



T-5230-08

June 1992

74BCT652 Transceiver/Register

## 74BCT652 Transceiver/Register

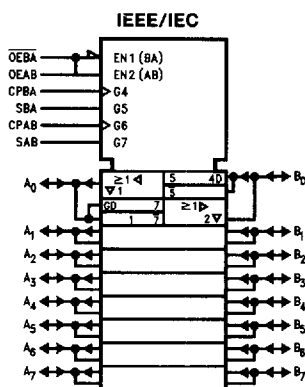
### General Description

This device consists of a bus transceiver circuit 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 HIGH logic level. Output Enable pins (OEAB, OEBA) are provided to control the transceiver function.

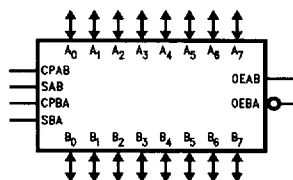
### Features

- Independent registers for A and B buses
- Multiplexed real-time and stored data
- Low  $I_{CCZ}$  through BiCMOS techniques
- Guaranteed multiple output switching specifications
- Guaranteed 4000V minimum ESD protection
- Guaranteed latchup protection
- Nondestructive hot insertion capability
- High impedance in power down ( $I_{ZZ}$  and  $V_{ID}$ )

### Logic Symbols



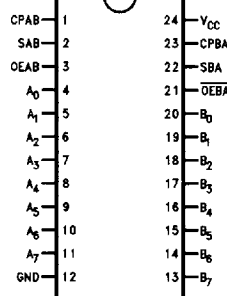
TL/F/10950-1



TL/F/10950-3

### Connection Diagrams

#### Pin Assignment DIP and SOIC



TL/F/10950-2

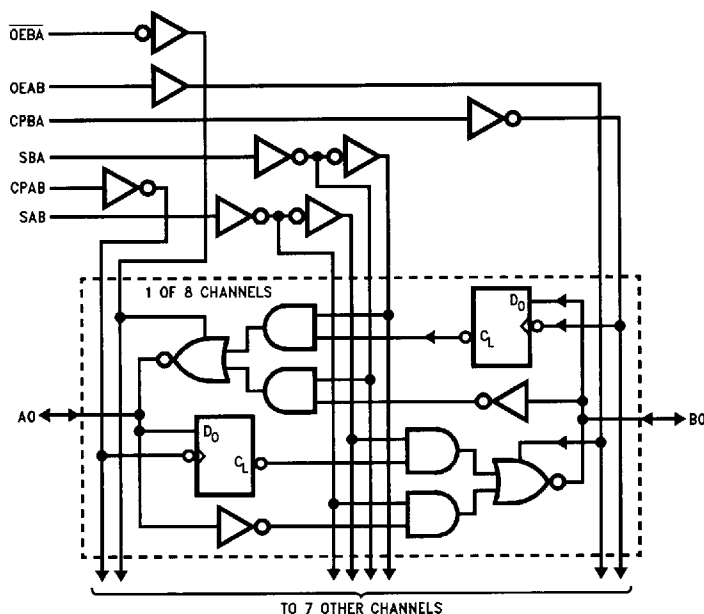
9000-3491

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

## Logic Diagram



TL/F/10950-5

Please note that this diagram is 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, 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 this device.

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.

