

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

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 $\overline{\text{SHIFT/LOAD}}$ input is held high, the serial data input is enabled and the eight flip-flops perform serial shifting with each clock pulse.

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

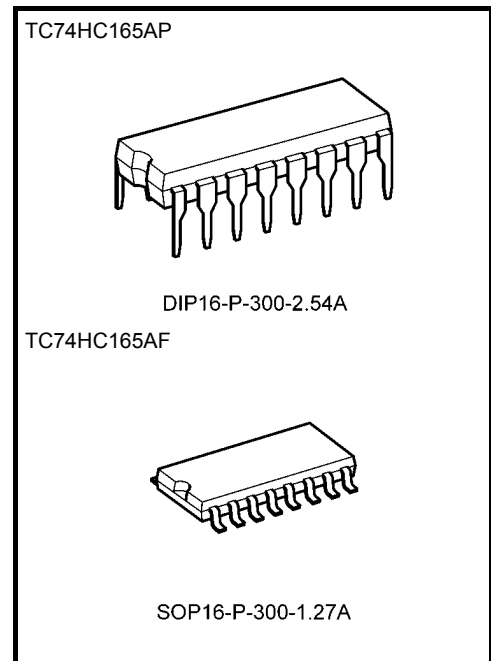
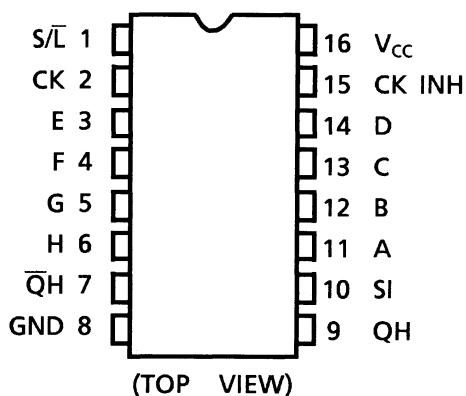
The CK-INH input should be shifted high only when the CK input is held high.

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

Features

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

Pin Assignment

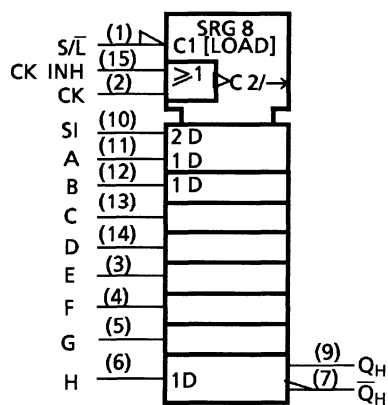


Weight

DIP16-P-300-2.54A : 1.00 g (typ.)

SOP16-P-300-1.27A : 0.18 g (typ.)

