TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

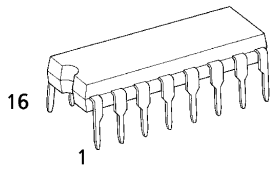
TC74HC173AP, TC74HC173AF

QUAD D – TYPE REGISTER (3 – STATE)

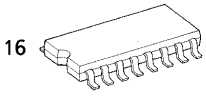
The TC74HC173A is a high speed CMOS D - TYPE REGISTER fabricated with silicon gate C^2MOS technology.
It achieves the high speed operation similar to equivalent LSTTL while maintaining the CMOS low power dissipation.
It consists a 4 - bit register consisting of D - type flip - flops and 3 - state buffers. The four flip - flops are controlled by a common clock input (CK) and a common clear input (CLR).
Signals applied to the data inputs (D1~D4) are stored in the respective flip - flops on the positive going transition of CK when clock control inputs (G1, G2) are held low.
The clear function is asynchronous to CK and active on a high level. The stored data are enabled to each outputs when output control inputs (M, N) are held low, else the outputs are high impedance state.
All inputs are equipped with protection circuits against static discharge or transient excess voltage.

FEATURES:

- High Speed ····· f_{MAX} = 47MHz(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 Immunity ····· 15 LSTTL Loads
- Symmetrical Output Impedance ··· $|I_{OH}| = I_{OL}$ = 6mA(Min.)
- Balanced Propagation Delays ····· $t_{pLH} \simeq t_{pHL}$
- Wide Operating Voltage Range ···· V_{CC} (opr.) = 2V~6V
- Pin and Function Compatible with 74LS173

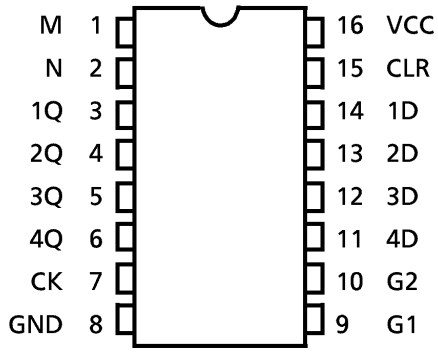


P (DIP16-P-300-2.54A)
Weight : 1.00g (Typ.)



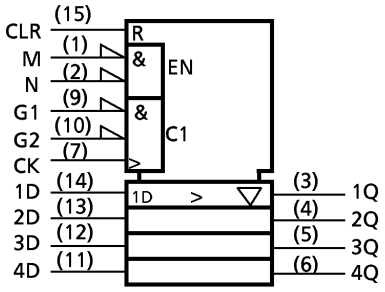
F (SOP16-P-300-1.27)
Weight : 0.18g (Typ.)

PIN ASSIGNMENT



(TOP VIEW)

