In this issue

CQ-DATV dotMOBI

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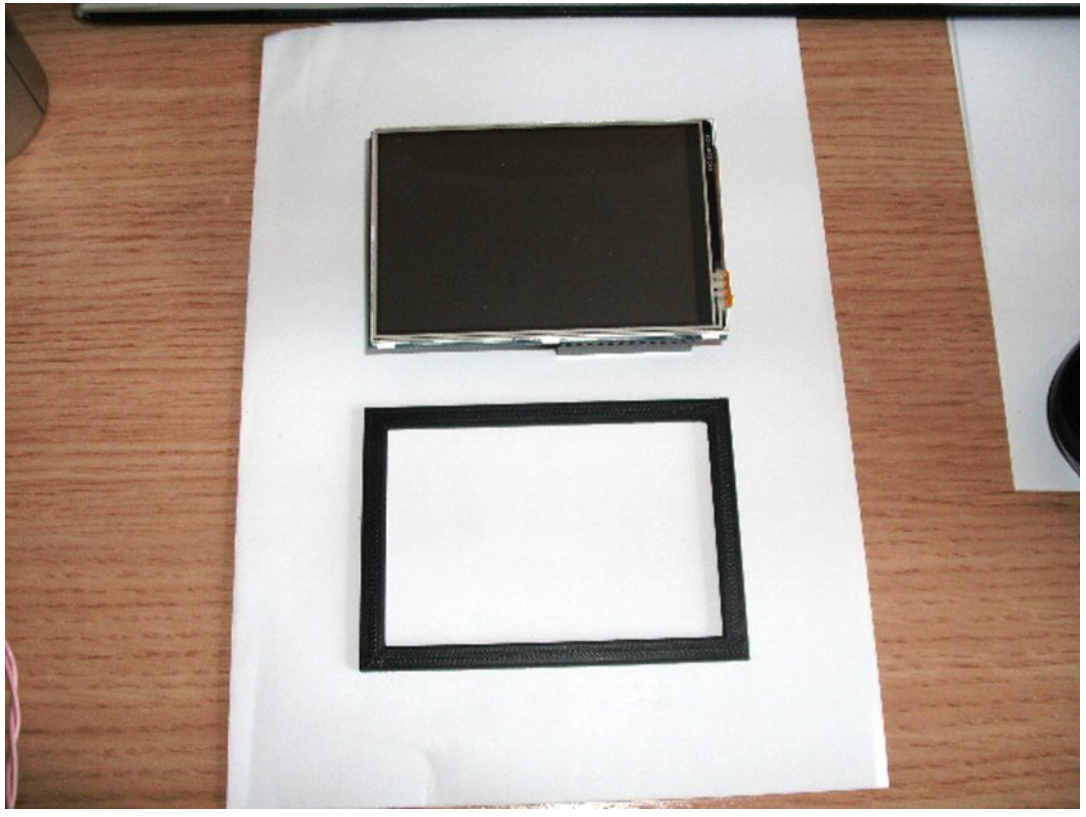
Editorial

Welcome to issue 35 and a special issue with a look at 3D printing and any ATV applications that may arise from this new technology. Alan Critchley G3SXC has started the ball rolling by purchasing a printer kit and programming it to produce a 10GHz horn antenna. John G3RFL has been testing various prototypes and generating some test results of the various available materials.

It doesn't stop there in our next issue John has produced a very upmarket SWR bridge that uses a TFT screen to show the results. The screen lacked a Bezel so Alan wrote a programme to 3D print the bezel and very smart it looks too, so more on that in the next issue.



The TFT screen and 3D printed bezel

It may seem we have gone a little overboard on this new technology, but as a magazine delivering a whole mix of projects including the very popular constructional projects, we are very anxious to keep home construction alive.

This is a field where support is very important. I am part of a generation that grew up with Meccano and Airfix, I did not have the engineering skills to create the wonders from scratch but with the support they provided all thing were possible.

The required support changes and at one time a diagram was all that was necessary, hence I built my first 8 valve TV camera from a diagram in CQ-TV 48. By the time I moved on to silicon construction that support came from Veroboard, but soon the projects increased in complexity and my first SPG (CQ-TV 100) could never have been made without a PCB similarly the later Arthur Critchley SPG.

PCB's provided support and initially they could be home etched, but together with the decline in shops selling components in low number we were forced into the bare kit mode and the revamped BATC shop provided that support.

What I would prefer not to do is become an appliance operator, where all I do is plug in kit and operate, why not it sounds reasonable, well yes and no we are indeed producing a generation of instant gratuity, by that I mean they expect more from less work, it's not wrong it's what big business has done to us all, it's how to get us to part with our hard earned cash.

Please note: articles in this magazine are provided with absolutely no warranty whatsoever; neither the contributors nor CQ-DATV accept any responsibility or liability for loss or damage resulting from readers choosing to apply this content to theirs or others computers and equipment.

But I still remember my first ATV contact with snowy pictures appearing from a tweaked UHF TV tuner and homemade preamp, and later the acknowledgement of my return pictures from a small I think QQVO2/6 PA, with somebody watching the output of my 8 valve camera via an AM 70cm contact, which was over 20 miles and at negligible cost, other than a great deal of time and effort.

Compare it with the noise free appliance generated pictures I get every week from my Granddaughters face time contacts and yes there is a buzz, but only because of who she is and what she can do at age 10 along with she wants to contact me. I send pictures back the same way, but it is a different kind of buzz and I still remember what I constructed and designed for a whole generation that followed in my footsteps with electronic character generators and the first micro project, in fact the whole Blue ATV Handbook which is on the CQ-DATV download site.

So 3D may be the door to ATV cases panels and who knows what, but for this issue its a 10GHz horn. Time will tell if we have opened a door!

Please enjoy CQ-DATV 35.

Trevor Brown G8CJS on behalf of the CQ-DATV editorial team

CQ-DATV dotMOBI

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

The ISS is sending SSTV signals

Image: Ryan Reynolds

"Unlike normal television that takes a lot of bandwidth, it sends it quite a bit more slowly on narrower bandwidth," Ryan Reynolds, an amateur radio operator who received the picture you see at the top, told me. "It took me three minutes to get a full picture."

Reynolds says if you know what you're doing, it's not a particularly expensive or difficult hobby to get into.

"There are guys doing this with homemade antennas that are $20-$30, and a handset radio can cost $30 on Amazon," he said. "From there, the software is free, you can do this."

People around the United States have had mixed luck grabbing the signals—a cloudy night, interference, or a lackluster antenna can garble the picture. Few of the images I saw were quite as crisp as Reynolds's.

See *https://youtu.be/aRdxCGgF3Uo*

ARISS school contact from Leverkusen

On February 29 students at the Leverkusen-Schlebusch comprehensive school (near Cologne) made a successful radio contact to the ISS, assisted by radio amateurs from DARC charter G11. All 20 questions could get an answer by astronaut Tim Peake (not self-evident), and additionally we had a live video stream on a big screen showing him in the Columbus module. It was coming over an internet connection from a HamTV receiving station in Cork, Ireland.

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://www.agaf.de/

For a next event we want to erect our own receiving station, the WLAN connection in our school hall was not very stable. But it is very cool to have available the complete video recording from OM in UK and Italy!
OR4ISS de DL0IL with HamTV:
https://youtu.be/u9QPr6bsiSM

Many thanks to our school, media people, YLs and OM devoting much free time to this contact, and to all students making it an exciting event.

DATV DX on 70 cm (Peter, DB8ZP)

On November 28th in 2014 Rolf, F9ZG, at Normandy, France (IN99KC), received our DVB-S signal from DATV repeater DB0TAN (Wasserkuppe, Germany) on 436 MHz with 25 dB S/N over ca. 600 km distance.

Last year we moved the DATV output site to DB0TAW about 13 km away from DB0TAN. That HAMNET node site is 150 m lower than Wasserkuppe mountain, but it has a 40 m lattice tower and gives an antenna height of 856 m ASL.

Five years ago we started to use WLAN equipment for ATV tests, but the available gear did not match our expectations. Eventually we found useful WLAN devices from "Ubiquity" that can be modified to work on Ham radio frequencies.

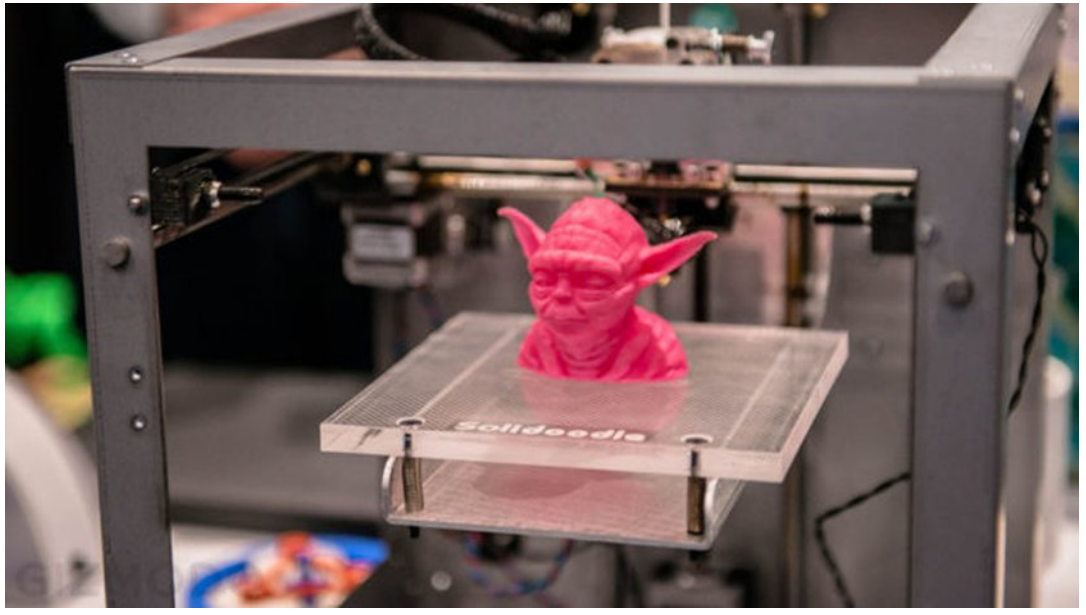
After testing different CoDecs (MPEG-4, H.261, H.263 and H.264) we compared several protocol versions. The packet oriented system turned up to be useful, and with special network adjustments we got QoS for video streaming.

