

## CD4028BC BCD-to-Decimal Decoder

### General Description

The CD4028BC is a BCD-to-decimal or binary-to-octal decoder consisting of 4 inputs, decoding logic gates, and 10 output buffers. A BCD code applied to the 4 inputs, A, B, C, and D, results in a high level at the selected 1-of-10 decimal decoded outputs. Similarly, a 3-bit binary code applied to inputs A, B, and C is decoded in octal at outputs 0–7. A high level signal at the D input inhibits octal decoding and causes outputs 0–7 to go LOW.

All inputs are protected against static discharge damage by diode clamps to  $V_{DD}$  and  $V_{SS}$ .

### Features

- Wide supply voltage range: 3.0V to 15V
- High noise immunity:  $0.45 V_{DD}$  (typ.)
- Low power TTL compatibility: fan out of 2 driving 74L or 1 driving 74LS
- Low power
- Glitch free outputs
- "Positive logic" on inputs and outputs

### Applications

- Code conversion
- Address decoding
- Indicator-tube decoder

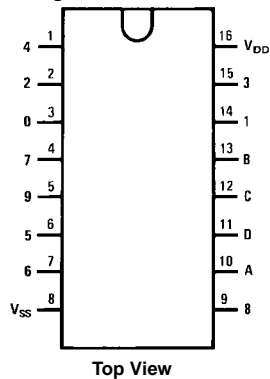
### Ordering Code:

Order Number	Package Number	Package Description
CD4028BCM	M16A	16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow Body
CD4028BCN	N16E	16-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide

Devices also available in Tape and Reel. Specify by appending the suffix letter "X" to the ordering code.

