16-bit edge triggered D-type flip-flop; (3-State) 74LVCH16374

FEATURES

- Wide supply voltage range of 1.2 V to 3.6 V
- Complies with JEDEC standard no. 8-1A
- CMOS low power consumption
- MULTIBYTE™ flow-through standard pin-out architecture
- Low inductance multiple power and ground pins for minimum noise and ground bounce
- Direct interface with TTL levels
- All data inputs have bushold
- Output drive capability 50Ω transmission lines @ 85°C

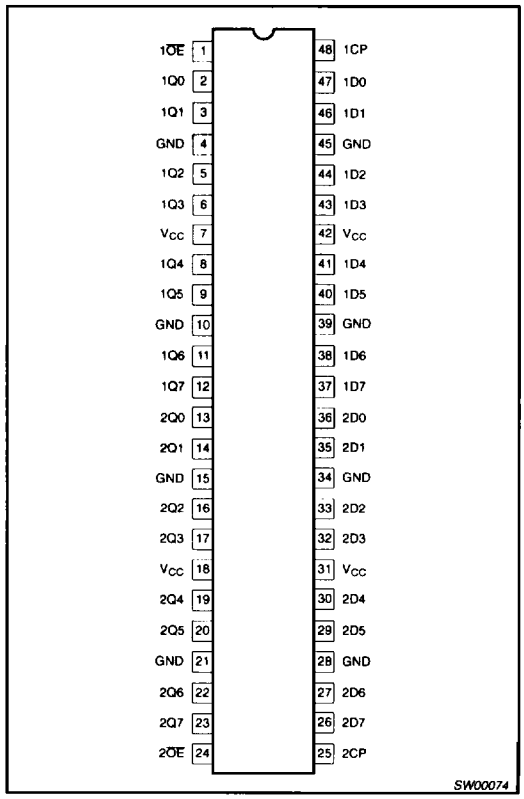
DESCRIPTION

The 74LVCH16374 is a 16-bit edge-triggered flip-flop featuring separate D-type inputs for each flip-flop and 3-State outputs for bus oriented applications. The 74LVCH16374 consists of 2 sections of eight edge-triggered flip-flops. A clock (CP) input and an output enable ($\overline{OE}$) are provided for each octal.

The flip-flops will store the state of their individual D-inputs that meet the set-up and hold time requirements on the LOW-to-HIGH CP transition.

When $\overline{OE}$ is LOW, the contents of the flip-flops are available at the outputs. When $\overline{OE}$ is HIGH, the outputs go to the high impedance OFF-state. Operation of the $\overline{OE}$ input does not affect the state of the flip-flops.

PIN CONFIGURATION



ORDERING INFORMATION

PACKAGES	TEMPERATURE RANGE	OUTSIDE NORTH AMERICA	NORTH AMERICA	DWG NUMBER
48-Pin Plastic SSOP Type III	−40°C to +85°C	74LVCH16374 DL	VCH16374 DL	SOT370-1
48-Pin Plastic TSSOP Type II	−40°C to +85°C	74LVCH16374 DGG	VCH16374 DGG	SOT362-1

QUICK REFERENCE DATA

GND = 0V; T_{amb} = 25°C; $t_r = t_f \leq 2.5$ ns

SYMBOL	PARAMETER	CONDITIONS	TYPICAL	UNIT
t_{PHL}/t_{PLH}	Propagation delay Dn to Qn	C_L = 50pF; V_{CC} = 3.3V	3.2	ns
f_{MAX}	Maximum clock frequency		350	MHz
C_I	Input capacitance		5.0	pF
C_{PD}	Power dissipation capacitance per flip-flop	V_I = GND to V_{CC}[1]	28	pF

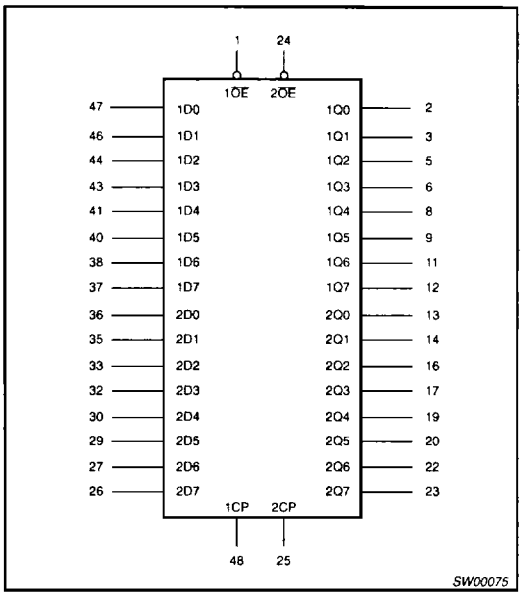
NOTES:

