

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC74VHC164F, TC74VHC164FK

8-Bit Shift Register (S-IN, P-OUT)

The TC74VHC164 is an advanced high speed CMOS 8-BIT SERIAL-IN PARALLEL-OUT SHIFT REGISTER 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.

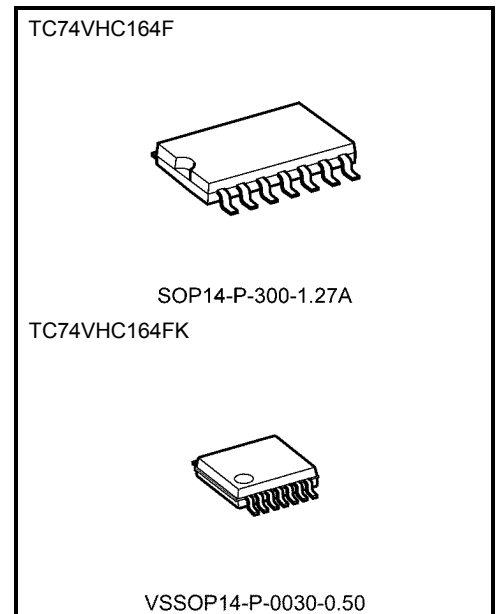
It consists of a serial-in, parallel-out 8-bit shift register with a CLOCK input and an overriding CLEAR input.

Two serial data inputs (A, B) are provided so that one may be used as a data enable.

An input protection circuit ensures that 0 to 5.5 V can be applied to the input pins without regard to the supply voltage. This device can be used to interface 5 V to 3 V 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: $f_{max} = 175$ MHz (typ.) at $V_{CC} = 5$ V
- Low power dissipation: $I_{CC} = 4$ μ A (max) at $T_a = 25^\circ$ C
- High noise immunity: $V_{NIH} = V_{NIL} = 28\%$ V_{CC} (min)
- Power down protection is provided on all inputs.
- Balanced propagation delays: $t_{pLH} \approx t_{pHL}$
- Wide operating voltage range: $V_{CC} (opr) = 2$ to 5.5 V
- Low noise: $V_{OLP} = 0.8$ V (max)
- Pin and function compatible with 74ALS164

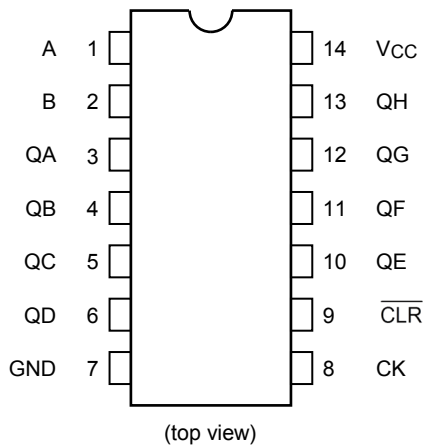


Weight

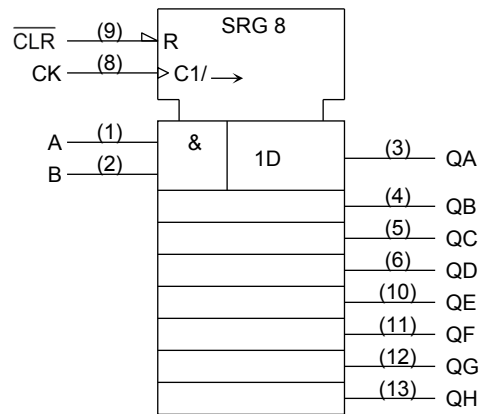
SOP14-P-300-1.27A	: 0.18 g (typ.)
VSSOP14-P-0030-0.50	: 0.02 g (typ.)

