FAIRCHILD SEMICONDUCTOR™

January 1999
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74LVT16374 • 74LVTH16374
Low Voltage 16-Bit D-Type Flip-Flop with 3-STATE Outputs

General Description

The LVT16374 and LVTH16374 contain sixteen non-inverting D-type flip-flops with 3-STATE outputs and is intended for bus oriented applications. The device is byte controlled. A buffered clock (CP) and Output Enable ($\overline{OE}$) are common to each byte and can be shorted together for full 16-bit operation.

The LVTH16374 data inputs include bushold, eliminating the need for external pull-up resistors to hold unused inputs.

These flip-flops are designed for low-voltage (3.3V) V_{CC} applications, but with the capability to provide a TTL interface to a 5V environment. The LVT16374 and LVTH16374 are fabricated with an advanced BiCMOS technology to achieve high speed operation similar to 5V ABT while maintaining a low power dissipation.

Features

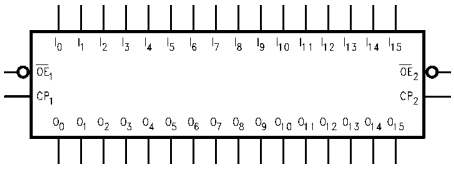
- Input and output interface capability to systems at 5V V_{CC}
- Bushold data inputs eliminate the need for external pull-up resistors to hold unused inputs (74LVTH16374), also available without bushold feature (74LVT16374).
- Live insertion/extraction permitted
- Power Up/Down high impedance provides glitch-free bus loading
- Outputs source/sink –32 mA/+64 mA

Ordering Code:

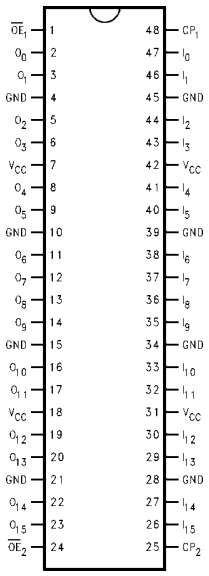
Order Number	Package Number	Package Description
74LVT16374MEA	MS48A	48-Lead Small Shrink Outline Package (SSOP), JEDEC MO-118, 0.300" Wide
74LVT16374MTD	MTD48	48-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 6.1mm Wide
74LVTH16374MEA	MS48A	48-Lead Small Shrink Outline Package (SSOP), JEDEC MO-118, 0.300" Wide
74LVTH16374MTD	MTD48	48-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 6.1mm Wide

Device also available in Tape and Reel. Specify by appending suffix letter "X" to the ordering code.

Logic Symbol



Connection Diagram



Pin Descriptions

Pin Names	Description
$\overline{OE}_n$	Output Enable Input (Active LOW)
CP_n	Clock Pulse Input
I_0–I_{15}	Inputs
O_0–O_{15}	3-STATE Outputs

Truth Tables

Inputs			Outputs
CP_1	$\overline{OE}_1$	I_0–I_7	O_0–O_7
↑	L	H	H
↑	L	L	L
L	L	X	O_o
X	H	X	Z

Inputs			Outputs
CP_2	$\overline{OE}_2$	I_8–I_{15}	O_8–O_{15}
↑	L	H	H
↑	L	L	L
L	L	X	O_o
X	H	X	Z

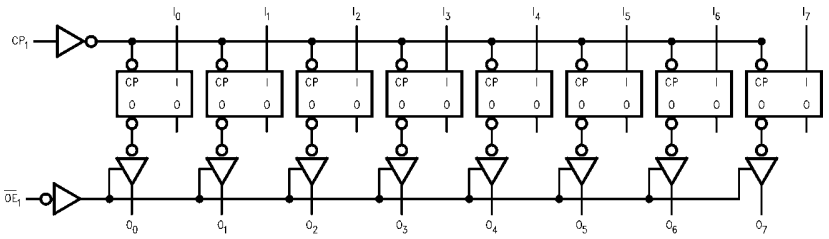
H = HIGH Voltage Level
L = LOW Voltage Level
X = Immaterial
Z = HIGH Impedance
O_o = Previous O_o before HIGH to LOW of CP

