# 20-BIT BUS EXCHANGE SWITCH

**IDT74FST163383**

## FEATURES:

- **Bus switches provide zero delay paths**
- **Low switch on-resistance: 5Ω**
- **TTL-compatible input and output levels**
- **ESD > 2000V per MIL-STD-883, Method 3015; > 200V using machine model (C = 200pF, R = 0)**
- **Available in SSOP and TSSOP packages**

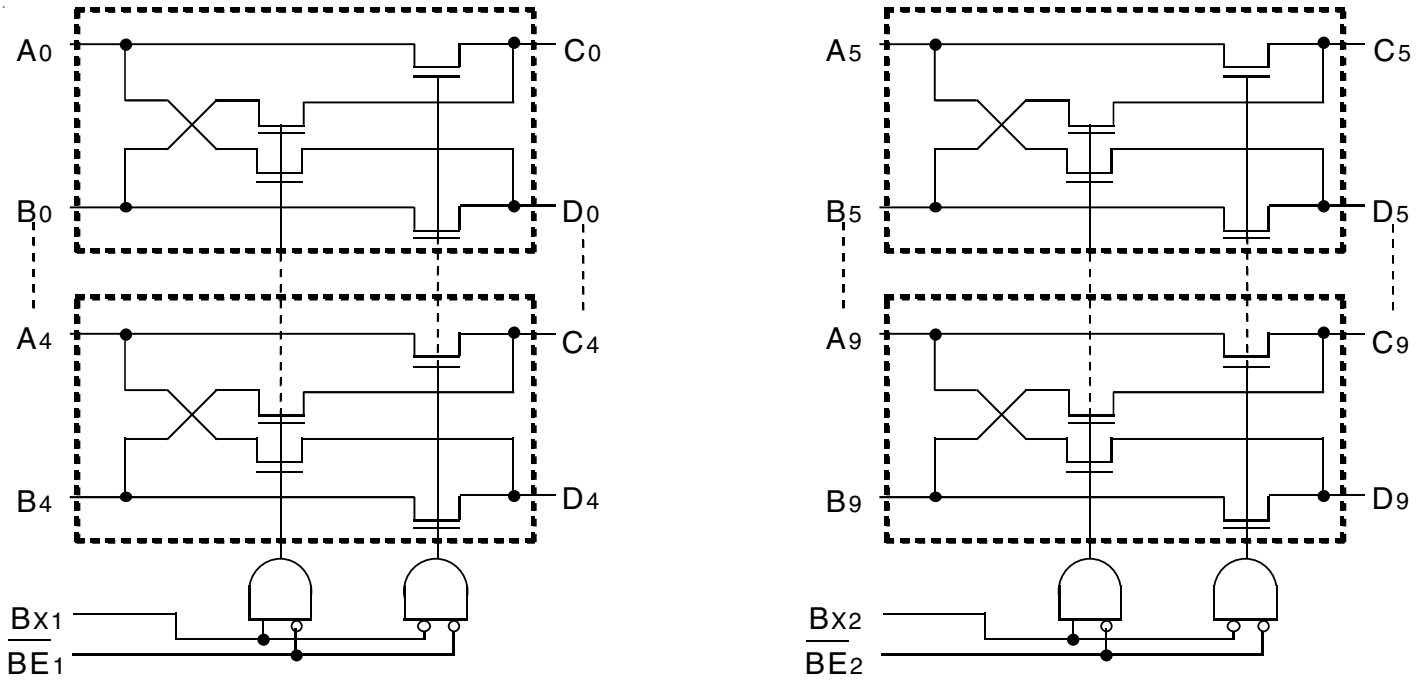
## DESCRIPTION:

The FST163383 belongs to IDT's family of Bus switches. Bus switch devices perform the function of connecting or isolating two ports without providing any inherent current sink or source capability. Thus they generate little or no noise of their own while providing a low resistance path for an external driver. These devices connect input and output ports through an n-channel FET. When the gate-to-source junction of this FET is adequately forward-biased the device conducts and the resistance between input and output ports is small. Without adequate bias on the gate-to-source junction of the FET, the FET is turned off, therefore with no $V_{CC}$ applied, the device has hot insertion capability.

The low on-resistance and simplicity of the connection between input and output ports reduces the delay in this path to close to zero.

The FST163383 provides four 4-bit TTL- compatible ports that supports 2 way bus exchange. The BX pin controls the bus exchange and the BE pin serves as the enable pin.

