P5

MARCH 1992

NEWSLETTER OF THE SEVERNSIDE TELEVISION GROUP EDITED BY SHAUN O'SULLIVAN G8VPG

IN THIS ISSUE

10 GHz for Amateur Television

Steve Walsh G8KUW

The TV Amateur will, at some stage, probably want to try experimenting with 10 GHz FMTV. The next "upgrade" to GB3ZZ will be a full featured 10 GHz repeater to be co-sited with GB3ZZ. The callsign GB3AA has been resurrected for this purpose.

Microwave technology has always been regarded as something of a 'Black Art' by those who do not work in the industry, as I work in the industry, I do not necessarily hold this opinion but I would not like my boss to think my job was too easy, so I won't disabuse him of that belief!

The theory behind most aspects of microwave technology can be somewhat daunting, but as with most complex issues, it can be brought down to basics quite simply. In this article I will relate some of the results of my recent experiments with microwave oscillators that may be of interest to the TV Amateur considering 3 cm operation.

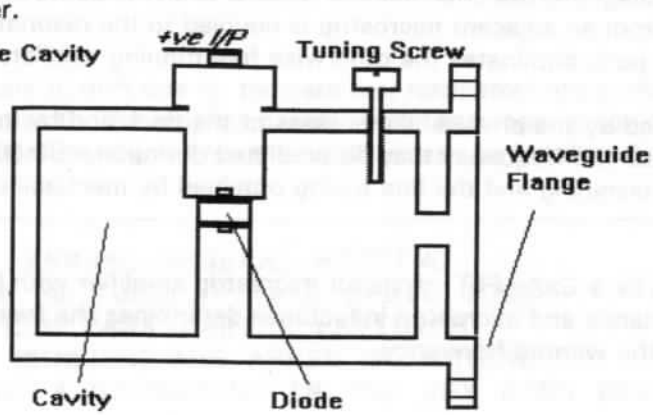
To transmit a TV picture at 10GHz, some way of generating a carrier at that relatively high frequency must be sought. The simplest way is the Gunn Diode Cavity Oscillator.

The Gunn Diode Cavity Oscillator

This is a very easy means of generating a 10 GHz (X band) carrier. These devices have been readily available for a number of years due to their popularity as burglar alarm doppler detectors. Companies such as **Solfan** produce heads that may easily be tuned to the amateur band. These oscillators are not particularly stable, both supply voltage and temperature have a large influence on frequency, so these devices are not very suitable for narrow band work.

How it works....

It may be of interest to know how the device works and some of its limitations. The Gunn Diode has a very thin junction of n-type GaAs (Gallium Arsenide). When a relatively large electric field is placed across the very thin n-type layer, the negative resistance diode produces coherent microwave oscillations. The effect is due to the charge carriers in the semiconductor forming domains, these move down the potential gradient at a speed determined by the charge carriers' mobility. The fast moving domains form fields called **TE** mode waves in a suitable cavity, and microwave energy is present at the output of the cavity. The cavity is usually formed by a closed end section of waveguide that conveniently mates to any other section of X band waveguide or circulator. This forms the basis of a very low power (5 mW) transmitter.

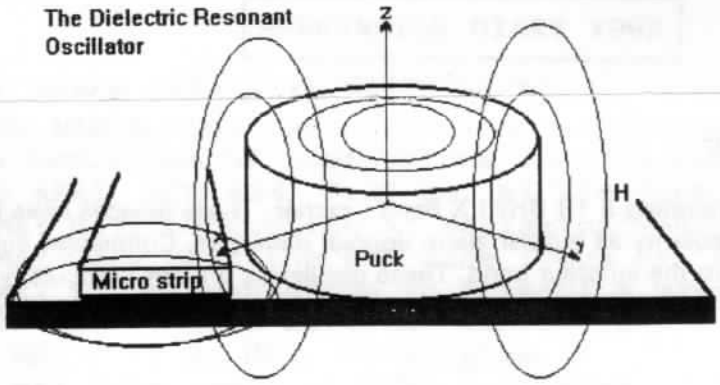


The cavity is mechanically tuned by a screw threaded through the side wall thereby altering the resonant frequency of the cavity, because the stored energy near the side wall is predominantly magnetic, turning the screw in will raise the resonant frequency. Another large influence on frequency is the supply voltage, because the voltage forms the electric field across the *fixed* width n-type layer, the potential gradient is a direct function of supply voltage.

