FAIRCHILD SEMICONDUCTOR™

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74LVTH16652
Low Voltage 16-Bit Transceiver/Register with 3-STATE Outputs

General Description

The LVTH16652 consists of sixteen bus transceiver circuits with D-type flip-flops, and control circuitry arranged for multiplexed transmission of data directly from the input bus or from the internal registers. Each byte has separate control inputs which can be shorted together for full 16-bit operation. 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, $\overline{OEBA}$) are provided to control the transceiver function (see Functional Description).

The LVTH16652 data inputs include bushold, eliminating the need for external pull-up resistors to hold unused inputs.

The transceivers are designed for low-voltage (3.3V) V_{CC} applications, but with the capability to provide a TTL interface to a 5V environment. The LVTH16652 is fabricated with an advanced BiCMOS technology to achieve high speed operation similar to 5V ABT while maintaining low power dissipation.

Features

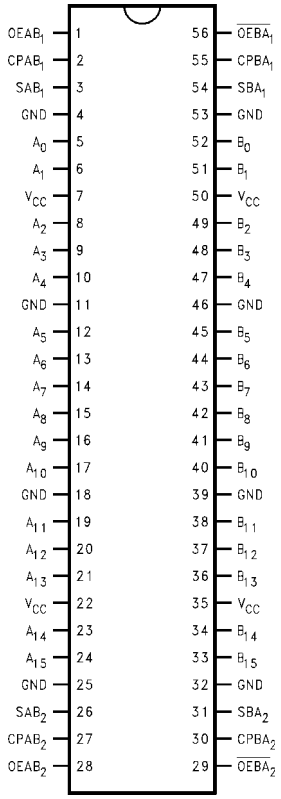
- Input and output interface capability to systems at 5V V_{CC}
- Bushold data inputs eliminate the need for external pull-up resistors to hold unused inputs
- Live insertion/extraction permitted
- Power Up/Down high impedance provides glitch-free bus loading
- Outputs source/sink –32 mA/+64 mA
- Functionally compatible with the 74 series 16652
- Latch-up performance exceeds 500 mA
- ESD performance:
  - Human-body model > 2000V
  - Machine model > 200V
  - Charged-device model > 1000V

Ordering Code:

Order Number	Package Number	Package Description
74LVTH16652MEA	MS56A	56-Lead Shrink Small Outline Package (SSOP), JEDEC MO-118, 0.300 Wide
74LVTH16652MTD	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.

Connection Diagram



Pin Descriptions

Pin Names	Description
A_0–A_{15}	Data Register A Inputs/ 3-STATE Outputs
B_0–B_{15}	Data Register B Inputs/ 3-STATE Outputs
$CPAB_n$, $CPBA_n$	Clock Pulse Inputs
SAB_n, SBA_n	Select Inputs
$OEAB_n$, $\overline{OEBA}_n$	Output Enable Inputs

Truth Table

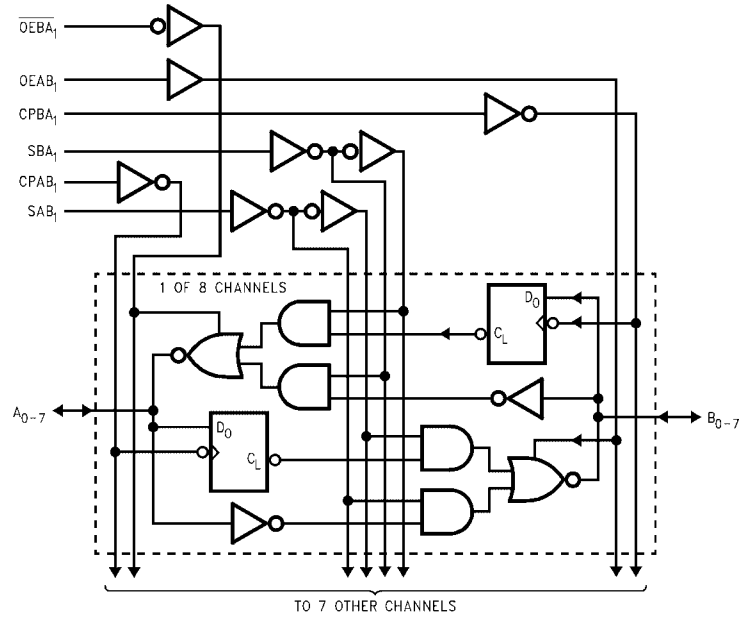
(Note 1)

