Build This
SLIDE-PRESENTATION MANAGER

Syncronize your slide presentations with a disciplined and brief narrative and let your stereo tape recorder and this interface circuit control the show.

BY J.A. NUNLEY

Today's personal computers make it relatively easy to produce superb presentation graphics. But seeing the graphics materialize on a VGA screen and presenting the graphics to the audience for which they are intended involves a jump. Probably the most common method of presenting the graphics is to make a hard copy of the graphics on the computer printer, and then make that into a large format transparency (using either a heat or a xerographic process) for an overhead projector.

Although that method is easy and fast, it loses the outstanding colors of the computer-generated graphics. In addition, overhead projectors are limited to small audiences and even then are somewhat distracting in terms of stray light, the lens head sticking up in the middle of the room, and the inevitable keystone distortion that results from the short focal length of the typical overhead projector lens.

Another possibility is to display the graphics on a large-screen television, or even a huge projection television. While that preserves the color of the graphics, if not the original resolution, it requires expensive electronics to convert the image files from the disk to standard NTSC signals that can be displayed on a television set. Furthermore, if the presentation is at a location other than where the graphics originated, there may be considerable difficulty in transporting the bulky equipment that's required to the presentation site.

More and more, those responsible for presentations are turning to an old standby—the 35-mm color slide—which first came into widespread use in the 1930's. The 35-mm slide offers substantial advantages over other presentation methods; it preserves all of the color, even subtle variations, of which most PC applications are now capable. In addition, the 35-mm color slide can deliver all the resolution up to and past super-VGA, and can produce a striking, self-illuminated image big enough for really large audiences.

Furthermore, there are two highly effective methods of producing 35-mm transparencies directly from the graphics files on computer floppy disks. One methods is to use an electronic Film Recorder. Although one would have to have a high rate of slide production to justify the cost of a Film Recorder, they do offer privacy, speed, and on-premises control of the process. One model, made by Polaroid Corp., can even produce instant color transparencies without having to send the 35-mm film to a processor. The other method is to submit the floppy disk files to a Film Service Bureau, which will make the graphics into finished 35-mm slides at a nominal cost per slide.

Having then obtained, by some method, a host of presentation graphics on 35-mm slides, the presenter is faced with the problem of making the best use of all that sophistication to avoid boring his audience with the usual disorganized jumble of slides, accompanied by a live, rambling, often repetitious narrative. In-
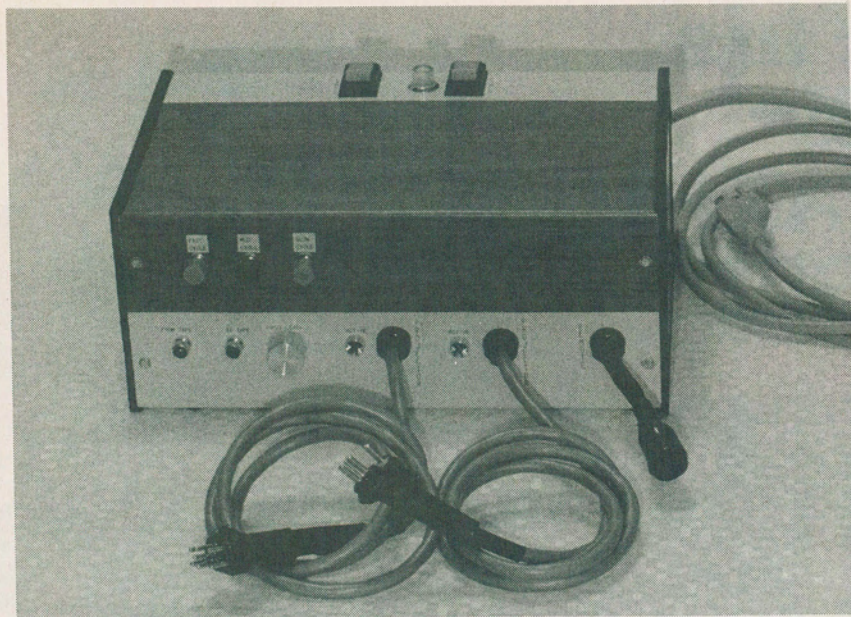
Fig. 1. On the top of the Slide-Presentation Manager toward the rear are two power switches; one for the overall power (which applies power to the Slide-Presentation Manager and controls power to a convenience outlet on the back of the unit), and one for power to the two projector lamps.

stead, each presentation should be thought out and carefully organized in some logical manner that will give it continuity and meaning.

A written narrative that's disciplined, brief, and pertinent should be prepared. To eliminate the temptation of the presenter to pause, ramble, or digress, the presentation should be mechanized by recording the narrative (with background music if desired) on a tape that also contains signals directing the slide changes at the correct times. And to make the slide presentation really attractive and professional, two projectors should be used so that there is no jarring one- or two-second blackout for each slide change. Instead, the images should fade smoothly, the on-screen slide dimming to black, with the next slide going to full brightness at the same time.

The *Slide-Presentation Manager* described in this article provides an efficient means of preparing and presenting a slide presentation. It does so by allowing you to interface one track of a stereo tape recorder with two projectors for control of the projectors, while synchronizing slide changes with the narrative recorded on the other track.

Functional Description. Figure 1 shows a overall frontal view of the Slide-Presentation Manager. On the top of the unit toward the rear are two power switches, one for the overall power and one for power to the two projector lamps. The overall power switch applies power to the Slide-Presentation Manager, and also controls power to convenience outlets on the back of the unit for connecting the power cords of the two projectors.

The projector lamp's switch is needed for two reasons: first, you will want to set up and aim the projectors so that their frames coincide before your audience arrives. That involves setting the slide trays at the proper starting points, checking focus, etc., leaving the Slide-Presentation Manager on and ready, but the projector lamps turned off so that there is no image on the screen. Then, to start the presentation, you need only turn on the projector lamps and start the tape player.

The second reason for the lamp switch is that it is wise to turn off the projector lamps, but leave their fans running for a few minutes to cool the lamps before moving the projectors. Moving projectors while the lamp filaments are still hot can lead to the early "death" of those lamps.

On the front panel at the upper left side are three momentary contact pushbuttons switches, labeled FAST CYCLE, MED CYCLE, and SLOW CYCLE, which are

used when recording a slide presentation. Pressing one of them causes the projectors to complete a cycle at the selected rate, and routes an AC signal to the TO TAPE jack on the front panel for recording on the control track of the tape recorder.

