PI74FCT191T
(25Ω Series) PI74FCT2191T

High Speed CMOS Presettable Synchronous 4-Bit Binary Counters

Product Features

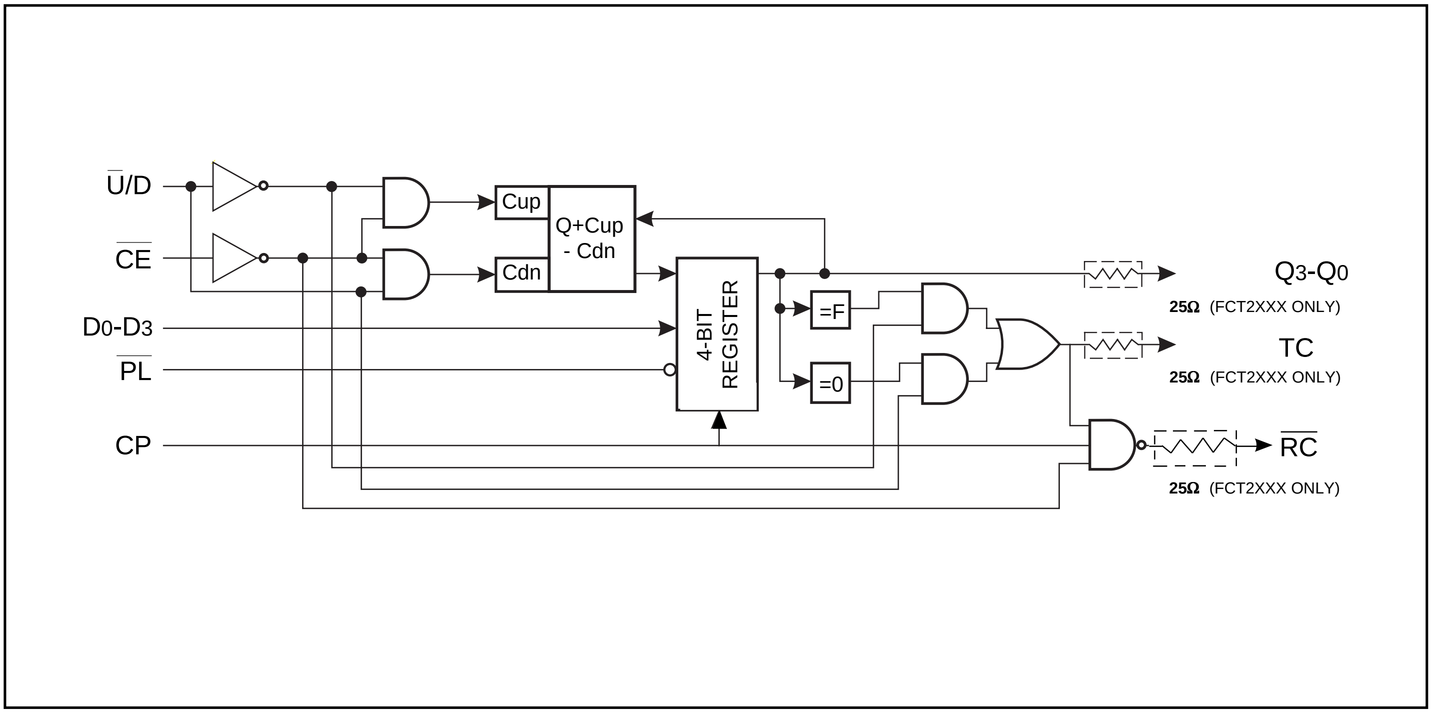
- PI74FCT191/2191T is pin compatible with bipolar FAST™ Series at a higher speed and lower power consumption
- 25Ω series resistor on all outputs (FCT2XXX only)
- TTL input and output levels
- Low ground bounce outputs (25Ω series only)
- Extremely low static power
- Hysteresis on all inputs
- Industrial operating temperature range: –40°C to +85°C
- Packages available:
  - – 16-pin 150 mil wide plastic QSOP (Q)
  - – 16-pin 300 mil wide plastic SOIC (S)

Product Description

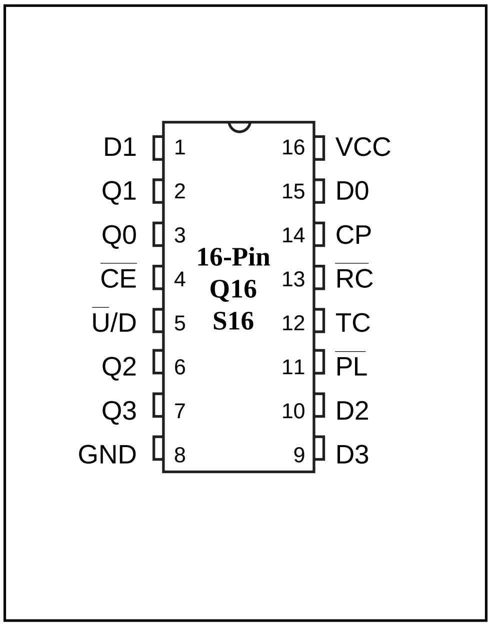
Pericom Semiconductor's PI74FCT series of logic circuits are produced in the Company's advanced 0.6 micron CMOS technology, achieving industry leading speed grades. All PI74FCT2XXX devices have a built-in 25 ohm series resistor on all outputs to reduce noise due to reflections, thus eliminating the need for an external terminating resistor.

