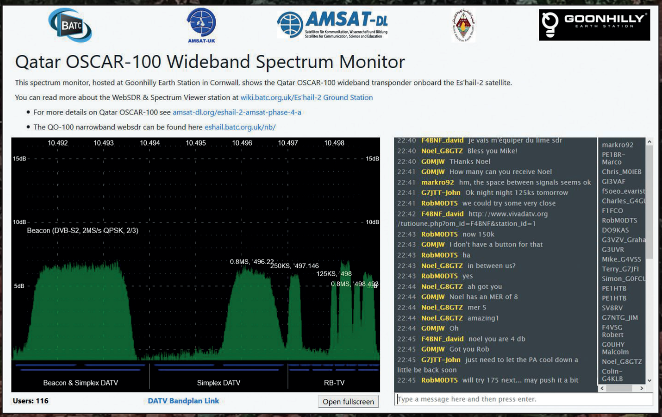
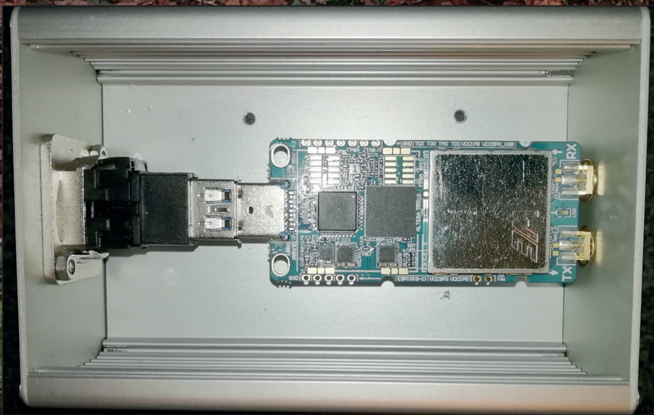
The British Amateur Television Club

CQ-TV

No. 263 – Spring 2019





Es'hail-2 open for business!

Cover images:

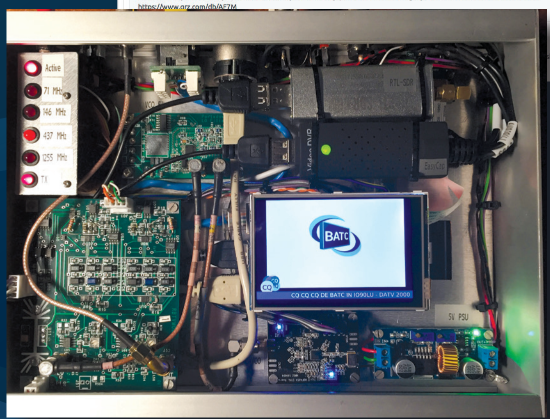
- *HE Abdullah bin Hamad Al Attiyah, A71A, declaring the amateur transponders open*
- *The Goonhilly based Wideband Web Spectrum Monitor*
- *A LimeMini securely bolted into a sturdy box*
- *Background: Graham G3VZV's Es'hail-2 dishes*

... and much more inside!

The British Amateur Television Club

The club provides the following for its members:

- A **colour magazine**, CQ-TV, produced for members in paper or .pdf (cyber membership) formats.
- **Web site** – where you can find our online shop stocking hard to get components, software downloads for published projects and much more.
- A **members forum** at https://forum.batc.org.uk/ for help, information and the interchange of ideas.
- A **video streaming** facility at https://batc.org.uk/live/ which enables repeaters and individual members to be seen worldwide.
- An **annual Convention** held in the UK where you can meet other members, visit demonstrations and listen to lectures.
- **Meet other club members** at the BATC stand at local rallies across the country.
- The **BATC Wiki** for all the details of systems and projects for all things ATV. https://wiki.batc.org.uk



www.batc.org.uk

BATC

BATC Online

Website: http://www.batc.org.uk
BATC Wiki: https://wiki.batc.org.uk/BATC_Wiki
Forum: https://forum.batc.org.uk/
Stream: https://batc.org.uk/live/
Dxspot: https://www.dxspot.tv/

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Contents:

Contributions

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

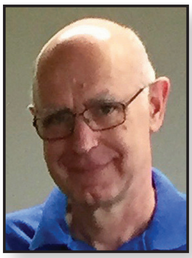
Alternatively you can write to us at:
BATC, Silverwood, South View Road, Pinner, HA5 3YA, United Kingdom

We aim to publish CQ-TV quarterly in 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 November 30th

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

From the Chairman...



Dave Crump G8GKQ

What an amazing time for Amateur Television!
The opening of the wideband transponder on the QO-100 has transformed our ability to transmit and receive amateur TV pictures across Europe and beyond.
Even if you do not have the ability to set up a big dish, I commend you to try receiving with a 60cm dish. You will certainly be able to see some of the stations on there.

Thanks to Phil M0DNY, Noel G8GTZ and Graham G3VZV for their work on the Goonhilly wideband spectrum monitor and narrowband WebSDR. This capability has enabled and encouraged so many people to get started with receiving and transmitting on the transponders. Your membership subscriptions (and those from AMSAT-UK members) have funded the capital purchases needed to set up the Goonhilly monitors – so thanks to you all as well.

Not surprisingly, the main theme of this issue is QO-100; its use is driving advances in our DVB coding techniques and introducing the vagaries of 2.4 GHz high power transmit and 10 GHz low noise receive to many operators who have never worked there before. However, I would ask you not to take your eye off of terrestrial Amateur TV. There is lots of fun to be had on all the other bands (from 71 MHz to 76 GHz), and we really do need to keep using them.

The IARU ATV Contest on the weekend of 8 and 9 June should be your main target for terrestrial activity; I know that the weather blew away any activity during the March activity weekend, but please try to get on the air in April and May so that you are ready for the contest. Remember that we had the highest number of entries of any country in Region 1 last year – and it would be good to sustain that record.

I know that the temporary non-availability of the BATC Shop, Streamer and website after the recent malicious attack will be fresh in your minds when you read this. I would like to put this in context; with the exception of our contracted WordPress developer, the system is run by volunteers and has processed over 2500 orders and streamed many thousands of hours of ATV since it went live last year. We have to put the security of members' information first and hence the site was taken off-line until we were ready to begin a planned recovery. This strategy paid off and prevented the compromise of any members' information.

I hope to meet many of you at the events that the BATC is supporting throughout the year. If you see a BATC Stand at a Rally or Show, please come along and say hello and sign-in. We really do want to hear your feedback and ideas for the future. The sign-in book gives us some idea of how many members we are able to make contact with. Please also support the Regional Amateur TV Conventions – and thank the organisers for all the hard work that they put in.

IARU Region 1 ATV Contest – Your Hobby Needs You!

The IARU Region I International ATV Contest will be held on 8/9 June. Last year, the UK put in the highest number of entries in Europe, and we need to try to do it again. The contest is open to all TV modes on all bands. It doesn't matter whether you just have a single one-way contact across town, or spend all weekend on a hilltop, this is our one chance to prove to OFCOM that we really do use the bands. So, for one weekend at least, please stop looking at QO-100 and get send pictures to the locals!

Full details will be ion the BATC Forum at https://forum.batc.org.uk/viewtopic.php?f=75&t=5949

The Listing

new and renewing members

Rob Burn G8NXG

The launch of what is now known as QO-100 (Qatar-OSCAR 100) has ignited additional interest for ATVers, at the same time raising the profile of the hobby and of the BATC. There are two significant spin-offs from this: our membership has increased to over 1200 and the BATC shop has seen a significant flurry of orders for special parts!

All good to see, plus the trend of members joining from outside the UK continues.

No doubt the receive footprint of QO-100 is a likely factor in this!

The Listing adheres to the usual format and covers the three months up to the end of February 2019. If you happen to notice that a member is located in close proximity and you wish to make contact via e-mail you will need to contact me in the first instance to facilitate an introduction.

Do not be too concerned if you renewed towards the very end of February; if so you are likely to see your details in the next issue of CQ-TV.

Meanwhile a new level of membership has been introduced – Student Membership. The BATC now offers free cyber membership to bona-fide students who are in full-time education. Easy access to the BATC provides the means for students to dabble with ATV (and perhaps catch the bug!) over a few years. This approach allows student members a convenient way to dovetail ATV interests with other demands on time.

Someone who has decided to dabble with ATV and join as a student is 11 year old Kassidy Fenton. I asked Greg, her father, how this all came about: "Kassidy's interest in amateur radio started when I took her to the local amateur radio rally (Houghton le Spring ARC) and talked to the friendly hams both attending the rally and manning the stalls."

"She had her first QSOs in October 2018 using the Club callsign G3NMD and enjoys taking her turn on the radio when the chance arises. Kassidy's interest in Amateur TV came from the SSTV side of things when I was receiving images from the ISS and she was watching the images appear. Being part of the "YouTube" generation she is very keen on taking the leap into amateur TV, and being able to communicate on what she sees as her own TV station, a step beyond where most people go."

Kassidy will take the Foundation examination in mid April so hopefully we will soon hear her and eventually see her on air! Congratulations on being the youngest member of the BATC!

Australia		
Daniel Granger	VK4KI	Burpengary
Andy Salmon	VK3XKA	Lysterfield
Stephen Rapley	VK2RH	Newtown
Ken Johnson	VK7KRJ	Rokeby
South Africa		
Leon Korkie	ZS1MM	Bredasdorp
Gary Immelman	ZS6YI	Three Rivets
Austria		
Kurt Baumann	OE1KBC	Wien
Josef Waser	OE3JWC	Neuhofen/Ybbs
Belgium		
Eric Van Offelen	ON5TA	Brussels
Stefaan van der Eecken	ON7WE	Denderleeuw
Marien Patrick	ON4APP	Dendermonde
Wim De Smedt	ON8DSW	Dendermonde
Roland De Beukelaer	ON4RDB	Diest
Frans Van de Velde	ON4VVV	Gent
Koen Perneel	ON4DAK	Ledegem
Daipra Guerrino	ON1EV	Malonne
Christian Dumortier	ON1RC	Melle
Willy De Paepe	ON7TW	Montignes-Sur-Sambre
Charles Verstappen	ON8YY	Waterloo
Finland		
Juha Kiili	OH2LKV	Perttula
France		
Fabrice Faure	F4HHV	Boissieres
Brenguier Gérard	F1BUY	Brignoles
Jean Louis Barthel	F5AJJ	Dijon
Patrick Jacquemin	F6EXX	Dijon
Masset Michel	F1VNI	Haulchin
Andre Michel Delmarle	FR5ZX	La Chaloupe St Leu
Francois Yronde		Saint-Aubin-de-Médoc

Philippe Cloarec	F1RGC	Saint Bihy
Patrick Samson	F6GWE	Sainte-maxime
Bruno Lequeu	F1MPE	Saint Jean de Boeuf
Dominique Taverne	F5MKM	Saint Jean le Blanc
Hervé Chadelat	F1UPL	Sementron
Patrice Soutoul	F1GIU	St Orens
Henri Boyer	F5NVQ	Tornac
Boulogne Gerard	F5DMY	Villeneuve Saint Germain
Germany		
Wolfram Winkler	DB5SL	Aspach
Siegfried Jackstien	DG9BFC	Barenburg
Oliver Dr. Welp	DL9QJ	Bendestorf
Ulrich Kaesbach	DD1KU	Bergisch Gladbach
Florian Wolters	DF2ET	Bochum
Hubertus Rathke	DC1OP	Bremen
Richard Neugebauer	DL9OBU	Diekholzen
Norbert Frommknecht	DK6NF	Ebsdorfergrund
Martin Huetter	DH0DAB	Gevelsberg
Michael Becker	DD4MB	Hannover
Karl-Heinz Schroeder		Helmstedt
Andreas Meier	DO7EN	Hennigsdorf
Peter Ehbrecht	DL4AS	Hildesheim
Dieter Meier	DL2VT	Kirchlinteln
Gerald Maenz	DL1YAQ	Lengerich
Thomas Richter	DH6ABE	Mahndor
Oliver Hirsch	DJ6DH	Nottuln
Holger Gramsch	DH1HGM	Oer-Erkenschwick
Wolfgang Buchner	DF3RO	Offenstetten
Oliver Goldenstein	DL6KBG	Panschwitz-Kuckau
Josef Schmitt	DK6RS	Pentling
Wolfgang Bartels	DK1OV	Ruppichteroth
Juergen Graetsch	DK8AP	Seesen
Joachim Rosenbaum	DG1HVX	Südharz OT-Schwenda
Udo Jestadt	DO6UJ	Varel
Reinhard Kuehn	DL4FBN	Weisel
Manfred Bachmann	DK5FA	Wildeck
Heiko Hinke	DL1HTY	Zeitz
Ireland		
Des Walsh	EI5CD	Ballinhassig
Tony Baldwin	EI8JK	Bantry

Italy		
Claudio Ariotti	IK1SLD	Casale Monferrato
Mariano Mezzetti	IW0DVV	Civitavecchia
Eros Menabue	I4EUM	Guiglia
Giuseppe Solimano	I8UZA	Napoli
Giulio Zanon	IV3GCH	Valvasone Arzene
Maurizio Bazzoni	I3YBD	Verona
Luxembourg		
Dan Jungels	LX1JU	Hautcharage
Malta		
Stanley Grixti	9H1LO	Zurrieq
Netherlands		
Herman IJff	PD7HAC	Amsterdam
Dave Hoebe	PA5DOF	Arnhem
Simon Quantrill	PA2SQ/ M0DCU	Emmeloord
Bert Fidder	PE2TV	Rijssen
Jan Roos	PD0HNI	Zoetermeer
Portugal		
Manuel Cardoso	CT1PR	Coimbra
Slovenia		
Matjaz Zibert	S59MZ	Kranj
Andrej Medved	S57NML	Lasko
Spain		
Francisco Diaz Fernandez	EB3CBE	Hospitalet de Llobregat
Jesus Mª Diaz Marticorena	EA2WM	Oiartzun
Blas Cantero	EA7GIB	Sevilla
Sweden		
Hakan Johansson	SM6TLX	Uddevalla
Switzerland		
Peter Schaerer	HB9DLI	Basel
Daniel Harzenmoser	HB9GVD	Dietikon
Pierre-andre Probst	HB9AZN	Vallamand
UK		
Mike Berry	G1LWX	Ashton-in-Makerfield
George Miller	G6WWY	Axminster
Michael Musgrave	G4NVT	Basildon
Maurice Jones	G7UQN	Bebington
Brian Madden	GI0RWO	Belfast
Brian Jordan	G4EWJ	Birkenhead
John Hesketh	G1JZX	Bolton
Geoff Mackrell	GW3KAX	Boncath

Richard Perzyna	G8ITB	Bromley
John Marsden	G8PEF	Bury
Dominic Baines	M1KTA	Cambridge
Derek Kozel	MW0LNA	Cardiff
Robert Lang	GW0FJV	Cardiff
Colin Elliott		Chatham
Colin Day	M1EAK	Clacton-on-Sea
Ivan Ivanov	M0YGM	Coventry
Alan Reeves	G4ZFQ	Cowes
Peter Hull	G4DCP	Denmead
Ed Murphy	GM3SBC	Edinburgh
Peter Goodhall	2M0SQL	Elgin
Allan Mitchell	G3YJZ	Enfield
Peter Carliell		Epsom
Bob Thornton	G3WKW	Fleet
Will Webb	M0XUM	Gosport
Jeffrey Akines	G8XXI	Grimsby
Kevin Smith	G7UXW	Guildford
Paul Marshall	G8MJW	Harby Notts
Andrew Dickson	G8DJF	High Wycombe
Gregory Fenton	2E0HIS	Houghton Le Spring
Martin Richmond-Hardy	G8BHC	Ipswich
Jim Smith	G7NTG	Kettering
Carolyn Williamson	G6WRW	Kidderminster
Matthew Willis		Kidlington
Steve Fletcher	G4GXL	Kings Lynn
Sarah Elliott	M1SJE	Leicester
Mick Hannam	G1EUZ	Lincoln
Peter King	G6BOK	Liverpool
Michael Cullen	M0ISR	London
Piotr Niewiadomski	M0PGN	London
Russell Garrett	2E0RGX	London
Ashley Burns	GW0UXJ	Merthyr Tydfil
Tom Mitchell	G3LMX	Milton Keynes
Heather Lomond	M0HMO	Much Wenlock
Justin Cockett	G8YTZ	Petts Wood
Alex Forbes-Perry	M0NZX	Plymouth
Keith Ferguson	G8ELA	Ravensden
Philip Goben	G0EPX	Rotherham
Geoff Findon	G3TQF	Rugby
Charles Suckling	G3WDG	Rushden
David Swale	G8ETS	Scarborough
Jason Barker	M0SOO	Scarborough
Graham Coyne	G3YJR	Sheffield
Joseph McElvenney	G3LLV	Sheffield
Denis Nicole	M0CYJ	Southampton
Graham Sunderland	G8UTH	Sowerby Bridge
Darren Storer	G7LWT	Stockport
Jon Byrne	M0RFU	Stockport
Richard Bown	G8JVM	Telford
Wayne Sheldon	G8ZBJ	Walsall
Roger Damm	M1CDQ	Waltham
Robert Whitfield	G8TSE	Wirral
David Brooke	G6GZH	Wisbech
Laurence James	G2DD	Wokingham
Canada		
Martin Bruchanov	VE1/OK2MNM	Halifax
USA		
Robert Gulley	AK3Q	Bellevue, KY
Donald Nelson	N0YE	Boulder
Byron Beck	N6UOB	Campbell
Bruce Kobie	K8FIX	Tipp City
Jim Welch	W1XR	Wake Forest
Jon Burchfield	K8FAM	Weirton

Photo Caption

We printed this photo in CQ-TV 261 announcing the sad passing of David, GW8PBX. Unfortunately we neglected to caption the photo.

They are from left:
Brian - GW3KAX
John GW3JGA
David Jones – GW8BPX

Our apologies to all concerned.

Silent Key

From the Narrow Bandwidth TV Association Newsletter:

Peter Smith G4JNU

We are extremely sorry to announce the recent death of Peter, for many years a very active member and designer of many of our standard circuits. Peter will be deeply missed and we offer warmest thoughts to his family.

His funeral was held at St Andrews Church, Harrogate Road, Caversham Heights, Reading, on Friday Jan 11th.

We were also sad to hear of the death of Howard Parker G8GUN

Contest and Activity News

Clive Reynolds G3GJA

Christmas 2018 Repeater Activity competition was run over the holiday for eight days. Only one repeater group's members participated in this new event which it had been hoped would encourage use of the ATV repeaters around the country. The Severn ATV repeater group submitted logs from five callsigns, some of which were used from multiple portable locations to amass a total of 7517 points from using GB3ZZ.

Of particular note was the entry from Adrian G4UVZ; he claimed 5814 of the GB3ZZ points in his first ever contest in 45 years of amateur radio.

The January Activity Weekend saw a record-breaking 28 km 76GHz 2-way contact between G4LDR/P and G8GTZ/P. The path was good enough for Neil to send 2MS full HD video from his C920 webcam. G4FRE took his 2m system to IO82UA78IP and had a two way QSOs with Noel G8GTZ/P at 73km and Mike G0MJW at 83km.

Noel G8GTZ carried out some tests requested by the RSGB on 50 MHz. On the Saturday he went to IO91FN and received Dave G4FRE on 50MHz at 12 dB MER from IO81UA over a 73 Km path. Dave saw his signals but before Dave got a decode Noel's transverter decided to blow a fuse. After replacing it three times with strands of wire he decided it was ill, so gave up.

The February ATV Activity Weekend was too cold for most portable operators although Gareth G4XAT did try but was unable to secure a contact. The High Band ATV Activity Weekend planned for the 9 and 10 of March 2019, with a special focus on 5665MHz and above with awards for leading stations on 5.6GHz, was pretty much a write-off due to the appalling weather over most of the country that weekend. Portable operation was just not a sane option for most operators although Rob M0DTS did venture out without any reward.

The QO-100 satellite is generating lots of DATV activity on the wideband transponder as reported elsewhere in this issue.

▶ *Viv Green, G1IXE, receives £100 from BATC chairman Dave Crump. The GB3ZZ group were winners of the club's Christmas repeater contest.*

Forthcoming Activity Weekends and ATV Contests calendar

1200 UTC 6 April 2019 – 1800 UTC 7 April 2019	ATV Activity Weekend
1200 UTC 4 May 2019 – 1800 UTC 5 May 2019	ATV Activity Weekend
1200 UTC 8 June 2019 – 1800 UTC 9 June 2019	IARU International ATV Contest
1200 UTC 13 July 2019 – 1800 UTC 14 July 2019	ATV Activity Weekend
1200 UTC 10 August 2019 – 1800 UTC 11 August 2019	ATV Activity Weekend
1200 UTC 14 Sept 2019 – 1800 UTC 15 Sept 2019	ATV Activity Weekend

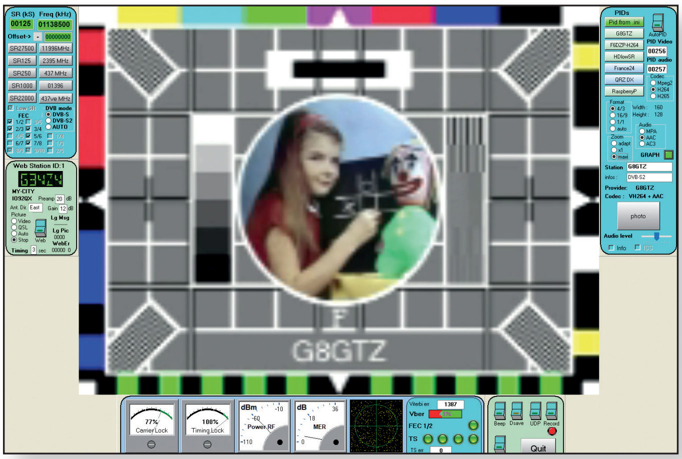
Please send activity reports to contests@batc.tv or post them in the forum under https://forum.batc.org.uk/viewforum.php?f=75

Rules for the IARU International ATV Contest will be posted on the forum.

