MC74HC589A

8-Bit Serial or Parallel-Input/Serial-Output Shift Register with 3-State Output

High–Performance Silicon–Gate CMOS

The MC74HC589A device consists of an 8–bit storage latch which feeds parallel data to an 8–bit shift register. Data can also be loaded serially (see the Function Table). The shift register output, Q_H, is a three–state output, allowing this device to be used in bus–oriented systems.

The HC589A directly interfaces with the SPI serial data port on CMOS MPUs and MCUs.

- Output Drive Capability: 15 LSTTL Loads
- Outputs Directly Interface to CMOS, NMOS, and TTL
- Operating Voltage Range: 2 to 6 V
- Low Input Current: 1 μA
- High Noise Immunity Characteristic of CMOS Devices
- In Compliance with the Requirements Defined by JEDEC Standard No. 7A
- Chip Complexity: 526 FETs or 131.5 Equivalent Gates

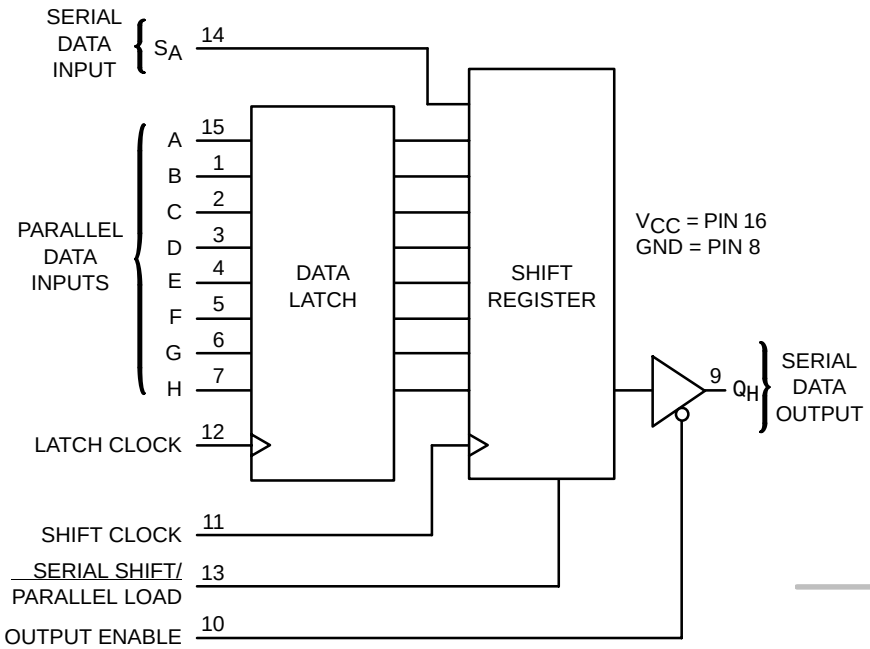

Figure 1. Logic Diagram

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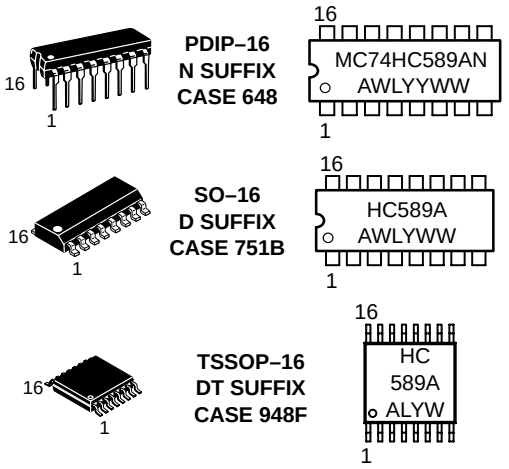
MARKING DIAGRAMS



A = Assembly Location
L, WL = Wafer Lot
Y, YY = Year
W, WW = Work Week

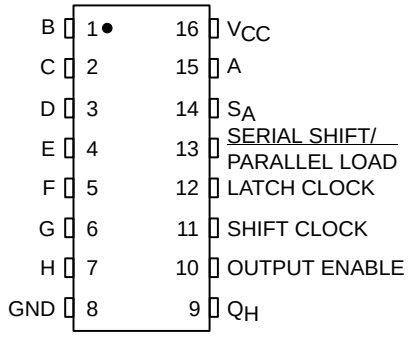


Figure 2. Pin Assignment

ORDERING INFORMATION

Device	Package	Shipping
MC74HC589AN	PDIP–16	2000/Box
MC74HC589AD	SOIC–16	48/Rail
MC74HC589ADR2	SOIC–16	2500/Reel
MC74HC589ADT	TSSOP–16	96/Rail
MC74HC589ADTR2	TSSOP–16	2500/Reel

MAXIMUM RATINGS (Note 1)

