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. $\overline{LT}$ input and $\overline{BI}$ 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).

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

F (SOP16-P-300-1.27)
Weight : 0.18g (Typ.)

MAXIMUM RATINGS

CHARACTERISTIC	SYMBOL	RATING	UNIT
DC Supply Voltage	V_{DD}	$V_{SS} - 0.5 \sim V_{SS} + 20$	V
Input Voltage	V_{IN}	$V_{SS} - 0.5 \sim V_{DD} + 0.5$	V
Output Voltage	V_{OUT}	$V_{SS} - 0.5 \sim V_{DD} + 0.5$	V
DC Input Current	I_{IN}	± 10	mA
Output High Current	I_{OH}	-50	mA
Power Dissipation	P_D	300 (DIP) / 180 (SOIC)	mW
Operating Temperature Range	T_{opr}	$-40 \sim 85$	°C
Storage Temperature Range	T_{stg}	$-65 \sim 150$	°C

PIN ASSIGNMENT

B	1	16	V_{DD}
C	2	15	f
$\overline{LT}$	3	14	g
$\overline{BI}$	4	13	a
LE	5	12	b
D	6	11	c
A	7	10	d
V_{SS}	8	9	e

(TOP VIEW)

DISPLAY

TRUTH TABLE

| INPUT							OUTPUT							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	*	*	*	*	△△							

