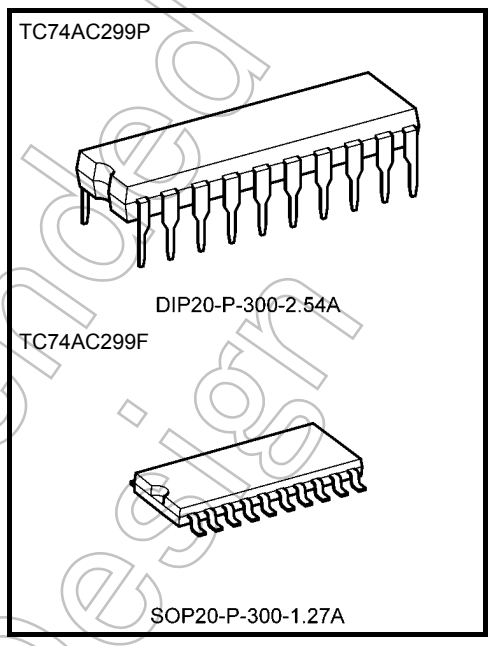
TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC74AC299P, TC74AC299F

8-Bit PIPO Shift Register with Asynchronousclear



Weight
DIP20-P-300-2.54A : 1.30 g (typ.)
SOP20-P-300-1.27A : 0.22 g (typ.)

The TC74AC299 is an advanced high speed CMOS 8-BIT PIPO SHIFT REGISTER fabricated with silicon gate and double-layer metal wiring C^2MOS 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 outputs 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 or transient excess voltage.

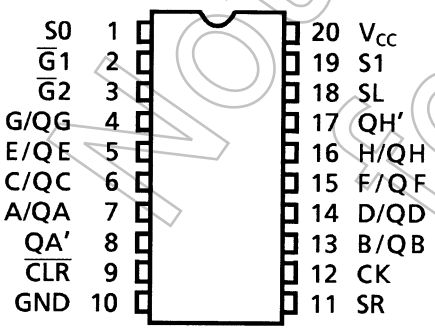
Features (Note 1)(Note 2)

- High speed: f_{max} = 150 MHz (typ.) at V_{CC} = 5 V
- Low power dissipation: I_{CC} = 8 μA (max) at Ta = 25°C
- High noise immunity: $V_{NIH} = V_{NIL}$ = 28% V_{CC} (min)
- Symmetrical output impedance: $|I_{OH}| = I_{OL}$ = 24 mA (min)
  Capability of driving 50 Ω transmission lines.
- Balanced propagation delays: $t_{pLH} \simeq t_{pHL}$
- Wide operating voltage range: V_{CC} (opr) = 2 to 5.5 V
- Pin and function compatible with 74F299

Note 1: Do not apply a signal to any bus terminal when it is in the output mode. Damage may result.

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

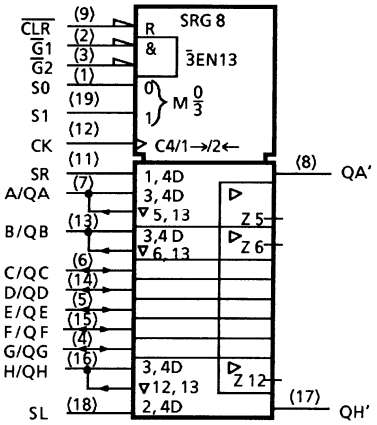
Pin Assignment



(TOP VIEW)

Start of commercial production
1988-05

IEC Logic Symbol



Truth Table

Mode	Inputs								Inputs/ Outputs		Outputs	
	$\overline{CLR}$	Function select		Outputs Control		CK	Serial		A/QA	H/QH	QA'	QH'
		S1	S0	$\overline{G}1$ (Note)	$\overline{G}2$ (Note)		SL	SR				
Clear	L	H	H	X	X	X	X	X	Z	Z	L	L
	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	QA0	QH0	QA0	QH0
Shift Right	H	L	H	L	L	↑	X	H	H	QGn	H	QGn
	H	L	H	L	L	↑	X	L	L	QGn	L	QGn
Shift Left	H	H	L	L	L	↑	H	X	QBn	H	QBn	H
	H	H	L	L	L	↑	L	X	QBn	L	QBn	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

