



## U74HC165

CMOS IC

### 8-BIT PARALLEL-LOAD SHIFT REGISTER

#### DESCRIPTION

The **U74HC165** is an 8-bit parallel-load shift register that, when clocked, shifts the data toward a serial ( $Q_H$ ) output. Parallel-in access to each stage is provided by eight individual direct data (A-H) inputs that are enabled by a low level at shift/load ( $\overline{SH}/\overline{LD}$ ) input. The U74HC165 also features a clock-inhibit (CLK INH) function and a complementary serial ( $\overline{Q}_H$ ) output.

Clocking is accomplished by a low-to-high transition of the clock (CLK) input while  $\overline{SH}/\overline{LD}$  is held high and CLK INH is held low. The functions of CLK and CLK INH are interchangeable. Since a low CLK and a low-to-high transition of CLK INH also accomplish clocking, CLK INH should be changed to the high level only while CLK is high. Parallel loading is inhibited when  $\overline{SH}/\overline{LD}$  is held high. While  $\overline{SH}/\overline{LD}$  is low, the parallel inputs to the register are enabled independently of the levels of the CLK, CLK INH, or serial (SER) inputs.

#### FEATURES

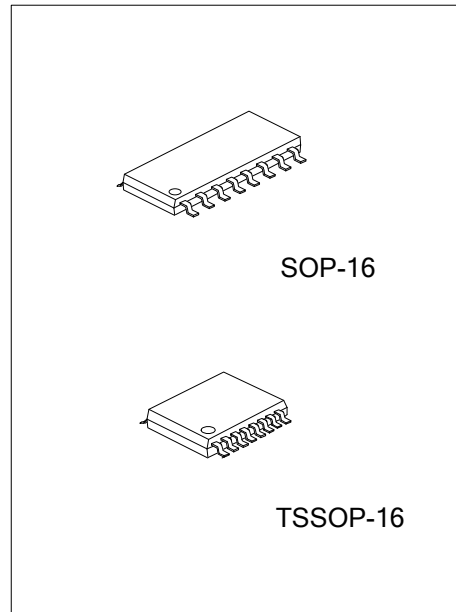
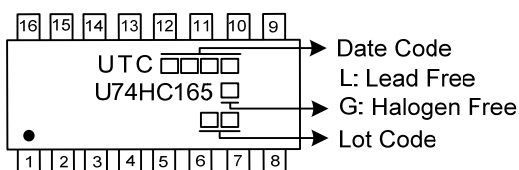
- \* Complementary Outputs
- \* Direct Overriding Load (Data) Inputs
- \* Gated Clock Inputs
- \* Parallel-to-Serial Data Conversion

#### ORDERING INFORMATION

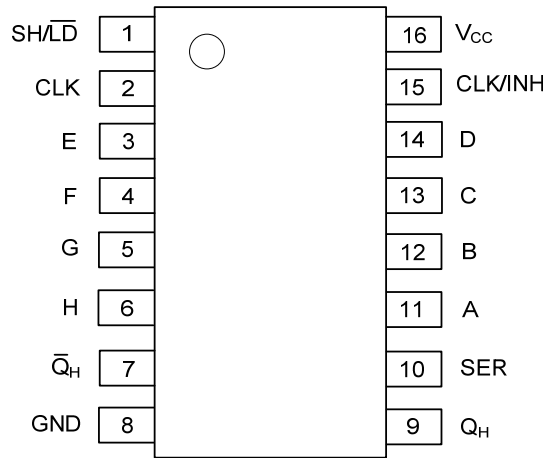
Ordering Number		Package	Packing
Lead Free	Halogen Free		
U74HC165L-S16-R	U74HC165G-S16-R	SOP-16	Tape Reel
U74HC165L-P16-R	U74HC165G-P16-R	TSSOP-16	Tape Reel

