



FAST CMOS OCTAL TRANSCEIVER/ REGISTER (3-STATE)

IDT74FCT652AT/CT

FEATURES:

- A and C grades
- Low input and output leakage $\leq 1\mu\text{A}$ (max.)
- CMOS power levels
- True TTL input and output compatibility:
 - $V_{OH} = 3.3V$ (typ.)
 - $V_{OL} = 0.3V$ (typ.)
- High Drive outputs (-15mA I_{OH} , 64mA I_{OL})
- Meets or exceeds JEDEC standard 18 specifications
- Power off disable outputs permit "live insertion"
- Available in SOIC and QSOP packages

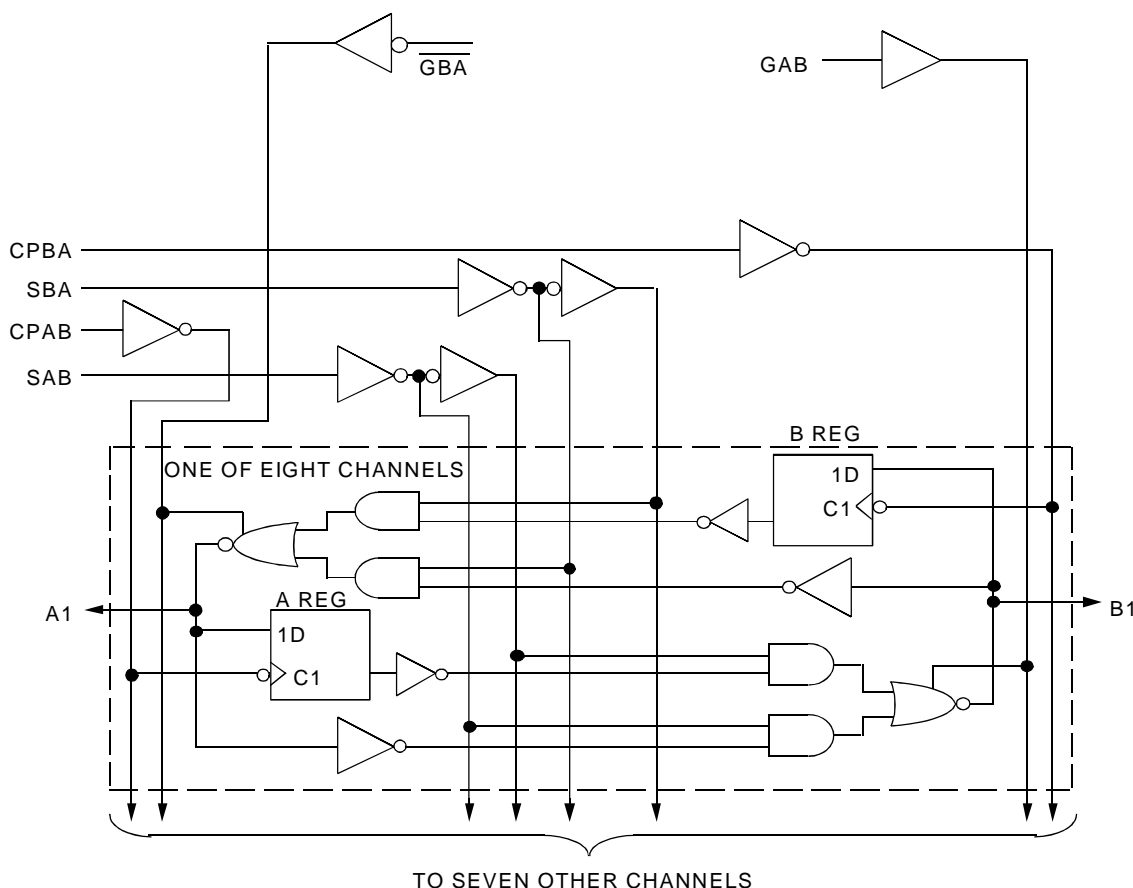
DESCRIPTION:

The FCT652T consists of a bus transceiver with 3-state D-type flip-flops and control circuitry arranged for multiplexed transmission of data directly from the data bus or from the internal storage registers. The FCT652T utilizes GAB and $\overline{\text{GAB}}$ signals to control the transceiver functions.

