



The British Amateur Television Club

# CQ-TV

No. 257 – Autumn 2017

## DigiTwist

The ADALM-PLUTO low cost SDR

Using a MinimOSD board for  
On Screen Callsign Display

The Portsdown Digital ATV  
Transmitter A Beginner's Guide

Notes on Amplifiers & Filters

A Vintage Pye Camera

5.6 GHz progress

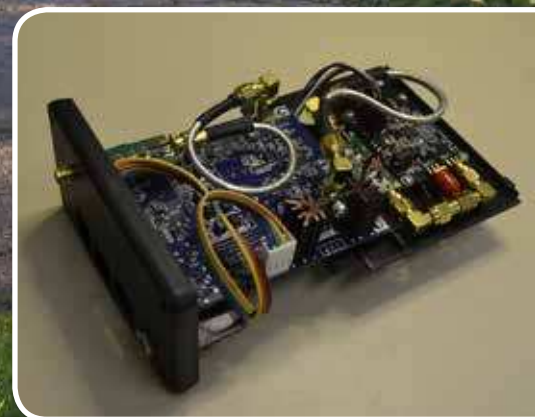
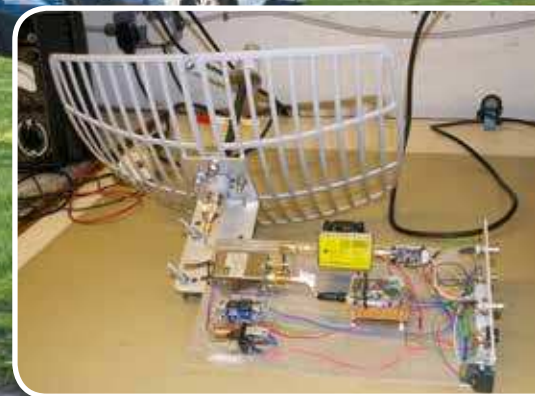
CAT17 report

Repeater Update - October 2017

The Bang-good 23cm aerial

A Coupler probe for use with the  
Rigol DSA 815-TG Spectrum Analyser

... and all the regular features





# The BATC Shop

<https://batc.org.uk/shop/>



## BATC DTX1 Digital TV Transmitter

### MPEG-2 encoder and DVB-S modulator

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



### Available from BATC shop

- ▶ DTX1 DATV transmitter PCB complete with case and front panel  
**£459** including postage

*Specification subject to change without notice*

### ▶ The Portsdown Project

- ▶ Filter Modulator - Blank PCB and ready Built
- ▶ Preprogrammed SD card
- ▶ Local oscillator filter - blank PCB
- ▶ 4-Band decode - blank PCB
- ▶ GPIO breakout board - blank PCB
- ▶ MiniTiouner USB receiver
- ▶ Blank PCBs for BATC projects
- ▶ Hard to get components at cost plus prices
- ▶ Programmed USB modules
- ▶ 70cms upconverters



**... plus: Renew Membership and Badges & Sundries**

<https://batc.org.uk/shop/>



**President:** Graham Shirville, G3VZV

**Chairman:** Noel Matthews, G8GTZ  
Club affairs and Technical queries.  
ETCC Liason.

**Email:** chairperson@batc.tv

**General Secretary:** David Mann, G8ADM  
General club correspondence and business.

**Email:** secretary@batc.tv

**Shop/Members Services:** Noel Matthews, G8GTZ  
**Email:** shop@batc.tv

**Hon. Treasurer:** Brian Summers, G8GQS  
Enquiries about club finances, donations,  
Club Constitution.

**Email:** treasurer@batc.tv

**Contests:** Dave Crump, G8GKQ

**Email:** contests@batc.tv

**CQ-TV Editor:** Frank Heritage, M0AEU

**Email:** editor@batc.tv

**Repeaters:** Clive Reynolds, G3GJA

**Publicity/Social media:** Ian Parker, G8XZD

**Email:** publicity@batc.tv

**Membership:** Robert Burn, G8NXG

All membership enquiries including new applications,  
current membership, non receipt of CQ-TV,  
subscriptions.

**Email:** memsec@batc.tv

### BATC Online

**Website:** <http://www.batc.org.uk>

**BATC Wiki:** <https://wiki.batc.tv>

**Forum:** <http://www.batc.org.uk/forum/>

**Stream:** <http://www.batc.tv>

**Dxspot:** <https://www.dxspot.tv/>

### Legal Niceties (the small print)

E&OE. Whilst every care is taken in the production of this publication, the editor accepts no legal responsibility for the advice, data and opinions expressed. The BATC neither endorses nor is it responsible for the content of advertisements or the activities of those advertisers. No guarantee of accuracy is implied or given for the material herein.

The BATC expressly disclaims all liability to any person in respect of anything and in respect of the consequences of anything done or omitted to be done wholly or partly in reliance upon the whole or any part of this magazine. As the regulations for the operation of radio frequency equipment vary in different countries, readers are advised to check that building or operating any piece of equipment described in CQ-TV will not contravene the rules that apply in their own country. The contents of this publication are covered by international copyright and must not be reproduced without permission, although an exception is made for not-for-profit publications (only) wishing to reprint short extracts or single articles and then only if acknowledgment is given to CQ-TV. Apart from any fair dealing for the purposes of published review, private study or research permitted under applicable copyright legislation, no part of this publication may be reproduced, stored in a retrieval system or transmitted in any form or by any means, electronic, mechanical, photocopy, recording or otherwise, without the prior permission of the publisher.

All copyrights and trademarks mentioned in this publication are acknowledged and no infringement of the intellectual copyright of others is intended.

Printed in Great Britain. ISSN 1466-6790

© Copyright BATC & Contributors 2017

# CQ-TV 257

## Contents:

- 4 News from the Chairman
- 5 Contest and Activity Weekend News
- 7 New and renewing members
- 9 Treasurers Report for 2016
- 10 DigiTwist
- 14 The ADALM-PLUTO low cost SDR
- 16 Silent Keys - G8AJN & G3KTU
- 17 Video Fundamentals 12
- 19 Using a MinimOSD board for On Screen Callsign Display
- 21 Antenna range tests at Finningley for the BATC
- 22 The Portsdown Digital ATV Transmitter A Beginner's Guide
- 26 The Portsdown Transmitter – Security Aspects
- 27 Notes on Amplifiers & Filters
- 29 A Vintage Pye Camera
- 30 5.6 GHz progress
- 30 Subscription Renewals
- 31 CAT17 report
- 33 Repeater Update - October 2017
- 34 The Bang-good 23cm aerial
- 35 The Portsdown Transmitter in pictures
- 36 A Coupler probe for use with the Rigol DSA 815-TG Spectrum Analyser
- 37 Turning Back the Pages - CQ-TV 69

## 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.



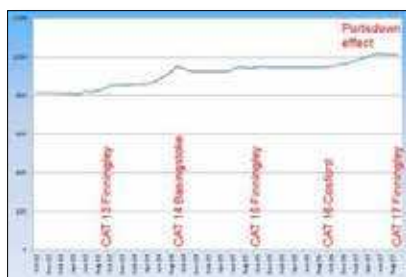
## From the Chairman...

Noel Matthews – G8GTZ

It was good to see so many members and friends, including many newcomers to the hobby, at CAT17 and there was a real buzz of enthusiasm about what was happening in the ATV community. One of the many highlights of the weekend was the Portsdown Construction competition and congratulations to Chris GW0LLK for his innovative design in a 3D printed case. If you missed CAT17, don't forget all the presentations are available on the batconline youtube channel.

The interest in ATV continued at the National HamFest where BATC had one of the busiest stands at the show and we almost sold out of MiniTiouner and Portsdown parts! Hopefully we will have restocked and recovered in time for the RSGB convention where we will have a stand in the societies lounge.

The Portsdown project has attracted a lot of people to return to ATV in the last 12 months and at the latest count we have almost 200 builders! BATC membership reflects this renewed interest with a 25% increase over the last 5 years and thanks to the Portsdown Project we know almost 20% of our members are actively involved in the hobby!



And this increased activity is not just members building Portsdown and it is good to see a significant increase in the numbers of stations "on the air" during the BATC

activity weekends and this year we have decided to continue these throughout the winter. Don't forget you don't have to go out and brave the elements, just use the activity weekend as an excuse to sit in your warm shack and get on the air – and if there doesn't seem to be any activity in your area, trying calling through your local repeater or on 144.750 – only activity generates activity!

The other project that is grabbing people's interest is the use of the low cost FPV units on 5.6GHz – there are now 25+ stations using these units and the Dx record has been extended to 138Kms which at ~£20 represents an excellent £ to Km ratio! The release of the ADALM-Pluto SDR hardware now means DATV on 5.6GHz is possible (see Charles' article in this CQ-TV) and we are also seeing more people active on 10GHz DATV using a combination of their ATV and NB microwave gear:

The BATC has recently provided test results to the RSGB IARU region 1 team to support the granting of an additional 2MHz at 50MHz which would include an allocation for RB-TV – this will be decided at the WARC conference in 2019. RSGB have recently announced that the process for getting a special permit to operate on the new 71 MHz band has been streamlined and hopefully we will start to see some RB-TV activity on that band. It is important that we are seen to be using the spectrum by Ofcom and they have requested that we provide details and video of the recent tests we did on 146MHz using DVB-S2 32APSK to transmit full HD in just 500KHz.

There have been some good news on TV repeater licensing during the last few weeks with GB3AT on the Isle of Wight receiving an NoV and the GB3CT application broke all records with the NoV being returned in less than 48 hours! GB3CT is based high on the Lincolnshire Wolds and should give great coverage to that area - we have yet to see any 23cms NoVs but as ETCCTV representative, I will ensure we keep the pressure on.

You will find the results of the June IARU ATV contest in this CQ-TV when we had a record number of UK entries – well done to everyone who entered but a particular congratulations to Terry GILPS who has been overall winner of the 3.4GHz section of the international contest for 3 years running!

Talking to people at Hamfest, one thing we need to try and do is help people to find other ATVers in their local area so they can build a local ATV community. There is an online map showing where Portsdown users are located and we wonder if we should do the same for BATC members – let us have your thoughts on this and any other topic, we'd love more feedback from members.

And finally a call for your help and support in the next couple of months – as you know BATC is run entirely by volunteers and we are at last going to be changing over to the new membership and shop website before the end of the year. The current system is showing its age, it did not send out reminders to members who membership expired last month and now every new member needs their password to be manually reset – as we changeover to the new system we know there are going to be teething problems and ask for your patience and support!

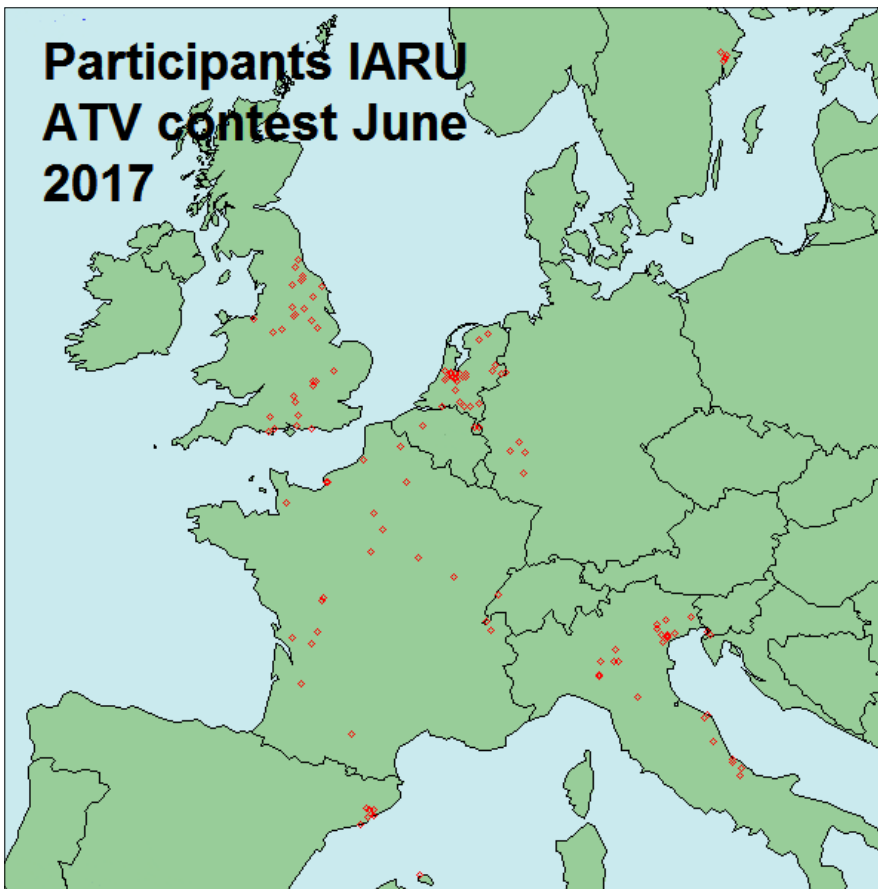
**We hope you enjoy this edition of CQ-TV and thank you for continuing to support BATC.**





# Contest and Activity Weekend News

Dave Crump – G8GKQ



## The overall UK results:

Position	Call	Points
1	M0DTS/P	6509
2	G1LPS	4599
3	G8GTZ/P	2462
4	G3NWR/P	2224
5	G8GKQ/P	1731
6	G7AVU	1538
7	M1EGI/P	1002
8	G4KLB	700
9	G7JTT/P	530
10	G3KKD	493
11	G0WFT	308
12	G8VAT/P	228
13	G8EOP	128
14	G4GUO	82

## IARU Contest 10/11 June 2017

The IARU Region 1 ATV Contest was the most successful for many years in terms of the number of stations on the air. We had 23 stations active in the UK with over 100 active across Region 1. The map shows the locations of those stations who entered.

The full region-wide results are at <https://vhf-uhf.veron.nl/wp-content/uploads/2015/08/IARU-ATV-results-2017.pdf>

Congratulations to Rob M0DTS/P who was the UK winner and 11th in Region 1, operating on all bands from 437 MHz up to 24 GHz. Also congratulations go to Terry G1LPS for winning the 3400 MHz section region-wide whilst operating on all bands as well.

Many who participated did not submit an entry – if your locals were on the air and did not submit an entry, please encourage them to do so next year.

## International Contest Date and Time

You may have read the letter in CQ-DATV asking for a change in the date and timings for the International ATV Contest. The June date and the extended timing have been very successful in increasing UK and European contest activity, so the BATC position is that neither the contest date nor the timings should be changed. These dates and times are set by the IARU, based on a vote by all participating nations.

## August Activity Weekend

On Saturday 16 August Charles G4GUO and I conducted some 146.5 MHz tests between Portsdown Hill and Worthing, but I did not hear of any other activity.

The Sunday was a completely different story. Five stations went out portable in Southern England with 5.6 GHz FM ATV equipment:

Call	Location	Locator
G8GTZ/P	Win Green nr Shaftsbury	IO80WX
G7JTT/P	Whether Down Near Petersfield	IO90LX
G8GKQ/P	Lulworth near Wareham	IO80WP
G3VPF/P	Hardy's Monument	IO80RQ
G4UVZ/P	Castle Hill	IO80LW

The best 5.6 GHz DX achieved on the day was between G7JTT/P and G8GKQ/P at 86 km. Rather noisy screen captures from each station are shown here.



Brian G4EWJ operated as GW3NWR/P from Rhosesmor, North Wales on Sunday, working G4CBW in Staffordshire on 146 MHz, and receiving G3ZGZ from Cleveleys. The longer path to M0DTS/P in IO94MJ did not work, although G3ZGZ did manage to receive Brian at 64 km when he was transmitting just 0.5mW!

### More Activity Weekends!

A few members have mentioned that they would like more regular activity weekends during the Winter, so I have now scheduled one for each month throughout the year. Remember that you don't need to go out portable – just warm up the shack and try to transmit or receive some ATV!

So, in addition to 9/10 December, 21/22 October and 18/19 November are likely to see increased activity on the bands. Please let others know of your planned activity by publicising it on the BATC Forum, and then follow it up with a progress report on the forum.

### Contest and Activity Day Manager Position

Please remember that I'm still looking for someone to take over from me as the Contest and Activity Day Manager so that I can spend more time on the Portsdown project.



## Contest and Activity Weekend Calendar

1200 UTC 21 October 2017 – 1800 UTC 22 October 2017	ATV Activity Weekend
1200 UTC 18 November 2017 – 1800 UTC 19 November 2017	ATV Activity Weekend
1200 UTC 9 December 2017 – 1800 UTC 10 December 2017	ATV Activity Weekend
1200 UTC 13 January 2018 – 1800 UTC 14 January 2018	ATV Activity Weekend
1200 UTC 10 February 2018 – 1800 UTC 11 February 2018	ATV Activity Weekend
1200 UTC 10 March 2018 – 1800 UTC 11 March 2018	ATV Activity Weekend
1200 UTC 7 April 2018 – 1800 UTC 8 April 2018	ATV Activity Weekend
1200 UTC 5 May 2018 – 1800 UTC 6 May 2018	ATV Activity Weekend
1200 UTC 9 June 2018 – 1800 UTC 10 June 2018	IARU ATV Contest
1200 UTC 14 July 2018 – 1800 UTC 15 July 2018	ATV Activity Weekend
1200 UTC 11 August 2018 – 1800 UTC 12 August 2018	ATV Activity Weekend
1200 UTC 8 September 2018 – 1200 UTC 9 September 2018	ATV Activity Weekend



## New and renewing members

*Rob Burn, Membership Secretary – G8NXG*

I am pleased to report that our current membership is now over 1,025 and this has remained consistent over the last few months. The introduction of the Portsdown, MiniTioune and other DATV projects has inspired many to join or rejoin the BATC and thus benefit from developments in DATV over recent years. Portsdown and MiniTioune offer an element of hands-on construction and in consequence some fun in getting a modern ATV station put together. In fact, the diminished size of these projects is a key factor for portable operation, making the prospect of being able to investigate your local hill top during an Activity Weekend a realistic opportunity for members to join in.

