



Integrated Device Technology, Inc.

## 4-BIT BUS SWITCH

IDT74FST3125

### FEATURES:

- Bus switches provide zero delay paths
- Extended commercial range of  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$
- Low switch on-resistance:  
FST3xxx –  $5\Omega$
- TTL-compatible input and output levels
- ESD > 2000V per MIL-STD-883, Method 3015;  
> 200V using machine model (C = 200pF, R = 0)
- Available in QSOP and SOIC

### DESCRIPTION:

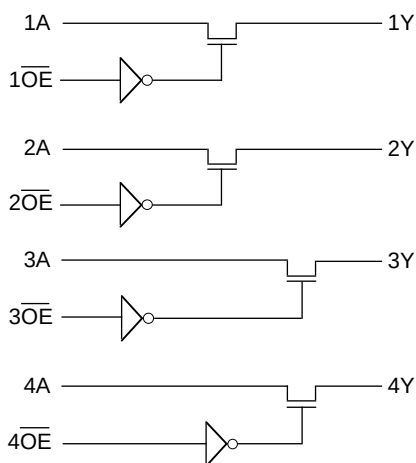
The FST3125 belong to IDT's family of Bus switches. Bus switch devices perform the function of connecting or isolating two ports without providing any inherent current sink or source

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 Vcc 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.

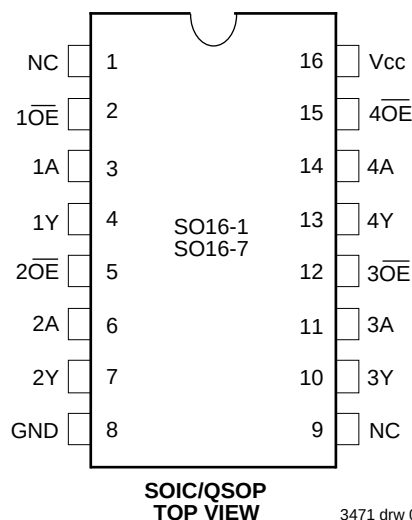
The FST3125 is a 4-bit TTL-compatible bus switch. The xOE pins provide individual enable control for each of the four bits.

### FUNCTIONAL BLOCK DIAGRAM



3471 drw 01

### PIN CONFIGURATION



SOIC/QSOP  
TOP VIEW

3471 drw 02

### PIN DESCRIPTION

| Pin Names | I/O | Description                    |
|-----------|-----|--------------------------------|
| 1A-4A     | I/O | Bus A                          |
| 1Y-4Y     | I/O | Bus B                          |
| NC        | —   | No Connect                     |
| 1OE, 4OE  | I   | Bus Switch Enable (Active LOW) |

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COMMERCIAL TEMPERATURE RANGE

AUGUST 1996

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## ABSOLUTE MAXIMUM RATINGS<sup>(1)</sup>

| Symbol                           | Description                          | Max.         | Unit |
|----------------------------------|--------------------------------------|--------------|------|
| V <sub>TERM</sub> <sup>(2)</sup> | Terminal Voltage with Respect to GND | −0.5 to +7.0 | V    |
| T <sub>STG</sub>                 | Storage Temperature                  | −65 to +150  | °C   |
| I <sub>OUT</sub>                 | Maximum Continuous Channel Current   | 128          | mA   |

### NOTES:

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- 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.
- V<sub>CC</sub>, Control and Switch terminals.

## FUNCTION TABLE

| $\overline{\text{OE}}$ | Y    | Description |
|------------------------|------|-------------|
| H                      | Hi-Z | Disconnect  |
| L                      | A    | Connect     |

3471 tbl 03

## CAPACITANCE<sup>(1)</sup>

| Symbol           | Parameter                       | Conditions <sup>(2)</sup> | Typ. | Unit |
|------------------|---------------------------------|---------------------------|------|------|
| C <sub>IN</sub>  | Control Input Capacitance       |                           | 4    | pF   |
| C <sub>I/O</sub> | Switch Input/Output Capacitance | Switch Off                |      | pF   |

### NOTES:

3471 tbl 04

- Capacitance is characterized but not tested
- T<sub>A</sub> = 25°C, f = 1MHz, V<sub>IN</sub> = 0V, V<sub>OUT</sub> = 0V

## DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE

Following Conditions Apply Unless Otherwise Specified:

Commercial: T<sub>A</sub> = −40°C to +85°C, V<sub>CC</sub> = 5.0V ±5%

| Symbol           | Parameter                           | Test Conditions <sup>(1)</sup>                                          | Min. | Typ. <sup>(2)</sup> | Max. | Unit |
|------------------|-------------------------------------|-------------------------------------------------------------------------|------|---------------------|------|------|
| V <sub>IH</sub>  | Input HIGH Voltage                  | Guaranteed Logic HIGH for Control Inputs                                | 2.0  | —                   | —    | V    |
| V <sub>IL</sub>  | Input LOW Voltage                   | Guaranteed Logic LOW for Control Inputs                                 | —    | —                   | 0.8  | V    |
| I <sub>IH</sub>  | Input HIGH Current                  | V <sub>CC</sub> = Max. V <sub>I</sub> = V <sub>CC</sub>                 | —    | —                   | ±1   | μA   |
| I <sub>IL</sub>  | Input LOW Current                   | V <sub>CC</sub> = Max. V <sub>I</sub> = GND                             | —    | —                   | ±1   | μA   |
| I <sub>OZH</sub> | High Impedance Output Current       | V <sub>CC</sub> = Max. V <sub>O</sub> = V <sub>CC</sub>                 | —    | —                   | ±1   | μA   |
| I <sub>OZL</sub> | (3-State Output pins)               | V <sub>CC</sub> = Max. V <sub>O</sub> = GND                             | —    | —                   | ±1   | μA   |
| I <sub>OS</sub>  | Short Circuit Current               | V <sub>CC</sub> = Max., V <sub>O</sub> = GND <sup>(3)</sup>             | —    | 300                 | —    | mA   |
| V <sub>IK</sub>  | Clamp Diode Voltage                 | V <sub>CC</sub> = Min., I <sub>IN</sub> = −18mA                         | —    | −0.7                | −1.2 | V    |
| R <sub>ON</sub>  | Switch On Resistance <sup>(4)</sup> | V <sub>CC</sub> = Min. V <sub>IN</sub> = 0.0V<br>I <sub>ON</sub> = 30mA | —    | 5                   | 7    | Ω    |
|                  |                                     | V <sub>CC</sub> = Min. V <sub>IN</sub> = 2.4V<br>I <sub>ON</sub> = 15mA | —    | 10                  | 15   | Ω    |
| I <sub>OFF</sub> | Input/Output Power Off Leakage      | V <sub>CC</sub> = 0V, V <sub>IN</sub> or V <sub>O</sub> ≤ 4.5V          | —    | —                   | ±1   | μA   |
| I <sub>CC</sub>  | Quiescent Power Supply Current      | V <sub>CC</sub> = Max., V <sub>IN</sub> = GND or V <sub>CC</sub>        | —    | 0.1                 | 3    | μA   |

### NOTES:

3471 tbl 05

- For conditions shown as Max. or Min., use appropriate value specified under Electrical Characteristics for the applicable device type.
- Typical values are at V<sub>CC</sub> = 5.0V, +25°C ambient.
- Not more than one output should be tested at one time. Duration of the test should not exceed one second.
- Measured by voltage drop between ports at indicated current through the switch.

## POWER SUPPLY CHARACTERISTICS

| Symbol          | Parameter                                         | Test Conditions <sup>(1)</sup>                                                                                                   |                                     | Min. | Typ. <sup>(2)</sup> | Max. | Unit                       |
|-----------------|---------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|------|---------------------|------|----------------------------|
| $\Delta I_{CC}$ | Quiescent Power Supply Current<br>TTL Inputs HIGH | $V_{CC} = \text{Max.}$<br>$V_{IN} = 3.4V^{(3)}$                                                                                  |                                     | —    | 0.5                 | 1.5  | mA                         |
| $I_{CCD}$       | Dynamic Power Supply<br>Current <sup>(4)</sup>    | $V_{CC} = \text{Max.}$<br>Outputs Open<br>Enable Pin Toggling<br>50% Duty Cycle                                                  | $V_{IN} = V_{CC}$<br>$V_{IN} = GND$ | —    | 30                  | 40   | $\mu A/$<br>MHz/<br>Switch |
| $I_C$           | Total Power Supply Current <sup>(6)</sup>         | $V_{CC} = \text{Max.}$<br>Outputs Open<br>Enable Pin Toggling<br>(4 Switches Toggling)<br>$f_i = 10\text{MHz}$<br>50% Duty Cycle | $V_{IN} = V_{CC}$<br>$V_{IN} = GND$ | —    | 1.2                 | 1.6  | mA                         |
|                 |                                                   |                                                                                                                                  | $V_{IN} = 3.4$<br>$V_{IN} = GND$    | —    | 1.5                 | 2.4  |                            |

