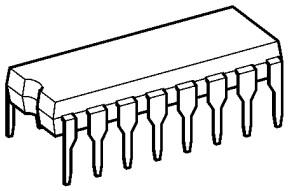
TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC4511BP, TC4511BF

TC4511B BCD-to-Seven Segment Latch/Decoder/Driver

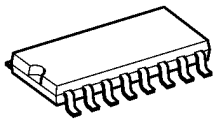
TC4511B is decoder which converts the input of BCD code into the 7 segment display element driving signal and the output has complementary connection of NPN bipolar transistor and N-channel MOS FET. Therefore, not only capability of directly driving cathode common type LED, this has capability of driving various display elements with simple interface circuits. $\overline{\text{LT}}$ input and $\overline{\text{BI}}$ input are to force all the outputs to be “H” (illuminated) and “L” (not illuminated) respectively regardless of BCD input. As the latch controlled by common LE input is inserted in each of four input lines, static display of dynamic information can be achieved. When an invalid BCD input, “10” or higher is applied, all the outputs become “L” (not illuminated).

TC4511BP



DIP16-P-300-2.54A

TC4511BF

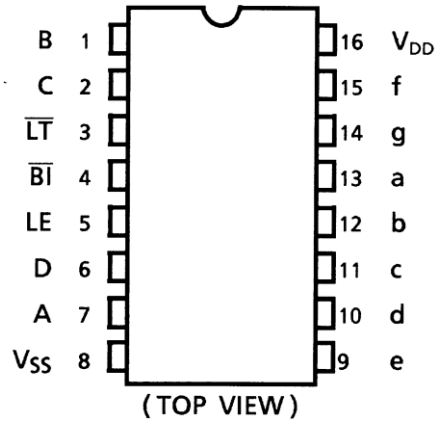


SOP16-P-300-1.27A

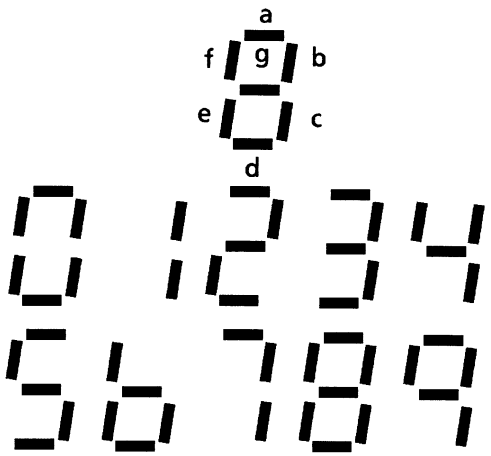
Weight

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

Pin Assignment



Display



Start of commercial production
1978-04

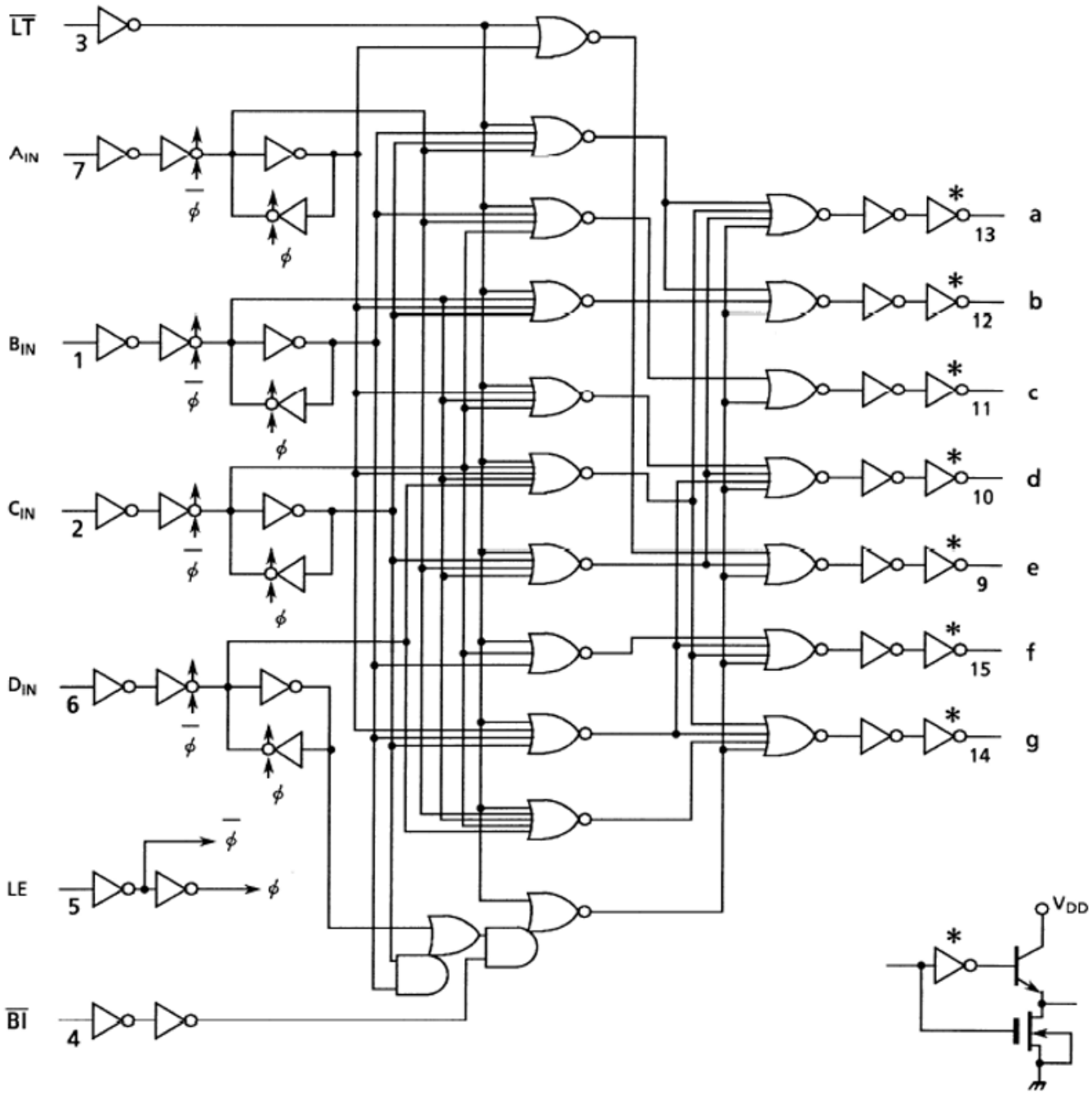
Truth Table

Inputs							Outputs							Display Mode
