Am93S10 • Am93S16

BCD Decade/Four-Bit Binary Counters

Distinctive Characteristics

- Fully synchronous counting
- Fully synchronous parallel loading
- Edge-triggered clock action
- Advanced Schottky technology
- 100% reliability assurance testing in compliance with MIL-STD-883.

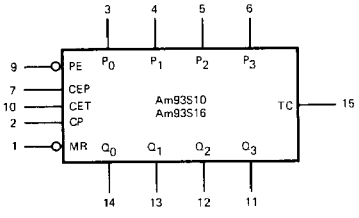
FUNCTIONAL DESCRIPTION

The Am93S10 and Am93S16 are fully synchronous 4-bit decimal and binary counters. With the parallel enable ($\overline{PE}$) LOW, data on the P_0-P_3 inputs is parallel loaded on the positive clock transition. When $\overline{PE}$ is HIGH and both count enables CEP and CET are also HIGH, counting will occur on the LOW-to-HIGH clock transition.

The terminal count state (1001 for the Am93S10 and 1111 for the Am93S16) is decoded and ANDed with CET in the terminal count (TC) output. If CET is HIGH and the counter is in its terminal count state, then TC is HIGH.

Both counters have an asynchronous master reset ($\overline{MR}$). A LOW on the $\overline{MR}$ input forces the Q outputs LOW independent of all other inputs. The only requirements on the $\overline{PE}$, CEP, CET and P_0-P_3 inputs is that they meet the set-up time requirements before the clock LOW-to-HIGH transition.

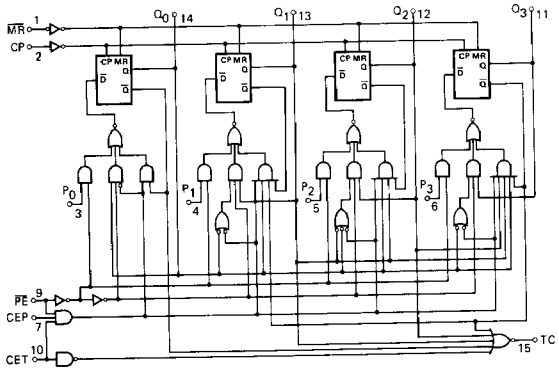
LOGIC SYMBOL



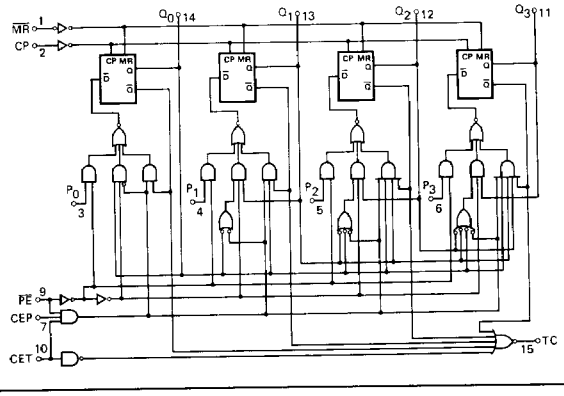
V_{CC} = Pin 16
GND = Pin 8

LOGIC DIAGRAMS

Am93S10



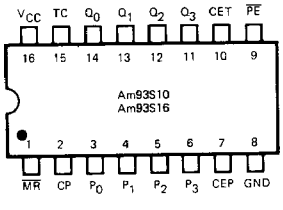
Am93S16



ORDERING INFORMATION

Package Type	Temperature Range	Am93S10 Order Number	Am93S16 Order Number
Molded DIP	0°C to +75°C	93S10PC	93S16PC
Hermetic DIP	0°C to +75°C	93S10DC	93S16DC
Dice	0°C to +75°C	93S10XC	93S16XC
Hermetic DIP	−55°C to +125°C	93S10DM	93S16DM
Hermetic Flat Pak	−55°C to +125°C	93S10FM	93S16FM
Dice	−55°C to +125°C	93S10XM	93S16XM

CONNECTION DIAGRAM
Top View



Note: Pin 1 is marked for orientation.