Symbol	Parameter		Value	Unit
V_{CC}	DC Supply Voltage	(Referenced to GND)	−0.5 to +7.0	V
V_{in}	DC Input Voltage	(Referenced to GND)	$-0.5 \le V_{CC} + 0.5$	V
V_{out}	DC Output Voltage	(Referenced to GND)	$-0.5 \le V_{CC} + 0.5$	V
I_{in}	DC Input Current, per Pin		±20	mA
I_{out}	DC Output Current, per Pin		±35	mA
I_{CC}	DC Supply Current, V_{CC} and GND Pins		±75	mA
I_{GND}	DC Ground Current per Ground Pin		±75	mA
T_{STG}	Storage Temperature Range		−65 to +150	°C
T_L	Lead Temperature, 1 mm from Case for 10 Seconds		260	°C
T_J	Junction Temperature Under Bias		+150	°C
θ_{JA}	Thermal Resistance	PDIP SOIC TSSOP	78 112 148	°C/W
P_D	Power Dissipation in Still Air at 85°C	PDIP SOIC TSSOP	750 500 450	mW
MSL	Moisture Sensitivity		Level 1	
F_R	Flammability Rating	Oxygen Index: 30% – 35%	UL–94–VO (0.125 in)	
V_{ESD}	ESD Withstand Voltage	Human Body Model (Note 2) Machine Model (Note 3) Charged Device Model (Note 4)	>4000 >200 >1000	V
$I_{LATCH-UP}$	Latch–Up Performance	Above V_{CC} and Below GND at 85°C (Note 5)	±300	mA

1. Absolute maximum continuous ratings are those values beyond which damage to the device may occur. Extended exposure to these conditions or conditions beyond those indicated may adversely affect device reliability. Functional operation under absolute maximum–rated conditions is not implied.
2. Tested to EIA/JESD22–A114–A.
3. Tested to EIA/JESD22–A115–A.
4. Tested to JESD22–C101–A.
5. Tested to EIA/JESD78.
6. For high frequency or heavy load considerations, see the ON Semiconductor High–Speed CMOS Data Book (DL129/D).

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter		Min	Max	Unit
V_{CC}	DC Supply Voltage	(Referenced to GND)	2.0	6.0	V
V_{in}, V_{out}	DC Input Voltage, Output Voltage	(Referenced to GND)	0	V_{CC}	V
T_A	Operating Temperature, All Package Types		−55	+125	°C
t_r, t_f	Input Rise and Fall Time (Figure 1)	V_{CC} = 2.0 V V_{CC} = 3.0 V V_{CC} = 4.5 V V_{CC} = 6.0 V	0 0 0	1000 800 500 400	ns

7. Unused inputs may not be left open. All inputs must be tied to a high–logic voltage level or a low–logic input voltage level.

DC ELECTRICAL CHARACTERISTICS (Voltages Referenced to GND, Note 8)

Symbol	Parameter	Test Conditions	V_{CC} V	Guaranteed Limit			Unit
				−55°C to 25°C	≤85°C	≤125°C	
V_{IH}	Minimum High–Level Input Voltage	V_{out} = 0.1 V or V_{CC} −0.1 V $\|I_{out}\| \leq 20$ μA	2.0 3.0 4.5 6.0	1.5 2.1 3.15 4.2	1.5 2.1 3.15 4.2	1.5 2.1 3.15 4.2	V
V_{IL}	Maximum Low–Level Input Voltage	V_{out} = 0.1 V or V_{CC} −0.1 V $\|I_{out}\| \leq 20$ μA	2.0 3.0 4.5 6.0	0.5 0.9 1.35 1.8	0.5 0.9 1.35 1.8	0.5 0.9 1.35 1.8	V
V_{OH}	Minimum High–Level Output Voltage	$V_{in} = V_{IH}$ or V_{IL} $\|I_{out}\| \leq 20$ μA	2.0 4.5 6.0	1.9 4.4 5.9	1.9 4.4 5.9	1.9 4.4 5.9	V
		$V_{in} = V_{IH}$ or V_{IL} $\|I_{out}\| \leq 2.4$ mA $\|I_{out}\| \leq 6.0$ mA $\|I_{out}\| \leq 7.8$ mA	3.0 4.5 6.0	2.48 3.98 5.48	2.34 3.84 5.34	2.20 3.70 5.20	
V_{OL}	Maximum Low–Level Output Voltage	$V_{in} = V_{IH}$ $\|I_{out}\| \leq 20$ μA	2.0 4.5 6.0	0.1 0.1 0.1	0.1 0.1 0.1	0.1 0.1 0.1	V
		$V_{in} = V_{IH}$ or V_{IL} $\|I_{out}\| \leq 2.4$ mA $\|I_{out}\| \leq 6.0$ mA $\|I_{out}\| \leq 7.8$ mA	3.0 4.5 6.0	0.26 0.26 0.26	0.33 0.33 0.33	0.40 0.40 0.40	
I_{in}	Maximum Input Leakage Current	$V_{in} = V_{CC}$ or GND	6.0	±0.1	±1.0	±1.0	μA
I_{OZ}	Maximum Three–State Leakage Current	Output in High–Impedance State $V_{in} = V_{IL}$ or V_{IH} $V_{out} = V_{CC}$ or GND	6.0	±0.5	±5.0	±10	μA
I_{CC}	Maximum Quiescent Supply Current (per Package)	$V_{in} = V_{CC}$ or GND I_{out} = 0 μA	6.0	4	40	160	μA