This effect can be utilised when building an FM transmitter, frequency modulation is acheived by altering the supply voltage very slightly. The most common way of modulating the supply voltage is to vary the base current of a transistor placed in the ground leg of a standard 78M05 voltage regulator. Gunn diodes usually require between 6 and 7 volts depending upon type, and an applied voltage either more or less than the required voltage will easily damage the device. If a potential of less than 6 volts is applied, the negative resistance region of conduction will not be reached and consequently a large current will flow through the diode (up to 250 ma), if a voltage greater than 7 volts is applied, then the junction breakdown voltage will be exceeded and certain damage will result.

The Dielectric Resonator Oscillator

This device is becoming very common these days with the advent of Satellite TV broadcasting. Almost all **Low Noise Block** downconverters (LNB's) use DROs as their local oscillator. The simplicity of design and relatively good stability means that the TV amateur can readily make use of these devices in designing transmitters and receivers.



How it works....

How these bits of ceramic we refer to as **PUCKS** determine the frequency of an oscillator is very interesting. The most common form of ceramic used to make these pucks is Alumina (Al_2O_3), however in order to obtain the highest Q, some designers use more exotic compounds such as Titanates ($Ba_2Ti_9O_{20}$). The ideal resonator has a very high Q, low loss, and high permittivity. Pucks are available in a variety of shapes including rods, plates and cylinders or discs. The commonest shapes you will see in LNBs are discs.

As can be seen from the diagram, the puck has the usual E and H (electric and magnetic) waves of stored energy, and providing the H field from an adjacent microstrip is coupled to the resonators' H field, the pucks' natural resonant frequency of the puck dominates the otherwise free running oscillator.

The frequency is determined by the physical dimensions of the puck and by its surroundings. By using some very complex Maxwell equations the frequency may be predicted during manufacture, more usually, the frequency is closely approximated by machining and the fine tuning obtained by mechanically tuning the cavity the microcircuit is inside.

The microcircuit will often be a GaAs FET transistor microstrip amplifier with heavy positive feedback, causing it to oscillate. The stray capacitance and microstrip inductance determines the free running frequency, usually designed to be slightly higher than the wanted frequency.

rcuit theory....

Coupling the H field of one or both microstrip elements into the $TE_{01}\delta$ mode of the puck is done by carefully positioning the DRO element and then fixing it in place by some form of glue. The glue does not have the same permittivity or dielectric constant as the puck so will not normally affect the frequency. 'Superglue' or nail varnish works well.

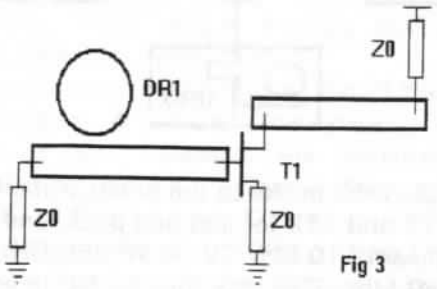


Fig 3

Many designs are to be found for making a DRO oscillator. The simplest design is the one outlined above, where the DRO puck is a parasitic element as shown in fig.3 , but the puck may also be configured to be the circuit feedback element coupling the positive feedback from the drain stripline to the gate stripline as shown here.

