

FEATURES

- Member of the Texas Instruments Widebus™ Family
- EPIC™ (Enhanced-Performance Implanted CMOS) Submicron Process
- Checks Parity
- Able to Cascade With a Second SN74ALVCH16903
- ESD Protection Exceeds 2000 V Per MIL-STD-883, Method 3015; Exceeds 200 V Using Machine Model (C = 200 pF, R = 0)
- Latch-Up Performance Exceeds 250 mA Per JESD 17
- Bus Hold on Data Inputs Eliminates the Need for External Pullup/Pulldown Resistors
- Package Options Include Plastic 300-mil Shrink Small-Outline (DL), Thin Shrink Small-Outline (DGG), and Thin Very Small-Outline (DGV) Packages

DESCRIPTION

This 12-bit universal bus driver is designed for 2.3-V to 3.6-V V_{CC} operation.

The SN74ALVCH16903 has dual outputs and can operate as a buffer or an edge-triggered register. In both modes, parity is checked on APAR, which arrives one cycle after the data to which it applies. The \overline{YERR} output, which is produced one cycle after APAR, is open drain.

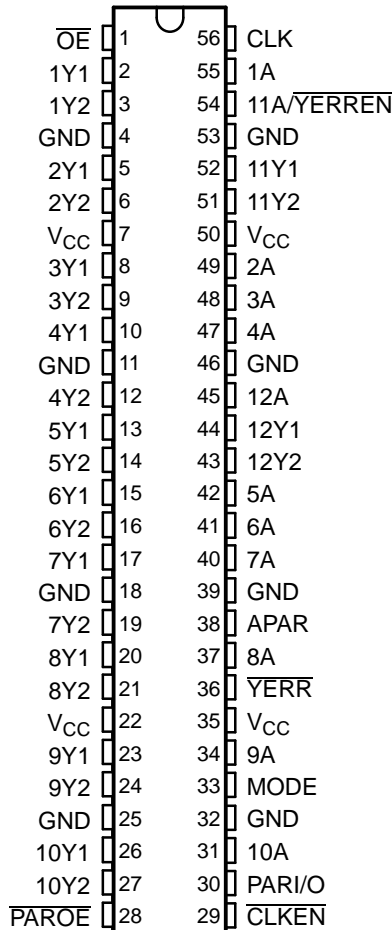
MODE selects one of the two data paths. When MODE is low, the device operates as an edge-triggered register. On the positive transition of the clock (CLK) input and when the clock-enable (\overline{CLKEN}) input is low, data set up at the A inputs is stored in the internal registers. On the positive transition of CLK and when \overline{CLKEN} is high, only data set up at the 9A–12A inputs is stored in their internal registers. When MODE is high, the device operates as a buffer and data at the A inputs passes directly to the outputs. 11A/ \overline{YERR} serves a dual purpose; it acts as a normal data bit and also enables \overline{YERR} data to be clocked into the YERR output register.

When used as a single device, parity output enable (\overline{PAROE}) must be tied high; when parity input/output (PARI/O) is low, even parity is selected and when PARI/O is high, odd parity is selected. When used in pairs and \overline{PAROE} is low, the parity sum is output on PARI/O for cascading to the second SN74ALVCH16903. When used in pairs and \overline{PAROE} is high, PARI/O accepts a partial parity sum from the first SN74ALVCH16903.

A buffered output-enable (\overline{OE}) input can be used to place the 24 outputs and \overline{YERR} in either a normal logic state (high or low logic levels) or a high-impedance state. In the high-impedance state, the outputs neither load nor drive the bus lines significantly. The high-impedance state and increased drive provide the capability to drive bus lines without need for interface or pullup components.

\overline{OE} does not affect the internal operation of the device. Old data can be retained or new data can be entered while the outputs are in the high-impedance state.

DGG, DGV, OR DL PACKAGE
(TOP VIEW)



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, EPIC are trademarks of Texas Instruments.

SN74ALVCH16903
3.3-V 12-BIT UNIVERSAL BUS DRIVER
WITH PARITY CHECKER AND DUAL 3-STATE OUTPUTS

SCES095D–MARCH 1997–REVISED SEPTEMBER 2004

DESCRIPTION (CONTINUED)

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.

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

The SN74ALVCH16903 is characterized for operation from 0°C to 70°C.

FUNCTION TABLES

FUNCTION

INPUTS					OUTPUTS	
\overline{OE}	MODE	\overline{CLKEN}	CLK	A	1Yn ⁽¹⁾ –8Yn ⁽¹⁾	9Yn ⁽¹⁾ –12Yn ⁽¹⁾
L	L	L	↑	H	H	H
L	L	L	↑	L	L	L
L	L	H	↑	H	Y ₀	H
L	L	H	↑	L	Y ₀	L
L	H	X	X	H	H	H
L	H	X	X	L	L	L
H	X	X	X	X	Z	Z

