



September 1983
Revised February 1999

MM74HC165

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

General Description

The MM74HC165 high speed PARALLEL-IN/SERIAL-OUT SHIFT REGISTER utilizes advanced silicon-gate CMOS technology. It has the low power consumption and high noise immunity of standard CMOS integrated circuits, along with the ability to drive 10 LS-TTL loads.

This 8-bit serial shift register shifts data from Q_A to Q_H when clocked. Parallel inputs to each stage are enabled by a low level at the SHIFT/LOAD input. Also included is a gated CLOCK input and a complementary output from the eighth bit.

Clocking is accomplished through a 2-input NOR gate permitting one input to be used as a CLOCK INHIBIT function. Holding either of the CLOCK inputs high inhibits clocking, and holding either CLOCK input low with the SHIFT/LOAD input high enables the other CLOCK input. Data transfer occurs on the positive going edge of the clock. Parallel

loading is inhibited as long as the SHIFT/LOAD input is HIGH. When taken LOW, data at the parallel inputs is loaded directly into the register independent of the state of the clock.

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

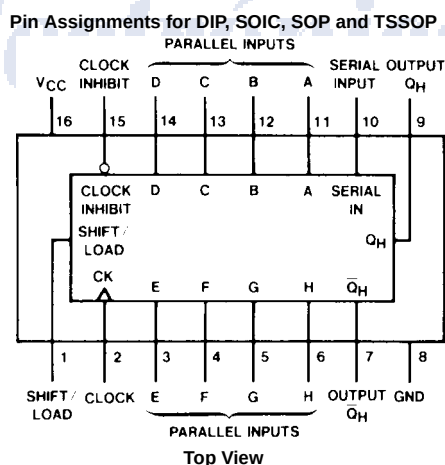
- Typical propagation delay: 20 ns (clock to Q)
- Wide operating supply voltage range: 2–6V
- Low input current: 1 μ A maximum
- Low quiescent supply current: 80 μ A maximum (74HC Series)
- Fanout of 10 LS-TTL loads

Ordering Code:

Order Number	Package Number	Package Description
MM74HC165M	M16A	16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow
MM74HC165SJ	M16D	16-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide
MM74HC165MTC	MTC16	16-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide
MM74HC165	N16E	16-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



Function Table

Shift/ Load	Clock Inhibit	Clock	Serial	Inputs	Internal Outputs	Output Q_H
				Parallel A . . . H		
L	X	X	X	a . . . h	a b	h
H	L	L	X	X	Q_{A0} Q_{B0}	Q_{H0}
H	L	$\uparrow$	H	X	H Q_{AN}	Q_{GN}
H	L	$\uparrow$	L	X	L Q_{AN}	Q_{GN}
H	H	X	X	X	Q_{A0} Q_{B0}	Q_{H0}

H = HIGH Level (steady state), L = LOW Level (steady state)

X = Irrelevant (any input, including transitions)

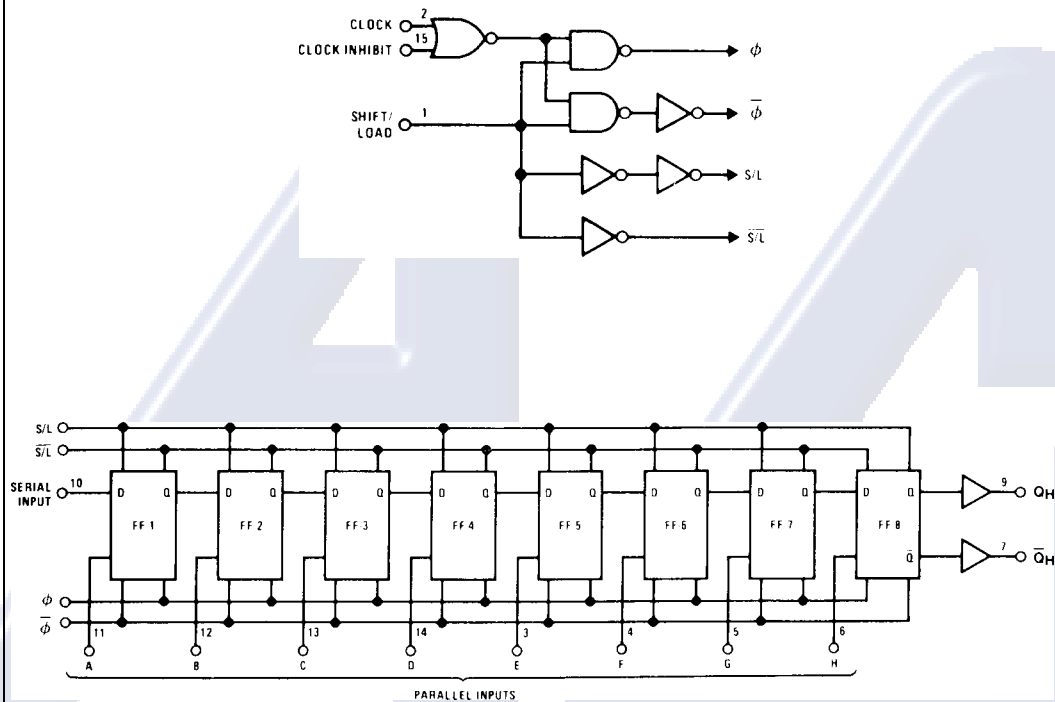
$\uparrow$ = Transition from LOW-to-HIGH level

