AUDIO-VIDEO PROCESSOR TYPE AVP300 – PART 1

An ELV design

The Type AVP300 audio-video processor is a multi-standard equipment that can be used almost anywhere in the world. It can translate between the three television standards (PAL, NTSC, and SECAM), hop from one type of signal to another (S-VHS, Hi-8, RGB, CVBS), and enables audio and video signals to be modified: video signals as regards colour saturation, contrast, brightness and the balance between red, green and blue, and audio signal(s) in respect of tone, balance and volume. Moreover, it has a (limited) facility for mixing signals.

THE audio-video processor is best compared to the control amplifier in an audio system. That, too, gives a choice of input signals. Where required, the signal standard may be changed. The quality of the signal can be modified in a manner comparable to tone control. Finally, the signal is output in a number of ways (as in tape and line outputs).

The design of the processor can be seen in the block diagram in Fig. 1. In the first instance, this diagram will be analysed stage by stage; this will at the same time give a sort of user instruction. The technical aspects will follow naturally when the various circuit diagrams are discussed.

Inputs and outputs

At the rear of the processor are no fewer than 16 different connectors—see Fig. 2. Which of these are required in any given situation depends on the type of termination of the relevant cable and on the available signal.

Video 1/6 is an input with dual function via a SCART* connector (also called Euroconnector). When used as Video 1 input, it is fed with a CVBS (Chroma, Video, Blanking, Synchronization) signal, which is sometimes just called composite video signal.

When used as Video 6 input, it accepts signals from an S-VHS recorder or camera. These signals consist of two components: chroma for colour information and VBS (black-and-white) for brightness.

The audio signals associated with these inputs are also applied via the Euroconnector.

Video 2 is a SCART* input for CVBS and RGB (Red, Green, Blue) signals; selection of either is effected by a slide switch. When the switch is in position CVBS, it is possible, with the aid of a computer and a genlock, to mix CVBS and RGB signals. It is planned to publish the design of a genlock later this year.

Video 3 is a BNC input for a CVBS signal. The associated audio signal is input via the two audio sockets next to the BNC socket.

Video 4 is a second SCART* socket that can also be used to input a CVBS signal. Moreover, it provides CVBS and RGB output signals. This arrangement is intended primarily for the standards conversion. To that end, the socket should be linked to the SCART socket on the television receiver. The tuner of the receiver will then provide the CVBS signal, whether NTSC, SECAM or PAL, to the processor. The processor translates this signal into an RGB signal and sends it to the TV receiver. At the same time,the blanking line is switched to arrange the TV receiver displaying the signal at the RGB inputs, that is, the converted signal, instead of that from its integral tuner. There is only one but: not all TV receivers, particularly older models, have RGB inputs on the SCART socket.

Video 5 is a mini DIN socket for inputting S-VHS signals. The associated audio signals are fed to the processor via audio sockets.

Video 7 is a mini DIN socket for outputting S-VHS signals. Again, the associated audio signals are output via standard audio sockets.

Video 8 is another SCART* socket for outputting CVBS or S-VHS signals: which one is determined by a switch adjacent to the socket. If the socket is used for S-VHS signals, nothing must be connected to Video 7, because of the terminating impedance of the S-VHS output. If a recorder or TV receiver is connected to Video 7, Video 8 may be used as a CVBS output only.

Audio 1–8 are the audio inputs and outputs associated with the correspondingly numbered video inputs and outputs.

Audio 9 (two sockets) is intended for feeding independent audio signals to the processor. These signals can either be mixed with the original sound or replace it.

Audio 10 (3.5 mm jack socket) is a stereo microphone input.

* Named after the French organization that proposed this 21-way connector in the early 1980s: **S**yndicat des **C**onstructeurs d'**A**ppareils **R**adiorécepteurs et **T**éléviseurs. The connector has since become a European standard.

Audio 11 is a headphone output via which the signals before *and* after the control amplifier can be heard.

Port is an 8-way DIN socket, via which external equipment can be used to control various functions of the processor. It will enable, for instance, the inputting of yet-to-be-developed video effects in the future without any further work on the processor.

Standards conversion

The processor can handle video signals of the following standards: PAL, SECAM, NTSC 3.58 MHz and NTSC 4.43 MHz. It is able to recognize these standards automatically and modify the chroma-VBS separation filter accordingly. Which standard is recognized is indicated by LEDs. Selection of positive or negative video signals is effected manually by a switch at the rear of the processor.

Also at the rear panel are the switches for setting the standard of the output signal, which is PAL or NTSC. In the case of NTSC, a further selection must be made of the colour carrier (3.58 MHz or 4.43 MHz). In the case of PAL, the switch *must* be set to 4.43 MHz.

Furthermore, the processor can be used to transform a conventional TV receiver into a multi-standard model (for relevant connections, see under Video 4).

Formats conversion

Apart from video standards, the processor can convert each of the signal formats S-VHS, RGB and CVBS to either of the other two. This is largely a matter of choosing the correct input and output connectors. Note that the CVBS/RGB-in switch (next to the Video 2 input) *must* be set to CVBS if an S-VHS or CVBS signal is input, irrespective of to which socket.

S-VHS to RGB: S-VHS signals can be input via the Video 5 or Video 6 sockets; the input switch must be set accordingly. The RGB signal is available at output Video 4: the CVBS/RGB-out slide switch must be set to RGB.

S-VHS to CVBS: S-VHS signals are input via the Video 5 or Video 6 sockets. The output may be taken from Video 4 or Video 8; both of these may be used simultaneously. The associated switch near these outputs must be set to CVBS.

RGB to SVHS: RGB signals are input via Video 2. The corresponding RGB/CVBS switch must be set to RGB. If this switch is in position CVBS, it may be changed over to RGB by applying a voltage of 1–3 V to pin 16 (blanking). The S-VHS signal may be taken from Video 7 or Video 8 (*not* simultaneously). The switch associated with Video 8 must be set to S-VHS.

RGB to CVBS: RGB signals are input via Video 2. The CVBS signal may be taken from Video 4 or Video 8; both of these may be used simultaneously. The switches at both the outputs must be set to CVBS.

CVBS to S-VHS: CVBS signals may be input via Video 1, Video 2 or Video 3. The converted signal is available at Video 7 or Video 8.

CVBS to RGB: CVBS signals may be input via Video 1, Video 2 or Video 3. The converted signal is available at output Video 4; the associated switch must be set to RGB.

Quality of converted formats

Retention of quality during the conversion from one format to another is ensured by special stages similar to those found in modern television receivers. However, in the case of conversion of CVBS signals. there may be a slight loss of quality. This is because the stripping of the chroma information from the signal tends to be troublesome: this, together with the limited bandwidth of standard VHS recorders, is the reason that the chroma and VBS components of the signal are kept separated in S-VHS recorders. In the conversion to a CVBS signal, there is no loss of quality. This assumes, of course, that the TV receiver and recorder connected to the processor are of good quality.

Controls

A close look at the block diagram in Fig. 2 shows that the processor resembles a modern multi-standard television receiver less the RF and CRT sections. The video section is the largest and most interesting part of the processor. Input signals follow two paths to the video colour controller. RGB signals from Video 2 are fed directly to this stage, but S-VHS and

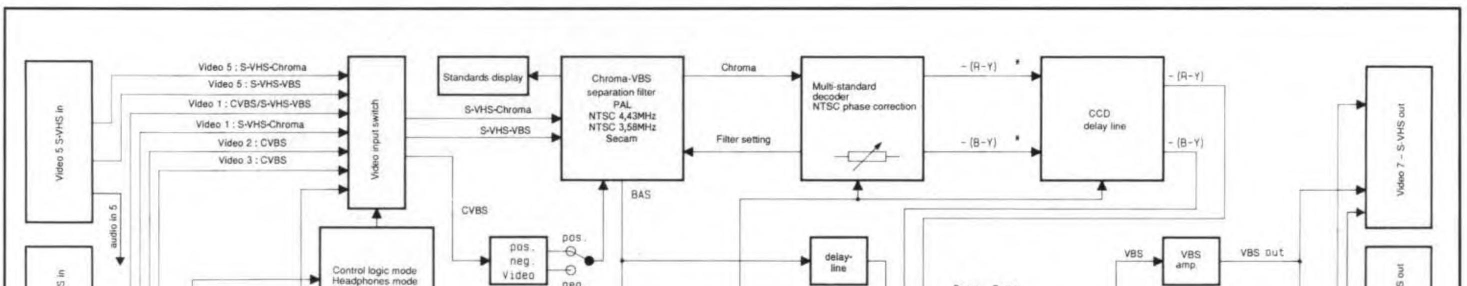


Fig. 1. Block diagram of the Type AVP300 audio video processor.

Fig. 2. Rear view of the audio video processor showing the 16 input sockets and the various switches.

CVBS signals must be decoded first. Switching between the decoded signals and RGB signals is carried out electronically in the decoder. The control signal for that is the RGB blanking signal. If the CVBS/RGB switch is set to position RGB, the output signals of the decoder relating to S-VHS and CVBS components are switched off by the controller. This is why it was emphasized earlier on that this switch must be set to CVBS.

S-VHS and CVBS signals are first applied to an input selector, an electronic switch that is operated by press button MODE on the processor. S-VHS signals are taken from the switch directly to the chroma-VBS separation filter. CVBS signals are first passed through a switchable inverter to enable positive as well as negative video signals to be processed. Normally, the switch is set to negative.

Readers may well ask why S-VHS signals are applied to the chroma-VBS separation filter, since these components are already separated in this format. That is, of course, so and with S-VHS signals the filter therefore serves as a buffer only. If, however, a CVBS signal is applied, the filter separates the sub-carrier and colour signal from the black-and-white (VBS) signal. The filter has two settings: one for PAL, SECAM and NTSC with a colour sub-carrier of 4.43 MHz and the other for NTSC with a colour sub-carrier of 3.58 MHz. The setting is determined by the multi-standard decoder as soon as this stage has detected which TV standard is used. At the same time, the type of standard is indicated by LEDs.

Following the filter, the chroma and VBS signals follow separate paths. To begin with, the VBS signal is applied to the sync pulse and sandcastle pulse generator, which derives new sync pulses from it. Separate line and field sync pulses, as well as sandcastle pulses, are fed to the Video 2 input. Sandcastle pulses indicate the various stages of the line, field and blanking pulses by voltage levels.

The sandcastle pulse is also applied to the video colour decoder, the multi-standard decoder and the CCD (**C**harge **C**oupled **D**evice) delay line to ensure that these stages perform their functions at the right moment.

The sync pulse and sandcastle pulse generator also provides a composite sync (BS or **B**lanking/**S**ynchronization) signal. This is used to re-render the picture signal, after it has been processed, into a VBS or CVBS signal, and also serves as sync signal for the RGB output.

