

# DATA SHEET

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**74F283**

4-bit binary full adder with fast carry

Product specification

1989 Mar 03

IC15 Data Handbook

# 4-bit binary full adder with fast carry

74F283

## FEATURES

- High speed 4-bit addition
- Cascadable in 4-bit increments
- Fast Internal carry look-ahead

## DESCRIPTION

The 74F283 adds two 4-bit binary words (A<sub>n</sub> plus B<sub>n</sub>) plus the incoming carry. The binary sum appears on the sum outputs (Σ<sub>0</sub>–Σ<sub>3</sub>) and the outgoing carry (C<sub>OUT</sub>) according to the equation:  

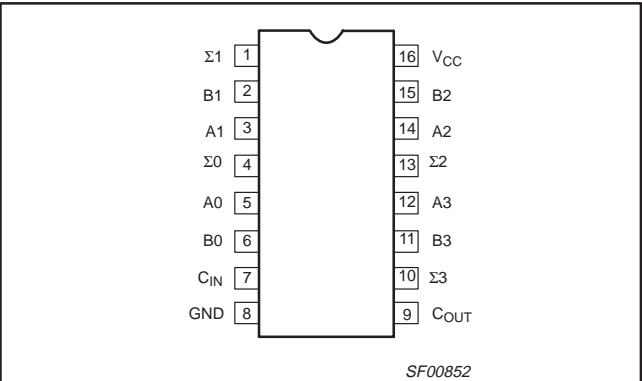
$$C_{IN} + 2^0(A_0 + B_0) + 2^1(A_1 + B_1) + 2^2(A_2 + B_2) + 2^3(A_3 + B_3)$$
  

$$= \Sigma_0 + 2\Sigma_1 + 4\Sigma_2 + 8\Sigma_3 + 16C_{OUT}$$
  
 where (+)=plus

Due to the symmetry of the binary add function, the 74F283 can be used with either all active-High operands (positive logic) or with all active-Low operands (negative logic). See Function Table. In case of all active-Low operands (negative logic) the results Σ<sub>1</sub>–Σ<sub>4</sub> and C<sub>OUT</sub> should be interpreted also as active-Low. With active-High inputs, C<sub>IN</sub> cannot be left open; it must be held Low when no "carry in" is intended. Interchanging inputs of equal weight does not affect the operation, thus A<sub>0</sub>, B<sub>0</sub>, C<sub>IN</sub> can arbitrarily be assigned to pins 5, 6, 7, etc.

Due to pin limitations, the intermediate carries of the 74F283 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.

## PIN CONFIGURATION



TYPE	TYPICAL PROPAGATION DELAY	TYPICAL SUPPLY CURRENT (TOTAL)
74F283	6.5ns	40mA

## ORDERING INFORMATION

DESCRIPTION	COMMERCIAL RANGE V <sub>CC</sub> = 5V ±10%, T <sub>amb</sub> = 0°C to +70°C	PKG DWG #
16-pin plastic DIP	N74F283N	SOT38-4
16-pin plastic SO	N74F283D	SOT109-1

