



The British Amateur Television Club

# CQ-TV

No. 243 – March 2014



**First Video received from the ISS**

**Details of BATC CAT14**

**3 New Repeaters on air**

**Receiving HamTV from the ISS - Two User stories**

**Using the Raspberry Pi to Control an Ultram VCO**

**Versatile Audio AGC Circuit**

**Digital ATV – Using a Spectrum Analyzer**

**... and all the regular columns**



# BATC DTX1 Digital TV Transmitter



## MPEG-2 encoder and DVB-S modulator

- ▶ Self contained unit - computer not required.
- ▶ Composite and S-video input
- ▶ 2 audio channels
- ▶ Single PCB design
- ▶ Plug in option for 2nd video & audio channels
- ▶ Size: 165mm wide; 120mm deep; 55mm high
- ▶ Tunes the 70cm and 23cm bands. Tuning range from 150Mhz - 2Ghz
- ▶ -5 dBm output
- ▶ Power 500mA at 12 volts
- ▶ LCD front panel and keypad control
- ▶ RS232 control port



## Available from BATC shop

- ▶ PCB only for self mounting with display (no keypad, 5 push buttons required) **£399**  
+ Shipping
- ▶ Case, front panel and keypad **£65**  
+ Shipping
- ▶ 2nd encoder channel **£175**  
+ Shipping



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# CQ-TV 243

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## Contributions

The preferred method of communication is by email, all email addresses are shown above.

You can also telephone 01400 414 243. You will then hear a menu that will allow you to be connected to the correct person if they are available.

Alternatively you can write to us at: BATC, Silverwood, South View Road, Pinner, HA5 3YA, United Kingdom

We aim to publish CQ-TV quarterly in February, May, August and November.

The deadlines for each issue are:  
 March - Please submit by January 31st  
 June - Please submit by April 30th  
 September - Please submit by July 31st  
 December - Please submit October 31st

Please send your contributions in as soon as you can prior to this date. Don't wait for the deadline if you have something to publish as the longer we have your article, the easier it is for us to prepare the page layouts. If you have pictures that you want including in your article, please send them, in the highest possible quality, as separate files. Pictures already embedded in a page are difficult to extract at high quality but if you want to demonstrate your preferred layout, a sample of your finished work with pictures in place is welcomed. Please note the implications of submitting an article which are detailed on the contents page.

## From the Chairman...

Noel Matthews - G8GTZ



Welcome to the second edition of the new look CQ-TV under the editorial control of Frank M0AEU – all the feedback we have had indicates you like the new clean modern image and that we continue to get the balance of technical and general interest articles about right – well done Frank!

A new look CQ-TV is not the only exciting thing that's happening in the world of ATV with the success of the ISS HAMTV signals being received by the ARISS team and by at least 3 of our BATC members both here in the UK and Australia – the BATC streamer is playing a major part in the distribution of the signals and we have a feature on a couple of the receiving stations in this edition of CQ-TV. We have also seen a number of ATV repeaters receive their NoVs and get on air including GB3IV on 23cms, GB3KM on 3.4GHz and GB3FY on 10 GHz – once again we have an article on this along with a photo gallery later in the magazine.

The DTX1 continues to sell well with over 40 units sold to members in the UK, Germany, France, Holland, Malta, US and Australia and at least 2 units are being used as the main encoder and transmit driver on repeaters with one of them being used to drive a transverter on one of the new UK 3.4 GHz repeaters.

The big BATC shop news is that we are very pleased to announce that the DTX1 is now joined in the shop by the DATV-Express which is a state of the art, high quality exciter for DVB-S and DVB-T formats. Working in partnership with the DATV-Express team, BATC is stocking the PCB to enable members in the UK and Europe to purchase it without the hassle of exchange rates / customs duty / VAT when importing it from the USA. The PCB is available under the hardware and kits category in the shop and for more details on the project please see <http://www.DATV-Express.com>

Unfortunately we have just received the resignation of Chris Smith G1FEF from the BATC committee – this is major blow to your club as Chris has been a valuable member of the committee for a number of years and has developed and is responsible for all the BATC on-line presence, including the BATC shop and unique BATC.TV streaming portal.

Chris has reluctantly come to this decision due to pressure of work and feels he can no longer dedicate the time required to the BATC, particularly now as we are starting to re-develop some of the on-line systems.

Clearly this leaves us in difficult position as our on-line presence has become a very important part of BATC and therefore we need to replace Chris in the next couple of months – it may well be that we have to resort to paying for some services to ensure things are kept running in the short term and also to start the redevelopment of the sites. Whilst we do have good cash reserves this may have an impact on the membership subscription levels which we charge in the future. If you know of anyone who has the right skills and time to help your club, please get in touch as soon as possible.

You will see that we have starting making arrangements for CAT14, our annual Convention for ATV which this year includes our formal General Meeting. It will be held over the weekend of Sept 6th and 7th at the Everest Community College in Basingstoke (the same venue as the convention in 2012) and will include the General Meeting on Sunday. For more details see the article in this CQ-TV and the formal General Meeting notice will be in the next edition of CQ-TV.

Finally as the summer months (and weather?) approach, how about trying a bit of portable ATV operation? In order to encourage you, the committee has decided to award a prize for digital participants in the Summer Fun Contest – see Contest news for more details - so go on, dust off that portable mast and get out there!

And don't forget, if you are organising a stand at a local rally, your BATC, which is so much more than just a magazine, is here to support you with banners and publicity material – just drop us an email to let us know what you need.

73,  
Noel – G8GTZ

### Your magazine needs your photos!

As you read through CQ-TV I hope you enjoy the content of the magazine. But getting the balance between text and image is often difficult, especially if the subject of the article doesn't directly lend itself to supplying good images...

What I'd like to do is to build a small library of stock images, relating to all things television that can be used from time to time to illustrate an article, or fill a space. If you have any images, please get in touch.

*Thank you – Frank, M0AEU; Editor CQ-TV*





## Overseas News

Dave Crump – G8GKQ

### New Zealand

This month, I'll be taking a look at New Zealand, where the broadcaster's switch to digital TV has reduced the usefulness of the analogue ATV Repeaters which had an output on Channel E39 (619.25 MHz). A new digital (DVB-T) repeater at was licensed from January 2013 on Digital Channel 25 (<http://www.vhf.org.nz/node/393>). This is located at Belmont, near Wellington on North Island. For more details, see <http://www.vhf.org.nz/OurRepeaters>

The 70 cm allocation in New Zealand is 430 – 440 MHz, but the recently revised Bandplan makes no provision for ATV, except in a proposal in a footnote: "Proposal: A suggestion has been made that we make an allocation at 430.000 MHz to 431.900 MHz for Digital ATV. This would be only 1.9 MHz wide and would probably only permit one program source but would be useable as an uplink to a DATV repeater or for station to station experiments. There are currently some repeater links using this group of frequencies and such an allocation to DATV would have to be on a non-interference basis." The old Bandplan had provision for 70 cm ATV Repeater inputs with an input frequency of 431.250 MHz vision and 436.750 MHz FM sound.

Mark, ZL3JVX (G8JVX) has been working on an FPGA-based DATV Transmitter <http://www.idesignz.org/DigiLiteZL/DigiLiteZL.htm>, with a lot of help from the UK Digilite team.

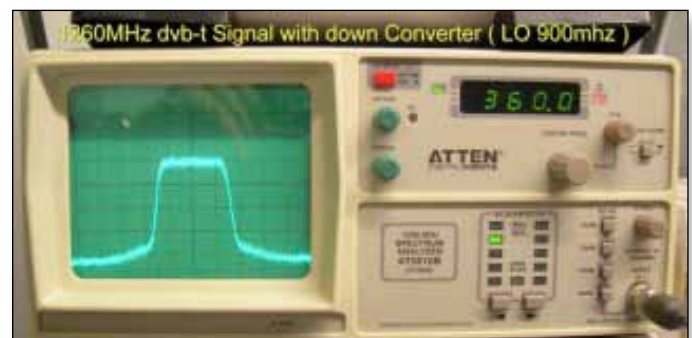
### Belgium

Whilst DATV repeaters are not uncommon, our Belgian colleagues have gone one step further with a 3D HD Repeater. ON0SNW, near Antwerp, is first in Europe to be able to relay HDTV and 3D HDTV with an output on 10.33 GHz. The photo shows a still from the SBS-3D transmission made by ON4FIN. Unfortunately, although the repeater streams on [batc.tv](http://batc.tv), you need to receive the 10 GHz RF to see it in 3D! ON4BHM, who provided this report, comments that DB0KO near Cologne is also HD-capable.

### The Netherlands

There were over 20 Dutch ATV stations active in the VERON December Contest on all bands from 70 cm to 3 cm ([http://www.pi6anh.com/veron/\\_pages/default.asp?page=ATV&categorie=Contest%20resultaten&artikel=49](http://www.pi6anh.com/veron/_pages/default.asp?page=ATV&categorie=Contest%20resultaten&artikel=49)). About a quarter of the contacts were using 70 cm. After the contest on 8/9 March, their next is on 14/15 June; worth a look? Many stations use 150 Watt PAs on 70 cm, including some water-cooled variants.

The latest ATV article in Electron, the Dutch equivalent of RadComm, mentions a interesting integrated camera and DVB-T transmitter made by HIDES. More details can be found at <http://www.oe7forum.at/viewtopic.php?f=7&t=410&hilit=Hides&start=90#p1255>. Although the text is in German, the images are self-explanatory. 🗣️



# Members News



*Dave Mann – G8ADM*

## **From Phil G8XTW, the Dunstable Downs Radio Club**

Digital ATV cluster in the Luton & Dunstable area. Three of our members over the Christmas period, and a further one in January have purchased and are now operating the DTXI transmitter, mainly on 437MHz. That brings the number of active, digital capable, ATV'ers in the Luton & Dunstable area up to 6.

The DTXI documentation does mention the need for a filter to reduce the third harmonic content when operating on 70 cms. A number of mimic based un-tuned driver amplifiers were built to allow the DTXI to drive some 70cm PAs. These PAs had a wideband 1st stage and a tuned 2nd stage. There were some 1st stage failures in the PAs as the now amplified third harmonic content had nowhere to go. Be aware – read the documentation.

Our GB3TZ repeater has had some problems with LDF550 feeder theft. This has happened twice in the last six months and for the time being we have installed a replacement Alford slot antenna array much lower down the mast. This antenna position allows the use of shorter feeders with much less copper and will hopefully be much less attractive to our uninvited visitors.

We have been helping Tom, G3PLX, with the maintenance of the GB3TG, 10 GHz/GB3TV gateway repeater in Brickhill. It now has a new low noise LNB and replacement PA both using slotted waveguide antennas. For those living in the Milton Keynes area the output can be found on 10.425 GHz

Our annual bootsale is a national event and is scheduled for Sunday 18th May 2014 at the usual venue, Stockwood Park, Luton. This will include ATV demonstrations and surplus equipment sales. The council has started digging up M1 Junction 10a to facilitate an underpass but alternative routes will be signposted. The date is subject to confirmation from the Council. See: <http://www.ddrcbootsale.org>

## **From Terry, G1LPS, County Durham. Here's what's happening in "KM LAND"**

Commissioning of our GB3KM repeater 3.4GHz DVB-S output is complete and the repeater is performing well using the Digilite and MK808 combination. M0DTS and G0EHV receive it on indoor antennas at about 28km each. This is the first of the newly licensed 3.4 G output repeaters to become operational.

The 3cm receiver has been upgraded by including an Octagon PLL LNB

Installation of ISS tracking display when the ISS is in range is currently under way. The repeater output will switch to HAM-TV from the ISS if it's active. Auto tracking and display of the ground track are being handled by a Raspberry Pi controlling an IF100 rotor interface and Yaesu 5400b azimuth elevation rotator, tracking an S band dish.

SDR display on the repeaters outputs is also being installed. This will show the the SSB and beacon portions on 3, 13, 23 and 70cm bands. Again a Raspberry Pi is handling this. New logic testcards etc. for the repeater are also being developed to run on the same Raspberry Pi as the SDR.

Rob M0DTS is developing the software which also includes a web interface for easy configuration of the repeater SDR and testcards.

The repeater has also had upgrades to its sound mixers to handle the complexity of feeding 2 analogue outputs and split right and left channels on DVB-S to avoid feedback / echo, ringing around.

## **From John, GW3JGA, Prestatyn, Denbighshire**

The GB3TM repeater in Anglesey will have a new 70cm receiver fitted as soon as the weather improves this is to improve the DVB-S reception.

## **From Keith G0KTD in St Austel, Cornwall.**

Keith and Paul G6MNJ, Mevagissey have been exchanging pictures on 70cm using very low power over a 5 mile range. Paul has also been trying to get a digital signal to G3MCD in Bodmin with no luck, with some antenna improvements Paul is confident that they will succeed over this hilly path.

They are also working on adding a 70cm DVB-S receiver to the GB3NQ repeater near St Austell, just waiting for better weather to put up the antenna.

## **From Darren, G7LWT, near Manchester**

The new Winter Hill TV Club, M0WTV is now up and running with Digital ATV on 70 cm and 23 cm, using an Antennair Quadrant DVB-S transmitter with two video channels over the multiplex. This new club station is located 850 feet ASL on Winter Hill, near Bolton, Lancs.

The station is continuously attended by G3SMU and G7GFK, with talkback on 144.750 MHz. Talkback can also be accommodated on 70 cm.

Digital transmissions from MOWTV are currently running low power, ~1 W, but signals have been received across the North West and as far South as Shropshire. Work is in hand to increase the power on 70 cm and 23 cm.

Analogue ATV is also available on 23 cm using 150 W transmitter and soon club members will enjoy the facility to be able to remotely control the club station. For further information about the Winter Hill TV Club, please contact G7LWT or G3SMU via e-mail or on 144.750 MHz, the ATV talkback channel.

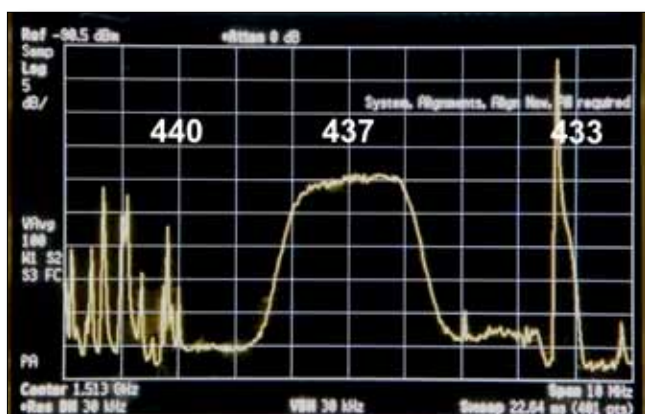
### Monitoring DATV Transmissions

The Tutoune monitoring software developed by Jean Pierre, F6DZP is now in use by several stations across Europe. Many of these receiving sites may be viewed on line and a very useful map is available here: <http://www.vivadatv.org/tutoune.php?what=map>.



By clicking on a station shown on the map you are taken to that station's Tutoune web site. Then if the station is active and can receive your signal you can measure your system performance on line.

On 70cm I have also been looking at the spectrum of this very crowded band from N.W. London. Fig 2. shows the band, frequency high on the left due to the LO in the up-converter being on the high side. Above 440 MHz, the band edge, on the left, is much analogue Tetra activity and on the right below 433.5 MHz are the local amateur voice repeaters. Also some in band non-amateur telemetry carriers can be seen. Even so the digital transmission shown on 437 MHz can be reduced by 15 dB before the



signal drops out. Clearly a low loss narrow band filter at the antenna would reduce the out of band interference but its down to luck as far as interference from the telemetry carriers is concerned.

### ISS

The Ham TV transmitter on the international space station is about to be activated. The situation is changing daily. For the current details and latest news see the BATC forum: <http://www.batc.org.uk/forum/>

### DATV EXPRESS

The DATV Express DATV encoder/modulator boards and software have now been released. You can now see the latest details and ordering information on the BATC forum: <http://www.batc.org.uk/forum/>

### Local TV

OFCOM have so far granted 19 licences for the new Local Television stations. These will be broadcast terrestrially in the UK as part of Freeview and on the Sky and Freesat satellite network. We did have local television for London and Manchester a few years ago available only by satellite. These channels were well run and ran for a few years but could not make enough money to survive. Let's hope by making these new channels available on Freeview as well as by satellite will make them more successful. The investments in these channels ranges from tens of millions of pounds for the London station to just a few hundred thousand pounds for the more rural stations. I do worry about men in suits being given huge amounts of money to try to compete with the major broadcasters. Survival will be a challenge if they follow the style of the traditional broadcaster. A better approach would be to give some lower cost HD cameras to a few local talented youngsters and let them create some truly original local programming. Maybe there would be some opportunities for BATC members who could offer some good advice on how to run a low cost local TV service! To find out more see: <http://localtv.org.uk/>. The transmitting multiplexes are run by: <http://comux.co.uk/>

### BT Television

Many of us were surprised about BT starting its own sports channels. They have a 10 year lease on some of the ex Olympics TV studio facilities in North London. However it does seem to have been more successful than I imagined, if you have watched these channels have you noticed the excellent picture quality, some of the best HD pictures that I have seen and the production is pretty slick as well.

Please send me your news to: [secretary@batc.org.uk](mailto:secretary@batc.org.uk)



# Contest News



Dave Crump – G8GKQ

## SummerFun Contest – Change of Date to 14/15 June – And a Prize!

I have delayed the Summer Fun Contest by one week so that it coincides with the Dutch ATV Contest. Given the high level of activity in The Netherlands, on both 70 cm and 23 cm, I decided that this was too good an opportunity to miss.

Additionally, in order to encourage digital activity using the BATC DTX-I and Digilite, the Committee have decided to create a new Digital Section and offer a prize of a Nexus 7 Tablet for the highest placed station.



