TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC74HC138AP,TC74HC138AF,TC74HC138AFN

3-to-8 Line Decoder

Note: xxxFN (JEDEC SOP) is not available in Japan.

The TC74HC138A is a high speed CMOS 3-to-8 DECODER fabricated with silicon gate C2MOS technology.

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

When the device is enabled, 3 Binary Select inputs (A, B and C) determine which one of the outputs ($\overline{Y}0$ - $\overline{Y}7$) will go low.

When enable input G1 is held low or either $\overline{G}2A$ or $\overline{G}2B$ is held high, decoding function is inhibited and all outputs go high.

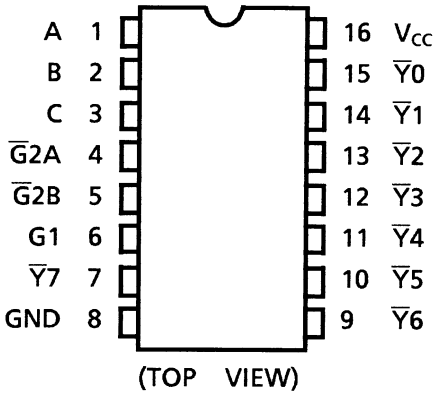
G1, $\overline{G}2A$, and $\overline{G}2B$ inputs are provided to ease cascade connection and for use as an address decoder for memory systems.

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

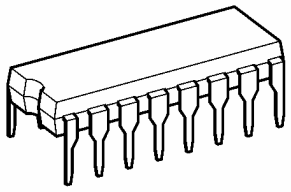
Features

- High speed: t_{pd} = 16 ns (typ.) at V_{CC} = 5 V
- Low power dissipation: I_{CC} = 4 μA (max) at Ta = 25°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 mA (min)
- Balanced propagation delays: $t_{pLH} \simeq t_{pHL}$
- Wide operating voltage range: V_{CC} (opr) = 2 to 6 V
- Pin and function compatible with 74LS138

Pin Assignment

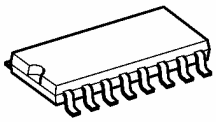


TC74HC138AP

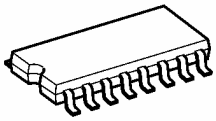


DIP16-P-300-2.54A

TC74HC138AF

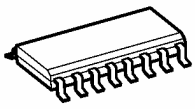


SOP16-P-300-1.27A



SOP16-P-300-1.27

TC74HC138AFN

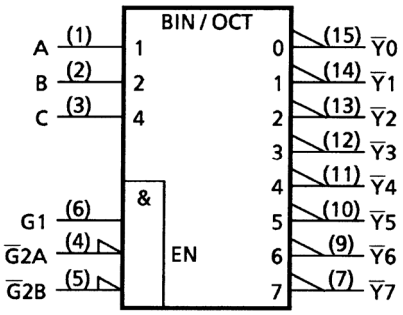


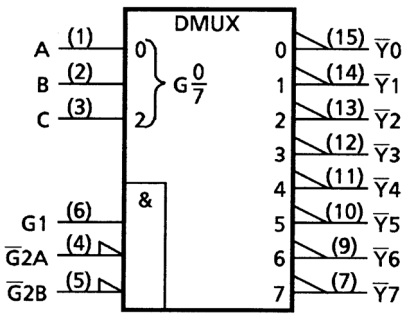
SOL16-P-150-1.27

Weight

DIP16-P-300-2.54A	: 1.00 g (typ.)
SOP16-P-300-1.27A	: 0.18 g (typ.)
SOP16-P-300-1.27	: 0.18 g (typ.)
SOL16-P-150-1.27	: 0.13 g (typ.)

