



# HIGH-SPEED CMOS BUS INTERFACE 10-BIT REGISTER

*IDTQS74FCT2821AT/BT/CT*

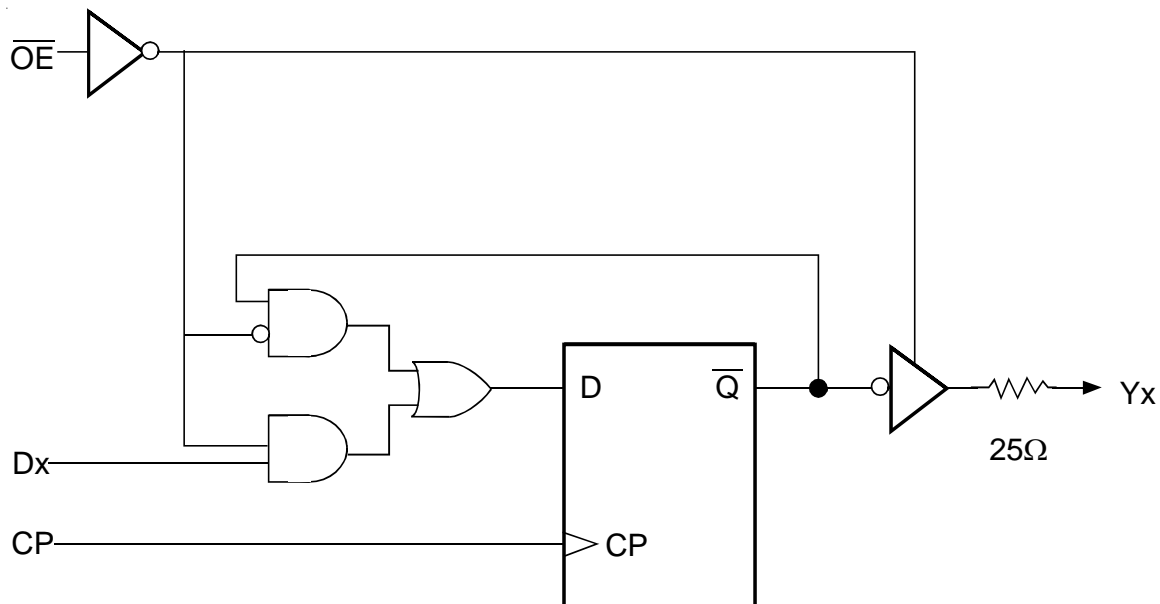
## FEATURES:

- CMOS power levels: <7.5mW static
- Undershoot clamp diodes on all outputs
- True TTL input and output compatibility
- Ground bounce controlled outputs
- Reduced output swing of 0 to 3.5V
- Built-in 25Ω series resistor outputs reduce reflection and other system noise
- A, B, and C speed grades
- IOL = 12mA
- Available in SOIC and QSOP packages

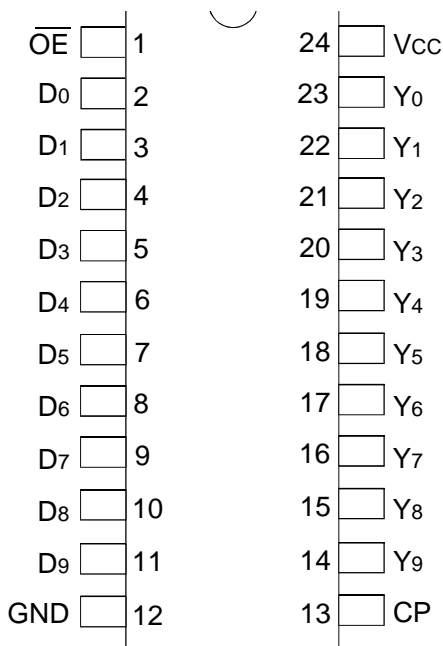
## DESCRIPTION:

The IDTQS74FCT2821T is a 10-bit high-speed CMOS TTL-compatible buffered register with 3-state outputs, with a 25Ω resistor that is useful for driving transmission lines and reducing system noise. The 2821 series parts can replace the 821 series to reduce noise in an existing design. All inputs have clamp diodes for undershoot noise suppression. All outputs have ground bounce suppression. Outputs will not load an active bus when Vcc is removed from the device.