* : DON'T CARE

△△ : DEPENDS UPON THE BCD CODE PREVIOUSLY APPLIED WHEN LE "L"
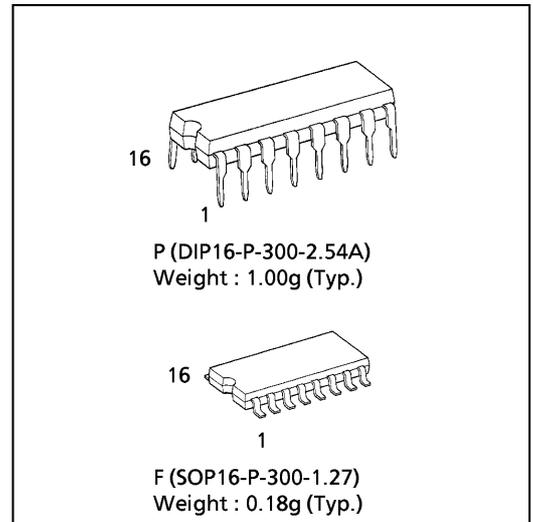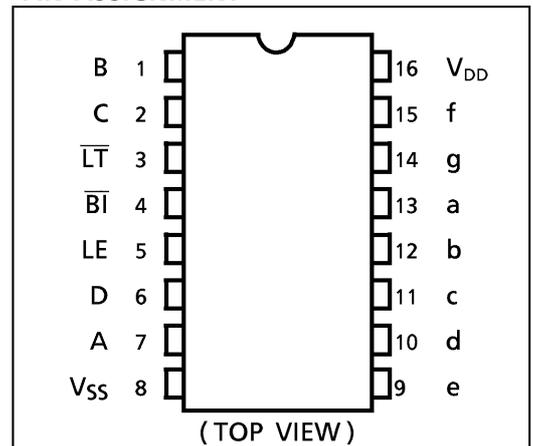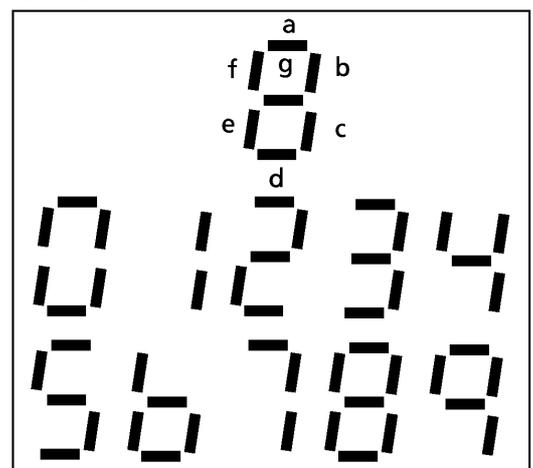
LOGIC DIAGRAM
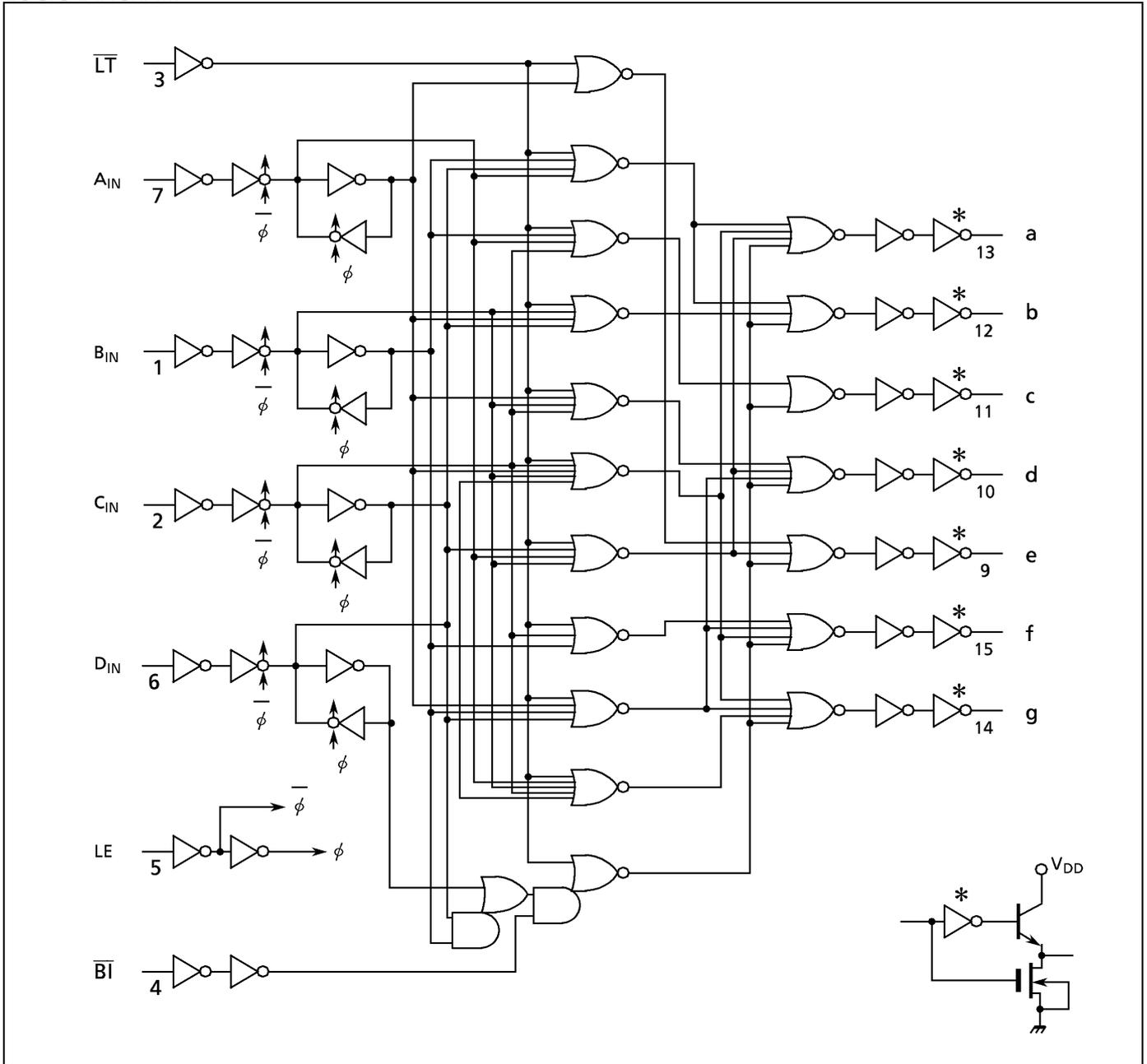
RECOMMENDED OPERATING CONDITIONS ($V_{SS} = 0V$)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNITS
DC Supply Voltage	V_{DD}		3	—	18	V
Input Voltage	V_{IN}		0	—	V_{DD}	V

STATIC ELECTRICAL CHARACTERISTICS ($V_{SS} = 0V$)

