MAPLIN

PROJECT

AUDIO/ VIDEO MODULATOR

XZ10L
Issue 2

FEATURES

- Simple to build
- No alignment equipment required
- Colour or black and white
- SCART facility
- Pre-punched steel casing
- Test signal for receiver tuning

APPLICATIONS

- Camcorder replay
- Video editing
- Linking VCRs
- Audio/video signal testing

PROJECT RATING 2

PROJECT

Audio/Video MODULATOR

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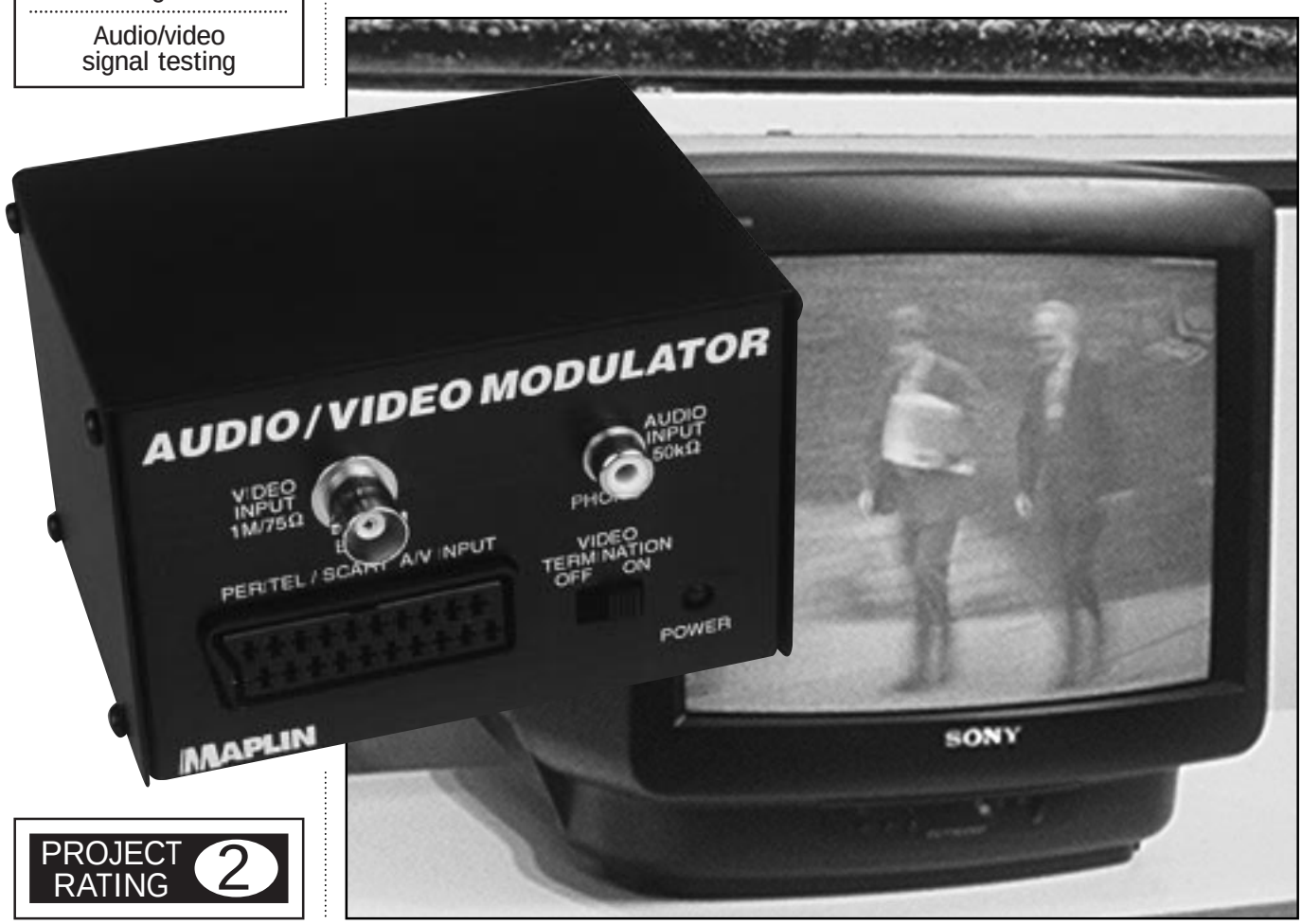
Text by Chris Barlow and Maurice Hunt



This project is a substantially revised version of the Audio and Video Modulator kit (LM79L), previously featured in the February 1989 issue (No.30) of* Electronics*. The main reason for the update is due to the discontinuation of the originally specified UHF modulator (the UM1286), so the new circuit was designed around the recently introduced (and superior) 'Alps' modulator. This modulator features an integral 'aerial throughput' RF mixer/booster and a built-in test signal for receiver tuning, which causes a bar pattern to be displayed on a TV connected to the project, so that the picture can be adjusted for optimum results.

