

HD74AC283/HD74ACT283

4-bit Binary Full Adder with Fast Carry

HITACHI

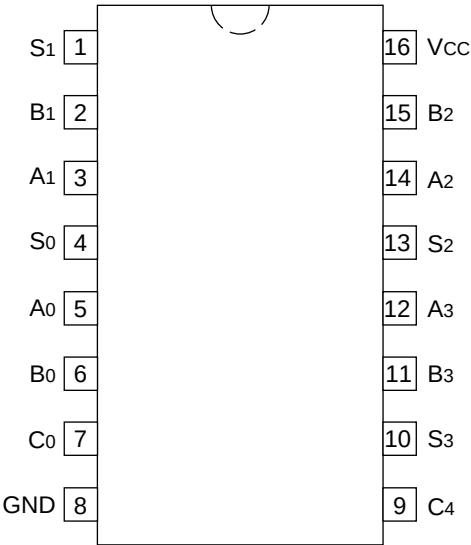
Description

The HD74AC283/HD74ACT283 high-speed 4-bit binary full adder with internal carry lookahead accepts two 4-bit binary works ($A_0 - A_3$, $B_0 - B_3$) and a Carry input (C_0). It generates the binary Sum outputs ($S_0 - S_3$) and the Carry output (C_4) from the most significant bit. The HD74AC283/HD74ACT283 will operate with either active High or active Low operands (positive or negative logic).

Features

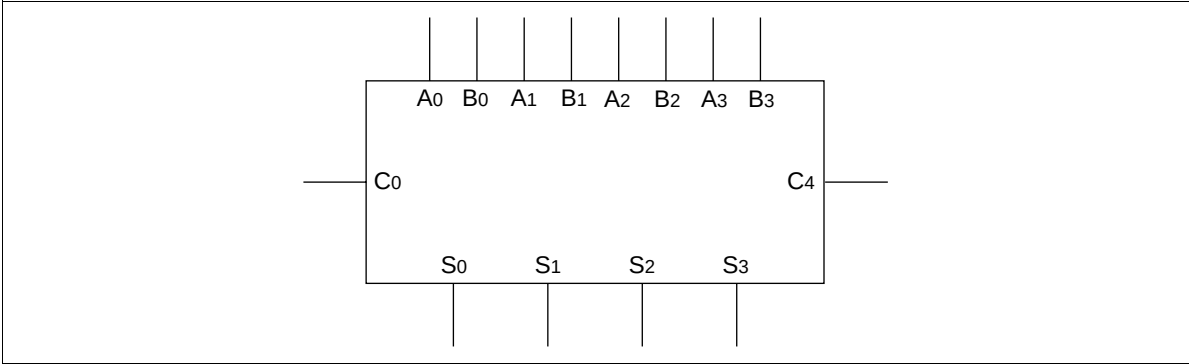
- Outputs Source/Sink 24 mA
- HD74ACT283 has TTL-Cmpatible Inputs

Pin Arrangement



(Top view)

Logic Symbol



Pin Names

- A₀ – A₃ A Operand Inputs
- B₀ – B₃ B Operand Inputs
- C₀ Carry Input
- S₀ – S₃ Sum Outputs
- C₄ Carry Output

Functional Description

The HD74AC283/HD74ACT283 adds two 4-bit binary words (A plus B) plus the incoming Carry (C₀). The binary sum appears on the Sum (S₀ – S₃) and outgoing carry (C₄) outputs. The binary weight of the various inputs and outputs is indicated by the subscript numbers, representing powers of two.

$$2^0 (A_0 + B_0 + C_0) + 2^1 (A_1 + B_1) + 2^2 (A_2 + B_2) + 2^3 (A_3 + B_3) = S_0 + 2S_1 + 4S_2 + 8S_3 + 16C_4$$

Where (+) = plus

Interchanging inputs of equal weight does not affect the operation. Thus C₀, A₀, B₀ can be arbitrarily assigned to pins 5, 6 and 7 for DIPS. Due to the symmetry of the binary add function, the HD74AC283/HD74ACT283 can be used either with all inputs and outputs active High (positive logic) or with all inputs and outputs active Low (negative logic). See Figure a. Note that if C₀ is not used it must be tied Low for active High logic or tied High for active Low logic.

