

**PRELIMINARY**

Notice: This is not a final specification. Some parametric limits are subject to change.

# MITSUBISHI HIGH SPEED CMOS M74HC4543P/FP/DP

## BCD-TO SEVEN-SEGMENT LATCH/DECODER/DISPLAY DRIVER FOR LIQUID-CRYSTAL DISPLAYS

### DESCRIPTION

The M74HC4543 is a semiconductor integrated circuit consisting of a seven-segment BCD decoder/driver, enable to drive liquid-crystal displays.

### FEATURES

- Contained latch for BCD input
- Blanking input
- High-speed: 45ns typ. ( $C_L=15\text{pF}$ ,  $V_{CC}=5\text{V}$ )
- Low power dissipation:  $20\mu\text{W}/\text{package}$ , max ( $V_{CC}=5\text{V}$ ,  $T_a=25^\circ\text{C}$ , quiescent state)
- High noise margin: 30% of  $V_{CC}$ , min ( $V_{CC}=4.5\text{V}$ ,  $6\text{V}$ )
- Wide operating voltage range:  $V_{CC}=2\sim 6\text{V}$
- Wide operating temperature range:  $T_a=-40\sim +85^\circ\text{C}$

### APPLICATION

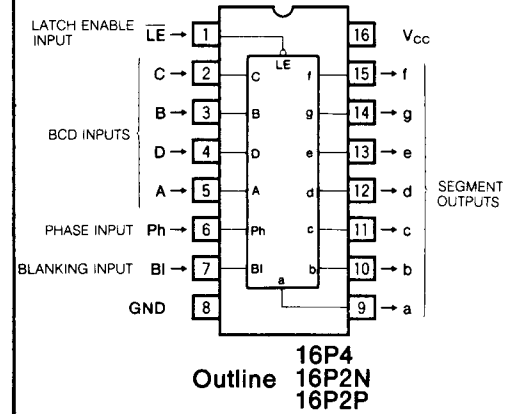
General purpose, for use in industrial and consumer digital equipment.

### FUNCTIONAL DESCRIPTION

When BCD code is applied to BCD (binary coded decimal) inputs A through D, the corresponding segment outputs a through g will become high. When each output is connected to a seven-segment display device, numeric characters are displayed as shown in the displayed character table.

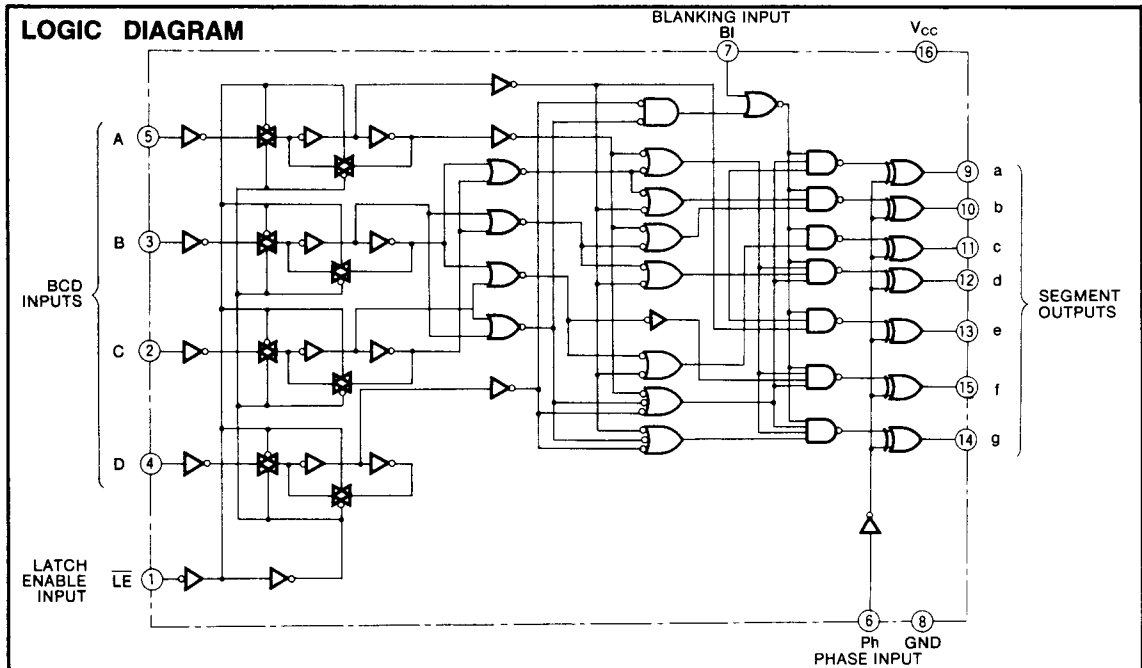
When latch enable input  $\overline{\text{LE}}$  changes from high-level to low-level, the signals existing immediately prior to the change at A through D will be stored in the latch. When

### PIN CONFIGURATION (TOP VIEW)



blanking input B1 is high, a~g will become low irrespective of A through D, and display will be put out.

