Interfacing digital circuitry with plastic rotary encoders

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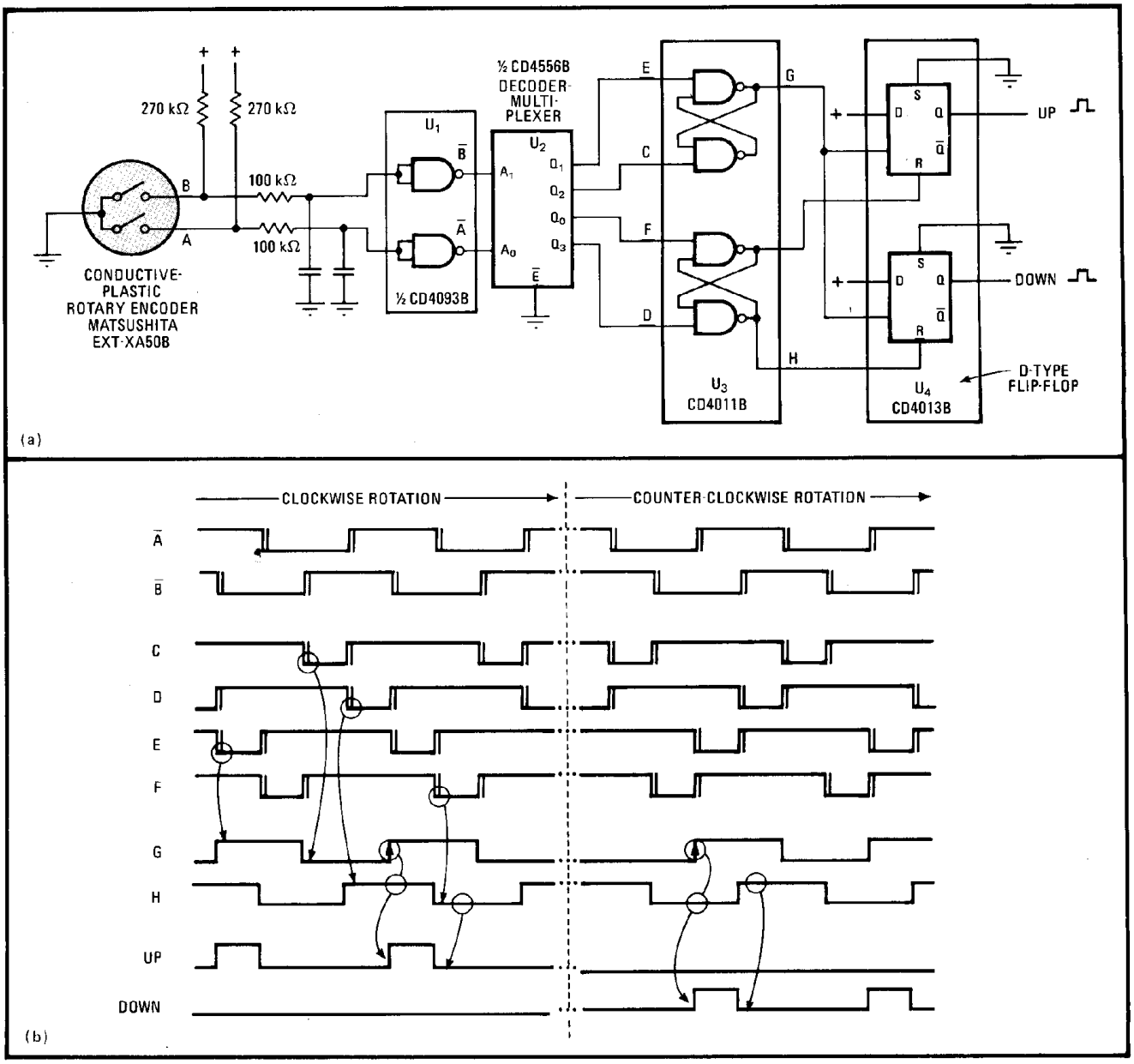
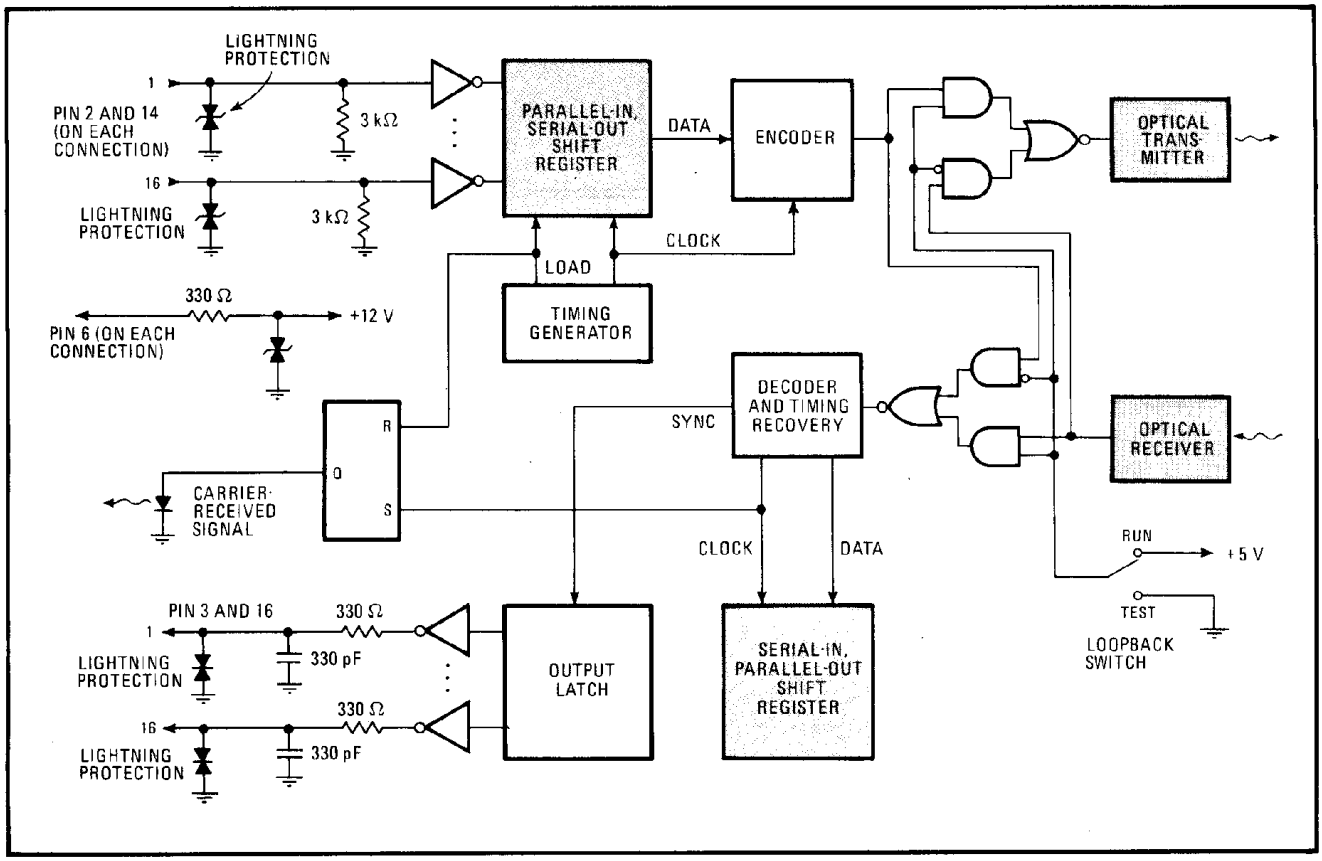
Although potentiometers are handier tuning devices than keyboards and push buttons, they cannot be easily interfaced with digital and microprocessor-controlled equipment, as can the other devices. This circuit links plastic rotary encoders to digital circuitry with just a few integrated circuits. The advantages of this type of control include programmable resolution, interrupt operation, and low cost.