Due to pin limitations, the intermediate carries of the HD74AC283/HD74ACT283 are not brought out for use as inputs or outputs. However, other means can be used to effectively insert a carry into, or bring a carry out from, an intermediate stage. Figure b shows how to make a 3-bit adder. Tying the operand inputs of the fourth adder (A₃, B₃) Low makes S₃ dependent only on, and equal to, the carry from the third adder. Using somewhat the same principle Figure c shows a way of dividing the HD74AC283/HD74ACT283 into a 2-bit and a 1-bit adder. The third stage adder (A₂, B₂, S₂) is used merely as a means of getting a carry (C₁₀) signal into the fourth stage (via A₂ and B₂) and bringing out the carry from the second stage on S₂. Note that as long as A₂ and B₂ are the same, whether High or Low, they do not influence S₂. Similarly, when A₂ and B₂ are the same the carry into the third stage does not influence the carry out of the third

stage. Figure d shows a method of implementing a 5-input encoder, where the inputs are equally weighted. The outputs S_0 , S_1 and S_2 present a binary number equal to the number of inputs $I_1 - I_5$ that are true. Figure e shows one method of implementing a 5-input majority gate. When three or more of the inputs $I_1 - I_5$ are true, the output M_5 is true.

Fig. a Active HIGH versus Active LOW Interpretation

	C ₀	A ₀	A ₁	A ₂	A ₃	B ₀	B ₁	B ₂	B ₃	S ₀	S ₁	S ₂	S ₃	C ₄
Logic levels	L	L	H	L	H	H	L	L	H	H	H	L	L	H
Active HIGH	0	0	1	0	1	1	0	0	1	1	1	0	0	1
Active LOW	1	1	0	1	0	0	1	1	0	0	0	1	1	0