OSCAR- 100 has arrived!

Graham Shirville G3VZV

The long-anticipated launch of the Qatari-owned Es'hail-2 broadcast satellite took place last November and the past two months have seen it being moved into its final intended orbit slot at 25.9 East. This spacecraft, as well as providing commercial systems for broadcast television, also has two transponders dedicated for amateur use. One is intended for narrowband signals and one for wideband DATV. This great facility has been made available through the Qatari Amateur Radio Society who have worked in collaboration with a team from AMSAT-DL in Germany.



After the inauguration on February 14th, the wideband transponder was immediately opened up for use, and Noel, G8GTZ, was the first to transmit a simplex reduced bandwidth TV (RBTV) signal that was received by others in the UK and Europe.

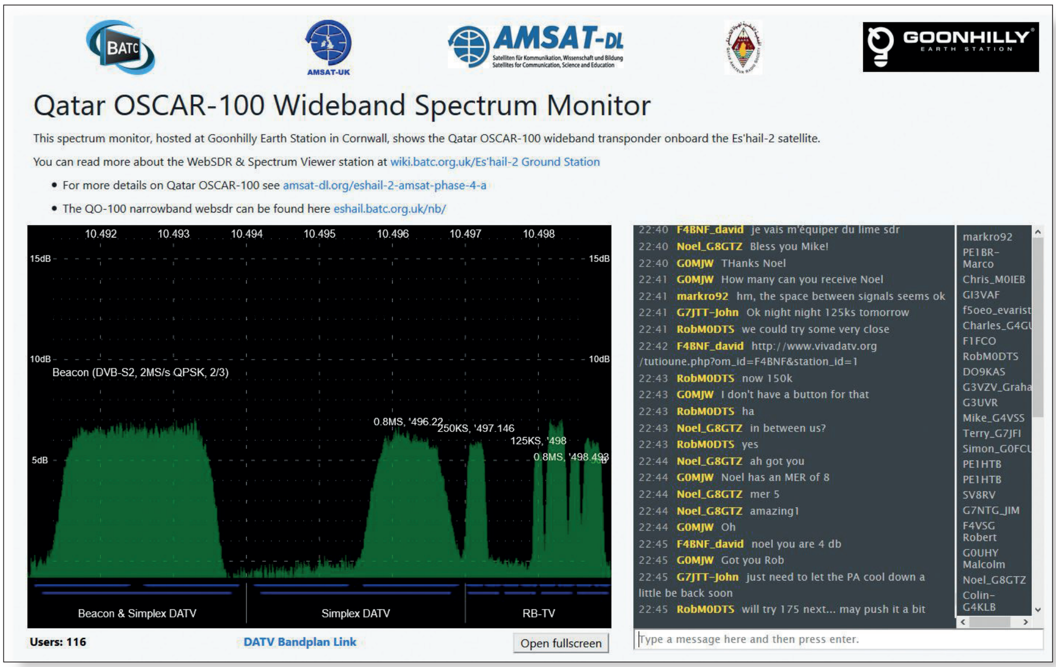
More than 30 stations have already successfully transmitted their pictures through the transponder from countries including F, I, DL, PA, HB, ON and G and new stations are becoming active every day. We have seen multiple signals on the satellite – the screen grab of the spectrum monitor shows 6 different signals using a range of Symbol rates from 125ks, 333Ks, 1ms and 2ms simultaneously!

The AMSAT-UK/BATC web spectrum monitor enables users to monitor for signals and also provides a text chat talkback facility and has proven invaluable during the first month of operation. ***https://eshail.batc.org.uk/wb/***

We have been asked why we are not streaming signals on the BATC streamer - however this is not possible as each signal uses a different frequency, SR and FEC making an automatic system very complex. Individual stations with receive systems do occasionally stream pictures on an adhoc basis and if you join in the chat on the monitor page you can ask people to do this.

The following articles describe how to receive Oscar 100, how to transmit DATV, modifications to the popular Spectrian PA modules for 2.4Ghz and details of the excellent dual band patch antennae to make transmitting and receiving Oscar 100 possible from the same dish.

For more details on Oscar 100 see this wiki page: ***https://wiki.batc.org.uk/Es%27hail-2_Basic_Information***



Receiving QO-100

Ian Parker - G8XZD

Although my long term ambition is to be able to transmit into Es'hailsat I thought I'd give the receive side of it a go as a start.

I offer this to inspire others - I'm not saying this is the best, but it's worked for me and I've had a lot of fun so far.

Over the months of waiting I'd been slowly squirrelling away bits for my ground station: I'd managed to purchase one of the Octagon Oslo PLL LNB before they went out of stock, (and up in price) acquired a zone 2 sky dish, some half decent CT100 cable, and one of my many Minitiounes, the mk 2 variety.

All the pre-launch material suggested that in the UK a 65cm dish would work – and an 85cm on the outer parts of the foot print.

I figured the bigger dish would do, and probably on one of the windiest days of the year assembled the dish and LNB on a lighting stand. (Definitely not recommended – too easy for the dish to blow over and damage something)

I thought back to when I'd done a similar project – when the original Astra launched – and reflected how much more you got for your money these days – and just as much fun now.

I attached my Satlink finder to the dish – entered in the parameters for BBC Arabic 11996 H 27500-3/4 and started sweeping the sky in what I though was the appropriate direction waiting for the signal strength and quality meter to kick into life and the blue lock lamp.

Well a couple of hours later – nothing.

▶ *Wonder if work will notice a G0MJW patch on one of these dishes?*

At that point everything was put into the garage in disgrace. Another attempt the next morning was similarly useless. So I went away and thought about it – and then everything, in the words of TV detective Hercule Poirot, suddenly made sense.

I decided the first thing to do would be to reliably receive something on Astra 28.2 E, and after studying the other dishes in the neighbourhood, pointed it in the same direction. After a bit of panning and tilting I found the signal. 11934 V 27500 5/6. Quality and signal strength was good and the lock lamp lit. I scanned that transponder with the Satlink and found the Sky Intro channel. Now with a bit of fine tuning everything was looking promising.

Interestingly my estimation of the skew angle was somewhat off. Looking into the dish from the LNB, it needs to be about 17 degrees or so in a clockwise direction (for the southern UK).

At this point you reflect on how quickly a Sky installer can get going – then you realise the elevation comes preset on their dishes – that the LNBs are also preset to the skew right angle and you just have to get the bubble in the middle of the spirit level for it all to work. All they have to do is get the pole vertical and then just pan left and right until they get an indication on their meter. You also quickly realise how grotty the clamps on the back of the dish are.

For my tests I clamped the dish to the lighting pole and then panned it by twisting the pole. This was far more repeatable and accurate than moving the dish on a (static) pole.

Es'Hailsat is only three degrees further to the south than Astra 28.2 – and the elevation needs to be a little higher. I tilted the dish up until the Astra signal noticeably weakened, set the sat finder to the BBC Arabic transponder and then gently panned towards the south. Three degrees doesn't sound like much but I have to admit it was further than I thought.

With a reasonable signal and quality and the lock light now on, I scanned the mux – and bingo BBC Arabic was one of them. A bit of fine tuning and I'd got the bit error rate down to 0.

Over to Minitioune now. As the transponder is H you need to feed 18V up the coax (see how to do this on the BATC wiki).

Alternatively you could use a Bias T to power the block and feed the ISOLATED side into Minitioune. You may end up damaging the tuner if you put volts back into it. Assuming it is an off-the-shelf LNB set the offset to -09750000. For guidance of how to use Minitioune look here. ***https://wiki.batc.org.uk/MiniTioune***

A quick set of the beacon parameters 10492500 SR 2000 – and there was the test loop at about a MER of 4-5dB.

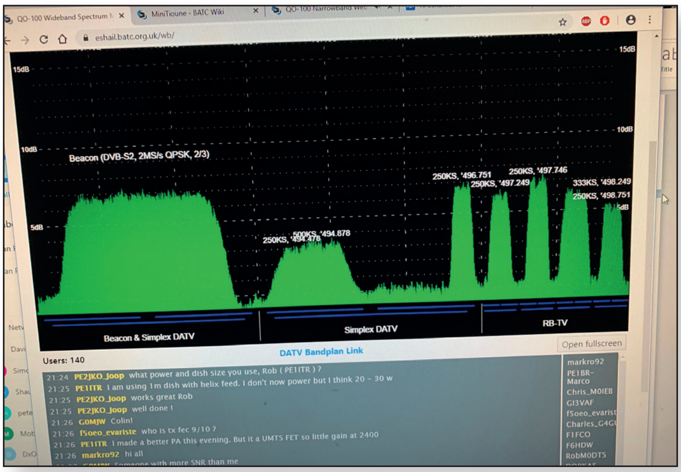
By studying the wideband spectrum monitor you can get an idea of the frequency and symbol rate of the transmission – and key these into Minitioune.

For first attempts I would try for ones about the 1M/s range – and ones about the same height as the beacon.

The majority of the signals are DVB-S2 – select this directly rather than auto - to get about 2dB better signal.

What you will find is some signals are better than others – some lock up straightaway – others don't. The most often scenario is you get carrier, SR and full lock but none of the LEDs light on the righthand side.

The other initial frustration is many stations only keep their signal up for a short time – by the time you've entered the parameters they've gone.



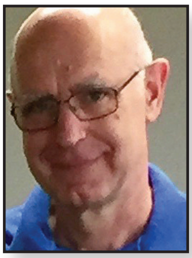
▶ *The busy spectrum monitor - Couldn't quite get a full house on the transponder*

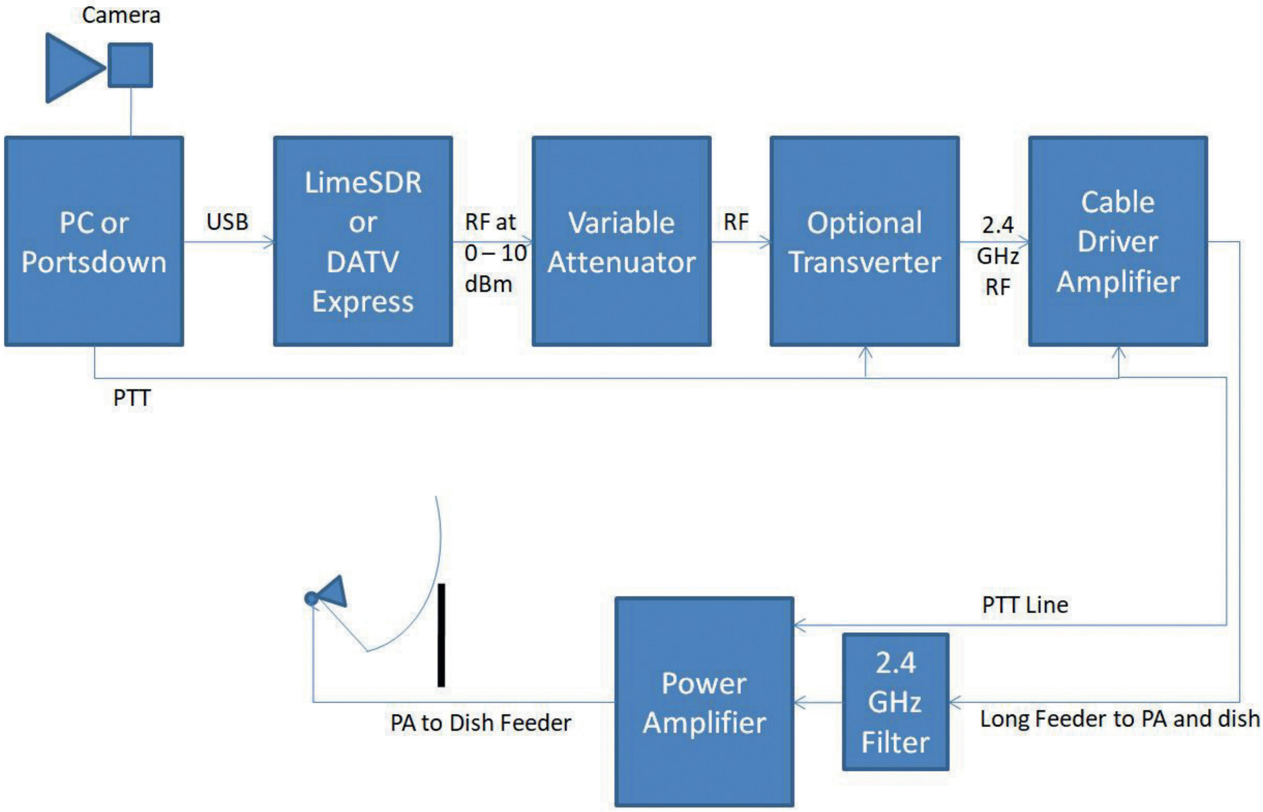
In the first three weeks of operation I've resolved about 20 different signals with quality varying between 8dB MER and -3dB MER – yes you can have 3dB more noise than signal. In conclusion I'd say these are the most important points to getting going:

- Don't try to rush – work logically – don't try to change too many variables at one time
- Make sure your pole is vertical – if possible clamp the dish to the pole then rotate the pole
- If possible make sure your sat finder has a Sky FTA channel and BBC Arabic pre-programmed – this will make everything easier
- Make sure everything is working by receiving a FTA signal from Sky
- Increase the elevation, select BBC Arabic, and pan the dish slightly more to the south
- Once you've got BBC Arabic, fine tune the position/skew for minimum Bit Error Rate (BER)
- If you are using a dish >85cm it will be a lot sharper and the adjustments will be more critical.
- Be patient – you'll get there – and have fun

Transmitting Systems for QO-100 on Es'hail-2

Dave Crump - G8GKQ





This article is intended to help you plan your DATV transmitting station for QO-100. The equipment requirements can be challenging as there is very little affordable commercial amateur equipment available. The PA is a particular issue.

A typical station is shown above. Before going into the technical detail, it can all be summarised as: "you need to put 30W of DATV into a 1.2m dish to transmit a reasonable strength 250KS signal through the satellite".

Now for the technical stuff!

Generating the DATV Signal

To get the best results with the Satellite, DVB-S2 is the preferred mode, as it gives a 2 dB advantage over DVB-S and every dB is hard to find (and expensive!). The conventional options for generating DVB-S2 at reduced bandwidth (RB-TV) are limited to LimeSDR or DATV Express driven by (DATV Express) software on a PC or the Portsdown software on a Raspberry Pi.

You can use DVB-S from the Portsdown with its filter-modulator board. Despite the slight disadvantage of DVB-S, you should be able to get pictures through the satellite to other users – so do give it a try! A number of such signals have been seen in recent weeks.

There are some other SDR solutions using GNU Radio and alternative applications to drive other SDRs (including the Pluto), but they are much more difficult to configure and use than DATV Express or the Portsdown.

The output from the LimeSDR or DATV Express will be on the range 0 to 10 dBm (1 – 10 mW, and it is useful to be able to adjust the drive easily. You can do this in software, but certainly for the Lime with the Portsdown, the gain steps are too big to be useful, so an external variable attenuator is very useful. That way you can watch the Spectrum monitor and set your power to an appropriate level. The software controlled attenuator described as part of the Portsdown system would work well here.

Some stations use the LimeSDR or DATV Express at 2400 MHz, while others prefer to transvert up to 2400 MHz from 432 or 146, allowing them to use the same equipment for the narrow-band transponder.

Getting the Signal to the Dish

All but the most fortunate will need a significant cable run from the shack to their dish. The cable loss will be a good few dBs even if high quality cable is used, so a cable driver amplifier in the shack is probably called for. One of the eBay WiFi amplifiers run well below its rated power might be suitable for this task.

The cable can be a single run of normal satellite cable, as long as you make sure that there aren't any discontinuities in it. I have about 20 dB loss at 2.4 GHz in the cable run between my shack and the dish.

Near the Dish

The power amplifier should as close to the dish as possible, as feeder losses between the PA and the dish will have a direct effect on your signal strength – and every fraction of a dB counts. It is normally a compromise between ensuring that your PA (and its mains power supply) is protected from moisture, and keeping the feeder length short. Consider a large watertight box adjacent to the dish, or a nearby shed; remember that you will need to dissipate a considerable amount of heat.

A 2.4 GHz band-pass filter at the input to the PA is a good idea. It provides isolation from any strong nearby mobile phone signals picked up on the long feeder and could also clean up spurii on your own transmission.

The power amplifier should be switched by the PTT line from the transmitter; you could achieve this by running a separate cable, or use a DC potential on the RF feeder. If using a LimeSDR, remember to use the delayed PTT so that you do not damage your PA or make illegal transmissions during the calibration before each transmission.

Dish Size and Power

The following guidance will be easier to understand if you have looked at the online Spectrum Monitor https://eshail.batc.org.uk/wb . As a starting point it gives guidance on what power (measured at the dish feed, not the PA output) is required to achieve the same power density (think watts per MHz), as the beacon. This will approximately equate to the same received MER (for DVB-S2 QPSK) as the beacon.

In this article, to keep it simple, dish efficiency is assumed to be 50%, and the roll-off of the transmitted signal is assumed to be 0.35. Note that the roll-off on the beacon is set to 0.2.

There are 3 key variables: dish size, power and symbol rate. The power received at the satellite varies with the square of the dish diameter, so for example a 1.2m dish will give 4 times the amount of power (6 dB more) than a 60 cm dish. The power density in terms of frequency will vary inversely proportional to the symbol rate. So a 250 KS signal will deliver double the power density (watts per MHz) at the satellite compared to a 500 KS signal of the same transmitted power.

Based on observed performance of the transponder, this table gives the power required and dish size to achieve the same level as the beacon at 250 KS:

Dish Diameter	Power Required
2.4m	7.5W
2.0m	11W
1.8m	13W
1.5m	19W
1.2m	30W
1m	43W
90cm	53W
80cm	67W
60cm	120W

Now we can look at the requirements for different symbol rates. The amount of power calculated from the table above (for 250 KS) can be corrected for other symbol rates by multiplying by the factor in the table below.

SR	Factor
66 KS	0.26
125 KS	0.5
250 KS	1.0
333 KS	1.33
500 KS	2.0
1000 KS	4.0
1500 KS	6.0

You can use the tables above to come out with the ideal power and dish combination so that you are the same strength as the beacon. Note that for normal standard definition H264 pictures, 250KS has proved to be more than adequate on the satellite.

Working With Lower Power

Not all of us are going to have the ability to transmit with the ideal power, or to use the ideal dish size calculated above. Let's initially examine the effect of lower power for other viewers using a 1.2 m dish to receive your signals. Typically, the effect on received MER is as shown in the table below:

Relative Power	Received MER
100%	8 dB
80%	7 dB
63%	6 dB
50%	5 dB
40%	4 dB
31%	3 dB
25%	2 dB
20%	1 dB
16%	0 dB
13%	-1 dB
10%	-2 dB

If you have a smaller dish, it will also affect the received signal strength. This is important when you are trying to receive stations that are weaker than the beacons – especially your own signal, if you are trying to transmit with the same smaller dish. Typical reported values (using standard Octagon LNBs) are below.

Dish Diameter	Received MER
1.2m	8 dB
1m	7 dB
90cm	6 dB
80cm	5 dB
60cm	4 dB

By combining the effect of these 2 tables, you can estimate a received MER for your own signal. Purists will say that it is not a simple mathematical addition/subtraction (and they are correct – due to the effects of system noise), but in practice it will give you an idea of what will sort of effect changes will have.

The Effect of FEC

The final step is to calculate what MER you need to decode the signal. This all depends on the transmission mode and the amount of Forward Error Correction (FEC). This can be read off the chart below. Each dot represents a specific transmission mode and FEC value. The values in our range of interest are reproduced in the table.

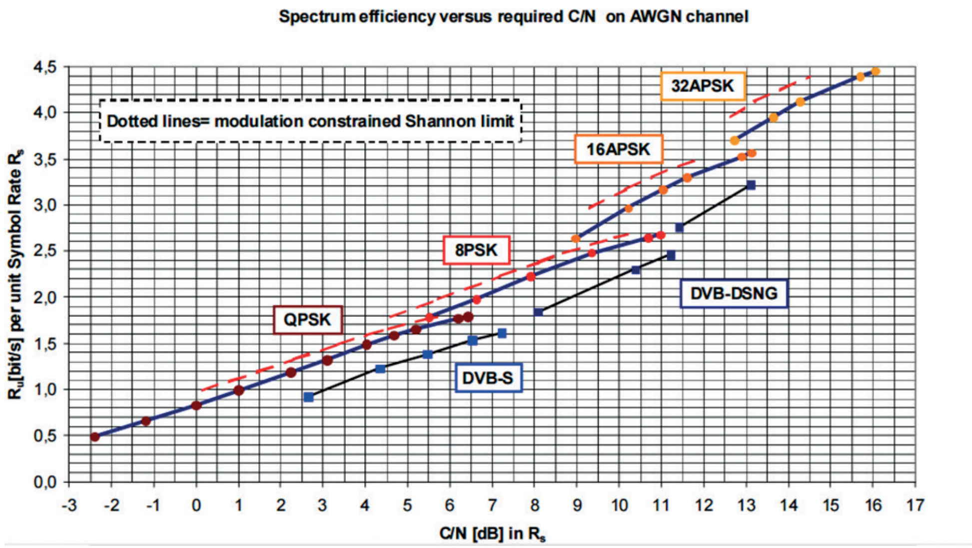
So, if you know the MER, you can reduce the FEC to get a decoded picture.