Functional Description

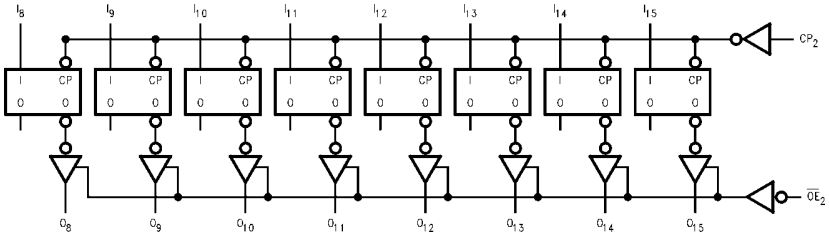
The LVT16374 and LVTH16374 consist of sixteen edge-triggered flip-flops with individual D-type inputs and 3-STATE true outputs. The device is byte controlled with each byte functioning identically, but independent of the other. The control pins can be shorted together to obtain full 16-bit operation. Each byte has a buffered clock and buffered Output Enable common to all flip-flops within that byte. The description which follows applies to each byte. Each flip-flop will store the state of their individual D-type inputs that meet the setup and hold time requirements on the LOW-to-HIGH Clock (CP_n) transition. With the Output Enable ($\overline{OE}_n$) LOW, the contents of the flip-flops are available at the outputs. When $\overline{OE}_n$ is HIGH, the outputs go to the high impedance state. Operation of the $\overline{OE}_n$ input does not affect the state of the flip-flops.

Logic Diagrams

Byte 1 (0:7)



Byte 2 (8:15)



Please note that these diagrams are provided for the understanding of logic operaiton and should not be used to estimate propagation delays.

Absolute Maximum Ratings(Note 1)

Symbol	Parameter	Value	Conditions	Units
V_{CC}	Supply Voltage	−0.5 to +4.6		V
V_I	DC Input Voltage	−0.5 to +7.0		V
V_O	DC Output Voltage	−0.5 to +7.0	Output in 3-STATE	V
		−0.5 to +7.0	Output in High or Low State (Note 2)	
I_{IK}	DC Input Diode Current	−50	V_I < GND	mA
I_{OK}	DC Output Diode Current	−50	V_O < GND	mA
I_O	DC Output Current	64	$V_O > V_{CC}$ Output at High State	mA
		128	$V_O > V_{CC}$ Output at Low State	
I_{CC}	DC Supply Current per Supply Pin	±64		mA
I_{GND}	DC Ground Current per Ground Pin	±128		mA
T_{STG}	Storage Temperature	−65 to +150		°C

Recommended Operating Conditions

Symbol	Parameter	Min	Max	Units
V_{CC}	Supply Voltage	2.7	3.6	V
V_I	Input Voltage	0	5.5	V
I_{OH}	High-Level Output Current		−32	mA
I_{OL}	Low-Level Output Current		64	mA
T_A	Free-Air Operating Temperature	−40	85	°C
$\Delta t/\Delta V$	Input Edge Rate, V_{IN} = 0.8V–2.0V, V_{CC} = 3.0V	0	10	ns/V

Note 1: Absolute Maximum continuous ratings are those values beyond which damage to the device may occur. Exposure to these conditions or conditions beyond those indicated may adversely affect device reliability. Functional operation under absolute maximum rated conditions is not implied.

Note 2: I_O Absolute Maximum Rating must be observed.

DC Electrical Characteristics

Symbol	Parameter		V_{CC} (V)	T_A = −40°C to +85°C			Units	Conditions
				Min	Typ (Note 3)	Max		
V_{IK}	Input Clamp Diode Voltage		2.7			−1.2	V	I_I = −18 mA
V_{IH}	Input HIGH Voltage		2.7–3.6	2.0			V	$V_O \le 0.1V$ or $V_O \ge V_{CC} - 0.1V$
V_{IL}	Input LOW Voltage		2.7–3.6			0.8	V	
V_{OH}	Output HIGH Voltage		2.7–3.6	V_{CC} − 0.2			V	I_{OH} = −100 µA
			2.7	2.4				I_{OH} = −8 mA
			3.0	2.0				I_{OH} = −32 mA
V_{OL}	Output LOW Voltage		2.7			0.2	V	I_{OL} = 100 µA
			2.7			0.5		I_{OL} = 24 mA
			3.0			0.4		I_{OL} = 16 mA
			3.0			0.5		I_{OL} = 32 mA
			3.0			0.55		I_{OL} = 64 mA
$I_{I(HOLD)}$ (Note 4)	Bushold Input Minimum Drive		3.0	75			µA	V_I = 0.8V
				−75				V_I = 2.0V
$I_{I(OD)}$ (Note 4)	Bushold Input Over-Drive Current to Change State		3.0	500			µA	(Note 5)
				−500				(Note 6)
I_I	Input Current		3.6			10	µA	V_I = 5.5V
		Control Pins	3.6			±1		V_I = 0V or V_{CC}
		Data Pins	3.6			−5		V_I = 0V
						1		V_I = V_{CC}
I_{OFF}	Power Off Leakage Current		0			±100	µA	0V ≤ V_I or V_O ≤ 5.5V
$I_{PU/PD}$	Power up/down 3-STATE Output Current		0–1.5V			±100	µA	V_O = 0.5V to 3.0V V_I = GND or V_{CC}
I_{OZL}	3-STATE Output Leakage Current		3.6			−5	µA	V_O = 0.5V
I_{OZH}	3-STATE Output Leakage Current		3.6			5	µA	V_O = 3.0V

