H	L	L	X	X	B_O‡	Clock inhibit

X = Don't care
H = High voltage level
L = Low voltage level
↑ = Low to High
Z = High impedance "off" state
† = A-to-B data flow is shown: B-to-A flow is similar but uses $\overline{OEBA}$, LEBA, CPBA, and $\overline{CEBA}$. The condition when $\overline{OEAB}$ and $\overline{OEBA}$ are both low at the same time is not recommended.
‡ = Output level before the indicated steady-state input conditions were established.
§ = Output level before the indicated steady-state input conditions were established, provided that CPAB was Low before LEAB went Low.

LOGIC SYMBOL (Positive Logic)



ABSOLUTE MAXIMUM RATINGS[1, 2]

SYMBOL	PARAMETER	CONDITIONS	RATING	UNIT
V_{CC}	DC supply voltage		–0.5 to +4.6	V
I_{IK}	DC input diode current	$V_I < 0$ V	–50	mA
V_I	DC input voltage[3]	A port	–0.5 to +7.0	V
		B port	–0.5 to +4.6	
I_{OK}	DC output diode current	$V_O < 0$ V; A port	–50	mA
V_{OUT}	DC output voltage[3]	Output in Off or High state; A port	–0.5 to +7.0	V
		Output in Off or High state; B port	–0.5 to +4.6	V
I_{OL}	Current into any output in the LOW state	A port	128	mA
		B port	80	mA
I_{OH}	Current into any output in the HIGH state	A port	–64	mA
T_{stg}	Storage temperature range		–65 to +150	°C

NOTES:
1. Stresses beyond those listed 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 performance capability of a high-performance integrated circuit in conjunction with its thermal environment can create junction temperatures which are detrimental to reliability. The maximum junction temperature of this integrated circuit should not exceed 150 °C.
3. The input and output negative voltage ratings may be exceeded if the input and output clamp current ratings are observed.

RECOMMENDED OPERATING CONDITIONS[1, 2]

SYMBOL	PARAMETER	TEST CONDITIONS	3.3V RANGE LIMITS			UNIT
			MIN	TYP	MAX	
V_{CC}	DC supply voltage		3.0	3.3	3.6	V
V_{TT}	Termination voltage	GTL	1.14	1.2	1.26	V
		GTLP	1.35	1.5	1.65	
V_{REF}	GTL reference voltage	GTL	0.74	0.8	0.87	V
		GTLP	0.9	1	1.10	
V_I	Input voltage	B port	0	V_{TT}	Note 3	V
		Except B port	0	V_{CC}	5.5	
V_{IH}	HIGH-level input voltage	B port	V_{REF}+50mV	—	—	V
		Except B port	2.0	—	—	
V_{IL}	LOW-level input voltage	B port	—	—	V_{REF}–50mV	V
		Except A port	—	—	0.8	
I_{OH}	HIGH-level output current	A port	—	—	–32	mA
I_{OL}	LOW-level output current	B port, GTL	—	—	32	mA
		B port, GTLP	—	—	40	mA
		A port	—	—	64	mA
$\Delta t/\Delta v$	Input transition rise or fall rate	Outputs enabled	—	—	10	ns/V
$\Delta t/\Delta V_{CC}$	Power-up rate		20	—	—	µs/V
T_{amb}	Operating free-air temperature range		–40	—	+85	°C

NOTES:
1. Normal connection sequence is GND first; V_{CC}, I/O, control inputs, V_{TT} and V_{REF} (any order) last.
2. V_{REF} can be adjusted to optimize noise margins, but normally is two-thirds V_{TT}.
3. V_{TT} and R_{TT} can be adjusted to accommodate backplane impedances if the DC recommended I_{OL} ratings are not exceeded and the absolute max V_I rating is not exceeded.

