TOSHIBA CMOS Digital Integrated Circuit   Silicon Monolithic

TC74VHC299F,TC74VHC299FW,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^{2}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 ($\overline{G}1$, $\overline{G}2$) 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 µA (max) at Ta = 25°C
* High noise immunity: V_{NIH} = V_{NIL} = 28% V_{CC} (min)
* Balanced propagation delays: $t_{pLH} \simeq t_{pHL}$
* 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.

Note: xxxFW (JEDEC SOP) is not available in Japan.

TC74VHC299F
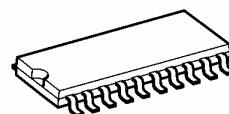
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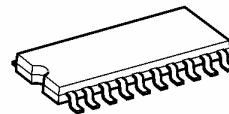
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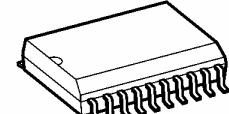
SOL20-P-300-1.27

TC74VHC299FT
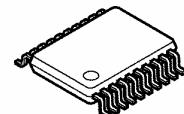
TSSOP20-P-0044-0.65A

Weight
SOP20-P-300-1.27A   : 0.22 g (typ.)
SOP20-P-300-1.27   : 0.22 g (typ.)
SOL20-P-300-1.27   : 0.46 g (typ.)
TSSOP20-P-0044-0.65A   : 0.08 g (typ.)

Pin Assignment

S0   1   20 V_{CC}
$\overline{G1}$ 2   19   S1
$\overline{G2}$ 3   18   SL
G/QG   4   17   QH'
E/QE   5   16   H/QH
C/QC   6   15   F/QF
A/QA   7   14   D/QD
QA'   8   13   B/QB
$\overline{CLR}$ 9   12   CK
GND   10   11   SR

(top view)
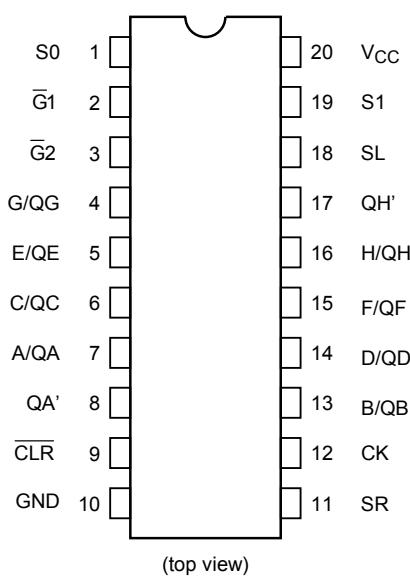
IEC Logic Symbol
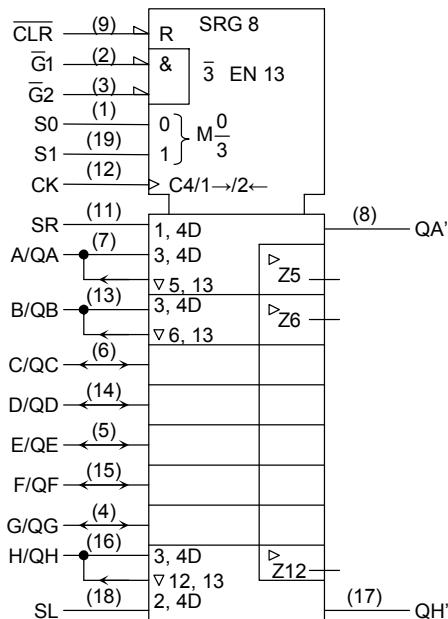
Truth Table