IEC Logic Symbol



Truth Table

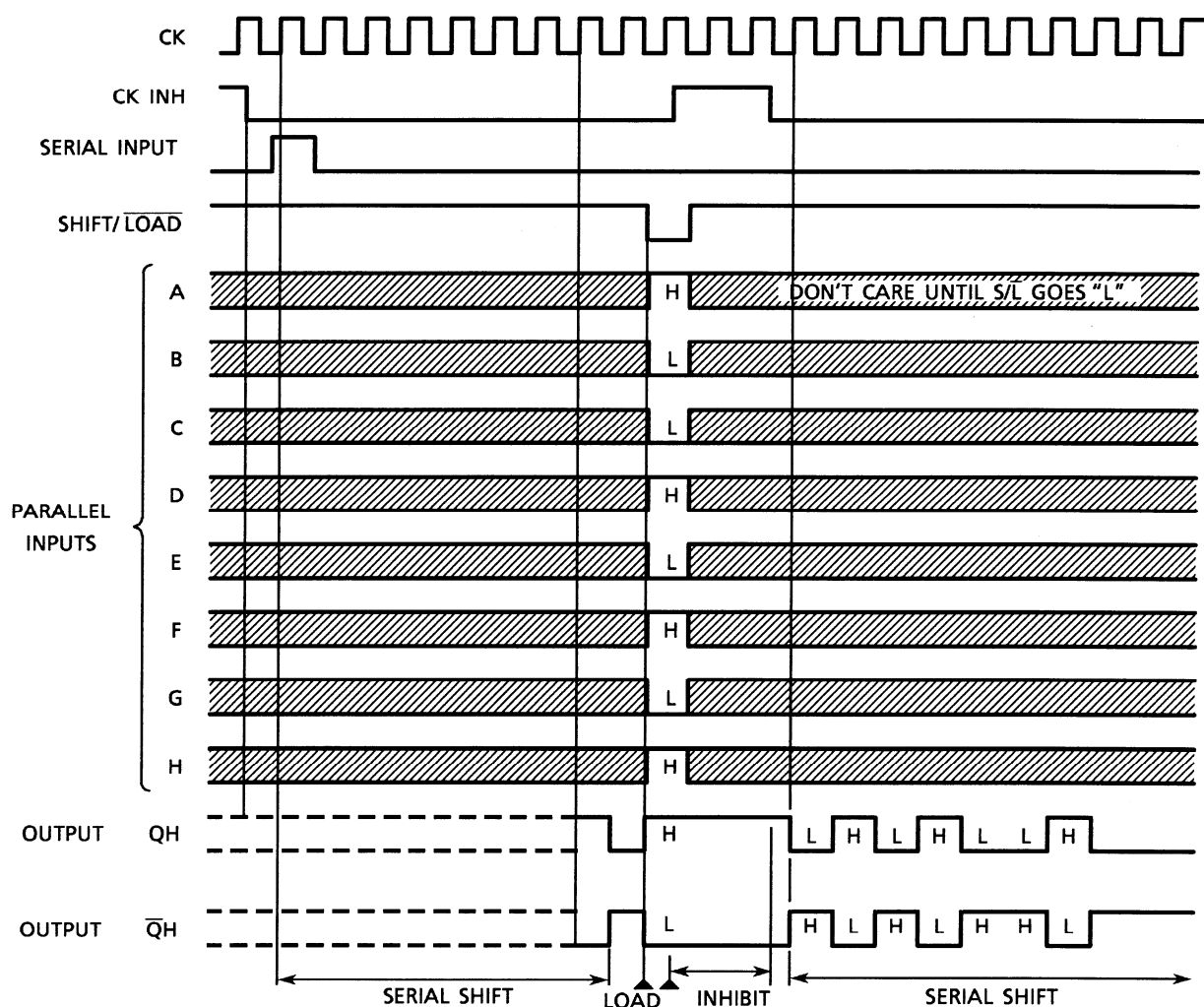
Inputs					Internal Outputs		Outputs	
SHIFT/LOAD	CLOCK INH	CLOCK	SERIAL IN	PARALLEL A·····H	QA	QB	QH	$\overline{QH}$
L	X	X	X	a·····h	a	b	h	$\overline{h}$
H	L		H	X	H	QAn	QGn	$\overline{QGn}$
H	L		L	X	L	QAn	QGn	$\overline{QGn}$
H		L	H	X	H	QAn	QGn	$\overline{QGn}$
H		L	L	X	L	QAn	QGn	$\overline{QGn}$
H	X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

