
HD74LV595A

8-bit Shift Registers with 3-state Outputs

HITACHI

ADE-205-281 (Z)
1st Edition
April 1999

Description

This device each contains an 8-bit serial-in, parallel-out shift registers that feeds an 8-bit D-type storage register. The storage register has parallel 3-state outputs. Separate clocks are provided for both the shift register and the storage register. The shift register has a direct-overriding clear, serial input, and serial output pins for cascading.

Both the shift register and the storage register clocks are positive-edge triggered. If the user wishes to connect both clocks together, the shift register state will always be one clock pulse ahead of the storage register. Low-voltage and high-speed operation is suitable for the battery-powered products (e.g., notebook computers), and the low-power consumption extends the battery life.

Features

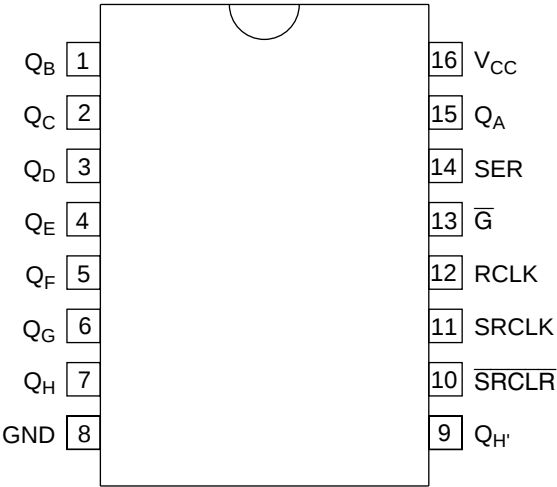
- $V_{CC} = 2.0\text{ V}$ to 5.5 V operation
- All inputs V_{IH} (Max.) = 5.5 V (@ $V_{CC} = 0\text{ V}$ to 5.5 V)
- All outputs V_O (Max.) = 5.5 V (@ $V_{CC} = 0\text{ V}$)
- Typical V_{OL} ground bounce $< 0.8\text{ V}$ (@ $V_{CC} = 3.3\text{ V}$, $T_a = 25^\circ\text{C}$)
- Typical V_{OH} undershoot $> 2.3\text{ V}$ (@ $V_{CC} = 3.3\text{ V}$, $T_a = 25^\circ\text{C}$)
- Output current $\pm 6\text{ mA}$ (@ $V_{CC} = 3.0\text{ V}$ to 3.6 V), $\pm 12\text{ mA}$ (@ $V_{CC} = 4.5\text{ V}$ to 5.5 V)

Function Table

Inputs					Function
SER	SRCLK	SRCLR	RCLK	G	
X	X	X	X	H	Force outputs into high-impedance state
X	X	X	X	L	Enable parallel output
X	X	L	X	X	Reset shift register
L	↑	H	X	X	Shift data into shift register
H	↑	H	X	X	Shift data into shift register
X	↓	H	X	X	Shift register remains unchanged
X	X	X	↑	X	Transfer shift register contents to latch register
X	X	X	↓	X	Latch register remains unchanged

Note: H: High level
L: Low level
X: Immaterial
↑: Low to high transition
↓: High to low transition

Pin Arrangement



(Top view)

Absolute Maximum Ratings

Item	Symbol	Ratings	Unit	Conditions
Supply voltage range	V _{CC}	−0.5 to 7.0	V	
Input voltage range* ¹	V _I	−0.5 to 7.0	V	
Output voltage range* ^{1, 2}	V _O	−0.5 to V _{CC} + 0.5 −0.5 to 7.0	V	Output: H or L Output: Z or V _{CC} : OFF
Input clamp current	I _{IK}	−20	mA	V _I < 0
Output clamp current	I _{OK}	±50	mA	V _O < 0 or V _O > V _{CC}
Continuous output current	I _O	±25	mA	V _O = 0 to V _{CC}
Continuous current through V _{CC} or GND	I _{CC} or I _{GND}	±70	mA	
Maximum power dissipation at Ta = 25°C (in still air)* ³	P _T	785 500	mW	SOP TSSOP
Storage temperature	Tstg	−65 to 150	°C	

Notes: The absolute maximum ratings are values which must not individually be exceeded, and furthermore, no two of which may be realized at the same time.

