FAIRCHILD SEMICONDUCTOR™

August 1986
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DM74LS166
8-Bit Parallel-In/Serial-Out Shift Register

General Description

These parallel-in or serial-in, serial-out shift registers feature gated clock inputs and an overriding clear input. All inputs are buffered to lower the drive requirements to one normalized load, and input clamping diodes minimize switching transients to simplify system design. The load mode is established by the shift/load input. When HIGH, this input enables the serial data input and couples the eight flip-flops for serial shifting with each clock pulse. When LOW, the parallel (broadside) data inputs are enabled and synchronous loading occurs on the next clock pulse. During parallel loading, serial data flow is inhibited.

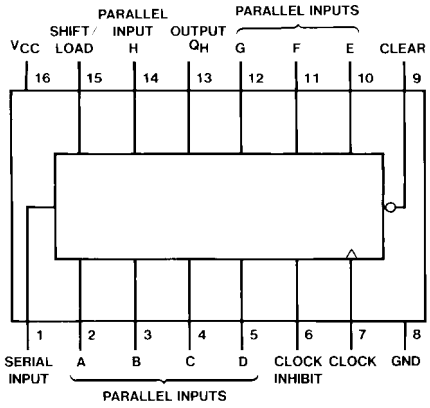
Clocking is accomplished on the LOW-to-HIGH level edge of the clock pulse through a two-input NOR gate, permitting one input to be used as a clock-enable or clock-inhibit function. Holding either of the clock inputs HIGH inhibits clocking; holding either LOW enables the other clock input. This allows the system clock to be free running, and the register can be stopped on command with the other clock input. The clock-inhibit input should be changed to the high level only while the clock input is HIGH. A buffered, direct clear input overrides all other inputs, including the clock, and sets all flip-flops to zero.

Ordering Code:

Order Number	Package Number	Package Description
DM74LS166M	M16A	16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150 Narrow
DM74LS166WM	M16B	16-Lead Small Outline Intergrated Circuit (SOIC), JEDEC MS-013, 0.300 Wide
DM74LS166N	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

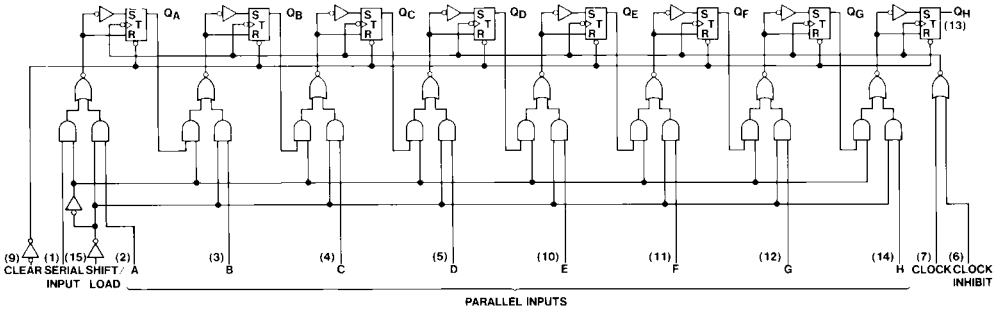


Function Table

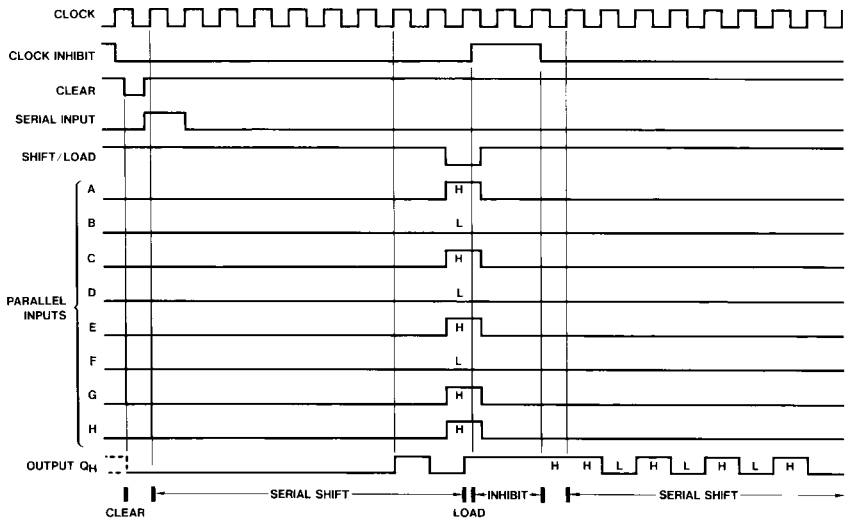
Inputs						Internal Outputs		Output
Clear	Shift/ Load	Clock Inhibit	Clock	Serial	Parallel A…H	Q_A	Q_B	Q_H
L	X	X	X	X	X	L	L	L
H	X	L	L	X	X	Q_{A0}	Q_{B0}	Q_{H0}
H	L	L	↑	X	a…h	a	b	h
H	H	L	↑	H	X	H	Q_{An}	Q_{Gn}
H	H	L	↑	L	X	L	Q_{An}	Q_{Gn}
H	X	H	↑	X	X	Q_{A0}	Q_{B0}	Q_{H0}

