



Portstown 4 – Start here

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This article is aimed at beginners and does not assume any previous knowledge of the Portstown project or the Raspberry Pi. It discusses each of the four key components in turn but the fifth component required to complete the transmitter, the power amplifier or transverter, is not discussed here.

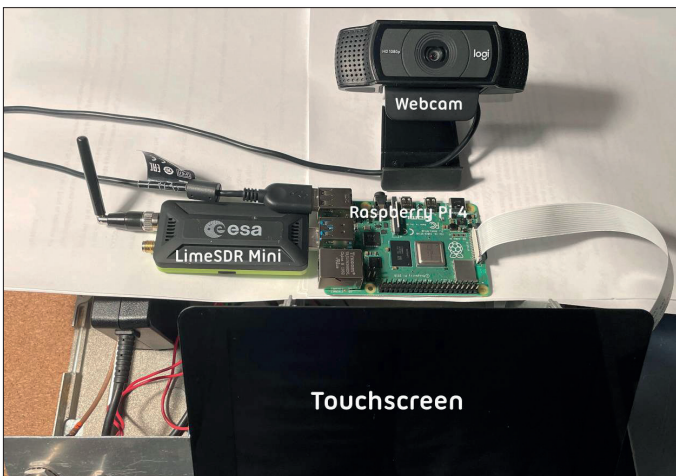
The Portstown 4 provides a really easy way to get started with digital ATV, either for use on 70 cms and the other terrestrial bands, or for use on QO-100. Unlike many of the more complex solutions (using Windows PCs), it has a standard set of parts and configuration-controlled software, so should “just work” when built and configured according to the instructions.

The key components are the video/audio source, the Raspberry Pi with touchscreen, the software defined radio (SDR) and the optional output switching as shown below. A parts list is provided at the end of the article.

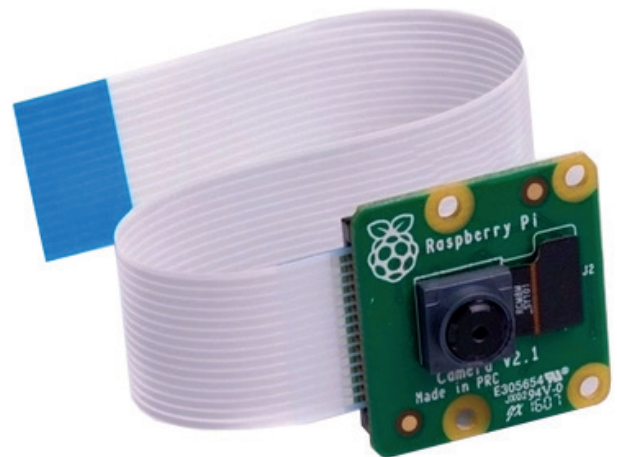
Video and Audio Source

Starting at the beginning, we need a way to get audio and video into the system. You can use a Raspberry Pi camera and a USB audio dongle, a Logitech C920 webcam, or an EasyCap video capture device with a PAL camera. For testing, an internally generated test card is available which does not need any extra hardware.

The Raspberry Pi camera can be an old version one (no longer available), a current version two, or the more expensive HQ camera which takes a (separately-purchased) C-mount lens. All come with short (15 cm) ribbon cables to connect them to the Raspberry Pi. You may want to buy a longer ribbon cable or use adapter sockets to use an HDMI cable extension. As described on the Wiki https://wiki.batc.org.uk/CSI-2_to_HDMI, these use HDMI hardware, but not the HDMI electrical standard.



► The simplest “full system”. Webcam, RPi4, touchscreen, LimeSDR and PSU (underneath)

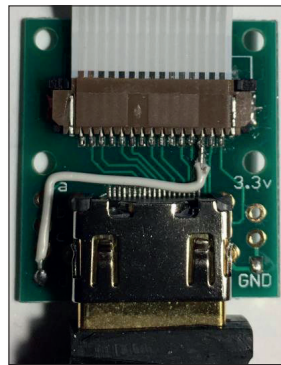


► Raspberry Pi camera version two with ribbon cable

Video and Audio source	Raspberry Pi and Touchscreen	SDR	Optional output and PTT switching	Power Amplifier(s) and/or Transverters
Pi camera and USB audio dongle	Raspberry Pi 4 with 2GB (or more) of RAM	LimeSDR Mini	Four-way switch	Not discussed here
or	and	or	or	
Logitech C920 Webcam	Programmed SD Card	LimeSDR USB	Eight-way switch	
or	and	or	or	
PAL camera and EasyCap	Official seven-inch touchscreen	Pluto	No switching	
or	and	or		
Internal Testcard	5.2V 3 Amp PSU	DATV Express PCB (DVB-S only)		

