

# HD74AC166/HD74ACT166

## 8-bit Shift Register

REJ03D0255-0200Z  
 (Previous ADE-205-375 (Z))  
 Rev.2.00  
 Jul.16.2004

### Description

The HD74AC166/HD74ACT166 is an 8-bit, serial or parallel-in, serial-out shift register using edge triggered D-type flip-flops. Serial and parallel entry are synchronous, with state changes initiated by the rising edge of the clock. An asynchronous Master Reset overrides other inputs and clears all flip-flops. The circuit can be clocked from two sources or one CP input can be used to trigger the other.

### Features

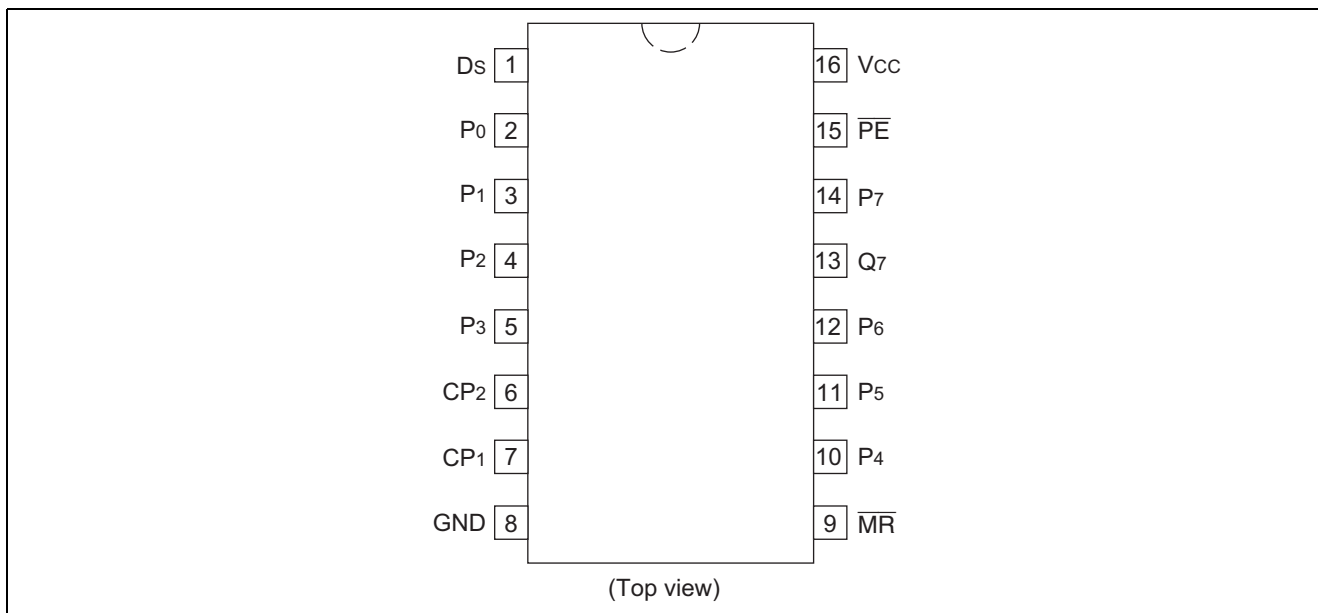
- Outputs Source/Sink 24 mA
- HD74ACT166 has TTL-Compatible Inputs
- Ordering Information: Ex. HD74AC166

Part Name	Package Type	Package Code	Package Abbreviation	Taping Abbreviation (Quantity)
HD74AC166AFPEL	SOP-16 pin (JEITA)	FP-16DAV	FP	EL (2,000 pcs/reel)
HD74AC166ARPEL	SOP-16 pin (JEDEC)	FP-16DNV	RP	EL (2,500 pcs/reel)
HD74AC166TELL	TSSOP-16 pin	TTP-16DAV	T	ELL(2,000 pcs/reel)