### Digital Section Rules

The Digital Section is simply another scoring method for Contacts made within the normal contest rules:

- To be counted within the Digital Section, contacts must be valid for scoring within the wider SummerFun Contest. The rules are published at: [http://www.batc.org.uk/contests/BATC\\_SummerFun\\_Contest\\_Rules.pdf](http://www.batc.org.uk/contests/BATC_SummerFun_Contest_Rules.pdf)
- Only contacts made using DVB-S or DVB-T transmission modes can be counted within the Digital section.
- Only contacts made on 70 cm and 23 cm can be counted within the digital section. Contacts on both bands are to be scored at 1 point per km for a one-way digital contact and 2 points per km for a 2-way digital contact. If a 2-way contact is made, but one transmission path is analogue, the contact counts as a one-way contact for the Digital Section.
- The winner of the digital section will be the station who achieves the highest total of points for 70 cm and 23 cm under these rules.
- In the event of a dispute, the decision of the BATC Committee will be final.

### In Short

The 2014 SummerFun contest is primarily aimed at encouraging Digital Activity from all those who have purchased BATC DTX-I's or built their own equipment. A prize will be offered for the winner of the Digital Section. The contest runs from 1300 local (1200 UTC) on Saturday 14 June until 1300 local (1200 UTC) on Sunday 15 June. Don't forget to look for activity from the Netherlands who are running their contest on the same weekend!

### Results for the December Repeater Contest.

BATC Repeater Contest 7/8 December 2013

	Call	Pts	Locator	QSO	Rptrs	
1	G3WFK	968	IO83XL	6	GB3UD	
2	G3MCD	126	IO70OJ	2	GB3NQ	
3	G4OCO	92	IO70MK	1	GB3NQ	
4=	G3NWR/P	0	IO91TO	0	GB3UD	GB3TM
4=	G8ADM	0	IO91TO	0	GB3BH	GB3HV

Congratulations to John on his well-deserved win. And thanks to Brian, G4EWJ for going out with the Wirral ARS crew and to Dave, G8ADM for their perseverance – even if they did not achieve any contacts!

Brian thinks that the Wirral ARS Crew might have been having problems with receiver blocking from transmissions from the Poll Hill mast.



▷ Photo © Copyright Peter Craine and licensed for reuse under the Creative Commons Licence

Contest News contd...

### Contest Calendar

- 1200 UTC 14 June 2014 – 1200 UTC 15 June 2014: *BATC Summer Fun Contest (Change of date)*  
 1800 UTC 13 September 2014 – 1200 UTC 14 September 2014: *International ATV Contest*  
 1200 UTC 6 December 2014 – 1200 UTC 7 December 2014: *BATC Repeater Contest*



Contest News contd

## Proposed Contest Rule Changes

BATC and RSGB have been providing inputs to Veron (the Dutch Amateur Radio Society) on a revamp of the IARU Region-I ATV Contest rules. This follows on from discussion last year in Vienna.

The major changes include:

- ▶ Change of date to the second full weekend in June.
- ▶ Extension of the allowable operating times to 30 hours: 1200 UTC Saturday until 1800 UTC Sunday)
- ▶ Enabling remote and Rover stations

I have opened a new topic on the BATC Forum for your comments.

You can see the current Veron draft on the RSGB IARU Consultation Forum at:-

<http://forums.thersgb.org/index.php?threads/c5-vhf-microwave-matters.12/#post-134>

(you will need to register first at <http://www.forums.thersgb.org/index.php?login/> in order to enable downloading and replies) 🗨

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## ISS HAMTV Received

On Saturday the 8th March at between 13.30 and 14.00 Hrs GMT the ISS Ham TV transmitter was switched on for the first time. This was the first amateur TV fast scan transmission from space. The AMSAT report stated that they would not be switching on the camera, they would only transmit a DVB-S signal with no video. As it happened they did switch on the camera and we could see the operator floating by the transmitter while he talked to the ground station.

Picture shows the transmission as shown on [batc.tv](http://batc.tv) is playing a major role in distributing the received pictures

### Details:

**Date/Time:** 13.30 - 14.00 GMT on 8th March 2014


**Downlink:** 2422 MHz circular polarisation.

**Callsign:** OR4ISS

**Receive sites:** Matira, Southern Italy,  
Shown on BATC Stream ISS1  
  
Monferrato, IK1SLD, North West Italy,  
Shown on BATC Stream ISS4  
  
Livorno, North West Italy,  
Shown on BATC Stream ISS5

The following morning, Sunday 9th March, Colin G4KLB in Southern UK, received a DVB-S signal with no video from the ISS. See his article later in this issue of CQ-TV.





Please note, your IP address and all activity on this chat is logged.

**Chat Messages**

**Online**

08/03 13:37 **guest709** : 73 de IW1AWH

08/03 13:38 **#sys#** : W6KGE joined the chat

08/03 13:38 **guest550** : Very good video beering receive in the UK: 73 from G7PEB

08/03 13:39 **W6KGE** : W6KGE Bob in Simi Valley, California.. Great...

08/03 13:44 **W8RUT** :

08/03 13:47 **guest100** : Currently over west Africa heading for New Zealand.

08/03 14:45 **guest855** : 73 de iv3zcx

08/03 14:47 **guest855** : NICE VIDEO 73 DE IV3ZCX MAURIZIO Cervignano ITALY

**G0KTD**

**G8adm**

**guest153**

**guest477**

**guest807**

**guest829**

**guest855**

**guest922**

**W8RUT**

# BATC CAT14 and Bi-annual General Meeting

Noel Matthews - G8GTZ

*The BATC is pleased to announce that we will be holding our Convention for Amateur Television 2014 (CAT14) over the weekend of 6th and 7th of September at the Everest Community Academy in Basingstoke, Hampshire which is the same venue as the highly successful 2012 convention was held.*

The weekend will follow the same format as previous two year's successful BATC Conventions in Basingstoke and Finningley with:

- ▶ A number of live demos / group presentations
- ▶ Specialist traders selling RF and video bits
- ▶ The BATC shop
- ▶ BATC members table top sales
- ▶ A "test it and fix it" area where you can bring things to be tested on professional test equipment

There will be a talks program covering a wide range of topics on Saturday afternoon and Sunday and the BATC 2014 General Meeting along with a BATC open forum panel discussion will take place on Sunday.

We are looking for talks and demonstrations on any topic related to ATV and also help with the organisation of the event – contact a member of the committee if you want to be involved.



## Date / timing:

The ATV Convention will be held on Saturday 6th (doors open at 12 noon and lectures start at 1:30pm) and Sunday 7th (start at 10am - close at 4pm) of September with the BiAGM taking place on Sunday.

## Location

The ATV Convention will be held in Basingstoke, which offers good motorway connections from London & South Coast (M3), from the Midlands & North (A34) and west via M4 and A34.



There are direct trains from London / South Coast / Southampton airport / Midlands / Manchester / Newcastle and Heathrow airport is just 45 minutes away.

## The Venue:

The ATV Convention will be hosted in the Everest Community Academy which has a 150 seat lecture theatre and open area for our use. [www.everest.hants.sch.uk/](http://www.everest.hants.sch.uk/)

In order to cover the costs for the weekend there will be an entrance fee for attending the convention of £7.50 per day, payable on the door. However BATC members will be able to pay a reduced entrance fee of £5.00 per day online at the BATC shop in advance of the event. Attendance to BiAGM only will be free to BATC members.

Free tea and coffee will be available all weekend and sandwiches, cakes and fruit will be available for purchase at lunchtime.





## Hotels / Convention dinner

A special BATC rate of £65 B&B (single), £75 (double) and £80 has been arranged at the Apollo (4\*) hotel which is within 1 mile of the convention venue <http://www.apollohotels.com/> – please ring the hotel reservations directly on 01256 796700 (not via the web site) and quote BATC 060914 to get this rate.

It is intended to hold the ATV Convention dinner on Saturday evening at the Apollo – details to follow, but please indicate your interest when registering on the BATC website.

There are a number of other hotels within 2 - 3 miles of the venue including Travelodge, Premier Inn and Holiday Inn.

## Other things to do

It is not intended to arrange an XYL program, however the Wyne National Trust house is just 3 miles away <http://www.nationaltrust.org.uk/main/w-thevyne>, and the Jane Austen museum is less than 30 minutes away <http://www.janeausten.org.uk/>

The historic city of Winchester is 20 minutes away by train, Portsmouth historic dockyard and the New Forest are less than 1 hour away by train or car.

Basingstoke has a very good modern shopping centre <http://www.festivalplace.co.uk/> the Hampshire Transport Museum <http://www3.hants.gov.uk/milestones> and a Ten Pin bowling alley and Ice Rink <http://www.planet-ice.co.uk/arena/Basingstoke>. Other shopping is also available in Southampton (30 mins), Reading (20 mins) and London is only 50 mins away.

More details to follow, but put the date in your diary now and let's make this an even bigger success than the Convention in 2013.

▷ The convention offers excellent presentations and the chance to meet fellow enthusiasts. Local places to visit include: (from the top down) a presentation from CAT 13; Jane Austen's House at Chawton, Alton; one of the presentations at CAT 13 being streamed; Milestones Museum and The Wyne; Basingstoke.



If you have any ideas you would like to see included, if you are willing to come and tell others about your experiences in ATV or have something you want to demonstrate please contact Noel G8GTZ. 📧



## GB3SQ, GB3FY & GB3IV - the new repeaters on-air

A number of ATV repeaters have recently received their NoVs and are already on air including GB3IV & GB3SQ on 23cms, GB3KM on 3.4GHz and GB3FY on 10GHz.

### GB3SQ – Dave Kenward G8AJN

From an original decision to begin applications for an ATV repeater for the Bournemouth area 14 years ago and following several changes to the specifications 6 years ago and a then move to a digital-only application 4 years ago, the NoV for GB3SQ was finally received in September 2013 making GB3SQ the UK's first digital-only ATV repeater.

In anticipation of the shrinking bandwidth available on 23cms a decision was made to apply for a digital-only input and digital-only output. It was decided also that by using a 4Ms/s digital input the bandwidth would be smaller and it could be fitted into the bottom end of the band at 1244MHz and would avoid any risk of breaking into the neighbouring Isle of Wight repeater GB3IV on 1249MHz (although this has recently moved inland to HMS Collingwood near Portsmouth), which was originally on a south-easterly path from several Bournemouth stations. Moving to higher frequencies would not have been acceptable under the latest Bandplan.

In a similar way the output frequency of 1304MHz was selected as the lowest available repeater output frequency based on a bandwidth of around 4 MHz and with maximum permitted power of 25W erp.

Using a duplexer a single Alford slot aerial is used concurrently for transmit and receive. This is being replaced by a G8ADM design slot this Spring.



▷ The aerals at GB3SQ



To reduce electricity costs, the repeater is receiving 24/7, but the transmit is off. When a valid digital signal is received the transmitter comes on and BATC streaming begins.

When you have finished, it is only necessary to drop your carrier. The repeater then runs a caption showing a countdown to the next Ident. (Ident is transmitted every ten minutes). It then returns to receive only.

On GB3SQ input, the audio is mono on the left channel whilst the right hand channel is reserved for DTMF control for operating some extra features such as real-time clock adjustments, signal strength meter and other engineering adjustments. The DTMF control is not required for normal day-to-day use.

On the transmitted signal the audio is still on the left hand channel but the right hand channel carries a relay of the 2mtr talkback channel. Using all-SMD devices the repeater controller uses a single 120mm x 90mm board to run all the non-rf functions.

Controlled by a PIC 18F452 running PicBasic the board holds VU meter drivers, speaker amplifier, audio limiter/processor, character generator, DTMF decoder, RS232 interface, video distribution amplifier, real-time clock, video and audio feed selection circuits.

A Porty with a lock-light is used for reception. The MPEG2 encoder is an SR Systems driving into a dual RA18H PA. This is under-run deliberately to improve linearity and (hopefully!) reliability.

At present the repeater sends a carousel of slides between 7pm and 8pm each evening unless being used by someone.

The signal is received off-air at my QTH about ¼ mile away by a Porty receiver. This unit's lock-light voltage is used to trigger the FileStart program on a USB feed into a PC and this is used to run the Adobe Live streaming for the BATC website. When the repeater shuts down the streaming remains 'on' for two minutes and then it stops.

The Bournemouth Amateur Tv Group Net is on Sundays from 8pm. Full information is available at [www.gb3sq.com](http://www.gb3sq.com)

### GB3IV – Peter Blakeborough G3PYB

A year ago, GB3IV lost the use of the excellent Stenbury site on the Isle of Wight, which gave wide coverage throughout the Solent and would be a hard act to follow to emulate the coverage

The Royal Navy Amateur Radio club (RNARS) had a club site just south of Fareham on the Gosport peninsular with two full size tilt over towers and they kindly offered to host the repeater. The SCART group had for several years been associated with the RNARS and provided equipment and streaming resources for the yearly public event for Collingwood Naval Open day and we are now an integral part of the RNARS at Collinwood.



The GB3IV equipment was re-installed at Collingwood RNARS plus an internet remote control system to allow supervised operation under licence Clause 10, whilst an application was made for

an NOV at the site. The site is on the Solent coastal plane and the TX coverage is restricted to a predominantly East- West, though there is a gap in the immediate hills to North. Extensive re working of the antenna on the VHF/ UHF tower had to be made and we have now received our NOV for a 23cm digital TX after only 10 months delay.

The excellent access to the antenna tower prompted the TV Group to improve the receiver coverage by adding steerable long yagi antennas for 23cm and 70cm using a WEB based rotator control system. The aim was to make both the beam heading and antenna switching to be available to remote users, to greatly increase the RX range. The rotator is controlled via the serial port on a PC, which also provides a full time Streamer service on [www.batc.tv](http://www.batc.tv), running PSTRotator software by YO3DMU and allows web control of the direction of the 70 and 23cms receive antennas. Early indications are that the system works well and allows stations outside the “normal” coverage area to access GB3IV whilst watching the output on batc.tv.



### Facilities' summary;-

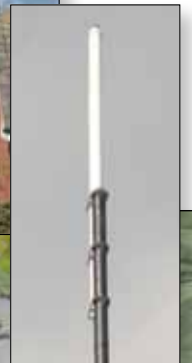
- ▶ 23cm DVBS TX on 1316Mhz 4MS/s. (24/7) TX antenna is omni and the NOV allows ERP of just below 100W.
- ▶ 23cm RX on 1249MHz for analogue FM or 4Ms/s DATV DVBS - RX mode selection is automatic.
- ▶ RX antennas for 23cm can be switched to the omni on antenna diplexer or to a 23 element slot fed MastHead yagi.
- ▶ 70cm RX (437MHz) is a 15 element J beam yagi which is permanently routed to a separate IRD.
- ▶ Main TX & streamer LH audio is programme feed and RH audio is 144.750.

Many thanks to the local ATV stations for all their effort to re-establish the repeater; and to RNARS for hosting the repeater.

### GB3FY – John Hudson G3RFL

John reports that GB3FY, the first new 10 GHz ATV repeater to be licensed for over 10 years and Lancashire's first TV repeater was put on air on 18th February. First reports are very encouraging with Bob G1EPL and others seeing the repeater.

▷ The aerials at GB3FY



▷ GB3FY coverage map



# The BATC and You the Member

*Brian Summers, - G8GQS - Honorary Treasurer*

## The members

I thought I would write a few words about how the BATC works and our part in it. We now are fortunate to have a sizeable number of members all over the world and there is that word "members" what does it mean? Well the BATC is a club, another strange British concept, the BATC is a club, your club, our club, and we all work together for the common good.

When you join the BATC you are part of a wide group of enthusiasts, the members, who are happy to help each other get going with which ever part of television that you are interested in. There is no profit motive! All our income is used for the benefit of our members. We are truly a mutual organisation.

## The committee

The BATC is run by a committee of members who do most of the work in organising the services that are available. But the committee can only do so much, and there is a lot to do in what is left of our spare time. You can help! Please tell us what you are doing, join in on the forum or streamer and best of all write something for CQ-TV.

We are now an international club, and our committee is geographically spread out so with modern communications distance is no real obstacle, the committee tries to meet just once a year and the rest of the business is done on email and the telephone.