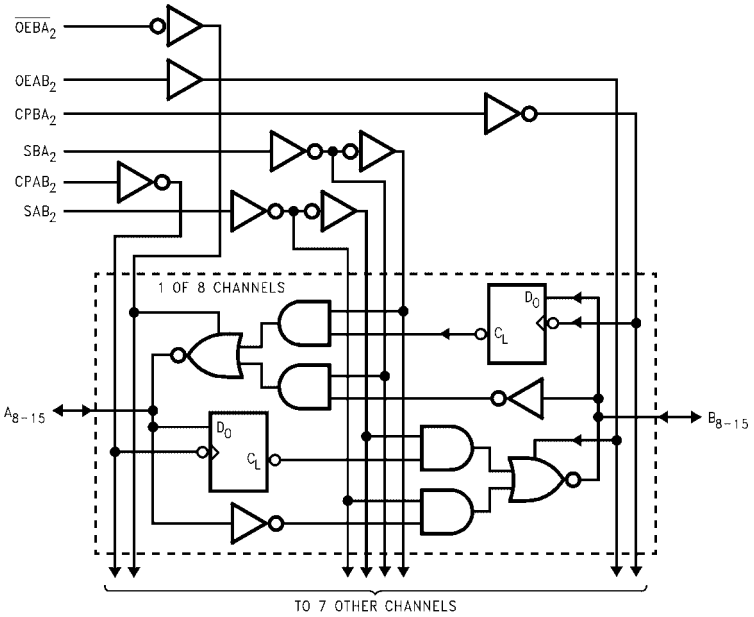
Inputs						Inputs/Outputs		Operating Mode
$OEAB_1$	$\overline{OEBA}_1$	$CPAB_1$	$CPBA_1$	SAB_1	SBA_1	A_0 thru A_7	B_0 thru B_7	
L	H	H or L	H or L	X	X	Input	Input	Isolation
L	H	↑	↑	X	X			Store A and B Data
X	H	↑	H or L	X	X	Input	Not Specified	Store A, Hold B
H	H	↑	↑	X	X	Input	Output	Store A in Both Registers
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 1: The data output functions may be enabled or disabled by various signals at OEAB or $\overline{OEBA}$ 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. This 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

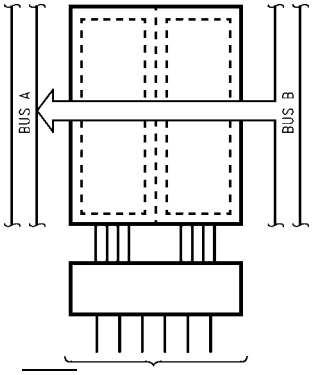
In the transceiver mode, data present at the HIGH impedance port may be stored in either the A or B register or both.

The select (SAB_n, SBA_n) controls can multiplex stored and real-time.

The examples below demonstrate the four fundamental bus-management functions that can be performed with the LVTH16652.

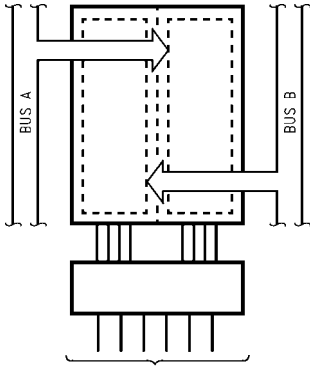
Data on the A or B data bus, or both can be stored in the internal D flip-flop by LOW-to-HIGH transitions at the appropriate Clock Inputs ($CPAB_n$, $CPBA_n$) regardless of the Select or Output Enable Inputs. When SAB and SBA are in the real time transfer mode, it is also possible to store data without using the internal D flip-flops by simultaneously enabling $OEAB_n$ and $\overline{OEBA}_n$. 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.

Real-Time Transfer
Bus B to Bus A



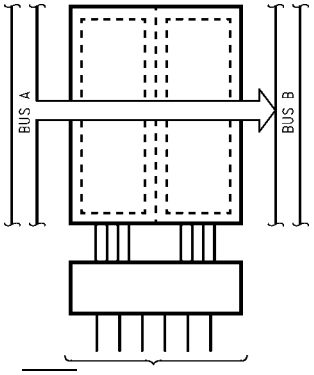
$OEAB_1$	$\overline{OEBA}_1$	$CPAB_1$	$CPBA_1$	SAB_1	SBA_1
L	L	X	X	X	L

Storage



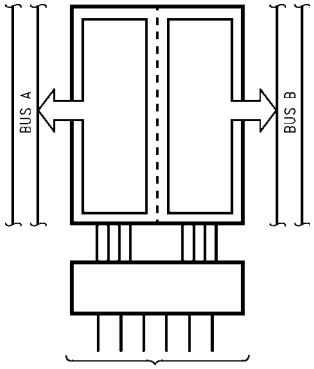
$OEAB_1$	$\overline{OEBA}_1$	$CPAB_1$	$CPBA_1$	SAB_1	SBA_1
X	H	⌐	X	X	X
L	X	X	⌐	X	X
L	H	⌐	⌐	X	X

Real-Time Transfer
Bus A to Bus B



$OEAB_1$	$\overline{OEBA}_1$	$CPAB_1$	$CPBA_1$	SAB_1	SBA_1
H	H	X	X	L	X

Transfer Storage
Data to A or B



$OEAB_1$	$\overline{OEBA}_1$	$CPAB_1$	$CPBA_1$	SAB_1	SBA_1
H	L	H or L	H or L	H	H

Absolute Maximum Ratings(Note 2)

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 3)	
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 2: 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 3: I_O Absolute Maximum Rating must be observed.

