



3.3V CMOS PRESETTABLE SYNCHRONOUS 4-BIT BINARY COUNTER WITH ASYNCHRONOUS RESET, 5 VOLT TOLERANT I/O

IDT74LVC161A

FEATURES:

- 0.5 MICRON CMOS Technology
- ESD > 2000V per MIL-STD-883, Method 3015; > 200V using machine model (C = 200pF, R = 0)
- 1.27mm pitch SOIC, 0.635mm pitch QSOP, 0.65mm pitch SSOP, 0.65mm pitch TSSOP packages
- Extended commercial range of - 40°C to +85°C
- V_{CC} = 3.3V ±0.3V, Normal Range
- V_{CC} = 2.3V to 3.6V, Extended Range
- CMOS power levels (0.4μW typ. static)
- Rail-to-Rail output swing for increased noise margin
- All inputs, outputs and I/O are 5 Volt tolerant
- Supports hot insertion

Drive Features for LVC161A:

- High Output Drivers: ±24mA
- Reduced system switching noise

APPLICATIONS:

- 5V and 3.3V mixed voltage systems
- Data communication and telecommunication systems

DESCRIPTION:

The LVC161A is a high-performance, low-power, low-voltage, Si-gate CMOS device, superior to most advanced CMOS-compatible TTL families.

The LVC161A is a presettable synchronous binary counter which features an internal look-ahead carry and can be used for high-speed

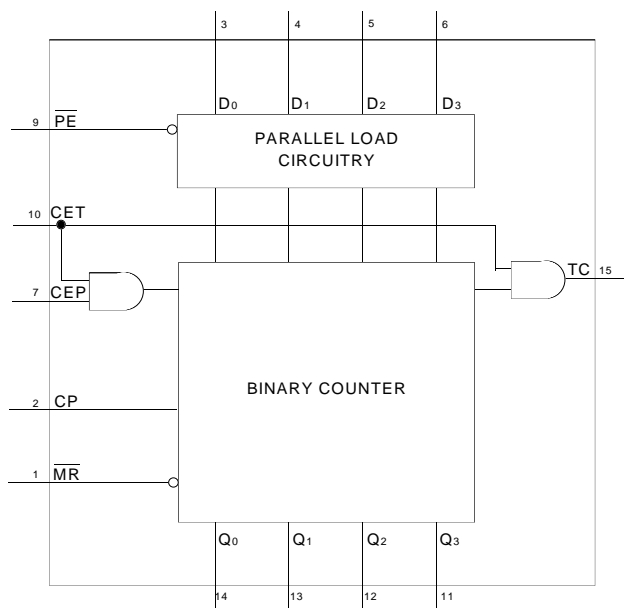
counting. Synchronous operation is provided by having all flip-flops clocked simultaneously on the positive-going edge of the clock (CP). Outputs (Q₀ to Q₃) of the counters may be preset to a high or low level. A low level at the parallel enable input (\overline{PE}) disables the counting action and causes the data at inputs (D₀ to D₃) to be loaded into the counter on the positive-going edge of the clock (provided that the set-up and hold time requirements for \overline{PE} are met). Preset takes place regardless of the levels at the count enable inputs (CEP and CET). A low level at the master reset input (\overline{MR}) sets all four outputs of the flip-flops (Q₀ to Q₃) to low level regardless of the levels at CP, \overline{PE} , CET, and CEP inputs (thus providing an asynchronous clear function).

The look-ahead carry simplifies serial cascading of the counters. Both count enable inputs (CEP and CET) must be high to count. The CET input is fed forward to enable the terminal count output (TC). The TC output thus enabled will produce a high output pulse of a duration approximately equal to a high level output of Q₀. This pulse can be used to enable the next cascaded stage. The maximum clock frequency for the cascaded counters is determined by the CP to TC propagation delay and CEP to CP set-up time, according to the following formula:

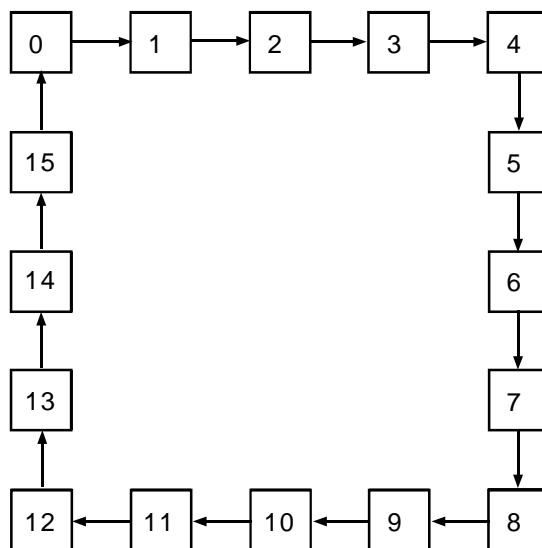
$$f_{max} = \frac{1}{t_{p(max)}(CP \text{ to } TC) + t_{su}(CEP \text{ to } CP)}$$

