



The Black Box ToolKit

Serious about science: Serious about timing

The Black Box ToolKit T-Pad v1 Installation Guide



Credits:

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Covers the following hardware:

The Black Box ToolKit T-Pad - USB Response Pad with Integral Timing

For the following platforms:

Microsoft Windows XP SP3, Vista SP2 (32/64), Windows 7 SP1 (32/64)
Windows 8 (32/64), Windows 8.1 (32/64), Windows 10 (32/64), Windows 11 (64)
Mac OS 8/9, OS-X
Linux 2.4 and greater

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Warnings and Cautions

Intended Usage

Unless otherwise labelled, all products offered for sale by The Black Box ToolKit Ltd are for academic study and/or research use only.

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Electrostatic Discharge Instructions



T-Pad system components that are sensitive to electrostatic discharge are marked with the ESD symbol. For these T-Pad components, users should not directly touch any internal pins and should adhere to the following precautions when connecting electrodes or adapters to these components. Users should always ground themselves before handling these T-Pad components. Users should then ground the T-Pad component before connecting to other equipment by touching the screw terminals of the component cable or by touching the metal shell of the component.

Note that the information in this manual is subject to change, without notice. The manufacturer declines responsibility for the safety, reliability, and performance of T-Pad system components if not used in compliance with T-Pad documentation.

2. Installing Drivers for the Virtual Serial Port & Setting COM Port Latency

Once the App has been installed and before you start using the BBTK T-Pad you will need to check that the FTDI VCP drivers are installed correctly and ensure that the Virtual COM Port Latency is set to 1 mS. This does not impact the internal hardware timer built-in to the T-Pad, but rather how quickly it can transmit serial data to the PC.

To do this plug-in the Serial USB lead, but leave the Keyboard lead unplugged for now.

Download and install the VCP drivers for your OS, i.e. Windows (Desktop) from:

<https://ftdichip.com/drivers/vcp-drivers/>

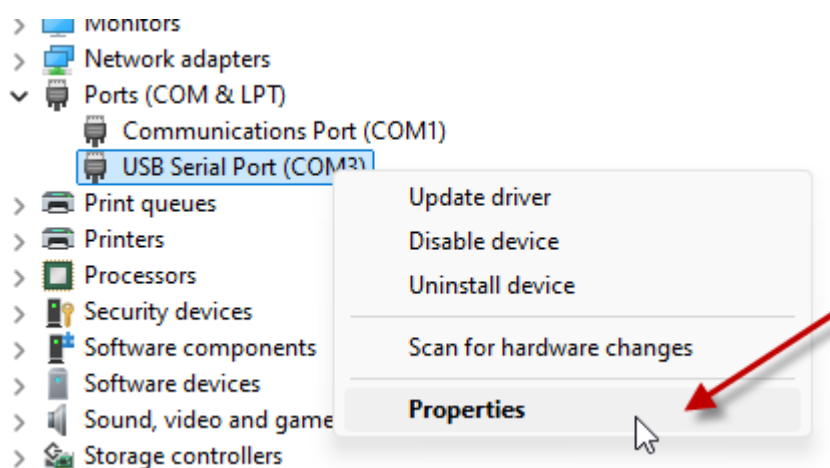
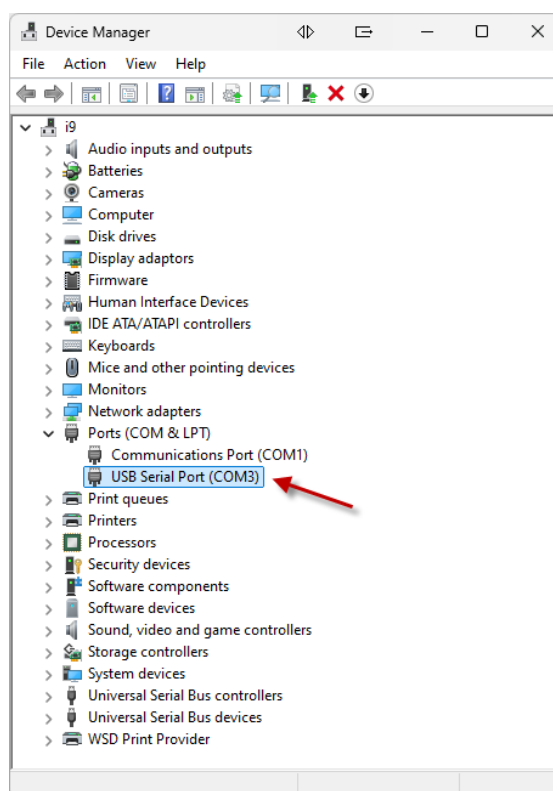
Windows Update may try to install FTDI drivers automatically in which case you may not need to install the above drivers, but you should still follow the procedure below for checking and setting serial port latency.

Once installed you should have a Virtual Communications Port on your computer through which the T-Pad will stream event and timing data back to the PC and through which you can control its operation.

