M74HC133P/FP/DP

13-INPUT POSITIVE NAND GATE

DESCRIPTION

The M74HC133 is a semiconductor integrated circuit consisting of a 13-input positive-logic NAND gates, usable as negative-logic NOR gates.

FEATURES

- High-speed: 20ns typ. (C_L=15pF, V_{CC}=5V)
- Low power dissipation: 5μW/package, max (V_{CC}=5V, T_a=25℃, quiescent state)
- High noise margin: 30% of V_{CC}, min (V_{CC}=4.5V, 6V)
- Capable of driving 10 74LSTTL loads
- Wide operating voltage range: V_{CC}=2~6V
- Wide operating temperature range: T_a=−40~+85℃

APPLICATION

General purpose, for use in industrial and consumer digital equipment.

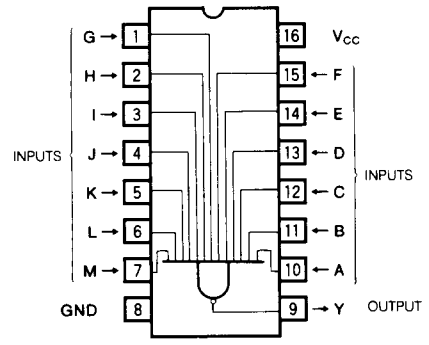
FUNCTIONAL DESCRIPTION

Use of silicon gate technology allows the M74HC133 to maintain the low power dissipation and high noise margin of the standard CMOS logic 4000B series while giving high-speed performance equivalent to the 74LS133.

Buffered output Y improve input-to-output transfer characteristics and reduce to a minimum output impedance variations with respect to input voltage variations.

When inputs A through M are all high, the output Y will become low and when at least one of A through M is low, the output Y will become high.

PIN CONFIGURATION (TOP VIEW)



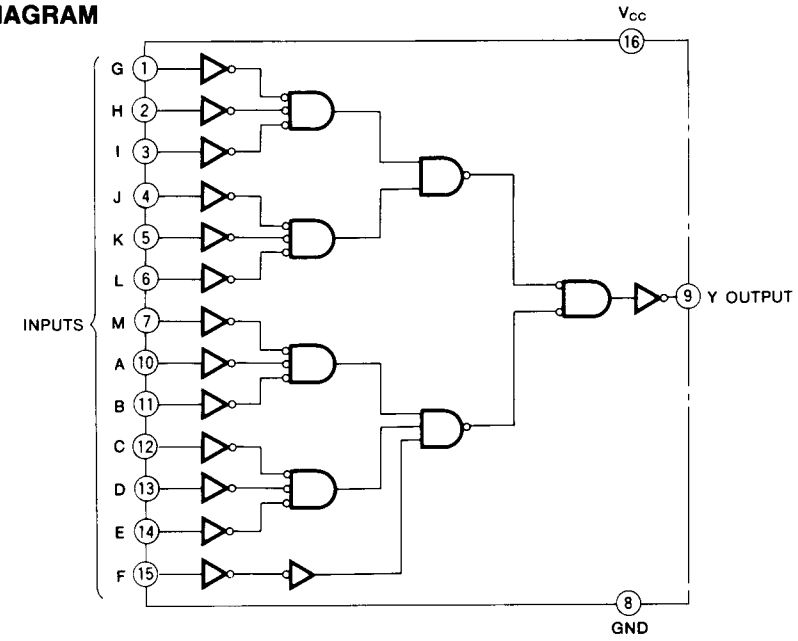
Outline 16P4, 16P2N, 16P2P

FUNCTION TABLE

Inputs		Output
A	N	Y
L	L	H
H	L	H
L	H	H
H	H	L

N = B·C·D·E·F·G·H·I·J·K·L·M

LOGIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS (T_a = −40∼+85℃, unless otherwise noted)

Symbol	Parameter	Conditions	Ratings	Unit
V_{CC}	Supply voltage		−0.5∼+7.0	V
V_I	Input voltage		−0.5∼V_{CC}+0.5	V
V_O	Output voltage		−0.5∼V_{CC}+0.5	V
I_{IK}	Input protection diode current	V_I < 0V	−20	mA
		V_I > V_{CC}	20	
I_{OK}	Output parasitic diode current	V_O < 0V	−20	mA
		V_O > V_{CC}	20	
I_O	Output current per output pin		±25	mA
I_{CC}	Supply/GND current	V_{CC}, GND	±50	mA
P_d	Power dissipation	(Note 1)	500	mW
Tstg	Storage temperature range		−65∼+150	℃

Note 1 : M74HC133FP, T_a = −40∼+70℃ and T_a = 70∼85℃ are derated at −6mW/℃.
M74HC133DP, T_a = −40∼+50℃ and T_a = 50∼85℃ are derated at −5mW/℃.