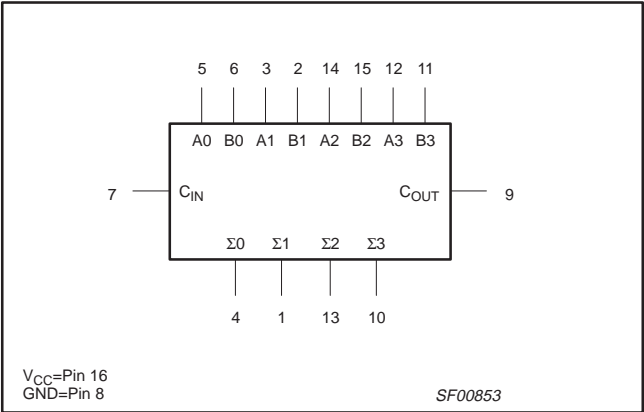
## INPUT AND OUTPUT LOADING AND FAN-OUT TABLE

PINS	DESCRIPTION	74F(U.L.) HIGH/LOW	LOAD VALUE HIGH/LOW
A <sub>0</sub> - A <sub>3</sub>	A operand inputs	1.0/2.0	20μA/1.2mA
B <sub>0</sub> - B <sub>3</sub>	B operand inputs	1.0/2.0	20μA/1.2mA
C <sub>IN</sub>	Carry input	1.0/1.0	20μA/0.6mA
C <sub>OUT</sub>	Carry output	50/33	1.0mA/20mA
Σ <sub>0</sub> –Σ <sub>3</sub>	Sum outputs	50/33	1.0mA/20mA

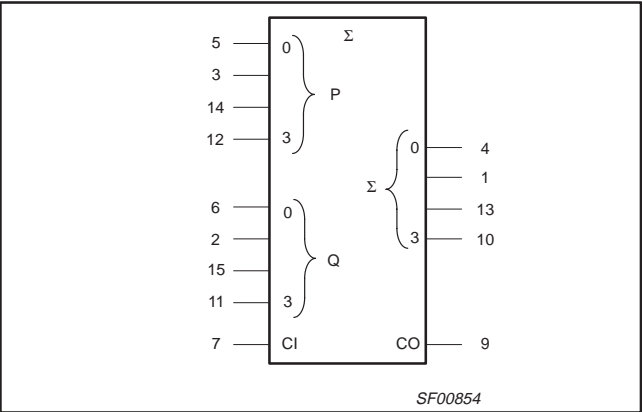
### NOTE:

One (1.0) FAST Unit Load is defined as: 20μA in the High state and 0.6mA in the Low state.

## LOGIC SYMBOL



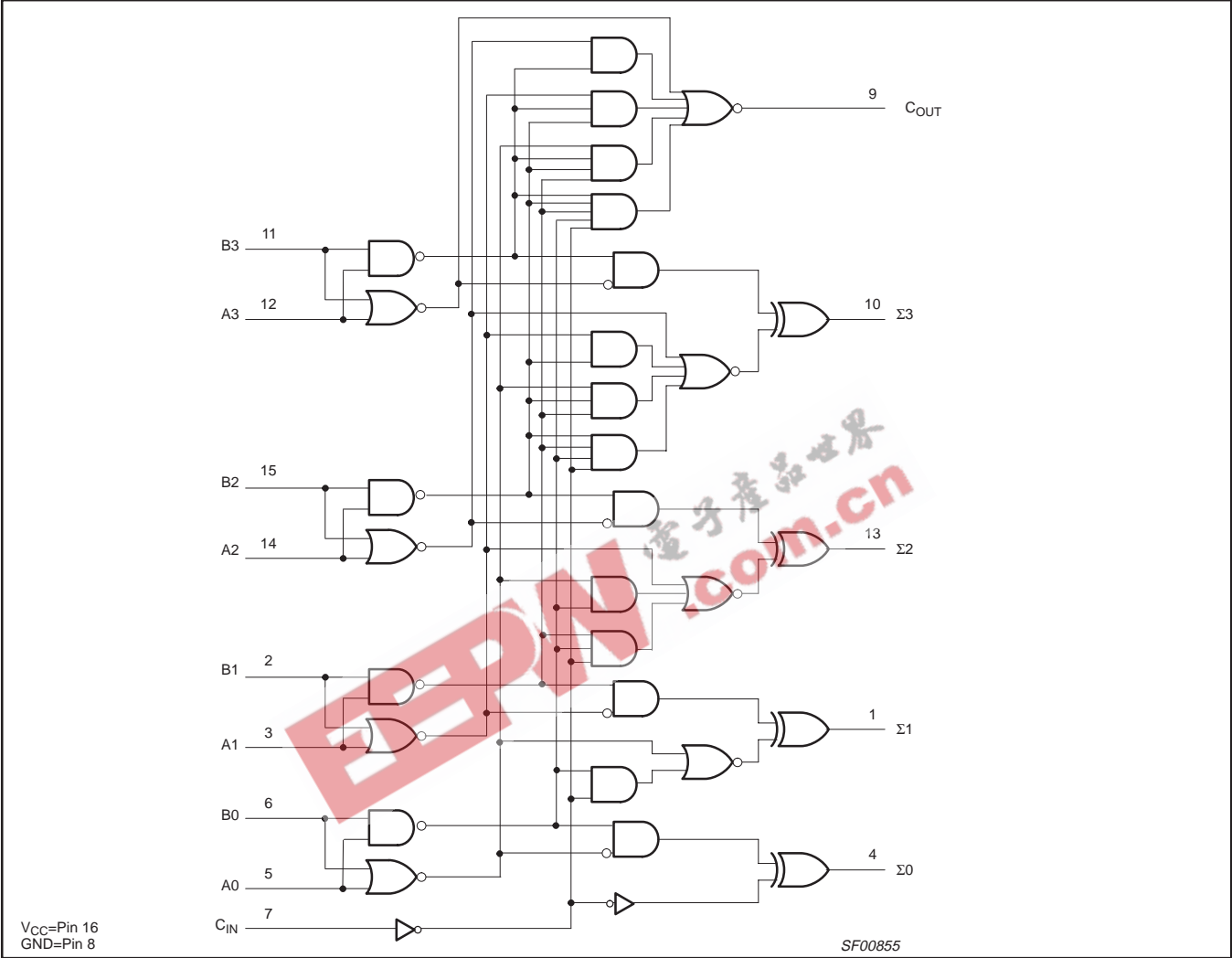
## LOGIC SYMBOL (IEEE/IEC)