### Connection Diagram

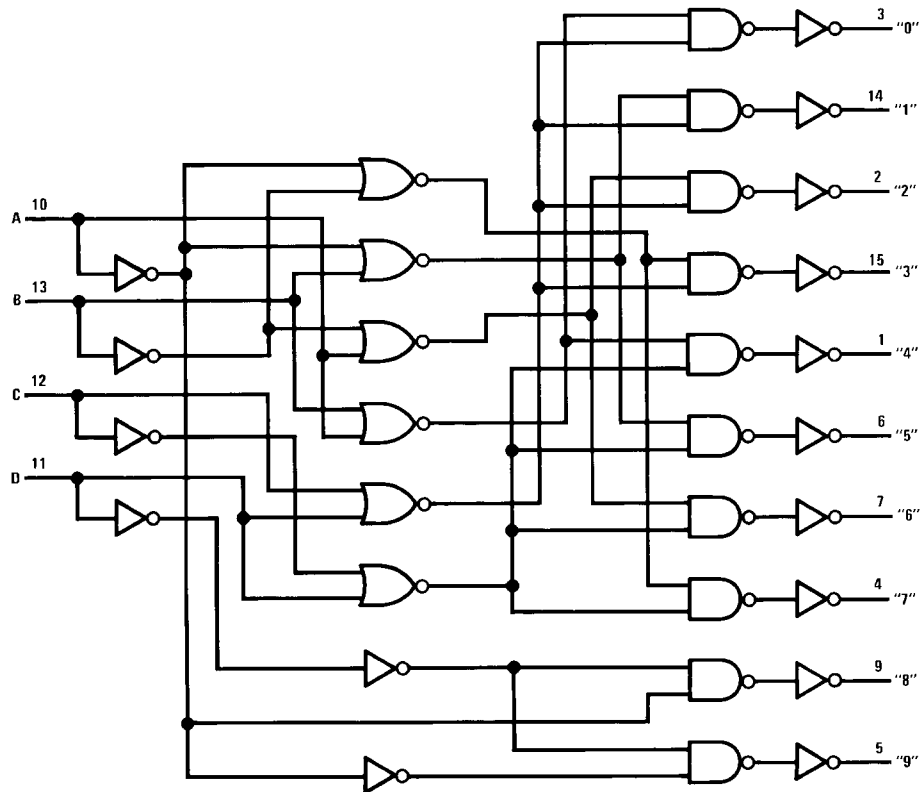
Pin Assignments for DIP and SOIC



Truth Table

	D	C	B	A	0	1	2	3	4	5	6	7	8	9	
1 = HIGH Level 0 = LOW Level	0	0	0	0	1	0	0	0	0	0	0	0	0	0	BCD States
	0	0	0	1	0	1	0	0	0	0	0	0	0	0	
	0	0	1	0	0	0	1	0	0	0	0	0	0	0	
	0	0	1	1	0	0	0	1	0	0	0	0	0	0	
	0	1	0	0	0	0	0	0	1	0	0	0	0	0	
	0	1	0	1	0	0	0	0	0	1	0	0	0	0	
	0	1	1	0	0	0	0	0	0	0	1	0	0	0	
	0	1	1	1	0	0	0	0	0	0	0	1	0	0	
	1	0	0	0	0	0	0	0	0	0	0	0	1	0	
	1	0	0	1	0	0	0	0	0	0	0	0	0	1	
Extraordinary States	1	0	1	0	0	0	0	0	0	0	0	0	1	0	
	1	0	1	1	0	0	0	0	0	0	0	0	0	1	
	1	1	0	0	0	0	0	0	0	0	0	0	1	0	
	1	1	0	1	0	0	0	0	0	0	0	0	0	1	
	1	1	1	0	0	0	0	0	0	0	0	0	1	0	
	1	1	1	1	0	0	0	0	0	0	0	0	0	1	

Logic Diagram



Absolute Maximum Ratings <sup>(Note 1)</sup>		Recommended Operating Conditions <sup>(Note 2)</sup>	
Supply Voltage ( $V_{DD}$ )	-0.5 to +18V	Supply Voltage ( $V_{DD}$ )	3 to 15V
Input Voltage ( $V_{IN}$ )	-0.5 to $V_{DD} + 0.5V$	Input Voltage ( $V_{IN}$ )	0 to $V_{DD}V$
Storage Temperature Range ( $T_S$ )	-65°C to +150°C	Operating Temperature Range ( $T_A$ )	-40°C to +85°C
Power Dissipation ( $P_D$ )			
Dual-In-Line	700 mW		
Small Outline	500 mW		
Lead Temperature ( $T_L$ )			
(Soldering, 10 seconds)	260°C		

**Note 1:** "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed, they are not meant to imply that the devices should be operated at these limits. The table of "Recommended Operating Conditions" and "Electrical Characteristics" provides conditions for actual device operation.