► Adapter to use HDMI cable for camera extension

► The correct USB audio dongle



For audio with the Raspberry Pi camera, you should use a cheap (less than £5 from eBay) USB audio dongle of the type shown here. Do not buy any other colour or shape, as they will probably be different internally and not work.

The Logitech C920 webcam is also supported as a video and audio source. There are two versions available – the older version has an internal H264 encoder and is preferable, the newer one works, but not quite as well. **Note that other models of webcams are unlikely to work.**



► The Logitech C920 webcam

The third option for a video source is to use an old composite video camera and a specific type of EasyCap USB adaptor: Note that there are four types of EasyCap adaptor which all look identical from the outside. The only one that works is the Fushicai USBTV007. These used to be stocked by the BATC shop (550 were sold) but they are now unobtainable in quantities of under 1000. Work is under way to modify the software to accommodate a suitable replacement.

The final video option, which is useful for testing, is the internal test card. This is selected from the touchscreen and can have your callsign overlaid.

Raspberry Pi and Touchscreen

The Portsdown 4 uses a Raspberry Pi 4. All testing is done on the cheapest 2 GB model, but the more expensive versions with more RAM will work. The Raspberry Pi 4 can run hot, and the best solution is to buy a heatsink case to protect it thermally and mechanically.

You will also need a suitable power supply. The current consumption is up to 3A, and major Raspberry Pi suppliers sell suitable mains power supplies with the USB-C connector. For portable operation a switching power supply (from eBay) can be used to supply 5.2V directly to the GPIO header pins.

The Raspberry Pi needs an SD card with the Portsdown software on it. The recommended type is the SanDisk Ultra 16 GB. These are sold pre-programmed by the BATC shop, or you can program it yourself – full instructions are on GitHub <https://github.com/BritishAmateurTelevisionClub/portsdown4>.

Other brands and types of SD Card do not work well with the Raspberry Pi, and it is not worth the trouble of using them.

The Portsdown is controlled by a touchscreen, which must be the official Raspberry Pi Foundation seven-inch touchscreen.



► The Raspberry Pi touchscreen

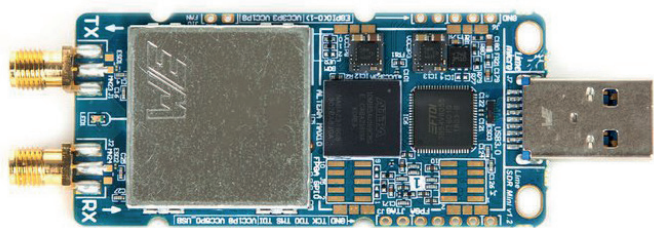
This touchscreen comes with a short ribbon cable to connect to the Raspberry Pi. You may want to buy a longer ribbon cable depending on your mechanical design. The ribbon cable is identical to the one used for the Pi Camera. The touchscreen is powered from the Raspberry Pi.

Software Defined Radio

The choice of SDR comes down to personal preference. The LimeSDR Mini and LimeSDR USB both work well out of the box, but there are not many other systems that use them. The Pluto needs bespoke configuration to be used with the Portsdown and some users have reported difficulty with this process. However, there are other applications (such as the Langstone microwave transceiver and the SatSaGen test equipment software) that also use the Pluto.

Finally, some of you may have a DATV Express PCB (which is no longer in production). This will work with the Portsdown 4 for DVB-S, but not DVB-S2. All produce an output in the region of one to 10 mW.

The LimeSDR Mini is supplied without a USB Cable, so a short USB3 extension cable is required if you are not going to plug it directly into the Raspberry Pi (which can be mechanically awkward).



► *The LimeSDR Mini*

For mechanical protection, it is highly recommended the LimeSDR Mini is mounted in a box and provided with adequate cooling as it runs quite hot.

