

Politecnico di Torino

DIPARTIMENTO DI ELETTRONICA E TELECOMUNICAZIONI

LABORATORIO DI NEURONICA

TIMEX SYSTEM

User guide

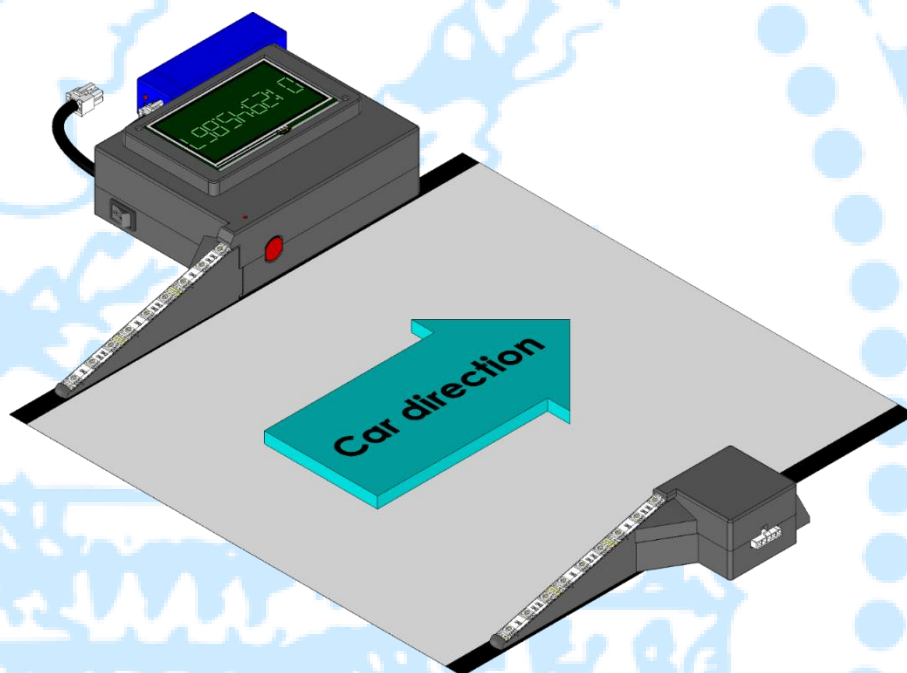


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Hardware units

Package description

The *Timex System* case contains:

- one main unit;
- one emitter unit;
- two battery units;
- two main-emitter connection cables (one is the backup cable);
- one power supply/battery recharger with an “Europlug” connector;
- one battery recharge adapter;
- one micro-USB cable.

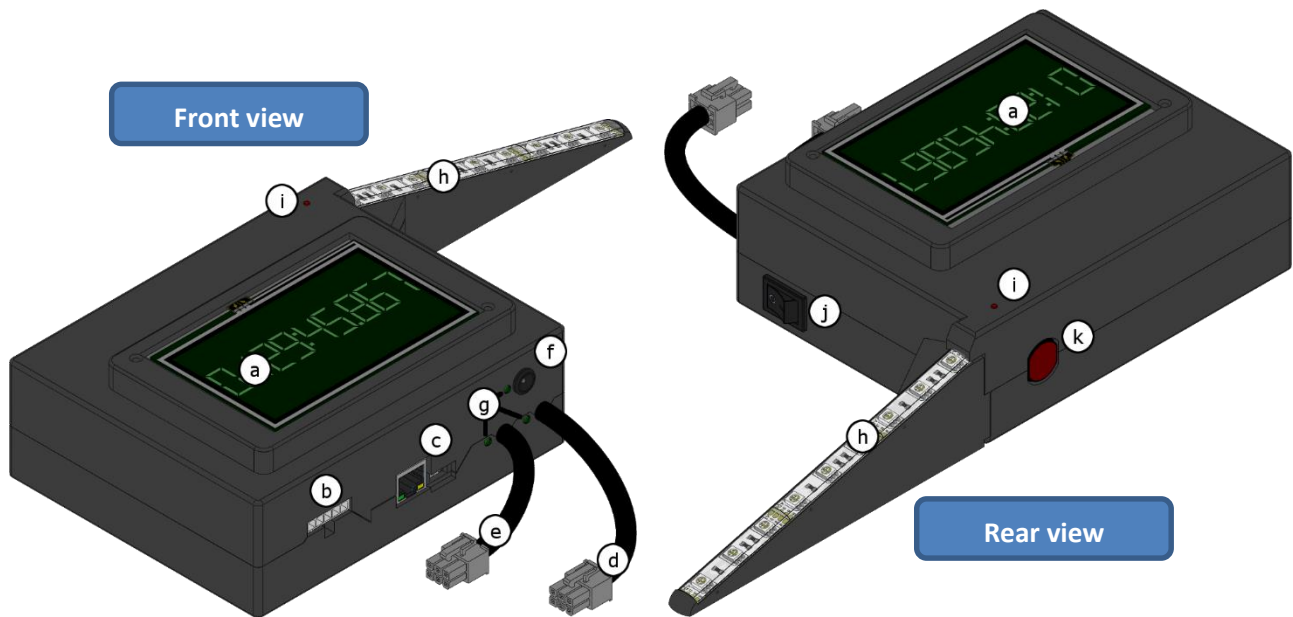


Emitter unit



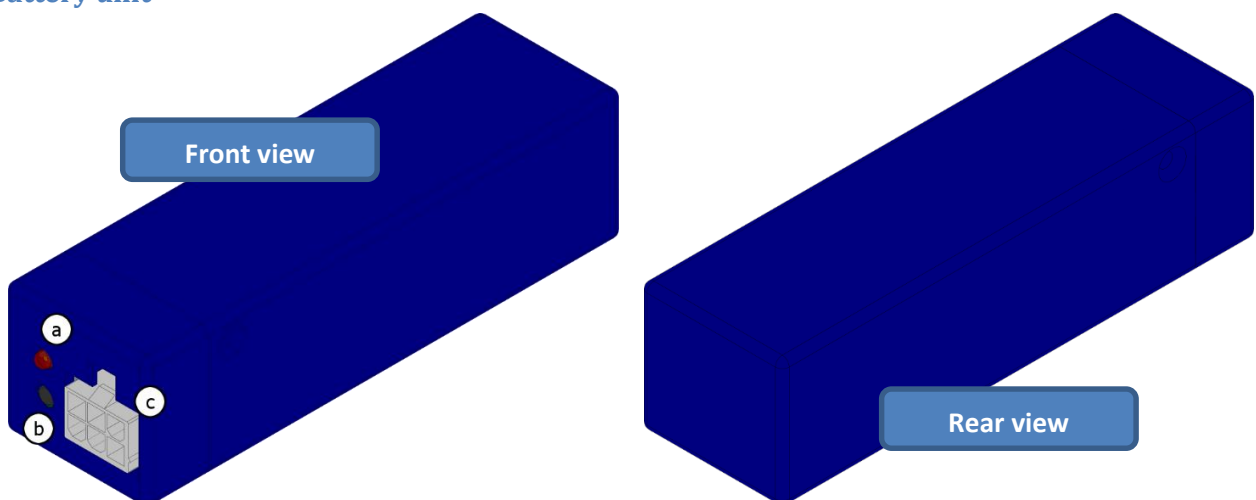
- a) Beam emitter
- b) RGB led strip
- c) Main-emitter cable connector

Main unit



- a) LCD and touch screen
- b) Main-emitter cable connector
- c') Ethernet connector
- c'') Micro-USB connector
- d) Battery A cable
- e) Battery B cable
- f) DC cable socket
- g) Power-good LED indicators
- h) RGB led strip
- i) Main-emitter unit alignment indicator
- j) Power switch
- k) Beam receiver

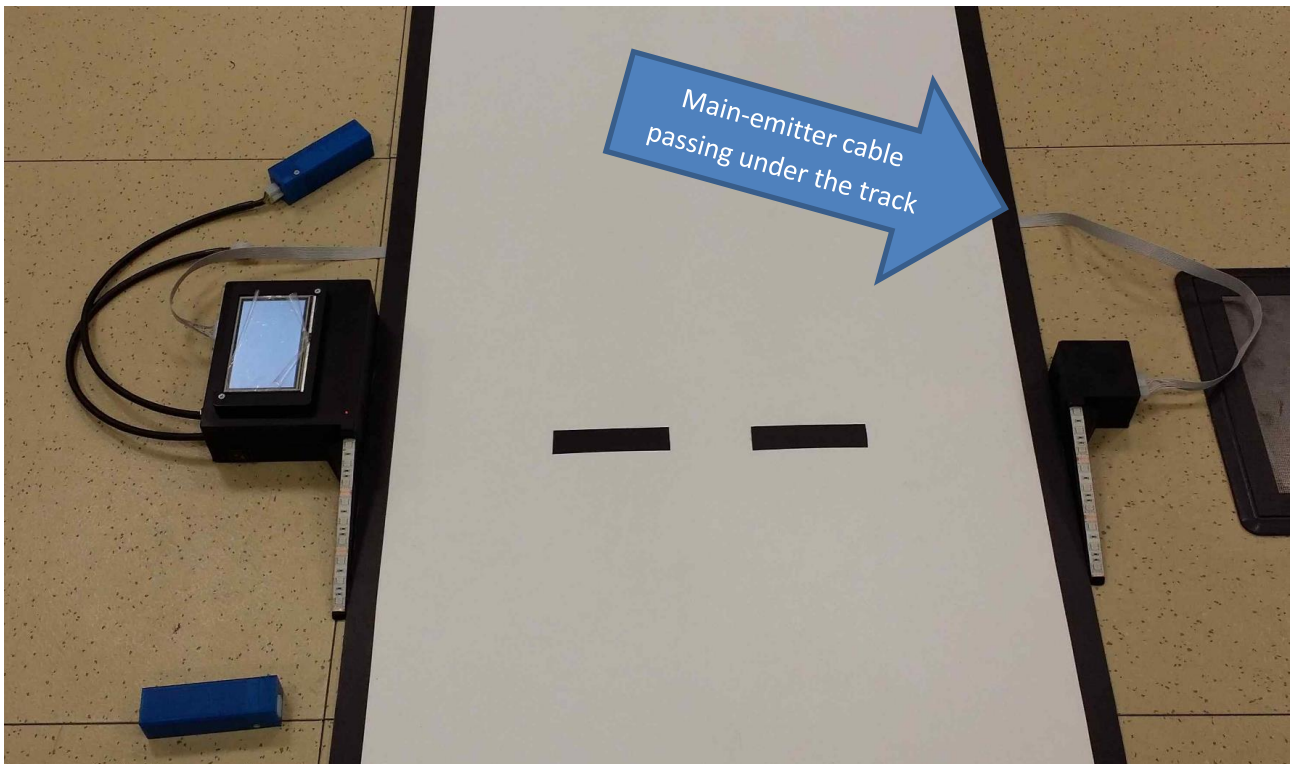
Battery unit



- a) Charge indicator
- b) Reset button
- c) Battery connector

Measuring system setup

In order to assemble the system, you have to lay the main-emitter connection cable beneath the track. The cable is only 1.27 mm thick, so the track would not be altered by it.