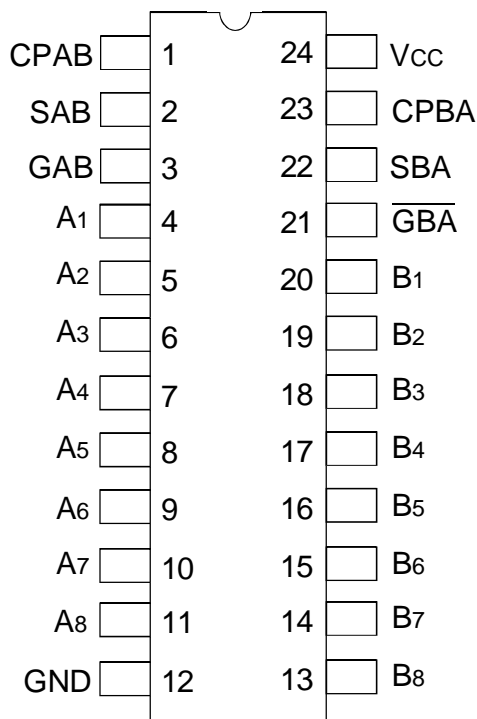
SAB and SBA control pins are provided to select either real-time or stored data transfer. The circuitry used for select control will eliminate the typical decoding glitch that occurs in a multiplexer during the transition between stored and real-time data. A low input level selects real-time data and a high selects stored data.

Data on the A or B data bus, or both, can be stored in the internal D flip-flops by low-to-high transitions at the appropriate clock pins (CPAB or CPBA), regardless of the select or enable control pins.

FUNCTIONAL BLOCK DIAGRAM



PIN CONFIGURATION



SOIC/ QSOP
TOP VIEW

ABSOLUTE MAXIMUM RATINGS⁽¹⁾

| Symbol | Description | Max | Unit |
|----------------------|--------------------------------------|-----------------|------|
| VTERM ⁽²⁾ | Terminal Voltage with Respect to GND | -0.5 to +7 | V |
| VTERM ⁽³⁾ | Terminal Voltage with Respect to GND | -0.5 to VCC+0.5 | V |
| TSTG | Storage Temperature | -65 to +150 | °C |
| IOUT | DC Output Current | -60 to +120 | mA |

NOTES:

- Stresses greater than those listed under ABSOLUTE MAXIMUM RATINGS may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability. No terminal voltage may exceed VCC by +0.5V unless otherwise noted.
- Inputs and VCC terminals only.
- Output and I/O terminals only.

CAPACITANCE (TA = +25°C, F = 1.0MHz)

| Symbol | Parameter ⁽¹⁾ | Conditions | Typ. | Max. | Unit |
|--------|--------------------------|------------|------|------|------|
| CIN | Input Capacitance | VIN = 0V | 6 | 10 | pF |
| COUT | Output Capacitance | VOUT = 0V | 8 | 12 | pF |

NOTE:

- This parameter is measured at characterization but not tested.

PIN DESCRIPTION

| Pin Names | Description |
|------------------------------|---|
| A1 - A8 | Data Register A Inputs Data Register B Outputs |
| B1 - B8 | Data Register B Inputs Data Register A Outputs |
| CPAB, CPBA | Clock Pulse Inputs |
| SAB, SBA | Output Data Source Select Inputs |
| GAB, $\overline{\text{GBA}}$ | Output Enable Inputs |

