TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

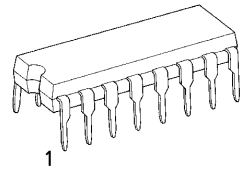
TC74HC4060AP, TC74HC4060AF

14 – STAGE BINARY COUNTER / OSCILATOR

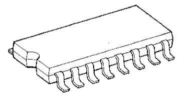
The TC74HC4060A is a high speed CMOS 14 - STAGE BINARY COUNTER fabricated with silicon gate C^2MOS technology.
It achieves the high speed operation similar to equivalent LSTTL while maintaining the CMOS low power dissipation.
The oscillator configuration allows designs using either RC or crystal oscillator circuits, or an external clock may be used.
The clear input resets the counter to a low level on all outputs and disables the oscillator.
A high CLR accomplishes this reset function.
A negative transition on the clock input ($\overline{\phi}$I) increments the counter Ten levels of divided output are provided ; 4 stage thru 10 stage and 12 stage thru 14 stage. At the last stage (Q14), a 1 / 16384 divided frequency is obtained.
The $\overline{\phi}$I input and CLR input are equipped with protection circuits against static discharge or transient excess voltage.

FEATURES :

- High Speed ······ f_{MAX} = 58MHz (typ.) at V_{CC} = 5V
- Low Power Dissipation ······ I_{CC} = 4μA (Max.)at Ta = 25°C
- High Noise Immunity ······ $V_{NIH} = V_{NIL}$ = 28% V_{CC} (Min.)
- Output Drive Capability ······ 10 LSTTL Loads
- Symmetrical Output Impedance ··· $|I_{OH}| = I_{OL}$ = 4mA(Min.)
- Balanced Propagation Delays ····· $t_{pLH} \simeq t_{pHL}$
- Wide Operating Voltage Range ···· V_{CC} (opr.) = 2V ~ 6V
- Oscillator Configuration ······ RC or Crystal Oscillator
- Pin and Function Compatible with 4060B

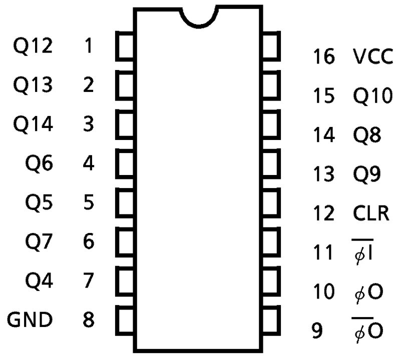


P (DIP16-P-300-2.54A)
Weight : 1.00g (Typ.)



F (SOP16-P-300-1.27)
Weight : 0.18g (Typ.)

PIN ASSIGNMENT

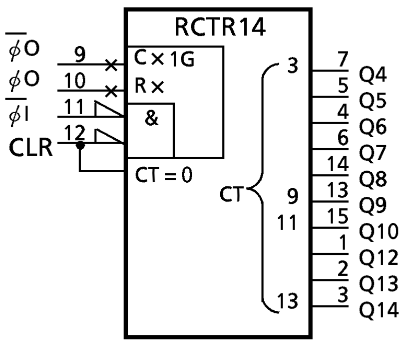


(TOP VIEW)

TRUTH TABLE

INPUTS		FUNCTION
$\overline{\phi}$I	CLR	
X	H	Counter is reset to zero state. ϕ0 output goes to high level. $\overline{\phi}$0 output goes to low level.
↓	L	Count up one step.
↑	L	No change

IEC LOGIC SYMBOL



ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	VALUE	UNIT
Supply Voltage Range	V_{CC}	−0.5~7	V
DC Input Voltage	V_{IN}	−0.5~V_{CC}+0.5	V
DC Output Voltage	V_{OUT}	−0.5~V_{CC}+0.5	V
Input Diode Current	I_{IK}	±20	mA
Output Diode Current	I_{OK}	±20	mA
DC Output Current	I_{OUT}	±25	mA
DC V_{CC}/Ground Current	I_{CC}	±50	mA
Power Dissipation	P_D	500 (DIP)* / 180 (SOP)	mW
Storage Temperature	T_{stg}	−65~150	°C

*500mW in the range of Ta = −40°C~65°C. From Ta = 65°C to 85°C a derating factor of −10mW/°C shall be applied until 300mW.