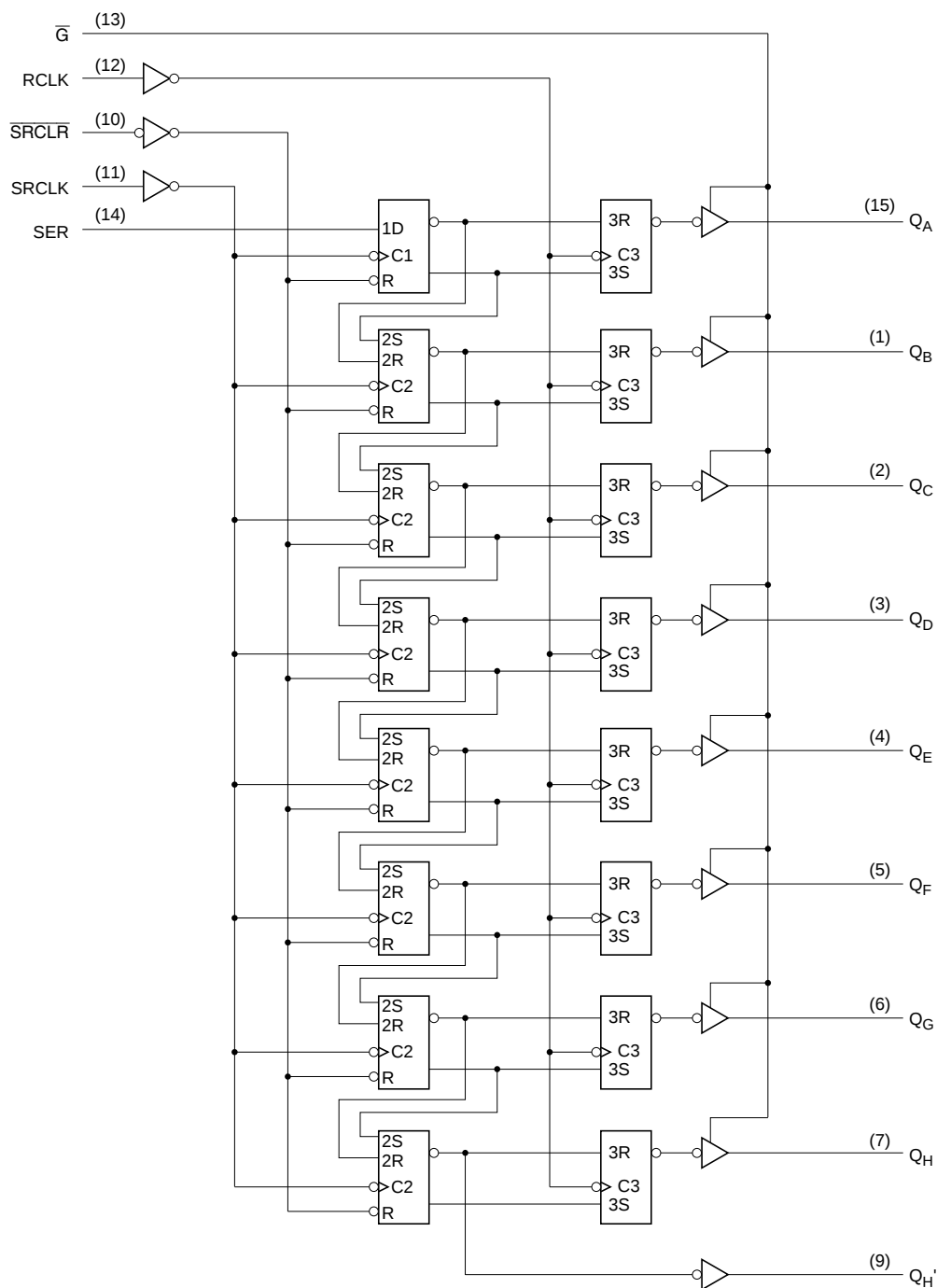
- 1. The input and output voltage ratings may be exceeded if the input and output clamp-current ratings are observed.
- 2. This value is limited to 5.5 V maximum.
- 3. The maximum package power dissipation was calculated using a junction temperature of 150°C.