The period June to September has maintained the level of membership joining/rejoining progress experienced this year as reflected by the list below. This time I have reorganised the list, where possible, to make it easier to locate a member who is reasonably close by and thus make contact.

As the list is manually created mistakes do occur; if you spot one please get in touch. Similarly, get in touch if you renewed during the period and expected to see your name here. 📞

<b>Australia</b>		
Stephen Whittingham	VK1AAB	Canberra
Michael Brockway	VK2EK	NSW
Jules Corben	VK2EXT	NSW
Sakari Mattila	VK2XIN	Canberra
Robert Hensel	VK3EHT	Victoria
David Park	VK3JDA	Victoria
John Munro	VK3JMC	Victoria
Tony Falla	VK3KKP	Victoria
Mark Stephenson	VK3PI	Victoria
Simon Judge	VK3ZSJ	Victoria
David Carwana	VK5DMC	Sth Australia
Tony Hutchison	VK5ZAI	Sth Australia
<b>East Asia</b>		
Claude Chiarot		Nagoya, Japan
<b>Europe</b>		
Albert Buysse	ON1CGB	Belgium
Michel Simon	ON7QL	Belgium
Wittmer Andre	F1FDB	France
Evariste Courjaud	F5OEO	France
Pierre Marie Gayral	F5XG	France
Francis Sarot	F6AWS	France
Uwe Giese	DF3KO	Germany
Gerd Kellner	DB9PQ	Germany
Roland Prosch	DF3LZ	Germany
Bastian Urschel	DL2UB	Germany
Mark Bannon		Ireland
John Gibbons		Ireland
Dermot Flanagan	E16FZ	Ireland
Giovanni Paolo Paleari	IW2NSA	Italy

Gert-jan Dam		Netherlands
Terence Theijn	PD3T	Netherlands
Paul Theunissen	PA5PT	Netherlands
Rene Tuijtel	PH3V	Netherlands
Joris Vrehen	PE1GLX	Netherlands
Jacinto Rebelo	CU2ED	Portugal
Sergio Silva	CT2GHB	Portugal
Gonzalo Giron Castillo	EA7AYB	Spain
David Loscos Garcia		Spain
Planas Jaume	EA3NE	Spain
Lorenzo Manso		Spain
Miguel Escalante Naranjo	EA7UH	Spain
Antonio Navarro	EA3CNO	Spain
Juan Piqueras	EA3TA	Spain
Alberto Martinez Salcedo	EA9AN	Spain
Ulf Hansson	SM7EGM	Sweden
Michel Burnand	HB9DUG	Switzerland
Charles Girardet	HB9ADJ	Switzerland
<b>England</b>		
Bob Leggett	G6KMM	Beds
David Chislett	G8XCK	Berks
Simon Watson	M0ZSU	Berks
Anthony Hornby	G1HBD	Berks
Peter Harman	G4XGD	Berks
John Smith	G3JZF	Birmingham
Viv Green	G1IXE	Bristol
John Witchell	G4OTJ	Bristol
Mike Isherwood	G4VSS	Cheshire

Graham Sowter	G8ULJ	Cornwall
David Shaw	M5TXJ	Cumbria
Peter Yarde	G8DKC	Derbys
Pip Price	G8NOP	Derbys
Derek Dell	G4WLA	Devon
Darren Rainer	G4VTQ	Devon
Steve Hicks		Devon
Christopher Worledge	M1ANO	Devon
Julian Smith	G0NZO	Dorset
Paul Marsh	M0EYT	Dorset
Clive Graham	G3XIG	Dorset
Mike Nicholas	G3TOI	Dorset
Jacob Saunders	2E0DQX	Dorset
Alf Partridge		Essex
Anthony Free	G4EYE	Essex
Keith Harding	G7FFI	Essex
Alan Gladding		Essex
Peter Morys	G4HQX	Glos
Dave Mann	G8ADM	Gtr London
Laurence Cook	M0LDZ	Gtr Manchester
Robert Head	M0RHE	Hants
John McCarthy	G7JTT	Hants
Peter Lewis		Isle of Wight
John Parfett	G0LAD	Kent
Alvin Hardy	G1BTF	Kent
Christopher Ashby		Kent
Steve Williamson	G3WGU	Lancs
John Hudson	G3RFL	Lancs
Ted Bottomley	G4MXR	Lancs
Mike Harriman	G4SJX	Leics
Graham Smith	2E0JOG	Leics
Matthew Biddles	G7OBR	Leics
Peter Kozlowski	M6LFP	Lincs
David Houghton	G0MXW	Merseyside
William Davies	G4YWD	Merseyside
Kevin Colman	M0UJD	Norfolk
Julian Horn	M0NUX	Norfolk
Mark Taylor	G0LGJ	Norfolk
Michael Spooner	G4PFG	Norfolk
Malcolm Grant	G7HPE	Northants
Lindsay Pennell		Northants
Andrew Garratt	M0NRD	Notts
Pieter Smit	G0LIY	Nth Yorks
Robert Day	G1CEO	Oxon
John Alexander	M6JAX	Salop
Robin Vince	G8DRK	Somerset

David Ryan	M0GIW	Sth Yorks
Ken Roberts	G8VDP	Sth Yorks
Robin Gape	G8DQX	Suffolk
Iain Tennent	M1IAN	Surrey
Simon Kennedy	G0FCU	Surrey
Eddie Ashburner	G0EHV	Tyne and Wear
Rich Morrall	G8ZHA	West Mids

**Northern Ireland**

Allen Mcmurtry	GI3MBB	Co Down
----------------	--------	---------

**Scotland**

Gordon Findlay	GM7VYR	Glasgow
----------------	--------	---------

**Wales**

Stephen Outen	GW0DWQ	Carmarthenshire
Gwilym Jones	GW6PVK	Clwyd
William Jones	MW1WEJ	Gwynedd

**Canada**

Terry Moorby	VE3DIJ	Ontario
--------------	--------	---------

**United States**

Gary Grivna	K0GX	Minnesota
Paul Fredette	K1YBE	Ohio
Jon Guizar	K3JEG	Pensylvania
Scott Chapman	K4KDR	Verginia
Michael Siwula	K6LDK	California
Patrick Miller	KK6DBX	California
Bill Ress	N6GHZ	California
Ken Konechy	W6HHC	California
Reuben Meeks	W8GUC	Ohio
Gary Poland	W8PU	Michigan
Greg Beat	W9GB	Illinois
Richard Peterson	WA6NUT	Colorado
Charles Beener	WB8LGA	Ohio
Terry Godley		California

**South America – Argentina**

Fernando Costarelli	LU1HKO	Cordoba
---------------------	--------	---------



► A Portsdown transmitter - built by Dave, G8GKQ, shown at CAT17





# Treasurers Report for 2016

Hon. Treasurer for BATC: Brian Summers – G8GQS

## Financial strategy

At the club's 2014 general meeting, it was agreed by the membership that our capital reserves were too high and that the club should use those funds for the good of ATV and we are continuing with that policy.

## The Balance Sheet

It has been the practice, for many years, to publish a simple condensed set of figures derived from a more detailed analysis of income and expenditure. Any member may examine the detailed accounts.

## Turnover

Our total expenditure was £24,452 including purchase of shop stock. The total income was £23,434 including shop sales (before PayPal fees). These gross figures take no account of the stock levels and are included for information only.

## Petty Cash

10 Euros were held.


## General outlook

One line in the accounts that is worth a mention is the "subscriptions in advance" figure of £6,923 for 2016. This is more than the previous year and I view this as a mark of the confidence that our members have in the club.

## The Shop

The BATC continues to make parts available to support ATV construction and operation. The shop returned a gross surplus of £2428 less the shops proportion of the PayPal fees, estimated at £580, gives a contribution of approximately £1848 to club funds.

## Equipment:

Equipment was purchased to support the streamer service to the value of £231. 



British Amateur Television Club			
Income & expenditure account, year ending 31 December 2016			
<b>Income account</b>	<b>2016</b>	<b>Expend account</b>	<b>2016</b>
Subscriptions	£7,496.05	CQ-TV Printing	£6,191.00
BATC Shop surplus (1)	£2,428.08	CQ-TV Postage	£2,665.10
Donations received	£117.58	Office expenses	£23.71
Interest received	£180.52	Committee expenses	£0.00
Miscellaneous Items	£6.00	RSGB affiliation fee	£47.00
Convention & BGM	£681.00	Web services	£2,367.03
Less PayPal commission (2)	<u>-£702.44</u>	Convention & BGM	£1,452.00
	£10,206.79	Publicity & m'ship renewals	£74.35
		Awards & Prizes	<u>£144.33</u>
			£12,964.52
<b>Balance sheet at 31 December 2016</b>			
<b>Assets</b>	<b>2016</b>		
Stock, BATC shop	£4,403.36		
HSBC account	£6,352.45		
PayPal account	£1,534.37		
Teachers building society	£36,283.65		
<b>Less Current liabilities</b>			
Subscriptions received in advance		<u>-£6,923.75</u>	
		£41,650.08	
<b>Represented by Accumulated fund</b>			
Balance brought forward	£44,407.81		
Surplus or Deficit	<u>-£2,757.73</u>		
Balance carried forward	<u>£41,650.08</u>		
<b>Notes to the accounts</b>			
(1) This is the net amount raised by the sales in the club's shop, but before allowing for the PayPal commission of some £500.00. The shop turnover was £14,459			
(2) The PayPal commission is included in income as a deduction as it is deducted at source. The figures for 2015 are available on page 12 of CQ-TV 252.			

# DigiTwist

Brian Jordan – G4EWJ



## Overview

*DigiTwist is an experimental two axis satellite tracker, primarily for the HamTV transmitter on the ISS. Two broadcast satellite dish positioners are connected together and are controlled by a dual Diseqc PCB, which is in turn controlled from a PC.*

It is experimental, in the sense that the satellite dish positioners were never meant to be used in this way and may fail. Development is continuing, particularly as to the size of the dish that can be carried. At the time of writing, it has not yet received the ISS, mainly due to lack of opportunity.

I was interested in receiving the Tim Peake transmissions from the ISS, but the available solutions seemed complicated and expensive. I looked at a system similar to the one described below, but the mechanic aspects proved too difficult and I let the project lapse.

When I heard that Tim Peake would be returning to the ISS, I resurrected the project and thanks to Rob MODTS helping me with the mechanical aspects, it has moved forward.

The estimated cost for 2 positioners, the joiner bar and the controller is £130.



► 40cm dish for demonstration purposes



► Positioners connected by a custom joiner bar  
Photo and CNC milling:  
MODTS



## Positioner Choice

The Technomate TM-2600M3 satellite positioner was chosen for its reasonable torque of about 2.1kgm and its sturdy construction. Satellite receivers generally provide up to 500mA on their F connectors and the positioner limits itself to this to avoid blowing a fuse in the receiver. It is possible that the current detector in the positioner could be changed so that more current could be taken, to allow more torque and a bigger dish.

The TM-2600M3 has adjustable hardware stops which limit movement to up +/- 74 degrees. These stops can be removed by opening the positioner housing.

The TM-2600M3 is a Diseqc 1.3 positioner, also known as 'GotoX'. It can be commanded to go to a certain angle and it does this autonomously without any further interaction with the controller. Diseqc 1.x is an outgoing protocol only, so there is no way to tell what the current rotor angle is, or whether the rotor is moving.

The TM-2600M3 (and other positioners that have been tested) ignore 'GotoX' commands outside the range +80 to -80 degrees. A workaround is to reset the lower rotor so that it goes from 90 south to 70 north. This is advantageous for the UK, as the ISS passes mostly to the south, but may not be suitable for lower latitudes.

Another drawback is that the positioner will stop moving briefly when it receives a 'GotoX' command, even if it was going in the correct direction. This reduces the effective speed of the rotor when it is moving at its quickest for an overhead pass.

### Positioner Configuration

The ISS moves at about 1 degree per second at its fastest when overhead. The positioners have a speed of about 2 degrees per second, but they would not be able to cope with the rapid movement needed for an overhead pass in the standard 'rotate then elevate' configuration.



Instead, the positioners are connected together in a similar way to the Catapult dish, with two horizontal rotors at right angles. The lower rotor is aligned east-west. This is effectively 'elevate then rotate' and there is no problem with an overhead pass. There are other problems near the east or west horizon, but ISS reception is difficult anyway when low down.

Satellite tracking software generally outputs azimuth and elevation information. In the 'elevate then rotate' configuration, a change in either azimuth or elevation can result in a change of both lower and upper rotor angles, so some conversion trigonometry is required. If the rotors are both considered to be at the zero position shown above and move +/- 90 degrees, it reduces down to these two equations:

$$UPPER = \arcsin(\sin(AZ) * \cos(EL))$$

$$LOWER = \arccos(\sin(EL) / \cos(UPPER))$$

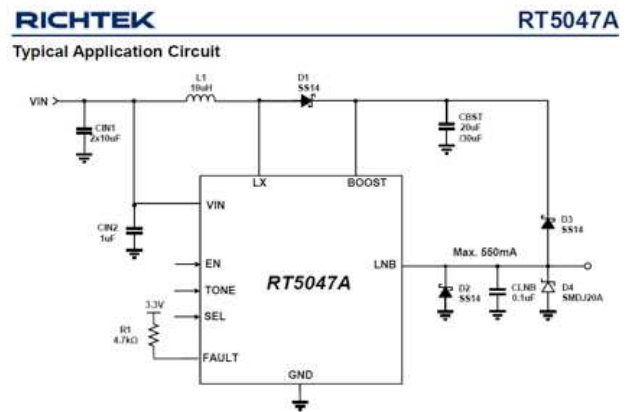
### DiSEqC Positioner Control

Digital Satellite Equipment Control, devised by EutelSat, is a means of sending commands over the signal cable from satellite receivers to remote devices such as LNBS, switches and positioners. The 13v or 18v that is usually on the LNB cable is modulated with pulses of 22kHz.

### Voltage Regulator / Diseqc Modulator

The RT5047A is a switched mode voltage regulator for LNBS. It provides 13.3v or 18.3v for vertical or horizontal polarisation from a supply of 8-16v. The 22kHz modulation is fed in on the TONE pin. It has short circuit protection with a fault status output.

Extra circuitry has been added on the DigiTwist controller PCB to measure current on the supply to each of the chips. This allows the PC control program to know when the rotor is moving and mitigate the effect of the rotor stopping briefly whenever it receives a command.



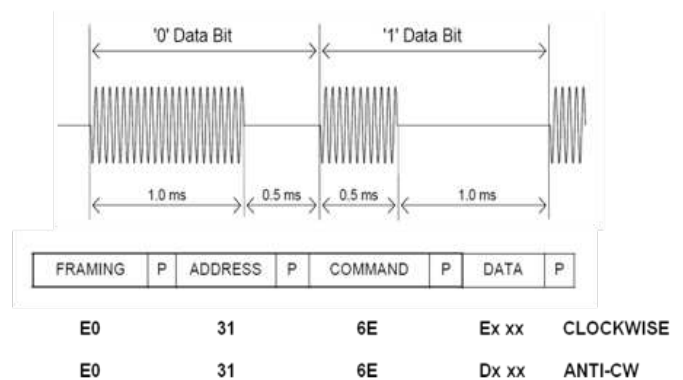
▶ LNB Voltage Regulator: surface mount 1.27mm pin spacing with underside ground pad

### DigiTwist Prototype Controller PCB

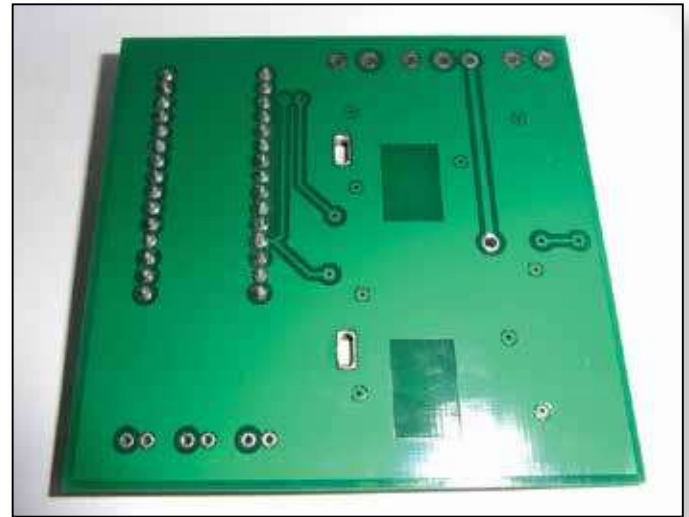
The controller uses an Arduino Nano module which receives position commands from the PC control program and translates them into Diseqc modulation for the two positioners.

The Arduino has a PC IDE (integrated development environment) to develop the software and program it into the Nano. The language used is C.

The surface mount components are the largest SMD category: 1206 and 1.27mm pin spacing on the chips. The only complication is the ground pad on the underside







of the chips. The PCB has large plated through holes underneath the chips, which can be filled with solder to ground the pads on the chips.

This is a prototype PCB. The final PCB will have connections brought out from the Nano to a header, so that a display or other device may be used.