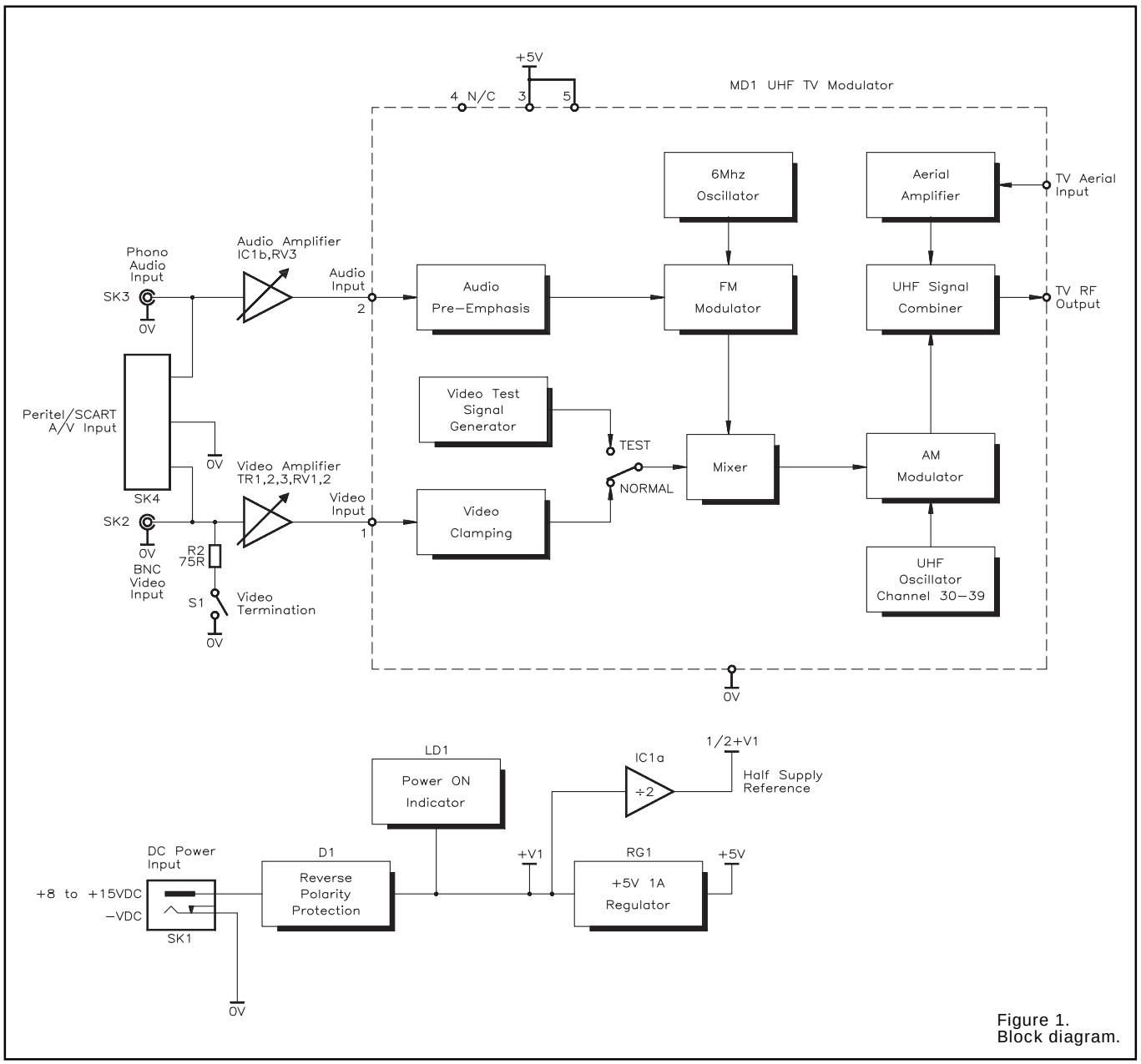


Figure 1.
Block diagram.

The opportunity was taken during the redevelopment process to add a number of useful extra features to the design, including a SCART socket and provision for adjustment to cater for the imminent Channel 5 introduction, while a pre-punched steel casing makes the project easier to construct.

Circuit Description

Refer to the block and circuit diagrams, shown in Figures 1 & 2, respectively. These should be of assistance when following the description.

The DC supply from the regulated AC-DC adaptor is applied to SK1, noting that the centre-pin is positive and the outer contact negative. D1 protects against reverse polarity damage to the circuit.

Low frequency decoupling of the supply is provided by capacitors C2 and C5, while C1, C3 & C4 take care of the high frequency decoupling. LED LD1 lights to confirm when power is applied. Voltage regulator RG1 provides a steady +5V level, which is required by the UHF modulator, MD1.

