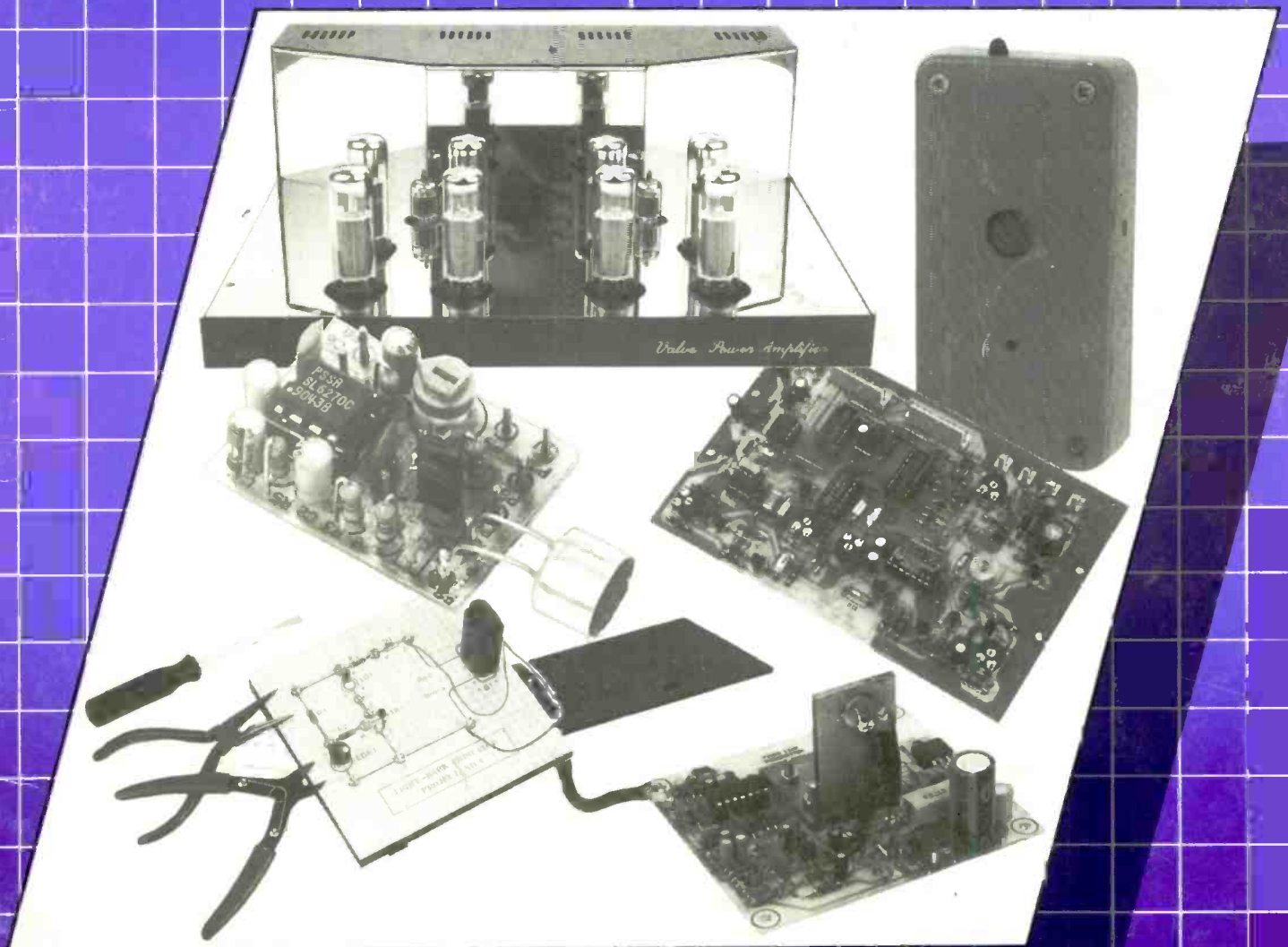


PROJECTS BOOK 51

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HI-FI STEREO VALVE AMPLIFIER
VIDEO BOX

INFRA-RED VIDEO LINK
'PEEP' ALARM

FUNTRONICS: LIGHT/DARK INDICATOR
DATA FILE: AGC MICROPHONE PREAMP

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MAPLIN PROJECTS BOOK FIFTY ONE

EDITORIAL

■ This Project Book replaces Issue 51 of 'Electronics' which is now out of print. Other issues of 'Electronics' will also be replaced by Project Books once they are out of print. For current prices of kits please consult the latest Maplin Catalogue or the free price change leaflet, order as CA99H.



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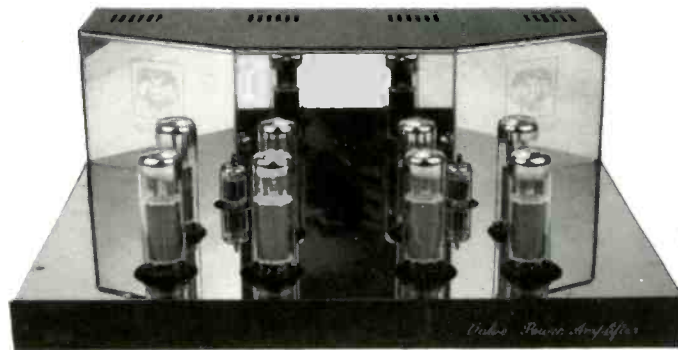
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PROJECTS

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■ A review of a superb Hi-Fi amplifier that sounds as good as it looks!

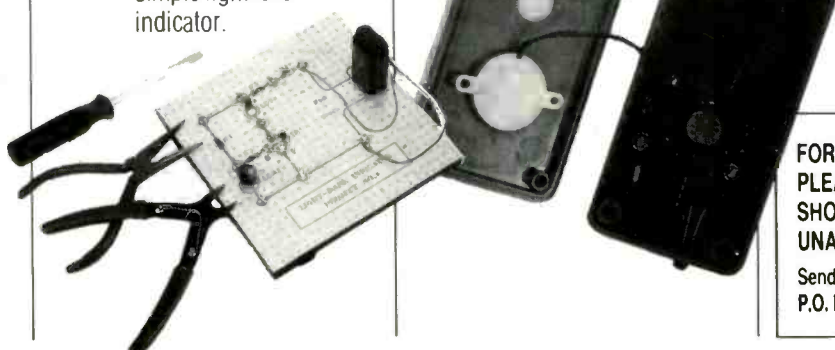
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■ Enables wireless transmission of video signals using infra-red light.



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■ Part of a beginner's series presenting a simple light level indicator.



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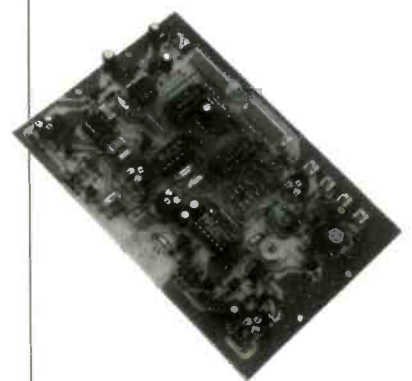
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■ A compact, low-power alarm unit that is light level triggered.



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Velleman K4000 Stereo Valve Amplifier

Part One – The Review by Alan Williamson

For those of you who have lusted after a valve amplifier for years, but are unable to afford one due to their high cost (compared to transistor designs), your fetish can now be satisfied. With the introduction of the Velleman K4000 valve amplifier (tube amplifier to our American friends) into the Maplin range of kits you can now turn your fantasy into reality. The K4000 is a fixed-bias ultra-linear design, delivering 95 watts in class A/B1 (see below), the first 15 watts are in class A.

Classy Operator

Class A is the situation when the anodes of both valves on each half of the output transformer primary are conducting at all times. Class A/B1 operation occurs when a signal is large enough to cut the valve off during the negative half of the cycle (only one valve is cut off at any time because of the inverted phase) and the cathodes are always negative with respect to the grid.

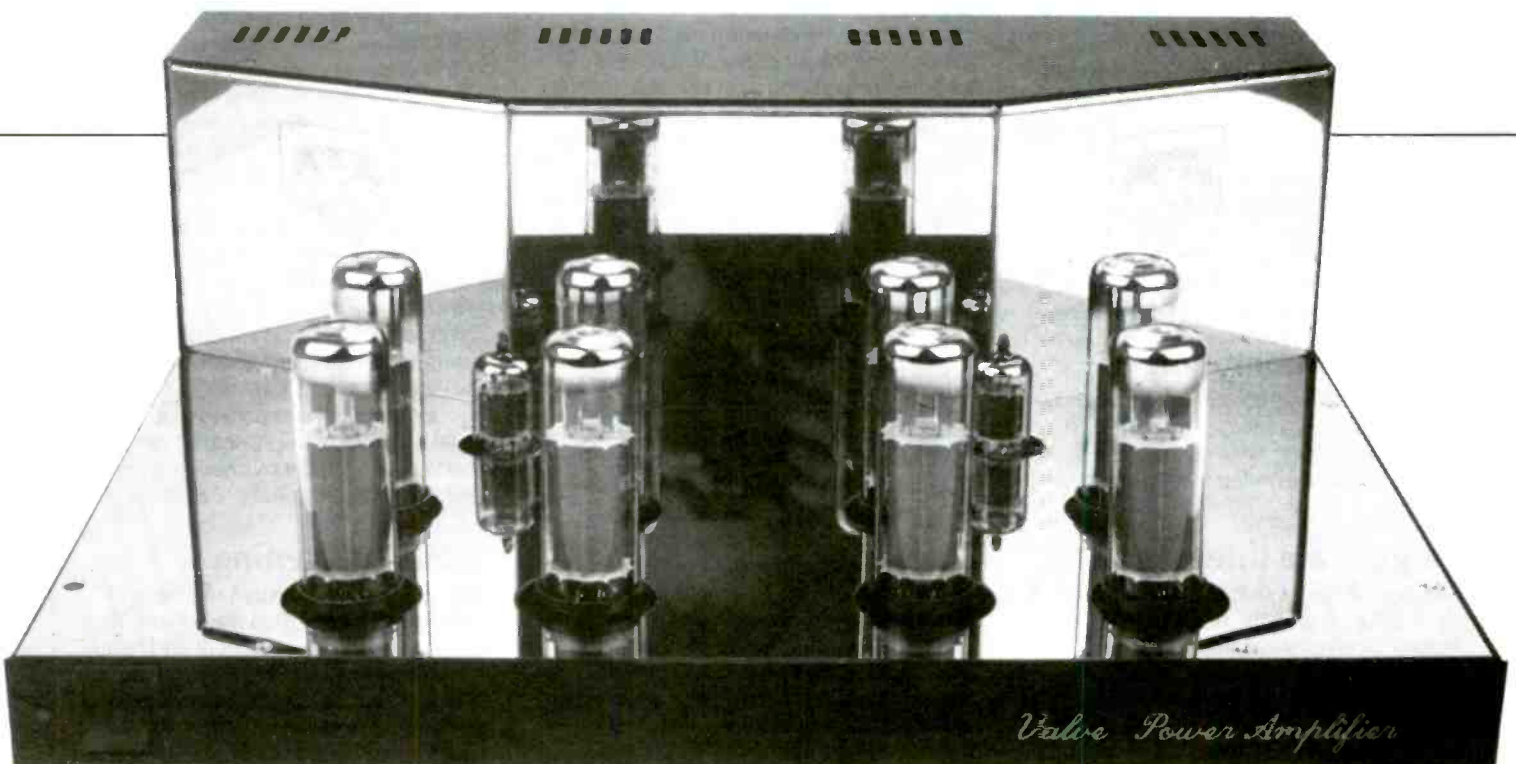
Specification	
Output power:	2 × 200W music power 2 × 95W rms in class A/B1 2 × 15W in class A
Power bandwidth (max. output, –3dB):	10Hz to 60kHz
Frequency bandwidth (ref. 1W, –3dB):	4Hz to 100kHz
Harmonic distortion:	0.08% (1kHz, 1W) 0.63% (1kHz, 95W)
Signal to noise ratio:	>102dB (A weighted at 95W)
Channel separation:	>67dB (at 95W)
Input impedance:	100kΩ
Input sensitivity:	0dB (775mV for 95W)
Loop feedback:	18dB
Damping factor:	25

Incidentally, Class A/B2 operation is such that, when one valve is conducting and the cathode of the other valve is driven positive with respect to the grid; this requires power to drive the grid rather than a voltage.

Weight Training

So what do you get for your money? Well for a start you don't get a flyweight

amplifier (it weighs 20kg!), the physical dimensions are 423 × 383 × 150mm (whd), including the mains switch and speaker terminals. In the kit you get everything you need to build the amplifier, right down to the last nut and bolt. You may, however, prefer to use an alternative audiophile cable and components (see later) to those supplied with the kit – please let us know the results.



The impressive looking, and sounding, K4000 amplifier.

When built, the amplifier is rather eye-catching – with the valves on display, as can be seen from the photograph. Styling is in a similar fashion to that of the Beard P35 or Audio By Design (formerly Audio Innovation) First and Second amplifiers.

Circuitry

The amplifier is a little unusual as it employs toroidal transformers in the output stages and power supply, but the rest of the circuit is fairly standard.

Referring to Figure 1, the input of the amplifier is AC coupled to one half of an ECC82 in the preamplifier stage (the other half being used for the other channel). The ECC82 is used as a buffer and pre-gain stage, without the use of cathode decoupling, and is not included in the feedback loop.

An ECC83 is used in the main amplifier proper. Half of the ECC83 is used as a gain stage, with the overall feedback loop terminating at the cathode, while the other half of the ECC83 is used as a phase-splitter.

The outputs of the phase-splitter then feed two parallel pairs of EL34s in the fixed-bias ultra-linear push-pull configuration. Power from the output valves is converted from high voltage low current, to low voltage high current via the ultra linear transformer, connections to the outside world being made by either the 8Ω or 4Ω tap, the overall feedback loop is taken from the 8Ω tap.

Although the EL34s are running at near maximum voltage, each valve is only delivering around 24 watts. A single EL34 can handle a maximum 48 watts, so you could say that the EL34s are conservatively run, which helps to extend valve life.

The Meaning of Life

A nominal figure for the lifetime of a valve is given at around 5000 hours, but valves should be replaced on a fairly regular basis, around every 1000 hours or so.

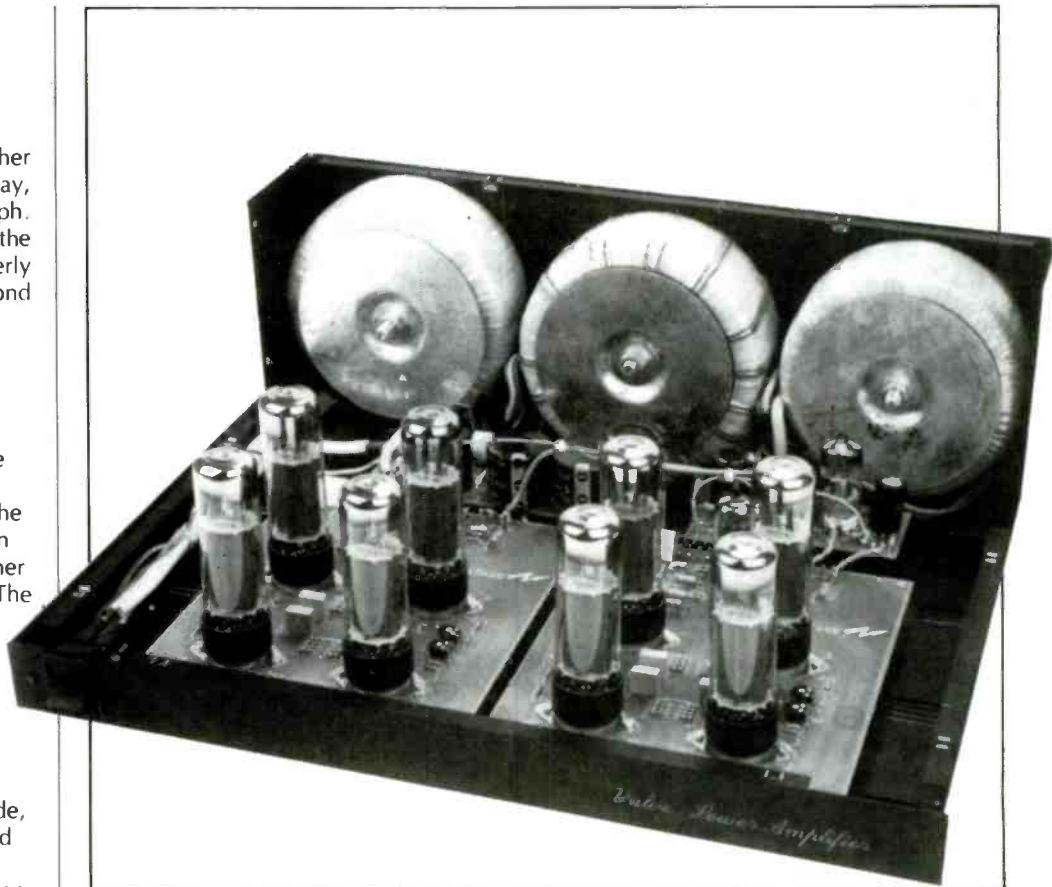
Ageing valves are generally noticed by a softening of the sound which can manifest itself in different ways, a loss of detail in the treble; speed, slam and articulation in the bass; a general blurring of information and a fuzzy stereo image.

Terminal Condition

WARNING: The amplifier must always be terminated with a speaker load BEFORE powering up, otherwise serious damage to the output valves and/or transformer may result.

Large Scale Integration

The amplifier was slotted into my usual stereo, which took the place of my trusty Edison Twelve (also valve, a triode coupled class A, 12 watter), although the Edison is no longer in production, the nearest living relative is the Audio by Design series 200, which sells for approximately £450 (at the time of going to press).



The K4000 with its covers removed.

The rest of the system consists of a Voyd Valdi turntable fitted with a Rega RB300 arm and Audio Technica OC7 cartridge, this feeds a home made head amp (based around the LT1028 Op-amp, better than my Audio South transformer, but that's another project). The preamp (valve) is a heavily modified Audion Premier. The speakers are a temporary pair of LNB 7s (a 70 litre transmission line design). Audio Note silver interconnects and Audio Note green/white speaker cable were used to stitch the system together.

A little consideration must be used when siting the amplifier. If you have children or pets you won't be able to leave the amplifier on the floor, and I doubt a shelf would be strong enough to take the weight. Placing the amplifier between the speakers or on large cabinets is also a no-no, otherwise you may end up with a feedback problem. You won't get a howl-round, but it will affect the sound quality (valves are mechanical devices, if you tap or flick any of the valves with your finger nail, you will be able to hear a ping from the speaker(s) which will last for several seconds – a characteristic commonly known as 'microphony').

Another thing that must be taken into account is that the amplifier needs plenty of ventilation, so you can't put it into a cabinet. The amplifier should also be kept out of draughts and away from plants – plants don't always like the hot air! The other reason you should keep plants away from the amplifier, is that some of them sweat and, sometimes, 'those people with green fingers' are not always careful when watering. Water dripping onto a hot valve, even a single drop, would prove disastrous ending up in a pyrotechnic display – pretty but expensive! At the

end of the day it would be best to use the amplifier on a proper equipment table, such as the ones manufactured by Target, Mana Acoustics, Oasis, Sound Organisation, etc.

Acclimatisation

Serious listening didn't take place for a couple of days – until the amplifier had settled in. I used the time to re-adjust to the sound my stereo made using this amp, which is quite different from what I am used to.

The first thing I noticed about the amplifier was what 'appeared' to be a lack of top-end, I say 'appeared' because the top-end is all there, it just doesn't grab you by the throat. I also discovered during the first couple of days that the Audion is not an ideal match for the Velleman, which didn't help matters.

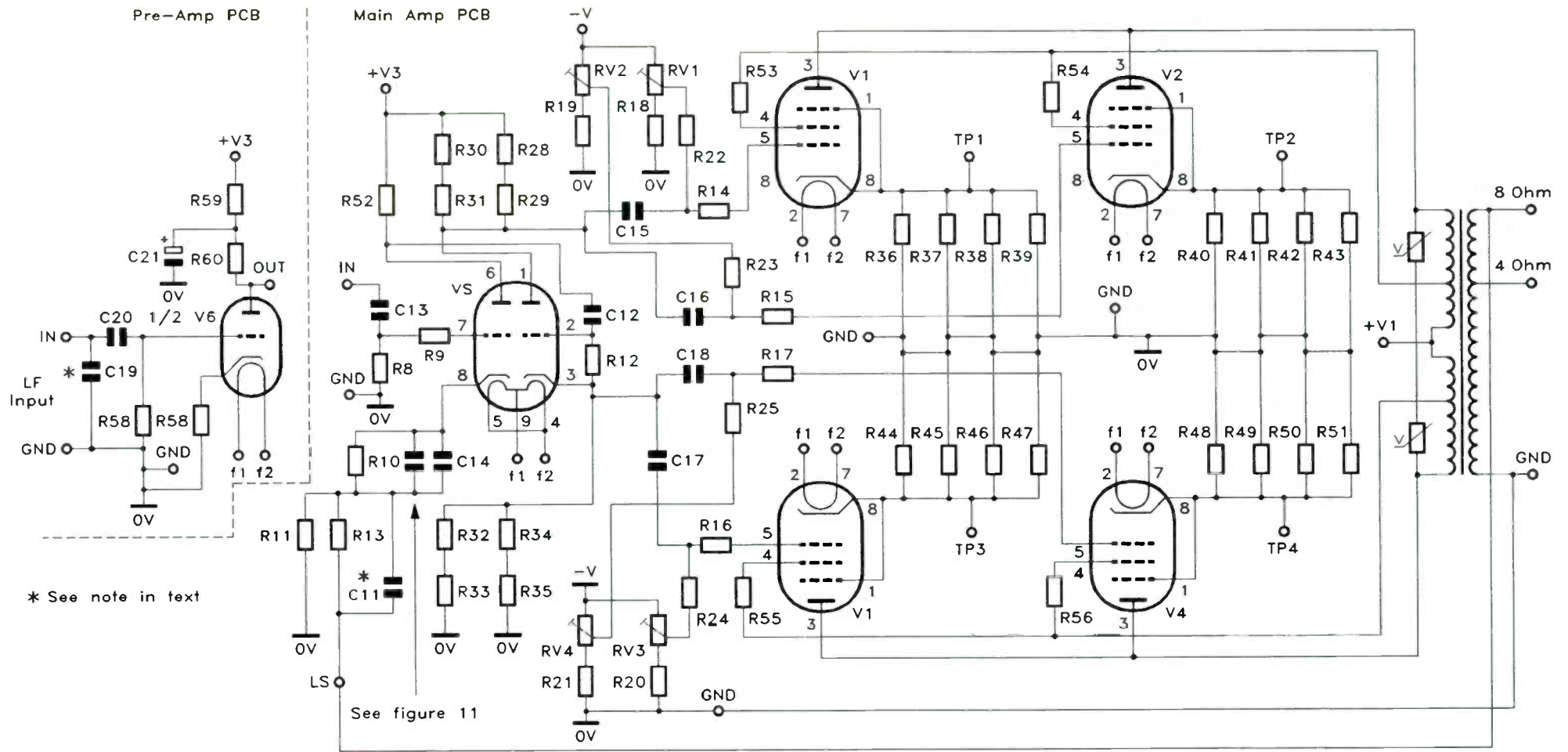
Substituting the Audion for an 'experimental' boded-together transistor preamp brought the top-end out alright, only now it was slicing my ears off!, so the Audion was recommissioned for the listening tests and the 'experiment' went into the bin.

Eventually I was able to jiggle the tonal qualities of the system to something that was acceptable by changing the interconnect and speaker cable.

Serious Listening

The sound stage is more tangible and three dimensional than the Edison, the stereo image has good depth and height, the width extended well beyond the speakers, but I did notice a couple of things. The musicians seemed to have taken a step backwards into the mix, this was not a bad thing really as the sound stage became more stable and realistic.

Figure 1. The circuit diagram of the K41000.



The other thing I noticed was that the stereo image seemed to be grainy, similar to looking through a net curtain or looking at a photograph printed in a newspaper. I wondered if this graininess could be due to the ceramic capacitors in the circuit? There are two per channel, one at the input of the amplifier and the other is in the feedback loop. I replaced both of them with polystyrene types (4 in total, BX24B and BR37S). The sound quality improved quite a bit and the stereo image wasn't grainy any more. It seemed as though someone had filled in the area between the spots! The mid range and treble was also of a more liquid quality, a simple and worthwhile modification.

The one thing that really impressed me about the amplifier is the amount of grunt it has in the bass; it is deep, solid and powerful, basically it's got balls, even at low volume.

After listening to the Velleman for a couple of days, I felt that I was not really going to be able to find the limitations of this amplifier in my system. A quick phone call to my friend arranged the use of his stereo over the weekend.

My friend's system is what some might call 'over the top' depending on your point of view. The turntable is an Omega Point Mentor, fitted with a Breuer type 8 arm and a Kiseki Blackheart cartridge, Audio Research SP11 preamp, two pairs of Ray Lumley M150 power amps and Snell All speakers. The system is wired together using Cardas interconnect and speaker cable.

