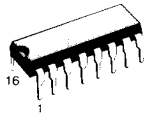
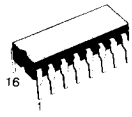
BCD-TO-DECIMAL DECODER

- HIGH SPEED
  t_{PD} = 25 ns (TYP.) at V_{CC} = 5V
- LOW POWER DISSIPATION
  I_{CC} = 4 μA (MAX.) at T_A = 25°C
- HIGH NOISE IMMUNITY
  V_{NIH} = V_{NIL} = 28% V_{CC} (MIN.)
- OUTPUT DRIVE CAPABILITY
  10 LSTTL LOADS
- SYMMETRICAL OUTPUT IMPEDANCE
  $|I_{OH}|$ = I_{OL} = 4 mA (MIN.)
- BALANCED PROPAGATION DELAYS
  t_{PLH} = t_{PHL}
- WIDE OPERATING VOLTAGE RANGE
  V_{CC} (OPR) = 2V to 6V
- PIN AND FUNCTION COMPATIBLE WITH 4028B



B1N
Plastic Package



F1
Ceramic Frit Seal Package

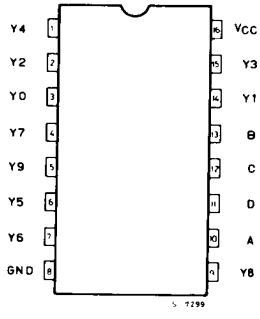
M1
Micro Package

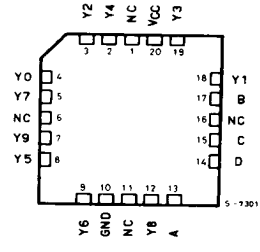
C1
Plastic Chip Carrier

ORDERING NUMBERS:

M54HC4028 F1	M74HC4028 C1
M74HC4028 B1N	M74HC4028 M1
M74HC4028 F1	

PIN CONNECTIONS (top view)





NC = No Internal Connection

DESCRIPTION

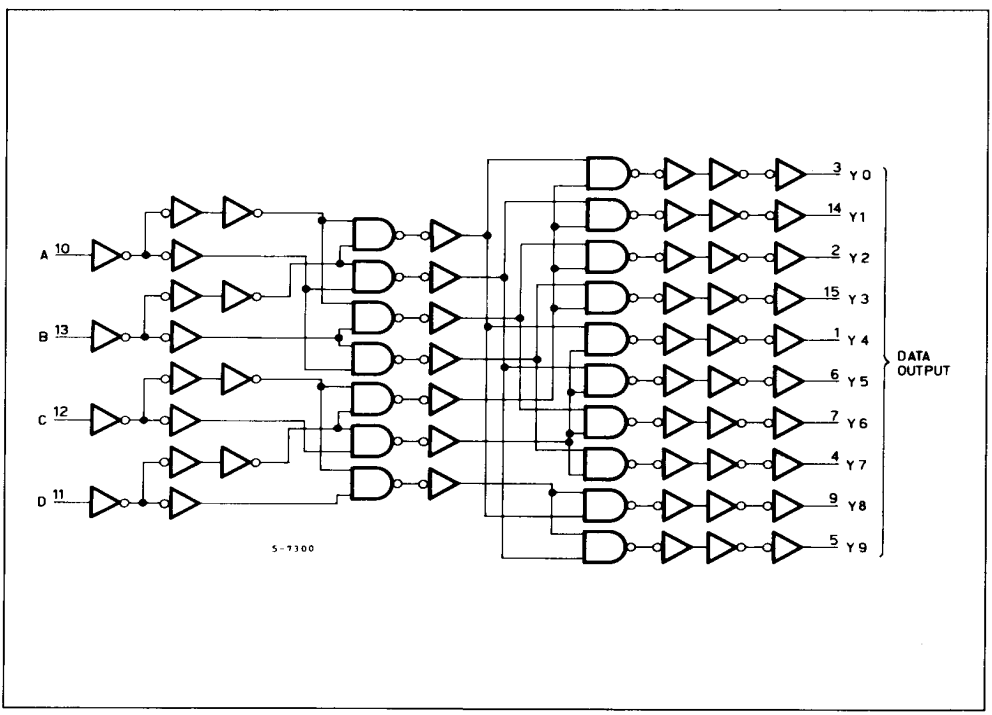
The M54/74HC4028 is a high speed CMOS BCD-TO-DECIMAL DECODER fabricated in silicon gate C²MOS technology. It has the same high speed performance of LSTTL combined with true CMOS low power consumption. A BCD code applied to the four inputs (A to D) provides a high level at the selected one of the decimal 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-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.

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	Y3
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	NOTE
H	H	X	X	L	L	L	L	L	L	L	L	L	L	NOTE

X: DON'T CARE

LOGIC DIAGRAM



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 Source Sink Current Per Output Pin	± 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

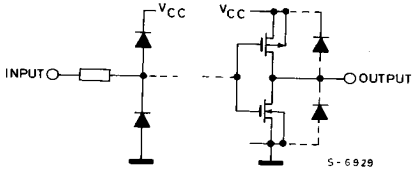
Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these condition is not implied.

