Video Controller

A simple unit which provides a video fader and an audio mono/stereo mixer and fader.

By Robert Penfold

Home video production appears to be an increasingly popular hobby and seems likely to gain a larger following than home movies of the film variety ever managed. Methods of production are very different to the old film techniques, and there is no absolute equivalent to splicing pieces of film together to edit the individual scenes into the finished product. The accepted technique with videos is to copy the scenes from tapes placed in one recorder to a single tape in a second recorder where the full video is built up.

This can actually be done without the need for any extra equipment apart from the connecting lead, albeit rather crudely. More professional results can be obtained with the aid of a video controller of some kind, and the most basic type is just a video fader. The idea is to fade down the signal at the end of one scene, and them fade it up again at the beginning of the next scene. This gives what is generally a better effect than an abrupt cut from one scene to the next, and it is a technique that is much used by professional program makers.

For best results an audio fader should also be fitted to suit the unit, so that the sound signal can be faded in unison with the video signal of desired. The normal approach is to have separate video and audio fader controls so that the two signals can be controlled in precisely the required manner, but to use slider controls mounted side-by-side so that they ar easily operated together when necessary. For greater versatility an audio mixer should be included, so that background music or a commentary are easily added to the original sound track.

The System

This video controller uses the arrangement shown in the block diagram of **Fig. 1**. The top set of three blocks form the video fader, which is separate from the audio section of the unit apart from a common on/off switch and battery supply. Although an audio signal can be faded up and down using nothing more than a simple potentiometer connected to act as a variable attenuator, things are far less straightforward with a video signal. This is due to the fact that a video signal is really a mixture of two signals. The main one is the positive modulation signal which varies the brightness of the spot which is scanned across the screen to produce the image. This is the signal which must be attenuated in order to fade down the picture. The other part of the signal is the negative-going synchronization pulses. There are two

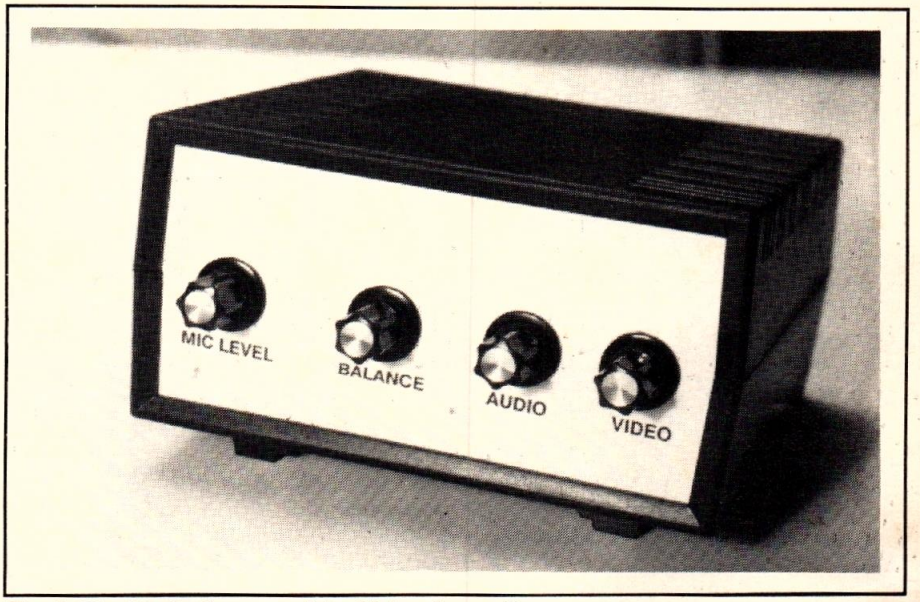

Fig. 1. The block diagram of the Video Controller.

