



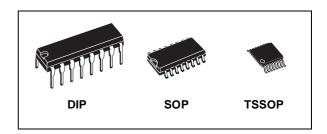
# **BCD TO DECIMAL DECODER**

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



The M74HC4028 is an high speed CMOS BCD TO DECIMAL DECODER fabricated with silicon gate C<sup>2</sup>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 TC 8



#### **ORDER CODES**

PACKAGE	TUBE	1 & K
DIP	M74HC4028B1R	.10
SOP	M74HC4028M1R	N.74.1C4028RM13TR
TSSOP	101	M74HC4028TTR

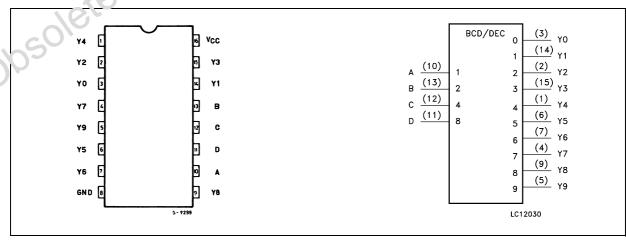
LINE DECODER, when D input is assigned as a disable input.

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.

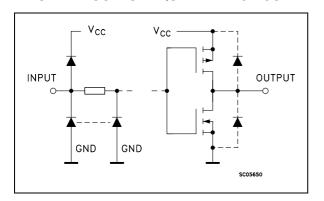
## PIN CONNECTION AND IEC LOGIC SYMBOLS

oduc'



August 2001 1/9

## INPUT AND OUTPUT EQUIVALENT CIRCUIT



## **PIN DESCRIPTION**

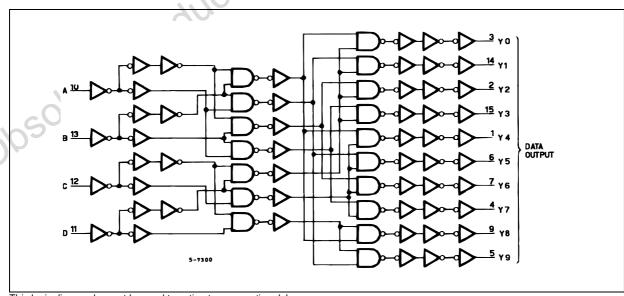
PIN No	SYMBOL	NAME AND FUNCTION
1, 2, 3, 4, 5, 6, 7, 9, 14, 15	Y0 to Y9	Decoder Outputs
10, 11, 12, 13	A to D	Data Inputs
8	GND	Ground (0V)
16	V <sub>CC</sub>	Positive Supply Voltage

#### **TRUTH TABLE**

	INP	UTS			OUTPUTS									SELECTED
D	С	В	Α	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	OUTPUT
L	L	L	L	Н	L	L	L	L	L	L	L	L	L	Y0
L	L	L	Н	L	Н	L	L	L	L	L	L	L	L	Y1
L	L	Н	L	L	L	Н	L	L	L	L	L			Y2
L	L	Н	Н	L	L	L	Н	L	L	L	L	(1)	L	Y3
L	Н	L	L	L	L	L	L	Н	L	L	L	L	L	Y4
L	Н	L	Н	L	L	L	L	L	Н	L.	>L	L	L	Y5
L	Н	Н	L	L	L	L	L	L	L	H	٦	L	L	Y6
L	Н	Н	Н	L	L	L	L	L	<b>L</b>	٦	Н	L	L	Y7
Н	L	L	L	L	L	L	L	L		L	L	Н	L	Y8
Н	L	Ĺ	Н	Ĺ	Ĺ	Ĺ	L	1	L	L	L	Ĺ	Н	Y9
Н	Χ	Н	Χ	Ĺ	Ĺ	Ĺ	L	L	Ĺ	L	L	L	L	NONE
Н	Н	Χ	Χ	Ĺ	Ĺ	L	Ľ	Ĺ	Ĺ	L	L	L	Ĺ	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 <sub>CC</sub>	Supply Voltage	-0.5 to +7	V
V <sub>I</sub>	DC Input Voltage	-0.5 to V <sub>CC</sub> + 0.5	V
Vo	DC Output Voltage	-0.5 to V <sub>CC</sub> + 0.5	V
I <sub>IK</sub>	DC Input Diode Current	± 20	mA
I <sub>OK</sub>	DC Output Diode Current	± 20	mA
Io	DC Output Current	± 25	mA
I <sub>CC</sub> or I <sub>GND</sub>	DC V <sub>CC</sub> or Ground Current	± 50	mA
P <sub>D</sub>	Power Dissipation	500(*)	mW
T <sub>stg</sub>	Storage Temperature	-65 to +150	°C
T <sub>L</sub>	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**

	Parameter	Value	Unit
V <sub>CC</sub>	Supply Voltage	2 to 6	V
VI	Input Voltage	0 to V <sub>CC</sub>	V
Vo	Output Voltage	0 to V <sub>CC</sub>	V
T <sub>op</sub>	Operating Temperature	-55 to 125	°C
	Input Rise and Fall Time $V_{CC} = 2.0V$		ns
$t_r$ , $t_f$	$V_{CC} = 4.5V$		ns
	$V_{CC} = 6.0V$	0 to 400	ns
	AUICE		
-01/	ate Producties).		

