

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 C²MOS 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.

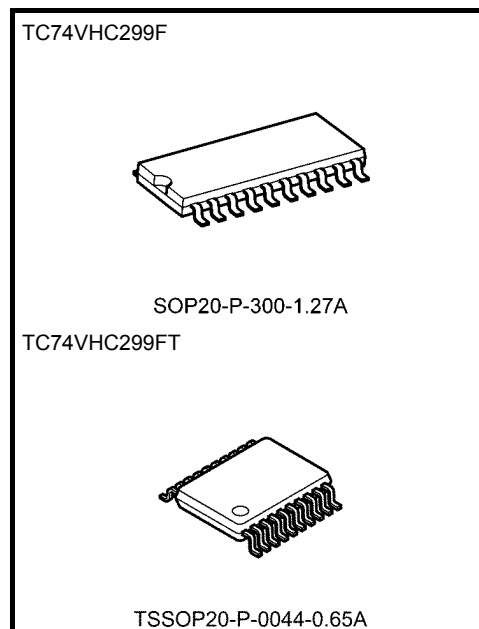
Features (Note 1) (Note 2) (Note 3)

- High speed: $f_{max} = 160$ MHz (typ.) at $V_{CC} = 5$ V
- Low power dissipation: $I_{CC} = 4$ μ A (max) at $T_a = 25^\circ\text{C}$
- 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.

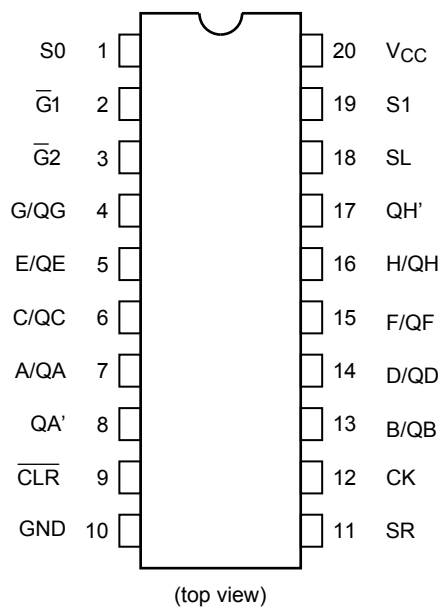
Note 2: All floating (high impedance) A/QA to H/QH bus terminals must have their input levels fixed by means of pull up or pull down resistors.

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.

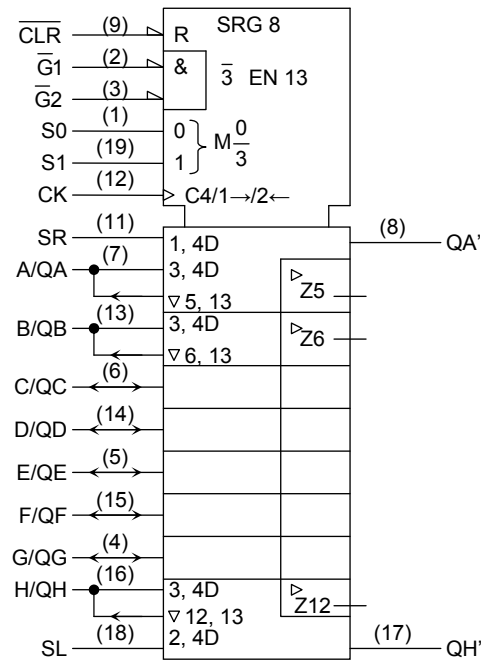


Weight	
SOP20-P-300-1.27A	: 0.22 g (typ.)
TSSOP20-P-0044-0.65A	: 0.08 g (typ.)

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 ₀	QH ₀	QA ₀	QH ₀
Shift Right	H	L	H	L	L	↑	X	H	H	QG _n	H	QG _n
	H	L	H	L	L	↓	X	L	L	QG _n	L	QG _n
Shift Left	H	H	L	L	L	↑	H	X	QB _n	H	QB _n	H
	H	H	L	L	L	↓	L	X	QB _n	L	QB _n	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