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MAXIMUM RATINGS (Above which the useful life may be impaired)

Storage Temperature	−65°C to +150°
Temperature (Ambient) Under Bias	−55°C to +125°
Supply Voltage to Ground Potential (Pin 16 to Pin 8) Continuous	−0.5V to +7
DC Voltage Applied to Outputs for HIGH Output State	−0.5V to +V_{CC} ma
DC Input Voltage	−0.5V to +5.5
DC Output Current, Into Outputs	30m
DC Input Current	−30mA to +5.0m

ELECTRICAL CHARACTERISTICS OVER OPERATING TEMPERATURE RANGE (Unless Otherwise Noted)

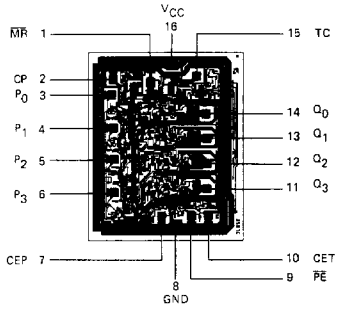
Am93S10XC, Am93S16XC	T_A = 0°C to 75°C	V_{CC} = 5.0V ±5% (COM'L)	MIN. = 4.75V	MAX. = 5.25V
Am93S10XM, Am93S16XM	T_A = −55°C to +125°C	V_{CC} = 5.0V ±10% (MIL)	MIN. = 4.5V	MAX. = 5.5V

Parameters	Description	Test Conditions (Note 1)		Min.	Typ. (Note 2)	Max.	Units
V_{OH}	Output HIGH Voltage	V_{CC} = MIN., I_{OH} = −1mA V_{IN} = V_{IH} or V_{IL}	XM	2.5	3.4		Volts
			XC	2.7	3.4		
V_{OL}	Output LOW Voltage	V_{CC} = MIN., I_{OL} = 20mA V_{IN} = V_{IH} or V_{IL}			0.35	0.5	Volts
V_{IH}	Input HIGH Level	Guaranteed input logical HIGH voltage for all inputs		2.0			Volts
V_{IL}	Input LOW Level	Guaranteed input logical LOW voltage for all inputs				0.8	Volts
V_I	Input Clamp Voltage	V_{CC} = MIN., I_{IN} = −18mA				−1.2	Volts
I_{IL} (Note 3)	Input LOW Current	V_{CC} = MAX., V_{IN} = 0.5V	P; MR; CEP			−2.0	mA
			CET			−3.0	
			$\overline{PE}$			−4.0	
			CP			−5.0	
I_{IH} (Note 3)	Input HIGH Current	V_{CC} = MAX., V_{IN} = 2.7V	P; $\overline{MR}$; CEP			50	µA
			CET			75	
			$\overline{PE}$			100	
			CP			125	
I_I	Input HIGH Current	V_{CC} = MAX., V_{IN} = 5.5V				1.0	mA
I_{SC}	Output Short Circuit Current (Note 4)	V_{CC} = MAX.		−40	−65	−100	mA
I_{CC}	Power Supply Current	V_{CC} = MAX. (Note 5)			82	127	mA

Notes:
1. For conditions shown as MIN. or MAX., use the appropriate value specified under Electrical Characteristics for the applicable device type.
2. Typical limits are at V_{CC} = 5.0V, 25°C ambient and maximum loading.
3. Actual input currents = Unit Load Current x Input Load Factor (See Loading Rules).
4. Not more than one output should be shorted at a time. Duration of the short circuit test should not exceed one second.
5. Outputs open; $\overline{MR}$ = 0V; all other inputs HIGH.