IEC LOGIC SYMBOL



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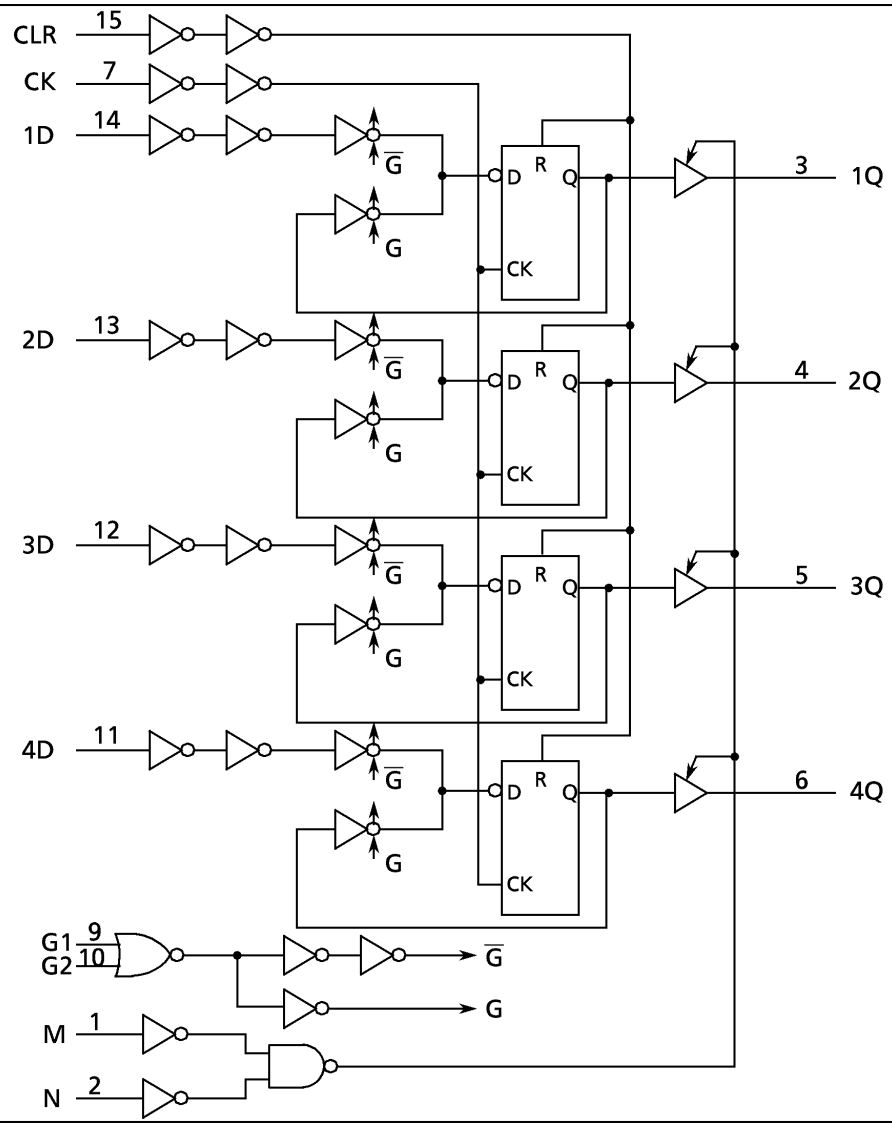
TRUTH TABLE

CLR	CK	DATA INABLE G1	DATA INABLE G2	Dn	OUTPUT CONTROL M	OUTPUT CONTROL N	Qn
X	X	X	X	X	H	X	Z
X	X	X	X	X	X	H	Z
H	X	X	X	X	L	L	L
L	↓	X	X	X	L	L	Q0
L	↑	H	X	X	L	L	Q0
L	↑	X	H	X	L	L	Q0
L	↑	L	L	H	L	L	H
L	↑	L	L	L	L	L	L

H : Don't Care

Z : High Impedance

SYSTEM DIAGRAM



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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}	± 35	mA
DC V_{CC} / Ground Current	I_{CC}	± 75	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 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} = −6 mA I_{OH} = −7.8mA	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} = 6 mA I_{OL} = 7.8mA	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	V_{CC} (V)	Ta = 25°C TYP.	Ta = 25°C LIMIT	Ta = −40~85°C LIMIT	UNIT
Minimum Pulse Width (CK)	$t_{W(L)}$ $t_{W(H)}$		2.0	—	75	95	ns
			4.5	—	15	19	
			6.0	—	13	16	
Minimum Pulse Width (CLR)	$t_{W(H)}$		2.0	—	75	95	
			4.5	—	15	19	
			6.0	—	13	16	
Minimum Set−up Time (G1, G2)	t_s		2.0	—	100	125	
			4.5	—	20	25	
			6.0	—	17	21	
Minimum Set−up Time (D)	t_s		2.0	—	75	95	
			4.5	—	15	19	
			6.0	—	13	16	
Minimum Hold Time (G1, G2, D)	t_h		2.0	—	0	0	
			4.5	—	0	0	
			6.0	—	0	0	
Minimum Removal Time (CLR)	t_{rem}		2.0	—	5	5	
			4.5	—	5	5	
			6.0	—	5	5	
Clock Frequency	f		2.0	—	9	7	
			4.5	—	43	34	
			6.0	—	51	40	

AC ELECTRICAL CHARACTERISTICS (Input $t_r = t_f = 6ns$)