(*) 500 mW: ≅ 65°C derate to 300 mW by 10 mW/°C: 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_A	Operating Temperature	74HC Series 54HC Series	−40 to 85 −55 to 125		°C
t_r, t_f	Input Rise and Fall Time	V_{CC} 2 V V_{CC} 4.5V V_{CC} 6 V	0 to 1000 0 to 500 0 to 400		ns

INPUT AND OUTPUT EQUIVALENT CIRCUIT



DC SPECIFICATIONS

Symbol	Parameter	V_{CC}	Test Condition		$T_A = 25°C$ 54HC and 74HC			-40 to $85°C$ 74HC		-55 to $125°C$ 54HC		Unit
					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	V_I	I_O	1.9	2.0	—	1.9	—	1.9	—	V
		4.5	V_{IH} or V_{IL}	$-20\ \mu A$	4.4	4.5	—	4.4	—	4.4	—	
		6.0			5.9	6.0	—	5.9	—	5.9	—	
		4.5		-4.0 mA	4.18	4.31	—	4.13	—	4.10	—	
		6.0		-5.2 mA	5.68	5.8	—	5.63	—	5.60	—	
V_{OL}	Low Level Output Voltage	2.0	V_{IH} or V_{IL}	$20\ \mu A$	—	0.0	0.1	—	0.1	—	0.1	V
		4.5			—	0.0	0.1	—	0.1	—	0.1	
		6.0			—	0.0	0.1	—	0.1	—	0.1	
		4.5		4.0 mA	—	0.17	0.26	—	0.33	—	0.40	
		6.0		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	—	± 1.0	—	± 1.0	μA
I_{CC}	Quiescent Supply Current	6.0	$V_I = V_{CC}$ or GND		—	—	4	—	40	—	80	μA

AC ELECTRICAL CHARACTERISTICS ($V_{CC} = 5V$, $T_A = 25°C$, $C_L = 15pF$, Input $t_r = t_f = 6ns$)

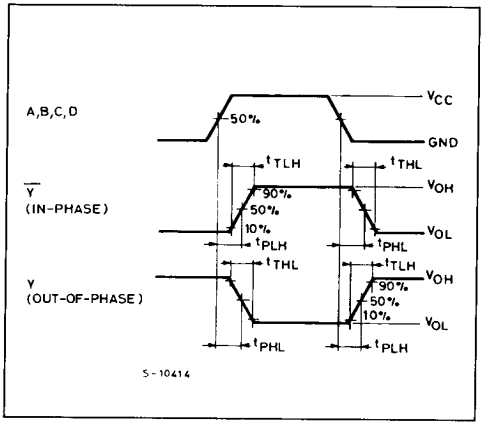
Symbol	Parameter	54HC and 74HC			Unit
		Min.	Typ.	Max.	
t_{TLH} t_{THL}	Output Transition Time		4	8	ns
t_{PLH} t_{PHL}	Propagation Delay Time (A,B,C-D)		25	39	ns

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

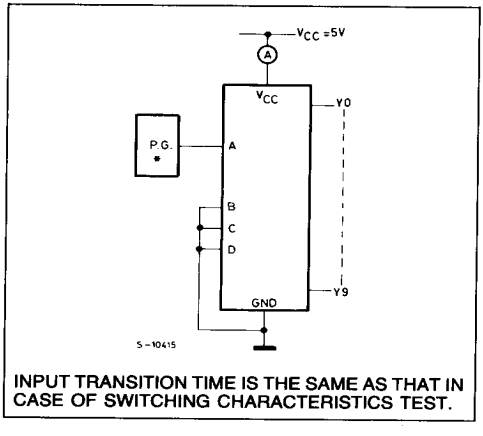
Symbol	Parameter	V_{CC}	Test Condition	T_A = 25°C 54HC and 74HC			−40 to 85°C 74HC		−55 to 125°C 54HC		Unit
				Min.	Typ.	Max.	Min.	Max.	Min.	Max.	
t_{TLH} t_{THL}	Output Transition Time	2.0		—	30	75	—	95	—	110	ns
		4.5		—	8	15	—	19	—	22	
		6.0		—	7	13	—	16	—	19	
t_{PLH} t_{PHL}	Propagation Delay Time (A, B, C, D)	2.0		—	116	225	—	280	—	340	ns
		4.5		—	29	45	—	56	—	68	
		6.0		—	25	38	—	48	—	58	
C_{IN}	Input Capacitance			—	5	10	—	10	—	—	pF
C_{PD} (*)	Power Dissipation Capacitance			—	58	—	—	—	—	—	pF

Note (*) 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:
$I_{CC(opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}$

SWITCHING CHARACTERISTICS TEST WAVEFORM



TEST CIRCUIT I_{CC} (Opr.)



INPUT TRANSITION TIME IS THE SAME AS THAT IN CASE OF SWITCHING CHARACTERISTICS TEST.