TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

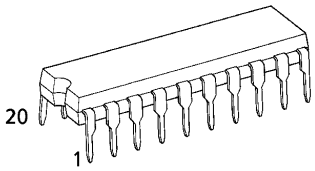
TC74HC697AP, TC74HC697AF

SYNCHRONOUS PRESETTABLE 4 – BIT BINARY UP/DOWN COUNTER WITH OUTPUT REGISTER (MULTIPLEXED 3 – STATE OUTPUTS)

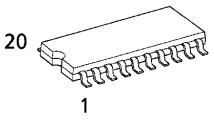
The TC74HC697A is high speed CMOS UP / DOWN COUNTERS fabricated with silicon gate C^2MOS technology.
It achieve the high speed operation similar to equivalent LSTTL while maintaining the CMOS low power dissipation.
It counts on the rising edge of the Counter Clock (CCK) input when "counter mode" is selected. If the up / down (U / $\overline{D}$) input is held high, the internal counter counts up. Conversely, if U / $\overline{D}$ is held low, it counts down.
The internal counters outputs are latched into the output registers on the rising edge of the Register Clock (RCK) input.
The outputs (QA ~ QD) are selected as either internal counter or registered outputs by the output select (R / $\overline{C}$) input. When high, the outputs are counter outputs and when low, they are registered outputs.
Two enable ($\overline{ENP}$, $\overline{ENT}$) inputs and a carry ($\overline{RCO}$) output are provided to enable cascading of the counters.
This facilitates easy implementation of n - bit counters without using external gates.
All inputs are equipped with protection circuits against static discharge or transient excess voltage.

FEATURES :

- High Speed ····· f_{MAX} = 38MHz (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 ····· 15 LSTTL Loads For QA ~ QD
  10 LSTTL Loads For $\overline{RCO}$
- Symmetrical Output Impedance ··· $|I_{OH}| = I_{OL}$ = 6mA (Min.) For QA ~ QD
  $|I_{OH}| = I_{OL}$ = 4mA (Min.) For $\overline{RCO}$
- Balanced Propagation Delays ··· $t_{pLH} \simeq t_{pHL}$
- Wide Operating Voltage Range ··· V_{CC} (opr.) = 2V ~ 6V
- Pin and Function Compatible with 74LS697

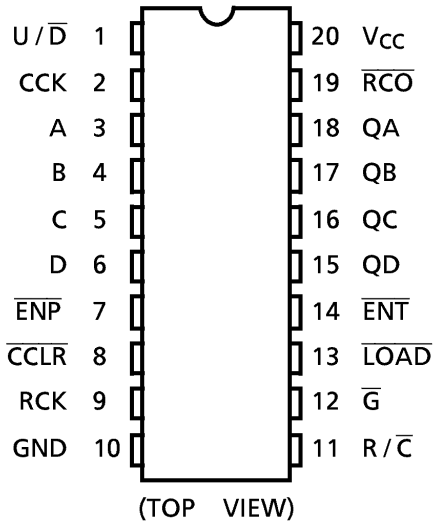


P (DIP20-P-300-2.54A)
Weight : 1.30g (Typ.)



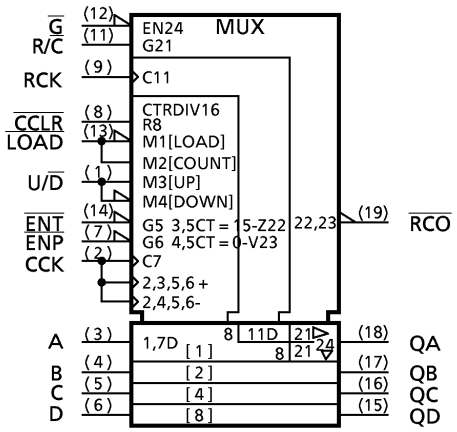
F (SOP20-P-300-1.27)
Weight : 0.22g (Typ.)