For the audio circuit to function correctly, a half +V1 supply reference is necessary, which is provided by half of IC1 (IC1a). The voltage reference applied to the input of this op-amp is derived from the two resistors R14 & R15, which form a potential divider. The op-amp is configured as a unity gain voltage follower to provide a low impedance half-supply, its input being decoupled by C13-16 and its output by C11 & C17-19.

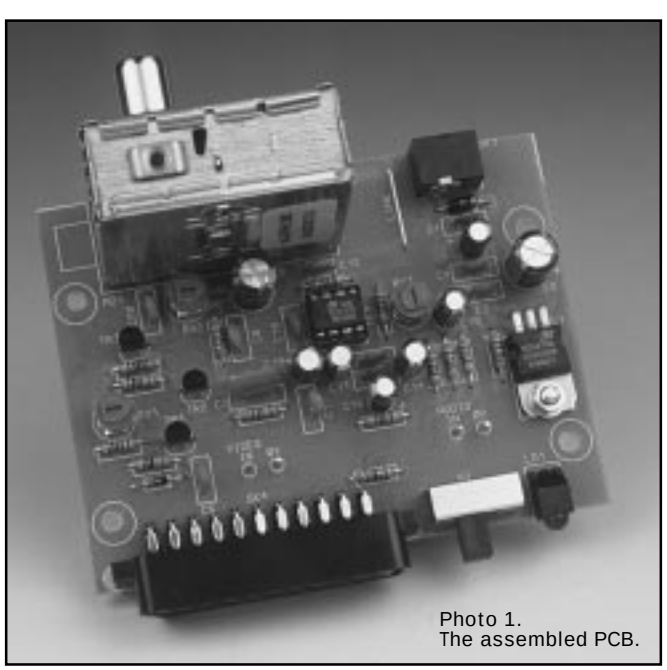


Photo 1.
The assembled PCB.

SPECIFICATION

Operating voltage:	8-15V DC (e.g. 12V 300mA AC-DC adaptor, YB23A)
DC power input connector:	2·5mm power socket, centre pin positive
Supply current:	144mA @ 12V
Audio input level:	150mV to 3V Pk-to-Pk
Audio input impedance:	50kΩ
Audio input connector:	Phono
Video input level:	200mV to 3V Pk-to-Pk
Video input impedance:	1MΩ approximately, 75Ω with termination load selected
Video input connector:	BNC
Audio/video connector:	SCART
RF TV output:	Channel 30-39 (543·25-615·25MHz)
FM sound sub-carrier:	6MHz
RF TV IN/OUT connectors:	Standard TV coax

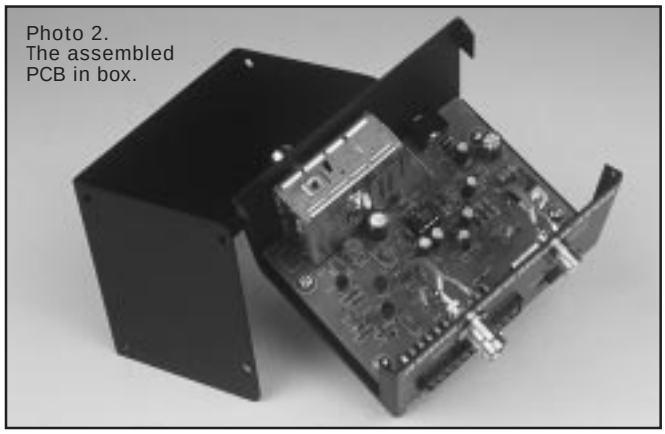


Photo 2. The assembled PCB in box.