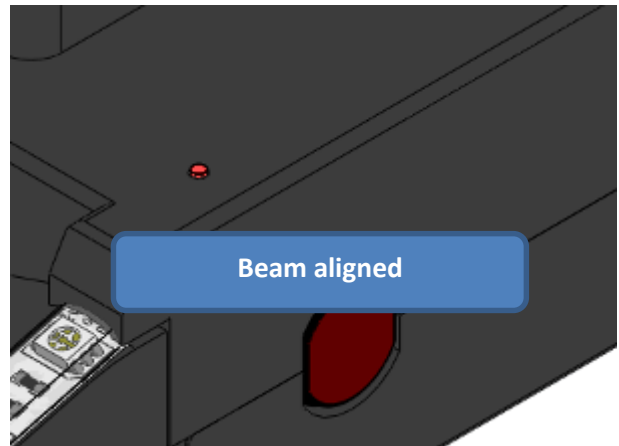
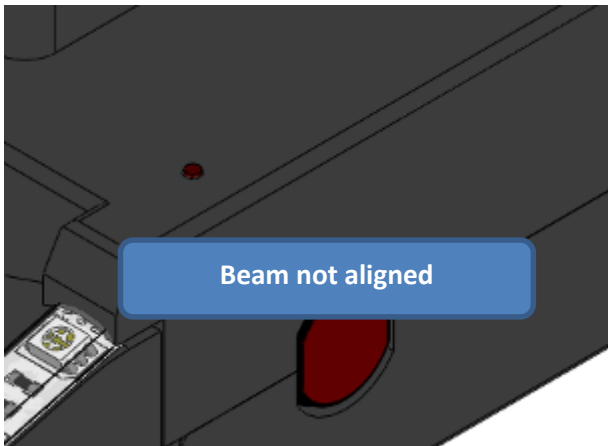
After laying the cable, put the main unit on the left of the track and the emitter on the right, with the LEDs supports just over the track edge. Then put the emitter opposite the main unit, trying to align the beam emitter ([Emitter unit, a](#)) and the beam receiver ([Emitter unit, k](#)).

Connect the main-emitter connection cable to the connectors on both the main unit ([Emitter unit, b](#)) and the emitter unit ([Emitter unit, c](#)).

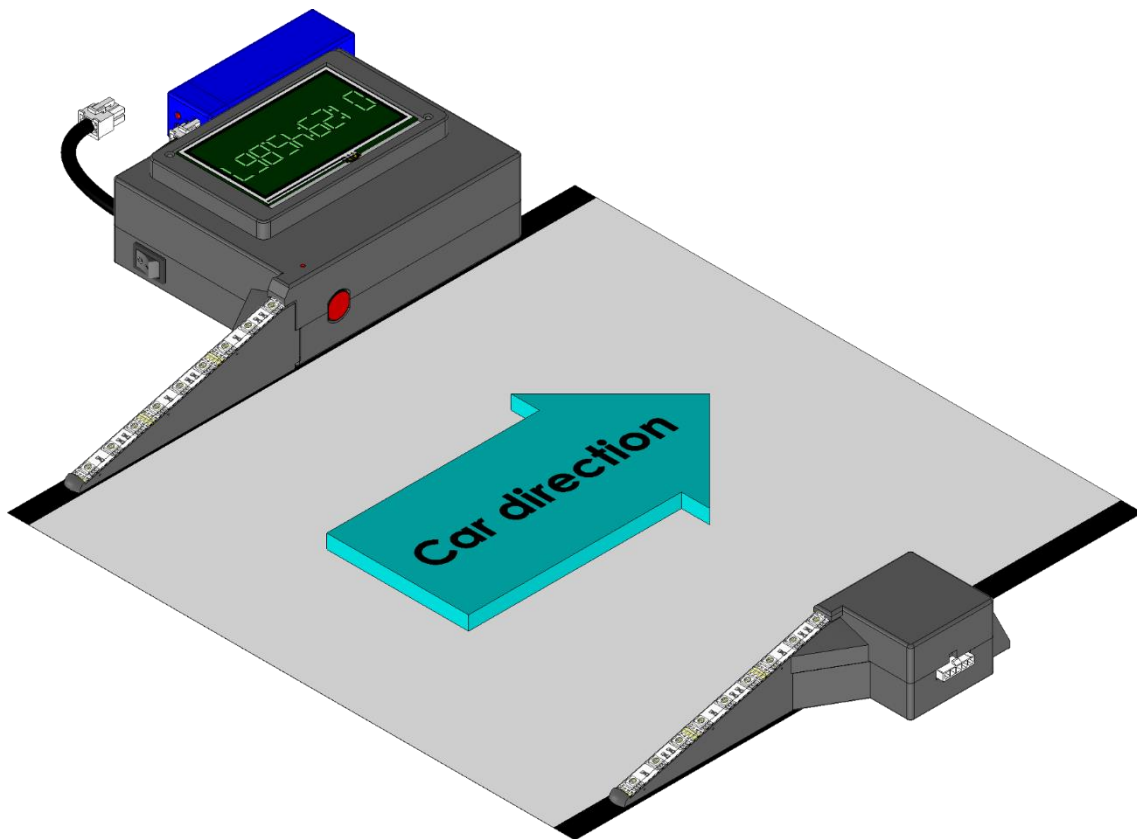
Connect one or more power supply sources to the respective connectors.

After having connected these, you can switch the main unit on. To do this, use the power switch ([Emitter unit, j](#)).

Now the system starts up. The emitter lights up and, since the beam is visible, you can see if the alignment was done properly. You can also look at the main-emitter unit alignment indicator ([Emitter unit, i](#)): when the LED lights up the beam is properly received.



Now the system is ready for the race.



Power supply description

Power can come through three different connectors:

1. External power supply ([Emitter unit, f](#));
2. Battery A ([Emitter unit, d](#));
3. Battery B ([Emitter unit, e](#)).

The different power supplies are hot-swappable, i.e. as long as at least one of them is applied the system is powered correctly. This means that, for instance, if the only power source is battery A and it is almost empty, you can attach a full battery at the battery B connector and, then, detach battery A. You can do this even during a race, because the system automatically switches to battery B when battery A becomes unavailable.

The system always checks the voltage on the three connectors and marks them as valid or not. An LED placed next to the connector ([Emitter unit, g](#)) shows its current state: when the LED is lit then the controller is marking that connector as valid.

Power-up sequence

The correct power-up sequence is:

- assemble the system (main unit, emitter, connection cable);
- attach one or more power supplies;
- then turn on the device;
- connect the system to the PC (via Bluetooth or USB).

Don't attach the USB cable before turning the system on because it can draw more current than the USB can supply, thus leading everything to an unexpected behavior.

If everything went smoothly, you will hear three "beeps" and see the RGB leds light in the red, green and blue colors for about 1.5 seconds.

After the power up, check that the system is correctly aligned (see paragraph [Measuring system setup](#)).

Power-down sequence

The correct power-down sequence is:

- disconnect the software from the system;
- disconnect the USB cable (if it was connected);
- turn off the system with the switch;
- disassemble the system starting from the power supplies

Again, do not leave the USB cable inserted without any power because this can lead to unexpected behavior. After you turned the device off wait for at least 10 seconds before trying to turn it on again.

Notes on connectors

The main-emitter unit and the batteries have Molex® Mini-Fit Jr.™ connectors. These connectors are strong and provide a good mating, thus reducing the risk of accidental detach. This, on the other side, makes them a bit hard to attach and detach.

- When you have to attach them to their connector, insert them in the correct way (if you try to connect them upside-down they will not fit) and then push until you hear a “click”. Ensure that the connector is completely inserted in.
- When you have to detach them, push on the tab and then pull the connector away from the plug. Hold the connector from the plastic housing, not from the cables!

