

TC74HC165AP, TC74HC165AF

8-Bit Shift Register (P-IN, S-OUT)

The TC74HC165A is a high speed CMOS 8-BIT PARALLEL/SERIAL-IN, SERIAL-OUT SHIFT REGISTER fabricated with silicon gate C²MOS technology.

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

It consists of parallel-in or serial-in, serial-out 8-bit shift register with a gated clock inputs. When the SHIFT/LOAD input is held high, the serial data input is enabled and the eight flip-flops perform serial shifting with each clock pulse.

When the SHIFT/LOAD input is held low, the parallel data is loaded asynchronously into the register at positive going transition of the clock pulse.

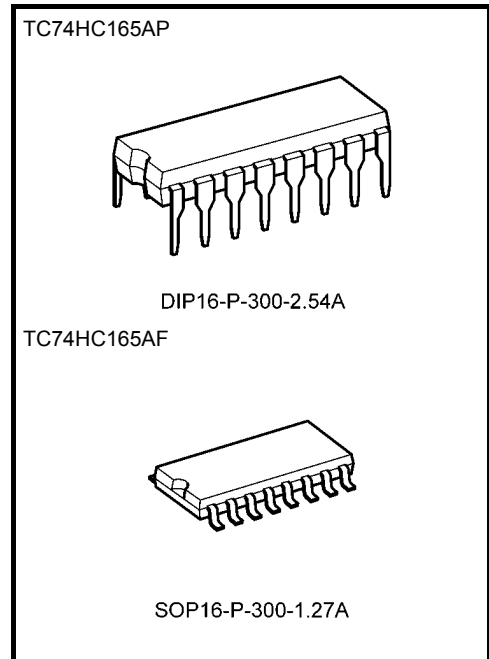
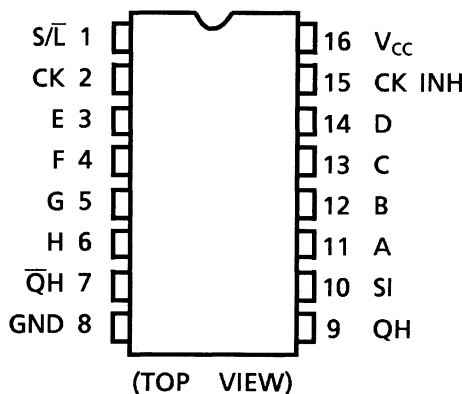
The CK-INH input should be shifted high only when the CK input is held high.

All inputs are equipped with protection circuits against static discharge or transient excess voltage.

Features

- High speed: $f_{max} = 56 \text{ MHz}$ (typ.) at $V_{CC} = 5 \text{ V}$
- Low power dissipation: $I_{CC} = 4 \mu\text{A}$ (max) at $T_a = 25^\circ\text{C}$
- High noise immunity: $V_{NIH} = V_{NIL} = 28\% V_{CC}$ (min)
- Output drive capability: 10 LSTTL loads
- Symmetrical output impedance: $|I_{OH}| = I_{OL} = 4 \text{ mA}$ (min)
- Balanced propagation delays: $t_{pLH} \approx t_{pHL}$
- Wide operating voltage range: $V_{CC} \text{ (opr)} = 2 \text{ to } 6 \text{ V}$
- Pin and function compatible with 74LS165

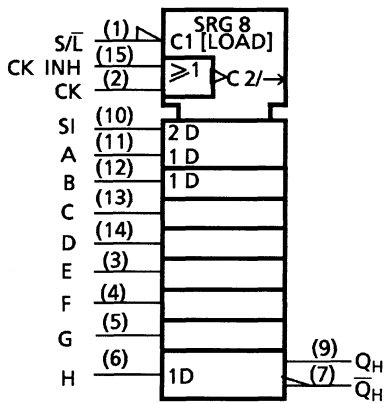
Pin Assignment



Weight	
DIP16-P-300-2.54A	: 1.00 g (typ.)
SOP16-P-300-1.27A	: 0.18 g (typ.)