RECOMMENDED OPERATING CONDITIONS (T_a = −40∼+85℃)

Symbol	Parameter		Limits			Unit
			Min	Typ	Max	
V_{CC}	Supply voltage		2		6	V
V_I	Input voltage		0		V_{CC}	V
V_O	Output voltage		0		V_{CC}	V
T_{opr}	Operating temperature range		−40		+85	℃
t_r, t_f	Input risetime, falltime	V_{CC} = 2.0V	0		1000	ns
		V_{CC} = 4.5V	0		500	
		V_{CC} = 6.0V	0		400	

ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Test conditions		Limits					Unit
				25℃			−40∼+85℃		
			V_{CC}(V)	Min	Typ	Max	Min	Max	
V_{IH}	High-level input voltage	V_O = 0.1V, V_{CC}−0.1V $\|I_O\|$ = 20μA	2.0	1.5			1.5		V
			4.5	3.15			3.15		
			6.0	4.2			4.2		
V_{IL}	Low-level input voltage	V_O = V_{CC}−0.1V $\|I_O\|$ = 20μA	2.0			0.5		0.5	V
			4.5			1.35		1.35	
			6.0			1.8		1.8	
V_{OH}	High-level output voltage	V_I = V_{IH}, V_{IL}	I_{OH} = −20μA	2.0	1.9			1.9		V
			I_{OH} = −20μA	4.5	4.4			4.4		
			I_{OH} = −20μA	6.0	5.9			5.9		
			I_{OH} = −4.0mA	4.5	4.18			4.13		
			I_{OH} = −5.2mA	6.0	5.68			5.63		
V_{OL}	Low-level output voltage	V_I = V_{IH}	I_{OL} = 20μA	2.0			0.1		0.1	V
			I_{OL} = 20μA	4.5			0.1		0.1	
			I_{OL} = 20μA	6.0			0.1		0.1	
			I_{OL} = 4.0mA	4.5			0.26		0.33	
			I_{OL} = 5.2mA	6.0			0.26		0.33	
I_{IH}	High-level input current	V_I = 6V		6.0			0.1		1.0	μA
I_{IL}	Low-level input current	V_I = 0V		6.0			−0.1		−1.0	μA
I_{CC}	Quiescent supply current	V_I = V_{CC}, GND, I_O = 0μA		6.0			1.0		10.0	μA

SWITCHING CHARACTERISTICS (V_{CC} = 5V, T_a = 25℃)

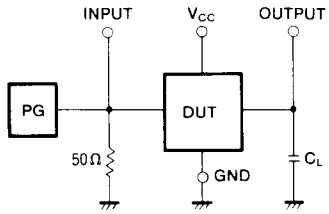
Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
t_{TLH}	Low-level to high-level and high-level to low-level	C_L = 15pF (Note 3)			10	ns
t_{THL}	output transition time				10	ns
t_{PLH}	Low-level to high-level and high-level to low-level				30	ns
t_{PHL}	output propagation time (A, B, C, D, E, F, G, H, I, J, K, L or M − Y)				30	ns

SWITCHING CHARACTERISTICS (V_{CC} = 2~6V, T_a = −40~+85℃)

Symbol	Parameter	Test conditions		Limits					Unit
				25℃			−40~+85℃		
			V_{CC}(V)	Min	Typ	Max	Min	Max	
t_{TLH}	Low-level to high-level and high-level to low-level output transition time	C_L = 50pF (Note 3)	2.0			75		95	ns
			4.5			15		19	
			6.0			13		16	
t_{THL}			2.0			75		95	ns
			4.5			15		19	
			6.0			13		16	
t_{PLH}	Low-level to high-level and high-level to low-level output propagation time (A, B, C, D, E, F, G, H, I, J, K, L or M − Y)		2.0			160		190	ns
			4.5			35		42	
			6.0			30		36	
t_{PHL}			2.0			160		190	ns
			4.5			35		42	
			6.0			30		36	
C_I	Input capacitance					10		10	pF
C_{PD}	Power dissipation capacitance (Note 2)				32				pF