## FUNCTIONAL BLOCK DIAGRAM

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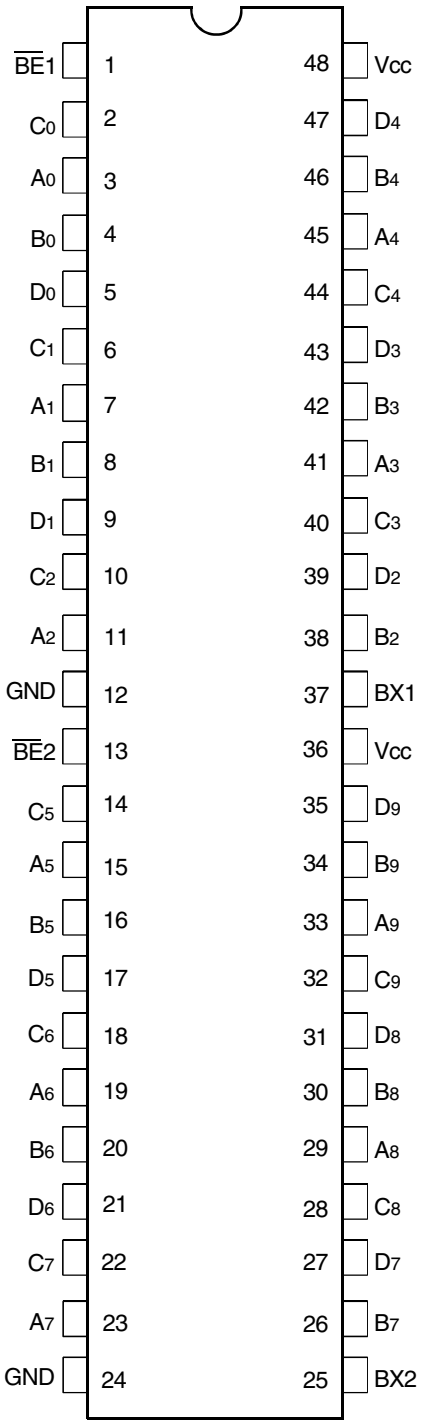
## PIN CONFIGURATION




**SSOP/ TSSOP**
**TOP VIEW**

## ABSOLUTE MAXIMUM RATINGS(1)

| Symbol | Description | Max | Unit |
|---|---|---|---|
| $V_{TERM}$(2) | Terminal Voltage with Respect to GND | –0.5 to +7 | V |
| $T_{STG}$ | Storage Temperature | –65 to +150 | °C |
| $I_{OUT}$ | Maximum Continuous Channel Current | 128 | mA |

**NOTES:**
1. 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.
2. Vcc, Control, and Switch terminals.

## CAPACITANCE(1)

| Symbol | Parameter | Conditions(2) | Typ. | Unit |
|---|---|---|---|---|
| $C_{IN}$ | Control Input Capacitance | | 4 | pF |
| $C_{I/O}$ | Switch Input/Output Capacitance | Switch Off | | pF |

**NOTES:**
1. Capacitance is characterized but not tested.
2. $T_A$ = 25°C, f = 1MHz, $V_{IN}$ = 0V, $V_{OUT}$ = 0V.

## PIN DESCRIPTION

| Pin Names | I/O | Description |
|---|---|---|
| $A_{0-9}$, $B_{0-9}$ | I/O | Buses A, B |
| $C_{0-9}$, $D_{0-9}$ | I/O | Buses C, D |
| $\overline{BE}_{1,2}$ | I | Bus Switch Enable (Active LOW) |
| $BE_{1,2}$ | I | Bus Exchange |

## FUNCTION TABLE(1)

| $\overline{BE}_1$ | $BX_1$ | $A_{0-4}$ | $B_{0-4}$ | Description |
|---|---|---|---|---|
| H | X | Z | Z | Disconnect |
| L | L | $C_{0-4}$ | $D_{0-4}$ | Connect |
| L | H | $D_{0-4}$ | $C_{0-4}$ | Exchange |

| $\overline{BE}_2$ | $BX_2$ | $A_{5-9}$ | $B_{5-9}$ | Description |
|---|---|---|---|---|
| H | X | Z | Z | Disconnect |
| L | L | $C_{5-9}$ | $D_{5-9}$ | Connect |
| L | H | $D_{5-9}$ | $C_{5-9}$ | Exchange |