Start of commercial production
1991-11

Pin Assignment



IEC Logic Symbol



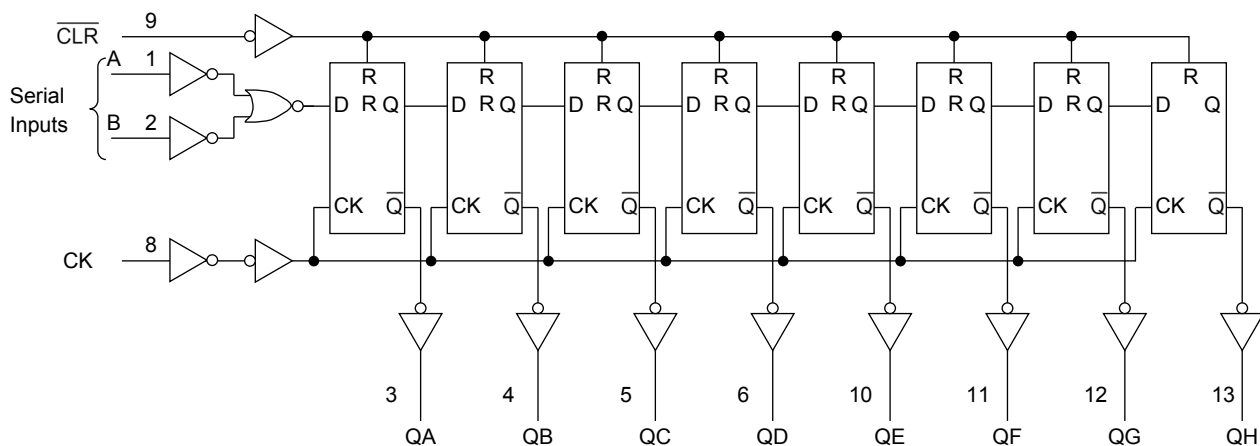
Truth Table

Inputs				Outputs			
$\overline{\text{CLR}}$	CK	Serial IN		QA	QB	...	QH
		A	B				
L	X	X	X	L	L	...	L
H		X	X	No Change			
H		L	X	L	QA _n	...	QG _n
H		X	L	L	QA _n	...	QG _n
H		H	H	H	QA _n	...	QG _n

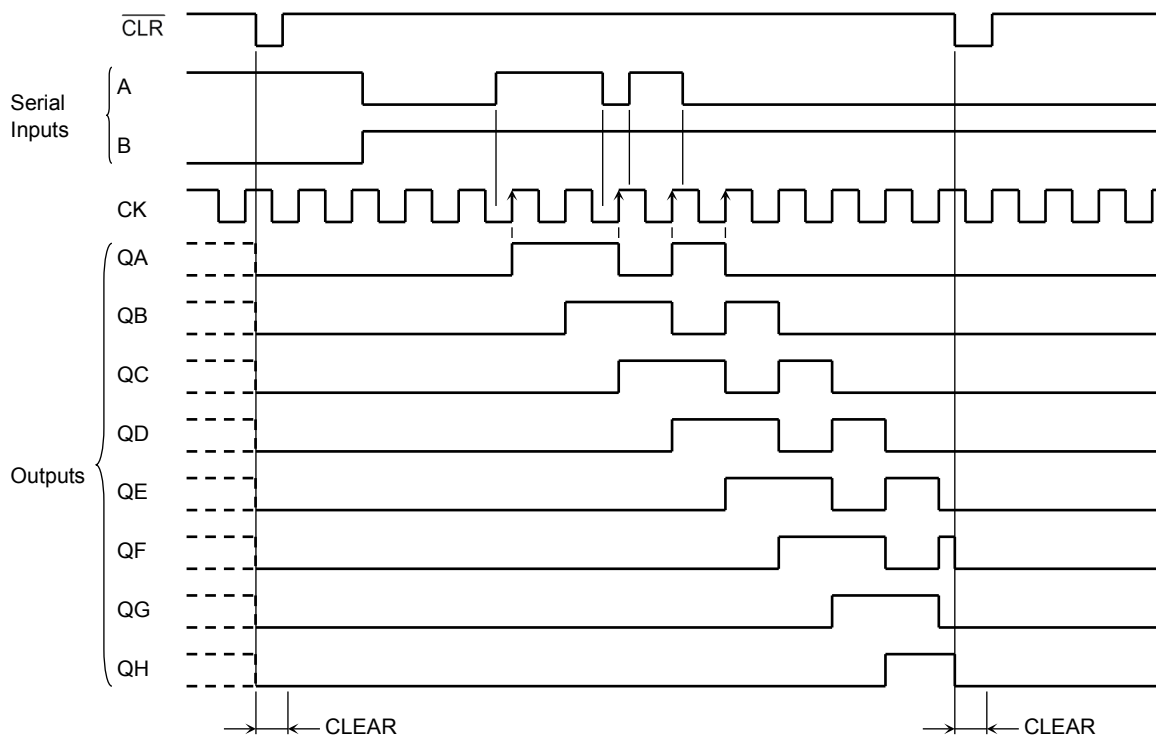
X: Don't care

QA_n to QG_n: The level of QA to QG, respectively, before the most recent positive edge of the clock.