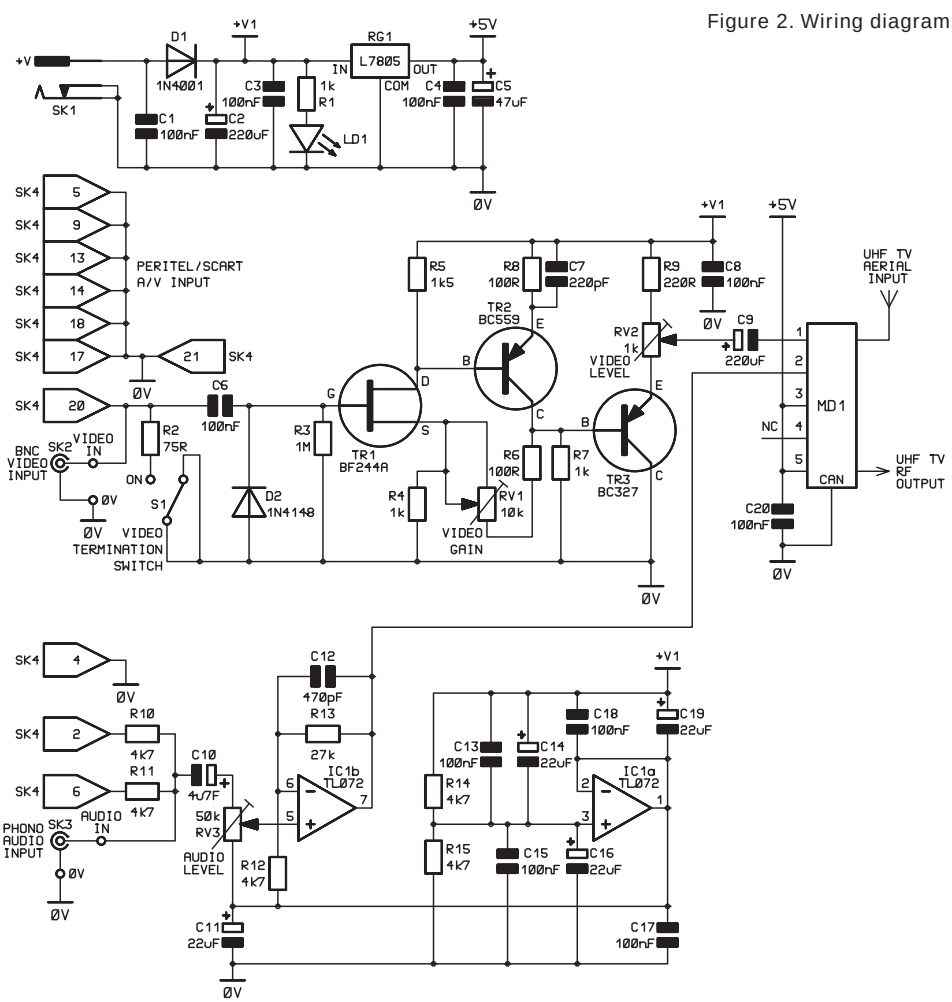
The other half of IC1 (IC1b) is used as an audio amplifier which drives the sound input (pin 2) of the UHF modulator, MD1. Resistors R12 & R13 determine the gain of the op-amp, with potentiometer RV3 setting the level of audio signal applied to the amplifier's input. The incoming signal from pins 2 & 6 of SK4, or from the phono socket SK3, is AC coupled to RV3 via C10.

The video signal is applied to pin 20 of SK4 and its ground is connected to pin 18. The input impedance of the video amplifier, formed from transistors TR1-3, is approximately 1MΩ. However, this can be reduced to 75Ω by closing switch S1, which places a 75Ω resistor (R2) across the video input – this is known as a termination load.

The video signals are AC coupled via C6 into the gate of TR1, a Field Effect Transistor (FET). Diode D2 and resistor R3 are used to maintain the correct bias level. TR1 & TR2 form a broadband buffer amplifier, the gain of which is set by the value of the negative feedback resistor, R6 and potentiometer RV1. Resistor R4 provides the source load for TR1 and preset potentiometer RV2 forms the emitter load for TR3. The DC bias for TR2 is derived from R5 and TR1. A small amount of frequency compensation is provided by C7.

The video output from the amplifier is tapped off from the wiper of RV2 and fed to the video input (pin 1) of the UHF modulator, MD1. Inside MD1, the audio signal is converted into a 6MHz frequency modulated (FM) sub-carrier. It is then mixed with the video signal and fed to the amplitude modulated (AM) section, where the UHF carrier is combined to produce the final modulated RF output suitable for the aerial input of domestic TV sets.

Figure 2. Wiring diagram.



PCB Construction

The PCB is a single-sided fibreglass type, with printed legend to assist assembly – refer to the PCB legend and track drawing, shown in Figure 3. The PCB has been designed for a minimum of off-board wiring, which is needed only to connect the video and audio sockets. The board is best assembled in order of ascending component size/height.

Start by fitting the four PCB pins in the position marked 'AUDIO'/'VIDEO' 'IN' & '0V'. Use the piece of 22swg wire supplied in the kit for the single wire link. Take care to ensure that polarised devices (electrolytic capacitors and semiconductors) are fitted the correct way round. Also, ensure that the IC socket for IC1 is fitted with its end notch aligning with the printed legend.

Fit the three preset potentiometers, and set them all to their half way positions; the circuit has been designed such that these settings should enable the unit to operate with a minimum of setting up being required.

The SCART socket (SK4) has two locating clips which are pushed through the holes in the PCB until they lock in place, then the socket pins can be soldered. Switch S1 has tabs at each corner of its metal body, which should all be soldered in to provide support. Fit the PCB-mounting LED LD1, and the power socket SK1 flush to the board.