8. Information on typical parametric values can be found in the ON Semiconductor High–Speed CMOS Data Book (DL129/D).

AC ELECTRICAL CHARACTERISTICS (C_L = 50 pF, Input $t_r = t_f$ = 6 ns, Notes 9 and 10)

Symbol	Parameter	V_{CC} V	Guaranteed Limit			Unit
			−55°C to 25°C	≤85°C	≤125°C	
f_{max}	Maximum Clock Frequency (50% Duty Cycle) (Figures 2 and 8)	2.0 3.0 4.5 6.0	6.0 15 30 35	4.8 10 24 28	4.0 8.0 20 24	MHz
t_{PLH}, t_{PHL}	Maximum Propagation Delay, Latch Clock to Q_H (Figures 1 and 8)	2.0 3.0 4.5 6.0	175 100 40 30	225 110 50 40	275 125 60 50	ns
t_{PLH}, t_{PHL}	Maximum Propagation Delay, Shift Clock to Q_H (Figures 2 and 8)	2.0 3.0 4.5 6.0	160 90 30 25	200 130 40 30	240 160 48 40	ns
t_{PLH}, t_{PHL}	Maximum Propagation Delay, Serial Shift/Parallel Load to Q_H (Figures 4 and 8)	2.0 3.0 4.5 6.0	160 90 30 25	200 130 40 30	240 160 48 40	ns
t_{PLZ}, t_{PHZ}	Maximum Propagation Delay, Output Enable to Q_H (Figures 3 and 9)	2.0 3.0 4.5 6.0	150 80 27 23	170 100 30 25	200 130 40 30	ns
t_{PZL}, t_{PZH}	Maximum Propagation Delay, Output Enable to Q_H (Figures 3 and 9)	2.0 3.0 4.5 6.0	150 80 27 23	170 100 30 25	200 130 40 30	ns
t_{TLH}, t_{THL}	Maximum Output Transition Time, Any Output (Figures 1 and 8)	2.0 3.0 4.5 6.0	60 23 12 10	75 27 15 13	90 31 18 15	ns
C_{in}	Maximum Input Capacitance	–	10	10	10	pF
C_{out}	Maximum Three–State Output Capacitance (Output in High–Impedance State)	–	15	15	15	pF

9. For propagation delays with loads other than 50 pF, see the ON Semiconductor High–Speed CMOS Data Book (DL129/D).
10. Information on typical parametric values can be found in the ON Semiconductor High–Speed CMOS Data Book (DL129/D).

		Typical @ 25°C, V_{CC} = 5.0 V	
C_{PD}	Power Dissipation Capacitance (per Package)*	50	pF

*Used to determine the no–load dynamic power consumption: $P_D = C_{PD} V_{CC}^2 f + I_{CC} V_{CC}$. For load considerations, see the ON Semiconductor High–Speed CMOS Data Book (DL129/D).

TIMING REQUIREMENTS (Input $t_r = t_f$ = 6 ns, Note 11)

Symbol	Parameter	V_{CC} V	Guaranteed Limit			Unit
			−55°C to 25°C	≤85°C	≤125°C	
t_{su}	Minimum Setup Time, A–H to Latch Clock (Figure 5)	2.0 3.0 4.5 6.0	100 40 20 17	125 50 25 21	150 60 30 26	ns
t_{su}	Minimum Setup Time, Serial Data Input S_A to Shift Clock (Figure 6)	2.0 3.0 4.5 6.0	100 40 20 17	125 50 25 21	150 60 30 26	ns
t_{su}	Minimum Setup Time, Serial Shift/Parallel Load to Shift Clock (Figure 7)	2.0 3.0 4.5 6.0	100 40 20 17	125 50 25 21	150 60 30 26	ns
t_h	Minimum Hold Time, Latch Clock to A–H (Figure 5)	2.0 3.0 4.5 6.0	25 10 5 5	30 12 6 6	40 15 8 7	ns
t_h	Minimum Hold Time, Shift Clock to Serial Data Input S_A (Figure 6)	2.0 3.0 4.5 6.0	5 5 5 5	5 5 5 5	5 5 5 5	ns
t_w	Minimum Pulse Width, Shift Clock (Figure 2)	2.0 3.0 4.5 6.0	75 40 15 13	95 50 19 16	110 60 23 19	ns
t_w	Minimum Pulse Width, Latch Clock (Figure 1)	2.0 3.0 4.5 6.0	80 40 16 14	100 50 20 17	120 60 24 20	ns
t_w	Minimum Pulse Width, Serial Shift/Parallel Load (Figure 4)	2.0 3.0 4.5 6.0	80 40 16 14	100 50 20 17	120 60 24 20	ns
t_r, t_f	Maximum Input Rise and Fall Times (Figure 1)	2.0 3.0 4.5 6.0	1000 800 500 400	1000 800 500 400	1000 800 500 400	ns

