Robix Software, Part I: Quick Start Tutorial

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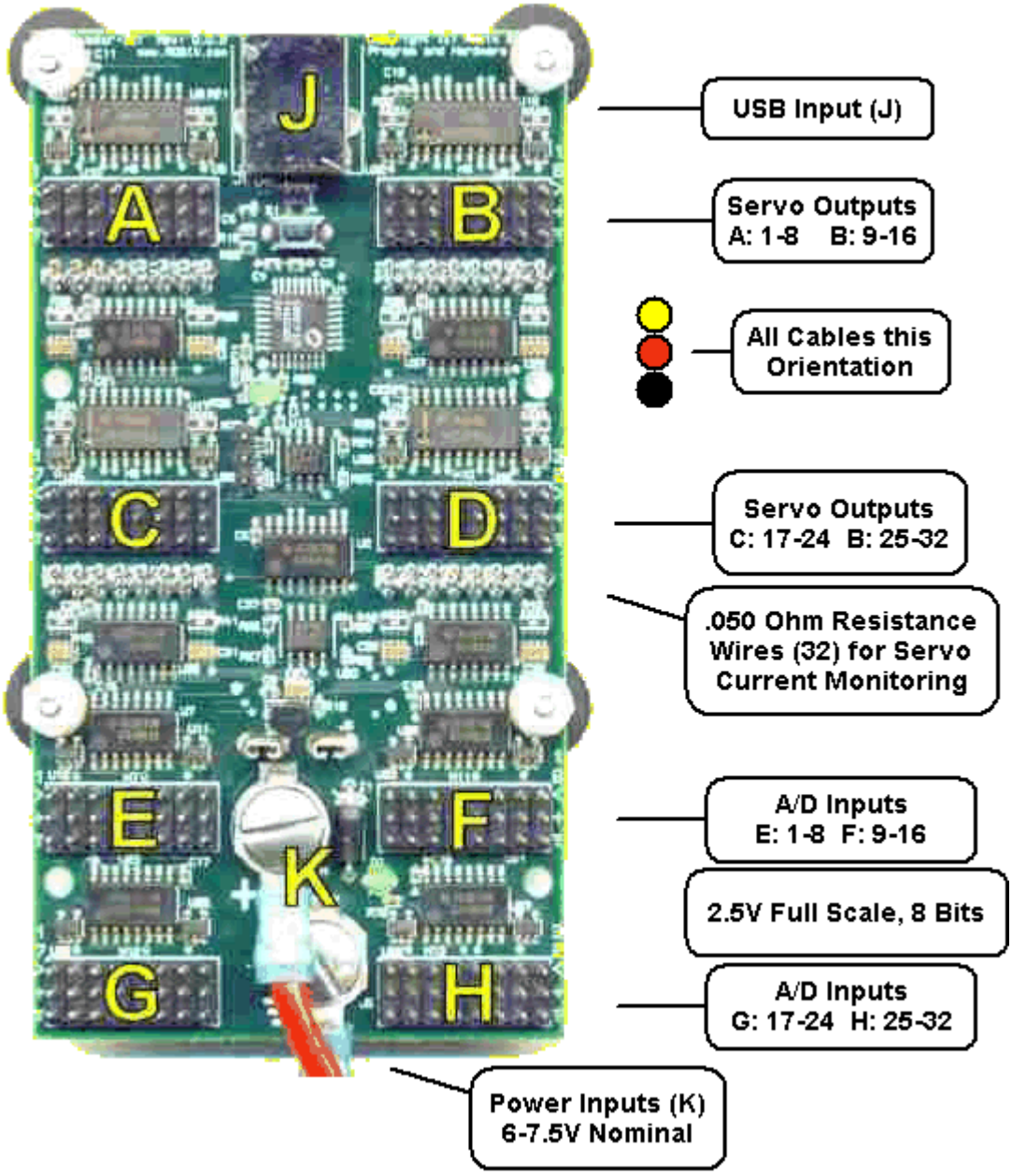
Feedback: desk@robix.com. Home: www.robix.com Last mod: 2005-02-1

(Note: For the Tutorial on the ***LPT*** -connected Controller, See "Help" in that software)

Here's the Usbor servo controller. Connect 6 servos to positions 1-6 on connector **'A'**. Make sure to have the yellow/orange wire on 'top', as shown in the **All Cables this Orientation** legend, below right.



Install the Robix Software

Install the Robix software according to the instructions on the CD that accompanies it. If you don't have the CD, you can download the software from www.robix.com by clicking on the download section and following the instructions there. Note that you may need to install the Java SDK if you don't have it already.

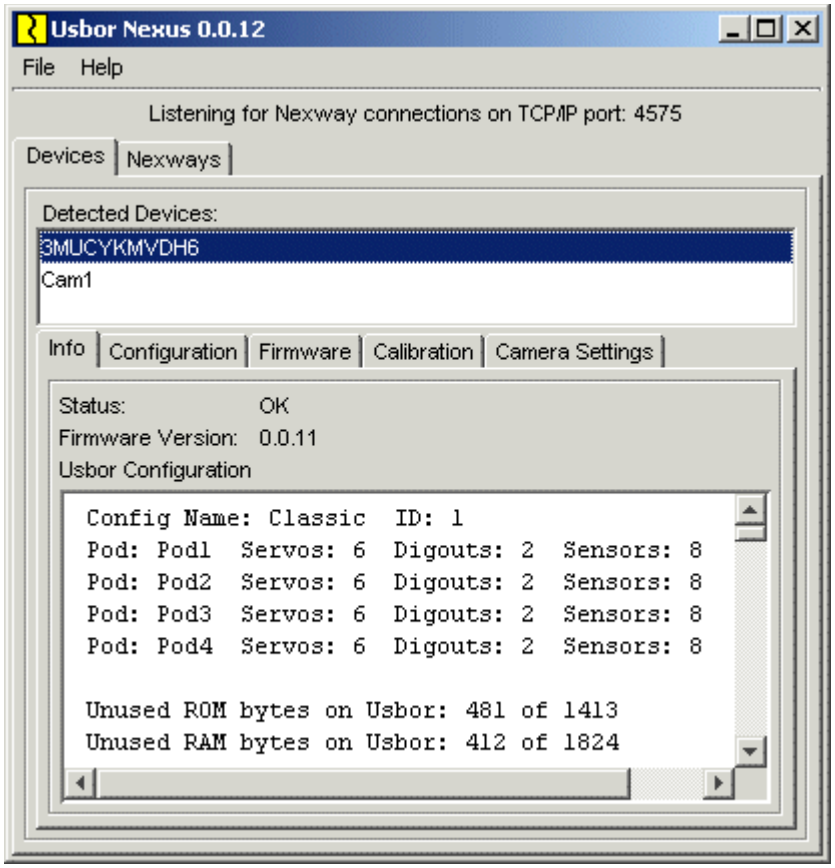
Plug in Power and USB

Once the software is installed, plug the power supply into the USB servo controller (called the "Usbor" for short) and use the USB cable to plug the controller into the computer.

Start the Software: Two Programs

Next, start **two** programs, called **Nexus** and **Nexway**. You can start them in either order.

In the Nexus window you should see an 11-character Usbor serial number. In this case it begins **3MU...**.



