

CONFERENCE OF
AMATEUR
TELEVISION
'**70**



THE BRITISH AMATEUR TELEVISION CLUB



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Front cover .. The station at G6NOX/T

I N T R O D U C T I O N

In the 21 years since the British Amateur Television Club was founded by a keen band of young men, it has grown in numbers from a mere handful to over 1,000 registered members. Some of these enthusiasts who started as amateurs, many doing their National Service at the time, have since reached eminence in professional television, and are still active members.

The only pickup tubes generally available in the early days were iconoscopes, of which the 5527 was the most popular, whilst for those who favoured the flying spot scanner for their experiments the 931A photomultiplier tube (obtained cheaply from wartime radar jammers) was indispensable. Later on the trend was for the image-orthicons - for those with friends in the industry - and the vidicon - a much more simple tube. There were even a few cameras with CPS Emitron tubes; one thinks of the excellent field-sequential colour pictures produced by our indefatigable librarian, Grant Dixon! A few members are now experimenting with lead oxide vidicons and fully electrostatic vidicons.

On the circuit side one saw the trend away from power-consuming (and heat-producing) valves to the simple transistor, which it is worth remembering is just the same age as the BATC! These days there is talk of new forms of pickup devices using semiconductor arrays, single tube colour cameras, Super 8 telecine and the like.

The BATC has led the field in a number of activities and one thinks particularly of slow-scan techniques.

There are still many ways in which the amateur can contribute to the enjoyment and expansion of this useful hobby in the future, and with the continuing enthusiasm of members we look forward to a membership of over 2,000 in our Silver Jubilee Year, 1974.

I.J.P. James.

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21 years of b.a.t.c.

BY C. GRANT DIXON G6AEC/T

CAT-70 marks the 21st birthday of the British Amateur Television Club and as it is highly probable that few of the readers of this booklet will be able to recall the beginnings of our club, this short article will take a look at the early years, remembering with gratitude those pioneering amateurs who gave us the world's first club devoted entirely to amateur TV transmission.

It was in 1949 that Michael Barlow G3CVO wrote letters to various magazines and succeeded in contacting a handful of people who were interested in amateur TV. He then started a circular 'Newletter' which apparently took so long to get round that in October 1949 he brought out the first issue of "CQ-TV" ... a duplicated issue of 25 copies. As a comparison we might mention that two years later with the tenth issue, this number had risen to 130. All the earlier issues were duplicated on an ordinary office duplicator and were characterised by the light-hearted humour so typical of Mike.

Initially almost all TV signals were generated by flying spot scanners as camera tubes were exceedingly difficult to obtain and prohibitively expensive. The 5527 iconoscope, costing £27.10.0d and requiring a Board of Trade import licence, gave a picture which would be considered definitely below par by modern amateur standards and was much less sensitive than the tubes we use today. A few lucky people had, however, acquired a tube, notably Ivan Howard G2DUS who gave the first public demonstration of amateur television under the name of the British Amateur Television Club in April 1950. Later

as a result of 'on-air' tests to see if amateur TV would interfere with certain commercial and military transmissions, the GPO decided to grant TV licences to amateurs and the TV 'ham' became a reality.

Apart from transmission over the air, there were many opportunities for TV demonstrations. In those days TV cameras were rarely seen outside broadcasting studios and as a result, these amateur demonstrations attracted enormous interest. In 1952 the demonstration at the Dagenham Town Show was seen by 17,000 people. In



Mike Barlow with his wife Margaret.

this year also the club was placed on a more formal footing by the appointment of officers..

Chairman	C. Grant Dixon
Hon. Sec. and Treasurer	Mike Barlow
Committee	Fred Rose Ian MacWhirter Don Bradford Doug Wheelie

By December 1952 the membership had risen to 200 and it was noted with satisfaction that it was not confined to this country, as the name of the club might suggest. Members were enrolled at this time from... Eire, France, Holland, Finland, Germany, U.S.A., Canada, South Africa, Australia, and New Zealand.



