

# HD74AC138/HD74ACT138

## 1-of-8 Decoder/Demultiplexer

REJ03D0248-0200Z  
 (Previous ADE-205-368 (Z))  
 Rev.2.00  
 Jul.16.2004

### Description

The HD74AC138/HD74ACT138 is a high-speed 1-of-8 decoder/demultiplexer. This device is ideally suited for high-speed bipolar memory chip select address decoding. The multiple input enables allow parallel expansion to a 1-of-24 decoder using just three HD74AC138/HD74ACT138 devices or a 1-of-32 decoder using four HD74AC138/HD74ACT138 devices and one inverter.

### Features

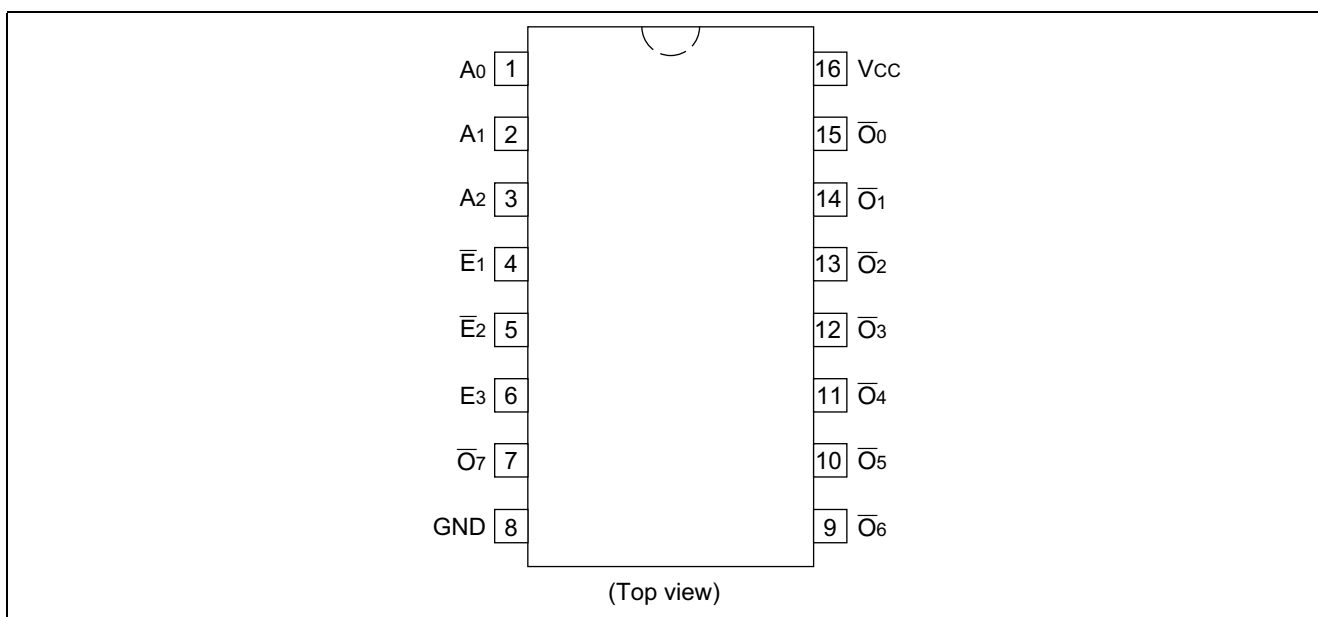
- Demultiplexing Capability
- Multiple Input Enable for Easy Expansion
- Active LOW Mutually Exclusive Outputs
- Outputs Source/Sink 24 mA
- HD74ACT138 has TTL-Compatible Inputs
- Ordering Information: Ex. HD74AC138