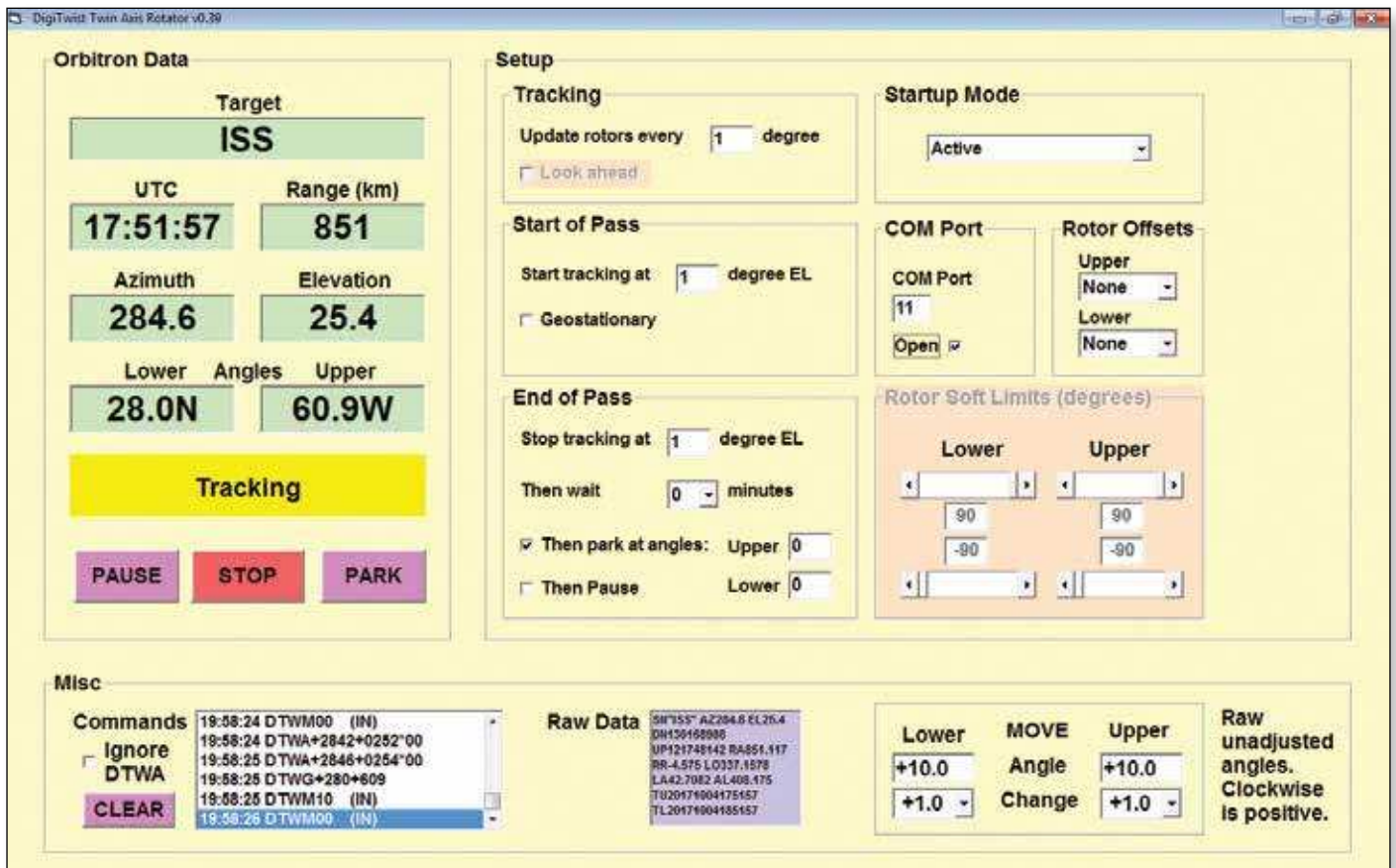
### PC Control Software

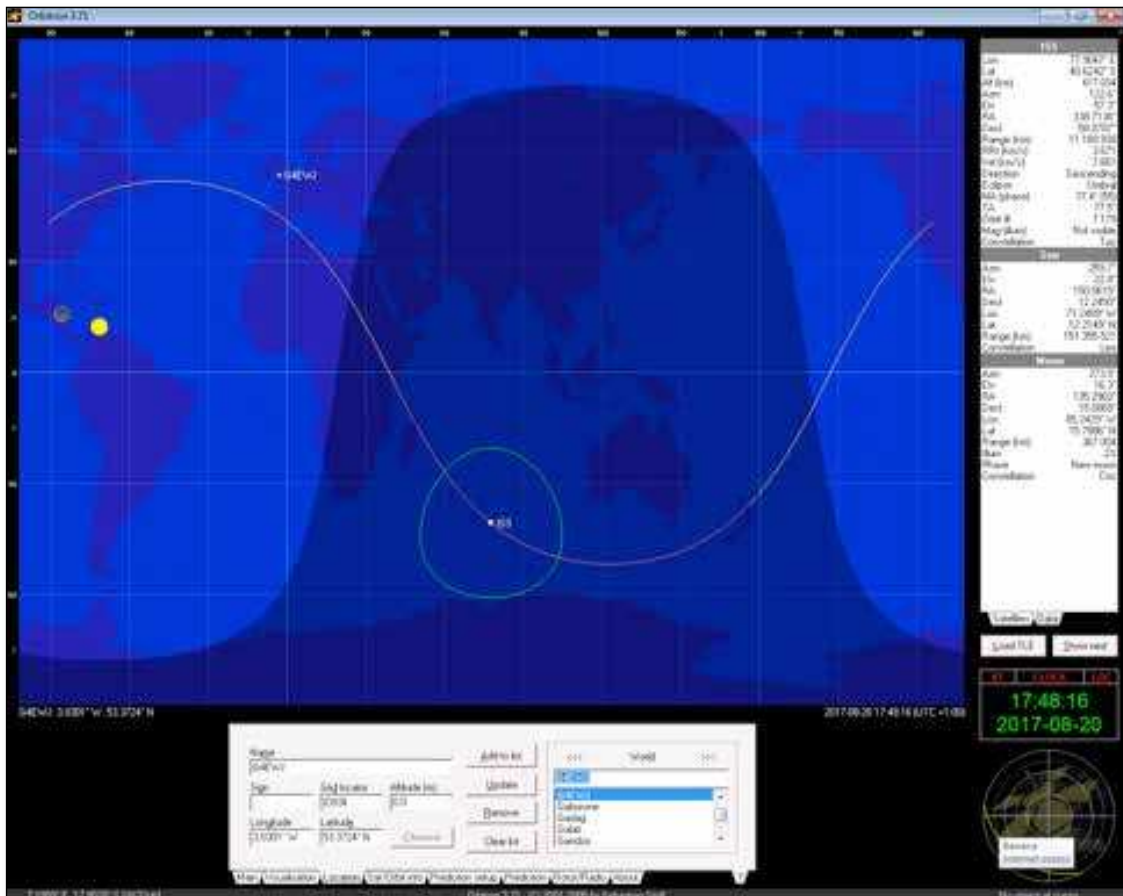
The Control program receives satellite position information from tracking software, works out the angles for the two rotors and sends the commands to the controller PCB.

It is written in VB6. The program works on Windows 7, W8 and W10 have not yet been tested. It may be necessary to manually install an OCX file for W7, W8 and W10.

### Tracking Software

Orbitron is used to determine the position of the satellite. It broadcasts the satellite data using the DDE (dynamic data exchange) protocol which is received by the DigiTwist PC control program. It should be possible to develop the PC control software to interface with other tracking software.





### DigiTwist Advantages

- ▶ Rather cheaper than a G5500 (£130 vs £650)
- ▶ Uses the 'Goto Angle' Diseqc command
- ▶ 12/18v operation - no mains voltages
- ▶ No feedback pots or turns counters (see disadvantages)
- ▶ Elevate then rotate configuration like the Goonhilly Catapult dish
- ▶ 2 horizontal rotors at right-angles - no drama when the satellite goes overhead
- ▶ Arduino Nano based positioner controller
- ▶ PC control program accepts DDE position data from Orbitron

### DigiTwist Disadvantages

- ▶ Unknown if the positioners will survive with loads and orientations they weren't designed for
- ▶ End mounted antennas only
- ▶ Antenna cannot be counterbalanced – it may be possible to counterbalance at the rotor
- ▶ Only 2 degrees / second rotation speed - but this is usually fast enough to track the ISS

- ▶ Low torque - about 2.1kgm - but this may be enough
- ▶ Basic rotor range is only +/- 80 degrees so operation near the horizon is restricted
- ▶ No feedback – you don't know where it is - only where you've told it to go
- ▶ Stops and starts when receiving a command, even if it was going the correct way

### Progress

- ▶ At the time of writing, ISS passes are occurring in the middle of the night. More live testing will be done as they move back into the evening.
- ▶ For the ISS transmitting on 13cm, lighter wire mesh dishes would be suitable and are being investigated.
- ▶ A few prototype controller PCBs were distributed at CAT17.
- ▶ Quotations are being sought for a batch of joiner bars.

### More Information

<https://www.youtube.com/watch?v=qC8CSi8kZTs>

<http://www.batc.org.uk/forum/viewtopic.php?f=2&t=5181>

<https://wiki.batc.tv/DigiTwist> 



# The ADALM-PLUTO low cost SDR

Charles Brain – G4GUO

*The ADALM-PLUTO is a low cost Software Define Radio (SDR) manufactured by Analog Devices. It is aimed at students and self learners. Currently it is being sold on special offer for \$99 from the likes of Digikey. The first batch of radios sold out in less than 4 days. More are being manufactured.*

Out of the box it covers a frequency range from 325 MHz to 3.8 GHz. With a slight software modification that frequency range can be extended to 48 MHz to 6 GHz on transmit and 70 MHz to 6 GHz on receive. The extended range is not guaranteed though.

The device consists of an AD9363 integrated transceiver which is the economy version of a range of chips collectively referred to by Analog Devices as the RadioVerse. As well as the transceiver chip there is also a Xilinx Zynq chip Z-7010. The Zynq consists of dual ARM Cortex A9 cores (although only one core is used in this design) and 28K of programmable ARTIX-7 FPGA logic. The interface to the PC uses a Microchip USB3320C-EZK USB2 PHY. See illustration 1 for an overview of the Pluto. The Pluto itself runs kernel version 4.6.0. Although it is a Linux device you don't need to understand Linux to use it.

Libiio is the interface Analog Devices chose to use to talk to the Pluto. IIO stands for Industrial Input Output.

After the drivers have been installed the Pluto when plugged in provides a number of interfaces to the host. It provides a network connection and a USB device as well as a file system. The interface that DATV-Express uses is the network connection which has a default address of 192.168.2.1.

Currently the main issue with the Pluto is that it only seems to handle 4 Million samples per second, the USB2 interface is capable of over twice that rate, more about that later. Currently the Windows Express program only uses the transmit path.

Looking at the transmit path, the DATV-Express software outputs IQ data at the symbol rate these symbols make their way to the FIR filter block in illustration 1, this Finite Impulse Response filter (FIR) interpolates the

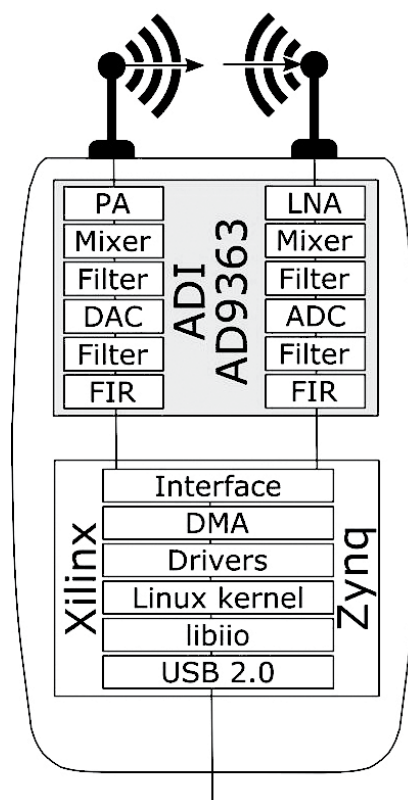
symbols by 4 and also gives them the classic Root Raised Cosine (RRC) filter shape. So for every symbol that goes into the filter 4 filtered samples come out. The filter is 128 taps in size. The next block in the transmit chain is called in the illustration a Filter; this is in fact 3 halfband filters. Halfband filters are special filters that magically set every other coefficient in the filter to zero. The zero coefficients have no effect on the output signal so don't have to be implemented. This makes the filters very efficient for their size. In fact there is nothing magical about the filters it just happens that when set it to half the bandwidth every other coefficient becomes zero. These filters also interpolate the samples further. The aim is to interpolate the samples up to around 320 Million samples per second which is the rate the DAC operates at.

Fortunately for us libiio works out the required interpolation rates to get the DAC sample rate into the correct range. The DAC is driven by a 715 MHz – 1430 MHz PLL which is divided to achieve the actual DAC clock.

The DAC itself is only 12 bits in precision, the lack of precision causes rounding errors which appears as noise in the output of the DAC. This noise is spread almost evenly across the entire bandwidth of the DAC. If we now use an analogue filter after the DAC we reduce the bandwidth

of the signal and therefore the amount of noise in the wanted bandwidth. So all this interpolation means our DAC performs as if it had many more bits of precision. The analogue filter is the block in the illustration that appears just before the mixer. The analogue filter also removes the aliasing of the baseband signal that appears around the sample rate. The DAC is effectively a mixer it is mixing the baseband signal with a series of harmonics of the sampling frequency and that is the reason an anti alias filter is needed. Outside of the AD9363 in the FPGA fabric of the Zynq device is another optional x8 interpolation, this allows a minimum symbol rate of 65K. The AD9363 itself only allows rates down to 521 K.

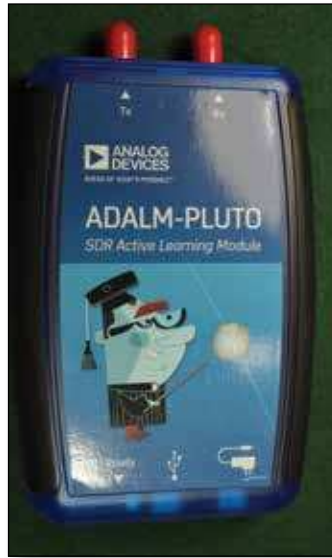
A similar operation applies to the receive side but the interpolation is replaced by decimation.





We have now covered the digital portion of the chip next for the analogue. The output of the DACs go to programmable low pass filter then to an IQ mixer. The output of the mixer then goes to the PA. Analog Devices quote an output of around 7 dBm. I have not been able to get more than 1 dBm out of the device.

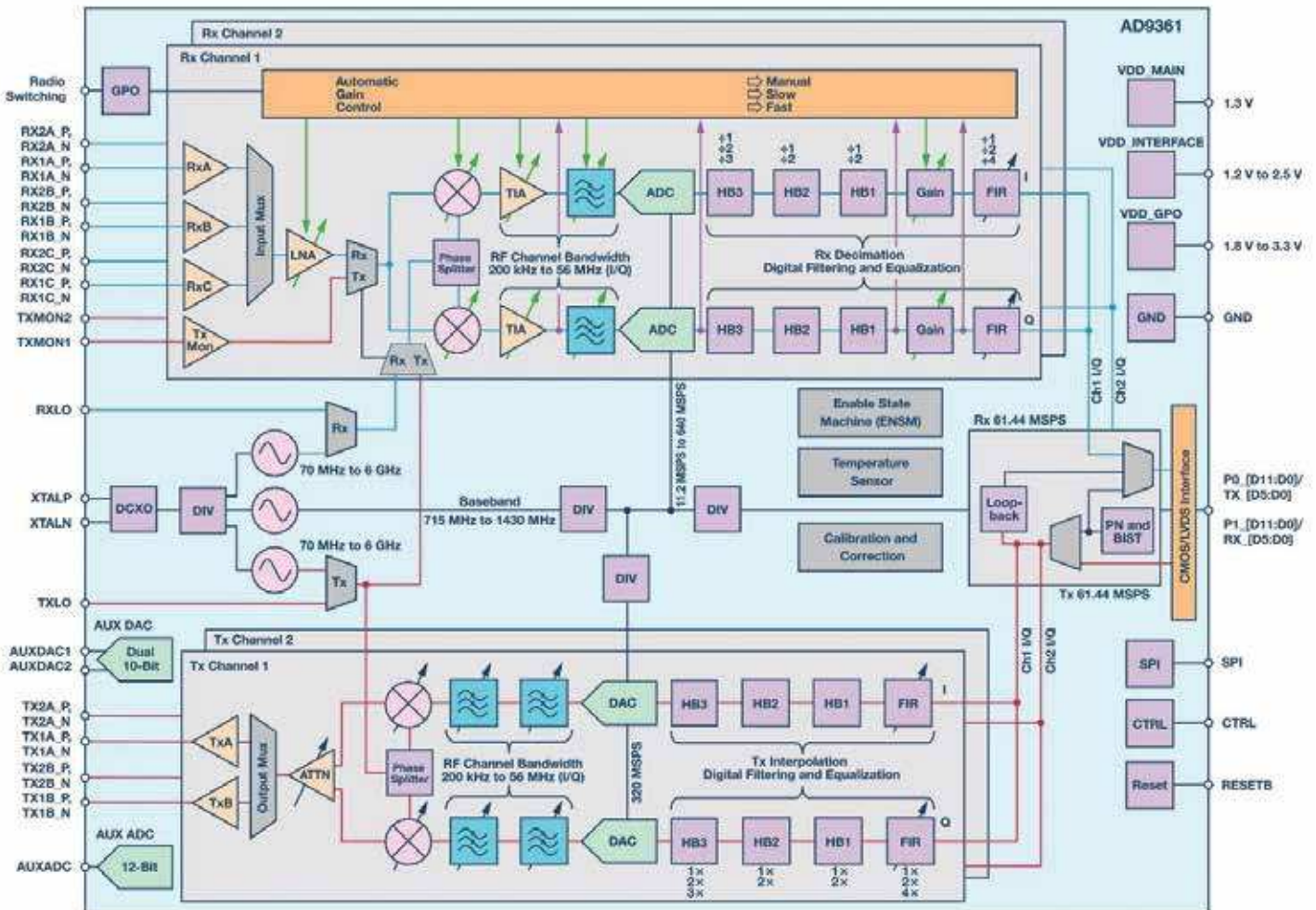
The design is based on the direct conversion principal and that causes a number of issues. The big advantage is that the design is simple and because there are no intermediate mixing stages the burden of filtering is reduced. All components are not perfect and in our case this can produce Local Oscillator (LO) leakage through the mixer and both phase and gain errors in the IQ channels. The leakage can be due to both a DC offset in the mixer/ DAC or lack of isolation in the mixer itself. This appears as a carrier in the centre of the transmit band. The gain and phase errors will appear as poor suppression of the unwanted side-band. Analog Devices mitigate these problems by carrying out a calibration routine. At device start-up baseband errors are reduced through base band



calibration, this is a one off operation. There is a further RF calibration that also runs. In auto mode the RF calibration will run every-time the AD9363 changes in frequency by more than 100 MHz.