(1) n = 1 or 2

PARITY FUNCTION

INPUTS						OUTPUT YERR
\overline{OE}	\overline{PAROE} (1)	11A/YERREN ⁽²⁾	PARI/O	Σ OF INPUTS 1A–10A = H	APAR	
L	H	L	L	0, 2, 4, 6, 8, 10	L	H
L	H	L	L	1, 3, 5, 7, 9	L	L
L	H	L	L	0, 2, 4, 6, 8, 10	H	L
L	H	L	L	1, 3, 5, 7, 9	H	H
L	H	L	H	0, 2, 4, 6, 8, 10	L	L
L	H	L	H	1, 3, 5, 7, 9	L	H
L	H	L	H	0, 2, 4, 6, 8, 10	H	H
L	H	L	H	1, 3, 5, 7, 9	H	L
H	X	X	X	X	X	H
L	X	H	X	X	X	H

(1) When used as a single device, \overline{PAROE} must be tied high.

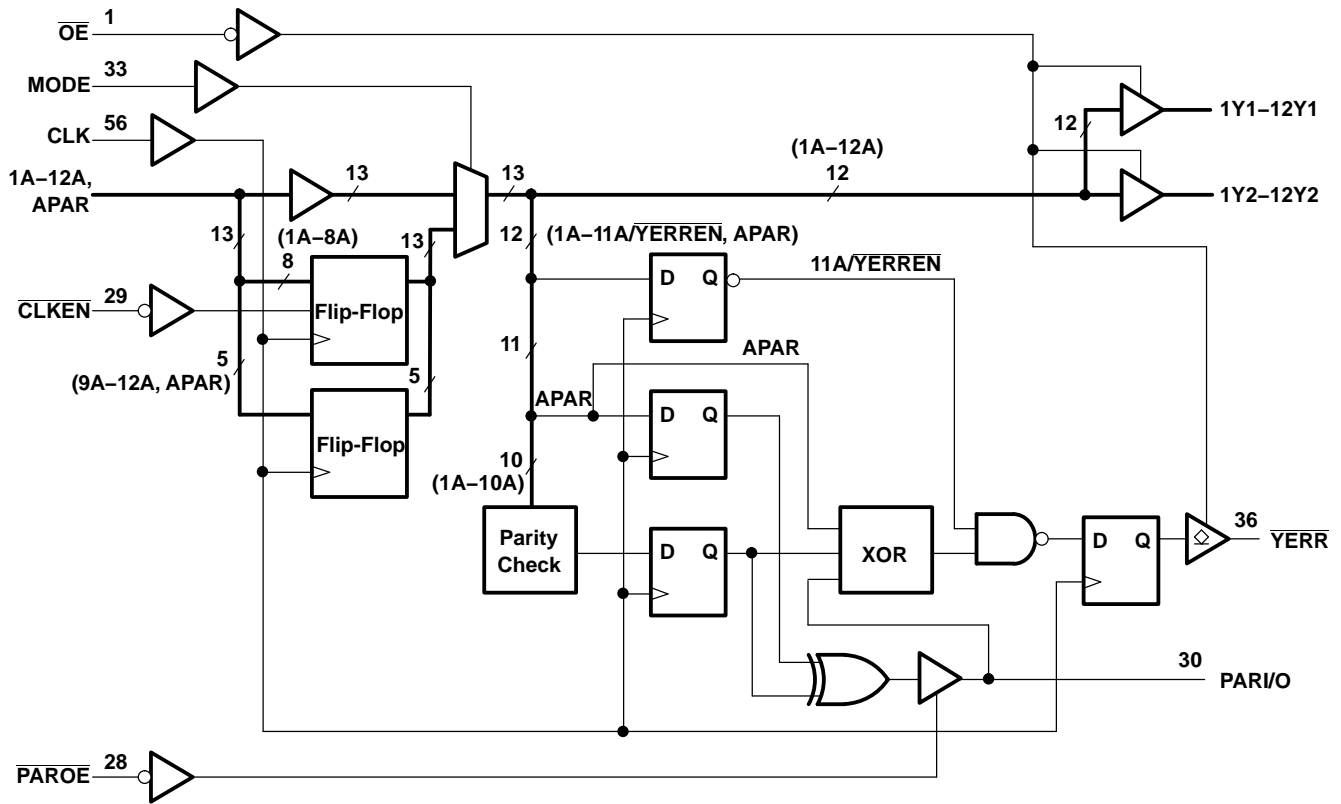
(2) Valid after appropriate number of clock pulses have set internal register

PARI/O FUNCTION⁽¹⁾

INPUTS			OUTPUT PARI/O
\overline{PAROE}	Σ OF INPUTS 1A–10A = H	APAR	
L	0, 2, 4, 6, 8, 10	L	L
L	1, 3, 5, 7, 9	L	H
L	0, 2, 4, 6, 8, 10	H	H
L	1, 3, 5, 7, 9	H	L
H	X	X	Z

(1) This table applies to the first device of a cascaded pair of SN74ALVCH16903 devices.

