Fig. 1: A USB soundcard – £3 delivered from Hong Kong (eBay).

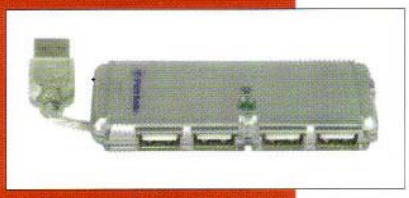


Fig. 2: A 4-way USB hub – £1 from eBay.

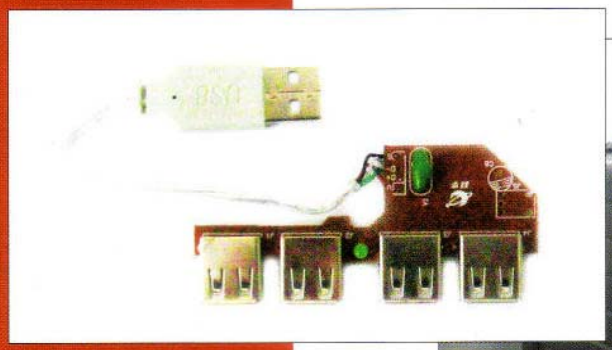


Fig. 3: A USB p.c.b. (2mm is removed from the right hand side of the p.c.b.

Fig. 4: A USB-to-serial adapter. But beware of some cheap versions available from eBay – they have a high failure rate.

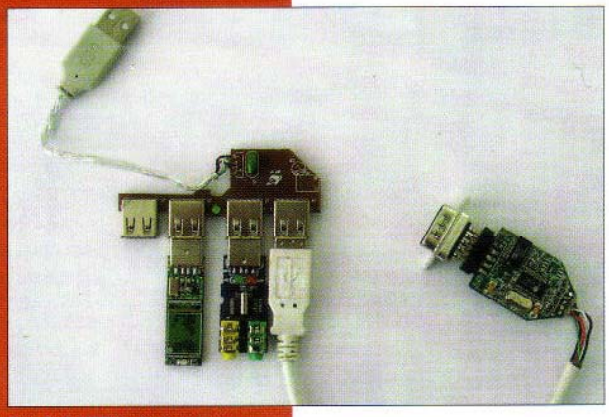


Fig. 5: A USB hub showing USB hub and daughter interfaces fitted.

Feature

A Budget USB Data Interface

Len Paget GM0ONX is well known for his antenna articles in *PW* but this month he's demonstrating that well known trait displayed by Radio Amateurs the world over – how to spot a bargain!

Boxed up smartly for a professional look!

Nowadays Radio Teletype (RTTY), Slow Scan TV (SSTV) and data modes such as PSK31 are really popular. Thanks to advances in computing power and the availability of suitable computer programs, all that's needed to receive these modes is a computer with a soundcard and simple cable between the computer's soundcard and the transceiver.

Transmitting is only marginally more complicated – requiring a single transistor push-to-talk (p.t.t.) circuit connected to the computer's serial coms port or by using the transceiver's voice operated changeover (VOX circuit).

The trouble with the simplistic approach is that audio earth loops can occur between the computer's soundcard and the transceiver causing distortion on audio (a.f.) and radio frequency (r.f.) interference (r.f.i.) can be a major problem on transmit. To add the problem many newer computers don't have serial ports any more making interfacing more complicated.

Commercial interfaces are available that include audio isolation, an onboard soundcard and the transceiver keying circuit all in one box that address these

problems. Unfortunately, they aren't a cheap solution.

While trawling the Internet I came across a USB soundcard for less than £2 on eBay, **Fig. 1**, and a thought was hatched! What about using one of these along with a USB-to-serial adapter, audio isolating transformer, p.t.t. circuit and then build the lot into one box myself?

The USB Hub

The heart of the USB Radio Interface described here is 4-way USB hub, again purchased from eBay **Fig. 2**, (but probably available elsewhere too). I found that that once the USB hub printed circuit board (p.c.b.) was removed from its case and I had trimmed 1mm from the side of the board, **Fig. 3**, it would fit into the side rails of a Hammond 1455K1202 enclosure. A small piece of *pvc* tape covers the edges the p.c.b. to prevent the tracks shorting to the enclosure sides and to gives it a firmer fit.

