THE BEST OF

CQ-TV

VOLUME-2

133 TO 146

Edited by Mike Wooding G6IQM

BRITISH AMATEUR TELEVISION CLUB

This book includes material from CQ-TV 112 to CQ-TV 146 (inclusive).

First printing October 1989.

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70CM ATV CONVERTER

A 70CM ATV TRANSMITTER
108.875MHZ CRYSTAL

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CQ-TV magazine is published quarterly and is sent free to all members. The magazine, which was started in 1949, is recognised as the leading authoritative journal on amateur television in the world. All subjects relating to the hobby side of television are covered and these include: Fast-scan TV, Slow-scan TV, video recording, studio equipment, cameras, sound, special effects, computers, DX TV, satellite TV, microwave TV, transmitting, receiving, TV repeaters, mobile and portable, plus a mine of other information relating to amateur TV.

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☆☆CONTENTS☆☆

N.B: Although this book ostensibly covers CQ-TV issues 133 to 146, the inclusion of the two projects from issues 112 and 122 is by popular request.

This book is dedicated to all those who have ever contributed to CQ-TV. It is they who make it what it is.

FOREWORD

Reading through John Wood's foreword to the previous, first issue, of 'The best of CQ-TV', one gets the impression of tremendous changes taking place in the field of amateur television in the period covered by the book and John's editorship. John carried on for a further three years at the helm, retiring and handing the coveted red pen to me at the end of 1989.

In the sphere of ATV probably the greatest advances since the last 'Best of' have been in 24cm and above as far as RF equipment is concerned. The video end of the hobby has seen major advances in the use of computers and computerised equipment for creating and manipulating graphics. Television repeaters are proliferating around the country and we have seen the formation of EATWG, the European Amateur Television Working Group.

Nonetheless, as far as the BATC is concerned the changes have not perhaps been so blatant. The membership remains at around the same level as three years ago, and the committee is for the greater part the same! The one shining light has of course been CQ-TV.

Your magazine in the past three years has seen some changes. It was during this time that the page count was stretched to its limit of around 100 pages (this limit is imposed by the stapling method of binding - and cost!). The production method was streamlined even further, introducing new methods of preparing the camera-ready artwork and text for the printers. John found himself an assistant to ease the pressure of work and, in the long run, school for the eventual shift of the reins.

Yes, it was just about the time of publication of the last 'Best of' that yours truly joined the team. Before becoming assistant editor my knowledge of word processors, artwork production, magazine compilation and just plain article writing was, to say the least, sketchy. It is thanks only to John's help and perseverence that I felt able late last year to take on full responsibility for production of CQ-TV, and allow John to take a well earned back seat rest.

Since taking over I have updated the editorial computer system with some of the latest equipment and have installed a powerful new commercial word processor package. Eventually, I hope to utilise a full desk-top publishing system and laser printer to produce a higher finished quality for the printers to work from. However, none of this smart state-of-the-art equipment and techniques makes the content of the magazine any better, nor the way it is actually put together. I owe all the basis of my knowledge in the magazine production to John Wood. Without his unselfish devotion to CQ-TV over the past nine years the magazine would probably still be just the journal of a group of like-minded people (not that I wish in any way to decry the efforts of those before John).

Today CQ-TV stands proud amongst the many magazines published today, and that includes many of the commercial ones published in far greater quantities than our 2500 per issue. I hope in my term as editor that, at the very least, your magazine will maintain these high standards set by John. On behalf of the club I wish to offer a vote of thanks to John Wood G3YQC for his tireless efforts as preceding editor.

70CM ATV CONVERTER

There are several methods for receiving 70cm ATV pictures, using television receivers that will directly tune to 435MHz, converting television tuners such as the U321, or by using custom built converters. The converter, as its name implies, converts the pictures being received at 70cm to a frequency usually around 700MHz (approximately UHF) channel 36. Thus in this case we need an up converter, with the 70cm aerial connected to the input and the output connected direct to a standard UHF TV set.

The converter described here was originally designed by G4DYP and has proved very popular over the years. The design is simplicity itself, utilising no special techniques and not requiring a special printed circuit board. However, the club has produced a PCB for this design which is available from Members' Services.

The converter is shown in Fig.1 with the layout diagram in Fig.2. The 70cm aerial is coupled to the input tuned line L2 via a 22pF capacitor. The line is tuned to 70cm by the 2-10pF trimmer capacitor at one end. A second tuned circuit is used at the amplifier output to further improve the selectivity of the converter and to provide a low impedance feed to the mixer. The mixer collector circuit is tuned to the chosen IF frequency and, although the tuned line L4 is the same size as L2 and L3, there is sufficient range on the 2-10pF trimmer capacitor to accommodate the higher frequency.

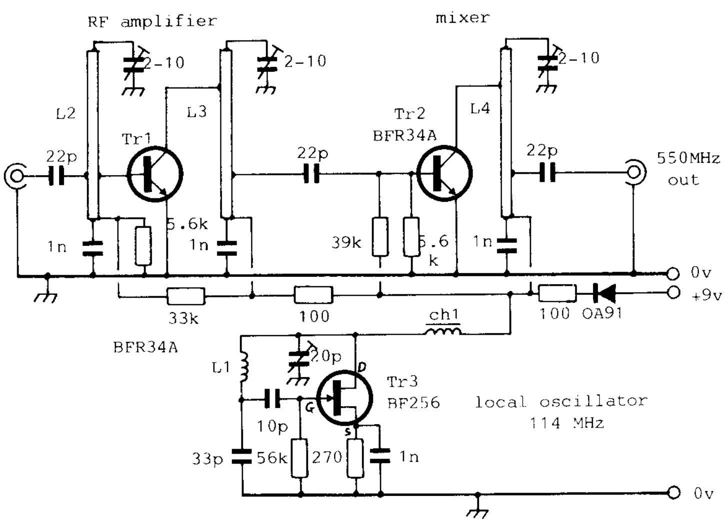
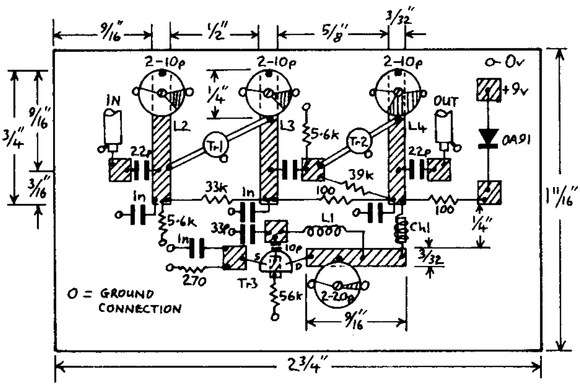


Fig.1 ATV Up-Converter Circuit.

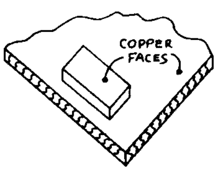
The local oscillator employs a standard L/C circuit tunable over an approximate range of 100 to 150MHz. Other frequencies could be used by varying the coil L1 and/or the 2-20pF trimmer. Local oscillator injection is somewhat unconventional in that it relies on stray coupling into the mixer. This is achieved by the proximity of the components, especially L1, and for this reason the layout shown in Fig.2 should be closely followed if that method of construction is chosen.

All capacitors should be good quality small disc or tubular ceramic types and resistors should be low noise ¼Watt. Trimmer capacitors may be good quality film dielectric or ceramic types. Choke Ch1 is made by close winding as many turns of 34swg enamelled copper wire as will fit on a single layer wound onto a ¼W 1M resistor. L1 is 6 turns of 20swg enamelled copper wound onto a 3/16" drill, 3/8" long and self-supporting.



PCB available

Fig. 2 LAYOUT DIAGRAM



Component mounting pads cut from PC board and 'instant' glued to main copper laminate board.
Pads are shown as shaded areas.
All components are mounted on the copper side.

CONSTRUCTION

If you are not using the printed circuit board then take a piece of single sided copper laminate board 2&3/4" x 1&11/16" and place it copper side uppermost. Now cut the pieces indicated by the shaded areas in Fig.2 from another piece of similar board using a small saw. Glue these pieces copper side up to the main board, so that the copper is insulated from the earth plane (position as shown in fig,2). The small pads are ¼" square, their actual positions on the board are not too critical, but should be close to those in the illustration.

ALIGNMENT

First check that the oscillator stage is working correctly and that it will tune to the frequency required. Connect the output to the aerial socket of a domestic TV set adjusted to a convenient channel around number 30. Switch on the converter and adjust the oscillator and mixer trimmers for maximum noise on the screen. Connect a signal generator to the 70cm input (a local amateur TV signal may be used or, if neither of these are available , the third harmonic of a 2 meter transmission could be used). Carefully tune the oscillator trimmer to receive the signal, finally peak the RF amplifier and mixer trimmers for maximum signal - indicated by minimum noise (snow) on the picture.

The converter should be housed in a suitable screened box fitted with good quality connectors (N or BNC).

A 70CM TRANSMITTER

This transmitter, although it has now been around for some years has been, and still is, very popular to such an extent that it was decided to include it yet again in another BATC publication. It is both easy to construct and align, and is capable of delivering up to 150mW of RF output in the 70cm band. It is intended as a low-power self contained transmitter, or as a driver for subsequent linear amplifiers. A video modulator is included on the printed circuit board and requires only the addition of a 100-ohm carbon potentiometer to provide adjustment of the video input level.

CIRCUIT DESCRIPTION

The circuit diagram is shown in Fig.1. Tr1 forms a crystal controlled oscillator which operates at 108.875MHz. In order to ensure maximum stability and spectral purity the oscillator is powered from a three terminal voltage regulator (IC1). The output is coupled directly to the base of Tr2, which operates as a frequency doubler. The collector tuned circuit (L2) resonates at 217.750MHz and, together with L3, forms a simple bandpass filter. Tr3 is another doubler stage and brings the signal to its final frequency of 435.50MHz.

The collector of Tr3 also connects to one half of a bandpass filter (L4) but derives its supply from the video modulator. Tr4 is the output amplifier and is also powered by the modulated rail. The collector connects to a simple Pi output stage which provides a low-impedance output suitable for matching into 50 or 75-Ohm coaxial cable.

Video modulation is applied to the base of the amplifier Tr5 via a panel mounted 100-Ohm variable carbon control providing adjustment of the actual video level. Tr5 base is biassed from a potentiometer circuit fed from a zener stabilised voltage source. DC restoration is provided by a 1N4148 diode. Tr6 acts as an emitter follower and delivers up to 12 volts (modulated) to Tr3 and 4.

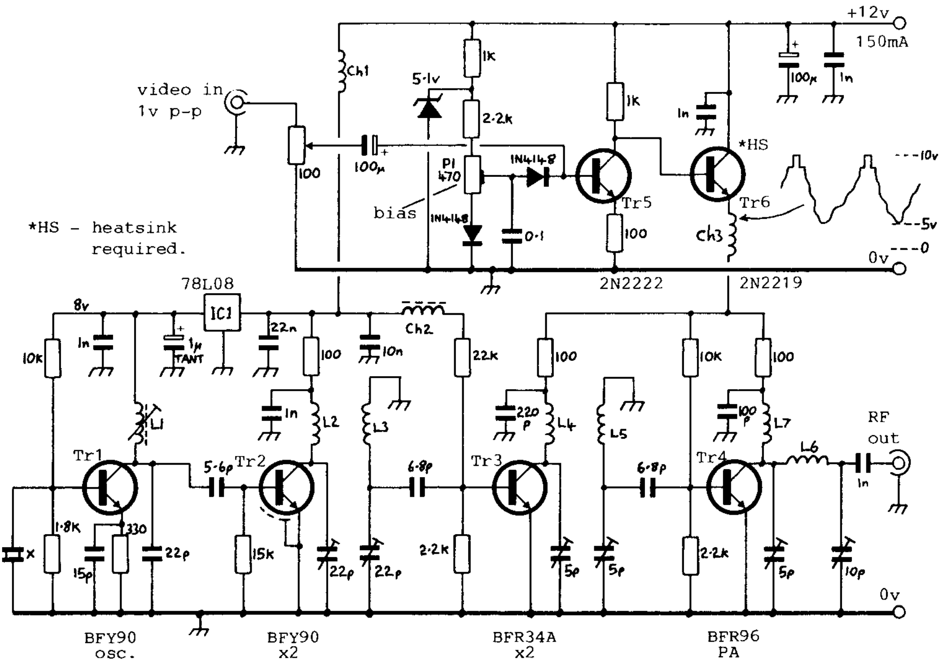
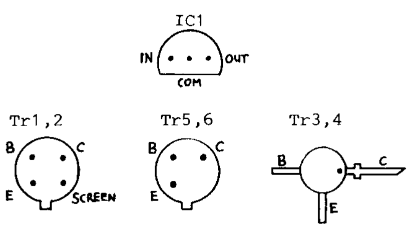


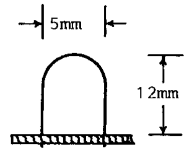
Fig.1 COMPLETE CIRCUIT FOR THE 70cm ATV TRANSMITTER

L1. 5½turns 26swg enamelled copper on 4.5mm former, with core.
L2,3. 1¾turns 20swg enamelled copper, 5mm i.d. spaced 2mm from board.
L4,5. ¾turn 20 swg enamelled copper bent to shape as illustrated.
L6. 1¾turns 20 swg enamelled copper or silver plated, spaced 2mm from board.
L7. 3turns 26swg enamelled copper, 3mm i.d. close wound.

Ch1. 10turns 26swg enamelled copper wound on 3mm drill, self-supporting.
Ch2. 3turns thin wire on ferrite bead.
Ch3. 8turns 26swg enamelled copper wound on 3mm drill, self-supporting.



PIN VIEWS



Detail of L4 and 5.

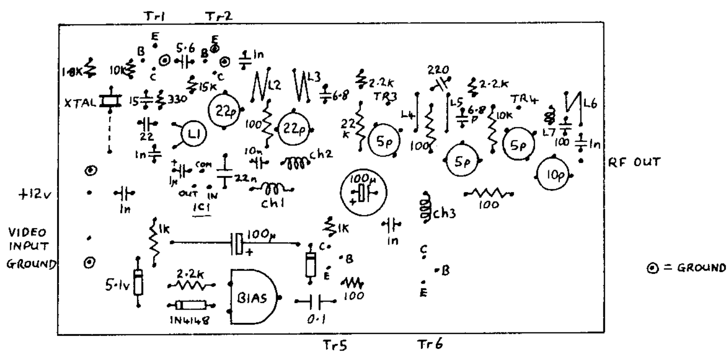
CONSTRUCTION

A double-sided printed circuit board is available for this transmitter from the BATC's Members' Services department. The component side of the board acts only as an earth plane and, where possible, component leads which are connected to ground should be soldered to both sides of the board.

Although HC18 or HC25-U crystal packages are most often used for frequencies over 100MHz, provision is made top use the larger HC6-U style as well.

Trimmers should be good quality PTFE film types. Try to use Mullard or DUA makes as these are among the high quality ones available, (note that this type of trimmer is not intended for lots of 'twiddling', and may become unserviceable if subjected to too many adjustments).

All lower value capacitors are miniature plate ceramic. One 100uF electrolytic is axial mounted whilst the other is a vertical radial type. A small heatsink should be fitted to Tr6.



Printed Board Component Layout

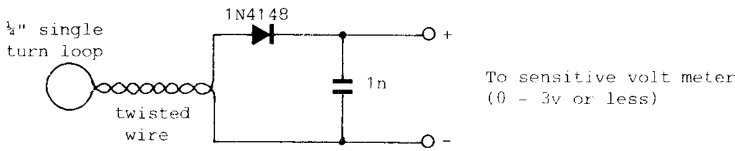
L2 and L3 are wound in opposite directions and should be wound to fit the holes provided. the screen lead of Tr1 may either be clipped off or soldered to ground on the top of the board.

A suitable sized hole should be drilled to accept the former used for L1. The former should be glued into position. 3/16" holes should be drilled in the board at the places indicated for Tr3 and Tr4. These transistors are mounted on the print side of the board and carefully soldered to the tracks provided. Care should be taken to ensure that the devices are installed the correct way round. The printing on the transistor package should face downwards.

The completed unit should be housed in a screened metal box fitted with a BNC socket for the RF output. Power is fed in through a 1000pF feedthrough capacitor.

ALIGNMENT

Alignment is straightforward and may be carried out using the minimum of equipment. Temporarily up-end Ch3 and apply power to the unit. Check that there is +8 volts at the collector of Tr1. using the RF 'sniffer' probe described below place the loop over the oscillator coil former and adjust the slug until the oscillator starts, indicated by a reading on the test meter.

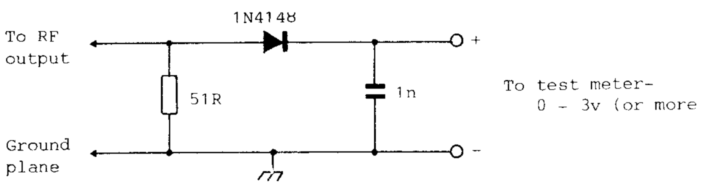


Mount on small piece of 'Vero' board.

RF 'Sniffer' Probe

Now place the probe near to L2 and adjust its trimmer for maximum indication. Whilst in this position re-peak the oscillator coil for maximum output, then withdraw the slug about a quarter turn. This should ensure that the oscillator starts readily. Switch the unit on and off several times to check that it does.

Re-connect Ch3 and turn the 'bias' control (P1) fully clockwise. Set the video gain control to minimum. Make a test load/detector circuit as shown below and connect it to the RF output.



Test Load/Detector Circuit

Apply power and adjust L2, L3, L4 and L5 tuned circuits for maximum indication on the test meter. Adjust the Pi output tuned circuit for maximum output, (one capacitor should be played off against the other).

At this stage the variation in the output power should be noticed if P1 is adjusted. If all is well, apply a video signal and turn up the video gain control. Turn P1 slowly anti-clockwise and as you do this the output power reading should fall. This indicates that video modulation is present. Do not be troubled if, when modulation is applied, the indicated power output power falls considerably. This does not mean that the actual *peak* power is degraded, it is merely the effect of the power meter which is averaging the power indication. To establish the peak power level simply unplug the video signal and watch the power meter, it will be indicating the actual power output level.

Monitor the output signal either using a monitor probe, or by receiving the signal on the station ATV receiver, and adjust the bias control for correct video/sync ratio. In practice this is usually almost at the fully anti-clockwise position. The video gain control should be turned up 'till just before the whites start becoming over-white, which would indicate that white crushing, or 'flat-topping, of the video waveform is occuring. In other words, you are driving the amplifiers into non-linearity.

This transmitter has been carefully designed so that even when adjusted without the aid of a spectrum analyser all harmonics are better than 30dB down. However, if equipment is available the transmitter should be aligned for minimum harmonic content. The following table shows the typical harmonic output levels from this unit after correct alignment, where f is the carrier frequency.

½ x f ...... -42dB,	2 x f ...... -44dB,	3 x f ...... -38dB
4 x f ...... -42dB,	5 x f ...... -38dB,	6 x f ...... -41dB

1.3GHZ POWER AMPLIFIER

This article first appeared in the Oct-Nov edition of the "MICROWAVE NEWSLETTER' and we thank the editors for permission to reproduce it here.

S.Jewell G4DDK,

When operation on the microwave bands is contemplated the problem of how to generate the local oscillator and transmitter signals occurs. A route often taken is to use a BGY22 module to amplify the output from a 'balloon" board and then to drive a diode based tripler to about 1 - 1.5 Watts at 1152MHz or thereabouts. This technique is practical but sometimes prone to instability, especially when the tripler output is then used to drive another varactor diode. Lots of attenuation between the interacting stages can cure the problem, but leads to low overall efficiency. With the cost of new CATV transistors coming down it has become at least as cost effective to amplify at 1152MHz direct. The amplifier described here accepts 10mW output from a low power oscillator board such as the G4DDK 001, and amplifies it to 1-Watt. (The G4DDK 001 local oscillator was originally described in 'RADCOM' Feb and March 1987, and special mention was made to possible modifications for ATV use made in CQ-TV 139, p.55. Circuit boards for this unit are available from the RSGB).

The unit described here has been built several times, each with different components, to prove its reproducability. In each case the amplifier has tuned up identically and output power has been within 0.5dB of 1-Watt, usually on the positive side! No instability has been observed at any stage of tune-up or operation.

In addition to operation at 1152MHz the amplifier can also be used between 1240 and 1300MHz. Used with a 1296MHz version of the oscillator board a low power 23cm FM/CW transmitter can be made. A bandwidth of 60MHz at a centre frequency of 1270MHz has been measured, suggesting that the amplifier may also be suitable for FM TV use. Last but not least, the amplifier operates in the linear mode, making it suitable for use with a low level mixer/modamp etc., to produce a 1296 or 1269MHz satellite up converter.

The Mitsubishi M57762 amplifier block requires only 1-Watt input for more than 10-Watts output across the whole of the 23cm band. Driven by this amplifier a compact 10-Watt minimum transverter can be built for little more than £100.

Detailed construction notes are not given in this article as it is felt that most microwave enthusiasts will be familiar with the required construction techniques. A circuit board is available from the RSGB.

OPERATION

The first stage of the amplifier operates in Class A at a bias of 17mA. Tuned input and output ensure that only signals in the required operating range are amplified. Murata, Sky or Oxley trimmers are specified for CV1 and 2, but almost any make of trimmer may be used as long as the minimum capacitance is no greater than 0.9pF. An NE021 transistor has been used successfully as a substitute in this stage.

A BFG34 is used in the second stage at a quiescent bias of 17 to 20mA, which is fed from the stabilized 8 volt rail. No suitable substitute has been found for this transistor. The BFR96 is definitely no-go!

The output transistor is a BFQ34, with its quiescent bias set at 35mA, also fed from the 8 volt rail. Several substitutes have been tried in this stage but none of them produced results as good as the BFQ34. It is possible that a change of bias could lead to improved results with some of the substitute devices, but this was not tried.

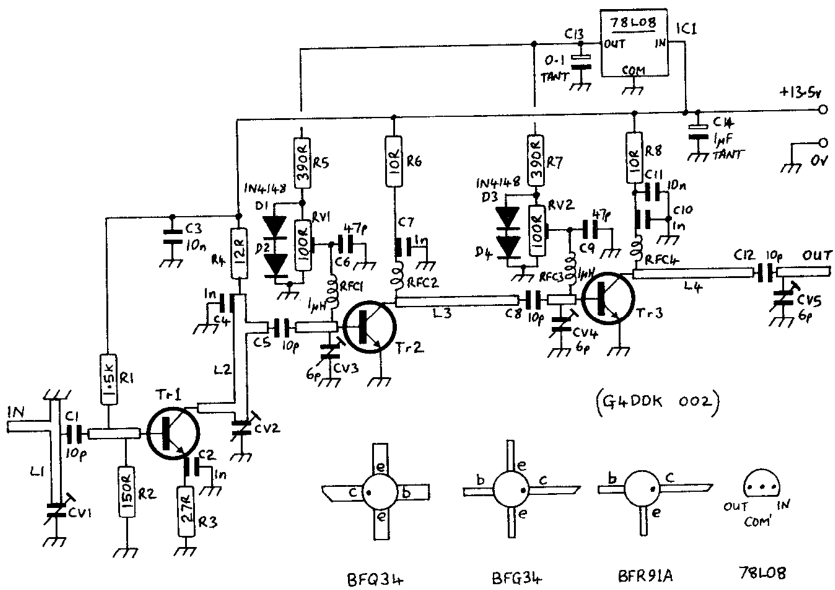
If 300 to 400mW is sufficient output the BFQ34 and associated bias components may be omitted and the output taken from the pad vacated by TR3 base lead. The match into 50-ohms is excellent at this point.

ALIGNMENT

A heatsink must be fitted to TR3 before any power is applied. Set RV1 and 2 so that the sliders are at the grounded end. Set CV1 to 5 to midway. Connect a 50-ohm power meter to the output but do not connect the input drive. Measure the voltage across R3 which should be 0.44 volts +/- .01v. If this is not the case check for shorts or incorrectly placed components.

With the meter leads across R6 slowly rotate RV1 rotor until a reading of 0.17 volts is indicated. This indicates a bias current of 17mA. This should occur at a rotor setting of about 55% from the supply end, ie. just over half way. Transfer the meter leads to R8 and adjust RV2 for a reading of 0.35 volts (35mA).

Apply drive of 10mW at the required frequency. Carefully re-adjust all trimmer capacitors for maximum output of about 1W. Check with a wide range wavemeter that the only response is at the required frequency, sub-harmonic levels should be so low as to be unmeasurable with almost anything but a spectrum analyser. Remove the drive and check that the amplifier output falls to zero, if not then reconnect the drive and retune, if all is well the amplifier is ready for service.



RV1,2 0.25W horizontal skeleton presets.
C2,4,7,10 470 - 1n trapezoidal (coffin) capacitors
CV1,2 0.9pF minimum foil trimmer, Sky, Oxley or Murata
CV3,4,5 Mullard 808 series 6pF foil trimmers
RFC1,3 1uH miniature moulded inductor
RFC2,4 1.5t 1mm tinned copper, 3mm i.d. self supporting
L1,2,3,4 Printed lines on PCB
Tr1 BFR91A, NE021
Tr2 BFG34
Tr3 BFQ34 (also tried: MRF511, TP3095, NE773)

Fig.1 PA circuit Diagram

SOME USEFUL VIDEO CIRCUITS

Bob Platts G8OZP

The LM359 programmable Norton amplifier IC can be used as a very useful video amplifier. Housed in the package are two high gain, high frequency stages, that can be configured to give gains of up to 30dB at frequencies up to 10Mhz, with output impedances of 75-ohms. One use for this Ic could be to replace the conventional circuitry in an FM demodulator, using one of the amplifiers between the phase-lock-loop stage, and the other as the output stage.

A suggested circuit is shown in Fig.1, both amplifier stages being identical. The pin numbers in brackets indicate the connections for the second stage. The input impedance is set at 75-ohms by R1. This resiistor may be omitted if a high-impedance input is required to match the output from the PLL circuit. The high frequency response is dictated by the value of C5. The suggested value of 1pF will cause the response to roll-off at 10MHz, whereas a value of 2pF will cause the roll-off to occur at 8MHz. The frequency response is also improved by the inclusion of C1, although it is not essential. The stage gain is adjusted by R6, and R7 sets the output impedance to 75-ohms.

Capacitors C3 and C4 should be mounted as close as possible to the IC in order to avoid instability. Due to the simplicity of construction and ease of setting-up of the amplifier, it could be worthwhile experimenting with this device in your FM IF system to see what improvements can be achieved.

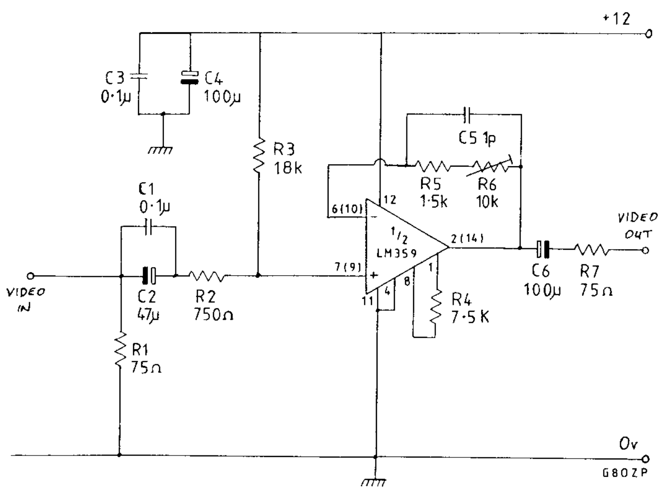


Fig.1 Video Amplifier.

REMOTE CONTROLLING THE NE592

The ubiquitous NE592 (LM733) as used in many FM IF's, including of course the BATC design, can be configured to allow remote or automatic gain control, instead of the usual pre-set gain control. The usefulness of this facility can become evident when receiving widely varying strengths of signals, with differing levels of deviation, requiring constant readjustment of the video gain control to achieve optimum performance. (This is assuming of course that the transmitting station is unable to adjust deviation by the required amount).

Commonly, the gain of the NE592 is set by altering the value of a potentiometer connected between pins-3 and 12 of the device. Because of instability problems this potentiometer must be mounted as close as is practical to the IC, thus making it impossible to mount the control on a front panel for remote adjustment.

The circuit shown in Fig.2 gives the complete circuit of a video amplifier featuring remote gain control. However, the circuitry of the remote control connected between pins- 3 and 12 of the IC can be added to an already existing circuit.

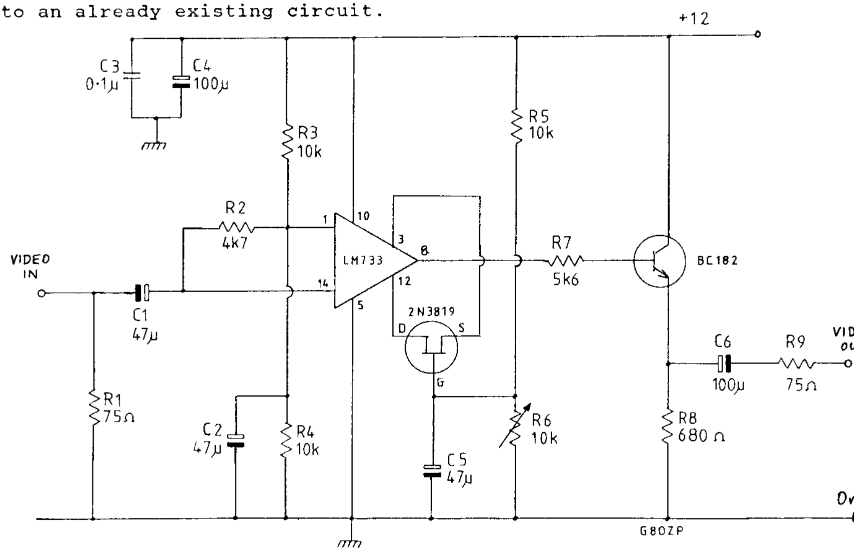


Fig.2 Video Amplifier Featuring Remote Gain Control.