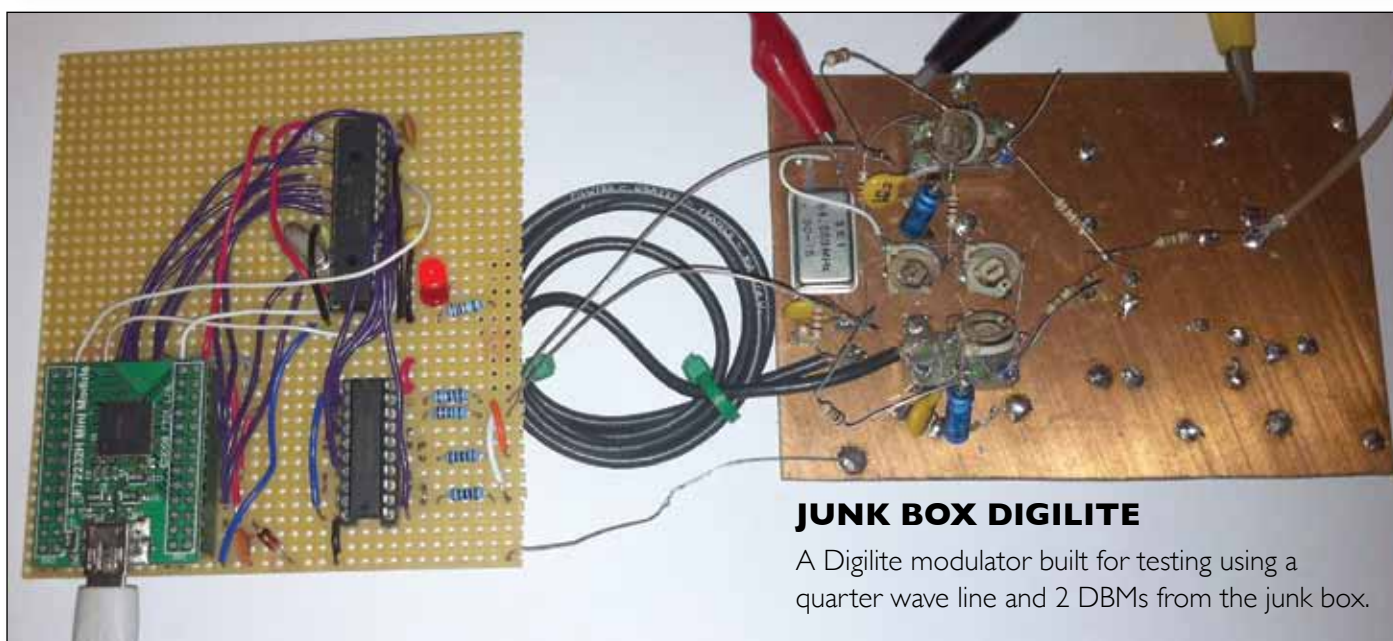
Your committee is elected at the General Meeting held every two years, normally during the weekend of our annual convention, and this year is a GM year. CAT14 will be held on the 6 / 7th of September and there will be lectures, items for sale, much talk and a chance to network with other ATVers. Come along if you can or watch us on the streamer. If you or a friend would like to stand for election at the forthcoming GM we would be pleased to hear from you.

## The General Meeting

One of the important things at this GM will be the proposal of a new and improved constitution, our governing set of rules. This proposal will be appearing in the next edition of CQ-TV and there will be an area on the forum set aside for your comments or you can email or write to us with your feedback and comments.

Now one of the problems in a big worldwide club like the BATC is the difficulty most of our members have in getting to our meetings - we can't help with the teleport, but we are hoping to widen the democracy by introducing a proxy voting system, more on this later.

The BATC is a broad church and we/our members are interested in all the different fields of television, there are even a few who are into valve vintage TV cameras, like me.... If you feel up to helping to run the BATC this is your chance to step forward - the BATC is a great club and you can help make it better. 🗣️



## JUNK BOX DIGILITE

A Digilite modulator built for testing using a quarter wave line and 2 DBMs from the junk box.



# DATV-Express PROJECT

After more than three years of hard work the DATV-Express team is delighted to announce a state of the art, low cost but simple to use DATV RF modulator board. Add a computer and video capture card in order to transmit a high quality, affordable digital television RF signal. Presently it's capable of DVB-S and limited DVB-T modulation with others to follow. It is significantly better and less expensive than current products on the market today.

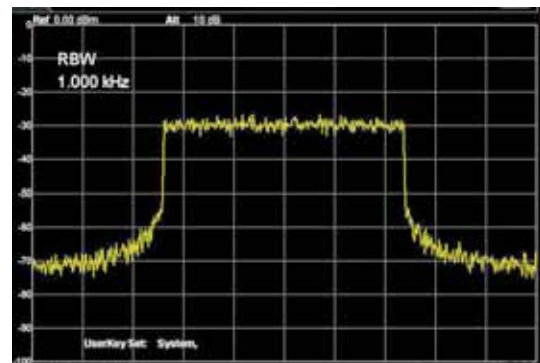


This board is basically an SDR product so it is capable of almost any modulation scheme. For example, ITU J.83b QAM protocol is planned but not started as well as a number of other Software Defined Radio possibilities. It's limited only by the software program driving it. We have successfully been able to replace the PC computer with a Raspberry Pi but so far only at low symbol rates due to limited Pi software speed. However, work is in process to enhance this capability. When the Pi capability is complete, we will have a truly portable combination. Code conversion from Linux to Windows® was planned also but the effort to create the Pi combination may make the Windows version unnecessary. HDTV transmission is also possible and has been demonstrated.

The team software engineer is busy developing added functions but it's a huge undertaking for one person. We welcome the help of willing and qualified software programmers to assist with future applications.

Interested programmers should contact G4GUO by e-mail at [chbrain@btinternet.com](mailto:chbrain@btinternet.com) if they would like to assist expanding and improving the software. They would be entitled to a discount from general sales as a bonus similar to a "Kickstarter" project.

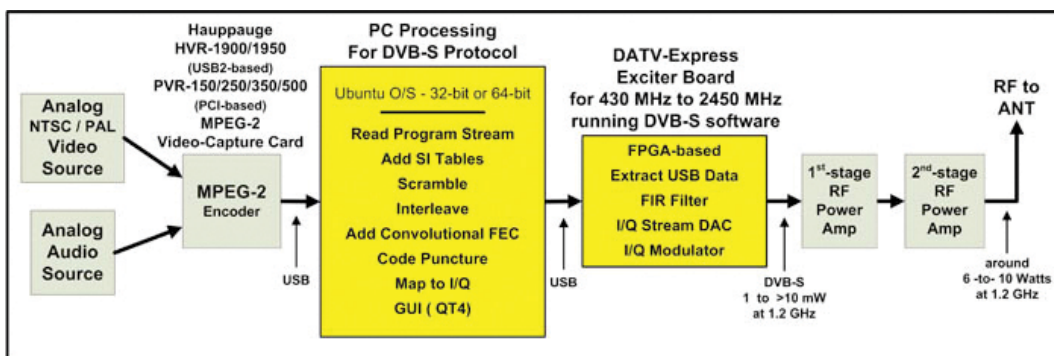
This is NOT a money making project but only a "labour of love" for the Amateur Television community. Board sales are used to repay our investment and stimulate DATV activity. The entire DATV-Express team is donating their time and expertise in order to promote DATV to the general Ham population.



▷ Clean 2 MHz wide bandwidth for DVB-T 2k mode using 4096 iFFT math - with NO alias spurs

With our effort we hope the DATV activity will greatly improve in both Europe and the USA. Review project progress at our web site: [www.datv-express.com](http://www.datv-express.com) and participate in the blog forum at [DigitalATV@yahoogroups.com](mailto:DigitalATV@yahoogroups.com).

Boards can be ordered with PayPal direct or through the BATC store. 🐼

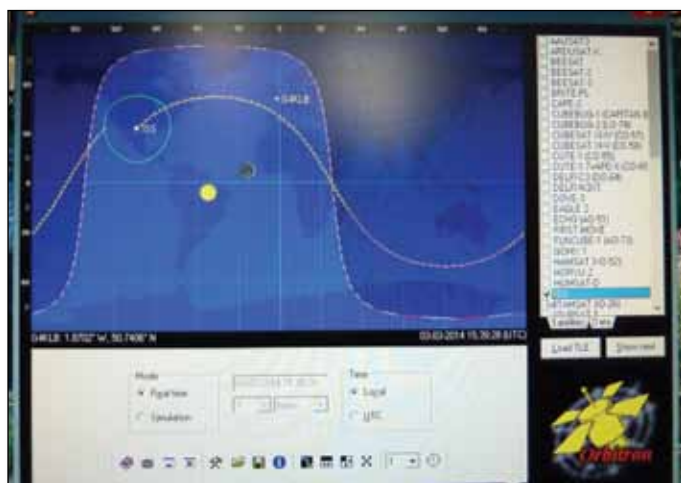


# HamTV from the ISS

Colin – G4KLB

As soon as I heard that a DATV system was going to be installed on the ISS, I was inspired to attempt to receive the signal. At the time information was a bit thin on the ground, a lot more is available now (see Amsat link below). However I quickly established that the signal was to be on 2.4GHz 1,3 Ms/S right hand circular polarisation and low power. My current RX system would not be suitable as it was.

The recommended equipment for a ground station (see link) is the best way to go about this, but at several thousand pounds would exceed my budget. There are many options you can choose but I will describe the system I am currently testing.



Firstly, I needed some method of tracking the ISS passes across the sky, again there are a number of alternatives, but I chose to use Orbitron.

OK, so now I need to find a way to use this data to move the dish, searching the internet a system originally designed for EME by Doug VK5DJ that can be interfaced to Orbitron fitted the bill. Doug can supply blank PCBs for the project and construction details are on his website.



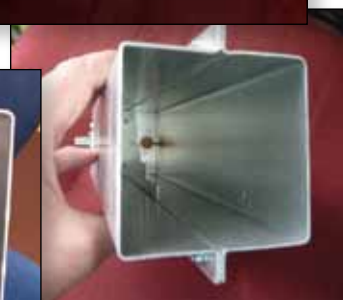
I looked at several types of AZ/EL rotators and all of them were over my budget at this time, so I would have to manufacture something else. I came across a very heavy duty CCTV pan and tilt unit at a rally and thought this would be good to use as a prototype.



Some method of feedback to indicate position would be needed; I could have used a simple Pot but elected to install the more accurate HH12 absolute encoders made by Georg DF1SR. There wasn't much spare room in the motor housing, so fitting two PCBs and two encoders did take a bit of working out, I had to make a bracket with a geared system to shoehorn them in!



I have an old 1.2M prime focus dish and have built a septum feed for it, but for my first tests will be using a 1.1M offset dish with a helix dish feed.



▷ The Septum feed, built to the specifications of OK1DFC





▷ The 1.1 mtr offset fed dish with helical feed



The 2.4G signal will need to be down converted to a frequency that is in the passband of my satellite RX. I had an S band LNB from a previous project but have also modified a MMDS convertor as a backup. (Worth noting that the latest version of Tutioune can now tune from 600MHz to 2600MHz)

In the absence of any signals to test the system, a DigiLite with a 2.4GHz local oscillator was used, so was able to confirm my untested S Band LNB was functional.

The prototype seems to be working well but the relentless gales of previous months have shown that the AZ/EL motor will need to be more substantial for a permanent installation, so am on the lookout for suitable parts for the MK2. However at £20 for the CCTV pan/tilt rally find, I am happy, just shows you don't have to spend a fortune to have a go! 🐶

#### Links

Beam Controller

<http://www.vk5dj.com/beam.html>

HH12 Encoder

<http://www.kutz-b.de/df1sr/index.html>

Orbitron satellite tracking system

<http://www.stoff.pl/>

Tutoune

<http://www.vivadstv.org/>

Recommended equipment

<http://ukamsat.files.wordpress.com/2013/08/iss-datv-gaston-bertels-on4wf.pdf>

Helix dish feed

<http://www.g6lvb.com/60cm.htm>

MMDS convertor

<http://www.m0dts.co.uk/index.php?tag=2.3GHz>

Septum feed

<http://www.ok1dfc.com/eme/emeweb.htm#Septum>

## Weak signal tools HF through microwave



- Broadband and single band (filtered) 23cm VLNA
- General purpose noise generators from 100kHz through 11GHz
- Calibrated 5dB & 15dB ENR noise sources from 10MHz through 11GHz



**RF  
Design**

For product data, application notes and weak signal resources please visit ...  
[www.G8FEK.com](http://www.G8FEK.com)

RFD representative Kevin Avery at G3AAF Electronics E-Mail: [Kevin@avery03.fsnet.co.uk](mailto:Kevin@avery03.fsnet.co.uk)



# VK6MJ – ISS Tracker



Peter Blakeborough – G3PYB

Our world travelling BATC President recently visited Martin, VK6MJ in Perth, Western Australia. Peter reports:

We wish Martin good luck and we look forward to seeing his video downlink from the ISS. 🗣️



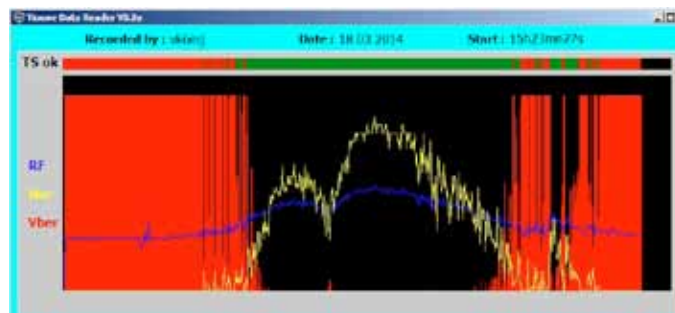
Live DATV video transmission from the International Space Station should be possible in the next few months and a number of ground stations are being prepared in several continents. VK6MJ in Western Australia has for some time provided a bridge/gateway for the ARISS project and is well placed to add this to his station. Martin has some useful experience from the 2.4GHz down link on the now defunct AO40 satellite, with a proven circular polarisation patch dish feed controlled from his shack, Fig. 1. For the LNC he opted for the DB6NT 2.4GHz to L band front end. Demodulation is achieved with a Toutioune software package and a Trend PC card IRD.



Tracking is based on a PC solution working with the Yaesu Az/EI rotators. VK6MJ's receiver output is streamed as ISS 5 on the BATC ISS streaming section, he originates test sequences from time to time. VK6 is 8 hours ahead of GMT. To see Martins pictures go to [www.batc.tv](http://www.batc.tv) click on the ISS button and then select his feed.

### Stop Press:

Martin reports: A problem I was having last week was all the noise from computer wifi access points in the neighbourhood. The change of frequency to 2.395GHz moved the signal to a quiet spot on the band and suddenly I had over 3 minutes of continuous signal (TS OK). It seems my signal was being trashed by QRM and that my set up is in fact working nicely 🗣️





# Using the Raspberry Pi to Control an Ultram VCO (for DigiLite?)

Dave Crump – G8GKQ

## Introduction

I have 3 Ultram VCOs of the type recommended for DigiLite, and wanted to put them to other uses on new frequencies. Before designing and programming a PIC Controller for them, I needed to check that the VCOs would work on the new frequencies and to learn about how they could be programmed using the SPI bus. I also had a Raspberry Pi computer which was not being used. This article describes how to program the Ultram VCOs directly using the Raspberry Pi.

## SPI Bus

The ADF4360-x VCO on the Ultram VCO board is programmed through an SPI bus. This bus normally has 4 signal wires carrying clock (SCLK), data from master to slave (MOSI), data from slave to master (MISO) and slave select (SS). The AD4360-x is a slave device and only receives data, so no data is sent back to the master. It is programmed using three 24-bit control words. The data bits are sensed on the rising edge of the clock, and words

are loaded one at a time into the three 24-bit latches on the rising edge of the slave select line. The ADF4360-x is a 3.3v device; luckily the Raspberry Pi also has a 3.3v interface, so no extra components are required.

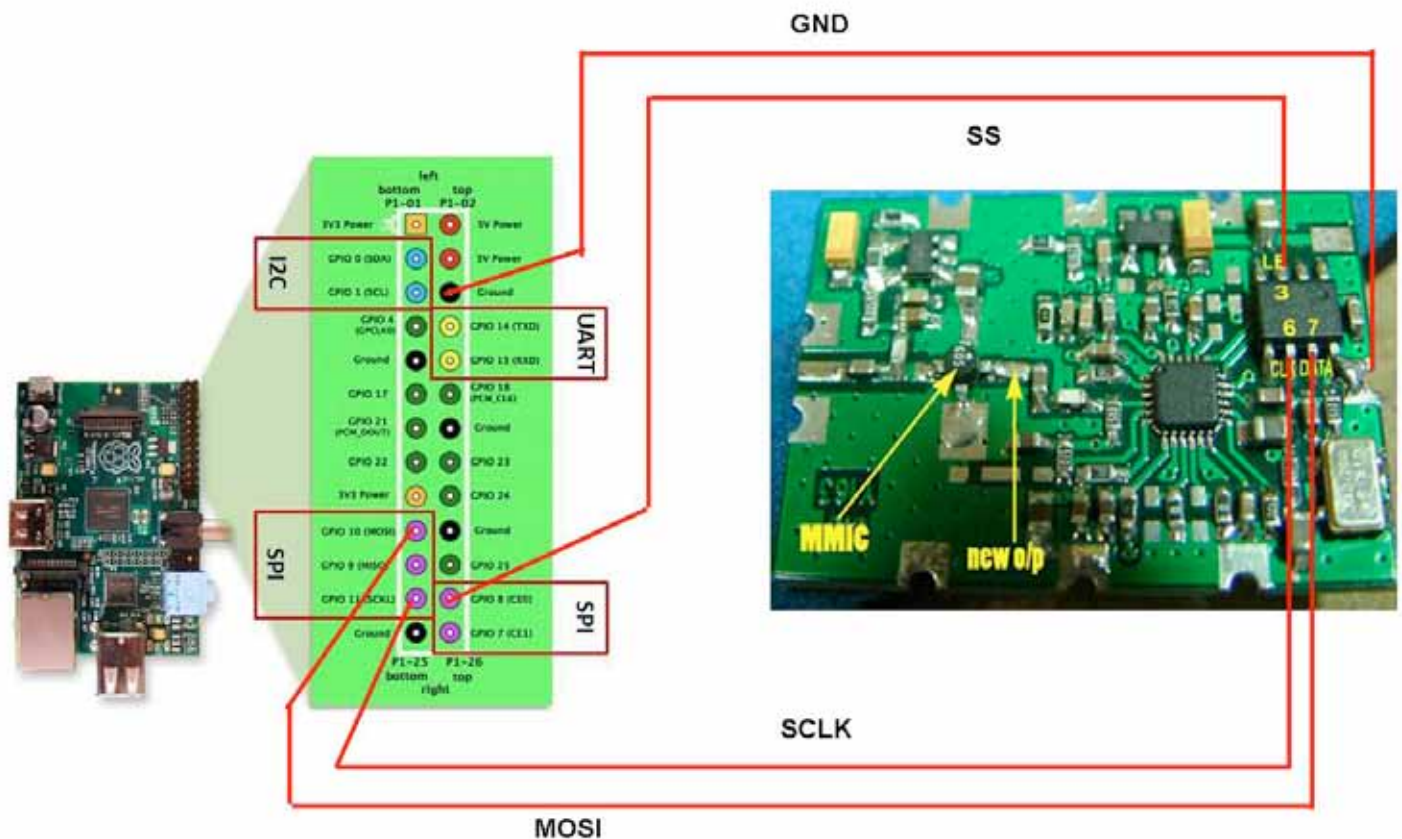
## Connecting the Pi to the VCO

The existing PIC on the VCO board needs to be carefully removed to allow the Pi to take over its role. I used a watchmaker's screwdriver and a soldering iron to raise one side of the PIC at a time. Once you have removed the PIC, you can wire the connections from the Pi to the VCO board as shown below:

Don't forget to take anti-static precautions. The connections are also listed in the program.

