FEATURES:

- Bus switches provide zero delay paths
- Extended commercial range of –40°C to +85°C
- Low switch on-resistance:
  FST163xxx – 5Ω
  FST1632xxx — 28Ω
- 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, TSSOP and TVSOP

DESCRIPTION:

The FST163383/1632383 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 FST1632xxx integrates terminating resistors in the device, thus eliminating the need for external 25Ω series resistors.

The FST163383 and FST1632383 each provide four 4-bit TTL- compatible ports that support 2 way bus exchange. The BX pin controls the bus exchange and the BE pin serves as the enable pin.

FUNCTIONAL BLOCK DIAGRAM
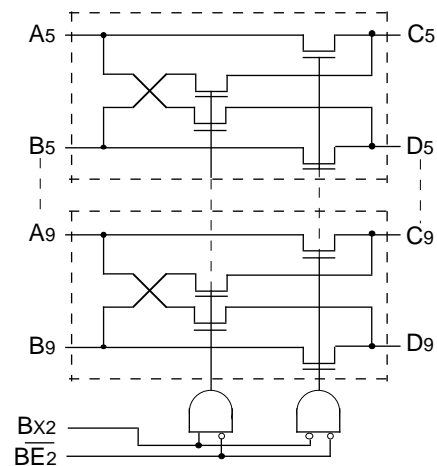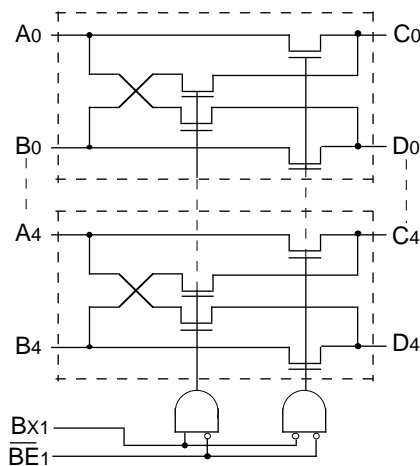
3474 drw 01

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)
$BX_{1,2}$	I	Bus Exchange

3474 tbl 01

COMMERCIAL TEMPERATURE RANGE   **MAY 1996**

DSC-3474/4

PIN CONFIGURATION

$\overline{BE}_1$	1	48	Vcc
C0	2	47	D4
A0	3	46	B4
B0	4	45	A4
D0	5	44	C4
C1	6	43	D3
A1	7	42	B3
B1	8	41	A3
D1	9	40	C3
C2	10	39	D2
A2	11	38	B2
GND	12	37	BX1
$\overline{BE}_2$	13	36	Vcc
C5	14	35	D9
A5	15	34	B9
B5	16	33	A9
D5	17	32	C9
C6	18	31	D8
A6	19	30	B8
B6	20	29	A8
D6	21	28	C8
C7	22	27	D7
A7	23	26	B7
GND	24	25	BX2

SO48-1
SO48-2
SO48-3
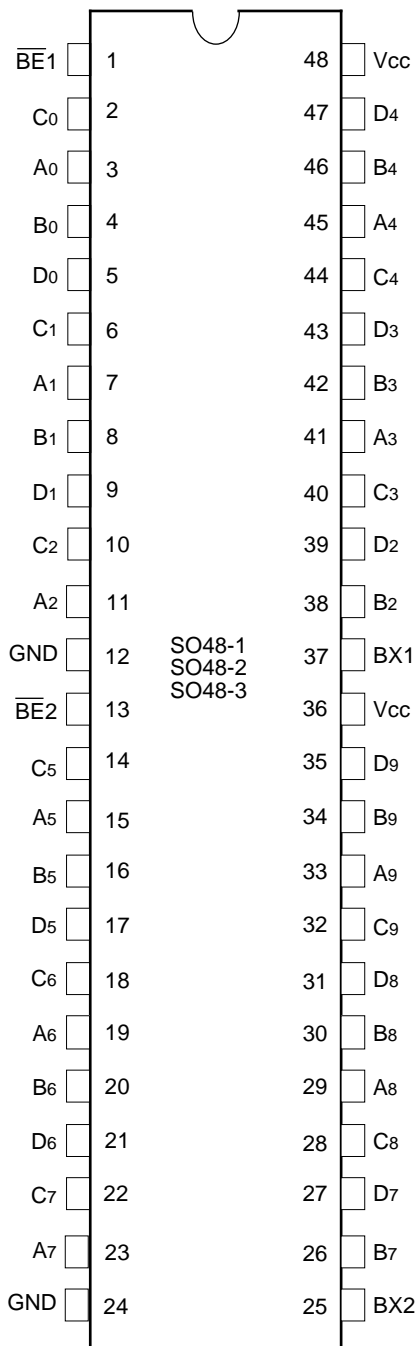
**SSOP/
TSSOP/TVSOP
TOP VIEW**