The projector cycle begins with the departing slide being dimmed to black. When that projector reaches full black, a command is issued, causing it to change to the next slide in preparation for the next cycle, while at the same time, the arriving slide is brought up from black to full brightness, resulting in a fade or dissolve effect that's very pleasing. Three fade or dissolve rates are provided for aesthetic effect: the fast rate results in a complete fade in 1.42 seconds, medium in 2.84 seconds, and slow in 5.69 seconds.

The medium cycle should be relied on most of the time, and the fast cycle can be used to move a series of slides through at a brisk clip. While the slow cycle can at times provide very dramatic effects, excessive use can be irritating to your audience.

The FROM TAPE jack on the front panel is connected to the control-track output of the tape recorder during a slide presentation. The three frequencies will have been recorded at various places on the control track during preparation of the slide presentation. When that signal is received at the FROM TAPE jack, it causes the projector to cycle at the fast, medium, or slow speed as described in the preceding paragraph. Because many tape decks do not have an output-level control, an INPUT LEVEL control is included on the front panel.

The Slide-Presentation Manager can be triggered with an input of from 100 to 200 mV. Setting the control too low results in some cycles being missed; setting it too high may result in false cycles due to noise, especially if the cable between the tape recorder and the unit is long. But the setting is not really critical and a proper setting can easily be arrived at by brief trial and error.

Note: The Slide Presentation Manager was designed specifically for use with two Kodak *Carousel* projectors, and the following descriptions are with reference to that fact. Although it is possible to adapt the Slide-Presentation Manager to other models of

projectors, the author will not cover such adaptations in this article, and that task is left to the reader.

To the right of the INPUT LEVEL control are two cables that connect to the rear jacks of the two projectors. Those cables carry the low-level signals for slide-change and remote focusing of the projector lenses, and the 117-volt AC signals to the projector lamps for the fade-down and fade-up of lamp brightnesses.

Adjacent to the two projector cables are a pair of LED's that show which projector is active; *e.g.*, which projector's lamp will be at full brightness when the projector lamp switch is turned on. It should be noted that during operation, the projector's own lamp switch must be set to *fan only*, and not to either of the two *lamp on* positions, which would defeat the fade function. Power to the projector lamps must be controlled entirely by the Slide-Presentation Manager, not by the projector's lamp switches.

Finally, at the right of the front panel is the connector for a single remote control; use the remote from one of the projectors for this. Here's how the remote will work in conjubnction with the Slide Presentation Manager: the control operates only with the active projector (the one indicated by the ACTIVE LED). The remote-focus function works normally (if you have projectors with automatic focus, you may want to omit the part of the circuit dealing with that function).

The forward and reverse buttons on the remote control function somewhat differently; The forward button simply adds a fast cycle to the program routine. That's useful in the unlikely event that a cycle command from the tape has been missed due to some malfunction or if the input level has been set too low; it allows you to put the program back in sync. The reverse function simply would not make sense in a tape-controlled, synchronized presentation; therefore, the reverse button is used to delete a cycle. To do so, the reverse button must be held down during the time when a cycle signal is arriving at the FROM TAPE jack. Holding down the reverse button merely shorts out the FROM TAPE jack input. It is also useful if somewhere in the presentation a false cycle occurs as a result of noise on the FROM-TAPE line, or a power surge, or some such unlikely

event. Deleting a cycle allows the presentation to come back into synchronization with the tape. It is a good idea to keep the remote control in your hand during a slide presentation in order to touch up the focus from slide-to-slide if necessary, and to add or bypass a cycle if required to restore synchronization of the slides with the narrative.

Figure 2 shows the Slide-Presentation Manager placed alongside two projectors and connected as it would be during a slide presentation. The two projectors are stacked one on top of the other to place the lenses of the two projectors as close together as possible in order to achieve the maximum registration (superimposition) of the frames of the projected images. If the projectors were placed side-by-side, the distance between the lenses would be greater and lateral keystoning of the frames would create an obvious mis-registration. Racks for stacking Kodak *Carousel* projectors vertically are available at larger photography or audio-visual retailers. The rack shown in Fig. 2 was easily fabricated using 16-gauge sheet aluminum and pop rivets.

Circuit Description. The schematic diagram of the Slide Presentation Manager's main logic circuitry is

shown in Fig. 3. During preparation of the slide presentation, audio signals from the Slide-Presentation Manager will have been recorded on one track of a stereo tape recorder. During the presentation itself, the output of that track is routed to J1 and applied to level-control R3.

From the slider of R3 through C1, the signal is applied to the pin 3 inputs of U1–U3 (three LM567 tone decoders). Those IC's consist of a highly stable oscillator, whose frequency is determined by the resistance between pin 5 and pin 6, and the capacitance between pin 6 and ground, and a phase-locked loop, which detects when the input-signal frequency equals the internal-oscillator frequency.

When that happens, an internal transistor with its open collector connected to pin 8 turns on, forcing that pin low. The oscillator in U1 is adjusted for 360 Hz, U2 for 180 Hz, and U3 for 90 Hz. The outputs of U1, U2, and U3 (at pin 5 of each IC) are routed to U7. From there, during preparation of the slide presentation, the selected signal is routed J2 for recording on the control track.

The capacitors connected from pins 1 and 2 of U1–U3 to ground (C3 and C4, C6 and C7, C9, and C10) determine the bandwidth of the tone
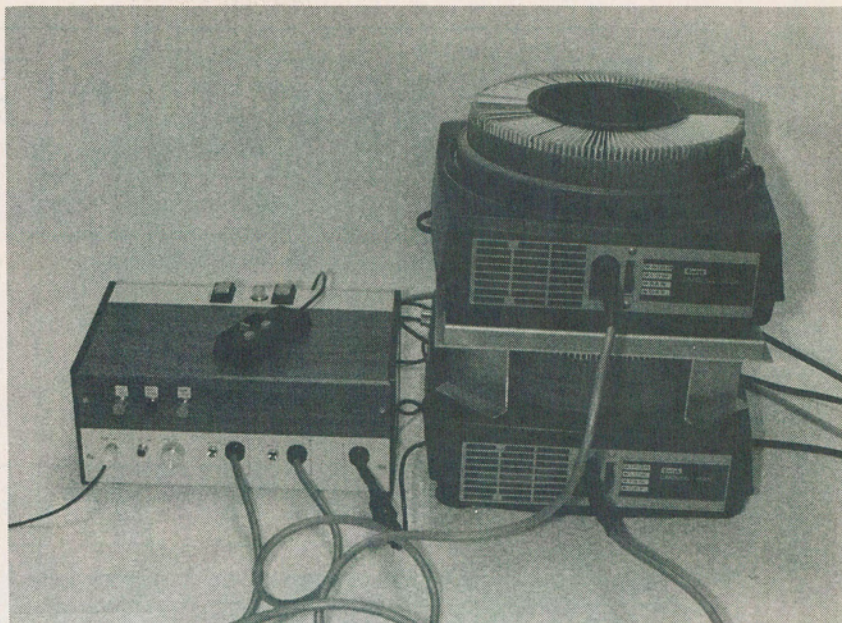

