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Production Team

Ian Pawson G8IQU Trevor Brown G8CJS
Terry Mowles VK5TM

Contributing Authors

Trevor Brown G8CJS
Ken Konechy W6HHC
Chris Leviston M0KPW
John Hudson G3RFL
Klaus Kramer DL4KCK
Mike Stevens G7GTN

Reader contributed articles welcome

Editorial

It's our 5th Birthday. Our first magazine was published in February 2013, so perhaps it's time to pause read what we set out to achieve and review if we have met or are meeting our objectives.

ATV has always been the poor relation of ham radio. Every country has a national ham radio body delivering a monthly magazine, with full time staff and a budget to match, provided by a hefty membership fee. ATV is an input to those bodies, but is small, often one page per issue, sometimes less.

For ATV to thrive it needs more and a publication with a world focus that also appears every month.

You might ask 'can we deliver that'? Well so far so good. Technology is on our side and e-publishing means we can. 5 years ago we floated this idea and met with resistance. The initial attempt was to focus an existing ATV magazine to make it happen and we lost the day.

So we set out on a lonely road to prove it could be done, with a very small team, no resources, just an idea. 5 years later we are still in production and delivering a broad spectrum of ATV articles. It has been harder work than anyone imagined, but has ATV benefited is the question?

Our download figures have at time surpassed our wildest dreams and the stats record that several issues of CQ-DATV have passed 10,000 downloads, so clearly we have readers, we can measure that, but not every issue enjoys that level of success. So what excited people about those particular issues?

Well to be honest, we do not know! CQ-DATV articles have been broader ranging than any ATV magazine from film making to lessons from history on the development of television, but also including many home construction projects. You name it we have covered it! We have been reprinted in other ATV magazines, so we must be doing something right.

We started in issue one with the construction of a 10GHz ATV repeater GB3FY and tracked it over several issues as it evolved recording the success and failures. It's still on the air today and has, like most ATV repeaters, developed an ATV community around it. Although it was analogue in an increasingly digital world, it did break new ground using a YIG based transmitter.

We did not reject digital and by issue 10 Jan Panteltje was showing us how to use the Raspberry PI to generate DATV. Since then others have also followed us down this route, but CQ-DATV was there first.

Home construction has been a cornerstone and hardly an issue has passed without John G3RFL turning on the home etcher and producing everything from power meters to a dummy loads and aerial rotators. We have seen his proposed project list for the future and yes, the best is yet to come.

We have started micro corner and carried out a whole range ATV experiments using off the shelf micros costing less than £5, have revisited I2C for those of you old enough to remember it the first time around and have looked back on TV history from the instigation of colour Television 50 years ago in the UK, to the birth of television news from airborne vehicles. The list is endless.

Our library is open to all and if you missed any of these items please feel free to download a back issue or download the ever growing omnibus of all our back issues.

This issue we have opened up a 5.6 GHz feature so we can explore TV communications using some of the inexpensive modules that are appearing. It might be the future, it might not, but if we don't try we will never find out. So yes we have worked hard and done more than just survive as a publication I hope we have proved that e-publishing works and has provided ATV with its own monthly publication that could not have been done any other way.

Where do we go from here? Well we would hope others would see the light and we could work together to generate one day a single ATV world beating publication producing something that could be read in every country interested in ATV technology. Our team is small, in fact too small. We need more contributors, editors, writers and ideas people,. We have the platform so why not come along and join us. CQ-DATV will be all the richer for your input.

So here's to the next 5 years and a brighter future for ATV not just in the UK but across our shrinking planet as we push the boundaries of communication taking our hobby with it, starting this issue with:-

John, G3RFL's, TFT aerial polar diagram plotter, based on his successful dinner party and introduction to a lazy Susan. John is and always will be an engineer and his take home points from this dinner party, that would be different to other diners.

Mike is still looking at the excellent VMIX Switching & streaming software and external controls delivered by various hardware devices including USB connected switch panels, MIDI controllers and also via Ethernet

Trevor has been looking at the festoon of video connection options from Yellow, Red and White phono sockets (sometimes called RCA connectors), SCART connectors, S Video and HDMI, but recalls this wasn't always the case as he explains and how they evolved to suit emerging requirements is interesting

Ken has produced his DATV report and this issue it kicks off with Art WA8RMC results with his first hand-soldered prototype unit using MiniTiouner-Express PCB blank boards.

We have an interesting article on Mesh and its use in repeaters that first appeared in the ATCO newsletter

Tim G4WIM has written an update on his interesting ATV repeater GB3FB

Chris Leviston M0KPW has started our 5.6 GHz corner using modules that cost around £8 from china, yes you did read that correct £8 it's not a typo, working with Nick G0HIK they have been exchanging pictures and we have the full story in this issue, more on this band in coming issues.

So as we always say sit back and enjoy CQ-DATV 56

CQ-DATV production team

Minitoune Express from USA less than $100 built

Wed Jan 10, 2018 3:30 pm

I just wanted to confirm that "Yes, the MiniTiouner-Express hardware unit will be available soon (within a few weeks) fully assembled, tested, and with a cover for US$75 + shipping (+ VAT where applicable)". Shipping within USA is US$7.00. International shipping outside USA is US$34.

MiniTiouner-Express first pre-production unit with cover

Six "first-article pre-production units" have been built by robots. Art WA8RMC reported that the solder-paste-mask needed to be adjusted under one regulator IC (too much solder paste had been applied). I will begin finishing a preliminary User Guide as soon as my MiniTiouner-Express unit arrives in the mail for me to begin testing.
Differing from Noel G8GTZ's earlier understanding in this thread, the MiniTiouner-Express hardware is intended for anyone world-wide who does not already own a MiniTiouner unit or does not own a MiniTiouner unit with DVB-S2 capability and wants a lower cost unit that is already assembled and tested. **73…de Ken W6HHC**

New BATC web site

We are currently beta testing the new website which includes web site, ecommerce shop, membership database and integrated streamer.

The beta site can be found here: *https://beta.batc.org.uk/*
We are looking for members to be involved in the testing program over the next 10 days - if interested, please PM me at chair@batc. tv

Sad to say that although it is a 'new' site it still relies on old outdated technology ie 'flash' is required to view the streamer which means that it is unusable on Apple and Android devices. Also, anyone with concerns over their PC security will have disabled it in the chrome browser as a matter of course - ED.

Repeater progress

Work on the GB3FB and FT repeaters for the Fylde coast has been progressing steadily albeit with a small pause over the Christmas period. All of the equipment is now in place and connected.

Initial tests indicate there's still some work to be down to improve the antenna situation as the 1.3GHz Alford slot is not working as well as we'd like coverage wise, thus we plan on trying out a couple of these small yagis One pointing North and another pointing South East - not much point wasting RF energy into the Irish sea.

We still await the OFCOM approval for GB3FT but in the meantime can carry out these 1.3GHz antenna experiments under clause 10 / G3WGU.

The 3.4GHz slot (for GB3FB) and the vertical dipole for 144.750MHz DTMF control

The 13GHz tx, the rx module and 3.4GHz PA all located in the loft space of G3WGU the repeater keeper

The 3.4GHz tx for GB3FB needs a small tweak as the PSU is at 14.1V which means the control firmware shuts down the PA as can be seen in picture 143. Fingers crossed the 3.4GHz TX will be on air shortly once this bug is sorted out.

The 146.5MHz rx is working well (and being streamed to the VIVADATV.org website) - Tony G4CBW was able to access it from over 100km away. The same signal is also streamed to the BATC website.

All in all, quite a lot going on DATV wise on the Fylde coast and hopefully will create still more activity in the future.

73 Tim G4WIM

Want to be notified when issues of CQ-DATV are published? Then join our *mailing list*.

Basic VMIX Software IR Remote Controller

Written by Mike G7GTN

Introduction

As we all know the excellent VMIX Switching & streaming software can be externally controlled by various hardware devices including USB connected switch panels, MIDI controllers and also via Ethernet. I wanted a very simple system that allowed IR control of the most basic features. For me this was to be basic switching of sources, Testcards and captions. Your limitation would be your imagination and also how many buttons you have on the remote that you actually want to use. What happens on a decoded IR Button is fully configured by the user via the VMIX setup shortcut control facility.

Hardware

Using one of the eBay ATTINY85 USB based boards alongside one of the standard 38KHz IR detectors to decode NEC IR Protocol the hardware is very modest. Connections are as shown in Figure 1 the data pin from the detector being connected to I/O pin PB0 on the processor module. The power supply for the detectors +5V and GND are taken directly from the three way power connector. My finished project was housed in a Hammond 1551GTBU project box (50 X 35 X 20MM) I fitted an optional 3MM LED on I/O PB1 via a 220Ω resistor to indicate that the unit was actually being USB Powered and hence ready for use.

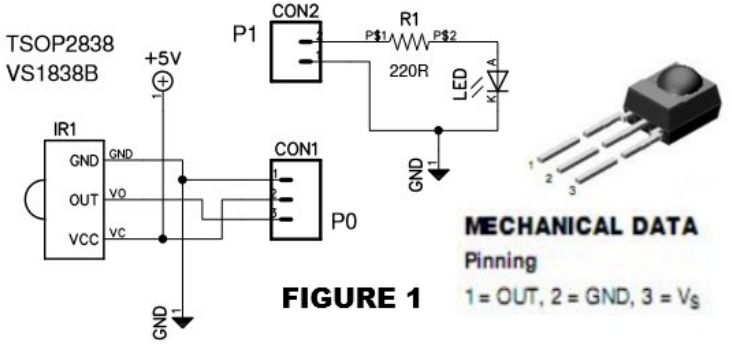


FIGURE 1

Ardunio IDE Setup

With the standard Ardunio IDE installed next we need to retrieve the Digispark libraries to work with the ATTINY85 module. This can be found using the link supplied. Next you need to download & install the Windows drivers again from the link supplied. Once completed you will see the dialogue box depicted in Figure 2

Figure 2 – USB Drivers Correctly Installed

All the listed USB driver files should now have a red tick mark against them to indicate a successful installation. I did have a small USB Connection issue which I resolved by reinstalling the drivers again from scratch.

Discovering your Remotes NEC codes

To get the required NEC codes uncomment the line #define showNEC using a text editor for the display press all required buttons. These will be returned as Binary values which we need to convert back to decimal. Shown in Figure 3 is a sample from the output that I obtained using the small MP3 remote control. These button numbers now need to be fed back in to the Case statement section.

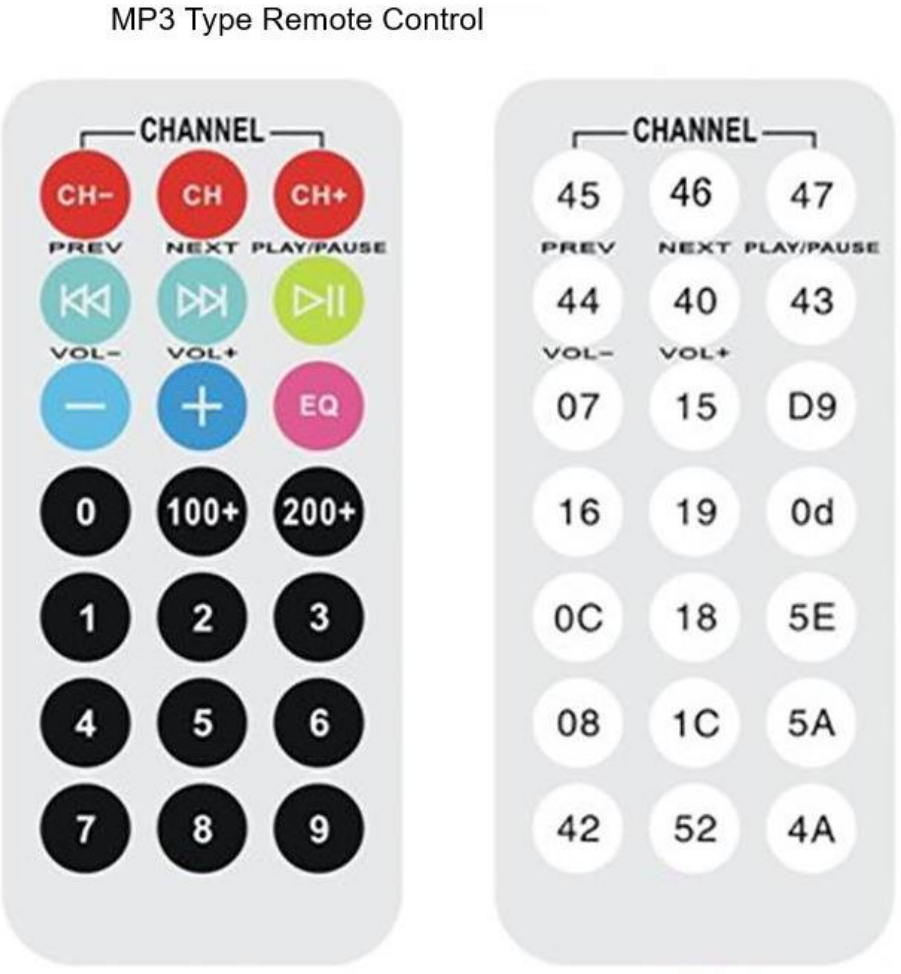


Figure 3 – Hex values which are returned from MP3 Remote Buttons

```
switch (key)  // Decode & Send user shortcuts to VMIX
{
  case 12: DigiKeyboard.sendKeyStroke(4); break;  // Send A
  case 8: DigiKeyboard.sendKeyStroke(7); break;   // Send D
  case 24: DigiKeyboard.sendKeyStroke(5); break;  // Send B
  case 28: DigiKeyboard.sendKeyStroke(8); break;  // Send E
  case 66: DigiKeyboard.sendKeyStroke(10); break; // Send G
  case 74: DigiKeyboard.sendKeyStroke(12); break; // Send I
  case 82: DigiKeyboard.sendKeyStroke(11); break; // Send H
  case 90: DigiKeyboard.sendKeyStroke(9); break;  // Send F
  case 94: DigiKeyboard.sendKeyStroke(6); break;  // Send C
}
```

Firmware

Using the Ardunio IDE and the Digispark USB keyboard functionality library we programme the ATTINY85 module to send keystrokes using the Human Interface Device (HID) commands.