**Note 2:**  $V_{SS} = 0V$  unless otherwise specified.

### DC Electrical Characteristics <sup>(Note 2)</sup>

Symbol	Parameter	Conditions	-40°C		+25°C			+85°C		Units
			Min	Max	Min	Typ	Max	Min	Max	
$I_{DD}$	Quiescent Device Current	$V_{DD} = 5V, V_{IN} = V_{DD}$ or $V_{SS}$		20		0.01	20		150	$\mu A$
		$V_{DD} = 10V, V_{IN} = V_{DD}$ or $V_{SS}$		40		0.01	40		300	$\mu A$
		$V_{DD} = 15V, V_{IN} = V_{DD}$ or $V_{SS}$		80		0.02	80		600	$\mu A$
$V_{OL}$	LOW Level Output Voltage	$ I_O  < 1 \mu A, V_{IL} = 0V, V_{IH} = V_{DD}$								
		$V_{DD} = 5V$		0.05		0	0.05		0.05	V
		$V_{DD} = 10V$		0.05		0	0.05		0.05	V
		$V_{DD} = 15V$		0.05		0	0.05		0.05	V
$V_{OH}$	HIGH Level Output Voltage	$ I_O  < 1 \mu A, V_{IL} = 0V, V_{IH} = V_{DD}$								
		$V_{DD} = 5V$	4.95		4.95	5		4.95		V
		$V_{DD} = 10V$	9.95		9.95	10		9.95		V
		$V_{DD} = 15V$	14.95		14.95	15		14.95		V
$V_{IL}$	LOW Level Input Voltage	$ I_O  < 1 \mu A$								
		$V_{DD} = 5V, V_O = 0.5V$ or $4.5V$		1.5		2.25	1.5		1.5	V
		$V_{DD} = 10V, V_O = 1V$ or $9V$		3.0		4.5	3.0		3.0	V
		$V_{DD} = 15V, V_O = 1.5V$ or $13.5V$		4.0		6.75	4.0		4.0	V
$V_{IH}$	HIGH Level Input Voltage	$ I_O  < 1 \mu A$								
		$V_{DD} = 5V, V_O = 0.5V$ or $4.5V$	3.5		3.5			3.5		V
		$V_{DD} = 10V, V_O = 1V$ or $9V$	7.0		7.0			7.0		V
		$V_{DD} = 15V, V_O = 1.5V$ or $13.5V$	11.0		11.0			11.0		V
$I_{OL}$	LOW Level Output Current (Note 3)	$V_{IH} = V_{DD}, V_{IL} = 0V$								
		$V_{DD} = 5V, V_O = 0.4V$	0.52		0.44	0.88		0.36		mA
		$V_{DD} = 10V, V_O = 0.5V$	1.3		1.1	2.2		0.9		mA
		$V_{DD} = 15V, V_O = 1.5V$	3.6		3.0	6.0		2.4		mA
$I_{OH}$	HIGH Level Output Current (Note 3)	$V_{IH} = V_{DD}, V_{IL} = 0V$								
		$V_{DD} = 5V, V_O = 4.6V$	-0.2		-0.16	-0.32		-0.12		mA
		$V_{DD} = 10V, V_O = 9.5V$	-0.5		-0.4	-0.8		-0.3		mA
		$V_{DD} = 15V, V_O = 13.5V$	-1.4		-1.2	-3.5		-1.0		mA
$I_{IN}$	Input Current	$V_{DD} = 15V, V_{IN} = 0V$		-0.3			-0.3		-1.0	$\mu A$
		$V_{DD} = 15V, V_{IN} = 15V$		0.3			0.3		1.0	$\mu A$

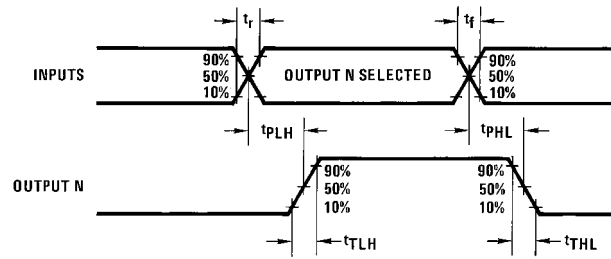
**Note 3:**  $I_{OL}$  and  $I_{OH}$  are tested one output at a time.

**AC Electrical Characteristics** (Note 4)  
 $T_A = 25^\circ\text{C}$ ,  $C_L = 50\text{ pF}$ ,  $R_L = 200\text{ k}$ , Input  $t_r = t_f = 20\text{ ns}$ , unless otherwise specified