Fig. 2. Here is the Slide-Presentation Manager placed alongside the two projectors and connected as it would be during a slide presentation. The two projectors are stacked on top of one another in order to place the lenses of the two projectors as close together as possible to achieve the maximum registration (superimposition) of the frames of the projected images.
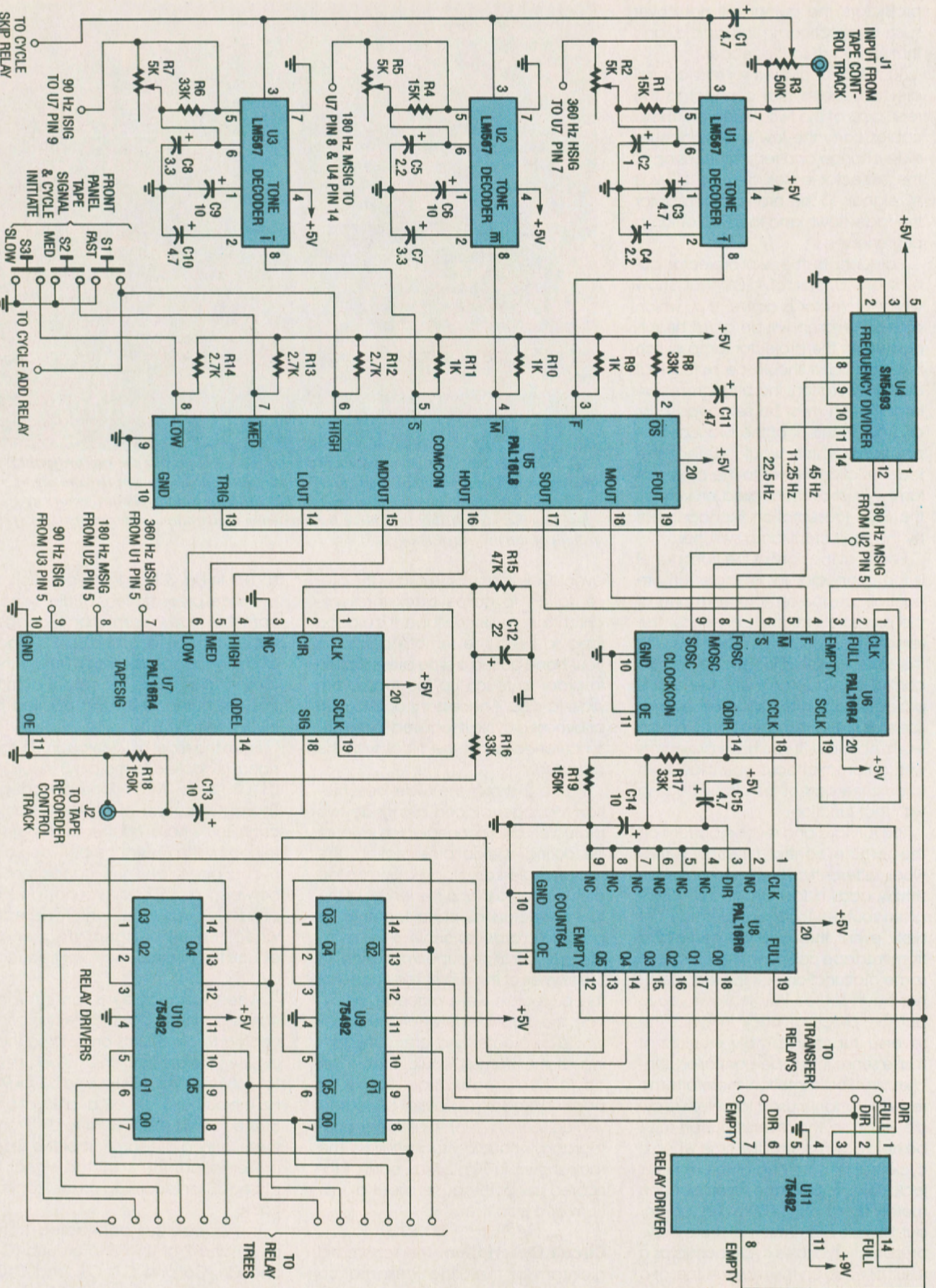
Fig. 3. The main logic circuit of the Slide Presentation Manager is comprised of 11 IC's, four of which (U5–U8) are programmable logic devices.

decoders, which in this application is about 7% or 8% above and below the fundamental frequency, allowing for some error in the tape speed. That results in slightly off-center frequencies. The 180-Hz output of U2 is also routed to the first stage of a 4-stage binary counter (U4) where the signal is divided down to the frequencies that will be used, after some processing, as the clock pulses for U8.

The central part of the circuit consists of four 20-pin programmable-logic devices (PLD's) of three different types. Those units (U5–U8) have been programed as special-purpose IC's to do specific jobs within the Slide-Presentation Manager. They greatly simplify the construction of the unit. (A full disclosure of the programming sheets and other data pertaining to those IC's is available from the author if you have the inclination and access to the required equipment to program the PLD's yourself; more on that later.) Suffice it to say, those four IC's take the place of approximately 20 conventional 54/74 series devices that would be required to implement the same functions.

Integrated circuit U5 (Command Control, or COMCON) receives six signals; three from the tone decoders (U1–U3) and three from the front-panel pushbutton switches (S1–S3). Pressing one of the three pushbuttons switches initiates a slide cycle and causes U5 to send a signal to U7, which then outputs a measured pulse that is routed to J2 for recording. Pull-up resistors are required at pins 3–8 of U5 because the tone decoder outputs are open-collector transistors, and to provide the appropriate high-to-low transition from S1–S3.

Integrated circuit U5 provides three functions. When a signal is received on one of its inputs, it locks out the other inputs until the corresponding required output has been generated, preventing ambiguity and improving noise immunity. It also provides the logic to send only the slide cycle signal if the input is received from a tone decoder (signifying that a slide presentation is in progress rather than being prepared), or both a slide cycle and a tone output if the input comes from one of the pushbuttons switches (which would only be used if a slide presentation were being prepared).