Control software

Installation

Pre-requisites

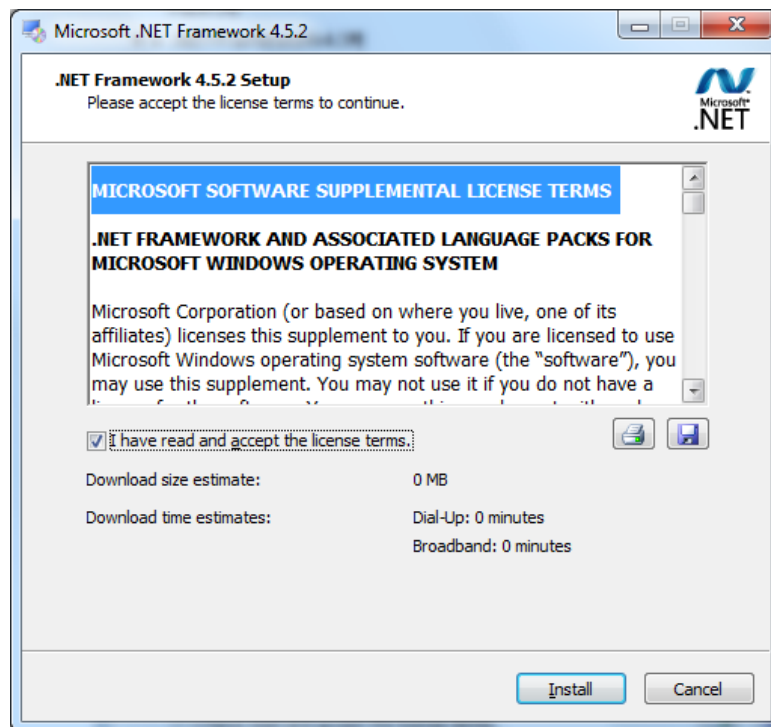
In order to install Timex User Interface (UI) some pre-requisites are necessary:

- OS: Windows 7 Service Pack 1; Windows 8; Windows 8.1; Windows Server 2008 R2 SP1; Windows Server 2008 Service Pack 2; Windows Server 2012; Windows Server 2012 R2; Windows Vista Service Pack 2
- .NET Framework 4.5
- 1 GHz Processor
- RAM 512 MB
- 850 MB available on Hard Disk (x86)
- 2 GB available on Hard Disk (x64)

Installation

In the program folder there are two executable files: “DotNet Framework 4.5.2 setup.exe” and “TimexUI.exe”.

First of all run “DotNet Framework 4.5.2 setup.exe” and follow the instructions on screen to install the .Net Framework 4.5.2.



If Net Framework 4.5.2 is already installed, the procedure will automatically stop.

Copy the application TimexUI.exe in your PC folder (even in the desktop, if you want).

Sensors' connection

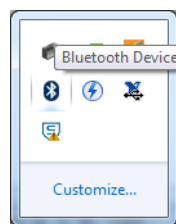
The system can be connected to the PC via a Bluetooth adapter or a USB port. Even if the software usage is the same whether you use the former or the latter, you have to properly configure the two interfaces in different ways to be able to use them.

These configurations need to be done just once.

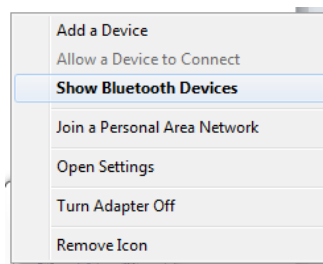
The following paragraph is for the Bluetooth connection. If you prefer to use the USB cable go to the appendix section.

Bluetooth pairing

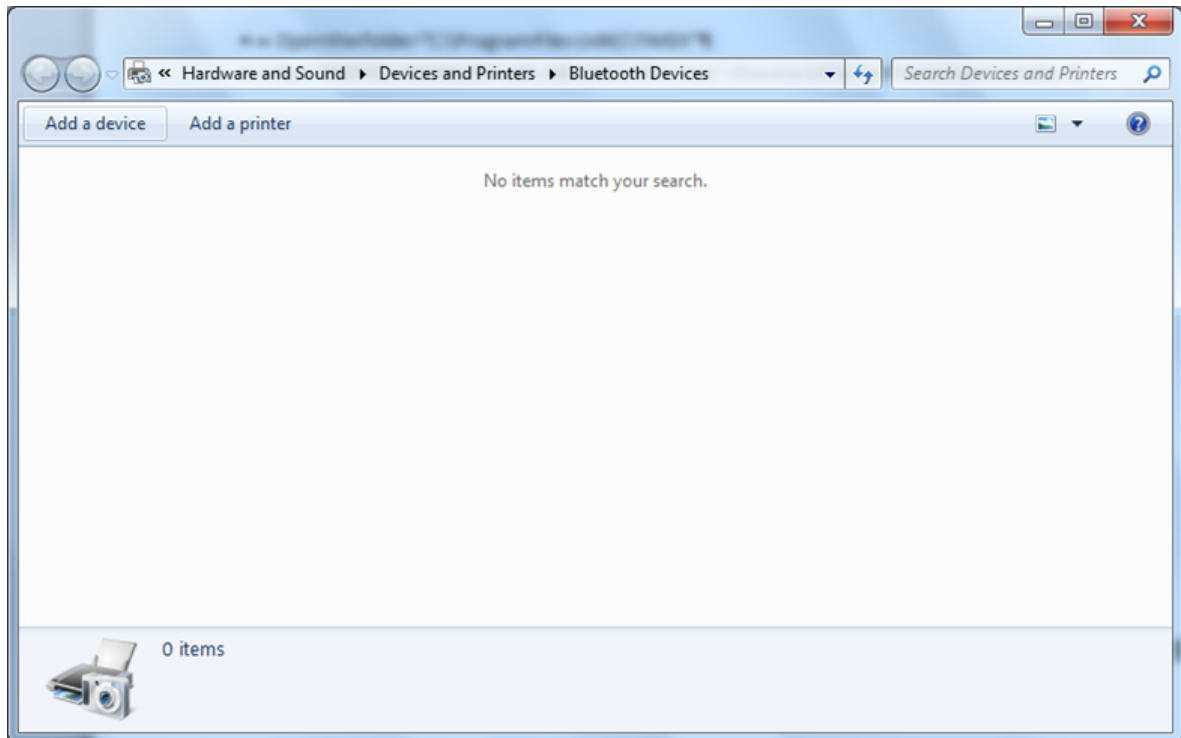
- Enable Bluetooth on your computer.
- Right click on Bluetooth Device icon in the system tray.



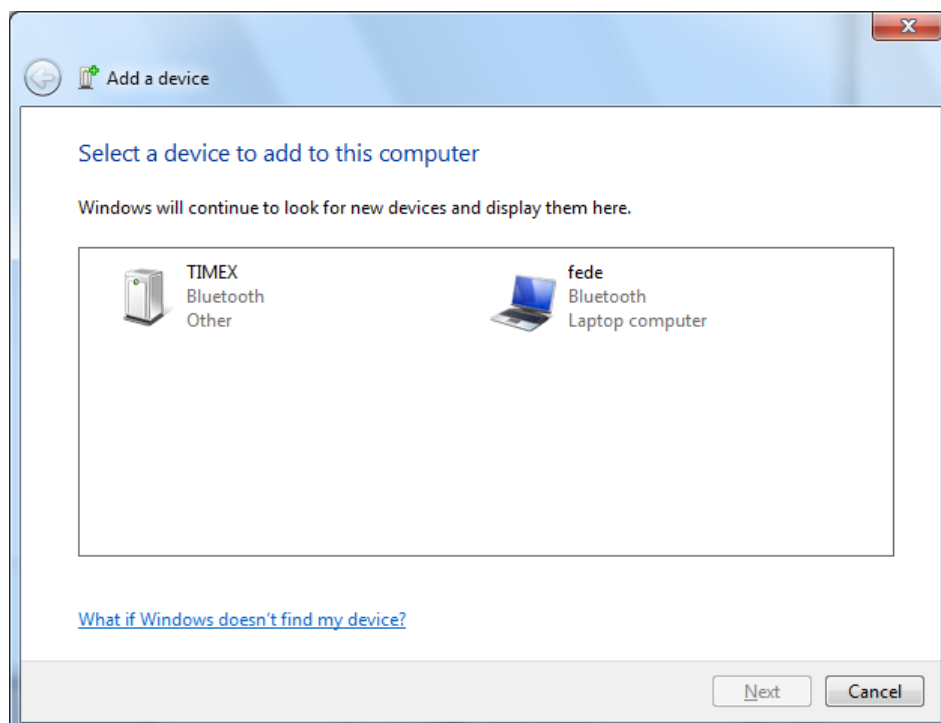
- Click on Show Bluetooth Devices



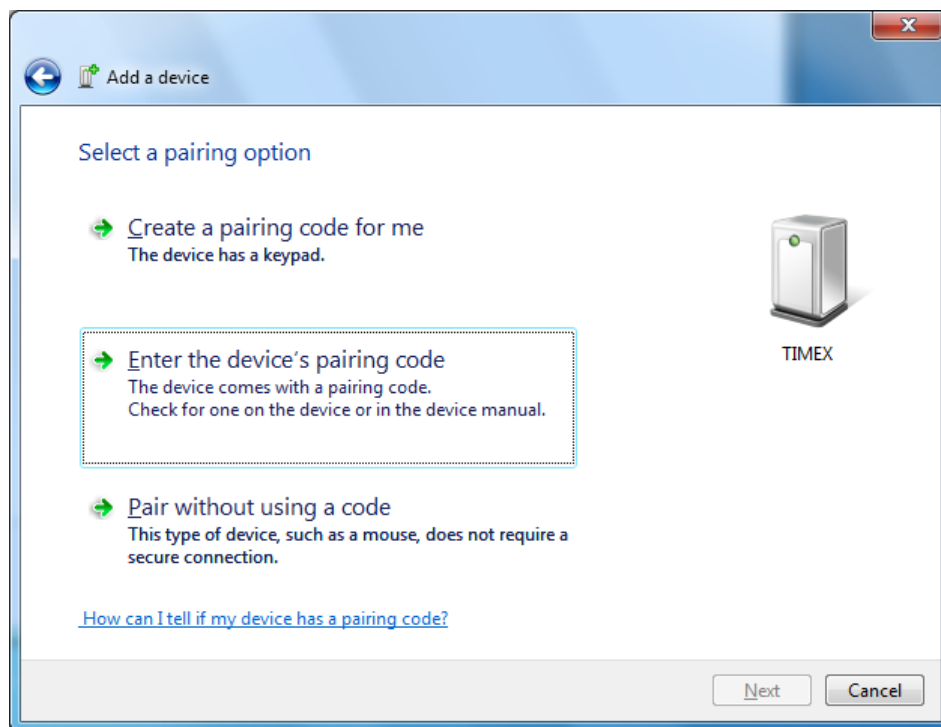
- Click on Add a device and wait for the system to identify the device (i.e. until the TIMEX device appears)