X: Don't care

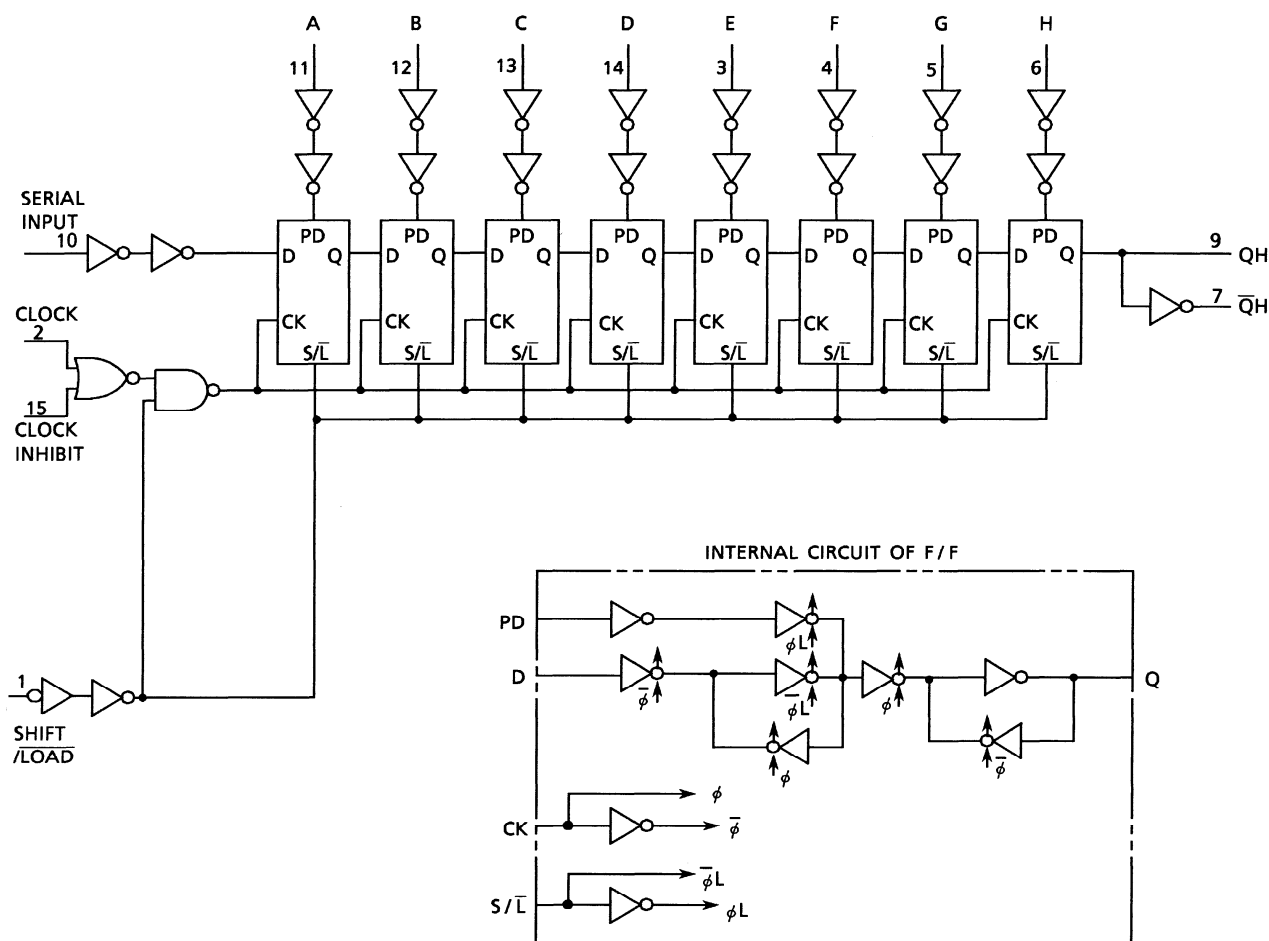
a·····h: The level of steady state input voltage at inputs A through H respectively

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	$^{\circ}\text{C}$

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°C . From $T_a = 65$ to 85°C a derating factor of -10 mW/ $^{\circ}\text{C}$ 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		$T_a = 25^\circ\text{C}$			$T_a = -40 \text{ to } 85^\circ\text{C}$		Unit
				V_{CC} (V)	Min	Typ.	Max	Min	Max
High-level input voltage	V_{IH}	—		2.0 4.5 6.0	1.50 3.15 4.20	— — —	— — —	1.50 3.15 4.20	V
Low-level input voltage	V_{IL}	—		2.0 4.5 6.0	— — —	— — —	0.50 1.35 1.80	— — —	V
High-level output voltage	V_{OH}	$V_{IN} = V_{IH} \text{ or } V_{IL}$	$I_{OH} = -20 \mu\text{A}$	2.0 4.5 6.0	1.9 4.4 5.9	2.0 4.5 6.0	— — —	1.9 4.4 5.9	V
			$I_{OH} = -4 \text{ mA}$	4.5 6.0	4.18 5.68	4.31 5.80	— —	4.13 5.63	
			$I_{OH} = -5.2 \text{ mA}$	6.0	5.68	5.80	—	5.63	
Low-level output voltage	V_{OL}	$V_{IN} = V_{IH} \text{ or } V_{IL}$	$I_{OL} = 20 \mu\text{A}$	2.0 4.5 6.0	— — —	0.0 0.0 0.0	0.1 0.1 0.1	— — —	V
			$I_{OL} = 4 \text{ mA}$	4.5 6.0	— —	0.17 0.18	0.26 0.26	— —	
			$I_{OL} = 5.2 \text{ mA}$	6.0	—	0.18	0.26	—	
Input leakage current	I_{IN}	$V_{IN} = V_{CC} \text{ or GND}$		6.0	—	—	± 0.1	—	μA
Quiescent supply current	I_{CC}	$V_{IN} = V_{CC} \text{ or GND}$		6.0	—	—	4.0	—	μA