LOGIC DIAGRAM (POSITIVE LOGIC)



SN74ALVCH16903
3.3-V 12-BIT UNIVERSAL BUS DRIVER
WITH PARITY CHECKER AND DUAL 3-STATE OUTPUTS

SCES095D–MARCH 1997–REVISED SEPTEMBER 2004

ABSOLUTE MAXIMUM RATINGS⁽¹⁾

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

		MIN	MAX	UNIT
V _{CC}	Supply voltage range	-0.5	4.6	V
V _I	Input voltage range ⁽²⁾	-0.5	4.6	V
V _O	Output voltage range ⁽²⁾⁽³⁾	-0.5	V _{CC} + 0.5	V
I _{IK}	Input clamp current	V _I < 0		-50 mA
I _{OK}	Output clamp current	V _O < 0		-50 mA
I _O	Continuous output current			±50 mA
Continuous current through each V _{CC} or GND				±100 mA
θ _{JA}	Package thermal impedance ⁽⁴⁾	DGG package		81
		DGV package		86
		DL package		74
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 negative-voltage and output voltage ratings may be exceeded if the input and output current ratings are observed.
- (3) This value is limited to 4.6 V maximum.
- (4) The package thermal impedance is calculated in accordance with JESD 51.

RECOMMENDED OPERATING CONDITIONS⁽¹⁾

		MIN	MAX	UNIT
V _{CC}	Supply voltage	2.3	3.6	V
V _{IH}	High-level input voltage	V _{CC} = 2.3 V to 2.7 V		1.7
		V _{CC} = 2.7 V to 3.6 V		2
V _{IL}	Low-level input voltage	V _{CC} = 2.3 V to 2.7 V		0.7
		V _{CC} = 2.7 V to 3.6 V		0.8
V _I	Input voltage	0	V _{CC}	V
V _O	Output voltage	0	V _{CC}	V
I _{OH}	High-level output current	V _{CC} = 2.3 V		-12
		V _{CC} = 2.7 V		-12
		V _{CC} = 3 V		-12
		Y port		-24
I _{OL}	Low-level output current	V _{CC} = 2.3 V		12
		V _{CC} = 2.7 V		12
		V _{CC} = 3 V		12
		PARI/O		12
		Y port		24
		YERR output		24
Δt/Δv	Input transition rise or fall rate	0	10	ns/V
T _A	Operating free-air temperature	0	70	°C

- (1) 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.

ELECTRICAL CHARACTERISTICS

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

PARAMETER		TEST CONDITIONS	V _{CC}	MIN	TYP ⁽¹⁾	MAX	UNIT
V _{OH}	Y port	I _{OH} = -100 μA	2.3 V to 3.6 V	V _{CC} - 0.2			V
		I _{OH} = -6 mA,	V _{IH} = 1.7 V	2.3 V	2		
				2.3 V	1.7		
		I _{OH} = -12 mA	V _{IH} = 2 V	2.7 V	2.2		
				3 V	2.4		
	I _{OH} = -24 mA,	V _{IH} = 2 V	3 V	2			
PARI/O	I _{OH} = -12 mA,	V _{IH} = 2 V	3 V	2			
V _{OL}	Y port	I _{OL} = 100 μA	2.3 V to 3.6 V			0.2	V
		I _{OL} = 6 mA,	V _{IL} = 0.7 V	2.3 V		0.4	
				2.7 V		0.4	
		I _{OL} = 12 mA	V _{IL} = 0.8 V	3 V		0.55	
	PARI/O	I _{OL} = 12 mA,	V _{IL} = 0.8 V	3 V		0.55	
	YERR output	I _{OL} = 24 mA	3 V			0.5	
I _I		V _I = V _{CC} or GND	3.6 V			±5	μA
I _{I(hold)}		V _I = 0.7 V	2.3 V	45			μA
		V _I = 1.7 V	2.3 V	-45			
		V _I = 0.8 V	3 V	75			
		V _I = 2 V	3 V	-75			
		V _I = 0 to 3.6 V ⁽²⁾	3.6 V			±500	
I _{OH}	YERR output	V _O = V _{CC}	0 to 3.6 V			±10	μA
I _{OZ} ⁽³⁾		V _O = V _{CC} or GND	3.6 V			±10	μA
I _{CC}		V _I = V _{CC} or GND, I _O = 0	3.6 V			40	μA
ΔI _{CC}		One input at V _{CC} - 0.6 V, Other inputs at V _{CC} or GND	3 V to 3.6 V			750	μA
C _i	Control inputs	V _I = V _{CC} or GND	3.3 V	5.5			pF
	Data inputs			5.5			
C _o	YERR output	V _O = V _{CC} or GND	3.3 V	5			pF
	Data outputs			6			
C _{io}	PARI/O	V _O = V _{CC} or GND	3.3 V	7			pF

 (1) All typical values are at V_{CC} = 3.3 V, T_A = 25°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) For I/O ports, the parameter I_{OZ} includes the input leakage current.