The 30-kilohm conductive plastic encoder (Fig. 1a) generates two phase-shifted signals $\overline{A}$ and $\overline{B}$ (Fig. 1b). The direction of rotation for the encoder may be determined by the phase angle between $\overline{A}$ and $\overline{B}$. Because both signals tend to drift, RC filters are placed at the input to minimize this noise. However, this chatter never occurs on both the signals simultaneously. In addition,



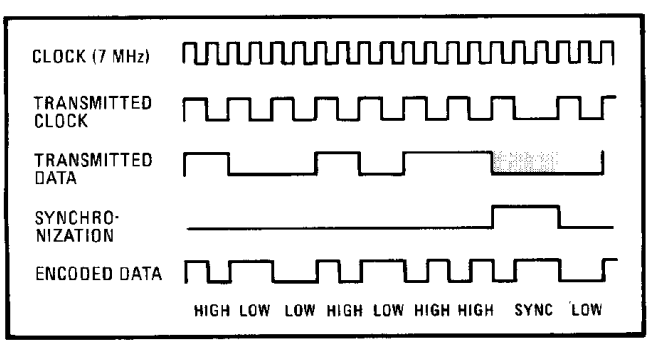
1. Rotary encoder. The circuit (a) interfaces a conductive-plastic rotary encoder with digital circuitry. The two phase-shifted signals that are generated by the encoder are also used to determine the direction of rotation. The up and down signals (b) generated by the digital circuit can be used for multiple purposes.



2. Inside story. The 39301A multiplexer has two separate cables to provide full-duplex transmission. The heart of its simple electronics are 16-channel parallel-in–serial-out and serial-in–parallel-out shift registers and a biphase encoder in the transmit section.

data from an RS-232-C source, such as a cathode-ray-tube terminal. An electrical switch under the instrument's top panel loops back the electrical signal before the fiber-optic board and returns the electrical outputs of this board, thereby retransmitting the received optical signal. This feature, used primarily to isolate a failure in a unit to the optical or electrical level, verifies the optical path once each 39301A in the data-communications link is deemed to be operating satisfactorily.

Several 39301A systems in use at HP provide intra- and inter-building communications. In one case, several terminals in the manufacturing area of a building are connected to the main computers in the administrative building. They provide remote word-processing and production-scheduling capabilities. Research and development areas connected to their own computer are able to gain access to files and data bases of the manufacturing and accounting areas through system links.