The smaller MP3 type remote control sends the button codes in NEC IR format of 32 bits at a time.

In this project I setup the keys from (A – I) within the VMIX settings section to perform the required functions. So pressing a remote button from Zero through Nine provides the corresponding action.

The file VMIXIR.ZIP is available from the software download page.

VMIX Setup

From VMIX Settings you need to select the Shortcuts section and then the Keyboard tab. Then you select the shortcut key from (A – I) and assign the action you would like this to perform. Pressing the OK Button will save the shortcuts that you have now setup.

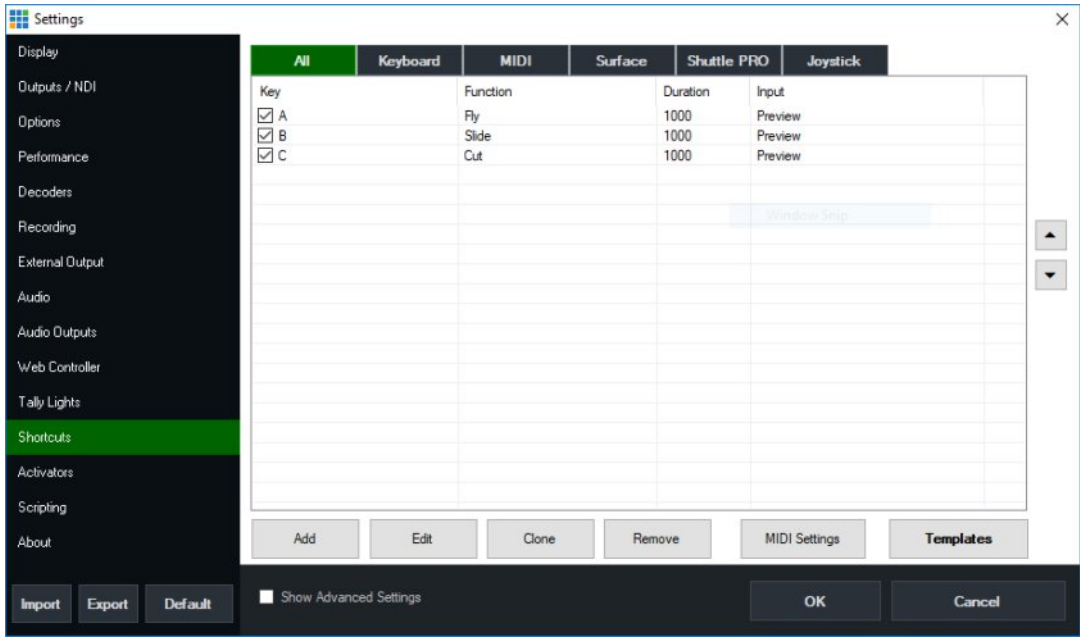


Figure 4 – Sample VMIX settings shown for three user shortcuts

Conclusion

For around £4.50 (including the project box) you can create a useful VMIX IR Controller with parts readily available from many eBay sources. With the current firmware the processor is 67% full. As long as you are able to decode the 38KHz codes for the remote you wish to use, then you decide what action each button will then perform.

Useful links

https://www.arduino.cc/en/Main/Software

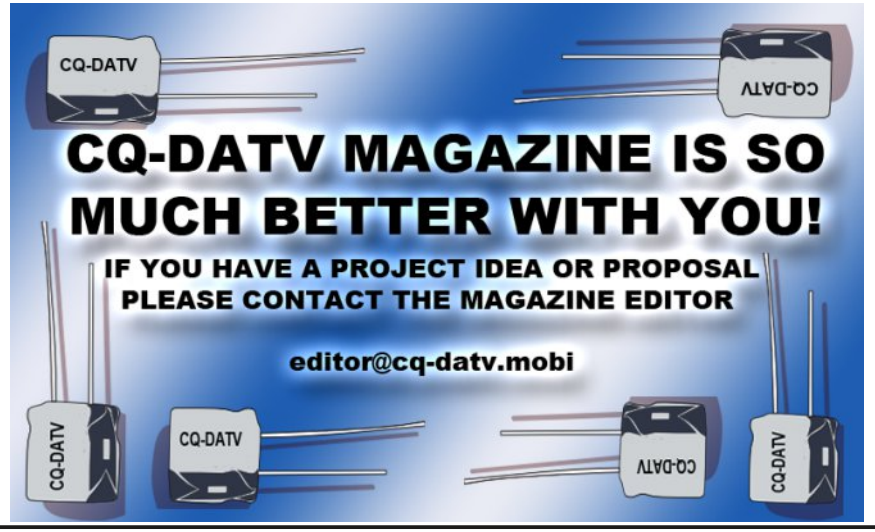
http://digistump.com/products/1

https://digistump.com/wiki/digispark/tutorials/connecting

http://www.sbprojects.com/knowledge/ir/nec.php

https://www.binaryhexconverter.com/hex-to-decimal-converter

https://www.vmix.com/knowledgebase/article.aspx/83/shortcuts



Check out the DKARS website at:-
http://dkars.nl/

Ham MESH Status in Central Ohio

From the ATCO Newsletter, January 2018,
http://www.atco.tv

Over the last 3 years, Ham Mesh has grown in number of stations, activity and applications in the US as well as Central Ohio. This exciting mode of operating is another form of the Digital evolution all around Amateur Radio. Packet, PSK 31, DATV, DMR, System Fusion, D-Star, JT 65/9 and LT 8 digital modes are all good examples.

The great enabler for these new modes is computing power in PC or embedded in the radio (like DMR, System Fusion). Amateur Radio is better as a result.

A little history

Before 2010, a Texas group formed Broadband-HamnetTM (BBHN) to focus on writing software to run on the ever-popular Linksys WRT-54G Routers. This effort was quite successful and many Hams got started on Mesh using the Linksys routers and the BBHN software. Many of the early technical standards and terminology created by BBHN are still in use today.

An Amateur Radio Group called Amateur Radio Emergency Data Networks (*AREDN.org*), with many of the same BBHN developers was formed to focus on Ham EMCOM. AREDN began using a sub-set of a new hardware/software platform from Ubiquity Networks (*www.UBNT.com*) in 2015.

AREDN Software takes advantage of a number of these outdoor rated, High Power devices (aka Nodes) which can be used on part 97 Ham Frequencies to avoid the part 15 interference of normal routers.

Enter ATCO in Mesh

In the Spring of 2014 at one of our Saturday Breakfast discussions, the topic came up on how ATCO could attract new (read young!) members to our club. We had already accomplished being the first North America Digital ATV repeater. Since the majority of the Breakfast participants were "Techie" by nature, we chose this path instead of the "Social" path to gain new members (ATCO still has this problem today!). During our brainstorming, MESH was suggested as technologies that may help ATCO grow in future years. The first problem was very little was known in our group about MESH! As Techies, we could learn!

Present Day Mesh in Central Ohio

Figure 1 is a snapshot of many of the full time Nodes that have registered with AREDN and displayed on their website. Nodes used mobile (AA8XA & W8RUT have full time mobile Nodes), portable (mostly used during ARES events) and experimental (Like the Solar powered, e-Bike, "Node in a bag" Nodes) are not shown.

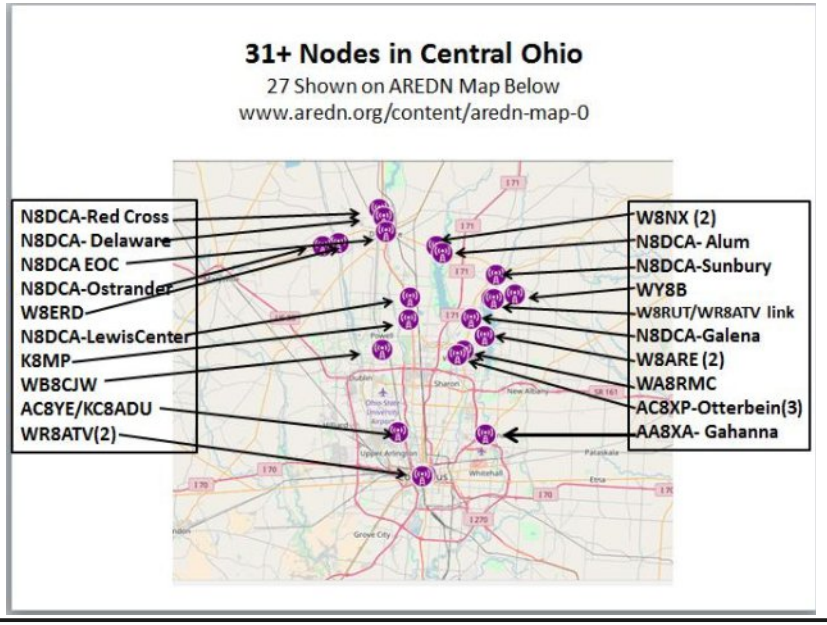


Figure 1

Also, not shown is K8OC-Portable (Otterbein College club call) operated by AC8XP from various locations around campus. We hope to interest some of the students at Otterbein.

The Nodes with call signs N8DCA (Delaware County ARES), AA8XP Gahanna, WR8ATV are on towers 120 feet to 180 feet tall with WR8ATV (co-located with the ATV Repeater) at 650 feet above street level.

More high place nodes are needed, with Nodes in Westerville and Upper Arlington in the planning/approval stage. We do need more tall sites in the other (mostly south of I-70) suburbs so if you know of any, please let me know.

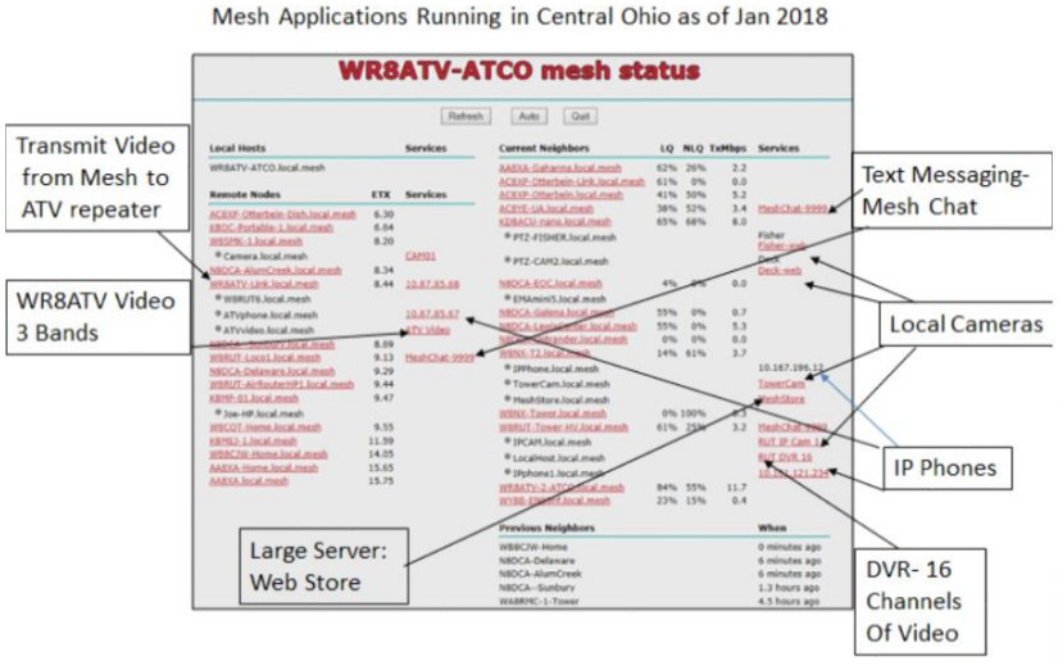


Figure 2

TV Amateur is a German Language ATV Magazine It is published 4 times a year and if you would like to subscribe go to *http://agaf-ev.org/*

Antenna Polar Diagram Plotter

By John Hudson G3RFL

Ok so it was one of those posh dinner parties, I had seen "Pretty Woman" I was well on top of which knife and folk to use for which course, but what really took my imagination was the revolving table centre piece, Julia Roberts never had to deal with one of those in the film.

