



Is Now Part of



ON Semiconductor®

To learn more about ON Semiconductor, please visit our website at
www.onsemi.com

ON Semiconductor and the ON Semiconductor logo are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor's product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using ON Semiconductor products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by ON Semiconductor. "Typical" parameters which may be provided in ON Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. ON Semiconductor does not convey any license under its patent rights nor the rights of others. ON Semiconductor products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use ON Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold ON Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that ON Semiconductor was negligent regarding the design or manufacture of the part. ON Semiconductor is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

74LCX16646

Low Voltage 16-Bit Transceiver/Register with 5V Tolerant Inputs and Outputs

General Description

The LCX16646 contains sixteen non-inverting bidirectional registered bus transceivers with 3-STATE outputs, providing multiplexed transmission of data directly from the input bus or from the internal storage registers. Each byte has separate control inputs which can be shorted together for full 16-bit operation. The DIR inputs determine the direction of data flow through the device. The CPAB and CPBA inputs load data into the registers on the LOW-to-HIGH transition (see Functional Description).

The LCX16646 is designed for low voltage (2.5V or 3.3V) V_{CC} applications with capability of interfacing to a 5V signal environment.

The LCX16646 is fabricated with an advanced CMOS technology to achieve high speed operation while maintaining CMOS low power dissipation.

Features

- 5V tolerant inputs and outputs
- 2.3V–3.6V V_{CC} specifications provided
- 5.2 ns t_{PD} max ($V_{CC} = 3.3V$), 20 μA I_{CC} max
- Power down high impedance inputs and outputs
- Supports live insertion/withdrawal (Note 1)
- ± 24 mA Output Drive ($V_{CC} = 3.0V$)
- Implements patented noise/EMI reduction circuitry
- Latch-up performance exceeds 500 mA
- ESD performance:
 - Human Body Model > 2000V
 - Machine Model > 200V

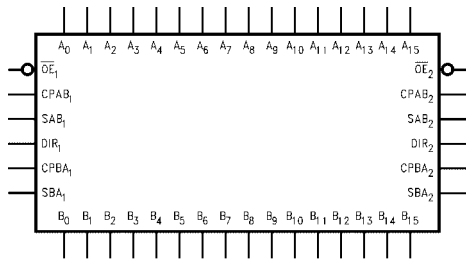
Note 1: To ensure the high-impedance state during power up or down, \overline{OE} should be tied to V_{CC} through a pull-up resistor; the minimum value or the resistor is determined by the current-sourcing capability of the driver.

Ordering Code:

Order Number	Package Number	Package Description
74LCX16646MEA	MS56A	56-Lead Shrink Small Outline Package (SSOP), JEDEC MO-118, 0.300" Wide
74LCX16646MTD	MTD56	56-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 6.1mm Wide

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

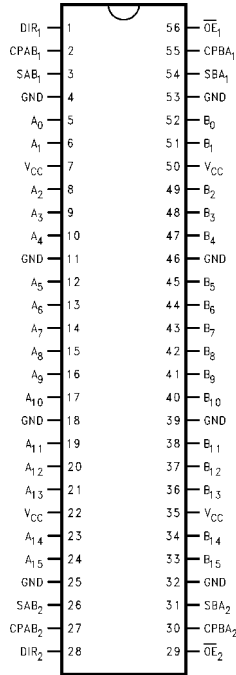
Logic Symbol



Pin Descriptions

Pin Names	Description
A_n	Side A Inputs or 3-STATE Outputs
B_n	Side B Inputs or 3-STATE Outputs
\overline{OE}_n	Output Enable Inputs
$CPAB_n, CPBA_n$	Clock Pulse Inputs
SAB_n, SBA_n	Select Inputs
DIR_n	Direction Control Inputs

