

DATA SHEET

For a complete data sheet, please also download:

- The IC04 LOCMOS HE4000B Logic Family Specifications HEF, HEC
- The IC04 LOCMOS HE4000B Logic Package Outlines/Information HEF, HEC

HEF4016B

gates

Quadruple bilateral switches

Product specification
File under Integrated Circuits, IC04

January 1995

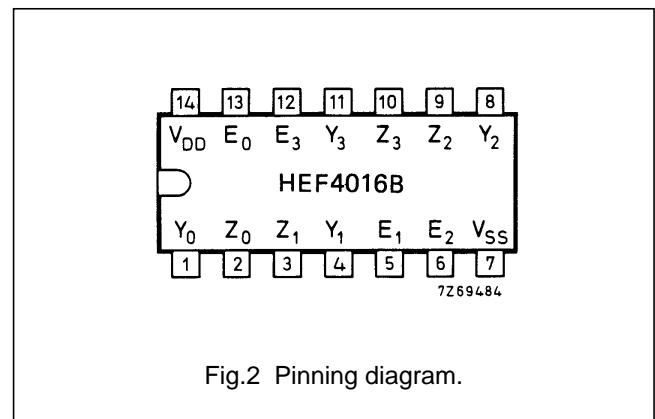
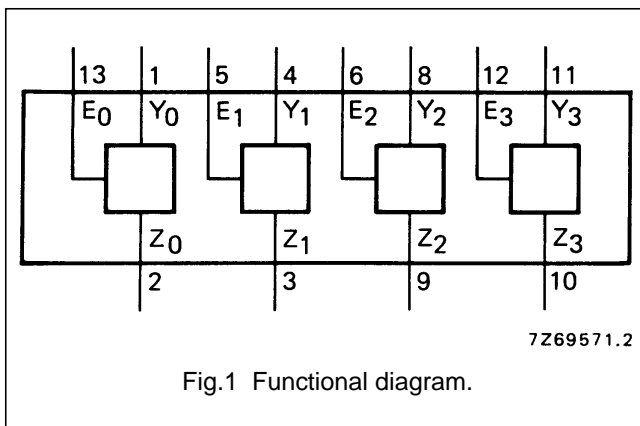
Quadruple bilateral switches

HEF4016B gates

DESCRIPTION

The HEF4016B has four independent analogue switches (transmission gates). Each switch has two input/output terminals (Y/Z) and an active HIGH enable input (E). When E is connected to V_{DD} a low impedance bidirectional path between Y and Z is established (ON condition). When E is connected to V_{SS} the switch is disabled and a high

impedance between Y and Z is established (OFF condition). Current through a switch will not cause additional V_{DD} current provided the voltage at the terminals of the switch is maintained within the supply voltage range; $V_{DD} \geq (V_Y, V_Z) \geq V_{SS}$. Inputs Y and Z are electrically equivalent terminals.



PINNING

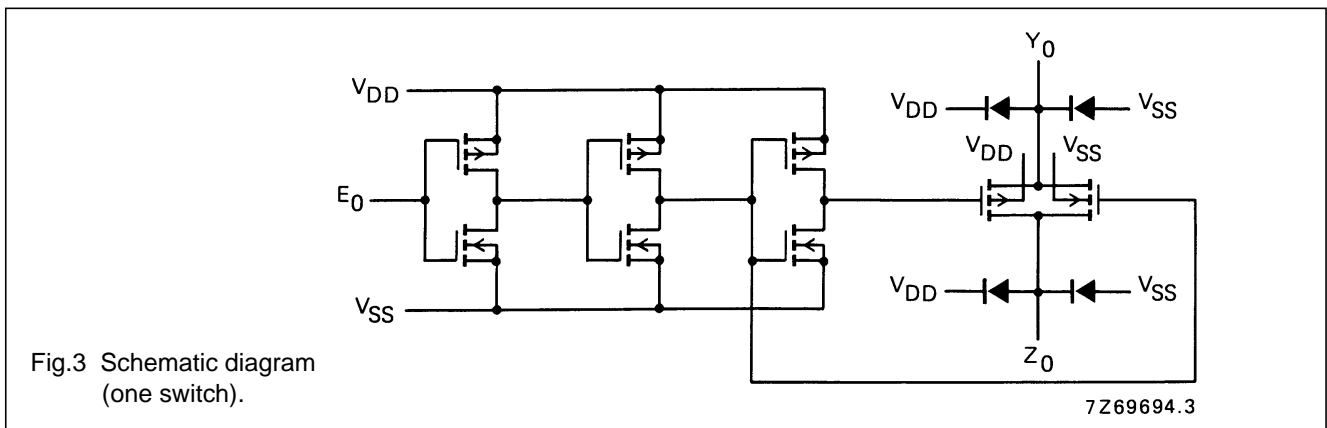
- E_0 to E_3 enable inputs
- Y_0 to Y_3 input/output terminals
- Z_0 to Z_3 input/output terminals