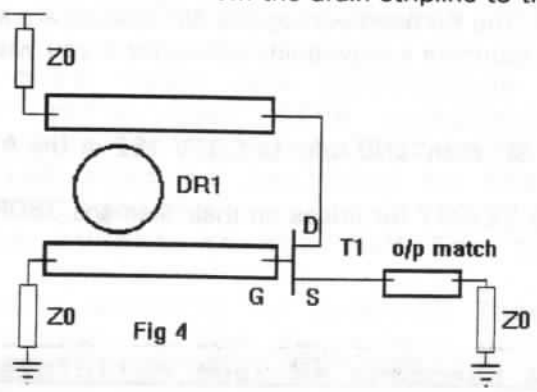


Fig 4

This type of oscillator is ideal as a fixed frequency local oscillator, but it is also possible to electrically tune the frequency. As varicap diodes are of little use at this frequency, there are only two methods that may be utilised by the TV amateur due to cost constraints. The method chosen depends on the amount of frequency deviation required.

The first method of frequency control is obtained by varying the bias on a varactor diode that is mutually coupled to the resonator. The amount of coupling applied determines the range of frequency variation, but it can be typically 1% of fundamental. This is more than enough for FM TV and therefore this method of control would more effectively be used for applying a phase locked loop control voltage to the oscillator, or even DC tuning.

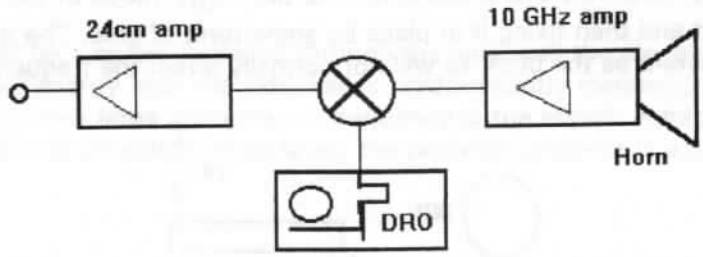
The second option offers only 0.1% deviation from centre frequency, but is easier to realise, and lends itself readily to FM TV. It relies on the fact that an oscillator is frequency sensitive to variations in the bias fed to the GaAs FET device. Modulating the transistor bias voltage with pre-emphasised video makes the basis of an ideal 10 GHz TV transmitter. The control range is still wide enough to apply phase locked loop control with minimum phase noise on the carrier.

The DRO oscillator is relatively immune to drift due to temperature, resonators are available that offer drifts of less than 200 ppm over -55 to +85 degrees C. The stripline design allows easy connection into a stripline MMIC amplifier circuit, or if desired the <10 dBm power from the oscillator can be fed directly into the antenna system.

ANNUAL GENERAL MEETING
7.30 pm TUESDAY 14th APRIL 1992
ELM PARK PARISH PAVILION
ALL MEMBERS ARE ASKED TO ATTEND
FOLLOWED BY A GATHERING IN THE KEY RING BAR

The DRO in amateur TV....

A DRO based 10 GHz convertor



There are a few companies that will supply DRO pucks to the amateur market, but prices do vary, so shop around. We can usually expect to pay between £9 and £12 for just one puck, and the most common frequency ordered is 9.1 GHz. This is because we normally transmit 10 GHz TV on 10.250 GHz, if the local oscillator in our receiver is chosen to be 9.1 GHz, our IF will be 1150 Mhz. This may then be fed to an existing 24cm TV receiver to form a complete 10 GHz receiver.

If you choose not to adopt this method of reception, it is very easy to modify an existing satellite LNB for this purpose simply by changing the puck inside the LNB and, if necessary, slightly extending the tuned lines in the LNBs front end GaAs FET amplifier. The Ku band waveguide dimensions are slightly different to X band waveguide sizes, so you will normally need to fabricate a waveguide convertor if you wish to adapt the LNB to an existing X band horn or dish.

For more details on modifying the 'Skyscan' LNB refer to CQTV 152 or the ATV Compendium (a BATC publication).

Call Oakbury Components on 0635 521077 for prices on their Siemens 38DRO9.10 9.1 GHz pucks.