**NOTE:**
1. H = HIGH Voltage Level
   L = LOW Voltage Level
   X = Don't Care
   Z = High-Impedance

## DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE

Following Conditions Apply Unless Otherwise Specified:
Industrial: $T_A$ = –40°C to +85°C, $V_{CC}$ = 5.0V ± 10%

| Symbol | Parameter | Test Conditions[1] | | Min. | Typ.[2] | Max. | Unit |
|---|---|---|---|---|---|---|---|
| $V_{IH}$ | Input HIGH Voltage | Guaranteed Logic HIGH for Control Inputs | | 2 | — | — | V |
| $V_{IL}$ | Input LOW Voltage | Guaranteed Logic LOW for Control Inputs | | — | — | 0.8 | V |
| $I_{IH}$ | Input HIGH Current | $V_{CC}$ = Max. | $V_I$ = $V_{CC}$ | — | — | ±1 | µA |
| $I_{IL}$ | Input LOW Current | | $V_I$ = GND | — | — | ±1 | |
| $I_{OZH}$ | High Impedance Output Current | $V_{CC}$ = Max. | $V_O$ = $V_{CC}$ | — | — | ±1 | µA |
| $I_{OZL}$ | (3-State Output Pins) | | $V_O$ = GND | — | — | ±1 | |
| $I_{OS}$ | Short Circuit Current | $V_{CC}$ = Max., $V_O$ = GND[3] | | — | 300 | — | mA |
| $V_{IK}$ | Clamp Diode Voltage | $V_{CC}$ = Min., $I_{IN}$ = –18mA | | — | –0.7 | –1.2 | V |
| $R_{ON}$ | Switch On Resistance[4] | $V_{CC}$ = Min., $V_{IN}$ = 0V, $I_{ON}$ = 30mA | | — | 5 | 7 | Ω |
| | | $V_{CC}$ = Min., $V_{IN}$ = 2.4V, $I_{ON}$ = 15mA | | — | 10 | 15 | |
| $I_{OFF}$ | Input/Output Power Off Leakage | $V_{CC}$ = 0V, $V_{IN}$ or $V_O \leq$ 4.5V | | — | — | ±1 | µA |
| $I_{CC}$ | Quiescent Power Supply Current | $V_{CC}$ = Max., $V_I$ = GND or $V_{CC}$ | | — | 0.1 | 3 | µA |

**NOTES:**
1. For conditions shown as Max. or Min., use appropriate value specified under Electrical Characteristics for the applicable device type.
2. Typical values are at Vcc = 5.0V, +25°C ambient.
3. Not more than one output should be shorted at one time. Duration of the test should not exceed one second.
4. Measured by voltage drop between ports at indicated current through the switch.

## POWER SUPPLY CHARACTERISTICS

| Symbol | Parameter | Test Conditions[1] | | Min. | Typ.[2] | Max. | Unit |
|---|---|---|---|---|---|---|---|
| $\Delta I_{CC}$ | Quiescent Power Supply Current<br>TTL Inputs HIGH | $V_{CC}$ = Max.<br>$V_{IN}$ = 3.4V[3] | | — | 0.5 | 1.5 | mA |
| $I_{CCD}$ | Dynamic Power Supply Current[4] | $V_{CC}$ = Max.<br>Outputs Open<br>Enable Pin Toggling<br>50% Duty Cycle | $V_{IN}$ = $V_{CC}$<br>$V_{IN}$ = GND | — | 30 | 40 | µA/<br>MHz/<br>Switch |
| $I_C$ | Total Power Supply Current[5] | $V_{CC}$ = Max.<br>Outputs Open<br>Enable Pins Toggling<br>(20 Switches Toggling)<br>$f_i$ = 10MHz<br>50% Duty Cycle | $V_{IN}$ = $V_{CC}$<br>$V_{IN}$ = GND | — | 6 | 8 | mA |
| | | | $V_{IN}$ = $V_{CC}$<br>$V_{IN}$ = 3.4V | — | 6.5 | 9.5 | |

**NOTES:**
1. For conditions shown as Max. or Min., use appropriate value specified under Electrical Characteristics for the applicable device type.
2. Typical values are at $V_{CC}$ = 5.0V, +25°C ambient.
3. Per TTL driven input ($V_{IN}$ = 3.4V). All other inputs at $V_{CC}$ or GND.
4. This parameter is not directly testable, but is derived for use in Total Power Supply Calculations.
5. $I_C = I_{QUIESCENT} + I_{INPUTS} + I_{DYNAMIC}$
   $I_C = I_{CC} + \Delta I_{CC} D_H N_T + I_{CCD} (f_i N)$
   $I_{CC}$ = Quiescent Current
   $\Delta I_{CC}$ = 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)
   $f_i$ = Control Input Frequency
   N = Number of Control Inputs Toggling at $f_i$

   All currents are in milliamps and all frequencies are in megahertz.

