

- Member of the Texas Instruments *Widebus™* Family
- *EPIC™* (Enhanced-Performance Implanted CMOS) Submicron Process
- *DOC™* (Dynamic Output Control) Circuit Dynamically Changes Output Impedance, Resulting in Noise Reduction Without Speed Degradation
- Dynamic Drive Capability Is Equivalent to Standard Outputs With I_{OH} and I_{OL} of ± 24 mA at 2.5-V V_{CC}
- Overvoltage-Tolerant Inputs/Outputs Allow Mixed-Voltage-Mode Data Communications
- I_{Off} Supports Partial-Power-Down Mode Operation
- ESD Protection Exceeds JESD 22
 - 2000-V Human-Body Model (A114-A)
 - 200-V Machine Model (A115-A)
- Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II
- Package Options Include Plastic Thin Shrink Small-Outline (DGG) and Thin Very Small-Outline (DGV) Packages

description

A Dynamic Output Control (DOC) circuit is implemented, which, during the transition, initially lowers the output impedance to effectively drive the load and, subsequently, raises the impedance to reduce noise. Figure 1 shows typical V_{OL} vs I_{OL} and V_{OH} vs I_{OH} curves to illustrate the output impedance and drive capability of the circuit. At the beginning of the signal transition, the DOC circuit provides a maximum dynamic drive that is equivalent to a high-drive standard-output device. For more information, refer to the TI application reports, *AVC Logic Family Technology and Applications*, literature number SCEA006, and *Dynamic Output Control (DOC™) Circuitry Technology and Applications*, literature number SCEA009.

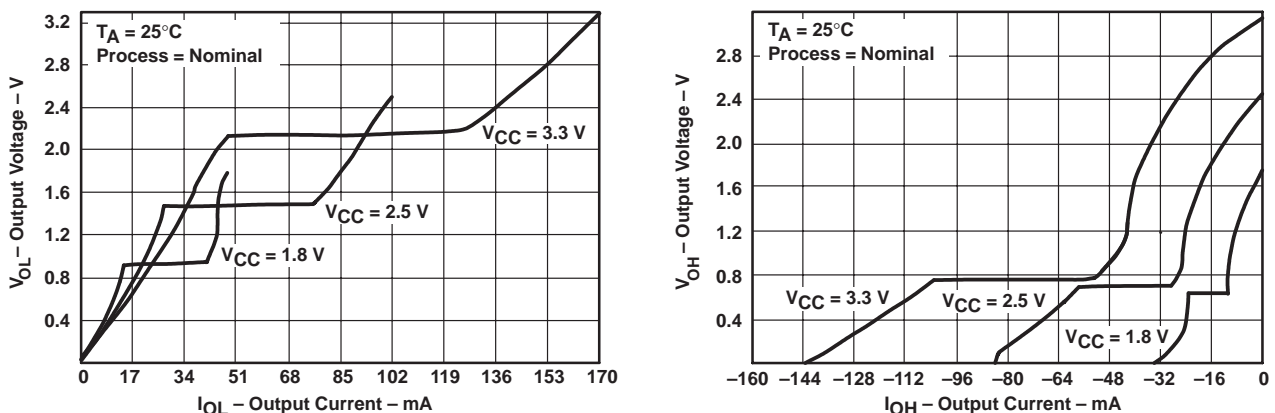


Figure 1. Output Voltage vs Output Current

This 16-bit transparent D-type latch is operational at 1.2-V to 3.6-V V_{CC} , but is designed specifically for 1.65-V to 3.6-V V_{CC} operation.

The SN74AVC16373 is particularly suitable for implementing buffer registers, I/O ports, bidirectional bus drivers, and working registers. This device can be used as two 8-bit latches or one 16-bit latch. When the latch-enable (LE) input is high, the Q outputs follow the data (D) inputs. When LE is taken low, the Q outputs are latched at the levels set up at the D inputs.



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SN74AVC16373

16-BIT TRANSPARENT D-TYPE LATCH WITH 3-STATE OUTPUTS

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description (continued)

A buffered output-enable (\overline{OE}) input can be used to place the eight outputs in either a normal logic state (high or low logic levels) or the high-impedance state. In the high-impedance state, the outputs neither load nor drive the bus lines significantly. The high-impedance state and the increased drive provide the capability to drive bus lines without need for interface or pullup components. \overline{OE} does not affect internal operations of the latch. Old data can be retained or new data can be entered while the outputs are in the high-impedance state.

