

# HD74LS191

## Synchronous Up / Down 4-bit Binary Counter (single clock line)

REJ03D0453-0200

Rev.2.00

Feb.18.2005

Synchronous operation is provided by having all flip-flops clocked simultaneously so that 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 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. Level changes at the down / up input should be made only when the clock input is high. This 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 to agree with the data inputs independently 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 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 cycles to 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.

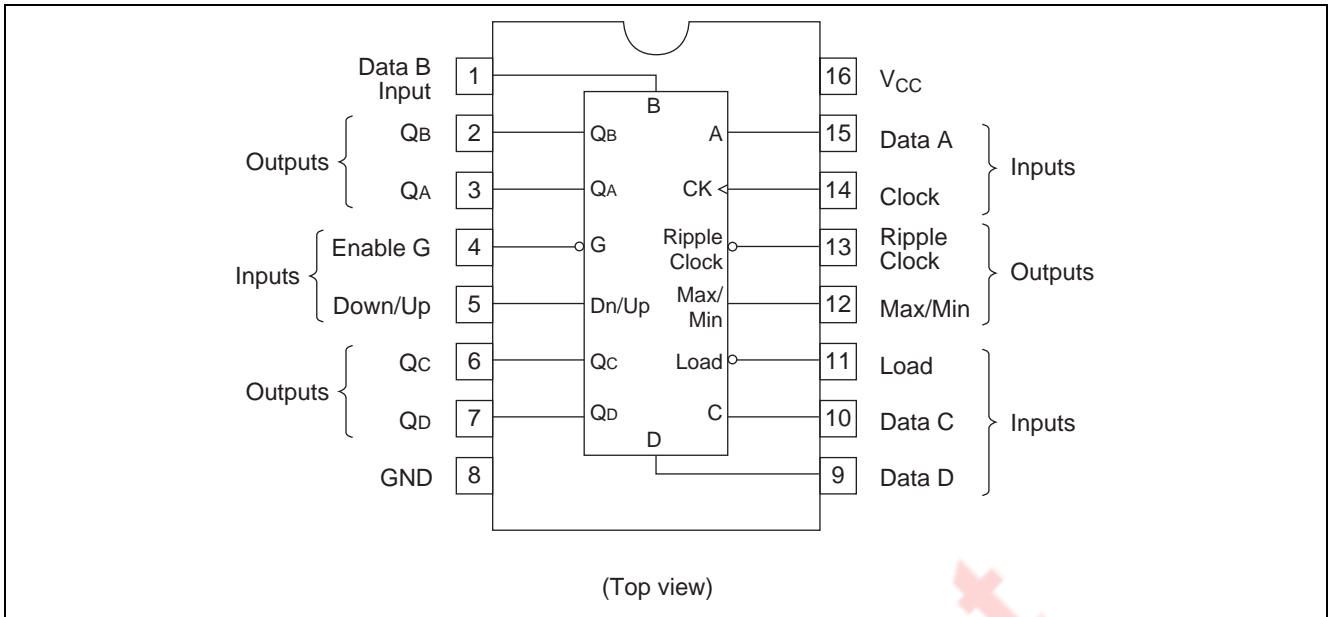
### Features

- Ordering Information

Part Name	Package Type	Package Code (Previous Code)	Package Abbreviation	Taping Abbreviation (Quantity)
HD74LS191P	DILP-16 pin	PRDP0016AE-B (DP-16FV)	P	—
HD74LS191FPEL	SOP-16 pin (JEITA)	PRSP0016DH-B (FP-16DAV)	FP	EL (2,000 pcs/reel)