| CHARACTERISTIC	SYMBOL	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}	$\|I_{OUT}\| < 1\mu A$ $V_{IN} = V_{SS}, V_{DD}$	5	4.1	—	4.1	4.41	—	4.2	—	V
			10	9.1	—	9.1	9.41	—	9.2	—	
			15	14.1	—	14.1	14.41	—	14.2	—	
Low-Level Output Voltage	V_{OL}	$\|I_{OUT}\| < 1\mu A$ $V_{IN} = V_{SS}, V_{DD}$	5	—	0.05	—	0.00	0.05	—	0.05	
			10	—	0.05	—	0.00	0.05	—	0.05	
			15	—	0.05	—	0.00	0.05	—	0.05	
Output High Voltage	V_{OH}	$I_{OH} = 0mA$	5	4.10	—	4.10	4.41	—	4.20	—	V
		$I_{OH} = 10mA$		3.90	—	3.90	4.25	—	3.90	—	
		$I_{OH} = 20mA$		3.55	—	3.55	4.19	—	3.30	—	
		$V_{IN} = V_{DD}, V_{SS}$									
		$I_{OH} = 0mA$	10	9.10	—	9.10	9.41	—	9.20	—	
		$I_{OH} = 10mA$		9.00	—	9.00	9.25	—	9.00	—	
		$I_{OH} = 20mA$		8.70	—	8.70	9.20	—	8.40	—	
		$V_{IN} = V_{DD}, V_{SS}$									
		$I_{OH} = 0mA$	15	14.10	—	14.10	14.41	—	14.20	—	
		$I_{OH} = 10mA$		14.00	—	14.00	14.26	—	14.00	—	
		$I_{OH} = 20mA$		13.75	—	13.75	14.21	—	13.50	—	
		$V_{IN} = V_{DD}, V_{SS}$									
Output Low Voltage	I_{OL}	$V_{OUT} = 0.4V$	5	0.61	—	0.51	1.2	—	0.42	—	mA
		$V_{OUT} = 0.5V$	10	1.5	—	1.3	3.2	—	1.1	—	
		$V_{OUT} = 1.5V$	15	4.0	—	3.4	12.0	—	2.8	—	
		$V_{IN} = V_{DD}, V_{SS}$									
Input High Voltage	V_{IH}	$V_{OUT} = 0.5V, 4.5V$	5	3.5	—	3.5	2.75	—	3.5	—	V
		$V_{OUT} = 1.0V, 9.0V$	10	7.0	—	7.0	5.50	—	7.0	—	
		$V_{OUT} = 1.5V, 13.5V$	15	11.0	—	11.0	8.25	—	11.0	—	
		$\|I_{OUT}\| < 1\mu A$									
Input Low Voltage	V_{IL}	$V_{OUT} = 0.5V, 4.5V$	5	—	1.5	—	2.25	1.5	—	1.5	
		$V_{OUT} = 1.0V, 9.0V$	10	—	3.0	—	4.5	3.0	—	3.0	
		$V_{OUT} = 1.5V, 13.5V$	15	—	4.0	—	6.75	4.0	—	4.0	
		$\|I_{OUT}\| < 1\mu A$									
Input Current "H" Level	I_{IH}	$V_{IH} = 18V$	18	—	0.3	—	10^{-5}	0.3	—	1.0	μA
Input Current "L" Level	I_{IL}	$V_{IL} = 0V$	18	—	−0.3	—	-10^{-5}	−0.3	—	−1.0	
Quiescent Supply Current	I_{DD}	$V_{IN} = V_{SS}, V_{DD}$ *	5	—	5	—	0.005	5	—	150	μA
			10	—	10	—	0.010	10	—	300	
			15	—	20	—	0.015	20	—	600	

∗ All valid input combinations.

**DYNAMIC ELECTRICAL CHARACTERISTICS** (Ta = 25°C, Vss = 0V, C_L = 50pF, R_L = 10kΩ)

CHARACTERISTIC	SYMBOL	TEST CONDITION	V_{DD}(V)	MIN.	TYP.	MAX.	UNIT
Output Transition Time (Low to High)	t_{TLH}		5	—	25	80	
			10	—	15	60	
			15	—	15	50	
Output Transition Time (High to Low)	t_{THL}		5	—	70	200	
			10	—	35	100	
			15	—	30	80	
Propagation Delay Time (DATA - OUT)	t_{pLH}		5	—	200	1040	
			10	—	90	420	
			15	—	65	300	
Propagation Delay Time (DATA - OUT)	t_{pHL}		5	—	230	1040	
			10	—	110	420	
			15	—	80	300	
Propagation Delay Time ($\overline{BI}$ - OUT)	t_{pLH}		5	—	75	640	
			10	—	45	260	
			15	—	35	200	
Propagation Delay Time ($\overline{BI}$ - OUT)	t_{pHL}		5	—	90	640	
			10	—	50	260	
			15	—	45	200	ns
Propagation Delay Time ($\overline{LT}$ - OUT)	t_{pLH}		5	—	60	300	
			10	—	40	150	
			15	—	35	100	
Propagation Delay Time ($\overline{LT}$ - OUT)	t_{pHL}		5	—	75	300	
			10	—	45	150	
			15	—	35	100	
Propagation Delay Time (LE - OUT)	t_{pLH}		5	—	180	600	
			10	—	90	300	
			15	—	65	250	
Propagation Delay Time (LE - OUT)	t_{pHL}		5	—	230	600	
			10	—	110	300	
			15	—	85	250	
Min. Pulse Time (LE)	t_{WL}		5	—	40	300	
			10	—	20	150	
			15	—	15	120	
Min. Set - up Time (DATA - LE)	t_{SU}		5	—	35	150	
			10	—	15	70	
			15	—	10	40	
Min. Hold Time (DATA - LE)	t_H		5	—	—	0	
			10	—	—	0	
			15	—	—	0	
Input Capacitance	C_{IN}			—	5	7.5	pF

