FAIRCHILD SEMICONDUCTOR™

September 1983
Revised May 2002

MM74HC164
8-Bit Serial-in/Parallel-out Shift Register

General Description

The MM74HC164 utilizes advanced silicon-gate CMOS technology. It has the high noise immunity and low consumption of standard CMOS integrated circuits. It also offers speeds comparable to low power Schottky devices.

This 8-Bit shift register has gated serial inputs and CLEAR. Each register bit is a D-type master/slave flip-flop. Inputs A & B permit complete control over the incoming data. A LOW at either or both inputs inhibits entry of new data and resets the first flip-flop to the low level at the next clock pulse. A high level on one input enables the other input which will then determine the state of the first flip-flop. Data at the serial inputs may be changed while the clock is HIGH or LOW, but only information meeting the setup and hold time requirements will be entered. Data is serially shifted in and out of the 8-Bit register during the positive going transition of the clock pulse. Clear is independent of the clock and accomplished by a low level at the CLEAR input.

The 74HC logic family is functionally as well as pin-out compatible with the standard 74LS logic family. All inputs are protected from damage due to static discharge by internal diode clamps to V_{CC} and ground.

Features

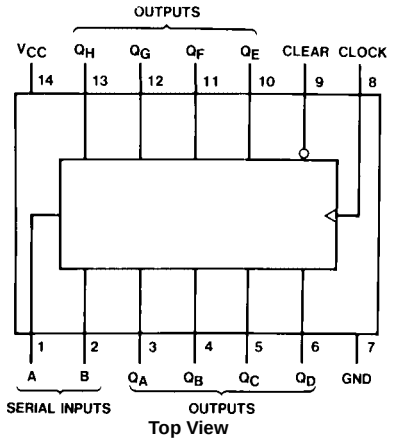
- Typical operating frequency: 50 MHz
- Typical propagation delay: 19 ns (clock to Q)
- Wide operating supply voltage range: 2 to 6V
- Low input current: 1 μA maximum
- Low quiescent supply current: 80 μA maximum (74HC Series)
- Fanout of 10 LS-TTL loads

Ordering Code:

Order Number	Package Number	Package Description
MM74HC164M	M14A	14-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow
MM74HC164N	N14A	14-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide

Devices also available in Tape and Reel. Specify by appending the suffix letter "X" to the ordering code.

Connection Diagram



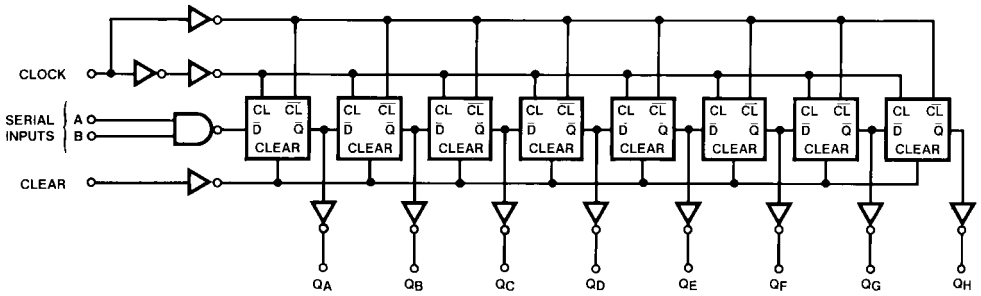
Top View

Truth Table

Inputs				Outputs			
Clear	Clock	A	B	Q_A	Q_B	…	Q_H
L	X	X	X	L	L		L
H	L	X	X	Q_{AO}	Q_{BO}		Q_{HO}
H	↑	H	H	H	Q_{An}		Q_{Gn}
H	↑	L	X	L	Q_{An}		Q_{Gn}
H	↑	X	L	L	Q_{An}		Q_{Gn}

H = HIGH Level (steady state), L = LOW Level (steady state)
X = Irrelevant (any input, including transitions)
↑ = Transition from LOW-to-HIGH level.
Q_{AO}, Q_{BO}, Q_{HO} = the level of Q_A, Q_B, or Q_H, respectively, before the indicated steady state input conditions were established.
Q_{An}, Q_{Gn} = The level of Q_A or Q_G before the most recent ↑ transition of the clock; indicated a one-bit shift.

