



MULTILEVEL PIPELINE REGISTER

IDT29FCT520AT/BT/CT

FEATURES:

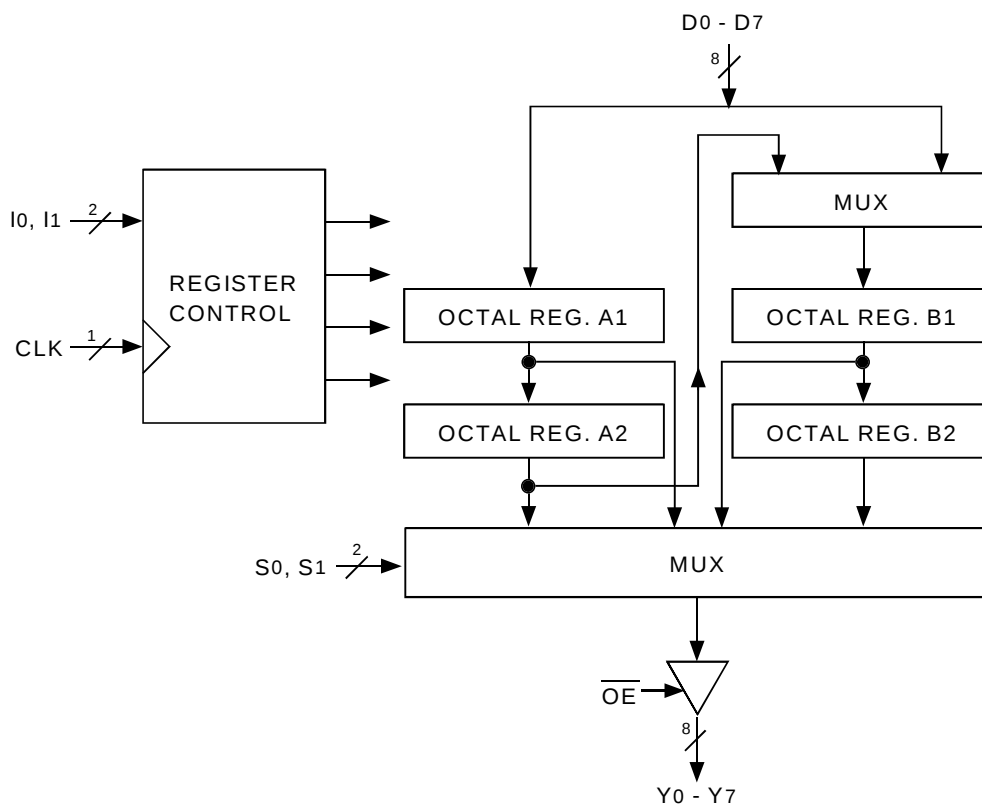
- Low input and output leakage $\leq 1\mu\text{A}$ (max.)
- CMOS power levels
- True TTL input and output compatibility
 - $V_{OH} = 3.3\text{V}$ (typ.)
 - $V_{OL} = 0.3\text{V}$ (typ.)
- High drive outputs (-15mA I_{OH} , 48mA I_{OL})
- Meets or exceeds JEDEC standard 18 specifications
- A, B, and C speed grades
- Available in SOIC, SSOP, and QSOP packages

DESCRIPTION:

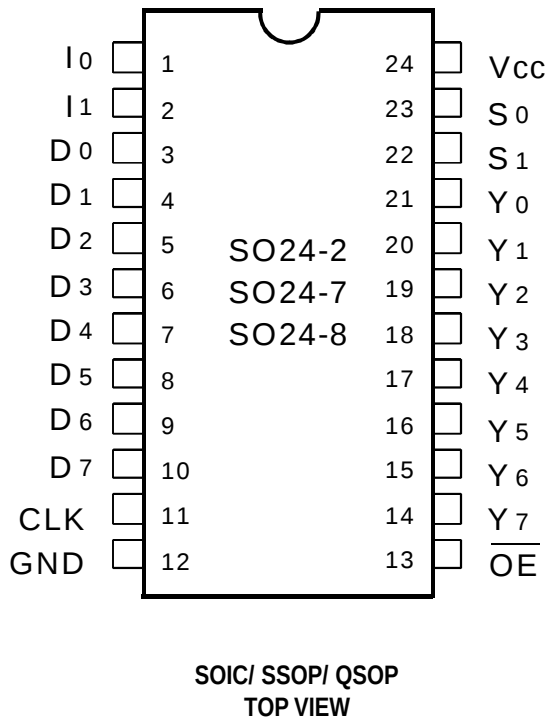
The 29FCT520T contains four 8-bit positive edge-triggered registers. These may be operated as a dual 2-level or as a single 4-level pipeline. A single 8-bit input is provided and any of the four registers is available at the 8-bit, 3-state output.