<p>U74HC165G-S16-R</p> <ul style="list-style-type: none"> <li>(1) Packing Type</li> <li>(2) Package Type</li> <li>(3) Green Package</li> </ul>	<ul style="list-style-type: none"> <li>(1) R: Tape Reel</li> <li>(2) S16: SOP-16, P16: TSSOP-16</li> <li>(3) G: Halogen Free and Lead Free, L: Lead Free</li> </ul>
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#### MARKING



■ PIN CONFIGURATION



■ PIN DESCRIPTION

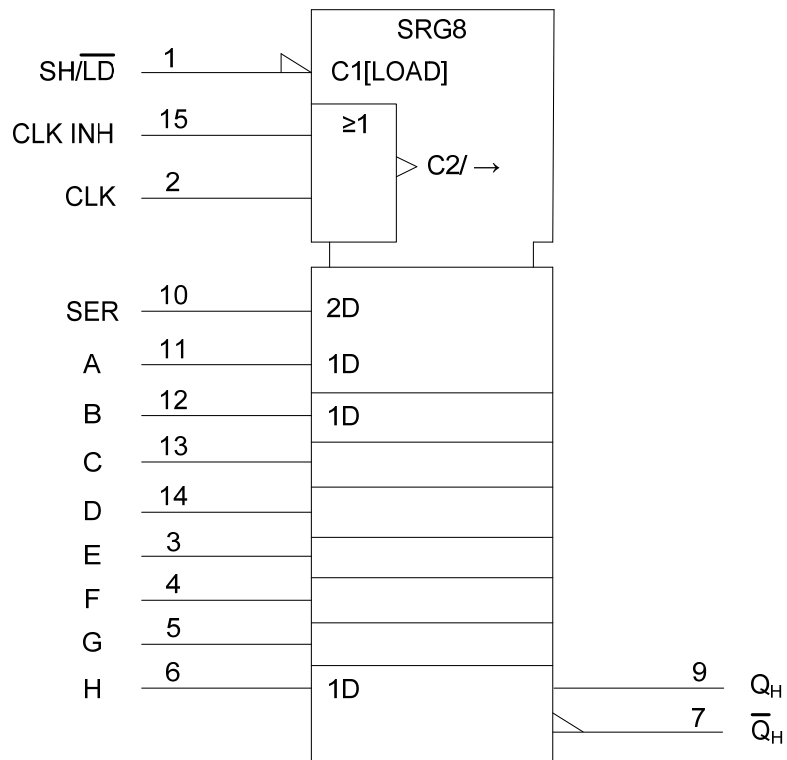
PIN NO.	PIN NAME	DESCRIPTION
1	SH/ $\overline{\text{LD}}$	Asynchronous parallel load input (active LOW)
2	CLK	Clock input (LOW-to-HIGH edge-triggered)
3, 4, 5, 6 11, 12, 13, 14	A to H	Parallel data inputs (also referred to as D <sub>n</sub> )
7	$\overline{\text{Q}}_{\text{H}}$	Complementary output from the last stage
8	GND	Ground (0V)
9	QH	Serial output from the last stage
10	SER	Serial data input
15	CLK/INH	Clock enable input (active LOW)
16	V <sub>CC</sub>	Positive supply voltage