Start of commercial production
1988-05

IEC Logic Symbol



Truth Table

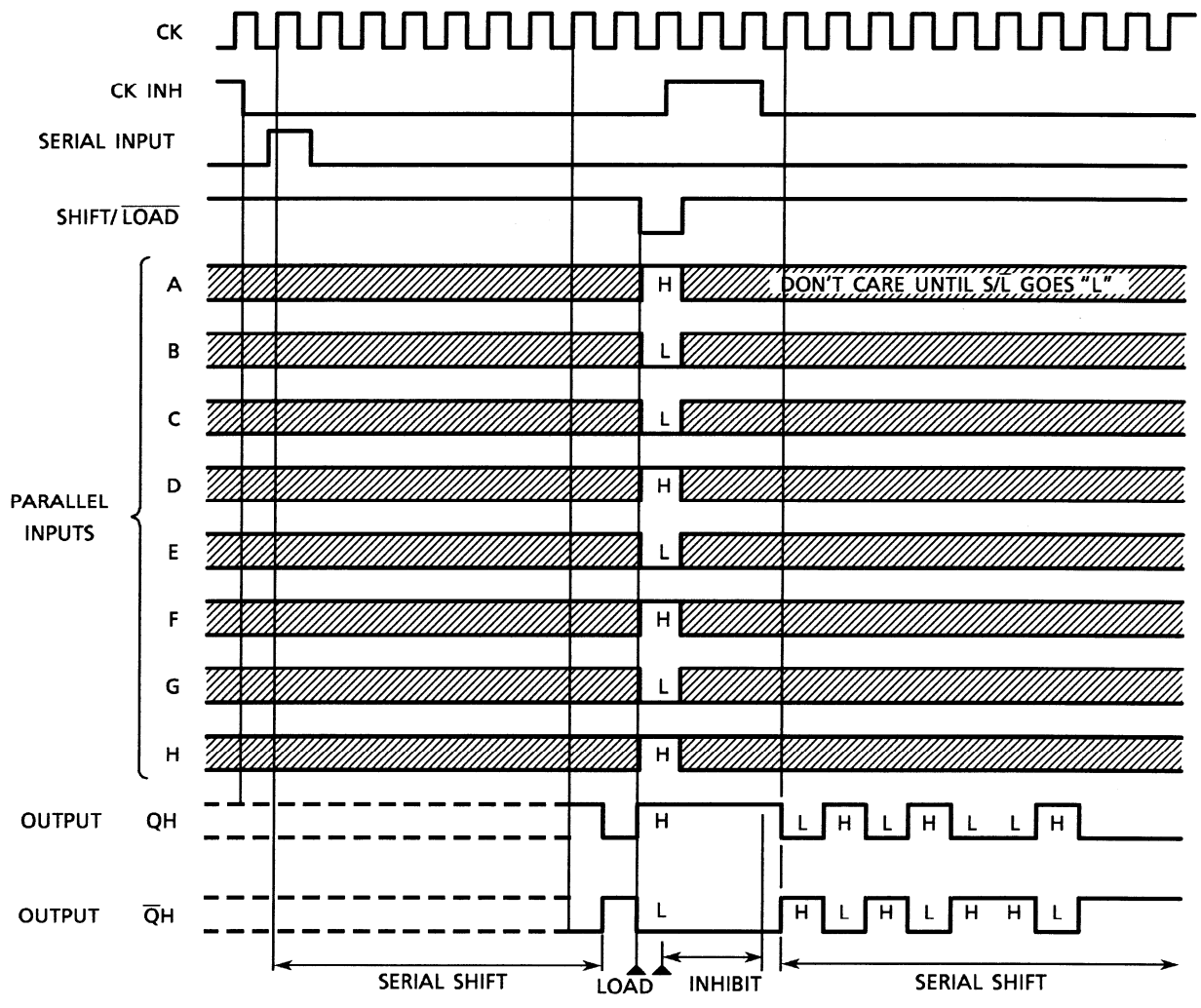
Inputs					Internal Outputs		Outputs	
SHIFT/LOAD	CLOCK INH	CLOCK	SERIAL IN	PARALLEL A·····H	QA	QB	QH	\overline{QH}
L	X	X	X	a·····h	a	b	h	\overline{h}
H	L	\uparrow	H	X	H	QAn	QGn	\overline{QGn}
H	L	\uparrow	L	X	L	QAn	QGn	\overline{QGn}
H	\uparrow	L	H	X	H	QAn	QGn	\overline{QGn}
H	\uparrow	L	L	X	L	QAn	QGn	\overline{QGn}
H	X	H	X	X	No Change			
H	H	X	X	X	No Change			