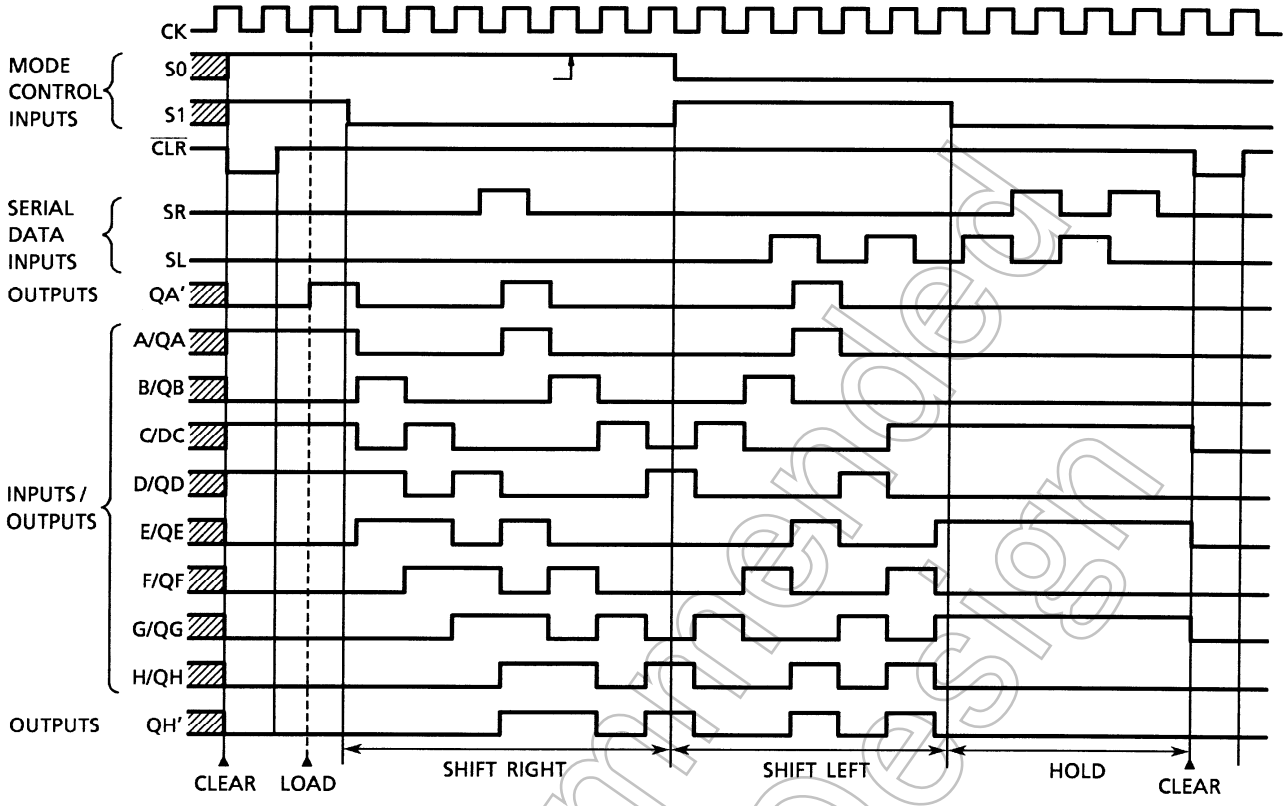
Qn0: The level of Qn before the indicated steady-state input conditions were established.

Qnn: The level of Qn before the most recent active transition indicated by ↓ or ↑.