WAVEFORM FOR MEASUREMENT OF DYNAMIC CHARACTERISTICS

WAVEFORM 1

A, B, C, D$_{IN}$

20ns   20ns
90%   90%
50%   50%
10%   10%

a~g

t_{THL} t_{TLH}
90%   90%
50%   50%
10%   10%

t_{pHL} t_{pLH}

WAVEFORM 2

$\overline{BI}$

20ns   20ns
90%   90%
50%   50%
10%   10%

a~g

t_{THL} t_{TLH}
90%   90%
50%   50%
10%   10%

t_{PHL} t_{PLH}

WAVEFORM 3

A, B, C, D$_{IN}$

20ns   20ns
90%   90%
50%   50%
10%   10%

LE

20ns   20ns
90%   90%
50%   50%
10%   10%   50%
                     t_{WL}
t_{SU} t_{H}

t_{pLH}

a~g

50%

WAVEFORM 4

$\overline{LT}$

20ns   20ns
90%   90%
50%   50%
10%   10%

a~g

50%   50%

t_{pLH} t_{pHL}
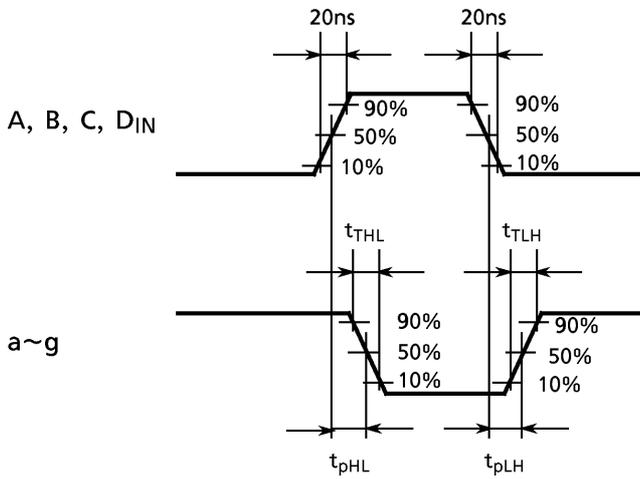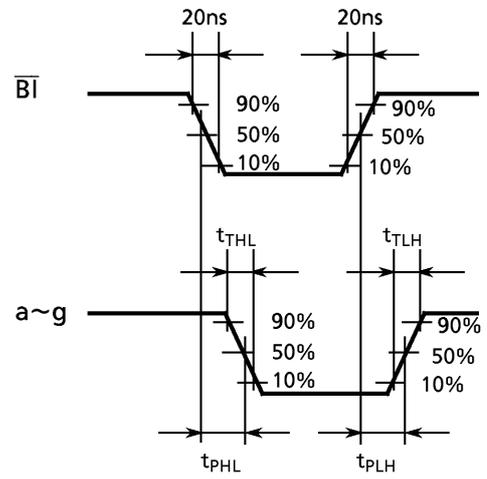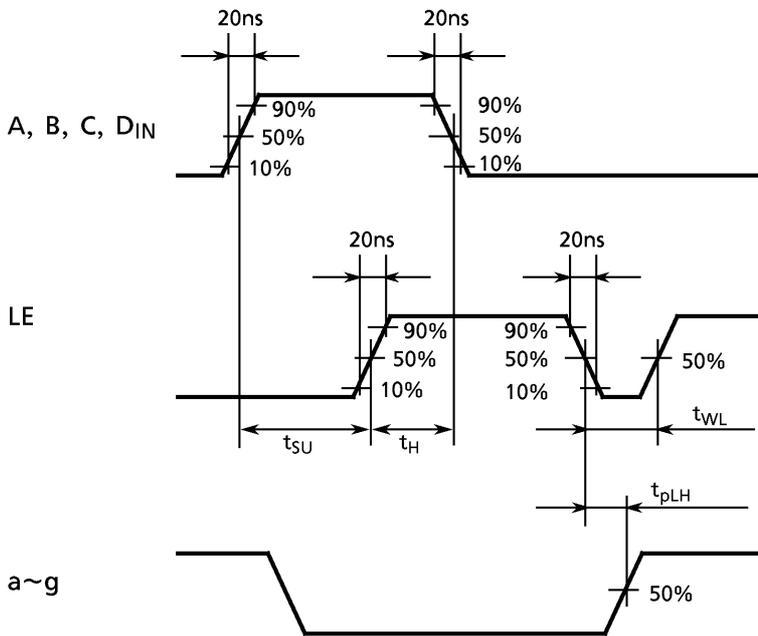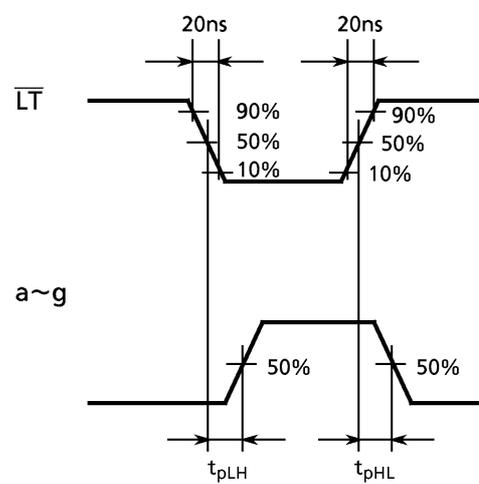
DIP 16PIN PACKAGE DIMENSIONS (DIP16-P-300-2.54A)

