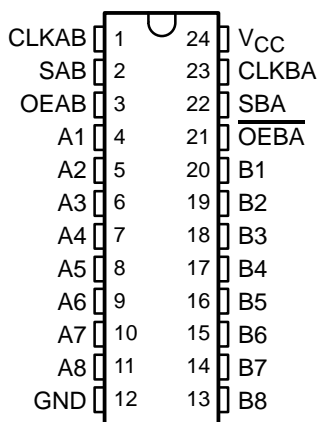


SN54HC652, SN74HC652 OCTAL BUS TRANSCEIVERS AND REGISTERS WITH 3-STATE OUTPUTS

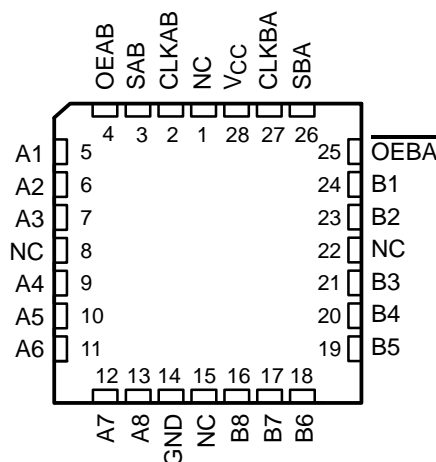
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- Wide Operating Voltage Range of 2 V to 6 V
- High-Current 3-State Outputs Can Drive Up To 15 LSTTL Loads
- Low Power Consumption, 80- μ A Max I_{CC}
- Typical $t_{pd} = 11$ ns
- ± 6 -mA Output Drive at 5 V
- Low Input Current of 1 μ A Max
- Independent Registers and Enables for A and B Buses
- Multiplexed Real-Time and Stored Data
- True Data Paths

SN54HC652 . . . JT OR W PACKAGE
SN74HC652 . . . DW OR NT PACKAGE
(TOP VIEW)



SN54HC652 . . . FK PACKAGE
(TOP VIEW)



NC – No internal connection

description/ordering information

The 'HC652 devices consist of bus-transceiver circuits, D-type flip-flops, and control circuitry arranged for multiplexed transmission of data directly from the data bus or from the internal storage registers. Output-enable (OEAB and OEBA) inputs are provided to control the transceiver functions. Select-control (SAB and SBA) inputs are provided to select real-time or stored-data transfer. A low input level selects real-time data, and a high input level selects stored data. Figure 1 illustrates the four fundamental bus-management functions that can be performed with these devices.

ORDERING INFORMATION

TA	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 85°C	PDIP – NT	Tube	SN74HC652NT	HC652
	SOIC – DW	Tube	SN74HC652DW	
		Tape and reel	SN74HC652DWR	
–55°C to 125°C	CDIP – JT	Tube	SNJ54HC652JT	SNJ54HC652JT
	CFP – W	Tube	SNJ54HC652W	SNJ54HC652W
	LCCC – FK	Tube	SNJ54HC652FK	SNJ54HC652FK

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



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**TEXAS
INSTRUMENTS**

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SN54HC652, SN74HC652

OCTAL BUS TRANSCEIVERS AND REGISTERS

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description/ordering information (continued)

Data on the A or B data bus, or both, can be stored in the internal D-type flip-flops by low-to-high transitions at the appropriate clock (CLKAB or CLKBA) terminals, regardless of the select- or output-control terminals. When SAB and SBA are in the real-time transfer mode, it is possible to store data without using the internal D-type flip-flops by simultaneously enabling OEAB and $\overline{\text{OEBA}}$. In this configuration, each output reinforces its input. When all other data sources to the two sets of bus lines are at high impedance, each set of bus lines remains at its last state.

To ensure the high-impedance state during power up or power down, $\overline{\text{OEBA}}$ should be tied to V_{CC} through a pullup resistor, and OEAB should be tied to GND through a pulldown resistor; the minimum value of the resistor is determined by the current-sinking/current-sourcing capability of the driver.