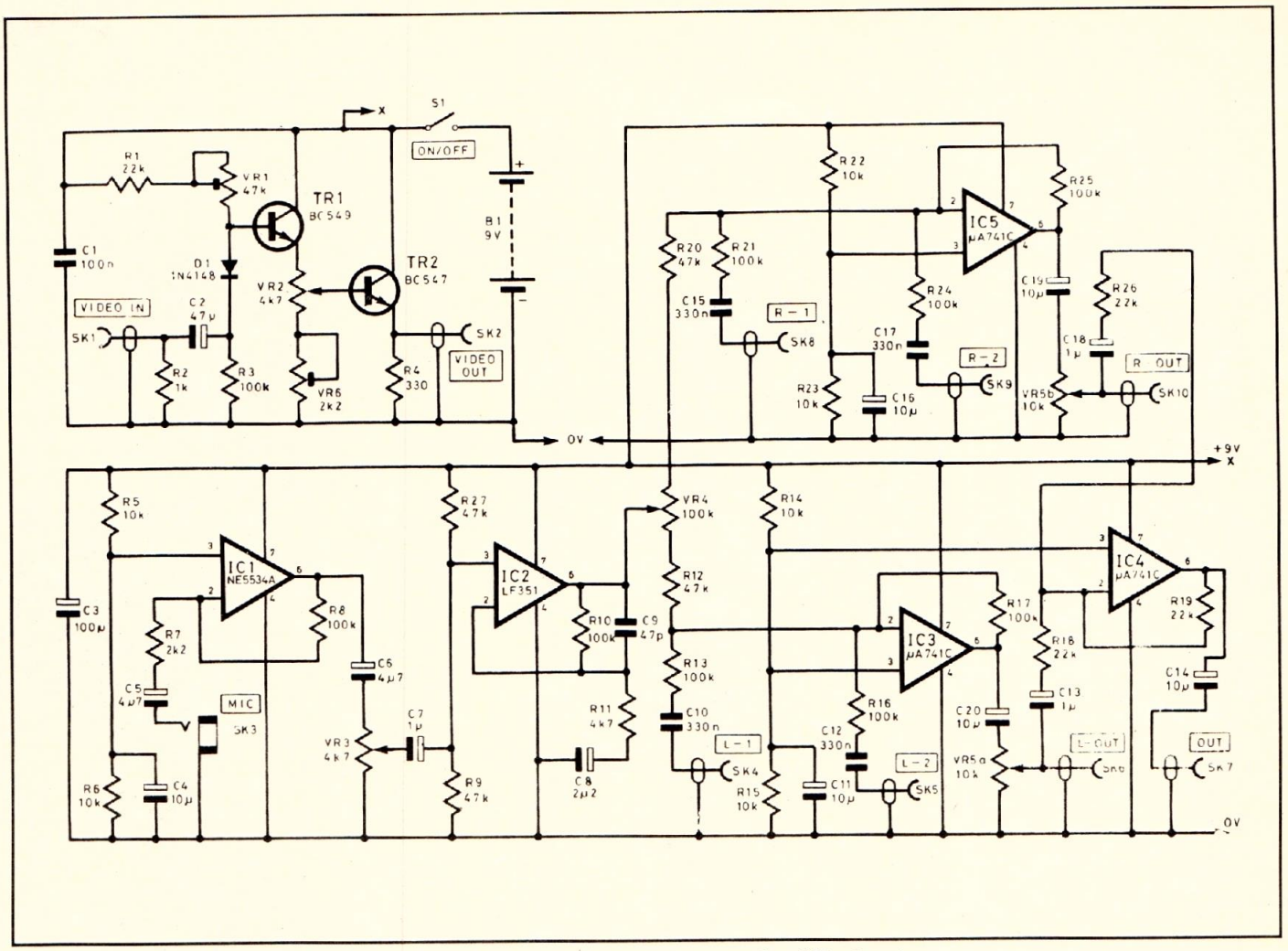

Fig. 2. The circuit schematic. See the text for substitutions for parts that may be difficult to locate.

types of synchronization pulses, the frame pulses at a frequency of 60 Hz, and the line synchronization pulses which are shorter and at a much higher frequency of about 15kHz. This second frequency may seem to be too low at first sight. However, it should be remembered that although there are 60 frames per second, a system of interlacing is used, and two frames are needed to product one complete picture. In the present context the important point is that a simple attenuator will not just fade down the modulation signal, but will also affect the synchronization pulses. It will give the desired fading effect, but there is a strong likelihood of proper synchronization being lost before the picture is fully faded down. At best this would give a grossly distorted picture, and at worst synchronization would be lost completely with the picture breaking up as a result. There are quite complex fader circuits which split the signal into its modulation and synchronization pulse elements, process the modulation signal, and then recombine the signals. It is not essential to do things in this way though, and it is possible to devise a circuit that will fade out the main picture signal while leaving a perfectly adequate modulation signal .