When phase input Ph is high, outputs a through g will be changed. To drive a liquid-crystal display device, the common square wave signal must be applied to Ph and the common backplane of display device. (See Application Example.) To drive other display devices, Ph must be set to low or high, and additional components must be connected to the segment outputs to increase the drive current.



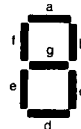
BCD-TO SEVEN-SEGMENT  
LATCH/DECODER/DISPLAY DRIVER FOR LIQUID-CRYSTAL DISPLAYS

FUNCTION TABLE (Note 1)

Decimal value or function	Inputs							Outputs						
	LE	Ph	BI	D	C	B	A	a	b	c	d	e	f	g
0	H	L	L	L	L	L	L	H	H	H	H	H	H	L
1	H	L	L	L	L	L	H	L	H	H	L	L	L	L
2	H	L	L	L	L	H	L	H	H	L	H	H	L	H
3	H	L	L	L	L	H	H	H	H	H	H	L	L	H
4	H	L	L	L	H	L	L	L	H	H	L	L	H	H
5	H	L	L	L	H	L	H	H	L	H	H	L	H	H
6	H	L	L	L	H	H	L	H	L	H	H	H	H	H
7	H	L	L	L	H	H	H	H	H	H	L	L	L	L
8	H	L	L	H	L	L	L	H	H	H	H	H	H	H
9	H	L	L	H	L	L	L	H	H	H	H	L	H	H
10	H	L	L	H	L	H	L	L	L	L	L	L	L	L
11	H	L	L	H	L	H	H	L	L	L	L	L	L	L
12	H	L	L	H	H	L	L	L	L	L	L	L	L	L
13	H	L	L	H	H	L	H	L	L	L	L	L	L	L
14	H	L	L	H	H	H	L	L	L	L	L	L	L	L
15	H	L	L	H	H	H	H	L	L	L	L	L	L	L
Latch	L	L	L	X	X	X	X	a <sup>0</sup>	b <sup>0</sup>	c <sup>0</sup>	d <sup>0</sup>	e <sup>0</sup>	f <sup>0</sup>	g <sup>0</sup>
Blanking	X	L	H	X	X	X	X	L	L	L	L	L	L	L
DITTO	†	H	†				†	The output levels shown above are inverted.						

Note 1 : X : Irrelevant  
a<sup>0</sup>~g<sup>0</sup> : Output state of a~g when latch enable pulse is applied.  
† : Same combination as above

Definitions of character segments



DISPLAYED CHARACTERS

Decimal value	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Displayed character	0	1	2	3	4	5	6	7	8	9						

ABSOLUTE MAXIMUM RATINGS (T<sub>a</sub> = -40~+85°C, unless otherwise noted)

Symbol	Parameter	Conditions	Ratings	Unit
V <sub>CC</sub>	Supply voltage		-0.5~+7.0	V
V <sub>I</sub>	Input voltage		-0.5~V <sub>CC</sub> +0.5	V
V <sub>O</sub>	Output voltage		-0.5~V <sub>CC</sub> +0.5	V
I <sub>IK</sub>	Input protection diode current	V <sub>I</sub> < 0V	-20	mA
		V <sub>I</sub> > V <sub>CC</sub>	20	
I <sub>OK</sub>	Output parasitic diode current	V <sub>O</sub> < 0V	-20	mA
		V <sub>O</sub> > V <sub>CC</sub>	20	
I <sub>O</sub>	Output current per output pin		±25	mA
I <sub>CC</sub>	Supply/GND current	V <sub>CC</sub> , GND	±50	mA
P <sub>D</sub>	Power dissipation	(Note 2)	500	mW
T <sub>stg</sub>	Storage temperature range		-65~+150	°C

Note 2 : M74HC4543FP, T<sub>a</sub> = -40~+70°C and T<sub>a</sub> = 70~85°C are derated at -6mW/°C.  
M74HC4543DP, T<sub>a</sub> = -40~+50°C and T<sub>a</sub> = 50~85°C are derated at -5mW/°C.

# MITSUBISHI HIGH SPEED CMOS M74HC4543P/FP/DP

## BCD-TO SEVEN-SEGMENT LATCH/DECODER/DISPLAY DRIVER FOR LIQUID-CRYSTAL DISPLAYS

### RECOMMENDED OPERATING CONDITIONS ( $T_a = -40 \sim +85^\circ\text{C}$ )

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	$^\circ\text{C}$
$t_r, t_f$	Input risetime, falltime	$V_{CC} = 2.0\text{V}$	0	1000	ns
		$V_{CC} = 4.5\text{V}$	0	500	
		$V_{CC} = 6.0\text{V}$	0	400	

### ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Test conditions	Limits					Unit
			25 $^\circ\text{C}$			-40 $\sim$ +85 $^\circ\text{C}$		
			$V_{CC}(\text{V})$	Min	Typ	Max	Min	
$V_{IH}$	High-level input voltage	$V_O = 0.1\text{V}, V_{CC} = 0.1\text{V}$ $ I_O  = 20\mu\text{A}$	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	$V_O = 0.1\text{V}, V_{CC} = 0.1\text{V}$ $ I_O  = 20\mu\text{A}$	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	$V_I = V_{IH}, V_{IL}$	$I_{OH} = -20\mu\text{A}$	2.0	1.9		1.9	V
			$I_{OH} = -20\mu\text{A}$	4.5	4.4		4.4	
			$I_{OH} = -20\mu\text{A}$	6.0	5.9		5.9	
			$I_{OH} = -0.4\text{mA}$	4.5	3.98		3.84	
			$I_{OH} = -0.52\text{mA}$	6.0	5.48		5.34	
$V_{OL}$	Low-level output voltage	$V_I = V_{IH}, V_{IL}$	$I_{OL} = 20\mu\text{A}$	2.0		0.1	0.1	V
			$I_{OL} = 20\mu\text{A}$	4.5		0.1	0.1	
			$I_{OL} = 20\mu\text{A}$	6.0		0.1	0.1	
			$I_{OL} = 0.4\text{mA}$	4.5		0.26	0.33	
			$I_{OL} = 0.52\text{mA}$	6.0		0.26	0.33	
$I_{IH}$	High-level input current	$V_I = 6\text{V}$	6.0		0.1	1.0	$\mu\text{A}$	
$I_{IL}$	Low-level input current	$V_I = 0\text{V}$	6.0		-0.1	-1.0	$\mu\text{A}$	
$I_{CC}$	Quiescent supply current	$V_I = V_{CC}, \text{GND}, I_O = 0\mu\text{A}$	6.0		4.0	40.0	$\mu\text{A}$	

### SWITCHING CHARACTERISTICS ( $V_{CC} = 5\text{V}, T_a = 25^\circ\text{C}$ )

Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
$t_{TLH}$	Low-level to high-level and high-level to low-level output transition time	$C_L = 15\text{pF}$ (Note 4)			10	ns
$t_{THL}$					10	ns
$t_{PLH}$	Low-level to high-level and high-level to low-level output propagation time (A~D - a~g)				66	ns
$t_{PHL}$					66	ns
$t_{PLH}$	Low-level to high-level and high-level to low-level output propagation time ( $\overline{\text{LE}}$ - a~g)				66	ns
$t_{PHL}$					66	ns
$t_{PLH}$	Low-level to high-level and high-level to low-level output propagation time (BI - a~g)				41	ns
$t_{PHL}$					41	ns
$t_{PLH}$	Low-level to high-level and high-level to low-level output propagation time (Ph - a~g)				30	ns
$t_{PHL}$				30	ns	

**BCD-TO SEVEN-SEGMENT  
LATCH/DECODER/DISPLAY DRIVER FOR LIQUID-CRYSTAL DISPLAYS**

**SWITCHING CHARACTERISTICS** ( $V_{CC} = 2\sim 6V$ ,  $T_a = -40\sim +85^\circ C$ )

Symbol	Parameter	Test conditions	Limits					Unit	
			V <sub>CC</sub> (V)	25°C			-40~+85°C		
				Min	Typ	Max	Min		Max
t <sub>TLH</sub>	Low-level to high-level and high-level to low-level		2.0			75		95	ns
			4.5			15		19	
			6.0			13		16	
t <sub>THL</sub>	output transition time		2.0			75		95	ns
			4.5			15		19	
			6.0			13		16	
t <sub>PLH</sub>	Low-level to high-level and high-level to low-level		2.0			385		480	ns
			4.5			77		96	
			6.0			66		82	
t <sub>PHL</sub>	output propagation time (A~D - a~g)	C <sub>L</sub> = 50pF (Note 4)	2.0			385		480	ns
			4.5			77		96	
			6.0			66		82	
t <sub>PLH</sub>	Low-level to high-level and high-level to low-level		2.0			385		480	ns
			4.5			77		96	
			6.0			66		82	
t <sub>PHL</sub>	output propagation time (LE - a~g)		2.0			385		480	ns
			4.5			77		96	
			6.0			66		82	
t <sub>PLH</sub>	Low-level to high-level and high-level to low-level		2.0			240		300	ns
			4.5			48		60	
			6.0			41		51	
t <sub>PHL</sub>	output propagation time (BI - a~g)		2.0			240		300	ns
			4.5			48		60	
			6.0			41		51	
t <sub>PLH</sub>	Low-level to high-level and high-level to low-level		2.0			175		220	ns
			4.5			35		44	
			6.0			30		37	
t <sub>PHL</sub>	output propagation time (Ph - a~g)		2.0			175		220	ns
			4.5			35		44	
			6.0			30		37	
C <sub>I</sub>	Input capacitance					10		10	pF
C <sub>PD</sub>	Power dissipation capacitance (Note 3)								pF

