Explore USB with this USB to CI-V Interface

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A few beta testers of a new satellite antenna controller interface that I have been developing requested that the new interface include universal serial bus (USB) capability.[1] Most new computers, particularly laptops, no longer come with a serial port — only USB ports. Adapters to run serial devices from a USB port are available, but they add cost and don't always work as expected. I found, for example, that the USB-to-serial interface adapter I use for computer Doppler control of my satellite radio via the radio's CI-V (ICOM-developed serial control interface) remote control port is not very well behaved. It frequently crashes my computer right at an inopportune time. I have resisted studying USB; it just seemed to be too intimidating. However, the requests from beta testers and my frustration with frequent computer crashes pushed me over the edge. To my surprise, USB isn't all that difficult.

A USB Adapter That Works

What follows is a description of a simple and inexpensive USB interface that you can build. The particular application described here is a USB to CI-V interface you can use to control a radio with CI-V remote control port capability and common radio frequency control software like *SatPC32*.[2]

The centerpiece of the circuit is the FTDI232RL device.[3] The circuit diagram for the interface is shown in Figure 1 and the completed hand-wired prototype is shown in Figure 2. The FTDI232RL device does all the USB-to-serial conversion for you. Though the device can be programmed with some specialized parameters, you really do not need to use them for this basic application. The device is well documented on the manufacturer's Web site,[4] and the requisite drivers for *Windows 98* and above operating systems are ready to download and installed.[5]

Making it Happen

There is one major drawback to the FTDI232RL device — it only comes in surface mount packages, which makes it a challenge to work with. Fortunately, a board is available to help with this issue. The
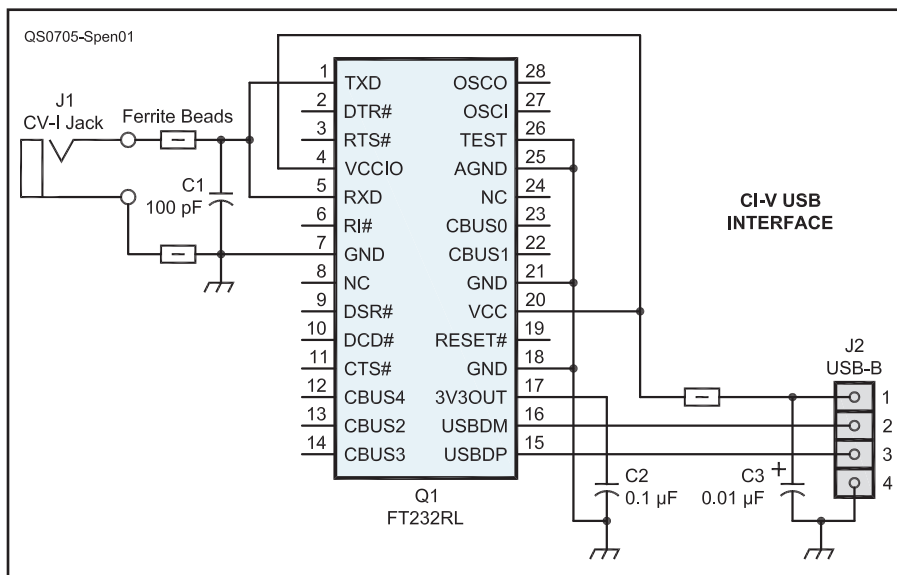
[1]Notes appear on page 55.

Figure 1 — Schematic diagram of the CI-V to USB interface adapter.

e-PBoard Design product called the SSOP-28 to DIP-28 IC Adapter makes working with this surface mount device doable.[6] The little adapter board has pre-tined solder pads for the surface mount *shrink small-outline package* (SSOP) device and pins that simulate an older (and larger) *dual in-line package* (DIP) (see Figure 3). The adapter board is moderately difficult to solder for the soldering neophyte but it can be done with some care and patience. Besides, learning to solder surface mount components is a good skill to master in

