

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

## TC74VHC299F, TC74VHC299FT

### 8-Bit Pipo Shift Register with Asynchronous Clear

The TC74VHC299 is an advanced high speed CMOS 8-BIT PIPO SHIFT REGISTER fabricated with silicon gate C<sup>2</sup>MOS technology.

It achieves the high speed operation similar to equivalent Bipolar Schottky TTL while maintaining the CMOS low power dissipation.

It has a four modes (HOLD, SHIFT LEFT, SHIFT RIGHT and LOAD DATA) controlled by the two selection inputs (S0, S1).

When one or both enable ( $\overline{G1}$ ,  $\overline{G2}$ ) are high, the eight I/O are forced to the high-impedance state; however, sequential operation or clearing of the register is not affected.

All inputs are equipped with protection circuits against static discharge.

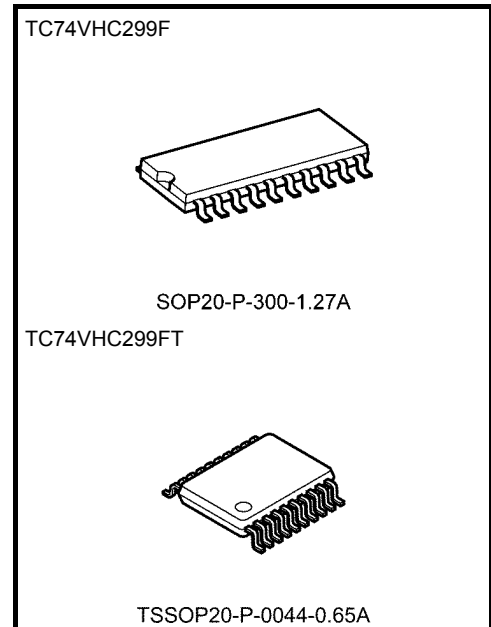
#### Features (Note 1) (Note 2) (Note 3)

- High speed:  $f_{max} = 160$  MHz (typ.) at  $V_{CC} = 5$  V
- Low power dissipation:  $I_{CC} = 4$   $\mu$ A (max) at  $T_a = 25^\circ$ C
- High noise immunity:  $V_{NIH} = V_{NIL} = 28\%$   $V_{CC}$  (min)
- Balanced propagation delays:  $t_{pLH} \approx t_{pHL}$
- Wide operating voltage range:  $V_{CC (opr)} = 2$  to  $5.5$  V
- Low noise:  $V_{OLP} = 1.4$  V (max)
- Pin and function compatible with 74ALS299

Note 1: Do not apply a signal to A/QA to H/QH bus terminal when it is in the output mode. Damage may result.

Note 2: All floating (high impedance) A/QA to H/QH bus terminals must have their input levels fixed by means of pull up or pull down resistors.

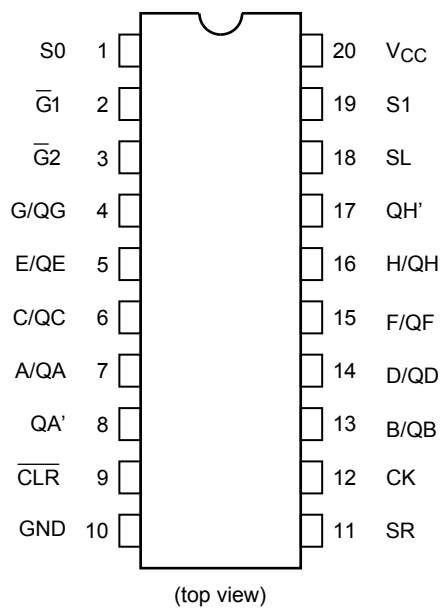
Note 3: A parasitic diode is formed between A/QA to H/QH bus and  $V_{CC}$  terminals. Therefore bus terminal can not be used to interface 5 V to 3 V systems directly.