Mode	Inputs							Inputs/Outputs		Outputs	
		Function Select		Output Control		CK	Serial					
	$\overline{CLR}$	S1	S0	$\overline{G1}$ (Note)	$\overline{G2}$ (Note)		SL	SR	A/QA	H/QH	QA'	QH'
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
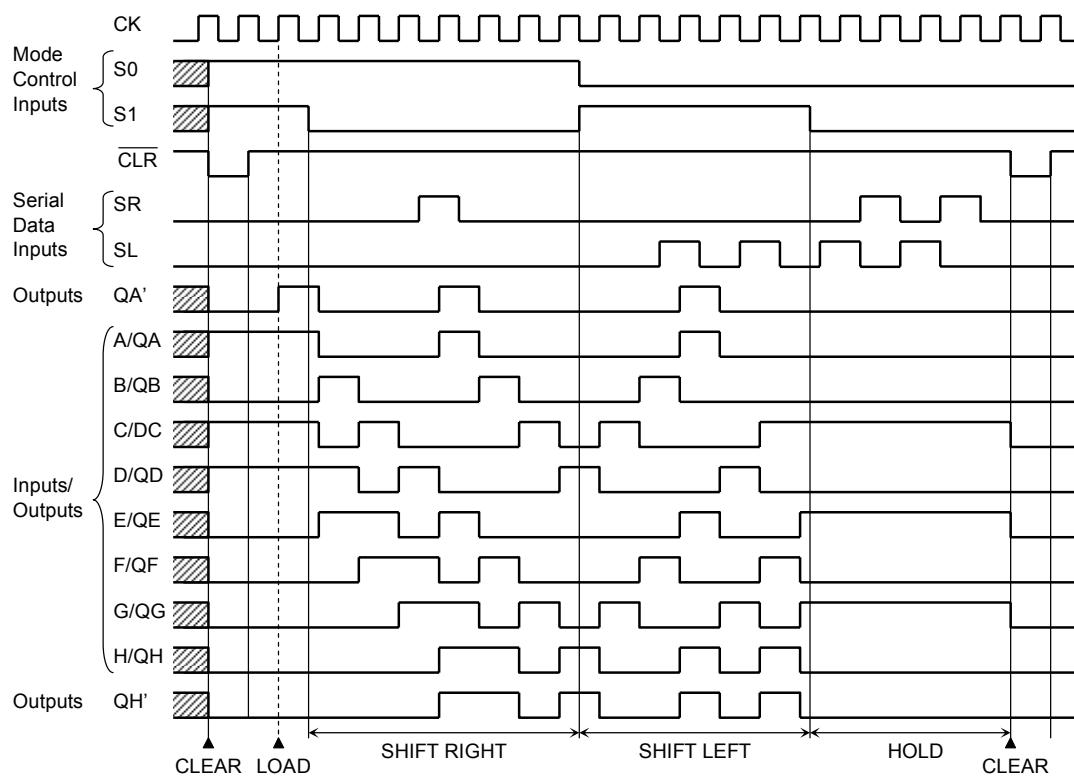
System Diagram
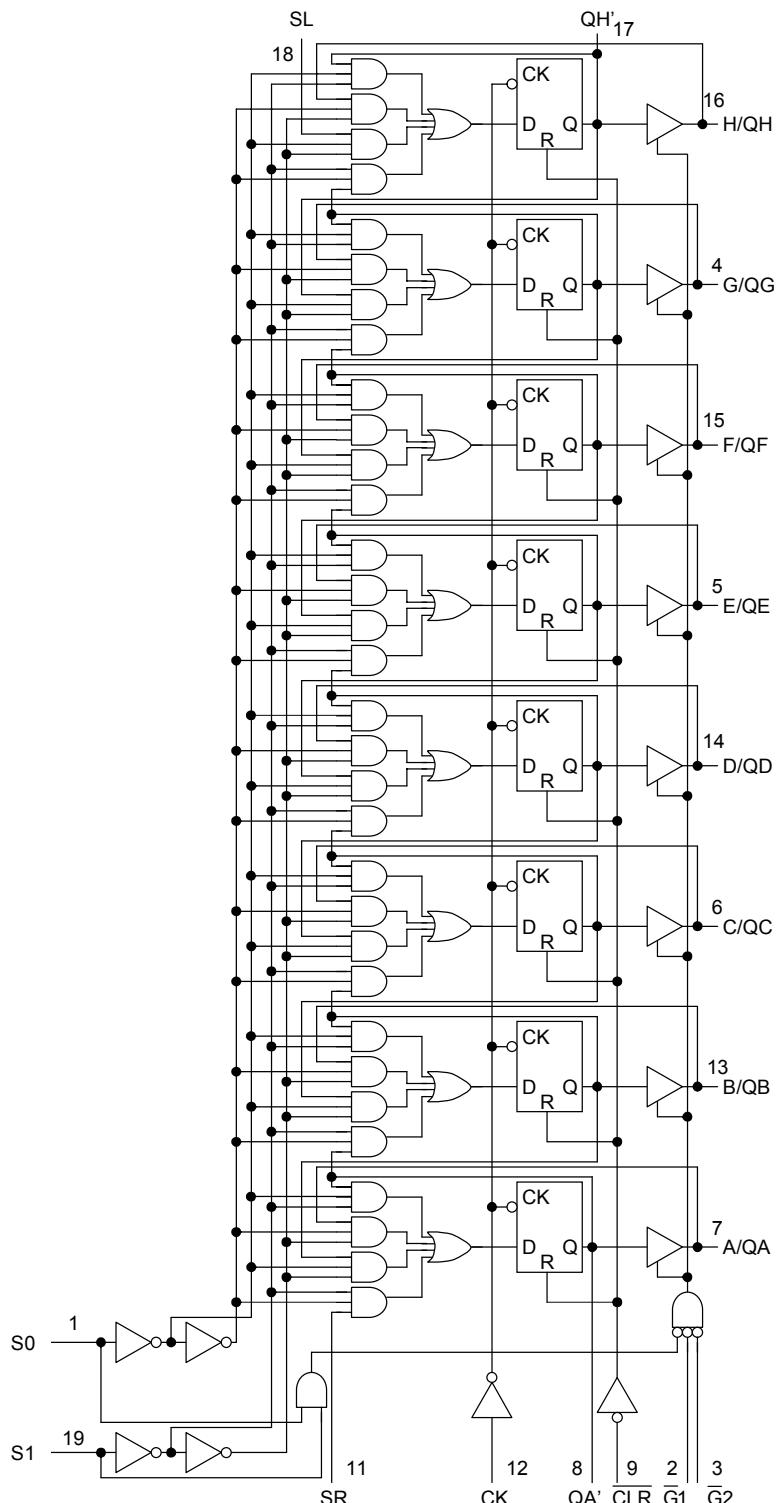
Absolute Maximum Ratings (Note)

