

# HD74LS162A

## Synchronous Decade Counter (synchronous clear)

REJ03D0446-0300

Rev.3.00

Jul.15.2005

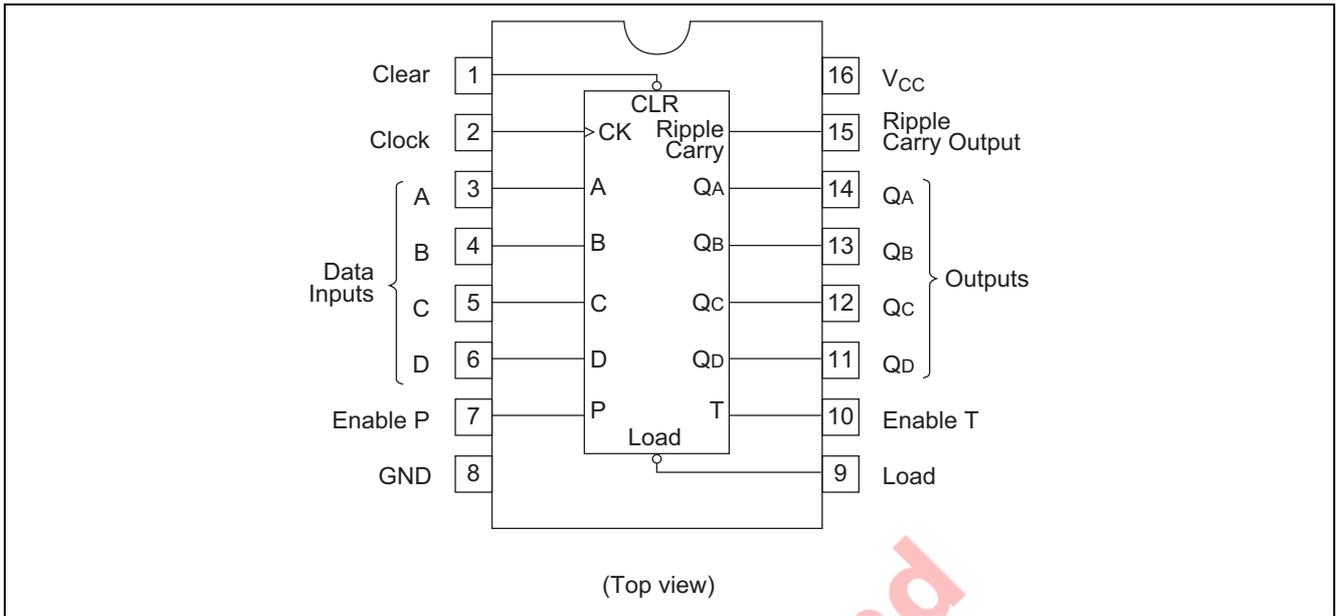
This synchronous decade counter features an internal carry look-ahead for application in high-speed counting designs. Synchronous operation is provided by having all flip-flops clocked simultaneously so that the outputs changes coincident with each other when so instructed by the count-enable inputs and internal gating. This mode of operation eliminates the output counting spikes that are normally associated with asynchronous (ripple clock) counters. A buffered clock input triggers the four flip-flops on the rising (positive-going) edge of the clock input waveform. This counter is fully programmable; that is, the outputs may be preset to either level. As presetting is synchronous, setting up a low level at the load input disables the counter and causes the outputs to agree with the setup data after the next clock pulse regardless of the levels of the enable inputs. Low-to-high transitions at the load input should be avoided when the clock is low if the enable inputs are high at or before the transition. The clear function is asynchronous and a low level at the clear input sets all four of the flip-flop outputs low after the next clock pulse, regardless of the levels of the enable inputs. This synchronous clear allows the count length to be modified easily as decoding the maximum count desired can be accomplished with one external NAND gate. The gate output is connected to the clear input to synchronously clear the counter to LLLL. Low-to-high transitions at the clear input should be avoided when the clock is low if the enable and load inputs are high at or before the transition. The carry look-ahead circuitry provides for cascading counters for n-bit synchronous applications without additional gating. Instrumental in accomplishing this function are two count-enable inputs and a ripple carry output. Both count-enable inputs (P and T) must be high to count, and input T is fed forward to enable the ripple carry output. The ripple carry output thus enabled will produce a high-level output pulse with a duration approximately equal to the high-level portion of the Q<sub>A</sub> output. This high-level overflow ripple carry pulse can be used to enable successive cascaded stages. High-to-low-level transitions at the enable P or T inputs should occur only when the clock input is high.