It was a clever piece of construction, using the top of an old beer barrel, that somehow I was not involved in the emptying of, but you cannot win them all. When the table was clear and the guests had moved to another room, I did sneak a look underneath to see how it revolved and well it was quite simple. It had a manufactured bearing built on two plates that could be adapted to almost any surface.

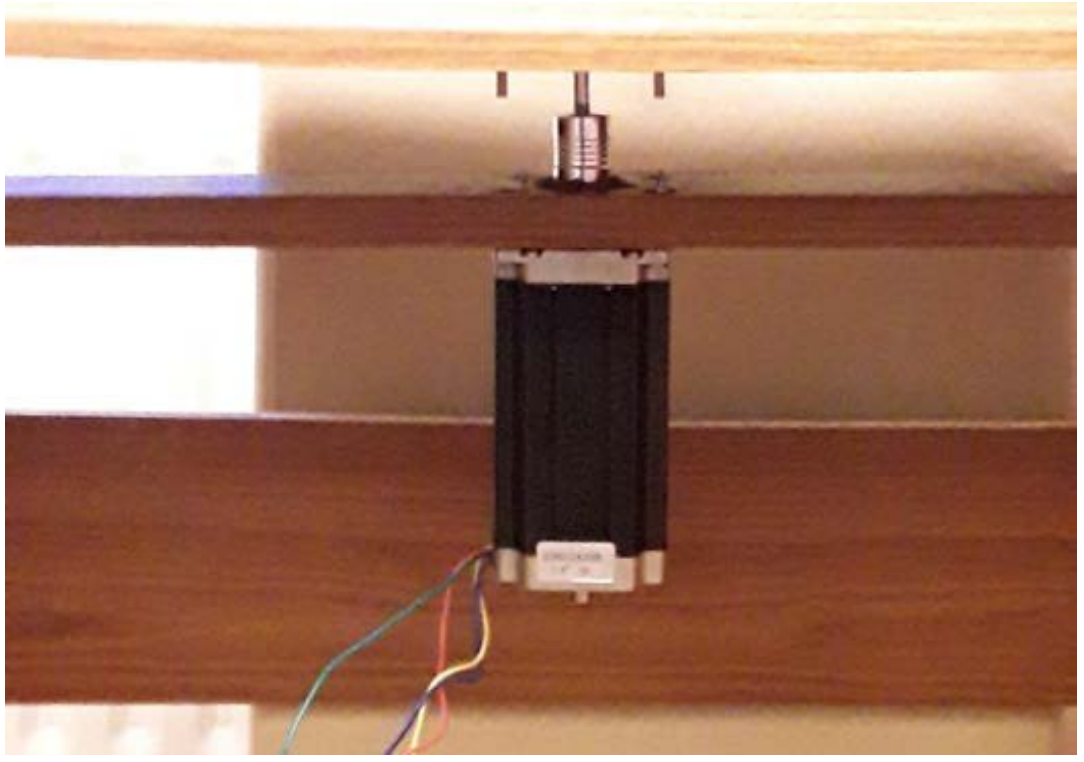
Underneath the Lazy Susan

Ok so I had to pump my host for the name of the device, what to search on and for those of you like me that perhaps do not move in these circles and have not come across one before, it's called a Lazy Susan.

It was the solution to a problem I had been working on, plotting on an LCD screen, polar diagram of an small aerial.

I had already covered the bare bones of this article in CQ-DATV 54 as an RSSI power level detector using the AD8313 chip to detect RF from 0 to 8Ghz and actually to 10.5 Ghz.

The next stage was to be able to rotate the aerial or any other piece of kit through 360 ° and plot the result onto an LCD screen and here was the solution to the rotating part of the problem, if it could be interface to a stepping motor, something that was not covered on the website for these Lazy Susan devices, but if was, then there would be nothing to invent.



So I added a stepper motor with what can only be described as a direct drive. Just some simple joinery below the turn table. the actual woodwork was an old TV table with centre shelf removed the direct coupling was via a bolt and a spring shaft coupler from eBay.

Motor Shaft 6mm to 10mm Joint, no drilling required on this version

I did have to drill out the spring coupler to fit the stepper shaft, which again surprised me, obviously designed for a smaller motor like the one Trevor chose for his aerial rotator project in CQ-DATV 46.

This worked well as I was unable to find an empty barrel anywhere, they were all supplied full and although I did have a solution to that, I resisted. The top of the turn table required some way to mount the aerials under test. My solution to the problem was a small vice.

The 3D printed aerial from CQ-DATV 35

Stepper Motor Driver Module

The next problem was the stepper motor driver and this was a custom module available on eBay, there are a lot to choose from but I went with TB6560 CNC 3A Router Single 1 Axis Controller Stepper Motor Driver Module.

At under £4 it's not worth putting something together yourself.

1. Working voltage DC 10V-35V.you are advised to use DC 24V

2. It use high speed light lotus root to sure high speed with no step out

3. There is low pressure off, stop when overheating or strong current

4. The rated maximum output: ±3A?Vpp 3.5A.

5. Suit for two-phase/four-phase/six-phase, stepping motor under 3A current, but not suit for stepping motor higher than 3A.

6. Half a stream automatically

7. Subdivide: synchronizing, half step,1/8 step,1/16 step,16 divide at most

8. Size:50x75x35mm

I was surprised that rotating the turntable did not require any great current from the stepper motor driver, this may have been due to the rather smooth running bearings, my good joinery or just the light equipment under test, coupled with the light duty cycle of a single rotation to produce a plot. The stepper motor has a lot of grunt and so will cope with stiffer bearings and or heavier kit, having power in reserve is always useful

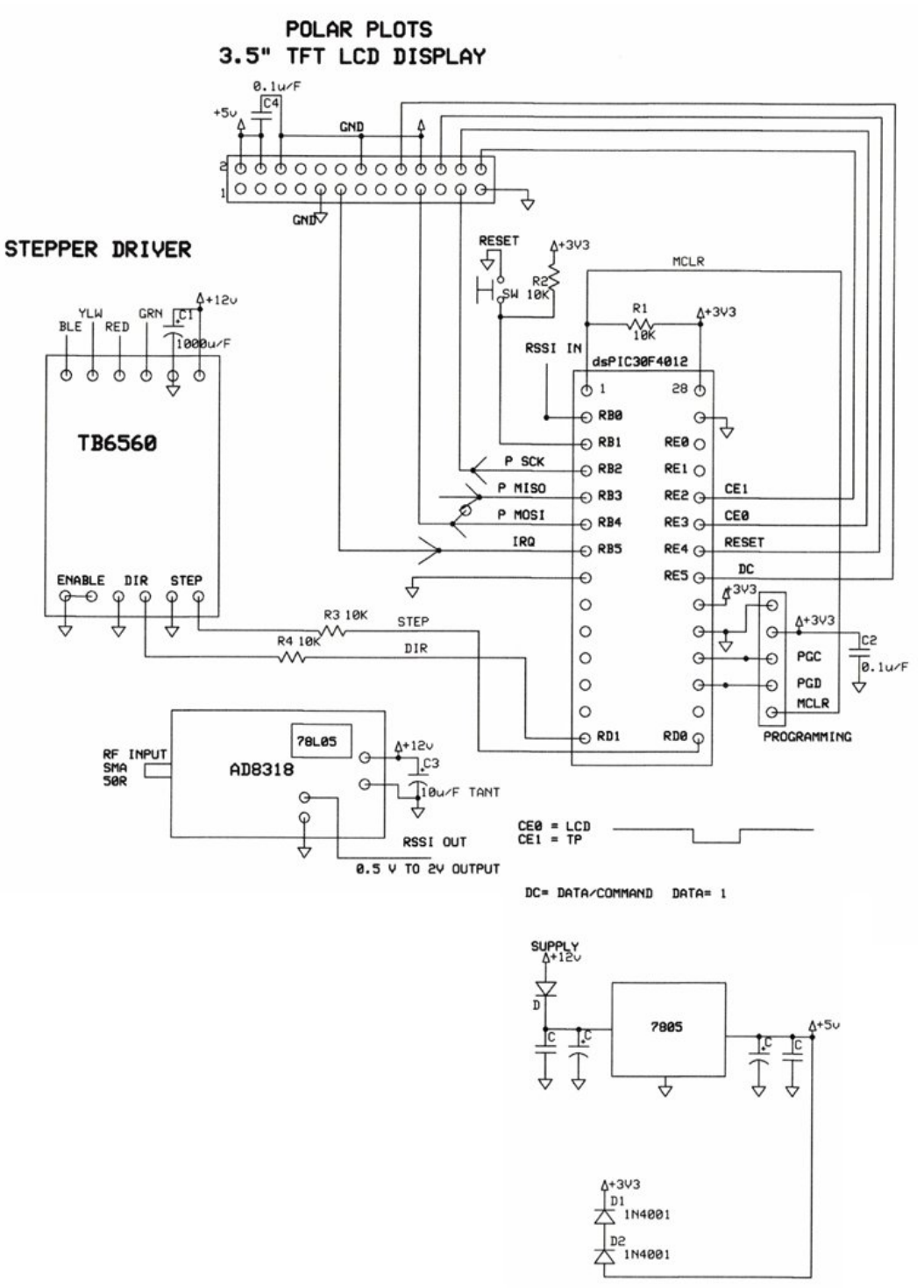
At some point the wood working and the pre made modules come to an end and you have to get your head around designing the electronics, writing the software and making the project work, to that end this is what I came up with. ➔

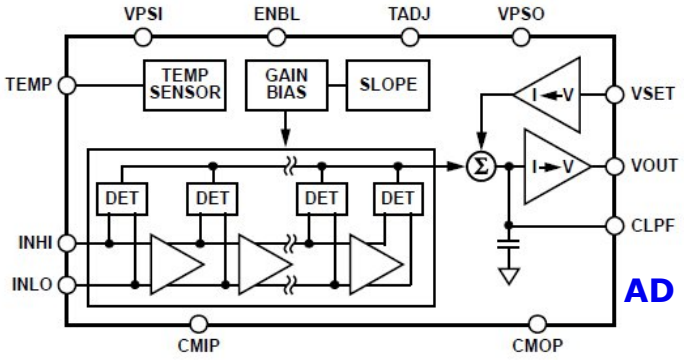
The TB650 provides sufficient current gain that the feeble outputs of a DSPC30F4012 can drive it direct, so all that was required was for me to write the software to control the rotation, what can possibly go wrong, well there were one or two attempts but I never let PIC code defeat me.

Once I had the table rotation part of the code written I could turn my attention to the display. This was something I frequently done in the past on several CQ-DATV projects, using the same TF LCD display. I have the display set to 320 X 480, I can only have 160 pixels full 30dB range I think it's good enough.

The RF pickups based on the AD8318 that was covered in CQ-DATV 54. The device was purchased as a complete module.

This is a demodulating logarithmic amplifier, capable of accurately converting an RF input signal to a corresponding decibel-scaled output voltage. It employs a progressive compression technique over a cascaded amplifier chain, each stage of which is equipped with a detector cell. The device is used in measurement or controller mode.





AD 8318 Block Diagram

The AD8318-EP maintains accurate log conformance for signals of 1 MHz to 6 GHz and provides useful operation to 8 GHz. The input range is typically 70 dB (re: 50 Ω) with error less than ±1 dB. The AD8318-EP has a 10 ns response time that enables RF burst detection to beyond 45 MHz. applications.