Connection Diagram



Truth Table

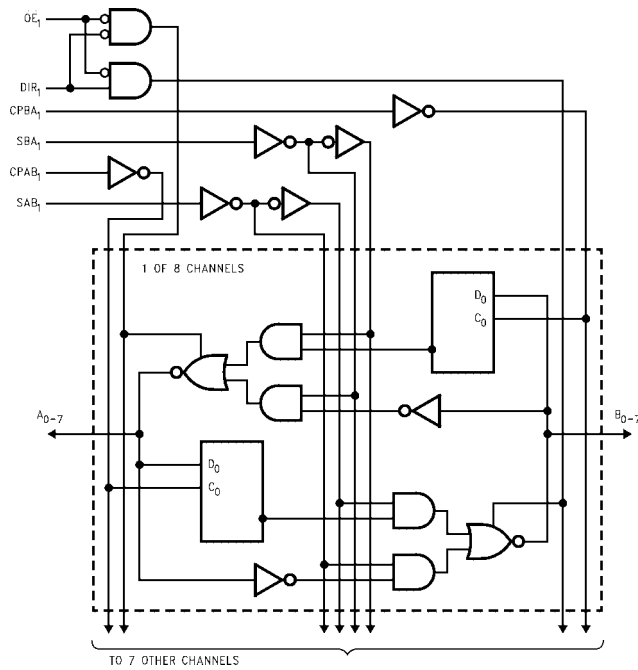
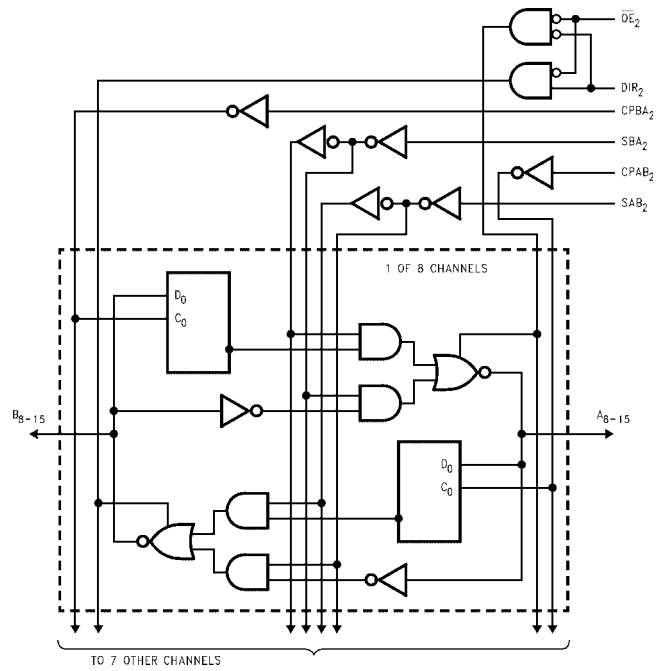
(Note 2)

Inputs						Data I/O		Output Operation Mode
OE ₁	DIR ₁	CPAB ₁	CPBA ₁	SAB ₁	SBA ₁	A ₀₋₇	B ₀₋₇	
H	X	H or L	H or L	X	X			Isolation
H	X	↗	X	X	X	Input	Input	Clock A _n Data into A Register
H	X	X	↗	X	X			Clock B _n Data Into B Register
L	H	X	X	L	X	Input	Output	A _n to B _n — Real Time (Transparent Mode)
L	H	↗	X	L	X			Clock A _n Data to A Register
L	H	H or L	X	H	X			A Register to B _n (Stored Mode)
L	H	↗	X	H	X			Clock A _n Data into A Register and Output to B _n
L	L	X	X	X	L	Output	Input	B _n to A _n — Real Time (Transparent Mode)
L	L	X	↗	X	L			Clock B _n Data into B Register
L	L	X	H or L	X	H			B Register to A _n (Stored Mode)
L	L	X	↗	X	H			Clock B _n into B Register and Output to A _n

H = HIGH Voltage Level X = Immaterial
 L = LOW Voltage Level ↗ = LOW-to-HIGH Transition.

Note 2: The data output functions may be enabled or disabled by various signals at the OE and DIR inputs. Data input functions are always enabled; i.e., data at the bus pins will be stored on every LOW-to-HIGH transition of the appropriate clock inputs. Also applies to data I/O (A and B: 8-15) and #2 control pins.