Unit in mm
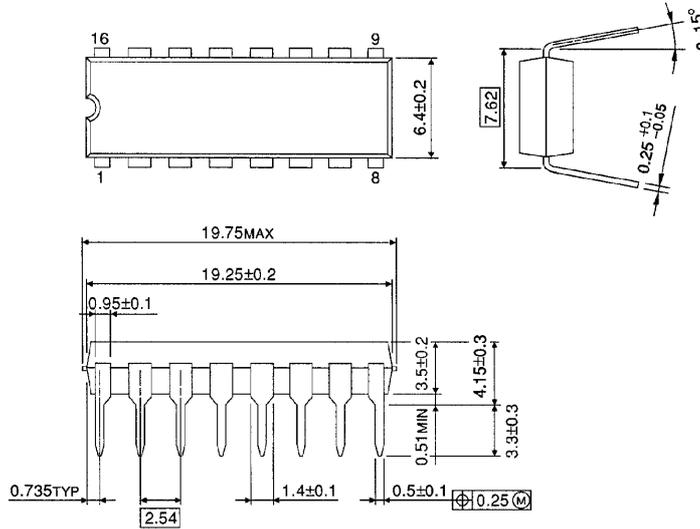
Weight : 1.00g (Typ.)

SOP 16PIN (200mil BODY) PACKAGE DIMENSIONS (SOP16-P-300-1.27)

Unit in mm
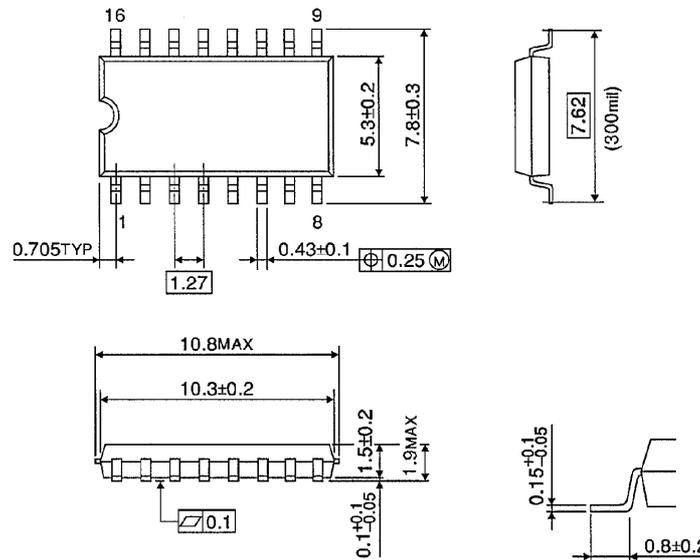
Weight : 0.18g (Typ.)

RESTRICTIONS ON PRODUCT USE