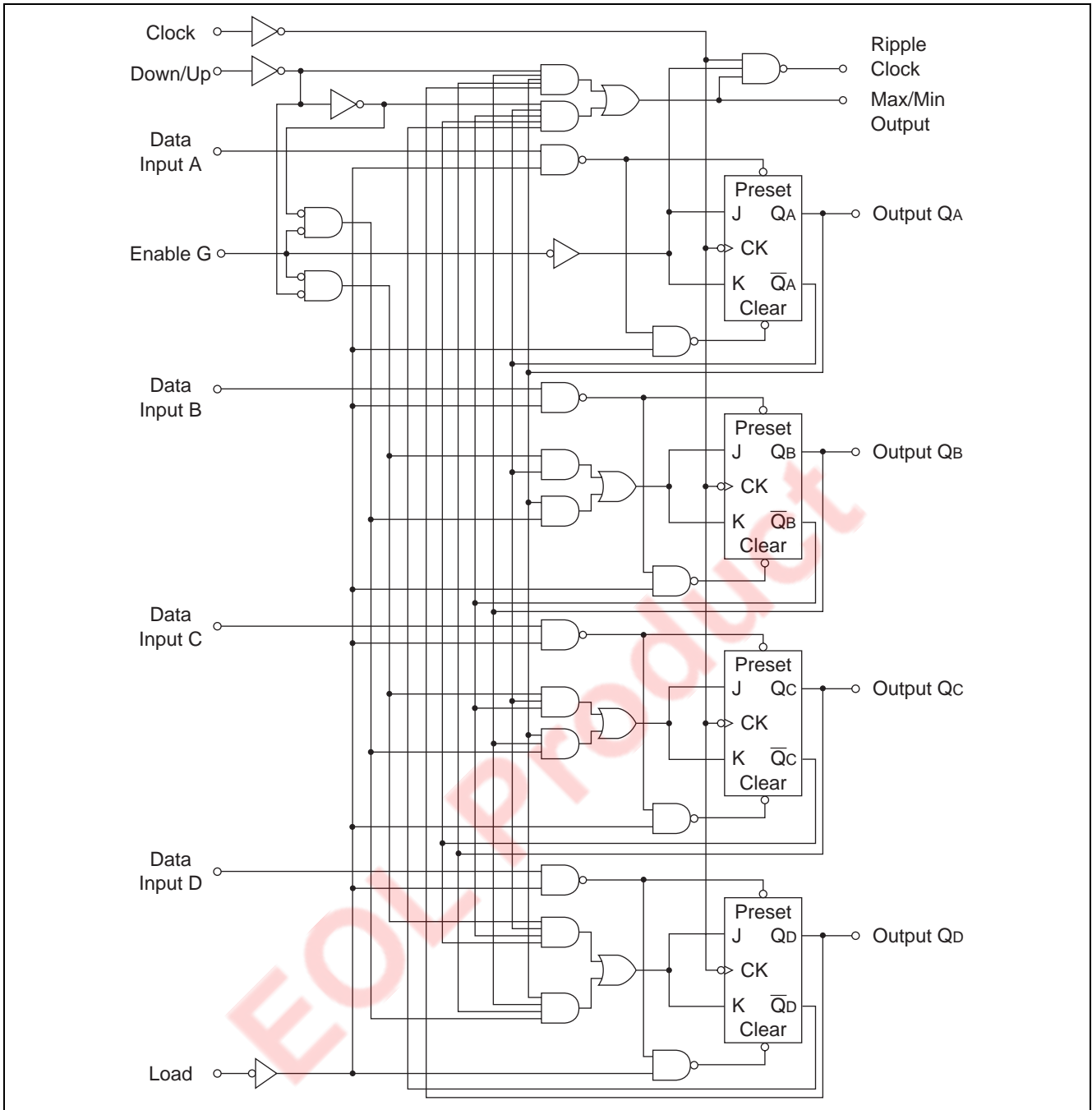
Note: Please consult the sales office for the above package availability.

Pin Arrangement



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**Block Diagram**



**Absolute Maximum Ratings**

Item	Symbol	Ratings	Unit
Supply voltage	$V_{CC}$	7	V
Input voltage	$V_{IN}$	7	V
Power dissipation	$P_T$	400	mW
Storage temperature	Tstg	-65 to +150	°C

Note: Voltage value, unless otherwise noted, are with respect to network ground terminal.

## Recommended Operating Conditions

Item	Symbol	Min	Typ	Max	Unit
Supply voltage	$V_{CC}$	4.75	5.00	5.25	V
Output current	$I_{OH}$	—	—	-400	$\mu$ A
	$I_{OL}$	—	—	8	mA
Operating temperature	$T_{opr}$	-20	25	75	$^{\circ}$ C
Clock frequency	$f_{clock}$	0	—	20	MHz
Clock pulse width	$t_w(CK)$	25	—	—	ns
Load pulse width	$t_w(Load)$	35	—	—	ns
Setup time	$t_{su}$	20	—	—	ns
Hold time	$t_h(data)$	3	—	—	ns
Enable time	$t_{enable}$	40	—	—	ns

## Electrical Characteristics

(Ta = -20 to +75  $^{\circ}$ C)

Item	Symbol	min.	typ.*	max.	Unit	Condition
Input voltage	$V_{IH}$	2.0	—	—	V	
	$V_{IL}$	—	—	0.8	V	
Output voltage	$V_{OH}$	2.7	—	—	V	$V_{CC} = 4.75$ V, $V_{IH} = 2$ V, $V_{IL} = 0.8$ V, $I_{OH} = -400$ $\mu$ A
	$V_{OL}$	—	—	0.4	V	$I_{OL} = 4$ mA
		—	—	0.5		$V_{CC} = 4.75$ V, $V_{IH} = 2$ V, $V_{IL} = 0.8$ V
Input current	Enable	—	—	60	$\mu$ A	$V_{CC} = 5.25$ V, $V_I = 2.7$ V
	Others			20		
	Enable	—	—	-1.2	mA	
	Others			-0.4		
	Enable	—	—	0.3	mA	
Others	0.1					
Short-circuit output current	$I_{OS}$	-20	—	-100	mA	$V_{CC} = 5.25$ V
Supply current**	$I_{CC}$	—	20	35	mA	$V_{CC} = 5.25$ V
Input clamp voltage	$V_{IK}$	—	—	-1.5	V	$V_{CC} = 4.75$ V, $I_{IN} = -18$ mA

Notes: \*  $V_{CC} = 5$  V, Ta = 25 $^{\circ}$ C\*\*  $I_{CC}$  is measured with all outputs open and all inputs grounded.