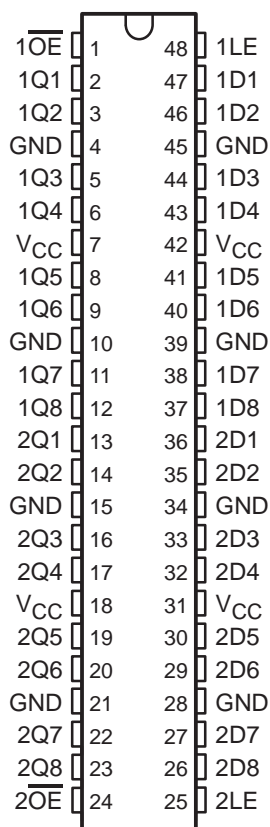
To ensure the high-impedance state during power up or power down, \overline{OE} should be tied to V_{CC} through a pullup resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver.

This device is 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.

The SN74AVC16373 is characterized for operation from -40°C to 85°C .

terminal assignments

DGG OR DGV PACKAGE
(TOP VIEW)



SN74AVC16373

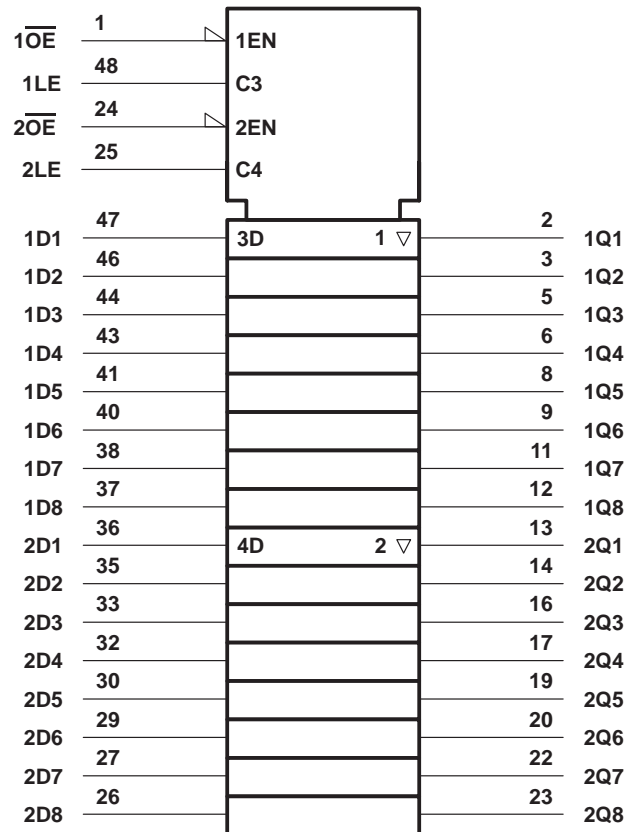
16-BIT TRANSPARENT D-TYPE LATCH WITH 3-STATE OUTPUTS

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FUNCTION TABLE
(each 8-bit latch)

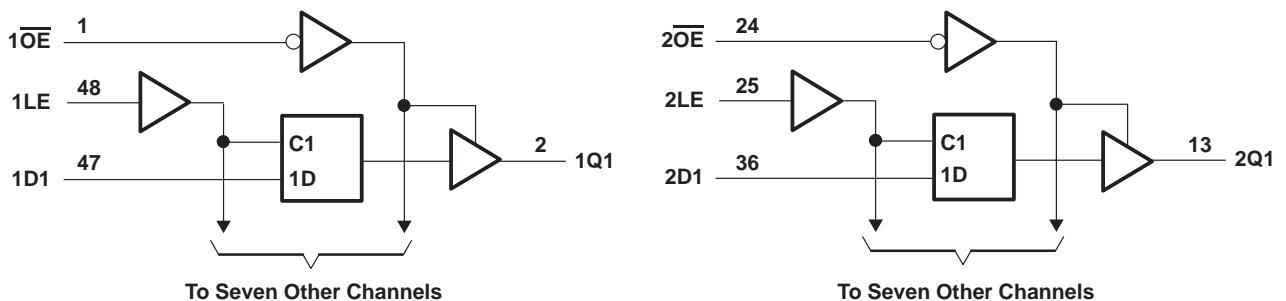
INPUTS			OUTPUT Q
\overline{OE}	LE	D	
L	H	H	H
L	H	L	L
L	L	X	Q_0
H	X	X	Z

logic symbol†



† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

logic diagram (positive logic)



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recommended operating conditions (see Note 4)