Q_{A0} , Q_{B0} , Q_{H0} = 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 $\uparrow$ transition of the clock; indicates a one-bit shift.

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Logic Diagrams



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Absolute Maximum Ratings ^(Note 1)				Recommended Operating Conditions				
(Note 2)					Min	Max	Units	
Supply Voltage (V_{CC})		–0.5 to +7.0V		Supply Voltage (V_{CC})	2	6	V	
DC Input Voltage (V_{IN})		–1.5 to V_{CC} +1.5V		DC Input or Output Voltage				
DC Output Voltage (V_{OUT})		–0.5 to V_{CC} +0.5V		(V_{IN} , V_{OUT})	0	V_{CC}	V	
Clamp Diode Current (I_{IK} , I_{OK})		±20 mA		Operating Temperature Range (T_A)	–40	+85	°C	
DC Output Current, per pin (I_{OUT})		±25 mA		Input Rise or Fall Times				
DC V_{CC} or GND Current, per pin (I_{CC})		±50 mA		(t_r , t_f) V_{CC} = 2.0V		1000	ns	
Storage Temperature Range (T_{STG})		–65°C to +150°C		V_{CC} = 4.5V		500	ns	
Power Dissipation (P_D)				V_{CC} = 6.0V		400	ns	
(Note 3)		600 mW		Note 1: Absolute Maximum Ratings are those values beyond which damage to the device may occur.				
S.O. Package only		500 mW		Note 2: Unless otherwise specified all voltages are referenced to ground.				
Lead Temperature (T_L)				Note 3: Power Dissipation temperature derating — plastic “N” package: –12 mW/°C from 65°C to 85°C.				
(Soldering 10 seconds)		260°C						
DC Electrical Characteristics (Note 4)								
Symbol	Parameter	Conditions	V_{CC}	$T_A = 25^\circ C$		$T_A = -40$ to $85^\circ C$	$T_A = -55$ to $125^\circ C$	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} \leq 20 \mu A$	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} \leq 4.0 \text{ mA}$ $ I_{OUT} \leq 5.2 \text{ mA}$	4.5V	4.2	3.98	3.84	3.7	V
			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} \leq 20 \mu A$	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} \leq 4.0 \text{ mA}$ $ I_{OUT} \leq 5.2 \text{ mA}$	4.5V	0.2	0.26	0.33	0.4	V
			6.0V	0.2	0.26	0.33	0.4	V
I_{IN}	Maximum Input Current	$V_{IN} = V_{CC}$ or GND $V_{CC} = 2-6V$	6.0V		±0.1	±1.0	±1.0	μA
I_{CC}	Maximum Quiescent Supply Current	$V_{IN} = V_{CC}$ or GND $I_{OUT} = 0 \mu A$ $V_{CC} = 2-6V$	6.0V		8.0	80	160	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.								

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AC Electrical Characteristics $V_{CC} = 5V$, $T_A = 25^\circ C$, $C_L = 15\text{ pF}$, $t_r = t_f = 6\text{ ns}$

Symbol	Parameter	Conditions	Typ	Guaranteed Limit	Units
f_{MAX}	Maximum Operating Frequency		50	30	MHz
t_{PHL}, t_{PLH}	Maximum Propagation Delay H to Q_H or $\bar{Q}_H$		15	25	ns
t_{PHL}, t_{PLH}	Maximum Propagation Delay Serial Shift/Parallel Load to Q_H		13	25	ns
t_{PHL}, t_{PLH}	Maximum Propagation Delay Clock to Output		15	25	ns
t_S	Minimum Setup Time Serial Input to Clock, Parallel or Data to Shift/Load		10	20	ns
t_S	Minimum Setup Time Shift/Load to Clock		11	20	ns
t_S	Minimum Setup Time Clock Inhibit to Clock		10	20	ns
t_H	Minimum Hold Time Serial Input to Clock or Parallel Data to Shift/Load			0	ns
t_W	Minimum Pulse Width Clock			16	ns