Part Name	Package Type	Package Code	Package Abbreviation	Taping Abbreviation (Quantity)
HD74AC138AP	DIP-16 pin	DP-16E, -16FV	P	—
HD74AC138AFPEL	SOP-16 pin (JEITA)	FP-16DAV	FP	EL (2,000 pcs/reel)
HD74AC138ARPEL	SOP-16 pin (JEDEC)	FP-16DNV	RP	EL (2,500 pcs/reel)
HD74AC138TELL	TSSOP-16 pin	TTP-16DAV	T	ELL(2,000 pcs/reel)

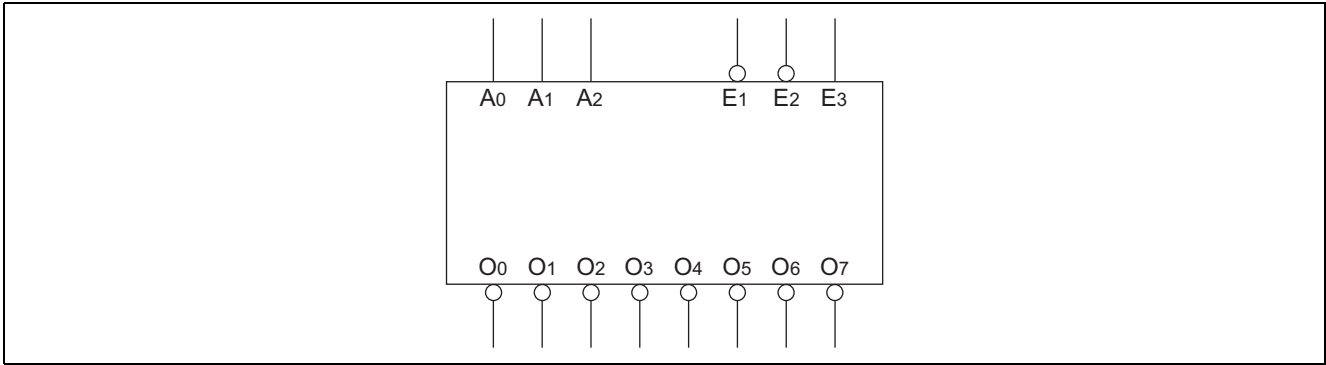
Notes: 1. Please consult the sales office for the above package availability.

2. The packages with lead-free pins are distinguished from the conventional products by adding V at the end of the package code.

### Pin Arrangement



Logic Symbol



Pin Names

- A<sub>0</sub> to A<sub>2</sub>    Address Inputs
- $\bar{E}_1$  to  $\bar{E}_2$     Enable Inputs
- E<sub>3</sub>            Enable Input
- $\bar{O}_0$  to  $\bar{O}_7$     Outputs

Functional Description

The HD74AC138/HD74ACT138 high-speed 1-of-8 decoder/demultiplexer accepts three binary weighted inputs (A<sub>0</sub>, A<sub>1</sub>, A<sub>2</sub>) and, when enabled, provides eight mutually exclusive active-LOW outputs ( $\bar{O}_0$  to  $\bar{O}_7$ ). The HD74AC138/HD74ACT138 features three Enable inputs, two active-Low ( $\bar{E}_1$ ,  $\bar{E}_2$ ) and one active-High (E<sub>3</sub>). All outputs will be High unless  $\bar{E}_1$  and  $\bar{E}_2$  are Low and E<sub>3</sub> is High. This multiple enabled function allows easy parallel expansion of the device to a 1-of-32 (5 lines to 32 lines) decoder with just four HD74AC138/HD74ACT138 devices and one inverter (See Figure a). The HD74AC138/HD74ACT138 can be used as an 8-output demultiplexer by using one of the active Low Enable inputs as the data input and the other Enable inputs as strobes. The Enables inputs which are not used must be permanently tied to their appropriate active-High or active-Low state.