today's technology climate. *The 2007 ARRL Handbook* has a good discussion of soldering surface mount components to help you get started.[7]
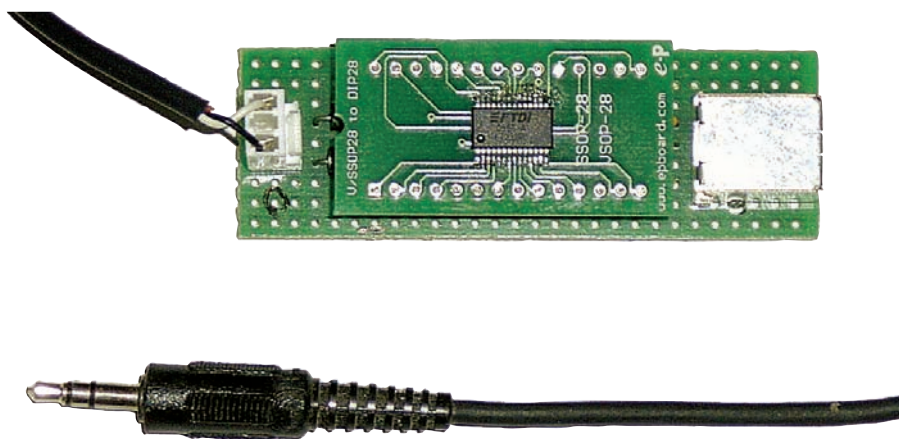
I used wire wrap techniques to make intra-DIP pin connections on the underside of the adapter board, as shown in Figure 3. A simulated 28 pin DIP socket is made on the main circuit board using two 14 pin in-line sockets. This allows for the adapter board with the installed device to be used in other USB related projects without having to duplicate a

Table 1
Parts Required for Interface Adapter

Part Description	Part Number	Supplier	Approximate Unit Price
C1 — 100 pF capacitor	P4570-ND	Digi-key	$0.07
C2 — 0.1 µF capacitor	P4593-ND	Digi-key	$0.13
C3 — 0.01 µF capacitor	P4582-ND	Digi-key	$0.07
J1 — Two circuit jack to match CV-I cable			
J2 — USB B jack, or	609-1039-ND	Digi-key	$0.87
3 position header	wm4201-ND	Digi-key	$0.34
3 position housing	wm2001-ND	Digi-key	$0.25
Q1 —FTDI232RL USB IC	604-00043	Parallax	$4.10
14-pin header plug female	S7012-nd	Digi-key	$0.65
Ferrite bead	240-2172-1-ND	Digi-key	$0.05
SSOP-28 to DIP IC adapter	E28-0023	e-Pboard Design	$9.25

Digi-key from **www.digikey.com**, Parallax from **www.parallax.com**, e-PBoard Design from **www.epboard.com**.

Figure 2 — Completed hand-wired prototype of the adapter including adapter board. J2 is on the right.

Figure 4 — The *Windows* DEVICE MANAGER screen showing the COM6 assignment of the USB connection. Your port number will differ depending on your quantity of assigned COM ports.

lot of interconnections between pins. The ferrite beads, capacitors, USB jack and connector for the CI-V cord (I used a 3-position header as shown in Figures 2 and 3 in place of a jack) are mounted on the main circuit board. The parts are listed in Table 1.

The purpose of the few ancillary components is fairly straightforward. The capacitors provide bypass routes for unwanted stray currents. The ferrite beads between the CI-V remote jack of the radio and the interface provide some blocking of unwanted stray RF that might get into the system from the transceiver. Likewise, the ferrite bead in the USB power line provides some blocking of unwanted noise getting into the system from the computer power supply.
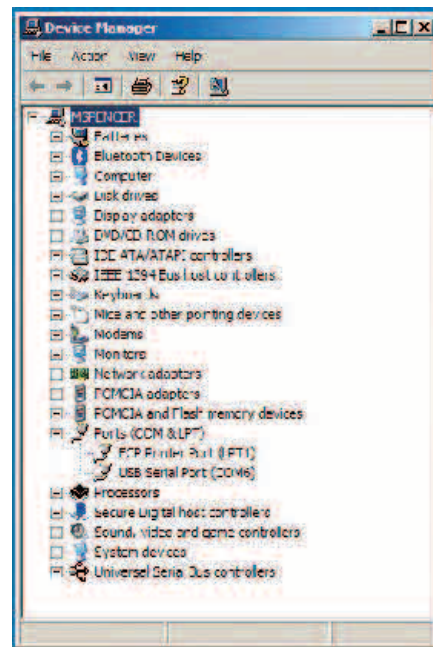
Making it Play

Before you plug the USB interface into your computer's USB port, it would be a good idea to download the drivers and read the documentation provided on the Web site. The installation of the drivers was pretty seamless on *Windows 98* and *XP* computers I have used to date with the steps in the documentation predicting what actually happened! Download the drivers to a place

on your hard drive where you can find them and plug the interface into a USB port. If all goes well, and you have no wiring errors, the *Windows Installation Wizard* should take over and guide you through the driver installation process.