X: Don't care

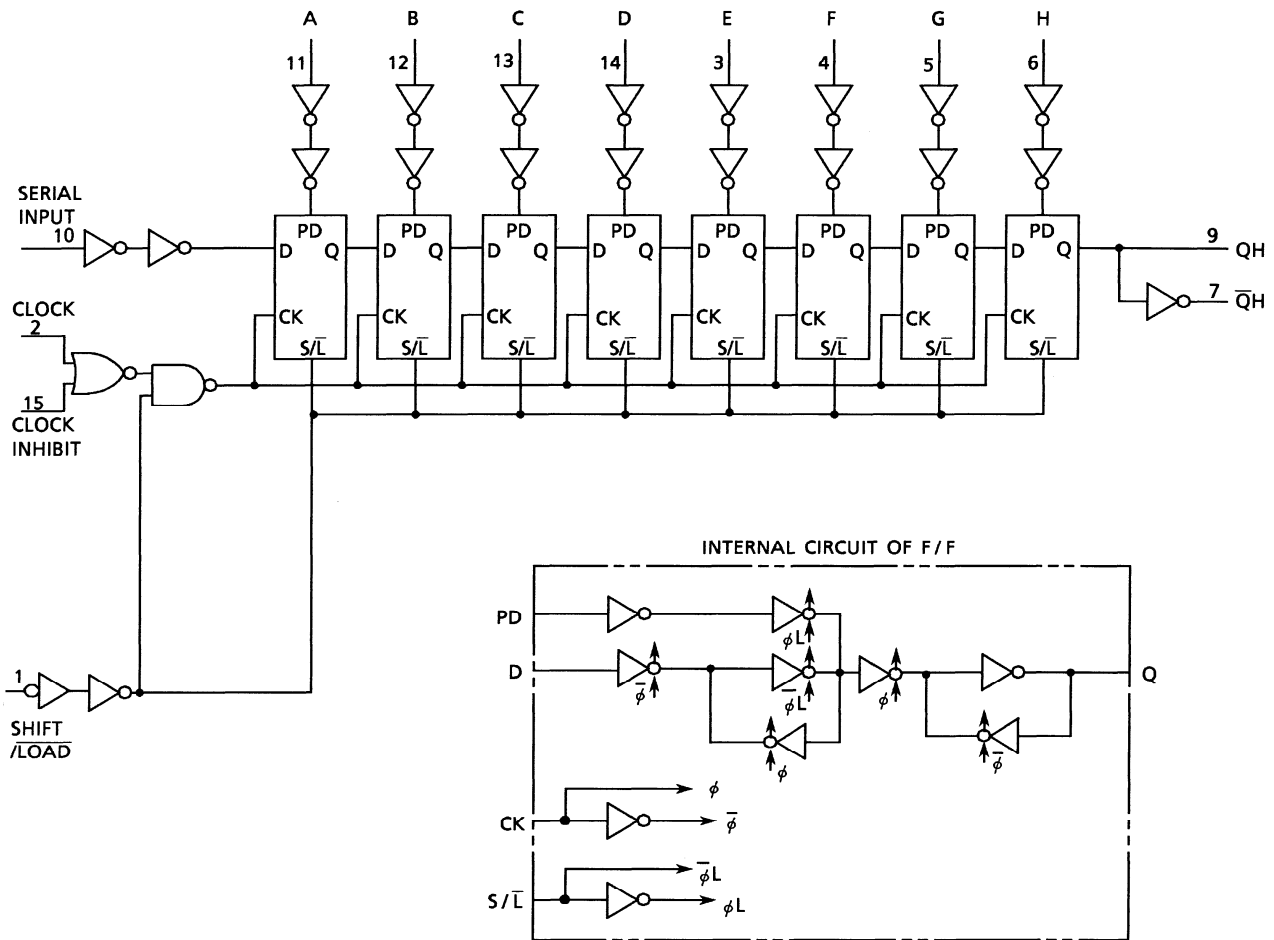
a·····h: The level of steady state input voltage at inputs A through H respectively

QAn~QGn: The level of QA~QG, respectively, before the most recent positive transition of the CK.