Recommended Operating Conditions

Item	Symbol	Min	Max	Unit	Conditions
Supply voltage range	V _{CC}	2.0	5.5	V	
Input voltage range	V _I	0	5.5	V	
Output voltage range	V _O	0	V _{CC}	V	H or L
		0	5.5		High impedance state
Output current	I _{OH}	—	−50	μA	V _{CC} = 2.0 V
		—	−2	mA	V _{CC} = 2.3 to 2.7 V
		—	−6		V _{CC} = 3.0 to 3.6 V
		—	−12		V _{CC} = 4.5 to 5.5 V
	I _{OL}	—	50	μA	V _{CC} = 2.0 V
		—	2	mA	V _{CC} = 2.3 to 2.7 V
		—	6		V _{CC} = 3.0 to 3.6 V
		—	12		V _{CC} = 4.5 to 5.5 V
Input transition rise or fall rate	Δt / Δv	0	200	ns/V	V _{CC} = 2.3 to 2.7 V
		0	100		V _{CC} = 3.0 to 3.6 V
		0	20		V _{CC} = 4.5 to 5.5 V
Operating free-air temperature	T _a	−40	85	°C	

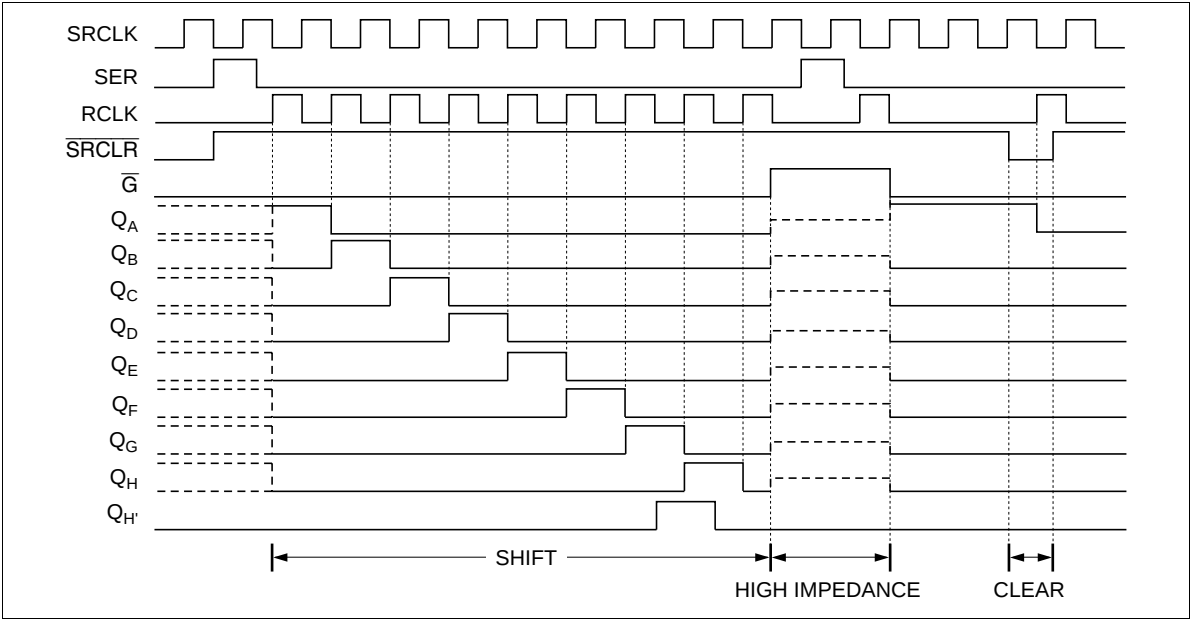
Note: Unused or floating inputs must be held high or low.

Logic Diagram



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Timing Diagram



DC Electrical Characteristics

• Ta = -40 to 85°C

Item	Symbol	V _{CC} (V)*	Min	Typ	Max	Unit	Test Conditions
Input voltage	V _{IH}	2.0	1.5	—	—	V	
		2.3 to 2.7	V _{CC} × 0.7	—	—		
		3.0 to 3.6	V _{CC} × 0.7	—	—		
		4.5 to 5.5	V _{CC} × 0.7	—	—		
	V _{IL}	2.0	—	—	0.5		
		2.3 to 2.7	—	—	V _{CC} × 0.3		
		3.0 to 3.6	—	—	V _{CC} × 0.3		
		4.5 to 5.5	—	—	V _{CC} × 0.3		
Output voltage	V _{OH}	Min to Max	V _{CC} - 0.1	—	—	V	I _{OH} = -50 µA
		2.3	2.0	—	—		I _{OH} = -2 mA
		3.0	2.48	—	—		I _{OH} = -6 mA
		4.5	3.8	—	—		I _{OH} = -12 mA
	V _{OL}	Min to Max	—	—	0.1		I _{OL} = 50 µA
		2.3	—	—	0.4		I _{OL} = 2 mA
		3.0	—	—	0.44		I _{OL} = 6 mA
		4.5	—	—	0.55		I _{OL} = 12 mA
Input current	I _{IN}	0 to 5.5	—	—	±1	µA	V _{IN} = 5.5 V or GND
Off-state output current	I _{OZ}	5.5	—	—	±5	µA	V _O = V _{CC} or GND
Quiescent supply current	I _{CC}	5.5	—	—	20	µA	V _{IN} = V _{CC} or GND, I _O = 0
Output leakage current	I _{OFF}	0	—	—	5	µA	V _I or V _O = 0 to 5.5 V
Input capacitance	C _{IN}	3.3	—	3.5	—	pF	V _I = V _{CC} or GND