## Setting Up the Pi

Before starting, it is worth checking that your Raspberry Pi is up to date with the latest software. Then download and install the Raspberry Pi GPIO Python Library.



## Program

I decided to use Python as the programming language, because it is well-supported on the Pi. I used the Idle3 development environment as some of the Python features I wanted were not available in the older version used by the basic Idle environment. To start Idle3, you can just type “sudo Idle3” in a terminal window (sudo is required to access the GPIO port). You can then load the program and run it from the drop-down menus. The program I wrote is simply intended to be easy to read, understand and modify and, as my first ever Python program, owes more to 40 years of experience of Fortran, Basic, Ada and Pascal than any Python expertise. I am sure that there are better ways to write the program, but this just worked! The program has 6 functions:

- ▶ Delay(milliseconds): This causes the program to pause for the stated number of milliseconds.
- ▶ Sendchar(Hex character): This converts a Hex character to an integer, and then sends the 4 bits on the SPI bus. It tests each of the four lowest bits in turn, toggling the clock line and setting the data line high or low during each of the 4 positive clock transitions.
- ▶ Send6string(6 character string): This sets Slave Select low, then takes the string of 6 Hex characters and peels off one character at a time, calling Sendchar() to send the characters on the SPI bus. It then sets Slave Select high to load the 24 bits into the VCO latch.
- ▶ Setparams(RCounter, Control, NCounter): This takes the 3 6-character Hex strings and calls Send6String 3 times to send them on the SPI bus. It pauses 5 ms between the last 2 strings to allow the VCO internal circuitry to settle.

The full listing of the Python code can be found on the BATC Forum at

<http://www.batc.org.uk/forum/viewtopic.php?f=71&t=3748>

## Calculating The VCO Parameters

Analog Devices provide a simple Windows program to calculate the parameters for the VCO. It displays the 3 6-character Hex words that need to be typed into the Python Program. The software can be downloaded from [http://www.analog.com/static/imported-files/eval\\_boards/ADF4360\\_Setup\\_v4\\_1\\_2.zip](http://www.analog.com/static/imported-files/eval_boards/ADF4360_Setup_v4_1_2.zip)

Note that the 3 words are not displayed in the same order as they need to be entered into the Python Program. The Python program has a number of alternative frequencies for the ADF4360-5 already defined. You just need to uncomment the appropriate line.

## Next Steps

As I mentioned, this program was just a stepping stone for me before writing a PIC program to control the Ultram VCO. I plan to develop the PIC program (in assembler), and perhaps publish it in a future CQ-TV. I hope that you have fun exploring what can be done with a Raspberry Pi and some RF hardware 🗣️

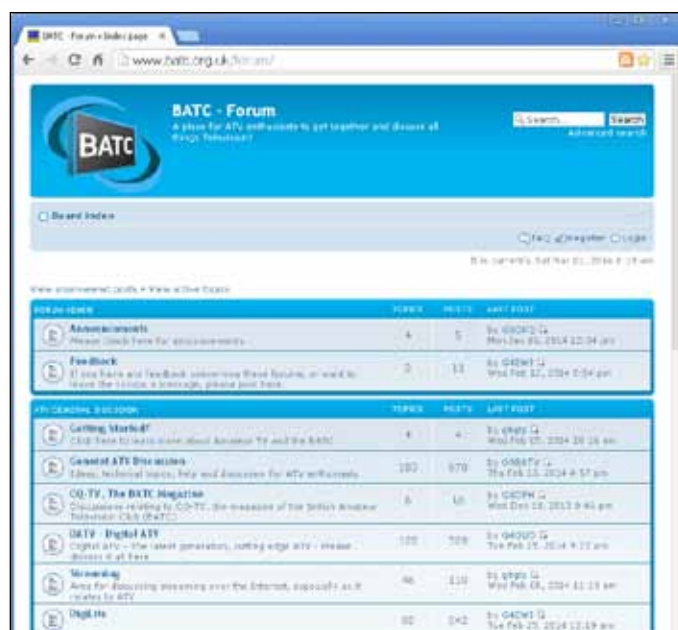
# The BATC Forum

Dave Crump – G8GKQ

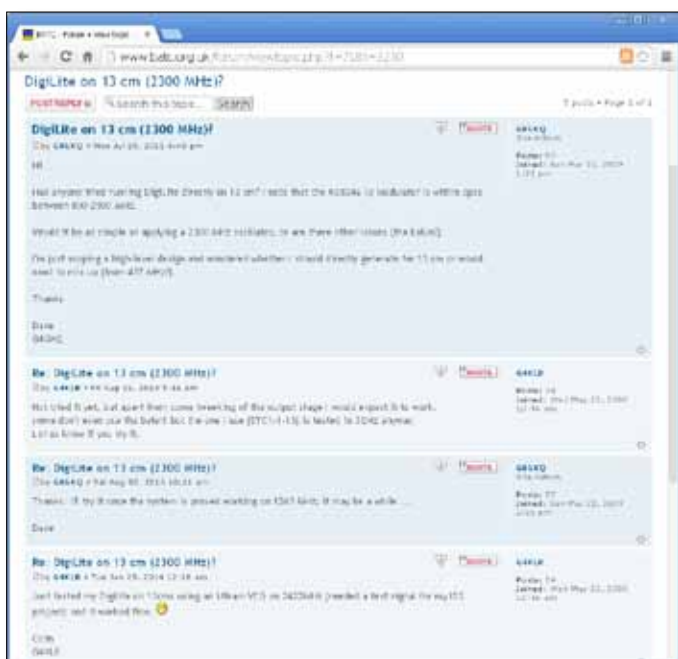
## Overview

The BATC Forum is an on-line Bulletin Board run by the BATC to promote discussion and information exchange about amateur television. You don't have to sign-up to view it, just go to <http://www.batc.org.uk/forum/>.

Sections of the Forum are devoted to broad areas of our hobby, such as Digital ATV, Digilite, Contests, Repeaters and Broadcast Equipment. There is also a General ATV Discussion section for all those questions that don't neatly fit anywhere else. The For Sale and Wanted columns that used to appear in CQ-TV have also migrated to the Forum – stuff seems to get sold fairly quickly now.







▷ A typical topic on the Forum:

Once you have looked at the Forum you may want to post a question or an answer. To do this you will need to sign up for an account.

## Getting an Account

The Forum is a stand-alone part of the website, so unfortunately your BATC Membership or streaming account will not work on the Forum and you will need to sign up for an account. This process is fairly simple, but you have to jump a few hurdles that we have put in place to prevent the Spammers using our forum to advertise kitchens (and worse!).

- ▶ Click on “Register” and then agree to the terms on the next page.
- ▶ In the registration form, please use your callsign as your username and put as much information in the other fields as possible. The final “silly” question is for automated spam prevention.
- ▶ You will receive an activation e-mail from [postmaster@batc.org.uk](mailto:postmaster@batc.org.uk). If you don't get it straight away, check your Spam folder (both in your mail client, if you use one, and with your ISP). Click on the activation link in the e-mail and then log-in to the Forum.
- ▶ Once you are logged in, you can reply to other Posts (by clicking the “Post Reply” button) or create new Topics within a Section (by clicking the “New Topic” button).

## Keeping up to date

There are 2 ways to keep absolutely up-to-date with the latest news on the BATC Forum. You can use RSS, which will show you all the latest posts, and the Digest, which will send you a regular e-mail with details of all the posts since your last e-mail.

- ▶ To set up RSS on a web browser, just load the appropriate plug-in or extension. I use “RSS Subscription Extension (by Google)” in Chrome, my preferred web browser. I also use the “News Free” app on my iPhone, and the “Feedly” app on my Android tablet. You don't even need to have registered for an account on the Forum.
- ▶ To set up a digest, you need to be registered on the Forum. Log-in and then select “User Control Panel”. Once the control panel loads, select the “Digests” tab. This will open in the “Basics” section. Here you need to select how often you want the Digests sent, what format the Digest should be in and what time of day it should be sent. If you want to receive Digests of the complete Forum, all you then need to do is click “Submit”. You can select more advanced options on the left hand side (but you don't need to).

## Moderation

The Forum should be a free and easy discussion about all aspects of ATV. Unfortunately, there are some (mainly outside the hobby) who want to use the Forum for other purposes. If you see a post which is inappropriate, please click on the Exclamation Mark in the triangle at the right hand side of the post. This will bring it to one of the Moderators' attention, and we will take appropriate action. We also delete or archive Sales and Wants that have been achieved, and generally try to keep the Forum tidy.

## Conclusion

If you have a question about an aspect of ATV, try looking on the Forum – that's what it's there for. If you have ideas on how to develop the Forum, please contact me. Lastly, I'd like to thank Chris G I F E F for keeping the forum on-line and John G M I M F N for doing the lion's share of the moderation. 🐾

# 70 cm Yagi

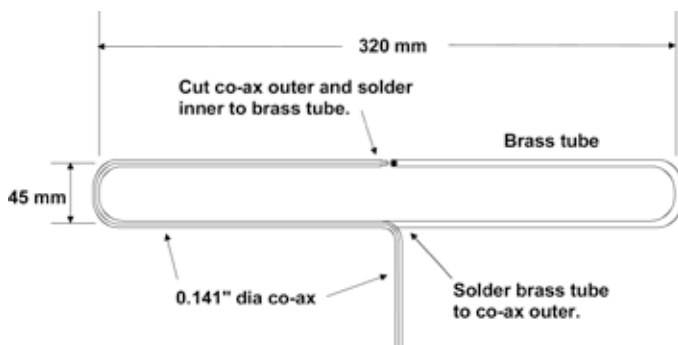
Most Yagi aerials can be improved by using a better balun. A balun changes from an unbalanced cable (Co-axial) to a balanced feed required by the driven element. Many so called baluns make a poor job of this or they add selectivity by placing a parallel tuned circuit in parallel with the driven element and so reduce the bandwidth. As much as 30% of the transmitted power can easily be lost in these bad baluns. The same applies to the received signal. Many dBs of improvement in the received signal can often be made by using a proper balun.

For Yagi aerials that use a folded dipole driven element the balun described below will improve the performance. This is very useful when working over long distances either using SSB or DATV. For those that do not use a folded dipole this approach may not be suitable.

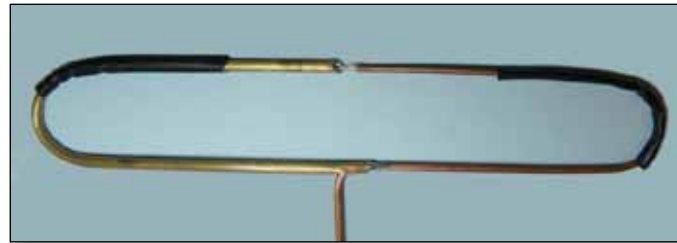
With a better balun or what I call an automatic balun, the feeder joins on to the driven element in a way that avoids the need for a separate balun as shown below. This is a folded dipole used as the yagi driven element. This version for 70cm uses 0.141" solid copper outer semi-rigid co-axial cable. This joins at the centre of the element which is naturally at ground potential. The outer of the co-ax then forms one half of the dipole which if fed opposite to the ground point. So there is no separate balun and all the RF power can only flow into the antenna.

For a seal, two layers of heat shrink sleeving are fitted over the feed point.

## 70 cm driven element dimensions



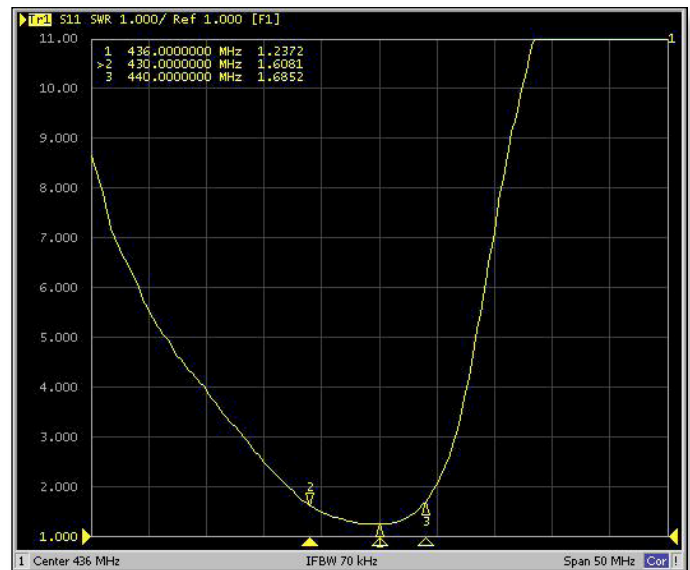
**Note:** These are the dimensions of the antenna that I was modifying. Make your dimensions the same dimensions as your existing element.



Comparing this antenna to the original when listening to the Belgian beacon gives many dB's increase in received signal strength.



## SWR Plot



Many of these feeds have been built by members with very good results. The same technique can be used on the lower bands. For 2m and below it is simpler to feed the co-axial cable inside the existing folded dipole. I normally use Mini RG8 cable for this purpose. Any questions, please email me at [secretary@batc.org.uk](mailto:secretary@batc.org.uk)

Dave Mann – G8ADM





# Versatile Audio AGC Circuit

Dave Kenward – G8AJN

*Whilst we spend many happy hours perfecting our video signals, the audio often tends to be an afterthought. For our local repeater a finely adjustable compressor/limiter circuit was required and this article describes what was found to be one of the most versatile solutions. With an independent built-in high gain pre-amplifier almost any microphone can also be used.*

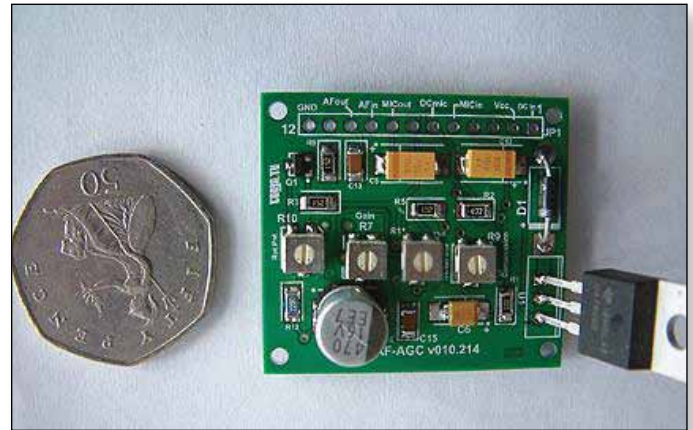
Popularly called VOGADs, automatic audio level controllers are essential for ATV use where a bench microphone can often be too far from the speaker while he is correctly positioned for the camera and will often be in a noisy (PA fans etc.) environment in which a poorly adjusted AGC circuit will raise the background to full volume when not speaking. Even a headset microphone can benefit from compression to avoid over-modulation. A solution would require a microphone amplifying chip containing a compressor with adjustable upper and lower compression points to allow more accurate settings to suit individual conditions would be ideal.

Analog Devices have come up with the solution in a low cost device. The SSM2166 is a complete audio and microphone signal conditioning system on a single integrated circuit. It provides amplification, RMS detection, limiting, variable compression, and downward expansion.

An integral voltage-controlled amplifier (VCA) provides up to 60 dB of gain in the signal path with approximately 30 kHz bandwidth. Additional gain if required is provided by an input buffer/ microphone input op amp circuit that can be set anywhere from 0dB to 20 dB, for a total signal path gain of up to 80 dB.

It is, as most are these days, surface mount, packaged in a 14 pin (SOIC14) body, making it tricky for home-brew. This article presents a commercially manufactured PCB specifically to allow for home construction. Small enough to be added easily to an existing project 35mm x 40mm (approx 1.25" x 1.5"), it is a low distortion, wideband audio circuit giving sufficient output from a microphone input to drive even the rather deaf Comtech ATV transmitters.

