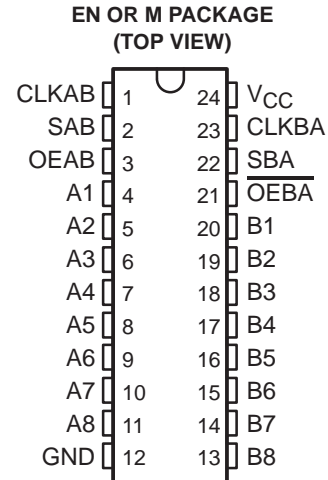


# CD74FCT654

## BiCMOS OCTAL BUS TRANSCEIVER AND REGISTER WITH OPEN-COLLECTOR AND 3-STATE OUTPUTS

SCBS732 – JULY 2000

- BiCMOS Technology With Low Quiescent Power
- Open-Collector Outputs on A Bus, 3-State Outputs on B Bus
- Buffered Inputs
- Noninverted Outputs
- Input/Output Isolation From  $V_{CC}$
- Controlled Output Edge Rates
- 64-mA Output Sink Current
- Output Voltage Swing Limited to 3.7 V
- SCR Latch-Up-Resistant BiCMOS Process and Circuit Design
- Bus Transceivers/Registers
- Independent Registers and Enables for A and B Buses
- Multiplexed Real-Time and Stored Data
- Package Options Include Plastic Small-Outline (M) Package and Standard Plastic (EN) DIP



### description

The CD74FCT654 is an octal bus transceiver and register with open-collector and 3-state outputs. It consists of D-type flip-flops and control circuitry arranged for multiplexed transmission of data directly from the data bus or from the internal storage registers. Output-enable (OEAB and OEBA) inputs control the transceiver functions. Select-control (SAB and SBA) inputs select real-time-data or stored-data transfer. The select-control circuitry eliminates the typical decoding glitch that occurs in a multiplexer during the transition between stored data and real-time data. A low input level selects real-time data, and a high input level selects stored data.

The device uses a small-geometry BiCMOS technology. The output state is a combination of bipolar and CMOS transistors that limits the output high level to two diode drops below  $V_{CC}$ . This resultant lowering of output swing (0 V to 3.7 V) reduces power-bus ringing [a source of electromagnetic interference (EMI)] and minimizes  $V_{CC}$  bounce and ground bounce and their effects during simultaneous output switching. The output configuration also enhances switching speed and is capable of sinking 64 mA.

The CD74FCT654 has noninverted outputs with open drains on the A outputs and 3-state outputs on the B side. Data on the A or B data bus, or both, can be stored in the internal D-type flip-flops by low-to-high transitions at the appropriate clock (CLKAB or CLKBA) terminals, regardless of the state of the select- or output-control terminals. When SAB and SBA are in the real-time transfer mode, it is possible to store data without using the internal D-type flip-flops by simultaneously enabling OEAB and OEBA. In this configuration, each output reinforces its input. When all other data sources to the two sets of bus lines are at high impedance, each set of bus lines remains at its last state.

The CD74FCT654 is characterized for operation from 0°C to 70°C.



