USB-COM Port Debug Techniques for Windows XP

Peter Hiscocks, James Gaston
Syscomp Electronic Design Limited
`syscomp-support@magma.ca`
`www.syscompdesign.com`
January 26, 2009

Contents

1 Overview

These notes are provided to aid debugging of USB-COM port operation. They are specific to Windows XP, but may apply to other Windows operating systems (such as Vista).

Syscomp instruments use a *virtual COM port* technique to communicate between the host PC and the hardware. When the hardware is plugged into a USB port on the host, Windows assigns it to a particular COM port, such as COM8. Thereafter the host PC communicates with this particular COM port.

Windows remembers that this particular device should always be assigned to COM8, even if it's plugged into a different USB port on the same machine. (As indicated below, you can change this assignment.)

The host PC has a driver by FTDI that creates a virtual COM port to talk to the USB port. The hardware has an FTDI chip installed that converts the USB protocol to a serial data stream. From the standpoint of a program running on the PC, it is talking and listening to a serial port, albeit a very fast one. Further information is available at the FTDI web site: `www.ftdi.com`.

2 Debugging Environment

It really helps in this type of exercise to have two computers: one that is the Patient that is being diagnosed, and the other the Advisor. The Advisor computer is connected to the Internet, so it is possible to search (Google) for information. It is invaluable at some impasse to be able to type in a related search term and find direction on a topic. This is particularly essential if one is not generally familiar with Windows operating systems, for example, how to execute commands from the command line.

The Advisor computer is also useful as a record-keeping device. Open an editor. Cut and paste advice into that document, and enter debugging notes. Then you have an extensive record.

3 Installation

The installation procedure is described in detail in the manual which is on the CD accompanying the hardware. In summary, under XP the installation process copies the Tcl Program to the host and installs two sets of files, which are the FTDI drivers. (Linux and Mac OS-X operating systems have the FTDI drivers built in, so there is no need to install them.).

4 Watching the COM Port Assignment

When you plug the hardware into a computer USB port, the computer should make its 'boing BOING' sound of recognition. The green 'connect' LED on the hardware should illuminate. Navigate to

```
my computer > control panel > system > device manager
```

Double click on `Ports(COM&LPT)` and you should see an entry like `USB Serial Port (COM8)`.

5 How Windows Selects the COM Port

Windows XP assigns the first 'unused' COM port. We advise avoiding ports 1,2 and 3 because it is likely that XP has assigned them to something like the mouse or keyboard. If a number of USB-COM port devices have been plugged into the computer at various times, then the assigned COM port number for this operation can be quite

large. That does not matter, but you may need to enter the number in the Tcl Program Port Settings dialog as described in Section 7.

If you are happy with this COM port assignment, skip to section 7. If you want to change the assignment, read section 6.

Syscomp devices should co-exist. For example, it should be possible to run a waveform generator and a scope at the same time, or two waveform generators.

6 Moving the COM Port Assignment

1. Left click on the Windows XP Device Manager entry `USB Serial Port (COM8)` (or whatever it is).

2. Select `Properties`. Right click on that. A new panel appears (figure 1).

Figure 1: Serial Port Properties

3. Select `'Port Settings > Advanced'`. A new panel appears. At the top, there is a selector box for the COM port assignment (figure 2).

4. Change that COM port setting to whatever you require. Let's move the device to COM17. Scroll down to COM17, which should then appear in the little window.

