

# 54LCX16374

*54LCX16374 Low Voltage 16-Bit D Flip-Flop with 5V Tolerant Inputs and Outputs*



Literature Number: SNOS488A

## 54LCX16374

# Low Voltage 16-Bit D Flip-Flop with 5V Tolerant Inputs and Outputs

### General Description

The LCX16374 contains sixteen non-inverting D flip-flops with TRI-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 LCX16374 is designed for low voltage (3.3V)  $V_{CC}$  applications with capability of interfacing to a 5V signal environment.

The LCX16374 is fabricated with an advanced CMOS technology to achieve high speed operation while maintaining CMOS low power dissipation.

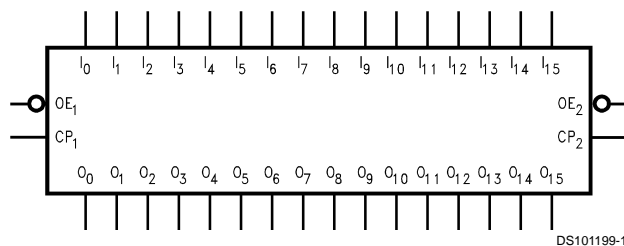
### Features

- 5V tolerant inputs and outputs
- Power down high impedance inputs and outputs
- Supports live insertion/withdrawal
- 2.0V–3.6V  $V_{CC}$  supply operation
- $\pm 24$  mA output drive
- Implements patented noise/EMI reduction circuitry
- Functionally compatible with the 54 series 16374
- ESD performance:
  - Human body model > 2000V
  - Machine model > 200V
- Standard Microcircuit Drawing (SMD) 5962-99535

### Ordering Code

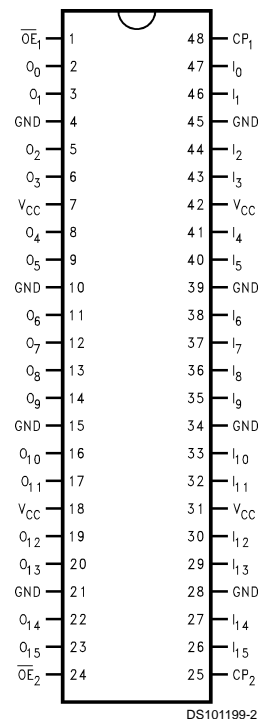
Order Number	Package Number	Package Description
54LCX16374W-QML	WA48A	48-Lead Ceramic Flatpack

### Logic Symbol



### Connection Diagram

Pin Assignment for Cerpack



### Pin Descriptions

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

## Functional Description

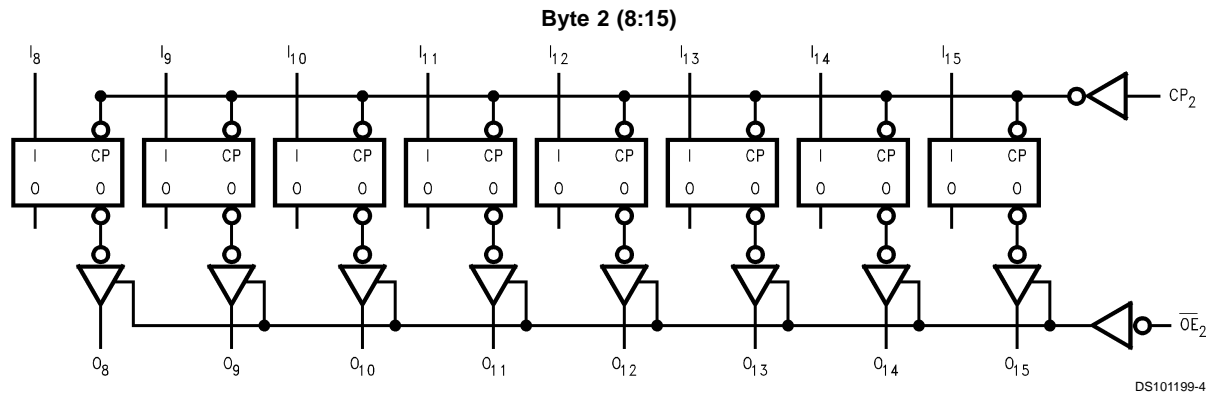
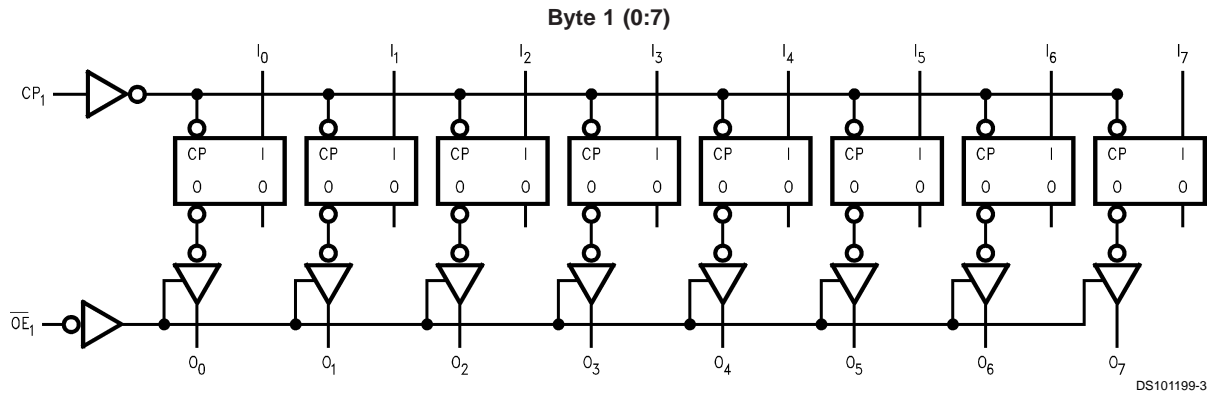
The LCX16374 consists of sixteen edge-triggered flip-flops with individual D-type inputs and TRI-STATE true outputs. The device is byte controlled with each byte functioning identically, but independent of the other. The control pins can be shorted together to obtain full 16-bit operation. Each byte 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 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  $OE_n$  input does not affect the state of the flip-flops.