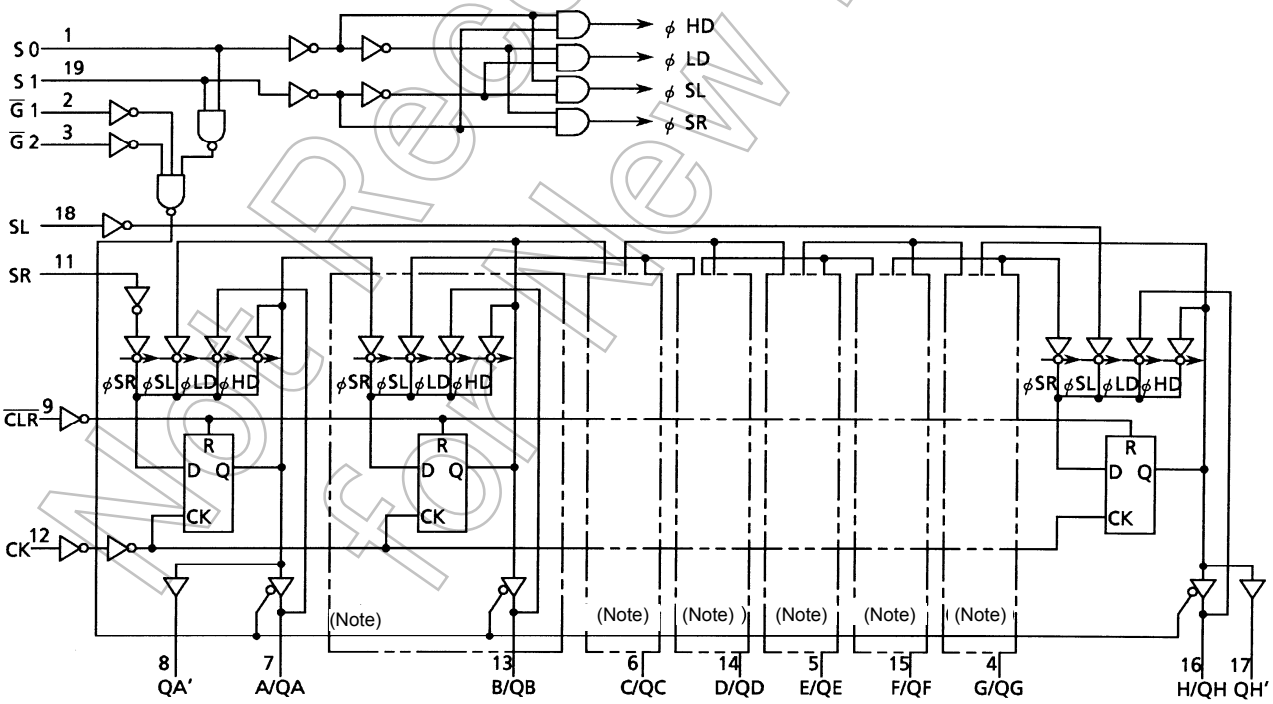
a, h: The level of the steady-state inputs A, H, respectively.

X: Don't care

Timing Chart



System Diagram



Note: Equivalent circuits

Absolute Maximum Ratings (Note 1)

Characteristics	Symbol	Rating	Unit
Supply voltage range	V_{CC}	−0.5 to 7.0	V
DC input voltage	V_{IN}	−0.5 to V_{CC} + 0.5	V
DC output voltage	V_{OUT}	−0.5 to V_{CC} + 0.5	V
Input diode current	I_{IK}	±20	mA
Output diode current	I_{OK}	±50	mA
DC output current	I_{OUT}	±50	mA
DC V_{CC}/ground current	I_{CC}	±250	mA
Power dissipation	P_D	500 (DIP) (Note 2)/180 (SOP)	mW
Storage temperature	T_{stg}	−65 to 150	°C

Note 1: 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).

Note 2: 500 mW in the range of Ta = −40 to 65°C. From Ta = 65 to 85°C a derating factor of −10 mW/°C should be applied up to 300 mW.

