

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 ${\rm Q_A}$ to ${\rm Q_H}$ 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 µA maximum
- Low quiescent supply current: 80 µA maximum (74HC Series)
- Fanout of 10 LS-TTL loads

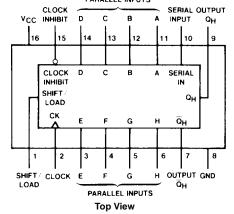
Ordering Code:

Order Number	Package Number	Package Description
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

Pin Assignments for DIP, SOIC, SOP and TSSOP PARALLEL INPUTS



Function Table

Inputs						rnal	Output
Shift/	Clock	Clock	Serial	Parallel	Out	puts	Q_H
Load	Inhibit			АН	Q_A	Q_B	
L	Х	Х	Х	ah	а	b	h
Н	L	L	Х	Х	Q_{A0}	Q_{B0}	Q_{H0}
Н	L	1	Н	Х	Н	Q_{AN}	Q_{GN}
Н	L	1	L	Х	L	Q_{AN}	Q_{GN}
Н	Н	Х	Х	Х	Q_{A0}	Q_{B0}	Q_{H0}

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

X = Irrelevant (any input, including transitions)

↑ = 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.

Logic Diagrams

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)	

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
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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)

(Soldering 10 seconds)

Symbol	Parameter	Conditions	V _{CC}	$T_A = 25^{\circ}C$		T _A = -40 to 85°C	T _A = -55 to 125°C	Units
Зупівої		Conditions	V CC	Тур		Guaranteed L	uaranteed Limits	
V _{IH}	Minimum HIGH Level		2.0V		1.5	1.5	1.5	V
	Input Voltage		4.5V		3.15	3.15	3.15	V
			6.0V		4.2	4.2	4.2	V
V _{IL}	Maximum LOW Level		2.0V		0.5	0.5	0.5	V
	Input Voltage		4.5V		1.35	1.35	1.35	V
			6.0V		1.8	1.8	1.8	V
V _{OH}	Minimum HIGH Level	$V_{IN} = V_{IH}$ or V_{IL}						
	Output Voltage	$ I_{OUT} \le 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} \le 4.0 \text{ mA}$	4.5V	4.2	3.98	3.84	3.7	V
		I _{OUT} ≤ 5.2 mA	6.0V	5.7	5.48	5.34	5.2	V
V _{OL}	Maximum LOW Level	$V_{IN} = V_{IH}$ or V_{IL}						
	Output Voltage	$ I_{OUT} \le 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} \le 4.0 \text{ mA}$	4.5V	0.2	0.26	0.33	0.4	V
		$ I_{OUT} \le 5.2 \text{ mA}$	6.0V	0.2	0.26	0.33	0.4	V
I _{IN}	Maximum Input	V _{IN} = V _{CC} or GND	6.0V		±0.1	±1.0	±1.0	μΑ
	Current	V _{CC} = 2-6V						
I _{CC}	Maximum Quiescent	V _{IN} = V _{CC} or GND	6.0V		8.0	80	160	μΑ
	Supply Current	$I_{OUT} = 0 \mu A$						
		V _{CC} = 2-6V						

260°C

Note 4: For a power supply of 5V \pm 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

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

Symbol	Parameter	Conditions	Тур	Guaranteed Limit	Units
f _{MAX}	Maximum Operating Frequency		50	30	MHz
t _{PHL} , t _{PLH}	Maximum Propagation Delay H to Q _H or \overline{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

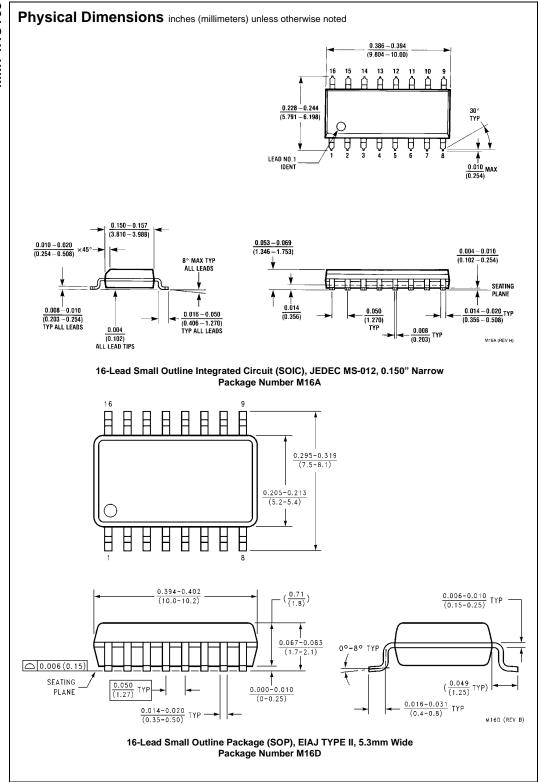
 $C_L = 50$ pF, $t_r = t_f = 6$ ns (unless otherwise specified)