## FUNCTIONAL BLOCK DIAGRAM



PIN CONFIGURATION

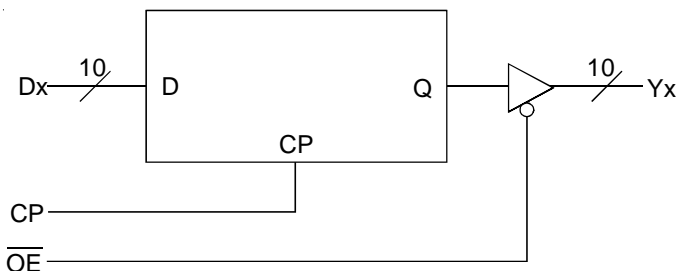


SOIC/ QSOP  
TOP VIEW

PIN DESCRIPTION

Pin Names	I/O	Description
Dx	I	D Flip-Flop Data Inputs
CP	I	Clock Pulse for the register. Enters data into the register on the LOW-to-HIGH transition.
Yx	O	Register 3-State Outputs
$\overline{OE}$	I	Output Control. When the $\overline{OE}$ input is HIGH, the Yx outputs are in the high impedance state. When the $\overline{OE}$ input is LOW, the TRUE register data is present at the Yx outputs.

LOGIC SYMBOL



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

Symbol	Description	Max	Unit
VTERM	Terminal Voltage with Respect to GND	-0.5 to +7	V
TSTG	Storage Temperature	-65 to +150	°C
IOUT	DC Output Current Max Sink Current/Pin	120	mA
I <sub>IK</sub>	Input Diode Current, V <sub>IN</sub> < 0	-20	mA
I <sub>OK</sub>	Output Diode Current, V <sub>OUT</sub> < 0	-50	mA

NOTE:

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.

CAPACITANCE (T<sub>A</sub> = +25°C, F = 1.0MHz)

Symbol	Parameter <sup>(1)</sup>	Conditions	Typ.	Max.	Unit
C <sub>IN</sub> <sup>(2)</sup>	Input Capacitance	V <sub>IN</sub> = 0V	4	—	pF
C <sub>IN</sub> <sup>(3)</sup>	Input Capacitance	V <sub>IN</sub> = 0V	8	—	pF
C <sub>OUT</sub> <sup>(4)</sup>	Output Capacitance	V <sub>OUT</sub> = 0V	6	—	pF
C <sub>OUT</sub> <sup>(5)</sup>	Output Capacitance	V <sub>OUT</sub> = 0V	8	—	pF

NOTES:

- This parameter is measured at characterization but not tested.
- Pins 1, 3-11, 13.
- Pin 2.
- Pins 15-22.
- Pins 14, 23.

FUNCTION TABLE<sup>(1)</sup>

$\overline{OE}$	Inputs		Internal Value Qx	Outputs Yx	Function
	Dx	CP			
H	L	↑	L	Z	High-Z
H	H	↑	H	Z	High-Z
H	L	↑	L	Z	Load
H	H	↑	H	Z	Load
L	L	↑	L	L	Load
L	H	↑	H	H	Load

NOTE:

- H = HIGH Voltage Level  
L = LOW Voltage Level  
Z = High-Impedance  
↑ = LOW-to-HIGH transition

## 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		Min.	Typ. <sup>(1)</sup>	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
$\Delta V_T$	Input Hysteresis	$V_{TLH} - V_{THL}$ for all inputs		—	0.2	—	V
$I_{IH}$	Input HIGH Current	$V_{CC} = \text{Max.}$	$0 \leq V_{IN} \leq V_{CC}$	—	—	$\pm 5$	$\mu\text{A}$
$I_{IL}$	Input LOW Current						
$I_{OZ}$	Off-State Output Current (Hi-Z)	$V_{CC} = \text{Max}$	$0 \leq V_{IN} \leq V_{CC}$	—	—	$\pm 5$	$\mu\text{A}$
$I_{OR}$	Current Drive	$V_{CC} = \text{Max.}, V_{OUT} = 2.0\text{V}^{(2)}$		50	—	—	mA
$V_{IC}$	Input Clamp Voltage	$V_{CC} = \text{Min.}, I_{IN} = -18\text{mA}, T_A = 25^{\circ}\text{C}^{(2)}$		—	-0.7	-1.2	V
$V_{OH}$	Output HIGH Voltage	$V_{CC} = \text{Min.}$	$I_{OH} = -15\text{mA}$	2.4	—	—	V
$V_{OL}$	Output LOW Voltage	$V_{CC} = \text{Min.}$	$I_{OL} = 12\text{mA}$	—	—	0.5	V
$R_{OUT}^{(3)}$	Output Resistance	$V_{CC} = \text{Min.}$	$I_{OH} = 12\text{mA}$	18	25	40	$\Omega$

