CMOS Four-Digit LCD Decoder-Drivers
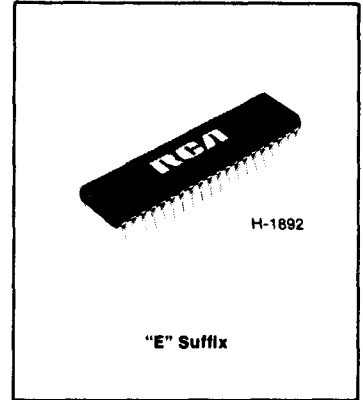
6-V Rating

Features
- 6-V supply-voltage rating
- No external components necessary
- 4-digit segment drive capability
- Backplane input/output allows synchronization for cascading devices to drive more digits
- Decodes multiplexed binary to hexadecimal (CD22104) and decimal (CD22104A) outputs

Applications
- Digital meters and calculators
- General-purpose displays
- Wall and table clocks
- Automobile dashboard displays
- Appliance control panels

H-1892

"E" Suffix

The RCA-CD22104 types are non-multiplexed, four-digit, seven-segment, liquid-crystal display decoder-drivers.
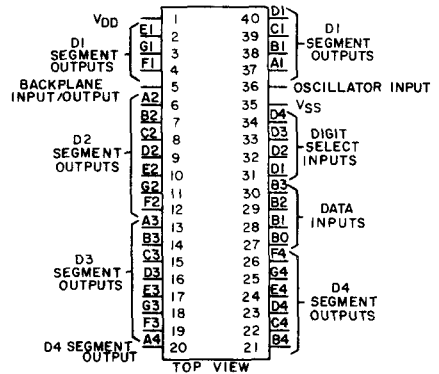
The CD22104 types contain all the circuitry necessary to drive conventional LCD displays (no external components required). Outputs are four sets of seven-segment driver signals and a backplane driver signal. The backplane signal, derived from an on-board free-running oscillator, is common to all four-digit displays.

The backplane and segment drives are designed so that p and n channels have the same ON resistances and thus equal rise and fall times. This equality eliminates any DC component, thereby maximizing display life. In addition to feeding the internal display drivers, the backplane signal can also be used as a master to drive a number of slave devices. The number of slaved devices should be limited to the load that keeps the backplane rise and fall times from exceeding 5 μs. If this limit is to be exceeded, the master backplane drivers should be disabled (by connecting pin 36, the oscillator input, to V_{SS}) and pin 5 should be fed from an external oscillator and all devices slaved to it. The maximum frequency of the external signal should be 125 Hz at room temperatures.

The on-board oscillator, which operates at 16 kHz when free-running (pin 36 floating), provides a backplane signal whose frequency is approximately 125 Hz. This frequency can be reduced by connecting an external capacitor to pin 36. Plots of backplane frequency vs. supply voltage at various values of external capacitance are shown in Fig. 3. The oscillator may be overdriven by an external signal but care must be taken to keep the lower voltage level above V_{SS} by at least 20 per cent of V_{DD} (for V_{DD}=5 V the signal should oscillate between +1 and +5 volts). This precaution prevents the backplane driver from being disabled, a condition that would present a DC component to the LCD display. A signal swinging from rail-to-rail can also be used to overdrive the oscillator but in this case the duty cycle should be such that the lower portion of the signal must be less than one-microsecond duration (the backplane disable sensing circuit will not respond to signals of this duration).

There are four data inputs and four digit-select inputs. The four-bit binary input is decoded by means of a PROM into seven-segment hexadecimal outputs for the CD22104 and into decimal seven-segment display outputs for the CD22104A. These devices are pin-compatible with the Intersil ICM7211IPL and ICM7211AIPL, respectively.

The CD22104 types are supplied in the 40-lead dual-in-line plastic (E suffix) package.

**CD22104, CD22104A
Terminal Assignment**

92CS-32933RI

MAXIMUM RATINGS, *Absolute-Maximum Values:*

DC SUPPLY-VOLTAGE RANGE, (V_DD) .... –0.3 to +6.5 V
  (Voltages referenced to Vss Terminal) .... –0.3 to V_DD +0.3 V
INPUT VOLTAGE RANGE, ALL INPUTS .... ±10 mA
DC INPUT CURRENT, ANY ONE INPUT* ....
POWER DISSIPATION PER PACKAGE (P_D):
  For T_A=–20 to +60°C .... 500 mW
  For T_A=+60 to +70°C .... Derate Linearly at 12 mW/°C to 380 mW
DEVICE DISSIPATION PER OUTPUT TRANSISTOR
  FOR T_A=FULL PACKAGE-TEMPERATURE RANGE .... 100 mW
OPERATING-TEMPERATURE RANGE (T_A): .... –20 to +70°C
STORAGE TEMPERATURE RANGE (T_stg) .... –55 to +125°C
LEAD TEMPERATURE (DURING SOLDERING):
  At distance 1/16 ± 1/32 in. (1.59 ± 0.79 mm) from case for 10 s max. .... +265°C

*Pin 36 limited to ±5 mA.