SN74ALVCH16903
3.3-V 12-BIT UNIVERSAL BUS DRIVER
WITH PARITY CHECKER AND DUAL 3-STATE OUTPUTS

SCES095D–MARCH 1997–REVISED SEPTEMBER 2004

TIMING REQUIREMENTS

over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Figure 1 and Figure 4)

				$V_{CC} = 2.5\text{ V} \pm 0.2\text{ V}$		$V_{CC} = 2.7\text{ V}$		$V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$		UNIT
				MIN	MAX	MIN	MAX	MIN	MAX	
f_{clock}	Clock frequency			125		125		125		MHz
t_w	Pulse duration, CLK \uparrow			3		3		3		ns
t_{su}	Setup time	1A–12A before CLK \uparrow	Register mode	1.7	1.9	1.45			ns	
		1A–10A before CLK \uparrow	Buffer mode	5.9	5.2	4.4				
		APAR before CLK \uparrow	Register mode	1.2	1.5	1.3				
			Buffer mode	4.6	3.6	3.1				
		PARI/O before CLK \uparrow	Both modes	2.4	2	1.7				
		11A/ $\overline{\text{YERR}}$ before CLK \uparrow	Buffer mode	2	1.9	1.6				
$\overline{\text{CLKEN}}$ before CLK \uparrow	Register mode	2.5	2.6	2.2						
t_h	Hold time	1A–12A after CLK \uparrow	Register mode	0.4	0.25	0.55			ns	
		1A–10A after CLK \uparrow	Buffer mode	0.25	0.25	0.25				
		APAR after CLK \uparrow	Register mode	0.7	0.4	0.7				
			Buffer mode	0.25	0.25	0.25				
		PARI/O after CLK \uparrow	Register mode	0.25	0.25	0.4				
			Buffer mode	0.25	0.25	0.5				
		11A/ $\overline{\text{YERR}}$ after CLK \uparrow	Buffer mode	0.25	0.25	0.4				
$\overline{\text{CLKEN}}$ after CLK \uparrow	Register mode	0.25	0.5	0.4						

SWITCHING CHARACTERISTICS

over recommended operating free-air temperature range (unless otherwise noted) (see Figure 1 and Figure 4)

PARAMETER		FROM (INPUT)	TO (OUTPUT)	$V_{CC} = 2.5\text{ V} \pm 0.2\text{ V}$		$V_{CC} = 2.7\text{ V}$		$V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$		UNIT
				MIN	MAX	MIN	MAX	MIN	MAX	
f_{max}				125		125		125		MHz
t_{pd}	Buffer mode	A	Y	1	4.4	4.2	1.1	3.8	ns	
	Both modes	CLK	$\overline{\text{YERR}}$	1	5.7	4.9	1.4	4.4		
				PARI/O	1.2	8.6	7.9	1.7	6.6	
$t_{\text{pd}}^{(1)}$	Both modes	CLK	PARI/O	1	6.8	5.2	1.3	4.5	ns	
t_{pd}	Both modes	MODE	Y	1	5.9	5.8	1.3	4.9	ns	
t_{PLH}	Register mode	CLK	Y	1	6.1	5.5	1.2	4.8	ns	
t_{PHL}				1	5.9	4.9	1.2	4.6		
t_{en}	Both modes	$\overline{\text{OE}}$	Y	1.1	6.5	6.4	1.4	5.4	ns	
		$\overline{\text{PAROE}}$	PARI/O	1	5.6	6	1	4.8		
t_{dis}	Both modes	$\overline{\text{OE}}$	Y	1	6.4	5.2	1.7	5	ns	
		$\overline{\text{PAROE}}$	PARI/O	1	3.2	3.8	1.2	3.8		
t_{PLH}	Both modes	$\overline{\text{OE}}$	$\overline{\text{YERR}}$	1	3.6	4.2	1.9	4	ns	
t_{PHL}				1.2	5.1	4.9	1.5	4.2		

(1) See Figure 2 and Figure 5 for the load specification.

SIMULTANEOUS SWITCHING CHARACTERISTICS⁽¹⁾

(see Figure 3 and Figure 6)

PARAMETER		FROM (INPUT)	TO (OUTPUT)	$V_{CC} = 2.5\text{ V} \pm 0.2\text{ V}$		$V_{CC} = 2.7\text{ V}$		$V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$		UNIT
				MIN	MAX	MIN	MAX	MIN	MAX	
t_{PLH}	Register mode	CLK	Y	1.8	6.5	6.1		1.8	5	ns
t_{PHL}				1.4	5.9	5.1		1.7	4.5	

(1) All outputs switching

OPERATING CHARACTERISTICS FOR BUFFER MODE

$T_A = 25^\circ\text{C}$

PARAMETER			TEST CONDITIONS	$V_{CC} = 2.5\text{ V} \pm 0.2\text{ V}$	$V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$	UNIT
				TYP	TYP	
C_{pd}	Power dissipation capacitance	Outputs enabled	$C_L = 0, \quad f = 10\text{ MHz}$	57.5	65	pF
		Outputs disabled		15	17.5	