Operating Ranges (Note)

Characteristics	Symbol	Rating	Unit
Supply voltage	V_{CC}	2.0 to 5.5	V
Input voltage	V_{IN}	0 to V_{CC}	V
Output voltage	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 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		V_{CC} (V)	Ta = 25°C Min	Ta = 25°C Typ.	Ta = 25°C Max	Ta = −40 to 85°C Min	Ta = −40 to 85°C Max	Unit
High-level input voltage	V_{IH}	—		2.0	1.50	—	—	1.50	—	V
				3.0	2.10	—	—	2.10	—	
				5.5	3.85	—	—	3.85	—	
Low-level input voltage	V_{IL}	—		2.0	—	—	0.50	—	0.50	V
				3.0	—	—	0.90	—	0.90	
				5.5	—	—	1.65	—	1.65	
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} = −24 mA	4.5	3.94	—	—	3.80	—	
			I_{OH} = −75 mA (Note)	5.5	—	—	—	3.85	—	
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} = 12 mA	3.0	—	—	0.36	—	0.44	
			I_{OL} = 24 mA	4.5	—	—	0.36	—	0.44	
			I_{OL} = 75 mA (Note)	5.5	—	—	—	—	1.65	
3-state output off-state current	I_{OZ}	V_{IN} = V_{IH} or V_{IL} V_{OUT} = V_{CC} or GND		5.5	—	—	±0.5	—	±5.0	μA
Input leakage current	I_{IN}	V_{IN} = V_{CC} or GND		5.5	—	—	±0.1	—	±1.0	μA
Quiescent supply current	I_{CC}	V_{IN} = V_{CC} or GND		5.5	—	—	8.0	—	80.0	μA

Note: This spec indicates the capability of driving 50 Ω transmission lines.

One output should be tested at a time for a 10 ms maximum duration.

Timing Recommended Operating Conditions (input: $t_r = t_f = 3$ ns)

Characteristics	Symbol	Test Condition		Ta = 25°C	Ta = −40 to 85°C	Unit
			V_{CC} (V)	Limit	Limit	
Minimum pulse width (CK)	$t_{W(L)}$	—	3.3 ± 0.3	8.0	8.0	ns
	$t_{W(H)}$		5.0 ± 0.5	5.0	5.0	
Minimum pulse width ($\overline{CLR}$)	$t_{W(L)}$	—	3.3 ± 0.3	7.0	7.0	ns
			5.0 ± 0.5	5.0	5.0	
Minimum set-up time (SL, SR, A~H)	t_s	—	3.3 ± 0.3	6.0	6.0	ns
			5.0 ± 0.5	4.0	4.0	
Minimum set-up time (S0, S1)	t_s	—	3.3 ± 0.3	11.9	13.6	ns
			5.0 ± 0.5	7.0	7.0	
Minimum hold time (SL, SR, A~H)	t_h	—	3.3 ± 0.3	1.0	1.0	ns
			5.0 ± 0.5	1.0	1.0	
Minimum hold time (S0, S1)	t_h	—	3.3 ± 0.3	0.0	0.0	ns
			5.0 ± 0.5	0.0	0.0	
Minimum removal time ($\overline{CLR}$)	t_{rem}	—	3.3 ± 0.3	5.0	5.0	ns
			5.0 ± 0.5	3.0	3.0	

AC Characteristics ($C_L = 50$ pF, $R_L = 500\ \Omega$, input: $t_r = t_f = 3$ ns)