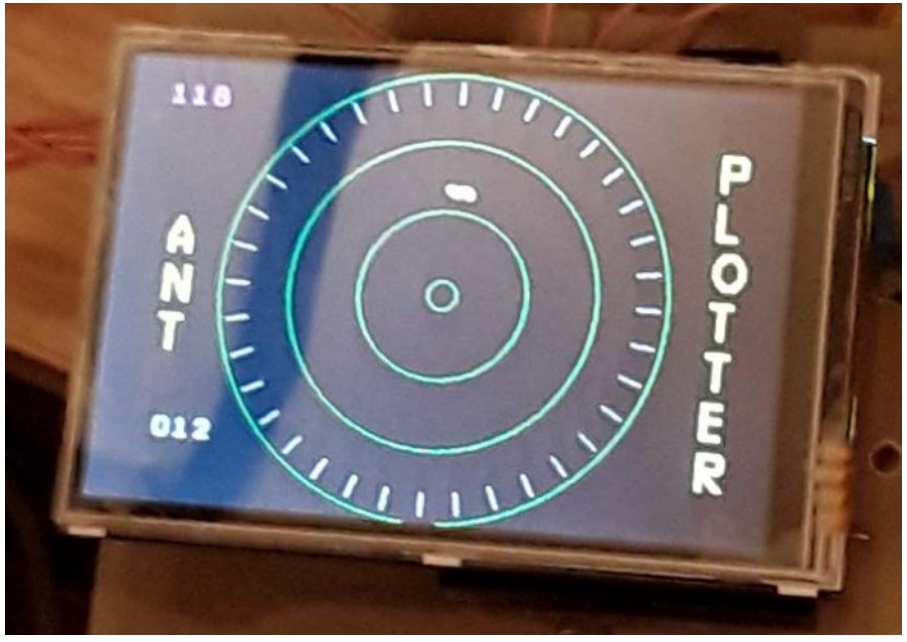
As a measurement device, Pin VOUT is externally connected to VSET to produce an output voltage, VOUT, which is a decreasing linear-in-dB function of the RF input signal amplitude. The logarithmic slope is nominally −25 mV/dB but can be adjusted by scaling the feedback voltage from VOUT to the VSET interface. The intercept is 20 dBm (re: 50 Ω, CW input) using the INHI input. These parameters are very stable against supply and temperature variations. The AD8318-EP is fabricated on a SiGe bipolar IC process and is available in a 4 mm × 4 mm, 16-lead LFCSP. Performance is specified over a temperature range of –55oC to +105oC.

Additional application and technical

As with the stepper driver module the AD 8318 is available as a pre built module, that for surface mounted components comes highly recommended and again at prices that will not break the bank. The output of the AD 8318 module is connected to pin 2 RD0 of the dsPIC30F4012 micro. The code to pre programme it is available from the CQ-DATV download site *http://cq-datv.mobi/downloads.php*

The AD 8318 module as purchased from eBay

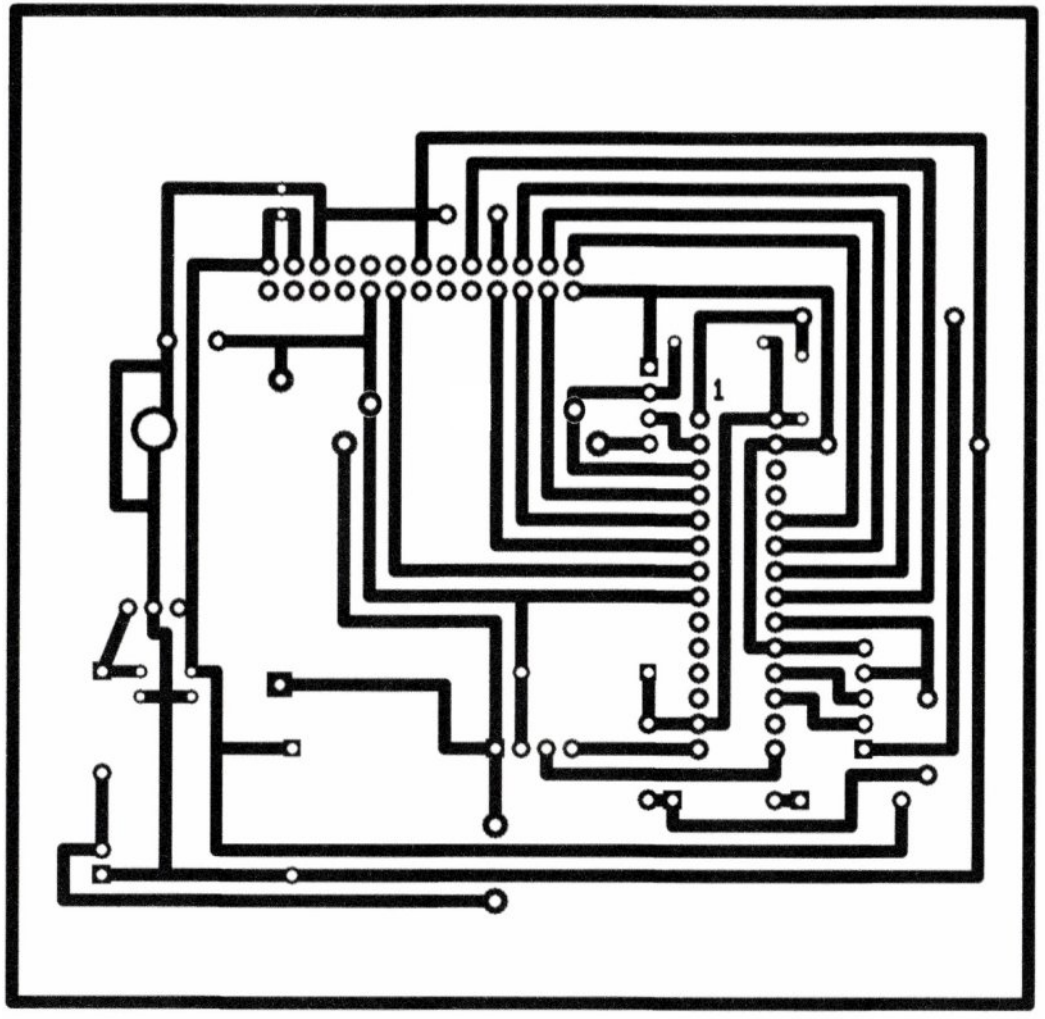
The first test was to plot the polar diagram of the 3D printed aerial covered in CQ-DATV 35. The test aerial was mounted in the small wave guide transmitter and clamped in the vice, and powered up. The SMA connector on the AD 8318 detector was fitted with a small pick up about 2 mm of wire and the unit was mounted on the LAZY SUSAN and placed at a distance so it reads 1m/W or 0dBm.



The TFT screen the display rings are set at 160 110 60, 10. 160 is the outer ring

All that remained was to press the reset button the button this will start the plotting and rotate the table slowly through 360° and create the plot on the TFT screen.

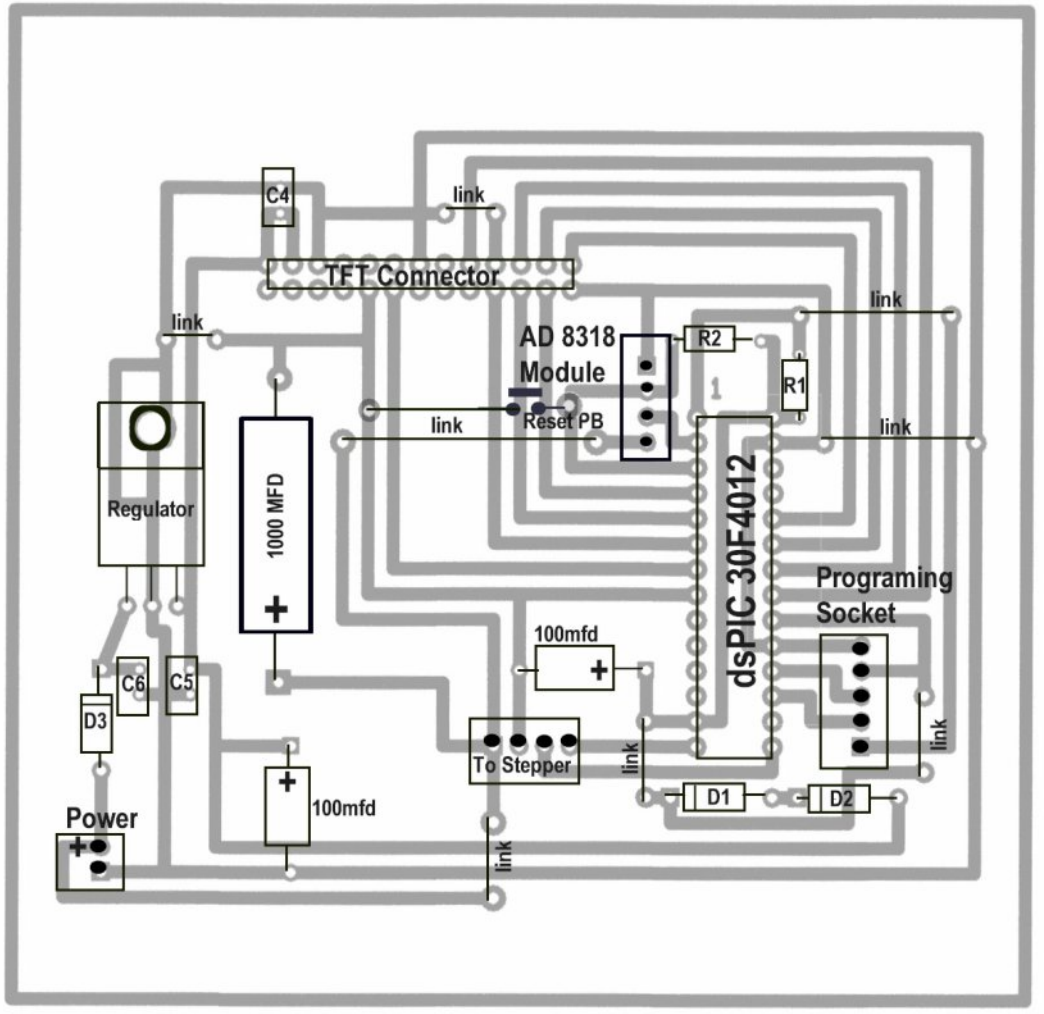
The final construction was on a home etched single sided PCB, I included a socket so the PIC could be reprogrammed without removal, two other sockets are for the connection of the AD8318 module, which includes the reset push button and a further socket to connect to the stepper motor. The module will eventually be housed in a Maplin box as seems to fast becoming the standard for all my projects.



Note: All past issues of CQ-DATV as referenced in this article are available for free download from:

http://www.cq-datv.mobi/ebooks.php

Left pcb track layout and below pcb component layout
NOTE: Not to scale



DATV-Express Project - December update report

Written by Ken Konechy - W6HHC

Art WA8RMC reported great results with his first hand-soldered prototype unit using MiniTiouner-Express PCB blank boards. The prototype hardware unit is shown in Figure 1. Art's initial testing demonstrates a higher sensitivity value than any set top box he owns. WA8RMC thought his Geosun set top box unit that we use at the WR8ATV repeater was as good as it gets, but this one is better and more stable.

The Geosun set top box units display frequent pixelation at the signal reception threshold but the MiniTiouner-Express unit is quite stable at that point with no pixelation. But, if I reduce the signal level of either just one dB, they drop out of lock as expected. The signal level at which the cliff effect takes place on the MiniTiouner-Express hardware prototype is -94dBm reliably (when receiving a transmission with FEC=7/8 and an RF BW of 5 MHz), which is about 5 dB lower than his sensitive Geosun STB.

Figure 1 – Hand-soldered prototype using MiniTiouner-Express PCB with Serit NIM. The NIM lies flat underneath the PCB assembly.

The MiniTiouner-Express hardware unit is designed to run with MiniTioune software developed by Jean Pierre Courjaud, F6DZP. Jean-Pierre F6DZP has been modifying Digital-ATV receivers for DVB-S protocol with software for years (and recently also DVB-S2) - in order to allow the tuner to provide information that hams need. The main problems with commercial DVB-S receivers are

(a) that if the signal is not good enough - they show only the "blank screen of death" and

(b) they do not work with smaller Symbol Rates that some hams want to use.

The MiniTiouner receiver/analyzer software from F6DZP solves these two problems. Figure 2 shows a screen-capture of WA8RMC's transmission received via the ATCO clubs DVB-S on 1268 MHz using F6DZP's V.0.6b software.

Three NOTES:

1. The received signal from the WR8ATV repeater is from about 15 miles away through trees.

2. The F6DZP software v0.6b being run with MiniTiouner-Express hardware does not yet recognize this hardware unit…hence Fig02 displays "NIM = SeritPro".

3. Jean Pierre F6DZP reports that the next version of the 'MINITIOUNE software that he releases, v0.8a - Receiver/Analyser DVB-S/S2 144 MHz to 2450 MHz - for MiniTiouner/ MiniTiouner-Pro/ MiniTiouner-Express', will correctly recognize the MiniTiouner-Express hardware.