The remote action is achieved by varying the voltage on the Gate of the FET by adjusting the potentiometer R6, which may be mounted away from the circuit on a front panel or whatever. Varying the resistance of R6 varies the amount by which the FET is turned on or off. This in turn varies the Drain/Source resistance of the FET, which is connected across the gain control pins of the IC, thus controlling the gain of the stage. The voltage on the Gate of the FET must be kept lower than the Drain/Source voltage, otherwise current will flow into the IC from the transistor causing problems. If this problem should arise select-on-test the value of R5 to compensate. It is advisable to use screened leads to connect the circuit to the remote control to prohibit any induced voltages corrupting the operation of the circuit.

VIDEO AGC

The circuit in Fig.3 shows how Automatic Gain Control can be added to the previous circuit, or in fact any existing video stage utilising the NE592. The network of D1, D2 and C8 produces a voltage which is directly proportional to the level of the output signal, rising as the output does. This voltage is fed to the base of the BC182, which turns on as the voltage rises. As the BC182 turns on the collector/emitter resistance decreases, thus reducing the voltage on the gate of the FET, and hence the gain of the IC.

The response time of the AGC circuit is controlled by C5, lowering its value decreases the cut-in time and vice versa. The threshold level at which the AGC operates is adjusted by the potentiometer R11. An AGC range of around 16dB is available, with a maximum amplifier gain of about 24dB.

This simple addition to the amplifier circuit could prove very useful in providing a constant video output for varying input signals. Again, it is well worth experimenting with this circuit in order to get the best out of your TV system.

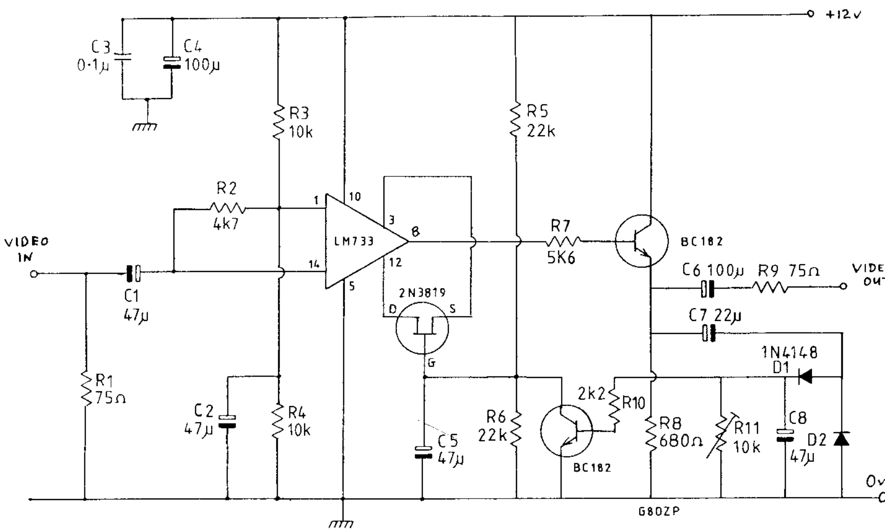


Fig.3 Video Amplifier with AGC.

GENLOCKING THE 'HANDBOOK-2' SPG

Trevor Brown G8CJS

In "The Revised Amateur Television Handbook 2" a design for a colour Sync Pulse Generator was produced, which has all the correct PAL offsets and Bruch blanking signals. A single Euro-card pcb is available through Members Services. Since publication of the original design I have had many requests to produce a Genlock system for this very popular design, so I have at last set my brain to work and come up with the following design.

In the original circuit of the SPG an error signal was derived from the subcarrier lock and used to modulate a varactor diode. The diode was placed across a crystal such that the error signal could be used to pull the crystal oscillator onto frequency. The problem that arises from this method is that crystals can only be lowered in frequency. So that unless the crystal is higher in frequency than the locking point, then the SPG may not always correctly synchronise the picture. The Genlock system described overcomes this problem by replacing the error locking system with a voltage controlled oscillator, locked by a TTL reference sync. It must be noted here that if the reference pulse disappears the SPG may stop, so that an auto-changeover system to non-genlock mode may be desirable.
In this design the input signal is treated as being monochrome and is synchronised to a two field lock, that is the odd and even fields of the SPG are locked to the reference pulse. This type of synchronising uses a hard reset and causes momentary disturbance to the picture before locking is achieved. (An alternative method of overcoming this picture bounce would be to use a slow field slide, but this would increase the complexity of the circuit beyond the capacity of a single pcb). Once in field lock the VCO maintains the picture in line lock by comparing each line and adjusting itself accordingly. Fine adjustment of the VCO allows for line phasing of the SPG for optimum picture quality.

The circuit diagram of the genlock unit is shown in Fig.1. The TTL reference sync and the sync from the SPG are fed to separate halves of a dual monostable (U1) with an unstable period, the duration of which is longer than half of one line of picture information. The outputs of the monostable are two square waves devoid of any vertical information (Fig.2). To improve phase advance one of the square waves is inverted using the bar Q output of U1. The two square waves are compared in U2 and the resultant error used to drive a VCO (U3). (The internal VCO in U2 cannot be utilised as it will not run at the desired 2.5625MHz). The output from the VCO is connected to pin-8 of the ZNA234 in the SPG via a changeover switch, allowing pin-8 to be connected to either the output of the VCO for genlocking, or to its original circuitry.

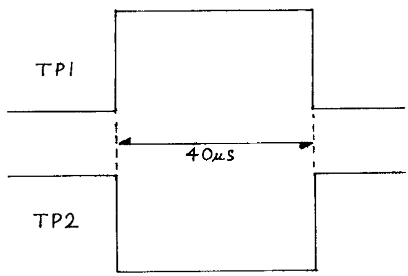


Fig.1 Squarewaves

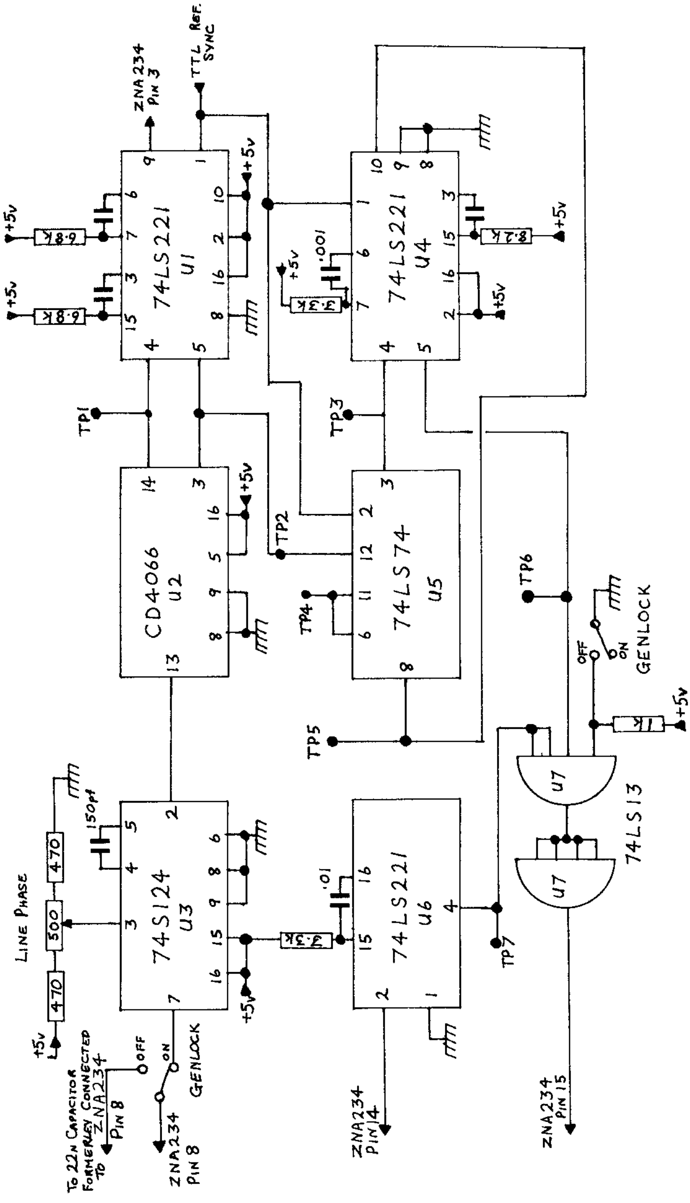


Fig.1 Genlock Circuit Diagram.

This first part of the circuit will result in the SPG being line locked to the reference sync, but it still requires bringing into frame phase by resetting the ZNA234 with an even field reference pulse. The TTL reference sync is fed to another monostable (U4) whose period is set at 12uS. The monostable is triggered by the leading edge of the reference sync and the output pulse (Fig.3a) is used to clock a D-type (U5), which also has the reference sync on its D input. The resultant output from U4 is a field pulse (Fig.3b), caused by the long duration broad pulses in the TV waveform. This field pulse is used to clock the other half of the D-type, which is also fed with the square reference pulse produced by U1 on its D input. The output of this second half of the D-type is a 25Hz square wave (Fig.3c), which is positive going at the start of even fields. This is due to interlace in the TV sync waveform, where the first broad pulse occurs halfway through a line on alternate fields. The 25Hz square wave is fed to the other half of the monostable U4, where its rising edge triggers a 2uS even field reset pulse (Fig.3d).

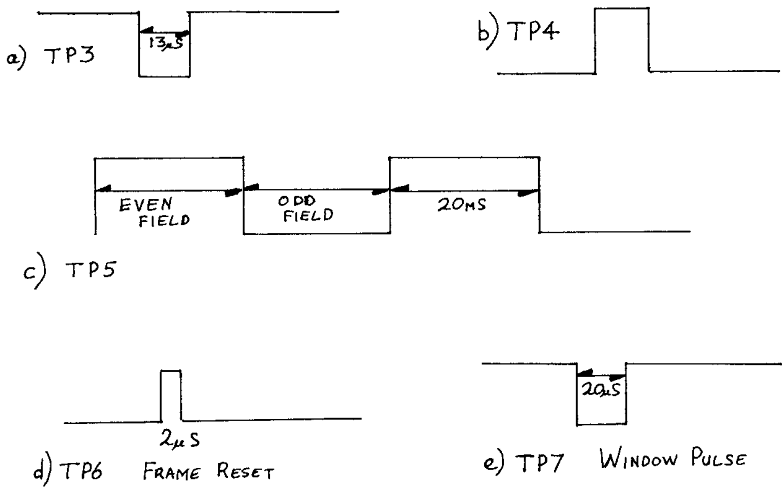


Fig.3 Waveforms

A 20uS window pulse (Fig.3e) is generated by triggering another monostable (U6) with the even field output of the ZNA234. This window pulse and the 2uS field reset pulse are 'ANDed' by U7 and the result fed to the ZNA234. In this way the frame is only reset when the reset pulse is outside the 'window' and in practice this only occurs when the system is switched on, or as a result of a change of reference signal. Because the genlocking system is free of all other reset pulses and lock is maintained by a smooth VCO, the performance of the SPG is not degraded.

The only setting up required is fine adjustment of the line phase control for optimisation of picture quality. The waveform diagrams included should help in fault location should problems be experienced with the unit.

AN ALTERNATIVE COLOUR ENCODER

Trevor Brown G8CJS

A problem being experienced with the very popular G4BAU electronic test card generator (Amateur-Television Handbook p.5Ø), is that the accompanying Pal coder circuit (p.84) uses the now difficult to obtain TBA52Ø integrated circuit. An alternative coder was described in CQ-TV 134 p.6Ø and whilst this circuit offers superior performance to the original, it is far more complex in it's design. The coder described here is much simpler in using readily available components and requiring a minimum of setting-up.

CIRCUIT DETAILS

The circuit is designed around the LM1886 Video matrix D-A converter and the LM1889 Video modulator. The LM1886 requires 3-bit digital inputs each for red, green and blue, from which the internal digital-to-analogue converters and video matrix provide luminance (Y) and colour difference (R-Y and B-Y) outputs. The chip also has an on-board R-Y polarity switch for PAL working, requiring an inverted burst gate trigger input. The mixed sync (MS) and mixed blanking (MB) trigger inputs also need to be inverted. The LM1889 video modulator is capable of interfacing audio, luminance and colour difference signals into a low band VHF or, minus the audio, a composite video output. It is in the latter mode that it is employed in the coder.

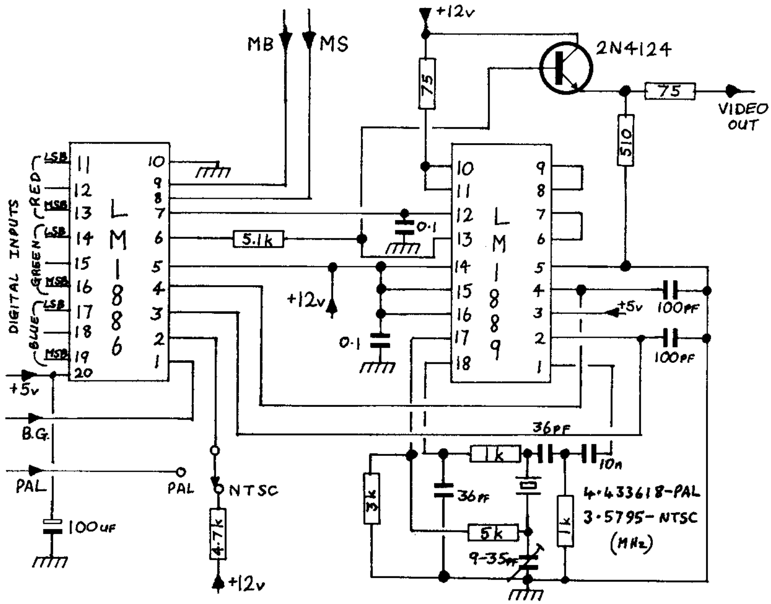


Fig.1 Pal Encoder Circuit Diagram.

The circuit is shown in Fig.1. The 3-bit binary coded colour signals are fed to the LM1886 at pins 11, 12 and 13 for red, pins 14, 15 and 16 for green and pins 17, 18 and 19 for blue. Inverted mixed blanking and mixed syncs are fed to pins 9 and 8 respectively, inverted burst gating to pin 1. The inverted PAL axis switch pulse is routed to pin 2 via a changeover switch, giving the facility to feed either the PAL signal to pin 2, or a logic 1 (5v) for NTSC working. The luminance and colour difference outputs of the LM1886 are fed to the LM1889. A sub-carrier at 4.433 MHz for PAL, or 3.576 MHz for NTSC, is provided by a simple crystal oscillator, the frequency required being determined by the crystal fitted. The composite video output at pin 13 is fed to a single transistor buffer, the output of which is 1 volt at an impedance of 75 ohm.

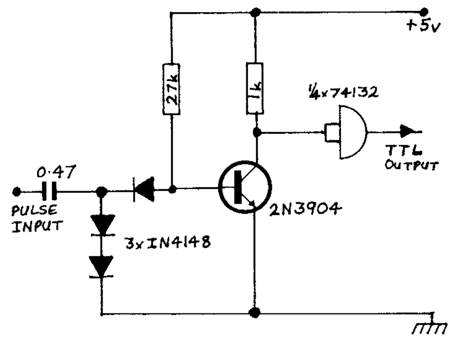


Fig.2 TTL Buffer.

CONSTRUCTION AND SETTING UP

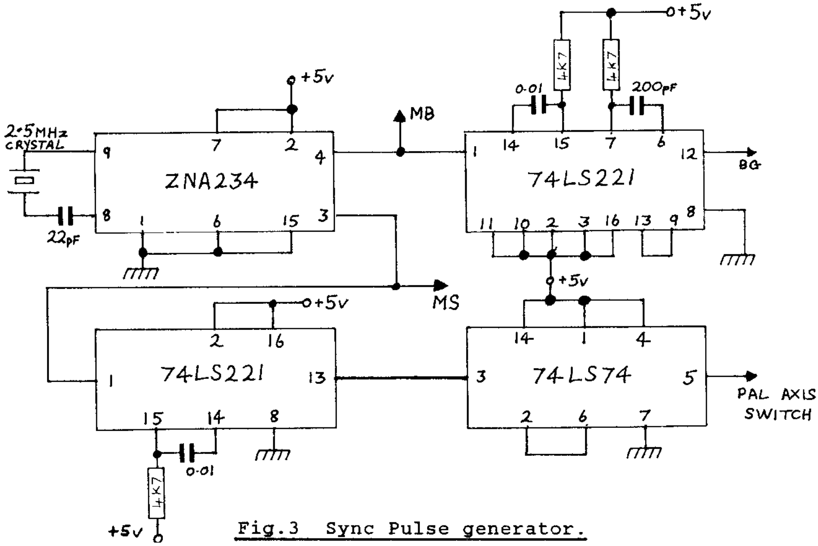
Due to the simplicity of design the coder can be constructed on Vero-board if producing a printed circuit board is not desired. No particular attention need be paid to the exact placement of components, but it is suggested that the digital inputs to the LM1886 be kept separate from other signals on the board.

Before connecting the power supplies check for short circuits etc. Switch on and check the supplies at the appropiate pins of the integrated circuits. Connect the video output to a monitor and, if no picture appears, confirm with the aid of an oscilloscope that the digital colour signals and trigger signals appear at the appropiate pins of the LM1886. If the picture on the monitor has incorrectly registered colour the trimmer capacitor in the sub-carrier oscillator should be adjusted to correctly place the colour component in the picture. Once this small adjustment has been made the coder should be producing a perfect colour picture on the monitor.

MODIFICATIONS TO TEST CARD GENERATOR

If it is intended to use the coder with the G4BAU test card generator the following modifications to the generator will need to be carried out.

The 3-bit digital inputs to the coder are taken from board 3 of the generator, IC38 pins 8, 3 and 6 for red, IC39 pins 8, 3 and 6 for green and IC40 pins 8, 3 and 6 for blue. The summing resistors associated with the three pins on each IC should be removed. As there are not enough spare edge connector pins available on board 3, further pins may be inserted in the holes previously occupied by the resistors on the printed circuit tracks from the IC's.

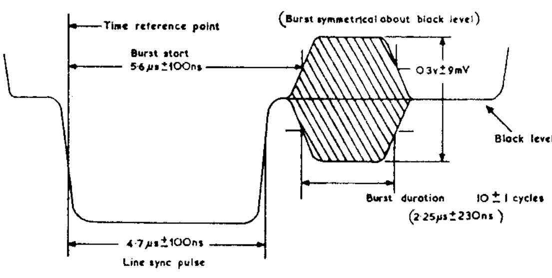


<u>Fig.3 Sync Pulse generator.</u>

The mixed sync and mixed blanking signals required for the coder can be sourced from the generator at the edge pins , but will need to be transformed to TTL level signals by incorporating the circuit shown in Fig.2. One circuit will be required for each signal.

Alternatively the timing signals MS and MB, plus the PAL axis switch and Burst gate pulses may be provided by the circuit in Fig.3, which previously appeared in Best of CQ-TV, p.90. This circuit, which is easy to construct requiring only a minimum of external components for the IC's, could also usefully serve as a station sync pulse generator. The only setting-up required is select-on-test adjustment of the value of Rx (nominally 18k) and/or Cx (nominally 200pf). This is to place the burst gate component of the composite video waveform output from the coder in it's correct time slot as shown in Fig.4.

The performance of the coder and the associated circuits discussed, whilst perhaps not meeting the severe constraints of broadcast TV, will suffice extremely well in the Amateur TV station. They provide a relatively simple answer to the problem discussed at the beginning of this article.



<u>Fig.4 Colour Burst Position.</u>

COLOURISING THE CROPREDY TEST CARD

Garry Shipton G4CRJ
& Richard Carden VK2XRW

Two minds with but a single thought....and so far apart as well!.

I have received not one, but two articles describing how the popular Cropredy electronic test card kit (marketed by Cirkit) may be upgraded by the addition of colour to the tonal areas of the pattern. It is a further coincidence that both designs use the same colour encoder chip - TEA2000. However, because each deals with the concept in a somewhat different way, I thought it best to combine the two articles and leave it up to the constructor to choose which design to build.

I have built two colourisers from the G4CRJ design (which was the first received by several weeks) and they both worked first time. I havn't had the opportunity of constructing VK2XRW's design but I'm sure it will work equally as well.

Editor

THE G4CRJ DESIGN

The Cropredy electronic test card generator produces a monochrome picture comprising cross hatch, grey scale, multiburst (definition bars) and various other patterns, all of which go to make up a complete test card not unlike the standard IBA pattern. The card also contains a large callsign together with a couple of lines of smaller text. With these features, it has been adopted by a number of TV repeaters for identification and GB3HV (my local repeater in High Wycombe) is no exception.

Our repeater computer generates colour pictures (block graphics) so it would be nice if the test card was in colour too. An examination of the actual circuit indicated that this should be quite straightforward to accomplish.

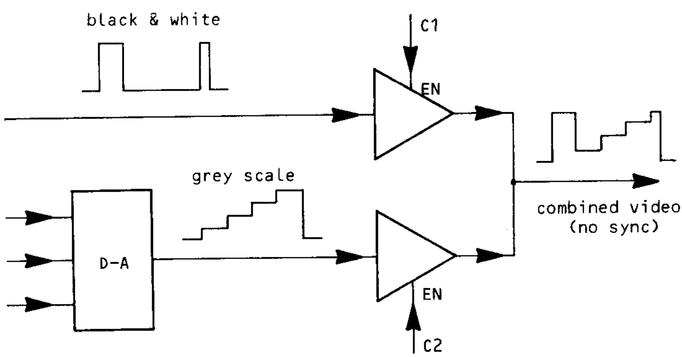


Fig.1

Fig.1 illustrates how the complete picture is built up. The black and white parts, at TTL levels, are passed through a tri-state buffer controlled by C1. The intermediate levels used by the grey scale and rectangles above the needle pulse are produced from three TTL signals which control a D-A converter, whose output is enabled by C2. The composite waveform is then formed by multiplexing the two waveforms together under the control of C1 and C2; the sync pulses being added later.

The same principle is used to produce a colour picture. Fig.2 shows the additional circuitry required and details the connections from the test card board itself. The three D-A signals are multiplexed with the black and white signal and only C1 is needed to control the 74LS157 quad 2-line to 1-line multiplexer. At this point, the resulting R.G.B. signals and syncs from Q2 on the test card board could drive an existing PAL coder, however, since one was not available, a TEA2000 single chip colour encoder was employed instead.

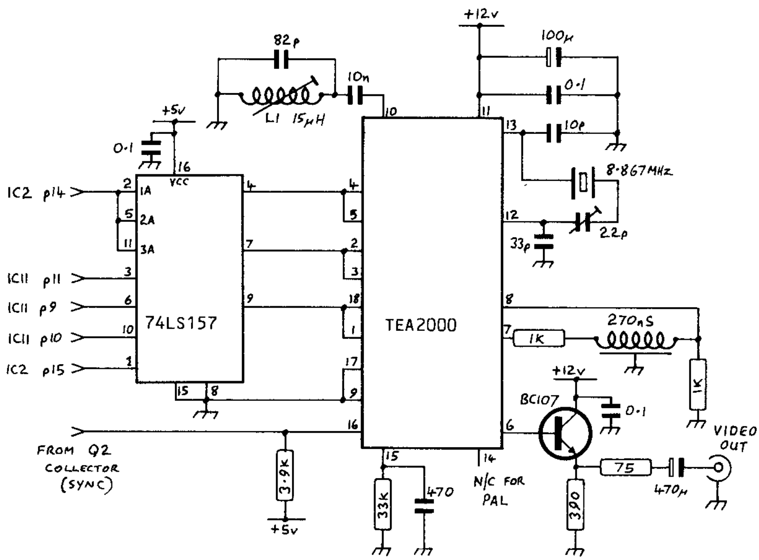


Fig.2 Test Card Colouriser circuit.

CONSTRUCTION AND ALIGNMENT

Decoupling on the TEA2000 is quite critical and the capacitors ossociated with pin-11 should be close to that pin and connect to a short ground plane around pin-9. Otherwise construction is fairly non-critical, although it makes sense to keep component leads and wiring as short and direct as is reasonably possible. A printed board is probably the best method of construction although Vero should be OK.

L1 is tuned for maximum burst as seen on a 'scope connected to the video output. The 22pF trimmer capacitor sets the colour subcarrier frequency which can be measured using a frequency counter on pin-12, using a low capacitance probe and a 10k resistor in series to prevent frequency pulling. NOTE: the crystal operates at TWICE the colour subcarrier frequency. If a counter is not available then use a colour monitor and find the extremes of the colour locking range, indicated by breaking-up of the colours, and set the trimmer halfway between these points.

The components on pin-15 set the frequency of a ramp generator which determines the duration and position of the colour burst.

Now view the composite waveform on an oscilloscope and adjust L1 for maximum colour information. The amplitude of the colour bars will extend above peak white and below black level (see Fig.3).

When the circuit is working correctly and using the standard EPROM pattern supplied by Cropredy, the grey areas will now be coloured. From left to right the grey scale will be CYAN, GREEN, MAGENTA, RED, BLUE and BLACK. Above the needle pulse will be GREEN, RED, GREEN.

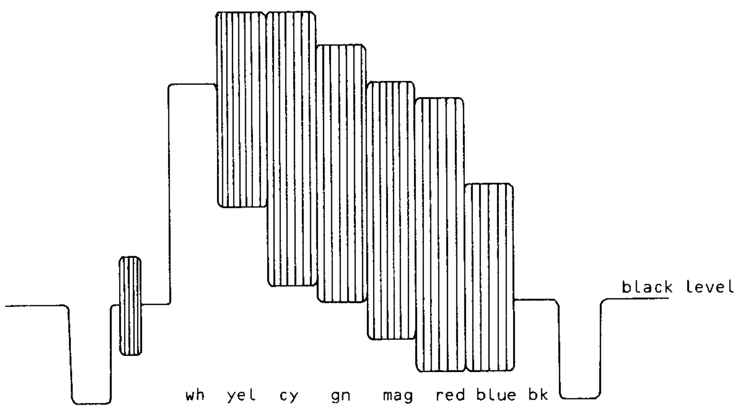


Fig.3 Line Waveform Øf 100.0.100.0 Colour Bars (100%).

THE VK2XRW DESIGN

Having built the Cropredy test card generator and, armed with some EPROM patterns from the Worthing TV Repeater Group, I decided to have a go at producing colour from it.

My aim was to use the existing grey-scale outputs from the '377. Although the luminance levels would be incorrect, for this application that didn't matter. My main problem was to find an encoder to bring the various available waveforms together unfortunately, most encoders require burst gate, sync, sub-carrier and PAL ident; these wern't easily available so I looked further.

I discovered a Philips chip, the TEA2000. This is a complete single chip colour encoder which only requires syncs and a set of TTL level RGB signals to drive it. It has its own subcarrier oscillator built in so it seemed ideal for my application. The other requirements were that, for PAL operation, composite (field and line) syncs must be used. The blanking input (pin 17) must be kept high during sync and colour burst, unless all colour inputs are low at this time. In this application blanking is not used and pin-17 is simply grounded.

A prototype was constructed to the circuit shown in Fig.4 and this worked first time. The luminance section was not used in my original and the combined chroma signal from pin-6 was added via a small capacitor to the existing output stage. The only real problem was one of colour crawl on the sharp transitions of the test pattern, however this could be reduced by wiring a suitable capacitor in the Cropredy output stage to reduce the rise time. Now though I use the TEA2000's luminance section, together with a suitable output amplifier, thus replacing the unit's existing output circuitry, this is much nicer.

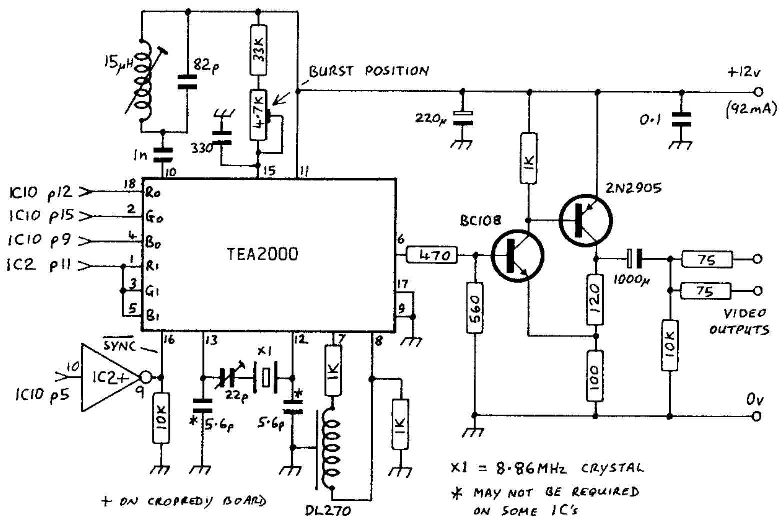


Fig.4 VK2XAL Test Card Colouriser circuit.

The TEA2000 requires a 6-bit binary input at TTL levels. In the first prototype the two bits per primary colour are connected together, thowever, in this case, R1, G1 and B1 are joined together and connected to the luminance output from pin-11 of IC2. Note that IC11 is no longer required and may be removed from the board. The unused inverter in IC2 on the Cropredy board can be used to invert the sync signal in order to provide the correct signal for the encoder: Pin 10 of IC2 should be cut and re-routed to pin-5 of IC10, the inverter output (pin-9) then feds pin-16 of the TEA2000. The unit adjustment is similar for the circuit previously described.

This version uses a video distribution amplifier from which up to about 4 separate 75-ohm video feeds may be taken at the same time. The main components for these circuits are available from Maplin Electronics. They are: TEA2000 (UH66W), DL270 delay line (UH84F), 8.867238MHz crystal (UH85G) and 15uF adjustable coil (UH86T). The numbers in brackets are Maplin's stock numbers. Please note that the Worthing group now offer a colouriser based on these designs, please consult their advert in the latest issue of CQ-TV for details.