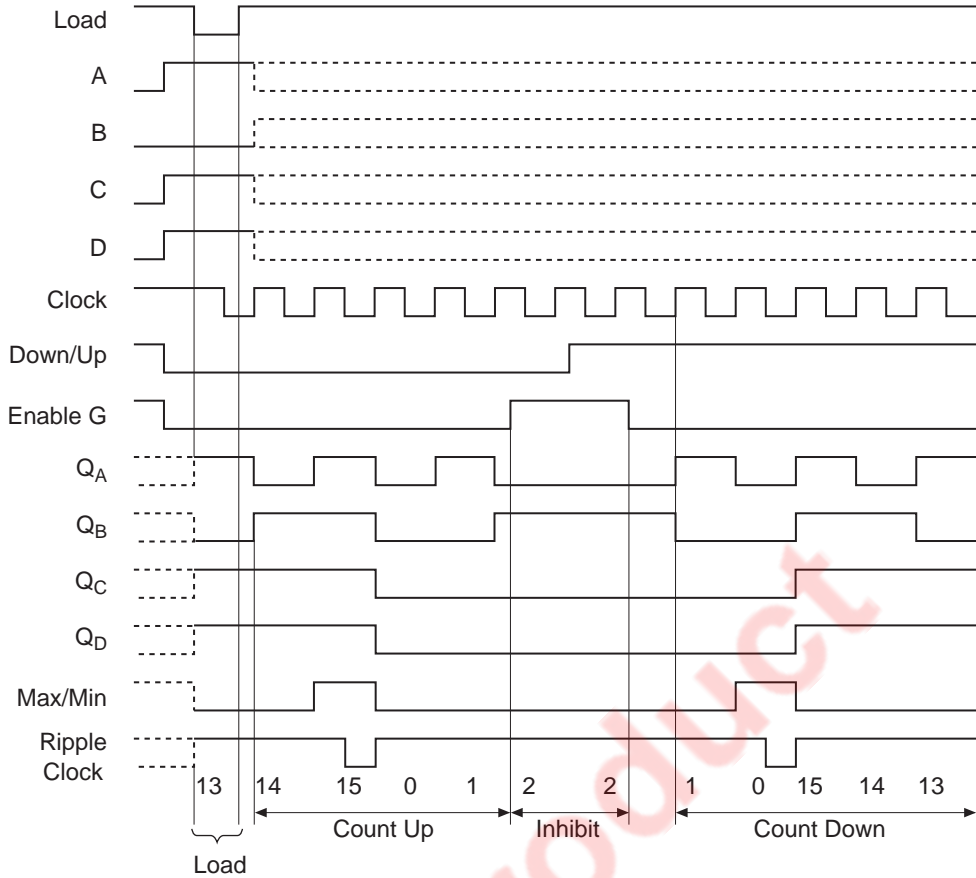
Switching Characteristics

( $V_{CC} = 5\text{ V}$ ,  $T_a = 25^\circ\text{C}$ )

Item	Symbol	Inputs	Outputs	min.	typ.	max.	Unit	Condition
Maximum clock frequency	$f_{max}$	Clock	$Q_A, Q_B, Q_C, Q_D$	20	25	—	MHz	$C_L = 15\text{ pF}$ , $R_L = 2\text{ k}\Omega$
Propagation delay time	$t_{PLH}$	Load	$Q_A, Q_B, Q_C, Q_D$	—	22	33	ns	
	$t_{PHL}$			—	33	50		
	$t_{PLH}$	Data A, B, C, D	$Q_A, Q_B, Q_C, Q_D$	—	20	32	ns	
	$t_{PHL}$			—	27	40		
	$t_{PLH}$	Clock	Ripple Clock	—	13	20	ns	
	$t_{PHL}$			—	16	24		
	$t_{PLH}$	Clock	$Q_A, Q_B, Q_C, Q_D$	—	16	24	ns	
	$t_{PHL}$			—	24	36		
	$t_{PLH}$	Clock	Max / Min	—	28	42	ns	
	$t_{PHL}$			—	37	52		
	$t_{PLH}$	Down / Up	Ripple Clock	—	30	45	ns	
	$t_{PHL}$			—	30	45		
	$t_{PLH}$	Down / Up	Max / Min	—	21	33	ns	
	$t_{PHL}$			—	22	33		
	$t_{PLH}$	Enable	Ripple Clock	—	21	33	ns	
$t_{PHL}$	—			22	33			