Note: For conditions shown as Min or Max, use the appropriate values under recommended operating conditions.

Switching Characteristics

- $V_{CC} = 2.5 \pm 0.2 \text{ V}$

Item	Symbol	Ta = 25°C			Ta = -40 to 85°C		Unit	Test Conditions	FROM (Input)	TO (Output)
		Min	Typ	Max	Min	Max				
Maximum clock frequency	$f_{\max}$	65	80	—	45	—	MHz	$C_L = 15 \text{ pF}$		
		60	70	—	40	—		$C_L = 50 \text{ pF}$		
Propagation delay time	t_{PLH}/t_{PHL}	—	11.6	16.4	1.0	19.5	ns	$C_L = 15 \text{ pF}$	SRCLK	Q_H'
		—	14.8	19.4	1.0	22.5		$C_L = 50 \text{ pF}$		
		—	10.5	15.3	1.0	18.0		$C_L = 15 \text{ pF}$	RCLK	$Q_A - Q_H$
		—	13.7	18.3	1.0	21.0		$C_L = 50 \text{ pF}$		
	t_{PHL}	—	11.2	16.2	1.0	18.2	ns	$C_L = 15 \text{ pF}$	$\overline{\text{SRCLK}}$	Q_H'
		—	14.4	19.2	1.0	21.2		$C_L = 50 \text{ pF}$		
Enable time	t_{ZH}	—	10.3	14.8	1.0	17.5	ns	$C_L = 15 \text{ pF}$	$\overline{G}$	$Q_A - Q_H$
	t_{ZL}	—	12.2	17.7	1.0	20.5		$C_L = 50 \text{ pF}$		
Disable time	t_{HZ}	—	7.6	11.5	1.0	13.5	ns	$C_L = 15 \text{ pF}$		
	t_{LZ}	—	14.4	18.2	1.0	19.2		$C_L = 50 \text{ pF}$		
Setup time	t_{SU}	5.5	—	—	5.5	—	ns		SER before SRCLK $\uparrow$	
		10.0	—	—	10.5	—			SRCLK $\uparrow$ before RCLK $\uparrow$	
		10.0	—	—	11.0	—			$\overline{\text{SRCLR}}$ low before RCLK $\uparrow$	
		5.0	—	—	5.0	—			$\overline{\text{SRCLR}}$ high (inactive) before SRCLK $\uparrow$	
Hold time	t_H	2.0	—	—	2.0	—	ns		SER after SRCLK $\uparrow$	
		0.5	—	—	0.5	—			SRCLK $\uparrow$ after RCLK $\uparrow$	
		0.5	—	—	0.5	—			$\overline{\text{SRCLR}}$ low after RCLK $\uparrow$	
Pulse width	t_W	7.0	—	—	7.5	—	ns		RCLK high or low	
		7.0	—	—	7.5	—			SRCLK high or low	
		6.0	—	—	6.5	—			$\overline{\text{SRCLR}}$ low	