		MIN	MAX	UNIT	
V _{CC}	Supply voltage	Operating	1.4	3.6	V
		Data retention only	1.2		
V _{IH}	High-level input voltage	V _{CC} = 1.2 V	V _{CC}		V
		V _{CC} = 1.4 V to 1.6 V	0.65 × V _{CC}		
		V _{CC} = 1.65 V to 1.95 V	0.65 × V _{CC}		
		V _{CC} = 2.3 V to 2.7 V	1.7		
		V _{CC} = 3 V to 3.6 V	2		
V _{IL}	Low-level input voltage	V _{CC} = 1.2 V	GND		V
		V _{CC} = 1.4 V to 1.6 V	0.35 × V _{CC}		
		V _{CC} = 1.65 V to 1.95 V	0.35 × V _{CC}		
		V _{CC} = 2.3 V to 2.7 V	0.7		
		V _{CC} = 3 V to 3.6 V	0.8		
V _I	Input voltage	0	3.6	V	
V _O	Output voltage	Active state	0	V _{CC}	V
		3-state	0	3.6	
I _{OHS}	Static high-level output current†	V _{CC} = 1.4 V to 1.6 V	–2		mA
		V _{CC} = 1.65 V to 1.95 V	–4		
		V _{CC} = 2.3 V to 2.7 V	–8		
		V _{CC} = 3 V to 3.6 V	–12		
I _{OLS}	Static low-level output current†	V _{CC} = 1.4 V to 1.6 V	2		mA
		V _{CC} = 1.65 V to 1.95 V	4		
		V _{CC} = 2.3 V to 2.7 V	8		
		V _{CC} = 3 V to 3.6 V	12		
Δt/Δv	Input transition rise or fall rate	V _{CC} = 1.4 V to 3.6 V		5	ns/V
T _A	Operating free-air temperature	–40	85	°C	

† Dynamic drive capability is equivalent to standard outputs with I_{OH} and I_{OL} of ±24 mA at 2.5-V V_{CC}. See Figure 1 for V_{OL} vs I_{OL} and V_{OH} vs I_{OH} characteristics. Refer to the TI application reports, **AVC Logic Family Technology and Applications**, literature number **SCEA006**, and **Dynamic Output Control (DOC™) Circuitry Technology and Applications**, literature number **SCEA009**.

NOTE 4: 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.

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

PARAMETER		TEST CONDITIONS	V _{CC}	MIN	TYP†	MAX	UNIT
V _{OH}		I _{OHS} = -100 μA	1.4 V to 3.6 V	V _{CC} -0.2			V
		I _{OHS} = -2 mA, V _{IH} = 0.91 V	1.4 V	1.05			
		I _{OHS} = -4 mA, V _{IH} = 1.07 V	1.65 V	1.2			
		I _{OHS} = -8 mA, V _{IH} = 1.7 V	2.3 V	1.75			
		I _{OHS} = -12 mA, V _{IH} = 2 V	3 V	2.3			
V _{OL}		I _{OLS} = 100 μA	1.4 V to 3.6 V			0.2	V
		I _{OLS} = 2 mA, V _{IL} = 0.49 V	1.4 V			0.4	
		I _{OLS} = 4 mA, V _{IL} = 0.57 V	1.65 V			0.45	
		I _{OLS} = 8 mA, V _{IL} = 0.7 V	2.3 V			0.55	
		I _{OLS} = 12 mA, V _{IL} = 0.8 V	3 V			0.7	
I _I		V _I = V _{CC} or GND	3.6 V			±2.5	μA
I _{off}		V _I or V _O = 3.6 V	0			±10	μA
I _{OZ}		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
C _i	Control inputs	V _I = V _{CC} or GND	2.5 V	3		pF	
			3.3 V	3			
	Data inputs	V _I = V _{CC} or GND	2.5 V	2.5			
			3.3 V	2.5			
C _O	Outputs	V _O = V _{CC} or GND	2.5 V	6.5		pF	
			3.3 V	6.5			

† Typical values are measured at V_{CC} = 2.5 V and 3.3 V, T_A = 25°C.

timing requirements over recommended operating free-air temperature range (unless otherwise noted) (see Figures 2 through 5)

		V _{CC} = 1.2 V		V _{CC} = 1.5 V ± 0.1 V		V _{CC} = 1.8 V ± 0.15 V		V _{CC} = 2.5 V ± 0.2 V		V _{CC} = 3.3 V ± 0.3 V		UNIT
		MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t _w	Pulse duration, LE high					2.2		2		1.8		ns
t _{su}	Setup time, data before LE↓	1.7		1.2		1.1		0.9		0.8		ns
t _h	Hold time, data after LE↓	2		1.1		1.1		1.1		1		ns

switching characteristics over recommended operating free-air temperature range (unless otherwise noted) (see Figures 2 through 5)