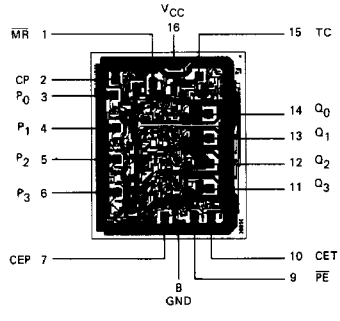
Metallization and Pad Layouts

Am93S10



DIE SIZE 0.078" X 0.096"

Am93S16



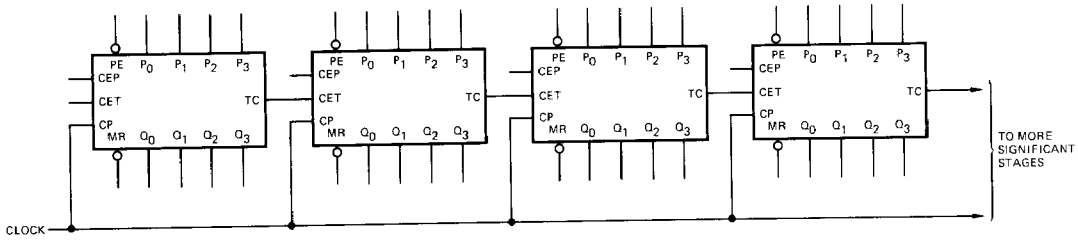
DIE SIZE 0.078" X 0.096"

SWITCHING CHARACTERISTICS (T_A = +25°)

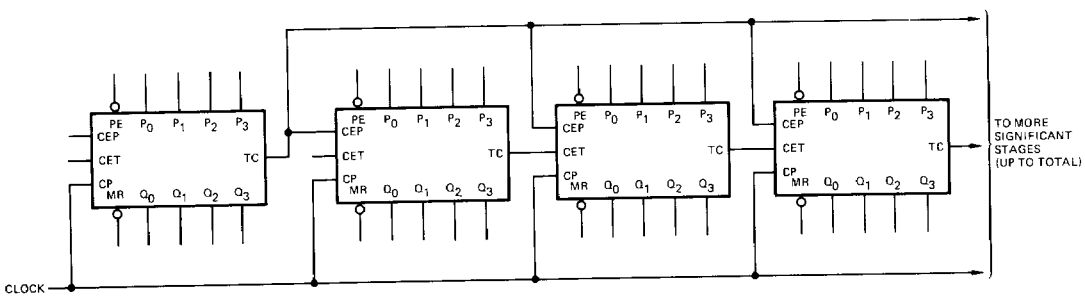
Parameters	Description	Test Conditions	Min.	Typ.	Max.	Units
f_{MAX}	Count Frequency	V_{CC} = 5.0V, C_L = 15 pF, R_L = 280Ω	70	100		MHz
t_{PLH}	Clock to Q			6	9	ns
t_{PHL}				8.5	13	
t_{PLH}	Clock to TC			12	18	ns
t_{PHL}				8	12	
t_{PLH}	CET to TC			6.5	10	ns
t_{PHL}				6.5	10	
t_{PHL}	$\overline{MR}$ to Q			14	20	ns
t_s	Recovery Time for MR (inactive)		6			ns
t_{pw}	Master Reset Pulse Width		13			ns
t_{pw}	Clock Pulse Width HIGH		6			ns
	Clock Pulse Width LOW		10			
t_s	Data to Clock		8			ns
t_h			0			
t_s	$\overline{PE}$ to Clock		16			ns
t_h			0			
t_s	CEP or CET to Clock		12			ns
t_h			0			

APPLICATIONS

SYNCHRONOUS MULTISTAGE COUNTING USING CET INPUT ONLY



FASTER SYNCHRONOUS MULTISTAGE COUNTING USING CET AND CEP INPUTS



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DEFINITION OF FUNCTIONAL TERMS

$\overline{PE}$ Parallel Enable. When $\overline{PE}$ is LOW, the parallel inputs, P_0 through P_3, are enabled. When $\overline{PE}$ is HIGH, the count function is possible.