1. C_{PD} is used to determine the dynamic power dissipation (P_D in µW):
   $P_D = C_{PD} \times V_{CC}^2 \times f_i + \Sigma (C_L \times V_{CC}^2 \times f_o)$ where:
   f_i = input frequency in MHz; C_L = output load capacity in pF;
   f_o = output frequency in MHz; V_{CC} = supply voltage in V;
   $\Sigma (C_L \times V_{CC}^2 \times f_o)$ = sum of outputs.

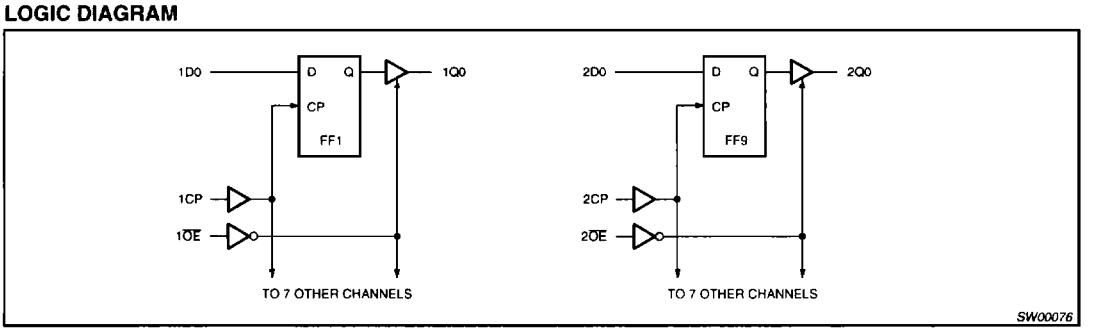
PIN DESCRIPTION

PIN NUMBER	SYMBOL	NAME AND FUNCTION
1	$1\overline{OE}$	Output enable input (active LOW)
2, 3, 5, 6, 8, 9, 11, 12	1Q1 to 1Q7	3-State flip-flop outputs
4, 10, 15, 21, 28, 34, 39, 45	GND	Ground (0V)
7, 18, 31, 42	V_{CC}	Positive supply voltage
13, 14, 16, 17, 19, 20, 22, 23	2Q1 to 2Q7	3-State flip-flop outputs
24	$2\overline{OE}$	Output enable input (active LOW)
25	2CP	Clock input
36, 35, 33, 32, 30, 29, 27, 26	2D1 to 2D7	Data inputs
47, 46, 44, 43, 41, 40, 38, 37	1D1 to 1D7	Data inputs
48	1CP	Clock input

