3.3V CMOS OCTAL EDGE-TRIGGERED D-TYPE FLIP-FLOP WITH 3-STATE OUTPUTS AND 5 VOLT TOLERANT I/O

IDT74LVC374A

FEATURES:

- **0.5 MICRON CMOS Technology**
- **ESD > 2000V per MIL-STD-883, Method 3015; > 200V using machine model (C = 200pF, R = 0)**
- **Vcc = 3.3V ± 0.3V, Normal Range**
- **Vcc = 2.7V to 3.6V, Extended Range**
- **CMOS power levels (0.4µ W typ. static)**
- **Rail-to-rail output swing for increased noise margin**
- **All inputs, outputs, and I/O are 5V tolerant**
- **Supports hot insertion**
- **Available in SOIC, SSOP, QSOP, and TSSOP packages**

DRIVE FEATURES:

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

APPLICATIONS:

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

DESCRIPTION:

The LVC374A octal edge triggered D-type flip-flop is built using advanced dual metal CMOS technology. This device features 3-state outputs designed specifically for driving highly capacitive or relatively low-impedance loads. The LVC374A device is particularly suitable for implementing buffer registers, input-output (I/O) ports, bidirectional bus drivers, and working registers.

On the positive transition of the clock (CLK) input, the Q outputs are set to the logic levels set up at the data (D) inputs.

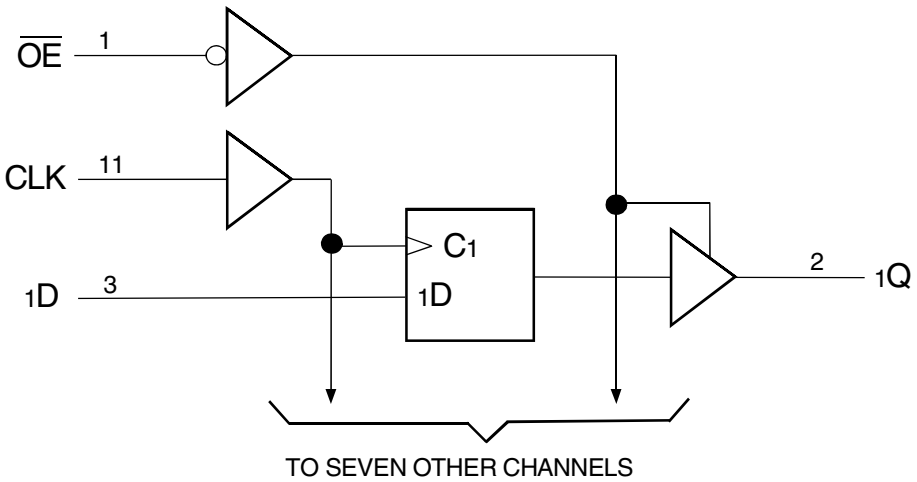
A buffered output-enable ($\overline{OE}$) input can be used to place the eight outputs in either a normal logic state (high or low logic levels) or a high-impedance state. In the high-impedance state, the outputs neither load nor drive the bus lines significantly. The high-impedance state and increased drive provide the capability to drive bus lines without interface or pullup components. $\overline{OE}$ does not affect internal operations of the latch. Old data can be retained or new data can be entered while the outputs are in the high-impedance state.

The LVC374A has been designed with a ±24mA output driver. This driver is capable of driving a moderate to heavy load while maintaining speed performance.

To ensure the high-impedance state during power up or power down, $\overline{OE}$ should be tied to Vcc through a pullup resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver.

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 system environment.

FUNCTIONAL BLOCK DIAGRAM



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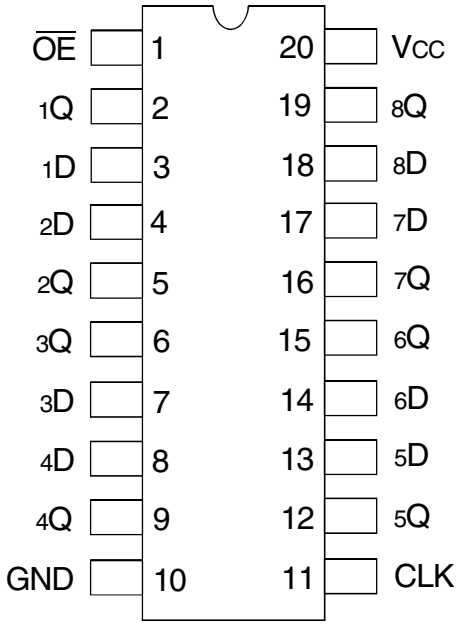
PIN CONFIGURATION



SOIC/ SSOP/ QSOP/ TSSOP
TOP VIEW

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

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

NOTE:
1. As applicable to the device type.

