

M54/74HC40102 M54/74HC40103

8 STAGE PRESETTABLE SYNCHRONOUS DOWN COUNTERS

- HIGH SPEED
 f_{MAX} = 40 MHz (TYP.) at V_{CC} = 5 V
- LOW POWER DISSIPATION $I_{CC} = 4 \ \mu A (MAX.)$ at $T_A = 25 \ ^{\circ}C$
- HIGH NOISE IMMUNITY VNIH = VNIL = 28 % Vcc (MIN.)
- OUTPUT DRIVE CAPABILITY 10 LSTTL LOADS
- SYMMETRICAL OUTPUT IMPEDANCE |I_{OH}| = I_{OL} = 4 mA (MIN.)
- BALANCED PROPAGATION DELAYS tPLH = tPHL
- WIDE OPERATING VOLTAGE RANGE
 V_{CC} (OPR) = 2 V to 6 V
- PIN AND FUNCTION COMPATIBLE WITH 40102B/40103B

DESCRIPTION

The M54/74HC40102/40103 are high speed CMOS 8-STAGE PRESETTABLE SYNCHRONOUS DOWN COUNTERS fabricated with silicon gate C²MOS technology. They achieve the high speed operation similar to equivalent LSTTL while maintaining the CMOS low power dissipation.

The HC40102, and HC40103 consist of an 8-stage synchronous down counter with a single output which is active when the internal count is zero. The HC40102 is configured as two cascaded 4-bit BCD counters, and the HC40103 contains a single 8-bit binary counter. Each type has control inputs for enabling or disabling the clock, for clearing the counter to its maximum count, and for presetting the counter either synchronously or asynchronously. All control inputs and the CARRY-OUT/ZERO-DETECT output are active-low logic. In normal operation, the counter is decremented by one count on each positive transition of the CLOCK. Counting is inhibited when the CARRY-IN/COUNTER ENABLE (CI/CE) input is high. The CARRY-OUT/ZERO-DETECT $(\overline{CO/ZD})$ output goes low when the count reaches zero if the $\overline{CI/CE}$ input is low, and remains low for one full clock period. When the SYNCHRONOUS PRESET-ENABLE (SPE) input is low, data at the J input is clocked into the counter on the next positive clock transition regardless of the state of the CI/CE input.





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DESCRIPTION (Continued)

When the ASYNCHRONOUS PRESET-ENABLE (APE) input is low, data at the J inputs is asynchronously forced into the counter regardless of the state of the SPE, CI/CE, or CLOCK inputs. J Inputs J0-J7 represent two 4-bit BCD words for the HC40102 and a single 8-bit binary word for the HC40103. When the CLEAR (CLR input is low, the counter is asynchronously cleared to its maximum count (99₁₀ for the HC40102 and 255₁₀ for the HC40103 regardless of the state of any other input. The precedence relationship between control input is indicated in the truth table. If all control inputs are high at the time of zero count, the counters will jump to the maximum count, giving a counting sequence of 100 pr 256 clock pulses long. The HC40102 and HC40103 may be cascaded using the CI/CE input and the CO/ZD output, in either a synchronous or ripple mode. All inputs are equipped with protection circuits against static discharge and transient excess voltage.

TRUTH TABLE

CONTROL INPUTS			5	MODE				
CLEAR	APE	SPE	CI/CE	MODE	FUNCTIONAL DESCRIPTION			
Н	Н	Н	Н	COUNT INHIBIT	EVEN IF CLOCK IS GIVEN, NO COUNT IS MADE			
Н	H	H	L	REGULAR COUNT	DOWN COUNT AT RISING EDGE OF CLOCK			
Н	Н	L	Х	SYNCHRONOUS PRESET	DATA OF PI TERMINAL IS PRESET AT RISING EDGE OF CLOCK			
Н	L	х	Х	ASYNCRONOUS PRESET	DATA PF PI TERMINAL IS ASYNCHRONOUSLY PRESET TO CLOCK			
L	Х	Х	Х	CLEAR	COUNTER IS SET TO MAXIMUM COUNT			

X: DON'T CARE - MAXIMUM COUNT: "99" FOR HC40102 AND "255": FOR HC40103

LOGIC DIAGRAM (HC40102)





LOGIC DIAGRAM (HC40103)



TIMING CHART





PIN DESCRIPTION

PIN No	SYMBOL	NAME AND FUNCTION
1	CLOCK	CLock Input (LOW to HIGH edge triggered)
2	CLEAR	Asynchronous Master Reset Input (Active LOW)
3	CI/CE	Terminal Enable Input
4, 5, 6, 7, 10, 11, 12, 13	J0 to J9	Jam Inputs
9	APE	Asynchronous Preset Enable Input (Active LOW)
14	CO/ZD	Terminal Count Output (Active LOW)
15	SPE	Synchronous Preset Enable Input (Active LOW)
8	GND	Ground (0V)
16	Vcc	Positive Supply Voltage