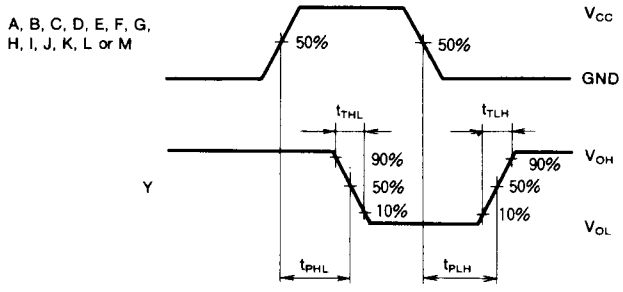
Note 2 : C_{PD} is the internal capacitance of the IC calculated from operation supply current under no-load conditions. (per gate)
The power dissipated during operation under no-load conditions is calculated using the following formula:
$P_D = C_{PD} \cdot V_{CC}^2 \cdot f_I + I_{CC} \cdot V_{CC}$

Note 3 : Test Circuit



(1) The pulse generator (PG) has the following characteristics (10%~90%): t_r = 6ns, t_f = 6ns
(2) The capacitance C_L includes stray wiring capacitance and the probe input capacitance.

TIMING DIAGRAM

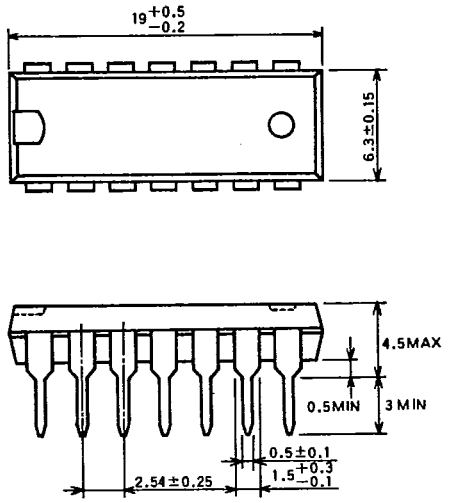


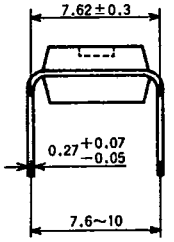
MITSUBISHI HIGH SPEED CMOS

PACKAGE OUTLINES

TYPE 14P4 14-PIN MOLDED PLASTIC DIP

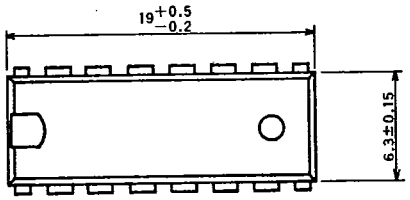
Dimension in mm