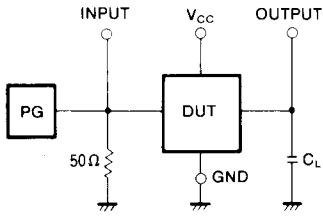
Note 3 : C<sub>PD</sub> is the internal capacitance of the IC calculated from operation supply current under no-load conditions.  
The power dissipated during operation under no-load conditions is calculated using the following formula:  
P<sub>0</sub> = C<sub>PD</sub> · V<sub>CC</sub><sup>2</sup> · f<sub>i</sub> + I<sub>CC</sub> · V<sub>CC</sub>

**TIMING REQUIREMENTS** ( $V_{CC} = 2\sim 6V$ ,  $T_a = -40\sim +85^\circ C$ )

Symbol	Parameter	Test conditions	Limits					Unit	
			V <sub>CC</sub> (V)	25°C			-40~+85°C		
				Min	Typ	Max	Min		Max
t <sub>w</sub>	LE pulse width		2.0			75		95	ns
			4.5			15		19	
			6.0			13		16	
t <sub>su</sub>	A~D setup time with respect to LE		2.0			75		95	ns
			4.5			15		19	
			6.0			13		16	
t <sub>h</sub>	A~D hold time with respect to LE		2.0			0		0	ns
			4.5			0		0	
			6.0			0		0	

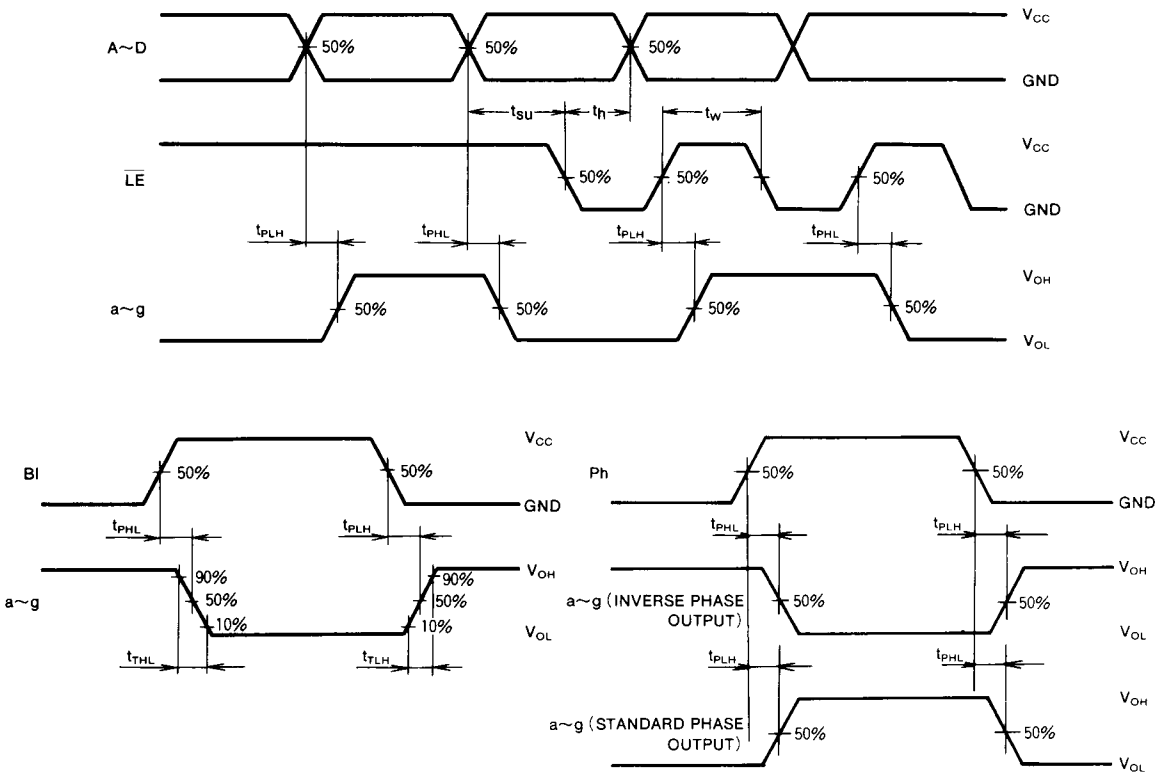
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LATCH/DECODER/DISPLAY DRIVER FOR LIQUID-CRYSTAL DISPLAYS**

Note 4 : Test Circuit



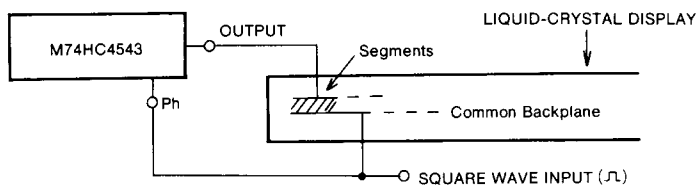
- (1) The pulse generator (PG) has the following characteristics (10%~90%):  $t_r = 6\text{ns}$ ,  $t_f = 6\text{ns}$
- (2) The capacitance  $C_L$  includes stray wiring capacitance and the probe input capacitance.