HD74LV595A

• V_{CC} = 3.3 ± 0.3 V

		Ta = 25°C			Ta = −40 to 85°C					
Item	Symbol	Min	Typ	Max	Min	Max	Unit	Test Conditions	FROM (Input)	TO (Output)
Maximum clock frequency	f _{max}	80	150	—	70	—	MHz	C _L = 15 pF		
		55	130	—	50	—		C _L = 50 pF		
Propagation delay time	t _{PLH} /t _{PHL}	—	8.8	13.0	1.0	15.0	ns	C _L = 15 pF	SRCLK	Q _H '
		—	11.3	16.5	1.0	18.5		C _L = 50 pF		
		—	7.7	11.9	1.0	13.5		C _L = 15 pF	RCLK	Q _A − Q _H
		—	10.2	15.4	1.0	17.0		C _L = 50 pF		
	t _{PHL}	—	8.4	12.8	1.0	13.7		C _L = 15 pF	$\overline{\text{SRCLK}}$	Q _H '
		—	10.9	16.3	1.0	17.2		C _L = 50 pF		
Enable time	t _{ZH}	—	7.5	11.5	1.0	13.5	ns	C _L = 15 pF	$\overline{\text{G}}$	Q _A − Q _H
	t _{ZL}	—	9.0	15.0	1.0	17.0		C _L = 50 pF		
Disable time	t _{HZ}	—	5.9	11.7	1.0	13.5	ns	C _L = 15 pF		
	t _{LZ}	—	12.1	15.7	1.0	16.2		C _L = 50 pF		
Setup time	t _{SU}	3.5	—	—	3.5	—	ns		SER before SRCLK ↑	
		8.0	—	—	8.5	—			SRCLK ↑ before RCLK ↑	
		8.0	—	—	9.0	—			$\overline{\text{SRCLR}}$ low before RCLK ↑	
		3.0	—	—	3.0	—			$\overline{\text{SRCLR}}$ high (inactive) before SRCLK ↑	
Hold time	t _h	1.5	—	—	1.5	—	ns		SER after SRCLK ↑	
		0.0	—	—	0.0	—			SRCLK ↑ after RCLK ↑	
		0.0	—	—	0.0	—			$\overline{\text{SRCLR}}$ low after RCLK ↑	
Pulse width	t _w	5.0	—	—	5.0	—	ns		RCLK high or low	
		5.0	—	—	5.0	—			SRCLK high or low	
		5.0	—	—	5.0	—			$\overline{\text{SRCLR}}$ low	

Switching Characteristics (cont)

- $V_{CC} = 5.0 \pm 0.5 \text{ V}$

Item	Symbol	Ta = 25°C			Ta = -40 to 85°C		Unit	Test Conditions	FROM (Input)	TO (Output)
		Min	Typ	Max	Min	Max				
Maximum clock frequency	$f_{\max}$	135	185	—	115	—	MHz	$C_L = 15 \text{ pF}$		
		95	155	—	85	—		$C_L = 50 \text{ pF}$		
Propagation delay time	t_{PLH}/t_{PHL}	—	6.2	8.2	1.0	9.4	ns	$C_L = 15 \text{ pF}$	SRCLK	Q_H'
		—	7.7	10.2	1.0	11.4		$C_L = 50 \text{ pF}$		
		—	5.4	7.4	1.0	8.5		$C_L = 15 \text{ pF}$	RCLK	$Q_A - Q_H$
		—	6.9	9.4	1.0	10.5		$C_L = 50 \text{ pF}$		
	t_{PHL}	—	5.9	8.0	1.0	9.1	ns	$C_L = 15 \text{ pF}$	$\overline{\text{SRCLK}}$	Q_H'
		—	7.4	10.0	1.0	11.1		$C_L = 50 \text{ pF}$		
Enable time	t_{ZH}	—	4.8	8.6	1.0	10.0	ns	$C_L = 15 \text{ pF}$	$\overline{G}$	$Q_A - Q_H$
	t_{ZL}	—	8.3	10.6	1.0	12.0		$C_L = 50 \text{ pF}$		
Disable time	t_{HZ}	—	4.8	8.6	1.0	10.0	ns	$C_L = 15 \text{ pF}$		
	t_{LZ}	—	7.6	11.0	1.0	11.0		$C_L = 50 \text{ pF}$		
Setup time	t_{SU}	3.0	—	—	3.0	—	ns		SER before SRCLK $\uparrow$	
		5.0	—	—	5.0	—			SRCLK $\uparrow$ before RCLK $\uparrow$	
		5.0	—	—	5.0	—			$\overline{\text{SRCLR}}$ low before RCLK $\uparrow$	
		2.5	—	—	2.5	—			$\overline{\text{SRCLR}}$ high (inactive) before SRCLK $\uparrow$	
Hold time	t_H	2.0	—	—	2.0	—	ns		SER after SRCLK $\uparrow$	
		0.0	—	—	0.0	—			SRCLK $\uparrow$ after RCLK $\uparrow$	
		0.0	—	—	0.0	—			$\overline{\text{SRCLR}}$ low after RCLK $\uparrow$	
Pulse width	t_w	5.0	—	—	5.0	—	ns		RCLK high or low	
		5.0	—	—	5.0	—			SRCLK high or low	
		5.0	—	—	5.0	—			$\overline{\text{SRCLR}}$ low	