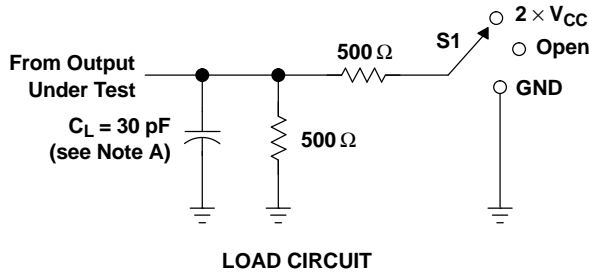
OPERATING CHARACTERISTICS FOR REGISTER MODE

$T_A = 25^\circ\text{C}$

PARAMETER			TEST CONDITIONS	$V_{CC} = 2.5\text{ V} \pm 0.2\text{ V}$	$V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$	UNIT
				TYP	TYP	
C_{pd}	Power dissipation capacitance	Outputs enabled	$C_L = 0, \quad f = 10\text{ MHz}$	57	87.5	pF
		Outputs disabled		16.5	34	

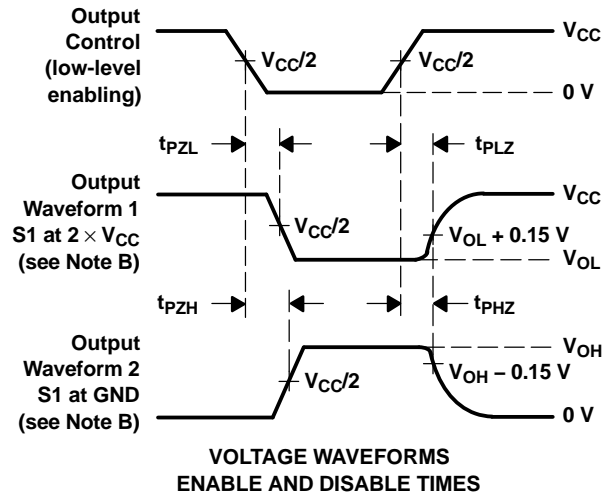
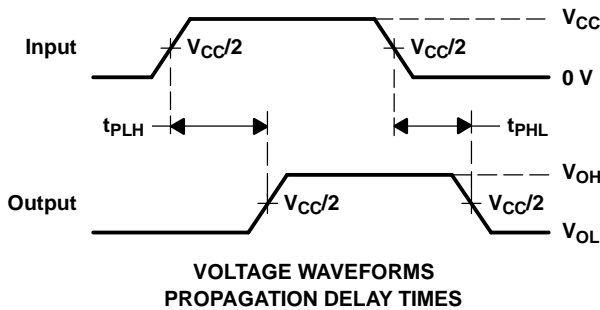
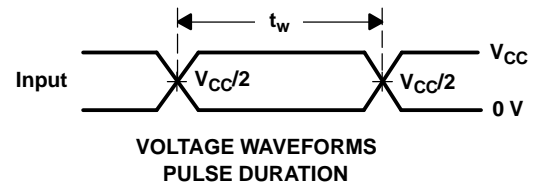
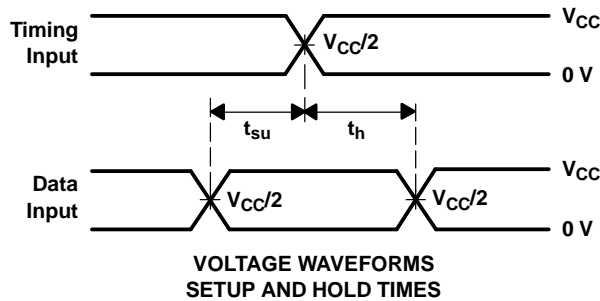
PARAMETER MEASUREMENT INFORMATION

$V_{CC} = 2.5\text{ V} \pm 0.2\text{ V}$



TEST	S1
t_{pd}	Open
t_{PLZ}/t_{PZL}	$2 \times V_{CC}$
t_{PHZ}/t_{PZH}	GND

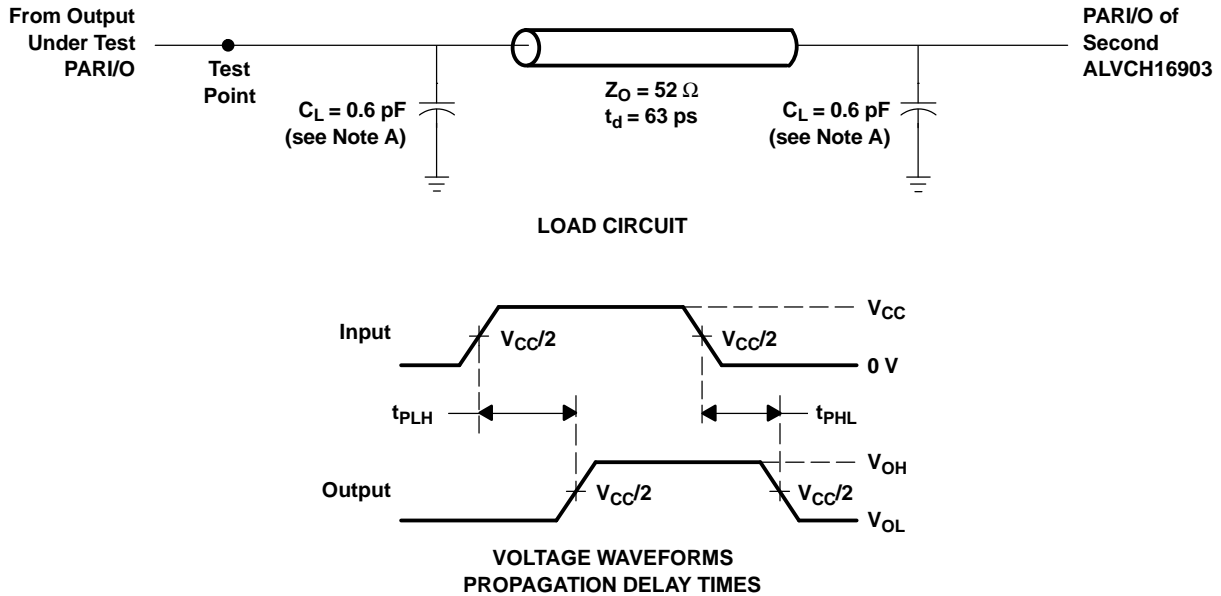
YERR	S1
t_{PHL} (see Note H)	$2 \times V_{CC}$
t_{PLH} (see Note I)	$2 \times V_{CC}$