The black-and-white signal is applied not only to the sync pulse and sandcastle pulse generator, but also to the video colour controller. In its path there is a delay line that prevents it arriving too early at the controller: the chroma signal is also delayed during decoding.

The chroma signal is fed to the multi-standard decoder, where it is demodulated (stripped of the 4.43 MHz or 3.58 MHz sub-carrier) and split into two colour-difference signals. To give the correct colour to the colour-difference signals, the decoder needs a reference, and this is provided by the NTSC phase preset. That control is not required with PAL or SECAM, because signals in those formats already contain a reference. With NTSC signals, the preset needs to be adjusted until the colours appear natural or as natural as possible.

From the multi-standard decoder, the two colour-difference signals are applied to a CCD delay line. There, the incoming picture line is compared with the previous picture line stored in the delay line. This arrangement enables the removal of any errors in the colour-difference signals.

The input signals have then been processed to the stage where they can be applied to the video colour controller—the heart of the audio video processor. Although the colour information has not been completely decoded at this stage, the video colour controller correctly converts the colour-difference signals to RGB (bear in mind that the controller is just one IC). The recaptured RGB signal is applied to the RGB switch of the video colour controller. This electronic switch enables the selection of either the S-VHS/ CVBS signal or the RGB signal. It is so fast that it is suitable for mixing the S-VHS/CVBS signal with the RGB signal. Although this requires external effects equipment, the actual mixing takes place in the video colour controller.

After the RGB signal has passed the RGB selector, the video colour controller lives up to its name: it enables changing the depth of each of the three colours (red, green and blue) by up to ±40%; it also has controls for adjusting the brightness, contrast and colour saturation.

After it has been processed in the video colour controller, the RGB signal must be revamped for transmission. That is simple if an RGB output is wanted: only a composite signal then needs to be added to it. If an S-VHS or CVBS is required, a modulator is needed: in Fig. 1, this is called PAL/NTSC encoder. That name already indicates that both PAL and NTSC signals can be provided. The standard of the output signals is determined with a switch. If that is set to NTSC, a second switch allows setting either of two frequencies for the chroma sub-carrier.

The audio section is arranged in a similar manner, but contains far fewer components. Audio signals are also input via switches, which are operated together with those for the video signals. In that way, the audio signal at the master potentiometer is always associated with the present video signal.

There are also two inputs for independent audio signals that can be mixed with the original sound. If the master potentiometer is turned off, the audio signals at these inputs can be used as a new sound for the present picture.

One of the two inputs is for line signals, the other for microphone signals. Microphone signals are first amplified to the same level as other audio signals.

After the audio signals have been mixed with the aid of the three slide potentiometers, they are applied to the control amplifier. A fader allows the volume of the mixed audio signals to be altered gradually.

The control amplifier also has controls for high and low tones and balance, as well a a mono/stereo selector.

Audio signals can be listened to with headphones. These signals may be taken either from the input or from the output of the control amplifier: selection is by means of a switch. This enables the audio input to be monitored with the fader 'off'. ■

Next month's instalment will describe the circuit of the video section.

AUDIO-VIDEO PROCESSOR TYPE AVP300 – PART 2

An ELV design

Input circuits and chroma-VBS separation filter

THE circuit in Fig. 3 serves to select one of the inputs and to separate the chroma and VBS signals. Note that, in spite of the English-language front panel, some rear panels have the annotation 'FBAS' instead of CVBS. FBAS is the acronym of the German Farbbild Austast Synchronsignal = chroma, video, blanking, synchronization signal.

The input signals may be divided into two groups: CVBS and S-VHS signals. In case of the former, the chroma and the VBS signals must be separated; with S-VHS signals that has already been done.

The CVBS signals are applied from the input selector circuit to two filters via S_{201}. Both these filters, L_{203}–C_{227} and L_{202}–C_{212}, are tuned to the colour subcarrier. Filter L_{203}–C_{227} is a band-stop filter that passes only the VBS signal to the output. The other filter passes only the subcarrier, and thus the colour signal, to the chroma output.

Filter L_{203}–C_{227} operates in conjunction with four transistors, T_{209}–T_{212}, that share a common emitter resistance, R_{260}. The d.c. operating points of the transistors ensure that at any one time only one of them is switched on: the others are off. Which one is switched on depends on the selected input and the colour standard identified by the

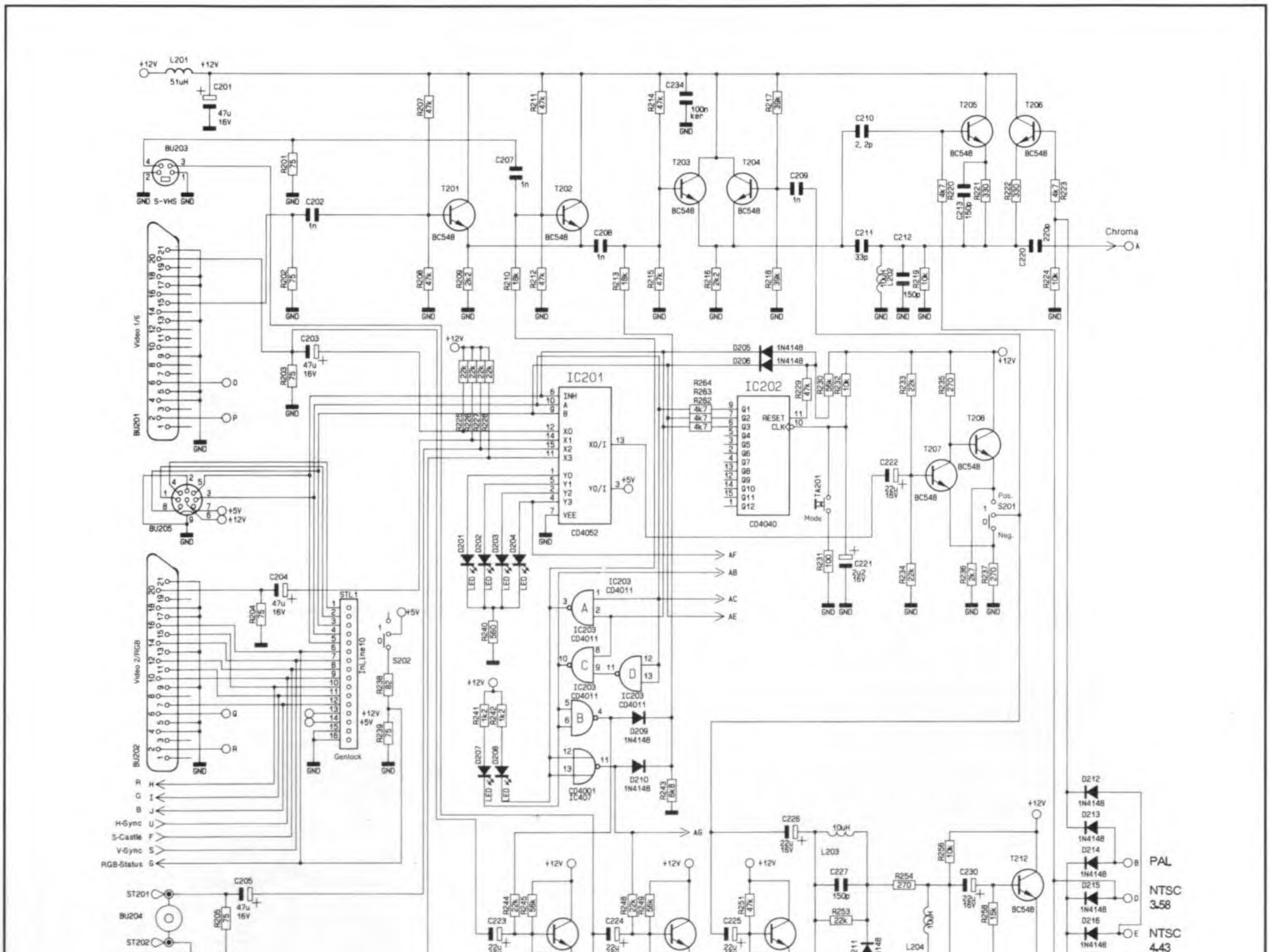


Fig. 3. Circuit diagram of the input stages and the chroma-VBS separation filter.

multi-standard decoder elsewhere in the processor.

Assuming that an input with a CVBS signal has been selected, a potential of about 2.5 V will be put on to the switching lines of the multi-standard decoder. Only T_{211} is then switched on, resulting in the complete CVBS signal being applied to terminal K. This has the additional advantage that in case of a black-and-white signal (when the decoder cannot identify a colour standard) no filters are switched into circuit, which is beneficial to the picture quality.

If a colour standard has been identified, the potential on one of the switching lines, B–E, becomes 5.5–6 V. That voltage is used, via D_{214}–D_{217}, to set the d.c. operating point of T_{212}. The drop across R_{260} then rises to a value that causes T_{211} to switch off. The CVBS signal is then forced to pass through band-stop filter L_{203}–C_{227} before it becomes available, via K, at T_{212}.

If the multi-standard decoder has also recognized that the signal is an NTSC signal with a 3.58 MHz subcarrier, diode D_{211} is switched on. This causes C_{228} to be connected in parallel with the band-stop filter so that the resonance frequency is shifted appropriately. Although the band-stop frequency for all other signals is 4.434 MHz, it should be noted that the SECAM subcarrier of 4.286 MHz is also suppressed adequately.

If no CVBS signal has been selected, the control logic ensures that T_{209} and T_{210} are switched on. The VBS signal of one of the S-VHS inputs is then passed directly to terminal K. At the same time, the drop across R_{260} ensures that both T_{211} and T_{212} are switched off.

The circuit associated with the chroma filter operates in a manner similar to that of the VBS band-stop filter. Here, the common emitter resistance of transistors T_{203}–T_{206} is R_{216}. The resonant frequency and Q of the filter are chosen for the SECAM signal (4.286 MHz). To enable the filter to handle the greater bandwidth of PAL and NTSC 4.434 MHz signals, it is shunted by R_{222} via T_{206} and decoupling capacitor C_{234}. The Q of the network will then drop, while the bandwidth increases. The small difference with the required bandwidth is negligible, so that the filter does not need retuning. To enable the filter to handle NTSC 3.58 MHz signals, it is shunted by capacitor C_{213} via T_{205}, while at the same time the bandwidth is increased because the Q factor is lowered by R_{221}.

The chroma filter selects between CVBS and S-VHS signals with the aid of T_{203}. In contrast to the VBS band-stop filter, the chroma filter is always in circuit. This does not affect the quality of the output signal.

When T_{203} is switched on (by its base voltage), one of the two S-VHS signals is passed to the chroma output, depending on the base potential of T_{202}. When that transistor is on, T_{201} is off and the VBS signal at input Video 5 is passed. When T_{201} is on and T_{202} is off, the signal at Video 1/6 is selected.