DC ELECTRICAL CHARACTERISTICS (3.3 V ±0.3 V RANGE)

SYMBOL	PARAMETER	TEST CONDITIONS		LIMITS			UNIT
				Temp = –40 to +85 °C			
				MIN	TYP[1]	MAX	
V_{IK}	Input clamp voltage	V_{CC} = 3.0 V; I_{IK} = –18 mA		—	–0.85	–1.2	V
V_{OH}	High-level output voltage	V_{CC} = 3.0 to 3.6 V; I_{OH} = –100 µA	A port	V_{CC}–0.2	V_{CC}	—	V
		V_{CC} = 3.0 V; I_{OH} = –32 mA		2.0	2.3	—	
V_{OL}	Low-level output voltage	V_{CC} = 3.0 V; I_{OL} = 100 µA	A port	—	0.07	0.2	V
		V_{CC} = 3.0 V; I_{OL} = 16 mA		—	0.25	0.4	
		V_{CC} = 3.0 V; I_{OL} = 32 mA		—	0.3	0.5	
		V_{CC} = 3.0 V; I_{OL} = 64 mA		—	0.4	0.55	
		V_{CC} = 3.0 V; I_{OL} = 40 mA	B port	—	0.4	0.5	V
I_I	Input leakage current	V_{CC} = 3.6 V; V_I = V_{CC} or GND	Control pins	—	0.1	±1	µA
		V_{CC} = 0 or 3.6 V; V_I = 5.5 V		—	0.1	10	
		V_{CC} = 3.6 V; V_I = 5.5 V	I/O Data pins[4] A port	—	0.1	20	µA
		V_{CC} = 3.6 V; V_I = V_{CC}		—	0.5	10	
		V_{CC} = 3.6 V; V_I = 0 V		—	0.1	-5	
		V_{CC} = 3.6 V; V_I = V_{TT} or GND	B port	—	—	±5	µA
I_{OFF}	Output off current	V_{CC} = 0 V; V_I or V_O = 0 to 4.5 V		—	0.1	±100	µA
I_{HOLD}	Bus Hold current, A outputs	V_{CC} = 3 V; V_I = 0.8 V		75	130	—	µA
		V_{CC} = 3 V; V_I = 2.0 V		–75	–140	—	
I_{EX}	Current into an output in the High state when V_O > V_{CC}	V_O = 5.5 V; V_{CC} = 3.0 V	A port	—	10	125	µA
$I_{PU/PD}$	Power up/down 3-State output current[3]	V_{CC} ≤ 1.2 V; V_O = 0.5 V to V_{CC}; V_I = GND or V_{CC} $\overline{OE}$ = Don't care		—	1.0	±100	µA
I_{CCH}	A-Port	V_{CC} = 3.6 V	Outputs high	V_I = GND or V_{CC}; I_O = 0	—	5.0	9.0	mA
I_{CCL}			Outputs low		—	10.5	18.5	
I_{CCZ}[5]			Disabled		—	6.0	11.5	
I_{CCH}	B-Port		Outputs high		—	9.7	17.5	
I_{CCL}			Outputs low		—	7.0	12.0	
ΔI_{CC}	Additional supply current per input pin[2]	V_{CC} = 3 V to 3.6 V; One input at V_{CC}–0.6 V, Other inputs at V_{CC} or GND		—	0.04	0.2	mA
C_{IN}	Control pins capacitance	V_I = 0 V or V_{CC}		—	4	—	pF
$C_{I/O}$	An I/O pin capacitance	$V_{I/O}$ = 0 V or V_{CC}		—	9.0	—	pF
$C_{I/O}$	Bn I/O pin capacitance	$V_{I/O}$ = 0 V or 1.5 V		—	5.3	7.3[6]	pF

NOTES:
1. All typical values are at V_{CC} = 3.3 V and T_{amb} = 25 °C.
2. This is the increase in supply current for each LVTTL input at the specified voltage level other than V_{CC} or GND
3. This parameter is valid for any V_{CC} between 0 V and 1.2 V with a transition time of up to 10 msec. From V_{CC} = 1.2 V to V_{CC} = 3.3 V ± 0.3 V a transition time of 100 µsec is permitted. This parameter is valid for T_{amb} = 25 °C only.
4. Unused pins at V_{CC} or GND.
5. I_{CCZ} is measured with outputs pulled up to V_{CC} or pulled down to ground.
6. The maximum Bn I/O pin capacitance is based on simulation data.

