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MM74HC589 8-Bit Shift Registers with Input Latches and 3-STATE Serial Output

General Description

The MM74HC589 high speed shift register utilizes advanced silicon-gate CMOS technology to achieve the high noise immunity and low power consumption of standard CMOS integrated circuits, as well as the ability to drive 15 LS-TTL loads.

The MM74HC589 comes in a 16-pin package and consists of an 8-bit storage latch feeding a parallel-in, serial-out 8-bit shift register. Data can also be entered serially the shift register through the SER pin. Both the storage register and shift register have positive-edge triggered clocks, RCK and SCK, respectively. SLOAD pin controls parallel LOAD or serial shift operations for the shift register. The shift register has a 3-STATE output to enable the wire-ORing of multiple devices on a serial bus.

The 74HC logic family is speed, function, and 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

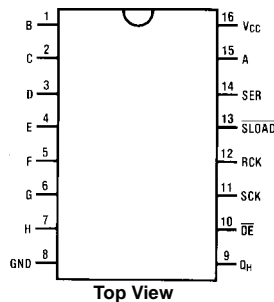
- 8-bit parallel storage register inputs
- Wide operating voltage range: 2V–6V
- Shift register has direct overriding load
- Guaranteed shift frequency. . . DC to 30 MHz
- Low quiescent current: 80 μ A maximum (74HC Series)
- 3-STATE output for 'Wire-OR'

Ordering Code:

Order Number	Package Number	Package Description
MM74HC589M	M16A	16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow
MM74HC589SJ	M16D	16-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide
MM74HC589N	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

