TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

TC74VHC374F, TC74VHC374FW, TC74VHC374FT

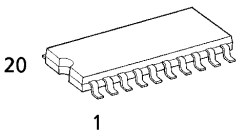
OCTAL D-TYPE FLIP-FLOP WITH 3-STATE OUTPUT

The TC74VHC374 is an advanced high speed CMOS OCTAL FLIP-FLOP with 3-STATE OUTPUT fabricated with silicon gate C²MOS technology.
It achieves the high speed operation similar to equivalent Bipolar Schottky TTL while maintaining the CMOS low power dissipation.
This 8-bit D-type flip-flop is controlled by a clock input (CK) and a output enable input ($\overline{OE}$).
When the $\overline{OE}$ input is high, the eight outputs are in a high impedance state.
An input protection circuit ensures that 0 to 7V can be applied to the input pins without regard to the supply voltage. This device can be used to interface 5V to 3V systems and two supply systems such as battery back up. This circuit prevents device destruction due to mismatched supply and input voltages.

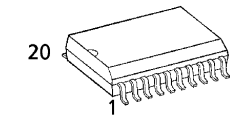
FEATURES:

- High Speed····· f_{MAX} = 185MHz(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.)
- Power Down Protection is provided on all inputs.
- Balanced Propagation Delays····· $t_{pLH} \simeq t_{pHL}$
- Wide Operating Voltage Range···· V_{CC} (opr) = 2V~5.5V
- Low Noise ····· V_{OLP} = 0.9V (Max.)
- Pin and Function Compatible with 74ALS374

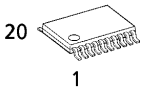
(Note) The JEDEC SOP (FW) is not available in Japan.



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

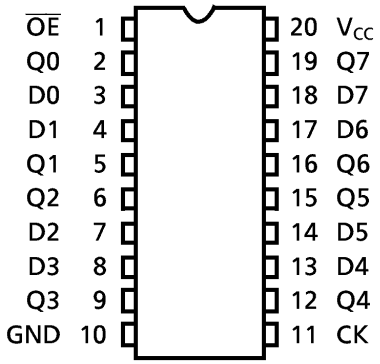


FW (SOL20-P-300-1.27)
Weight : 0.46g (Typ.)



FT (TSSOP20-P-0044-0.65)
Weight : 0.08g (Typ.)

PIN ASSIGNMENT



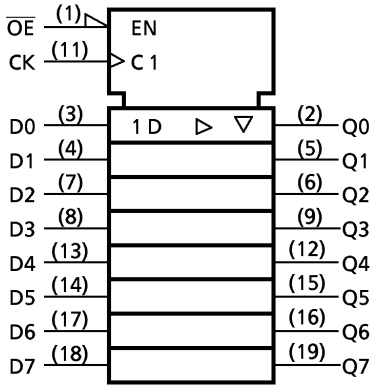
(TOP VIEW)

TRUTH TABLE

INPUTS			OUTPUT
$\overline{OE}$	CK	D	
H	X	X	Z
L	↓	X	Q_n
L	↑	L	L
L	↑	H	H

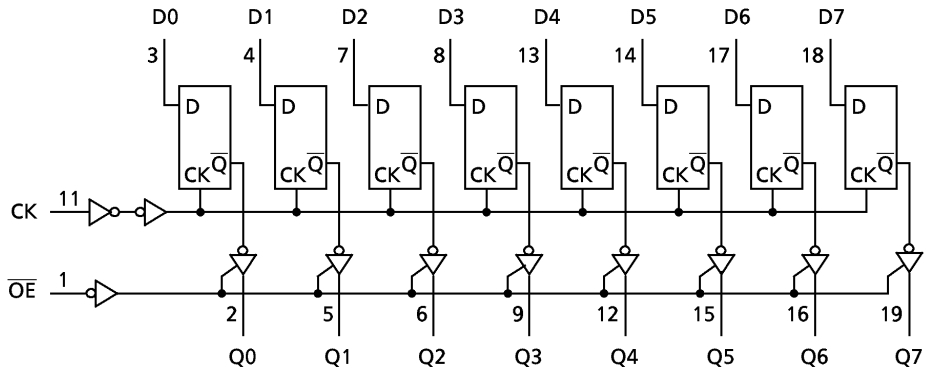
X : Don't Care
Z : High Impedance
Q_n : No Change