LE	$\overline{BI}$	$\overline{LT}$	D	C	B	A	a	b	c	d	e	f	g	
*	*	L	*	*	*	*	H	H	H	H	H	H	H	8
*	L	H	*	*	*	*	L	L	L	L	L	L	L	Blank
L	H	H	L	L	L	L	H	H	H	H	H	H	L	0
L	H	H	L	L	L	H	L	H	H	L	L	L	L	1
L	H	H	L	L	H	L	H	H	L	H	H	L	H	2
L	H	H	L	L	H	H	H	H	H	H	L	L	H	3
L	H	H	L	H	L	L	L	H	H	L	L	H	H	4
L	H	H	L	H	L	H	H	L	H	H	L	H	H	5
L	H	H	L	H	H	L	L	L	H	H	H	H	H	6
L	H	H	L	H	H	H	H	H	H	L	L	L	L	7
L	H	H	H	L	L	L	H	H	H	H	H	H	H	8
L	H	H	H	L	L	H	H	H	H	L	L	H	H	9
L	H	H	H	L	H	L	L	L	L	L	L	L	L	Blank
L	H	H	H	L	H	H	L	L	L	L	L	L	L	Blank
L	H	H	H	H	*	*	L	L	L	L	L	L	L	Blank
H	H	H	*	*	*	*	ΔΔ							

*: Don’t care

ΔΔ: Depends upon the BCD code previously applied when LE “L”

Logic Diagram



Absolute Maximum Ratings (Note)

Characteristics	Symbol	Rating	Unit
DC supply voltage	V_{DD}	V_{SS} − 0.5 to V_{SS} + 20	V
Input voltage	V_{IN}	V_{SS} − 0.5 to V_{DD} + 0.5	V
Output voltage	V_{OUT}	V_{SS} − 0.5 to V_{DD} + 0.5	V
DC input current	I_{IN}	±10	mA
Output high current	I_{OH}	−50	mA
Power dissipation	P_D	300 (DIP)/180 (SOP)	mW
Operating temperature range	T_{opr}	−40 to 85	°C
Storage temperature range	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 Range (V_{SS} = 0 V) (Note)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
DC supply voltage	V_{DD}	—	3	—	18	V
Input voltage	V_{IN}	—	0	—	V_{DD}	V

Note: The operating ranges must be maintained to ensure the normal operation of the device.
Unused inputs must be tied to either V_{DD} or V_{SS}.