In this case the general scheme of things is to use some preprocessing ahead of a variable attenuator to ensure that the faded signal retains a sufficiently strong synchronization signal.

A buffer amplifier at the output of the video section ensures that the unit has a low enough output impedance to drive a composite video input properly. Note that the unit will only work with a composite video signal, and it can not be used with a UHF or VHF signal.

Audio Section

The audio section includes a two-stage microphone preamplifier which incorporates a microphone level control. There are three mixer stages, which can make the unit look a bit confusing at first, but the extra mixer is needed because the unit is designed to give both mono and stereo outputs. The microphone signal is fed to both inputs of the stereo mixer, and a channel balance control is included here. There are two high level inputs for each channel of the stereo mixer circuit, but there are no level controls for either of these. It has been assumed that the output controls of the tape decks (or whatever equipment feeds these inputs) will be used to get the signal levels right. Of course there would be no difficulty in adding volume control style variable attenuators at each input if desired.

Parts List

See text for parts substitutions.

Resistors
(.25 OR .5 watt, 5%)

R1 ..... 22k
R2 ..... 1k
R3 ..... 100k
R4 330
R5,6,14 15,22,23 ..... 10k
R7 ..... 2k2
R8,10,13,16,17 21,24,25 ..... 47k
R11 ..... 4k7
R18,19,26 ..... 22k

Potentiometers

VR1 ..... 47k trim
VR2 ..... 4k7 linear
VR3 ..... 4k7 audio
VR4 ..... 100k linear
VR5 ..... 10k dual audio
VR6 ..... 2k2 trim

Capacitors

C1 ..... 100n
C2 ..... 47u 16V
C3 ..... 100u 10V
C4,11,14 16,19,20 ..... 10u 25V
C5,6 ..... 4u7 63V
C7,C13,C18 ..... 1u 63V
C8 ..... 2u2 63V
C9 ..... 47p
C10,12,15,17 ..... 330n

Semiconductors

TR1,2 ..... BC549 or 2N3904
IC1 ..... NE5534A (see text)
IC2 ..... LF351 (see text)
IC3,4,5 741
D1 ..... 1N4148 or 1N914

Miscellaneous

SK1,2 4,5,6,7 ..... phono socket
SK3 ..... 3.5mm jack, or to suit mic.
S1 ..... SPST switch
B1 ..... 9V batt. (see text)

Case such as Radio Shack 270-250 (used in cover photo), knobs, battery connector, shielded wire, hookup wire, 4-40 nuts and bolts.

A dual gang potentiometer can be used to control the output level from both channels of the mixer. It is the outputs from this main fader control that constitute the stereo output signal. The third mixer stage is simply used to combine the stereo output signals to provide a mono output. If the mono output is used, then obviously the microphone balance control is superfluous, and will have little effect.

Video Circuit

The circuit diagram for the video stages of the unit appears in **Fig. 2**. There is nothing much to the preprocessing circuit which is basically just a diode and potential divider circuit which ensures that suitable voltages are fed to the video fader potentiometer VR2. Transistor TR1 acts as a buffer amplifier which provides a low enough output impedance to drive the fader circuit properly. VR1 and VR6 are adjusted to give a good control characteristic from VR2. This avoids having the fade- down introduced over a short length of track towards the middle of VR2's adjustment range.

By having the fade-down introduced over virtually all VR2's adjustment range it is much easier to precisely control things and to have a very slow fadeout is desired. It also gives a better match with the audio fade-down control. The effect on the picture as the signal is faded out is much the same as turning down the brightness control of a television contrast as the signal is attenuated.

Audio Circuit

The audio stages are somewhat more complete, as can be seen from the preamplifier and mixer circuit diagram which appears in Fig. 2. IC1 acts as the preamplifier stage, and this is a special low noise operational amplifier which operates here in the inverting mode. It has a voltage gain of about 45 times and gives an input impedance of 2K2. The circuit will work using a less expensive device in the IC1 position, including the standard uA741C type. The NE5534A is much to be preferred though, as the output from a microphone is at a very low level, and noise from the preamplifier can be excessive when using a device which offers anything less than excellent noise performance. The noise level is actually about 20dB lower (one-tenth in terms of voltage) using the NE5534A instead of an ordinary uA741C or a similar device.