RECOMMENDED OPERATING CONDITIONS

PARAMETER	SYMBOL	VALUE	UNIT
Supply Voltage	V_{CC}	2~6	V
Input Voltage	V_{IN}	0~V_{CC}	V
Output Voltage	V_{OUT}	0~V_{CC}	V
Operating Temperature	T_{opr}	−40~85	°C
Input Rise and Fall Time	t_r, t_f	0~1000 (V_{CC}=2.0V) 0~500 (V_{CC}=4.5V) 0~400 (V_{CC}=6.0V)	ns

DC ELECTRICAL CHARACTERISTICS

PARAMETER	SYMBOL	TEST CONDITION		V_{CC} (V)	Ta = 25°C			Ta = −40~85°C		UNIT
					MIN.	TYP.	MAX.	MIN.	MAX.	
High - Level Input Voltage	V_{IH}			2.0 4.5 6.0	1.50 3.15 4.20	— — —	— — —	1.50 3.15 4.20	— — —	V
Low - Level Input Voltage	V_{IL}			2.0 4.5 6.0	— — —	— — —	0.50 1.35 1.80	— — —	0.50 1.35 1.80	V
High - Level Output Voltage (Qn)	V_{OH}	V_{IN} = V_{IH} or V_{IL}	I_{OH} = −20μA	2.0 4.5 6.0	1.9 4.4 5.9	2.0 4.5 6.0	— — —	1.9 4.4 5.9	— — —	V
			I_{OH} = −4 mA I_{OH} = −5.2 mA	4.5 6.0	4.18 5.68	4.31 5.80	— —	4.13 5.63	— —	
High - Level Output Voltage (ϕO, $\bar{\phi}$O)	V_{OH}	V_{IN} = V_{IH} or V_{IL}	I_{OH} = −20μA	2.0 4.5 6.0	1.8 4.0 5.5	2.0 4.5 5.9	— — —	1.8 4.0 5.5	— — —	
Low - Level Output Voltage (Qn)	V_{OL}	V_{IN} = V_{IH} or V_{IL}	I_{OL} = 20μA	2.0 4.5 6.0	— — —	0.0 0.0 0.0	0.1 0.1 0.1	— — —	0.1 0.1 0.1	V
			I_{OL} = 4 mA I_{OL} = 5.2 mA	4.5 6.0	— —	0.17 0.18	0.26 0.26	— —	0.33 0.33	
Low - Level Output Voltage (ϕO, $\bar{\phi}$O)	V_{OL}	V_{IN} = V_{IH} or V_{IL}	I_{OL} = 20μA	2.0 4.5 6.0	— — —	0.0 0.0 0.1	0.2 0.5 0.5	— — —	0.2 0.5 0.5	
Input Leakage Current	I_{IN}	V_{IN} = V_{CC} or GND		6.0	—	—	±0.1	—	±1.0	μA
Quiescent Supply Current	I_{CC}	V_{IN} = V_{CC} or GND		6.0	—	—	4.0	—	40.0	

TIMING REQUIREMENTS (Input $t_r = t_f = 6ns$)

PARAMETER	SYMBOL	TEST CONDITION	V_{CC} (V)	Ta = 25°C TYP.	Ta = 25°C LIMIT	Ta = −40~85°C LIMIT	UNIT
Minimum Pulse Width ($\bar{\phi}$I)	$t_{W(L)}$ $t_{W(H)}$		2.0 4.5 6.0	— — —	75 15 13	95 19 16	ns
Minimum Pulse Time (CLR)	$t_{W(H)}$		2.0 4.5 6.0	— — —	75 15 13	95 19 16	ns
Minimum Removal Time	t_{rem}		2.0 4.5 6.0	— — —	100 20 17	125 25 21	ns
Clock Frequency	f		2.0 4.5 6.0	— — —	6 30 35	5 24 28	MHz