Now that we have covered the basics of the Pluto we can go on to describe what the DATV-Express Windows application brings to the party. The program is basically the same for both the Express hardware and the Pluto. To support the Pluto I had to add support for the iio interface I also had to add a module to create and download the RRC FIR filter into the AD9363. I also had to add code to generate a DVB-S IQ stream, fortunately

I already had DVB-T modulator code in the program and all the routines I needed were already in that code. I also added a hardware abstraction layer so the program could support many different radios in the future. As well as the support for Pluto it also now supports a FCOMMS4 card and Zedboard, Zedboard is a Zynq 7020 development board and the FCOMMS4 board is a development board from Analog devices that contains the





big brother of the AD9363 the AD9364. This combination of boards supports a Gigabit Ethernet interface so will work at higher symbol rates than the Pluto will. However it currently does not have the x8 interpolation filter that the Pluto has so will not work at low symbol rates.

As a point of interest the Pluto software is built upon the now discontinued Avnet PicoZed SDR. While the USB2 interface of the Pluto is limited to just over 4 MS/s of transfer with no samples dropped it is possible to see 56 MHz of spectrum with device once the frequency modification has been done. The samples are not continuous but that is not needed for a waterfall display.

I don't have an exhaustive list of applications that work with the Pluto but I do know the following ones work, DATV-Express, leandvb, Analog Devices IIO Oscilloscope, GNURadio, GQRX, Matlab and support for SDR# is partially working. This is still early days for this device.

Around about the time I started writing this article news was released of a new SDR from Lime Microsystems called the Lime-SDR Mini. This is a lower priced single channel version of the Lime-SDR it is priced to compete with the Pluto. While it only has a frequency range of 10 MHz to 3.5 GHz it does have a USB3 interface which makes it better for high bandwidth modes. The software interface is supposed to be the same as that of the original Lime-SDR, so once I have completed support for the Lime-SDR I should also have support for the Mini. The Mini is supposed to be available around the 31st of December. The LimeSDR Mini is available from Crowd Supply.

*All illustrations are courtesy of Analog Devices and are made available for non commercial use.*

*The photos are my own. - Charles, G4GUO* 📷

## The UK ATV community has lost 2 keen operators in the last 3 months

**Dave Kenward G8AJN** passed away on July the 9th. He will be known to many as the "Fat controller" on the Sunday night GB3SQ net. As well as being the prime mover behind the GB3SQ repeater in Bournemouth, Dave will also played a major in the Digilite project both as PCB designer and project manager. As part of the Digilite team and to recognise the significant role he played in helping to promote DATV, Dave was jointly awarded the Grant Dixon award at the 2012 BATC BGM. Dave has



continued to develop various circuits and designs for the ATV community and will be sadly missed by all who knew him.

Also from the Bournemouth area, **Tony, G3KTU**, sadly passed away in September 2017. Tony was a very keen ATVer and an active member of both the SCART group, who run GB3AT and GB3IV, and the GB3SQ group. Tony was one of those people who was willing to help anyone and was very active both on the air and behind the scenes for the various clubs and groups he belonged to. He will also be sadly missed by all who knew him.







# Video Fundamentals 12

## Cables, Connectors & Termination

Brian Summers – G8GQS

*This time I would like to talk about connecting analogue video items up. Simple really just connect A to B right? Well in practice it can be just so, but like a lot of systems there is more to it than that.*

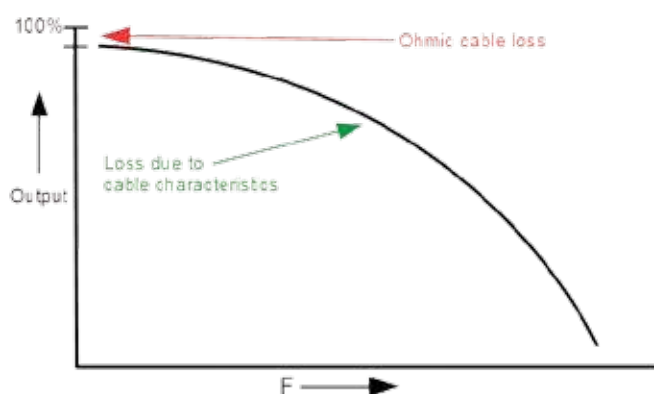
### Type of cable and losses.

Ideally you use good quality  $75\Omega$  co-axial cable with BNC connectors, but even in this ideal scenario there are losses, not to much at the low frequency end of the video spectrum, but increasing with frequency. The colour burst and chroma waveforms will be reduced in amplitude leading to the picture being de-saturated, additionally the high frequency edges will be attenuated with apparent loss of resolution. Length for length, poor quality or small diameter cable will show these effects sooner.

### Equalisation

There are a number of issues here, first modern TVs with video inputs often “auto correct” for chroma loss and low video, this is fine, but can lead to a false sense that all is well. If the burst to chroma ratio is wrong at source, the TV can add to the problem by auto correcting incorrectly!

The correct way to proceed is to use an equalising DA<sup>ii</sup> the simple ones have gain, to correct LF losses and HF gain to correct chroma loss. Better ones have a proper network to give gain to match the losses in the type of cable in use.



► Fig. 1: Typical cable loss against frequency

### Hum

This can be a problem, often caused by the sending unit and the receiving unit having different earth (ground) potentials. Perhaps by being different parts of the building. As the video signal is only 700mV. it does not take much difference in earth potential to create a problem. In mild cases this shows up in a dark hum bar drifting up or down

the screen<sup>iii</sup>, in bad cases loss of picture lock can happen. Safety note if the earth potentials are wildly different, perhaps due to some fault condition, a shock is possible along with a bang as you connect up! Some intelligent awareness of possible hazards is necessary.

### Dealing with HUM

In the past this was difficult and a special DA with a differential input was used or a device called a “stop coil” could be inserted in the input to the receiving unit. A stop coil<sup>iv</sup> was a large transformer with a coil of co-ax just wound on to it, it’s inductance providing a series impedance to limit the flow of current due to the different earth potentials.

Later “stop coils” were real transformers using modern ferrites to give a wide, but not perfect frequency response, they were small and light, ideal for external monitors but, professionally, you would not want to put one in the transmission path. See Fig 2.



► Fig. 2: Vintage “Stop Coil” with the modern transformer version

### Differential inputs

This useful technique is worth a better explanation as it is widely used on all sorts of equipment. Simplistically it can be considered to have the same effect as the balanced input transformers found on professional audio equipment. In video use the inner pin of the BNC would go to one input of a differential input amplifier and the BNC outer, insulated from earth, would go to the other differential inverting input. With this method of input connection, as the Hum voltage was applied to both inputs in phase it cancelled out at the output of the input stage. The wanted video signal being amplified as normal.

### Connectors

The common BNC is a good choice, for analogue video it does not make much difference if they are 50 or  $75\Omega$ . The so called UHF connector (PL-259) is OK but tedious to do up and if loose can lead to LF distortion, not recommended. If I have a unit with the SO-239 connectors I normally leave an adaptor to BNC permanently fitted, and well tightened. The only good





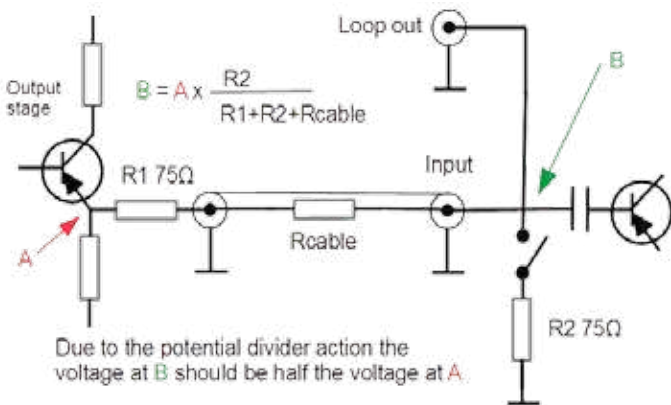
point about a phono connector is its cheapness. Another connector often encountered in professional use is the Musa, handy for jackfield use.

**Tee Adaptors & Loop Through**

Video equipment, monitors and the like normally, have an input and output connector, used in conjunction with a switched termination. If the monitor is the last or only item connected it should be terminated with a 75Ω resistor. If you are looping through all but the last unit should be in the un-terminated state; i.e. high input impedance.

**Terminations & Reflections.**

You may be wondering why this termination business is so important? There are two practical aspects that need consideration:-



► Fig. 3: Simplified termination circuit

- a. For video a coaxial cable is a 75Ω transmission line. That is the signal is sent from a 75Ω source and terminated with a 75Ω load resistor. If either is wrong the video signal level will be wrong! Easy to tweak if you are looking at a monitor but what about your transmitter? is the level low or high? dim or clipped? In Fig.3, by Ohms Law, you can see the potential for errors. The obvious ones are  
 No termination = 200% volts  
 Double termination = 66% volts

The resistance of the cable (R<sub>cab</sub>) has a smaller, but measurable effect.

- b. Simplistically any length of co-ax cable can be seen as a transmission line with a characteristic impedance, 75 Ω for video work. A signal propagating along the line will see the terminating resistor (75Ω impedance) as a continuation of the cable and no reflection will occur. However if the terminating impedance (R<sub>2</sub>) is wrong, a most extreme case is if the termination is open circuit. The signal energy “having nowhere to go” will be reflected back up the cable and be absorbed by the sending resistor (R<sub>1</sub> 75Ω impedance). If the load is > 75Ω the reflection is non-inverted. If the load is < 75 Ω the reflection is inverted. Both the source and load impedance must be wrong if reflections are to be seen at the receiving end.

Any impedance discontinuity along the cable can cause reflections depending on the impedance change and the length of this impedance discontinuity. These small/short discontinuities are more troublesome for digital signals acting to reduce the eyehight’.

**Any Questions?**

This is the twelfth in this series of simple explanations and now is your chance to have that troublesome question answered? Drop me an email and I will have a go at it. The answer may appear here in number thirteen or on the BATC Wiki

- i An interesting effect can be seen if you just parallel up two of these domestic TV monitors, as you add the second connection the upstream TV goes dim for a moment while it thinks about it and then springs back to the “normal” display.
- ii DA = Distribution Amplifier
- iii The drift is caused by the difference in mains (50/60Hz.) and the picture field rate frequency.
- iv The stop coil was aptly named, as well as reducing hum, it was sufficiently heavy to stop you picking it up!
- v See Video Fundamentals part 8 for “Eye Hight”

# Using a MinimOSD board for On Screen Callsign Display

William Hill – MIBKF

*The MinimOSD range of on-screen telemetry boards for first-person-view drone instrumentation are cheap, Arduino-based and can be re-purposed for overlaying callsign display and potentially other data on a ham TV video signal.*

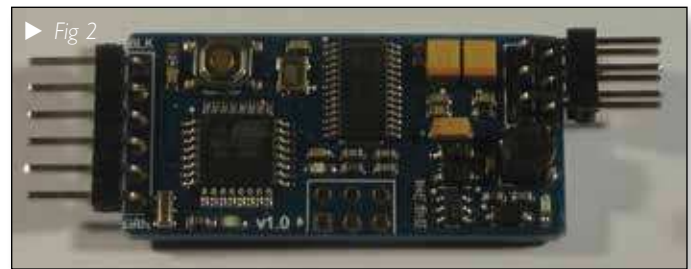
At the Barford Radio Rally last July I saw the “Tarot 5.8GHz FPV 600mW Wireless Image Video Transmission Set” at the BATC stall. I had been planning out a 10GHz system and was looking to be able to get to about 5mW, so a 600mW, 5665MHz system at the price of these units looked very attractive.

Well, I ordered a system, got boxes, bits of perfboard and metal, wires and everything ready to put everything together and on first power-up everything worked! For about 3 seconds. Wagging the power cable for the RX unit yielded at least another 5 seconds of operation, in a number of sub-second bursts. So, I soldered the power cables in. This at least cured the intermittent operation; now it didn't work at all. After a few more attempts over the next few days I gave up and started looking for a replacement. I eventually got a USB 5.8GHz receiver which presents itself to a computer as a standard USB camera. While looking through the various FPV gadgets I saw several “MinimOSD” boards; devices which overlay telemetry information on the video stream from a drone. I had previously wanted to overlay my callsign on the video from a 23cm Comtech system, but all the boards and kits for doing this, such as the SparkFun MAX7456 breakout, seemed to have been discontinued years ago. Well, the MinimOSD board was cheap, so I gave it a go.

The best guide I've found for this board, for drone use, is this one:

<https://nathan.vertile.com/blog/2015/04/22/minimosd>

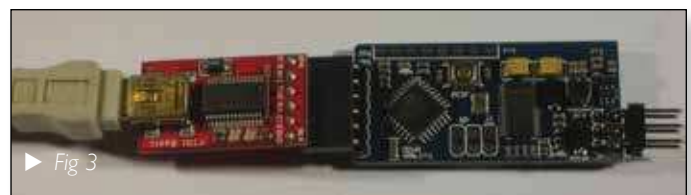
The MinimOSD board is designed for use in drones to overlay system telemetry on the video broadcast stream. There are different versions of this board: the “micro” form factor and the larger one I've used as in Fig.1 I have seen 2 versions of this, with extra inputs along the side for direct



monitoring of voltages, and a slightly slimmer version without, as Fig.2. Since these inputs aren't currently used this version should be OK to use, but I haven't tested it yet. These boards have an ATmega328 processor; a MAX7456 “Single-Channel Monochrome On-Screen Display with Integrated EEPROM” and miscellaneous support circuitry. The boards I have seen so far (3 of them) have all come pre-flashed with the Arduino bootloader and some variant of the MinimOSD firmware, and so are ready to “plug'n'go” for drone use.

Since this callsign display use will involve reprogramming, that Arduino bootloader is needed and a USB to serial converter (or solder in the ISP pins and use a programmer). This will mean that the MinimOSD board can be connected to a computer running the Arduino environment; shows as a serial device; and can be reprogrammed as an “Arduino Pro or Pro Mini” with an “ATmega328P (5V, 16MHz)” processor. The USB to serial I used was the “SparkFun 5V FTDI basic” which I had in the bits box, as in Fig.3 (The CTS on the FTDI connecting to GND on the MinimOSD is not a problem.) Any 5V USB to serial should work, connected correctly.

I wanted to start writing a ham callsign display program by modifying already available code. The firmware is open

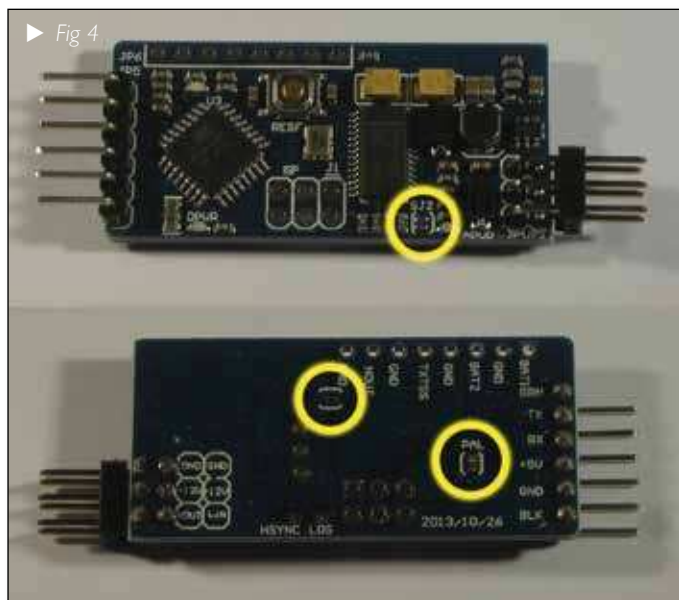


source and available for download. However, there are many versions of the MinimOSD firmware available, and some are quite old and will no longer compile in the current Arduino environment. (Version 1.83, at the time of writing.) The first one I found that compiled and actually displayed something on a screen was “ShikOfTheRa's” “ScarabOSD” So the callsign display I've written is derived from this.