AC CHARACTERISTICS (A PORT)

GND = 0 V; $t_r = t_f$ = 2.5 ns; C_L = 50 pF; R_L = 500 Ω; T_{amb} = –40 to +85 °C.

GTLPH16612 An Port			GTLP V_{CC} = 3.3 V ±0.3 V V_{REF} = 1.0 V			UNIT
SYMBOL	PARAMETER	WAVEFORM	MIN	TYP[1]	MAX	
F_{max}			250	290	—	MHz
t_{PLH}	Bn to An	2	1.5	2.6	5.5	ns
t_{PHL}	Bn to An	2	2.6	4.3	6.5	ns
t_{PLH}	LEBA to An	3	1.6	3.0	4.9	ns
t_{PHL}	LEBA to An	3	2.0	3.0	4.5	ns
t_{PLH}	CPBA to An	1	1.1	2.7	4.9	ns
t_{PHL}	CPBA to An	1	1.8	3.0	4.6	ns
t_{PZH}	$\overline{OEBA}$ to An	5	1.5	4.3	6.2	ns
t_{PHZ}	$\overline{OEBA}$ to An	5	1.4	3.6	4.8	ns
t_{PZL}	$\overline{OEBA}$ to An	6	1.5	3.8	6.2	ns
t_{PLZ}	$\overline{OEBA}$ to An	6	1.0	2.6	5.5	ns

NOTE:
1. Typical values are at V_{CC} = 3.3 V, T_{amb} = +25 °C.

AC CHARACTERISTICS (B PORT)

GND = 0 V; $t_r = t_f$ = 2.5 ns; C_L = 30 pF; R_L = 25 Ω; T_{amb} = –40 to +85 °C.

GTLPH16612 Bn Port			GTLP V_{CC} = 3.3 V ±0.3 V V_{REF} = 1.0 V			UNIT
SYMBOL	PARAMETER	WAVEFORM	MIN	TYP[1]	MAX	
F_{max}			250	270	—	MHz
t_{PLH}	An to Bn	2	1.8	4.8	9.0	ns
t_{PHL}	An to Bn	2	1.0	3.9	8.2	ns
t_{PLH}	LEAB to Bn	3	1.9	4.6	8.4	ns
t_{PHL}	LEAB to Bn	3	1.9	4.5	8.0	ns
t_{PLH}	CPAB to Bn	1	2.7	5.1	8.7	ns
t_{PHL}	CPAB to Bn	1	2.2	4.9	8.6	ns
t_{PLH}	$\overline{OEAB}$ to Bn	7	1.4	4.2	8.3	ns
t_{PHL}	$\overline{OEAB}$ to Bn	7	1.5	5.0	9.5	ns
t_{rise}	Transition time B outputs 20% to 80%		—	3.1	—	ns
t_{fall}	Transition time B outputs 20% to 80%		—	4.6	—	ns

NOTE:
1. Typical values are at V_{CC} = 3.3 V, T_{amb} = +25 °C.

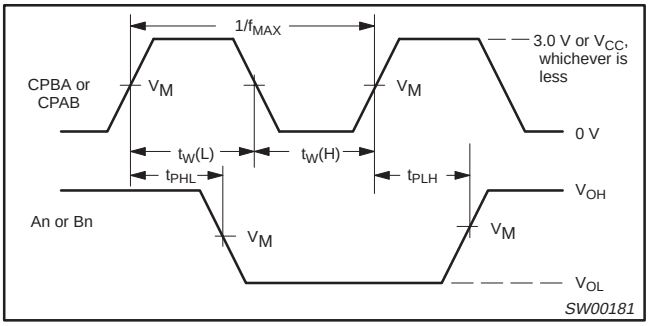
AC SETUP REQUIREMENTS (3.3 V ±0.3 V RANGE)