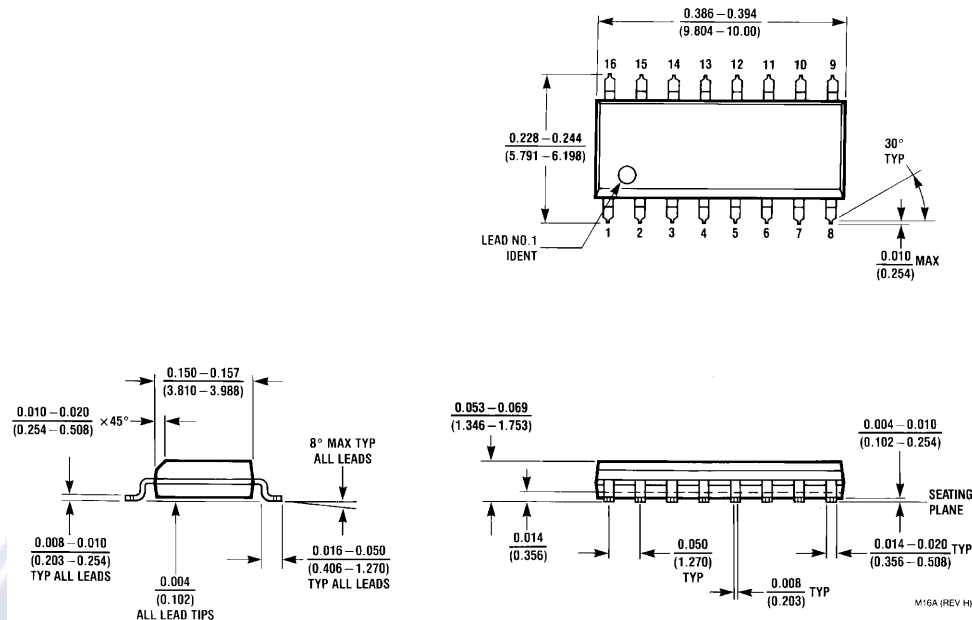
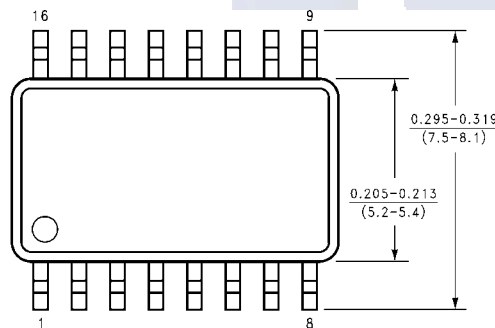
AC Electrical Characteristics $C_L = 50\text{ pF}$, $t_r = t_f = 6\text{ ns}$ (unless otherwise specified)

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			
t _{MAX}	Maximum Operating Frequency		2.0V	10	5	4	4	MHz
			4.5V	45	27	21	18	MHz
			6.0V	50	32	25	21	MHz
t _{PHL} , t _{PLH}	Maximum Propagation Delay H to Q _H or $\overline{Q}_H$		2.0V	70	150	189	225	ns
			4.5V	21	30	38	45	ns
			6.0V	18	26	33	39	ns
t _{PHL} , t _{PLH}	Maximum Propagation Delay Serial Shift/Parallel Load to Q _H		2.0V	70	175	220	260	ns
			4.5V	21	35	44	52	ns
			6.0V	18	30	37	44	ns
t _{PHL} , t _{PLH}	Maximum Propagation Delay Clock to Output		2.0V	70	150	189	225	ns
			4.5V	21	30	38	45	ns
			6.0V	18	26	33	39	ns
t _S	Minimum Setup Time Serial Input to Clock, or Parallel Data to Shift/Load		2.0V	35	100	125	150	ns
			4.5V	11	20	25	30	ns
			6.0V	9	17	21	25	ns
t _S	Minimum Setup Time Shift/Load to Clock		2.0V	38	100	125	150	ns
			4.5V	12	20	25	30	ns
			6.0V	9	17	21	25	ns
t _S	Minimum Setup Time Clock Inhibit to Clock		2.0V	35	100	125	150	ns
			4.5V	11	20	25	30	ns
			6.0V	9	17	21	25	ns
t _H	Minimum Hold Time Serial Input to Clock or Parallel Data to Shift/Load		2.0V		0	0	0	ns
			4.5V		0	0	0	ns
			6.0V		0	0	0	ns
t _W	Minimum Pulse Width, Clock		2.0V	30	80	100	120	ns
			4.5V	9	16	20	24	ns
			6.0V	8	14	18	20	ns
t _{THL} , t _{TLH}	Maximum Output Rise and Fall Time		2.0V	30	75	95	110	ns
			4.5V	9	15	19	22	ns
			6.0V	8	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