The switching of input signals is effected by IC_{201}–IC_{203}. Video signals (audio signals will be reverted to later) are present at one of the four input connectors. The standard value of their signal strength is 1 V_{pp}. All inputs are terminated into a 75 Ω resistor, R_{203}–R_{206}. The signals are passed to analogue multiplexer IC_{201} (2×4 positions) via coupling capacitors C_{203}–C_{206}. The multiplexer selects one of the signals, which is indicated by the associated LEDs.

The control signals for the multiplexer are provided by counter IC_{202}, which is operated by switch TA_{301}.

The selected signal is applied to buffer/inverter T_{207}–T_{208}. The processor may be set for positively or negatively modulated signals by switch S_{201}. From that switch, the signal is split into two: one part to the chroma filter and the other to the VBS band-stop filter.

Since SCART connector BU_{201} also serves as an S-VHS input, the signal at pin 20 is passed not only to the multiplexer, but also directly to the VBS band-stop filter.

S-VHS signals are not switched by the multiplexer, but by transistor stages in the filter sections: T_{201}–T_{202} and T_{209}–T_{210}. The necessary switching signals are derived from the state of counter IC_{202} by IC_{203}.

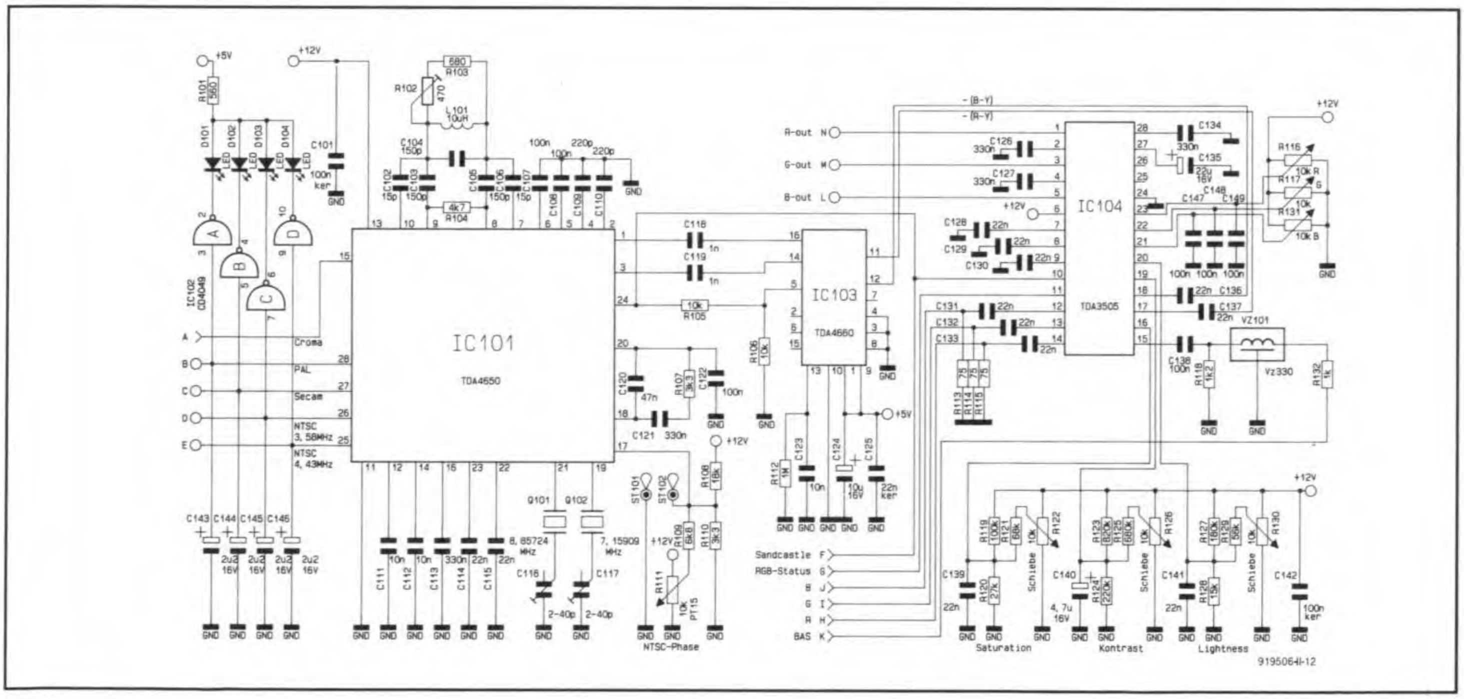


Fig. 4. Circuit diagram of the multi-standard decoder and the video colour controller.

Multi-standard decoder and video colour controller

The circuit of the multi-standard decoder and video colour controller, shown in Fig. 4, carries out the decoding and processing of all video signals.

The actual decoding is effected by IC_{101}. The standard of the incoming signal is determined by IC_{101} on the basis of the chroma signal at pin 15. The chroma filter is set up (wide band) to enable any chroma signal to be passed correctly. The standard is translated into appropriate voltage levels at input/output pins 25–28. Four levels are recognized: 0.5 V—standard out; 2.5 V—search mode; 6 V—standard on; 9 V—forced acceptance of a standard.

Although the multi-standard decoder is a fairly complex circuit, it has only three calibration points, which, by the way, have nothing to do with the internal of the IC, but are merely intended for adjusting some external components. These are (1) the SECAM reference circuit, L_{101}–C_{104}, (2) Q_{101} and (3) Q_{102}.

Because NTSC signals lack a colour burst, there is no reference for the chroma signals. R_{111} is provided to make sure that the reference of the decoder is, nevertheless, the same as that of the transmitter. Maladjustment of this potentiometer results in unnatural colouring of the picture.

The output of IC_{101} consists of two colour difference-signals that are applied to delay line IC_{103}. The output of this line is also two colour-difference signals but with corrected transit times. These signals are then ready for the final stage in the decoding and for being processed into a picture signal. Those tasks are performed by IC_{104}, the video colour controller.

In addition to the colour-difference signals, the inputs to IC_{104} consist of the VBS signal that is provided via delay line VZ_{101}, or the RGB signals that are input via Video 2 and terminals H–J.

Circuit IC_{104} synthesizes the colour-difference and VBS signals to an RGB signal. This synthesis may be affected by the setting of R_{111} (colour saturation control). Apart from its white-point adjustment, the RGB signal can be modified in respect of brightness and contrast. The final RGB signal is applied to the PAL/NTSC encoder via pins 1, 3 and 5.

PAL/NTSC encoder

The diagram of the circuit that reconverts the RGB signal into a CVBS signal, PAL or NTSC standard, is shown in Fig. 5. Apart from the RGB signal, the Type TPE1378A encoder, IC_{301}, requires a number of other signals. The first of these is the synchronization signal at pin 15, which is provided by the synchronization circuit to be discussed in Part 3 of this article.

Generation of the colour subcarrier requires a generator: since NTSC 4.43 MHz as well as NTSC 3.56 MHz signals can be handled, two generators are needed. When either of these is energized, the relevant bandpass filter, BPF_{301} or BPF_{302}, is also actuated. To compensate for the delay of the chroma signal in the filter, the VBS signal is also delayed: in VZ_{301}.

The RGB input signal is also available as a buffered output of IC_{301}. The RGB lines are connected to the relevant pins of connector BU_{302} (Video 4 output) via coupling capacitors and terminating resistors. A voltage can be applied to this connector by S_{301} to force the equipment connected to the processor to use the RGB signals instead of the CVBS signal on pin 19 as input.

The CVBS signal is available at pin 5 of IC_{301}. It is applied to S_{304} via a coupling capacitor and a terminating resistor, and to electronic switch IC_{302}. That switch ensures that, if Video 4 is used as input and as output, for instance, during format conversion, the CVBS signal is replaced by a composite sync (BS or **B**lanking/**S**ynchronization) signal. This arrangement prevents the arising of noise and interference between the colour subcarriers of the input and output signals in the connecting cable. This means, of course, that in the final analysis only the RGB signal can be used as an output signal.

The remaining signals provided by IC_{301} are the VBS and chroma signals for the S-VHS outputs. These signals are applied to the relevant connectors, BU_{301} and BU_{303}, via a buffer stage. To ensure that the terminating impedance of the VBS or chroma signal is correct, connectors BU_{301} and BU_{303} must not be used simultaneously, unless S_{304} is in position CVBS and no S-VHS equipment is connected to BU_{301}. ■

The instalment in the July issue will describe the audio, power supply and synchronization circuits, while that in the September issue will deal with the construction and setting up.