3474 drw 02

ABSOLUTE MAXIMUM RATINGS[1]

Symbol	Description	Max.	Unit
VTERM[2]	Terminal Voltage with Respect to GND	−0.5 to +7.0	V
TSTG	Storage Temperature	−65 to +150	°C
IOUT	Maximum Continuous Channel Current	128	mA

3474 tbl 02

NOTES:
1. Stresses greater than those listed under ABSOLUTE MAXIMUM RAT-INGS 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 condiitions for extended periods may affect reliability.
2. Vcc, Control and Switch terminals.

CAPACITANCE[1]

Symbol	Parameter	Conditions[2]	Typ.	Unit
CIN	Control Input Capacitance		4	pF
CI/O	Switch Input/Output Capacitance	Switch Off		pF

3474 tbl 03

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

FUNCTION TABLE

$\overline{BE}_1$	BX1	A0-4	B0-4	Description
H	X	Hi-Z	Hi-Z	Disconnect
L	L	C0-4	D0-4	Connect
L	H	D0-4	C0-4	Exchange

$\overline{BE}_2$	BX2	A5-9	B5-9	Description
H	X	Hi-Z	Hi-Z	Disconnect
L	L	C5-9	D5-9	Connect
L	H	D5-9	C5-9	Exchange

3474 tbl 04

DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE

Following Conditions Apply Unless Otherwise Specified:
Commercial: 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		2.0	—	—	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 Voltage		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} = 0.0V	163xxx	—	5	7	Ω
		I_{ON} = 30mA	1632xxx	17	28	40	
		V_{CC} = Min. V_{IN} = 2.4V	163xxx	—	10	15	Ω
		I_{ON} = 15mA	1632xxx	20	35	48	
I_{OFF}	Input/Output Power Off Leakage	V_{CC} = 0V, V_{IN} or V_O ≤ 4.5V		—	—	1	µA
I_{CC}	Quiescent Power Supply Current	V_{CC} = Max., V_{IN} = GND or V_{CC}		—	0.1	3	µA

3474 tbl 05

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. Not more than one output should be tested 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
ΔI_{CC}	Quiescent Power Supply Current TTL Inputs HIGH	V_{CC} = Max. V_{IN} = 3.4V[3]		—	0.5	1.5	mA
I_{CCD}	Dynamic Power Supply Current[4]	V_{CC} = Max. Outputs Open Enable Pin Toggling 50% Duty Cycle	V_{IN} = V_{CC} V_{IN} = GND	—	30	40	µA/ MHz/ Switch
I_C	Total Power Supply Current[6]	V_{CC} = Max. Outputs Open Enable Pins Toggling (20 Switches Toggling) f_i = 10MHz 50% Duty Cycle	V_{IN} = V_{CC} V_{IN} = GND	—	6.0	8.0	mA
			V_{IN} = 3.4 V_{IN} = GND	—	6.5	9.5	