Output-skew Characteristics

- $C_L = 50\text{ pF}$

Item	Symbol	$V_{CC} = (V)$	Ta = 25°C		Ta = −40 to 85°C		Unit
			Min	Max	Min	Max	
Output skew	$t_{sk(O)}$	2.3 to 2.7	—	2.0	—	2.0	ns
		3.0 to 3.6	—	1.5	—	1.5	
		4.5 to 5.5	—	1.0	—	1.0	

Note: Skew between any outputs of the same package switching in the same direction. This parameter is warranted but not production tested.

Operating Characteristics

- $C_L = 50\text{ pF}$

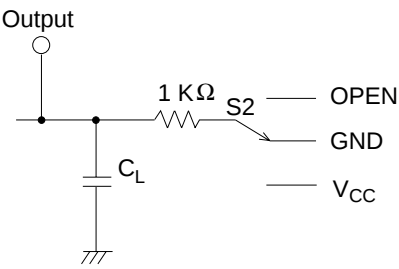
Item	Symbol	$V_{CC} = (V)$	Ta = 25°C			Unit	Test Conditions
			Min	Typ	Max		
Power dissipation capacitance	C_{PD}	3.3	—	32.7	—	pF	f = 10 MHz
		5.0	—	33.1	—		

Noise Characteristics

- $C_L = 50\text{ pF}$

Item	Symbol	$V_{CC} = (V)$	Ta = 25°C			Unit	Test Conditions
			Min	Typ	Max		
Quiet output, maximum dynamic V_{OL}	$V_{OL(P)}$	3.3	—	0.65	0.8	V	
Quiet output, minimum dynamic V_{OL}	$V_{OL(V)}$	3.3	—	−0.59	−0.8		
Quiet output, minimum dynamic V_{OH}	$V_{OH(V)}$	3.3	—	2.84	—		
High-level dynamic input voltage	$V_{IH(D)}$	3.3	2.31	—	—		
Low-level dynamic input voltage	$V_{IL(D)}$	3.3	—	—	0.99		

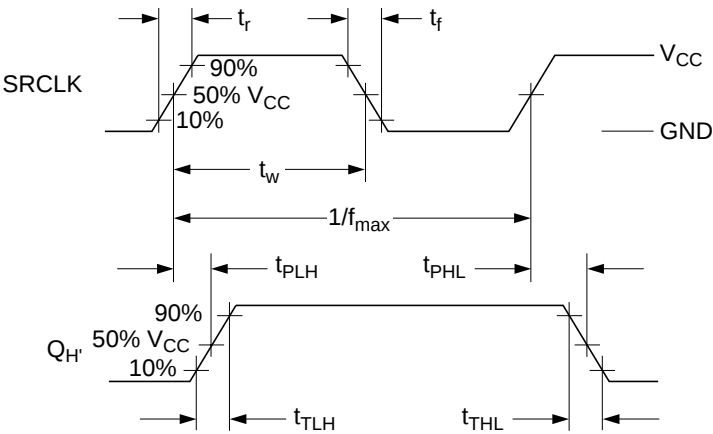
Test Circuit



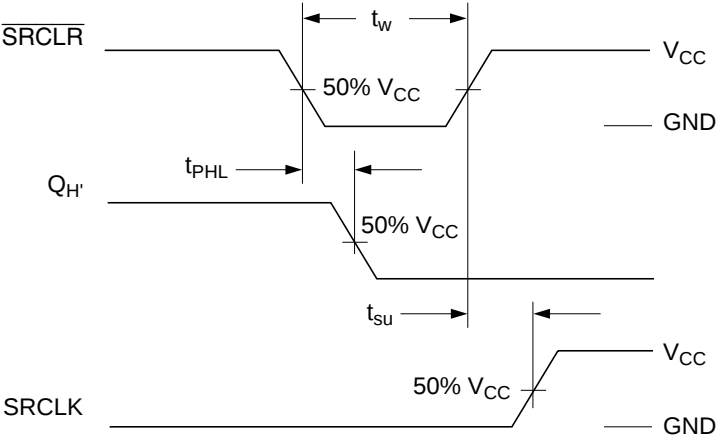
TEST	S2
t _{PLH} / t _{PHL}	OPEN
t _{ZH} / t _{HZ}	GND
t _{ZL} / t _{LZ}	V _{CC}

Note: C_L includes the probe and jig capacitance.