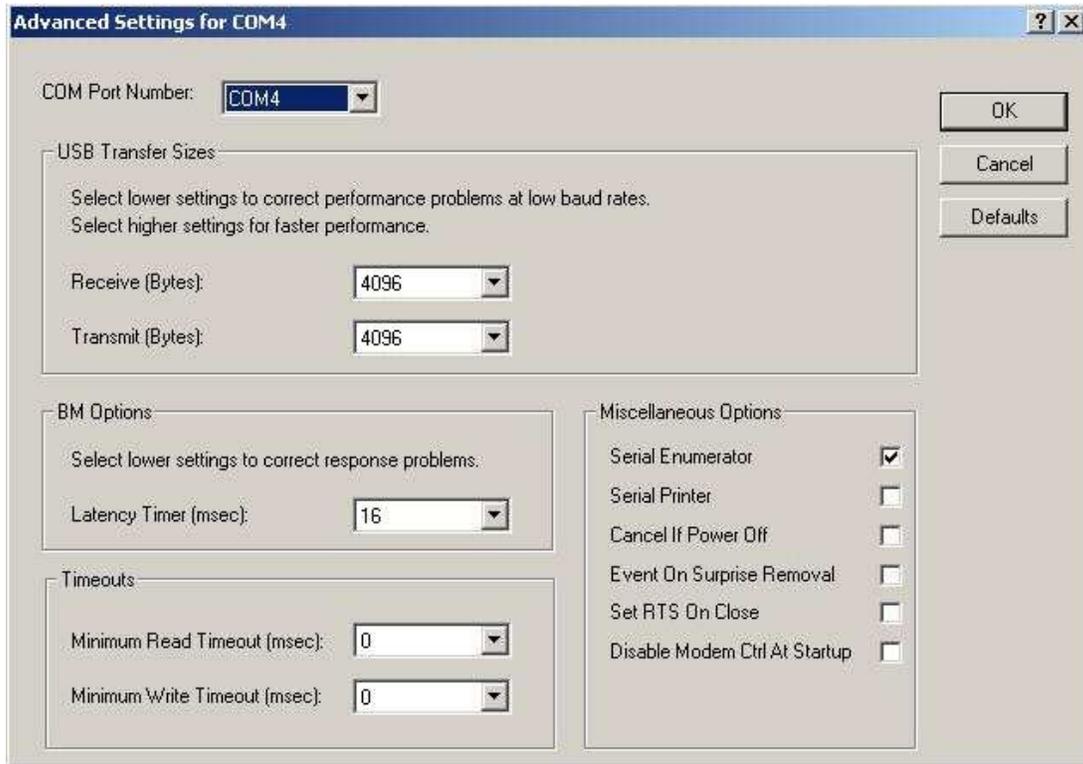5. Back out to the Device Manager panel.

Figure 2: Serial Port Properties, Advanced

6. Under the `Action` menu item, select `Scan for hardware changes`. The COM port entry should now be be reading `USB Serial Port (COM17)`.

7   Connecting after Moving a COM Port Assignment

1. Start up the Tcl Program.

2. The top panel shows 'Disconnected' with a red background. Select `Hardware > Connect`. The 'Port Settings' panel appears.

There are two ways to change the COM port setting at this point: 'Autodetect', and manual.

1. Trying 'Autodetect', the computer reports 'CGR-101 found on COM17'. Back out of these panels to the 'Port Settings' panel. Click on 'Save and Exit'. The Tcl Program top panel shows 'Connected' with a green background.

   The scope is in `Auto` trigger mode, so the red 'activity' LED should flash every second or so.

2. To set the port number manually on the Tcl Program `Port Settings` dialog, if the number is between 1 and 9, click on that button. If the number is greater than 9, type the port selection string into the 'Other'

4

Figure 3: Port Settings Panel

entry widget. In this case, the entry would be '\\.\com17'. This bizarre format is a requirement of the Windows operating system[1].

8   That Should Be It

Once the device has connected successfully, it should connect thereafter without incident. You should be able to start the program (by double-clicking on an icon on the Desktop, for example) and the program should start and connect.

If this fails, the host or the hardware are confused. Unplug the USB cable. Reboot Windows. Rerun the program. Plug in the hardware. When the 'not connected' panel pops up, move to the Port Settings panel. If the port setting is correct, then click on 'Save and Exit'. The program should connect.

9   What Can Go Wrong

Normally, the installation process should proceed without incident. When activated, the port scan routine should autodetect the appropriate COM port. Then, when that value is saved, the unit should connect. A large majority of installations proceed without incident. A minority require moving the COM port assignment. A very small minority (less than 1%) may require more extensive diagnosis and repair.

9.1   Autodetect Fails

The port scan routine is not foolproof. If it announces that it cannot detect a port, then you may have to select the port manually.

Select it in the program by selecting a button or entering a COM port number in the Port Settings panel as described in section 7 above.

9.2   Port Assignment Conflict

A modern PC installation involves various devices such as mice, Bluetooth, PDA's and USB-Serial port adaptors. All of these and others may use one or several of the virtual COM ports. A given driver may be disabled or uninstalled and still not give up its port assignment. Consequently, there is the possibility of conflict between two devices that have been assigned the same COM port.

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[1]We may provide a selector list for COM ports above number 9, so this may change in the future.

Often the solution is simply to move the Syscomp instrument COM port assignment to a higher-numbered port, as we did above in moving a device from COM8 to COM17.

In more difficult cases, it may be necessary to identify the offending device or driver and manually remove the driver files.