I removed the existing USB Type A plug on the USB hub and replaced it with a USB type B socket. This was mounted to the rear of the enclosure to allow a standard USB cable to be used. If preferred, you can leave the original plug as it is and dangle out the back of the interface and use a USB extension cable to connect it to the computer.

With the USB hub now fitted in the enclosure, the USB soundcard is plugged into any one of the four available ports. As space is tight between the port outlets the soundcard is also removed from its case and it is secured in place using hot-melt glue.

The next part to be connected to the hub is the USB-to-serial adapter, **Fig. 4**. This provides the switching for the p.t.t./c.w. circuits and a serial port for use with the transceiver's CAT port.

Most programs and transceivers allow the CAT interface to be used without using the RTS/DTS lines allowing them to be used for the p.t.t./c.w. functions. *Ham Radio Deluxe* is one exception and if you use this – you'll need separate serial ports for p.t.t./c.w. and the CAT interfaces.

The PC system *Windows XP* allows multiple USB-to-serial adapters to be used and a second USB-to-serial adapter to be fitted in the enclosure if required. Just plug it into the spare USB hub port.

Pins 4 (DTR), 5 (RTS) and 7 (Earth) on the USB-to-serial adapter are used to control the p.t.t. and the c.w. keying circuit. The easiest way to access these is to remove the interface from the plastic moulding. (I also shortened the cable to make installation neater).

The photo, **Fig. 5.** shows the trimmed USB hub with the soundcard, USB-to-serial converter and a USB memory stick and is used to store the drivers for the USB-to-serial adapter and the data mode software plugged in. As space is tight the covers to the soundcard and memory stick are removed. The photo, **Fig. 6**, shows the USB hub and boards located in the lower section of the enclosure

Fig. 6: The USB hub fitted to the enclosure.

The PTT Circuit

Some designs use opto-isolators to totally isolate p.t.t./c.w. circuit from the transceiver. I don't because most mains powered desktop computers and transceivers already share a common earth via as the mains and I've not found it causing any problems.

The p.t.t./c.w. interface and audio isolation transformers are housed on a separate p.c.b. above the USB hub and are shown in **Fig. 7** and the circuit, **Fig. 8**, uses a BC548 transistor which 'grounds' the p.t.t./c.w. connection when operated.

Fig. 7: The p.t.t./c.w. circuit and isolation transformer.

If your transceiver uses a method **other** than grounding to earth to operate the p.t.t. and c.w. functions this interface will not work. The illustrations, **Fig. 9** and **10** show the RTS/DTS solder points on the USB-to-serial converter.

If your transceiver uses a negative keying voltage, a *pnp* transistor such as the BC558 should be substituted for the present one. Older valve type transceivers often used higher keying voltages – so bear this in mind and choose a suitable switching transistor as a BC548 has a maximum operating voltage of only about 30V.

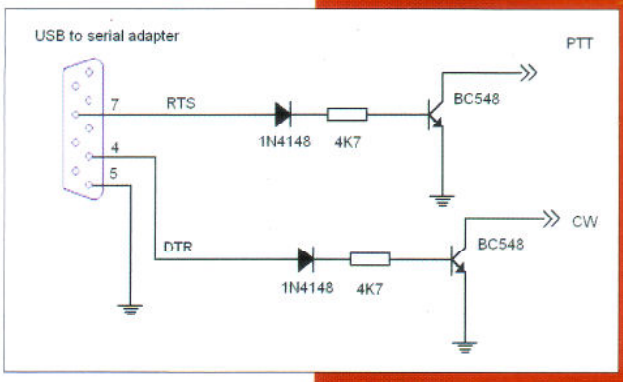


Fig. 8: The p.t.t./c.w. circuit.

Audio Isolation

Although I don't isolate any of the p.t.t./c.w. keying circuits, isolation of the audio circuit is a different matter. Most USB soundcards are designed to be used with headphones and audio hum, earth loops and r.f.i. can be a problem if the USB soundcard is not isolated from earth.