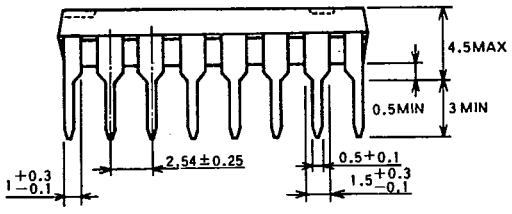


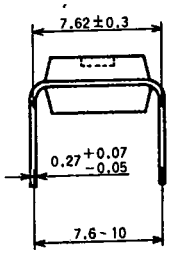


TYPE 16P4 16-PIN MOLDED PLASTIC DIP

Dimension in mm





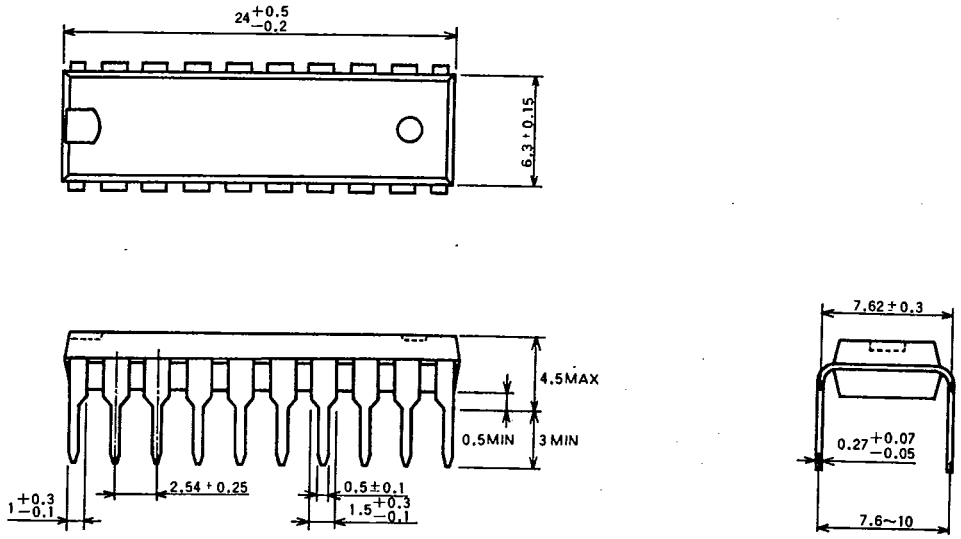


MITSUBISHI HIGH SPEED CMOS

PACKAGE OUTLINES

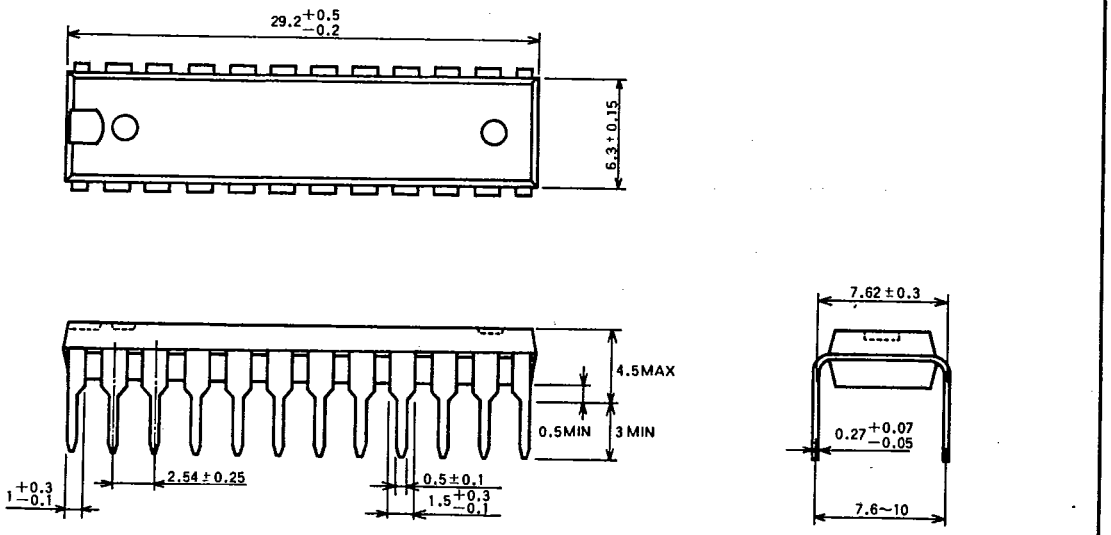
TYPE 20P4 20-PIN MOLDED PLASTIC DIP

Dimension in mm



TYPE 24P4D 24-PIN MOLDED PLASTIC DIP

Dimension in mm



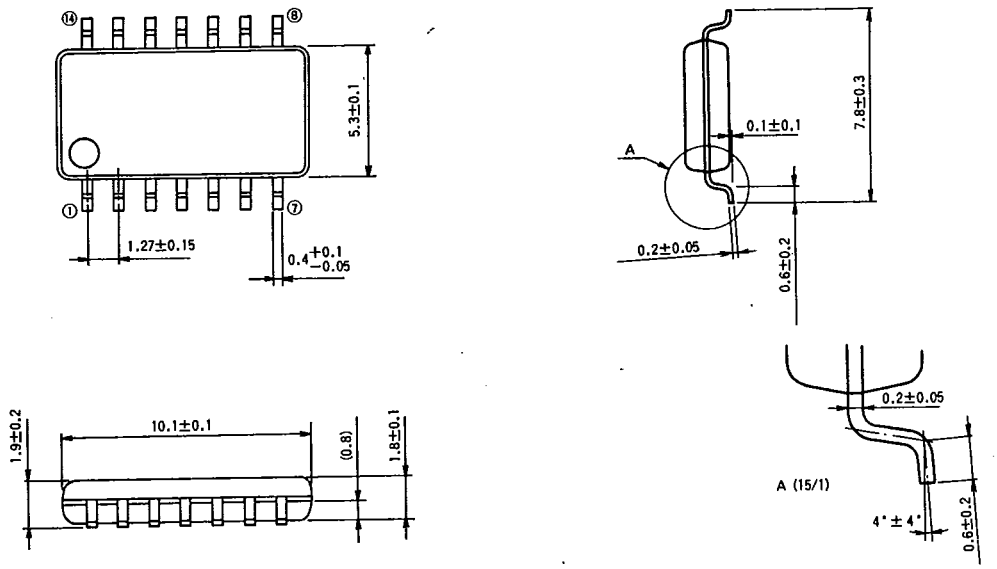