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

**TEXAS  
INSTRUMENTS**

POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

Copyright © 2000, Texas Instruments Incorporated

# CD74FCT654

## BiCMOS OCTAL BUS TRANSCEIVER AND REGISTER

### WITH OPEN-COLLECTOR AND 3-STATE OUTPUTS

SCBS732 – JULY 2000

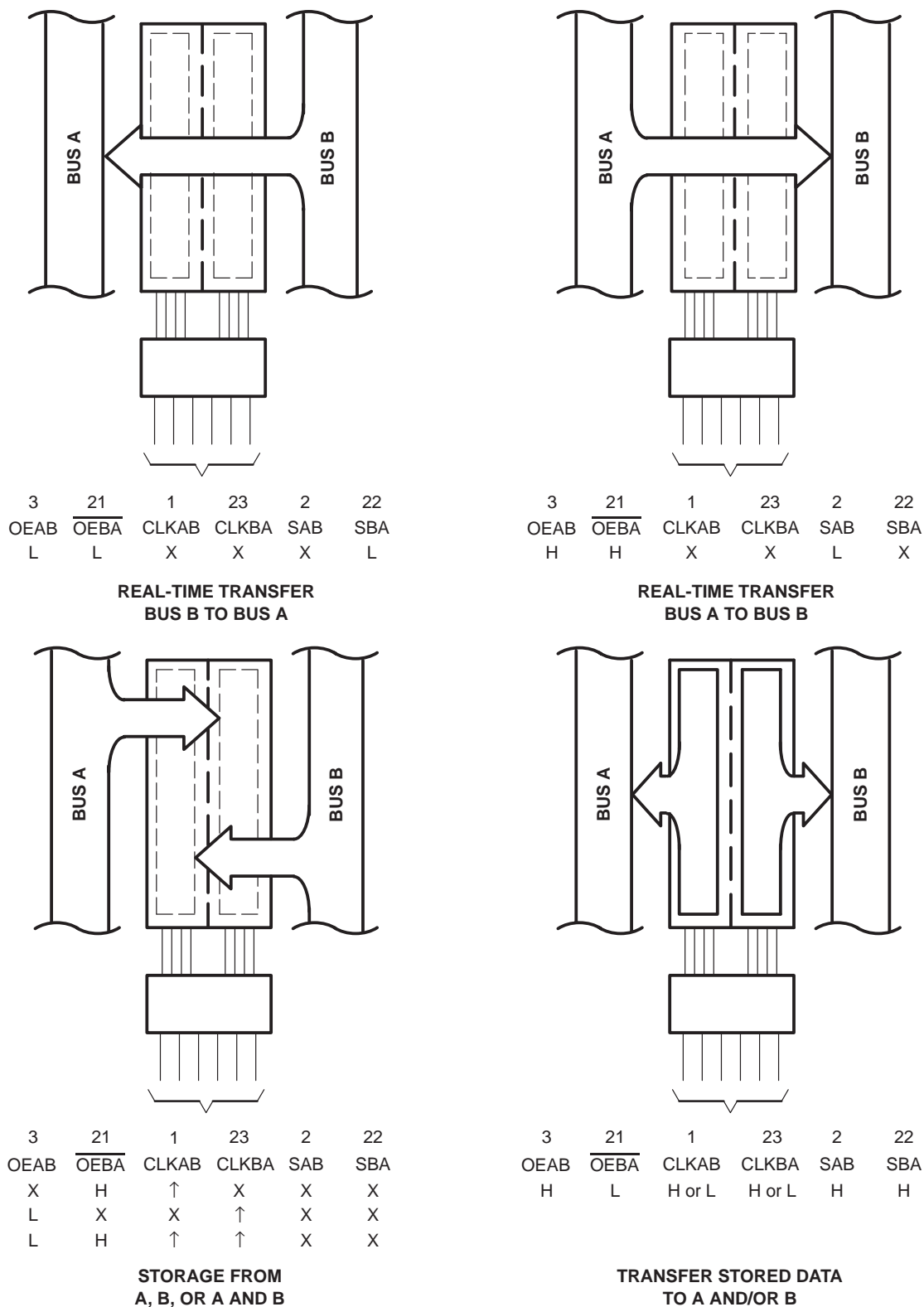


Figure 1. Bus-Management Functions

# CD74FCT654

## BiCMOS OCTAL BUS TRANSCEIVER AND REGISTER WITH OPEN-COLLECTOR AND 3-STATE OUTPUTS

SCBS732 – JULY 2000

FUNCTION TABLE

INPUTS						DATA I/O†		OPERATION OR FUNCTION
OEAB	OEBA	CLKAB	CLKBA	SAB	SBA	A1–A8	B1–B8	
L	H	H or L	H or L	X	X	Input	Input	Isolation‡
L	H	↑	↑	X	X	Input	Input	Store A and B data
X	H	↑	H or L	X	X	Input	Unspecified§	Store A, hold B
H	H	↑	↑	X§	X	Input	Output	Store A in both registers
L	X	H or L	↑	X	X	Unspecified§	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	Output	Input	Stored 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	Input	Output	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

