

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

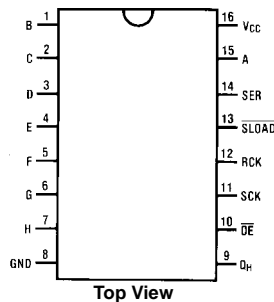
- 8-bit parallel storage register inputs
- Wide operating voltage range: 2V–6V
- Shift register has direct overriding load
- Guaranteed shift frequency. . . DC to 30 MHz
- Low quiescent current: 80 μ A maximum (74HC Series)
- 3-STATE output for 'Wire-OR'

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

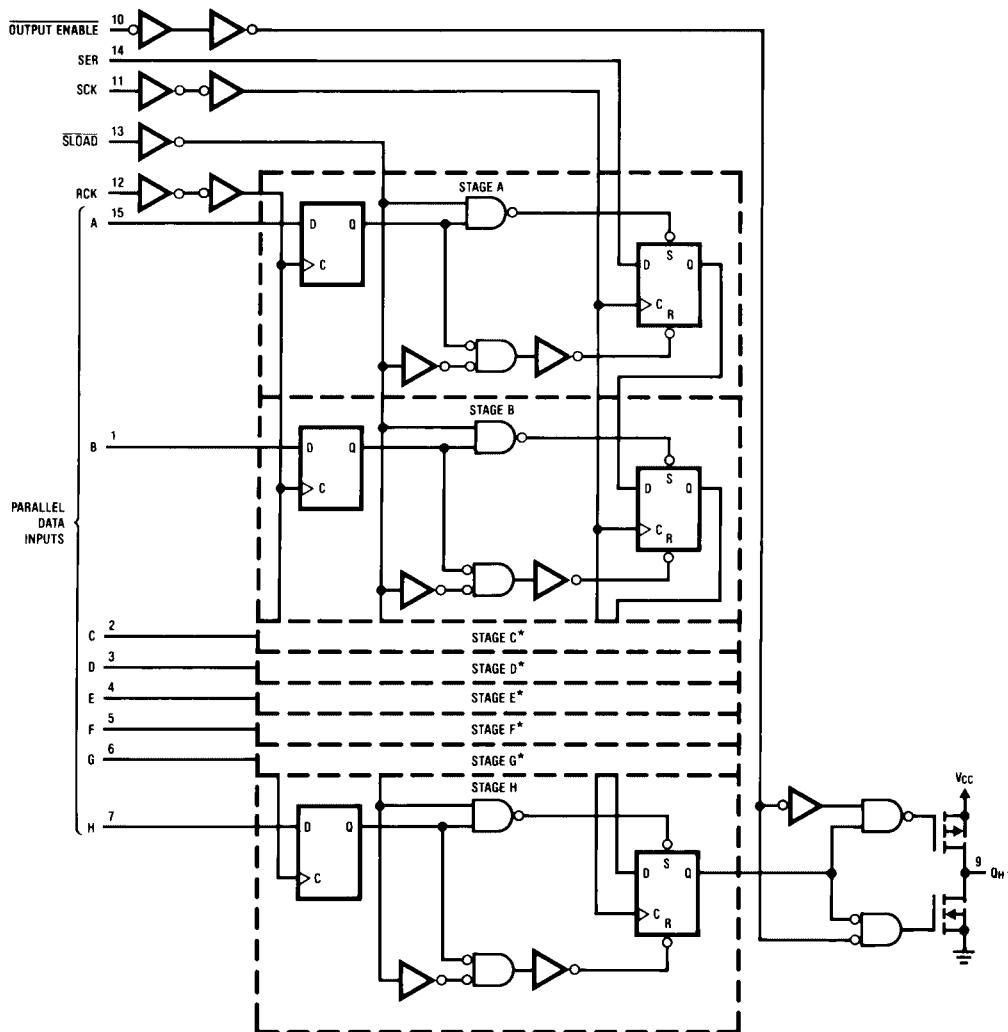


Truth Table

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

MM74HC589

Block Diagram (positive logic)