### Features

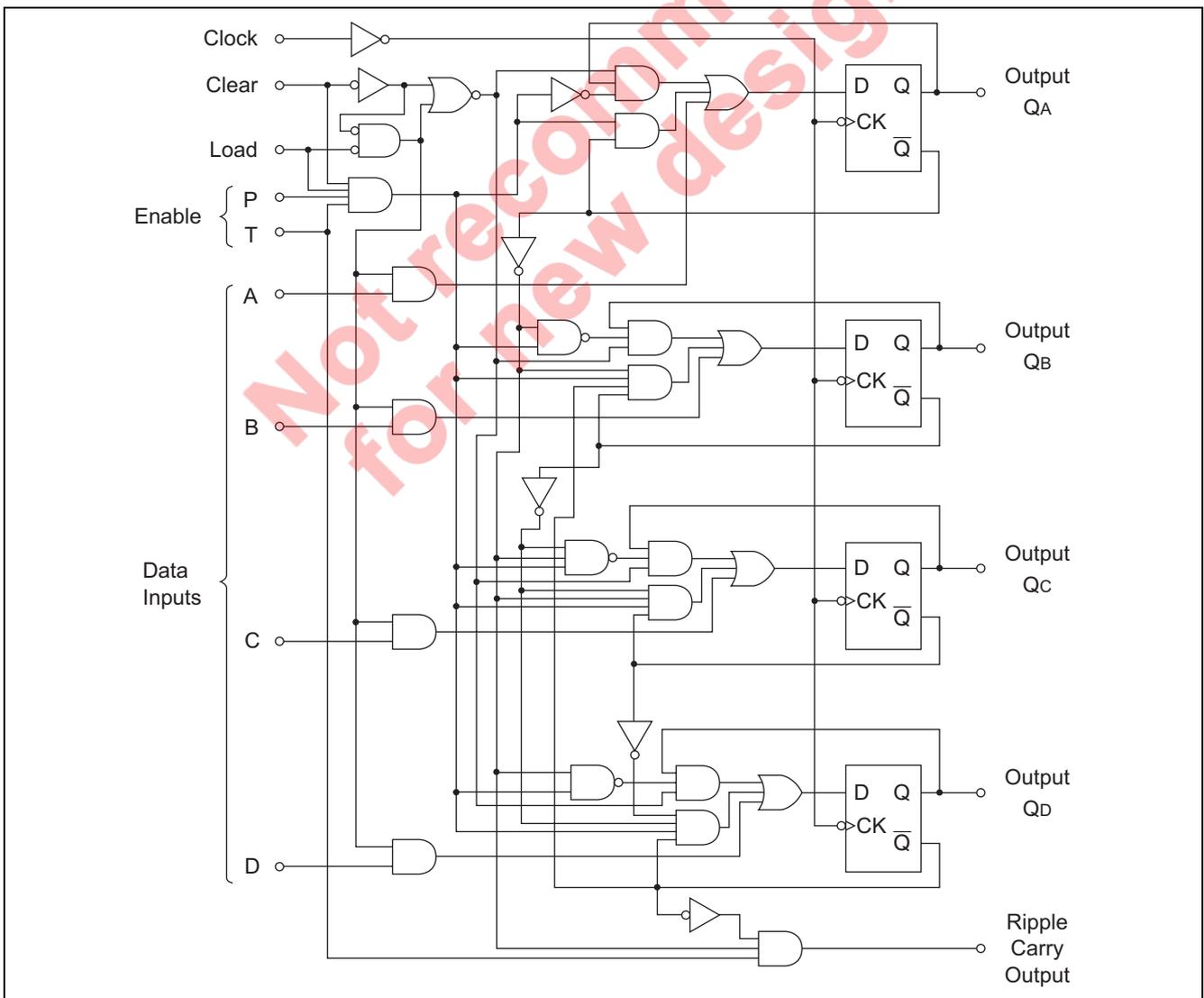
- Ordering Information

Part Name	Package Type	Package Code (Previous Code)	Package Abbreviation	Taping Abbreviation (Quantity)
HD74LS162AFPEL	SOP-16 pin (JEITA)	PRSP0016DH-B (FP-16DAV)	FP	EL (2,000 pcs/reel)