The simplest way to achieve d.c. islation is to use an audio transformer. Most commercial interfaces use a 600Ω isolating transformer but these are expensive

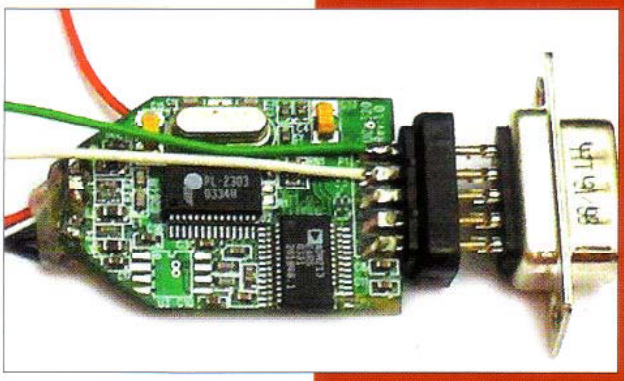


Fig. 9: The USB adapter connections (top view).

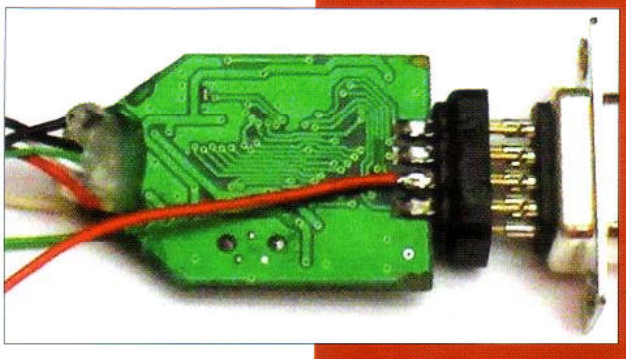


Fig. 10: The USB adapter connections (bottom view).

and difficult to source in small quantities. Instead I used an Eagle LT700 transformer – which is available from Maplin and eBay for around £2 each.

The transformers have a 1.2kΩ input impedance and 3Ω output and give a reasonable match between the transceiver and the soundcard. The soundcard is connected to the transformer using a 3.5mm stereo plug using the tip and outer ring connections. **Note:** Don't use a mono plug as this will short one channel of the soundcard out.

Dependent on the transceiver and user port used the audio levels between the USB radio interface and the transceiver to may be too high. Resistors R3/R4 and R5/R6 as shown in **Fig. 11**, act as an attenuator to reduce the audio levels to with limits that can be easily adjusted by the 'sliders' in the soundcard software.

As the USB soundcard's audio output is designed to be used with headphones or amplified speakers it is already at low level and may not require further attenuation. If this is the case R4 may be omitted and R3 replaced with a wire link. The audio level from the USB radio interface should be set so that the ALC meter of your transceiver below its maximum recommended level.

The PCB Lay-out

The layout of the p.c.b. are shown in **Fig. 12** and component layout **Fig. 13**. The layout is not critical and it is possible to use Veroboard if you prefer. The p.c.b. layout is centred on a 74 x 90mm blank piece of board so that it slides into the enclosure's side rails. The completed p.c.b. is secured in place using hot glue.

Configuring The interface

Connect the interface to the transceiver and a convenient USB port on the computer. The computer should automatically detect the hub, soundcard and USB-to-serial adapter. With the exception of the USB-to-serial adapter all use generic drivers and don't require a set up disk when using *Windows XP*. The USB to Serial connector should come with a driver disk.

When you plug the interface in your computer will change the default soundcard to the USB soundcard. From the Windows Start menu select, Setting, Control Panel, Sounds and Audio Devices options then Audio tab and change back to the default soundcard.

Start your data software and configure it to use the sound card on the USB radio interface using the drop-down menu similar to that shown in **Fig. 14**. The USB-to-serial adapter software should set a new Com port number. This is usually one more than the existing com port number or Com 1 if none are fitted, **Fig. 15**. The soundcard input levels should be set so that background is either black or dark blue and the 'tramway' lines on a PSK signal should be clearly visible on the waterfall display as shown in **Fig. 16**.

Transmit levels should be set so that the automatic level control (ALC) levels on the transceivers meter are not exceeded. **Note:** Remember to switch off any audio processing when using data modes.

As well as a versatile data mode interface, the USB Radio Interface can be used as both a c.w. and voice keyer with contest logging programs like *N1MM*. Ideal for those long 12 midnight to 4a.m. shifts where you've already worked most of the world and nobody else wants to speak to you!