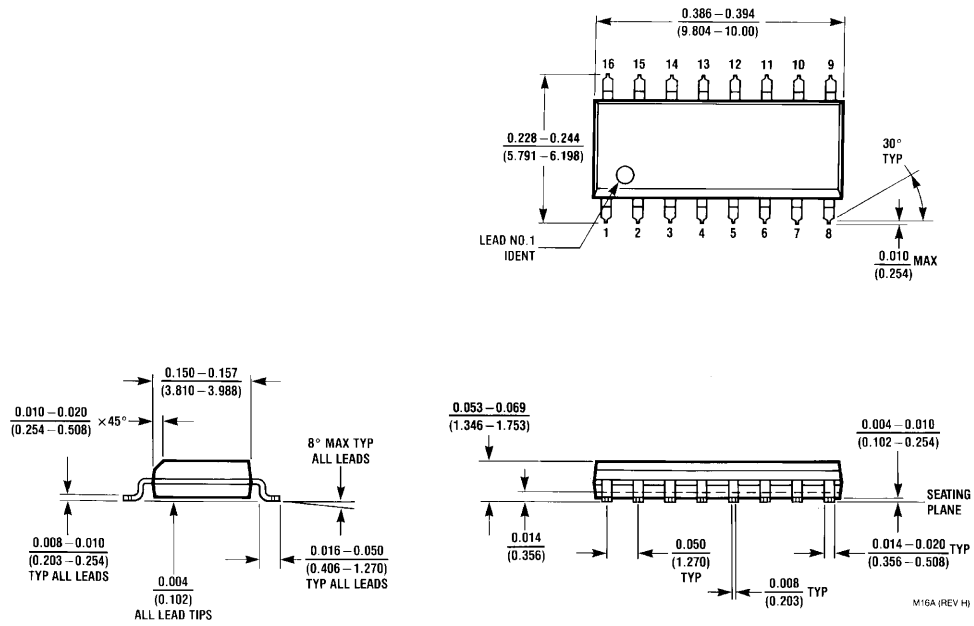
Symbol	Parameter	Conditions	Min	Typ	Max	Units
$t_{PHL}$ or $t_{PLH}$	Propagation Delay Time	$V_{CC} = 5\text{V}$		240	480	ns
		$V_{CC} = 10\text{V}$		100	200	ns
		$V_{CC} = 15\text{V}$		70	140	ns
$t_{THL}$ or $t_{TLH}$	Transition Time	$V_{CC} = 5\text{V}$		175	350	ns
		$V_{CC} = 10\text{V}$		75	150	ns
		$V_{CC} = 15\text{V}$		60	110	ns
$C_{IN}$	Input Capacitance	Any Input		5	7.5	pF

Note 4: AC Parameters are guaranteed by DC correlated testing.

**Switching Time Waveforms**

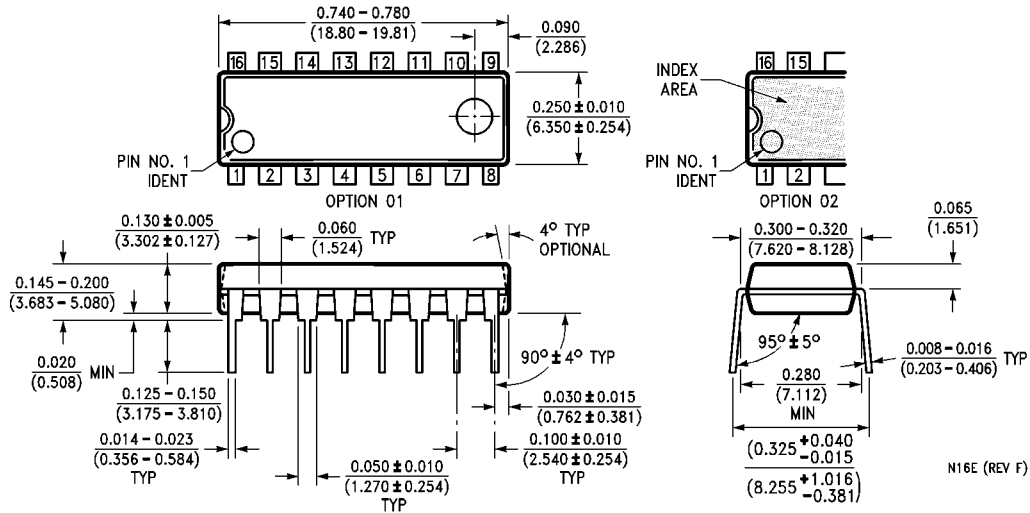


**Physical Dimensions** inches (millimeters) unless otherwise noted



**16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow Body  
Package Number M16A**

**Physical Dimensions** inches (millimeters) unless otherwise noted (Continued)



**16-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide  
Package Number N16E**

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