Pin Arrangement



Block Diagram



### Absolute Maximum Ratings

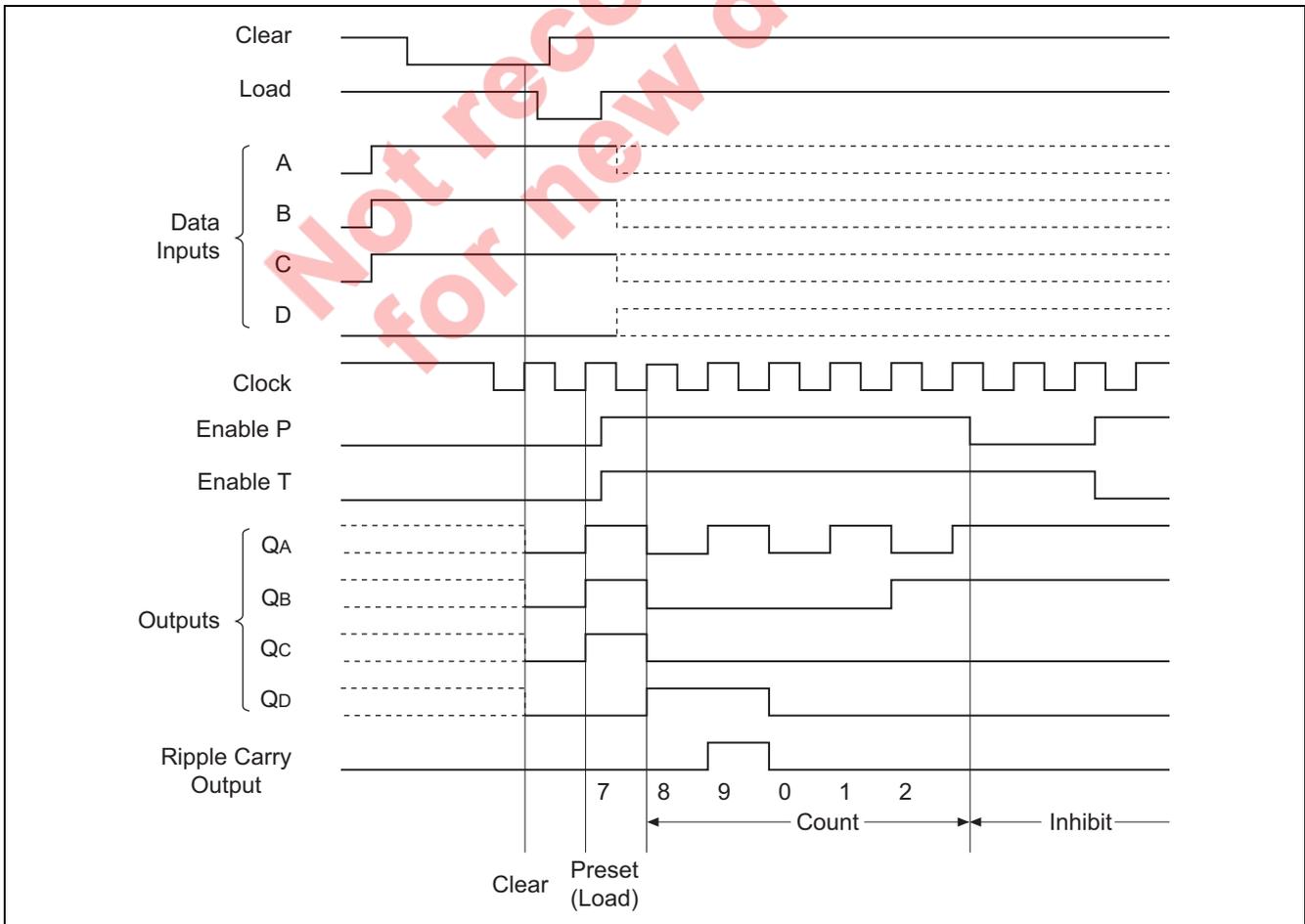
Item	Symbol	Ratings	Unit
Supply voltage	$V_{CC}$	7	V
Input voltage	$V_{IN}$	7	V
Power dissipation	$P_T$	400	mW
Storage temperature	$T_{stg}$	-65 to +150	°C

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	μA
	$I_{OL}$	—	—	8	mA
Operating temperature	$T_{opr}$	-20	25	75	°C
Clock frequency	$f_{clock}$	0	—	25	MHz
Clock pulse width	$t_w (clock)$	25	—	—	ns
Clear pulse width	$t_w (clear)$	20	—	—	ns
Setup time	A, B, C, D	20	—	—	ns
	Enable P, T	20	—	—	ns
	Load	20	—	—	ns
	Clear	20	—	—	ns
Hold time	$t_h$	3	—	—	ns

### Typical Clear, Preset, and Inhibit Sequence



**Electrical Characteristics**

(Ta = -20 to +75 °C)

Item		Symbol	min.	typ.*	max.	Unit	Condition
Input voltage		V <sub>IH</sub>	2.0	—	—	V	
		V <sub>IL</sub>	—	—	0.8	V	
Output voltage		V <sub>OH</sub>	2.7	—	—	V	V <sub>CC</sub> = 4.75 V, V <sub>IH</sub> = 2 V, V <sub>IL</sub> = 0.8 V, I <sub>OH</sub> = -400 μA
		V <sub>OL</sub>	—	—	0.4	V	V <sub>CC</sub> = 4.75 V, V <sub>IH</sub> = 2 V, V <sub>IL</sub> = 0.8 V
—	—		0.5				
Input current	Data, Enable P	I <sub>IH</sub>	—	—	20	μA	V <sub>CC</sub> = 5.25 V, V <sub>I</sub> = 2.7 V
	Load, Clock, Enable T		—	—	40		
	Clear		—	—	40		
	Data, Enable P	I <sub>IL</sub>	—	—	-0.4	mA	V <sub>CC</sub> = 5.25 V, V <sub>I</sub> = 0.4 V
	Load, Clock, Enable T		—	—	-0.8		
	Clear		—	—	-0.8		
	Data, Enable P	I <sub>I</sub>	—	—	0.1	mA	V <sub>CC</sub> = 5.25 V, V <sub>I</sub> = 7 V
	Load, Clock, Enable T		—	—	0.2		
	Clear		—	—	0.2		
Short-circuit output current		I <sub>OS</sub>	-20	—	-100	mA	V <sub>CC</sub> = 5.25 V
Supply current**		I <sub>CCH</sub>	—	18	31	mA	V <sub>CC</sub> = 5.25 V
		I <sub>CCL</sub>	—	19	32	mA	V <sub>CC</sub> = 5.25 V
Input clamp voltage		V <sub>IK</sub>	—	—	-1.5	V	V <sub>CC</sub> = 4.75 V, I <sub>IN</sub> = -18 mA