11. Information on typical parametric values can be found in the ON Semiconductor High–Speed CMOS Data Book (DL129/D).

FUNCTION TABLE

Operation	Inputs						Resulting Function		
	Output Enable	Serial Shift/ Parallel Load	Latch Clock	Shift Clock	Serial Input S_A	Parallel Inputs A–H	Data Latch Contents	Shift Register Contents	Output Q_H
Force Output into High Impedance State	H	X	X	X	X	X	X	X	Z
Load Parallel Data into Data Latch	L	H	↑	L, H, ↓	X	a–h	a–h	U	U
Transfer Latch Contents to Shift Register	L	L	L, H, ↓	X	X	X	U	$LR_N \rightarrow SR_N$	LR_H
Contents of Input Latch and Shift Register are Unchanged	L	H	L, H, ↓	L, H, ↓	X	X	U	U	U
Load Parallel Data into Data Latch and Shift Register	L	L	↑	X	X	a–h	a–h	a–h	h
Shift Serial Data into Shift Register	L	H	X	↑	D	X	*	SR_A = D, $SR_N \rightarrow SR_{N+1}$	$SR_G \rightarrow SR_H$
Load Parallel Data in Data Latch and Shift Serial Data into Shift Register	L	H	↑	↑	D	a–h	a–h	SR_A = D, $SR_N \rightarrow SR_{N+1}$	$SR_G \rightarrow SR_H$

LR = latch register contents
SR = shift register contents
a–h = data at parallel data inputs A–H
D = data (L, H) at serial data input S_A
U = remains unchanged
X = don't care
Z = high impedance
* = depends on Latch Clock input

Switching Waveforms

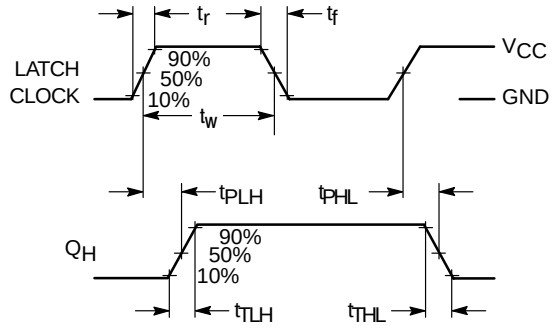


Figure 3. (Serial Shift/Parallel Load = L)

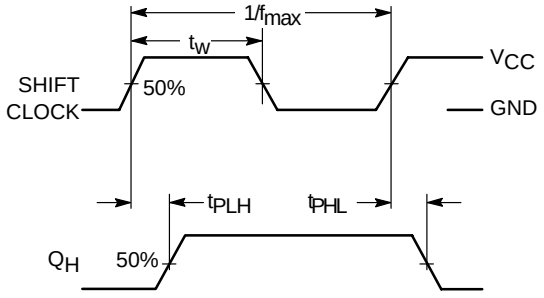


Figure 4. (Serial Shift/Parallel Load = H)

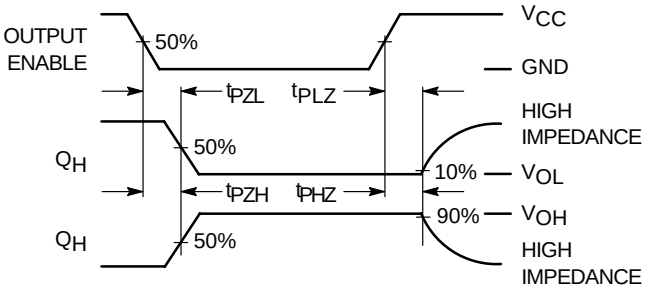


Figure 5.

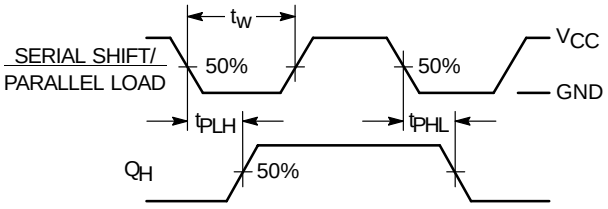


Figure 6.