- 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, $Z_O = 50\ \Omega$, $t_r \leq 2$ ns, $t_f \leq 2$ ns.
D. The outputs are measured one at a time, with one transition per measurement.
E. t_{PLZ} and t_{PHZ} are the same as t_{dis} .
F. t_{PZL} and t_{PZH} are the same as t_{en} .
G. t_{PLH} and t_{PHL} are the same as t_{pd} .
H. t_{PHL} is measured at $V_{CC}/2$.
I. t_{PLH} is measured at $V_{OL} + 0.15\text{ V}$.

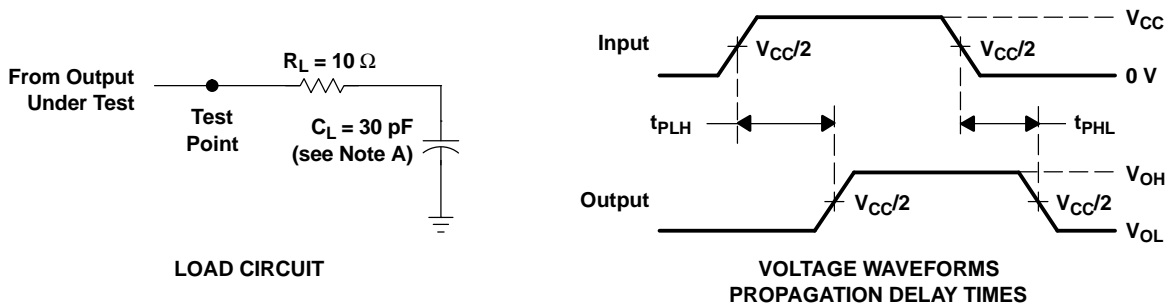
Figure 1. Load Circuit and Voltage Waveforms

PARAMETER MEASUREMENT INFORMATION
 $V_{CC} = 2.5 V \pm 0.2 V$



- NOTES: A. C_L includes probe and jig capacitance.
B. All input pulses are supplied by generators having the following characteristics: $PRR \leq 10 \text{ MHz}$, $Z_O = 50 \Omega$, $t_r \leq 2 \text{ ns}$, $t_f \leq 2 \text{ ns}$.
C. t_{PLH} and t_{PHL} are the same as t_{pd} .

Figure 2. Load Circuit and Voltage Waveforms

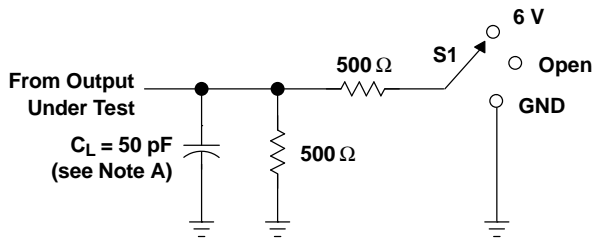


- NOTES: A. C_L includes probe and jig capacitance.
B. All input pulses are supplied by generators having the following characteristics: $PRR \leq 10 \text{ MHz}$, $Z_O = 50 \Omega$, $t_r \leq 2 \text{ ns}$, $t_f \leq 2 \text{ ns}$.