■ FUNCTION TABLE

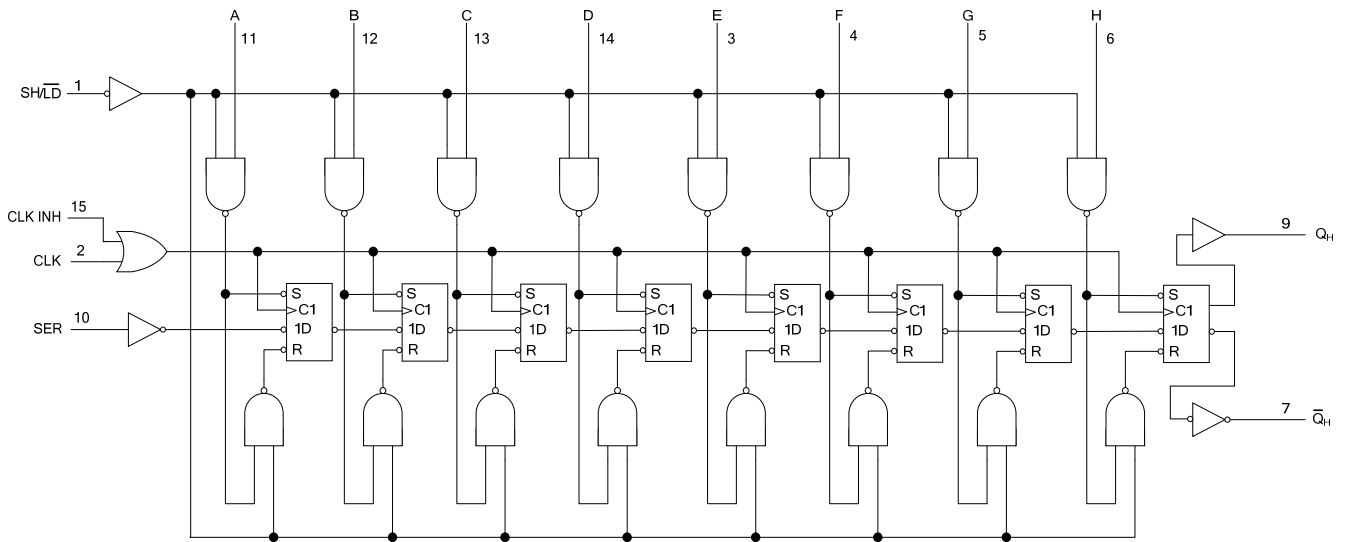
INPUTS			FUNCTION
SH/ $\overline{\text{LD}}$	CLK	CLK INH	
L	X	X	Parallel load
H	H	X	No change
H	X	H	No change
H	L	↑	Shift↑
H	↑	L	Shift↑

↑ Shift=content of each internal register shifts toward serial output Q<sub>H</sub>. Data at SER is shifted into the first register.

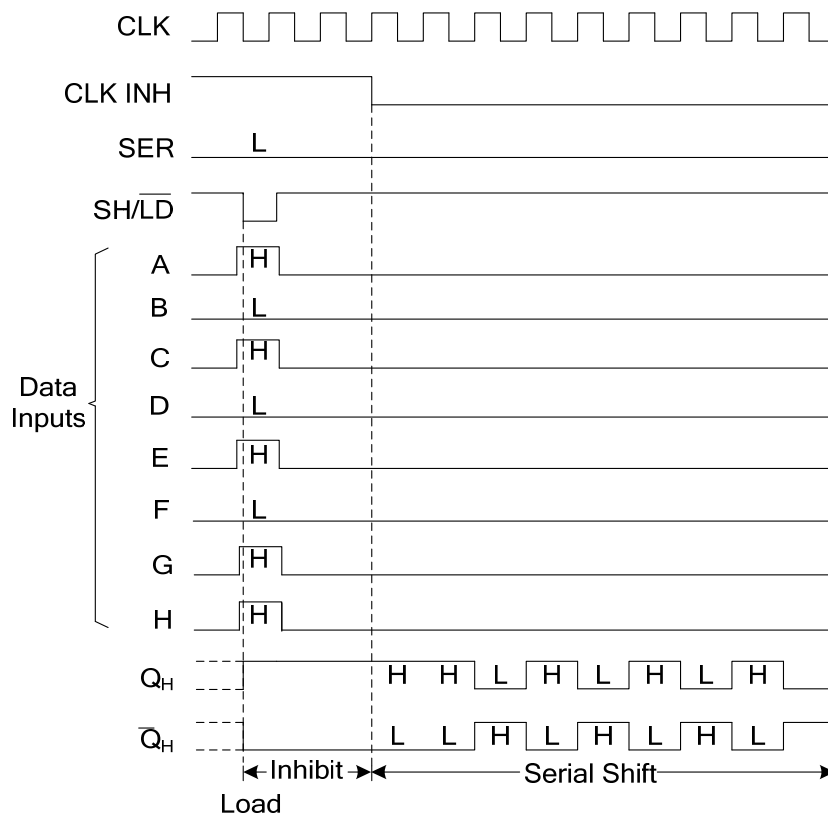
■ LOGIC SYMBOL



■ LOGIC DIAGRAM (positive logic)