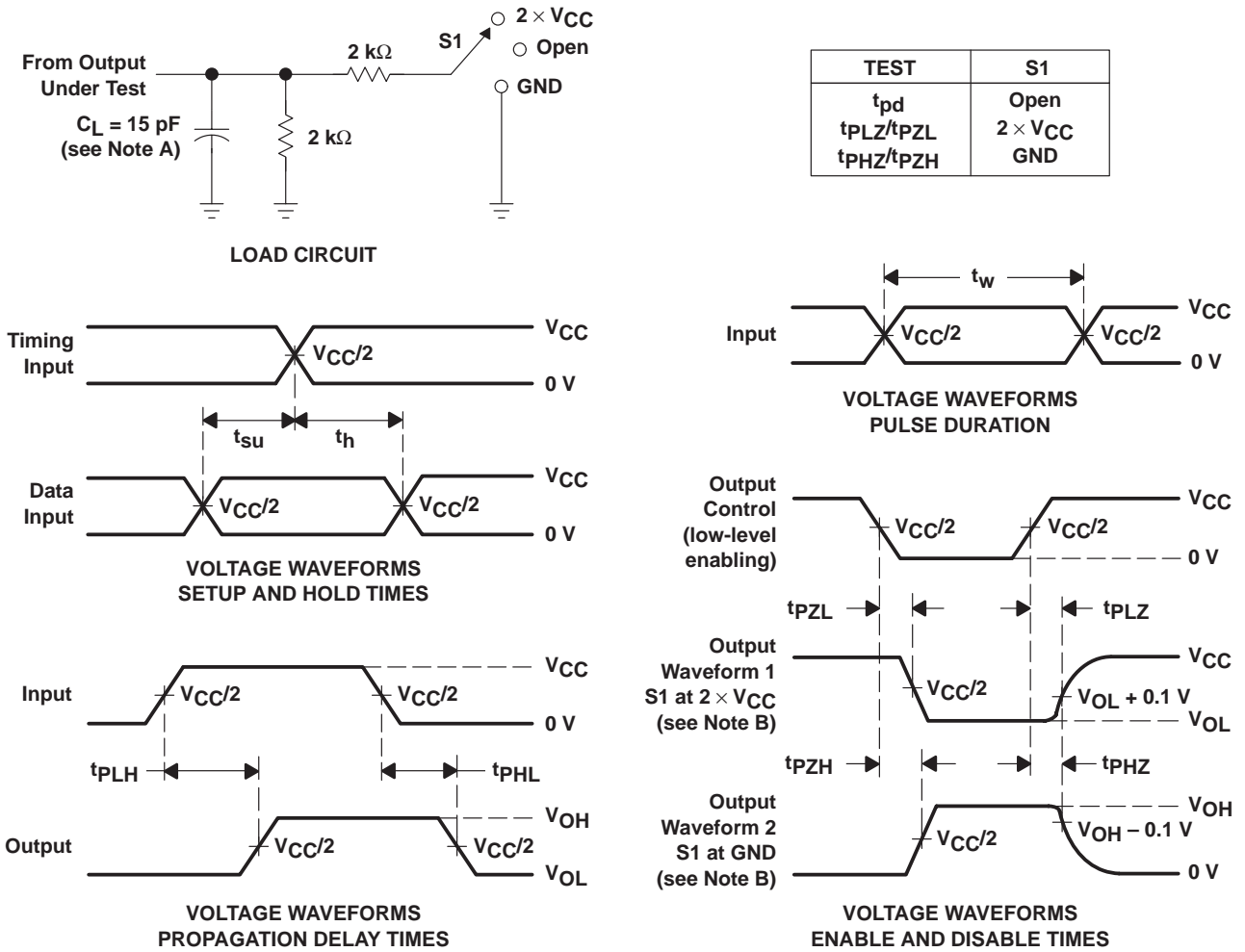
PARAMETER	FROM (INPUT)	TO (OUTPUT)	V _{CC} = 1.2 V		V _{CC} = 1.5 V ± 0.1 V		V _{CC} = 1.8 V ± 0.15 V		V _{CC} = 2.5 V ± 0.2 V		V _{CC} = 3.3 V ± 0.3 V		UNIT
			TYP	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	
t _{pd}	D	Q	5.8	1.2	6.8	1	5.7	0.8	3.3	0.7	2.8	ns	
	LE		7.2	1.4	8.3	1.1	6.6	0.8	4	0.7	3.2		
t _{en}	\overline{OE}	Q	7.4	1.6	8.8	1.6	6.7	1.4	4.3	0.7	3.4	ns	
t _{dis}	\overline{OE}	Q	8.4	2.5	9.4	2.3	7.8	1.3	4.2	1.2	3.9	ns	