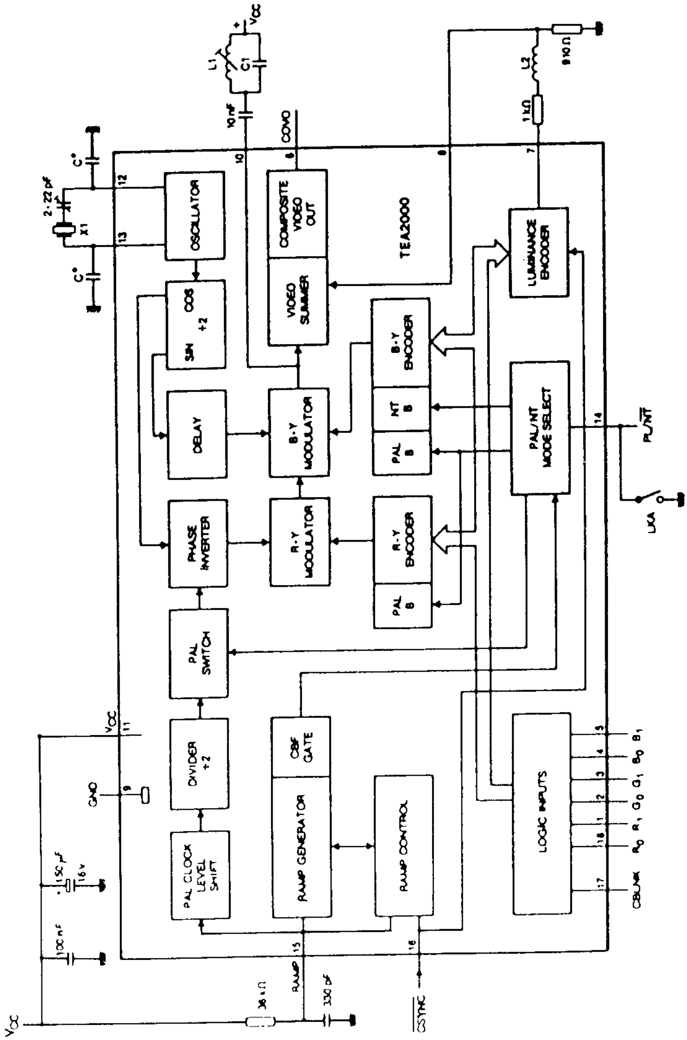


Fig.5 TEA2000 Block Diagram.

GREY/COLOUR BARS FOR THE 'WCY SSTV SCAN CONVERTER

Brian Roberts G4VYG,

One very useful facility which is often included in the specifications of commercial SSTV equipment is the provision of built-in grey scale and colour bar generators. As an aid to setting up and checking transmissions it is invaluable when building and using home-brew equipment. Also, it is very useful to a receiving station to have these 'screens' available from the transmitting station, to enable accurate tuning etc.

This article describes an add-on board for the G4ENA/G3WCY SSTV transceive system (The Slow Scan Companion pp 52-75). The features provided by this modification are:

1) When transmitting in the 8-second mode, an eight shade grey scale over the whole frame for set-up purposes, or covering the bottom eight lines only for inclusion with a picture.

2) When transmitting in the 24-second Line Sequential Colour mode, a correctly registered set of colour bars, over the whole frame or on the bottom eight lines only on snatched pictures. On colour pictures loaded by the RGB method, a grey scale only will be present on the bottom eight lines of the picture.

CIRCUIT OPERATION

Referring to the circuit diagram in Fig.1; the grey scale bars are generated by a dual 4-bit integrated circuit (IC1), which is driven from the fast scan row counter on the digital board in the converter (IC27 pin 11) at 128 times line frequency. Counts 32, 64 and 128 are used to form a three bit code for grey scale generation, and individually one in each of the three colour memories for colour bar generation (see Fig.2).

The required output from the bar generator is selected by a 2 to 1 line data selector (IC2). A logic high on the select input (pin 1) of IC2 enables the B input, routing the counter outputs as a four-bit code to IC3. The most significant bit and the least significant bit are joined to give the 4-bit code required by the memory.

A logic low on the select pin of IC2 enables the A input, activating the colour bar mode. Each of the memories has to be loaded in turn with one of the count outputs, all four bits being the same. A quad tri-state buffer (IC5) selects each memory in turn using switching data from the converter's auxiliary board. IC4a is used to invert data from the tri-state buffer to present the colour bars the correct way round.

The required picture or bar data is selected for loading into the memories by another quad 2 to 1 line data selector (IC3). A high on select pin-1 outputs picture data to memory, a low outputs bar data. Switch S1 is an optional extra and allows the bars to beswitched off, inserted on the bottom eight lines of a picture, or loaded over the whole frame.

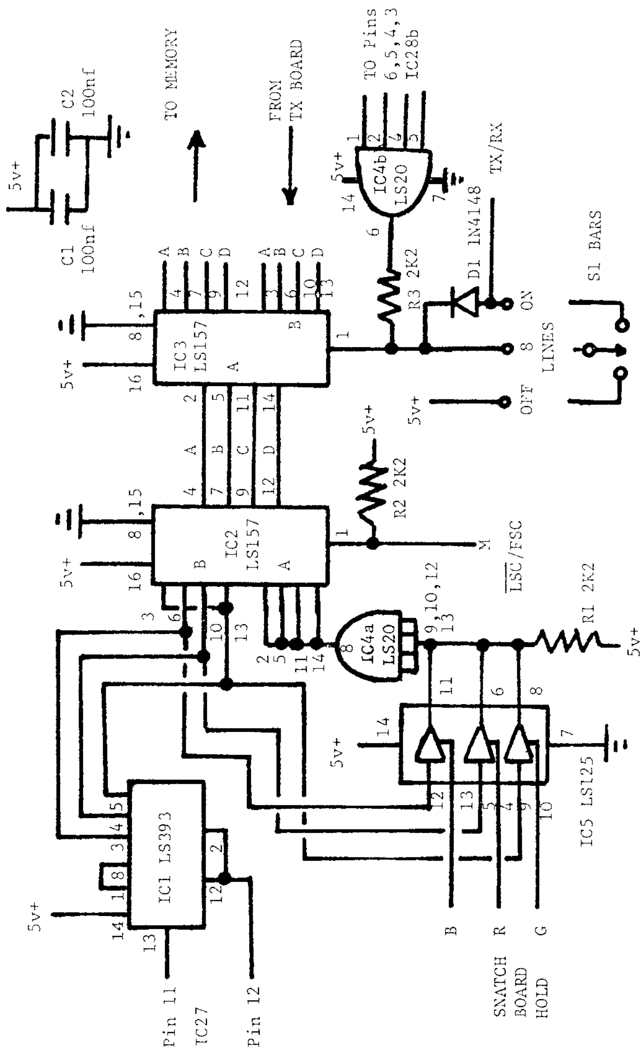


Fig.1 Grey Scale/Colour Bar circuit.

The second half of the inverter (IC4b) is connected to the fast scan column counter in the converter. When the count reaches 120 the output of the inverter goes low, thus selecting bars which are then inserted on the last eight lines of the frame.

Diode D1 is fed from the transmit/receive switch on the converter, ensuring that when receiving pictures the bars are not selected.

CONSTRUCTION AND INSTALLATION

Either a printed board or Vero can be used for the construction. Mount the board in a convenient position in the converter, as close as possible to the transmit and memory boards. The shorter the data wires linking the boards the better. Remove the four video data output leads A, B, C and D from the transmit board and connect them to the memory output of the new board. Connect four new wires from the transmit board outputs to the transmit inputs A, B, C and D of the new board. Thus the new board is now connected in the transmit board output lines.

The count inputs for IC4 are taken from the Auxiliary board, IC28b pins 3, 4, 5 and 6. The RGB select inputs are taken from Snatch board hold outputs, IC5 pins 6, 2 and 4 respectively. The line clock and the reset signals should be carefully taken from the pcb side of IC27 pins 11 and 12 on the digital board. The M input is taken from the LSC/FSC switch on the converter. If the bar generator board is to be used with a converter having one memory for 8 second working only, the connections to RGB select and M may be omitted. Switch S1 can also be omitted if the bars are only required in the bottom eight lines of the picture.

This straightforward circuit performs extremely well and provides an efficient method for setting up the transmit converter as well as giving a 'professional' touch to the pictures.

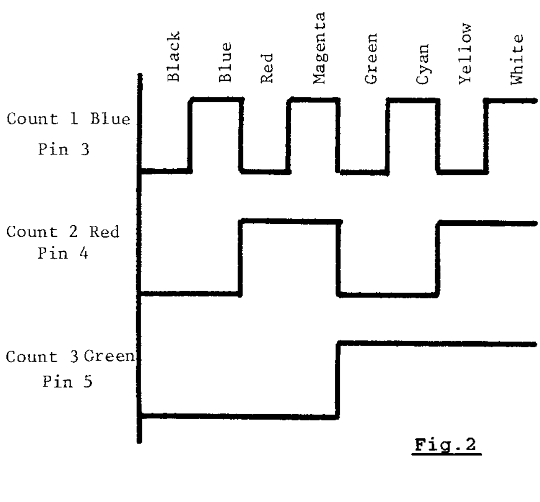


Fig.2

A VOGAD AMPLIFIER FOR INTERCARRIER SOUND

John Wood G3YQC

This circuit was put together in order to operate the Wood & Douglas intercarrier sound generator (TVSG1) from a microphone. The generator requires 1v p-p to drive it and this unit has been designed to produce more than 1-volt, thus leaving a bit in hand.

Instead of making just a straight audio amplifier though, I felt it would be much nicer to incorporate a Voice Operated Gain Adjusting Device (VOGAD) so that, no matter what level of input is applied (within limits), the output level remains constant and no gain control is required. A wide variety of microphones and other audio sources may be connected.

CIRCUIT DESCRIPTION

Pins 4 and 5 of the VOGAD are balanced microphone inputs with an impedance of around 150-ohms, this circuit however is wired to accept the more usual unbalanced microphone input. The AGC time constant is set by the components on pin-1 and the circuit exhibits fast attack and slow decay.

The 2.2uF capacitor between pins 2 and 7 limit the LF response, whilst the 22n connecting pins 7 and 8 cause the HF to start rolling off at around 20KHz. Power is obtained from a 3-terminal 6-volt regulator and adequate decoupling of the supply rail is provided on pin-3.

The levelled audio output is of the order of 100mV rms and this is applied to a two-transistor amplifier using shunt feedback. This amplifier is extremely useful in audio, video and RF work up to 30MHz or so, depending on the transistors used.

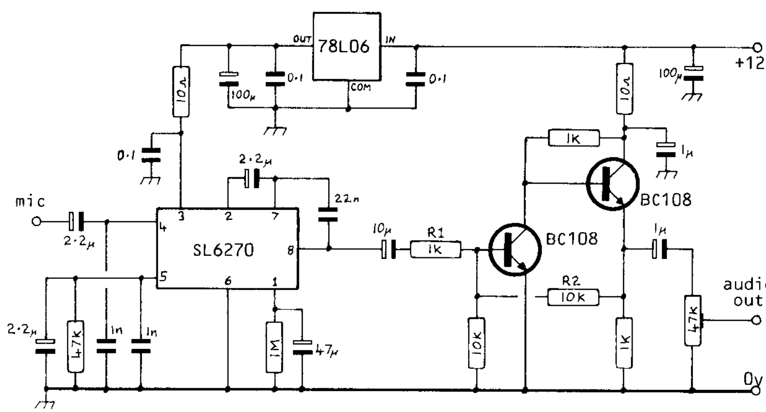


Fig.1 VOGAD Amplifier circuit diagram.

The input impedance at the base of the first transistor is virtually zero, this means that a very well defined input impedance is produced by the value of R1. The gain is approximated by the ratio of R2 to R1 (in our case R2 = 10k, R1 = 1k and the gain is therefore 10). Output impedance is low and, due to the shunt feedback arrangement, loading of the output has virtually no effect on the input impedance, therefore the amplifier exhibits excellent isolation qualities (useful as a buffer, say, for a VFO).

When connecting this amplifier to the TVSG1, the input terminating resistor (R1 - 680-ohm) should be removed from the board. A short length of screened audio lead is used to connect the two modules together, and the input level (audio deviation) is adjusted by the 47k preset. Once set for your own transmitter this control will not need further adjustment.

A 50HZ STANDARD

Jeff Underwood, G6BNE

How many times has there been a requirement for an accurate 50Hz signal source? For instance: when converting a 'mains only' TV camera for battery use. Also, some cameras have 50Hz oscillators which are locked to the mains frequency, but when used on battery the oscillators free-run, often producing mediocre accuracy. I had a similar ploblem; a mains only camera, which relied on AC for its 50Hz timebase, there being no oscillator at all.

With an eye for new applications for existing integrated circuits, I came across the M706BI 50Hz timebase C-MOS chip. This employs a 3.2769MHz clock and has an internal divider chain to produce 50Hz with phase complimentary outputs. The circuit is shown in Fig.1

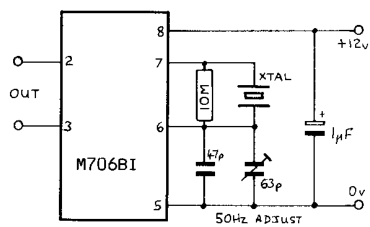


Fig.1 Circuit Diagram.

The unit can be assembled on a small piece of stripboard and will fit into the most compact cameras. Since most cameras run off 12v this supply is adequate, however, being C-MOS, it will quite happily run from lower voltages.

The output of the circuit is simply connected to the original AC input point to the timebase, either output may be used. All components are available from Electromail (RS Components).

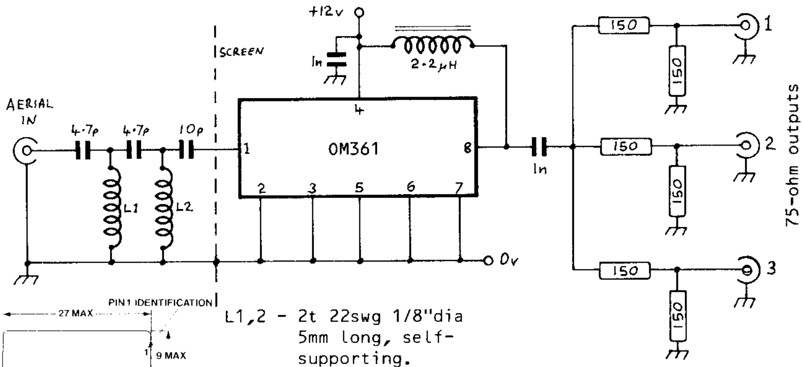
Results on my camera are excellent and I observe no interference to the field sync. I see no reason why this circuit couldn't form the basis for a voltage invertor, by using both outputs. Or perhaps even a battery clock.

TV DISTRIBUTION AMPLIFIER

John Wood, G3YQC

Not so much amateur as general TV this one. How many of you run more than one TV set in the house from a single aerial? It's OK if you live close to a TV transmitter but many of us live in fringe areas. After splitting the available signal, usually passively, into two or more, there is often not enough signal left to drive the sets properly.

What is required of course is an aerial amplifier with multiple outputs, so that a decent signal can be fed to each set. I came across this problem when I wanted to watch the test matches on three TV's (strategically placed around the house), so I put together the little amplifier shown in Fig.1.



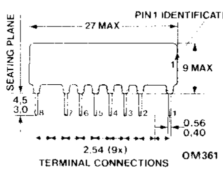


Fig.1 TV Aerial Distribution Amplifier.

CIRCUIT DESCRIPTION

This amplifier is based around a OM361 hybrid RF module (Electromail 302-485) which, by itself, exhibits around 28dB gain flat across the UHF TV spectrum. In fact the module amplifies at full spec. right down to about 40MHz, so they are pretty useful devices to have around.

I live close to Rugby Radio station and BBC Daventry and I therefore need to keep an eye on the bandwidth of amplifiers, otherwise their already strong signals will just blast in along with everything else. Therefore I have included a simple high-pass filter at the input which effectively attenuates signals below the bottom of the UHF band. This can be seen from the plot in fig.2. The HF rolloff is due to the amplifier's natural bandwidth characteristics.

I suppose it would have been nice to divide the output signal using toroidal transmission line transformers. However, always one to find the easy way out, as well as making the design repeatable for others, I opted for a simple resistive divider circuit. Each output is largely independent of the others and will match into 75-ohm coaxial cables. The total gain for each leg of this design is around 10dB. The quoted noise figure for the OM361 is only around around 6dB, not good for communications but reasonable for domestic TV.

CONSTRUCTION

Be a little careful about the construction of this unit. Make sure you keep input and output components well separated and preferably screened from each other, otherwise the amplifier may tend to self-oscillate.

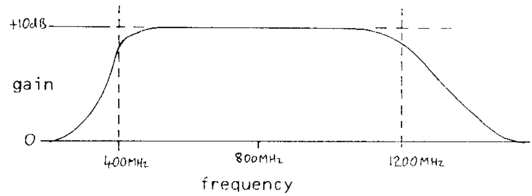


Fig.2 Frequency plot.

Probably the best way of building is to make a little printed circuit board, double sided, with the top as just an earth plane. Solder the ground legs of the amplifier to both top and underside and provide several similar stakethroughs around the rest of the board. Keep all tracks as short as possible and make sure the decoupling capacitor at pin-4 is mounted close to the pin. The choke is an ordinary axial type available from Bonex Ltd. Capacitors should be miniature ceramics and resistors 1/4W carbon. L1 and L2 are made from enamelled or bare copper wire

For those not able to make a PC board it is possible to lie the amplifier flat onto a piece of plain copper laminate and hand-wire the components to the legs. The ground connections should be carefully bent down and then out ('L' shaped) so that the amplifier lies against the board and the leads just touch the surface. Solder these five leads to the board which will firmly secure the amplifier. For the other component connections (other than those to ground) small pieces (around 3/16" square) of PCB material may be cut from an off cut and glued to the main board, these will act as junction pads to which the other components can be soldered.

It is still possible to put a screen in the position shown, although the lead of the 10pF capacitor will have to be brought through a hole, and insulated, either by using a feedthrough insulator or by sliding a short piece of plastic sleeving over the lead. Keep the lead length to a minimum. Alternatively the screen can bridge across the module itself, towards the input end. Although a suitable shape will have to be cut out of the screen first.

TESTING AND OPERATION

The amplifier should be tested to see that it performs satisfactorily and does not self-oscillate, then it can be mounted into a small metal box.

Power should be fed into the box via a 1n feedthrough capacitor. The unit will draw around 50mA and will run quite warm.

BAND SCAN DISPLAY

Geoff Mather G8DHE

This circuit was created in response to a need to visually display the output of a band scanner for the 24cm amateur band. Originally the scanner output was displayed on an oscilloscope in the form of a simple spectrum analysis, but this resulted in the oscilloscope being permanently tied up, whilst the normal TV monitor was idle.

The generated display from this unit consists of horizontal bars across the screen for each signal present in the band. The lowest frequency is at the bottom of the display, whilst the top represents the highest. Even very low levels of signal are discernable on the display often resulting in P0 grades when they are viewed directly. A thin white marker band is provided to indicate the position of a manual tuning control so that tuning can be set to the correct frequency before coming out of the scan mode to view the signal.

The circuit breaks down into 3 sections: (1) The scanner and power supplies, (2) Video processing of the resulting scan and (3) The audio alarm circuitry.

1. SCANNER AND POWER SUPPLIES (Fig.1)

The converter used was a Wood and Douglas 1250DC50 which requires a tuning voltage in the range 0 to 8.5 volts to cover the band 1240MHz to 1320MHz. To generate this voltage half of a CMOS NE556A (IC2) connected as an astable oscillator at 50Hz is used, the ramp waveform from the timing capacitor (C2) being picked off and fed to the inverting input of an op-amp (IC3) which provides the necessary gain and level shifting required. In this design the gain of the op-amp is fixed to provide a ramp of about 10 volts whose DC offset can be varied by VR1. A frequency of 50Hz is used as the resulting scan is displayed on the screen in a vertical direction. A measure of overscan is provided in the ramp waveform to allow the 1240 to 1320MHz limits to be fitted within the display. The frame synchronisation pulse which is required by the video processing stage is derived from the normal output of the astable, as this goes low during the flyback period.

The second half of IC2 is used for two purposes: to generate a negative supply rail for the op-amps and to generate the line sunc pulses required in the video processing stage. The normal output of the astable is used in a charge-pump operation and produces approximately -7 volts, the actual level is not critical and provided that at least -5 volts is produced then the other circuits will operate satisfactorily. Due to the loading of the normal output by the charge-pump operation it cannot be used to generate the required level of sync pulses, so the source of the pulses is taken from the discharge output (pin 5) of the integrated circuit. The two potentiometers, VR2 and VR3, allow the line and frame periods to be adjusted to 15625Hz and 50Hz respectively.

The final stage in this part of the circuitry generates a marker 'pip' to be added to the video signal to represent the position of the manual tuning control. The ramp waveform is compared with the steady

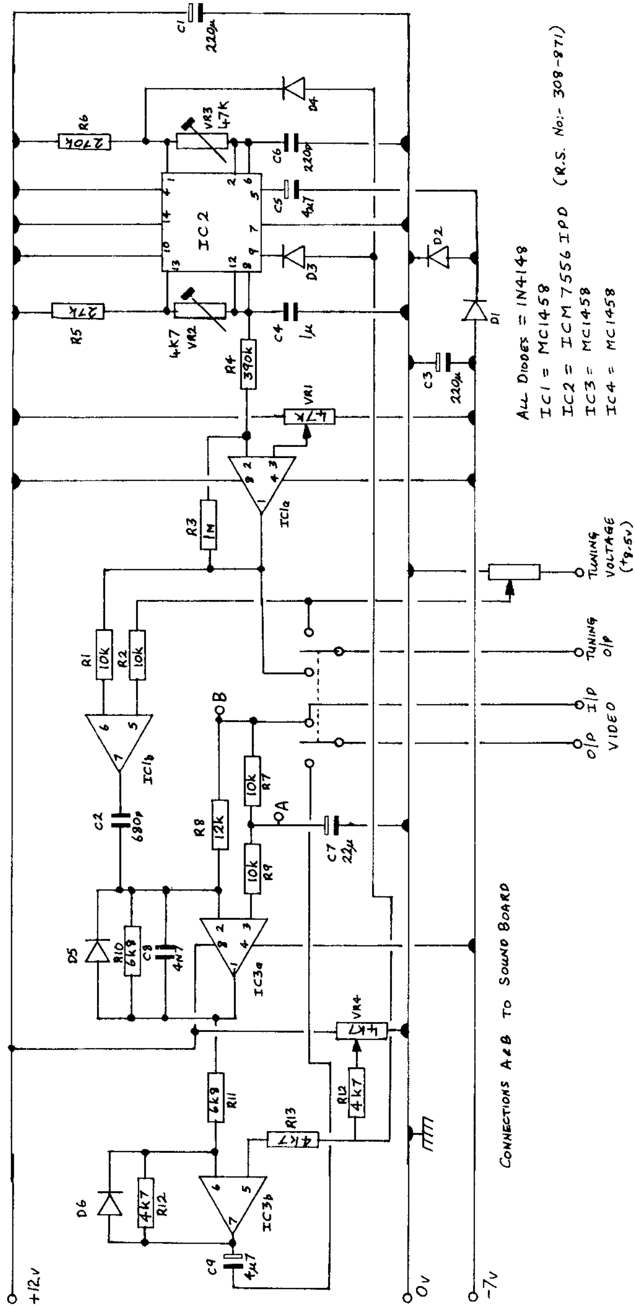


Fig.1 Power Supply and Video Processing

voltage from the tuning control, and a positive going pulse is generated whose rising edge is differentiated by C1 to provide the 'pip', giving the position of the tuning control relative to the scan.

2. VIDEO PROCESSING (Fig.1)

The video processing stage is divided into two parts: the first part (IC3a) provides for removal of the DC component from the video waveform to be displayed (R7, R9 and C7), attenuation of the signal to within the range 0.5 to 0.7 volts p-p (R8 and R10), limiting of the waveform to prevent the black level being crossed, as this would have the effect of causing spurious sync pulses (D5) and for filtering out of the high frequency content of the scanned signals (C8). The resulting output is centered around 0 volts and will not exceed +0.35 volts (black at this stage). The marker 'pip' is also fed to the inverting input of this half of the op-amp (pin 2), to provide a thin white line on the display indicating the position of the manual tuning control.

The second part of the video processing stage provides inversion of the video signal and mixes in the line and frame sync pulses. Due to limitations in the slew rate of the op-amp the sync pulses tend to have a triangular appearance if a pulse level exceeding 0.5 volts is attempted, so care should be taken in setting this level.

3. AUDIO ALARM (Fig.2)

This circuit was designed as an extra, but could equally well be used on its own if a video output is not required; however the audio output is rather harsh, so filtering may be required to suit personal tastes.

The first stage (IC4a) squares up the positive swings of the video waveform to provide a constant amplitude pulse when signals are detected, the resulting waveform (50Hz for one station, 100Hz for two stations etc.) is smoothed by R18 and C9. D7 and R19 exhibit a long discharge time-constant and R20 and C10 form the timing elements of a sawtooth oscillator whose frequency varies with the voltage appearing across C9, thus providing a relative indication of the number and strength of signals being detected in the band. With no signals present there will be no voltage generated, hence no audio output at all.

The second stage (IC4b) provides the active element of the oscillator. By comparing the voltage across C10 with zero volts it switches to a negative state when the capacitor charges, thus discharging C10 via D9 in the process. D8 and C11 hold the op-amp negative long enough to ensure that C10 discharges to a reasonable depth before switching back to the positive state.

4. CONSTRUCTION AND TESTING

A printed circuit board has not been designed as yet, the initial three units having been built satisfactorily on Vero-board. However if there is sufficient demand a board and possibly a kit may be made available by the Worthing and District Repeater Group. Please contact the group if you are interested and keep an eye on our advertisements in future issues of CQ-TV.

After the circuits have been built and checked for short circuits etc. the potentiometers should be set to the following initial positions: VR1 = 50%, VR2 = max, VR3 = max and VR4 = 10%. Connect the 12-volt supply rail and check that the negative supply rail appears at the junction of D1 and C3 within the range -5 to -9 volts, also check that the current consumption from the 12-volt supply is of the order of 30 to 60mA.

Connect the video output to a monitor and adjust VR2 and VR3 for a stable display. If difficulty is experienced then adjust VR4 in small steps whilst readjusting VR2 and VR3 until stability is achieved. If an oscilloscope is available the sync pulses can be set to the correct level of 0.3 volts with VR4 before setting the frequencies with VR2 and VR3.

Connect the manual tuning control and set it for the lowest freqency. A single white bar should appear towards the bottom of the display moving upwards as the control is advanced. Return the control to the low frequency end and adjust VR1 to place the bar at the bottom of the display, turning the control to the high frequency end should place the bar at the top of the display. On completion of these adjustments the tuning voltage output may be connected to the converter.

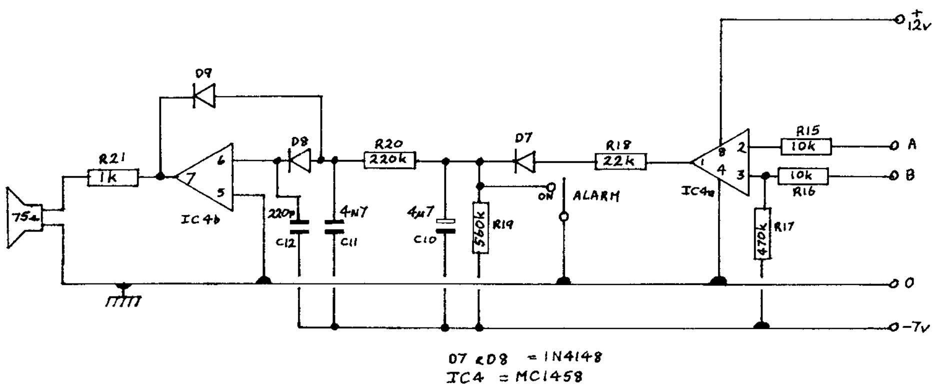


Fig.2 Audio Alarm.

With the converter now scanning the band the resulting video output can be connected to the scanner. If signals are present then with an FM IF a bar will appear for each carrier (this band may appear black or white). If an AM IF is being used then a broad white band will appear for each carrier detected; if the audio circuit is connected it should also produce tones indicating the presence of the carriers.

In operation the number and variety of signals detected across the band will be surprising. Marine radar shows up as a rapidly moving streak across part of the band whilst morse and phone stations in the all-mode sections will occasionally appear, and if the eye can cope the morse can quite easily be read

HOW WIDE IS WIDE?

John Wood, G3YQC

An important consideration in any amateur TV station, particularly when working in the 70cm band, is that of the bandwidth taken up by the transmission. In order that TV'ers can make sure that their transmissions stay within the amateur allocation in compliance with the licence regulations, and also that they do not interfere with other band users, it is important to be aware of just what a television signal consists of when it is transmitted over the air.

Since this article is mainly concerned with operation in the 70cm band, only amplitude modulation (AM) will be considered.

Referring to the amateur licence schedule (22nd March 1982), high definition television (A3F) may be used in the band 432 - 440MHz. Now according to both the BBC and IBA the total channel bandwidth of a 625-line broadcast colour TV transmission is 8MHz so at first glance it would seem that one can just fit a full specification TV transmission into the amateur allocation. Now comes the rub:

432 to 434MHz is used by amateur phone and CW stations whilst repeaters operate as high as 435MHz. 435 - 438MHz is also used (along with amateur TV) for space communications, so you see we have company on the band and it is up to us all to try to ensure a peaceful co-existance so that everyone may enjoy their particular branch of the hobby.