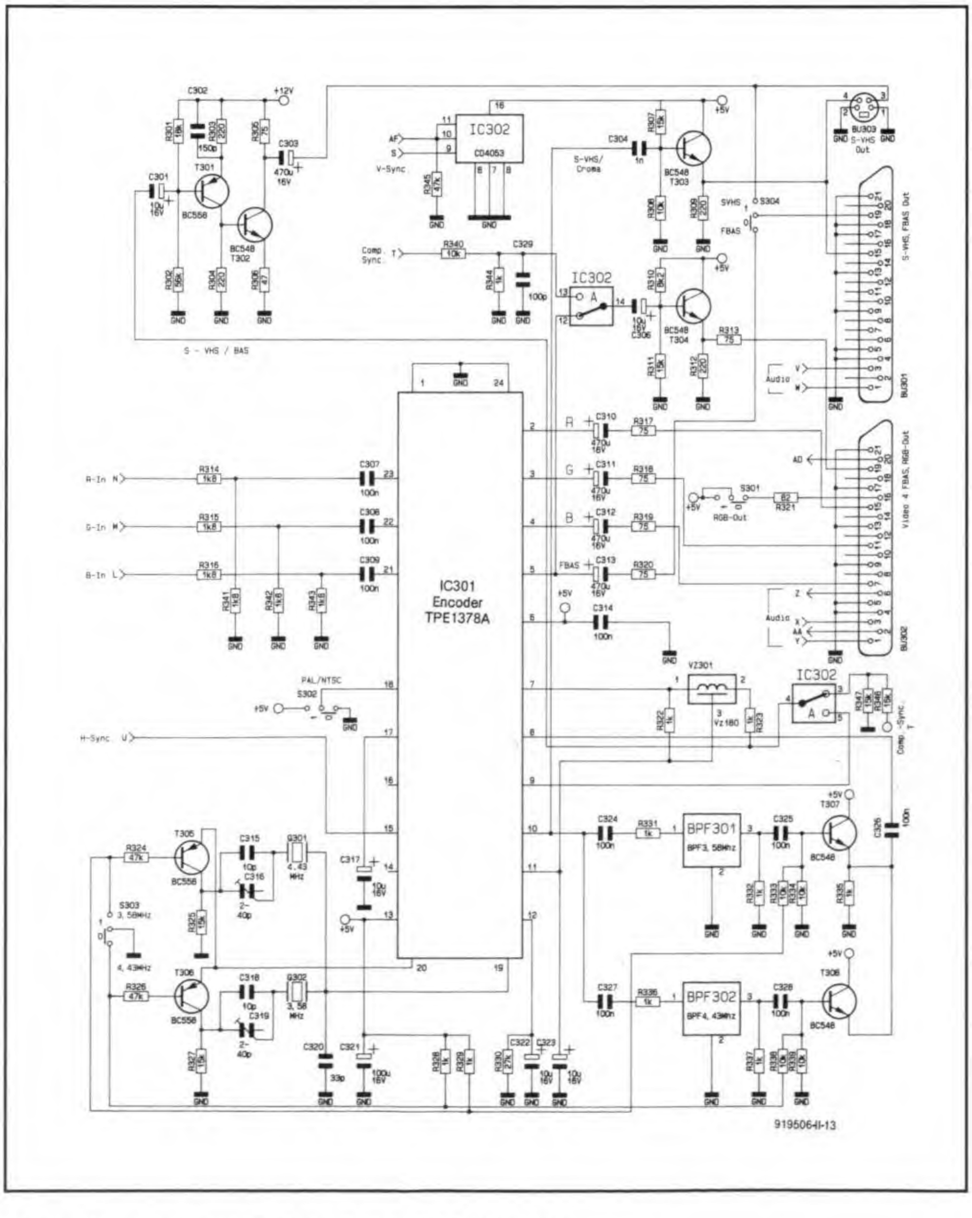


Fig. 5. Circuit diagram of the PAL/NTSC encoder

AUDIO-VIDEO PROCESSOR TYPE AVP300 – PART 3

An ELV design

Synchronization circuit

THE signals in a number of circuits of the processor must be matched to the input signal to prevent a wandering or distorted picture. The circuit responsible for this is the sync(hronization) circuit, whose diagram is shown in Fig. 6.

The sync circuit is based on sync separator IC_{601}. This circuit is fed with the VBS signal via T_{601} and provides three output signals: a sandcastle pulse at pin 7; a square wave at pin 3, whose first transition (leading edge) determines the onset of the horizontal sync pulse; and the vertical sync pulse at pin 10.

The signals at pin 3 and pin 7 are not yet suitable for further use. The sandcastle pulse contains as yet no information on the vertical blanking that is essential for colour demodulator IC_{101} (Fig. 4). Also, a signal that merely determines the onset of the horizontal sync pulse is not enough for further processing of the video signal. To make it into a true sync signal, a fly-back pulse is required. In fact, three pulses are needed: a horizontal and a vertical blanking pulse (12 μs and 1.9 ms respectively) and a horizontal sync pulse of 4.7 μs. These pulses are generated by monostables IC_{602}, IC_{603a} and IC_{603b} respectively.

The horizontal blanking pulse generated by IC_{603a} (pin 6) is superimposed on to the sandcastle pulse via R_{623}. The modified sandcastle pulse has exactly the right shape to ensure correct functioning of IC_{101}.

The reason for IC_{602} being fed directly by the sync separator, whereas both IC_{603a} and IC_{603b} are fed via potential dividers, is that IC_{602} operates from the 12 V supply line and the other two from the 5 V line.

Gate IC_{604b} combines the horizontal and vertical blanking pulses into a composite sync signal. Note that the vertical blanking pulse is applied to the gate via XOR gate IC_{604a}, because this signal is difficult to load owing to the impedance R_{617}-R_{618}.

Audio frequency circuits

To enable background music or a commentary to be added to the audio signal, the processor is equipped with a mixer and tone control.

The input of the audio circuits shown in Fig. 7 enables up to three signals to be mixed: the audio signal associated with the selected video source (master), a randomly selected audio signal (line) and a signal from a stereo microphone.

Selection of the master signal is facilitated by an input selector switch, consisting of analogue multiplexer IC_{404}, and two electronic switches, IC_{405b} and IC_{405c}. The multiplexer selects four of the five possible audio signals, while the electronic switches take care of the fifth. Three audio signals are available from the SCART connectors in Fig. 3 and connector BU_{301} in Fig. 5. The other two arrive from the S-VHS connector and the BNC socket.

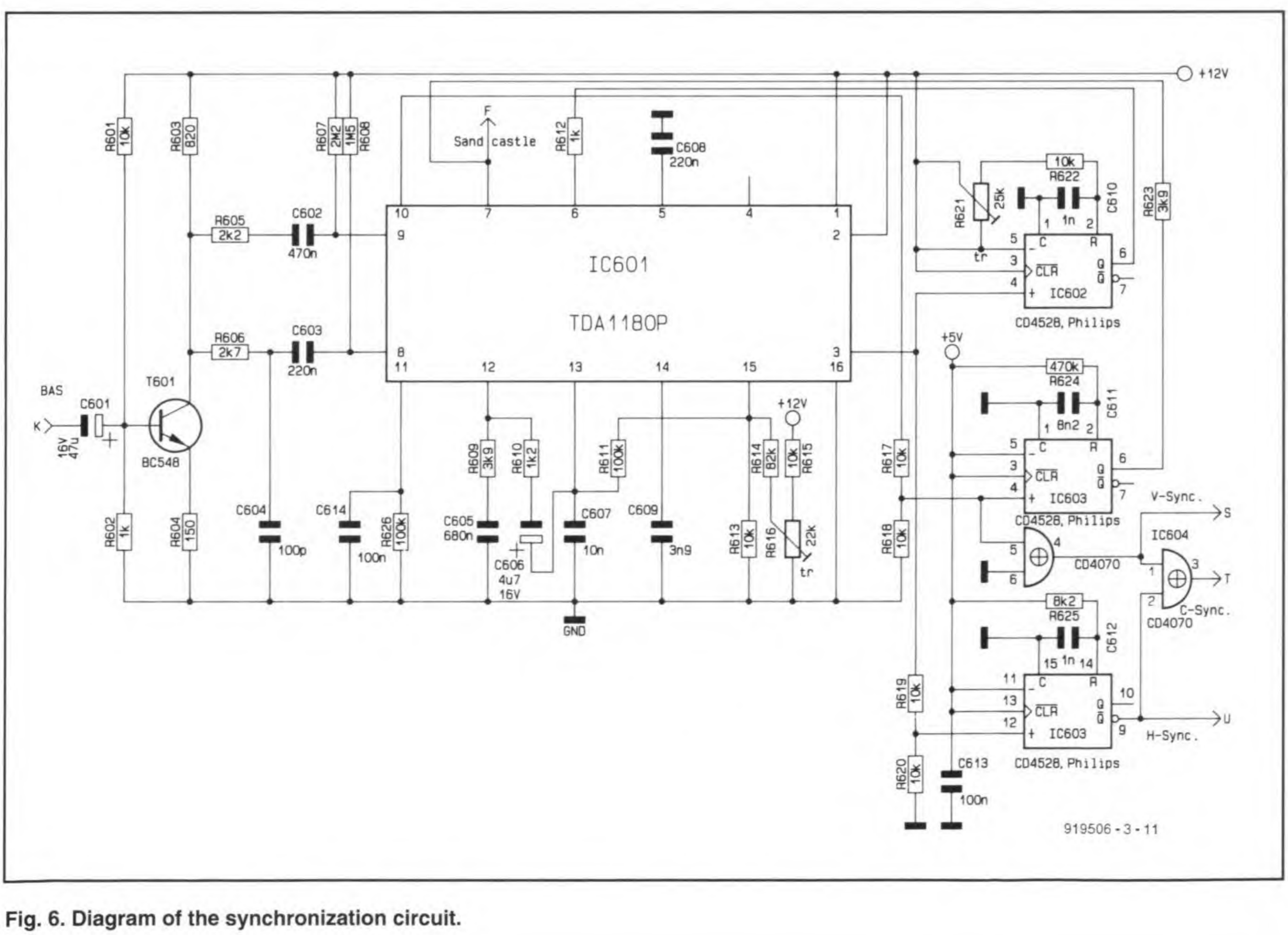


Fig. 6. Diagram of the synchronization circuit.

The line signal at sockets BU_{406} and BU_{407} is connected directly to the line control potentiometers on the mixer.

The level of the microphone signal is well below that of the line and master signals and is, therefore, amplified in IC_{401} (left-hand) and IC_{402} (right-hand).

The mixer consists of three linear stereo slide potentiometers, whose wipers are connected to the relevant left-hand or right-hand line via a summing resistor. The use of linear potentiometers may not seem right, but their wipers are loaded by the summing resistors in a manner that results in traditional logarithmic volume control.

Since not many video signals carry stereo sound, the audio circuit can be switched to mono by closing electronic switch IC_{405a},

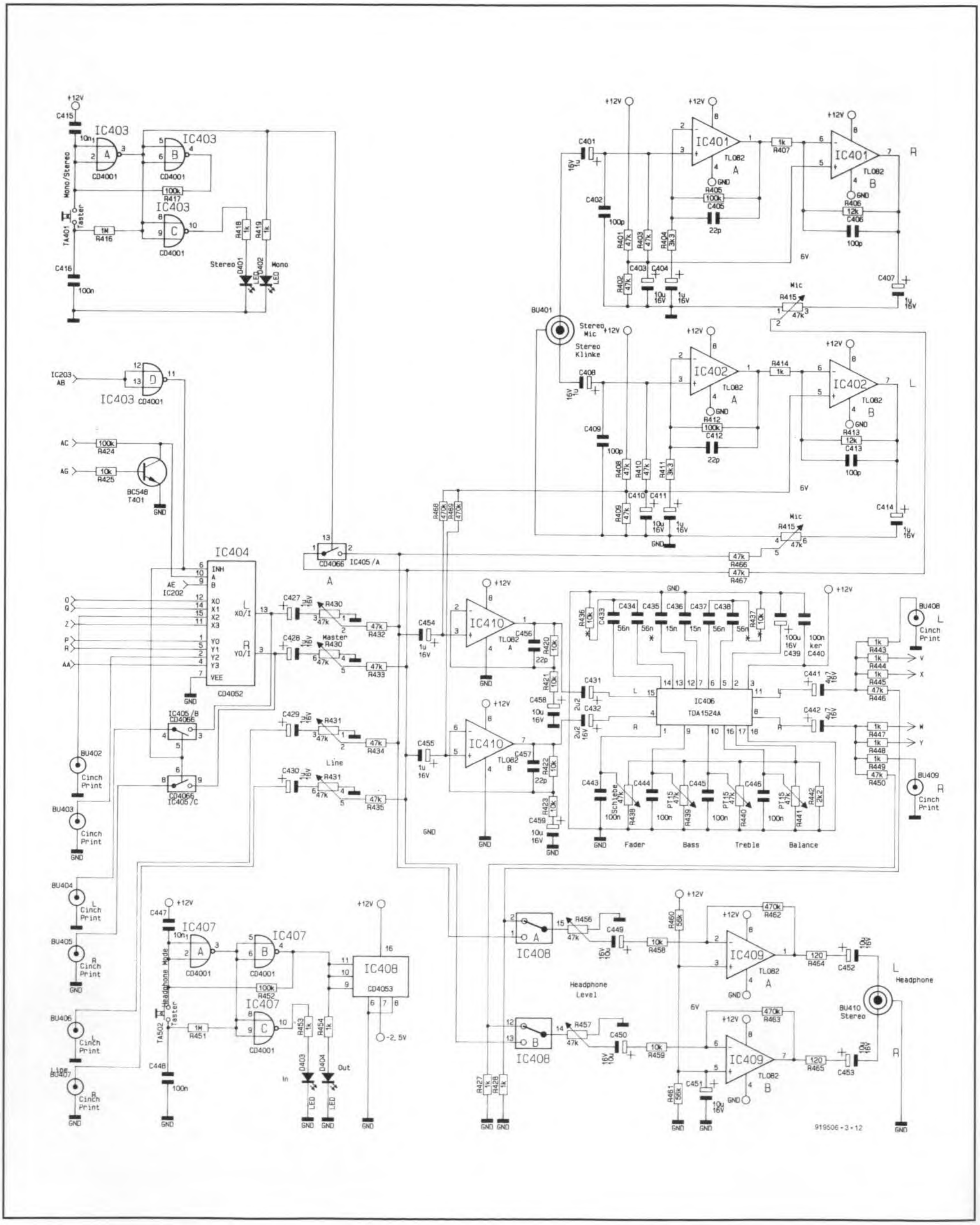


Fig. 7. Diagram of the audio circuits.

which is controlled with switch TA_{401} and a bistable, IC_{403}. The left-hand and right-hand signals from the mixer are then interconnected; their sum is seen by the remainder of the circuit as a mono signal.