SEVERNSIDE TELEVISION GROUP
NOMINATION FORM FOR OFFICERS & COMMITTEE 1992/93.

We wish to nominate ..... (name) ..... (call)
for the post of : Chairman
Chief Engineer & Vice Chairman
Honorary Secretary
Honorary Treasurer
Committee Member.

Proposer ..... (signed) ..... (call)

Seconder ..... (signed) ..... (call)

I agree to serve in the capacity indicated if elected,

..... (nominees signature) ../../1992.

This from must be returned to the Secretary no later than 31st March 1992.

ANNUAL GENERAL MEETING

NOTICE : Formal notice is hereby given of the Annual General Meeting of the Severnside Television Group. This will take place on Tuesday 14th April 1992 at 7.30 pm, at Elm Park Parish Pavilion, Elm Park, Filton, Bristol.

All members are asked to attend the meeting. Guests and non-members are welcome to attend, but only fully paid up members will be able to participate by speaking or voting.

NOMINATIONS : Nominations are now invited for the following posts ; Chairman, Chief Engineer & Vice Chairman, Honorary Secretary, Honorary Treasurer and up to five committee members. All nominations must be deposited in writing with the Secretary (who is currently S.P.O'Sullivan G8VPG, 15,Witney Close, Saltford, Bristol BS18 3DX) no later than Tuesday 31st March 1992. Nominations must be proposed and seconded by two fully paid up members of the Group, and the nominee who must also be a fully paid up member of the Group, must indicate his agreement to serve in the capacity indicated if elected. You may nominate someone for more than one post, the elections will take place in the order given above and the nominee must accept the first two posts to which he is elected. A member cannot hold more than two posts.

In the event of more than one nomination being received for any Officers post, or more than five nominations being received for committee members posts, a secret ballot will be held at the AGM.

A suitable nomination form is included in this issue of "P5", but the use of this is not obligatory.

Nominations will be sought at the AGM for the non-committee post of Honorary Auditor.

RESOLUTIONS : Members wishing to propose Resolutions at the AGM must submit them in writing to the Secretary no later than Tuesday 31st March 1992. Each resolution must be proposed and seconded by two fully paid up members of the Group, who should be prepared to address the AGM when the resolution is discussed.

Members should note that whilst there will be an opportunity to discuss minor matters under "Any Other Business" at the AGM, constitutional or major matters must be submitted in advance as a formal resolution.

SUBSCRIPTIONS : Members are reminded that all annual subscriptions become due after the AGM. A suitable renewal form is included with this issue of "P5", and all members are asked to renew promptly. The rate will be set by the AGM.

CURRENT COMMITTEE : For your information, the current committee is listed below ;

Chairperson, Mrs.Viv Green, G1IXE.
Chief Engineer & Vice Chairman, Steve Walsh G8KUW.
Honorary Secretary, Shaun O'Sullivan G8VPG.
Honorary Treasurer, Mrs.Jean Fletcher G0AWX.
Committee Members, Ivor Green G1IXF, Paul Stevenson G8YMM, Ted Halliday G3JMY, Ken Stevens G4BVK and Brian Kelly GW6BWX.
Honorary Auditor, Dr.Chris Newton, G0FGZ.

PLEASE DON'T FORGET
TO RENEW YOUR ANNUAL MEMBERSHIP PROMPTLY
AND CONTINUE TO BENEFIT FROM
*** GB3ZZ, THE MOST ADVANCED REPEATER IN THE UK**
*** "P5", OUR QUARTERLY NEWSLETTER PACKED WITH NEWS AND TECHNICAL TOPICS**
*** G7ATV/P, OUR VERY SUCCESSFUL CONTEST TEAM**
*** REGULAR SOCIAL EVENINGS DURING THE YEAR**

IMPROVING FM TV RECEPTION

The Editor looks at a few ideas, some new and some seen before bu perhaps forgotten, about how to improve reception of FM TV.