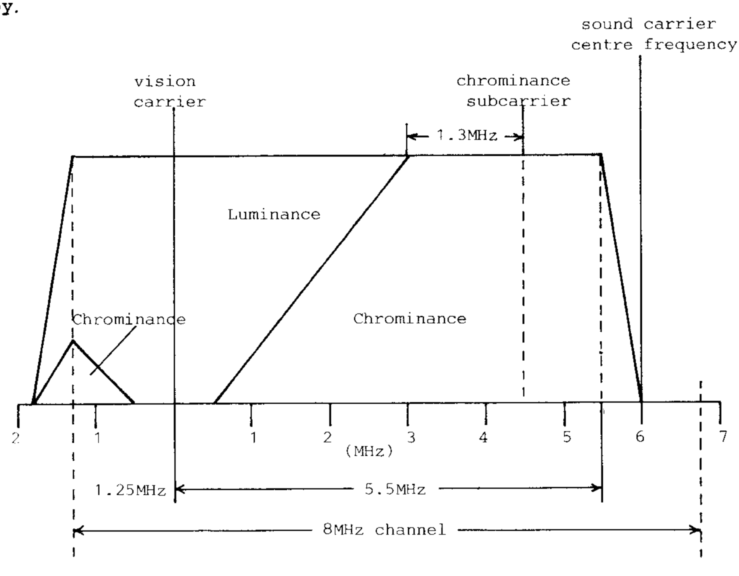


Fig.1 Broadcast vestigial Sideband signal.

Fig.1 illustrates the frequency bands occupied by the colour picture components and sound signal from an ideal transmitter (broadcast specification). The transmission has its lower sideband largely suppressed and is called a 'Vestigial Sideband' (VSB) transmission. There are very few amateurs who are able to transmit such signals so we can re-draw the diagram to show the bandwidth which would be occupied if we were to transmit a full spec picture without the use of vestigial sideband (Fig.2) - frightening isn't it? Obviously of course this is not possible for use on 70cm however we can still transmit our pictures by making a few compromises.

SIDEBANDS

The signal bandwidth for a full spec 625-line system is approximately 6MHz resulting in a modulation bandwidth of 12MHz when AM double sideband (DSB) is used. In order to economise bandwidth, one can use a form of DSB in which a 'vestige' of one sideband is transmitted together with the whole of the other sideband (Fig.1). This reduces the overall bandwidth to about 8MHz.

Fig.1 shows the transmitter characteristics where the vestige of the lower sideband includes transmission of the d.c. signal since it represents the average brightness of the picture and its important picture detail. As a result, during transmission, the higher frequency components of the signal in the vestigial sideband are overemphasised, and so the receiver is provided with a response characteristic which reduces the high frequency components, this restores the information content on reception to its original balance prior to transmission. It is quite possible for amateurs to construct a TV transmitter using vestigial sideband and such a project (for which PC boards are available) is described in both the BATC's 'Amateur Television Handbook - vol.2' and 'The Revised Amateur Television Handbook'. There is no reason of course why a VSB filter cannot be fitted to most ATV transmitters.

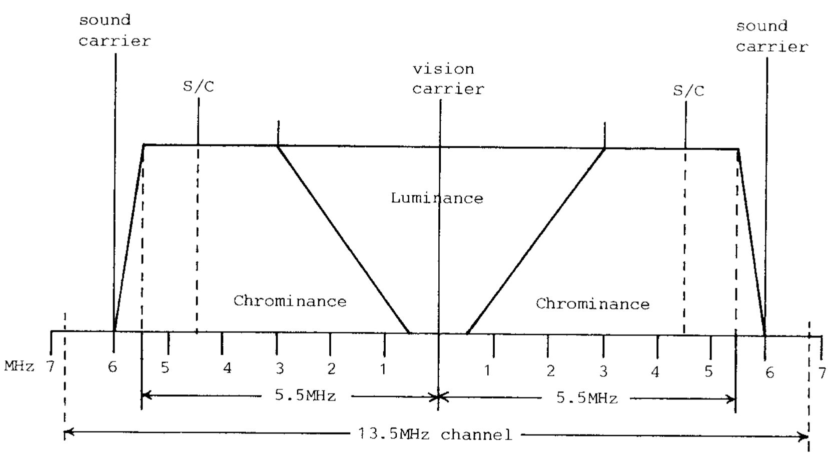


Fig.2 Broadcast Double Sideband signal.

PRACTICAL CONSIDERATIONS

First let's see how amateur pictures differ from commercial ones. The specified bandwidth of a commercial video signal is 5.5MHz, but there is little likelihood of a domestic or surveillance camera having anything like that bandwidth, in fact 2.5 - 3MHz is probably the very best you could expect. Video cassette recorders usually have a bandwidth of only 2 - 2.5MHz so we amateurs can save a fair bit of bandwidth there. Intercarrier sound is transmitted on a 6MHz subcarrier (UK) and there is little we can do about that. Obviously +- 6MHz from any carrier frequency we can use (DSB system) will put the sound carrier outside the band; so intercarrier sound is out on 70. The colour subcarrier frequency of 4.433618MHz should also be considered in the same light.

Having removed the sound and colour we can now re-draw Fig.2 to show the theoretical bandwidth occupied by a 'typical' double sideband amateur TV transmission (Fig.3). Similarly Fig.4 shows the same transmission but using a VSB filter. Now you can see that 625-line ATV is perfectly possible on 70cm without spreading out too far.

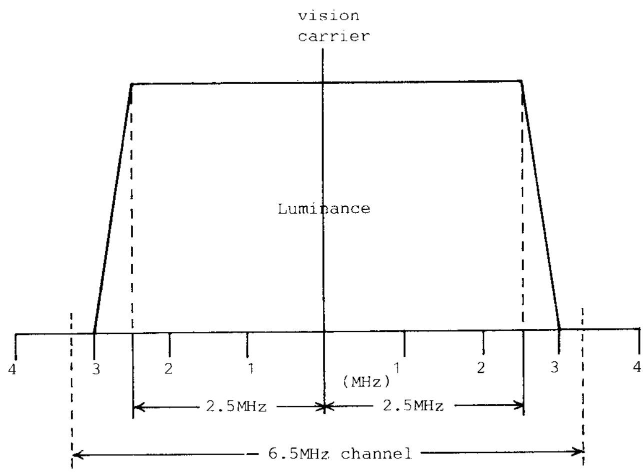


Fig.3 Amateur Double Sideband signal.

So far all the illustrations have only been theoretical. They show a 'wall' of RF energy emanating from the carrier at constant amplitude. Of course in practice the energy dispersion is nothing like that. The photograph shows a picture of a broadcast specification television transmission taken from the screen of a spectrum analyser. You can clearly see that the actual transmitted energy falls away sharply as it spreads from the carrier, therefore it would only be those band users in the immediate vicinity of an ATV station who would be aware of such a transmission. Further away the TV sidebands will be so far below the carrier level that they become insignificant.

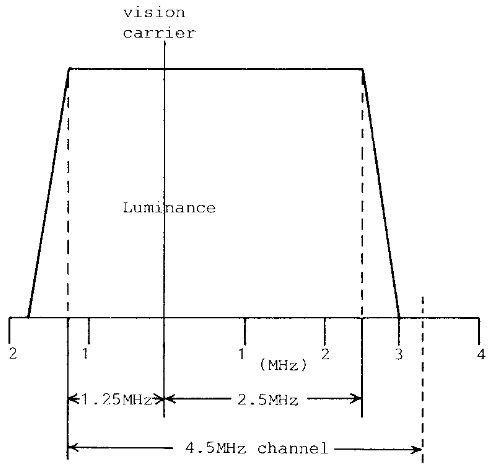


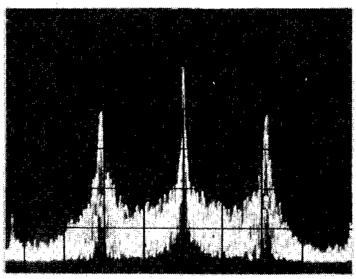
Fig.4 Amateur Vestigial Sideband signal.

THE VIDEO SIGNAL

As I mentioned above the actual video bandwidth necessary to produce an acceptable quality picture is around 2MHz. This can be determined by experimentation on broadcast signals: If a band-pass filter were fitted into an ordinary TV set between the tuner and IF amplifier, by varying the bandwidth of the filter the various effects of reducing that bandwidth can easily be observed. The first to go of course is the sound; then the colour as the subcarrier is attenuated and then the picture resolution starts to deteriorate. In practice it is difficult to see any deterioration until the filter reaches about 3MHz. Going down to 2MHz still produces a good picture although some of the resolution bars on a testcard multiburst will have become indistinct. In fact even when the bandwidth is reduced to 1MHz you can still see a good bit of detail in the picture. This technique incidentally is ideal for improving reception of weaker signals and rejecting adjacent channel interference, especially under lift conditions.

For practical purposes a bandwidth of 2 - 2.5MHz is a good compromise. If shots from a camera or video recorder are being used then it is unlikely that this figure will be exceeded, however, if you are using a digitally derived picture or one from a home micro, then the overall bandwidth is liable to be very wide indeed - often much wider than 6MHz. The reason for this is that the fast logic switching within the generation circuitry produces very high frequency pulses which, if not filtered out, will cause a TV transmission to spread much more than is desired.

The answer is to fit a low-pass filter at the video input to your TV transmitter. Such a filter was described in CQ-TV120 although an updated version may be found in the BATC's 'TV for Amateurs' and the new 'Best of CQ-TV' publication advertised in this issue. This unit uses a Toko block filter so no alignment is necessary, and a printed circuit board is available from Members Services. In fact this design was originally intended for colour use and therefore has a cutoff around 4.5MHz, however a range of suitable filters is available from Cirkit and Bonex Ltd and the correct one may be chosen for your particular application. If you have access to sweep equipment then a passive low-pass filter may be used. Such a filter is illustrated in Fig.5.



Spectrum analyser photo' of a double-sideband TV signal modulated with a 100% saturated colour bars.

The colour subcarrier can be clearly seen and the picture illustrates the energy dispersion within an amateur TV colour transmission.

Horiz resolution: 2MHz per div.
Vert resolution: 10dB per div.

(sound subcarrier absent)

Photo: G8CJS

A PASSIVE VIDEO LOW-PASS FILTER

This simple 5-pole elyptical design uses toroidal inductors in order to achieve repeatability. Its characteristic impedance is 75-ohms, the cutoff frequency is 3MHz and it has been tailored to have a deep notch at the 4.43MHz colour subcarrier frequency. Stop-band loss is around 40dB and the maximum insertion loss between DC and 3MHz is 0.2dB The prototypes were built on single-sided PCB and the capacitors were low-voltage 2.5% tubular polystyrene. Provided the circuit values are followed exactly and the specified components used, there is no reason why the filter shouldn't work well without any adjustment, however, to be certain, it is best to test it using either sweep equipment or by plotting the response using a signal generator and an oscilloscope.

If you route all your video sources through a filter immediately prior to transmission, you will significantly reduce the likelihood of interfering with other band users and, more especially, make sure that your transmission remains within the band.

So, for 70cm the best thing to do is:-

FORGET THE SOUND
DO AWAY WITH COLOUR
USE A FILTER

Of course you CAN use a full spec system if you want to - go to 24cm or one of the other microwave bands which can support broadband television!

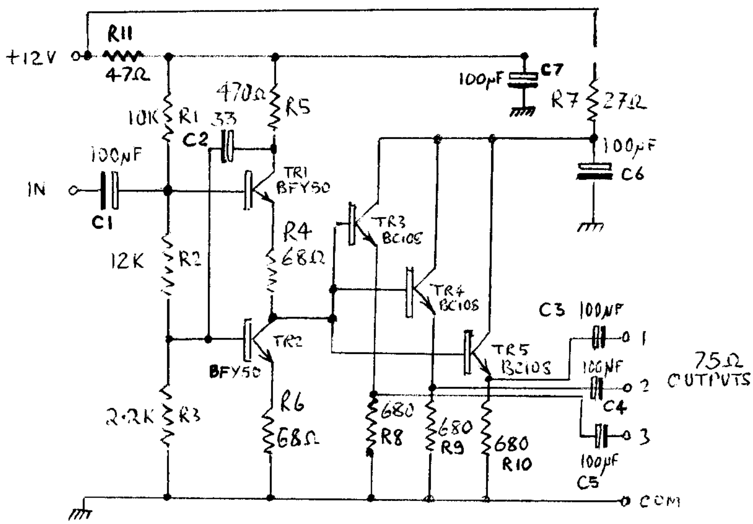
ONE IN - THREE OUT

Peter Johnson G4LXC

Designed specifically for home-brew receivers such as the Handbook ATV receiver and IF strip, this circuit accepts a high impedance signal at its input and provides three, short-circuit proof, independent 75-ohm outputs.

Tr1 and 2 form a feedback pair having a high impedance input requirement but delivering a low impedance output. This drives three emitter follower stages (Tr3,4 and 5), each one providing a 1v p-p video signal across a 75-ohm termination from a DC isolated output.

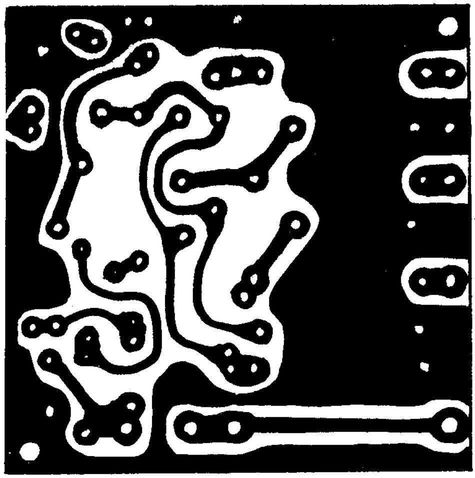
Although the prototype was made on Veroboard, it is nicer to use a custom printed-circuit board. The printed pattern and component layout are shown, full size, for those wishing to make one.



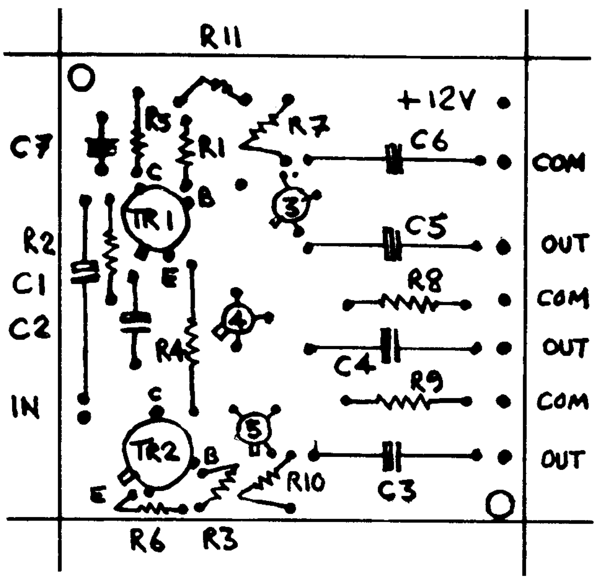
None of the components are hard to get and, what the junk box can't provide, any number of component suppliers can (see suggestions in the centre-page pullout section). If identical boards are wired in parallel, it is possible to have six or even twelve outputs at once. The unit is, of course, fully colour compatible.

It is interesting to note that a uL733 i/c will drive this circuit directly. The '733 is able to provide gain control and frequency compensation plus an inversion facility.

This design makes a very good quality, colour distribution amplifier, and, if used with the uL733 system suggested, has a flexibility which should meet almost all requirements within an ATV'ers shack.



Video Distribution Amplfier - print pattern (actual size).



Component layout.

A TV IF PREAMPLIFIER

Mike Wooding G6IQM,

When searching out those weak signals on 70cm ATV the usual answer is to reach out for another RF pre-amplifier. However, as those who have tried this may have discovered, as often as not the only achievement obtained by cascading several pre-amps is to increase the noise rather than the wanted signal. Another problem with providing too much RF gain is that the mixer stages in the up-converter and the TV tuner will become overloaded, thus producing cross-modulation. The end result therefore can be to degrade a received picture rather than enhance it!

IF PRE-AMPLIFIER

One method of overcoming these problems is to provide extra IF rather than RF gain. The reason for this is that when receiving weak signals the IF stages of the TV are working at maximum gain and are not being driven into limiting. The result is that the signal-to-noise ratio of the IF stages is lowered considerably. The inclusion of a pre-amp in between the tuner and IF ensures that the IF stages receive maximum signal under all receive conditions, thus improving the S/N ratio. The overall effect of this is to give considerable improvement in strength of received pictures.

The circuit in Fig.1 shows an amplifier based around a 3SK51 MOSFET transistor. The original circuit used a 40673 but this is becoming difficult to obtain now. A gain control is included, although this can be replaced by a 50k resistor if it isn't required. A simple band-pass filter is included in the output to minimise unwanted signals reaching the following stages. The power requirements of the amplifier are 12 to 15 volts at 4 to 5mA, and, fortunately this voltage is usually available inside most TV receivers, so it can be powered direct from the set.

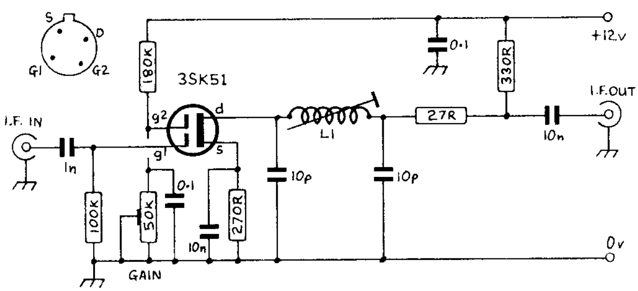


Fig.1 IF Preamplifier

The unit can be constructed on Vero-board as the layout is not critical The variable gain control may be fitted onto the front panel of the TV set, along with a switch to bypass the amplifier thus restoring the set to normal working. The coil L1 is constructed from 13 turns of 38swg enamelled copper wire wound onto a 4mm former with tuning slug. The amplifier should be housed in a metal box to screen it from the large fields generated by the scan circuits of the TV. The only setting-up required is to tune L1 for maximum signal strength with minimum noise whilst receiving a picture.

FILTER

Another very useful addition to this IF system is to include a narrow-band filter in the line before the pre-amplifier. This type of receive system is used by many of our more infamous portable stations to great effect, as you may have heard on the air. The on-screen effect of working 'narrow-band' is an apparent considerable increase in received signal strength. However, the filter described here is a passive device so no amplification (in fact a loss occurs) of the signal is achieved. What actually takes place is a further improvement in the S/N ratio of the IF stages resulting in less noise and more picture on the screen.

The filter shown in Fig.2, designed by John Wood G3YQC, reduces the bandwidth of the receiver from 7.5MHz to something of the order of 2.5MHz at the 3dB points. The filter is a combination unit with a high-pass section followed by a low-pass one. The values given for the capacitors are not preferred ones so they may have to be made up using series/parallel combinations. The coils are all constructed on 5mm formers with tuning slugs using 30swg enamelled copper wire. The turns required to give the inductance values quoted are given below:

L1, L3 & L5 ...... 4 turns
L2 .... 6 turns
L4 & L6 .... 7 turns

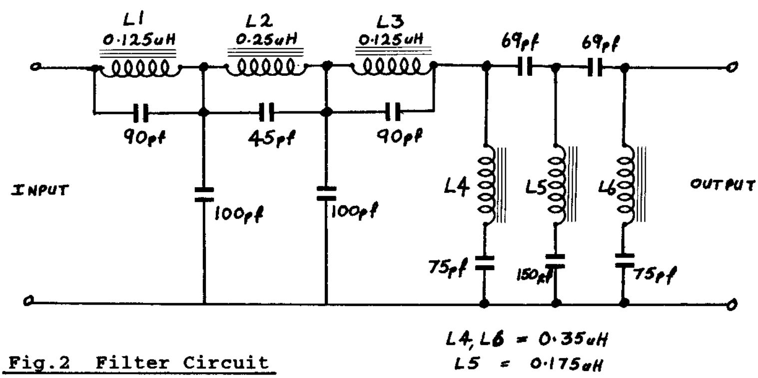


Fig.2 Filter Circuit

Setting-up of the filter is not really practical without the aid of either a network analyser, or sweep equipment. Final adjustments on-air are possible, but only to accurately match the filter to the centre frequency of the TV IF. If the TV set is to be used for normal broadcast reception, or if regular reception of high strength pictures is the norm, then provision should be made to switch the amplifier and filter out of circuit. This will enable the received pictures to be viewed at full bandwidth and normal definition.

AN FM-TV MODULATOR

Michael Sheffield ZL1ABS and ZL1TBG

The NE564 PLL IC is well known for its use as an FM-TV demodulator but it can be used as a modulator as well. The specified frequency range of the NE564 is up to around 50MHz although many devices will go higher. The use of higher frequencies (such as 70MHz) in receivers though can often cause problems, however no such problems have been encountered whilst using the '564 as a modulator. The design presented here will work over the range 30 to 70MHz.

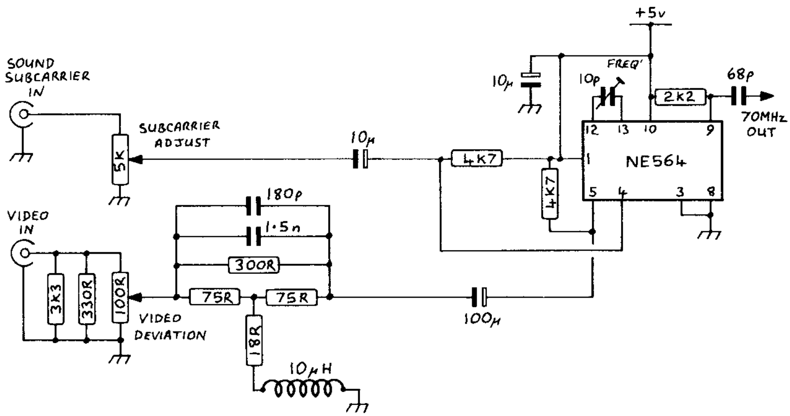


Fig.1 FM TV Modulator

Because there are two inputs available the one not being used for video can be used to inject a sound subcarrier. This removes the need for a separate mixing stage or any sound traps in the vision path. Since the sound signal is symetrical (sinusoidal) it doesn't matter if it is inverted, therefore if the oposite video polarity is required pins 4 and 5 can simply be swapped over.

Video is applied to an adjustable 75-ohm termination network, the control of which is used to adjust video deviation. Note that video and sound carrier deviations are independent of each other in this design. The video signal passes through a conventional CCIR pre-emphasis network and then on to the NE564.

An audio subcarrier is terminated in a 5k potentiometer (this value can be changed to suit the output of any available sound source) and the signal, whose level is adjustable, is passed to the NE564.

This design is ideal for use with a conventional linear transverter in which case an IF of around 70MHz is about right. It can also be used as a test transmitter for setting-up demodulators, the circuit is then adjusted to the desired IF frequency.

A LIMITER FOR FM-TV

Klaus Hirschelmann DJ7OO,

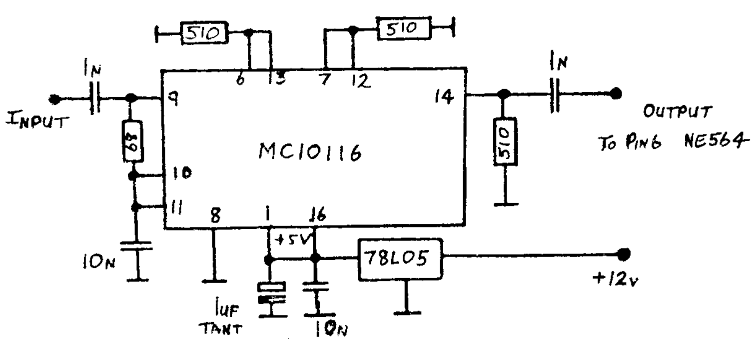
This article first appeared in TV-AMATEUR 62/1986 and we thank the editors for their permission to reproduce it here.

The phase-lock-loop integrated circuit type NE564N, which is used extensively by amateurs for the demodulation of FM ATV signals, is easily overdriven by strong input signals. Although a limiting arrangement is built into the device, frequency rejections and signal distortions can still occur. To remedy this problem it must be ensured that the input level of the NE564 is not too high. This can be accomplished by using external signal limiters, and for this the Motorola MC10116 device is very suitable.

The MC 10116 line receiver is used in this application as a limiting broad-band amplifier, with approximately 20dB of IF gain it delivers a stable output of approximately 0.8 volts. The circuit of this simple unit is shown in Fig.1 and can easily be assembled using a small piece of Vero-board.

The connection between the output of the last IF amplifier and the input to the NE564 on the demodulator is broken and the circuit inserted. The input and output connections to the limiter must be as short as possible. Power requirements for this modification are provided by the 78L05 regulator shown in the circuit, which is fed from the supply to the demodulator.

This improvement for the NE564 demodulator can be carried out easily and quickly, and is non-critical, in that no further adjustments to the system need be made. It leads to a noted improvement of the receive qualities and should therefore be part of any such equipment.



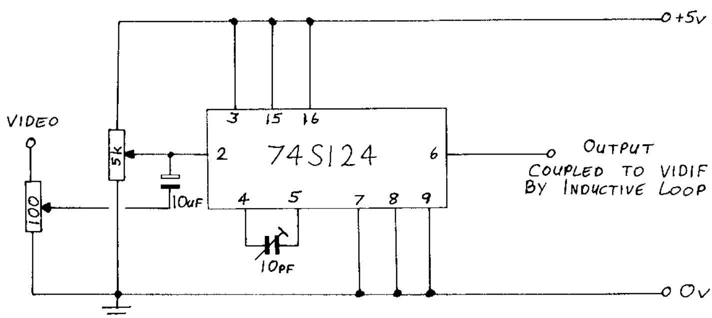
A 50MHZ TEST SOURCE

Trevor Brown G8CJS

Having a Wood & Douglas FM VIDIF strip that appeared to be causing loss of colour on received pictures, I decided that I needed a 50MHz colour source that could be fed into the input of the strip instead of the receiver. The following simple circuit was the outcome, in fact it works so well that it is worth considering adding a black level clamp and turning it into a permanent piece of test equipment.

The circuit is based on a 74S124 dual voltage controlled oscillator IC. Only one of the VCO's is used in this design, so it could be worthwhile configuring the other VCO to provide a 6MHz source for troubleshooting sound demodulators.

The design is simplicity itself. Course tuning to 50MHz is provided by the 10pF trimmer capacitor and fine tuning by the 5k potentiometer. The video source is connected to pin-2 via a 100-ohm potentiometer, thus allowing the deviation to be adjusted whilst providing a termination for the video.



A switchable pre-emphasis network could also be included before the deviation control, to allow for the testing of units with de-emphasis networks on board. Using the circuit to test IF's without incorporating any matching pre-emphasisi network could possibly mask any faults that may be present.

Although the demodulated chrominance is not to broadcast specification, measured in the green bar it was within 10% and the burst was found to be slightly less, presumably due to the differential gain characteristics of the IC. It is, however, satisfactory as a test signal and should prove a useful aid in the shack for working on 24cm FM-TV receivers.

INTERCARRIER SOUND MODULATOR

C.Melen VK4ZCM & B.I.Riding

This frequency modulated intercarrier sound generator has been designed to interface with any ATV video modulator. It is designed to accept standard 'line' level audio in, and is capable of producing in excess of 6v p-p of subcarrier output. This high output capability allows for adequate mixing of the subcarrier with the video signal at the input of a video modulator.

PERFORMANCE SPECIFICATIONS

Input signal level:	100 - 500mV rms.
Input impedance:	Constant 50k
Frequency response:	15Hz - 16kHz + 2dB relative to a standard 50uS pre-emphasis curve
Signal/noise ratio:	(sound board only) >65dB relative to 1kHz
Distortion (50kHz dev, 1kHz):	<2% (peak programme level)
Distortion (20kHz dev, 1kHz):	<1% (average programme level)
Sub-carrier output:	>6v p-p (typical 8v p-p)
Sub-carrier spurious outputs:	>20dB down (including harmonics)
Sub-carrier output impedance:	<250-ohms

CIRCUIT DESCRIPTION

The unit consists of three basic sections:

(i) Input amplifier and pre-emphasis circuit.
(ii) Modulated subcarrier oscillator.
(iii) Output amplifier.

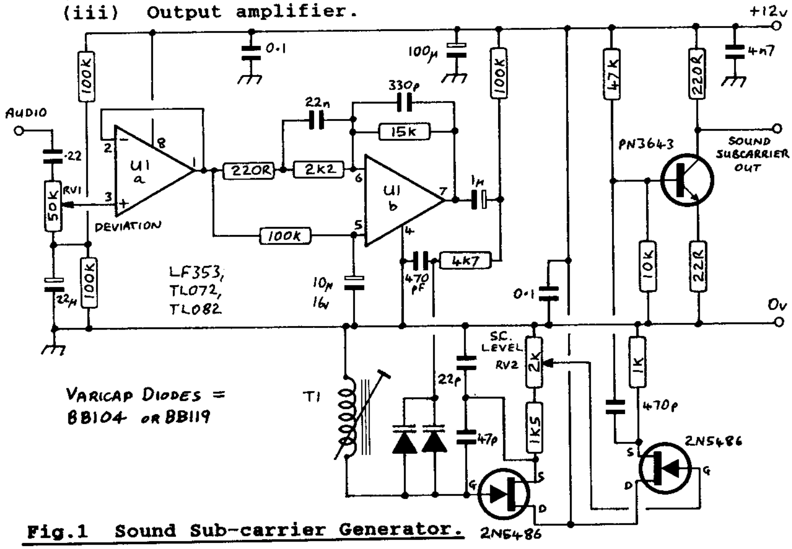


Fig.1 Sound Sub-carrier Generator.

Fig.1 shows the complete circuit diagram. The input amplifier is a two-stage arrangement. The first stage (U1a) is used purely as a buffer, which prevents the input source impedance from effecting the circuit performance, while the second is an inverting amplifier having a frequency response approximating a 50uS pre-emphasis curve. The input impedance is defined by the deviation control RV1. Bias of half-supply is applied via the lower end of RV1 to allow for operation of the op-amp by a single power rail.

U1b provides the necessary voltage gain to drive the varactor diodes and also defines the 50uS pre-emphasis curve; this is set by the 22nF capacitor and 2k2 resistor parallel combination. The 330pF capacitor across the feedback resistor sets a ceiling on the stage's high-frequency gain, thereby avoiding the possibility of stage instability.