The voltage regulator, RG1 leads must be pre-bent at 90° and the regulator heatsink tab fitted flat onto the board

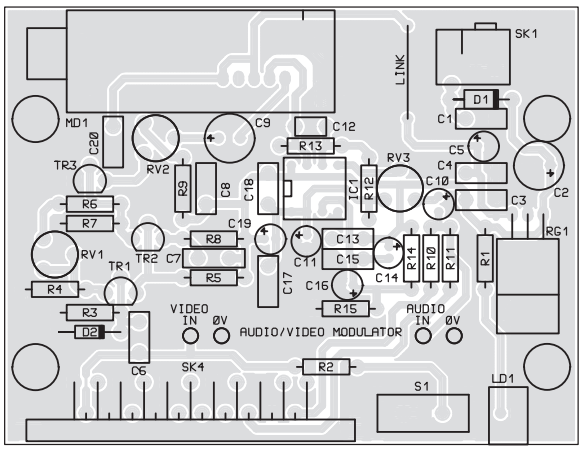


Figure 3. PCB legend and track.

using the M3 hardware supplied, as shown in Figure 4, the exploded assembly diagram.

The UHF modulator, MD1, is fitted vertically, with its corner tabs soldered in to provide support.

Install IC1 last of all, with its end notch aligning with that of the socket.

Having completed the board, check your work carefully for misplaced components, solder whiskers, bridges and dry joints, then clean off excess flux using a suitable solvent.

Testing

Testing of the completed board should be carried out prior to its installation into the casing, since faultfinding will then be easier, should it be required.

Temporary connection to the board should be made, as shown in Figure 5. At this stage, the wires can be longer than required, as they are cut to size during the final assembly.

All the tests can be made with a minimum of equipment. You will require a multimeter, a UHF TV set and an audio/video source. A regulated 12V AC-DC adaptor, with centre-pin positive, will also be required to power the unit. Carefully lay the PCB assembly onto a non-conductive surface, such as dry paper or plastic.

The first test is to measure the resistance at the DC power socket, SK1. With the multimeter set to read ohms, connect its red (+) test lead to the centre terminal and the

