



74LCX652

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

General Description

The LCX652 consists of bus transceiver circuits with D-type flip-flops, and control circuitry arranged for multiplexed transmission of data directly from the input bus or from internal registers. Data on the A or B bus will be clocked into the registers as the appropriate clock pin goes to the HIGH logic level. Output Enable pins (OEAB, OEBA) are provided to control the transceiver function.

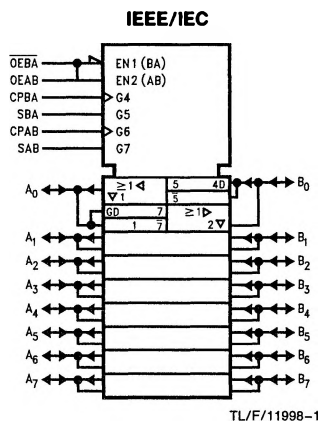
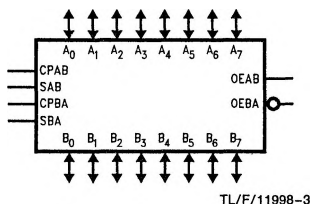
The LCX652 is designed for low voltage (3.3V) V_{CC} applications with capability of interfacing to a 5V signal environment.

The LCX652 is fabricated with an advanced CMOS technology to achieve high speed operation while maintaining CMOS low power dissipation.

Features

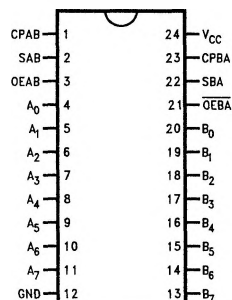
- 5V tolerant inputs and outputs
- 7.0 ns t_{PD} max, 10 μ A I_{CCQ} max
- Power down high impedance inputs and outputs
- 2.0V–3.6V V_{CC} supply operation
- ± 24 mA output drive
- Implements patented Quiet Series™ noise/EMI reduction circuitry
- Functionally compatible with 74 series 652
- Latch-up performance exceeds 500 mA
- ESD performance:
 - Human body model > 2000V
 - Machine model > 200V

Logic Symbols



Connection Diagram

Pin Assignment for SOIC, SSOP and TSSOP



Pin Names	Description
A ₀ –A ₇ , B ₀ –B ₇	A and B Inputs/TRI-STATE® Outputs
CPAB, CPBA	Clock Inputs
SAB, SBA	Select Inputs
OEAB, OEBA	Output Enable Inputs

	SOIC JEDEC	SSOP Type II	TSSOP JEDEC
Order Number	74LCX652WM 74LCX652WMX	74LCX652MSA 74LCX652MSAX	74LCX652MTC 74LCX652MTCX
See NS Package Number	M24B	MSA24	MTC24

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, SBA) controls can multiplex stored and real-time.

The examples in *Figure 1* demonstrate the four fundamental bus-management functions that can be performed with the Octal bus transceivers and receivers.

Data on the A or B data bus, or both can be stored in the internal D flip-flop by LOW to HIGH transitions at the appro-

priate Clock Inputs (CPAB, CPBA) regardless of the Select or Output Enable Inputs. When SAB and SBA are in the real time transfer mode, it is also possible to store data without using the internal D flip-flops by simultaneously enabling OEAB and OEBA. In this configuration each Output reinforces its Input. Thus when all other data sources to the two sets of bus lines are in a HIGH impedance state, each set of bus lines will remain at its last state.