3474 tbl 06

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. Values for these conditions are examples of the I_{CC} formula. These limits are guaranteed but not tested.
6. I_C = $I_{QUIESCENT}$ + I_{INPUTS} + $I_{DYNAMIC}$
   I_C = I_{CC} + ΔI_{CC} $D_H N_T$ + I_{CCD} ($f_i N$)
   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_i = Input Frequency
   N = 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°C to +85°C, V_{CC} = 5.0V ±10%

| Symbol	Description	Condition[1]	Min.[2]	Typ.	163383	1632383	Unit
					Max.		
t_{PLH} t_{PHL}	Data Propagation Delay Ai to Ci, Di Bi to Ci, Di[3,4]	C_L = 50pF R_L = 500Ω	—	—	0.25	1.25	ns
t_{BX}	Switch Multiplex Delay BX to Ai, Bi, Ci, Di		1.5	—	6.5	7.5	ns
t_{PZH} t_{PZL}	Switch Turn on Delay BE to Ai, Bi, Ci, Di		1.5	—	6.5	7.5	ns
t_{PHZ} t_{PLZ}	Switch Turn off Delay BE to Ai, Bi[3]		1.5	—	5.5	5.5	ns
$|Q_{CI}|$	Charge Injection, Typical[5,7]		—	1.5	—	—	pC
$|Q_{CDI}|$	Charge Injection, Typical[6,7]		—	0.5	—	—	

3474 tbl 07

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. 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.
7. Characterized parameter. Not 100% tested.

TEST CIRCUITS AND WAVEFORMS
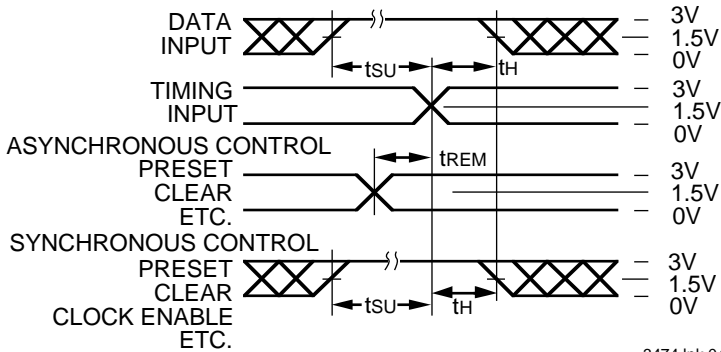## TEST CIRCUITS FOR ALL OUTPUTS
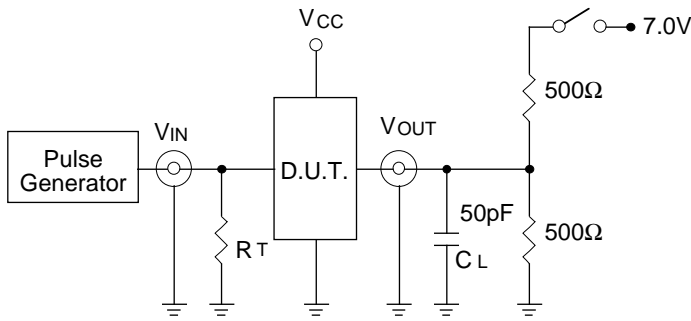
3474 lnk 03

SWITCH POSITION

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

3474 lnk 08

DEFINITIONS:

C_L = Load capacitance: includes jig and probe capacitance.

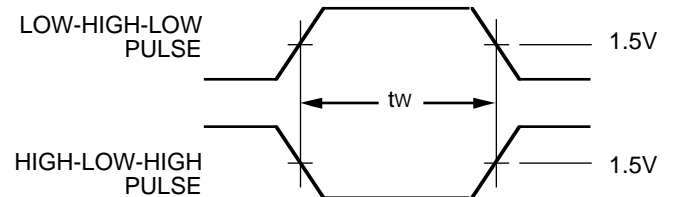R_T = Termination resistance: should be equal to Z_{OUT} of the Pulse Generator.
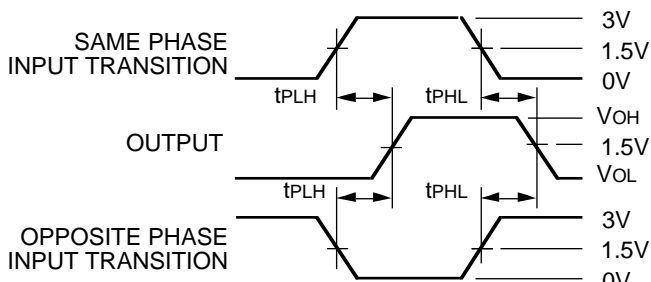
SET-UP, HOLD AND RELEASE TIMES
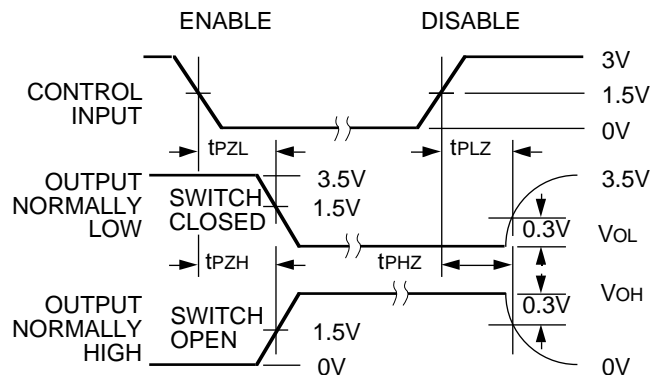