A Port: GND = 0 V; Input $t_r = t_f$ = 2.5 ns; C_L = 50 pF; R_L = 500 Ω; T_{amb} = –40 to +85 °C; V_{REF} = 0.8 V or 1.0 V.
B Port: GND = 0 V; Input $t_r = t_f$ = 2.5 ns; C_L = 30 pF; R_L = 25 Ω; V_{REF} = 0.8 V or 1.0 V.

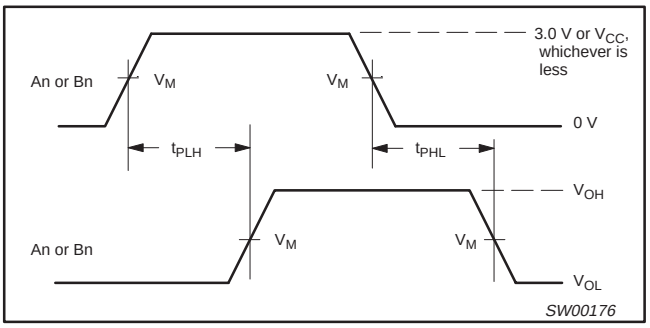
SYMBOL	DESCRIPTION	PARAMETER	WAVEFORM	LIMITS			UNIT
				V_{CC} = 3.3 V ±0.3 V			
				MIN	TYP	MAX	
t_w(H)	Pulse duration	LEAB or LEBA	3	1.0	—	—	ns
t_w(H or L)	Pulse duration	CPAB or CPBA	4	2.5	—	—	ns
t_s(H or L)	Setup time	An before CPAB rising edge	4	2.0	—	—	ns
t_s(H)	Setup time	Bn before CPBA rising edge	4	2.5	—	—	ns
t_s(L)	Setup time	Bn before CPBA rising edge	4	3.1	—	—	ns
t_s(H or L)	Setup time	An before LEAB falling edge	4	0.5	—	—	ns
t_s(H or L)	Setup time	Bn before LEBA falling edge	4	2.5	—	—	ns
t_s(L)	Setup time	CEAB before CPAB rising edge	4	0	—	—	ns
t_s(L)	Setup time	CEBA before CPBA rising edge	4	0	—	—	ns
t_h(H or L)	Hold time	An after CPAB rising edge	4	0	—	—	ns
t_h(H or L)	Hold time	Bn after CPBA rising edge	4	0	—	—	ns
t_h(H or L)	Hold time	An after LEAB falling edge	4	0.5	—	—	ns
t_h(H or L)	Hold time	Bn after LEBA falling edge	4	0	—	—	ns
t_h(H)	Hold time	CEAB after CPAB rising edge	4	1.1	—	—	ns
t_h(H)	Hold time	CEBA after CPBA rising edge	4	1.1	—	—	ns

AC WAVEFORMS

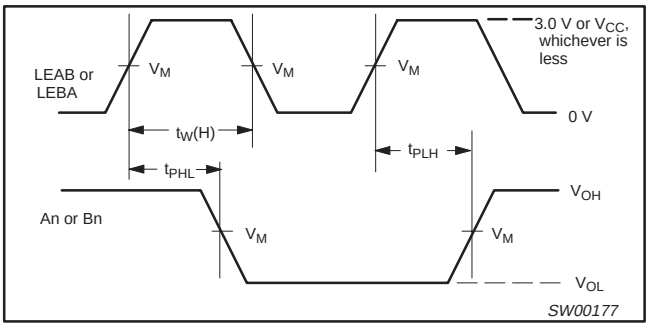
V_M = 1.5 V at $V_{CC} \geq$ 3.0 V. V_M = 1.5 V for A ports and control pins; V_M = 1.0 V for B ports in GTLP mode.
$V_X = V_{OL}$ + 0.3 V at $V_{CC} \geq$ 3.0 V.
$V_Y = V_{OH}$ – 0.3 V at $V_{CC} \geq$ 3.0 V.