operating characteristics, $T_A = 25^\circ\text{C}$

PARAMETER		TEST CONDITIONS	$V_{CC} = 1.8\text{ V}$	$V_{CC} = 2.5\text{ V}$	$V_{CC} = 3.3\text{ V}$	UNIT
			TYP	TYP	TYP	
C_{pd}	Power dissipation capacitance	Outputs enabled	40	43	47	pF
		Outputs disabled	20	22	24	

PARAMETER MEASUREMENT INFORMATION
 $V_{CC} = 1.2\text{ V AND } 1.5\text{ V} \pm 0.1\text{ V}$



- 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 $\leq 10\text{ MHz}$, $Z_O = 50\ \Omega$, $t_r \leq 2\text{ ns}$, $t_f \leq 2\text{ ns}$.
 - 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} .

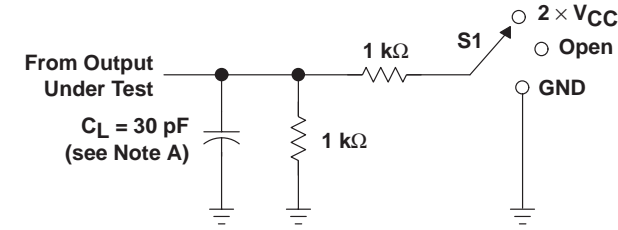
Figure 2. Load Circuit and Voltage Waveforms

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16-BIT TRANSPARENT D-TYPE LATCH
WITH 3-STATE OUTPUTS

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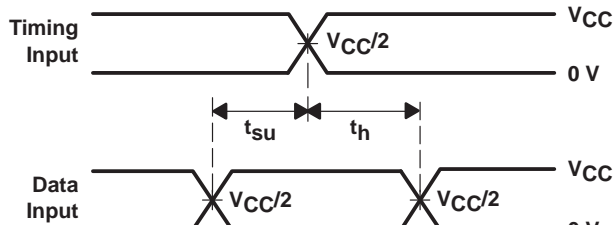
PARAMETER MEASUREMENT INFORMATION

$V_{CC} = 1.8\text{ V} \pm 0.15\text{ V}$

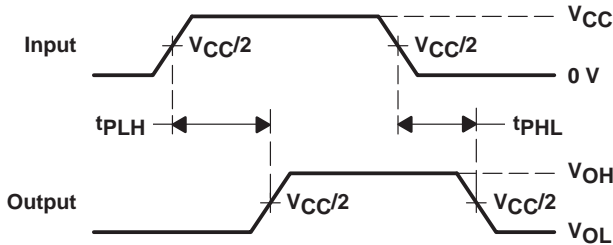


LOAD CIRCUIT

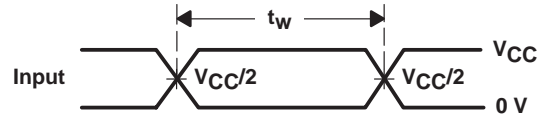
TEST	S1
t_{pd}	Open
t_{PLZ}/t_{PZL}	2 \times V_{CC}
t_{PHZ}/t_{PZH}	GND