You can sometimes see the effect of stations using higher FECs at low MERs when MiniTioune achieves carrier, symbol rate and full lock (3 greens on the left hand side), but is then unable to decode the video data, as it does not have sufficient MER for the error correction (FEC) to work.

Mode	FEC	C/N Required
DVB-S2 QPSK	1/4	-2.4 dB
DVB-S2 QPSK	1/3	-1.2 dB
DVB-S2 QPSK	1/2	1.0 dB
DVB-S2 QPSK	3/5	2.3 dB
DVB-S2 QPSK	2/3	3.1 dB
DVB-S2 QPSK	3/4	4.0 dB
DVB-S2 QPSK	5/6	5.2 dB
DVB-S2 QPSK	8/9	6.3 dB
DVB-S2 QPSK	9/10	6.5 dB
DVB-S2 8PSK	3/5	5.5 dB
DVB-S2 8PSK	2/3	6.6 dB
DVB-S2 8PSK	3/4	7.8 dB
DVB-S (QPSK)	1/2	2.6 dB
DVB-S (QPSK)	2/3	4.4 dB
DVB-S (QPSK)	3/4	5.5 dB
DVB-S (QPSK)	5/6	6.5 dB
DVB-S (QPSK)	7/8	7.2 dB

Availability of PAs

The limiting factor for many stations will be the availability of PAs. There is nothing that you can buy at a reasonable price that is packaged off-the-shelf. Many stations are using modified ex-telecoms PAs, however finding ones that work at 2.4GHz (rather than 2.1 GHz, or 2.6 GHz) can be difficult. The best option currently available is one of the 75W Spectrian PAs sold by "pyrojoseph" on eBay. Mike G8LES describes the modifications required elsewhere in this CQ-TV.



Final Word

Even if you think that you do not have enough power, or a big enough dish, you can try transmitting at 66KS DVB-S2 FEC ½. At the very least you should see a "spike" appear on the Wideband Spectrum Monitor. You could then ask one of the stations with a bigger receive dish to try to receive you.
Well worth a try!

G8LES Spectrian Amplifier mods for 2.3-2.4GHz

Mike Sanders - G8LES

The amplifier, which is available from ebay seller Pryjoseph, is really designed for 2.1GHz but provided the power splitters and combiners are broad band (I couldn't identify what they were), then as the XRF286 are specified to 2.5GHz there should be nothing impairing power output on 2.4Ghz apart from the PCB components or design.

Stripline designs are usually fairly broadband and with some small tweaks can be made to work over a range of frequencies, and as the frequency increases (excepting HiQ filters) 10% of the frequency in useful power bandwidth should be achievable.

My amplifier up the mast is an un-modified unit which gives 60 watts with a 1 watt driver chip on 2320 through to 2350 but then drops like a stone to about 10 watts at 2400. The Spectrian amplifier destined for the Es'Hail PA when driven with an additional 5watt Wi-Fi booster only could manage about 15 watts on 2410 as standard. After the mods described below it dinks the Bird Thru line meter needle on the end stop with a 50 watt element

Warnings

The circuit board pads are not strong and will peel off if put under mechanical stress.

Do not use heavy duty stiff cable onto the power-in pad unless it is going to be anchored down close to the circuit board. I recommend some super flexible cable instead. If the input power pad comes away you will have to feed the power-in to the output transistor 100uF caps as you will lose the plated through holes.

Although you can use SMA sockets with one side filed down the same applies to the earth pads you will solder the socket to. The best method is to solder a copper strip with two screw holes to the semi rigid cable next to the end, fix it down to the heatsink with screws right next to the PCB then solder the inner to the RF line.

Mods

OK so now onto the mods, you will need a good temperature controlled iron of 40 watts minimum as the board takes away the heat quickly. If using a Weller magnostat iron (one with a magnetic controlled switch) they create nasty on/off pulses so suggest you earth the iron to the ground plane of the PCB with a wire before you start.

Do not touch the output lines if running more than 10 watts out, if you do it will burn your finger.

Step 1

Remove the two trimmer capacitors, they act as a notch on 2.4GHz and you will observe that the earth pad isn't connected to ground; it is a series capacitor to reduce the value of the trimmer.

Step 2

Remove all the tuning flag attachments on the drains of the FET's and save for later.

Step 3

Cut away half the input tuning flag as in the circle marked B on the input side photo.

Step 4

Cut off the tuning flag next to the DC isolating capacitor highlighted in circle D on the input side photo.

Step 5

Cut angles on the drain pads on the driver transistor as highlighted by circle marked C on the input side photo.

Step 6

Add a piece of strip as removed from the drains to point A as highlighted on the input side photo. This improves the input SWR.

G8LES Mods Spectrian amp input side

Ok so let's move onto the power splitter and output.

G8LES Mods Spectrian Amplifier splitter & O/P

Step 7

Cut the Drain Pads at an angle as shown in the photo highlighted G in the splitter and output photo.

Step 8

Add a tuning flag as marked to Point F

Step 9

Add a tuning flag to get started as shown to point E. This may or may not need to be larger.

Step 10

This will have to be tried under test. One on Colin G4KLB's amplifiers needed the tuning flags on the outputs marked H in the photo cut off the other did not.

Test condition:

Set up so the transistors have about 2 amps bias current, the measuring points are detailed on the sheet that accompanies the board.

I adjusted mine with just a 12 volts supply. But it can be done equally well with 26 volts.

You will need a power meter or an RF pick up loop next to the output with a Schottky diode and a meter to see what you are doing.

Low RF drive: set up so the amplifier is giving about 10 watts out and after each modification reduce the drive to get back to 10 watts out. Over 20 watts out it is much more difficult to adjust.

Tip for testing the tuning; -

Cut the end off a cotton bud so that you are just left with the shaft. Add a blob of Blue Tack to the end. Stick on a copper strip you saved earlier about 5 mm long by 3mm wide (not critical) to the Blue Tack then you can use that to test whether the tuning is optimised by pressing it down on the RF lines in various places.

One of Colin G4KLB's amplifiers required a larger copper strip added at point E in the output photo.

You can of course check the drive balance by adding a Schottky diode to the power splitter dummy load (the blue resistor top left of the photo). Ideally if all the power of the driver is to be delivered to the output pair, there should be no RF at that point, but that is rarely the case.

I have been unable to discover the specs of the power splitters used on the board it depends how broad band they are as to the overall efficiency.

Note:

I have a 50 watt 400Mhz Bird through line element which I broke by dropping it on a hard floor, the diode shattered. I replaced it with an HP2800 and it now works on 13cm. However with my home made SWR bridge in front of the meter I discovered it has a good match without the element inserted and 1.5:1 with the plug in fitted, and that applies to any of the plugins on this frequency, so this is beyond its capabilities.

Power combiners for more than one amplifier.

Colin had one similar to this photo. It was I noted on 1/16th PCB, and should really be on 1/32nd Duroid as it did not look a good match, i.e. 1.5:1 when tested.

Don't forget though that it changes the phase of the amplifiers. One amp is at 90 degrees (one quarter wave) relative to the input the other is 180 degrees.

When you combine two amplifiers you need to mirror the connection on the output so that they both finish up at 270 degrees otherwise they will cancel rather than add up as Colin found out, with two adjusted amplifiers taking an increase in drain current with the drive applied and no power output showing. I guess that says that we balanced the tuning on both amplifiers pretty well.

I did find they worked just as well on 2.3GHz for anyone that wants to use them on the normal SSB end.

Portsdown Newsletter

Dave Crump, G8GKQ

The Portsdown project has moved into a new phase with the LimeSDR Mini as the primary modulator, rather than the bespoke Portsdown filter-modulator board. We will continue to support the Portsdown filter-modulator board, but future development will be concentrated on the LimeSDR.

This move certainly seems to have given the project a boost, and we are now up to over 350 Portsdown users, with a good proportion of the signals seen on QO-100 being Portsdown-generated.

The advantages of the LimeSDR include:

- Coverage of a wider frequency range (30 – 3499 MHz)
- Availability of DVB-S2 modes (QPSK, 8PSK, 16APSK, 32APSK)
- Significantly improved spectral shape and MER
- No requirement for ADF4351 or LO filter board
- Small size
- Compatible with the 8-way RF switch
- Can be used with other transmit and receive programs

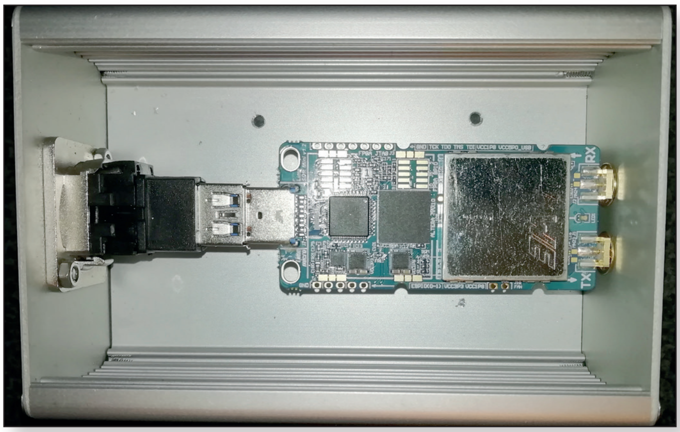
The disadvantages are that:

- The symbol rate in Portsdown is limited to 1MS due to Raspberry Pi performance
- It is mechanically delicate
- It outputs a calibration signal before starting to transmit

The cost comparison between the 2 options comes out about balanced. We have been stocking the LimeSDR Mini in the BATC Shop and have sold 100 so far; a further 50 have been ordered.

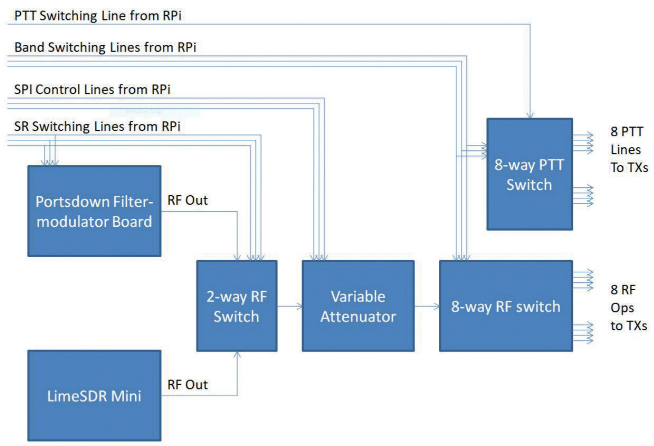
Lime Hardware Configuration

It is worth protecting your LimeSDR from damage by mounting it in a box. There are a number of commercial and 3D printed solutions available, but G4FRE sent this photo of his neat solution using a Hammond 1455K1201 box from Farnell with 6mm milled off of one end.



If you are transmitting on more than one band with a LimeSDR, the Portsdown 8-way switch board enables you to route RF and PTT signals to the correct transmitter. You can also use a switched attenuator controlled by the Portsdown to set the exact output level required on each band. Although the LimeSDR output level can be adjusted by setting the "Lime Gain", the steps are typically too large for the adjustment of transmitter output levels.

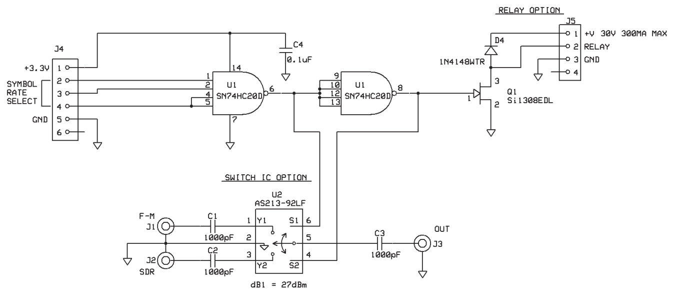
You can use the LimeSDR alongside the Portsdown Filter-Modulator Board to provide a wider range of symbol rates. This allows access to your local repeater, possibly using DVB-S at 2 MS from the Portsdown filter-modulator board, while also allowing you to transmit DVB-S2 at lower SR using higher-order modes from the LimeSDR.



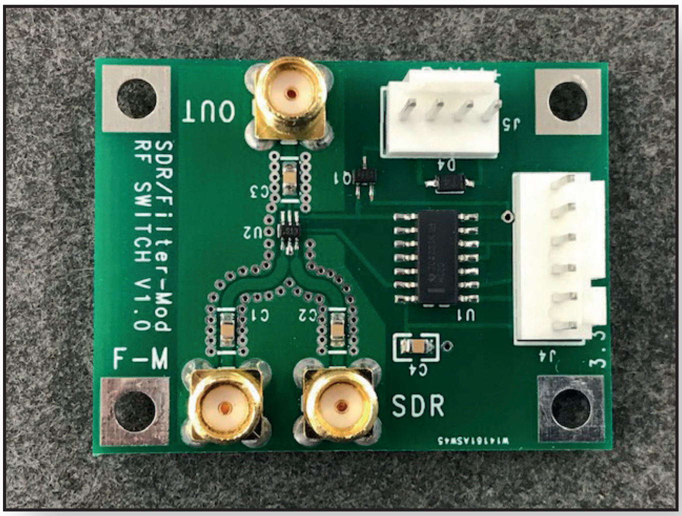
▶ *Portsdown Output Control and Switching*

The 2-way RF switch is a new addition to the Portsdown system. It decodes a signal sent on the symbol rate switching lines (all 3 high, which was previously unused) which is used to indicate that the LimeSDR output should be used, rather than the Filter-modulator board.

The block diagram shows a comprehensive arrangement with all the features. Many of the blocks are optional – it depends on your requirements.



▶ *2-way RF Switch Circuit*



▶ *The assembled 2-way RF Switch*

The test results for the switch (when running from 3.3v) were:

Frequency	Insertion Loss	Isolation
71 MHz	< 0.5 dB	36 dB
146 MHz	< 0.5 dB	35 dB
437 MHz	0.8 dB	31 dB
1255 MHz	1.5 dB	21 dB
2405 MHz	3.5 dB	19 dB

The insertion loss at 2405 MHz can be reduced by 0.5 dB by trimming the centre pins of the SMA connectors to be flush with the underside of the PCB. A further improvement could probably be made by trimming the RF tracks on the top of the PCB so that they do not extend beyond the SMA centre pin.

The PCB for the RF switch is available from the BATC shop and construction details are posted on the BATC Wiki.

Recent Software Developments

Although most of the recent development has been focussed on improving the performance (particularly H264 audio) with the LimeSDR Mini, there have been a number of menu and system improvements.

The main menu selection buttons have been rearranged in a more logical fashion and the system configuration menu has been enlarged and populated with some new features. These now enable you to backup and restore your full Portsdown configuration on a USB stick, or on the /boot partition of the SD Card. The advantage of both of these locations is that they can be read and archived on a Windows PC. Other buttons allow you to enable or disable hardware shutdown, and to invert the 7 inch display if you are using one of the early design display mounts.

One feature that might take some explaining is the "force_pwm_open" button. This button allows you to use the RPi 3.5mm audio output jack and then transmit using the filter-modulator board. The default is force_pwm_open=1 which prevents audio popping by keeping the PWM outputs enabled for audio after first use of the audio, which disables any further use of the Portsdown Filter-modulator board (which also uses PWM). If you set it to force_pwm_open=0 and reboot, then the PWM outputs are released for transmit use after they have been used for audio.

Other changes allow the C920 webcam to co-exist with the Pi Camera and both to be selected from the touchscreen. Additionally, the Lime functions have been added to the (ssh) console menu; they were previously only available from the touchscreen.

One very important feature that has been implemented is delayed PTT for the LimeSDR. This delays the switching of the PTT until after the SDR has done its calibration, and so protects your PA and also prevents illegal and unsociable out of band or unnecessary transmissions.

Current Challenges

The reliable communication channel and large audiences of Es'hail-2 have increased the demand for good quality audio with H264-encoded transmissions. This is a real challenge and many hours are being spent by Evariste and myself to get this right for the Portsdown. We are getting there, but it is real "self training in wireless telegraphy"!

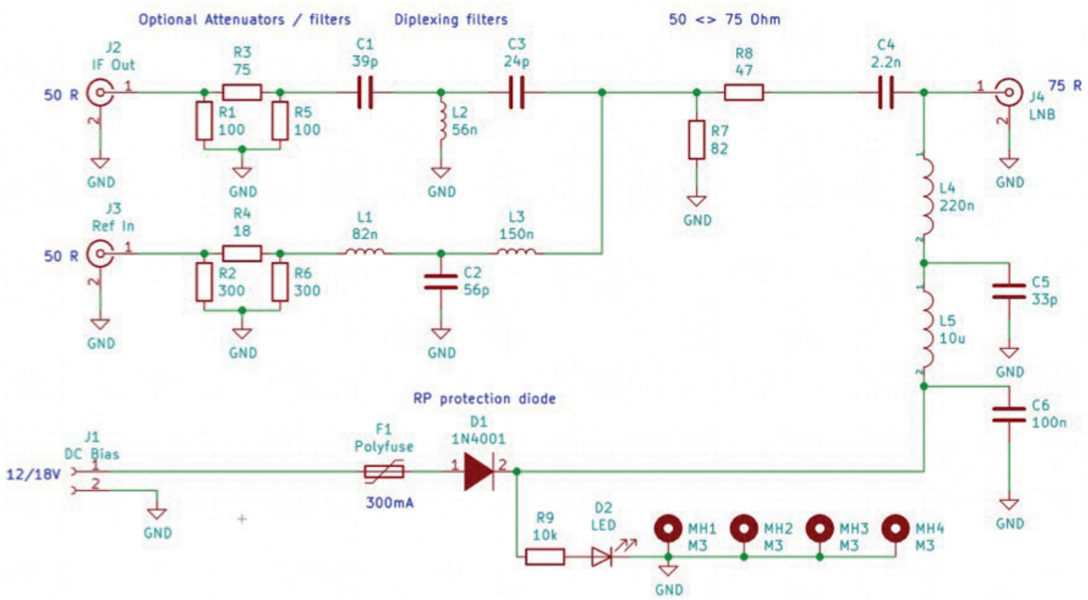
Future Developments

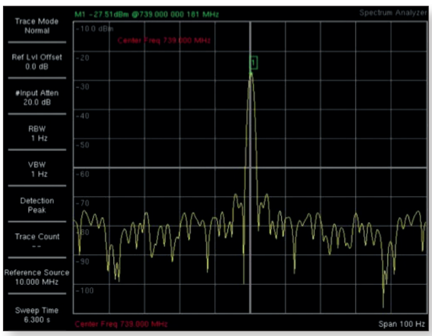
A number of solutions are being developed to allow a PC to encode video in H264 or H265 and send it over a LAN to a Portsdown for transmission. The advantage of this approach is that video sources such as vMix and Open Broadcaster Software can then feed into the Portsdown with no PAL degradation. Once these solutions are better developed, they will be posted on the BATC Wiki.

Bias and reference injection board

Mike, G0MJW

Many people are planning to receive Es'hail-2 using a standard satellite dish and LNB. The LNB normally converts signals in the range 10.7-12.5GHz down to an IF in the 1-2GHz range which passes via cable to a satellite receiver. Many of these LNBs have been found to be still useful in the amateur 3cm band at 10.368 GHz and should also work at 10.489GHz. Typically, they use a local oscillator switchable between 9.75 GHz and 10.6 GHz via a 22kHz tone. The corresponding IF is then around 600-800MHz and most recent LNBs pass these signals fine and the use of satellite LNBs for terrestrial ATV is well established.





▶ *10.489 GHz test signal in a 100 Hz span*

The potential for narrowband modes via satellite puts much greater demands on frequency stability than wideband TV does. There are now low cost LNBs available that are based on phase locked loops. They use a 25 MHz or 27 MHz crystal reference. These are fine just as they are for DATV but for SSB or CW their frequency drift is still an issue. The solution to this is to lock them to stable reference. Usually the crystal is removed, and a reference frequency applied in its place. This also has the advantage that the LO frequency can be altered, within limits, perhaps to move the IF up to the range where a standard satellite receiver can receive it, or within the coverage of an existing receiver.

This project is about doing that. An LNB can be modified to add or re-purpose an existing connector to supply the reference frequency. This board is not for that. This method sends the reference and power up and the IF down using just one cable. Useful for LNBs with only one connector.

Here is the schematic.

The reference is assumed to be around 25MHz and the IF above 400 MHz so a simple diplexer can be used to keep them apart. The diplexer is made up from C1-C3 and L1-L3. The PCB allows a wide range of inductor sizes, including hand wound. All the capacitors are 0805 size.

Optional attenuators set the right levels. If attenuation is not needed, then short out R3 or R4 and don't fit R1 and R2, or R5 and R6.

