M74HC4028

BCD TO DECIMAL DECODER

- **HIGH SPEED:**
  t_{PD} = 20ns (TYP.) at V_{CC} = 6V
- **LOW POWER DISSIPATION:**
  I_{CC} = 4µA(MAX.) at T_A=25°C
- **HIGH NOISE IMMUNITY:**
  V_{NIH} = V_{NIL} = 28 % V_{CC} (MIN.)
- **SYMMETRICAL OUTPUT IMPEDANCE:**
  $|I_{OH}|$ = I_{OL} = 4mA (MIN)
- **BALANCED PROPAGATION DELAYS:**
  $t_{PLH} \cong t_{PHL}$
- **WIDE OPERATING VOLTAGE RANGE:**
  V_{CC} (OPR) = 2V to 6V
- **PIN AND FUNCTION COMPATIBLE WITH 74 SERIES 4028**

DESCRIPTION

The M74HC4028 is an high speed CMOS BCD TO DECIMAL DECODER fabricated with silicon gate C^{2}MOS technology.

A BCD code applied to the four inputs (A to D) provides a high level at the selected one of the decimal decoded outputs. An illegal BCD code such as eleven to fifteen gives a low level at all outputs. The device also can be used as 3 TO 8

DIP **SOP** **TSSOP**

ORDER CODES

| PACKAGE	TUBE	T & R
DIP	M74HC4028B1R	
SOP	M74HC4028M1R	M74HC4028RM13TR
TSSOP		M74HC4028TTR

LINE DECODER, when D input is assigned as a disable input.

The device is useful for code conversion, address decoding, memory selection, demultiplexing, or read out decoding.

All inputs are equipped with protection circuits against static discharge and transient excess voltage.

PIN CONNECTION AND IEC LOGIC SYMBOLS
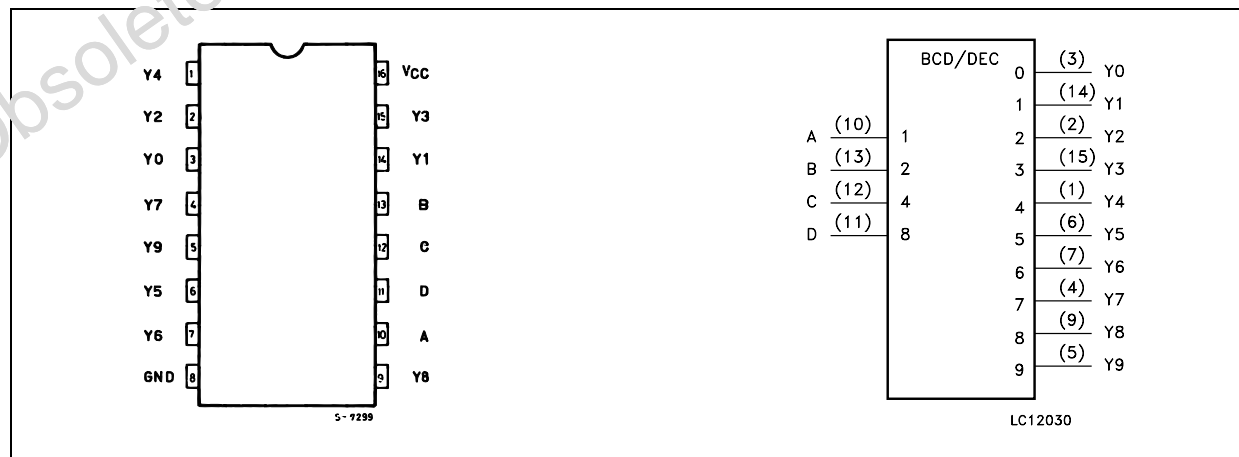
INPUT AND OUTPUT EQUIVALENT CIRCUIT
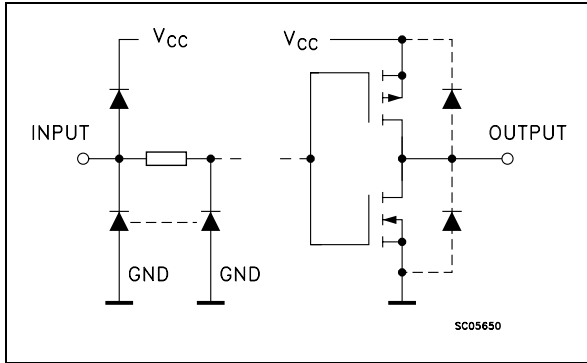