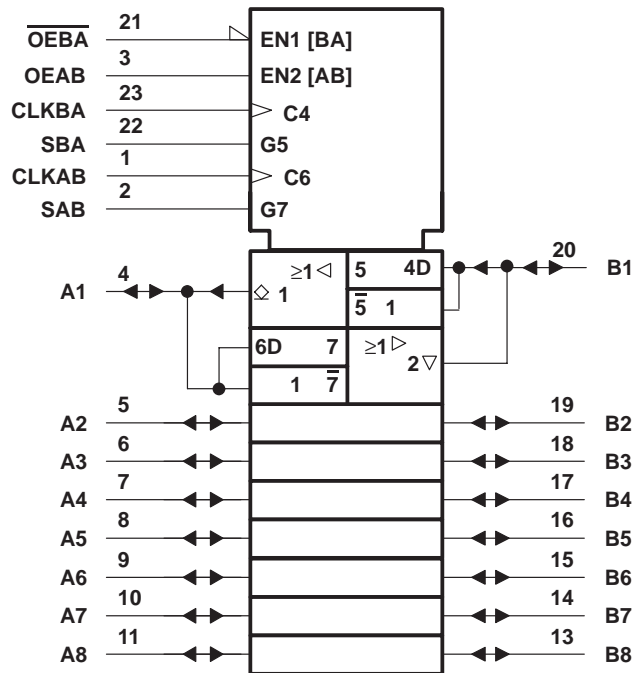
† The data output functions can be enabled or disabled by various level combinations at OEAB or OEBA. Data input functions always are enabled; i.e., data at the bus terminals is stored on every low-to-high transition of the clock inputs.

‡ To prevent excess currents in the high-impedance (isolation) state, all I/O terminals should be terminated with 10 kΩ to 1 MΩ resistors.

§ Select control = L (Clocks can occur simultaneously.)

Select control = H (Clocks must be staggered to load both registers.)

### logic symbol¶



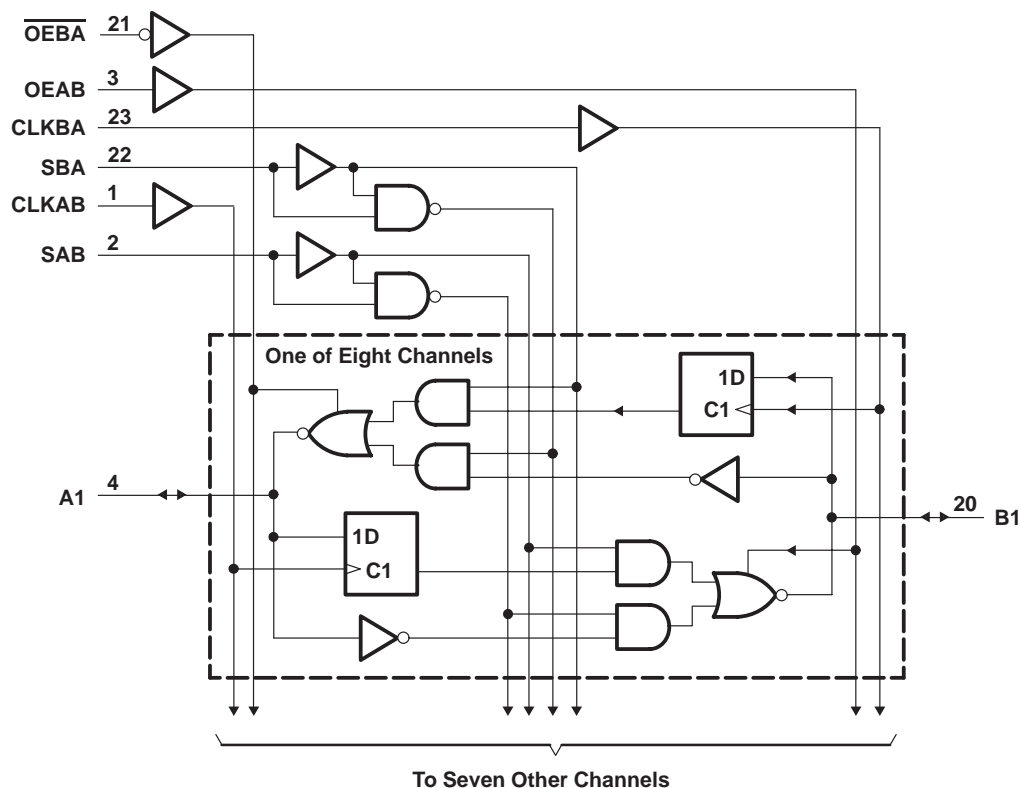
¶ This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