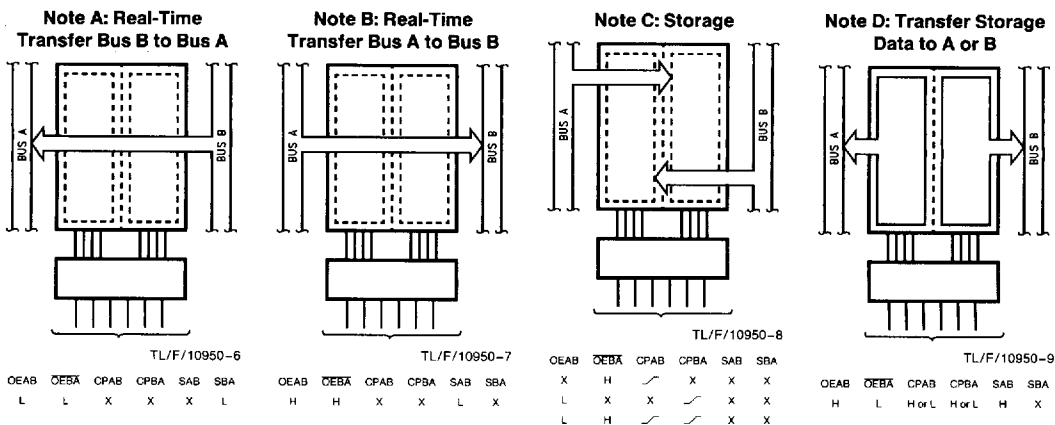


FIGURE 1

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| Inputs |      |        |        |     |     | Inputs/Outputs (Note 1)            |                                    | Operating Mode                                    |
|--------|------|--------|--------|-----|-----|------------------------------------|------------------------------------|---------------------------------------------------|
| OEAB   | OEBA | CPAB   | CPBA   | SAB | SBA | A <sub>0</sub> thru A <sub>7</sub> | B <sub>0</sub> thru B <sub>7</sub> |                                                   |
| 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   |                                    |                                    | Real-Time B Data to A Bus                         |
| L      | L    | X      | H or L | X   | H   | Input                              | Output                             | Store B Data to A Bus                             |
| H      | H    | X      | X      | L   | X   |                                    |                                    | Real-Time A Data to B Bus                         |
| H      | H    | H or L | X      | H   | X   | Output                             | Output                             | Stored A Data to B Bus                            |
| H      | L    | H or L | H or L | H   | H   |                                    |                                    | 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 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.

|                                             |                   |
|---------------------------------------------|-------------------|
| Storage Temperature                         | -65°C to +150°C   |
| Ambient Temperature under Bias              | -55°C to +125°C   |
| Junction Temperature under Bias             |                   |
| Plastic                                     | -55°C to +150°C   |
| V <sub>CC</sub> Pin Potential to Ground Pin | -0.5V to +7.0V    |
| Input Voltage (Note 2)                      | -0.5V to +7.0V    |
| Input Current (Note 2)                      | -30 mA to +5.0 mA |

**Note 1:** Absolute maximum ratings are values beyond which the device may be damaged or have its useful life impaired. Functional operation under these conditions is not implied.

**Note 2:** Either voltage limit or current limit is sufficient to protect inputs.

Voltage Applied to Any Output  
in the Disable or Power-Off State  
in the HIGH State

-0.5V to +5.5V  
-0.5V to V<sub>CC</sub>

Current Applied to Output  
in LOW State (Max)

twice the rated I<sub>OL</sub> (mA)

ESD Last Passing Voltage (Min)