Static Electrical Characteristics (V_{SS} = 0 V)

Characteristics	Sym-bol	Test Condition	V_{DD} (V)	−40°C Min	−40°C Max	25°C Min	25°C Typ.	25°C Max	85°C Min	85°C Max	Unit
High-level output voltage	V_{OH}	$\|I_{OUT}\| < 1$ μA $V_{IN} = V_{SS}, V_{DD}$	5 10 15	4.1 9.1 14.1	— — —	4.1 9.1 14.1	4.41 9.41 14.41	— — —	4.2 9.2 14.2	— — —	V
Low-level output voltage	V_{OL}	$\|I_{OUT}\| < 1$ μA $V_{IN} = V_{SS}, V_{DD}$	5 10 15	— — —	0.05 0.05 0.05	— — —	0.00 0.00 0.00	0.05 0.05 0.05	— — —	0.05 0.05 0.05	V
Output high voltage	V_{OH}	I_{OH} = 0 mA I_{OH} = 10 mA I_{OH} = 20 mA $V_{IN} = V_{DD}, V_{SS}$	5	4.10 3.90 3.55	— — —	4.10 3.90 3.55	4.41 4.25 4.19	— — —	4.20 3.90 3.30	— — —	V
		I_{OH} = 0 mA I_{OH} = 10 mA I_{OH} = 20 mA $V_{IN} = V_{DD}, V_{SS}$	10	9.10 9.00 8.70	— — —	9.10 9.00 8.70	9.41 9.25 9.20	— — —	9.20 9.00 8.40	— — —	
		I_{OH} = 0 mA I_{OH} = 10 mA I_{OH} = 20 mA $V_{IN} = V_{DD}, V_{SS}$	15	14.10 14.00 13.75	— — —	14.10 14.00 13.75	14.41 14.26 14.21	— — —	14.20 14.00 13.50	— — —	
Output low voltage	I_{OL}	V_{OUT} = 0.4 V V_{OUT} = 0.5 V V_{OUT} = 1.5 V $V_{IN} = V_{DD}, V_{SS}$	5 10 15	0.61 1.5 4.0	— — —	0.51 1.3 3.4	1.2 3.2 12.0	— — —	0.42 1.1 2.8	— — —	mA
Input high voltage	V_{IH}	V_{OUT} = 0.5 V, 4.5 V V_{OUT} = 1.0 V, 9.0 V V_{OUT} = 1.5 V, 13.5 V $\|I_{OUT}\| < 1$ μA	5 10 15	3.5 7.0 11.0	— — —	3.5 7.0 11.0	2.75 5.50 8.25	— — —	3.5 7.0 11.0	— — —	V
Input low voltage	V_{IL}	V_{OUT} = 0.5 V, 4.5 V V_{OUT} = 1.0 V, 9.0 V V_{OUT} = 1.5 V, 13.5 V $\|I_{OUT}\| < 1$ μA	5 10 15	— — —	1.5 3.0 4.0	— — —	2.25 4.5 6.75	1.5 3.0 4.0	— — —	1.5 3.0 4.0	V
Input current “H” level	I_{IH}	V_{IH} = 18 V	18	—	0.1	—	10^{-5}	0.1	—	1.0	μA
Input current “L” level	I_{IL}	V_{IL} = 0 V	18	—	−0.1	—	-10^{-5}	−0.1	—	−1.0	μA
Quiescent supply current	I_{DD}	$V_{IN} = V_{SS}, V_{DD}$ (Note)	5 10 15	— — —	5 10 20	— — —	0.005 0.010 0.015	5 10 20	— — —	150 300 600	μA