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Count Sequences

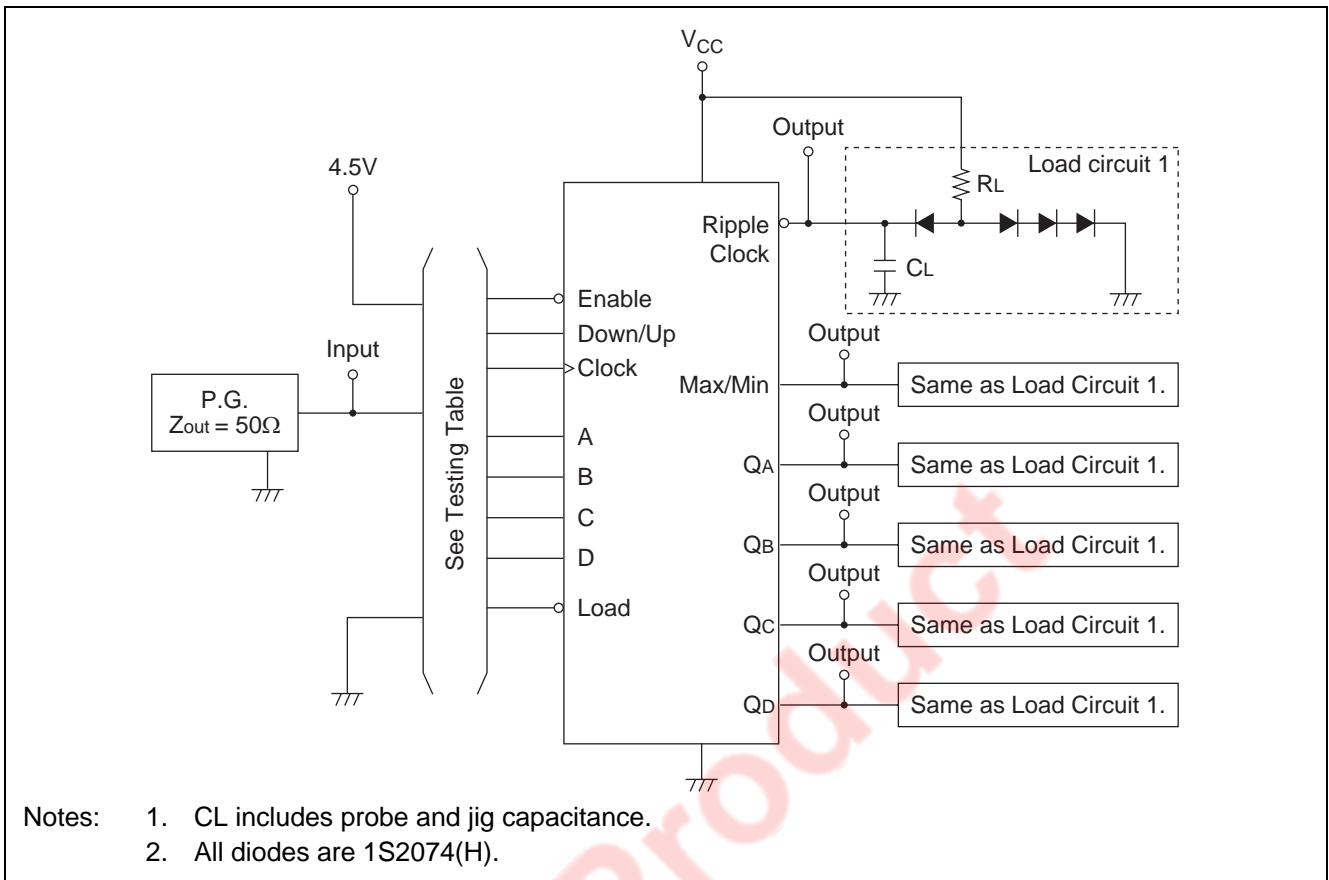


Illustrated below is the following sequence:

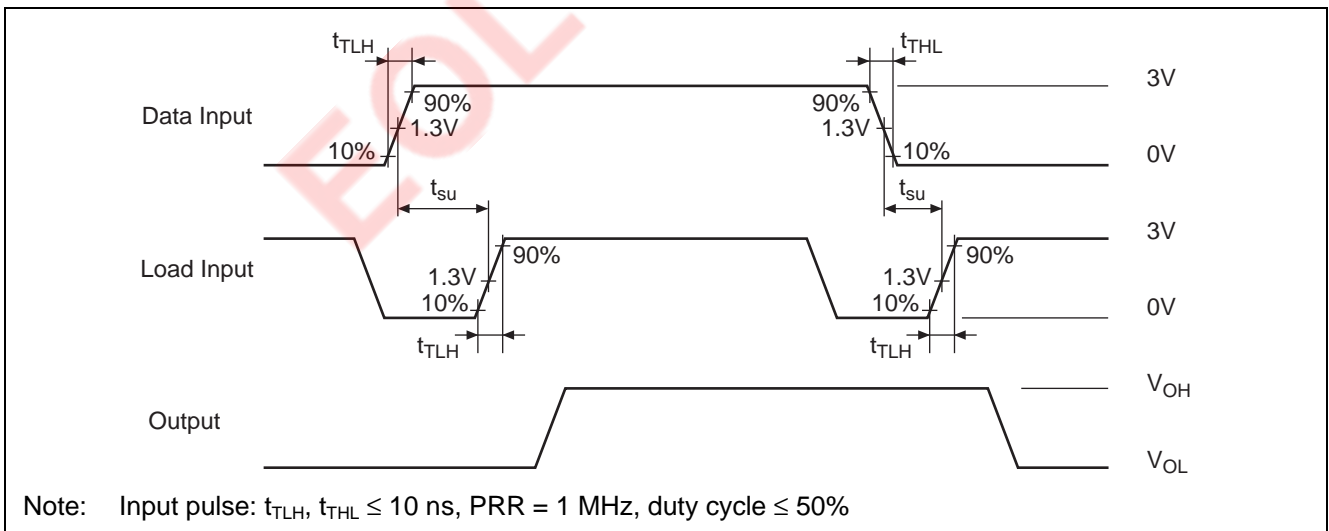
1. Load (preset) to binary thirteen.
2. Count up to fourteen, fifteen (maximum), zero, one and two.
3. Inhibit
4. Count down to one, zero (minimum), fifteen, fourteen, and thirteen.