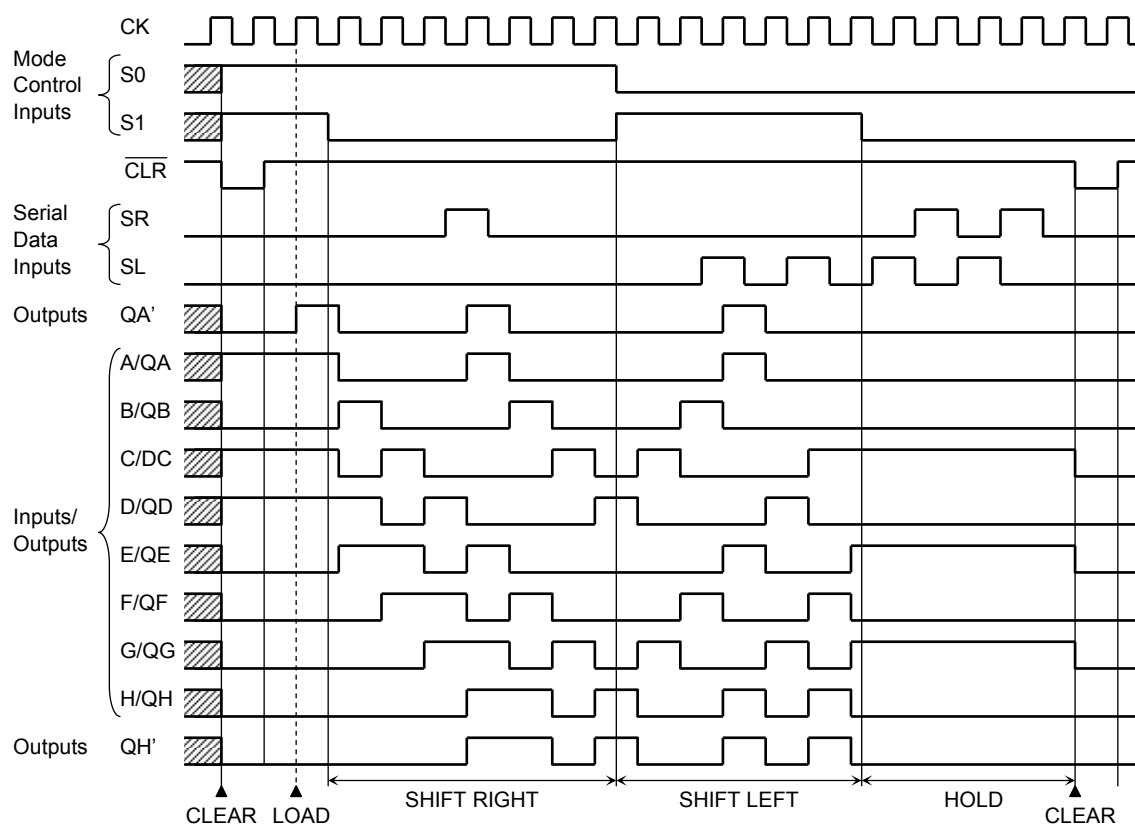
Q_{n0}: The level of Q_n before the indicated steady-state input conditions were established.

Q_{nn}: The level of Q_n before the most recent active transition indicated by ↓ or ↑.