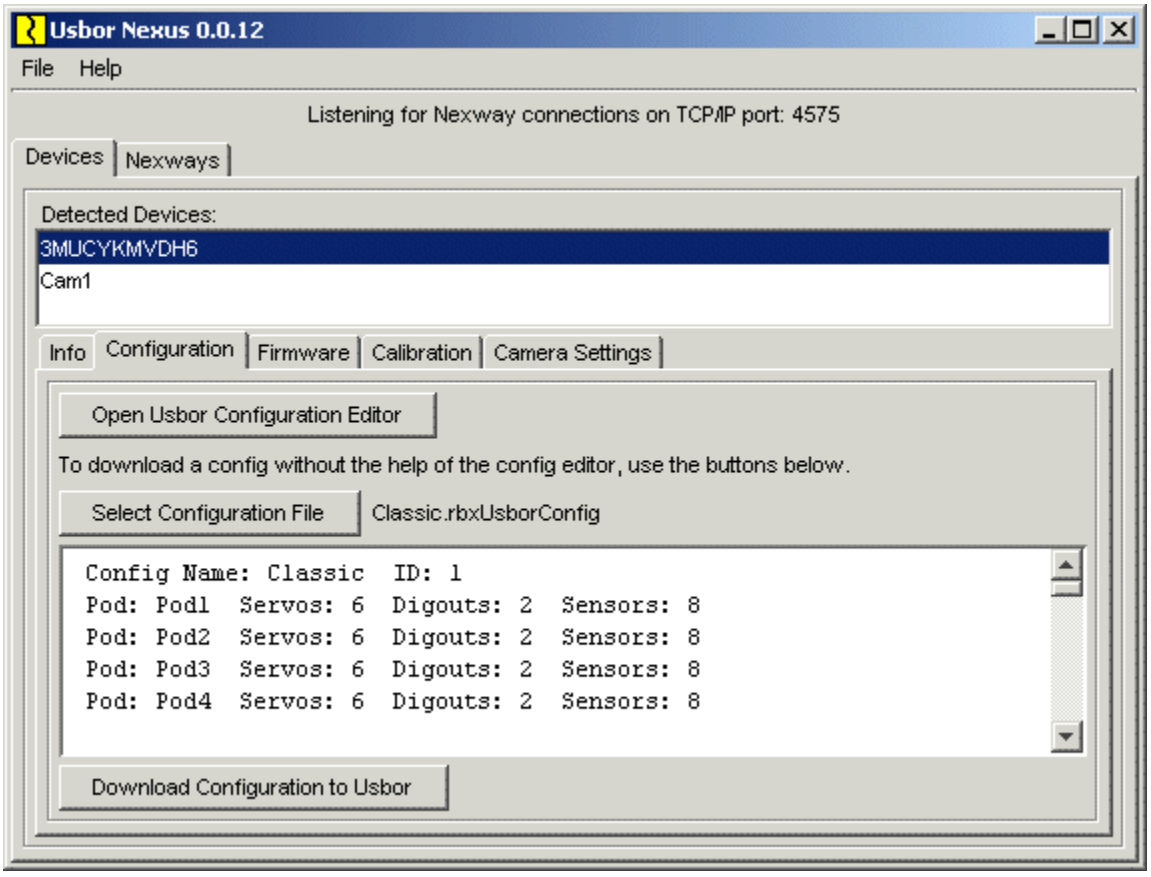
If Usbor show configuration **Config Name: Classic ID: 1** at the top of the lower window then you can skip the next page. Otherwise you'll have to load the Classic config.

If Needed: Loading the Classic Configuration into the Usbor

In the Nexus, click on the **Configuration** tab. Click on the **Select Configuration File** button and in the file dialog that follows you *should* see **Classic.rbxUsborConfig** listed.

> If you *do not* see **Classic.rbxUsborConfig** listed then create it as follows: Close the file dialog if still open, then click **Open Usbor Configuration Editor**. Click **File** | **New Configuration** | **'Classic'**. Then click **File** | **Save Configuration** and in the file dialog click **Save** (the filename **Classic** should already be filled in for you in the file dialog). Close the Usbor Configuration Editor. Now you can return to the top of this page and again follow the instructions there.

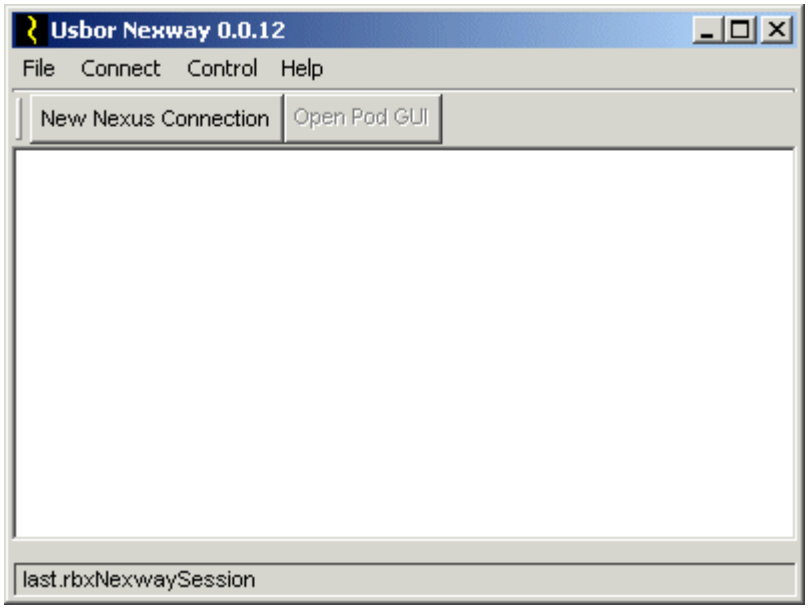
Open **Classic.rbxUsborConfig** to see:



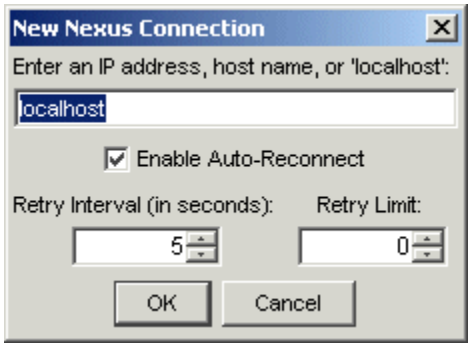
Click the **Download Configuration to Usbor** button and the configuration is re-loaded into the Usbor. The process will take a few seconds.

The Nexway, first time Starting

When you open the Nexway for the very first time, you see a blank window: (If this is not the first time the Nexway has been opened then you'll skip the rest of this page and the next one.



If your Nexway is blank, click on the **New Nexus Connection** button to see:

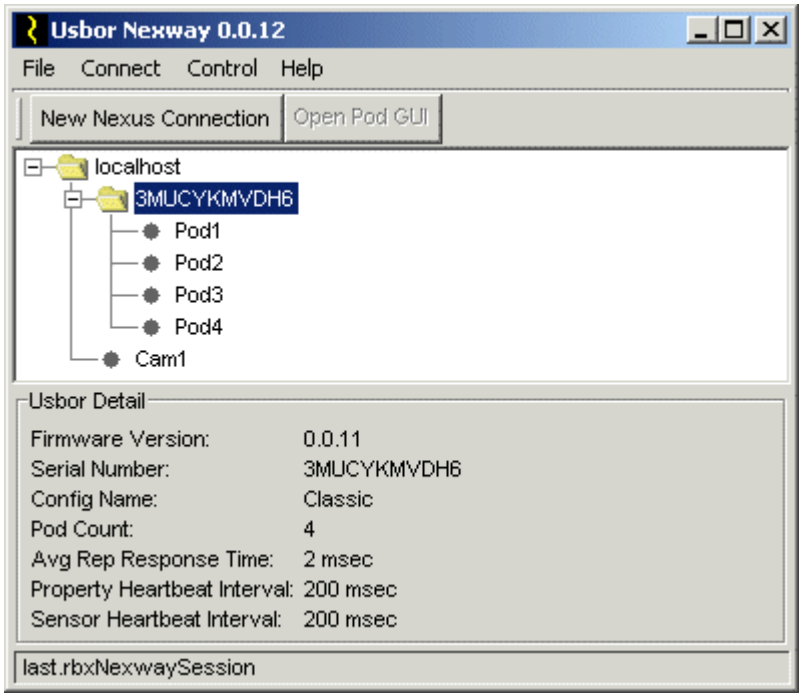


Since we are working **locally**, that is, with the **Nexway** and **Nexus** on the **same computer**, we select the default of **localhost** by clicking **OK.**