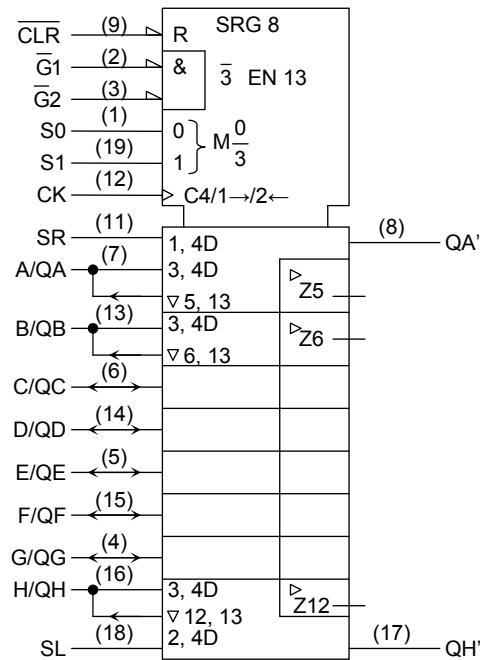
Weight

SOP20-P-300-1.27A	: 0.22 g (typ.)
TSSOP20-P-0044-0.65A	: 0.08 g (typ.)

## Pin Assignment



## IEC Logic Symbol



## Truth Table

Mode	Inputs						Inputs /Outputs		Outputs			
	CLR	Function Select		Output Control		CK	Serial		A/QA	H/QH	QA'	QH'
		S1	S0	G1 (Note)	G2 (Note)		SL	SR				
Z	L	H	H	X	X	X	X	X	Z	Z	L	L
Clear	L	L	X	L	L	X	X	X	L	L	L	L
	L	X	L	L	L	X	X	X	L	L	L	L
Hold	H	L	L	L	L	X	X	X	QA <sub>0</sub>	QH <sub>0</sub>	QA <sub>0</sub>	QH <sub>0</sub>
Shift Right	H	L	H	L	L	↑	X	H	H	QG <sub>n</sub>	H	QG <sub>n</sub>
	H	L	H	L	L	↑	X	L	L	QG <sub>n</sub>	L	QG <sub>n</sub>
Shift Left	H	H	L	L	L	↑	H	X	QB <sub>n</sub>	H	QB <sub>n</sub>	H
	H	H	L	L	L	↑	L	X	QB <sub>n</sub>	L	QB <sub>n</sub>	L
Load	H	H	H	X	X	↑	X	X	a	h	a	h

Note: When one or both output controls are high, the eight input/output terminals are in the high-impedance state; however sequential or clearing of the register is not affected.