IEC LOGIC SYMBOL



961001EBA2

SYSTEM DIAGRAM



ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	VALUE	UNIT
Supply Voltage Range	V_{CC}	−0.5~7.0	V
DC Input Voltage	V_{IN}	−0.5~7.0	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}	±75	mA
Power Dissipation	P_D	180	mW
Storage Temperature	T_{stg}	−65~150	°C

RECOMMENDED OPERATING CONDITIONS

PARAMETER	SYMBOL	VALUE	UNIT
Supply Voltage	V_{CC}	2.0~5.5	V
Input Voltage	V_{IN}	0~5.5	V
Output Voltage	V_{OUT}	0~V_{CC}	V
Operating Temperature	T_{opr}	−40~85	°C
Input Rise and Fall Time	dt / dv	0~100 (V_{CC} = 3.3 ± 0.3V) 0~20 (V_{CC} = 5 ± 0.5V)	ns / V

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	1.50	—	—	1.50	—	V
				3.0~5.5	$V_{CC}\times0.7$	—	—	$V_{CC}\times0.7$	—	
Low - Level Input Voltage	V_{IL}			2.0	—	—	0.50	—	0.50	V
				3.0~5.5	—	—	$V_{CC}\times0.3$	—	$V_{CC}\times0.3$	
High - Level Output Voltage	V_{OH}	V_{IN} = V_{IH} or V_{IL}	I_{OH} = −50μA	2.0	1.9	2.0	—	1.9	—	V
				3.0	2.9	3.0	—	2.9	—	
				4.5	4.4	4.5	—	4.4	—	
			I_{OH} = −4mA	3.0	2.58	—	—	2.48	—	
			I_{OH} = −8mA	4.5	3.94	—	—	3.80	—	
Low - Level Output Voltage	V_{OL}	V_{IN} = V_{IH} or V_{IL}	I_{OL} = 50μA	2.0	—	0.0	0.1	—	0.1	V
				3.0	—	0.0	0.1	—	0.1	
				4.5	—	0.0	0.1	—	0.1	
			I_{OL} = 4mA	3.0	—	—	0.36	—	0.44	
			I_{OL} = 8mA	4.5	—	—	0.36	—	0.44	
3 - State Output Off - State Current	I_{OZ}	V_{IN} = V_{IH} or V_{IL} V_{OUT} = V_{CC} or GND		5.5	—	—	±0.25	—	±2.50	μA
Input Leakage Current	I_{IN}	V_{IN} = 5.5V or GND		0~5.5	—	—	±0.1	—	±1.0	
Quiescent Supply Current	I_{CC}	V_{IN} = V_{CC} or GND		5.5	—	—	4.0	—	40.0	

TIMING REQUIREMENTS (Input $t_r = t_f$ = 3ns)

PARAMETER	SYMBOL	TEST CONDITION	V_{CC} (V)	Ta = 25°C		Ta = −40~85°C	UNIT
				TYP .	LIMIT	LIMIT	
Minimum Pulse Width (CK)	$t_{W(H)}$		3.3 ± 0.3	—	5.0	5.5	ns
	$t_{W(L)}$		5.0 ± 0.5	—	5.0	5.0	
Minimum Set - up Time	t_s		3.3 ± 0.3	—	4.5	4.5	
			5.0 ± 0.5	—	3.0	3.0	
Minimum Hold Time	t_h		3.3 ± 0.3	—	2.0	2.0	
			5.0 ± 0.5	—	2.0	2.0	

AC ELECTRICAL CHARACTERISTICS (Input $t_r = t_f = 3ns$)

PARAMETER	SYMBOL	TEST CONDITION			Ta = 25°C			Ta = −40~85°C		UNIT
			V_{CC} (V)	CL (pF)	MIN.	TYP.	MAX.	MIN.	MAX.	
Propagation Delay Time (CK-Q)	t_{pLH} t_{pHL}		3.3 ± 0.3	15	−	8.1	12.7	1.0	15.0	ns
				50	−	10.6	16.2	1.0	18.5	
			5.0 ± 0.5	15	−	5.4	8.1	1.0	9.5	
				50	−	6.9	10.1	1.0	11.5	
3-State Output Enable Time	t_{pZL} t_{pZH}	RL = 1kΩ	3.3 ± 0.3	15	−	7.1	11.0	1.0	13.0	
				50	−	9.6	14.5	1.0	16.5	
			5.0 ± 0.5	15	−	5.1	7.6	1.0	9.0	
				50	−	6.6	9.6	1.0	11.0	
3-State Output Disable Time	t_{pLZ} t_{pHZ}	RL = 1kΩ	3.3 ± 0.3	50	−	10.2	14.0	1.0	16.0	
			5.0 ± 0.5	50	−	6.1	8.8	1.0	10.0	
Maximum Clock Frequency	f_{MAX}		3.3 ± 0.3	15	80	130	−	70	−	MHZ
				50	55	85	−	50	−	
			5.0 ± 0.5	15	130	185	−	110	−	
				50	85	120	−	75	−	
Output to Output Skew	t_{osLH} t_{osHL}	(Note 1)	3.3 ± 0.3	50	−	−	1.5	−	1.5	ns
			5.0 ± 0.5	50	−	−	1.0	−	1.0	
Input Capacitance	C_{IN}				−	4	10	−	10	pF
Output Capacitance	C_{OUT}				−	6	−	−	−	
Power Dissipation Capacitance	C_{PD}	(Note 2)			−	32	−	−	−	

