

54LCX16373

*54LCX16373 Low Voltage 16-Bit Transparent Latch with 5V Tolerant Inputs
and Outputs*



Literature Number: SNOS490A

54LCX16373

Low Voltage 16-Bit Transparent Latch with 5V Tolerant Inputs and Outputs

General Description

The LCX16373 contains sixteen non-inverting latches with TRI-STATE® outputs and is intended for bus oriented applications. The device is byte controlled. The flip-flops appear transparent to the data when the Latch Enable (LE) is HIGH. When LE is low, the data that meets the setup time is latched. Data appears on the bus when the Output Enable (\overline{OE}) is LOW. When OE is HIGH, the outputs are in TRI-STATE.

The LCX16373 is designed for low voltage (3.3V) V_{CC} applications with capability of interfacing to a 5V signal environment.

The LCX16373 is fabricated with an advanced CMOS technology to achieve high speed operation while maintaining CMOS low power dissipation.

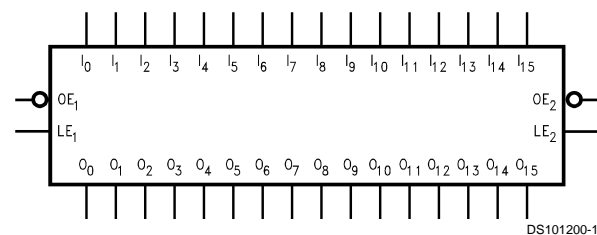
Features

- 5V tolerant inputs and outputs
- Power down high impedance inputs and outputs
- Supports live insertion/withdrawal
- 2.0V–3.6V V_{CC} supply operation
- ± 24 mA output drive
- Implements patented noise/EMI reduction circuitry
- Functionally compatible with the 54 series 16373
- ESD performance:
 - Human body model > 2000V
 - Machine model > 200V
- Standard Microcircuit Drawing (SMD) 5962-9953401

Ordering Code

Order Number	Package Number	Package Description
54LCX16373W-QML	WA48A	48-Lead Ceramic Flatpack

