

## DM74LS191

### Synchronous 4-Bit Up/Down Counter with Mode Control

#### General Description

The DM74LS191 circuit is a synchronous, reversible, up/down counter. Synchronous operation is provided by having all flip-flops clocked simultaneously, so that the outputs change simultaneously when so instructed by the steering logic. This mode of operation eliminates the output counting spikes normally associated with asynchronous (ripple clock) counters.

The outputs of the four master-slave flip-flops are triggered on a LOW-to-HIGH level transition of the clock input, if the enable input is LOW. A HIGH at the enable input inhibits counting. Level changes at either the enable input or the down/up input should be made only when the clock input is HIGH. The direction of the count is determined by the level of the down/up input. When LOW, the counter counts up and when HIGH, it counts down.

The counter is fully programmable; that is, the outputs may be preset to either level by placing a LOW on the load input and entering the desired data at the data inputs. The output will change independent of the level of the clock input. This feature allows the counters to be used as modulo-N dividers by simply modifying the count length with the preset inputs.

The clock, down/up, and load inputs are buffered to lower the drive requirement; which significantly reduces the number of clock drivers, etc., required for long parallel words.

Two outputs have been made available to perform the cascading function: ripple clock and maximum/minimum count. The latter output produces a high-level output pulse with a duration approximately equal to one complete cycle of the clock when the counter overflows or underflows. The ripple clock output produces a low-level output pulse equal in width to the low-level portion of the clock input when an overflow or underflow condition exists. The counters can be easily cascaded by feeding the ripple clock output to the enable input of the succeeding counter if parallel clocking is used, or to the clock input if parallel enabling is used. The maximum/minimum count output can be used to accomplish look-ahead for high-speed operation.

#### Features

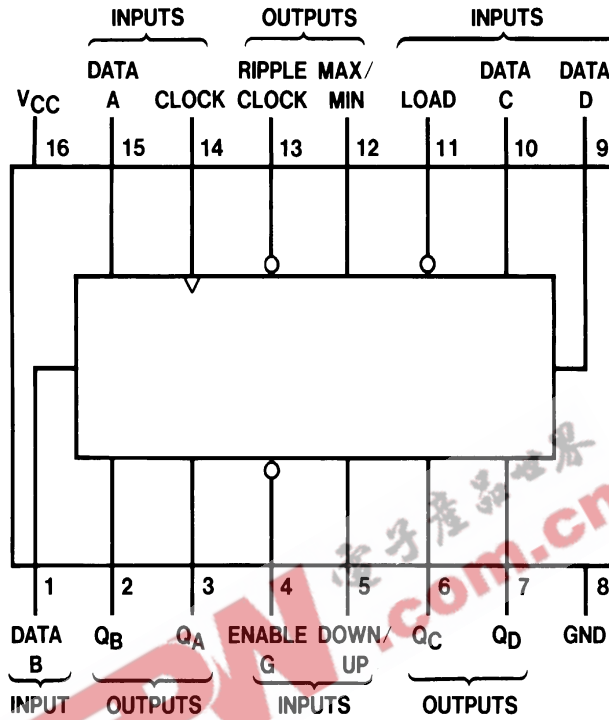
- Counts binary
- Single down/up count control line
- Count enable control input
- Ripple clock output for cascading
- Asynchronously presettable with load control
- Parallel outputs
- Cascadable for n-bit applications
- Average propagation delay 20 ns
- Typical clock frequency 25 MHz
- Typical power dissipation 100 mW

#### Ordering Code:

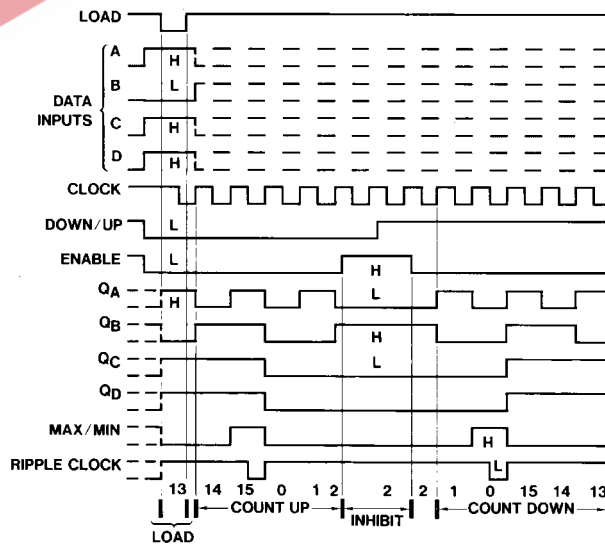
Order Number	Package Number	Package Description
DM74LS191M	M16A	16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow Body
DM74LS191N	N16E	16-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide

Devices also available in Tape and Reel. Specify by appending the suffix letter "X" to the ordering code.