FUNCTION TABLE

INPUTS						DATA I/O†		OPERATION OR FUNCTION
OEAB	$\overline{\text{OEBA}}$	CLKAB	CLKBA	SAB	SBA	A1–A8	B1–B8	
L	H	H or L	H or L	X	X	Input	Input	Isolation
L	H	↑	↑	X	X	Input	Input	Store A and B data
X	H	↑	H or L	X	X	Input	Unspecified‡	Store A, hold B
H	H	↑	↑	X‡	X	Input	Output	Store A in both registers
L	X	H or L	↑	X	X	Unspecified‡	Input	Hold A, store B
L	L	↑	↑	X	X‡	Output	Input	Store B in both registers
L	L	X	X	X	L	Output	Input	Real-time B data to A bus
L	L	X	H or L	X	H	Output	Input	Stored B data to A bus
H	H	X	X	L	X	Input	Output	Real-time A data to B bus
H	H	H or L	X	H	X	Input	Output	Stored A data to B bus
H	L	H or L	H or L	H	H	Output	Output	Stored A data to B bus and stored B data to A bus

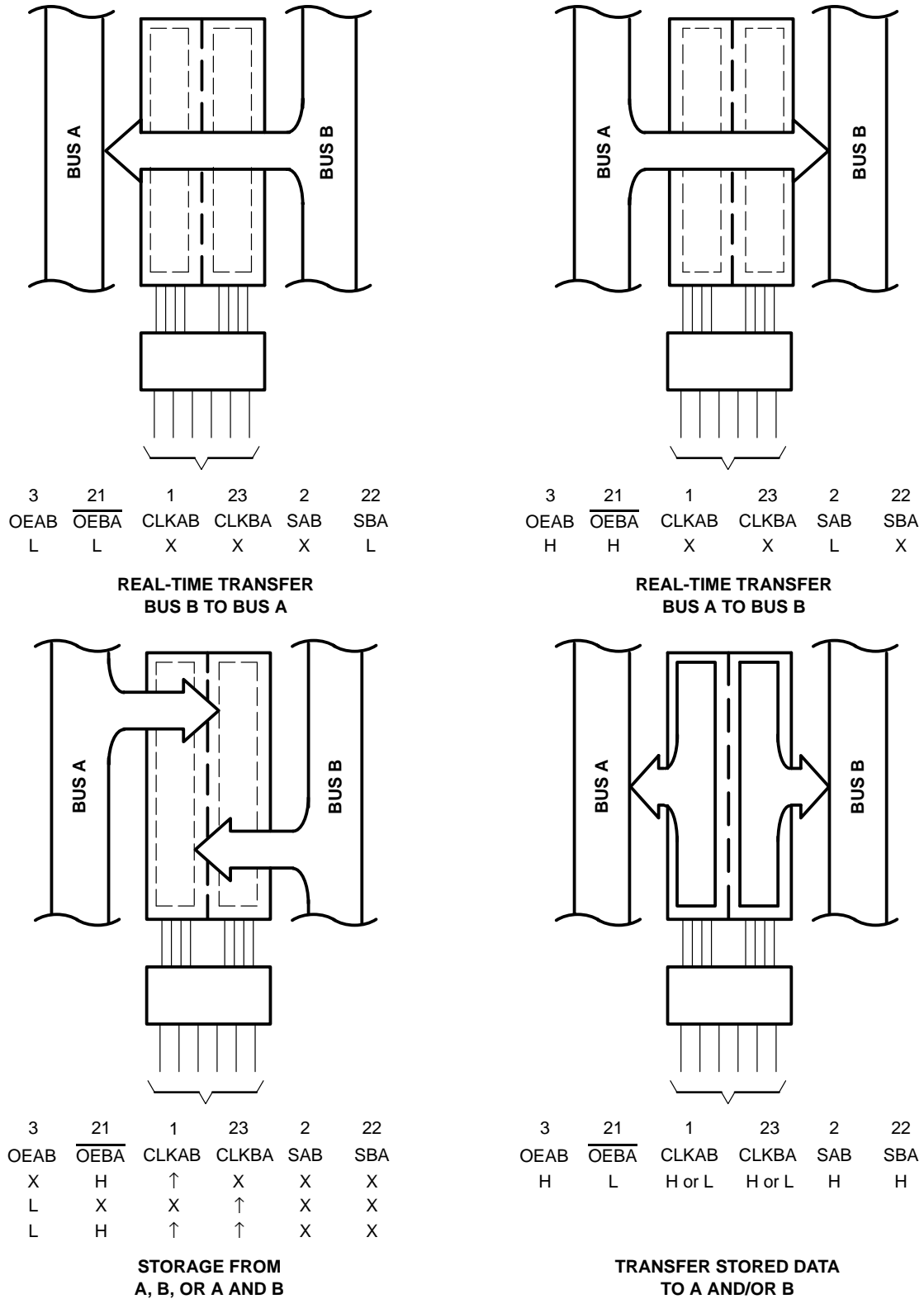
† The data-output functions are enabled or disabled by a variety of level combinations at OEAB or $\overline{\text{OEBA}}$. Data-input functions always are enabled; i.e., data at the bus terminals is stored on every low-to-high transition on the clock inputs.