Both pairs of Lumleys were disconnected and the Velleman was slotted in place. Unfortunately because the Cardas cable is so large, the Velleman would not accept two pairs of cables so the Snells could not be bi-wired. Half an hour was allowed for the amplifier to warm up before listening commenced.

A record was put on the turntable, the arm cue lowered and we both sat back to listen. After the first track my friend looked at me and said, "Hmmm, ... ain't bad is it!"

My initial comments about the lack of top end is unfounded in this system. Although the top end didn't sparkle quite as much as with the Lumleys, it certainly wasn't dull, but it was improving all the time, even after 4 hours of continuous music it was still getting better.

I have a feeling that with the amplifier's excellent dynamics and tonal characteristics, it has primarily been designed with CD in mind, unfortunately I didn't have one to hand to confirm my suspicion.

I have to admit the performance of the amplifier did surprise me a couple of times. Playing 'The Game' from Nusrat Fateh Ali Khan's *Mustt Mustt* album (Real World LP15) made the floor shake in a very meaningful way. The Velleman was making the Snells move a lot of air, so much so that my friend is now considering replacing a pair of the Lumleys with the Velleman to drive the bottom half of the Snells. (A pair of Lumleys are more than



The K4000 kit of parts.

7½ times the price of the Velleman.)

The other thing that surprised me was that the Velleman didn't sound too out of place in a system of this calibre, it has its limitations; even the Lumleys have limitations, but there again doesn't every thing!

This amplifier loves music, any music, especially solo acoustic. The double-bass and tablas on the track 'Prancing' from Colin Walcot's *Cloud Dance* album (ECM 1 1062) was very holographic; I could almost walk around the instruments. The sitar and double-bass on 'Eastern Song' from the same album had wonderful presence, the whole room seemed to energeise. Small nuances could be heard on the Egberto Gismonti *Sol Do Meio Dia* album (ECM 1 1116). I could hear the rasp of his fingers moving over the strings, I also could hear his sleeve brushing on the guitar body quite clearly, the saxophone also had a lovely bite to it, spine tingling even.

Modern pop/rock/indy recordings (although not the best) are reasonably well reproduced, I thoroughly enjoyed listening to 'Fishing and Bags' on PILs 'Album' (Virgin OVED 245). Morrissey's *Alsatian Cousin* (Viva Hate, HMV label, Virgin CDS 3787) just totally bowled me over. Another surprise the amplifier had in store for me was that I originally wrote-off Big Audio Dynamite's *Megatop Phoenix* album (CBS 465790 1) as a poor recording. Not so, the bass and drum kit via the Edison was over blown which was most evident on 'Start, Rewind and The Green Lady', it was previously about as tight as... [I'm sorry but I can't print that - Ed!]. But when played through the Velleman it is tight and very deep, it's just that the Edison bottles out - sic.

On the down side, the only faults that stick out are that the amplifier does tend to lose the fine detail of the music and it does tend to compress the three dimensional image into a wall of sound when the going gets fast and furious (the amplifier didn't like the Sex Pistols [who does? - Ed.]). But there again the Velleman doesn't carry a state-of-the-art price tag and you also have the fun of building it yourself.

During the listening tests I was limited to the amount of equipment available, I would have liked to have had a chance of using the amplifier with a wider variety of speakers. But given the amplifier's tonal characteristics it should be able to fit in to any good quality system that is on the neutral to bright side, or any one using a pair of small speakers that could do with a bit of beefing up.

Unfortunately, I am not able to vouch for the amplifier's performance with difficult (highly reactive) loads, a pair of full range ribbon speakers would have been handy to find out how the amplifier coped.

To fully exploit the Velleman K4000, a system entry level would require a minimum of a specialist turntable or a two box CD player.

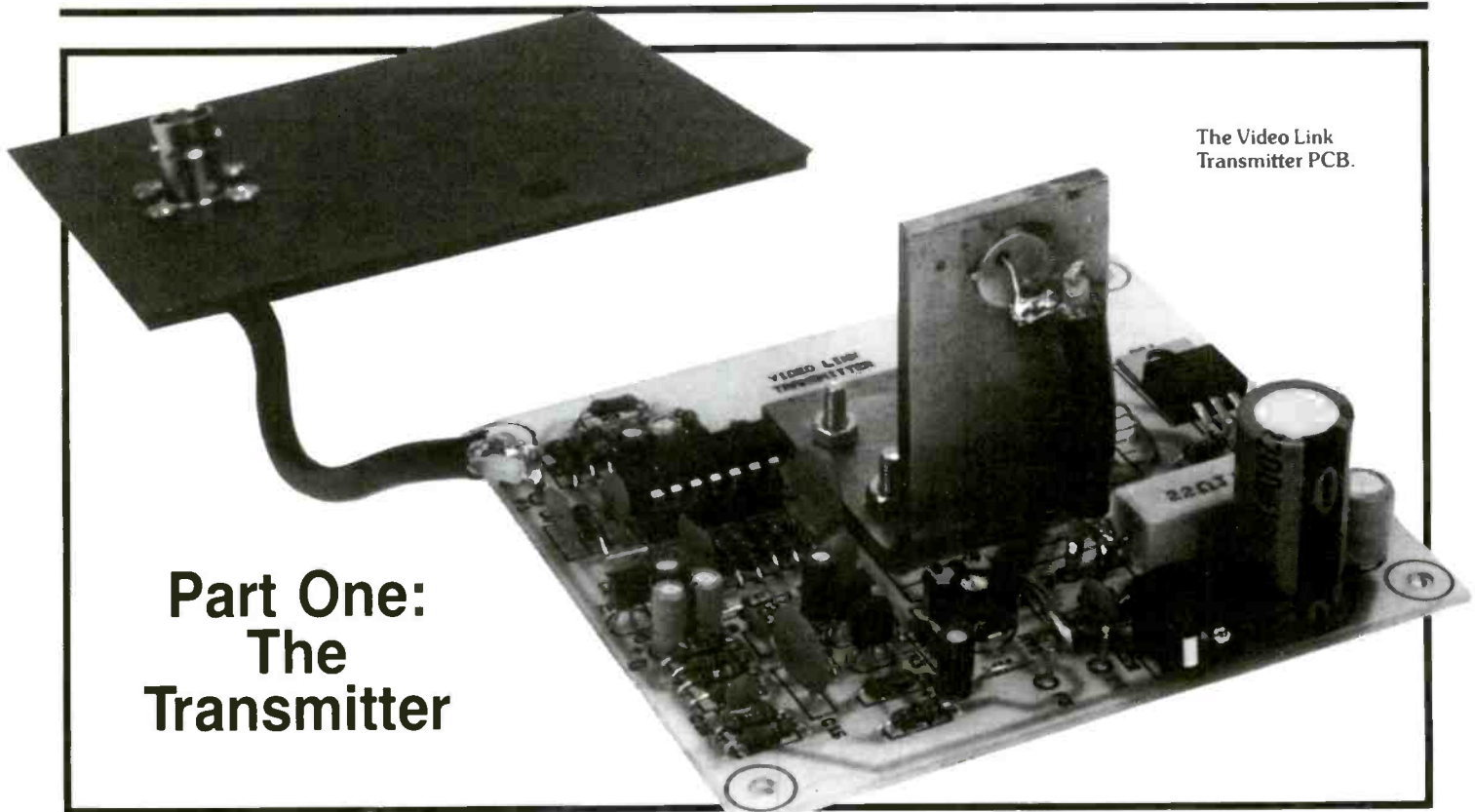
Does the amplifier represent value for money? Only you can decide this, but if you can justify spending this sort of money on an amplifier, then you owe it to yourself to investigate this one further.

I'm personally going to have to buy one to play with.

NOTE: Part Two, which gives full construction details, can be found in Issue 52 (XA52G).

INFRA-RED VIDEO LINK

B Y G A V I N C H E E S E M A N



The Video Link Transmitter PCB.

Part One: The Transmitter

FEATURES

- ★ Range up to 100m
- ★ 12V operation
- ★ Replaces long video cables

APPLICATIONS

- ★ Point-to-point video link
- ★ Security
- ★ General Communications

The Infra-Red Video Link allows the transmission of monochrome composite video over a distance of up to 100 metres. The system makes use of large Fresnel lenses to focus the infra-red energy at much greater distances than are possible using standard techniques.

Circuit Description

Figure 1 shows the circuit diagram of the transmitter. The power supply is connected via SK1. Diode D1 provides reverse-polarity protection. The circuit requires two separate supply rails: a 12V, high current

Power Supply Voltage	12V to 14V
Power Supply Current (Quiescent)	150mA at 12V
Range	Up to 100m
PCB Dimensions	83 × 83mm approx.
Focal Length of Lens	270mm approx.
Peak Infra-red Wavelength	940nm
Composite Video Input	1V peak-to-peak
Video Bandwidth	4MHz

Table 1. Prototype Specification.

supply; and a 5V, low current supply. Regulator RG1, with its associated components, provides the regulated 5V supply for IC1. A composite video signal, at a standard 1V peak-to-peak level, is applied to the circuit between P1 and P2.

A video signal essentially consists of three parts; synchronisation (sync) pulses, a luminance (brightness) signal, and chrominance (colour) information. The circuit makes use of only the sync and luminance components; for practical purposes, the chrominance signal can be ignored. Separating the sync and luminance signals allows each of these to be

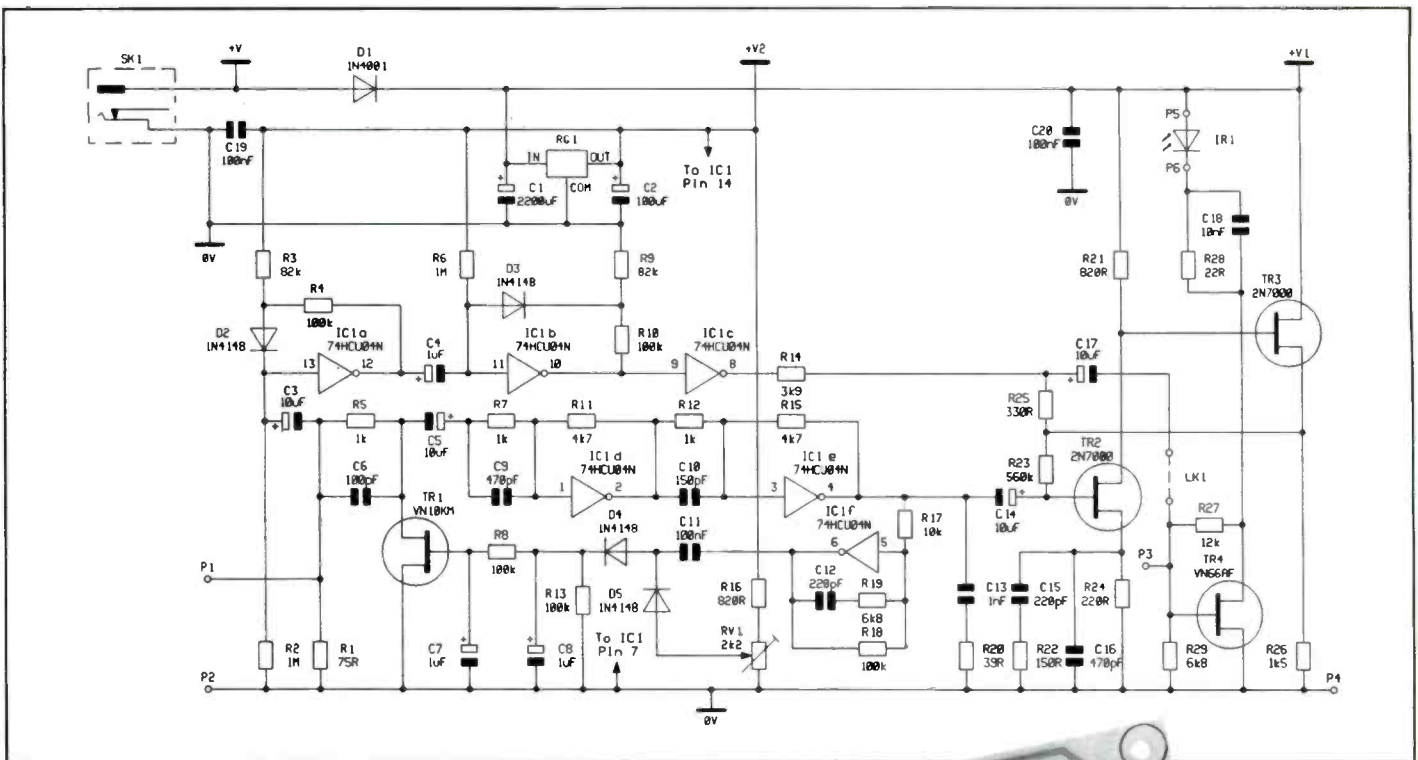


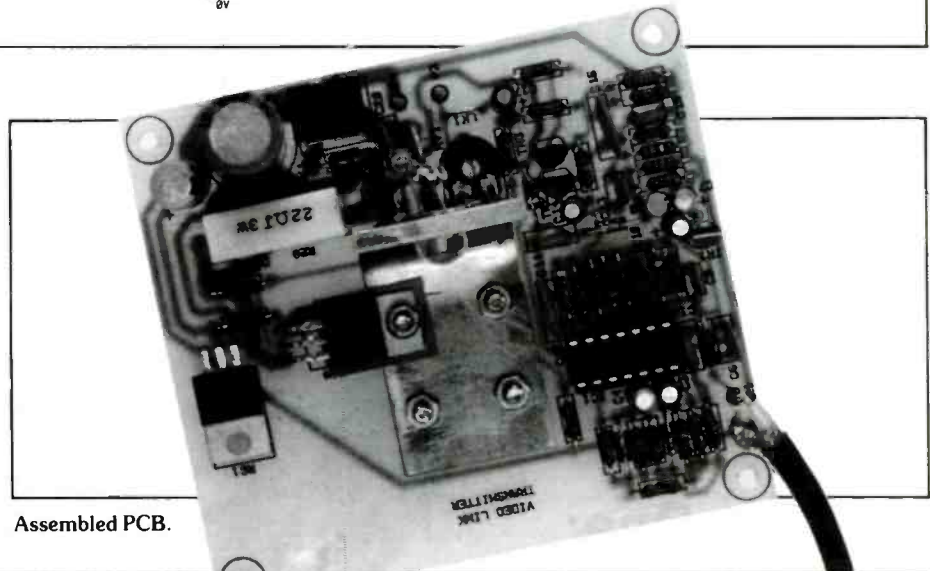
Figure 1. Circuit diagram.

handled separately, as each requires different processing.

The high frequency luminance signal is separated and processed by IC1d and e. It is necessary for the overall gain of the circuit to peak at high frequencies to compensate for the poor response of the infra-red emitter at higher frequencies. Capacitors C6, C9 and C10 provide high frequency peaking.

The sync signal is processed by IC1a, b and c to remove the high frequency luminance signal, and to produce clean frame and line sync pulses.

IC1f forms part of an AGC (automatic gain control) amplifier. The output from



Assembled PCB.

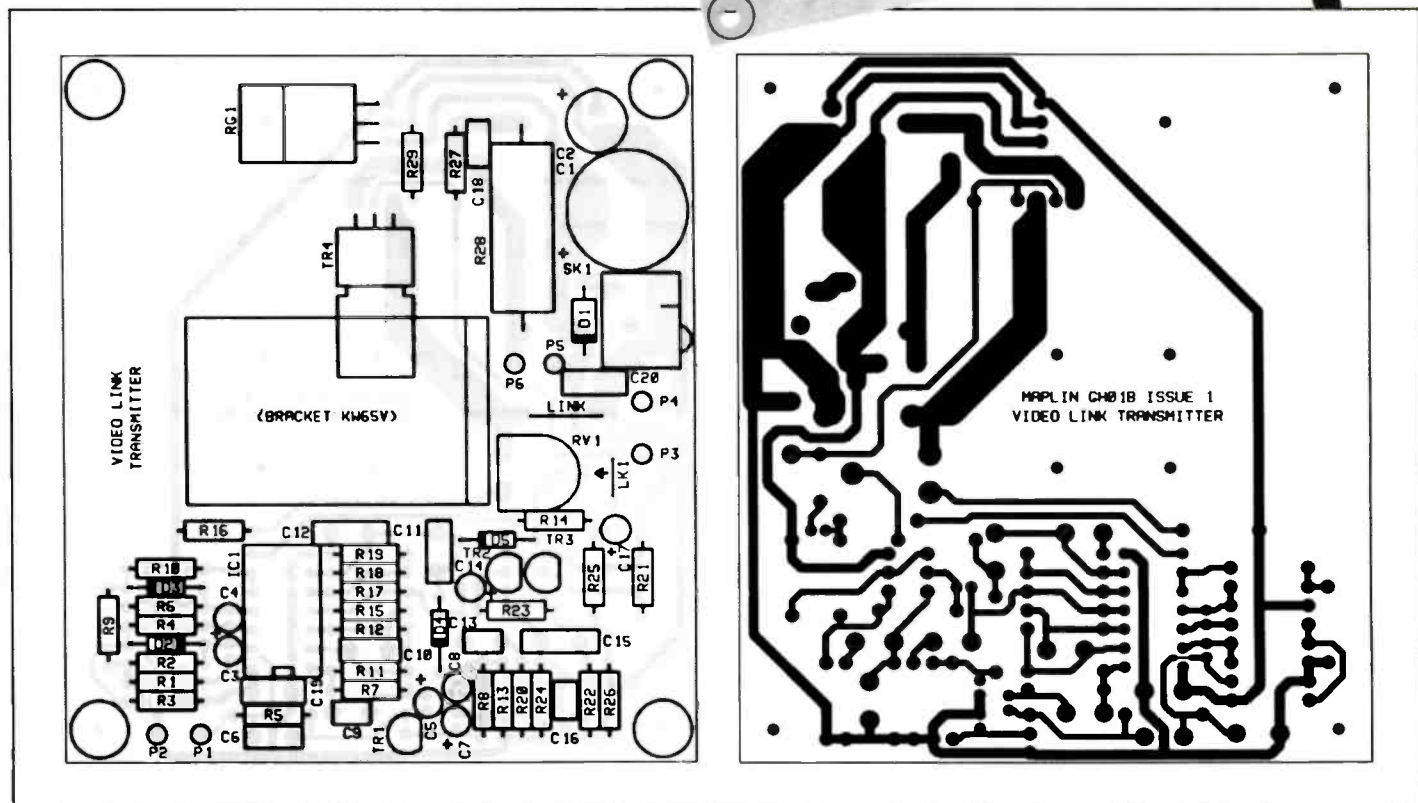
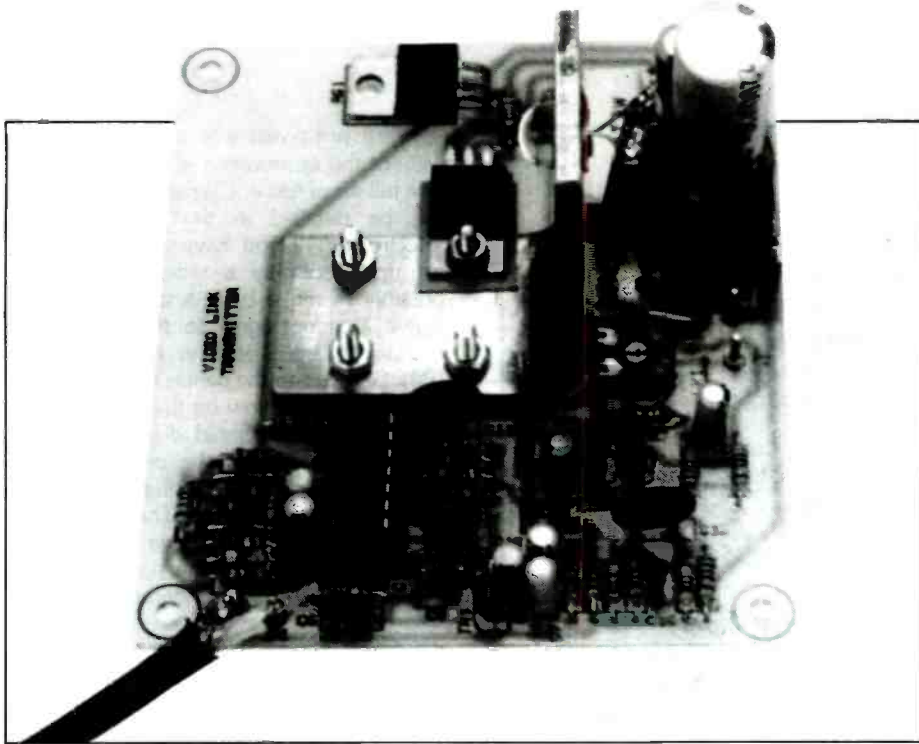


Figure 2. PCB legend and track.



Close-up of PCB, showing mounting (and wiring) of infra-red emitter.

this stage is rectified by D4 and fed to TR1, which maintains a relatively constant signal in the system, helping to prevent overloading. Preset resistor RV1 adjusts the AGC level, and indirectly controls the output level of the transmitter.

The sync and luminance signals are recombined after processing, and are fed to output transistor TR4, which drives the high power infra-red emitter, IR1. IR1 is positioned at approximately the focal length of a large Fresnel lens such that the infra-red energy is focused to infinity.

Construction

After identifying the components and ensuring that all are present, insert and solder them onto the PCB, following the instructions given below and referring to

the legend shown in Figure 2. If you have had little, or no, experience of electronic project construction, then please refer to the Constructors' Guide (included with the kit), for useful practical information.

Start assembly by fitting the resistors, as these are fairly low profile components which may be difficult to fit at a later stage in construction. When fitting the IC socket, make sure that the notch at one end of the socket corresponds with that on the PCB legend; do not fit the IC until all other components have been soldered in place.

The PCB pins should be fitted next, these being inserted into the PCB and then pressed home using a hot soldering iron. When the pins are heated to the correct temperature, very little pressure is required to push them into place. There are two

wire links on the PCB, and both of these are fitted in normal operation. Link LK1 connects the output of the driver stage to the power output stage and may be omitted if it is required to drive the power output stage directly via P3 and P4, as may be necessary in some non-standard applications. For standard operation using composite video, however, LK1 must be fitted.

Next, fit the capacitors, remembering to fit the electrolytic capacitors the correct way around. Please note that C3 and C4 share the same '+' symbol on the board legend. All semiconductors must also be fitted with correct polarity, as shown on the PCB. The infra-red transmitter diode is mounted on a metal bracket, which in turn is mounted on the component side of the PCB, as shown in Figure 3. The diode is mounted through the hole in the bracket; this arrangement should provide a relatively tight fit, and the small sachet of epoxy glue supplied with the kit can be used to hold the diode even more securely in position. Four nuts and bolts are used to fasten the bracket to the PCB. The diode is wired onto P5 (anode) and P6 (cathode) on the PCB, using the screened cable supplied. The leads of the diode should be cut to 10mm and bent in such a way as to reduce the possibility of shorting. Sleeving may also be used if necessary, but the leads of the diode are comparatively rigid and should stay apart once correctly positioned.

The transistors (and regulator RG1) are fitted so that their cases correspond with the relevant outlines on the PCB. A hole is provided on the PCB, allowing the regulator to be bolted to the PCB using an M3 nut and bolt; however, this is optional and it is not essential to do this. TR4 uses the diode bracket as a heatsink to aid heat dissipation, and is mounted as shown in Figure 4, using the M2.5 nut and bolt

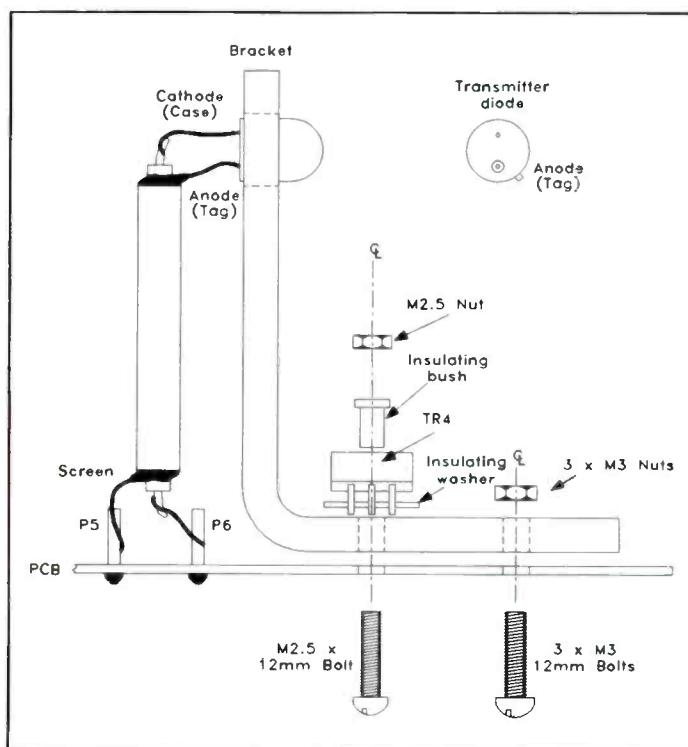


Figure 3. Mounting the emitter diode and diode bracket.