H = HIGH Level (steady state)
L = LOW Level (steady state)
X = Don't Care (any input, including transitions)
↑ = Transition from LOW-to-HIGH level
a…h = The level of steady-state input at inputs A through H, respectively
Q_{A0}, Q_{B0}, Q_{H0} = The level of Q_A, Q_B, Q_H, respectively, before the indicated steady-state input conditions were established
Q_{An}, Q_{Gn}, = The level of Q_A, Q_G, respectively, before the most recent ↑ transition of the clock

Logic Diagram



Timing Diagram



Typical Clear, Shift, Load, Inhibit and Shift Sequences

Absolute Maximum Ratings(Note 1)

Supply Voltage	7V
Input Voltage	7V
Operating Free Air Temperature Range	0°C to +70°C
Storage Temperature Range	−65°C to +150°C

Note 1: The "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. The device should not be operated at these limits. The parametric values defined in the Electrical Characteristics tables are not guaranteed at the absolute maximum ratings. The "Recommended Operating Conditions" table will define the conditions for actual device operation.

Recommended Operating Conditions

Symbol	Parameter		Min	Nom	Max	Units
V_{CC}	Supply Voltage		4.75	5	5.25	V
V_{IH}	HIGH Level Input Voltage		2			V
V_{IL}	LOW Level Input Voltage				0.8	V
I_{OH}	HIGH Level Output Current				−0.4	mA
I_{OL}	LOW Level Output Current				8	mA
f_{CLK}	Clock Frequency (Note 2)		0		25	MHz
	Clock Frequency (Note 3)		0		20	MHz
t_W	Pulse Width (Note 4)	Clock	20			ns
		Clear	20			
t_{SU}	Setup Time (Note 4)	Mode	30			ns
		Data	20			
t_H	Hold Time (Note 4)		0			ns
T_A	Free Air Operating Temperature		0		70	°C

Note 2: C_L = 15 pF, R_L = 2 kΩ, T_A = 25°C and V_{CC} = 5V.

Note 3: C_L = 50 pF, R_L = 2 kΩ, T_A = 25°C and V_{CC} = 5V.

Note 4: T_A = 25°C and V_{CC} = 5V.

Electrical Characteristics

over recommended operating free air temperature range (unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ (Note 5)	Max	Units
V_I	Input Clamp Voltage	V_{CC} = Min, I_I = −18 mA			−1.5	V
V_{OH}	HIGH Level Output Voltage	V_{CC} = Min, I_{OH} = Max V_{IL} = Max, V_{IH} = Min	2.7	3.4		V
V_{OL}	LOW Level Output Voltage	V_{CC} = Min, I_{OL} = Max V_{IL} = Max, V_{IH} = Min		0.35	0.5	V
		I_{OL} = 4 mA, V_{CC} = Min		0.25	0.4	
I_I	Input Current @ Max Input Voltage	V_{CC} = Max, V_I = 7V			0.1	mA
I_{IH}	HIGH Level Input Current	V_{CC} = Max, V_I = 2.7V			20	µA
I_{IL}	LOW Level Input Current	V_{CC} = Max, V_I = 0.4V			−0.4	mA
I_{OS}	Short Circuit Output Current	V_{CC} = Max (Note 6)	−20		−100	mA
I_{CC}	Supply Current	V_{CC} = Max (Note 7)		22	38	mA

Note 5: All typicals are at V_{CC} = 5V, T_A = 25°C.

Note 6: Not more than one output should be shorted at a time, and the duration should not exceed one second.

Note 7: With all outputs OPEN, 4.5V applied to the serial input, all other inputs except the CLOCK grounded, I_{CC} is measured after a momentary ground, then 4.5V is applied to the CLOCK.

