

# UC100

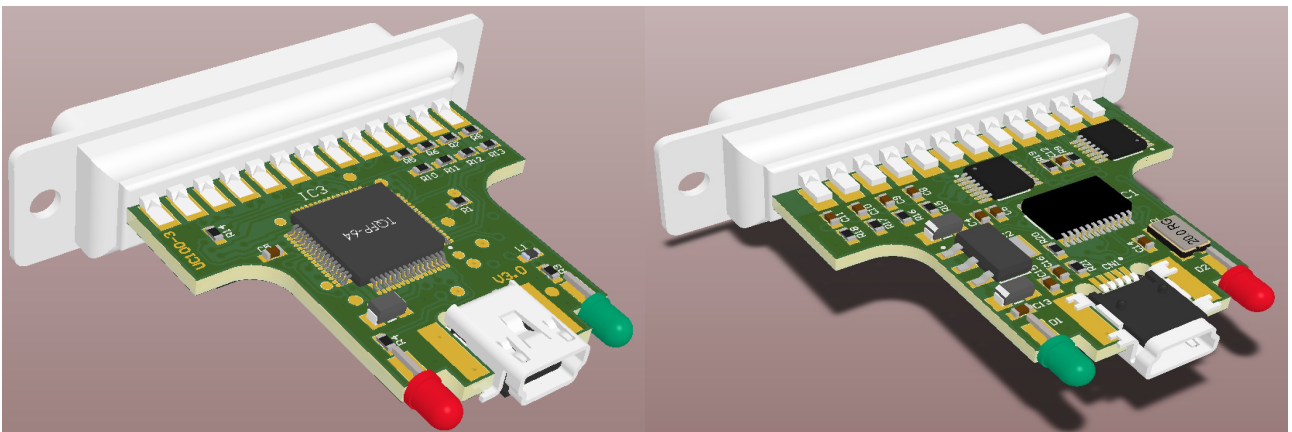
USB CNC motion controller  
to use with MACH3 software

Current plugin version: V2.106



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## 1. Product description and background of working

Mach3 is a popular CNC machine tool control software running on desktop computers and laptops under Windows operating system. Mach3 in default working the the computer's parallel (printer) port and sending all signals via this port. Windows is not a realtime operating system and therefor it is a difficult and CPU time consuming task for Mach3 to generate these signals in a precise manner. As the output signals frequency gets higher with using todays more and more advanced motor control electronics Mach3 needs the more processor time of the computer. If the computer gets overloaded by Mach3 or by running othersoftware in the background may leads to a lagging of the G-code code execution to even a falter in the motion interpolation which may lead to a catastrophic failure of some applications.

Another problem with the LPT port is that in todays informatic technology this kind of port is no more used and is a dying out device and non of the new laptops having this kind of port built in anymore.

The UC100 motion controller overcomes these problems with removing all time critical tasks from the control computer and Windows and executing all these tasks on inside it's own high speed DSP control chip outside the PC. The UC100 controller connects to the PC via the USB port and this kind of port is more modern as an LPT port and exists on all todays computers.

The UC100 has a look as if it was a "simple USB to LPT port converter module", but it is much more than this. The UC100 is the result of a 2 years hard development and testing cycle and it implements linear and arc interpolation routines with trajectory planner, communication routines, limits and homing functions handling and it has nearly all the functions (with some limitations) as what Mach3 supports with the LPT port driver.

Because of using a high speed DSP core the UC100 making the interpolations and other timings much more precise as Mach3 could ever do using it's standard LPT port driver and because the time critical tasks are no more done on the PC side, but on the UC100 controller the PC's CPU time usage is much lower and the risk of overloading the PC resources lowers with factors as the UC100 has a long enough data buffer so that it can handle a 100% CPU usage and overload for some seconds without interrupting the motion and the G-code execution.

For these reasons it is also possible to use a much slower and cheaper computer together with the UC100 as what is needed for Mach3 if using the LPT port drivers and this can even lower the system's overall cost.

When developing we also thought about backward compatibility with the old LPT printer port and therefore the UC100 has a DSUB-25 female connection interface to the environment with the same pinout as what a printer port has. This means that the UC100 can replace an LPT port on an existing system simply with plugging the controller to the USB port of the PC and plugging the DSUB25 cable end (which was originally plugged into the LPT port of the PC) to the UC100 controller's DSUB-25 port.