LOGIC SYMBOL



LOGIC DIAGRAM

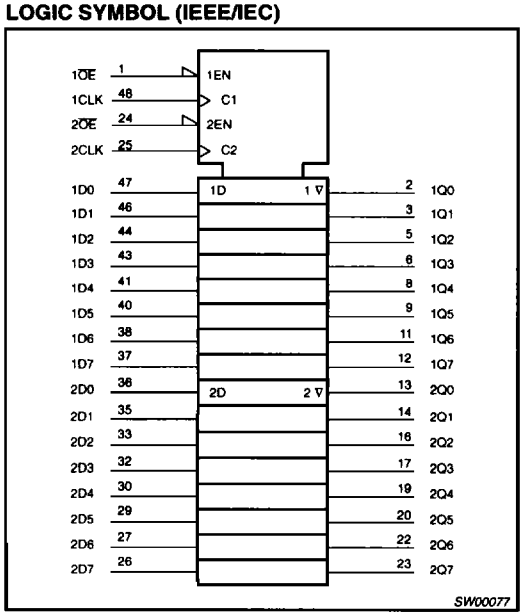


FUNCTION TABLE

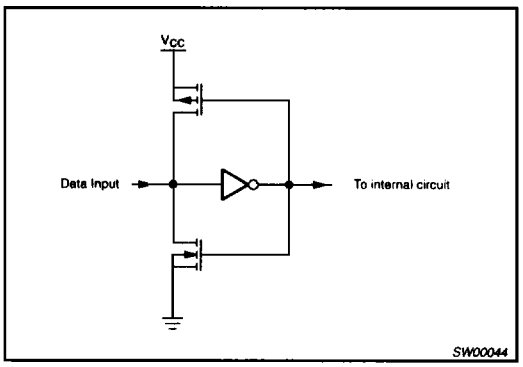
OPERATING MODES	INPUTS			INTERNAL FLIP-FLOPS	OUTPUTS
	$\overline{OE}$	CP	Dn		Q0 to Q7
Load and read register	L L	↑ ↑	l h	L H	L H
Load register and disable outputs	H H	↑ ↑	l h	L H	Z Z

H = HIGH voltage level
h = HIGH voltage level one set-up time prior to the HIGH-to-LOW LE transition
L = LOW voltage level
l = LOW voltage level one set-up time prior to the HIGH-to-LOW LE transition
Z = high impedance OFF-state
↑ = LOW-to-HIGH CP transition

LOGIC SYMBOL (IEEE/IEC)



BUSHOLD CIRCUIT



ABSOLUTE MAXIMUM RATINGS[1, 2]

In accordance with the Absolute Maximum Rating System (IEC 134)
Voltages are referenced to GND (ground = 0V)

SYMBOL	PARAMETER	CONDITIONS	RATING	UNIT
V_{CC}	DC supply voltage		−0.5 to +4.6	V
I_{IK}	DC input diode current	$V_I < 0$	−50	mA
V_I	DC input voltage	For control pins only[3]	−0.5 to +5.5	V
V_I	DC input voltage	For data inputs only[3]	−0.5 to V_{CC} +0.5	V
I_{OK}	DC output diode current	$V_O > V_{CC}$ or $V_O < 0$	±50	mA
V_{OUT}	DC output voltage	Note 3	−0.5 to V_{CC} +0.5	V
I_{OUT}	DC output source or sink current	V_O = 0 to V_{CC}	±50	mA
I_{GND}, I_{CC}	DC V_{CC} or GND current		±100	mA
T_{stg}	Storage temperature range		−60 to +150	°C
P_{TOT}	Power dissipation per package −plastic medium-shrink SO (SSOP) −plastic mini-pack (TSSOP)	For temperature range: −40 to +125 °C above +55°C derate linearly with 11.3 mW/K above +55°C derate linearly with 8 mW/K	 850 600	mW

NOTES:

1. Stresses beyond those listed 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.
2. The performance capability of a high-performance integrated circuit in conjunction with its thermal environment can create junction temperatures which are detrimental to reliability. The maximum junction temperature of this integrated circuit should not exceed 150°C.
3. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

RECOMMENDED OPERATING CONDITIONS

SYMBOL	PARAMETER	CONDITIONS	LIMITS		UNIT
			MIN	MAX	
V_{CC}	DC supply voltage (for max. speed performance)		2.7	3.6	V
V_{CC}	DC supply voltage (for low-voltage applications)		1.2	3.6	V
V_I	DC Input voltage range	Data inputs only	0	V_{CC}	V
V_I	DC Input voltage range	Control pins only	0	5.5	V
V_O	DC output voltage range		0	V_{CC}	V
T_{amb}	Operating free-air temperature range		–40	+85	°C
t_r, t_f	Input rise and fall times	V_{CC} = 2.7 to 3.0V V_{CC} = 3.0 to 3.6V	0 0	20 10	ns/V

