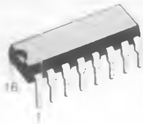
SGS-THOMSON MICROELECTRONICS

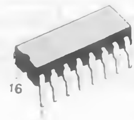
M54HC4060
M74HC4060

14-STAGE BINARY COUNTER/OSCILLATOR

- HIGH SPEED
  f_{MAX} = 60 MHz (TYP) at V_{CC} = 5V
- LOW POWER DISSIPATION
  I_{CC} = 4 μA (MAX.) at T_A = 25°C
- HIGH NOISE IMMUNITY
  $V_{NIH} = V_{NIL}$ = 28% V_{CC} (MIN.)
- OUTPUT DRIVE CAPABILITY
  10 LSTTL LOADS
- SYMMETRICAL OUTPUT IMPEDANCE
  $|I_{OH}| = I_{OL}$ = 4 mA (MIN.)
- BALANCED PROPAGATION DELAYS
  $t_{PLH} = t_{PHL}$
- WIDE OPERATING VOLTAGE RANGE
  V_{CC} (OPR) = 2V to 6V
- PIN AND FUNCTION COMPATIBLE
  WITH 4060B



B1N
Plastic Package



F1
Ceramic Frit Seal Package

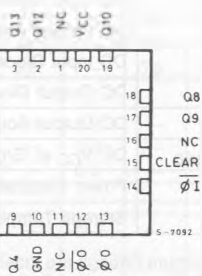
M1
SO Micro Package

C1
Plastic Chip Carrier

ORDERING NUMBERS:

M54HC4060 F1
M74HC4060 B1N
M74HC4060 F1
M74HC4060 C1
M74HC4060 M1

PIN CONNECTION (top view)



NC =
No Internal
Connection

DESCRIPTION

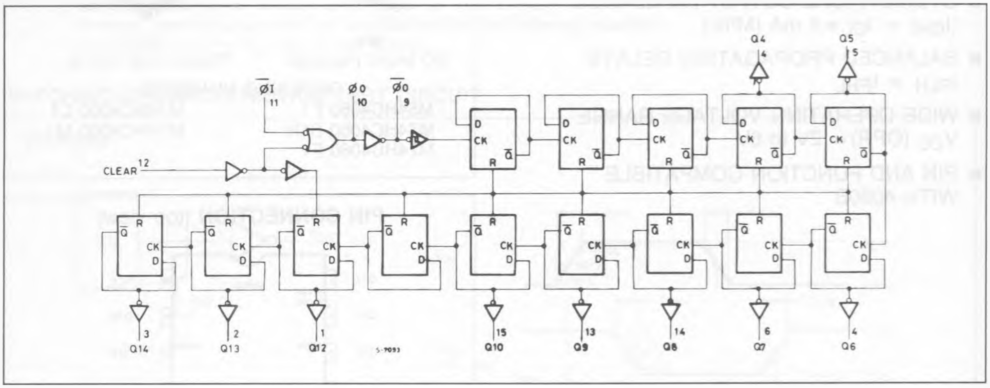
The M54/74HC4060 is a high speed CMOS 14-STAGE BINARY COUNTER/OSCILLATOR fabricated in silicon gate C^2MOS technology. It has the same high speed performance of LSTTL combined with true CMOS low power consumption. It operates ten times faster than metal-gate C^2MOS IC (4060B) with the same power dissipation.
The oscillator configuration allows design of either RC or crystal oscillator circuits. A high level on the CLEAR accomplishes the reset function, i.e. all counter outputs are made low and the oscillator is disabled.
A negative transition on the clock input increments the counter. Ten kinds of divided output are provided; 4 to 10 and 12 to 14 stage inclusive. The maximum division available at Q12 is 1/16384 f oscillator.
The $\overline{Ø_1}$ input and the CLEAR input are equipped with protection circuits against static dischage and transient excess voltage.

TRUTH TABLE

INPUTS		FUNCTION
$\overline{\emptyset_I}$	CLEAR	
X	H	COUNTER IS RESET TO ZERO STATE $\emptyset_0$ OUTPUT GOES TO HIGH LEVEL $\overline{\emptyset_0}$ OUTPUT GOES TO LOW LEVEL
⌐_ (falling edge)	L	COUNT UP ONE STEP.
_⌐ (rising edge)	L	NO CHANGE.

X: DON'T CARE

LOGIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CC}	Supply Voltage	−0.5 to 7	V
V_I	DC Input Voltage	−0.5 to V_{CC} + 0.5	V
V_O	DC Output Voltage	−0.5 to V_{CC} + 0.5	V
I_{IK}	DC Input Diode Current	± 20	mA
I_{OK}	DC Output Diode Current	± 20	mA
I_O	DC Output Source Sink Current Per Output Pin	± 25	mA
I_{CC} or I_{GND}	DC V_{CC} or Ground Current	± 50	mA
P_D	Power Dissipation	500 (*)	mW
T_{stg}	Storage Temperature	−65 to 150	°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: ≅ 65°C derate to 300 mW by 10 mW by 10 mW/°C: 65°C to 85°C.