Truth Table

Inputs						Outputs							
$\bar{E}_1$	$\bar{E}_2$	E <sub>3</sub>	A <sub>0</sub>	A <sub>1</sub>	A <sub>2</sub>	$\bar{O}_0$	$\bar{O}_1$	$\bar{O}_2$	$\bar{O}_3$	$\bar{O}_4$	$\bar{O}_5$	$\bar{O}_6$	$\bar{O}_7$
H	X	X	X	X	X	H	H	H	H	H	H	H	H
X	H	X	X	X	X	H	H	H	H	H	H	H	H
X	X	L	X	X	X	H	H	H	H	H	H	H	H
L	L	H	L	L	L	L	H	H	H	H	H	H	H
L	L	H	H	L	L	H	L	H	H	H	H	H	H
L	L	H	L	H	L	H	H	L	H	H	H	H	H
L	L	H	H	H	L	H	H	H	L	H	H	H	H
L	L	H	L	L	H	H	H	H	H	L	H	H	H
L	L	H	H	L	H	H	H	H	H	H	L	H	H
L	L	H	L	H	H	H	H	H	H	H	H	L	H
L	L	H	H	H	H	H	H	H	H	H	H	H	L

- H : High Voltage Level
- L : Low Voltage Level
- X : Immaterial

Logic Diagram

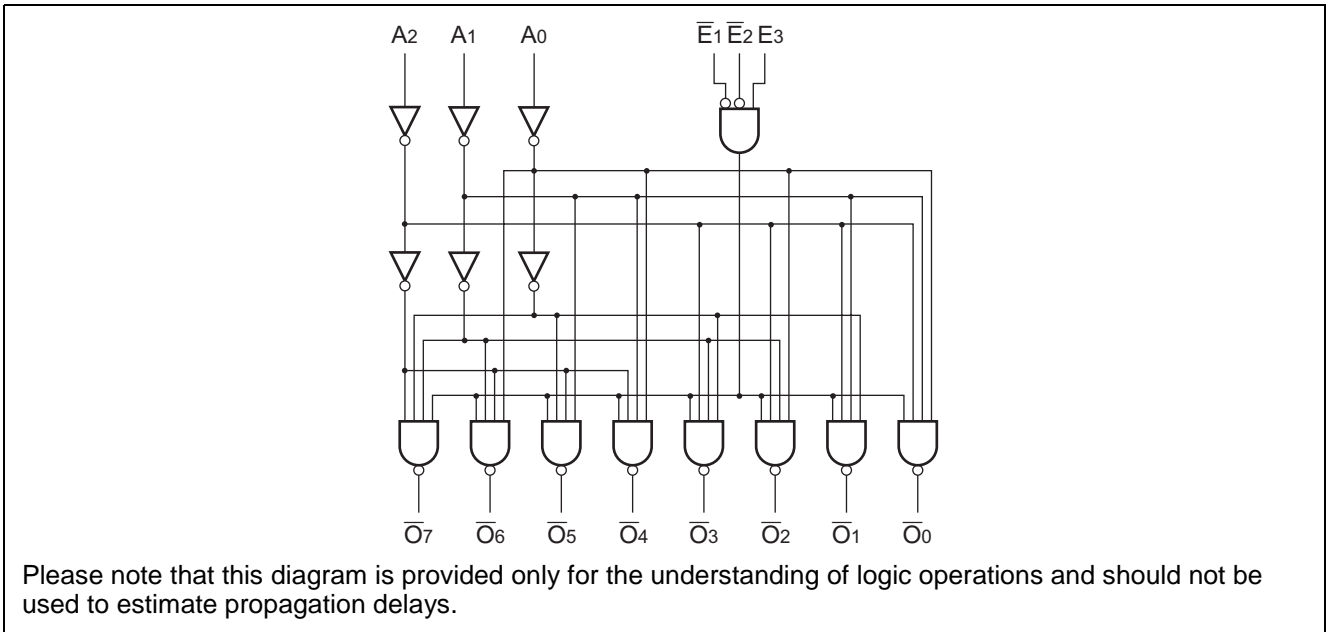
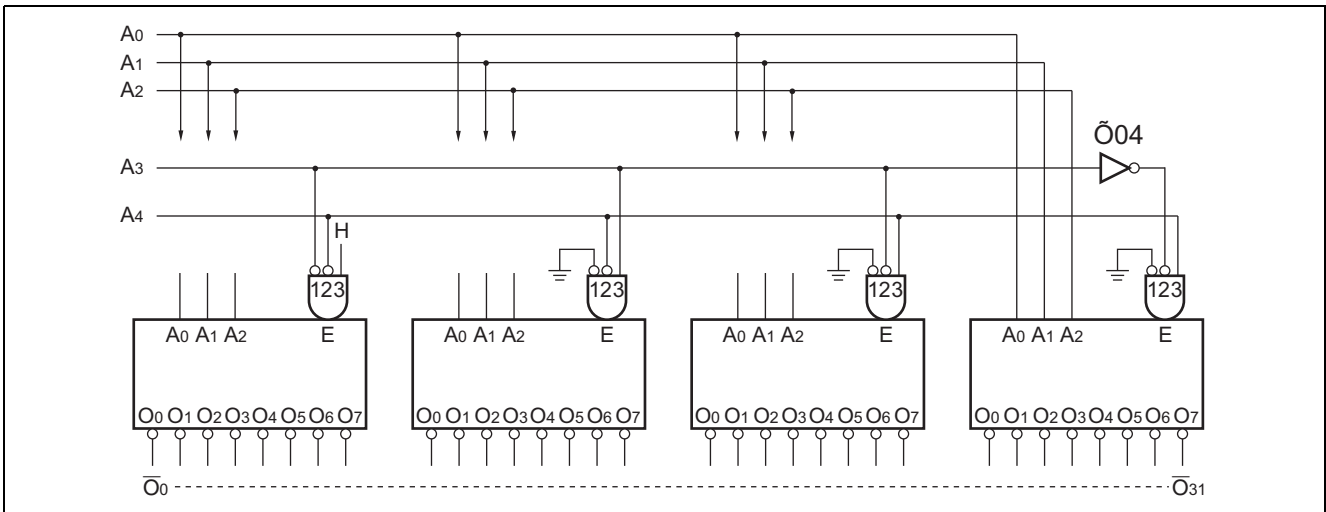