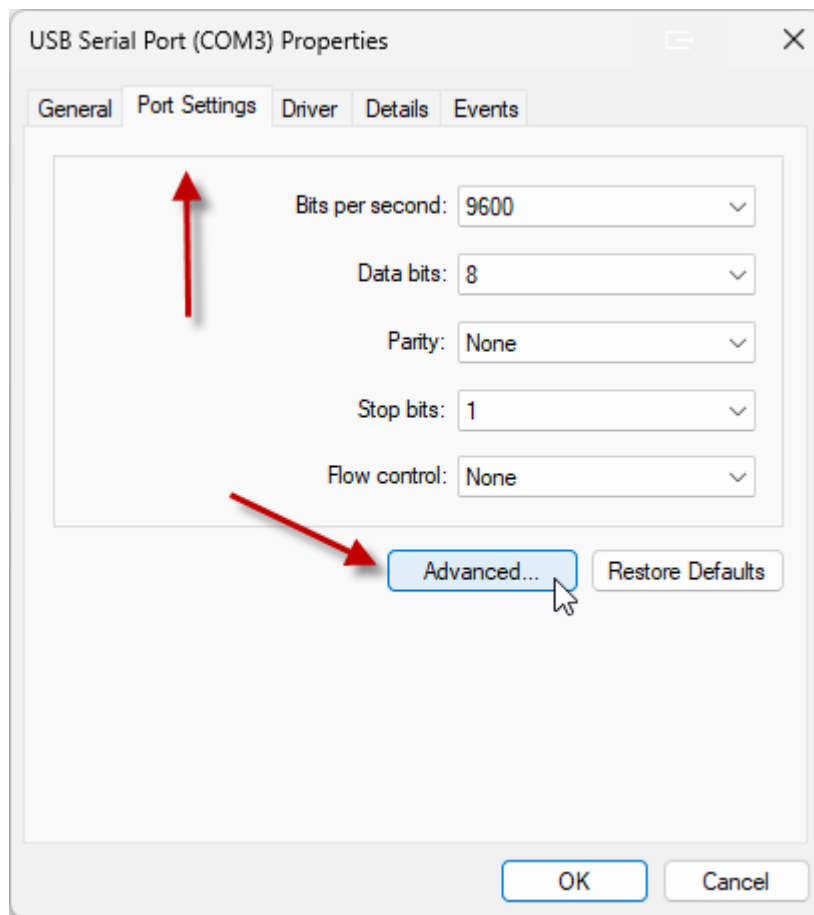
You do not need to install any drivers or alter any settings to use the T-Pad in Keyboard HID mode as drivers for USB keyboards are built into the Operating System.

Before you use the T-Pad for the first time however you need to set the latency of the communications to 1 mS as the default is 16 mS which is too slow.

First locate the COM port in Computer Management in Windows. In the example below COM 3 this is COM 3.

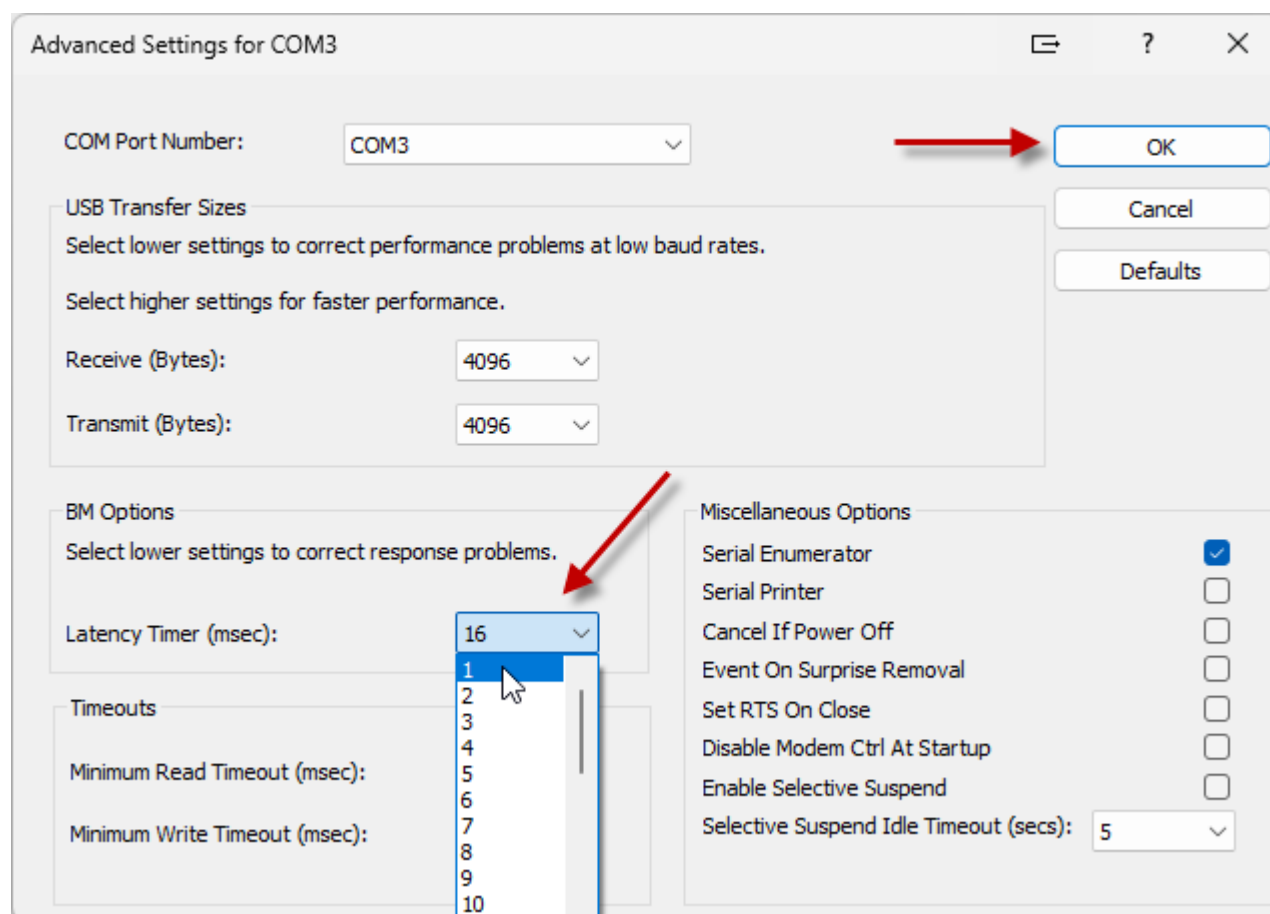


Right click on the COM port and then left click on Properties.



Next click on the Port Settings tab and then on the Advanced... button.

Drop down the Latency Timer (msec) combo and select 1 mS and then click on OK. Finally click on OK again.