I think that most people have now been convinced by practical experience, if not by theoretical considerations, that FM TV gives a very good standard of ATV picture quality. However, there have been a few problems over the years that have proved quite intractable. I am referring to the odd picture that refuses lock properly, or pulls to one side or which can't be seen in colour even though it may be of good signal strength.

One of the difficulties of curing these problems is that they seem so variable and inconsistent. One testcard from the repeater rolls, but all the others lock up solid. A small adjustment in transmitter deviation may cure that problem, but then starts another rolling and off we go again.

Back in 1989, Ken Stevens G4BVK, spent some time looking at the GB3ZZ receiver, and came up with some modifications for the Wood & Douglas receive system that so many of us use. I make no apologies for repeating that article, since it contained some very useful ideas and newer members may not have seen it. You will see that he recommends increasing the value of the video coupling capacitors. This I found to have a useful effect, and I recently took this a step further by increasing the value of C30, C33 and C34 on the VIDIF from 100uF to 470uF. Maplins sell a suitable 16 V 470uF vertical mounting electrolytic capacitor that is compact enough and has the same lead spacing to fit the original pcb exactly.

However, I think that the most infuriating problem is the picture that refuses to lock, and just keeps rolling. It seems that the popular 5" colour TV's with video inputs that so many of us use (JVC and various clones) are very fussy and will roll hopelessly with pictures that other sets will lock up to with no difficulty. Some people have found that looping the video through the input/output of a VCR will improve matters, but this is not always effective. However, it does often keep the output video at a constant level, since the VCR contains a video AGC system.

Over my Christmas holiday, I had time to give some thought to this matter. I was browsing through back issues of magazines, when I chanced upon the circuit diagram of a satellite receiver. The final video output stage contained a simple clamping circuit, designed to remove the 25 Hz energy dispersal flicker that satellites give. I wondered whether this might have some beneficial effect on our ATV signals, and quickly knocked up the circuit on a piece of veroboard.

The effect was quite dramatic. When the video signal level was increased to the point where the clamping circuit started to clip the bottom of the sync pulses, even the most recalcitrant rolling picture locked up solidly. The reason is obvious, as Figure 1 will show.

This is a sketch of the oscilloscope trace of a typical ATV video signal. As can be seen, the bottom of the sync pulse is ragged. However, when the action of the clamping circuit starts to clip the bottom of the sync pulses, they are cleaned up and the monitor is able to lock to them. There was one snag with the original circuit that I used, and that was that the clamping voltage was fixed. In order to institute the required degree of sync pulse clipping, it was necessary to increase the video signal level to an unacceptably high value that was overdriving the monitor.

I therefore developed the circuit shown in Figure 2. This features a variable clamping voltage, which can be adjusted over the range of

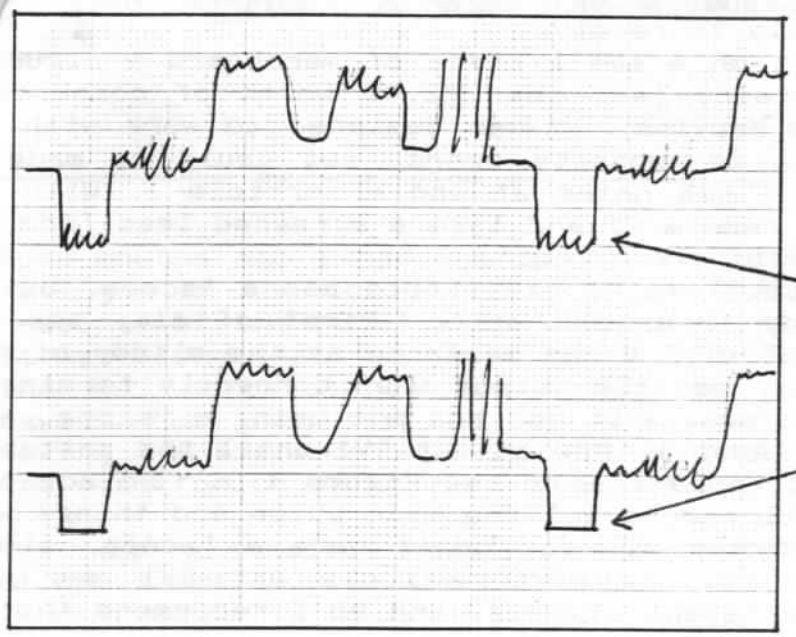


Figure 1

Before - note ragged bottoms to sync pulses.