These devices are ideal for high speed burst writes and reads in processor/memory applications.

FUNCTIONAL BLOCK DIAGRAM



PIN CONFIGURATION



ABSOLUTE MAXIMUM RATINGS⁽¹⁾

Symbol	Rating	Max.	Unit
V _{TERM} ⁽²⁾	Terminal Voltage with Respect to GND	−0.5 to +7	V
V _{TERM} ⁽³⁾	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 +120	mA

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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 V_{CC} by +0.5V unless otherwise noted.
- Inputs and V_{CC} terminals only.
- Outputs and I/O terminals only.

CAPACITANCE (T_A = +25°C, f = 1.0MHz)

Symbol	Parameter ⁽¹⁾	Conditions	Typ.	Max.	Unit
C _{IN}	Input Capacitance	V _{IN} = 0V	6	10	pF
C _{OUT}	Output Capacitance	V _{OUT} = 0V	8	12	pF

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NOTE:

- This parameter is measured at characterization but not tested.

PIN DESCRIPTION

Pin Names	Description
$\overline{D_n}$	Register Input Port
CLK	Clock Input. Enter data into registers on LOW-to-HIGH transitions.
I ₀ , I ₁	Instruction Inputs. See Figure 1 and Instruction Control tables.
S ₀ , S ₁	Multiplexer Select. Inputs either register A ₁ , A ₂ , B ₁ , or B ₂ data to be available at the Output Port.
$\overline{OE}$	Output Enable for 3-State Output Port
Y _n	Register Output Port

REGISTER SELECTION

S ₀	S ₁	Register
0	0	B ₂
0	1	B ₁
1	0	A ₂
1	1	A ₁

DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE

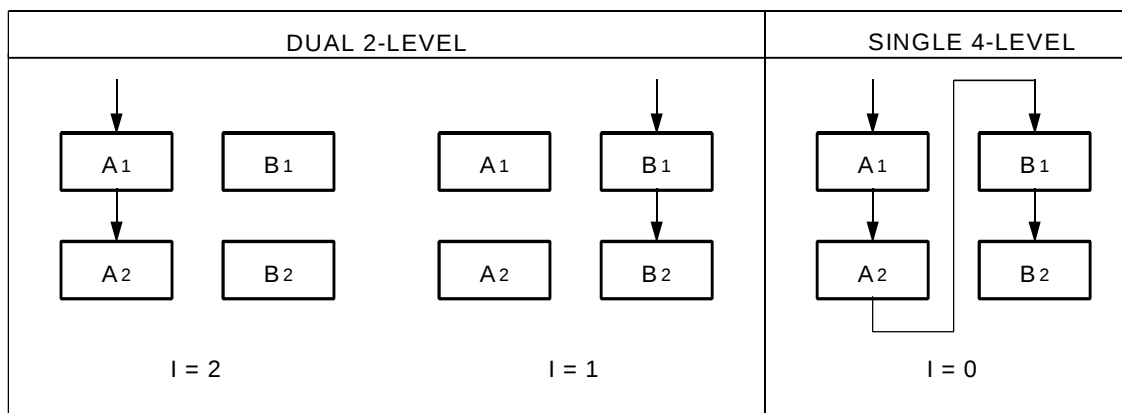
Following Conditions Apply Unless Otherwise Specified:

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⁾		$V_I = 0.5\text{V}$	—	—	± 1	
I_{OZH}	High Impedance Output Current ⁽⁴⁾	$V_{CC} = \text{Max.}$	$V_O = 2.7\text{V}$	—	—	± 1	μA
I_{OL}			$V_O = 0.5\text{V}$	—	—	± 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
I_{OS}	Short Circuit Current	$V_{CC} = \text{Max.}^{(3)}, V_O = \text{GND}$		-60	-120	-225	mA
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	$V_{CC} = \text{Min.}$ $V_{IN} = V_{IH} \text{ or } V_{IL}$	$I_{OL} = 48\text{mA}$	—	0.3	0.5	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	μA

NOTES:

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



NOTE:

- $I = 3$ for hold.

