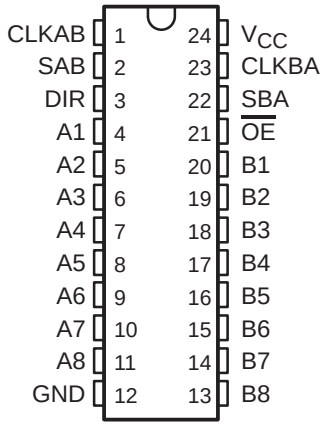
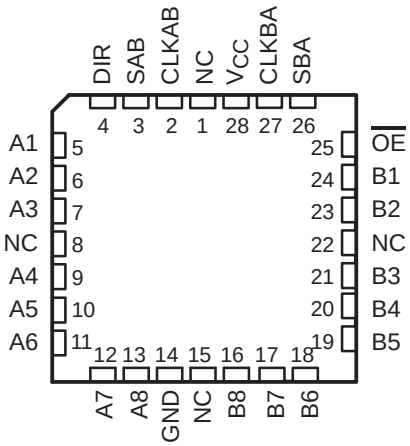
- **Independent Registers for A and B Buses**
- **Multiplexed Real-Time and Stored Data**
- **True Data Paths**
- **High-Current 3-State Outputs Can Drive up to 15 LSTTL Loads**
- **Package Options Include Plastic Small-Outline (DW) and Ceramic Flat (W) Packages, Ceramic Chip Carriers (FK), and Standard Plastic (NT) and Ceramic (JT) 300-mil DIPs**

SN54HC646 . . . JT OR W PACKAGE
SN74HC646 . . . DW OR NT PACKAGE
(TOP VIEW)



SN54HC646 . . . FK PACKAGE
(TOP VIEW)



NC – No internal connection

description

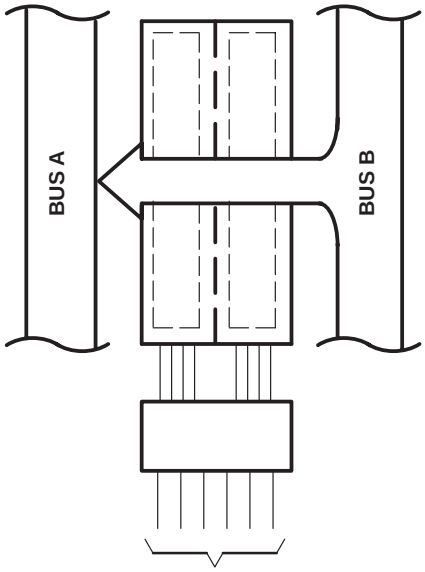
The ’HC646 consist of bus-transceiver circuits with 3-state outputs, D-type flip-flops, and control circuitry arranged for multiplexed transmission of data directly from the input bus or from the internal registers. Data on the A or B bus is clocked into the registers on the low-to-high transition of the appropriate clock (CLKAB or CLKBA) input. Figure 1 illustrates the four fundamental bus-management functions that can be performed with the ’HC646.

Output-enable ($\overline{OE}$) and direction-control (DIR) inputs control the transceiver functions. In the transceiver mode, data present at the high-impedance port may be stored in either or both registers.

The select-control (SAB and SBA) inputs can multiplex stored and real-time (transparent mode) data. DIR determines which bus receives data when $\overline{OE}$ is active (low). In the isolation mode ($\overline{OE}$ high), A data may be stored in one register and/or B data may be stored in the other register.

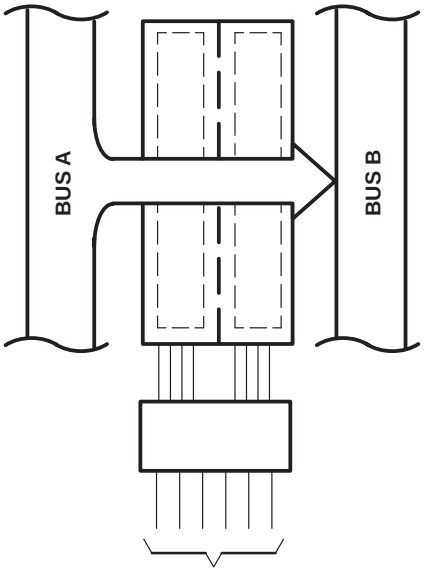
When an output function is disabled, the input function is still enabled and can be used to store and transmit data. Only one of the two buses, A or B, may be driven at a time.