System Diagram



Timing Chart



Absolute Maximum Ratings (Note)

Characteristics	Symbol	Rating	Unit
Supply voltage range	V_{CC}	-0.5 to 7.0	V
DC input voltage	V_{IN}	-0.5 to 7.0	V
DC output voltage	V_{OUT}	-0.5 to $V_{CC} + 0.5$	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 to 150	$^{\circ}C$

Note: Exceeding any of the absolute maximum ratings, even briefly, lead to deterioration in IC performance or even destruction. Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings and the operating ranges. Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

Operating Ranges (Note)

Characteristics	Symbol	Rating	Unit
Supply voltage	V _{CC}	2.0 to 5.5	V
Input voltage	V _{IN}	0 to 5.5	V
Output voltage	V _{OUT}	0 to V _{CC}	V
Operating temperature	T _{opr}	-40 to 85	°C
Input rise and fall time	dt/dv	0 to 100 (V _{CC} = 3.3 ± 0.3 V) 0 to 20 (V _{CC} = 5 ± 0.5 V)	ns/V

Note: The operating ranges must be maintained to ensure the normal operation of the device.
Unused inputs must be tied to either V_{CC} or GND.

Electrical Characteristics

DC Characteristics

Characteristics	Symbol	Test Condition	Ta = 25°C			Ta = -40 to 85°C		Unit		
			V _{CC} (V)	Min	Typ.	Max	Min		Max	
High-level input voltage	V _{IH}	—	2.0 3.0 to 5.5	1.50 V _{CC} × 0.7	— —	— —	1.50 V _{CC} × 0.7	— —	V	
Low-level input voltage	V _{IL}	—	2.0 3.0 to 5.5	— —	— —	0.50 V _{CC} × 0.3	— —	0.50 V _{CC} × 0.3	V	
High-level output voltage	V _{OH}	V _{IN} = V _{IH} or V _{IL}	I _{OH} = -50 μA	2.0 3.0 4.5	1.9 2.9 4.4	2.0 3.0 4.5	— — —	1.9 2.9 4.4	— — —	V
			I _{OH} = -4 mA	3.0	2.58	—	—	2.48	—	
			I _{OH} = -8 mA	4.5	3.94	—	—	3.80	—	
Low-level output voltage	V _{OL}	V _{IN} = V _{IH} or V _{IL}	I _{OL} = 50 μA	2.0 3.0 4.5	— — —	0.0 0.0 0.0	0.1 0.1 0.1	— — —	0.1 0.1 0.1	V
			I _{OL} = 4 mA	3.0	—	—	0.36	—	0.44	
			I _{OL} = 8 mA	4.5	—	—	0.36	—	0.44	
Input leakage current	I _{IN}	V _{IN} = 5.5 V or GND	0 to 5.5	—	—	±0.1	—	±1.0	μA	
Quiescent supply current	I _{CC}	V _{IN} = V _{CC} or GND	5.5	—	—	4.0	—	40.0	μA	

Timing Requirements (input: $t_r = t_f = 3$ ns)

Characteristics	Symbol	Test Condition	Ta = 25°C			Ta = -40 to 85°C	Unit
			VCC (V)	Typ.	Limit	Limit	
Minimum pulse width (CK)	$t_w(L)$	—	3.3 ± 0.3	—	5.0	5.0	ns
	$t_w(H)$		5.0 ± 0.5	—	5.0	5.0	
Minimum pulse width (CLR)	$t_w(L)$	—	3.3 ± 0.3 5.0 ± 0.5	— —	5.0 5.0	5.0 5.0	ns
Minimum set-up time	t_s	—	3.3 ± 0.3 5.0 ± 0.5	— —	5.0 4.5	6.0 4.5	ns
Minimum hold time	t_h	—	3.3 ± 0.3 5.0 ± 0.5	— —	0.0 1.0	0.0 1.0	ns
Minimum removal time (CLR)	t_{rem}	—	3.3 ± 0.3 5.0 ± 0.5	— —	2.5 2.5	2.5 2.5	ns