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

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Output Transition Time	t_{TLH} t_{THL}		—	4	8	ns
Propagation Delay Time ($\bar{\phi}$I − Q_4)	t_{pLH} t_{pHL}		—	36	53	ns
Propagation Delay Time Difference (Qn − Qn + 1)	Δt_{pd}	$C_L = 50pF$ (Qn, Qn + 1)	—	6	14	ns
Propagation Delay Time (CLR)	t_{pHL}		—	19	34	ns
Maximum Clock Frequency	f_{MAX}		33	58	—	MHz

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

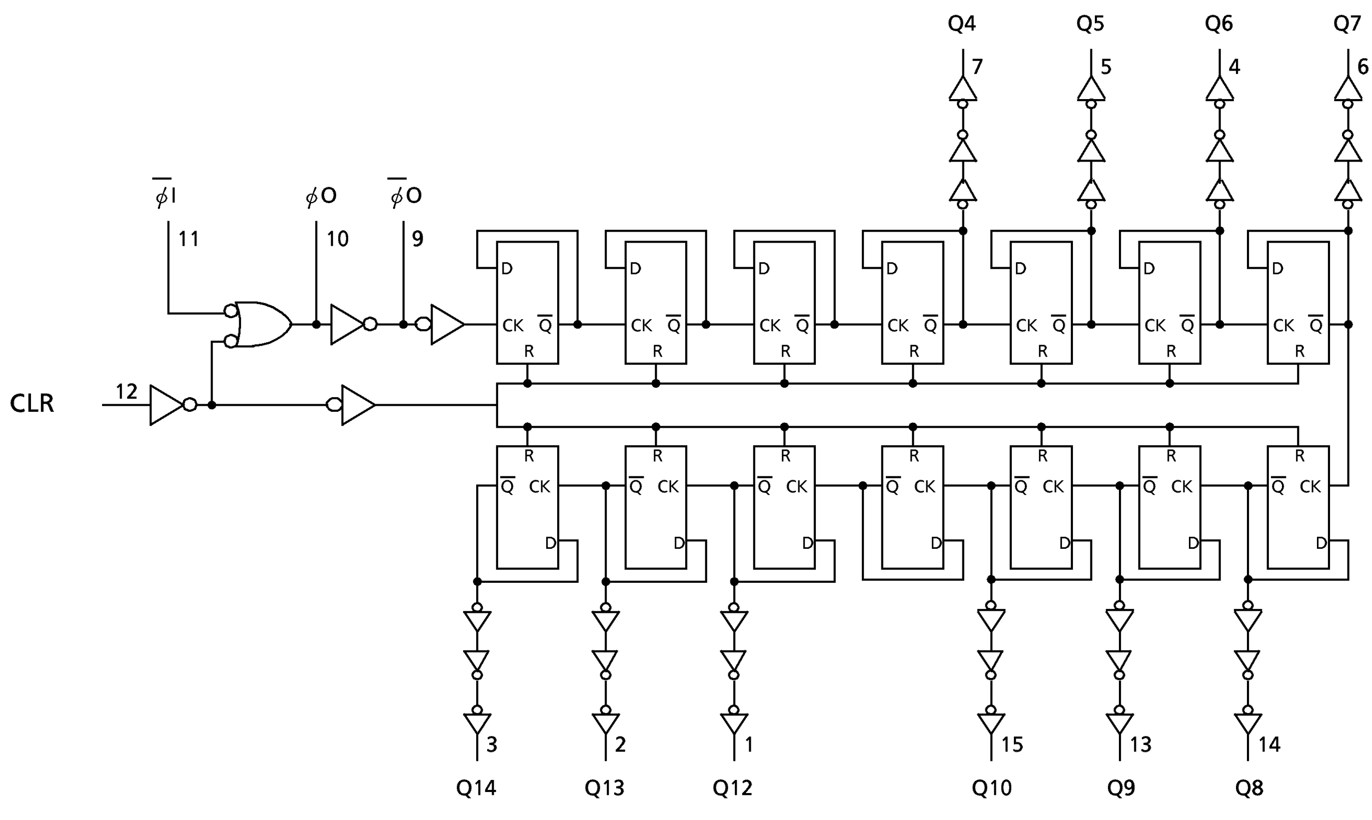
PARAMETER	SYMBOL	TEST CONDITION	V_{CC} (V)	Ta = 25°C MIN.	Ta = 25°C TYP.	Ta = 25°C MAX.	Ta = −40~85°C MIN.	Ta = −40~85°C MAX.	UNIT
Output Transition Time	t_{TLH} t_{THL}		2.0 4.5 6.0	— — —	30 8 7	75 15 13	— — —	95 19 16	ns
Propagation Delay Time ($\bar{\phi}$I − Q_4)	t_{pLH} t_{pHL}		2.0 4.5 6.0	— — —	170 41 30	300 60 51	— — —	375 75 64	ns
Propagation Delay Time Difference (Qn − Qn + 1)	Δt_{pd}	$C_L = 50pF$(Qn,Qn + 1)	2.0 4.5 6.0	— — —	32 7 5	75 15 13	— — —	95 19 16	ns
Propagation Delay Time (CLR)	t_{pLH} t_{pHL}		2.0 4.5 6.0	— — —	85 23 17	195 39 33	— — —	245 49 42	ns
Maximum Clock Frequency	f_{MAX}		2.0 4.5 6.0	6 30 35	12 50 65	— — —	5 24 28	— — —	MHz
Input Capacitance	C_{IN}			—	5	10	—	10	pF
Power Dissipation Capacitance	C_{PD}	Note (1)		—	27	—	—	—	pF