Lastly, U5 one-shots all of the inputs

to the outputs. Thus, regardless of the duration of the inputs, the output will be a one-shot pulse of about 15 milliseconds. That one-shot action is provided by delaying the trigger signal at pin 13 of U5. Pin 13 of U5 goes low when any signal is input, provided pin 2 is high. Pin 13, after the delay injected by C11 and R8, pulls pin 2 of U5 low, terminating all input signals and sending pin 13 high again.

Next, consider the action of U7 (the TAPESIG-PLD). That IC has the single purpose of metering approximately 0.75 seconds of AC signal to J2 in response to a high, medium, or low pulse from U5 (pins 14–16). The high output (U5 pin 16) sends the 360-Hz signal (which corresponds to a fast cycle command) to the Slide-Presentation Manager; the medium output (pin 15) routes a 180-Hz signal for the medium cycle; and the low output (pin 14) feeds a 90-Hz signal for the slow cycle.

Unlike U5, which contains no flip-flops, U7 contains four flip-lops in addition to four unregistered outputs. The high, medium, and low inputs each sets its own "hold" flip-flop and any of the three will also set pin 14 of U7 (the QDEL flip-flop) and generate a self clock (SCLK) pulse at pin 19 of U7. We are assured of that short pulse by the one-shot action of U5. The internal propagation delay assures that the clock will arrive at each flip-flop after the D input is in place. The QDEL output of U7 (through a delay established by R16, C12, and R15) is applied to pin 2 (CLR) of U7, which clears all four flip-flops, terminating the AC output at pin 18, SIG, of U7. Thus, the appropriate AC output (one of the three frequencies) is delivered to J2, starting when the one-shot pulse is received from U5, and ending about 0.75 seconds later, when the delayed QDEL signal is received at U7 pin 2. The 0.75-second duration of the AC signal is right for reliable recording on the control track, and for reliable triggering of U1–U3 during playback.

Refer back to U4 (the four-bit binary counter), which receives a 180-Hz input from the U2 oscillator. That 180-Hz signal is divided down to 90, 45, 22.5, and 11.25 Hz. The 90-Hz signal from the counter is not used, but the other three frequencies will ultimately be gated through to become clock pulses for U8. That's accomplished by

means of U6 (which is programed as the Clock Control, or CLOCKCON). Like U7, U6 has four flip-flops and four unregistered outputs. When one of the FM, or S signals (all are active low) is received, it sets one of the D flip-flops as a hold flip-flop. (Like U7, U6 generates its own clock pulses—which is output at SCLK, pin 19, and applied to pin 1, CLK—for the flip-flops when any of the three inputs are received).

The output of those three hold flip-flops are actually available on pins 15, 16, and 17, which are not shown in the schematic. The reason is that the direct outputs are not used, but are fed back internally to gates that will control the CCLK (counter clock) output at pin 18 of U6. Meanwhile, the FOSC, MOSC, and SOSC signals are continuously being received at pins 7, 8, and 9 of U6. When the F signal sets its hold flip-flop, the FOSC signal is gated out at pin 18, and to the pin 1 input of U8. Similarly, the M signal gates out MOSC, and the S signal gates out SOSC.

The hold flip-flops are reset, and thus the clock signal at CCLK is terminated, when either the full or empty signal is received at pin 2 or pin 3 from pin 19 or pin 12 of U8, respectively. Integrated circuit U6 also outputs a direction signal at pin 14 and is routed to pin 3 of U8, where it determines if the counter will count up from 0 through 63, or down from 63 through 0. The direction flip-flop is set or reset by the FULL and EMPTY signals that are operated on and gated in U6. The FULL and EMPTY signals are also routed to relay driver U11 to bring about relay closures that cause the inactive projector (the one that has just gone fully dark) to change to the next slide.

The duration of the full and empty signals is actually determined by the pin 3 output of U11, which, when it arrives at pin 3 of U6, terminates the FULL or EMPTY signal, whichever is active. To be sure the FULL or EMPTY signal is of sufficiently long duration to reliably trigger a slide change (a mechanical process), the signal at U6 pin 14 (the direction signal) is delayed by a network composed of C14, C15, R17, and R18. The reason that this network is a bit more complicated than the usual RC delay circuit is that the direction signal must be delayed on each transition, whether from high to low or from low to high. The direction signal is also routed to relay driver U11, which
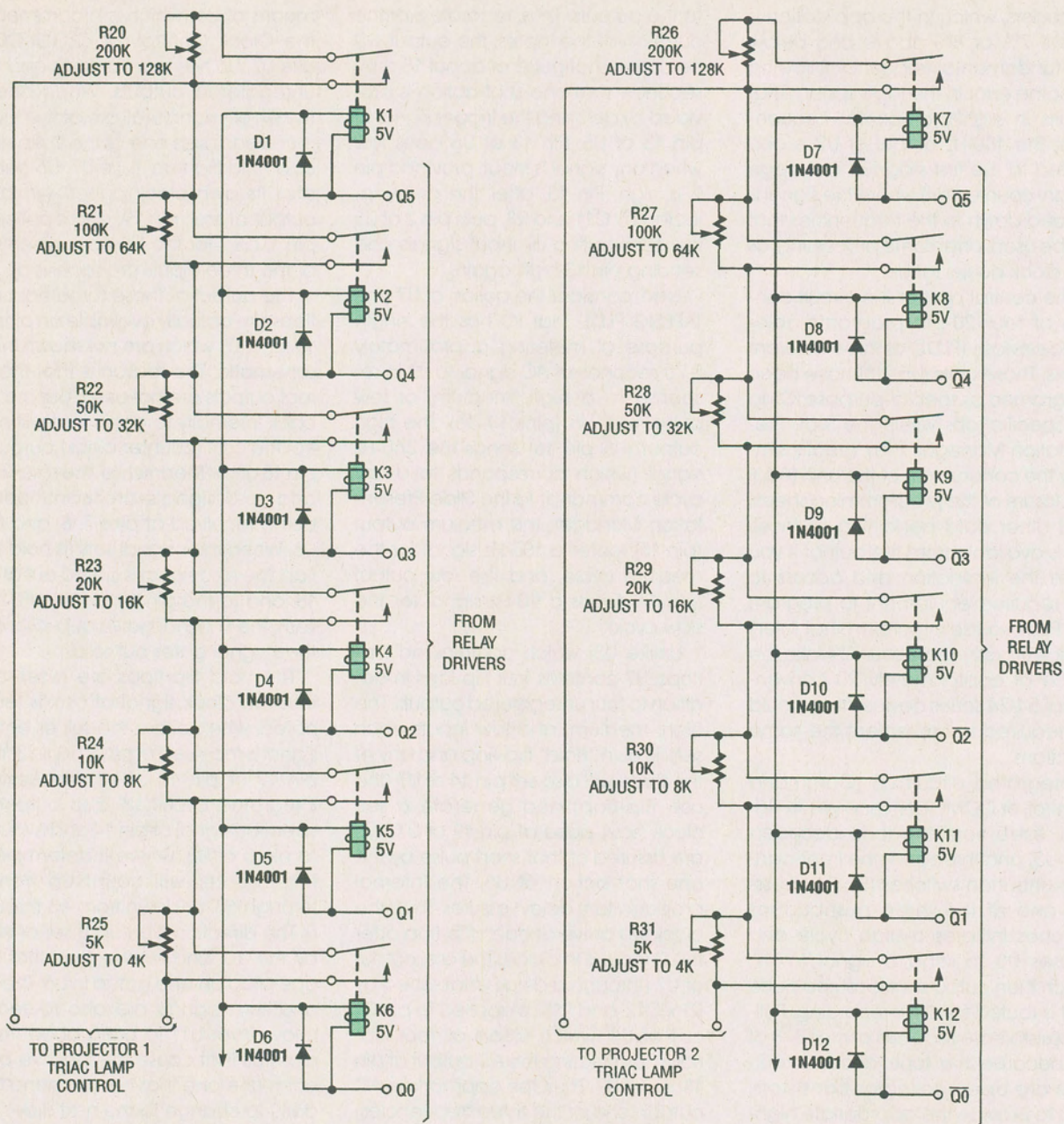
Fig. 4. The relay trees, a relatively simple circuit, is actually a form of digital-to-analog converter (DAC) that is used to convert a six-bit binary input to resistance values.