Logic Diagram



Absolute Maximum Ratings (Note 1)

(Note 2)

Supply Voltage (V_{CC})	−0.5 to +7.0V
DC Input Voltage (V_{IN})	−1.5 to V_{CC} +1.5V
DC Output Voltage (V_{OUT})	−0.5 to V_{CC} +0.5V
Clamp Diode Current (I_{IK}, I_{OK})	±20 mA
DC Output Current, per pin (I_{OUT})	±25 mA
DC V_{CC} or GND Current, per pin (I_{CC})	±50 mA
Storage Temperature Range (T_{STG})	−65°C to +150°C
Power Dissipation (P_D)	
(Note 3)	600 mW
S.O. Package only	500 mW
Lead Temperature (T_L)	
(Soldering 10 seconds)	260°C

Recommended Operating Conditions

	Min	Max	Units
Supply Voltage (V_{CC})	2	6	V
DC Input or Output Voltage			
(V_{IN}, V_{OUT})	0	V_{CC}	V
Operating Temperature Range (T_A)	−40	+85	°C
Input Rise or Fall Times			
(t_r, t_f) V_{CC} = 2.0V		1000	ns
V_{CC} = 4.5V		500	ns
V_{CC} = 6.0V		400	ns

Note 1: Absolute Maximum Ratings are those values beyond which damage to the device may occur.

Note 2: Unless otherwise specified all voltages are referenced to ground.

Note 3: Power Dissipation temperature derating — plastic "N" package: −12 mW/°C from 65°C to 85°C.

DC Electrical Characteristics (Note 4)

Symbol	Parameter	Conditions	V_{CC}	T_A = 25°C	T_A = −40 to 85°C	T_A = −55 to 125°C	Units
				Typ	Guaranteed Limits		
V_{IH}	Minimum HIGH Level Input Voltage		2.0V		1.5	1.5	1.5	V
			4.5V		3.15	3.15	3.15	V
			6.0V		4.2	4.2	4.2	V
V_{IL}	Maximum LOW Level Input Voltage		2.0V		0.5	0.5	0.5	V
			4.5V		1.35	1.35	1.35	V
			6.0V		1.8	1.8	1.8	V
V_{OH}	Minimum HIGH Level Output Voltage	V_{IN} = V_{IH} or V_{IL}						
		$\|I_{OUT}\| \le 20$ μA	2.0V	2.0	1.9	1.9	1.9	V
			4.5V	4.5	4.4	4.4	4.4	V
			6.0V	6.0	5.9	5.9	5.9	V
		V_{IN} = V_{IH} or V_{IL}						
		$\|I_{OUT}\| \le 4.0$ mA	4.5V	4.2	3.98	3.84	3.7	V
		$\|I_{OUT}\| \le 5.2$ mA	6.0V	5.7	5.48	5.34	5.2	V
V_{OL}	Maximum LOW Level Output Voltage	V_{IN} = V_{IH} or V_{IL}						
		$\|I_{OUT}\| \le 20$ μA	2.0V	0	0.1	0.1	0.1	V
			4.5V	0	0.1	0.1	0.1	V
			6.0V	0	0.1	0.1	0.1	V
		V_{IN} = V_{IH} or V_{IL}						
		$\|I_{OUT}\| \le 4.0$ mA	4.5V	0.2	0.26	0.33	0.4	V
		$\|I_{OUT}\| \le 5.2$ mA	6.0V	0.2	0.26	0.33	0.4	V
I_{IN}	Maximum Input Current	V_{IN} = V_{CC} or GND	6.0V		±0.1	±1.0	±1.0	μA
I_{CC}	Maximum Quiescent Supply Current	V_{IN} = V_{CC} or GND	6.0V		8.0	80	160	μA
		I_{OUT} = 0 μA						

Note 4: For a power supply of 5V ±10% the worst case output voltages (V_{OH}, and V_{OL}) occur for HC at 4.5V. Thus the 4.5V values should be used when designing with this supply. Worst case V_{IH} and V_{IL} occur at V_{CC} = 5.5V and 4.5V respectively. (The V_{IH} value at 5.5V is 3.85V.) The worst case leakage current (I_{IN}, I_{CC}, and I_{OZ}) occur for CMOS at the higher voltage and so the 6.0V values should be used.