Inputs can be driven from either 3.3V or 5V devices. This feature allows the use of this device as a translator in a mixed 3.3V/5V supply system.

FUNCTIONAL DIAGRAM



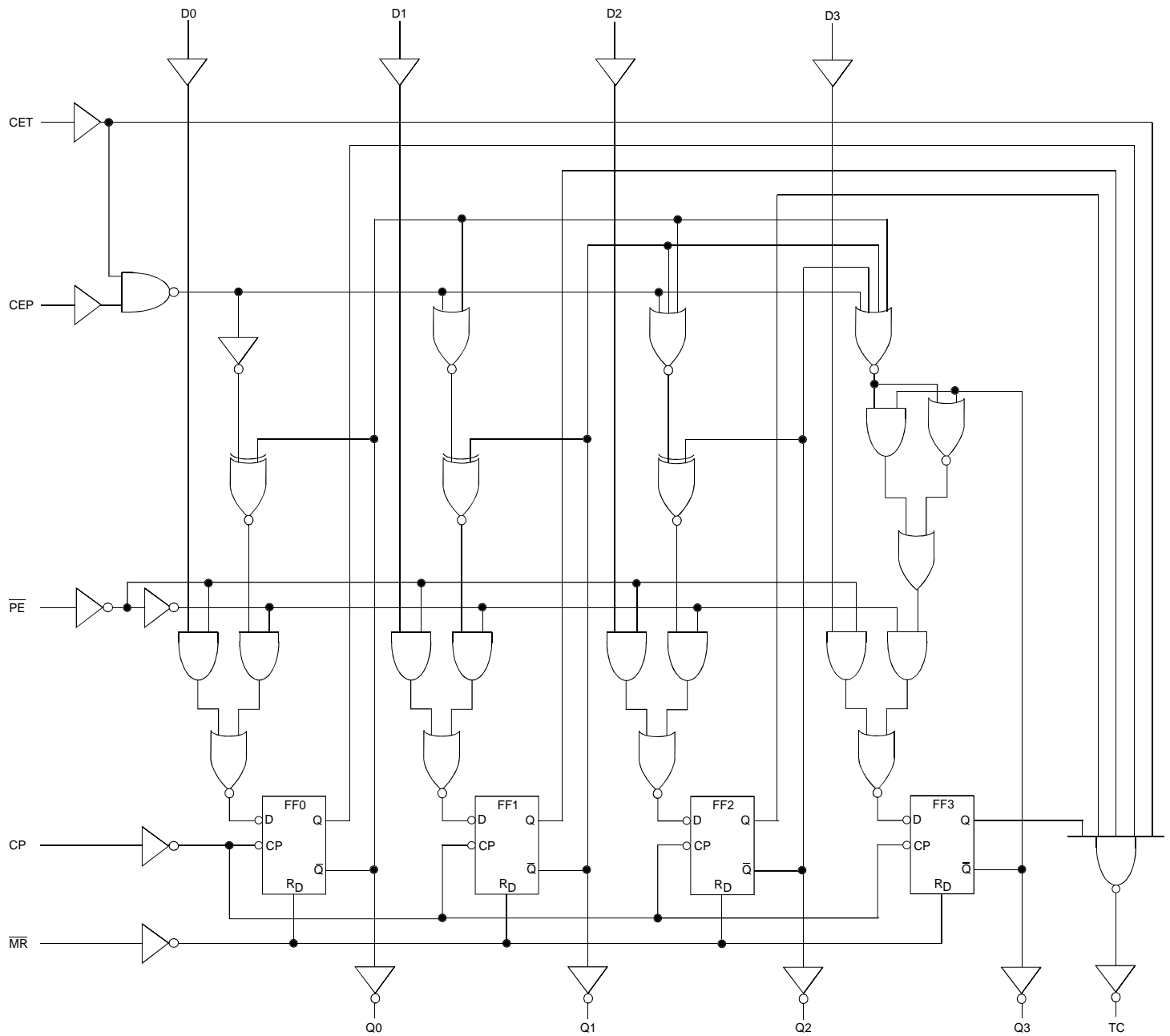
STATE DIAGRAM



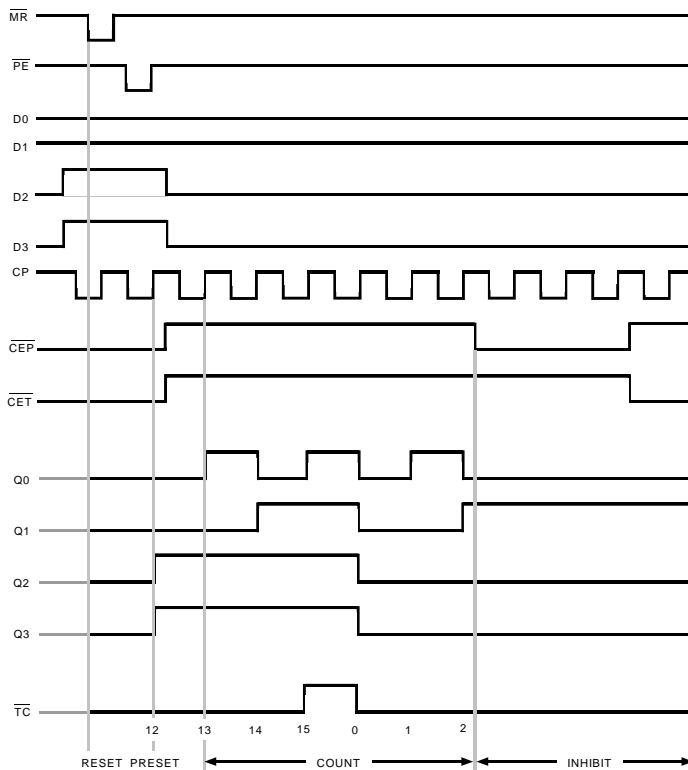
EXTENDED COMMERCIAL TEMPERATURE RANGE

OCTOBER 1999

FUNCTIONAL BLOCK DIAGRAM



TYPICAL TIMING SEQUENCE



ABSOLUTE MAXIMUM RATINGS (1)

Symbol	Description	Max.	Unit
V _{TERM}	Terminal Voltage with Respect to GND	- 0.5 to +6.5	V
T _{STG}	Storage Temperature	- 65 to +150	°C
I _{OUT}	DC Output Current	- 50 to +50	mA
I _{IK} I _{OK}	Continuous Clamp Current, V _I < 0 or V _O < 0	- 50	mA
I _{CC} I _{SS}	Continuous Current through each V _{CC} or GND	±100	mA

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NOTE:

1. Stresses greater than those listed under ABSOLUTE MAXIMUM RATINGS may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

CAPACITANCE (T_A = +25°C, f = 1.0MHz)

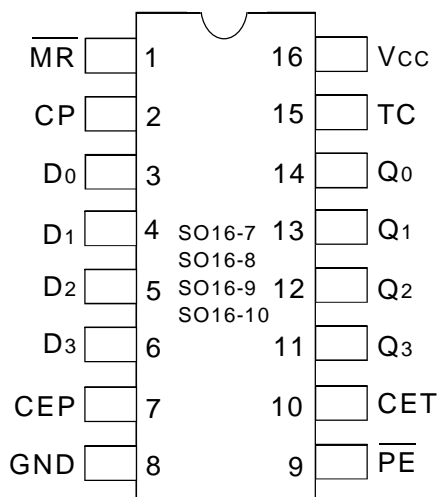
Symbol	Parameter(1)	Conditions	Typ.	Max.	Unit
C _{IN}	Input Capacitance	V _{IN} = 0V	4.5	6	pF
C _{OUT}	Output Capacitance	V _{OUT} = 0V	5.5	8	pF
C _{I/O}	I/O Port Capacitance	V _{IN} = 0V	6.5	8	pF

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NOTE:

1. As applicable to the device type.

PIN CONFIGURATION



SOIC/ SSOP/ TSSOP/ QSOP
 TOP VIEW

PIN DESCRIPTION

Pin Names	Description
\overline{MR}	Asynchronous Master Reset (Active LOW)
CP	Clock Input (LOW-to-HIGH, Edge-Triggered)
D _x	Data Inputs
CEP	Count Enable Inputs
GND	Ground (0V)
\overline{PE}	Parallel Enable Input (Active LOW)
CET	Count Enable Carry Input
Q _x	Flip-Flop Outputs
TC	Terminal Count Output
V _{CC}	Positive Supply Voltage