Now DB0TAN and DB0TAW have HAMNET in- and outputs as well as an ATV link to get experience in WLAN video streaming. At our DB0TAW site we are using ecological power systems for sun and wind energy.
Translations Klaus, DL4KCK *www.agaf.de*

3D Printing a Horn Antenna for 10 GHz

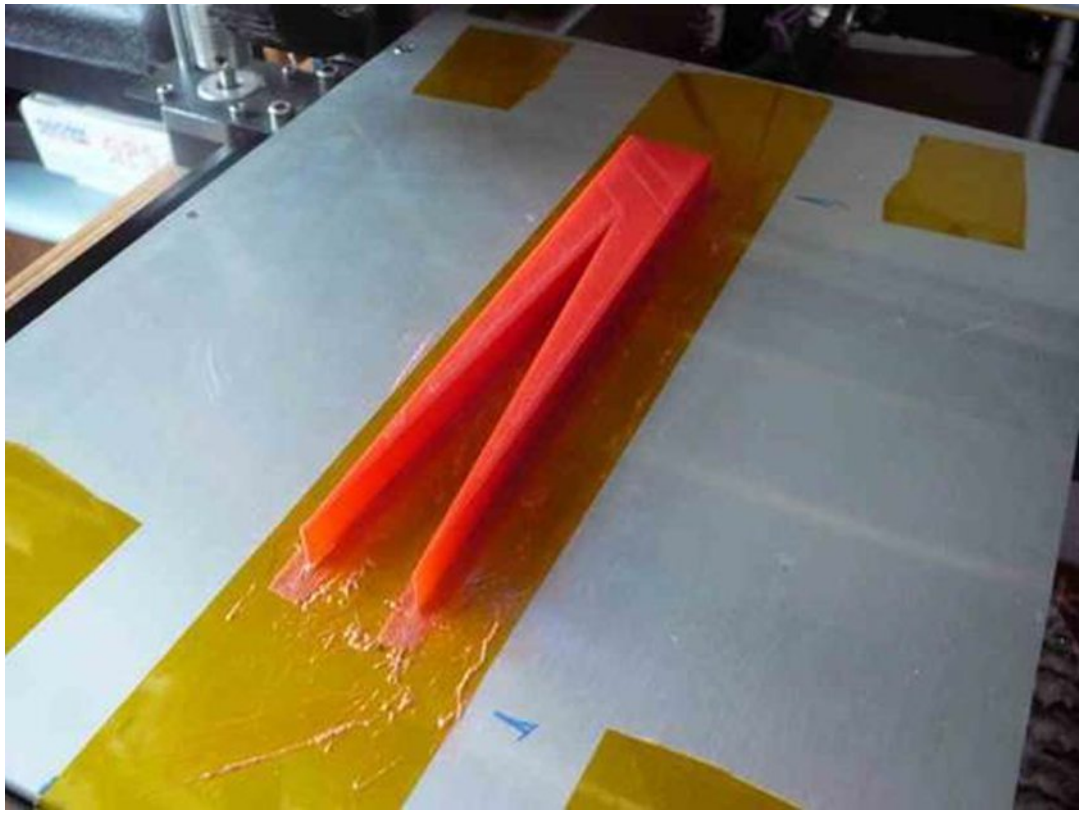
By John Hudson G3RFL and Alan Critchley G3SXC

3D printing or additive manufacturing is a process of making three dimensional solid objects from a digital file. The creation of a 3D printed object is achieved using additive processes. In an additive process, an object is created by laying down successive layers of material until the entire object is created. Each of these layers can be seen as a thinly sliced horizontal cross-section of the eventual object.



3D technology Amateur TV constructional

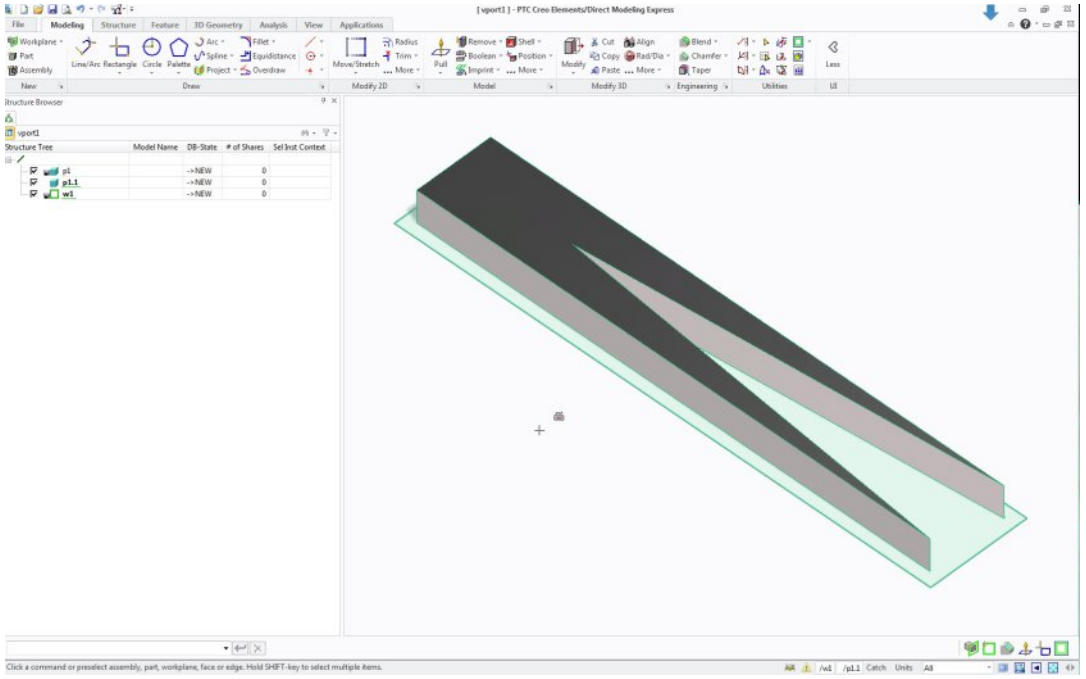
Well, first you have to understand the limitations. It's a bottom to top layering system, so for example if we wanted to make a tea cup then the printer could layer up a cup if it was supplied with instructions and it could produce a cup the correct way up or even upside down, but not on its side as it would involve sitting layers on top of fresh air and this is not possible.



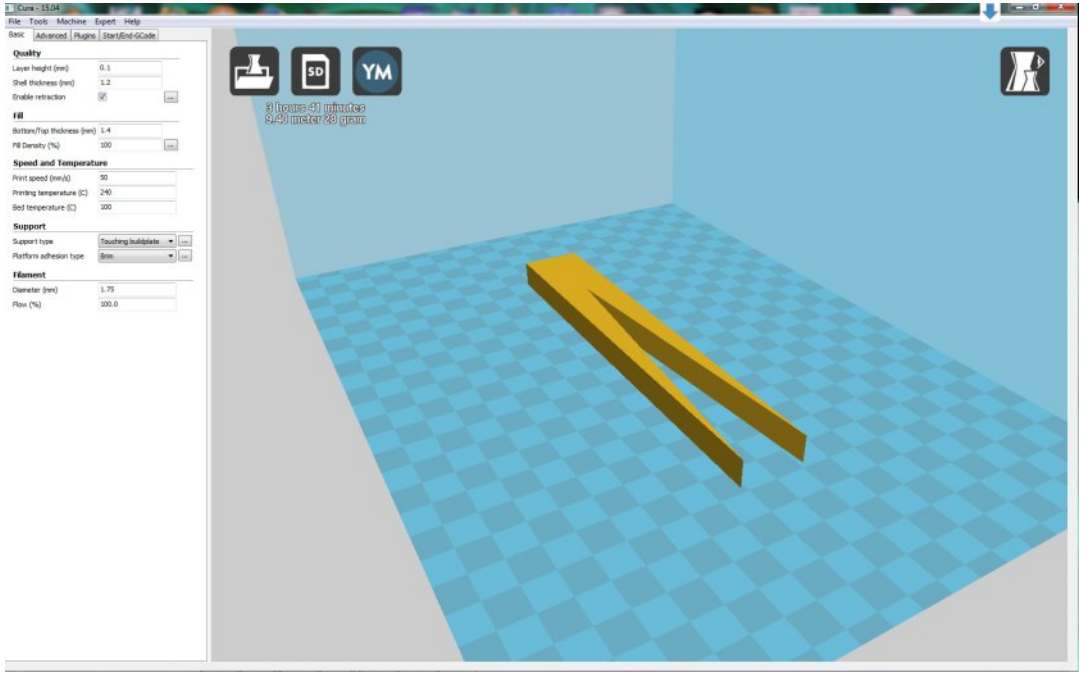
So think your projects through. This 10Ghz wave guide aerial was produced using an Reprap Prusa i3 printer, made from a kit (Chinese of course).

So it could not have been printed if it was rotated by 90 degrees as that would have involved laying down a layer on fresh air.

The plastic material that the Reprap printer uses are supplied on reels, rather like a spool of wire and there are several choices of material.



PTC Horn



CURA Horn

We produced several of these wave guide aerials made from a range of materials, so we could test the dielectric loss and recommend the most suitable one for RF applications.

Having made four so far, one from PLA and three from ABS. One of the ABS ones was 'hollow' like a honeycomb structure, I believe this didn't work too well - understandably, you need a solid dielectric. The other two ABS ones were the best and used for the TX and RX test, PLA performed the worst.

The instruction set for the printers takes some getting your head around. I used a program called PTC Creo Elements which is a free download for personal use and produces a STL file which is then processed by a program called Cura which came with the machine.

This slices the model and adds info such as nozzle temp, bed temp, layer thickness, wall thickness (if hollow) and how the model is attached to the bed.