PARAMETER	SYMBOL	TEST CONDITION	CL (pF)	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}		50	2.0	—	20	60	—	75	ns
				4.5	—	6	12	—	15	
				6.0	—	5	10	—	13	
Propagation Delay Time (CK−Q)	t_{pLH} t_{pHL}		50	2.0	—	50	115	—	145	
				4.5	—	15	23	—	29	
				6.0	—	12	20	—	25	
			150	2.0	—	65	155	—	195	
				4.5	—	20	31	—	39	
				6.0	—	16	26	—	33	
Propagation Delay Time (CLR−Q)	t_{pHL}		50	2.0	—	50	115	—	145	
				4.5	—	15	23	—	29	
				6.0	—	12	20	—	25	
			150	2.0	—	63	155	—	195	
				4.5	—	20	31	—	39	
				6.0	—	16	26	—	33	
Output Enable time	t_{pZL} t_{pZH}	$R_L = 1k\Omega$	50	2.0	—	50	115	—	145	
				4.5	—	15	23	—	29	
				6.0	—	12	20	—	25	
			150	2.0	—	63	115	—	195	
				4.5	—	20	31	—	39	
				6.0	—	16	26	—	33	
Output Disable time	t_{pLZ} t_{pHZ}	$R_L = 1k\Omega$	50	2.0	—	36	135	—	170	
				4.5	—	17	27	—	34	
				6.0	—	15	23	—	29	
Maximum Clock Frequency	f_{MAX}		50	2.0	9	20	—	7	—	MHz
				4.5	43	67	—	34	—	
				6.0	51	84	—	40	—	
Input Capacitance	C_{IN}				—	5	10	—	10	pF
Output Capacitance	C_{OUT}				—	10	—	—	—	
Power Dissipation Capacitance	C_{PD} (1)				—	45	—	—	—	

Note (1) C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

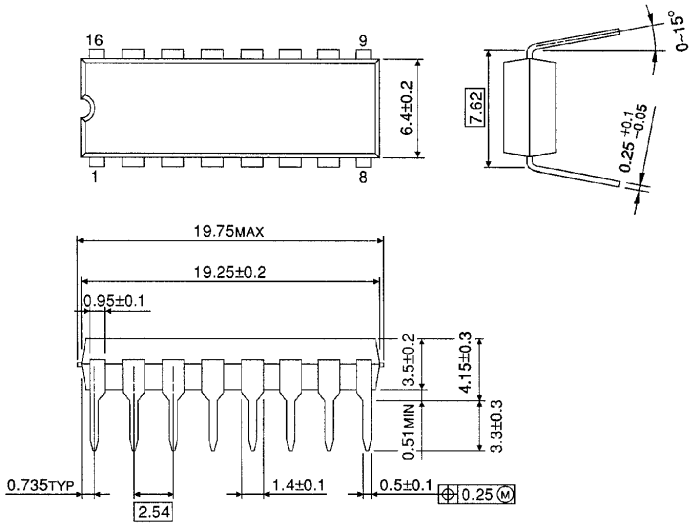
Average operating current can be obtained by the equation :

$$I_{CC}(opr) = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/4 \text{ (per Flip Flop)}$$

And the total C_{PD} when n pcs of Flip Flop operate be gained by the following equation :

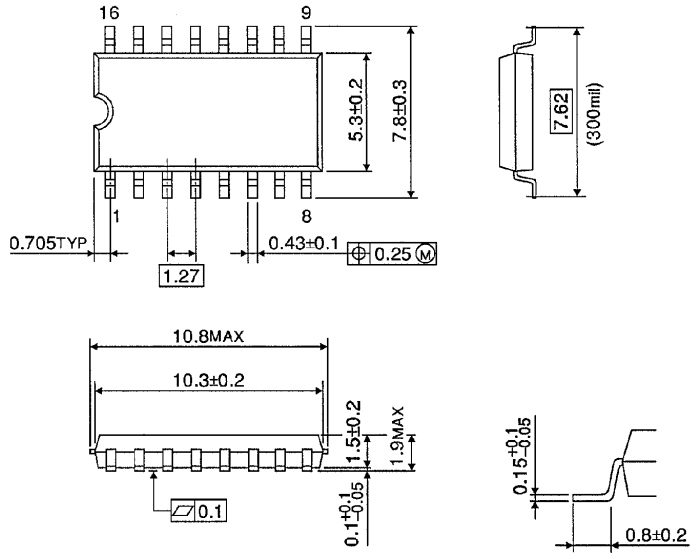
$$CPD(total) = 28 + 17 \cdot n$$

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.)