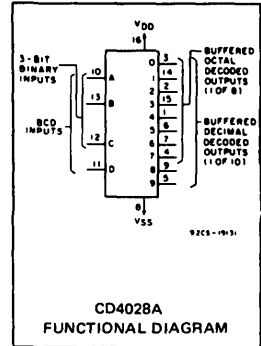


COS/MOS BCD-to-Decimal Decoder

The RCA-CD4028A types are BCD-to-decimal or binary-to-octal decoders consisting of pulse-shaping circuits on all 4 inputs, decoding-logic gates, and 10 output buffers. A BCD code applied to the four inputs, A to D, results in a high level at the selected one of 10 decimal decoded outputs. Similarly, a 3-bit binary code applied to inputs A through C is decoded in octal code at output 0 to 7. A high-level signal at the D input inhibits octal decoding and causes outputs

0 through 7 to go low. If unused, the D input must be connected to V_{SS}. High drive capability is provided at all outputs to enhance dc and dynamic performance in high fan-out applications.

These types are supplied in 16-lead hermetic dual-in-line ceramic packages (D and F suffixes), 16-lead dual-in-line plastic package (E suffix), 16-lead ceramic flat package (K suffix), and in chip form (H suffix).



MAXIMUM RATINGS, Absolute-Maximum Values:

STORAGE-TEMPERATURE RANGE (T _{stg})	-65 to +150°C
OPERATING-TEMPERATURE RANGE (T _A):	
PACKAGE TYPES D, F, H	-55 to +125°C
PACKAGE TYPE E	-40 to +85°C
DC SUPPLY-VOLTAGE RANGE, (V _{DD})	
(Voltages references to V _{SS} Terminal)	-0.5 to +15 V
POWER DISSIPATION PER PACKAGE (P _D):	
FOR T _A = -40 to +60°C (PACKAGE TYPE E)	500 mW
FOR T _A = +60 to +85°C (PACKAGE TYPE E)	Derate Linearly at 12 mW/°C to 200 mW
FOR T _A = -55 to +100°C (PACKAGE TYPES D, F)	500 mW
FOR T _A = +100 to +125°C (PACKAGE TYPES D, F)	Derate Linearly at 12 mW/°C to 200 mW
DEVICE DISSIPATION PER OUTPUT TRANSISTOR	
FOR T _A = FULL PACKAGE-TEMPERATURE RANGE (ALL PACKAGE TYPES)	100 mW
INPUT VOLTAGE RANGE, ALL INPUTS	-0.5 to V _{DD} + 0.5 V
LEAD TEMPERATURE (DURING SOLDERING)	
At distance 1/16 ± 1/32 inch (1.59 ± 0.79 mm) from case for 10 s max.	+265°C

RECOMMENDED OPERATING CONDITIONS

For maximum reliability, nominal operating conditions should be selected so that operation is always within the following ranges:

CHARACTERISTIC	V _{DD} (V)	LIMITS				UNITS
		D, F, H PACKAGES		E PACKAGE		
		MIN.	MAX.	MIN.	MAX.	
Supply-Voltage Range (For T _A =Full Package-Temperature Range)		3	12	3	12	V

Features:

- BCD-to-decimal decoding or binary-to-octal decoding
- High decoded output drive capability 8 mA (typ.) sink or source
- "Positive logic" inputs and outputs decoded outputs go high on selection
- Medium-speed operation t_{THL}, t_{TLH} = 30 ns (typ.) @ V_{DD} = 10 V
- Quiescent current specified t₁₅ V
- Maximum input leakage current of 1 μA at 15 V (full package-temperature range)
- 1-V noise margin (full package-temperature range)

Applications:

- Code conversion
- Address decoding—memory selection control
- Indicator-tube decoder

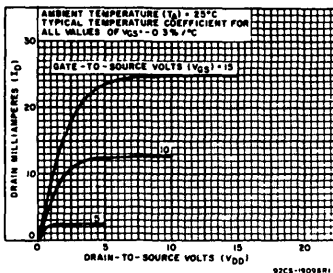


Fig. 1 - Typical output n-channel drain characteristics.

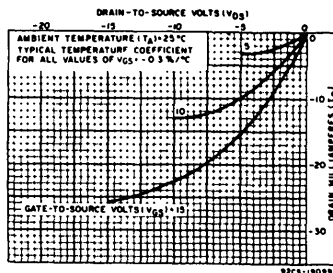


Fig. 2 - Typical output p-channel drain characteristics.