#### **DC SPECIFICATIONS**

		1	Test Condition				Value				
Symbol	Parameter	V <sub>CC</sub>		T <sub>A</sub> = 25°C			-40 to	-40 to 85°C		125°C	Unit
		(V)		Min.	Тур.	Max.	Min.	Max.	Min.	Max.	
V <sub>IH</sub>	High Level Input	2.0		1.5			1.5		1.5		
	Voltage	4.5		3.15			3.15		3.15		V
		6.0		4.2			4.2		4.2		
$V_{IL}$	Low Level Input	2.0				0.5		0.5		0.5	
	Voltage	4.5				1.35		1.35		1.35	V
		6.0				1.8		1.8		1.8	
$V_{OH}$	High Level Output Voltage	2.0	I <sub>O</sub> =-20 μA	1.9	2.0		1.9		1.9		
		4.5	I <sub>O</sub> =-20 μA	4.4	4.5		4.4		4.4		
		6.0	I <sub>O</sub> =-20 μA	5.9	6.0		5.9		5.9		V
		4.5	I <sub>O</sub> =-4.0 mA	4.18	4.31		4.13		4.10		
		6.0	I <sub>O</sub> =-5.2 mA	5.68	5.8		5.63		5.60	10	
V <sub>OL</sub>	Low Level Output	2.0	I <sub>O</sub> =20 μA		0.0	0.1		0.1		0.1	
	Voltage	4.5	I <sub>O</sub> =20 μA		0.0	0.1		0.1	10	0.1	
		6.0	I <sub>O</sub> =20 μA		0.0	0.1		0.1	O.	0.1	V
		4.5	I <sub>O</sub> =4.0 mA		0.17	0.26	24	0.33		0.40	
		6.0	I <sub>O</sub> =5.2 mA		0.18	0.26	V	0.33		0.40	
I <sub>I</sub>	Input Leakage Current	6.0	$V_I = V_{CC}$ or GND			± 0.1		± 1		± 1	μΑ
I <sub>CC</sub>	Quiescent Supply Current	6.0	$V_I = V_{CC}$ or GND	C	$O_{J_{\ell}}$	4		40		80	μА

# AC ELECTRICAL CHARACTERISTICS ( $C_L = 50 \text{ pF}$ , Input $t_r = t_f = 6 \text{ns}$ )

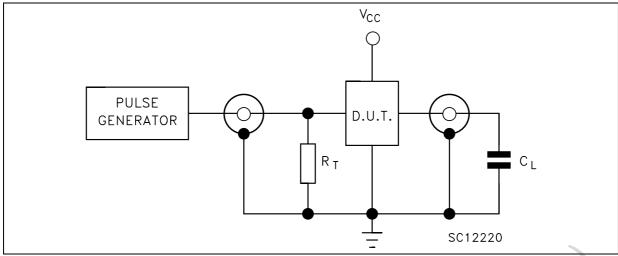
		Test Condition		Value							
Symbol	mbol Parameter		V <sub>CC</sub>	T <sub>A</sub> = 25°C			-40 to 85°C		-55 to 125°C		Unit
		V <sub>CC</sub> (V)		Min.	Тур.	Max.	Min.	Max.	Min.	Max.	
t <sub>TLH</sub> t <sub>THL</sub>	Output Transition	2.0			30	75		95		110	
	Time	4.5			8	15		19		22	ns
		6.0			7	13		16		19	
t <sub>PLH</sub> t <sub>PHL</sub>	Propagation Delay	2.0			96	185		230		280	
	Time	4.5			24	37		46		56	ns
	O	6.0			20	31		39		48	

# CAPACITIVE CHARACTERISTICS

		Test Condition		Value							
Symbol	Parameter	v <sub>cc</sub>		T <sub>A</sub> = 25°C			-40 to 85°C		-55 to 125°C		Unit
		(V)	Min.	Тур.	Max.	Min.	Max.	Min.	Max.		
C <sub>IN</sub>	Input Capacitance	5.0			5	10		10		10	pF
C <sub>PD</sub>	Power Dissipation Capacitance (note 1)	5.0			39						pF

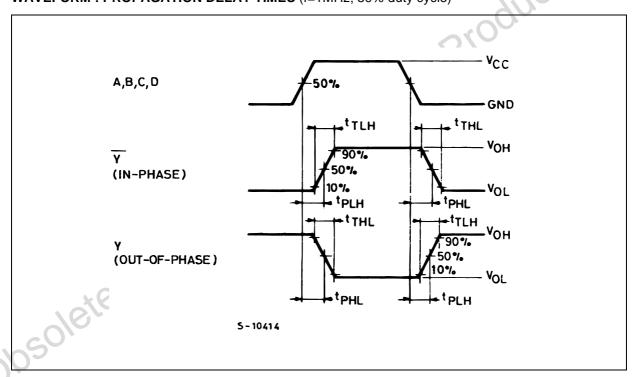
<sup>1)</sup> C<sub>PD</sub> is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to Test Circuit). Average operating current can be obtained by the following equation. I<sub>CC(opr)</sub> = C<sub>PD</sub> x V<sub>CC</sub> x f<sub>IN</sub> + I<sub>CC</sub>