After - note that bottoms of sync pulses are squared off and cleaned up.

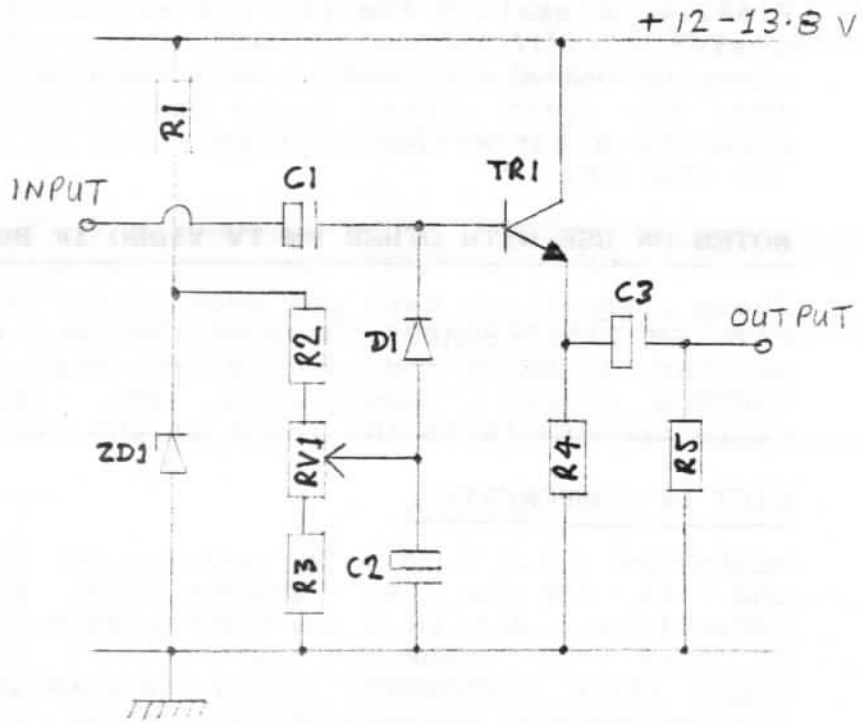


Figure 2 - the circuit diagram of the variable voltage clamp.

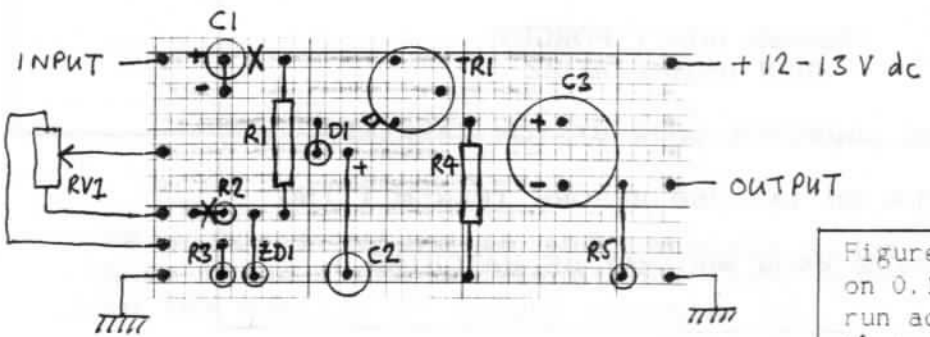


Figure 3 - a suggested layout on 0.1" veroboard. Note - strips run across the page.
X indicates a break in the strip. 2 are needed in total.

