Integrated Device Technology, Inc.

3.3V CMOS 16-BIT REGISTER (3-STATE)

IDT74FCT163374/A/C

FEATURES:

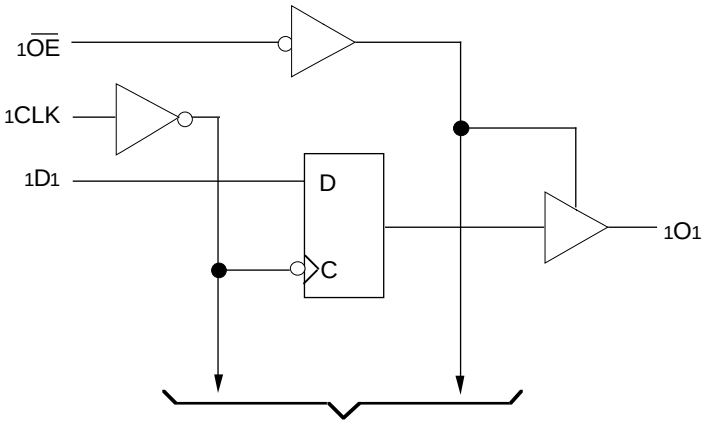
- 0.5 MICRON CMOS Technology
- **Typical $t_{SK(o)}$ (Output Skew) < 250ps**
- ESD > 2000V per MIL-STD-883, Method 3015; > 200V using machine model (C = 200pF, R = 0)
- Packages include 25 mil pitch SSOP, 19.6 mil pitch TSSOP and 15.7 mil pitch TVSOP
- Extended commercial range of -40°C to +85°C
- V_{CC} = 3.3V ±0.3V, Normal Range or V_{CC} = 2.7 to 3.6V, Extended Range
- CMOS power levels (0.4µW typ. static)
- Rail-to-Rail output swing for increased noise margin
- Low Ground Bounce (0.3V typ.)
- Inputs (except I/O) can be driven by 3.3V or 5V components

DESCRIPTION:

The FCT163374/A/C 16-bit edge-triggered D-type registers are built using advanced dual metal CMOS technology. These high-speed, low-power registers are ideal for use as buffer registers for data synchronization and storage. The Output Enable ($x\overline{OE}$) and clock (xCLK) controls are organized to operate each device as two 8-bit registers or one 16-bit register with common clock. Flow-through organization of signal pins facilitates ease of layout. All inputs are designed with hysteresis for improved noise margin.

The inputs of FCT163374/A/C can be driven from either 3.3V or 5V devices. This feature allows the use of these devices as translators in a mixed 3.3V/5V supply system.

FUNCTIONAL BLOCK DIAGRAM



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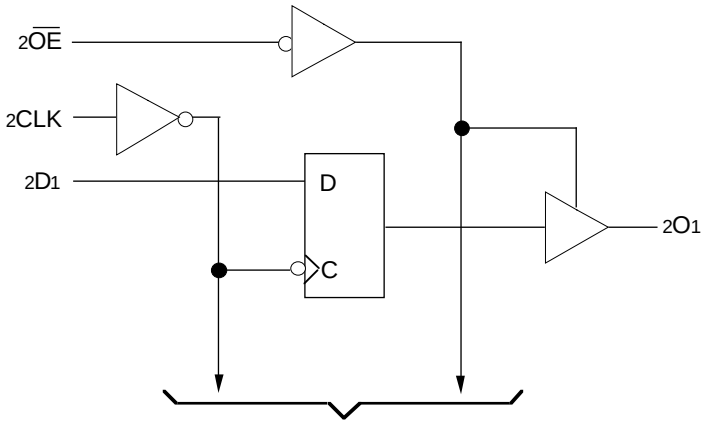