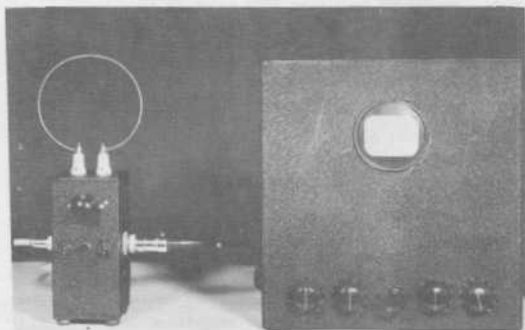
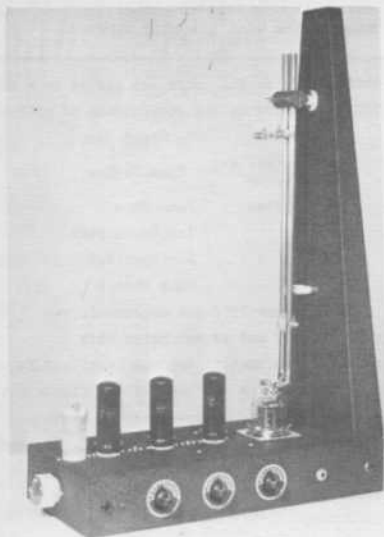
Ivan Howard, G2DUS/T, with his first camera. Photo taken in 1950.

The first Convention of the club was held in 1951 in London and was attended by approximately 25 people of whom 16 had travelled over 100 miles to be present. The second Convention was held in 1955 and in the intervening four years considerable progress had been made. The generosity of Messrs E.M.I. in making available 'Emitron' tubes to six members on a 'permanent loan' basis must be acknowledged with thanks. One of these tubes was displayed in a frame-sequential colour camera at the 1955 Convention and in the following Spring, history was made when colour test patterns were transmitted over the air by amateurs before the BBC had commenced their colour tests.

The 1955 Convention was also memorable for the fact that the subscription was raised to 10/- per annum and members will note that it still stands at this value fifteen years later.

During the latter half of the decade there was an ever increasing activity in the way of public demonstration; for example, in 1957 the EATC demonstration at the Dagenham Town Show included 6 cameras and occupied a 40' x 40' marquee. Mention should also be made of that wonderful effort by the Cambridge Group... "Matilda"... a complete mobile TV station housed in a London taxicab; using valves, of course, as transistors were not available at this time. This project so caught the imagination of the TV programmers that "Matilda" and her crew were interviewed by the late Richard Dimbleby in a "Panoram" programme....an event which was reported in the papers next day as...."amateurs save BBC show". Technically, it made history because it was the first occasion on which the BBC radiated a video signal which had originated in amateur-built equipment.

Left, TV transmitter for 114.7MHz and below, RF probe and 3" monitor built by O.B.Freire (Brasil) in 1946





The celebrated "Matilda" and crew.

Around 1957 Bill Stapleton in Dublin was experimenting with an elementary form of slow-scan TV and succeeded in recording simple patterns on tape. A more advanced system using a subcarrier was proposed by Copthorne Macdonald in the U.S.A. and on Nov. 22nd 1959 John Flowman G3AST succeeded in receiving slow-scan pictures across the Atlantic. Surprisingly, very few BATC members were attracted to this mode of transmission, but as the number of slow-scan amateurs in the U.S.A. and Canada is rapidly increasing we may see developments in this field in the 1970's here in Britain.

Taking up the story of 'normal' TV once again, we note that Vidicons became available in 1957, and in CQ-TV 36, which appeared in the spring of 1958, a transistor pattern generator was first described.

The 5th Convention was held on Sept 10th 1960 and featured telecine by Bob Tebbutt, a Monoscope by Graham Hill, slow-scan gear by Grant Dixon, Gordon Sharpley and John Flowman. By this time vidicons were available at a price (£10) which made it possible for an ever increasing number of amateurs to start building their own live camera.

The next decade saw the growth of transistorised equipment. CQ-TV 48 carried

a description of a fully transistorised pulse and waveform generator by Mike Cox, and the next issue contained circuits for a transistorised camera by Deryck Aldridge. Noting the trends in commercial television we find that these are paralleled by amateur activity: 625-line pictures were first radiated by G2WJ/T to G3QAT/T, a distance of 49 miles, and in 1961 at the Radio Hobbies Exhibition the BATC stand was devoted to colour TV. John Ware's excellent home-constructed colour receiver was used to show pictures supplied by the BBC and also colour bars from a generator built by Bill Hipwell.

In 1958 Grant Dixon had given a lecture to the Television Society in London on "The present state of Amateur Television" and a demonstration was given of closed circuit TV.

At the DAGEHAM TOWN SHOW in 1958





The B.A.T.C. stand at the 1968 Radio Communications Exhibition.