- HEF4016BP(N): 14-lead DIL; plastic (SOT27-1)
- HEF4016BD(F): 14-lead DIL; ceramic (cerdip) (SOT73)
- HEF4016BT(D): 14-lead SO; plastic (SOT108-1)
- () : Package Designator North America

APPLICATION INFORMATION

Some examples of applications for the HEF4016B are:

- Signal gating
- Modulation
- Demodulation
- Chopper



Quadruple bilateral switches

HEF4016B gates

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Power dissipation per switch P max. 100 mW

For other RATINGS see Family Specifications

DC CHARACTERISTICS

$T_{amb} = 25\text{ °C}$; $V_{SS} = 0\text{ V}$ (unless otherwise specified)

PARAMETER	V_{DD} V	SYMBOL	TYP.	MAX.	UNIT	CONDITIONS
ON resistance	5	R_{ON}	8000	–	Ω	E_n at V_{IH} ; $V_{is} = 0$ to V_{DD} ; see Fig.4
	10		230	690	Ω	
	15		115	350	Ω	
ON resistance	5	R_{ON}	140	425	Ω	E_n at V_{IH} ; $V_{is} = V_{SS}$; see Fig.4
	10		65	195	Ω	
	15		50	145	Ω	
ON resistance	5	R_{ON}	170	515	Ω	E_n at V_{IH} ; $V_{is} = V_{DD}$; see Fig.4
	10		95	285	Ω	
	15		75	220	Ω	
' Δ ' ON resistance between any two channels	5	ΔR_{ON}	200	–	Ω	E_n at V_{IH} ; $V_{is} = 0$ to V_{DD} ; see Fig.4
	10		15	–	Ω	
	15		10	–	Ω	

PARAMETER	V_{DD} V	SYMBOL	T_{amb} (°C)						UNIT	CONDITION
			–40		+ 25		+ 85			
			MIN.	MAX.	MIN.	MAX.	MIN.	MAX.		
Quiescent device current	5	I_{DD}	–	1,0	–	1,0	–	7,5	μA	$V_{SS} = 0$; all valid input combinations; $V_I = V_{SS}$ or V_{DD}
	10		–	2,0	–	2,0	–	15,0	μA	
	15		–	4,0	–	4,0	–	30,0	μA	
Input leakage current at E_n	15	$\pm I_{IN}$	–	–	–	300	–	1000	nA	E_n at V_{SS} or V_{DD}
OFF-state leakage current, any channel OFF	5	I_{OZ}	–	–	–	–	–	–	nA	E_n at V_{IL} ; $V_{is} = V_{SS}$ or V_{DD} ; $V_{os} = V_{DD}$ or V_{SS}
	10		–	–	–	–	–	–	nA	
	15		–	–	–	200	–	–	nA	
E_n input voltage LOW	5	V_{IL}	–	1,5	–	1,5	–	1,5	V	switch OFF; see Fig.9 for I_{OZ}
	10		–	3,0	–	3,0	–	3,0	V	
	15		–	4,0	–	4,0	–	4,0	V	
E_n input voltage HIGH	5	V_{IH}	3,5	–	3,5	–	3,5	–	V	low-impedance between Y and Z (ON condition) see R_{ON} switch
	10		7,0	–	7,0	–	7,0	–	V	
	15		11,0	–	11,0	–	11,0	–	V	