4-bit binary full adder with fast carry

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LOGIC DIAGRAM



FUNCTION TABLE

PINS	C <sub>IN</sub>	A0	A1	A2	A3	B0	B1	B2	B3	Σ0	Σ1	Σ2	Σ3	C <sub>OUT</sub>	Example: 1001 1010 10011 (10+9=19) (carry+5+6=12)
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	

H = High voltage level  
L = Low voltage level

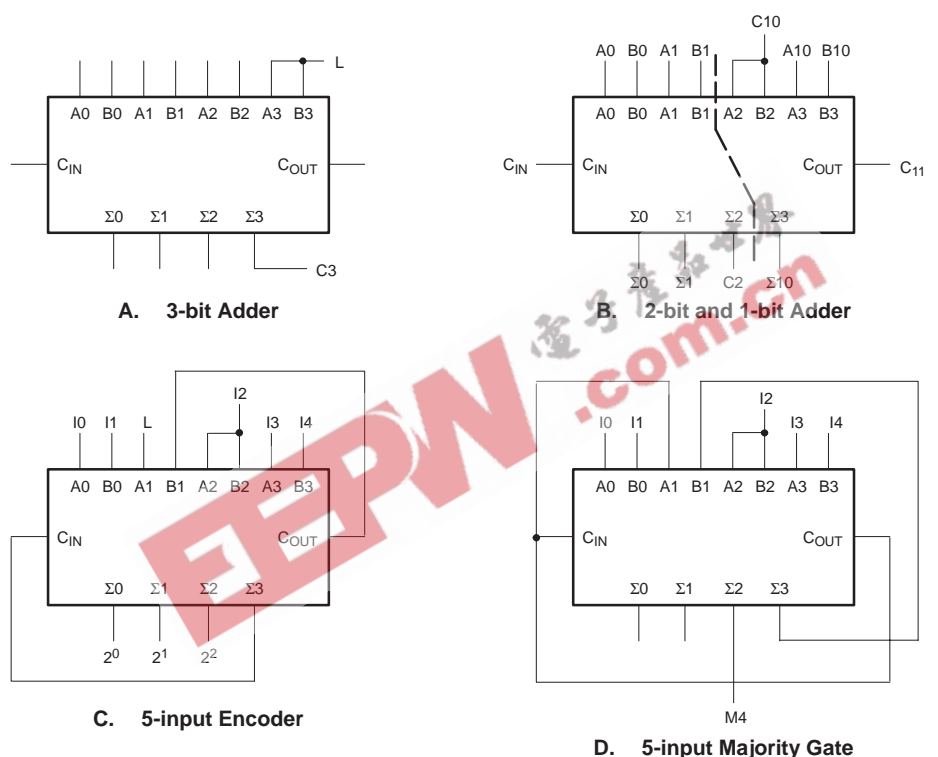
## 4-bit binary full adder with fast carry