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}	$T_A = 25^\circ C$			$T_A = -40 \text{ to } 85^\circ C$			Units
				Typ	Guaranteed Limits		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)

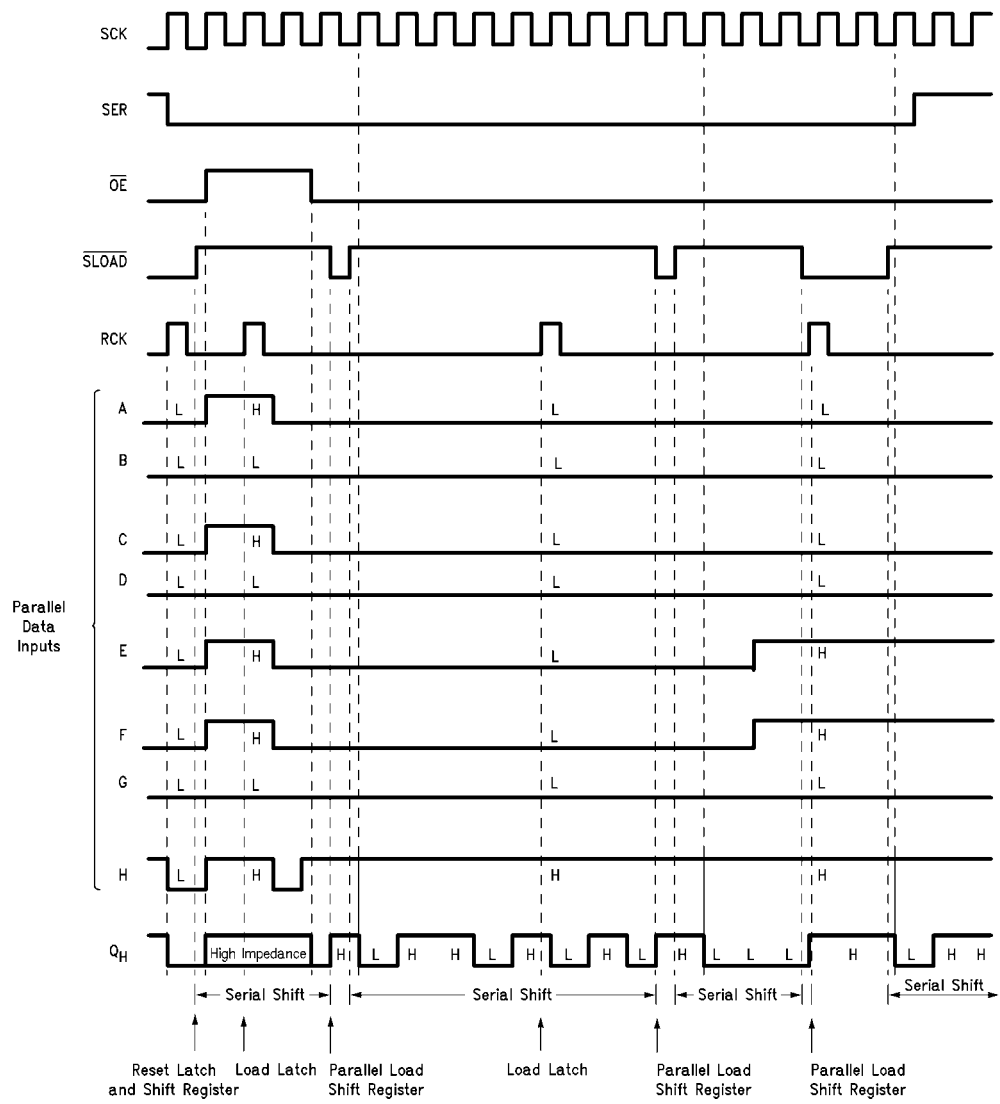
Symbol	Parameter	Conditions	V_{CC}	$T_A = 25^\circ C$			$T_A = -40\text{ to }85^\circ C$	$T_A = -55\text{ to }125^\circ C$	Units
				Typ	Guaranteed Limits				
f_{MAX}	Maximum Operating Frequency for SCK		2.0V		6	4.8	4	MHz	
			4.5V		30	24	20	MHz	
			6.0V		35	28	24	MHz	
t_{PHL} , t_{PLH}	Maximum Propagation 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)