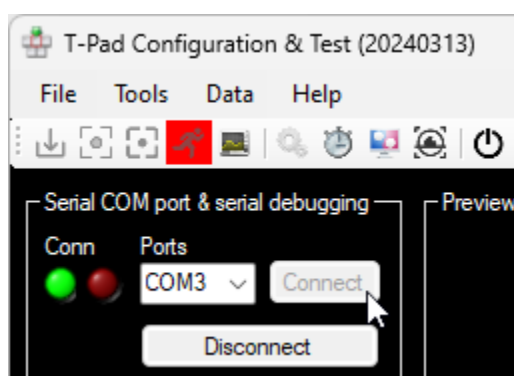
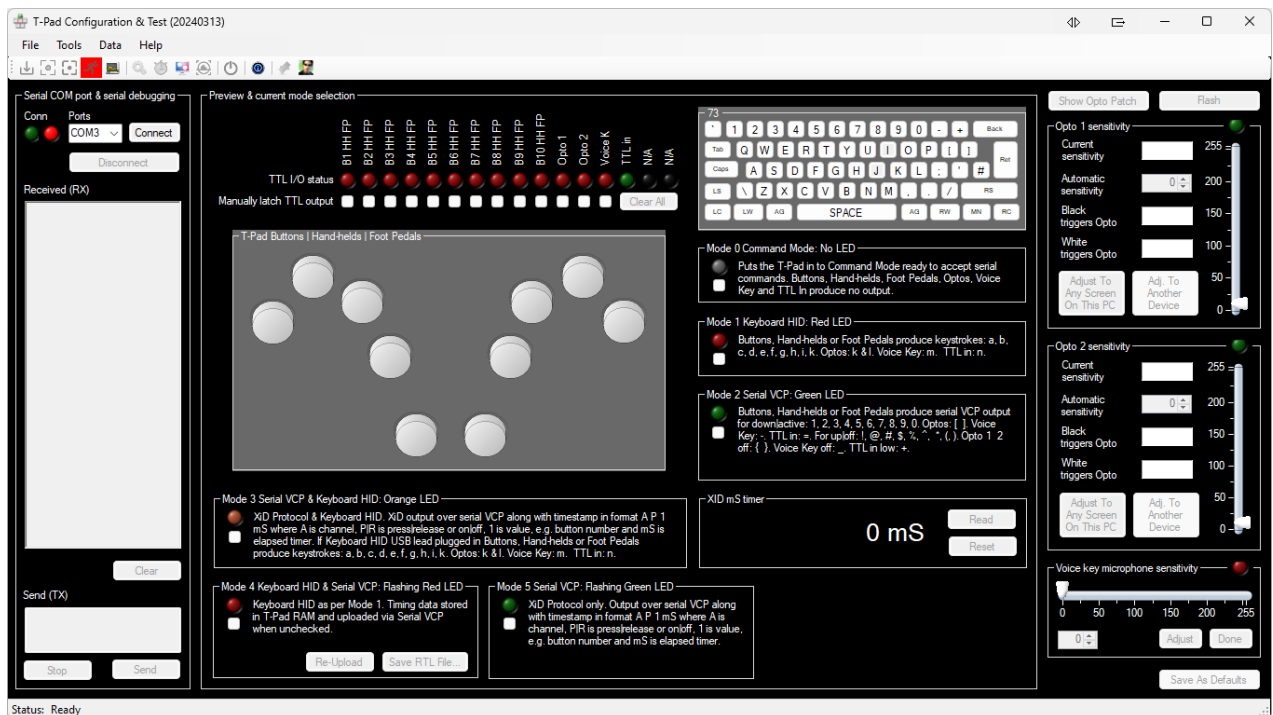
Now that you have a serial/Virtual COM Port (VCP) setup you will be able to communicate with the T-Pad. Make a note of the COM port number so you know which port the T-Pad is installed on.

3. Checking Serial Port Latency Empirically

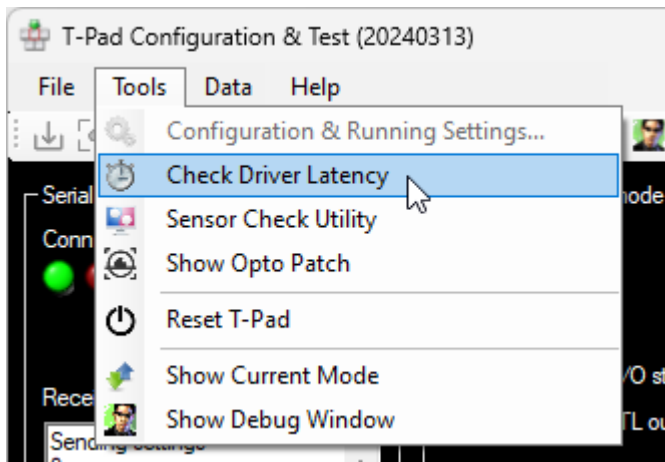
You can empirically test whether your VCP latency is set correctly using the T-Pad Configuration & Test App. The App sends commands to the T-Pad over serial and checks how quickly it can receive “real time” replies. If there are issues with latency on your PC you will need to investigate further and check your driver latency settings.

Until the T-Pad passes the driver latency tests you are advised not to use it for timing critical research.

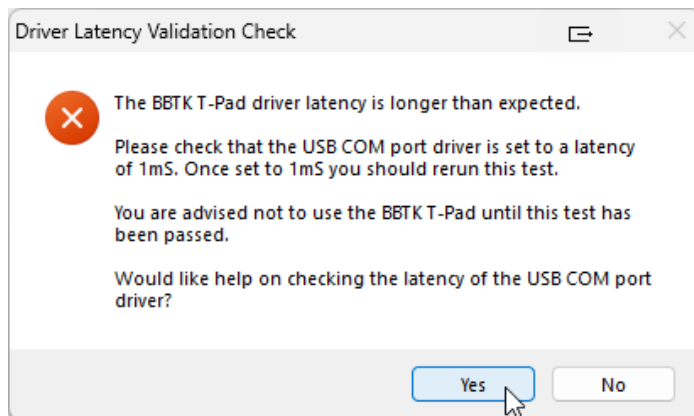
To check driver latency start the T-Pad App.



Select the VCP Serial Port your T-Pad is connected and then click on the Connect button.