**TIMING DIAGRAM**



**APPLICATION EXAMPLE**

LIQUID-CRYSTAL DISPLAY DRIVER



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PACKAGE OUTLINES

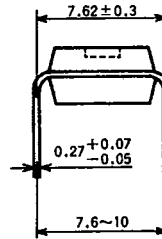
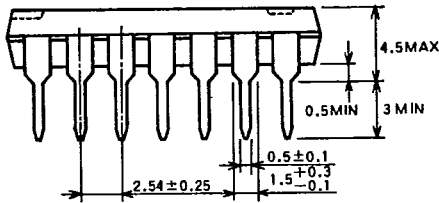
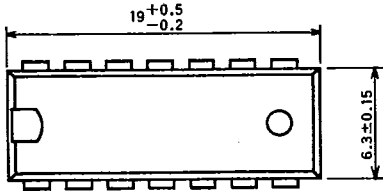
6249827 MITSUBISHI (DGTL LOGIC)

91D 12849

D T-90-20

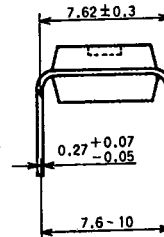
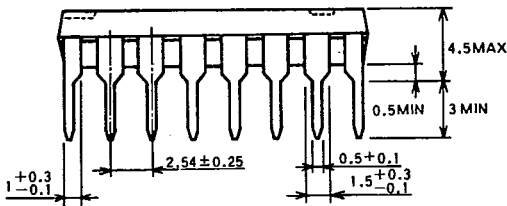
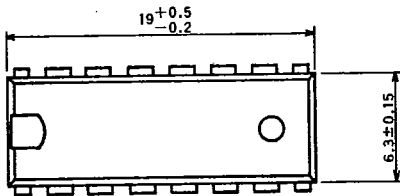
TYPE 14P4 14-PIN MOLDED PLASTIC DIP

Dimension in mm



TYPE 16P4 16-PIN MOLDED PLASTIC DIP

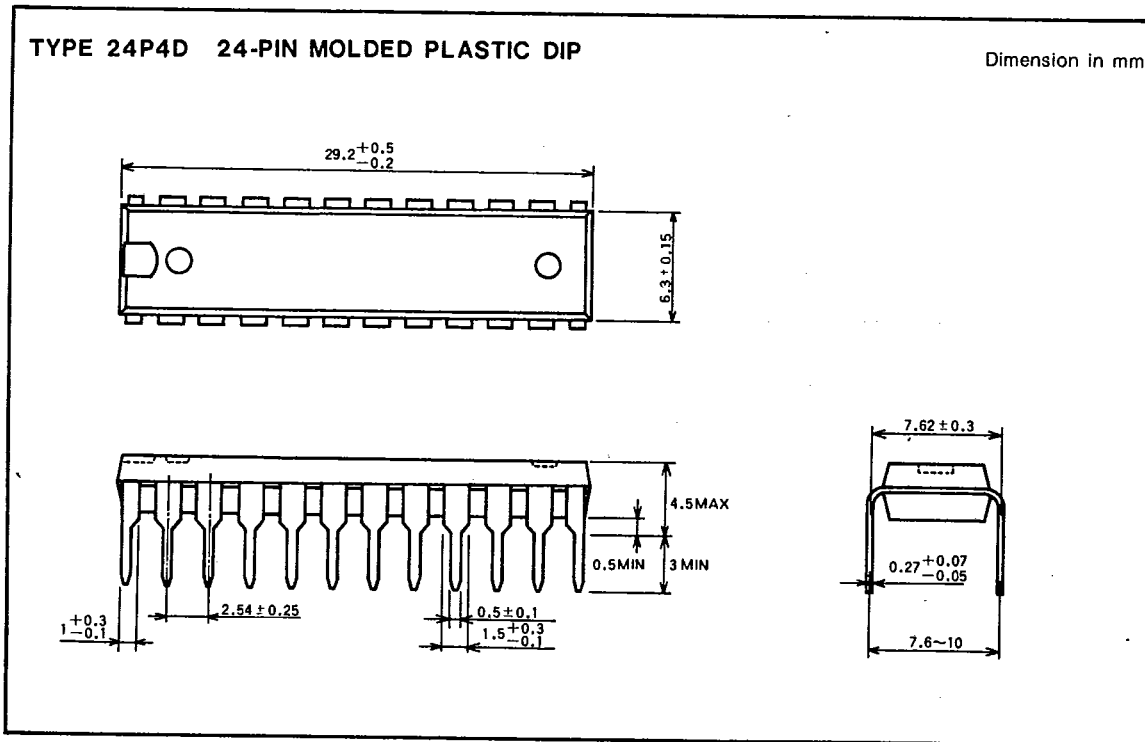
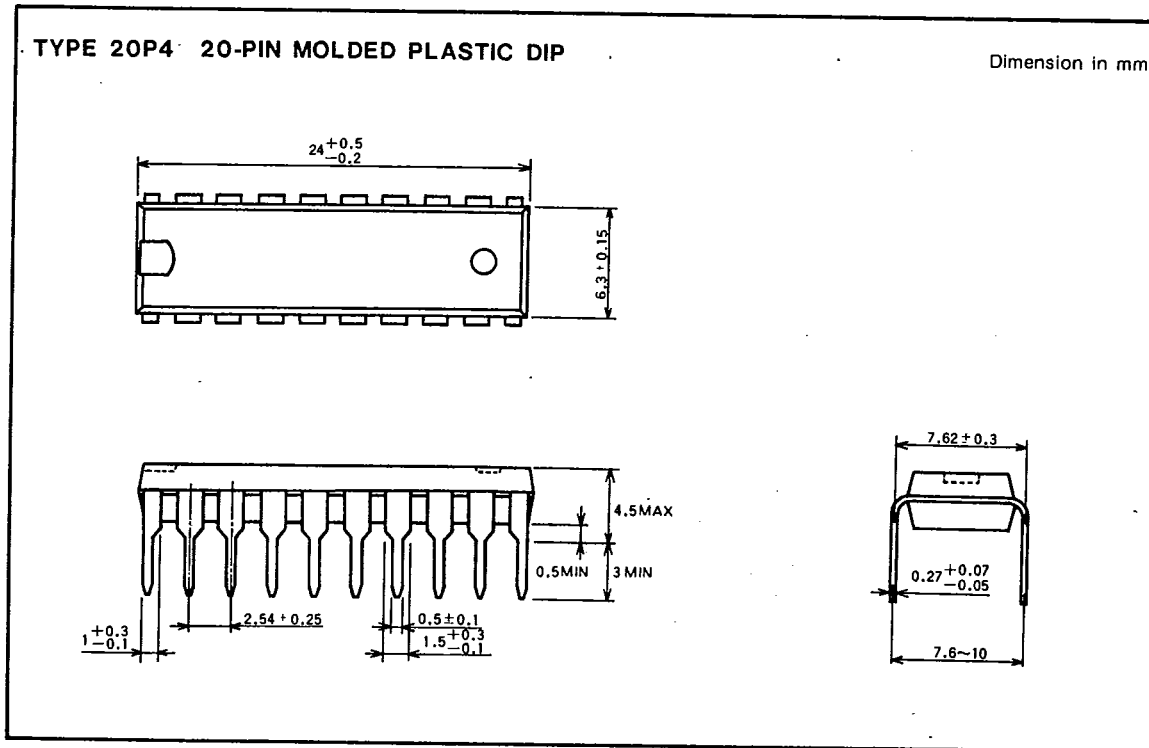
Dimension in mm



