PRELIMINARY DATA

BCD-TO-DECIMAL DECODER

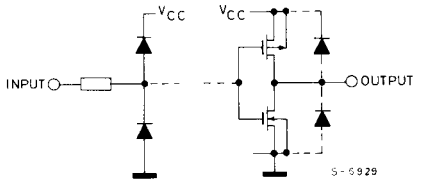
DESCRIPTION

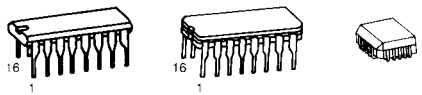
The M54/74HC4028 is a high speed CMOS BCD-TO-DECIMAL DECODER fabricated in silicon gate C²MOS technology. It has the same high speed performance of LSTTL combined with true CMOS low power consumption. A BCD code applied to the four input (A thru D) provides a high level at the selected one of the decimal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

FEATURES

- 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

INPUT AND OUTPUT EQUIVALENT CIRCUIT

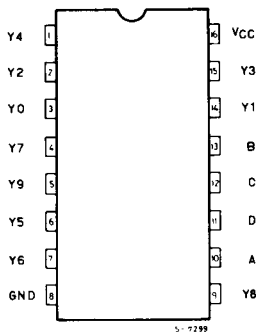




B1 Plastic Package | **F1** Ceramic Package | **C1** Chip Carrier

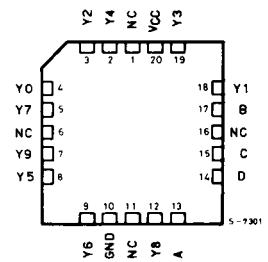
ORDERING NUMBERS: M54HC4028 F1
M74HC4028 B1
M74HC4028 F1
M74HC4028 C1

PIN CONNECTIONS
(top view)



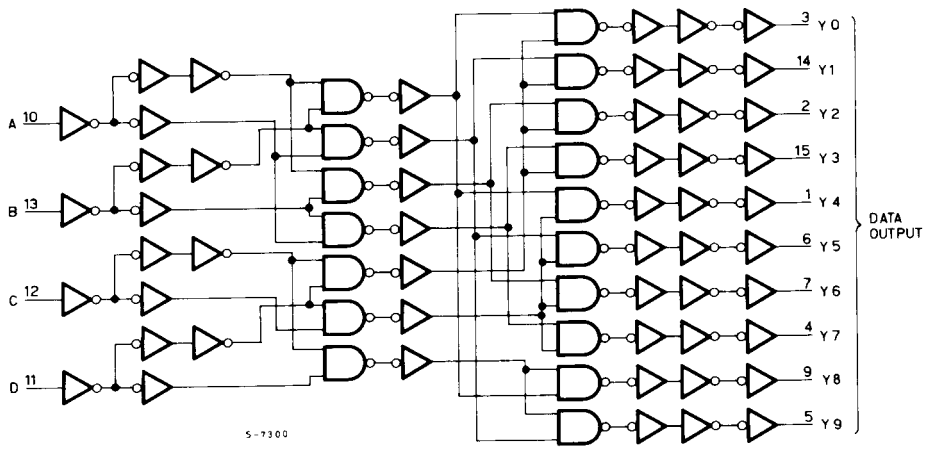
Dual in line

CHIP CARRIER



NC = No Internal Connection

LOGIC DIAGRAM



TRUTH TABLE

INPUTS				OUTPUTS										SELECTED OUTPUT
D	C	B	A	Y_0	Y_1	Y_2	Y_3	Y_4	Y_5	Y_6	Y_7	Y_8	Y_9	
L	L	L	L	H	L	L	L	L	L	L	L	L	L	Y_0
L	L	L	H	L	H	L	L	L	L	L	L	L	L	Y_1
L	L	H	L	L	L	H	L	L	L	L	L	L	L	Y_3
L	L	H	H	L	L	L	H	L	L	L	L	L	L	Y_3
L	H	L	L	L	L	L	L	H	L	L	L	L	L	Y_4
L	H	L	H	L	L	L	L	L	H	L	L	L	L	Y_5
L	H	H	L	L	L	L	L	L	L	H	L	L	L	Y_6
L	H	H	H	L	L	L	L	L	L	L	H	L	L	Y_7
H	L	L	L	L	L	L	L	L	L	L	L	H	L	Y_8
H	L	L	H	L	L	L	L	L	L	L	L	L	H	Y_9
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

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		Limit		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

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
			V_I	I_O	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_{IH} or V_{IL}	−20 μA	1.9	2.0	—	1.9	—	1.9	—	V
		4.5			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	—	

DC SPECIFICATIONS (Continued)

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_{OL}	Low Level Output Voltage	2.0	V_I	I_O	—	0	0.1	—	0.1	—	0.1	V
		4.5	V_{IH}	20 μA	—	0	0.1	—	0.1	—	0.1	
		6.0	or		—	0	0.1	—	0.1	—	0.1	
		4.5	V_{IL}	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		±1	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	—	90			ns
		4.5		—	8	15	—	18			
		6.0		—	7	13	—	16			
t_{PLH} t_{PHL}	Propagation Delay Time (A, B, C, D)	2.0		—	110	225	—	270			ns
		4.5		—	29	45	—	54			
		6.0		—	25	39	—	46			
C_{IN}	Input Capacitance			—	5	10	—	10			pF
C_{PD} (*)	Power Dissipation Capacitance				58						pF

Note (*) C_{PD} is defined as the value the IC's of internal equivalent capacitance which is calculated from the operating current consumption without load.

Average operating current can be obtained by the following equation.

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