Notes: \* V<sub>CC</sub> = 5 V, Ta = 25°C

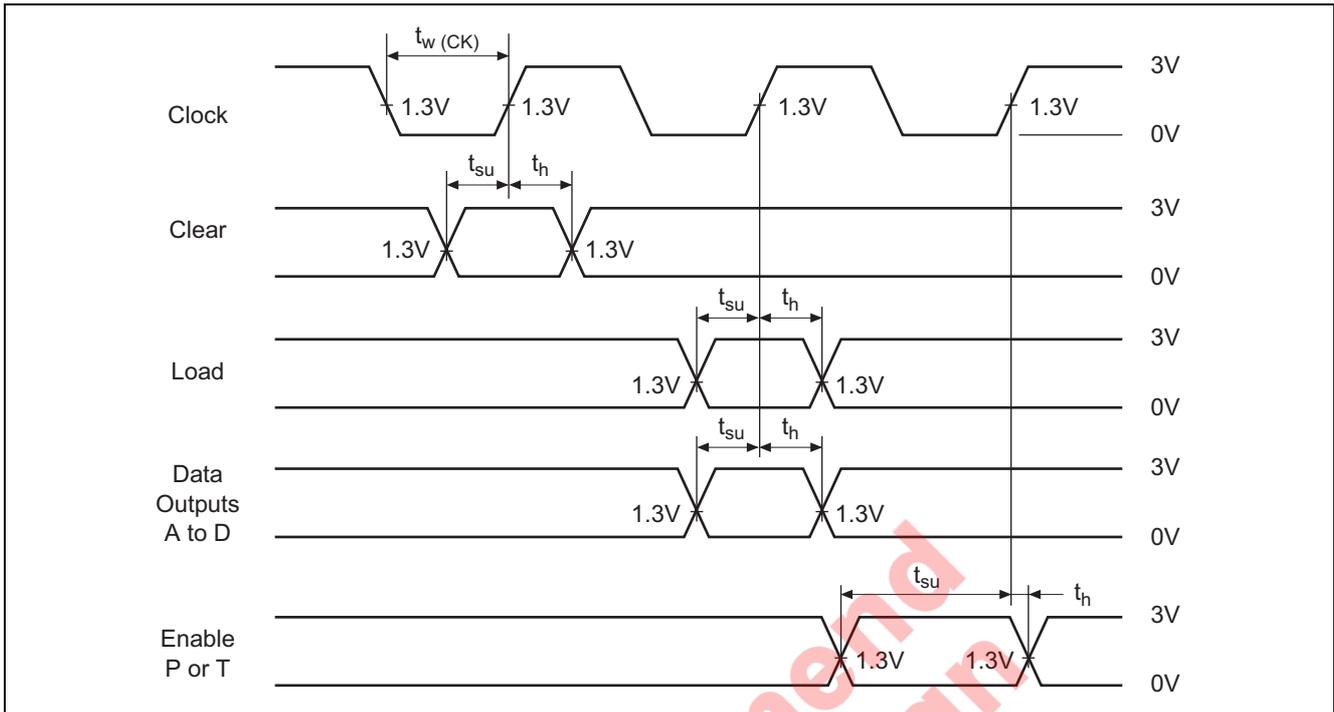
\*\* I<sub>CCH</sub> is measured with the load input high, then again with the load input low, with all other inputs high and all outputs open. I<sub>CCL</sub> is measured with the clock input high, then again with the clock input low, with all other inputs low and all outputs open.