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.

Recommended Operating Conditions (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 ± 0.3 V) 0 to 20 (V_{CC} = 5 ± 0.5 V)	ns/V

Note: The recommended operating conditions are required 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		V_{CC} (V)	Ta = 25°C			Ta = −40 to 85°C		Unit
					Min	Typ.	Max	Min	Max	
High-level input voltage	V_{IH}	—		2.0	1.50	—	—	1.50	—	V
				3.0 to 5.5	V_{CC} × 0.7	—	—	V_{CC} × 0.7	—	
Low-level input voltage	V_{IL}	—		2.0	—	—	0.50	—	0.50	V
				3.0 to 5.5	—	—	V_{CC} × 0.3	—	V_{CC} × 0.3	
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	—	0.44	
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 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} t_{pHL}	—	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 ($\overline{CLR}$ -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} t_{pHL}	—	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 ($\overline{CLR}$ -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} t_{pZH}	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	
			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} t_{pHZ}	R_L = 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_{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:

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

Timing Requirements (input: $t_r = t_f = 3$ ns)

Characteristics	Symbol	Test Condition		Ta = 25°C		Ta = −40 to 85°C	Unit
			V_{CC} (V)	Typ.	Limit	Limit	
Minimum pulse width (CK)	$t_{w (H)}$ $t_{w (L)}$	—	3.3 ± 0.3	—	7.0	8.0	ns
			5.0 ± 0.5	—	7.0	8.0	
Minimum pulse width ($\overline{CLR}$)	$t_{w (L)}$	—	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 ($\overline{CLR}$)	t_{rem}	—	3.3 ± 0.3	—	5.0	6.0	ns
			5.0 ± 0.5	—	4.0	4.0	

Noise Characteristics (input: $t_r = t_f = 3$ ns) (Note)

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 (1.0)	1.2 (1.4)	V
Quiet output minimum dynamic V_{OL}	V_{OLV}	$C_L = 50$ pF	5.0	−0.9 (−1.0)	−1.2 (−1.4)	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

Note: The value in ( ) only applies to JEDEC SOP (FW) devices.

Input Equivalent Circuit   **A/QA to H/QH Bus Terminal Equivalent Circuit**
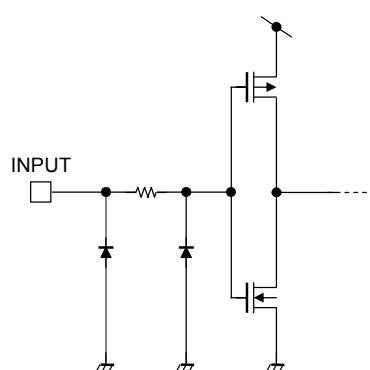
INPUT