Note (1) C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.
Average operating current can be obtained by the equation :

$$I_{CC}(opr) = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}$$

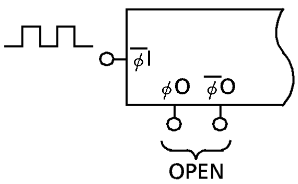
When CR or Crystal oscillation circuit is adopted, the dynamic power dissipation will be greater than the above calculation, because these oscillation circuits spend much supply current.

SYSTEM DIAGRAM

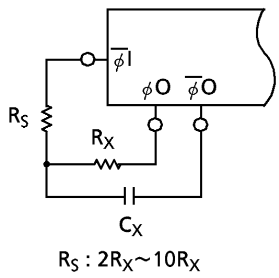


TYPICAL CLOCK DRIVE CIRCUITS

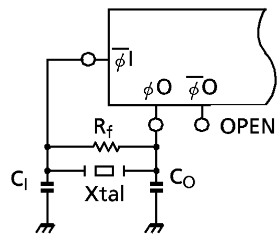
External Clock Drive



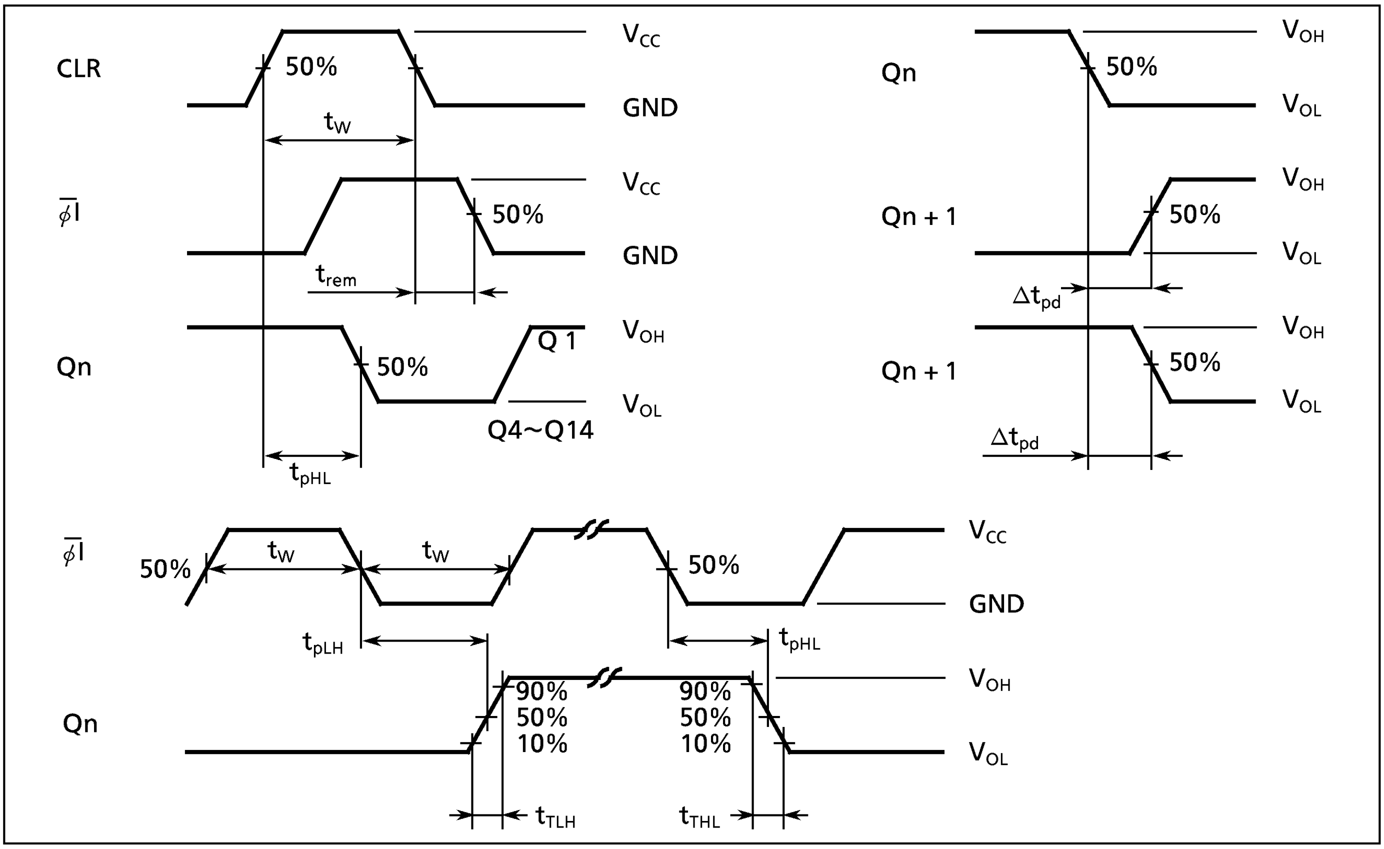
Typical RC Circuit



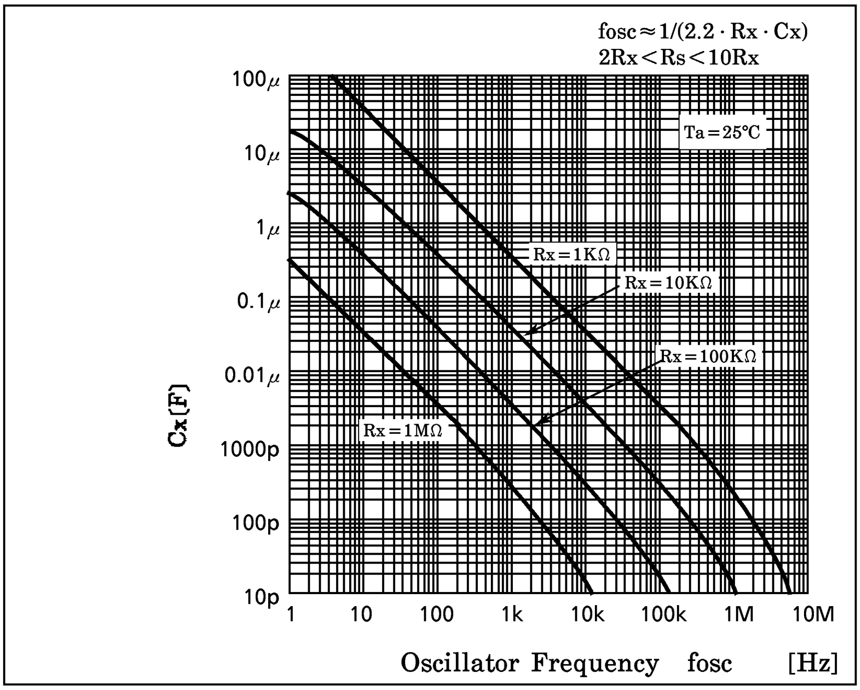
Typical Crystal Circuit