### NOTES:

- Typical values are at  $V_{CC} = 5.0\text{V}$ ,  $T_A = 25^{\circ}\text{C}$ .
- This parameter is measured at characterization but not tested.
- $R_{OUT}$  changed on March 8, 2002. See rear page for more information.

## POWER SUPPLY CHARACTERISTICS

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 <sup>(1)</sup>	Min.	Max.	Unit
$I_{CC}$	Quiescent Power Supply Current	$V_{CC} = \text{Max.}$ freq = 0 $0\text{V} \leq V_{IN} \leq 0.2\text{V}$ or $V_{CC} - 0.2\text{V} \leq V_{IN} \leq V_{CC}$	—	1.5	mA
$\Delta I_{CC}$	Supply Current per Input TTL Inputs HIGH	$V_{CC} = \text{Max.}$ $V_{IN} = 3.4\text{V}^{(2)}$ freq = 0	—	2	mA
$I_{CCD}$	Supply Current per Input per MHz	$V_{CC} = \text{Max.}$ Outputs Open and Enabled One Bit Toggling 50% Duty Cycle Other inputs at GND or $V_{CC}^{(3,4)}$	—	0.25	mA/MHz

### NOTES:

- For conditions shown as Min. or Max., use the appropriate values specified under DC Electrical Characteristics.
- Per TTL driven input ( $V_{IN} = 3.4\text{V}$ ).
- For flip-flops,  $I_{CCD}$  is measured by switching one of the data input pins so that the output changes every clock cycle. This is a measurement of device power consumption only and does not include power to drive load capacitance or tester capacitance.
- $I_{CC} = I_{QUIESCENT} + I_{INPUTS} + I_{DYNAMIC}$   
 $I_{CC} = I_{CC} + \Delta I_{CC} D_H N_T + I_{CCD} (f_{CP}/2 + f_i N_i)$   
 $I_{CC}$  = Quiescent Current  
 $\Delta I_{CC}$  = Power Supply Current for a TTL High Input ( $V_{IN} = 3.4\text{V}$ )  
 $D_H$  = Duty Cycle for TTL Inputs High  
 $N_T$  = Number of TTL Inputs at  $D_H$   
 $I_{CCD}$  = Dynamic Current Caused by an Output Transition Pair (HLH or LHL)  
 $f_{CP}$  = Clock Frequency for Register Devices (Zero for Non-Register Devices)  
 $f_i$  = Input Frequency  
 $N_i$  = Number of Inputs at  $f_i$   
 All currents are in milliamps and all frequencies are in megahertz.

SWITCHING CHARACTERISTICS OVER OPERATING RANGE<sup>(1)</sup>

Symbol	Parameter	FCT2821AT		FCT2821BT		FCT2821CT		Unit
		Min.	Max.	Min.	Max.	Min.	Max.	
t <sub>PLH</sub> t <sub>PHL</sub>	Clock to Y Delay $\overline{OE} = \text{LOW}$	—	10	—	7.5	—	6	ns
t <sub>PLH</sub> t <sub>PHL</sub>	Clock to Y Delay $\overline{OE} = \text{LOW}^{(2)}$	—	20	—	15	—	12.5	ns
t <sub>S</sub>	Data to CP Setup Time	4	—	3	—	3	—	ns
t <sub>H</sub>	Data to CP Hold Time	2	—	1.5	—	1.5	—	ns

NOTES:

1. C<sub>LOAD</sub> = 50pF, R<sub>LOAD</sub> = 500Ω unless otherwise noted.
2. C<sub>LOAD</sub> = 300pF.

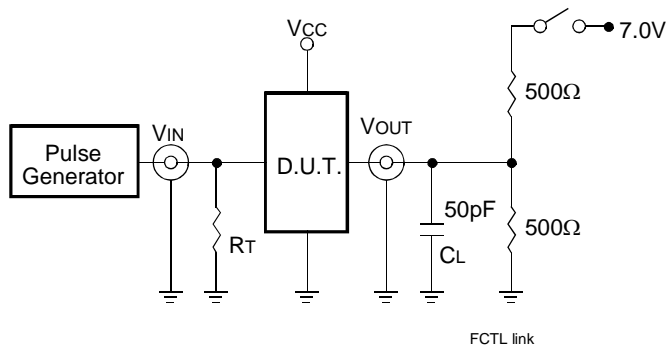
TIMING REQUIREMENTS OVER OPERATING RANGE<sup>(1)</sup>

Symbol	Parameter <sup>(2)</sup>	FCT2821AT		FCT2821BT		FCT2821CT		Unit
		Min.	Max.	Min.	Max.	Min.	Max.	
t <sub>PLH</sub> t <sub>PHL</sub>	Clock to Y Delay HIGH or LOW	7	—	6	—	6	—	ns
t <sub>PZH</sub> t <sub>PZL</sub>	Output Enable Time $\overline{OE}$ to Y <sub>x</sub>	—	12	—	8	—	7	ns
t <sub>PZH</sub> t <sub>PZL</sub>	Output Enable Time <sup>(3)</sup> $\overline{OE}$ to Y <sub>x</sub>	—	23	—	—	—	—	ns
t <sub>PHZ</sub> t <sub>PLZ</sub>	Output Disable Time <sup>(4)</sup> $\overline{OE}$ to Y <sub>x</sub>	—	7	—	6.5	—	6.2	ns
t <sub>PHZ</sub> t <sub>PLZ</sub>	Output Disable Time $\overline{OE}$ to Y <sub>x</sub>	—	9	—	7.5	—	6.5	ns

NOTES:

1. C<sub>LOAD</sub> = 50pF, R<sub>LOAD</sub> = 500Ω unless otherwise noted.
2. See Test Circuits and Waveforms
3. C<sub>LOAD</sub> = 300pF.
4. C<sub>LOAD</sub> = 5pF.

## TEST CIRCUITS AND WAVEFORMS



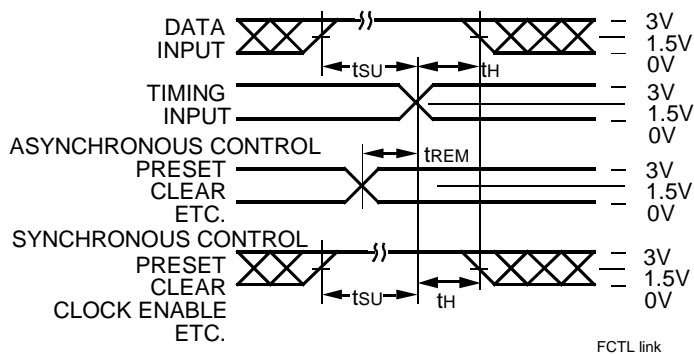
*Test Circuits for All Outputs*

## SWITCH POSITION

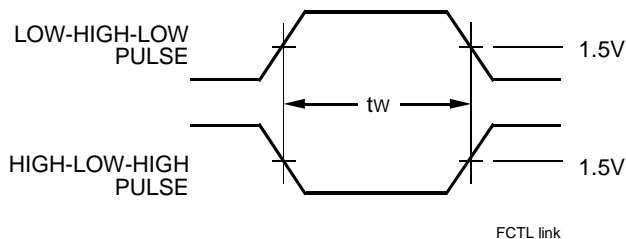
Test	Switch
Open Drain Disable Low Enable Low	Closed
All Other Tests	Open

### DEFINITIONS:

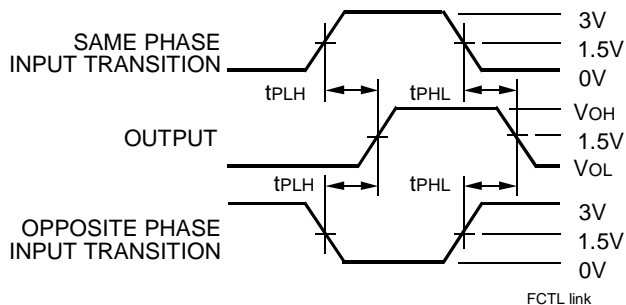
CL = Load capacitance: includes jig and probe capacitance.  
RT = Termination resistance: should be equal to Zout of the Pulse Generator.