PIN DESCRIPTION

PIN No	SYMBOL	NAME AND FUNCTION
1, 2, 3, 4, 5, 6, 7, 9, 14, 15	Y0 to Y9	Decoder Outputs
10, 11, 12, 13	A to D	Data Inputs
8	GND	Ground (0V)
16	V_{CC}	Positive Supply Voltage

TRUTH TABLE

INPUTS				OUTPUTS										SELECTED OUTPUT
D	C	B	A	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	
L	L	L	L	H	L	L	L	L	L	L	L	L	L	Y0
L	L	L	H	L	H	L	L	L	L	L	L	L	L	Y1
L	L	H	L	L	L	H	L	L	L	L	L	L	L	Y2
L	L	H	H	L	L	L	H	L	L	L	L	L	L	Y3
L	H	L	L	L	L	L	L	H	L	L	L	L	L	Y4
L	H	L	H	L	L	L	L	L	H	L	L	L	L	Y5
L	H	H	L	L	L	L	L	L	L	H	L	L	L	Y6
L	H	H	H	L	L	L	L	L	L	L	H	L	L	Y7
H	L	L	L	L	L	L	L	L	L	L	L	H	L	Y8
H	L	L	H	L	L	L	L	L	L	L	L	L	H	Y9
H	X	H	X	L	L	L	L	L	L	L	L	L	L	NONE
H	H	X	X	L	L	L	L	L	L	L	L	L	L	NONE

X : Don't Care

LOGIC DIAGRAM
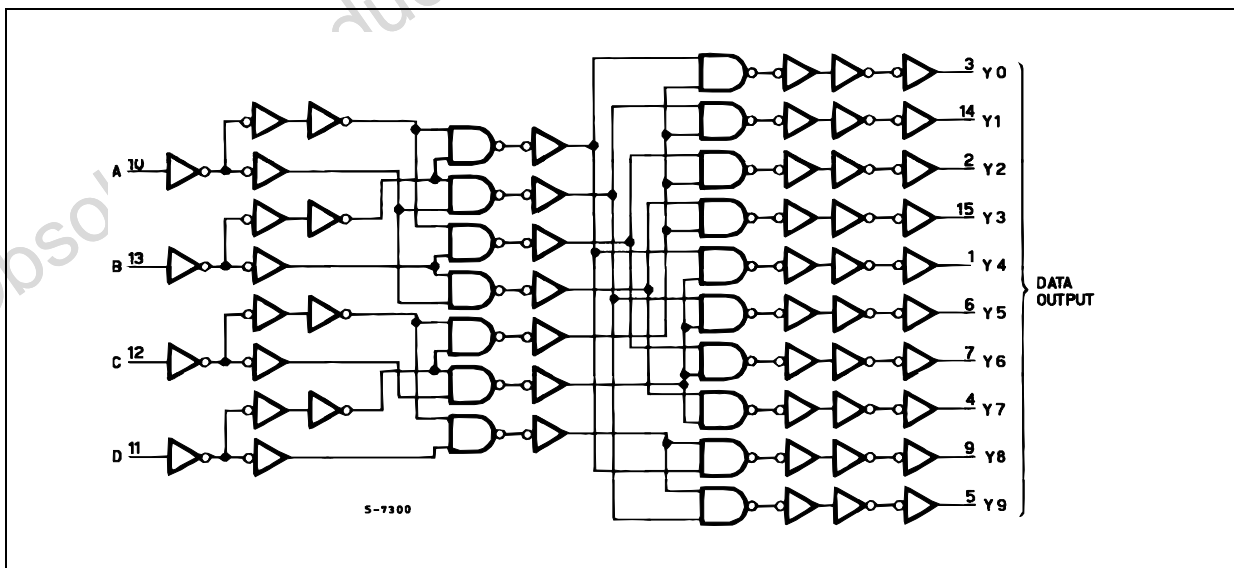
This logic diagram has not be used to estimate propagation delays