activates relays that transfer the projector's remote-control functions (focus, forward, and reverse) to the active projector; *i.e.*, the one that has just gone to full brightness.

Finally, we come to U8 ("COUNT64"), a six-bit binary counter capable of 64 steps (0 through 63). Like all binary counters, it must have a flip-flop for each bit, Q0 through Q5, pins 13 through 18. In addition, it has two unregistered outputs at pins 12 and 19. As with the other PLD's having flip-flops,

pin 11 is grounded to enable the outputs. The IC has only two inputs; clock at pin 1 (which is received from U6 as described above) and direction at pin 3 (again as described above). The other inputs are grounded to provide stability and low power usage.

When clock pulses are delivered to pin 1 of U8, it begins to count at the rate of the clock pulse supplied, and in the direction dictated by the direction input. A low direction signal is recognized as a command to count up,

and a high signal is recognized as a command to count down. When the count is at binary 63—*i.e.*, pins 13–18 (Q0 through Q5) are all high, and the direction signal is low—the full signal is generated and sent back to U6, terminating the clock input and stopping the counter.

Similarly, when the clock pulses arrive and the direction signal is high, U8 counts down until pins 13–18 (Q0 through Q5) are all low. At that point, an empty signal is sent to U6, causing

the clock pulses to cease and U8 to stop. Thus, U8 merely counts from 0 through 63 (in binary) then stops, then counts from 63 through 0 and stops.

Integrated circuit U8 receives clock pulses at either 45 Hz, 22.5 Hz, or 11.25 Hz. To make 64 counts at a rate of 45 Hz, the counter will take 64/45 = 1.42 seconds; 64/22.5 = 2.84 seconds; and 64/11.25 = 5.69 seconds. Those are the times of the fast, medium, and slow slide dissolves provided by the Slide-Presentation Manager. The Q0 through Q5 outputs (U8 pins 13–18) are routed to relay drivers U9 and U10, which, in turn, activate a set of relay trees.

Relay Trees.

Figure 4 is a schematic diagram of the relay trees. That relatively simple circuit is actually a form of digital-to-analog converter (DAC), which converts the six-bit binary input to resistance values. Relays, rather than some other type of DAC are used to provide the necessary isolation between the logic circuitry and a pair of Triac-based 117-volt AC control circuits. The Triac circuits, to be discussed shortly, are lamp dimmers that are not unlike the wall-mounted dimmers in your home. However, in this case, the lamp dimmers are used to control the projector lamps.

The relay trees take the place of the variable resistor found in conventional lamp dimmers. The particular Triac circuits in the Slide-Presentation Manager require a resistance that varies from 0 to approximately 250k in order to go from full-off to full-on. The six relays in each of the two trees correspond to Q0 through Q5 and the inverse of Q0 through Q5. When activated, each of the SPST relays merely shorts across a segment of resistance, the six resistors of the tree all being in series. For a relay tree of that type, having a total number of counting steps (S), a maximum required resistance of R_{max}, the value of the resistor at Qn is:

$$ResQn = 2^n(R_{max})/S$$

For convenience, we'll allow R_{max} to be 256k, which is well within the tolerance of the circuit. Then:

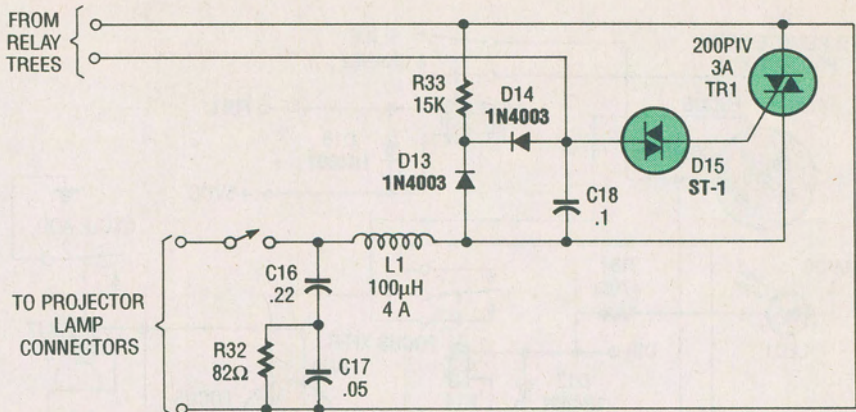$$R_{max} = 256000$$
$$S = 64$$
$$R_{max}/S = 256000/64 = 4000$$

The individual resistors are then 1 × 4000 ohms, 2 × 4000 ohms, 4 × 4000 ohms, and so on. The result is a variable resistor that changes in 4000-ohm increments, or 1.56% of the total, with each binary count, which provides a smooth transition of the Triac circuits and the resulting change in the brightness of the projector lamps. Since the resistor values must be close in order for the slide fades to be smooth, and because the multiples of 4000-ohm resistors do not correspond with standard resistor values, potentiometers are used and adjusted to the required values (as indicated in Fig. 4) using an accurate ohmmeter.