PIN DESCRIPTION

Pin Names	Description
$\overline{OE}$	Output Enable Input (Active LOW)
CLK	Clock Input
xD	Data Inputs
xQ	Data Outputs

FUNCTION TABLE (EACH FLIP-FLOP)(1)

Inputs			Outputs
xD	**CLK**	**$\overline{OE}$**	**xQ**
H	↑	L	H
L	↑	L	L
X	H or L	L	Q(2)
X	X	H	Z

NOTES:
1. H = HIGH Voltage Level
   X = Don't Care
   L = LOW Voltage Level
   Z = High-Impedance
   ↑ = LOW-to-HIGH Transition
2. Output level before the indicated steady-state input conditions were established.

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}	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 $V_O \leq$ 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_{CCL} I_{CCH}	Quiescent Power Supply Current	V_{CC} = 3.6V	V_{IN} = GND or V_{CC}	—	—	10	µA
I_{CCZ}			$3.6 \leq V_{IN} \leq 5.5V$(2)	—	—	10	
ΔI_{CC}	Quiescent Power Supply Current Variation	One input at V_{CC} - 0.6V, other inputs at V_{CC} or GND		—	—	500	µA

NOTES:
1. Typical values are at V_{CC} = 3.3V, +25°C ambient.
2. This applies in the disabled state only.

OUTPUT DRIVE CHARACTERISTICS

Symbol	Parameter	Test Conditions(1)		Min.	Max.	Unit
V_{OH}	Output HIGH Voltage	V_{CC} = 2.3V to 3.6V	I_{OH} = – 0.1mA	V_{CC} – 0.2	—	V
		V_{CC} = 2.3V	I_{OH} = – 6mA	2	—	
		V_{CC} = 2.3V	I_{OH} = – 12mA	1.7	—	
		V_{CC} = 2.7V		2.2	—	
		V_{CC} = 3V		2.4	—	
		V_{CC} = 3V	I_{OH} = – 24mA	2.2	—	
V_{OL}	Output LOW Voltage	V_{CC} = 2.3V to 3.6V	I_{OL} = 0.1mA	—	0.2	V
		V_{CC} = 2.3V	I_{OL} = 6mA	—	0.4	
			I_{OL} = 12mA	—	0.7	
		V_{CC} = 2.7V	I_{OL} = 12mA	—	0.4	
		V_{CC} = 3V	I_{OL} = 24mA	—	0.55	

NOTE:
1. V_{IH} and V_{IL} must be within the min. or max. range shown in the DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE table for the appropriate V_{CC} range. T_A = – 40°C to + 85°C.

OPERATING CHARACTERISTICS, V_{CC} = 3.3V ± 0.3V, T_A = 25°C

Symbol	Parameter	Test Conditions	Typical	Unit
C_{PD}	Power Dissipation Capacitance per Flip-Flop Outputs enabled	C_L = 0pF, f = 10Mhz	54.5	pF
C_{PD}	Power Dissipation Capacitance per Flip-Flop Outputs disabled		13.5	

SWITCHING CHARACTERISTICS(1)