‡ Select control = L: clocks can occur simultaneously.

Select control = H: clocks must be staggered to load both registers.

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Pin numbers shown are for the DW, JT, NT, and W packages.

Figure 1. Bus-Management Functions

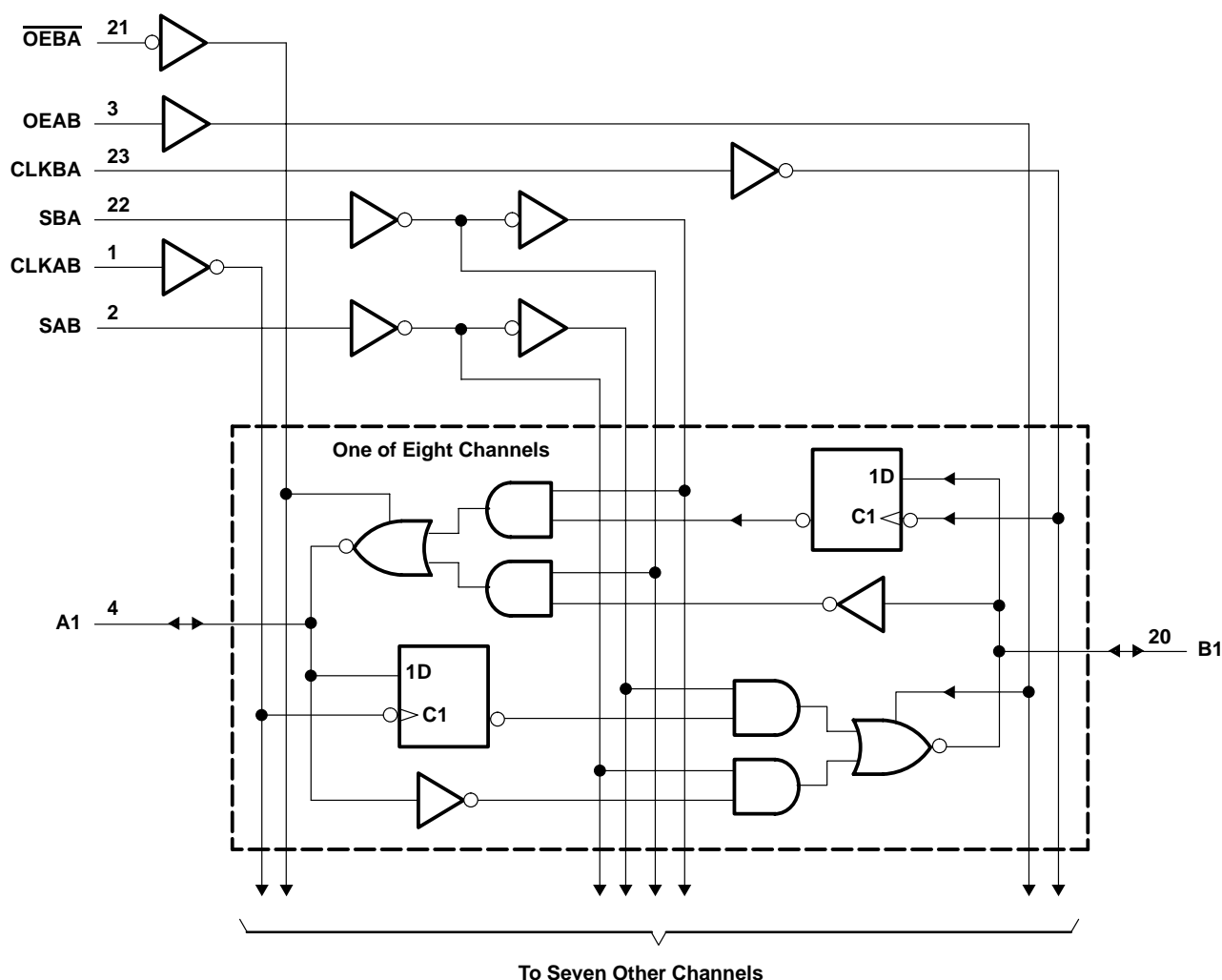
SN54HC652, SN74HC652

OCTAL BUS TRANSCEIVERS AND REGISTERS

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logic diagram (positive logic)