Figure a: Expansion of 1-of-32 Decoding



Absolute Maximum Ratings

Item	Symbol	Ratings	Unit	Condition
Supply voltage	$V_{CC}$	-0.5 to 7	V	
DC input diode current	$I_{IK}$	-20	mA	$V_I = -0.5V$
		20	mA	$V_I = V_{CC}+0.5V$
DC input voltage	$V_I$	-0.5 to $V_{CC}+0.5$	V	
DC output diode current	$I_{OK}$	-50	mA	$V_O = -0.5V$
		50	mA	$V_O = V_{CC}+0.5V$
DC output voltage	$V_O$	-0.5 to $V_{CC}+0.5$	V	
DC output source or sink current	$I_O$	$\pm 50$	mA	
DC $V_{CC}$ or ground current per output pin	$I_{CC}, I_{GND}$	$\pm 50$	mA	
Storage temperature	$T_{stg}$	-65 to +150	$^{\circ}C$	

**Recommended Operating Conditions: HD74AC138**

Item	Symbol	Ratings	Unit	Condition
Supply voltage	$V_{CC}$	2 to 6	V	
Input and output voltage	$V_I, V_O$	0 to $V_{CC}$	V	
Operating temperature	$T_a$	-40 to +85	°C	
Input rise and fall time (except Schmitt inputs) $V_{IN}$ 30% to 70% $V_{CC}$	$t_r, t_f$	8	ns/V	$V_{CC} = 3.0V$
				$V_{CC} = 4.5 V$
				$V_{CC} = 5.5 V$