The PI74FCT191T is a high speed CMOS 4-bit binary up/down counter. It has a single clock with clock enable and up/down control inputs and ripple carry output. The 191 has asynchronous preload inputs which override the count inputs. All inputs have clamp diodes for undershoot noise suppression. All outputs have ground bounce suppression.

Logic Block Diagram



Product Pin Configurations (All Pins Top View)



Product Pin Description

Pin Name	I/O	Description
D3-D0	I	Data Inputs
Q3-Q0	O	Data Outputs
$\overline{PL}$	I	Preload
$\overline{U}$/D	I	Up/Down Select
$\overline{CE}$	I	Count Enable
CP	I	Count Clock
TC	O	Terminal Count
$\overline{RC}$	O	Ripple Clock

Truth Table(1)

Inputs				Outputs				
PL	**$\overline{U}$/D**	**CP**	**$\overline{CE}$**	**DI**	**Q3-Q0**	**TC**	**$\overline{RC}$**	**Function**
L	X	X	X	D3-D0	D3-D0	X	X	Load Data
H	L	↑	L	X	Q+1	L	H	Count Up
H	H	↑	L	X	Q-1	L	H	Count Down
H	X	X	H	X	Q	X	X	Count Inhibit
H	L	H	L	X	F	H	H	Count Up = 1111
H	L	⊔	L	X	F	H	⊔	Count Up = 1111
H	L	X	X	X	0-E	L	H	Count Up ≠ 1111
H	H	H	L	X	0	H	H	Count Down = 0000
H	H	⊔	L	X	0	H	⊔	Count Down = 0000
H	H	X	X	X	1-F	L	H	Count Down ≠ 0000

Notes:

1. H = High Voltage Level
   L = Low Voltage Level
   X = Don't Care
   Z = High Impedance

Maximum Ratings

(Above which the useful life may be impaired. For user guidelines, not tested.)

Storage Temperature	–65°C to +150°C
Ambient Temperature with Power Applied	-40°C to +85°C
Supply Voltage to Ground Potential (Inputs & Vcc Only)	–0.5V to +7.0V
Supply Voltage to Ground Potential (Outputs & D/O Only)	–0.5V to +7.0V
DC Input Voltage	–0.5V to +7.0V
DC Output Current	120 mA
Power Dissipation	0.5W

Note:
Stresses greater than those listed under 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.

DC Electrical Characteristics (Over the Operating Range, T_A = –40°C to +85°C, V_{CC} = 5.0V ± 5%)

Parameters	Description	Test Conditions(1)		Min.	Typ(2)	Max.	Units
V_{OH}	Output HIGH Voltage	V_{CC} = Min., V_{IN} = V_{IH} or V_{IL}	I_{OH} = –15.0 mA	2.4	3.0		V
V_{OL}	Output LOW Current	V_{CC} = Min., V_{IN} = V_{IH} or V_{IL}	I_{OL} = 48 mA		0.3	0.50	V
V_{OL}	Output LOW Current	V_{CC} = Min., V_{IN} = V_{IH} or V_{IL}	I_{OL} = 12 mA (25Ω Series)		0.3	0.50	V
V_{IH}	Input HIGH Voltage	Guaranteed Logic HIGH Level		2.0			V
V_{IL}	Input LOW Voltage	Guaranteed Logic LOW Level				0.8	V
I_{IH}	Input HIGH Current	V_{CC} = Max.	V_{IN} = V_{CC}			1	µA
I_{IL}	Input LOW Current	V_{CC} = Max.	V_{IN} = GND			–1	µA
V_{IK}	Clamp Diode Voltage	V_{CC} = Min., I_{IN} = –18 mA			–0.7	–1.2	V
I_{OFF}	Power Down Disable	V_{CC} = GND, V_{OUT} = 4.5V		—	—	100	µA
I_{OS}	Short Circuit Current	V_{CC} = Max.(3), V_{OUT} = GND		–60	–120		mA
V_H	Input Hysteresis				200		mV

Capacitance (T_A = 25°C, f = 1 MHz)

Parameters(4)	Description	Test Conditions	Typ	Max.	Units
C_{IN}	Input Capacitance	V_{IN} = 0V	6	10	pF
C_{OUT}	Output Capacitance	V_{OUT} = 0V	8	12	pF

Notes:

1. For Max. or Min. conditions, use appropriate value specified under Electrical Characteristics for the applicable device type.
2. Typical values are at V_{CC} = 5.0V, +25°C ambient and maximum loading.
3. Not more than one output should be shorted at one time. Duration of the test should not exceed one second.
4. This parameter is determined by device characterization but is not production tested.