Triac Lamp Dimmers.

Figure 5 shows the schematic diagram for the Triac lamp-dimmer circuit; two such circuit are required (one for each projector). The dimmer circuits are controlled by the relay trees, which, in turn, control the projector lamps. The dimmer circuit (which was taken from General Electric Triac-application literature) differs from the common run of lamp dimmers in that it has extra components to prevent hysteresis effects.

Hysteresis in this application would be disastrous from an aesthetic point of view, since the rate of change in brightness in the up direction would not be the same as in the down direction. In addition, in the up direction, there is a characteristic delay of turn-on until about one-third of the resistance is in the circuit, resulting in a sudden turn-on at partial brightness. The circuit also contains circuitry to prevent RF interference that, in my opinion, no thyristor circuit should be allowed to be without.

Transfer Relays.

The operation of the Kodak Carousel projectors is electromechanically controlled by switches mounted on the body of the projector or on the remote control. The basic power for that control comes from a 25-volt AC transformer secondary that is actually a winding on the core of the fan motors.

For practical purposes, the fan motor can be considered a transformer as well as a motor. One side of the 25-volt AC winding is connected to the metal body of the projector; thus, the windings on the two projectors must be isolated from each other or, depending on the orientation of the two AC power input plugs, the two windings could be out of phase and effectively in series, placing a potential 50 volts AC between the body of one projector and the body of the other. That's enough voltage to render a very unpleasant shock or, if the two projector bodies should come in direct contact, enough to cause damage to the projectors.

Figure 6 shows the schematic diagram of a section of the Slide Presentation Manager that I call the transfer relays. Those relays provide the required transformer-winding isolation, transfer the remote control functions to the active (full bright) projector, and send a slide-change command to the projector that has just gone full dark.

Relay K14—which is activated by the DIR signal from U6 through relay driver U11—transfers the focus function from one projector to the other. The focus has two directions, of course, so that the lens can be racked in either direction to achieve focus.

Fig. 5. The Triac lamp dimmer circuits are controlled by the relay trees and they, in turn, control the projector lamps.
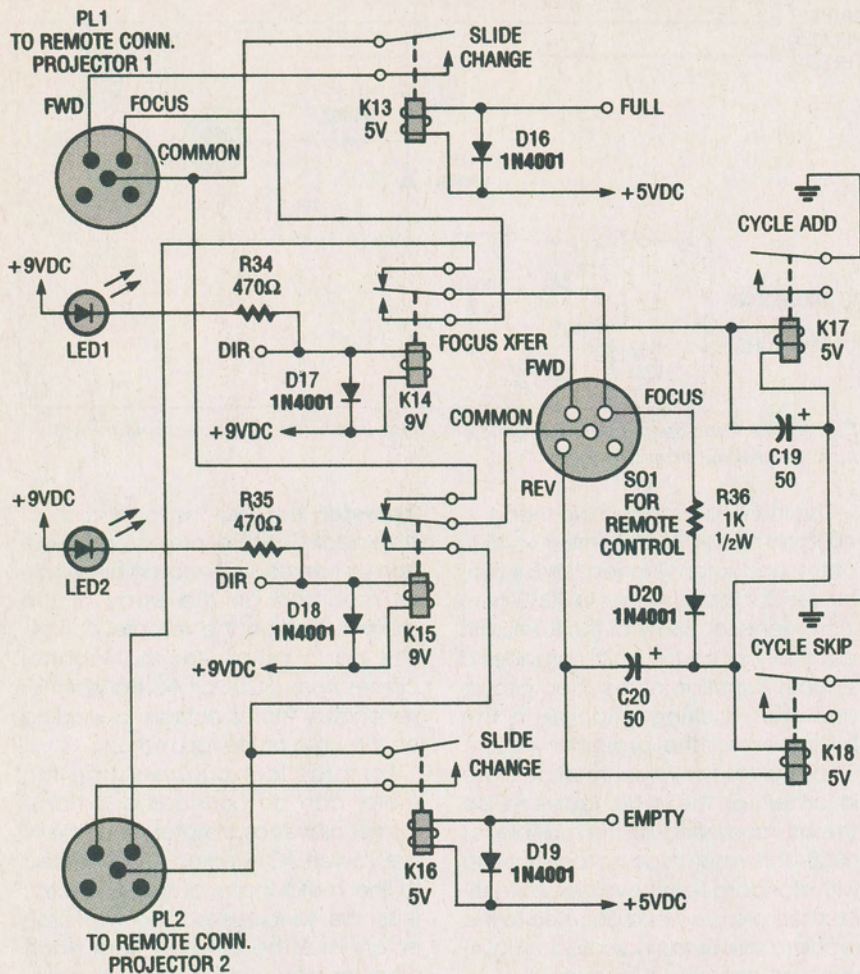
Fig. 6. The transfer relays provide the required transformer-winding isolation, transfer the remote control functions to the active (full bright) projector, and send a slide-change command to the projector that has just gone full dark.
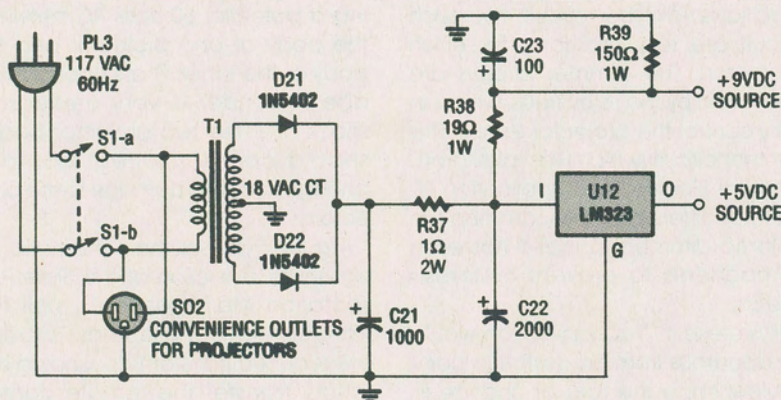

Fig. 7. The power supply for the Slide-Presentation Manager is conventional in every respect. It consists of a fullwave rectifier, RC filter circuit, and a 3-terminal LM323 voltage regulator.

provide the most efficient use of the relay driver. Relays K13 and K16 provide the contact closure that causes a slide to be pushed up from the projection gate, the carousel to be advanced one notch, and the new slide to be dropped into the projection gate. Those relays are driven by the FULL and EMPTY signals from U8 through relay driver U11. As stated before, the slide change happens to the projector that has just gone dark, keeping the audience completely unaware of the slide change.