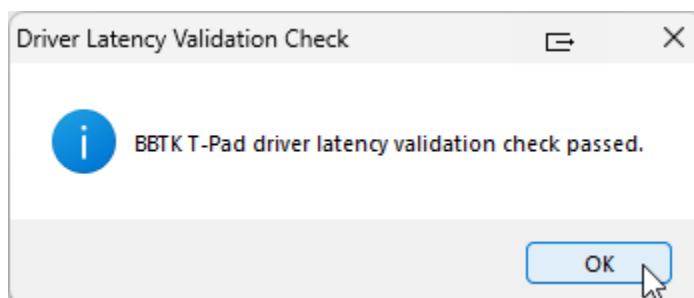
Once the green Conn LED is lit, under the Tools menu click on Check Driver Latency. This will attempt to send a command to the T-Pad and measure how quickly the response can be sent back to your PC.



If the response cannot be received quickly enough you will be told that the latency is longer than expected as shown.

If this is the case you will need to check your driver latency settings and ensure that it is set to 1 mS as described in the proceeding section.

To recheck your latency you will either need to Disconnect and then Connect again or quit the App and restart it.



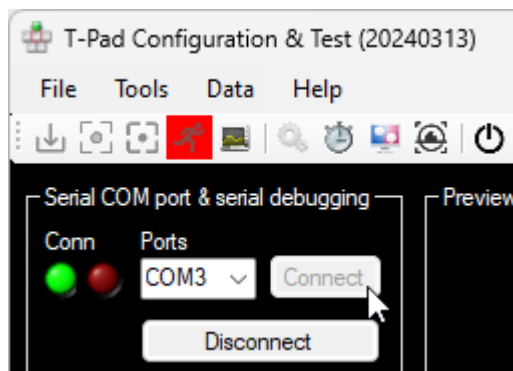
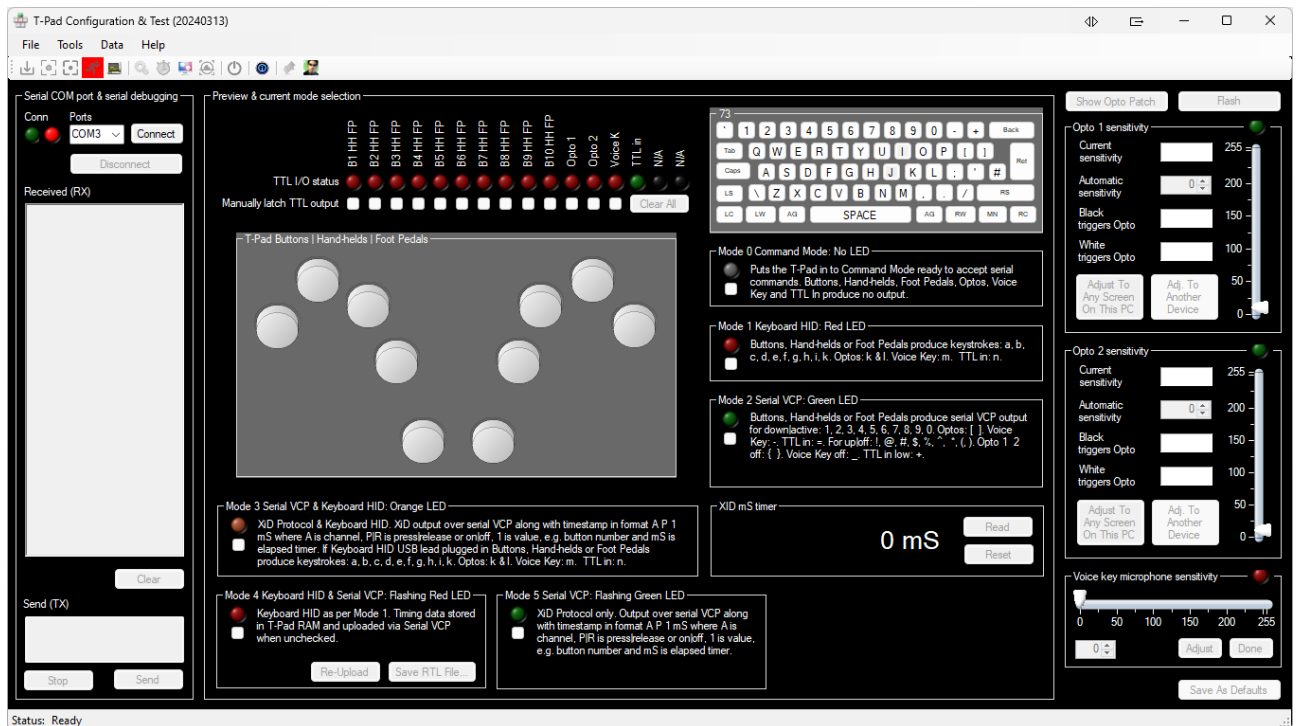
Once your latency is set correctly you will set a Driver Latency Validation Check pass message box.

Remember that although the T-Pad has its own built-in millisecond accurate timer, transmitting commands and returning this timer does require the VCP Serial connection to be operating as fast as possible.

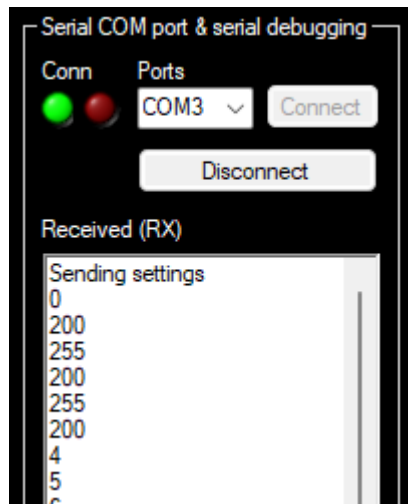
4. Checking Basic T-Pad Functionality

Our partner PC App allows you to configure and test your T-Pad with ease. In addition to allowing you to test that everything is connected and working correctly it also helps you automatically set opto-detector sensitivity for both optos alongside threshold for Voice Key activation.

Simply connect both USB leads and you can preview hardware based timing data as well as the keyboard HID keystrokes that will be sent to your experiment. To check button functionality start the T-Pad App.