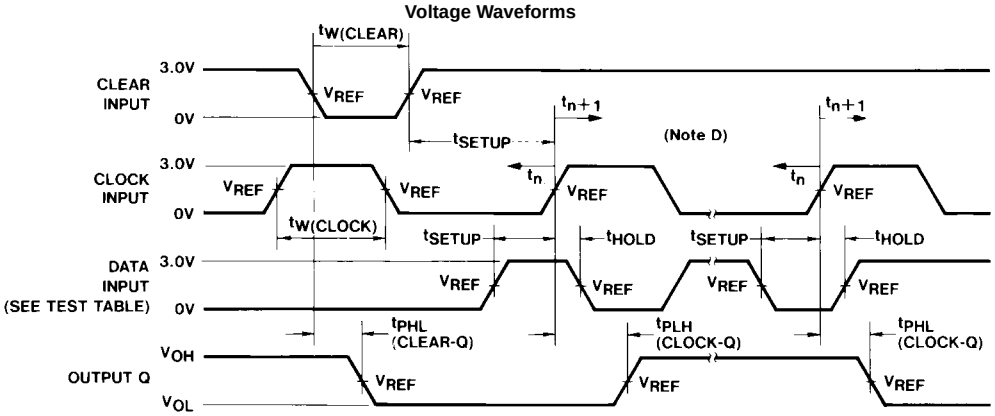
Switching Characteristics

at V_{CC} = 5V and T_A = 25°C

Symbol	Parameter	From (Input) To (Output)	R_L = 2 kΩ				Units
			C_L = 15 pF		C_L = 50 pF		
			Min	Max	Min	Max	
f_{MAX}	Maximum Clock Frequency		25		20		MHz
t_{PLH}	Propagation Delay Time LOW-to-HIGH Level Output	Clock to Output	8	35		38	ns
t_{PHL}	Propagation Delay Time HIGH-to-LOW Level Output	Clock to Output	8	35		41	ns
t_{PHL}	Propagation Delay Time HIGH-to-LOW Level Output	Clear to Output	6	30		36	ns

Parameter Measurement Information

Voltage Waveforms



Test Table for Synchronous Inputs

Data Input for Test	Shift/Load	Output Tested (See Note C)
H	0V	Q_H at T_{N+1}
Serial Input	4.5V	Q_H at T_{N+8}

Note A: The clock pulse has the following characteristics: $t_{W(clock)} \geq 20$ ns and PRR = 1 MHz. The clear pulse has the following characteristics: $t_{W(clear)} \geq 20$ ns and $t_{HOLD} = 0$ ns. When testing f_{MAX}, vary the clock PRR.

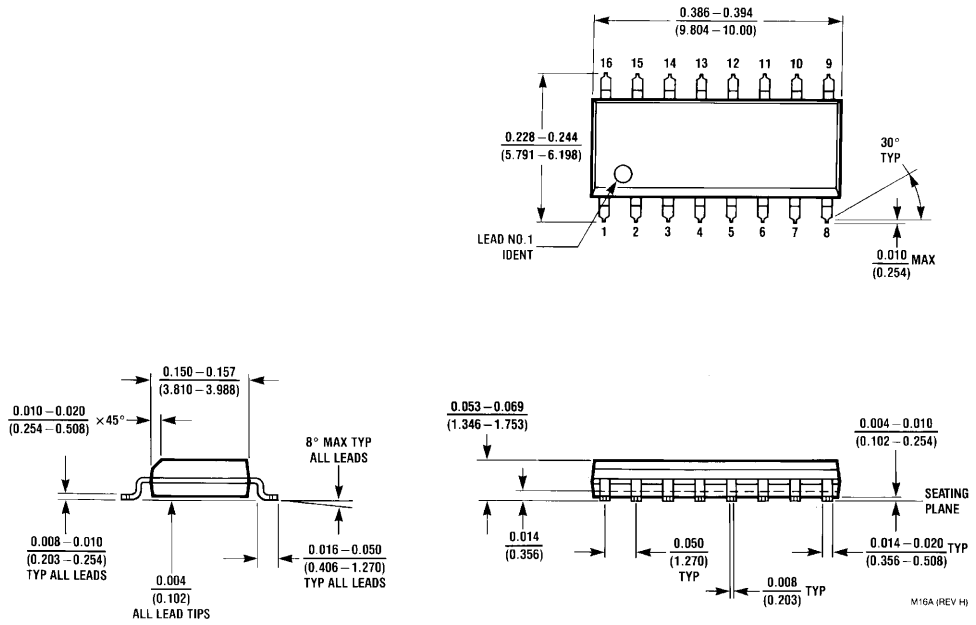
Note B: A clear pulse is applied prior to each test.