IEC Logic Symbol



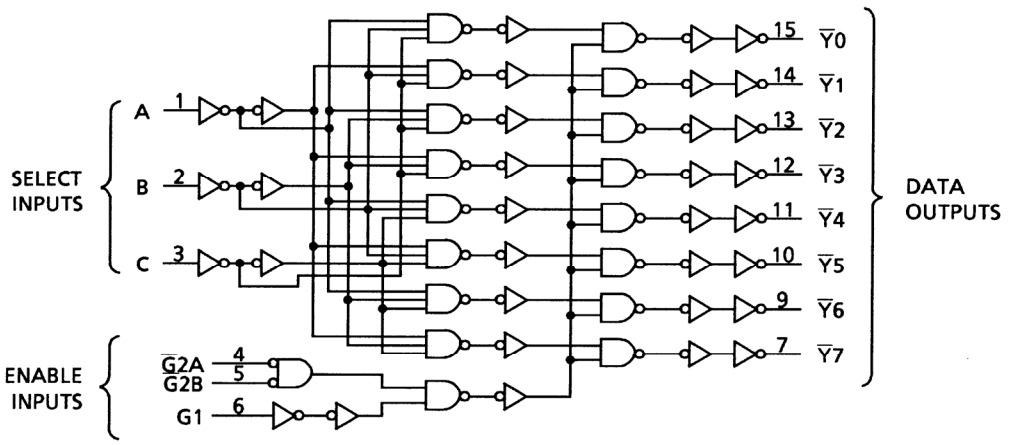


Truth Table

Inputs						Outputs								Selected Output
Enable			Select			$\overline{Y}0$	$\overline{Y}1$	$\overline{Y}2$	$\overline{Y}3$	$\overline{Y}4$	$\overline{Y}5$	$\overline{Y}6$	$\overline{Y}7$	
G1	$\overline{G}2A$	$\overline{G}2B$	C	B	A									
L	X	X	X	X	X	H	H	H	H	H	H	H	H	None
X	H	X	X	X	X	H	H	H	H	H	H	H	H	None
X	X	H	X	X	X	H	H	H	H	H	H	H	H	None
H	L	L	L	L	L	L	H	H	H	H	H	H	H	$\overline{Y}0$
H	L	L	L	L	H	H	L	H	H	H	H	H	H	$\overline{Y}1$
H	L	L	L	H	L	H	H	L	H	H	H	H	H	$\overline{Y}2$
H	L	L	L	H	H	H	H	H	L	H	H	H	H	$\overline{Y}3$
H	L	L	H	L	L	H	H	H	H	L	H	H	H	$\overline{Y}4$
H	L	L	H	L	H	H	H	H	H	H	L	H	H	$\overline{Y}5$
H	L	L	H	H	L	H	H	H	H	H	H	L	H	$\overline{Y}6$
H	L	L	H	H	H	H	H	H	H	H	H	H	L	$\overline{Y}7$

X: Don't care

Logic 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	°C

Note 1: Exceeding any of the absolute maximum ratings, even briefly, lead to deterioration in IC performance or even destruction.

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 shall be applied until 300 mW.

Recommended Operating Conditions (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 recommended operating conditions are required to ensure the normal operation of the device. Unused inputs must be tied to either VCC or GND.

Electrical Characteristics

DC Characteristics

Characteristics	Symbol	Test Condition		V_{CC} (V)	Ta = 25°C Min	Typ.	Max	Ta = −40 to 85°C Min	Max	Unit
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 μA	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 mA	4.5	4.18	4.31	—	4.13	—	
			I_{OH} = −5.2 mA	6.0	5.68	5.80	—	5.63	—	
Low-level output voltage	V_{OL}	V_{IN} = V_{IH} or V_{IL}	I_{OL} = 20 μA	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 mA	4.5	—	0.17	0.26	—	0.33	
			I_{OL} = 5.2 mA	6.0	—	0.18	0.26	—	0.33	
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

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} t_{THL}	—	—	4	8	ns
Propagation delay time (A, B, C- $\overline{Y}$)	t_{pLH} t_{pHL}	—	—	16	26	ns
Propagation delay time (G, $\overline{G}$ - $\overline{Y}$)	t_{pLH} t_{pHL}	—	—	15	25	ns

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} t_{THL}	—	2.0	—	30	75	—	95	ns
			4.5	—	8	15	—	19	
			6.0	—	7	13	—	16	
Propagation delay time (A, B, C- $\overline{Y}$)	t_{pLH} t_{pHL}	—	2.0	—	70	150	—	190	ns
			4.5	—	19	30	—	38	
			6.0	—	16	26	—	32	
Propagation delay time (G, $\overline{G}$ - $\overline{Y}$)	t_{pLH} t_{pHL}	—	2.0	—	65	145	—	180	ns
			4.5	—	18	29	—	36	
			6.0	—	15	25	—	31	
Input capacitance	C_{IN}	—		—	5	10	—	10	pF
Power dissipation capacitance	C_{PD} (Note)	—		—	47	—	—	—	pF