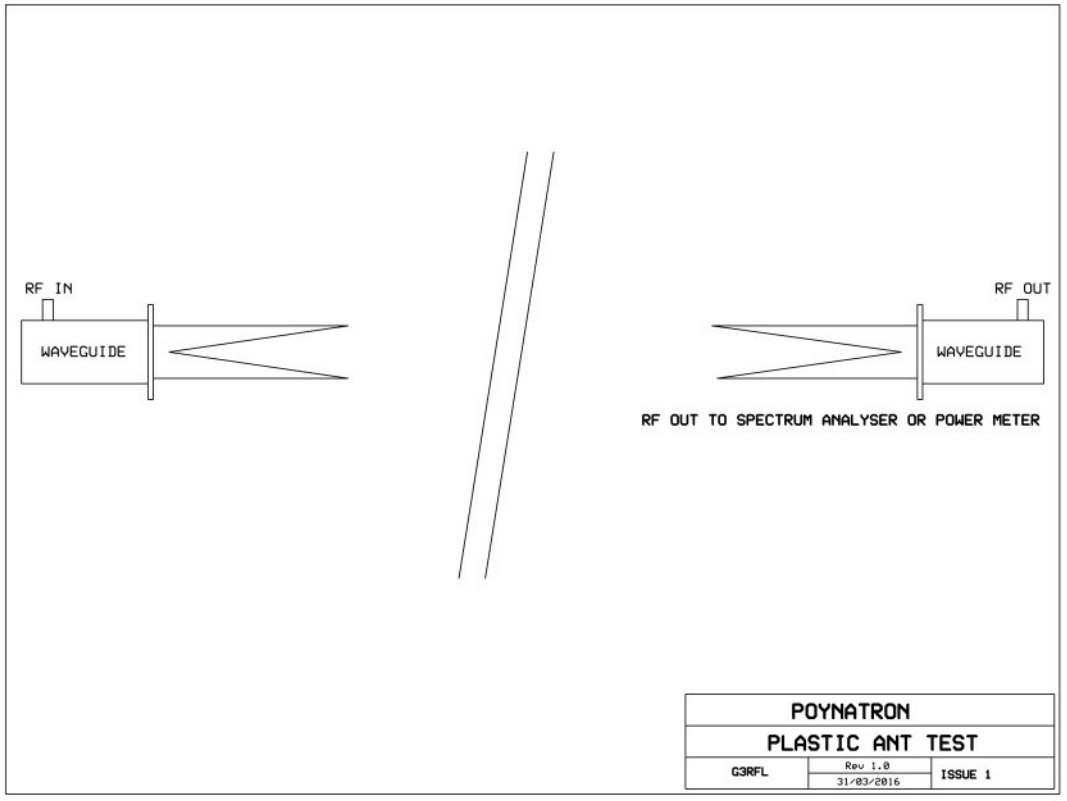
If it has a small footprint then it is usual to add a 'raft' to increase the area in contact with the bed to aid stability. This or a 'brim' which is thinner also help to anchor the edges to the bed to prevent warping due to shrinkage as the model cools.

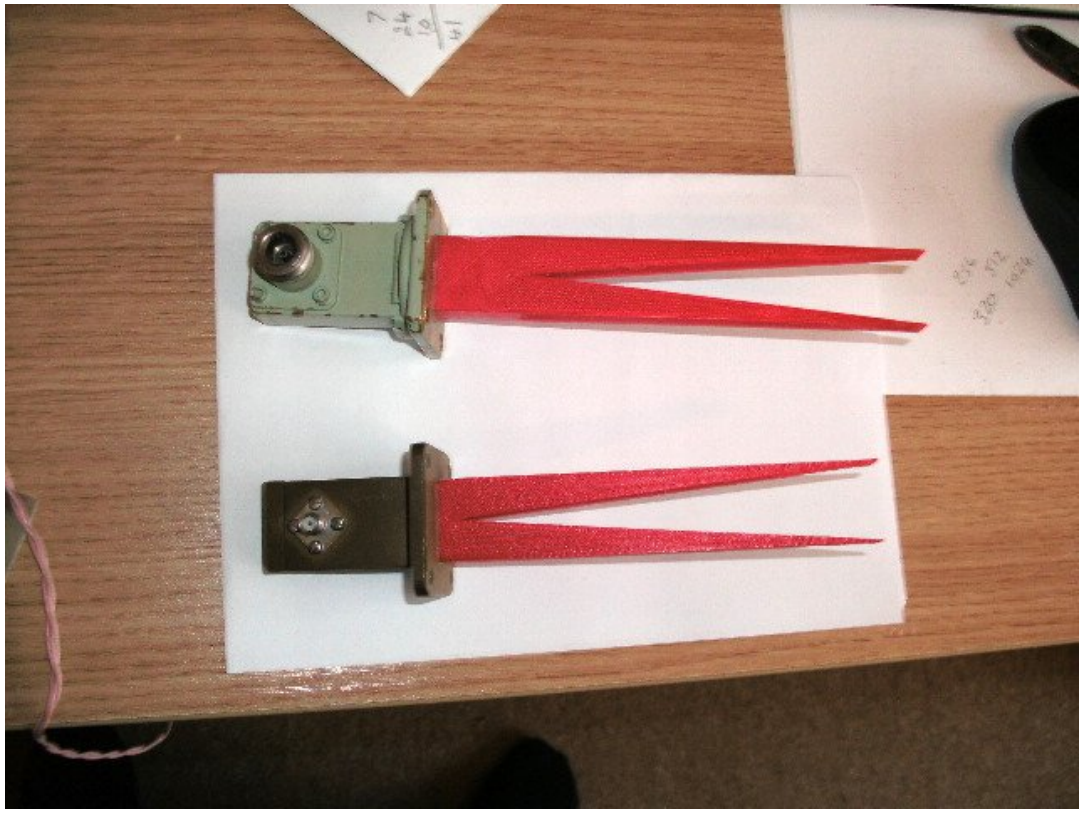
The raft or brim is easily snapped off after the model is finished. A brim was used for the aerials.

Cura outputs a 'Gcode' file which is then used to control the heaters, fans and stepper motors of the printer. The two files are on the *CQ-DATV download site*.

Both are text file and can be opened with any text editor i.e. notepad.

The STL isn't easy to understand but the Gcode one is well commented.





Test Jig

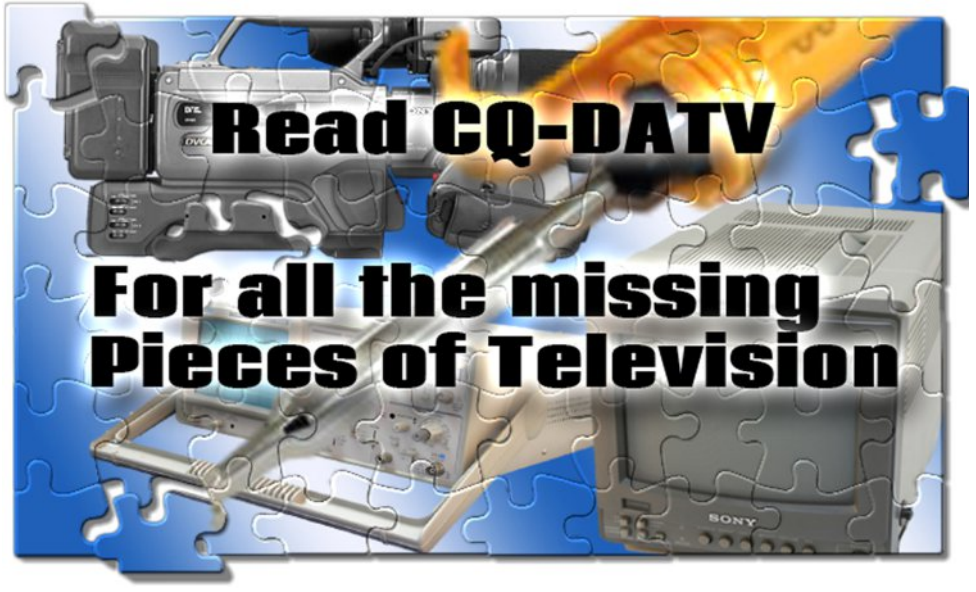
The Horn antenna's

These were designed to fit a standard WG16 waveguide.

The first test was with one open ended wave guide and one equipped with a 3D printed horn and the path was 14db REF open ended waveguide. Adding a second horn as per the diagram produced double the value eg 28dB

See the article "**3D printing and amateur radio**" elsewhere in this issue for more details of 3D printing.

CQ-DATV dotMOBI ePUB



Surprising neighbourhood

By Klaus Welter, DH6MAV

Until end of February 2016 an exhibition in the Landsberg Town Museum showed reminders of Cold War times in the Ex US Airforce Base Penzing near Landsberg, Bavaria. One of many US soldiers there was John Ray Cash from Texas, military radio operator from 1951 to 1954. He bought his first guitar for 5 Dollars in Landsberg, and later on he became known worldwide as Jonny Cash...

At the Airforce Base he listened to radio communications in the Warsaw Pact countries, and knowing Russian Morse code with 105 letters per minute he was the first westerner to hear of Stalins death in 1953. Another first was the message from a successful russian jet fighter pilot in Sibiria who pounded it live into the morse key on his thigh!

The phrase "Don't take your guns to town" was an official order to US soldiers to leave their weapons in their barracks when going to town. In 1958 it headed a well known country ballad, and now a book by Edith Raim and Sonja Fischer in the "Volk" publishing house.

The exhibition objects in Landsberg ranged from an Army Jeep over a chewing gum automat to a live music box surrounded by photographs, text and video displays. Another highlight was an original radio operator post with several wireless receiving sets and measurement devices, borrowed from the "miltary history collection" at Air Base Lagerlechfeld. The ancient round scale indicators and rotary knobs are really different from todays smartphone touch-screens and joystick controls.

Another place, another time: Herkomer-Museum in Landsberg am Lech, Von-Kuehlmann-Str. 2. The all-round genius Hubert von Herkomer (1849 - 1914) was an artistic painter, designer and craftsman, cinema and automobile fan.