Z: High impedance

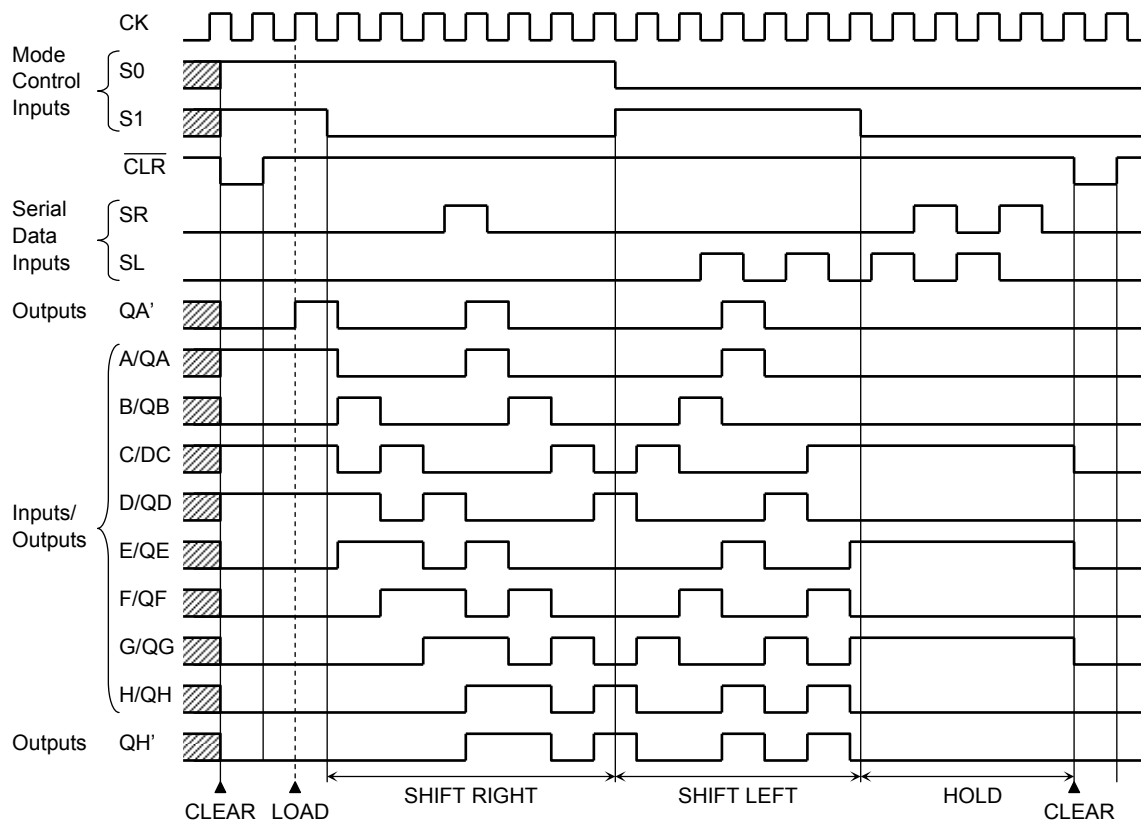
Q<sub>n0</sub>: The level of Q<sub>n</sub> before the indicated steady-state input conditions were established.

Q<sub>nn</sub>: The level of Q<sub>n</sub> before the most recent active transition indicated by ↓ or ↑.

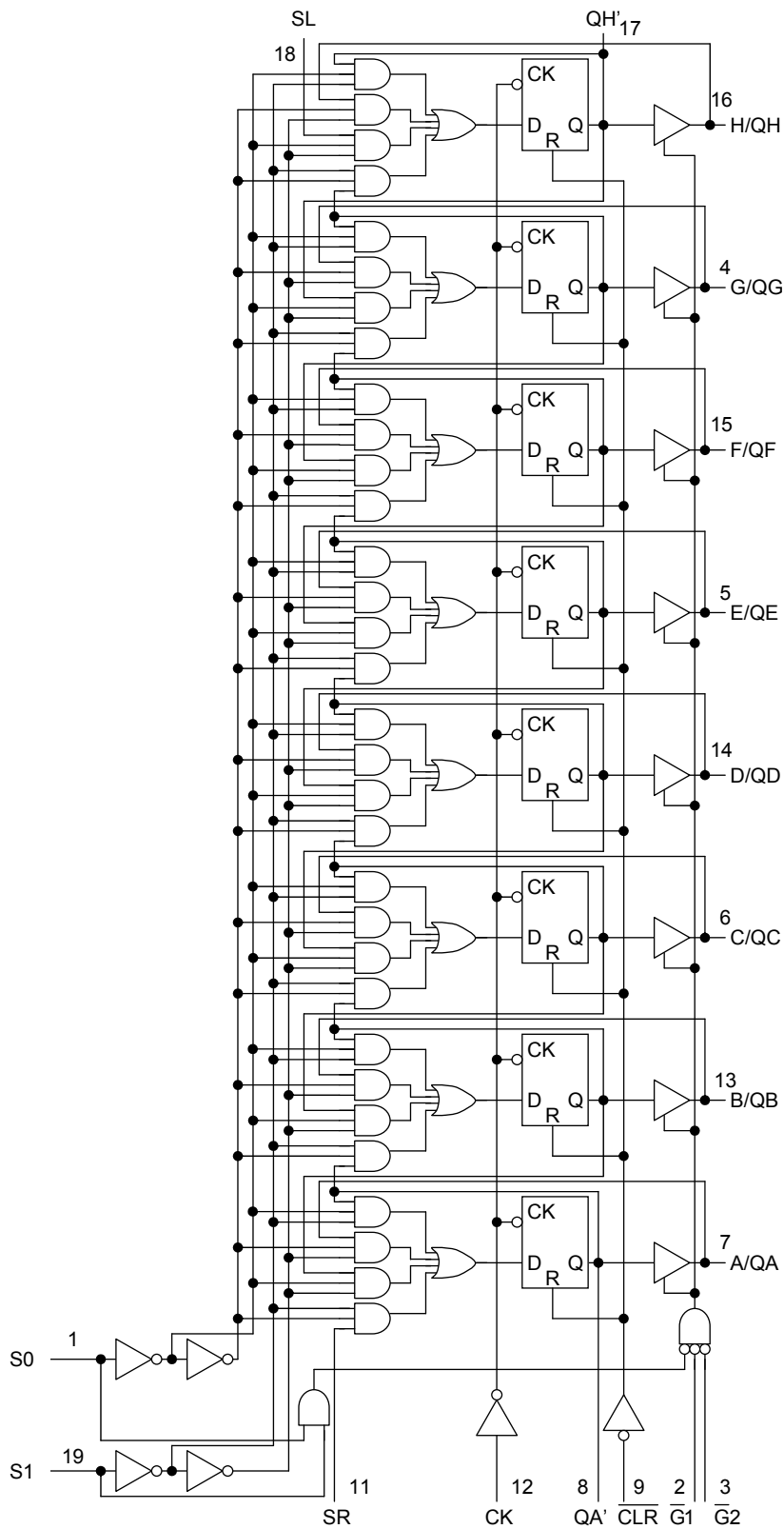
a, h: The level of the steady-state inputs A, H, respectively.