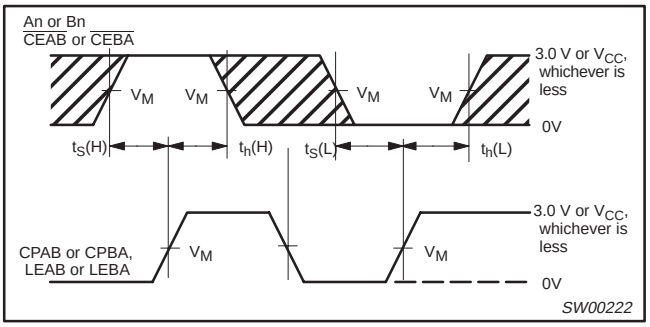
Waveform 1. Propagation delay, clock input to output, clock pulse width, and maximum clock frequency



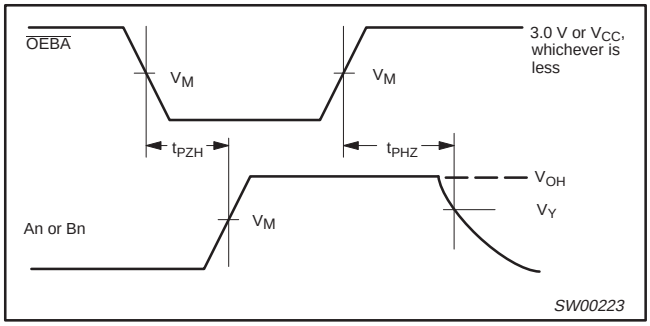
Waveform 2. Propagation delay, transparent mode



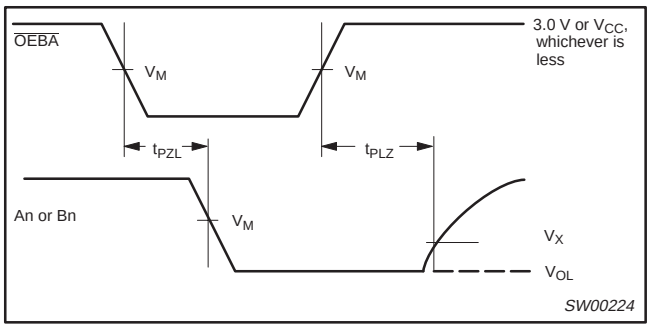
Waveform 3. Propagation delay, enable to output, and enable pulse width



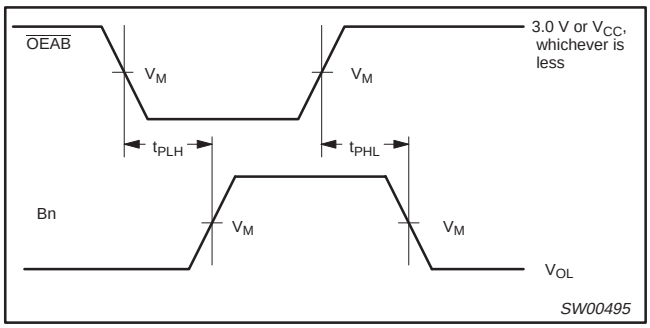
Waveform 4. Data setup and hold times



Waveform 5. 3-State output enable time to high level and output disable time from high level

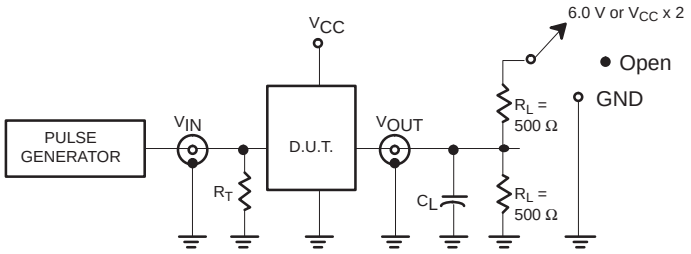


Waveform 6. 3-State output enable time to low level and output disable time from low level