MITSUBISHI ELECTRIC

MITSUBISHI HIGH SPEED CMOS

PACKAGE OUTLINES

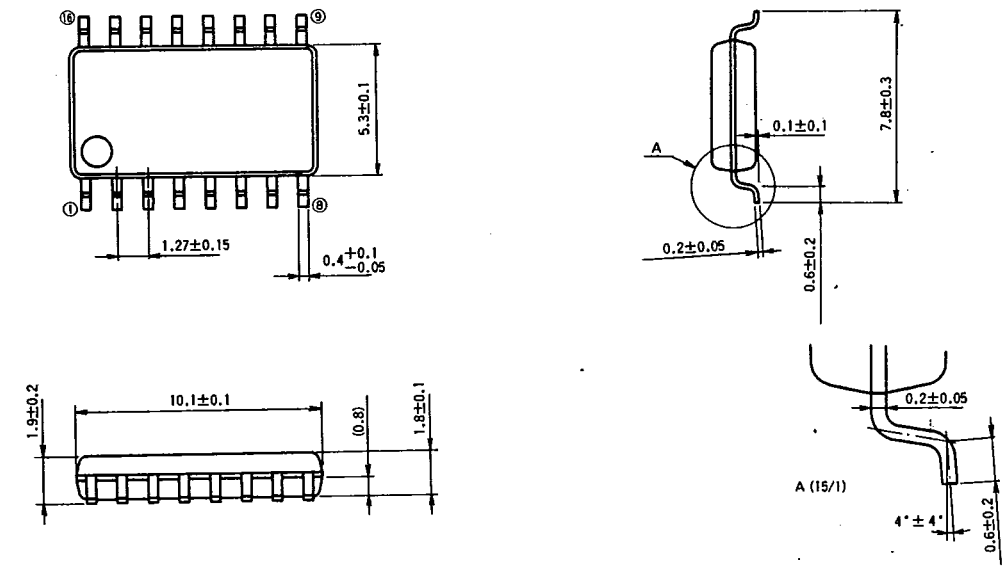
TYPE 14P2N 14PIN MOLDED PLASTIC SOP

Dimension in mm



TYPE 16P2N 16PIN MOLDED PLASTIC SOP

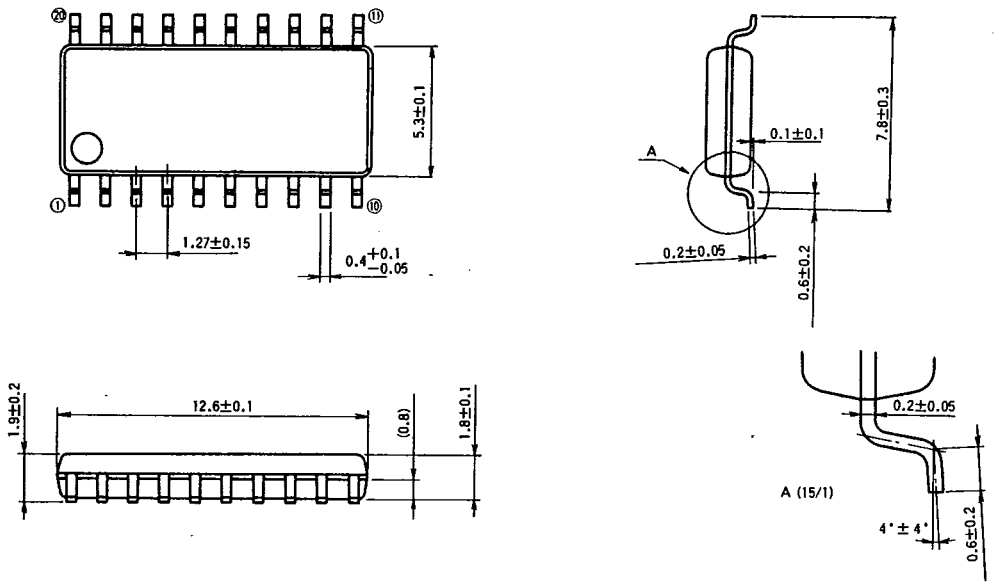
Dimension in mm



PACKAGE OUTLINES

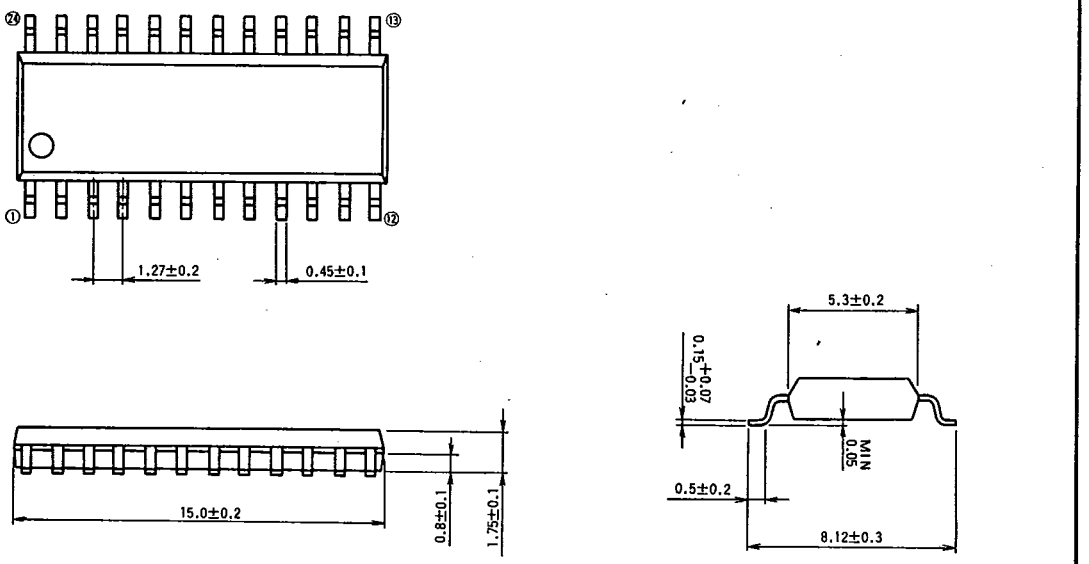
TYPE 20P2N 20PIN MOLDED PLASTIC SOP

Dimension in mm