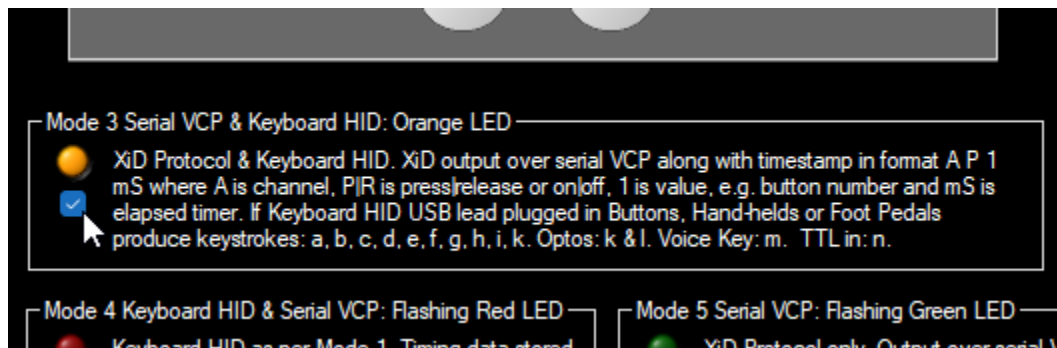


Select the VCP Serial Port your T-Pad is connected and then click on the Connect button.



If you have successfully connected to the T-Pad the LED will turn green and some settings data may flash past. If you can't connect first time try Disconnecting and reconnecting.

To check that everything is working correctly click on the Mode 3 checkbox:



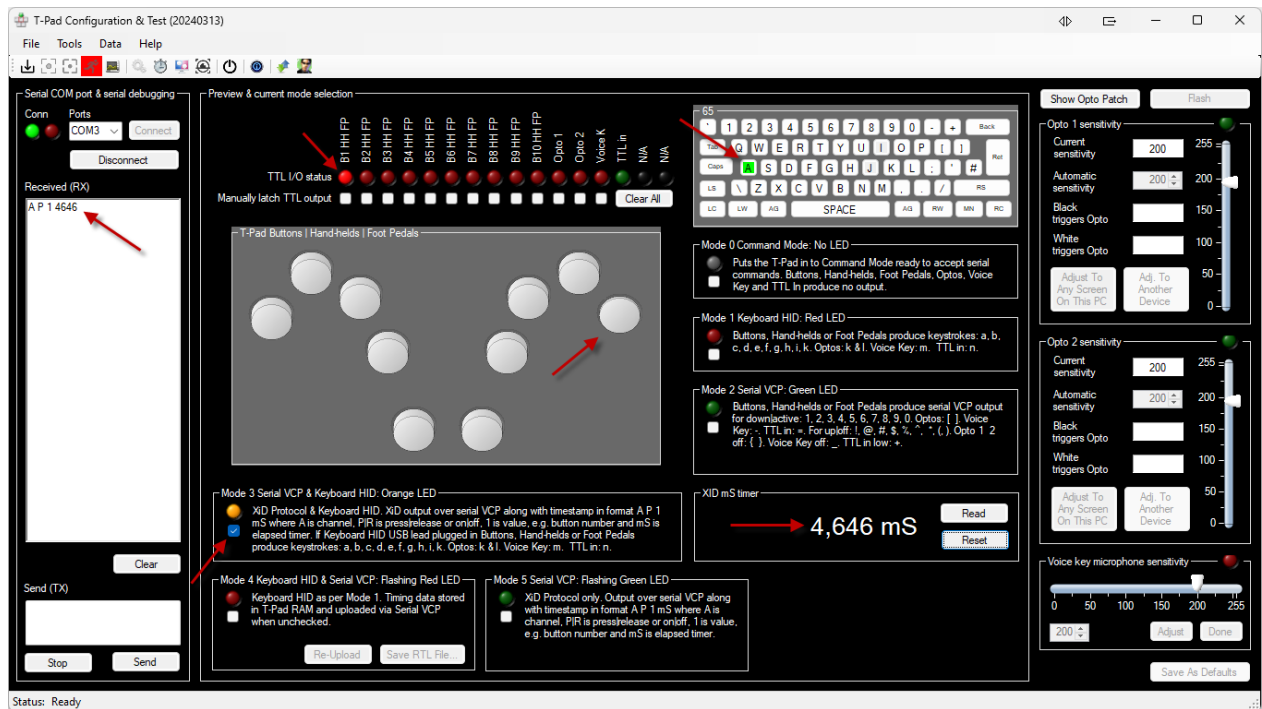
Then press button 1, Hand-held 1 or Foot Pedal 1.

Mode 3 is a hybrid operating mode where both the USB Keyboard HID lead and Serial lead are plugged in and both are live.