I/O
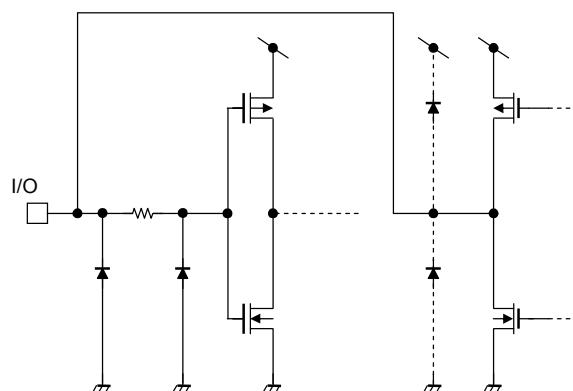
Package Dimensions

SOP20-P-300-1.27A   Unit: mm
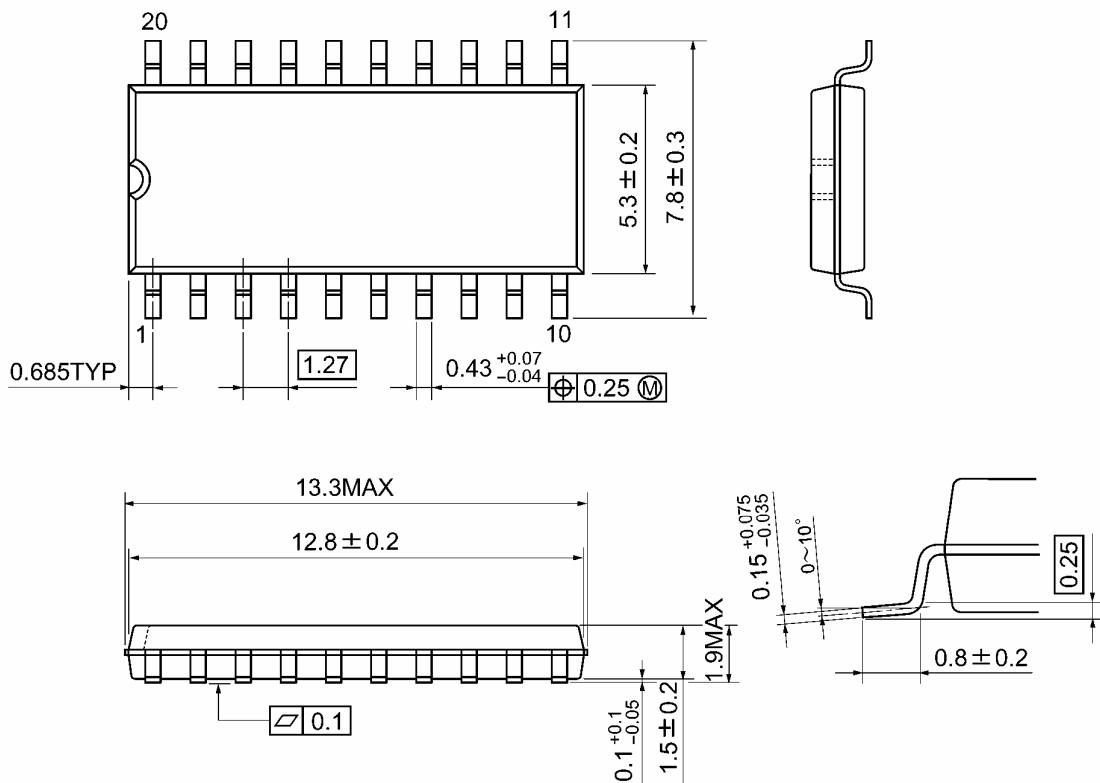

Weight: 0.22 g (typ.)