Logic Symbol

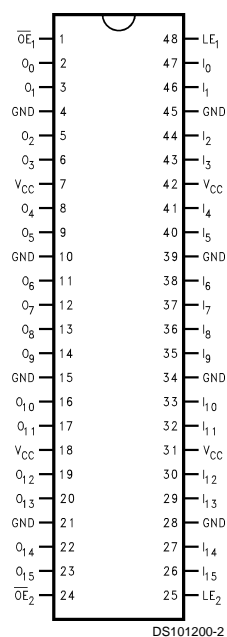


Pin Descriptions

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

Connection Diagram

Pin Assignment for Cerpack



Functional Description

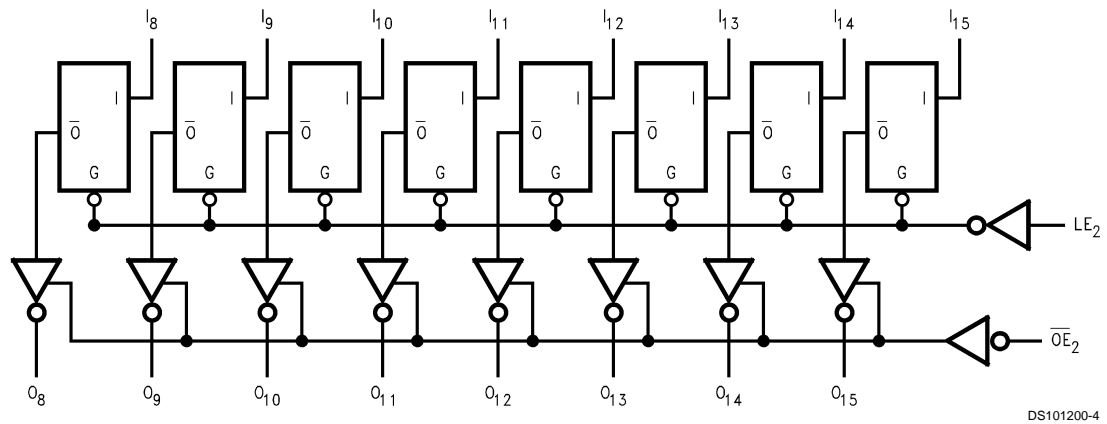
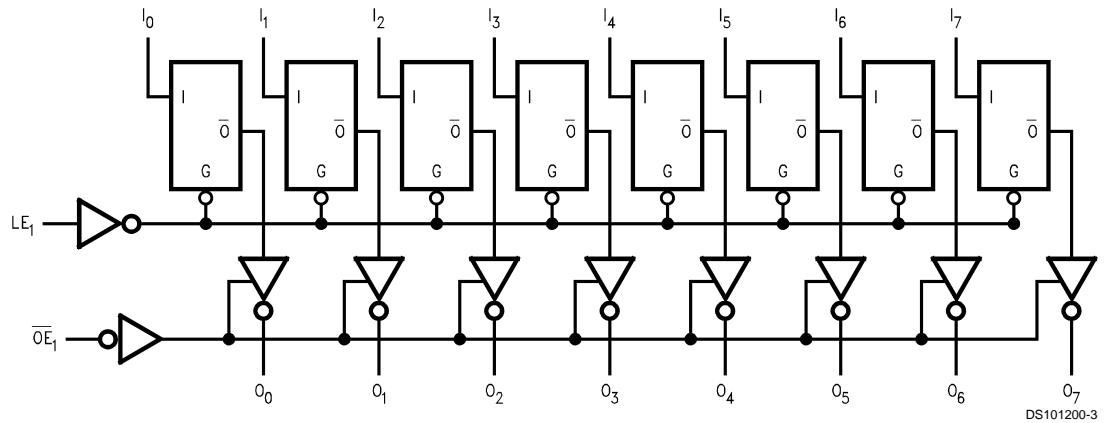
The LCX16373 contains sixteen D-type latches with TRI-STATE standard outputs. The device is byte controlled with each byte functioning identically, but independent of the other. Control pins can be shorted together to obtain full 16-bit operation. The following description applies to each byte. When the Latch Enable (LE_n) input is HIGH, data on the I_n enters the latches. In this condition the latches are transparent, i.e. a latch output will change state each time its I input changes. When LE_n is LOW, the latches store information that was present on the I inputs a setup time preceding the HIGH-to-LOW transition of LE_n . The TRI-STATE standard outputs are controlled by the Output Enable (\overline{OE}_n) input. When \overline{OE}_n is LOW, the standard outputs are in the 2-state mode. When \overline{OE}_n is HIGH, the standard outputs are in the high impedance mode but this does not interfere with entering new data into the latches.

Inputs			Outputs
LE_1	\overline{OE}_1	I_0-I_7	O_0-O_7
X	H	X	Z
H	L	L	L
H	L	H	H
L	L	X	O_0

Inputs			Outputs
LE_2	\overline{OE}_2	I_8-I_{15}	O_8-O_{15}
X	H	X	Z
H	L	L	L
H	L	H	H
L	L	X	O_0

H = High Voltage Level
 L = Low Voltage Level
 X = Immaterial
 Z = High Impedance
 O_0 = Previous O_0 before HIGH to LOW transition of Latch Enable

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)

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	$\pm 400\text{mA}$
Storage Temperature Range (T_{STG})	-65°C to +150°C
Power Dissipation	750mW
Junction Temperature (T_J)	175°C

Recommended Operating Conditions (Note 3)

Supply Voltage (V_{CC})	
Operating	2.7V 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, $V_{CC} = 3.0V$	0ns/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.