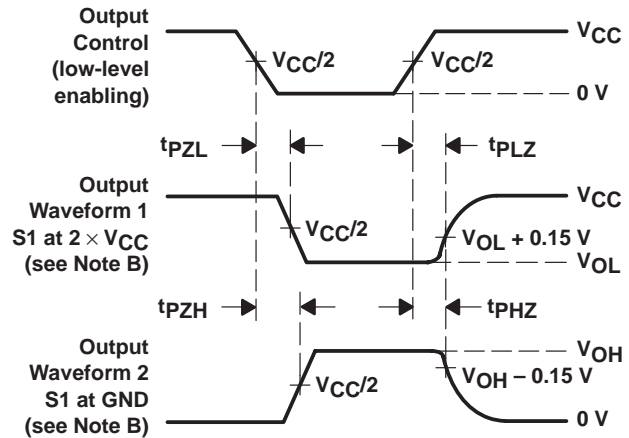
**VOLTAGE WAVEFORMS
 SETUP AND HOLD TIMES**



**VOLTAGE WAVEFORMS
 PROPAGATION DELAY TIMES**



**VOLTAGE WAVEFORMS
 PULSE DURATION**



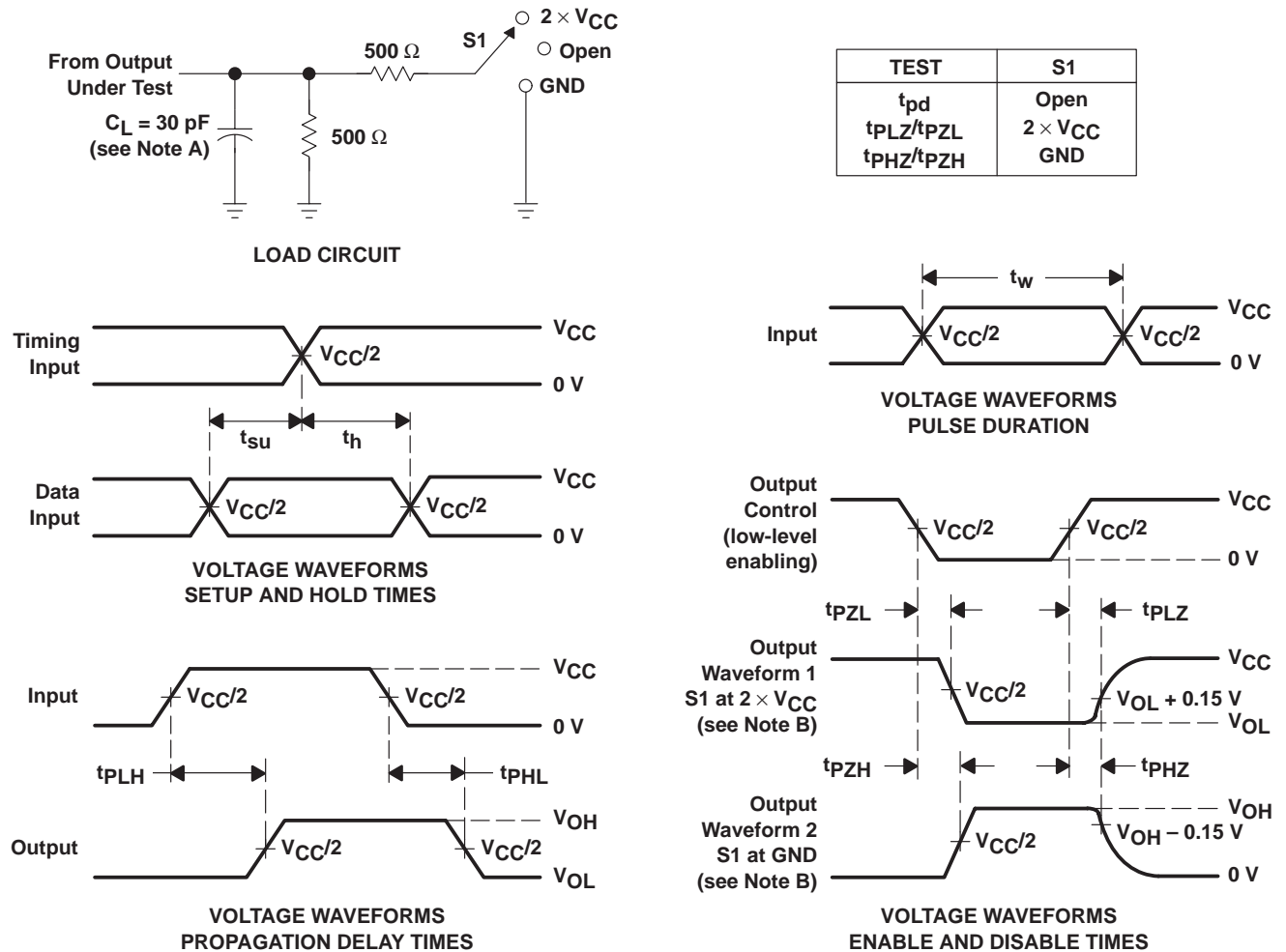
**VOLTAGE WAVEFORMS
 ENABLE AND DISABLE TIMES**

- 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: $PRR \leq 10\text{ MHz}$, $Z_O = 50\ \Omega$, $t_r \leq 2\text{ ns}$, $t_f \leq 2\text{ ns}$.
 - 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} .

Figure 3. Load Circuit and Voltage Waveforms

PARAMETER MEASUREMENT INFORMATION

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



- 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: $PRR \leq 10\text{ MHz}$, $Z_O = 50\ \Omega$, $t_r \leq 2\text{ ns}$, $t_f \leq 2\text{ ns}$.
 - 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} .