The 470pF/4k7 combination on pin-4 of U1b is a simple filter which sharpens the high-frequency roll-off of audio drive to the modulator diodes above the audio spectrum. The 470pF capacitor also presents an RF 'earth' for the intercarrier signal itself, which is present at the cathodes of the diodes.

The modulated oscillator is a standard Colpitts circuit using an FET which is biassed for best thermal stability. The feedback ratio is set by the 47 and 22pF capacitors and ensures sufficient feedback to assure reliable oscillation, but without producing a distorted waveform. The output is fed to an FET source follower to minimise loading by the following stages.

The output amplifier is a common-emmitter type having a stage gain of ten. Under open-circuit conditions the stage has more than enough gain to produce greater than 6v p-p output. Note that capacitive loading of the output will limit the gain, resulting in insufficient output. Care should therefore be taken in the length of wiring between the output and the video modulator sound input terminal.

The inductor L1 should be around 45 turns of 30swg enamelled copper wire, close-wound on a 5mm former, although this may need some adjustment to obtain the required frequency range.

To set the deviation, apply station level audio to the input and power to the supply rail. Using an oscilloscope and probe, monitor U1 pin-7 and adjust RV1 for 1.8 to 1.9v p-p.

To set the sound injection level on the transmitted signal in a 24cm FM ATV system, monitor the demodulated video and adjust RV2 such that there is the maximum level of audio without disturbance to the picture. If a spectrum analyser is available, set the audio subcarrier to around 12 to 15dB below the vision carrier.

To set the injection level on an AM transmitter (non-UK) you will need an accurate demodulator and an oscilloscope. Measure the transmitted video's peak sync level relative to zero volts. Remove the video signal and adjust RV2 so that the p-p value of the sub-carrier (observed on the 'scope) is equal to the sync tip level of the video previously determined but divided by 1.75. This will give a vision carrier/sound sub-carrier ratio of around 13dB.

INTERCARRIER SOUND DEMODULATOR

Peter Delaney G8KZG,

There have been a number of designs for a receiver IF strip in club publications, for which PCB's are available. For AM use, the TDA2540 and SL1430 with a SAW filter makes an easy to set up system which, with a varicap tuner, will cover the broadcast channels or 70cm (described in Amateur Television Handbook). For FM use there is the design using an NE564 and a pair of NE592 or LM733 devices. This appeared in CQ-TV122, and "The Best of CQ-TV", and with a suitable down converter (see CQ-TV117, "The Best of CQ-TV" or CQ-TV 144) makes a receiver for the 24cm band, including the TV repeaters. It also has applications at 10GHz, etc.

The piece lacking from these boards is a sound demodulator for the intercarrier sound found on broadcast or 24cm and higher amateur transmissions. (There is not room on 70cm for intercarrier sound using the usual double sideband transmitters).

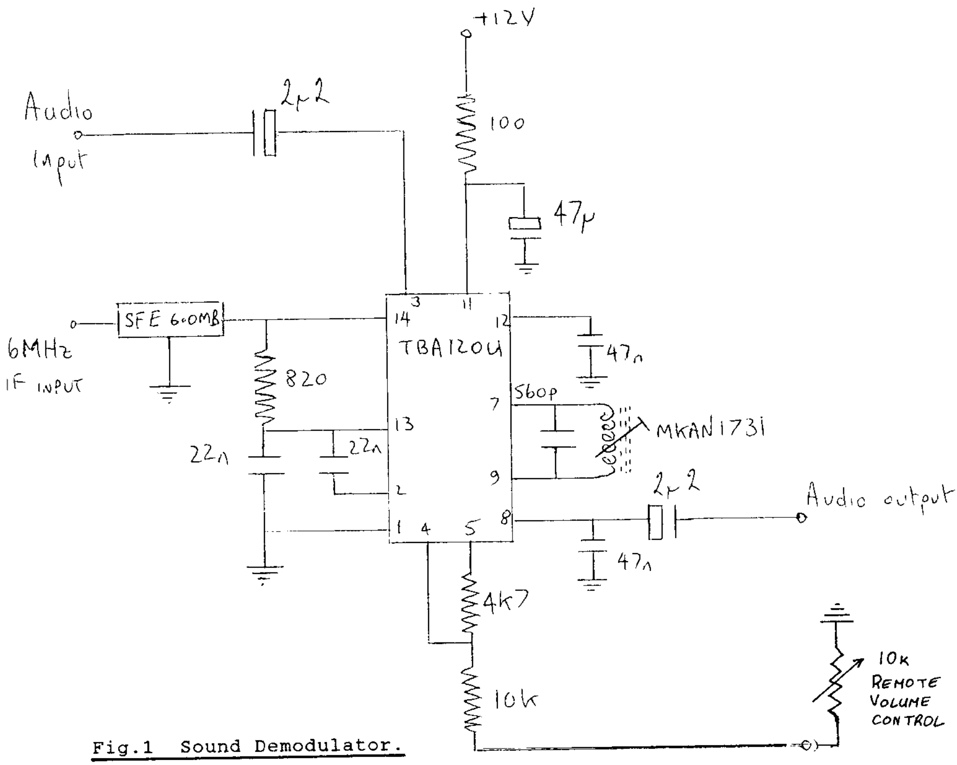


Fig.1 Sound Demodulator.

CIRCUIT DESCRIPTION

This circuit takes the video output signal, (a suitable take-off point is provided on the FM demodulator board), and produces an audio signal. It is built around the readily available TBA120U (the other variants have different internal circuitry). The input is passed through a ceramic filter for the audio subcarrier frequency in use (6MHz in U.K., 5.5MHz in Europe, etc), although a conventional tuned circuit could be used in place of the 820-ohm resistor, with a 56pF coupling capacitor where the filter sits. The demodulator tuned circuit uses a Toko pre-wound part, available from Bonex etc., although a home made coil could obviously be used. If making your own coils, the input one should have a 'Q' of about 75, and the demodulator coil a 'Q' of 40.

The output voltage is of the order of 1V r.m.s. (depending on the deviation set at the transmitter, of course), across a 1k-ohm load, which is quite adequate to drive a small audio amplifier like the LM380 etc. The output level can be set by the gain control, which, as it is a voltage control rather than passing the audio through it, can be positioned remotely in some convenient position. It gives about 80dB of control.

The circuit also allows another audio signal to be fed in at pin-3, and amplified by about 8dB - if this is not required, ground the audio input (pin-3).

The circuit diagram in Fig.1 shows all the details, although the filter and tuned circuit would need changing in "non-6MHz" areas. The single sided board pattern and component layout are reproduced full size in Fig.2. The circuit draws about 15mA at 12V. The Toko coil comes pre-aligned, but a slight adjustment may be made to get the maximum undistorted output. You can then listen to as well as watch the local tv repeater!

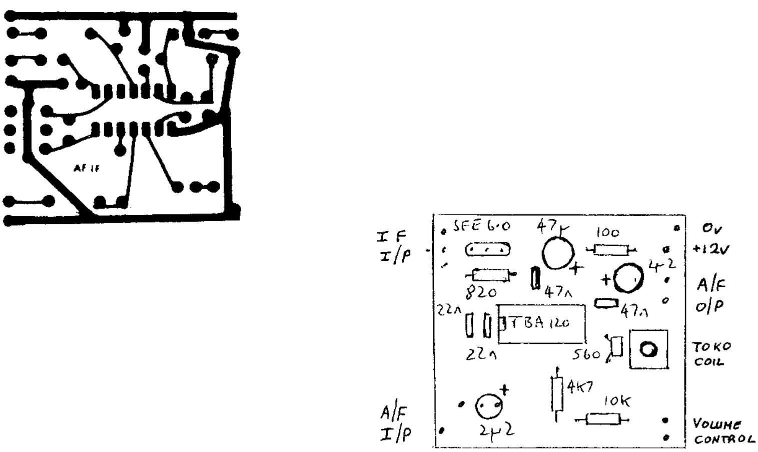
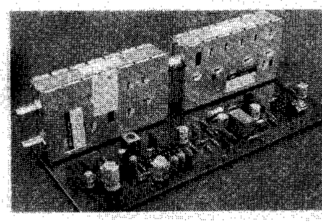


Fig.2 PCB layout and component overlay.

A TVRO RECEIVER

John Wood, G3YQC

In CQ-TV134 we announced two new modules by ASTEC intended for use in satellite TVRO (TeleVision Receive Only) receivers. Thanks to the valuable assistance given by Rob Nicholls of Astec Europe, CQ-TV has had the opportunity of evaluating the units and has produced a complete receiver module design. It includes not only video processing, but also a single-chip intercarrier sound demodulator, which can be configured for any of the broadcast sound systems. A printed circuit board and layout diagram is available from Member's Services.



AT-1020 TVRO TUNER HEAD

This unit is a dual input TVRO tuner which accepts a standard 950 to 1450MHz signal from a block down converter (LNB) and produces a 612MHz IF output. The AT-1020 is intended for use in a block conversion satellite receiver.

FEATURES:

1) 950 to 1450MHz block IF, minimising UHF/VHF interference from other services.
2) 612MHz IF, eliminating image and in-band interference problems.
3) VCO on 1564 to 2060MHz eliminates interference between receivers.
4) Dual inputs for horizontal and vertical polarizations, or C and Ku IF signals.
5) Built-in -256 prescaler for external frequency synthesizer.
6) Conversion gain of 30dB min.
7) 7dB typical noise figure.
8) Wide range for input signals.
9) Standard TVRO 'F' connectors for RF input, 'Belling-Lee' output connector.
10) External gain control for cable loss compensation.

30dB (typ) gain control range can be achieved by applying between 0 and +12v to pin 7, maximum gain being achieved at 12v. The VCO operates in fundamental oscillation mode and a tuning voltage applied to pin 4 can tune the VCO from 1564 to 2060MHz. The dual RF inputs (A/B) are provided for both horizontal and vertical polarization signals and are switched by an internal relay; +12v on pin 2 selects A and 0v selects B. A LNB supply pin is provided which conveys the voltage applied to it up the coaxial cable centre conductor in order to power the block down converter (max +35v). The AT1020 pin connections are shown in Fig.1.

SPECIFICATION: *

DESCRIPTION	MAX	TYP	MIN	UNIT
RF input level (@VG=0v)	-25	-	-45	dBm
RF input level (@VG=12v)	-40	-	-70	dBm
Dual input (A/B) isolation	-	28	24	dB
IF output frequency	-	612	-	MHz
Conversion gain	-	36	30	dB
Gain control range	-	30	28	dB
3dB IF output bandwidth	-	45	24	MHz
Image rejection (950-1450MHz)	-	60	-	dB
Noise figure	9.5	7	-	dB
VCO tuning voltage - 1582MHz	-	2.4	0.8	V
2042MHz	17.5	13.0	-	V
VCO output frequency - VCO=1582MHz	-	6.18	-	MHz
VCO=2042MHz	-	7.98	-	MHz
Prescaler O/P level	1.2	1.0	0.8	Vp-p
Polarity switch voltage 'A'	13	12	10	V
'B'	1	0	0	V

B+ supply = 18v +-5%. Vcc Supply = 5v +-5%

* According to ASTEC specification details - 1985.

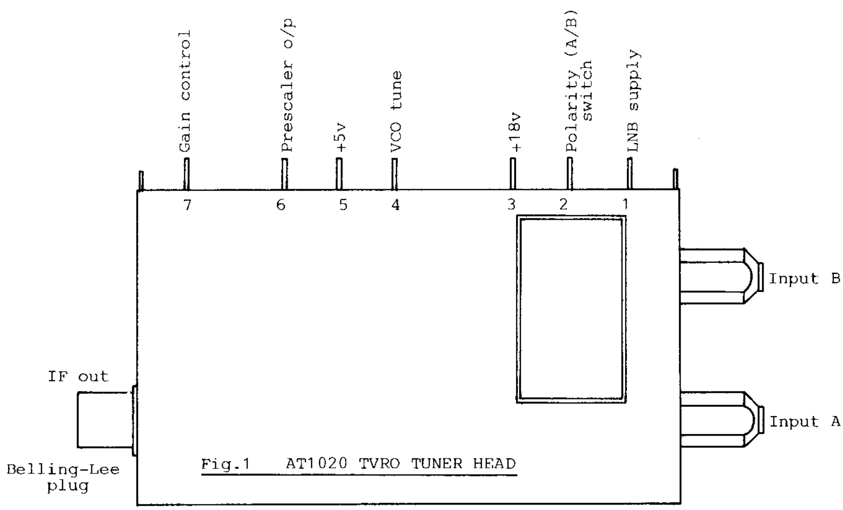


Fig.1 AT1020 TVRO TUNER HEAD

AT-3010 TVRO IF/DEMODULATOR

The AT-3010 is a TVRO IF/Demodulator which accepts a 612MHz IF input signal and provides a composite baseband signal output. The unit is intended to be used in conjunction with the 1020 tuner head. The module incorporates a Surface Acoustic Wave (SAW) IF filter which provides excellent adjacent channel rejection. The IF filter switch can extend the noise threshold by suppressing the 602MHz and 622MHz signal frequency by at least 5dB, this results in an improvement in noise threshold of around 2dB and is a very useful facility for assisting the reception of weaker signals. IF demodulation is achieved by the use of a single-chip quadrature FM discriminator and a level limiter, the input of which is at the IF frequency of 612MHz. The baseband video output level at pin 6 is dependent upon the deviation of the received transmission; typical amplitudes lie between 0.5 and 1v p-p when terminated in 75-ohms.

SPECIFICATION: *

DESCRIPTION	MAX	TYP	MIN	UNIT
IF input frequency	-	612	-	MHz
602 and 622MHz suppression ....at IF filter "ON"	-	7	5	dB
IF demodulator bandwidth at IF filter "OFF" (-35 dBm IF input)	-	-	24	MHz
....at IF filter "OFF" (-30 dBm IF input)	-	-	18	MHz
Noise threshold				
....at IF filter "OFF"	11	9	-	dB
....at IF filter "ON"	9	7	-	dB
Video demodulation sensitivity	60	50	40	mV/MHz
Video output level (at no modulation)	3.0	2.8	2.6	Vdc
Signal sense output (at IF filter "OFF", AGC=12v)	4.5	2.5	0.5	Vp

B+ supply = +18v +-5%

* According to ASTEC specification details - 1985.

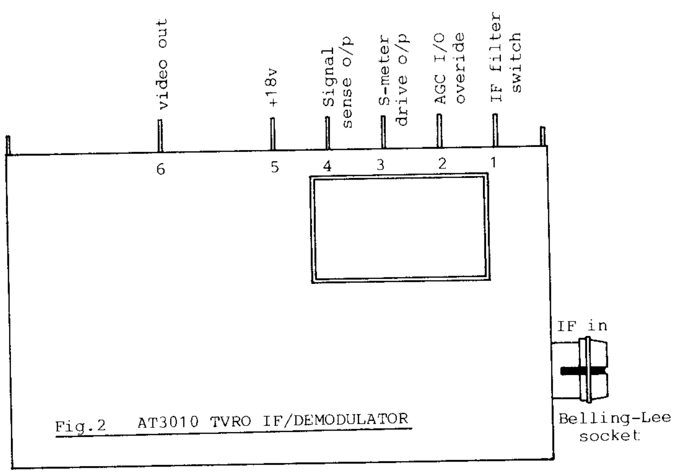
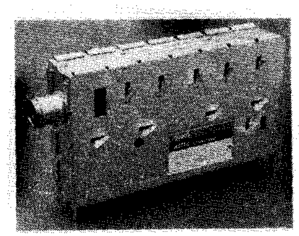


Fig.2 AT3010 TVRO IF/DEMODULATOR

Wideband operation is achieved with +18v applied to pin 1 whilst 0v switches in the threshold extension filter. The automatic gain control voltage on pin 2 rests at around +12v with no signal applied and reduces depending on signal strength. The signal strength meter drive output rests at around +17v with no signal which again reduces depending on signal strength. The baseband video output impedance is 75-ohms. Constructors should note that applying more than +5v to this pin could result in damage to the demodulator, therefore it is recommended that ac coupling be employed. The AT3010 pin connections are shown in Fig.2.

CIRCUIT CONSIDERATIONS



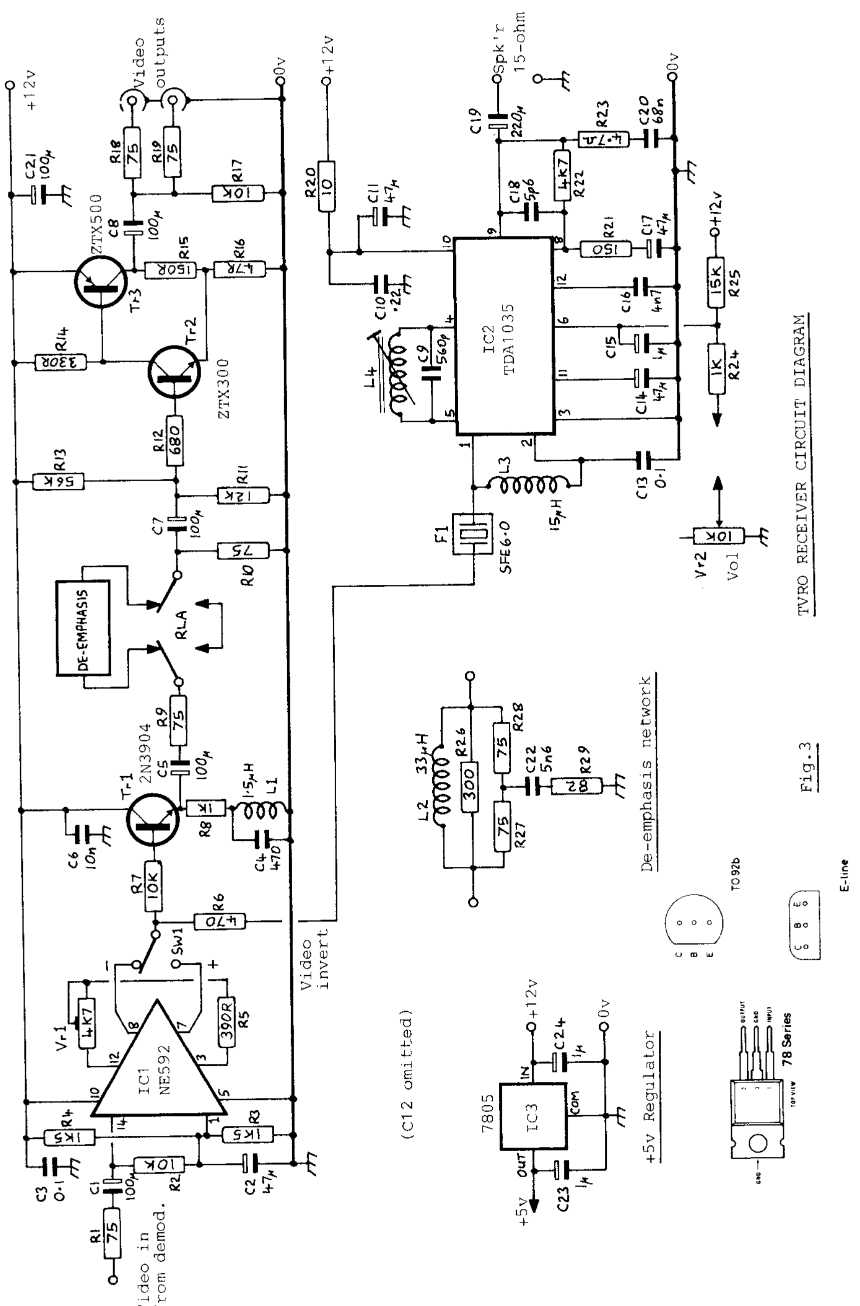
AT 3010 IF/DEMODULATOR MODULE

In deciding on suitable circuitry to use with the two modules several considerations had to be borne in mind. First, the video circuits needed to be kept reasonably straightforward but without sacrificing essential facilities. Since the receiver could be used with a variety of signals (commercial, amateur, wide/narrow deviations) a wide range of video amplitudes from the demodulator could be expected, therefore it was considered essential to provide some form of video gain control. Since it is also desirable to have a video invert facility I thought that the obvious gain controllable amplifier to use would be the NE592 (uA733).

Of course CCIR de-emphasis facilities should be provided and this has been included on-board and controlled by a changeover relay. It is often required to drive more than one display device from the video output therefore an output driver has been used which has two outputs on-board, although a couple more can be added if necessary. each output will provide 1v p-p across a 75-ohm termination.

There are several sound systems in use and skysearchers will no doubt have their own preferences for intercarrier sound demodulators. Nevertheless I thought it was essential to provide an on-board sound demodulator. The choice of the TDA1035 was made mainly because it is well known in domestic TV circles, is widely available and does the entire job in a single chip. To use it for different standards only the input ceramic filter and quad tuned circuit need be altered, however there is a sufficient margin of signal amplitude to permit the connection of a second demodulator to the sound take-off point on the PC board if this is required.

The whole unit requires +5v, +12v and +18v rails. The +18v, and more particularly the +12v draws a fairly high current and need heatsinks on the regulators. There is insufficient room on the board for all the regulators, but since the +5v rail draws a modest current, its regulator is mounted on the board and driven from +12v. This 5v rail is only needed to power the LO prescaler in the tuner and may be omitted if this facility is not required.



TVRO RECEIVER CIRCUIT DIAGRAM

Fig.3

CIRCUIT DESCRIPTION

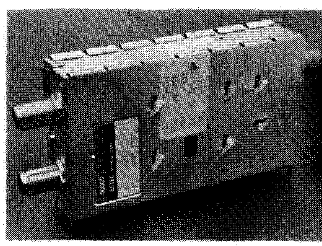
The complete circuit diagram of the receiver board is shown in Fig.3 (excluding module connections). Composite video from the demodulator is applied to the input of a NE592 wideband video amplifier via a 75-ohm matching resistor. Since the level applied to this amplifier is relatively high the range of gain has been restricted to between 1.0 and 15.0. Either positive or negative-going video is available at IC1's output and the selected signal is passed to an emitter follower (Tr1). This stage provides a low impedance output to the de-emphasis network and it has also been provided with a sound trap in its emitter circuit. The values shown are for 6MHz but other frequencies can of course be used instead.

The De-emphasis network is a well known circuit and this is switched in or out by a miniature relay. In theory an attenuator equal to the loss through the de-emphasis network should be provided for 'straight through' video, on test though the difference in output level was considered to be not worth the effort, thus the component count is kept down. Video is then passed to a distribution amplifier which has a gain of four. A number of independent outputs can be taken from this circuit although only two are provided on board.

The intercarrier sound signal is extracted from the output of IC1 and passed to a ceramic filter via a matching resistor. IC2 is a limiter, amplifier, audio pre-amplifier and audio power amplifier all in one package. A single ceramic filter provides adequate selectivity and a fairly non-critical quad tuned circuit are the only frequency determining components. Audio gain control is accomplished electronically by a 10k linear potentiometer. The audio output voltage drives a 15-ohm loudspeaker and more than sufficient volume for normal needs is available (around 1W).

In the interests of simplicity and versatility no extra circuitry associated with the various facilities provided by the two modules has been incorporated, with the exception of an optional resistive potential divider for range setting the tuning control.

PRINTED CIRCUIT BOARD



A printed circuit board has been designed for this project which is available from Members Services. The board measures 8.4" x 3.9", is single-sided and comes complete with a layout diagram. The two modules are intended to plug directly into each other via the IF input/output connectors, one being a plug and the other a socket. This method of construction obviates the need for a coaxial coupling lead and ensures a loss-free transfer of signal from tuner to IF with maximum screening. The modules are mounted on edge and soldered into the PC board (see photo). However they should not be installed until after preliminary checks have been carried out. Each of the pins to which access may be needed (with the exception of the LNB supply pin) is brought to a 12-way PCB connector plug. The +5v supply is connected on-board and an external terminal is therefore not provided, the same goes for the demodulator output.

All other components are mounted alongside the modules and 1mm circuit pins installed for the various external connections.

It will be necessary to cut slots in the board to accommodate the four earth tags at the corners of each module and the earth tab/heatsink lugs on IC2. Some holes will probably need to be opened out before fitting such components as VR1, L4, IC3, P11 and the module pins and Vero pins.

COMPONENTS

There are no 'special' or hard-to-get components used in this design and suggested sources for the various parts are detailed at the end of this article.

Most of the component information is contained in the accompanying parts list, however there are one or two points which should be mentioned:

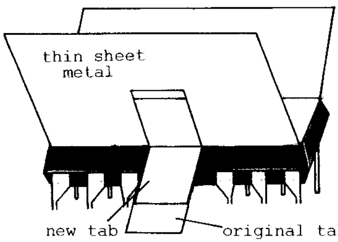


Fig.4 SUGGESTED HEATSINK

The Signetics NE592 (IC1) may be directly replaced by a uA733 - these are pin-for-pin compatible. L1, L2, L3 are fixed axial-mounted chokes. IC2 MUST be a suffix 'S' or 'T' version which has two large metal lugs protruding from the IC for heat sinking. no extra heatsinking was found necessary on the prototypes ('T' suffix) however if it is required then a simple shape may be formed from a piece of tin, copper or brass sheet and soldered to the ic's metal lugs (see Fig.4). The legs of IC2 are formed in staggered groups of three. A Toko coil is specified for L4 however other coils, even home-made ones, may be used just as effectively. Remember that the loaded Q of this tuned circuit should be quite high. The 4.7-ohm resistor at the audio output may be formed by wiring two 10-ohm resistors in parallel. The SFE 6.0 ceramic filter is the flat type with three inline legs.

TUNING CONTROL

As you can see the tuner will cover 500MHz with a tuning pin voltage range of 0.7 to 18v and, as an aid to determining frequency against voltage, Astec individually mark each tuner with the tuning voltage required for both 2042 and 1582MHz. Obviously if a single-turn potentiometer were connected between ground and +18v (Fig.5a) then the tuning rate would be very fast. If the full band is required it is much better to use a good quality 10-turn potentiometer or, for even more precise tuning, a range switch could be provided as well (Fig.5c,d). Some constructors may not wish to tune the whole 500MHz range of the tuner, amateur TV enthusiasts for example, therefore positions for two resistors have been provided; one returned to +18v and the other to ground. The purpose of these is to enable a potential divider to be installed to restrict the tuning range to only that required (see fig.5b). In fact it has been found that both tuners tried in amateur service covered the complete 1.3GHz allocation with an applied tuning voltage between about 9 and 11v, therefore a 12v rail could be used in this application if required.

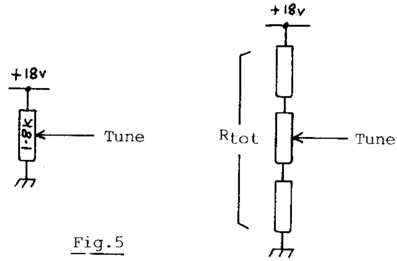
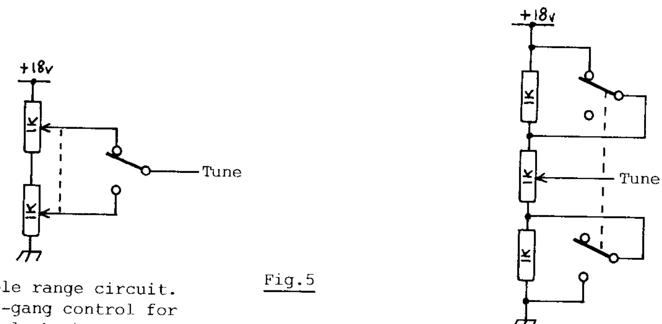


Fig.5

(a)Basic circuit covering the full tuning range.

(b)Modified circuit to give restricted range. (R_{tot} = 1.8k)

The DC current to the 'tune' pin is of the order of 1mA and it is therefore necessary to choose the total resistance of the potential divider such that it draws around 10-times the pin current, ie. 10mA. This is achieved by making the total resistance (tuning control plus two padding resistors) about 1.8k. Choosing this value has the added advantage of easing calculation - the volts drop across the potential divider is then 1v per 100-ohms.



(c)Double range circuit. Twin-gang control for 'single knob' operation or two separate coltrols for 'twin VFO' operation.

Fig.5

(d)Alternative 'single knob' circuit covering 250MHz per range.

POWER SUPPLIES

Power requirements for the two modules are: +5v, +12v and +18v. As previously mentioned +5v is derived on the printed circuit board from the +12v line using a 1-Amp 3-terminal voltage regulator. However there is insufficient space on the board for the other regulators therefore they must be arranged separately. The total current drawn from the supplies (under 'normal' audio level conditions) is: +5v = 100mA, +12v = 900mA and +18v = 750mA. The +12v supply can rise to almost 1.5A at maximum audio volume. A suggested power supply is shown in Fig.6.

ADJUSTMENT

The modules should not yet be installed. Connect the video output to a monitor terminated in 75-ohms; a gain control for the audio stage, a loudspeaker and a +12v supply. Switch on and check that +12v is available on all ICs. Check that +5v is present at the output of IC3 (if fitted). Turning up the audio gain should produce noise and adjusting Vr1 should produce noise on the screen. Now install the two modules. Connect an input signal to RF input B; a +18v supply; A tuning control (around 2k); and take the tuner pin 7 (gain control) pin to +12v. Upon switch-on you should now be able to tune in to a TV signal (the modules may take a few moments to 'warm up' from cold). When one is found monitor the video output on an oscilloscope (making sure that it is terminated) and display a couple of lines of composite video. Adjust VR1 for a total amplitude of 1v p-p. The video inverting switch should be set so that the displayed video is positive-going, this may be either by a front panel switch (use short leads) or a wire link on the appropriate board pins.

Once a signal has been tuned in, turn up the volume and adjust L4 for best sound. Check that the de-emphasis switching relay operates correctly by grounding the relay pin.

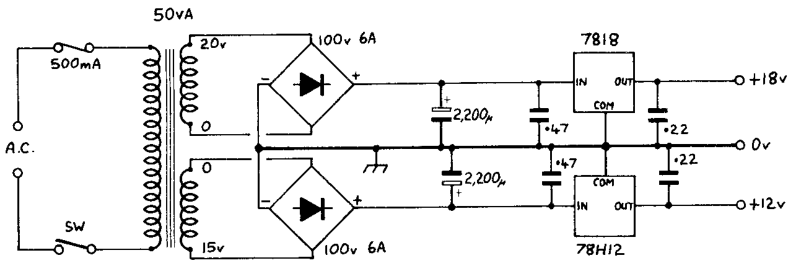


Fig.6 Suggested power supply.