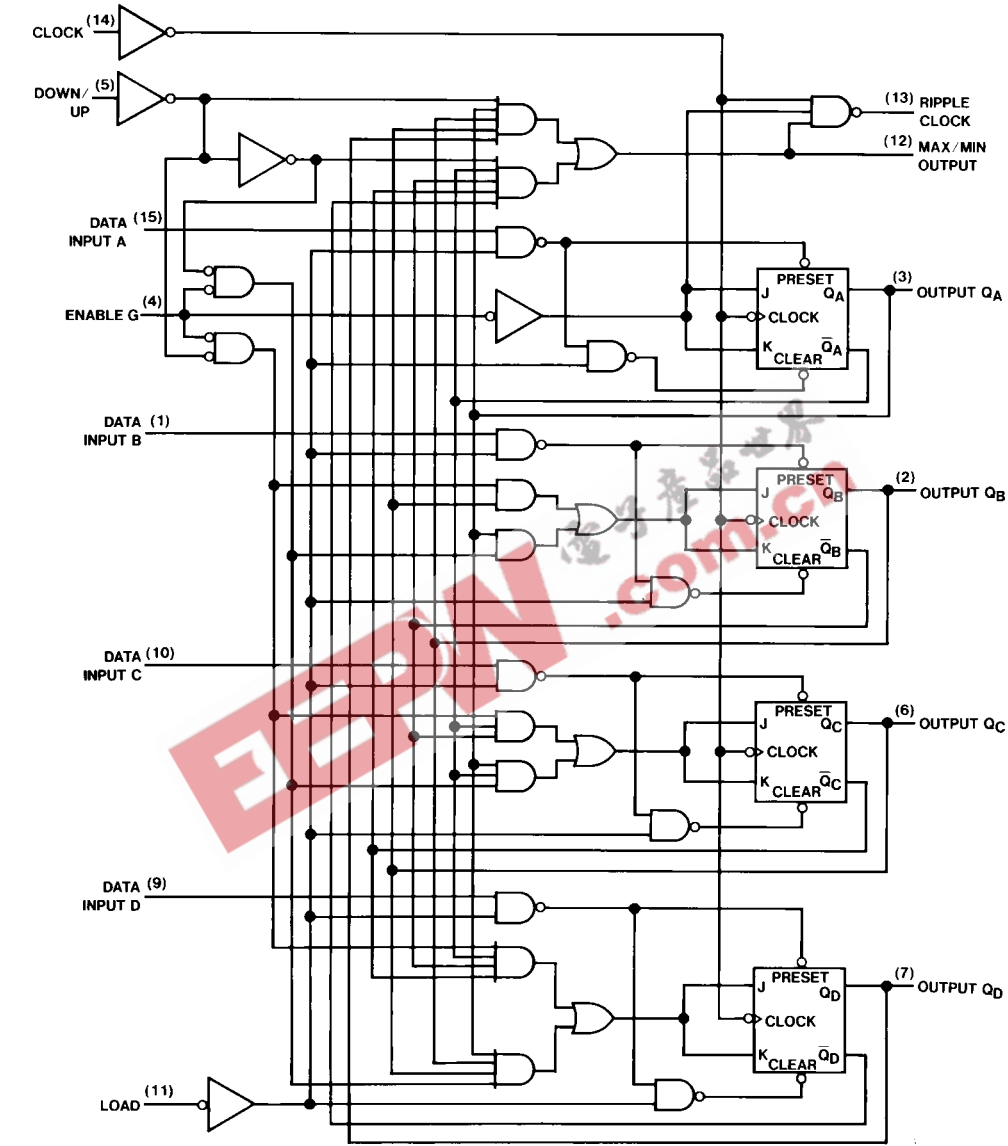
Connection Diagram



Timing Diagram



### Logic Diagram



Pin (16) = V<sub>CC</sub>, Pin (8) = GND

**Absolute Maximum Ratings**(Note 1)

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

**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 <sub>CC</sub>	Supply Voltage	4.75	5	5.25	V
V <sub>IH</sub>	HIGH Level Input Voltage	2			V
V <sub>IL</sub>	LOW Level Input Voltage			0.8	V
I <sub>OH</sub>	HIGH Level Output Current			-0.4	mA
I <sub>OL</sub>	LOW Level Output Current			8	mA
f <sub>CLK</sub>	Clock Frequency (Note 2)	0		20	MHz
t <sub>W</sub>	Pulse Width (Note 2)	Clock	25		ns
		Load	35		
t <sub>SU</sub>	Data Setup Time (Note 2)	20			ns
t <sub>H</sub>	Data Hold Time (Note 2)	0			ns
t <sub>EN</sub>	Enable Time to Clock (Note 2)	30			ns
T <sub>A</sub>	Free Air Operating Temperature	0		70	°C

**Note 2:** T<sub>A</sub> = 25°C and V<sub>CC</sub> = 5V.

**DC Electrical Characteristics**

Symbol	Parameter	Conditions	Min	Typ (Note 3)	Max	Units
V <sub>I</sub>	Input Clamp Voltage	V <sub>CC</sub> = Min, I <sub>I</sub> = -18 mA			-1.5	V