DC Electrical Characteristics

Symbol	Parameter		V_{CC} (V)	$T_A = -40°C$ to $+85°C$ Min	Max	Units	Conditions
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_{IL}	Input LOW Voltage		2.7–3.6		0.8		$V_O \ge V_{CC} - 0.1V$
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
$I_{I(HOLD)}$	Bushold Input Minimum Drive		3.0	75		µA	$V_I = 0.8V$
				−75			$V_I = 2.0V$
$I_{I(OD)}$	Bushold Input Over-Drive		3.0	500		µA	(Note 4)
	Current to Change State			−500			(Note 5)
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	$0V \le V_I$ or $V_O \le 5.5V$
$I_{PU/PD}$	Power up/down 3-STATE		0–1.5V		±100	µA	$V_O = 0.5V$ to $3.0V$
	Output Current						V_I = GND or V_{CC}
I_{OZL}	3-STATE Output Leakage Current		3.6		−5	µA	$V_O = 0.0V$
I_{OZH}	3-STATE Output Leakage Current		3.6		5	µA	$V_O = 3.6V$
I_{OZH+}	3-STATE Output Leakage Current		3.6		10	µA	$V_{CC} < V_O \le 5.5V$
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	$V_{CC} \le V_O \le 5.5V$,
							Outputs Disabled
ΔI_{CC}	Increase in Power Supply Current		3.6		0.2	mA	One Input at $V_{CC} - 0.6V$
	(Note 6)						Other Inputs at V_{CC} or GND

Note 4: An external driver must source at least the specified current to switch from LOW-to-HIGH.

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

Note 6: 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 7)

Symbol	Parameter	V_{CC} (V)	$T_A = 25°C$ Min	Typ	Max	Units	Conditions $C_L = 50$ pF, $R_L = 500\Omega$
V_{OLP}	Quiet Output Maximum Dynamic V_{OL}	3.3		0.8		V	(Note 8)
V_{OLV}	Quiet Output Minimum Dynamic V_{OL}	3.3		−0.8		V	(Note 8)

Note 7: Characterized in SOIC package. Guaranteed parameter, but not tested.

Note 8: 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	Max	Min	Max	
f_{MAX}	Maximum Clock Frequency		150		150		MHz
t_{PHL}	Propagation Delay		1.3	4.8	1.3	5.4	ns
t_{PLH}	CPAB or CPBA to A or B		1.3	5.1	1.3	5.6	
t_{PHL}	Propagation Delay		1.0	4.5	1.0	5.1	ns
t_{PLH}	Data to A or B		1.0	4.4	1.0	4.7	
t_{PHL}	Propagation Delay		1.0	4.9	1.0	5.5	ns
t_{PLH}	SBA or SAB to A or B		1.0	4.8	1.0	5.4	
t_{PZL}	Output Enable Time		1.0	4.9	1.0	5.8	ns
t_{PZH}	$\overline{OE}$ to A		1.0	4.8	1.0	5.8	
t_{PLZ}	Output Disable Time		1.6	5.6	1.6	6.1	ns
t_{PHZ}	$\overline{OE}$ to A		2.0	5.4	2.0	6.1	
t_{PZL}	Output Enable Time		1.3	5.0	1.3	5.4	ns
t_{PZH}	OE to B		1.3	4.8	1.3	5.4	
t_{PLZ}	Output Disable Time		1.3	5.5	1.3	6.2	ns
t_{PHZ}	OE to B		1.3	5.6	1.3	6.3	
t_S	Setup Time	A or B before CPAB or CPBA, Data HIGH	1.2		1.5		ns
		A or B before CPAB or CPBA, Data LOW	2.0		2.8		
t_H	Hold Time	A or B before CPAB or CPBA, Data HIGH	0.5		0.0		ns
		A or B before CPAB or CPBA, Data LOW	0.5		0.5		
t_W	Pulse Width	CPAB or CPBA HIGH or LOW	3.3		3.3		ns
t_{OSHL}	Output to Output Skew (Note 9)			1.0		1.0	ns
t_{OSLH}				1.0		1.0	