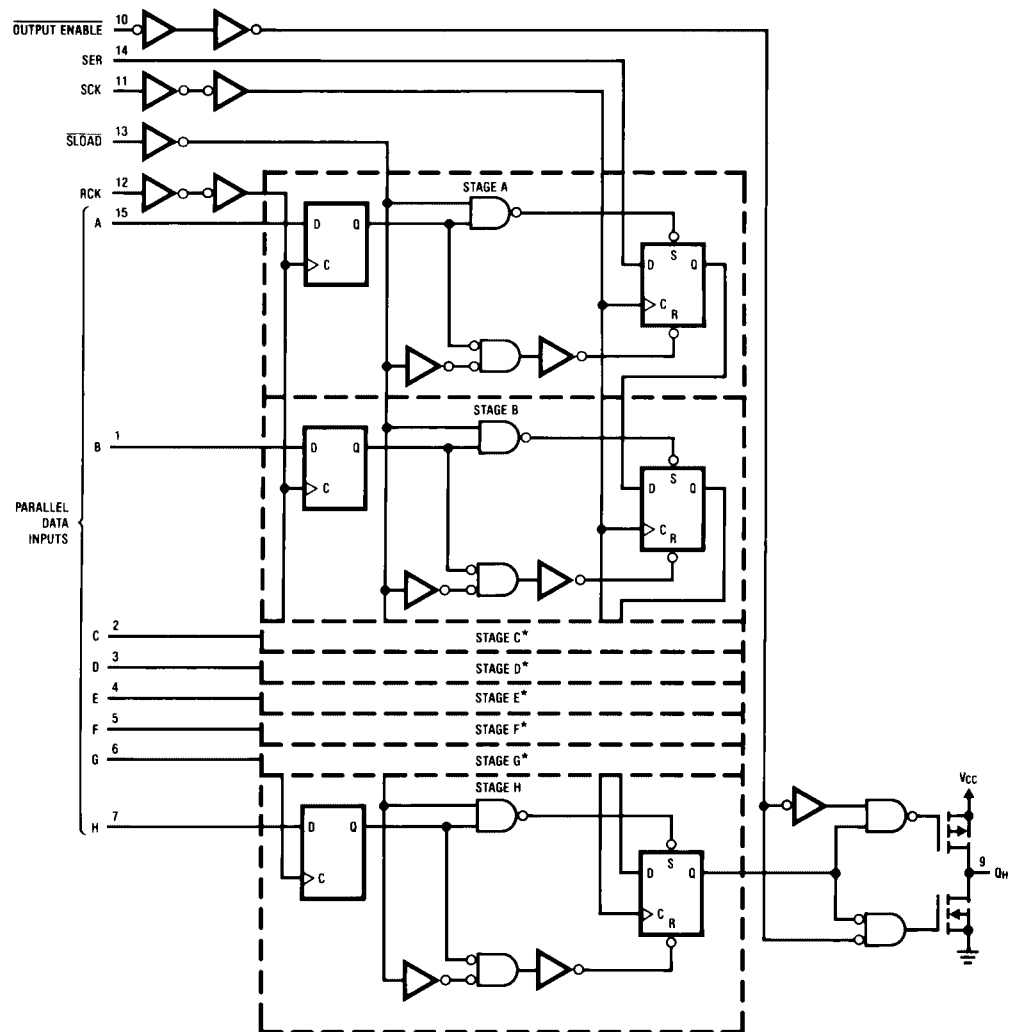


Truth Table

RCK	SCK	SLOAD	OE	Function
X	X	X	H	Q_H in Hi-Z State
X	X	X	L	Q_H is enabled
\uparrow	X	X	X	Data loaded into input latches
\uparrow	X	L	X	Data loaded into shift register from pins
H or L	X	L	X	Data loaded from latches to shift register
X	\uparrow	H	X	Shift register is shifted. Data on SER pin is shifted in.
\uparrow	\uparrow	H	X	Data is shifted in shift register, and data is loaded into latches

MM74HC589

Block Diagram (positive logic)



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	$^{\circ}C$
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 $^{\circ}C$ to +150 $^{\circ}C$	$V_{CC} = 4.5V$		500	ns
Power Dissipation (P_D)		$V_{CC} = 6.0V$		400	ns
(Note 3)	600 mW				
S.O. Package only	500 mW				
Lead Temperature (T_L)					
(Soldering 10 seconds)	260 $^{\circ}C$				

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/ $^{\circ}C$ from 65 $^{\circ}C$ to 85 $^{\circ}C$.

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 6.0$ mA $ I_{OUT} \leq 7.8$ mA	4.5V		3.98	3.84	3.7	V	
			6.0V		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 6.0$ mA $ I_{OUT} \leq 7.8$ mA	4.5V		0.26	0.33	0.4	V	
			6.0V		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 $I_{OUT} = 0 \mu A$	6.0V		8.0	80	160	μA	
I_{OZ}	Maximum 3-STATE Leakage Current	Output in High Impedance State $V_{IN} = V_{IL}$ or V_{IH} $V_{OUT} = V_{CC}$ or GND $OE = V_{IH}$	6.0V		± 0.5	± 5.0	± 10.0	μA	

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

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

Symbol	Parameter	Conditions	Typ	Guaranteed Limit	Units
f_{MAX}	Maximum Operating Frequency for SCK		50	30	MHz
t_{PHL} , t_{PLH}	Maximum Propagation Delay from SCK to Q_H			30	ns
t_{PHL} , t_{PLH}	Maximum Propagation Delay from \overline{SLOAD} to Q_H			30	ns
t_{PHL} , t_{PLH}	Maximum Propagation Delay from LCK to Q_H	$\overline{SLOAD} = \text{logic "0"}$	25	45	ns
t_{PZH} , t_{PZL}	Output Enable Time	$R_L = 1\text{ k}\Omega$	18	28	ns
t_{PHZ} , t_{PLZ}	Output Disable Time	$R_L = 1\text{ k}\Omega$, $C_L = 5\text{ pF}$	19	25	ns
t_S	Minimum Setup Time from RCK to SCK		10	20	ns
t_S	Minimum Setup Time from SER to SCK		10	20	ns
t_S	Minimum Setup Time from Inputs A thru H to RCK		10	20	ns
t_H	Minimum Hold Time		0	5	ns
t_W	Minimum Pulse Width SCK, RCK, \overline{SLOAD}		8	16	ns

AC Electrical Characteristics

$V_{CC} = 2.0\text{--}6V$, $C_L = 50\text{ pF}$, $t_r = t_f = 6\text{ ns}$ (unless otherwise specified)