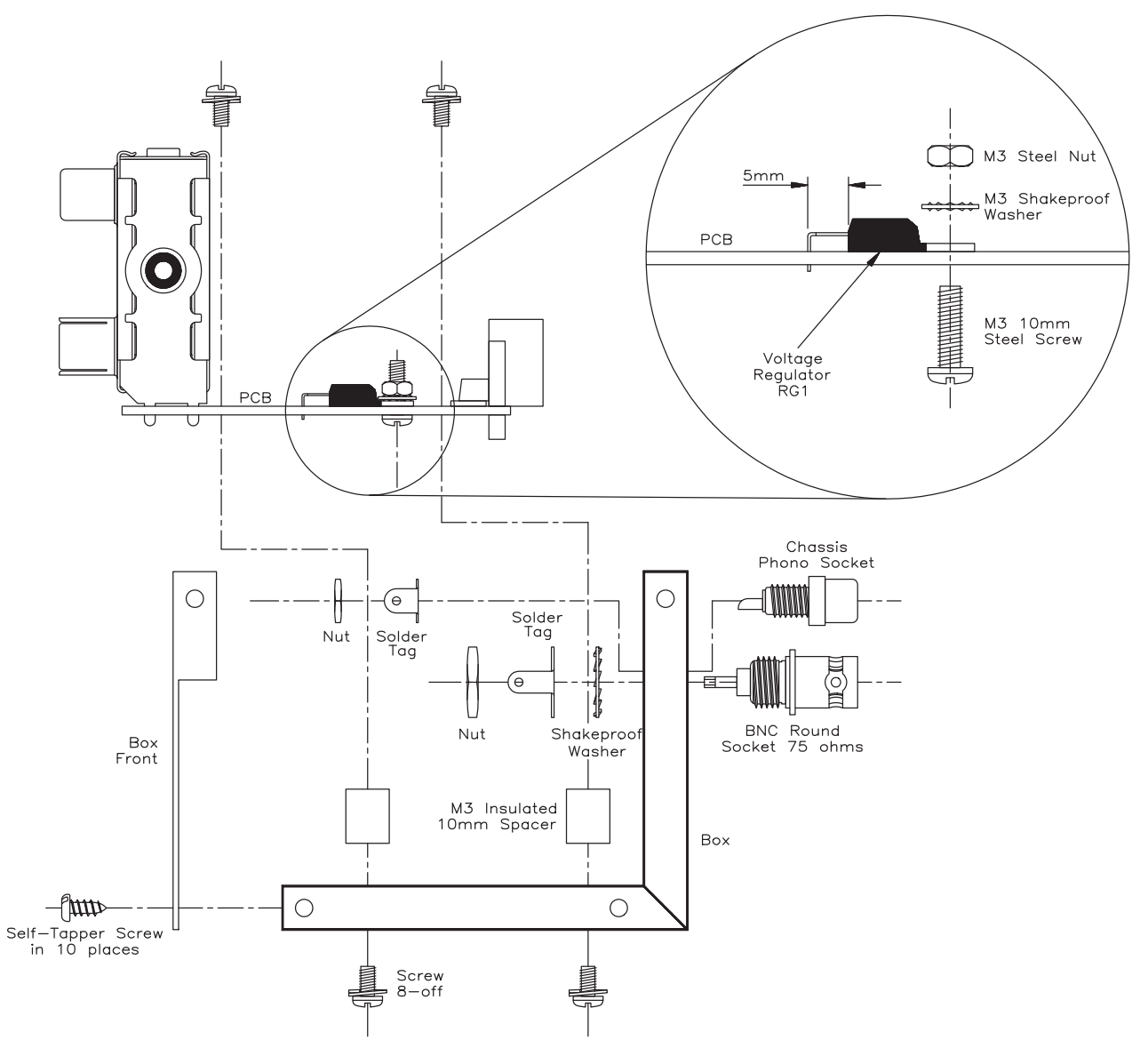


Figure 4. Exploded assembly.

Figure 3a. Video level set too low, resulting in a dark picture.

Figure 3b. Video level set correctly, giving the best picture quality.

Figure 3c. Video level set too high, resulting in saturation and flaring out of the peak whites.

black (–) test lead to the power socket's side tag or any other 0V point on the unit (such as the UHF modulator casing). You should get a reading of approximately 1·5MΩ and, when the test leads are reversed, a much higher reading in excess of 20MΩ should be present, due to the reverse polarity protection diode D1.

Next, the 12V AC-DC adaptor should be switched on but not yet plugged into the onboard power socket, and the multimeter set on a DC current range that will accommodate up to 300mA. The aim is to test the current consumption of the unit in its quiescent state (no signal applied). The following process is a little fiddly in practice, and care must be taken not to short circuit the power supply.

The multimeter's red (+) test probe should be inserted into the power supply centre hole, the negative (–) test lead held on the DC power socket (SK1) centre pin, and the outer contact of the power supply plug must simultaneously be brought into contact with the tab (0V terminal) of the power socket. This can be achieved either (preferably) using a lead terminated in crocodile clips, by pressing the outer contact of the power supply plug onto the power socket tab, or onto the metal body of the UHF modulator. The 'power on' LED, LD1 should light and a current reading of around 144mA should be obtained.

If the current consumption is satisfactory, the power supply can be plugged directly into the power socket. The multimeter should then be set to read DC volts (up to 20V). With the negative (black) test lead attached to a convenient 0V point on the board (e.g. the modulator body), voltages on the board should approximately match the following:

Cathode of diode D1	=	+11·2V DC
Link	=	+5V DC
Pin 1 of IC1	=	+5·6V DC
Pin 7 of IC1	=	+5·6V DC

This completes the DC testing of the audio/video modulator, and the multimeter can now be put aside.

Next, connect a coax lead (GW61R) from the RF output of the modulator to the aerial input of a UHF television. With the UHF modulator's test switch 'on' (upper position), tune a spare channel on the TV to approximately 36, where you should see a screen with two vertical white bars on a black background, with no sound. Connect an audio/video signal to the input (BNC/phono or SCART) of the modulator. If no other video connection is made to the unit then the termination switch (S1) must be on.

To set the audio level, adjust potentiometer RV3 until the sound level is the same as for an off air transmission (BBC, ITV, CH4/5). Next, set RV1 fully anticlockwise and RV2 to its halfway position, so that peak whites don't flare out and produce excessive buzzing on the sound channel. The final setting of the video level is down to your personal preference – see Photos 3a-c. DO NOT make any attempts to adjust any of the presets inside the UHF modulator (MD1), as these are factory set using sophisticated test equipment.