Note (1) Parameter guaranteed by design. $t_{osLH} = |t_{pLHm} - t_{pLHn}|$, $t_{osHL} = |t_{pHLm} - t_{pHLn}|$

Note (2) 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:

$$I_{CC(opr.)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC} / 8 \text{ (per F/F)}$$

And the total C_{PD} when n pcs. of Latch operate can be gained by the following equation:

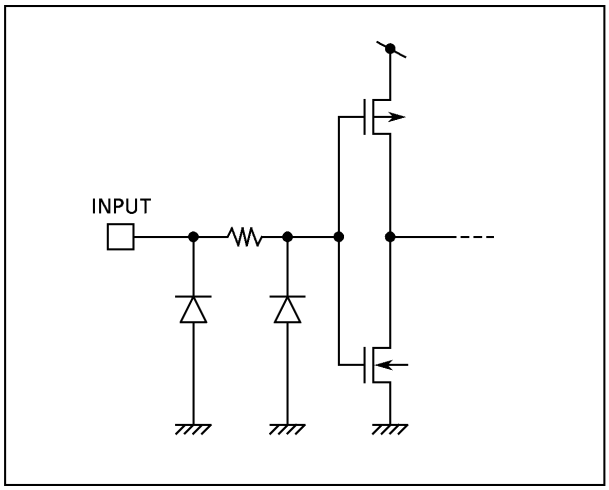
$$C_{PD} \text{ (total)} = 20 + 12 \cdot n$$

NOISE CHARACTERISTICS (Input $t_r = t_f = 3ns$)

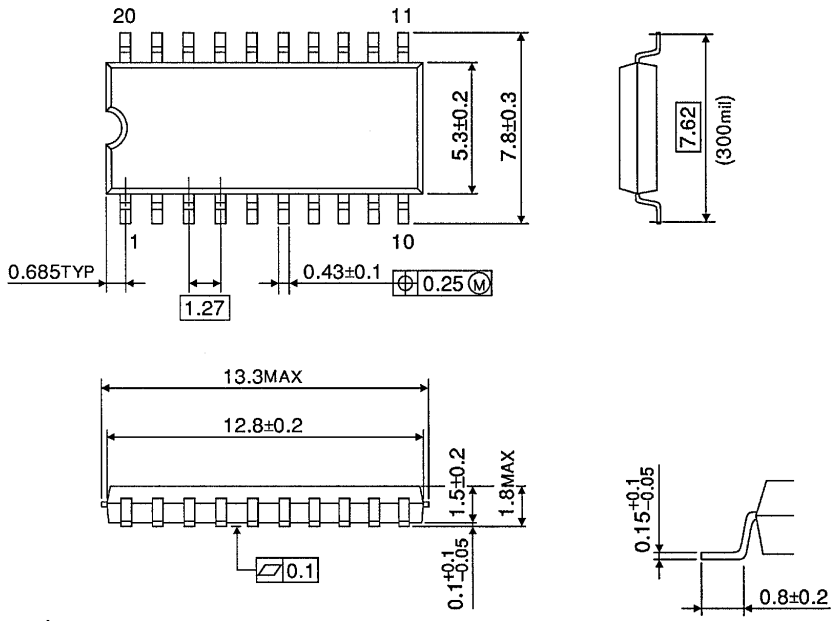
PARAMETER	SYMBOL	TEST CONDITION		Ta = 25°C		UNIT
			V_{CC} (V)	TYP.	MAX.	
Quiet Output Maximum Dynamic V_{OL}	V_{OLP}	C_L = 50pF	5.0	0.5 (0.6)	0.8 (0.9)	V
Quiet Output Minimum Dynamic V_{OL}	V_{OLV}	C_L = 50pF	5.0	−0.5 (−0.6)	−0.8 (−0.9)	V
Minimum High Level Dynamic Input Voltage	V_{IHD}	C_L = 50pF	5.0	−	3.5	V
Maximum Low Level Dynamic Input Voltage	V_{ILD}	C_L = 50pF	5.0	−	1.5	V

(Note) The value in ( ) only applies to JEDEC SOP (FW) devices.