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

H = High Voltage Level  
 L = Low Voltage Level  
 X = Immaterial  
 Z = High Impedance  
 $O_0$  = Previous  $O_0$  before HIGH to LOW of CP

## Logic Diagrams



Please note that this diagram is provided only for the understanding of logic operations and should not be used to estimate propagation delays.

**Absolute Maximum Ratings** (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Supply Voltage ( $V_{CC}$ )	-0.5V to +7.0V
DC Input Voltage ( $V_I$ )	-0.5V to +7.0V
DC Input Diode Current ( $I_{IK}$ )	
$V_I < \text{GND}$	-50 mA
DC Output Diode Current ( $I_{OK}$ )	
$V_O < \text{GND}$	-50mA
$V_O \geq V_{CC}$	+50mA
DC Output Voltage ( $V_O$ ) (Note 2)	
Output in High or Low State	-0.5V to $V_{CC} + 0.5V$
Output in TRI-STATE	-0.5V to 7.0V
DC Output Source or Sink Current ( $I_O$ )	$\pm 50\text{mA}$
DC $V_{CC}$ or Ground Current	$\pm 100\text{mA}$
Storage Temperature Range ( $T_{STG}$ )	-65°C to +150°C
Power Dissipation	750mW
Junction Temperature ( $T_J$ )	175°C

**DC Electrical Characteristics**

Symbol	Parameter	Conditions	$V_{CC}$ (V)	$T_A = -55^\circ\text{C}$ to $+125^\circ\text{C}$		Units
				Min	Max	
$V_{IH}$	HIGH Level Input Voltage		2.7–3.6	2.0		V
$V_{IL}$	LOW Level Input Voltage		2.7–3.6		0.8	V
$V_{OH}$	HIGH Level Output Voltage	$I_{OH} = -100 \mu\text{A}$	2.7–3.6	$V_{CC} - 0.2$		V
		$I_{OH} = -12 \text{ mA}$	2.7	2.2		V
		$I_{OH} = -12 \text{ mA}$	3.0	2.4		V
		$I_{OH} = -24 \text{ mA}$	3.0	2.2		V
$V_{OL}$	LOW Level Output Voltage	$I_{OL} = 100 \mu\text{A}$	2.7–3.6		0.2	V
		$I_{OL} = 12 \text{ mA}$	2.7		0.4	V
		$I_{OL} = 24 \text{ mA}$	3.0		0.55	V
$I_I$	Input Leakage Current	$0 \leq V_I \leq 5.5V$	2.7–3.6		$\pm 5.0$	$\mu\text{A}$
$I_{OZ}$	3-STATE Output Leakage	$0 \leq V_O \leq 5.5V$ $V_I = V_{IH}$ or $V_{IL}$	2.7–3.6		$\pm 5.0$	$\mu\text{A}$
$I_{OFF}$	Power-Off Leakage Current	$V_I$ or $V_O = 5.5V$	0		10	$\mu\text{A}$
$I_{CC}$	Quiescent Supply Current	$V_I = V_{CC}$ or GND	2.7–3.6		20	$\mu\text{A}$
		$3.6V \leq V_I, V_O \leq 5.5V$	2.7–3.6		$\pm 20$	$\mu\text{A}$
$\Delta I_{CC}$	Increase in $I_{CC}$ per Input	$V_{IH} = V_{CC} - 0.6V$	2.7–3.6		500	$\mu\text{A}$