TYPE 24P2 24PIN MOLDED PLASTIC SOP

Dimension in mm

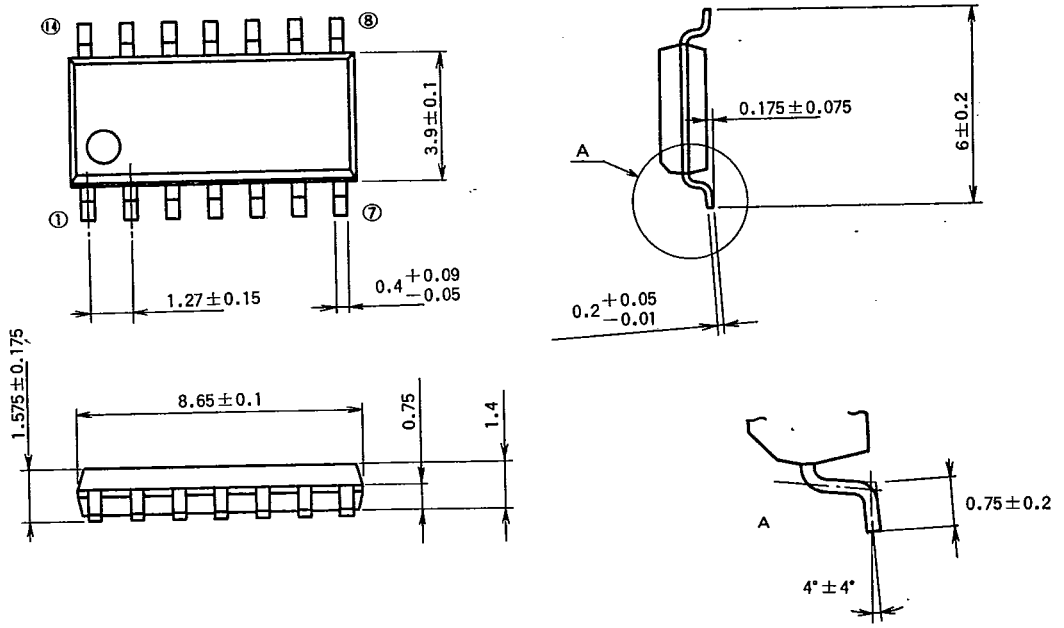


MITSUBISHI ELECTRIC

PACKAGE OUTLINES

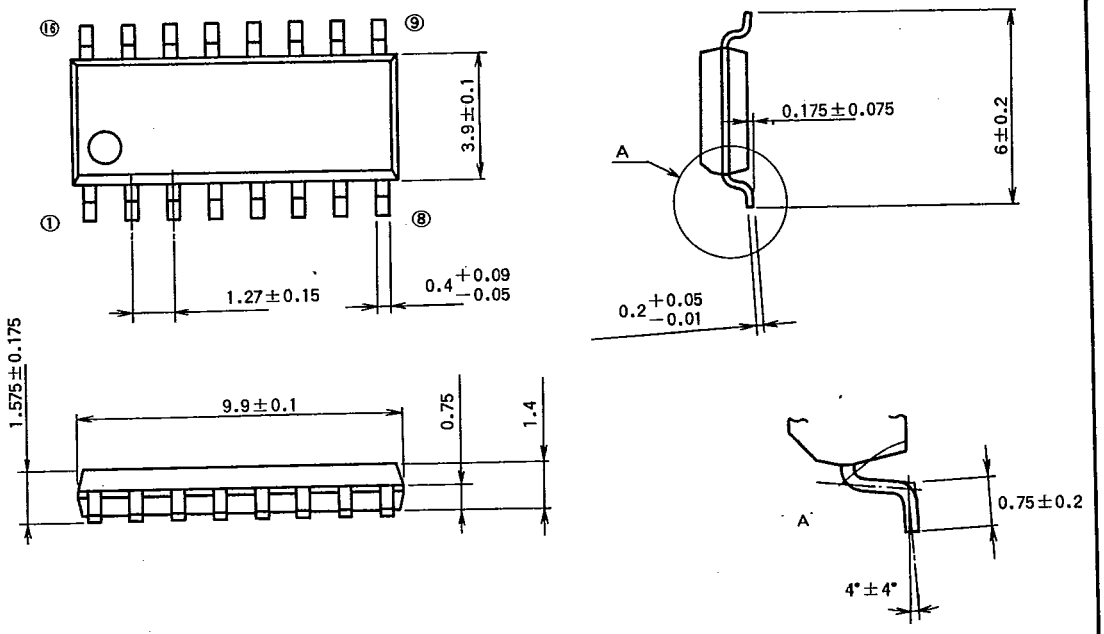
TYPE 14P2P 14-PIN MOLDED PLASTIC SOP(JEDEC 150mil body)

Dimension in mm



TYPE 16P2P 16-PIN MOLDED PLASTIC SOP(JEDEC 150mil body)

Dimension in mm



PACKAGE OUTLINES

TYPE 20P2V 20-PIN MOLDED PLASTIC SOP(JEDEC 300mil body)

Dimension in mm