Quadruple bilateral switches

HEF4016B
gates

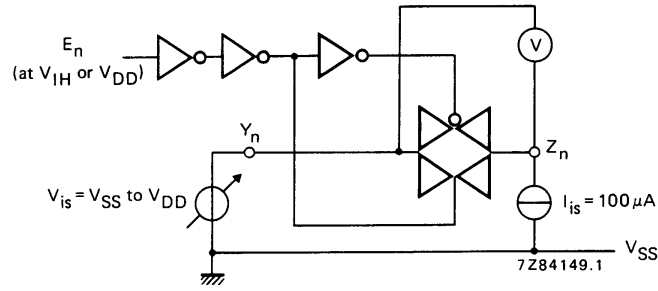
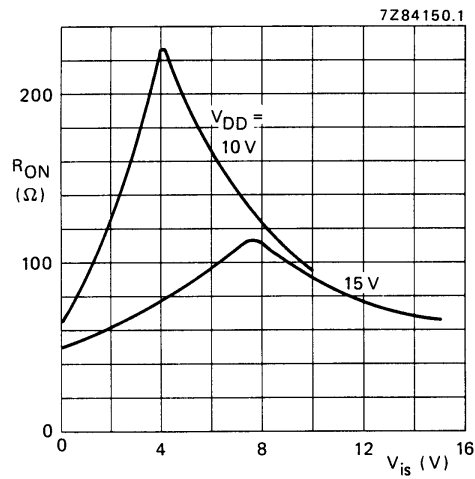


Fig.4 Test set-up for measuring R_{ON} .



$E_n > V_{IH}$
 $I_{is} = 100 \mu A$
 $V_{SS} = 0 V$

Fig.5 Typical R_{ON} as a function of input voltage.

Quadruple bilateral switches

HEF4016B gates

AC CHARACTERISTICS

$V_{SS} = 0\text{ V}$; $T_{amb} = 25\text{ °C}$; input transition times $\leq 20\text{ ns}$

	V_{DD} V	SYMBOL	TYP.	MAX.		
Propagation delays $V_{is} \rightarrow V_{os}$ HIGH to LOW	5		25	50	ns	note 1
	10	t_{PHL}	10	20	ns	
	15		5	10	ns	
LOW to HIGH	5		20	40	ns	note 1
	10	t_{PLH}	10	20	ns	
	15		5	10	ns	
Output disable times $E_n \rightarrow V_{os}$ HIGH	5		90	130	ns	note 2
	10	t_{PHZ}	80	110	ns	
	15		75	100	ns	
LOW	5		85	120	ns	note 2
	10	t_{PLZ}	75	100	ns	
	15		75	100	ns	
Output enable times $E_n \rightarrow V_{os}$ HIGH	5		40	80	ns	note 2
	10	t_{PZH}	20	40	ns	
	15		15	30	ns	
LOW	5		40	80	ns	note 2
	10	t_{PZL}	20	40	ns	
	15		15	30	ns	
Distortion, sine-wave response	5		–	–	%	note 3
	10		0,08	–	%	
	15		0,04	–	%	
Crosstalk between any two channels	5		–	–	MHz	note 4
	10		1	–	MHz	
	15		–	–	MHz	
Crosstalk; enable input to output	5		–	–	mV	note 5
	10		50	–	mV	
	15		–	–	mV	
OFF-state feed-through	5		–	–	MHz	note 6
	10		1	–	MHz	
	15		–	–	MHz	
ON-state frequency response	5		–	–	MHz	note 7
	10		90	–	MHz	
	15		–	–	MHz	

Quadruple bilateral switches

HEF4016B gates

Notes

V_{is} is the input voltage at a Y or Z terminal, whichever is assigned as input.

V_{os} is the output voltage at a Y or Z terminal, whichever is assigned as output.

- $R_L = 10 \text{ k}\Omega$ to V_{SS} ; $C_L = 50 \text{ pF}$ to V_{SS} ; $E_n = V_{DD}$; $V_{is} = V_{DD}$ (square-wave); see Figs 6 and 10.
- $R_L = 10 \text{ k}\Omega$; $C_L = 50 \text{ pF}$ to V_{SS} ; $E_n = V_{DD}$ (square-wave);
 $V_{is} = V_{DD}$ and R_L to V_{SS} for t_{PHZ} and t_{PZH} ;
 $V_{is} = V_{SS}$ and R_L to V_{DD} for t_{PLZ} and t_{PZL} ; see Figs 6 and 11.
- $R_L = 10 \text{ k}\Omega$; $C_L = 15 \text{ pF}$; $E_n = V_{DD}$; $V_{is} = \frac{1}{2}V_{DD(p-p)}$ (sine-wave, symmetrical about $\frac{1}{2}V_{DD}$);
 $f_{is} = 1 \text{ kHz}$; see Fig.7.
- $R_L = 1 \text{ k}\Omega$; $V_{is} = \frac{1}{2}V_{DD(p-p)}$ (sine-wave, symmetrical about $\frac{1}{2}V_{DD}$);

$$20 \log \frac{V_{os} (B)}{V_{is} (A)} = -50 \text{ dB}; E_n (A) = V_{SS}; E_n (B) = V_{DD}; \text{ see Fig. 8.}$$