4000V

DC Latchup Source Current

500 mA

Over Voltage Latchup

V<sub>CC</sub> + 4.5V

**Recommended Operating Conditions**

Free Air Ambient Temperature  
Commercial

0°C to +70°C

Supply Voltage  
Commercial

+4.5V to +5.5V

**DC Electrical Characteristics**

| Symbol                             | Parameter                          | 74BCT      |     |      | Units | V <sub>CC</sub> | Conditions                                                            |
|------------------------------------|------------------------------------|------------|-----|------|-------|-----------------|-----------------------------------------------------------------------|
|                                    |                                    | Min        | Typ | Max  |       |                 |                                                                       |
| V <sub>IH</sub>                    | Input HIGH Voltage                 | 2.0        |     |      | V     |                 | Recognized as a HIGH Signal                                           |
| V <sub>IL</sub>                    | Input LOW Voltage                  |            |     | 0.8  | V     |                 | Recognized as a LOW Signal                                            |
| V <sub>CD</sub>                    | Input Clamp Diode Voltage          |            |     | -1.2 | V     | Min             | I <sub>IN</sub> = -18 mA (Non I/O Pins)                               |
| V <sub>OH</sub>                    | Output HIGH Voltage                | 2.4<br>2.0 |     |      | V     | Min             | I <sub>OH</sub> = -3 mA<br>I <sub>OH</sub> = -15 mA                   |
| V <sub>OL</sub>                    | Output LOW Voltage                 |            |     | 0.55 | V     | Min             | I <sub>OL</sub> = 64 mA                                               |
| I <sub>IH</sub>                    | Input HIGH Current                 |            |     | 5.0  | μA    | Max             | V <sub>IN</sub> = 2.7V (Non I/O Pins)                                 |
| I <sub>BVI</sub>                   | Input HIGH Current Breakdown Test  |            |     | 7.0  | μA    | Max             | V <sub>IN</sub> = 7.0V (Non I/O Pins)                                 |
| I <sub>BVIT</sub>                  | Input HIGH Current Breakdown (I/O) |            |     | 100  | μA    | Max             | V <sub>IN</sub> = 5.5V (A <sub>n</sub> , B <sub>n</sub> )             |
| I <sub>CEX</sub>                   | Output HIGH Leakage Current        |            |     | 50   | μA    | Max             | V <sub>OUT</sub> = V <sub>CC</sub> (A <sub>n</sub> , B <sub>n</sub> ) |
| V <sub>ID</sub>                    | Input Leakage Test                 | 4.75       |     |      | V     | 0.0             | I <sub>ID</sub> = 1.9 μA<br>All Other Pins Grounded                   |
| I <sub>IL</sub>                    | Input LOW Current                  |            |     | -250 | μA    | Max             | V <sub>IN</sub> = 0.5V (Non I/O Pins)                                 |
| I <sub>IH</sub> + I <sub>OZH</sub> | Output Leakage Current             |            |     | 70   | μA    | Max             | V <sub>OUT</sub> = 2.7V (A <sub>n</sub> , B <sub>n</sub> )            |
| I <sub>IL</sub> + I <sub>OZL</sub> | Output Leakage Current             |            |     | -225 | μA    | Max             | V <sub>OUT</sub> = 0.5V (A <sub>n</sub> , B <sub>n</sub> )            |
| I <sub>OS</sub>                    | Output Short-Circuit Current       | -100       |     | -225 | mA    | Max             | V <sub>OUT</sub> = 0V                                                 |
| I <sub>ZZ</sub>                    | Bus Drainage Test                  |            |     | 100  | μA    | 0.0V            | V <sub>OUT</sub> = 5.25V (A <sub>n</sub> , B <sub>n</sub> )           |
| I <sub>COH</sub>                   | Power Supply Current               |            | 15  | 22   | mA    | Max             | V <sub>O</sub> = HIGH                                                 |
| I <sub>CCL</sub>                   | Power Supply Current               |            | 40  | 49   | mA    | Max             | V <sub>O</sub> = LOW                                                  |
| I <sub>CCZ</sub>                   | Power Supply Current               |            | 15  | 22   | mA    | Max             | V <sub>O</sub> = HIGH Z                                               |