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CC}	Supply Voltage	-0.5 to +7	V
V_I	DC Input Voltage	-0.5 to V_{CC} + 0.5	V
V_O	DC Output Voltage	-0.5 to V_{CC} + 0.5	V
I_{IK}	DC Input Diode Current	± 20	mA
I_{OK}	DC Output Diode Current	± 20	mA
I_O	DC Output Current	± 25	mA
I_{CC} or I_{GND}	DC V_{CC} or Ground Current	± 50	mA
P_D	Power Dissipation	500(*)	mW
T_{stg}	Storage Temperature	-65 to +150	°C
T_L	Lead Temperature (10 sec)	300	°C

Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these conditions is not implied
(*) 500mW at 65 °C; derate to 300mW by 10mW/°C from 65°C to 85°C

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter		Value	Unit
V_{CC}	Supply Voltage		2 to 6	V
V_I	Input Voltage		0 to V_{CC}	V
V_O	Output Voltage		0 to V_{CC}	V
T_{op}	Operating Temperature		-55 to 125	°C
t_r, t_f	Input Rise and Fall Time	V_{CC} = 2.0V	0 to 1000	ns
		V_{CC} = 4.5V	0 to 500	ns
		V_{CC} = 6.0V	0 to 400	ns

DC SPECIFICATIONS

Symbol	Parameter	Test Condition		Value							Unit
		V_{CC} (V)		$T_A = 25°C$			-40 to 85°C		-55 to 125°C		
				Min.	Typ.	Max.	Min.	Max.	Min.	Max.	
V_{IH}	High Level Input Voltage	2.0		1.5			1.5		1.5		V
		4.5		3.15			3.15		3.15		
		6.0		4.2			4.2		4.2		
V_{IL}	Low Level Input Voltage	2.0				0.5		0.5		0.5	V
		4.5				1.35		1.35		1.35	
		6.0				1.8		1.8		1.8	
V_{OH}	High Level Output Voltage	2.0	I_O=-20 µA	1.9	2.0		1.9		1.9		V
		4.5	I_O=-20 µA	4.4	4.5		4.4		4.4		
		6.0	I_O=-20 µA	5.9	6.0		5.9		5.9		
		4.5	I_O=-4.0 mA	4.18	4.31		4.13		4.10		
		6.0	I_O=-5.2 mA	5.68	5.8		5.63		5.60		
V_{OL}	Low Level Output Voltage	2.0	I_O=20 µA		0.0	0.1		0.1		0.1	V
		4.5	I_O=20 µA		0.0	0.1		0.1		0.1	
		6.0	I_O=20 µA		0.0	0.1		0.1		0.1	
		4.5	I_O=4.0 mA		0.17	0.26		0.33		0.40	
		6.0	I_O=5.2 mA		0.18	0.26		0.33		0.40	
I_I	Input Leakage Current	6.0	$V_I = V_{CC}$ or GND			± 0.1		± 1		± 1	µA
I_{CC}	Quiescent Supply Current	6.0	$V_I = V_{CC}$ or GND			4		40		80	µA

AC ELECTRICAL CHARACTERISTICS (C_L = 50 pF, Input $t_r = t_f$ = 6ns)

Symbol	Parameter	Test Condition		Value							Unit
		V_{CC} (V)		$T_A = 25°C$			-40 to 85°C		-55 to 125°C		
				Min.	Typ.	Max.	Min.	Max.	Min.	Max.	
t_{TLH} t_{THL}	Output Transition Time	2.0			30	75		95		110	ns
		4.5			8	15		19		22	
		6.0			7	13		16		19	
t_{PLH} t_{PHL}	Propagation Delay Time	2.0			96	185		230		280	ns
		4.5			24	37		46		56	
		6.0			20	31		39		48	

CAPACITIVE CHARACTERISTICS

Symbol	Parameter	Test Condition		Value							Unit
		V_{CC} (V)		$T_A = 25°C$			-40 to 85°C		-55 to 125°C		
				Min.	Typ.	Max.	Min.	Max.	Min.	Max.	
C_{IN}	Input Capacitance	5.0			5	10		10		10	pF
C_{PD}	Power Dissipation Capacitance (note 1)	5.0			39						pF