Timing Chart



System Diagram



Absolute Maximum Ratings (Note 1)

Characteristics	Symbol	Rating	Unit
Supply voltage range	V_{CC}	-0.5 to 7	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}	± 20	mA
DC output current	I_{OUT}	± 25	mA
DC V_{CC} /ground current	I_{CC}	± 50	mA
Power dissipation	P_D	500 (DIP) (Note 2)/180 (SOP)	mW
Storage temperature	T_{stg}	-65 to 150	$^{\circ}C$

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 $T_a = -40$ to $65^{\circ}C$. From $T_a = 65$ to $85^{\circ}C$ a derating factor of -10 mW/ $^{\circ}C$ shall be applied until 300 mW.

Operating Ranges (Note)

Characteristics	Symbol	Rating	Unit
Supply voltage	V_{CC}	2 to 6	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	t_r, t_f	0 to 1000 ($V_{CC} = 2.0$ V) 0 to 500 ($V_{CC} = 4.5$ V) 0 to 400 ($V_{CC} = 6.0$ V)	ns

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	$T_a = 25^\circ\text{C}$			$T_a = -40$ to 85°C		Unit		
			V_{CC} (V)	Min	Typ.	Max	Min		Max	
High-level input voltage	V_{IH}	—	2.0	1.50	—	—	1.50	—	V	
			4.5	3.15	—	—	3.15	—		
			6.0	4.20	—	—	4.20	—		
Low-level input voltage	V_{IL}	—	2.0	—	—	0.50	—	0.50	V	
			4.5	—	—	1.35	—	1.35		
			6.0	—	—	1.80	—	1.80		
High-level output voltage	V_{OH}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OH} = -20 \mu\text{A}$	2.0	1.9	2.0	—	1.9	—	V
				4.5	4.4	4.5	—	4.4	—	
				6.0	5.9	6.0	—	5.9	—	
			$I_{OH} = -4 \text{ mA}$ $I_{OH} = -5.2 \text{ mA}$	4.5	4.18	4.31	—	4.13	—	
				6.0	5.68	5.80	—	5.63	—	
				6.0	—	—	—	—	—	
Low-level output voltage	V_{OL}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OL} = 20 \mu\text{A}$	2.0	—	0.0	0.1	—	0.1	V
				4.5	—	0.0	0.1	—	0.1	
				6.0	—	0.0	0.1	—	0.1	
			$I_{OL} = 4 \text{ mA}$ $I_{OL} = 5.2 \text{ mA}$	4.5	—	0.17	0.26	—	0.33	
				6.0	—	0.18	0.26	—	0.33	
				6.0	—	—	—	—	—	
Input leakage current	I_{IN}	$V_{IN} = V_{CC}$ or GND	6.0	—	—	± 0.1	—	± 1.0	μA	
Quiescent supply current	I_{CC}	$V_{IN} = V_{CC}$ or GND	6.0	—	—	4.0	—	40.0	μA	

Timing Requirements (input: $t_r = t_f = 6$ ns)

Characteristics	Symbol	Test Condition	Ta = 25°C		Ta = -40 to 85°C		Unit
			V _{CC} (V)	Typ.	Limit	Limit	
Minimum pulse width (CK, CK INH)	t_W (H) t_W (L)	—	2.0	—	75	95	ns
			4.5	—	15	19	
			6.0	—	13	16	
Minimum pulse width (S/L)	t_W (L)	—	2.0	—	75	95	ns
			4.5	—	15	19	
			6.0	—	13	16	
Minimum set-up time (PI-S/L)	t_s	—	2.0	—	75	95	ns
			4.5	—	15	19	
			6.0	—	13	16	
Minimum set-up time (SI-CK, CK INH)	t_s	—	2.0	—	75	95	ns
			4.5	—	15	19	
			6.0	—	13	16	
Minimum set-up time (S/L-CK, CK INH)	t_s	—	2.0	—	75	95	ns
			4.5	—	15	19	
			6.0	—	13	16	
Minimum hold time (PI-S/L)	t_h	—	2.0	—	0	0	ns
			4.5	—	0	0	
			6.0	—	0	0	
Minimum hold time (SI-CK, CK INH)	t_h	—	2.0	—	0	0	ns
			4.5	—	0	0	
			6.0	—	0	0	
Minimum hold time (S/L-CK, CK INH)	t_h	—	2.0	—	0	0	ns
			4.5	—	0	0	
			6.0	—	0	0	
Minimum removal time (CK INH-CK) (CK-CK INH)	t_{rem}	—	2.0	—	75	95	ns
			4.5	—	15	19	
			6.0	—	13	16	
Clock frequency	f	—	2.0	—	7	6	MHz
			4.5	—	30	24	
			6.0	—	41	28	