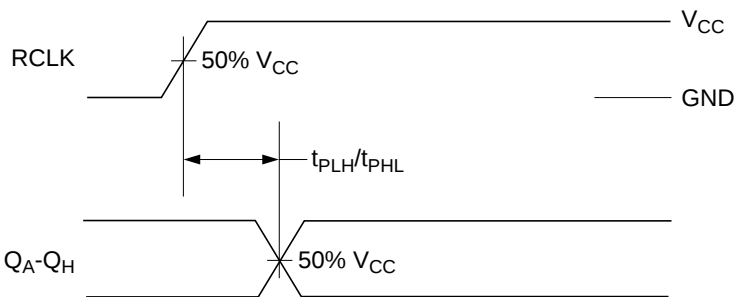
Waveform – 1



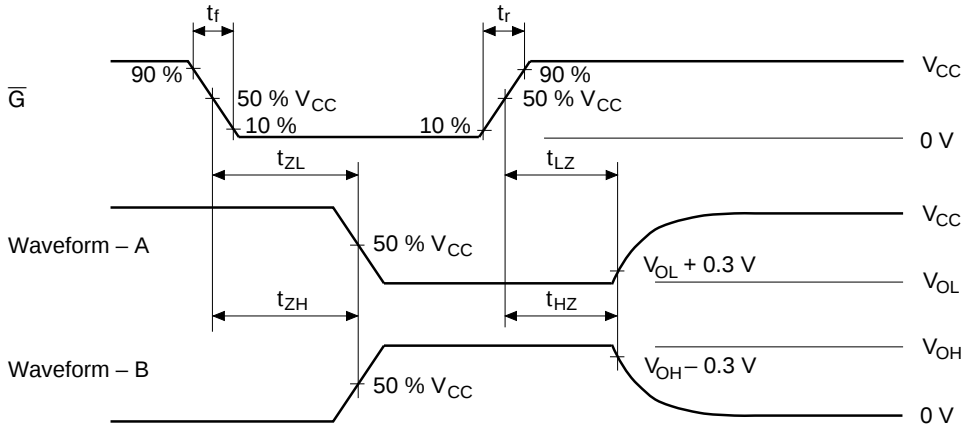
Waveform – 2



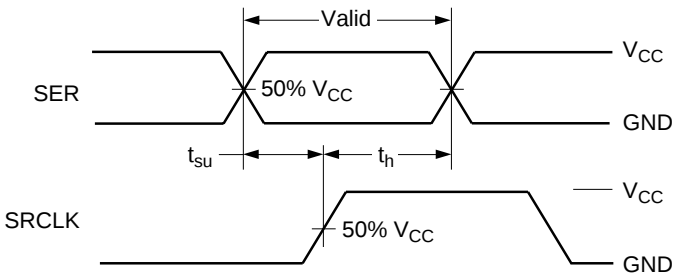
Waveform – 3



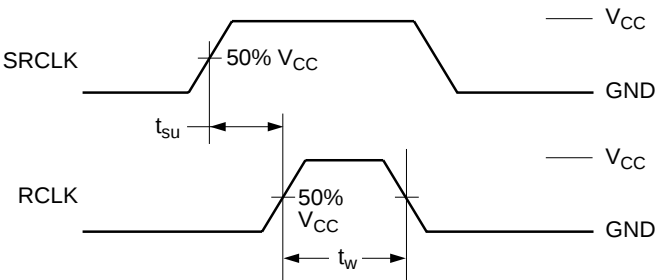
Waveform – 4



Waveform – 5

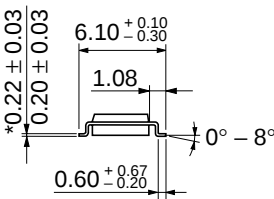
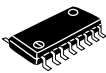
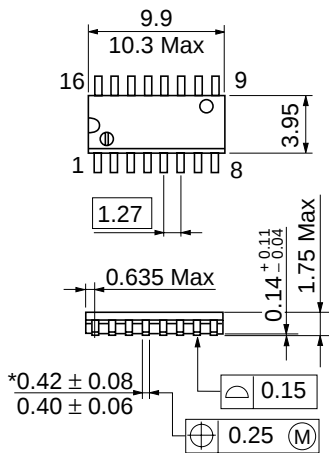