Figure 1. Data Loading in 2-Level Operation

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 $\overline{OE} = \text{GND}$ One Input Toggling 50% Duty Cycle	$V_{IN} = V_{CC}$ $V_{IN} = \text{GND}$	—	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 $\overline{OE} = \text{GND}$ One Bit Toggling at $f_i = 5\text{MHz}$ 50% Duty Cycle	$V_{IN} = V_{CC}$ $V_{IN} = \text{GND}$	—	1.5	3.5	mA
			$V_{IN} = 3.4V$ $V_{IN} = \text{GND}$	—	2	5.5	
		$V_{CC} = \text{Max.}$, Outputs Open $f_{CP} = 10\text{MHz}$ 50% Duty Cycle $\overline{OE} = \text{GND}$	$V_{IN} = V_{CC}$ $V_{IN} = \text{GND}$	—	3.8	7.3 ⁽⁵⁾	
		Eight Bits Toggling at $f_i = 2.5\text{MHz}$ 50% Duty Cycle	$V_{IN} = 3.4V$ $V_{IN} = \text{GND}$	—	6	16.3 ⁽⁵⁾	

NOTES:

- For conditions shown as Max. or Min., use appropriate value specified under Electrical Characteristics for the applicable device type.
- Typical values are at $V_{CC} = 5.0V$, $+25^\circ\text{C}$ 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 the I_{CC} formula. These limits are guaranteed but not tested.
- $I_C = I_{QUIESCENT} + I_{INPUTS} + I_{DYNAMIC}$
 $I_C = I_{CC} + \Delta I_{CC} D_{HNT} + I_{CCD} (f_{CP}/2 + f_i N_i)$
 $I_{CC} = \text{Quiescent Current}$
 $\Delta I_{CC} = \text{Power Supply Current for a TTL High Input } (V_{IN} = 3.4V)$
 $D_H = \text{Duty Cycle for TTL Inputs High}$
 $N_T = \text{Number of TTL Inputs at } D_H$
 $I_{CCD} = \text{Dynamic Current Caused by an Input Transition Pair (HLH or LHL)}$
 $f_{CP} = \text{Clock Frequency for Register Devices (Zero for Non-Register Devices)}$
 $f_i = \text{Input Frequency}$
 $N_i = \text{Number of Inputs at } f_i$
 All currents are in milliamps and all frequencies are in megahertz.

SWITCHING CHARACTERISTICS OVER OPERATING RANGE

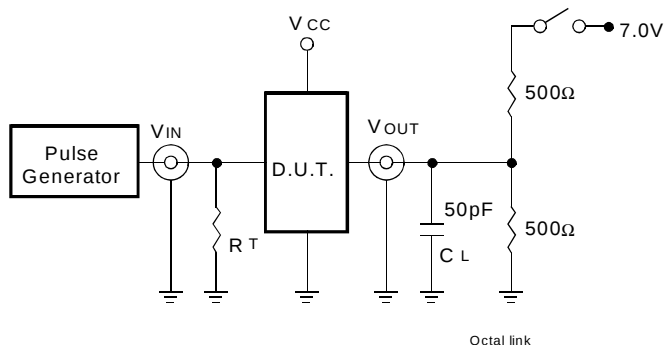
Symbol	Parameter	Condition ⁽¹⁾	FCT520AT		FCT520BT		FCT520CT		Unit
			Min. ⁽²⁾	Max.	Min. ⁽²⁾	Max.	Min. ⁽²⁾	Max.	
t _{PHL} t _{PLH}	Propagation Delay CLK to Y _n	C _L = 50pF R _L = 500Ω	2	14	2	7.5	2	6	ns
t _{PHL} t _{PLH}	Propagation Delay S ₀ or S ₁ to Y _n		2	13	2	7.5	2	6	ns
t _{su}	Set-up Time, HIGH or LOW D _n to CLK		5	—	2.5	—	2.5	—	ns
t _h	Hold Time, HIGH or LOW D _n to CLK		2	—	2	—	2	—	ns
t _{su}	Set-up Time, HIGH or LOW I ₀ or I ₁ to CLK		5	—	4	—	4	—	ns
t _h	Hold Time, HIGH or LOW I ₀ or I ₁ to CLK		2	—	2	—	2	—	ns
t _{PHZ} t _{PLZ}	Output Disable Time		1.5	12	1.5	7	1.5	6	ns
t _{PZH} t _{PZL}	Output Enable Time		1.5	15	1.5	7.5	1.5	6	ns
t _w	Clock Pulse Width, HIGH or LOW		7	—	5.5	—	5.5	—	ns