# CD74FCT654

## BiCMOS OCTAL BUS TRANSCEIVER AND REGISTER WITH OPEN-COLLECTOR AND 3-STATE OUTPUTS

SCBS732 – JULY 2000

### logic diagram (positive logic)



### absolute maximum ratings over operating free-air temperature range (unless otherwise noted)<sup>†</sup>

DC supply voltage range, $V_{CC}$	–0.5 V to 6 V
DC input clamp current, $I_{IK}$ ( $V_I < -0.5$ V)	–20 mA
DC output clamp current, $I_{OK}$ ( $V_O < -0.5$ V)	–50 mA
DC output sink current per output pin, $I_{OL}$	70 mA
DC output source current per output pin, $I_{OH}$	–30 mA
Continuous current through $V_{CC}$ , $I_{CC}$	140 mA
Continuous current through GND	528 mA
Package thermal impedance, $\theta_{JA}$ (see Note 1): EN package	67°C/W
M package	46°C/W
Storage temperature range, $T_{stg}$	–65°C to 150°C

<sup>†</sup> Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

NOTE 1: The package thermal impedance is calculated in accordance with JESD 51.

**CD74FCT654**  
**BiCMOS OCTAL BUS TRANSCEIVER AND REGISTER**  
**WITH OPEN-COLLECTOR AND 3-STATE OUTPUTS**

SCBS732 – JULY 2000

**recommended operating conditions (see Note 2)**

		MIN	MAX	UNIT
V <sub>CC</sub>	Supply voltage	4.75	5.25	V
V <sub>IH</sub>	High-level input voltage	2		V
V <sub>IL</sub>	Low-level input voltage		0.8	V
V <sub>I</sub>	Input voltage	0	V <sub>CC</sub>	V
V <sub>O</sub>	Output voltage	0	V <sub>CC</sub>	V
I <sub>OH</sub>	High-level output current		–15	mA
I <sub>OL</sub>	Low-level output current		64	mA
Δt/Δv	Input transition rise or fall rate	0	10	ns/V
T <sub>A</sub>	Operating free-air temperature	0	70	°C

NOTE 2: All unused inputs of the device must be held at V<sub>CC</sub> or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

**electrical characteristics over recommended operating temperature range (unless otherwise noted)**

PARAMETER	TEST CONDITIONS	V <sub>CC</sub>	T <sub>A</sub> = 25°C		MIN	MAX	UNIT
			MIN	MAX			
V <sub>IK</sub>	I <sub>I</sub> = –18 mA	4.75 V		–1.2		–1.2	V
V <sub>OH</sub>	I <sub>OH</sub> = –15 mA	4.75 V	2.4		2.4		V
V <sub>OL</sub>	I <sub>OL</sub> = 64 mA	4.75 V		0.55		0.55	V
I <sub>I</sub>	V <sub>I</sub> = V <sub>CC</sub> or GND	5.25 V		±0.1		±1	μA
I <sub>OZ</sub>	V <sub>O</sub> = V <sub>CC</sub> or GND	5.25 V		±0.5		±10	μA
I <sub>OS</sub> <sup>†</sup>	V <sub>I</sub> = V <sub>CC</sub> or GND, V <sub>O</sub> = 0	5.25 V	–60		–60		mA
I <sub>CC</sub>	V <sub>I</sub> = V <sub>CC</sub> or GND, I <sub>O</sub> = 0	5.25 V		8		80	μA
ΔI <sub>CC</sub> <sup>‡</sup>	One input at 3.4 V, Other inputs at V <sub>CC</sub> or GND	5.25 V		1.6		1.6	mA
C <sub>i</sub>	V <sub>I</sub> = V <sub>CC</sub> or GND			10		10	pF
C <sub>o</sub>	V <sub>O</sub> = V <sub>CC</sub> or GND			15		15	pF

<sup>†</sup> Not more than one output should be tested at a time, and the duration of the test should not exceed 100 ms.

<sup>‡</sup> This is the increase in supply current for each input at one of the specified TTL voltage levels rather than 0 V or V<sub>CC</sub>.