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G-02

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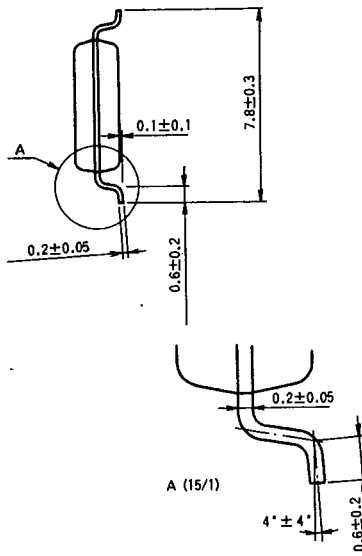
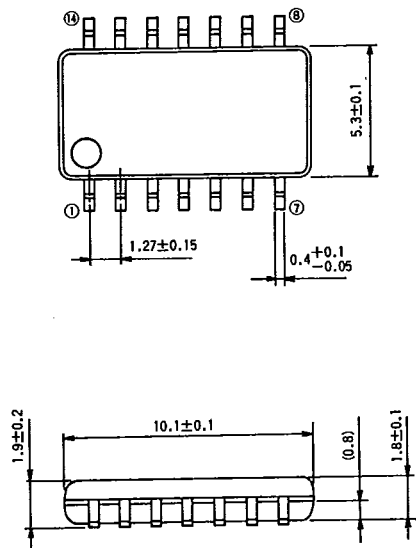
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91D 12851 D T-90.20

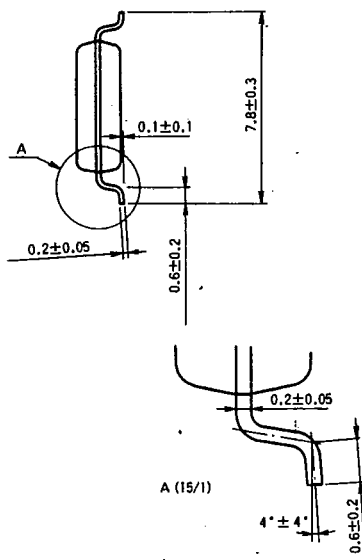
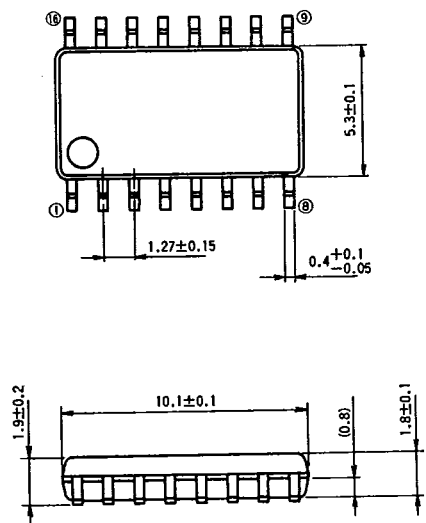
TYPE 14P2N 14PIN MOLDED PLASTIC SOP