FUNCTION TABLE⁽¹⁾

| Inputs | | | | | | Data I/O | | Operation or Function |
|--------|-------------------------|--------|--------|-----|-----|----------------------------|----------------------------|---|
| GAB | $\overline{\text{GBA}}$ | CPAB | CPBA | SAB | SBA | A1 - A8 | B1 - B8 | |
| L | H | H or L | H or L | X | X | Input | Input | Isolation |
| L | L | ↑ | ↑ | X | X | | | Store A and B Data |
| X | H | ↑ | H or L | X | X | Input | Unspecified ⁽²⁾ | Store A, Hold B |
| H | H | ↑ | ↑ | X | X | Input | Output | Store A in Both Registers |
| L | X | H or L | ↑ | X | X | Unspecified ⁽²⁾ | 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 | | | 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 | | | 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 |

NOTES:

1. H = HIGH

L = LOW

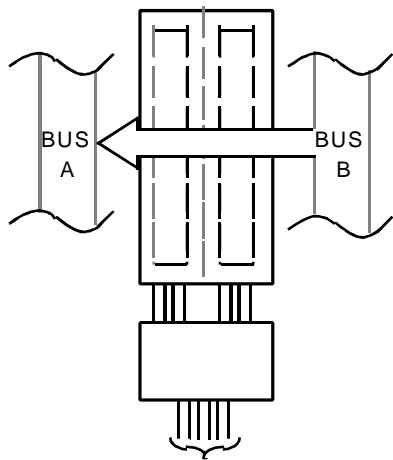
X = Don't Care

↑ = LOW-to-HIGH transition.

Select control = L: clocks can occur simultaneously.

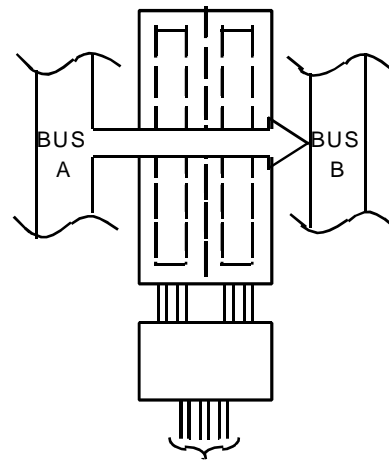
Select control = H: clocks must be staggered in order to load both registers.

2. The data output functions may be enabled or disabled by various signals at the GAB or $\overline{\text{GBA}}$ 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.



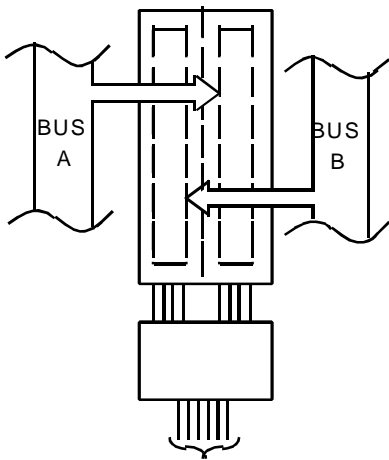
| | | | | | |
|-----|-------------------------|------|------|-----|-----|
| GAB | $\overline{\text{GBA}}$ | CPAB | CPBA | SAB | SBA |
| L | L | X | X | X | L |

*Real-Time Transfer
Bus B to A*



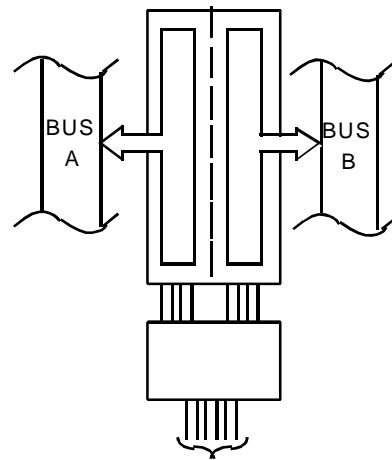
| | | | | | |
|-----|-------------------------|------|------|-----|-----|
| GAB | $\overline{\text{GBA}}$ | CPAB | CPBA | SAB | SBA |
| H | H | X | X | L | X |

*Real-Time Transfer
Bus A to B*



| | | | | | |
|-----|-------------------------|------|------|-----|-----|
| GAB | $\overline{\text{GBA}}$ | CPAB | CPBA | SAB | SBA |
| X | H | ↑ | X | X | X |
| L | X | X | ↑ | X | X |
| L | H | ↑ | ↑ | X | X |