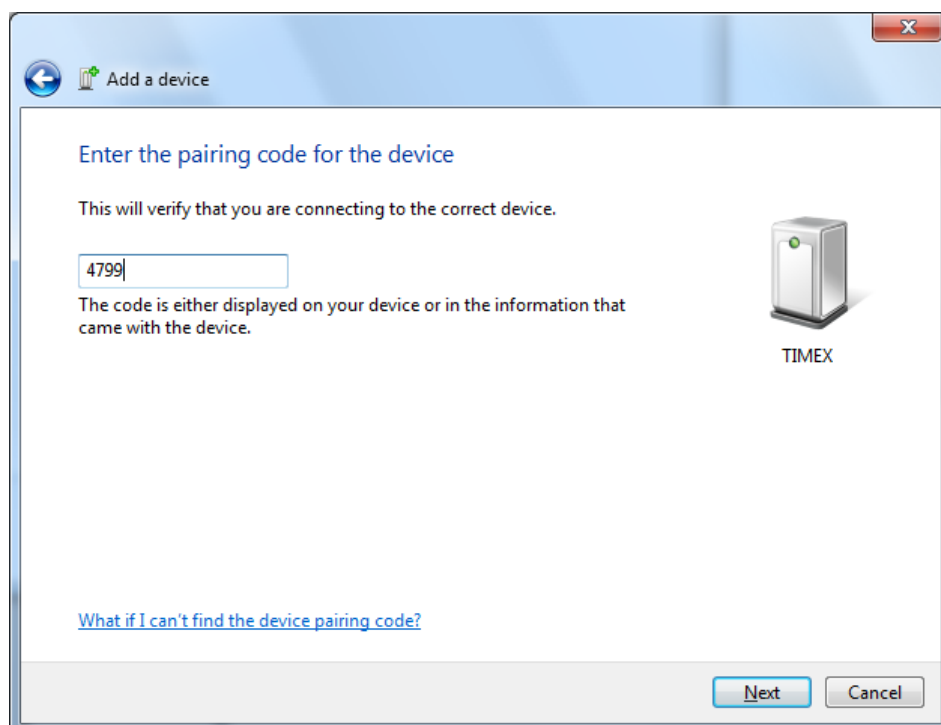
- Double click on "TIMEX"



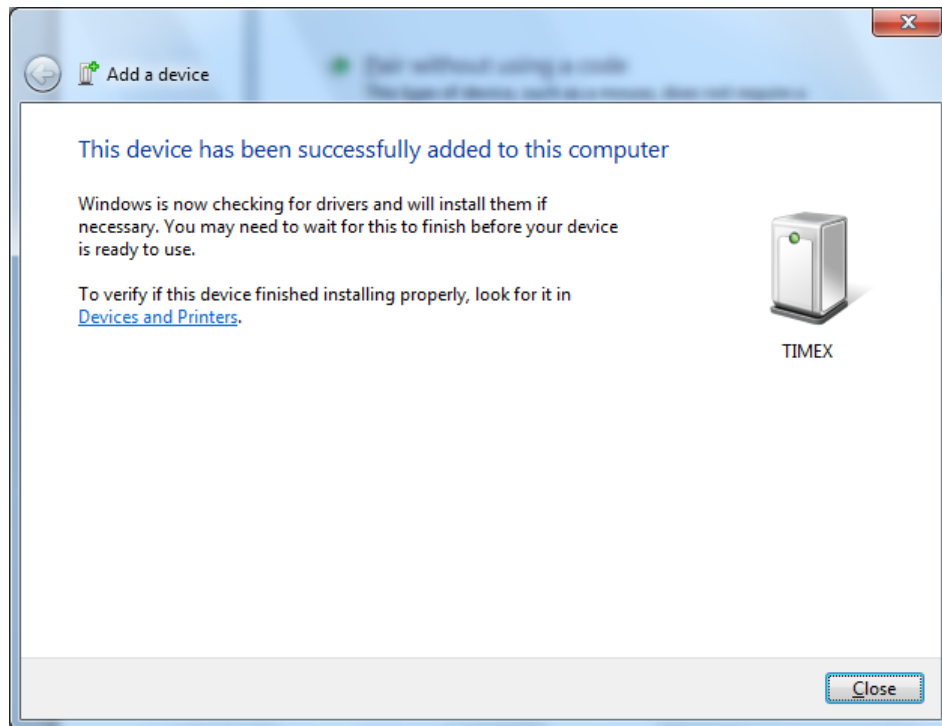
- Choose “Enter the device’s pairing code”



- Insert the pairing code **4799** and click “next”



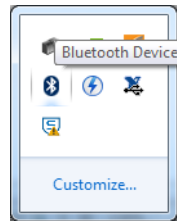
Now the system is paired with the PC. This means that every time both the system and the Bluetooth peripheral on the PC are turned on, a virtual serial port will be open between the two.



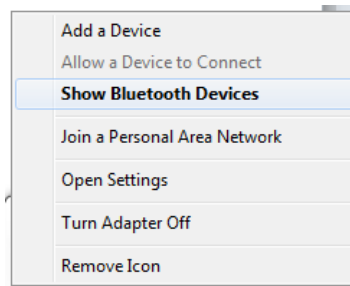
Now click close.

Find out the Bluetooth device port number

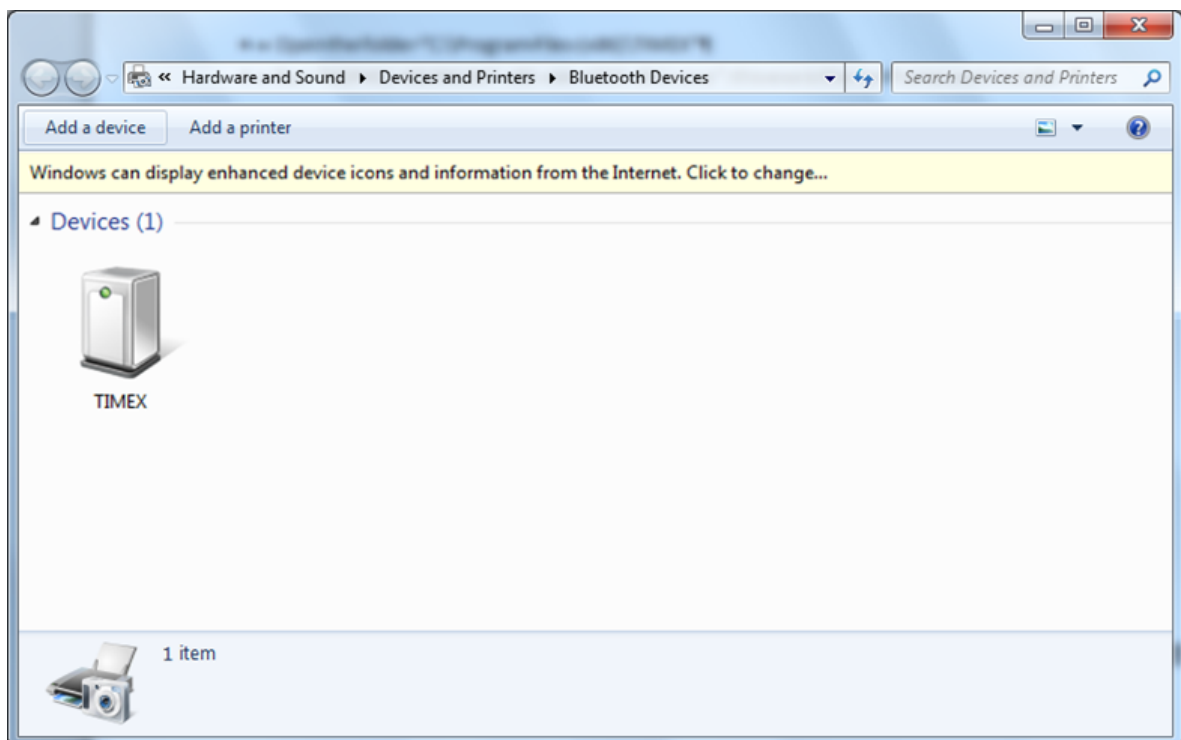
- Right click on Bluetooth Device icon



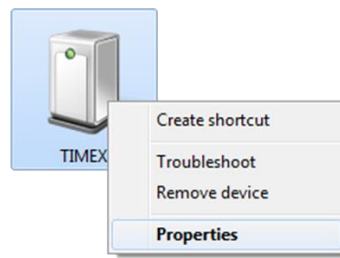
- Click on Show Bluetooth Devices



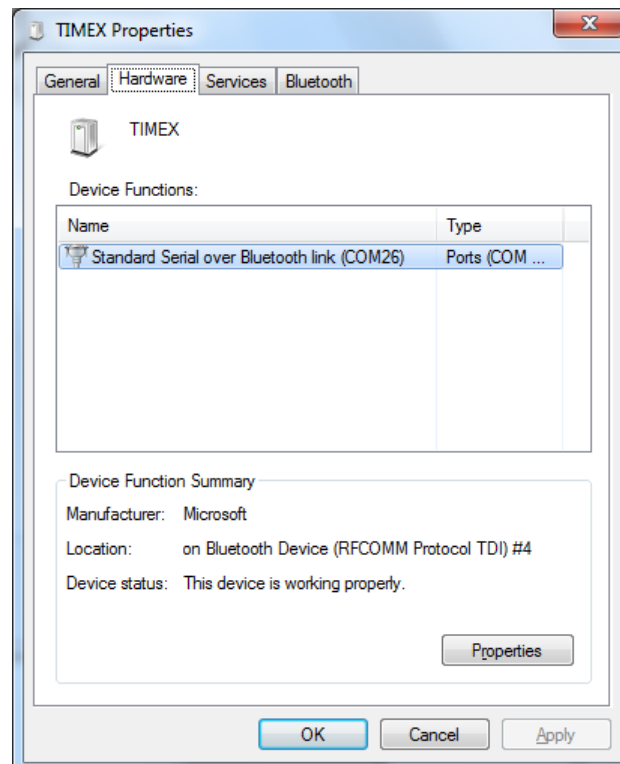
- Right click on "TIMEX"