Figure 3. Load Circuit and Voltage Waveforms

PARAMETER MEASUREMENT INFORMATION

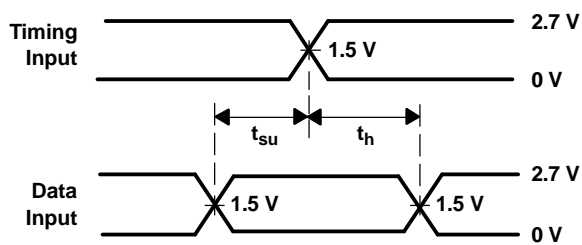
$V_{CC} = 2.7\text{ V AND } 3.3\text{ V} \pm 0.3\text{ V}$



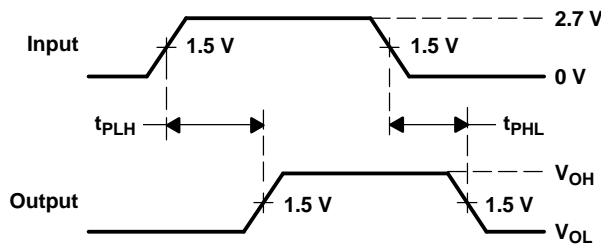
LOAD CIRCUIT

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

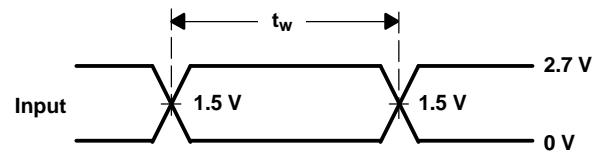
\overline{YERR}	S1
t_{PHL} (see Note H)	6 V
t_{PLH} (see Note I)	6 V



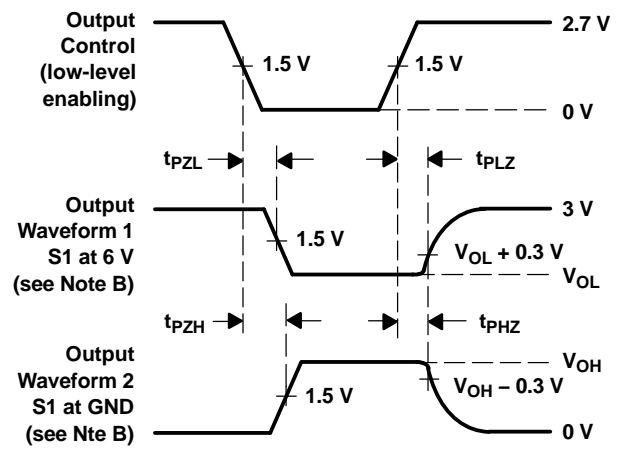
VOLTAGE WAVEFORMS
 SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS
 PROPAGATION DELAY TIMES



VOLTAGE WAVEFORMS
 PULSE DURATION

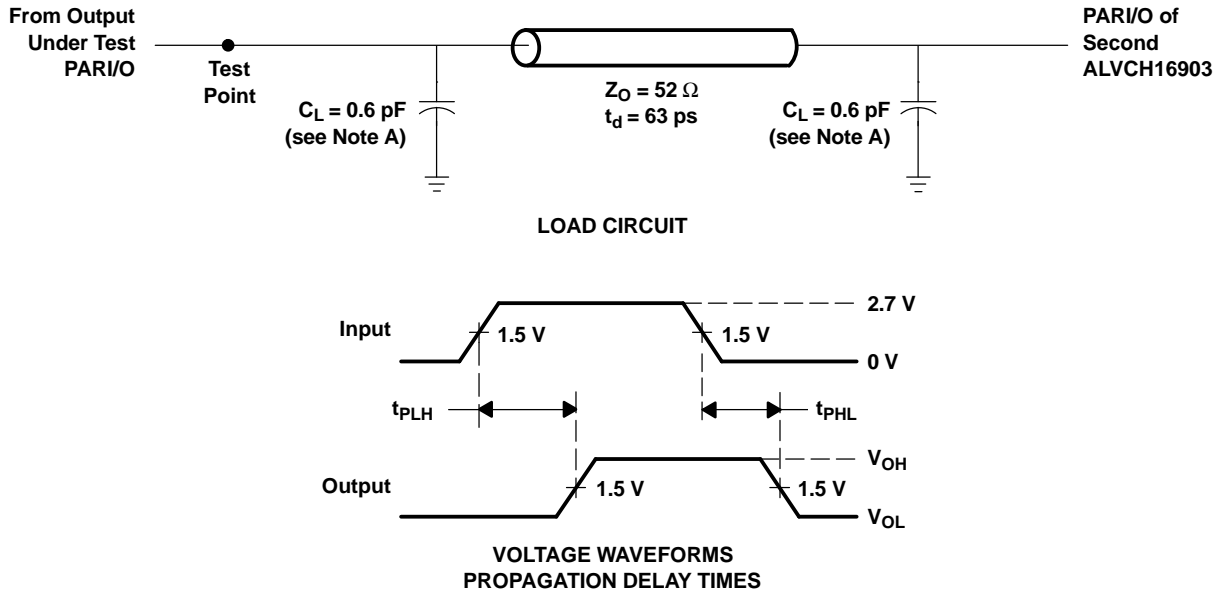


VOLTAGE WAVEFORMS
 ENABLE AND DISABLE TIMES

- NOTES:
- C_L includes probe and jig capacitance.
 - 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 are supplied by generators having the following characteristics: $PRR \leq 10\text{ MHz}$, $Z_O = 50\ \Omega$, $t_r \leq 2.5\text{ ns}$, $t_f \leq 2.5\text{ ns}$.
 - The outputs are measured one at a time, with one transition per measurement.
 - t_{PLZ} and t_{PHZ} are the same as t_{dis} .
 - t_{PZL} and t_{PZH} are the same as t_{en} .
 - t_{PLH} and t_{PHL} are the same as t_{pd} .
 - t_{PHL} is measured at 1.5 V.
 - t_{PLH} is measured at $V_{OL} + 0.3\text{ V}$.