■ TYPICAL SHIFT, LOAD, AND INHIBIT SEQUENCE



■ ABSOLUTE MAXIMUM RATING (Unless otherwise specified)

PARAMETER	SYMBOL	RATINGS	UNIT
Supply Voltage	$V_{CC}$	-0.5 ~ 7	V
$V_{CC}$ or GND Current	$I_{CC}$	±50	mA
Output Current	$I_{OUT}$	±25	mA
Input Clamp Current	$I_{IK}$	±20	mA
Output Clamp Current	$I_{OK}$	±20	mA
Storage Temperature	$T_{STG}$	-65 ~ + 150	°C

Note: Absolute maximum ratings are those values beyond which the device could be permanently damaged.  
 Absolute maximum ratings are stress ratings only and functional device operation is not implied.

■ RECOMMENDED OPERATING CONDITIONS

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Supply Voltage	$V_{CC}$		2	5	6	V
High-level Input Voltage	$V_{IH}$	$V_{CC}=2V$	1.5			V
		$V_{CC}=4.5V$	3.15			V
		$V_{CC}=6V$	4.2			V
Low-level Input Voltage	$V_{IL}$	$V_{CC}=2V$			0.5	V
		$V_{CC}=4.5V$			1.35	V
		$V_{CC}=6V$			1.8	V
Input Voltage	$V_{IN}$		0		$V_{CC}$	V
Output Voltage	$V_{OUT}$		0		$V_{CC}$	V
Input Transition (Rise and Fall) Time	$t_t$	$V_{CC}=2V$			1000	ns
		$V_{CC}=4.5V$			500	ns
		$V_{CC}=6V$			400	ns
Operating Free-air Temperature	$T_A$		-40		+125	°C

■ THERMAL DATA

PARAMETER	SYMBOL	RATINGS	UNIT
Junction to Ambient	SOP-16	73	°C/W
	TSSOP-16	110	°C/W

■ ELECTRICAL CHARACTERISTICS (Unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	$T_A=25^{\circ}C$			$T_A=-40\sim+125^{\circ}C$			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
Output Voltage High-Level	$V_{OH}$	$V_{CC}=2V, I_{OH}=-20\mu A$	1.9	1.998		1.9			V
		$V_{CC}=4.5V, I_{OH}=-20\mu A$	4.4	4.499		4.4			V
		$V_{CC}=6V, I_{OH}=-20\mu A$	5.9	5.999		5.9			V
		$V_{CC}=4.5V, I_{OH}=-4mA$	3.98	4.3		3.7			V
		$V_{CC}=6V, I_{OH}=-5.2mA$	5.48	5.8		5.2			V
Output Voltage Low-Level	$V_{OL}$	$V_{CC}=2V, I_{OL}=20\mu A$		0.002	0.1			0.1	V
		$V_{CC}=4.5V, I_{OL}=20\mu A$		0.001	0.1			0.1	V
		$V_{CC}=6V, I_{OL}=20\mu A$		0.001	0.1			0.1	V
		$V_{CC}=4.5V, I_{OL}=4mA$		0.17	0.26			0.4	V
		$V_{CC}=6V, I_{OL}=5.2mA$		0.15	0.26			0.4	V
Input Leakage Current	$I_{(LEAK)}$	$V_{CC}=6V, V_{IN}=V_{CC}$ or GND		±0.1	±1			±1	μA
Quiescent Supply Current	$I_{CC}$	$V_{CC}=6V, V_{IN}=V_{CC}$ or GND, $I_{OUT}=0$			8			160	μA