X: Don't care.

**Timing Chart**



**System Diagram**



**Absolute Maximum Ratings (Note)**

Characteristics	Symbol	Rating	Unit
Supply voltage range	$V_{CC}$	-0.5 to 7.0	V
DC input voltage	$V_{IN}$	-0.5 to 7.0	V
DC bus I/O voltage (A/QA to H/QH')	$V_{IN/OUT}$	-0.5 to $V_{CC} + 0.5$	V
DC output voltage (QA' to QH')	$V_{OUT}$	-0.5 to $V_{CC} + 0.5$	V
Input diode current	$I_{IK}$	-20	mA
Output diode current	$I_{OK}$	$\pm 20$	mA
DC output current	$I_{OUT}$	$\pm 25$	mA
DC $V_{CC}$ /ground current	$I_{CC}$	$\pm 80$	mA
Power dissipation	$P_D$	180	mW
Storage temperature	$T_{stg}$	-65 to 150	$^{\circ}C$

Note: Exceeding any of the absolute maximum ratings, even briefly, lead to deterioration in IC performance or even destruction.

Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings and the operating ranges.

Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

**Operating Ranges (Note)**

Characteristics	Symbol	Rating	Unit
Supply voltage	$V_{CC}$	2.0 to 5.5	V
Input voltage	$V_{IN}$	0 to 5.5	V
DC bus I/O voltage (A/QA to H/QH)	$V_{IN/OUT}$	0 to $V_{CC}$	V
DC output voltage (QA' to QH')	$V_{OUT}$	0 to $V_{CC}$	V
Operating temperature	$T_{opr}$	-40 to 85	$^{\circ}C$
Input rise and fall time	dt/dV	0 to 100 ( $V_{CC} = 3.3 \pm 0.3$ V) 0 to 20 ( $V_{CC} = 5 \pm 0.5$ V)	ns/V

Note: The operating ranges must be maintained to ensure the normal operation of the device. Unused inputs must be tied to either VCC or GND.