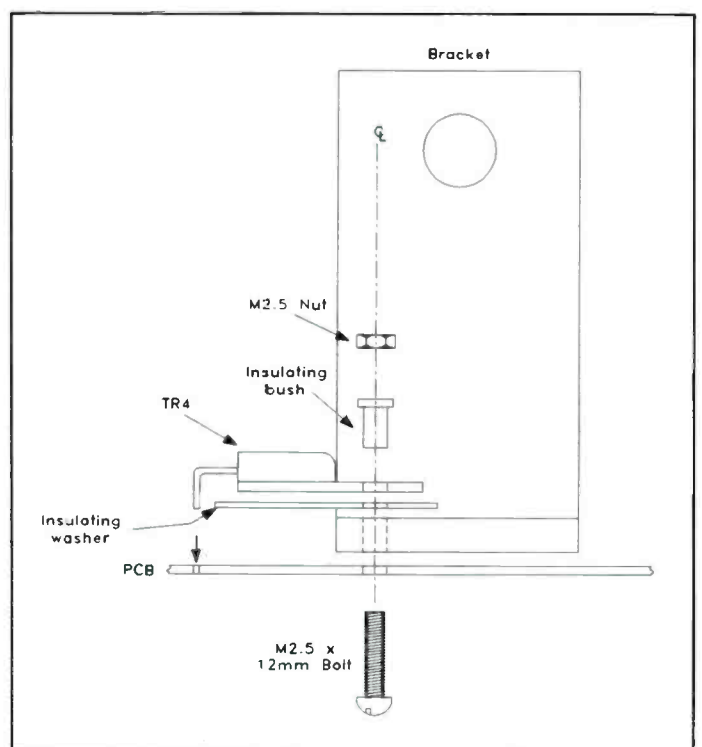


Figure 4. Mounting TR4 onto the bracket.



Infra-Red Video Link transmitter with top lid removed, showing internal assembly detail.

supplied in the kit. Please note: the transistor needs to be insulated from the bracket with an insulating bush and a greaseless washer.

Testing

Before applying power to the circuit, it is recommended that you double-check your work to ensure that all of the components are fitted correctly, and that there are no dry joints or solder bridges. Power supply connections are made via a PCB-mounted 2.5mm power socket; the outer part of the power plug should be connected to 0V,

and the inner part to +V. The circuit requires a 12V to 14V DC power supply capable of supplying at least 500mA. Although the module has its own on-board regulation and decoupling components, it is recommended that a power supply with a suitably smooth output is used to prevent any unwanted modulation of the supply rails. A suitable power supply for the unit is YZ21X. The composite video input signals are applied to P1 (input), and the return (ground) to P2 (0V), via the BNC input socket. The input signal level should be approximately 1V peak-to-peak.

It is not possible to test the unit fully without the appropriate infra-red receiver, or a full set of test equipment. The receiver will be detailed in the next issue of 'Electronics'. If you have an oscilloscope set up to display a video signal, it is possible to make basic tests on the unit. Apply a video signal to the input, and monitor the signal between P3 and ground (P4). Set RV1 to the centre of its travel, as marked by the arrow on the PCB legend. The oscilloscope should display a similar waveform to that of the original source video signal, although the levels will probably be different. The waveform displayed is that of the drive signal to the power output stage. If the signal on P6 is monitored, a somewhat compressed version of the signal should be displayed on the scope screen: this corresponds to the voltage across IR1. Although these tests are relatively simple, they allow the basic operation of the circuit to be assessed. The setting of preset RV1 depends on the location of the transmitter and receiver, and should be left until both units are in place and the system is up and running.

Housing

An undrilled case is supplied in the kit, to house the transmitter. The drilling details are shown in Figure 5. The box has slots to hold the Fresnel lens in place. In each case, the PCB is mounted using 4 x M3 nuts and bolts. 1/4in. spacers are used to position the PCB at the correct height in the case. The PCB is mounted such that the vertical part of the 'diode bracket' is positioned 270mm from the lens (as

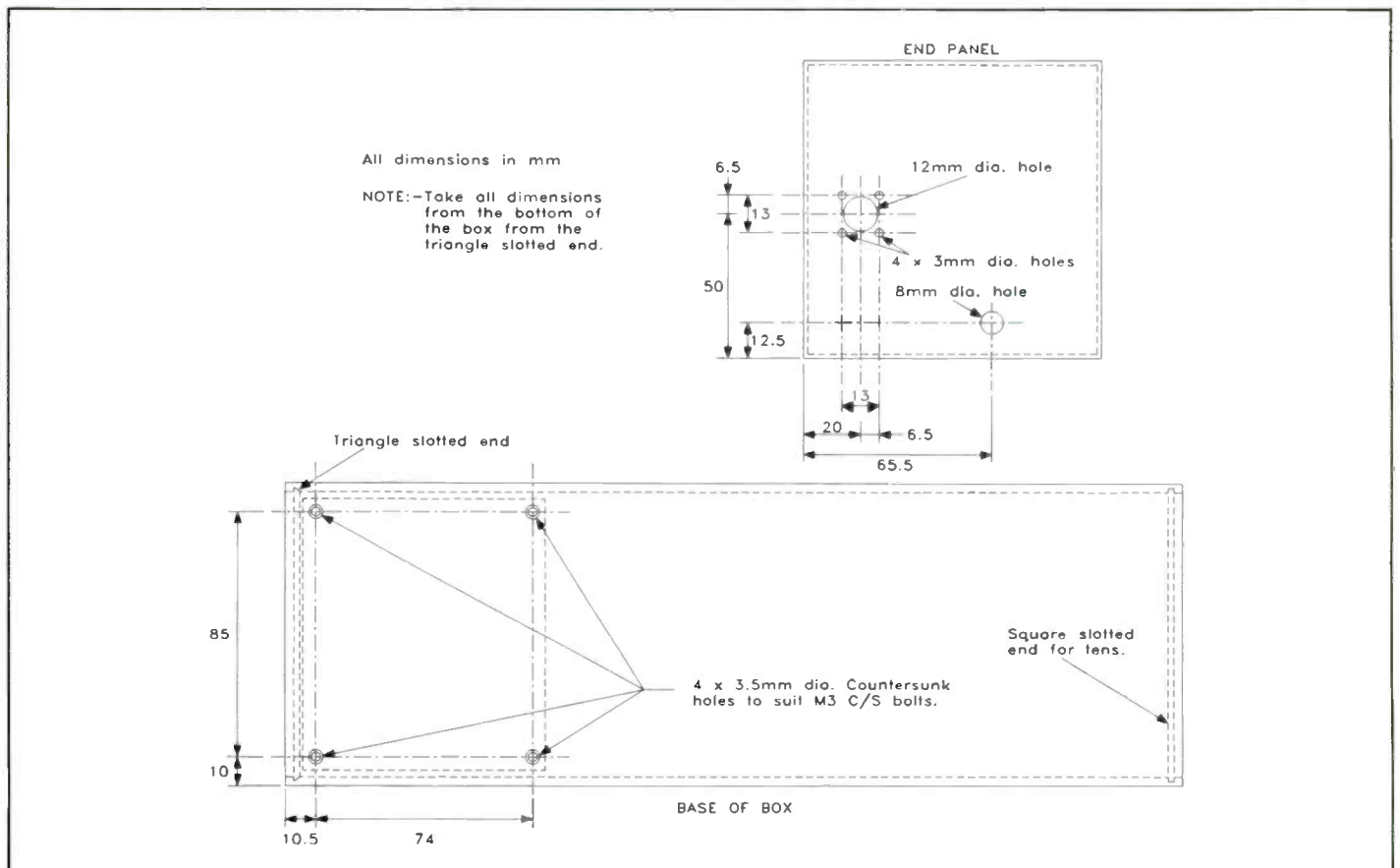
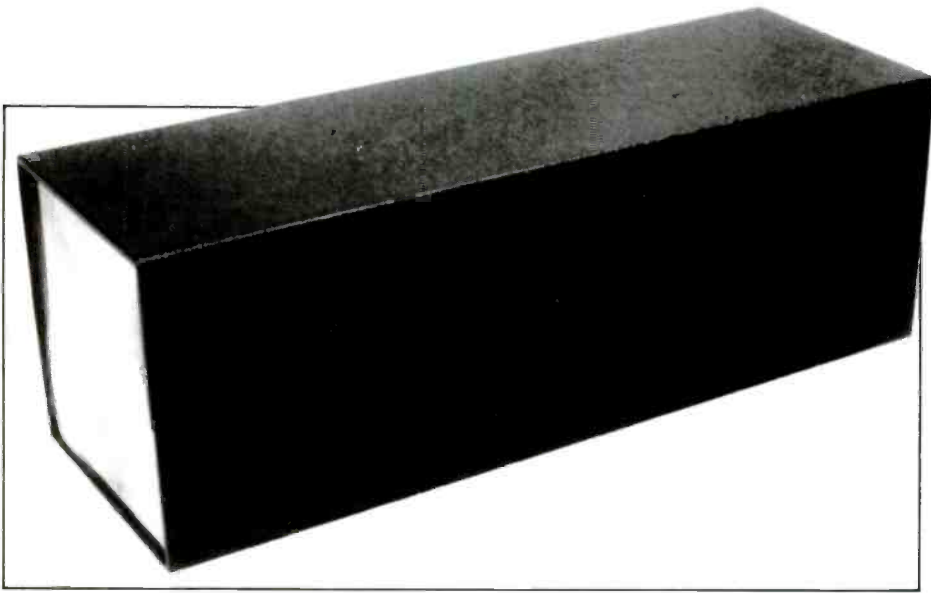


Figure 5. Drilling details.



Front of unit, showing mounting of Fresnel lens.

accurately as possible); this is approximately the focal length of the lens and has been found to provide the optimum range. Figures 6 and 7 show how to mount the lens and PCB in the case (see note below). The input (BNC) socket, SK2, is mounted on the rear panel, and is wired to the PCB. The power socket (SK1) does not require any additional wiring, being PCB mounted. It is, however, necessary to drill a suitable hole in the rear panel of the box to allow a 2.5mm power plug to be inserted.

The Fresnel lens, as supplied, is too large to fit into the end of the box supplied in the kit, and a box to hold a lens of this size would not be practical in many cases. It is therefore necessary to cut the lens to the correct size to fit into the box, and this is 103mm x 103mm. It is important that the lens is cut as carefully and accurately as

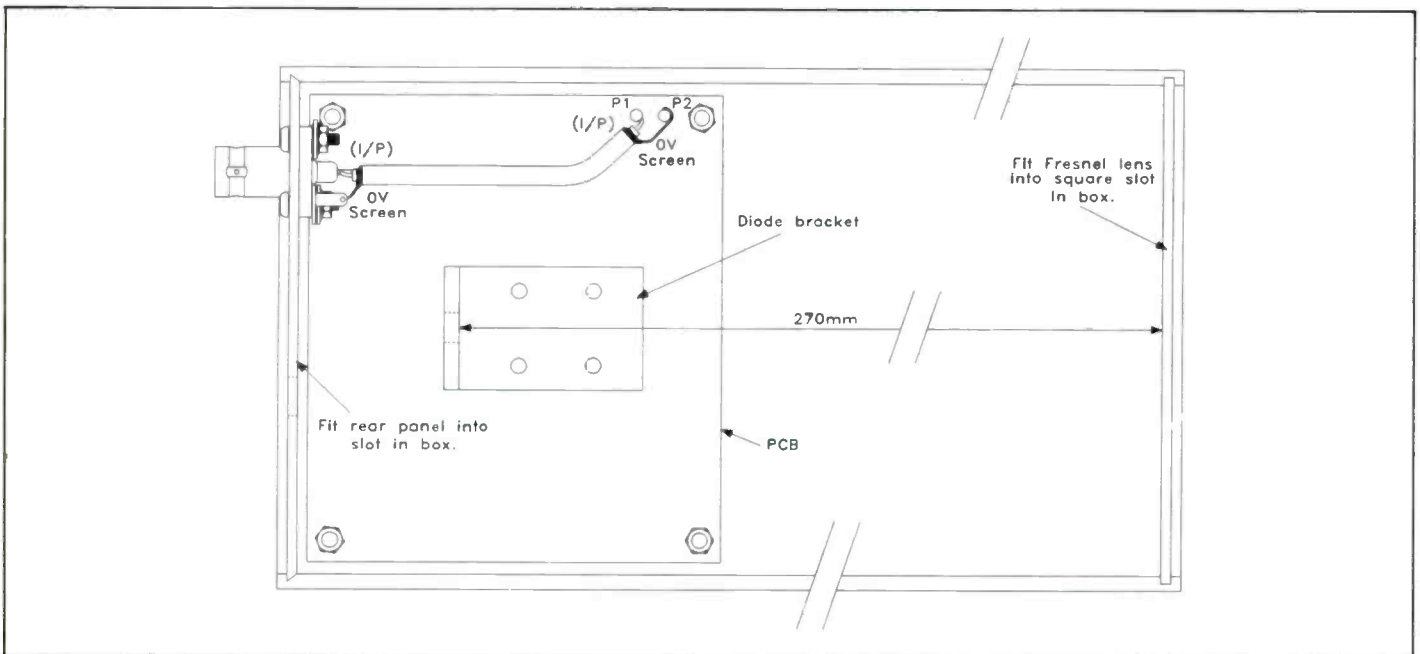


Figure 6. Positioning the PCB and wiring SK2.

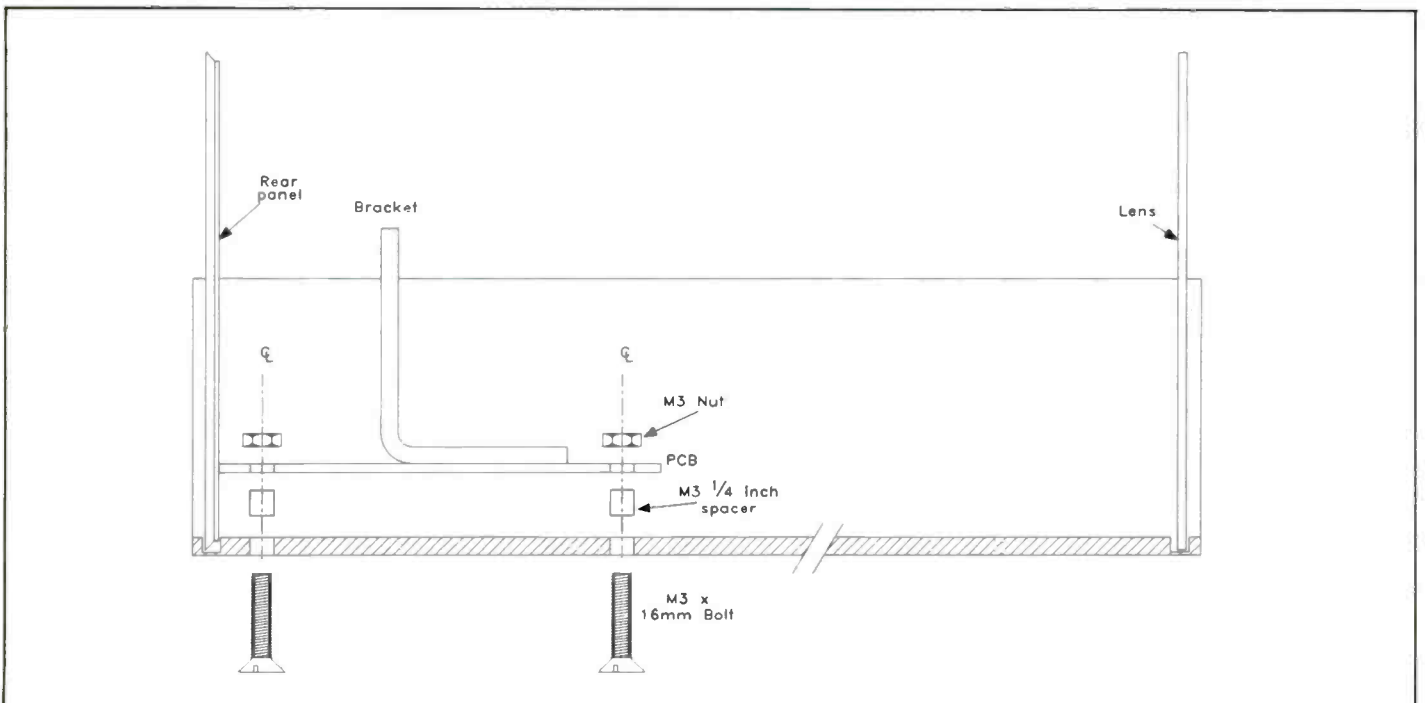


Figure 7. Mounting the PCB, lens and rear panel.

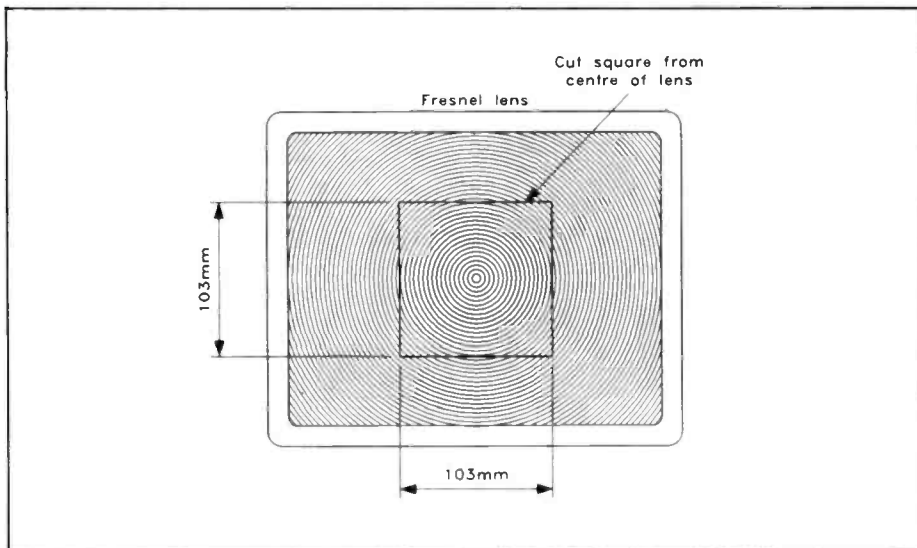


Figure 8. Cutting the Fresnel lens.

possible to ensure a correct fit. In addition, when trimming the lens down to size, material should be cut equally from the four sides so that the central point of the concentric rings is in the centre of the square, as shown in Figure 8. The box is not resistant to water and if the system is used outdoors, a degree of waterproofing will be necessary. This may be achieved by smearing a thin layer of silicone rubber

sealant around all of the box joints, including the grooves for the lens and the rear panel. A suitable sealant is YJ91Y. It is recommended that where possible, the unit is mounted in a sheltered location.

Mounting Considerations

It is necessary to provide a secure mounting point for the transmitter and receiver units. This may be achieved in a

variety of ways; one method, used for the prototype, makes use of small speaker stands (stock code GL18U), which are supplied in a pack of 2 with a selection of different types of bracket. The stands are particularly useful as they allow the bracket to be moved freely for alignment purposes, and also clamp securely in place when alignment is complete. There are obviously many different methods of mounting the transmitter and receiver units, and the most suitable method must be chosen for each individual situation.

It is important that the finished transmitter is NOT pointed directly at the sun, as the lens could focus the sun's rays onto the PCB, emitter diode or associated components, generating heat and causing irreparable damage. This consideration may dictate where the unit is mounted, and in problem cases it may prove beneficial to devise a protective hood for the front of the unit, to shield the lens from direct sunlight.

NOTE: Part Two, which gives details of the matching receiver can be found in Issue 52 (XA52G).

INFRA/RED VIDEO LINK TRANSMITTER PARTS LIST

RESISTORS: All 0.6W 1% Metal Film (Unless specified)

R1	75Ω	1	(M75R)
R2,6	1M	2	(M1M)
R3,9	82k	2	(M82K)
R4,8,10,13,18	100k	5	(M100K)
R5,7,12	1k	3	(M1K)
R11,15	4k7	2	(M4K7)
R14	3k9	1	(M3K9)
R16,21	820Ω	2	(M820R)
R17	10k	1	(M10K)
R19,29	6k8	2	(M6K8)
R20	39Ω	1	(M39R)
R22	150Ω	1	(M150R)
R23	560k	1	(M560K)
R24	220Ω	1	(M220R)
R25	330Ω	1	(M330R)
R26	1k5	1	(M1K5)
R27	12k	1	(M12K)
R28	22Ω Wirewound 3W	1	(W22R)
RV1	2k2 Hor Enclosed Preset	1	(UH01B)

CAPACITORS

C1	2200μF 16V PC Electrolytic	1	(FF60Q)
C2	100μF 16V Minelect	1	(RA55K)
C3,5,14,17	10μF 16V Minelect	4	(YY34M)
C4,7,8	1μF 63V Minelect	3	(YY31J)
C6	100pF Ceramic	1	(WX56L)
C9,16	470pF Ceramic	2	(WX64U)
C10	150pF Ceramic	1	(WX58N)
C11,19,20	100nF 16V Minidisc	3	(YR75S)
C12,15	220pF Ceramic	2	(WX60Q)
C13	1nF Ceramic	1	(WX68Y)
C18	10nF Ceramic	1	(WX77J)

SEMICONDUCTORS

IC1	74HCU04	1	(UB04E)
RG1	μA7805UC	1	(QL31J)
TR1	VN10KM	1	(QQ27E)
TR2,3	2N7000	2	(UF89W)
TR4	VN66AF	1	(WQ97F)
D1	1N4001	1	(QL73Q)

D2-5	1N4148	4	(QL80B)
IR1	I/R Photo Emitter	1	(KW66W)

MISCELLANEOUS

P1-6	Pin 2145	1 Pkt	(FL24B)
	14-Pin DIL Socket	1	(BL18U)
	PCB	1	(GH01B)
SK2	BNC Square Socket	1	(YW00A)
SK1	PCB 2.5mm DC Power Socket	1	(FK06G)
	I/R Video Case	1	(GL48C)
	Fresnel Lens	1	(KW60Q)
	Diode Bracket	1	(KW65V)
	Insulator TO220	1	(QY45Y)
	Plastic Bush TO66	1 Pkt	(JR78K)
	Low Capacitance Cable	1m	(XR19V)
	TC Wire 1.6mm 16swg	1 Pkt	(BL11M)
	Pozi Screw M3 × 16mm	1 Pkt	(JC70M)
	Nut M3	1 Pkt	(JD61R)
	Bolt M2.5 × 12mm	1 Pkt	(JY31J)
	Nut M2.5	1 Pkt	(JD62S)
	Bolt M3 × 12mm	1 Pkt	(JY23A)
	Double Bubble Satchet	1	(FL45Y)
	Spacer M3 × 1/4in.	1 Pkt	(FG33L)
	Instruction Leaflet	1	(XK44X)
	Constructors' Guide	1	(XH79L)

The Maplin 'Get-You-Working' Service is available for this project, see Constructors' Guide or current Maplin Catalogue for details.

The above items are available as a kit, which offers a saving over buying the parts separately. Order As LP59P (I/R Video Link Tx Kit).

Please Note: Where 'package' quantities are stated in the Parts List (e.g., packet, strip, reel, etc.), the exact quantity required to build the project will be supplied in the kit.

