

F95010 • F95016

BCD DECADE COUNTER/4-BIT BINARY COUNTER

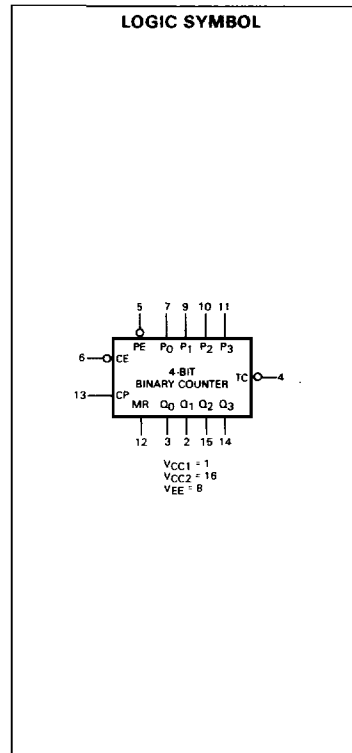
GENERAL DESCRIPTION — The F95010 is a high speed synchronous, presettable, cascadable BCD Decade Counter and the F95016 is a high speed synchronous, presettable, cascadable 4-Bit Binary Counter. They are multifunction MSI building blocks useful for a large number of counting, digital integration, and conversion applications. Up to nine devices can be cascaded with no speed degradation using standard 95K gates. A multidecade synchronous counter up to 150 MHz can be built. Typical count frequency is 200 MHz.

Features include assertion inputs and outputs on each of the four master/slave counting flip-flops. Terminal count is generated internally in a manner that allows synchronous loading at nearly the speed of the basic counter.

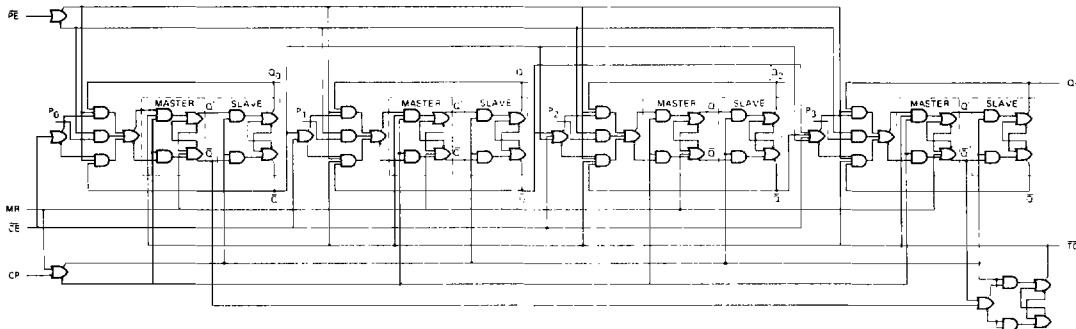
- HIGH SPEED COUNT . . . 200 MHz TYPICAL COUNT FREQUENCY
- INTERNAL COUNT ENABLE — FOR HIGHEST SPEED EXPANSION
- ASYNCHRONOUS MASTER RESET
- 50Ω DRIVE CAPABILITY
- WIRED-OR CAPABILITY
- SEPARATE V_{CC} PINS — ELIMINATE NOISE COUPLING
- INTERNAL 50 kΩ INPUT PULL DOWNS
- SINGLE -5.2 V POWER SUPPLY

PIN NAMES

\overline{PE}	Parallel Load Enable (Active LOW)
P_n	Parallel Inputs
CP	Clock Input (Clocks on Positive Transition)
\overline{CE}	Count Enable (LOW to Count)
MR	Master Reset (HIGH Forces all Q Outputs LOW)
TC	Terminal Count (95010, LOW at HLLH; 95016 LOW at HHHH)
Q_n	Counter Outputs

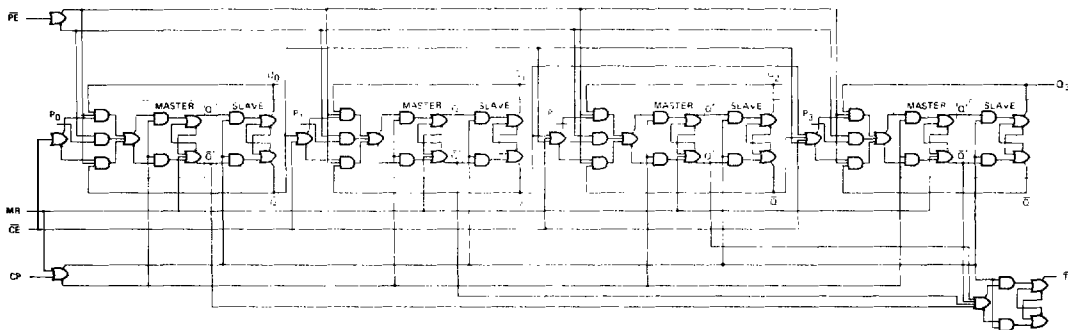


LOGIC DIAGRAM F95010



Note that this diagram is provided for understanding of logic operation only. It should not be used for evaluation of propagation delays as many gate functions are achieved internally without incurring a full gate delay.