Logic Diagrams

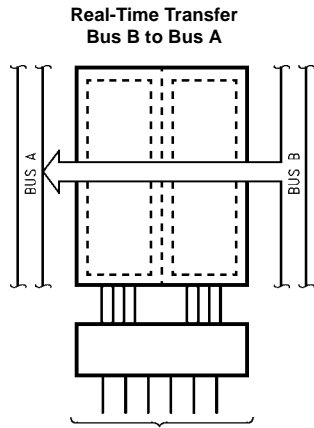


Please note that these diagrams are provided only for the understanding of logic operations and should not be used to estimate propagation delays.

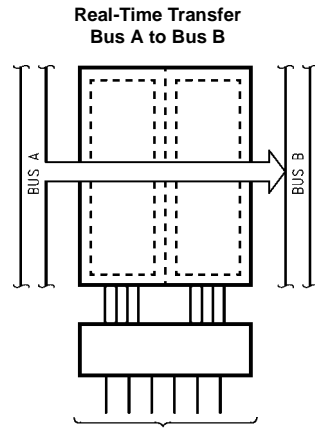
Functional Description

In the transceiver mode, data present at the HIGH impedance port may be stored in either the A or B register or both. The select (SAB_n , SBA_n) controls can multiplex stored and real-time. The examples shown below demonstrate the four fundamental bus-management functions that can be performed.

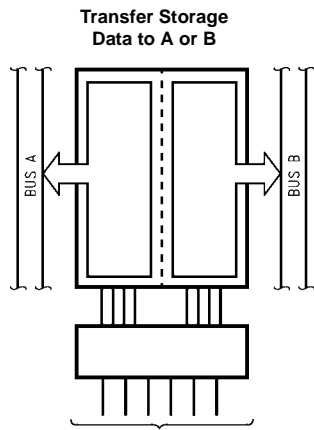
The direction control (DIR_n) determines which bus will receive data when \overline{OE}_n is LOW. In the isolation mode (\overline{OE}_n HIGH), A data may be stored in one register and/or B data may be stored in the other register. When an output function is disabled, the input function is still enabled and may be used to store and transmit data. Only one of the two busses, A or B, may be driven at a time.



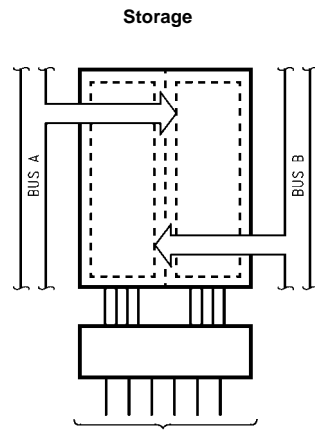
\overline{OE}	DIR	CPAB	CPBA	SAB	SBA
L	L	X	X	X	L