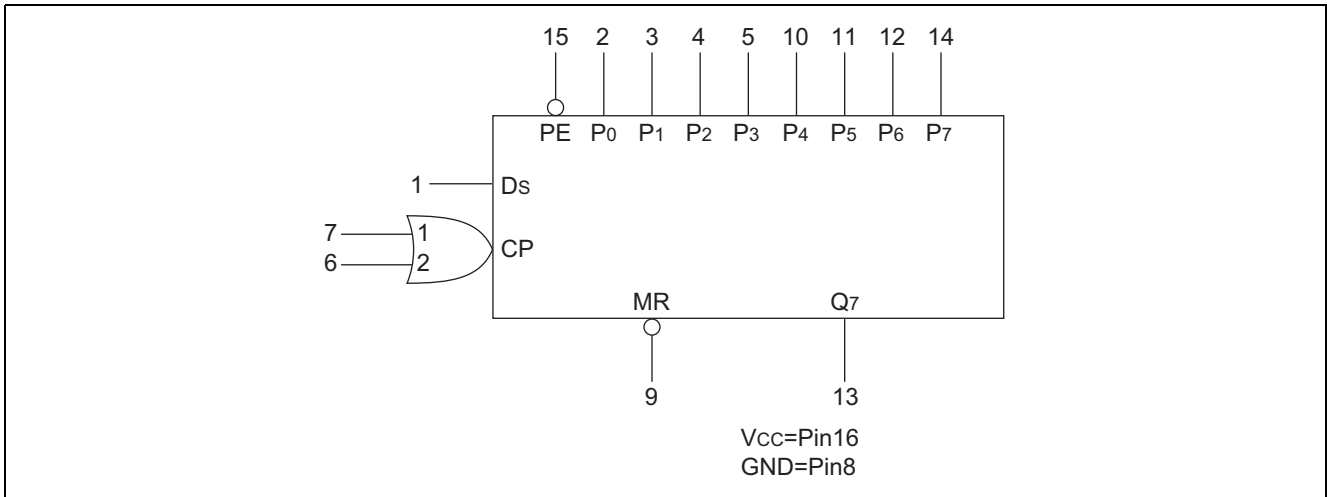
Notes: 1. Please consult the sales office for the above package availability.

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**

- CP<sub>1</sub>, CP<sub>2</sub> Clock Pulse Inputs (Active Rising Edge)
- D<sub>S</sub> Serial Data Input
- $\overline{PE}$  Parallel Enable Input (Active Low)
- P<sub>0</sub> to P<sub>7</sub> Parallel Data Inputs
- $\overline{MR}$  Asynchronous Master Reset Input (Active Low)
- Q<sub>7</sub> Last Stage Output