The SN54HC646 is characterized for operation over the full military temperature range of –55°C to 125°C. The SN74HC646 is characterized for operation from –40°C to 85°C.



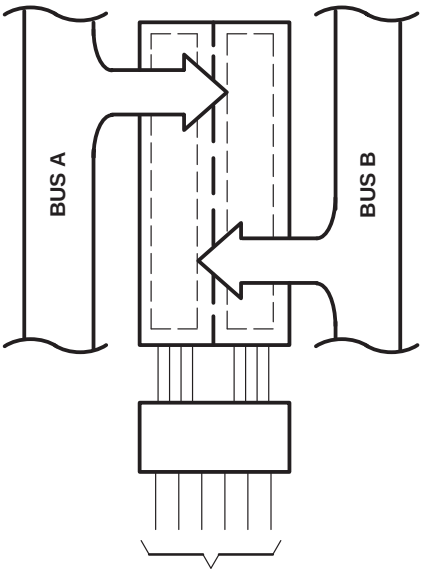
21 $\overline{OE}$	3 DIR	1 CLKAB	23 CLKBA	2 SAB	22 SBA
L	L	X	X	X	L

REAL-TIME TRANSFER
BUS B TO BUS A



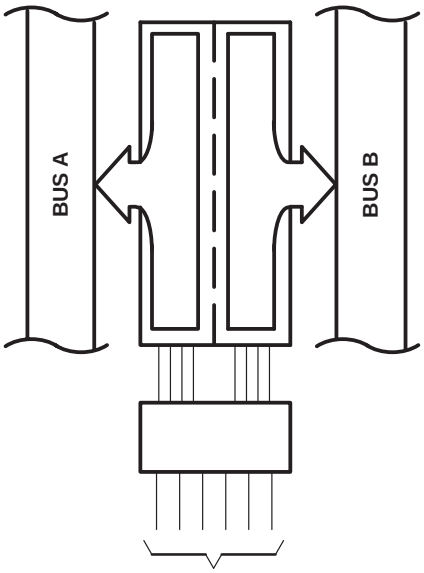
21 $\overline{OE}$	3 DIR	1 CLKAB	23 CLKBA	2 SAB	22 SBA
L	H	X	X	L	X

REAL-TIME TRANSFER
BUS A TO BUS B



21 $\overline{OE}$	3 DIR	1 CLKAB	23 CLKBA	2 SAB	22 SBA
X	X	↑	X	X	X
X	X	X	↑	X	X
H	X	↑	↑	X	X

STORAGE FROM
A, B, OR A AND B



21 $\overline{OE}$	3 DIR	1 CLKAB	23 CLKBA	2 SAB	22 SBA
L	L	X	H or L	X	H
L	H	H or L	X	H	X