1) C_{PD} is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to Test Circuit). Average operating current can be obtained by the following equation. $I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}$
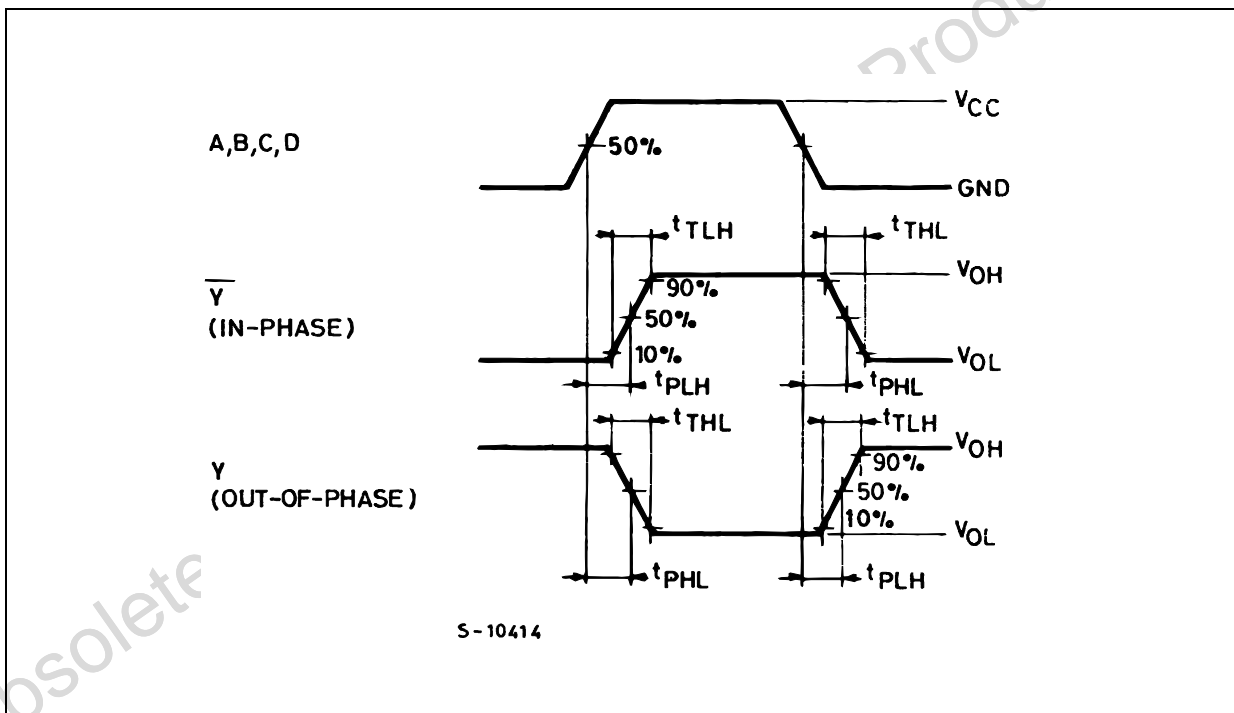
