TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

TC74HC670AP, TC74HC670AF

4 WORD × 4 BIT REGISTER FILE (3 – STATE)

The TC74HC670A is a high speed 4−WORDS×4−BITS REGISTER FILE fabricated with silicon gate C2MOS technology.

It achieves the high speed operation similar to equivalent LSTTL while maintaining the CMOS low power dissipation.

The register file is organized as 4 words of 4 bits each.

Separate read and write address inputs (RA, RB, and WA, WB) and enable inputs ($\overline{RE}$, $\overline{WE}$) are available permitting simultaneous writing into one word location and reading from another location.

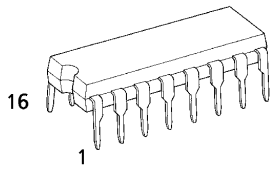
Four data inputs (D0~D3) are provided to store the 4-bit words.

The write address inputs (WA, WB) determine the location of the stored word in the register. When write Enable($\overline{WE}$)is held low, the data is enterd into addressed location. When $\overline{WE}$ is held high, data and address inputs are inhibited. The data acquisition from the four registers is made possible by the read address inputs (RA, RB) when the Read Enable ($\overline{RE}$) is held low. When RE is held high the data outputs are in the high impedance state.

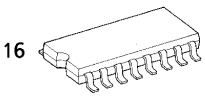
All inputs are equipped with protection circuits against static discharge or transient excess voltage.

FEATURES:

- High Speed····· t_{pd} = 23ns (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
- Pin and Function Compatible with 74LS670

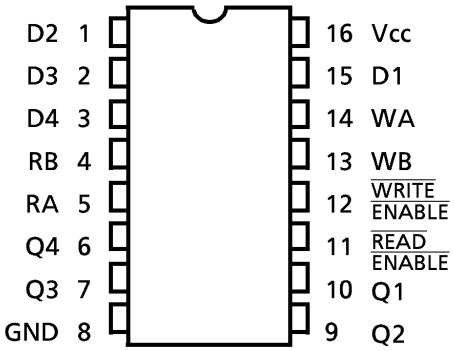


P (DIP16-P-300-2.54A)
Weight : 1.00g (Typ.)



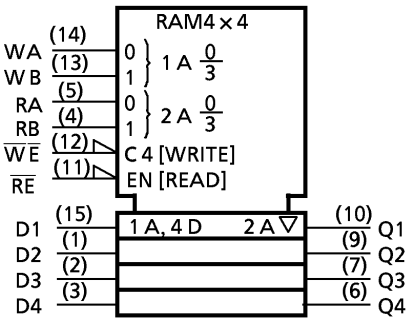
F (SOP16-P-300-1.27)
Weight : 0.18g (Typ.)

PIN ASSIGNMENT



(TOP VIEW)

IEC LOGIC SYMBOL



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TRUTH TABLE

WRITE FUNCTION TABLE

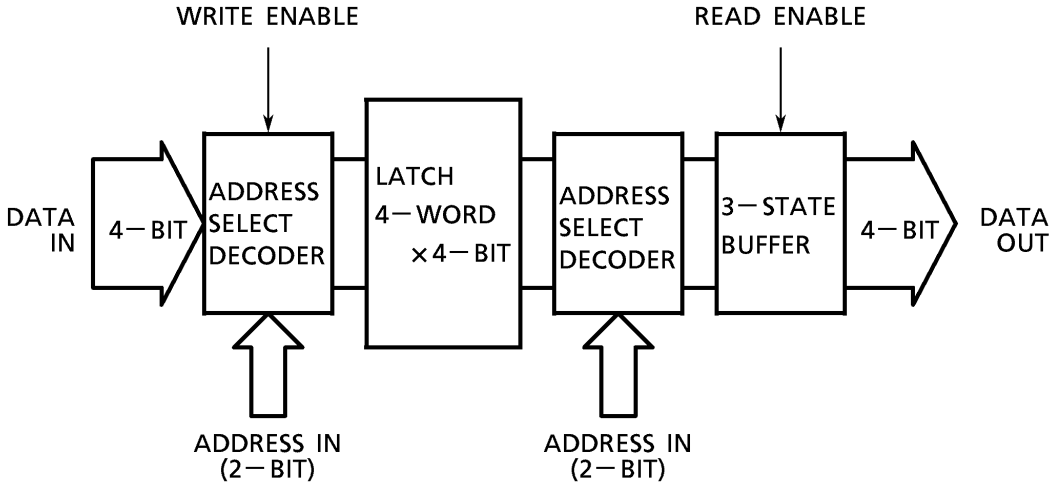
WRITE INPUTS			WORDS			
WB	WA	$\overline{WE}$	0	1	2	3
L	L	L	Q = D	Q0	Q0	Q0
L	H	L	Q0	Q = D	Q0	Q0
H	L	L	Q0	Q0	Q = D	Q0
H	H	L	Q0	Q0	Q0	Q = D
X	X	H	Q0	Q0	Q0	Q0