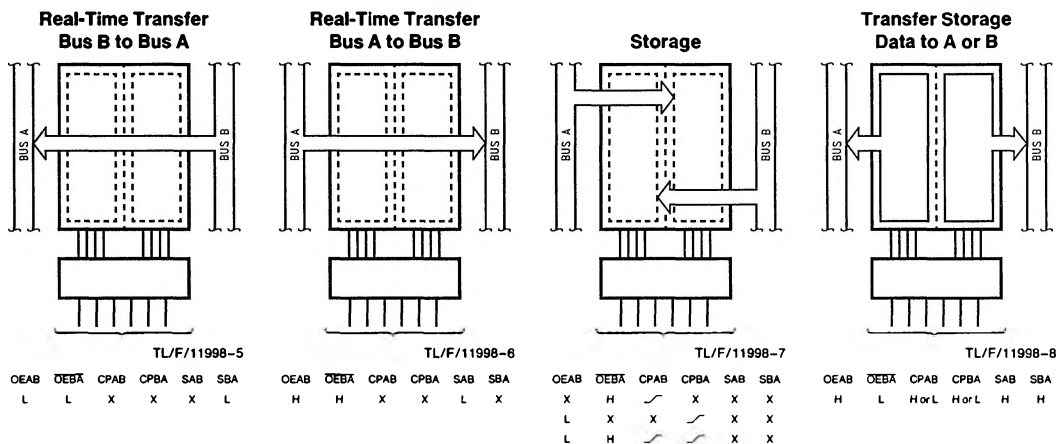
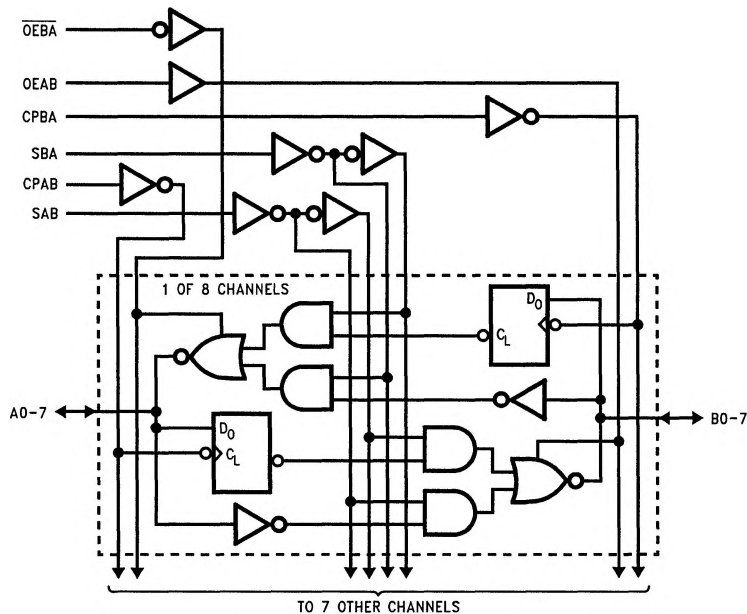


FIGURE 1

Logic Diagram



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

Function Table (Note)

Inputs						Inputs/Outputs		Operating Mode
OEAB	OEBA	CPAB	CPBA	SAB	SBA	A ₀ thru A ₇	B ₀ thru B ₇	
L	H	H or L	H or L	X	X	Input	Input	Isolation
L	H	⌄	⌄	X	X			Store A and B Data
X	H	⌄	H or L	X	X	Input	Not Specified	Store A, Hold B
H	H	⌄	⌄	X	X	Input	Output	Store A in Both Registers
L	X	H or L	⌄	X	X	Not Specified	Input	Hold A, Store B
L	L	⌄	⌄	X	X	Output	Input	Store B in Both Registers
L	L	X	X	X	L	Output	Input	Real-Time B Data to A Bus
L	L	X	H or L	X	H			Store B Data to A Bus
H	H	X	X	L	X	Input	Output	Real-Time A Data to B Bus
H	H	H or L	X	H	X			Stored A Data to B Bus
H	L	H or L	H or L	H	H	Output	Output	Stored A Data to B Bus and Stored B Data to A Bus

H = HIGH Voltage Level
L = LOW Voltage Level
X = Immaterial
⌄ = LOW to HIGH Clock Transition

Note: The data output functions may be enabled or disabled by various signals at OEAB or OEBA inputs. Data input functions are always enabled, i.e., data at the bus pins will be stored on every LOW to HIGH transition on the clock inputs.

Absolute Maximum Ratings (Note 1)

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

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	Output in TRI-STATE	V
		-0.5 to $V_{CC} + 0.5$	Output in High or Low State (Note 2)	V
I_{IK}	DC Input Diode Current	-50	$V_I < GND$	mA
I_{OK}	DC Output Diode Current	-50	$V_O < GND$	mA
		+50	$V_O > V_{CC}$	
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

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" table 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.