DC ELECTRICAL CHARACTERISTICS

SYMBOL	PARAMETER	TEST CONDITIONS		LIMITS Temp = –40°C to +85°C			UNIT
				MIN	TYP[1]	MAX	
V_{IH}	HIGH level Input voltage	V_{CC} = 1.2V		V_{CC}			V
		V_{CC} = 2.7 to 3.6V		2.0			
V_{IL}	LOW level Input voltage	V_{CC} = 1.2V				GND	V
		V_{CC} = 2.7 to 3.6V				0.8	
V_{OH}	HIGH level output voltage	V_{CC} = 2.7V; V_I = V_{IH} or V_{IL}; I_O = –12mA		V_{CC}–0.5			V
		V_{CC} = 3.0V; V_I = V_{IH} or V_{IL}; I_O = –100µA		V_{CC}–0.2	V_{CC}		
		V_{CC} = 3.0V; V_I = V_{IH} or V_{IL}; I_O = –24mA		V_{CC}–1.0			
V_{OL}	LOW level output voltage	V_{CC} = 2.7V; V_I = V_{IH} or V_{IL}; I_O = 12mA				0.4	V
		V_{CC} = 3.0V; V_I = V_{IH} or V_{IL}; I_O = 100µA				0.2	
		V_{CC} = 3.0V; V_I = V_{IH} or V_{IL}; I_O = 24mA				0.55	
I_I	Input leakage current	V_{CC} = 3.6V; V_I = 5.5V or GND	Control pins		±0.1	±5	µA
		V_{CC} = 3.6V; V_I = V_{CC} or GND	Data input pins[2]		±0.1	±5	
I_{IHZ}/I_{ILZ}	Input current for common I/O pins	V_{CC} = 3.6V; V_I = V_{CC} or GND			±0.1	±15	µA
I_{OZ}	3-State output OFF-state current	V_{CC} = 3.6V; V_I = V_{IH} or V_{IL}; V_O = V_{CC} or GND			0.1	±10	µA
I_{CC}	Quiescent supply current	V_{CC} = 3.6V; V_I = V_{CC} or GND; I_O = 0			0.2	40	µA
ΔI_{CC}	Additional quiescent supply current per control pin	V_{CC} = 2.7V to 3.6V; V_I = V_{CC} –0.6V; I_O = 0			5	500	µA
ΔI_{CC}	Additional quiescent supply current per data I/O pin	V_{CC} = 2.7V to 3.6V; V_I = V_{CC} –0.6V; I_O = 0			150	750	µA
IBHL	Bushold LOW sustaining current	V_{CC} = 3.0V; V_I = 0.8V[2, 3]		75			µA
IBHH	Bushold HIGH sustaining current	V_{CC} = 3.0V; V_I = 2.0V[2, 3]		–75			µA
IBHLO	Bushold LOW overdrive current	V_{CC} = 3.6V[2, 4]		450			µA
IBHHO	Bushold HIGH overdrive current	V_{CC} = 3.6V[2, 4]		–450			µA

NOTES:
1. All typical values are at V_{CC} = 3.3V and T_{amb} = 25°C.
2. For data inputs only, control inputs do not have a bushold circuit.
3. The specified sustaining current at the data input holds the input below the specified V_I level.
4. The specified overdrive current at the data input forces the data input to the opposite logic input state.

AC CHARACTERISTICS

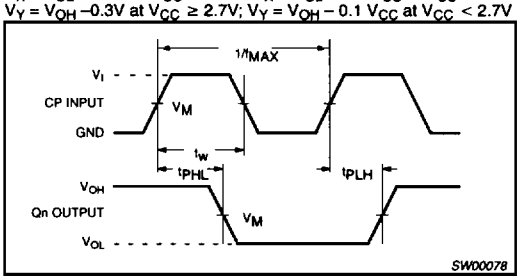
GND = 0V; $t_R = t_F$ = 2.5ns; C_L = 50pF; R_L = 500Ω; T_{amb} = −40°C to +85°C.

SYMBOL	PARAMETER	WAVEFORM	LIMITS						UNIT
			V_{CC} = 3.3V ±0.3V			V_{CC} = 2.7V		V_{CC} = 1.2V	
			MIN	TYP[1]	MAX	MIN	MAX	MAX	
t_{PHL} t_{PLH}	Propagation delay CP to Qn	1, 4		3.5	6.0		7.0		ns
t_{PZH} t_{PZL}	3-State output enable time $\overline{OE}$ to Qn	2, 4		3.6	6.5		7.5		ns
t_{PHZ} t_{PLZ}	3-State output disable time $\overline{OE}$ to Qn	2, 4		3.4	6.0		6.5		ns
t_W	CP pulse width HIGH or LOW	1	4.0			5.0			ns
t_{su}	Set-up time Dn to CP	3	2.0			2.5			ns
t_h	Hold time Dn to CP	3	1.5			2.0			ns
f_{max}	Maximum clock pulse frequency	1	125			100			MHz