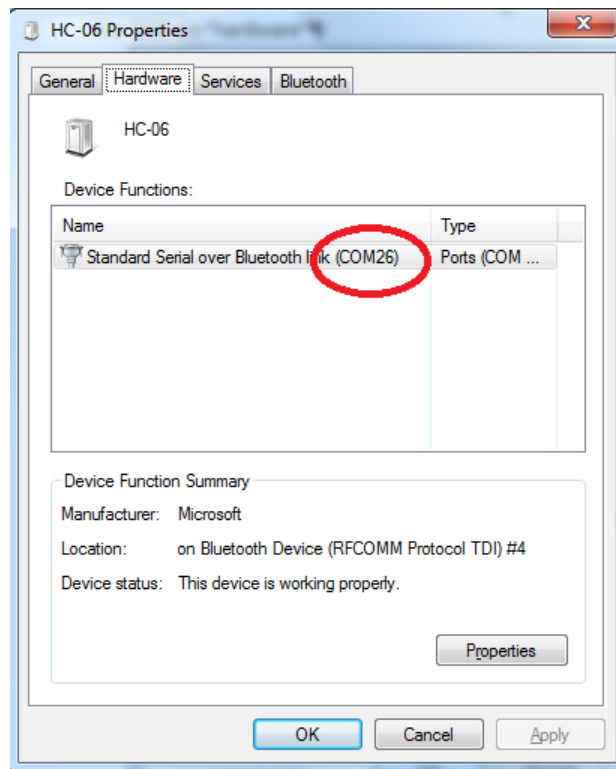
- Click on “Properties”



- Go to the “Hardware” tab

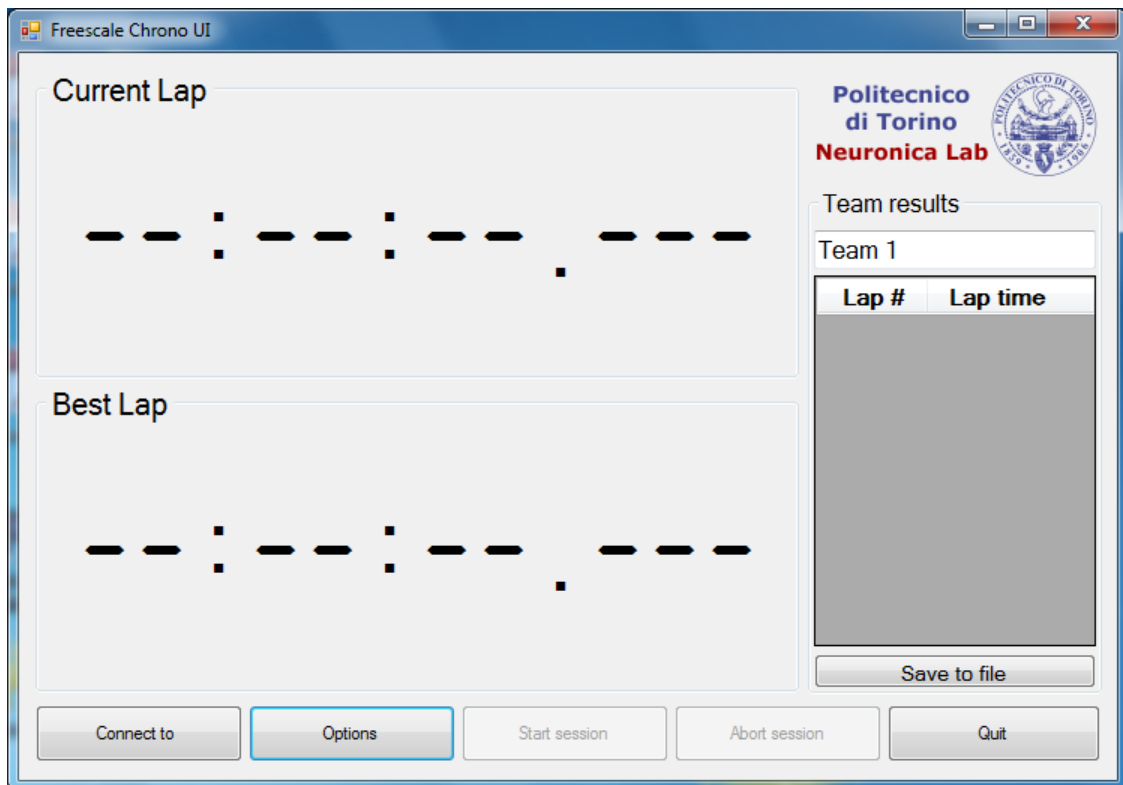


- Read the “COM” port associated with the device.



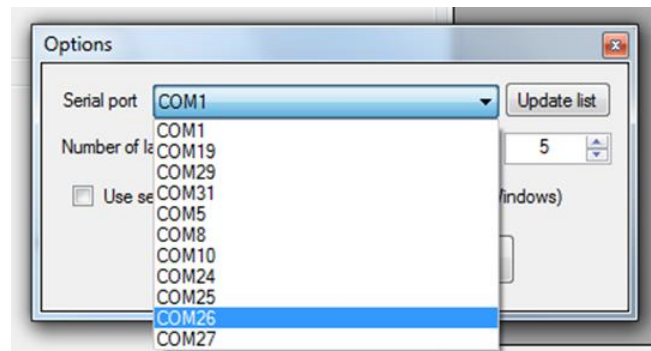
User interface

To run the application, simply double click on the TimexUI.exe file. The GUI will then pop up.



You can maximize the window to get a better view of the times.

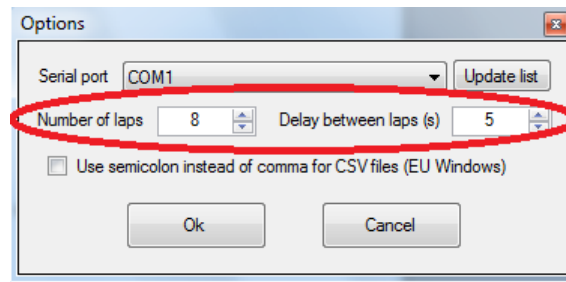
Click on “Options” to set the communication parameters.



You need to choose the correct COM port for the sensor. In order to do this, use the procedure shown in [Find out the Bluetooth device port number](#) or [Find out the USB device port number](#), according to the connection you have.

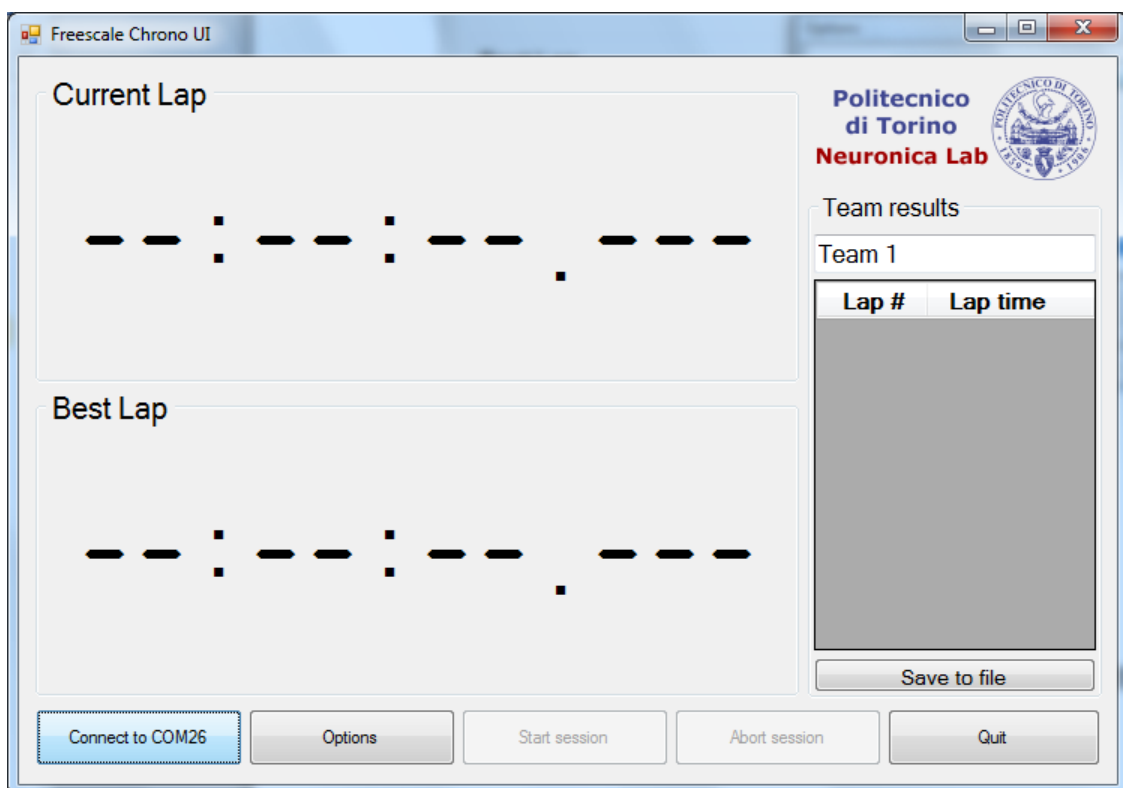
Since our Bluetooth port was COM26, we are choosing this one from the drop-down menu.