Next we click on **3MU...** (or whatever your Usbor's serial number is) and we see:

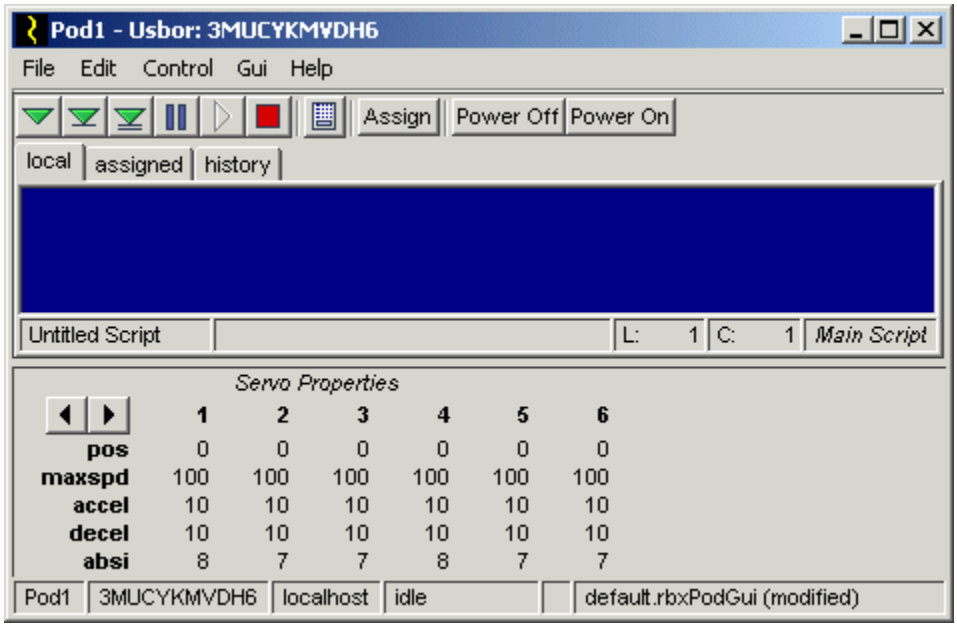
The Nexway

Click on the + signs to open the folders to see:



The Pod's Graphical User Interface (GUI)

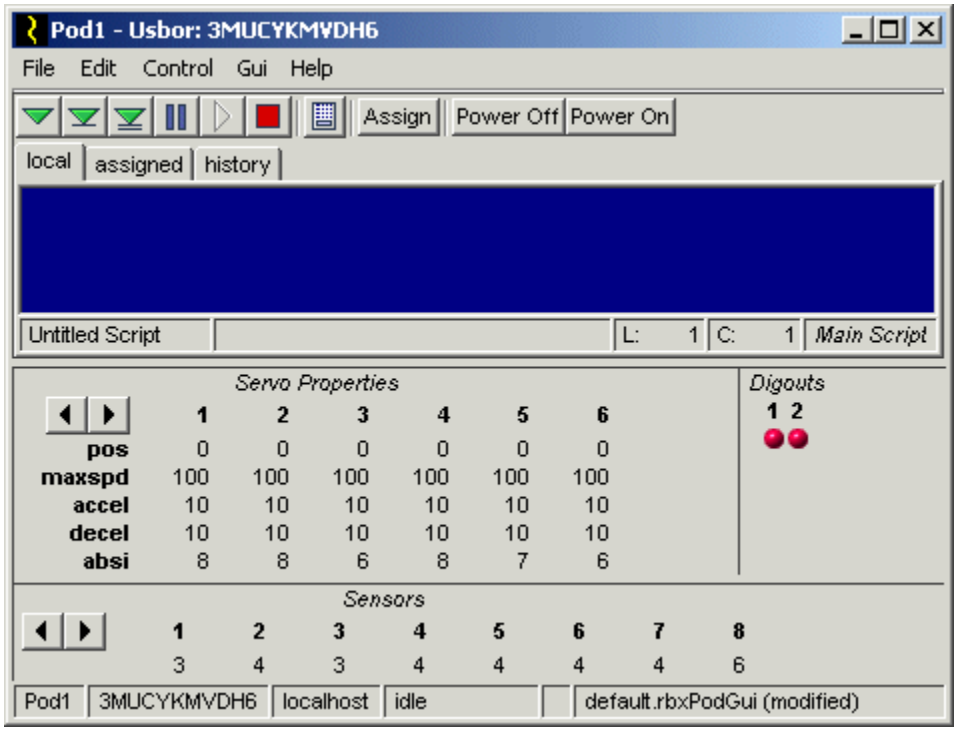
Click on **pod1** in the Nexway to open that pod's gui ("gooey").



Adjusting the Pod GUI

Right click anywhere in the **Servo Properties** panel and select **Split This Pane** and then **▼Down**. Then right click in the new panel and select **Replace With** and then **Sensors**,

Now right click again in the **Servo Properties** panel and select **Split This Panel** and then **►Right**. Then right click in the new panel and select **Replace With** and then **Digouts**.



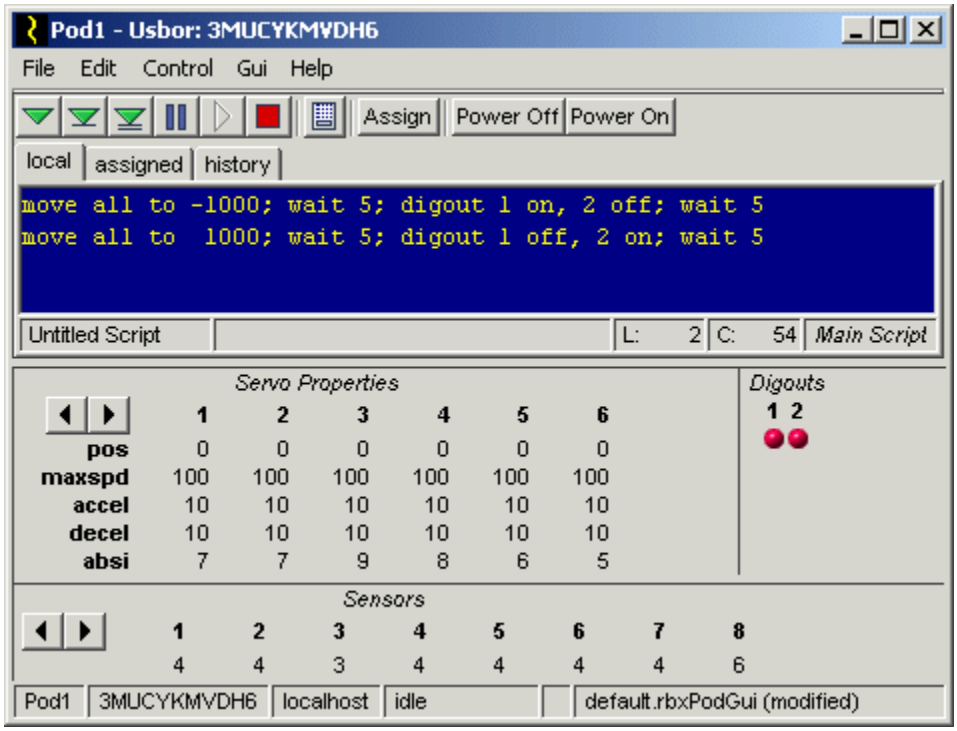
Click **Gui** in the menu and save as **default**.

Your First Script

If you don't have links or at least link horns on the 6 servos you plugged in at the beginning of this tutorial, add them now so that servo motion is readily visible.