Package Dimensions

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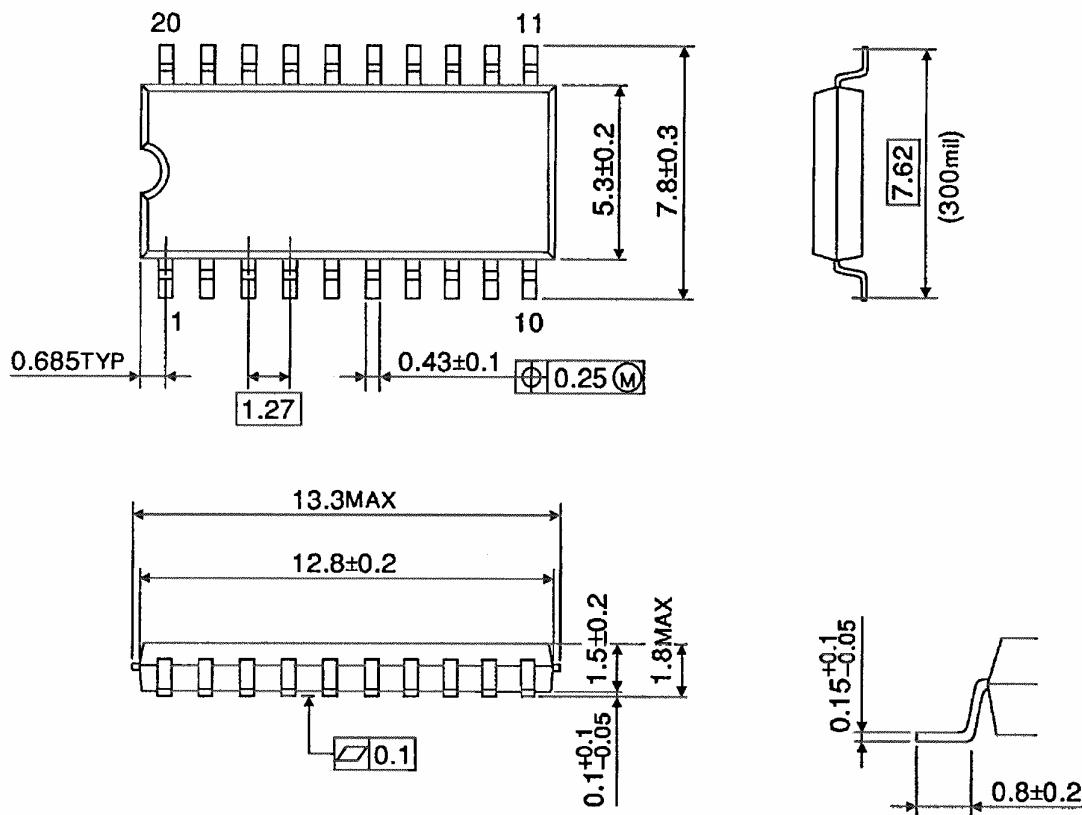
Weight: 0.22 g (typ.)

Package Dimensions (Note)

SOL20-P-300-1.27   Unit : mm
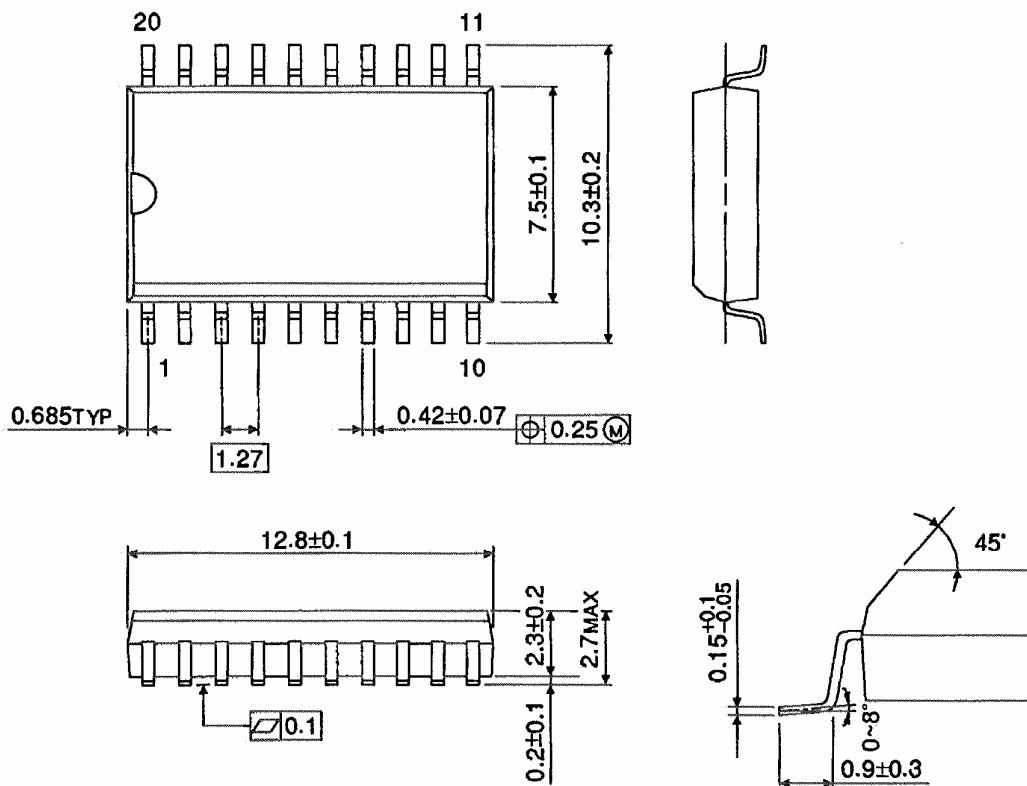
Note: This package is not available in Japan.