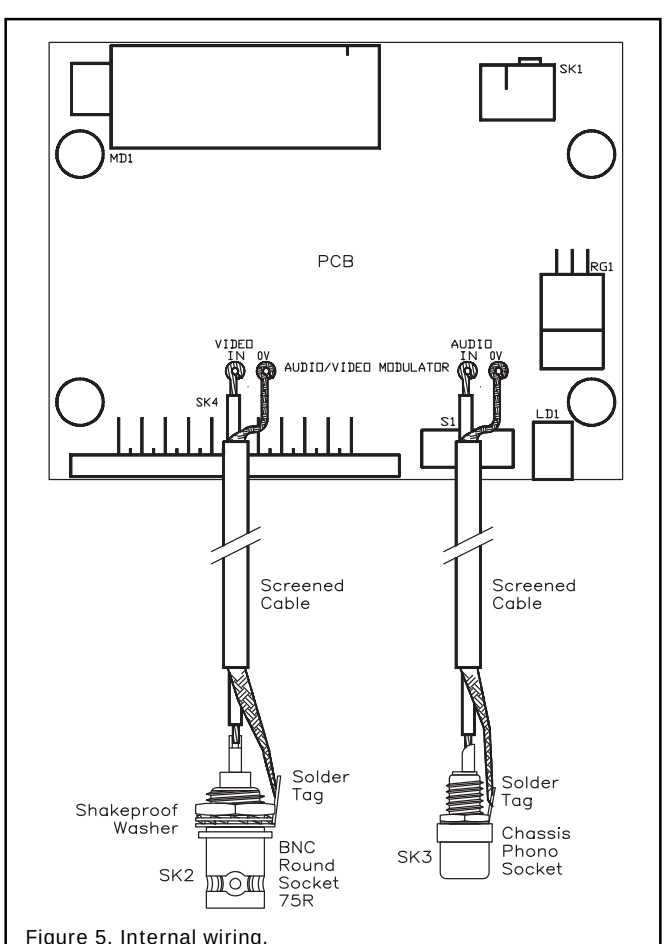


Figure 5. Internal wiring.

Final Assembly

The unit is housed in a pre-punched screened metal casing for ease of construction. Fit the 10mm threaded insulated spacers to the holes in the PCB, and carefully install the PCB into the casing – see Figure 4, showing the exploded assembly diagram.

Install the BNC and phono sockets into their holes in the casing and secure them with the nuts and washers supplied with the sockets. Connect the sockets to the audio and video input PCB pins using short lengths of suitable screened cable (the outer screen connects to the 0V terminal in each case) – refer to Figure 5, showing the internal wiring required.

Finally, fit the lid onto the casing with the screws supplied, and stick on the four rubber feet on the box underside.

Using the Modulator

Refer to Figure 6, showing the general application wiring between the unit and various pieces of video equipment that can be used with it. The test switch on the modulator can be switched in to assist the tuning in of a different TV set to match the modulator if the system setup is altered.

Note on Tuning for Channel 5

When the new Channel 5 is introduced, the UHF modulator may need to be tuned for a different frequency, away from the existing channel 36 and towards channel 39. This can be achieved by adjusting the channel frequency preset control – see Figure 6.