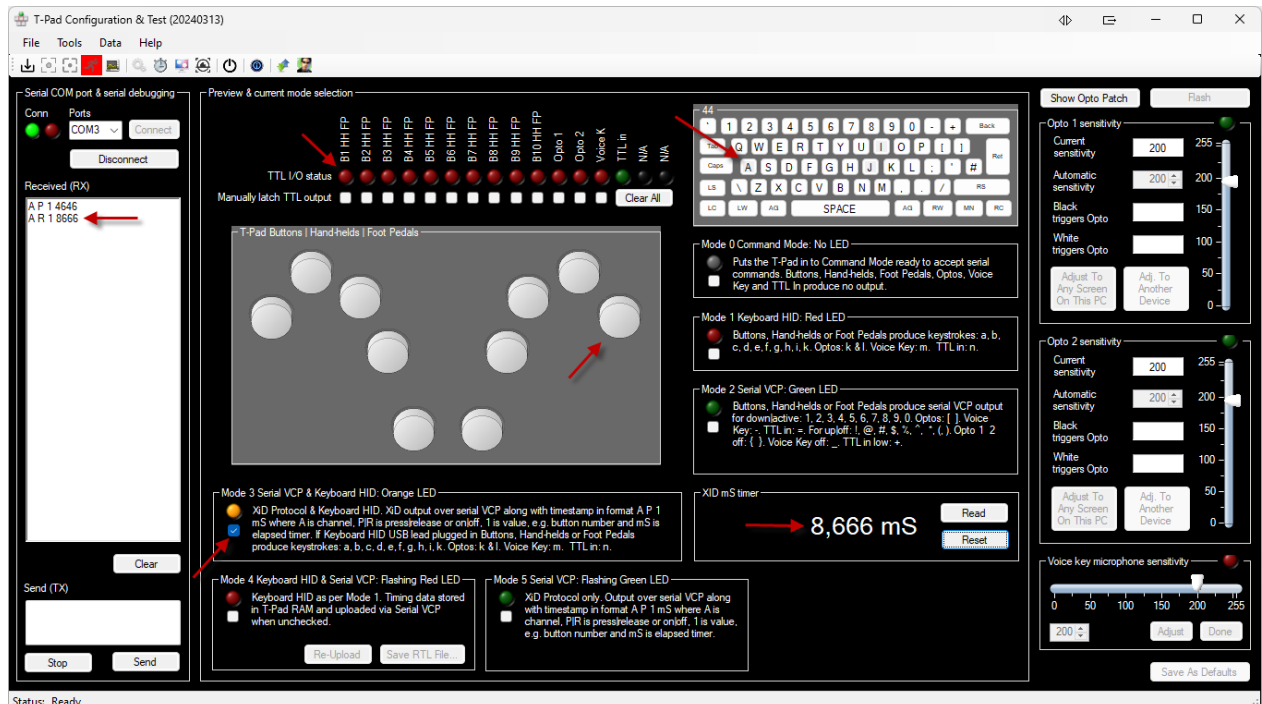
For example in this mode when a button is pressed a keyboard keystroke is sent to the PC over the USB Keyboard HID as though a key on a keyboard had been pressed. Simultaneously an XiD protocol command and independent hardware timestamp is also sent over the Serial USB connection.

If your T-Pad operates correctly in Mode 3 over both Keyboard HID and Serial USB interfaces this means that it should function in all modes.

As you press button 1 you will see the virtual button press down, a XiD command and timestamp sent to the Received (RX) window over serial showing a press, a virtual LED TTL I/O light and an internal built-in millisecond elapsed time be displayed. The virtual on-screen keyboard will also show that the letter 'a' has been pressed and held down as though pressed and held down on a standard USB keyboard.



As you release button 1 you will see the virtual button go up, an XiD command and timestamp sent to the Received (RX) window over serial showing a release, a virtual LED TTL I/O go out and an internal built-in millisecond elapsed time be displayed. The virtual on-screen keyboard will also show that the letter A has been let up as though let up on a standard USB keyboard.



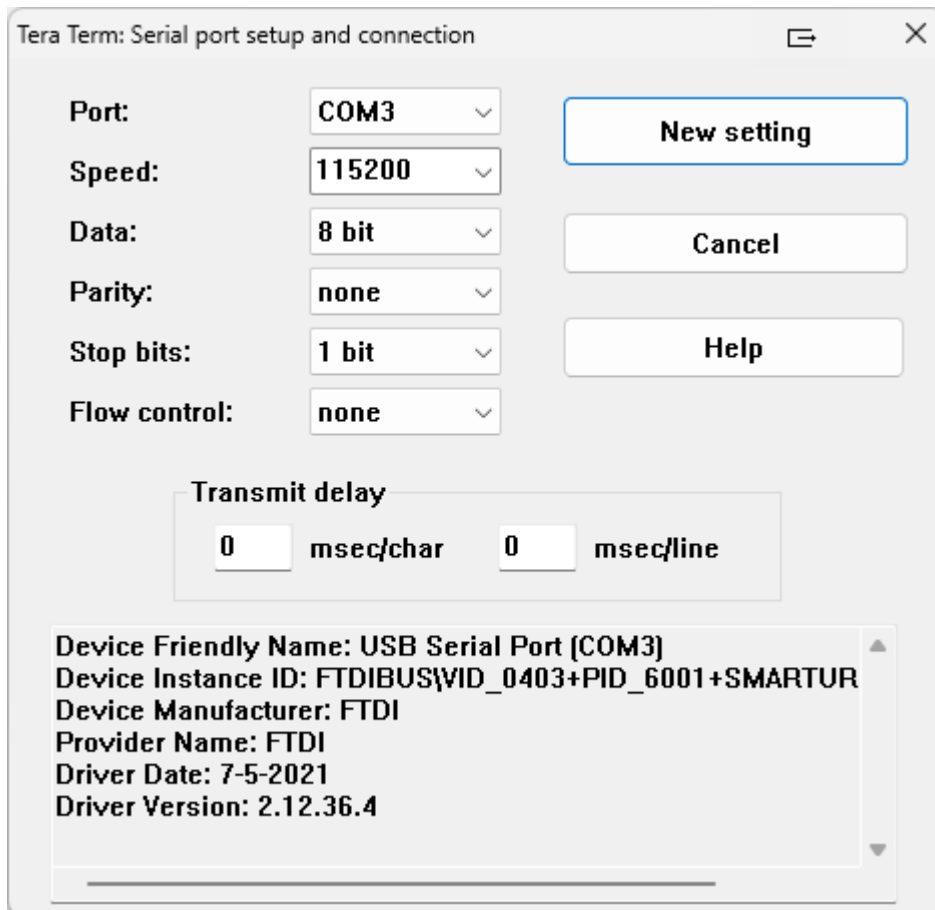
5. Checking Basic Functionality Using a Serial Terminal

The T-Pad App uses serial to communicate with the T-Pad using its own API or sets of commands. This is done behind the scenes in the App, but the API it uses is the same one that your experiment generator or own software would use.

To check basic functionality you should use a serial terminal such as Tera Term, RealTerm or Free Serial Port Terminal to communicate with the T-Pad. You can use any of these pieces of software, but in house we use Tera Term.

The examples that follow use Tera Term, but the principle are the same whichever serial terminal you choose to use.

Before you can communicate with the T-Pad you will need to tell the serial terminal software which serial port to use. This is the VCP that was created when you installed the FTDI serial chip. This may have been done automatically via Windows Update or you may have done this manually by installing the drivers as outlined in the previous section.