Pin numbers shown are for the DW, JT, NT, and W packages.

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)[†]

Supply voltage range, V_{CC}	–0.5 V to 7 V
Input clamp current, I_{IK} ($V_I < 0$ or $V_I > V_{CC}$) (see Note 1)	±20 mA
Output clamp current, I_{OK} ($V_O < 0$ or $V_O > V_{CC}$) (see Note 1)	±20 mA
Continuous output current, I_O ($V_O = 0$ to V_{CC})	±35 mA
Continuous current through V_{CC} or GND	±70 mA
Package thermal impedance, θ_{JA} (see Note 2): DW package	46°C/W
(see Note 3): NT package	67°C/W
Storage temperature range, T_{stg}	–65°C to 150°C

[†] 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.

- NOTES:
1. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.
 2. The package thermal impedance is calculated in accordance with JESD 51-7.
 3. The package thermal impedance is calculated in accordance with JESD 51-3.



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SN54HC652, SN74HC652

OCTAL BUS TRANSCEIVERS AND REGISTERS

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recommended operating conditions (see Note 4)

			SN54HC652			SN74HC652			UNIT
			MIN	NOM	MAX	MIN	NOM	MAX	
V _{CC}	Supply voltage		2	5	6	2	5	6	V
V _{IH}	High-level input voltage	V _{CC} = 2 V	1.5			1.5			V
		V _{CC} = 4.5 V	3.15			3.15			
		V _{CC} = 6 V	4.2			4.2			
V _{IL}	Low-level input voltage	V _{CC} = 2 V			0.5			0.5	V
		V _{CC} = 4.5 V			1.35			1.35	
		V _{CC} = 6 V			1.8			1.8	
V _I	Input voltage		0		V _{CC}	0		V _{CC}	V
V _O	Output voltage		0		V _{CC}	0		V _{CC}	V
t _t	Input transition (rise and fall) time	V _{CC} = 2 V			1000			1000	ns
		V _{CC} = 4.5 V			500			500	
		V _{CC} = 6 V			400			400	
T _A	Operating free-air temperature		–55		125	–40		85	°C

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.

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

PARAMETER		TEST CONDITIONS	V _{CC}	T _A = 25°C			SN54HC652		SN74HC652		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
V _{OH}		V _I = V _{IH} or V _{IL}	2 V	1.9	1.998		1.9		1.9		V
			4.5 V	4.4	4.499		4.4		4.4		
			6 V	5.9	5.999		5.9		5.9		
		I _{OH} = –6 mA	4.5 V	3.98	4.3		3.7		3.84		
		I _{OH} = –7.8 mA	6 V	5.48	5.8		5.2		5.34		
V _{OL}		V _I = V _{IH} or V _{IL}	2 V		0.002	0.1		0.1		0.1	V
			4.5 V		0.001	0.1		0.1		0.1	
			6 V		0.001	0.1		0.1		0.1	
		I _{OL} = 6 mA	4.5 V		0.17	0.26		0.4		0.33	
		I _{OL} = 7.8 mA	6 V		0.15	0.26		0.4		0.33	
I _I	Control inputs	V _I = V _{CC} or 0	6 V		±0.1	±100		±1000		±1000	nA
I _{OZ}	A or B	V _O = V _{CC} or GND	6 V		±0.01	±0.5		±10		±5	μA
I _{CC}		V _I = V _{CC} or 0, I _O = 0	6 V			8		160		80	μA
C _i	Control inputs		2 V to 6 V		3	10		10		10	pF

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OCTAL BUS TRANSCEIVERS AND REGISTERS