FUNCTION TABLE (1)

OPERATING MODES	INPUTS						OUTPUTS	
	\overline{MR}	CP	CEP	CET	\overline{PE}	Dx	Qx	TC
Reset (clear)	L	X	X	X	X	X	L	L
Parallel load	H	↑	X	X	l	l	L	L
	H	↑	X	X	l	h	H	*
Count	H	↑	h	h	h	X	count	*
Hold (do nothing)	H	X	l	X	h	X	Q ₀	*
	H	X	X	l	h	X	Q ₀	L

NOTE:

- H = HIGH Voltage Level
 h = HIGH Voltage level one setup time prior to the LOW-to-HIGH clock transition.
 L = LOW Voltage Level
 l = LOW Voltage level one setup time prior to the LOW-to-HIGH clock transition.
 Q₀ = Indicates the state of the referenced output one set up time prior to the LOW-to-HIGH clock transition.
 X = Don't care
 * = The TC output is HIGH when CET is HIGH and the counter is at Terminal Count (HHHH).
 ↑ = LOW-to-HIGH clock transition

DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE

Following Conditions Apply Unless Otherwise Specified:

Operating Condition: T_A = - 40°c to +85°c

Symbol	Parameter	Test Conditions		Min.	Typ. ⁽¹⁾	Max.	Unit
V _{IH} ⁽²⁾	Input HIGH Voltage Level	V _{CC} = 2.3V to 2.7V		1.7	—	—	V
		V _{CC} = 2.7V to 3.6V		2	—	—	
V _{IL}	Input LOW Voltage Level	V _{CC} = 2.3V to 2.7V		—	—	0.7	V
		V _{CC} = 2.7V to 3.6V		—	—	0.8	
I _{IH} I _{IL}	Input Leakage Current	V _{CC} = 3.6V	V _I = 0 to 5.5V	—	—	±5	μA
I _{OZH} I _{OZL}	High Impedance Output Current (3-State Output pins)	V _{CC} = 3.6V	V _O = 0 to 5.5V	—	—	±10	μA
I _{OFF}	Input/Output Power Off Leakage	V _{CC} = 0V, V _{IN} or V _O ≤ 5.5V		—	—	±50	μA
V _{IK}	Clamp Diode Voltage	V _{CC} = 2.3V, I _{IN} = - 18mA		—	- 0.7	- 1.2	V
V _H	Input Hysteresis	V _{CC} = 3.3V		—	100	—	mV
I _{CC1} I _{CC2} I _{CC3}	Quiescent Power Supply Current	V _{CC} = 3.6V	V _{IN} = GND or V _{CC}	—	—	10	μA
ΔI _{CC}	Quiescent Power Supply Current Variation	One input at V _{CC} - 0.6V other inputs at V _{CC} or GND		—	—	500	μA

NOTES:

- Typical values are at V_{CC} = 3.3V, +25°C ambient.
- Clock Pin (CP) requires a minimum V_{IH} of 2.5V.

OUTPUT DRIVE CHARACTERISTICS

Symbol	Parameter	Test Conditions ⁽¹⁾		Min.	Max.	Unit
VOH	Output HIGH Voltage	VCC = 2.3V to 3.6V	IOH = - 0.1mA	VCC - 0.2	—	V
		VCC = 2.3V	IOH = - 6mA	2	—	
		VCC = 2.3V	IOH = - 12mA	1.7	—	
		VCC = 2.7V		2.2	—	
		VCC = 3.0V		2.4	—	
		VCC = 3.0V	IOH = - 24mA	2.2	—	
VOL	Output LOW Voltage	VCC = 2.3V to 3.6V	IOL = 0.1mA	—	0.2	V
		VCC = 2.3V	IOL = 6mA	—	0.4	
			IOL = 12mA	—	0.7	
		VCC = 2.7V	IOL = 12mA	—	0.4	
		VCC = 3.0V	IOL = 24mA	—	0.55	

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NOTE:

1. VIH and VIL must be within the min. or max. range shown in the DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE table for the appropriate VCC range. TA = - 40°C to +85°C.