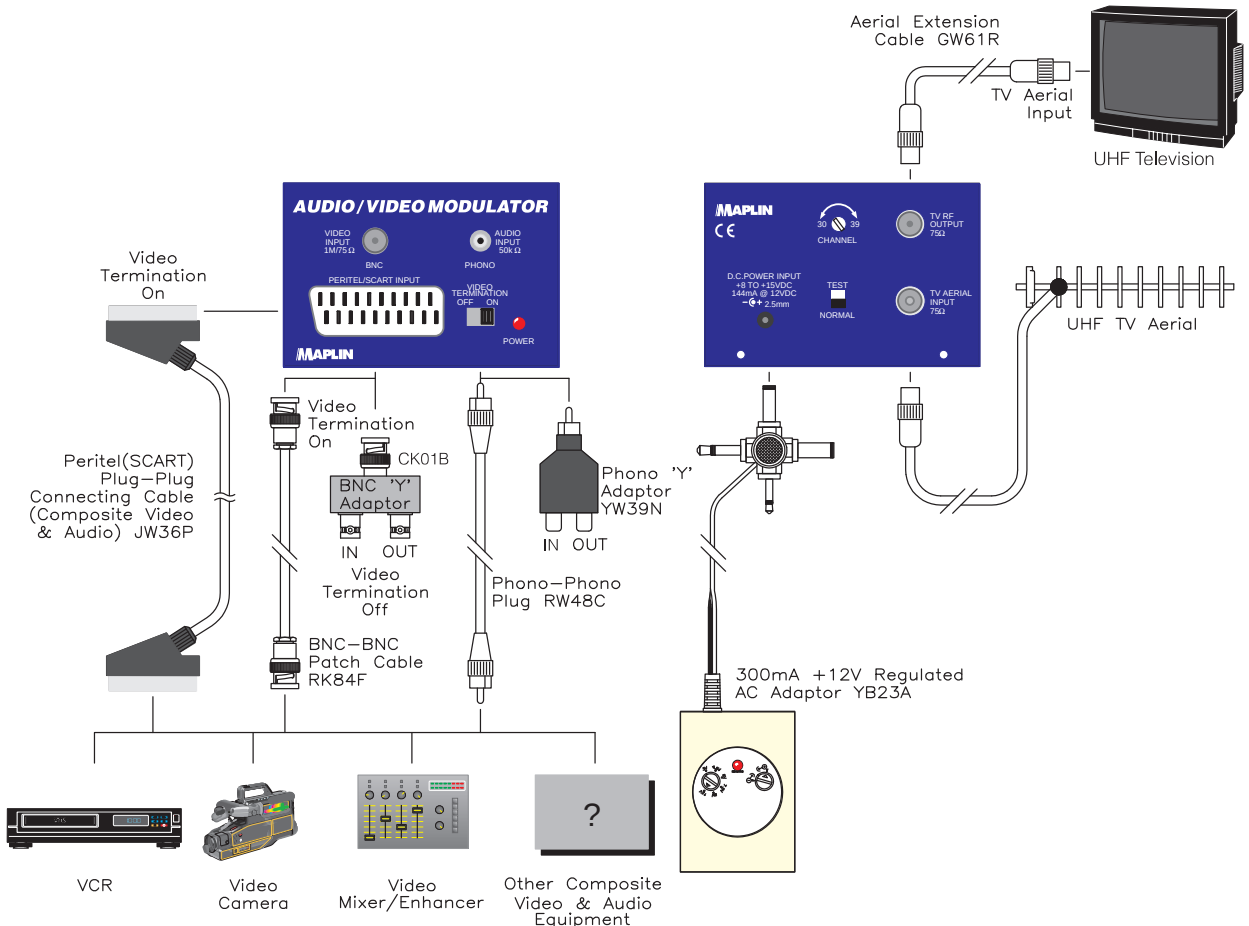


Figure 6. General application wiring.

PROJECT PARTS LIST

RESISTORS (All 0·6W 1% Metal Film, Unless Stated)

R1,4,7	1kΩ	3	(M1K)
R2	75Ω	1	(M75R)
R3	1MΩ	1	(M1M)
R5	1k5Ω	1	(M1K5)
R6,8	100Ω	2	(M100R)
R9	220Ω	1	(M220R)
R10-15	4k7Ω	5	(M4K7)
R13	27kΩ	1	(M27K)
RV1	10kΩ Preset Potentiometer	1	(WR42V)
RV2	1kΩ Preset Potentiometer	1	(WR40T)
RV3	50kΩ Preset Potentiometer	1	(WR43W)

CAPACITORS

C1,3,4,6, 8,13,15, 17,18,20	100nF 16V Ceramic Disc	10	(YR75S)
C2,9	200µF 16V Radial Electrolytic	2	(AT41U)
C5	47µF 16V Radial Electrolytic	1	(AT39N)
C7	200pF Ceramic Disc	1	(WX60Q)
C10	4µ7F 63V Radial Electrolytic	1	(AT76H)
C11,14, 16,19	22µF 16V Radial Electrolytic	4	(AT37S)
C12	470pF Ceramic Disc	1	(WX64U)

SEMICONDUCTORS

D1	1N4001	1	(QL73Q)
D2	1N4148	1	(QL80B)
RG1	L7805CV	1	(QL31J)
LD1	PCB-mounted Red LED	1	(QY86T)
TR1	BF244A	1	(QF16S)
TR2	BC559	1	(QQ18U)
TR3	BC327	1	(QB66W)
IC1	TL072CN	1	(RA68Y)

MISCELLANEOUS

SK1	PCB-mounted 2·5mm DC Power Socket	1	(FK06G)
SK2	BNC Round Socket 75Ω	1	(FE31R)
SK4	Peritel Right-angled Socket (Lugless)	1	(BP65V)
SK3	Chassis-mounted Phono Socket	1	(YW06G)
S1	Right-angled SPDT Slide Switch	1	(FV01B)
MD1	6MHz UHF Modulator	1	(WC21X)
	8-pin DIL Socket	1	(BL17T)
	1mm Single-ended PCB Pin	4	(FL24B) ★
	M3 10mm Insulated Spacer	4	(FS36P) ★
	M3 10mm Steel Screw	1	(JY22Y) ★
	M3 Steel Nut	1	(JD61R) ★
	M3 Shakeproof Washer	1	(BF44X) ★
	0·71mm 22swg Tinned Copper Wire	1 length	(BL14Q) ★
	Miniature Coax Cable	1 length	(XR88V) ★
	Stick-On Feet Domed	4	(BP58N) ★
	Box	1	(BL98G)
	PCB	1	(GJ59P)
	Instruction Leaflet	1	(XZ10L)
	Constructors' Guide	1	(XH79L)

OPTIONAL (Not in Kit)

300mA AC Adaptor Regulated	1	(YB23A)
Aerial Extension Cable	1	(GW61R)
Peritel Audio & Composite Video Plug to Plug	1	(JW36P)
75Ω Video Patch Lead	As Req.	(RK84F)
BNC Y Adaptor	1	(CK01B)
Single Phono-Phono Plug	As Req.	(RW48C)
2-to-1 Phono Adaptor	1	(YW39N)

The Maplin 'Get-You-Working' Service is available for this project, see Constructors' Guide or current Maplin Catalogue for details.
The above items (excluding Optional) are available as a kit.
Order As LU35Q (Audio/Video Modulator)

Please Note: Items in the Parts List marked with a ★ are supplied in 'package' quantities (e.g., packet, strip, reel, etc.), see current Maplin Catalogue for full ordering information.

The following new items (which are included in the kit) are also available separately.
Audio/Video Modulator PCB **Order As GJ59P**
Audio/Video Modulator Box **Order As BL98G**

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