#### **TEST CIRCUIT**



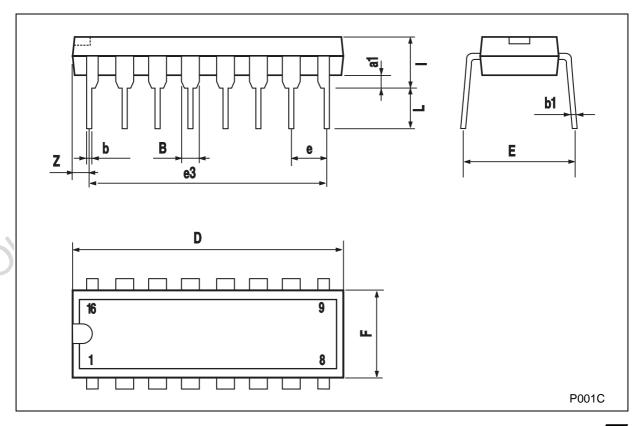
 $C_L$  = 50pF or equivalent (includes jig and probe capacitance)  $R_T$  =  $Z_{OUT}$  of pulse generator (typically 50 $\Omega$ )

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



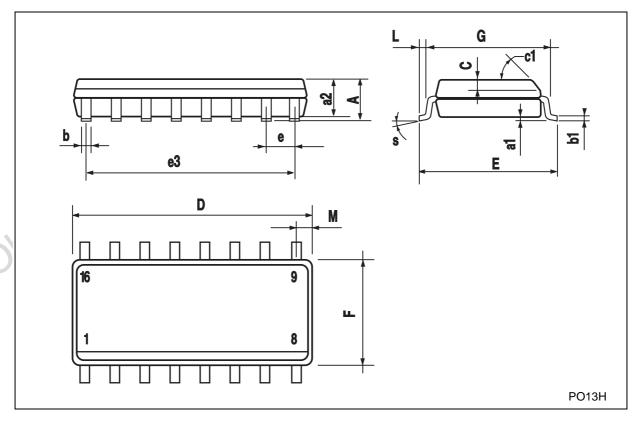
# Plastic DIP-16 (0.25) MECHANICAL DATA

DIM		mm.			inch	
DIM.	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
a1	0.51			0.020		
В	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	
е		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



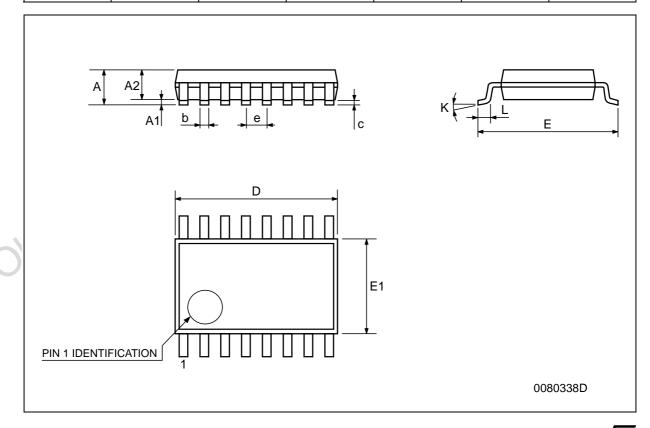
# **SO-16 MECHANICAL DATA**

DIM		mm.			inch	
DIM.	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
Α			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
С		0.5			0.019	
c1			45°	(typ.)	•	
D	9.8		10	0.385		0.393
E	5.8		6.2	0.228		0.244
е		1.27			0.050	
еЗ		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
М			0.62			0.024
S			8° (	max.)	·	



# **TSSOP16 MECHANICAL DATA**

DIM.		mm.			inch	
DIN.	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
А			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
С	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
е		0.65 BSC			0.0256 BSC	
К	0°		8°	0°		8°
L	0.45	0.60	0.75	0.018	0.024	0.030



Informations on the production of the production Information furnished is believed to be accurate and reliable. However, STMicroelectronics assumes no responsibility for the

consequences of use of such information nor for any infringement of patents or other rights of third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of STMicroelectronics. Specifications mentioned in this publication are subject to change without notice. This publication supersedes and replaces all information previously supplied. STMicroelectronics products are not authorized for use as critical components in life support devices or systems without express written approval of STMicroelectronics.

© The ST logo is a registered trademark of STMicroelectronics

© 2001 STMicroelectronics - Printed in Italy - All Rights Reserved STMicroelectronics GROUP OF COMPANIES

Australia - Brazil - China - Finland - France - Germany - Hong Kong - India - Italy - Japan - Malaysia - Malta - Morocco Singapore - Spain - Sweden - Switzerland - United Kingdom © http://www.st.com