LOGIC DIAGRAM F95016



Note that this diagram is provided for understanding of logic operation only. It should not be used for evaluation of propagation delays as many gate functions are achieved internally without incurring a full gate delay.

FUNCTIONAL DESCRIPTION — The F95010 is a high speed BCD Decade Counter and the F95016 is a high speed Binary Counter. The four master/slave flip-flops are fully synchronous and are driven in parallel through a clock driver. The masters are loaded during the LOW period of the clock pulse. During the LOW to HIGH transition of the clock, the master is disabled from the input and data is transferred to the slaves and then to the outputs. When the clock is HIGH, the masters are inhibited from changing and the master/slave data path remains open. During the HIGH to LOW transition of the clock, the master/slave data path is inhibited, followed by the enabling of the masters for the acceptance of inputs from the counting logic, parallel entry, or count hold logic.

The Terminal Count (\overline{TC}) is generated at count 9 (HLLH) on the 95010 and at count 15 (HHHH) on the 95016.

The \overline{TC} output is available simultaneously with the Q outputs through the use of unique lookahead logic and a fifth slave which is loaded during the LOW portion of the clock cycle. This feature, in conjunction with the triggered Count Enable (\overline{CE}) and the Parallel Enable (\overline{PE}) select the mode of operation as shown in the table below. The status of these control lines is sampled only during the LOW to HIGH transition of the clock.

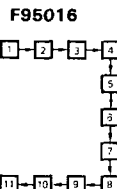
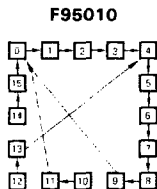
The Master Reset (MR) function is asynchronous. When HIGH, it overrides all other commands and forces all Q outputs LOW and the \overline{TC} HIGH.

TRUTH TABLE

\overline{CE}	\overline{PE}	MR	CP	Function
L	L	L	\downarrow	Load Parallel (P_n to Q_n)
H	L	L	\downarrow	Load Parallel (P_n to Q_n)
L	H	L	\downarrow	Count
H	H	L	\downarrow	Hold
X	X	L	\downarrow	Masters Respond, Slaves Hold
X	X	H	X	Reset ($Q_n = \text{LOW}$, $\overline{TC} = \text{HIGH}$)

L = LOW
H = HIGH Voltage Level
X = Don't Care
 \downarrow = Clock Pulse (LOW to HIGH)
 \uparrow = Clock Pulse (HIGH to LOW)

STATE DIAGRAMS



NOTE: The 95010 can be preset to any state, but will not count beyond 9 (HLLH). If preset to state 10, 11, 12, 13, 14 or 15, it will return to its normal sequence within two clock pulses.

FAIRCHILD ECL DATA SHEET • F95010 • F95016

DC ELECTRICAL CHARACTERISTICS OVER OPERATING TEMPERATURE RANGE: $V_{EE} = -5.2\text{ V}$, $T_A = 0^\circ\text{C}$ to 75°C

SYMBOL	CHARACTERISTIC	LIMITS			UNITS	CONDITIONS
		B	TYP	A		
V_{OH}	Output Voltage HIGH	-1025	-965	880	mV	50 Ω to -2.0 V
V_{OL}	Output Voltage LOW	-1810	-1705	-1620	mV	50 Ω to -2.0 V
V_{OHC}	Output Voltage HIGH	-1035			mV	50 Ω to -2.0 V
V_{OLC}	Output Voltage LOW			-1610	mV	50 Ω to -2.0 V
V_{IH}	Input Voltage HIGH	-1165		-880	mV	Guaranteed Input HIGH for All Inputs
V_{IL}	Input Voltage LOW	-1810		-1475	mV	Guaranteed Input LOW for All Inputs
I_{IH}	Input Current HIGH, MR (Pin 12)			265 700	μA μA	$V_{IN} = V_{IHA}$
I_{IL}	Input Current LOW	0.5			μA	$V_{IN} = V_{ILB}$
I_{EE}	Power Supply Current	-115	-80		mA	MR to V_{IH} , Other Inputs and Outputs Open