Power Supply Characteristics

Parameters	Description	Test Conditions[1] Min.		Typ[2]	Max.	Units	
I_{CC}	Quiescent Power Supply Current	V_{CC} = Max. Freq = 0	$V_{IN} \geq V_{HC}$; $V_{IN} \geq V_{LC}$		0.1	500	µA
ΔI_{CC}	Supply Current per Input @ TTL HIGH	V_{CC} = Max. Freq = 0	V_{IN} = 3.4V[3]		0.5	2.0	mA
I_{CCD}	Supply Current per Input per MHz[4]	V_{CC} = Max., Outputs Open and Enabled One Bit Toggling 50% Duty Cycle, other input at GND or V_{CC}	$V_{IN} = V_{CC}$ V_{IN} = GND		0.15	0.25	mA/ MHz
Ic	Total Power Supply Current[6]	Vcc=Max., Outputs Open Preset Mode $\overline{PL}=\overline{CE}=\overline{U}/D=CP=GND$ One Bit Toggling at fi = 5MHz 50% Duty Cycle	V_{IN} = Vcc V_{IN} = GND	—	0.8	2.3	mA
			V_{IN} = 3.4V V_{IN} = GND	—	1.0	3.3	
		Vcc=Max., Outputs Open Preset Mode $\overline{PL}=\overline{CE}=\overline{U}/D=CP=GND$ Four Bits Toggling at fi = 5MHz 50% Duty Cycle	V_{IN} = Vcc V_{IN} = GND	—	3.0	6.0[5]	
			V_{IN} = 3.4V V_{IN} = GND	—	4.0	10.0[5]	

Notes:

1. For Max. or Min. conditions, use appropriate value specified under Electrical Characteristics for the applicable device.
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 Icc formula. These limits are guaranteed but not tested.
6. $I_C = I_{QUIESCENT} + I_{INPUTS} + I_{DYNAMIC}$
   $I_C = I_{CC} + \Delta I_{CC} D_H N_T + I_{CCD} (f_{CP}/2 + f_I N_I)$
   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_{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)

Symbol	Description[1]	Conditions	191T 2191T		191AT 2191AT		191CT		Unit
			Min.	Ma.x	Min.	Max.	Min.	Max.	
tCPQ	Propagation Delay CP TO Qi	CL = 50 pF RL = 500Ω	2.5	12	2.5	7.8	2.0	6.9	ns
tCPTC	Propagation Delay CP to TC		3.0	14	3.0	11.8	2.5	10.2	
tCPRC	Propagation Delay CP to $\overline{\text{RC}}$		2.5	8.5	2.5	8.5	2.0	8.0	
tCERC	Propagation Delay $\overline{\text{CE}}$ to $\overline{\text{RC}}$		2.0	8.0	2.0	7.2	1.5	6.8	
tUDRC	Propagation Delay $\overline{\text{U}}$/D to $\overline{\text{RC}}$		4.0	15	2.0	9.8	2.0	9.0	
tUDTC	Propagation Delay $\overline{\text{U}}$/D to TC		3.0	11	3.0	7.2	2.0	6.8	
tDQ	Propagation Delay Di to Qi		2.0	14	2.0	9.1	2.0	8.5	
tPLQ	Propagation Delay $\overline{\text{PL}}$ to Qi		3.0	13	3.0	8.5	2.0	7.8	

Notes:

1. See Test Circuit and Waveforms.
2. Minimum limits are guaranteed but not tested on Propgation Delays.
3. This parameter guaranteed but not production tested.

Timing Characteristics (Over Operating Range)

Symbol	Description	Conditions	191T 2191T		191AT 2191AT		191CT 2191CT		Unit
			Min.	Max.	Min.	Max.	Min.	Max.	
t_{DPLS}	Di to PL Setup	C_L = 50 pF R_L = 500Ω	5.0		4.0		4.0		ns
t_{DPLH}	Di to $\overline{\text{PL}}$ Hold		1.5		1.5		1.5		
t_{CS}	$\overline{\text{CE}}$ to CP Setup		10		9.0		9.0		
t_{CH}	$\overline{\text{CE}}$ to CP Hold		0		0		0		
t_{UDCPS}	$\overline{\text{U}}$/D to CP Setup		12		10		10		
t_{UDCPH}	$\overline{\text{U}}$/D to CP Hold		0		0		0		
t_{CPW}	Clock Pulse(1) Width HIGH or LOW		5.0		4.0		4.0		
t_{PL}	$\overline{\text{PL}}$ LOW		6.0		5.5		5.5		
t_{PLCPR}	$\overline{\text{PL}}$ to CP Recovery		6.0		5.0		5.0		

Notes:

1.See Test Circuit and Waveforms.
2. Minimum limits are guaranteed but not tested on Propagation Delays.
3. This parameter guaranteed but not production tested.