## Testing Method

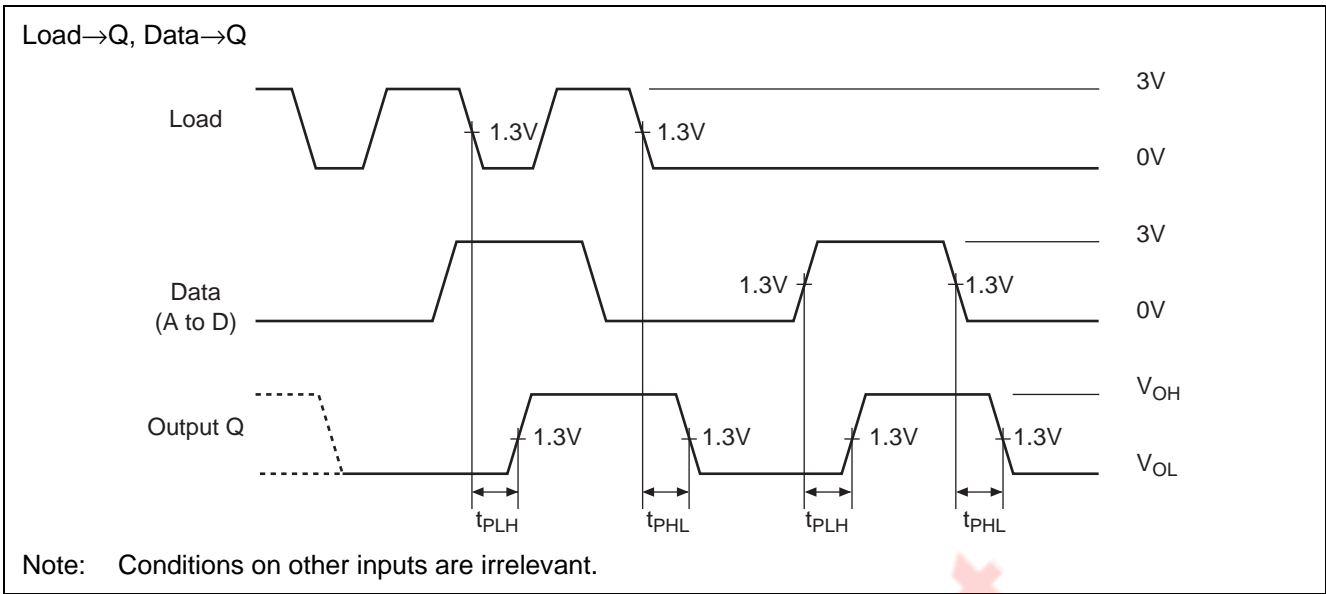
### Test Circuit



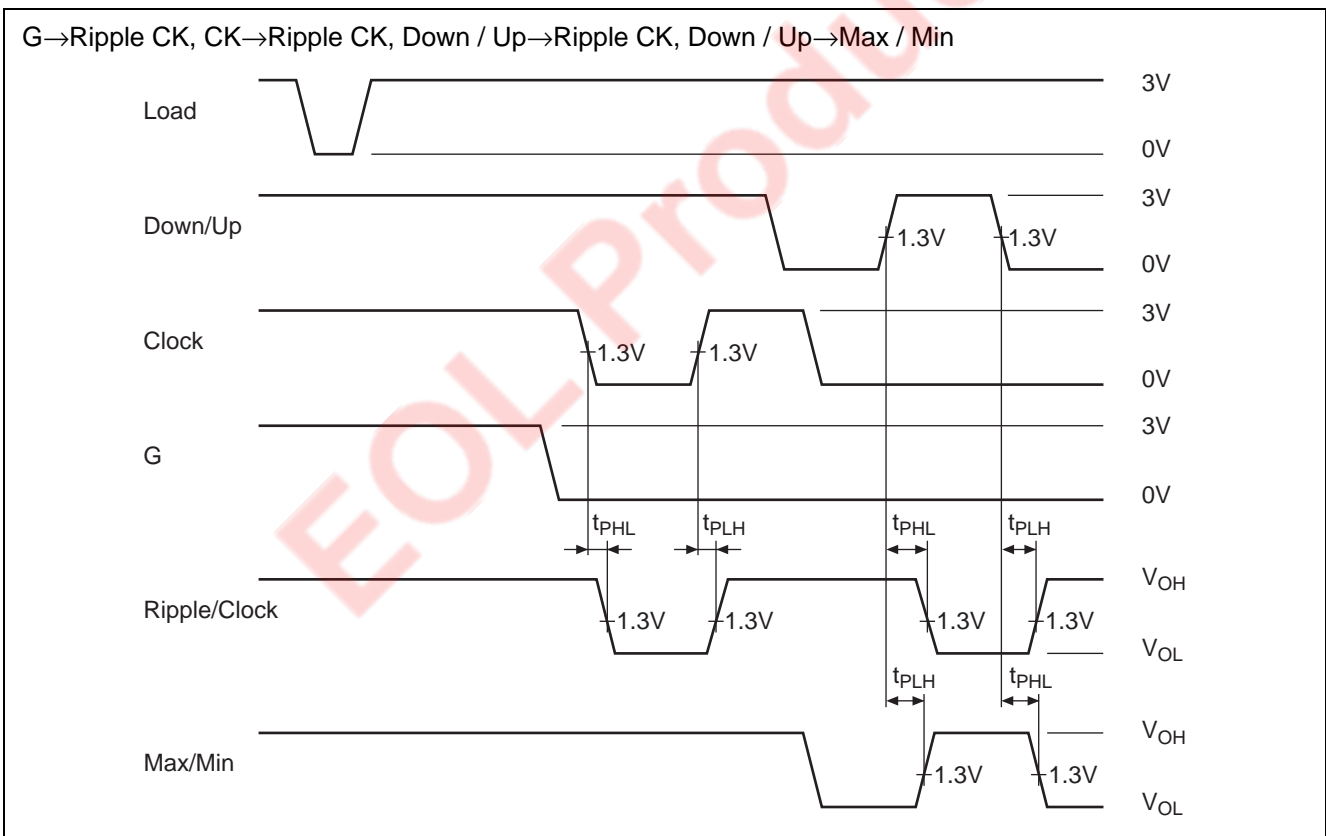
### Waveforms 1



Waveforms 2

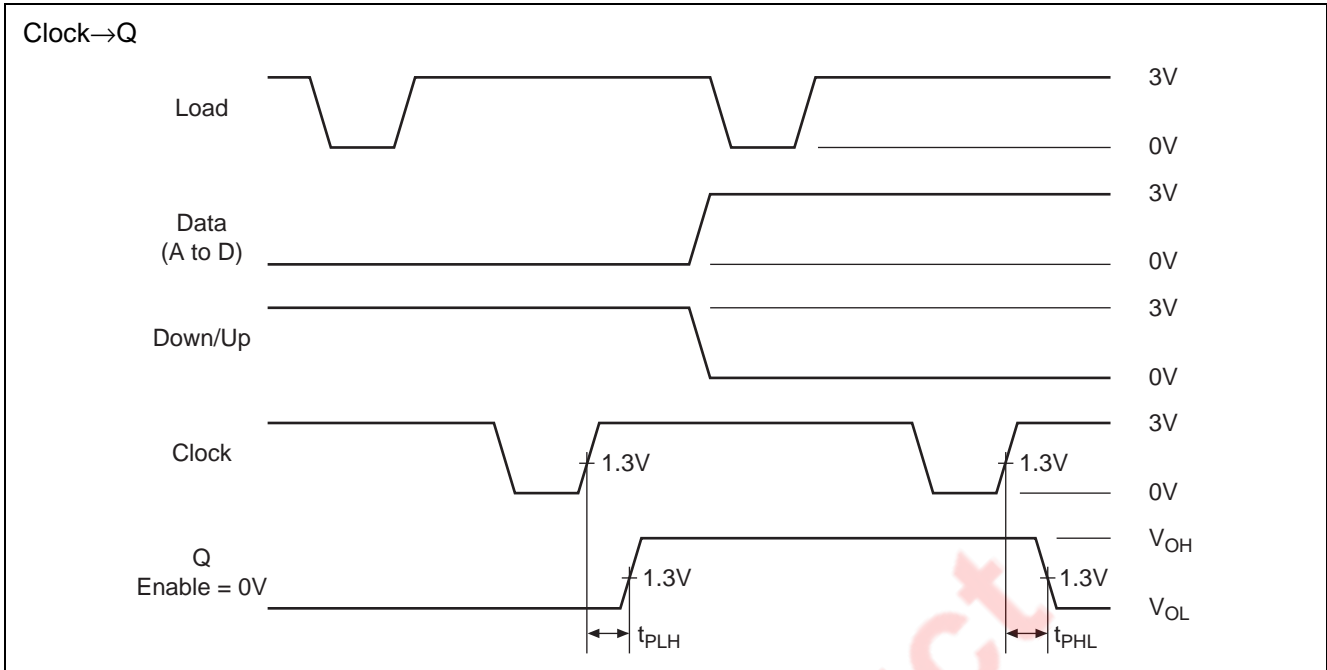


Waveforms 3

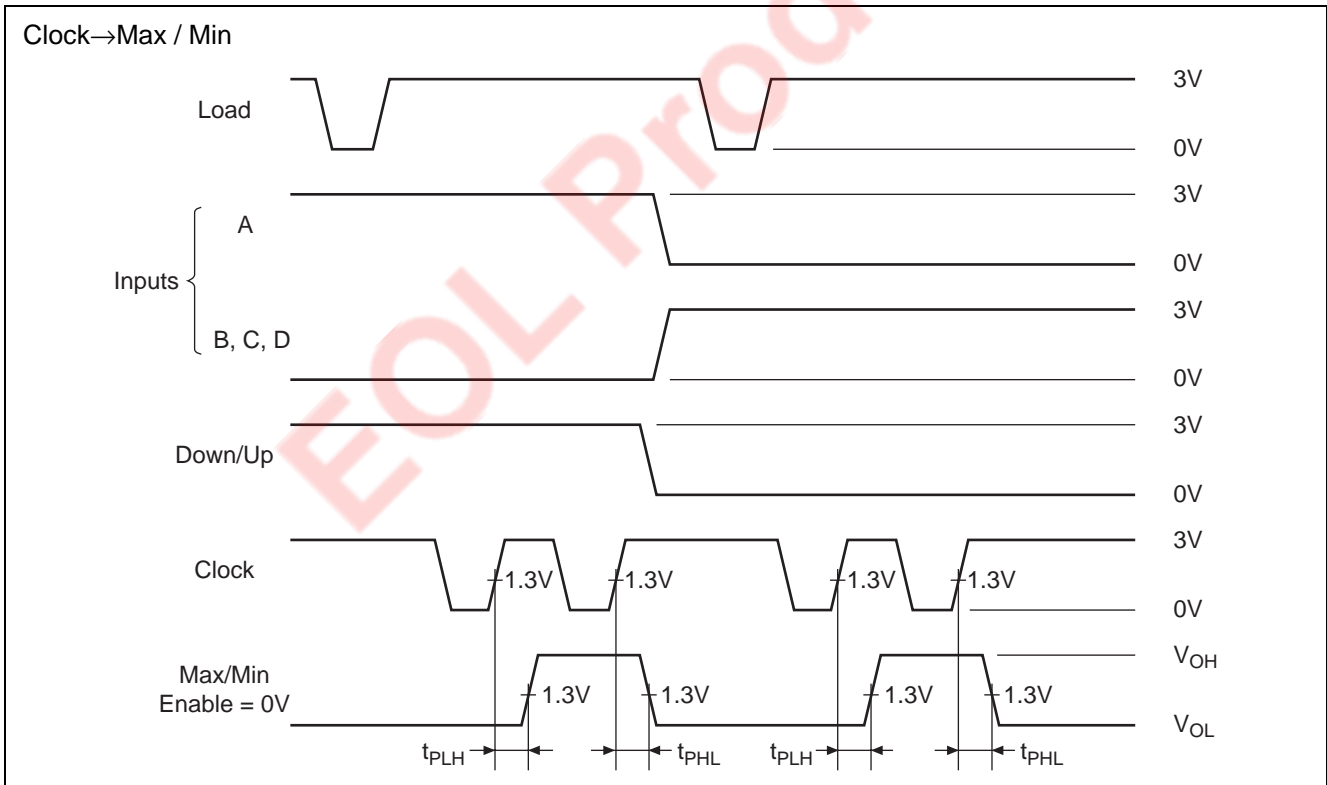




Waveforms 4

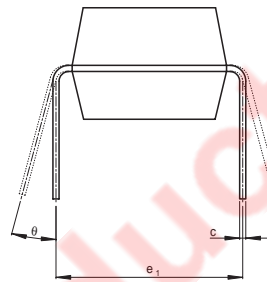
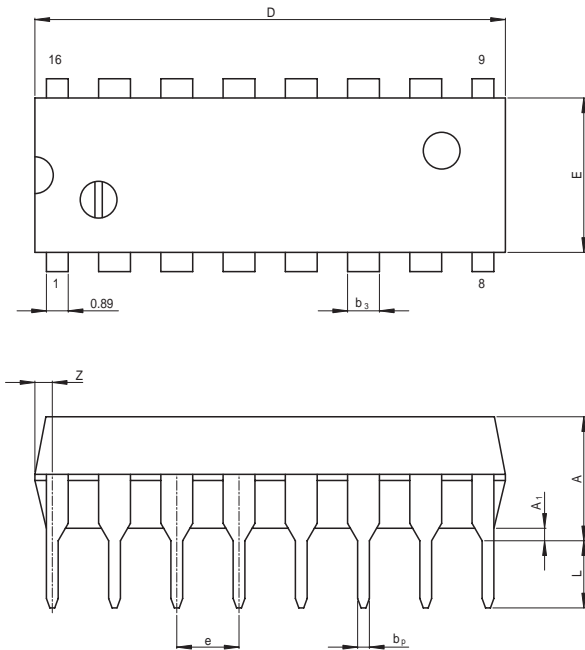


Waveforms 5



Package Dimensions

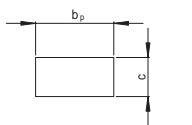
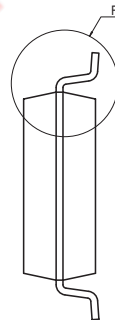
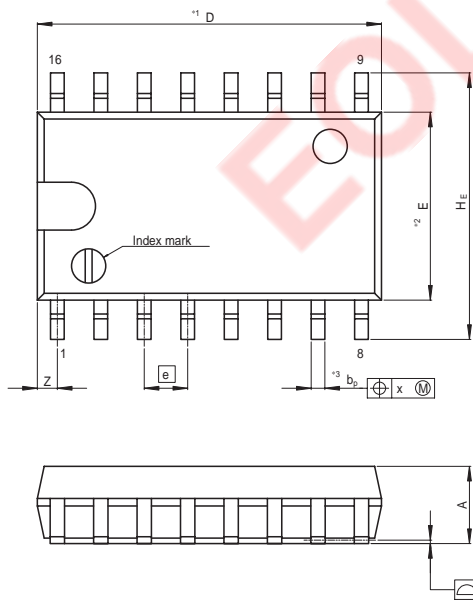
JEITA Package Code	RENESAS Code	Previous Code	MASS[Typ.]