In 1965 Mike Cox gave a similar lecture with a much more elaborate demonstration which involved a team with a video tape-recorder making recordings in N.Wales, Manchester and Herefordshire, and also a live TV link with the Radio Communications Exhibition. The contrast between these two demonstrations reveals the progress made by amateur TV.

Further evidence of progress was given by the transmission of PAL colour test patterns between G6ACW/T and G6LEE/T... Tony Jaques and Gordon Sharpley... in April of 1968.

One of the early pioneers of amateur TV was Jeremy Royle, now licensed as G6NOX/T. His station is exceedingly well equipped and he has contributed notably to the history of amateur TV as the following extracts from his station log will show:-

May '63...First duplex TV contact
Sept '63...First TV contact with Holland
Oct '63...First TV relay transmission
Nov '64...Best DX TV contact..G3ILD/T
Nov '67...First TV contact with Germany
Sept '69...First TV contact with Belgium
Sept '69...First one-way TV contact with France.

It is expected that during CAT-70 it will be possible to visit this station and others in the Cambridge area, either in person or over the air.



Bob Tebbutt's telecine gear at the 1962 B.A.T.C. Convention.

Whilst considering the international aspect of modern amateur TV, one must not omit to report the highly successful First International Amateur TV Conference held at Armentieres in the Spring of 1969. W3DD and his team are to be congratulated on their enterprise.

Finally, let us use this Conference in Cambridge to take stock of our achievements over the past two decades and look to possible future developments in the 1970s. For those who are of an experimental turn of mind, here are a few projects which might prove fruitful in the next ten years...

1. Application of integrated circuits to pulse generators and video amplifiers.
2. Reduction of camera size. When $\frac{1}{2}$ " Vidicons become available they can be used with the cheaper 'D mount' lenses.
3. $\frac{1}{2}$ " working with transistorised transmitters.
4. 'CQ-TV' still lacks a design for a neat small, transistorised monitor.
5. Use of higher frequency bands..23cm, 13cm, and 3cm. (What about point-to-point TV using a LASER?)
6. Colour TV, of course, and stereo also?
7. Medical TV using infra-red scanners.
8. Slow-scan TV for DX. Will G6 license holders be able to send slow-scan TV to the USA by satellite?

Perhaps bearing this last suggestion in mind we can well and truly say that for B.A.T.C. members the sky will never be the limit.

A SIMPLE AMATEUR TELEVISION STATION

BY IAN WATERS G6KKD/T

While many good articles have appeared in CQ-TV and elsewhere describing specific items of both video and R.F. equipment used in an Amateur Television Station, little has been said about overall station planning. These brief notes and the accompanying block diagram show a possible lay-out for a simple but very functional station. Obviously the system is capable of an infinite number of variations but it is hoped that it may be a useful guide to someone with Amateur Radio experience contemplating going /T. We have only attempted to give a general guide as to what has to be done, the details of various units such as cameras, modulators, etc. can be obtained from published articles. A list of references is given at the end.

1. The Receiver/Picture monitor

First obtain a domestic television set with most conveniently a 14" or 17" tube. This should be of the switchable type if operation on both 625 and 405 line standards is required. It is essential that the chosen receiver should have a good flywheel horizontal sync. circuit.

The receiver should be modified to add a two way switch or a relay to isolate the existing tuner unit, and to transfer the input to the I.F. amplifiers to be fed by a separate 70 cm converter. This switch should remove the H.T. from the sets normal tuner when 70 cm is used in order to prevent harmonics of the local oscillator causing beat patterns in the 70 cm band.

It is then necessary to break the connection between the vision detector and the video output stage. The detector output should be fed to a cathode follower stage to enable a video line terminated in 75 ohms to be taken out. The circuit used for

this cathode follower should have a good amplitude linearity to permit the full detector output to be handled without any sync. or peak white crushing. A 3-position switch enables the input to the video output stage to be selected from either this cathode follower, or two coaxial inputs. Each of these inputs is provided with a 2K Ω non-inductive potentiometer to balance the gains. These inputs are fed with the local camera video, and a demodulated signal from the transmitter feeder. An extra, simple, two stage video amplifier may be necessary between the switch and the sets own video output stage to enable 1.0 v pp. signals to fully modulate the tube. Two stages are necessary to keep the picture polarity correct.

To complete the modification it is necessary to supply it with mains via a good quality double wound isolating transformer. This will enable the chassis to be connected to earth via other video equipment. If one can obtain a portable TV set with a mains transformer built in so much the better.