**DC Characteristics: HD74AC138**

Item	Sym- bol	Vcc (V)	$T_a = 25^\circ C$			$T_a = -40$ to $+85^\circ C$		Unit	Condition			
			min.	typ.	max.	min.	max.					
Input Voltage	$V_{IH}$	3.0	2.1	1.5	—	2.1	—	V	$V_{OUT} = 0.1 V$ or $V_{CC} - 0.1 V$			
		4.5	3.15	2.25	—	3.15	—					
		5.5	3.85	2.75	—	3.85	—					
	$V_{IL}$	3.0	—	1.50	0.9	—	0.9		$V_{OUT} = 0.1 V$ or $V_{CC} - 0.1 V$			
		4.5	—	2.25	1.35	—	1.35					
		5.5	—	2.75	1.65	—	1.65					
Output voltage	$V_{OH}$	3.0	2.9	2.99	—	2.9	—	V	$V_{IN} = V_{IL}$ or $V_{IH}$ $I_{OUT} = -50 \mu A$			
		4.5	4.4	4.49	—	4.4	—					
		5.5	5.4	5.49	—	5.4	—					
		3.0	2.58	—	—	2.48	—				$V_{IN} = V_{IL}$ or $V_{IH}$	$I_{OH} = -12 mA$
		4.5	3.94	—	—	3.80	—					$I_{OH} = -24 mA$
		5.5	4.94	—	—	4.80	—					$I_{OH} = -24 mA$
	$V_{OL}$	3.0	—	0.002	0.1	—	0.1		$V_{IN} = V_{IL}$ or $V_{IH}$ $I_{OUT} = 50 \mu A$			
		4.5	—	0.001	0.1	—	0.1					
		5.5	—	0.001	0.1	—	0.1					
		3.0	—	—	0.32	—	0.37		$V_{IN} = V_{IL}$ or $V_{IH}$	$I_{OL} = 12 mA$		
		4.5	—	—	0.32	—	0.37			$I_{OL} = 24 mA$		
		5.5	—	—	0.32	—	0.37			$I_{OL} = 24 mA$		
	Input leakage current	$I_{IN}$	5.5	—	—	$\pm 0.1$	—		$\pm 1.0$	$\mu A$	$V_{IN} = V_{CC}$ or GND	
	Dynamic output current*	$I_{OLD}$	5.5	—	—	—	86		—	mA	$V_{OLD} = 1.1 V$	
$I_{OHD}$		5.5	—	—	—	-75	—	mA	$V_{OHD} = 3.85 V$			
Quiescent supply current	$I_{CC}$	5.5	—	—	8.0	—	80	$\mu A$	$V_{IN} = V_{CC}$ or ground			

\*Maximum test duration 2.0 ms, one output loaded at a time.

**Recommended Operating Conditions: HD74ACT138**

Item	Symbol	Ratings	Unit	Condition
Supply voltage	$V_{CC}$	2 to 6	V	
Input and output voltage	$V_I, V_O$	0 to $V_{CC}$	V	
Operating temperature	$T_a$	-40 to +85	°C	
Input rise and fall time (except Schmitt inputs) $V_{IN}$ 0.8 to 2.0 V	$t_r, t_f$	8	ns/V	$V_{CC} = 4.5V$ $V_{CC} = 5.5V$