Stretch the pod gui vertically to increase the size of the blue scripting panel. Then type in these two lines.

```
move all to -1000; wait 5; digout 1 on, 2 off; wait 5
move all to  1000; wait 5; digout 1 off, 2 on; wait 5
```

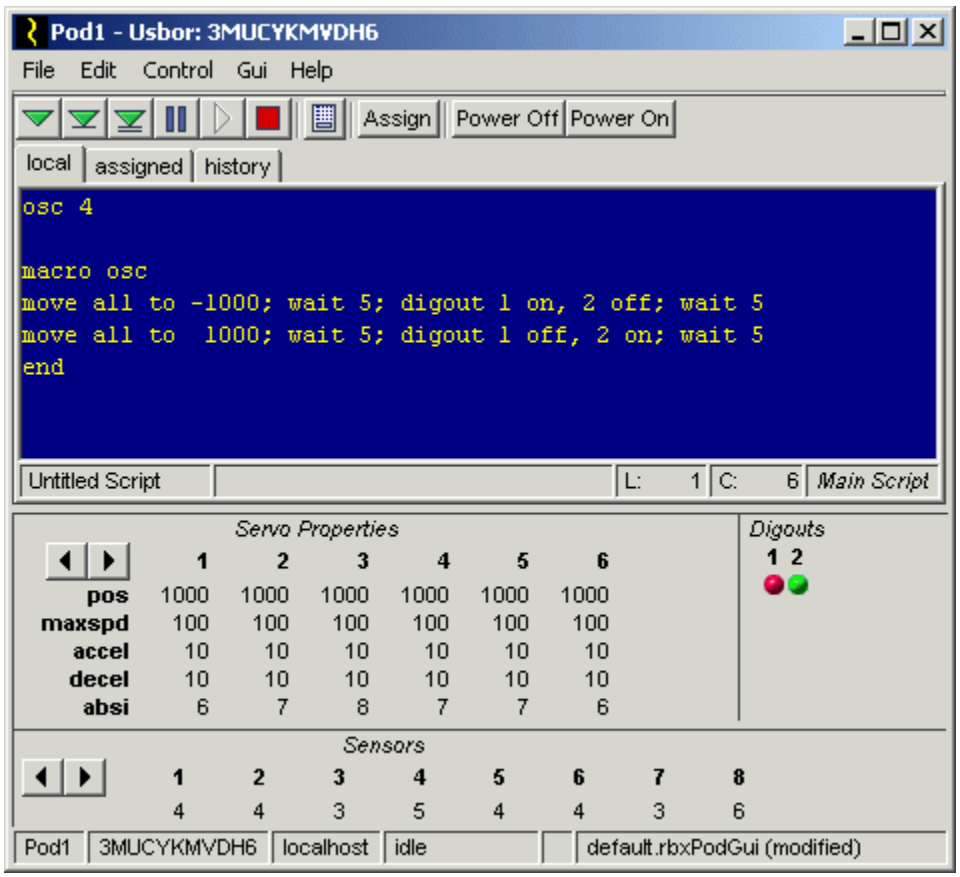


Now **run the script by clicking the**  **'run' button** at upper left.

Click  again to run the script again. Notice that the servos move back and forth, the **pos** values change, and the digouts change color as they are turned on and off..

Your First Macro

Stretch the pod gui vertically to make more room in the scripting area. Then turn the two script lines into a script **macro** named **osc** by altering the script to this form:



Note that the **osc 4** line could also have come after the macro definition instead of before it.

Run this script as before () and see that **osc** runs 4 times. If you change the **4** to **0** and run the script, you'll see that **osc** runs indefinitely. After **osc** has repeated several times, **stop the script** by clicking **anywhere in the script area**, or by clicking on the red stop button  .

Note that in general, you can have multiple commands on single line separated by `;`'s. A `;` is allowed at the end of a line but is not required. Commands may not 'span' lines; that is, a command needs to start and end on the same line.

A script may contain **any number of macros**, and macros can call other macros.

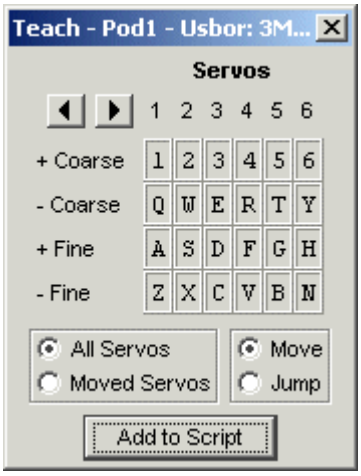
Servo Current and Torque

Now **apply gentle rotational pressure** on the output shaft of servo 1 and watch the **absi** value of servo 1 increase as the servo draws more current to oppose the force you are exerting. The **absi** value is the absolute value of the short-term (~.1 second) average of the servo current. This value, in general, indicates the torque being exerted by the servo and are approximately equal to the milliamps being drawn by the servo.

Remember: **Don't leave servos straining** with **absi** over about 500-600 for more than a couple of minutes at a time; otherwise your servos can overheat, shortening their lives.

Teach Mode

Next, **position the text cursor on the word 'end'** at the end of the macro and **open the Teach Window** by clicking on the teach button '  '. You should notice an arrow, `'->',` appear in a new blank line above 'end'. In addition, the teach window will appear:



While the **Teach Window** has focus your keyboard is acting as a **teach pendant**. That is, holding down various keys, as indicated in the Teach Window , will move the corresponding servo by coarse or fine increments in the positive or negative direction. You will see the position servos move and their **pos** values change in the pod gui.

After you have moved the pod's servos to new positions, click on the 'Add to Script' button in the Teach window, and a move command will be inserted on the line with the '->' arrow and the arrow will move down a line. Repeat these steps to add several new lines to the **osc** macro, then run the script again to see your added move commands in action.

Robix Software, Part II: Tutorial in Depth

Why Two Programs?

Why **two** programs? Because the Robix software has the advanced capability to run robots ***remotely,*** over a network, or even over the internet. But if two machines are involved then they each need to be running a program. One program, the Nexus, "talks" directly to the Usbor via USB. The second program (the Nexway) talks over the network to the Nexus, sending commands and receiving continual status reports.

In the case when you're running "locally", that is, on just one machine, then the Nexus and Nexway run on that one machine.

And what's so valuable about operating robots remotely? To begin with, it allows two or even more student groups on separate but adjacent computers to share the same Usbor controller, reducing expenses:. The controller can run 32 servos at once, and these can be divided between the groups or what we call "pods".

In addition, and at least as important, remote monitoring and control of robots reflects the reality of today's factory floors.

The Nexus, continued

The word "**nexus**" is generally defined as "**a means of connection**". The Nexus in our case connects hardware such as Usbor **controllers** and their **servos**, and **webcams** used in the V-1.0 vision system **to user interfaces and user programs**. The Nexus is needed because, as mentioned, the user interfaces and programs may be running on other computers on a network or on the internet.

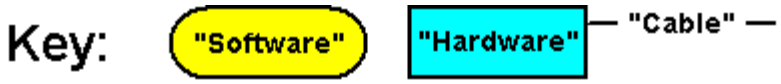
In case you're wondering, the Nexus communicates to these other programs using TCP/IP, the primary protocol(s) of the internet.