Weight: 0.46 g (typ.)

Package Dimensions

TSSOP20-P-0044-0.65A

Unit: mm
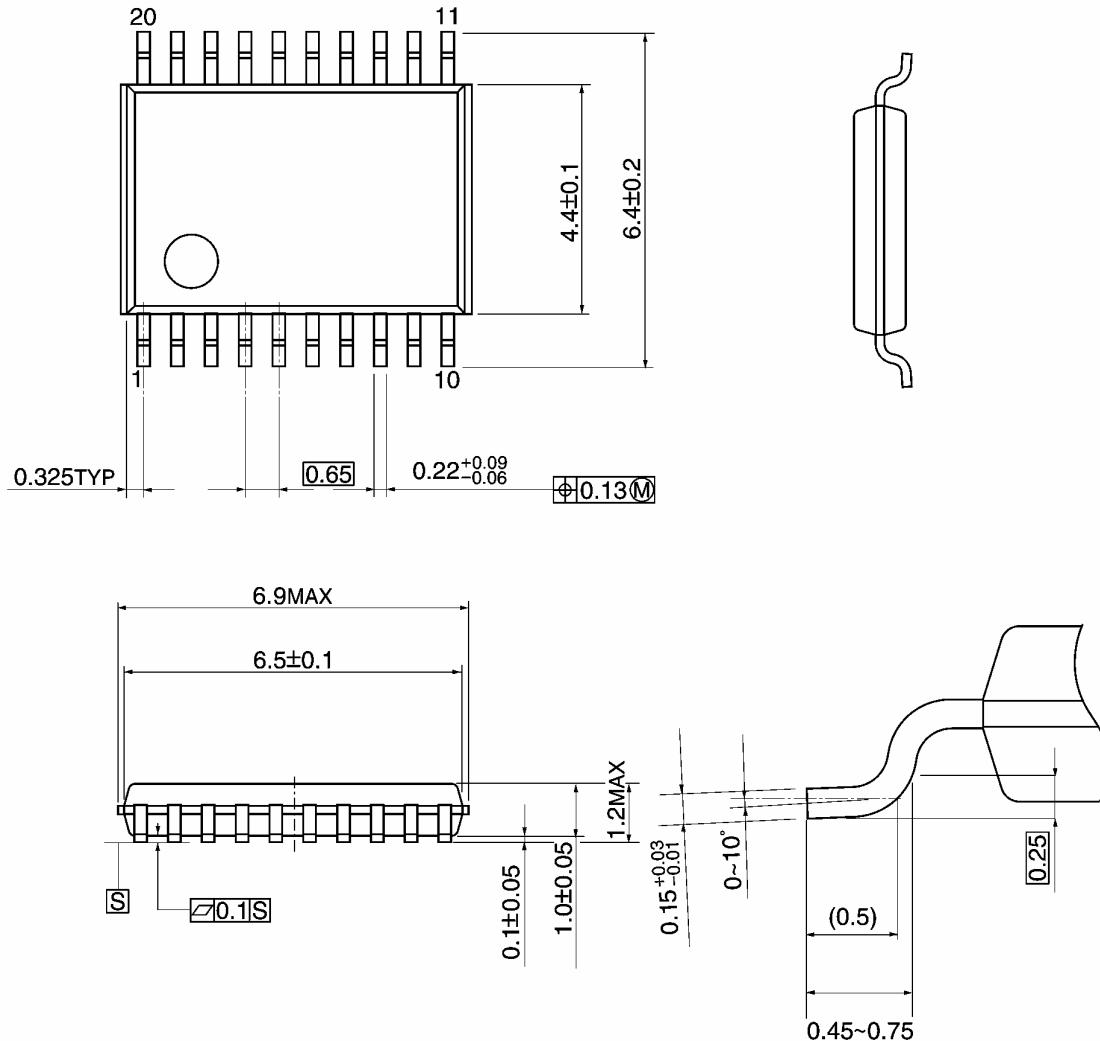
Weight: 0.08 g (typ.)

Note: Lead (Pb)-Free Packages
SOP20-P-300-1.27A TSSOP20-P-0044-0.65A

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