DC Electrical Characteristics (Continued)

Symbol	Parameter	V_{CC} (V)	$T_A = -40°C$ to $+85°C$			Units	Conditions
			Min	Typ (Note 3)	Max		
I_{OZH}+	3-STATE Output Leakage Current	3.6			10	μA	$V_{CC} < V_O \leq 5.5V$
I_{CCH}	Power Supply Current	3.6			0.19	mA	Outputs High
I_{CCL}	Power Supply Current	3.6			5	mA	Outputs Low
I_{CCZ}	Power Supply Current	3.6			0.19	mA	Outputs Disabled
I_{CCZ}+	Power Supply Current	3.6			0.19	mA	$V_{CC} \leq V_O \leq 5.5V$, Outputs Disabled
ΔI_{CC}	Increase in Power Supply Current (Note 7)	3.6			0.2	mA	One Input at $V_{CC} - 0.6V$ Other Inputs at V_{CC} or GND

Note 3: All typical values are at $V_{CC} = 3.3V$, $T_A = 25°C$.

Note 4: Applies to bushold versions only (74LVTH16374).

Note 5: An external driver must source at least the specified current to switch from LOW to HIGH.

Note 6: An external driver must sink at least the specified current to switch from HIGH to LOW.

Note 7: This is the increase in supply current for each input that is at the specified voltage level rather than V_{CC} or GND.

Dynamic Switching Characteristics (Note 8)

Symbol	Parameter	V_{CC} (V)	$T_A = 25°C$			Units	Conditions $C_L = 50$ pF, $R_L = 500\Omega$
			Min	Typ	Max		
V_{OLP}	Quiet Output Maximum Dynamic V_{OL}	3.3		0.8		V	(Note 9)
V_{OLV}	Quiet Output Minimum Dynamic V_{OL}	3.3		−0.8		V	(Note 9)

Note 8: Characterized in SSOP package. Guaranteed parameter, but not tested.

Note 9: Max number of outputs defined as (n). n–1 data inputs are driven 0V to 3V. Output under test held LOW.

AC Electrical Characteristics

Symbol	Parameter	$T_A = -40°C$ to $+85°C$, $C_L = 50$ pF, $R_L = 500\Omega$					Units
		$V_{CC} = 3.3V \pm 0.3V$			$V_{CC} = 2.7V$		
		Min	Typ (Note 10)	Max	Min	Max	
f_{max}	Maximum Clock Frequency	160			160		MHz
t_{PHL}	Propagation Delay	1.9		4.3	1.9	4.6	ns
t_{PLH}	CP to O_n	1.6		4.5	1.6	5.2	
t_{PZL}	Output Enable Time	1.3		4.4	1.3	5.0	ns
t_{PZH}		1.0		4.5	1.0	5.4	
t_{PLZ}	Output Disable Time	1.5		4.6	1.5	4.8	ns
t_{PHZ}		2.0		5.0	2.0	5.4	
t_S	Setup Time	1.8			2.0		ns
t_H	Hold Time	0.8			0.1		ns
t_W	Pulse Width	3.0			3.0		ns
t_{OSHL}	Output to Output Skew (Note 11)			1.0		1.0	ns
t_{OSLH}				1.0		1.0	

Note 10: All typical values are at $V_{CC} = 3.3V$, $T_A = 25°C$.