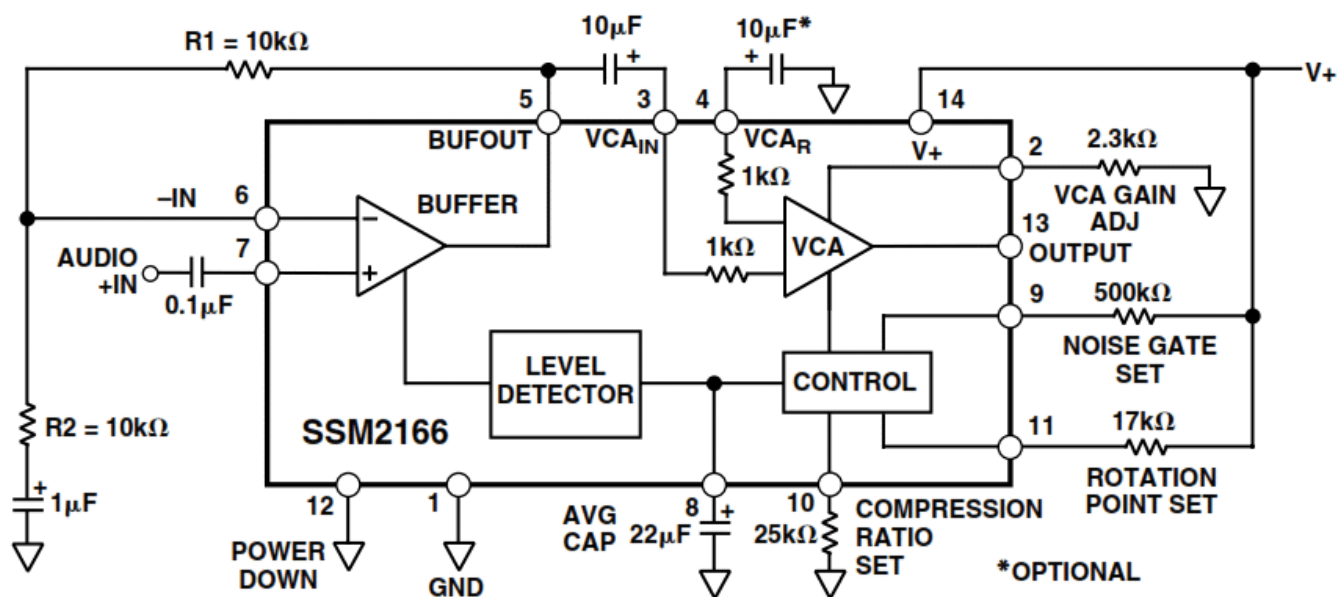
The SSM2166 operates on a single +5V supply at 8mA, accepts input signals up to 3v pk-pk into the VCA and will accept microphone signals into the buffer amp below 15mV, and produces output signal levels of over 3V p-p into loads over 5 k.



The low noise voltage-controlled amplifier (VCA) provides a gain that is dynamically adjusted by a control loop to maintain a set compression characteristic. The compression ratio is set by a single preset trimmer resistor and can be varied from 1:1 to over 15:1 relative to a user defined "rotation point"; signals above the rotation point are limited to prevent overload and eliminate "popping" and over-modulation.

- ▶ In the 1:1 compression setting, the SSM2166 can be programmed with a fixed gain of up to 20 dB;
- ▶ this gain is in addition to the variable gain in other compression settings.
- ▶ A downward expander (noise gate) prevents amplification of noise or hum. This results in optimized signal levels in noisy environments.
- ▶ The compression ratio and time constants are set with preset trimmer resistors.
- ▶ The compression ratio may be varied from 1:1 (no compression) to over 15:1 via a single resistor, R9
- ▶ The nominal gain of the system may be increased by the user via the on-board VCA by up to 20 dB.
- ▶ Additionally, the input buffer of the SSM2166 can be configured to provide fixed gains of 0 dB to 20 dB with R2.

Input signals below the threshold are downward expanded; that is, a -1 dB change in the input signal level causes approximately a -3 dB change in the output level. As a result, the gain of the system is small for very small input signal levels, even though it may be quite large for small input signals above the downward expansion threshold which is set externally by the user via R11 at Pin 9.



## SSM2166 SIGNAL PATH

Figure 1 illustrates the block diagram of the SSM2166. The audio input signal is processed by the input buffer and then by the VCA. The input buffer presents an input impedance of approximately 180k to the source. A DC voltage of approximately 1.5V is present at AUDIO +IN (Pin 7 of the SSM2166), requiring the use of a blocking capacitor (C1) for ground referenced sources. The input buffer is a unity-gain stable amplifier that can drive the low impedance input of the VCA.

- ▶ The VCA is a low distortion, variable-gain amplifier whose gain is set by the side-chain control circuitry. The input to the VCA is a virtual ground in series with approximately 1k. An external blocking capacitor (C5) is used between the buffer's output and the VCA input. The 1k impedance between amplifiers determines the value of this capacitor, which is 10μF.
- ▶ The VCA amplifies the input signal current flowing through C16 and converts this current to a voltage at the SSM2166's output pin (Pin 13). The net gain from input to output can be as high as 60dB (without additional buffer gain), depending on the gain set by the control circuitry.
- ▶ The gain of the VCA at the rotation point is set by the value of a preset resistor R7 connected between Pin 2 and GND.
- ▶ The AGC range of the SSM2166 can be as high as 60dB.
- ▶ The VCA pin (Pin 3) on the SSM2166 is the non-inverting input terminal to the VCA. The inverting input of the VCA is also available on the SSM2166's Pin 4 (VCAIN) and exhibits an input impedance of 1k, as

well. As a result, this pin can be used for differential inputs or for the elimination of grounding problems by connecting a capacitor whose value equals that used in series with the VCA IN R pin, to ground.

- ▶ The output impedance of the SSM2166 is typically less than 75R, and the external load on Pin 13 should be >5k.
- ▶ The nominal output dc voltage of the device is approximately 2.2V. This DC is used to bias the emitter follower transistor BC848. Any low noise high gain NPN audio transistor should be fine in this location.
- ▶ The bandwidth of the SSM2166 is quite wide at all gain settings. The upper 3dB point is approximately 30 kHz at gains as high as 60 dB (using the input buffer for additional gain, circuit bandwidth is unaffected).
- ▶ The lower 3 dB cut-off frequency of the SSM2166 is set by the input impedance of the VCA (1k) and C5. While the noise of the input buffer is fixed, the input referred noise of the VCA is a function of gain. The VCA input noise is designed to be a minimum when the gain is at a maximum, thereby optimizing the usable dynamic range of the part.

## LEVEL DETECTOR

The SSM2166 incorporates a full-wave rectifier and a patent pending true rms level detector circuit whose averaging time constant is set by an external capacitor C12 connected to pin 8. For optimal low frequency operation of the level detector down to 10Hz, the value of the capacitor should be 2.2μF.



Some experimentation with larger values for C12 may be necessary to reduce the effects of excessive low frequency ambient background noise. The value of the averaging capacitor affects sound quality: too small a value for this capacitor may cause a “pumping effect” for some signals, while too large a value can result in slow response times to signal dynamics. Electrolytic capacitors are recommended here for lowest cost and should be in the range of 2 $\mu$ F to 47 $\mu$ F.

Capacitor values from 10 $\mu$ F to 22 $\mu$ F have been found to be more appropriate in voice-band applications, where capacitors on the low end of the range seem more appropriate for music program material.

The rms detector filter time constant controls both the steady-state averaging in the rms detector as well as the release time for compression; that is, the time it takes for the system gain to react when a large input is followed by a small signal. The attack time, the time it takes for the gain to be reduced when a small signal is followed by a large signal, is controlled partly by capacitor C12 value, but is mainly controlled by internal circuitry that speeds up the attack for large level changes. This limits overload time to under 1ms in most cases. The attack time of the RMS level detector is dependent only on C12, but the release times are linear ramps whose decay times are dependent on both C12 and the input signal step size. The rate of release is approximately 240 dB/s for a C12 of 2.2 $\mu$ F, and 12 dB/s for a C12 of 22 $\mu$ F.

## CONTROL CIRCUITRY

The output of the RMS level detector is a signal proportional to the log of the true rms value of the buffer output with an added DC offset. The control circuitry subtracts a dc voltage from this signal, scales it, and sends the result to the VCA to control the gain. The VCA's gain control is logarithmic—a linear change in control signal causes a dB change in gain. It is this control law that allows linear processing of the log RMS signal to provide the flat compression characteristic.

## COMPRESSION RATIO

Changing the scaling of the control signal fed to the VCA causes a change in the circuit's compression ratio. The compression ratio can be set by R9 between pin 10 and GND.

Lowering R9 gives smaller compression ratios with values of about 17k or less resulting in a compression ratio of 1:1. AGC performance is achieved with compression ratios between 2:1 and 15:1, and is dependent on the application. A 100k potentiometer is used to allow this parameter to be adjusted.

## ROTATION POINT

Rotation Point Set, pin 11. The rotation point may be varied from approximately 20 mV RMS to 1V RMS. For example, 1k would typically set the rotation point at 1V RMS, whereas 55k would typically set the rotation point at approximately 30mV RMS.

Since limiting occurs for signals larger than the rotation point, the rotation point effectively sets the maximum output signal level. It is recommended that the rotation point be set at the upper extreme of the range of typical input signals so that the compression region will cover the entire desired input signal range. Occasional larger signal transients will then be attenuated by the action of the limiter.

## GAIN ADJUST

The maximum gain of the SSM2166 is set by the GAIN ADJUST pin 2 via R7.

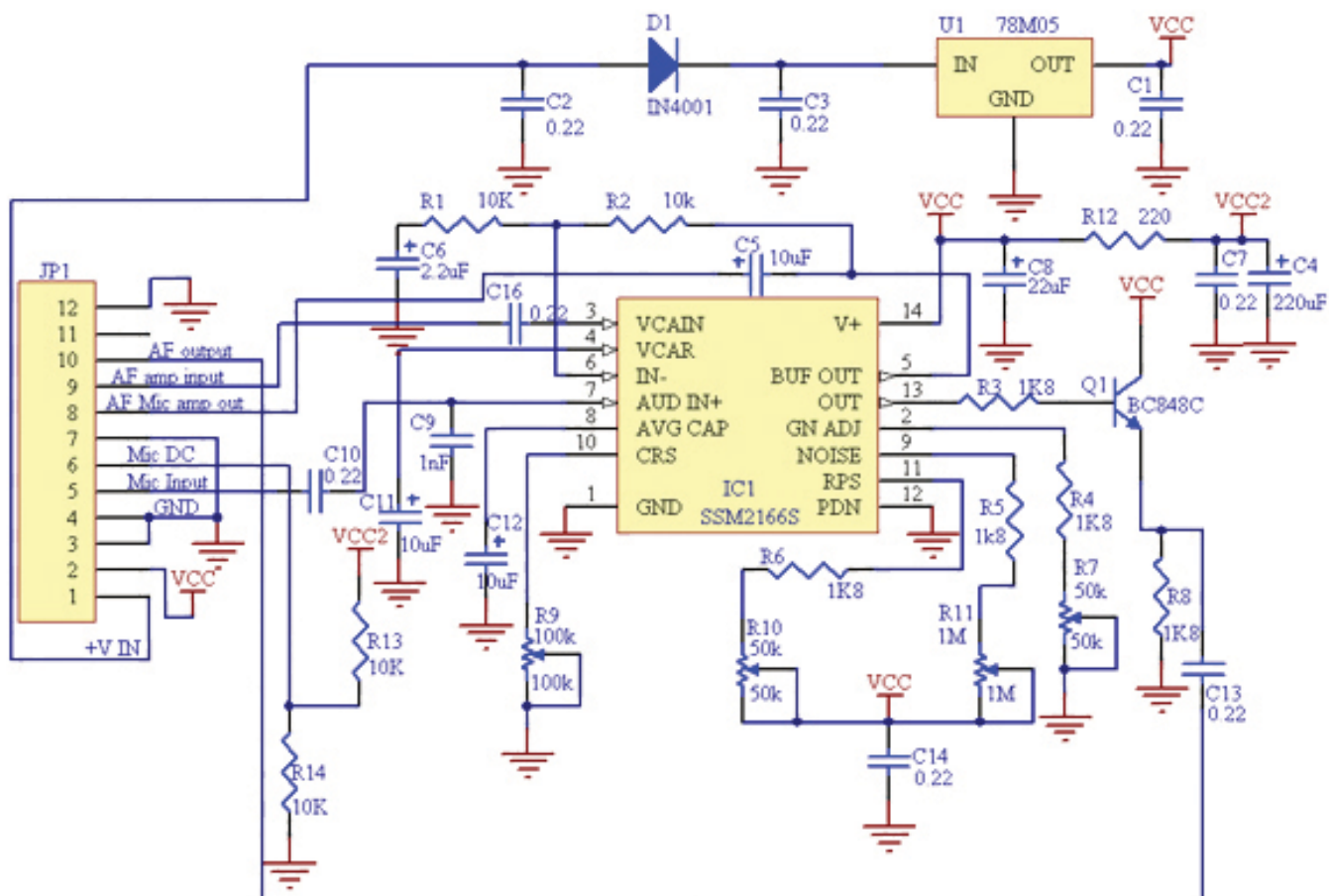
This resistor will cause the nominal VCA gain to vary from 0 dB to approximately 20 dB, respectively.

Switching Pin 2 through 330 R or less to ground will mute the output. Either a switch connected to ground or a transistor may be used. To avoid audible “clicks” when using this mute feature, a 10nF capacitor can be connected from Pin 2 to GND. The value of the capacitor is arbitrary and should be determined empirically, no provision for this feature has been incorporated in the pcb design.

## DOWNWARD EXPANSION THRESHOLD

The downward expansion, or noise gate, threshold is determined via a second reference voltage internal to the control circuitry. This second reference can be varied in the SSM2166, connected between the positive supply and the NOISE GATE SET pin (Pin 9) of the SSM2166.

The downward expansion threshold may be set between 300  $\mu$ V RMS and 20 mV RMS by varying the resistance value between Pin 9 and the supply voltage. Like the ROTATION ADJUST, the downward expansion threshold is inversely proportional to the value of this resistance: setting this resistance to 1 M sets the threshold at approximately 250  $\mu$ V RMS, whereas a 10 k resistance sets the threshold at approximately 20 mV RMS. In general, the downward expansion threshold should be set at the lower extreme of the desired range of the input signals, so that signals below this level will be attenuated. Best adjusted to suit personal taste.



Q1 has been added to give a buffered output for various loads. C13 can be increased for lower output impedance loads. C15 is no longer required.

### PRINTED CIRCUIT BOARD CONSIDERATIONS

Since the SSM2166 is capable of wide bandwidth operation and can be configured for as much as 80 dB of gain, reasonable care must be exercised in the positioning and cabling of the PCB that contains the IC and its associated components. The following applications hints should be considered and/or followed:

1. In some high system gain applications, the shielding of input wires to minimize possible feedback from the output of the SSM2166 back to the input circuit may be necessary.
2. A single-point (“star”) ground implementation is recommended in addition to maintaining short lead lengths.
3. The internal buffer of the SSM2166 was designed to drive only the input of the internal VCA and its own feedback network.

Stray capacitive loading to ground from the buffer output in excess of 5 pF to 10 pF can cause excessive phase shift and can lead to circuit instability.

4. When using high impedance input sources (>5 k ), system gains in excess of 60 dB are not recommended. This configuration is rarely appropriate, as virtually all high impedance inputs provide larger amplitude signals that do not require as much amplification.
5. When using high impedance sources, however, it can be advantageous to shunt the source with a capacitor C9 to ground at the input pin of the IC (Pin 7) to lower the source impedance at high frequencies, a capacitor with a value of 1000pF is a good starting value and sets a low-pass corner at 31kHz for 5k sources. In applications where the source ground is not as “clean” as would be desirable, a capacitor from the VCA input to the source ground might prove beneficial. This capacitor is used in addition to the grounded capacitor used in the feedback around the buffer, assuming that the buffer is configured for gain.



This connection makes the source ground noise appear as a common-mode signal to the VCA, allowing the common-mode noise to be rejected by the VCA's differential input circuitry. C11 can also be useful in reducing ground loop problems and in reducing noise coupling from the power supply by balancing the impedances connected to the inputs of the internal VCA.

The SSM2166 has an input buffer that may be used when the overall gain required exceeds 20 dB, the maximum user selectable gain of the VCA. For example, the desired output of 500 mV for an input around 15 mV, requires a total gain of 30 dB.

The 7805 regulator is used to allow wide ranges of input DC supply. As the whole board uses less than 25mA an external 5v regulated supply could be used and the regulator and diode replaced by links. The supply to the SSM2166 must not exceed 5v.

If a fixed usage is planned it is possible to reduce expense by fitting fixed resistors in place of several of the preset trimmers. If you are considering this here are some suggestions...

- ▶ **Pin 2:** Gain. For low level signal sources, the VCA should be set to maximum gain using a 20 k resistor. Setting the VCA gain to its maximum can also be achieved by leaving the pin in an open condition (no connection).
- ▶ **Pin 6:** Inverting Input to the Buffer. A 10 k feedback resistor R2 from the buffer output Pin 5 to this input pin, and a resistor R1, from this pin through a 1 µF capacitor to ground gives gains of 6 dB to 20 dB for R1 = 10 k to 1.1 k.
- ▶ **Pin 8:** Detector Averaging Capacitor. A capacitor, 2.2 µF to 22 µF, to ground from this pin is the averaging capacitor for the detector circuit.
- ▶ **Pin 9:** Noise Gate Threshold Set Point. A resistor to V+ sets the level below which input signals are downward expanded. For a 0.7 mV threshold, the resistor value is approximately 380 k. Increasing the resistor value reduces the threshold.
- ▶ **Pin 11:** Rotation Point Set Pin. This is set by a resistor to the positive supply. This resistor together with the gain adjust pin determines the onset of limiting. A typical value for this resistor is 17 k for a 100 mV "rotation point." Increasing the resistor value reduces the level at which limiting occurs.

Comment	Pattern	Qty	Component Number	Part Number
1nF	1206	1	C9	F 1759337, R 758-0354
0.22	1206	9	C1, C3, C10, C13, C16 C2, C7, C14	C15 not used F 1759362
2.2uF	C	1	C6	F 1457419
10uF	D	4	C5, C8, C11, C12	F 1432447
220uF	E	1	C4	F 2326089
220R	1206	1	R12	F 2139380
1K5	1206	5	R4, R5, R6	F 2331868
10K	1206	3	R1, R13, R14	F 2057856
2K2	1206	2	R3, R8	F 233145, R 740-9097
4K7	1206	1	R2 (or 10k for non-electret)	F 2331874
50k preset	4mm SMD	2	R7, R10	F 1520634
100k preset	4mm SMD	1	R9	R 486-7554
1M preset	4mm SMD	1	R11	R 177-419 or F 1689911
L78M05	TO220V	1	U1	F 1087117
BC848C	SOT23-3	1	Q1	F 9846670
IN4001	Axial	1	D1	R 1458986
SSM2166S	SOIC14	1	IC1	R 412-888
Header, 12-Pin	2.5mm spacing	1	JPI (optional)	**

**Note:** Part numbers are for guidance only. Numbers beginning with R indicate RS, F for Farnell.

(Do not include these letters when ordering from the supplier!)