This firmware is a large, versatile and comprehensive system that can deal with many models of drone flight control module, obtain data from them using the “MavLink” telemetry protocol, communicate with a configuration program on a PC to set various options, monitor analog inputs, upload font bitmaps to non-volatile storage, and display information such as battery voltage and current, false horizon, speed, altitude and much more besides. Whilst impressive, this is quite overkill for just a callsign. So I started digging in and lopping off bits that seemed unnecessary for this callsign overlay. (And putting things back when everything stopped working. And cursing when I figured out that was because the 12V battery had gone flat, nothing to do with the code.) So, after gently trimming it from 13344 lines of code to 180 I've uploaded the code to <https://github.com/rufty/CallsignOSD>

The programming is then: download the [https://raw.githubusercontent.com/rufty/CallsignOSD/master/CallSign\\_OSD.ino](https://raw.githubusercontent.com/rufty/CallsignOSD/master/CallSign_OSD.ino) file into a folder “CallsignOSD” Open it in the Arduino environment. CHANGE THE CALLSIGN FROM MINE! Connect the MinimOSD board to the USB-to-serial adapter, and connect the USB-to-serial to the computer. Set the board to “Arduino Pro or Pro Mini”, the processor to “ATmega328P (5V, 16MHz)” (if setting the board type didn't do that already) and set the serial port to the serial port the PC assigned to the USB-to-serial converter. Now click upload in the Arduino environment to compile and transfer the callsign firmware.

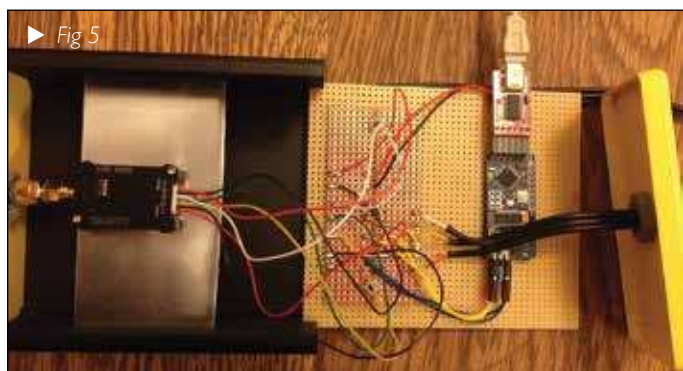
**Caveats:** I've removed a lot, and this includes the font upload code. So this depends on the fonts already being in non-volatile storage. For the “plug'n'go” ready boards, this is the case. This is currently PAL only, but NTSC could be put back from the full firmware. The camera I have is a 20+ year old security camera and the quality is not great.



This on screen overlay looks fine in this context but I haven't had a chance to view it with a decent signal.

Now to wire up the MinimOSD. The variant of this board with the analog inputs has 2 sections. This is so that when fitted in a drone the video section can be powered separately from the CPU+motor-control section, so eliminating on-screen glitching. In the absence of motors this is not needed so PSU circuitry is simpler if these sections are joined. To do this there are 2 solder jumpers to short, one on the back, one on the front, as Fig.4 There's also a jumper for PAL which I soldered too, but this just is just an input to the CPU that isn't even read in this firmware.

The video connection is the 2x3 pins at the right. Two ground, video in and video out, and the unneeded connections for isolated video power. The main power is 5V, to the programming 6x1 pin connection at the left. Just connect to 5V and GND as labelled. I used the 5V output of the Tarot 5.8GHz Tx module, but I did find that a good 12V input was needed to get 5V out to run the MinimOSD; if the 12V sagged the OSD misbehaved, including freezing, not operating and glitching. The Tx functioned fine, however. My 5665MHz system is as in Fig.5



And finally, a field test: Fig.6 is a screen capture of 5665MHz transmission.





Further work. Currently the callsign is hard-coded into the firmware uploaded to the MinimOSD. I would like to add a switch or selector for Callsign/P, /A, /M at the very least. Also, the original firmware had the ability to display position from a GPS unit. I would like to add this back,

but without the need for a flight control unit to decode the GPS NMEA information, and to Maidenhead grid if possible. 📡

- ▶ The blog I worked from:  
<https://nathan.vertile.com/blog/2015/04/22/minim-osd>

- ▶ The firmware I derived this from:  
<https://github.com/ShikOfTheRa/scarab-osd>
- ▶ The MinimOSD I used for my 5665MHz system, which had the extra analog inputs, despite the photo:  
<http://www.ebay.co.uk/itm/321843140980>
- ▶ The one without the inputs:  
<http://www.ebay.co.uk/itm/282598638075>
- ▶ The replacement USB Rx unit:  
<http://www.ebay.co.uk/itm/253074931969>
- ▶ The callsign display code:  
<https://github.com/rufy/CallsignOSD>

## Antenna range tests Finningley BATC - 10 Sept 2017

<b>Band: 2.320 GHz</b>					
Antenna description	Reading	Range	Total	Relative Level dB	Gain dBi
Reference Horn	-3.8	-40	-43.8	0.0	12.3
G4SAQ Helix (-1dB down at 90deg)	-7.5	-40	-47.5	-3.7	8.6
G4AAF Helix (-1dB down at 90deg)	-8.0	-40	-48.0	-4.2	8.1
Laser cut professional Vivaldi	-6.0	-40	-46.0	-2.2	10.1
<b>Band: 3.400 GHz</b>					
Antenna description	Reading	Range	Total	Relative Level dB	Gain dBi
Reference Horn	-10.0	-40	-50.0	0.0	12.3
16 Slot WG antenna (face)	-5.0	-40	-45.0	5.0	17.3
16 Slot WG antenna (edge)	-9.0	-40	-49.0	1.0	13.3
Small squarial	-5.3	-40	-45.3	4.7	17.0
<b>Band: 5.760 GHz</b>					
Antenna description	Reading	Range	Total	Relative Level dB	Gain dBi
Reference Horn	-6.5	-50	-56.5	0.0	12.3
10 Slot Wg antenna (face) GILPS	-3.2	-50	-53.2	3.3	15.6
10 Slot Wg antenna (edge) GILPS	-7.0	-50	-57.0	-0.5	11.8
Grid Mesh Dish- Hyperlink	-9.0	-40	-49.0	7.5	19.8
<b>Band: 10.368 GHz</b>					
Antenna description	Reading	Range	Total	Relative Level dB	Gain dBi
Reference Horn	-0.4	-40	-40.4	0.0	18.3
90cm perf dish + amstrad horn, 2EQ	-4.0	-20	-24.0	16.4	34.7
Printed Horn - GIMGE	-2.2	-40	-42.2	-1.8	16.5
G3UVR Squarial	-0.2	-30	-30.2	10.2	28.5
Stainless Very Large welded horn	-6.0	-30	-36.0	4.4	22.7
Another Squarial	-8.4	-20	-28.4	12.0	30.3
<b>Band: 24.048 GHz</b>					
Antenna description	Reading	Range	Total	Relative Level dB	Gain dBi
Reference Horn	-3.8	-50	-53.8	0.0	18.5
Link Drum Antenna GILPS	-9.0	-30	-39.0	14.8	33.3
Link Drum Antenna G8GTZ	-1.8	-40	-41.8	12.0	30.5
Small Printed Horn	-9.0	-50	-59.0	-5.2	13.3
Larger Printed Horn	-7.5	-50	-57.5	-3.7	14.8
1/2 Penny feed Dish G8GTZ	-3.2	-40	-43.2	10.6	29.1
1/2 Penny feed Dish G8GTZ-refocus	-1.5	-40	-41.5	12.3	30.8



# The Portsdown Digital ATV Transmitter

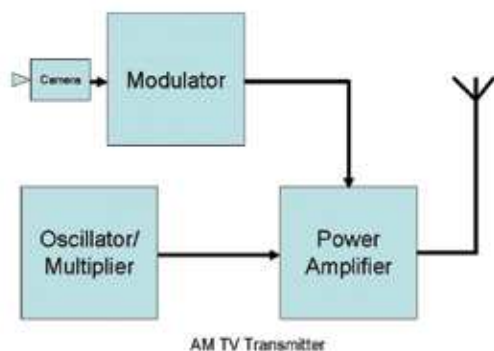
## A Beginner's Guide

Dave Crump – G8GKQ

The aim of this article is to introduce the Portsdown transmitter to those who may be familiar with analogue TV or microwave techniques but who are not familiar with digital ATV. This guide talks you through the step-by-step approach to building the system, concentrating on the software aspects. All of the information required to construct the Portsdown is on the BATC Wiki [https://wiki.batc.tv/The\\_Portsdown\\_Transmitter](https://wiki.batc.tv/The_Portsdown_Transmitter). This article is intended to take the fear factor out of dealing with the software for the first time.

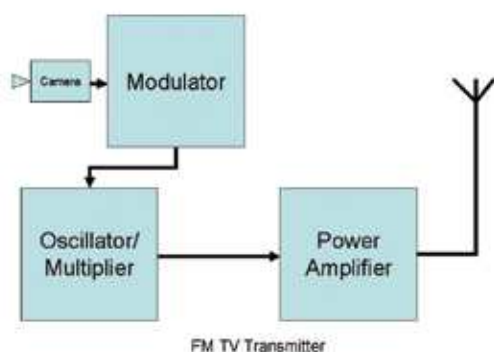
### Basic Principles

The amplitude modulated (AM) 70 cm ATV transmitters that many of us started with had 3 simple components: the oscillator/multiplier chain, the modulator and the power amplifier:



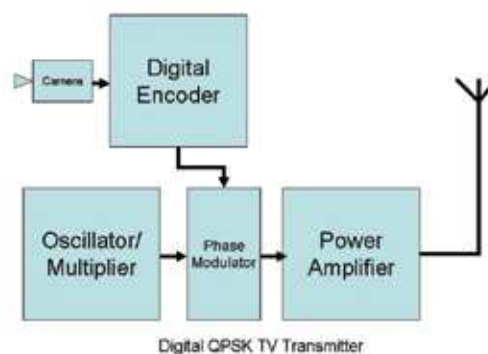
For AM, the modulation was normally applied directly to the PA, or perhaps one of the driver stages. The transmitted signal was very similar to the terrestrial broadcasts of the time.

More recent entrants to the hobby will be familiar with the 23 cm frequency modulated (FM) ATV transmitters, which again had an oscillator/multiplier chain, a modulator and a PA.



For FM, the modulator applied pre-emphasis and was used to vary the frequency of the oscillator. The transmitted signal was similar to the early satellite TV broadcasts, although with lower deviation.

The Portsdown Digital ATV transmitter has similar components, but the modulator goes in between the oscillator/multiplier and the PA:



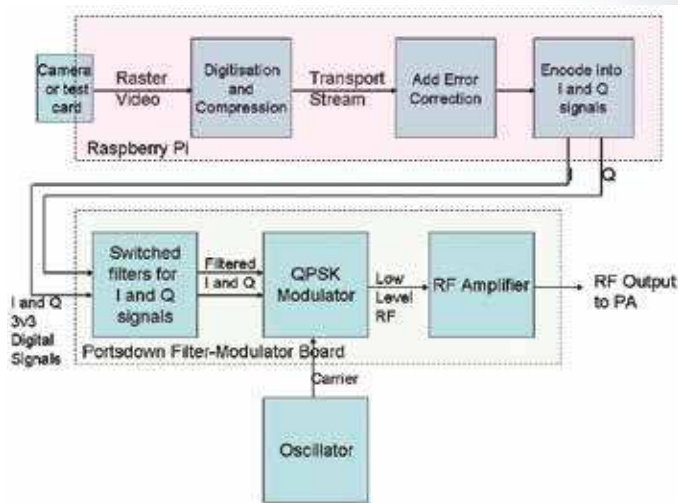
The modulator applies phase modulation to the signal from the oscillator which is then amplified by the PA. The modulation is digitally encoded from the video to produce a signal to the same standard as current DVB-S satellite TV broadcasts.

### Digital Modulation

For digital modulation the picture and sound are encoded into digital form, using compression techniques to reduce the amount of information that needs to be transmitted, and then error correction is added so that the signal can be recovered if there is noise on it when received. In the Portsdown transmitter all of these processes are done by the software on the Raspberry Pi. This means that all the operator needs to do is to tell the software what symbol rate to transmit, and choose how much error correction to use. As the Portsdown can also control the transmitter oscillator, it also needs to know the transmit frequency. Preset settings are provided for all these controls.

The phase modulator applies Quadrature Phase Shift Keying (QPSK) to the signal, meaning that at any one time the signal can be at one of 4 possible phases. The phase is changed many times a second (at the "Symbol Rate") to enable the digital information to be sent. This modulation is simply an extension of the idea used by RTTY, where one of 2 states was sent by varying the carrier frequency 45.5 or 50 times a second.

The split of functions between the Raspberry Pi and the Portsdown filter-modulator board is shown below.



## The Portsdown Modular Approach Step 1: Controlling the RPi

The aim of the Portsdown project is to provide a modular DATV transmitter suitable for home construction, so initially I will describe how to control the Raspberry Pi on its own. You can operate the Raspberry Pi (RPi) computer without any of the other Portsdown components. All you need is the RPi, a programmed SD Card, and a power supply for the RPi. You can purchase a pre-programmed SD Card from the BATC Shop.

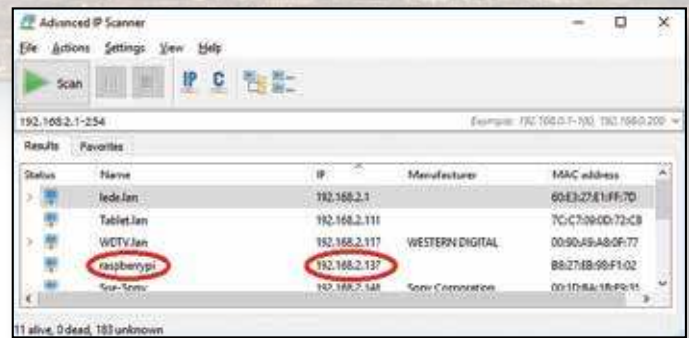
G8GTZ has put together a comprehensive video describing this step on the BATC YouTube channel:

<https://www.youtube.com/watch?v=nkjheie8uOk>

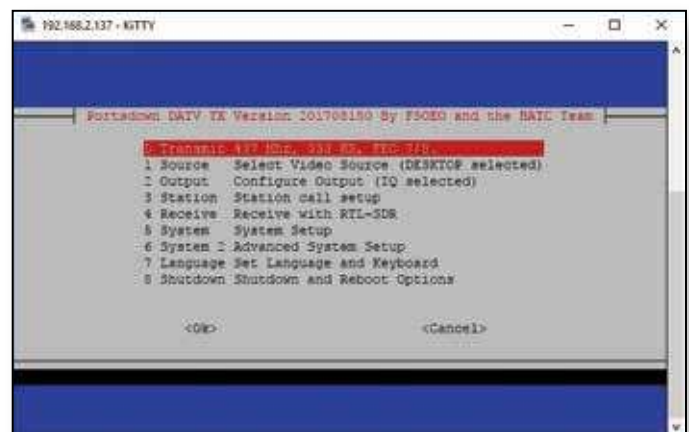
First insert the programmed SD Card into the RPi, and connect the RPi to your home network with an Ethernet lead. Then connect the RPi power supply and turn it on. No screen or keyboard are required to be connected to the RPi.

Now go to your PC (on the same network as the RPi) and download and install 2 pieces of software: The first is "Advanced IP Scanner" [http://filehippo.com/download\\_advanced\\_ip\\_scanner/](http://filehippo.com/download_advanced_ip_scanner/) which you will use to find your Raspberry Pi's IP address on the network. The second is "Putty" <http://www.chiark.greenend.org.uk/~sgtatham/putty/download.html> which you will use to control your Raspberry Pi from the PC.

Run the advanced IP scanner, click "Scan" and then look for the entry named raspberrypi. Make a note of the IP address against that entry – it is unlikely to change in the next 48 hours. Close Advanced IP Scanner.



Now open Putty and enter the IP address that you noted into the "Host Name" field and then click "Open". You will get a security warning if it is the first time that you have connected to the RPi; you should accept this by clicking Yes. You will then have a black window with the text "login as:". Enter "pi" (lower case without the quotes) and press enter. You should then see text like pi@192.168.2.137's password: The numbers will be the IP address that you entered earlier. Now type "raspberrypi" (again all lower case without the quotes); nothing will be shown on the screen – Linux does not show anything when passwords are entered. Press enter and you should see the blue and red Portsdown console menu.



If you have reached this point then you have learnt all the software techniques that you need to know for the Portsdown!

You can use the arrow keys to highlight menu items and then press enter to select them.

## Ugly Mode

With the simple set-up described above, it is possible to transmit low symbol rate pictures across the Shack in "Ugly Mode". This uses one of the internal oscillators in the RPi and QPSK modulates it using some very clever techniques. The transmitted signal is not very clean (hence "Ugly Mode"), but if you use a MiniTioner on 437 MHz set to 333KS, and select transmit on the Portsdown console menu, you should see the BATC logo transmitted



from the Portsdown software. Press enter again to come out of transmit and back to the menu.

You can safely shutdown or reboot your RPi by going to option 8 “Shutdown” and then selecting the appropriate option and pressing enter.

## The Portsdown Modular Approach Step 2: Generating RF

The next step is to put together the radio frequency parts of your transmitter. You will need at a minimum:

- ▶ A Raspberry Pi 3 computer (as in step 1)
- ▶ A programmed SD Card for the Raspberry Pi (as in step 1)
- ▶ A GPIO breakout board from the BATC Shop
- ▶ An extra tall stacking header (40-pin) from adafruit or the Pi Hut  
(<https://thepihut.com/products/stacking-header-for-raspberry-pi-2x20-extra-tall-header>)
- ▶ A local oscillator
- ▶ A Portsdown filter-modulator board from the BATC Shop.

The local oscillator can be any oscillator on the desired transmission frequency producing between 0.5 mW and 5 mW. If you use the recommended eBay ADF4351 oscillator its frequency can be controlled by the Portsdown software.

The interconnection diagram for all of these boards is on the BATC Wiki. Take particular care to get the band-switching lines that go to J02 on the filter-modulator board in the correct order – the board marking is not as clear as it might be.