*Storage From
A and/or B*



| | | | | | |
|-----|-------------------------|--------|--------|-----|-----|
| GAB | $\overline{\text{GBA}}$ | CPAB | CPBA | SAB | SBA |
| H | L | H or L | H or L | H | H |

*Transfer Stores
Data to A and/or B*

DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE

Following Conditions Apply Unless Otherwise Specified:

Industrial: $T_A = -40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$, $V_{CC} = 5.0\text{V} \pm 5\%$

| Symbol | Parameter | Test Conditions ⁽¹⁾ | | Min. | Typ. ⁽²⁾ | Max. | Unit |
|-----------|---|--|---------------------|------|---------------------|---------|---------------|
| V_{IH} | Input HIGH Level | Guaranteed Logic HIGH Level | | 2 | — | — | V |
| V_{IL} | Input LOW Level | Guaranteed Logic LOW Level | | — | — | 0.8 | V |
| I_{IH} | Input HIGH Current ⁽⁴⁾ | $V_{CC} = \text{Max.}$ | $V_I = 2.7\text{V}$ | — | — | ± 1 | μA |
| I_{IL} | Input LOW Current ⁽⁴⁾ | $V_{CC} = \text{Max.}$ | $V_I = 0.5\text{V}$ | — | — | ± 1 | μA |
| I_{OZH} | High Impedance Output Current (3-State output pins) ⁽⁴⁾ | $V_{CC} = \text{Max.}$ | $V_O = 2.7\text{V}$ | — | — | ± 1 | μA |
| I_{OZL} | | | $V_O = 0.5\text{V}$ | — | — | ± 1 | |
| I_I | Input HIGH Current ⁽⁴⁾ | $V_{CC} = \text{Max.}, V_I = V_{CC} (\text{Max.})$ | | — | — | ± 1 | μA |
| V_{IK} | Clamp Diode Voltage | $V_{CC} = \text{Min.}, I_{IN} = -18\text{mA}$ | | — | -0.7 | -1.2 | V |
| V_H | Input Hysteresis | — | | — | 200 | — | mV |
| I_{CC} | Quiescent Power Supply Current | $V_{CC} = \text{Max.}, V_{IN} = \text{GND or } V_{CC}$ | | — | 0.01 | 1 | mA |

OUTPUT DRIVE CHARACTERISTICS

| Symbol | Parameter | Test Conditions ⁽¹⁾ | | Min. | Typ. ⁽²⁾ | Max. | Unit |
|-----------|---|--|-------------------------|------|---------------------|---------|---------------|
| V_{OH} | Output HIGH Voltage | $V_{CC} = \text{Min.}$ $V_{IN} = V_{IH} \text{ or } V_{IL}$ | $I_{OH} = -8\text{mA}$ | 2.4 | 3.3 | — | V |
| | | | $I_{OH} = -15\text{mA}$ | 2 | 3 | — | |
| V_{OL} | Output LOW Voltage | $V_{CC} = \text{Min.}$ $V_{IN} = V_{IH} \text{ or } V_{IL}$ | $I_{OL} = 64\text{mA}$ | — | 0.3 | 0.55 | V |
| I_{OS} | Short Circuit Current | $V_{CC} = \text{Max.}, V_O = \text{GND}^{(3)}$ | | -60 | -120 | -225 | mA |
| I_{OFF} | Input/Output Power Off Leakage ⁽⁵⁾ | $V_{CC} = 0\text{V}, V_{IN} \text{ or } V_O \leq 4.5\text{V}$ | | — | — | ± 1 | μA |

NOTES:

1. For conditions shown as Min. or Max., use appropriate value specified under Electrical Characteristics for the applicable device type.
2. Typical values are at $V_{CC} = 5.0\text{V}$, $+25^{\circ}\text{C}$ ambient.
3. Not more than one output should be tested at one time. Duration of the test should not exceed one second.
4. The test limit for this parameter is $\pm 5\mu\text{A}$ at $T_A = -55^{\circ}\text{C}$.
5. This parameter is guaranteed but not tested.