\* Decoupling, other values > 10mfd may be used if available.

\*\* The (optional) header should be non-reversible such as the SPOX series.

Header (socket) R 6878076 with 12way housing (plug) R 6878026 and with crimp terminal pins R 6877152. If desired a right-angle header could be used.

Presets should be 4mm SMD types (shown on the left), those with 'protruding' contacts (shown on right) are difficult to fit due to their extra lead length but can be cut to fit or the legs can be folded under the body. Similar types in 3mm format can be fitted instead.

Do not be tempted to save money by getting the cheaper 'open' skeleton types as they fall apart too easily.

## CONSTRUCTION NOTES

JPI is a 12 way 2.5mm connector for the board including the DC input. This connector is entirely optional and wires can be directly soldered into the holes instead or individual pins may be used. To avoid the need for heat-sinking the 7805 regulator the input should be around 10 – 12v DC .

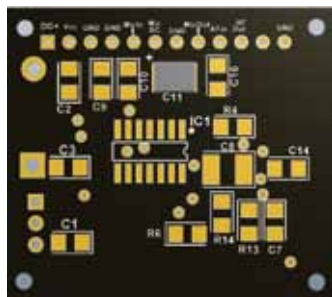
Mainly SMD components are used. Resistors are 1206, the presets are 4mm spacing although it should be possible to use 3mm with care placing them due to tracking beneath the component.

Small capacitors are mostly 1206. Electrolytics are intended to be SMD but wire-ended may be used by cutting the legs to 5mm and bending to an 'L' shape for soldering to the PCB solder pads. Due to the high price of tantalum capacitors, they could be used only for the cheaper 2.2uF and 10uF while the larger values could be aluminium.

With the high gains available in this circuit, sensible cabling and grounding techniques should be used and suitable screening from nearby RF sources employed.

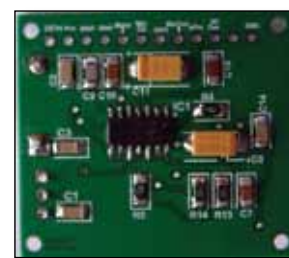


▷ Board Topside overlay



▷ Board Bottom overlay

The output of the preamp section (pin 5) is taken out to pin 8 of the connector JPI. This gives the option to feed a different source in via switching. If the facility is not needed the pins 8 and 9 can be linked together.



▷ Bottom View.

Pin 2 of the connector JPI carries the 5v line to enable a test point or front panel 'ON' light.

Pin 6 of the JPI supplies DC to run an electret microphone if required. Link pins 6 to pin5 to enable it. R13 and R14 values may be tweaked to provide sufficient voltage for individual types of microphone. Initially the values give halfVcc (2.5v) off load. But if more or less is required the values can be altered accordingly. C15 is not required in this circuit.

If you are not using a low level microphone input the value of R1 can be dropped to suit the levels likely to be encountered. Unity gain R2 = 0R (with R1 = O/C), for maximum gain R2 = 22k. I suggest a 4k7 for electret or 10k for regular magnetic microphones. A 10k could always be placed on top of the R2 10k at a later time to reduce the gain if desired.

I suggest placing the 12 way connector header JPI (if intending to use one), but do not solder it in yet as you may need to remove it to permit fitting of the adjacent electrolytics. Do semiconductors first, followed by all other bottom-side components, then the preset trimmers, then top-side electrolytic capacitors to ensure ease of soldering followed by the remaining top-side components. Place the 7805 last.

## INITIAL SETTINGS.

My preferred method is to set all presets to mid-position. Connect microphone to pin 5 of JPI (if electret type then link JPI pin 6 & pin 5) and link pins 9 & 8. The audio output on pin 10 should go into an audio amplifier for monitoring via headphones. (There is often sufficient output to drive earphones). Connect the DC supply to JPI and check for the 5v at Pin 2 of the connector. Now adjust the presets to give the type of agc/compression/limiting required. Large audio signals, line input levels for example, can bypass the front amplifier stage and go straight in onto pin 9 of JPI.

Please check with my website [www.g8ajn.tv](http://www.g8ajn.tv) under PROJECTS menu for updates and details of purchasing these inexpensive commercially manufactured PCBs. 📺



# Digital ATV – Using a Spectrum Analyzer

Ken Konechy - W6HHC

Reproduced from the Orange County Amateur Radio Club newsletter. [www.W6ZE.org](http://www.W6ZE.org)

I will venture to guess that most hams do not use a “stand-alone” Spectrum Analyzer instrument. Quite a few hams have a Spectrum Analyzer built into their HF rig (like the Icom IC-7000, the Icom IC-7600, Yaesu FT DX 3000, or even a Yaesu FTM-4000M VHF/UHF rig, etc.) to look for signals on the band. In my situation, I was introduced to a built-in Spectrum Analyzer (SA) when I purchased an Icom IC-756-Pro3 in 2007 and a stand-alone Spectrum Analyzer instrument was purchased in 2013 because my involvement in digital-ATV.

Historically, “stand-alone” Spectrum Analyzer instruments were built by companies like HP and Agilent for use in industry and had huge price tags of \$20,000 to \$40,000 new! A ham could only hope to find a used Spectrum Analyzer for sale that still worked and had an affordable price tag. At least one instrumentation company based-in-China is now producing good-quality Spectrum Analyzers at a much more reasonable price.

## Spectrum Analyzer Uses

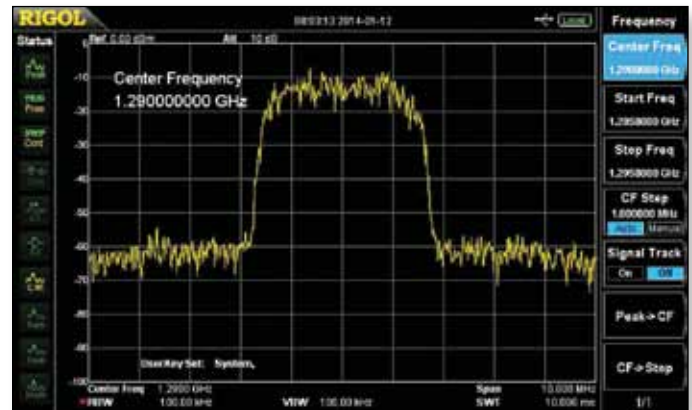
Rigol Technologies produces many types of instruments, including several families of Spectrum Analyzers. Charles G4GUO pointed out to me that the Rigol Model DSA815 SA instrument is an entry-level unit that can operate up to 1500 MHz and has a base-price that is only US\$1295.



▷ Rigol Model DSA815 Spectrum Analyzer can operate from 9 KHz to 1500 MHz

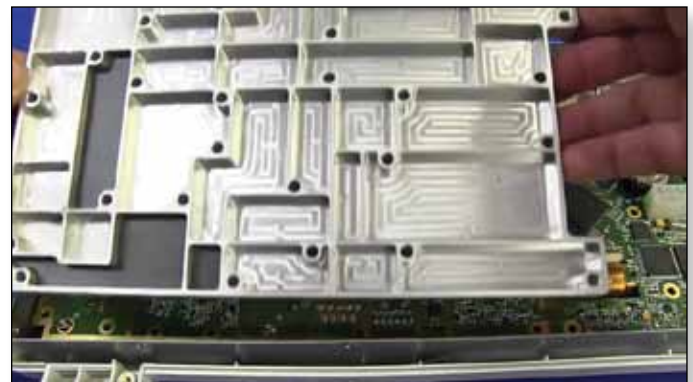
The basic use of a Spectrum Analyzer is to analyze an RF signal over a range of frequencies. This is especially useful in DigitalATV (DATV) where you are interested in measuring band-width, looking for distortion, side-spurs and harmonics. These tasks of measuring band-width, looking for distortion, side-spurs and harmonics are very difficult to accomplish with only an oscilloscope

Fig02 shows a typical DVB-S/QPSK digital modulated signal on 1.290 GHz that is well-shaped and without distortion. The display is 10 MHz wide at 1 MHz per horizontal division.



▷ Spectrum Analyzer display of QPSK digital modulation on 1290 MHz

The design of a good quality spectrum analyzer that is useable up to 1500 MHz requires immense attention to details like shielding to prevent introducing cross-talk. Fig03 shows that the Rigol unit utilized a complex shielding-box milled from a solid block of aluminum to contain the RF radiations of one part of the design from unintentionally interfering with another part of the circuit design.



▷ Construction of the RF shielding-box milled from solid aluminium block (Courtesy of YouTube EEV #391)

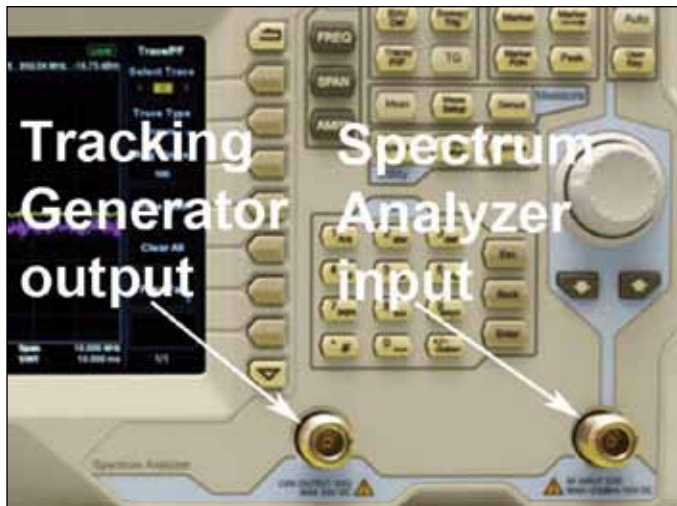
There are quite few other functions that can be performed by a Spectrum Analyzer, such as:

- ▶ Signal generation
- ▶ SWR measurements
- ▶ Power measurements



### Tracking Generator option

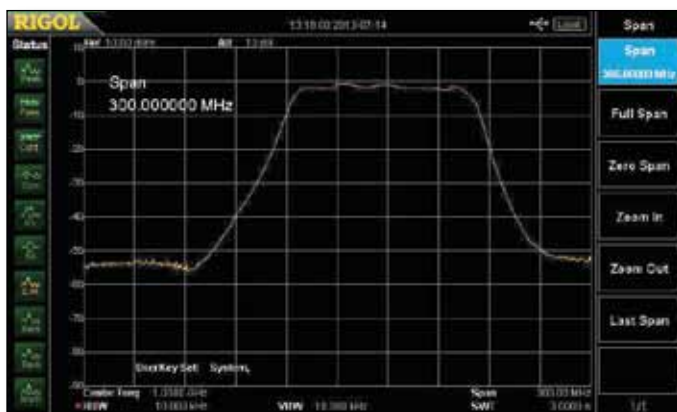
Rigol produces a variation of the base DSA815 SA unit that includes a “tracking generator” option. This model is called DSA815-TG. A tracking generator is a sweeping signal generator that tracks with the display span of the Spectrum Analyzer. Not only does the tracking generator help measure the performance of filters, but it makes a fine stand-alone RF signal generator that operates from 9 KHz up to 1500 MHz.



▷ Location of Tracking Generator output relative to the input connector of the SA

Do you want to calibrate a receiver...? just place the tracking-generator output on the frequency of interest with a steady carrier and no sweeping.

As I mentioned earlier, one use of a tracking-generator option is to simplify the measurements of and displaying the performance of a filter. Fig05 shows the measured performance a surplus tunable band-pass filter loaned to me for testing by Robbie KB6CJZ.



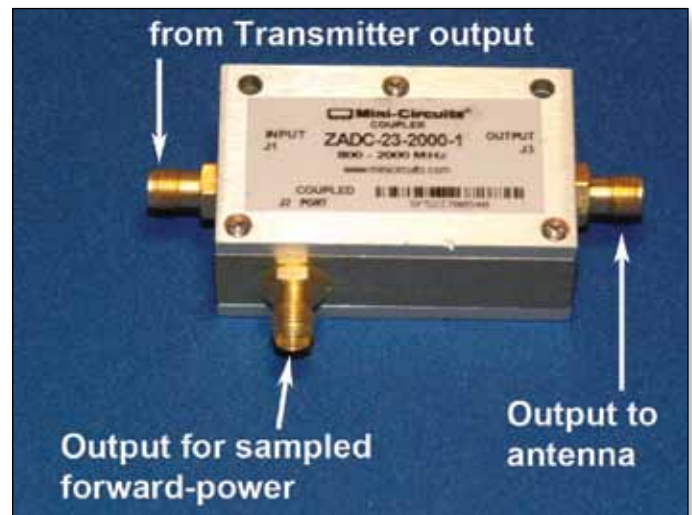
▷ Spectrum display (center frequency set to 1.0 GHz) of a surplus tunable band-pass filter

This tunable filter had the value of 1030 MHz hand-written on the unit. I think it is easy to envision using the Spectrum Analyzer to confirm re-tuning of this band-pass filter:

The Rigol Tracking-Generator option is priced at US\$200, but must be ordered as a model DSA 815-TG Spectrum Analyzer, since it is not a plug-in option. The price of a DSA815-TG unit is US\$1495, total.

### SWR option

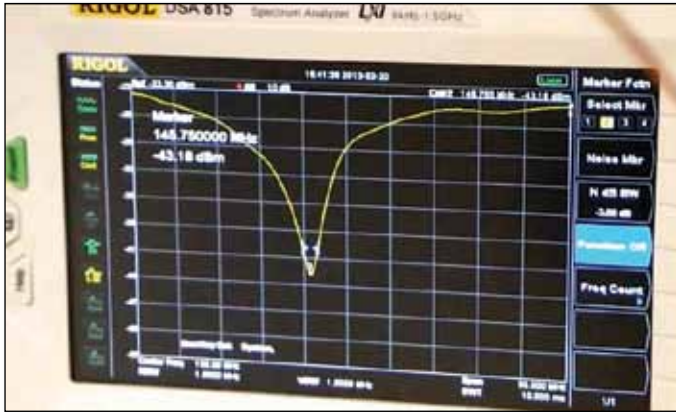
Another neat aspect of a tracking-generator is that it simplifies measurement and reports for documenting SWR of an antenna. The heart of making an SWR measurement with a Spectrum Analyzer is using a microwave directional-coupler to take a sample of the reflected RF and puts that sampled signal back into the input connector of the SA. Fig06 shows a typical surplus microwave directional coupler.



▷ Typical surplus directional-coupler with an output connector for sampled forward-power

Surplus directional-couplers are usually specified for a specific range of microwave frequencies. However for basic measurements of antenna SWR, you can use directional-couplers that are designed for a different frequency range. All that really changes is the gain of the sampled signal. Art WA8RMC did point out to me that the “gain of the directivity” also changes when you operate in a different frequency range. Note - directional-couplers can be purchased with either SMA or N-connectors. Finally, these units are reversible; connect the transmitter to the J3 connector on the unit in Fig06... and now the sampling connector delivers reflective-power as an output.

Fig07 illustrates how a directional-coupler can be used with the Tracking-Generator output to find resonance on an antenna and help you tune it to the correct frequency. As a NOTE: No special Rigol optional-cost SWR software was used to perform the test.



▷ Using a direction-coupler to tune an antenna (but, using no special SWR software)

Next, because modern Spectrum Analyzers contain microprocessors, a little software can be offered as an option to measure all the displayed SWR signal strength values... calculate a few values... and can provide you with a finished SWR report.



▷ The Rigol software DSA800-VSWR option measures values and displays SWR report

Rigol optionally sells two SWR accessories. The software-only measurements-calculations accessory Model DSA800-VSWR software kit sells for US\$459 and provides professional reports that perform all of the tedious calculations.

- Rigol also sells accessory Model VB1020 kit that includes
- a specially de-signed directional-coupler hardware unit that has a frequency range from 1 MHz to 1500 MHz,
  - the hardware unit screws directly onto the TG-output and the SA-input connectors, and
  - the software measurements and SWR report code.

The cost of the optional Rigol Model VB1020 kit is US\$599.

### Power Measurement option

All Spectrum Analyzers can perform power measurements on simple carriers and even complex digital modulation without special soft-ware. Just put the SA into the dBm scale. However, for the complex digital-modulation signals, you need to compensate for the video-bandwidth setting of the SA, compared to the channel-bandwidth of the digital-modulation signal.

For a simple un-modulated carrier signals, be-cause the bandwidth of the signal is so narrow (less than 1 KHz), the peak reading of the carrier is directly equal to the output power-level.

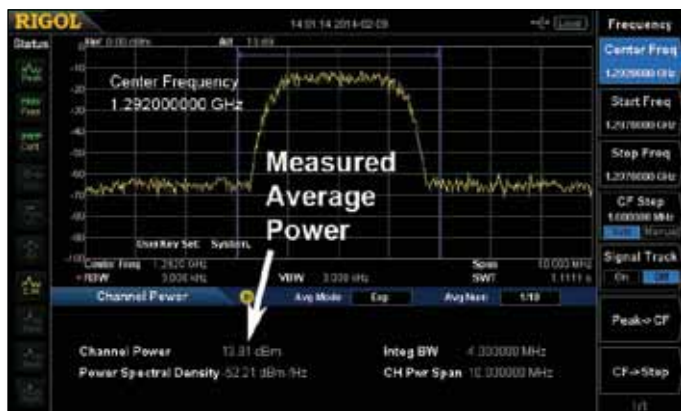
Mike WA6SVT (a commercial television station engineer) explained to me that for a more com-plicated RF signal such as a DVB-S/QPSK “hay-stack” (see Fig02 as an example), the Video BandWidth (VBW) and Resolution BandWidth (RBW) setting on the Spectrum Analyzer has to be set to a value that is a little wider than the DATV signal you want to measure. If the RBW can be set correctly, then the DATV average power level is the value displayed at the top of the “hay stack”.