Once you have checked the wiring, apply power to the oscillator and filter modulator boards and the RPi. Open a Console using Putty to control the RPi just like you did in Step 1. Then go to Option 2, “Output” and press enter. Then go to Option 3 “Output Mode” and press enter. Now use the arrow keys to highlight “IQ” mode (the top option) and use the space bar to select it. Then press enter to execute the change; accept the defaults (12 and 13) for the GPIO pins by pressing enter a further 2 times, and then you will be back at the main menu. This action takes the Portsdown out of Ugly Mode and tells it to use the Portsdown Filter Modulator instead.

If you now select transmit, your oscillator should start on the selected frequency and the output of the filter-modulator board should be a few mW of clean Digital ATV on that frequency.

## The Portsdown Modular Approach Step 3: Touchscreen Control

If you want to install the touchscreen, make sure that the power is off and then carefully place the screen on the pins on the top of the GPIO board. Ensure that the pin alignment is correct – tests have shown that incorrect alignment damages the display. Power up the RPi and, once boot-up is complete, the display should show the BATC logo with your IP address.

You need to log in to the console for one last time to make the display automatically start up in the Portsdown touchscreen menu system. Once at main menu, select option 5 “System Setup”, then option 1 “Autostart”. Use the arrow keys to highlight “Display\_boot” and press the space bar to select it. Then press enter to execute the command.

Go to option 8 “Shutdown” and then select option 2 “Reboot Now”, and press enter. When the RPi reboots, you should see the BATC Logo on the touchscreen for a few seconds, then the Touchscreen Menu. You can now control the basic functions of your Portsdown from the touchscreen without connecting to your network.

## The Portsdown Modular Approach Step 4: Video and Audio

You will want to be able to transmit pictures from a camera. You can connect both a Raspberry Pi camera (using the ribbon cable supplied with the camera) and a USB EasyCap composite video capture device (available from the BATC Shop). You can also connect a cheap USB sound dongle to enable a microphone to be used with the Raspberry Pi camera. You can select any of these inputs from the touchscreen menu.

## The Portsdown Modular Approach Step 5: Switching

The Portsdown filter-modulator board will work on all bands from 71 MHz to 1300 MHz, and it is convenient to have separate RF and PTT outputs for each band. There are 2 PCB designs described on the BATC Wiki for this purpose.

The first PCB switches the modulated signal from the filter-modulator board to one of 4 outputs – one for each band. The second PCB buffers and routes the transmit switching to one of 4 separate outputs.

If the ADF4351 local oscillator is being used, the 3rd harmonic of its output (when used at 71 MHz, 146 MHz and 437 MHz) needs filtering out to ensure correct operation of the QPSK modulator on the filter-modulator board. A switched filter PCB is available from the BATC

Shop to achieve this. The reason that this is required is that the ADF4351 outputs a square wave below 2200 MHz and the QPSK modulator expects a sine wave on its input. The 3rd harmonic at 1255 MHz is at a much lower level, so does not require filtering.

## The Portsdown Modular Approach Step 6: Signal Monitoring

The Portsdown software suite includes the capability to use an RTL-SDR and the leandvb software to monitor a low symbol rate DVB-S signal and display the images on the screen. The receiver parameters are set to the same as selected for the transmitter. Currently the capability only works at 125 KS and 333 KS, but it is hoped to improve this in future software versions.



Additional facilities including the capability to monitor 144.75 MHz FM, and the ability to run an RTL-SDR TCP server so that signal can be viewed and received using

SDR-Sharp on a Windows computer connected to the same network, are planned.

All that is required is that an RTL-SDR dongle be connected to the RPi by USB.

## The Portsdown Modular Approach Step 7: Extra Functions

The latest version of the Portsdown software has a "Video Out" transmit function. In this mode the Pi Camera, test pattern or contest numbers are output as a composite video signal to the RPi's video output. This enables the Portsdown to be used as a very capable video source for analogue transmitters. Additionally, the sound from any connected USB microphone dongle is relayed to the RPi's audio output.

A video display and capture facility has also been added. In one mode, the video input to the EasyCap dongle is sampled at 1 second intervals and displayed on the touchscreen. In another mode, the video images can be captured to a .jpg image and saved on the SD Card. The 5 most recent snapshots can be previewed from the touchscreen; all images can later be exported to a Windows computer. Unfortunately, it is not possible to display continuous video at present.

## The Portsdown Modular Approach Step 8: Software Updates

As new features and improvements for the Portsdown software are developed and tested, they are published on the BATC GitHub website as a software update. You can only update the software from the console, not from the

## Programming Your own Micro SD Card

Pre-programmed Micro SD Cards are available from the BATC Shop, but you can program your own SD Card. The card needs to be of at least 4 GB capacity and ideally should have a speed rating of Class 10 or UHS-I. SanDisk Ultra cards are recommended, if only because we have not observed any problems at all with them. Samsung cards seem to have some incompatibility with the Raspberry Pi and have caused trouble for some constructors.



Up-to-date detailed instructions for programming a blank card are published on the BATC GitHub website here: <https://github.com/BritishAmateurTelevisionClub/rpidatv> just beneath the picture.

There are 5 steps to building the card:

- ▶ Download and unzip the Linux operating system image
- ▶ Write the Linux image to the SD Card
- ▶ Add a blank file called "ssh" to the boot volume (this tells the operating system to enable remote access to the RPi when it is first booted).
- ▶ Boot up your RPi, find its IP address and log-in.
- ▶ Download and run the Portsdown installation script.

The complete process takes about 30 minutes with an average internet connection

touchscreen, so when you see that an update is available (details are posted on the BATC Forum and BATC Wiki), you need to connect your Portsdown to the network and log on to the console as in Step 1 above. It should be easier this time, because when you turn your Portsdown on, it displays its IP address on the touchscreen.

Alternatively, if it has already booted, you can display the IP address by selecting the “Info” button on Touchscreen Menu 3.

Once you are connected, select option 5, “System Setup” and then option 9 “Update”. The software will check for a

new update and then update if you say Yes to the update. It will ask you to reboot at the end of the process and the Portsdown should restart with all of your original settings unchanged.

### Getting Help

The Portsdown team realise that this is a new area of the hobby for many of you. If you can't find the information that you need on the Wiki, or in existing Forum Posts, please post details of your problem on the Forum and we will try to help you. We will then try to improve the Wiki so that other constructors know the solution. 🗨️

## The Portsdown Transmitter – Security Aspects

Dave Crump – G8GKQ

***It would be remiss of me not to consider security as I develop the Portsdown software. The good news is in normal use, the Portsdown Transmitter will not be a security risk to itself or other computers on your network.***

This is the brief analysis that I conducted before coming to that conclusion:

First of all let's consider what could happen if a hostile attacker gained control of the Raspberry Pi computer in your Portsdown:

- ▶ The attacker could deny you use of the Portsdown and possibly use it to transmit or stream undesirable content.
- ▶ The attacker could use your Portsdown as part of a “botnet” to attack other computers.
- ▶ The attacker could use your Portsdown as a springboard to attack other computers on your network and possibly impersonate you or destroy your data.

All these 3 scenarios require the attacker to be able to remotely log-in to your Portsdown. The only way that they can do that is by using the same “ssh” mechanism that you use to access the Portsdown console. By default a standard home router will prevent “ssh” and other remote access from the wider internet. Changing port-forwarding, DMZ or other similar settings may however expose your Portsdown to attackers able to carry out many hostile login attempts per second. To protect your Portsdown and yourself, I very strongly recommend that you leave your home router on the default port-forwarding and DMZ settings to prevent “ssh” access to your Portsdown from the internet. Please do, however, change your router access password and your WiFi password.

The second layer of defence for Portsdown transmitters is that they are not usually turned on for 24 hours a day. The exception to this is those Portsdown units that are used for repeater streaming. These units (and the routers protecting them) are generally left unmonitored for long periods, increasing their vulnerability. For this reason, I recommend that, if your Portsdown is left turned on and connected to the internet for extended periods, you change the default log-on password from raspberry to a complex 16 character password. Write the password down on a piece of paper, fold it in half and tape it to the underside of your Portsdown. That way you are more likely to choose a non-guessable password as you do not have to remember it; if an attacker has physical access to your Portsdown, you have bigger problems than him knowing the password!

You could add a third layer of defence, an application that frustrates brute-force password guessing attacks. I have been recommended the free program “fail2ban” which locks an attacker out after a few failures. You can install this program by typing “sudo apt install fail2ban” at the Linux prompt.

Every time that you update the Portsdown software, it also updates the system software with the latest security patches. So, if you keep your Portsdown regularly updated, this also reduces any security risk. Hopefully this article will have reassured you that your Portsdown transmitter is a safe addition to your home network, and that you can use it without any additional concerns. 🗨️





# Notes on Amplifiers & Filters

Shaun O'Sullivan – G8VPG

## ALL BANDS

I have used a number of the MMIC kits from Minikits Australia, which form useful driver amplifiers. The ones that have worked well include;

PHA1

<http://www.minikits.com.au/electronic-kits/rf-amplifiers/rf-wideband/PHA-1-Amplifier>

MGA31189

<http://www.minikits.com.au/electronic-kits/rf-amplifiers/rf-wideband/MGA31189-Amplifier>

I have also used a simple MMIC amplifier kit from G4DDK, using the PGA103. I used an earlier version of this as a driver amplifier for my 23cm amplifier. However, I and others have found that the PGA103 is fragile and prone to failure. My experience is that it does not like being plugged/unplugged. The two in my 23cm amplifier have worked well for two years now, because they are permanently terminated into other items. When they are floating items, assembled each time for use, they fail more often.

<http://www.g4ddk.com/PGA103amp.pdf>

## 146.5MHz

### Filters

I extracted an old design for a 2m bandpass filter from the RSGBVHF/UHF Manual, fourth edition, 1985, page 7.1, which was reproduced in CQ-TV 250.

The low pass filter which features in the amplifiers below is very effective and I could detect no harmonics up to 1.5GHz.

### Amplifiers

Sam Jewell G4DDK produces a couple of 2m amplifier kits and pcb's. The first I built is a low power design rated at 8W, using a Mitsubishi block. However, this will not produce more than 2W clean digital ATV.

<http://www.g4ddk.com/144MHz8WPA.pdf>

I think most people are now aware of the 60W Mitsubishi block amplifier, which most 2m ATVers seem to have adopted. The pcb is available from G4DDK.

<http://www.ifwtech.co.uk/g3sek/vhfdx/gm3sek-pa-module-board.jpg>

A similar amplifier is also available ready assembled from Roberto DG0VE.

<http://www.dg0ve.de/en/poweramplifier%200,1-%201ghz.htm>

### Pre-amplifiers

I have used a couple of 2m pre-amplifiers. The first is the Minikits Australia one, which works well.

<http://www.minikits.com.au/electronic-kits/rf-amplifiers/rf-preamplifiers/2m-RX-Preamplifier>

The second is the PGA144 from G4DDK, using the PGA103 device. When it works, it work well, but I have had two failures of the PGA103 in it and it is wise to always carry a spare!

<http://www.g4ddk.com/PGA144Build2.pdf>

## 437MHz

### Filters

For 437MHz, I have used the Minikits low pass filter, which is very effective.

<http://www.minikits.com.au/electronic-kits/filter-kits/uhf-lowpass-filters/LPF7-450M>

At low power levels, I have used the helical filter which is available from Antennair or the manufacturer Roberto DG0VE.

<http://www.dtxl.info/downloads/DTXF70.pdf>

<http://www.dg0ve.de/en/filter.htm>

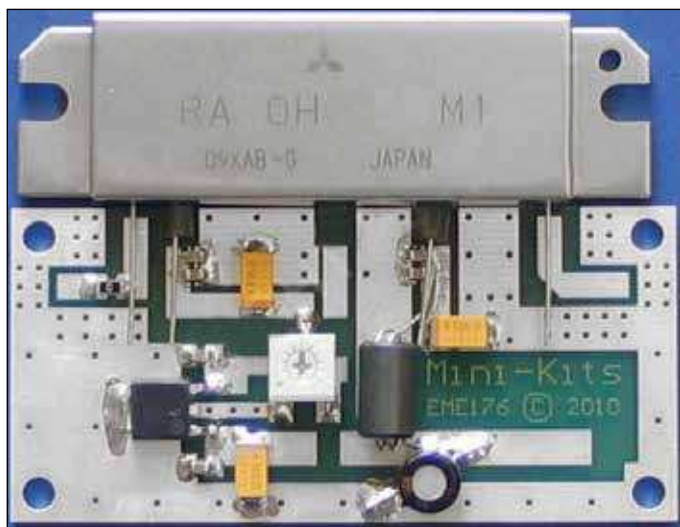


## Amplifiers

For 437MHz, I have used the Minikits design based on the Mitsubishi block, which can produce around 30W of digital ATV.

<http://www.minikits.com.au/electronic-kits/rf-amplifiers/rf-high-power/RA-UHF-Amplifier>

I have found with all of these Mitsubishi blocks that it is essential to securely earth bond the module to the pcb, otherwise the power output can become unstable. I use a solder tag on each bolt holding the module and solder this to the pcb using the shortest route.



## Pre-amplifiers

437MHz is a clean sweep for Minikits, although G4DDK is now producing a PGA432 using the PGA103.

<http://www.minikits.com.au/electronic-kits/rf-amplifiers/rf-preamplifiers/70cm-RX-Preamplifier>

<http://www.g4ddk.com/PGA432Techdes.pdf>

## 1249MHz

### Filters

At low power levels, I have used the pcb filter which is available from Antennair or the manufacturer Roberto DGOVE.

<http://www.dtxl.info/downloads/DTXF23.pdf>

[http://www.dg0ve.de/en/index\\_htm\\_files/BP23\\_5\\_2014\\_01.pdf](http://www.dg0ve.de/en/index_htm_files/BP23_5_2014_01.pdf)

### Amplifiers

For low power levels or as a driver amplifier, I have used a kit rated at 2.5W from John G4BAO.

<http://www.g4bao.com>

Mitsubishi produce a 20W power module for 23cm and circuit boards, kits and fully assembled amplifiers are available from Bert PEIRKI. Bert produces a range of amplifiers, filters and pre-amps for the microwave bands and has a CNC controlled milling machine and produces some superb enclosures milled from a solid billet of aluminium, at reasonable cost.

<http://www.peirki.com/amplifiers.html>

I also have a 60W 23cm amplifier from Kuhne Electronics in Germany. This requires 2-3W drive level (do not overdrive it – I did and had to replace the transistor!). I bought mine as a kit with the matching enclosure, but Kuhne produce a wide range of ready made power amplifiers, pre-amps etc.

<https://shop.kuhne-electronic.de/kuhne/en/shop/power-amplifiers/MKU+PA+23CM60W+KIT/?card=631>



I drove this amplifier from a Mitsubishi block and experienced some instability/oscillation from the Kuhne, which was cured by inserting a 2dB attenuator between the pair.

### Pre-amps

The best pre-amp that I have found for 23cm is the RF Design two stage device with built in bandpass filtering from RF Design. This is widely available at most British radio rallies from Kevin G3AAF.

<http://g8fek.com/lna.html>

A 437MHz version is now available.

An alternative is the kit available from Minikits Australia.

<http://www.minikits.com.au/electronic-kits/rf-amplifiers/rf-preamplifiers/23cm-RX-Preamplifier>

There is a small input coil that adjusts the matching of this pre-amp. Adjusting this is a bit tricky and because it is directly connected to the input transistor gate, I managed to blow the device and had to replace it. In fact, whenever I order Minikits items, I always add a spare for each of the active devices because they are not easy to obtain in one-offs in the UK. 🐼

# A Vintage Pye Camera

*It's been a while since we had any vintage cameras in CQ-TV so when Giles Read, G1MFG sent me some nice pictures of a Pye Mk3 on display in the Museum of Photography in Charleoi, Belgium, I thought it time to correct that deficiency!*

This Pye camera, model 2014RE serial number 328, is in fine condition and is set in a mocked up studio scene with lamps, monitors and an interesting early caption roller. There were no cables and there wasn't enough of anything to make a functional studio but it did nicely set the scene.



The camera is a fairly late production model with the improved side and top ventilation. The "E" indicates it was able to operate on the continental 819 line standard, at the time in the UK we were on 405 lines! The 3 inch Image Orthicon tube it used was very capable at 405 or even 625 line operation, but it was felt, in the UK, that 819 lines was somewhat optimistic.

The Pye Mk3 had a number of interesting features, all the optical controls were motorised, the turret change and iris control and the focus control was a servo. The large blue knobs on both sides of the camera drove the position of the complete scanning yoke and hence the optical focus. Just by the focus controls were two micro switch buttons that could open or close the lens iris. One nice feature of the design was the pre-positioning of the focus setting when the turret was rotated to present a different lens to the tube. In the lens mounting plate there were resistors that formed part of the servo "bridge", these made contact with spring loaded studs and the servo automatically moved the yoke to more or less the correct focus point. All of this in a camera that first saw the light of day in 1951 just two thirds of a century ago.

*Brian Summers, G8GQS & Giles Read, G1MFG*

One of the options for this camera was a remote control box for the optics, this sat by the side of the camera's CCU in the control room. So the convention of the cameraman doing lens selection and focus and the CCU operator controlling the iris became somewhat blurred, no pun intended!