Switching Waveforms

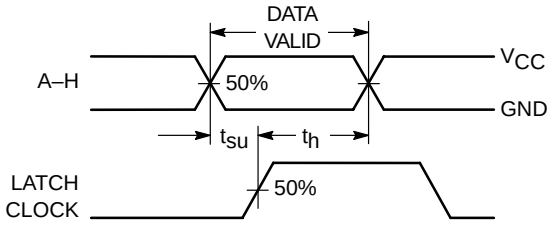


Figure 7.

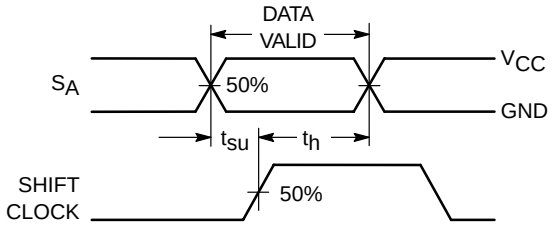


Figure 8.

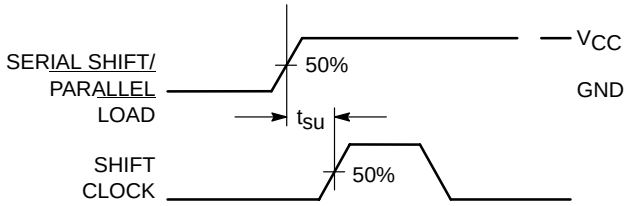
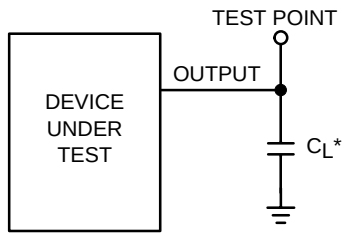
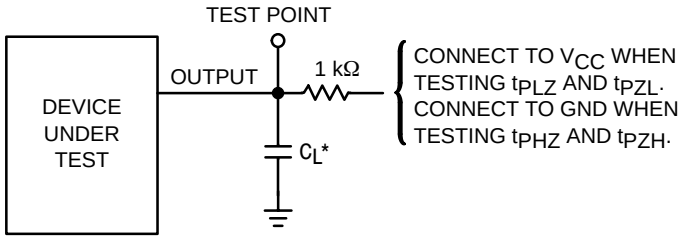


Figure 9.



*Includes all probe and jig capacitance.

Figure 10. Test Circuit



*Includes all probe and jig capacitance.

Figure 11. Test Circuit

Pin Descriptions

Data Inputs

A, B, C, D, E, F, G, H (Pins 15, 1, 2, 3, 4, 5, 6, 7)

Parallel data inputs. Data on these inputs are stored in the data latch on the rising edge of the Latch Clock input.

S_A (Pin 14)

Serial data input. Data on this input is shifted into the shift register on the rising edge of the Shift Clock input if Serial Shift/Parallel Load is high. Data on this input is ignored when Serial Shift/Parallel Load is low.

Control Inputs

Serial Shift/$\overline{\text{Parallel Load}}$ (Pin 13)

Shift register mode control. When a high level is applied to this pin, the shift register is allowed to serially shift data. When a low level is applied to this pin, the shift register accepts parallel data from the data latch.

Shift Clock (Pin 11)

Serial shift clock. A low–to–high transition on this input shifts data on the serial data input into the shift register and data in stage H is shifted out Q_H, being replaced by the data previously stored in stage G.

Latch Clock (Pin 12)

Data latch clock. A low–to–high transition on this input loads the parallel data on inputs A–H into the data latch.

Output Enable (Pin 10)

Active–low output enable A high level applied to this pin forces the Q_H output into the high impedance state. A low level enables the output. This control does not affect the state of the input latch or the shift register.

Output

Q_H (Pin 9)

Serial data output. This pin is the output from the last stage of the shift register. This is a 3–state output.