POWER SUPPLY CHARACTERISTICS

| Symbol | Parameter | Test Conditions ⁽¹⁾ | | Min. | Typ. ⁽²⁾ | Max. | Unit |
|-----------------|---|--|-------------------------------------|------|---------------------|---------------------|------------|
| ΔI_{CC} | Quiescent Power Supply Current TTL Inputs HIGH | $V_{CC} = \text{Max.}$ $V_{IN} = 3.4V^{(3)}$ | | — | 0.5 | 2 | mA |
| I_{CCD} | Dynamic Power Supply Current ⁽⁴⁾ | $V_{CC} = \text{Max.}$ Outputs Open $GAB = \overline{GBA} = GND$ One Input Toggling 50% Duty Cycle | $V_{IN} = V_{CC}$ $V_{IN} = GND$ | — | 0.15 | 0.25 | mA/ MHz |
| I_C | Total Power Supply Current ⁽⁶⁾ | $V_{CC} = \text{Max.}$ Outputs Open $f_{CP} = 10\text{MHz}$ 50% Duty Cycle $GAB = \overline{GBA} = GND$ One Bit Toggling at $f_i = 5\text{MHz}$ | $V_{IN} = V_{CC}$ $V_{IN} = GND$ | — | 1.5 | 3.5 | mA |
| | | | $V_{IN} = 3.4V$ $V_{IN} = GND$ | — | 2 | 5.5 | |
| | | $V_{CC} = \text{Max.}$ Outputs Open $f_{CP} = 10\text{MHz}$ 50% Duty Cycle $GAB = \overline{GBA} = GND$ Eight Bits Toggling at $f_i = 2.5\text{MHz}$ | $V_{IN} = V_{CC}$ $V_{IN} = GND$ | — | 3.8 | 7.3 ⁽⁵⁾ | |
| | | | $V_{IN} = 3.4V$ $V_{IN} = GND$ | — | 6 | 16.3 ⁽⁵⁾ | |

NOTES:

- For conditions shown as Min. or Max., use appropriate value specified under Electrical Characteristics for the applicable device type.
 - Typical values are at $V_{CC} = 5.0V$, $+25^\circ\text{C}$ ambient.
 - Per TTL driven input; ($V_{IN} = 3.4V$). All other inputs at V_{CC} or GND .
 - This parameter is not directly testable, but is derived for use in Total Power Supply Calculations.
 - Values for these conditions are examples of ΔI_{CC} formula. These limits are guaranteed but not tested.
 - $I_C = I_{QUIESCENT} + I_{INPUTS} + I_{DYNAMIC}$
 $I_C = I_{CC} + \Delta I_{CC} D_H N_T + I_{CCD} (f_{CP}/2 + f_i N_i)$
 I_{CC} = Quiescent Current
 ΔI_{CC} = Power Supply Current for a TTL High Input ($V_{IN} = 3.4V$)
 D_H = Duty Cycle for TTL Inputs High
 N_T = Number of TTL Inputs at D_H
 I_{CCD} = Dynamic Current caused by an Input Transition Pair (HLH or LHL)
 f_{CP} = Clock Frequency for Register Devices (Zero for Non-Register Devices)
 f_i = Output Frequency
 N_i = Number of Outputs at f_i
- All currents are in milliamps and all frequencies are in megahertz.