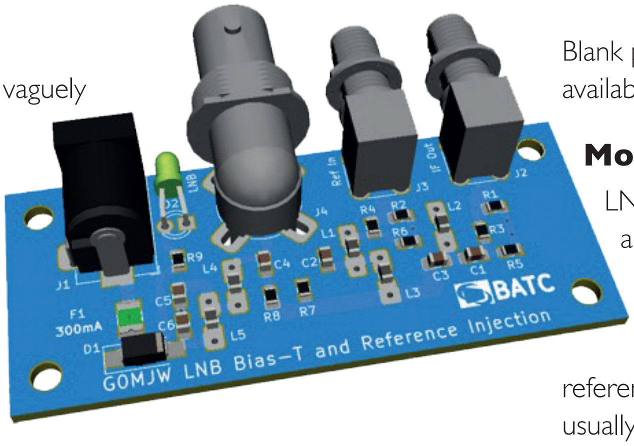
LNBs typically need about 0 dBm of reference. A diplexer rather than a splitter prevents strong 25 MHz signals upsetting the receiver front end. If the reference is very rich in harmonics, and some are, the diplexer might not provide enough isolation. In that case an additional low pass filter can be built in place of the reference attenuator to improve matters, or you could just filter it externally.

A 50-75 ohm conversion is done as, in theory at least, LNBs are matched to 75 ohms. If you use 50 ohm feeder, you won't want to fit this, just short out R8 and don't fit R7. It has a 6 dB loss which needs to be factored in when considering appropriate signal levels.

L4 and L5 are the DC feed to the LNB. LNBs typically take about 100mA. Provision is made for a Polyfuse to mitigate accidents. The aim is for the fuse to protect the inductors rather than the other way around, so use appropriate inductors able to carry the fault current.

J4 is the connection to the LNB. A BNC is preferred but an F-type can be used if there really isn't any viable alternative.

Once built it might look vaguely like this:



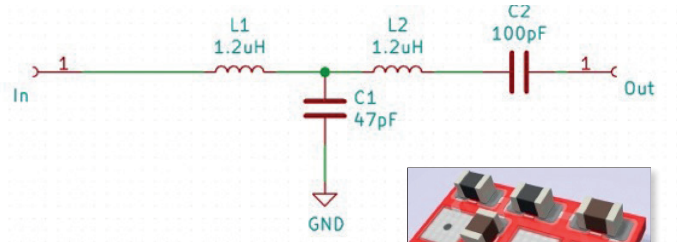
Here is a parts list:

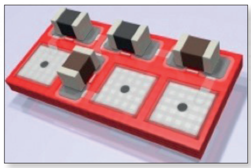
Part	Value	Package	Notes
J1	2.1mm DC	EJ508A and others	Fairly standard size, e.g. EJ508A
J2, J3	SMA	TE Connectivity 619540-1	Most standard SMAs will fit I expect
J4	BNC	TE-Connectivity 1478204	This is smaller than many of the Ebay ones
R1-R6	As required	0603	Optional Attenuator - see schematic
R7	82R	0603	50-75 ohm matching
R8	47R	0603	50-75 ohm matching
R9	10K	0603	LED series resistor
C1	39p COG	0805	
C2	56p COG	0805	
C3	24p COG	0805	
C4	2n2 X7R	0805	
C5	33p COG	0805	
C6	100n COG	0805	
L1	82nH	2012	Or hand wound
L2	56nH	2012	Or hand wound
L3	150nH	2012	Or hand wound
L4	220nH	2012	Or hand wound
L5	10uH	2012	E.g. MurataLQH32PN Series
F1	300mA	1210	Polyfuse
D1	GP Diode	SOD-323	Any able to pass the current. E.g. SMD 1N4007
D2	3mm LED		Any colour you like

Blank printed circuit boards have been ordered and are available from the BATC Shop.

Modifying the LNB

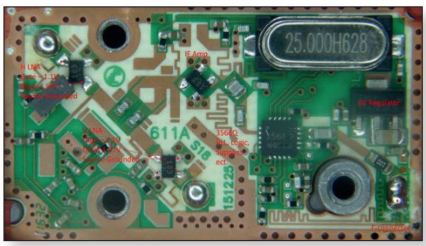
LNBs aren't really within the scope of this article and there is a host of information on modifications on the web. Each model is different; however, the general principles are the same. You need to carefully remove the crystal and feed in the reference to one side or the other of its pads. One side usually works best - which side that is will need to be tested as there are too many variants to be specific.



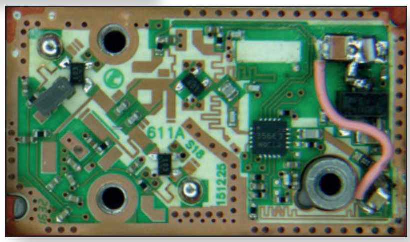


This simple band pass filter circuit should be built inside the LNB case. Its job is to isolate the DC and IF so only 25 MHz goes to the PLL. You could probably get away with a series inductor and capacitor tuned to 25MHz though the outcome may be less predictable. The best way I found to build it was with SMD parts dead-bug style, as although I designed a PCB that would go in place of the crystal, getting such a small PCB made is difficult.

It is wired between the centre of the F-connector and whichever pad of the crystal was found to work best. For my specific LNB, an Octagon OSLO Model 1609 it was thus:



I tidied up and replaced and shortened the wire after I had demonstrated it worked.



That fat pink wire is under 1mm thick, but I used some 0.1mm enamelled copper wire in the second version. The wire now goes to the right-hand side of the grey SMD part next to the PLL chip and the inductors/capacitors are tidied up. My LNB worked fine from 0 dBm.

Easy Hole Plating at Home

Achille Galliena I2GLI

A VIA (Latin for path or way, aka Vertical Interconnect Access) must be often plated, to interconnect lower side ground plane and tracks located on the upper side or to provide with an escape route for heat created by a medium-power active device. A rather simple method to plate the vias in a printed circuit board for frequencies up to microwaves, even with challenging substrates such as Teflon, is described in the following lines.

In the following example, a double-sided teflon substrate with a thickness of 0.5 mm and 35-micron copper (1oz/sqft) with a dielectric constant of 2.33 will be used to build a 2300MHz amplifier equipped with a SHF589 affording a gain of 10dB and an output power of 2W.

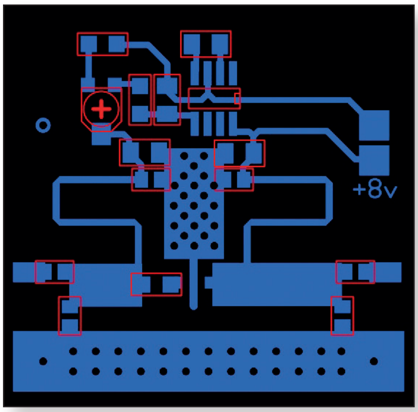


Fig. 1 shows the small circuit designed with Sprint-Layout, one of the many software applications available for this purpose.

▶ *Fig. 1 Layout of the RF amplifier with a SHF589*

From this layout an Excellon .DRL file can be obtained to drill holes into the PCB using a CNC machine.

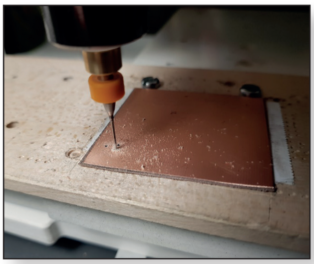
Steps include:

- Drilling holes
- Graphite coating
- Copper plating
- Photoresist application, exposure and development
- Attack by acid

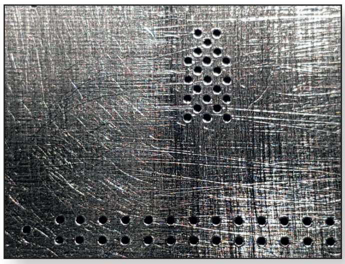
Drilling holes

The first step is drilling holes into a virgin PCB. The holes are subsequently metallised in a copper electroplating bath.

The holes should be drilled with a high-quality bit (ideally tungsten) at the highest possible speed. This will result in clean entrance and exit edges and, after plating, smooth inner hole walls.



▶ *Fig. 2 The CNC machine at work. Rotation speed is 11,000 rpm*



▶ *Fig. 3 The drilled PCB. Each hole measures 0.8 mm*

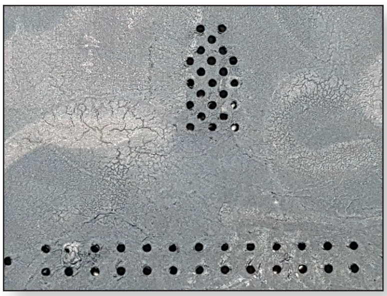
Both sides need to be smoothed with a scourer in order to remove any mechanical drilling residue as well as oxide build-ups.

Graphite coating

Spray both sides with Graphit 33 (Kontakt Chemie's liquid graphite), which will seep into the holes and create conductive "bridges".

▶ *Fig. 4 Graphit 33*

Resistance is quite high but sufficient to trigger copper electroplating.

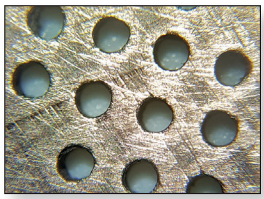


Of course, other products available on the market can be used with comparable results.

▶ *Fig. 5 – the PCB with graphite coating on both sides*

Next, both sides need to be scraped and smoothed with 800- or even 1000-grit sandpaper in order to remove the graphite. This operation should be limited to the surface of the PCB.

The graphite should not be removed from the inner hole walls.



▶ *Fig. 6 – Scraped surface and graphite-coated 0.8 mm holes, ready for copper plating*

Copper plating

Copper electroplating involves two 99% pure copper anodes (positioned in front of the two sides of the PCB) with a current density of 0.32A/sq. inch. The electrolyte used in this example is produced by Tifoo, but there are many others.

In this example, the total surface (including both sides of the PCB and 53 0.8 mm holes drilled in the 0.5 mm thick substrate) amounts to approximately 2.3 sq inch.

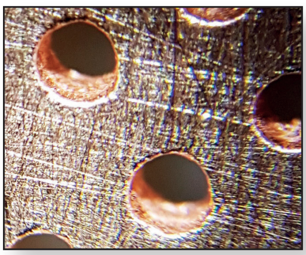
Therefore, the necessary current is about 740 mA. The necessary tension, on the other hand, depends on multiple elements (the electroplating bath, the surface of the anodes, their distance from the object to be plated, etc.), but it's normally between 1 and 2 volts. As the plating progresses, the current changes and the tension provided by the anodes needs to be adjusted accordingly in order to maintain an optimal value.

A small aquarium bubbler was used to expedite the process, as it keeps the electrolyte in chaotic motion and ensures an even distribution.

This is by no means a critical process; simply keeping the current slightly below the theoretical optimal value will ensure high-quality copper deposition.

At this current density the deposition rate is about 1 micron of copper per minute. Of course, each micron will deposit anywhere in the holes and on either side of the PCB.

In order to prevent too much copper depositing on the two sides (part of it will need to be removed in the last step, when it is attacked by acid), deposition is limited to 15 microns, obtainable in about 30 minutes (at first, deposition in the holes is slower due to the low conductivity of the graphite). 15 microns of copper in each hole is more than enough to ensure a resistance below 35 milli-ohm. At microwave frequency, parasitic inductance inside the holes is a greater concern than resistance.



▶ *Fig. 7 – Plated 0.8 mm holes.*

Optional: once the PCB has been copper plated it should ideally be electroplated with silver. A layer of a few microns is more than enough to improve surface conductivity for the future tracks. The skin effect also limits the penetration of alternating currents in good conductors: for silver, about 2GHz at approximately 1.5 microns; 5GHz at slightly below 1 micron; and 10GHz at about 0.6 microns. Greater thicknesses (increased by 100% for redundancy) would not bring any additional benefit, except ensuring excellent conductivity to direct current, i.e. power supply to the devices. The salts and acids normally used to attack copper also attack silver (sodium persulfate, ferric chloride, hydrochloric acid plus hydrogen peroxide, etc.).

Again, the goal is to deposit silver throughout the surface of the PCB and remove all that is unnecessary (such a shame…).

A silver plating bath is possible even when the tracks have already been made. However, the thickness will not exceed 0.5-0.7 microns as the free silver must bind to the substrate. Once this has occurred, no more silver will deposit. In addition, welding causes a "discolouration" of the tracks and the surrounding area. The reason for this is that the deposited silver melts and mixes with the copper, creating an alloy. To prevent this, an insulating nickel layer should be added between the copper and the silver layers. However, these are electroplating techniques that go beyond the scope of this example.

Photoresist application, exposure and development

Photoresist is applied to the end of protecting the tracks on the PCB, which will be obtained by subtraction, i.e. removing any unnecessary material. A different example is alumina: the metal constituting the printed circuit will deposit on it and the tracks will be obtained by addition, i.e. adding the necessary material.

Besides protecting the tracks constituting the printed circuit, a crucial problem is to protect the holes from the attack of the acid. This is because the holes have sharp edges and the photoresist layer is very thin (just a few microns). As a result, it can easily chip or crack, creating small fissures through which the acid can seep in.

The first step is to protect the back side of the circuit by spraying it with quick-drying paint. Direct the spray vertically on the plated holes to make sure that as much as possible of the micronised, extremely fluid paint flows into each plated hole, protecting it. Let the paint dry completely.

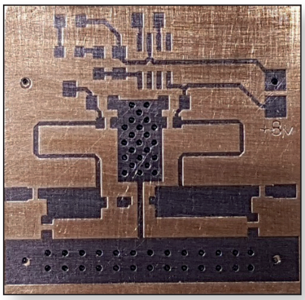
▶ *Fig. 8 – Ground plane protected with spray paint*

One of the types of photoresist that can be used is dry film as it's easy, quick and allows for very high resolutions (down to under 0.10 mm, should it be necessary).

Dry films are applied and adhere through heat and (gentle) pressure, for example using a laminator. The optimal temperature is 110°C (230°F), and the film should be run through the laminator four or five times. There are dozens of demo videos on YouTube. However, the same result can be achieved with an iron: just set the temperature on low and let its weight do the job.

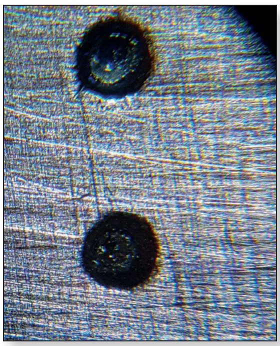
Next, expose it applying a negative mask (when using dry film, only the areas exposed to UV rays for a couple of minutes polymerise and become resistant to acid).

Development can be achieved by simply using some calcium carbonate (Solvay's washing soda is excellent) in a 1-3% solution (not at all critical) for 20-30 seconds. There is no need to buy expensive developer powders.



▶ *Fig. 9 – Exposed and developed PCB*

At this stage, it is very important to make sure that each hole is properly protected.

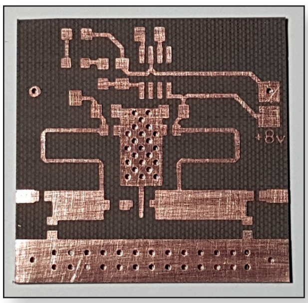


▶ *Fig. 10 – The edges of the two holes are protected only by a very thin layer of photoresist*

Quite simply, apply a microscopic drop of any nitro lacquer diluted at 40-50% to each plated hole. The best - and cheapest - solution is to use a toothpick. When a tiny, fluid drop of lacquer forms on the tip, drop it onto the hole. This is an excellent protection in view of the next step.

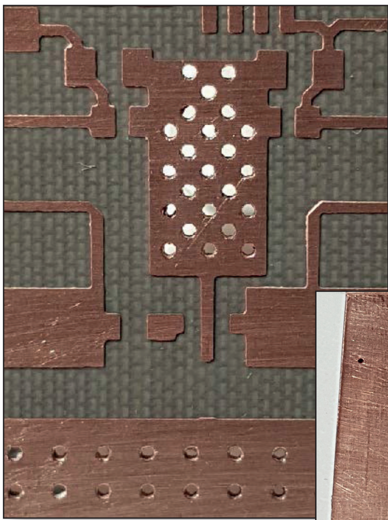
Attack by acid

The last step is to dip the circuit in a sodium persulfate solution (250 gr per litre of water) at a temperature of about 45°C (110°F) while agitating it with the above-mentioned aquarium bubbler.

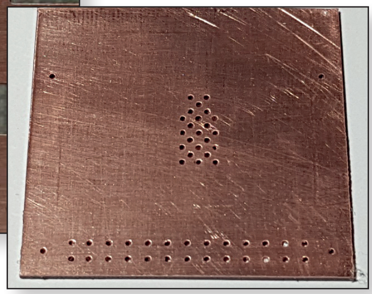


In about half an hour, the exposed copper parts (with a thickness of 35 microns plus the layer deposited during hole plating) will be completely removed. You can see the result below:

▶ *Fig. 11 – The finished circuit with the exposed Teflon substrate*



▶ *Fig. 12 – The central plate with metallised holes*



▶ *Fig. 13 – The back side, the circuit's Ground Plane The PCB is now ready for welding SMD components.*

Optional step: welding mask (it may be helpful given the extremely small size of the components).

The circuit is fitted with the following SMD components: 1206 resistors, 0805 capacitors, one ICL 7660 and one SHF-589.

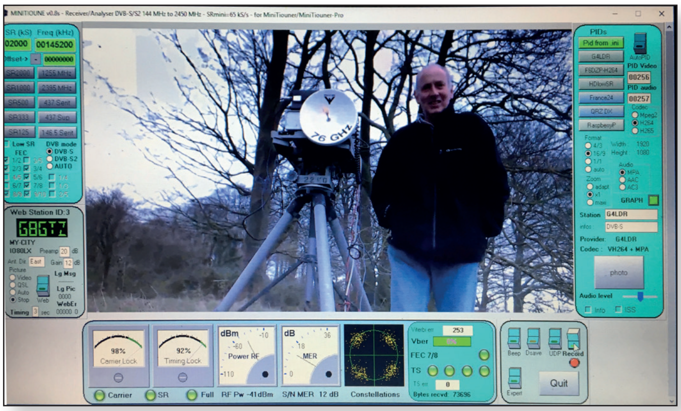
A detailed layout is provided in a separate article.

Achille Galliena, I2GLI - ***i2gli.ag@gmail.com***
www.e-doodles.it/en

New DATV record on 76Ghz

Neil - G4LDR

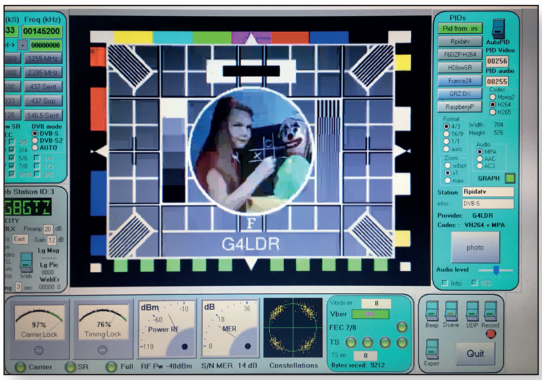
Monday 28th January was one of the coldest days this winter (in the south of England anyway). Noel G8GTZ and I decided we would try to extend the 76GHz DATV distance record we set two weeks earlier. Initially we checked the 28km path between Hannington (northwest of Basingstoke) and Cheesefoot Head (near Winchester) narrow band and then DATV pictures were exchanged again without difficulty.



Noel then drove to Coombe Gibbet (south of Hungerford) to try the 38km line of sight path to Cheesefoot Head. Narrow band signals were good but unfortunately no DATV signals were exchanged in either direction. Noel decided to drive to the Walbury Hill PMR mast which is about 2km from the top of Walbury Hill and 3km nearer to me at Cheesefoot Head.

This time DATV pictures were received over the 35km path. Unlike on the 28km path where Full HD pictures were exchanged, only reduced bandwidth DATV (333ksymbols per sec) would work.

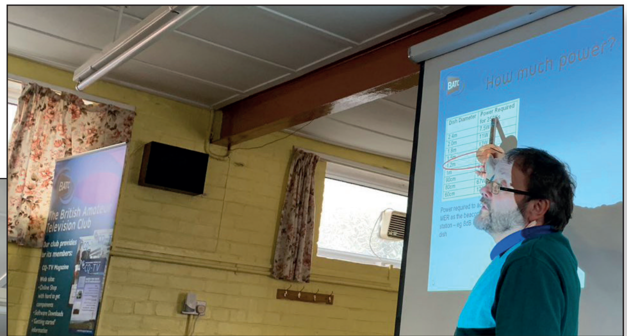
Noel and I had hoped to have achieved greater distances particularly with the low absolute humidity we had on the day meaning about 6dB less water vapour attenuation on the 35km path compared to a typical summers day (20deg C and 50% R/H). Although we have missed the really cold weather, we will return to try and push the distance up to 45+ Kms.



Bristol Mini-CAT

Dave - G8GKQ

A mini-Convention was held in Bristol on Sunday 31st March 2019. It included demonstrations of digital ATV, microwave ATV transceivers and Qatar Oscar 100 (Es'Hailsat2) reception; Dave, G8GKQ, spoke about the latest development's with the club's Portsdown DATV transmitter., and Noel, G8GTZ, presented on the challenges of working through QO-100.