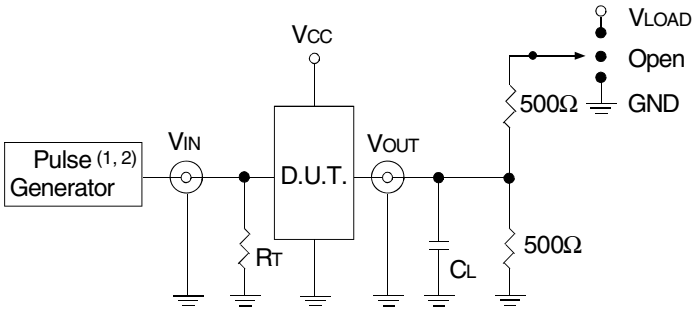
Symbol	Parameter	Vcc = 2.7V		Vcc = 3.3V ± 0.3V		Unit
		Min.	Max.	Min.	Max.	
f_{MAX}		80	—	100	—	MHz
t_{PLH} t_{PHL}	Propagation Delay CLK to xQ	—	8.1	1.5	7	ns
t_{PZH} t_{PZL}	Output Enable Time $\overline{OE}$ to xQ	—	8.5	1.5	7.5	ns
t_{PHZ} t_{PLZ}	Output Disable Time $\overline{OE}$ to xQ	—	7.1	1.5	6.5	ns
t_W	Pulse Duration, CLK HIGH or LOW	3.3	—	3.3	—	ns
t_{SU}	Set-up Time, data before CLK↑	2	—	2	—	ns
t_H	Hold Time, data after CLK↑	1.5	—	1.5	—	ns
$t_{SK}(o)$	Output Skew(2)	—	—	—	1	ns

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	$V_{CC}^{(1)}$= 3.3V±0.3V	$V_{CC}^{(1)}$= 2.7V	$V_{CC}^{(2)}$= 2.5V±0.2V	Unit
V_{LOAD}	6	6	2 x Vcc	V
V_{IH}	2.7	2.7	Vcc	V
V_T	1.5	1.5	Vcc / 2	V
V_{LZ}	300	300	150	mV
V_{HZ}	300	300	150	mV
C_L	50	50	30	pF



LVC Link

Test Circuit for All Outputs

DEFINITIONS:

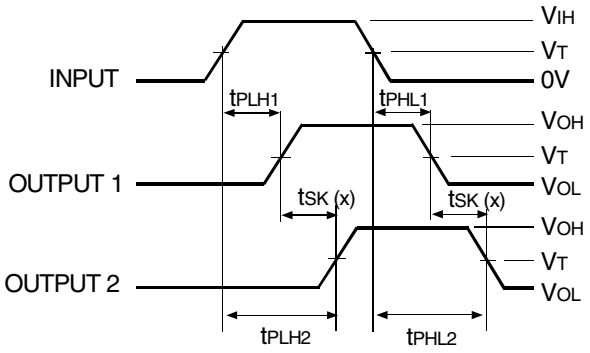
C_L = Load capacitance: includes jig and probe capacitance.
R_T = Termination resistance: should be equal to Z_{OUT} of the Pulse Generator.

NOTES:

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

SWITCH POSITION

Test	Switch
Open Drain Disable Low Enable Low	V_{LOAD}
Disable High Enable High	GND
All Other Tests	Open



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

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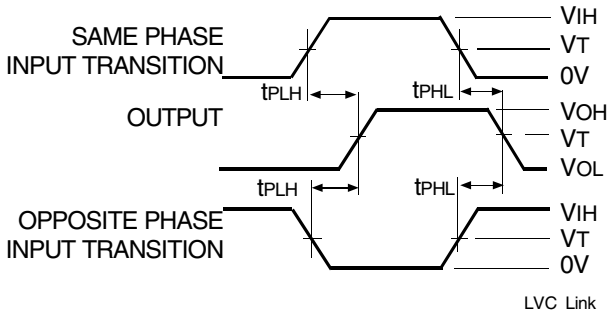
Output Skew - $t_{SK(x)}$

NOTES:

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



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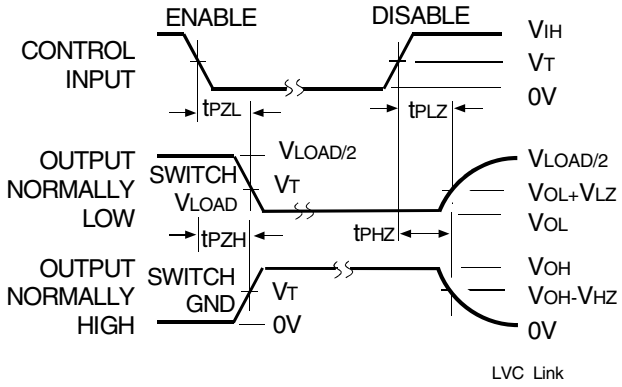
Propagation Delay