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Figure A shows how to make a 3-bit adder. Tying the operand inputs of the fourth adder (A3, B3) Low makes  $\Sigma 3$  dependent only on, and equal to, the carry from the third adder. Using somewhat the same principle, Figure B shows a way of dividing the 74F283 into a 2-bit and a 1-bit adder. The third stage adder (A2, B2,  $\Sigma 2$ ) is used as means of getting a carry (C10) signal into the fourth stage adder (via A2 and B2) and bringing out the carry from the second stage on  $\Sigma 2$ . Note that as long as A2 and B2 are the same, whether High or Low,

they do not influence  $\Sigma 2$ . 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 C shows a method of implementing a 5-input encoder where the inputs are equally weighted. The outputs  $\Sigma 0$ ,  $\Sigma 1$  and  $\Sigma 2$  present a binary number of inputs I0–I4 that are true. Figure D shows one method of implementing a 5-input majority gate. When three or more of the inputs I0–I4 are true, the output M4 is true.

## APPLICATIONS



SF00856

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## ABSOLUTE MAXIMUM RATINGS

(Operation beyond the limits set forth in this table may impair the useful life of the device. Unless otherwise noted these limits are over the operating free-air temperature range.)

SYMBOL	PARAMETER	RATING	UNIT
$V_{CC}$	Supply voltage	-0.5 to +7.0	V
$V_{IN}$	Input voltage	-0.5 to +7.0	V
$I_{IN}$	Input current	-30 to +5	mA
$V_{OUT}$	Voltage applied to output in High output state	-0.5 to $V_{CC}$	V
$I_{OUT}$	Current applied to output in Low output state	40	mA
$T_{amb}$	Operating free-air temperature range	0 to +70	°C
$T_{stg}$	Storage temperature	-65 to +150	°C

## RECOMMENDED OPERATING CONDITIONS

SYMBOL	PARAMETER	LIMITS			UNIT
		Min	Nom	Max	
$V_{CC}$	Supply voltage	4.5	5.0	5.5	V
$V_{IH}$	High-level input voltage	2.0			V
$V_{IL}$	Low-level input voltage			0.8	V
$I_{IK}$	Input clamp current			-18	mA
$I_{OH}$	High-level output current			-1	mA
$I_{OL}$	Low-level output current			20	mA
$T_{amb}$	Operating free-air temperature range	0		70	°C

## DC ELECTRICAL CHARACTERISTICS

(Over recommended operating free-air temperature range unless otherwise noted.)