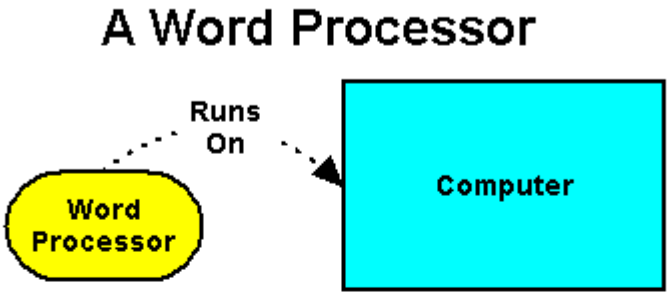
The Nexway, continued

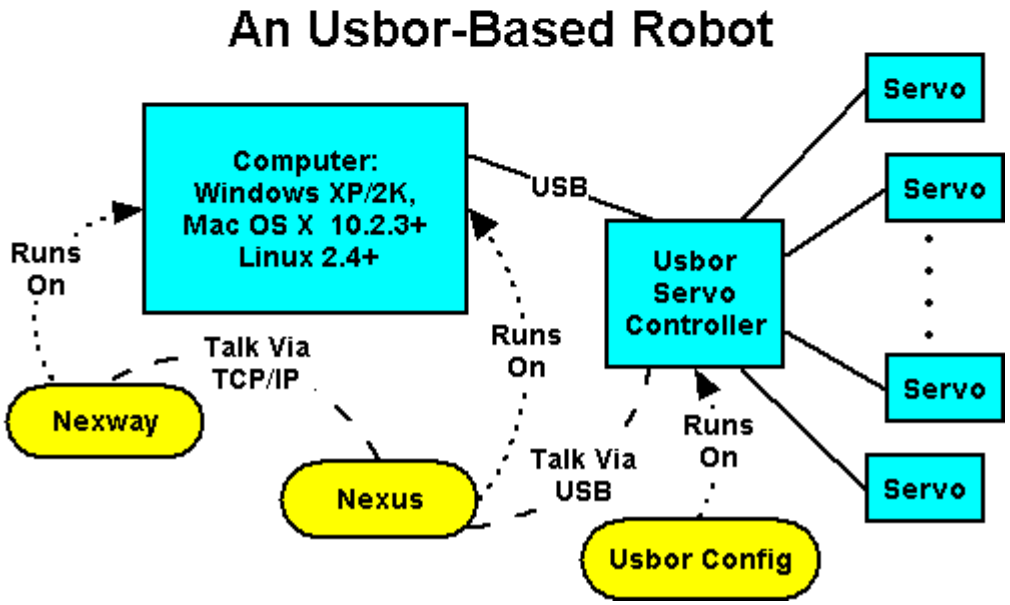
The Nexway (think "Gateway to Nexus") is the last link in the chain joining the user interface (and user programs) through the Nexus to the Usbor and its pods and finally to the pods' servos, digouts (digital outputs) and sensors.

Summary So Far...

To sum up, here's a diagram so far of the software and hardware. We contrast a conventional program (a word processor) with our remote robotic software:







Editing Scripts to Change Servo Parameters

Commands that alter servo properties need to be edited into the script by hand. In the macro **osc**, change the speed of the motion, add the command

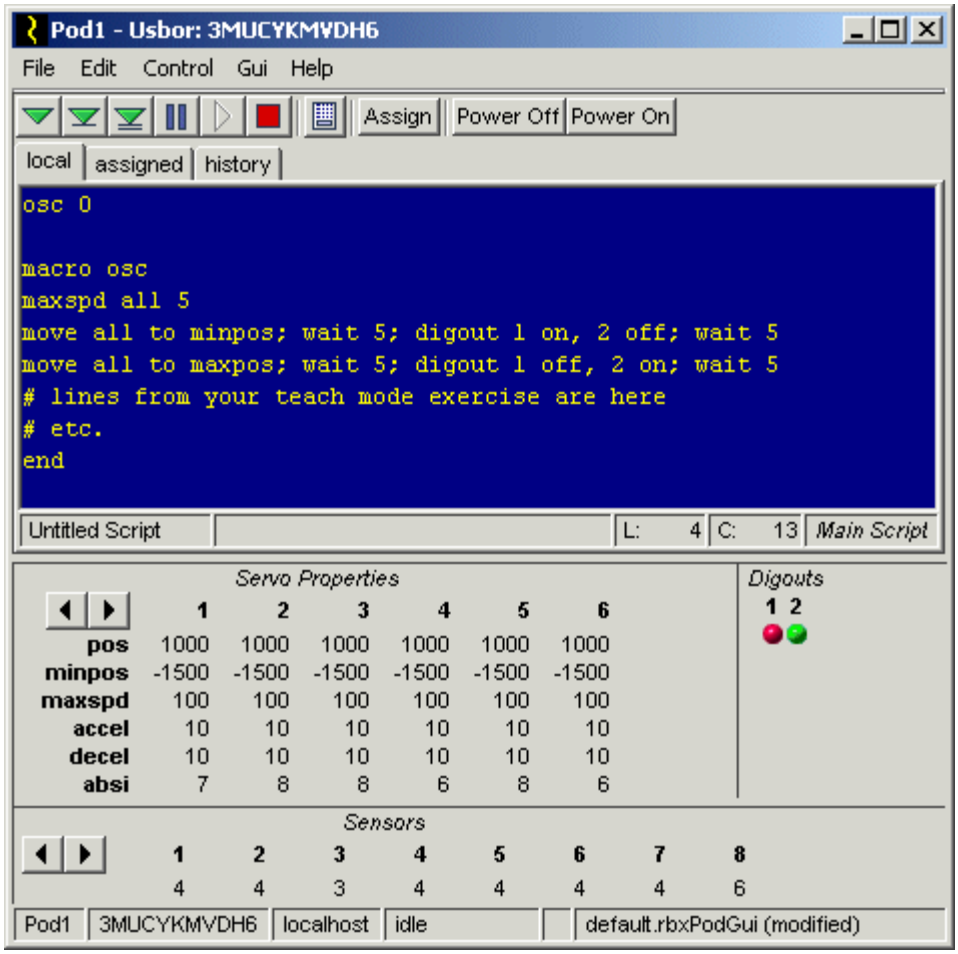
maxspd all 5

as the first line in the macro, and then run the script again. You'll see that the motion is slower than before.

By the way, instead of running the script with the  button, you can also double-click on the **osc 0** line to run the osc macro indefinitely.

You can also adjust other servo properties, assuming that these servo properties were defined as 'variable' (the default case) in the pod's **configuration**. For example, change the **-1000** in your script to **minpos** and change the **1000** to **maxpos**. And right-click on the **Servo Properties** panel and choose **Select Properties**. Then check **minpos** and click **OK**.

Now run **osc** again to see that the range of motion has been increased.



Next, see what happens when you add the line

minpos all -800; maxpos all 800

to the top of the macro **osc** and then run the macro again. Now the motion is more restricted.
Finally, change this last line added to

minpos all default; maxpos all default

to return the values to their defaults of -1400 and 1400.

For a listing of all script commands and their usage go to

http://www.robix.com/Robix Scripting Reference.pdf

Understanding the Usbor Configuration

The Usbor configuration is stored in the flash memory of the Usbor itself and is retained even when power is removed. The configuration defines how the 32 servo outputs (each of which can alternately be a digital output or 'digout') and the 32 analog inputs are assigned to various pods in the Usbor.

Firmware Design Features
Prelim. See Usbor/Status

* XML-based protocol over USB. Open, published spec.

*Field updates to flash.