His portrait paintings showed Queen Victoria from England as well as King Edward VII., who appointed Herkomer a professor of arts (he never had academic education). Besides the first german car races Herkomer promoted cinematographic developments and predicted in 1912:
"The film projector is a valid every day factor now, and may be the day will come, when living pictures with colour and sound will be fed into every home like electric power and gases today. Every child will learn geographic, history and biotany from screens instead of books, actors and singers will be recorded in sight and sound. A film will contain logged facts for ever. I don't dare to state that this will evolve for the collective good, but innovative manpower is pushing in that direction."

Only 50 kilometers away from Herkomers home lived Max Dieckmann, an inventor of "wireless television on a Braun tube" (cathode ray tube), with only a black and white raster in the beginning (patented 1906).

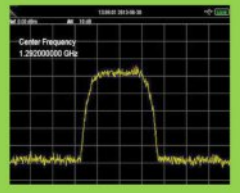
It was later on used for wireless weather map distribution, called FAX.

The late Professor Max Dieckmann worked on this field with Rudolf Hell (another pioneer), and from 1934 he engaged in UHF and microwave experiments near Munic, for instance at a Dornier airport in Oberpfaffenhofen (now an ESA and ISS ground station), see TV-AMATEUR 176.

Translation Klaus, DL4KCK

Digital Amateur TeleVision Exciter/Transmitter

now available from



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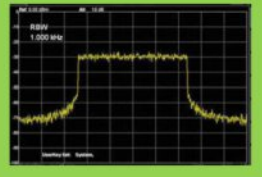
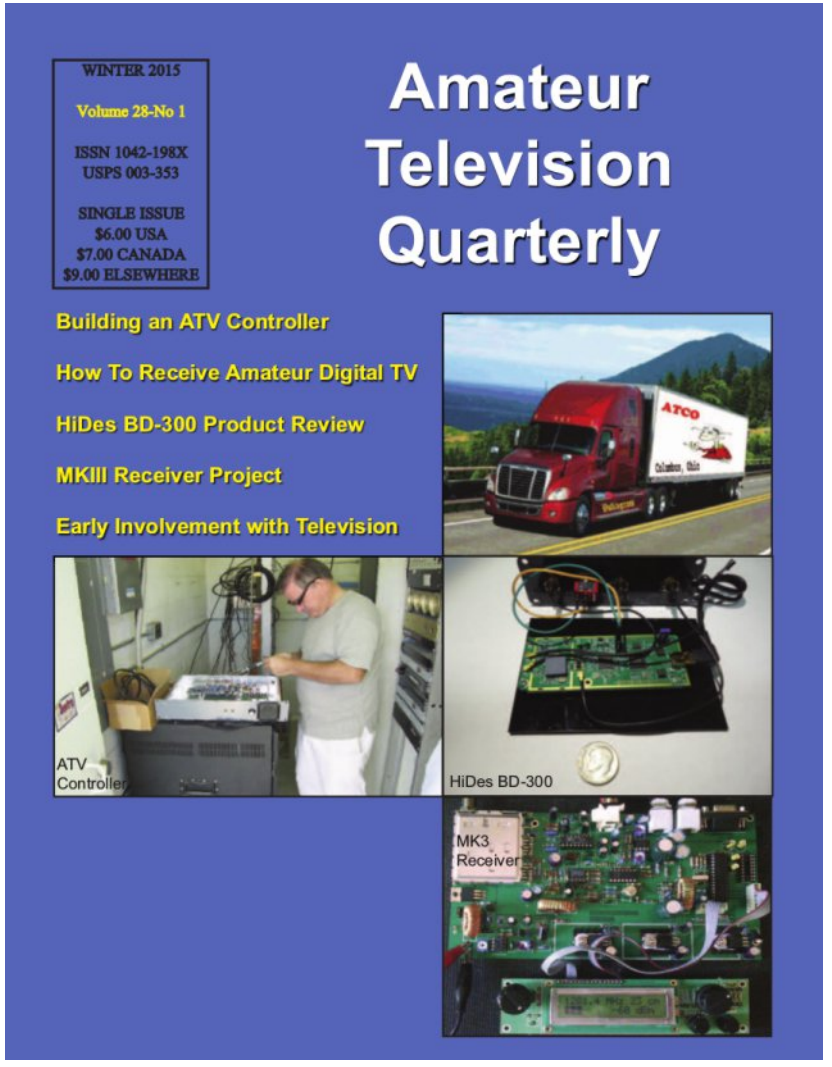
- A more affordable DATV exciter can now be ordered
- Fully-assembled and tested PCBA
- DVB-S protocol for DATV (using QPSK modulation)
- Can operate all ham bands from 70 MHz-to-2450 MHz
- RF output level up to 10 dBm (min) all bands (DVB-S)
- Software Defined Radio (SDR) architecture allows many variations of IQ modulations
- "Software-Defined" allows new features to be added over the next few years, without changing the hardware board
- As extra bonus, the team has been able to get the board to transmit DVB-T 2K mode, however we cannot guarantee the performance of that protocol. Caveat Emptor!
- Requires PC running Ubuntu linux (see User Guide)
- Price is US$300 + shipping – order using PayPal



For more details and ordering

www.DATV-Express.com

register on the web site to be able to see the PURCHASE page



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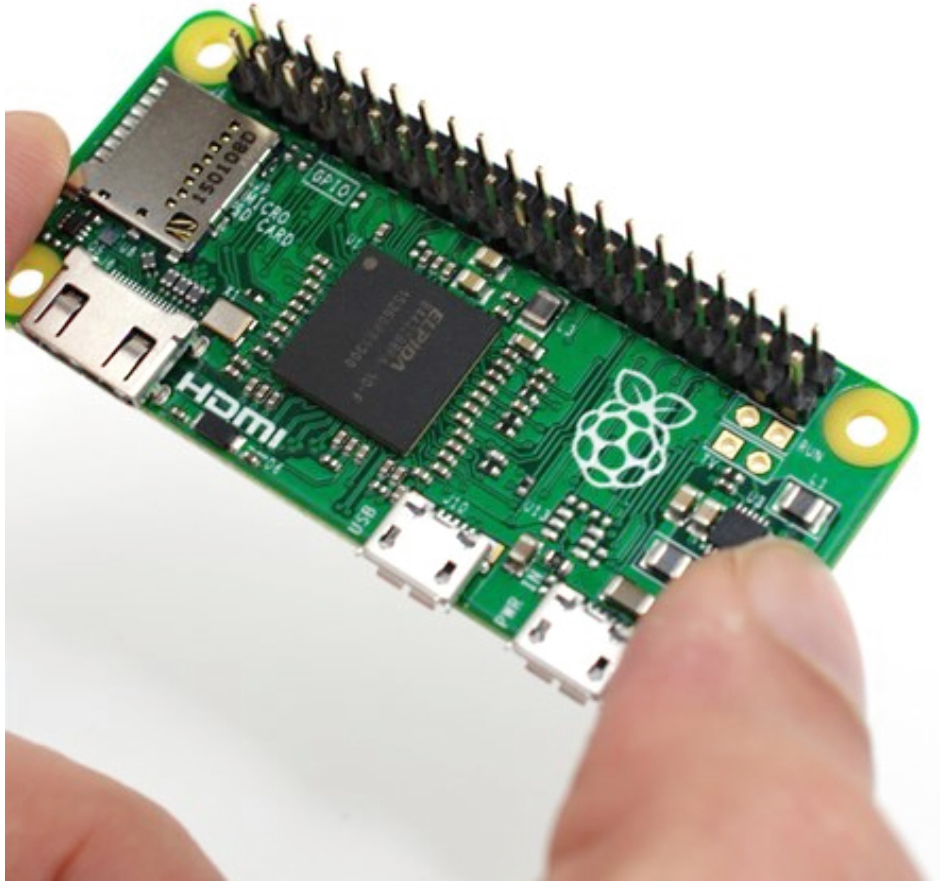
Raspberry Pi Zero Contest Number Generator

By Mike G7GTN



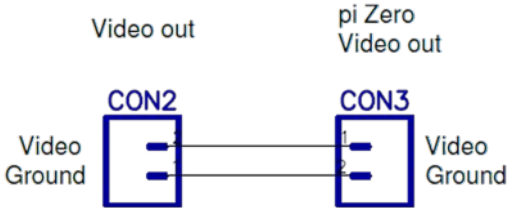
Introduction

I had the requirement for a simple but very customisable Contest Number Generator. We will make use of the recently introduced Raspberry pi Zero module to generate our PAL (or NTSC) video signal. The font is large enough to be viewed over even somewhat tricky RF paths.

Our contest numbers do of course have to be non consecutive in the ordering sequence to be valid. So the ATV operator simply selects and enters the required and preferred numbers within a setup text file. So now we can smarten up our number generation solutions ready for the BATC Summer fun TV contest being held in June.

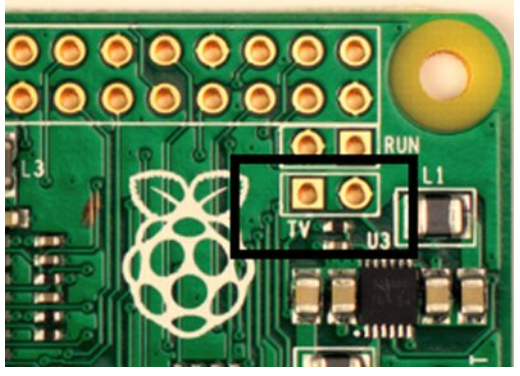
Connecting PAL (or NTSC) Composite video output

On the Zero modules we can populate the standard 2.54mm two way pin header to make our PAL (or NTSC) connection to our required video output source either video monitor or transmission chain. The square around the hole indicates the Video side with the circle being the ground connection. Next we need to edit our systems boot config.txt file to inform the Operating system what specific standard of composite video output is required and also specify an aspect ratio at the same time.



A couple of changes are made to your boot config.txt file, this is located within the /boot sub-directory
(see pic top of next page)

My own configuration file is included in the code download ZIP file for you to quickly see how these have been implemented.