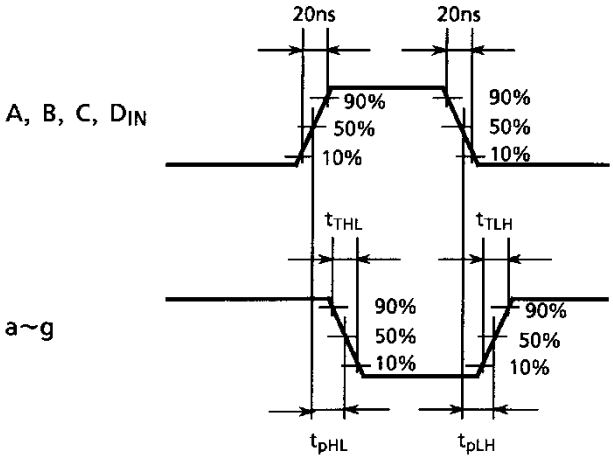
Note: All valid input combinations.

Dynamic Electrical Characteristics (Ta = 25°C, V_{SS} = 0 V, C_L = 50 pF, R_L = 10 kΩ)

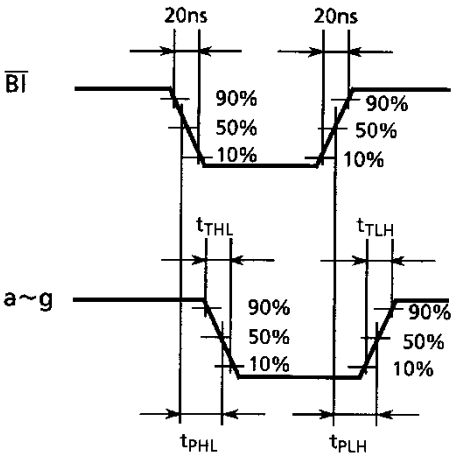
Characteristics	Symbol	Test Condition	V_{DD} (V)	Min	Typ.	Max	Unit
Output transition time (low to high)	t_{TLH}	—	5	—	25	80	ns
			10	—	15	60	
			15	—	15	50	
Output transition time (high to low)	t_{THL}	—	5	—	70	200	ns
			10	—	35	100	
			15	—	30	80	
Propagation delay time (DATA-OUT)	t_{pLH}	—	5	—	200	1040	ns
			10	—	90	420	
			15	—	65	300	
Propagation delay time (DATA-OUT)	t_{pHL}	—	5	—	230	1040	ns
			10	—	110	420	
			15	—	80	300	
Propagation delay time ($\overline{BI}$ -OUT)	t_{pLH}	—	5	—	75	640	ns
			10	—	45	260	
			15	—	35	200	
Propagation delay time ($\overline{BI}$ -OUT)	t_{pHL}	—	5	—	90	640	ns
			10	—	50	260	
			15	—	45	200	
Propagation delay time ($\overline{LT}$ -OUT)	t_{pLH}	—	5	—	60	300	ns
			10	—	40	150	
			15	—	35	100	
Propagation delay time ($\overline{LT}$ -OUT)	t_{pHL}	—	5	—	75	300	ns
			10	—	45	150	
			15	—	35	100	
Propagation delay time (LE-OUT)	t_{pLH}	—	5	—	180	600	ns
			10	—	90	300	
			15	—	65	250	
Propagation delay time (LE-OUT)	t_{pHL}	—	5	—	230	600	ns
			10	—	110	300	
			15	—	85	250	
Min pulse time (LE)	t_{WL}	—	5	—	40	300	ns
			10	—	20	150	
			15	—	15	120	
Min set-up time (DATA-LE)	t_{SU}	—	5	—	35	150	ns
			10	—	15	70	
			15	—	10	40	
Min hold time (DATA-LE)	t_H	—	5	—	—	0	ns
			10	—	—	0	
			15	—	—	0	
Input capacitance	C_{IN}	—		—	5	7.5	pF