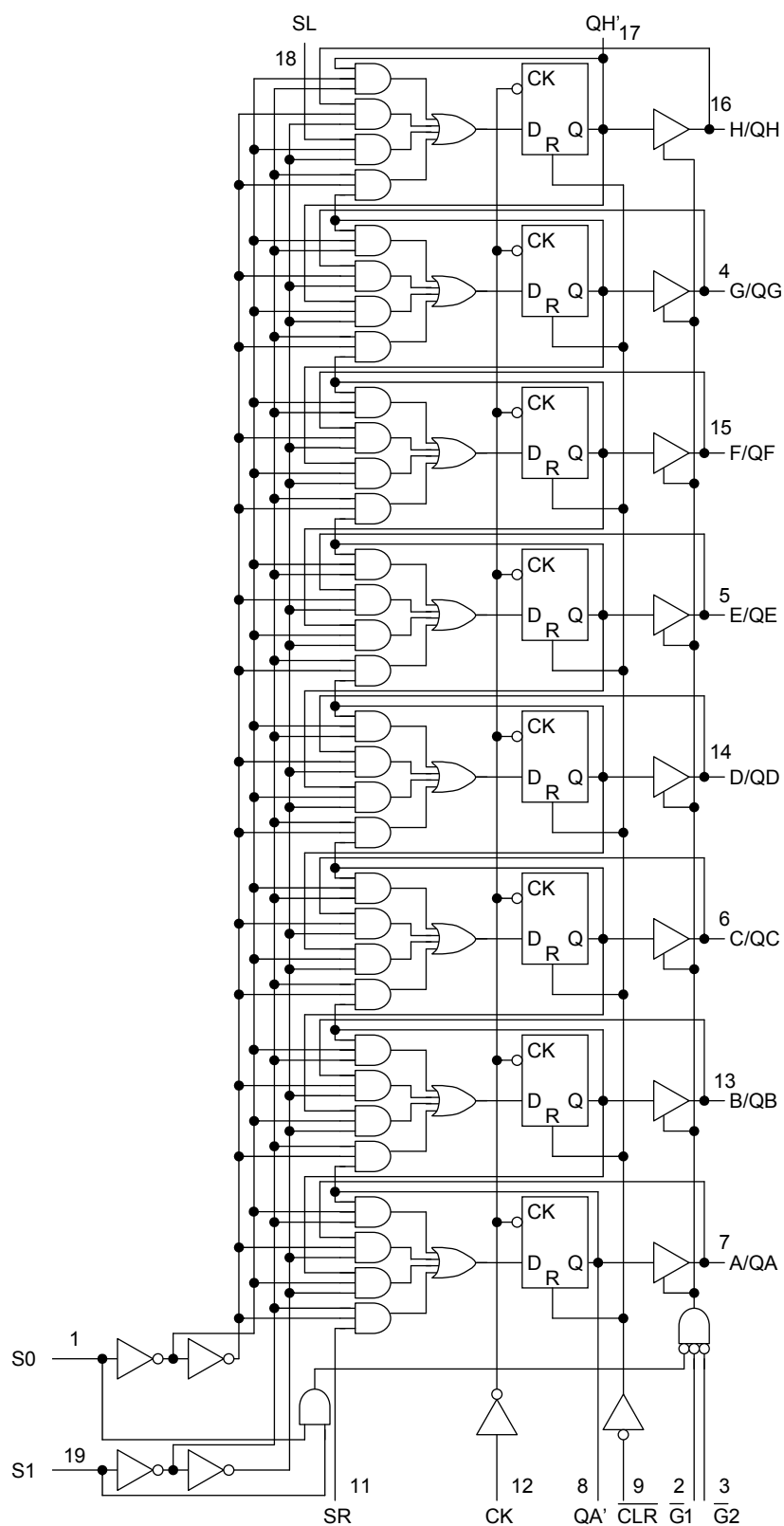
a, h: The level of the steady-state inputs A, H, respectively.

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}	± 20	mA
DC output current	I_{OUT}	± 25	mA
DC V_{CC} /ground current	I_{CC}	± 80	mA
Power dissipation	P_D	180	mW
Storage temperature	T_{stg}	-65 to 150	°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	°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 V_{CC} or GND.

Electrical Characteristics
DC Characteristics

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

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

Characteristics	Symbol	Test Condition			Ta = 25°C			Ta = −40 to 85°C		Unit
			V _{CC} (V)	C _L (pF)	Min	Typ.	Max	Min	Max	
Propagation delay time (CK-QA', QH')	t _{pLH}	—	3.3 ± 0.3	15	—	12.2	17.2	1.0	19.8	ns
				50	—	14.7	20.7	1.0	23.3	
	t _{pHL}		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 _{pHL}	—	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 _{pLH}	—	3.3 ± 0.3	15	—	10.3	14.3	1.0	16.6	ns
				50	—	12.8	17.8	1.0	20.1	
	t _{pHL}		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 _{pHL}	—	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 _{pZL}	R _L = 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	
	t _{pZH}		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 _{pLZ}	R _L = 1 kΩ	3.3 ± 0.3	50	—	18.0	21.3	1.0	24.3	ns
	t _{pHZ}		5.0 ± 0.5	50	—	11.8	13.2	1.0	15.0	
Maximum clock frequency	f _{max}	—	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 _{IN}	—			—	4	10	—	—	pF
Bus I/O capacitance (A/QA to H/QH)	C _{OUT}	—			—	8	—	—	—	pF
Power dissipation capacitance	C _{PD}	(Note)			—	110	—	—	—	pF

Note: C_{PD} 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:

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

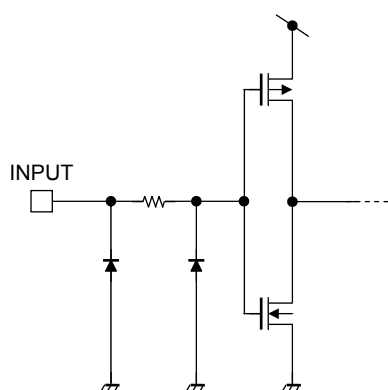
Timing Requirements (input: $t_r = t_f = 3 \text{ ns}$)

Characteristics	Symbol	Test Condition	Ta = 25°C		Ta = -40 to 85°C		Unit
			V _{CC} (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	—	6.0	7.0	ns
			5.0 ± 0.5	—	6.0	7.0	
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	—	8.0	9.0	ns
			5.0 ± 0.5	—	4.0	4.0	
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_{rem}	—	3.3 ± 0.3	—	5.0	6.0	ns
			5.0 ± 0.5	—	4.0	4.0	