If you copy this file make sure you consider any previous changes that you have made to your original file, or certain elements of your system could suddenly stop working.

```
sdtv_mode=0    Normal NTSC
sdtv_mode=1    Japanese version of NTSC - no pedestal
sdtv_mode=2    Normal PAL
sdtv_mode=3    Brazilian version of PAL - 525/60 rather than 625/50, different subcarrier
```

```
sdtv_aspect=1  4:3
sdtv_aspect=2  14:9
sdtv_aspect=3  16:9
```

Switching the 3 large number screens

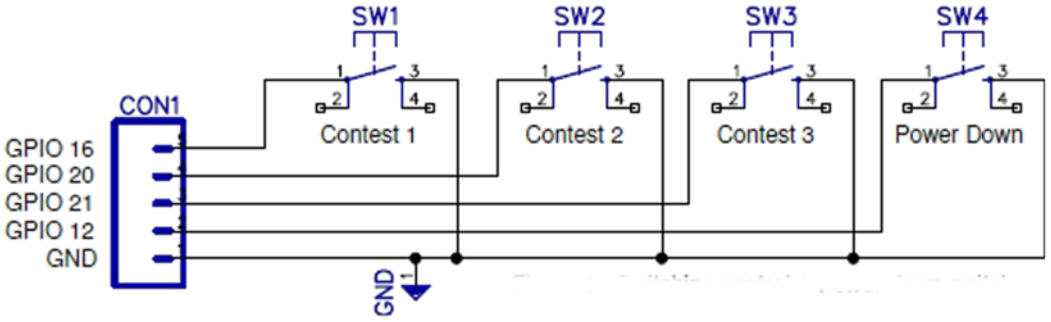


Figure 1 - Switching control & Power down switch

The push button switches are wired directly to GPIO pins, the other end to ground. The software implements internal pull down resistors making use of the Python GPIO library.

User Configuration & option settings

```
# ================================================================================
# Project : Large Contest Number Generator
# Purpose : Users configuration file
# ================================================================================

[user settings]
ContestNumber = 2473

# enter font name in lower case
# mode7.ttf, ariblk.ttf
#
[font setting]
UseFont = mode7.ttf

# enter colour name in lowercase
# valid white,blue,green,yellow
#
[font colour]
TextColour = white
```

The background images used were created at (768X576) pixels. You can select between two different font styles. All user changes are made by editing a supplied setup.ini text file. This should be quite self-explanatory on available setting options. You may optionally add the additional push button depicted in Figure 2 to gain user instruction screens which auto rotate after a 10 second delay.

Full and very comprehensive installation & setup instructions are included within the download file.

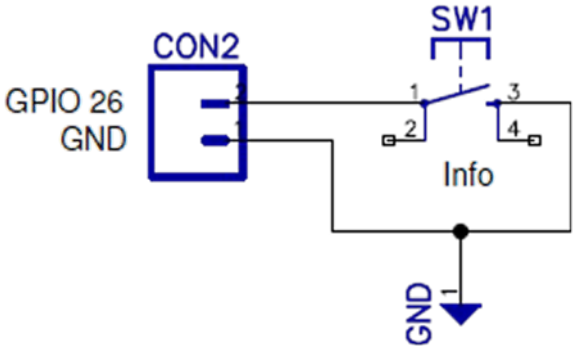
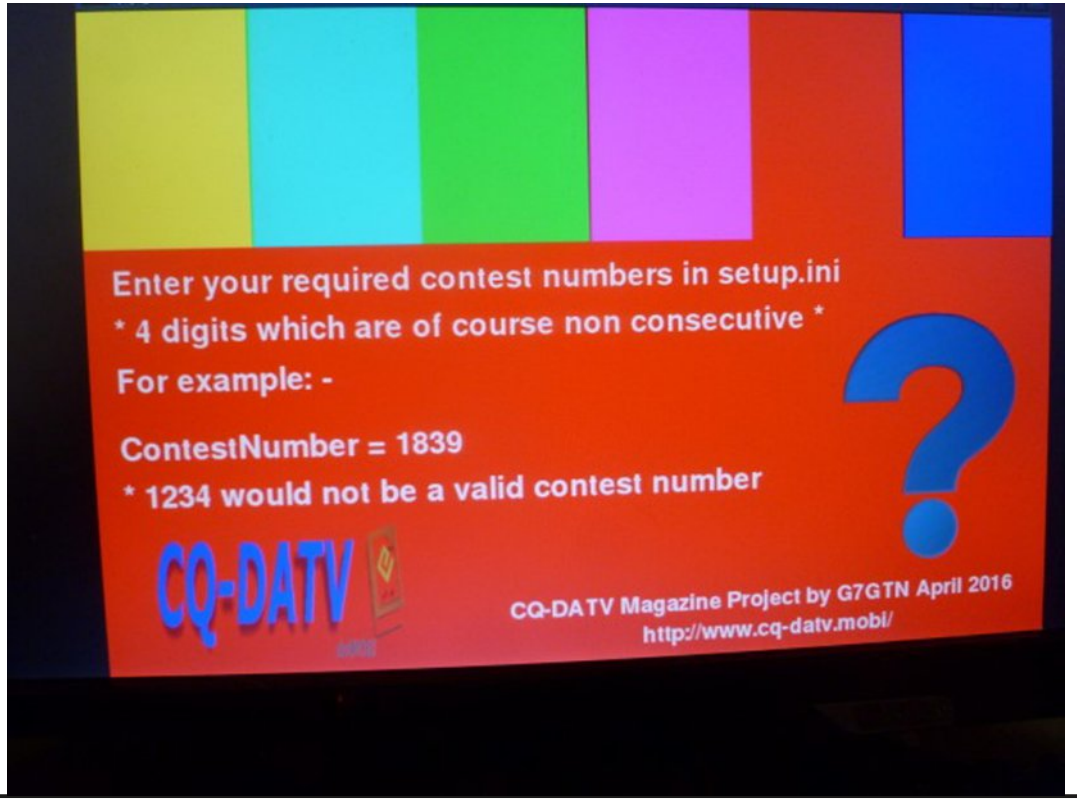


Figure 2 - Optional Information Switch



This can be downloaded from the usual CQ-DATV software page as *cng.zip*

Notes

Slightly like back in the old days when valves had to warm up our pi Zero generator project takes around 45 seconds to fully boot from cold and then produce a composite video output with our contest numbers, so you might need to plan for this ahead of time in television contesting transmission. Of course the module consumes so little power that would be fine just left powered up.

If you wish to design some different screens then I would certainly recommend the Windows based Testcard Maker Software.

An interesting review of this was previously written by Richard VK4XRL and published in CQ-DATV edition number 5 *http://www.cq-datv.mobi/5.php*

Samples of the two differing font types (Mode 7 & Arial Black) and instruction screen.

3D printing and amateur radio

By Jonathan Hare, G1EXG

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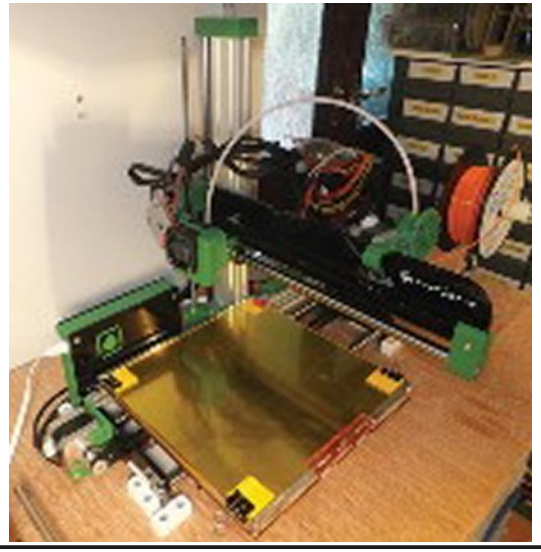
You can find more information on the authors web site at *http://www.creative-science.org.uk/3D.html*

A new world of possibilities: making your own plastic parts at home

What is a 3d Printer?

A 3D printer is a device that can fabricate three dimensional objects. Just as you can print an article from a PDF or document file using a standard printer, so you can 'print out' an object by sending a 3D file to a 3D printer. The printer described here uses a reel of plastic filament as the building material. Instead of printing ink on paper, it melts the filament producing a thin thread that it uses to build up, layer upon layer, the 'printed' object.

ORMEROD Rep Rap Pro.



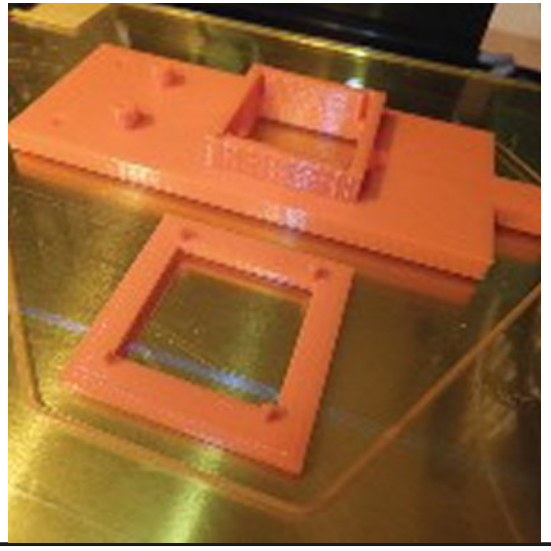


PHOTO 1: Far left, the 3D printer with a reel of orange plastic filament. Left, a 3D printed object 'hot off the press'.

There are currently many 3D printers on the market, costing from under £300 – and prices are coming down all the time. My 3D printer (Photo 1) is an *Ormerod Rep Rap Pro* (supplied to me by RS Components), which came as a kit that I had to assemble, set up and calibrate. It took me about 10-12 hours to assemble the printer and a few evenings over a couple of months to properly set it up and overcome the odd technical problem, learn the software and so on.
http://www.creative-science.org.uk/3D/JPH_Ormerod_review_2014.pdf

Why 3D Printing?

Why would a 3D printer be useful? Well, Photo 2 shows a prototype wind powered generator (anemometer) partly made from the orange 3D printed parts.