All
You Need
to Build Your Own

FUN
TRONICS
PROJECT
No4

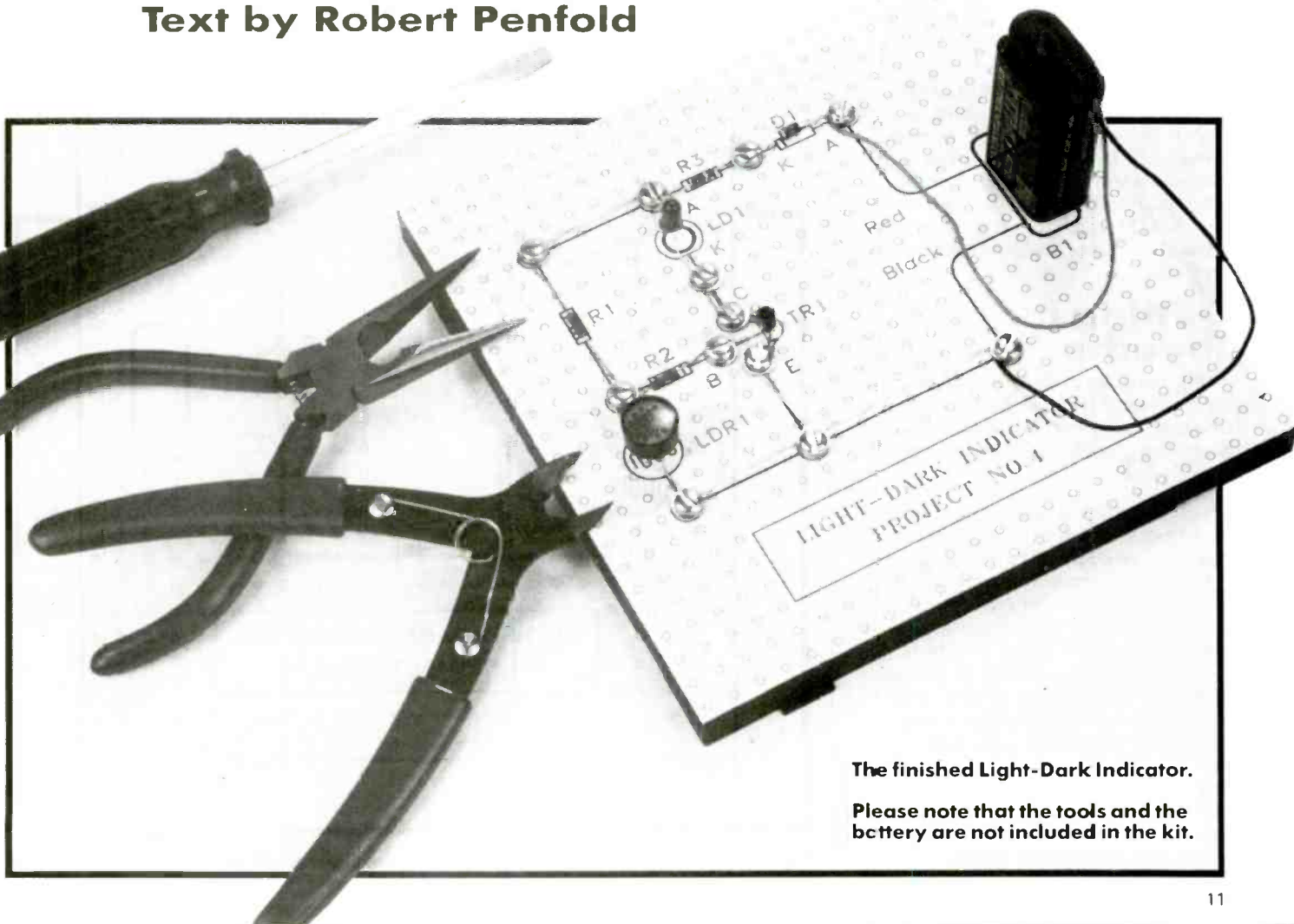
LIGHT-DARK INDICATOR

Text by Robert Penfold

This is the fourth in a series of easy-to-build electronic projects for complete beginners, who require a simple and fun starter to electronic project building. These projects are ideal for the young person as no soldering is needed. All the projects are built on the same type and size of plastic 'peg-board'. The only tools needed to build this project, and the others in the series, are a pair of wire cutters/strippers and a small screwdriver; a pair of pliers would also be useful.

This Month's Project

Light-operated switches are much used in day-to-day life, such as in street light switches, lift-door protectors, and other similar uses. This project is a very simple light-operated switch. In fact, it simply switches on a light-emitting diode (LED for short) indicator if it detects the absence of light. With a simple change to the circuit, this project will do the opposite — in other words, it will operate the LED indicator if the light level is above a certain amount.



The finished Light-Dark Indicator.

Please note that the tools and the battery are not included in the kit.

How it Works

The circuit diagram for the light-operated switch is shown in Figure 1. This is the darkness detector version of the unit (The 'lightness' detector is dealt with later). At the heart of the circuit is LDR1, the 'photocell'. This component is known as a 'light dependent resistor' (LDR for short), which means simply that its electrical resistance changes in sympathy with the light level that it receives. In darkness, LDR1 has a very high resistance, but in strong light it conducts electricity quite well.

Let us look, first of all, at how the circuit behaves in darkness. In this case, LDR1 has such a high resistance that it has very little effect on the circuit. The current through resistors R1 and R2 is enough to switch on the transistor (TR1), which in turn switches on the LED (LD1). R3 reduces the current flow to a level that is safe for both TR1 and LD1. D1 is a protection diode which is included in all 'Funtronics' projects. All this does is to 'block' the supply, should you accidentally connect the battery around the wrong way. This is because D1 (and all other types of diode, for that matter) allows electricity to flow in one direction only.

If the room is lit, or the unit is placed in daylight, the light level received by LDR1 is quite high. Because its resistance decreases, this component 'taps off' most of the current that would flow into the 'base' of TR1 if no light were to fall on LDR1. As a result, not enough current is present at this point to switch TR1 on, and so LD1 remains turned off. The circuit does not provide a true 'switching' (in other words, on/off) action; in other words, LD1 will light up dimly, over a small range of 'in-between' light levels.

Getting it Together

Firstly, read through this section and then *carefully* follow the instructions, one step at a time. Refer to the photographs of the finished project if this helps.

1. Cut out the component guide-sheet provided with the kit (which is a full-size copy of Figure 2), and glue it to the top of the plastic board. Paper glue or gum should be okay. Do not soak the paper with glue, a few small 'dabs' will do.

2. Fit the link-wires to the board using the self-tapping screws and washers provided. The link-wires are made from bare wire. Loop the wire, in a *clockwise* direction around each screw to which it must connect, taking the wire under the washers. Do not fully tighten a screw until all the leads that are

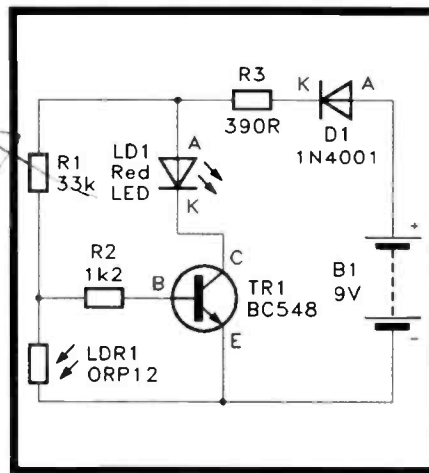


Figure 1. The Light-Dark Indicator Circuit Diagram. LDR1 is the photocell.

under it are in place, and do not over-tighten the screws, otherwise the plastic board may be damaged.

3. Recognise and fit the components, in the order given below, using the same method as for the link wires. Cut the components' wires so that they are just long enough to loop around the screws; otherwise long leads left flapping around may touch each other (this is known as a 'short-circuit') and may stop your circuit from working.

a) The first components to be fitted are Resistors R1, R2 and R3. These are small sausage-like components having a lead-out wire at each end, and four coloured bands around their bodies. The fourth band tells us how near to the given value the resistor is likely to be. This fourth band is known as the

'tolerance' band, and is gold in colour. However, we are interested in the first three bands, which tell us the value of the resistor. For R1, these bands are all orange. The colours for R2 are brown, red, and red again. The colour of R3's first three bands are orange, white and brown. These three coloured bands on each resistor tell us that: R1 has a value of 33,000 ohms, which is often written as 33 kilohms (or 33k Ω for short); R2 has a value of 1,200 ohms (written as 1k2 for short); and R3 has a value of 390 ohms (written as 390R for short). Unlike diodes or transistors, it does not matter which way round resistors are connected.

b) Next fit the LED, LD1, which is a 'blob' of clear red plastic, with two wires coming out of one end, as shown in Figure 3. It is fitted in the position shown on the guide-sheet, and *must* be connected the right way round – or it will not light up. One side of the LED is flattened (the lead on this side of the LED is known as the cathode (K), while the lead on the other, rounded, side is called the anode (A)). Make sure that the LEDs are fitted so that the 'flattened' sides line up with the drawing of the LED printed on the guide-sheet.

c) The next component to be fitted is D1, which is a small tube-like component having a lead at each end of its black body, as shown in Figure 4. Like LD1, it must be connected the right way round (In other words, D1 is a 'polarised'

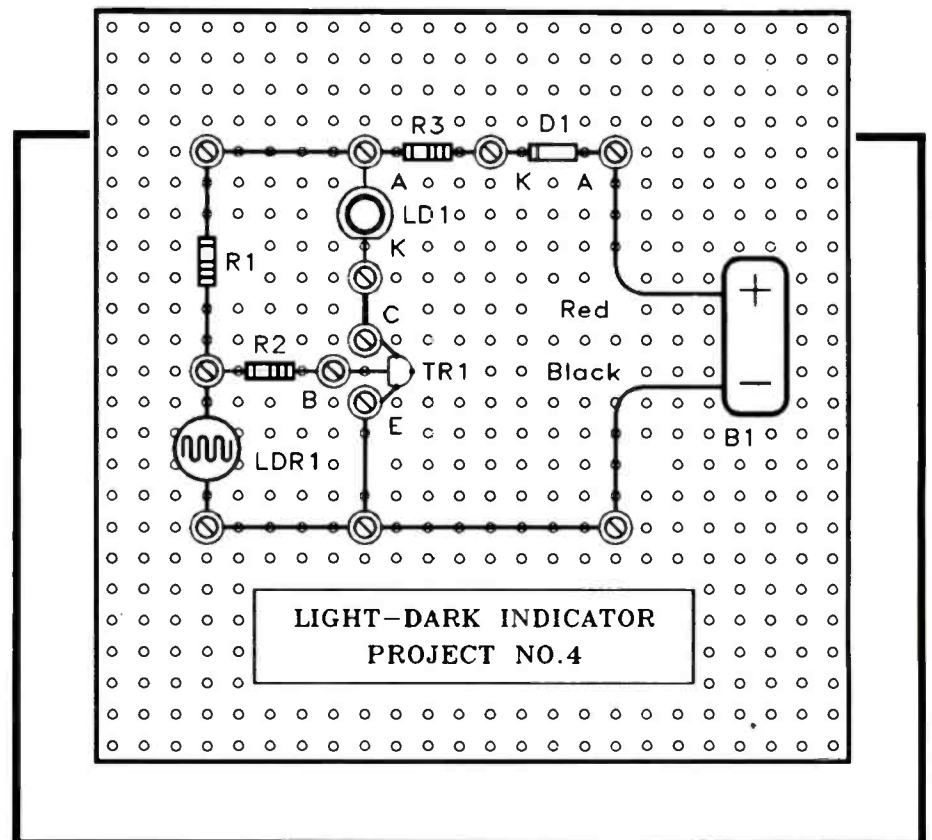


Figure 2. The component guide-sheet for the Light-Dark Indicator.

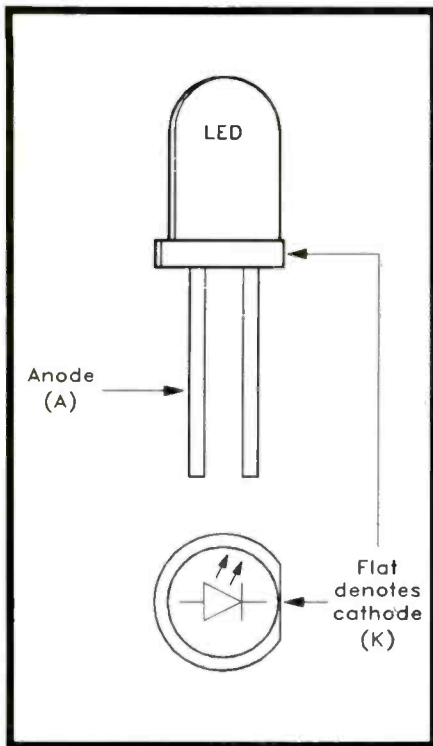


Figure 3. LED (LD1) connections.

component). Its 'polarity', which tells us the way in which it must be positioned, is indicated by a white (or silver) band close to one end of the body. The diode should be fitted so that the band lines up with that on the drawing of the diode on the guide-sheet.

d) TR1, the transistor, should now be fitted to the board. This has a small black plastic body with three lead-out wires. It will be marked with the type number, which in this case is 'BC548'. Other markings may also be present; you will have to get used to picking out the important markings on chips and transistors (and ignoring the others!). You must ensure that TR1 is fitted to the board correctly. Figure 5 shows which lead is which, making this task easy.

e) Next, fit LDR1, which is a thick disc-shaped component having two lead-out wires. The shiny surface with the visible zig-zag 'pattern' is the light sensitive one, and should face upwards. The distinctive pattern is in fact the track of light sensitive material (cadmium sulphide in this case). LDR1, being a resistor, can be connected either way round.

f) Lastly, fit the battery connector and battery, B1. The connector must be attached to the board with its coloured leads the correct way round. The battery connector has two press-stud clips on a piece of plastic and two wires coming from it, coloured red and black. The red and black leads should be connected as shown on the guide sheet. The 9V PP3 type battery should be connected to the battery connector; it will only fit properly one way round.

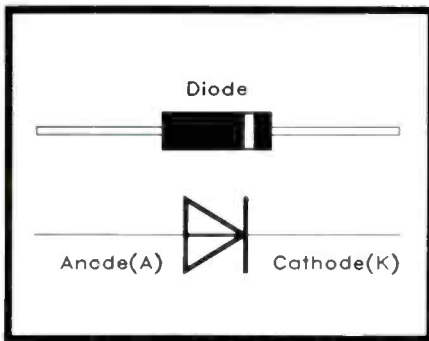
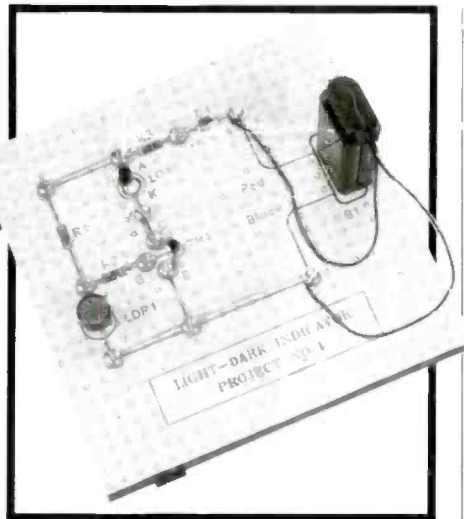


Figure 4. Diode (D1) connections.

Testing and Use

After checking that everything is in the right place and properly connected to the terminals, connect the battery to the battery dip. LD1 should not light up when the assembled unit is placed in daylight. Even the lower light levels produced by most electric lighting should keep LD1 turned off. Therefore, if LD1 switches on, disconnect the battery AT ONCE and recheck the wiring. In particular, make sure that LD1, D1, TR1, and the battery are fitted the right way round.

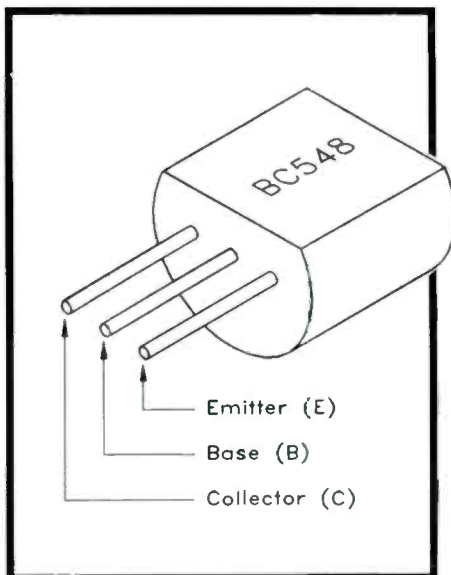


Figure 5. Transistor (TR1) connections.

If LD1 does not switch on, try placing your hand over LDR1, so that it receives very little light. This should force LD1 to come on. Although the circuit does not provide strict on/off switching, you should find it difficult to position your hand so that LD1 glows with anything less than full brightness. The high signal gain of the transistor ensures that only a very narrow range of light levels give 'in-between' brightness from LD1.

Using the Circuit as a Light Detector

In order to get the unit to work as a light detector, simply swap over R1 and LDR1. When LDR1 is subjected to light conditions, TR1 is now provided with an input current. TR1 then switches on, and turns on LD1. When LDR1 is in darkness, very little or no input current is supplied to TR1. Neither TR1 or LD1 are switched on as a result.

Uses of the Light-Dark Indicator

With LDR1 and LD1 within only centimetres of each other, the unit has little practical use. However, if you connect either LDR1 or LD1 to the main unit via a piece of two-way cable (which can be a few metres long if necessary), LDR1 or LD1 can be remotely located from the rest of the unit. A useful purpose for a project of this type is a photographic darkroom indicator. In this case, the unit would be set up as a darkness indicator, with LDR1 mounted inside the darkroom, and LD1 mounted outside it.

If LD1 is switched on, this would indicate that the room was dark. In other words, developing of film could be taking place, and so it may not be safe to enter the room. On the other hand, LD1 being switched off indicates a high light level in the room, telling us that it would safe to enter (assuming, of course, that the unit's battery had not run down!)

Availability

The Funtronics Light-Dark Indicator is available from Maplin Electronics, through our chain of regional stores, or by mail order, order code LP93B.



PEEP ALARM

The Peep Alarm is a light-operated sounder, simple but effective in its operation. In a dark environment, the unit remains quiet, and is for all practical purposes switched off. However, when light falls on the alarm's photosensor, the unit emits a loud, shrill tone. In addition, a light emitting diode (LED) illuminates, providing secondary indication that the circuit has been triggered. An on-board light sensitivity control is included in the design to allow operation in a variety of situations, over a range of light levels.

Circuit Description

Figure 1 shows the circuit diagram of the module. The circuit is based around a 4093BE CMOS quad Schmitt NAND IC (IC1). Diode D1 prevents damage to the circuit if the battery is unintentionally connected the wrong way round. The photosensitive device used is an ORP12 light dependent resistor (LDR), chosen for its wide change in resistance relative to a comparatively small change in light level. Together with R1, R2 and RV1, LR1 forms a potential divider. As light falls on LR1, its resistance decreases, reducing the voltage at the centre of the divider chain. When the voltage level drops to the switching threshold of IC1a, the output of the gate switches from low to high. The output of IC1a is fed to IC1b, which forms a gated oscillator. When the logic level on pin 5 is high, the oscillator operates, but when the level is low, the oscillator is disabled. The operating frequency of the oscillator is determined by R3 and C1, the supplied values of R3 and C1 generating a frequency of approximately 4.6kHz. IC1c forms an inverting buffer between the oscillator and sounder PZ1. Diode D2 is used to protect IC1 from any high voltage spikes which the sounder may produce. The output of IC1a is also fed to IC1d, which drives light emitting diode LD1. Resistor R4 limits the current through the LED.

FEATURES

- ★ Low Quiescent Current Consumption
- ★ Operates From 9V PP3 Battery
- ★ Simple Effective Design
- ★ Fibreglass PCB
- ★ LED Alarm Indicator
- ★ Light Sensitivity Control
- ★ Reverse-Polarity Protection

APPLICATIONS

- ★ Door Open Reminder
- ★ Case Alarm

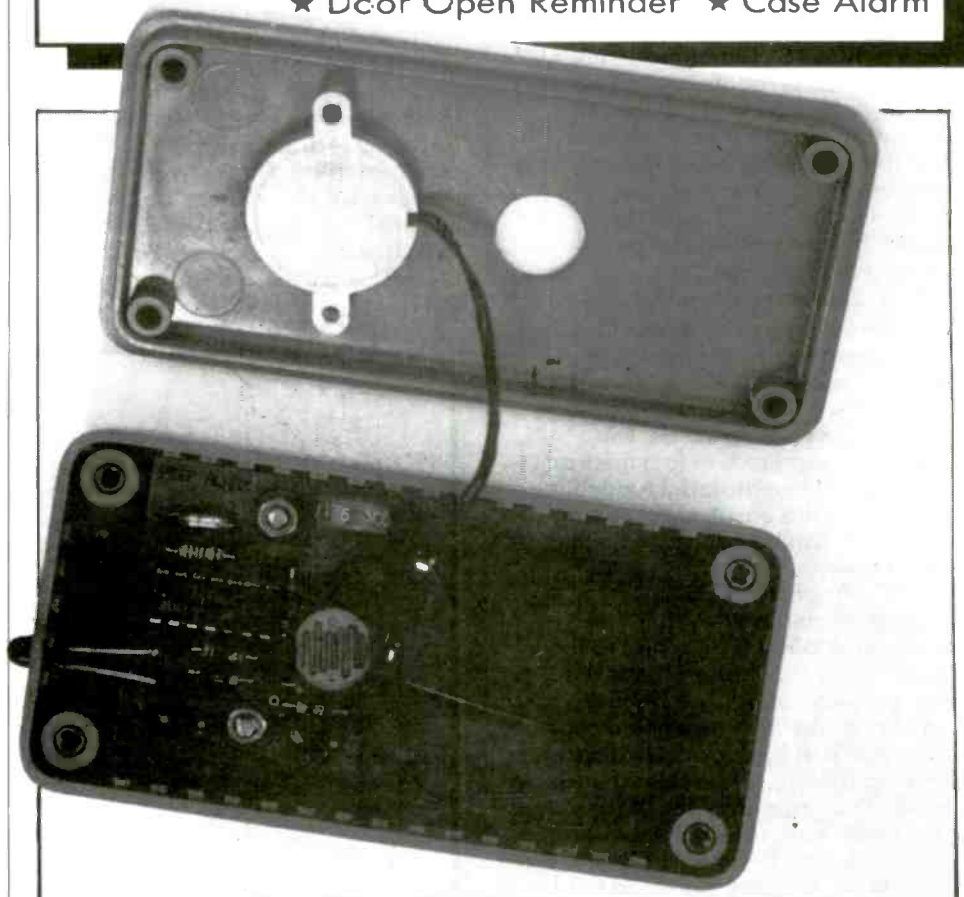


Photo 1. Assembled Peep Alarm with lid removed, showing positioning of PCB and battery.

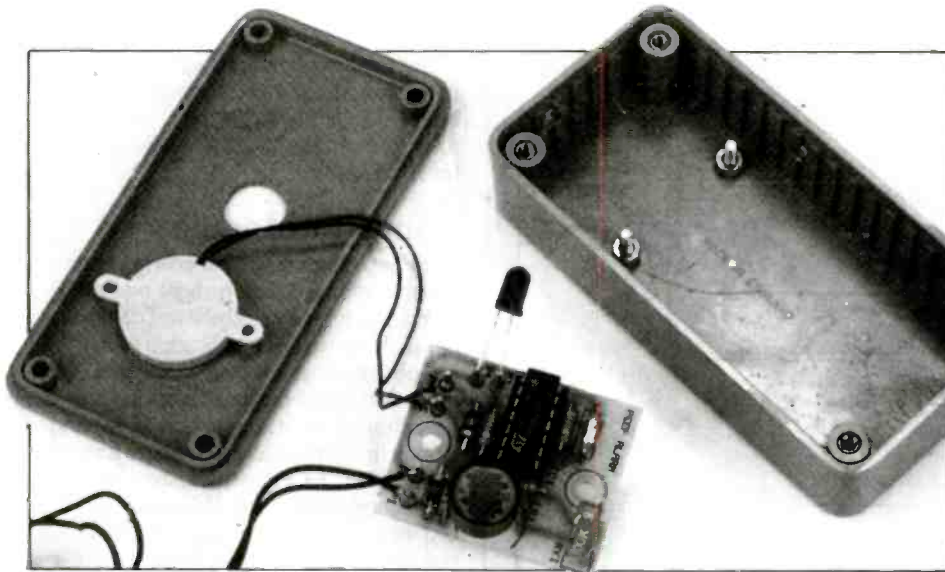


Photo 2. The complete Peep Alarm prior to final assembly.

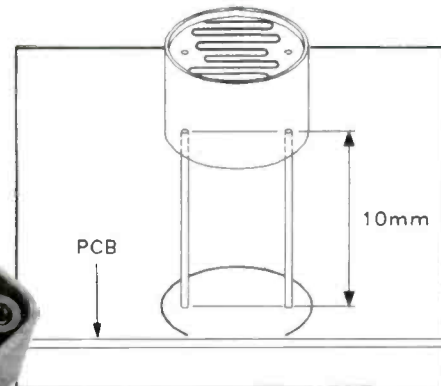


Figure 3. Mounting LR1.

corresponds with that in the socket. The battery clip is wired to P1 (red) and P2 (black). The light emitting diode, LD1, is soldered between P3 (anode) and P4 (cathode). The cathode of the LED is indicated by a flat edge on the side of the component body, and by the shorter of the two leads. PZ1, the piezo sounder, is wired between P5 and P6. All connections are illustrated in Figure 4, together with assembly information.

Housing

The Peep Alarm is housed in a small plastic box, which is included in the kit. The PCB is held in the box using M3 nuts and bolts, as shown in Figure 5. Additional M3 nuts are used as spacers under the PCB. The easiest method of assembly is to first insert the bolts into the underside of the box. Thread an M3 nut onto each of the bolts and screw down until locked into position. Now fit the PCB over the bolts, and lock it into place using a second set of M3 nuts. It is necessary to remove some of the moulded plastic guides from the end of the box to allow the battery to fit comfortably. It is also necessary to drill several holes in the box. Apart from those used to mount the PCB, holes must be drilled in the case lid, so that light can fall on LR1, and to allow the buzzer to be heard as loudly as possible. The drilling details are shown in Figure 6. Piezo sounder PZ1 should be held in place on the inside of the box lid (as shown in Photo 2), using the epoxy adhesive supplied in the kit. This device should be pressed, as tightly as possible, against the lid until the adhesive sets. Note: the hole in the centre of the sounder must correspond with the hole in the box lid.