**Switching Characteristics**

(V<sub>CC</sub> = 5 V, Ta = 25°C)

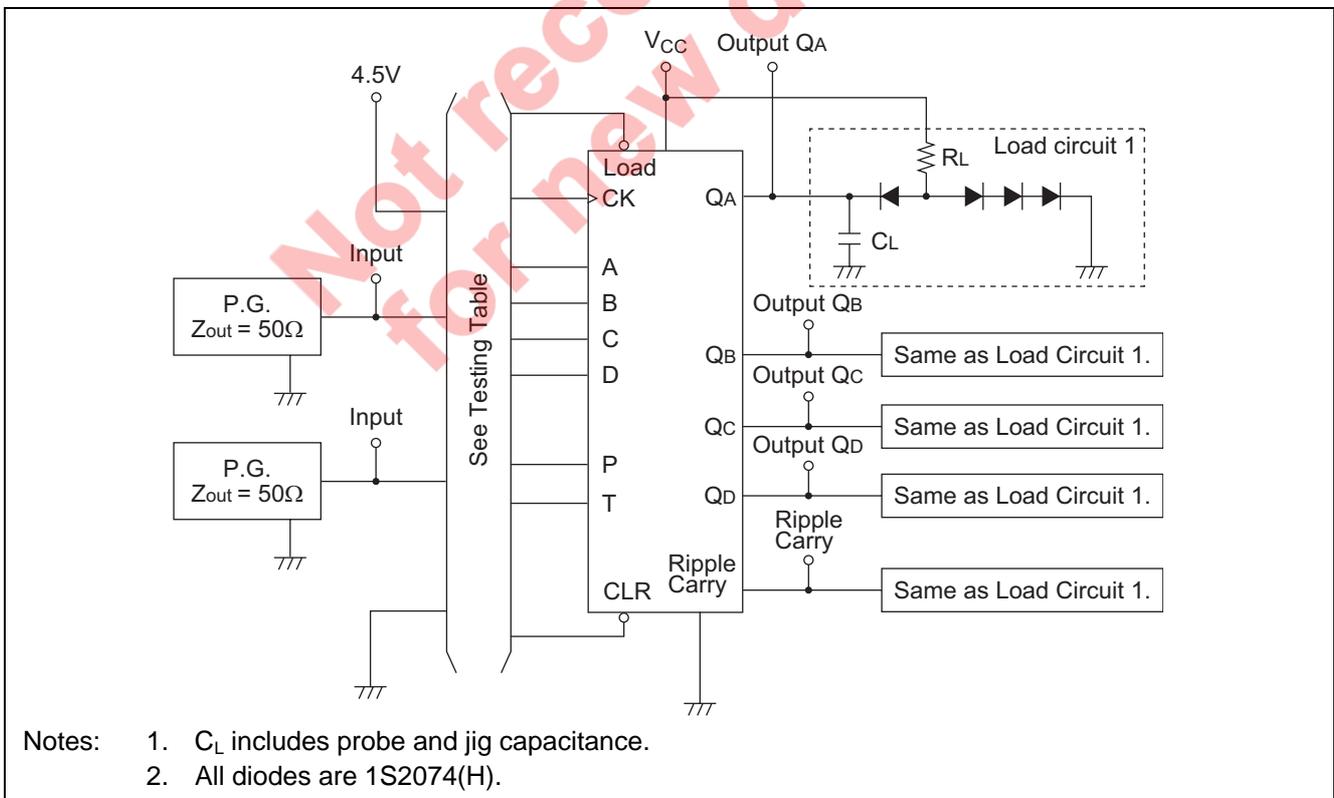
Item	Symbol	Inputs	Outputs	min.	typ.	max.	Unit	Condition
Maximum clock frequency	f <sub>max</sub>	Clock	Q <sub>A</sub> to Q <sub>D</sub>	25	32	—	MHz	
Propagation delay time	t <sub>PLH</sub>	Clock	Ripple	—	20	35	ns	C <sub>L</sub> = 15 pF, R <sub>L</sub> = 2 kΩ
	t <sub>PHL</sub>		Carry	—	18	35	ns	
	t <sub>PLH</sub>	Clock (Load = "H")	Q <sub>A</sub> to Q <sub>D</sub>	—	13	24	ns	
	t <sub>PHL</sub>			—	18	27	ns	
	t <sub>PLH</sub>	Clock (Load = "L")	Q <sub>A</sub> to Q <sub>D</sub>	—	13	24	ns	
	t <sub>PHL</sub>			—	18	27	ns	
	t <sub>PLH</sub>	Enable T	Ripple Carry	—	9	14	ns	
	t <sub>PHL</sub>			—	9	14	ns	
t <sub>PHL</sub>	Clear	Q <sub>A</sub> to Q <sub>D</sub>	—	20	28	ns		

### Timing Method



### Testing Method

#### Test Circuit



- Notes:
1.  $C_L$  includes probe and jig capacitance.
  2. All diodes are 1S2074(H).