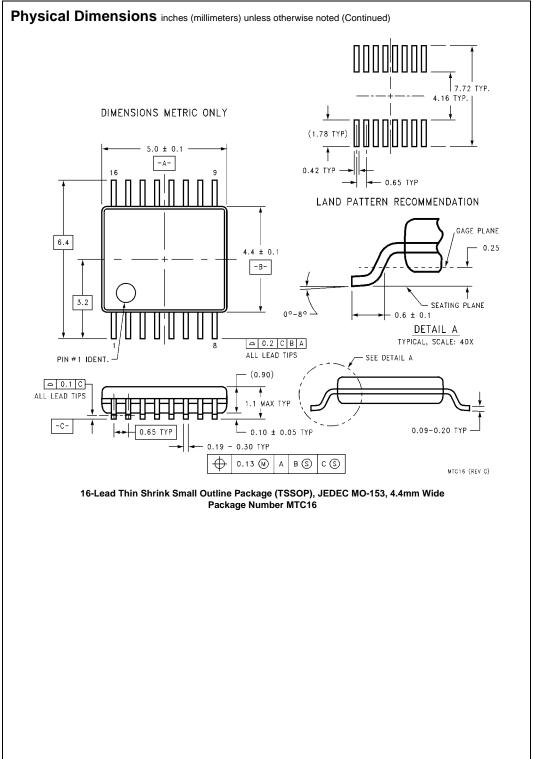
Symbol	Parameter	Conditions	v _{cc}	$T_A = 25^{\circ}C$		$T_A = -40 \text{ to } 85^{\circ}\text{C}$	T _A = -55 to 125°C	Units
Symbol				Тур		Guaranteed L	imits	Ullits
f _{MAX}	Maximum Operating		2.0V	10	5	4	4	MHz
	Frequency		4.5V	45	27	21	18	MHz
			6.0V	50	32	25	21	MHz
t _{PHL} , t _{PLH}	Maximum Propagation		2.0V	70	150	189	225	ns
	Delay H to Q _H or Q H		4.5V	21	30	38	45	ns
			6.0V	18	26	33	39	ns
t _{PHL} , t _{PLH}	Maximum Propagation		2.0V	70	175	220	260	ns
	Delay Serial Shift/		4.5V	21	35	44	52	ns
	Parallel Load to Q _H		6.0V	18	30	37	44	ns
t _{PHL} , t _{PLH}	Maximum Propagation		2.0V	70	150	189	225	ns
	Delay Clock to Output		4.5V	21	30	38	45	ns
			6.0V	18	26	33	39	ns
t _S	Minimum Setup Time		2.0V	35	100	125	150	ns
	Serial Input to Clock,		4.5V	11	20	25	30	ns
	or Parallel Data to Shift/Load		6.0V	9	17	21	25	ns
t _S	Minimum Setup Time		2.0V	38	100	125	150	ns
	Shift/Load to Clock		4.5V	12	20	25	30	ns
			6.0V	9	17	21	25	ns
t _S	Minimum Setup Time		2.0V	35	100	125	150	ns
	Clock Inhibit to Clock		4.5V	11	20	25	30	ns
			6.0V	9	17	21	25	ns
t _H	Minimum Hold Time Serial		2.0V		0	0	0	ns
	Input to Clock or		4.5V		0	0	0	ns
	Parallel Data to Shift/Load		6.0V		0	0	0	ns
t _W	Minimum Pulse Width,		2.0V	30	80	100	120	ns
	Clock		4.5V	9	16	20	24	ns
			6.0V	8	14	18	20	ns
t _{THL} , t _{TLH}	Maximum Output		2.0V	30	75	95	110	ns
	Rise and Fall Time		4.5V	9	15	19	22	ns
			6.0V	8	13	16	19	ns
t _r , t _f	Maximum Input Rise and		2.0V		1000	1000	1000	ns
	Fall Time		4.5V		500	500	500	ns
			6.0V		400	400	400	ns

AC Electrical Characteristics (Continued)

Symbol	Parameter	Conditions	v _{cc}	$T_A = 25^{\circ}C$		$T_A = -40 \text{ to } 85^{\circ}\text{C}$ $T_A = -55 \text{ to } 125^{\circ}$		Units	
C)20.	. u.u.i.ete	Conditions		Тур	Guaranteed Limits			7011110	
C _{PD}	Power Dissipation	(per package)		100				pF	
	Capacitance (Note 5)								
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 (Continued) 0.090 (18.80 - 19.81)(2.286)**16 15 14 13 12 11 10 9 16 15 C** INDEX AREA 0.250 ± 0.010 $\overline{(6.350 \pm 0.254)}$ PIN NO. 1 PIN NO. 1 1 2 3 4 5 6 7 8 1 2 IDENT OPTION 01 OPTION 02 $\frac{0.065}{(1.651)}$ $\frac{0.130 \pm 0.005}{(3.302 \pm 0.127)}$ $\frac{0.060}{(1.524)}$ TYP 4° TYP OPTIONAL 0.300 - 0.320 (7.620 - 8.128)0.145 - 0.200 (3.683 - 5.080)95°±5° 0.008 = 0.016 (0.203 = 0.406) TYP 90° ± 4° TYP 0.020 $\frac{0.280}{(7.112)}$ 0.125 - 0.150 (3.175 - 3.810) 0.030 ± 0.015 MIN (0.762 ± 0.381) 0.014 = 0.023 (0.356 = 0.584) 0.100 ± 0.010 (0.325 +0.040 -0.015 (2.540 ± 0.254) 0.050 ± 0.010 N16E (REV F) (1.270 ± 0.254)

16-Lead Plastic Dual-In-Line Package (PDIP), MS-001, 0.300" Wide Package N16E

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