The LimeSDR USB is a more expensive version of the LimeSDR with more options and requires an external power supply.

The Analog Devices Pluto needs three modifications before it can be used with the Portsdown.

Firstly, you need to extend its frequency range by telling it that it has a different IC in it. Details here:

<https://wiki.analog.com/university/tools/pluto/users/customizing> and scroll down to “Updating to the AD9364”.

Second, you need to enable the second processor. Details here: <https://www.ph4x.com/pluto-sdr-hack-2nd-cpu-core/>.

The final modification is to load a specific version of F5OEO’s custom firmware. Note that it must be this version, not more recent versions.

The firmware can be found here together with a link to the upgrade instructions https://wiki.batc.org.uk/Portsdown_4_Pluto#Suitable_Pluto_Firmware . If you are not comfortable with these steps, either use a LimeSDR Mini instead or arrange for someone else to make the modifications.

► *The Analog Devices Pluto*

The Pluto comes with a suitable USB lead for connection to the Raspberry Pi and is housed in a plastic protective case.



The final SDR option, which is only capable of DVB-S (not DVB-S2) with the Portsdown, is the DATV Express board, which simply connects by USB.

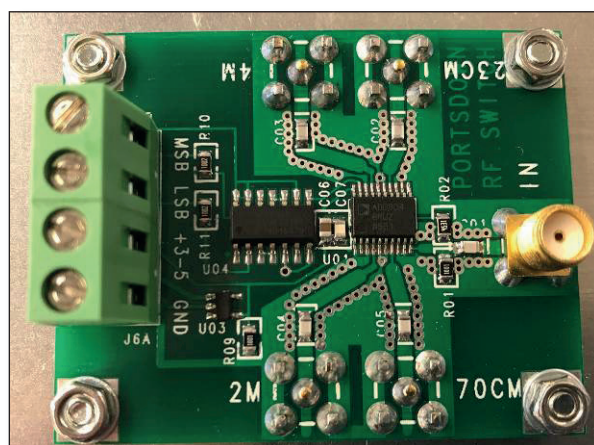
Optional output and PTT switching

If you are manually switching a power amplifier (PA) for a single band, then you can simply connect the output of your chosen SDR to the amplifier and switch the PA on once the SDR has started.

However, some automated switching is strongly recommended as both the LimeSDR and Pluto produce a calibration signal (often much more powerful than the normal transmission) before the transmission starts and this has led to the destruction of several PAs. A delayed PTT signal is available from pin 40 of the Raspberry Pi GPIO connector and this only goes high once the calibration pulse is finished.

If you want to drive up to four PAs for different bands from your Portsdown, then the BATC’s four-way RF switch and four-way switch control board are recommended.

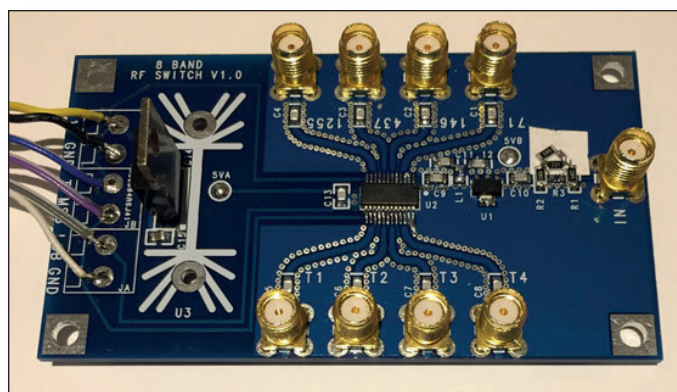
Full details are on the BATC Wiki here: https://wiki.batc.org.uk/Portsdown_hardware#4-Band_RF_Output_Switch



► *The four-way RF switch*

You can drive up to eight PAs or transverters with the BATC’s eight-way RF switch, control board and PIC. Again, the details are on the BATC Wiki here:

https://wiki.batc.org.uk/8-Band_RF_Output_Switch



► *The eight-way RF switch*

Both the four-way and the eight-way RF switches allow the PTTs for individual PAs to be controlled safely.