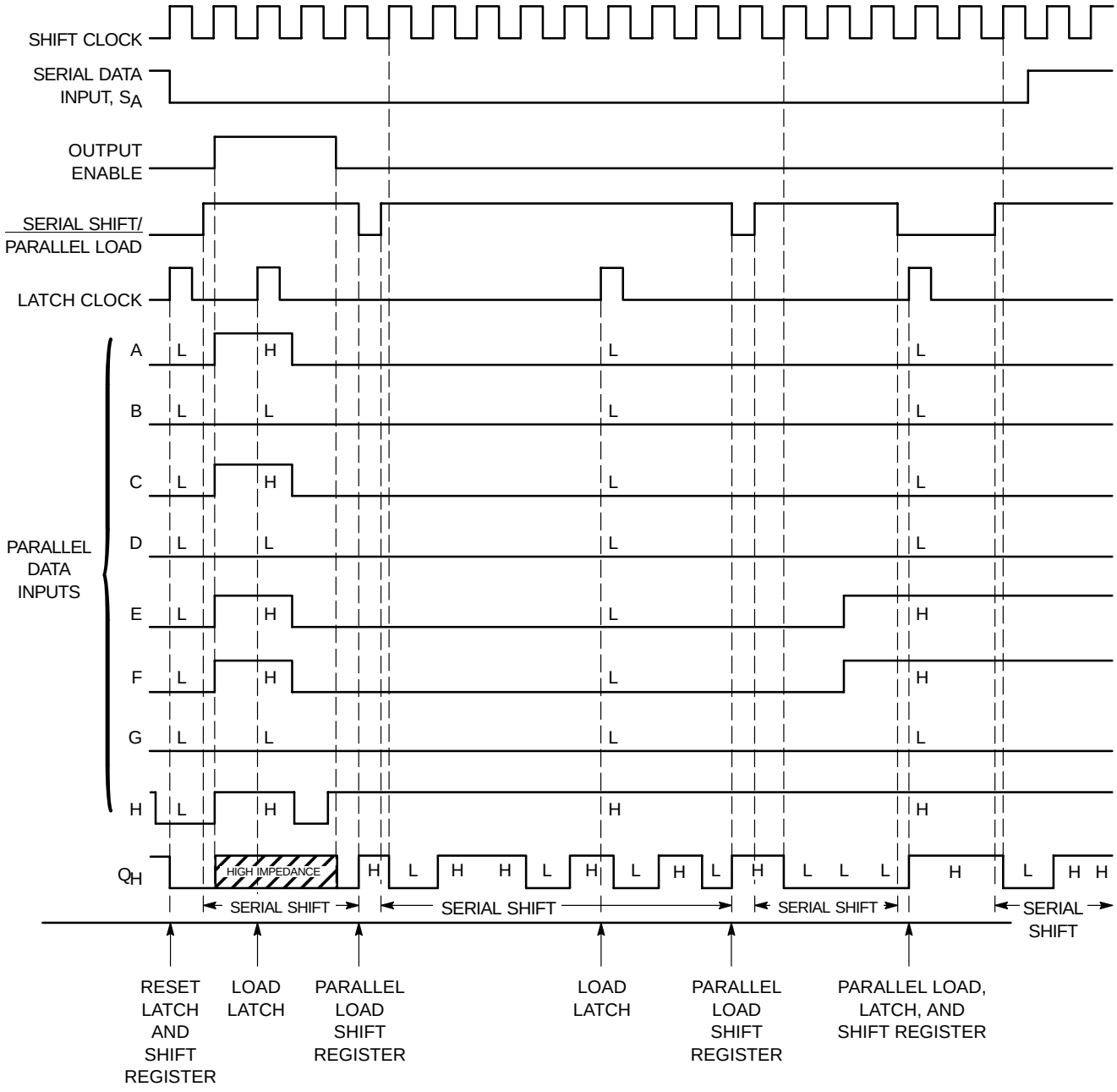