After choosing the COM port, you have to select the race parameters. This has to be done from the same window as the COM port choice.

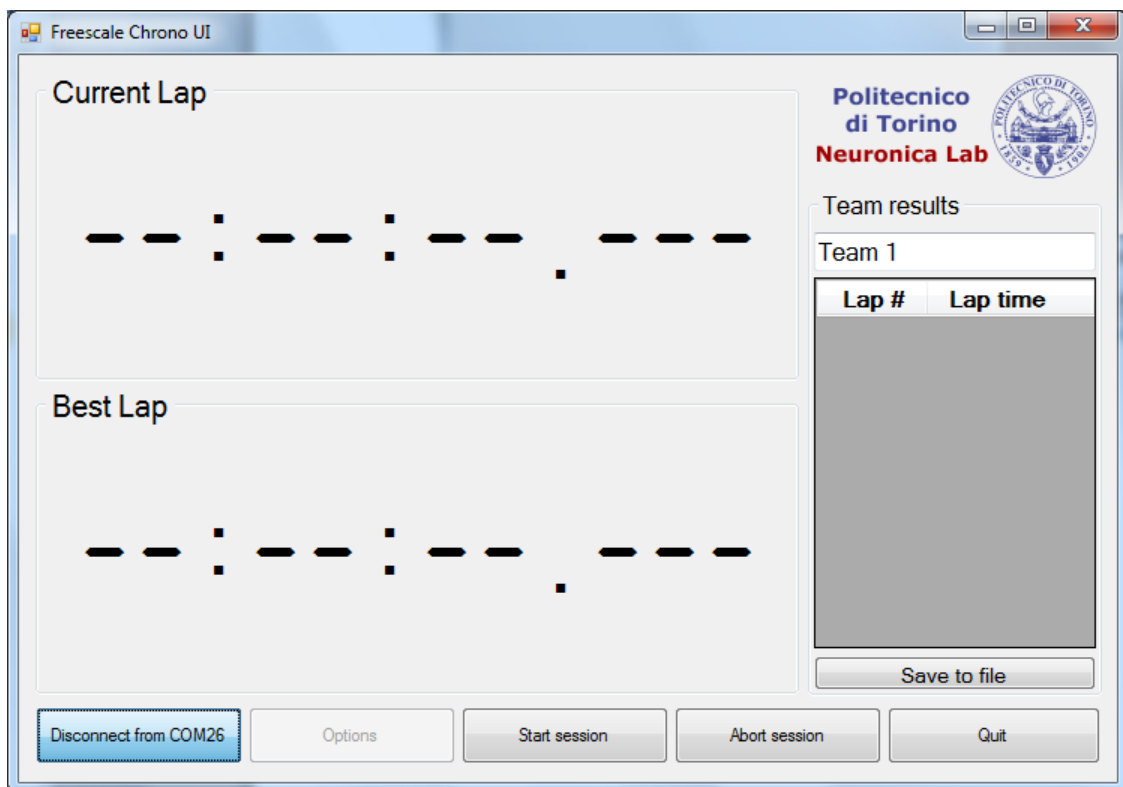


You can select the number of laps and the delay between laps (in seconds). The latter is used to avoid false measurements when a car slowly passes in front of the sensor. The default value (5 seconds) is good for almost every race.

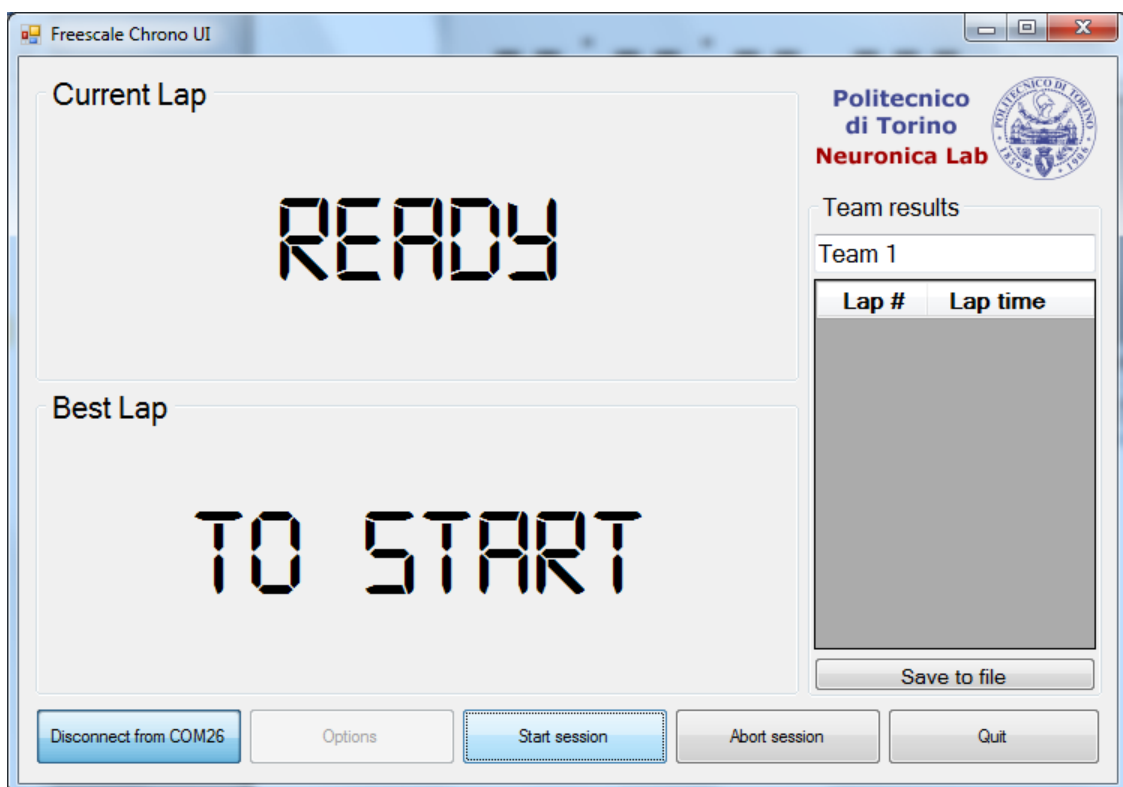
After choosing the parameters, you can press Ok to return to the main form, then you can click on "Connect to ..." to start the connection procedure.



After the connection the buttons change.



At this point you can press the “Start session” button. The system enters a waiting state until the car passes.



When the car passes the start line, the system starts the first lap counting.

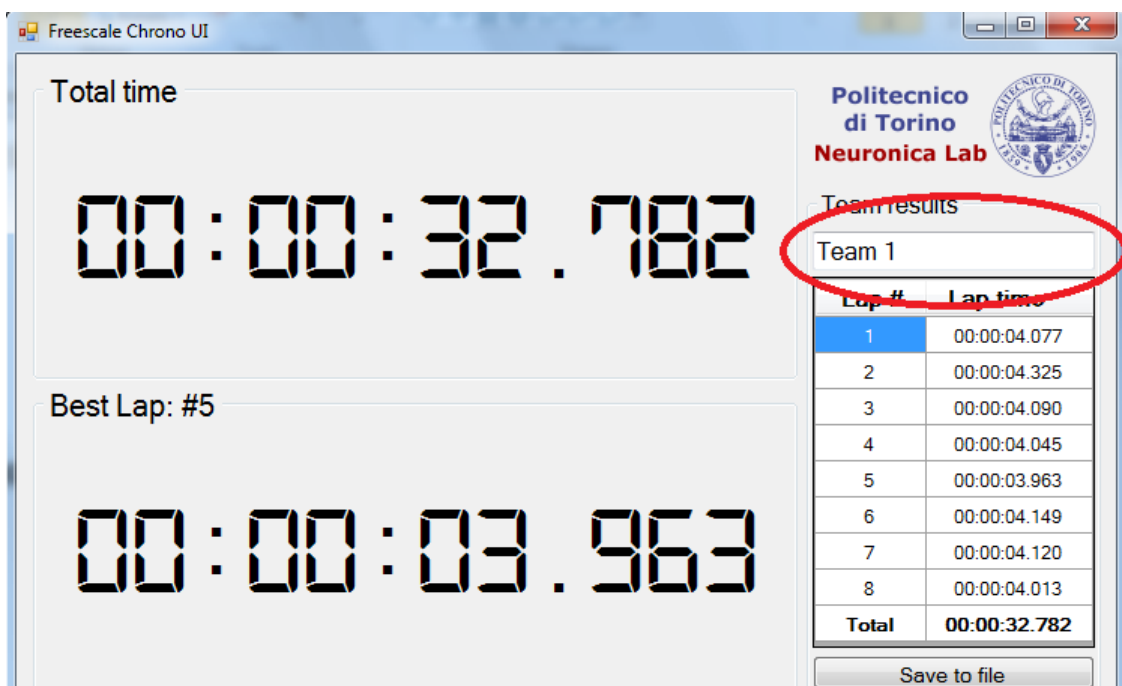
To stop the measurement you can either

1. Press the “Start session” button. The system will then enter the “ready to start” state.
2. Press the “Abort session” button. The system will then stop the measuring and return to the initial state.