SYMBOL	PARAMETER	TEST CONDITIONS <sup>NO TAG</sup>	LIMITS			UNIT
			MIN	TYP NO TAG	MAX	
$V_{OH}$	High-level output voltage	$V_{CC} = \text{MIN}, V_{IL} = \text{MAX}$	$\pm 10\%V_{CC}$	2.5		V
		$V_{IH} = \text{MIN}, I_{OH} = \text{MAX}$	$\pm 5\%V_{CC}$	2.7	3.4	
$V_{OL}$	Low-level output voltage	$V_{CC} = \text{MIN}, V_{IL} = \text{MAX}$	$\pm 10\%V_{CC}$		0.30	V
		$V_{IH} = \text{MIN}, I_{OL} = \text{MAX}$	$\pm 5\%V_{CC}$		0.30	
$V_{IK}$	Input clamp voltage	$V_{CC} = \text{MIN}, I_I = I_{IK}$		-0.73	-1.2	V
$I_I$	Input current at maximum input voltage	$V_{CC} = \text{MAX}, V_I = 7.0\text{V}$			100	μA
$I_{IH}$	High-level input current	$V_{CC} = \text{MAX}, V_I = 2.7\text{V}$			20	μA
$I_{IL}$	Low-level input current	$C_{IN}$ only			-0.6	mA
		An, Bn			-1.2	mA
$I_{OS}$	Short-circuit output current <sup>NO TAG</sup>	$V_{CC} = \text{MAX}$	-60		-150	mA
$I_{CC}$	Supply current (total) <sup>4</sup>	$V_{CC} = \text{MAX}$		40	55	mA

## NOTES:

- For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions for the applicable type.
- All typical values are at  $V_{CC} = 5\text{V}$ ,  $T_{amb} = 25^\circ\text{C}$ .
- Not more than one output should be shorted at a time. For testing  $I_{OS}$ , the use of high-speed test apparatus and/or sample-and-hold techniques are preferable in order to minimize internal heating and more accurately reflect operational values. Otherwise, prolonged shorting of a High output may raise the chip temperature well above normal and thereby cause invalid readings in other parameter tests. In any sequence of parameter tests,  $I_{OS}$  tests should be performed last.
- $I_{CC}$  should be measured with all outputs open and the following conditions:
  - Condition 1: all inputs grounded
  - Condition 2: all B inputs Low, other inputs at 4.5V
  - Condition 3: all inputs at 4.5V

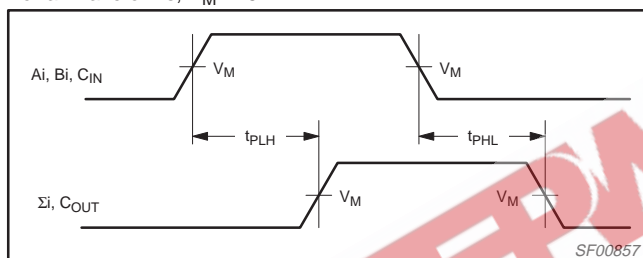
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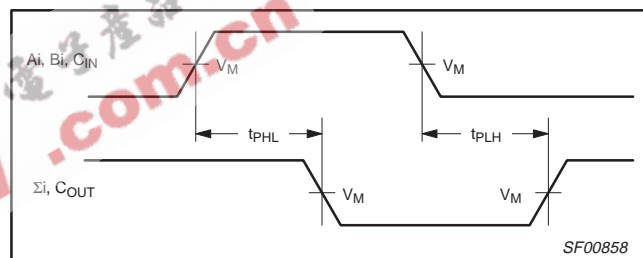
## AC ELECTRICAL CHARACTERISTICS

SYMBOL	PARAMETER	TEST CONDITIONS	LIMITS					UNIT
			T <sub>amb</sub> = +25°C V <sub>CC</sub> = +5.V C <sub>L</sub> = 50pF, R <sub>L</sub> = 500Ω			T <sub>amb</sub> = 0°C to +70°C V <sub>CC</sub> = +5.V ± 10% C <sub>L</sub> = 50pF, R <sub>L</sub> = 500Ω		
			MIN	TYP	MAX	MIN	MAX	
t <sub>PLH</sub> t <sub>PHL</sub>	Propagation delay C <sub>IN</sub> to Σ <sub>i</sub>	Waveform 1, 2	3.5 4.0	7.0 7.0	9.5 9.5	3.0 3.5	10.5 10.5	ns ns
t <sub>PLH</sub> t <sub>PHL</sub>	Propagation delay A <sub>i</sub> or B <sub>i</sub> to Σ <sub>i</sub>	Waveform 1, 2	3.5 3.5	7.0 7.0	9.5 9.5	2.5 3.5	10.5 10.5	ns ns
t <sub>PLH</sub> t <sub>PHL</sub>	Propagation delay C <sub>IN</sub> to C <sub>OUT</sub>	Waveform 2	3.5 3.0	5.7 5.4	7.5 7.0	3.5 2.5	8.5 8.0	ns ns
t <sub>PLH</sub> t <sub>PHL</sub>	Propagation delay A <sub>i</sub> or B <sub>i</sub> to C <sub>OUT</sub>	Waveform 1, 2	3.5 2.5	5.7 5.3	7.5 7.0	3.0 2.5	8.5 8.0	ns ns