PIN ASSIGNMENT



980508EBA2

IEC LOGIC SYMBOL



980508EBA2'

TRUTH TABLE

INPUTS									OUTPUTS				FUNCTION
$\overline{CCLR}$	$\overline{LOAD}$	$\overline{ENP}$	$\overline{ENT}$	CCK	U / $\overline{D}$	RCK	R / $\overline{C}$	$\overline{G}$	QA	QB	QC	QD	
X	X	X	X	X	X	X	X	H	Z	Z	Z	Z	HIGH INPEDANCE
L	X	X	X	X	X	X	L	L	L	L	L	L	CLEAR COUNTER
H	L	X	X	↑	X	X	L	L	a	b	c	d	LOAD COUNTER
H	H	H	X	↑	X	X	L	L	NO CHANGE				NO COUNT
H	H	X	H	↑	X	X	L	L					
H	H	L	L	↑	H	X	L	L	COUNT UP				COUNT
H	H	L	L	↑	L	X	L	L	COUNT DOWN				COUNT
H	X	X	X	↓	X	X	L	L	NO CHANGE				NO COUNT
X	X	X	X	X	X	↑	H	L	a′	b′	c′	d′	LOAD REGISTER
X	X	X	X	X	X	↓	H	L	NO CHANGE				NO COUNT

X : Don't Care

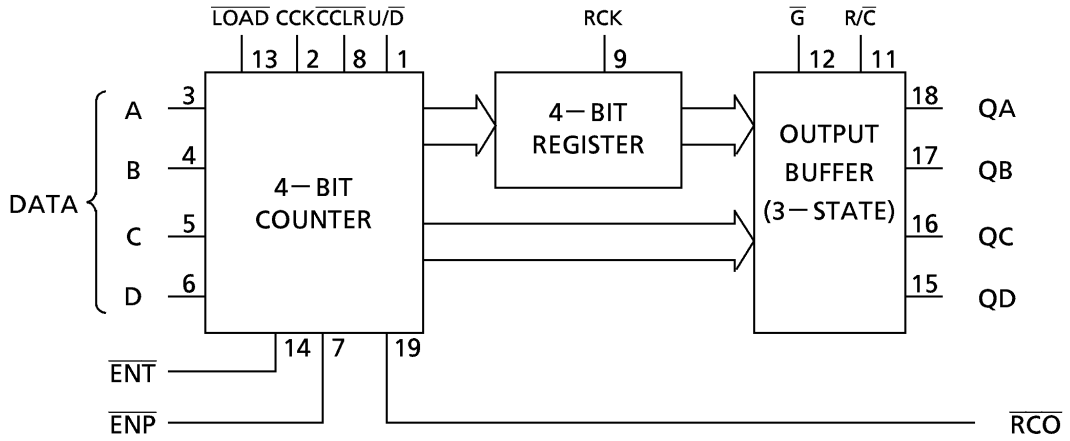
Z : High Impedance

a~d : The level of steady state inputs at inputs A through D respectively.