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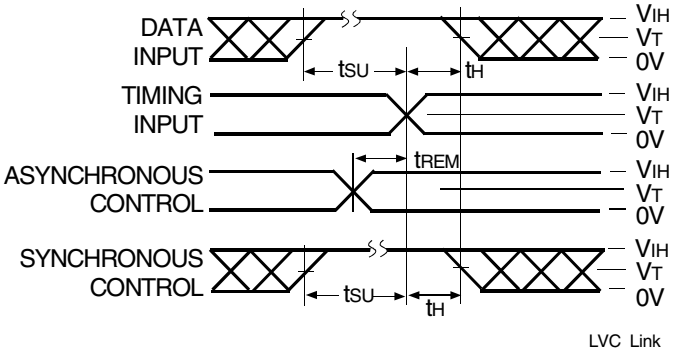
Enable and Disable Times

NOTE:

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



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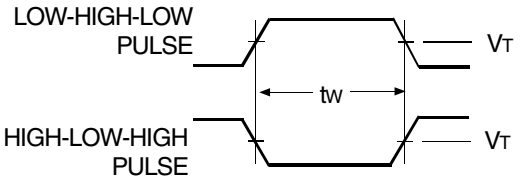
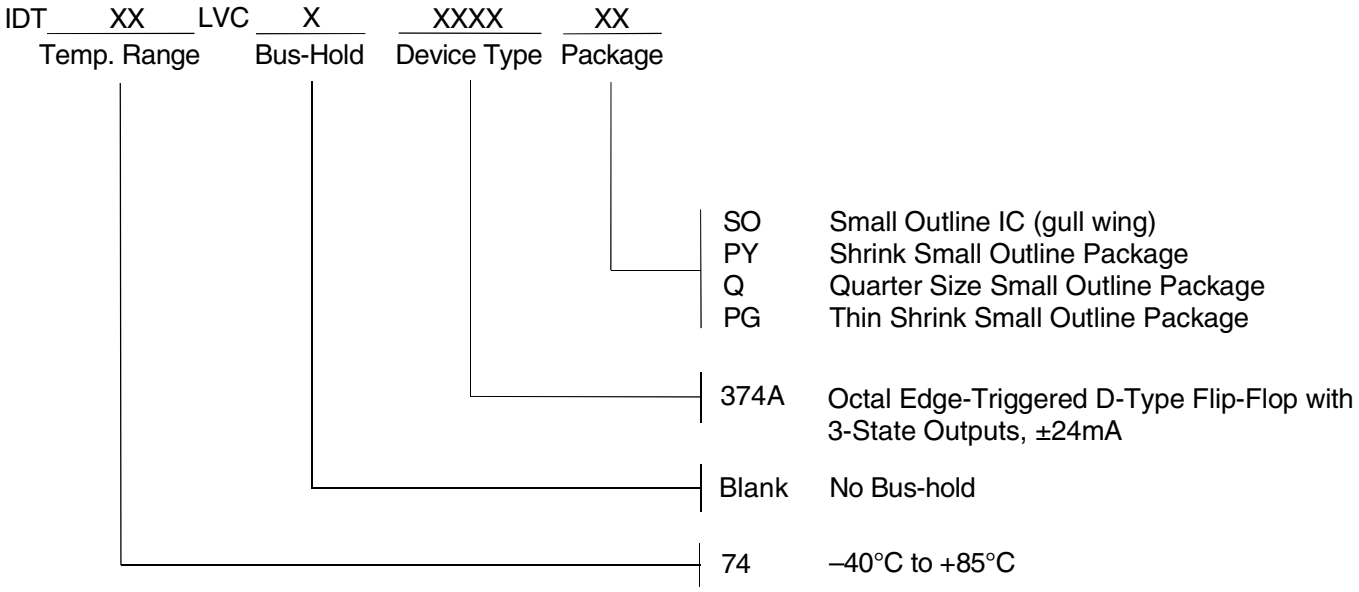
Set-up, Hold, and Release Times



LVC Link

Pulse Width

ORDERING INFORMATION



CORPORATE HEADQUARTERS
6024 Silver Creek Valley Road
San Jose, CA 95138

for SALES:
800-345-7015 or 408-284-8200
fax: 408-284-2775
www.idt.com

for Tech Support:
logichelp@idt.com