Windows remembers device to COM port assignments. Normally, it doesn't show them.

9.3   Displaying Hidden Device Assignments (Transient)

Device Manager has an option `View > Show Hidden Devices`. For reasons known only at Redmond, this has no effect on COM port assignment visibility unless an Environment Variable is set. Here's how you do that on a temporary basis. If you want to do it permanently, so you can see the hidden items whenever you want, go to section 9.4.

1. Right click on `My Computer`.

2. Go to `Properties > Advanced > Environment Variables` (at the bottom of the panel, figure 4).
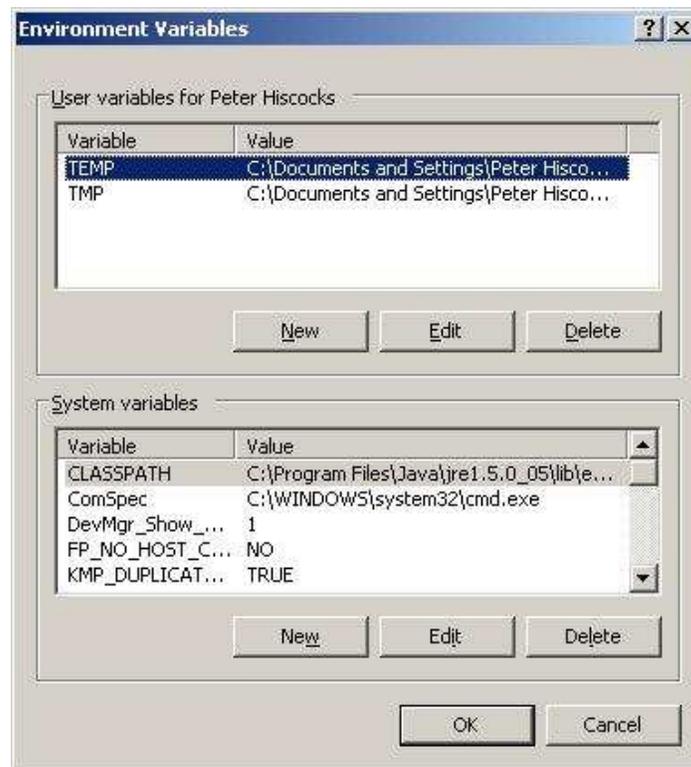

Figure 4: Environment Variables

3. On the `System Variable` panel select `New`.

4. Set the Variable name as `DevMgr_Show_NonPresent_Devices` Set the Variable value as 1

5. Now return to the Device Manager.

6. Under the View menu, click on `Show Hidden Devices`.

   Under `Ports(COM&LPT)`, there should now be a list of USB Serial devices. On my machine, there are 44 entries, many to the same COM port (figure 5). Notice that the Microsoft GPS (a recent addition) installed itself on `COM3`, which would overwrite anything else on `COM3`. That's why it's not a good idea to use low-number COM ports.
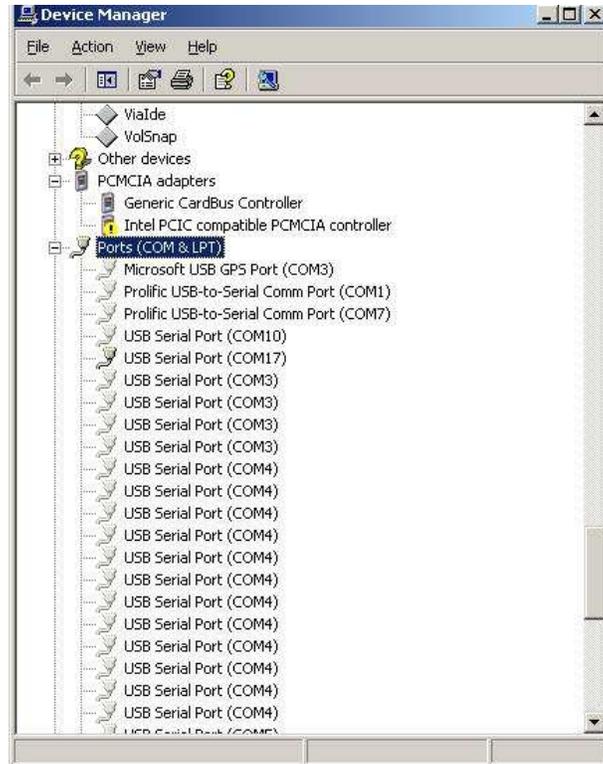

Figure 5: Device Manager, Hidden Devices

Unfortunately, this setting of an environment variable goes away immediately. To make it permanent, you need to do this in administrator mode[2] which is in section 9.4.