Portsdown 4 parts list and suggested suppliers

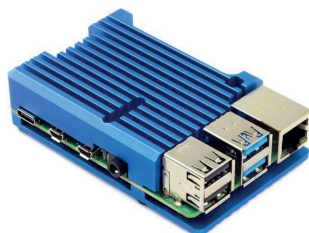
Here is a list of parts required for the Portsdown 4 and some possible suppliers:

Audio and video Source:

- ▶ RPi Camera V2 – RPi Suppliers
- ▶ Optional longer ribbon cable – RPi Suppliers
- ▶ Optional Arducam CSI to HDMI cable kit – thepihut.com
- ▶ Optional HDMI cable for extension – Multiple suppliers
- ▶ USB audio adapter – eBay **or:**
- ▶ Logitech C920 webcam – multiple suppliers **or:**
- ▶ Fushicai USBTV007 EasyCap video capture device – Ex BATC shop, now out of stock.

Raspberry Pi and touchscreen

- ▶ Raspberry Pi 4 2GB model – RPi Suppliers
- ▶ Raspberry Pi 4 heatsink Case – RPi Suppliers
- ▶ Raspberry Pi 4 3A Power Supply – RPi Suppliers
- ▶ Official seven-inch touchscreen – RPi Suppliers
- ▶ Optional longer ribbon cable – RPi Suppliers
- ▶ Portsdown 4 SD card – BATC Shop



SDR

- ▶ LimeSDR Mini – Mouser-UK part number cs-lime-05
- ▶ USB 3 extension cable– multiple suppliers **or:**
- ▶ Analog Devices Pluto – Mouser-UK part number 584-ADALM-PLUTO **or:**
- ▶ DATV Express Board – no longer manufactured.

Optional Output and PTT Switching

- ▶ Homebuilt PTT Driver controlled from GPIO Pin 40 **or:**
- ▶ BATC four-way switch as described on BATC Wiki **or:**
- ▶ BATC eight-way switch as described on BATC Wiki

Major Raspberry Pi Suppliers:

- ▶ Pimoroni <https://shop.pimoroni.com/>
- ▶ The Pi Hut <https://thepihut.com/>

Further information

Further reference information can be found on the BATC Wiki <https://wiki.batc.org.uk/>. More information, and answers to specific questions can be found on the BATC Forum <https://forum.batc.org.uk/> .

ATV frequencies and recommended modes

I'm often asked what frequencies and modes are used for simplex amateur TV.

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There is no mandated list, but here is a guide to the most-used frequencies and modes on each band. There may be extra licence restrictions in some regions and regional variations to prevent interference to and from the band's primary users.

The frequencies stated for the higher bands are those where there is likely to be activity during ATV contests.

ATV repeater input and output channels are not listed.

Voice talkback in the UK is generally on 144.75 MHz FM, but other frequencies may be used in some areas.

Before transmitting, please check your licence and the RSGB band plan. 🗣️

Frequency	Mode	Parameters	Notes
29.25 MHz	DVB-T	333 kHz QPSK	Max 500 kHz bandwidth
51.7 MHz	DVB-T	333 kHz QPSK	Max 500 kHz bandwidth
71.0 MHz	DVB-T	333 kHz QPSK	NoV required. 70.5 - 71.5 MHz
	DVB-S2	333 kS QPSK	
146.5 MHz	DVB-S2	333 kS QPSK	NoV required. 146.0 – 147.0 MHz
437.0 MHz	DVB-S2	333 kS QPSK 1 MS QPSK	Band plan 436.0 – 438.0 MHz
1255.0 MHz	DVB-S2 FM ATV	Various SRs	FM ATV being replaced by DATV Caution not to interfere with Primary User
2395.0 MHz	DVB-S2	Various SRs	
3405.0 MHz	DVB-S2	333 kS	
5665.0 MHz	FM ATV	Wideband FM	Using FPV drone equipment
5762.5 MHz	DVB-S2	333 kS	Using NB Transverters (from 146.5)
10370.5 MHz	DVB-S2	333 kS	Using NB Transverters (from 146.5)
24047.5 MHz	DVB-S2	333 kS	Using NB Transverters (from 143.5)
47090.5 MHz	DVB-S2	333 kS	Using NB Transverters (from 146.5)
75978.5 MHz	DVB-S2	333 kS	Using NB Transverters (from 146.5)