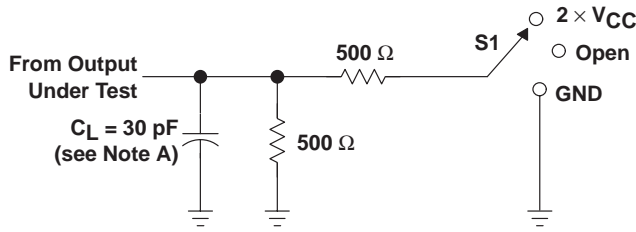
Figure 4. Load Circuit and Voltage Waveforms

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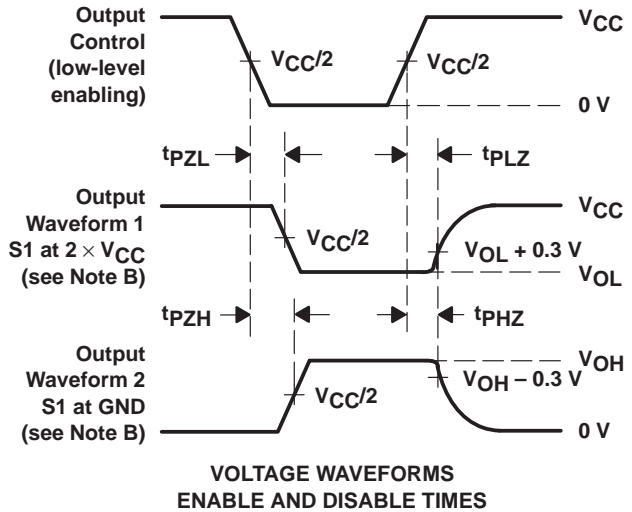
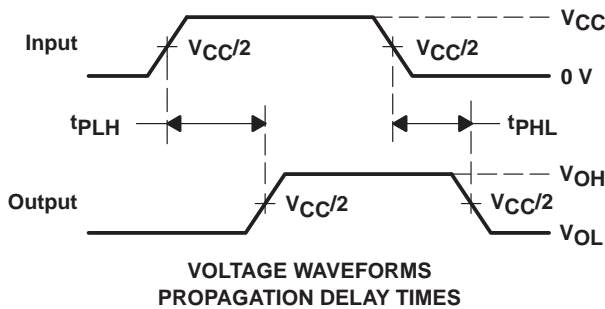
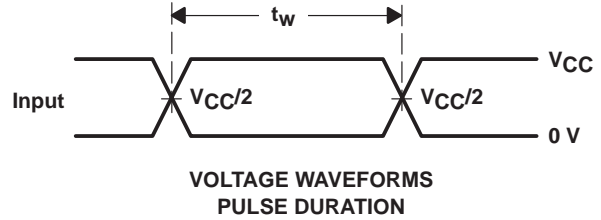
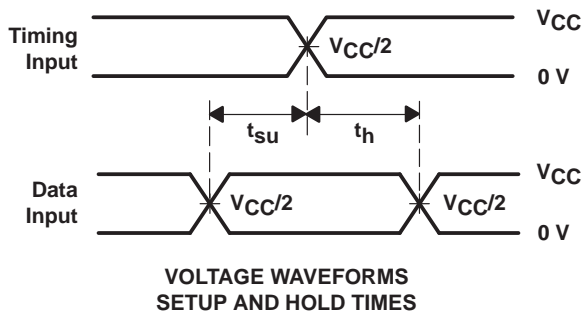
PARAMETER MEASUREMENT INFORMATION

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



LOAD CIRCUIT

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



- 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 $\leq 10\text{ MHz}$, $Z_O = 50\ \Omega$, $t_r \leq 2\text{ ns}$, $t_f \leq 2\text{ ns}$.
 - 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} .

Figure 5. 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⁾
SN74AVC16373DGGR	ACTIVE	TSSOP	DGG	48	2000	Pb-Free (RoHS)	CU NIPDAU	Level-1-250C-UNLIM
SN74AVC16373DGVR	ACTIVE	TVSOP	DGV	48	2000	Pb-Free (RoHS)	CU NIPDAU	Level-1-250C-UNLIM
SN74AVC16373GQLR	ACTIVE	VFBGA	GQL	56	1000	None	SNPB	Level-1-240C-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.

OBSOLETE: TI has discontinued the production of the device.

⁽²⁾ Eco Plan - May not be currently available - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

None: Not yet available Lead (Pb-Free).