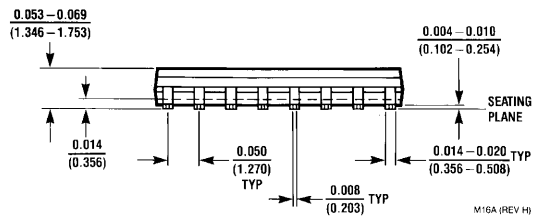
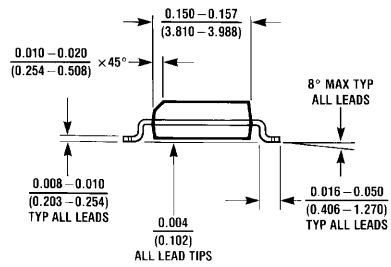
Symbol	Parameter	Conditions	V _{CC}	T _A = 25°C		T _A = -40 to 85°C	T _A = -55 to 125°C	Units
				Typ	Guaranteed Limits			
t _r , t _f	Maximum Input Rise and Fall Time, Clock		2.0V		1500	1500	1500	ns
			4.5V		500	500	500	ns
			6.0V		400	400	400	ns
t _{THL} , t _{TLH}	Maximum Output Rise and Fall Time		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**

M16A (REV H)

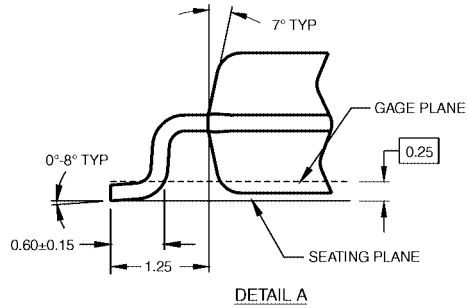
Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



DIMENSIONS ARE IN MILLIMETERS

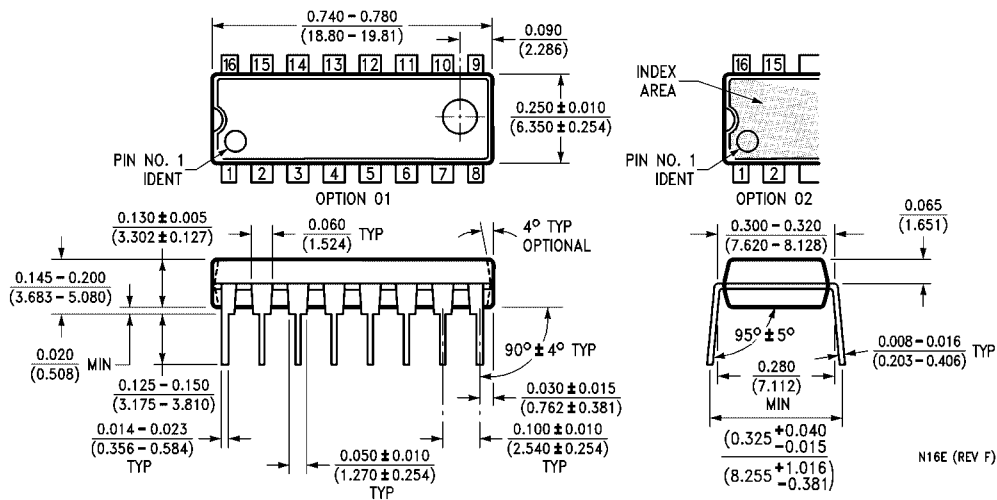
- NOTES:
 A. CONFORMS TO EIAJ EDR-7320 REGISTRATION, ESTABLISHED IN DECEMBER, 1998.
 B. DIMENSIONS ARE IN MILLIMETERS.
 C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.

M16DRevB1



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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