OPERATING CHARACTERISTICS, TA = 25°C

Symbol	Parameter	Test Conditions	VCC = 2.5V±0.2V	VCC = 3.3V±0.3V	Unit
			Typical	Typical	
CPD	Power Dissipation Capacitance	CL = 0pF, f = 10Mhz	—	—	pF

SWITCHING CHARACTERISTICS (1)

Symbol	Parameter	V _{CC} = 2.7V		V _{CC} = 3.3V±0.3V		Unit
		Min.	Max.	Min.	Max.	
t _{PHL} t _{PLH}	Propagation Delay CP to Qx	—	9	—	8	ns
t _{PHL} t _{PLH}	Propagation Delay CP to TC	—	11	—	9.5	ns
t _{PHL} t _{PLH}	Propagation Delay CET to TC	—	8.8	—	7.8	ns
t _{PHL}	Propagation Delay \overline{MR} to Qx	—	10	—	9	ns
t _{PHL}	Propagation Delay \overline{MR} to TC	—	11	—	10	ns
t _w	Clock Pulse Width HIGH or LOW	5	—	4	—	ns
t _w	Master Reset width LOW	4	—	3	—	ns
t _{REM}	Removal Time \overline{MR} to CP	0.5	—	0.5	—	ns
t _{SU}	Set-Up Time Dx to CP	3.5	—	3	—	ns
t _{SU}	Set-Up Time \overline{PE} to CP	3.5	—	3	—	ns
t _{SU}	Set-Up Time CEP, CET to CP	5.5	—	5	—	ns
t _H	Hold Time Dx, \overline{PE} , CEP, CET to CP	0	—	0	—	ns
t _{SK(o)}	Output Skew ⁽²⁾	—	—	—	500	ps

NOTES:

1. See test circuits and waveforms. T_A = -40°C to +85°C.
2. Skew between any two outputs of the same package and switching in the same direction.

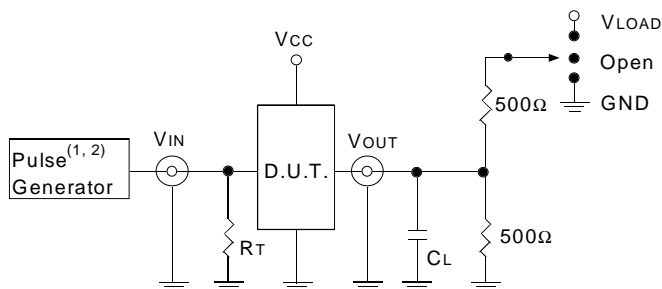
TEST CIRCUITS AND WAVEFORMS

TEST CONDITIONS

Symbol	V _{CC} (1) = 2.5V ± 0.2V	V _{CC} (2) = 3.3V ± 0.3V & 2.7V	Unit
V _{LOAD}	2 x V _{CC}	6	V
V _{IH}	V _{CC}	2.7	V
V _T	V _{CC} / 2	1.5	V
V _{LZ}	150	300	mV
V _{HZ}	150	300	mV
C _L	30	50	pF

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TEST CIRCUITS FOR ALL OUTPUTS



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DEFINITIONS:

C_L = Load capacitance: includes jig and probe capacitance.

R_T = Termination resistance: should be equal to Z_{OUT} of the Pulse Generator.

NOTES:

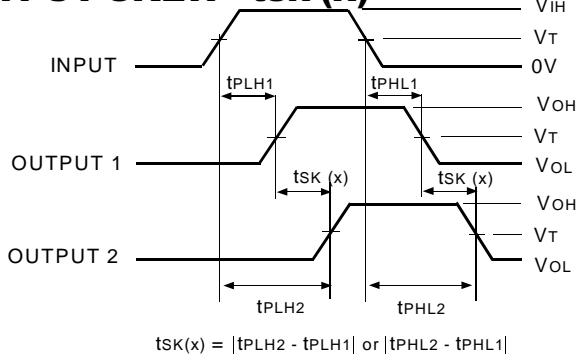
1. Pulse Generator for All Pulses: Rate ≤ 10MHz; t_r ≤ 2ns; t_r ≤ 2ns.
2. Pulse Generator for All Pulses: Rate ≤ 10MHz; t_r ≤ 2.5ns; t_r ≤ 2.5ns.