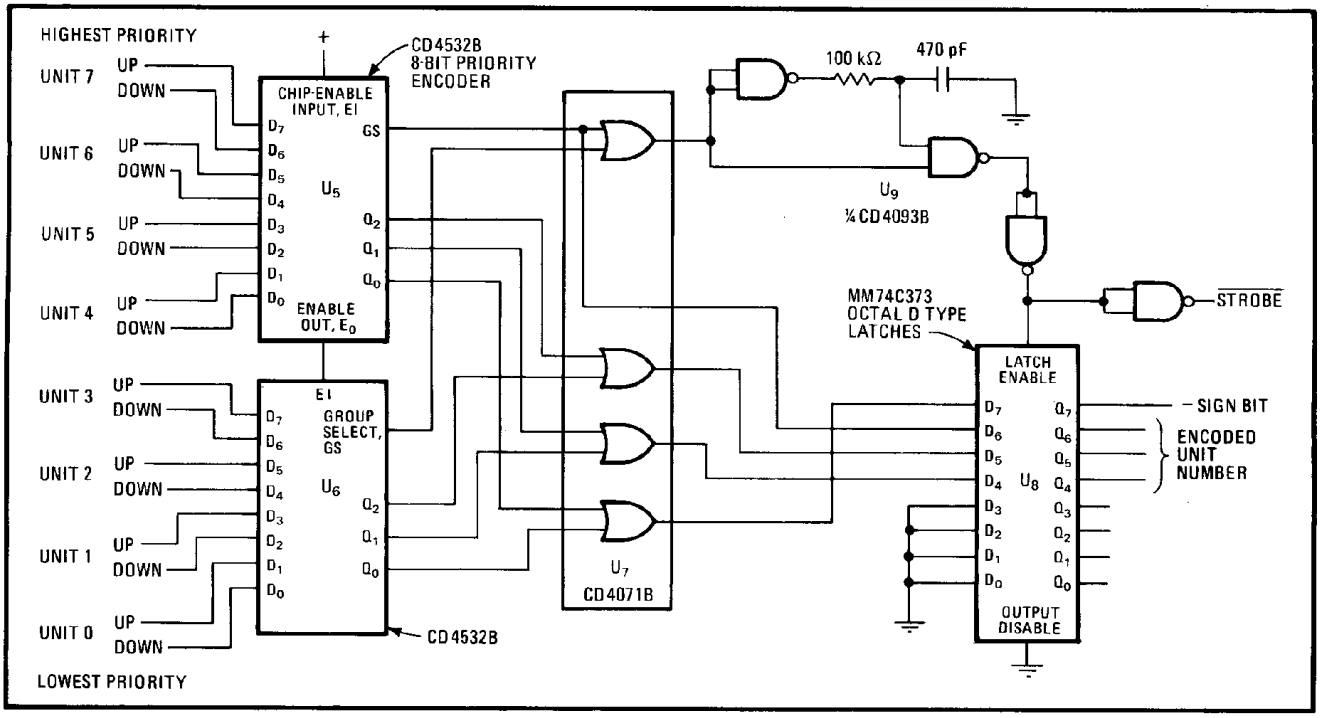
3. Timing. The multiplexer's data-coding pattern requires that two short pulses represent a high level on the corresponding input line. A single long pulse represents a low level and a short pulse followed by a long one is a synchronization signal.

In another application, a company occupying three floors of a high-rise office building uses a 39301A system to connect three clusters of terminals to a computer. Order processing, accounts receivable, and shipping coordination are now all tied directly to the main computers with no sacrifice in terminal or computer speed over the 300-m distances.

Other uses

A large complex of manufacturing buildings could use these systems to send signals from bar-code readers to the main computer system. Still another application might have remote terminals in a typesetting area connected to a CPU and a second cluster at editors' and reporters' desks on another floor of a newspaper office.

There are still other possibilities. Clusters of numerically controlled machines on a large factory floor can be downloaded from the main computer where program development is done. The long-distance data communications and noise immunity of fiber optics keep data error-free in the factory environment and from the programmer stations to the CPU. Finally, a large manufacturing building may have remote printers, plotters, and terminals connected to the CPU, providing graphics capability in the drafting areas and plotter printouts of the designs directly on the manufacturing floor. □



2. Interface. The circuit encodes eight rotary encoders into a 3-bit code that enables the rotary encoders to perform like a keyboard interface. Sixteen up and down pulses that are generated by the circuit are encoded into a 3-bit code using the 8-bit priority encoders U_5 and U_6 and OR gates U_7. Latch U_8 holds the output code when the strobe pulse is generated.

the encoder has a resolution of 50 periods per turn.

Demultiplexer U_2 decodes each of the four discrete states represented by the two signals generated with the encoder. The output of U_2 is used to set and reset the pair of flip-flops in U_3. The output at G clocks the D-type flip-flops (U_4), which generate the up and down pulses. These pulses are employed as interrupt signals for microcomputers.

An application for this technique is to encode the outputs of eight rotary encoders into 3-bit code. The encoders generate 16 up and down pulses (Fig. 2). These signals are further encoded into a 3-bit code by the 8-bit priority encoders U_5 and U_6 and OR gates U_7. Whenever one of the encoders is rotated, a strobe (low) pulse is generated that interrupts the microprocessor and sets latch U_8 so that it will hold the output code until the next up or down pulse arrives. □

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