- $R_L = 10 \text{ k}\Omega$ to V_{SS} ; $C_L = 15 \text{ pF}$ to V_{SS} ; $E_n = V_{DD}$ (square-wave); crosstalk is $|V_{os}|$ (peak value); see Fig.6.
- $R_L = 1 \text{ k}\Omega$; $C_L = 5 \text{ pF}$; $E_n = V_{SS}$; $V_{is} = \frac{1}{2}V_{DD(p-p)}$ (sine-wave, symmetrical about $\frac{1}{2}V_{DD}$);

$$20 \log \frac{V_{os}}{V_{is}} = -50 \text{ dB}; \text{ see Fig. 7.}$$

- $R_L = 1 \text{ k}\Omega$; $C_L = 5 \text{ pF}$; $E_n = V_{DD}$; $V_{is} = \frac{1}{2}V_{DD(p-p)}$ (sine-wave, symmetrical about $\frac{1}{2}V_{DD}$);

$$20 \log \frac{V_{os}}{V_{is}} = -3 \text{ dB}; \text{ see Fig. 7.}$$

	V_{DD} V	TYPICAL FORMULA FOR P (μ W)	
Dynamic power dissipation per package (P) ⁽¹⁾	5 10 15	$550 f_i + \sum (f_o C_L) \times V_{DD}^2$ $2\ 600 f_i + \sum (f_o C_L) \times V_{DD}^2$ $6\ 500 f_i + \sum (f_o C_L) \times V_{DD}^2$	where f_i = input freq. (MHz) f_o = output freq. (MHz) C_L = load capacitance (pF) $\sum (f_o C_L)$ = sum of outputs V_{DD} = supply voltage (V)

Note

- All enable inputs switching.