V <sub>OH</sub>	HIGH Level Output Voltage	V <sub>CC</sub> = Min, I <sub>OH</sub> = Max V <sub>IL</sub> = Max, V <sub>IH</sub> = Min	Mil	2.5	3.4	V
			Com	2.7	3.4	
V <sub>OL</sub>	LOW Level Output Voltage	V <sub>CC</sub> = Min, I <sub>OL</sub> = Max V <sub>IL</sub> = Max, V <sub>IH</sub> = Min I <sub>OL</sub> = 4 mA, V <sub>CC</sub> = Min		0.25	0.4	V
				0.35	0.5	
				0.25	0.4	
I <sub>I</sub>	Input Current @ Max Input Voltage	V <sub>CC</sub> = Max V <sub>I</sub> = 7V	Enable		0.3	mA
			Others		0.1	
I <sub>IH</sub>	HIGH Level Input Current	V <sub>CC</sub> = Max V <sub>I</sub> = 2.7V	Enable		60	μA
			Others		20	
I <sub>IL</sub>	LOW Level Input Current	V <sub>CC</sub> = Max V <sub>I</sub> = 0.4V	Enable		-1.08	mA
			Others		-0.4	
I <sub>OS</sub>	Short Circuit Output Current	V <sub>CC</sub> = Max (Note 4)	Mil	-20	-100	mA
			Com	-20	-100	
I <sub>CC</sub>	Supply Current	V <sub>CC</sub> = Max (Note 5)		20	35	mA

**Note 3:** All typicals are at V<sub>CC</sub> = 5V, T<sub>A</sub> = 25°C.

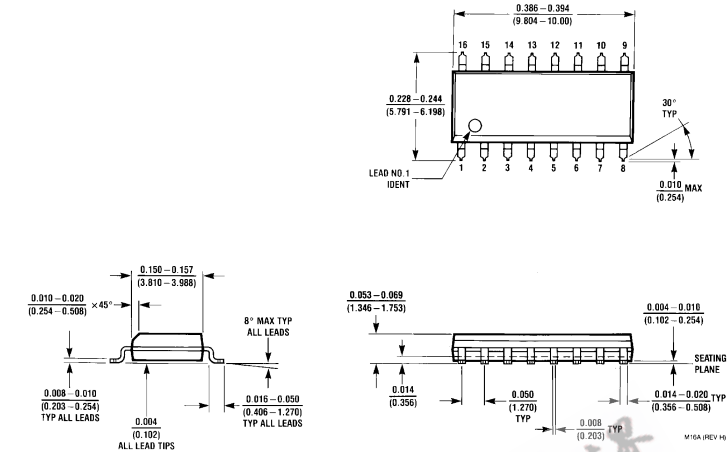
**Note 4:** Not more than one output should be shorted at a time, and the duration should not exceed one second.