\overline{OE}	DIR	CPAB	CPBA	SAB	SBA
L	H	X	X	L	X



\overline{OE}	DIR	CPAB	CPBA	SAB	SBA
L	L	X	H or L	X	H
L	H	H or L	X	H	X



\overline{OE}	DIR	CPAB	CPBA	SAB	SBA
L	H	~	X	L	X
L	X	X	~	X	L
H	X	~	X	X	X
H	X	X	~	X	X

Absolute Maximum Ratings ^(Note 3)						
Symbol	Parameter	Value	Conditions	Units		
V _{CC}	Supply Voltage	-0.5 to +7.0		V		
V _I	DC Input Voltage	-0.5 to +7.0		V		
V _O	DC Output Voltage	-0.5 to +7.0 -0.5 to V _{CC} + 0.5	Output in 3-STATE Output in HIGH or LOW State (Note 4)	V		
I _{IK}	DC Input Diode Current	-50	V _I < GND	mA		
I _{OK}	DC Output Diode Current	-50 +50	V _O < GND V _O > V _{CC}	mA		
I _O	DC Output Source/Sink Current	±50		mA		
I _{CC}	DC Supply Current per Supply Pin	±100		mA		
I _{GND}	DC Ground Current per Ground Pin	±100		mA		
T _{STG}	Storage Temperature	-65 to +150		°C		
Recommended Operating Conditions (Note 5)						
Symbol	Parameter	Min	Max	Units		
V _{CC}	Supply Voltage	Operating	2.0	3.6	V	
		Data Retention	1.5	3.6		
V _I	Input Voltage	0	5.5	V		
V _O	Output Voltage	HIGH or LOW State	0	V _{CC}	V	
		3-STATE	0	5.5		
I _{OH} /I _{OL}	Output Current	V _{CC} = 3.0V – 3.6V		±24	mA	
		V _{CC} = 2.7V – 3.0V		±12		
		V _{CC} = 2.3V – 2.7V		±8		
T _A	Free-Air Operating Temperature	-40	85	°C		
Δt/ΔV	Input Edge Rate, V _{IN} = 0.8V–2.0V, V _{CC} = 3.0V	0	10	ns/V		
<p>Note 3: 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.</p> <p>Note 4: I_O Absolute Maximum Rating must be observed.</p> <p>Note 5: Unused inputs and I/Os must be held HIGH or LOW. They may not float.</p>						
DC Electrical Characteristics						
Symbol	Parameter	Conditions	V _{CC} (V)	T _A = -40°C to +85°C		Units
				Min	Max	
V _{IH}	HIGH Level Input Voltage		2.3 – 2.7	1.7		V
			2.7 – 3.6	2.0		
V _{IL}	LOW Level Input Voltage		2.3 – 2.7		0.7	V
			2.7 – 3.6		0.8	
V _{OH}	HIGH Level Output Voltage	I _{OH} = -100 μA	2.3 – 3.6	V _{CC} - 0.2		V
		I _{OH} = -8 mA	2.3	1.8		
		I _{OH} = -12 mA	2.7	2.2		
		I _{OH} = -18 mA	3.0	2.4		
		I _{OH} = -24 mA	3.0	2.2		
V _{OL}	LOW Level Output Voltage	I _{OL} = 100 μA	2.3 – 3.6		0.2	V
		I _{OL} = 8 mA	2.3		0.6	
		I _{OL} = 12 mA	2.7		0.4	
		I _{OL} = 16 mA	3.0		0.4	
		I _{OL} = 24 mA	3.0		0.55	
I _I	Input Leakage Current	0 ≤ V _I ≤ 5.5V	2.3 – 3.6		±5.0	μA
I _{OZ}	3-STATE I/O Leakage	0 ≤ V _O ≤ 5.5V V _I = V _{IH} or V _{IL}	2.3 – 3.6		±5.0	μA
I _{OFF}	Power-Off Leakage Current	V _I or V _O = 5.5V	0		10	μA