Quadruple bilateral switches

HEF4016B
gates

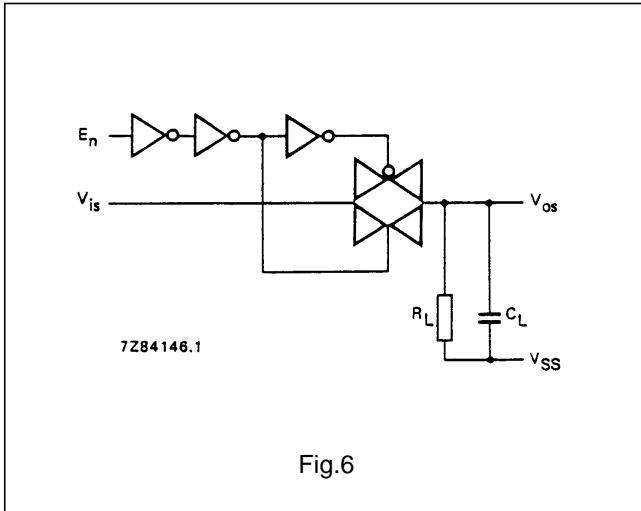


Fig.6

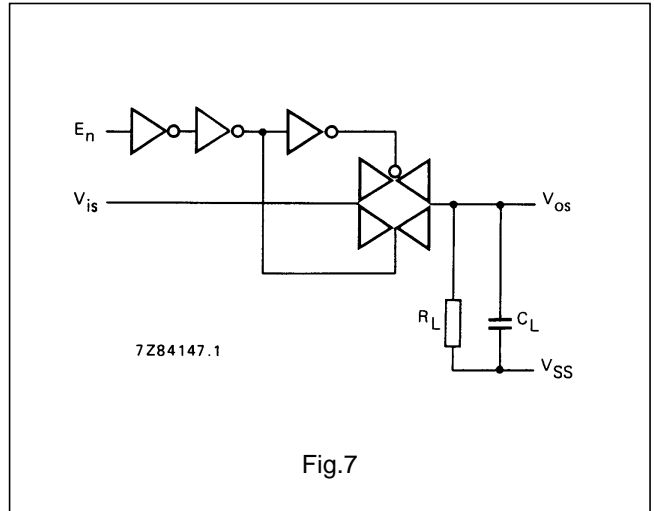


Fig.7

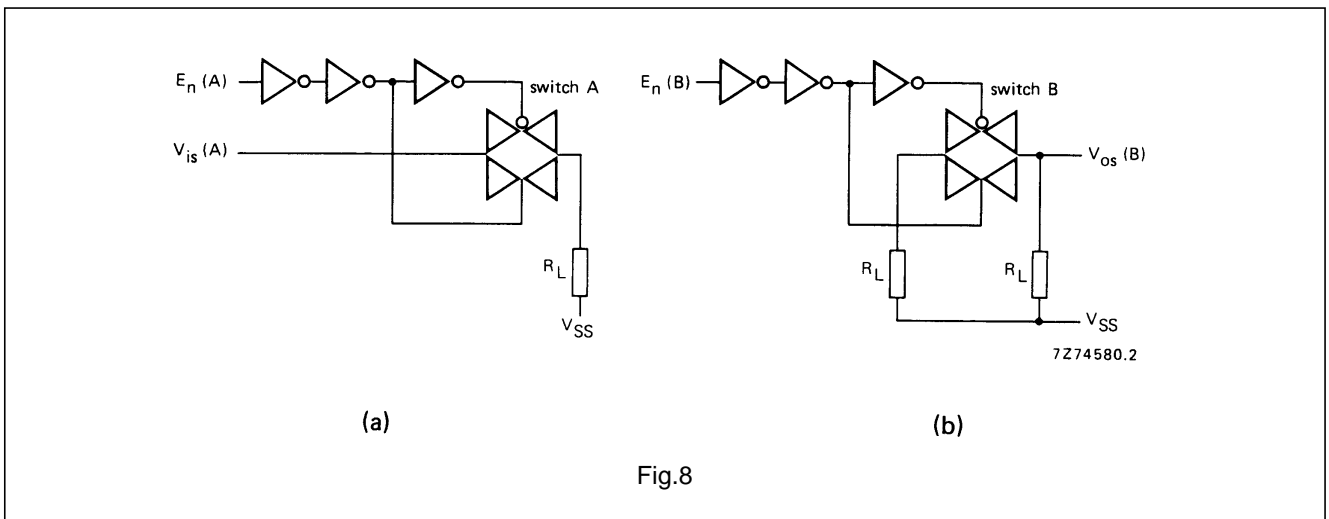


Fig.8

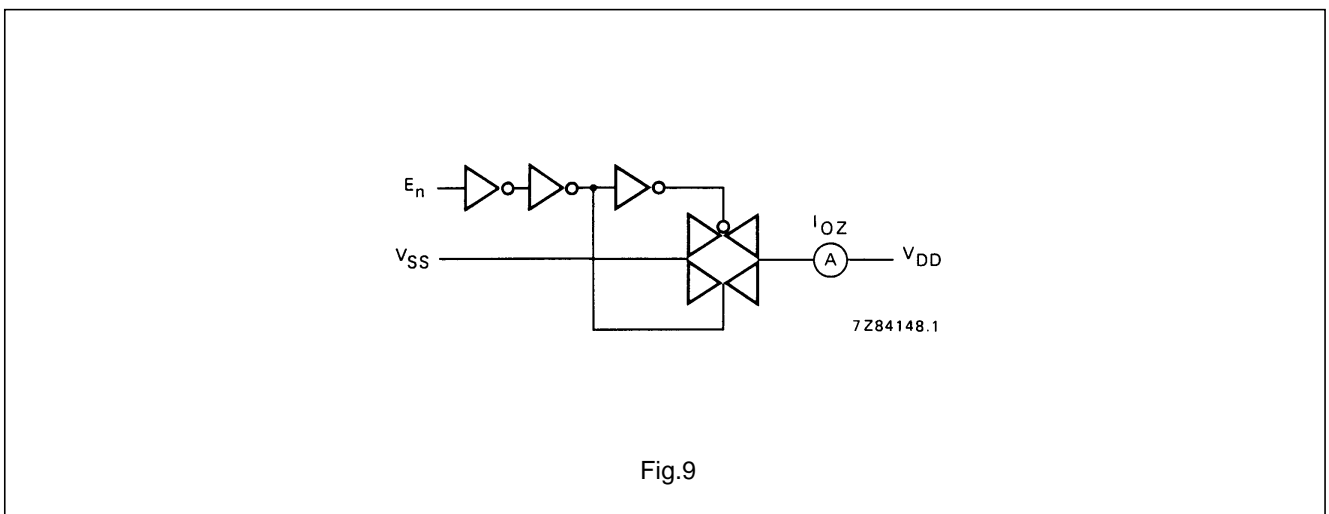


Fig.9

Quadruple bilateral switches