EXTERNAL CONTROLS

To aid constructors the following external controls and provisions are necessary:-

Main tuning control.
Video IF filter switch.
De-emphasis select switch.
Audio gain control.
Loudspeaker.
Video output coax socket(s).

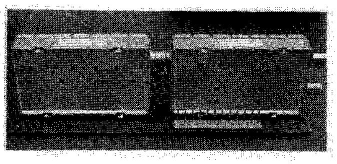
The following are optional:-

RF input polarity (input A/B) select switch.
Gain control potentiometer (tuner pin 7).
Signal strength meter.

Of course one doesn't necessarily need to use the relay for de-emphasis changeover; wire links could be used for semi-permanent operation or, since the network has 75-ohm input/output impedences, short lengths of coax could convey the signal to and from a front panel switch.

RESULTS

Here I must make a confession: I do not own a satellite receive system and therefore most of my work with the modules has been conducted using amateur TV signals in the 1.3GHz spectrum and bench test equipment. Nevertheless I have briefly tried the unit on one TVRO installation and found the results to be first class; equal in performance to a receiver costing many times more than this unit. I have also received reports from others using the Astec modules for satellite work and their findings support my own. One user however did suggest that the passband of the IF/demodulator was a little narrower than that normally used to receive 'European' satellites in the 12GHz band. The modules seem to have been designed more for 4GHz operation in the U.S.A. Nevertheless two independent comparisons which have been carried out indicate that any degradation of signals which may be caused by a narrower passband cannot be detected by eye, in fact a narrower system is likely to produce a rather better noise threshold.



REAR VIEW SHOWING CONNECTOR PLUG

The quality of recovered video is very high indeed, good colour and sound being received even on quite weak transmissions. The receiver is very smooth in its tuning and noise and 'sparklies' disappear quickly as signals become stronger. The local oscillator is remarkably stable considering its high frequency and fundamental mode of operation. At first I thought of designing a frequency synthesiser but, certainly for general use, the stability is such as to render such a system rather unneccessary.

AMATEUR TELEVISION APPLICATION

The AT 1020 tuner head comfortably covers the complete 1.3GHz amateur TV allocation making it virtually ideal for amateur applications. There are however one or two points which should be considered:

Although the tuner's conversion gain is high (around 30dB) the overall noise figure, compared to custom designed amateur tuners, is quite poor (around 7dB). The reason for this is primarily the fact that these tuners were not designed for low-noise, direct aerial connection applications. They are in fact intended as a first IF following a microwave block downconverter, therefore since the system noise performance is largely governed by that of the block converter there is no need for the tuner noise to be kept low. Coupled to this is the wideband capability of the RF circuitry. The result therefore is that for ATV use a good low-noise pre-amplifier must be provided ahead of the tuner for best performance.

The 612MHz IF output is almost ideal if the unit is to connect to a conventional varicap TV tuner. The tuner can be set to around channel 37 and left (band tuning being accomplished by the Astec module). This system is likely to find favour with existing stations since a FM-TV demodulator will already be available with an IF of around 36MHz. Of course if just the tuner is purchased then the PC board will not be necessary.

The use of the AT 3010 IF/demodulator as well, together with the PCB, will provide a complete 24cm receive system needing no extra equipment (except for a RF pre-amp and a display monitor) and will give very high quality results with the added bonus of being able to double for satellite TV use.

COMPARISON TESTS

I consider the Wood & Douglas combination of a 1250DC tuner and VIDIF IF/demodulator to be probably the most sensitive 24cm ATV receiver in popular use. I have therefore based my tests and observations on comparisons between the W&D and Astec systems, using a common 26-element JVL Loop Yagi and a Comex systems low-noise wideband pre-amplifier. I must however state that I have incorporated one or two modifications in my W&D IF/demodulator board mainly in an attempt to reduce the noise produced within the circuit. Modifications have also been made to the video amplifiers to produce a standard 1v p-p output with minimum distortion. The IF has been carefully adjusted using sweep equipment and optimised for best overall noise performance, therefore it may be that my particular unit performs slightly better than a 'standard' system.

The first thing I noticed when tuning in to a weakish (P2 - 3) picture was that the Astec system appeared to be slightly less sensitive than the W&D; an estimation of around half a 'P' point being typical. This apparent lack of sensitivity continued until signals became stronger (above P4) then the noise and 'sparklies' on the picture diminished somewhat earlier on the Astec system than the W&D. In fact when all trace of noise had just disappeared using the Astec, only a P4.5 report could be given on the W&D since there was still a significant amount of noise discernable on the picture.

I use the word 'apparent' when referring to a lack of sensitivity since that is the effect one sees on the screen, however the reason can almost certainly be attributed to the TRULY wide-band performance of the Astec IF system which, as a consequence, produces a somewhat noisier IF. Coupled to that the use of a quadrature discriminator, which doesn't have the benefit of threshold extension as is possible with phase-lock loops, does nothing to improve or enhance the noise performance.

This properly tailored wideband IF and superbly linear demodulator, which is designed specifically for FM-TV reception, makes the quality of the recovered video signal very high indeed. Even when receiving quite weak amateur pictures good colour is still obtainable well after it has disappeared on the W&D. The same can be said of the audio: You know how annoying it is when you tune in a weak commercial broadcast station on a domestic TV set and can still receive perfectly good sound, and then you try the same thing on an amateur signal; it's

COMPONENT LIST

R1,9,10,18, 19,27,28	75R
R2,7,17	10k
R3,4	1k5
R5	390R
R6	470R
R8,24	1k
R11	12k
R12	680R
R13	56k
R14	330R
R16	47R
R20	10R
R21,15	150R
R22	4k7
R23	4.7R
R25	15k
R26	300R
R29	82R
VR1	4k7 hor preset 10mm
VR2	10k lin carbon
Tr1	2N3904
Tr2	ZTX300
Tr3	ZTX500
IC1	NE592N, uA733N
IC2	TDA1035T or S
IC3	7805

C1,5,7,8	100uF 16v vert
C2	47uF 16v vert
C3,13	0.1 ceramic or mylar (5mm)
C4	470pF polystyrene 5%
C6	10n ceramic or mylar (5mm)
C9	560pF polystyrene 5%
C10	0.22 tant
C11,14,17	47uF 25v tant
C15,23,24	1uF 25v tant
C16	4n7 ceramic or mylar (5mm)
C18	5p6 plate ceramic
C19	220uF 16v vert
C20	68n mylar (5mm)
C21	100uF 25v vert
C22	5n6 polystyrene 5%
L1	1.5uH axial fixed inductor
L2	33uH axial fixed inductor
L3	15uH axial fixed inductor
L4	Toko MKANSK1731HM (6MHz)
SW1	SPCO toggle
F1	SFE 6.0
Pl1	0.2" PCB connector 12-way
Rla	12v DPDT (OUB) Maplin YX95D Bonex 46-70030

(numbers in brackets are lead spacings)

AT 1020 TVRO tuner head
AT3010 TVRO IF/demodulator
Type 'F' coax plugs

Available from: THAME SYSTEMS Ltd, Thame park Road, Thame, Oxfordshire, OX9 3XD. Tel: 0844 217676.

Please enquire as to prices and availability of the Astec modules before commencing this project.

The TDA1035 and probably F1 (check first for correct style) is available from: Sendz Components, 63 Bishopsteignton, Shoeburyness, Essex SS3 8AF (Tel: 0702 332992.

Other components from Bonex Ltd.,

Printed circuit board from Members Services (see order form in CQ-TV) just not there. Well, with the Astec system the sound remains almost to the point of sync loss caused by a weak picture.

Now that the new system has been in use for some weeks I must conclude that (at least in my case) the Astec receiver is slightly worse at receiving weak signals. So if you are a DX'er and like dredging around in the noise, or if you don't have fairly local stations from whom you regularly receive stronger signals, or a repeater, then the new receiver is unlikely to better your existing receiver, (assuming of course, that your existing system is up to scratch!).

If however you own a questionable receive set-up or mainly receive stronger signals (perhaps from the local TV repeater), then you will certainly appreciate the sheer quality of reception by the Astec receiver. Don't forget of course that it doubles as a satellite TV receiver as well.

Since this article was written and typed-up ready for the magazine there have been certain developments regarding the project, as well as some further information:

The circuit and parts list gives component details for the U.K. 6MHz intercarrier sound system, however, it is possible to change these components for other frequencies. The table below suggests some alternative values:

FREQ	C9	C4	F1
5.0MHz	800pF	680pF	SFE5.0
5.5MHz	650pF	560pF	SFE5.5
6.5MHz	470pF	390pF	SFE6.5
7.0Mhz	400pF	350pF	SFE7.0
7.5MHz	350pF	300pF	SFE7.5

(capacitor values are to the nearest 10pF and are calculated only)

It is not certain whether SFE ceramic filters are available for all the above frequencies, therefore constructors must ascertain this for themselves. In order to retain the use of the specified inductors, only the capacitor values need be changed.

A version of this article is published in the august issue of Radio & Electronics World and acknowledgement is made to the editor, Duncan Leslie, for allowing this article to appear.

Printed circuit boards are available from BATC Members' Services.

A 70 OR 24CM PA

Peter Johnson, G4LXC

This power amplifier, although designed for the 1.3GHz band, is also suitable for use at 70cm after some simple modifications. The unit is based on the Mullard BLV93 transistor which has a rating of 10W peak and a power gain of better than 6dB at 24cm. This design can be used with all modes of emmission - SSB, NBFM, CW, AM or FM-TV. A drive level of <2W is required and the 2W figure should not be exceeded.

CIRCUIT DESCRIPTION

Fig.1 shows the complete circuit diagram. Drive is applied to L1, a printed stripline whose characteristic impedance is 50-ohms, and transferred to L2 via C1. C1 enables the correct application of the drive signal to the input tuned circuit, a Pi network consisting of L2, C2 and C3 which is resonated at the wanted frequency, the signal is then applied to the base of Tr1. A potential divider base bias network produces the correct dc signal and is applied to Tr1's base via RFC-1.

As is usual with this type of amplifier Tr1 is operated in a grounded emitter configuration, having its emitter connected directly to earth. Another Pi network tuned to the required frequency connects to the collector which is supplied with its dc via RFC2 and RFC3 together with heavy decoupling at RF frequencies. C6 is adjusted for optimum transfer of power to the output stripline L4.

Tr1 is a intended for broadband applications although this unit will not cover the whole of our 1.3GHz allocation without re-peaking. The approximate 0.5dB bandwidth is +-15MHz from nominal at 1.3 and +-6MHz at 70cm.

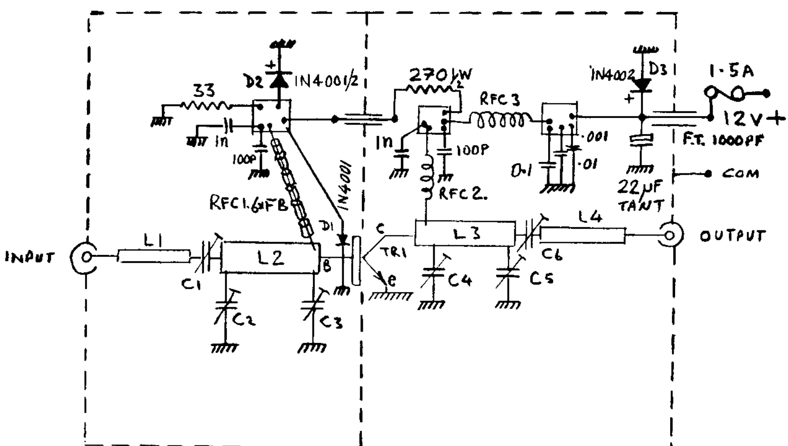


Fig.1 Complete circuit diagram.

COMPONENTS

It is important that the correct type of trimmer capacitor be used since this circuit has been designed to cater for devices having specific self-capacitance and inductance characteristics. The ones used are Mullard type 809 (part No.809 05001) which are square, PTFE film dielectric, professional, miniature components having a minimum capacitance of 1.2pF and a capacitance swing of 2.3pF. (1)

The transistor - type BLV93 is currently priced at around £20 and is available from (1).

Good quality single-sided fibreglass PC board material is used for the main board. Decoupling capacitors are miniature ceramic wired with short leads, and input/output connectors are square-flanged BNC. The heatsink is 100 x 75mm 4.0%C/W (RS Components 401-497) although Maplin type 4Y (order No.FL41U) or Cirkit type 4M-229 (stock No.21-08229) should also be suitable. Ferrite beads are FX1115 or similar VHF types and the feedthrough capacitors are 1000pF bolt-in ceramics. A suitable diecast box is required to house the amplifier.

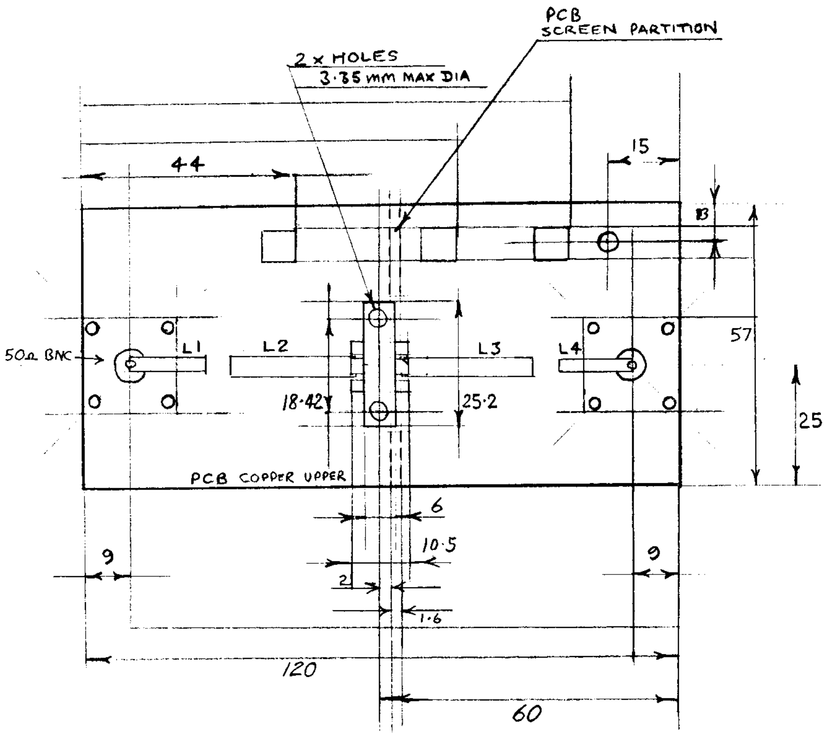


Fig.2 Key dimensions for the main board.

70cm OPERATION

This amplifier will tune to 70cm using the inductor dimensions given for 24cm (Fig.2) in which case all the trimmer capacitors should be changed for type 808 devices (green, film dielectric) having a range of 2 - 22pF. However if it is intended that the amplifier be only used for 70 then the appropriate inductor dimensions should be used (see component list). A variation in overall board length and diecast box size will be needed.

At 435MHz the amplifier achieves around 9dB of gain therefore 1W input would produce 9 - 10W of RF under narrow-band conditions. For linear AM-TV 0.5W of drive will produce 5W rms without sync crushing although the peak sync power would be of the order of 8 - 9W. For 70cm the RF chokes will require additional ferrite beads (see component list).

CONSTRUCTION

Cut out the laminated fibreglass PC board to the dimensions in Fig.2, trim the outside edges to fit the inside lid area of a suitable diecast box and cut a slot in the centre to provide a clearance fit for the bolt-down sections of Tr1. Place the board copper uppermost inside the box lid and clamp it in a vice. Drill holes for the BNC sockets at either end (see Fig.2) providing 6BA clearances for the four screws and a suitable size hole to accept the metal protrusion on the underside of the socket. Trim the PTFE insulation from both sockets so that they are flush with the underside of the lid allowing the centre pin to pass through a 3/16" hole in the PC board. Using four screws to each socket bolt-on the connectors clamping the PC board and box lid firmly together.

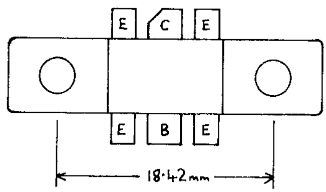


Fig.4 Detail of TR1.

Carefully mark the centres for the bolt holes for Tr1 (see Fig.4) and drill these holes using a 6BA tap size drill, check the alignment of the centres and offer up the heatsink clamping it in the vice central to the lid. Drill two holes with the 6BA tap drill through the heat sink and remove it from the vice. Tap the two 6BA holes (use paraffin or light oil as a cutting lubricant) and de-burr all holes and edges. With a 6BA clearance drill open up the two holes in the lid and de-burr the edges. Mark a safe area around the heatsink and drill a hole for the 1n feedthrough allowing room for the fixing nut. Bolt Tr1 to the heatsink using thermal compound on both Tr1 and heatsink-to-lid sandwich using 2, 0.5" 6BA screws with washers placed on top of Tr1 flanges since the holes provided are slightly larger than 6BA clearance. Make sure that Tr1's base and emitter lugs are correctly orientated - the collector has a diagonal cut on the lug. Now firm down the assembly just enough to squeeze out some of the heatsink compound as it takes a little time for final tightening down. Position the heatsink gently for square alignment and finally tighten Tr1's screws firmly. It will be noticed that a gap is evident between the emitter flanges and the ground plane, make four copper spacers to fit in this gap and quickly solder them into position at the four emitter connections.

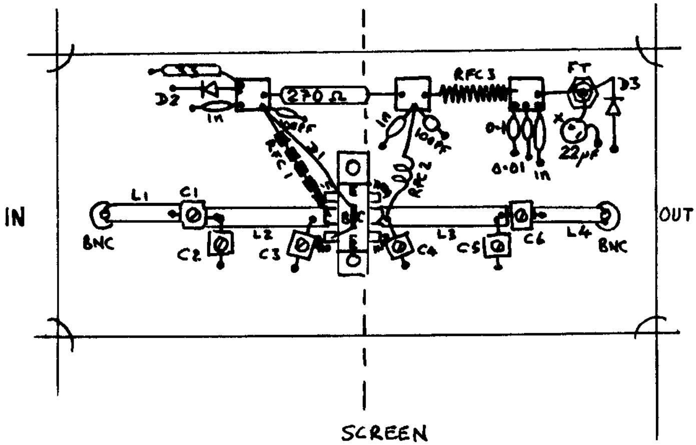


Fig.3 Component layout diagram.

Using a small saw cut out L's 1 to 4 from a similar piece of PCB material as that used for the main board (see component list), also cut out three square pads 7mm x 7mm, de-burr the edges and fix them to the main board using super glue in the positions indicated in Fig.2, the inductors should just tuck under the base and collector lugs of Tr1 and the matching lines (L1 and L4) butt up to the centre pin of the BNC connectors, allow time for the glue to cure.

Solder all components into position as indicated in Fig.3 with the exception of the screen and associated feedthrough capacitor. D1 (heat sense diode) should be positioned across the top of Tr1 and good thermal contact made using heatsink compound. Check your work against both Fig's 1 and 3. Finally cut out a screen from tinplate, sheet brass or copper or PCB material to fit the inside of the diecast box, making suitable cutouts to avoid shorting out Tr1's collector and any other components, the clearance above Tr1 collector should be at least 1/16". A hole should be drilled in a suitable position to accept the feedthrough capacitor. Solder the screen in position (Fig's 2 and 3) tacking it first and ensuring that the assembly fits inside the box, then solder the screen to the main board all along the seam.

ALIGNMENT

To avoid any costly mistakes check the following:-

1. That Tr1 is the correct way round.
2. There are no wiring errors.
3. The resistors are of correct value.
4. The diodes are the right way round.
5. The coaxial socket centre pins are connected to L1 and L4.

Arrange input and output cables and provide a SWR meter or diode probe and a 50-ohm dummy load. Provide a 5v or 5-12v power supply with 1.5A current limit. Apply drive and +5v and adjust all trimmers for maximum power output, gradually increase the voltage re-tuning for

maximum output each time until 12v is reached, then check the current stability by switching the amplifier off and on several times whilst monitoring the current drawn, it should be the same each time the unit is switched on. If all is well fit the amplifier inside the diecast box, tightening down the lid and re-check the readings, they should be approximately the same or slightly higher.

If fluctuations or variations in the current readings are observed it indicates that instability is present. Try a re-tune and check the load and drive conditions. Remove the drive and make sure the standing current falls to below 100mA (it should normally be around 80mA at 12v operation), if it does not then the amplifier is oscillating. Check that you have all the right components, if it still oscillates reduce the bias voltage or change the type of decoupling capacitors or even add some extra ones. Note that VERY SHORT or ZERO lead lengths only are permissable at these frequencies; try different values of capacitors as well.

(1) All components are available from: LMW Electronics, 102 Stamford Street, Ratby, Leicestershire LE6 0JU

COMPONENT LIST

D1, D2, D3	- 1N4001/2 or similar.
RFC-3	- 22t 26swg enamelled copper wire 1/8" dia.
Tr1	- Mullard BLV93

1.3GHz

RFC-1	- 6 small ferrite beads threaded on hookup wire.
RFC-2	- 2t 26swg enamelled copper wire 1/8" dia.
L1, L4	- 2.5mm wide copper laminate, length as required to butt against socket pins.
L2, L3	- 3.25mm wide copper laminate 18mm long.
C1 - 6	- Mullard type 809 1.2 - 3.5pF trimmers.

70cm

RFC-1	- 8 small ferrite beads threaded on hookup wire.
RFC-2	- 3t 26swg enamelled copper wire 1/8" dia.
L1, L4	- 2.9mm wide 1.6mm thick copper laminate 15mm long.
L2, L3	- 3.25mm wide 1.6mm thick copper laminate 24mm long.
C1 - 6	- Mullard type 808 (or similar) 2-22pF miniature film trimmers.

A PROCESSING AMPLIFIER

Bryan Dandy, G4YPB

Having decided to upgrade my ATV system to colour it made sense to start at the last link in the chain; the processing amplifier, and work backwards allowing testing at all times into working units. The processing amplifier which I built is shown in Fig.1 and is based on the design by John Goode in CQ-TV 130, with a few changes as described below.

Using +&- 12v rails caused a problem with dissipation in TR8 and it's associated collector resistors, this was overcome by using +&- 5v rails with no loss of performance. Also this type of output stage works better inverted when driven with video signals so, as the board had already been designed in the original article, I decided to invert all the circuitry. Clamp pulses for the amplifier are derived from the mixed syncs, rather than from the more commonly used line drive. This ensures that clamping always takes place while the signal is at black level (provided of course that the incoming sync pulses match the local ones). Also with this method simple sync pulse generators, such as the ZNA234, can be used without having to provide line drive.

A printed circuit design is shown in Fig.2 and the component layout in Fig.3. Provision has been made on the PCB for two extra 100nF decoupling capacitors on the positive rail, in the area of the clamping and blanking circuitry. Resistors are all 1/4W, but it is possible to use 1/2W types in the output stage if higher than +&- 5v rails are used. Transistors TR1, TR3, TR7 and TR9 to TR12 are all general purpose NPN types such as BC182 or BC107. Transistors TR2, TR5, TR6 and TR13 are PNP types such as BC213 or BC177. Transistor TR4 is a BSX20 and TR8 can be any NPN TO-39 type such as BC461 or 2N2905. All the diodes are 1N4148 and the 47uH choke can be a Sigma SC10 or SC15 type.

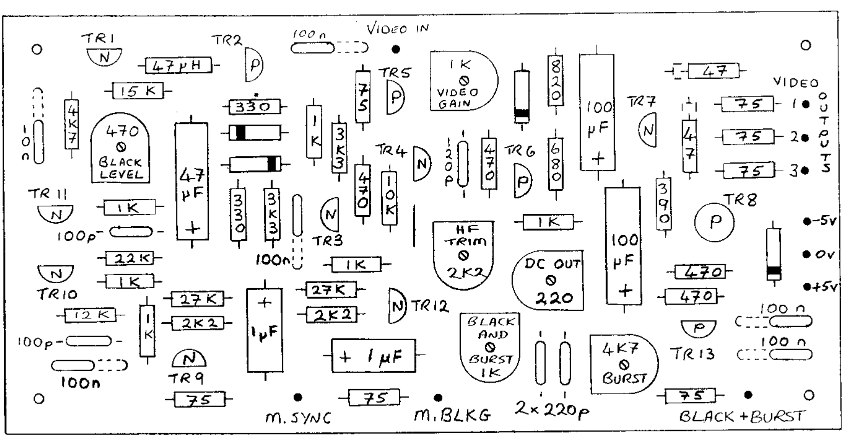


Fig.3 Component layout.

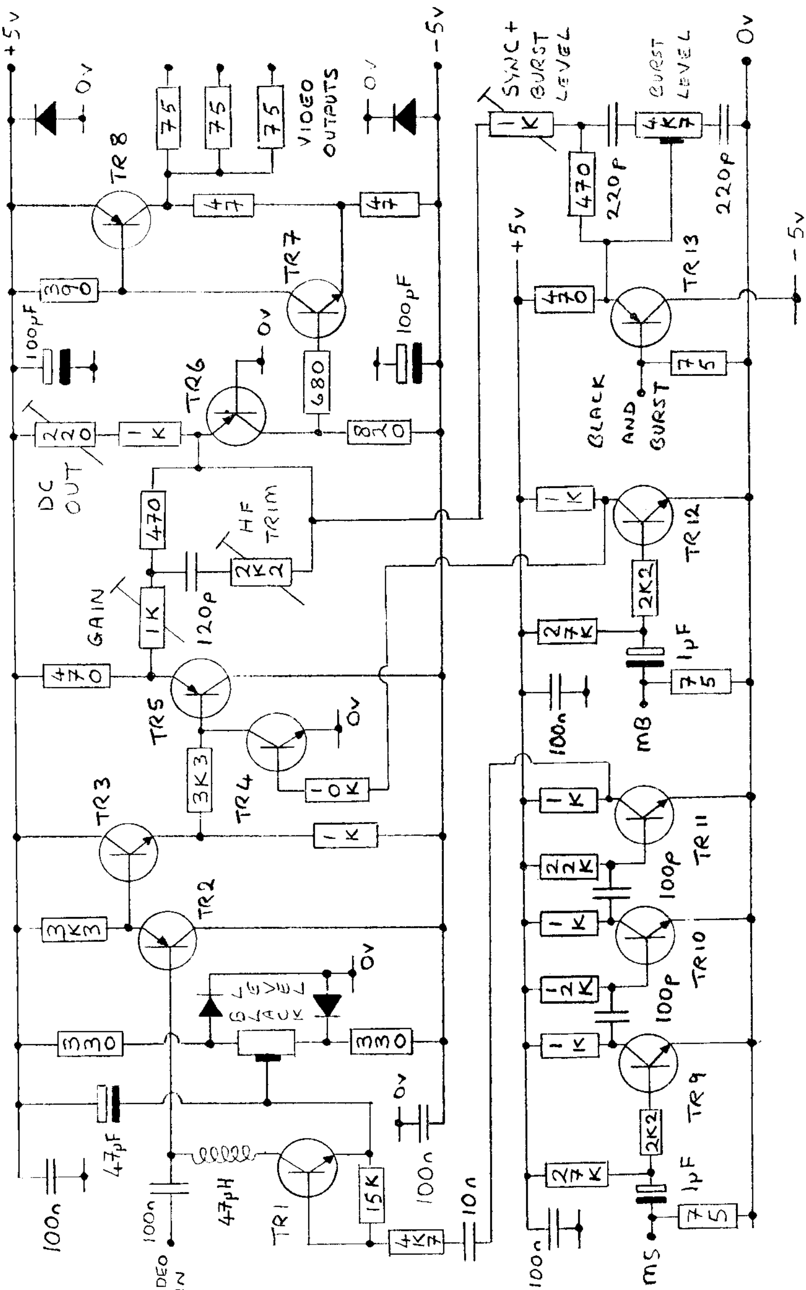


Fig.1 Circuit Diagram.

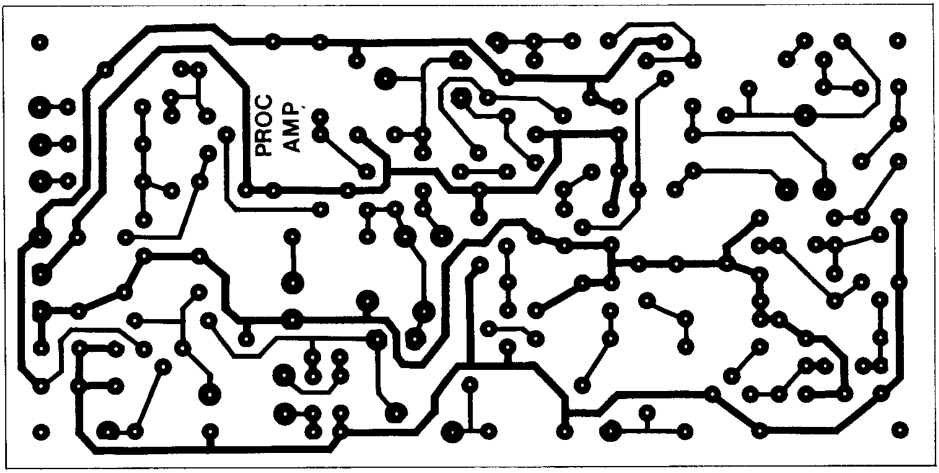
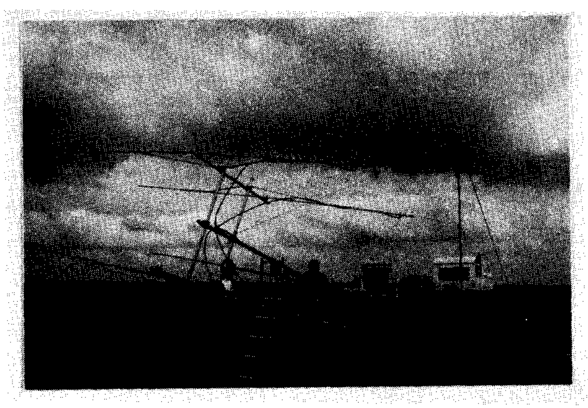


Fig.2 Printed Circuit layout.