The signal is then applied to two non-inverting opamps, IC_{410a} and IC_{410b} and from these to control amplifier IC_{406}. The control amplifier enables the volume, bass and treble , and the balance to be adjusted. The control range of the bass frequencies can be enlarged by using R_{436}, R_{437}, C_{434} and C_{438} (marked with an asterisk). Without these components, the bass range is the traditional ±20 dB. The output of IC_{406} is available at output sockets BU_{408} and BU_{409}.

The headphone amplifier enables the signal before and after the control amplifier to be listened to, depending on the position of electronic switches IC_{408a} and IC_{408b}. These switches are controlled by push button TA_{502} and the circuit based on IC_{407}. The signals from the two sections of IC_{408} are applied to potentiometers R_{456} and R_{457}, with which the volume and balance of the signal to the headphones can be adjusted. The signal to the headphone is amplified in dual opamp IC_{409}.

Power supply

The circuit of the mains-operated power supply is shown in Fig. 8. The rectifier may look unfamiliar, but it is a straightforward bridge, whose negative connection is not directly to earth, but via three diodes. The drop across these diodes is used as an auxiliary negative supply (–2.5 V) for electronic switches IC_{405} and IC_{408}.

Transistor T_{501} serves as the on/off control; it is operated by push button TA_{501} and the circuit based on IC_{503}. That IC is fed by the potential across C_{501} to ensure that it can always be powered. That voltage is too high, however, and it is, therefore, lowered by zener diode ZD_{501}. The output of IC_{503c} is additionally protected against too high voltages by zener diode ZD_{502}.

The circuit following switching transistor T_{501} is traditional: two three-terminal regulators ensure stable output voltages of 5 V and 12 V. The capacitors following the regulators are decoupling devices used at miscellaneous positions in the circuits.

The next and final instalment, dealing with the construction and calibration, will appear in our September issue (there is no August issue).

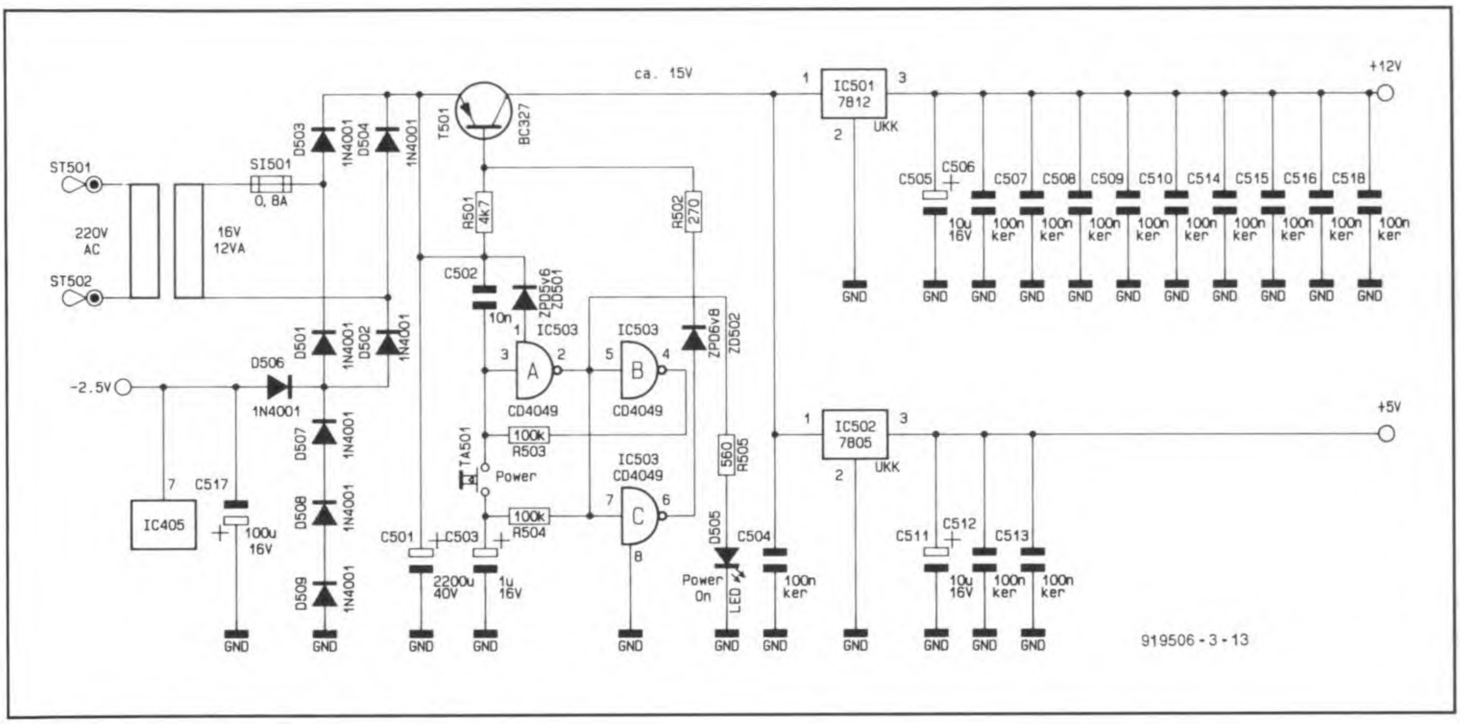
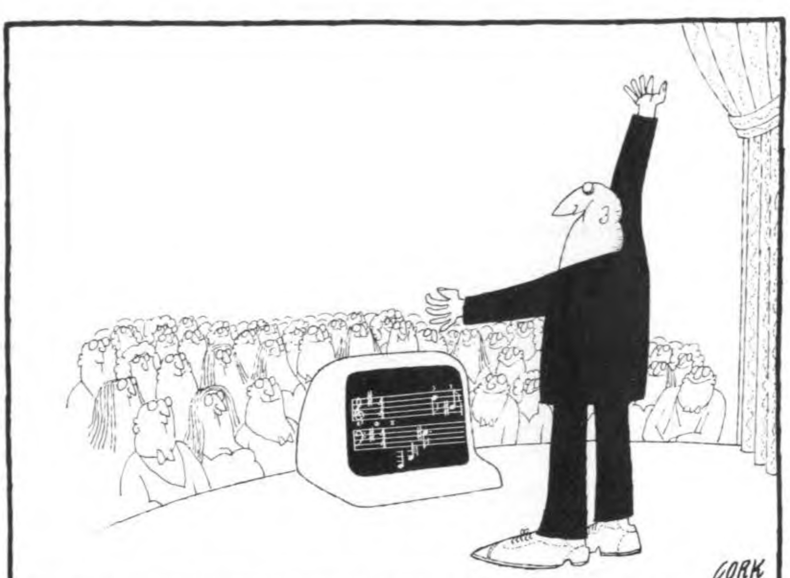


Fig. 8. Circuit diagram of the power supply.



AUDIO-VIDEO PROCESSOR TYPE AVP300 – PART 4

919506-IV

An ELV design

THE audio-video processor is constructed on four printed circuit boards: potmeter board, measuring 314.5×159.5 mm (Fig. 9), mother board, measuring 330×198 mm (Fig. 10), intermediate board, 232×198 mm and the switches board, 145×35 mm (both in Fig. 11).

There are no special comments regarding the components, but the following points should be borne in mind.

- All ceramic capacitors, the four SCART connectors, the ten shift potmeters and the four push-button switches must be mounted as close to the board as possible.
- The 15 LEDs must be mounted so that their tops protrude 23 mm through the board.
- Soldering pins ST_{303} and ST_{304} and headers STL A' and STL B' must be soldered at the track side of the intermediate board. If the pins of the headers just do not protrude through the board, there is just enough room to solder them.
- The mains transformer must be fastened with four M4×6 nuts and bolts before its connections are soldered.
- Voltage regulators IC_{501} and IC_{502} must be fitted to a common heat sink, which is then fitted lying down on to the board. Here again, bolt the heat sink down before soldering any connections.
- Resistor R_{626} is normally a wire link. In some cases, however, it may be required to keep the regulating speed of the phase-locked loop (PLL) to which R_{626} belongs down. This is so if, for instance, the processor is used purely as a multi-standard decoder. In that case, R_{626} should be 820 kΩ. If the processor is used in conjunction with a video recorder, it is advisable, however, to use the higher speed of the PLL.
- The terminal wires of all components should be cut as short as feasible.
- In a number of locations, the MKT capacitors are very close together; take care that the non-insulated ends of these components do not touch each other.

The mother board of the audio-video processor built in the Elektor Electronics laboratory was found to have no earth connections for a number of components since it had been forgotten to drill the relevant holes. This deficiency is easily overcome by scratching away the solder mask in these locations and solder the relevant component terminal directly to the earth plane at the component side of the board.

When all components have been mounted and soldered, check carefully that there are no bits of solder across tracks.

The size of a metric bolt or screw is defined by the letter M followed by a number corresponding to the overall diameter of the thread in mm, the × sign and the length of the bolt or screw, also in mm. For instance, an M4×6 bolt has a thread diameter of 4 mm and a length of 6 mm. The overall diameter of the thread in the BA sizes is: 0 BA = 6.12 mm; 2 BA = 4.78 mm; 4 BA = 3.68 mm; 6 BA = 2.85 mm; 8 BA = 2.25 mm.