Recommended Operating Conditions

Symbol	Parameter	Min	Max	Units
V_{CC}	Supply Voltage	Operating	2.0	V
		Data Retention	1.5	
V_I	Input Voltage	0	5.5	V
V_O	Output Voltage	HIGH or LOW State	0	V
		TRI-STATE	V_{CC} 5.5	
I_{OH}/I_{OL}	Output Current	$V_{CC} = 3.0V-3.6V$ $V_{CC} = 2.7V$	± 24 ± 12	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

DC Electrical Characteristics

Symbol	Parameter	Conditions	V_{CC} (V)	$T_A = -40^\circ\text{C to } +85^\circ\text{C}$		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	$I_{OH} = -100 \mu A$	2.7-3.6	$V_{CC} - 0.2$		V
		$I_{OH} = -12 \text{ mA}$	2.7	2.2		V
		$I_{OH} = -18 \text{ mA}$	3.0	2.4		V
		$I_{OH} = -24 \text{ mA}$	3.0	2.2		V
V_{OL}	LOW Level Output Voltage	$I_{OL} = 100 \mu A$	2.7-3.6		0.2	V
		$I_{OL} = 12 \text{ mA}$	2.7		0.4	V
		$I_{OL} = 16 \text{ mA}$	3.0		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 I/O Leakage	$0 \leq V_O \leq 5.5V$ $V_I = V_{IH} \text{ or } V_{IL}$	2.7-3.6		± 5.0	μA
I_{OFF}	Power-Off Leakage Current	$V_I \text{ or } V_O = 5.5V$	0		100	μA
I_{CC}	Quiescent Supply Current	$V_I = V_{CC} \text{ or } GND$	2.7-3.6		10	μA
		$3.6V \leq V_I, V_O \leq 5.5V$	2.7-3.6		± 10	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 = −40°C to +85°C				Units
		V _{CC} = 3.3V ± 0.3V		V _{CC} = 2.7V		
		Min	Max	Min	Max	
f _{max}	Maximum Clock Frequency	150				MHz
t _{PHL} t _{PLH}	Propagation Delay Bus to Bus	1.5 1.5	7.0 7.0	1.5 1.5	8.0 8.0	ns
t _{PHL} t _{PLH}	Propagation Delay Clock to Bus	1.5 1.5	8.5 8.5	1.5 1.5	9.5 9.5	ns
t _{PHL} t _{PLH}	Propagation Delay Select to Bus	1.5 1.5	8.5 8.5	1.5 1.5	9.5 9.5	ns
t _{PZL} t _{PZH}	Output Enable Time	1.5 1.5	8.5 8.5	1.5 1.5	9.5 9.5	ns
t _{PLZ} t _{PHZ}	Output Disable Time	1.5 1.5	8.5 8.5	1.5 1.5	9.5 9.5	ns
t _S	Setup Time	2.5		2.5		ns
t _H	Hold Time	1.5		1.5		ns
t _W	Pulse Width	3.3		3.3		ns
t _{OSHL} t _{OSLH}	Output to Output Skew (Note 1)		1.0 1.0			ns

Note 1: 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)	$T_A = 25^{\circ}\text{C}$	Unit
				Typical	
V_{OLP}	Quiet Output Dynamic Peak V_{OL}	$C_L = 50\text{ pF}$, $V_{\text{IH}} = 3.3\text{V}$, $V_{\text{IL}} = 0\text{V}$	3.3	0.8	V
V_{OLV}	Quiet Output Dynamic Valley V_{OL}	$C_L = 50\text{ pF}$, $V_{\text{IH}} = 3.3\text{V}$, $V_{\text{IL}} = 0\text{V}$	3.3	0.8	V

Capacitance

Symbol	Parameter	Conditions	Typical	Units
C_{IN}	Input Capacitance	$V_{CC} = \text{Open}$, $V_I = 0\text{V}$ or V_{CC}	7	pF
$C_{\text{I/O}}$	Input/Output Capacitance	$V_{CC} = 3.3\text{V}$, $V_I = 0\text{V}$ or V_{CC}	8	pF
C_{PD}	Power Dissipation Capacitance	$V_{CC} = 3.3\text{V}$, $V_I = 0\text{V}$ or V_{CC} , $F = 10\text{ MHz}$	25	pF

74LCX652 Ordering Information

The device number is used to form part of a simplified purchasing code where the package type and temperature range are defined as follows:

