The British Amateur Television Club

CQ-TV

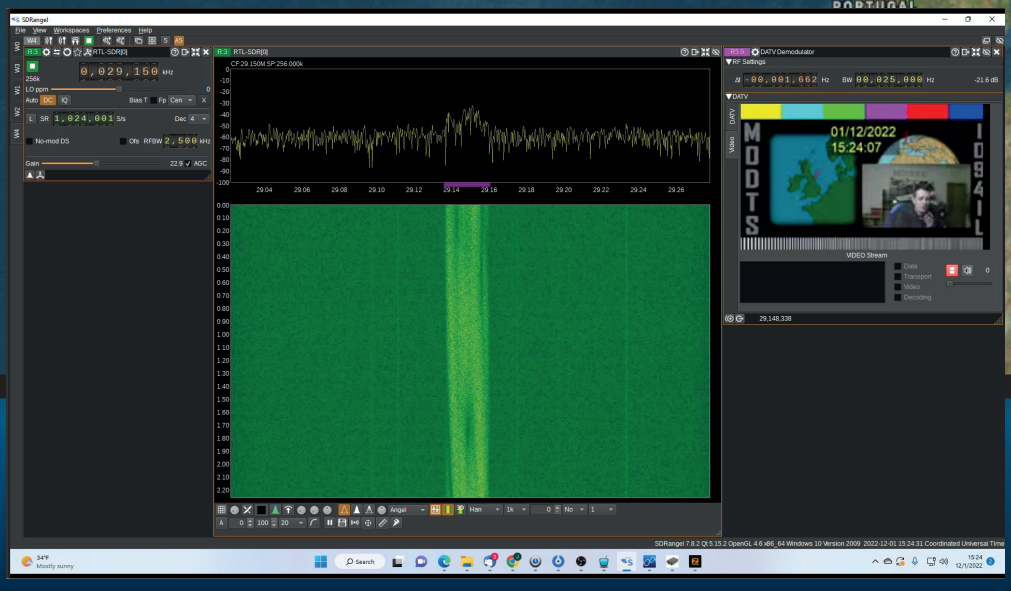
No. 278 – Winter 2022

Rob - MODTS

Digital TV Trans-Atlantic Experiments on 29 MHz

7th November 2022

KiwiSDR Pennsylvania



CQ-TV 278

Contents:

Contributions

Contributions for publication or for constructive comment are welcome. The preferred method of communication is by email; all relevant committee email addresses are published in CQ-TV.

Alternatively you can write to us at:
BATC Secretary, 12 Petrel Croft, Kempshott, Basingstoke, Hampshire, RG22 5JY, UK

Contributing authors should note that we aim to publish CQ-TV quarterly in March, June, September and December.

The deadlines for each issue are:
Spring - Please submit by February 28th
Summer - Please submit by May 31st
Autumn - Please submit by August 31st
Winter - Please submit by November 30th

Please submit your contribution as soon as you can before the deadline date. Do not wait for the deadline if you have something to publish as it is easier to prepare page layouts where we have contributions in advance.

Contributions can be in almost any file format - except Microsoft Publisher! MS Word is preferred. Pictures should be submitted in high quality as separate files. Pictures embedded in a file are difficult to extract for publication however if you do wish to demonstrate your completed layout, a sample of your finalised work should be submitted at the same time.

Please note the implications of submitting an article detailed in the 'Legal Niceties'

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From the Chairman...

Martin Charman G4FKK

As the sunspots increase and HF conditions improve, it was inevitable that some intrepid BATC members would set their sights on getting moving pictures 'across the pond' on 10m.

John, K0ZAK, has set up some VRBTV (very reduced bandwidth television), receivers and has managed successfully to decode DVB-S from Rob, M0DTS, Gareth, G4XAT, and Mike, G0MJW on the other side of the Atlantic.

More details follow in this issue of CQTV and it will be fascinating to see what exotic DX can be achieved in the coming months. Rob also managed a new 70cms, RBTV (DVB-S2), DX record when he worked another Rob, PE1ITR, during the activity weekend on the 13th of November. As reported by Ken, W6HHC; so now it's official

QO100 has now been available to us for four years and it's great to see so many BATC members active on the satellite. These days, getting onto the satellite bands is a lot easier and more reliable than I remember it being just a few years ago. QO100 has a projected life of 15 years so, if you haven't already done so, you've got at least 11 years left to give it a try.

As 2022 draws to a close, it's a good time to reflect on ATV activity and development over the last year. The Portsdown, Ryde and WinterHill projects continue to improve and, as you will have seen in the last CQTV, Tom, ZR6TG, has been busy developing useful and creative software to make use of existing facilities of the latter two.

Portsdown 4 has become an extremely useful, general purpose, must-have adjunct to any shack and Kevin, G3AAF, is making the RXGen noise-source available to members at a special price, making the Portsdown noise figure meter affordable if you don't already have a suitable noise-source available. More details further down.

BATC members also attended and set up stands at the RSGB convention, the Newark Rally and the Midland Round Table and I'd like to thank, on behalf of the whole club, the stalwarts who made these events informative, useful and professional looking.

A lot of work goes into planning, preparing and manning stands, stalls and lectures; the club benefits from sales and new/renewed membership so well worth the effort. And more goes on behind the scene as well and I'd particularly like to thank and recognise a couple of the 'back room boys' who make things tick; Brian, G8GQS, who has been our treasurer for, pretty much, as long as I can remember and Phil, M0DNY, who continually does battle with our IT and web-based services along with developing innovative, core software for many of our more advanced projects.

Have a great Christmas and let's hope 2023 is as exciting in the ATV world as this year has been. I'm already looking forward to CAT23 - hopefully it'll be warmer by then!

Martin, G4FKK

▶ *The Inb at Martin's QTH, in the recent snow.*

The Listing

new and renewing members

Rob Burn G8NXG

There has been a small but noticeable increase in member numbers during this quarter period, leading to a new total membership figure of around 1430. This is great news, so thanks to our new members for joining and thanks also to existing members who continue to support the Club. Another point of interest is the continuing international appeal of the BATC, as new recruits tend to reside in many parts of the world thus reflecting the diverse nature of our membership.

As is usual, the list which follows includes only those who have signed-up or renewed during the three month period to the end of November. For those who are perhaps not familiar with this, the idea is that the list follows the quarterly publication deadlines of CQ-TV.

Accordingly, if you joined or renewed your membership within that time period, the list will at least be able to confirm your membership and you can also determine if anyone is local to you with similar interests.

What if you expected to see your details and they are missing? Just get in touch! The list is manually created thus prone to the odd error and I would be happy to correct any omissions.

Finally an appeal regarding e-mail addresses. As almost all of our Club communications rely on the use of e-mail it follows that your e-mail address needs to be up to date – easily overlooked if you make use of multiple e-mail addresses and cancel the one that you had used for the BATC!

Australia		
Tim Hann	VK5AV	Mount Gambier
Luke Groeneveld	VK2LGW	Punchbowl
John O'Shea	VK2ATU	Revesby
Ed Roache	VK3BG	Wallan
Austria		
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Karl-Heinz Rudolph	OE8KHR	Sankt Johann im Rosental
Peter Mohr	OE1MPB	Wien
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Johan van Brabandt	ON7UC	Zedelgem
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Marek Kolin	OK1ZW	Prague
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Franck Dubuis	F1SSF	La Tuiliére
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Francois-xavier Rol	F6FKQ	Mainvilliers
Jean Lemercier	F1YI	Pelissanne
Dominique Taverne	F5MKM	Saint Jean le Blanc
Gerard Bouvier	F5ELY	Saint Romain de Benêt
Camille Farrougia	F4IBA	Villeneuve Loubet
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Kurt Gothe	DF1KG	Meppen
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Hans Schubert	DL9YCC	Rheine
Matthias Rauhut	DF2OF	Sonsbeck
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Jim Smith	EI4CP	Greystones
Italy		
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Antonio Boncristiano	IK2OWU	Milano
Brunetto Cecchini	I0TYB	Narni (TR)
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Andrea Pancrazio Francesco Saetta	IT9FKD	Sant'Agata Li Battiati
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R Snijder		Zwolle
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Vladimir Rybar	OM7AVR	Valaska
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Martin Klaper	HB9ARK	Kappel
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Carl Aldous	2E0GWZ	Ashford
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Simon Lloyd Hughes	GW0NVN	Barry
Geoff Chapman	G7RMG	Blandford
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Kenneth Vickers	G3YKI	Bridgnorth
Simon Murphy	M0SMU	Bristol
Ivor Green	G1IXF	Bristol
Julian Baldwin	G3UHK	Bristol
Shaun O'Sullivan	G8VPG	Bristol
David Holburn	G3XZP	Cambridge
Raymond Koster	G7BHQ	Canvey Island
Gary Franklin	G4GHD	Canvey Island
Keith Winnard	GW3TKH	Cardiff
Colin Walker	M7TFT	Carterton
Nigel Jones	2E0NJT	Chingford
Darren Smith	2E0VWF	Corby
Roger Gregory	G4OCO	Cornwall
Philip Raybould		Coventry
Dave Cawley	G4IUG	Dartmouth
Ian McCrum	MI5AFL	Downpatrick
Steve Marshall	M0SKM	Dunstable
Robert Williams	G0PEB	East Cowes
Peter Lewis		East Cowes
Andrew Britton	MM0MGB	Edinburgh
Malcolm Gregory	G0JYQ	Fareham
Rik Kershaw	M7YIB	Frome
Alan Course	G4HND	Geddington
Gareth Cattle	MW0IQZ	Gelligaer Hengoed
John Spurgeon	G4LKD	Goole
Geoff Cowling	G0FRX	Goole
Martin Smith	M5MSX	Great Yarmouth

David Rudderham	M0YAA	Grimsby
Adrian Patton	G1BRB	Grimsby
William Ball	G1FNN	Herne Bay
Kevin Staley	G0PWR	Horsehay, Telford
George Knox	G0UCF	Hove
Philip Howarth	GM3YAC	Isle of Skye
Malcolm Grant	G7HPE	Kettering
Mark Wild	G6DDX	Kings Lynn
Michael Still		Lancing
Ian Collins	G8ZVZ	Ledbury
Phil Taylor	M0VSE	Leicester
Steve Greaves	2E0XAY	Leicester Forest East
Brian Woolnough	M5ADQ	Leiston
Bryan Harber	G8DKK	Letchworth
Jon Shamash	G7RUP	Lincoln
Ross Sissons	M7CNN	London
Mervyn Wooltorton	G4TAD	Lowestoft
Daniel Samuels	G7NTC	Luton
Richard Giles	G4LBH	Luton
Adrian Dodd	M0PAI	Macclesfield
Roger Reeves	M0ROJ	Malpas
Andy Rutter	G8HCK	Malton
Ian Lowe	G0PDZ	Margate
Paul Newman	G8UDI	Market Rasen
Peter Watts	G0FQB	Matlock
James McNab		Matlock
Peter Harston	GW4JQP	Milford Haven
Kay Pullan	G8NZR	Mirfield
Roger Farmer		Monmouth
Malcolm Grisdale	M0VNA	Newcastle Upon Tyne
Nicholas Camp	G7KFQ	Newquay
Kevin Francks	M0BFB	Newquay
Michael Topple	2M0GUI	Newton Mearns
John Grant	GI7UGV	Newtownards
John Wilkins	G1WUY	Norfolk
John Quartermaine	2E1FUQ	Northampton
Colin Williams	G4EYT	Norwich
Stuart Tyler	G1ZAR	Nottingham
Courtney Blount	G1MIS	Nuneaton
Ian Harbert	2E0MWU	Orpington
Alexander Wynne	M0OOE	Oxford
Tom Melvin	GM8MJV	Pathhead
Sid Milsom	G8SFA	Prudhoe
Ian Bailey	M0HVO	Ringwood
Mike Richards	G4WNC	Ringwood
Peter Scovell	G1PRX	Sandford
Angus Young	M0IKB	Scarborough
Frank Rowsell	G8PQH	Selsey
Barry Chambers	G8AGN	Sheffield
Chris Wilson	M0YZA	Sheffield
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David Leary	G8JKV	St. Ives
Stephen Smith	MM0SAJ	Stenhousemuir
Mike Binks	G0LJF	Stockport
Matthew Miller	M0DQW	Stone
Martin Goodrum	G3ZQU	Stowmarket
David Cockram	M0RQQ	Swindon
James Patterson	M1DST	Swindon
Philip Gabel	G1TAI	Towcester
Arthur Turner	G4CPE	Upper Sundon
Steven Maxwell	G6IHD	Wallasey
Terry Martin	M0CLH	Wantage
Brian Bailey	G1UFA	Waterlooville
Rob Mott	G0ECX	Weymouth
David Tarr	G3OUA	Worthing
Brian Duffell	G3VGZ	Yarm
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Sawyer Quick		Cato
Donald Hill	KE6BXT	Henderson
Tim Shroyer	KH6N	Los Altos
James Tittle	K6SOE	Pittsburg
Neil Gustafson	W3ZQI	Timonium
Benjamin Lanari	WO0C	Tower
Larry Nussbaumer	N8GGG	Westminster

▶ *Dave, G8GKQ at the National Hamfest, Newark*

Hamfest report

Rob Burn G8NXG

This year's Hamfest was held on 14 and 15 October 2022 after a break of three years and a change from what was the usual slot in September. The event was held in the George Stephenson's Hall at the Newark Show ground. The rally has become the premier UK rally and as it is normally well attended the BATC makes a point of being in attendance.

As you would expect, as the event is billed as the National Hamfest the organisers set out to attract as many interested parties as possible, so the displays and exhibitions tend to reflect a broad range of amateur radio activities.

There are the major dealers, smaller retailers, specialist manufacturers and the component retailers. The special interest groups such as the BATC are well represented and tend to be located in the same area. Naturally, the RSGB took up a large share of space to provide individual stands for book sales, Raynet, Awards and Planning etc.

Finally, even in October the outdoor flea market and trade areas were in full flow.

This year the BATC had a prominent corner plot and as this was at the edge of the Special Interest Groups area we seemed to benefit from a good deal of interest from attendees. Friday in particular was the busiest day so it was just as well that the stand was manned by four BATC members – Dave G8GKQ, Clive G3GJA, Lyndon M0LDR and yours truly.

We were kept busy. Dave brought along various iterations of the Portsdown and Ryde to demonstrate plus a MiniTiouner.

For the second day, the stand was manned by Dave and myself and as the numbers in attendance had dwindled compared with the first day it remained busy but manageable.

Judging by the folk we were able to chat to, it seems that interest in ATV has not diminished. Shop sales were busy (in fact we ran out of some items) and we were able to recruit a few new members including a student member. Most of the membership forms and advertising material was also consumed, another good sign of interest.

Unfortunately, a couple of the major retailers elected not to exhibit and another tried out a new approach by only making available a computer for online orders. A sign of the times perhaps? Next year's National Hamfest will be held at the East of England Showground, Peterborough on 6/7 October. Keep an eye on the rear cover of CQ-TV for details of rallies that the BATC will attend.

IMPORTANT - Change of BATC bank details

The BATC bank details will be changing as of 1 January 2023, so if you pay by bank transfer, please take a note of these new details:

PayPal is our preferred means of payment, and as we look to further automate the routine shop and membership transactions it would be very helpful if members could use PayPal.

Dave G8GKQ, Treasurer(designate)

UK Bank Transfer

British Amateur Television Club
Lloyds Bank
Sort code 30-99-50
Account number 30070860

International Bank Transfer

British Amateur Television Club
Lloyds Bank

BIC11 number = LOYDGB21287
IBAN number = GB84LOYD30995030070860

29MHz transatlantic DATV experiments

Noel G8GTZ

It all started when I was playing with my new Icom 705 radio and started to listen to the New York FM repeater on 29.620MHz – at times it was fully quieting, albeit with some audible phase changes.

It then struck me it was stronger than some DATV signals I have decoded on 146MHz and thought that it might be possible that despite the phase changes that DATV signals could be successfully transmitted across the Atlantic.

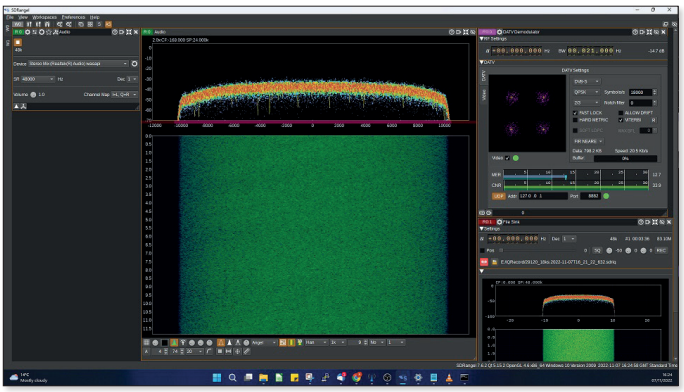
I posted my thoughts on both the BATC forum and the US based DigitalATV io group and so a new challenge was born!

My initial thoughts were that US stations would transmit and UK would receive but it appears there are some potential limitations in the US amateur license that may prevent the transmission of video on 29MHz.

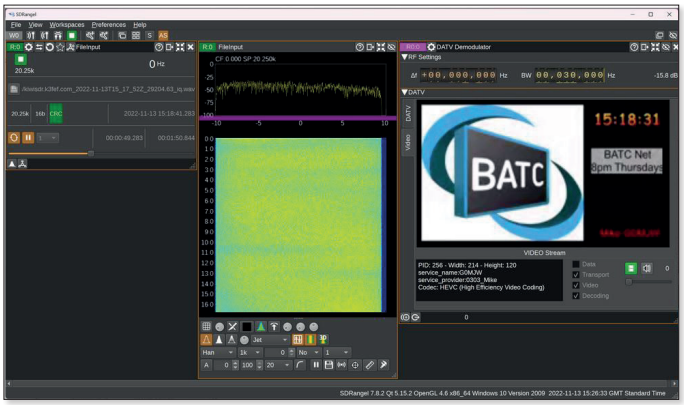
And so UK stations have been transmitting on 29.150MHz and initially using the K3FEF Kiwi SDR in the USA to receive their own signals - *http://kiwisdr.k3fef.com:8073/* Unfortunately the Kiwi SDR bandwidth is limited to 20khz and so very narrowband width DATV signals have to be generated using FFMPEG.

The F2 and E skip that provides good DX on 10m usually comes at the cost of multipath distortion. In practice this means our usual phase modulated signals (e.g. Quadrature Phase Shift keying (QPSK)) of above a few kHz bandwidth can't be decoded. Success so far has used relatively low bandwidth 18ks/s QPSK in a bandwidth of ~20kHz but even this is too wideband and does not deliver particularly good video.

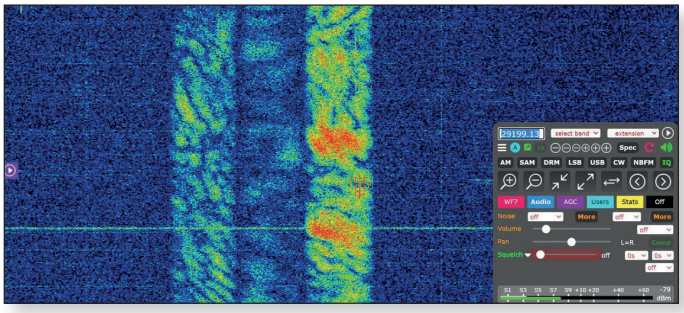
On November 7th Rob M0DTS managed the first successful decode of a single frame using SDRangel to decode the 18ks output from the websdr. The websdr audio in IQ mode is fed in to SDRAngel using the Windows stereo mix output as the input.



On the following Saturday November 13th Mike G0MJW commented that signals were incredibly strong and he achieved a few seconds of video



It was clear that the limiting factor in the tests was, as predicted, frequency selective multipath and phase distortion – the following picture shows three narrow band signals received by a networked radio in Pennsylvania. They are Gareth G4XAT, Rob M0DTS and Mike G0MJW. All were about 100W, with Mike and Rob using beams and Gareth a vertical. The multipath distortion is very apparent, as is the difference in propagation paths.



John K0ZAK in Baltimore began receiving signals in late November and on December 1st captured a few frames of video from Rob M0DTS.

On December 5th John K0ZAK eventually managed to decode 10 seconds of video from Mike G0MJW walking around his shack - probably the first transatlantic reception of Digital Amateur Television!

More details on the tests can be found on the BATC forum at *https://forum.batc.org.uk/viewtopic.php?f=15&t=8183*

A wiki page has been set up with more details *https://wiki.batc.org.uk/29_MHz*

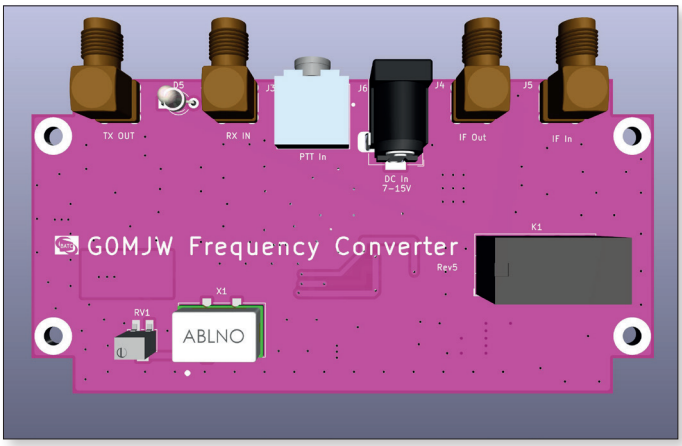
Simple 144MHz to 29MHz transverter

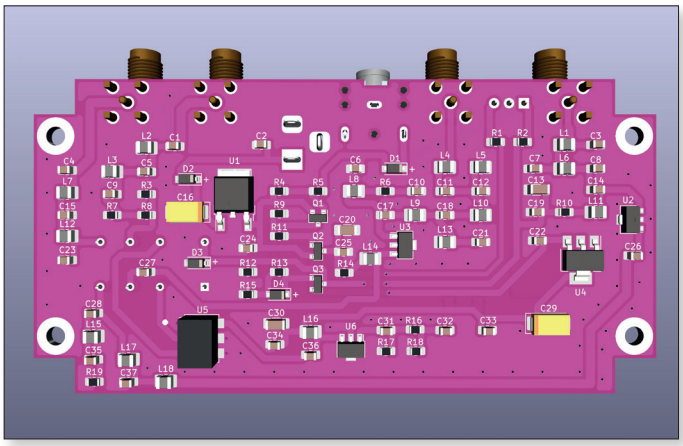
The popular SDRs that are used to transmit DATV at higher frequencies are the Adalm-Pluto and Lime Mini. The Pluto does not work below 70MHz and while the Lime Mini does cover 29MHz natively, in practice the spectrum it generates in this region is not sufficiently clean to use on the air.

To get round these issues, Mike G0MJW has designed a simple 144 to 29MHz transverter.

Full details of the transverter and the Bill-Of-Materials and schematics are available on the BATC wiki:

https://wiki.batc.org.uk/29MHz_transverter





Beware the inverted Spectrum with SDR Angel...

TV repeater GB3JV transmits on 3.404GHz using DVB-S2. The transmitter consists of an SR-Systems HD Modulator that produces an IF signal at 404MHz which is followed with a Kuhne up-converter with an LO of 3GHz that mixes up to the final output frequency at 3.404GHz. The modulator is set to spectrum = normal (as opposed to inverted). A typical receiver chain consists of a Titanium or Norsat C-Band LNB with a LO of 5.150GHz, giving an IF of 1.746GHz. Note that as the LO is above the received IF frequency, the received spectrum is inverted at IF.

All is well receiving this "inverted" spectrum on every receiver I have tried: Sony TV, Minitiouner with Ryde, Portsdown or MiniTioune, GT Media Sat finder and various random domestic satellite receivers. I've never had a problem which way up the spectrum is.

However, when using SDR Angel's DATV de-modulator the constellation freezes and no decode is possible, however invert the spectrum of the transmitter so that the received spectrum is "Normal" at the receiver (due to the LNB inversion) then all is ok and SDR Angel decodes correctly with an almost instant lock.

The LO of a Sky typical TV LNB is 9.75GHz or 10.6GHz, which is below the received frequency, so no inversion occurs at IF.

If you're having problems decoding some transmissions using SDR Angel, make sure that the Tx/Rx arrangement when using up/down-converters ensures that the received spectrum is not inverted. Steve G4NZV kindly pointed out that it is possible to swap IQ in the SDR Angel. In the source device's 'select' box press the 'X'; then using the IQ button to swap the IQ to QI (if you have an inverted spectrum). Moving forward it is important we all adhere to a standard transmitter arrangement and ensure we do not transmit an inverted spectrum.

There is a very good write-up by the author, Edouard (F4EXB) on his GitHub page. It is well worth a read to understand how best to configure the SDR Angel DATV demodulator for best results.

https://github.com/f4exb/sdrangel/blob/master/plugins/channelrx/demoddatv/readme.md

Justin Cockett - G8YTZ

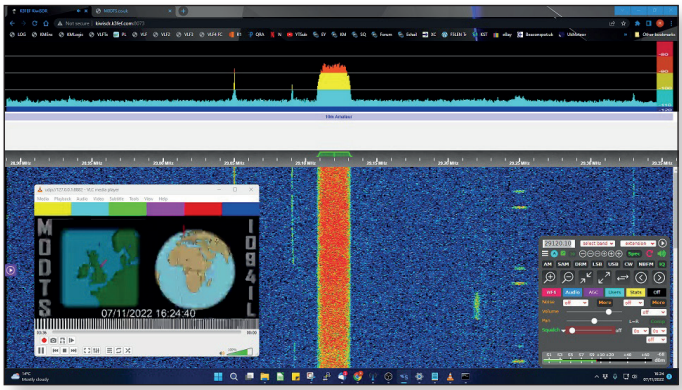
It's DATV Jim, but not as we know it

Gareth G4XAT

A post on the BATC forum by Noel, G8GTZ, (*https://forum.batc.org.uk/viewtopic.php?f=15&t=8183*) and prompted by recent improvements in HF propagation, has produced some excellent results.

This is a brief write-up of my own experiences and is firmly-based on the work of others, notable Rob M0DTS (who hacked a script for FFMPEG to produce a DVBS signal comprising just 18ks at two frames a second and Mike, G0MJW, whose excellent 10m transverter does the frequency changing bit.

Back in the 1980s I ran a 10m mobile station, 100 watts into a quarter-wave on a gutter mount. Some unusual stations were worked and it remains an interesting band with a variety of propagation. Some determination to get going on the band was provided when Rob proved that he could decode his signal by recording it on a remote SDR, in this case in Milford PA USA *http://kiwisdr.k3fef.com:8073*

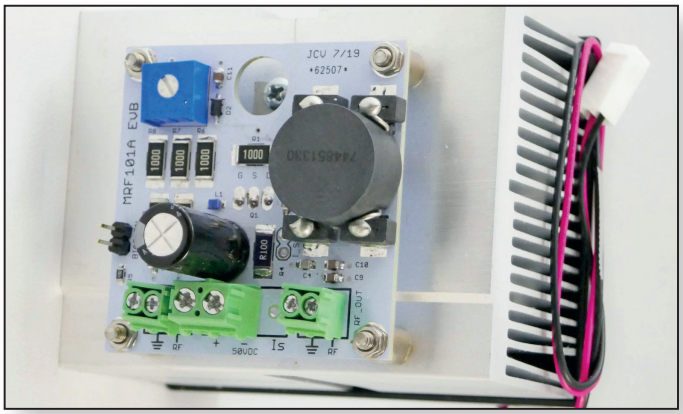


The extremely narrow bandwidth was chosen for two reasons - the Kiwi SDR only allows a recording of a 20kHz bandwidth and the multi-pathing visible on a wider signal (eg 66ks) pointed to a slim chance of a successful decode.

For reception of the DVBS signal, the SDRAngel software was used as any symbol rate can be specified. It takes some getting used to but as you can feed it with a variety of SDRs (Pluto, RTL dongle etc) and sources (sound-card files) it makes a free and useful tool. The RTL dongle will receive your own signal directly as most work down to 25MHz, useful for a shack sanity check.

For my TX I used an i7 gen seven laptop running OBS (V27) and virtual camera, Rob's script to run FFMPEG (Intel encoder) and a Pluto version C/D with Evariste, F5OEO's 0303 firmware. The Pluto web interface allows control of the TX frequency, SR and output power.

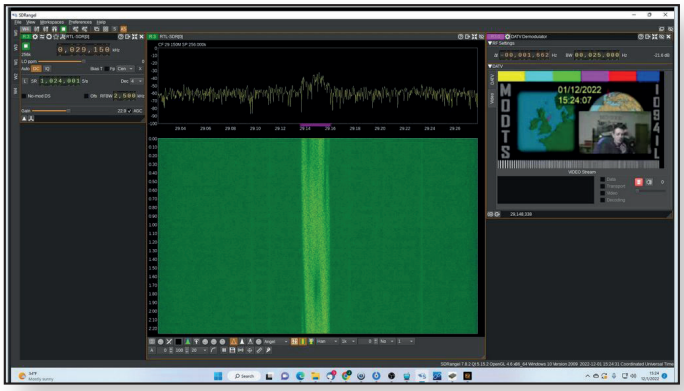
The RF from the Pluto feeds my very useful CA2832C CATV distribution amplifier which delivers more than a watt from one-MHz to 200MHz at a stable gain of 35dB. Other than needing 28 Volts, it's a really handy little block.



From here it goes into a MRF101AN HF amplifier board (*https://sites.google.com/site/rfpowertools/rf-power-tools/nxp-mrf-101*) and then through a suitable filter before heading down the garden to a Slim Jim for 10m.

This was built with the aid of an on-line calculator and uses 450 Ohm slotted black open-wire feeder (*http://www.infotechcomms.co.uk/downloads/10m_Slim_Jim.pdf*) and is mounted on a 10m fishing pole, itself mounted some three-metres above ground level. By a handy coincidence its best VSWR is at 29.2MHz.

Success for Rob came with the reception and decoding of his signal by John, K0ZAK in Baltimore a few days later in late November.



Subsequent experiment by myself, Rob and Mike led to all three of our signals being seen side by side on the web SDR. (See preceding article for image). The multi-pathing/ fading patterns are absolutely fascinating, presumably down to the different paths out signals have taken. It's all on the BATC forum thread with screenshots etc.

Further experiments of a more local nature (with Justin G8YTZ just up the road some two-miles away) led to easy copy so we tried a higher SR of 66ks. This worked with sound too, occasional multi-path effects were seen as a vaguely sine wave drifting across the top of the displayed carrier.

As a further experiment, it was tried on 146.5MHz (co-linear to co-linear) but with just one-Watt of TX power. This worked well too.

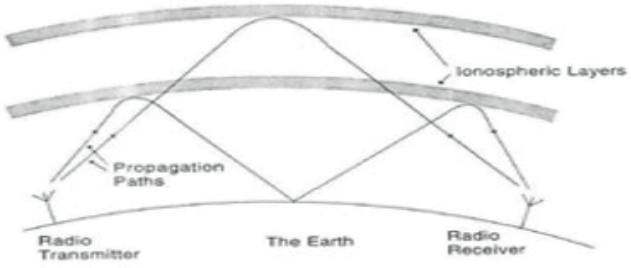
I'm sure there are better modulation methods available (or yet to be written?) that would perform better than good old DVBS, but it's fun to push the boundaries. A dedicated amplifier using a MRF300AN (or its cheaper relation the MHT1803A) will run a very easy 100W and an acceptable 200W at reasonable efficiency (seven-Amps at 50V - 350W). As HF conditions improve things will get interesting and with next year's Es to look forward to.

Sending High Speed Data over HF Channels

C.H Brain G4GUO

'Abandon Hope all ye who enter here'

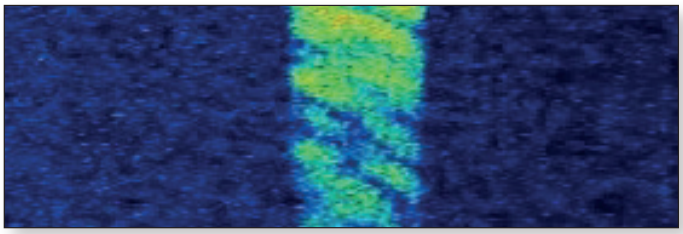
First we have to discuss what an HF channel does to a radio signal.



▶ *Fig 1*

From the classic HF propagation diagram of a sky-wave Fig 1, we can see that it is possible to receive multiple copies of the same signal at the receiver, each having taken a slightly different path. From this we get the term multipath. Each copy of the signal will have a different time delay and strength.

These copies of the signal can constructively or destructively add, depending on the frequency and path length, this is what causes selective fading of the signal Fig 2. With a narrowband signal like SSB this is not too noticeable, on a wideband data signal this can be catastrophic and can manifest itself as deep fades in the signal both in frequency and in time. We can also get severe Doppler spreading but this usually is only seen on trans polar paths. If there is only one path the fading is called flat fading.



▶*Fig 2*

There are two main methods for transmitting high speed data over such a channel. The first being referred to as a serial tone waveform (DBV-S/S2 being an example of this class of modem) and the second being a parallel tone waveform (DVB-T being an example).

Parallel Tone Modem

The parallel tone waveform splits the data into multiple orthogonal carriers (usually using a Fast Fourier Transform, FFT). Some of the carriers called pilot tones act as magnitude and phase references. These tones usually do not carry user data, in the case of DVB-T some of them signal the format of the following payload. Usually a guard interval (formed from a repeated section of the end part of the symbol being added in front of the start of the same symbol). This guard interval is set to be longer than the the worst case length of the multipath. This way, even with multipath added each symbol will only interfere with itself and not the adjacent symbol see Fig 3. The guard section is usually discarded at the receiver but it can be used for time and frequency synchronisation.

▶ *Fig 3*

Using the pilot references tones, phase and magnitude corrections can be made to remove phase and magnitude errors in each of the individual data carriers. These pilot tones are also used to make any overall frequency error correction of the entire waveform, this type of modem is very sensitive to frequency errors.

Interleaving of the data and FEC is done before the modulation stage described above. Ideally the period of the interleaver is greater than that of the fading.

The disadvantage of the parallel tone approach is that it has a very high Peak to Average Power Ratio (PAPR). There are a number of techniques used to try to mitigate this, the simplest being to add a clipper to the modulator then filter the clipped output. Modern 4G mobile phone systems use this type of modulation so a lot of work has been done on the PAPR issue, a entire book could be written on the subject.

Serial Tone Modem

The ionospheric channel is assumed to be linear and can be modelled by a simple formula.

$R = WT + N$

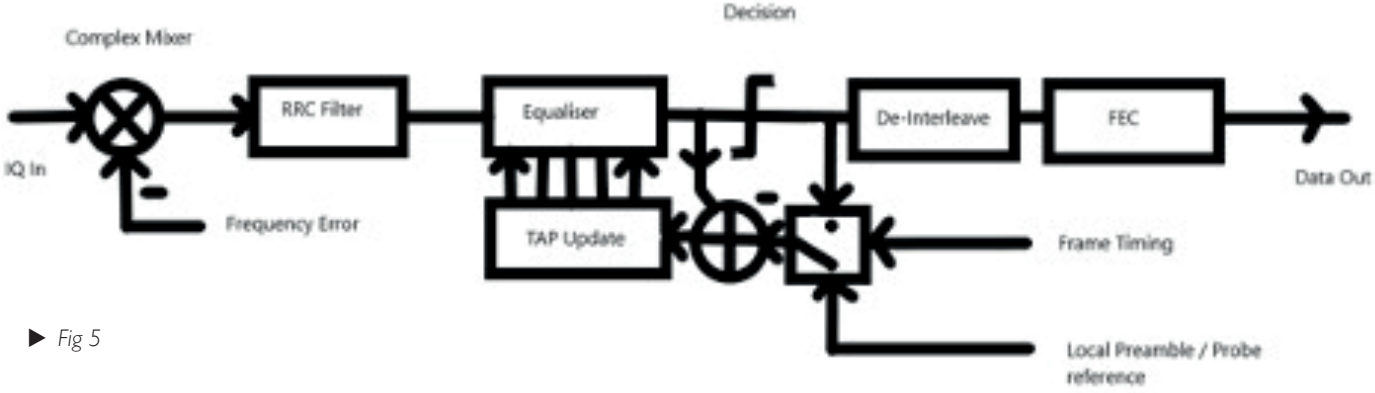
Where R is the received symbol, T is the transmitted symbol, N is the noise and W is a transversal filter that represents the effects of the multiple paths caused by the ionosphere.

A serial tone modem designed for HF adds extra symbols to those symbols that contain the data being sent. These extra symbols are used to measure the ionospheric modification. Usually the modem will transmit a preamble and then sporadically transmit know probe symbols see Fig 4. The preamble often contains the format of the following payload. In the case of STANAG 4285 it does not, but in MIL-STD 188-110 serial modems it does.

▶ *Fig 4*

There are at many methods used to recover the data, the first is called Decision Feedback Equalisation.

This effectively creates a filter that when convolved with the set of received symbols spits out the actual transmitted symbols. The filter is updated initially using the known training symbols in the preamble, it then goes into a free running mode where it decodes an unknown data symbol, makes a decision as to what it was and then updates the filter coefficients assuming it's decision was correct. After it has swallowed the unknown data it trains again using the next set of known symbols. There are three main issues with this approach, the first is that when it is receiving the unknown data symbols, if it makes a mistake when it does it's decision, the filter tap update routine will be fed with bad information, things will then go horribly wrong very quickly. The second problem is that if the training algorithm cannot update the filter taps as fast as the channel is changing the decoding will fail. The final problem is that the maximum multipath delay must not exceed the length of the probe information or it won't fall within the equaliser filter's length and can't be corrected. See Fig 5 for the basic modem layout. The clever part is



▶ *Fig 5*

in the tap update section. In the past I have used (Ref 6) to do this. The frame timing is used to switch between known and unknown data.

A second method used to recover the received data is known as Data Directed Equalisation (DDE). Here instead of trying to train a filter to remove the multipath we train a filter to estimate the channel multipath (channel impulse response) and then by using matrix inversion we can calculate the actual received symbols. This technique processes a complete block at a time. It then uses the unknown symbol closest to the known (probe) symbols to re-evaluate the channel (this is because these have the highest probability of being correct) it then carries out the inversion process again, each time refining the impulse response. This technique is computationally more complex than the first but has a significantly lower Bit Error Rate than DFE (Ref 1).

There is another technique called Block Decision Equalisation, this is used in more modern HF modems it is similar in concept to the previous DDE idea.

Another type of equaliser is the Turbo Equaliser (Ref 4), this uses the similar ideas to those found in Turbo FEC decoders. Work has also been done on joint demodulation and equalisation.

I understand from talking to an HF modem manufacturer recently that a form of frequency domain equalisation is now considered state of the art but I have not researched that and have no idea as to how it works.

Like parallel tone modems, serial modems also use interleavers and FEC techniques to reduce the bit error rate. The combined function of the Equaliser and Interleaver is to make the highly distorted multipath channel look like a Gaussian Noise channel, which is the type of channel that FEC codes like best.

What is wrong with DVB-S / S2 on HF.

Both S and S2 receivers have an equaliser function in them but they are only designed to cope with reflections in the cables between the satellite dish and the receiver. They are not designed to cope with the 6 ms or more of a typical HF channel.

DVB-S has no preamble or pilot information in the waveform so the above described techniques would not be applicable.

DVB-S2 has both a preamble (and optionally probes) but the block of unknown symbols (the data carrying part) is very long which would challenge the techniques I have already described. The waveform could be made to operate on HF but the implementations seen in domestic Set Top Boxes are not designed for the very long multipath delays seen on HF, commercially adding that feature would add cost for no benefit.

What about DVB-T

DVB-T should work as the guard period when using reduced bandwidths should be adequate for the type of channel seen on 29 MHz. The lower the symbol rate the longer the guard period.

If I were doing the tests I would set the bandwidth to the maximum available, the FEC to ½ and the guard to ¼. Set the Frames Per Second to as low as possible. Knucker won't operate at 100 kHz so GNURADIO would have to be utilised for very narrow bandwidths.

This of course is all theory and practice is something else, so don't take my word for it, experiment with whatever you have available.

It may be possible to pre-process the received signals using an FFT/IFFT filter to fill in the spectral holes and do some sort of deconvolution of the signal. Then feed the modified signal into a standard S/S2 decoder. Just an idea. My reference book on FFTs (Ref 7) includes an example of using FFTs to do multipath removal but I have never tried it.

What else should a good modem do

Before a modem can decode the data it must be able to gain initial time and frequency sync, then it must be able to maintain that sync. There is another characteristic of a good modem and that is Late Entry, if the receiver comes across a transmission but misses the initial preamble section it should be able to obtain the time and frequency sync from the body of the waveform. This can be done from the probe segments.

Who else has been doing this

In 2000 at the University of Rennes 1, France, project Trilion undertook a study of ionospheric transmission of video. At the same time similar work was being done at the University of Poitiers, France. (Ref 3)

In 2012 Rockwell-Collins carried out some UK trials of Wideband data on HF between the South Coast of England and the northern part of Scotland. The trials used H.264 video and a modem with a bandwidth of 24 kHz. The modem was as defined in MIL-STD 188-110C appendix D and used 256 point QAM.

Frequencies used were between 6 and 7 MHz (a much more challenging environment than the 29 MHz we are targetting). Transmitter power was 400 W, they achieved a maximum data-rate of 120 kbps.

A S/N of > 24 dB being required. The information on these trials is quite scant which probably means they weren't too successful.

And finally

This is just a simple overview of what makes a good HF modem. A lot of work has been done on this subject over the years and there are a myriad of ideas on how best to achieve the goal. Many a Masters Thesis and PhD Dissertation have been written on this subject. Over the years I have had many goes at writing software based on these ideas. So far they have all been for 3 kHz bandwidths and I have had mixed results. I finally abandoned this work in about 2005 as I could find little application for it on the crowded Amateur HF bands. I did use this work successfully in an ARINC 635-4 HFDL decoder.

Like we have scaled down DVB waveforms for Amateur use we could also scale up these military waveforms for DATV use. The 36 tone parallel modem I developed many years ago for digital voice usage (Ref 5) which was tested on the 7 MHz band used differential QPSK to encode the data.

If anyone is interested in the subjects briefly described in this article they can contact me directly for a deeper discussion. I apologise for the brevity of the article, which is due to the short timescale I had to write it.

One final thought, as well as looking at the modem waveform we should also be looking at compressing the transport stream, there is a lot of overhead in that stream which is unnecessary for our application. It should for example, be possible to use Codec2 for the audio. If the stream needs to be compatible with a MPEG TS for distribution then the compressed stream at the receiver could have the necessary extra overhead (SI tables) added and the Codec2 audio transcoded back to standard AAC audio.

References

1. STANAG 4285 This includes a good description of how to implement an HF modem. A scanned copy of the original spec can be obtained by contacting me.
2. MIL-STD 188-110D The latest U.S standard for HF data modems. Copies are available on the internet.
3. IET Conference on HF Radio Systems and Techniques 2000
4. IET Conference on HF Radio Systems and Techniques 2003
5. TAPR Digital Communications Conference 1999
6. IET Transactions on information theory Vol IT-28 no 5 Sept 1982, "Square Root Kalman Filtering for High Speed Data Received over Fading Dispersive HF Channels" by Frank M. Hsu.
7. "The Fast Fourier Transform and its applications" E.Oran Brigham ISBN 0-13-307505-2

BATC-branded shirts (and other items)

Unfortunately since the death of Frank M0AEU's father, who used to do the embroidery, we have been unable to offer BATC-branded golf shirts for sale in the BATC shop.

However, Dave M5TXJ has found a company local to him in Penrith who specialises in branded clothing and arranged for samples of BATC-branded shirts and other items to be produced.

We are now pleased to say that the designs have been approved and are now offered in a separate BATC section of Sam Scott's website. Founded in 1977, Sam Scotts is a family-run clothing shop specialising in workwear, schoolwear, printing & embroidery – please note that you are dealing direct with Sam Scott Ltd and any questions / comments should be sent to them.

To purchase items please go to *https://samscotts.co.uk/collections/british-amateur-television-club* and enter the password BATC1

There is a wide range of items on the main Sam Scott website – if you would like to see any of these added to the BATC shop please send an email to *m5txj@yahoo.co.uk*

Please note Dave is not connected to Sam Scott but has agreed to be the main BATC contact with them.

Height and position of your antenna is important!

Chris van den Berg PA3CRX

Playing with the height and position of your antenna could make the contact just happen. If you make contacts at higher frequencies you will undoubtedly encounter some unusual propagation.

This time it's more about tropo and the phenomenon that I experience when I making contacts while beaming over a lake, where the signal becomes weaker as the antenna is raised. It has also been reported by amateurs that are able to raise and lower their masts; the highest position does not always result in the strongest signal.

I found clues about this in a book on radio transmission from 1988, written by Ir. B. Matthews. Despite the fact that insights have probably changed a bit, this does not apply to laws of course.

If you like formulas, you can find them by googling 'RECOMMENDATION ITU-R P.530-8'. In CQ-TV I think readability is more important so I try to avoid formulas as much as possible.

The troposphere

Fixed radio links are basically contacts between two points especially where these are offered commercially - a certain degree of signal strength must be guaranteed.

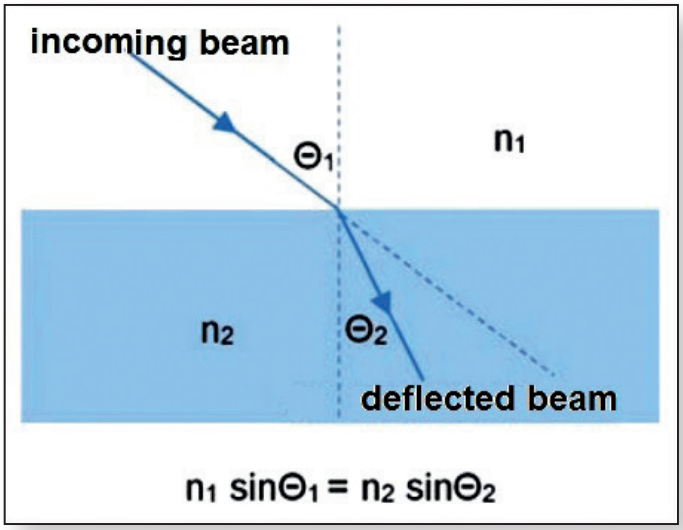
A radio link is affected by the properties and changes in the troposphere, such as:

- the refractive index
- frequency selective and non frequency selective multi-way fading
- ground reflections
- scintillation (see below)
- damping due to gases
- rain damping

In order to determine the direction of propagation of an electromagnetic wave in the troposphere, it is first necessary to understand what happens when the electromagnetic wave crosses an interface between two media with different densities.

Here, n1 and n2 are the refractive indices of the media.

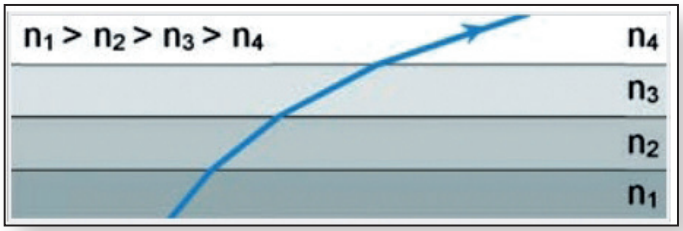
If the density of medium two is higher than the density of medium one, the through wave will be diffracted - the relationship between the angles is given by Snell's law.



▶ *Refractive index and the law of Snellius*

If the refractive index of the individual media is known, the propagation speed in the media can be calculated using a formula.

The troposphere can be represented by many layers on top of each other, each marking an area with a different refractive index.



▶ *Schematic of the Troposphere with layers of different refractive index.*

Under normal conditions, the refractive index decreases as a function of height, which means that the electromagnetic waves, instead of propagating in a straight line, deflect in the direction of the earth.

The following factors affect the refractive index:

- air pressure (mb)
- absolute temperature (Kelvin)
- water vapour pressure (mb)

If one wants to gain insight into the propagation of electromagnetic waves, it is important to have insight in the refractive index (N) as a function of height (dN/dH).

Measurements were (at that time) taken for three years, of which the following table shows the measurement results for the first 150 meters above the earth's surface.

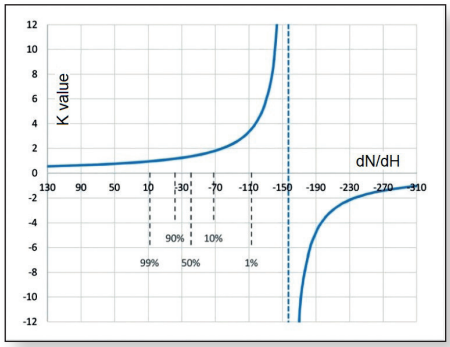
	[dN/dH] (N/km)		
	10%	50%	90%
Total	-68	-41	-22
Winter	-56	-37	-22
Spring	-74	-42	-24
Summer	-77	-46	-24
Autumn	-63	-40	-18

It follows from the table that the dN/dH is <-22 for 90% of the time, <-41 for 50% of the time and <-68 for 10% of the time.

The measurements also show that dN/dH is <-113 for 1% of the time and dN/dH < 8 for 99% of the time. The extreme values measured once were -237 and 129.

When designing radio links, there are two ways to provide a simple representation of the signal path relative to earth. One method uses an apparent change in the radius of the Earth (6380 km) by a factor of K.

The table shows that the average value of dN/dH is close to -40. For this value K=1.33

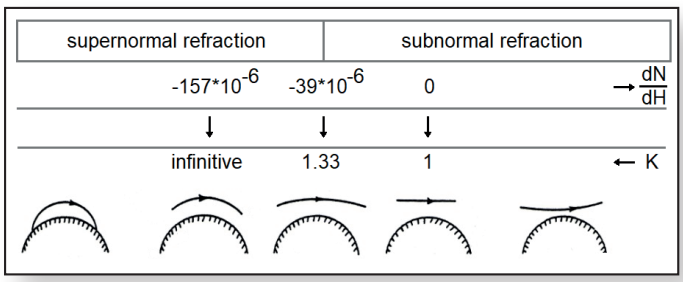


▶ *K as a function of dN divided by dH*

A special value is dN/dH = -157.

For this value, K is infinite, which means that the electromagnetic waves follow exactly the curvature of the earth.

If K= one the electromagnetic waves propagate rectilinearly with respect to the earth and for values of K less than one, the electromagnetic waves deflect away from the earth.



▶ *K as a function of dN/dH. Average is K=4/3 (=1.33).*

Sometimes change in temperature (and therefore density of the medium) is not gradual, but with a big jump. Then the signal is not deflected slightly downwards, but very strongly.

Depending on that effect (which sometimes occurs very locally), it is even possible that the signal is again reflected by the earth, goes up and is again deflected to earth by refraction.

This effect is called 'surface ducting'. The signal is 'trapped' between the earth and the sudden temperature difference. Unfortunately, the earth does absorb a lot of signal. However, it can be even better: the signal can be trapped between two (in height) sudden temperature differences ('elevated ducting'). Then the signal does not reflect upwards via the earth, but against another 'temperature jump'. This gives little loss and the signals can travel very far. Probability difficult to predict.

Multi-path fading

Depending on the course of the dN/dH as a function of the height, it is possible that several electromagnetic waves reach the receiving antenna via different paths through the troposphere.

These waves have a different phase and amplitude compared to the direct wave, partly due to the different propagation speeds, and can therefore lead to both amplification and attenuation of the reception level. This phenomenon is known as multi-path fading.

Another form of fading occurs at trajectories that have a reflection point for which the reflection coefficient is approximately -1 (e.g. trajectories over water).

The reflected wave interferes with the direct wave.

For signals with a relatively wide frequency spectrum (such as broad digital or ATV), this means that certain frequencies are attenuated more than other frequencies in the spectrum (frequency selective fading).

There may be a situation where the direct electromagnetic wave has much greater amplitude than all the other waves reaching the receiving antenna through different paths.

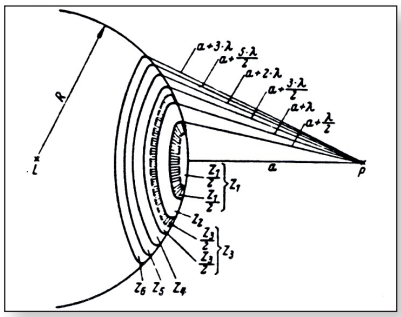
A fast, slightly fluctuating field strength is then measured on the receiving side with a Gaussian distribution. This phenomenon is called 'scintillation'.

Path clearance

There the principle of Huygens is quoted, which is based on the following:

If a light source L emits light, then at a distance R one can imagine a sphere of which each elementary surface

element can be regarded as a separate light source (Huygens principle). Point P receives light from all surface elements visible from P.



▶ *Principle of Huygens*

The sphere can be divided into rings for which the distances to the upper boundary of each ring structure differ by half lambda (Fresnel zones). The surfaces of the zones Z1, Z2, Z3, etc are then equal.

Since for every point in a zone there is a point in the next zone for which the path length difference is half lambda, this would mean that point P receives no light.

What has not yet been taken into account, is the attenuation of the waves as a result of the distance differences between the points in the different zones up to P. If these differences in distance are taken into account, the top half of the first zone, the second zone, disappears. and the lower half of the third zone apart.

The same reasoning applies for the other zones. As a result, the point P receives light only from the lower half of the first Fresnel zone.

Because electromagnetic waves from radio links behave more or less like light, the above reasoning is also valid for radio links. In the design of radio links, it is therefore assumed that the first Fresnel zone must be free for K = 1.33.

Difficult to imagine because where does that sphere with those rings suddenly come from? What about the muting of the signal through the top half of the first zone, the second zone and the bottom half of the third zone?

By the way, what is up and down in this context, and don't you have the same issue for left and right?

A reference point in the text is that it concerns Fresnel zones. A more understandable explanation has therefore been found. This theory of Huygens and the Fresnel that elaborates on it has been criticised here and there but the principle of the Fresnel zones has clearly been embraced.

Shape and size of the Fresnel zone

As explained in CQ-TV 277, between a transmitting antenna and a receiving antenna, the signal is a well-definable cigar-shape. The distance between the antennas and the frequency determine the diameter of that cigar.

The rule of thumb is that at least 60% of this zone must reach the receiving antenna in order not to have too much signal loss.

More Fresnel zones

However, there is not one Fresnel zone, but many more, which surround the cigar shape like the layers of an onion. If you 'cut' the Fresnel onion/cigar, you will see the different Fresnel zones as rings, like a leek.

Of course, this happens gradually and not as abruptly as the rings in a leek.

The signal path (distance between transmitting and receiving antenna) is smallest in the first Fresnel zone, because the higher Fresnel zones deviate further and further from the direct signal.

If a signal takes longer, it means that there is a phase shift. This makes it possible to distinguish the various Fresnel zones, and because the signal takes half a wavelength longer for each zone, this means a phase shift of 180 degrees (half lambda). In addition, the signal level at the second, third, fourth and so on Fresnel zone is getting smaller and smaller.

We often focus on the first Fresnel zone, because that's where the most energy is.

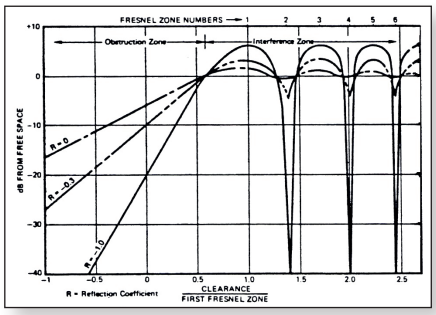
We often look what happens when it is obstructed or reflected by the earth or buildings.

However, it becomes more interesting if we also look at the subsequent Fresnel zones: what happens when they hit a reflection surface?

If the earth (as a reflector) falls within the first Fresnel zone, the reflected signal arrives out of phase at the receiving antenna, making the signal as a whole weaker.

If the earth falls within the second Fresnel zone (which is therefore already out of phase), the longer path (via the reflection) ensures that the signals are added together: so a stronger signal than without that reflection!

In the third zone again like the first, the fourth like the second etc.



▶ *Depending on which Fresnel zone is reflected, and how much, has an effect on the final signal strength*

It is clear to see that the signals arrived together are stronger or weaker than if the path had been covered in free space.

Of course it also depends on how well that earth (or water) reflects.

Water is more clearly defined as a reflector than soil, in which even the moisture of the soil but even more the vegetation and differences in height play a role.

In addition, the reflection for vertical and horizontal polarisation is not identical (maybe later more on that). Circular polarisation does not change polarisation direction at smaller angles with a reflection plane, otherwise the negative aspect of attenuation due to reflection of Fresnel zones could be avoided.

Calculating the diameter of the Fresnel zones based on the distance and frequency is simple, but the height relative to the earth is not always the same. The reason for this is explained above: is the travelled path straight, does it bend towards the earth or away from it (value of 'K')?

And then there is not only the earth as a reflection point but the Fresnel zones are after all three-dimensional, so for obstacles that reflect the Fresnel zones to the left or right of the signal, the same situation arises, as long as the signals arrive at the receiving antenna.

Obstacles

What effect is noticed on the receiving side if there are obstacles along the path? Obstacles include apartment buildings, hills, church towers, flat earth, water surfaces, etc.

For example, for a pointed church tower in the middle of the beam path, the reflection coefficient R = 0. If the church tower runs exactly to the centre line of the radio link, half of the first Fresnel zone is covered, i.e. 50% of the E field cannot reach the receiving antenna.

On a power basis, this is 6dB attenuation relative to the free space attenuation shown in the graph by the 0dB line.

If the church tower reaches exactly to the first Fresnel zone, all Fresnel zones that extinguished the lower part of the first Fresnel zone are shielded. This means a 25% increase in the E field on the receiving side!

Another possibility could be that the first Fresnel zone exactly touches a water surface. The water surface has a reflection coefficient of R = -1. The minus sign indicates that a 180 degree phase rotation is occurring.

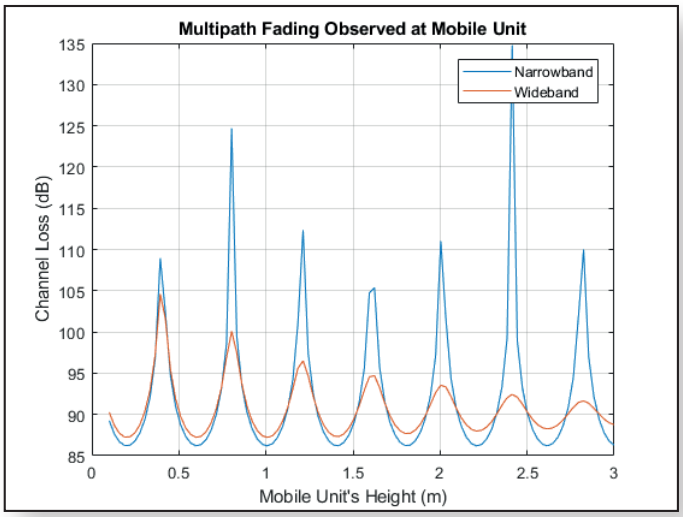
The first Fresnel zone was characterised by a collection of points that have a half wavelength path length difference from the direct path. Together with the half-wavelength phase shift of the water reflection, the total phase rotation is 360 degrees and the amplitude of the field strength vector is the same as that of the direct wave. There is a gain of 6 dB.

Should the second Fresnel zone (path length difference one wavelength) touch the water surface instead of the first Fresnel zone, the total phase rotation would be 540 degrees and the direct wave and reflected wave would be in opposite phase. A very large damping then occurs.

Narrowband versus Broadband Signals

Because the diameter of the Fresnel zones is determined by the frequency, a broadband signal therefore produces a rapidly varying amount of Fresnel zones in diameter.

A reflection will therefore be able to fall largely in one zone for one frequency and largely in the other for another frequency. A simulation with the software Matlab shows what happens if we vary the narrowband signal by 10% in frequency.



▶ *The multipath effect on narrowband and broadband signals*

As expected, the effect is much less pronounced with a wider signal. A FM-ATV or data signal of 20 MHz wide already seems very wide, for frequencies in the GHz bands that is of course a narrowband signal in percentage. However, it can already be noticed that phase distortion occurs when the signal is received (especially visible in an FM-ATV image).

Practice

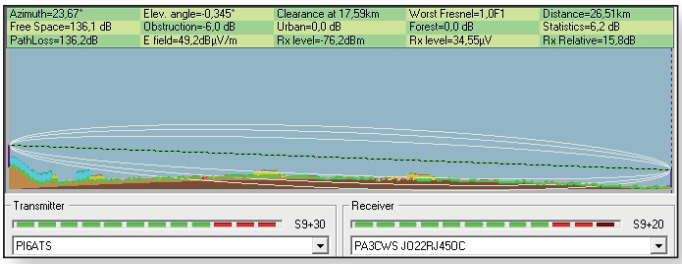
With radio links, we assume that a higher antenna is better, because then there are fewer obstacles in the signal path. I have simulated this situation with the Radio Mobile program (whereby I am not convinced that the situation is always correctly displayed, but clear enough for this simulation).

I used a location on a hill in Soest (Netherlands), where over a distance of 26 km with 10 Watt ERP, 5780 MHz is sent to a receiver with a sensitivity of -92dBm and an antenna gain of 28dBi.

There is a line of sight path

If the antenna of the receiving station is 2.5 meters above the polder ground, the signal is 3.3dB above the required signal strength

If we raise the antenna on the receiving side to a height of 17 meters, the signal strength increases by 12.5 dB.

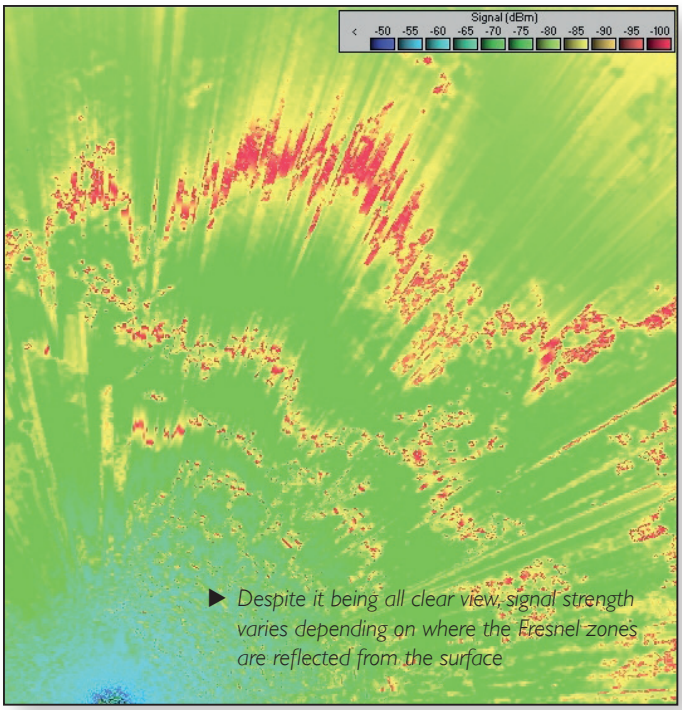


▶ *The first Fresnel zone completely unimpeded*

However, if we raise the antenna further, to a height of 30 meters, the signal strength has decreased so much that it is 15 dB below the threshold of the receiver.So 18.3 dB less than with the antenna at a height of 2.5 meters.

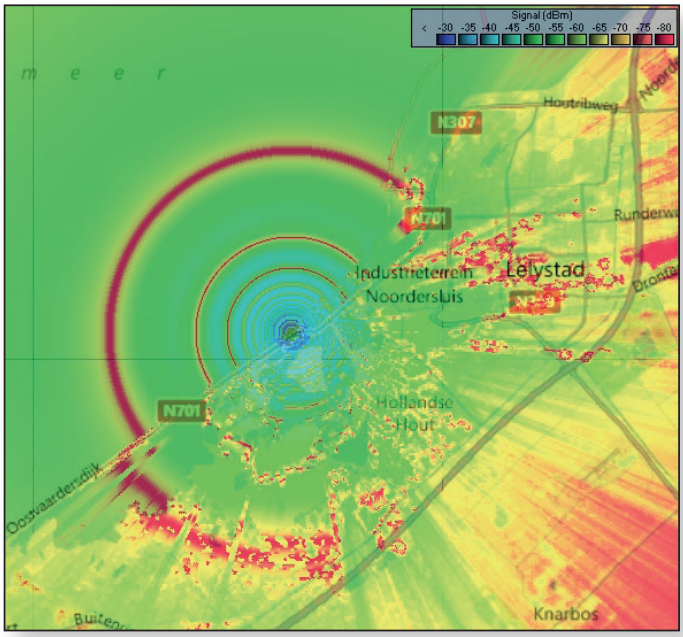
▶ *Because the 2nd Fresnel zone is reflected by the earth, the signal is lost at this height*

Plotting this situation 360 degrees around clearly shows that there are several circles on which the signal is strongly attenuated.



▶ *Despite it being all clear view, signal strength varies depending on where the Fresnel zones are reflected from the surface*

The erratic shapes arise because the reflection point of the Fresnel zone (the earth) is not like a mirror.The situation is different over water. Because of the beautiful reflection surface, sharply delineated circles are created then. If you just you're your antenna on the spot of such a circle at that height, the signal strength would be much lower than at another height or outside that circle.



▶ *A 5780 MHz signal broadcast at a height of 14 meters on the edge of the lake Markermeer shows that water is a beautiful reflector*

In this example, if you stand on the dyke and think that the signal will become stronger if you raise the antenna to a height of 14 meters, you will be disappointed. Often this effect is not noticed at all because in practice no movement is made unless driving (or flying). Lowering a height-adjustable mast sometimes allows a greater signal strength to be established, depending on the band, of course.

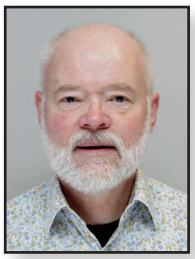
This is also the effect that is noticed many times with moving the (portable) setup one or two meters sideward.

As long as the signal strength is good, nobody will notice. However, if it's a matter of receiving the signal or not, that can make a difference (sometimes a lot).

There is much more to investigate and tell about this interesting matter, such as Fresnel zones reflected against aircraft (or communication with those aircraft). Or what happens when the water is swelled? Many publications can be consulted about this on the internet (with many formulas for those who love it).

A prototype DATV repeater

Richard GI4DOH



I refer to the subject of this article as a prototype as it is a work in progress and it still has a long way to go before it becomes a fully-fledged design. However, it is part way there and it is operational as a streaming service as a benchmark of its progress.

My background with amateur radio has mainly been associated with DXing and contests at the CW end of the HF bands but being introduced to DATV by John GI7UGV at a local club talk changed all that. The advent of QO-100 has also changed the dynamics of DATV here from something that might happen occasionally to something that is always there. This project is perhaps a natural progression of my shift in radio interest now that I am in hook, line and sinker.

At the BATC stand at the Friedrichshafen amateur radio exhibition in June 2022, Noel G8GTZ and I talked about the possibility of a TV repeater in Northern Ireland – there had been one many, many years ago. Investigation suggested that the previous repeater location, above Carrickfergus in County Antrim, was less than ideal in coverage of the Belfast area - even if it were possible to locate there.

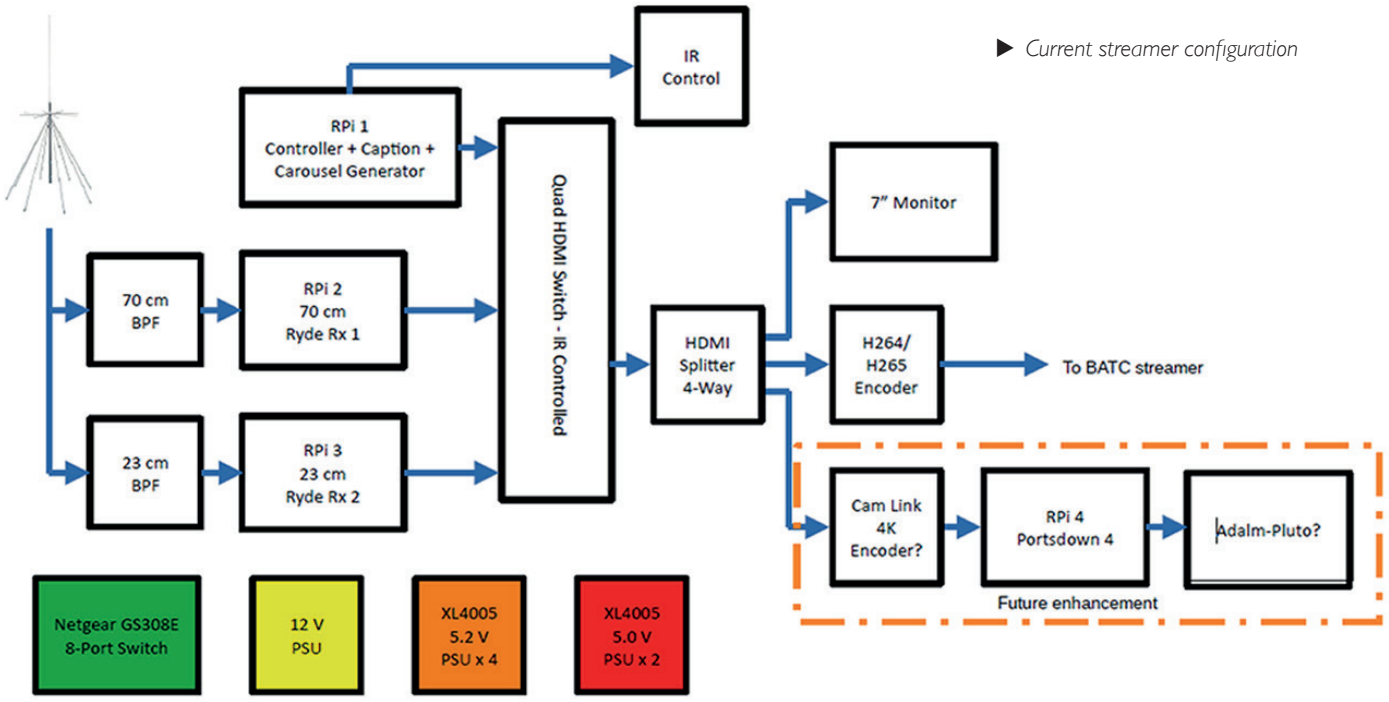
My own QTH doesn't have brilliant coverage either, but it does have the advantage that I live here. Sadly, with the passing of my wife last year, I don't have to ask for permission to do these things any more. To that end, I have applied for a TV repeater licence with the call GB3DO for County Down (and with remarkable similarities to my own call).

One advantage of this project is that I am not trying to provide something that covers the functionality of an existing analogue repeater so I can focus entirely on DATV. A basic configuration of output on 23 cm and inputs on 23 cm and 70 cm with an option for a third band (possibly 2 m) seemed like a good place to start.

I already have a Diamond discone antenna capable of taking more power on 23 cm than I am ever likely to subject it to. The local planning authority accepts that they can't touch it but they did turn down a planning application a couple of years ago and it is not in my interest to change anything significantly here.

It's bit of a compromise but that's how it is. I also have a WiMo Big Wheel 70 cm antenna and I plan to mount that discretely somewhere for the 70 cm receive side as I won't be able to share the discone once I put a duplexer in.

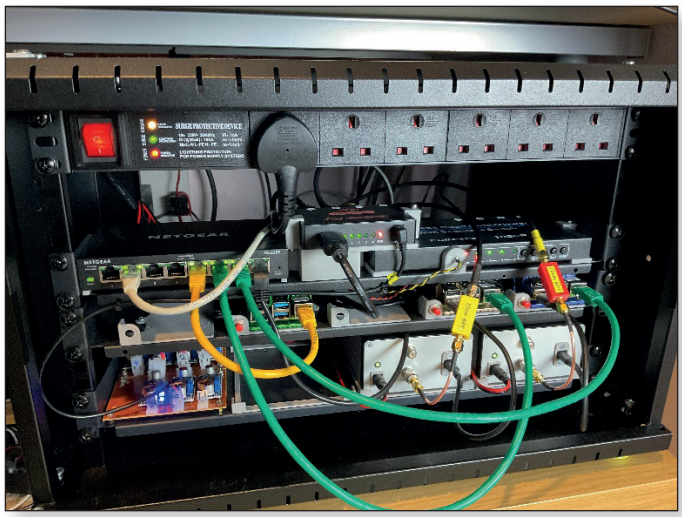
A major encouragement for starting this project was the existence of the BATC ATV repeater controller using a Raspberry Pi 4. This is the backbone of the project along with the BATC Ryde receivers (Minitiouner + Raspberry Pi) that I would be putting together as tried and testing building blocks.



▶ *Current streamer configuration*

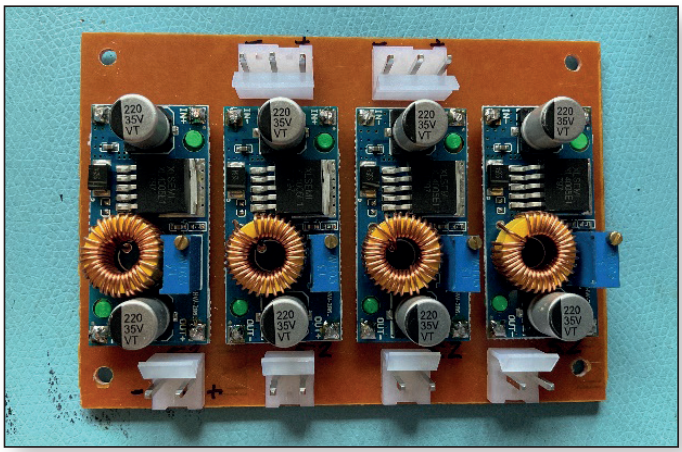
Using the 'think big, start small' philosophy, my initial goal was to get a streamer service running. If I succeeded in that, I would be in a better position to see what else was needed than if I tried to plan everything in from the start given that this is all new ground for me. I had hoped that some of the unknowns or question marks would resolve themselves along the way. Some have, though not all. Along with my starting configuration of controller and receivers, I would also need HDMI switching, HDMI splitting and encoding for the streamer and of course power distribution.

Regardless of whether the repeater was to be based here or on some remote site, it made sense to package it properly from the start. Ironically, I was able to purchase a brand new 6U high 19" rack from Poland at an all-up price of less than I could buy a used one and have it delivered from the mainland. I have seen many 19" racks go in skips over the years but I never thought some day I might actually want to own one myself. I also got a 1U-high 13 amp distribution strip and while that has been useful in the development stage, if I find myself short of space further down the line it can always be removed.



▶ *Plenty of room to add the RF bits*

The individual modules required either 12 V or 5 V so I got a 13 amp rated switched mode 12 V power supply as the basic supply. We all know that the Raspberry Pi likes something in the order of 5.2 V while the Adalm-Pluto seems to be more stable at less than 5 V. To keep my options open, I designed and milled a couple of PCBs, each holding up to four XL4005 buck converters. That way, each module can have whatever voltage I think best for it. While I was in the mood for milling PCBs, I also made one to hold an IR LED driver circuit for use with the HDMI switch – more about that in a minute.



▶ *Buck converter mounting PCB (2 of these)*

I had some problems with noise on the 12 volt line to start with but grounding the negative rail at the power supply and the buck converter distribution boards sorted that out. One advantage of the per-module buck converters is that I won't carry noise from one module to another.

In deciding my layout in the 19" rack, at the bottom, I use a shelf that was the full depth of the cabinet as interconnects could only be going upwards. There was plenty of room for the power distribution and three Minitiouner receivers (one spare) on that. Originally I just mounted my 23 cm and 70 cm Minitiouner PCBs directly onto the shelf but I had a few issues with interference to start with while testing with a Portsdown 4/Lime combination with paper clip antennas on the receivers. I decided that for good practice and long-term peace of mind to mount them in the standard Hammond boxes. I made 3D printed frames to keep them in place including putting a third frame in position for future expansion. The shelf is about 1.5U high with plenty of room for natural ventilation.

Building the Minitiouner receivers was in itself a doddle as I have already built one as a free-standing Minitiouner and one in a box with a RPi as a self-contained Ryde receiver complete with the pushbuttons on the front. But as always, it's a bit of a relief when you finally see them working.

I also used available space on the bottom shelf to hold an HDMI video encoder to generate the rtmp stream to go to the BATC streamer. This module was advertised on AliExpress as 'H.265 WiFi HDMI Video Encoder'. In reality, I found it to be problematic. When I was receiving a signal on 23 cm or 70 cm, the video stream could be very jerky on moving images such as the good old original Portsdown animated testcard.

I tried turning the encoder WiFi off and ultimately disconnecting the little antenna from the PCB in case the WiFi signal was overloading the Ryde receivers but that didn't help. I ended up buying another encoder from AliExpress and this went under the description of 'H.264 H.265 H265 Hevc HDMI-compatible to rmtp live stream IPTV rtsp encoder video full HD 1080p@60fps For Facebook Vmix Youtube'.

Note there is a tremendous range of pricing for what appears to be the same thing and shipping can vary a lot too – I think I paid around the £100 mark but I felt I needed to try something different to the one I was having trouble with. It's always good to have a second opinion. Fortunately this turned out to be a good buy and all the jerky issues on the rtmp stream have gone.

Setting up the encoder for the streamer was a bit frustrating to start with but I was perhaps over-analysing things a bit and it was really quite simple – the main secret being to get the rtmp(s)/rtsp push URL in the settings right, which for me is rtmp://rtmp.batc.org.uk/live/gi4doh-mypassword.

My second shelf up is about 15 cm deep and has provision for six Raspberry Pi units mounted in the 'armoured' type heatsink boxes. These remove any need for fan-assisted cooling. I made 3D printed mounts to hold the RPi plus a push button switch for manual shutdown. As Dave G8GKQ has suggested on the Wiki, you might want to disable the shutdown button on a remote site where curious fingers might be tempted. The RPi allocation is one each for the 23 cm and 70 cm Ryde controllers and space for a third Ryde one, the repeater controller and ultimately a RPi as a Portsdown 4 for generating the RF.

To make the interconnections between each RPi, I have plugged a 2x20 pin header strip into each RPi and then have point to point wiring soldered onto those for the likes of the valid RX signals on the receivers and the controller IR sender signals. The shelf can be removed as a complete unit so I don't need to have additional connectors within this harness – if I need to remove a RPi, I can just take off the 2x20 header. The RPi shelf is only 1U high with space for natural ventilation.

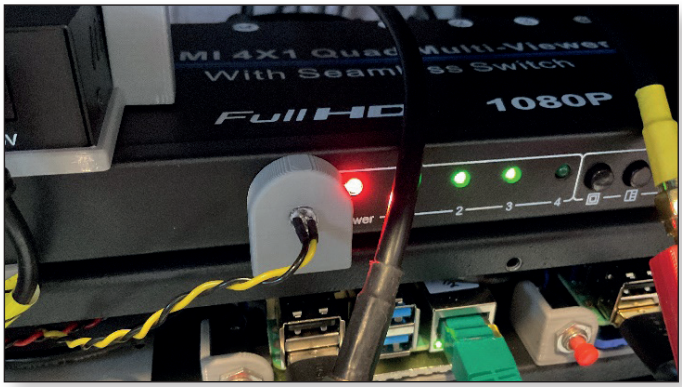
The third shelf is my general-purpose shelf, also 15 cm deep. I can always use deeper shelves if future real estate needs arise. I started with a Netgear GS308E 8-way Ethernet switch as I already have a couple of these in the shack and better the devil you know. In fact they are simply plug and play and no configuration effort was required.

► *Third shelf up - 3D printer is great for making custom mounts*

The shelf also holds an active HDMI splitter and an HDMI switch. As ever, I used custom 3D printed mounts for all the modules and in fact the HDMI splitter even overlaps the HDMI switch a bit. This shelf is a height of 1.5U so overall 4U has been taken up leaving 2U for the RF stages and anything else.

With the HDMI splitter, I had tried a cheap eBay passive dual HDMI one to start with but it was a bit temperamental and didn't always start up correctly. I replaced this with a quad powered one for a paltry sum from eBay and it is fine in every way. It gives me an HDMI output for the streamer encoder, an output for a local monitor and an output for the RF side of things plus a spare HDMI output for any future need. I should have started with that one in the first place.

The HDMI switch was troublesome in that my original one took a long time with a blank screen when switching while it assessed the new input and configured itself. The main inputs are the repeater controller carousel and information screens and the two Ryde receiver HDMI outputs. Switching is done by Infrared control and this is where the IR driver circuit mentioned above comes in.



► *IR LED mounted over HDMI Switch remote control sensor*

When the repeater controller receives a valid RX signal from one of the receivers or if it wants to switch to its own output or another HDMI source, it sends a signal for an IR LED that is mounted on the HDMI switch that mimics the standard remote control. Thus the HDMI switch tracks the appropriate HDMI source. Details of a suitable IR LED driver circuit are on the BATC Wiki and I made up a small PCB for that purpose.

I spent quite a bit of time messing about trying to get the timing right with the HDMI switching delays but I still wasn't happy with the results. I eventually went on eBay and bought what was described as 'HDMI 4x1 quad multi viewer with seamless switch'. It does what it says on the tin and all my timing woes have gone. You can configure the repeater controller to tell the HDMI switch to go into quad screen mode if you have more than one valid input;

the other option being to prioritise the inputs so you only ever display one input at a time.

However, this idea of multiple inputs brings in questions like where do you get your audio from if you are in quad split mode? With the basic prioritisation configuration, the audio source will automatically track the HDMI source. The BATC does sell a PCB for an I²C audio switch and that allows you to configure the repeater controller to select whatever audio source you wish under whatever conditions. I've got the PCB and the components but haven't built it yet because I haven't worked out how I might configure it – but it is there if I need it further down the line.

While there have been a few changes in my plans along the way, like deciding to box the receivers and replacement of the HDMI encoder and the HDMI switch with different models, the ability to produce custom 3D printed mounts has been a great help with getting everything to fit in this limited space. Changing to a module with different dimensions has just meant reworking the mount design. There are a few redundant holes in my 19" rack shelves but that doesn't matter.

Configuration of the repeater controller has taken a bit of playing around but once you have worked out what is going on it is easy to tailor things. I think the concept that took me longest to work out was that items like the annotated displays and the audio ID messages are generated at startup so you need to edit at the generating process and inputs, not the generated files. I know I can always get help on the BATC forum but there is still a stubborn streak in me after all these years and I like to find things out the hard way.

My current configuration as a streamer runs most days when I am at home. I currently monitor 1255 MHz and 437 MHz at 250ks, 333ks and 500ks but it is easy to configure for other symbol rates if desired. I don't think there is a need for 1Ms at the moment given the less-than-ideal location and antenna configuration. I also have a local HDMI input for a camera or whatever other input I might like to add. Output currently goes to the BATC streamer at batc.org.uk/live/gi4doh. The whole setup takes about 50 W from the mains and that includes a local seven-inch HDMI monitor. Obviously if I were to be pumping out RF that would go up a bit but it's not going to break the bank – not yet anyway.

Has anyone else accessed it yet?

Robert GI3VAF, who is a couple of miles away, can put a good signal in on 70 cm. John GI7UGV is a bit further away and on a path that we have trouble with even on 10 m. So far he hasn't been able to put a signal in from home but getting the 70 cm Big Wheel up at my end might help. We have a couple of budding DATV guys on the far side of Belfast Lough who are close to line of sight with me. I hope they will get in easily when they are ready to go.

Final transmit arrangements have yet to be decided but there will probably be a Portsdown transmitter with something like a LimeSDR or Adalm-Pluto. Dave G8GKQ and Noel G8GTZ are looking at options for getting from HDMI to RF in the repeater environment and I will no doubt follow their lead.

The plan is to receive on 1248 MHz and transmit on 1310 MHz with 70cm receive frequency TBC. Don EI8DJ has kindly lent me a duplexer for 1248 and 1310 and conveniently these are the frequencies that Noel had recommended. I have also procured an interdigital filter from ID-Elektronik GmbH that claims a better than 85 dB notch at 1310 MHz. I'll address further filtering if I find a need when things become operational but in the meantime I have off the shelf 23 cm and 70 cm filters in line with the receivers to stop issues with strong local test signals.

What else needs to be done?

The streamer has been very reliable and I have never needed to reset anything in its normal day-to-day operation. However, if a suitable site were to become available, and there is a possibility that might happen, I would need another level of control to allow me to do power resets and the like. The repeater controller does a reset every afternoon at 3pm as a matter of form but it would be good to be able to force power resets on each RPi individually.

Within the terms of a repeater licence, I will need to be able to remotely shutdown (I can do that here with a network-enabled 13 amp socket) and it would be nice to be able to remotely start up again too. So more work is needed to get something in place for that. I may locate the repeater in the loft to reduce cable runs once it has matured a bit and doesn't need to be so accessible. That will be a good test of its suitability for a remote location – the ultimate goal.

This has been an interesting project and I am very grateful to all at BATC that have made these building blocks available to us. My hope is that having something like a repeater in place permanently might encourage more people to give DATV a go in Northern Ireland. A repeater in itself should be self-promoting and hopefully the word and interest will spread. Given the progress made in DATV in recent years, the future looks good – even from here.

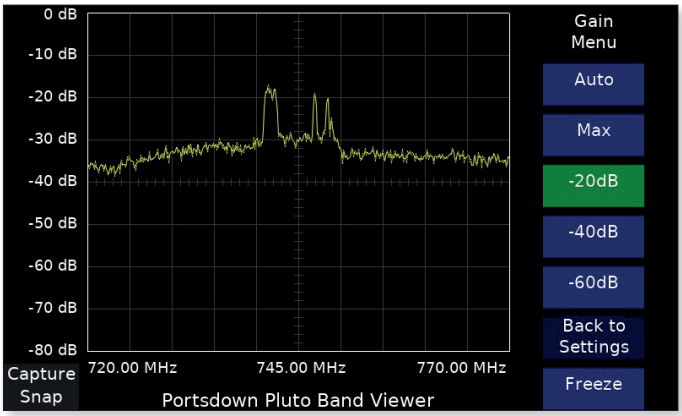
The Portsdown Newsletter

Dave Crump, G8GKQ

There have been a few enhancements to the existing Portsdown 4, but I have been concentrating on getting "Portsdown 4 Next Generation" started in the right direction.

BandViewer

BandViewer on the Portsdown 4 now works with a Pluto (as well as the LimeSDR, Airspy R2 and RTL-SDR). The native frequency coverage is 70MHz to 6GHz, but in fifth harmonic mode it can display frequencies up to 30GHz with much reduced sensitivity.



▶ *50MHz span on Pluto BandViewer*

The Pluto will provide a 50MHz scan width with other selectable widths down to 2MHz.

I have also added the ability to view the BandViewer display (at a 1Hz refresh rate) from a web browser. Note that this is not web control, just a viewing capability.

The Pluto BandViewer and web view are only available on the Portsdown 4.

Choice of SDR for new Portsdowns

Portsdown has long supported both the LimeSDR and the Pluto SDR. The recent availability problems caused by the global chip shortage have affected both devices, but the Pluto is now available again from Mouser at less than £250. Orders for the LimeSDR Mini version two placed now are estimating a Feb 2023 delivery at a cost of $400+.

I discussed Pluto reliability in CQ-TV 277. Since then, I have found that powering the Pluto from the second USB socket seems to help. This input does not appear to suffer from the voltage sensitivity of the data socket.

There have also been some problems with LimeSDR Mini reliability on the Portsdown 4. It seems that the LimeSDR Mini is more reliable when connected to the USB2 (black) sockets than when connected to the USB3 (blue) sockets.

I know that this is counter-intuitive, and I have not found a cause. Remember that the LimeSDR Mini likes to be supplied with at least 5.1V and is less reliable at lower supply voltages.

The CaribouLite RPi Hat (at about $150) remains a possibility for the future, but is not yet supported by the Portsdown, is totally unproven and has missed a number of shipping deadlines.

The DATV Express board continues to be supported for DVB-S transmissions, but is no longer available.

The Portsdown development team have also considered custom-built SDR hardware, but it is very hard to better the Pluto in terms of cost and capability.

Given all these factors and its capability with BandViewer, our current recommendation is that the Pluto is the best new-buy SDR for the Portsdown project. We will keep this under review as new products become available.

Digital multimeter display

The Parkside PDM300 C3 multimeter (seasonally available for £11.99 from Lidl) can be modified to provide a serial output. I have been working on an application to display and log its readings. The display is released in the latest Portsdown build, and a testing system for rechargeable batteries is under development. More details on the BATC Wiki at *https://wiki.batc.org.uk/Portsdown_DMM_Display_and_Logger* .

▶ *Large screen DMM display*

HDMI Input Devices

I mentioned the Elgato Camlink 4K dongle as a possible HDMI input device in CQ-TV 277. This appears to work really well with a stable HDMI input signal (such as a single camera, or the display/secondary output from a PC), but does not handle transitions between different HDMI sources (as experienced in repeater applications) very well.

Investigations continue to find a reliable repeater input solution and the LinkPi series of encoders is currently being evaluated.

Portsdown 4 Next Generation

The current version of the Portsdown 4 is built on the Buster operating system which has already been superseded by the Bullseye operating system. Unfortunately, the Bullseye operating system requires major changes to the way the Portsdown works, so up till now we have stuck with the older operating system. This situation is not sustainable in the long term, so I have started work on the Portsdown 4 Next Generation (Portsdown 4 NG) which will be based on the latest operating system.

I am also taking the opportunity to restructure the Portsdown code into a more logical format, and rebuilding some of the capabilities from the bottom up. This is not a quick process, so it will be some time before the Portsdown 4 NG is ready for widespread use. My first target is to build a reliable HDMI input, LimeSDR output, repeater transmitter.

Note that, **although the Portsdown 4 NG build is already published on GitHub, it is not yet useable** without "inside" knowledge. In particular, there is no touchscreen or SSH Console menu.

Raspberry Pi availability

Availability of Raspberry Pi boards continues to be difficult. It is forecast to improve during 2023. You can track where they might be available on the website *https://rpilocator.com/* The site also has a Twitter feed and an RSS feed. The situation is not impossible – at the time of writing, Pimoroni had Raspberry Pi 3s in stock.

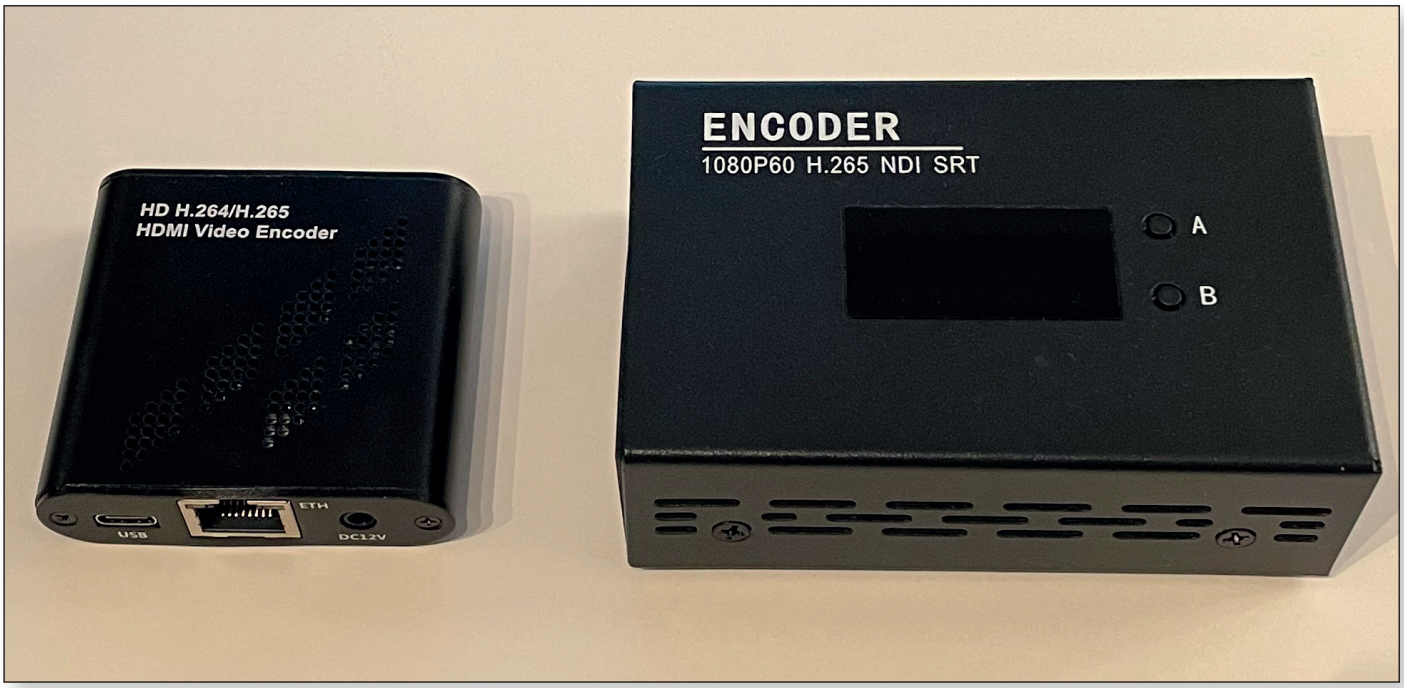
It is worth looking for Raspberry Pi kits – these are sold with an additional power supply and other accessories, but are sometimes more readily available than the boards on their own. The Cambridge Raspberry Pi shop often has stock available for walk-in purchasers.

Please do not pay inflated prices on eBay for Raspberry Pis – this just encourages non-approved profiteering resellers to buy up any stock that does become available and deny it to hobbyists.

Please post on the Forum if you need a Raspberry Pi for a repeater or other community project – someone might be able to help.

Future Development

The highest priorities on my to-do list include the BandViewer waterfall, and designing a reliable LinkPi-based HDMI input repeater configuration. No promises though.



▶ *The LinkPi TinyENC1 and the LinkPi ENC1". Initial indications are that the "Tiny" is not reliable enough for repeater use, but the ENC1 is looking promising*

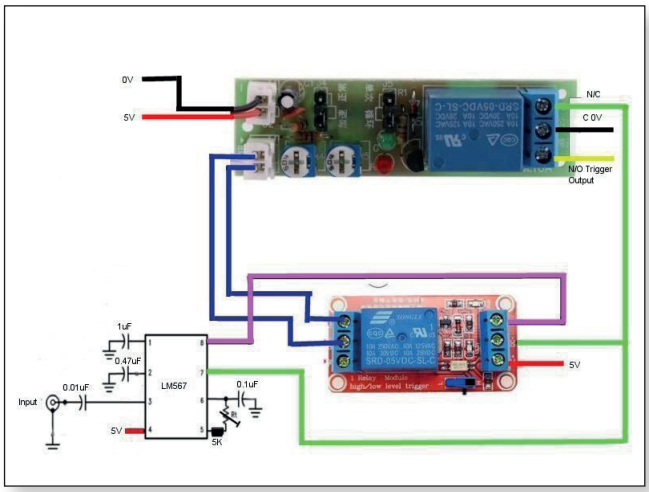
SSTV on GB3GG

John Ferrier G0ATW

It was 2020 when I was first asked about the possibility of a SSTV input to GB3GG, while this may seem strange with the dash for HD and fully digital repeaters, the idea of trying a different mode to generate other operators was attractive.

Looking around for software required to test and build a system I found an encoder and decoder application available for my Android phone and MMSSTV for the PC, even coupling the phone by holding it next to a speaker or microphone seems to work extremely well.

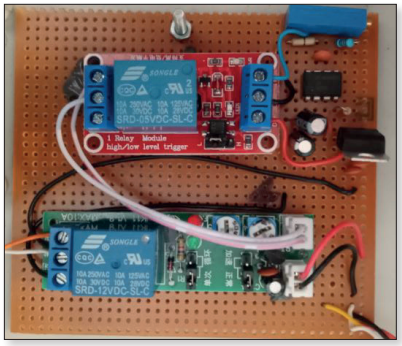
On GB3GG we do have spare video inputs with closing contact detection for valid signals, so the first challenge was to produce a SSTV sync detection circuit, the circuit shown in diagram was the result of delving through my junk boxes.



The LM567 IC is used to detect the SSTV signal with components chosen to detect over a wide bandwidth so signals are not missed, RT is a multi turn 10k pot for accurate alignment.

The relay and timer boards are readily available on eBay; the diagram shows both as 5V working unfortunately my timer PCB was a 12V one so I had to use an additional 7805 regulator.

On detection of a valid signal relay one is activated by pin eight of the LM567 going low, the closing contact of the relay triggers the input of the timer. The timer is set as a monostable with its time adjusted to display the received SSTV picture and display it for a few seconds longer than it takes to send.



Note the normally closed contacts of the timer N/C open on detection of a signal disconnecting the ground 0V to the LM567 and relay, stopping any false detections during the display period.

The normally open contacts N/O are used to trigger the logic.

The decoded video is supplied from a small atom PC running MMSSTV the VGA output from the PC is fed into a readily available converter "pictured" again from eBay with this you can zoom and move into the area of the display to be converted, in our case the picture viewer of MMSSTV.

I put a simple resistive audio mixer on the input so we have a possibility of three different receivers feeding into the system.

We have recently gone live on 144.5MHz with a radio donated by G1BRB the aerial is shared with the SDR *http://www.grimsbyradio.co.uk/*

After two weeks of operation we have received more than 60 pictures with multiple operators, a vast increase in repeater activity.

If you give it a try and are watching via the BATC stream remember there is a long delay between the repeater seeing your signal and viewing it via the web page.

John Ferrier G0ATW.

SM ATV exciter for 23cm, 13cm or 6cm

Sjef Verhoeven PE5PVB

For a while I was looking for a method to easily get on air on 6cm ATV. There are standard transmitters for sale, but those only work with preset channels, have different video pre-emphasis and are technically not that great either. In addition, it is also nice to build this yourself instead of connecting ready-made modules.

But how do you do that? Mix, multiply or directly at the wanted frequency? During my search on AliExpress I came across three VCOs, one of which falls into our 6cm (SM5800) ATV band, the other two, 23cm (SM1200) and 13cm (SM2400). An idea was born. A transmitter, PLL controlled, with baseband video input. Many similar circuits already exist, but they were designed quite a long time ago. Many parts are not, or only poorly, available and actually stop at 13cm. So, to keep it reproducible I have to start from scratch. We live in the 21st century and almost all parts today are SMD.

Oops, I hope you keep reading, because I notice that there is a kind of fear of SMD within some radio amateurs.

Therefore first the following: ***What a fantastic time we live in as a self-building radio amateur.***

There is a huge range of parts available, making a 50 ohm circuit is no longer a problem at all, many parts no longer even need any matching circuit and in the digital domain there is more and more in one chip. Controlling this is often a piece of cake, due to the cheap microcontroller.
Okay, there's a downside. All is SMD.
But that shouldn't be a problem.

The biggest problem for amateurs who don't (want to) work with SMD is fear and ignorance. For those people: Before you throw away any old broken device, take out the PCB and get practising. I only work with SMD. Why? It is the best soldering method. Part off? No problem, just heat it up and you literally take it off your PCB. And yes, the legs are close together, sometimes they don't even come out from under the part, so it is therefore important to use the right tools.

A good soldering iron with a good tip. Soldering flux, preferably in the form of gel. A stable and neat workplace with the right light and sometimes some magnification can also be useful. At the moment I am using a JBC soldering station with a hollow tip. In that tip you can put a little bit of tin and you can solder SMD components such as ICs according to the drag technique. Solder flux can be bought in a tube for a few pounds, which will last a long time.

Good light and some magnification is essential, take a look at the radio markets, you often buy a beautiful magnifying lamp with built-in LED lighting for less than £50. And if you have to enlarge it a bit further, for example for soldering QFN parts, a microscope is useful. I use a low-budget microscope for this. These are often sold "for insect viewing". I therefore take down the argument of not having a steady hand, because I don't have one either.

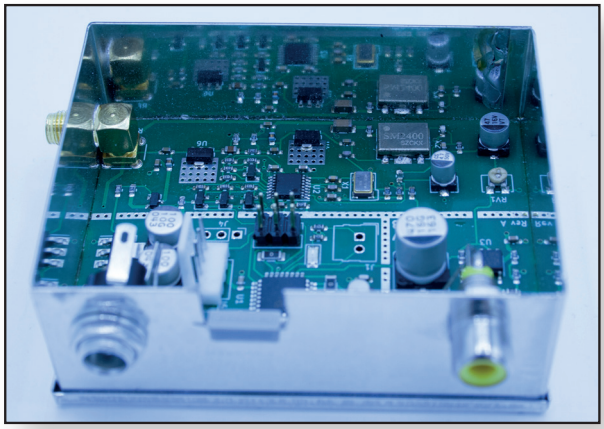
While soldering, my palm is always on the table, eliminating that problem right away. I recently spoke with an amateur friend who is quite old and who I also got into SMD a few years ago. He agrees with the above story. It's a matter of practice and more practice. And if you do that with demolition PCBs, it costs nothing.

A few drops of solder at most.

Back to the project

We have the VCO. To make it not too complex, I want to use a PLL with as few parts as possible that need to be added. I have been using PLLs from Analog Devices for a while now. This manufacturer has a wide range of PLLs and a very nice development environment. I am referring to the software that is free to download for the evaluation boards. The advantage of the software is that it indicates exactly what must be programmed in which registers for the values you have set. This is very handy when making a prototype, because you then know exactly which bits you have to fire at the part.

My eye fell on the ADF4106. This PLL has a built-in prescaler up to 6GHz. The dividers are set via the SPI bus and in addition to a loop filter and a reference signal, only some decoupling capacitors are needed. The task of the PLL is to get the signal to be supplied in phase, after division, with the reference signal.



If you are going to modulate FM then you are actually bullying your PLL, the PLL tries to keep it in phase, but your modulator always prevents that. To keep that fight from escalating, add a loop filter. In addition to filtering, you also slow down the correction speed of the PLL so that the effect of the PLL on the final FM signal is as little as possible.

The ADF4106 has another nice feature, the MUXOUT. You can configure this pin as a lock detect pin. In other words, the IC gives a signal as soon as the VCO is in phase with the reference signal. This is therefore ideal for controlling your output stage; if you don't, your transmitter will first cycle happily over the band at full power during the start. That lock detector is picky, because if you start making deviation, you may still think that the PLL is locked, but the IC often thinks differently about that. And to have to remove your modulation plug from a transmitter every time you change frequency is not really user-friendly either. It is therefore important not to offer modulation as long as the PLL is not locked. That brings me to the modulator part.

I chose a current-feedback op amp as the input stage. Since almost all components used work on 5V or lower, the op amp must also be able to work on that. It is also useful to be able to turn off the op amp for the aforementioned problem with regard to the PLL lock detect. My eye quickly fell on the OPA695 from Texas Instruments. It doesn't really need to be amplified, but it's nice to have a buffer between your input and your VCO.

After going through the datasheet I designed the circuit used. The disable pin is controlled by the microcontroller and can enable or disable the opamp. It does not give 100% separation, but more than sufficient for the approval of the lock detector of the PLL. R19 and C20 have been added to compensate for the loss of higher frequencies.

So now we have a VCO, with PLL and an input stage. We give some RF to the PLL to measure and we are left with about 0-3dBm. In other words, 1-2mW. Let's amplify that so we can eventually drive an output stage. We already have 50 ohms, let's keep it that way, then we don't have to match anything. And again, we would like to use 5V or less. Usable up to 6GHz and preferably in two steps, so that we can only switch on that last step once the PLL has given the green light. If you don't do that in two steps, pulling will cause the VCO to sweep over the band as soon as you engage the last stage.

With this information I started searching and came across the SKY65017 MMIC. It has about 20dB gain and a 1dB compression point of 20dBm - 100mW. Excellent ability to control an output stage. Since I put two in a row, the signal between the two stages is considerably weakened to prevent overdrive.

After some experiments, because the data in the datasheet has of course not been measured on our amateur design with a Chinese FR4 circuit board, I need about 8dB attenuation. This is the Pi attenuator network R21-R22-R23. In practice, it appears that the value of this attenuator sometimes deviates considerably, because there is quite a spread in the output level of the AliExpress VCOs.
The last stage is powered by a FET (Q1) which is turned on by the microcontroller.

To control everything, I opted for the well-known Atmega328P. A now somewhat outdated microcontroller, but more than sufficient for controlling this circuit.
The advantage is that the software can be written in the widely accepted Arduino IDE. I honestly didn't think it was necessary to include a complete Arduino on a socket in the circuit, so I chose to include only the microcontroller with crystal in the circuit.

Programming is easy using a USBASP. A very handy device and can be bought for a few pounds. You connect this to the six-pin connector J7 and can be used as a programmer via Arduino IDE. Please note, with a blank programmed Atmega328P the configuration bits must first be set correctly.

The easiest way to do this is to simply program the Arduino bootloader. You only have to do this once. As long as you do not overwrite them, they will remain stored. For the control I chose a rotary encoder and a separate pushbutton, because we like knobs that we can turn and it's also handy that we can switch off the transmitter without having to disconnect the power. Since the PLL works at 3.3V and the microcontroller at 5V, a level converter is included.
These are Q2, Q3, Q4 and Q5.

The display does not have to be large, because we only want to know which frequency we are tuned to. After some research I came across a cheap 0.91" OLED screen which can be programmed via I2C. Our frequency fits in perfectly here, and is perfectly readable.

We put the soldering iron and the PCB away for a while and we grab the old-fashioned paper and pen, because now comes perhaps the most important thing for the user of the transmitter, the user interface.

What do we want, or in this case, what do I want? Change frequency? Since it is a broadband FM signal, you don't have to be accurate to the kHz, but I like a step size of at least 100kHz in the most extreme case. I also want to be able to define the minimum and maximum adjustable frequency, and during testing the display sometimes turned out to be a bit bright, so it would be useful to be able to dim it.

So the final menu contains three items: contrast (high or low), frequency step size (100kHz, 500kHz or 1MHz), minimum

frequency (in 1MHz steps) and maximum frequency (in 1MHz steps). This data, in addition to the tuning frequency and standby status, is stored in the EEPROM of the microcontroller. As soon as the transmitter is put on standby, the tuning frequency is set to a low (unachievable) frequency, in this case 1000MHz causing the VCO voltage to drop to 0 and the output stage is switched off.

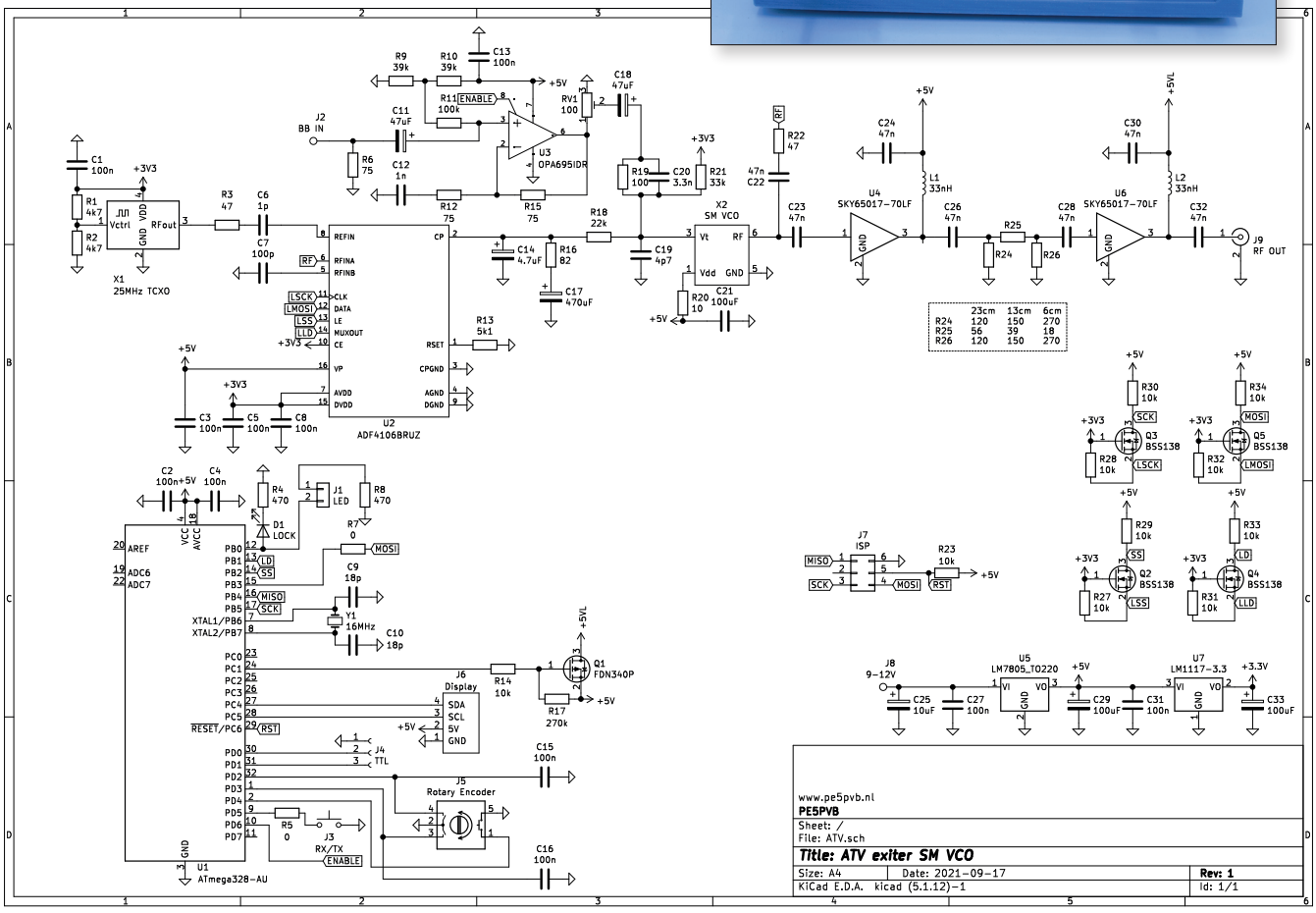
If I turn the rotary encoder, the frequency can be changed. The display will then start to flash. Only as soon as I press the rotary encoder the new frequency is set, and as soon as the PLL is locked again, the output stage and the modulator are switched on again. I have built the software as simple as possible so that you can adjust it as desired. At the very top of the script you can set the BAND definition to 23, 13 or 6. This way the default values for the desired band are chosen and written to the memory. This makes it easy for people who are not that familiar with the Arduino IDE to program the correct band in the microcontroller while flashing.

The circuit is built on a PCB that fits nicely in a 55x74mm box. A supply voltage of at least 7V is required for the circuit to work. The higher the voltage, the more energy is converted into heat in the 5V voltage regulator.

The circuit does not contain a low-pass filter, so it is unwise to connect it directly to an antenna. All passive parts are SMD size 0603, except C21, D1, R4, R6, and R20, are 1208. C28 is 0805 and the electrolytic capacitors are sized depending on capacity. J4 has been added as a TTL RS232 port. You can connect a USB to RS232 converter to this to connect the circuit to the PC. This part is not yet included in the software, but you can find a challenge here yourself.

As a final tip I would like to add that many parts are available through most well-known Chinese web shops. I always recommend ordering extra, despite the fact that the used parts are rarely supplied as counterfeit, unfortunately many components on those websites are rejected production and simply don't work. I have made the Gerbers and the Arduino sketch available so that you can have PCBs made by your chosen manufacturer and expand the software as desired. Have fun building, Sjef, PE5PVB

Full details and files, along with 3D files to print your casing, are available on the website:
https://github.com/PE5PVB/SM_ATV



A noise source for my Portsdown 4

Gareth G4XAT

The Portsdown 4 project keeps on growing (thanks Dave), in my latest build I decided it was going to be a mule that could be used for pretty much anything, depending on what I choose to plug in.

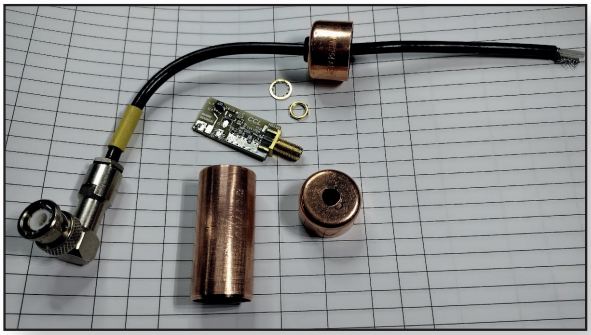
Unlike my first PD4 build where I tried to fit it all in the box, this version is a minimalist approach with the smaller five-inch DXRobot touch screen, an internally screened box (nickel spray) and sockets for access to the outside world.

So it can be a Portsdown 4, (Lime or Pluto), a Langstone, and so far, noise factor meter, ADF4351 signal generator, RF power meter and last but not least, a Lidl DMM logger.

These add-ons are really handy pieces of kit for the experimenter and having been persuaded that noise factor (NF) measurements were the way to improve my microwave kit I put out feelers for a suitable noise source.

After a good spot on eBay via fellow ATVer Malcolm (G4UHY), I bought a BBGen noise source for £30. This is specced as 100kHz-5GHz and worked as expected. I built up the BATC noise source power supply board and tested it – yes, it worked and provides and interesting insight into what's good and bad in the RF world.

But it needed packaging in a RF proof enclosure so I rummaged through and extensive stash of die-cast boxes, new and used, and uncharacteristically came up with nothing suitable. Then I spied a pipe-cap filter that I have been experimenting with recently.



The light came on and I reached into my stock of such things and pulled out a couple of new 22mm end-feed stop ends. A quick check on size – perfect - so down to the workshop to find a short piece of 22mm copper pipe.

The pipe caps were drilled on my lathe to suit the SMA noise source connector (6.5mm) and a rubber grommet (7.5mm) for the coaxial power feed to exit. The caps are a good snug fit on the pipe and don't really need securing although some tape or small self-tappers could easily be added if required.

Over the years I have used plumbing (both copper and plastic waste) fittings for a huge range of radio-related projects. This solution is so suitable that I surprised even myself.

Noise source offer

The Portsdown noise figure meter described in CQ-TV 274 requires a "calibrated" noise source for correct operation. Commercial noise sources are very expensive, but Kevin G3AAF is now offering the RXGen noise source to BATC members at a very reasonable price.

This noise source covers 2 – 2400 MHz with an ENR 10dbB +/- 0.5 dB. As such, it is ideal for testing transverters and preamps on all bands up to and including 13cm.

The RXGen Noise Source

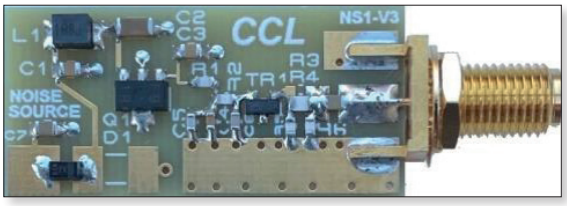
The detailed specification are:

- 11 – 15V drive at 9mA
- 10 dB ENR +/- 0.5dB from 2MHz to 2400MHz
- VSWR <1.15:1 on or off across the frequency range

This is a compact, uncased PCB; I measured one and it seemed to perform well within its specification. Perfect for mounting in a small die-cast box housing (or similar) and easily driven from the BATC noise source PSU.

Kevin G3AAF has these devices for sale to BATC members for £60 including postage. Please contact Kevin directly quoting your BATC membership number for payment and delivery details. His e-mail address is *kevin.g3aaf@gmail.com* .

Dave, G8GKQ



BATC at Midlands Round Table - December 22

Noel G8GTZ

The BATC recently attended the Midlands Round Table organised by Paul G8AQA and John G7ACD at Eaton Manor Farm in deepest Shropshire.

This was the fourth time the event has been held with some 50 people attending and is fast turning in to a first class event for anyone interested in microwaves and/or amateur television.

The club had a test-and-fix area, including noise figure measurement, and the BATC shop. Also new this year, Noel, G8GTZ organised an indoor antenna test range in the old chicken shed and tested a range of antennas from satellite dishes to horns on 3.4 to 24GHz.

Paul and John organised a general microwave test equipment bench, a live QO100 uplink and four lectures. These featured Neil G4DNB describing his recent adventures on BBC2 and his visit to Rogers in the USA, Dave G8GKQ talked about the Portsdown test equipment facilities,

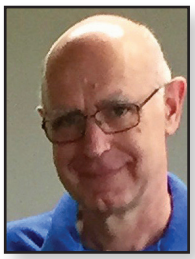
Noel G8GTZ described his adventures on 122GHz and Dave G4ASR tried to convince the age of the tripod when operating portable is dead.

There was of course a bring and buy area – get in quick before Gareth, G4XAT gets the bargains, but perhaps the highlight of the day was the hot two-course meal served by John's XYL Nicky. The meal is included in the ticket price and featured homemade Shropshire damson crumble – delicious.

Thanks again to John and Paul for organising it and if you feel Church Stretton is too far to go in one day, they do organise overnight accommodation at very reasonable rates which features more of Nicky's home cooking and a chance to socialise with other attendees over a glass of local ale.

Name / Callsign	Description	Size	Ref gain dB	Ref level	Measured level	Gain above reference	Estimated gain dB
24GHz							
G8GKQ	Penny feed dish	46cms	20	-53	-40	13	33
M0GHZ	Sky dish + I0JXX feed	50cms	20	-51	-35	16	36
G7MHF	New Andrew (HB feed)	40cms	20	-63	-49	14	34
G7MHF	New Andrew (HB feed)	60cms	20	-63	-44	19	39
10GHz							
G4HWA	Rfhams (feed not aligned)	1mt	11.7	-60	-45	15	26.7
G1YFG	CML with crook feed	60cms	11.7	-62.5	-42	20.5	32.2
G7MHF	Cambium penny feed	40cms?	11.7	-63	-46	17	28.7
GW0MDQ	Flann Horn with h/b transition		11.7	-63	-57	6	17.7
GW0MDQ	Radar horn		11.7	-63	-56	7	18.7
5.7GHz							
G4HWA	Rfhams (quoted gain 26dB)	1mt	10	-44	-30	14	24
G4XAT	Sat dish (HB feed)	90cms	10	-45	-30	15	25
G4ASR	Sat dish	60cms	10	-46	-31	15	25
3.4GHz							
G4HWA	Rfhams (Quoted gain 25dB)	1mt	11.6	-64	-52	12	23.6
G4XAT	Sat dish (HB feed)	90cms	11.6	-64	-58	6	17.6

Introduction to ATV videos



Dave G8GKQ

The RSGB have recently published two videos on YouTube that are ideal for promoting ATV amongst the amateur radio community.

The first, more suited to a younger audience, features Phil M0DNY being interviewed by David G7URP at the RSGB Convention. It lasts for just under nine minutes and can be found at *https://youtu.be/78Bt0aIJXQg?t=1935*

The second, longer, video (42 minutes) is entitled "Digital ATV - Opening New Horizons" and can be found at *https://www.youtube.com/watch?v=oUoGvXYoY0Y* . This is the talk that I gave at the RSGB Convention that explains how much progress we have made since the days of 70cm AM ATV and what the hobby has to offer now.

A more informal video has been published by Carl M0SZT, describing his visit to the Midland Microwave Round Table. The antenna test range (run by Noel G8GTZ) is shown at 10:26, and the rest of the video provides a good introduction to the Portsdown project and ATV in general. *https://www.youtube.com/watch?v=XujK39ILIII*

Please consider whether you could use at least some extracts from these videos for talks at your local radio club or for other ATV publicity.

Taming the Pluto in a Portsdown 4/Langstone

Dave M5TXJ

From day one I had intermittent issues with my Portsdown 4/Langstone build, mainly Pluto (rev B) not detected messages which would require a shutdown and restart.

While operating on QO-100 I would go to TX only for the carrier to appear and then disappear within a couple of seconds, again requiring a reboot. I suspected the USB cable from the Pi to the Pluto or the Pluto USB port but all seemed good.

One day I spotted on the forum a post by Dave G8GKQ remarking that the Pluto preferred a supply voltage of 5V or slightly lower, of course my Pluto being pow-ered from the Pi was running at 5.15V to avoid the dreaded Pi lightning bolt.

Well I was struck, not by lightning, but a spark of inspiration.

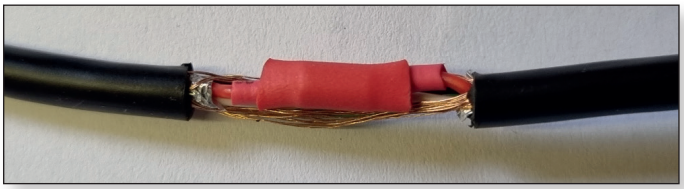
I removed the USB lead connecting the Pi to the Pluto and using a scalpel very care-fully removed the outer insulation mid-way along the cable.

Using a pair of dress-making pins I was very quickly able to prove that the red wire in the cable was the positive supply.

A 1N5817 1A Schottky diode was added in series with the red wire and insulated with heatshrink, a piece of copper foil from some low loss coax wrapped around and a further layer of heatshrink finished the job.

The end result isn't very pretty but the result was amazing, with the Pi running at 5.15V and the Pluto at 4.85V the system is 100% reliable and I've not had any issues at all.

Diode added and insulated before added screening and final heatshrink insulation.



Portable operation at the Crystal Palace Radio and Electronics Club

Gareth G4XAT

Operating successfully /P is 'proof of the pudding' you have a reliable system, so in my case, as it's still 'work in progress' - I only had three errors this time.

Justin G8YTZ mentioned that he was giving his DATV presentation to one of my local radio clubs (2/9/22), CPREC (*https://cprec.chessck.co.uk/*) based around Crystal Palace (south London), the nearby high-spot.

I offered to provide an 'OB-style link' back to the GB3JV repeater which Justin owns/manages in Petts Wood, a distance of seven miles, and theoretically a LOS path. I checked on Google Earth where I might locate my station and, other than some trees, things looked promising.

Arriving on site an hour before kick-off, I got my 70cms beam up at four metres AGL and hooked up my Portsdown 4 and small 70cms amplifier.

Watching the streamer showed I was not getting in, so I reached into the boot and extracted my big 70cms linear, along with its 45V power supply which I brought along 'just in case'.

I was feeling smug that my mains extension lead was just long enough to reach the nearest power socket. Only I'd left the IEC mains lead for the PSU behind (mistake one) fortunately Justin has a spare and power was restored.

Running 100 Watts DVBS-2 gave easy access into 'JV' so I turned the power down to about 40, this was 'adequate' as Rolls Royce used to say. I think the wall of trees (and possibly buildings beyond) were soaking up the RF. I progressed to attempting direct reception of the repeater on 3.404GHz, using an old Sky 70cm dish and a DIY LNB mount for a Titanium C LNB.

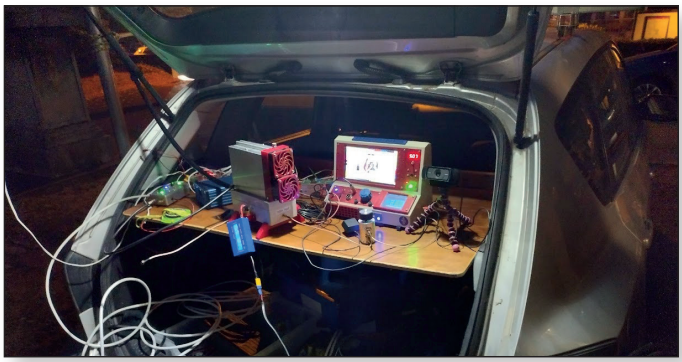
▶ *RX Success – screenshot of GB3JV received on site*

▶ *Sky LNB showing a repurposed Sky dish and LNB mount, atop a 'Tilt-O-Matic'.*

This was mounted on one of my Tilt-O-Matic tripods (see previous CQ-TV for details) and I was able to receive with just enough margin, although I suspect interference from a nearby (like 200 yards away) comms tower was upsetting the LNB. Lining up the dish and diagnosing the problem would have been easier if I hadn't left my RTL dongle behind (mistake two) as I was unable to use the Portsdown Band Viewer.

Although I had both boxes of my RF connectors I seemed to have left behind the N-male to female SMA (mistake three) but was able to use a double-N to N Female/SMA female to connect everything up. (The location has some history as our own Dave Mann and Dave G8GKQ went to this club many years ago).

Club members later came out to have a look at the source of the RF and a brief description of my setup followed - despite it being dark by then. Fortunately my LED floodlight proved adequate illumination by putting it on top of my car tailgate, shining down through the rear window.

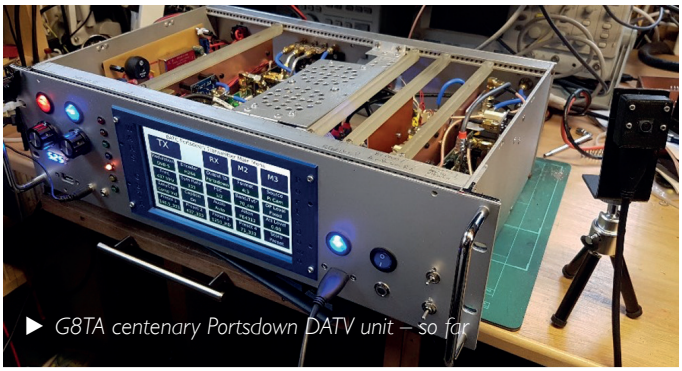


▶ *Operating - the functional but apparently chaotic station in the back of my car*

G8TA centenary DATV unit build

David Holman M0YDH

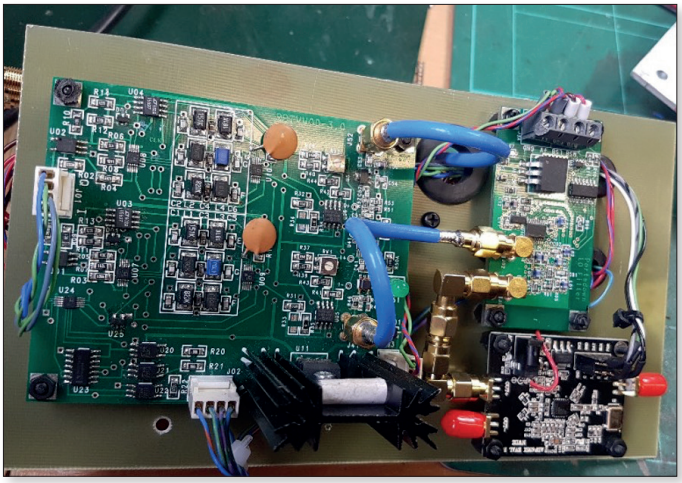
Wolverhampton Amateur Radio Society [WARS] G8TA celebrated its hundredth birthday in 2022. I offered to build a full Portsdown 3 transmitter receiver unit as a centenary project so that club members can use digital ATV at club events using my station as the other end of the QSO.



▶ *G8TA centenary Portsdown DATV unit – so far*

Round here in the West Midlands, I find that I have to build two of everything to have any terrestrial activity. [Come on all the Portsdown builders in the wider region and finish your gear – please] A second full portable station in our city would be very good.

WARS already had an unhoused Minitiouner v1.5 that we built a few years ago. These have the lovely flat layout. At CAT21 I'd bought the RF boards from Noel G8GTZ for an original Portsdown for a very good price. The filter modulator board Portsdown is a wonder – it just works once set up correctly so it's ideal for club use and on short distance links.



▶ *The filter modulator side of the transmit card*

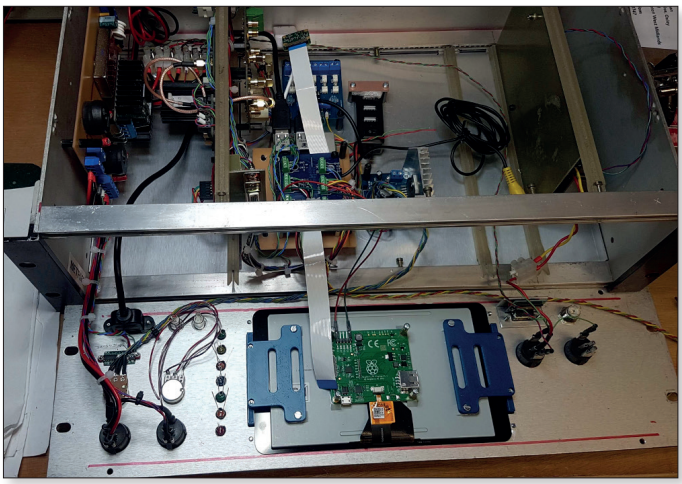
I proposed that we make a unit in a 19" 3U box that contained:-

- Portsdown 3 with filter modulator board and ADF4351 synthesiser
- Two-way RF switch, programmable attenuator and four-way RF switch for four-band operation
- a LIME Mini SDR loaned from me – for DVB-S2 and band-viewer capability
- Minitiouner v1.5 receiver
- Band viewer relay selector switch
- 4m and 6m receive capability
- Tx/Rx changeover and PA selection controller

We decided that it had to be operable by a regular club member after a few minutes demonstration and once they've connected the correct antenna to the unit. The unit needs to behave rather like a black box HF transceiver and go from Tx to Rx with only a few button presses on the touch screen.

The changeover controller is key to this and I have one in my portable rack with a non-latching 12V four into one coax switch This has proven itself over and over on activity days where you can hear on 2m talkback other stations engaged in the struggle to re-connect the receiver to the aerial after a transmission.

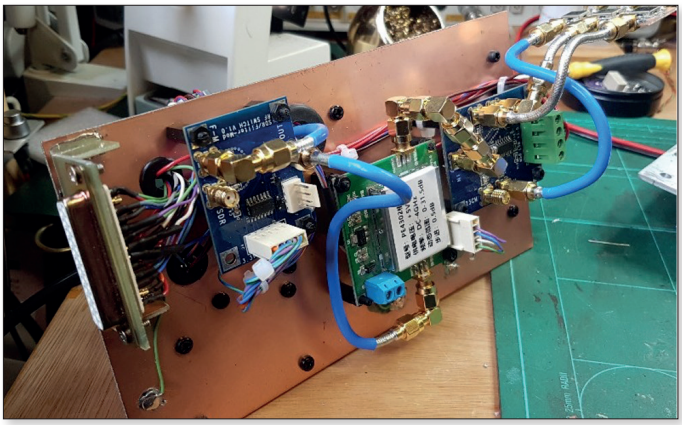
I had bought a latching 24V six into one coax switch at Telford Hamfest in 2019 and made a mounting bracket for it so it sits well on the back face of the unit. Ron M0RNW is working on the hardware and Arduino sketch for this such that it takes the outputs from the four-band decode board, routes through to the correct PA port and controls Rx to Tx changeover when the PTT is pressed on the touch screen. We hope to write about this design in a future edition of CQ-TV.



▶ *Unit under construction. G4XAT screen bezel makes mounting the seven-inch screen easy.*

The first stroke of luck I had was the offer of a 3U chassis for the project from John G7CAD (thank you) complete with rusty Pye of Cambridge circuit cards. Club members set about these with gusto and an empty chassis with rails was soon to hand. I made a bottom sheet for it from scrap aluminium then made the power supply card using a 5A buck converter for 5.1V and a Traco DC-DC converter for 12V [thanks James G0DQH] with some chokes and capacitors on their outputs.

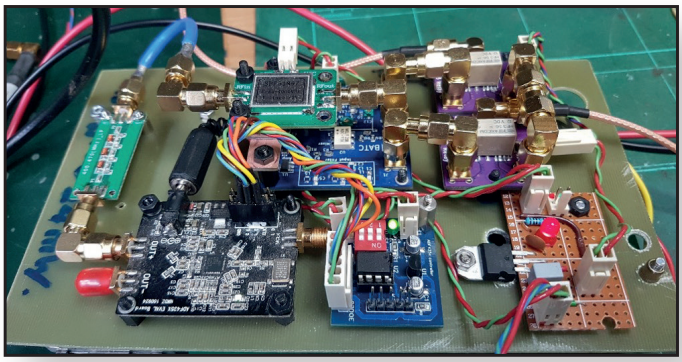
To use the space efficiently, I mounted the filter modulator, ADF4351 and its filter board on one side of a copper board that slid into the rack rails. On the other side is a 25-way D sub connector in a bracket, two-way RF switch, PE4032 attenuator card and the four-way RF switch.



Often these are positioned to suit standard SMA couplers and elbows. M3 plastic stand-offs make card mounting easy too. Semi-rigid coax of the drone FPV sort (RG-402) was used to replace temporary patch leads as the job matured. I mounted three Mini-Circuits band pass filters on a plain PCB carved with a slitting saw. The RBP-75, –140 and -440 are in their EZ Samples programme if you ask nicely. These were plumbed in with semi-rigid coax so I know we're making clean signals into PAs on 4m, 2m and 70cm.

Wayne M7WLH soldered up the GPIO breakout board and Andy G7CFC put the four-band decode board together for me. We mounted the Pi3 bought from Gareth G4XAT and the breakout board to the floor of the unit. I made a wiring loom to connect between the Pi and the Tx circuit card connector. I can disconnect five SMAs and the connector and slide all the Tx side out for examination. That's really nice.

Also mounted on the floor are an eBay audio amp (the ones with the awful voltage spike if you turn them on after the Pi) and a four-way powered USB hub from the Pi-Hut. Ron M0RNW found some aluminium 3U blank panels in his collection and I bought a seven-inch screen bezel from Gareth G4XAT. These are wonderful and he put the club callsign in the printed frame too. I marked and cut out all the holes and apertures.



▶ *6m/4m receive up-converter. Anticlockwise from bottom right:- voltage regulator / PIC controller for synthesiser / ADF4351 synthesiser/ 70cm LPF/ 30dB amp into -6dB attenuator on board/ G0MJW up-converter/ pair of relays for bypass or up- conversion.*

As the panel was 3mm thick some counterbores on the rear face were necessary for LED bezels and audio sockets which are intended for 1mm sheet thickness. I'm going to make a fresh panel on a CNC mill hopefully [offers please] and have drawn the design and the engraving in CAD. It'll be for the RSGB main construction competition where a beautiful G3IUZ Portsdown with machine engraved labels was runner up last year. Roger certainly set the bar high. The .dxf file of the panel is on the BATC Wiki for import into your CAD software. Maybe a .stp model will fit on the Wiki too.

I put my loan Lime Mini on a PCB card so that can slide in and out. The Minitiouner was mounted on a further long card. On the other face I laid out the elements of the 6m and 4m receive up-converter designed by Mike G0MJW. He'd sent me the Gerbers for his super useful SPDT RF relay design. I had 20 PCBs made at JLCPCB for £8 delivered. I've used five so far and they're handy for swapping with other members. The relays are about £8 each from Farnell.

A pair of these in normally open mode are the bypass line for the received signal. A single switch energises the relays and the whole up-converter to add the 400MHz LO to incoming signal. Now there are two of these locally so I can have a 71MHz DATV exchange.

I mounted a further G0MJW relay for the selection of receiver or band viewer instead of using a splitter. This is a relatively lossless way to route to the Lime Mini receive port.

I made a 437MHz PA on a square of plywood using an Ali-Express FM amp modified per G4XAT article in this magazine to set the bias, a 24V coax relay and a transistorised relay switch which when grounded by the Portsdown PTT line switches on a boost converter and energises the relay.

The 70cm beam is a home made effort using B&Q materials. Ssh! Don't tell 'em that they're an antenna shop. A Pi camera is mounted on a bracket to a small tripod and a tie-clip microphone is used with the usual white sound card dongle. I mounted the speakers in a hinged top plate. I know the sound is mono but we couldn't resist having two.

The unit has been used at two club events as a demonstration over distances of tens of metres. We tried it out at Northicote Farm park here in Wolverhampton across the farmyard. It sent and received pictures reliably as long as I ran back and forth to instruct the operators.

▶ *Andy G7CFC trying the new TV unit out at a WARS special event station day at Northicote Farm in July 2022. He joined BATC after trying the gear out.*

At the recent local Jamboree on the Air the club Portsdown was used as the indoor unit next to the usual HF and 2m stations putting milliwatts into a turnstile antenna. Across the car park and in full view of any leaders was the open tailgate of my estate car with my station set up.

Scouts and cubs took turns to use PMR radios to talk to each other while the DATV exchanges in vision on 70cm were controlled by club members. So fun exchanges like "do a silly dance" with a performance on TV a few seconds later were very much enjoyed by the young people and their leaders. Our members got the hang of using the DATV gear and we had a lot of fun alongside the young people. Both of these exchanges will go in this year's BATC 70cm activity ladder at a mere 10 points each.

▶ *Harry M7HJH talking to Cubs during our JOTA event while pictures from upstairs are received.*

Naturally we had a display of working DATV at our 100 years party. RSGB president Stewart G3YSX was telling the city's deputy mayor about the TV side of our hobby in some depth while I was trying to get a screen shot on my receiving Portsdown of the smart men in their chains of office. I have used the Lime mini in the unit to transmit to QO-100 successfully from home too.

Hopefully this is a useful nuts and bolts article and the unit's layout appeals to new and existing builders.

Thank you to BATC for bursary fund support to cover some of the construction costs. We hope to have the two stations out working between some of the city's hill tops in BATC activity ladder contest next year.

David M0YDH

http://www.wolverhamptonars.co.uk/

Turning Back the Pages

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

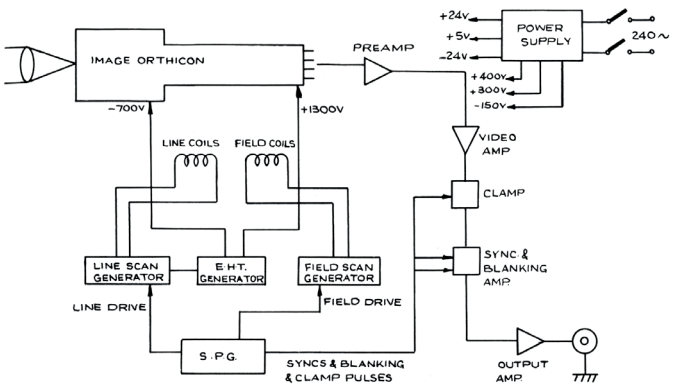
Peter Delaney - G8KZG

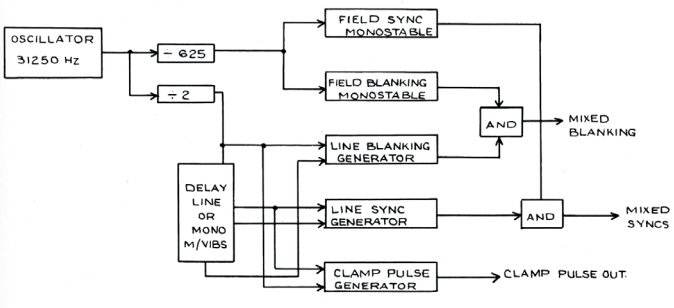
CQ-TV 89

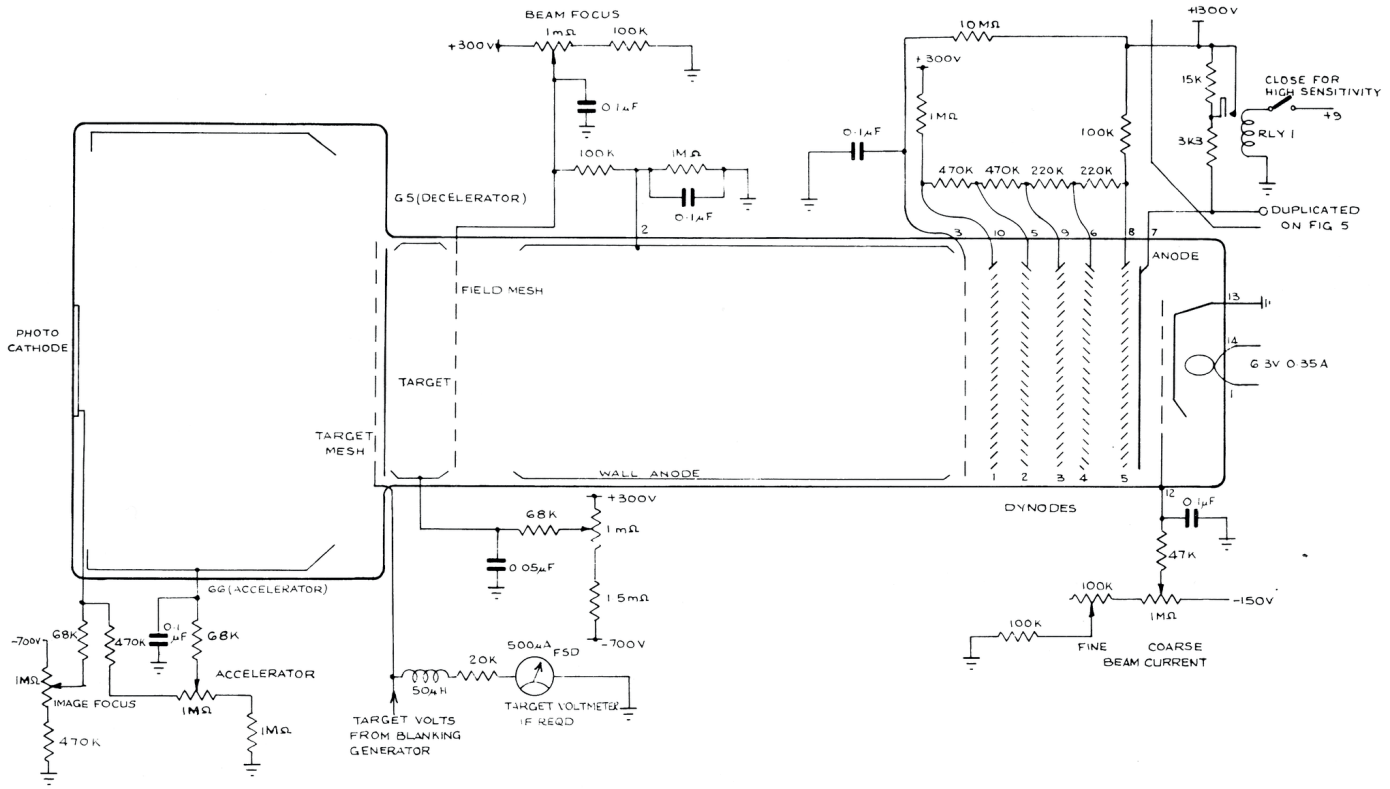
Although as noted in *Turning Back the Pages* in *CQ-TV 273* the most popular camera tube used by amateurs was the vidicon tube, the main article in CQ-TV 89 - in February 1975 - concerned the image orthicon tube. This was the normal device used in broadcast cameras in the 1950s and 1960s. It came in two variants, of either 3" or 4½" diameter. The copper scan coils were also much larger, of course, so cameras built using these tubes were much heavier, as well as larger, than those based around the 1" or 2/3" vidicon.

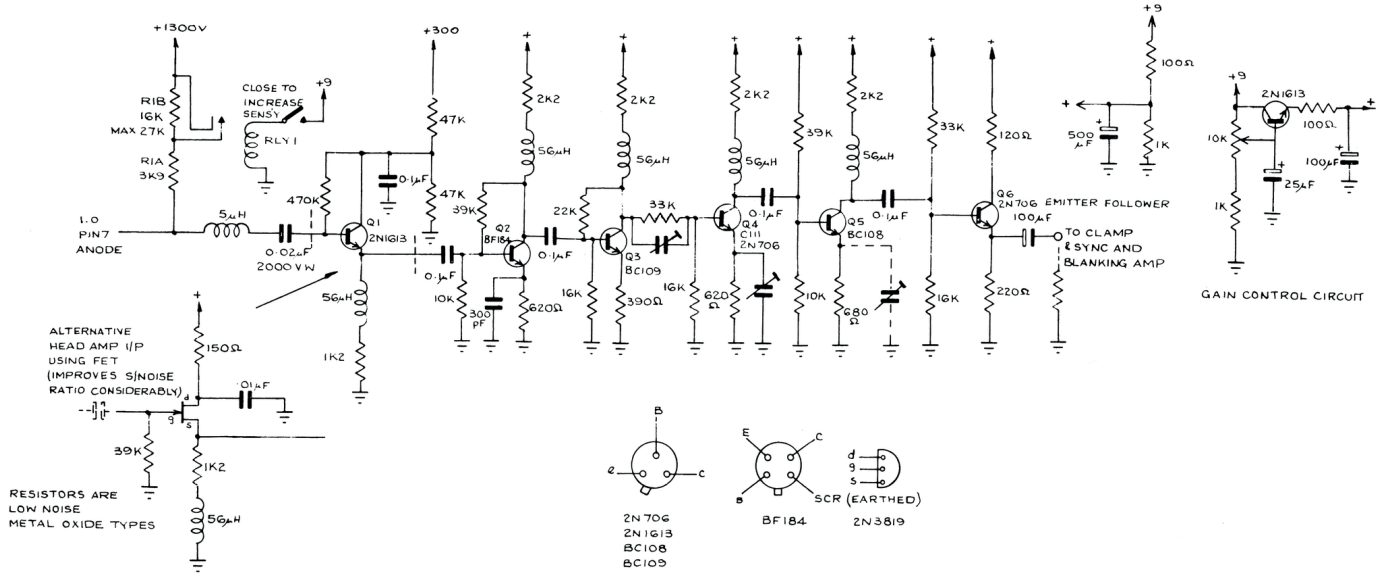
P Hayes' article began with a diagram of the tube and the various power supplies and controls it needed. "A full description would occupy an issue of CQ-TV by itself!", he said. The larger diameter image section at the left created secondary emission electrons to strike the target mesh, and so increase the sensitivity of the tube. The narrower section provided the beam to scan the target, together with a series of dynodes at the right hand end to provide signal multiplication, and results in a much better signal to noise ratio.

The block diagram of the camera included an eht generator, for the tube supplies, and a sync pulse generator as well as scan circuits and video amplifiers that would be found in vidicon cameras. Another block diagram showed the sync pulse generator, which was built around 4 divide by ten counters and 31 transistors.





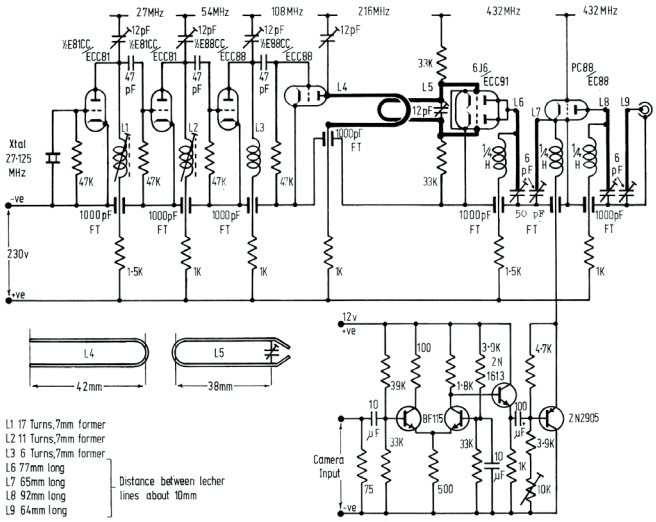


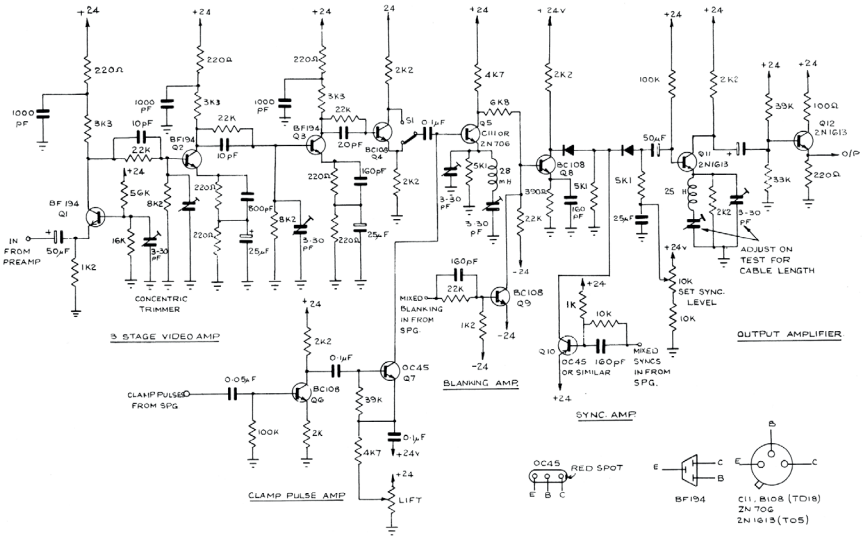


The video signal circuits were shown in two parts. The head amplifier took the very low signal from the image orthicon anode, with a relay able to able to short out part of the supply resistor to increase the sensitivity under low light conditions, but at the expense of less definition. With such small signals, low noise resistors were needed at the input. The first stage of the amplifier was designed to present a high impedance at the input - replacing the first stage with an FET would also help to keep the noise figure down. The video was brought up to about 0.5 V at the output of Q5, with an emitter follower to link to the next amplifier.

This further amplified the video signal to about 5V for peak white at the collector of Q3, followed by a unity gain stage that produced complementary outputs that could be selected by the switch to give positive or negative images before being clamped at the base of Q5 to set the black level. The remaining stages then added mixed blanking and sync pulses to produce the standard video output.

BATC, of course, caters for those with an interest in the RF side television work as well as the video aspects, and in this edition there was a design for a "Transistor Transmitter". In reality, it was the modulator that was transistorised, accepting a positive going video signal to create a negative modulated transmission.

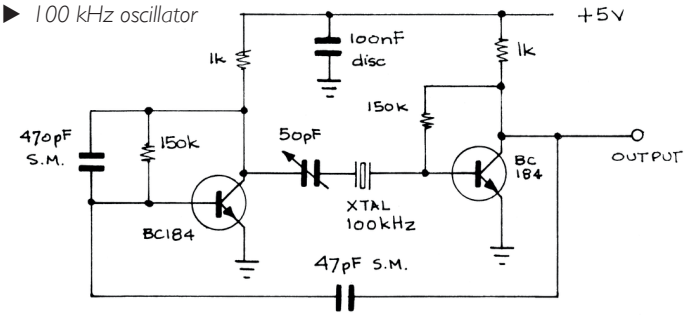




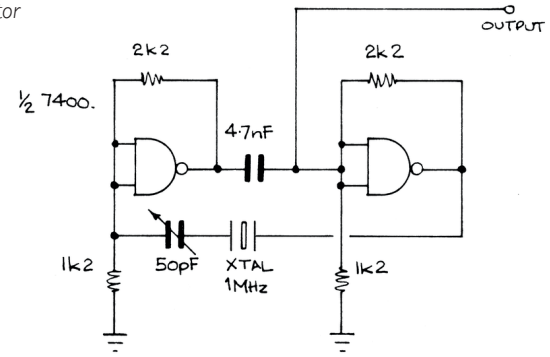
The upper part of the circuit comprised a 27 MHz crystal oscillator stage, followed by a series of frequency doublers. The design had originated with a Dutch member, PA0TEI/T, and as well as working as a stand-alone low power transmitter was also said to work well as the driver for a more powerful set-up using a valve such as the QQV03/20 or 4CX150 biased to operate in linear mode.

John Lawrence's ever useful Circuit Notebook included several circuit ideas for crystal oscillators, to suit ranges from 100 kHz to over 100 MHz.

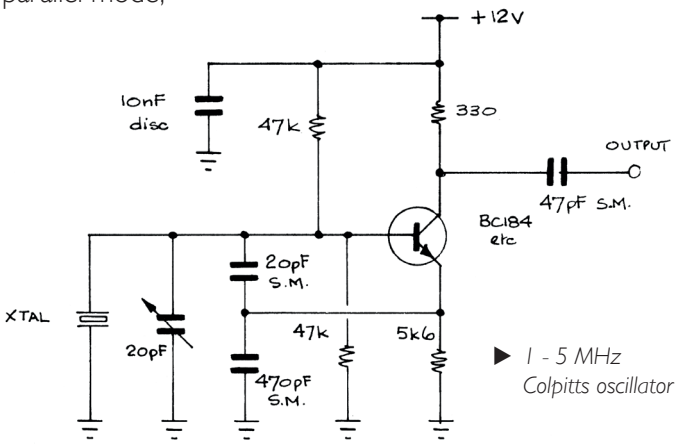
▶ *100 kHz oscillator*



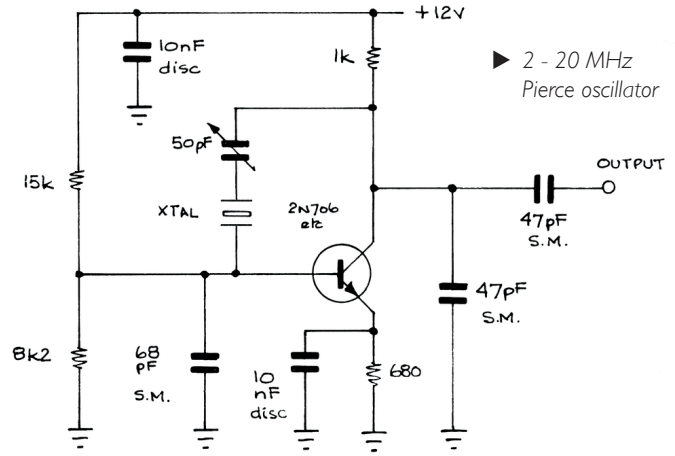
▶ *TTL oscillator*



The first pair used the crystal in series mode, whilst the next pair operated with the crystal in fundamental parallel mode,



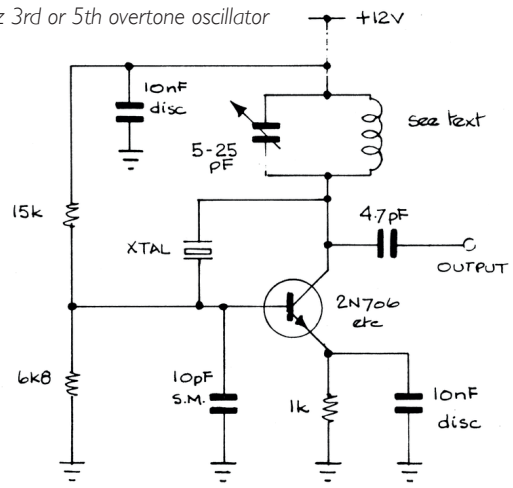
▶ *1 - 5 MHz Colpitts oscillator*



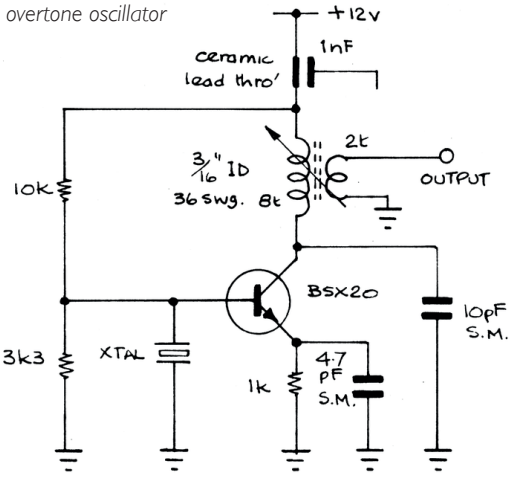
▶ *2 - 20 MHz Pierce oscillator*

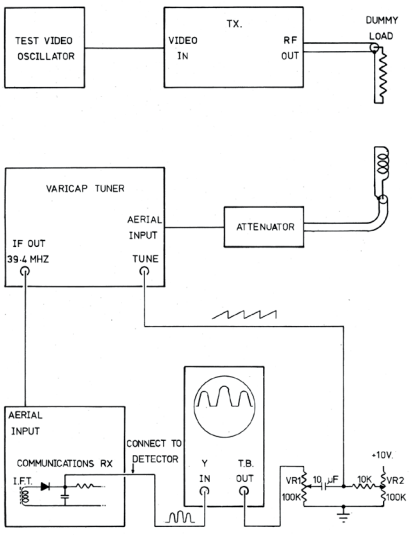
and the last pair worked with the crystal in overtone mode.

▶ *30 - 100 MHz 3rd or 5th overtone oscillator*



▶ *100 MHz 5th overtone oscillator*





Brian Summers had found a novel use for a varicap tuner. He had been building a vestigial sideband transmitter, and in order to align the transmitter used the X timebase signal of the oscilloscope to sweep the tuner across its frequency range. The tuner IF output was then fed to a suitable communications receiver, and the output sent to the Y input of the oscilloscope. The resultant display would show a pulse that corresponded to the transmitter carrier and sidebands.

The British Amateur Television Club

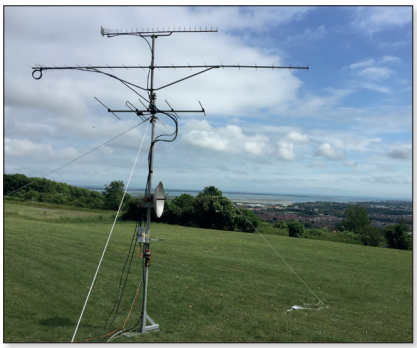
Out and About

Rallies and events with a BATC stand: (Provisional – more to come, and subject to change)

May	*Dunstable Downs*
25 June	*Newbury Radio Rally*
16 July	*McMichael Rally (Reading)*
August	*BATC CAT 23*
August	*Flight Refuelling Rally (Wimborne)*
6/7 October	*National Hamfest (Peterborough Showground)*
December	*Midland Microwave Round Table*

The most up to date status can be found on this RSGB web page: *https://rsgb.org/main/news/rallies/*
If you are able to help on the BATC Rally stands, please contact the BATC secretary.

Activity Weekends & Contests



Don't forget the 70cm and 6cm Activity Ladders running till 31st December 2022

The Christmas Repeater and Activity Challenges will commence on 24 December 2022 and run until the 2 Jan 2023.

2023 Activity Days:

Jan 21st/22nd; Activity Weekend - 2m & Down + 23cm
Feb 18th/19th Activity Weekend - 13cm & Up + 23cm
Mar 18th/19th Activity Weekend - 70cm & 23cm
Apr 15th/16th Activity Weekend - 2m & Down + 23cm
May 13th/14th Activity Weekend - 70cm & 23cm - All Bands (IARU Prep)
Jun 10th/11th IARU Region 1 ATV Contest
Jul 8th/9th Activity Weekend - 6m & 4m + 23cm (Es Special)
Aug 5th/6th Activity Weekend - 70cm & 23cm
Sep 2nd/3rd Activity Weekend - 13cm & Up + 23cm
Sep 30th/Oct 1st Activity Weekend - 2m & Down + 23cm
Oct 28th/29th Activity Weekend - 70cm & 23cm
Nov 25th/26th Activity Weekend - 13cm & Up + 23cm

BATC Online

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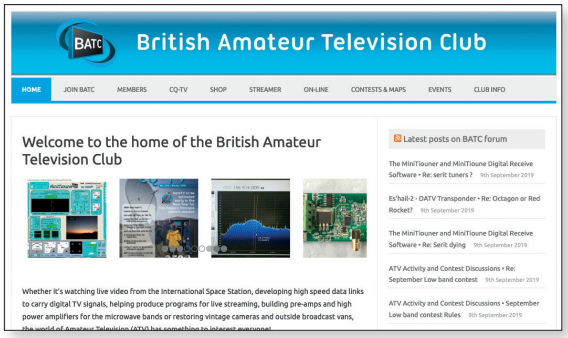
YouTube:	https://tinyurl.com/BATCYouTube



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