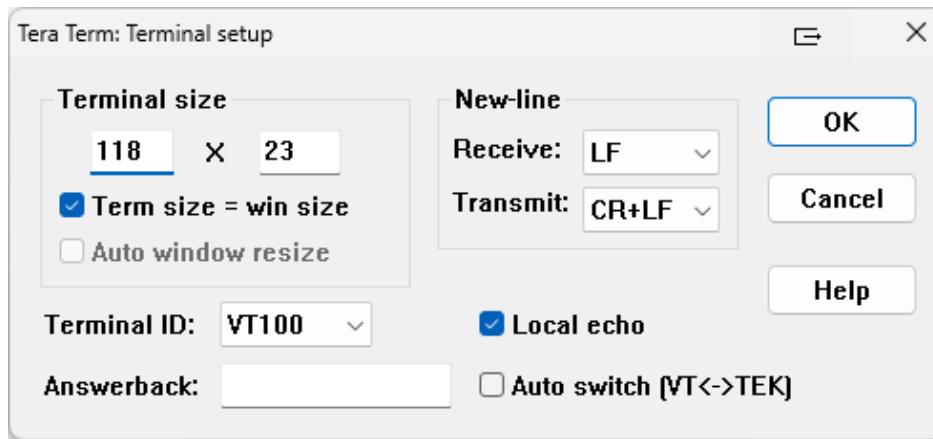


From the Setup menu select, Serial Port...

Connect with the following settings:

115,200, 8, N, 1, None

Once you are happy click on the New setting button.



You will also need to configure your terminal for sending and receiving serial data under the Setup, Terminal... menu.

In the New-line group box select Receive: LF and Transmit: CR+LF.

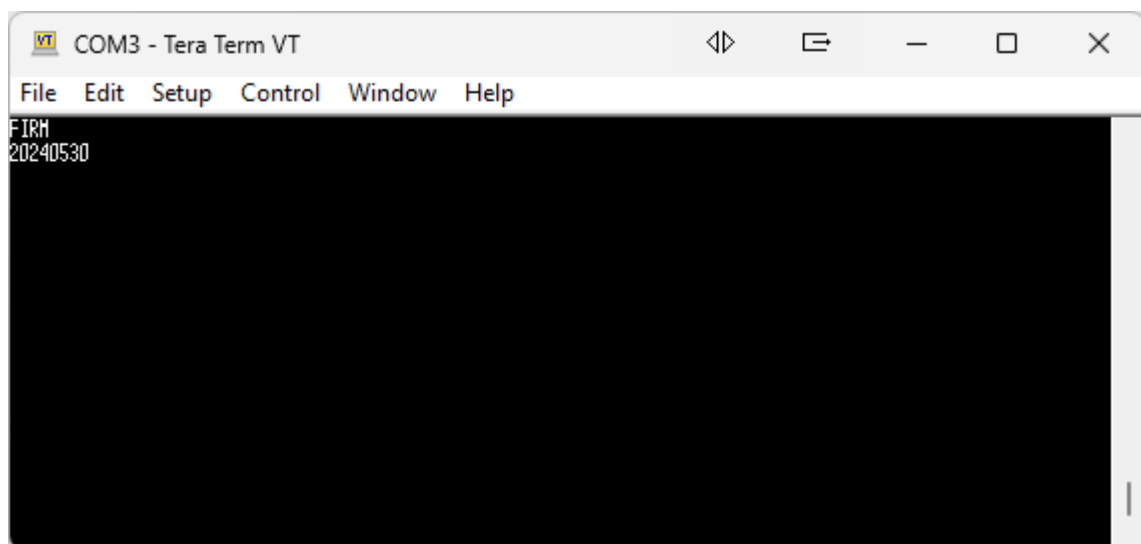
Ensure that Local echo is ticked and Terminal ID: VT100 is selected.

When you use any Windows App to communicate with the T-Pad you will need to use these serial settings, e.g. the BBTK T-Pad App, PsychoPy or any other experiment generator.

You do not need to install any drivers or alter any settings to use the T-Pad in Keyboard HID mode as drivers for USB keyboards are built into the Operating System.

Ensure you are in Mode 0, LED on rear of the T-Pad not lit and that only the serial USB lead is plugged-in. Remember that you need to check that the serial port VCP latency is set to 1mS as described in the previous section.

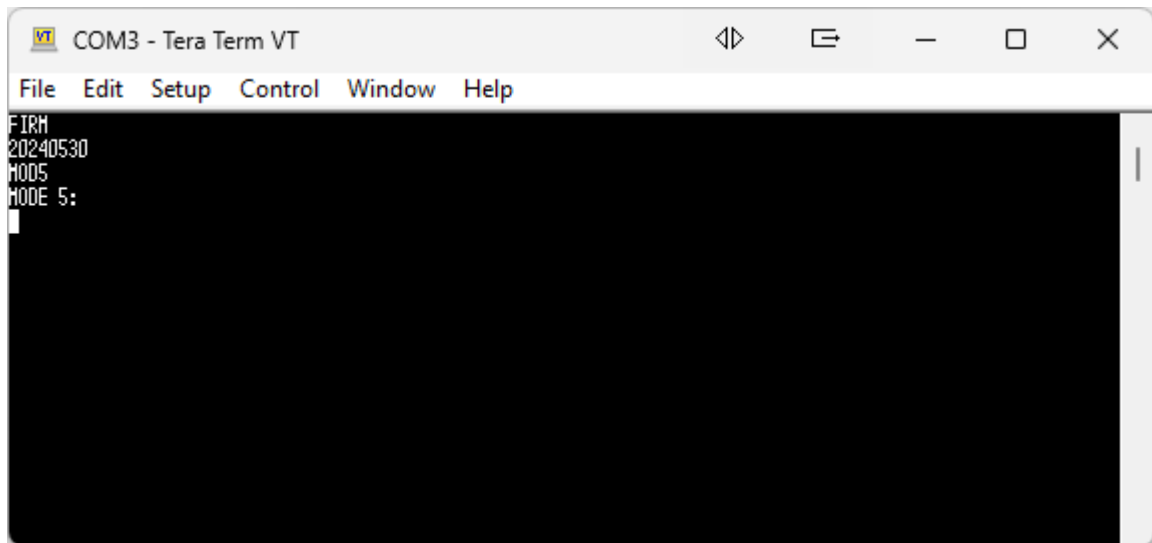
Once you have configured your serial terminal to check you can communicate with the T-Pad over serial type FIRM followed by return:



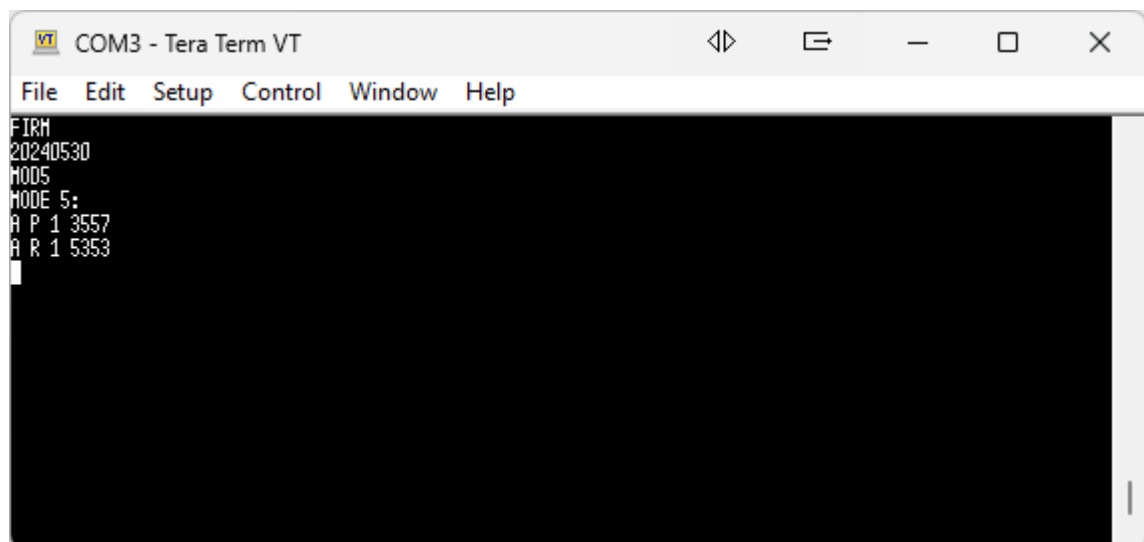
If you are connected correctly the T-Pad will return the date of the firmware installed in YYYYMMDD format.

Now you can check data streaming by switching to Mode 5, XiD protocol mode. You can do this by either pressing the Command Button on the rear of the T-Pad until the LED flashes green or by typing MOD5 and pressing return.

As we are checking serial functionality type MOD5 and then press return. The T-Pad should respond with MOD 5: showing that it has entered Mode 5.



Now when you press a button, Hand-Held or Foot-Pedal you should see an XiD command returned as shown below.

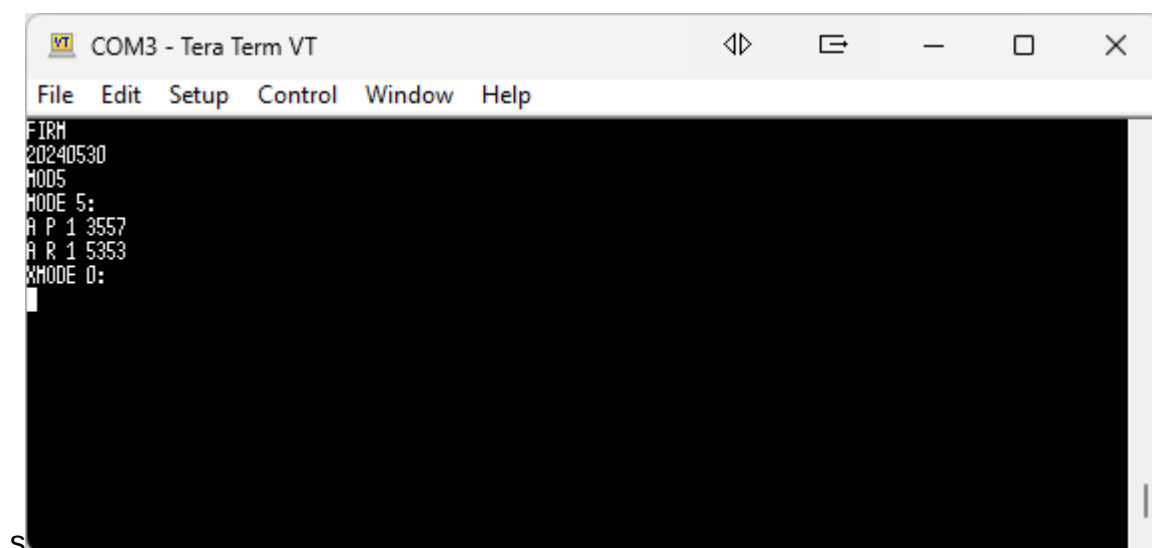


In this example channel A, buttons is active, P is pressed, 1 is button one and the last longer number is the T-Pads built-in millisecond timer which shows the elapsed time since power on, since switched to the current mode or resetting the timer. The second line shows when button 1 was released.

All XiD protocol activity is streamed in this way.

To get back to Mode 0, Command Mode, type X. That is press shift on your keyboard and hit X to get a capital X.

Note in this case you do not need to press return.



The screenshot shows a terminal window titled 'COM3 - Tera Term VT'. The menu bar includes 'File', 'Edit', 'Setup', 'Control', 'Window', and 'Help'. The terminal output is as follows:

```
FIRM
20240530
MODE
MODE 5:
A P 1 3557
A R 1 5353
XMODE 0:
S
```

Immediately after sending an X you will be returned to Command Mode, Mode 0 and MODE 0: will be returned for the T-Pad.

NOTE: You can ONLY have ONE SERIAL APP RUNNING AT ONCE under Windows or you will get errors. So close any terminal Apps such as Tera Term before trying to use the BBTK T-Pad App or PsychoPy for example.