Testing

Before testing the module, it is a good idea to double-check your work to make sure that all of the components are inserted correctly, and to ensure that there are no dry joints, or solder bridges between tracks. If all is well, connect a 9V alkaline type PP3 battery to the battery clip, observing the correct polarity. Place the module in a well-lit area, and adjust preset resistor RV1 until the sounder emits a loud high-pitched tone. If the unit is then placed in the dark (i.e. there is very little light falling on the sensitive surface of LR1), PZ1 should stop sounding. During the period when the unit is sounding, LD1 should glow, providing a secondary indication that the unit has been triggered. If you do not require LD1, this component may be omitted without any detrimental effect on the operation of the circuit. RV1 adjusts the sensitivity of the unit to light,

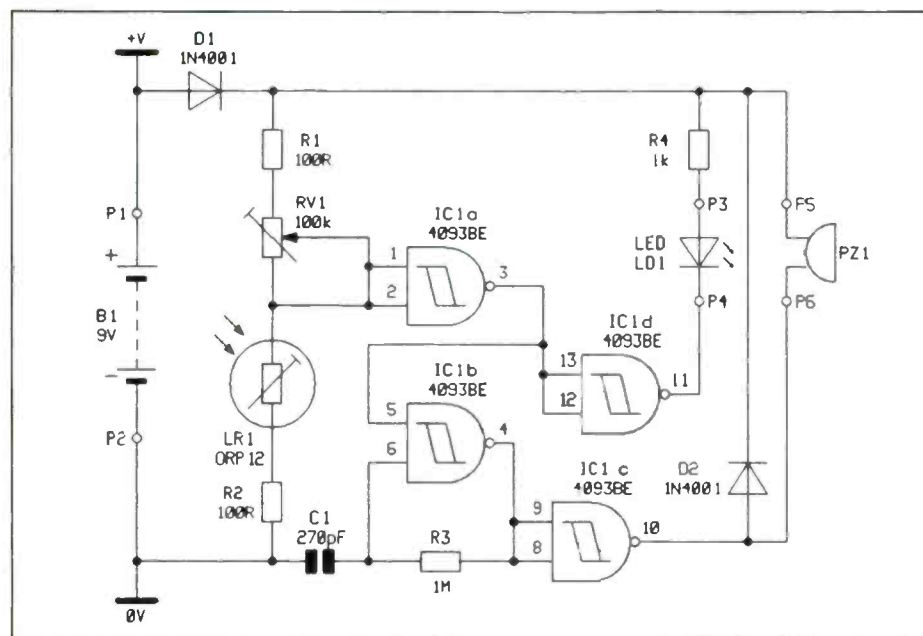


Figure 1. Circuit diagram.

Construction

The design uses a high quality, single-sided, glass fibre PCB, with a screen-printed legend, see Figure 2. Insert and solder the components onto the PCB, referring to the component legend, starting with resistors R1 to R4 and capacitor C1. Fit the IC socket, ensuring that the position of the notch at one end of the socket corresponds with that on the component legend. Do not fit the IC at this stage. P1 to P6, the PCB pins, are inserted into the PCB from the track side using a hot soldering iron. The head of the pin should be heated to the extent that very little pressure is required to press it home into the PCB. After the pin has been inserted it may then be soldered. Preset resistor RV1 is inserted so that its case corresponds with the outline on the component legend. When fitting D1 and D2, it is important that the correct polarity is observed; the negative end of the diode, indicated by a band at one end of the component, should be inserted so that it matches the band printed on the legend. Light dependent resistor LR1 should be mounted at a height of 10mm above the PCB, as shown in Figure 3. IC1 may then be inserted into the socket. The IC should be positioned so that the notch at one end of the component

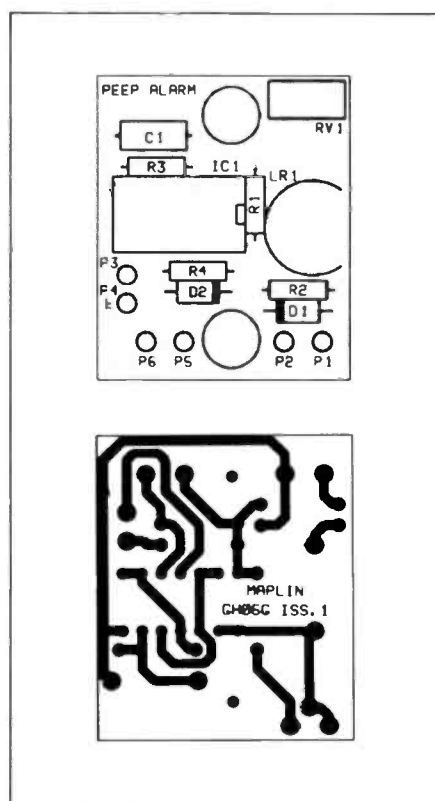


Figure 2. PCB legend and track.

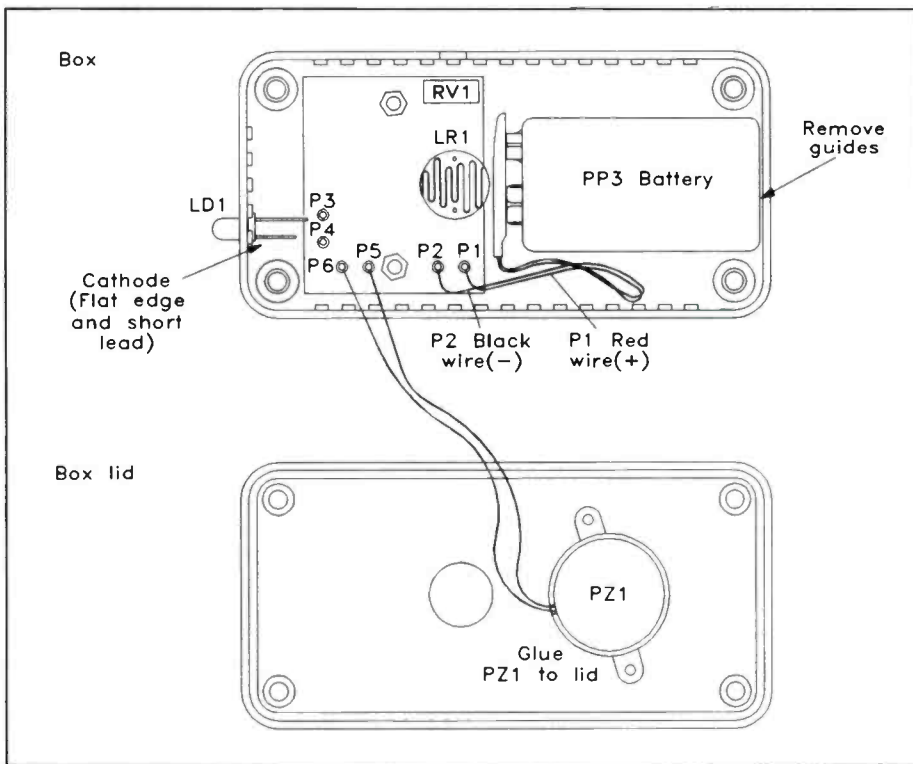


Figure 4. Assembly and wiring diagram.

and in practice it is necessary to adjust this control for optimum performance in any one particular situation. The circuit is set for maximum sensitivity when RV1 is fully anticlockwise.

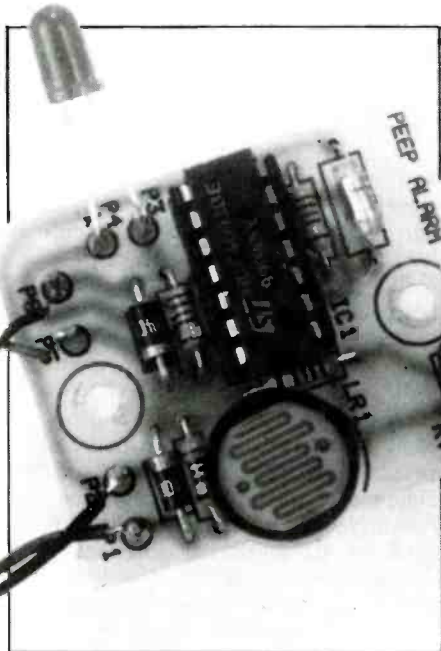
Using the Module

The Peep Alarm may be used in a variety of applications requiring a light-operated alarm. In a typical application, it could be used to provide an indication that a cupboard or case is open; a situation that could arise from an attempt to gain unauthorised access, or simply by leaving it open unintentionally. The alarm is purely intended to give a local indication, and is not designed to be audible over a long distance. Obviously the alarm will only operate in an environment where there is a significant increase in light level when the cupboard or case is opened. The Peep Alarm is, however, designed to operate over a wide range of ambient light levels.

Another application for the Peep Alarm is in a dark-room, where it could be used to give warning when the door is opened, or a light is switched on.

In a dark environment, the circuit is in its quiescent state, and therefore draws very little current; in this condition, the unit should operate for many hours from an alkaline PP3 battery. When the unit is sounding, the current drain is several milliamps; for this reason it is recommended that the unit is not left in the triggered state for more than a few minutes at a time, otherwise the battery will become quickly drained.

Table 1 shows the specification of the prototype Peep Alarm; the figures stated may vary slightly in practice due to component tolerances.



The assembled PCB

Power Supply:	9V alkaline type PP3 battery
Quiescent current drain:	less than $1\mu\text{A}$
Operating current:	14mA
Alarm Frequency:	4-6kHz approximately
PCB Dimensions:	41 x 34mm approximately

Table 1. Specification of prototype.

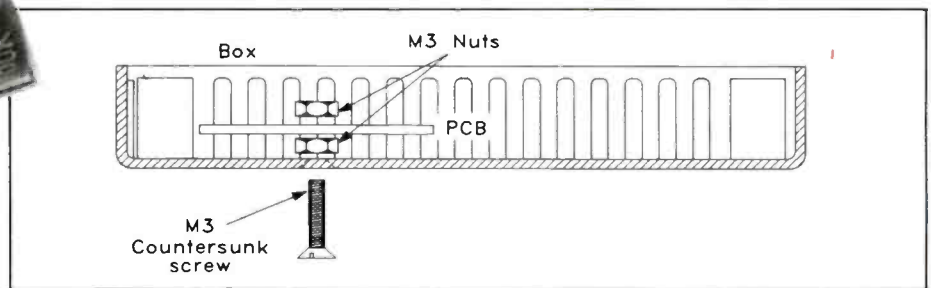


Figure 5. Mounting the PCB.

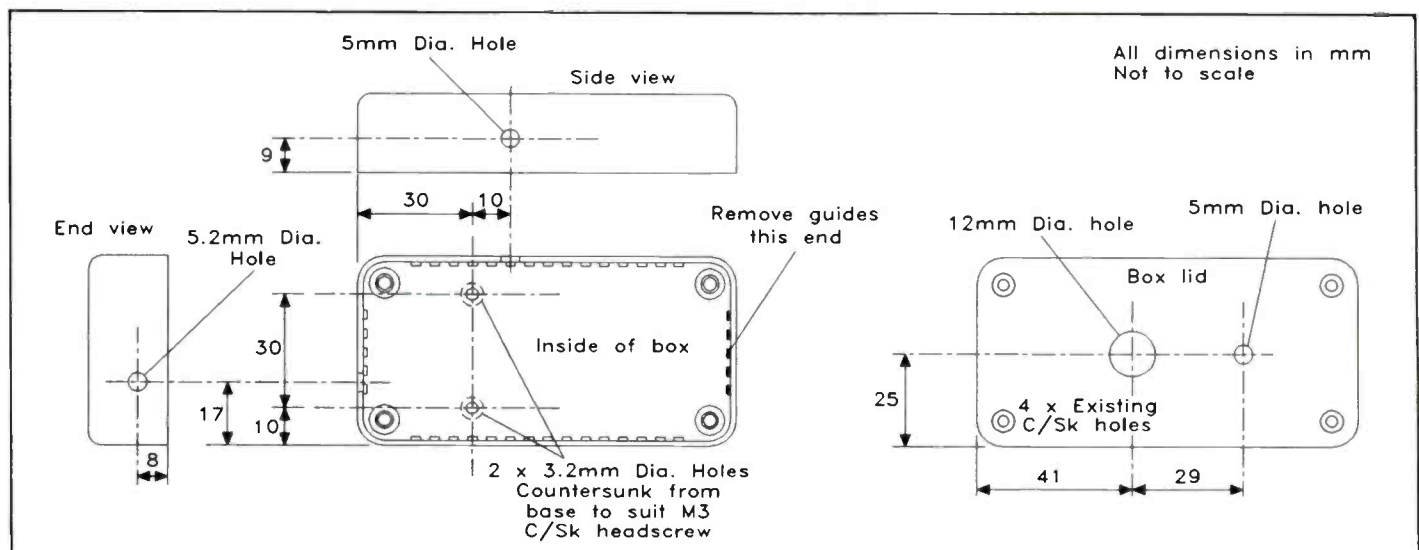


Figure 6. Drilling details.

PEEP ALARM PARTS LIST

RESISTORS: All 0.6W 1% Metal Film (Unless specified)

R1,2	100Ω	2	(M100R)
R3	1M	1	(M1M)
R4	1k	1	(M1K)
RV1	100k Vert Enclosed Preset	1	(UH19V)

CAPACITORS

C1	270pF 1% Polystyrene	1	(BX50E)
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SEMICONDUCTORS

IC1	4093BE	1	(QW53H)
D1,2	1N4001	2	(QL73Q)

MISCELLANEOUS

LD1	LED Red 5mm 2mA	1	(UK48C)
PZ1	Low Profile Sounder	1	(KU57M)
LR1	LDR ORP12	1	(HB10L)
	PP3 Clip	1	(HF28F)
	Pin 2145	1 Pkt	(FL24B)
	14-Pin DIL Socket	1	(BL18U)

PCB	1	(GH06G)
ABS Box 2002	1	(WY03D)
Pozi Screw M3 × 10mm	1 Pkt	(LR57M)
Nut M3	1 Pkt	(JD61R)
Double Bubble Sachet	1	(FL45Y)
Instruction Leaflet	1	(XT41U)
Constructors' Guide	1	(XH79L)

The Maplin 'Get-You-Working' Service is available for this project, see Constructors' Guide or current Maplin Catalogue for details.

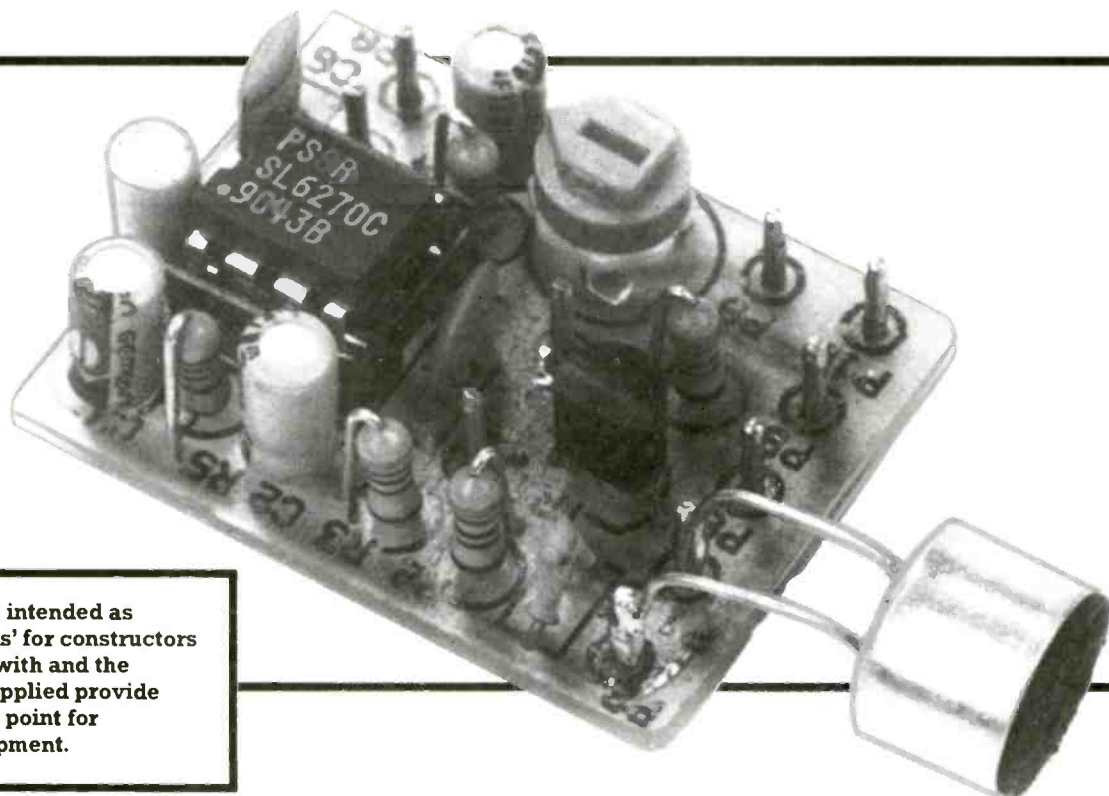
The above items are available as a kit, which offers a saving over buying the parts separately.

Order As LP50E (Peep Alarm Kit).

Please Note: Where 'package' quantities are stated in the Parts List (e.g., packet, strip, reel, etc.), the exact quantity required to build the project will be supplied in the kit.

**DATA
FILE**

SL6270 AGC MICROPHONE PREAMPLIFIER



'Data Files' are intended as 'building blocks' for constructors to experiment with and the components supplied provide a good starting point for further development.

FEATURES

- ★ CONSTANT OUTPUT SIGNAL
- ★ FAST ATTACK
- ★ LOW POWER CONSUMPTION
- ★ SIMPLE CIRCUITRY
- ★ SINGLE-ENDED OR DIFFERENTIAL INPUT

APPLICATIONS

- ★ Audio AGC system
- ★ Transmitter overmodulation protection
- ★ Tape recorders
- ★ Audio surveillance

The SL6270 is a small 8-pin Integrated Circuit (IC) combining the functions of an audio amplifier and Voice Operated Gain Adjusting Device (VOGAD). It is designed to accept small signals from a microphone and to provide an essentially constant output signal from an

input covering a range of 50dB. The dynamic range, attack and decay times are controlled by external components. The device will operate over a wide range of power supply voltages between 4.5V to 10V and consumes only 9mA from a 9V battery. Figure 1 shows the IC

pinout, and Table 1 gives the electrical characteristics of the device.

IC Description

Figure 2 shows the block diagram of the SL6270. Its positive power supply input is on pin 3, which should be decoupled to 0V ground by a

small 100nF ceramic capacitor. Pin 6 is used as a common 0V ground return for all stages within the device.

The AGC controlled preamplifier stage has a true differential input on pins 4 and 5, allowing it to be driven single endedly without the problems caused by other

PROTOTYPE SPECIFICATION

Power Supply Voltage: +4.5V to +10V (P6) and 0V (P5)
 Power Supply Current: 11mA (+9V Supply)
 Microphone Input: Electret or Dynamic inserts
 Input Impedance: Electret 4k7Ω (P1) and 0V (P2)
 Dynamic 150Ω (P3) and 0V (P2)
 Dynamic 300Ω (P3 and P4)
 Voltage Gain: 52dB
 Maximum Output: 90mV rms (P9) and 0V (P10)
 Minimum Load Impedance: 1kΩ
 Frequency Bandwidth (-3dB): 300Hz to 3kHz

forms of push-pull circuits. The applied audio signal must be AC coupled to the input via a capacitor, and in the single ended mode it can be applied to either input. Each input has a very low impedance, only 150Ω if single-ended, doubling up to 300Ω if differential mode is used. Signals of less than a few hundred microvolts are amplified normally, but as the input level increases the AGC begins to take effect and the output signal on pin 8 is held constant at approximately 90mV rms over the full input range of 50dB, see Figure 3. The test conditions used to obtain this graph were as follows: power supply voltage +6V, input frequency 1kHz, ambient temperature +25°C, single-ended input. In order to ensure that internal offsets within the amplifier are of such polarity as to inhibit oscillation at the onset of AGC, a 22k

extends beyond 1MHz, see Figure 4. However, this bandwidth can be restricted by placing an external capacitor between pins 7 and 8. These are the input and output connections of the main amplifier, which has an internal 10kΩ resistor to set the flat response open loop gain. As the value of the external capacitor increases, the upper frequency response decreases and for radio communications this is normally chosen to give a -3dB point at 3kHz, which corresponds to 4.7nF. In addition, the dynamic range and sensitivity of the system can be reduced by placing a resistor between these two pins, and as its value decreases, the voltage gain of the main amplifier will continue to drop. An approximate reduction of 20dB in gain can be achieved with a

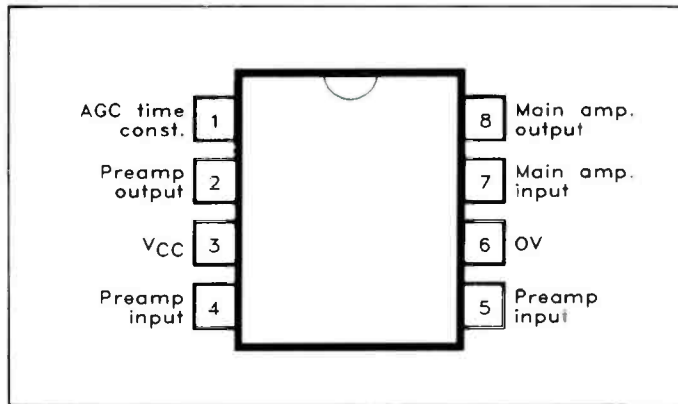


Figure 1. IC Pin connections.

Test conditions - Supply voltage V_{cc} : 6V Input signal frequency: 1kHz Ambient temperature: -30°C to +85°C					
Characteristic	Value			Units	Conditions
	Min.	Typ.	Max.		
Supply current		5	10	mA	
Input impedance		150		Ω	Pin 4 or 5
Differential input impedance		300		Ω	
Voltage gain	40	52		dB	72μV rms input pin 4
Output level	55	90	140	mV rms	4mV rms input pin 4
THD		2	5	%	90mV rms input pin 4
Equivalent noise input voltage		1		μV	300Ω source, 400Hz to 25kHz bandwidth

Table 1. Typical electrical characteristics.

resistor should be connected from pin 5 to the 0V supply line.

The output from the AGC preamp stage (pin 2) is coupled via a capacitor to the input of the main amplifier (pin 7). The low frequency (LF) response of the system is determined by the value of this capacitor and the internal 680Ω resistor on pin 2. For normal speech radio communications, this coupling capacitor is chosen to give a -3dB output amplitude point at 300Hz, which corresponds to 2.2μF. The LF response can be extended down to 100Hz or less by simply increasing the value of this capacitor, although values greater than 100μF are not recommended.

The combined amplification system has an upper frequency response which

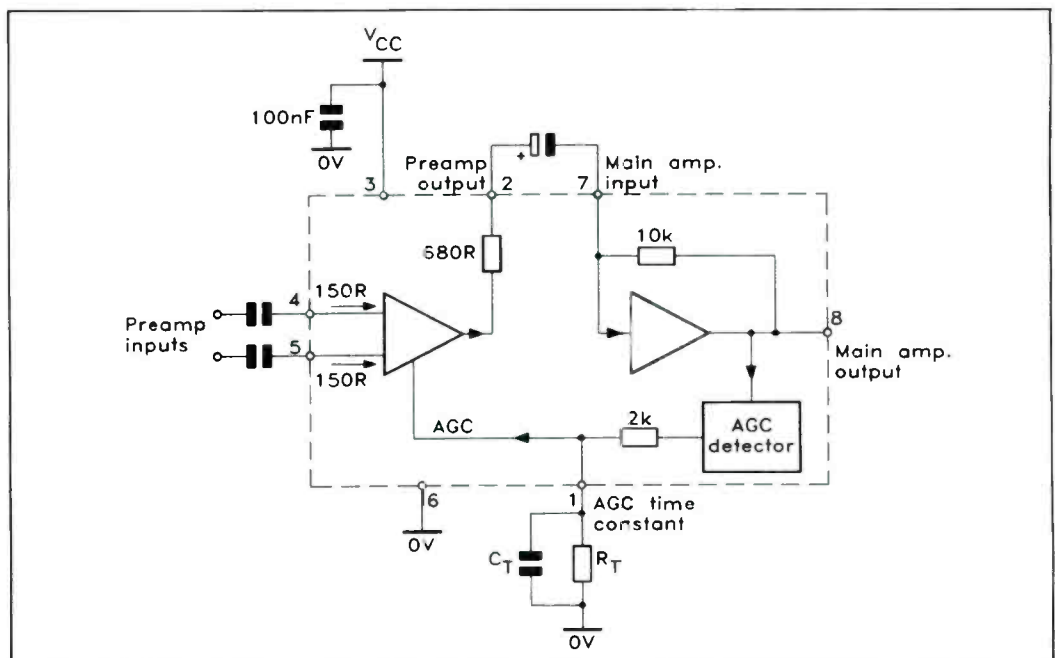


Figure 2. Block diagram.

value of $1k\Omega$, but values less than 680Ω are not advised. The final audio output on pin 8 has a small DC offset voltage, so it is good practice to use an AC coupling capacitor before connecting it to any other circuits. To ensure a good LF response into loads as low as $1k\Omega$, this capacitor should be not less than $22\mu F$.

The main amplifier also drives the AGC detector, and the DC voltage generated by this circuit is directly related to the signal level applied to the preamp input pins 4 and 5. This control voltage is used to progressively reduce the gain of the preamp as the input level increases. Because of its careful design, the device has an extremely high input dynamic range and using the same test conditions as before; Figure 5 shows the distortion characteristics at various input levels.