SWITCHING CHARACTERISTICS: $V_{EE} = -5.2\text{ V}$, $T_A = 25^\circ\text{C}$, $V_{CC} = \text{GND}$

SYMBOL	CHARACTERISTIC	LIMITS			UNITS	CONDITIONS
		B	TYP	A		
f_{count}	Count Frequency	140	200		MHz	See Figure 1
t_{PLH}	Propagation Delay Clock to Output (Q_n or \overline{TC})	2.0	3.6	5.0	ns	See Figure 2
t_{PHL}	Propagation Delay Clock to Output (Q_n or \overline{TC})	2.0	3.6	5.0	ns	
t_{PHL}	Propagation Delay Master Reset to Output		4.0		ns	See Figure 3
T_{TLH}	Output Transition Time LOW to HIGH (20% to 80%)	1.3	2.5	3.3	ns	See Figure 2
t_{THL}	Output Transition Time HIGH to LOW (80% to 20%)	1.3	2.5	3.3	ns	
t_w	Clock Pulse Width		2.3		ns	See Figure 2
t_w	MR Pulse Width		2.8		ns	See Figure 3
t_s	Set-Up Time Prior to Clock P_n to CP	2.0			ns	
t_s	Set-Up Time Prior to Clock \overline{PE} or \overline{CE} to CP	2.5			ns	
t_h	Hold Time After Clock \overline{PE} or \overline{CE} to CP	0.5			ns	



SWITCHING CIRCUITS AND WAVEFORMS

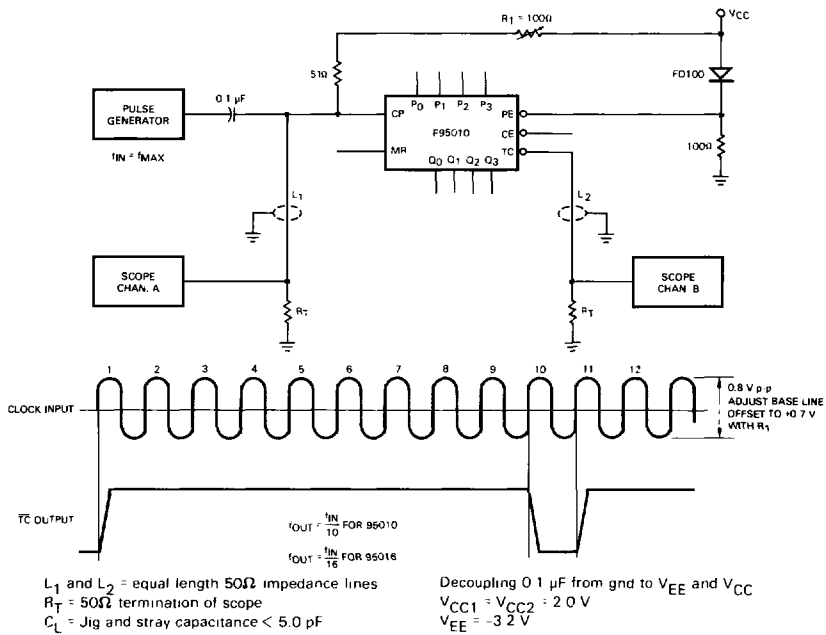


Fig. 1. Maximum Count Frequency

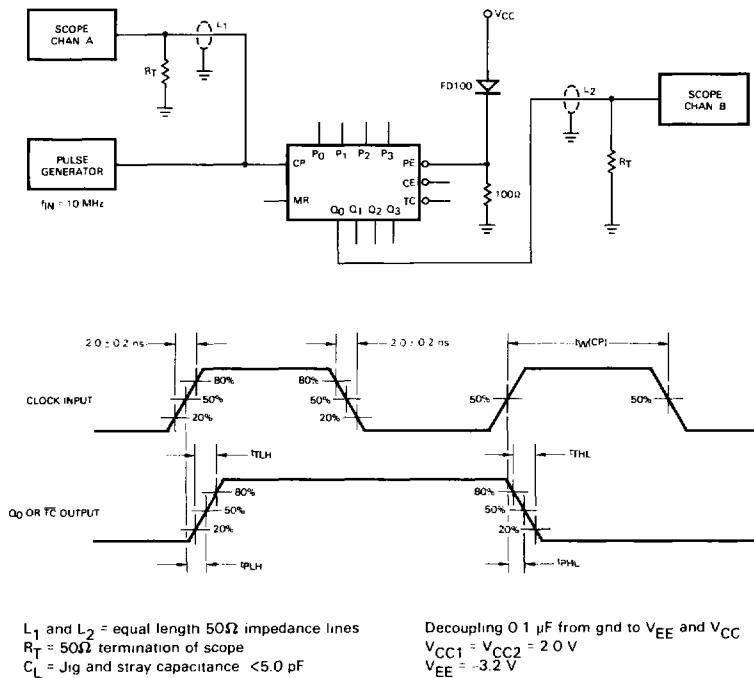


Fig. 2. Clock to Output

SWITCHING CIRCUITS AND WAVEFORMS (Cont'd.)