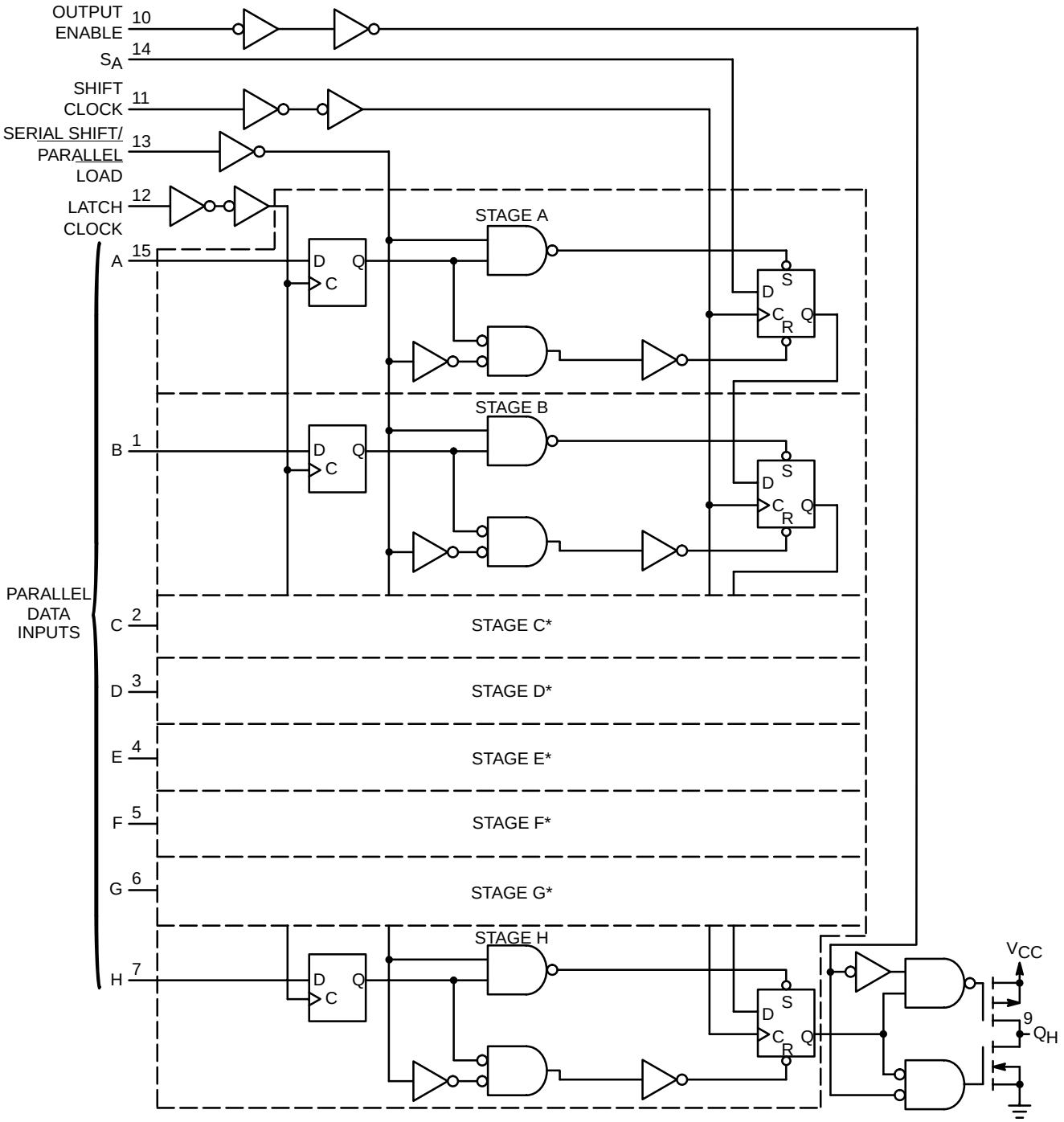