If the amplifier is to be used with Monochrome signals feed the Black and Burst input from the Mixed Sync input via a 560-ohm resistor.



The G8LIR contest team - on holiday?

70CM PRE-AMPLIFIERS

J.Gannaway G3YGF and C.Suckling G3WDG

This article first appeared in RADCOM in December 1980 and we thank the editor for his permission to reproduce it here. Although 7 years old this design and the techniques involved are still relevant today.

INTRODUCTION

This article describes the construction of a preamplifier for 70cm, with a noise figure of around 0.5dB, using a Gallium Arsenide Field Effect Transistor (GaAsFET). Also included is a design for a second-stage preamplifier with a noise figure of around 2dB, using a BFR34A transistor. These preamplifiers are in current use by several ATV stations with great success. The main emphasis is on achieving very low noise figures, but the devices are also capable of very good strong signal performance, with a consequent reduction in noise figure.

The one major problem when using GaAsFETs is that they have a very high input impedance. Bipolar transistors have input impedances which are relatively close to 50-ohms, typically a few hundred ohms, so they are quite easy to match in either narrow or broadband systems. This leaves open the option of fitting narrow, low-loss filters in front of preamplifiers using them. However, with GaAsFETs the input impedance is in the order of tens of kilohms, so a very high-Q network is necessary to step up the impedance with low loss, and it is consequently difficult to make them operate over a broad bandwidth. This is a disadvantage for many professional applications, but a

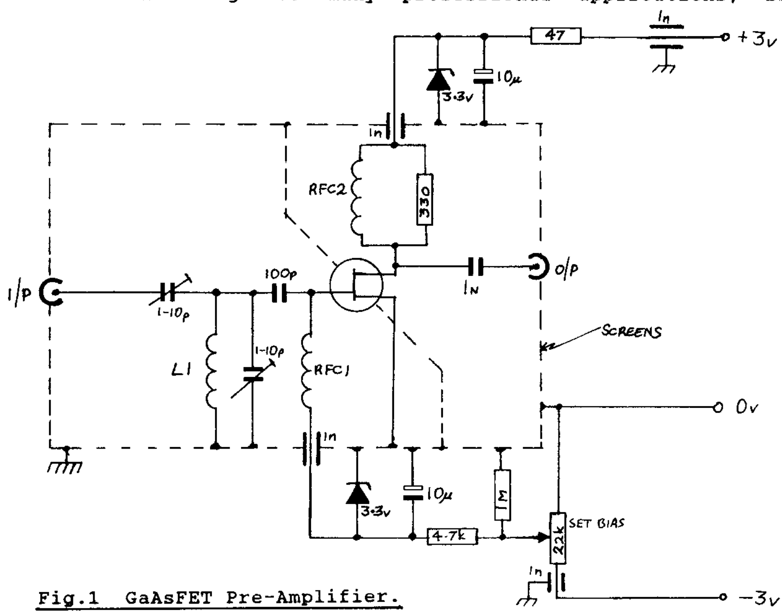


Fig.1 GaAsFET Pre-Amplifier.

positive benefit for amateur applications. It requires the construction of a very narrow bandwidth, low-loss input matching circuit, which will reject out-of-band signals and reduce the number of spurious products generated in the receiver. This is particularly effective since the filter is in front of all the active devices in the receiver. Broadband preamplifiers can suffer badly in this respect from the large number of strong signals present in the VHF and UHF bands. This preamplifier has been used in close proximity to quite powerful 2 metre transmitters with aerials on the same mast without experiencing problems.

CONSTRUCTION

The circuit of the GaAsFET amplifier is shown in Fig.1, and the layout shown in Fig.2. It is built on double sided printed circuit board, which is used as a ground plane. The whole amplifier fits inside a 4.4 x 2.4 x 1.25 inch diecast box, with the ground plane replacing the lid. The screens are also made from double sided pcb for rigidity and ease of soldering. The covers for the input inductor L1 are made from thin brass or copper foil.

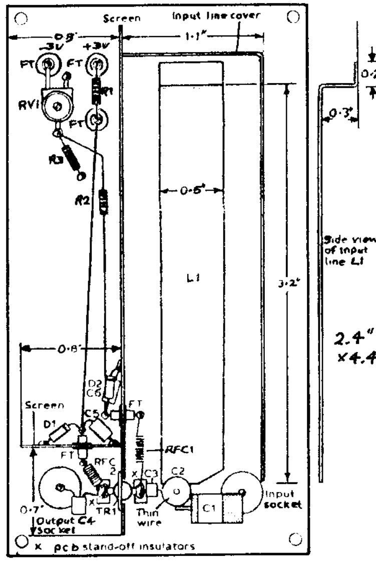


Fig.2 GaAsFET Pre-amplifier layout.

Firstly mark and cut out the PCB to fit over the top of the diecast box and drill the mounting holes in each corner. Mark the position of the posts in the corners of the box on the pcb, so as to avoid mounting anything on the board which will foul them; this is likely to occur if the input socket is too near the corner of the box.
Solder the three pieces of pcb screen (0.8in high) in place, soldering both sides of the screens along all of their length. Mount the feedthrough capacitors in the screen and lid. The capacitor entering the GaAsFET's drain compartment should be about halfway up the screen, and the one into the gate line about 0.2in from the top of the screen. Cut out two small pieces of pcb about 0.125in square as mounting pads for the FET leads and glue them down flat to the ground plane on each side of the gap in the screen. Mount the input and output sockets and C2, making sure that the sockets do not foul the sides of the box. If sockets requiring four mounting holes are used they can be pushed through the PCB from the inside of the box and soldered to the ground plane on the inside. Single hole fixing sockets can be used in this way or just bolted in. BNC, TNC or SMA sockets are suitable due to their size, whereas N-type sockets would be too large.

Adjust the distance by which the input socket protudes above the PCB so that C1 can be easily soldered to both C2 and the socket. Next, form the input inductor L1 from some copper sheet about 0.040in thick. Solder the inductor in place, grounded end first and then the end resting on C2. All the other components can then be installed. Take care when soldering to the trimmers as the top connections can become unsoldered from the body if they get too hot. A piece of flexible wire, rather than copper strip, should be used to connect C2 to C3 to prevent any stress being applied to C3. Next, bend up the screen to cover the top, side and end of L1 and solder it in place along all the joints. The screen should stop just at the end of L1, leaving access to both trimmers and the FET, and be about Ø.3in above the copper line forming L1.

The next step is to install the GaAsFET. This requires sensible precautions when handling the device to avoid damage due to transient static voltages. A few simple precautions to follow are:

1) Do not handle the device in a room where one can draw sparks from objects after walking across the floor.
2) Touch earthed objects frequently. Alternatively a static conducting wristband could be worn suitably earthed.
3) Touch the source first when picking up the device.
4) When installing the device in the amplifier hold the amplifier chassis at the same time, thus keeping them both at the same potential.
5) When soldering the GaAsFET into the circuit, unplug the iron from the mains and ensure that the iron is earthed to the pcb during soldering.

There are two types of package for the GaAsFET that may be encountered: the threaded stud type and the cross type of package. If using a device in a threaded stud housing, drill a 1.2mm diameter hole in the pcb between the two stand-off pads. The lead with a 45 degree cut across the end is the gate of the device, the stud is the source and the other lead is the drain. Bolt the device into place and tighten up the nut before soldering the leads, in order not to tear them off due to the device rotating. The leads may then be soldered to the stand-off pads.

For GaAsFET's housed in the cross type of package, solder the two source leads (again the gate is the lead with the diagonal cut, the drain being diametrically opposite), to the screens on either side of the stand-off pads. The gap between the two screens can now be closed by soldering some thin metal foil across it. Another metal foil screen can now be soldered over the end and top of the input circuit, leaving access to adjust C1.

The trimmers C1 and C2 need to be low loss types and Johanson or JFD types are recommended. Miniature PTFE dialectric gold-plated trimmers similar to those supplied by Vero have also been used successfully, as have Sky trimmers (Piper Communications) and Hewlett Packard types. C3 is ideally a chip capacitor, but an ordinary disc ceramic may be suitable. RFC1 is constructed from 15 turns of 26swg enamelled copper wire, self supporting with an internal diameter of Ø.125 inches. RFC2 is 1Ø turns of 26swg wire wound onto the body of R4.

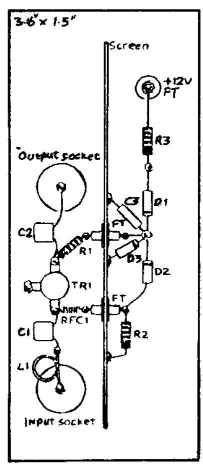


Fig.4 BFR34A Pre-amp layout.

BIPOLAR AMPLIFIER

The BFR34A preamplifier (Fig.3) is built in a similar manner in a smaller diecast box. Construction is very simple and the layout is shown in Fig.4. The base and collector of the transistor is soldered to stand-off pads and the emitter soldered to the PCB. The input and output sockets are located such that only the shortest leads are required on the interconnecting components. A PCB screen is soldered along the whole length of the centre of the board, with the two feedthrough capacitors mounted as shown. All the power feed components are mounted onto stand-off pads on the other side of the screen, with power being fed into the box via another feedthrough capacitor.

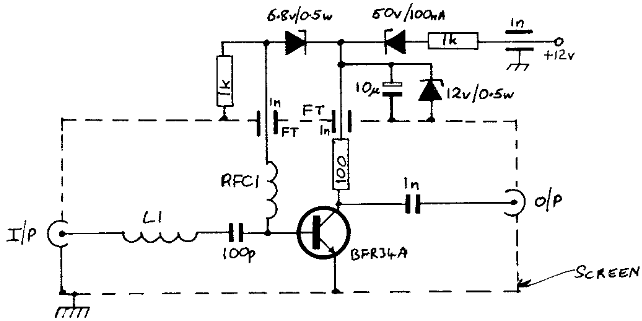


Fig.3 Bipolar Pre-Amplifier.

POWER SUPPLIES

GaAsFET's are very sensitive to transient voltages because of the very small capacitances and physical dimensions of the chip. The width of the gate is about 1 micron, so even relatively low voltages can produce very high fields in the chip. The manufacturers maximum ratings are typically as follows:

Vgs	6 to 0v
Vds	0 to 6v
Vdg	0 to 10v
Pmax	500mW
Max forward gate current	2mA
Max reverse biassed gate leakage current	10uA

The gate is the electrode most susceptible to damage by transients, but once it is installed in the circuit it is fairly robust. By far the safest and very strongly recommended method of powering the preamplifier is from batteries. Holders for four HP7's can conveniently provide +/- 3v if a connection is made to the centre tap of the batteries. These would be mounted near to the preamp, as excessively long leads may increase the chance of picking up transients from other equipment, such as relays. However several of these units have been built and powered from simple mains power supplies without any problems being encountered. The over-voltage zener protection provided in the preamp circuit takes care of power supply fluctuations, however, care must be taken as these diodes are not fast acting enough to protect against power surges caused by lightning etc.

TESTING

Set the bias pre-set to half way and then connect the supplies. For optimum safety apply first the gate and then the drain supplies, as this avoids the device drawing too high a current should the gate supply be applied later than the drain. The reverse procedure should be observed when switching off. The drain current should initially be set to 10mA, and can be monitored by measuring the voltage across R1 being approximately 0.5v. If the preamplifier is operated without a 50-ohm load on the input spurious oscillations may be generated. If suitable test equipment for optimising noise is not available, connect the two preamps together and put them into the receive line. Adjust C1 for maximum received signal and C2 for minimum noise on the screen. Do not be misled into tuning C2 for maximum signal strength, as this invariably will not be achieved at the setting for the best noise figure, and a consequent degradation of the system will result. Once optimised the preamps should yield a total gain in the order of 25 to 30dB, with resultant picture strengths being improved by at least one P-point.

CONCLUSIONS

The GaAsFET preamp should ideally be mounted as close to the aerial as possible, as any feeder losses will add to the overall noise figure. If the losses in the feeder are likely to exceed 1dB, then the second stage preamp should also be mounted at the masthead.

Various GaAsFET's have been tried in the circuit, including the Plessey GAT4, GAT5 and GAT6, the NEC NE12683 and the Alpha 1000, all of them giving very similar performance. Although these devices have inherent noise figures much lower than 0.5dB, the noise figure of the circuit remains at best at that figure. The extra noise comes from the losses in the input circuit, and it is here that there may be scope for experimentation and improvement. Other well known devices that have not been tried but may well be suitable are the Mitsubishi MGF1400 series and the NEC V244 and V388.

SSTV CALLING...144.500

10GHZ ATV...10.250

THE G11 TV CHASSIS ON 70CM

Eric Edwards, GW8LJJ

Now that the G11 series of Philips and Pye televisions are coming on to the second-hand market at reasonable prices, it is worth considering them for 70cm ATV. With just a simple modification to the tuner it is possible to tune into the 70cm band directly, whilst still maintaining normal broadcast reception capability. The tuner/IF strip can also be used independently of the TV set to provide a complete 70cm down converter/IF system, the only extra circuitry needed being a video buffer amplifier to bring the output to 1v p-p into 75-ohms.

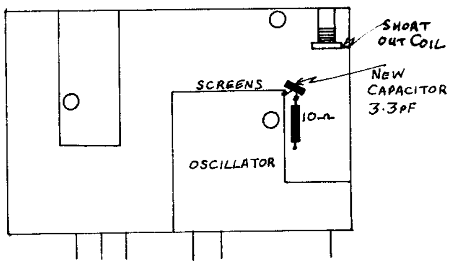


Fig.1 U321 Tuner modification.

To modify the tuner 'in situ' all that is required is the addition of a 3.3pF capacitor inside the U321 tuner. Remove the tuner from the printed circuit board and take off the covers. Locate the 10-ohm resistor adjacent to the oscillator section as shown in Fig.1. Solder the 3.3pF capacitor to the resistor as shown with the other end soldered to the screen, ensuring that the resistor remains connected as normal. Replace the covers and return the tuner to the printed circuit. The tuning range with this modification fitted will have been extended to cover the 70cm band, without altering the range of coverage of the broadcast bands. With the addition of suitably tuned pre-amplifiers quite acceptable results can be obtained on 70cm ATV.

A more convenient method for shack purposes however is to use the unit as a normal up converter system. To achieve this remove the complete tuner/IF strip from the television and carry out the modification to the tuner as described above. A tuning control and the external connections to the board are shown in Fig.2. The supply to the tuning control must be well regulated and adjustment of the tuning range is achieved by varying the value of the 100k resistor. With the resistor values shown in Fig.2 only the very bottom end of the UHF band will be covered and it is unlikely that any domestic channels will be received.

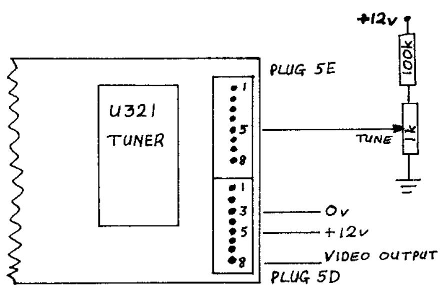


Fig.2 External connections.

The video output from the tuner/IF strip is around Ø.95v p/p at high impedance, so, in order to use it effectively, a buffer amplifier must be provided to produce 1v p-p into 75-ohms. Fig.3 illustrates a suitable amplifier circuit, the input is connected to pin-8 of the IF unit and the potentiometer VR1 adjusted to give 1v p-p output when terminated with 75-ohms.

The results when using this converter system are comparable with other custom built units and has the advantage of a video output rather than UHF, thus eliminating broadcast breakthrough interference on the TV receiver.

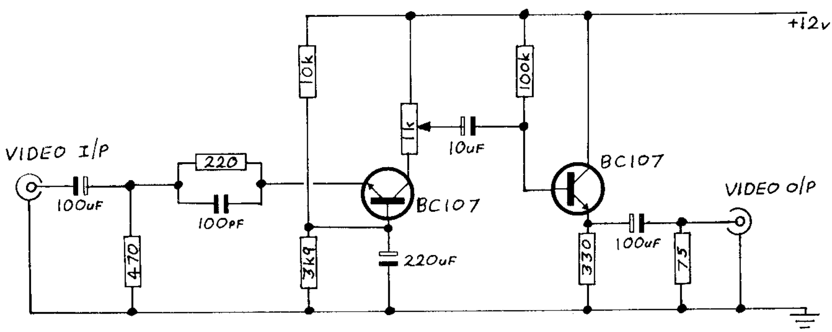


Fig.3 Video buffer Amplifier.

A 'NON-SYNC' DETECTOR

Anthony Fouracre

This simple circuit can be used with the CQ-TV mix/effects amplifier card, or any vision mixer which uses a composite video input.

CIRCUIT DESCRIPTION

The complete circuit diagram is shown in Fig.1. Transistors Q1 and Q2 form two simple sync separators. IC1 is a C-MOS exclusive NOR gate which looks at the lack of coincidence between the 'A' and 'B' row sync separators, which causes positive pulses to pass through D1. These pulses are rectified by D1 to produce a DC level of Ø.6v at pins-1 and 2 of IC1.

Positive feedback is applied through the 2M2 resistor and Q3 sinks the current through to the LED. RV1 sets the sensitivity of the sync signal bias-to-IC2 feedback circuit. In other words, RV1 sets the 'H' phase window between the two rows of cross points.

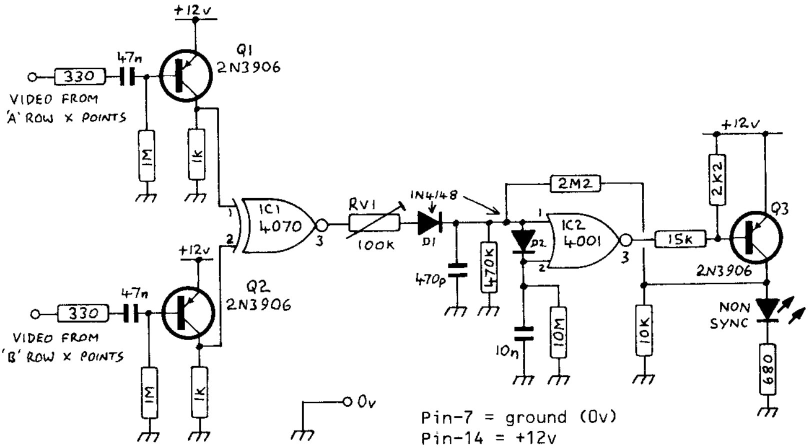


Fig.1 Circuit diagram

SET-UP

Feed two synchronous video signals top the vision mixer. If you don't have locked sources select the same signal on both banks. If the LED is ON adjust RV1 until it goes out. Now select a non-synchronised signal on a 'B' button and the led should light, if not re-adjust RV1 and start the set-up operation. Repeat the whole procedure until the LED lights or not according to the input signals.

For a more accurate procedure use a reference grey scale or black level signal. Connect one timebase of a dual-timebase oscilloscope to the 'A' row mix effects amplifier and the other timebase to the 'B' row. On the 'B' row you will need a camera with an 'H' phase adjustment, or a genlock SPG with 'H' phase adjustment. The sync window should be +/-500ns from the leading edge of sync.

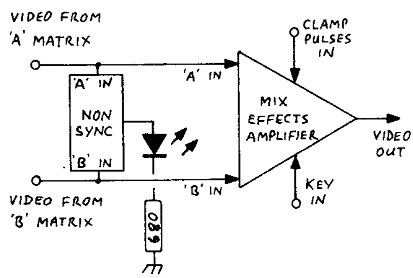


Fig.3 Block diagram.

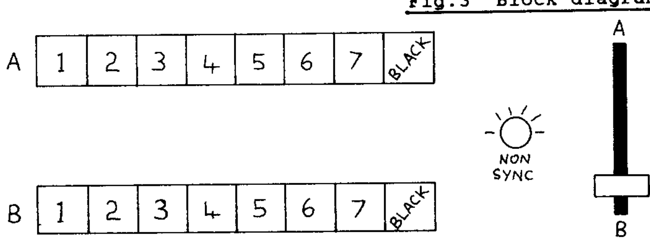
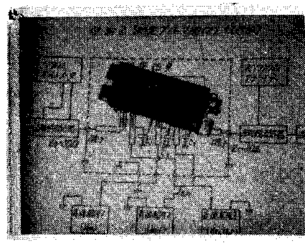


Fig.2 Panel layout.

POWER AMPLIFIER FOR 24

John Wood G3YQC

At last, after years of waiting and knowing all along that they were being made - RF power modules for the 1.3GHz band have reached our shores.



Having been a keen devotee of 24cm ATV for many years, I have been anxiously awaiting the arrival of a decent power module, capable of delivering a reasonable power level yet at an affordable price. For ages I have struggled on with a 2C39 PA with all its inherent power supplies, blowers and tuning drift. I have kept an eye on the one or two designs for discrete transistor PA's, but apart from being a bit difficult to make and align (too easy to blow up a £25 transistor), and needing reasonable test equipment to set them up, they somehow never quite produced the power which one hoped for. Now all that has changed and with the module described here, you can realise up to 15 Watts of RF output for around 1 Watt in, and without any alignment whatsoever!

The module is in fact used in the ICOM IC1271 23cm transceiver and is specified as a 10W device. I contacted Thanet Electronics explaining what I was about, they were most helpful and supplied circuit details of the transceiver so that I could work out how to use the module. In fact they very kindly telexed Japan for the device data sheet as well which, despite being mostly in Japanese, proved very useful indeed. Please don't deluge Thanet with similar requests though, the information given here is about as much as you could glean from the sheets anyway. I should like to thank Thanet Electronics, and especially Chris in the Service Department for his valuable assistance with this project. The price of the module (January '87) is £48.52 plus VAT and postage, but a quick call to Thanet will give you any updating on that. It will also tell you whether they are in stock.

DESCRIPTION

The module itself is designated SC-1040 and has the ICOM name and logo printed on it. Anyone who has seen the 70cm Motorola MHW-710 'blue brick' will know what it looks like - except that this one is black! The circuitry is encapsulated and mounted onto a slab of metal. This serves not only to dissipate heat but also provides a means of bolting it on to an additional heat sink. Fig.3 illustrates the general apearance from the top.

SPECIFICATION

	typ	Max
Power output (Vcc=12.5v, Vbb=9v, f=1.24-1.3GHz)	18W	20W
Power input	1W	2W
Gain (typical)	13dB	15dB
Vcc	12.5v	17V
Vbb	+9v	+10v
Total power consumption (at 15W output)	4.3A	
Operating frequency	1.24 - 1.3GHz	
Operating temperature	-30 - +110%C	
Input/output impedances	50-ohms	

CIRCUIT CONSIDERATIONS

Fig.1 shows the complete circuit diagram of the power amplifier. RF input is via a 50-ohm stripline (3mm wide on 1.5mm double-sided PC board) to which pin-1 is soldered. Pins 2 and 4 carry the 13v supply to the collectors of the three amplifying stages and heavy decoupling is used to ensure a 'clean' supply. Power is directly applied to pin 4 and also to pin 2 via an RF choke. Pin 3 is the base bias supply (Vbb) for all stages and requires +9v. This voltage can easily be derived from the main supply by using a 1A +9v three terminal regulator. Pin 5 conveys the RF out, again via a stripline.

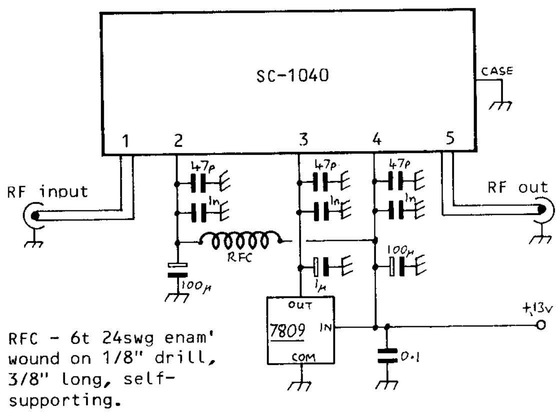


Fig.1 Power Amplifier Circuit.

COMPONENT CONSIDERATIONS

Although the amplifier uses only a few external components it is worth considering them in more detail: The 47pF and 1n decoupling capacitors should be miniature ceramic types of at least 35v working. The 100uF electrolytics are radial (upright mounting) types at 25v working, whilst the 1uF need only be 16v. The 0.1 may be any small type (preferably ceramic).

The 7809 regulator is a bit of a rare beast. I use a 7808 and wire a series silicon diode (1N4001 etc) in series with its common leg (see Fig.2).

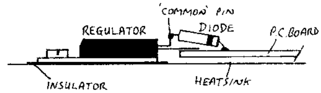


Fig.2 Regulator diode

Don't forget to insulate the body from ground! If you can't get an 8v device either then use a 7805. In this case you will need a 3.9V zener (BZY88C3V9) in the common leg. The voltage on pin 3 doesn't seem to be very critical, in fact I observed little change in output when it was reduced to 8v. Nevertheless I recommend that you get as near to the specified 9v as you can.

The module gets rather hot, therefore you will need a good heat sink, especially with us TV'ers driving the poor thing at 100% duty cycle for hour-long transmissions. My prototype uses one of those finned heatsinks which is flat on one side (150 x 95mm), however this gets a bit too warm for my liking after a few minutes of full power operation. What I do is use a small equipment fan to blow some air onto the heatsink fins, this keeps it nice and cool. However many of you will not wish to go to this trouble so be prepared to shell out on a good sized heatsink for safety.

CONSTRUCTION

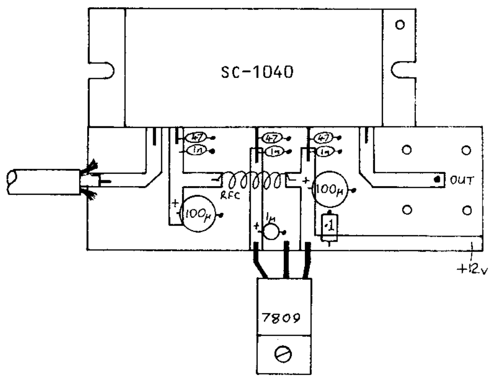


Fig.3 COMPONENT LAYOUT

Fig.4 illustrates the full-size PC board pattern which I have devised. Although I used a piece of 1.6mm Teflon board, I see no reason why good quality double-sided fibreglass board should not be just as effective. The shaded area is the copper land and you can see that the pattern is all made with straight lines. This means that instead of having to etch a board, you can cut away the unwanted copper using a sharp craft knife. The dots indicate where stakethrough wires should be fitted to bond together the upper and lower ground planes, and five crosses indicate 6BA mounting holes.

For the type of heatsink I used I thought the best way of connecting the output would be to mount a BNC socket onto the heatsink (see fig.5) and let the centre pin protrude up through. The pin passes through the PC board itself and is soldered into the end of the output stripline. Because the top and bottom ground planes have been bonded together with wires, the board itself cannot lay flat against the heatsink. I spaced the board away using five 6BA brass washers (four on the BNC socket flange and one at the other end). This meant that the board could be firmly fixed and made a good ground connection.

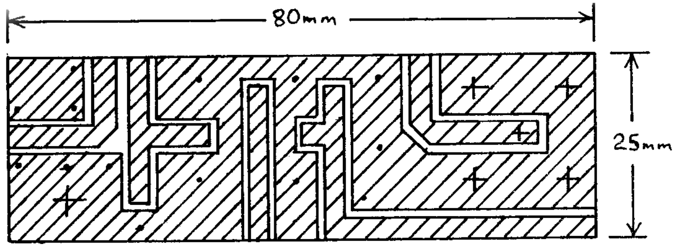


Fig.4 Printed circuit Pattern.

A recommended sequence of assembly is as follows:-

1. Having produced a PC board, drill small holes for the stakethroughs. Now drill holes for the 4-hole fixing BNC socket pin and its four mounting screws, then another 6BA clearance hole as indicated by a cross at the other end of the board.

2. Lay the board in a suitable position on the heatsink (bear in mind such things as leaving enough room to fit the aerial plug and where the module fixing screws will protrude through the heatsink). Then mark and drill the heatsink to accept the BNC socket and the end mounting screw. The centre hole for the socket will need enlarging to accept the protruding boss under the socket's flange.

3. Solder the stakethroughs in (use resistor wire offcuts or a piece of tinned copper wire) ensuring that the underneath solder joints are as low-profiled as possible. These may be filed flatter if they stand too proud for the washers. Now fit the PC board to the heatsink using the five washers (see fig.5) and finally solder the coax socket centre pin to the output line.

4. Now position the regulator (fig.3) and fit it to the heatsink using a 4BA screw and nut. Note that if you are using a lower voltage device and wiring a diode in the common lead, the regulator must be insulated from the heatsink by a mica washer. A 6BA screw will then be required together with suitable insulating bushes. Alternatively a 4BA nylon screw and nut can be used.

The regulator legs are carefully bent out and positioned so that they lie against the board in their correct places, then they can be soldered in. If a series diode is to be used the common (centre) pin should not be soldered to the board but should instead be bent upwards at right angles. The lead is clipped off short and the diode soldered from it to ground (see fig.2). Now install the 1uF and 0.1 capacitors, they are to decouple the regulator and should be fitted as close to the leads as possible. The regulator voltage should be tested now before the module is fitted. Connect +12v (or so) to the board and check that +9v (or a bit less perhaps) is available at the regulator's output.

5. Position the power module against the edge of the board in a position where its pins line up with the PC tracks. Now mark the positions for two fixing holes and drill and tap them 4BA in the heatsink.

6. By offering up the module you will see that the pins (wires) protrude from it slightly higher that the PC board. These wires must be bent down and then out so that they lay flat on the board. DO NOT bend the wires directly from the module body, doing this more than a couple of times will surely break off the leads and render the module useless. (Well you never know if it will need to be removed at a later date, perhaps for re-fitting somewhere else). Grasp the lead against the module using a pair of long-nosed pliers, then bend it downwards. Now, using the pliers, bend the leads out again so that they lay flat on the board - trim off any excess (see fig.5).