READ FUNCTION TABLE

READ INPUTS			OUTPUTS			
RB	RA	$\overline{RE}$	Q1	Q2	Q3	Q4
L	L	L	W0B1	W0B2	W0B3	W0B4
L	H	L	W1B1	W1B2	W1B3	W1B4
H	L	L	W2B1	W2B2	W2B3	W2B4
H	H	L	W3B1	W3B2	W3B3	W3B4
X	X	H	Z	Z	Z	Z

NOTES 1. X : Don't Care Z : High Impedance
2. (Q = D) : The four selected internal flip-flop outputs will assume the states applied to the four external data Inputs.
3. Q0 : The level of Q before the indicated input conditions were established.
4. W0B1 : The first bit of word 0, etc.

BLOCK DIAGRAM



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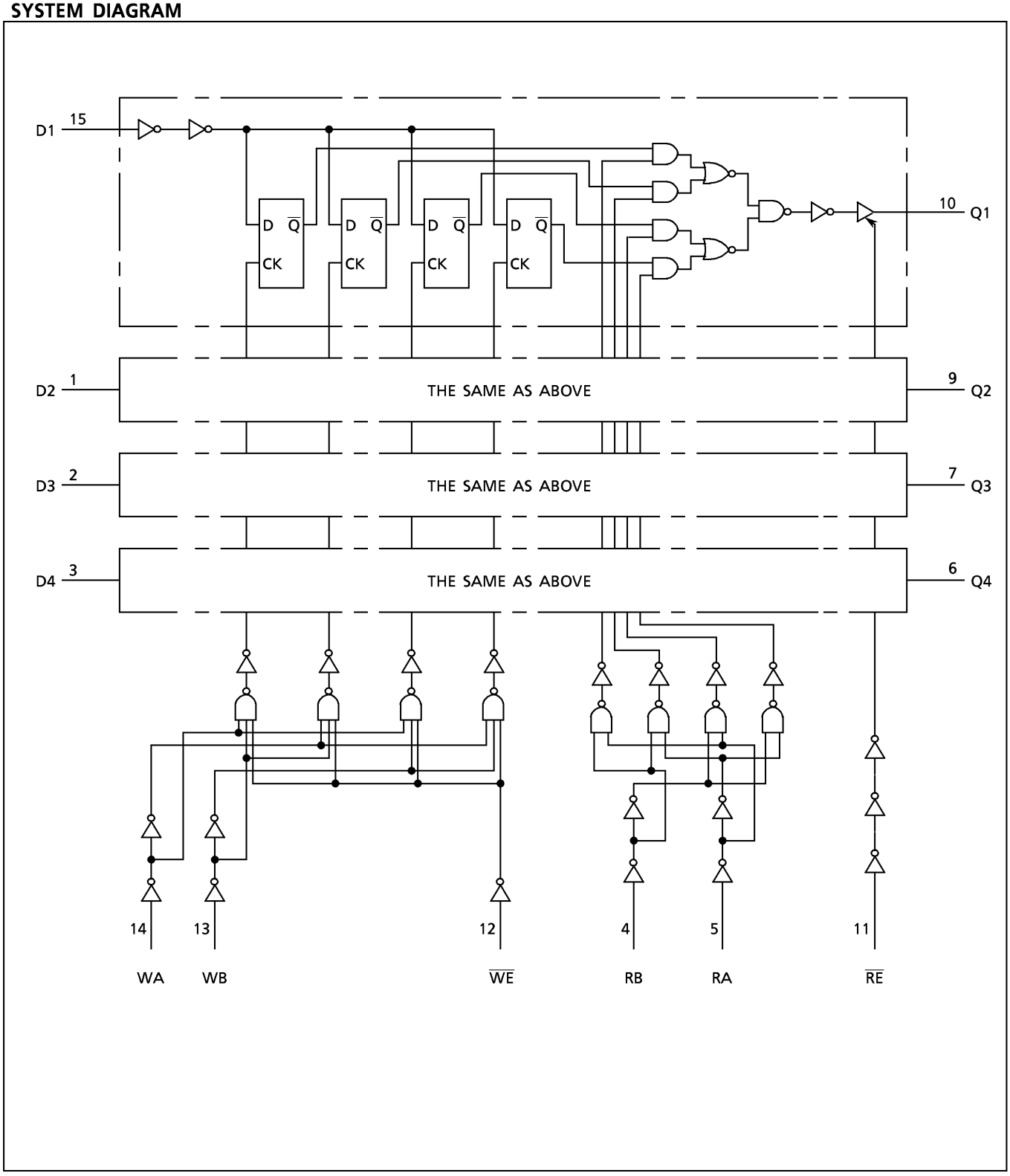
SYSTEM DIAGRAM



ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	VALUE	UNIT
Supply Voltage Range	V_{CC}	−0.5~7.0	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 should 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 MIN.	Ta = 25°C TYP.	Ta = 25°C MAX.	Ta = −40~85°C MIN.	Ta = −40~85°C MAX.	UNIT
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	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} = −5.2mA	4.5 6.0	4.18 5.68	4.31 5.80	— —	4.13 5.63	— —	
Low - Level Output Voltage	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} = 5.2mA	4.5 6.0	— —	0.17 0.18	0.26 0.26	— —	0.33 0.33	
3 - State Output Off - State Current	I_{OZ}	V_{IN} = V_{IH} or V_{IL} V_{OUT} = V_{CC} or GND		6.0	—	—	± 0.5	—	± 5.0	μA
Input Leakage Current	I_{IN}	V_{IN} = V_{CC} or GND		6.0	—	—	± 0.1	—	± 1.0	
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		Ta = 25°C		Ta = −40~85°C	UNIT
			V_{CC} (V)	TYP.	LIMIT	LIMIT	
Minimum Pulse Width ($\overline{WE}$)	$t_{W(L)}$		2.0	—	75	95	ns
			4.5	—	15	19	
			6.0	—	13	16	
Minimum Set-up Time (Dn − $\overline{WE}$)	t_s		2.0	—	50	65	
			4.5	—	10	13	
			6.0	—	9	11	
Minimum Set-up Time (WA, WB − $\overline{WE}$)	t_s		2.0	—	0	0	
			4.5	—	0	0	
			6.0	—	0	0	
Minimum Hold Time (Dn − $\overline{WE}$)	t_h		2.0	—	5	5	
			4.5	—	5	5	
			6.0	—	5	5	
Minimum Hold Time (WA, WB − $\overline{WE}$)	t_h		2.0	—	0	0	
			4.5	—	0	0	
			6.0	—	0	0	
Minimum Latch Time ($\overline{WE}$ − RA, RB)	t_{latch}	Note(1)	2.0	—	75	95	
			4.5	—	15	19	
			6.0	—	13	16	

Note(1): t_{latch} is the time allowed for the internal output of the latch to assume the state of new data. This is important only when attempting to read from a location immediately after that location has received new data.