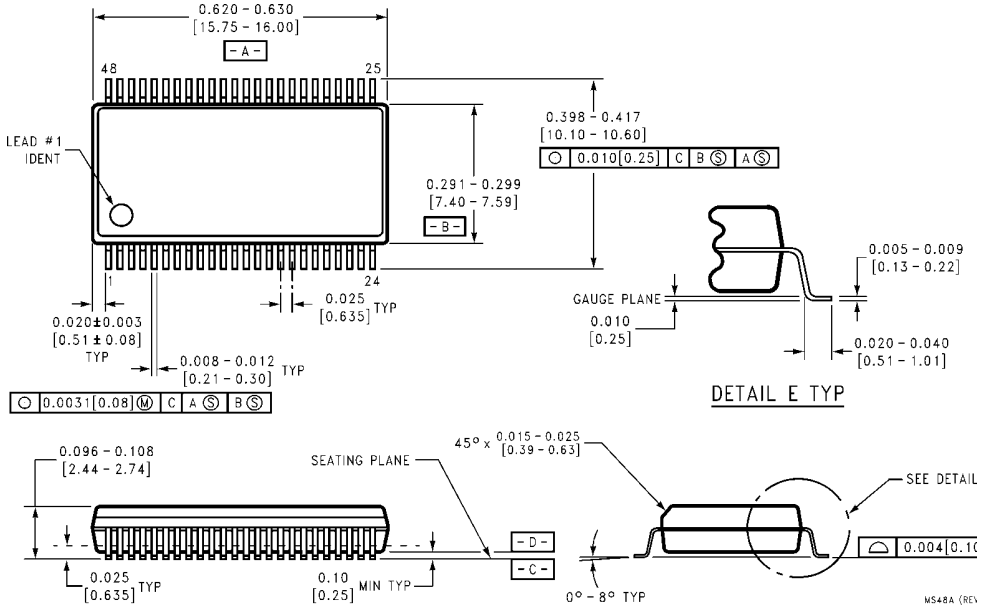
Note 11: Skew is defined as the absolute value of the difference between the actual propagation delay for any two separate outputs of the same device. The specification applies to any outputs switching in the same direction, either HIGH to LOW (t_{OSHL}) or LOW to HIGH (t_{OSLH}).

Capacitance (Note 12)

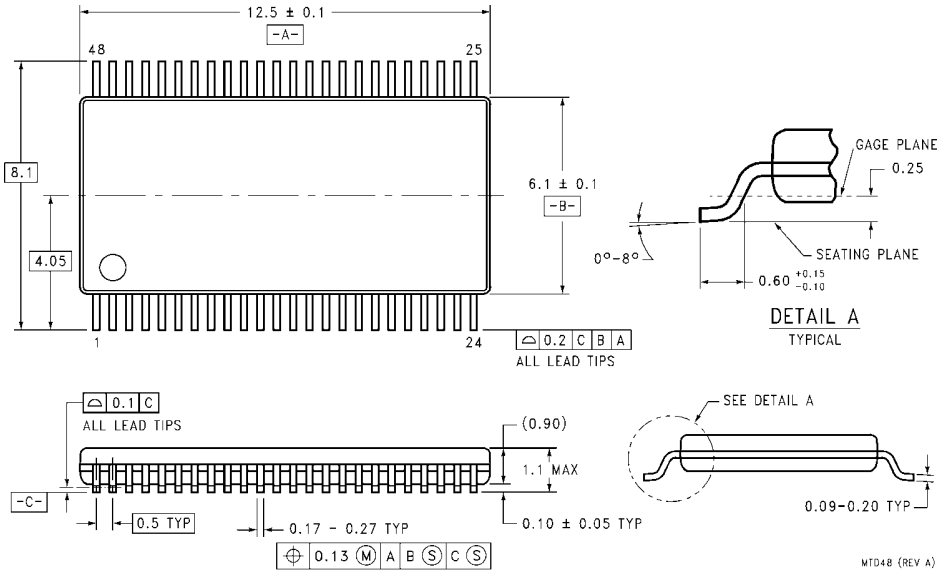
Symbol	Parameter	Conditions	Typical	Units
C_{IN}	Input Capacitance	V_{CC} = Open, $V_I = 0V$ or V_{CC}	4	pF
C_{OUT}	Output Capacitance	$V_{CC} = 3.0V$, $V_O = 0V$ or V_{CC}	8	pF

Note 12: Capacitance is measured at frequency f = 1 MHz, per MIL-STD-883, Method 3012.

Physical Dimensions inches (millimeters) unless otherwise noted



48-Lead Small Shrink Outline Package (SSOP), JEDEC MO-118, 0.300" Wide
Package Number MS48A



48-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 6.1mm Wide
Package Number MTD48

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2. A critical component in any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

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