## Electrical Characteristics

### DC Characteristics

Characteristics	Symbol	Test Condition		Ta = 25°C			Ta = -40 to 85°C		Unit	
				V <sub>CC</sub> (V)	Min	Typ.	Max	Min		Max
High-level input voltage	V <sub>IH</sub>	—		2.0 3.0 to 5.5	1.50 V <sub>CC</sub> × 0.7	— —	— —	1.50 V <sub>CC</sub> × 0.7	— —	V
Low-level input voltage	V <sub>IL</sub>	—		2.0 3.0 to 5.5	— —	— —	— —	0.50 V <sub>CC</sub> × 0.3	0.50 V <sub>CC</sub> × 0.3	V
High-level output voltage	V <sub>OH</sub>	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OH</sub> = -50 μA	2.0 3.0 4.5	1.9 2.9 4.4	2.0 3.0 4.5	— — —	1.9 2.9 4.4	— — —	V
			I <sub>OH</sub> = -4 mA	3.0	2.58	—	—	2.48	—	
			I <sub>OH</sub> = -8 mA	4.5	3.94	—	—	3.80	—	
Low-level output voltage	V <sub>OL</sub>	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OL</sub> = 50 μA	2.0 3.0 4.5	— — —	0.0 0.0 0.0	0.1 0.1 0.1	— — —	0.1 0.1 0.1	V
			I <sub>OL</sub> = 4 mA	3.0	—	—	0.36	—	0.44	
			I <sub>OL</sub> = 8 mA	4.5	—	—	0.36	—	0.44	
3-state output off-state current	I <sub>OZ</sub>	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> V <sub>OUT</sub> = V <sub>CC</sub> or GND		5.5	—	—	±0.25	—	±2.50	μA
Input leakage current	I <sub>IN</sub>	V <sub>IN</sub> = 5.5 V or GND		0 to 5.5	—	—	±0.1	—	±1.0	μA
Quiescent supply current	I <sub>CC</sub>	V <sub>IN</sub> = V <sub>CC</sub> or GND		5.5	—	—	4.0	—	40.0	μA

## AC Characteristics (input: $t_r = t_f = 3$ ns)

Characteristics	Symbol	Test Condition	Ta = 25°C			Ta = -40 to 85°C		Unit				
			V <sub>CC</sub> (V)	C <sub>L</sub> (pF)	Min	Typ.	Max		Min	Max		
Propagation delay time (CK-QA', QH')	t <sub>pLH</sub>	—	3.3 ± 0.3	15	—	12.2	17.2	1.0	19.8	ns		
				50	—	14.7	20.7	1.0	23.3			
	5.0 ± 0.5		15	—	8.5	10.8	1.0	12.0				
			50	—	10.0	12.8	1.0	14.0				
Propagation delay time ( $\overline{\text{CLR}}$ -QA', QH')	t <sub>pHL</sub>	—	3.3 ± 0.3	15	—	13.0	19.0	1.0	22.0	ns		
				50	—	15.5	22.5	1.0	25.5			
			5.0 ± 0.5	15	—	9.1	11.2	1.0	13.5			
				50	—	10.8	13.2	1.0	15.5			
Propagation delay time (CK-QA to QH)	t <sub>pLH</sub>	—	3.3 ± 0.3	15	—	10.3	14.3	1.0	16.6	ns		
				50	—	12.8	17.8	1.0	20.1			
	5.0 ± 0.5		15	—	7.3	9.1	1.0	10.4				
			50	—	8.8	11.1	1.0	12.4				
Propagation delay time ( $\overline{\text{CLR}}$ -QA to QH)	t <sub>pHL</sub>	—	3.3 ± 0.3	15	—	10.8	17.0	1.0	19.5	ns		
				50	—	13.3	20.5	1.0	23.0			
			5.0 ± 0.5	15	—	7.7	10.5	1.0	12.0			
				50	—	9.2	12.5	1.0	14.0			
Output enable time	t <sub>pZL</sub>	R <sub>L</sub> = 1 kΩ	3.3 ± 0.3	15	—	13.3	16.5	1.0	19.2	ns		
				50	—	14.8	19.0	1.0	21.7			
	5.0 ± 0.5		15	—	8.9	9.7	1.0	11.3				
			50	—	10.4	11.2	1.0	12.6				
Output disable time	t <sub>pLZ</sub>	R <sub>L</sub> = 1 kΩ	3.3 ± 0.3	50	—	18.0	21.3	1.0	24.3	ns		
			5.0 ± 0.5	50	—	11.8	13.2	1.0	15.0			
Maximum clock frequency	f <sub>max</sub>		—	3.3 ± 0.3	15	65	100	—	55		—	MHz
					50	55	90	—	50		—	
		5.0 ± 0.5		15	125	160	—	110	—			
				50	115	150	—	100	—			
Input capacitance	C <sub>IN</sub>	—	—	—	4	10	—	—	pF			
Bus I/O capacitance (A/QA to H/QH)	C <sub>OUT</sub>	—	—	—	8	—	—	—	pF			
Power dissipation capacitance	C <sub>PD</sub>	(Note)	—	—	110	—	—	—	pF			