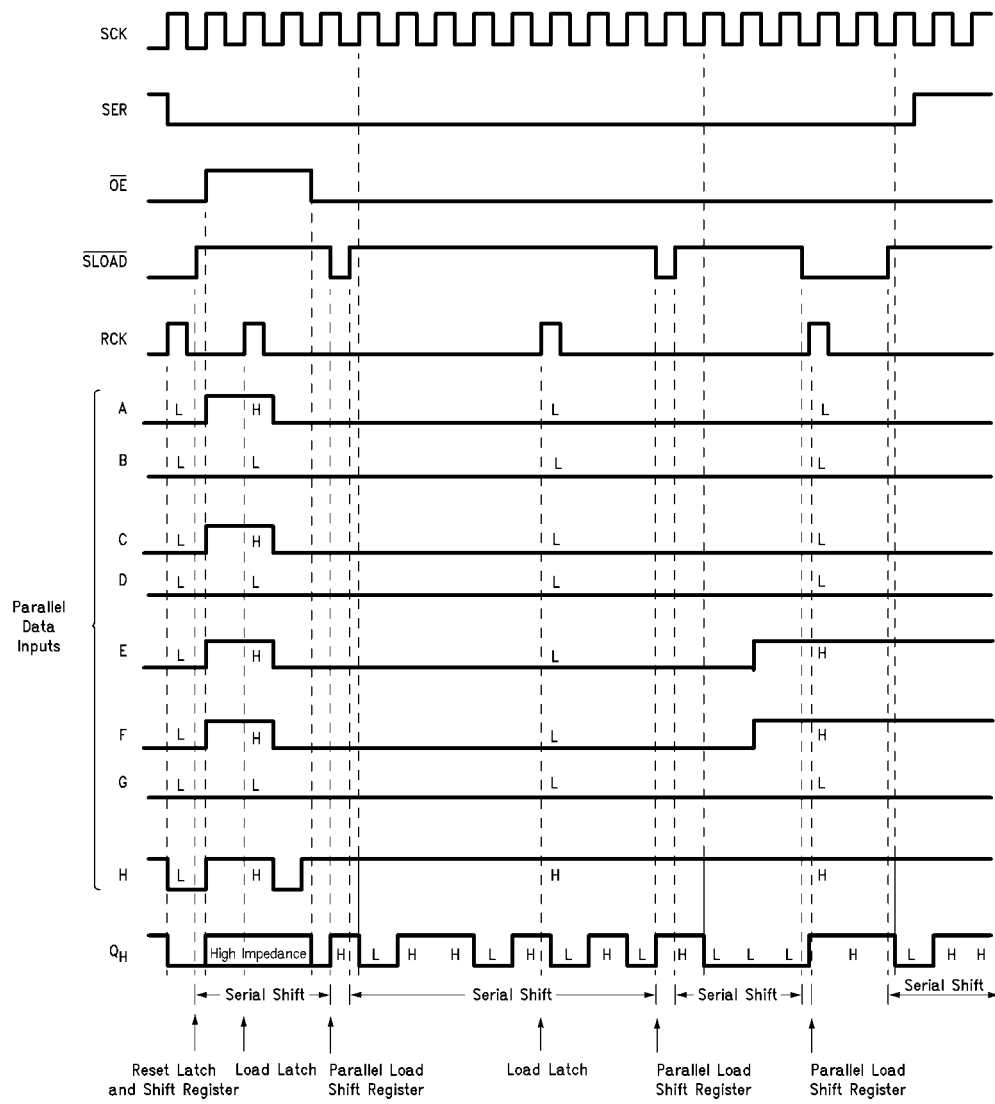
Symbol	Parameter	Conditions	V_{CC}	$T_A = 25^\circ C$			$T_A = -40\text{ to }85^\circ C$	$T_A = -55\text{ to }125^\circ C$	Units
				Typ	Guaranteed Limits				
f_{MAX}	Maximum Operating Frequency for SCK		2.0V		6	4.8	4	MHz	
			4.5V		30	24	20	MHz	
			6.0V		35	28	24	MHz	
t_{PHL} , t_{PLH}	Maximum Propagation Delay from SCK or \overline{SLOAD} to Q_H		2.0V	62	175	220	265	ns	
			4.5V	20	35	44	53	ns	
			6.0V	18	30	37	45	ns	
t_{PHL} , t_{PLH}	Maximum Propagation Delay from SCK or \overline{SLOAD} to Q_H	$C_L = 150\text{ pF}$	2.0V	120	225	280	340	ns	
			4.5V	31	45	56	68	ns	
			6.0V	28	38	48	58	ns	
t_{PHL} , t_{PLH}	Maximum Propagation Delay from RCK to Q_H		2.0V	80	210	265	315	ns	
			4.5V	25	42	53	63	ns	
			6.0V	21	36	45	54	ns	
t_{PHL} , t_{PLH}	Maximum Propagation Delay RCK to Q_H	$C_L = 150\text{ pF}$	2.0V	80	210	265	313	ns	
			4.5V	25	52	66	77	ns	
			6.0V	21	44	56	66	ns	
t_{PZH} , t_{PZL}	Output Enable Time	$R_L = 1\text{ k}\Omega$	2.0V	70	150	189	224	ns	
			4.5V	22	30	38	45	ns	
			6.0V	20	26	32	38	ns	
t_{PHZ} , t_{PLZ}	Output Disable Time	$R_L = 1\text{ k}\Omega$	2.0V	70	150	189	224	ns	
			4.5V	22	30	38	45	ns	
			6.0V	20	26	32	38	ns	
t_S	Minimum Setup Time from RCK to SCK		2.0V		100	125	150	ns	
			4.5V		20	25	30	ns	
			6.0V		17	22	25	ns	
t_S	Minimum Setup Time from SER to SCK		2.0V		100	125	150	ns	
			4.5V		20	25	30	ns	
			6.0V		17	22	25	ns	
t_S	Minimum Setup Time from Inputs A thru H to RCK		2.0V		100	125	150	ns	
			4.5V		20	25	30	ns	
			6.0V		17	22	25	ns	
t_H	Minimum Hold Time		2.0V	-5	5	5	5	ns	
			4.5V	0	5	5	5	ns	
			6.0V	1	5	5	5	ns	
t_W	Minimum Pulse Width SCK, RCK, \overline{SLOAD} , \overline{SLOAD}		2.0V	30	80	100	120	ns	
			4.5V	9	16	20	24	ns	
			6.0V	8	14	17	20	ns	