AC Electrical Characteristics

V_{CC} = 5V, T_A = 25°C, C_L = 15 pF, $t_r = t_f$ = 6 ns

Symbol	Parameter	Conditions	Typ	Guaranteed Limit	Units
f_{MAX}	Maximum Operating Frequency			30	MHz
t_{PHL}, t_{PLH}	Maximum Propagation Delay, Clock to Output		19	30	ns
t_{PHL}	Maximum Propagation Delay, Clear to Output		23	35	ns
t_{REM}	Minimum Removal Time, Clear to Clock		–2	0	ns
t_S	Minimum Setup Time Data to Clock		12	20	ns
t_H	Minimum Hold Time Clock to Data		1	5	ns
t_W	Minimum Pulse Width Clear or Clock		10	16	ns

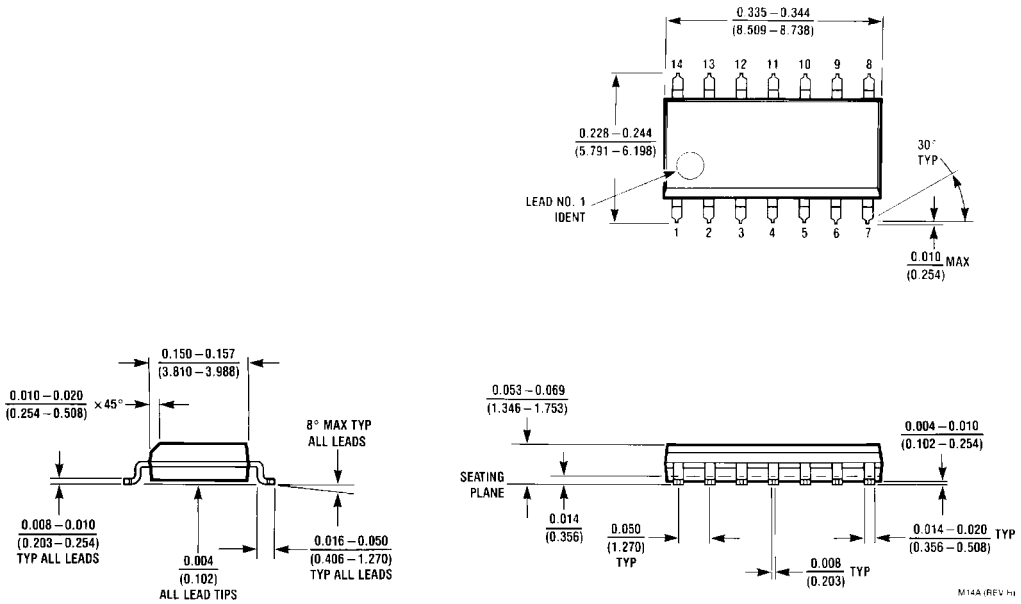
AC Electrical Characteristics

C_L = 50 pF, $t_r = t_f$ = 6 ns (unless otherwise specified)