Note: C<sub>PD</sub> is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

Average operating current can be obtained by the equation:

$$I_{CC(opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}$$

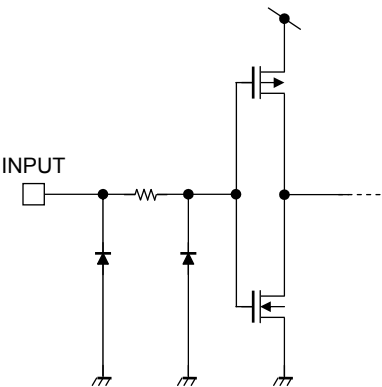
### Timing Requirements (input: $t_r = t_f = 3 \text{ ns}$ )

Characteristics	Symbol	Test Condition	Ta = 25°C		Ta = -40 to 85°C		Unit
			V <sub>CC</sub> (V)	Typ.	Limit	Limit	
Minimum pulse width (CK)	$t_w$ (H)	—	3.3 ± 0.3	—	7.0	8.0	ns
	$t_w$ (L)		5.0 ± 0.5	—	7.0	8.0	
Minimum pulse width ( $\overline{\text{CLR}}$ )	$t_w$ (L)	—	3.3 ± 0.3 5.0 ± 0.5	— —	6.0 6.0	7.0 7.0	ns
Minimum set-up time (SL, SR)	$t_s$	—	3.3 ± 0.3	—	8.5	10.0	ns
			5.0 ± 0.5	—	5.0	5.0	
Minimum set-up time (A to H)	$t_s$	—	3.3 ± 0.3 5.0 ± 0.5	— —	8.0 4.0	9.0 4.0	ns
Minimum set-up time (S0, S1)	$t_s$	—	3.3 ± 0.3	—	14.5	17.0	ns
			5.0 ± 0.5	—	7.0	8.0	
Minimum hold time (SL, SR)	$t_h$	—	3.3 ± 0.3	—	1.0	1.0	ns
			5.0 ± 0.5	—	1.0	1.0	
Minimum hold time (A to H)	$t_h$	—	3.3 ± 0.3	—	0.5	0.5	ns
			5.0 ± 0.5	—	1.5	1.5	
Minimum hold time (S0, S1)	$t_h$	—	3.3 ± 0.3	—	0	0	ns
			5.0 ± 0.5	—	0.5	0.5	
Minimum removal time ( $\overline{\text{CLR}}$ )	$t_{\text{rem}}$	—	3.3 ± 0.3	—	5.0	6.0	ns
			5.0 ± 0.5	—	4.0	4.0	

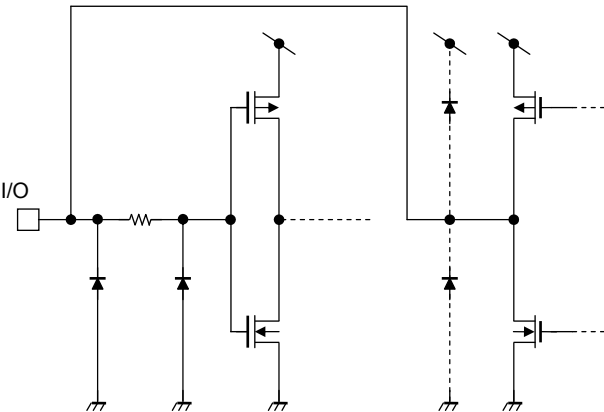
### Noise Characteristics (input: $t_r = t_f = 3 \text{ ns}$ )