## AC WAVEFORMS

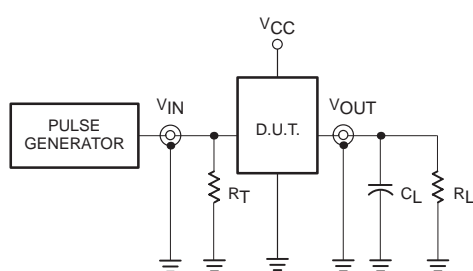
For all waveforms, V<sub>M</sub> = 1.5V.

Waveform 1. Propagation Delay  
Operands and Carry Inputs to Outputs

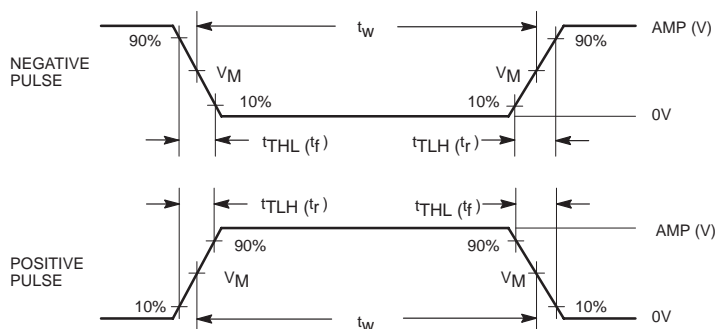


Waveform 2. Propagation Delay  
Operands and Carry Inputs to Outputs

## TEST CIRCUIT AND WAVEFORM



Test Circuit for Totem-Pole Outputs



## DEFINITIONS:

- R<sub>L</sub> = Load resistor;  
see AC ELECTRICAL CHARACTERISTICS for value.  
C<sub>L</sub> = Load capacitance includes jig and probe capacitance;  
see AC ELECTRICAL CHARACTERISTICS for value.  
R<sub>T</sub> = Termination resistance should be equal to Z<sub>OUT</sub> of  
pulse generators.

## Input Pulse Definition

family	INPUT PULSE REQUIREMENTS					
	amplitude	V <sub>M</sub>	rep. rate	t <sub>w</sub>	t <sub>TLH</sub>	t <sub>THL</sub>
74F	3.0V	1.5V	1MHz	500ns	2.5ns	2.5ns