Active HIGH: $0 + 10 + 9 = 3 + 16$

Active LOW: $1 + 5 + 6 = 12 + 0$

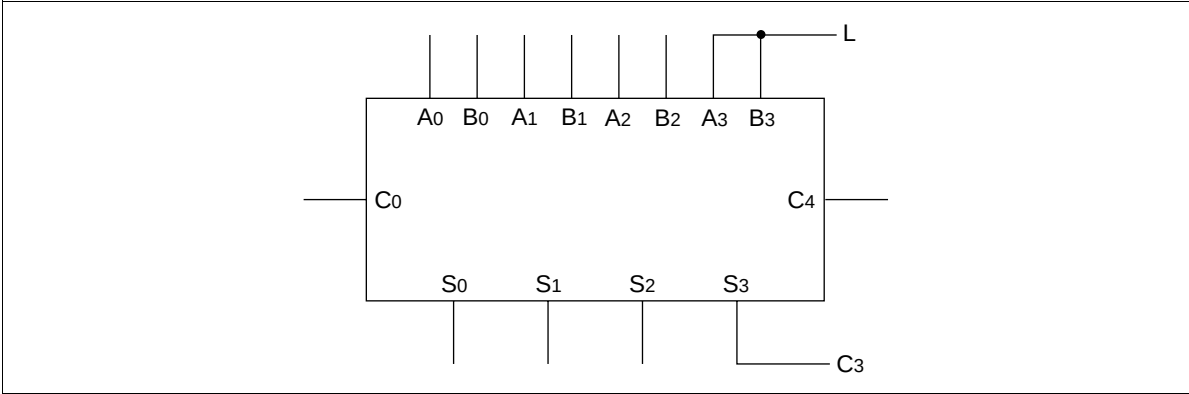


Fig. b 3-bit Adder

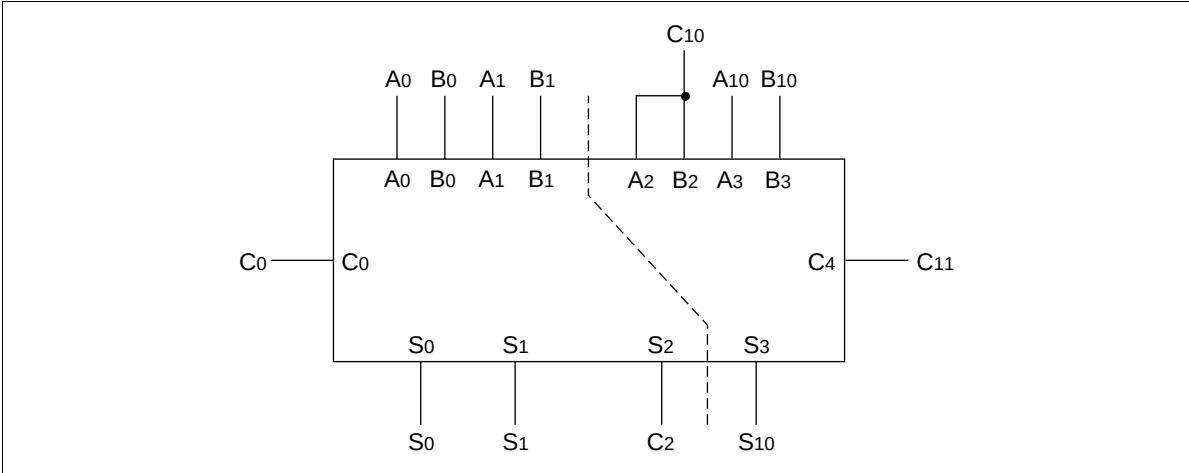


Fig. c 2-bit and 1-bit adders