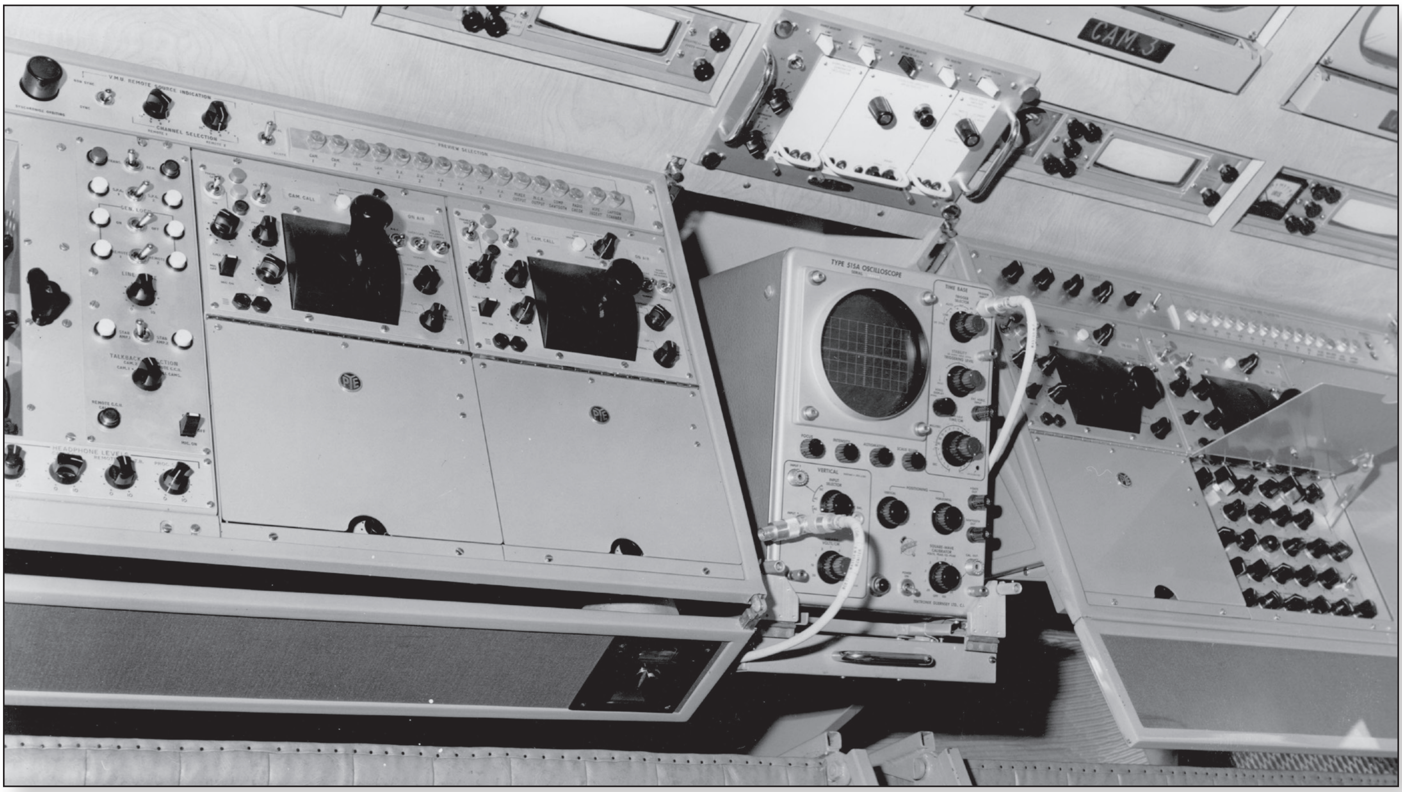
▶ *Noel G8GTZ talking about Qatar Oscar 100*

Broadcast Television Technology Trust MCR21 Progress

Brian Summers G8GQS

In CQTV261 I wrote about the Trusts project for the restoration and public display of MCR21. The ownership of MCR21 has been transferred to the BTTT (Broadcast Television Technology Trust) and our work progresses, the funding application is with the Heritage Lottery Fund and we have great hopes for success.

This application is not a simple thing and it has taken a lot of effort, but when we are successful it will all worthwhile. We also have other funding plans under consideration.



This picture is the original "Vision Control" area. The picture was taken at Pye when the vehicle was nearing completion. You can see one of the BBC designed waveform monitors needs the iris indicator fitting. These waveform monitors were designed to be used in studios mounted vertically, here they are used horizontally and the iris meter scale changes from ± 1 stop to the full iris range.

MCR21 had 4 Pye Mk6 cameras installed each with an OCPs (Operational Control Panel) and to the right a spare position for a possible 5th camera or caption scanner. In the centre is the Tektronix 515A oscilloscope, used as the master waveform monitor.

At the left end is the Vision Supervisors panel with a telephone, and important switches like the SPG and Stabilising Amplifier changeover, the Transmission-Rehearsal switch. The ones that would cause a lot of shouting if operated without good reason!

In 1963 and for that matter today, the SPG was central to the correct operation of the OB or studio and two were/are installed with a change over switch in case of failure. To mitigate against total failure of the vision mixer, it was designed with two semi independent routes through it hence the stab amp change over switch. The BBC designed vision mixer electronics were built into large boxes that plugged into the overall frame. In theory the stab amp and cut fade crates could be hot swapped, not something to be done lightly! These plug in crates were known as "Biscuit Tins" by the vision crew.

These two desks will have to be "re-created" to match as closely as possible to the original design. even to the extent of finding an original ash tray, seen in the fold down wrist rest near the Tek scope. Fortunately we have the scope, some of the OCPs, the V.S. panel, the matrix selector panels that run across the desks will have to be remade.

www.BTTT.org.uk
www.mcr21.org.uk
www.tvcameramuseum.org

The old and new models of the Octagon Twin LNB

Jen Easdown G4HIZ

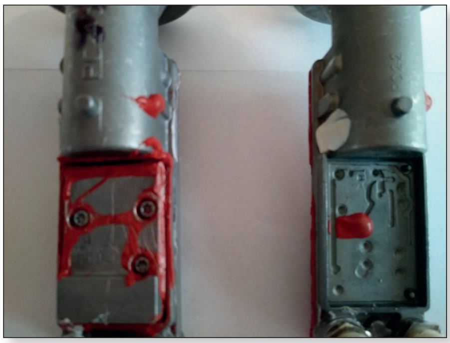
One of questions I hear occasionally, is how to identify the difference between the two versions of twin output Octagon LNB (OTLSO version), which seems to be a popular choice for reception of the recently launched Es'hail-2 satellite, now denoted Qatar Oscar-100.

▶ *Octagon twin output LNB OTLSO types, 27MHz left, 25MHz right. Notice the skew graduations. Photo G4HIZ*

From my experience with several units, there are a couple of pointers. First, just to recall that the original unit had a 27MHz PLL crystal reference, whereas later units had a 25MHz crystal. It is felt by some that if you should wish to 'injection lock' one of these units then the 25MHz type may be easier. Although personally, I prefer the 27MHz type, as with a new 26MHz crystal this will give an LO of 9388.888MHz, which is useful if you want to shift the converted signal into the L-band range that standard satellite receivers use (950 to 2150MHz). You also benefit from about 20dB of gain that is lost when using the original LNB LO of 9750MHz with QO-100 downlinks.

How do you tell if you have a 27MHz or 25MHz type, given that the packaging gives no real clues and even the bar code looks the same? Without removing the plastic shell of the LNB there is a clue, at least on the units I have. If you look at the graduations around the neck which are used to adjust the skew, you will see that the earlier type (27MHz) has 3 marks either side of an arrow, whereas the later type (25MHz) has 25 marks, see photo below.

If you really wish to be sure though, remove the plastic case. I did this using a small flat bladed screwdriver near the output end. You will inevitably break the plastic clips slightly, but there were usually sufficient to hold the plastic parts together afterwards. Now turn the LNB over so that the underside is visible and the connectors uppermost. You will notice that with a 27MHz type there is a set of 3 screws with a housing cover for a second PCB. For a 25MHz type this housing does not exist, see photo below.



▶ *Octagon twin output LNB OTLSO types with covers removed, 27MHz left, 25MHz right. Notice the lack of the 3 screws on the 25MHz unit. Photo G4HIZ*

Route du Rhum Crowds Monitored by Portsdown Transmitter

On Sunday 4 November 2018 the Route du Rhum, an ocean race from Saint-Malo to Guadeloupe, set off from Saint-Malo. Large crowds were expected at the headland by Cap Frehel lighthouse to view the boats as they departed, and the local authorities requested amateur radio assistance in a "sécurite civile" operation.

Roland F8CHK, Jean-Claude F6FDH and Pierre F5MIM set up a Portsdown transmitter with camera at the top of the Cap Frehel Lighthouse to enable the authorities to monitor the crowds. Transmissions were 10W into a 10 element yagi on 437 MHz SR1000 using MPEG-2.

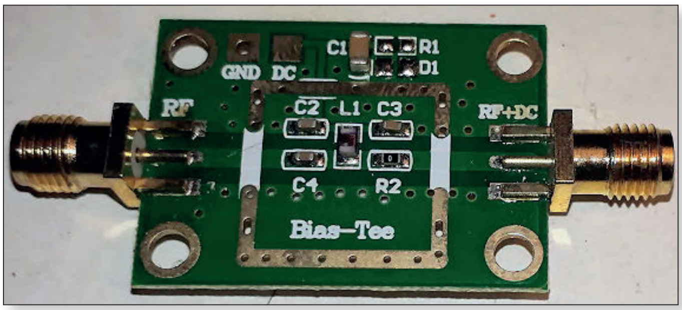
At the operational command centre 4 km away, Jean-Luc F6FMN and Alain F6HRP received the pictures using a MiniTiouner Pro receiver and displayed them on an HDMI TV. The link ran for 8 hours. Needless to say the command centre authorities were impressed with the pictures.

Once the crowds had dispersed, the transmit aerial was turned towards Camille F6HRO who received the pictures from 65 km away.

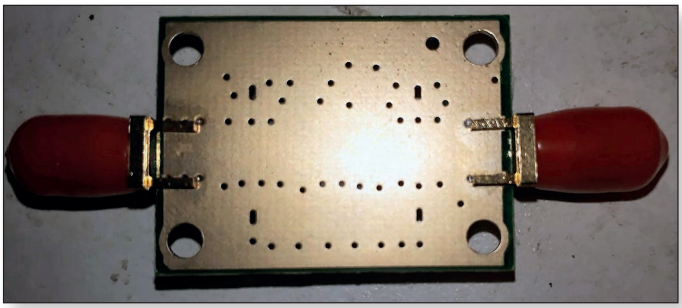
Thanks to Roland F8CHK and his team for the story and pictures.

Cheap Ebay Bias Tee

Paul - M0PNN



▶ *Top Side*



▶ *Bottom*

I have two DG8 preamps for the two-metre band one on the mast and one for portable use. Usually, they are powered when in use via the Icom IC-910 so there's no need for an external Bias Tee as the rig takes care of power switching etc. I was pleasantly surprised when reading the MiniTiouner would benefit with a DG8 preamp in front of it. All I required was a way of powering the DG8 preamp via the coax cable; I can worry about switching at a later date, for now, it's Rx only.

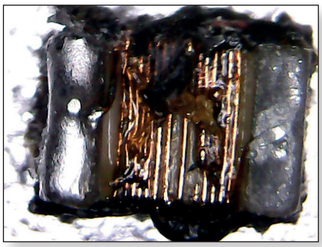
After looking at circuits, kits and taking import duty into consideration I looked on Ebay. A suitable Bias Tee was found to supply 10-15v 140 mA for the grand sum of £2.50 – ok let's give it a go. Two weeks later it duly arrived.

- The unit is 32mm wide and 24mm high.
- Two SMA sockets.
- Operating frequency: 10MHz-6GHz
- Insertion loss <1.2dB
- Working voltage 1-50V DC
- Maximum operating current <0.5A

The first thing I did was remove the SMA sockets and power the unit up with current limiting supply. The unit is powered via two solder pads gnd and DC. I have 12v DC out of the Antenna side so that's working.

I bought a couple of small project boxes from the Telford Rally this year so I used one of them to box it up. With a bit of Dremel work, the female N-Plug Sockets and solder tags were fitted. The board was mounted on four M3 PCB mounts and some RG174 Super Thin (Military Spec) Coax Cable was used between Bias Tee and the female NPlug sockets.

The Bias Tee worked fine with my spare DG8 preamp. Next I tested it with an RTL Dongle connected to a Raspberry Pi 3 which I use for monitoring FT8 on 2m. The preamp is connected Rx side of a 2-port coaxial power combiner with a couple of homemade 8 element LFA for 2m after it. All working fine with no problem so then I tested it with my Icom IC-910; there was no difference in Rx between the internal and new Bias Tee Power. The real difference came when testing with my FT817 I did not realize how deaf it was on 2m the preamp made a real difference.

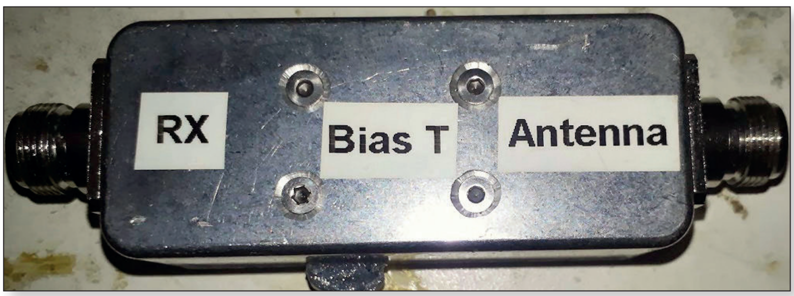


The small inductor (on the left) shows what happens when you connect it to your 6-metre antenna by mistake and power it up.

Conclusion

A reverse protection diode on the DC power in, a 0,5 amp inline fuse, a power on indicator diode and an on/off toggle switch will finish the job. For £2.50 it works with some suitable modifications. There are better deals on Ebay.com than the UK site. Today, 6 Jan the cost is £2.24 including postage. Search using this description: "RF Biaser Bias Tee 10MHz-6GHz FOR HAM radio RTL SDR LNA Low Noise Amplifier"

Cheers
Paul M0PNN



Experiments with baseband digital video

Mark Atherton - ZL3JVX

Introduction

Having recently been given an old, but fully functioning Sony DXC-D35WSP broadcast TV camera, I was rather intrigued by a reference to '76P Digital' on the outside of this apparently analogue-only unit. This article describes some of the adventures which were involved before a low cost, internal serial digital interface (SDI) could be designed and fitted.

One of the reasons that this project was contemplated was an attempt to put some of the 'Amateur' back into Amateur TV. By this I mean bending the rules, understanding the gubbins[1] (at least a little more), and exposing some previously dark interface.

Finally, it is worth being clear that this article has a heavy bias towards uncompressed baseband video, rather than the more usual compressed video formats such as MPEG, AVC etc.

Very brief history of Amateur TV transmission

Back in the mists of time, it was possible, and actually quite normal for the amateur television enthusiast to be able to build all parts of the transmitting chain from image acquisition (with the aid of a vidicon) through to RF source, frequency multiplication, and final RF PA (maybe a QQV03/20A), and almost certainly the antenna.

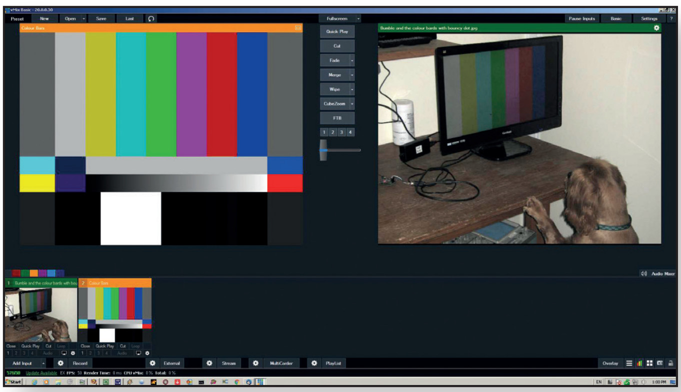
Technology moved on, and the maybe the station became solid state; image acquisition was now by means of CCD pickup, transmit frequency was agile (with some help from a phase locked loop), spectrum was more efficiently used (vestigial sideband IF filter), and the whole mess unconverted to the band of interest, then amplified by one of those lovely (and expensive) linear hybrid strip-line PA modules.

In more recent times, with increasing levels of integration, image acquisition can be by way of a low cost, high definition web-cam, with built-in video compression, modulation can now accomplished by serialising this bit-stream, then digitally modulating an RF carrier to create a constellation of vector-positions. This RF signal can now be compatible with DVB-S satellite tuners, with an IF in the 1296MHz amateur band.

In the first two examples, analogue video was the norm to carry the signal between camera and transmitter. In the latter example, a purely digital link (maybe USB) now carries information which is closer to data than 'real video'. For more complex Digital Amateur TV set-ups, several other data link formats allow base band video (the digital equivalent of component video) to connect image acquisition to the next piece of equipment in the chain (be it the video compressor, or a video mixer). These formats include HDMI (common in the home video arena), and (HD)-SDI, which is the norm in the broadcast arena.

With the current rate-of-change of technology, equipment is being made obsolete so swiftly that it is also possible to build a DATV system by piecing together low-cost surplus professional equipment.

From my point of view, yet another video technology has recently become available, that of Vmix [2]. This is a computer based approach to video mixing where the Graphics Processing Unit (GPU) manages the (very) high speed blending of video signals, and allows unsynchronised video inputs to be mixed. At the current price-point, this really is quite incredible. Clearly, having a couple of video cameras set up, along with a capable video mixer can go a long way towards providing a source of high (production) quality video source material for transmission via either the Internet, or via the local Digital Video Repeater. It was this last context which I find the most intriguing, so having a pure-digital video source becomes quite appealing.



▶ *Figure 1, screen capture of vMix*

Digital Video Transport : HDMI and SDI

A recent, and remarkable product to enter the consumer marketplace is the LVK373A. This is a device designed to convert HDMI base-band video into a compressed video (and audio) format which can be carried as Internet Packets (IP) over a regular network. As an added (significant) bonus, this network feed can be used directly as a video source for Vmix. 'DanMan' has made quite a mission out of exploring this product [3] , some of his work has further been expanded by several people, including Chris Tanner.

▶ *Figure 2, LVK373A HDMI to Ethernet, and SDI to HDMI converters*

So, within the context of this project, a means is required to convert the output of the Sony DXC-D35WSP into HDMI. This is a rather a grey area, since the former is a professional product, while the latter is a domestic (consumer) format. As a side issue, the current preferred method of carrying professional digital video around is in a high speed serial format (aka [HD] SDI, this translates to the standards SMPTE [4] 292M and SMPTE 259M).

From an enthusiastic-amateur point of view, one of the major differences between HDMI and SDI (ignoring the physical layer for a moment) is that HDMI is a closed format; legal access to the bitstream format, and associated ICs etc. requires (very expensive) membership of the HDMI alliance, and a suitably large pile of non-disclosure agreements signed in blood. Clearly this is not optimal for those of us who like to tinker. (HD)SDI in contrast are ratified and published standards (care of SMPTE), with interface components being readily available.

There are a couple of other pieces of the puzzle, and one is care of the CCTV industry. One of the many video formats used by the surveillance industry is a close-cousin of SDI, and to help with inexpensive connectivity between CCTV cameras and home TVs, a whole industry has sprung up manufacturing low cost SDI to HDMI and HDMI to SDI converters.

Assuming that SDI video can be squeezed out (it is after all a serial format) of the video camera in question, the video chain can then be completed as described above (camera SDI -> SDI/HDMI -> LVK373A -> vMix).

Enter the (Digital) Video Camera:

As was mentioned earlier, a small 'DIGITAL' marking on the rear casting of the camera section of this unit was the single item which started the ball rolling. A web search, and later a service-manual search for the various attachable 'backs' [5] did not immediately explain why the digital output was provided, and certainly did not explain anything about a possible data-format.

Before visiting the digital side, the camera was investigated quite extensively in the analogue domain to check that

▶ *Figure 3, Sony DXC-D35WSP configured with DV back, Camera and Lens*

everything was working as expected. The trusty old Tektronix 1740 vectorscope (modified for PAL) [6] was brought into action and confirmed that the whole camera, including the colour bar generator (and for that matter the whole PAL modulator) seemed to be in reasonable working condition.

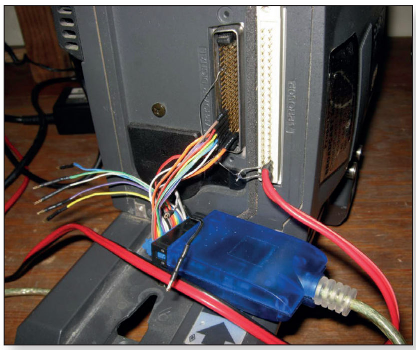
One of the delights of owning (old) professional video equipment is the build-quality compared to their equivalent domestic (consumer) counterparts. The DXC-D35 is no exception, with all major external surfaces manufactured from high quality, custom diecast aluminium. In the case of this unit, the modular construction allows the Recorder, Camera and Lens to be separated, exposing all manner of interesting mechanical and electrical interfaces.

Looking at figure 3, the long white vertical strip (image centre) is actually a 50 way DIN 41612 connector. Sitting slight in-land from it is a custom high density 76 pin connector, with the tantalising(?) words '76P Digital'.

Next step in the exploration was to purchase a full service manual for the DSR-1P recorder section, as well as for the camera assembly. Due to copyright issues, it is not possible to reproduce anything from these manuals, but suffice it to say that there is a ten-bit digital bus and associated clock exposed on the 76P connector of the camera section.

Time to capture some Digital Bits:

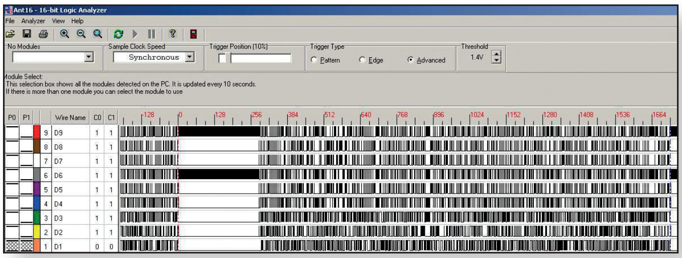
First order of business was to get the camera working stand-alone. This entailed making a compatible DIN 41612 connector (to carry 12V power) into the unit, then to inspect the digital-video clock using a 'scope. It was with some delight



▶ *Figure 4, logic analyser attached to rear of camera unit* that a 27MHz square wave output was found, which is a common clock used in standard-definition video.

At this point, it is time to capture some data using a small logic analyser, with some help of a small birds-nest...

Given that the data is rattling along at 27M samples per second, some time and effort was put into making a very short custom probe assembly for the ANT-16 USB logic analyser capture head. A low impedance ground connection is essential if reliable waveform capture is hoped for at these sort of data-rates. One other significant feature that is required for this activity is the ability to sample digital video on every rising edge of the clock. While the ANT-16 is getting a little long in the tooth (as most things, and people are around here are), this unit does offer synchronous capture. This means that data can be latched into the logic analyser using an external clock.



▶ *Figure 5, captured digital video-noise, and blanking*

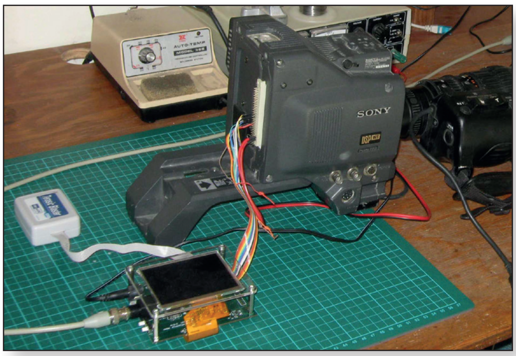
Before the digital video was investigated, the lens was replaced with a cap, and the various gains associated with the video path were cranked up as high as possible (somewhere around +24dB). The intent being that the video portion of the data frame should be noise, while any blanking period should have stable data.

As messy, and apparently confusing as the screen capture from the logic analyser is (in figure 5), the blanking period is clearly visible. Each digital video lines contains 1728 samples, of which 1440 samples are active video. It is also worth noting during the blanking period that data alternates between hex 0x200 and 0x40. This is consistent with the 4:2:2 data format where values are respectively chrominance value 0, and luminance value 64 (close to black). Actually the sequence is Cb, Y, Cr, Y. Anyway, this data looks suspiciously like BT.656 [7] , which is the parallel data version of SDI (SMPTE 259M). Various pattern searches were also made on this data to confirm the presence of embedded syncs etc. There is still a lot of work to go before this might be converted to SDI, but the stars were starting to align.

Final validation:

As part on an unrelated project, I have already built a small selection of test equipment designed to process and display BT.656, so a couple of hours were spent hooking this new-found video source into the equipment just as a final verification.

▶ *Figure 6, final digital video validation, using an external 3.5" LCD*



Much to my delight the setup in figure 6 worked first time with full-frame video on the 3.5" LCD display; this all came as bit of a (pleasant) surprise.

The serial interface:

Up to this point in the project enough work and validation has been completed so the chances of building a working custom serial interface were pretty high. One of the continuing headaches with the current rate-of-change of technology is that the geometry of electronic parts is shrinking. I did manage to find a contemporary parallel to serial interface designed for this application (but it was manufactured in a ball grid array (BGA) package, with a hundred or so pins (balls) crammed into something smaller than a 10x10mm space. After further digging around I managed to locate a National Semiconductors (now Texas Instruments) CLC020, which is 1990s vintage, and in line with parts of that age is packaged as a 20 pin device, around 10x10mm; much easier to handle. It was a surprise to discover that the latest datasheet was dated 2013, I was expecting it to have gone obsolete many years ago. Anyway, managed to order several of these parts from eBay for around $10 each.

Next major decision was how to attach the serialiser to the camera. Reasonably(?) obvious options include 1) outside, and 2) inside the camera.

- Option 1. This initially seemed the way to go, but as has been indicated earlier, this solution would required an external enclosure, but more to the point in terms of difficulty, a 76 pin Sony custom connector. After considerable effort, the number of this custom part was tracked down, and a supplier located. That's the good news, the bad news was that it could cost almost $100. Option 1B was to fabricate a custom connector using socket-pins from an HD15 connector (VGA style), and mounting them directly onto a PCB. This solution had every chance of working, but I was (very) unhappy with the possible appearance of the rear-facing-carbuncle solution. An inordinate amount of time was spent investigating this option, but as they 'Never Give Up, Never Surrender' (NGUNS) [8]

- Option 2. This really was not initially taken seriously as an option since the moderate data rates require very low inductance, low capacitance connectivity along with a decent, solid ground reference. The service manual was consulted, and while there was quite an adventure just tracing the data path from the external connector back to the data source (via several PCBs, connectors, and a ribbon cable enclosed in a ferrite EMC filter) the right hand mother board held the bulk of the data interconnect, along with 5V power and a couple of ground pins.

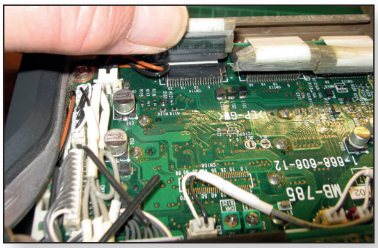


Figure 7, location for the interface : CN114

The full horror of attempting to attach to CN114 isn't quite conveyed in figure 7. The connector is 0.8mm pitch (which is quite low density, by today's standards), but is also surface mount, and hasn't been soldered to for quite some time. As usual, preparation is the key to success with these kinds of (idiotic ?) ventures. Once the rear of the connector had been re-tinned and cleaned and a paper model of the anticipated PCB constructed, the whole project seemed less daunting. A PCB was duly designed (basically the reference design for the CLC020, along with some decoupling capacitors), then sent out for fabrication at OSH park. OSH park at the time were the low cost go-to fabricator at the time, with a total charge of around $5 for three PCBs, plus a few dollars shipping.

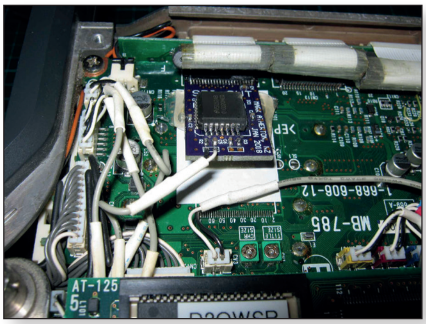


Figure 8, digital video interface installed

This was not my favourite PCB in terms of installation, since it had to be placed at a small incline, and then hot-glued in place. Having said that, the unit has had considerable use and is proving to be quite reliable.

One added bonus I nearly forgot to mention was that the loom from main video output connector(s) also passed through this part of the camera. It was a simple task to cut the coax and feed the BNC with the newly generated 270Mb/s digital video.

Figure 9, SDI video, via SDI to HDMI adaptor into an HDMI monitor

Conclusion.

A huge amount has been learned from this project but the main point of reproducing the project here is hopefully to encourage exploration and to some extent determination. The world is slowly filling with turn-key solutions for all manner of applications to the point where modification and self education are becoming much less common. It will be a great loss when the old days of tinkering finally ceases. Above all, NGUNS !

With thanks.

To Joe Morgan, who always seems to pick up the phone and call me before disposing of tasty video-goodies, and to Alan Page for listening to me witter on about idiotic new projects, and provide useful feedback when it is most needed. Last but not least to Hunnious Bunnious (possibly Latin for long suffering wife), for feeding and encouraging eccentric behaviour.

References

1. 'Gubbins' a small device or gadget, or even possibly a silly person. http://www.dictionary.com/browse/gubbins
2. https://www.vmix.com/
3. https://blog.danman.eu/new-version-of-lenkeng-hdmi-over-ip-extender-lkv373a/
4. SMPTE, the 'Society of Motion Picture & Television Engineers'
5. Some professional video cameras can be configured for purpose by changing an external module. Add a tape or a hard drive and you have an ENG setup. Add a studio interface and associated CCU and you have a studio camera etc.
6. Vectorscope conversion from NTSC to PAL, CQTV 239, P19, Atherton
7. A comprehensive discussion on the subject of the parallel digital baseband (4:2:2) video is beyond the scope of this article, but some healthy bed-time reading (for the insomniac) can be found here https://en.wikipedia.org/wiki/ITU-R_BT.656
8. 'Galaxy Quest' the meta sci-fi comedy film 1999, Tim Allen, Sigourney Weaver, Alan Rickman et al.

A New Audio Mixer for GB3KM

Rob Swinbank - M0DTS

Ever since 'Going Digital' on GB3KM we have had to contend with audio issues and most of these issues span from the delay added by using a digital output. Prior to this the analogue audio mixing was very easy as we just combined all audio inputs onto one subcarrier.

KM has always been a multi-user repeater allowing multiple stations to access it at once with split screen etc so if two stations are accessing then both of their audio signals are fed to the transmitter. The audio signals on the digital output are delayed by around 1 second before the user hears it back which is rather annoying and disrupts speech dramatically. Apparently hearing delayed version of your own voice at around 200ms lag is the most disruptive - try it and see! On Analogue there is no delay so no effect is noticed. The current solution is to feed the two most used input's audio to opposite audio channels of the transmitter so they can just listen to each other's audio by selecting left/right audio on their receiver but this limits it to two users/inputs.

Upgrading KM's logic is ongoing and the Audio Mixer was added as part of this project. The final idea was to use multiple ADC's/DAC's for input/output with the ability to mix the audio in software using code in an FPGA.

I thought for a long time about how to mix the audio with multiple analogue mux chips and opamps etc. This could be done but would require so much buffering for isolation I gave up and decided I could probably do it in the FPGA more easily… turns out I was right but it did take most of my spare time last Christmas to achieve it. Try drawing out an 'analog' version of the system below and see how complicated it gets!

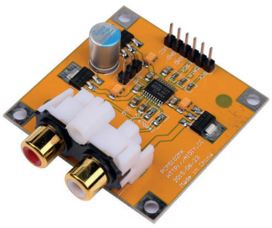
This 'software' method opens up the possibility of adding multiple audio signals on the Left/Right audio channels of the digital Tx i.e. the first two users audio is as normal on the baseband of Left/Right, any more user's audio could be frequency shifted up and converted back again at the users end so allowing 4 users audio to be sent at once. An alternate way would be to have more sound streams configured in the Digital Tx but that's not an easy option at present. Apart from the filtering for the squelch the code in the FPGA is just summing samples from the selected ADC's accordingly and passing the combination to the DAC's.

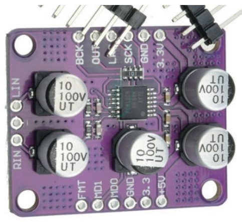
If one day a neat solution appears for repeater A/V linking with little delay then we will have the option of muting the incoming internet user's audio on their return path automatically.

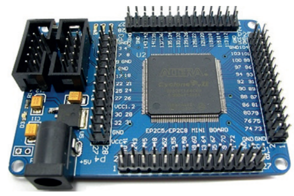
This audio mixer project is still ongoing but is 'functional' at this stage, the current capabilities are:

- Can mix any input(s) with any output(s)
- Adjustable audio level on each output
- Adjustable audio level on each input
- HF noise squelch on 1st 4 inputs (for analogue receivers)
- Audio bandwidth 32KHz

The hardware is all readily available, total cost was about £50 and it could be scaled down if not all of the inputs/outputs are required. The ADC's are PCM1808, DAC's are PCM5102, FPGA is an EP2C5T144. The IC's usually come on a made up board to make life easier.



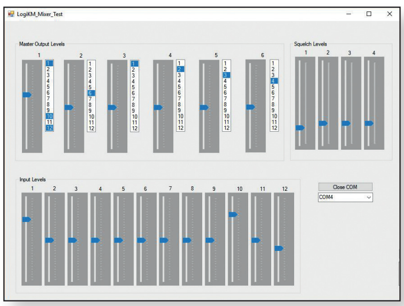


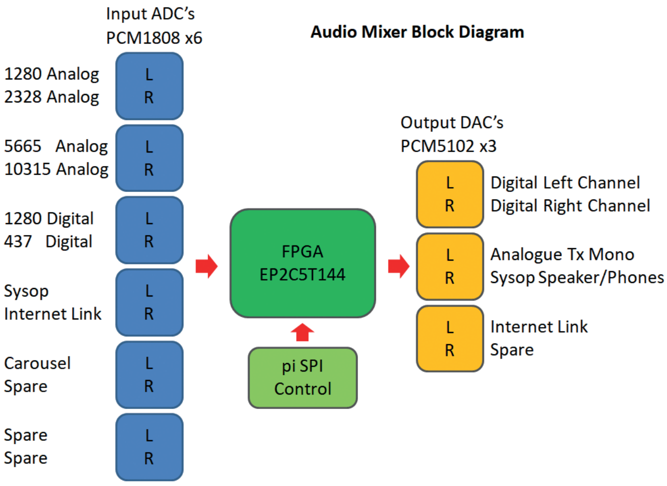


The ADC's and DAC's are all controlled with an FPGA, it's using the cheap dev board that Charles wrote about in his FPGA basics articles. It may be possible with some modern cpu instead of an FPGA but I wanted to learn some FPGA programming, it has turned out ok so far although the FPGA utilisation with my code is nearly full!

The interface with the mixer and pc (or Raspberry Pi in GB3KM's new system) is via a very basic SPI interface on the FPGA. For testing I programmed up an Arduino as a serial to SPI interface and it worked well with a simple C# GUI application to control everything.

The operation of the sliders should be fairly obvious for levels, but the white selection boxes at each output slider select which inputs are mixed to that output.





▶ *Here is a block diagram of how it will be used on GB3KM:*

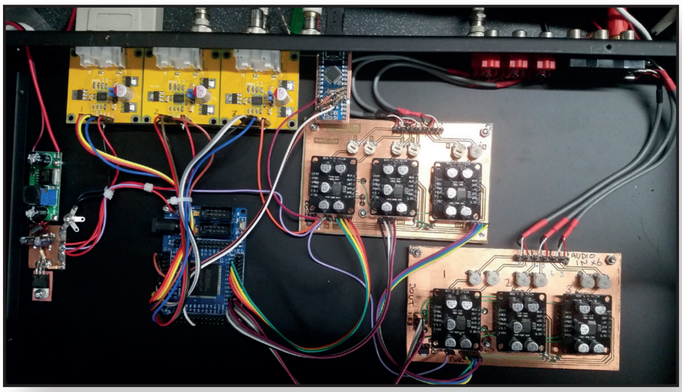
The audio squelch is currently limited to the first 4 channels as I ran out of FPGA space to do the filtering, currently it does a high pass filter at about 12KHz then averages the HF level to determine the noise. If above the set threshold (audio noisy or no signal) then the audio on that channel is muted automatically.

Work is still ongoing with KM's new logic but this mixer is already incorporated into it, the Raspberry Pi (as we find everywhere now) is now in control and depending on the active inputs it automatically routes the user's audio to the Tx Left or Right audio channels and the Sysop to all output channels. Audio levels will be set by a config file on the Pi as required to begin with but will be adjustable via the web interface later on.

Here it is all connected together working well in tests for GB3KM's upgrade, I would like to make a full custom pcb at some point but that will have to wait for now.

Any ideas to further this are welcome, for now it functions as required but hopefully I will get some time in the future to improve it.

The code for the FPGA is available on request, I have not yet drawn up a schematic diagram but the FPGA pin configuration should be enough for anyone willing.



BATC Website Incident

Dave, G8GKQ

On Tuesday 19 March two attackers used a newly-discovered vulnerability in one of the plugins on our main Wordpress site to gain some control over the website. They then set up a diversion from our website to their malicious website.

This was spotted within an hour of the attack and we immediately shut down the virtual server hosting the site. The attackers then made further unsuccessful attempts to access the site during the evening and the following morning.

We log information about all access to, and responses from, our services on the BATC server system. After detailed analysis of these logs we are confident that none of our members' data has been altered or subject to unauthorised access. We also found the attacker's access point and have closed it. These logs are not on the same virtual machine as the website itself and so the attackers will have had no access to them.

Following some excellent detective work by Phil M0DNY, and follow-on actions by our WordPress contractor, the site was re-opened one week after the incident.

We take the security of our members' data very seriously and so have asked an independent security expert to carry out an audit of the website. We did make an interim report to the UK Information Commissioners' Office (as initially we could not be certain that members' data had not been compromised), and have now made a follow-up report to close the incident with that certainty. We are also reviewing several additional measures that we can take to reduce the chances of success of similar attacks in the future.

You may ask why it took one week for the site to be restored. Two simple reasons: firstly, the website is run by volunteers and we rely on their availability; secondly, we place the security of members' data above the availability of the website, streamer and shop. Our other hosted services such as the Forum, Wiki and DXSpot.TV run on separate virtual servers and so were isolated from this incident.

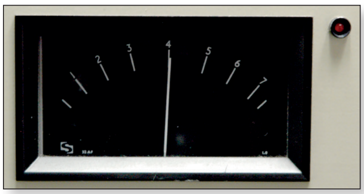
Video Fundamentals 17

PPM's & Rasterizors

Brian Summers G8GQS

Using a PPM or Peak Programme Meter is the way sound levels are measured in Broadcast applications, none broadcast users favour the VU meter or Volume Units. The standard 0dB. line-up tone is PPM level 4 or 775mV. Traditionally this was across a 600Ω resistor developing 1mW. This practice of "terminating" the line has long since ceased and output devices are a low impedance source and receiving device (the PPM in this case) a high input impedance. There are 4dBs between the scale markings thus the peak signal should be less than PPM 6 or +8dB which is the maximum voltage level.

One of the main differences between PPM and VU meters is the response time. PPM meters have a demanding ballistic specification and display the peak of the programme level with a slow fall back time. The VU meter is a simple voltmeter that responds quickly but falls back quickly. In a VU meter zero level is typically, but not always, -8 on the VU scale.



▶ *An analogue PPM meter*

This PPM meter, which is half of a stereo pair has the addition of an LED that comes on as the signal approaches PPM 6.

The history of the PPM goes back a long way almost to the birth of broadcasting. The BBC used a "Programme Meter" for level control in the newly built Broadcasting House in 1932. See the extensive Wikipedia page for more information.

The use of digital signals and the easy digitization of analogue signals led to a change in the way PPM's, waveforms and the like could be displayed. Once in the digital domain the data could be manipulated and it became easy to create or overlay a video signal for display on a picture monitor. This process is known as "rasterization".

▶ *TV picture with overlaid "Nordic" PPM indicator*

This overlay was produced by a Hamlet unit, it has 4 audio channels, left & right pairs which can be displayed on either side of the screen.

The green (+) and red (-) bar at the top indicated the phase between the L & R inputs. The display can be set to a PPM scale, a VU scale or as photographed a Nordic scale.

This discarded broadcast unit came to me at a very reasonable price because the video input/output is 625 analogue. A casualty of the move to HD! The "Eurovision" caption makes a nice change from boring colour bars.

Tektronix WVR7200 Rasterizer and monitor display

▶ *The Tektronix Rasterizer seems to do everything!*

Tektronix make a video/audio/data monitor and analyser all-in-one platform that does almost everything! (but it does not make the tea!)

When I was gainfully employed, not that many years ago, we used this rasterization equipment. A single 20" Apple computer display showing up to 8 small pictures, with cameras 1 to 4 and mixer out plus waveform displays. It is a very flexible arrangement and all pictures could be re-selected, resized or moved around the screen. A very useful spin-off from the use of a flat panel display was to create a storage cupboard behind. On OB's there was always a need for more storage: co-ax adaptors, plugs, cleaning spray, gaffer tape, first-aid kit.... the things never considered by OB unit designers.

▶ *Hamlet DigiScope DS9000*

This Hamlet Digiscope unit showing R,G,B video signals, a vector display, the picture and 4 channels of audio PPMs.

▶ *Leader LV7390 Rasterizer display with 4 pictures and Cues*

Although there is no subcarrier or vector phases in the PAL sense with SDI or HD SDI, a tradition vector display is of use in assessing the colours and their balance and saturation.

This display by "Leader" has 4 pictures the large one might be mixer out and overridden by the iris & lit selector on the operators OCP to give that cameras picture on the large display. This unit has the option for cues or tallies, red and green ones.

There are many different rasterizers each with numerous options.

Reference:

https://en.wikipedia.org/wiki/Peak_programme_meter

3D Printed horn antennas - Part 2

Gary M1EGI

This article is to follow up on my previous piece about 3D printing of horn antennas. I'm pleased to bring you a few significant updates that not only prove that the concept does work, but can also be made available should there be enough interest/commitment in the form similar to crowd funding (to cover initial material costs).

The second part to this story started on the 23rd June last year when my ears pricked up to a tweet from "Antenna Test Lab Co" (**@antennatestlab**) when they announced "We are 3D printing standard gain horns for our upcoming whitepaper" – I thought this is one to keep an eye on, as they have an RF anechoic chamber and testing antennas is their profession!

On September the 18th the next major tweet was posted indicating they have an article due to be published in the October Microwave & RF magazine detailing how "you can 3D print and spray coat horns to get perfect results up to 40 GHz, verified in our chamber. Learn from our mistakes and get a few tricks".

Then on October 18th another tweet hinted towards more tests results and a link to their web page with the research results so far including some tips and tricks. Best of all, two download links to zip files containing the STL and SketchUp files so you can edit and/or print the horns as tested by them in the anechoic chamber!

These are 15dBi standard gain horns, eight in total.

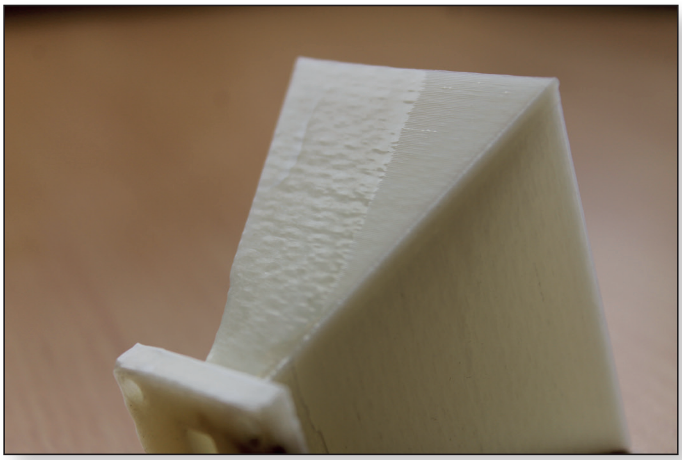
https://antennatestlab.com/3dprinting

Metallisation of the prints was done with a nickel based paint (like in my previous tests) and a silver coated copper (both from MG Chemicals), with two coats being sufficient.

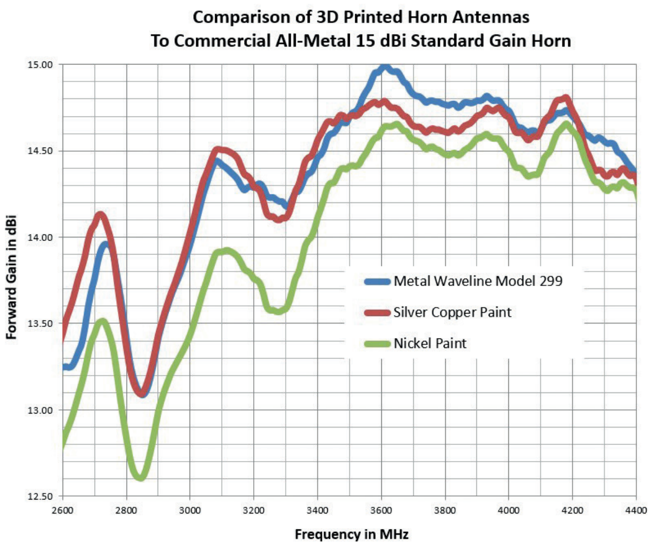
Once tested the results were 5dBi - this is very similar to the results we was getting on the test range at Finningley - at around 10dBi down on expected gain. This then led onto them questioning why they weren't performing as they should and their conclusion was down to the surface finish of the 3D printing process – tiny ripples or ridges as each layer is produced.

They next experimented with smoothing the printed horns by sanding and filing them and also solvent smoothing the prints, then later on even epoxy painting the surface to smooth out the ridges.

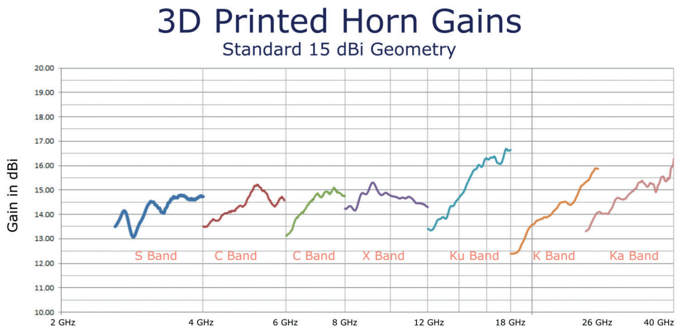
It was found that using Acetone on the ABS prints was the quickest and easiest route to smoothing the surface. This is a process I have come across before in 3D printing, also known as chemical polishing… so I decided to get a rejected print and half dip it in Acetone a couple of times to try see for myself how much the surface became smoothed/polished, the results can be seen in Fig1.



Once these smoothed prints were painted and tested again, the results were now very close to that of the reference horn. This now highlighted that the silver coated copper yielded better results out of the two paint types (see Fig2 taken from antennatestlab.com) with a good performance up to 26GHz, 26-40GHz showed a 3dB loss but filing the horn smooth rather than via Acetone brought it back up to 15dBi (see Fig3 taken from antennatestlab.com).



Overall it was found that the silver coated copper horns were within +/-0.2dB of "a lab grade Waveline Model 299 Standard Gain Horn Antenna", Fig4 (taken from antennatestlab.com) this shows the results of all seven horns made and tested.



Final thoughts:

Producing these horns could offer the amateur community a relatively cheap horn antenna to get going on the higher bands. Another option could be to use two horns to get around the need for an RF relay, or even be used as a dish feed.

An additional avenue to explore is the effectiveness of 3D printing waveguide transitions/launchers, as well as the potential for cavity filters.

If people would be interested in buying some of these horns, we would be prepared to undertake producing them at around £20+P&P each. This mostly covers material costs which may include a number of rejected 3D prints and the very expensive paint!

Due to the cost of the paint, this process is probably best for batch builds rather than one-off's. How far the paint covers is of course down to the size and quantities horns produced. This would require a certain level of commitment to funding before starting.

If you are interested please e-mail me on the following address and I will make a list. If we have sufficient numbers we can start the process.

Gary M1EGI – Barnsley, South Yorkshire
gary.m1egi@gmail.com

Simple dual band dish feed for Es'hail-2

Mike Willis G0MJW, Remco den Besten PA3FYM, Paul Marsh M0EYT

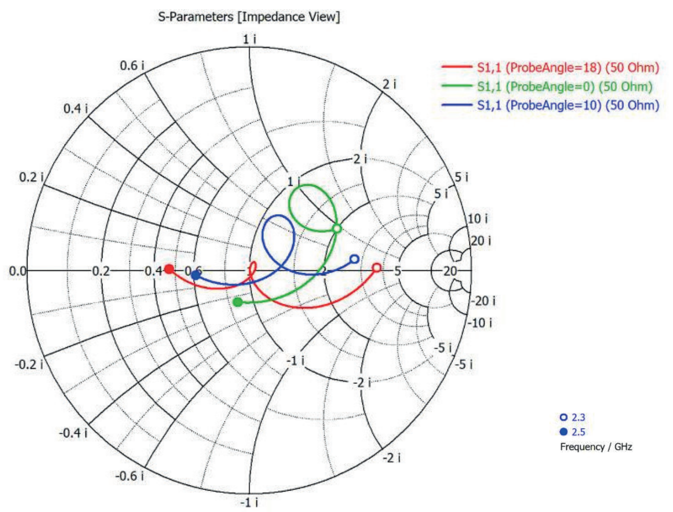
Abstract

An easy to build 2.4 and 10 GHz dish feed, using commonly available materials, for Es'hail-2 / QO-100 deployment is presented. The feed consists of a LHCP patch antenna for 2.4GHz and a waveguide feed for 10 GHz, to be placed in the focal point of commonly available and cheap offset satellite TV dishes with f/D's of around 0.6.

Design

The 2.4 - 10 GHz dual band feed was designed and modeled with CST Studio (student edition) and comprises of a LHCP patch feed with a circular waveguide passing through it. Because the (free) student version of CST Suite has limitations there initially was some concern if the modeled results could be realised in practice. Modeling and optimising the patch feed meant adjusting the patch size, patch spacing, cut-out size and feed point location. All variables were iterated towards the final dimensions to let the patch generate LHCP and a sufficient match to Z = 50Ω resistive at 2400MHz.

Figure 1 depicts the final impedance response (red line) on a Smith Chart.

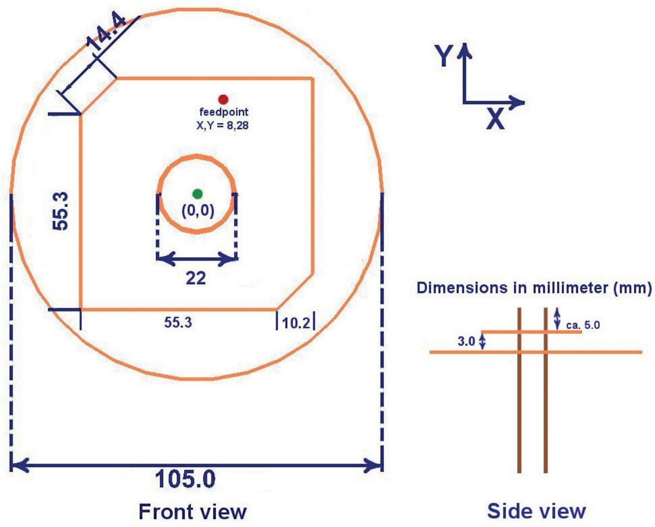


▶ *Figure 1 - Smith chart of various feed point positions.*

Getting good LHCP depends on two resonances being properly set up through the geometry of the patch. The patch may be considered as two antennas having resonant frequencies lagging and heading 45° in phase to produce the desired 90° phase difference at the design frequency (2400 MHz).

Dimensions

Figure 2 displays the dimensions of the dual band feed. It contains a 105 mm diameter circular reflector but a square reflector with cropped edges (25mm) is also suitable. The patch itself is square with two opposite corners cropped. Material is ca. 1mm thick copper or brass plate. The waveguide is made from standard copper 'plumbing' tube (22 OD / 20 mm ID), ca. 120mm long and protrudes ca. 5mm above the patch surface. The centre (green dot) of the construction is marked as (X=0,Y=0) and the feed point position (red dot) is at (X=8mm, Y=28mm), thus 8mm right and 28mm above the centre.

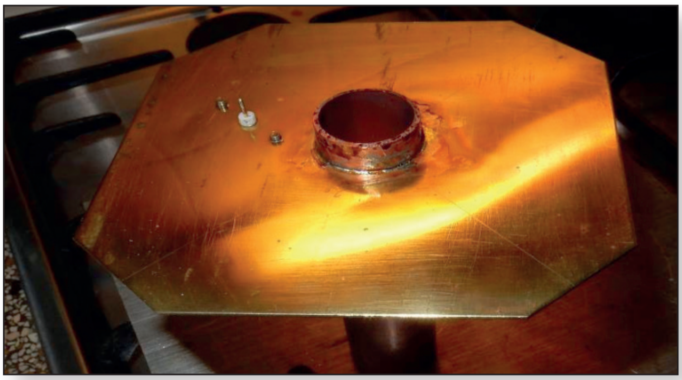


▶ *Figure 2 - Dimensions of the 2.4 – 10 GHz dual band feed. The patch is spaced 3mm from the reflector.*

Construction

Cut the material according to the dimensions given in Figure 2. Drill or punch 22mm holes in the respective centres of the plates. Cut the waveguide with a pipe cutter and de-burr the ends. Position the plates onto the waveguide so that they are centred. Drill a 1 mm diameter hole through both plates at the feed point position (X=8mm, Y=28mm). Mark out, drill and tap the mounting holes for your chosen connector on the reflector

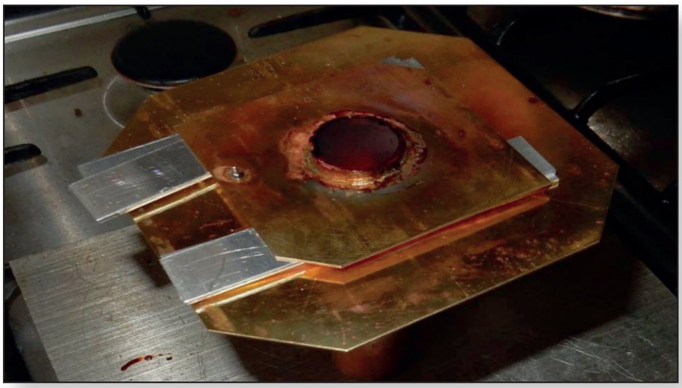
Prior to soldering, degrease all parts with hot soapy water and clean with Scotchbrite or wire wool to ensure the surface will solder perfectly. First solder the reflector on the waveguide, see Figure 3. Keep the plate aligned at 90° to the 22mm tube at the right place (e.g. with an olive or clamp ring underneath), hold the assembly in a vice, taking care not to crush the copper tubing and ensure 9 - 10mm of 22mm tube is protruding above the reflector. Don't use excessive solder. Flux paste will aid the process.



▶ *Figure 3 - Reflector soldered on the waveguide.*

Next, attach the feed connector. Connector mounting screws should not protrude above the reflector surface or they will act as unwanted tuning screws. If they protrude, grind them down or they will affect the matching of the patch.

Finally, press the patch itself around the waveguide and use 3mm thick metal spacers to solder the patch and feed point, see Figure 4. It is important to get the spacing accurate. Aim for 3.0mm, not "about 3mm".

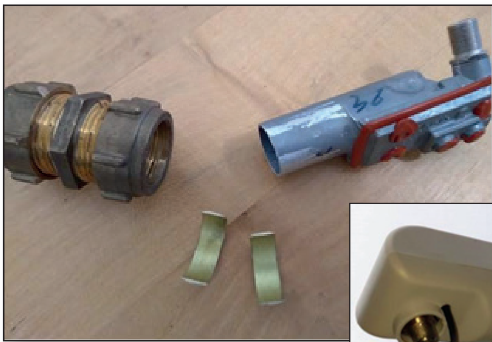


▶ *Figure 4 - Soldering the patch using 2 x 1.5mm thick aluminium plates as spacers.*

Clean and de-flux the feed and your result should look like the examples below.

Mounting the LNB

How to mount the LNB to the waveguide depends on its inner or outer diameter. If the LNB has a horn (like most do) this horn has to be cut off. LNB's having an outer diameter of 20mm are also available. Using some sandpaper it can be squeezed into the waveguide. Most LNB's have a somewhat larger outer diameter. In these cases the waveguide internal diameter of the copper pipe has to be increased (e.g. swaged out on a lathe) prior to soldering the plates. As alternatives a 22 – 22 mm solder 'socks' or compression couplers can be used, or even another olive/clamp ring, see Figures 5 and 6.

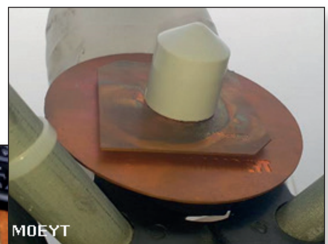


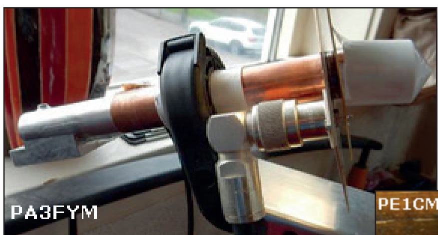
▶ *Figure 5 – Compression fitting for a decapitated LNB*

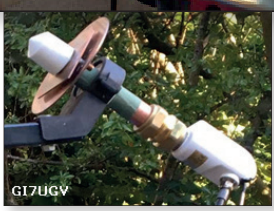
▶ *Figure 6 – Mounted LNB*

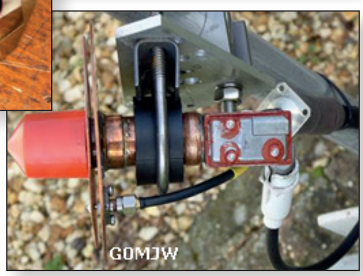
Adjustments

If the patch is made precisely enough it should show two resonances just below and above 2400MHz. When the overall maximum return loss is too low or too high in frequency, bending the distances of the patch corners from or to the reflector plate helps centering the maximum return loss around 2400MHz. In practice, there will probably be only a single shallow dip of around 20 dB. Any higher is suspicious as it implies that both resonances are the same frequency, which will not give good circular polarization. Figure 7 displays modeled return loss and Figure 8 measured return loss of a sample.

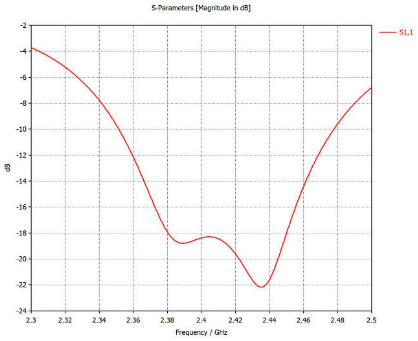




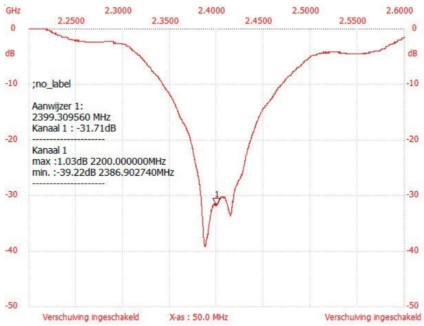




▶ *G0MJW (note olive/clamp ring behind reflector)*



▶ *Figure 7 - Modeled return loss*



▶ *Figure 8 - Measured return loss of PE9RX's feed*

Waveguide 10 GHz dielectric lens

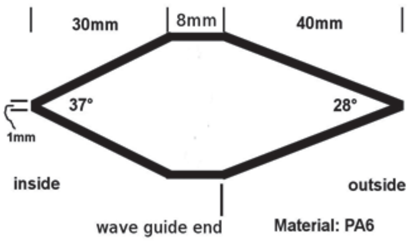
The waveguide alone over illuminates a standard f/D = 0.6 offset dish and also presents a poor match. In order to illuminate properly most LNB's have horns. However, there are LNB's on the market destined to be placed close to each other so that with multiple LNB's multiple satellites can be received simultaneously using a single dish. These LNB's are known as 'rocket LNB's' because their shape resembles a rocket. These LNB's use a dielectric lens and are useful in this application as they do not disturb the 2.4 GHz patch. They are complex structures designed to optimally illuminate the dish. Options are to buy a (cheap) rocket LNB and use the lens only, or to buy a PLL rocket LNB (rare).

▶ *Figure 9 – Rocket LNB*

▶ *Figure 10 – Rocket LNB lens on patch*

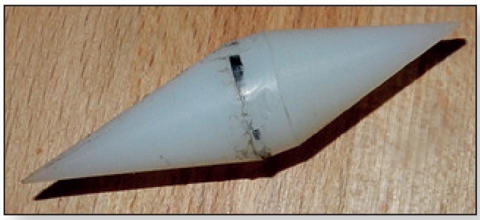
Another approach is to produce a lens yourself on a lathe. In Figure 11 an experimental lens is depicted, made from 20mm diameter Nylon-6 (PolyAmide 6, or PA6).

The final dimensions of the lens is still work in progress. Figure 12 shows a sample.



▶ *Figure 11 - Experimental lens dimensions*

▶ *Figure 12 - Prototype of Figure 11*



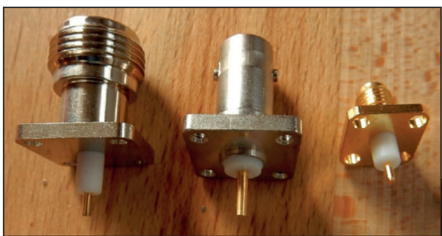
Conclusion

One month after the first successful prototypes were built and measured, almost 100 of this dual band dish feeds have been sent out and/or made by a large diversity of persons. The design is reproducible and strikingly simple. Although precision is the main virtue, this dual band feed already serves as the de-facto standard for a single QO-100 dish. The modeled -10 dB opening angle of the 2.4 GHz LHCP patch amounts ca. 105° and illuminates standard/consumer satellite dishes with f/D's of around 0.6 (which require ca. 90°) sufficiently, bearing in mind the patch is only used to transmit.

Appendix / hints and tips

Connectors

Use panel mounts with flanges and PTFE (teflon) dielectric as depicted in Figure 13. Don't use chassis connectors which protrude the reflector plate (too much)..



▶ *Figure 13 - Examples of suitable panel mount flanges*

▶ *Figure 14 - A more weatherproof setup*

Radomes

We leave it up to the builders creative imagination how to construct a suitable radome to protect the feed against weather influences. It is important that the (plastic) material does not heat up in a microwave oven. Test before usage! Figure 14 shows an example.

Materials

Copper and brass give similar results and performance. Double sided FR4 PCB has not been tried (yet).

Aligning feed/phase point

When the feedpoint of the waveguide is in the optimal position (tweak the dual band feed for maximum signal or SNR listen to the QO-100 beacon on 10489.550 MHz) the 2.4 GHz LHCP patch is also in the focal point of the dish. A convenient method to optimise the feed position is to use a SDR and maximise the transponder noise floor by looking at the waterfall.