**Note 5:** I<sub>CC</sub> is measured with all inputs grounded and all outputs open.

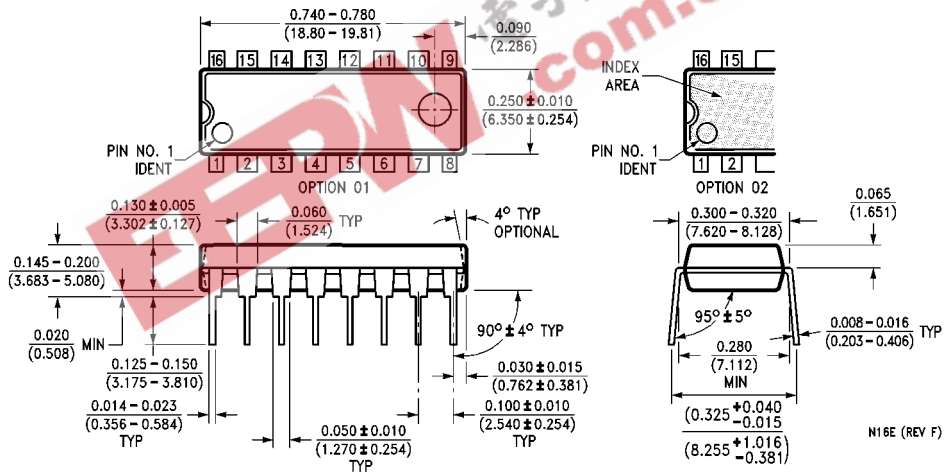
## AC Electrical Characteristics

Symbol	Parameter	From (Input) To (Output)	$R_L = 2\text{ k}\Omega$				Units
			$C_L = 15\text{ pF}$		$C_L = 50\text{ pF}$		
			Min	Max	Min	Max	
$f_{\text{MAX}}$	Maximum Clock Frequency		20		20		MHz
$t_{\text{PLH}}$	Propagation Delay Time LOW-to-HIGH Level Output	Load to Any Q		33		43	ns
$t_{\text{PHL}}$	Propagation Delay Time HIGH-to-LOW Level Output	Load to Any Q		50		59	ns
$t_{\text{PLH}}$	Propagation Delay Time LOW-to-HIGH Level Output	Data to Any Q		22		26	ns
$t_{\text{PHL}}$	Propagation Delay Time HIGH-to-LOW Level Output	Data to Any Q		50		62	ns
$t_{\text{PLH}}$	Propagation Delay Time LOW-to-HIGH Level Output	Clock to Ripple Clock		20		24	ns
$t_{\text{PHL}}$	Propagation Delay Time HIGH-to-LOW Level Output	Clock to Ripple Clock		24		33	ns
$t_{\text{PLH}}$	Propagation Delay Time LOW-to-HIGH Level Output	Clock to Any Q		24		29	ns
$t_{\text{PHL}}$	Propagation Delay Time HIGH-to-LOW Level Output	Clock to Any Q		36		45	ns
$t_{\text{PLH}}$	Propagation Delay Time LOW-to-HIGH Level Output	Clock to Max/Min		42		47	ns
$t_{\text{PHL}}$	Propagation Delay Time HIGH-to-LOW Level Output	Clock to Max/Min		52		65	ns
$t_{\text{PLH}}$	Propagation Delay Time LOW-to-HIGH Level Output	Up/Down to Ripple Clock		45		50	ns
$t_{\text{PHL}}$	Propagation Delay Time HIGH-to-LOW Level Output	Up/Down to Ripple Clock		45		54	ns
$t_{\text{PLH}}$	Propagation Delay Time LOW-to-HIGH Level Output	Down/Up to Max/Min		33		36	ns
$t_{\text{PHL}}$	Propagation Delay Time HIGH-to-LOW Level Output	Down/Up to Max/Min		33		42	ns
$t_{\text{PLH}}$	Propagation Delay Time LOW-to-HIGH Level Output	Enable to Ripple Clock		33		36	ns
$t_{\text{PHL}}$	Propagation Delay Time HIGH-to-LOW Level Output	Enable to Ripple Clock		33		42	ns

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



**16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS012, 0.150" Narrow Body Package Number M16A**



**16-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 300" Wide Package Number N16E**

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