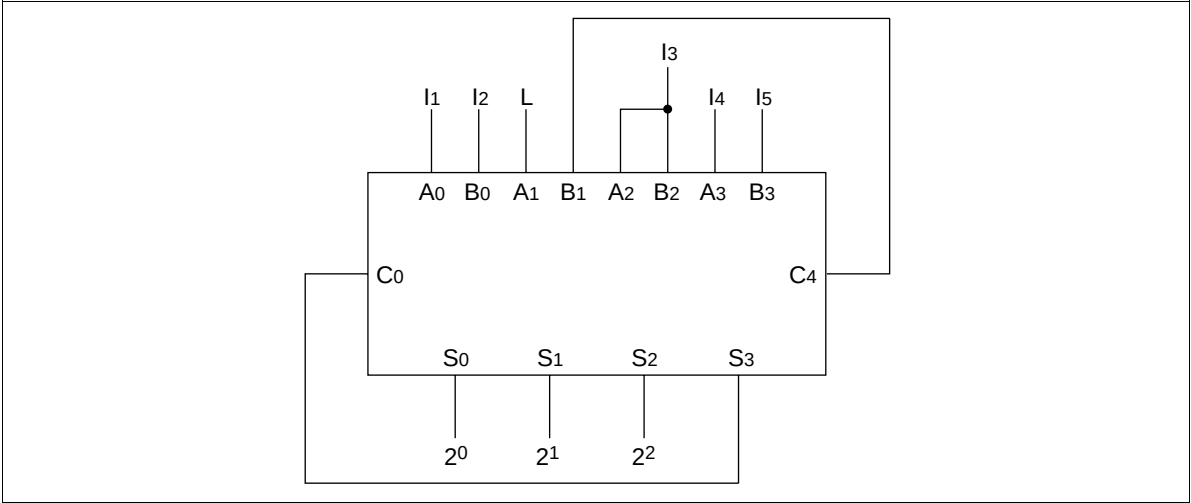


Fig. d 5-Input Encoder

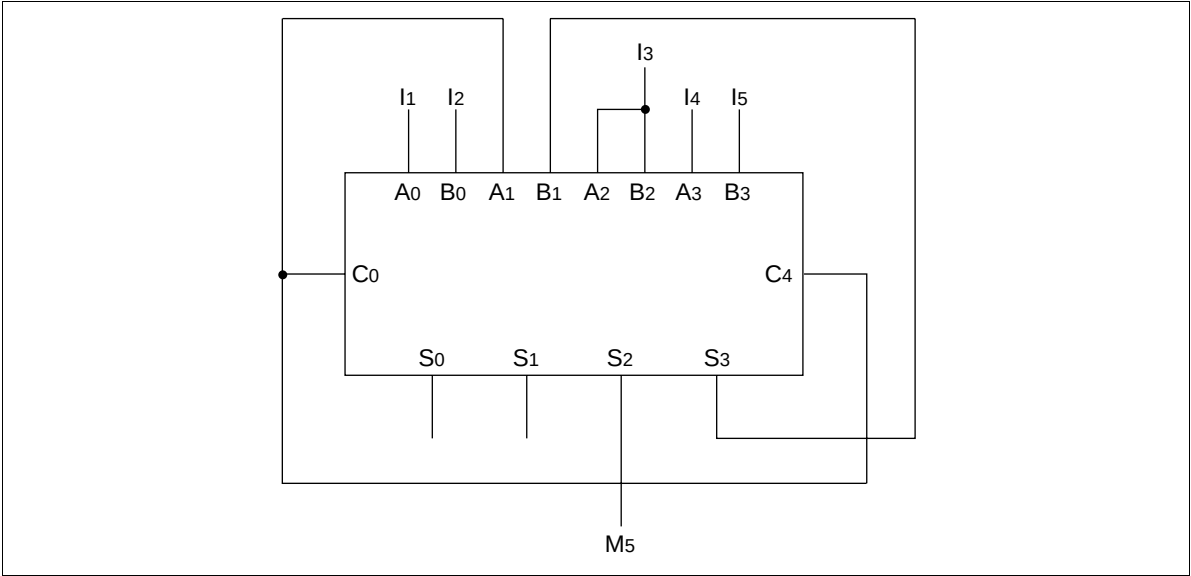
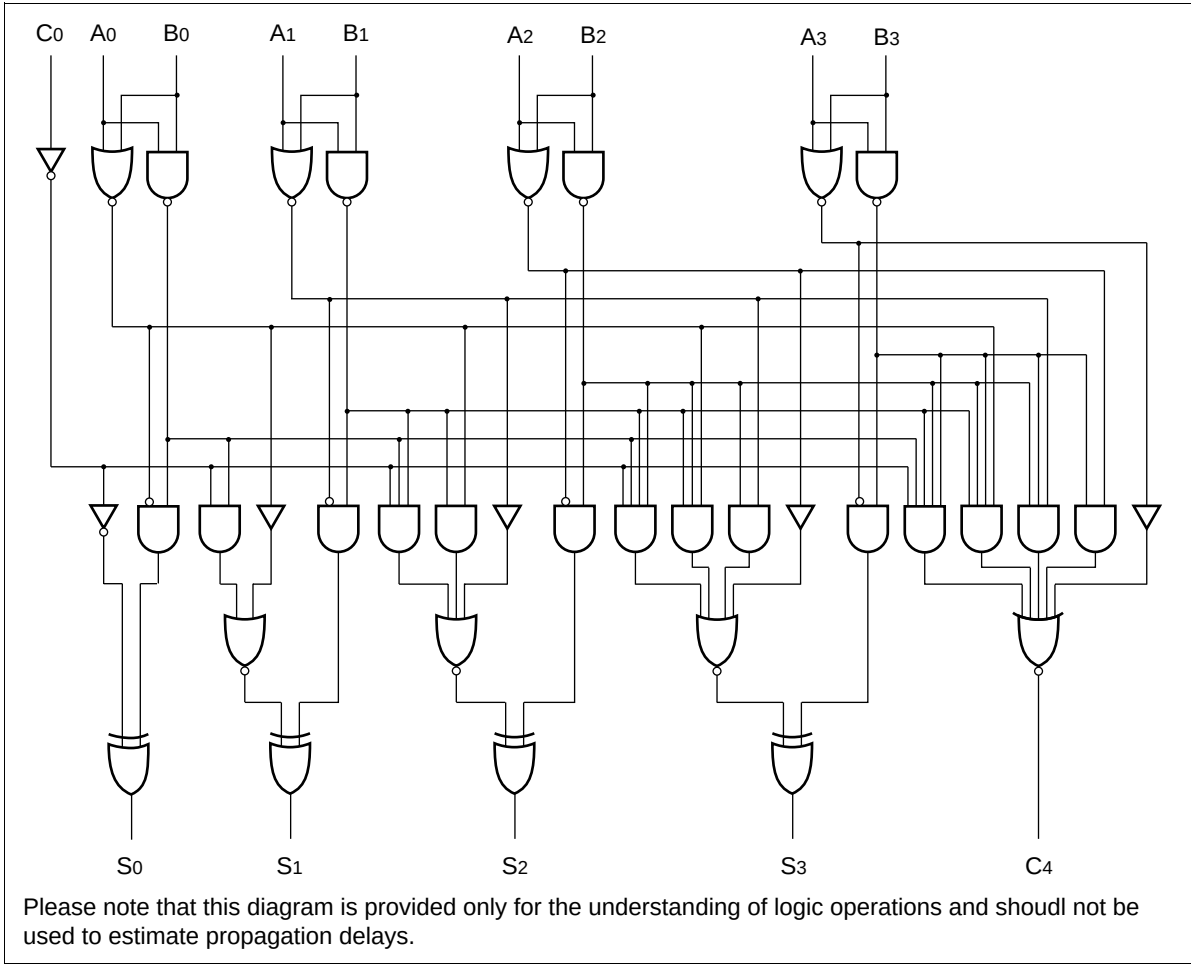


Fig. e 5-Input Majority Gate

Logic Diagram



DC Characteristics (unless otherwise specified)