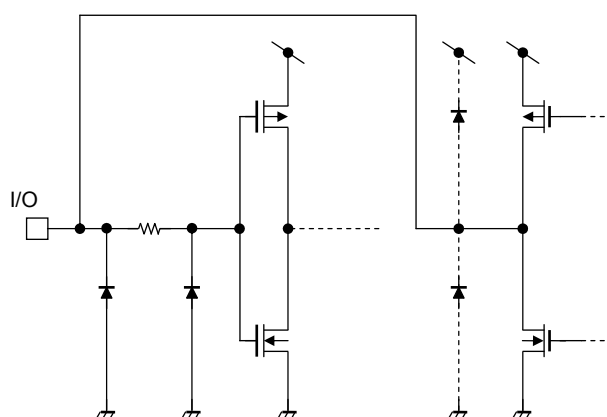
Noise Characteristics (input: $t_r = t_f = 3 \text{ ns}$)

Characteristics	Symbol	Test Condition	Ta = 25°C		Unit	
			V _{CC} (V)	Typ.		Limit
Quiet output maximum dynamic V _{OL}	V _{OLP}	C _L = 50 pF	5.0	0.9	1.2	V
Quiet output minimum dynamic V _{OL}	V _{OLV}	C _L = 50 pF	5.0	−0.9	−1.2	V
Minimum high level dynamic input Voltage	V _{IHD}	C _L = 50 pF	5.0	—	3.5	V
Maximum low high level dynamic input Voltage	V _{ILD}	C _L = 50 pF	5.0	—	1.5	V

Input Equivalent Circuit



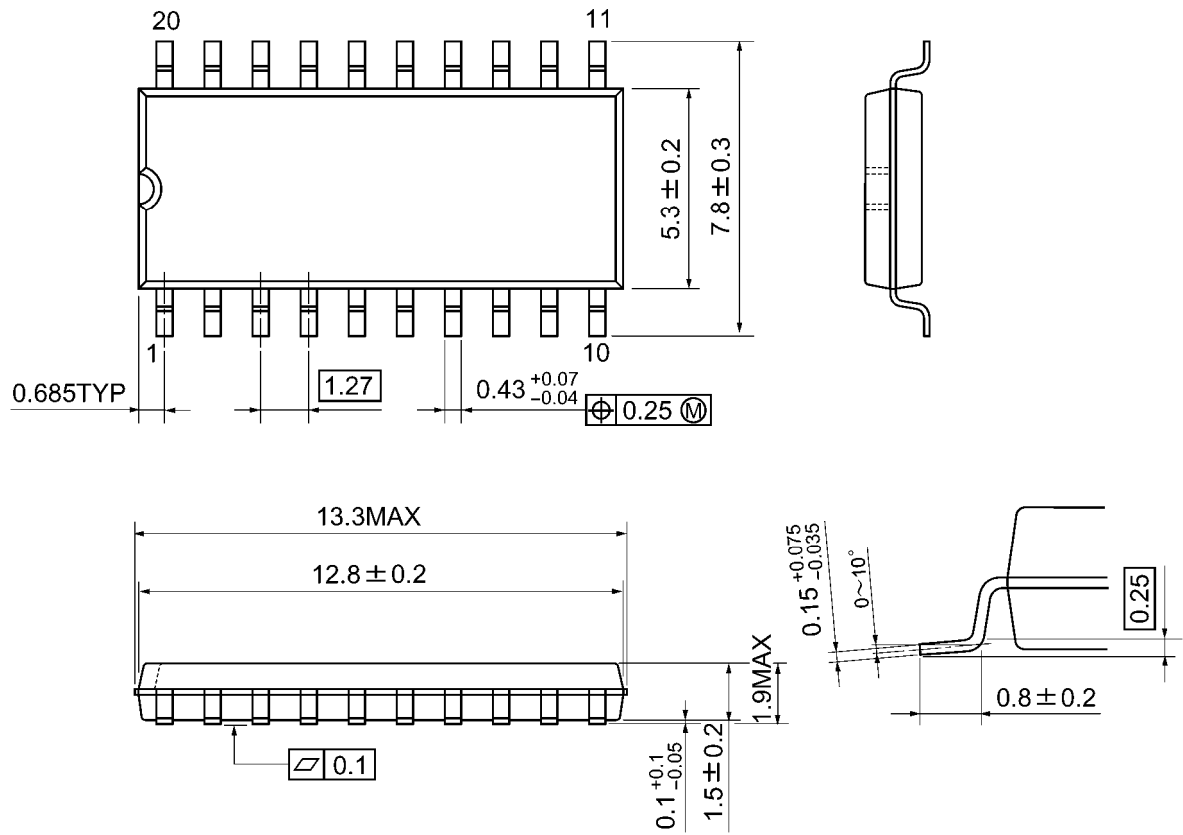
A/QA to H/QH Bus Terminal Equivalent Circuit