## AC Electrical Characteristics

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| Symbol           | Parameter               | 74BCT                                                                          |     |      | 74BCT                                              |      | Units |
|------------------|-------------------------|--------------------------------------------------------------------------------|-----|------|----------------------------------------------------|------|-------|
|                  |                         | $T_A = +25^{\circ}\text{C}$<br>$V_{CC} = +5.0\text{V}$<br>$C_L = 50\text{ pF}$ |     |      | $T_A, V_{CC} = \text{Com}$<br>$C_L = 50\text{ pF}$ |      |       |
|                  |                         | Min                                                                            | Typ | Max  | Min                                                | Max  |       |
| $f_{\text{max}}$ | Max. Clock Frequency    | 90                                                                             | 172 |      | 90                                                 |      | MHz   |
| $t_{\text{PLH}}$ | Propagation Delay       | 2.8                                                                            | 5.9 | 8.8  | 2.8                                                | 9.9  | ns    |
| $t_{\text{PHL}}$ | Clock to Bus            | 2.8                                                                            | 5.1 | 8.8  | 2.8                                                | 9.9  |       |
| $t_{\text{PLH}}$ | Propagation Delay       | 1.7                                                                            | 4.6 | 7.5  | 1.7                                                | 8.9  | ns    |
| $t_{\text{PHL}}$ | Bus to Bus              | 2.4                                                                            | 5.8 | 9.2  | 2.4                                                | 9.8  |       |
| $t_{\text{PLH}}$ | Propagation Delay       | 3.0                                                                            | 7.0 | 11.0 | 3.0                                                | 11.3 | ns    |
| $t_{\text{PHL}}$ | SBA to A or<br>SAB to B | 2.4                                                                            | 6.6 | 11.0 | 2.4                                                | 11.3 |       |
| $t_{\text{PZH}}$ | Enable Time             | 2.5                                                                            | 5.5 | 8.9  | 2.5                                                | 10.6 | ns    |
| $t_{\text{PZL}}$ | *OEBA to A              | 3.2                                                                            | 6.3 | 10.1 | 3.2                                                | 10.6 |       |
| $t_{\text{PHZ}}$ | Disable Time            | 1.8                                                                            | 5.4 | 8.6  | 1.8                                                | 9.5  |       |
| $t_{\text{PLZ}}$ | *OEBA to A              | 2.4                                                                            | 5.4 | 8.6  | 2.4                                                | 9.5  |       |
| $t_{\text{PZH}}$ | Enable Time             | 1.5                                                                            | 4.6 | 7.1  | 1.5                                                | 8.1  |       |
| $t_{\text{PZL}}$ | OEAB to B               | 2.3                                                                            | 5.2 | 8.1  | 2.3                                                | 8.1  |       |
| $t_{\text{PHZ}}$ | Disable Time            | 2.2                                                                            | 5.2 | 9.1  | 2.2                                                | 9.1  | ns    |
| $t_{\text{PLZ}}$ | OEAB to B               | 2.2                                                                            | 5.2 | 8.0  | 2.2                                                | 8.0  |       |

## AC Operating Requirements

| Symbol          | Parameter                                | 74BCT                                                  |     | 74BCT                      |     | Units |
|-----------------|------------------------------------------|--------------------------------------------------------|-----|----------------------------|-----|-------|
|                 |                                          | $T_A = +25^{\circ}\text{C}$<br>$V_{CC} = +5.0\text{V}$ |     | $T_A, V_{CC} = \text{Com}$ |     |       |
|                 |                                          | Min                                                    | Max | Min                        | Max |       |
| $t_s(\text{H})$ | Setup Time, HIGH or<br>LOW, Bus to Clock | 5.0                                                    |     | 5.0                        |     | ns    |
| $t_s(\text{L})$ |                                          | 5.0                                                    |     | 5.0                        |     |       |
| $t_h(\text{H})$ | Hold Time, HIGH or<br>LOW, Bus to Clock  | 1.0                                                    |     | 1.0                        |     | ns    |
| $t_h(\text{L})$ |                                          | 1.0                                                    |     | 1.0                        |     |       |
| $t_w(\text{H})$ | Clock Pulse Width<br>HIGH or LOW         | 5.0                                                    |     | 5.0                        |     | ns    |
| $t_w(\text{L})$ |                                          | 5.0                                                    |     | 5.0                        |     |       |

## Extended AC Electrical Characteristics

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| Symbol           | Parameter               | 74BCT                                                                                                         |      | 74BCT                                                                                                         |      | 74BCT                                                                                                              |      | Units |
|------------------|-------------------------|---------------------------------------------------------------------------------------------------------------|------|---------------------------------------------------------------------------------------------------------------|------|--------------------------------------------------------------------------------------------------------------------|------|-------|
|                  |                         | T <sub>A</sub> = Com<br>V <sub>CC</sub> = Com<br>C <sub>L</sub> = 50 pF<br>8 Outputs<br>Switching<br>(Note 1) |      | T <sub>A</sub> = Com<br>V <sub>CC</sub> = Com<br>C <sub>L</sub> = 250 pF<br>1 Output<br>Switching<br>(Note 2) |      | T <sub>A</sub> = Com<br>V <sub>CC</sub> = Com<br>C <sub>L</sub> = 250 pF<br>8 Outputs<br>Switching<br>(Notes 1, 2) |      |       |
|                  |                         | Min                                                                                                           | Max  | Min                                                                                                           | Max  | Min                                                                                                                | Max  |       |
|                  |                         |                                                                                                               |      |                                                                                                               |      |                                                                                                                    |      |       |
| t <sub>PLH</sub> | Propagation Delay       | 2.8                                                                                                           | 10.5 | 3.0                                                                                                           | 12.0 | 4.0                                                                                                                | 15.6 | ns    |
| t <sub>PHL</sub> | Clock to Bus            | 2.8                                                                                                           | 10.5 | 3.0                                                                                                           | 12.0 | 4.0                                                                                                                | 15.6 |       |
| t <sub>PLH</sub> | Propagation Delay       | 2.0                                                                                                           | 9.5  | 2.5                                                                                                           | 10.9 | 4.0                                                                                                                | 15.0 | ns    |
| t <sub>PHL</sub> | Bus to Bus              | 3.0                                                                                                           | 11.0 | 3.0                                                                                                           | 11.5 | 4.0                                                                                                                | 15.0 |       |
| t <sub>PLH</sub> | Propagation Delay       | 3.0                                                                                                           | 12.5 | 3.0                                                                                                           | 14.2 | 4.0                                                                                                                | 18.1 | ns    |
| t <sub>PHL</sub> | SBA to A or<br>SAB to B | 3.0                                                                                                           | 12.5 | 3.0                                                                                                           | 14.2 | 4.0                                                                                                                | 18.1 |       |