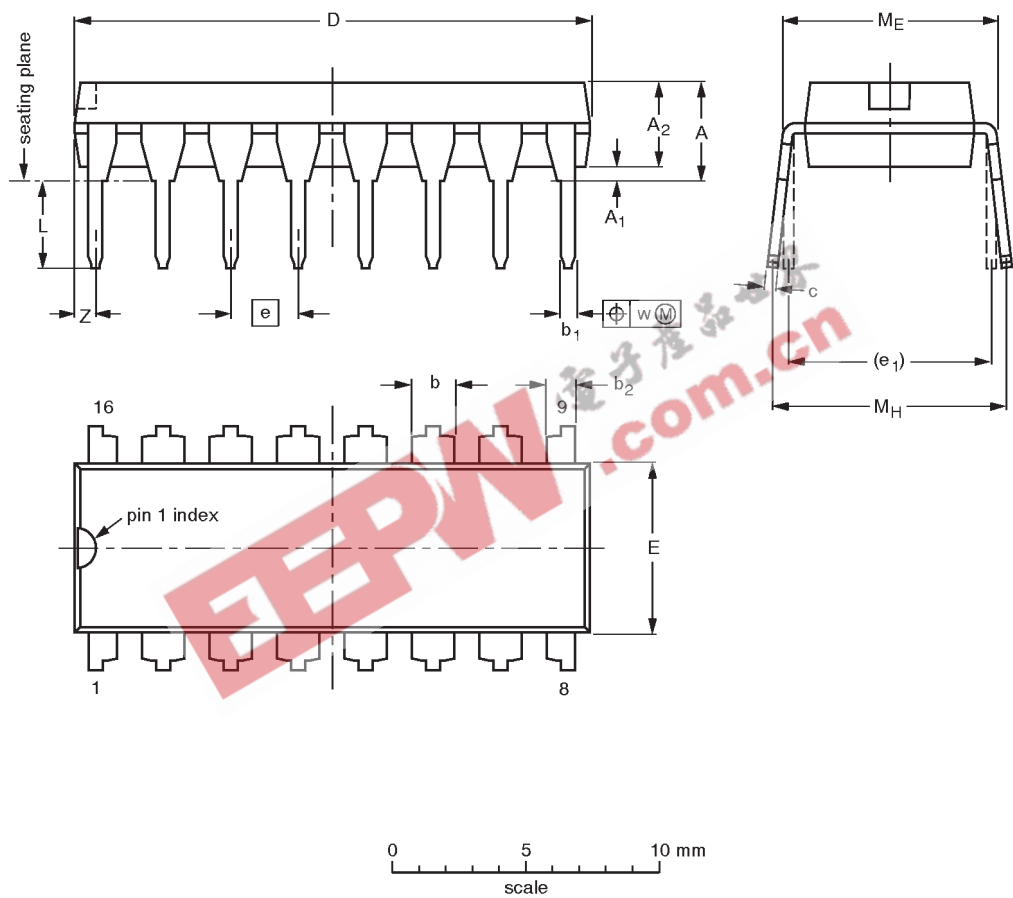
SF00006

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DIP16: plastic dual in-line package; 16 leads (300 mil)

SOT38-4




DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A <sub>1</sub> min.	A <sub>2</sub> max.	b	b <sub>1</sub>	b <sub>2</sub>	c	D <sup>(1)</sup>	E <sup>(1)</sup>	e	e <sub>1</sub>	L	M <sub>E</sub>	M <sub>H</sub>	w	z <sup>(1)</sup> max.
mm	4.2	0.51	3.2	1.73 1.30	0.53 0.38	1.25 0.85	0.36 0.23	19.50 18.55	6.48 6.20	2.54	7.62	3.60 3.05	8.25 7.80	10.0 8.3	0.254	0.76
inches	0.17	0.020	0.13	0.068 0.051	0.021 0.015	0.049 0.033	0.014 0.009	0.77 0.73	0.26 0.24	0.10	0.30	0.14 0.12	0.32 0.31	0.39 0.33	0.01	0.030