**DC Characteristics: HD74ACT138**

Item	Symbol	V <sub>CC</sub> (V)	Ta = 25°C			Ta = -40 to +85°C		Unit	Condition				
			min.	typ.	max.	min.	max.						
Input voltage	V <sub>IH</sub>	4.5	2.0	1.5	—	2.0	—	V	V <sub>OUT</sub> = 0.1 V or V <sub>CC</sub> -0.1 V				
		5.5	2.0	1.5	—	2.0	—						
	V <sub>IL</sub>	4.5	—	1.5	0.8	—	0.8		V <sub>OUT</sub> = 0.1 V or V <sub>CC</sub> -0.1 V				
		5.5	—	1.5	0.8	—	0.8						
Output voltage	V <sub>OH</sub>	4.5	4.4	4.49	—	4.4	—	V	V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> I <sub>OUT</sub> = -50 μA				
		5.5	5.4	5.49	—	5.4	—						
		4.5	3.94	—	—	3.80	—			V <sub>IN</sub> = V <sub>IL</sub>	I <sub>OH</sub> = -24 mA		
		5.5	4.94	—	—	4.80	—				I <sub>OH</sub> = -24 mA		
	V <sub>OL</sub>	4.5	—	0.001	0.1	—	0.1		V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> I <sub>OUT</sub> = 50 μA				
		5.5	—	0.001	0.1	—	0.1						
		4.5	—	—	0.32	—	0.37			V <sub>IN</sub> = V <sub>IL</sub>	I <sub>OL</sub> = 24 mA		
		5.5	—	—	0.32	—	0.37				I <sub>OL</sub> = 24 mA		
		Input current	I <sub>IN</sub>	5.5	—	—	±0.1			—	±1.0	μA	V <sub>IN</sub> = V <sub>CC</sub> or GND
		I <sub>CC</sub> /input current	I <sub>CCT</sub>	5.5	—	0.6	—			—	1.5	mA	V <sub>IN</sub> = V <sub>CC</sub> -2.1 V
Dynamic output current*	I <sub>OLD</sub>	5.5	—	—	—	86	—	mA	V <sub>OLD</sub> = 1.1 V				
	I <sub>OHD</sub>	5.5	—	—	—	-75	—	mA	V <sub>OHD</sub> = 3.85 V				
Quiescent supply current	I <sub>CC</sub>	5.5	—	—	8.0	—	80	μA	V <sub>IN</sub> = V <sub>CC</sub> or ground				

\*Maximum test duration 2.0 ms, one output loaded at a time.

**AC Characteristics: HD74AC138**

Item	Symbol	V <sub>CC</sub> (V)* <sup>1</sup>	Ta = +25°C C <sub>L</sub> = 50 pF			Ta = -40°C to +85°C C <sub>L</sub> = 50 pF		Unit
			Min	Typ	Max	Min	Max	
Propagation delay A <sub>n</sub> to $\bar{O}_n$	t <sub>PLH</sub>	3.3	1.0	8.5	13.0	1.0	15.0	ns
		5.0	1.0	6.5	9.5	1.0	10.5	
Propagation delay A <sub>n</sub> to $\bar{O}_n$	t <sub>PHL</sub>	3.3	1.0	8.0	12.5	1.0	14.0	ns
		5.0	1.0	6.0	9.0	1.0	10.5	
Propagation delay $\bar{E}_1$ or $\bar{E}_2$ to $\bar{O}_n$	t <sub>PLH</sub>	3.3	1.0	11.0	15.0	1.0	16.0	ns
		5.0	1.0	8.0	11.0	1.0	12.0	
Propagation delay $\bar{E}_1$ or $\bar{E}_2$ to $\bar{O}_n$	t <sub>PHL</sub>	3.3	1.0	9.5	13.5	1.0	15.0	ns
		5.0	1.0	7.0	9.5	1.0	10.5	
Propagation delay E <sub>3</sub> to $\bar{O}_n$	t <sub>PLH</sub>	3.3	1.0	11.0	15.5	1.0	16.5	ns
		5.0	1.0	8.0	11.0	1.0	12.5	
Propagation delay E <sub>3</sub> to $\bar{O}_n$	t <sub>PHL</sub>	3.3	1.0	8.5	13.0	1.0	14.0	ns
		5.0	1.0	6.0	8.0	1.0	9.5	