AC Characteristics (input: $t_r = t_f = 3$ ns)

Characteristics	Symbol	Test Condition	Ta = 25°C			Ta = -40 to 85°C		Unit		
			VCC (V)	CL (pF)	Min	Typ.	Max		Min	Max
Propagation delay time (CK-Q)	t_{pLH}	—	3.3 ± 0.3	15	—	8.4	12.8	1.0	15.0	ns
				50	—	10.9	16.3	1.0	18.5	
	5.0 ± 0.5		15	—	5.8	9.0	1.0	10.5		
			50	—	7.3	11.0	1.0	12.5		
Propagation delay time (CLR-Q)	t_{pHL}	—	3.3 ± 0.3	15	—	8.3	12.8	1.0	15.0	ns
				50	—	10.8	16.3	1.0	18.5	
			5.0 ± 0.5	15	—	5.2	8.6	1.0	10.0	
				50	—	6.7	10.6	1.0	12.0	
Maximum clock frequency	f_{max}	—	3.3 ± 0.3	15	80	125	—	65	—	MHz
				50	50	75	—	45	—	
			5.0 ± 0.5	15	125	175	—	105	—	
				50	85	115	—	75	—	
Input capacitance	C_{IN}	—	—	4	10	—	10	pF		
Power dissipation capacitance	C_{PD}	(Note)	—	76	—	—	—	pF		

Note: CPD is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

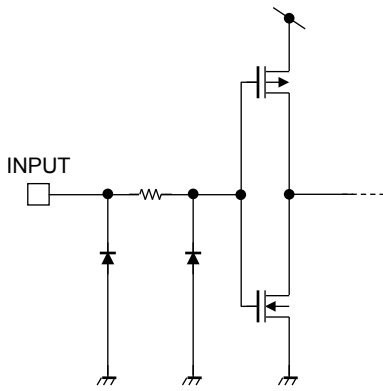
Average operating current can be obtained by the equation:

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

Noise Characteristics (input: $t_r = t_f = 3$ ns)

Characteristics	Symbol	Test Condition	Ta = 25°C			Unit
			VCC (V)	Typ.	Max	
Quiet output maximum dynamic VOL	VOLP	CL = 50 pF	5.0	0.5	0.8	V
Quiet output minimum dynamic VOL	VOLV	CL = 50 pF	5.0	-0.5	-0.8	V
Minimum high level dynamic input voltage	VIHD	CL = 50 pF	5.0	—	3.5	V
Maximum low level dynamic input voltage	VILD	CL = 50 pF	5.0	—	1.5	V