AC Electrical Characteristics (Continued)

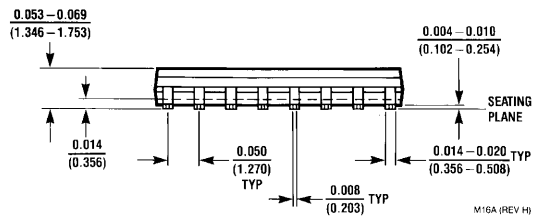
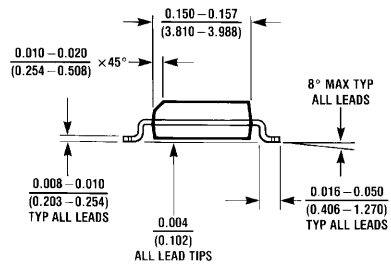
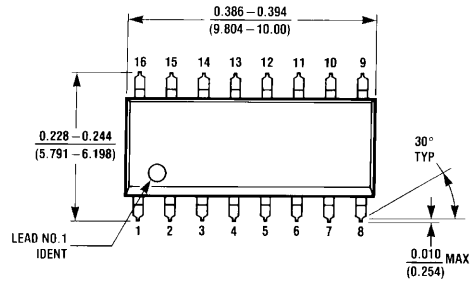
Symbol	Parameter	Conditions	V _{CC}	T _A = 25°C		T _A = -40 to 85°C	T _A = -55 to 125°C	Units
				Typ	Guaranteed Limits			
t _r , t _f	Maximum Input Rise and Fall Time, Clock		2.0V		1500	1500	1500	ns
			4.5V		500	500	500	ns
			6.0V		400	400	400	ns
t _{THL} , t _{TLH}	Maximum Output Rise and Fall Time		2.0V	25	60	75	90	ns
			4.5V	6	12	15	18	ns
			6.0V	5	10	12	15	ns
C _{PD}	Power Dissipation Capacitance (Note 5)			87				pF
C _{IN}	Maximum Input Capacitance			5	10	10	10	pF
C _{OUT}	Maximum Output Capacitance			15	20	20	20	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, $I_S = C_{PD} V_{CC} sf + I_{CC}$.

Timing Diagram



Physical Dimensions inches (millimeters) unless otherwise noted



**16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow
Package Number M16A**

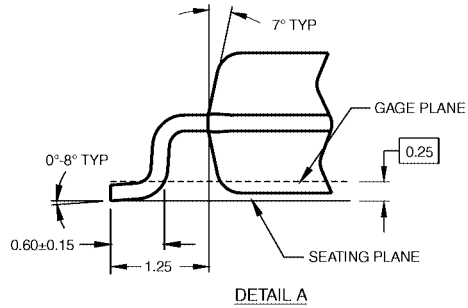
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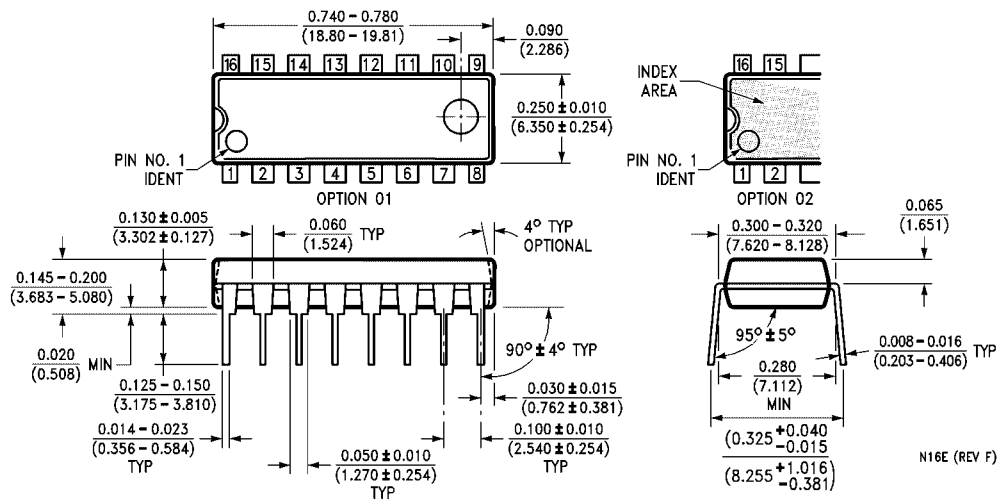
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M16DRRevB1



16-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide Package Number M16D

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



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

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