Note: 1. Voltage Range 3.3 is 3.3 V ± 0.3 V  
Voltage Range 5.0 is 5.0 V ± 0.5 V

**AC Characteristics: HD74ACT138**

Item	Symbol	V <sub>CC</sub> (V)*1	Ta = +25°C C <sub>L</sub> = 50 pF			Ta = -40°C to +85°C C <sub>L</sub> = 50 pF		Unit
			Min	Typ	Max	Min	Max	
Propagation delay An to $\bar{O}_n$	t <sub>PLH</sub>	5.0	1.0	7.0	10.5	1.0	11.5	ns
Propagation delay An to $\bar{O}_n$	t <sub>PHL</sub>	5.0	1.0	6.5	10.5	1.0	11.5	ns
Propagation delay $\bar{E}_1$ or $\bar{E}_2$ to $\bar{O}_n$	t <sub>PLH</sub>	5.0	1.0	8.0	11.5	1.0	12.5	ns
Propagation delay $\bar{E}_1$ or $\bar{E}_2$ to $\bar{O}_n$	t <sub>PHL</sub>	5.0	1.0	7.5	11.5	1.0	12.5	ns
Propagation delay E <sub>3</sub> to $\bar{O}_n$	t <sub>PLH</sub>	5.0	1.0	8.0	12.0	1.0	13.0	ns
Propagation delay E <sub>3</sub> to $\bar{O}_n$	t <sub>PHL</sub>	5.0	1.0	6.5	10.5	1.0	11.5	ns

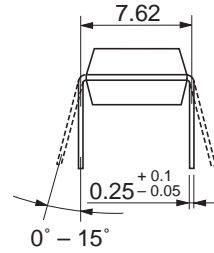
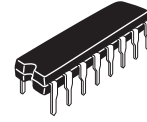
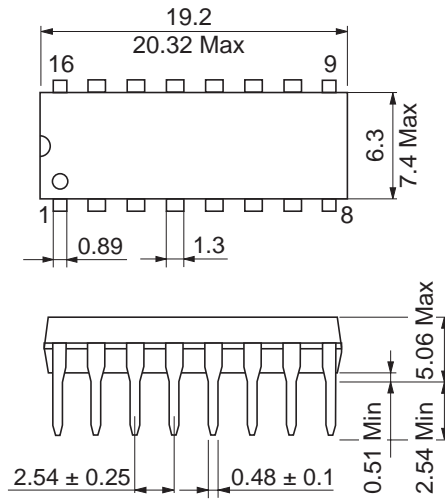
Note: 1. Voltage Range 5.0 is 5.0 V ± 0.5 V

**Capacitance**

Item	Symbol	Typ	Unit	Condition
Input capacitance	C <sub>IN</sub>	4.5	pF	V <sub>CC</sub> = 5.5 V
Power dissipation capacitance	C <sub>PD</sub>	60.0	pF	V <sub>CC</sub> = 5.0 V

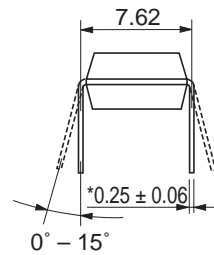
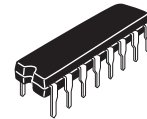
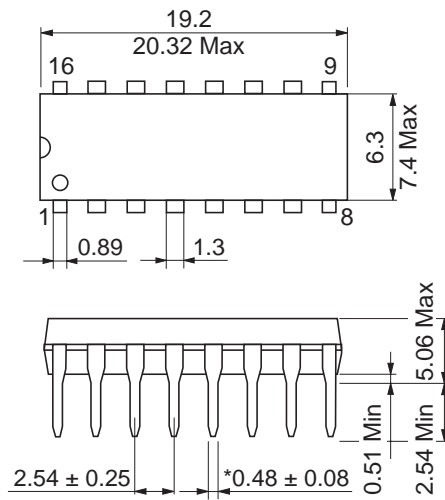
Package Dimensions