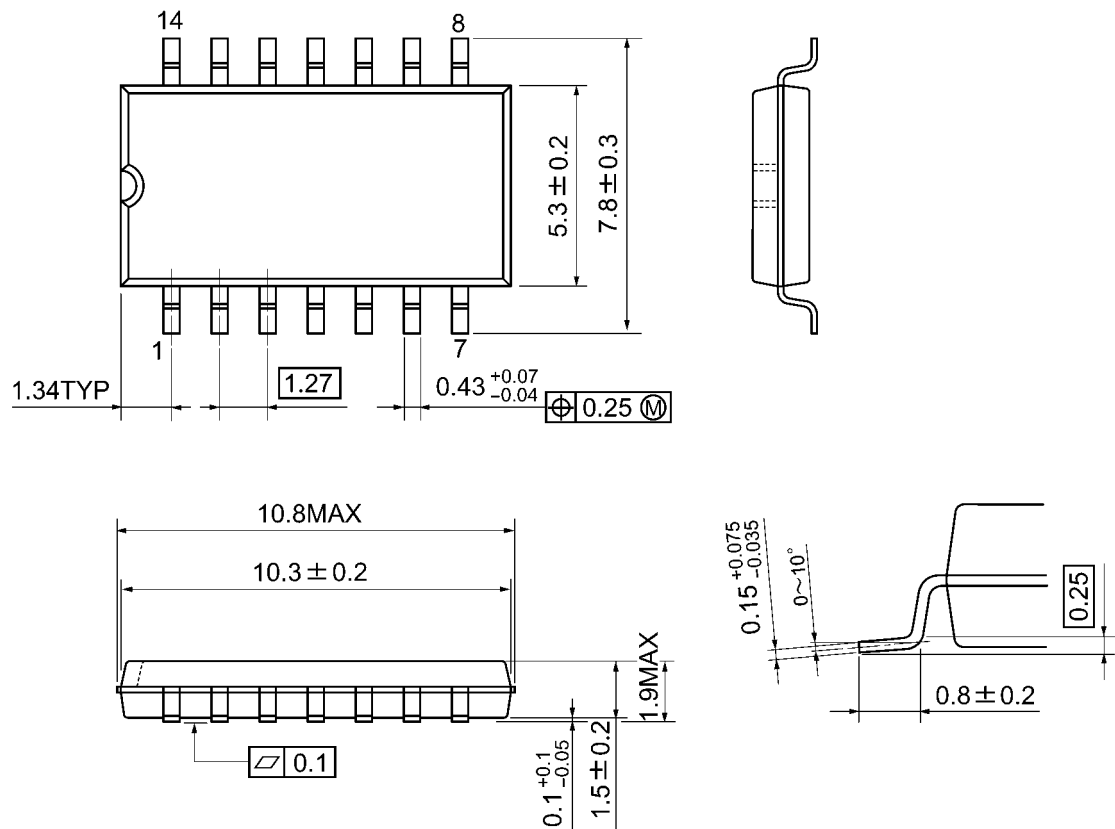
Input Equivalent Circuit



Package Dimensions

SOP14-P-300-1.27A

Unit: mm

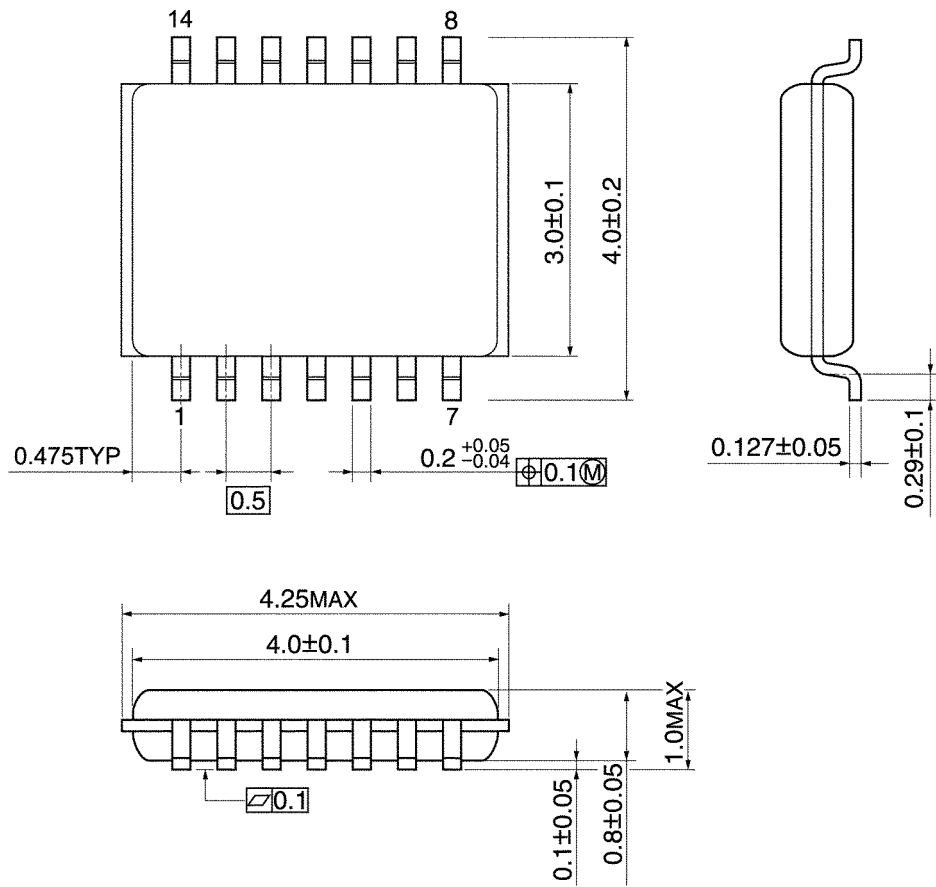


Weight: 0.18 g (typ.)

Package Dimensions

VSSOP14-P-0030-0.50

Unit: mm



Weight: 0.02 g (typ.)

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