Waveform for Measurement of Dynamic Characteristics

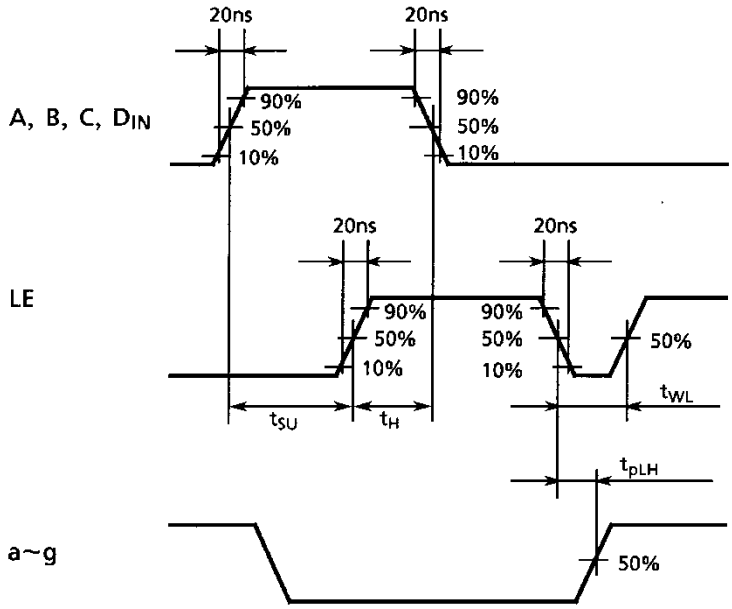
Waveform 1



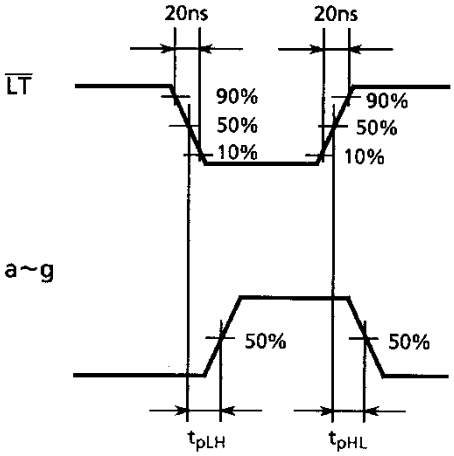
Waveform 2



Waveform 3

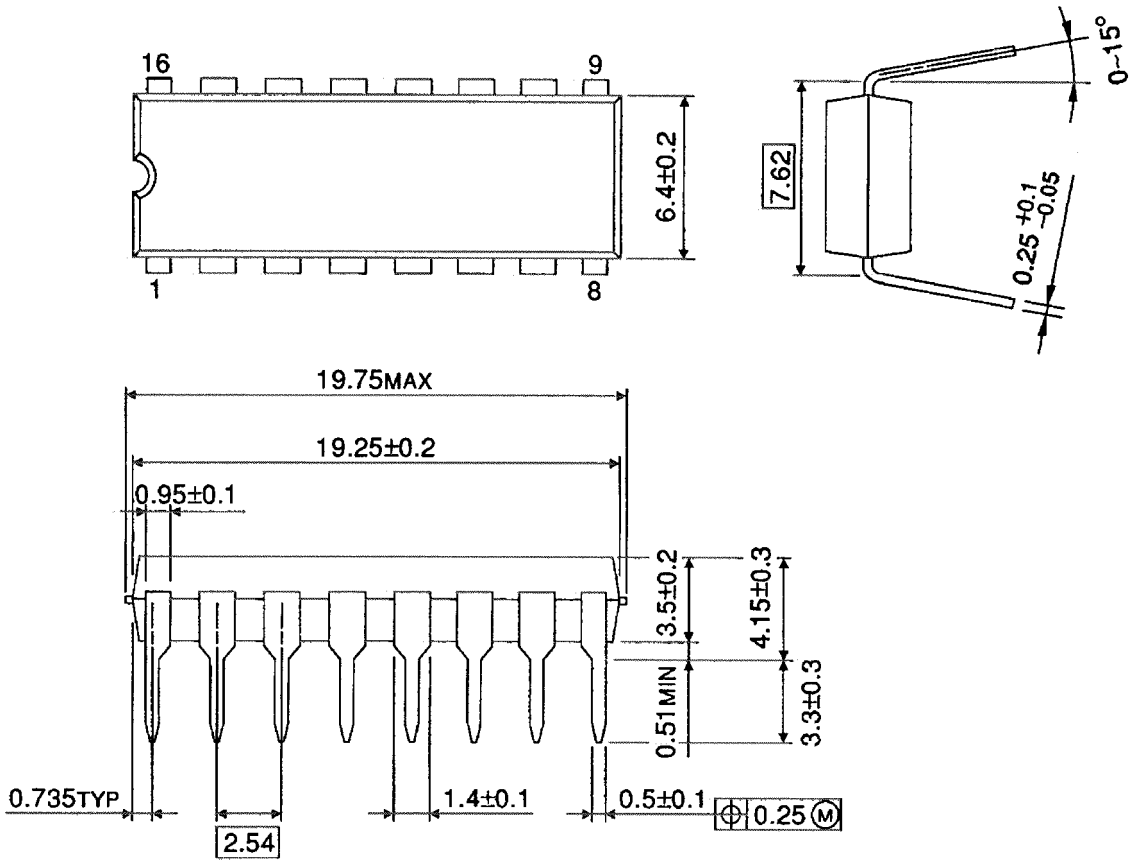


Waveform 4