Testing Table

Item	From input to output	Inputs								
		Clear	Load	Enable		Clock	Data			
				P	T		A	B	C	D
$f_{max}$		4.5V	4.5V	4.5V	4.5V	IN	GND	GND	GND	GND
$t_{PLH}$ $t_{PHL}$	CK Ripply → Carry	4.5V	4.5V	4.5V	4.5V	IN	GND	GND	GND	GND
	CK → Q	4.5V	4.5V	4.5V	4.5V	IN	GND	GND	GND	GND
	CK → Q	4.5V	GND	GND	GND	IN	IN*	IN*	IN*	IN*
	Enable T → Ripple Carry	4.5V	GND	4.5V	IN	IN**	4.5V	GND	GND	4.5V
	CLR → Q	IN	GND	GND	GND	IN**	4.5V	4.5V	4.5V	4.5V

Notes: \*. Measuring outputs correspond to this condition, each outputs ( $Q_A$ ,  $Q_B$ ,  $Q_C$ , and  $Q_D$ ) must not be over the following rate, "H", "L", "L", and "H".

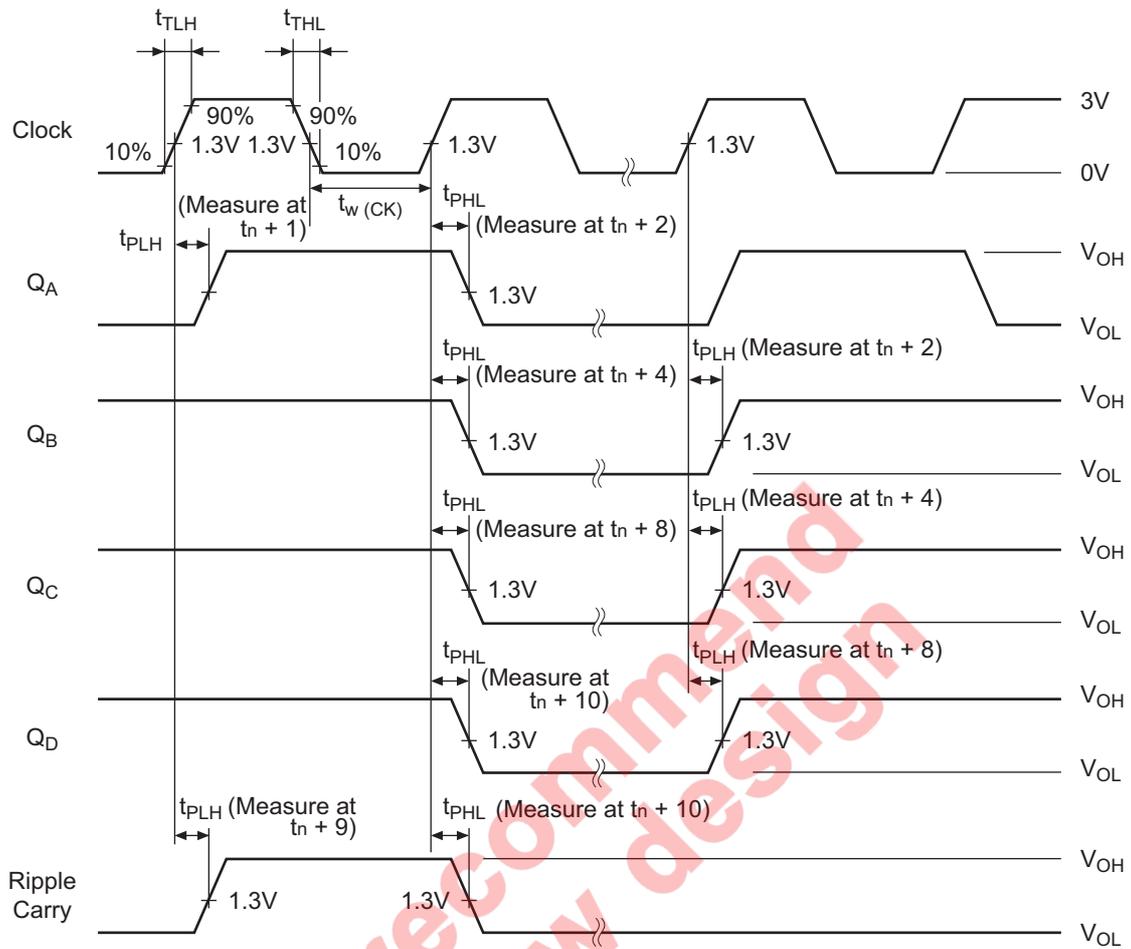
\*\* For initialized

Item	From input to output	Outputs				
		$Q_A$	$Q_B$	$Q_C$	$Q_D$	Ripple Carry
$f_{max}$		OUT	OUT	OUT	OUT	OUT
$t_{PLH}$ $t_{PHL}$	CK→Ripple Carry	—	—	—	—	OUT
	CK→Q	OUT	OUT	OUT	OUT	—
	CK→Q	OUT	OUT	OUT	OUT	—
	Enable T→Ripple Carry	—	—	—	—	OUT
	CLR→Q	OUT	OUT	OUT	OUT	—