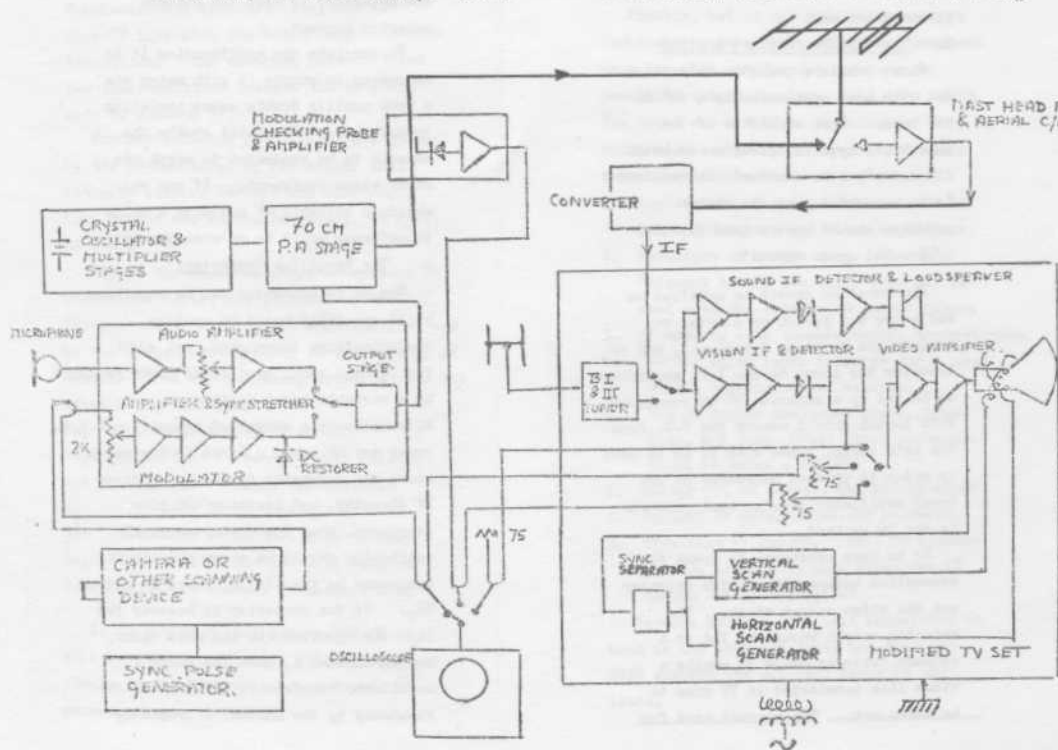
2. The Receiving Converter.

The 70 cm converter can be something built specially based on amateur communications techniques, but with the crystal local oscillator chain replaced by a variable local oscillator. Alternatively a converted television U.H.F. tuner may be used. If as is suggested above the converter feeds the receiver IF directly, and assuming 405 line standards, then the converter local oscillator should be above the carrier frequency by the IF i.e. about 34 - 39.5 MHz. If the converter is however fed into the receiver via the main tuner, say on channel 1, then the local oscillator requires to be lower in frequency by the channel 1 frequency



ABOVE
The Author, Ian Waters G6KKD/T (1964)

BELOW
Block diagram of a simple amateur TV station.



of 45 MHz. If these precautions are taken then amateur sound signals radiated in the 70 cm band at the correct separation will automatically be received together by the TV set. Vestigial sideband transmission (most are DSB) will also be correctly received. Since UHF, TV tuners are designed for higher channels it will be found easier to tune the local oscillator to the high side of the carrier when used at 70 cm.

If the basic receiver is of the 405/625 switchable type employing an I.F. amplifier basically 5 MHz wide between the 3 db points (and limited to 2.5 MHz when used on 405), then if the converter oscillator is on the high side of the carrier an amateur 625 line upper sideband transmission will also be correctly received. The converter local oscillator will also require to be some 6MHz higher for 625 reception.

3. The Preamplifier

Although when using modern 70cm converters with a good noise figure, the aerial can be connected directly to the converter, better results will often be obtained, especially when the aerial is high up, with a long feeder, if a mast head preamplifier is used. With a typical feeder run of say 100 ft, this can improve the signal to noise of the received picture by 3 - 4 dB, which can make all the difference between a useable or unusable result when the signal is anything but strong. When this is done the aerial change-over relay has to be at the mast head, and this can be energised on receive by the same supply that powers the amplifier conveyed via the inner of the receiving co-ax cable. The relay will, if energised on receive, fail safe to transmit enabling a conventional relay to be used at the equipment end if a failure occurs up the mast.