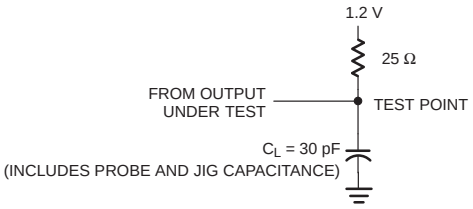


Waveform 7. Output enable time on open collector output with pull-up

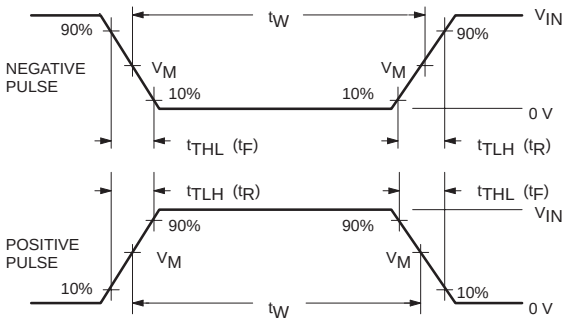
TEST CIRCUIT



Test Circuit for A Outputs



Load Circuit for B Outputs



Input Waveforms

SWITCH POSITION

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

DEFINITIONS

R_L = Load resistor; see AC CHARACTERISTICS for value.

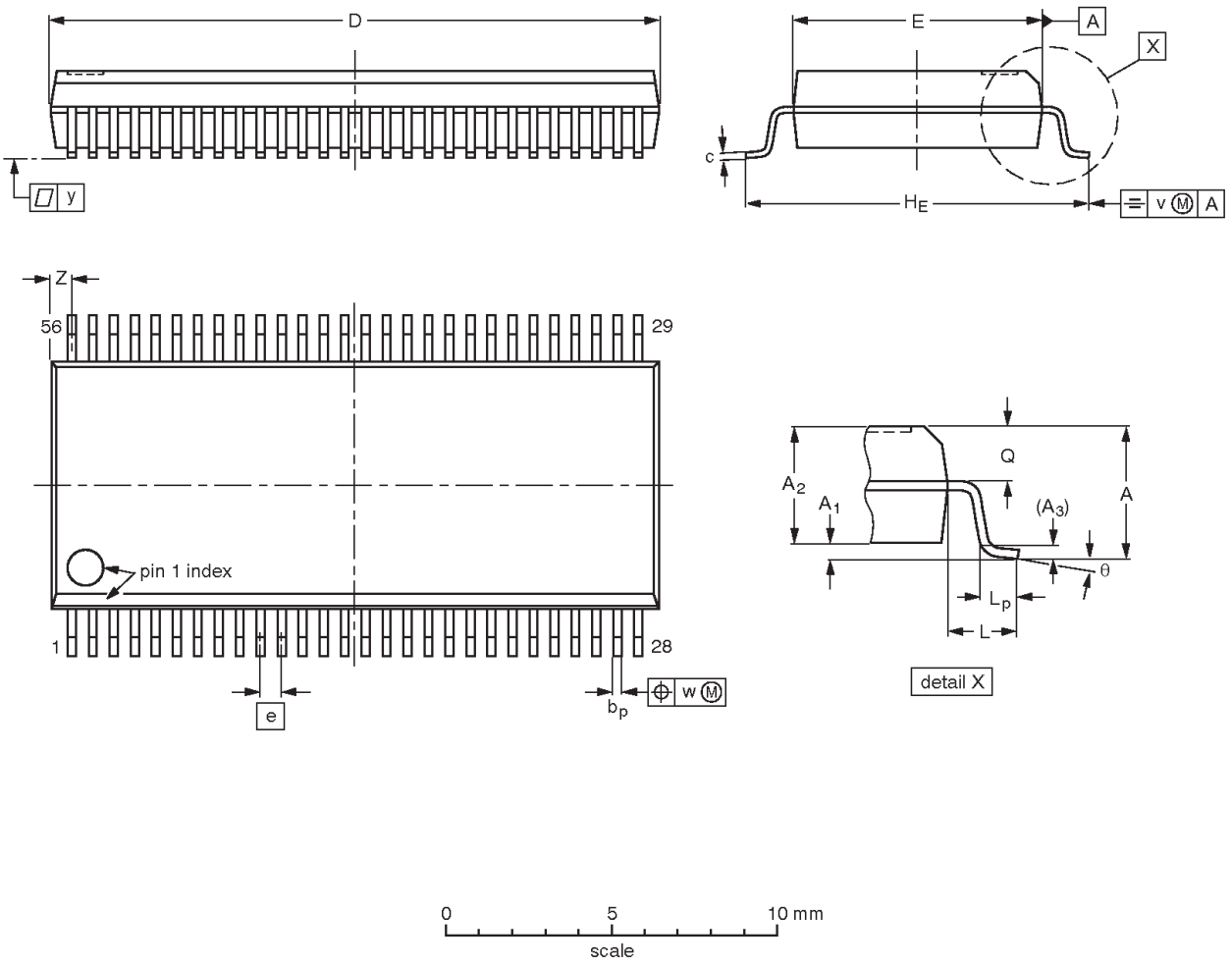
C_L = Load capacitance includes jig and probe capacitance: See AC CHARACTERISTICS for value.