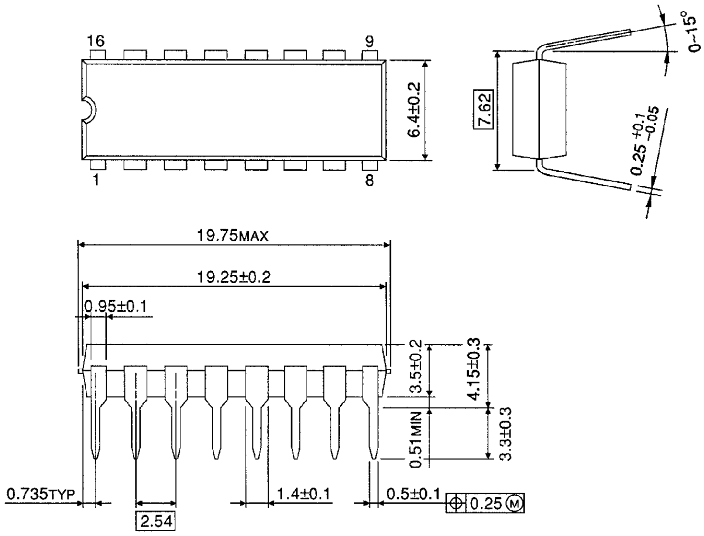
SWITCHING CHARACTERISTICS TEST WAVEFORM



CR Oscillator Characteristics (Typical)

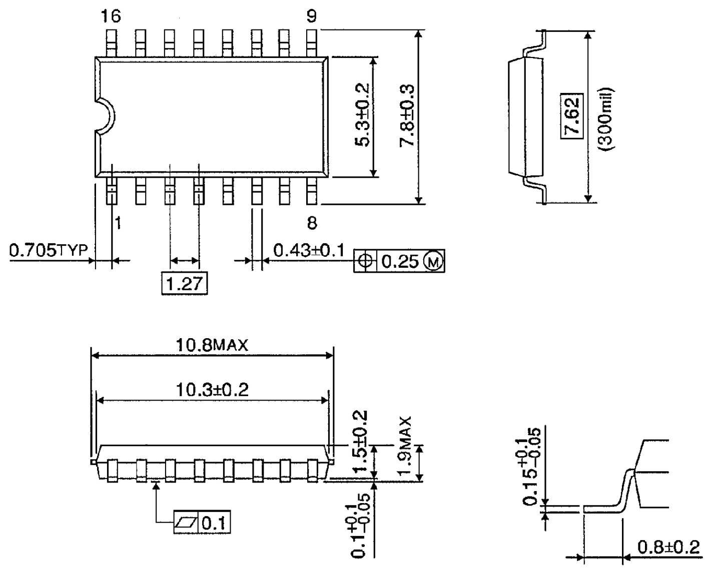


DIP 16PIN PACKAGE DIMENSIONS (DIP16-P-300-2.54A) Unit in mm



Weight : 1.00g (Typ.)

SOP 16PIN (200mil BODY) PACKAGE DIMENSIONS (SOP16-P-300-1.27) Unit in mm



Weight : 0.18g (Typ.)

RESTRICTIONS ON PRODUCT USE