TRANSFER STORED DATA
TO A AND/OR B

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

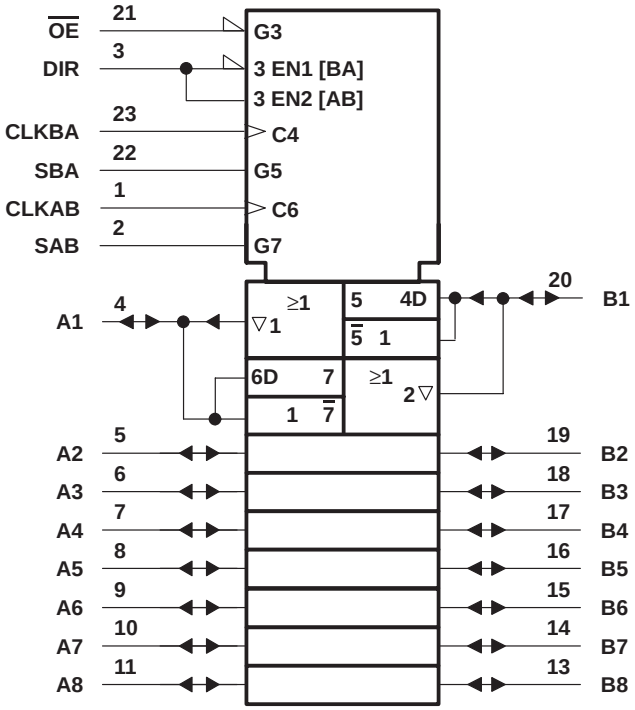
Figure 1. Bus-Management Functions

FUNCTION TABLE

INPUTS						DATA I/O		OPERATION OR FUNCTION
$\overline{OE}$	DIR	CLKAB	CLKBA	SAB	SBA	A1–A8	B1–B8	
X	X	↑	X	X	X	Input	Unspecified†	Store A, B unspecified†
X	X	X	↑	X	X	Unspecified†	Input	Store B, A unspecified†
H	X	↑	↑	X	X	Input	Input	Store A and B data
H	X	H or L	H or L	X	X	Input disabled	Input disabled	Isolation, hold storage
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
L	H	X	X	L	X	Input	Output	Real-time A data to B bus
L	H	H or L	X	H	X	Input	Output	Stored A data to B bus

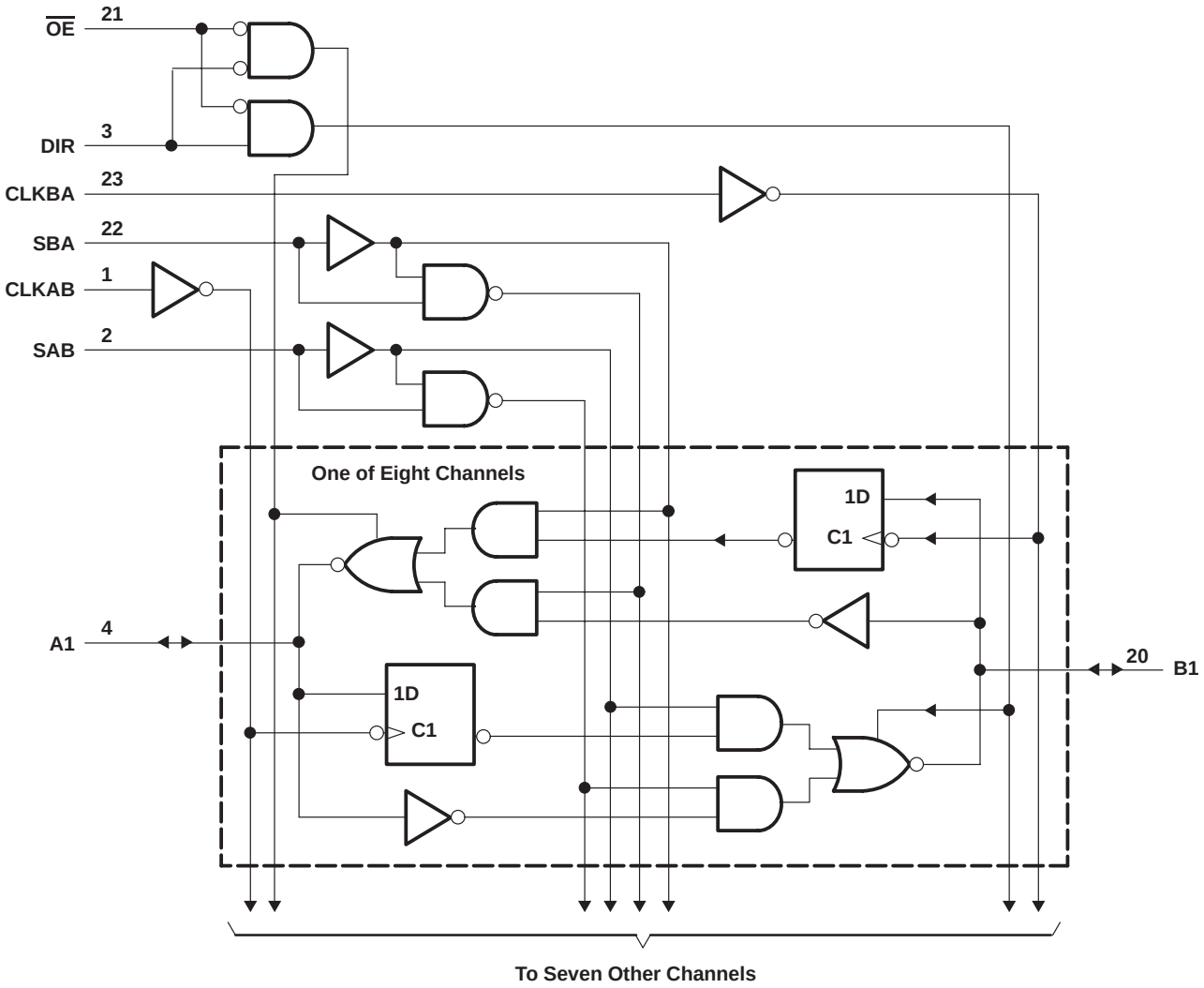
† The data-output functions can be enabled or disabled by various signals at $\overline{OE}$ and DIR. Data-input functions are always enabled; i.e., data at the bus terminals is stored on every low-to-high transition of the clock inputs.