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter		Value		Unit
V_{CC}	Supply Voltage		2 to 6		V
V_I	Input Voltage		0 to V_{CC}		V
V_O	Output Voltage		0 to V_{CC}		V
T_A	Operating Temperature	74HC Series 54HC Series	–40 to 85 –55 to 125		°C
t_r, t_f	Input Rise and Fall Time		V_{CC} 2 V V_{CC} 4.5V V_{CC} 6 V	0 to 1000 0 to 500 0 to 400	ns

DC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	V_{CC}	Test Condition		T_A = 25°C 54HC and 74HC			–40 to 85°C 74HC		–55 to 125°C 54HC		Unit
					Min.	Typ.	Max.	Min.	Max.	Min.	Max.	
V_{IH}	High Level Input Voltage	2.0			1.5	—	—	1.5	—	1.5	—	V
		4.5			3.15	—	—	3.15	—	3.15	—	
		6.0			4.2	—	—	4.2	—	4.2	—	
V_{IL}	Low Level Input Voltage	2.0			—	—	0.5	—	0.5	—	0.5	V
		4.5			—	—	1.35	—	1.35	—	1.35	
		6.0			—	—	1.8	—	1.8	—	1.8	
V_{OH}	High Level Output Voltage (Q Outputs)		V_I	I_O								
		2.0	V_{IH} or V_{IL}	–20 μA	1.9	2.0	—	1.9	—	1.9	—	V
		4.5			4.4	4.5	—	4.4	—	4.4	—	
		6.0			5.9	6.0	—	5.9	—	5.9	—	
		4.5		–4.0 mA	4.18	4.31	—	4.13	—	4.10	—	
		6.0		–5.2 mA	5.68	5.8	—	5.63	—	5.60	—	
V_{OL}	Low Level Output Voltage (Q Outputs)	2.0	V_{IH} or V_{IL}	20 μA	—	0.0	0.1	—	0.1	—	0.1	V
		4.5			—	0.0	0.1	—	0.1	—	0.1	
		6.0			—	0.0	0.1	—	0.1	—	0.1	
		4.5		4.0 mA	—	0.17	0.26	—	0.33	—	0.40	
		6.0		5.2 mA	—	0.18	0.26	—	0.33	—	0.40	
V_{OH}	High Level Output Voltage $Ø_0$, $\overline{Ø}_0$ Output		V_I	I_O								
		2.0	V_{IH} or V_{IL}	–20 μA	1.8	2.0	—	1.8	—	1.8	—	V
		4.5			4.0	4.5	—	4.0	—	4.0	—	
		6.0			5.5	5.9	—	5.5	—	5.5	—	
V_{OL}	Low Level Output Voltage $Ø_0$, $\overline{Ø}_0$ Output	2.0	V_{IH} or V_{IL}	20 μA	—	0.0	0.2	—	0.2	—	0.2	V
		4.5			—	0.0	0.5	—	0.5	—	0.5	
		6.0			—	0.1	0.5	—	0.5	—	0.5	
I_I	Input Leakage Current	6.0	V_I = V_{CC} or GND		—	—	±0.1	—	±1	—	±1	μA
I_{CC}	Quiescent Supply Current	6.0	V_I = V_{CC} or GND		—	—	4	—	40	—	80	μA

AC ELECTRICAL CHARACTERISTICS (V_{CC} = 5V, T_A = 25°C, C_L = 15pF, Input $t_r = t_f$ = 6ns)

Symbol	Parameter	54HC and 74HC			Unit
		Min.	Typ.	Max.	
t_{TLH} t_{THL}	Output Transition Time		4	8	ns
t_{PHL} t_{PHL}	Propagation Delay Time ($\overline{\varnothing}$ - Q_4)		43	65	ns
t_{PLH} t_{PHL}	Propagation Delay Time (Q_n - Q_{n+1})		7	12	ns
t_{PLH} t_{PHL}	Propagation Delay Time (CLEAR - Q_n)		21	34	ns
f_{MAX}	Maximum Clock Frequency	33	60		MHz

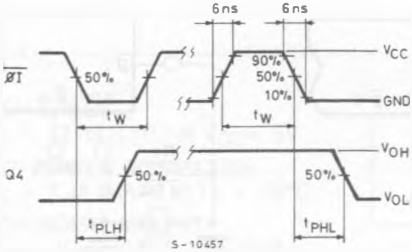
AC ELECTRICAL CHARACTERISTICS (C_L = 50pF, Input $t_r = t_f$ = 6ns)