### NOTES:

3471 tbl 06

- For conditions shown as Max. or Min., use appropriate value specified under Electrical Characteristics for the applicable device type.
- Typical values are at  $V_{CC} = 5.0V$ ,  $+25^\circ C$  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 the  $I_{CC}$  formula. These limits are guaranteed but not tested.
- $I_C = I_{QUIESCENT} + I_{INPUTS} + I_{DYNAMIC}$   
 $I_C = I_{CC} + \Delta I_{CC} D_{HNT} + I_{CCD} (f_i N)$   
 $I_{CC} = \text{Quiescent Current}$   
 $\Delta I_{CC} = \text{Power Supply Current for a TTL High Input } (V_{IN} = 3.4V)$   
 $D_H = \text{Duty Cycle for TTL Inputs High}$   
 $N_T = \text{Number of TTL Inputs at } D_H$   
 $I_{CCD} = \text{Dynamic Current Caused by an Input Transition Pair (HLH or LHL)}$   
 $f_i = \text{Input Frequency}$   
 $N = \text{Number of Switches Toggling at } f_i$   
All currents are in milliamps and all frequencies are in megahertz.

## SWITCHING CHARACTERISTICS OVER OPERATING RANGE

Following Conditions Apply Unless Otherwise Specified:

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

| Symbol     | Description                                                     | Condition <sup>(1)</sup>                 | Min. <sup>(2)</sup> | Typ. | Max. | Unit |
|------------|-----------------------------------------------------------------|------------------------------------------|---------------------|------|------|------|
| $t_{PLH}$  | Data Propagation Delay<br>A to Y, Y to A <sup>(3,4)</sup>       | $C_L = 50\text{pF}$<br>$R_L = 500\Omega$ | —                   | —    | 0.25 | ns   |
| $t_{PZH}$  | Switch Turn on Delay<br>$\overline{OE}$ to A, Y                 |                                          | 1.5                 | —    | 6.5  | ns   |
| $t_{PHZ}$  | Switch Turn off Delay<br>$\overline{OE}$ to A, Y <sup>(3)</sup> |                                          | 1.5                 | —    | 5.5  | ns   |
| $t_{PLZ}$  |                                                                 |                                          |                     |      |      |      |
| $ Q_{CI} $ | Charge Injection <sup>(5,6)</sup>                               |                                          | —                   | 1.5  | —    | pC   |

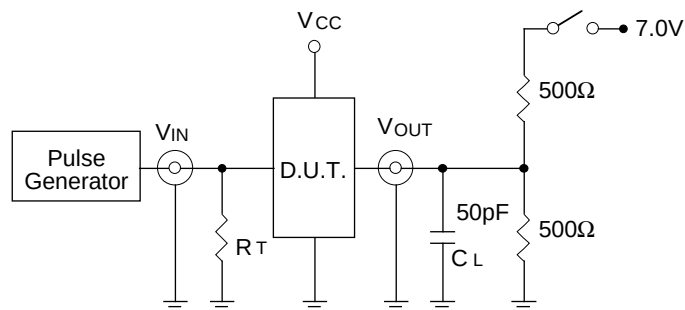
### NOTES:

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- See test circuit and waveforms.
- Minimum limits guaranteed but not tested.
- This parameter is guaranteed by design but not tested.
- 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.
- Measured at switch turn off, load = 50 pF in parallel with 10M $\Omega$  scope probe,  $V_{IN} = 0.0$  volts.
- Characterized parameter. Not 100% tested.