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Green (RoHS & no Sb/Br): TI defines "Green" to mean "Pb-Free" and in addition, uses package materials that do not contain halogens, including bromine (Br) or antimony (Sb) above 0.1% of total product weight.

⁽³⁾ MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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DGV (R-PDSO-G**)

PLASTIC SMALL-OUTLINE

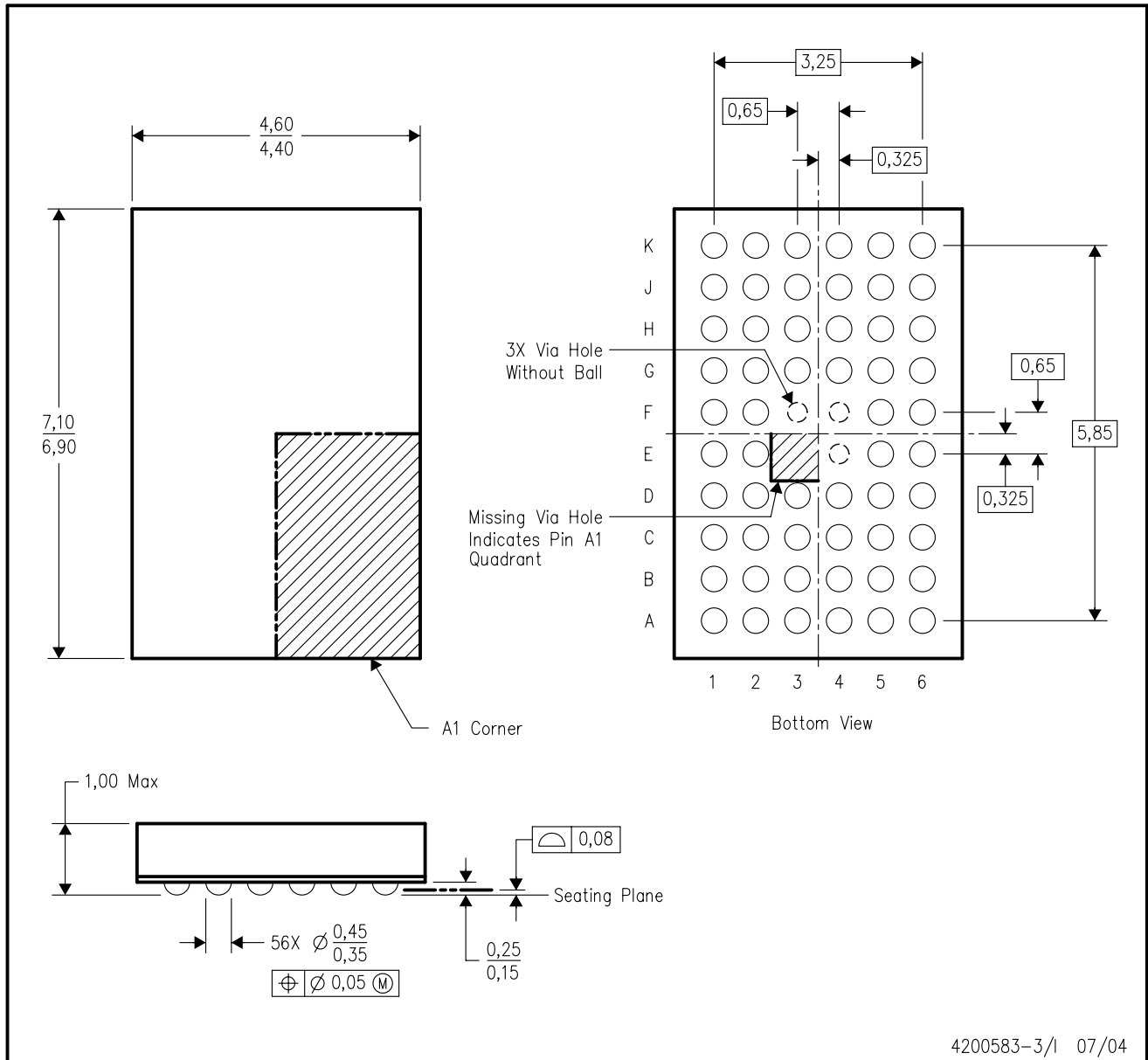
24 PINS SHOWN



- 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

GQL (R-PBGA-N56)

PLASTIC BALL GRID ARRAY



4200583-3/1 07/04

- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Falls within JEDEC MO-225 variation BA.
 - D. This package is tin-lead (SnPb). Refer to the 56 ZQL package (drawing 4204437) for lead-free.

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