**Note 1:** This specification is guaranteed but not tested. The limits apply to propagation delays for all paths described switching in phase (i.e., all low-to-high, high-to-low, etc.).

**Note 2:** This specification is guaranteed but not tested. The limits represent propagation delays with 250 pF load capacitors in place of the 50 pF load capacitor the standard AC load. This specification pertains to single output switching only.

## Capacitance

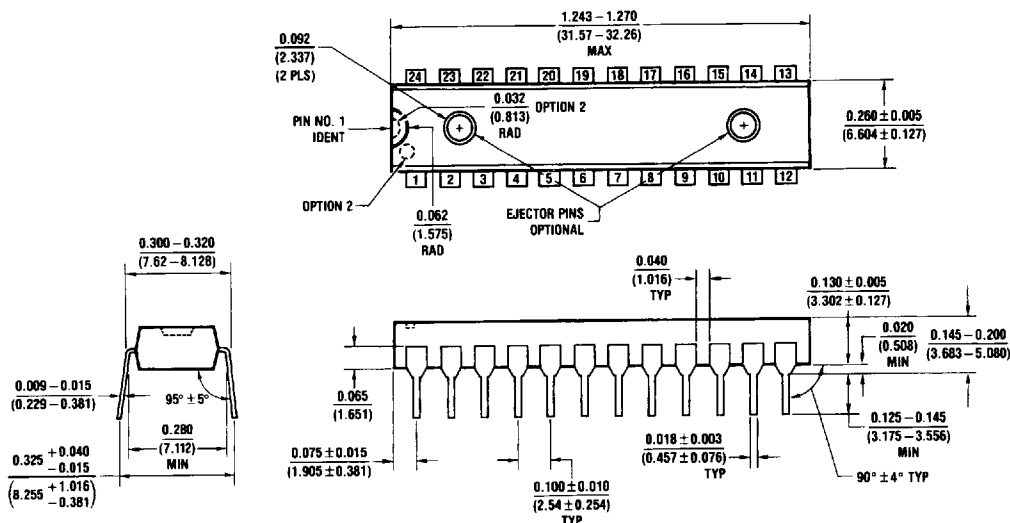
| Symbol           | Parameter                    | Typ  | Units | Conditions                                                   |
|------------------|------------------------------|------|-------|--------------------------------------------------------------|
| C <sub>IN</sub>  | Input Pin Capacitance        | 6.0  | pF    | V <sub>CC</sub> = 5.0V<br>(Control Inputs)                   |
| C <sub>I/O</sub> | Input/Output Pin Capacitance | 12.5 | pF    | V <sub>CC</sub> = 5.0V<br>(A <sub>n</sub> , B <sub>n</sub> ) |



## Physical Dimensions inches (millimeters) (Continued)

T-52-30-08

Lit # 114868



N24C (REV F)

24 Lead Slim (0.300" Wide) Plastic Dual-In-Line Package (SP)  
NS Package Number N24C

## LIFE SUPPORT POLICY

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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.



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