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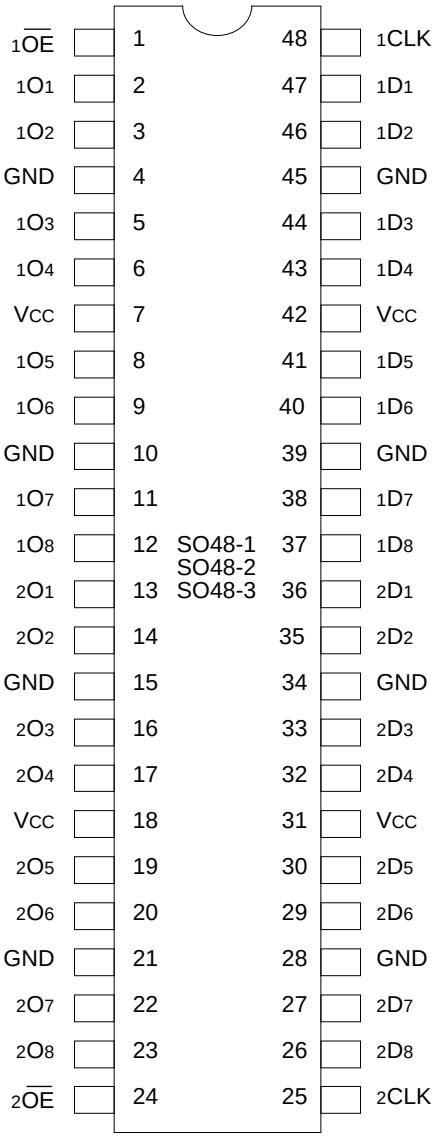
PIN CONFIGURATIONS



SSOP/ TSSOP/TVSOP TOP VIEW

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PIN DESCRIPTION

Pin Names	Description
xDx	Data Inputs
xCLK	Clock Inputs
xOx	3-State Outputs.
x$\overline{OE}$	3-State Output Enable Input (Active LOW)

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ABSOLUTE MAXIMUM RATINGS(1)

Symbol	Description	Max.	Unit
V_{TERM}(2)	Terminal Voltage with Respect to GND	–0.5 to +4.6	V
V_{TERM}(3)	Terminal Voltage with Respect to GND	–0.5 to +7.0	V
V_{TERM}(4)	Terminal Voltage with Respect to GND	–0.5 to V_{CC} + 0.5	V
T_{STG}	Storage Temperature	–65 to +150	°C
I_{OUT}	DC Output Current	–60 to +60	mA

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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 terminals.
3. Input terminals.
4. Output and I/O terminals.

FUNCTION TABLE(1)

Function	Inputs			Outputs
	xDx	xCLK	x$\overline{OE}$	xOx
Hi-Z	X	L	H	Z
	X	H	H	Z
Load Register	L	↑	L	L
	H	↑	L	H
	L	↑	H	Z
	H	↑	H	Z

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

CAPACITANCE (T_A = +25°C, f = 1.0MHz)

Symbol	Parameter(1)	Conditions	Typ.	Max.	Unit
C_{IN}	Input Capacitance	V_{IN} = 0V	3.5	6.0	pF
C_{OUT}	Output Capacitance	V_{OUT} = 0V	3.5	8.0	pF

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NOTE:
1. This parameter is measured at characterization but not tested.

DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE

Following Conditions Apply Unless Otherwise Specified:
Commercial: T_A = –40°C to +85°C, V_{CC} = 2.7V to 3.6V