Package Dimensions

DIP16-P-300-2.54A Unit : mm

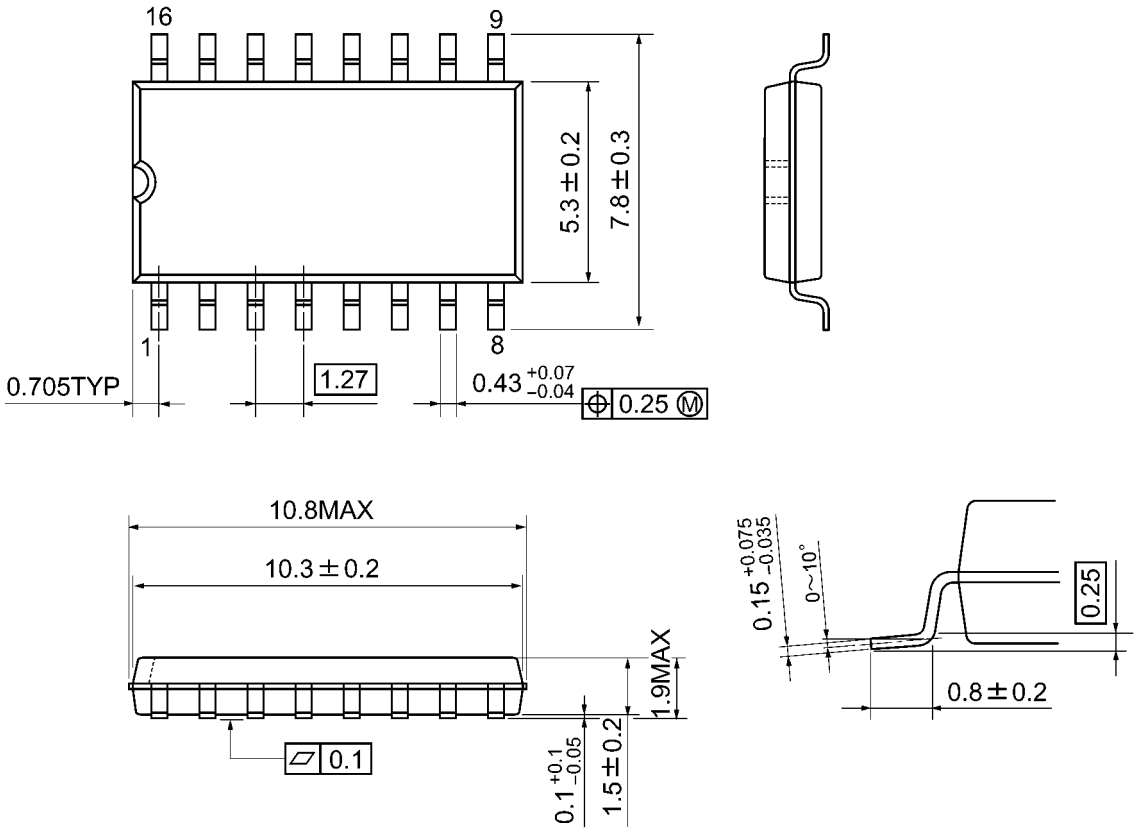


Weight: 1.00 g (typ.)

Package Dimensions

SOP16-P-300-1.27A

Unit: mm



Weight: 0.18 g (typ.)

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