Relays K17 and K18 provide the cycle-add or cycle-skip functions by either triggering a fast cycle or shorting out the FROM TAPE input during a signal arrival, as discussed previously. The circuitry that activates those relays is a little odd because the pushbuttons activating the add cycle or skip cycle are actually in the remote control, labeled FOR and REV, respectively.

One side of those switches is connected to the common of the projector's 25-volt AC windings and so the relays must be driven by that source. We get into the other side of the winding through the FOCUS line, which means that current to activate K17 or K18 actually passes through the winding of the focus motor. However, the relays require only 30 mA and are fed through R36, which is not sufficient to cause the focus motor to turn. The 25 volts AC, being dropped by R36, is half-wave rectified by D20 and applied to one side of both relays, each of which has its own 50-μF filter capacitor.

Pressing either the FOR or REV button on the remote completes the circuit to the common of the active projector and closes the appropriate relay to provide either an added cycle or a skipped cycle. Sharp-eyed readers will notice that if the focus control is activated in either direction, neither K17 nor K18 can be activated—an unlikely event since it would require two thumbs to operate the remote control in that manner.

Power Supply. Figure 7 shows the schematic diagram of the power supply for the Slide-Presentation Manager. The power supply, conventional in every respect, consists of a fullwave rectifier, RC filter circuit, and a 3-terminal LM323 voltage regulator. Nine volts DC for some of the transfer relays

That's accomplished with a single line by means of diodes in the remote control, which apply either a positive or negative DC voltage to the FOCUS line. The focus motor in the projector is a small permanent-magnet unit that runs forward or reverse depending on

the polarity of the voltage applied across it.

Relay K15 selects the common return of the transformer winding of the active projector. It is driven by the inverse DIR signal from U11, a scheme which has no significance except to

PARTS LIST FOR THE SLIDE PRESENTATION MANAGER

SEMICONDUCTORS
U1–U3—LM567 tone decoder, integrated circuit
U4—SN5493 4-bit binary counter, integrated circuit
U5—PAL16L8 programmable-logic device, integrated circuit, see text
U6, U7—PAL16R4 programmable-logic device, integrated circuit, see text
U8—PAL16R6 programmable-logic device, integrated circuit, see text
U9–U11—SN75492 MOS-to-LED hex digit-driver, integrated circuit, see text
U12—LM323 5-volt, 3-amp, positive-voltage regulator, integrated circuit
TR1—200-PIV, 3A Triac
D1–D12, D16–D20—1N4001 1-amp, 50-PIV, silicon-rectifier diode
D13, D14—1N4003 1-amp, 200-PIV, silicon-rectifier diode
D15—ST-1 diac
D21, D22—1N5402, 3-amp, 200-PIV, silicon-rectifier diode
LED1, LED2—Light-emitting diode

RESISTORS
(All fixed resistors are ¼-watt, 5% units, unless otherwise noted.)
R1, R4—15,000-ohm
R2, R5, R7, R25, R31—5000-ohm potentiometer
R3—50,000-ohm linear potentiometer
R6, R8, R16, R17—33,000-ohm
R9–R11—1000-ohm
R12–R14—2700-ohm
R15—47,000-ohm
R18, R19—150,000-ohm
R20, R26—200,000-ohm potentiometer
R21, R27—100,000-ohm potentiometer
R22, R28—50,000-ohm potentiometer
R23, R29—20,000-ohm potentiometer
R24, R30—10,000-ohm potentiometer
R32—82-ohm, ½-watt
R33—15,000-ohm, ½-watt
R34, R35—470-ohm
R36—1000-ohm, ½-watt
R37—1-ohm, 2-watt
R38—19-ohm, 1-watt
R39—150-ohm, 1-watt

CAPACITORS
C1, C3, C10, C15—4.7-µF, 10-WVDC, tantalum
C2—1-µF, 10-WVDC, tantalum
C4, C5—2.2-µF, 10-WVDC, tantalum
C6, C9, C13, C14—10-µF, 10-WVDC, tantalum
C7, C8—3.3-µF, 10-WVDC, tantalum
C11—0.47-µF, 10-WVDC, tantalum
C12—22-µF, 10-WVDC, tantalum
C16—0.22-µF, ceramic-disc
C17—0.05-µF, ceramic-disc
C18—0.1-µF, ceramic-disc
C19, C20—50-µF, 10-WVDC, electrolytic
C21—1000-µF, 16-WVDC, electrolytic
C22—2000-µF, 16-WVDC, electrolytic
C23—100-µF, 16-WVDC, electrolytic

ADDITIONAL PARTS AND MATERIALS
K1–K12—SPST 5-volt, 30-mA reed relay
K14–K15—SPDT 9-volt, 20-mA relay
K13, K16–K18—SPST 5-volt, 30-mA relay
L1—100-µH, 4-amp, coil
T1—18-volt center-tapped step-down transformer
J1, J2—Stereo phono jack
PL1, PL2—5-conductor plug (see text)
PL3—117-volt molded AC power plug with line cord
SO1—5-conductor socket (see text)
SO2—117-volt AC power socket
S1—DPST toggle switch
Perfboard materials, enclosure, wire, solder, hardware, etc.

Note: A set of four PLD's (U5–U8) pre-programmed as COMCON, CLOCKCON, TAPESIG, and COUNT64 are available from the author for $25.00, postage paid. Send check or money order to: J. A. Nunley, 1515-108 No. Milpitas Blvd., Milpitas, CA 95035. All checks will be held for 10 days to clear. California residents, please add appropriate sales tax.

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is furnished unregulated by the voltage divider consisting of R38 and R39 and filtered by C23. The power switch is shown as switching both sides of the 117 volt AC input.

The significance of that is to disconnect both sides of the convenience outlets for the projectors as a safety measure. When the projectors are connected to the AC line, AC appears at the two-pin projector-lamp connectors. Those connectors, at least the ones on my projectors, are not the latest thing in fool-proof safety.

It would be possible, when making connections to these pin-type jacks, to touch a live conductor. It is imperative that connections to and disconnections from the lamp connectors be made with all power removed. The best way to assure that is to connect the projectors to the convenience outlets on the Slide-Presentation Manager, then when connecting or disconnecting the lamp connectors, first make sure the AC power switch is off.