Symbol	Parameter	Test Conditions[1]		Min.	Typ.[2]	Max.	Unit
V_{IH}	Input HIGH Level (Input pins)	Guaranteed Logic HIGH Level		2.0	—	5.5	V
	Input HIGH Level (I/O pins)			2.0	—	V_{CC}+0.5	
V_{IL}	Input LOW Level (Input and I/O pins)	Guaranteed Logic LOW Level		–0.5	—	0.8	V
I_{IH}	Input HIGH Current (Input pins)	V_{CC} = Max.	V_I = 5.5V	—	—	±1	µA
	Input HIGH Current (I/O pins)		V_I = V_{CC}	—	—	±1	
I_{IL}	Input LOW Current (Input pins)		V_I = GND	—	—	±1	
	Input LOW Current (I/O pins)		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	
V_{IK}	Clamp Diode Voltage	V_{CC} = Min., I_{IN} = –18mA		—	–0.7	–1.2	V
I_{ODH}	Output HIGH Current	V_{CC} = 3.3V, V_{IN} = V_{IH} or V_{IL}, V_O = 1.5V[3]		–36	–60	–110	mA
I_{ODL}	Output LOW Current	V_{CC} = 3.3V, V_{IN} = V_{IH} or V_{IL}, V_O = 1.5V[3]		50	90	200	mA
V_{OH}	Output HIGH Voltage	V_{CC} = Min.	I_{OH} = –0.1mA	V_{CC}–0.2	—	—	V
		V_{IN} = V_{IH} or V_{IL}	I_{OH} = –3mA	2.4	3.0	—	
		V_{CC} = 3.0V, V_{IN} = V_{IH} or V_{IL}	I_{OH} = –8mA	2.4[5]	3.0	—	
V_{OL}	Output LOW Voltage	V_{CC} = Min.	I_{OL} = 0.1mA	—	—	0.2	V
		V_{IN} = V_{IH} or V_{IL}	I_{OL} = 16mA	—	0.2	0.4	
			I_{OL} = 24mA	—	0.3	0.55	
		V_{CC} = 3.0V, V_{IN} = V_{IH} or V_{IL}	I_{OL} = 24mA	—	0.3	0.50	
I_{OS}	Short Circuit Current[4]	V_{CC} = Max., V_O = GND[3]		–60	–135	–240	mA
V_H	Input Hysteresis	—		—	150	—	mV
I_{CCL} I_{CCH} I_{CCZ}	Quiescent Power Supply Current	V_{CC} = Max., V_{IN} = GND or V_{CC}		—	0.1	10	µA

NOTES:

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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 = 3.3V, +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. This parameter is guaranteed but not tested.
5. V_{OH} = V_{CC} –0.6V at rated current.

POWER SUPPLY CHARACTERISTICS

Symbol	Parameter	Test Conditions[1]		Min.	Typ.[2]	Max.	Unit
ΔI_{CC}	Quiescent Power Supply Current	V_{CC} = Max.	$V_{IN} = V_{CC} - 0.6V$[3]	—	2.0	30	µA
I_{CCD}	Dynamic Power Supply Current[4]	V_{CC} = Max. Outputs Open $x\overline{OE}$ = GND 50% Duty Cycle One Input Toggling	$V_{IN} = V_{CC}$ V_{IN} = GND	—	50	75	µA/ MHz
I_C	Total Power Supply Current[6]	V_{CC} = Max. Outputs Open f_{CP} = 10MHz 50% Duty Cycle	$V_{IN} = V_{CC}$ V_{IN} = GND	—	0.5	0.8	mA
		$x\overline{OE}$ = GND fi = 5MHz 50% Duty Cycle One Bit Toggling	$V_{IN} = V_{CC} - 0.6V$ V_{IN} = GND	—	0.5	0.8	
		V_{CC} = Max. Outputs Open f_{CP} = 10MHz 50% Duty Cycle	$V_{IN} = V_{CC}$ V_{IN} = GND	—	2.5	3.8[5]	
		$x\overline{OE}$ = GND fi = 2.5MHz 50% Duty Cycle Sixteen Bits Toggling	$V_{IN} = V_{CC} - 0.6V$ V_{IN} = GND	—	2.5	4.0[5]	

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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} = 3.3V, +25°C ambient.
3. Per TTL driven input; 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. $I_C = I_{QUIESCENT} + I_{INPUTS} + I_{DYNAMIC}$
   $I_C = I_{CC} + \Delta I_{CC} D_H N_T + I_{CCD} (f_{CP} N_{CP}/2 + f_i N_i)$
   I_{CC} = Quiescent Current (I_{CCL}, I_{CCH} and I_{CCZ})
   ΔI_{CC} = Power Supply Current for a TTL High Input
   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)
   N_{CP} = Number of Clock Inputs at f_{CP}
   f_i = Input Frequency
   N_i = Number of Inputs at f_i

SWITCHING CHARACTERISTICS OVER OPERATING RANGE[4]