logic symbol‡



‡ This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.
Pin numbers shown are for the DW, JT, NT, and W packages.

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†

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	81°C/W
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, except for through-hole packages, which use a trace length of zero.

recommended operating conditions

			SN54HC646			SN74HC646			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		0.5	0		0.5	V
		V_{CC} = 4.5 V	0		1.35	0		1.35	
		V_{CC} = 6 V	0		1.8	0		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	0		1000	0		1000	ns
		V_{CC} = 4.5 V	0		500	0		500	
		V_{CC} = 6 V	0		400	0		400	
T_A	Operating free-air temperature		–55		125	–40		85	°C

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

PARAMETER		TEST CONDITIONS		V_{CC}	T_A = 25°C			SN54HC646		SN74HC646		UNIT
					MIN	TYP	MAX	MIN	MAX	MIN	MAX	
V_{OH}		V_I = V_{IH} or V_{IL}	I_{OH} = –20 μA	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}	I_{OL} = 20 μA	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 0		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

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

		V_{CC}	T_A = 25°C		SN54HC646		SN74HC646		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	
f_{clock}	Clock frequency	2 V	0	6	0	4.3	0	5.5	MHz
		4.5 V	0	31	0	22	0	27	
		6 V	0	36	0	25	0	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			SN54HC646		SN74HC646		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
f_{max}			2 V	6	11		4.4		5.5		MHz
			4.5 V	31	54		22		27		
			6 V	36	64		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}	$\overline{OE}$	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}	$\overline{OE}$	A or B	2 V		85	245		370		305	ns
			4.5 V		25	49		74		61	
			6 V		20	42		63		52	
t_{en}	DIR	A or B	2 V		80	245		370		305	ns
			4.5 V		25	49		74		61	
			6 V		20	42		63		52	
t_{dis}	DIR	A or B	2 V		80	245		370		305	ns
			4.5 V		25	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.

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

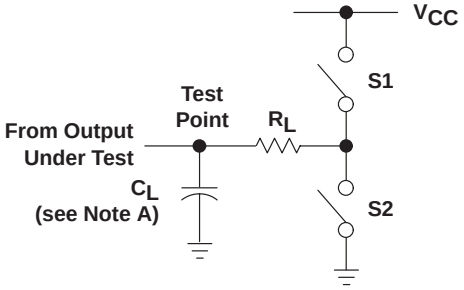
PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CC}	T_A = 25°C			SN54HC646		SN74HC646		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
t_{pd}	CLKBA or CLKAB	A or B	2 V		90	265		400		330	ns
			4.5 V		24	53		80		66	
			6 V		20	46		68		57	
	A or B	B or A	2 V		70	220		335		280	
			4.5 V		20	44		67		56	
			6 V		15	38		57		49	
	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}	$\overline{OE}$	A or B	2 V		113	330		500		410	ns
			4.5 V		33	66		100		82	
			6 V		27	57		85		71	
	DIR	A or B	2 V		113	330		500		410	
			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°C