Dimension in mm



TYPE 16P2N 16PIN MOLDED PLASTIC SOP

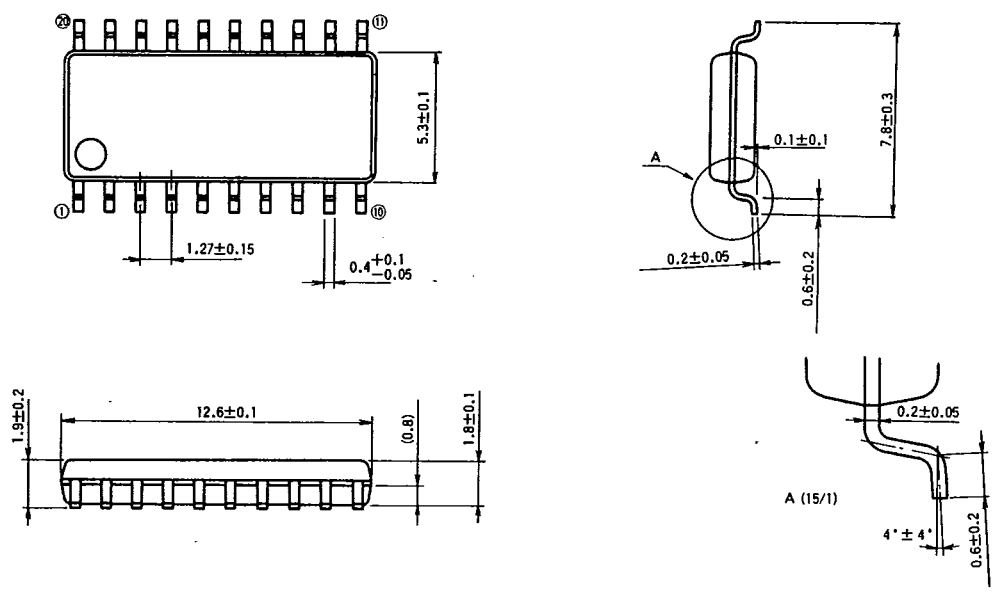
Dimension in mm





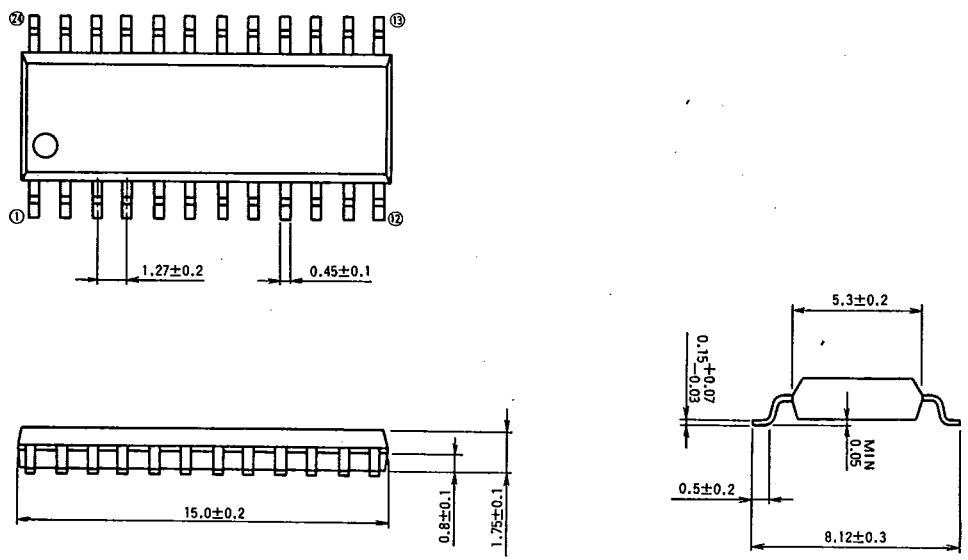
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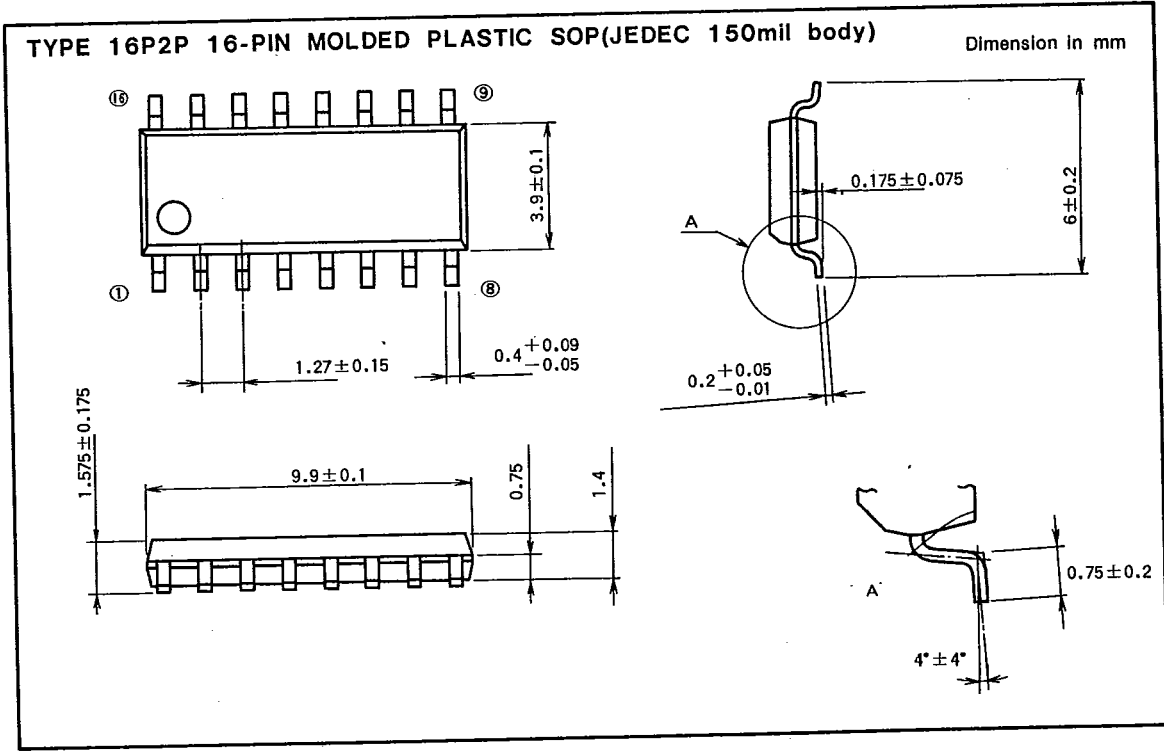