CEP Count Enable Parallel. CEP is one of the count enable inputs that must be HIGH for the counter to count.

CET Count Enable Trickle. CET is one of the count enable inputs that must be HIGH for the counter to count. In addition, CET is included in the TC output gate and must be HIGH for TC to be HIGH.

CP Clock Pulse. Causes the required output change on the LOW-to-HIGH transition (Edge-triggered).

$\overline{MR}$ Master Reset. When the asynchronous master reset is LOW, the Q_0 through Q_3 outputs will be LOW regardless of the other inputs.

P_0, P_1, P_2, P_3 The parallel data inputs for the four internal flip-flops.

Q_0, Q_1, Q_2, Q_3 The four parallel outputs from the counter.

TC Terminal Count. The terminal count output will be HIGH for CET HIGH and binary nine on the Am93S10 or CET HIGH and binary 15 on the Am93S16.

LOADING RULES (In Unit Loads)

Input/Output	Pin No.'s	Input Unit Load	Fan-out Output HIGH	Fan-out Output LOW
$\overline{MR}$	1	1	–	–
CP	2	2.5	–	–
P_0	3	1	–	–
P_1	4	1	–	–
P_2	5	1	–	–
P_3	6	1	–	–
CEP	7	1	–	–
GND	8	–	–	–
$\overline{PE}$	9	2	–	–
CET	10	1.5	–	–
Q_3	11	–	20	10
Q_2	12	–	20	10
Q_1	13	–	20	10
Q_0	14	–	20	10
TC	15	–	20	10
V_{CC}	16	–	–	–

A Schottky TTL Unit Load is defined as 50μA measured at 2.7V HIGH and −2.0mA measured at 0.5V LOW.

FUNCTION TABLE

INPUTS									OUTPUTS			
CP	$\overline{MR}$	$\overline{PE}$	CEP	CET	P_0	P_1	P_2	P_3	Q_0	Q_1	Q_2	Q_3
X	L	X	X	X	X	X	X	X	L	L	L	L
↑	H	L	X	X	D_0	D_1	D_2	D_3	D_0	D_1	D_2	D_3
↑	H	H	L	L	X	X	X	X	NC	NC	NC	NC
↑	H	H	L	H	X	X	X	X	NC	NC	NC	NC
↑	H	H	H	L	X	X	X	X	NC	NC	NC	NC
↑	H	H	H	H	X	X	X	X	COUNT			

H = HIGH
L = LOW
X = Don't Care

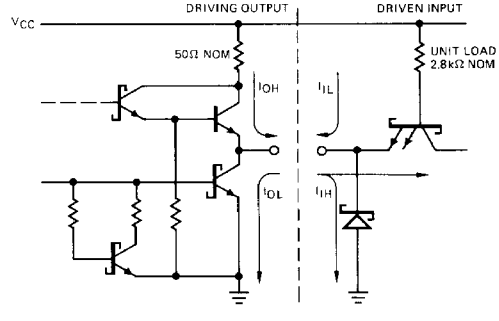
NC = No Change
D_i may be either HIGH or LOW
↑ LOW-to-HIGH Transition

TERMINAL COUNT (TC) TRUTH TABLE

Am93S10					Am93S16					TC
CET	Q_0	Q_1	Q_2	Q_3	CET	Q_0	Q_1	Q_2	Q_3	
H	H	L	L	H	H	H	H	H	H	H
L	X	X	X	X	L	X	X	X	X	L
X	L	X	X	X	X	L	X	X	X	L
X	X	H	X	X	X	X	L	X	X	L
X	X	X	H	X	X	X	X	L	X	L
X	X	X	X	L	X	X	X	X	L	L

H = HIGH
L = LOW
X = Don't Care

SCHOTTKY INPUT/OUTPUT CURRENT INTERFACE CONDITIONS



Note: Actual current flow direction shown.