4. The Aerial

The aerial should be installed in as high, and unobstructed position as possible and should be made easily rotatable. Either a co-linear stack array, or a Yagi or stack of Yagis can be used. The aerial can either be home made, or one of the good commercial types on the market can be employed. The chosen array should have a gain of not less

than 15 dB, and preferably 16 - 20 dB in order to give the station a good working range. The best quality VHF low loss coaxial feeder must be used.

5. The Transmitter Drive stages

The transmitter drive stages follow conventional amateur practice to give a 70 cm drive to the PH valve. Only sufficient drive to operate the valve in Class B is required, and some method of varying the drive level, (i.e. by means of a variable voltage as the screen of the final drive stage) should be provided. Care must be taken to ensure that the drive level is stable, and that it is free from hum. A stabilised power supply is desirable. The frequencies used in the multiplier stages should be chosen to avoid those employed by television both for Bands I and III and the IF. If interference with neighbours (and your own) TV reception is to be avoided. The writer has found the use of a crystal in the region of 12 MHz and multiplier stages tuned to 24, 72 & 144 MHz gives freedom from this problem.

6. The Transmitter PA Stage.

The P.A. stage may employ any suitable valve depending upon the power output required. The stage is grid modulated, and since the gridbase and hence the modulation voltage swing and standing bias are reasonably constant regardless of the valve used, the modulator and drive stages can be used with a larger P.A. stage at a later date. The P.A. may follow conventional amateur practice except that

- (a) the final must be an amplifier and not a multiplier
- (b) In order to get the optimum linearity required for television it is necessary to couple the aerial feeder more tightly than the correct adjustment for the maximum output with telephony. The aerial loading should be made easily adjustable
- (c) Under television modulation conditions the best linearity is obtained by using the maximum rated anode voltage permitted for the valve employed and a lower anode current for a given power compared with telephony practice.
- (d) One should remember that a television P.A. is a video amplifier as well as an RF amplifier. All decoupling capacitors

must therefore be suitable for video frequencies i.e. D.C. to say 5 MHz as well as the carrier frequency

- e. Any telephony modulation equipment, i.e. a modulation transformer must be switched out of circuit when TV is used.

7. The Modulator.

The modulator is required to give a linear voltage swing of the order of 30 - 40 V pp. from a low impedance source. The modulator is also required to provide a stable but adjustable negative d.c. bias of a similar value for the P.A. valve. The modulator output stage can conveniently be a valve cathode follower or an emitter follower. Since it is also necessary to modulate the vision carrier with telephony (to comply with the licence) facilities for this can conveniently be built into the modulator.

A similar audio voltage swing will be required but in order to keep the modulation balanced the standing bias will require to be adjusted. It is convenient to switch between two present bias levels one for TV, and the other for telephony, the d.c. restorer or black level clamp required for television can be switched at the same time. Due to the non-linearity of the P.A. valve grid base it is necessary (on positive 405 modulation) to apply a modulating waveform with a signal to sync. ratio of approximately 50 : 50 if the conventional 70 : 30 ratio is to be radiated. Since the normal ratio of the video signal from a camera or other source will be 70 : 30 it will be necessary to predistort or stretch the signal in the modulator. Alternatively the output from the source can be made non-standard. If negative 625 line modulation is employed the peak white region of the video signal will require to be stretched. Since the input video will always be white positive, an extra stage will be required in the modulator to reverse the sense of modulation.

8. The Feeder Probe.

In order to be able to adjust a television transmitter it is quite essential to have a good system for monitoring the outgoing signal in the feeder. This takes the form of a probe and diode circuit suitable for demodulating TV signals, feeding out 1.0 V pp video into a 75

ohm line, via a suitable output stage. The system must have a very good linearity, and must be able to handle a signal level greater than that required, since any distortion occurring here would mask the true form of the transmitter output, and make correct adjustment impossible. The video output from this circuit is fed to one of the receiver video inputs for picture monitoring, and to the oscilloscope to permit the wave form to be observed. The diode current can be read by a sensitive meter to indicate the mean carrier power. It is useful also to provide some means of periodically short circuiting the diode load in order to indicate a zero output, so that any residual unmodulated Rf below the tip of sync, (or peak white) can be observed.