7. Solder the leads to the PC board and then fit the small decoupling capacitors (don't fit them too far away from the module body) in the positions shown. Fit the choke, ensuring that it does not short to ground and finally install the two 100uF electrolytic capacitors.

8. A coaxial cable for the drive should be soldered to the input, splitting the braid in two and soldering to either side of the input line (see fig.3). Now check over your work and make sure the supplies are connected correctly.

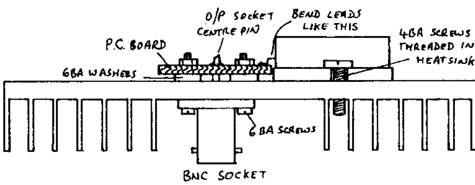


Fig.5 MECHANICAL ARRANGEMENT

TESTING

Not much to do here. The bias supply (Vbb) should have already been tested, so connect the output to a terminated power meter, dummy load or aerial. Apply around 1W of drive to the input and you should see a healthy reading. Do remember that to get a correct measure of output on a non-terminated (thru) type of meter, the output termination should be a good quality 50-ohm RESISTIVE load, an aerial is only resistive at the frequencies where it is correctly matched, therefore using one as a load may well alter the power meter reading to some extent. If you have no power meter then you can get an indication of whether it is working by (a) measuring the total current drawn, (b) feeling the heatsink get warm and (c) getting someone to look at an off-air picture.

No problems have been experienced with my prototype unit, and provided it has been assembled as described, it should work first time. I havn't yet run the amplifier into an open circuit (and I hope I never will!), so I can't comment on its ruggedness in that respect. My advice is DON'T!

FINAL NOTES

I was hoping to plot a graph of power output versus power input over the frequency range. However, the appropriate test equipment was not available to me at the time, so I have had to refer only to the maximum power output condition. I have every reason to suppose though that the power gain will remain substantially constant over a fairly wide range of input levels. If this is so it should be possible to calculate the approximate power output to expect from lower drive levels.

Although the specification quotes a 1W drive level for full output, I had to drive it with just over 1.2W to gain the maximum 15W from my unit. I must point out though that I am using it at 1249MHz which is fairly close to its specification limit, and it is perhaps reasonable to suppose that a slight degradation in performance is being experienced because of that.

I am using a (slightly) throttled back Fortop TVT13ØØ as a drive source, but I would think that the Solent 1W 24cm ATV transmitter would be almost ideal.

TELEVISION RECEIVER FIELD STRENGTH INDICATOR

Ralph Berres DF6WU,

The following article first appeared in the Summer 2/1987 issue (volume 19) of VHF Communications Magazine, and we would like to thank the Editors for their permission to reproduce it here.

An item of equipment that could be very useful for the TV amateur is a received level indicator. Not wishing ot mount a moving coil type of meter into the television cabinet I designed this unit, which superimposes a moving column of light along the top of the screen. The length of this column is dependant upon the strength of the incoming signal.

FUNCTIONAL DESCRIPTION

As may be seen from the circuit diagram of Fig.1 there is nothing very difficult about the practical realisation of this circuit. The transistor T1 together with potentiometer P1 form a constant current source, which charges capacitor C1. The charging time is controlled by P1 and lies in the region of 6ØuS. The capacitor C1 is discharged by transistor T2 during the period of every line pulse. This produces a saw-tooth wave which is synchronised to line frequency, and the amplitude of which is dependant upon the charging current - the latter being controlled by P1.

The diodes D3 and D4 prevent the saw-tooth wave from reaching zero volts, because otherwise the following operational amplifier OP1 will receive a voltage overload at its input terminals.

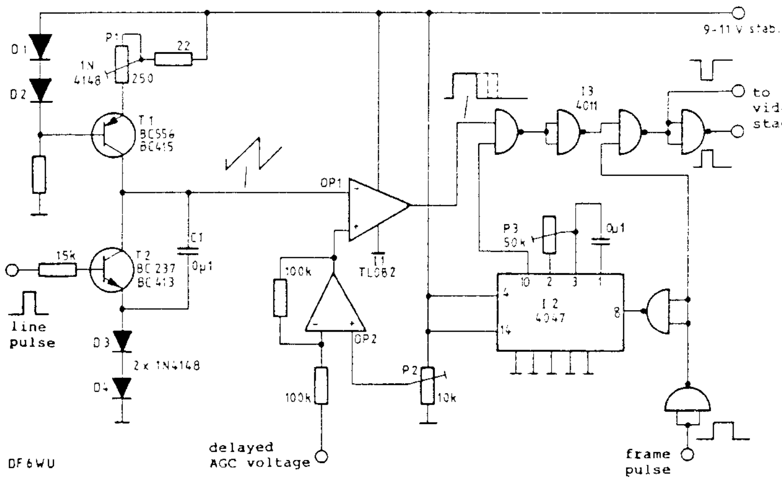


Fig.1 TV Receiver Field Strength Indicator.

The AGC voltage of a television tuner is, in general, 6 to 9 volts in the absence of signal, and reduces with increasing signal strength. For our purposes this behaviour must be reversed and that is accomplished by OP2, which is connected as an adder. The potentiometer P2 at its non-inverted input controls the scaling value of the AGC control voltage.

The inverted AGC voltage is then taken to OP1 which is used as a comparator. When the AGC voltage at any instant is more positive than the saw-tooth wave, the output of the comparator goes directly to the potential of the positive rail +Vb. The length of time it stays at this potential is dependant upon the AGC voltage which, in turn, is dependant upon the incoming signal strength. This sequence is repeated for the duration of line time (Fig.2) at line frequency.

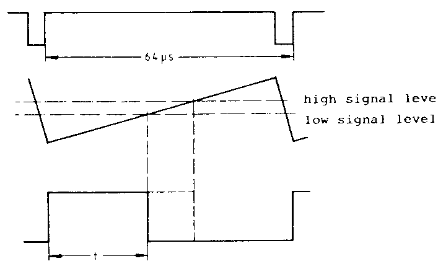


Fig. 2:
The signal control voltage, saw-tooth wave and the variable duration pulse derived from them

In order that half of the screen, from top to bottom, does not 'white out' the incoming signal must, in some way, be connected with the frame pulse. For this purpose a C-MOS type 4047 mono-stable trigger is used. Its output pulse duration is controlled by P3, this being the control for the width of the moving column of light indicator. This signal is now gated with the column-length signal in the 4011 NAND gate.

The following gating with the frame pulse is intended to prevent TV sets having automatic brilliance control from throwing the colour symmetry out of balance. The gating produces a white line for each colour during the vertical blanking time, it also ensures that the moving column only starts at the end of the frame pulse.

INSTALLATION AND ADJUSTMENT

The few components employed are loaded quite simply onto a piece of vero-board and connected up. The main problem is the determination of suitable circuit interface points which will accomodate the board without causing any deterioration to the rest of the picture. Unfortunately, no specific instructions can be given here as there are simply too many basically different circuit concepts.

In my own set I used the 'sandcastle' pulse to derive the line pulse. Difficulties can occur if the picture blanking pulse is used since it is not possible to blank brilliance and black at the same time. In this case it is reccomended to delay the line pulse by a further 5uS using the simple gate delay circuit of Fig.3.

The frame pulse can be obtained from the limiter which, at the same time, is used for the synchronisation of the vertical deflection. The accompanying spurious pulses are rendered harmless by the second gate.

After the module has been completed and successfully connected into the TV circuitry P1 and P2 are turned to mid-position and P3 to maximum. The TV set is then switched on and a very strong signal tuned in. The indicator column of light should be visible. With an oscilloscope connected to the output of the unit a pulse should be visible whose width is a function of the received signal.

The length of the column is now adjusted with P1 such that it nearly reaches the right-hand edge of the screen. The signal is removed and P2 adjusted until the column is now nearly at the left-hand edge of the screen. These two potentiometers should be readjusted until the column moves satisfactorily from extreme left to extreme right with no and full signals respectively. Finally, the column width is set by P3.

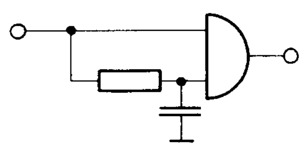


Fig. 3: 5μs delay circuit. R = 10 KΩ, C = 470 pF

READ CQ-TV....OR ELSE!!

UNIVERSAL SYNC RE-PROCESSOR

John Goode

Those of you with long enough memories to stretch back to CQTV 131 may remember reading an article with the snappy title of "Synchronising Micros and VTRs". In it I tried to outline some of the problems that arise when trying to synchronise these pieces of equipment with other vision sources in the shack without (1) extensive modifications that invalidate guarantees, and (2), spending large sums of money on ancilliary equipment. One piece of gear that was referred to as being under development was the "Universal Sync Unit". It is now built and working; however, I have decided that a slight change of name was desirable so that it sounds as if it should be in the shack rather than the kitchen!

The idea of the USR is to have a unit that will produce the standard SPG pulses and subcarrier locked to ANY source of composite PAL video, including micros that may have non-standard scanning. This is done by using a direct locking circuit for the field pulses rather than counting down from twice-line. The unit should therefore lock to any signal that a TV receiver or monitor will, as it uses similar techniques. Note that it is NOT a stand-alone Sync Gen., and MUST have an input signal to lock to.

As I wanted to test it with my own vision mixer, I have included a black and burst generator in the prototype, but this is optional of course. Nevertheless, I have taken this opportunity to build and debug a new design of BBG (suggested in CQTV134) using the 1496 (cost, approx. 90p) instead of the 1445 (around £9 if you can get it), and I am quite pleased with the results.

The building and testing of the prototype has been jointly undertaken by the Editor (G3YQC), David Ellis Jones (GW8PBX), and my (unlicenced) self; as this involved it travelling from Warwickshire, via Anglesey to Hertfordshire, all to busy people, you may begin to realise why it has been some time in coming!

CIRCUIT DESCRIPTION

The circuit can be conveniently divided into four parts:-

(Board 1) Video input, horizontal and subcarrier oscillators;
(Board 2) Pulse forming and subcarrier distribution circuits;
(Board 3) Black and burst generator;
(Board 4) Power supply.

Fig.1 shows the input circuit. Q1 separates the chroma from the luminance; the luma is amplified and inverted then applied to IC1, a TBA920 chip containing the sync separator and horizontal oscillator. The time-constant of the oscillator PLL is wired in the 'fast' mode so that the unit is suitable for following the instabilities present when replaying videotaped material. This means that some horizontal "ragging" may occur if a noisy signal is used as the master source (so don't). The chroma signal is applied to a TDA3950 BLO chip arranged in a similar circuit to that due to GW8PBX shown in CQTV129. Both chips

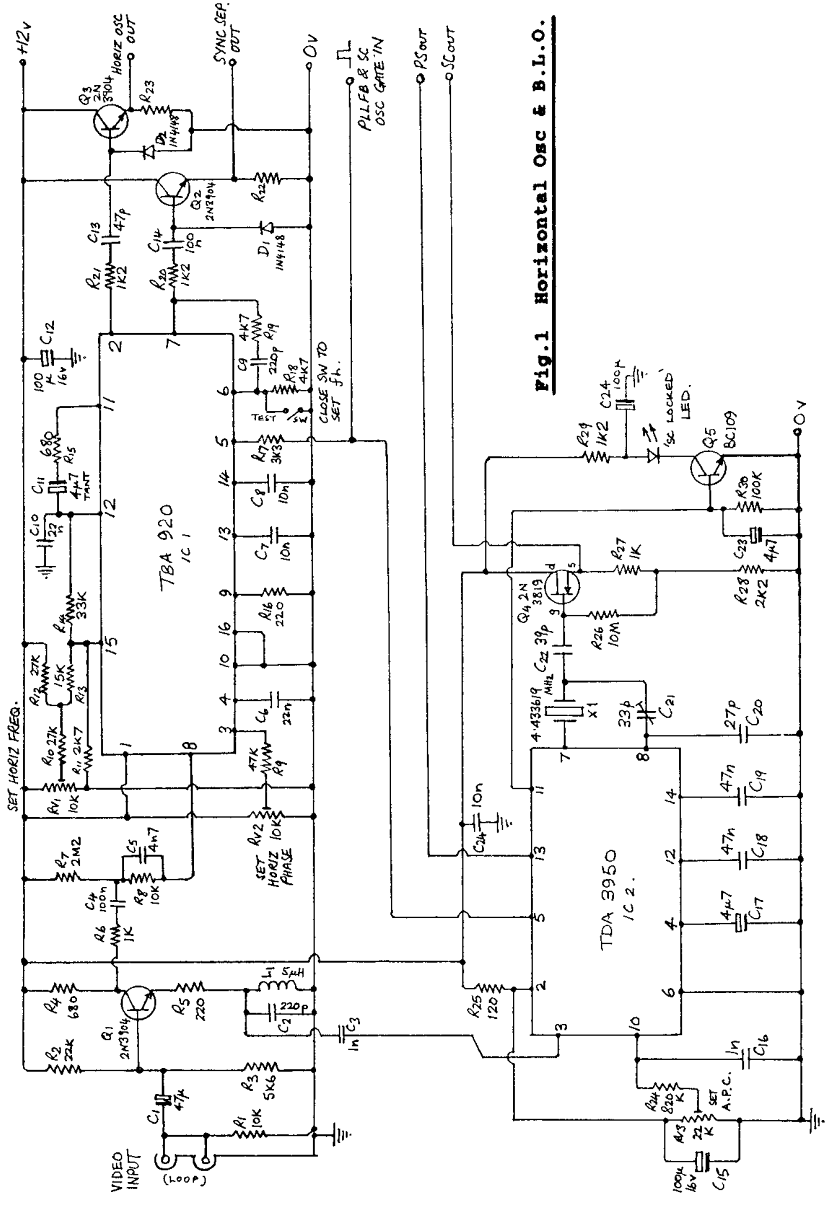


Fig.1 Horizontal Osc & B.L.O.

use a feed of line blanking fed back from board 2 - the TBA920 as the PLL sample, and the TDA3950 to gate the burst for oscillator synchronisation. As well as producing a subcarrier output, the BLO chip also produces a PAL Squarewave output synchronised to incoming video.

Fig.2 shows the pulse and subcarrier phasing circuits. The output from the horizontal oscillator is used to generate line-blanking, and from that the other horizontal pulses are generated. The separated sync output is integrated (C30,R10) to provide field sync, and from this the other field-rate pulses are generated. During testing with a processing amp., it was found necessary to arrange for the field-blanking signal to start prior to the regenerated field-sync, otherwise the original field sync would not be fully blanked (due to the unavoidable delay in the integrator). This has been achieved by delaying FB for just under one field period, using a dual monostable type 556 (N9). This exhibits much less jitter at high duty-cycles than the 74-series monostables, essential in this application. (As this unit is designed to be able to work with non-standard signals, the more accurate method of using line-counters is not appropriate).

The PS waveform is generated from the "swinging burst" by the TDA3950. This is converted to TTL level using Z1, and this and R34 sink the input current for N6a. I have checked this circuit using both a 74LS86 and a 7486, and it seems to work reliably.

A suggestion from GW8PBX was that instead of regenerating MS with a single field pulse, we use separated sync so that if a full-spec. signal were at the input, at least then we would get a full-spec. output. However, due to the biassing of the sync separator in the TBA920, the width of the output pulses appears to be increased, in the case of line sync, beyond the start of burst-gate. In view of this I didn't persue the matter further. Whether this can be improved I don't know, so if anyone else feels strongly about it please have a go!

The subcarrier from board 1 is amplified by Q1, and then sliced by N7 a 74LS13 Schmitt-trigger gate. The resulting TTL signal can then be delayed by the adjustable monostable N4a to give fine phase control. The signal is then reformed by N4b, and coarse phase control is provided by N6b. Thus, by using a combination of these controls, the subcarrier phase can be adjusted over the range of one cycle, and be used to adjust the colour of any driven coders to be in step with the master source. The TTL signal is then filtered to a sinewave and distributed by the amplifier Q2,Q3.

Fig.3 is the new black & burst generator. This accepts TTL pulses (MS.BG,PS) from board 2, together with 75 ohm phased subcarrier. The sc input network R2,RV1,C2,R3,C1 provides two quaderature feeds which are then switched by the PS signal in IC1. BG is then attenuated by R19 and R20, and DC restored by D1 before application to IC2, a balanced modulator. The output, suitably buffered and filtered is then added to MS (at Q8) to form the black & burst signal.

Fig.4 shows a suitable power supply, using 78-series 3-terminal regulators. The overall current requirement including the BBG is around 600mA (all outputs terminated).

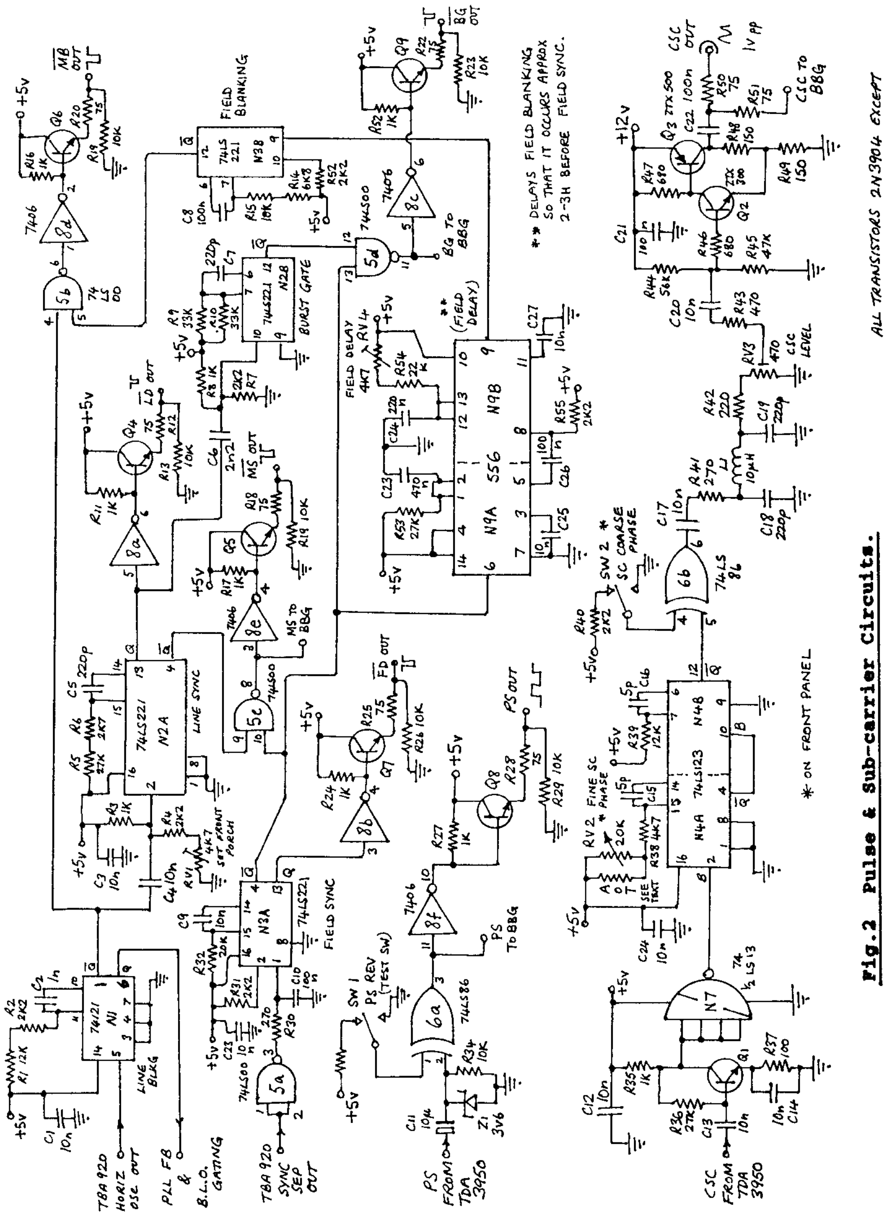


Fig.2 Pulse & Sub-carrier Circuits.

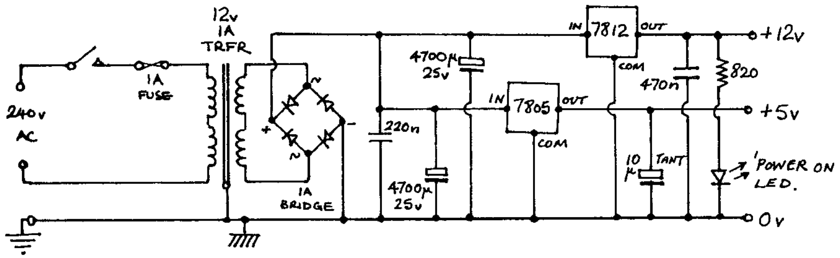


Fig.4 Power supply.

SETTING-UP

It is necessary to begin by setting up the sync regeneration before adjusting the subcarrier circuit. The optional BBG cannot be set up until the other signals are correct.

(1) Earth pin 6 of the TBA920 (use the test switch if fitted), and monitor the emitter of Q3 on ch.B of a dual trace 'scope. On ch.A monitor a broadcast (BBC or IBA) signal. Trigger to ch.A (TV line mode), and adjust stability for a stable ch.A trace. Adjust RV1 on input board (Horiz freq) for a minimum rate of run-through compared with off-air signal. Remove earth from pin 6.

(2) Apply broadcast signal to video input, while still leaving it on ch.A of the 'scope. Monitor the PLL f/b (N2 pin 6, R17,TDA3950 pin 5), and adjust RV2 (Horiz phase) so that the leading edge of this waveform coincides with the start of line-blanking on the off-air signal.

(3) Check that the broadcast signal is a colour transmission with a reasonable burst amplitude. If so, with RV3 (set APC) centered, adjust C21 so that the "sc locked" LED lights. Then trim RV3 for the brightest and most stable indication.

(4) Transfer the 'scope ch.B probe to the MS output, and terminate it with 75-ohms. Now adjust RV1 on board 2 (Set front porch) so that the leading edge of line syncs agree with the off-air signal.

(5) Using the terminated ch.B 'scope input, confirm that the other pulses coincide with the appropriate parts of the off-air signal. Note that due to field pulses being recovered using a simple integrator, they will be approximately a half-line late compared with the master signal. In practice this has not been found to be a problem, provided that the start of regenerated field-blanking agrees with the start of field-blanking on the input (master) signal. With the broadcast signal as the master, adjust the start of field blanking with RV4 (field delay).

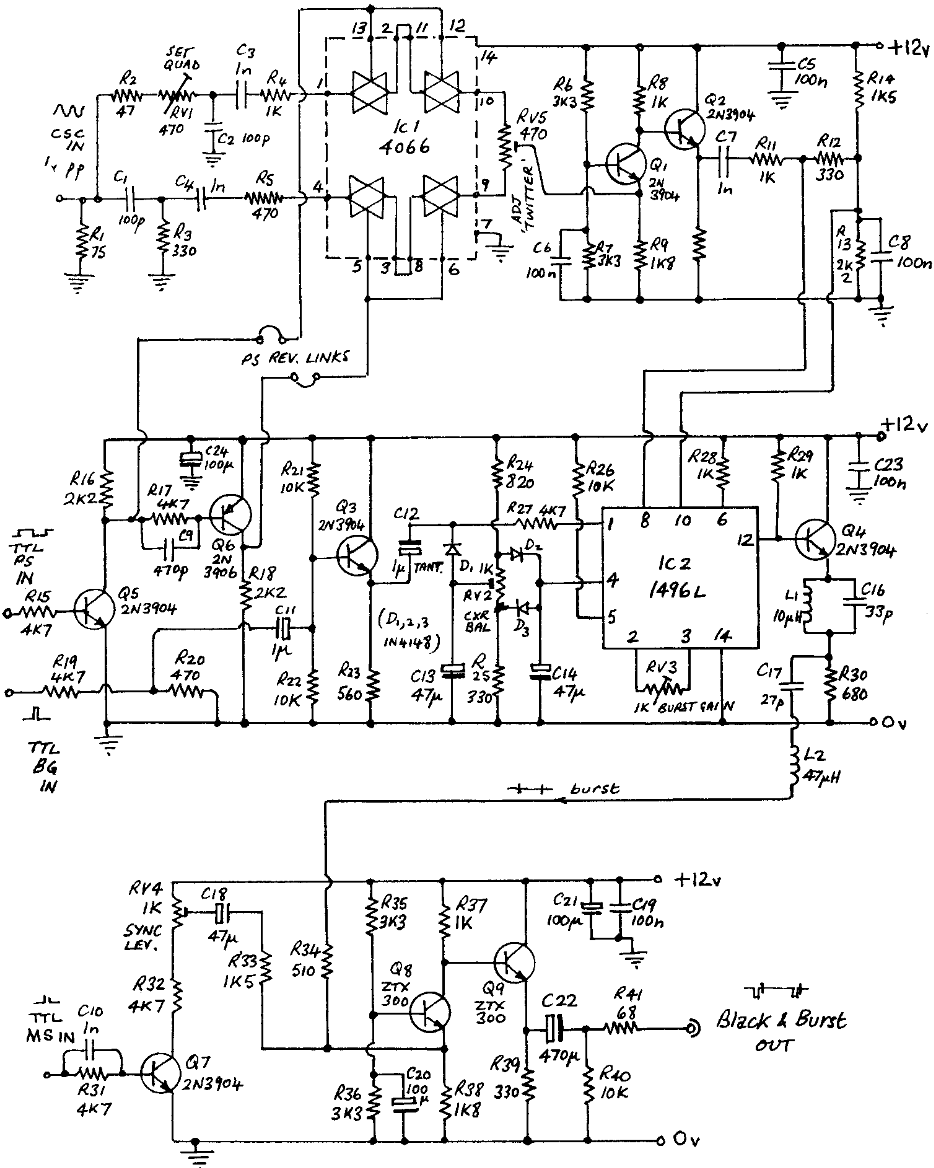


Fig.3 Black & Burst Generator.

(6) Provided that your 'scope has a vertical bandwidth of at least 15MHz, reconnect ch.A to the sc output from board 1, and trigger to it (HF mode). If possible, advance the sweep speed so that the wave form is observable (it probably won't be very sinusoidal). Connect ch.B (terminated) to the CSC output, and adjust RV3 (CSC level) to give a 1v pp output. Now try adjusting RV2 (fine phase); if your scope has a fast enough timebase to show the waveform, you should see the csc shift in phase compared to ch.A. If the csc disappears at extreme settings of RV2, it is because there is too much range, and you will have to shunt RV2 with an AOT resistor - start at about 100K and work downwards. Also, check the action of SW2 (coarse phase) - this should change the CSC phase by 180 degrees.

OPTIONAL BLACK & BURST GENERATOR.

Centre all presets. Reconnect ch.A of the 'scope to broadcast signal, trigger from it at line rate. Connect ch.B (terminated) to BBG output; it will probably be covered in subcarrier. Adjust RV2 (cxr bal) to minimise subcarrier, and burst should 'emerge'; continue adjustment until subcrrier is eliminated from all parts of the signal except the burst itself. Adjust RV4 (sync level) for 0.3v pp sync pulses, and RV3 for 0.3v pp burst amplitude. Now adjust the 'scope sweep-speed to show up any line-to-line 'twitter' on the burst, and use RV5 to minimise it. If a vectorscope is available, RV1 can be used to accurately set the burst axes 90 degrees apart. If so, it may be necessary to retrim RV5 as they do interact. If no vectorscope is available, it is best to leave RV1 centered. (Note that if your 'scope's bandwidth is less than 15MHz, you can't be sure that the level settings involving the subcarrier are correct).

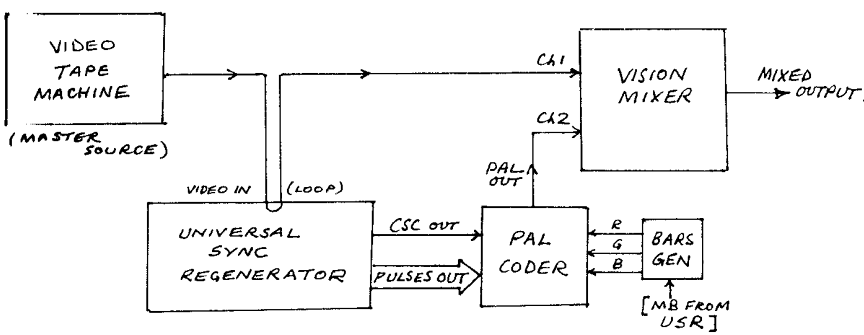


Fig.5 Mixing sources (see text).

CHECKING FOR COLOUR LOCK

During testing I have found that the 'sc locked' indicator is not foolproof, and that the only way to be absolutely sure that full colour synchronisation is occurring is to actually use the unit to lock a second colour source to the master, and mix between them. Let's suppose that the master source were (say) videotape, and the second source were bars from a colour coder using the pulses and csc from the USR. If the mixer got its sync and burst from videotape it should pass that satisfactorally, and theoretically we should now be able to mix to the bars. Let's go through what might be wrong.

(1) Bars have no colour or streaky random colour:
(Adjust the BLO frequency (C21)).
(2) Colour flickers:
(Adjust APC pot.(RV3)).
(3) Colour is locked, but incorrect:
(Adjust Coarse SC Phase (SW2) for correct bars colour sequence; adjust Fine SC Phase (RV2) for maximum saturation. If neither position of SW2 gives the correct colour sequence, it is necessary to change SW1 on board 2 to reverse the PS phase).

N.B.- If a vectorscope is available, use this to set the Fine SC Phase (RV2) rather than adjusting for maximum saturation.

All the above instructions assume that the circuit is working properly, and that you don't have duff chips, etc. as the Editor did when he first tried to get the unit going!

FURTHER NOTES

If you want to synchronise more than one colour coder to this unit you will need a subcarrier phasing and distribution amplifier so that each additional source can be colour-phased to the master signal - see CQTV127, p.31. As suggested in the same article, the pulses could be distributed by looping-through and terminating the end of the chain. Please note that the pulse output stages used in this unit only work correctly when terminated in 75 ohms.