Note C: Propagation delay times ($t_{PLH}$and t_{PHL}) are measured at t_{n+1}. Proper shifting of data is verified at t_{n+8} with a functional test.

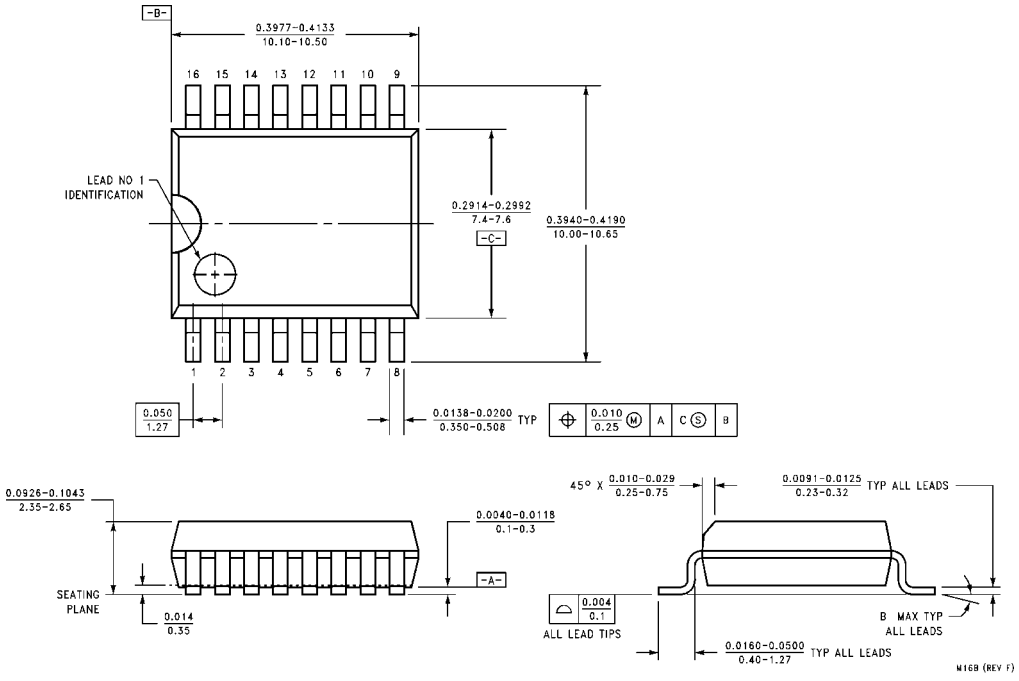
Note D: t_n = bit time before clocking transition
t_{n+1} = bit time after one clocking transition
t_{n+8} = bit time after eight clocking transitions

Note E: V_{REF} = 1.3V.

Physical Dimensions inches (millimeters) unless otherwise noted

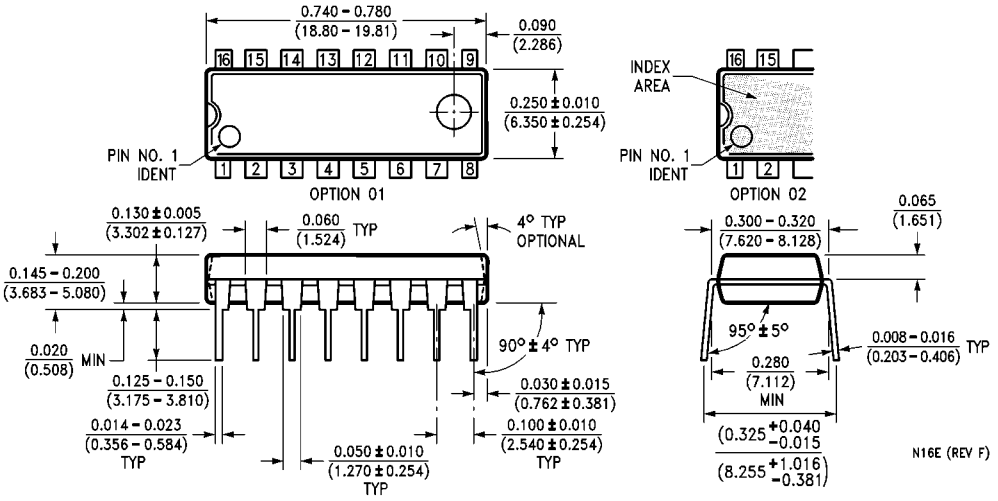


16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150 Narrow
Package Number M16A



16-Lead Small Outline Intergrated Circuit (SOIC), JEDEC MS-013, 0.300 Wide
Package Number M16B

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