Not recommended for new design

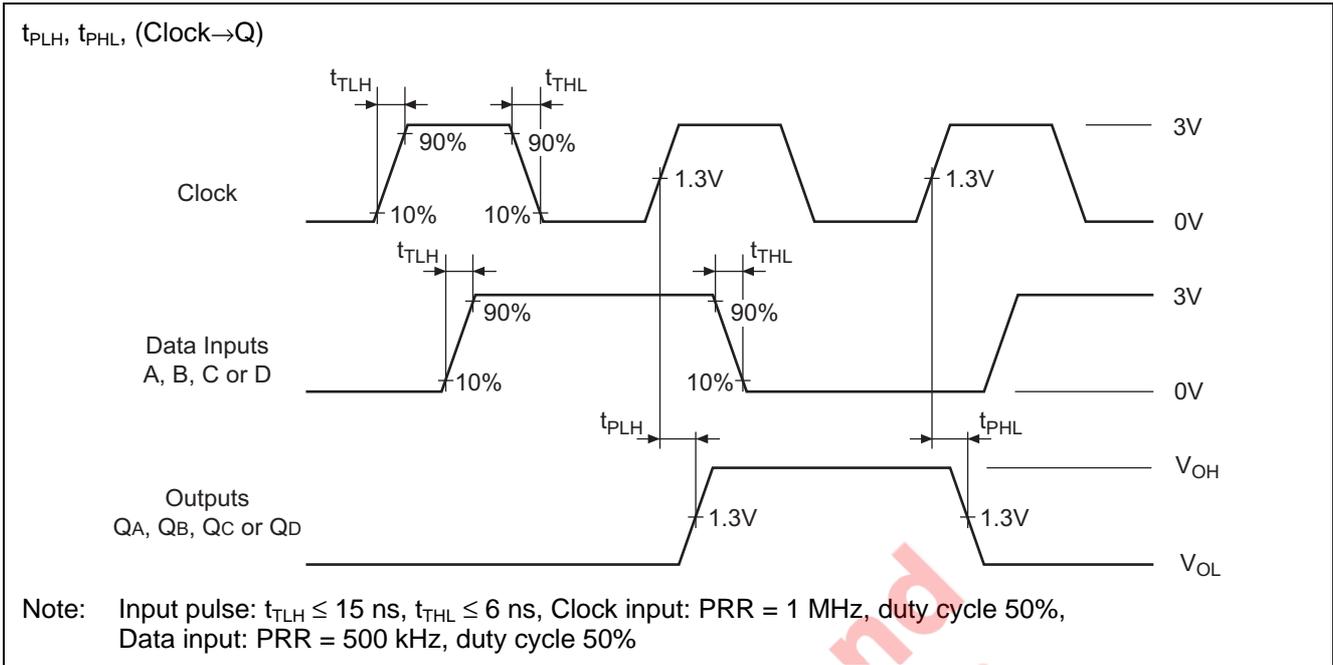
Waveforms 1

$f_{max}$ ,  $t_{PLH}$ ,  $t_{PHL}$ , (Clock→Q, Ripple Carry)

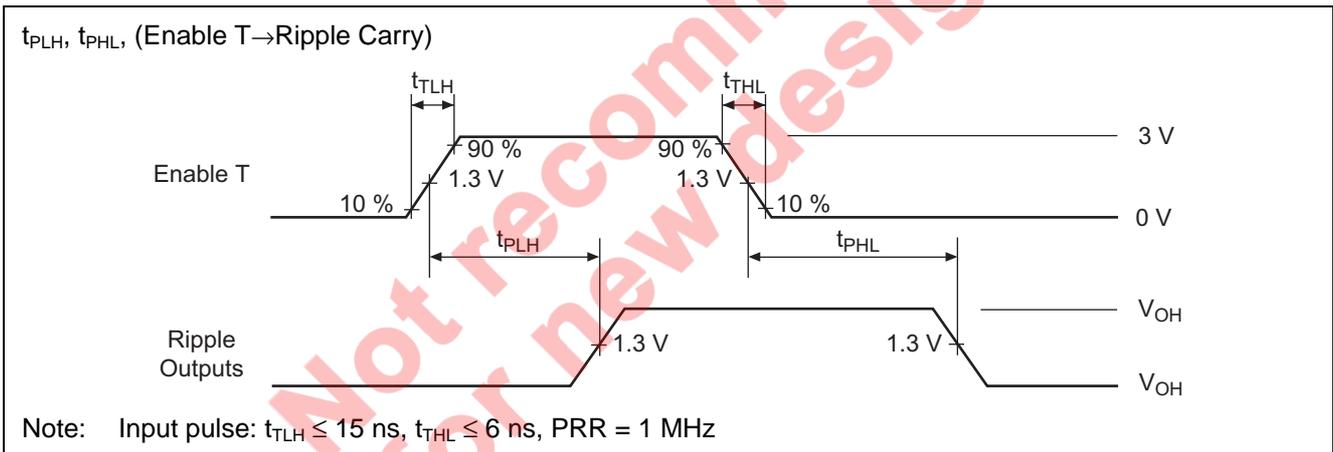


Note: Clock input pulse;  $t_{TLH} \leq 15$  ns,  $t_{THL} \leq 6$  ns, PRR = 1 MHz, duty cycle 50%  
 and :  $f_{max} t_{TLH} = t_{THL} \leq 2.5$  ns.  
 $t_n$  is reference bit time when all outputs are low.