WA8RMC's intent is to produce a smaller and assembled and tested version of the Serit NIM PCBA design at an affordable price.

The MiniTiouner-Express project team has decided to sell the MiniTiouner-Express hardware unit (with cover included) at US$75 plus shipping from USA (plus any applicable VAT).

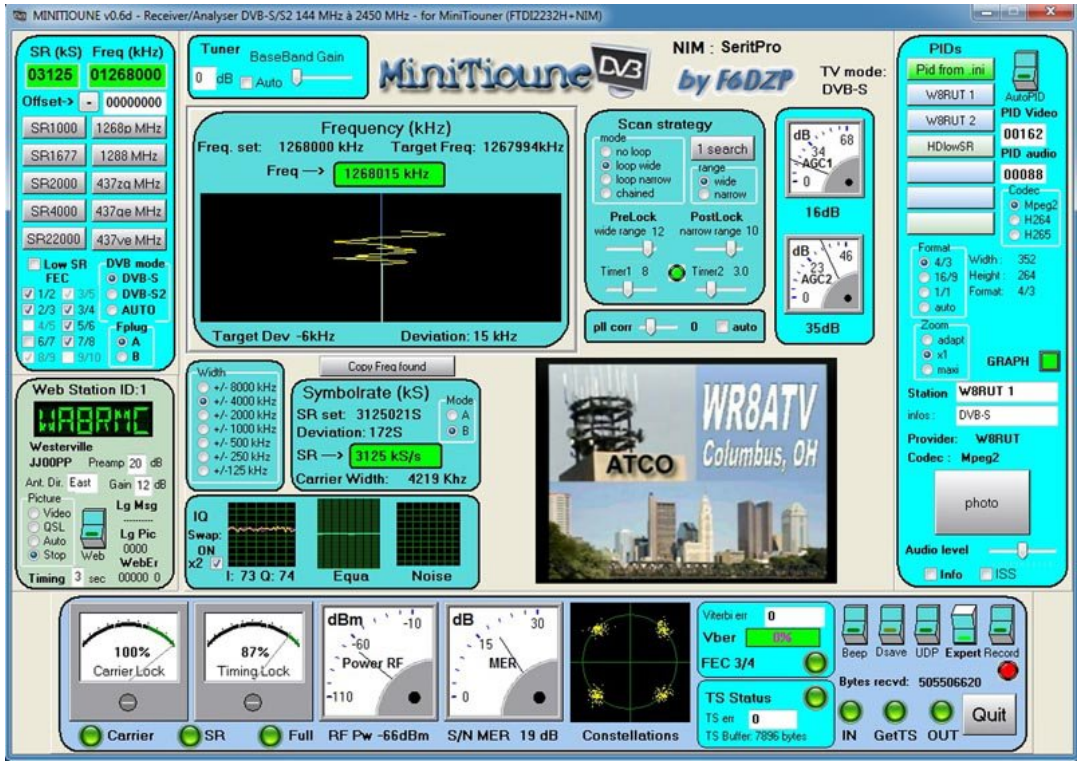


Figure 2 – Screen-capture using F6DZP MiniTiouner v0.6d software being received from ATCO WR8ATV repeater (about 15 miles away)

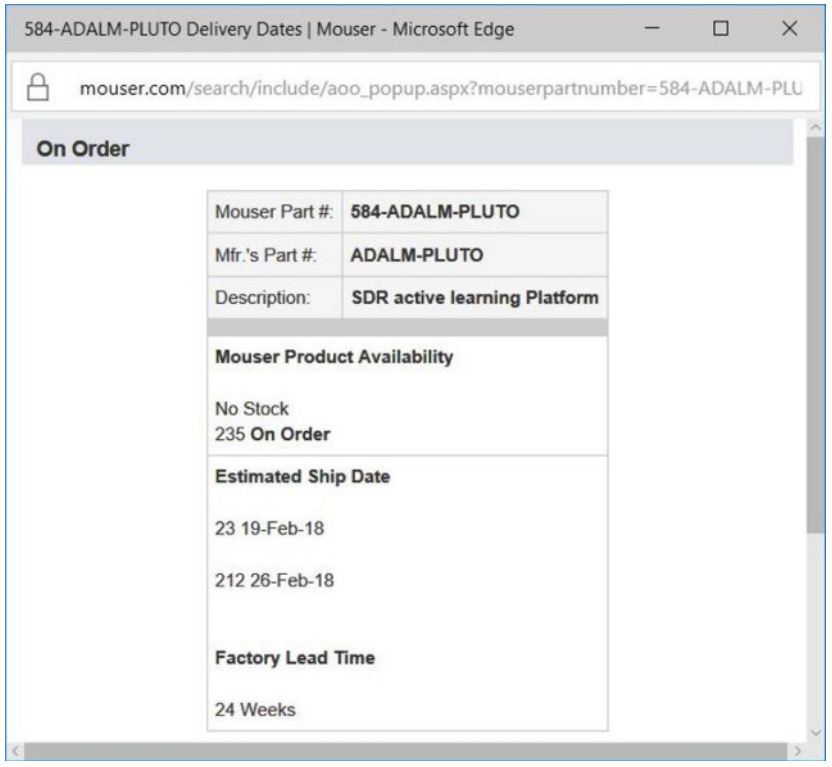


Figure03 – Screen-capture from electronic distributor, Mouser USA, on latest PLUTO-SDR Tx/Rx availability.

Art reports that he expects to robot-assemble the "first article" MiniTiouner-Express PCBA around January 05 and then begin testing.

Finally, Analog Devices appears to have delayed the next PLUTO Tx/Rx lot availability in order re-spin the PLUTO PCB. The PLUTO availability slipped out from 16 weeks…to 24 weeks, see Figure 3 from electronics distributor, Mouser USA.

Charles G4GUO had spotted an Analog Devices explanation of the PLUTO availability delay in the release-notes of Analog Devices which described a circuit change in the PLUTO PCB to improve the PLUTO power-supply noise.

"Project speed set to slow" …. de Ken W6HHC

M0KPW 5.6GHz ATV

Written by Chris Leviston M0KPW *http://m0kpw.com/*

Introduction

I had always thought of ATV as something that would interest me, but knowing absolutely nothing about microwave bands and not being a dab-hand a 'home brew' I always knew it was nothing more than me thinking 'that's something I'd like to try... one day'.

Then many many years later I read a short article in the ATV column of the September 2017 edition of RadCom that stated 5.6GHz ATV could be achieved by using cheap 'First Person Video' (FPV) transmitter and receiver units – intended for use in drones - for less that £30.00.

As I would see, £30.00 may have been an underestimation the way I did it, but hey – the world of ATV was now within reach.

Having discussed it at our radio club, it was clear there were a few others interested in this and we set up a project with an aim of getting 2 or 3 completed stations set up and working. Nick, G0HIK, was first to get started and built up a station using a dish as the antenna, relay switching for RX and TX and a host of other features all built into one.

I opted for something slightly different, and that is what I shall describe here. Although my system would ultimately cost more (mainly due to 2 antennas as opposed to 1) it was a method more within my capabilities (relays and the like are not my forte) and it shows that ATV can be achieved without too much technical know-how. Plus it allows us to compare the differences in two slightly diffident station set ups, yet delivering essentially the same thing... 5.6GHz ATV.

My station comprises of the following:

- *TX unit and camera*
- *RX unit and monitor (and speakers)*
- *2 panel antennas*
- *12v battery supply and power distribution*
- *Media card reader for test card / call sign display*
- *5v supply*
- *Tripod*
- *Beacon unit*

Each section is described in detail below...

TX unit and camera options

The RadCom article talked about First Person Video (FPV) transmit and receive units (used predominantly for drones), and these are the essence of the station. So the first thing I did was email the British Amateur TV Club (BATC) – who had written the article - for more information on the units required.

Upon receiving a speedy response, I ordered a couple of TX units from eBay – the units cost around £8.00 each and would be delivered from China.

The order was placed (along with RX units, described further down) and they arrived in about 10 days – which was very quick indeed.

These first set of units were actually used by Nick, G0HIK, for his system, so I ordered some more – these took over 2 months to arrive, so in the same time I placed an order for an addition 2 units from a UK seller, which costs slightly more, but arrived within a week.

The TX units in question are : TS58285.8GHz 600mW 32 Channels Mini Wireless 2dbm A/V Transmitter Video TX.

They offer an output of just 600mw, but this combined with excellent gain on suitable antennas, can make signal acquisition over a distance of 80 miles. The units can be set to a certain frequency (channelised), and the recognised standard for 6cm ATV in the UK is 5665MHz so it was important to ensure this frequency is covered.

These units offer 32 channels covering bands A, B, E and F and have two switching buttons for the band and channel. Conveniently they feature power off memory for last channel and band saving, so once set you don't need to worry about setting the frequency again.

Specifications:

- *Video format supported: PAL and NTSC*
- *Antenna connection: RP-SMA (Reverse Polarity SMA – more on that later)*
- *Power input: 7 – 24 Volts*
- *Transmitting power: 600mW*
- *Supplied antenna gain: 2dbm (the supplied antennas were not used, other to ensure the units worked)*
- *Working current: 310mA at 12V*
- *Video bandwidth: 8Mhz*
- *Audio bandwidth : 6.5Mhz*
- *Dimension: 23x 25x 7.7mm (excluding antenna)*

Frequency range:

- *FR1 5865, 5845, 5825, 5805, 5785, 5765, 5745, 5725 MHz*
- *FR2 5733, 5752, 5771, 5790, 5809, 5828, 5847, 5866 MHz*
- *FR3 5707, 5685, 5665 , 5645, 5885, 5905, 5925, 5945 MHz*
- *FR4 5740, 5760, 5780, 5800, 5820, 5840, 5860, 5880 MHz*

As mentioned above these units use RP SMA connectors – so an adaptor is required to connect to the panel antenna which has an N type female. A RP SMA Male to N Type Male adaptor was acquired for a few pounds, again from eBay.

The TX unit does get quite hot when transmitting, even for short periods, so a piece of head sink was glued to the back of the unit to help with heat distribution. As nearly all ATV activity takes place outside the cooler surroundings also helps with this. A 12v fan to cool the unit may be added if required.

The TX unit was mounted in a case which allows for direct connection to the panel antenna. The units come with a lead supplied for power, audio, video and ground, making for easy connection.

RCA phono sockets were added to allow easy connection of video and audio sources (the ground was added to the video source). As there is no obvious way of knowing if the unit is powered up (there's no LED or anything to indicate if power is on), so a simple LED was added to show that power, and therefore TX, is on.

A power lead comes from the bottom of the case and is plugged into the 12v power distribution unit (described further down).

As RCA phono sockets were added, this allows for different AV devices to be used. For ease and initial testing 2 small 12v cameras were used. Any video camera with a composite source will work and these have also been used.

I already had a 12v car reversing camera in a drawer in the shack so that was used initially and worked well, giving clear video signals. There were a couple of downsides to this camera, one being that it was video only, so no sound was possible and the other was that as it was a 'reversing camera' intended for a car it had red, yellow and green 'marker lines' that were transmitted. Not the end of the world, and certainly fine for testing purposes.

An added bonus was that the camera was waterproof, so ideal for using during winter!

Options for a new 12v camera seemed to be limited, and it always seemed to be a 'compromise' when finding alternatives. Another camera which was used offering the added bonus of sound, but only a black and white video signal. But again, the low cost (about £5.00 a camera) from eBay made it a suitable choice when trying to keep the cost of 'sundries' down.

These little 380 line PAL black and white mini cameras were brand new and feature switching infra red and have sound. The infra red LED's automatically switch on when light levels get low. They have standard AV connectors for audio and video and require a 12v power supply – a must as I wanted to power all the kit from one 12v distribution unit. The main body of the camera is just 35mm x 25mm x 15mm and they are fitted with a 3.6mm lens.

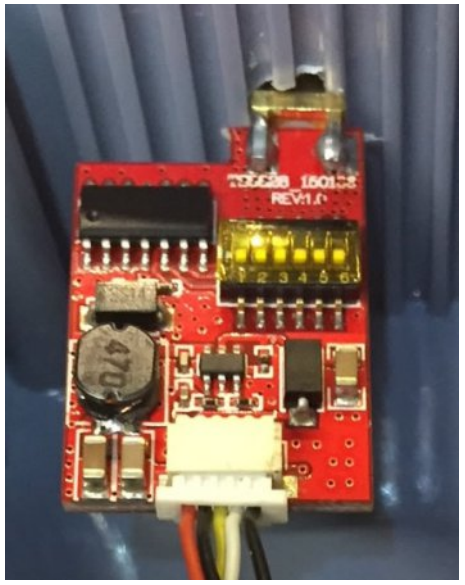
What the black and white video looses, the audio quality from these cameras more than compensates for. As these ATV systems are FM, the audio is just like any other FM signal – loud and clear!
As already mentioned, I use separate antennas for transmit and receive. More details of the antennas is further down, but for TX a 5.8GHz 24dBi 'Gibeon' panel antenna is used – which covers down to 5665MHz with an SWR of 1:1.

I used slightly differed panel antennas for RX and TX simply due to supply issues, and being only able to purchase one of each type – unless I wanted to spend well over £100 per antenna. As it is the antennas came in at a little under £100 for the two – so slightly more than the 'Get on ATV for under £30.00' RadCom had promised!

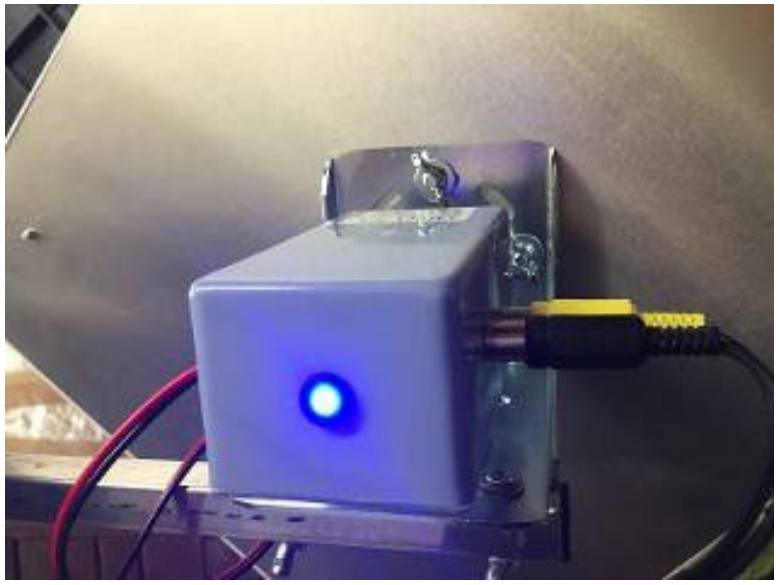
RX unit and monitor

Similar to the TX units, the RX units were ordered via eBay at a cost of around £10 each and were delivered from China within 10 days (the second batch again taking over 2 months).

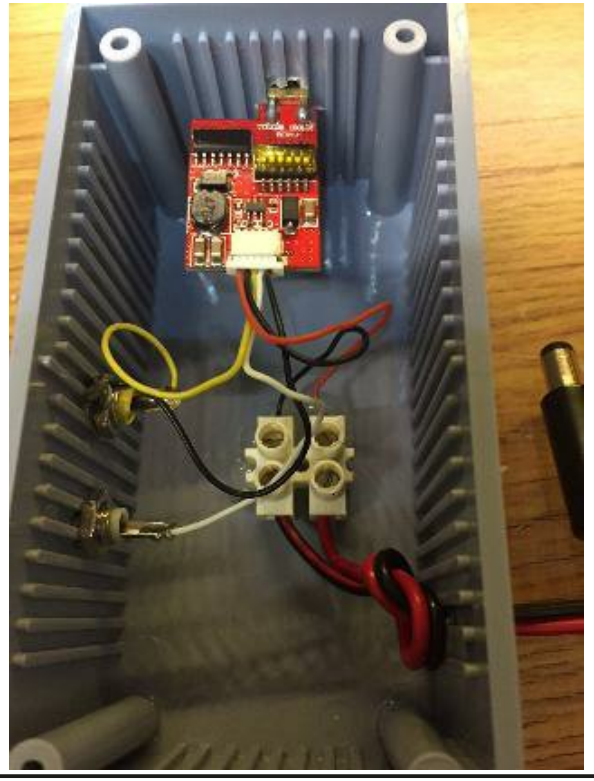
TS5828 5.8GHz 600mW 32 Channels Mini Wireless 2dbm A/V Transmitter



5.8GHz 600mW A/V Transmitter unit and below installed in case with A/V phono sockets and 12v input lead



A/V Transmitter unit attached to panel antenna - LED was added to show power/TX is on and below 12v camera



The units in question are 32CH 5.8GHz Video/Audio FPV RC832 Wireless Receiver, again intended for FPV drone usage.

Specifications:

- *Video format supported : PAL / NTSC*
- *Antenna connection: RP-SMA*
- *Power input: 12V*
- *Working current: 200mA max*
- *Antenna impedance: 50Ω*
- *Supplied antenna gain: 2db*
- *RX sensitivity -90dBm*
- *Video impedance: 75Ω*
- *Dimension: 80x 65 x15mm*
- *Weight: 85g*

Frequency range:

- *FR1 5865, 5845, 5825, 5805, 5785, 5765, 5745, 5725 MHz*
- *FR2 5733, 5752, 5771, 5790, 5809, 5828, 5847, 5866 MHz*
- *FR3 5707, 5685, 5665 , 5645, 5885, 5905, 5925, 5945 MHz*
- *FR4 5740, 5760, 5780, 5800, 5820, 5840, 5860, 5880 MHz*

There was very little to do with these units, set to channel 33 (which sets the receiver to 5665MHz) and use a reverse polarity SMA Male to N Type Male adapter to allow it to be connected directly to the antenna.

The antenna for the RX station is a TL-ANT5823B 5GHz 23dBi outdoor panel antenna, which will be described in more detail further down.

Power is supplied from the 12v distribution unit and the video signal is fed into a 12v monitor, with the audio being fed into a set of portable speakers.

The monitor is something else I had in the shack, it's a 7 inch monitor intended for use in a car for viewing a reversing camera. Works with both PAL and NTSC it has 2 video inputs, but the downside is no audio – hence the use of portable speakers. There are adjustment for brightness, colour and contrast plus format settings for 4:3 or 16:9 sources.

It's very light weight so helps keep the overall weight of the station down, and it was easy to attached to the tripod arm with a couple of bolts and wing nuts.

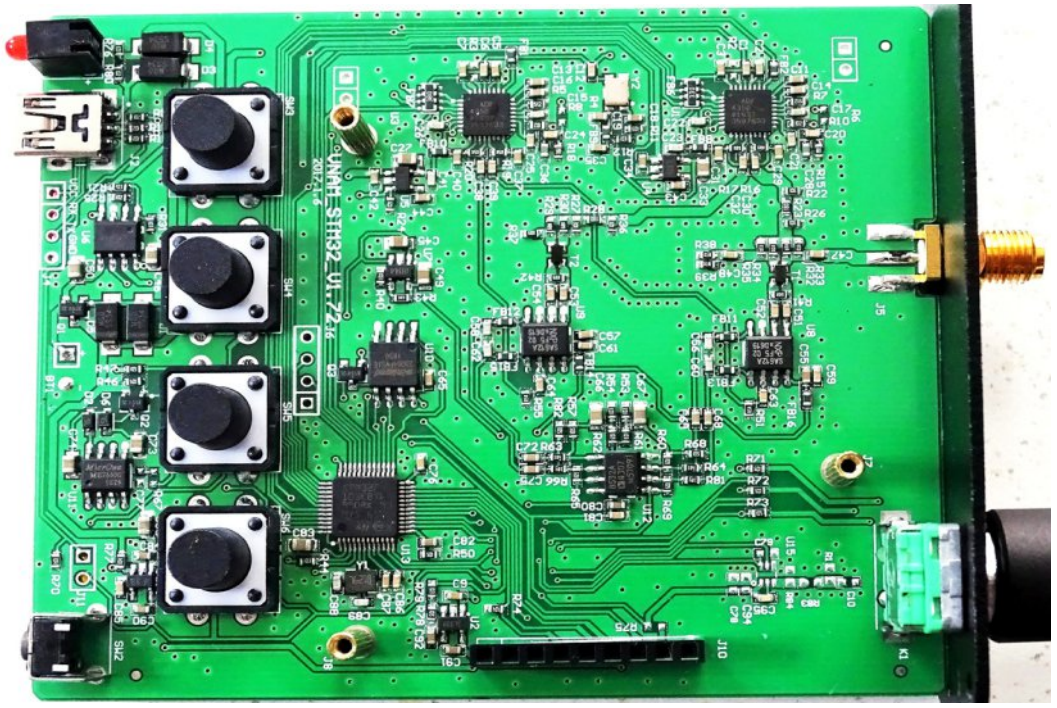
RC832 Wireless Receiver unit

Above:7 inch monitor - 12v Below: Out in the field /P

To be concluded next month.....

N1201SA antenna analyzer for 140 to 2700 MHz (Rainer Mueller, DM2CMB)

The N1201SA from China **[REF 1]** is a simple to use mobile antenna analyzer for vector impedance measurements, that include amateur radio bands from 2 m up to 13 cm. It has four graphical user interfaces that are: one-point-measurement, scanning, calibration and system information. An internal high-power LiIon-accumulator with 2000 mAh capacity gives long duration usage time mobile. It is charged via an USB connector with 400 mA, so any USB recharger can be used.

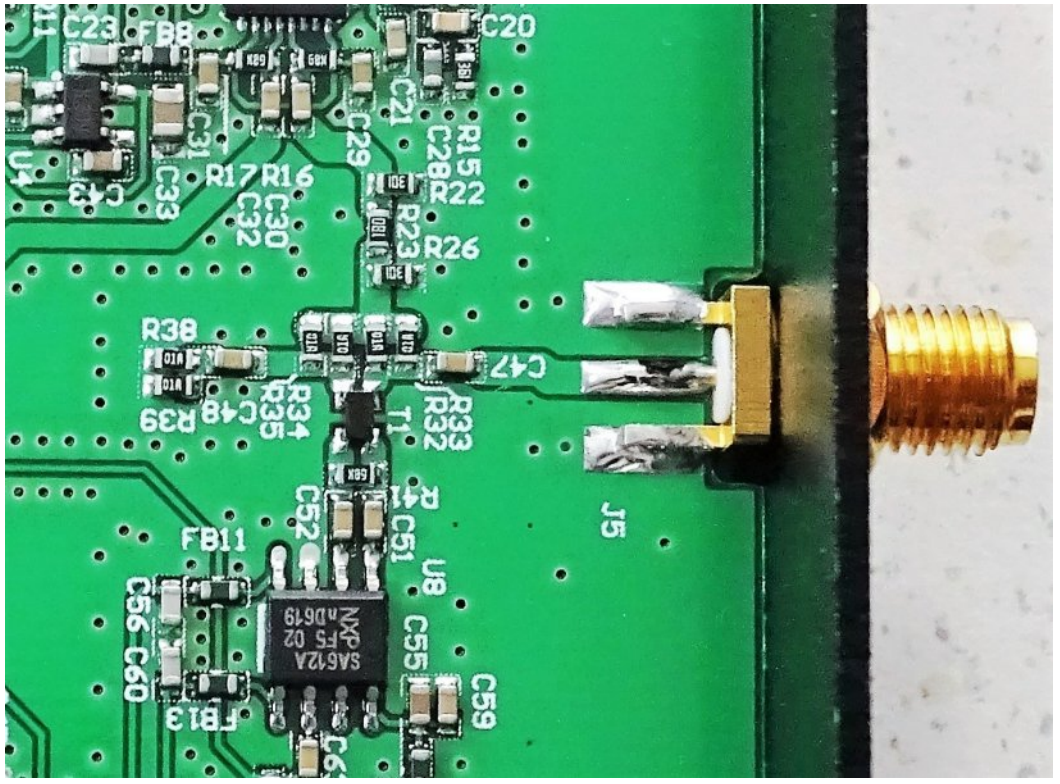


Picture 2 (above) is showing the PCB without display, on the back side the accumulator is placed. An LED as charging control sits next to the USB connector. At the other edge of the board the reset knob is placed accessible through a small hole in the unit's plastic housing.

For antenna analyzing (S11) an internal resistance bridge is used, the test object is connected at the SMA port (there are no circuit diagrams available). Picture 3 (next page) is showing the input part of the PCB with the reflection matrix, the reference resistor (R38/R39) is connected via a capacitor (C48). The transformer (T1) sends a symmetrical measuring signal to the mixer IC (U8).

Operation

In order to activate the analyzer you have to press the control button together with the OK button. This prevents from activating the unit unintentionally during transport.



For switching off the OK button is pressed for more than two seconds.

After activating the user interface for one-point-measurement is shown. Then you have to set the measurement frequency by turning the rotary encoder on top and changing the digit with left/right buttons. The other measurements like impedance, capacity, induction and S-parameter are activated by pushing the OK button.

The user interface for scanning is more detailed with diagrams of five scanning parameters like S11, VSWR, Z, R and X.

At first the start- and the end-frequency as well as the wanted parameter are set. Additionally you can change the scaling, see picture 6 with VSWR of a 13 cm patch antenna between 2300 and 2600 MHz.