**Recommended Operating Conditions** (Note 3)

Supply Voltage ( $V_{CC}$ )	
Operating	2.0V to 3.6V
Data Retention	1.5V to 3.6V
Input Voltage ( $V_I$ )	0V to 5.5V
Output Voltage ( $V_O$ )	
High or Low State	0V to $V_{CC}$
TRI-STATE	0V to 5.5V
Operating Temperature ( $T_A$ )	-55°C to +125°C

Minimum Input Edge Rate ( $\Delta t/\Delta V$ )

$V_{IN}$  from 0.8V to 2.0V,  $V_{CC} = 3.0V$     Ons/V to 10ns/V

**Note 1:** The Absolute Maximum Ratings are those values beyond which the safety of the device cannot be guaranteed. The device should not be operated at these limits. The parametric values defined in the Electrical Characteristics tables are not guaranteed at the Absolute Maximum Ratings. The "Recommended Operating Conditions" table will define the conditions for actual device operation.

**Note 2:**  $I_O$  Absolute Maximum Rating must be observed.

**Note 3:** Unused inputs must be held HIGH or LOW. They may not float.

## AC Electrical Characteristics

Symbol	Parameter	$T_A = -55^{\circ}\text{C to } +125^{\circ}\text{C}, C_L = 50\text{pF}, R_L = 500\Omega$				Units
		$V_{CC} = 3.3\text{V} \pm 0.3\text{V}$		$V_{CC} = 2.7\text{V}$		
		Min	Max	Min	Max	
$f_{\text{MAX}}$	Maximum Clock Frequency	200		200		MHz
$t_{\text{PHL}}$	Propagation Delay	0.5	6.5	1.0	7.0	ns
$t_{\text{PLH}}$	CP to $O_n$	0.5	6.5	1.0	7.0	
$t_{\text{PZL}}$	Output Enable Time	0.5	6.5	1.0	7.0	ns
$t_{\text{PZH}}$		0.5	6.5	1.0	7.0	
$t_{\text{PLZ}}$	Output Disable Time	1.0	6.5	1.0	7.0	ns
$t_{\text{PHZ}}$		1.0	6.5	1.0	7.0	
$t_{\text{S}}$	Setup Time	3.5		3.5		ns
$t_{\text{H}}$	Hold Time	2.0		2.0		ns
$t_{\text{W}}$	Pulse Width	4.0		4.0		ns
$t_{\text{OSHL}}$	Output to Output Skew (Note 4)		1.0		1.0	ns
$t_{\text{OSLH}}$			1.0		1.0	

**Note 4:** 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 ( $t_{\text{OSHL}}$ ) or LOW to HIGH ( $t_{\text{OSLH}}$ ). Parameter guaranteed by design.