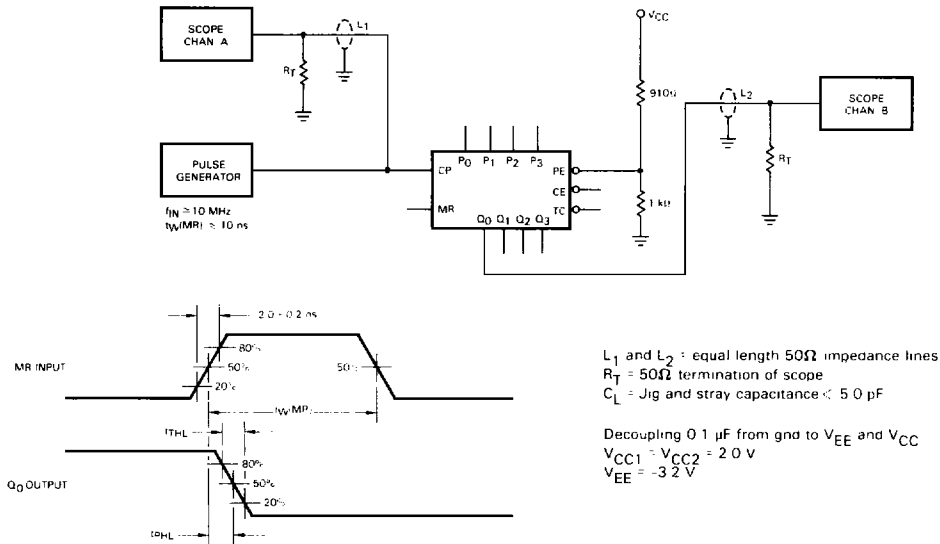
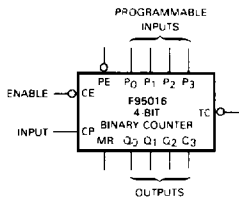


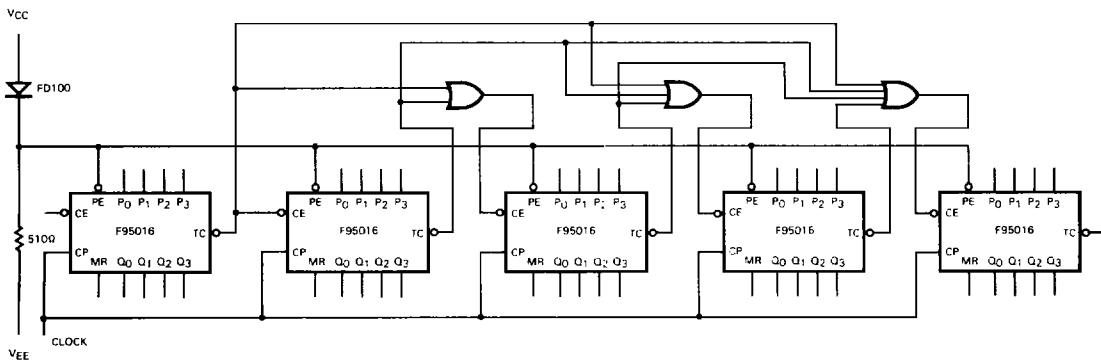
Fig. 3. Master Reset to Output

APPLICATION INFORMATION



DIVIDE RATIO	P ₀	P ₁	P ₂	P ₃
2	L	H	H	H
3	H	L	H	H
4	L	L	H	H
5	H	H	L	H
6	L	H	L	H
7	H	L	L	H
8	L	L	L	H
9	H	H	H	L
10	L	H	H	L
11	H	L	H	L
12	L	L	H	L
13	H	H	L	L
14	L	H	L	L
15	H	L	L	L
16	L	L	L	L

The F95016 may be connected to divide by any modulo from 2 to 16. The table illustrates the inputs required for each modulo. The terminal count output is utilized to load the parallel data, this in turn determines the number of clock pulses which will occur before $\overline{\text{TC}}$ goes LOW again.



CASCADE COUNTERS USING OR GATES FOR CARRY PROPAGATION