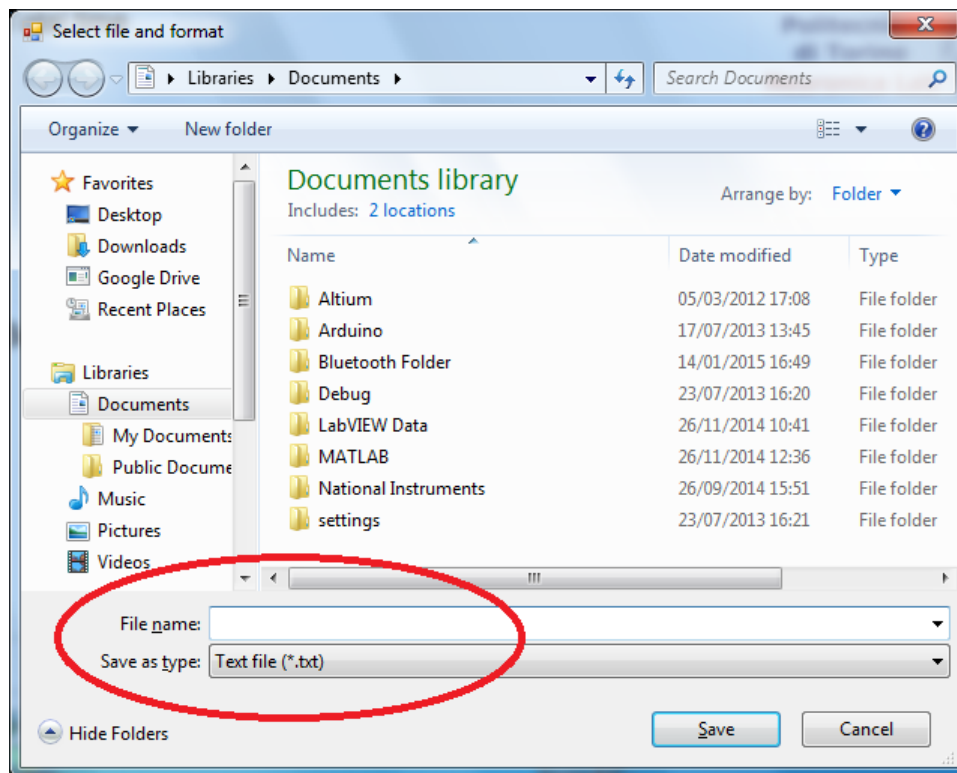
You can in any time press the “Start session” button again to enter the waiting state again, or the Abort session to cancel the current measurements. We suggest to first end a session (by ending all the laps or pressing abort) before disconnecting. After a disconnection, the port can be not available for some minutes (this varies from one adapter manufacturer to the other).

Saving the results

At the end of the laps, you can save the results in a file. Simply write a name in the “Team results” textbox and hit “Save to file”.



Now, in the window that pops up, select the directory where you want to save the file and choose its name. You can save the file in textual (*.txt) or comma-separated values (*.csv) format, changing the value in the “Save as type” box. In either case, if the file you selected already exists the new data will be appended to the file.



Closing the software

It is suggested that you disconnect the device (by clicking the “disconnect” button or closing the program) BEFORE turning off the device.

Remember to save the file before exiting (the results are not saved automatically).

Notes on the software

- Sometimes the interfaces (mainly the Bluetooth one) hang in a wrong state; consequently they will not allow to connect. If the peripheral hangs, you can
 1. Try to close the program, turn off the Bluetooth peripheral or detach the USB cable, wait for 10 seconds, then plug the cable back in or turn on the peripheral and open the program again.
 2. If this did not work, disconnect the system, turn it off, reboot the PC, turn the system on again and try to connect.
 3. If even rebooting didn't solve the problem, go to the Device Manager (for the USB connection) or Bluetooth Devices (for Bluetooth connection, see above for how to reach these locations) and remove the device. Then disconnect the USB cable if it was attached, shut down the system and, after 10 seconds, turn it on again, and then connect the device again (by installing the USB driver or restarting the Bluetooth pairing).

Technical specifications

Timing

The system has both long- and short-term stability higher than the average clocking systems, thanks to an external high precision oscillator:

- Long-term Stability: Max. ± 3.0 ppm/year;
- Frequency/Temperature characteristics:
 - Max. ± 0.5 ppm (-10 to +70°C)
 - Max. ± 1.5 ppm (-30 to -10°C) (+70 to +85°C)
(Based on frequency at +25 \pm 2 °C)
- Short-term Stability: Max. 1.0 ppb;

The aforementioned features allow a sub-millisecond accuracy over a two-minute lap (within one year after calibration).

The long-term stability impact on performances can be minimized by performing the calibration operations every year.

Serial communication

The board can be controlled with both a Bluetooth 2.0 and USB serial connection. In the latter case the drivers installation cause the USB device to appear as an additional COM port available to the PC. Application software can access the USB device in the same way as it would access a standard COM port.

The protocol for both communication modes (Bluetooth o USB) has the following features:

Baud rate	9600
Data Bits	8
Parity	No parity
Stop Bit	1

Bluetooth

- Bluetooth protocol: Bluetooth Specification v2.0 + EDR;
- Band: 2.40 GHz ÷ 2.48 GHz, ISM Band;
- Modulation: GFSK (Gaussian Frequency Shift Keying);
- Emission power: ≤ 4 dBm, Class 2;
- Sensitivity: ≤ -84 dBm at 0.1% BER;
- Speed: Asynchronous: 2.1 Mbps(Max) / 160 kbps, Synchronous: 1 Mbps/1 Mbps;
- Security: Authentication and encryption;
- Profiles: Bluetooth serial port;
- Working temperature: -20 ÷ 75 Centigrade;

USB electrical specifications

The USB electrical parameters for the USB module conform to the standards documented by the Universal Serial Bus Implementers Forum. For the most up-to-date standards, visit usb.org.

Connectors

The DC plug is a standard DC Power Connector Plug.

External diameter: 5.5 mm

Internal diameter: 2.1 mm

The positive wire is connected to the inner contact.

Electrical

The board is powered by two rechargeable batteries or a DC power supply (included in the case).

When the DC power supply is connected, it can power the board along with recharging one of the batteries.

DC power supply for the system

The board can be connected to the mains through a power supply with the following specifications:

Input: AC 100-240V 0.3A 50/60Hz.

Output: 4.5V to 5.5V (suggested value: 5V), output current 3 A.

- A DC power supply with an output current of 1.5 A can also be used, but **in this case the batteries must be disconnected from the system, because the recharge is not available**. However, if you use the provided DC power supply (3 A) you can connect the batteries too.

DC power supply for recharging the batteries

It is also possible to recharge the batteries independently (without connecting them to the system).

In this case connect the battery through the proper adapter (included in the pack) to a power supply with the following specifications:

Output: 4.5V to 5.5V (suggested value: 5V), minimum output current 1.5 A per battery pack.

This means that with the provided power supply you can recharge both battery packs. If you use a less powerful adapter, you will be able to charge only one of them (don't try to attach the other one, otherwise you can break the power supply and/or the battery packs).

Lithium-Ion rechargeable batteries

The system comes with two battery packs, each of them based on a single Panasonic Li-Ion cell and a proper recharge and protection circuit.

- Nominal Capacity (at 25°C): Typ. 3350 mAh;
- Nominal Voltage: 3.6 V;
- Charging Voltage (on battery pins): 4.2 V;
- Charging Voltage (on power supply pins): 4.5 ÷ 5.5 V;
- Charging Current: 1.5 A;
- Charging Time: see the next paragraph;
- Ambient Temperature: Charge (10 ÷ 45°C);
Discharge (-20 ÷ 60°C);
Storage (-20 ÷ 50°C);

- Gravimetric Energy Density: 243 Wh/kg;

Recharge time

The recharge time is less than 180 minute for each battery pack (85% of the charge is reached within 90 minutes).

N.B If both the low battery pack are connected to the system, the recharge time is doubled because the packs are recharged sequentially (first the battery pack A and then the battery pack B).

LCD Touch Screen Display Specifications

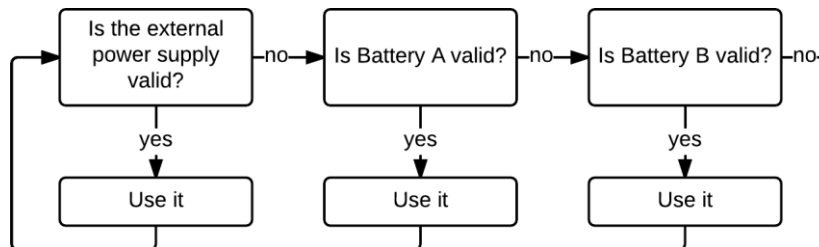
- Dimension: 4.3";
- Resolution: 480 x 272 pixels;
- Internal controller: SSD1963;
- Resist film to protect the LCD screen;
- LCD Type: TFT Transmissive Normal White super wide viewing angle;
- LCD Panel: HannStar HSD050IDW1;
- Interface: 8/16bit parallel bus interface;
- Active Area: 95.06mm x 52.86mm;
- Pixel pitch: 0.135mm x 0.135mm;
- Touch screen technology: resistive;

Appendix

Power supply additional notes

Prioritized power supply description

The controller is a prioritized one; this means that it picks the first valid input as the current one: the flow chart can be summarized like this.



Battery recharge system

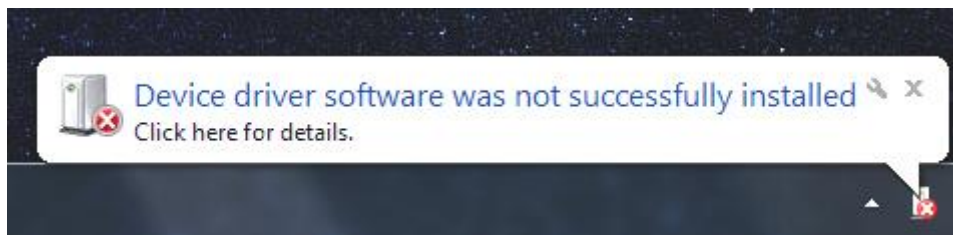
The included power supply can both power the circuit and recharge one of the two batteries. When you plug the power supply in, it tries to recharge Battery A. After its full recharge, Battery B becomes recharging.