3474 lnk 04

PULSE WIDTH

3474 lnk 05

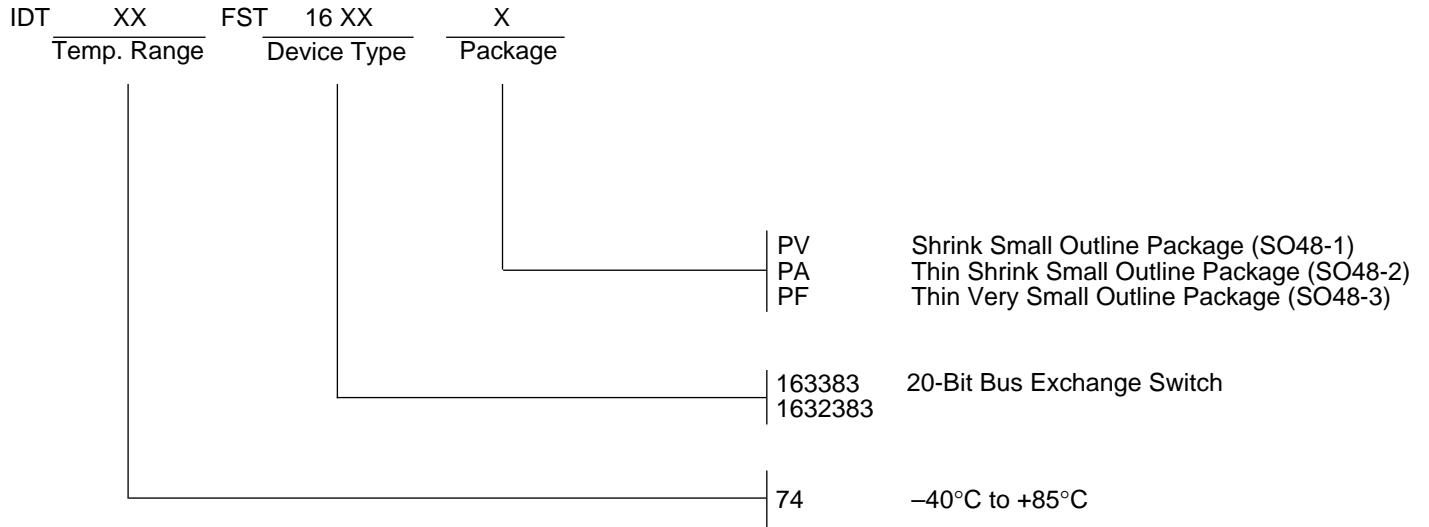## PROPAGATION DELAY

3474 lnk 06

ENABLE AND DISABLE TIMES

3474 lnk 07

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

```
IDT      XX      FST   16 XX          X
      Temp. Range     Device Type   Package
```

PV	Shrink Small Outline Package (SO48-1)
PA	Thin Shrink Small Outline Package (SO48-2)
PF	Thin Very Small Outline Package (SO48-3)

163383	20-Bit Bus Exchange Switch
1632383	

74	−40°C to +85°C

3474 drw 08