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

	V _{CC}	T _A = 25°C		SN54HC652		SN74HC652		UNIT
		MIN	MAX	MIN	MAX	MIN	MAX	
f _{clock} Clock frequency	2 V		6		4.3		5.5	MHz
	4.5 V		31		22		27	
	6 V		36		25		31	
t _w Pulse duration, CLKBA or CLKAB high or low	2 V		80		115		95	ns
	4.5 V		16		23		19	
	6 V		14		20		16	
t _{su} Setup time, A before CLKAB↑ or B before CLKBA↑	2 V		100		150		125	ns
	4.5 V		20		30		25	
	6 V		17		26		21	
t _h Hold time, A after CLKAB↑ or B after CLKBA↑	2 V		5		5		5	ns
	4.5 V		5		5		5	
	6 V		5		5		5	

switching characteristics over recommended operating free-air temperature range, C_L = 50 pF (unless otherwise noted) (see Figure 2)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V _{CC}	T _A = 25°C			SN54HC652		SN74HC652		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
f _{max}			2 V	6	10		4.3		5.5		MHz
			4.5 V	31	40		22		27		
			6 V	36	45		25		31		
t _{pd}	CLKBA or CLKAB	A or B	2 V		65	180		270		225	ns
			4.5 V		18	36		54		45	
			6 V		14	31		46		38	
	A or B	B or A	2 V		50	135		205		170	
			4.5 V		14	27		41		34	
			6 V		11	23		35		29	
	SBA or SAB†	A or B	2 V		70	190		285		240	
			4.5 V		20	38		57		48	
			6 V		16	32		48		41	
t _{en}	OEBA or OEAB	A or B	2 V		85	245		370		305	ns
			4.5 V		25	49		74		61	
			6 V		20	42		63		52	
t _{dis}	OEBA or OEAB	A or B	2 V		50	245		370		305	ns
			4.5 V		23	49		74		61	
			6 V		20	42		63		52	
t _t		Any	2 V		28	60		90		75	ns
			4.5 V		8	12		18		15	
			6 V		6	10		15		13	

† These parameters are measured with the internal output state of the storage register opposite that of the bus input.

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SN54HC652, SN74HC652 OCTAL BUS TRANSCEIVERS AND REGISTERS WITH 3-STATE OUTPUTS

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switching characteristics over recommended operating free-air temperature range, $C_L = 150 \text{ pF}$
(unless otherwise noted) (see Figure 2)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CC}	$T_A = 25^\circ\text{C}$			SN54HC652		SN74HC652		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
t_{pd}	CLKBA or CLKAB	A or B	2 V		90	265		400		330	ns
			4.5 V		24	53		80		66	
			6 V		18	46		68		57	
	A or B	B or A	2 V		70	220		335		275	
			4.5 V		20	44		70		55	
			6 V		15	38		57		48	
	SBA or SAB [†]	A or B	2 V		80	275		415		345	
			4.5 V		24	55		83		69	
			6 V		20	47		70		60	
t_{en}	$\overline{\text{OEBA}}$ or OEAB	A or B	2 V		100	330		500		410	ns
			4.5 V		33	66		100		82	
			6 V		27	57		85		71	
t_t		Any	2 V		45	210		315		265	ns
			4.5 V		17	42		63		53	
			6 V		13	36		53		43	

[†] These parameters are measured with the internal output state of the storage register opposite that of the bus input.

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

PARAMETER		TEST CONDITIONS	TYP	UNIT
C_{pd}	Power dissipation capacitance	No load	50	pF

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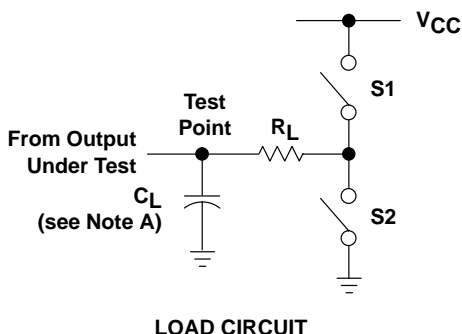