The input characteristics of the microphone input are suitable for most types of microphone. Low or medium impedance dynamic types will work well with the unit, as will any types that have similar output properties. With some low impedance types it may be better to reduce R7 to 1k so as to give slightly increased gain. The unit will work with high impedance dynamic microphones and similar types, but better results are likely with these if R7 is raised to about 22k in value. This reduces gain and boosts the input impedance.

Crystal microphones are unsuitable for use with this project.

Potentiometer VR3 is the microphone gain control, and this is followed by the second stage of the microphone preamplifier. This is a non-inverting circuit based in IC2, and it provides a voltage gain of approximately 22 times. Its output feeds straight into the channel balance control, VR4.

The stereo mixer uses IC3 and IC5 as conventional summing mode mixers, one in each stereo channel. These have unit voltage gain and provide an input impedance of about 100k at each input. VR4 forms part of one input resistance for each channel, and it gives approximately unity voltage gain from the output if IC2 to the output of each mixer, but only when it is at a central setting. By adjusting VR4 so that the wiper is right at one end of its track or the other, the two input resistances become unequal. One becomes just the 47k of the fixed input resistor, while the other become this 47k plus the full 100k of VR4's track (totalling 147k).

The gain of each mixer circuit is equal to 100k divided by the input resistance. Therefore at the extremes of its settings VR4 boosts the microphone signal in one channel by about 6dB, and reduces it by a few dB in the other channel. This does not permit the microphone signal to be panned from full-left to full- right. In terms of position in the sound stage, as little as 6dB difference between the two channels is adequate to place a signal well over to one side or the other. VR4 can therefore be used to pan the microphone signal over to one