**Functional Description**

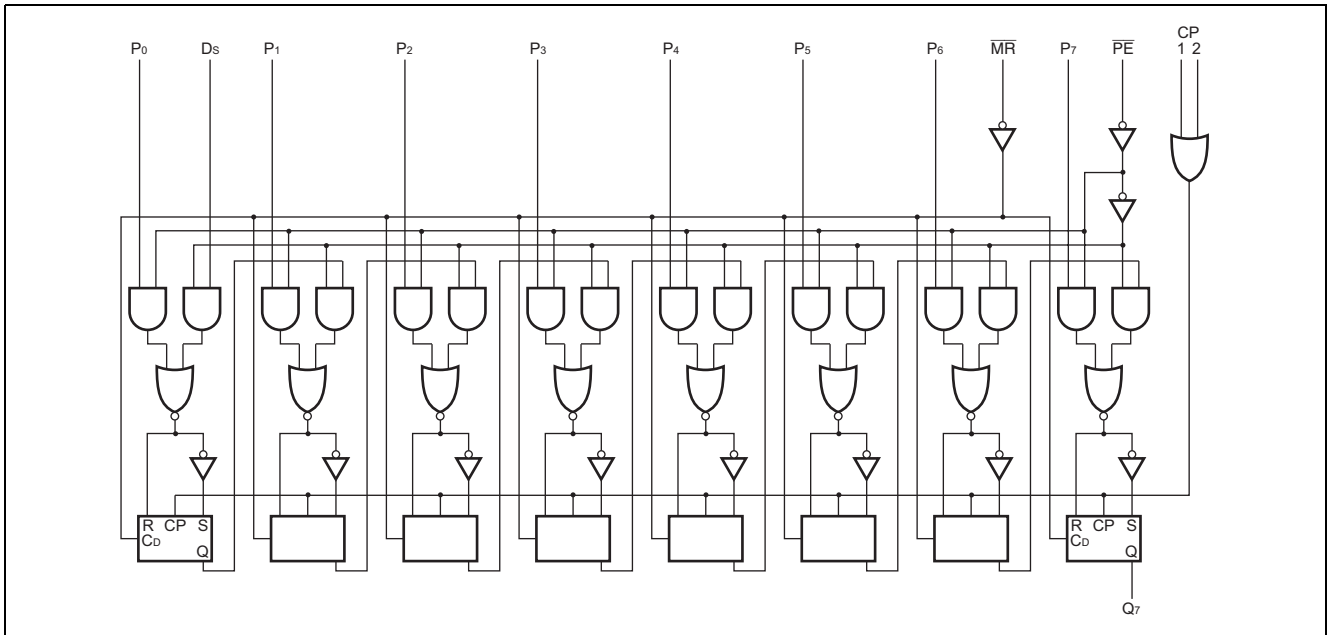
Operation is synchronous (except for Master Reset) and state changes are initiated by the rising edge of either clock input if the other clock input is Low. When one of the clock inputs is used as an active High clock inhibit, it should attain the High state while the other clock is still in the High state following the previous operation. When the Parallel Enable ( $\overline{PE}$ ) input is Low, data is loaded into the register from the Parallel Data (P<sub>0</sub> to P<sub>7</sub>) inputs on the next rising edge of the clock. When  $\overline{PE}$  is High, information is shifted from the Serial Data (D<sub>S</sub>) input to Q<sub>0</sub> and all data in the register is shifted one bit position (i.e., Q<sub>0</sub> → Q<sub>1</sub>, Q<sub>1</sub> → Q<sub>2</sub>, etc.) on the rising edge of the clock.

**Truth Table**

Inputs						Internal Outputs		Output
$\overline{MR}$	$\overline{PE}$	CP <sub>2</sub>	CP <sub>1</sub>	D <sub>S</sub>	Parallel	Q <sub>0</sub>	Q <sub>6</sub>	Q <sub>7</sub>
					P <sub>0</sub> to P <sub>7</sub>			
L	X	X	X	X	X	L	L	L
H	X	L	L	X	X	Q <sub>A0</sub>	Q <sub>B0</sub>	Q <sub>H0</sub>
H	L	L		X	a ... h	a	b	h
H	H	L		H	X	H	Q <sub>An</sub>	Q <sub>Gn</sub>
H	H	L		L	X	L	Q <sub>An</sub>	Q <sub>Gn</sub>
H	X	H		X	X	Q <sub>A0</sub>	Q <sub>B0</sub>	Q <sub>H0</sub>

- H : High Voltage Level
- L : Low Voltage Level
- X : Immaterial
- : Low-to-High Clock Transition

Logic Diagram



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: HD74AC166

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	$^{\circ}C$	
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: HD74AC166**

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>	3.0	2.1	1.5	—	2.1	—	V	V <sub>OUT</sub> = 0.1 V or V <sub>CC</sub> -0.1 V		
		4.5	3.15	2.25	—	3.15	—				
		5.5	3.85	2.75	—	3.85	—				
	V <sub>IL</sub>	3.0	—	1.50	0.9	—	0.9		V <sub>OUT</sub> = 0.1 V or V <sub>CC</sub> -0.1 V		
		4.5	—	2.25	1.35	—	1.35				
		5.5	—	2.75	1.65	—	1.65				
Output voltage	V <sub>OH</sub>	3.0	2.9	2.99	—	2.9	—	V	V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> I <sub>OUT</sub> = -50 μA		
		4.5	4.4	4.49	—	4.4	—				
		5.5	5.4	5.49	—	5.4	—				
		3.0	2.58	—	—	2.48	—			V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> I <sub>OH</sub> = -12 mA	
		4.5	3.94	—	—	3.80	—				I <sub>OH</sub> = -24 mA
		5.5	4.94	—	—	4.80	—				I <sub>OH</sub> = -24 mA
	V <sub>OL</sub>	3.0	—	0.002	0.1	—	0.1	V	V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> I <sub>OUT</sub> = 50 μA		
		4.5	—	0.001	0.1	—	0.1				
		5.5	—	0.001	0.1	—	0.1				
		3.0	—	—	0.32	—	0.37			V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> I <sub>OL</sub> = 12 mA	
		4.5	—	—	0.32	—	0.37				I <sub>OL</sub> = 24 mA
		5.5	—	—	0.32	—	0.37				I <sub>OL</sub> = 24 mA
	Input leakage current	I <sub>IN</sub>	5.5	—	—	±0.1	—	±1.0	μA	V <sub>IN</sub> = V <sub>CC</sub> or GND	
	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.