Item	Symbol	Max	Unit	Condition
Maximum quiescent supply current	I_{CC}	80	μA	$V_{IN} = V_{CC}$ or ground, $V_{CC} = 5.5 V$, $T_a = \text{Worst case}$
Maximum quiescent supply current	I_{CC}	8.0	μA	$V_{IN} = V_{CC}$ or ground, $V_{CC} = 5.5 V$, $T_a = 25^{\circ}C$
Maximum I_{CC}/input (HD74ACT283)	I_{CCT}	1.5	mA	$V_{IN} = V_{CC} - 2.1 V$, $V_{CC} = 5.5 V$, $T_a = \text{Worst case}$

HD74AC283/HD74ACT283

AC Characteristics: HD74AC283

Item	Symbol	V _{cc} (V)* ¹	Ta = +25°C C _L = 50 pF			Ta = −40°C to +85°C C _L = 50 pF		Unit
			Min	Typ	Max	Min	Max	
Propagation delay	t _{PLH}	3.3	1.0	11.5	15.0	1.0	16.5	ns
C ₀ to S _n		5.0	1.0	9.5	11.5	1.0	12.5	
Propagation delay	t _{PHL}	3.3	1.0	10.5	14.0	1.0	15.5	ns
C ₀ to S _n		5.0	1.0	8.5	10.5	1.0	11.5	
Propagation delay	t _{PLH}	3.3	1.0	14.0	17.0	1.0	18.5	ns
A _n or B _n to S _n		5.0	1.0	11.5	13.5	1.0	14.5	
Propagation delay	t _{PHL}	3.3	1.0	13.5	16.5	1.0	18.0	ns
A _n or B _n to S _n		5.0	1.0	11.0	13.0	1.0	14.0	
Propagation delay	t _{PLH}	3.3	1.0	9.5	12.5	1.0	15.5	ns
C ₀ to C ₄		5.0	1.0	7.5	9.5	1.0	10.5	
Propagation delay	t _{PHL}	3.3	1.0	10.0	13.0	1.0	14.0	ns
C ₀ to C ₄		5.0	1.0	8.0	10.0	1.0	11.0	
Propagation delay	t _{PLH}	3.3	1.0	11.5	14.5	1.0	16.0	ns
A _n or B _n to C ₄		5.0	1.0	9.5	11.5	1.0	12.5	
Propagation delay	t _{PHL}	3.3	1.0	12.0	15.0	1.0	16.5	ns
A _n or B _n to C ₄		5.0	1.0	10.0	12.0	1.0	13.0	

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: HD74ACT283

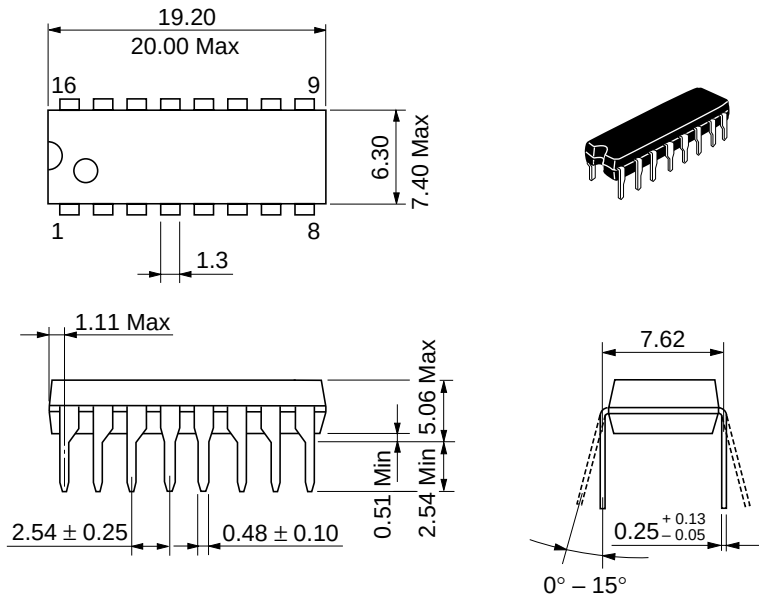
Item	Symbol	V_{CC} (V)* ¹	Ta = +25°C C _L = 50 pF			Ta = -40°C to +85°C C _L = 50 pF		Unit
			Min	Typ	Max	Min	Max	
Propagation delay C ₀ to S _n	t _{PLH}	5.0	1.0	11.5	13.5	1.0	14.5	ns
Propagation delay C ₀ to S _n	t _{PHL}	5.0	1.0	10.0	12.0	1.0	13.0	ns
Propagation delay A _n or B _n to S _n	t _{PLH}	5.0	1.0	13.0	15.0	1.0	16.5	ns
Propagation delay A _n or B _n to S _n	t _{PHL}	5.0	1.0	12.0	14.0	1.0	15.5	ns
Propagation delay C ₀ to C ₄	t _{PLH}	5.0	1.0	9.0	11.0	1.0	12.0	ns
Propagation delay C ₀ to C ₄	t _{PHL}	5.0	1.0	10.0	12.0	1.0	13.0	ns
Propagation delay A _n or B _n to C ₄	t _{PLH}	5.0	1.0	11.0	13.0	1.0	14.0	ns
Propagation delay A _n or B _n to C ₄	t _{PHL}	5.0	1.0	11.5	13.5	1.0	14.5	ns