This VSWR scaling is set to X=1.0, so it shows S=1 to S=6. With X=0.1 the range from S=1 to S=1.5 would show up.

How to set parameters

There are modes for parameter selection and for parameter setting changed by pressing the OK button. For parameter selection you can press the left arrow or the right arrow button or turn the rotary encoder.

With pushing the OK button or the rotary encoder knob you can switch to the parameter setting mode. Alterations are set by pressing the left arrow or the right arrow button or turning the rotary encoder.

If you are pushing the CTRL button and then the M button, the system information interface is shown for changing the time of automatic power-off.

With another pushing of M and CTRL the calibration mode is activated, and with sequentially pushing the M button alone the user interface for one-point-measurement is shown.

The N1201SA has been calibrated by the manufacturer, but if you want to do it again, you have to possess the needed calibration elements. These are SHORT, OPEN and LOAD, available for instance under **[REF 2]**. Frequency calibration is simple as well.

Specification:

Working range: 140~2700 MHz
Actual range: 137.5~2700 MHz
Stepped frequency: 1 kHz
Display: 2.4" TFT trdp
Resolution ratio: 320 x 240 (QVGA)
Battery capacity: 2000 mAH (7.4 Wh)
Power consumption: <1.5 W
Charge current: 400 mA
Charge port: USB
Auto power off can be set 5-60 minutes.
Measured parameters: Resistence, Reactance, Standing wave, S11
Resolution ratio: 4 number
Frequency accuracy: about 5 ppm
Connector: SMA-K

Measurement range:

Impedance: 0.1~1000 Ohm
Standing wave: 1.000~65
S11(dB): 0dB~-60 dB
Working temperature: 0~40 degr. Celsius

References:

[1] *https://www.banggood.com/N1201SA-UV-RF-Vector-Impedance-ANT-SWR-Antenna-Analyzer-Meter-Tester-140MHz-2_7GHz-p-1090983.html?currency=EUR&utm_source=criteo&utm_medium=cpc&utm_content=all&utm_campaign=electronic-DE-English&cur_warehouse=CN*

[2] *http://www.wimo.com/messtechnik_d.html#21010.SMA*

Thoughts about DATV via EME (Uwe Kraus, DJ8DW)

In TV-AMATEUR 186 we reported about a test by AMSAT-UK and AMSAT-DL to send and to receive a DATV signal via EME using big dishes in Bochum (20 m) and in Goonhilly (32 m) at 3400 MHz. Unfortunately this failed - otherwise we would have got a great publicity for DATV.

I have been thinking about that too, but some preliminiary considerations have discouraged me. The DATV mode GMSK would be advisable, with its constant envelope any nonlinear PA can amplify the signal without spectrum widening.

Using radio amateur devices it would be possible to produce 1000 W on 70 cm equal to 60 dBm. A long-yagi group antenna for TX and RX would enable a gain of 25 dB in each direction. That sums up to 110 dBm - but the attenuation on the way to and from the moon over 800.000 km is about 260 dB on 70 cm.

The reflected signal would produce a power of -150 dBm at the receiver input. Our home-made 70-cm-GMSK-DATV-RX is able to reproduce a stable video signal with -90 dBm and 2 MHz rf bandwidth - how do we get the missing 60 dB? A higher TX power is not feasible, and antenna gain cannot rise accordingly.

Receiver sensitivity might be further improved by some dB, and also bandwidth reduction to a quarter (RB-DATV) gives only some dB more. So obviously we cannot succeed, even not with ideal conditions.

In practice the problem gets even worse due to polarisation turns in the earth atmosphere, long multi-echoes from the convex moon surface and space noise. In the end for DATV via space we need an active repeater, may be in the earth orbit like ISS or on a geostationary satellite. With a future moon mission the astronauts could leave a DATV repeater with appropriate TX power on the moon surface.

AMSAT-DL symposium 2017 in Bochum (Jens Schoon, DH6BB)

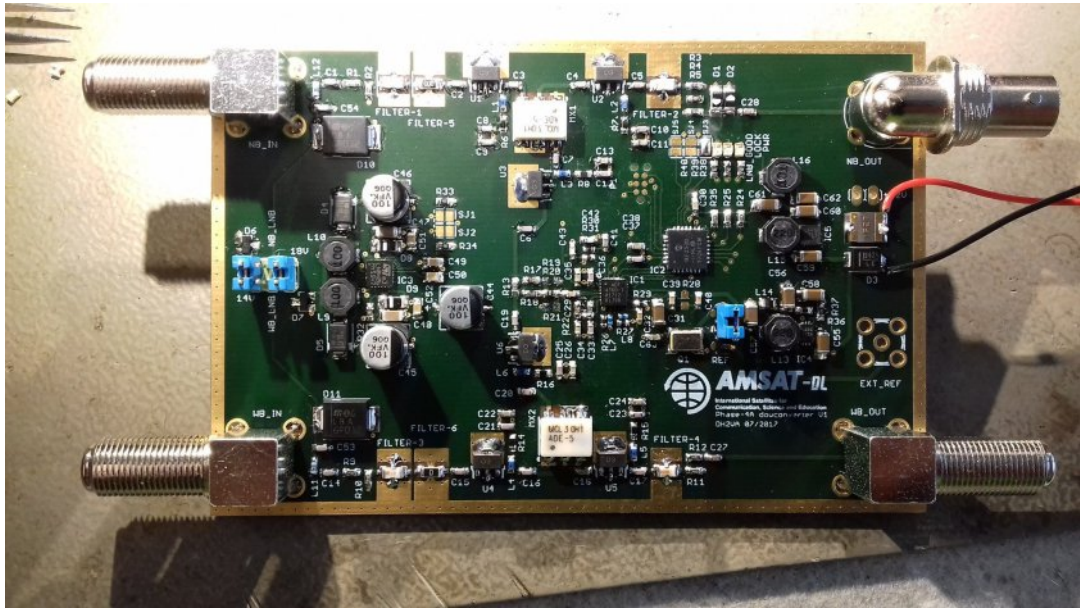
The 2017 symposium on 30th of September in the IUZ observatory Bochum had two topics. At first Thilo Elsner, DJ5YM, gave an overview on 60 years since Sputnik and the developments in Bochum.

In 1946 Heinz Kaminski founded the observatory Bochum as part of the adult education centre. It developed after launch of Sputnik 1 in 1957 to "Institute for space research / observatory Bochum". The first received Sputnik signals in the western hemisphere came from there, and the antenna and RX systems got improved afterwards. So in 1969 the audio signals from the first moon mission have been received directly in Bochum.

In 1982 the observatory was renamed to "Insitute for environmental and future research" (IUZ in german). Nowadays the 20 m dish is used by AMSAT-DL for data reception from the "STEREO" sun observation satellites for NASA. During the 2017 symposium a wheather balloon was launched with much publicity. Because of bad wheather conditions the prepared Sputnik 1 model stayed on earth.

The second topic was Es'Hail-2 with P4A-transponders.

Achim Vollhardt, DH2VA, reported on a double down-converter for SSB and DATV reception, that processes amateur radio signals from Es'Hail-2 on 10 GHz. Normal PLL-LNBs have a disadvantage - the IF comes out on an unusable band at 745 MHz. The AMSAT-DL down-converter transferres this to 2 m for the narrow-band transponder signals. Using an LNB with two outputs the IF is mixed to 1340 MHz additionally, so the wide-band transponder signals with DATV are handed out to a usual DVB-S2 receiver.



One oscillator (middle of the picture) mixes the narrow-band signal to the 2m band section (above). The same oscillator signal is used in the lower section for mixing the wide-band transponder signals to a usable DVB-S2 RX range. On the left side the power supply for the LNB (14V/18V per channel disconnectable). Added are some filters and a microcontroller, that programmes the oscillator frequency. The F-connectors for input and for wide-band output have 75 Ohm impedance, the BNC connection for 2m has 50 Ohm.

During the symposium a working down-converter proto-type was tested, it is planned to provide a construction set after a successful launch of Es'Hail-2.

Then Jens Schoon, DH6BB, reported on AMSAT-DL ground stations in Bochum and in Doha (Quatar).

As the radio amateurs have no controlling hardware and software on the geostationary satellite their beacons and control signals must be generated in their ground stations. The backup-station in Bochum shall also give a testing platform for software developments. Near the big 20m parabol dish radom a 3m dish for TX and a 2.4m dish for reception from Es'Hail-2 are available. AMSAT-DL will also construct a mobile ground station for presentations at big events like HAMRADIO Friedrichshafen.

Thomas Kleffel, DG5NGI, then reported on DATV devices within the ground stations.

There are the modes DVB-S, DVB-S2 and DVB-S2X, where DVB-S2 is the right choice for the beacon transmission. DVB-S2X would be interesting for future operations, but at present there is no affordable user equipment. Thomas also presented a special mode to transfer software updates via Es'Hail-2 to the ground station hardware in Doha.

In the following general assembly of AMSAT-DL the chair Peter Guelzow, DB2OS, stated, that the launch date of Es'Hail-2 seams to emerge early in 2018, but not yet officially.

During coffee breaks, some equipment was being tested, i.e. a dummy transponder that transferred signals from 13 cm to 10 GHz. So besides CW and SSB contacts experimental DVB-S transmissions were performed.

The narrow band contacts showed that stability of PLL-LNB and down-converter is sufficient without external reference. DVB-S signals showed typical difficulties with reflections and multi-path in the room - later on via the real transponder in orbit that will vanish.

But a look at the signals on a spectral analyzer revealed another problem: you have to control your rf bandwidth! Only because of a warm PA taking up much energy the signal must not be good - in the room this was easy to repair, but “on satellite” that can be a bigger task.

Now in winter it is time to construct your own receiver and transmitter units - also take a look at new developments on SDR and RB-TV technics.

Translation: Klaus, DL4KCK *http://www.agaf.de*

TV Video Connectors

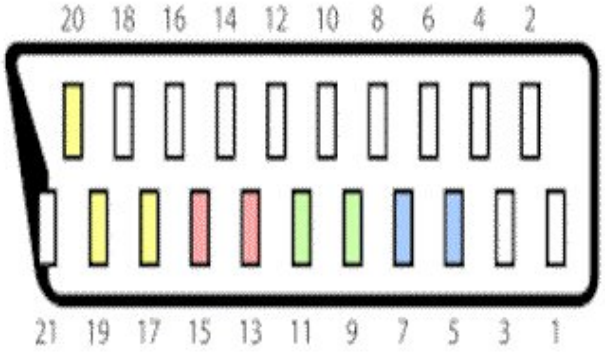
Written by Trevor G8CJS

Look at the back of any modern TV set and you will see a festoon of video connection options from Yellow, Red and White phono sockets (sometimes called RCA connectors) , SCART connectors, S Video and HDMI, but this wasn't always the case.

When I started in ATV the 60's the only input to a TV set was via the aerial socket, fortunately some TV camera's had RF output and the TV could be tuned to receive the camera, not ideal when you want to start running TV transmitters and 2m talkback, particularly at high power. Moving the channels did help solve some interference problems, but still this was not a proper solution. The TV sets could be modified to have a video input, but most of them employed live chassis power connections, so one side of the mains was connected direct to the TV chassis. So to add a video input and a mains isolating transformer was required and these were not cheap.

Fortunately time marches on and there appeared on the high street, more and more equipment to connect to your TV set, much of it requiring a direct video connection. TV power supplies evolved and the live chassis became a thing of the past, and video connectors started to appear. Like buses you wait and wait then two come at once, so it was with video connections, The Phono and the SCART came along almost at the same time.

The SCART owes its origination more to politics than necessity, it originated in France and was a 21 pin connector that did a lot more than just allow a TV camera to be connected. The SCART had component connections, CVBS inputs and outputs along with stereo audio and digital control. This socket was a mandatory requirement in France and TV sets without a SCART connector were not allowed to be sold in the country. The story goes it was more about curbing the import of TV sets and providing a degree of protectionism to French manufactures. This was not the only measure employed hence the belief it was a about protectionism and perhaps the scant information on what each pin actually did might support this theory.