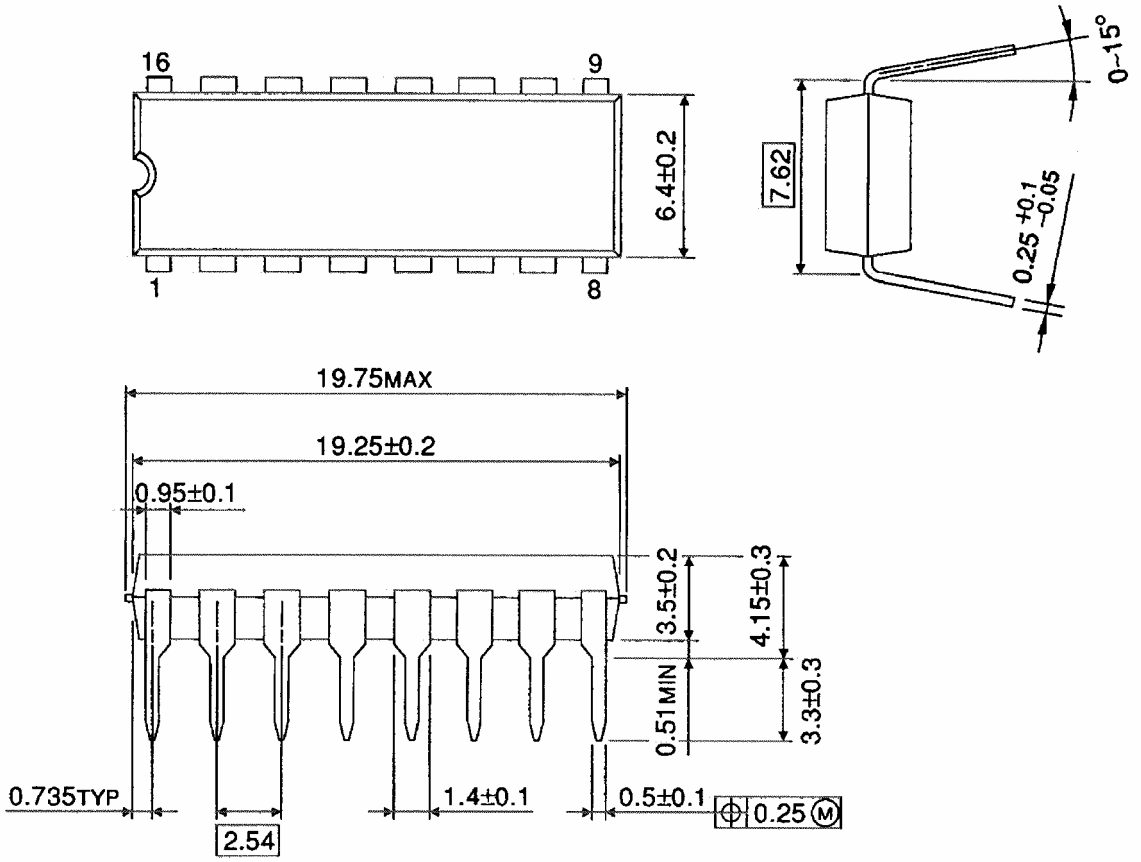
Note: C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

Average operating current can be obtained by the equation:

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

Package Dimensions

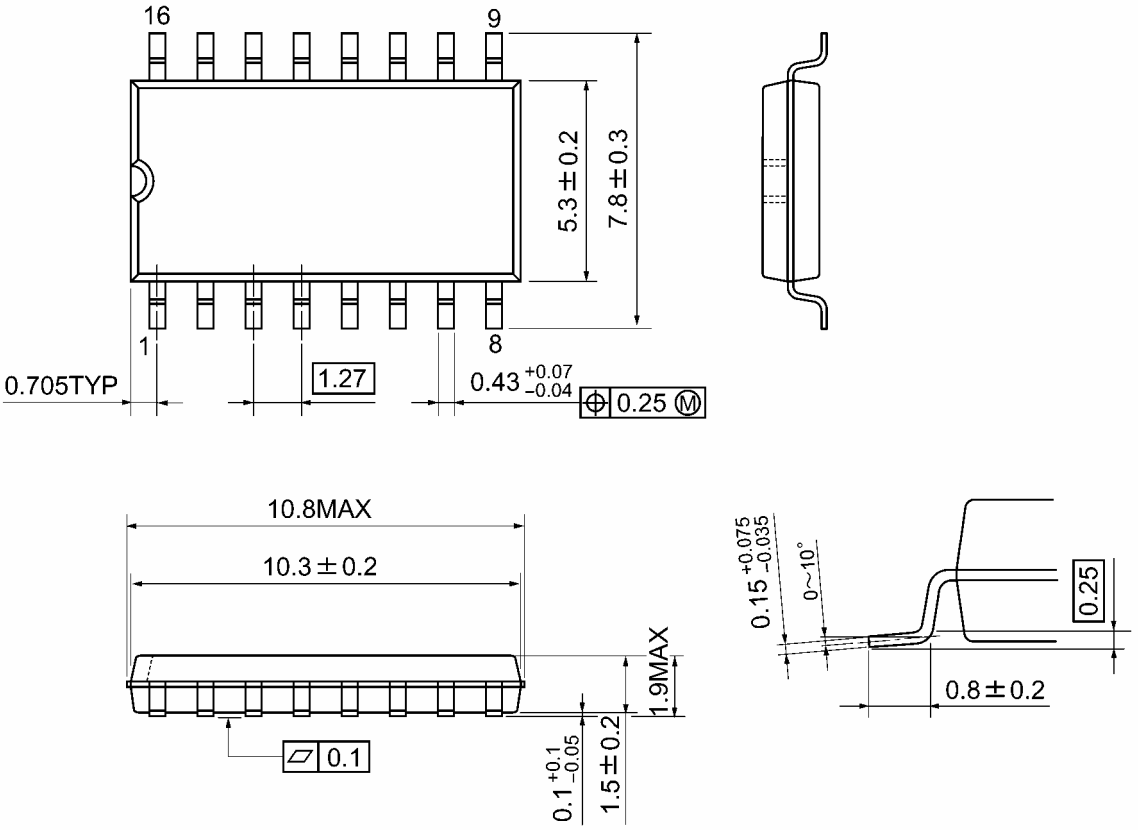
DIP16-P-300-2.54A Unit : mm



Weight: 1.00 g (typ.)