Package Dimensions

SOP20-P-300-1.27A

Unit: mm

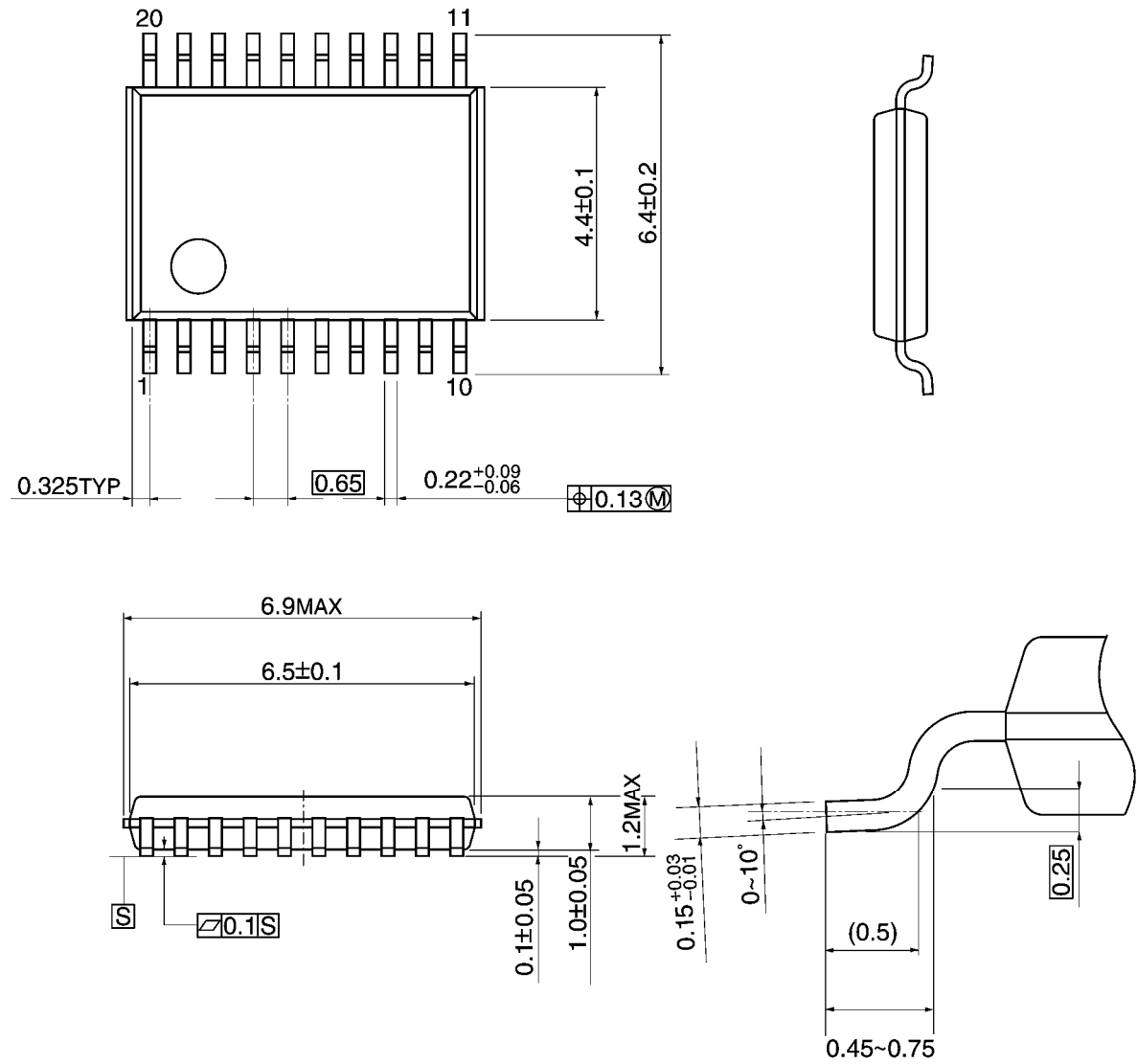


Weight: 0.22 g (typ.)

Package Dimensions

TSSOP20-P-0044-0.65A

Unit: mm



Weight: 0.08 g (typ.)

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