# SWITCHING CHARACTERISTICS OVER OPERATING RANGE

Following Conditions Apply Unless Otherwise Specified:

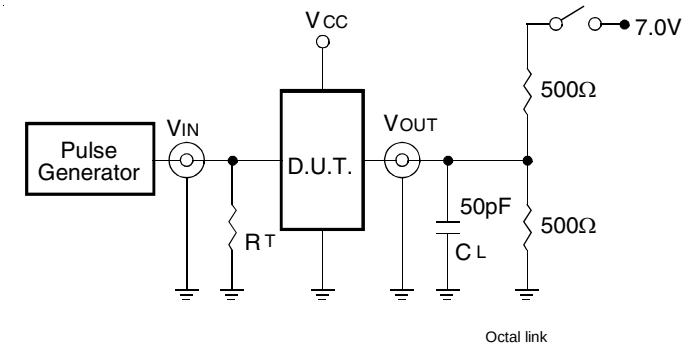
Industrial: $T_A$ = -40°C to +85°C, $V_{CC}$ = 5.0V ± 10%

| Symbol | Description[1] | Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $t_{PLH}$<br>$t_{PHL}$ | Data Propagation Delay<br>Ax to Cx, Dx and/or Bx to Cx and/or Dx[3,4] | $C_L$ = 50pF<br>$R_L$ = 500Ω | — | — | 0.25 | ns |
| $t_{BX}$ | Switch Multiplex Delay<br>BX to Ax, Bx, Cx, Dx | | 1.5 | — | 6.5 | ns |
| $t_{PZH}$<br>$t_{PZL}$ | Switch Turn On Delay<br>BE to Ax, Bx, Cx, Dx | | 1.5 | — | 6.5 | ns |
| $t_{PHZ}$<br>$t_{PLZ}$ | Switch Turn Off Delay<br>BE to Ax, Bx[3] | | 1.5 | — | 5.5 | ns |
| $\|Q_{CI}\|$ | Charge Injection, Typical[5,6] | | — | 1.5 | — | pC |
| $\|Q_{DCI}\|$ | Charge Injection, Typical[6,7] | | — | 0.5 | — | |

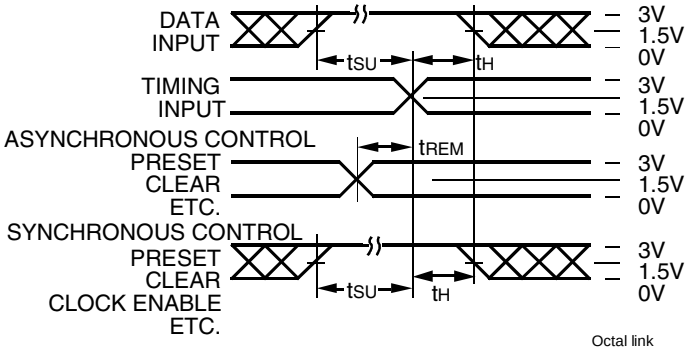
**NOTES:**

1. See test circuit and waveforms.
2. Minimum limits guaranteed but not tested.
3. This parameter is guaranteed by design but not tested.
4. The bus switch contributes no propagation delay other than the RC delay of the on resistance of the switch and the load capacitance. The time constant for the switch alone is of the order of 2.5ns for 50pF load. Since this time is constant and much smaller than the rise/fall times of typical driving signals, it adds very little propagation delay to the system. Propagation delay on the bus switch when used in a system is determined by the driving circuit on the driving side of the switch and its interaction with the load on the driven side.
5. Measured at switch turn off, load = 50 pF in parallel with 10 MΩ scope probe, $V_{IN}$ = 0.0 volts.
6. Characterized parameter. Not 100% tested.
7. Measured at switch turn off through bus multiplexer, (e.g.- A to C = >A to D), load = 50 pF in parallel with 10 MΩ scope probe, $V_{IN}$ at A = 0.0 volts. Charge injection is reduced because the injection from the turn off of the A to C switch is compensated by the turn on of the B to C switch.