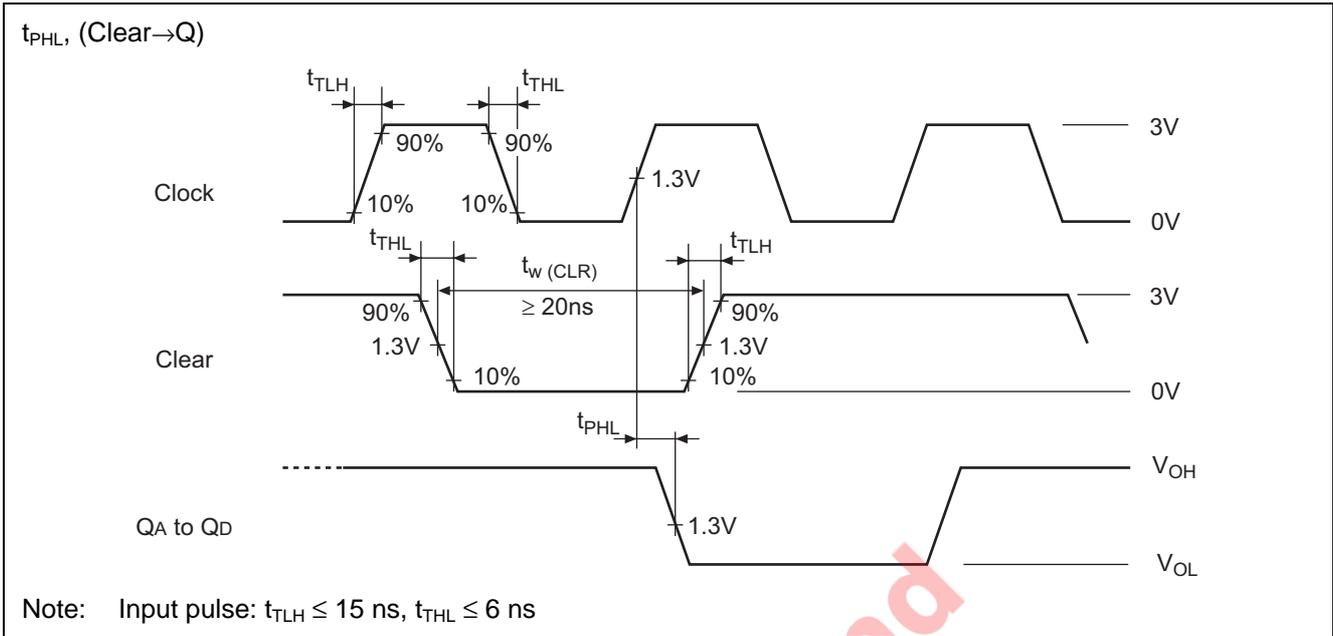
Waveforms 2



Waveforms 3



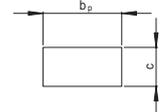
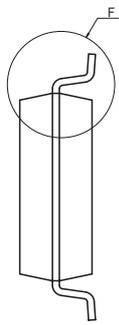
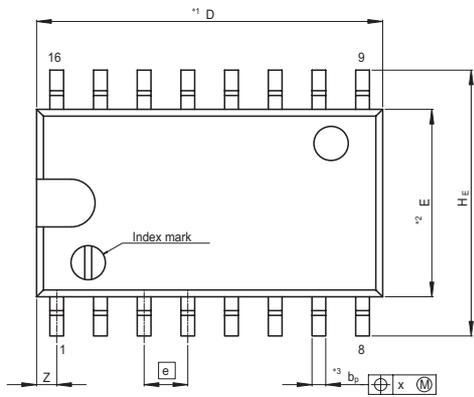
Waveforms 4



Not recommended for new design

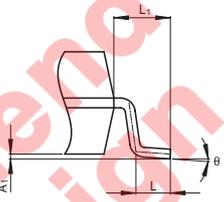
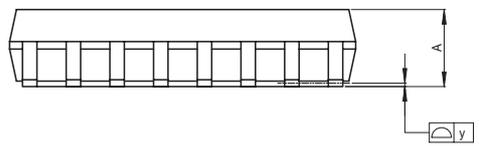
Package Dimensions

JEITA Package Code P-SOP16-5.5x10.06-1.27	RENESAS Code PRSP0016DH-B	Previous Code FP-16DAV	MASS[Typ.] 0.24g
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Terminal cross section  
( Ni/Pd/Au plating )

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



Detail F

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
e	—	1.27	—
x	—	—	0.12
y	—	—	0.15
Z	—	—	0.80
L	0.50	0.70	0.90
L <sub>1</sub>	—	1.15	—

Not recommended for new design

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