Characteristics	Symbol	Test Condition	Ta = 25°C		Unit	
			V <sub>CC</sub> (V)	Typ.		Limit
Quiet output maximum dynamic V <sub>OL</sub>	V <sub>OLP</sub>	C <sub>L</sub> = 50 pF	5.0	0.9	1.2	V
Quiet output minimum dynamic V <sub>OL</sub>	V <sub>OLV</sub>	C <sub>L</sub> = 50 pF	5.0	-0.9	-1.2	V
Minimum high level dynamic input Voltage	V <sub>IHD</sub>	C <sub>L</sub> = 50 pF	5.0	—	3.5	V
Maximum low high level dynamic input Voltage	V <sub>ILD</sub>	C <sub>L</sub> = 50 pF	5.0	—	1.5	V

Input Equivalent Circuit



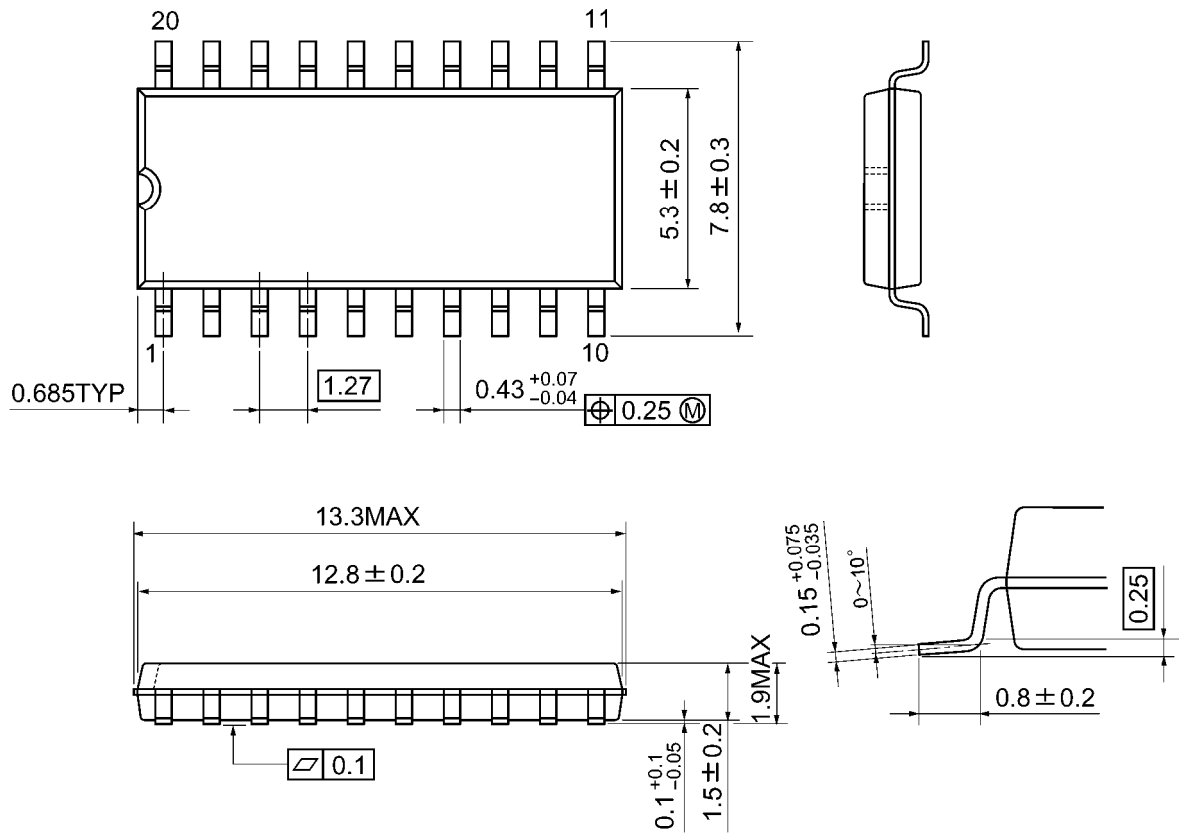
A/QA to H/QH Bus Terminal Equivalent Circuit