STATIC ELECTRICAL CHARACTERISTICS
T_A=25°C, V_DD=5 V, Vss=0 V

CHARACTERISTIC	SYMBOL	CONDITIONS	LIMITS			UNITS
			MIN.	TYP.	MAX.	
Operating Supply Voltage Range	V_DD	Vss = 0 V	3	5	6	V
Operating Current	I_op	Display Operating	—	10	50	μA
Oscillator Input Current	I_OL, I_OH	Pin 36	—	±2	±10	μA
Segment Rise and Fall Time	t_rs, t_fs	C_L = 200 pF	—	0.5	—	μs
Backplane Rise and Fall Time	t_rB, t_fB	C_L = 5000 pF	—	1.5	—	μs
Oscillator Frequency	f_osc	Pin 36 Floating	—	16	—	kHz
Backplane Frequency	f_BP	Pin 36 Floating	—	125	—	Hz
Input High Voltage	V_IH		3.5	—	—	V
Input Low Voltage	V_IL		—	—	1.5	V
Input Leakage Current	I_IL	Pins 27-34	—	±0.01	±1	μA
Input Capacitance	C_I	Pins 27-34	—	5	—	pF
Backplane Input Leakage	I_IL(BP)	Pin 5 with Pin 36 @ Vss	—	±0.01	±1	μA
Backplane Input Capacitance	C_I(BP)		—	200	—	pF

DYNAMIC ELECTRICAL CHARACTERISTICS
T_A=25°C, V_DD=5 V, Vss=0 V

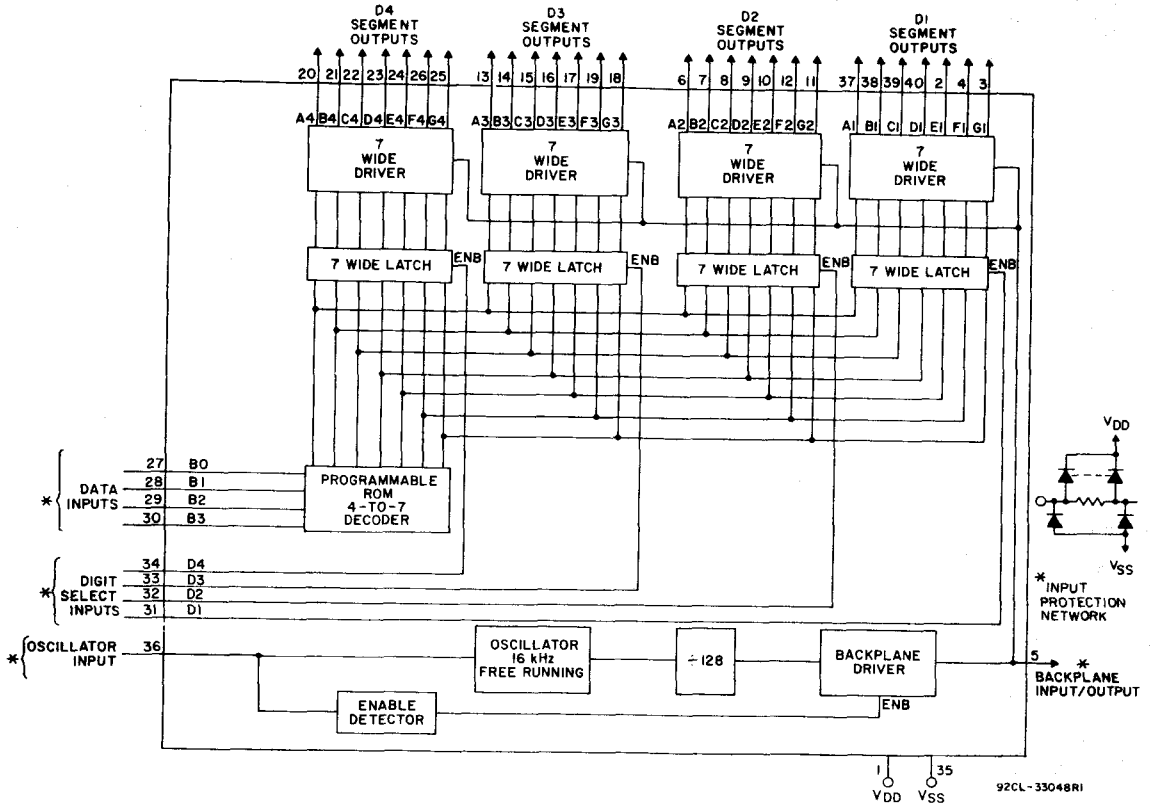| CHARACTERISTIC	SYMBOL	CONDITIONS	TYP. VALUES	UNITS
Digit-Select Active Pulse Width	t_sa	See Timing Diagram	0.5	μs
Data Setup Time	t_ds	See Timing Diagram	250	ns
Data Hold Time	t_dh	See Timing Diagram	100	ns
Inter-Digit Select Time	t_ids	See Timing Diagram	1	μs

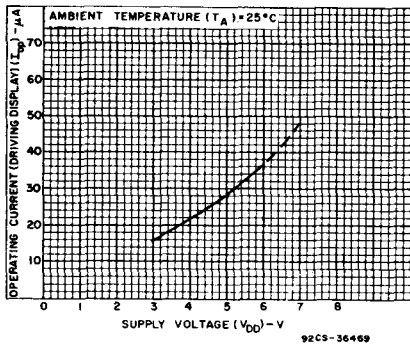Fig. 1 - Block diagram of CD22104 and CD22104A.