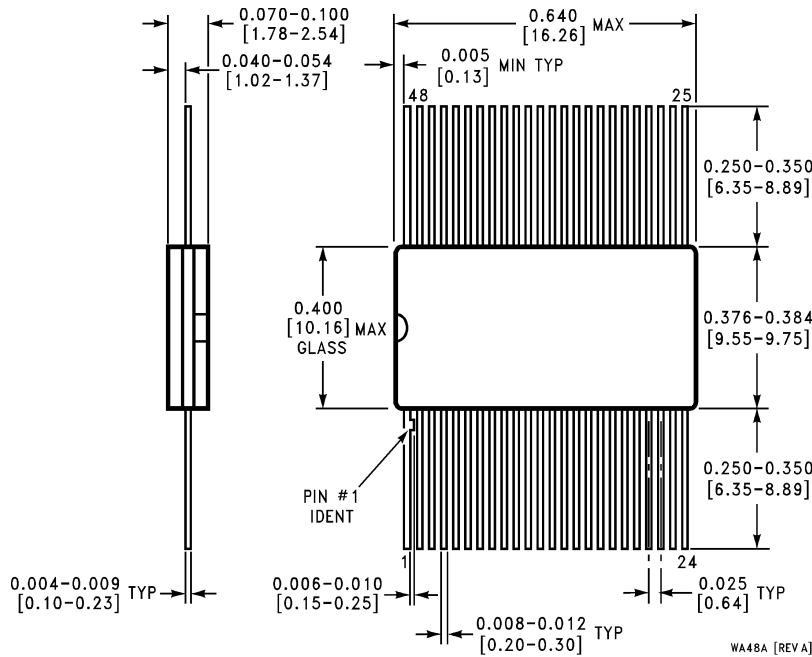
## Dynamic Switching Characteristics

Symbol	Parameter	Conditions	$V_{CC}$ (V)	$T_A = 25^{\circ}\text{C}$	Units
				Max	
$V_{\text{OLP}}$	Quiet Output Dynamic Peak $V_{\text{OL}}$	$C_L = 50\text{ pF}, V_{\text{IH}} = 3.3\text{V}, V_{\text{IL}} = 0\text{V}$	3.3	1.2	V
$V_{\text{OLV}}$	Quiet Output Dynamic Valley $V_{\text{OL}}$	$C_L = 50\text{ pF}, V_{\text{IH}} = 3.3\text{V}, V_{\text{IL}} = 0\text{V}$	3.3	-1.1	V

## Capacitance

Symbol	Parameter	Conditions	Max	Units
$C_{\text{IN}}$	Input Capacitance	$V_{CC} = \text{Open}, V_I = 0\text{V or } V_{CC}$	10	pF
$C_{\text{OUT}}$	Output Capacitance	$V_{CC} = 3.3\text{V}, V_I = 0\text{V or } V_{CC}$	12	pF
$C_{\text{PD}}$	Power Dissipation Capacitance	$V_{CC} = 3.3\text{V}, V_I = 0\text{V or } V_{CC}, f = 10\text{ MHz}$	40	pF

**Physical Dimensions** inches (millimeters) unless otherwise noted



**48-Lead Ceramic Flatpack  
Package Number WA48A**

**LIFE SUPPORT POLICY**

NATIONAL'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT AND GENERAL COUNSEL OF NATIONAL SEMICONDUCTOR CORPORATION. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
2. A critical component is 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.

 **National Semiconductor Corporation**  
Americas  
Tel: 1-800-272-9959  
Fax: 1-800-737-7018  
Email: support@nsc.com  
www.national.com

**National Semiconductor Europe**  
Fax: +49 (0) 180-530 85 86  
Email: europe.support@nsc.com  
Deutsch Tel: +49 (0) 69 9508 6208  
English Tel: +44 (0) 870 24 0 2171  
Français Tel: +33 (0) 1 41 91 8790

**National Semiconductor Asia Pacific Customer Response Group**  
Tel: 65-2544466  
Fax: 65-2504466  
Email: ap.support@nsc.com

**National Semiconductor Japan Ltd.**  
Tel: 81-3-5639-7560  
Fax: 81-3-5639-7507

## IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

### Products

Audio	<a href="http://www.ti.com/audio">www.ti.com/audio</a>
Amplifiers	<a href="http://amplifier.ti.com">amplifier.ti.com</a>
Data Converters	<a href="http://dataconverter.ti.com">dataconverter.ti.com</a>
DLP® Products	<a href="http://www.dlp.com">www.dlp.com</a>
DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>
Clocks and Timers	<a href="http://www.ti.com/clocks">www.ti.com/clocks</a>
Interface	<a href="http://interface.ti.com">interface.ti.com</a>
Logic	<a href="http://logic.ti.com">logic.ti.com</a>
Power Mgmt	<a href="http://power.ti.com">power.ti.com</a>
Microcontrollers	<a href="http://microcontroller.ti.com">microcontroller.ti.com</a>
RFID	<a href="http://www.ti-rfid.com">www.ti-rfid.com</a>
OMAP Mobile Processors	<a href="http://www.ti.com/omap">www.ti.com/omap</a>
Wireless Connectivity	<a href="http://www.ti.com/wirelessconnectivity">www.ti.com/wirelessconnectivity</a>

### Applications

Communications and Telecom	<a href="http://www.ti.com/communications">www.ti.com/communications</a>
Computers and Peripherals	<a href="http://www.ti.com/computers">www.ti.com/computers</a>
Consumer Electronics	<a href="http://www.ti.com/consumer-apps">www.ti.com/consumer-apps</a>
Energy and Lighting	<a href="http://www.ti.com/energy">www.ti.com/energy</a>
Industrial	<a href="http://www.ti.com/industrial">www.ti.com/industrial</a>
Medical	<a href="http://www.ti.com/medical">www.ti.com/medical</a>
Security	<a href="http://www.ti.com/security">www.ti.com/security</a>
Space, Avionics and Defense	<a href="http://www.ti.com/space-avionics-defense">www.ti.com/space-avionics-defense</a>
Transportation and Automotive	<a href="http://www.ti.com/automotive">www.ti.com/automotive</a>
Video and Imaging	<a href="http://www.ti.com/video">www.ti.com/video</a>

TI E2E Community Home Page

[e2e.ti.com](http://e2e.ti.com)

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265  
Copyright © 2011, Texas Instruments Incorporated