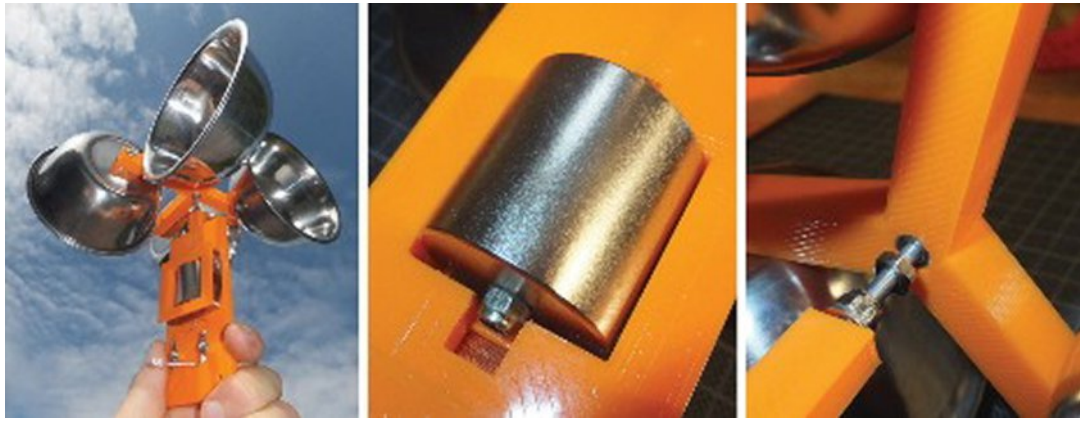


PHOTO 2 (above): Left, a prototype 4-cup wind powered generator (anemometer). Middle, special magnet in its custom made housing and, right, the 3-cup spreader with hexagonal countersunk hole with fixing nut embedded (with another nut along the threaded shaft just about to be tightened onto it).

The cups are connected via a four-way spreader to a threaded shaft and this is also connected to a magnet, which has the poles at the sides rather than top and bottom. There is a coil of wire around the magnet. When the wind turns the cups it spins the magnet and the rotating magnetic flux generates a current / voltage in the coil of wire.

The 3D printer allowed me to make a neat coil former around the magnet so that the wire could be as close as possible (to maximise the voltage). I could also design small sections to accommodate the rotating nuts that hold the magnet (middle image).

This would be tricky and time consuming to make by hand but is easy to do on a 3D printer. I then thought it might be interesting to try a 3-cup version and simply modified the 3D software design to create a three-way spreader.

I had also learnt from previous versions that this spreader often came lose on the shaft, so I now included a hexagonal countersunk hole to take a locking nut (right image). This countersunk hex hole would be quite hard to make with simple hand tools!

3D printing therefore provides a powerful way of prototyping ideas. Using the software you can easily change and modify designs, creating objects that would be hard or impossible to make using basic hand tools. If you want to try different magnets, or scale up or down in size etc, you can simply print out new versions of your ideas and perfect your projects!

How does it work?

Stepper motors are used to move a printing bed back and forth (along the X axis) and also drive a moving heated nozzle (Y and Z axis). A further motor supplies the heated nozzle with the plastic filament material. The hot nozzle (at about 200°C) extrudes a thin thread of plastic.

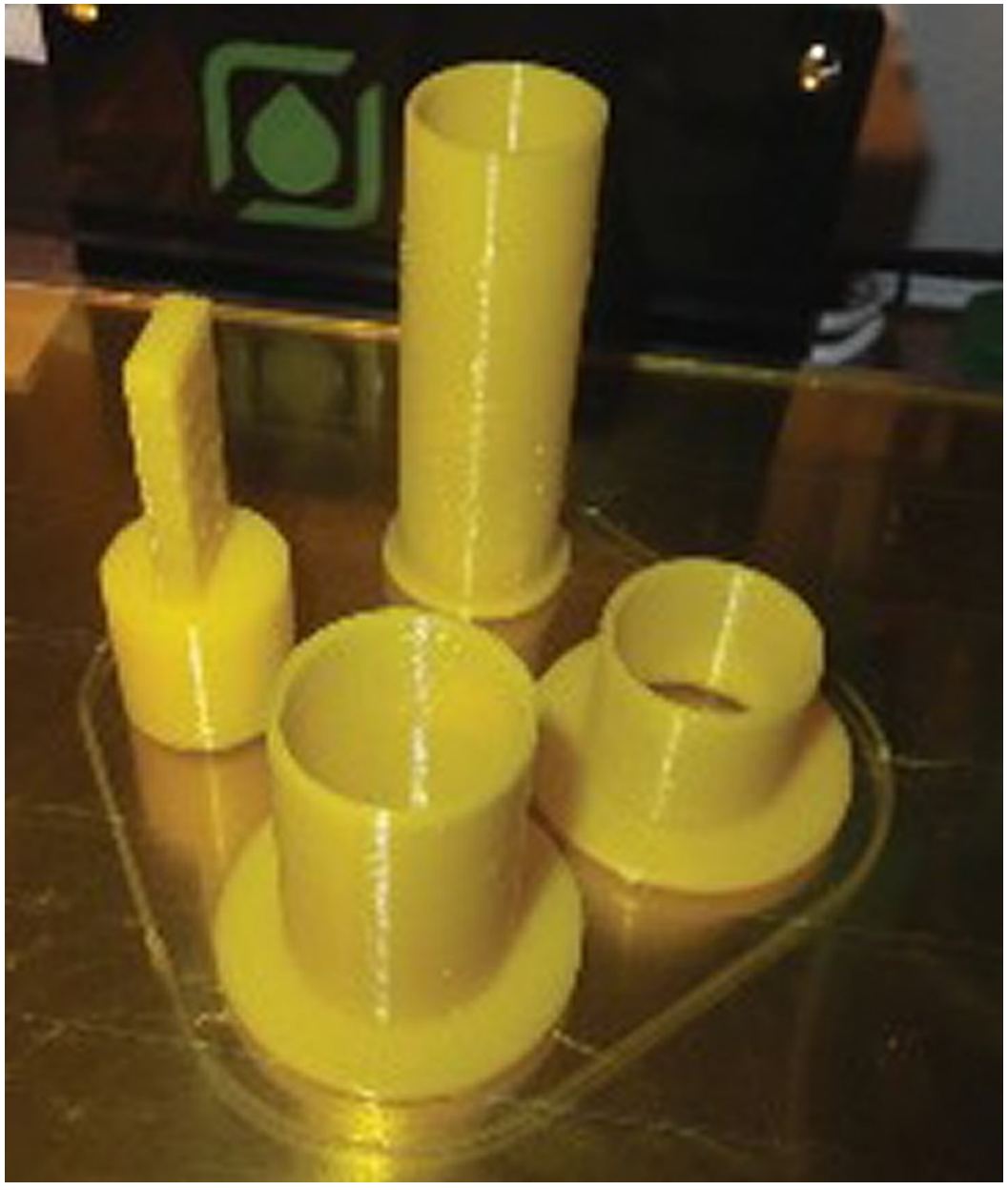
The printing bed also has a built in heater (~50°C) so that the first layer of plastic will adhere to the bed, then the other layers build on this. The X and Y axis move about while printing but the Z axis only ever slowly rises as the 3D object emerges from the printing bed. An onboard microcontroller board deals with the complex task of co-ordinating the motors and heating control.

The Filament

Key to the success of the technique is to find a plastic that will melt reliably and uniformly when required to, yet will form a strong durable material when cooled. Many 3D printers use PLA or ABS plastics. PLA, polylactic acid, is a biodegradable polymer material with mechanical properties ideal for 3D printing [3]. It comes in many colours and reel lengths and is not that expensive. All the objects in this article can be printed out from one small (80m, ~250g) reel of PLA, which cost about £12 on eBay. Larger reels are even more economical (1kg costs about £20).

Software

There are many software options for drawing 3D designs. I used openSCAD, which is free and an easy to learn program. It gives great control of parameters such as shape, size angle of solid parts as well as control of bolt holes size etc. Once you have designed a 3D object you can save it as a standard 3D file format, .stl (eg antenna.stl). We then open this file in a 'slicer' program that slices the 3D file into thin layers and produces the .g file (eg antenna.g) that the printer uses to create the 3D object layer-by-layer. The .g file is transferred to the printer via an SD card, then you just press 'print' on the computer-printer interface. The printer 'homes' and starts to print out your object. As the printer is controlled by the onboard electronics and SD card files it no longer needs a computer connection and you can leave it to do its job.



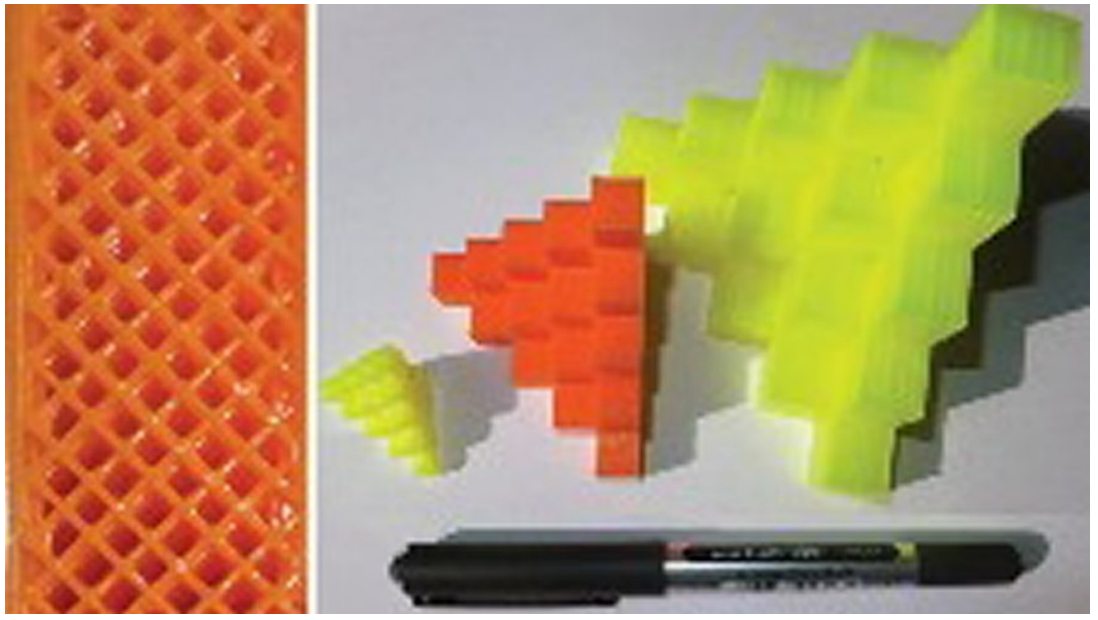


PHOTO 3: Top right, the inner cross hatch fabrication in the printing process makes for economical use of the plastic filament, light weight parts with good strength. Above, a model printed at three different sizes (see text).