Symbol	Parameter	Conditions	V_{CC}	T_A = 25°C	T_A = –40 to 85°C	T_A = –55 to 125°C	Units
				Typ	Guaranteed Limits		
f_{MAX}	Maximum Operating Frequency		2.0V		5	4	3	MHz
			4.5V		27	21	18	MHz
			6.0V		31	24	20	MHz
t_{PHL}, t_{PLH}	Maximum Propagation Delay, Clock to Output		2.0V	115	175	218	254	ns
			4.5V	13	35	44	51	ns
			6.0V	20	30	38	44	ns
t_{PHL}	Maximum Propagation Delay, Clear to Output		2.0V	140	205	256	297	ns
			4.5V	28	41	51	59	ns
			6.0V	24	35	44	51	ns
t_{REM}	Minimum Removal Time Clear to Clock		2.0V	–7	0	0	0	ns
			4.5V	–3	0	0	0	ns
			6.0V	–2	0	0	0	ns
t_S	Minimum Setup Time Data to Clock		2.0V	25	100	125	150	ns
			4.5V	14	20	25	30	ns
			6.0V	12	17	21	25	ns
t_H	Minimum Hold Time Clock to Data		2.0V	–2	5	5	5	ns
			4.5V	0	5	5	5	ns
			6.0V	1	5	5	5	ns
t_W	Minimum Pulse Width Clear or Clock		2.0V	22	80	100	120	ns
			4.5V	11	16	20	24	ns
			6.0V	10	14	18	20	ns
t_{THL}, t_{TLH}	Maximum Output Rise and Fall Time		2.0V		75	95	110	ns
			4.5V		15	19	22	ns
			6.0V		13	16	19	ns
t_r, t_f	Maximum Input Rise and Fall Time		2.0V		1000	1000	1000	ns
			4.5V		500	500	500	ns
			6.0V		400	400	400	ns
C_{PD}	Power Dissipation Capacitance (Note 5)	(per package)	5.0V	150				pF
C_{IN}	Maximum Input Capacitance			5	10	10	10	pF

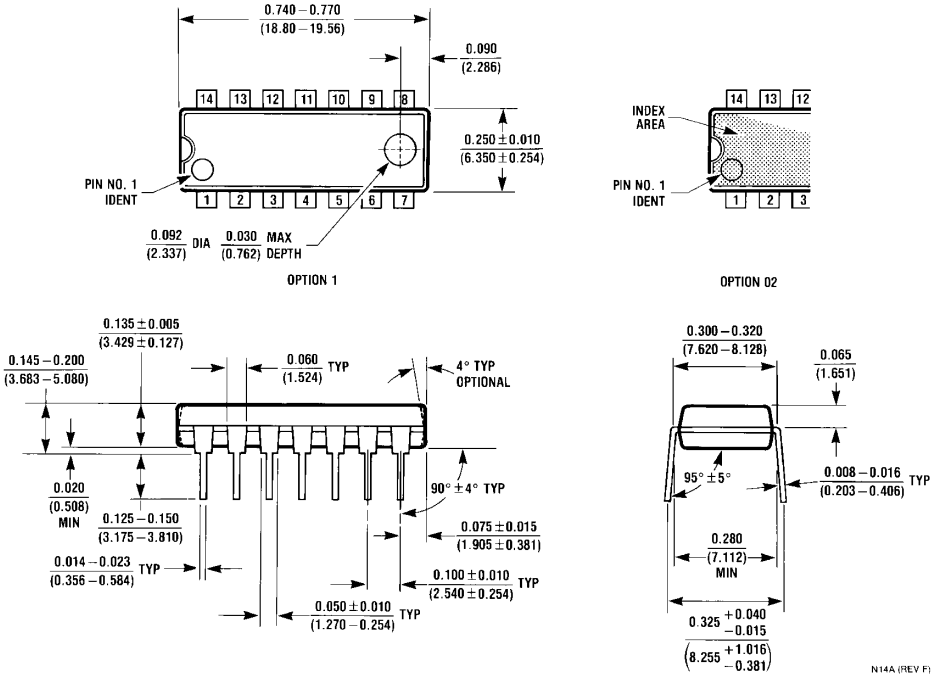
Note 5: C_{PD} determines the no load dynamic power consumption, $P_D = C_{PD} V_{CC}^2 f + I_{CC} V_{CC}$, and the no load dynamic current consumption, $I_S = C_{PD} V_{CC} f + I_{CC}$.

Physical Dimensions inches (millimeters) unless otherwise noted



14-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-120, 0.150" Narrow
Package Number M14A

Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



14-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide
Package Number N14A