**timing requirements over recommended operating temperature conditions (unless otherwise noted) (see Figure 2)**

			MIN	MAX	UNIT
f <sub>clock</sub>	Clock frequency		80		MHz
t <sub>w</sub>	Pulse duration	CLKAB or CLKBA high	6		ns
		CLKAB or CLKBA low	6		ns
t <sub>su</sub>	Setup time	A before CLKAB↑ or B before CLKBA↑	4		ns
t <sub>h</sub>	Hold time	A after CLKAB↑ or B after CLKBA↑	2		ns



# CD74FCT654

## BiCMOS OCTAL BUS TRANSCEIVER AND REGISTER

### WITH OPEN-COLLECTOR AND 3-STATE OUTPUTS

SCBS732 – JULY 2000

switching characteristics over recommended operating temperature conditions (unless otherwise noted) (see Figure 2)

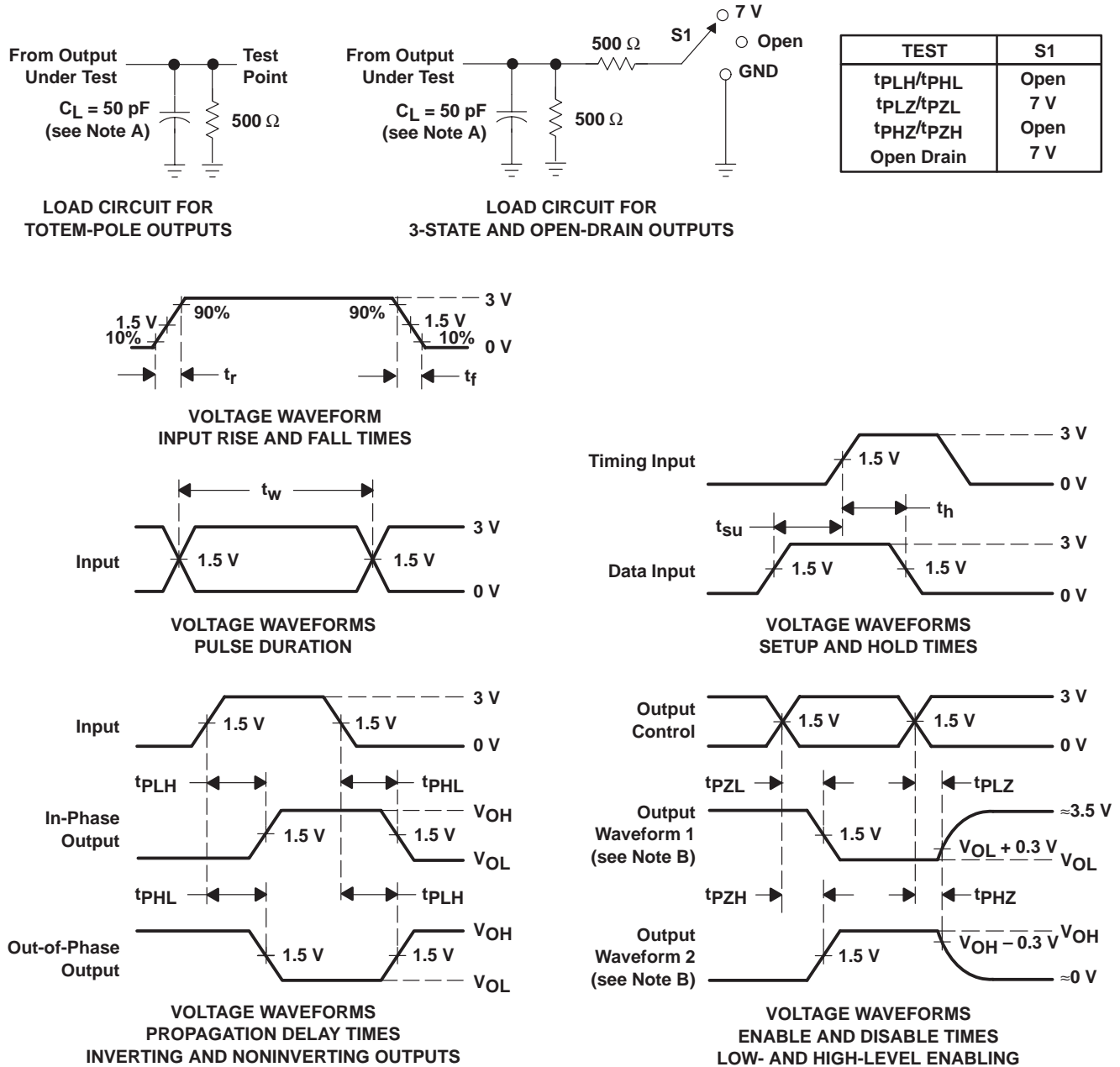
PARAMETER	FROM (INPUT)	TO (OUTPUT)	T <sub>A</sub> = 25°C	MIN	MAX	UNIT
			TYP			
f <sub>max</sub>				80		MHz
t <sub>pd</sub>	CLKAB	B	6.8	2	9	ns
t <sub>PLZ</sub>	CLKBA	A	6.8	2	9	ns
t <sub>PZL</sub>			6.8	2	9	
t <sub>pd</sub>	A	B	6.8	2	9	ns
t <sub>PLZ</sub>	B	A	6.8	2	9	ns
t <sub>PZL</sub>			6.8	2	9	
t <sub>pd</sub>	SAB <sup>†</sup>	B	8.3	2	11	ns
t <sub>PLZ</sub>	SBA <sup>†</sup>	A	6.8	2	9	ns
t <sub>PZL</sub>			6.8	2	9	
t <sub>en</sub>	OEAB	B	11.3	2	15	ns
t <sub>dis</sub>	OEAB	B	6.8	2	9	ns
t <sub>PLZ</sub>	$\overline{\text{OEBA}}$	A	6.8	2	9	ns
t <sub>PZL</sub>			11.3	2	15	