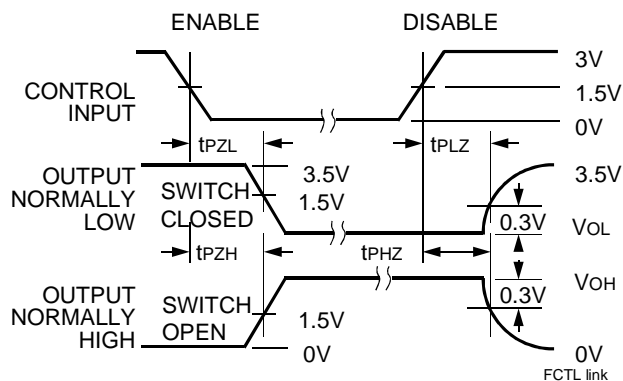
*Set-Up, Hold, and Release Times*



*Pulse Width*



*Propagation Delay*

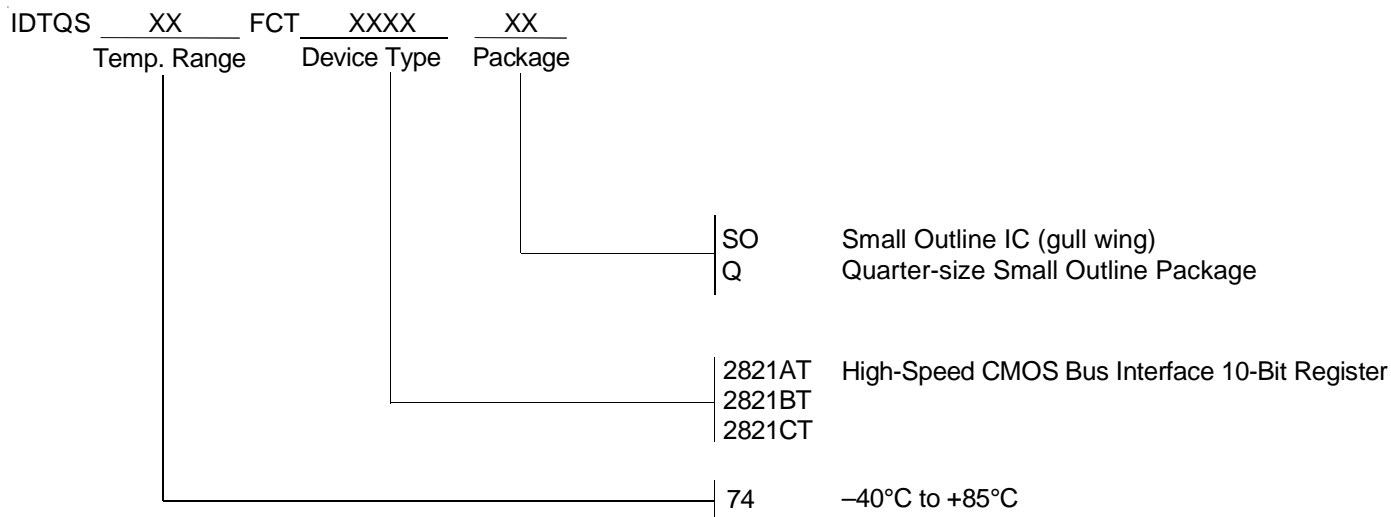


*Enable and Disable Times*

### NOTES:

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

## ORDERING INFORMATION



As per PCN L0201-02, the Output Resistance (R<sub>OUT</sub>) specifications have changed as of March 8, 2002. The original specifications were:

Parameter	Description	Min.	Typ.	Max.	Unit
R <sub>OUT</sub>	V <sub>CC</sub> = Min, I <sub>OL</sub> = -15mA	20	28	40	Ω



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