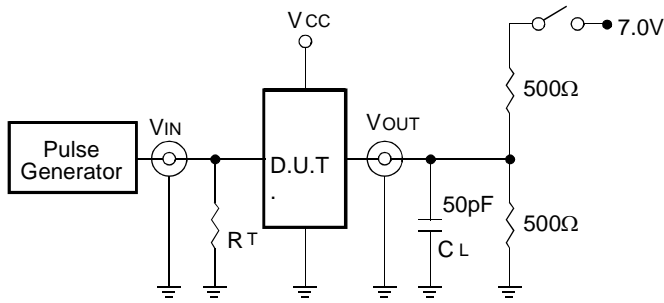
SWITCHING CHARACTERISTICS OVER OPERATING RANGE

| Symbol | Parameter | Condition ⁽¹⁾ | FCT652AT | | FCT652CT | | Unit |
|--------------------------------------|--|--|---------------------|------|---------------------|------|------|
| | | | Min. ⁽²⁾ | Max. | Min. ⁽²⁾ | Max. | |
| t _{PLH} t _{PHL} | Propagation Delay Bus to Bus | C _L = 50pF R _L = 500Ω | 2 | 6.3 | 1.5 | 5.4 | ns |
| t _{PZH} t _{PZL} | Output Enable Time, GAB, $\overline{\text{GBA}}$ to Bus | | 2 | 9.8 | 1.5 | 7.8 | ns |
| t _{PHZ} t _{PLZ} | Output Disable Time, GAB, $\overline{\text{GBA}}$ to Bu | | 2 | 6.3 | 1.5 | 6.3 | ns |
| t _{PLH} t _{PHL} | Propagation Delay Clock to Bus | | 2 | 6.3 | 1.5 | 5.7 | ns |
| t _{PLH} t _{PHL} | Propagation Delay SBA or SAB to Bus | | 2 | 7.7 | 1.5 | 6.2 | ns |
| t _{SU} | Set-up Time HIGH or LOW, Bus to Clock | | 2 | — | 2 | — | ns |
| t _H | Hold Time HIGH or LOW, Bus to Clock | | 1.5 | — | 1.5 | — | ns |
| t _w | Clock Pulse Width, HIGH or LOW ⁽³⁾ | | 5 | — | 5 | — | ns |

NOTES:

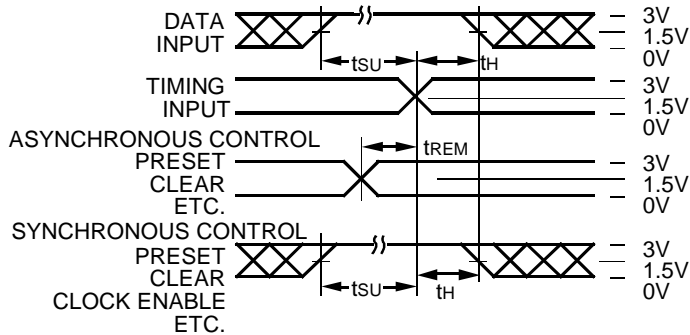
1. See test circuit and waveforms.
2. Minimum limits are guaranteed but not tested on Propagation Delays.
3. This parameter is guaranteed but not tested.

TEST CIRCUITS AND WAVEFORMS



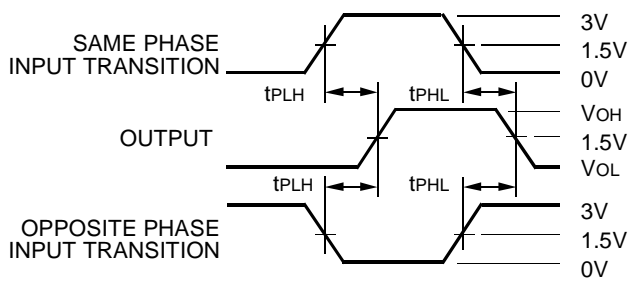
Octal Link

Test Circuits for All Outputs



Octal Link

Set-Up, Hold, and Release Times



Octal Link

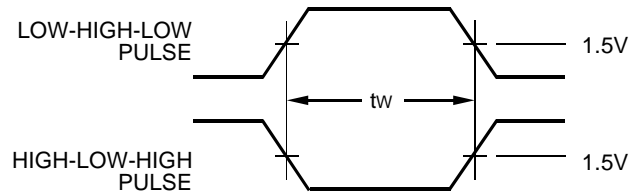
Propagation Delay

SWITCH POSITION

| Test | Switch |
|---|--------|
| Open Drain Disable Low Enable Low | Closed |
| All Other Tests | Open |