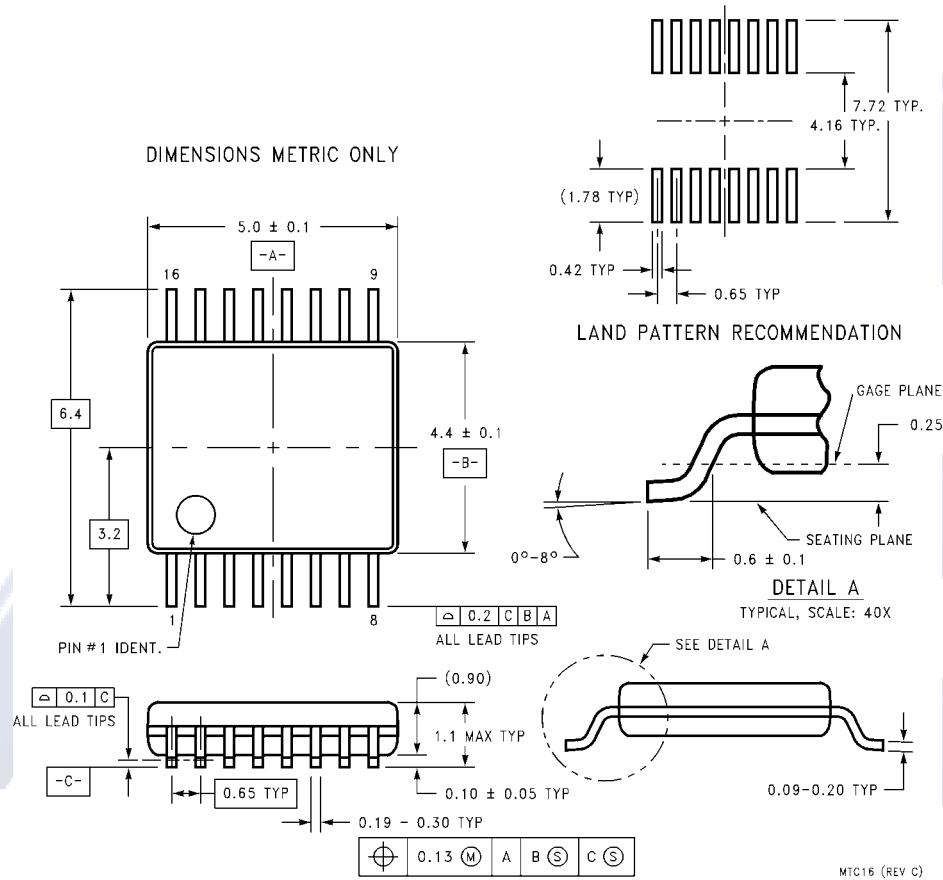
AC Electrical Characteristics (Continued)								
Symbol	Parameter	Conditions	V _{CC}	T _A = 25°C		T _A = -40 to 85°C	T _A = -55 to 125°C	Units
				Typ	Guaranteed Limits			
C _{PD}	Power Dissipation Capacitance (Note 5)	(per package)		100				pF
C _{IN}	Maximum Input Capacitance			5	10	10	10	pF
Note 5: 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} .								

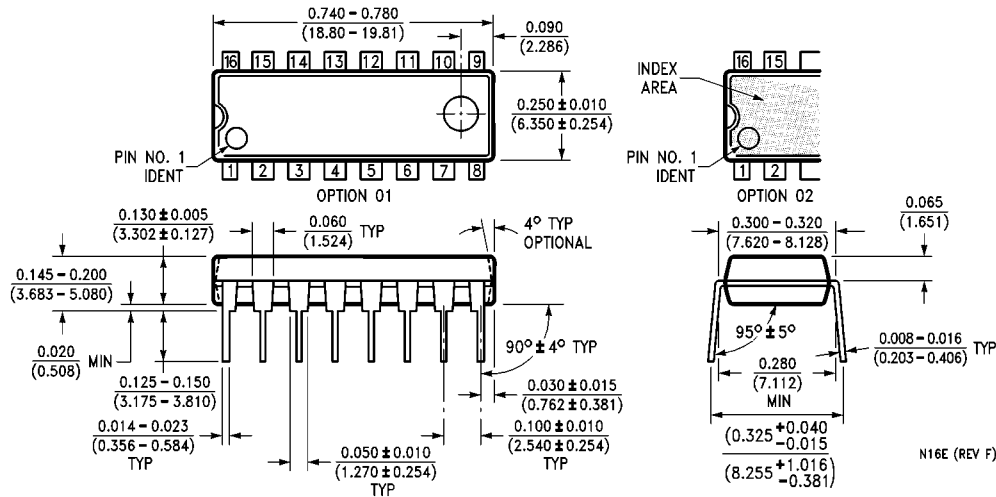
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Physical Dimensions inches (millimeters) unless otherwise noted**16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow Package Number M16A****16-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide Package Number M16D**

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

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