NOTES:

1. See Test Curcuits and Waveforms.
2. Minimum values are guaranteed but not tested on Propagation Delays.

TEST CIRCUITS AND WAVEFORMS

TEST CIRCUITS FOR ALL OUTPUTS



SWITCH POSITION

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

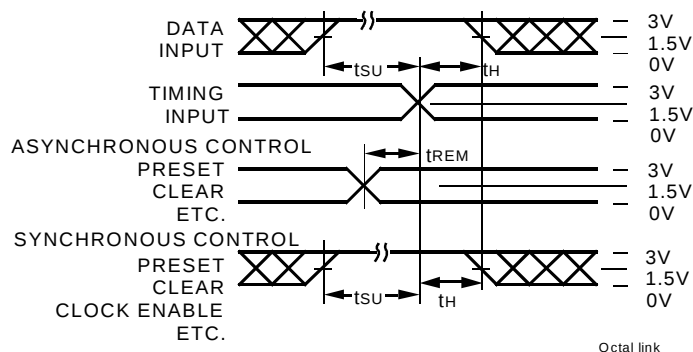
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DEFINITIONS:

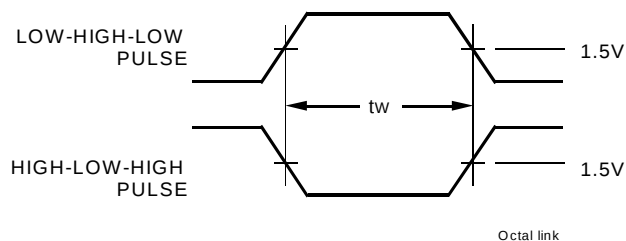
CL = Load capacitance: includes jig and probe capacitance.

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

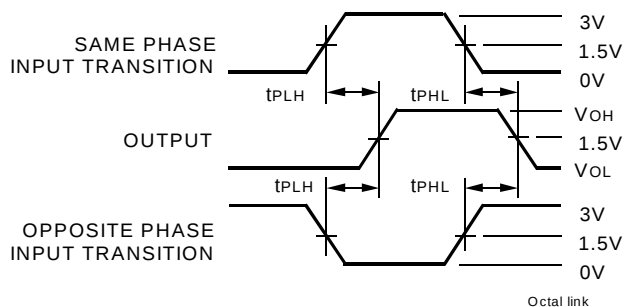
SET-UP, HOLD, AND RELEASE TIMES



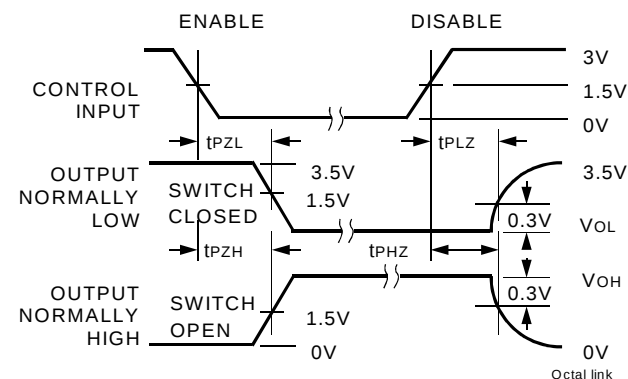
PULSE WIDTH



PROPAGATION DELAY



ENABLE AND DISABLE TIMES



NOTES:

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

ORDERING INFORMATION

IDT29FCT	<u>XXXXX</u>	<u>X</u>		
	Device Type	Package		
			SO	Small Outline IC (SO24-2)
			PY	Shrink Small Outline Package (SO24-7)
			Q	Quarter-size Small Outline Package (SO24-8)
			520AT	Multilevel Pipeline Register
			520BT	
			520CT	



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