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 (RA, AB − Qn)	t_{pLH} t_{pHL}		—	23	34	
Propagation Delay Time ($\overline{WE}$ − Qn)	t_{pLH} t_{pHL}		—	24	38	
Propagation Delay Time (Dn − Qn)	t_{pLH} t_{pHL}		—	22	32	
3 − State Output Enable Time	t_{pZL} t_{pZH}	$R_L = 1k\Omega$	—	11	18	
3 − State Output Disable Time	t_{pLZ} t_{pHZ}	$R_L = 1k\Omega$	—	11	15	

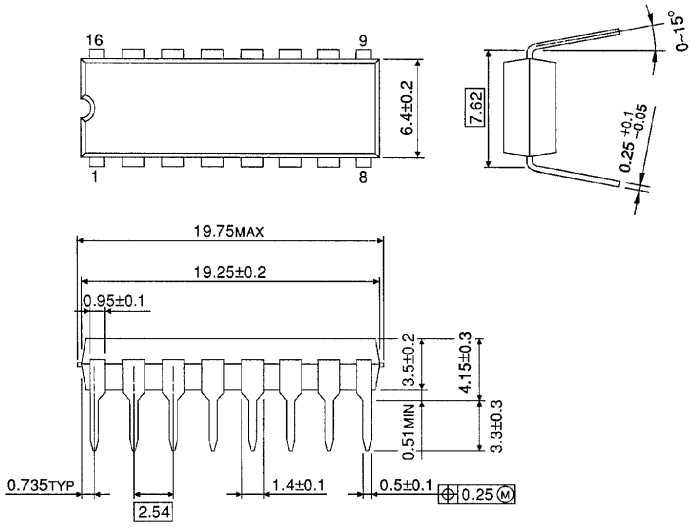
AC ELECTRICAL CHARACTERISTICS (C_L = 50pF, Input $t_r = t_f$ = 6ns)

PARAMETER	SYMBOL	TEST CONDITION		Ta = 25°C			Ta = −40~85°C		UNIT
			V_{CC} (V)	MIN.	TYP.	MAX.	MIN.	MAX.	
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 (RA, AB − Qn)	t_{pLH} t_{pHL}		2.0 4.5 6.0	− − −	90 27 22	195 39 33	− − −	245 49 42	
Propagation Delay Time ($\overline{WE}$ − Qn)	t_{pLH} t_{pHL}		2.0 4.5 6.0	− − −	95 28 22	220 44 37	− − −	275 55 47	
Propagation Delay Time (Dn − Qn)	t_{pLH} t_{pHL}		2.0 4.5 6.0	− − −	90 26 20	185 37 31	− − −	230 46 39	
Output Enable time	t_{pZH} t_{pZL}	R_L = 1kΩ	2.0 4.5 6.0	− − −	46 14 12	110 22 19	− − −	140 28 24	
Output Disable time	t_{pLZ} t_{pHZ}	R_L = 1kΩ	2.0 4.5 6.0	− − −	25 14 12	95 19 16	− − −	120 24 20	
Input Capacitance	C_{IN}			−	5	10	−	10	pF
Output Capacitance	C_{OUT}			−	10	−	−	−	
Power Dissipation Capacitance	C_{PD} (1)			−	101	−	−	−	

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:

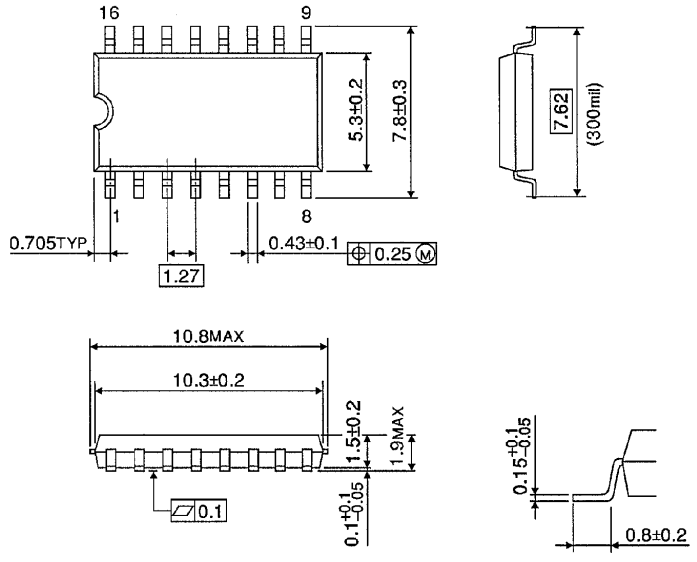
$$I_{CC}(opr) = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}$$

DIP 16PIN OUTLINE DRAWING (DIP16-P-300-2.54A) Unit in mm



Weight : 1.00g (Typ.)

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



Weight : 0.18g (Typ.)