The AGC attack and decay characteristics are set by the external RC timing components on pin 1. Normally the SL6270 is required to respond quickly by holding the output level almost constant as the input level is increased. This attack time is set by the value of the capacitor C4, and is defined as the time taken for the output to return to within 10% of the original level following a 20dB increase in input level. A fast attack response can be obtained by using an electrolytic capacitor in the range $22\mu F$ to $47\mu F$. The decay time is set by the value of the resistor R6, which discharges the current held by the capacitor, the recommended decay rate being approximately 20dB/second, and this slower response time is obtained by using a value of $1M\Omega$.

Maplin Kit

A kit of parts, including a small fibreglass PCB with printed legend, is available as stock code LP98G. The basic kit as supplied is for use with radio communication equipment, and Table 2 shows the specification of the prototype. Because the SL6270 may be used in many varied applications, some of the component values supplied in the basic kit will not be suitable, so alternative values must be calculated to

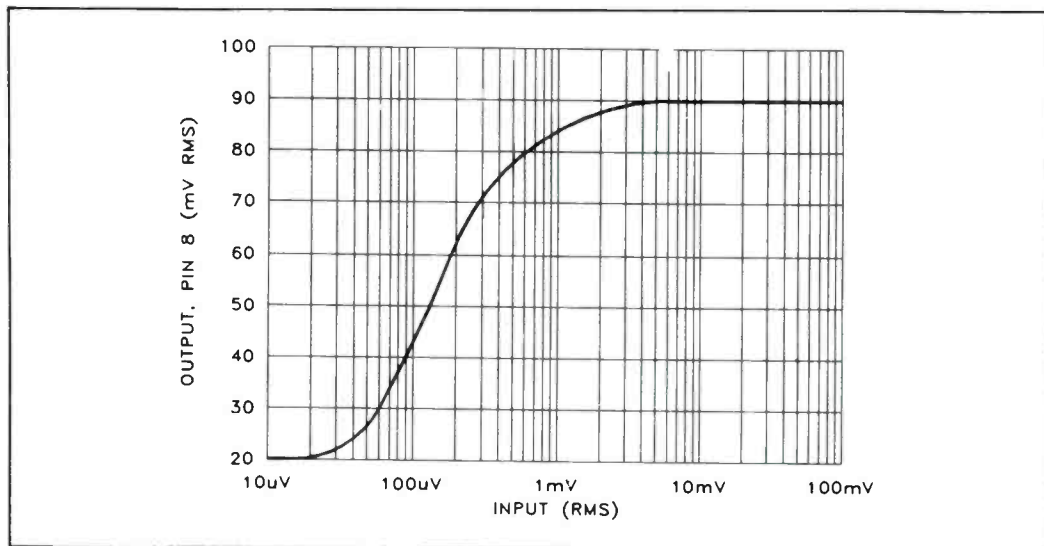


Figure 3. Input/output characteristics.

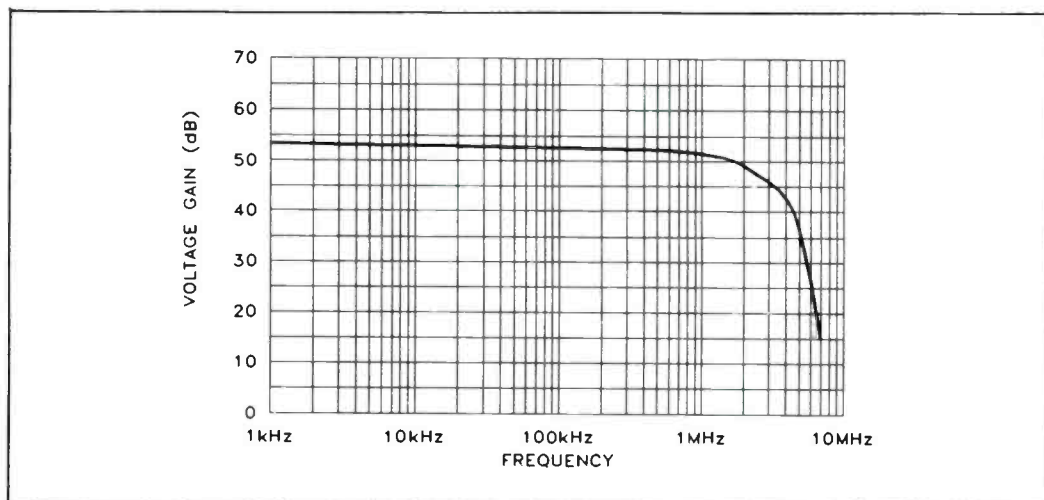


Figure 4. Frequency response.

determine the new working parameters.

Figure 6 shows the circuit diagram of the module, and as can be seen, some additional components have been included to provide the following extended features. A low noise transistor, TR1, is

used to provide a suitable input for an electret microphone insert which is included in the kit. A preset resistor, RV1, provides the means of adjusting the audio output level. Finally, terminal pins are provided for the off-board connections:

- P1. Electret microphone insert signal input.
- P2. Electret microphone insert 0V ground.
- P3. Dynamic microphone insert signal input 1.
- P4. Dynamic microphone insert signal input 2.

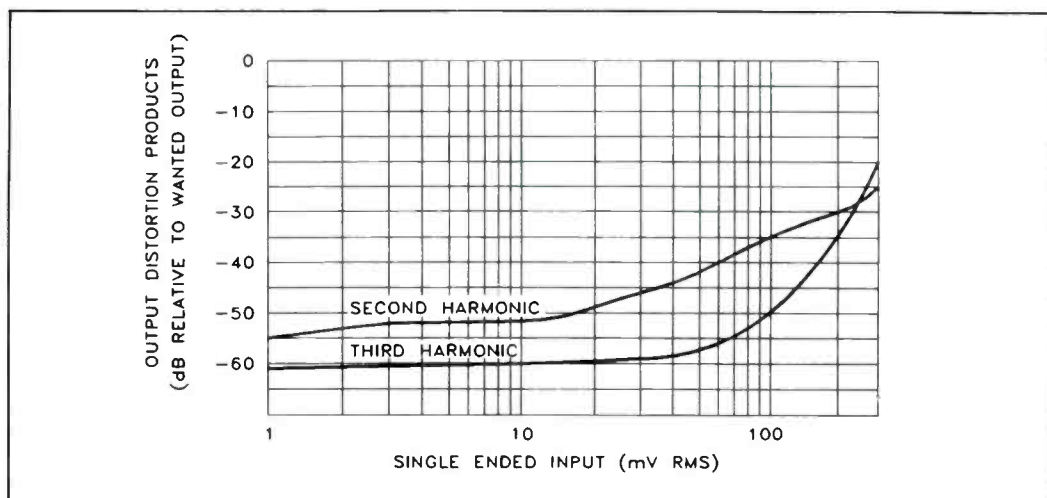


Figure 5. Distortion products versus input signal.

- P5. 0V ground power supply (-V battery).
- P6. +V power supply input (+4.5V to +10V).
- P7, P8. Dynamic range and sensitivity reduction (4k7 or 1k resistor).
- P9. Audio output (90mV rms into 1k).
- P10. Audio output 0V ground.

All the components and their relative positions are shown in Figure 7.

Using the Module

The electret microphone insert connections to the module are illustrated in Figure 8a. This wiring diagram also shows the power supply, audio output and optional dynamic range/sensitivity reduction resistor. If you intend to use a low impedance dynamic insert (not supplied in kit) then the option outlined in Figure 8b (single-ended), or 8c (differential) should be followed, taking note of the necessary component changes to the PCB:

Remove R1, R2, R3, C1 and TR1.

Reverse the polarity of C2.

To minimise any stray electrical noise pick-up, the connecting leads between the microphone insert and the module should be kept as short as possible, e.g. less than 50mm. For longer runs screened cable is recommended (as supplied in kit) but this too should be kept as short as possible, e.g. less than 500mm. When using electret or dynamic single-ended inserts, miniature single core screened cable is suitable. However, when using a dynamic microphone in the differential input mode, as in Figure 8c, open wires or twin overall screened cable can be used. To ensure effective screening, the outer braiding of the cable should *always* be connected to the 0V ground on P2.

The module is designed to operate over a wide supply voltage range and has a relatively low power consumption, making it suitable for battery operation. A good quality alkaline 9V PP3 battery is capable of running the circuit for a considerable period of time. For this reason a PP3 battery clip is also included in the kit. However,

no on/off switch is supplied because of the numerous switch styles, types and switching methods available, here are just a few to choose from:

Toggle, Rocker, Rotary, Slide, Push and microphone PTT.

On most radio communication microphones an integral Push-To-Talk (PTT) switch is used to activate the transmitter. If this switch has a spare set of contacts then the power to the module can only be applied during the transmit period, so this technique extends the operational life of the battery. If you do not intend to use a battery then it is important that the power supply is adequately decoupled to prevent audio, digital, or mains derived hum and noise from entering the circuit via the supply rail.

Screened cable should also be used on the audio output of the module and be kept as short as possible, e.g. less than 3 metres. To ensure effective screening the outer braiding of the cable must be connected to the 0V ground at P10. The output level of the module is adjusted by RV1, with its minimum setting at the fully counterclockwise position, see Figure 8.

With no additional resistor placed across pins P7 and P8 the sensitivity of the module will be at maximum. Under this condition any low level sound picked up by the microphone will be highly amplified. If there is an unduly high level of distracting background noise the overall speech intelligibility will suffer. To minimise this effect the sensitivity of the module must be reduced by adding a resistor across P7 and P8, see Figure 8. As its value decreases, so also will the sensitivity, until the permitted 680Ω minimum is reached. After some experimentation the following resistor values where chosen:

- No resistor = full sensitivity.
- 4k7 resistor = medium sensitivity.
- 1k resistor = low sensitivity.

As the sensitivity decreases it will become necessary to speak louder, and/or closer to the microphone in order to maintain the same average output level.

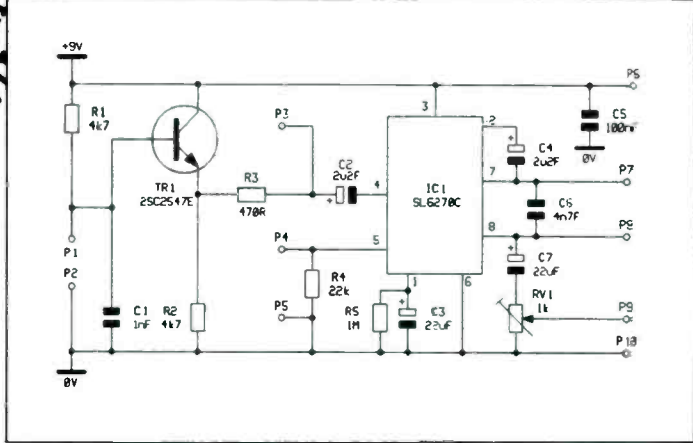


Figure 6. Circuit diagram.

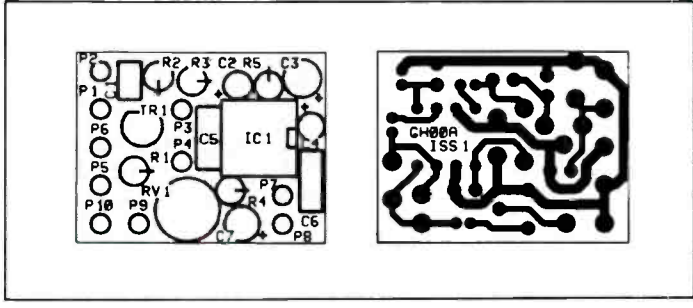
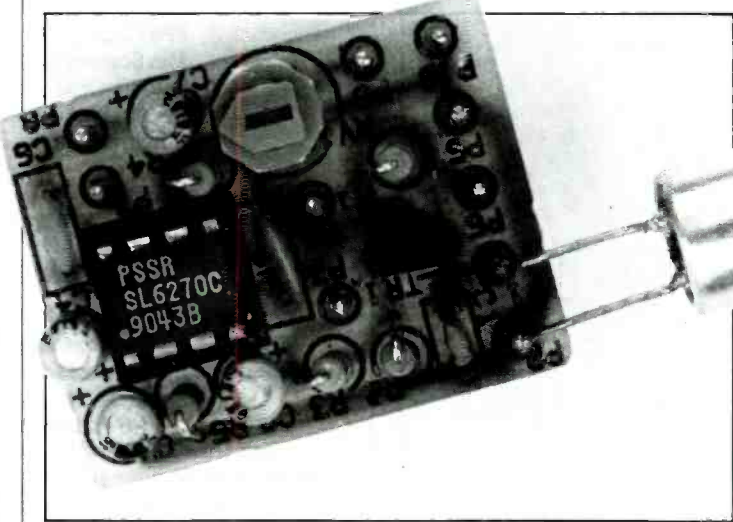


Figure 7. PCB legend and track.



Close-up of assembled PCB.

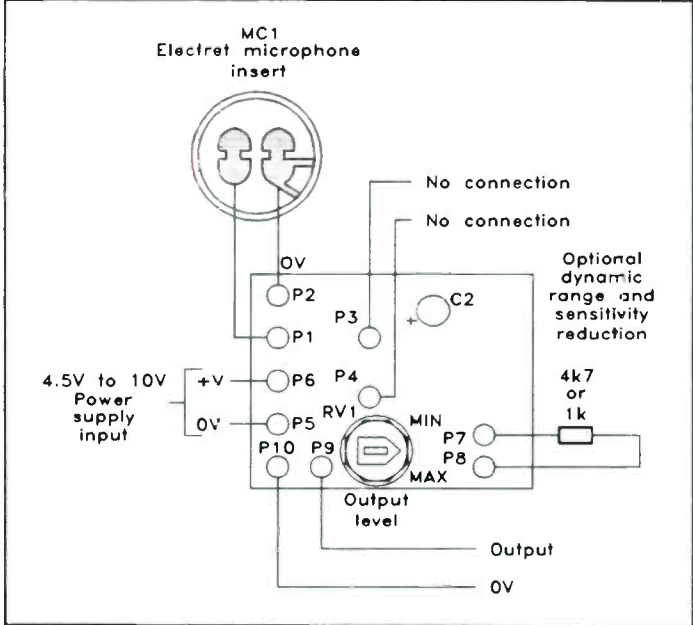


Figure 8a. Wiring diagram A.

SL6270 AGC MIC PREAMPLIFIER PARTS LIST

RESISTORS: All 0.6W 1% Metal Film (Unless specified)

R1,2	4k7	2	(M4K7)
R3	470Ω	1	(M470R)
R4	22k	1	(M22K)
R5	1M	1	(M1M)
RV1	1k Cermet Preset	1	(WR40T)
	4k7	1	(M4K7)
	1k	1	(M1K)

CAPACITORS

C1	1nF Ceramic	1	(WX68Y)
C2,4	2μF 63V Minelect	2	(YY32K)
C3,7	22μF 16V Minelect	2	(YY36P)
C5	100nF 16V Minidisc	1	(YR75S)
C6	4n7F Ceramic	1	(WX76H)

SEMICONDUCTORS

IC1	SL6270	1	(UM73Q)
IC2	2SC2547E	1	(QY11M)

MISCELLANEOUS

P1-10	Pin 2145	1 Pkt	(FL24B)
	8-Pin DIL Socket	1	(BL17T)
	PCB	1	(GH00A)
	Quickstick Pads	1 Strip	(HB22Y)
	PP3 Clip	1	(HF28F)
	Min Screened Cable	1m	(XR15R)
	Submin Omni Insert	1	(FS43W)
	Instruction Leaflet	1	(XT26D)
	Constructors' Guide	1	(XH79L)

OPTIONAL (Not in Kit)

Alkaline PP3 Battery	1	(FK67K)
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The Maplin 'Get-You-Working' Service is not available for this project.

The above items (excluding Optional) are available as a kit, which offers a saving over buying the parts separately.

Order As LP98G (SL6270 AGC Mic Amplifier).

Please Note: Where 'package' quantities are stated in the Parts List (e.g., packet, strip, reel, etc.), the exact quantity required to build the project will be supplied in the kit.

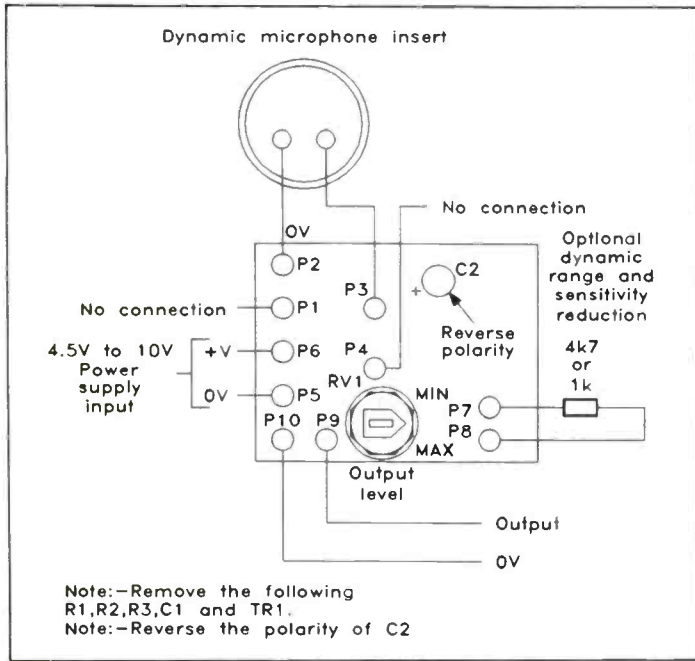


Figure 8b. Wiring diagram B.

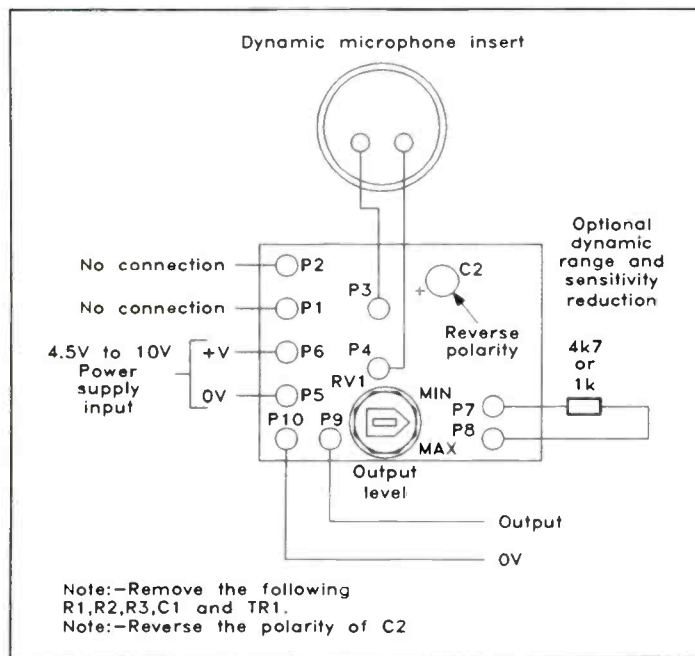
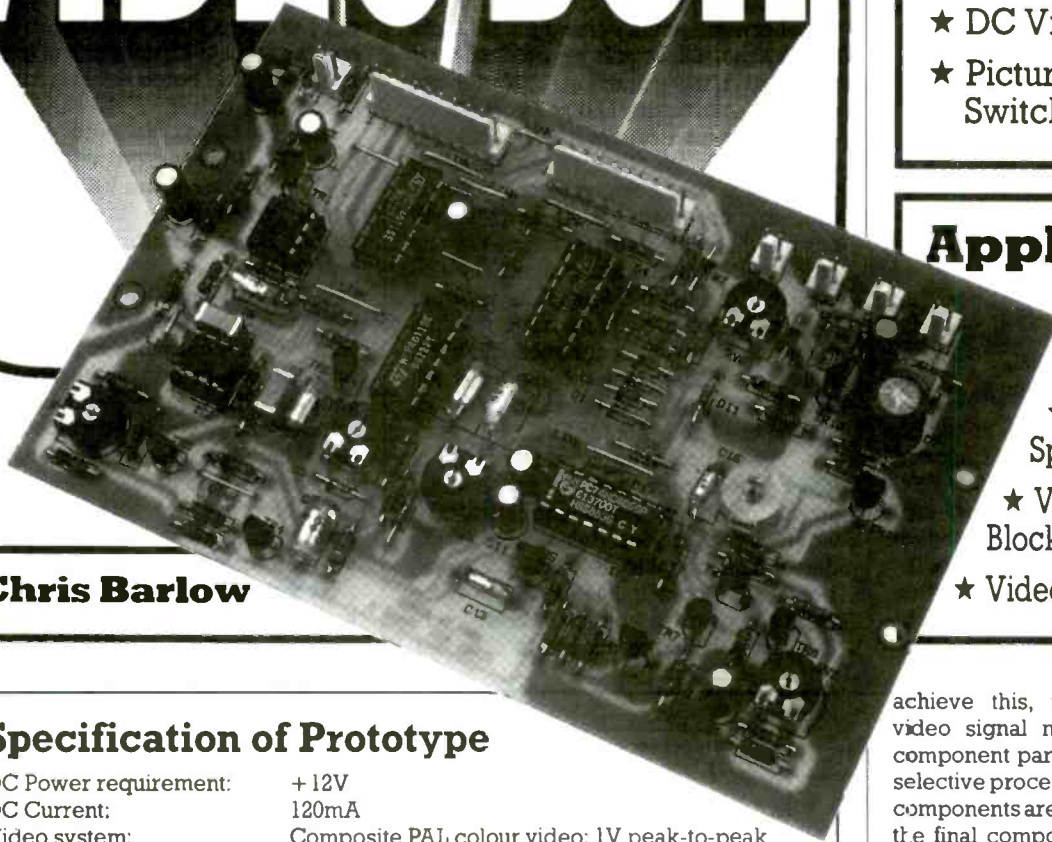


Figure 8c. Wiring diagram C.

The Maplin VIDEO BOX



by Chris Barlow

Specification of Prototype

DC Power requirement:	+12V
DC Current:	120mA
Video system:	Composite PAL colour video; 1V peak-to-peak
Video gain:	0dB
Frequency bandwidth:	10MHz
Input impedance:	75Ω (nominal)
Output impedance:	75Ω (nominal)
Video control:	Fade to black External control
Synchronized switches:	Video normal or inverted Video defeat Colour burst defeat Output defeat
Composite sync:	On/off External input
Timing outputs: (All +12V CMOS)	Composite sync Inverted composite sync Vertical sync Odd/even field index Video blanking Inverted video blanking Colour burst gate Inverted colour burst gate

To fade out an audio signal is a relatively simple task, being achieved by reducing the amplitude of all its frequency components at the same time. In its most basic form this can be accomplished by using nothing more than a potentiometer, tapping off the required amount of audio signal. However, composite video signals are made up from several different elements (colour, brightness and timing), and if all

are reduced by the same amount at the same time, the picture will begin to break up long before maximum fade to black is reached.

To maintain a stable picture, a more complex signal processing arrangement is required. The Video Box, shown in block form in Figure 1, permits the reduction in amplitude of picture information, while maintaining the level of the timing signals used to synchronize it. To

FEATURES

- ★ Composite Colour Video In/Out
- ★ Sync In/Out
- ★ Fade to Black
- ★ Normal or Negative Picture
- ★ DC Video Control
- ★ Picture Synchronized Switch Functions

Applications

- ★ Picture Fader
- ★ Video Dubbing
- ★ Video/Sync Splitter/Combiner
- ★ Video Building Block
- ★ Video Enhancement

achieve this, the incoming composite video signal must be split up into its component parts, each of which undergo selective processing. Following this, these components are re-assembled, to produce the final composite output. An additional video inverter has been included, allowing the option for a negative picture to be displayed (useful for home video and long distance/satellite TV enthusiasts!). Apart from its own function as a video fader, the system timing signals have been made available, and as a result the finished unit can be used as a versatile building block for use within other video projects.

Circuit Description

In addition to the block diagram shown in Figure 1, a detailed circuit diagram is provided in Figure 2. These two diagrams should assist you when following the circuit description, or fault-finding in the completed unit. For the circuit to function correctly, it must be powered from a well-regulated +12V DC supply. This supply enters the unit on PL6, and must have the correct polarity (negative on pin 1 and positive on pin 2), otherwise damage may occur to the semiconductors. The main supply decoupling is provided by C2, 15, 19 and C22; with C1, 14, 18, 21 and C27 giving additional high-frequency suppression.

The incoming video is connected to PL1 (pin 1 ground, pin 2 signal), and is terminated by R1. The video signals are AC-coupled via C3 into the video buffer,

an emitter-follower stage based around TR1. This signal is fed to the following video processing circuits:

- Sync amplifier IC1.
- Normal video switch IC3.
- Video inverter amplifier TR4.
- Colour burst signal gate IC3.

The function of IC1, the sync amplifier, is to obtain the maximum amount of sync information from the composite video signal. This is brought about by the circuit's combination of gain, DC input bias and frequency response. The cleaned-up and filtered signal is then fed via C7 to the input (pin 2) of the sync separator, IC2. This LM1881 device is a dedicated chip that extracts the timing information (sync) from the processed composite video signal. Four major sync signals are produced by the IC:

1. Composite sync (on pin 1).
2. Vertical sync (on pin 3).
3. Colour burst gate (on pin 5).
4. Odd/even field index (on pin 7).