Symbol	Parameter	Condition[1]	FCT163374		FCT163374A		FCT163374C		Unit
			Min.[2]	Max.	Min.[2]	Max.	Min.[2]	Max.	
t_{PLH} t_{PHL}	Propagation Delay xCLK to xOx	C_L = 50pF R_L = 500Ω	2.0	10.0	2.0	6.5	2.0	5.2	ns
t_{PZH} t_{PZL}	Output Enable Time		1.5	12.5	1.5	6.5	1.5	5.5	ns
t_{PHZ} t_{PLZ}	Output Disable Time		1.5	8.0	1.5	5.5	1.5	5.0	ns
t_{SU}	Set-up Time HIGH or LOW, xDx to xCLK		2.0	—	2.0	—	2.0	—	ns
t_H	Hold Time HIGH or LOW, xDx to xCLK		1.5	—	1.5	—	1.5	—	ns
t_W	xCLK Pulse Width HIGH or LOW		7.0	—	5.0	—	5.0	—	ns
$t_{SK}(o)$	Output Skew[3]		—	0.5	—	0.5	—	0.5	ns

NOTES:
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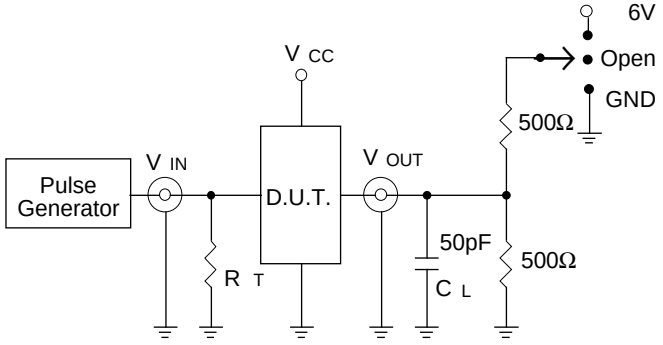
1. See test circuit and waveforms.
2. Minimum limits are guaranteed but not tested on Propagation Delays.
3. Skew between any two outputs, of the same package, switching in the same direction. This parameter is guaranteed by design.
4. Propagation Delay and Enable/Disable times are with V_{CC} = 3.3V ±0.3V, Normal Range. For V_{CC} = 2.7V to 3.6V, Extended Range, all Propagation Delays and Enable/Disable times should be degraded by 20%.

TEST CIRCUITS AND WAVEFORMS

TEST CIRCUITS FOR ALL OUTPUTS



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SWITCH POSITION

Test	Switch
Open Drain Disable Low Enable Low	6V
Disable High Enable High	GND
All Other tests	Open

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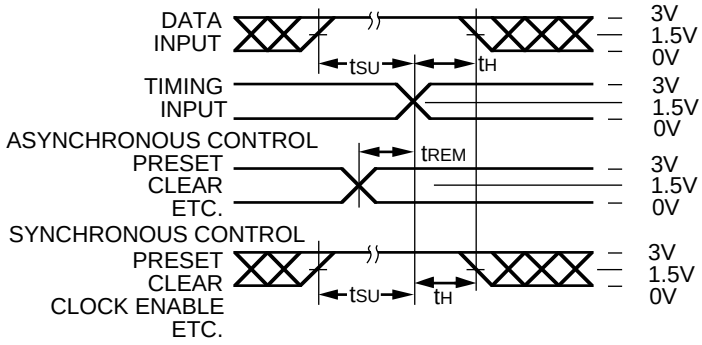
DEFINITIONS:

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



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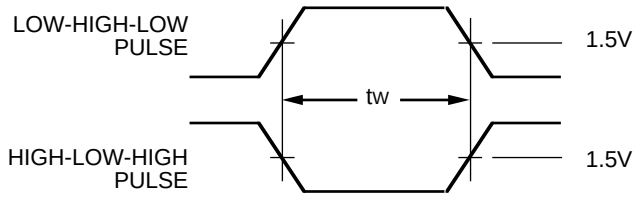
PULSE WIDTH