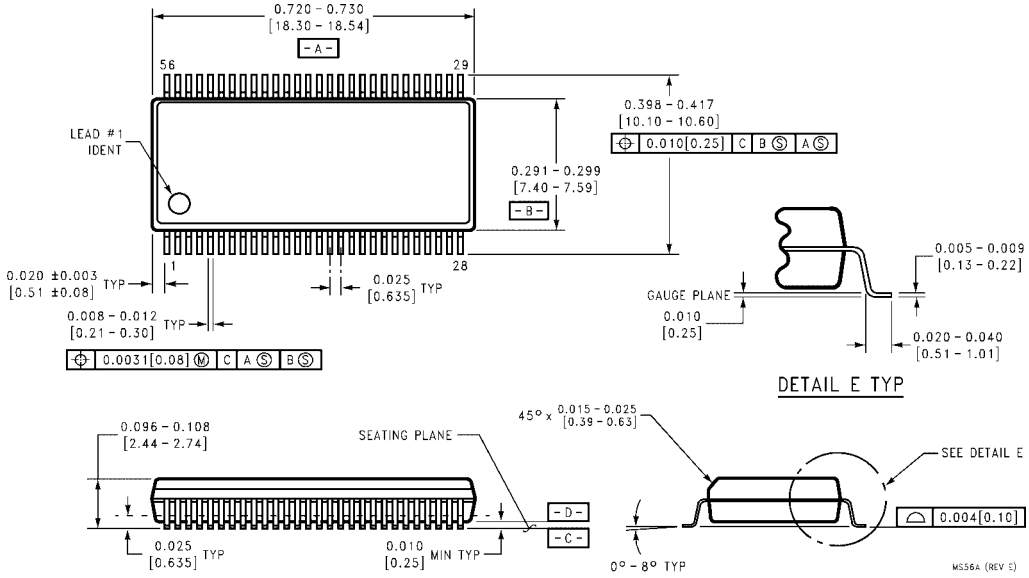
Note 9: Skew is defined as the absolute value of the difference between the actual propagation delay for any two separate outputs of the same device. The specification applies to any outputs switching in the same direction, either HIGH-to-LOW (t_{OSHL}) or LOW-to-HIGH (t_{OSLH}).

Capacitance (Note 10)

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

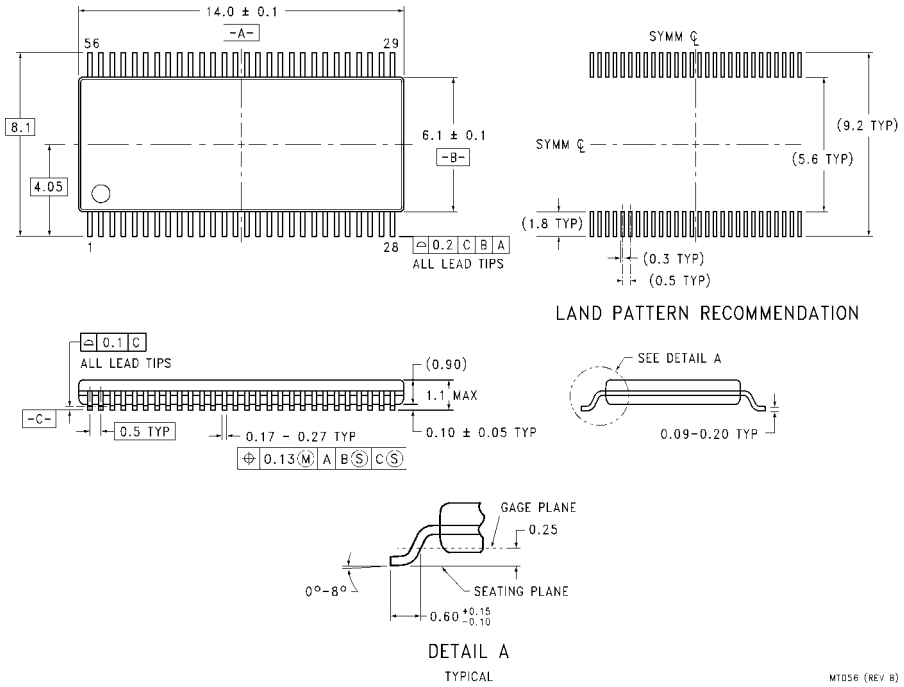
Note 10: Capacitance is measured at frequency f = 1 MHz, per MIL-STD-883, Method 3012.

Physical Dimensions inches (millimeters) unless otherwise noted



56-Lead Shrink Small Outline Package (SSOP), JEDEC MO-118, 0.300 Wide
Package Number MS56A

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



56-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 6.1mm Wide
Package Number MTD56

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