As of January, 2003  
Unit: mm



Package Code	DP-16E
JEDEC	Conforms
JEITA	Conforms
Mass (reference value)	1.05 g

Unit: mm

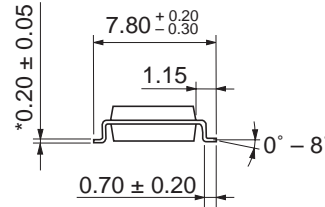
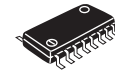
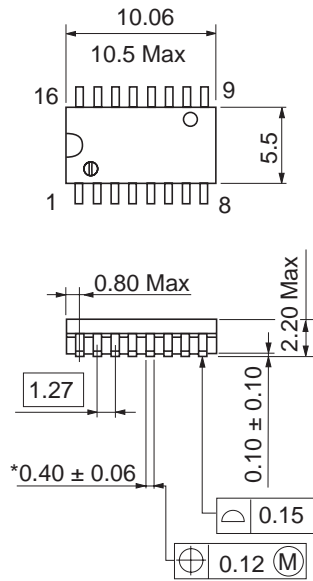


\*Ni/Pd/AU Plating

Package Code	DP-16FV
JEDEC	Conforms
JEITA	Conforms
Mass (reference value)	1.05 g

As of January, 2003

Unit: mm

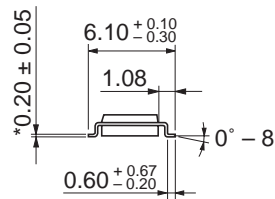
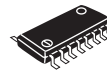
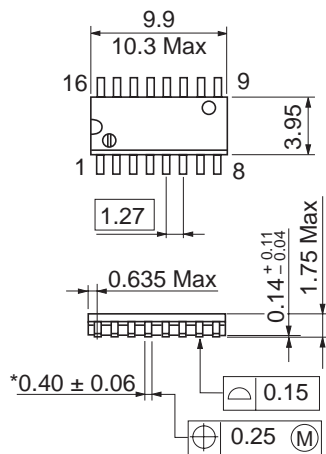


\*Ni/Pd/Au plating

Package Code	FP-16DAV
JEDEC	—
JEITA	Conforms
Mass (reference value)	0.24 g

As of January, 2003

Unit: mm



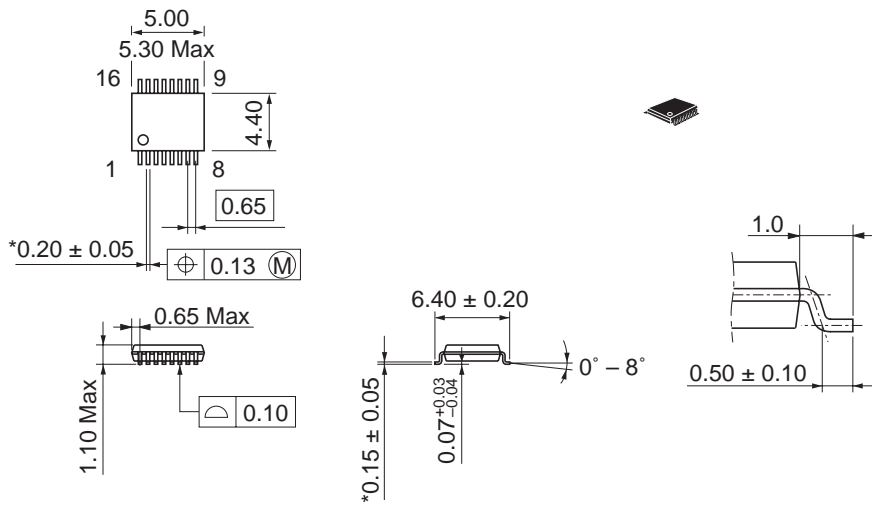
\*Ni/Pd/Au plating

Package Code	FP-16DNV
JEDEC	Conforms
JEITA	Conforms
Mass (reference value)	0.15 g



As of January, 2003

Unit: mm



\*Ni/Pd/Au plating

Package Code	TTP-16DAV
JEDEC	—
JEITA	—
Mass (reference value)	0.05 g

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