<sup>†</sup> These parameters are measured with the internal output state of the storage register opposite that of the bus input.

noise characteristics, V<sub>CC</sub> = 5 V, C<sub>L</sub> = 50 pF, T<sub>A</sub> = 25°C

PARAMETER		MIN	TYP	MAX	UNIT
V <sub>OL(P)</sub>	Quiet output, maximum dynamic V <sub>OL</sub>		1		V
V <sub>OH(V)</sub>	Quiet output, minimum dynamic V <sub>OH</sub>		0.5		V
V <sub>IH(D)</sub>	High-level dynamic input voltage	2			V
V <sub>IL(D)</sub>	Low-level dynamic input voltage			0.8	V

## PARAMETER MEASUREMENT INFORMATION



- NOTES: A.  $C_L$  includes probe and jig capacitance.
- B. Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high except when disabled by the output control.
- C. All input pulses are supplied by generators having the following characteristics:  $PRR \leq 1 \text{ MHz}$ ,  $Z_O = 50 \Omega$ ,  $t_r$  and  $t_f = 2.5 \text{ ns}$ .
- D. The outputs are measured one at a time with one input transition per measurement.
- E.  $t_{PLZ}$  and  $t_{PHZ}$  are the same as  $t_{dis}$ .
- F.  $t_{PZL}$  and  $t_{PZH}$  are the same as  $t_{en}$ .
- G.  $t_{PHL}$  and  $t_{PLH}$  are the same as  $t_{pd}$ .

**Figure 2. Load Circuit and Voltage Waveforms**

## PACKAGING INFORMATION

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
CD74FCT654EN	OBSOLETE	PDIP	NT	24		TBD	Call TI	Call TI

<sup>(1)</sup> The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSOLETE:** TI has discontinued the production of the device.