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

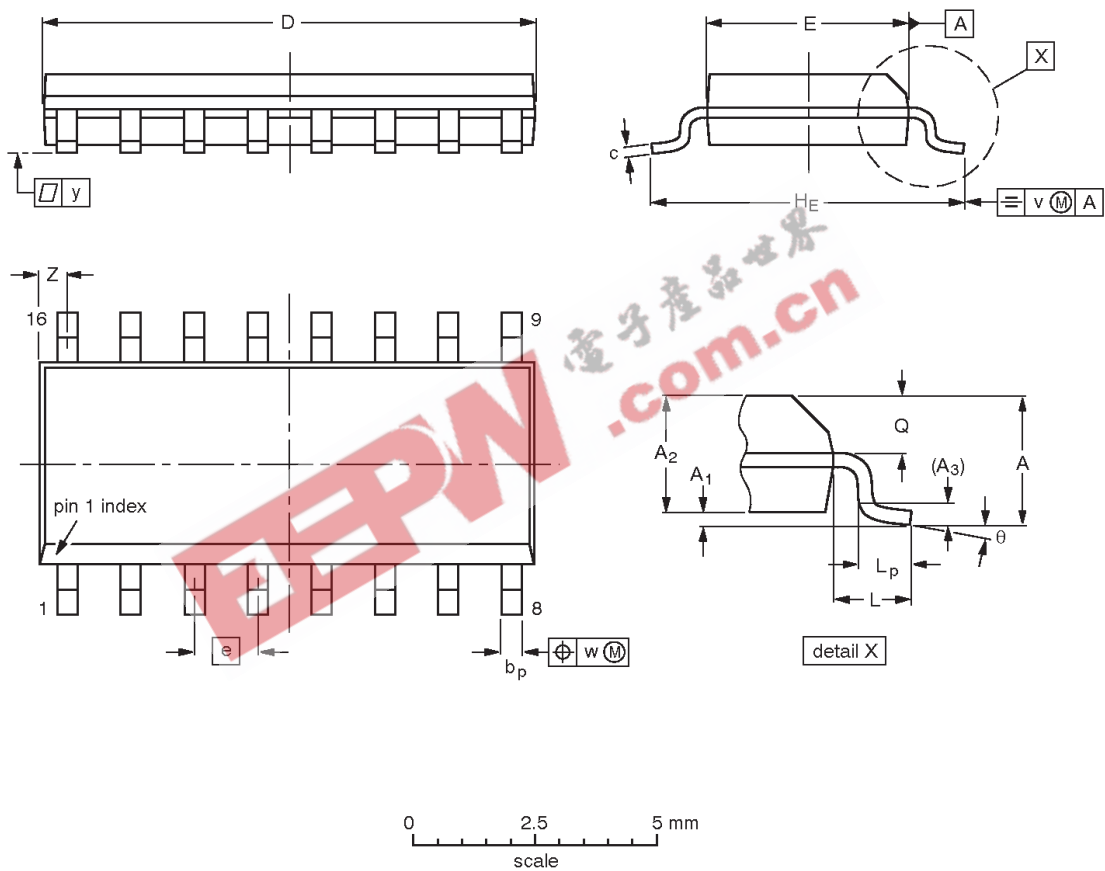
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT38-4						92-11-17 95-01-14

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SO16: plastic small outline package; 16 leads; body width 3.9 mm

SOT109-1



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	b <sub>p</sub>	c	D <sup>(1)</sup>	E <sup>(1)</sup>	e	H <sub>E</sub>	L	L <sub>p</sub>	Q	v	w	y	Z <sup>(1)</sup>	θ
mm	1.75	0.25 0.10	1.45 1.25	0.25	0.49 0.36	0.25 0.19	10.0 9.8	4.0 3.8	1.27	6.2 5.8	1.05	1.0 0.4	0.7 0.6	0.25	0.25	0.1	0.7 0.3	8° 0°
inches	0.069	0.010 0.004	0.057 0.049	0.01	0.019 0.014	0.0100 0.0075	0.39 0.38	0.16 0.15	0.050	0.244 0.228	0.041	0.039 0.016	0.028 0.020	0.01	0.01	0.004	0.028 0.012	

Note

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT109-1	076E07S	MS-012AC				95-01-23 97-05-22



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**NOTES**

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## Data sheet status

Data sheet status	Product status	Definition [1]
Objective specification	Development	This data sheet contains the design target or goal specifications for product development. Specification may change in any manner without notice.
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[1] Please consult the most recently issued datasheet before initiating or completing a design.

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