9.4   Displaying Hidden Device Assignments (Permanent)

In order to be able to see these hidden devices any time we enable `Show Hidden Devices`, we need to make this environment variable permanent. We need to do that as a system Administrator. Here's the drill.

1. Restart the computer in Safe Mode.

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[2]Under Windows, it's difficult to see the hidden devices. The design philosophy seems to be to hide things that someone has determined 'you shouldn't need to see this'. So you need to become Administrator to see these hidden devices on a permanent basis. Under Linux, the philosopy is to let the user see just about everything, but limit critical tasks (such as removal of devices) to the Administrator. Moreover, it's *much* easier to switch to administrator mode on a Linux machine. It's a single command (su), followed by a request for a password.

2. To get into Safe Mode, which is required for administrative access, during the boot process you should press and hold the F8 key, or tap it continuously. Alternatively, shut off the computer power as windows is booting. Then the next start will take you to the safe mode screen. On my Acer laptop, the first method did not work. The second method did.

3. Click on `Administrative Mode`. No password is requested on my machine, yours may differ.

4. The Safe Mode screen comes up. Many icons are missing, including My Computer. We need to navigate the Environment Variables panel:

5. Click `Start`

6. Right click on `My Computer`

7. Left click on `Properties`

8. Click on `Advanced`

9. Click on `Environment Variables`

10. Click on `New`

11. In the `Variable Name` box enter `DevMgr_Show_NonPresent_Devices`
    In the `Variable Value`, enter **1**.

12. Check that this environment variable now shows up in the `System Variables` window of that panel.

13. Click on `OK` to back out to the `Properties` page.

14. Click on `OK` to back out to the desktop.

15. Go back to the normal user mode: shutdown and restart the computer, let the boot process complete normally.

16. Navigate to the `Environment Variables` display as before

17. Check that `DevMgr_Show_NonPresent_Devices` is still there.

18. Now check in `Device Manager` for the device list.

    (a) Navigate to the `Device Manager` display as described above.
    (b) Plug in a USB-Serial device to create the `Ports(COM&LPT)` entry.
    (c) Under `View`, click on `Show Hidden Devices`.

You should now see a longer list of USB Serial Port devices. You should be able to see that any time by navigating to `Device Manager` and clicking on `Show Hidden Devices`.

10   Investigating Hidden Devices

Once you know what devices are associated with a given COM port from section 9.3 or 9.4, you can right click on the entry to investigate their properties such as what device they are associated with. Beware, however. The limited intelligence of Device Manager reports that a CircuitGear baud rate is 9600 when it is actually 230400. On the other hand, the USB Serial Port Properties under Details reports a device instance ID containing the string CGR, so this is likely the ID of a CircuitGear unit.

Multiple entries for the same COM port are non necessarily a problem. However, that may be a clue regarding a more serious issue.

For example, if a particular port is associated with a PDA that you no longer use, you could remove that association by deleting that entry. You should also use the Hardware Add and Remove facility in Device Manager to remove any programs associated with that device.

11   Detailed Listing of Devices: DevCon

From Microsoft Help and Support Note 311272:

The DevCon utility is a command-line utility that acts as an alternative to Device Manager. Using DevCon, you can enable, disable, restart, update, remove, and query individual devices or groups of devices. DevCon also provides information that is relevant to the driver developer and is not available in Device Manager.

    http://support.microsoft.com/kb/311272

Typical output from DevCon is shown below:

```
FTDIBUS\VID_0403+PID_6001+CGR9D24XA\0000                    : USB Serial Port (COM8)
FTDIBUS\VID_0403+PID_6001+CGR9XVS8A\0000                    : USB Serial Port (COM10)
FTDIBUS\VID_0403+PID_6001+CGRIOMALA\0000                    : USB Serial Port (COM8)
FTDIBUS\VID_0403+PID_6001+DSPSD8LVA\0000                    : USB Serial Port (COM3)
FTDIBUS\VID_0403+PID_6001+DSQ3Q7ZOA\0000                    : USB Serial Port (COM7)
FTDIBUS\VID_0403+PID_6001+DSQ8ZXJFA\0000                    : USB Serial Port (COM4)

USB\VID_0403&PID_6001\CGR9D24X                              : USB Serial Converter
USB\VID_0403&PID_6001\CGR9XVS8                              : USB Serial Converter
USB\VID_0403&PID_6001\CGRIOMAL                              : USB Serial Converter
USB\VID_0403&PID_6001\DSPSD8LV                              : USB Serial Converter
USB\VID_0403&PID_6001\DSQ3Q7ZO                              : USB Serial Converter
USB\VID_0403&PID_6001\DSQ8ZXJF                              : USB Serial Converter
```

This is a small exerpt: the file is quite large.