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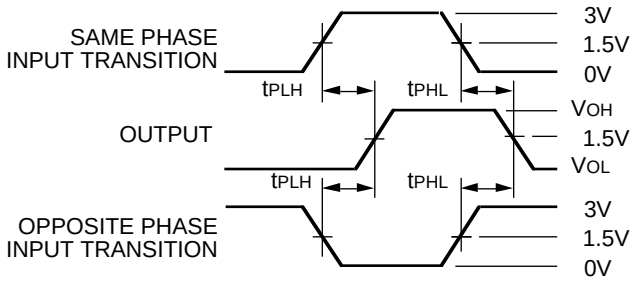
PROPAGATION DELAY



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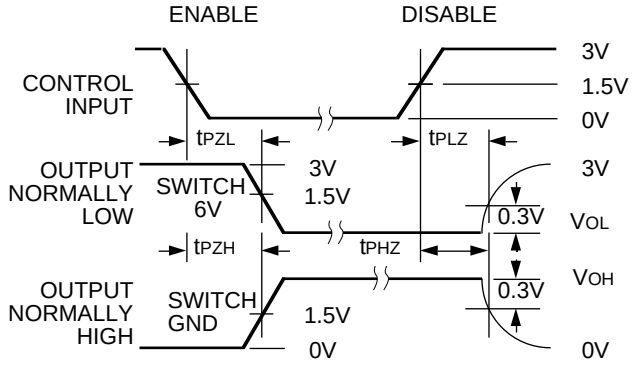
ENABLE AND DISABLE TIMES



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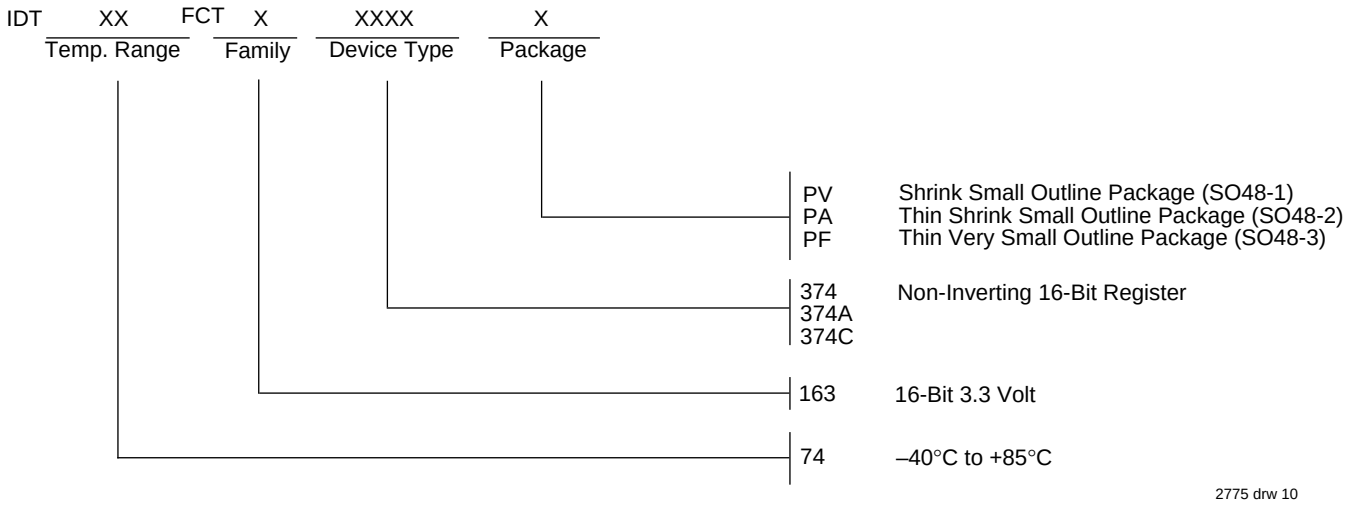
NOTES:

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.
3. If V_{CC} is below 3V, input voltage swings should be adjusted not to exceed V_{CC}.

ORDERING INFORMATION



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