INPUT EQUIVALENT CIRCUIT



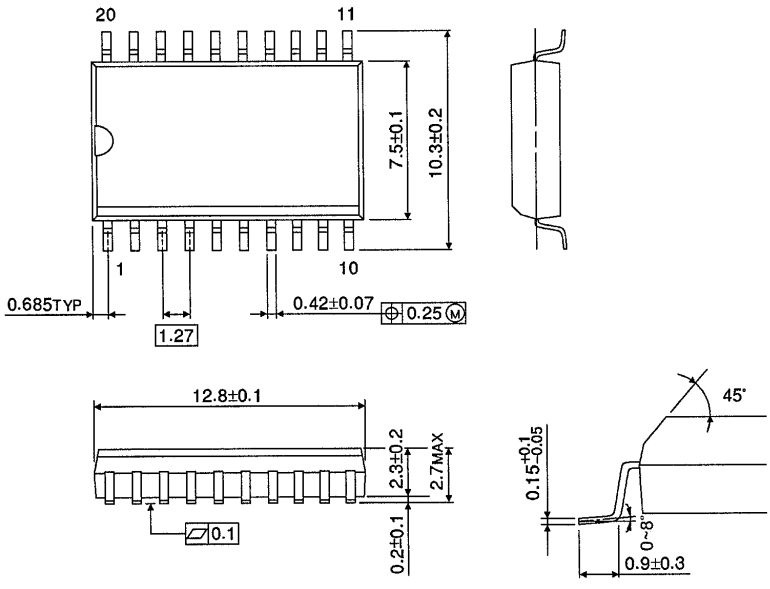
SOP 20PIN (200mil BODY) OUTLINE DRAWING (SOP20-P-300-1.27) Unit in mm



Weight : 0.22g (Typ.)

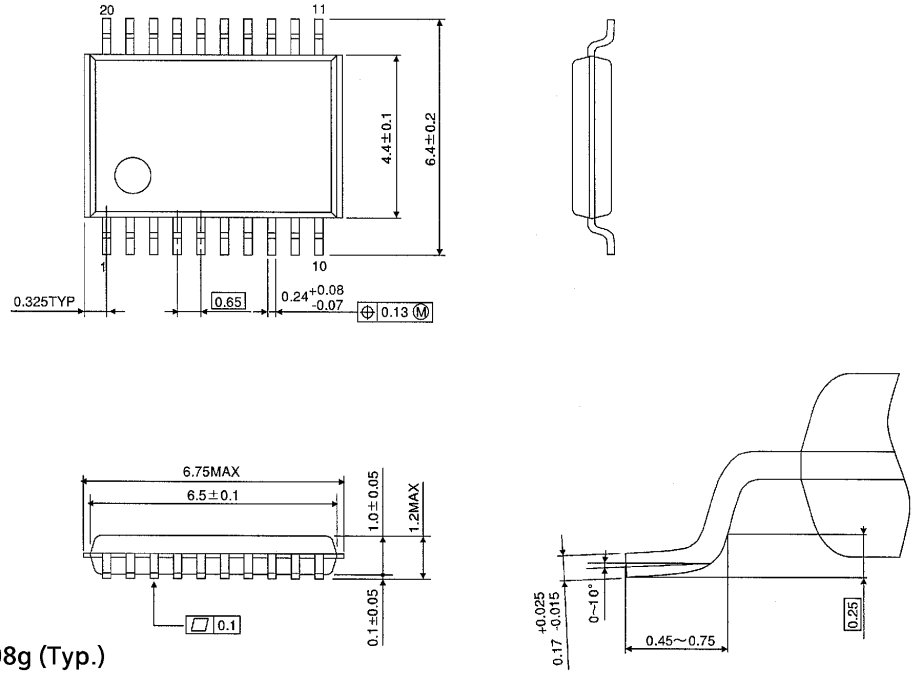
SOP 20PIN (300mil BODY) OUTLINE DRAWING (SOL20-P-300-1.27) Unit in mm

(Note) This package is not available in Japan.



Weight : 0.46g (Typ.)

TSSOP 20PIN OUTLINE DRAWING (TSSOP20-P-0044-0.65) Unit in mm



Weight : 0.08g (Typ.)