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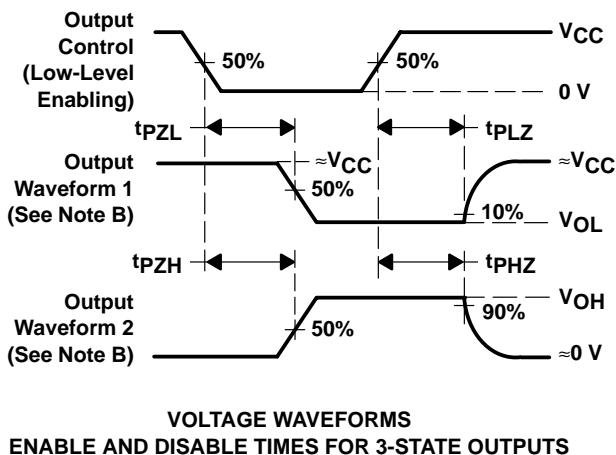
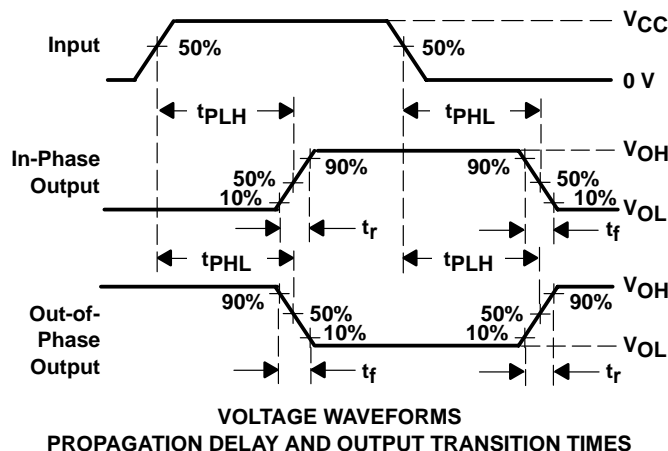
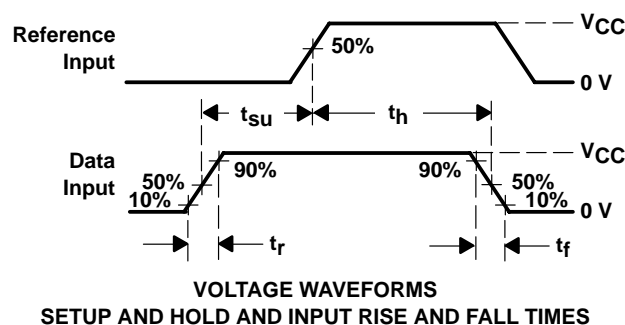
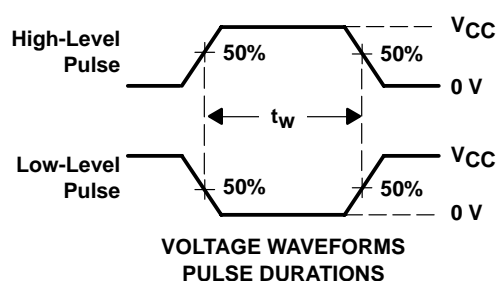
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PARAMETER MEASUREMENT INFORMATION



PARAMETER	R_L	C_L	S1	S2
t_{en}	1 k Ω	50 pF or 150 pF	Open	Closed
			Closed	Open
t_{dis}	1 k Ω	50 pF	Open	Closed
			Closed	Open
t_{pd} or t_t	—	50 pF or 150 pF	Open	Open



- NOTES:
- C_L includes probe and test-fixture 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.
 - Phase relationships between waveforms were chosen arbitrarily. All input pulses are supplied by generators having the following characteristics: $PRR \leq 1 \text{ MHz}$, $Z_O = 50 \Omega$, $t_r = 6 \text{ ns}$, $t_f = 6 \text{ ns}$.
 - For clock inputs, f_{max} is measured when the input duty cycle is 50%.
 - The outputs are measured one at a time with one input 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} .