Symbol	Parameter	V_{CC}	Test Condition	T_A = 25°C 54HC and 74HC			−40 to 85°C 74HC		−55 to125°C 54HC		Unit
				Min.	Typ.	Max.	Min.	Max.	Min.	Max.	
t_{TLH} t_{THL}	Output Transition Time	2.0 4.5 6.0		— — —	30 8 7	75 15 13	— — —	95 19 16	— — —	110 22 19	ns
t_{PLH} t_{PHL}	Propagation Delay Time ($\varnothing_I$ - Q_4)	2.0 4.5 6.0		— — —	196 49 42	370 74 63	— — —	465 93 80	— — —	555 111 95	ns
t_{PLH} t_{PHL}	Propagation Delay Time (Q_n - Q_{n+1})	2.0 4.5 6.0		— — —	35 9 8	75 15 13	— — —	95 19 16	— — —	110 22 19	ns
t_{PHL}	Propagation Delay Time (CLEAR - Q_n)	2.0 4.5 6.0		— — —	100 25 21	195 39 33	— — —	245 49 42	— — —	295 59 50	ns
f_{MAX}	Maximum Clock Frequency	2.0 4.5 6.0		6 30 35	13 55 64	— — —	5 24 28	— —	4 20 24	— — —	MHz
$t_{W(L)}$ $t_{W(H)}$	Minimum Pulse Width CLOCK ($\varnothing_I$)	2.0 4.5 6.0		— — —	30 8 7	75 15 13	— — —	95 19 16	— — —	110 22 19	ns
$t_{W(H)}$	Minimum Pulse Width (CLEAR)	2.0 4.5 6.0		— — —	60 15 13	125 25 21	— — —	155 31 26	— — —	190 38 32	ns
t_{REM}	Minimum Removal Time (CLEAR)	2.0 4.5 6.0		— — —	40 10 9	100 20 17	— — —	125 25 21	— — —	150 30 26	ns
C_{IN}	Input Capacitance			—	5	10	—	10	—	10	pF
C_{PD}(*)	Power Dissipation			—	33	—	—	—	—	—	pF

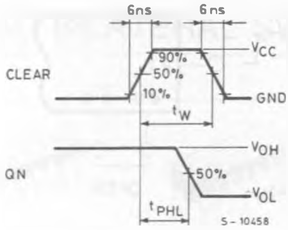
Note (*) C_{PD} is defined as the value of the IC's of internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to Test Circuit)
Average operating current can be obtained by the following equation I_{CC} (Opr.) = $C_{PD} \cdot V_{CC} \cdot f_{IN}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

SWITCHING CHARACTERISTICS TEST WAVEFORM

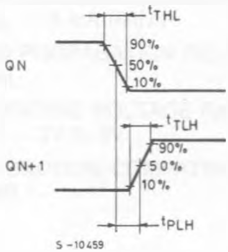
t_{PLH}, t_{PHL} (CLOCK-Q) t_W (CLOCK)

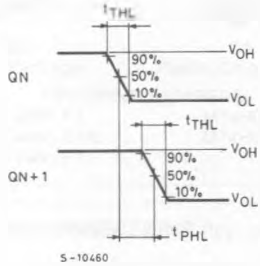


t_{PHL} (CLEAR - Qn), t_W (CLEAR)

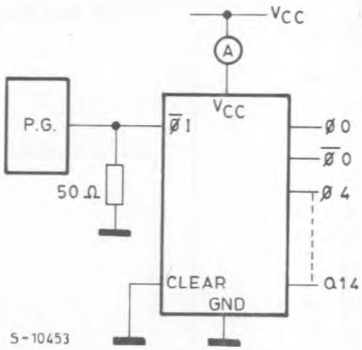


t_{PLH}, t_{PHL} (Qn - Qn + 1)





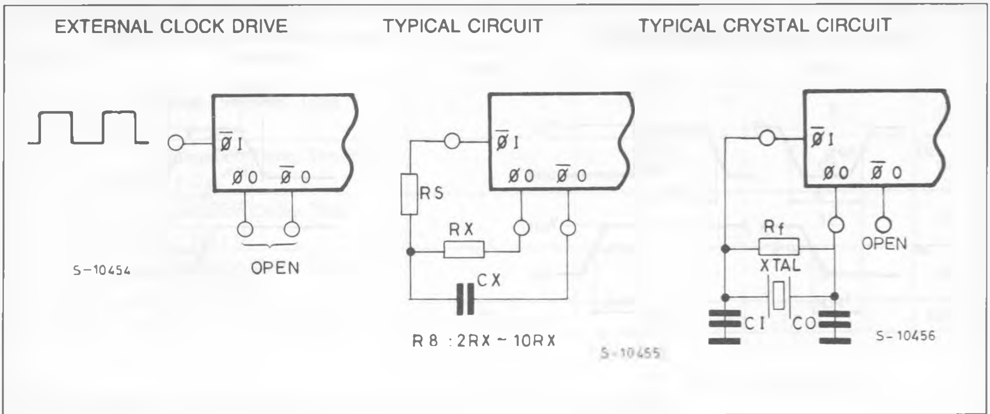
TEST CIRCUIT I_{CC} (Opr.)



* $Ø_I$ INPUT $t_r = t_f = 6$ ns
DUTY = 50%

NOTE: WHEN CR OR CRYSTAL OSCILLATION CIRCUIT IS ADOPTED, THE DYNAMIC POWER DISSIPATION WILL BE GREATER THAN THE MEASURED VALUE FROM THE TEST CIRCUIT SHOWN LEFT, BECAUSE THESE OSCILLION CIRCUITS SPEND MUCH SUPPLY CURRENT

TYPICAL CLOCK DRIVE CIRCUITS



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