INPUT AND OUTPUT EQUIVALENT CIRCUIT



IEC LOGIC SYMBOLS



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
Vcc	Supply Voltage	-0.5 to +7	V
VI	DC Input Voltage	-0.5 to V _{CC} + 0.5	V
Vo	DC Output Voltage	-0.5 to V _{CC} + 0.5	V
l _{IK}	DC Input Diode Current	± 20	mA
I _{ОК}	DC Output Diode Current	± 20	mA
lo	DC Output Source Sink Current Per Output Pin	± 25	mA
Icc or Ignd	DC V _{CC} or Ground Current	± 50	mA
PD	Power Dissipation	500 (*)	mW
T _{stg}	Storage Temperature	-65 to +150	°C
TL	Lead Temperature (10 sec)	300	°C

Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these condition is not implied. (*) 500 mW: \cong 65 °C derate to 300 mW by 10mW/°C: 65 °C to 85 °C



RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter		Value	Unit
Vcc	Supply Voltage		2 to 6	V
VI	Input Voltage		0 to V _{CC}	V
Vo	Output Voltage		0 to V _{CC}	V
T _{op}	Operating Temperature: M54HC Series M74HC Series		-55 to +125 -40 to +85	သိ
t _r , t _f	Input Rise and Fall Time	$V_{CC} = 2 V$	0 to 1000	ns
		$V_{CC} = 4.5 V$	0 to 500	
		$V_{CC} = 6 V$	0 to 400	

DC SPECIFICATIONS

		Test Conditions			Value							
Symbol	Parameter				T 54H	A = 25 ^c C and 7	C 4HC	-40 to 74	85 °C HC	-55 to 54	125 °C HC	Unit
		(*)			Min.	Тур.	Max.	Min.	Max.	Min.	Max.	
VIH	High Level Input	2.0			1.5			1.5		1.5		
	Voltage	4.5			3.15			3.15		3.15		V
		6.0			4.2			4.2		4.2		
VIL	Low Level Input	2.0					0.5		0.5		0.5	
	Voltage	4.5					1.35		1.35		1.35	V
		6.0					1.8		1.8		1.8	
V _{OH}	High Level	2.0	V _I = V _{IH} or V _{IL}	I _O =-20 μΑ	1.9	2.0		1.9		1.9		
	Output Voltage	4.5			4.4	4.5		4.4		4.4		
		6.0			5.9	6.0		5.9		5.9		V
		4.5		I _O =-4.0 mA	4.18	4.31		4.13		4.10		
		6.0		I ₀ =-5.2 mA	5.68	5.8		5.63		5.60		
Vol	Low Level Output	2.0	V			0.0	0.1		0.1		0.1	
	Voltage	4.5	VI – Viii	I _O = 20 μA		0.0	0.1		0.1		0.1	.,
		6.0	or			0.0	0.1		0.1		0.1	V
		4.5	VIL	I _O = 4.0 mA		0.17	0.26		0.33		0.40	
		6.0		I _O = 5.2 mA		0.18	0.26		0.33		0.40	
lı	Input Leakage Current	6.0	$V_{I} = V_{CC} \text{ or } GND$				±0.1		±1		±1	μΑ
Icc	Quiescent Supply Current	6.0	Vi = 1	V _{CC} or GND			4		40		80	μA



		Те	est Conditions	Value							
Symbol	Parameter	Vcc		T 54H	T _A = 25 °C 54HC and 74HC			85 °C HC	-55 to 54	125 °C HC	Unit
		(v)		Min.	Тур.	Max.	Min.	Max.	Min.	Max.	
t _{TLH}	Output Transition	2.0			30	75		95		110	
t _{THL}	Time	4.5			8	15		19		22	ns
		6.0			7	13		16		19	
t _{PLH}	Propagation	2.0			96	185		230		280	
t _{PHL}	Delay Time	4.5			24	37		46		56	ns
	(CK - CO/ZD)	6.0			20	31		39		47	
t _{PLH}	Propagation	2.0			116	225		280		340	
t _{PHL}	Delay Time	4.5			29	45		56		68	ns
	(APE - CO/ZD)	6.0			25	38		48		57	
t PLH	Propagation	2.0			104	200		250		300	
t _{PHL}	Delay Time	4.5			26	40		50		60	ns
	(CL - CO/ZD)	6.0			22	34		43		51	
t PLH	Propagation	2.0			48	95		120		145	
t _{PHL}	Delay Time	4.5			12	19		24		29	ns
	(CI/CE - CO/ZD)	6.0			10	16		20		24	
f _{MAX}	Propagation	2.0		4	8		3		2.6		
Delay Time	Delay Time	4.5		20	32		16		13		pF
		6.0		24	38		19		15		
CIN	Input Capacitance				5	10		10		10	pF
C _{PD} (*)	Power Dissipation Capacitance				60						pF

AC ELECTRICAL CHARACTERISTICS ($C_L = 50 \text{ pF}$, Input $t_r = t_f = 6 \text{ ns}$)

(*) C_{PD} is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to Test Circuit). Average operting current can be obtained by the following equation. $I_{CC}(opr) = C_{PD} \bullet V_{CC} \bullet f_{|N} + I_{CC}$

TEST CIRCUIT Icc (Opr.)