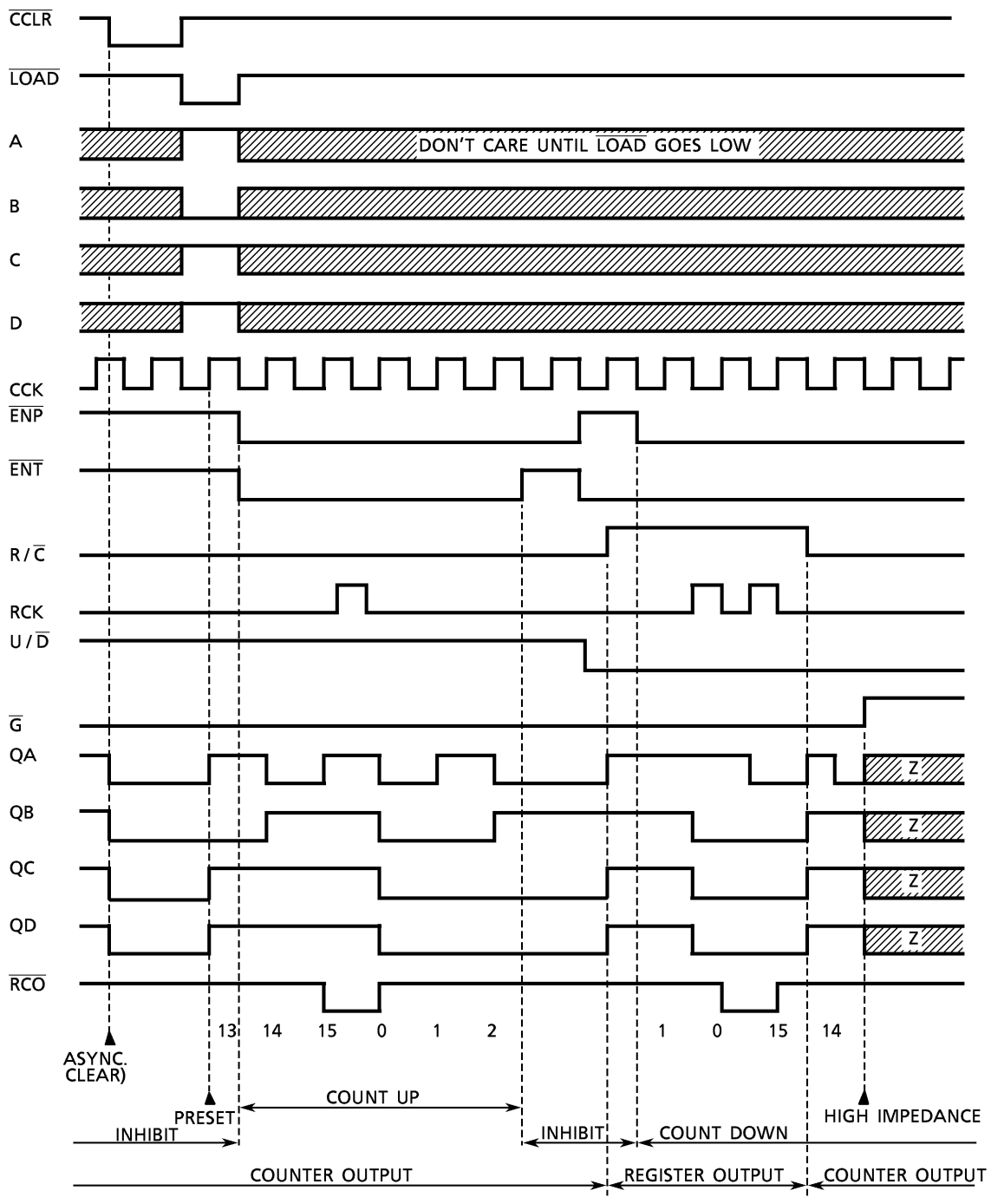
a′~d′ : The level of steady atate outputs at internal counter outputs QA′ through QD′ respectively.

$\overline{RCO} = (UP \cdot QA \cdot QB \cdot QC \cdot QD \cdot ENT + \overline{UP} \cdot \overline{QA} \cdot \overline{QB} \cdot \overline{QC} \cdot \overline{QD} \cdot ENT)$