TEST CIRCUIT
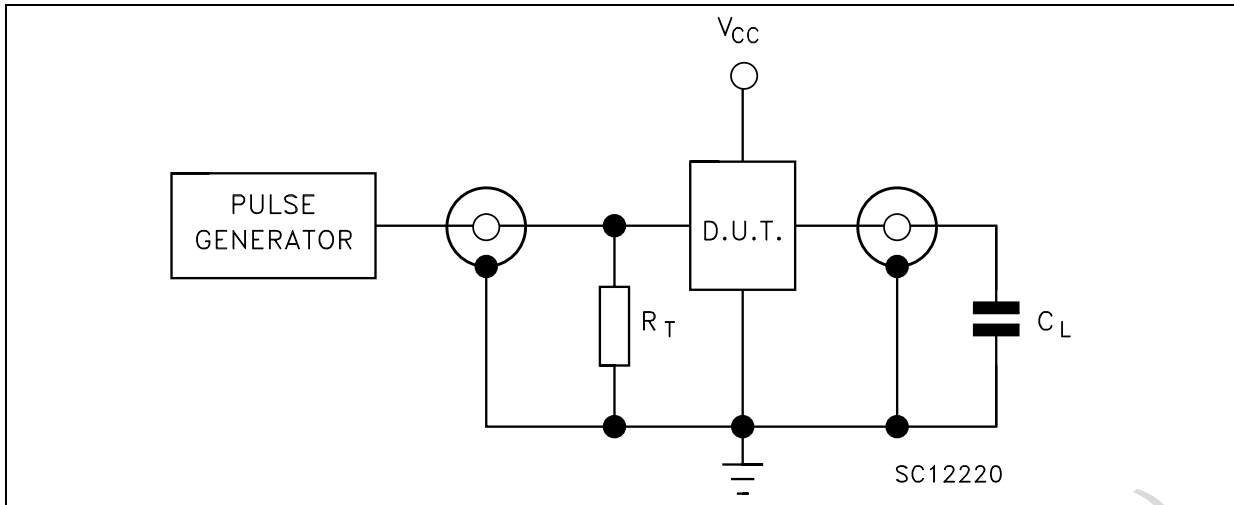
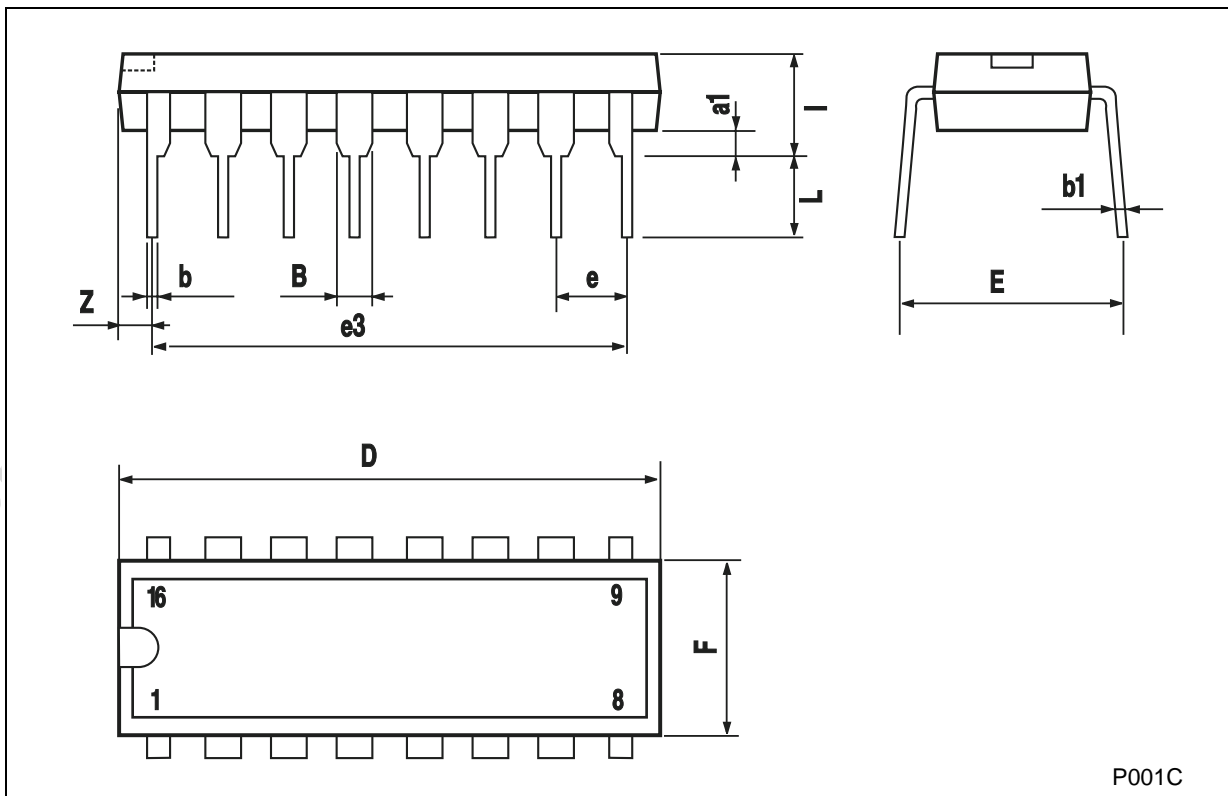C$_L$ = 50pF or equivalent (includes jig and probe capacitance)
R$_T$ = Z$_{OUT}$ of pulse generator (typically 50Ω)