FUNCTIONAL DESCRIPTION

The HC40102 and HC40103 are 8-stage presettable synchronous down counters. Carry Out/Zero Detect ($\overline{CO/ZD}$) is output at the "L" level for the period of 1 bit when the readout becomes "0". The HC40102 adopts binary coded decimal notation, making setting up to 99 counts possible. While the HC40103 adopts 8-bit binary counter and can set up to 255 counts.

COUNT OPERATION

At the "H" level of control input of $\overline{\text{CLEAR}}$, $\overline{\text{SPE}}$ and $\overline{\text{APE}}$, the counter carriers out down count operation one by one at the rise of pulse given to CLOCK input. Count operation can be inhibited by setting Carry Input/Clock Enable $\overline{\text{CI/CE}}$ to the "H" level.

CO/ZD is output at the "L" level when the readout becomes "0" but is <u>not</u> output even if the readout becomes "0" when CI/CE is at the "H" level, thus maintaining the "H" level.

Synchronous cascade operation can be carried out by using CI/CE input and CO/ZD output.

The contents of count jump to maximum count (99 for the HC40102 and 225 for the HC40103) if clock is given when the readout is "0". Therefore, operation of 100-frequency division and that of 256-frequency division are carried out for the HC40102 and HC40103, respectively, when clock input alone is given without various kinds of preset operation.

PRESET OPERATION AND RESET OPERATION

When Clear (CLEAR) input is set to the "L" level, the readout is set to the maximum count independetly of other inputs. When Asynchronous Preset Enable (APE) input is set to the "L" level, readouts given on J0 to J7 can be preset asynchronously to counter independently of inputs other than CLEAR input. When Synchronous Preset Enable (SPE) is set to the "L" level, the readouts given on J0 to J7 can be preset to counter synchronously with the rise of clock.

As to these operation modes, refer to the truth table.





SWITCHING CHARACTERISTICS TEST WAVEFORM





EXAMPLE OF TYPICAL APPLICATION



Note :The above formula does not take into account the phase of clock input. Therefore, the real pulse width is the distance between the above formula-1/fIN ~ the above formula.



Plastic DIP16 (0.25) MECHANICAL DATA

ЫМ		mm		inch			
Dim	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	
a1	0.51			0.020			
В	0.77		1.65	0.030		0.065	
b		0.5			0.020		
b1		0.25			0.010		
D			20			0.787	
E		8.5			0.335		
е		2.54			0.100		
e3		17.78			0.700		
F			7.1			0.280	
Ι			5.1			0.201	
L		3.3			0.130		
Z			1.27			0.050	





ЫМ		mm		inch			
Dim.	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	
А			20			0.787	
В			7			0.276	
D		3.3			0.130		
E	0.38			0.015			
e3		17.78			0.700		
F	2.29		2.79	0.090		0.110	
G	0.4		0.55	0.016		0.022	
Н	1.17		1.52	0.046		0.060	
L	0.22		0.31	0.009		0.012	
М	0.51		1.27	0.020		0.050	
Ν			10.3			0.406	
Р	7.8		8.05	0.307		0.317	
Q			5.08			0.200	

Ceramic DIP16/1 MECHANICAL DATA



				inch			
DIM.	MIN.	ТҮР.	MAX.	MIN.	TYP.	MAX.	
A			1.75			0.068	
a1	0.1		0.2	0.004		0.007	
a2			1.65			0.064	
b	0.35		0.46	0.013		0.018	
b1	0.19		0.25	0.007		0.010	
С		0.5			0.019		
c1		-	45°	(typ.)	•		
D	9.8		10	0.385		0.393	
E	5.8		6.2	0.228		0.244	
е		1.27			0.050		
e3		8.89			0.350		
F	3.8		4.0	0.149		0.157	
G	4.6		5.3	0.181		0.208	
L	0.5		1.27	0.019		0.050	
М			0.62			0.024	
S		1	8° (I	max.)	1		

SO16 (Narrow) MECHANICAL DATA



DIM.		mm		inch			
2	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	
А	9.78		10.03	0.385		0.395	
В	8.89		9.04	0.350		0.356	
D	4.2		4.57	0.165		0.180	
d1		2.54			0.100		
d2		0.56			0.022		
E	7.37		8.38	0.290		0.330	
е		1.27			0.050		
e3		5.08			0.200		
F		0.38			0.015		
G			0.101			0.004	
М		1.27			0.050		
M1		1.14			0.045		

PLCC20 MECHANICAL DATA



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