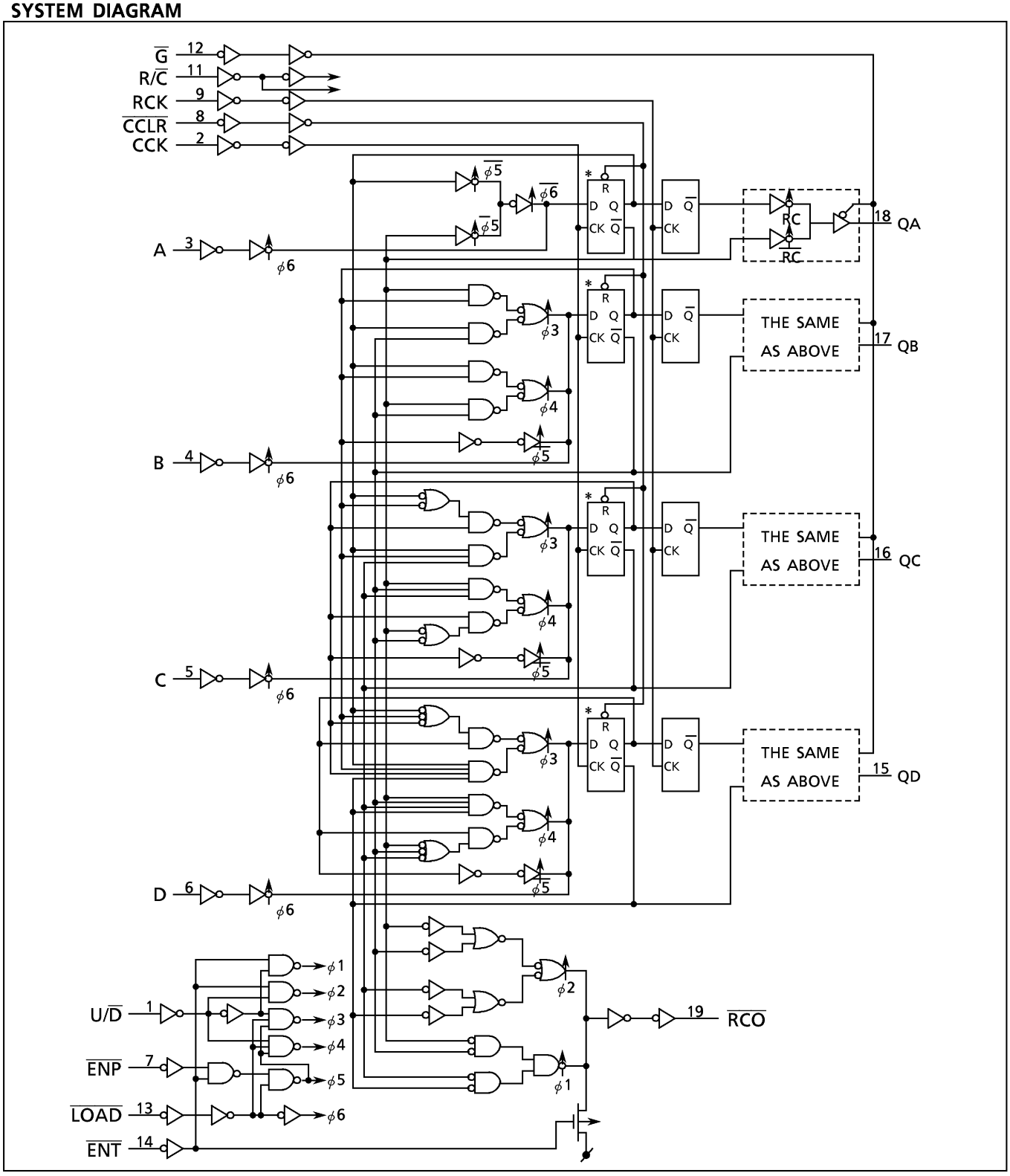
BLOCK DIAGRAM



TIMING CHART



SYSTEM DIAGRAM



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 ($\overline{RCO}$) (Q_A~Q_D)	I_{OUT}	±25 ±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
		$\overline{RCO}$	I_{OH} = −4 mA I_{OH} = −5.2mA	4.5 6.0	4.18 5.68	4.31 5.80	— —	4.13 5.63	— —	
		Q_A ~ Q_H	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
		$\overline{RCO}$	I_{OL} = 4 mA I_{OL} = 5.2mA	4.5 6.0	— —	0.17 0.18	0.26 0.26	— —	0.33 0.33	
		Q_A ~ Q_H	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		4.5 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 (CCK, $\overline{RCK}$)	$t_{W(L)}$ $t_{W(H)}$		2.0	—	75	95	ns
			4.5	—	15	19	
			6.0	—	13	16	
Minimum Pulse Width ($\overline{CCLR}$)	$t_{W(L)}$		2.0	—	75	95	
			4.5	—	15	19	
			6.0	—	13	16	
Minimum Set−up Time ($\overline{LOAD}$, $\overline{ENT}$, $\overline{ENP}$)	t_s		2.0	—	150	190	
			4.5	—	30	38	
			6.0	—	13	32	
Minimum Set−up Time (A, B, C, D)	t_s		2.0	—	50	65	
			4.5	—	10	13	
			6.0	—	9	11	
Minimum Set−up Time (U / $\overline{D}$)	t_s		2.0	—	100	125	
			4.5	—	20	25	
			6.0	—	17	21	
Minimum Set−up Time (CCK−RCK)	t_s		2.0	—	100	125	
			4.5	—	20	25	
			6.0	—	17	21	
Minimum Hold Time (A, B, C, D)	t_h		2.0	—	5	5	
			4.5	—	5	5	
			6.0	—	5	5	
Minimum Hold Time	t_h		2.0	—	0	0	
			4.5	—	0	0	
			6.0	—	0	0	
Minimum Removal Time	t_{rem}		2.0	—	5	5	
			4.5	—	5	5	
			6.0	—	5	5	
Clock Frequency	f		2.0	—	5	4	MHz
			4.5	—	25	20	
			6.0	—	29	24	