Characteristics	Symbol	Test Condition	Ta = 25°C			Ta = −40 to 85°C		Unit
		V_{CC} (V)	Min	Typ.	Max	Min	Max	
Propagation delay time (CK-QA', QH')	t_{pLH}	3.3 ± 0.3	—	10.6	18.4	1.0	21.0	ns
	t_{pHL}	5.0 ± 0.5	—	6.8	10.5	1.0	12.0	
Propagation delay time ($\overline{CLR}$-QA', QH')	t_{pLH}	3.3 ± 0.3	—	8.1	14.0	1.0	16.0	ns
	t_{pHL}	5.0 ± 0.5	—	6.1	9.2	1.0	10.5	
Propagation delay time (CK-QA~QH)	t_{pLH}	3.3 ± 0.3	—	10.9	19.3	1.0	22.0	ns
	t_{pHL}	5.0 ± 0.5	—	7.3	10.5	1.0	12.0	
Propagation delay time ($\overline{CLR}$-QA~QH)	t_{pLH}	3.3 ± 0.3	—	9.8	16.7	1.0	19.0	ns
	t_{pHL}	5.0 ± 0.5	—	6.7	10.9	1.0	12.4	
Output enable time	t_{pZL}	3.3 ± 0.3	—	9.9	17.5	1.0	20.0	ns
	t_{pZH}	5.0 ± 0.5	—	6.6	9.6	1.0	11.0	
Output disable time	t_{pLZ}	3.3 ± 0.3	—	8.1	14.0	1.0	16.0	ns
	t_{pHZ}	5.0 ± 0.5	—	6.4	9.6	1.0	11.0	
Maximum clock frequency	f_{max}	3.3 ± 0.3	45	90	—	45	—	MHz
		5.0 ± 0.5	80	140	—	80	—	
Input capacitance	C_{IN}	—	—	5	10	—	10	pF
Bus input capacitance	$C_{I/O}$	—	—	13	—	—	—	pF
Power dissipation capacitance	C_{PD} (Note)	—	—	137	—	—	—	pF

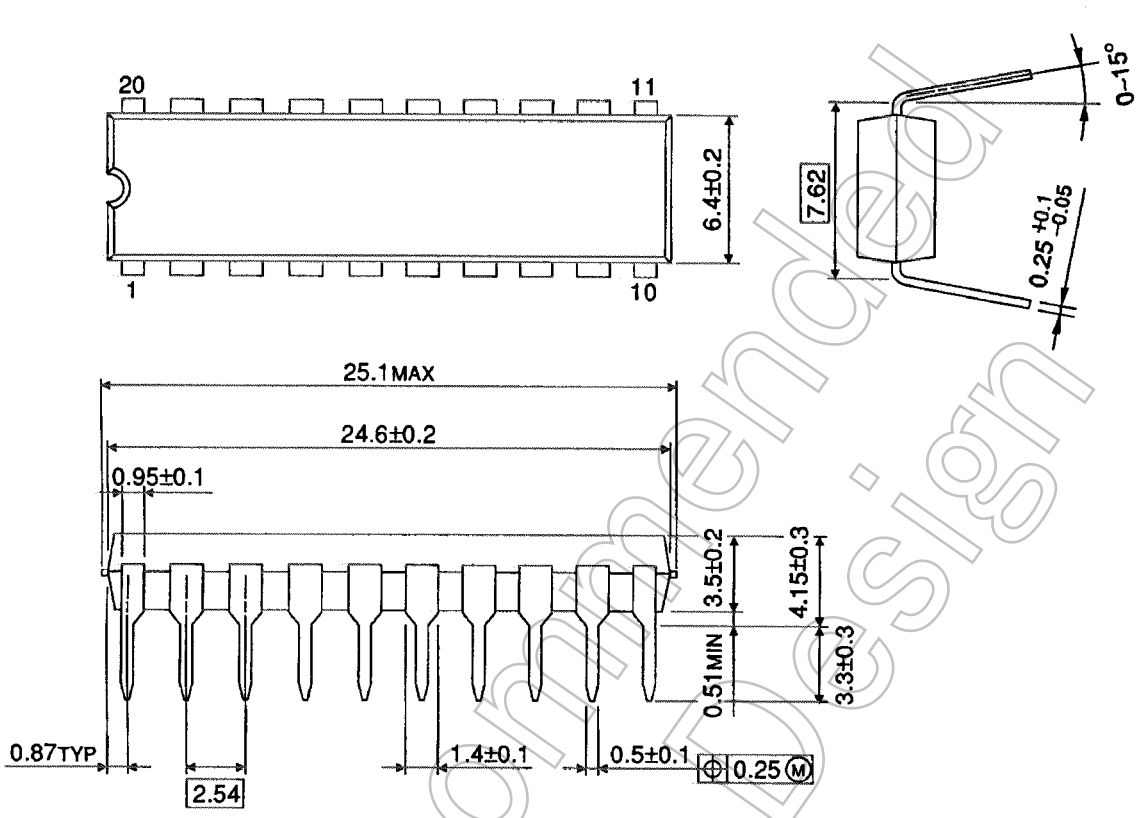
Note: C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