about 2 to 6.5 V. This should be adequate for all the si deviations that we are likely to receive.
The circuit is easily built on a small piece of veroboard (Figure is a suggestion) and contains less than £2.00 worth of component all readily available from Maplins. It was designed to work with th Wood & Douglas VP/D1 video de-emphasis board, but could be made to work with any other board (see notes at end of article). With the W&D VP/D1 board, carefully remove C5 and take a screened lead from the emitter of TR2 to the input of the circuit.
The board is easy to set up. Ideally you should use a 'scope, but it can be done without one by trial and error. First of all, set the clamping voltage level to about 5 V, as measured at the slider of RV1. With a video signal applied, set the output when correctly terminated into 75 Ohms to 1 V peak to peak (if you are not using a 'scope, then just set it to its normal level). Now adjust RV1 until the bottom of the sync pulses are just clipped flat (see Figure 1). Do not over do the clipping, or you will remove all the sync pulse and things will be worse than when you started. If you don't have a 'scope, simply adjust RV1 until a badly rolling picture locks up. RV1 may need periodic adjustment with different signals, and so I recommend that it be made a front panel control.
A couple of final notes ; this circuit has been very effective in improving the stability of signals with ragged sync pulses, but it cannot cure a signal whose sync pulse frequency is awry. However, most people can at least get the sync pulse frequency correct these days.
Finally, a small prize for the reader cleverer than me who can devise a simple modification to this circuit to make the adjustment of the clamping voltage automatic with varying signal levels. I would imagine that the video signal could be rectified and smoothed, and used to generate a correcting voltage in an Op Amp chip. Will anyone rise to the challenge ?.

NOTES ON USE WITH OTHER FM TV VIDEO IF BOARDS :

These suggestions have not been tried, but should prove workable.
BATC FM TV IF BOARD : Remove C28, and take a screened lead from the emitter of TR3 to the input of the circuit.
CAMTECH BOARD : Remove R60, and take a screened lead from the collector of U18 to the input of the circuit.

LIST OF COMPONENTS :

RESISTORS : All 0.25 W 5% carbon : R1 1 kOhm : R2 330 Ohm : R3 470 Ohm : R4 560 Ohm : R5 10 kOhm : RV1 1 kOhm LIN Pot.
CAPACITORS : All 16 V vertically mounting electrolytics : C1 47uF : C2 22uF : C3 470uF.
SOLID STATE COMPONENTS : ZD1 8.2 V 400 mW Zener : D1 IN4148 or similar general purpose silicon diode : TR1 BFY51.

PLEASE DON'T FORGET
WHEN USING GB3ZZ

ALWAYS IDENTIFY YOUR VISION CARRIER

AND LISTEN ON 144.750 BEFORE TRANSMITTING

YOU NEVER KNOW WHO MAY BE WATCHING !

MOD'S TO WOOD & DOUGLAS VID IF

KEN STEVENS G4BVK

Some months ago I had the opportunity to look into the problem we were having with the colour response of GB3ZZ. I had my suspicions of the response of the NE564 when I built a receiver for 23cm some years ago. It was found that the NE564 has a poor frequency response. To reproduce the full bandwidth of the modulation video signal it is important to have a flat response and the NE564 has not. It seems a bit pointless having Pre-emphasis and then De-emphasis networks to a precise law if the electronics being used have not.

It is possible modify the De-emphasis network to make up for some of the shortfalls of the NE564.