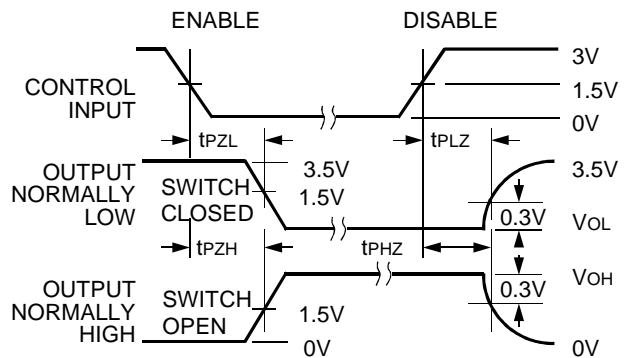
DEFINITIONS:

CL = Load capacitance: includes jig and probe capacitance.
RT = Termination resistance: should be equal to ZOUT of the Pulse Generator.



Pulse Width

Octal Link



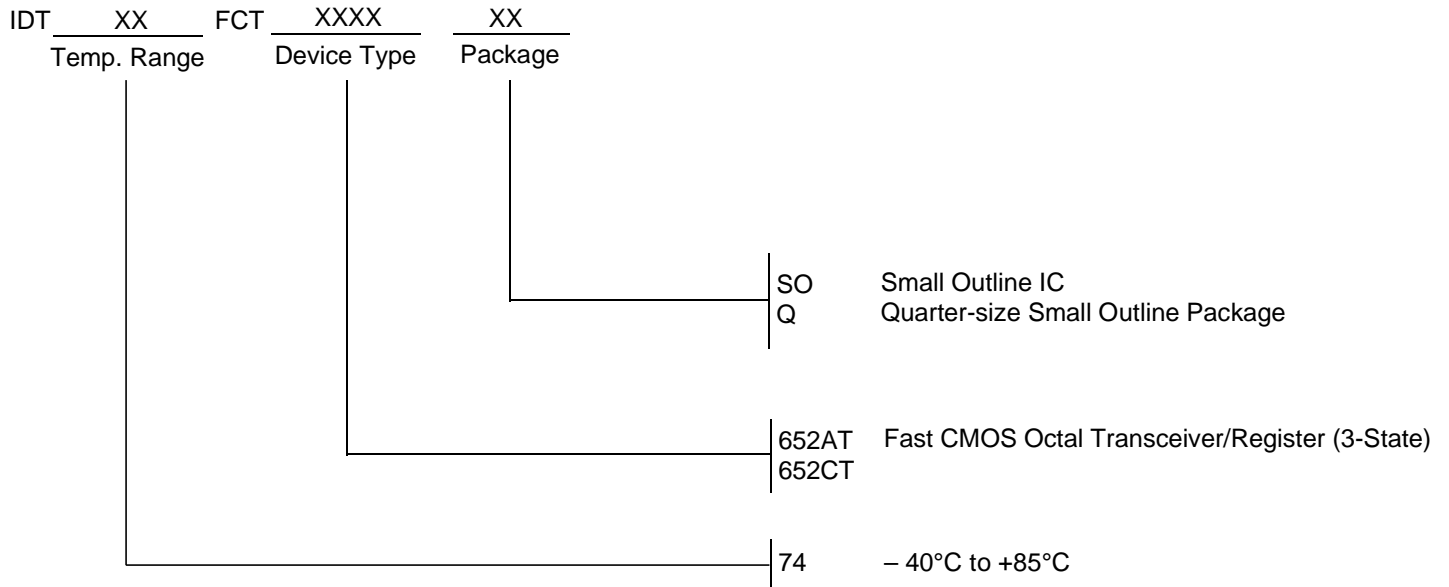
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Enable and Disable Times

NOTES:

- Diagram shown for input Control Enable-LOW and input Control Disable-HIGH.
- Pulse Generator for All Pulses: Rate ≤ 1.0MHz; tr ≤ 2.5ns; tr ≤ 2.5ns.

ORDERING INFORMATION



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