### ■ TIMING REQUIREMENTS

PARAMETER		SYMBOL	TEST CONDITIONS	T <sub>A</sub> =25°C			T <sub>A</sub> =-40~+125°C			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
Clock frequency		f <sub>clock</sub>	V <sub>CC</sub> =2V	0		6			4.2	MHz
			V <sub>CC</sub> =4.5V	0		31			21	MHz
			V <sub>CC</sub> =6V	0		36			25	MHz
Pulse duration	SH/ $\overline{\text{LD}}$ low	t <sub>w</sub>	V <sub>CC</sub> =2V	80			120			ns
			V <sub>CC</sub> =4.5V	16			24			ns
			V <sub>CC</sub> =6V	14			20			ns
	CLK high or low		V <sub>CC</sub> =2V	80			120			ns
			V <sub>CC</sub> =4.5V	16			24			ns
			V <sub>CC</sub> =6V	14			20			ns
Setup time	SH/ $\overline{\text{LD}}$ high before CLK↑	t <sub>su</sub>	V <sub>CC</sub> =2V	80			120			ns
			V <sub>CC</sub> =4.5V	16			24			ns
			V <sub>CC</sub> =6V	14			20			ns
	SER before CLK↑		V <sub>CC</sub> =2V	40			60			ns
			V <sub>CC</sub> =4.5V	8			12			ns
			V <sub>CC</sub> =6V	7			10			ns
	CLK INH low before CLK↑		V <sub>CC</sub> =2V	100			150			ns
			V <sub>CC</sub> =4.5V	20			30			ns
			V <sub>CC</sub> =6V	17			25			ns
	CLK INH high before CLK↑		V <sub>CC</sub> =2V	40			60			ns
			V <sub>CC</sub> =4.5V	8			12			ns
			V <sub>CC</sub> =6V	7			10			ns
Data before SH/ $\overline{\text{LD}}$ ↓	V <sub>CC</sub> =2V	100			150			ns		
	V <sub>CC</sub> =4.5V	20			30			ns		
	V <sub>CC</sub> =6V	17			25			ns		
Hold time	SER data after CLK↑	t <sub>h</sub>	V <sub>CC</sub> =2V	5			5			ns
			V <sub>CC</sub> =4.5V	5			5			ns
			V <sub>CC</sub> =6V	5			5			ns
	PAR data after SH/ $\overline{\text{LD}}$ ↓		V <sub>CC</sub> =2V	5			5			ns
			V <sub>CC</sub> =4.5V	5			5			ns
			V <sub>CC</sub> =6V	5			5			ns