## TEST CIRCUITS AND WAVEFORMS

### TEST CIRCUITS FOR ALL OUTPUTS



3471 drw 03

### SWITCH POSITION

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

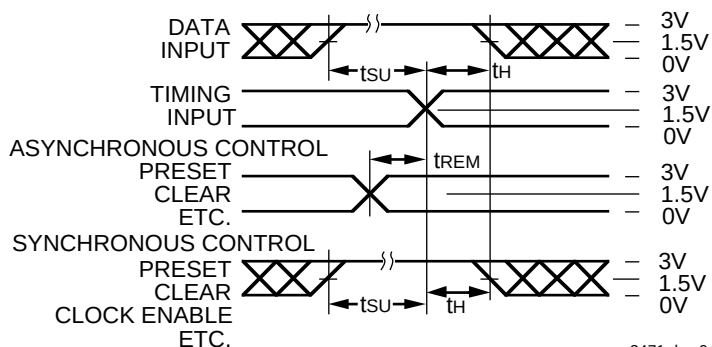
#### DEFINITIONS:

CL = Load capacitance: includes jig and probe capacitance.

RT = Termination resistance: should be equal to ZOUT of the Pulse Generator.

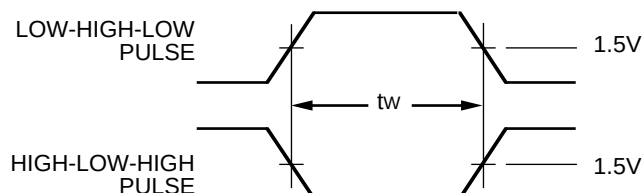
3471 Ink 08

### SET-UP, HOLD AND RELEASE TIMES



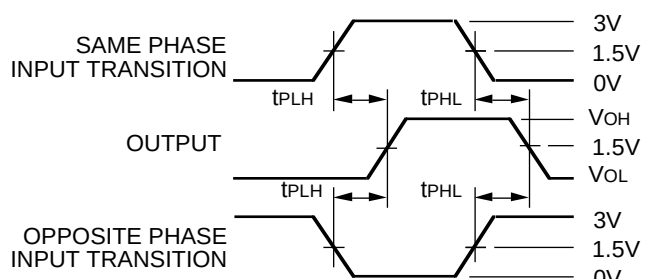
3471 drw 04

### PULSE WIDTH



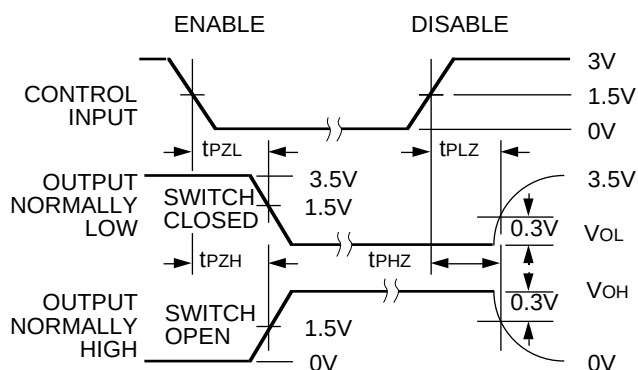
3471 drw 05

### PROPAGATION DELAY



3471 drw 06

### ENABLE AND DISABLE TIMES



3471 drw 07

#### NOTES:

- Diagram shown for input Control Enable-LOW and input Control Disable-HIGH
- Pulse Generator for All Pulses: Rate  $\leq 1.0\text{MHz}$ ;  $t_r \leq 2.5\text{ns}$ ;  $t_f \leq 2.5\text{ns}$

ORDERING INFORMATION

| IDT         | XX | FST         | XX | X       |  |                                             |
|-------------|----|-------------|----|---------|--|---------------------------------------------|
| Temp. Range |    | Device Type |    | Package |  |                                             |
|             |    |             |    | SO      |  | Small Outline IC (SO16-1)                   |
|             |    |             |    | Q       |  | Quarter-size Small Outline Package (SO16-7) |
|             |    |             |    | 3125    |  | 4-Bit Bus Switch                            |
|             |    |             |    | 74      |  | −40°C to +85°C                              |

3471 drw 08

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