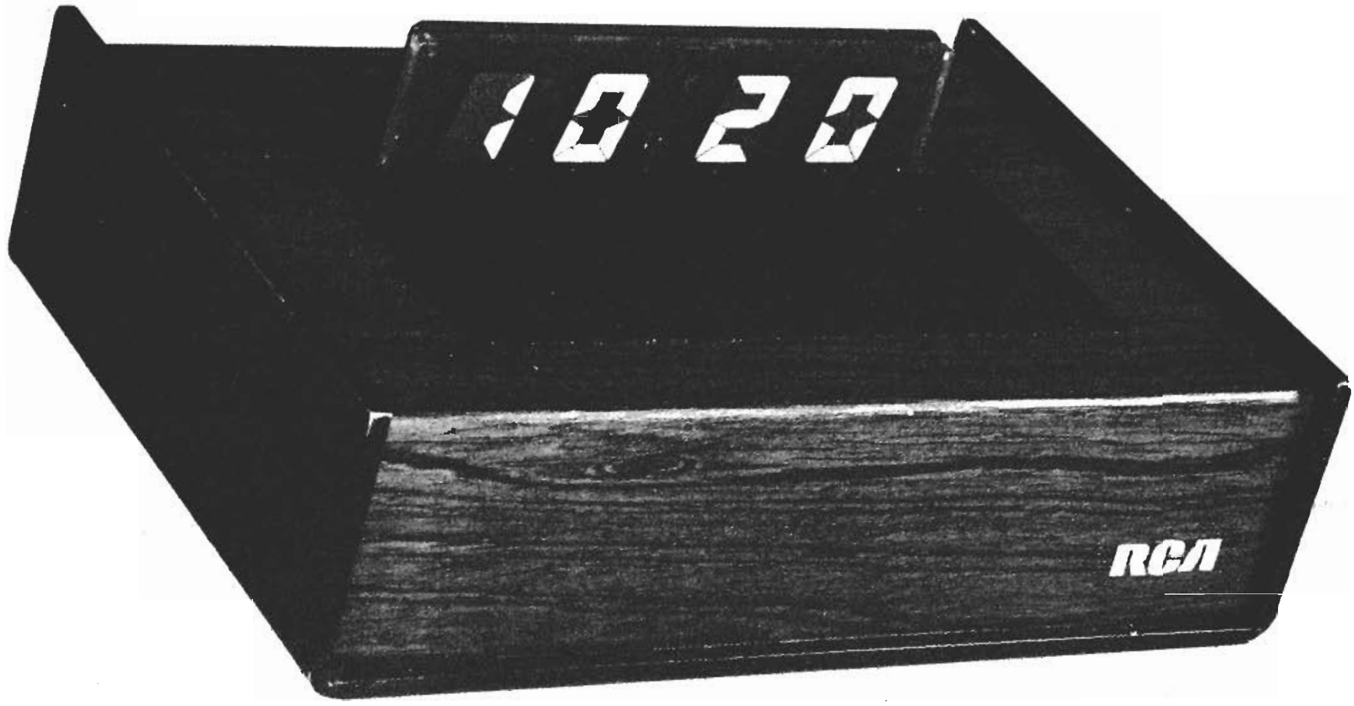


Liquid-Crystal Clock

Build it from a kit for $89.95. It runs on one set of pen light batteries for a year. Crystal oscillator makes it accurate.

WE FIRST BROACHED THE IDEA OF A practical IC digital clock using low-power CMOS IC's driving a liquid-crystal digital readout in **Radio-Electronics,** one year ago, in the April 1973 issue. At that time we presented a construction article on just such a clock. Unfortunately, both the IC's and the readout were hard to come by, and their prices were staggering. Anyone building the clock now has one of the most expensive digital clocks our readers ever built.

Now, just one year later, we are pleased to report on a new liquid-crystal clock kit, that is very similar to the clock project we presented. It's the RCA model KC-4014 and will be available from RCA distributors across the United States for $89.95.

This is a complete kit with all parts and construction details. IC's, liquid crystal display, two-sided circuit board, case, oscillator crystal, even the batteries are included.