**Recommended Operating Conditions: HD74ACT166**

Item	Symbol	Ratings	Unit	Condition
Supply voltage	V <sub>CC</sub>	2 to 6	V	
Input and output voltage	V <sub>I</sub> , V <sub>O</sub>	0 to V <sub>CC</sub>	V	
Operating temperature	Ta	-40 to +85	°C	
Input rise and fall time (except Schmitt inputs) V <sub>IN</sub> 0.8 to 2.0 V	tr, tf	8	ns/V	V <sub>CC</sub> = 4.5V V <sub>CC</sub> = 5.5V

**DC Characteristics: HD74ACT166**

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	—						
	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						
		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: HD74AC166**

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	
Maximum clock frequency	f <sub>max</sub>	3.3	75	—	—	65	—	MHz
		5.0	100	—	—	80	—	
Propagation delay CP <sub>1</sub> or CP <sub>2</sub> to Q <sub>7</sub>	t <sub>PLH</sub>	3.3	1.0	11.0	14.5	1.0	15.5	ns
		5.0	1.0	9.5	11.5	1.0	12.5	
Propagation delay CP <sub>1</sub> or CP <sub>2</sub> to Q <sub>7</sub>	t <sub>PHL</sub>	3.3	1.0	10.5	14.0	1.0	15.0	
		5.0	1.0	9.0	11.0	1.0	12.0	
Propagation delay MR to Q <sub>7</sub>	t <sub>PHL</sub>	3.3	1.0	9.5	12.0	1.0	13.0	
		5.0	1.0	6.5	9.0	1.0	10.0	

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 Operating Requirements: HD74AC166**

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
			Typ	Guaranteed Minimum		
Setup time PE or P <sub>n</sub> or D <sub>S</sub> to CP <sub>n</sub>	t <sub>su</sub>	3.3	3.0	5.5	6.0	ns
		5.0	2.0	4.0	4.5	
Hold time CP <sub>n</sub> to PE or P <sub>n</sub> or D <sub>S</sub>	t <sub>h</sub>	3.3	-1.5	3.0	3.0	
		5.0	-0.5	3.0	3.0	
Pulse width CP <sub>n</sub> or MR	t <sub>w</sub>	3.3	2.0	5.5	7.0	
		5.0	2.0	4.5	5.0	
Recovery time MR to CP <sub>n</sub>	t <sub>rec</sub>	3.3	-2.5	0.0	0.0	
		5.0	-1.5	0.0	0.0	

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: HD74ACT166**

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	
Maximum clock frequency	f <sub>max</sub>	5.0	100	—	—	80	—	MHz
Propagation delay CP <sub>n</sub> to Q <sub>7</sub>	t <sub>PLH</sub>	5.0	1.0	10.0	12.5	1.0	13.5	ns
Propagation delay CP <sub>n</sub> to Q <sub>7</sub>	t <sub>PHL</sub>	5.0	1.0	9.5	12.0	1.0	13.0	
Propagation delay MR to Q <sub>7</sub>	t <sub>PHL</sub>	5.0	1.0	8.5	11.0	1.0	12.0	