Figure 2. Load Circuit and Voltage Waveforms

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
SN74HC652DW	ACTIVE	SOIC	DW	24	25	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	HC652	Samples
SN74HC652DWR	ACTIVE	SOIC	DW	24	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	HC652	Samples

(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) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

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

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

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TAPE AND REEL INFORMATION


*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
SN74HC652DWR	SOIC	DW	24	2000	330.0	24.4	10.75	15.7	2.7	12.0	24.0	Q1

TAPE AND REEL BOX DIMENSIONS

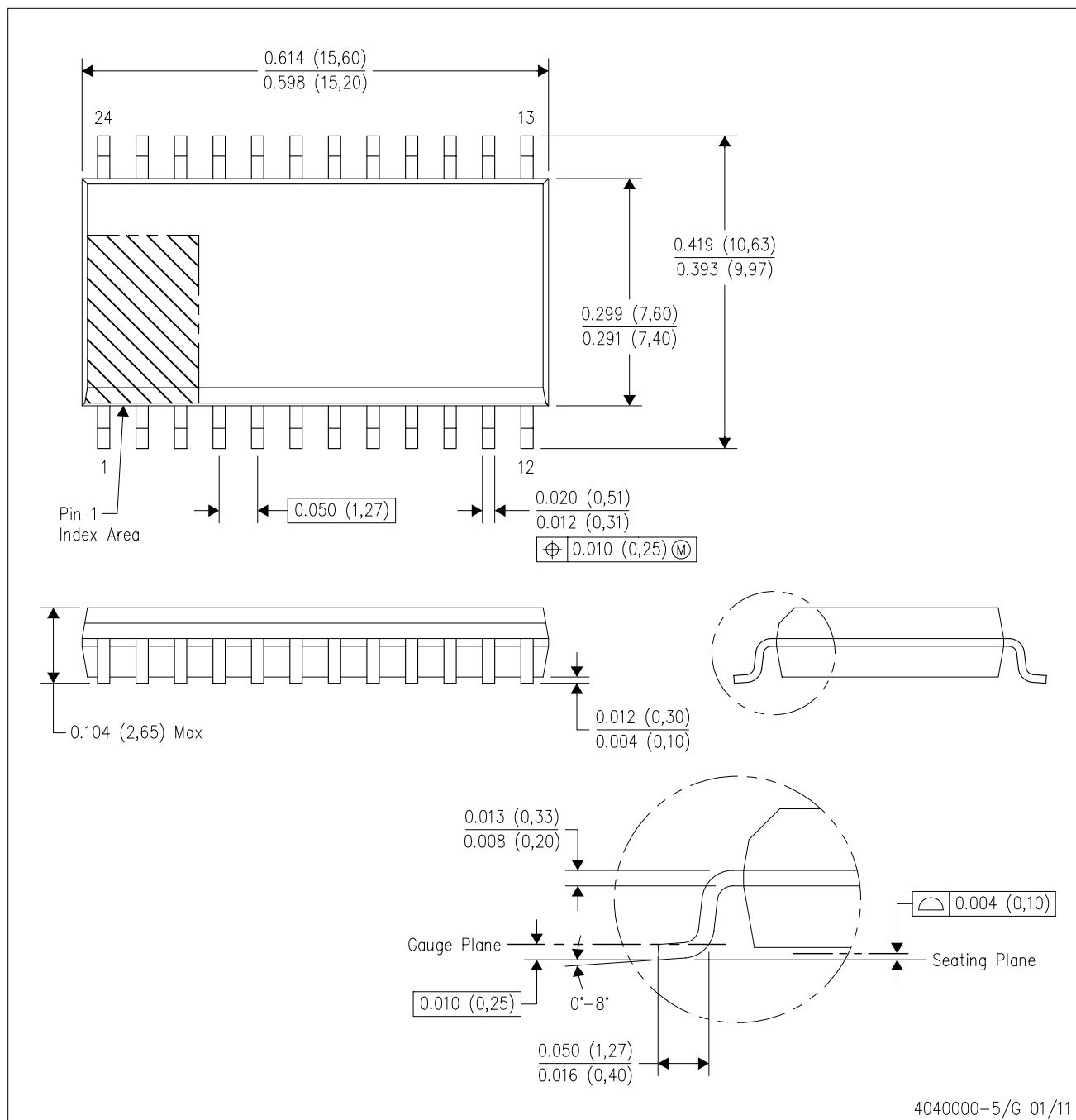


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74HC652DWR	SOIC	DW	24	2000	350.0	350.0	43.0

DW (R-PDSO-G24)

PLASTIC SMALL OUTLINE



- NOTES:
- All linear dimensions are in inches (millimeters). Dimensioning and tolerancing per ASME Y14.5M-1994.
 - This drawing is subject to change without notice.
 - Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
 - Falls within JEDEC MS-013 variation AD.

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