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 ($\overline{RCO}$)	t_{TLH} t_{THL}		—	4	8	ns
Propagation Delay Time (CCK−$\overline{RCO}$)	t_{pLH} t_{pHL}		—	24	41	
Propagation Delay Time (ENT−$\overline{RCO}$)	t_{pLH} t_{pHL}		—	13	23	
Propagation Delay Time ($\overline{CCLR}$−$\overline{RCO}$)	t_{pLH}		—	23	38	
Maximum Clock Frequency	f_{MAX}		25	38	—	MHz

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

PARAMETER	SYMBOL	TEST CONDITION			Ta = 25°C			Ta = −40~85°C		UNIT
			CL (pF)	V_{CC} (V)	MIN.	TYP.	MAX.	MIN.	MAX.	
Output Transition Time (Qn)	t_{TLH} t_{THL}		50	2.0	—	25	60	—	75	ns
				4.5	—	7	12	—	15	
				6.0	—	6	10	—	13	
Output Transition Time ($\overline{RCO}$)	t_{pLH} t_{pHL}		50	2.0	—	30	75	—	95	
				4.5	—	8	15	—	19	
				6.0	—	7	13	—	16	
Propagation Delay Time (CCK − Q)	t_{pLH} t_{pHL}		50	2.0	—	90	195	—	245	
				4.5	—	26	39	—	49	
				6.0	—	19	33	—	42	
			150	2.0	—	103	235	—	295	
				4.5	—	31	47	—	59	
				6.0	—	23	40	—	50	
Propagation Delay Time (RCK − Q)	t_{pLH} t_{pHL}		50	2.0	—	82	180	—	225	
				4.5	—	24	36	—	45	
				6.0	—	18	31	—	38	
			150	2.0	—	95	220	—	275	
				4.5	—	29	44	—	55	
				6.0	—	22	37	—	47	
Propagation Delay Time (R / $\overline{C}$ − Q)	t_{pLH} t_{pHL}		50	2.0	—	60	145	—	180	
				4.5	—	19	29	—	36	
				6.0	—	14	25	—	31	
			150	2.0	—	73	185	—	230	
				4.5	—	24	37	—	46	
				6.0	—	18	31	—	39	
Propagation Delay Time ($\overline{CCLR}$ − Q)	t_{pHL}		50	2.0	—	89	195	—	245	
				4.5	—	26	39	—	49	
				6.0	—	20	33	—	42	
			150	2.0	—	102	235	—	295	
				4.5	—	31	47	—	59	
				6.0	—	24	40	—	50	
Propagation Delay Time (CCK − $\overline{RCO}$)	t_{pLH} t_{pHL}		50	2.0	—	108	235	—	295	
				4.5	—	31	47	—	59	
				6.0	—	23	40	—	50	
Propagation Delay Time ($\overline{ENT}$ − $\overline{RCO}$)	t_{pLH} t_{pHL}		50	2.0	—	63	135	—	170	
				4.5	—	18	27	—	34	
				6.0	—	14	23	—	29	
Propagation Delay Time ($\overline{CCLR}$ − $\overline{RCO}$)	t_{pLH}		50	2.0	—	98	220	—	275	
				4.5	—	29	44	—	55	
				6.0	—	23	37	—	47	