On my entry-level Rigol DSA815, the largest VBW and RBW setting available is 300 KHz. This bandwidth is too small to directly measure power on a DATV signal that has 3 MHz or greater Occupied BandWidth. Fortunately there is a mathematical conversion that can compensate for a narrow VBW/RBW setting. Ron W6RZ and Rob MØDTS both suggested to me on the Yahoo DigitalATV Forum that the correction factor in dB for spectrum analyzers is:

$$10 * \log 10 (\text{channel bandwidth} / \text{resolution bandwidth})$$

Rigol optionally sells a software-add-on accessory to measure power directly called DSA800-AMK (Advanced Measurements Kit). The Channel Power mode of this kit uses the built SA microprocessor to integrate the power level measurements over an “integration BW” that you can select.

Fig09 is a display of the optional Channel Power mode measuring the RF output of a bare-foot DATV-Express board signal running SR=2.2 MSymb/sec at 1292 MHz. The integration BW was set to 4 MHz for this measurement of 13.81 dBm power output. This Channel Power mode option certainly makes it simple to measure DATV power levels. No more worrying if the Bird power meter you are using is a bolometer/thermal type or not...and without digging out your scientific log calculator. The optional cost of the Rigol Model DSA800-AMK kit is US\$499.



▷ Display of Channel Power option measuring 13.81 dBm average power (DVB-S at 2.2 MSymbols/sec)

## “Secret” Demo-Mode for Options

One complaint that I have is that NONE of the Rigol (or Rigol distributor) literature or web site materials explains that most of the extra-cost software options are available as a free demo mode to try out. The time-out period on the demo-modes is 200 hours of Rigol Spectrum Analyzer power-on. A phone conversation with technical support of Rigol (quite good at helping me use the instrument) hinted about the unpublicized demo-mode... but he did not have any real details of trial-period, etc. I finally discovered the “secret” demo-mode when I only had about 11 hours of use left to try them out.

## Easy Screen-Capture Feature

A small feature on the Rigol SA that I really enjoy using is the one-button screen capture directly to an inserted USB-memory-stick. Just plug the USB-memory into the front-panel USB port... make sure the screen displays what you want to record... and press the PRINT button on the SA. Capturing the screen (just as displayed) could not be easier. I wish Windows would think about providing a setting for printing the screen directly to a USB-memory-stick.

## Conclusion

While not essential, a Spectrum Analyzer is a very useful instrument to have available for looking at DATV signals. For normal DATV usage, viewing the SA is perfect for adjusting the drive into RF power amplifiers. An over-driven PA starts to exhibit spectral-regrowth distortion where the distortion creates a signal that grows wider and wider as the drive level is increased. The problem with spectral-regrowth is that the received video still looks good, but more and more RF interference is occurring on the sides of your intended signal. DATV uses include:

- ▶ Adjusting RF power amplifier drive
- ▶ Inspecting quality of transmitted signal
- ▶ Confirming any spurs are low-level
- ▶ Checking for undesired harmonics
- ▶ Tuning band-pass filters
- ▶ Adjusting SWR on antennas
- ▶ Measuring power of digital-modulation
- ▶ Pointing antenna to weak DX signal

(Spectrum Analyzer will see weak signal faster than STB can lock onto the signal) 📺

## Contact Info

The author may be contacted at [W6HHC@ARRL.net](mailto:W6HHC@ARRL.net)

### Useful URLs

Rigol Technologies (North America) [www.Rigolna.com/](http://www.Rigolna.com/)

Rigol (United Kingdom) [www.Rigol-UK.co.uk/](http://www.Rigol-UK.co.uk/)

TEquipment USA Distributor for Rigol [www.TEquipment.net/](http://www.TEquipment.net/)

YouTube “Tear-down” of Rigol DSA815-TG unit (EEVblog #391) [www.youtube.com/watch?v=EY0acWrCYjw](http://www.youtube.com/watch?v=EY0acWrCYjw)

BATC info site for DTXI DVB-S exciter [www.DTXI.info](http://www.DTXI.info)

British ATV Club – Digital/DigiLite/DTXI forums [www.BATC.org.UK/forum/](http://www.BATC.org.UK/forum/)

DATV-Express Project web site (SDR-based exciter) [www.DATV-Express.com](http://www.DATV-Express.com)

British ATV Club - Digital Forum [www.BATC.org.UK/forum/](http://www.BATC.org.UK/forum/)

Orange County ARC entire series of newsletter DATV articles [www.W6ZE.org/DATV/](http://www.W6ZE.org/DATV/)

Yahoo Group for Digital ATV [groups.yahoo.com/group/DigitalATV/](http://groups.yahoo.com/group/DigitalATV/)

dBm to Watt power convertor [www.rapidtables.com/convert/power/dBm\\_to\\_mW.htm](http://www.rapidtables.com/convert/power/dBm_to_mW.htm)





# Amateur Television Quarterly



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## Early Colour Cameras and their problems- Part 2.

Brian Summers – G8GQS



In the UK Marconi had an exchange deal with RCA and they took the RCA design and made one for the BBC to test out. This camera, like the RCA one was basically 3 monochrome cameras in the one box, even to the extent of having 3 camera cables<sup>1</sup>. This camera was developed and became the production version, the Marconi BD848, now tidied up with just the one cable with 88 wires in it.<sup>2</sup>



▷ The RCA TK40 3 tube IO camera

RCA had invented the shadow mask tube, so the receivers were sorted out, but the cameras were still Very Big and Very Expensive. In the USA colour broadcasting was slowly being introduced and in the UK there was much talk about the BBC starting a colour service.

The BBC had been running test transmissions using the Marconi 3 IO colour cameras for some time and it was apparent to Broadcasters and manufacturers alike that colour was on the way. What could be done?

EMI had a perfectly sound 3 vidicon camera in production, but it liked a lot of light and its pictures were not really good enough for a broadcast live camera. EMI then made an experimental camera with a 4½ inch IO tube and 3 vidicons, to see how well it worked. It is thought that the experience gained led to the 4 tube EMI 2001 a few years later. Over in the USA, RCA made a similar decision and took that camera, the TK-42 into production, this replaced the ageing 3 tube I.O. cameras they were selling. The BBC sent a team over to RCA to evaluate the camera and their report was quite favourable<sup>3</sup> but the cost was huge, \$70,000 in 1965 money, about £350,000 today. So there was a lot evaluation of different cameras to see what could be used and afforded!

At this point Philips came to the rescue with their new tube, the 30mm diameter Plumbicon. The Plumbicon was a vidicon type tube with a lead oxide target, but it performed much better than an ordinary



▷ RCA TK-42 4 tube camera



▷ Philips PC60 in use at Wimbledon

vidicon and its small size made it very suitable for colour cameras. Philips made a demonstration camera which was evaluated by the BBC<sup>4</sup> and this led to the BBC buying the production version, the PC60, for the first of their colour mobile control rooms (CMCRs). At this point it was obvious to everyone that the Plumbicon tube was the way to go. In the UK Marconi was the first (1965) with the 4 tube MkVII closely followed by EMI and their 2001 (1966) camera also a 4 tube design. It was the perceived wisdom that a 4 tube camera with a separate luminance tube was the best solution, but Philips stuck to a 3 tube design with “contours of of green” processing. The next generation of cameras proved Philips to be correct with the 3 tube design. All of these cameras produced satisfactory pictures (for the late 1960s). Meanwhile RCA having invested heavily in their IO + 3 tube TK-42 camera stuck with it till about 1970. Tube cameras continued their development through the 1970 and 1980s, but the writing was on the wall for them by the early 1980s. 🗨️

### Notes:

1. A report in Practical Television, Dec 1955 describes the BBC receiving the experimental colour equipment to operate on 405 lines with modified NTSC coding.
2. A report in Practical Television Sept. 1958 describes the BD848 camera and associated OB unit.
3. BBC report No.T-134 An appraisal of the RCA 4 tube colour camera TK-42.
4. BBC research department report No.T-132 Comparisons between different colour cameras.

The original lecture can be viewed at the BATC Streamer “Film Archive” CAT13/04  
More information early colour cameras can be found at the Museum of the Broadcast TV Camera



# Classic circuits

## Remote control of a relay switching unit using DTMF commands.

By Brian Kelly

Like most of my projects, this unit started its life as a scribble on scrap paper. It was designed and built in a hurry and the scrap paper was never turned into a proper document package. Please forgive any discrepancy between the description and reality as I've had to write this from a two and half-year-old recollections and some reverse engineering. The PCB layout and PIC program were, however, safely archived.

gap in the valid command sequence 'for future developments'. In hindsight, this was a good idea as it left space for commands this design could use. The range of MF commands available is \*50# through to \*59# although this can easily be changed by modifying the source code and re-assembling the PIC program. The source is available from the BATC web site and on the BATC CD. Unfortunately, GB3XG uses single digit commands so for example, keying \*52# would be seen as four individual instructions which could leave the repeater performing an unwanted

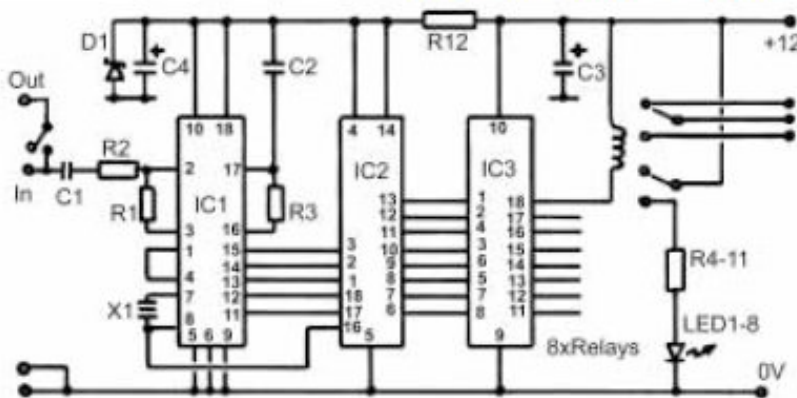
- \*56# turns relay 3 on
- \*57# turns relay 3 off
- \*58# turns relay 2 on
- \*59# turns relay 2 off (also turns off after 5 minutes period)

Relay 1 is used to interrupt the audio loop-through.

### Circuit description.

The industry standard 8870 chip performs the decoding of audio tones to a binary number. This chip not only filters the audio but also uses a clever 'decision' process to check that both the necessary tones are present for at least 40mS. When it has decided that a genuine MF signal has been received it decodes it to a binary number and signals that it has done so by raising a 'tone detected' (strobe) pin. All these signals are fed to the 16C84 device which waits for the 8870 to send a strobe signal then reads the numbers in through port A. It then checks to see if the number corresponded with the '\*' digit and if so, it disconnects the downstream audio feed by operating relay 1 and starts a 5 second timeout counter. If the following digits are in the 50 to 59 range and received within the 5 seconds, it drives the appropriate port B pins high or low. If the 5 second period runs out before the remaining digits have been received it purges any that did get through and turns the audio back on again.

The port B pins are capable of driving the relay coils directly but would be pushed close to their limits to do so. To ease the strain on them, a ULN2803 driver transistor IC used which also has the benefit of having a diode clamp on each of its outputs, eliminating the need to add a diode across each relay coil. The remainder of the circuit consists of LEDs and current limiting resistors to show which relays are energised; they can be omitted if desired. The unit runs on a 12 volt supply but can be modified to run on 5V if the relays are replaced with ones having a 5V coil rating, the zener diode is removed and its series resistor replaced with a link. I have not tried this and although it is technically feasible, there could be problems with switching spikes from the relays and PSU borne noise upsetting the tone decoder and PIC chips.



The circuit diagram

I was asked to design a unit that could be used to control monitoring equipment at a repeater site. It had to accept commands sent as DTMF tones over the repeaters audio channel and be able to switch either AV signals or power supply feeds at currents up to 1 Amp. The switching requirements left no option but to use relays and the cheap and easily available 'BT53' style was chosen. As these are two pole relays and only one pole was called for, the other was put to use to drive a monitoring LED. The LED is illuminated when the relay is energised. It would be simple to modify the wiring to allow both poles to be used if the LED facility is not needed.

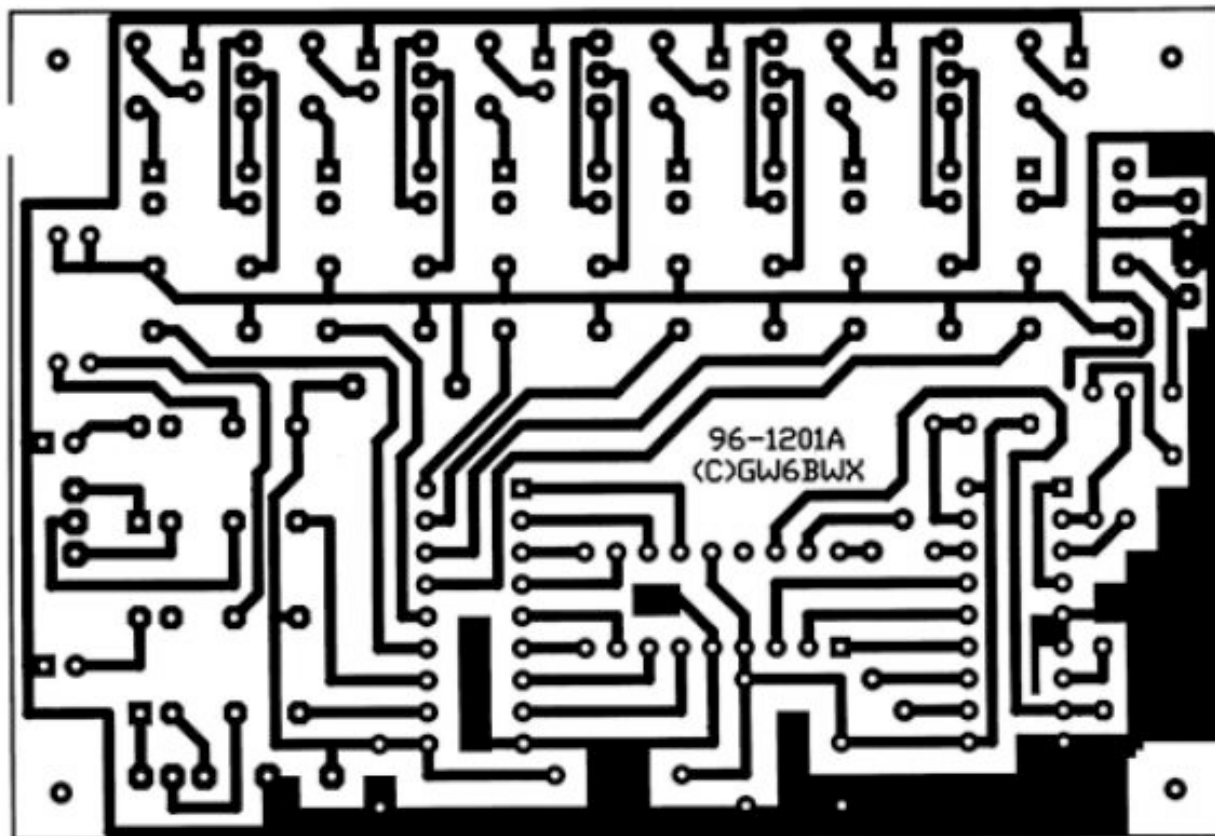
The design specification stated that the unit should co-exist with other MF controlled equipment, specifically the single MF tone pair commands that GB3XG used and the four MF tone sequence used by GB3ZZ. When I wrote the operating system for GB3ZZ almost a decade ago (when I had far fewer grey hairs!) I deliberately left a

action. To overcome this problem, the audio feed to the repeaters existing MF decoder had to be disconnected as soon as the '\*' was seen and then reconnected after the '#' was received. One of the relays is used for this purpose. The audio is looped through the board and interrupted for the duration of the command sequence. All the other relays have changeover switch contacts (note: SK6 & 7 have reversed pins) are available for general-purpose use. To make the unit as versatile as possible, the relays are operated in different ways. Some are selectable as 'one of four', some are turned on with one code and off with another and one relay has a timed on period before switching itself off.