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

**AC Operating Requirements: HD74ACT166**

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
			Typ	Guaranteed Minimum		
Setup time PE or P <sub>n</sub> or D <sub>S</sub> to CP <sub>n</sub>	t <sub>su</sub>	5.0	2.5	7.0	8.0	ns
		5.0	0.0	1.5	1.5	
Hold time CP <sub>n</sub> to PE or P <sub>n</sub> or D <sub>S</sub>	t <sub>h</sub>	5.0	0.0	1.5	1.5	
		5.0	4.5	7.0	8.0	
Recovery time MR to CP <sub>n</sub>	t <sub>rec</sub>	5.0	-2.5	0.5	0.5	

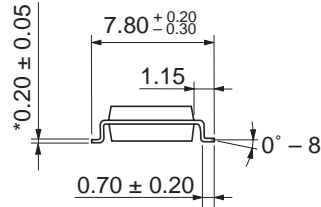
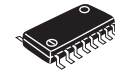
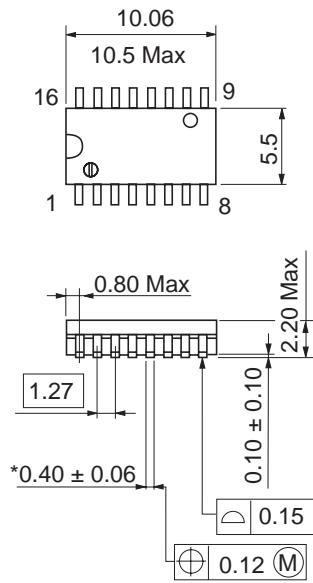
Note: 1. Voltage Range 5.0 is 5.0 V ± 0.5 V

**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>	35.0	pF	V <sub>CC</sub> = 5.0 V

Package Dimensions

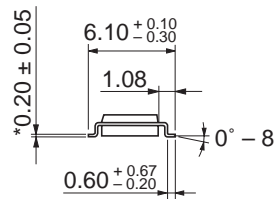
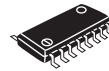
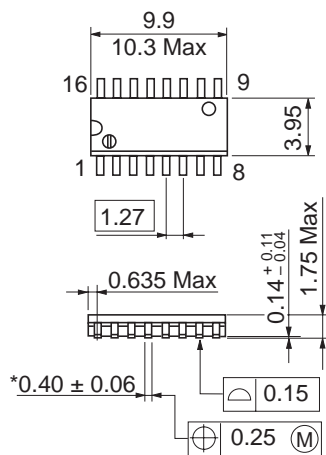
As of January, 2003  
Unit: mm



\*Ni/Pd/Au plating

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

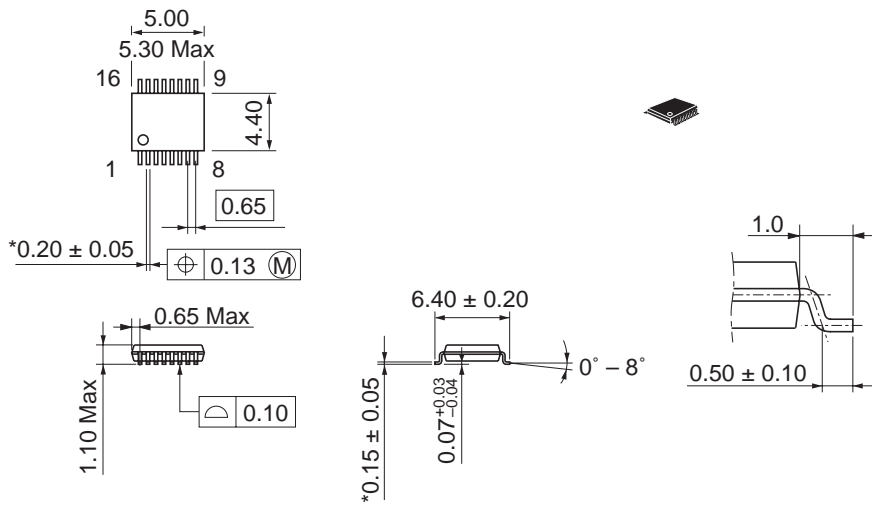
As of January, 2003  
Unit: mm



\*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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