Waveform – 6



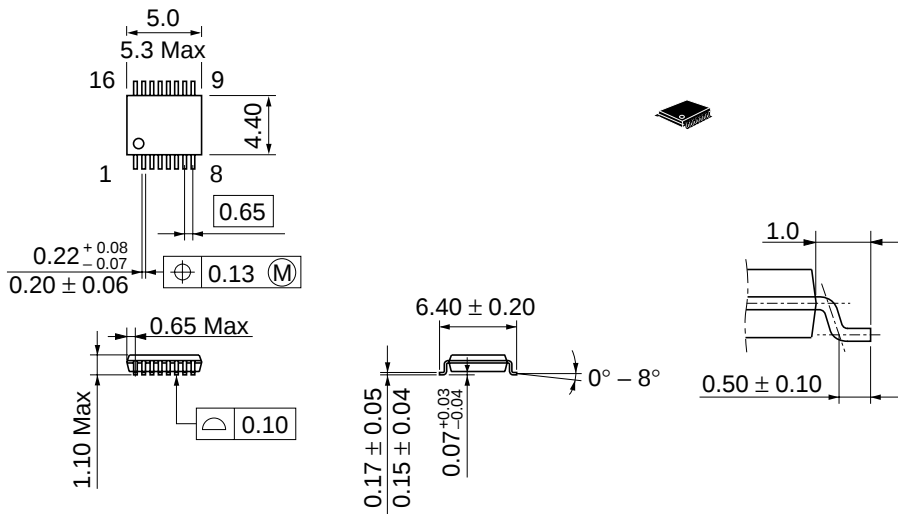
- Notes:
1. Input waveform: $PRR \leq 1 \text{ MHz}$, $Z_o = 50 \Omega$, $t \leq 3 \text{ ns}$, $t \leq 3 \text{ ns}$
 2. Waveform-A is for an output with internal conditions such that the output is low except when disabled by the output control.
 3. Waveform-B is for an output with internal conditions such that the output is high except when disabled by the output control.
 4. The output are measured one at a time with one transition per measurement.

Unit: mm



*Dimension including the plating thickness
Base material dimension

Hitachi Code	FP-16DN
JEDEC	Conforms
EIAJ	Conforms
Weight (reference value)	0.15 g



Dimension including the plating thickness
Base material dimension

Hitachi Code	TTP-16DA
JEDEC	—
EIAJ	—
Weight (reference value)	0.05 g

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Hitachi, Ltd.

Semiconductor & Integrated Circuits.
Nippon Bldg., 2-6-2, Ohte-machi, Chiyoda-ku, Tokyo 100-0004, Japan
Tel: Tokyo (03) 3270-2111 Fax: (03) 3270-5109

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For further information write to:

Hitachi Semiconductor (America) Inc. 179 East Tasman Drive, San Jose, CA 95134 Tel: <1> (408) 433-1990 Fax: <1> (408) 433-0223	Hitachi Europe GmbH Electronic components Group Dornacher Straße 3 D-85622 Feldkirchen, Munich Germany Tel: <49> (89) 9 9180-0 Fax: <49> (89) 9 29 30 00 Hitachi Europe Ltd. Electronic Components Group. Whitebrook Park Lower Cookham Road Maidenhead Berkshire SL6 8YA, United Kingdom Tel: <44> (1628) 585000 Fax: <44> (1628) 778322
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Hitachi Asia Pte. Ltd. 16 Collyer Quay #20-00 Hitachi Tower Singapore 049318 Tel: 535-2100 Fax: 535-1533 Hitachi Asia Ltd. Taipei Branch Office 3F, Hung Kuo Building, No.167, Tun-Hwa North Road, Taipei (105) Tel: <886> (2) 2718-3666 Fax: <886> (2) 2718-8180
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Hitachi Asia (Hong Kong) Ltd.
Group III (Electronic Components)
7/F., North Tower, World Finance Centre,
Harbour City, Canton Road, Tsim Sha Tsui,
Kowloon, Hong Kong
Tel: <852> (2) 735 9218
Fax: <852> (2) 730 0281
Telex: 40815 HITEC HX

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