Giles writes:- *The camera still had its distinctive smell, which was wonderful. I wasn't able to ascertain how much of the*



► *The camera is displayed complete with an authentic selection of lenses.*

*internals were still in place but if it's anything like the other exhibits in the museum it's probably (fairly) complete, if not necessarily in working order. All of the other thousands of exhibits were in superb condition and included things I'd never seen before, such as some early Autochrome colour photographs made with dyed potato starch granules that were of stunning quality, despite being a century old. The museum describes itself as the most important museum of photography in Europe, and on the basis of my visit, I'd believe it. If you're ever passing in the vicinity of Belgium it's worth a look.*

**A brochure for the Type 2014 camera is here:-**

[www.tvcameramuseum.org/pdfs/pye/pyemk3broc1.pdf](http://www.tvcameramuseum.org/pdfs/pye/pyemk3broc1.pdf)

**Details of the museum here:-**

<http://tinyurl.com/yTurk6xl>



► *The Pye 2014 sits on a wheeled Houston Fearless pedestal in a large room whose walls are decorated with TV related memorabilia and artworks.*



## 5.6 GHz progress

Pete Biggadike - G8JAN



Having been persuaded by the BATC chairman (thanks Noel!) to return to ATV, I decided to purchase a set of FPV Tx and Rx units and give 5.6GHz a try. The receiver module is the scanning model ROTG01 made by Eachine and the output goes via a USB cable into my laptop where it inputs to the NCH Debut Video Capture Software which can be freely downloaded. The software shows the frequency readout while scanning. At the moment the scanner needs a button press to start each scan but I'm sure we can get around that.



I picked up a caravan satellite dish system at Hamfest and decided to use a 6 ele Biquad as the feed - it's nice and small and seems to illuminate the dish OK.

The design is published here

<http://buildyourownantenna.blogspot.co.uk/2014/07/double-biquad-sector-antenna-for-5-ghz-wifi.html>

As we are using horizontal polarisation the feed is vertical. It will be handy to have the dish on top of the car roof so no tripod will be needed just a large hill with a road leading up it! (not easy to find in Norfolk!).



I've only done local field trials but the system seems to work very well and Pete G4NJJ and I are planning some more tests before attempting longer distances across the very flat fens of Cambridgeshire. Watch this space! 🗣️

## Subscription Renewals

The start of a new year is our busiest time for renewals, and we plan to have our new website and updated shop in operation by then. So it should all be easy! Payment options are: PayPal, Bank transfer and cheque (UK only). If you are having difficulties paying please contact us for a workaround.

Subscription rates will not increase until the Spring of 2018 when we will have to review them to take account of any increases in our running costs.

**Full Membership** UK £20 1 year, £39 2 years  
(cyber plus paper) Europe £30 1 year, £59 2 years

World £35 1 year, £69 2 years

**Full Membership** All Locations £8 1 year, £15 2 years  
(cyber only)

All members with a valid email address will get a link to download their personal copy of CQ-TV and those who have a "plus paper" membership will receive a printed copy of our journal as well.

Over this last year we have had a significant increase in our membership, this has helped a lot with the running of the club, enabling us to do even more to support ATV throughout the world.

Many of our members are "cyber" members who simply download their CQ-TV. This is a great benefit to members spread throughout the world where the postage cost would be significant, but for those who are in the UK I would ask you to consider the "paper" option when renewing your subscription. The production of a printed magazine keeps our quality high and encourages authors to write interesting articles for us. Additionally, you get a quality paper copy which is a lot easier to refer to when building the latest project! 🗣️



## CAT17 report

Robert Burn - G8NXG

*Those members who have been around awhile and have visited Finningley Radio Club on a previous occasion will have already overcome the challenge of finding the place! So this was a new journey for me and eventually I found the location – mainly because I was able to spot Noel's travelling ATV station (the legendary silver Land-Rover) parked outside.*



The club buildings sit within and to one side of an open field; an arrangement which I guess does not provide for contentious planning applications each time that a new aerial is erected! The Club has the additional fortune of occupying the two buildings on site, one of which serves as the club house, the other the size of a small aircraft hanger which serves as 'stores'. Part of this was utilised as the 'Bring and Buy' section of CAT-17.



The main club house is divided into a number of rooms each of which serves a particular purpose; workshop, canteen, HF ops room, VHF/UHF ops room, test/measurement room etc. In doing so, the Club provides opportunities for members to explore many different facets of amateur radio without having the disadvantage of having to arrange everything beforehand – it is all there to use.

The BATC lecture streams were held in the largest room in the building, which serves as a lecture room and museum. This is particularly interesting to those of a certain age...

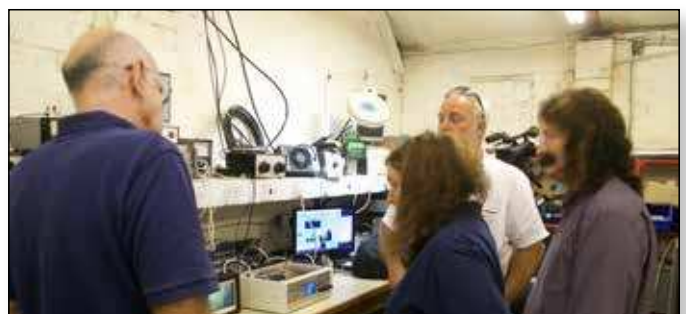
Equipment setup for the internet stream, camera and mic positioning was carried out on the Friday beforehand. By the time that all of this installation was completed this room probably contained 80 years worth of electronics development!



Over 50 members attended the weekend and Saturday commenced with the Informal Portsdown demos and workshops – several people were seen making final adjustments before judging for the construction competition took place!

Noel commenced the afternoon proceedings with his usual run-down of Committee members (providing faces to names) and quick BATC review - - this was followed by G4HJW Bernie's 'Introduction to Optical Communications'.

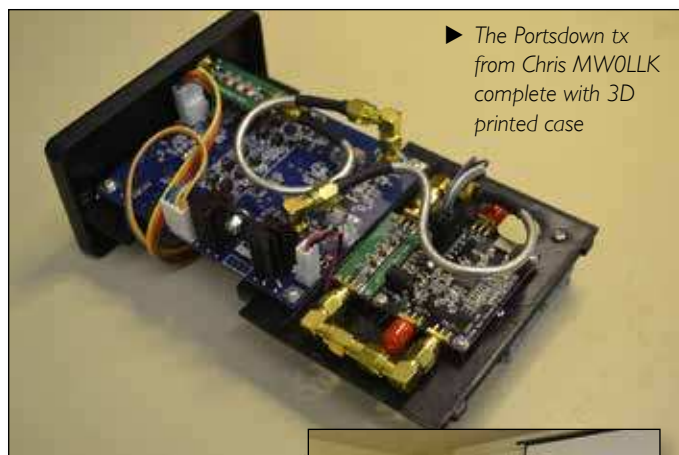
In the talk on the Portsdown DATV transmitter Dave G8GKQ paid tribute to the many team members that he has been able to call upon during development of the project; this team spirit goes on. He also made a plea for ideas – if you consider that you would like an additional feature to be implemented in Portsdown then get in touch with Dave, so that we may all share it.





I am not sure how many members brought along versions of the Portsdown for judging in the construction competition however I was impressed by the quality of construction and internal layout of the exhibits. I was certainly inspired to get on and complete my build of the project!

Later, the time came when the prize for the best Portsdown build was made and the winner was Chris MW0LLK for his innovative 3D printed case. An additional award was made to Jeff G4HIZ for coming a close second with his fold-down touchscreen.



► The Portsdown tx from Chris MW0LLK complete with 3D printed case

Other BATC awards were presented to G0MJW and G8GTZ for first RB-TV contact over 250Kms. Awards were announced for John G7JTT for best one-way and 2-way Portsdown DX in the International Contest, and the winner's certificate was presented to Rob M0DTS.



The last session of the day was delivered by Brian G4EWJ on his experimental Low Cost Satellite tracking system 'DigiTwist'. By means of two motors, a custom made bar to couple the motors and some software you have a workable solution for tracking amateur satellites.

Members of Finningley Radio Club are also fortunate to have a great Pub/ Restaurant within walking distance so most delegates were able to take advantage of joining others for an evening meal. This, in line with previous occasions is completely informal and as they say, a good time was had by all.



After putting the Antennae Test Range together (results in this CQ-TV) and a hiccup with a camera the Sunday session started with a look at the feasibility of using inexpensive 5GHz 'FPV' products. Dave G8GKQ explained the results of experiments carried out using these modules, which are essentially 'plug and play' and easy to obtain. Coupling them to dish or Yagi aerials provides enough gain to extend the working distance between stations.

In the second session of the day Noel G8GTZ reminded us that there is a TV allocation at 10GHz and that DATV is perfectly feasible at this frequency.

Charles Brain G4GUO then introduced us to the Analogue Devices 'ADALM-Pluto' – a device manufactured for experimentation. This is primarily a SDR with both transmit and receive capabilities. Its introduction has certainly inspired many people as the initial introductory stock have all been sold and we are all hoping that the price does not increase!

On Sunday afternoon we were treated to sessions on DATV best practices which stressed the need for filters on all bands. Dave G8GKQ gave us an update on the exciting Es'hail Geostationary satellite project which will hopefully launch in early 2018.

The weekend closed with Noel giving us a mouth watering view of the big boys toys down at Goonhilly which have recently been used for EME contacts around the world.

### Epilogue:

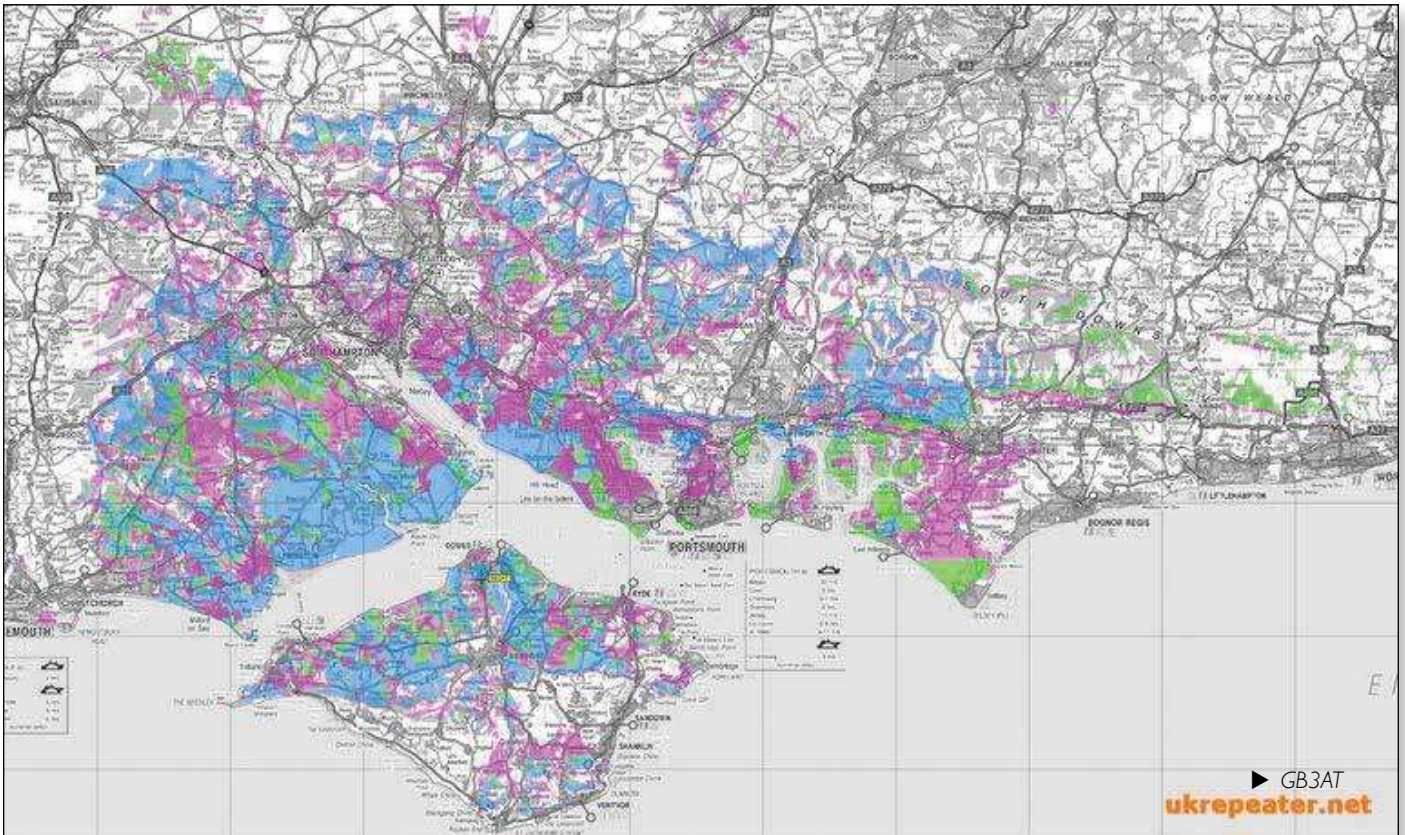
I manned the shop for most of the proceedings and was able to meet many members – great to chat to people with similar interests – and to sell a few parts!

Finningley Radio Club bats way above it's membership of 14 folk and deserves a big vote of thanks for allowing us to bring BATC members for CAT 17. 🗣️

**All the presentations and links to videos on the BATC Youtube channel are available on the BATC wiki: [https://wiki.batc.tv/CAT\\_17](https://wiki.batc.tv/CAT_17)**



# Repeater Update - October 2017



*After months of no news about repeater licensing there have been some updates in the last month.*

**GB3AT** at Cowes on the Isle of Wight has received the NoV for 10,235 MHz transmit and 10,425 MHz receive. The transmitter is currently on in beacon mode and Bob G8MBU hopes to have receiver and logic working shortly.

**GB3IV** - Unfortunately the requested move by the group to Fort Widley above Portsmouth was refused and so the repeater remains off air.

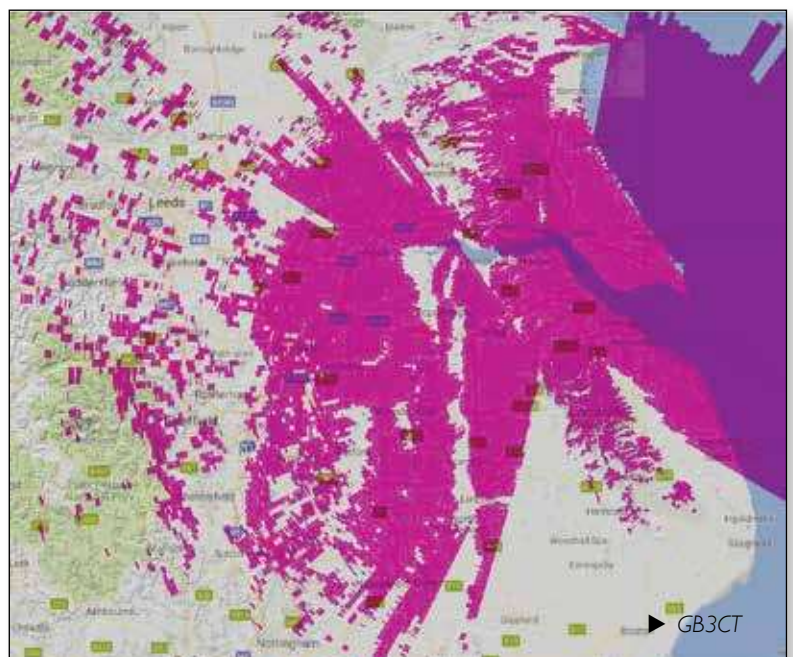
**GB3CT** at Caistor on Lincolnshire Wolds received an NoV in 48 hours setting a record for the fastest ever TV NoV to be issued! The repeater is located at an excellent site high on the Wolds and will transmit on 3404 MHz and receive initially on 2435MHz. The group are running around trying to find bits and Jason G7KPM predicts it will be on air before the end of the year.

**GB3FB** – Spurred on by the success of GB3CT, the GB3FY group near Blackpool have submitted an application for a 3.4GHz output repeater to be co-sited with GB3FT, the proposed 23cms repeater. It is hoped the 3.4 GHz application will enable the repeater to get on air quickly and if both

applications are successful in the future, the repeaters will be run together as a dual output unit. 📡

*For a current status report on these and all TV repeaters visit*

<https://www.ukrepeater.net/tvrepeaterlist.htm>





# The Bang-good 23cm aerial

Dave Williams - G8PUO



*Compact 23cm antennas remain a current topic and aside from making some bi-quad antennas (also known as figure of 8 or bow tie), have been asked to provide a review of one I mentioned in another article, namely the Bang-good 1.2G 14dbi High Gain Directional RX FPV Antenna (Product ID: 1164453).*

[https://www.banggood.com/1\\_2G-14dbi-High-Gain-Directional-RX-FPV-Antenna-p-1164453.html](https://www.banggood.com/1_2G-14dbi-High-Gain-Directional-RX-FPV-Antenna-p-1164453.html)

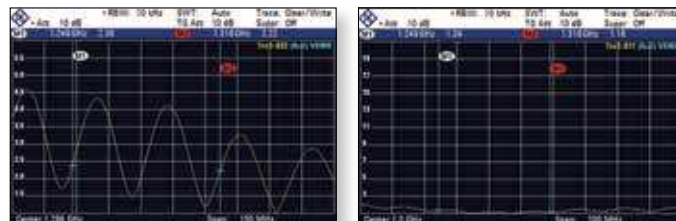
This antenna is a neat flat panel design (Size: 210x180x44), and comes complete with mounting bracket and around 2.9M (old money 9.5ft), length of SYV-50-3 coax complete with a standard SMA connector. The bracket is a typical chrome finish but out in the wilds it may not remain shiny.

With a published frequency range of 1180-1380 and gain of 14 dBi, this low cost 'receive' antenna looked ideal to have a play with, so off went my order. Delivery was within a couple of weeks and carefully packed with mounting bracket all was soon ready to start some analysis, of course starting with a peep at the inside first!