These timing signals are at +12V CMOS logic levels, and are used by some of the other stages within the Video Box system to synchronize events. They are also available (some with inverted logic) on PL2. Here, the inverted composite sync is provided by IC5b, while the inverted colour burst gate is supplied by IC5c. The inverted composite sync from

pin 4 of IC5b passes through an inverting gate, IC5a, before being mixed back with the picture information at TR11. This gate is used to turn off, or remove, the composite sync from the final composite video output, which appears at pin 2 of PL7. This function is activated when S1 and/or S2 are closed.

The composite sync signal is also used by the input detector (TR2) and video blanking (IC6) circuits. With no signal present at the video input (PL1 pin 2), no sync pulses will be produced by IC2. Under this condition, TR2 will not conduct, so indicator LD1 will not light up – until a signal is available. From the composite sync, the video blanking circuit generates a timing signal, which is used by the main video amplifier to ensure that only picture information is processed. This blanking signal is also available on PL2 pin 9, with its inverted logic condition present on pin 8. The fine tuning of this event is controlled by RV4, which is used to set the start (or left edge), while the end (or right edge) of the picture line is set by RV5.

The vertical sync signal from pin 3 of IC2 is used to control the sync-locked switch functions; video normal/inverse, video defeat, colour defeat and output defeat. This signal is also available on pin 1 of PL2. By locking these switches to the vertical sync, a cleaner and more professional picture change is obtained.

This is achieved by using a quad D-type latch IC4 (4042BE), which has its clock input (pin 5) connected to the vertical sync signal. Only when this signal is present will the output of this IC change state upon operating one of the above function switches, the sync-locked logic outputs from this IC being used to control the system's sync, colour-burst and video processing circuits.

The colour-burst gating signal from pin 5 of IC2 is connected to pin 6 of PL2, and the input of IC5c (which is used as an inverter). The output of this inverter is connected to pin 7 of PL2, and also passes via R34 to the colour-burst signal gate IC3. However, before it reaches its final destination it can be interrupted by being pulled down to ground by the colour-burst and/or output defeat switches.

The odd/even field index signal from pin 7 of IC2 is not used by the Video Box. However, it is available on pin 2 of PL2 for possible use in additional circuitry. For example, this output could be useful in frame memory storage applications, or in extracting test signals that may occur only in alternate fields.

There are two paths that the video signal can take on its way to the main video processing amplifier, both of which pass through IC3. This analogue switching device is used to select the normal or inverted (picture negative) video infor-

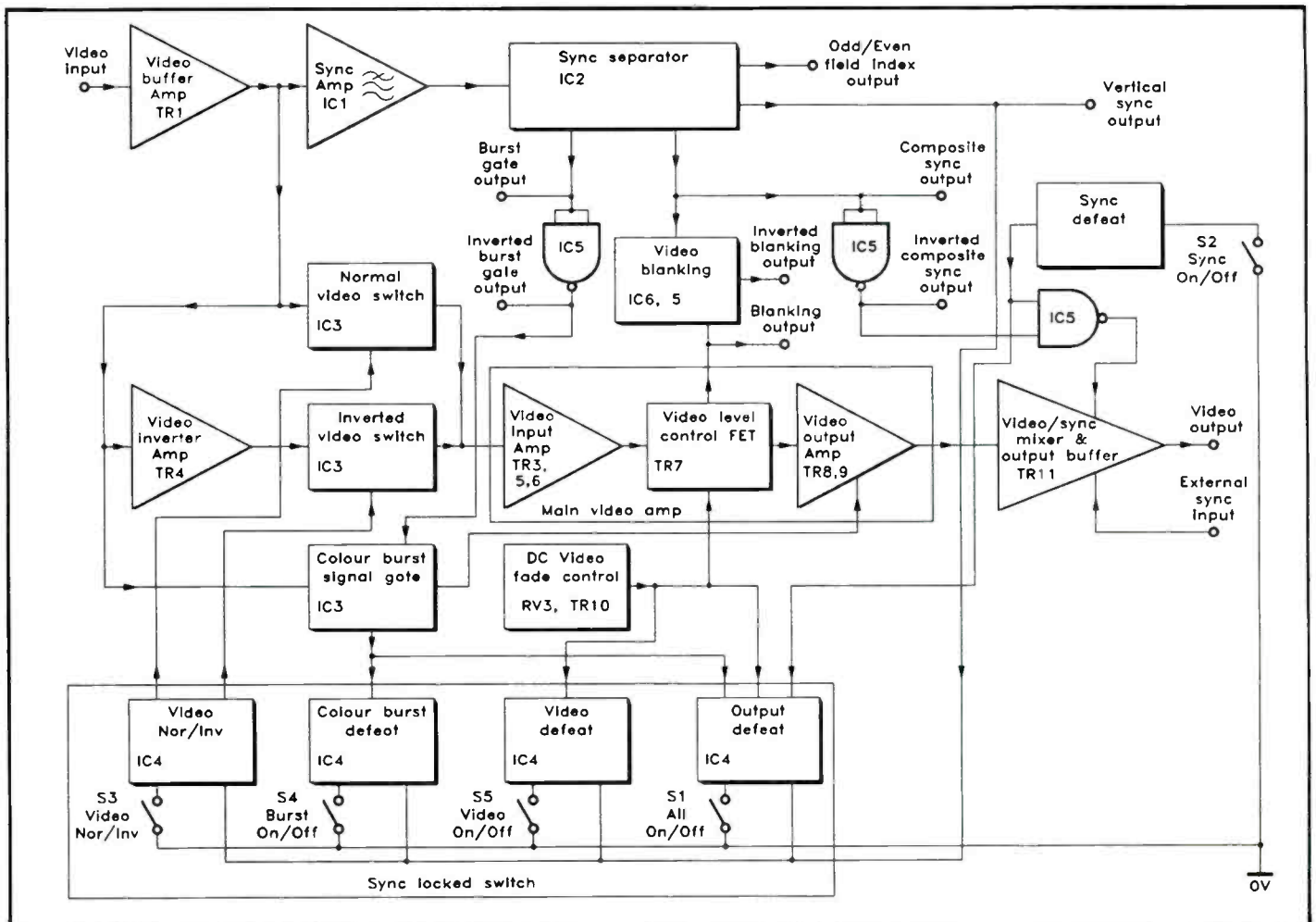


Figure 1. Block diagram.

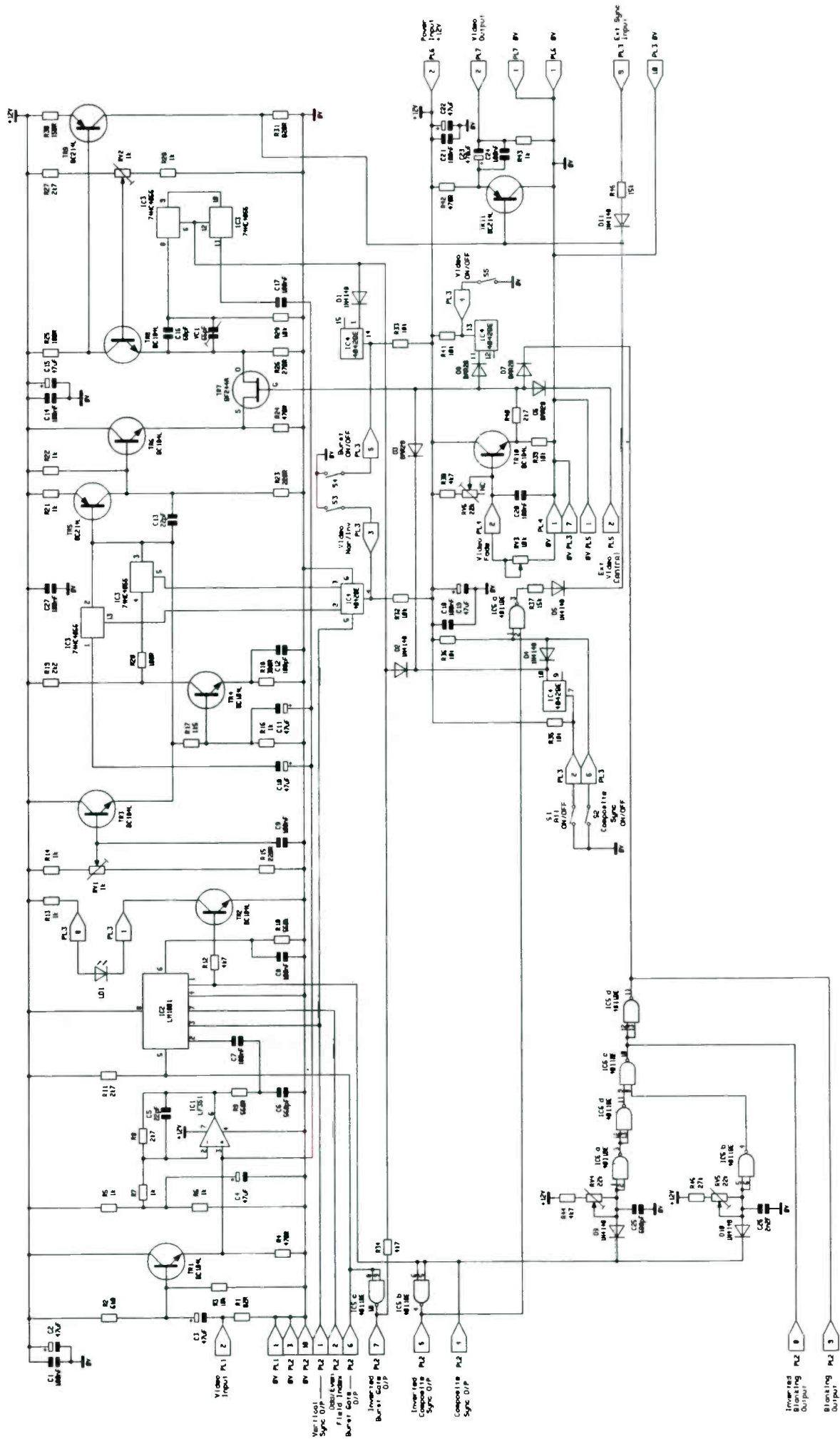


Figure 2. Circuit diagram.

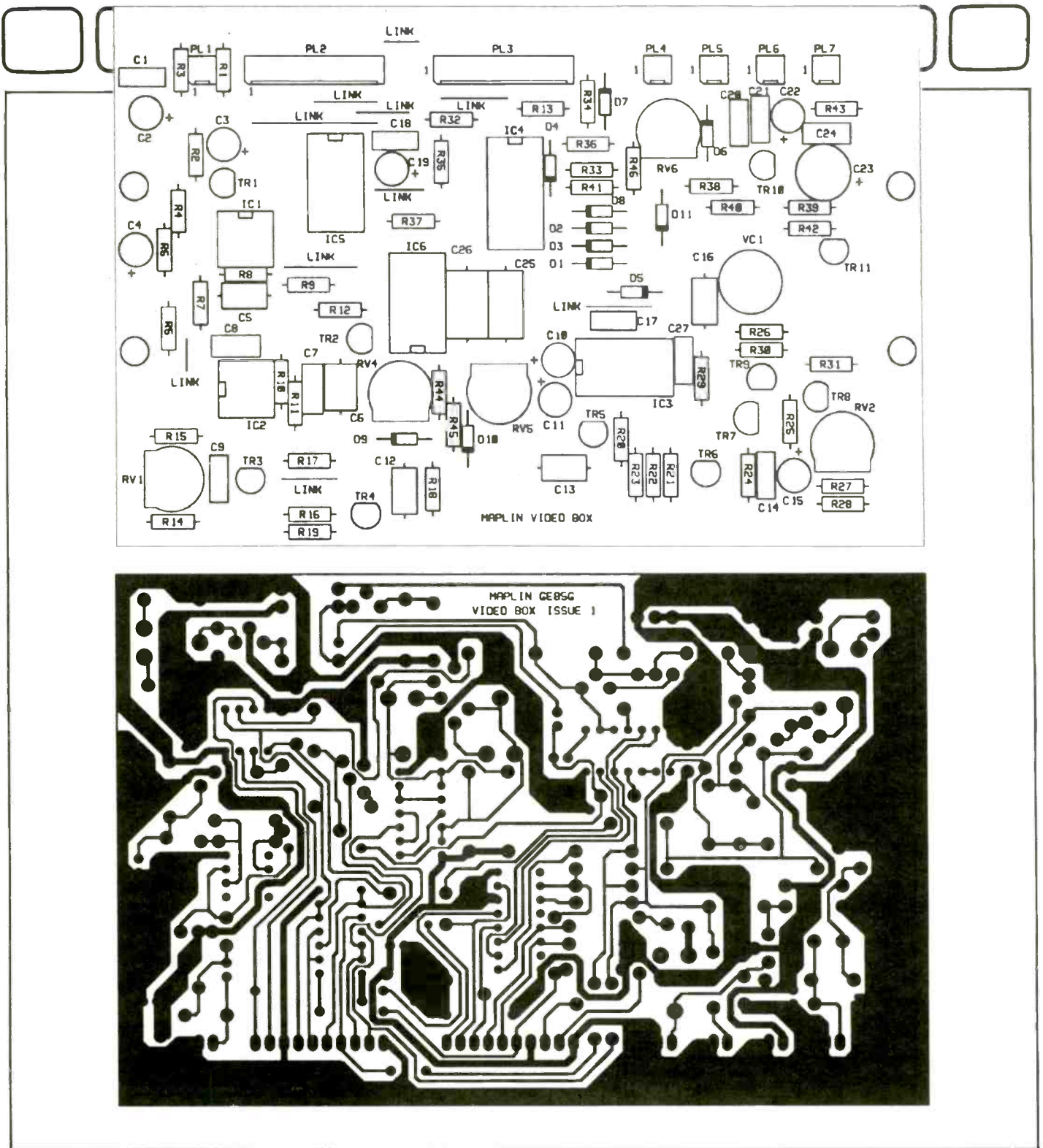


Figure 3. PCB legend and track.

mation, and is controlled by two of the logic outputs from IC4 (S3). When the normal (or non-inverted) signal is selected, the signal path is from the output of the video buffer amp, TR1, to the input of the main amp, TR5. When the inverted signal is selected, the video path is from the output of the video inverter amp, TR4, to the input of the main amp, TR5. The DC bias for both TR4 and TR5 is provided by TR3, and is set by RV1.

The colour-burst signal must remain at a constant level as the video picture information is reduced. Otherwise, the monitor/VCR will try to over-compensate by increasing the colour intensity as the video level is reduced. Eventually, its colour-killer circuit will operate. At the

point just before this threshold is reached, the colour video information will appear very noisy (when viewed on a monitor) before suddenly cutting out, leaving a black-and-white (monochrome) picture on the screen. The colour-killer circuit is included by the majority of video/TV equipment designers to accommodate the possibility of a monochrome signal, or if the overall signal is too weak/noisy to reproduce a good enough quality colour picture.

The colour-burst is maintained by gating the composite video signal from TR1 at a precise moment in time, and then re-combining it after the video level control circuit, TR7. This signal gating is achieved by IC3, which receives its

switching control signal from the logic output of IC5c. However, it can be removed if the colour-burst defeat switch, S4, and/or output defeat switch, S1, is activated.

The main video level processing amplifier consists of four stages:

1. The DC bias for the input buffer is supplied by TR3. The output of this stage is determined by the level of voltage applied to the base of TR3 by RV1.
2. The input buffer, formed by TR5 and TR6, then conditions the video signal into a form suitable for feeding TR7, the video level control FET.
3. TR7 is controlled by the DC voltage

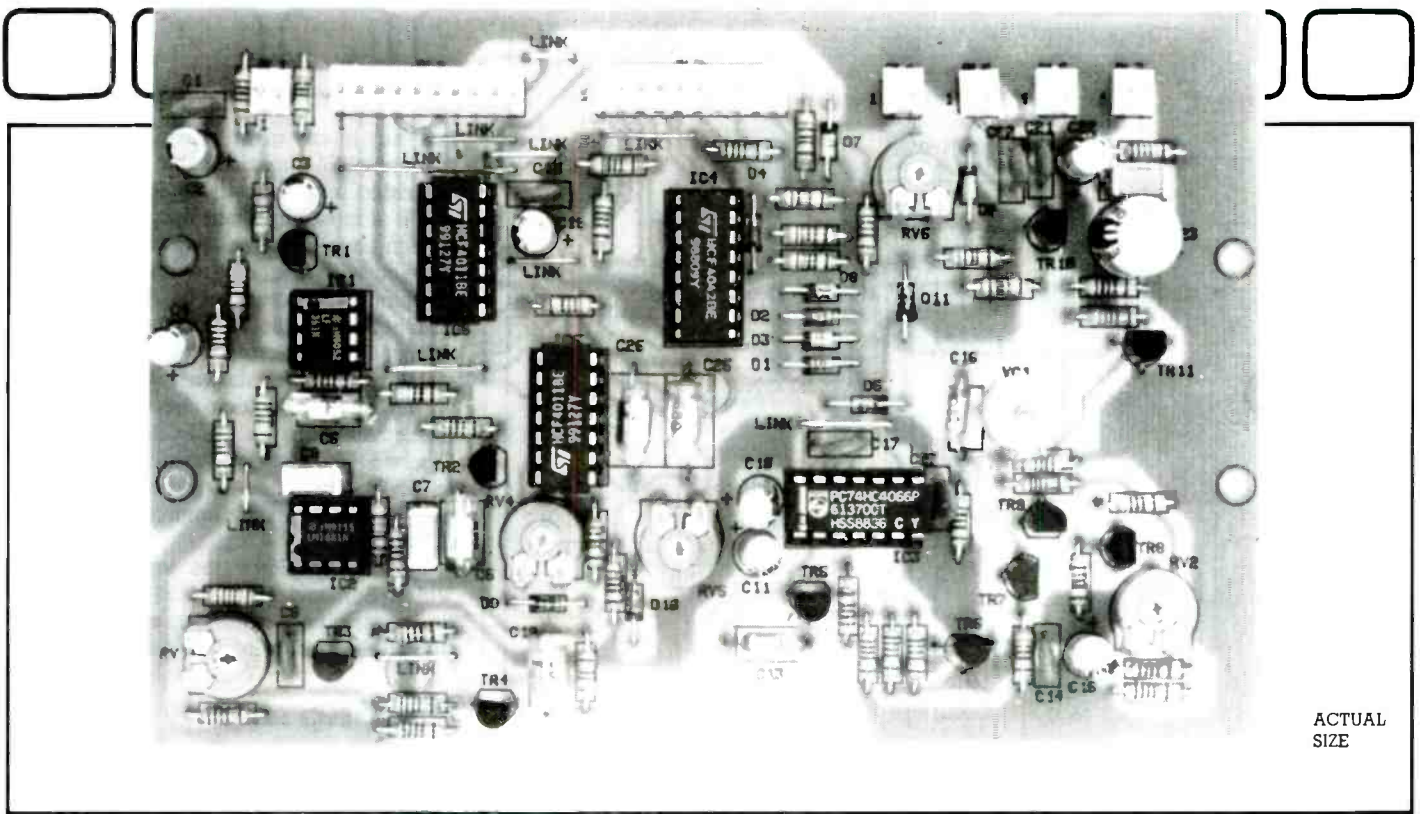


Photo 1. Completed PCB.

applied to its gate; the higher this is, the higher the amplifier gain will be. This voltage is supplied by the DC video fade control transistor, TR10. A potential divider on the base of TR10 is created by using three resistors: a fixed resistor, R38; a preset, RV6; and a rotary (or slide) control, RV3. The combined value of R38 and RV6 sets the maximum voltage limit, which corresponds to the maximum video level. However, as the value of RV3 decreases, this voltage will drop until the zero point is reached, corresponding to minimum video level. The voltage output from TR10 is grounded by the video blanking circuit, which is based around IC5d and IC6. This has the effect of turning off the main video amplifier during the sync and colour-burst time slots. The voltage can also be manually grounded if the video defeat (S5) and/or output defeat (S1) switches are activated. Additionally, it can be grounded by an external influence applied to pin 2 of PL5.

4. The output amplifier, comprised of TR8 and TR9, receives the video signals from TR7, and the colour-burst signal from IC3. Two capacitors, C16 and VC1, are used to set the injection level of the colour burst. A second DC bias control, RV2, sets the black level of the video signal.

The output from the main video processing amplifier is supplied to TR11, where the previously extracted composite sync is mixed with it to produce the final composite colour video output signal. As well as mixing the two signals, TR11 acts as a buffer, providing a low impedance 75R output drive which passes through C23 and C24, onto pin 2 of PL7. This video/sync mixer stage can also be supplied with external sync information applied to pin 9 of PL3.

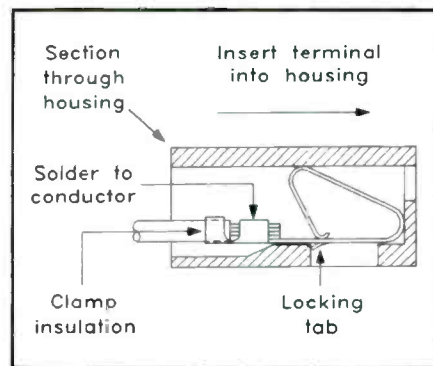


Figure 4. Terminating the wires.

PCB Assembly

All the information required to help you with soldering and assembly techniques, should you need it, can be found in the Constructors' Guide included in the kit (also separately available as stock code XH79L). The printed circuit board (PCB) is a single-sided glass fibre type, chosen for maximum reliability and mechanical stability. Removal of an incorrectly-fitted component can be fairly difficult without damaging it, or the PCB, in some way, so please double-check each component type, value, and polarity (where appropriate) before soldering! The PCB has a legend to assist you in correctly positioning each item (see Figure 3). It is usually easier to start with the smaller components, such as the resistors. Next, mount the ceramic, polylayer, polystyrene and electrolytic capacitors. All the diodes have a band at one end; be sure to position them according to the legend. When installing the transistors, make certain that each case matches its outline. This also applies to the IC sockets and 'Minicon' connectors, where you should match the notch with the block on the legend. The next components to be installed are the five preset resistors

(RV1, 2, 4, 5, 6) and the trimmer capacitor, VC1. Only after all the other components have been fitted should you then carefully insert the relevant ICs into their sockets, making sure that you correctly orientate them. Finally, do not forget to fit all ten wire links. These can be made from component lead off-cuts, or the 22SWG tinned copper wire included in the kit. Photo 1 shows in detail the completed PCB assembly.

This completes the assembly of the PCB, and you should now check your work very carefully, making sure that all the solder joints are sound. It is also very important to ascertain that the solder side of the circuit board does not have any trimmed component leads protruding by more than 2mm, as a short-circuit may otherwise result.

Final Assembly

No specific box has been designated for the project, as your finished unit could contain other PCBs (e.g. video digitiser and computer cards). However, the basic unit fitted nicely in to an ABS console M6006 (stock code LH66W). This, and the additional connectors and hardware, are listed under 'Optional' (Not in kit), in the parts list. Once you have completed the mechanical assembly of the unit, you should check your work very carefully before proceeding to the wiring stage.