During one of my first attempts at building the interface I had inadvertently left a ground pin unconnected. When I plugged the interface into the computer, a warning window conveniently appeared letting me know that the USB interface was not working properly. That caused me to recheck the wiring; after I found and corrected my error, the driver installation went as predicted.

Putting it to Use

If you are using the interface with *SatPC32* (which is the only software package that I tested the interface with for Doppler tracking), you will need to know the COM Port assignment given to the interface by the computer. That is easily found by right-clicking on MY COMPUTER, right-clicking on PROPERTIES, HARDWARE, DEVICE MANAGER, and finally PORTS (COM & LPT). You will see USB SERIAL PORT (COM#) listed as shown in Figure 4; that is the COM
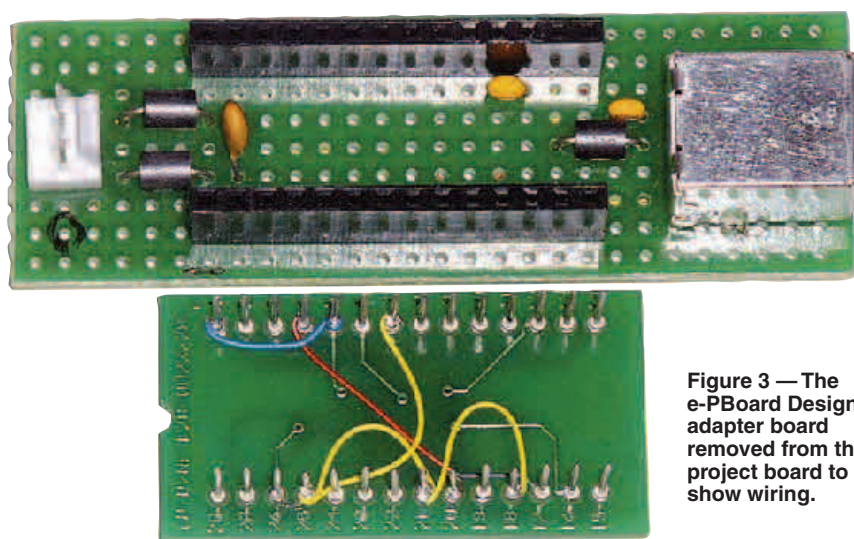
Port assignment you will use when you CONFIGURE RADIO SETUP in the *SatPC32* Setup menu. Mine is COM 6 as shown in the screen shot of Figure 4.

So this simple project allows you to explore USB and access your USB port for this as well as other projects. The FTDI232RL is a wonderful device that is easy to set up and use, and is well supported by the manufacturer. Most importantly, the drivers that support the device are well behaved and should minimize the potential for software conflicts and computer crashes. The SSOP adapter board is an equally useful addition that allows you to handle USB devices in the human (non surface mount) environment. Finally, once you have tamed the USB port for this project, you might consider adapting the project to other serial-related projects around your shack.

Notes

[1] *AMSAT Journal*, May/Jun 2006.
[2] www.amsat-na.com/item.php?id=100020.
[3] www.parallax.com/detail.asp?product_id=604-00043.
[4] www.ftdichip.com/.
[5] www.ftdichip.com/FTDrivers.htm.
[6] www.epboard.com/eproducts/proto-adapter.htm#SSOPtoDIPAdapter.
[7] *The ARRL Handbook for Radio Communications*, 2007 Edition, pp 8.12-8.13. Available from your ARRL dealer or the ARRL Bookstore, ARRL order no. 9760. Telephone 860-594-0355, or toll-free in the US 888-277-5289; www.arrl.org/shop/; pubsales@arrl.org.

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Figure 3 — The e-PBoard Design adapter board removed from the project board to show wiring.