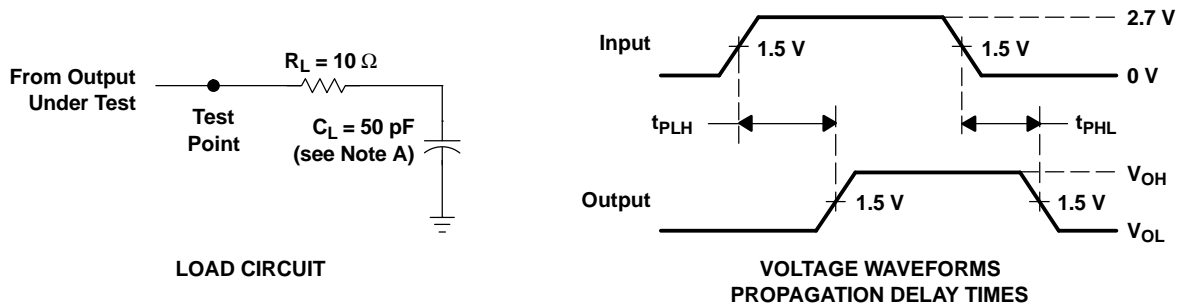
Figure 4. Load Circuit and Voltage Waveforms

PARAMETER MEASUREMENT INFORMATION
 $V_{CC} = 2.7\text{ V}$ AND $3.3\text{ V} \pm 0.3\text{ V}$



- NOTES: A. C_L includes probe and jig capacitance.
B. All input pulses are supplied by generators having the following characteristics: $PRR \leq 10\text{ MHz}$, $Z_O = 50\ \Omega$, $t_r \leq 2.5\text{ ns}$, $t_f \leq 2.5\text{ ns}$.
C. t_{PLH} and t_{PHL} are the same as t_{pd} .

Figure 5. Load Circuit and Voltage Waveforms



- NOTES: A. C_L includes probe and jig capacitance.
B. All input pulses are supplied by generators having the following characteristics: $PRR \leq 10\text{ MHz}$, $Z_O = 50\ \Omega$, $t_r \leq 2.5\text{ ns}$, $t_f \leq 2.5\text{ ns}$.

Figure 6. 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⁾
74ALVCH16903DGGRE4	ACTIVE	TSSOP	DGG	56	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
74ALVCH16903DGGRG4	ACTIVE	TSSOP	DGG	56	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
74ALVCH16903DGVRE4	ACTIVE	TVSOP	DGV	56	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
74ALVCH16903DGVRG4	ACTIVE	TVSOP	DGV	56	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
74ALVCH16903DLG4	ACTIVE	SSOP	DL	56	20	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
74ALVCH16903DLRG4	ACTIVE	SSOP	DL	56		TBD	Call TI	Call TI
SN74ALVCH16903DGGR	ACTIVE	TSSOP	DGG	56	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ALVCH16903DGVR	ACTIVE	TVSOP	DGV	56	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ALVCH16903DL	ACTIVE	SSOP	DL	56	20	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

⁽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.

OBSELETE: 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.

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.

TAPE AND REEL INFORMATION

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
SN74ALVCH16903DGGR	TSSOP	DGG	56	2000	330.0	24.4	8.6	15.6	1.8	12.0	24.0	Q1
SN74ALVCH16903DGVR	TVSOP	DGV	56	2000	330.0	24.4	6.8	11.7	1.6	12.0	24.0	Q1

TAPE AND REEL BOX DIMENSIONS


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74ALVCH16903DGGR	TSSOP	DGG	56	2000	346.0	346.0	41.0
SN74ALVCH16903DGVR	TVSOP	DGV	56	2000	346.0	346.0	41.0

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

DGV (R-PDSO-G**)

PLASTIC SMALL-OUTLINE

24 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 flash or protrusion, not to exceed 0,15 per side.
 D. Falls within JEDEC: 24/48 Pins – MO-153
 14/16/20/56 Pins – MO-194

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

Amplifiers	amplifier.ti.com
Data Converters	dataconverter.ti.com
DLP® Products	www.dlp.com
DSP	dsp.ti.com
Clocks and Timers	www.ti.com/clocks
Interface	interface.ti.com
Logic	logic.ti.com
Power Mgmt	power.ti.com
Microcontrollers	microcontroller.ti.com
RFID	www.ti-rfid.com
RF/IF and ZigBee® Solutions	www.ti.com/lprf

Applications

Audio	www.ti.com/audio
Automotive	www.ti.com/automotive
Broadband	www.ti.com/broadband
Digital Control	www.ti.com/digitalcontrol
Medical	www.ti.com/medical
Military	www.ti.com/military
Optical Networking	www.ti.com/opticalnetwork
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 © 2009, Texas Instruments Incorporated