SWITCH POSITION

Test	Switch
Open Drain Disable Low Enable Low	V _{LOAD}
Disable High Enable High	GND
All Other tests	Open

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OUTPUT SKEW - t_{SK}(x)



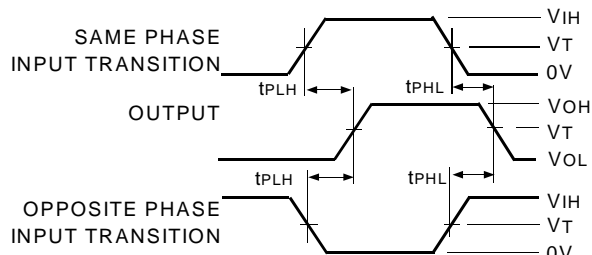
$$t_{SK}(x) = |t_{PLH2} - t_{PLH1}| \text{ or } |t_{PHL2} - t_{PHL1}|$$

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NOTES:

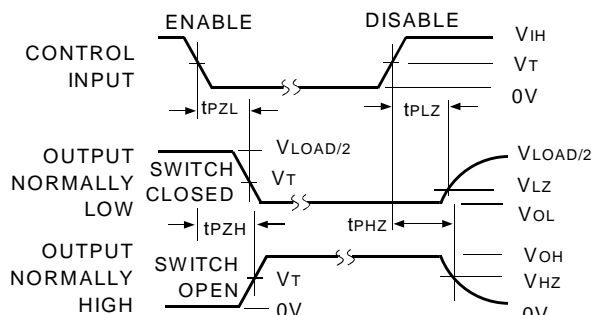
1. For t_{SK}(a) OUTPUT1 and OUTPUT2 are any two outputs.
2. For t_{SK}(b) OUTPUT1 and OUTPUT2 are in the same bank.

PROPAGATION DELAY



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ENABLE AND DISABLE TIMES

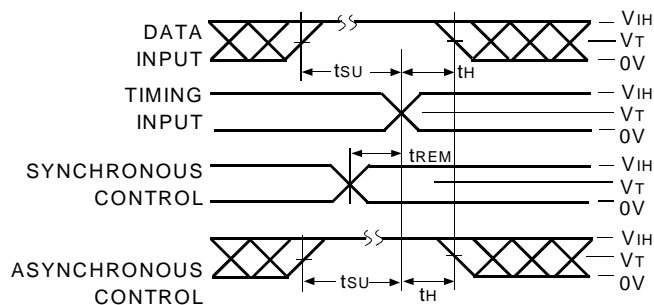


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NOTE:

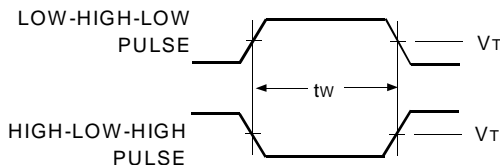
1. Diagram shown for input Control Enable-LOW and input Control Disable-HIGH.

SET-UP, HOLD, AND RELEASE TIMES



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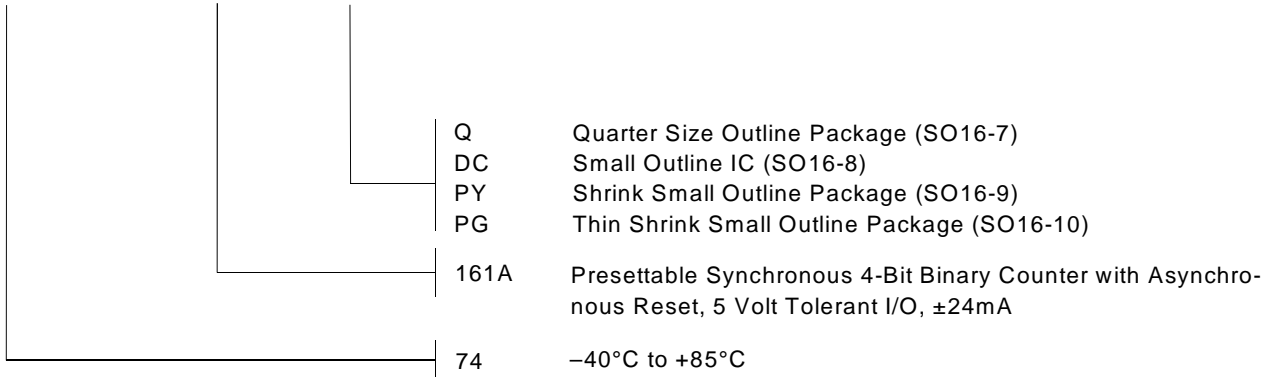
PULSE WIDTH



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ORDERING INFORMATION

IDT XX LVC XXXX XX
Temp. Range Device Type Package



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