Wiring

Wiring is in many instances perhaps the wrong word: often two boards are soldered together without any wires. For instance, the switches board is pushed upright over the SCART connectors into the recesses in the mother board. Corresponding tracks of the two boards are then simply soldered together. It is advisable to start by connecting the outer two tracks first in such a way that the switches board sticks out about 1.5 mm over the mother board.

A cable containing three individually screened wires should be used to connect terminals W, B and G on the mother and switches boards. The three screens should be soldered to sol-

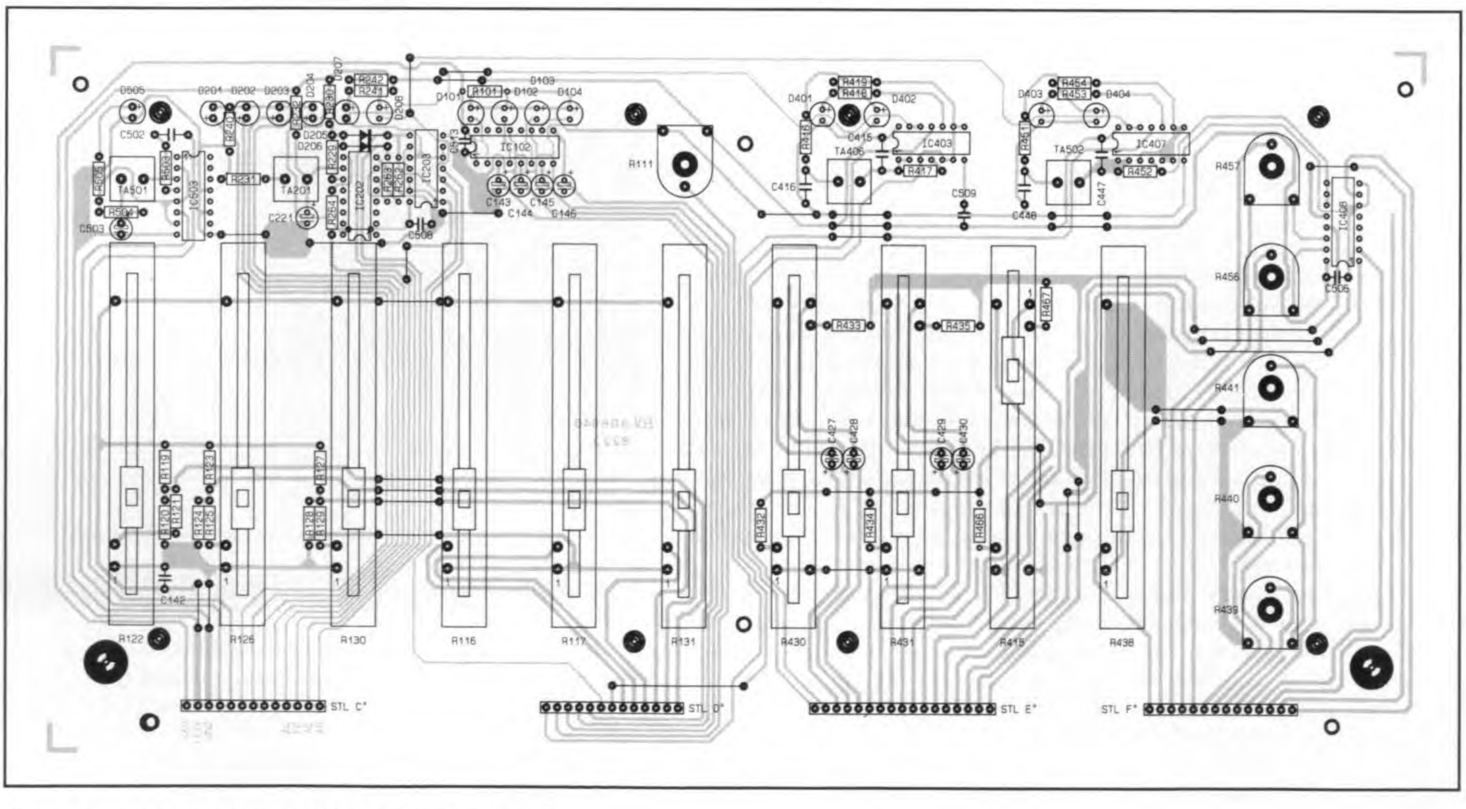


Fig. 9. Component layout of the potmeter board.

der pin A. On the switches board, connect the wires directly to the relevant terminals of switch S_{201}.

The boards are interconnected by lengths of flatcable between terminals points A–F as shown below.

A 5 cm long, 13-way; 2 connectors.
B 5 cm long, 16-way; 2 connectors.
C, D 10 cm long, 13-way; 1 connector.
E 10 cm long, 17-way; 1 connector.
F 10 cm long, 14-way; 1 connector.

The six lengths can be made from a 25 cm long, 32-way piece of flatcable: they are easily separated with a pair of scissors. Four of the 'cables' are terminated into a connector at only one end; their free ends should be soldered to the track side of the potmeter board. The connectors are press-on types that can be fitted to the 'cables' by clamping them on to the cable in a vise.

The connections ST_{203}–ST_{303} and ST_{204}–ST_{304} can be made with lengths of circuit wire about 35 mm long. This is best done when the boards are already interconnected by flatcable and the intermediate board is 'hinged' upwards as shown in Fig. 12.

Initial tests

Figure 12 shows the preferred positioning of the boards for the first test and adjustments. Flatcables E and F cannot yet be connected. Make sure that that the 'hinged upwards' intermediate board cannot touch the switches board.

When the power is switched on, the relevant LED should light. With a voltmeter, check the output voltage of the voltage regulator: negative to heat sink and positive to the pin furthest away from the transformer. If the measured voltage differs more than 5% from the specified one, there is a fault somewhere, which must be rectified before further work can be done.

Next, replace the mains fuse by an ammeter set to the 1 A a.c. range. With power on, the meter should read 600–800 mA. If the current is appreciably higher, check the correct operation of T_{501}.

Correct reaction of the LEDs to the electronic switches indicates that the control signals to these switches are all right. The LEDs that indicate the video standard behave like a running light: as long as no standard is recognized, the decoder continues scanning.

Adjustment

Although no special test equipment is required if operation on only one television standard is required (the test card received on a TV receiver or video recorder is then sufficient), a test pattern generator is required for multi-standard operation. This generator should provide PAL, SECAM and NTSC 3.58 MHz signals. NTSC 4.43 MHz requires no adjustment, since that is included in the PAL calibration.

Connect a TV receiver with video input, or, preferably, RGB inputs, to one of the outputs of the audio-video processor and apply the test signal to one of the inputs, but not to an S-VHS one.

Set all potmeters in the video section on the potmeter board to the centre of their travel.

Set the switch at the extreme left of the switches board (RGB out) in accordance with the input of the used TV receiver (left = RGB; right = CVBS). Set the other switches, starting with the one adjacent to the RGB out switch as follows: right, left, right, right, left.

If all is well, the receiver should show some sort of test pattern. Adjust R_{616} (line synchronization) until the picture is stable and then set it to the centre of the range over which stability is obtained. The edges of the picture are determined by the flyback pulse. Adjust the width of this pulse with R_{621} until the picture is centred on the screen. If you have an oscilloscope, this pulse may be measured at pin 6 of IC_{602}: ideally, it should be 12 µs. At the same time, check the shape of the sandcastle pulse at pin 7 of IC_{601}.

If all is well, the screen should now show a good black-and-white picture; if not, there is a fault that must be rectified before further work can be done.

The chroma filter is best calibrated with a SECAM signal (4.286 MHz), because its Q factor is then optimum. Connect pin 27 of IC_{101} to the +12 V line (which sets the decoder to SECAM) and apply a SECAM signal to one of the inputs. Adjust L_{202} for optimum colour reproduction (if a monitor with a composite video input is used, adjust L_{202} for optimum quality). If an oscilloscope is available, adjust L_{202} for minimum amplitude of the signal at pin 15 of IC_{101}. If only a PAL signal is available, connect pin 28 of IC_{101} to the +12 V line and carry out the procedure as described.

Continuing with the SECAM signal, adjust L_{101} until the red and blue in the picture have the same brightness. Then adjust the receiver for a black-and-white picture and set the grey of the picture as desired with R_{102}.

If an oscilloscope is available, adjust L_{101} until the level of the black signal at pin 3 of IC_{101} is the same as that of the sync signal. Lastly, adjust R_{102} until the level of the black signal at pin 1 of IC_{101} is the same as that of the sync signal.

Remove the +12 V line from pin 27 of IC_{101} and connect it to pin 28 of this IC. Also, strap ST_{101} to ST_{102}. Connect an oscilloscope to pin 1 or pin 3 of IC_{101}, apply a PAL signal to one of the inputs (not S-VHS), and adjust C_{116} until the drifting of the colours is a minimum.

Then, replace the PAL signal by an NTSC 3.58 MHz (also called NTSC/M) signal, shift the +12 V line from pin 27 to pin 26 of IC_{101} and adjust C_{117} until the drifting of the colours is a minimum.

If an RGB receiver or monitor is used, the screen should now show a faultless colour picture. If a CVBS signal had to be used, this may not be so, because the encoder has not yet been calibrated.

Remove the link between ST_{101} and ST_{102} and the +12 V line from pin 26 of IC_{101}, and set the RGB out switch to CVBS. Apply a PAL signal to one of the inputs and set C_{316} to the centre of the range over which the picture is in colour. Then, set the 4.43/3.58 MHz switch to 3.58 MHz, apply an NTSC/M signal to one of the inputs and set C_{319} to the centre of the range over which the picture is in colour. Note that the band filters in the encoder have already been calibrated during manufacture.

Finally, adjust L_{203} and L_{204} (band-stop filters) for minimum cross-luminance interference. If an oscilloscope is available, connect it across R_{206} and adjust these inductors until the residue of the colour subcarrier on the luminance signal is a minimum.