DC Electrical Characteristics (Continued)								
Symbol	Parameter	Conditions	V _{CC} (V)	T _A = -40°C to +85°C		Units		
				Min	Max			
I _{CC}	Quiescent Supply Current	V _I = V _{CC} or GND	2.3 – 3.6		20	μA		
		3.6V ≤ V _I , V _O ≤ 5.5V (Note 6)	2.3 – 3.6		±20			
ΔI _{CC}	Increase in I _{CC} per Input	V _{IH} = V _{CC} - 0.6V	2.3 – 3.6		500	μA		
Note 6: Outputs disabled or 3-STATE only.								
AC Electrical Characteristics								
Symbol	Parameter	T _A = -40°C to +85°C, R _L = 500Ω						Units
		V _{CC} = 3.3V ± 0.3V		V _{CC} = 2.7V		V _{CC} = 2.5V ± 0.2V		
		C _L = 50 pF		C _L = 50 pF		C _L = 30 pF		
		Min	Max	Min	Max	Min	Max	
t _{MAX}	Maximum Clock Frequency	170					ns	
t _{PHL}	Propagation Delay	1.5	5.2	1.5	6.0	1.5	6.2	ns
t _{PLH}	Bus to Bus	1.5	5.2	1.5	6.0	1.5	6.2	
t _{PHL}	Propagation Delay	1.5	6.0	1.5	7.0	1.5	7.2	ns
t _{PLH}	Clock to Bus	1.5	6.0	1.5	7.0	1.5	7.2	
t _{PHL}	Propagation Delay	1.5	6.0	1.5	7.0	1.5	7.2	ns
t _{PLH}	Select to Bus	1.5	6.0	1.5	7.0	1.5	7.2	
t _{PZL}	Output Enable Time	1.5	7.5	1.5	8.5	1.5	9.8	ns
t _{PZH}		1.5	7.5	1.5	8.5	1.5	9.8	
t _{PLZ}	Output Disable Time	1.5	6.5	1.5	7.5	1.5	7.8	ns
t _{PHZ}		1.5	6.5	1.5	7.5	1.5	7.8	
t _S	Setup Time	2.5		2.5		3.0		ns
t _H	Hold Time	1.5		1.5		2.0		ns
t _W	Pulse Width	3.0		3.0		3.5		ns
t _{OSHL}	Output to Output Skew (Note 7)		1.0					ns
t _{OSLH}			1.0					
Note 7: 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°C		Units		
				Typical				
V _{OLP}	Quiet Output Dynamic Peak V _{OL}	C _L = 50 pF, V _{IH} = 3.3V, V _{IL} = 0V	3.3	0.8		V		
		C _L = 30 pF, V _{IH} = 2.5V, V _{IL} = 0V	2.5	0.6				
V _{OLV}	Quiet Output Dynamic Valley V _{OL}	C _L = 50 pF, V _{IH} = 3.3V, V _{IL} = 0V	3.3	-0.8		V		
		C _L = 30 pF, V _{IH} = 2.5V, V _{IL} = 0V	2.5	-0.6				
Capacitance								
Symbol	Parameter	Conditions	Typical	Units				
C _{IN}	Input Capacitance	V _{CC} = Open, V _I = 0V or V _{CC}	7	pF				
C _{I/O}	Input/Output Capacitance	V _{CC} = 3.3V, V _I = 0V or V _{CC}	8	pF				
C _{PD}	Power Dissipation Capacitance	V _{CC} = 3.3V, V _I = 0V or V _{CC} , F = 10 MHz	20	pF				

AC LOADING and WAVEFORMS Generic for LCX Family

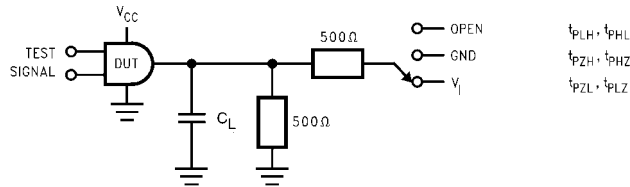
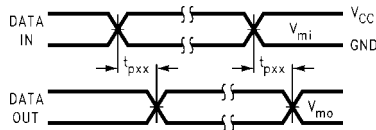
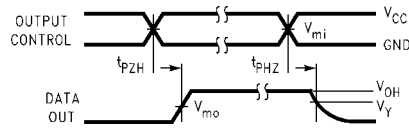


FIGURE 1. AC Test Circuit (C_L includes probe and jig capacitance)

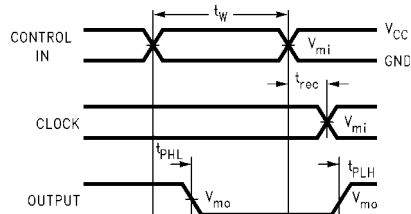
Test	Switch
t_{PLH}, t_{PHL}	Open
t_{PZL}, t_{PLZ}	6V at $V_{CC} = 3.3 \pm 0.3V$ $V_{CC} \times 2$ at $V_{CC} = 2.5 \pm 0.2V$
t_{PZH}, t_{PHZ}	GND



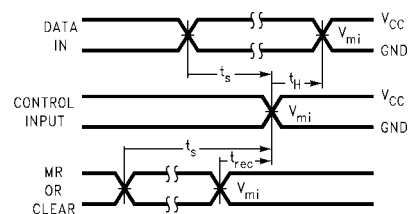
Waveform for Inverting and Non-Inverting Functions



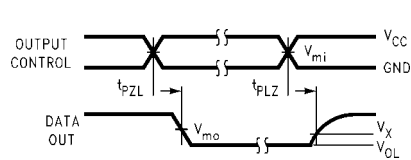
3-STATE Output High Enable and Disable Times for Logic