Timing Requirements (input: $t_r = t_f = 6 \text{ ns}$)

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

AC Characteristics ($C_L = 15 \text{ pF}$, $V_{CC} = 5 \text{ V}$, $T_a = 25^\circ\text{C}$, input: $t_r = t_f = 6 \text{ ns}$)

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, $\bar{Q}H$)	t_{PLH}	—	—	15	25	ns
	t_{PHL}					
Propagation delay time ($S/\bar{L}$ -QH, $\bar{Q}H$)	t_{PLH}	—	—	15	25	ns
	t_{PHL}					
Propagation delay time (H-QH, $\bar{Q}H$)	t_{PLH}	—	—	14	26	ns
	t_{PHL}					
Maximum clock frequency	f_{max}	—	35	56	—	MHz

AC Characteristics ($C_L = 50 \text{ pF}$, input: $t_r = t_f = 6 \text{ ns}$)

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} t_{THL}	—	2.0	—	25	75	—	95
			4.5	—	8	15	—	19
			6.0	—	7	13	—	16
Propagation delay time (CK, CK INH-QH, $\overline{QH}$)	t_{PLH} t_{PHL}	—	2.0	—	55	150	—	190
			4.5	—	18	30	—	38
			6.0	—	15	26	—	33
Propagation delay time (S/L-QH, $\overline{QH}$)	t_{PLH} t_{PHL}	—	2.0	—	60	165	—	205
			4.5	—	19	33	—	41
			6.0	—	16	28	—	35
Propagation delay time (H-QH, $\overline{QH}$)	t_{PHL}	—	2.0	—	52	135	—	170
			4.5	—	17	27	—	34
			6.0	—	14	23	—	29
Maximum clock frequency	f_{max}	—	2.0	7	14	—	6	—
			4.5	30	46	—	24	—
			6.0	41	65	—	28	—
Input capacitance	C_{IN}	—	—	—	5	10	—	10
Power dissipation capacitance	C_{PD} (Note)	—	—	—	55	—	—	—

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

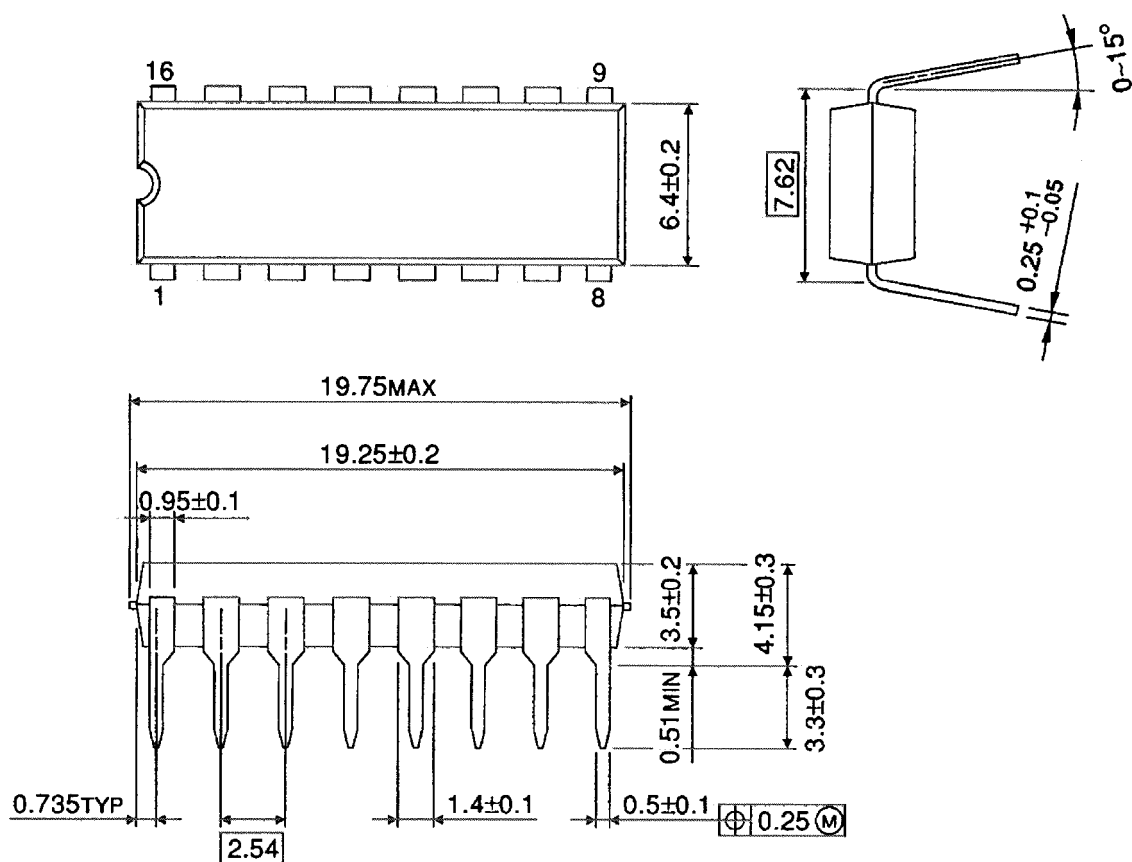
Average operating current can be obtained by the equation:

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

Package Dimensions

DIP16-P-300-2.54A

Unit : mm

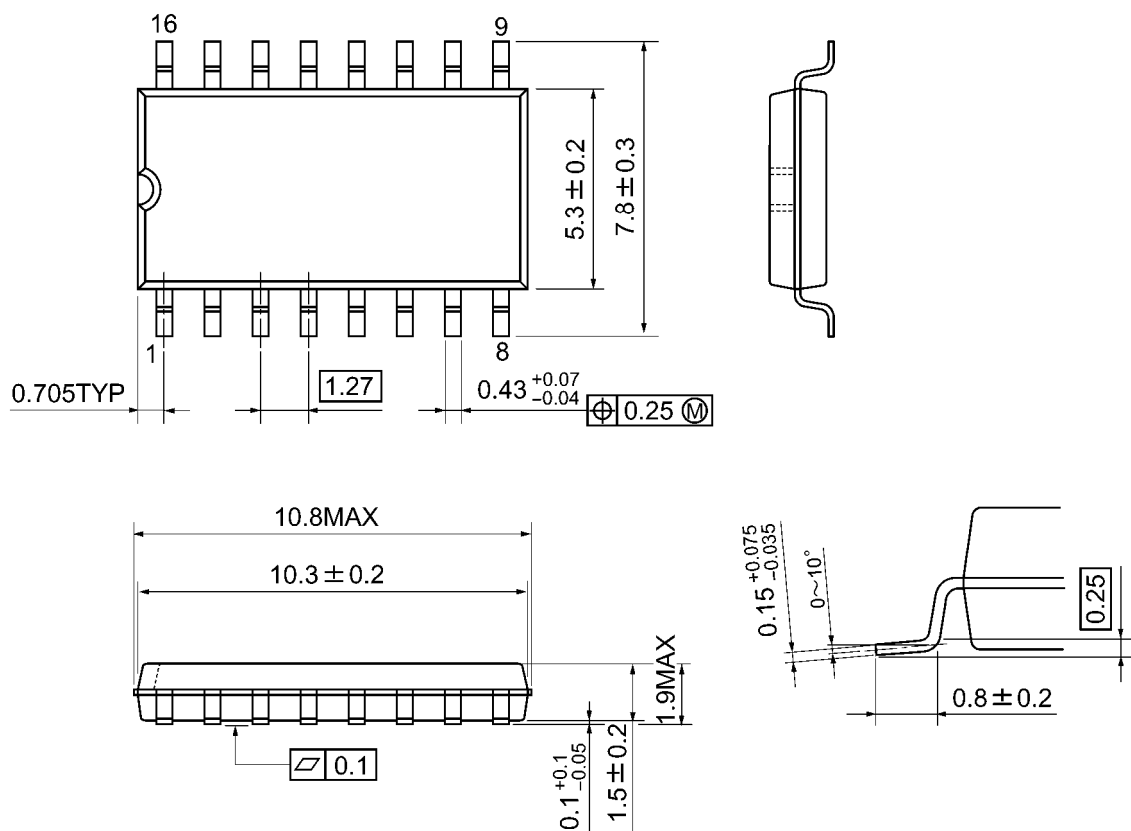


Weight: 1.00 g (typ.)

Package Dimensions

SOP16-P-300-1.27A

Unit: mm



Weight: 0.18 g (typ.)

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