COMPONENTS LIST

Potmeter board

Resistors:
R101, R240, R505 = 560 Ω
R11 = 10 kΩ preset
R116, R117, R122, R126, R130, R131 = 10 kΩ shift potmeter, mono, linear
R119 = 100 kΩ
R120 = 27 kΩ
R121 = 68 kΩ
R123 = 820 kΩ
R124 = 220 kΩ
R125 = 680 kΩ
R127 = 180 kΩ
R128 = 15 kΩ
R129, R230 = 56 kΩ
R229, R432–R435, R466, R467 = 47 kΩ
R231 = 100 Ω
R232 = 10 kΩ
R241, R242 = 1.2 kΩ
R262–R264, R418, R419, R453, R454 = 1 kΩ
R415, R430, R431 = 47 kΩ, shift pot meter, stereo,linear
R416, R451 = 1 MΩ
R417, R452 = 100 kΩ
R438 = 47 kΩ shift potmeter, mono, linear
R439–R441, R456, R457 = 47 kΩ preset
R503, R504 = 100 kΩ

Capacitors:
C142, C506, C508, C509, C513 = 100 nF, ceramic
C143–C146, C221 = 2.2 µF, 16 V
C415, C447, C502 = 10 nF
C416, C448 = 100 nF
C427–C430, C503 = 1 µF, 16 V

Semiconductors:
D101–D104, D201–D204, D207, D208, D401–D404, D505 = LED, 5 mm, red
D205, D206 = 1N4148
IC102, IC503 = 4049
IC202 = 4040
IC203 = 4011
IC403, IC407 = 4001
IC408 = 4053

Miscellaneous

TA201, TA401, TA402, TA501 = push-button switch

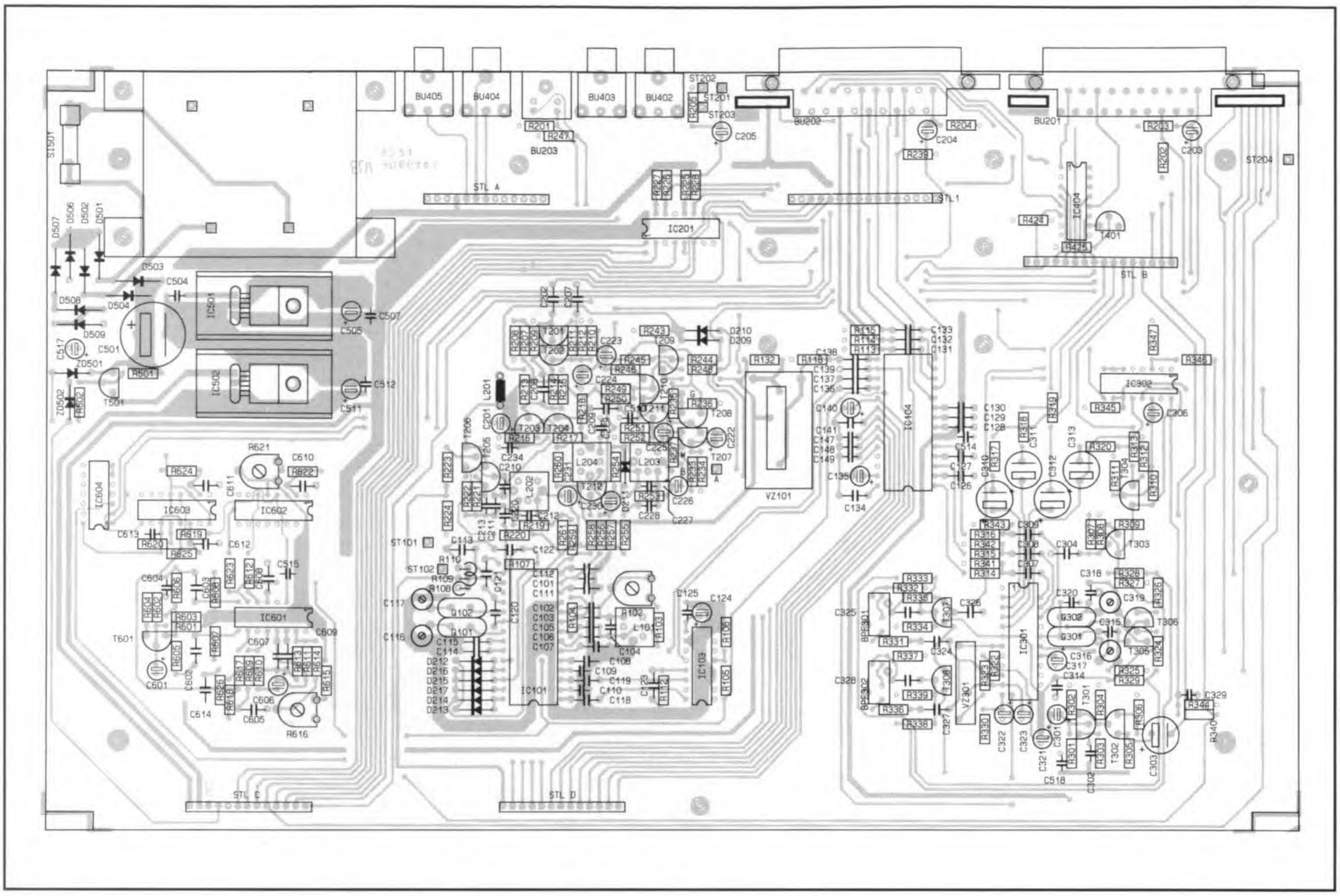


Fig. 10. Component layout of the mother board.

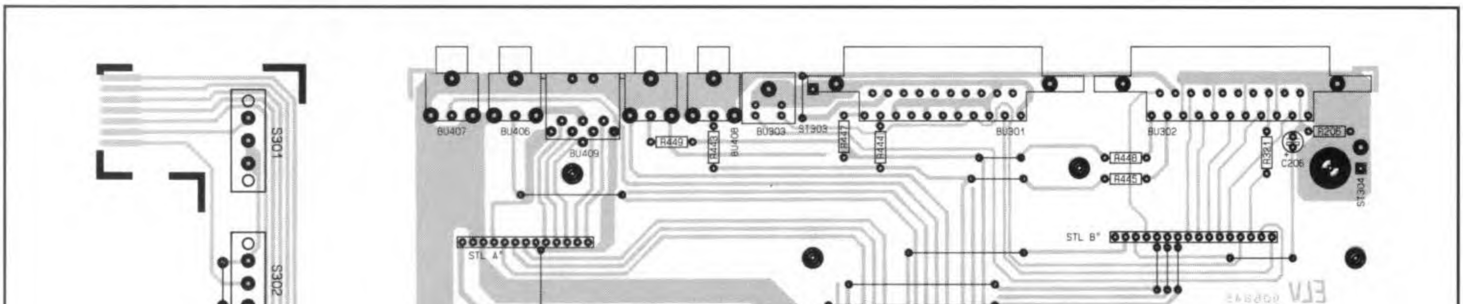


Fig. 11. Component layout of the switches board (left) and intermediate board.

Assembly

Commence with assembling the upper part of the enclosure, the front panel and the potmeter board. Make sure that no parts of the enclosure touch any components on the board. Fasten the board to the upper half of the case with six self-tapping screws. Next, fit two M4 bolts in the appropriate holes in the front of the enclosure; do not tighten these too much. Finally, fasten the front panel to the board with seven insulated screws and one

COMPONENTS LIST

Mother board

Resistors:
R103 = 680 Ω
R104, R220, R223, R259, R501 = 4.7 kΩ
R105, R106, R219, R224, R256, R261, R308, R333, R334, R338–R340, R425, R601, R613, R615, R617–R620, R622 = 10 kΩ
R107, R110 = 3.3 kΩ
R108, R210, R213, R301 = 18 kΩ
R109, R243 = 6.8 kΩ
R112 = 1 MΩ
R113–R115, R201–R205, R239, R247, R305, R313, R317–R320 = 75 Ω
R118, R255, R610 = 1.2 kΩ
R132, R257, R322, R323, R328, R329, R331, R332, R335–R337, R344, R612 = 1 kΩ
R207, R208, R211, R212, R214, R215, R251, R324, R326, R345 = 47 kΩ
R209, R216, R260, R605 = 270 Ω
R217, R218 = 39 kΩ
R221, R222 = 330 Ω
R225–R228, R233, R234, R244, R248, R253 = 22 kΩ
R235, R237, R254, R502 = 270 Ω
R236, R606 = 2.7 kΩ
R245, R246, R249, R250, R302 = 56 kΩ
R252, R330 = 27 kΩ
R258, R307, R311, R325, R327, R346, R347 = 15 kΩ
R303, R304, R309, R312 = 220 Ω
R306 = 47 Ω
R310, R625 = 8.2 kΩ
R314–R316, R341–R343 = 1.8 kΩ
R424, R611 = 100 kΩ
R602 = 1.5 kΩ
R603 = 820 Ω
R604 = 150 Ω
R607 = 2.2 MΩ
R608 =1.5 MΩ
R609, R623 = 3.9 kΩ
R614 = 82 kΩ
R624 = 470 kΩ
R626 = 820 kΩ
R102 = 470 Ω preset
R616, R621 = 25 kΩ preset

Capacitors:
C101, C147–C149, C234, C314, C504, C507, C510, C512, C514, C515, C518, C613 = 100 nF, ceramic
C102, C106 = 15 pF
C103–C105, C212, C213, C227, C302 = 150 pF
C107, C108, C122, C138, C307–C309, C324–C328, C614 = 100 nF
C109, C110, C220 = 220 pF
C111, C112, C123, C607 =10 nF
C113, C121, C126, C127, C134 = 330 nF
C114, C115, C128–C133, C136, C137, C139, C141 = 22 nF
C116, C117, C316, C319 = 2–40 pF trimmer
C118, C119, C202, C207–C209, C304, C610, C612 = 1 nF
C120 = 47 nF
C124, C301, C306, C317, C322, C323, C505, C511 = 10 μF, 16 V
C125 = 22 nF, ceramic
C135, C222–C226, C230 = 22 μF, 16 V
C140, C606 =4.7 μF, 16 V
C201, C203–C205, C601 = 47 μF, 16 V
C210 = 2.2 pF
C211, C320 = 33 pF
C228 = 68 pF
C229 = 120 pF
C231 = 2.2 μF, 16 V
C303, C310–C313 = 470 μF, 16 V
C315, C318 = 10 pF
C321, C517 = 100 μF, 16 V
C329, C604 = 100 pF
C501 = 2200 μF, 40 V
C602 = 470 nF
C603, C608 = 220 nF
C605 = 680 nF
C609 = 3.9 nF
C611 = 8.2 nF

Semiconductors:
D209–D217 = 1N4148
D501–D504, D506–D509 = 1N4001
ZD501 = zener, 5.6 V, 400 mW
ZD502 = zener. 6.8 V, 400 mW
T501 = BC327
T201–T212, T302–T304, T307, T308, T401, T601 = BC548
T301, T305, T306 = BC558
IC101 = TDA4650
IC103 = TDA4660
IC104 = TDA3505
IC201, IC404 = 4052
IC301 = TPE1378A
IC302 = 4053
IC501 = 7812
IC502 = 7805
IC601 = TDA1180P
IC602, IC603 = 4528
IC604 = 4070

Miscellaneous:
L101, L202–L204 = 10 μH
L201 = 51 μH
Q101 = crystal 8.85724 MHz
Q102 = crystal 7.15909 MHz
Q301 = crystal 4.43 MHz
Q302 = crystal 3.58 MHz
BFP301 = 3.58 MHz band-pass filter
BFP302 = 4.43 MHz band-pass filter
VZ101 = 330 ns delay line
VZ301 = 180 ns delay line
BU201, BU202 = SCART socket for PCB mounting
BU203 = S-VHS socket
BU204 = BNC socket
BU402–BU405 = audio socket
SI501 = fuse holder and 800 mA fuse
STL A, STL C, STL D = 13-way header for PCB mounting
STL1, STL B = 16-way header for PCB mounting
Mains transformer 240 V to 15 V, 12 VA, with integral mains cable
Flatcable and connectors (see text)
Heat sinks (2) for IC501 and IC502