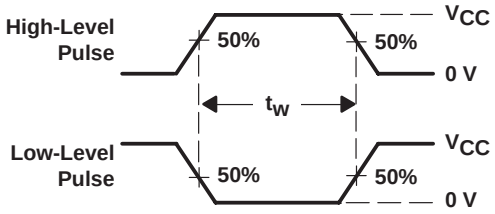
PARAMETER		TEST CONDITIONS	TYP	UNIT
C_{pd}	Power dissipation capacitance	No load	50	pF

PARAMETER MEASUREMENT INFORMATION

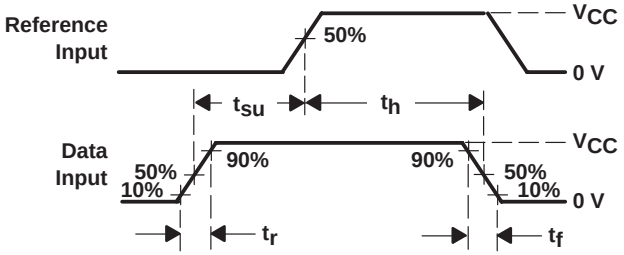


LOAD CIRCUIT

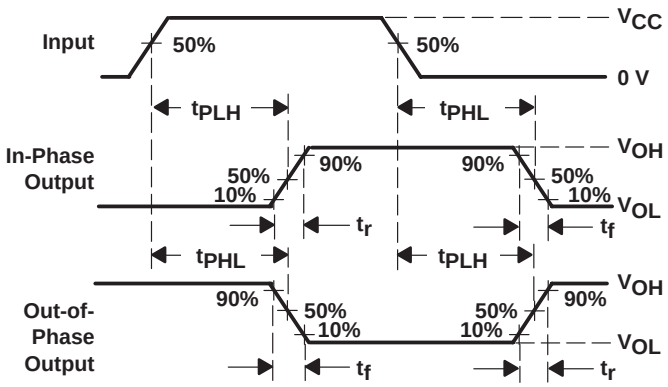
PARAMETER		R_L	C_L	S1	S2
t_{en}	t_{PZH}	1 kΩ	50 pF or 150 pF	Open	Closed
	t_{PZL}			Closed	Open
t_{dis}	t_{PHZ}	1 kΩ	50 pF	Open	Closed
	t_{PLZ}			Closed	Open
t_{pd} or t_t		––	50 pF or 150 pF	Open	Open



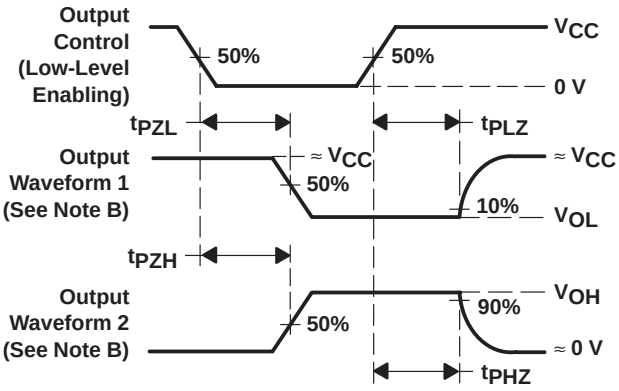
VOLTAGE WAVEFORMS
PULSE DURATIONS



VOLTAGE WAVEFORMS
SETUP AND HOLD AND INPUT RISE AND FALL TIMES



VOLTAGE WAVEFORMS
PROPAGATION DELAY AND OUTPUT TRANSITION TIMES



VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES FOR 3-STATE OUTPUTS

NOTES: A. C_L includes probe and test-fixture 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. Phase relationships between waveforms were chosen arbitrarily. All input pulses are supplied by generators having the following characteristics: PRR ≤ 1 MHz, Z_O = 50 Ω, t_r = 6 ns, t_f = 6 ns.
D. For clock inputs, f_{max} is measured when the input duty cycle is 50%.
E. The outputs are measured one at a time with one input transition per measurement.
F. t_{PLZ} and t_{PHZ} are the same as t_{dis}.
G. t_{PZL} and t_{PZH} are the same as t_{en}.
H. t_{PLH} and t_{PHL} are the same as t_{pd}.

Figure 2. Load Circuit and Voltage Waveforms

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