1) R1 Be changed from 300R to 120R

2) R4 Be changed from 18R to 15R

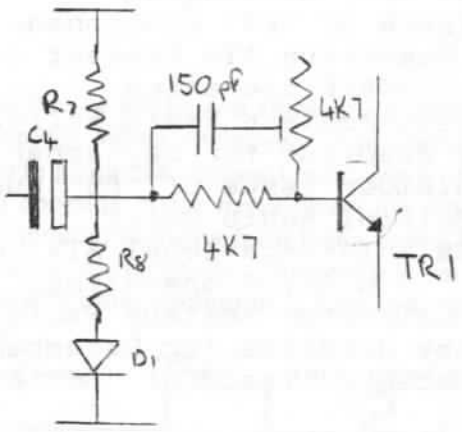
This will give an HF lift of 6dbs at around 5MHz. I also found the need for a small EQ peaking circuit on the base of TR1 to maintain its response.(fig 1) Additionally I also found that the VID IF has a poor ramping problem which is partly due to insufficient coupling.

3) Increasing C35 on VID IF board from 100uf to 470uf.

4) Increasing C4 De-emphasis board from 10uf to 47uf.

5) Increasing C5 De-emphasis board from 330uf to 470uf.

These mods are only my own observation on the problem we had with GB3ZZ. Colour through seems to be better and reports are good.



(fig 1)

NB ; Fig 1 refers to the seperate video de-emphasis board. I have tried these modifications, and there is a marked increase in the quality of colour signals. Ed.

METEOSAT NEWS

Following on from the large feature on the Meteosat facility currently available on GB3ZZ, regular viewers will know that it has since been further developed. Both Meteosat channels are now available - a different DTMF code is required depending on which channel you wish to see.
In January, we lost the system for a week after the JVL quad loop aerial failed. It appeared that damp got into the driven element, and the signal disappeared completely. Ivor G1IXF rebuilt the aerial, and the down time was taken advantage of to move the 1.7 GHz GaAsFET pre-amp from the shack to just below the aerial. This has further improved the satellite signal strength and the pictures now seem brighter and sharper, with little if any visible noise.

I am sorry that some items had to be held over to the next issue of "P5". Next month, we should continue with more news of DX-TV from Steven Michie, and a further chapter from the "Guide to 23 cm Television".
It is nice to be spoilt for choice when compiling an issue of "P5" and I would appeal to all members to keep the articles, letters and comments flowing.

SEVERNSIDE DIARY 1992

SATURDAY **7th MARCH** London AR Rally at Picketts Lock.
SATURDAY **14th MARCH** RSGB VHF Convention at Sandown Park.
TUESDAY **31st March** Close of nominations for STG committee.
TUESDAY **14th APRIL** STG AGM, 7.30 pm, at Elm Park.
SUNDAY **3rd MAY** BATC Convention at Harlaxton Manor.
FRIDAY **8th MAY** Copy deadline for June issue of "P5".
FRIDAY **8th MAY** STG presentation to Bristol & West Video Camera Club.
SATURDAY **30th MAY**) RSGB National Convention
SUNDAY **31st MAY**) at NEC, Birmingham.
SUNDAY **31st MAY** June issue of "P5" published.
SATURDAY **13th JUNE**) Summerfun ATV Contest (date provisional).
SUNDAY **14th JUNE**) G7ATV/P operating.
SUNDAY **28th JUNE** Longleat Amateur Radio Rally.
FRIDAY **7th AUGUST** Copy deadline for September issue of "P5".
SUNDAY **30th AUGUST** September issue of "P5" published.
SUNDAY **6th SEPTEMBER** Bristol Radio Rally.
SATURDAY **12th SEPTEMBER**) International ATV Contest (provisional).
SUNDAY **13th SEPTEMBER**) G7ATV/P operating.
SATURDAY **31st OCTOBER** Leicester Amateur Radio Show.
FRIDAY **6th NOVEMBER** Copy deadline for December issue of "P5".
SUNDAY **29th NOVEMBER** December issue of "P5" published.

Please advise the Secretary G8VPG of any changes, additions etc.

© 1992 SEVERNSIDE TELEVISION GROUP. "P5" is published quarterly for the Severnside Television Group by S.P.O'Sullivan, 15,Witney Close, Saltford, Bristol BS18 3DX, and is sent free of charge to all members. Extracts may be published by genuine Amateur Radio publications provided full credit is given to "P5", STG and the author.