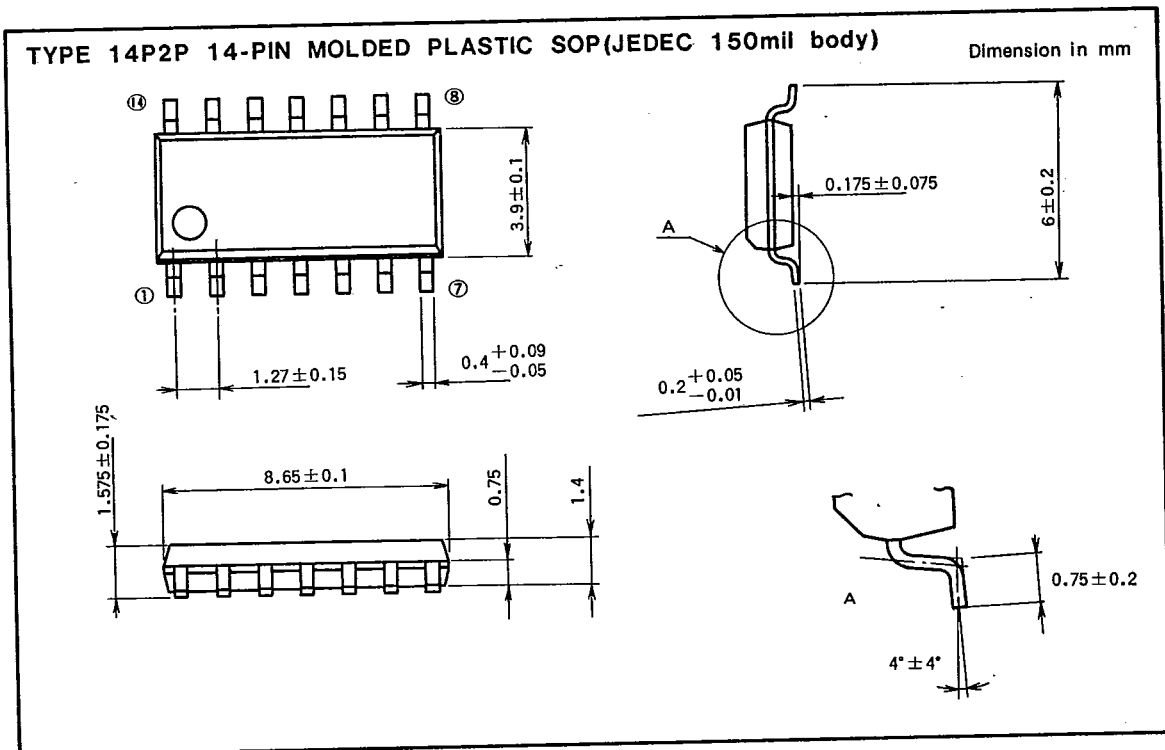
Dimension in mm



TYPE 24P2 24PIN MOLDED PLASTIC SOP

Dimension in mm





MITSUBISHI HIGH SPEED CMOS  
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