An interesting clock

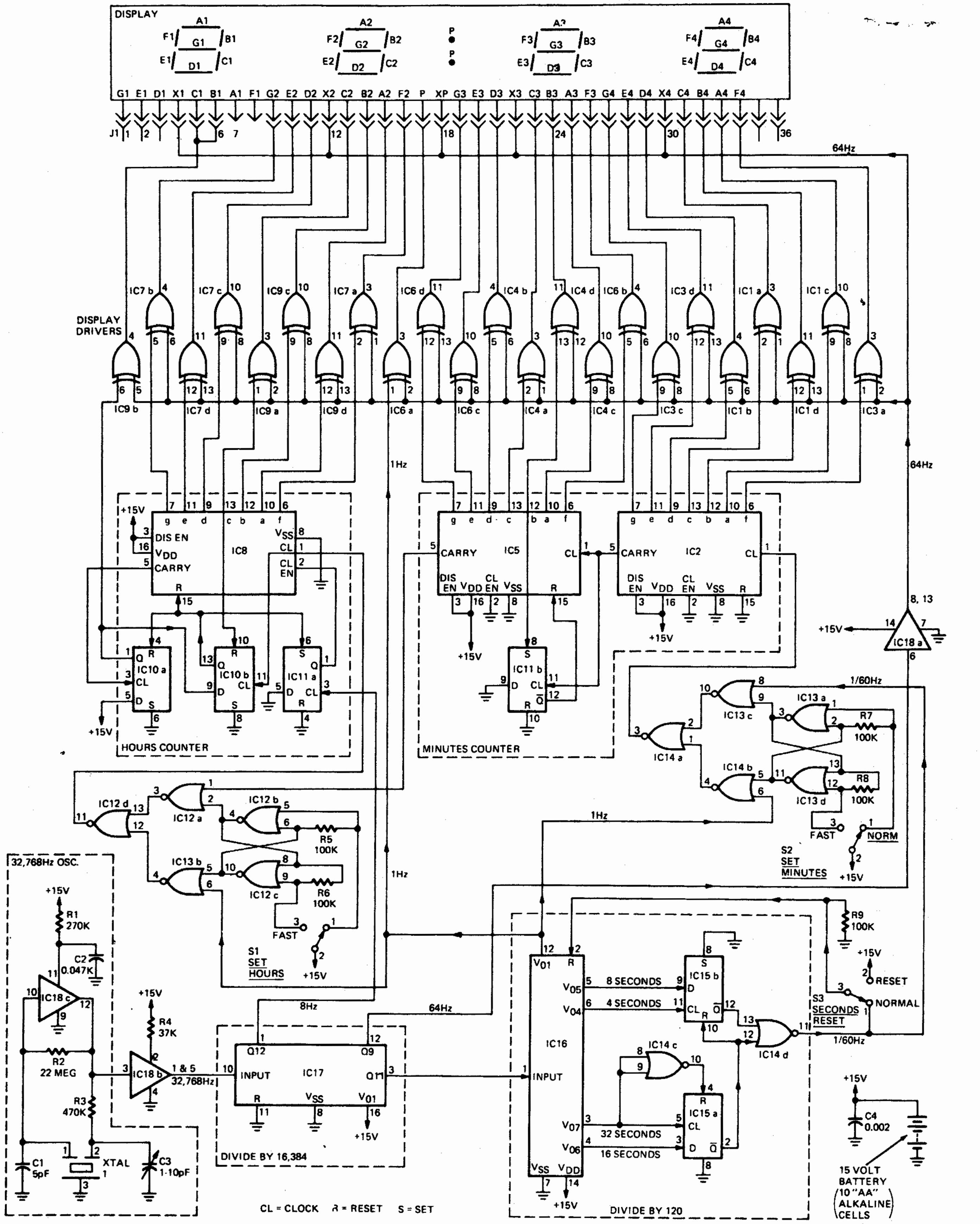
The liquid-crystal display provides a 4-digit readout that tells the hour and minute. The colon between the hours and minutes blinks off the seconds. There are 18 CMOS IC's mounted on one side of a two-sided circuit board that has plated-through holes. The readout plugs into a special set of contacts that the builder solders to the board.

All parts except for the three time-setting switches mount directly on the circuit board. The switches are attached to the rear of the clock case and connected with ordinary hookup wire to the circuit board.

The oscillator crystal is in a minuature TO-8 type case. There is one special feature of this device that deserves special notice. When you take a close look at it you'll see that the top of the crystal case is transparent. This is done because the crystal is trimmed to its precise frequency after it is in its case. It's done with a laser.

The liquid crystal display is highly visible, as you can see in the photos

LOOKING FROM the rear you can see the three time-set switches and the crystal oscillator frequency adjustment.



COMPLETE SCHEMATIC OF THE CLOCK. CMOS IC's and liquid-crystal readout combine to make this completely portable unit that requires no ac hookup.