1 Audio Output Right
2 Audio Input Right
3 Audio Output Left
4 Audio Input Right
5 Blue Ground
6 Audio Input Left
7 Blue Signal
8 Current Swich/ Slow Blanking
9 Green Ground
10 Data 2
11 Green Signal
12 Data 1
13 Red Ground
14 Data Ground
15 Red Signal
16 RGB Status/Slow Blanking
17 Video Signal Ground
18 Synchronisation Signal Ground
19 Video CVBS Out
20 Video CVBS Input
21 Shield

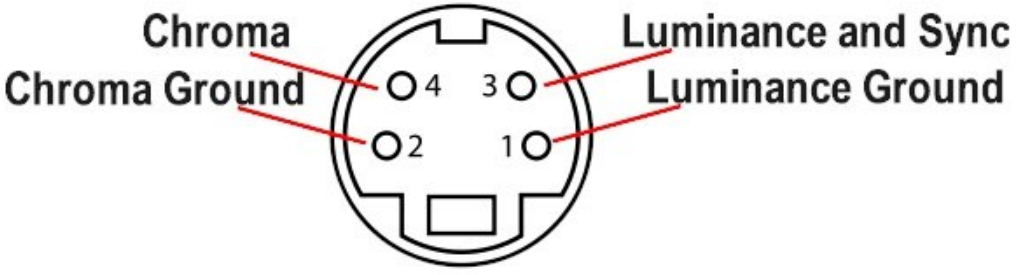
SCART Connections viewed from the rear

This was an important step because it allowed component connections to be made to the TV set at a time when Television started to move away from CVBS signals and their inherent subcarrier patterning..

Also clever adaptors appeared to allow connection between connectors like the Phono and SCART.

Component/CVBS Phono to SCART adaptor

The next development was the S video connection, which was a way of cabling the chroma and luminance signal on separate connections, this became a problem when the improved VHS machines called S VHS machines started to appear. Normally chroma and luminance can share the same connection, there is an overlap of the two signals, but the clever choice of subcarrier frequency provides for an interleaving of the two signals.



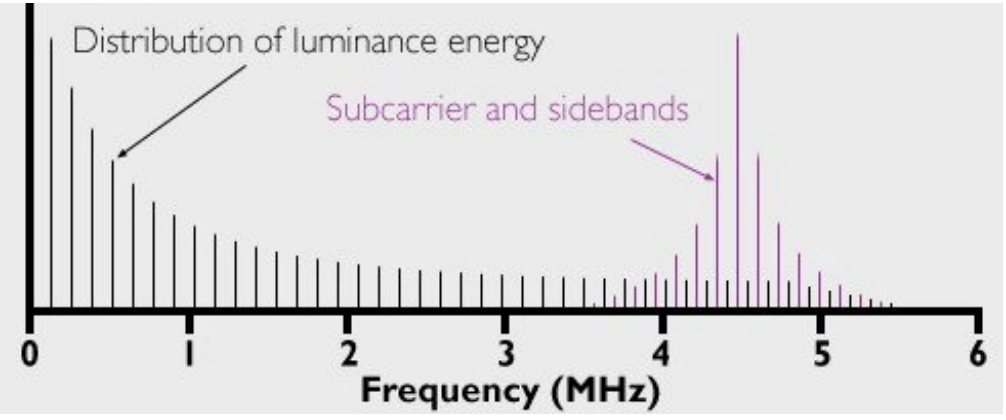
S VIDEO Connector

The problem is when home video recorders appeared, they had no time base correction so the video signal had jitter, caused by inertia in mechanical servo's. This was a problem in that colour decoders could not decode signal with jitter on them, with the probable exception of SECAM.

The solution (Colour Under) was to stabilise the chroma signal with a heterodyne system that not only frequency converted chroma to a lower frequency for recording onto tape, but that also removed the jitter when it was converted back to the correct frequency on playback. This process may have stabilised the chroma component of the signal, but not the luminance component.

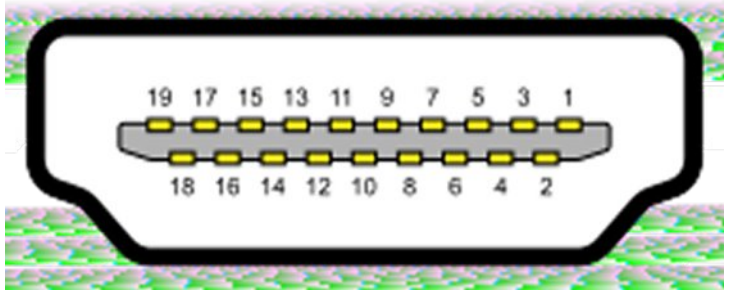
This resulted in movement or jitter of the luminance component and the separation of the sidebands by interleaving, was subsequently destroyed. The solution was to keep the signal separate and Chroma and Luminance were assigned separate pins on the S video connector.

This was not a problem on the standard VHS machines as the Luminance bandwidth is restricted and the two signals do not overlap, it only became a problem with the extended bandwidth of the S VHS format.



Luminance Spectrum and the interleaving, if you chose the correct Subcarrier frequency 4.43361875 MHz for PAL. NTSC 3.579545 MHz

The next big step was the HDMI connector and a leap into digital connections. The HDMI founders were Hitachi, Panasonic, Philips, Silicon Image, Sony, Thompson, RCA, and Toshiba. The first implementation HDMI 1 appeared in late 2003



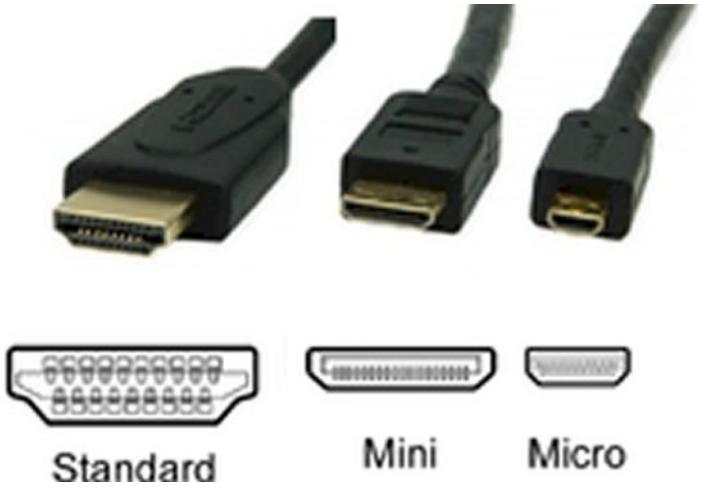
HDMI Connector

Pin 1	TMDS Data2+	**Pin 13**	CEC
Pin 2	TMDS Data2 Shield	**Pin 14**	Reserved (HDMI 1.0–1.3a) Utility/HEAC+ (HDMI 1.4+, optional, HDMI Ethernet Channel and Audio Return Channel)
Pin 3	TMDS Data2−		
Pin 4	TMDS Data1+		
Pin 5	TMDS Data1 Shield	**Pin 15**	SCL (I²C serial clock for DDC)
Pin 6	TMDS Data1−	**Pin 16**	SDA (I²C serial data for DDC)
Pin 7	TMDS Data0+	**Pin 17**	Ground (for DDC, CEC, ARC, and HEC)
Pin 8	TMDS Data0 Shield	**Pin 18**	+5 V (min. 0.055 A)[3]
Pin 9	TMDS Data0−	**Pin 19**	Hot Plug Detect (all versions) HEAC− (HDMI 1.4+, optional, HDMI Ethernet Channel and Audio Return Channel)
Pin 10	TMDS Clock+		
Pin 11	TMDS Clock Shield		
Pin 12	TMDS Clock−		

HDMI Connections

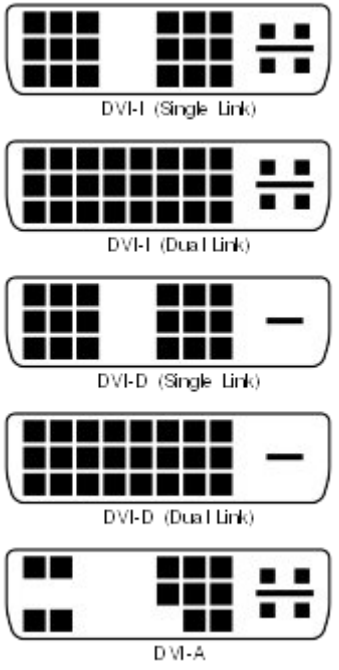
HDMI is electrically compatible with (DVI). No signal conversion is necessary, nor is there a loss of video quality when a DVI-to-HDMI adapter is used.

The thing to remember about DVI and all its incarnations is that some of the connectors carry VGA legacy analogue signals.



HDMI plugs, the three variations in common use

DVI connectors in all its variations



These are not part of any HDMI connector, only the digital signals are carried across an adaptor and VGA analogue legacy signals are disguarded .

So it might be you have a DVI VDU displaying analogue video which will for obvious reasons will not go down a passive HDMI digital adaptor.

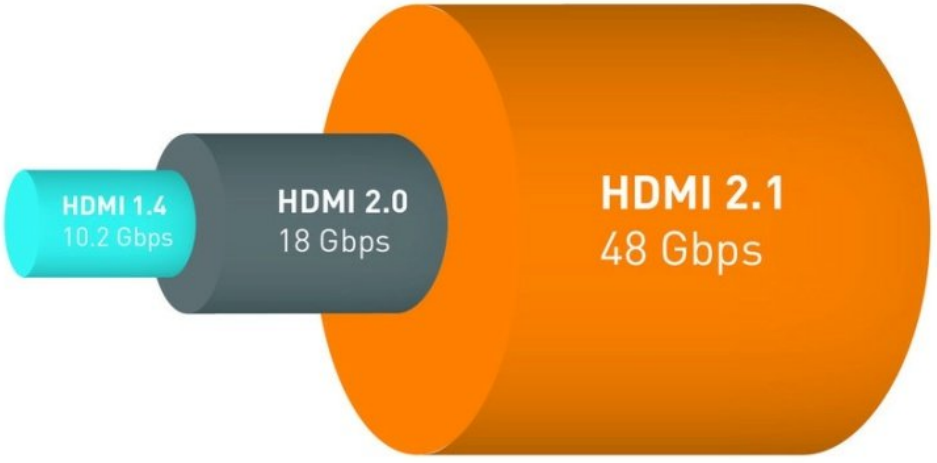
HDMI also has a maximum cable run of 50ft, but in practice it is hard to find a cable longer than 25ft

Another thing to remember about HDMI was it supports DRM (Digital Rights Management) now called HDCP (High-Bandwidth Digital Content Protection).

This protects Blue Ray and DVD discs from being copied and is part of HDMI compliance, making HDMI more than just DVI repackaged into a better connector.

Devices called HDCP strippers can remove the HDCP information from the video signal so the video can play on non-HDCP-compliant displays, though a fair use arrangement, part of USA law.

HDMI has moved on and in its latest version HDMI 2.1 promises to deliver 10K video, 120 Hz refresh rates and much more with a large boost in Bandwidth.



HDMI 2.1 also opens a door to "Dynamic HDR," This feature uses, dynamic metadata which is processed on a frame-by-frame basis, allowing colour settings and brightness to adapt on the fly.

To take advantage of all the new features offered by HDMI 2.1, a new "Ultra High-Speed HDMI Cable" is necessary. Cables certified for use with the new standard will be built for 48 Gbps transfer rates and all the other features details with the revised specification.

Pin 1	TMDS data 2−	Digital red− (link 1)	**Pin 17**	TMDS data 0−	Digital blue− (link 1) and digital sync
Pin 2	TMDS data 2+	Digital red+ (link 1)	**Pin 18**	TMDS data 0+	Digital blue+ (link 1) and digital sync
Pin 3	TMDS data 2/4 shield		**Pin 19**	TMDS data 0/5 shield	
Pin 4	TMDS data 4−	Digital green− (link 2)	**Pin 20**	TMDS data 5−	Digital red− (link 2)
Pin 5	TMDS data 4+	Digital green+ (link 2)	**Pin 21**	TMDS data 5+	Digital red+ (link 2)
Pin 6	DDC clock		**Pin 22**	TMDS clock shield	
Pin 7	DDC data		**Pin 23**	TMDS clock+	Digital clock+ (links 1 and 2)
Pin 8	Analog vertical sync		**Pin 24**	TMDS clock−	Digital clock− (links 1 and 2)
Pin 9	TMDS data 1−	Digital green− (link 1)	**C1**	Analog red	
Pin 10	TMDS data 1+	Digital green+ (link 1)	**C2**	Analog green	
Pin 11	TMDS data 1/3 shield		**C3**	Analog blue	
Pin 12	TMDS data 3−	Digital blue− (link 2)	**C4**	Analog horizontal sync	
Pin 13	TMDS data 3+	Digital blue+ (link 2)	**C5**	Analog ground	Return for R, G, and B signals
Pin 14	+5 V	Power for monitor when in standby			
Pin 15	Ground	Return for pin 14 and analog sync			
Pin 16	Hot plug detect				

DVI Connections

Might be a while before I start implementing HDMI 2.1 on my ATV equipment, so I won't worry about the cost of these new cables, just yet, but I like to be on top of TV and video standards.

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

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

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

https://www.hdmi.org/manufacturer/hdmi_2_1/

http://www.broadcaststore.com/pdf/model/793698/TT201%20-%204918.pdf

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