9. The Oscilloscope

A television station requires a simple oscilloscope with a deflection sensitivity sufficient to give a good display of a 1.0 V pp video input, and a 'Y' band width of about 1.5 to 2 MHz. The time base should be switchable between 25Hz and 50Hz (7.5 kHz for 625) to display 2 fields or 2 lines showing the sync. intervals.

The oscilloscope input impedance should be high, and a switch provided to enable it to bridge the three video lines, i.e. Local Video, Demodulated Rf from the transmitter, and received video from the receiver. This latter facility will enable a report to be made on other stations transmissions.

10. The Local Video Source and Sync. Pulse

GS Generator

This part of the station can take many forms, but it will usually consist of some form of Vidicon camera or flying spot scanner. The circuits employed should be such that a correctly proportioned video waveform is produced with correctly defined blanking and sync. regions at both line and field rates. The black level should be essentially independent of the video content, and the syncs. should not be crushed if the camera is over exposed. The sync pulse generator may be included in the camera or separate. The system may be 405 or 625 line as required, and be either fully 2:1 interlaced, or use random interlace. The vertical sync.

may conveniently take the form of a single broad pulse of about 1 line duration instead of the conventional serrated field pulse with or without equalising pulses as used in professional practice. It is desirable but not essential that the field scan should be locked to the a.c. supply frequency.

Sound

In this simple station it has been assumed that sound and vision will be transmitted alternately on the same carrier, however to obtain the full benefit from amateur television it is desirable to be able to transmit a simultaneous sound transmission. It must at all times be possible to modulate the vision carrier with telephony to comply with the licence conditions.

Sound may be transmitted in the 70 cm band and if this is accompanying a 405 vision transmission it should be amplitude modulated and radiated on a frequency 3.5 MHz lower than the vision carrier. If it is associated with a 625 line transmission it should; if it is to be recovered by standard receivers; be frequency modulated and 6.0 MHz above the vision. For simplicity two transmitting aerials can be used or the two carriers can be combined in a suitable combining unit and fed to a common aerial.

Alternatively the TV sound can be transmitted in the two metre band, or in any other amateur allocation for which the Station is licensed

For reception if the Station received is modulating the same carrier with vision and sound it will be necessary to slightly retune the converter when going from one modulation to the other. If a correctly separated A.M. or F.M. sound carrier is received then provided that the local oscillator is on the correct side of the carrier it should be automatically recovered by the receiver, assuming of course that a switchable standard receiver, probably employing an intercarrier sound system, is used for 625. When receiving weak signals it is beneficial to use a completely separate sound receiving system consisting of a separate converter and a communications receiver. If this is done

both the vision and sound channels can be tuned for optimum results.

References.

Video & Sync: A Vidicon Camera (including SPG)

CQ-TV No. 65

A Transistorised Vidicon Camera

Deryck Aldridge CQ-TV No 53

A Flying Spot Scanner

M.H. Cox CQ-TV No. 50

A Simple S.P.G.

GW6JGA/T CQ/TV No. 68

A Simple Video Processing Unit

GW6JGA/T CQ-TV No.68

Flying Spothead Amplifier

CQ-TV No. 65

Modulation: Amateur TV Transmission Techniques

G6KKD/T CQ-TV 64

A Transistor Modulator

G6RSA/T CQ/TV No 60

A Quality Vision Modulator

A.P. Harding CQ-TV No. 52

R.F drive and P.A. stages

RSGB Radio amateurs handbook

MK III 70 cm FM solid state
Tram

G8ACC RSGB Radio Communication
October '68

R.F Probes etc:

70 cm combining unit

G6KKD/T CQ-TV No.66

70 cm off-air probe

G6OUO/T CQ-TV No.56

Reception:

Receiving Amateur T.V.
Transmissions.

G6ACU/T RSGB Radio Communications
March '70.

70 cm mast head preamplifier

G6KKD/T CQ-TV No. 54

FET converter for 70 cm.

G5HEW RSGB Bulletin February '67

Transistor tuner 4306 MHz

P. Johnson CQ-TV No. 59

UHF Tuners CQ-TV No. 58

A FEW RESULTS...



G6NOX/T on closed circuit.
Note the waveform monitor.



Picture received at G6KED/T
after being relayed through G6NOX/T



G6KED/T as received at G6ILD/T,
a distance of 260 Km.

READ CQ-TV