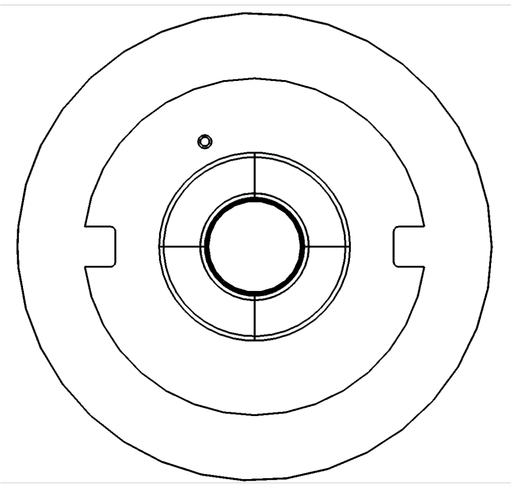
Update: New patch feed with horn

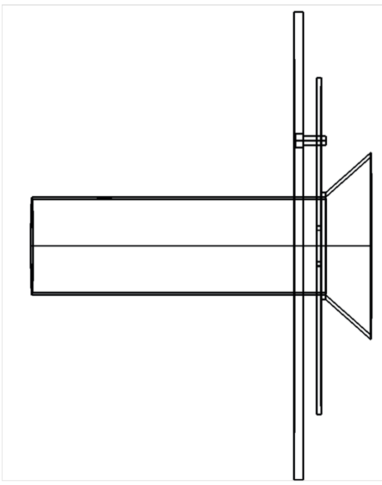
Mike Willis G0MJW

The new patch design uses notches to achieve the same effect as the cut off corners. You could also use tabs or make the patch elliptical. You could also use a capacitor like G3RUH did. The requirement is to have two resonance modes in the correct phase and amplitude to generate circular polarisation. I have modeled all of these and you can see examples on my twitter feed. (***https://twitter.com/TheRealMike***)

The square patch is easy to make. If you have a lathe or CNC facilities the round patch is easy to make.

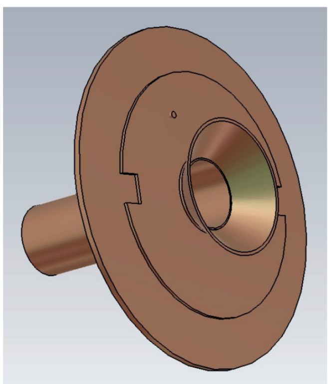
The advantage of the round patch is that it can be designed to be less disturbed by putting a small horn on the end for 10GHz. The limit is about 42mm which is handy as a standard 22mm-42mm plumbing fitting can be made into a horn.





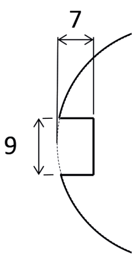
All dimensions in mm

Dia of reflector	105
Outer Dia of waveguide	22
Thicknes of reflector	2
WG Inner Dia	21
Start point of WG relative to reflector	-60
End of WG relative to Reflector	12
Hight of bottom of patch above reflector	3
Thickness of patch	1
Size of patch	75.5
Distance of s band feed from centre	26
Angle offset of probe from Y axis	-25
Where Lens is compared to reflector	12
Length of straight section of lens	8
Depth of slot	7
Width of slot	9
Length of narrow section of pipe fitting	1
length of fitting taper	10



Notes:

- The "waveguide" is 22mm copper water pipe
- The "horn" is a standard 22mm – 42mm fitting, suitably cut down
- The gap between reflector and patch is 3mm
- The notch depth is 7mm compared to the diameter of the patch.



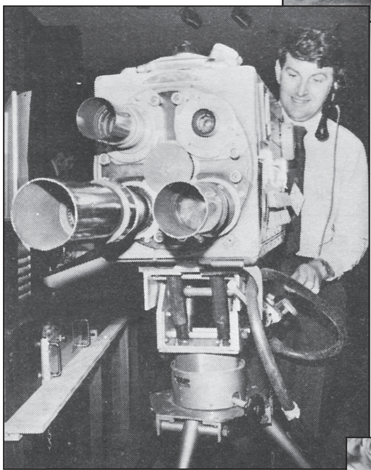
Turning Back the Pages

A dip into the archives of CQ-TV, looking at the issue of 47 years ago

Peter Delaney - G8KZG

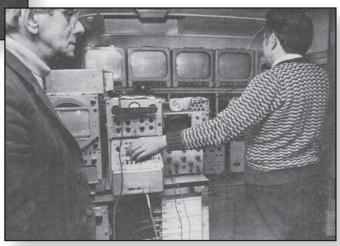
CQ-TV 75

CQTV 75 was published in August 1971, and readers would have found a picture on "Monoculus" on the front cover.



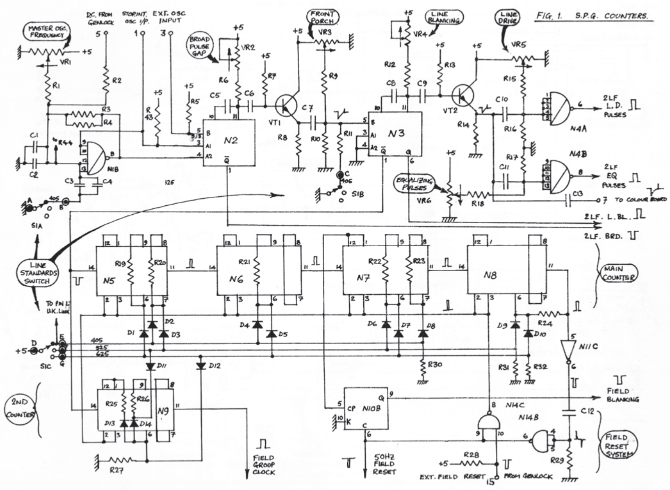
▶ *Ian Lever with camera from Monoculus*

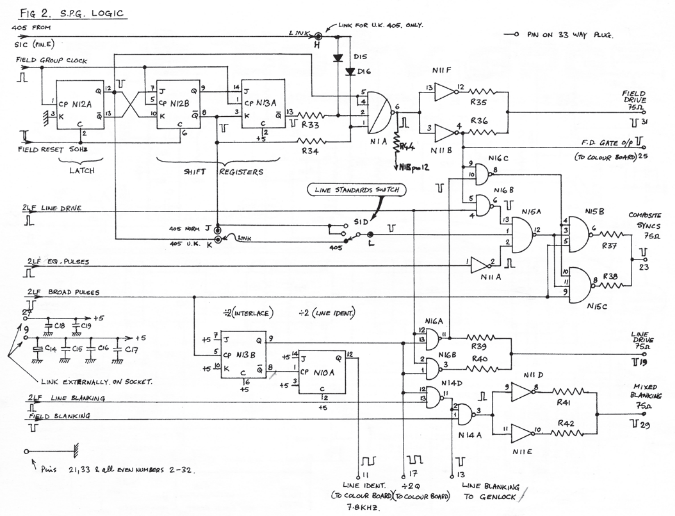
This was an outside broadcast vehicle owned by Joe Rose, G6STO/T, which was equipped with four image orthicon cameras (using 3" diameter camera tubes) and a 2" video tape recorder. The OB van had been on display at the VHF Convention, held at Twickenham earlier in the year, where it had been used to help with the lectures given by members of BATC, and also one on microwaves.



▶ *Inside Monoculus*

The main 'technical' article described what was probably the most complex project designed for CQTV up to that time. Arthur Critchley had introduced members to the - then - relatively new integrated circuit devices, in a series that had been running for about a year, and had progressed to describing the '74' series of TTL logic chips. This project used circuits from this range to produce a synchronising pulse generator (S.P.G.). An S.P.G. is the heart of a television system, apart from the most basic, as it generates the various timing pulses needed so that the various picture sources, - cameras, flying spot scanners, caption generators, etc - all start each frame and each line of the picture at the same instant in time. Basic designs for such circuits had appeared in CQTV before, but this incorporated many digital techniques that would be unfamiliar to most members at the time (although still used a couple of monostables in generating some of the line timings). To generate the other pulses, digital counters and logic were used. As if that were not complex enough, Arthur designed it to work for three different television standards - the old UK 405 line, the CCIR 625 line, and the American 525 line formats. The basic circuit was shown in Fig 1 and Fig 2, along with the relevant timings for the pulses at the various stages, including how the complex mixed blanking and composite sync pulses were generated by the logic. Although this circuit only produced the outputs needed for a monochrome set up (line drive,





field drive, composite sync and mixed blanking), provision was made for further circuitry to use the signals available to then generate the pulses required in a colour system. A simplified version of the counter circuit, for just the 625 and 525 standards, was also described.

Fig 3 Line Timings (Idealized) for 625

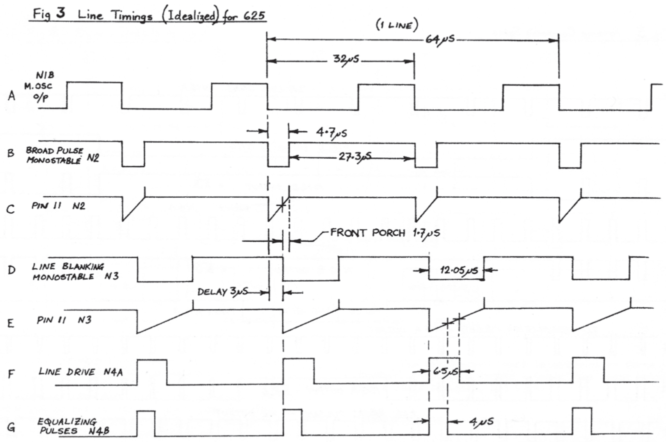


Fig 5 Forming Composite Syncs

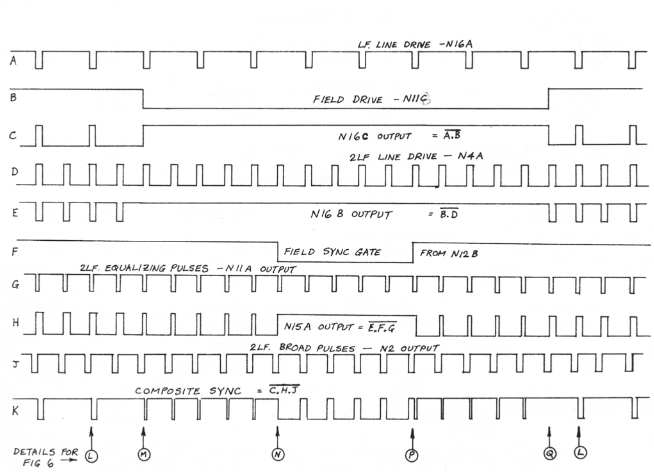
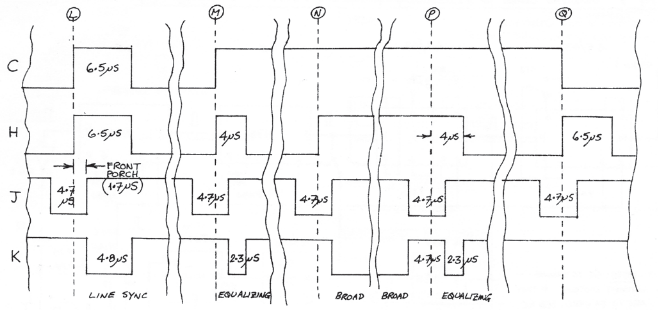
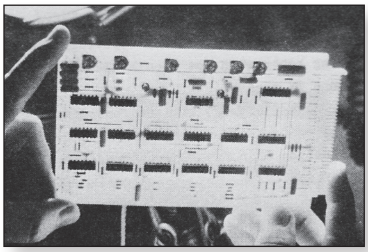


Fig 6 Sync.– Details of fig 5



(For those interested to 'follow the logic' of this design, N1 and N4 were both 7413 dual Schmitt trigger circuits; N2 and N3 were 74121 monostables, N5, N6, N7, N8 and N9 were 7490 counters; N10, N12 and N13 were 7473 bistables, N14 and N16 were 7400 quad NAND gates, and N15 the similar 7410 triple NAND gate, whilst the various invertors of N11 were provided by a 7404 device).



To help those who wanted to build this, printed circuit boards were made available for members - the first time such had been offered to members.

Fig 7 Simplified Counter for 625/525 only (Incorporating a choice of Field Blanking Length)

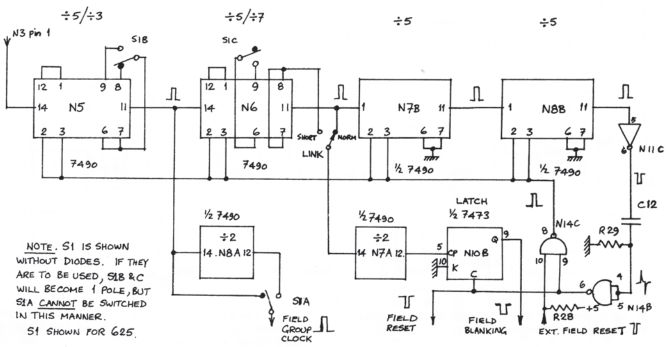
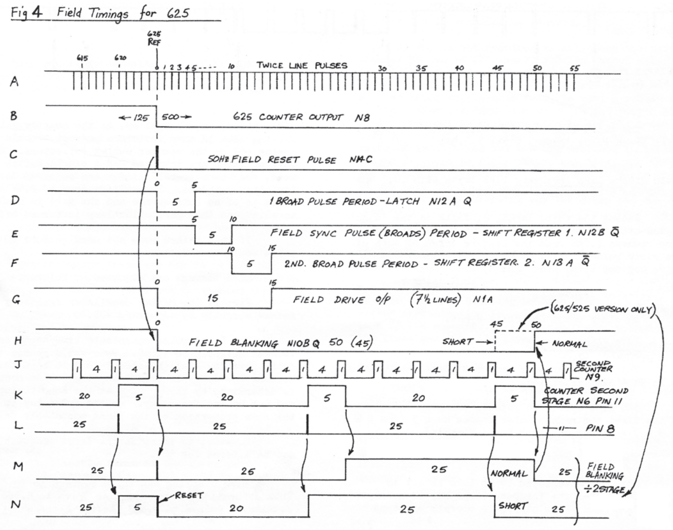


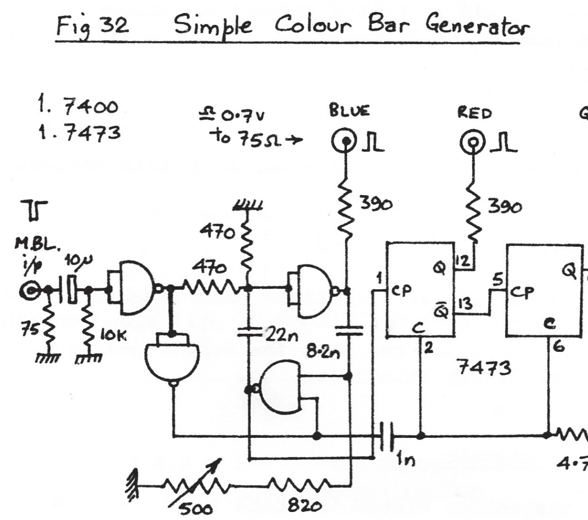
Fig 4 Field Timings for 625



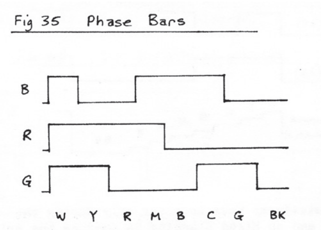
Arthur also contributed a further part of his series on integrated circuits, covering the uses of NOR gates and exclusive OR gates, showing how bistable circuits could be formed and used, short pulses be produced (without any R-C timing networks), and a Schmitt trigger produced, and the topic of monostables was also covered.

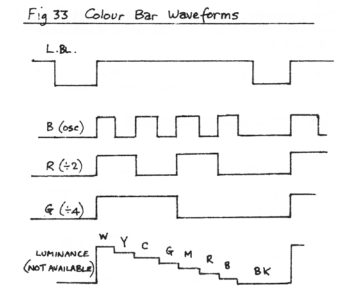
SPG Specifications

	Osc Freq kHz	Broad Pulses		Front Porch		Line Blanking	Line Drive	Eq Pulses Gener'd	Eq Pulses Actual	Line Sync	Field Blanking		Field Drive	Eq Pulses	Broad Pulses	Burst Gate Delay	Burst Gate Width
		ON	OFF	Delay	Actual						Normal	Short					
		μs	μs	μs	μs	μs	μs	μs	μs	μs	Lines	Lines	Lines			μs	μs
405	20.25	39.95	9.4	7.9	1.5	18.00	9.7	6.00	2.60	6.3	15	13½	4 (or12)	8 + 8	8	-	-
525	31.50	27.15	4.7	3.0	1.7	11.00	6.0	3.65	1.95	4.3	21	19½	9	6 + 6	6	5.25	2.3
625	31.25	27.3	4.7	3.0	1.7	12.05	6.5	4.00	2.30	4.8	25	22½	7½	5 + 5	5	5.75	2.3

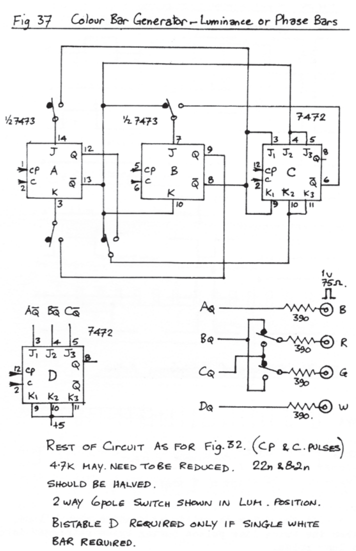


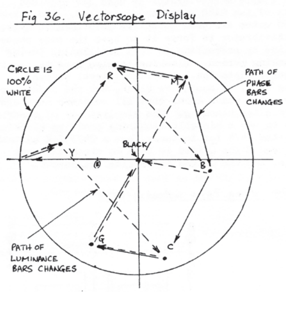
To illustrate how some of these could be used, a simple colour bar was shown, using just two integrated circuits, which could produce the red, green and blue drive signals in descending order of luminance, as shown. Being driven by mixed blanking, the output only occurred during the active part of the frame.

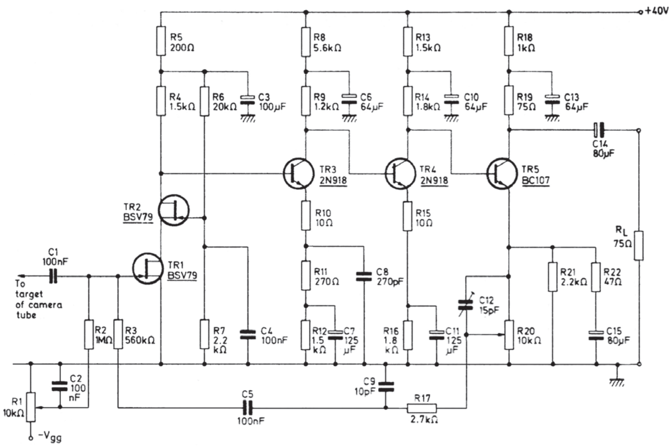




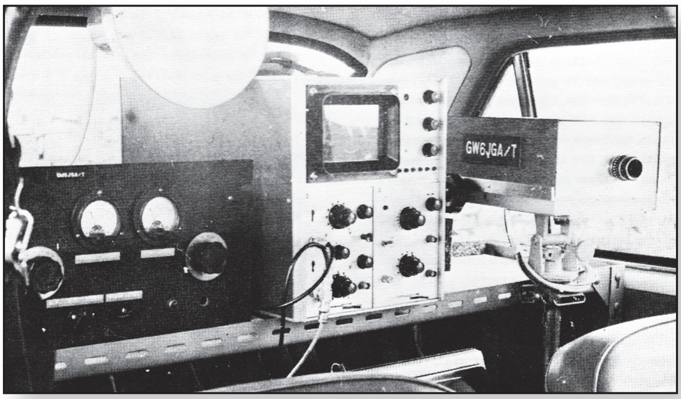
To generate the phase (rather than luminance) sequence of colour bars was not so straightforward. Such bars were preferred, however, as the vectorscope display would produce a hexagon of lines round the display (as shown by the solid lines on the diagram), rather than criss-cross the display as happened for luminance bars (as the dashed lines show on the diagram). The additional circuit allowed either version of bars to be selected.







Apart from logic circuits, a useful design included in this issue was for a camera head amplifier, intended to use with the lead-oxide target tubes (Plumbicons). These were the 'state of the art' in image sensing at that time, suffering far less from 'lag' in the picture signal than the vidicon cameras more commonly used by amateurs then. The output signal from a camera tube target was extremely low, and the head amplifier needed to add as little noise or distortion, and as level a frequency response, as possible. The design made use of FETs, which had the advantage of very high input impedance. They generated less noise than a bipolar device, and by putting two in cascade at the 'front' end of the amplifier, an optimum signal to noise ratio and frequency response were obtained.



On-air operational matters included details of a transmission from the top of the Great Orme, at Llandudno, to the Bangor University Radio Society. John Lawrence, GW6JGA/T had installed the transmitter, monitor, oscilloscope, camera and lighting into the back of an MG1100 car, and signals were radiated on the 70cm band, with sound on 2m. One 'difficulty' had been obtaining a source of power. It had been hoped to use a portable generator, but as that was not available, arrangements were made to use the mains supply of the Great Orme Tramway!

BATC Out and About

Rallies and events with an BATC stand: (subject to change)

2019

14 April	West London	www.radiofairs.co.uk
28 April	NARS, Blackpool	www.narsa.org.uk
11 May	BATC Local Convention Wirral	https://forum.batc.org.uk
19 May	Dunstable Downs RC	www.ddrcbootsale.org
15 June	Norden, Rochdale	https://m0nvq.me/rally/
16 June	West of England	www.westrally.org.uk
23 June.	Newbury	www.nadars.org.uk
21-23 June	Friedrichshafen	www.hamradio-friedrichshafen.de
14 July.	McMichael Radio Rally	www.mcmichaelrally.org.uk
11 August	Flight Refuelling	www.frars.org.uk
27-28 September	National Hamfest	www.nationalhamfest.org.uk
11-13 October	RSGB Convention	https://rsgb.org

For a list of all rallies see: http://rsgb.org/main/news/rallies/

If you are able to help on the BATC Rally stands, please contact the BATC secretary.