Printing Out.

I was really impressed with the quality, strength and stiffness of the plastic prints. Depending on the intricacies of the print you do sometimes get a few extraneous flecks of filament on the surface but these can easily be removed by hand or knife. The printer usually creates a smooth outer layer, while the inside is built up of a cross-hatch lattice work creating a very rigid, but light structure (see Photo 3).

For example I downloaded a pyramid shaped object (from the website Thingiverse) as a test shape. I used the software to scale this by x1, x2 and x3 (ie 300%). The step size of the largest pyramid is three times that of the smallest, so it should be (3 3)=27 times the volume and weight of the smaller one. However, because it is not solid plastic it turns out to be only about 15 times heaver. The exact details will no doubt vary depending on the software and printer settings and nozzle diameter used etc. 3D printing creates low density objects using less filament than I expected, yet producing light and strong structures – ideal for making all sorts of beautiful and useful things.

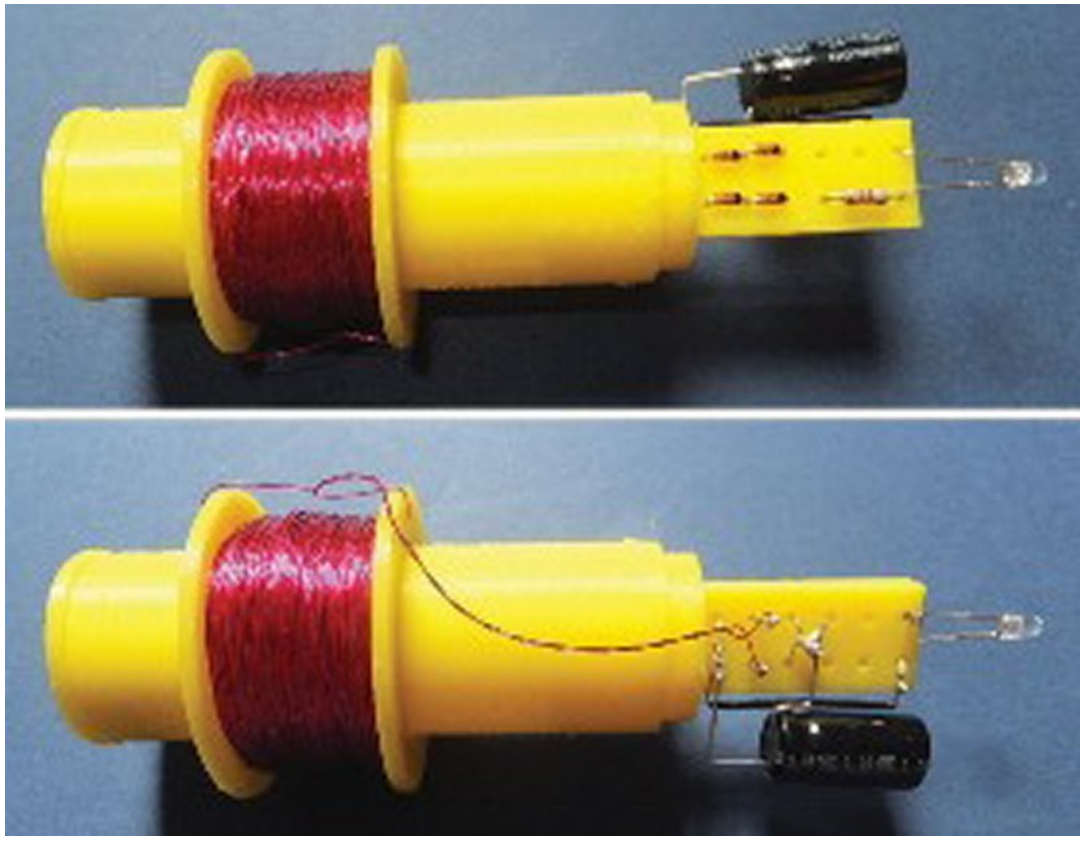


PHOTO 4: Top, four 3D printed parts for a shake-a-gen torch. Bottom, the completed torch.

Photo 4 shows a shake-a-gen device that I use in a workshop for school children to demonstrate Faraday induction (electricity generation)*http://www.creative-science.org.uk* (click on 3D Printing).

It's a coil of wire around a magnet; when you shake the device the magnet moves in and out the coil of wire, creating enough voltage to light an LED. The participants can calculate the number of turns of wire required for the coil using a basic formula and knowing the strength of the magnet etc. 35mm film cans were ideal for the workshop but these are no longer made. So recently I designed a 3D printed version, the parts of which you can see just completed on the printer bed.

In the printed version I add a small prototyping area for a rectifier and capacitor storage stage and so get ongoing light after a bit of shaking. I chose magnets with a central hole in them and so I also added a hole in the base of the shake-a-gen so that a shaft could be added to connect it to an engine etc.

The 3D printer really comes into its own, not only for being able to try out different ideas, modifications and innovations, but also because I can simply print out as many as I need for the workshop. I don't have to spend too much prep time making each part myself beforehand.

Designing Something 3D

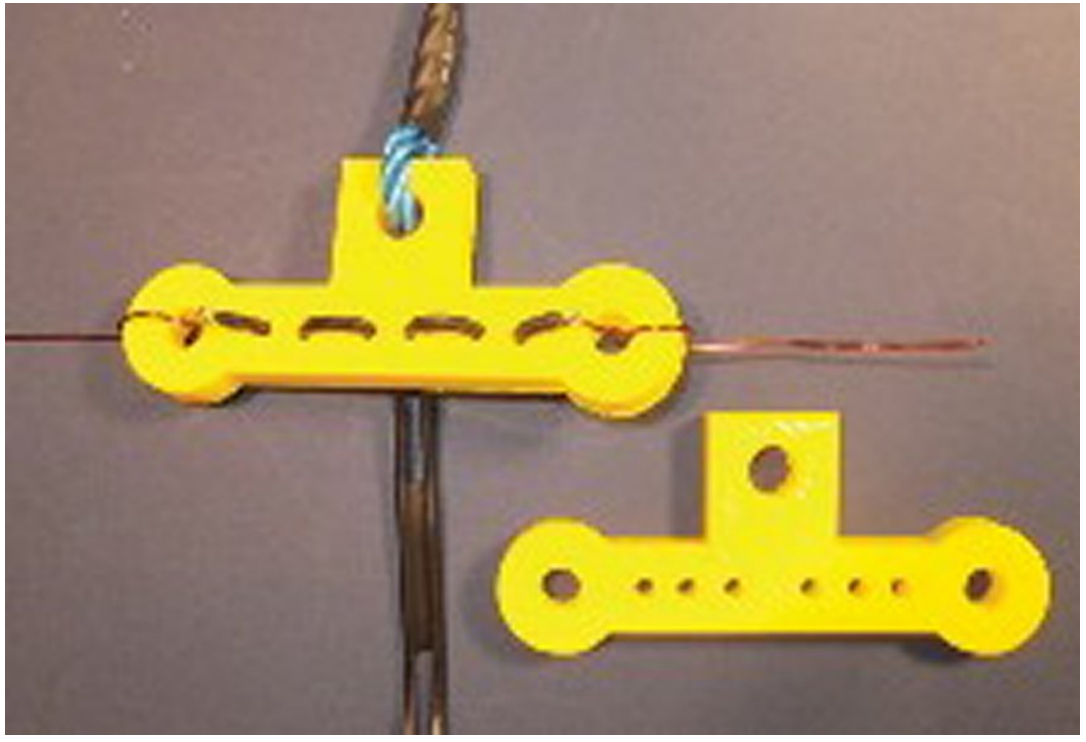


PHOTO 5: 3D printed dipole centres, shown as-made and in use.

Let's look at the design process so you can see how we might actually make something useful for amateur radio – a simple dipole centre. I won't go into too much technical detail (the software has clear tutorials), just concentrate on the basic ideas. Photo 5 shows the yellow inverted V centre and the antenna feed with open wire feeder. The two dipole wires are tied to the round anchor points while the ladder line comes in to the middle via two holes. The two feeder wires part, snake in and out of the holes for grip and are then soldered to the antenna element wires.

So how would you deign this in software? To save space I haven't printed out the code here but you can download the file from my website [4] and read through the notes. To create this shape is very simple. You could start off by defining the left hand round anchor point using a 'cylinder' command.
"cylinder [(h=12, r=15, $fn=30)]" will define a cylinder of height 12mm, radius 15mm and of resolution $fn = 30.

If $fn = 8, say, it would produce a polygon of 8 sides, an octagon. If we use $fn = 30 we get quite a round cylinder. We use 'translate' to place this object a few cm away from the axis centre. We repeat this for the right hand anchor point, but of course place it the other side of the centre. Then we create a solid block between them using 'cube' and also a section for the rope anchor point (it sits above the centre rather than to the side). The 'difference' function in the software allows us to use the 'cube' and 'cylinder' commands to create voids rather than just solids. Using this we can create holes for the rope and dipole anchor points and the small holes for the wires.

There are a whole host of other software commands you can use, as well as mathematical functions, so you can create pretty much any shape you might want. So let's look at some more possibilities: an LF/HF receiving loop, mounting brackets for a FT-817 radio and some dipole centres.

LF/HF Loop

This is a table top receiving antenna that covers much of the LF and HF spectrum. If you are a flat-dweller or just need a small antenna to monitor the bands, this works surprisingly well. There is a nice sharp null in the pattern so you can rotate it to reduce noise. It is basically a six turn square loop (~45 x 45cm) brought into resonance by a tuning capacitor. A small single turn triangular coupling coil takes the signal to the receiver via standard coax. The loop covers both Top Band and 80m.