**WAVEFORM : PROPAGATION DELAY TIMES** (f=1MHz; 50% duty cycle)

S-10414

Plastic DIP-16 (0.25) MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
a1	0.51			0.020		
B	0.77		1.65	0.030		0.065
b		0.5			0.020	
b1		0.25			0.010	
D			20			0.787
E		8.5			0.335	
e		2.54			0.100	
e3		17.78			0.700	
F			7.1			0.280
I			5.1			0.201
L		3.3			0.130	
Z			1.27			0.050

P001C

SO-16 MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			1.75			0.068
a1	0.1		0.2	0.003		0.007
a2			1.65			0.064
b	0.35		0.46	0.013		0.018
b1	0.19		0.25	0.007		0.010
C		0.5			0.019	
c1	45° (typ.)					
D	9.8		10	0.385		0.393
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		8.89			0.350	
F	3.8		4.0	0.149		0.157
G	4.6		5.3	0.181		0.208
L	0.5		1.27	0.019		0.050
M			0.62			0.024
S	8° (max.)					

PO13H

7/9
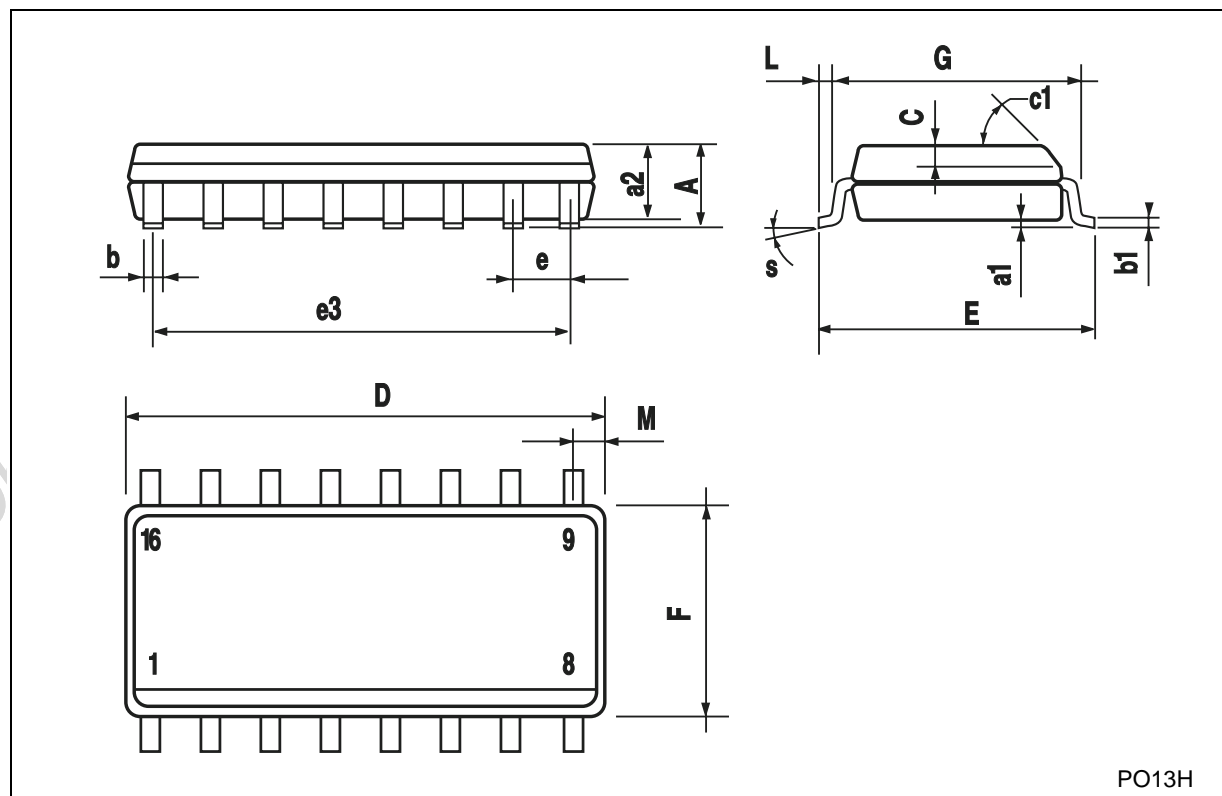
TSSOP16 MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			1.2			0.047
A1	0.05		0.15	0.002	0.004	0.006
A2	0.8	1	1.05	0.031	0.039	0.041
b	0.19		0.30	0.007		0.012
c	0.09		0.20	0.004		0.0089
D	4.9	5	5.1	0.193	0.197	0.201
E	6.2	6.4	6.6	0.244	0.252	0.260
E1	4.3	4.4	4.48	0.169	0.173	0.176
e		0.65 BSC			0.0256 BSC	
K	0°		8°	0°		8°
L	0.45	0.60	0.75	0.018	0.024	0.030

PIN 1 IDENTIFICATION

0080338D