Propagation Delay, Pulse Width and t_{rec} Waveforms



Setup Time, Hold Time and Recovery Time for Logic



3-STATE Output Low Enable and Disable Times for Logic

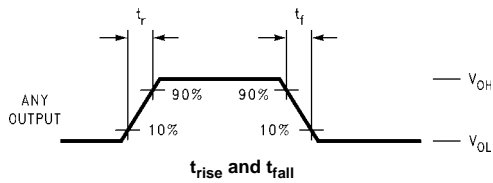
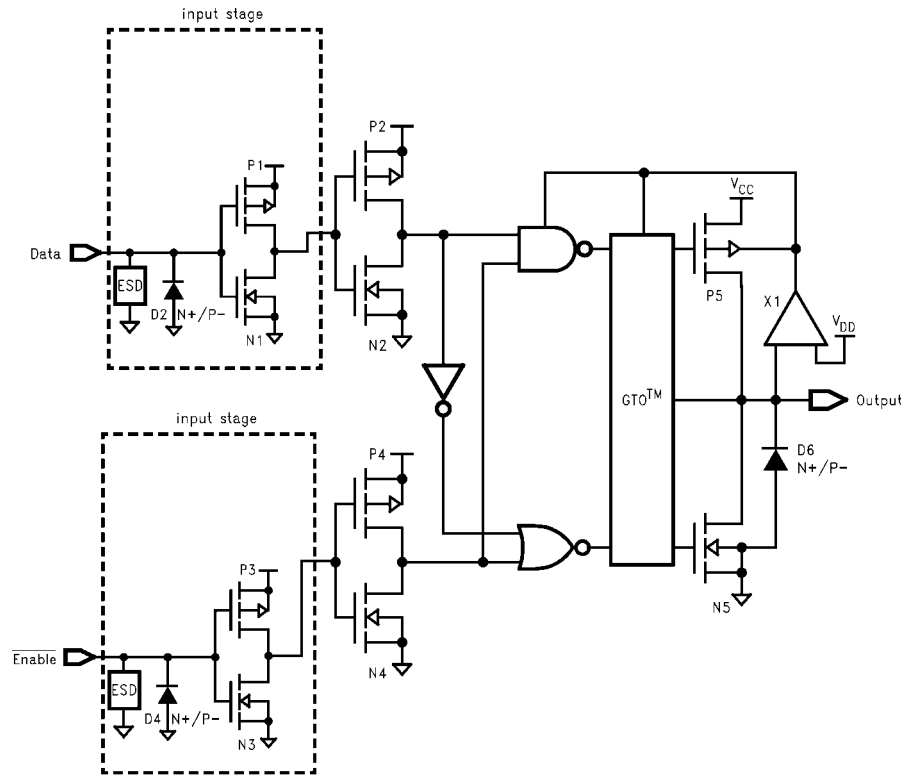
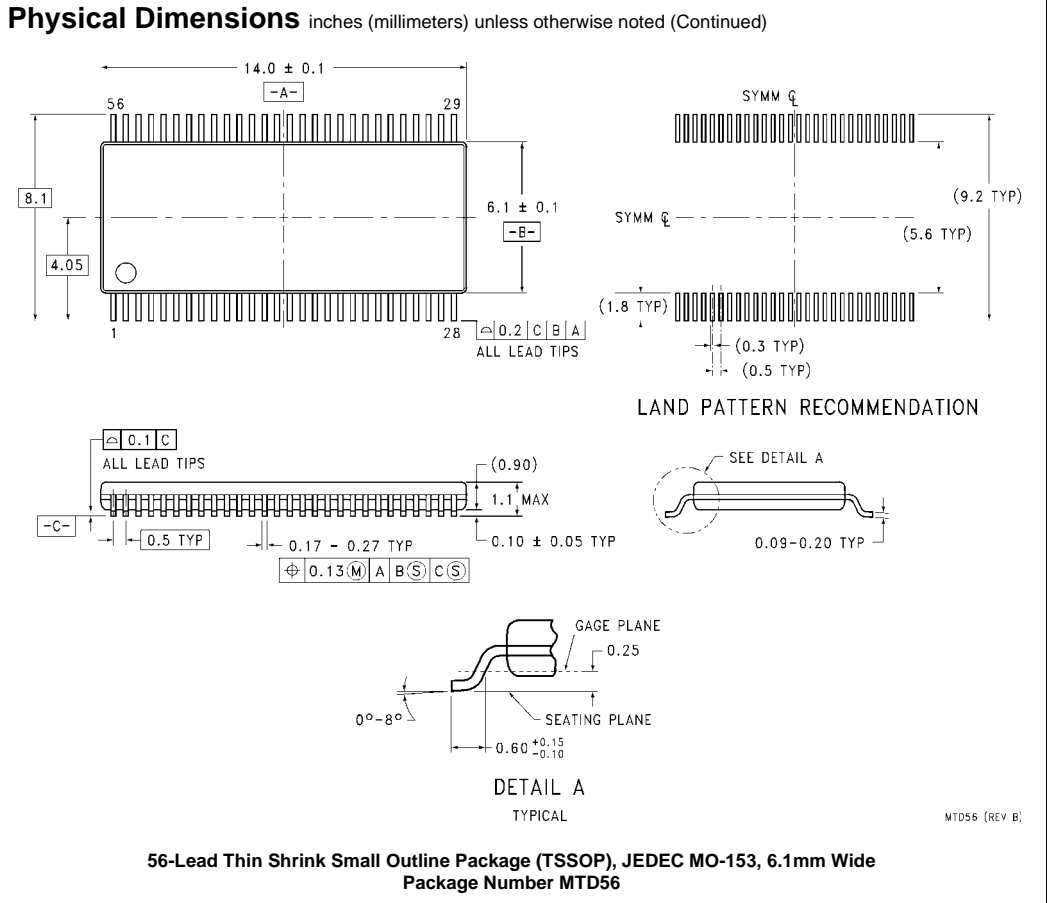