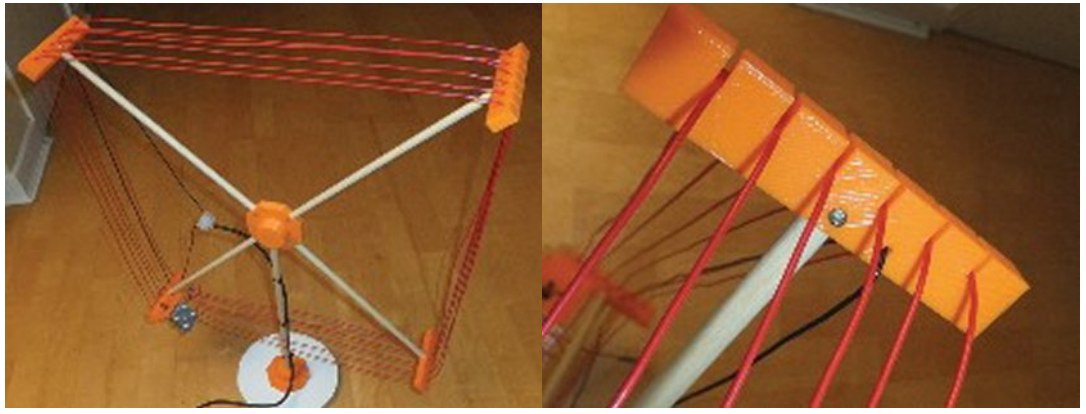


PHOTO 6: Printed components for the LF/HF receiving loop, with detail of the wire spreader.

This 3D printed version consists of an octagonal base and centre piece and four spreaders to hold and space the turns of wire. One of these spreaders also includes a flat section to hold the tuning capacitor.

Each spreader goes to a 300mm long dowel that slots into the centre piece. The long side of the triangular coupling coil is close to one side of the main coil; the other two sides meet close to the middle.

The coax is joined via a connector block, just visible to the left of centre in Photo 6.

TABLE 1: LF/HF loop data (see text).

No of turns	Large cap f_{min}	f_{max}	Small cap f_{min}	f_{max}
6	0.9MHz	4.6MHz	1.7MHz	4.8MHz
5	1.1MHz	5.4MHz	1.9MHz	5.6MHz
4	1.2MHz	6.5MHz	6.8MHz	2.3MHz
3	1.6MHz	8.3MHz	2.9MHz	8.9MHz
2	2.2MHz	12MHz	4.0MHz	13MHz
1	3.6MHz	21MHz	6.7MHz	23MHz

Table 1 shows the frequency that the loop covers versus number of turns of wire for two different tuning capacitors: a 500 + 500pF ('Large cap') and a small transistor radio type ('Small cap'). In both cases the two sets of vanes are connected together. It is difficult to find knobs to go on these small capacitors (they don't have the usual 6mm shaft) so I 3D printed a knob to fit – see Photo 7. The bolt is M2.5 x 20mm.

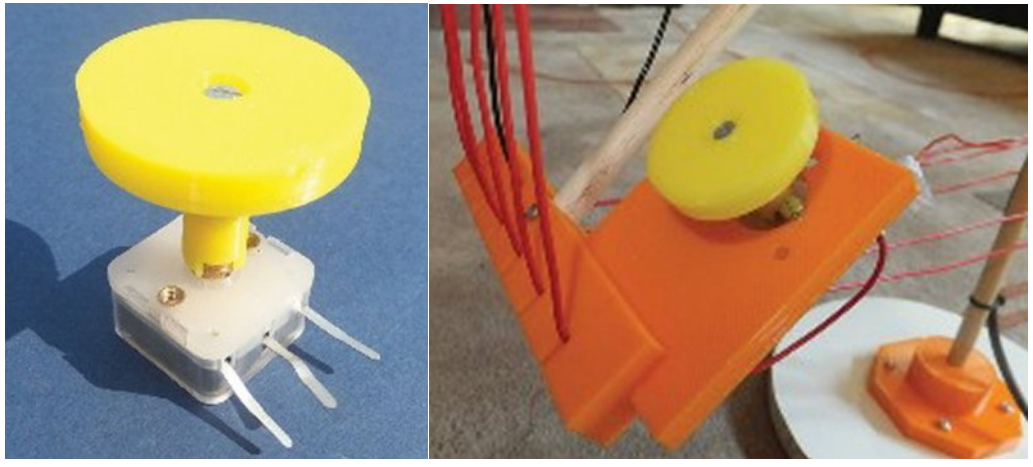


PHOTO 7: 3D printed knob for the small transistor radio type capacitor, and how the cap is mounted on the loop assembly.

FT-817 Mounting Brackets

The Yaesu FT-817 has front strap attachments but it does not have mounting holes like you might find on a larger radio. I have designed some simple fixing brackets so that you can mount the radio into a box or onto a panel etc (Photo 8).

I have printed in orange, yellow and white to highlight the differences and show up clearly in photos, but you would probably want to print them out in black to match the radio.

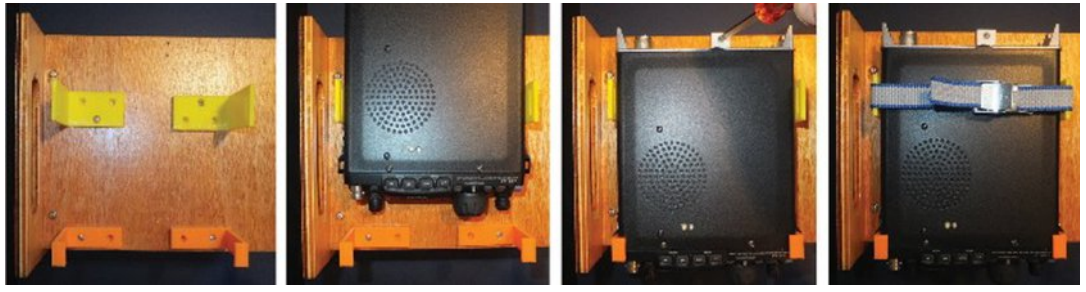


PHOTO 8: Mounting brackets for the FT-817. A bracket is screwed to the base at the back to stop the radio sliding, and a securing strap keeps it from falling out.

There are five brackets: a front pair (orange) that slot into the radio's strap fixings, a side pair (yellow) and a small one for the rear (white). The front pair go under the radio via countersunk two screw / bolt holes. These brackets curve around the top of the radio and secure it.

The side brackets have three fixing holes (also under the radio) and make sure the radio can't drift sideways. Each bracket also includes a slot near the top of the radio that can take a flat bungee or strap. A small rear bracket that goes on last and secures the radio so it can't slide out.

You could also 3D print all the brackets onto a flat base as a one-part device. I didn't, partly to save on filament and also because having separate brackets is more versatile.

Dipole Centres

The datasheets on PLA filament claim good UV stability so you should be able to make objects that go outside. Following on from the Inverted V centre, Photo 9 shows a couple more dipole centres that might be useful for portable operation, where a bright yellow / orange colour is easy to see in long grass etc.

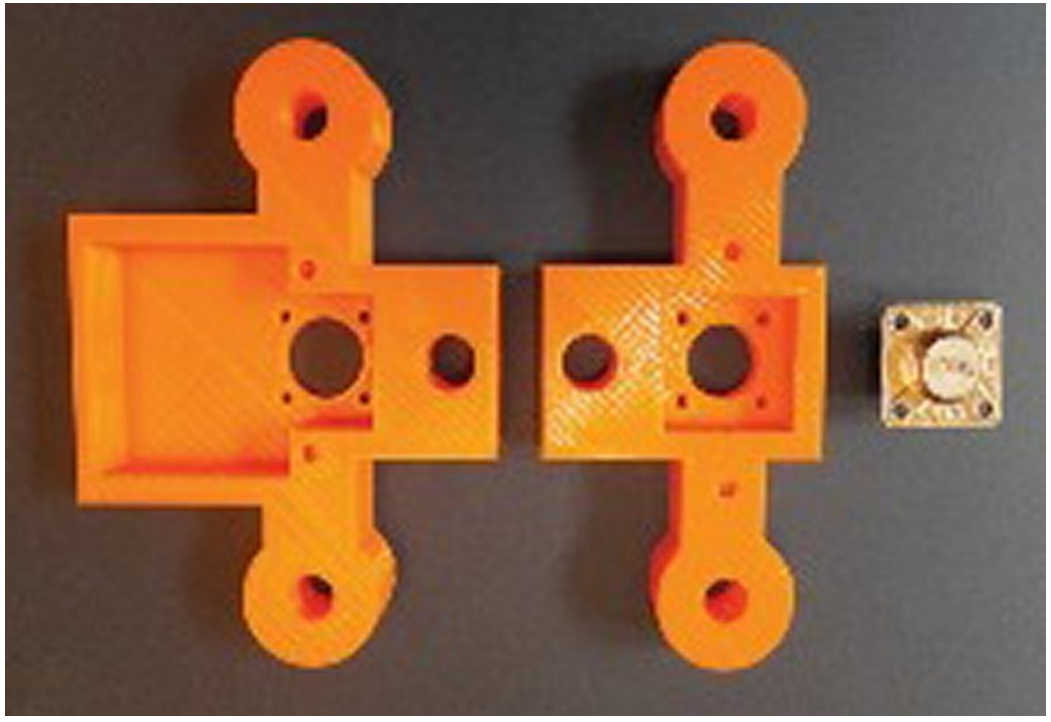


PHOTO 9: Two variants of dipole centre with space for SO239 socket

They will take a standard SO239 and I have included channels in the structure so that you can feed in the antenna wires from the round anchor points. The left hand version also has a larger case that could take a torodial balun, but you will have to modify the code for your particular sized toroid. The idea with these simple devices is that once these have been made they can be weatherproofed by filling with sealant.

Final Remarks

I have chosen these examples because I found them to be useful and fun to make. There are of course all sorts of other possibilities for 3D printing in amateur radio including microphone holders, front panels for projects (eg PIC LCD bezels), boom supports for Yagi elements, replacing broken knobs on old equipment, custom made fittings for old / foreign parts etc. Please see my website *http://www.creative-science.org.uk* (click on 3D Printing) for other ideas and hints and tips.

I would like to thank RS Components for the donation of the Ormerod Printer.

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