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

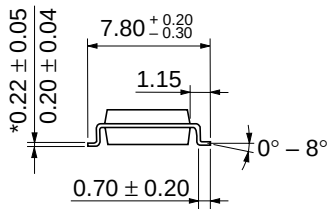
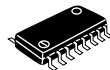
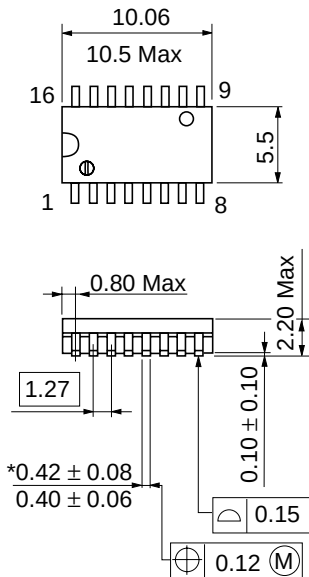
Capacitance

Item	Symbol	Typ	Unit	Condition
Input capacitance	C _{IN}	4.5	pF	V _{CC} = 5.5 V
Power dissipation capacitance	C _{PD}	60.0	pF	V _{CC} = 5.0 V

Unit: mm

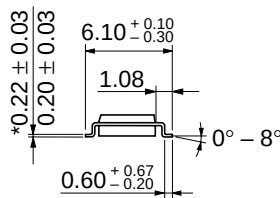
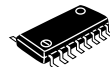
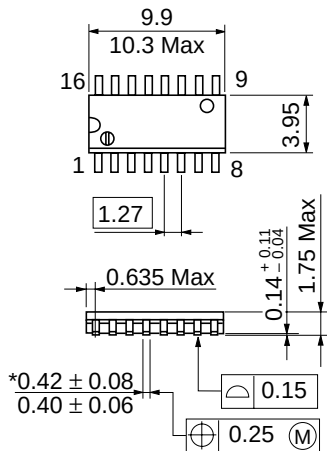


Hitachi Code	DP-16
JEDEC	Conforms
EIAJ	Conforms
Weight (reference value)	1.07 g



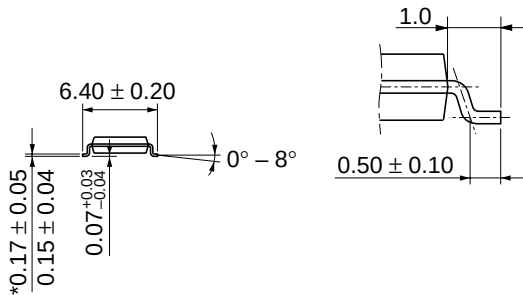
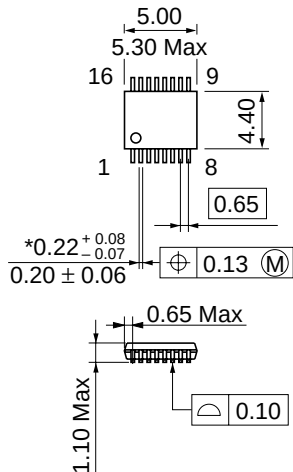
*Dimension including the plating thickness
Base material dimension

Hitachi Code	FP-16DA
JEDEC	—
EIAJ	Conforms
Weight (reference value)	0.24 g



*Dimension including the plating thickness
Base material dimension

Hitachi Code	FP-16DN
JEDEC	Conforms
EIAJ	Conforms
Weight (reference value)	0.15 g



*Dimension including the plating thickness
Base material dimension

Hitachi Code	TTP-16DA
JEDEC	—
EIAJ	—
Weight (reference value)	0.05 g

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