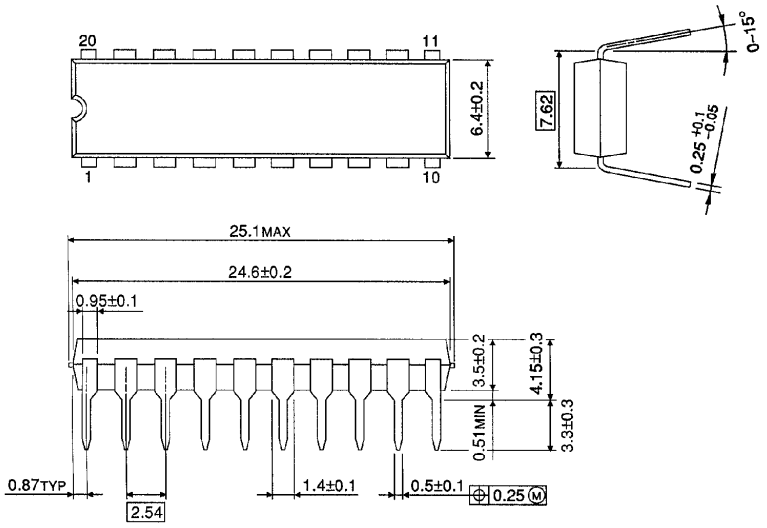
AC ELECTRICAL CHARACTERISTICS (Input $t_r = t_f = 6ns$)

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 Enable Time ($\overline{G}-Q$)	t_{pZL} t_{pZH}	$R_L = 1k\Omega$	50	2.0	—	45	115	—	145	ns
				4.5	—	15	23	—	29	
				6.0	—	12	20	—	25	
			150	2.0	—	58	155	—	195	
				4.5	—	20	31	—	39	
				6.0	—	16	26	—	33	
Output Disable Time ($\overline{G}-Q$)	t_{pLZ} t_{pHZ}	$R_L = 1k\Omega$	50	2.0	—	32	115	—	145	
				4.5	—	17	23	—	29	
				6.0	—	14	20	—	25	
Maximum Clock Frequency	f_{MAX}		50	2.0	5	11	—	4	—	MHz
				4.5	25	38	—	20	—	
				6.0	29	52	—	24	—	
Input Capacitance	C_{IN}				—	5	10	—	10	pF
Output Capacitance	C_{OUT}				—	13	—	—	—	
Power Dissipation Capacitance	C_{PD} (1)				—	72	—	—	—	

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:

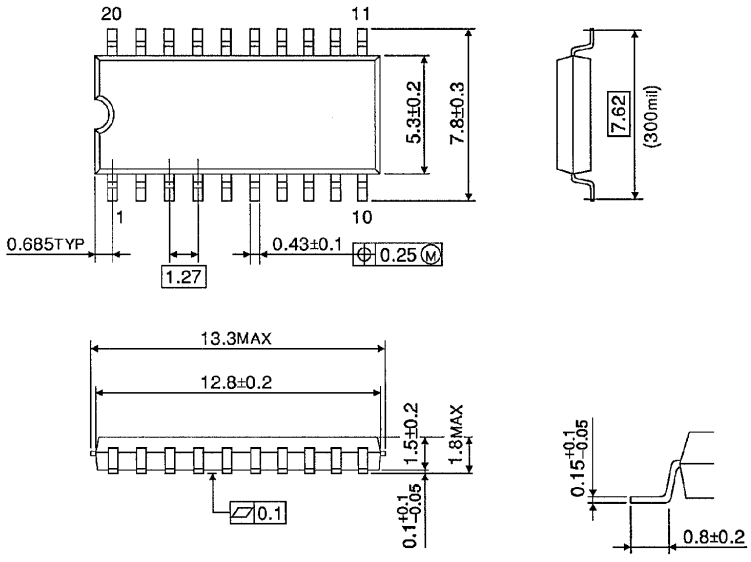
$$I_{CC}(opr) = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}$$

DIP 20PIN OUTLINE DRAWING (DIP20-P-300-2.54A) Unit in mm



Weight : 1.30g (Typ.)

SOP 20PIN (200mil BODY) OUTLINE DRAWING (SOP20-P-300-1.27) Unit in mm



Weight : 0.22g (Typ.)