IC TYPES

IC1, IC3, IC4, IC6, IC7, IC9—KD2134
IC2, IC5, IC8—KD2135
IC10, IC11, IC15—KD2136
IC12, IC13, IC14—KD2137
IC16—KD2138
IC17—KD-2140
IC18—KD2139

READOUT—KD-2133
OSCILLATOR CRYSTAL—KD2141
List of RCA distributors who have this clock kit will be published by RCA next month.

and on this month's cover. This is true even when light levels are low. The reflective type display, with the back plate and black felt in front of it provides maximum visibility.

Why batteries?

Battery operation makes this clock completely portable and independent of the ac line. As a result you can use it anywhere, indoors or out. Battery powered digital clocks have been built before, but the major problem has always been the life of the battery. Normally, between the current drain of the IC's and the power required by the display, batteries will only last for a relatively short time. Some battery powered clocks are set up so the time display is turned on only when you want it, to conserve power.

In this clock we see only CMOS IC's. They, in conjunction with the liquid-crystal display (another power-saving device) make it possible. For more information on CMOS IC's see the article "CMOS—Why Is It So Good" by Don Lancaster in the December 1973 issue of **Radio-Electronics.**

If you are looking for full circuit operation of this clock we suggest you take a look at the April 1973 issue where we presented the original story "Battery-Powered IC Digital Clock" by Steve Leckerts.

R-E Puts it all together

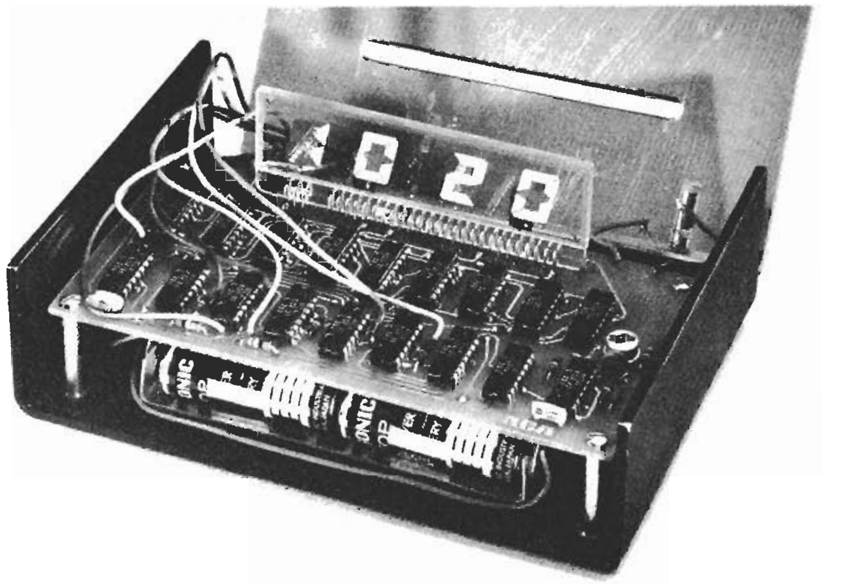
Assembling the kit is a snap. The parts plug into the board and are soldered into place. Since the board has plated through holes you only have to solder on one side.

The one thing we did notice, is that this is not a quick 1 - 2 - 3 assembly job. There are 19 IC's and that means an awful lot of soldered connections that must be made. The biggest problem we had was making sure that we didn't create solder bridges between the IC connections. We do suggest that when you build your clock you double check each time you complete soldering one set of IC connectors. A solder aid brush and a hot iron are all you need to cure this potential problem.

It is vital that you use a small iron —one with small tip size that is. A 1/16-inch tip is excellent for the job. But except for this one caution, normal printed circuit assembly techniques will see you through.

After you've got all the parts on the board the batteries are plugged into place and the board fastened down over them. There's more than enough clearance, but make sure you trim all leads projecting from the bottom of the circuit board to avoid shorts.

With the circuit board in place the cover is fitted in place over the top and fastened down. Now it's just a matter of setting the clock to the proper time.



WITH THE TOP COVER REMOVED you can see all the inner workings. Digital readout plugs into the circuit board. It is a reflective liquid crystal display.

TEN PEN LIGHT CELLS IN BATTERY CLIPS, located under the circuit board, power this clock. As battery replacement is not frequent compact stacking is practical.

This is done using the three rear-panel switches.

If you find your assembled clock is not keeping precise time, you will have to adjust the oscillator frequency with the adjustment capacitor. This can be done with or without equipment. With a frequency counter you simply set the oscillator up to provide the exact frequency specified in the instructions. Using a communications receiver tuned to WWV, you can adjust the oscillator precisely in a matter of minutes. Without equipment you simply adjust the oscillator capacitor and wait a few hours to judge the result.

We tried setting up the clock without the counter and found that it took about four days to get the adjustment on the nose. Since then we've had the clock operating for about three months and find no significant drift. **R-E**