Average operating current can be obtained by the equation:

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

Package Dimensions

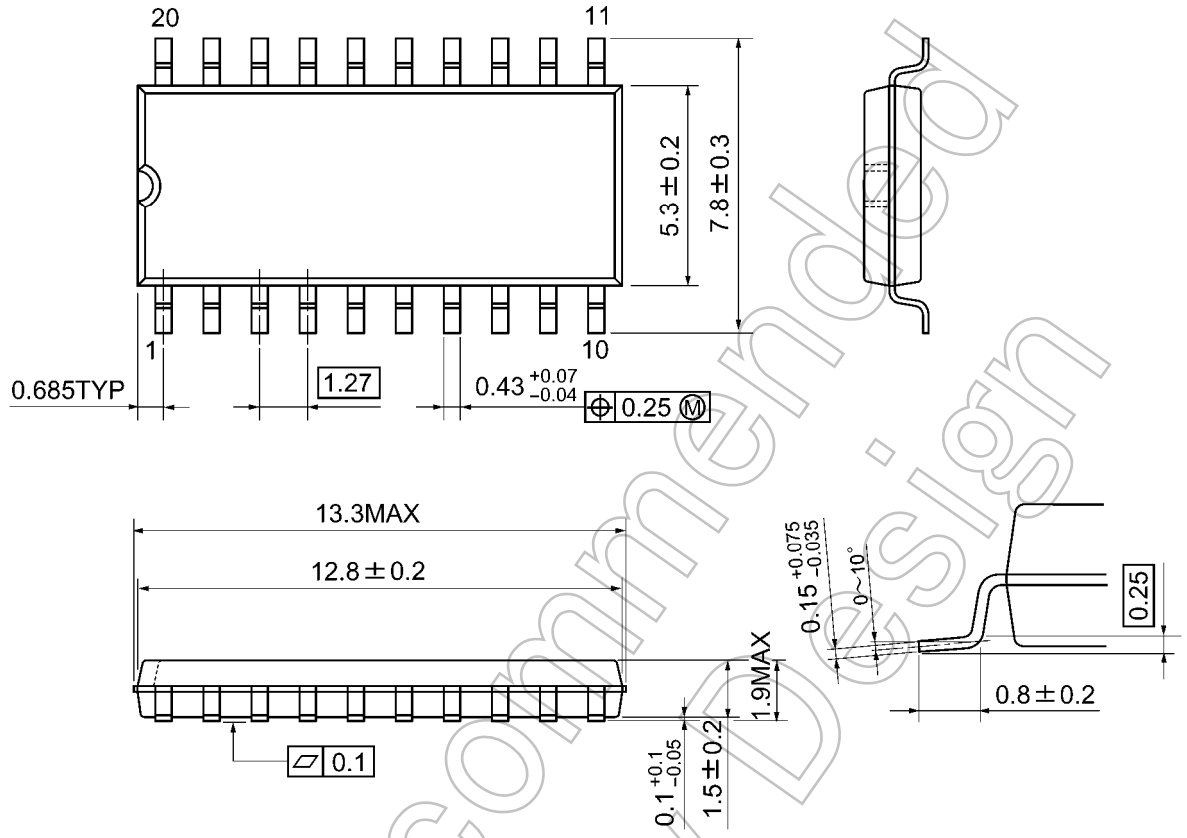
DIP20-P-300-2.54A Unit : mm



Weight: 1.30 g (typ.)

Package Dimensions

SOP20-P-300-1.27A Unit: mm



Weight: 0.22 g (typ.)

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