FIGURE 2. Waveforms
(Input Characteristics; $f = 1MHz, t_R = t_F = 3ns$)

Symbol	V_{CC}		
	$3.3V \pm 0.3V$	$2.7V$	$2.5V \pm 0.2V$
V_{mi}	1.5V	1.5V	$V_{CC}/2$
V_{mo}	1.5V	1.5V	$V_{CC}/2$
V_x	$V_{OL} + 0.3V$	$V_{OL} + 0.3V$	$V_{OL} + 0.15V$
V_y	$V_{OH} - 0.3V$	$V_{OH} - 0.3V$	$V_{OH} - 0.15V$

Schematic Diagram Generic for LCX Family





Fairchild does not assume any responsibility for use of any circuitry described, no circuit patent licenses are implied and Fairchild reserves the right at any time without notice to change said circuitry and specifications.

LIFE SUPPORT POLICY

FAIRCHILD'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT OF FAIRCHILD 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 (c) 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 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.

www.fairchildsemi.com

ON Semiconductor and  are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor's product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using ON Semiconductor products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by ON Semiconductor. "Typical" parameters which may be provided in ON Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. ON Semiconductor does not convey any license under its patent rights nor the rights of others. ON Semiconductor products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use ON Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold ON Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that ON Semiconductor was negligent regarding the design or manufacture of the part. ON Semiconductor is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:

Literature Distribution Center for ON Semiconductor
19521 E. 32nd Pkwy, Aurora, Colorado 80011 USA
Phone: 303-675-2175 or 800-344-3860 Toll Free USA/Canada
Fax: 303-675-2176 or 800-344-3867 Toll Free USA/Canada
Email: orderlit@onsemi.com

N. American Technical Support: 800-282-9855 Toll Free
USA/Canada
Europe, Middle East and Africa Technical Support:
Phone: 421 33 790 2910
Japan Customer Focus Center
Phone: 81-3-5817-1050

ON Semiconductor Website: www.onsemi.com
Order Literature: <http://www.onsemi.com/orderlit>
For additional information, please contact your local
Sales Representative