HEF4016B
gates

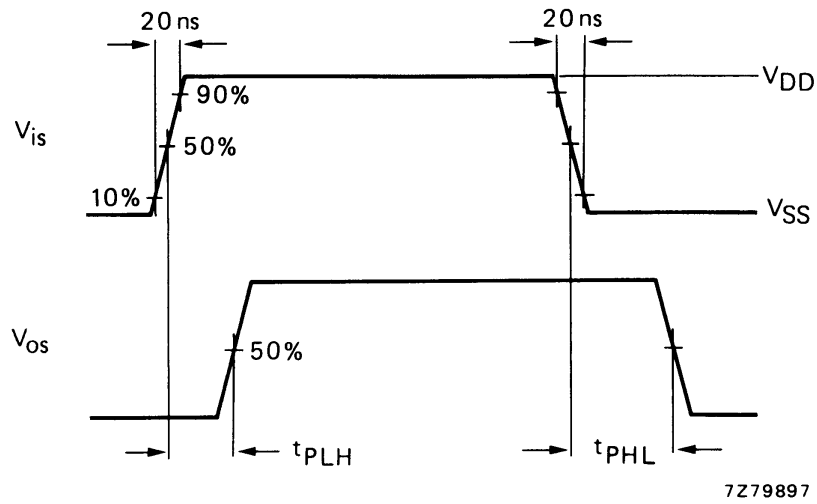
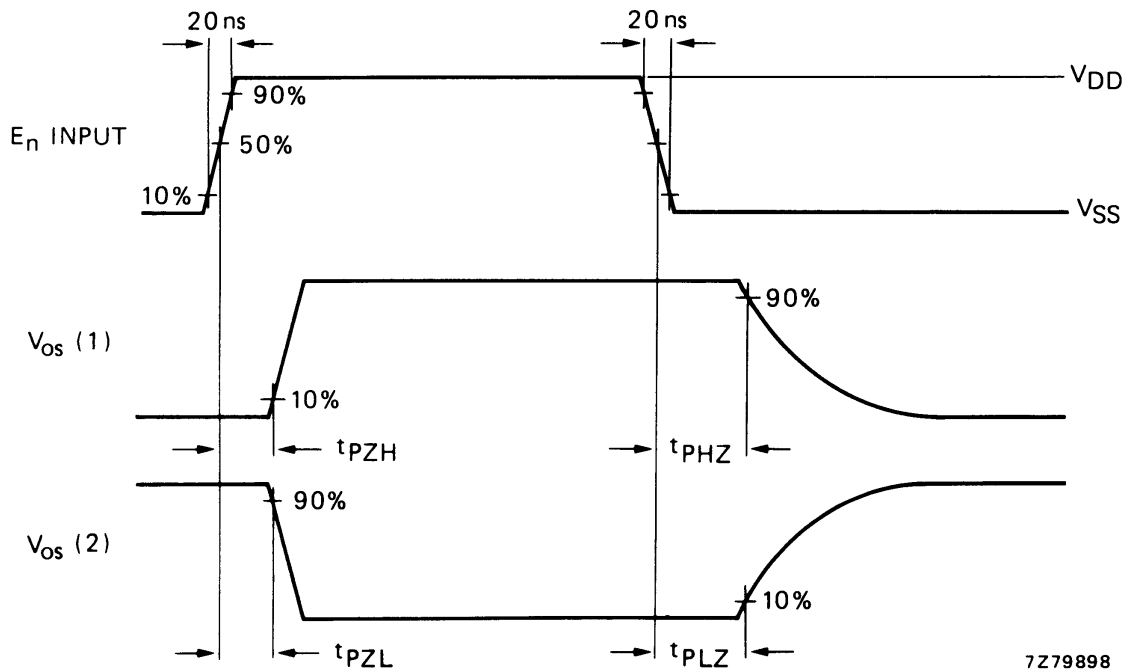


Fig.10 Waveforms showing propagation delays from V_{is} to V_{os} .



- (1) V_{is} at V_{DD}
- (2) V_{is} at V_{SS}

Fig.11 Waveforms showing output disable and enable times.