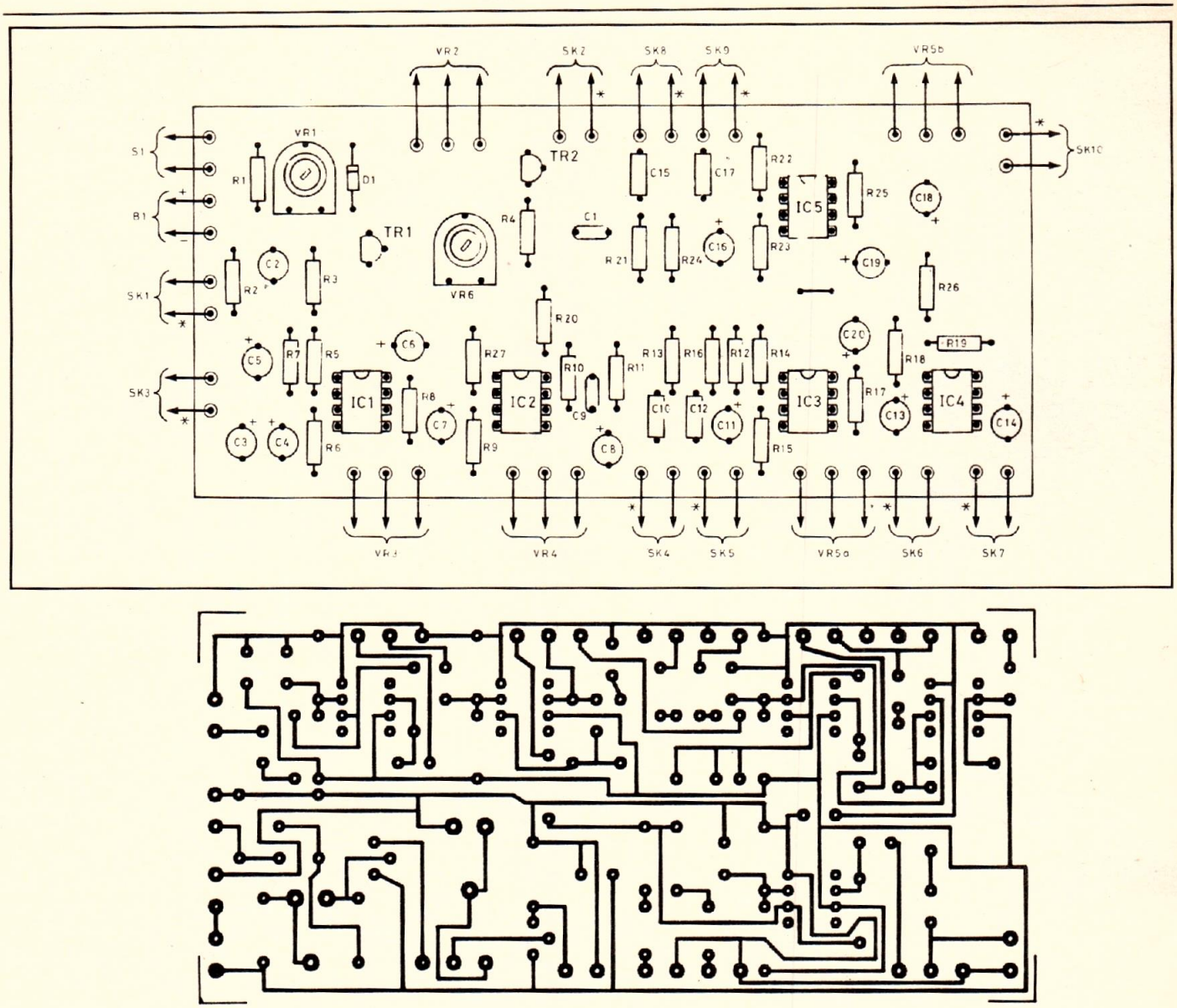

Fig. 3. The component location and printed circuit board. The asterisks on the location diagram mark the ground connections.

side of the sound stage if desired, instead of using it to balance the signal for a central image. The main audio fader control of VR5 and the stereo outputs are fed directly from its wiper terminals. The two signals are combined into the mono output by IC4 which acts as another summing mode mixer circuit.

Power is provided by a nine volt battery, and as the current consumption is quite high at around 17 milliamps an alkaline 9V battery is a good idea.

Parts Substitution

As mentioned above, the 5534 op amp can be replaced with a 741 general-purpose type at the expense of noise (though video sound is less than hifi anyway). This also applies to the 351, IC2.

Presets VR1 and VR6 should be fairly close to the stated value; a 5k linear taper (Radio Shack, etc.) is ideal for VR2. VR3 can be any value from 5k to 50k, preferably with an audio taper, though a linear tap will work (though the volume jumps up suddenly from zero). VR4 is an easily obtainable 100k.

The 10k dual audio taper is an ideal value, but it's rather hard to find one; many component stores don't have a good stock of duals. Complicating this is the fact that the pot's sliders are used as outputs (L-Out and R-Out on the schematic). If you use an easily obtainable pot, such as Radio Shack's 100k dual, the output resistance will be ten times higher than we'd like. This higher impedance might be susceptible to noise, but it's a possibility if you want to try it. Another way is to use Radio Shack's 1k dual linear balance control as a volume pot. It works, but the control range will be somewhat compressed compared to an audio taper.

Construction

Details of the printed circuit board are provided in **Fig.3**. None of the integrated circuits are MOS types, but I