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		± 5.0	μA
I_{OZ}	TRI-STATE Output Leakage	$0 \leq V_O \leq 5.5V$ $V_I = V_{IH}$ or V_{IL}	2.7–3.6		± 5.0	μA
I_{OFF}	Power-Off Leakage Current	V_I or $V_O = 5.5V$	0		10	μA
I_{CC}	Quiescent Supply Current	$V_I = V_{CC}$ or GND	2.7–3.6		20	μA
		$3.6V \leq V_I, V_O \leq 5.5V$	2.7–3.6		± 20	μA
ΔI_{CC}	Increase in I_{CC} per Input	$V_{IH} = V_{CC} - 0.6V$	2.7–3.6		500	μA

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	
t_{PHL}	Propagation Delay	1.0	6.0	1.5	6.5	ns
t_{PLH}	I_n to O_n	1.0	6.0	1.5	6.5	
t_{PHL}	Propagation Delay	1.0	6.5	1.5	7.0	ns
t_{PLH}	LE to O_n	1.0	6.5	1.5	7.0	
t_{PZL}	Output Enable Time	1.0	6.5	1.5	7.0	ns
t_{PZH}		1.0	6.5	1.5	7.0	
t_{PLZ}	Output Disable Time	1.0	6.5	1.5	7.0	ns
t_{PHZ}		1.0	6.5	1.5	7.0	
t_S	Setup Time, I_n to LE	2.5		2.5		ns
t_H	Hold Time, I_n to LE	2.0		2.0		ns
t_W	LE Pulse Width	3.5		3.5		ns
t_{OSHL}	Output to Output Skew (Note 4)		1.0		1.0	ns
t_{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_{OSHL}) or LOW to HIGH (t_{OSLH}). Parameter guaranteed by design.

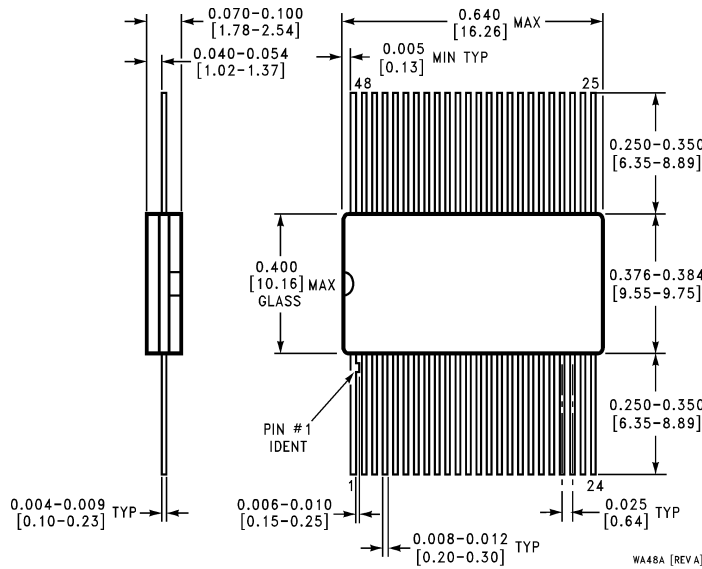
Dynamic Switching Characteristics

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

Capacitance

Symbol	Parameter	Conditions	Max	Units
C_{IN}	Input Capacitance	$V_{CC} = \text{Open}, V_I = 0\text{V or } V_{CC}$	10	pF
C_{OUT}	Output Capacitance	$V_{CC} = 3.3\text{V}, V_I = 0\text{V or } V_{CC}$	12	pF
C_{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	www.ti.com/audio
Amplifiers	amplifier.ti.com
Data Converters	dataconverter.ti.com
DLP® Products	www.dlp.com
DSP	dsp.ti.com
Clocks and Timers	www.ti.com/clocks
Interface	interface.ti.com
Logic	logic.ti.com
Power Mgmt	power.ti.com
Microcontrollers	microcontroller.ti.com
RFID	www.ti-rfid.com
OMAP Mobile Processors	www.ti.com/omap
Wireless Connectivity	www.ti.com/wirelessconnectivity

Applications

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

TI E2E Community Home Page

e2e.ti.com

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