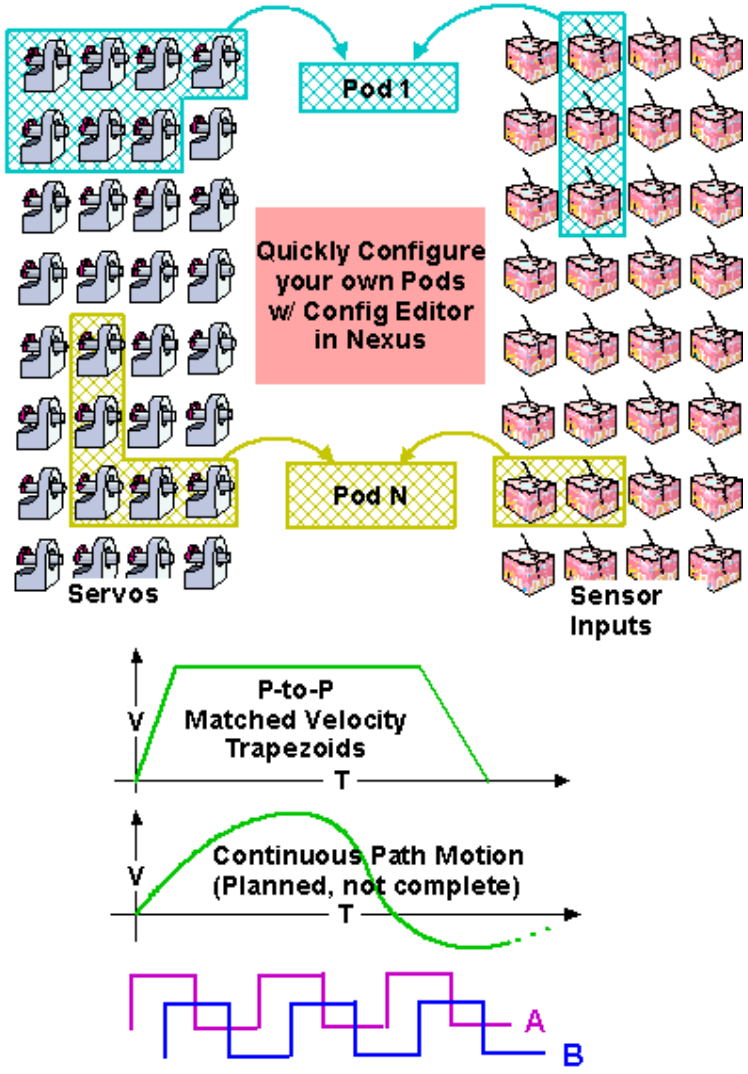
* Pod configuring supports indep. Pods (Robots, Organs...) composed of user-selected servos and sensors.

* Point-to-Point mode with automatically matched velocity trapezoids and per-servo control of accel, decel, maxspd, minpos, maxpos, initpos (on reset) duty cycle, and invert.

* Continuous Path mode with buffered stream of sequence of positions. (Planned, not complete.)

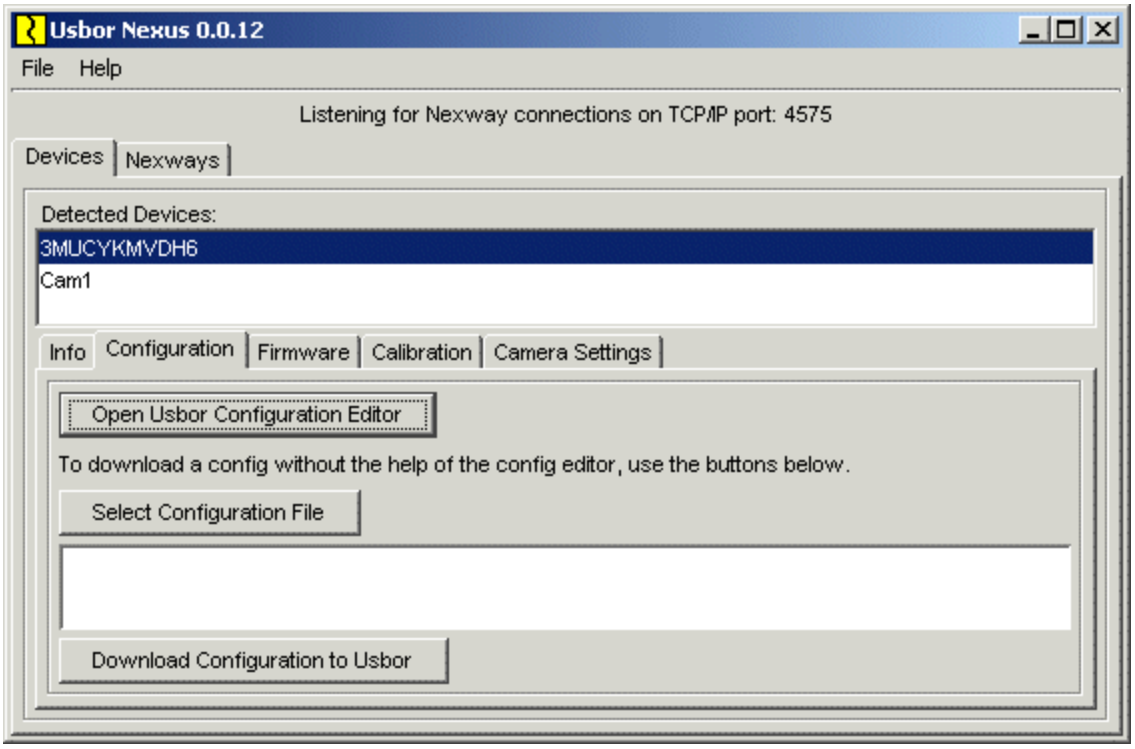
* Servo pulse resolution of 500 nsec for fine control.

* Auto-quadrature count on pairs of inputs, to 60 Hz.

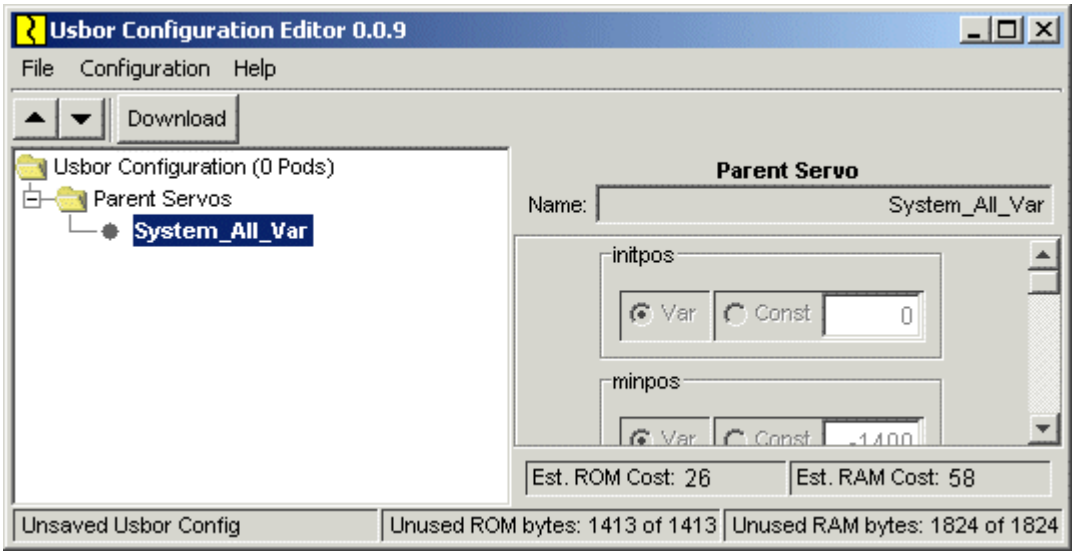


Creating Your First Configuration and Loading it into the Usbor

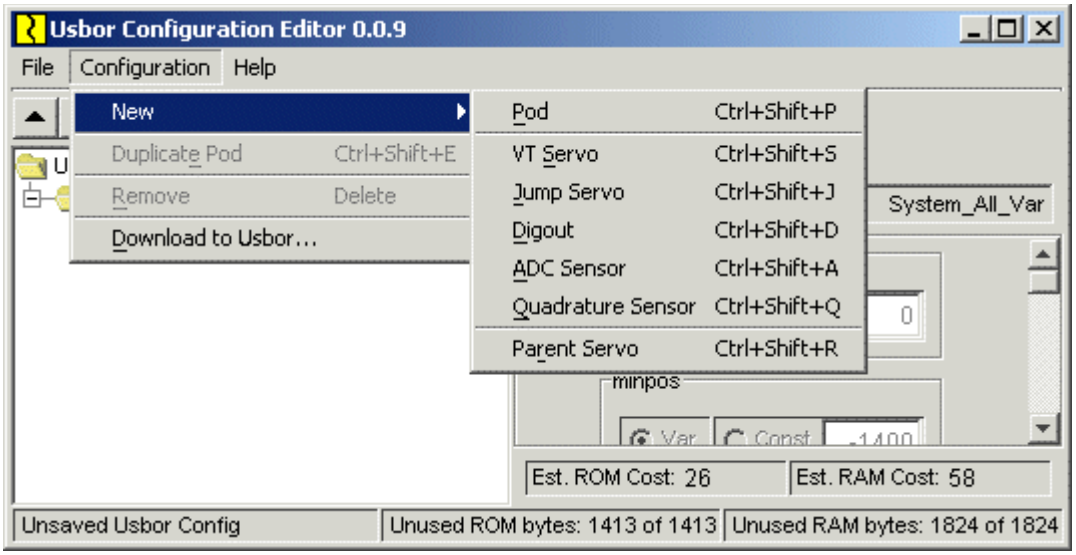
In this example we will use 18 of the 32 servos, and make three pods of 10, 5 and 3 servos each. We begin by clicking the **Configuration Tab** on the **Nexus**.