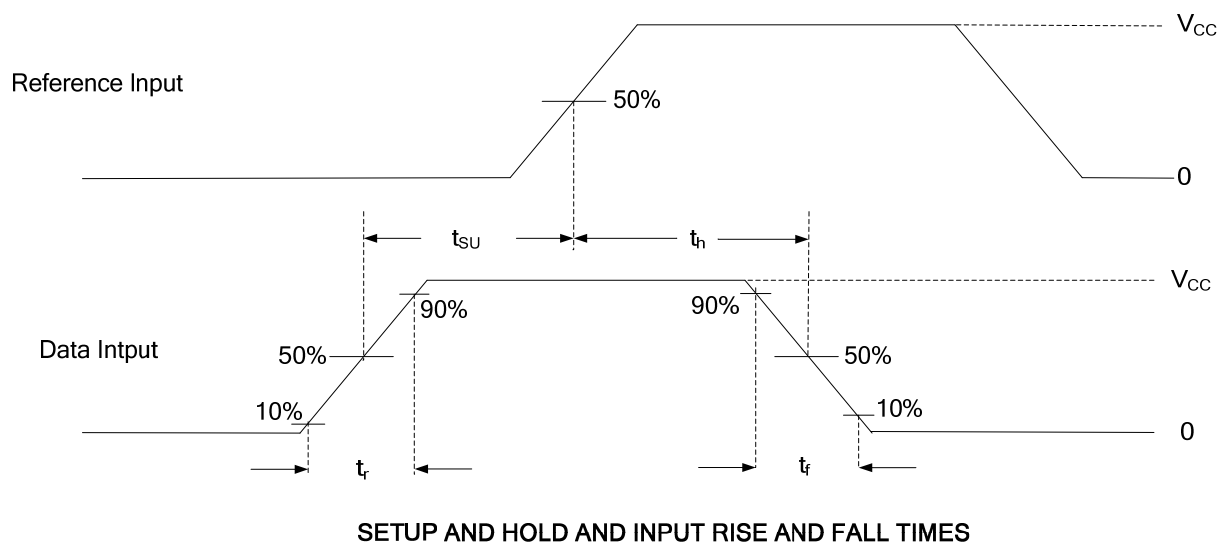
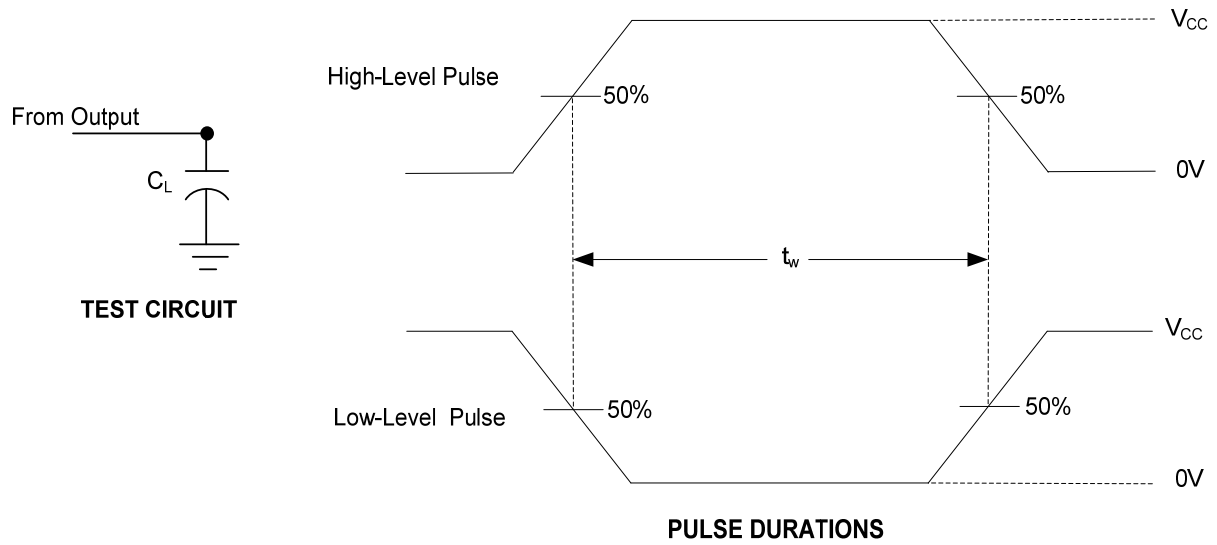
■ SWITCHING CHARACTERISTICS ( $t_r = t_f = 6\text{ns}$ ,  $C_L = 50\text{Pf}$ , unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	$T_A = 25^\circ\text{C}$			$T_A = -40 \sim +125^\circ\text{C}$			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
Minimum Frequency Response	$f_{\text{max}}$	$V_{\text{CC}} = 2\text{V}$	6	13		4			MHz
		$V_{\text{CC}} = 4.5\text{V}$	31	50		20			MHz
		$V_{\text{CC}} = 6\text{V}$	36	62		24			MHz
Propagation delay from input (SH/ $\overline{\text{LD}}$ ) to output (QH or $\overline{\text{QH}}$ )	$t_{\text{PD}}$	$V_{\text{CC}} = 2\text{V}$		80	150			250	ns
		$V_{\text{CC}} = 4.5\text{V}$		20	30			50	ns
		$V_{\text{CC}} = 6\text{V}$		16	26			43	ns
Propagation delay from input (CLK) to output (QH or $\overline{\text{QH}}$ )	$t_{\text{PD}}$	$V_{\text{CC}} = 2\text{V}$		75	150			250	ns
		$V_{\text{CC}} = 4.5\text{V}$		15	30			50	ns
		$V_{\text{CC}} = 6\text{V}$		13	26			43	ns
Propagation delay from input (H) to output (QH or $\overline{\text{QH}}$ )	$t_{\text{PD}}$	$V_{\text{CC}} = 2\text{V}$		75	150			180	ns
		$V_{\text{CC}} = 4.5\text{V}$		15	30			36	ns
		$V_{\text{CC}} = 6\text{V}$		13	26			31	ns
To Output (Any)	$t_t$	$V_{\text{CC}} = 2\text{V}$		38	75			110	ns
		$V_{\text{CC}} = 4.5\text{V}$		8	15			22	ns
		$V_{\text{CC}} = 6\text{V}$		6	13			19	ns