Simple & Effective

Although it's simple in construction this USB radio interface will give a good account of itself and do visually the all functions as the most commercial units. It will also tidy up the inevitable 'rats net' of wires that accumulate behind the PC when you use the computer's own board soundcard, leaving the original computer soundcard available for non-radio use. ●

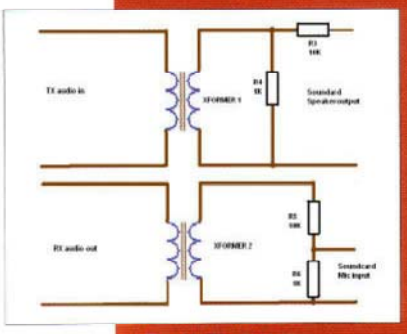


Fig. 11: The isolation transformer and attenuator circuit.

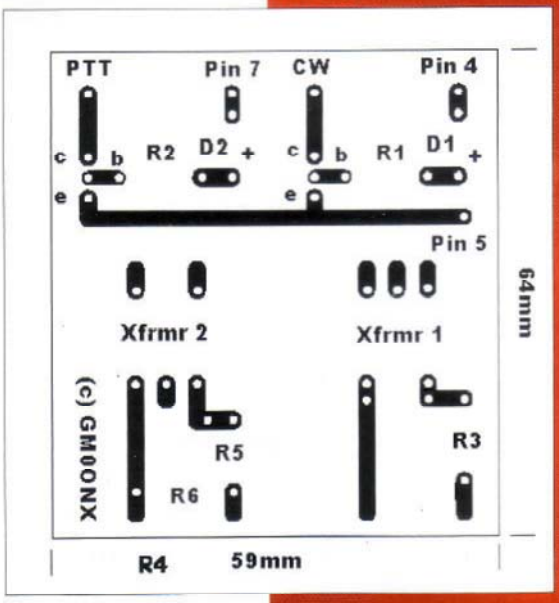


Fig. 12: The underside of the p.c.b.

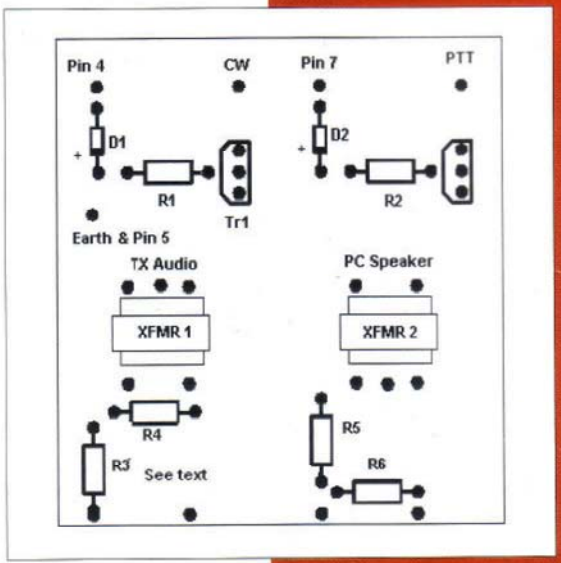
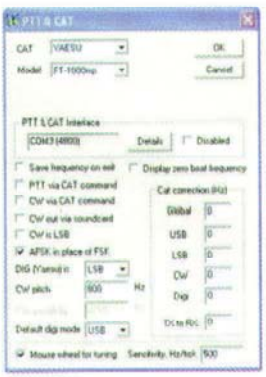


Fig. 13: The p.c.b. component overlay

Fig 14: Illustration of the *MixW* Soundcard menu.



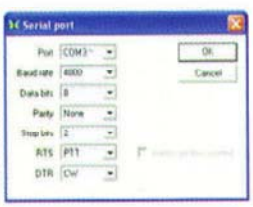


Fig. 15: The *MixW* p.t.t. and CAT menu.

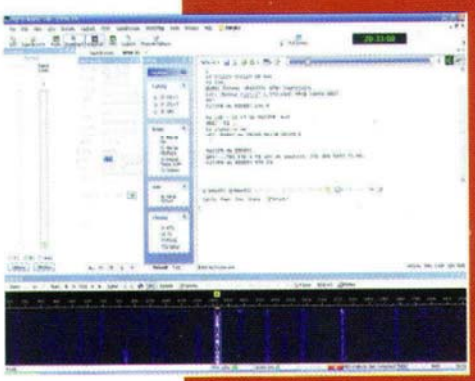


Fig. 16: The *MixW* trace showing correct sound levels.