Next click **Open Usbor Configuration Editor** and get



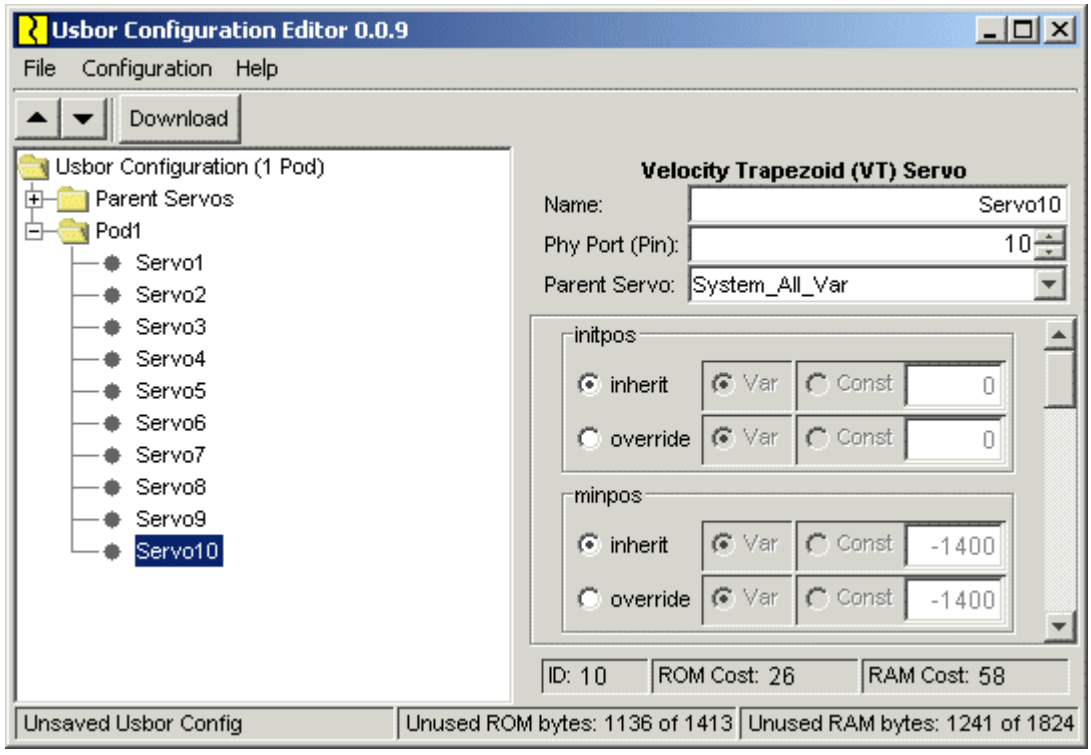
Now we click **Configuration** and float over **New** and we see



We will be making new **pods** (with **Ctrl+Shift+P**) and adding **servos** (with **Ctrl+Shift+S**) to the **pods**.

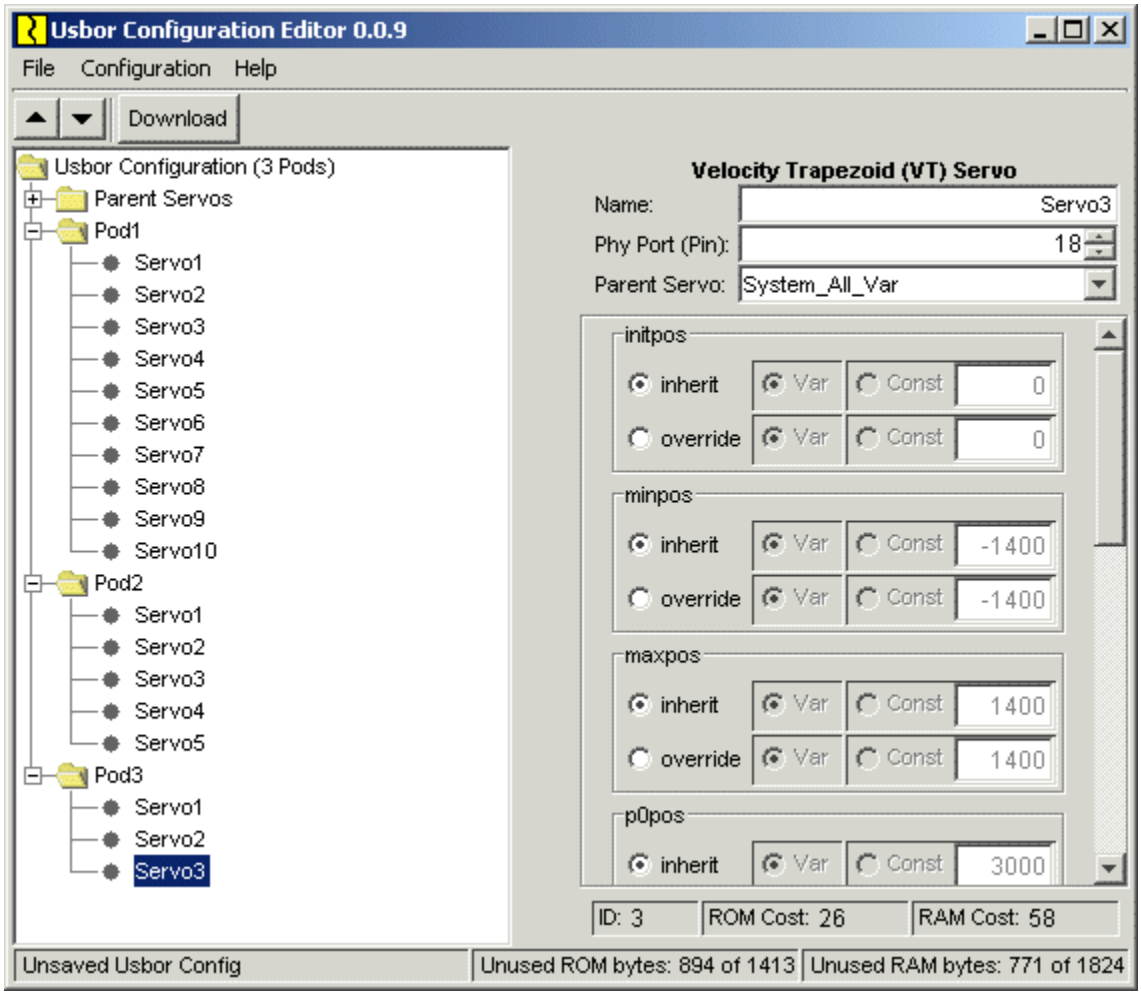
> We're using VT (velocity trapezoid) servos which give smooth motion. Jump servos save configuration memory but can only execute jump commands which result in sharp, uncoordinated motions.

Let's add the pod with 10 servos first. It's very quick and easy. Press Ctrl+Shift+P once to start a new pod. Press Ctrl+Shift+S 10 times to add 10 servos. That's it!



And if you make a mistake, just delete the pod (s) and start over.

Now add another pod and 5 servos and finally a third pod and 3 servos. This gives us:



Now we need to give this configuration a name. We'll call it 10-5-3. Click on File / Save and save our configuration with that name.