To use DevCon:

1. Download the program from the URL given above. Move it to a suitable directory and unzip the package.

2. This is a command-line driven program. The easiest way to run it is to start a command window. Click on Start and then click on Run...

3. In the Open entry widget type cmd and click on OK.

4. A *command window* opens.

5. Using cd commands, navigate to the directory where you placed the devcon program.

6. You can now get a help screen and list of devcon options by typing into the command window `devcon help`.

7. To get a device listing, type the command `devcon findall * > junk.txt`. This will list all devices, redirecting the result into a file called `junk.txt`.

8. Start some editor (such as notepad) and load `junk.txt` to read it.

12 Clearing All Port Associations

If you have a large number of COM port associations and you wish to start with a clean slate, the procedure is described at this URL:

`http://www.bisque.com/sc/forums/p/446/430.aspx`

This procedure requries editing the registry, so it should be approached with extreme caution. A mistake in editing the registry can brick a computer.

13 Changing BAUD Rate

The Syscomp instruments communicate at some fixed baud rate, 230400 in the case of the CGR-101. We could have provided adjustable Baud rate, but that opens another can of worms. The initial communication of the host PC with the device requires knowing the baud rate. If that has been changed from the default, then the host simply cannot connect.

The DSO-101 oscilloscope starts at 38400 baud with the idea that this is a standard speed and likely to be available. Then it switches to 230400.

Generally speaking, this works fine. However, there are some programs that one would like to be able to communicate with the hardware, that do not have 230400 baud available[3]. Visual Basic is one example.

Possible techniques for dealing with this problem are given at the following URLs:

`http://www.mev.co.uk/usbbaudwin.htm`
`http://www.mev.co.uk/vbbaud.htm`
`http://www.ftdichip.com/Documents/AppNotes/AN232B-05_BaudRates.pdf`

Acknowledgement: Ian Lowes (ian.lowes@plexus.com) brought this problem to our attention.

14 Viewing Installed Drivers

To see the installed drivers, navigate to:

`my computer > control panel > system > device manager`

Double click on `Ports(COM&LPT)` and you should see an entry like tt USB Serial Port (COM8).

1. Click on the entry `USB Serial Port (COM8)` (or whatever it is).

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[3]This problem is not limited to high speeds. For some reason, Hyperterminal does not provide the baud rate 600, which is used by some serial-port digital voltmeters.

2. Select `Properties`.

3. Right click on that. A new panel appears.

4. Select `Driver`. A new panel appears, showing the current FTDI driver installation (2.2.4.0 in my case.)

5. Click on 'Driver Details' to see the installed files and their locations.

The drivers for their respective FTDI chips are found on the FTDI web site in the VCP (Virtual COM Port) section at `http://www.ftdichip.com/Drivers/VCP.htm`. They are:

Instrument	FTDI Chip	FTDI Driver (Certified)	FTDI Driver (Uncertified)
WGM-101 Waveform Generator	FT232BM	2.04.06	2.04.14
DSO-101 Oscilloscope	FT232BM	2.04.06	2.04.14
CGR-101 CircuitGear	FT232RL	2.04.06	2.04.14

Either the certified or uncertified drivers should do, but the certified drivers are probably a bit safer to use.

Clearly the FTDI driver numbers do not match the Driver Properties shown by XP. However, we can compare file names to see if there is a credible driver in place.

From the FTDI website download the 2.04.06 driver to receive a file with name `CDM 2.04.06 WHQL Certified.zip`. Unzip that to see the contents of the driver package.

Now navigate as we did before to the USB Serial Port properties page, and then to `USB Serial Port Properties > Driver > Driver Details`. This shows a list of the installed driver files, (4 of them, in my case). You can check that those file names correspond to files in the driver package. If they do, that is some assurance that the driver is in place.

15   Call for Comments and Corrections

We would appreciate your comments, corrections or elaborations on this material. You can send these to Peter Hiscocks at the email address in the title block.

Revision History

25 January 2009: First release