The actual commands are:

- \*50# turns relay 8 on, 5,6 & 7 off
- \*51# turns relay 7 on, 5,6 & 8 off
- \*52# turns relay 6 on, 5,7 & 8 off
- \*53# turns relay 5 on, 6,7 & 8 off
- \*54# turns relay 4 on
- \*55# turns relay 4 off





Copper layout – not actual size

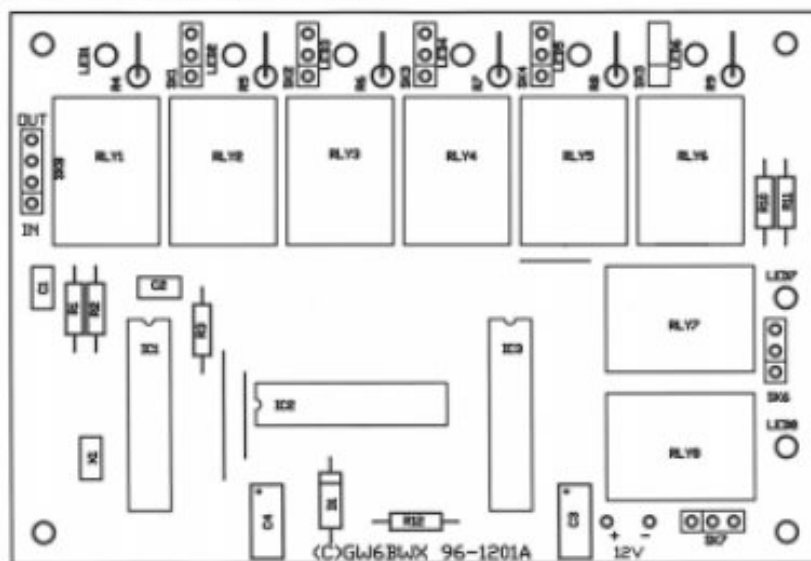
### Construction

The PCB artwork file in printable format is included with the source code. Apart from the usual static precautions, there isn't much to advise about building it. The 16C84 must be programmed before use and be set to its 'XT' crystal configuration. It actually gets its clock from the generator inside the 8870 but setting it to XT mode will

ensure the on-chip oscillator doesn't try to start up. The original unit used 0.1in Molex type connectors but Veropins could be employed or even just soldering wires to the board is acceptable. Remember to connect the audio input and output pins the right way around or the unit will always disconnect itself and never hear more than a single tone!

### Components list:

- R1, R2 100K 0.25W
- R3 330K 0.25W
- R4 - R11 1K 0.25W
- R12 470R 0.25W
- C1, C2 100nF
- C3, C4 10uF 16V Tantalum bead
- D1 BZX88 C5V1
- X1 3.579MHz ceramic resonator (Maplin DJ31J)
- IC1 MV8870 or HT9170 (Maplin AZ12N)
- IC2 16C84 (Maplin AY31J)
- IC3 ULN2803 (Maplin QY79L)
- LED1 - 8 Red 0.2" LED
- RLY1 - 8 BT53/3 style (Farnell 280-537 or Maplin DC33L)



Component overlay

Note: The software to accompany this article can be downloaded from the software page on our web site at [www.batc.org.uk/software.htm](http://www.batc.org.uk/software.htm) – ED.

# Turning Back the Pages

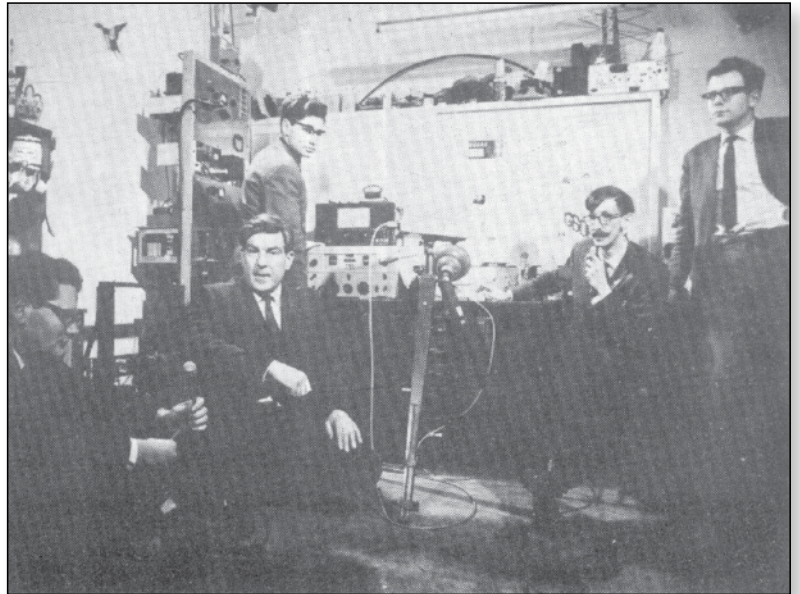
A dip into the archives of CQ-TV, looking at the issue of 48 years ago.

## CQ-TV 56

**The issue is not dated, but was issued in mid 1965**

A notable event that this issue of CQTV reported was a visit by the BBC to the ATV station of Mike Bues. This was no 'one camera' interview session, but a full outside broadcast, and the magazine cover showed the fleet of OB vehicles parked outside for the day! The insert top right showed the microwave link that was used and a BBC engineer adjusting a 70cm 8 over 8 aerial. Just visible are the two wire cables running vertically from the top of the mast, which were used to hold it steady. The vans were - from right to left - a storage van, the mobile control room, a generator van, the microwave ling mast van, and another articulated vehicle on the far left of the picture.

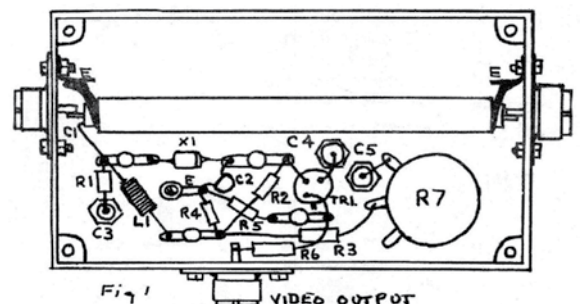
The interviewer was Christopher Rainbow - later a reported for the ITV London region, and he is seen on the left in the picture of Mike's shack, with BATC members John Ware, L Woolf, Mike Bues and Mike Cox on the right. The OB team had arrived to set up their four 4½" image orthicon cameras and 2½ lighting in Mike's home,



and interviews with the ATV group and off-air pictures were sent using the microwave link and coax cable back to Television Centre, where they were recorded on video tape for an hour and a half during the evening, the BBC team eventually leaving at 10pm.



The longest of the technical articles was by Dave Mann, who described a 70cm off air probe, for use in setting up a tv transmitter. It provided a video output of 1 volt across a 75Ω load. The diagrams show the circuit (Fig 2), form of construction (Fig 1) in a 5⅜" x 2⅜" x 1" diecast aluminium box, and way in which it was used in Fig 3.



As shown, it was suitable for use with a positive modulation signal, but by reversing the diode, changing the transistor from an npn to a pnp type and reversing the power supply polarity, it would work for a negative modulation system.



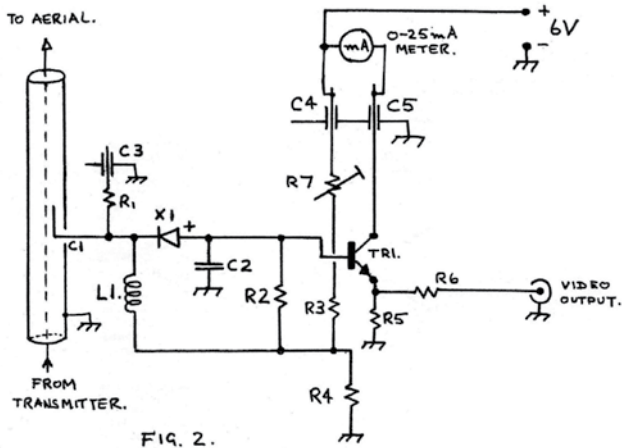


FIG. 2.

COMPONENT LIST.

C1	SEE TEXT	R1	SEE TEXT
C2	3.3 pF. CERAMIC DISC	R2	2.2 KΩ ± 20% 1/10 W
C3	100 pF FEED THROUGH.	R3	220 Ω " "
C4	1,000 pF " "	R4	220 Ω " "
C5	1,000 pF " "	R5	1K Ω " "
X1	9EX 66.	R6	56 Ω " "
TRI.	2N697, SEE TEXT.	R7	500 Ω POT.
L1	R.F. CHOKE, 12 TURNS. 1/8" DIA., 26 S.W.G. ENAMELED COPPER WIRE.		

The centre pins of the coax sockets were cut to 3/16", to make the coax connections as short as possible. C1 was made of a length of 21 swg copper wire, supported at one end on a ceramic insulator, and the other end pushed 1/8" into the space in the coax dielectric. R1 and C3 were used to match to different transmitter powers - for a transmitter of under 50W they could be left out, and the length of C1 within the coax adjusted until the meter read 15mA on full power, whilst for more powerful transmitters R1 was provided to achieve the same meter rating at full power (typically 220 Ω for a 150W transmitter).

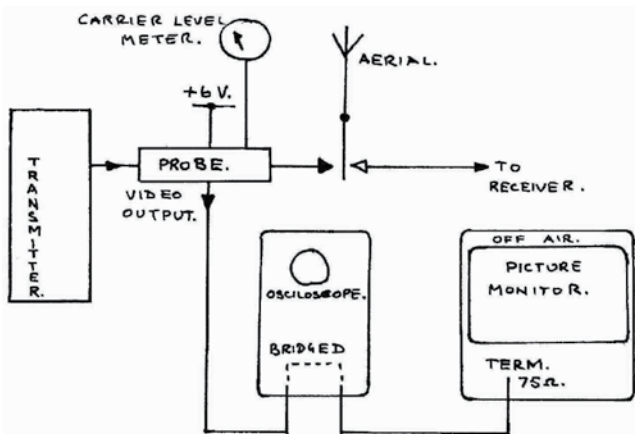
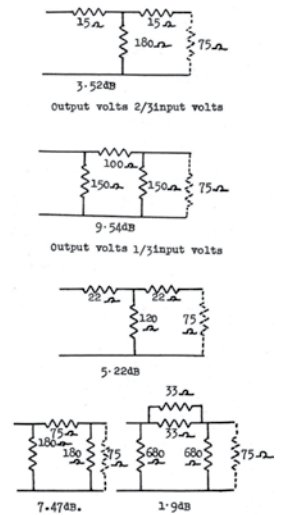
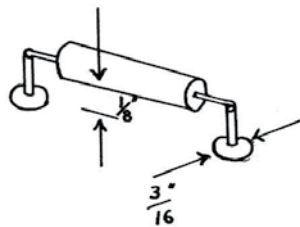


FIG. 3.

Don Reid - who had moved on to work with a broadcast television company in Eastern Nigeria - provided details of some fixed T and π attenuators, using preferred resistor values, and arranged to give an input impedance of 75Ω when terminated by 75Ω. The use of resistors of 5% tolerance or better was advised.



Several members had found problems when trying to build a vidicon camera head amplifier. It was suggested that this was usually because of instability due to layout problems. The magazine explained that no difficulties were experienced when "the standard method of construction for high-gain, wide-band amplifiers was used". This used a single-sided copper-clad board as a basic ground plane. Components were soldered to small pins about 1/4 inch long driven into holes in the insulating board; the copper being cleared within a 3/16 inch diameter circle of each pin hole. This gave a pin-to-ground capacitance of less than 0.5 pF. Components were mounted 1/8 inch clear of the ground plane. The note also advised that in a vidicon head amplifier it was wise to keep the signal components (transistors and feedback elements) closely spaced, and that feedback resistor should be synthesized from a number of physical resistors to reduce the effective shunt capacitance Cs down to the design value.



"From the postbag" included mention of a 3 vidicon colour camera 'which is well on the way to completion' by Mike Cox. Whilst Dave Lawton of Bolton was now licenced as G6ABE/T. His transmitter was not then complete, but he had heard G6LEE/T and G6SOG/T on 70cm, and had almost finished building a vidicon camera. Laurie Hunton reported on regular 70cm activity in the Darlington area, and there was a report of the 70cm activity of the Cambridge group. Also on 70cm, Peter Johnson in Dublin had a scheduled ATV exchange on Friday mornings with EI4Q, and Harold Jones had portable equipment which he could take to 1000 ft above sea level from his Plymouth home, to use during ATV contests.



## Late News

### Es'HailSat-2 will carry two geostationary "Phase 4" amateur radio transponders!

As a result of a concept proposed by the Qatar Amateur Radio Society, Es'Hailsat, the Qatar Satellite Company, have announced that their new, geostationary, Es'HailSat-2 communications spacecraft will provide transponders for use by radio amateurs. The spacecraft is expected to be ready for launch by the end of 2016.

Es'HailSat-2 will provide a 250kHz linear transponder intended for conventional analogue operations in addition to another transponder which will have an 8MHz bandwidth. The latter transponder is intended for experimental digital modulation schemes and DVB amateur television.

### Additional 1 MHz at 146 MHz for ATV

Posted by Noel Matthews, G8GTZ

As well as news of a ATV satellite transponder in 2016, the Ofcom document available here [http://stakeholders.ofcom.org.uk/binaries/consultations/vhf-143-169mhz/summary/VHF\\_consultation.pdf](http://stakeholders.ofcom.org.uk/binaries/consultations/vhf-143-169mhz/summary/VHF_consultation.pdf) says the following:

*4.28 The Radio Amateur community have made a case for utilising additional spectrum to develop new digital technologies for voice, data and video and we have considered this request carefully. We propose to make around 1 MHz*

### Latest ISS Reception

Colin, G4KLB

Since my first update I have tracked the ISS every day, and decoded video every time on 2.422GHz but when the ISS changed to 2.395GHz I didn't receive the signal, however as this is a clearer frequency almost free from Wi-Fi QRM everyone else was getting much better results than before.

To cut a long story short, I discovered the problem was the bandwidth of my S Band LNB. Once this was swapped out I began to obtain far better results than before.

The Tutoune software can record the data from the transmission and display it as a graph. The green TS bar along the top indicates when you will see video. It also shows the quality of the signal - the constellations should form four points; the tighter together the points are, the better the signal as can also be seen by the MER (similar to signal to noise ratio). A MER of 5 will normally give a picture.

The blank signals have been invaluable in fine tuning the system, now on a good pass I can receive several minutes on uninterrupted video (lost the signal at 1300 Km today)

Precise uplink and downlink frequencies remain to be finalized but the uplinks will be in the 2.40-2.45GHz and the downlinks in the 10.450-10.500GHz amateur satellite service allocations. Both transponders will have broad beam antennas to provide full coverage over about 1/3rd of the earth's surface.

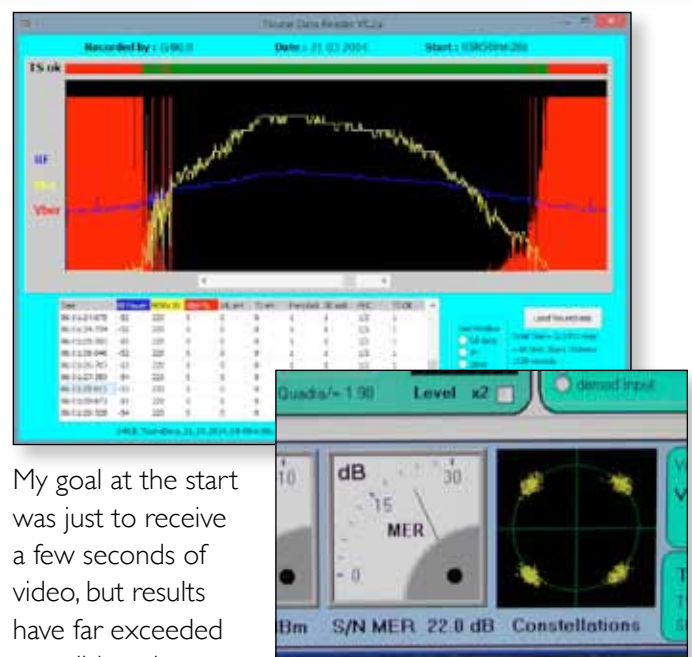
Precise operational plans will be finalised over the coming months but it is anticipated that only quite simple ground equipment will be required to use this satellite.

A team of amateurs, led by Peter Guelzow DB2OS (President of AMSAT-DL) are providing technical support to this ground breaking project which is expected to provide an exciting new phase of activity for radio amateurs for the 21st century. <http://www.eshailsat.qa/>

*of spectrum temporarily available with restrictions through a time limited Notice of Variation (NoV) for full Amateur Radio licence holders. We propose to make available the spectrum from 146 to 147 MHz for this use. This is adjacent to the existing Amateur Radio allocation at 144 to 146 MHz.*

Good news but note that we all need to respond to the Ofcom to make it happen. Follow the discussion on

<http://www.batc.org.uk/forum/viewtopic.php?f=2&t=3780> and make sure you respond by 26th May to make this exciting development happen.



My goal at the start was just to receive a few seconds of video, but results have far exceeded my wildest dreams.

As with all my ATV activity's I have not done this in isolation, many thanks to the many Amateurs from around the world that have given me help and advice.



## Out and About



*RadioFairs*

**You will be able to see the BATC stand at the following forthcoming rallies and events. Come and say hello!**



**13th April** - West London Radio & Electronics Fair, Kempton Park

[See: www.radiofairs.co.uk](http://www.radiofairs.co.uk)

**18th May** - Dunstable Downs Radio Club Bootsale

[See: www.ddrcbootsale.org](http://www.ddrcbootsale.org)



**15th June** - Newbury Radio Rally - Newbury Showground, Berkshire.

[See: www.nadars.org.uk](http://www.nadars.org.uk)

**29th June** - West of England Radio Rally - Bridge St, Frome, Somerset,

[See: www.westrally.org.uk](http://www.westrally.org.uk)



**13th July** - McMichael Rally - Reading Rugby Football Club

[See: www.McMichaelRally.org.uk](http://www.McMichaelRally.org.uk)

**10th August** - Flight Refuelling Hamfest - Wimbourne, Dorset

[See: www.frars.org.uk](http://www.frars.org.uk)



**27-28 September** - National Hamfest - Newark, Lincoln.

[See: www.nationalhamfest.org.uk](http://www.nationalhamfest.org.uk)



**10-12 October** - RSGB Convention - Milton Keynes

[See: www.rsgb.org](http://www.rsgb.org)



**6/7 September 2014** - BATC CAT14 and BGM - Basingstoke

[See: www.batc.org.uk](http://www.batc.org.uk)

**November 2014** - West London Radio & Electronics Fair - Details to be announced.

[See: www.radiofairs.co.uk](http://www.radiofairs.co.uk)

**If you would like BATC support at an event you are organising, please contact the membership secretary.**

batc.org.uk