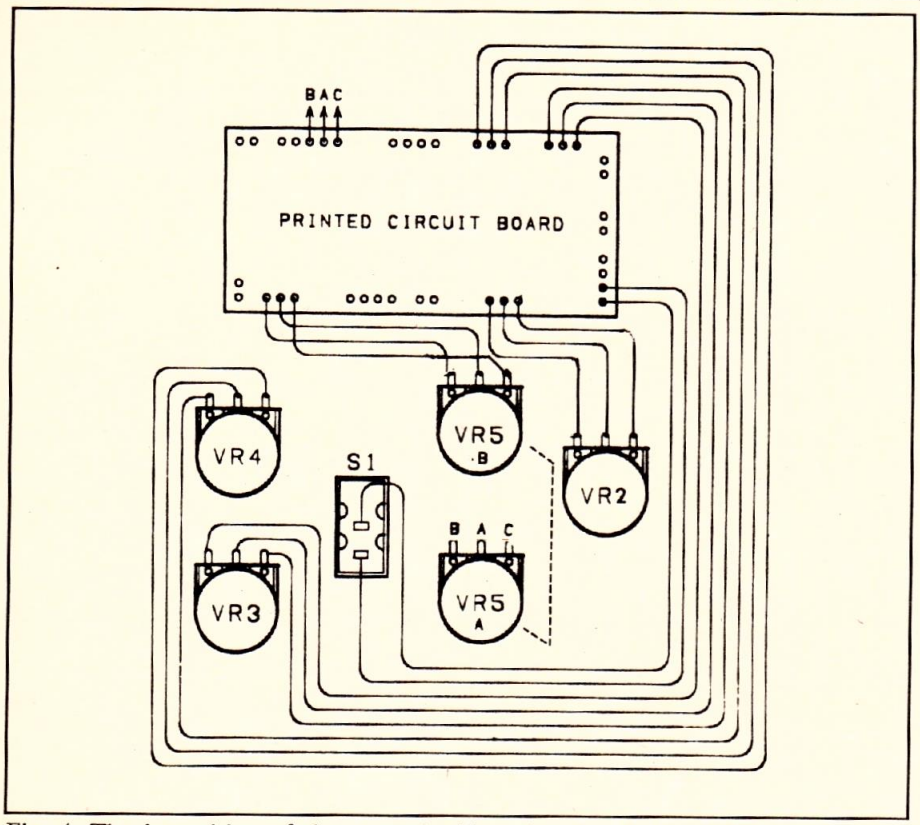

Fig. 4. The interwiring of the controls. Note that the dual pot VR5 is shown as separate sections for clarity.

would still strongly advocate the use of a holder for IC1 at least. The NE5534A is rather more expensive than the average operational amplifier. The capacitors must all be miniature printed circuit mounting types if they are to fit onto the board neatly and without difficulty.

Be careful not to omit the single link wire which is situated about half way between IC3 and IC5. A piece of wire trimmed from a resistor lead can be used for this link. Be careful to fit the integrated circuits and the polarized components the right way around. At points where connections to off-board components will be made only single-sided pins are fitted to the board at this stage.

From the electrical point of view the exact layout used is not too important, and it is really a matter of arranging the components in a manner that makes the unit easy to use. Phono sockets were used for all the input and output sockets, apart from SK3 (the microphone socket) which is a 3.5 millimetre jack type. If necessary though, these can be changed to any types which fit in with your particular audio and video equipment. You might find it better to use BNC connectors for SK1 and SK2 for example. The phono jacks can be separate units, or the type with 8 jacks mounted on a phenolic board.

The completed printed circuit board is mounted on the base panel of the case using small nuts and bolts. An extra nut on the bolt shaft can hold the board clear of the case. Make sure that it is mounted where it will not come into contact with any of the front panel mounted components when the top/front panel is fitted into place. Also be careful to leave sufficient space for the battery somewhere in the case.

Wiring

There is a substantial amount of hard wiring needed to complete the unit. It is probably best to start with the wiring to the sockets, and this is fairly straightforward. The only point to watch is that each ground terminal on the board connects to the appropriate tag on its corresponding socket. The cable which connects the board to SK3 must be a shielded type (with the outer braiding carrying the ground connection) as the microphone input is very sensitive to stray pick up. It is advisable to use shielded lead for the connections from SK1 and SK2 to the board. This is to prevent radiation of the video signal and stray pick up in the microphone preamplifier wiring. It is also advisable to keep the wiring to VR2 as far away from the microphone preamplifier components as possible. It is not essential to use shielded cable for the connections to the other sockets, but it is probably best to play safe and do so for any leads that are more than about 25 millimetres long.

The wiring to the controls is shown in **Fig. 4**. I would recommend the use of twin shielded cable for the leads which connect to VR3, VR4 and VR5. In the case of VR4 there is no track connection to the negative supply rail that can be connected to the outer braiding in order to provide screening. Connecting the braiding to the wiper (middle) terminal of VR4 will give effective screening of the other two leads though, and these are the ones that are sensitive to stray pick up.

Adjustment and Use

Exactly how the unit is wired into your system will obviously depend on precisely what equipment is in use. All the connecting leads should be of the appropriate shielded variety. There should be no difficulty in testing the audio mixer section of the unit, and this does not require any setting up or adjustment before it is ready to use.

There are two trim pots (presets) to be set up in the video fader section and initially VR1 should be adjusted to a roughly mid- point setting. VR6 should be set at maximum value (turned fully clockwise). The unit may well work perfectly satisfactorily with the presets at these initial settings, but it might be found that there is still some picture evident when VR2 is fully backed off. VR6 should then be adjusted in an counterclockwise direction just far enough to fully blank the screen of the monitor. VR1 is given any setting that provides a good fade-up characteristic. A little experimentation is called for here, and with some systems virtually any setting of VR1 will give good results.