Wiring

If you purchase the Maplin kit (stock code LP48C), it should contain a one metre length of ten-way ribbon cable. This is used for all the DC connections. However, no specific colour has been designated for each wire connection; this choice is left entirely to you. Coloured wire is used to simplify matters, making it easier to trace separate connections to off-board components, just in case there

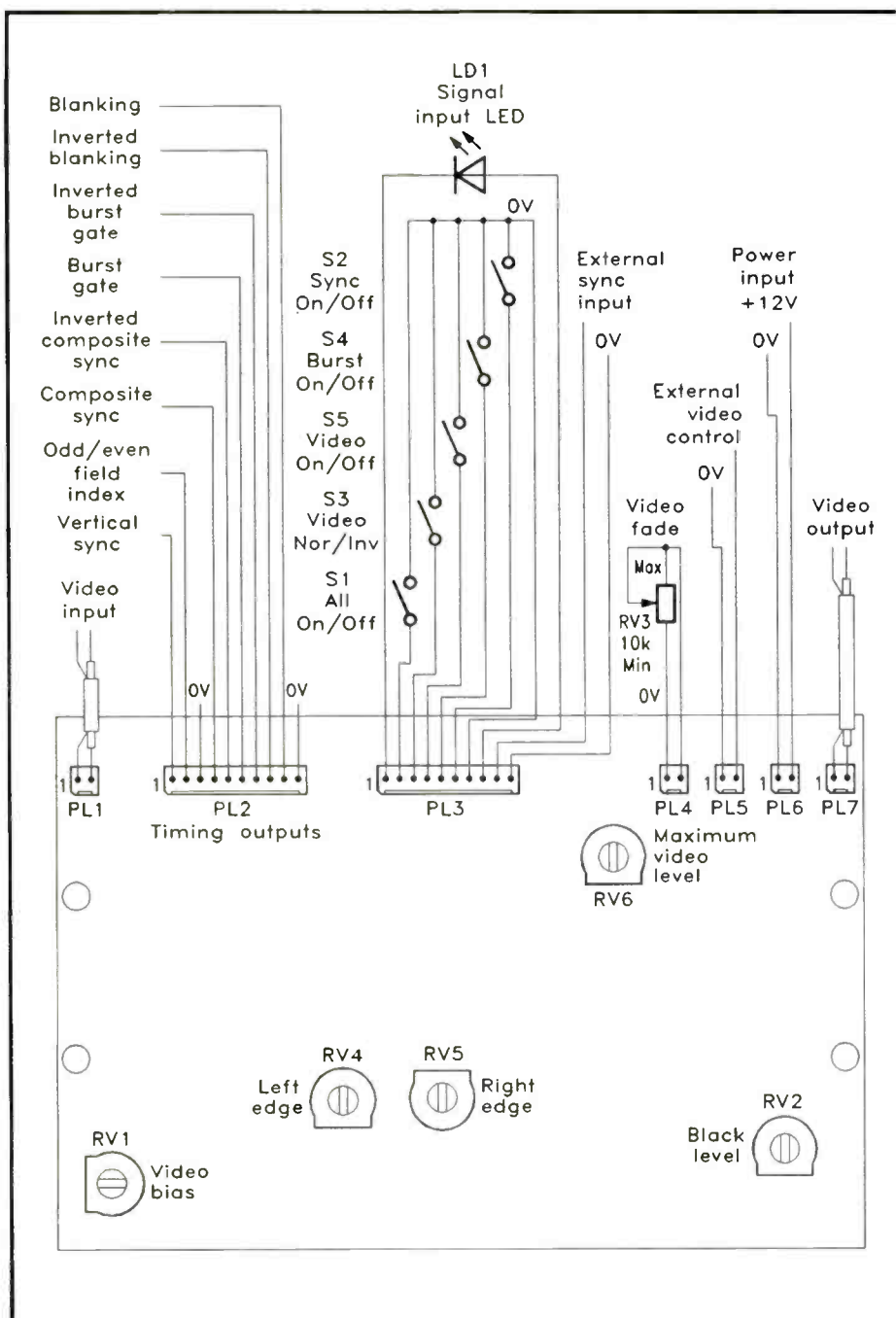


Figure 5. Wiring.

is a fault in any given part of the circuit. Miniature 75Ω coaxial cable is used for the video in/out signals on PL1 and PL7, and it is most important that the braided screen should not be able to come into contact with the centre conductor, or anything connected to it. All the wire connections to the PCB are made using 'Minicon' connectors; the method of installing these is shown in Figure 4. A wiring diagram, which shows all of the interconnections on the PCB, is given in Figure 5. The actual physical connections to the rotary video fade potentiometer, and the optional slide control, are shown in Figure 6.

This completes the wiring of the Video Box and you should now check your work very carefully, making sure that all the solder joints are sound.

Testing and Alignment

The initial DC testing procedure can be undertaken using the minimum amount of equipment. You will need a multimeter and a well-regulated +12V DC power supply, capable of providing at least 150mA. All of the following readings are taken from the prototype using a digital multimeter, and some of the readings you obtain may vary slightly, depending upon the type of meter used!

Before you commence testing the unit, set the PCB presets (RV1,2,4,5,6 and VC1) to their half-way positions, and the the off-board function switches (S1,2,3 and 4) to their 'open' or 'off' positions. Ensure that the rotary (or slide) video fade control, RV3, is set to its maximum level, as shown in Figure 6. DO NOT connect any power or video signals to the unit at this stage of testing.

The first test is to ensure that there are no short-circuits before connecting the unit to a DC power supply. Set your

TERMINAL BLOCKS

PL1	PL2	PL3	PL4	PL5	PL6	PL7
pin 1 = 0V	pin 1 = 0V	pin 1 = 10·8V	pin 1 = 0V	pin 1 = 0V	pin 1 = 0V	pin 1 = 0V
pin 2 = 0V	pin 2 = 12V	pin 2 = 12V	pin 2 = 4·7V	pin 2 = 0·5V	pin 2 = 12V	pin 2 = 0V
	pin 3 = 0V	pin 3 = 12V				
	pin 4 = 0V	pin 4 = 12V				
	pin 5 = 12V	pin 5 = 12V				
	pin 6 = 12V	pin 6 = 12V				
	pin 7 = 0V	pin 7 = 0V				
	pin 8 = 12V	pin 8 = 12V				
	pin 9 = 0V	pin 9 = 0V				
	pin 10 = 0V	pin 10 = 0V				

SEMICONDUCTORS

TR1	TR2	TR3	TR4	TR5	TR6	TR7	TR8	TR9	TR10	TR11
E = 6·3V	E = 0V	E = 3·2V	E = 0·6V	E = 3·9V	E = 3V	S = 3V	E = 3V	E = 11·5V	E = 4V	E = 3·2V
B = 7V	B = 0·1V	B = 3·8V	B = 1·3V	B = 3·2V	B = 3·6V	G = 0·5V	B = 3·6V	B = 10·9V	B = 4·7V	B = 2·5V
C = 12V	C = 10·8V	C = 12V	C = 8·6V	C = 3·6V	C = 12V	D = 3V	C = 10·9V	C = 2·5V	C = 12V	C = 0V

IC1	IC2	IC3	IC4	IC5	IC6
pin 7 = 12V	pin 8 = 12V	pin 14 = 12V	pin 16 = 12V	pin 14 = 12V	pin 14 = 12V

Table 1. DC test measurements (read with a digital voltmeter).

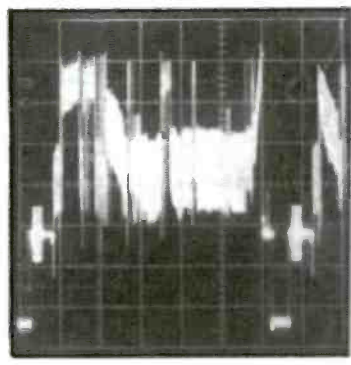
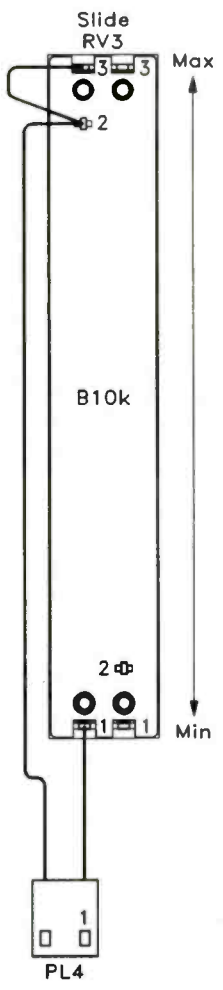
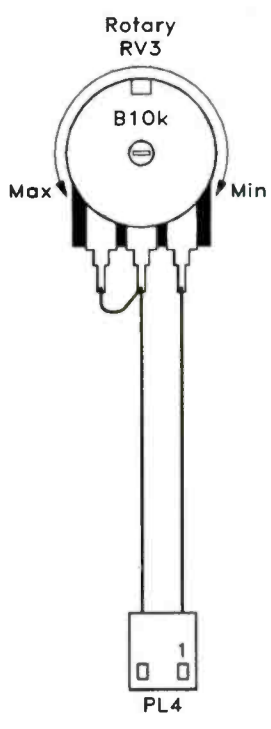


Photo 2 (above right): Correctly aligned picture (monitor screen).
 Photo 3 (above left): Correct composite video waveform (CRT display).

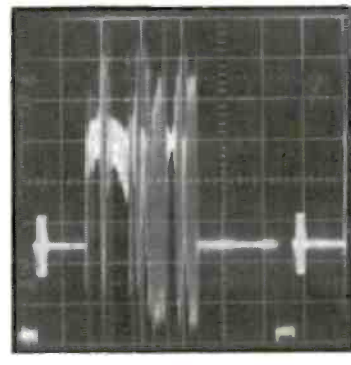


Photo 4 (above right): Incorrectly aligned picture (monitor screen).
 Photo 5 (above left): Incorrectly aligned picture (CRT display).

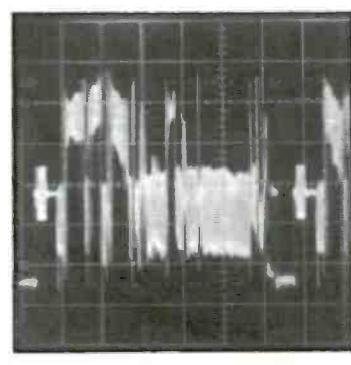


Photo 6 (above right): Incorrectly aligned black-level - too low (monitor screen).
 Photo 7 (above left): Incorrectly aligned black-level - too low (CRT display).

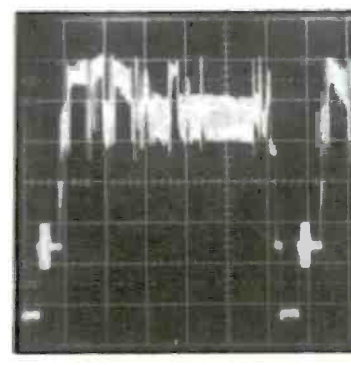


Photo 8 (above right): Incorrectly aligned black-level - too high (monitor screen).
 Photo 9 (above left): Incorrectly aligned black-level - too high (CRT display).

Figure 6. Video fade potentiometers.



multimeter to read 'OHMS' on its resistance range, and connect the two test probes to pin 1 and pin 2 of PL6. With the probes either way round, a reading greater than 60Ω should be obtained. If a much lower reading is registered, then check that solder joints and component leads are not shorting between tracks. Next, monitor the supply current; set your meter to the DC mA range and place it in series with the positive line, pin 2 of PL6. Connect up and switch on your regulated +12V power supply, ensuring correct polarity. A current reading of approximately 110mA should be obtained, and the signal input indicator LD1 should not be illuminated. Switch off, disconnect the power supply and remove the meter.

Reconnect the power supply, and set your multimeter to read DC volts. All of the voltages are positive with respect to ground, so connect your negative test lead to any of the 0V ground pins on the terminal blocks:

PL1 pin 1	PL5 pin 1
PL2 pin 3 or pin 10	PL6 pin 1
PL3 pin 7 or pin 10	PL7 pin 1
PL4 pin 1	

The voltages present on the PCB assembly should approximately match the readings shown in Table 1. When these tests have been completed successfully, remove power from the unit.

To commence the video testing and alignment, you will require some additional video equipment and test gear. You will need a source of composite colour video which could be a VCR, TV tuner, video camera or pattern generator. To observe the resultant output, you will require a composite colour video monitor (or a TV/VCR with a video input) and a 20MHz oscilloscope with TV coupling. If you haven't got access to the more exotic video test gear, DON'T PANIC! - it is still possible to obtain acceptable results using only the video equipment and your own visual judgment. The picture image used in our tests was taken from a colour video camera, and is of the 1992 Maplin catalogue.

Connect the video source to the input (PL1), and the monitor to the output (PL7). If you have an oscilloscope, set it up as follows: TV coupling; horizontal time-base $10\mu\text{s}$; auto-trigger with negative polarity; vertical input $0.2\text{V}/\text{div}$ DC coupled. Next, connect its vertical input to the video output on PL7.

Ensure that all of the function switches on the Video Box are set to their 'off' or 'open' positions, and that the video fade control, RV3, is set to maximum. Apply power to the unit and, if all is correct, then LD1 should light and you should observe a clear high-quality picture on the monitor screen (see Photo 2) and a composite video waveform on the oscilloscope display (see Photo 3). However, this is unlikely since none of the presets have been critically adjusted, and so the picture is more likely to resemble the one shown in Photos 4 and 5. Each preset will affect a particular parameter of the video signal. Interaction may occur

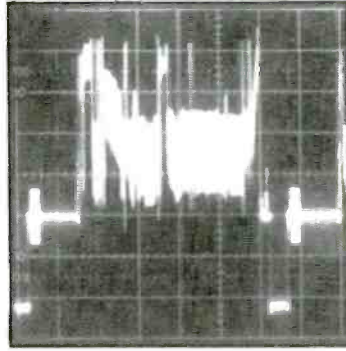


Photo 10 (above right): Left-hand edge RV4 (monitor screen).
Photo 11 (above left): Left-hand edge RV4 (CRT display).

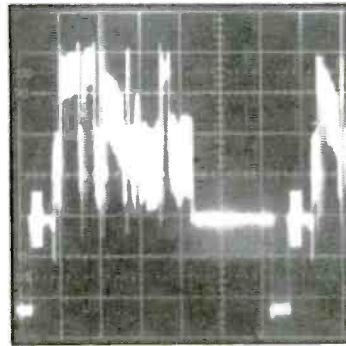


Photo 12 (above right): Right-hand edge RV5 (monitor screen).
Photo 13 (above left): Right-hand edge RV5 (CRT display).

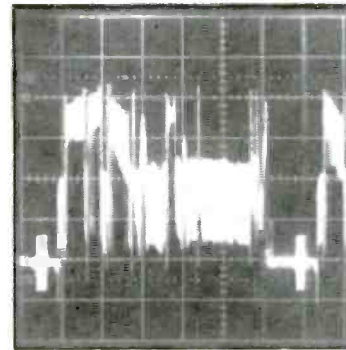


Photo 14 (above right): Composite sync removed (monitor screen).
Photo 15 (above left): Composite sync removed (CRT display).

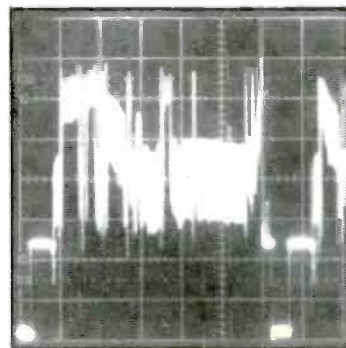


Photo 16 (above right): Colour-burst removed (monitor screen).
Photo 17 (above left): Colour-burst removed (CRT display).



Photo 18. Picture distortion (monitor screen).

between several of these adjustments, and so progressive re-calibration may be required.

The first adjustment is to set the correct input and black-level bias points. As RV1 is turned anticlockwise, the picture quality will progressively deteriorate as the level of high-frequency distortion increases. This will continue until the picture inverts on highlights, as shown in Photo 18. Turn RV1 clockwise until this effect is corrected; over-adjustment of this preset will have an adverse result on the inverse-video mode. The black-level is set by RV2, and as this is turned anticlockwise the video information will progressively drop down into the sync region, eventually causing picture break-up (see Photos 6 and 7). If this preset is turned too far clockwise, the picture will look washed out (see Photos 8 and 9). RV1 and RV2 do have a small effect on each other, and so progressive re-adjustment may be necessary.

The next parameter to correct is the amount of picture information shown on the screen. The left-hand edge is adjusted using RV4, while the right-hand edge is set by RV5 (see Photos 10 to 13 inclusive).

If an oscilloscope is not available, RV6 and VC1 will not be as easy to set up as the other presets. This is because RV6 sets the maximum video level, and most modern equipment can accept a significantly over-driven input, particularly VCRs, which feature a video AGC circuit. The colour-burst signal level, set by VC1, is used to control the colour intensity of the picture. To calibrate the unit to give a standard 1V peak-to-peak video output, an oscilloscope will be required (see Photo 3). However, a rough setting can be made by comparing the relative bright-

ness and colour intensity of the direct video signal to the processed one.

Finally, test the following functions:

1. Range-test the video fade control, RV3. The control should give complete control from maximum picture level, down to a black screen (as shown in Photo 19).
2. Output defeat switch, S1. All video signal components should be blocked when S1 is closed.
3. Sync defeat switch, S2. The composite sync pulses should be removed when S2 is closed, resulting in a slipping picture, as shown in Photos 14 and 15.
4. Video invert switch, S3. Picture should become a 'negative' image when S3 is closed – see Photo 20.

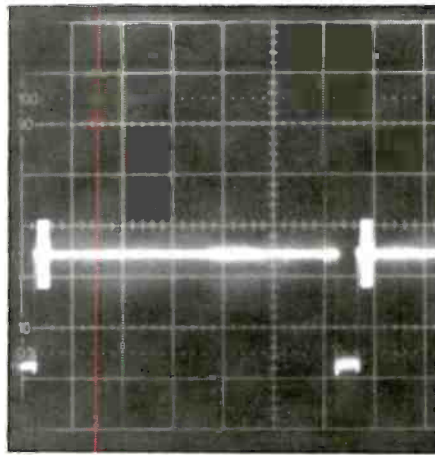


Photo 19. Video fade to black (CRT display).

5. Colour-burst defeat switch, S4. The picture should change to a black-and-white one when S4 is closed; refer to Photos 16 and 17.
6. Video defeat switch, S5. Only the sync and colour burst information should be passed when S5 is closed, producing a blank screen, as can be seen from Photo 15.

Using the Video Box

There are two major factors which can cause a reduction in performance from the Video Box. Firstly, if a +12V DC power supply with poor smoothing or regulation is used, some of the functions will not work properly and the overall picture quality will suffer. For this reason, it is strongly recommended that if a ready-built DC supply is used, it should

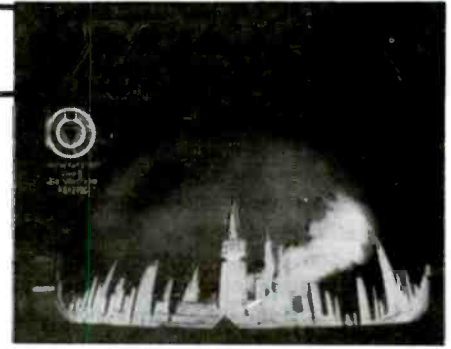


Photo 20. Inverted picture (monitor screen).

be the regulated 300mA 12V type featured in the 1992 Maplin Catalogue (stock code YB23A). If you are constructing your own, it should incorporate a +12V regulator, such as the $\mu A78M12UC$ (stock code QL29G). Please note that the Video Box is NOT reverse-polarity protected, and so damage will occur to the circuit if the power supply connections are reversed. Secondly, if an inferior video signal is fed into the unit then a poor quality signal will be produced. This can result in a dim, fuzzy and possibly unstable picture on the monitor screen.

The main function of the Video Box is to provide the ability for fading the picture information down to a blank screen. This effect can be used as a 'fade-in' or 'fade-out' on dubbed recordings (e.g. camcorder to VCR), lending a more professional appearance to your video productions. The whole picture, but not the sync, can be suddenly switched on and off by operating the video defeat switch, S5. The output defeat switch, S1, can appear to have a similar effect, but as it switches off all the signal components, your video equipment can take some time to re-synchronize to the signal.

Two additional video effects have been provided for. When operated, the picture inverse switch, S3, produces a 'negative' image. This unusual effect has often been exploited by pop video and sci-fi film makers. The colour burst defeat switch, S4, should have the effect of turning off the colour circuits within your video equipment. This function is commonly referred to as the 'colour-killer' circuit (as discussed earlier), and when activated has the effect of producing a black-and-white picture. It is unlikely that you will ever need to use the sync defeat switch, S2, as this removes the composite sync from the video signal. However, if the Video Box is used as part of a larger video system, it may be necessary to switch off its own recovered sync, or possibly feed in external sync.

Modification to Video Box

It has recently been reported that when using the Video Box with certain VHS video recorders, a colour shift or distortion to the picture may be noticeable. To correct this, the following modification should be implemented when first building, or to update, your kit.

Add a 47 μ H Choke (Order Code WH39N) in series with resistor R21; see Figure 1. As there is no physical position on the PCB for this additional component, it must be fitted as shown in Figure 2. De-solder, and lift out of the board the lead of R21 nearest to the edge of the PCB. Next, insert the choke and solder it in place. Finally, solder the free end of R21 to the free end of the choke.

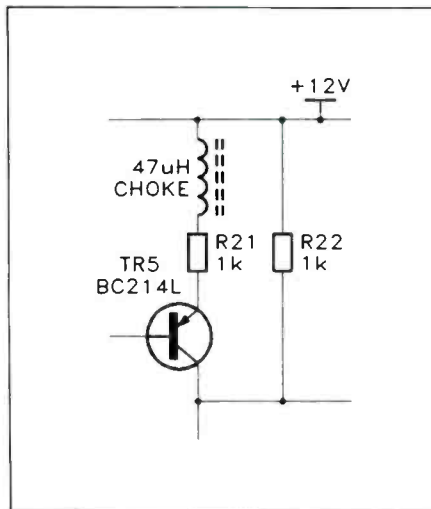


Figure 1. Modified circuit.

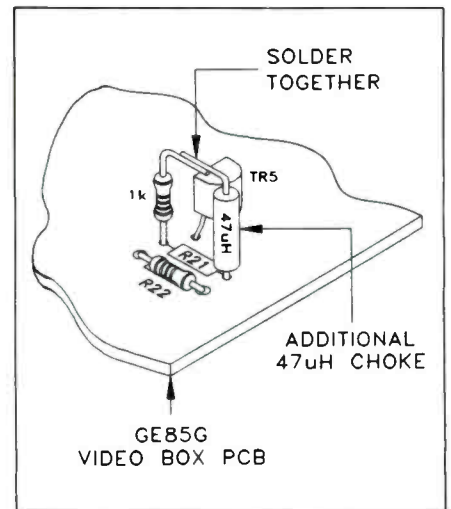


Figure 2. Positioning the choke.

VIDEO BOX PARTS LIST

RESISTORS: All 0.6W 1% Metal Film (Unless specified)

R1	82 Ω	1	(M82R)
R2	6k8	1	(M6K8)
R3,29,32,33,35, 36,39,41	10k	8	(M10K)
R4,24,42	470 Ω	3	(M470R)
R5,6,7,13,14,16, 21,22,28,43	1k	10	(M1K)
R8,11,27,40	2k7	4	(M2K7)
R9	560 Ω	1	(M560R)
R10	560k	1	(M560K)
R12,34,38,44	4k7	4	(M4K7)
R15,23	220 Ω	2	(M220R)
R17	1k5	1	(M1K5)
R18	390 Ω	1	(M390R)
R19	2k2	1	(M2K2)
R20,25	100 Ω	2	(M100R)
R26	270 Ω	1	(M270R)
R30	150 Ω	1	(M150R)
R31	820 Ω	1	(M820R)
R37,46	15k	2	(M15K)
R45	27k	1	(M27K)
RV1,2	1k Hor Enclosed Preset	2	(UH00A)
RV3	10k Min Pot Lin	1	(JM71N)
RV4-6	22k Hor Enclosed Preset	3	(UH04E)

CAPACITORS

C1,9,14,17,18, 20,21,27	100nF 16V Minidisc	8	(YR75S)
C2,3,4,10,11,15, 19,22	47 μ F 25V PC Electrolytic	8	(FF08J)
C5,13	22pF Polystyrene	2	(BX24B)
C6	560pF Polystyrene	1	(BX33L)
C7,8,24	100nF Poly Layer	3	(WW41U)
C12	100pF Polystyrene	1	(BX28F)
C16	68pF Polystyrene	1	(BX27E)
C23	470 μ F 16V PC Electrolytic	1	(FF15R)
C25	680pF Polystyrene	1	(BX34M)
C26	2n2F Polystyrene	1	(BX37S)
VC1	65pF Trimmer	1	(WL72P)

SEMICONDUCTORS

IC1	LF351	1	(WQ30H)
IC2	LM1881N	1	(UL75S)
IC3	74HC4066 (12V)	1	(UF10L)
IC4	4042BE	1	(QX19V)
IC5,6	4011BE	2	(QX05F)
TR1,2,3,4,6,8,10	BC184L	7	(QB57M)
TR5,9,11	BC214L	3	(QB62S)

TR7	BF244A	1	(QF16S)
DL1,2,4,5,9,10,11	1N4148	7	(QL80B)
D3,6,7,8	BAR28	4	(QQ13P)

MISCELLANEOUS

LD1	LED Red	1	(WL27E)
PL1,4,5,6,7	2-Way Latch Plug	5	(RK65V)
PL2,3	10-Way Latch Plug	2	(RK66W)
	2-Way Latch Housing	5	(HB59P)
	10-Way Latch Housing	2	(FY94C)
	Latch Terminal	3	(YW25C)
	Miniature Coax	1m	(XR88V)
	10-Way Ribbon Cable	1m	(XR06G)
	TC Wire 0.71mm 22swg	1 Reel	(BL14Q)
	8-Pin DIL Socket	2	(BL17T)
	14-Pin DIL Socket	3	(BL18U)
	16-Pin DIL Socket	1	(BL19V)
	47 μ H Choke	1	(WH39N)
	PCB	1	(GE85G)
	Instruction Leaflet	1	(XT04E)
	Constructors' Guide	1	(XH79L)

OPTIONAL (Not in Kit)

RV3	10k Min Slide Pot Lin	1	(JM85G)
	Slide Knob B	1	(YG09K)
	Knob K14B	1	(FK39N)
	LED Clip 5mm	1	(YY40T)
	SPST Ultra Min Toggle	5	(FH97F)
	AC Adaptor Regulated	1	(YB23A)
	ABS Console M6006	1	(LH66W)
	BNC Round Socket 75 Ω	2	(FE31J)
	Panel Mount Power Socket 2.5	1	(JK10L)
	Self Tap Screws No.4 \times 1/4in. 1 Pkt	1	(FE68Y)

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, which offers a saving over buying the parts separately.

Order As LP48C (Video Box Kit).

Please Note: Where 'package' quantities are stated in the Parts List (e.g., packet, strip, reel, etc.), the exact quantity required to build the project will be supplied in the kit.

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