P-DIP16-6.3x19.2-2.54	PRDP0016AE-B	DP-16FV	1.05g



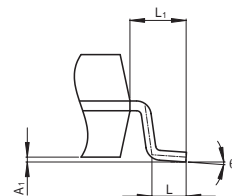
( Ni/Pd/Au plating )

Reference Symbol	Dimension in Millimeters		
	Min	Nom	Max
e <sub>1</sub>	—	7.62	—
D	—	19.2	20.32
E	—	6.3	7.4
A	—	—	5.06
A <sub>1</sub>	0.51	—	—
b <sub>p</sub>	0.40	0.48	0.56
b <sub>3</sub>	—	1.30	—
c	0.19	0.25	0.31
θ	0°	—	15°
e	2.29	2.54	2.79
Z	—	—	1.12
L	2.54	—	—

JEITA Package Code	RENESAS Code	Previous Code	MASS[Typ.]
P-SOP16-5.5x10.06-1.27	PRSP0016DH-B	FP-16DAV	0.24g



Terminal cross section ( Ni/Pd/Au plating )



Detail F

NOTE)  
 1. DIMENSIONS\*1 (Nom)\*AND\*2\*  
 DO NOT INCLUDE MOLD FLASH.  
 2. DIMENSION\*3\*DOES NOT  
 INCLUDE TRIM OFFSET.

Reference Symbol	Dimension in Millimeters		
	Min	Nom	Max
D	—	10.06	10.5
E	—	5.50	—
A <sub>2</sub>	—	—	—
A <sub>1</sub>	0.00	0.10	0.20
A	—	—	2.20
b <sub>p</sub>	0.34	0.40	0.46
b <sub>1</sub>	—	—	—
c	0.15	0.20	0.25
c <sub>1</sub>	—	—	—
θ	0°	—	8°
H <sub>E</sub>	7.50	7.80	8.00
a	—	1.27	—
x	—	—	0.12
y	—	—	0.15
Z	—	—	0.80
L	0.50	0.70	0.90
L <sub>1</sub>	—	1.15	—

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