<sup>(2)</sup> Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

<sup>(3)</sup> MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

**Important Information and Disclaimer:** The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

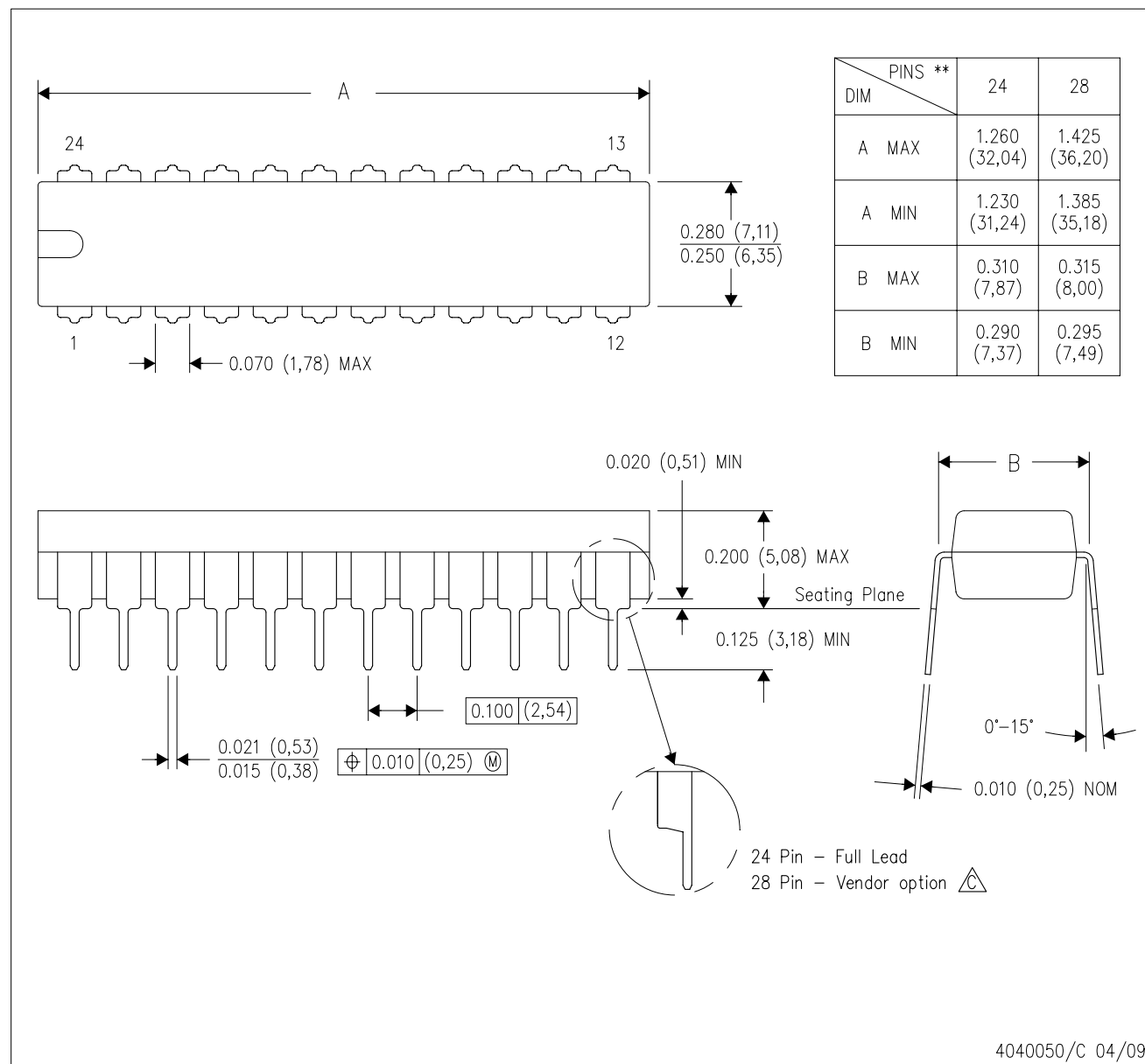


# MECHANICAL DATA

NT (R-PDIP-T\*\*)

24 PINS SHOWN

PLASTIC DUAL-IN-LINE PACKAGE



- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
  - B. This drawing is subject to change without notice.
  - $\triangle C$  The 28 pin end lead shoulder width is a vendor option, either half or full width.

## 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

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>
RF/IF and ZigBee® Solutions	<a href="http://www.ti.com/lprf">www.ti.com/lprf</a>

### Applications

Audio	<a href="http://www.ti.com/audio">www.ti.com/audio</a>
Automotive	<a href="http://www.ti.com/automotive">www.ti.com/automotive</a>
Broadband	<a href="http://www.ti.com/broadband">www.ti.com/broadband</a>
Digital Control	<a href="http://www.ti.com/digitalcontrol">www.ti.com/digitalcontrol</a>
Medical	<a href="http://www.ti.com/medical">www.ti.com/medical</a>
Military	<a href="http://www.ti.com/military">www.ti.com/military</a>
Optical Networking	<a href="http://www.ti.com/opticalnetwork">www.ti.com/opticalnetwork</a>
Security	<a href="http://www.ti.com/security">www.ti.com/security</a>
Telephony	<a href="http://www.ti.com/telephony">www.ti.com/telephony</a>
Video & Imaging	<a href="http://www.ti.com/video">www.ti.com/video</a>
Wireless	<a href="http://www.ti.com/wireless">www.ti.com/wireless</a>

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265  
Copyright © 2009, Texas Instruments Incorporated