AC Characteristics (C_L = 15 pF, V_{CC} = 5 V, Ta = 25°C, input: $t_r = t_f = 6$ ns)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Output transition time	t_{TLH}	—	—	4	8	ns
	t_{THL}					
Propagation delay time (CK, CK INH-QH, QH)	t_{pLH}	—	—	15	25	ns
	t_{pHL}					
Propagation delay time (S/L-QH, QH)	t_{pLH}	—	—	15	25	ns
	t_{pHL}					
Propagation delay time (H-QH, QH)	t_{pLH}	—	—	14	26	ns
	t_{pHL}					
Maximum clock frequency	f_{max}	—	35	56	—	MHz

AC Characteristics (C_L = 50 pF, input: t_r = t_f = 6 ns)

Characteristics	Symbol	Test Condition	Ta = 25°C			Ta = -40 to 85°C		Unit	
			V _{CC} (V)	Min	Typ.	Max	Min		Max
Output transition time	t _{TLH}	—	2.0	—	25	75	—	95	ns
	t _{THL}		4.5	—	8	15	—	19	
			6.0	—	7	13	—	16	
Propagation delay time (CK, CK INH-QH, \overline{QH})	t _{pLH}	—	2.0	—	55	150	—	190	ns
	t _{pHL}		4.5	—	18	30	—	38	
			6.0	—	15	26	—	33	
Propagation delay time (S/ \overline{L} -QH, \overline{QH})	t _{pLH}	—	2.0	—	60	165	—	205	ns
	t _{pHL}		4.5	—	19	33	—	41	
			6.0	—	16	28	—	35	
Propagation delay time (H-QH, \overline{QH})	t _{pHL}	—	2.0	—	52	135	—	170	ns
			4.5	—	17	27	—	34	
			6.0	—	14	23	—	29	
Maximum clock frequency	f _{max}	—	2.0	7	14	—	6	—	MHz
			4.5	30	46	—	24	—	
			6.0	41	65	—	28	—	
Input capacitance	C _{IN}	—	—	5	10	—	10	pF	
Power dissipation capacitance	C _{PD} (Note)	—	—	55	—	—	—	pF	

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

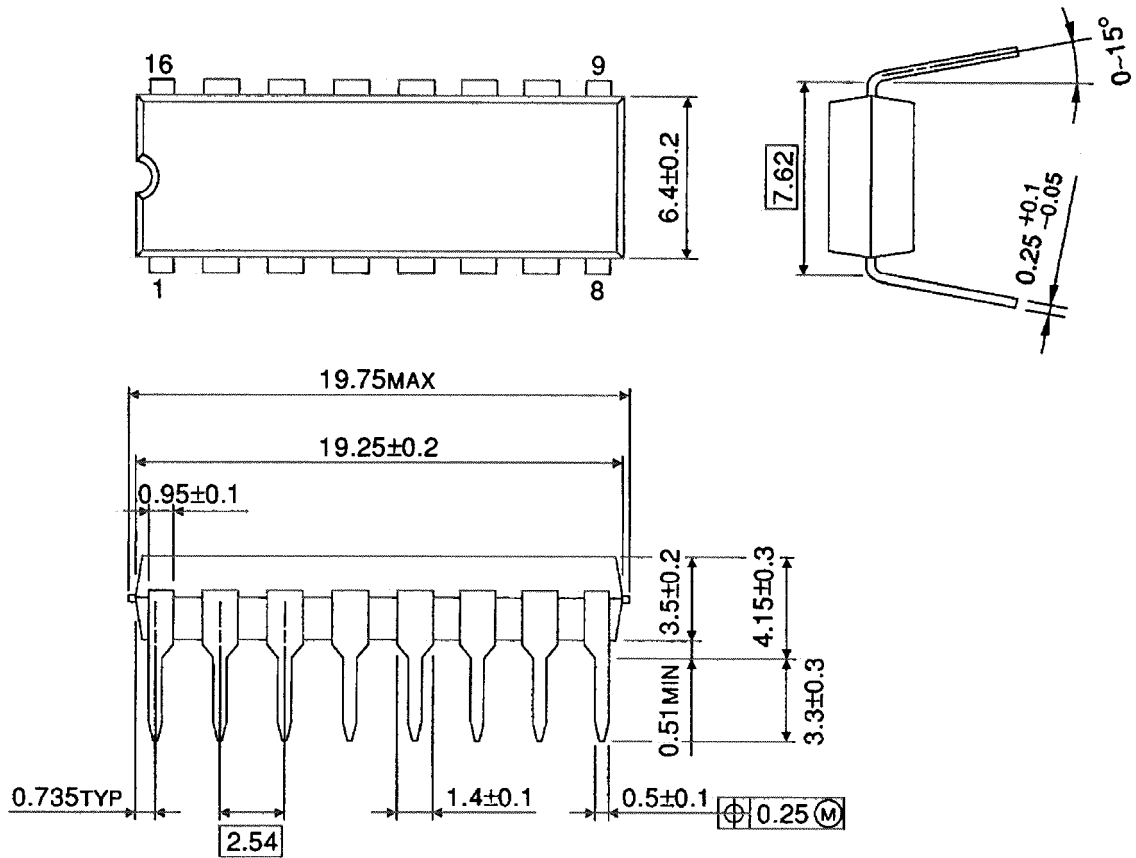
Average operating current can be obtained by the equation:

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

Package Dimensions

DIP16-P-300-2.54A

Unit : mm

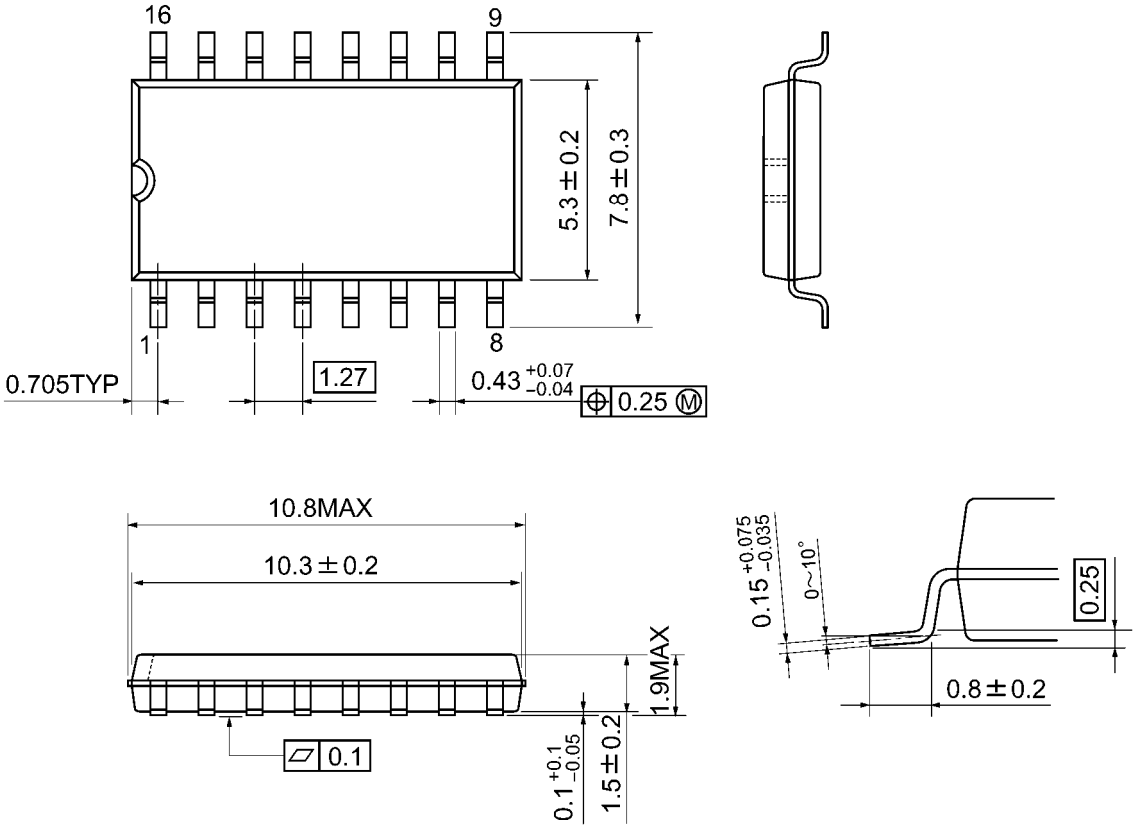


Weight: 1.00 g (typ.)

Package Dimensions

SOP16-P-300-1.27A

Unit: mm



Weight: 0.18 g (typ.)

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