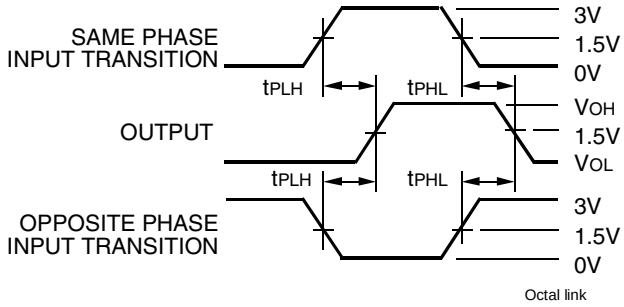
# TEST CIRCUITS AND WAVEFORMS




***Test Circuits for All Outputs***




***Set-up, Hold, and Release Times***




***Propagation Delay***

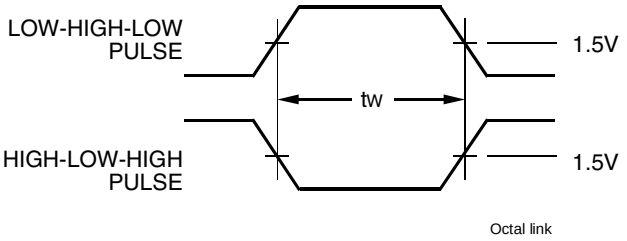
## SWITCH POSITION

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

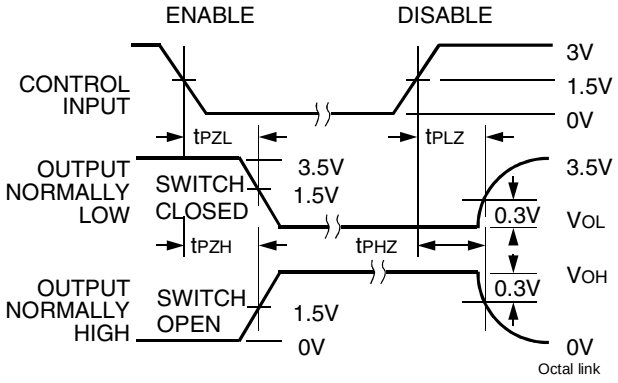
**DEFINITIONS:**

$C_L$ = Load capacitance: includes jig and probe capacitance.

$R_T$ = Termination resistance: should be equal to $Z_{OUT}$ of the Pulse Generator.




***Pulse Width***

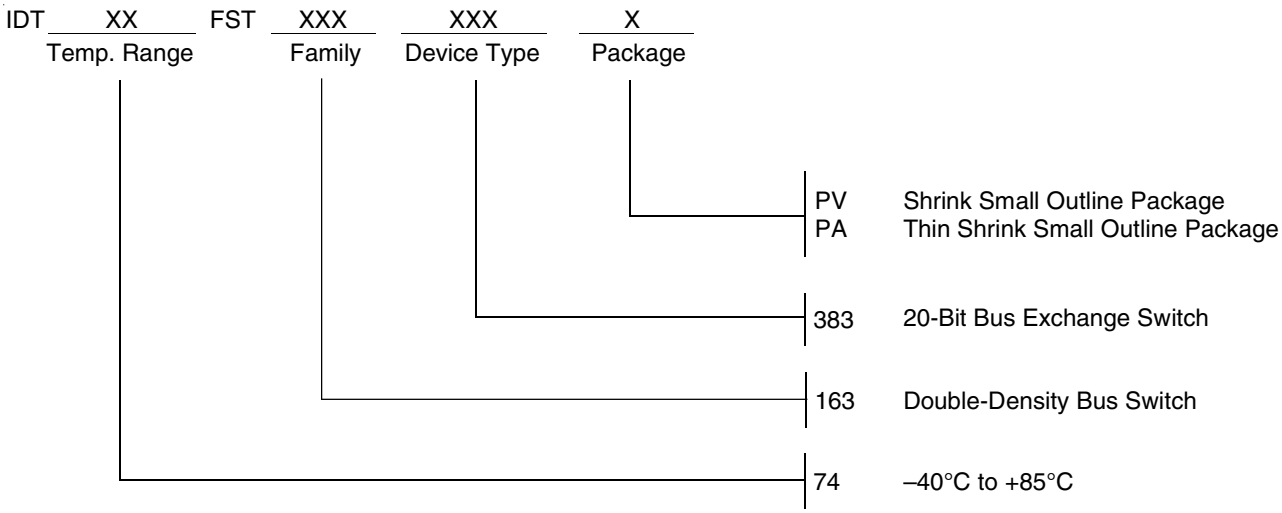



***Enable and Disable Times***

**NOTES:**

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

## ORDERING INFORMATION




## DATA SHEET DOCUMENT HISTORY

5/28/2002 Removed TVSOP package

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