Fig. 2 - Typical operating current as a function of supply voltage.

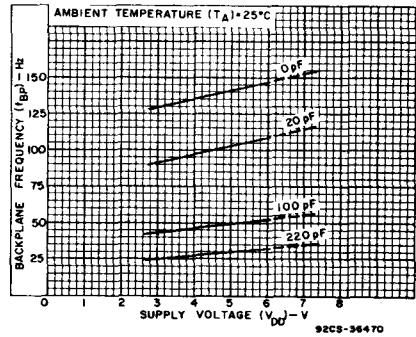

Fig. 3 - Typical backplane frequency as a function of supply voltage and external capacitance on pin 36.
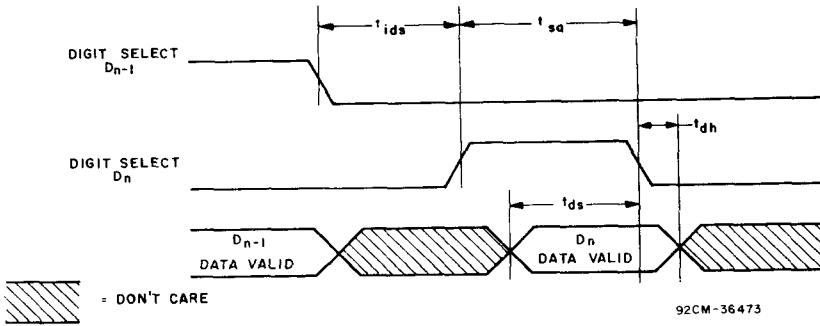
Fig. 4 - CD22104, CD22104A timing diagram.

Fig. 5 - Test circuit.
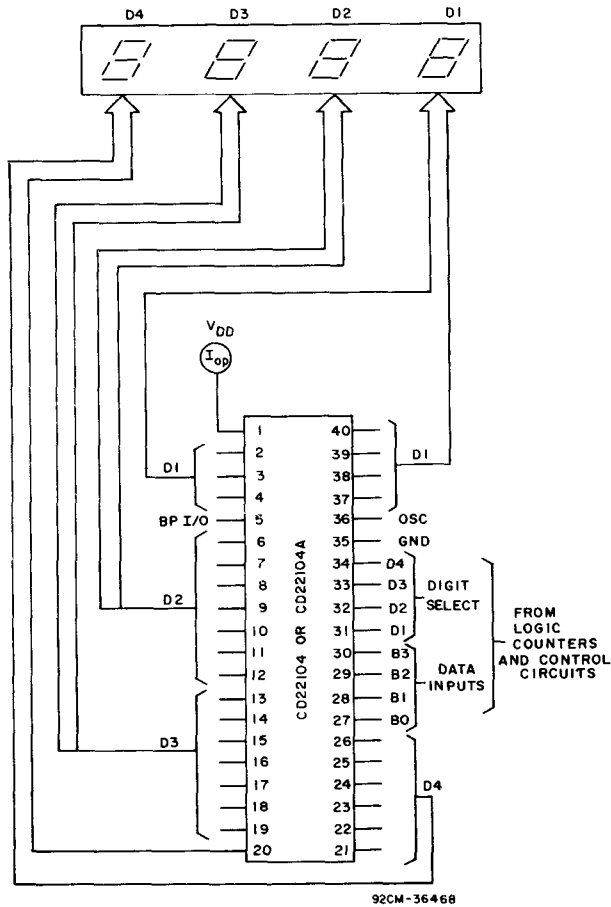
Table I — Output Codes

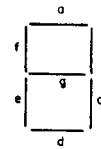| Binary Input B3 B2 B1 B0	Display Hexadecimal CD22104	Display Decimal CD22104A
0 0 0 0	0	0
0 0 0 1	1	1
0 0 1 0	2	2
0 0 1 1	3	3
0 1 0 0	4	4
0 1 0 1	5	5
0 1 1 0	6	6
0 1 1 1	7	7
1 0 0 0	8	8
1 0 0 1	9	9
1 0 1 0	A	-
1 0 1 1	b	E
1 1 0 0	C	H
1 1 0 1	d	L
1 1 1 0	E	P
1 1 1 1	F	(BLANK)

92CS-33050

DIGIT SELECTION TRUTH TABLE

Pins				Digit Selected
31	32	33	34	
1	0	0	0	D1 (LSD)
0	1	0	0	D2
0	0	1	0	D3
0	0	0	1	D4 (MSD)

DISPLAY SEGMENTS

92CS-31376

Fig. 6 - Display waveforms.