Figure 12. Timing Diagram

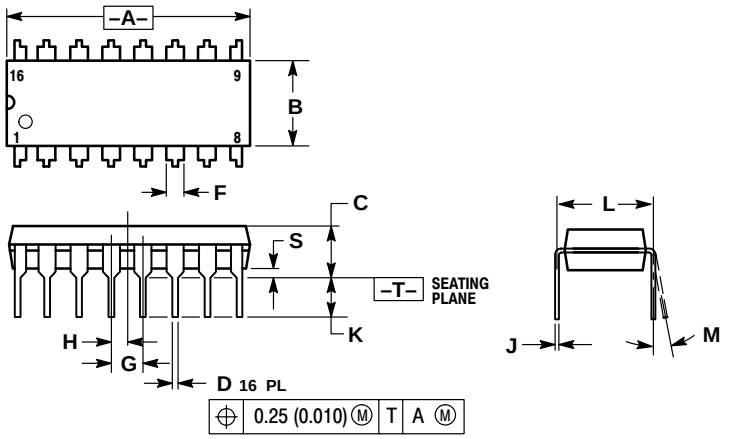


*Stages C thru G (not shown in detail) are identical to stages A and B above.

Figure 13. Logic Detail

PACKAGE DIMENSIONS

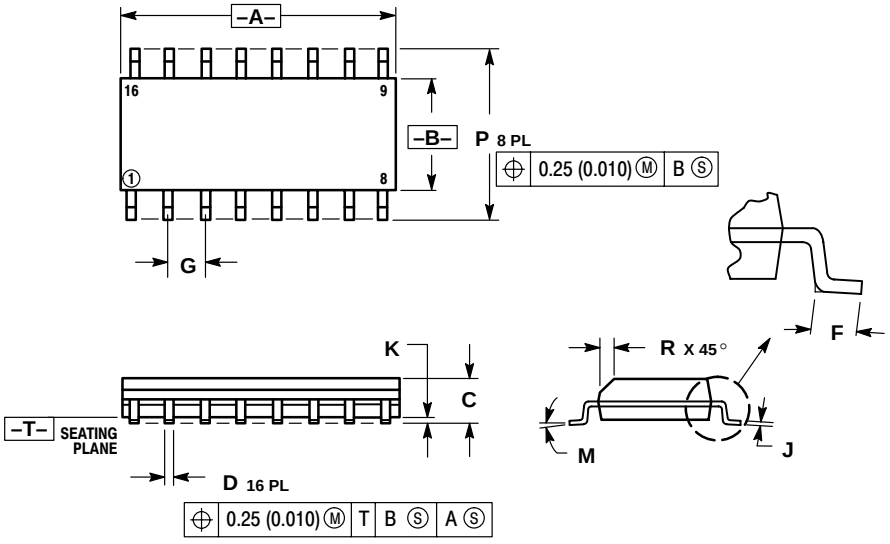
PDIP–16
N SUFFIX
CASE 648–08
ISSUE R



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
4. DIMENSION B DOES NOT INCLUDE MOLD FLASH.
5. ROUNDED CORNERS OPTIONAL.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.740	0.770	18.80	19.55
B	0.250	0.270	6.35	6.85
C	0.145	0.175	3.69	4.44
D	0.015	0.021	0.39	0.53
F	0.040	0.70	1.02	1.77
G	0.100 BSC		2.54 BSC	
H	0.050 BSC		1.27 BSC	
J	0.008	0.015	0.21	0.38
K	0.110	0.130	2.80	3.30
L	0.295	0.305	7.50	7.74
M	0 °	10 °	0 °	10 °
S	0.020	0.040	0.51	1.01

SOIC–16
D SUFFIX
CASE 751B–05
ISSUE J

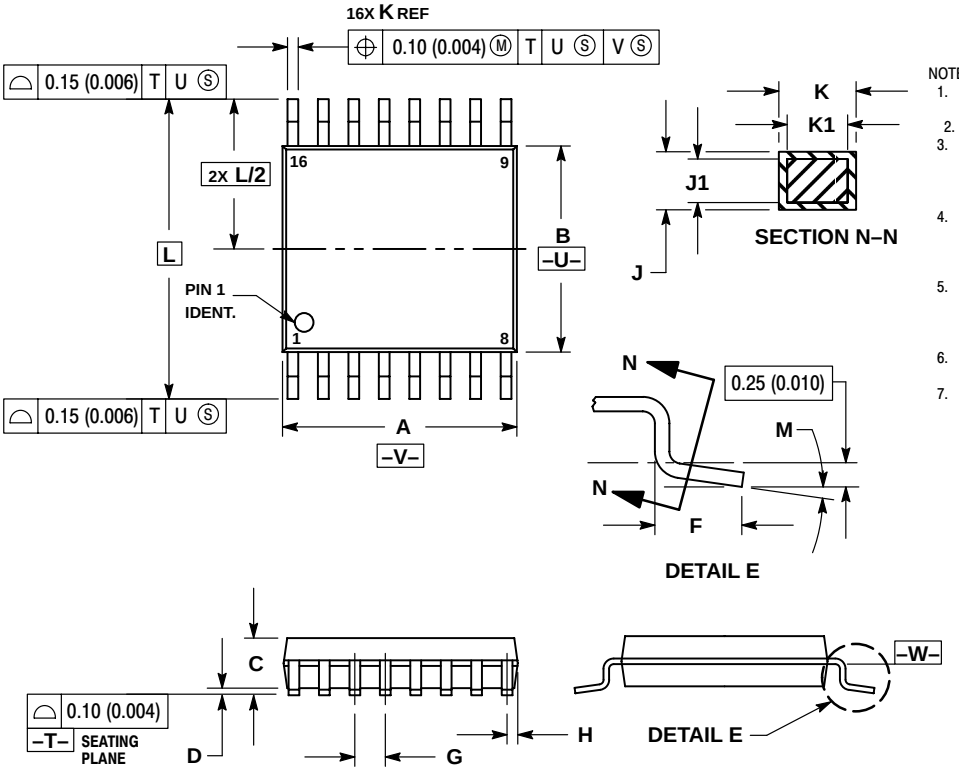


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	9.80	10.00	0.386	0.393
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.054	0.068
D	0.35	0.49	0.014	0.019
F	0.40	1.25	0.016	0.049
G	1.27 BSC		0.050 BSC	
J	0.19	0.25	0.008	0.009
K	0.10	0.25	0.004	0.009
M	0 °	7 °	0 °	7 °
P	5.80	6.20	0.229	0.244
R	0.25	0.50	0.010	0.019

PACKAGE DIMENSIONS

TSSOP–16
DT SUFFIX
CASE 948F–01
ISSUE O



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH. PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.
5. DIMENSION K DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE K DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
7. DIMENSION A AND B ARE TO BE DETERMINED AT DATUM PLANE –W–.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	4.90	5.10	0.193	0.200
B	4.30	4.50	0.169	0.177
C	---	1.20	---	0.047
D	0.05	0.15	0.002	0.006
F	0.50	0.75	0.020	0.030
G	0.65 BSC		0.026 BSC	
H	0.18	0.28	0.007	0.011
J	0.09	0.20	0.004	0.008
J1	0.09	0.16	0.004	0.006
K	0.19	0.30	0.007	0.012
K1	0.19	0.25	0.007	0.010
L	6.40 BSC		0.252 BSC	
M	0°	8°	0°	8°

PUBLICATION ORDERING INFORMATION

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