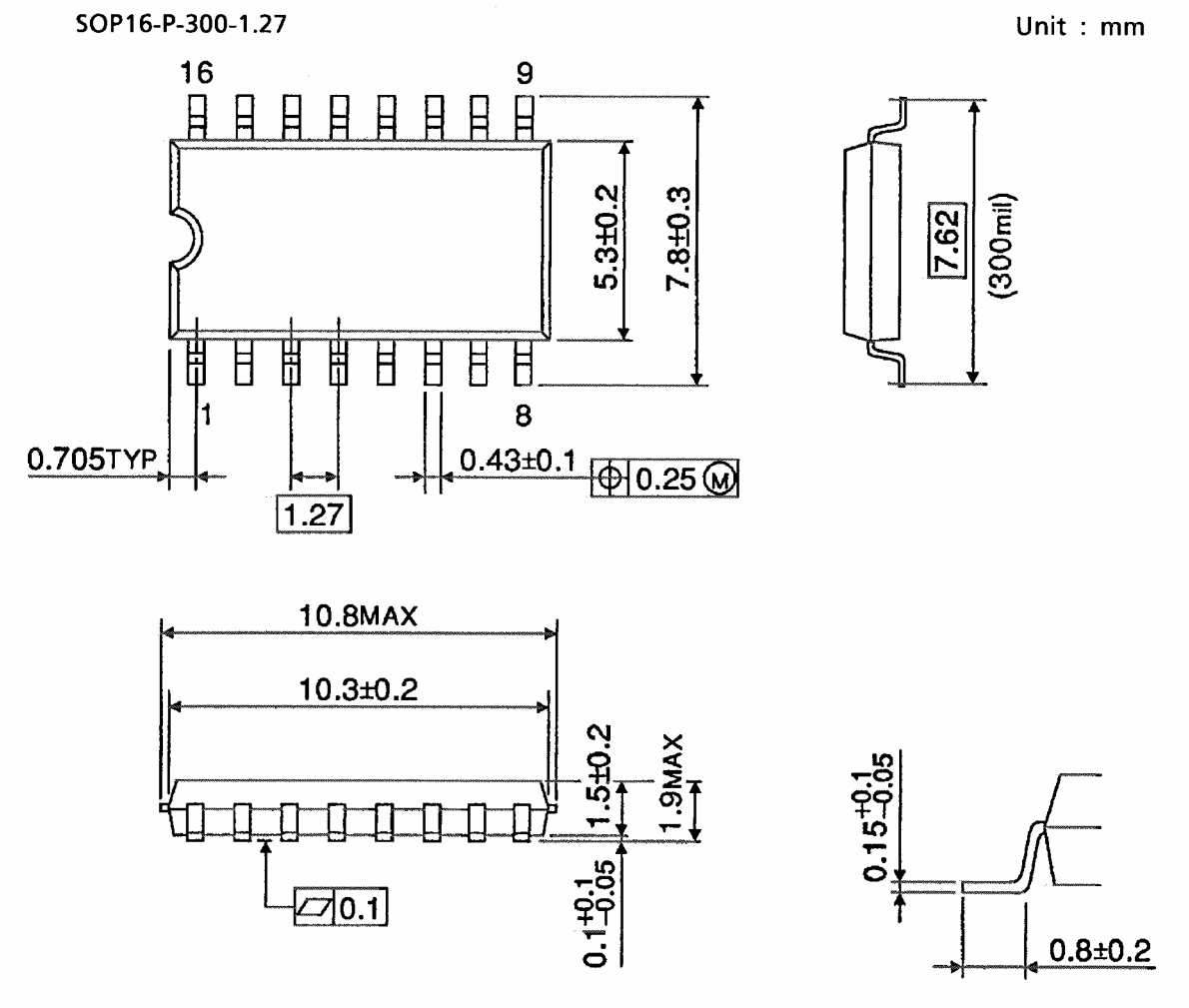
Package Dimensions

SOP16-P-300-1.27A Unit: mm



Weight: 0.18 g (typ.)

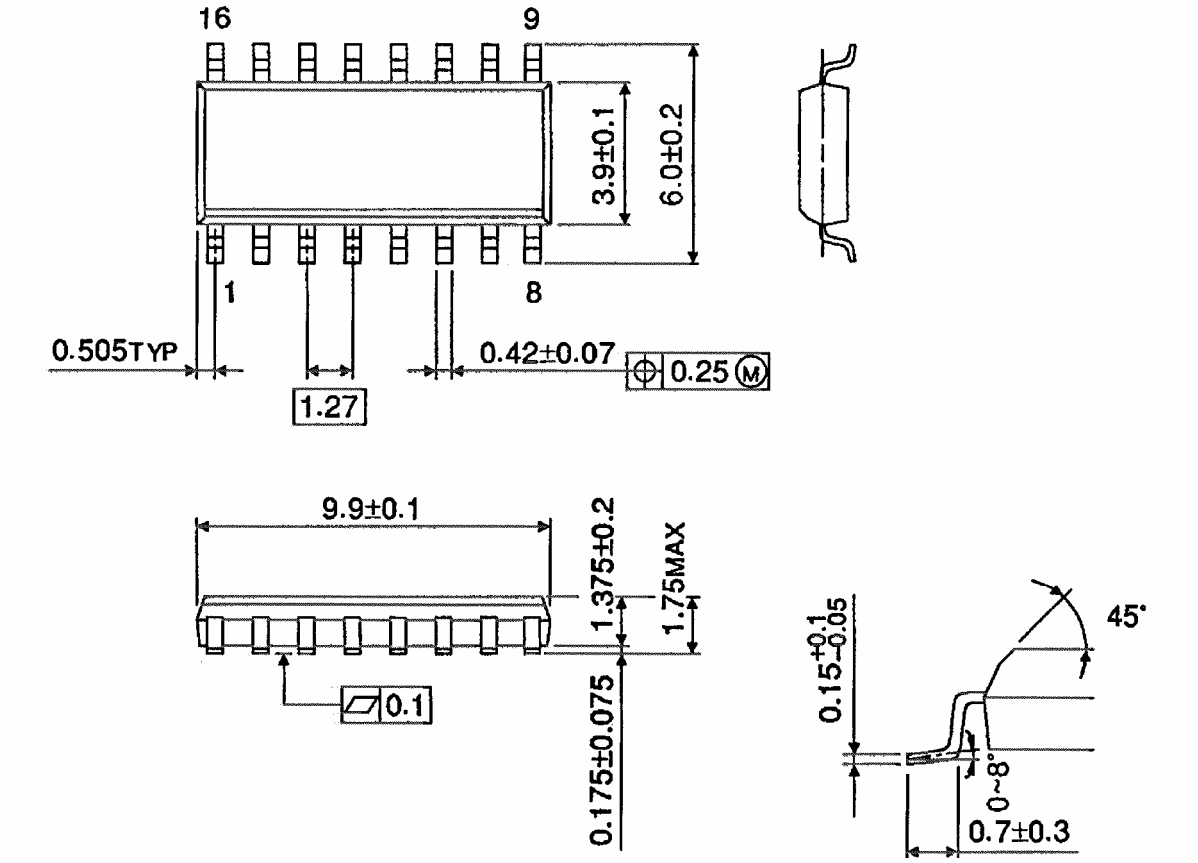
Package Dimensions



Weight: 0.18 g (typ.)

Package Dimensions (Note)

SOL16-P-150-1.27 Unit : mm



Note: This package is not available in Japan.

Weight: 0.13 g (typ.)

Note: Lead (Pb)-Free Packages

DIP16-P-300-2.54A SOP16-P-300-1.27A SOL16-P-150-1.27

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