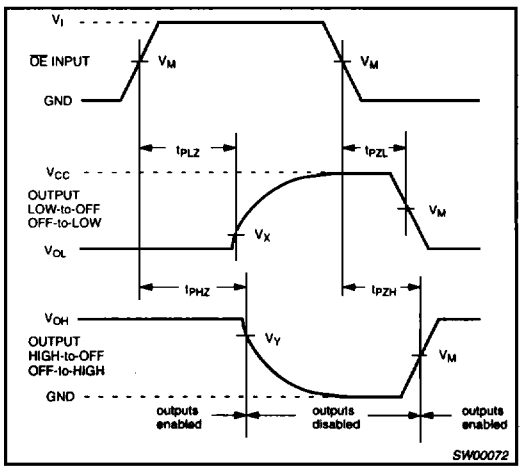
NOTE:
1. All typical values are at V_{CC} = 3.3V and T_{amb} = 25°C.

AC WAVEFORMS

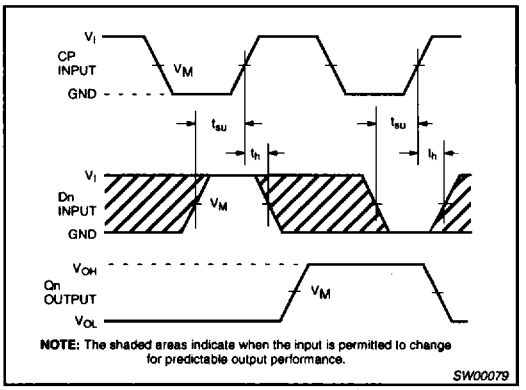
V_M = 1.5V at $V_{CC} \geq$ 2.7V; V_M = 0.5 V_{CC} at V_{CC} < 2.7V.
V_{OL} and V_{OH} are the typical output voltage drop that occur with the output load.
$V_X = V_{OL}$ + 0.3V at $V_{CC} \geq$ 2.7V; $V_X = V_{OL}$ + 0.1 V_{CC} at V_{CC} < 2.7V
$V_Y = V_{OH}$ −0.3V at $V_{CC} \geq$ 2.7V; $V_Y = V_{OH}$ − 0.1 V_{CC} at V_{CC} < 2.7V



Waveform 1. Waveforms showing the clock (CP) to output (Qn) propagation delays, the clock pulse width and the maximum clock pulse frequency

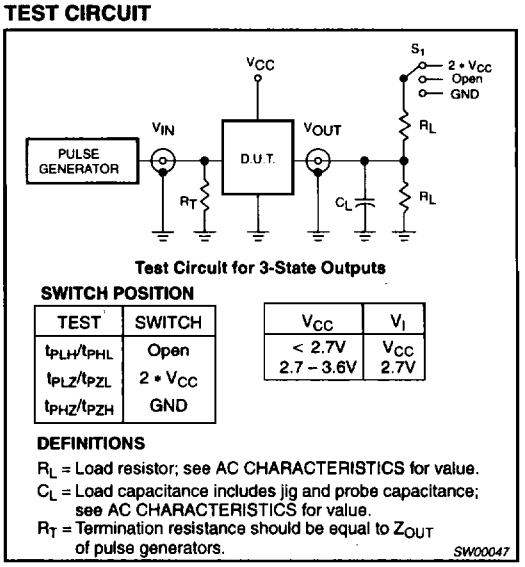


Waveform 2. Waveforms showing the 3-State enable and disable times



Waveform 3. Waveforms showing the data set-up and hold times for the Dn input to the CP input

TEST CIRCUIT



Test Circuit for 3-State Outputs

SWITCH POSITION

TEST	SWITCH
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	2 * V_{CC}
t_{PHZ}/t_{PZH}	GND

V_{CC}	V_I
< 2.7V	V_{CC}
2.7 – 3.6V	2.7V

DEFINITIONS

R_L = Load resistor; see AC CHARACTERISTICS for value.
C_L = Load capacitance includes jig and probe capacitance; see AC CHARACTERISTICS for value.
R_T = Termination resistance should be equal to Z_{OUT} of pulse generators.

SW00047

Waveform 4. Load circuitry for switching times