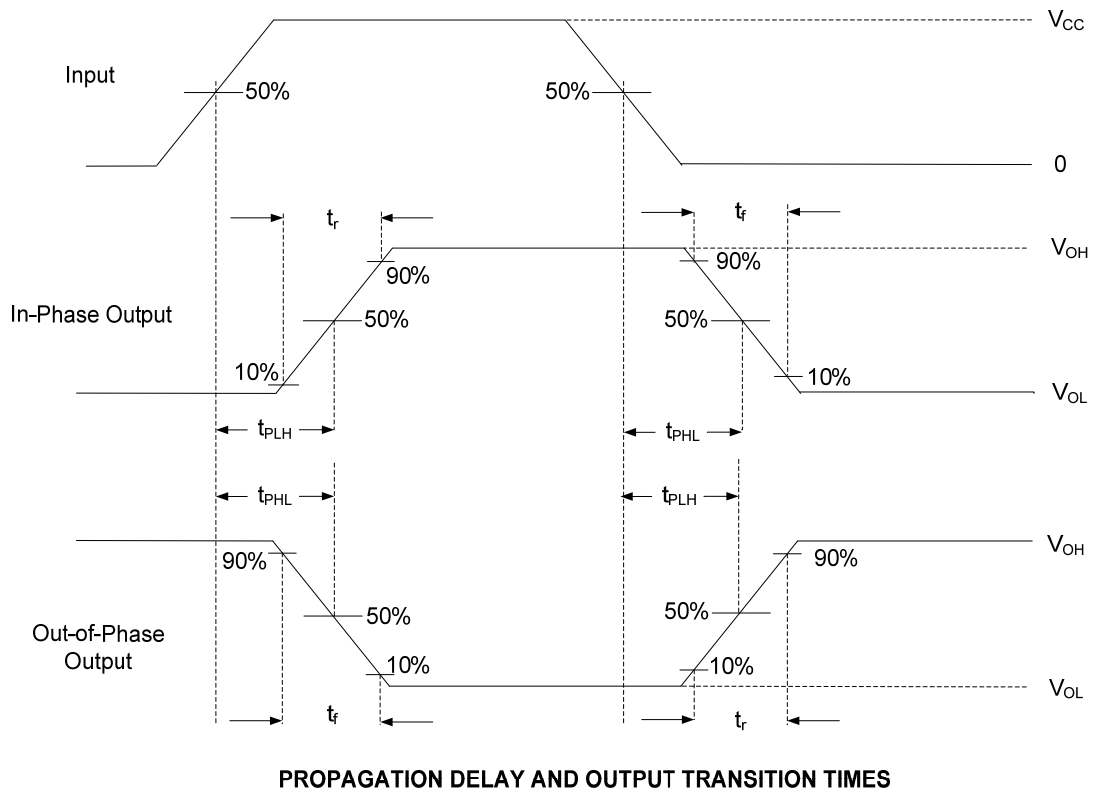
■ OPERATING CHARACTERISTICS (Unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Input Capacitance	$C_i$	$V_{\text{CC}} = 2\text{V to } 6\text{V}$		3	10	pF
Power Dissipation Capacitance	$C_{\text{PD}}$	No load		75		pF

■ TEST CIRCUIT AND WAVEFORMS



■ TEST CIRCUIT AND WAVEFORMS (Cont.)



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