**Package Dimensions**

SOP20-P-300-1.27A

Unit: mm

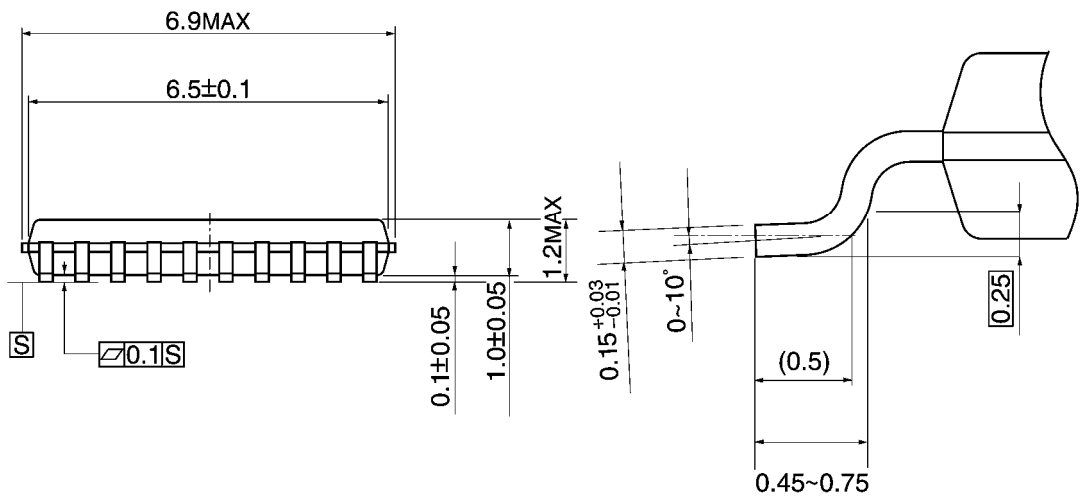
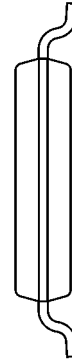
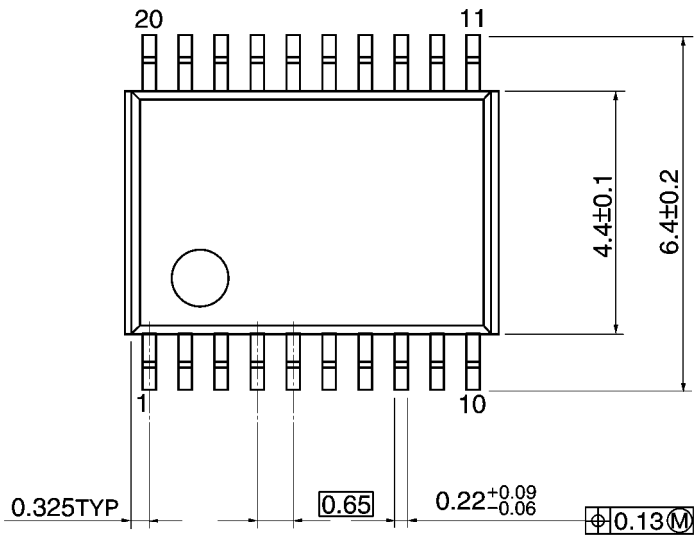


Weight: 0.22 g (typ.)

**Package Dimensions**

TSSOP20-P-0044-0.65A

Unit: mm



Weight: 0.08 g (typ.)

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