Intermediate board

Resistors:
R206 = 75 Ω
R321 = 82 Ω
R401–R403, R408–R410 = 47 kΩ
R404, R411 = 3.3 kΩ
R405, R412 = 100 kΩ
R406, R413 = 12 kΩ
R407, R414, R427, R428, R443–R445, R447–R449 = 10 kΩ
R420–R423. R436, R437, R458, R459 =10 kΩ
R442 = 2.2 kΩ
R446, R450 = 47 kΩ
R460, R461 = 56 kΩ
R462, R463, R468, R469 = 470 kΩ
R464, R465 = 120 Ω

Capacitors:
C206 = 47 μF, 16 V
C401, C404, C407, C408, C411, C414, C454, C455 = 1 μF, 16 V
C402, C406, C409, C413 = 100 pF
C403. C410, C449–C453, C458, C459 =10 μF, 16 V
C405, C412, C456, C457 = 22 pF
C431, C432 = 2.2 μF, 16 V
C433, C434, C437, C438 = 56 nF
C435, C436 = 15 nF
C439 = 100 μF, 16 V
C440, C516 = 100 nF, ceramic
C441, C442 = 4.7 μF, 16 V
C443–C446 = 100 nF

Semiconductors:
BU205 = 8-way DIN socket
BU301, BU302 = SCART socket for PCB mounting
BU303 = S-VHS socket
BU401, BU410 = 3.5 mm stereo jack socket
BU406–BU409 = audio socket
STL A' = 13-way header for PCB mounting
STL B' = 16-way header for PCB mounting
STL E' = 17-way header for PCB mounting
STL F' = 14-way header for PCB mounting

Switches board

Resistors:
R238 = 82 Ω

Miscellaneous:
S201, S202, S301–S304 = slide switch, 1 change-over contact

metal one (for earth connection). If the board bends even slightly, the M4 bolts are too tight.

Fit the intermediate board to the mother board with four bolts and spacers. Fit an M4×30 bolt and a 25 mm spacer to the centre front of the mother board; an M4×35 bolt and 30 mm spacer to the centre right of this board; and two M4×40 bolts and 35 mm spacers right at the back of the board. The remaining holes in the board can be ignored here: they are intended for a possible extension connected to STL_1. Fit the BNC socket to the back panel and connect this to ST_{201} and ST_{202} (earth) via two short lengths of circuit wire.

Invert the enclosure so that its top rests on the workbench and insert a centring rod into each of the four fixing holes at the corners of the underside. Fit the assembled mother board, intermediate board and rear panel to the bottom of the enclosure with M5 bolts, nuts, washers and 60 mm and 15 mm spacers (as appropriate)—see Fig. 13. As soon as the length of the flatcables allows, connect them to the relevant board.

Next, fit the front panel—after removing the ring nuts from the jack sockets. When the front panel is seated firmly, fasten the ring nuts back on to the sockets. Then, fit the knobs to the potentiometers.

Finally, fasten the bottom of the enclosure on to the four M5 bolts with suitable washers and nuts, and fit four anti-slip feet. ■

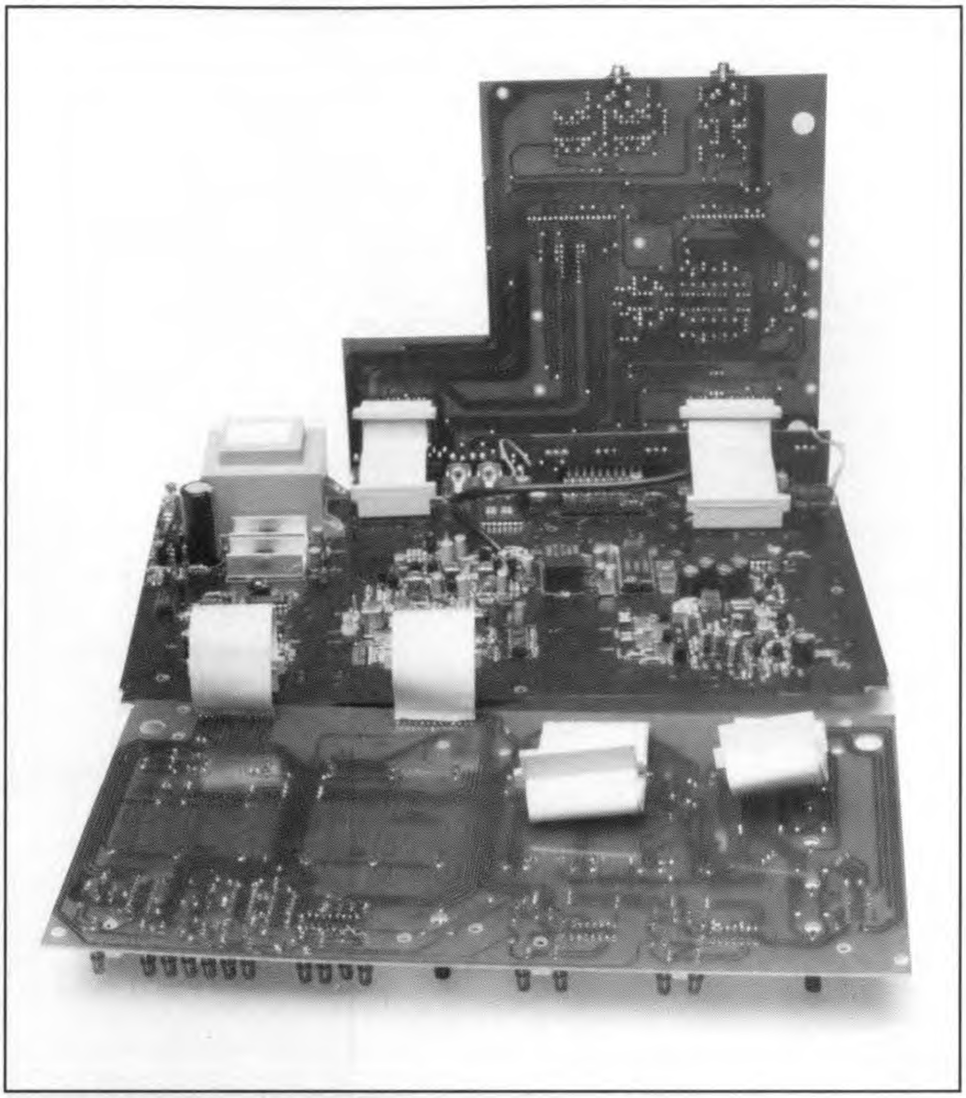


Fig. 12. With the prints hinged away from each other, all calibration points are easily accessible.

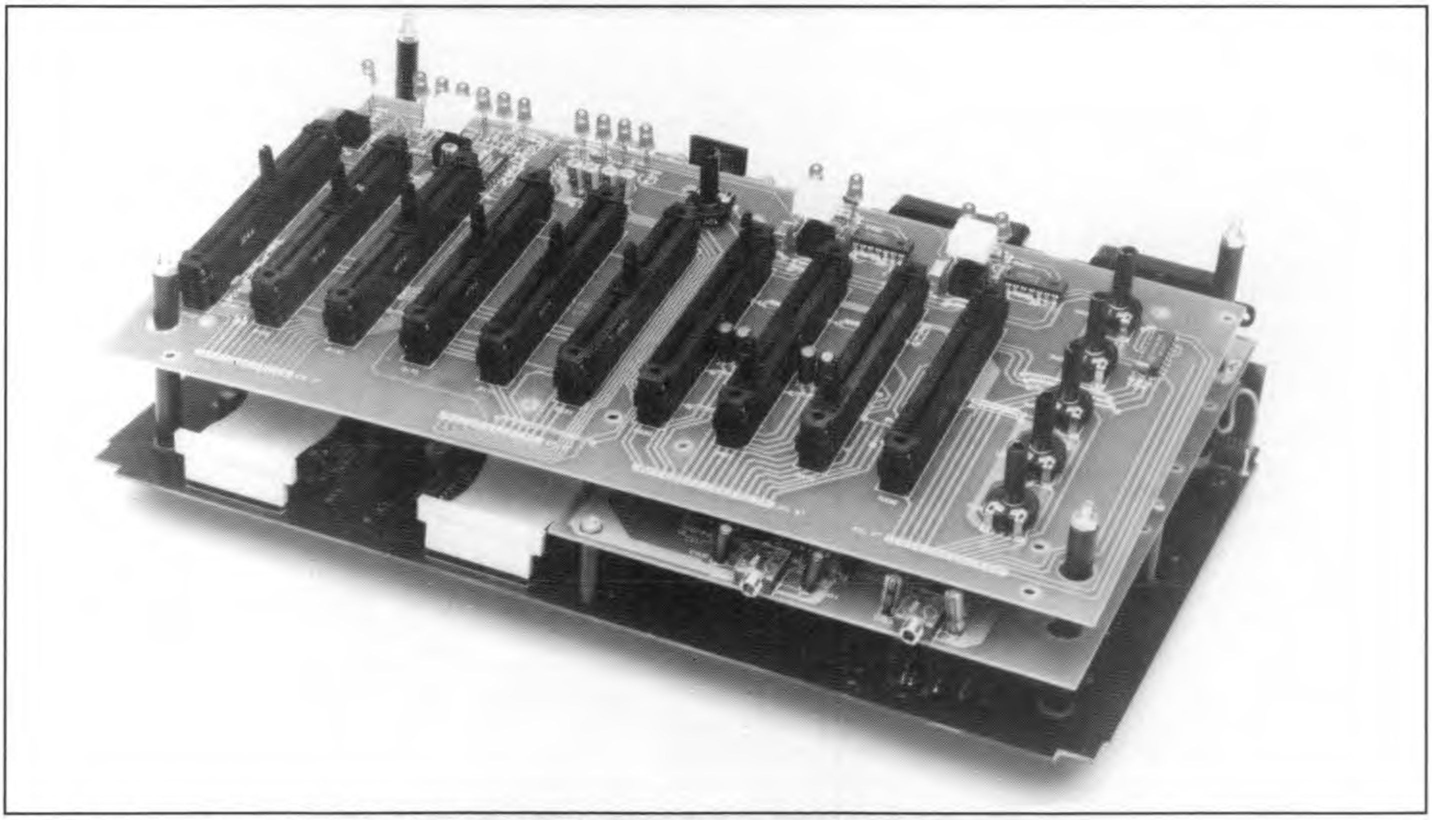


Fig. 13. The completed audio-video processor less front panel and most of the enclosure.