R_T = Termination resistance should be equal to Z_{OUT} of pulse generators.

FAMILY	INPUT PULSE REQUIREMENTS				
	Amplitude	Rep. Rate	t_W	t_R	t_F
GTLP	3.0 V or V_{CC} whichever is less	≤ 10 MHz	500 ns	≤ 2.5 ns	≤ 2.5 ns

SW00255

SSOP56: plastic shrink small outline package; 56 leads; body width 7.5 mm **SOT371-1**



DIMENSIONS (mm are the original dimensions)

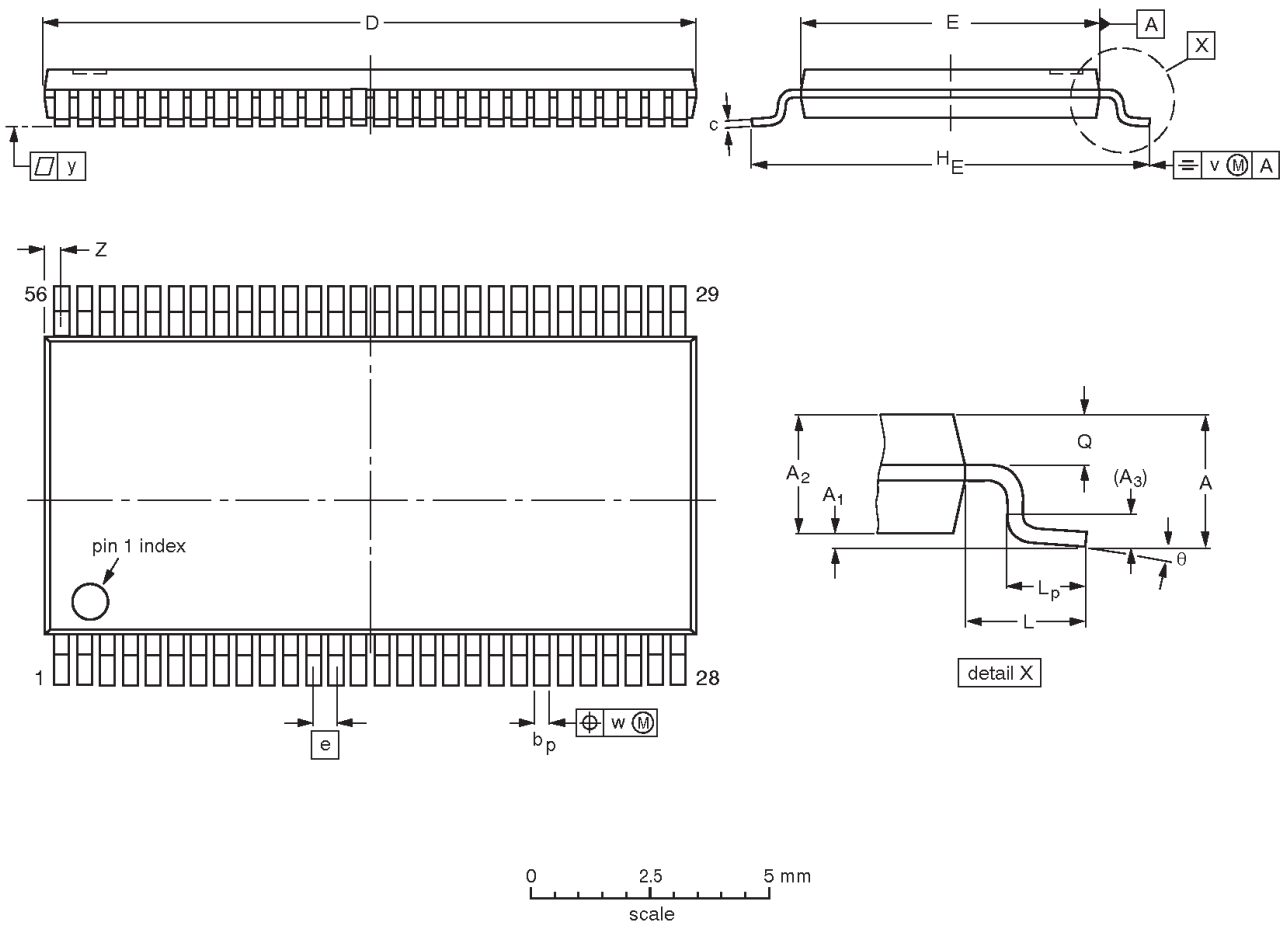
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	2.8	0.4 0.2	2.35 2.20	0.25	0.3 0.2	0.22 0.13	18.55 18.30	7.6 7.4	0.635	10.4 10.1	1.4	1.0 0.6	1.2 1.0	0.25	0.18	0.1	0.85 0.40	8^o 0^o

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT371-1		MO-118				~~95-02-04~~ 99-12-27

TSSOP56: plastic thin shrink small outline package; 56 leads; body width 6.1 mm SOT364-1



DIMENSIONS (mm are the original dimensions).

UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(2)}$	e	H_E	L	L_p	Q	v	w	y	Z	θ
mm	1.2	0.15 0.05	1.05 0.85	0.25	0.28 0.17	0.2 0.1	14.1 13.9	6.2 6.0	0.5	8.3 7.9	1.0	0.8 0.4	0.50 0.35	0.25	0.08	0.1	0.5 0.1	8^o 0^o

Notes

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES					EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ				
SOT364-1		MO-153					~~95-02-10~~ 99-12-27

NOTES

18-bit GTLP to LVTTL/TTL bidirectional universal translator (3-State)

GTLPH16612

Data sheet status

Data sheet status [1]	Product status [2]	Definitions
Objective data	Development	This data sheet contains data from the objective specification for product development. Philips Semiconductors reserves the right to change the specification in any manner without notice.
Preliminary data	Qualification	This data sheet contains data from the preliminary specification. Supplementary data will be published at a later date. Philips Semiconductors reserves the right to change the specification without notice, in order to improve the design and supply the best possible product.
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[1] Please consult the most recently issued data sheet before initiating or completing a design.

[2] The product status of the device(s) described in this data sheet may have changed since this data sheet was published. The latest information is available on the Internet at URL http://www.semiconductors.philips.com.

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Limiting values definition — Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 60134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.

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