As you will see, this is a slightly odd design (any explanation is welcomed on its design), and the front radome and rear metal plate, together form the antenna. Elements are attached to the Radome and rear plate, so forming the complete antenna when assembled. If this is to be mounted outside, it would probably welcome a smidgen of silicone around the rear edge. A useful 'safety' point is that this antenna is electrically open circuit, so no DC block required or having to ensure the receiver LNB power is disabled.

A Vector Analyser sweep showed a VSWR @ 1249 Mhz of 2.3 and 1318 Mhz of 2.3 which circa aligns with the published spec. Although the antenna is sold for RX FPV, this does lend itself to use not only as a receive antenna but also for low power transmitter use.



► On the left, the 23cm aerial, and on the right the bi-quad

For real-time performance testing, I used my MiniTiouner with a delta antenna comparison with an old home-made bi-quad antenna.

The bi-quad antenna, sitting on my window sill and looking out towards GB3JT shows around -81dBm and 16 dB MER. Note though that this has side panels to provide more directivity.



The Bang-good HG was then held in hand and pointed roughly out of the window in same direction as bi-quad. This showed around -88 dBm and 10 dB MER. However, it is important to point out that this is certainly not a scientific measurement and correctly mounted would see an improvement – just did not want to go outside and get wet!

At the time of writing and after the initial Facebook post, it is good to see interest in this antenna already, as the supplier has just sold out and currently restocking. I have asked for a polar plot but alas has unfortunately not arrived in-time for this review. Will post details when available, or run my own plots in the lab when I get a few moments.

In summary, this £17 antenna (including shipping), was well worth the investment and has room for future testing. If all fails, the radome case would certainly make a great enclosure for a bi-quad antenna, so all is not lost. 🐸



# The Portsdown Transmitter in pictures

Entries to the construction competition at CAT17



▶ Left: MWOLLK's winning entry, and below the very neat compact construction.



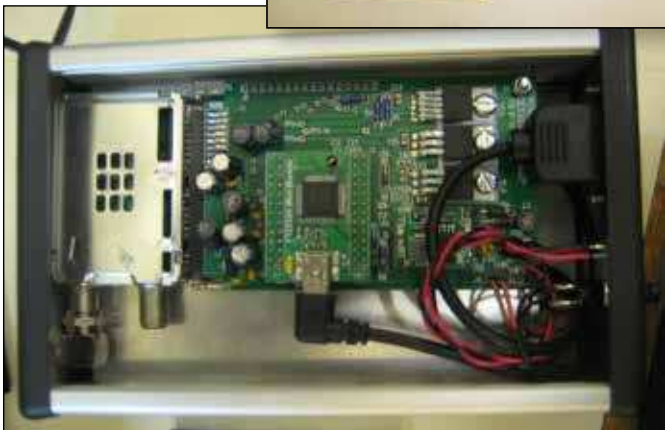
▶ Neat 3D Printed LCD Bezel



▶ Below: Breadboard Portsdown by Tony GOAZQ



▶ Below: MWOLLK's Matching MiniTouner



▶ The BATC Demo Portsdown



▶ Pi Camera on HDMI Extension Lead





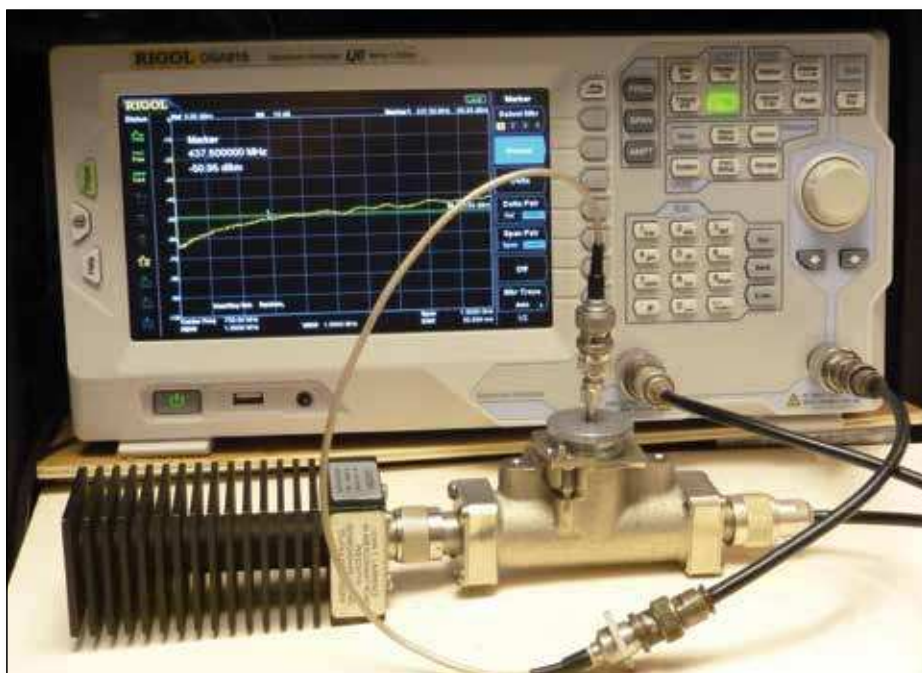
## A Coupler probe for use with the Rigol DSA 815-TG Spectrum Analyser

John Lawrence – GW3JGA

Having acquired a Rigol DSA 815-TG Spectrum Analyser earlier this year, I then required a method of coupling from the output coax of my 437MHz DATV transmitter to monitor the RF signal.

I have a Bird 43 power meter for general power measurements. This contains a precision 50ohm coaxial line into which a suitable detector plug may be inserted.

My Bird 43 came with an aluminium dummy plug which, when inserted, keeps muck out of the coax line and short-circuits the meter to prevent damage in transit. This plug became the basis of my coupler probe.



### Making the probe

I drilled a concentric 4mm hole through the centre of the plug to take a short length of copper sheathed 141 (0.141 in dia.) conformal coax. One end of the piece of coax was already fitted with an SMA connector.

The 141 coax is 3.58mm in diameter and so is a loose fit in the 4mm hole. I drilled a hole at right angles to the 4mm hole and tapped this 4BA to accept a grub screw, (4BA – because the grub screw was recovered from an old radio knob).



I prepared the free end of the coax to leave a small piece of the centre conductor protruding. I passed the coax through the bore and fitted a 47ohm 1/4W resistor between the centre conductor and the outer copper sheath, keeping the leads as short as possible.

I positioned the coax as shown and tightened the grub screw. This should provide adequate clearance between the resistor and the internal coax line. I fitted an SMA to BNC adaptor to provide ease of connection.

### Calibration

Calibration is done using the Tracking Generator facility on the DSA 815-TG spectrum analyser.

I had a spare Bird 50ohm line section (out of its case) so I used this, but a standard Bird 43 could be used. One end of the 50ohm line is connected to the tracking generator output, the other end is terminated in a 50ohm load. The output from the probe is taken to the analyser input, as shown.

The tracking generator output is set to full sweep. The probe is inserted into the line and rotated for maximum signal and smoothest response. On my probe the coupling was -40dB at 437MHz and -33dB at 1249MHz. This is not a precision accessory but enables the transmitter output to be easily monitored for adjustment purposes.



# Turning Back the Pages

A dip into the archives of CQ-TV, looking at the issue 47.5 years ago.

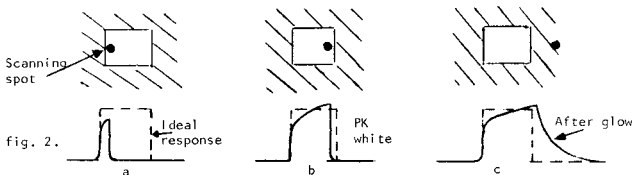
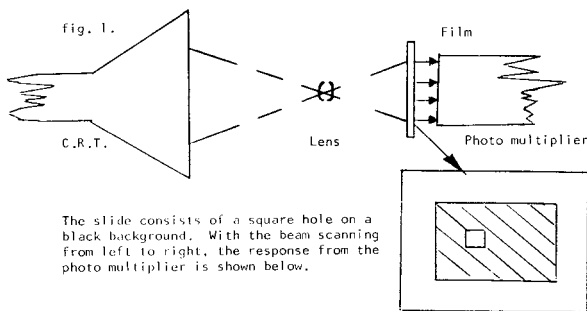
Peter Delaney - G8KZG

## CQ-TV 69

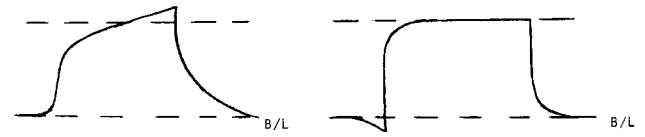
The production of CQTV having slipped behind schedule (hence '47 years ago', rather than 50) CQTV 69 appeared early in 1970. Members were told how they would be credited with a year's free membership in either 1969 or 1970 to compensate for the lack of issues of the Club magazine. This issue had been edited as a 'stop-gap' measure by Peter Blakeborough, before a newly appointed editor took over.

The Club was planning a large Amateur Television Convention, to be held at Churchill College, Cambridge in the July of 1970 (not surprisingly to be known as CAT-70), and the centre 8 pages contained information and a booking form for the event. One of the questions on the form was "I will be accompanied by a lady YES/NO" - which could indicate the 'status' of many members at that time!

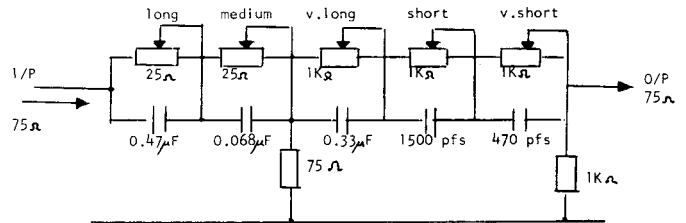
The first technical article (from an un-named author) explored problems that could be caused by the afterglow from a CRT. At the time, a popular picture source was created by using a crt to scan 35mm slides, the light transmitted by the slide being detected by a photo multiplier, as shown in Fig 1, where the slide is a



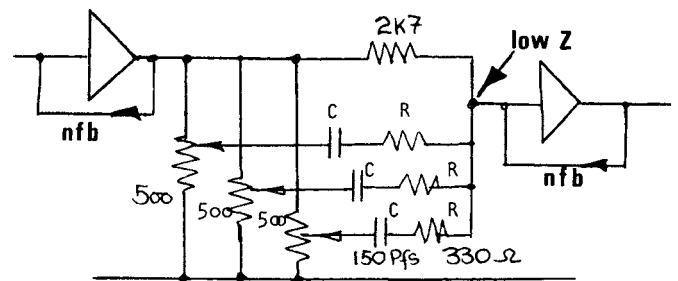
rectangular hole in a black background. The crt phosphor would continue to radiate some light after the scanning beam had moved on, and this would distort the waveform - as shown in Fig 2 a, b and c. The resultant picture displayed on a monitor would therefore show a streaking effect - some short term, some longer. A simple afterglow circuit was shown, with various controls to compensate



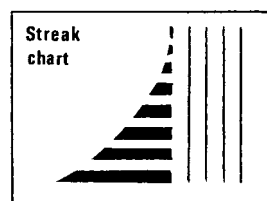
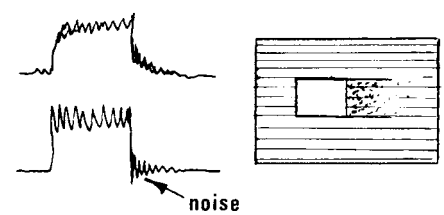
A suitable circuit for such a corrector is drawn below.



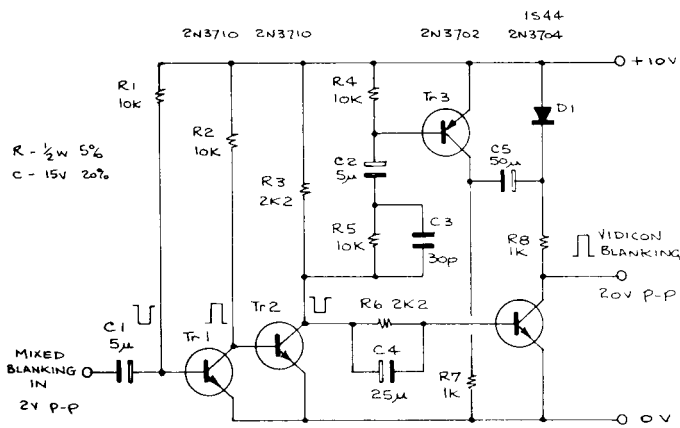
for the streaks, as shown in the waveforms shown above the circuit (B/L indicating 'black level' - the corrected version would initially dip below that level, but that would not be seen on the resultant display). A better method was to use a set of adjustable filters between a pair of amplifying stages. The disadvantage was that the high frequency of the correction circuit tended to add to the



noise signal coming from the photomultiplier. The article included a chart that could be used to test



for afterglow - drawn in black ink and photographed, the resulting negative could be put in the flying spot scanner, and the correction controls adjusted until the afterglow disappeared into the background.



John Lawrence continued his 'Circuit Notebook' series with details of a blanking generator for use with in a vidicon camera. Earlier cameras based on valve circuitry could produce a pulse of suitable magnitude to drive the camera tube's grid, but in a transistorized camera this was less practical. The solution was to mix the line and field rate blanking signals, and use them to drive the vidicon cathode positive by about 20V. This was achieved by adding the supply line voltage to that stored in capacitor C5 during the active part of each line.



The other main features in the magazine reported on displays of amateur television. The Ealing and District Club had mounted a demonstration in Hanwell, using two camera and several monitors around the hall at a model engineering exhibition. One of the cameras was a one inch vidicon type fixed on a tripod, but the other (seen in the picture) used a half inch tube, and had a Sony 'micro tv' hung below it as a monitor. (The monitor in the foreground shows this set up as seen by the one inch vidicon camera). Fed with 100 ft of cable for mains supply and for the video signal, the assembly was described as a 'portable roving eye'.



The other demonstrations had been put on at the RSGB exhibition, with the general arrangements shown in

pictures 1 and 2. Most of the pictures were shown from video tape machines - one in picture 3 replaying 625 line signals, whilst a smaller Philips video recorder seen



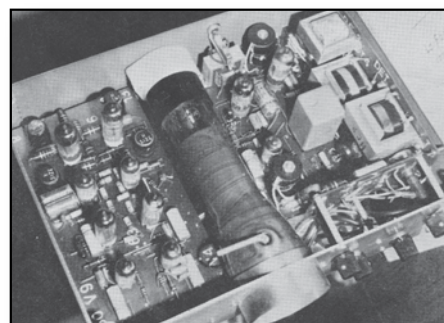
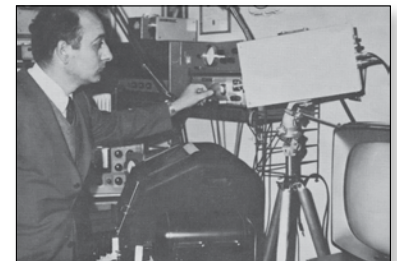
in picture 4 showed 405 live tv. Amongst the speakers was David Mann, whilst a complete pre-recorded programme from the East Anglia net was provided by Ian Waters.

The results from the Philips recorder were described as excellent - the "machine being no larger than a standard audio recorder". (Video recorders for non-professional use were very rare at the time).



One of the present day new techniques is to use 'reduced bandwidth' tv for transmission. In the days before digital television etc, the method used to send television over a narrow bandwidth channel was slow-scan.

An exponent of the art was Prof Franco Fanti, who had used to mode to transmit tv pictures from Italy to amateurs in North America and Canada. He was shown with his slow scan equipment, whilst the slow scan monitor used to display the images on a 3 inch diameter 3FP7 used valve circuitry, as seen in the photograph.





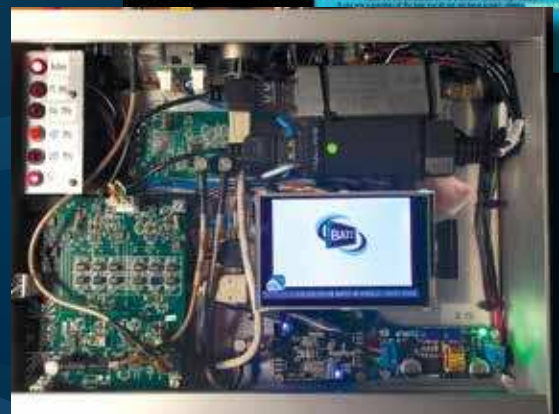
# The British Amateur Television Club



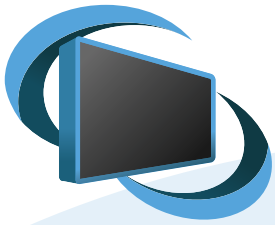
BATC

## 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 projects and much more.
- ▶ A members forum at [www.batc.org.uk/forum/](http://www.batc.org.uk/forum/) for help, information and the interchange of ideas.
- ▶ A video streaming facility at [www.batc.tv](http://www.batc.tv) which enables repeaters and individuals 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.tv/>



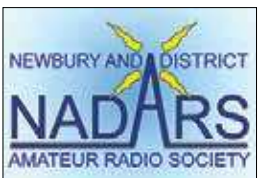
[www.batc.org.uk](http://www.batc.org.uk)



# BATC

## Out and About

RadioFairs



**Rallies and events with an BATC stand:** (subject to change)  
More will be added as they become known.

### 2017

13-15 October	RSGB Convention
5 November	West London
18 November	RADARS, Rochdale

[www.rsgbevents.org](http://www.rsgbevents.org)  
[www.radiofairs.co.uk](http://www.radiofairs.co.uk)  
[www.radars.me.uk](http://www.radars.me.uk)

### 2018

15 April	West London
24 June 15th	West of England
4 November	West London

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

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.**