Batteries have a “stop after one charge” functionality, which means that if you completely recharge one of them then it will not be charged again unless you

- Unplug the connector and then plug it in again, or
- Press the reset button ([Battery unit, b](#)).

USB drivers

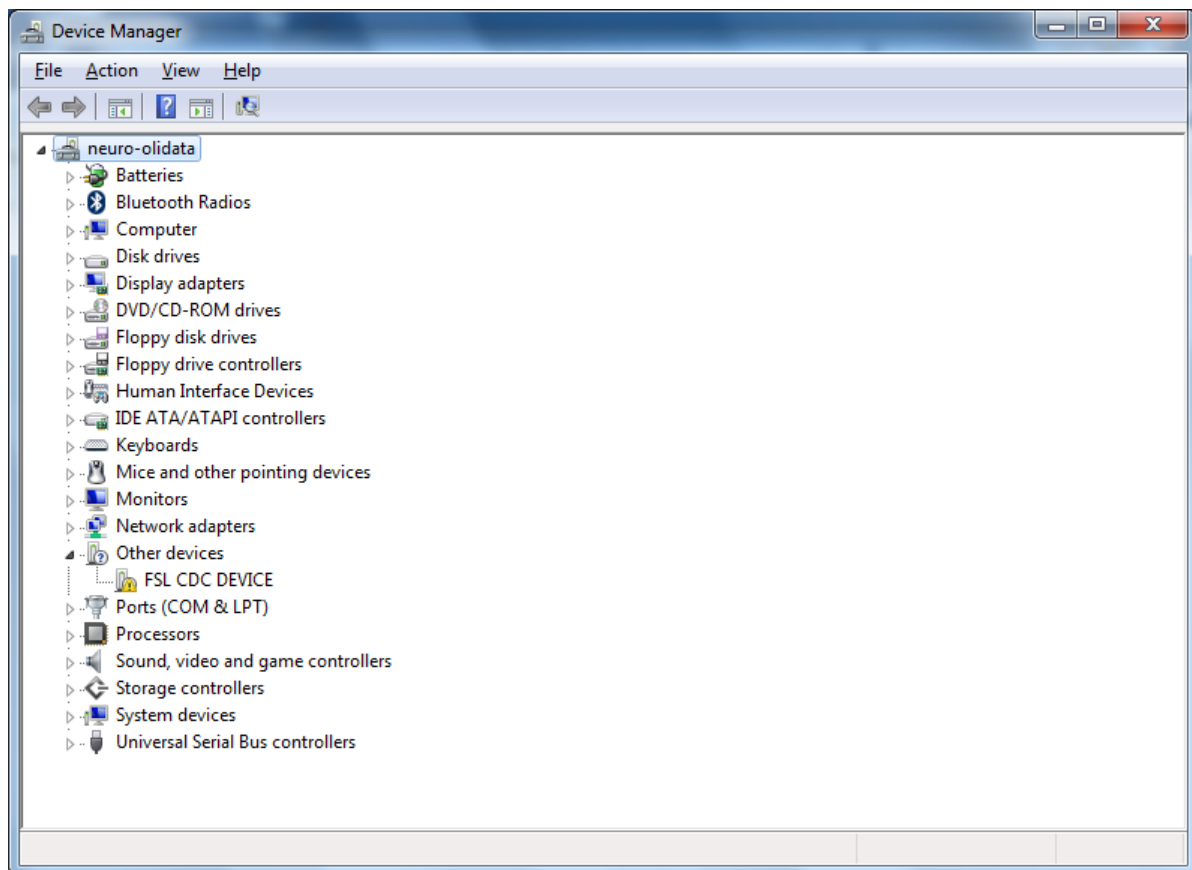
When you first plug the USB cable in you will get an error, since the drivers are not installed.



You have to open the device manager. To do this you can

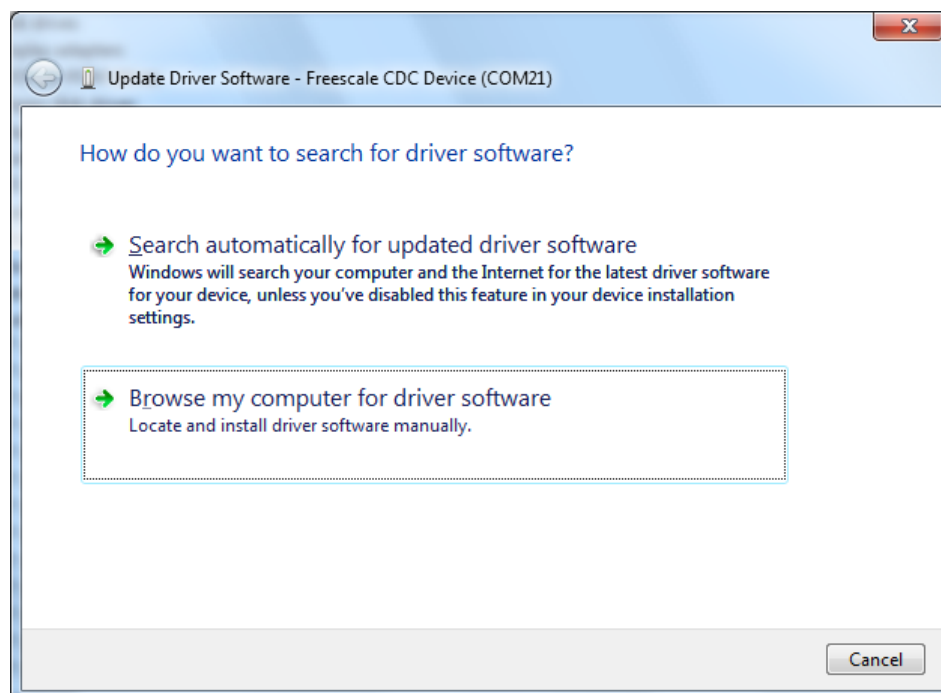
- Click on start, in the search box type “Device manager” and then open it.
- Click on start, then go to the Control Panel. Click on “System and security”, then under System click on “Device Manager”
- Hit Windows+R on your keyboard, then in the run box that opens type “mmc devmgmt.msc” and hit enter.

You will see the following window.



Under “Other devices” you will see “FSL CDC DEVICE”. The yellow alert sing indicates that the drivers are missing.

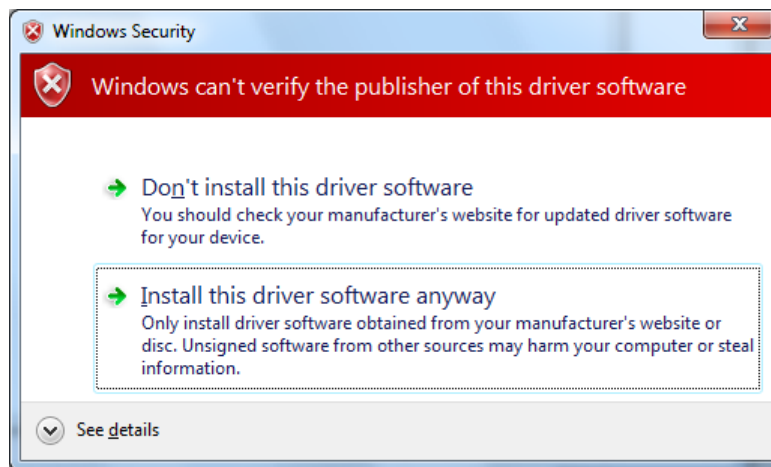
Now right click on the device and choose to “Update Driver Software”.



In this window choose “Browse my computer for driver software”.

Then click on Browse and navigate to the folder where the file “TIMEX_USB_DRIVER.inf” resides.

One note. The driver is not signed, so Windows will show you this window after hitting “Next”:



Tell him “Install this driver software anyway”.

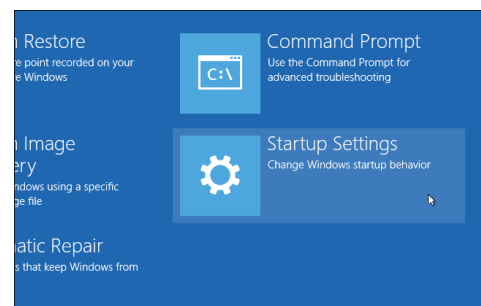
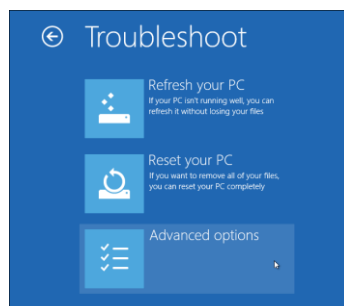
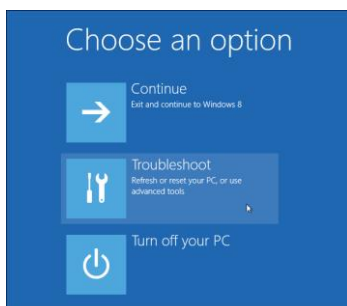
At this point, the driver is installed.

Windows 8 remarks

Starting from Windows 8, Microsoft made the unsigned driver installation harder in order to enhance security. This leads to a more difficult way to install the driver.

At the beginning you have to reboot the PC with the advanced startup. To do so, simply press Windows + R keys on the keyboard, then write “shutdown /r /o” (without the quotes) and hit enter. The system will reboot and enter the advanced startup menu.

Here you have to choose Troubleshoot, then Advanced Options and, at the end, Startup Settings.



Now just press Restart. At the next boot, hit F7 to disable driver signature enforcement. The system will then boot without that feature; following the procedure above you will be able to install it.

When you have installed the drivers, reboot the PC. This way the driver signature enforcement will be enabled again.

Find out the USB device port number

Open the Device Manager. Now, under “Ports (COM and LPT)”, you will see the “Freescale CDC Device” with its COM port.