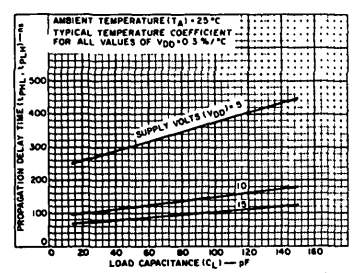


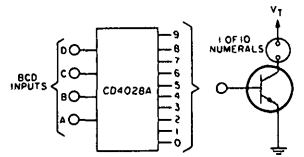
Fig. 3 - Typical propagation delay time vs. C_L.

CD4028A Types

DYNAMIC ELECTRICAL CHARACTERISTICS

at $T_A = 25^\circ\text{C}$, Input $t_r, t_f = 20\text{ ns}$, $C_L = 15\text{ pF}$, $R_L = 200\text{ k}\Omega$

CHARACTERISTIC	TEST CONDITIONS	LIMITS						UNITS	
		VDD (V)	D, F, H PACKAGES			E PACKAGE			
			MIN.	TYP.	MAX.	MIN.	TYP.		MAX.
Propagation Delay Time; t_{PLH}, t_{PHL}		5	-	250	480	-	250	700	ns
		10	-	100	180	-	100	290	
Transition Time; t_{THL}, t_{TLH}		5	-	60	150	-	60	300	ns
		10	-	30	75	-	30	150	
Average Input Capacitance, C_i	Any Input	-	-	5	-	-	5	-	pF



▲ (Trademark) Burroughs Corp. 92CS-1729501

TUBE REQUIREMENTS

Type	V _I (Vdc)	mA/Numeral
Burroughs (84081)	170	1.4
84336/718	170	2
84037	170	1.4
84071	170	1.4

TRANSISTOR CHARACTERISTICS

Leakage with transistor cutoff: $\leq 0.05\text{ mA}$
 $V_{IB}/V_{ICED} \geq 10V$

Fig. 9 - Neon readout (Nixie Tube[▲]) display application.

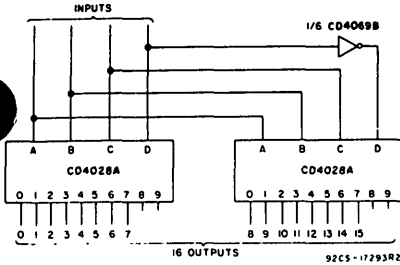


Fig. 8 - Code conversion circuit.

The circuit shown in Fig. 9 converts any 4-bit code to a decimal or hexadecimal code. Table 2 shows a number of codes and the decimal or hexadecimal number in these codes which must be applied to the input terminals of the CD4028A to select a particular output. For example: in order to get a high on output No. 8 the input must be either an 8 expressed in 4-Bit Binary code, a 15 expressed in 4-Bit Gray code, or a 5 expressed in Excess-3 code.

TABLE II - CODE CONVERSION CHART

INPUTS				INPUT CODES					OUTPUT NUMBER																		
				Hexa-Decimal		Decimal																					
D	C	B	A	4-BIT BINARY	4-BIT GRAY	EXCESS-3	EXCESS-3 GRAY	AIKEN	4:2:1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
0	0	0	0	0	0					0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0	0	0	1	1	1					1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
0	0	1	0	2	3			0	2	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
0	0	1	1	3	2			0	3	3	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	
0	1	0	0	4	7			1	4	4	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	
0	1	0	1	5	6			2		3	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	
0	1	1	0	6	4			3	1		4	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	
0	1	1	1	7	5			4	2			0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	
1	0	0	0	8	15			5			0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	
1	0	0	1	9	14			6			5	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	
1	0	1	0	10	12			7	9		6	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	
1	0	1	1	11	13			8			5	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	
1	1	0	0	12	8			9	5		6	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	
1	1	0	1	13	9			6	7		7	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
1	1	1	0	14	11			8	8		8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
1	1	1	1	15	10			7	9		9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1

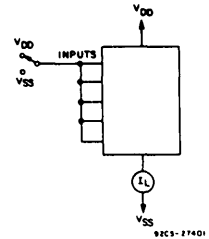


Fig. 10 - Quiescent device current test circuit.

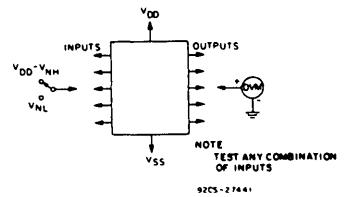


Fig. 11 - Noise-immunity test circuit.

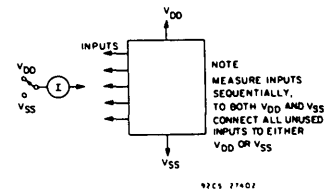


Fig. 12 - Input-leakage-current test circuit.