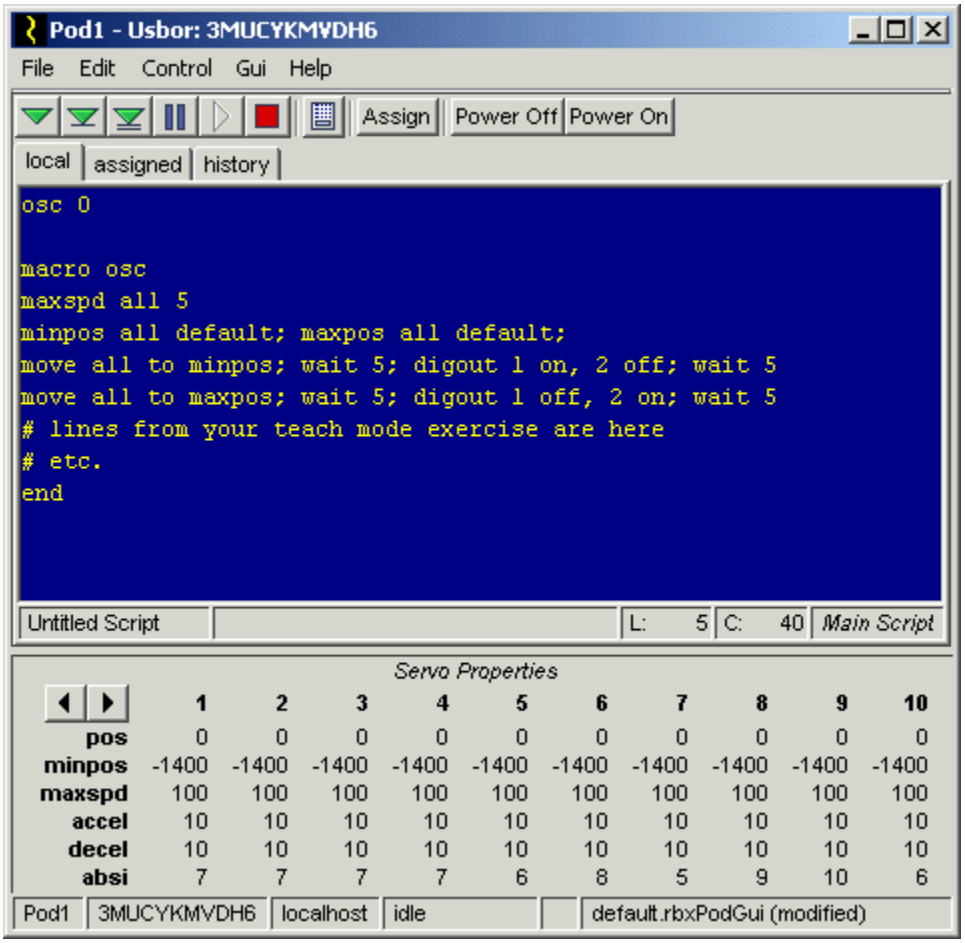
Finally, we have to download this configuration to the Usbor.

Click **Download**. Then select your Usbor (if you have more than one connected) for the download.

When complete you can close the download selector and the configuration editor.

Take a look at the gui for pod1. It has automatically detected the change to its pod and adjust its contents accordingly. Since there are no digital outputs or sensors in this pod we have removed the digout and sensor windows (by right clicking and selecting **Remove This Panel**)

Select **Gui** from the menu and click **Save**. Then save the gui layout as **default**. Any other pod gui's that you open will now have this layout. You could also have saved this gui under some other name. This would enable you to switch layouts easily by selecting **Gui** again and then **Open Pod Gui...**.



Run the script again. Note the error **Number is out of range – 1** and that the "1" in **digout 1** is highlighted. This is because the pod now has no digital outputs. Remove **digout 1 on, 2 off** and **digout 1 off, 2 on** and run again. This time execution should proceed without error.

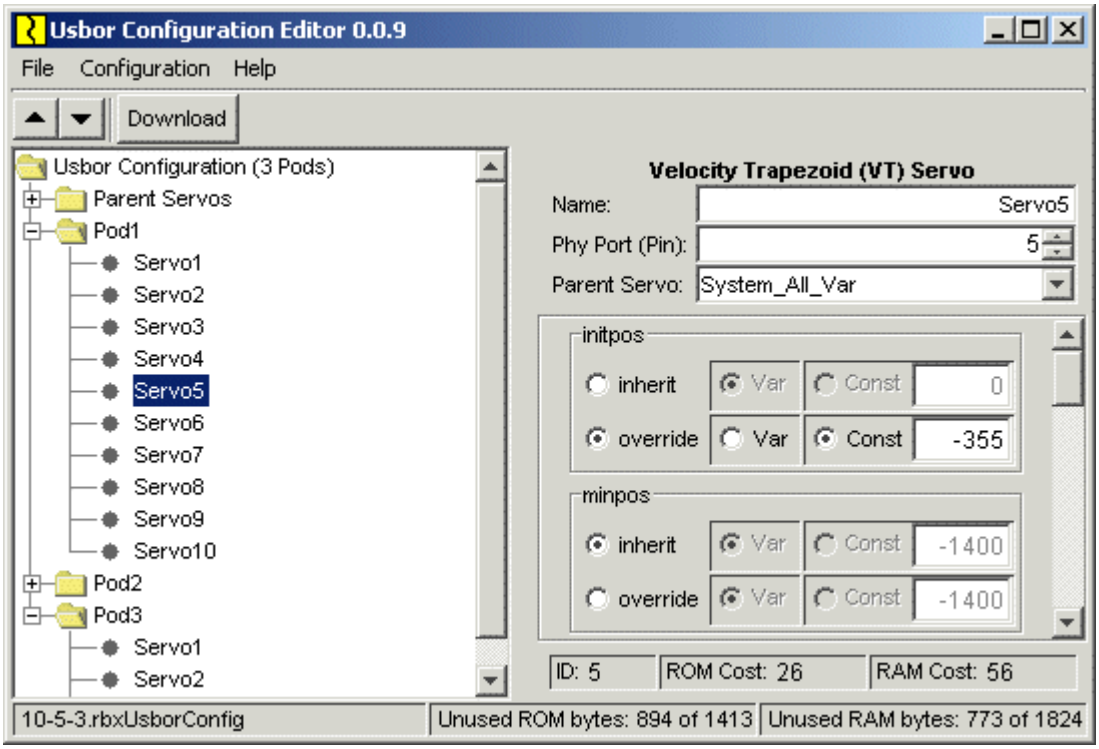
Special Subject: Setting Initpos

When servos first power up and “come to attention” they immediately track as quickly as possible to their **Initpos** (initial position) which is 0 by default, or about at the middle of their travel. This can cause problems depending on what's in the way.

Consider the situation where you have prepared a “work cell”, that is, some fixtures surrounding your robot with which it will interact. However, when the robot starts up it smacks into your fixtures and dislodges them. This problem can be addressed in the configuration editor by changing the **Initpos** of some or all of the servos in your robot.

First use teach mode to move the robot to the desired starting position. Then open the configuration editor and for each servo whose initial position needs to be adjusted click the appropriate servo in the configuration list and change its **Initpos** radio buttons from **Inherit** and **Var** to **Override** and **Const**. Then note the **Pos** value of the servo in the pod gui and copy this value into the text area to the right of **Const**. Below we have changed **Initpos** of **Servo5** on **Pod1** to **-355**.

When you're done, save and download the configuration. The robot will relax for a moment during reset then come to attention at the desired initial position.



Setting Other Servo Parameters

Except for **Initpos** it is rarely necessary to preset servo parameters. In the unusual case where the configuration you choose is too large to fit the Usbor controller's memory you can save a few bytes by changing some addition parameters to Const from Var. Otherwise there is little reason to make any adjustments.