PLD's. For readers who are interested in learning more about the PLD's or perhaps wish to program their own, a brief tutorial on PLD's and how they are programed, copies of the actual software coding used to create the PLD's in the four different configurations, and copies of the standard JEDEC fuse maps that are used to burn-in the PLD's, is a available from J. A. Nunley, 1515-108 No. Milpitas Blvd., Milpitas, CA 95035 for $8.00 check or money order (includes postage and handling).

Be forewarned, however, that programming the PLD's requires access to an IBM personal computer (or compatible) and a compatible PLD programmer in which the blank chips are installed for the actual burn-in.

Construction. The main logic and relay sections of the Slide Presentation Manager were assembled on a 6- by 8-inch perforated board. The IC sockets were secured to the board, each by a single 2-56 screw and nut. The other components are held in place by their leads, which pass through the perforations and are bent so as to hold them in place. After the circuits were wired and tested, to be reasonably sure none of the components would have to be replaced, they were further secured to the board with a small dab of hot-melt glue.

Connections to the power supply, the Triac circuits, and the many leads

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going to the projectors and remote control, are made with screw-type terminals, along the edge of the board. On the back side of the board, the circuit was interconnected with a combination of wire-wrap and solder connections.

The boards were housed in a general-purpose enclosure with aluminum top, bottom, front, and back, and plastic sides. The main logic board is mounted on stand-offs to the bottom of the case. The power supply was built directly on the bottom of the case at the right of the main logic board. The components were mounted on standard terminal strips fastened to the bottom of the case. The voltage regulator was mounted on a piece of ⅛-inch aluminum pop-riveted to the bottom of the case, providing adequate heat sinking. The power transformer is mounted to the rear of the case on the right side.

The two Triac lamp-dimmer circuits were built on the rear of the case to the left of the power transformer. The components are mounted on standard terminal strips, which are fastened to the back of the case. The Triacs themselves were chosen to have isolated tabs so that the tabs can be mounted directly to the aluminum back of the case with screws, avoiding the inconvenience of insulating hardware while still providing sufficient heat sinking by means of the case only. The fast, medium, and slow switches are mounted to the front of the removable top panel and are connected to the main logic board by a 4-pin connector, enabling the top cover to be removed without inconvenience.

There is little that is critical in any of the circuitry. Tantalum capacitors were used in most of the applications because of their compactness. If you have the space, you may want to use less expensive but bulkier standard electrolytics. The twelve relays used in the two relay trees must be reed-type units with fast pull-in and fast-release characteristics. Relays with more massive armatures, which pull in and release more slowly, will create a flickering effect during the slide fades.

The other relays are not critical as long as they are within the voltage and current capabilities of the relay drivers. The relays driven by the relay drivers are all shunted with suppression diodes, which are necessary to prevent inductive pulses from causing spurious responses.

The Kodak *Carousel* projectors have two connectors on the back (or on the side in newer models), a five-pin connector for the remote control, and a 2-pin connector in series with the lamp filament. In searching for a connector that would match the spacing of the 5-pin connector, I stumbled across Radio Shack catalog numbers 270-041 (male) and 274-1215 (female), which fit the *Carousel* connector exactly, but are sold by Radio Shack as automotive sound system connectors.

The 2-pin connector, on the other hand, turned out to be more of a problem. Nowhere I did find a regularly available 2-pin connector that would match the spacing of the one on the Carousel. As luck would have it, I discovered a half-a-dozen 2-pin connectors in my junkbox that with a hard push would fit that connector.

The 2-pin connector was epoxied to the bottom of the 5-pin connector, and that combination was covered with shrink tubing to make a unified 7-pin assembly that connects to the back of the *Carousel* projector. If you are unable to find a 2-pin connector that will fit, one solution might be to open the projector and solder 18-gauge zip cord to the two pins of the 2-pin connector, and then bring out the zip cord and connect it to a female connector of a commonly available type. (Bear in mind that if your projectors are new, any modifications would void your warranty.) Be wary, however: the 2-pin lamp connector and anything subsequently connected to it is live with 117-volts AC whenever the *Carousel* projector is connected to the power line.

Setting the Tone Decoders. The last task to complete is to set the frequency of the tone-decoder oscillators. If the same Slide-Presentation Manager used to record the slide presentation is used to present the slide presentation, you can be sure the program will work no matter how the oscillators are set. The reason being that the same tone-decoder oscillators that are used to generate the record signal to the tape recorder are also used to gate the fade signal from the tape recorder.

However, since the middle tone-decoder oscillator (U2, operating at 180 Hz) is also used as the base for the clock pulses that drive U8, if the frequency of that oscillator is far from 180 Hz, the dissolve times stated elsewhere in this article will be off. A lot of experimentation went into deciding on the right dissolve times, and a great departure from those times will result in less satisfactory results from an aesthetic point of view.

Set the tone-decoder oscillators as follows: If you have a frequency counter, connect its input to pin 5 of U1 and adjust R2 for exactly 360 Hz. Then connect the counter to pin 5 of U2 and adjust R5 for 180 Hz, and finally connect the counter to pin 5 of U3 and adjust R7 for 90 Hz. If you don't have a frequency counter, but have an oscilloscope, connect the vertical input to pin 5 of U1 and an isolated source of AC-line 60 Hz to the horizontal input, and adjust R2 for a stable Lissajous figure containing 6 loops, U2 and R5 for 3 loops, and U1 and R7 for 1½ loops.

If you have neither a frequency counter nor an oscilloscope, but have an audio oscillator or function generator, apply the output of the generator to J1 (the FROM-TAPE jack), and adjust the level for approximately 0.5 volt. Set the generator to 360 Hz (the accuracy of this setting will determine the accuracy of the tone decoder), connect a DC voltmeter (set to the 5-volt DC range) to pin 8 of U1, then adjust R2 until the voltage at R8 goes low. Similarly, do the same for U2 and U3, setting the audio oscillator for 180 Hz and 90 Hz and adjusting R5 and R7, respectively.

Finally, if you have none of the above equipment, set R2, R5, and R7 at mid-rotation and let the chips fall where they may. Then, never change the settings and always use the same Slide-Presentation Manager to present the slide show that was used to make the slide presentation. If you use the last method, before you make a slide presentation, try the various dissolve rates—fast, medium, and slow—with slides in the trays. If the dissolve rates don't please you, adjust R5 until you are happy with them. ∎