## 2. Installation

The UC100 controller is compatible with the same operating systems as what Mach3 is compatible with, these are Windows XP and Windows 7. The installation can be done two ways.

a.) One way is to use the automatic installer software which can be downloaded here: <http://www.cncdrive.com/UC100.html>

The automatic installer is an online and offline installer which means it connects to the internet and downloading and installing the latest plugin and the USB drivers for the UC100 controller. If the software cannot connect to the internet (due to missing internet connection of the computer) then it installing the prepacked plugin and drivers versions, this is the offline installation mode.

Currently the automatic installer working under Windows 7/32bit and Windows XP and it is not working under Windows 7/64bit version.

b.) The other way of installation is installing the plugin and the USB drivers manually. The latest plugin and USB drivers can be reached here: <http://www.cncdrive.com/UC100.html>

The manual installation procedure is simple and straightforward and it contains 2 steps.

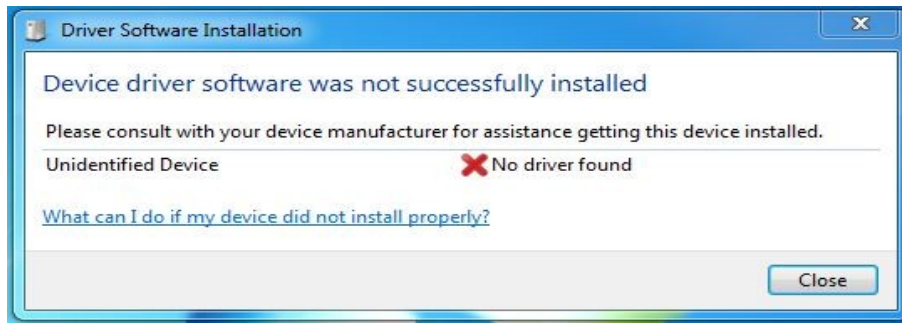
- Installing the USB drivers
- Installing the UC100 plugin to Mach3

In the following the datasheet illustrates the installation procedures to the different operating systems.

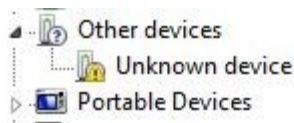
- Installing the USB drivers to Windows 7 operating system

First download the UC100 USB drivers and the up to date UC100 plugin from our website.

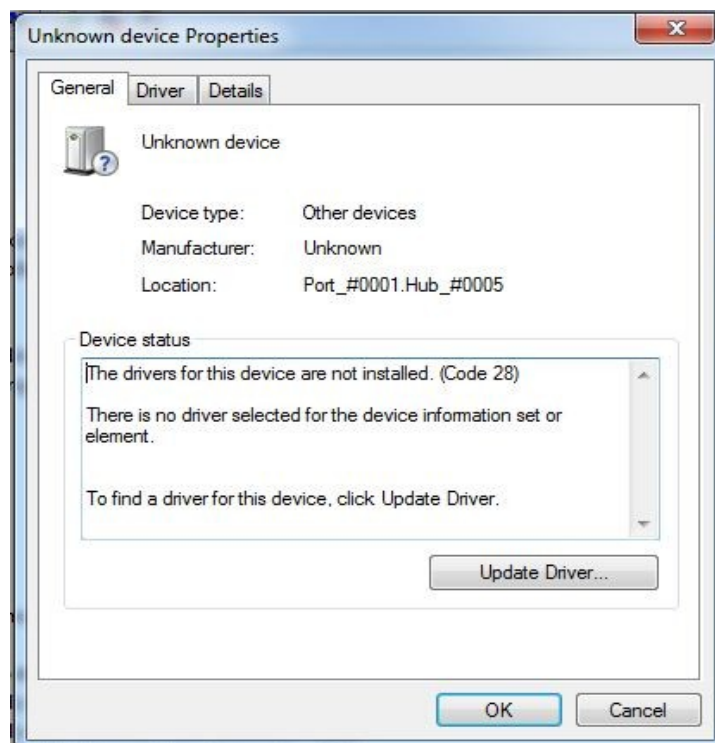
Plug the UC100 to the USB port of the computer and the following screen will popup:



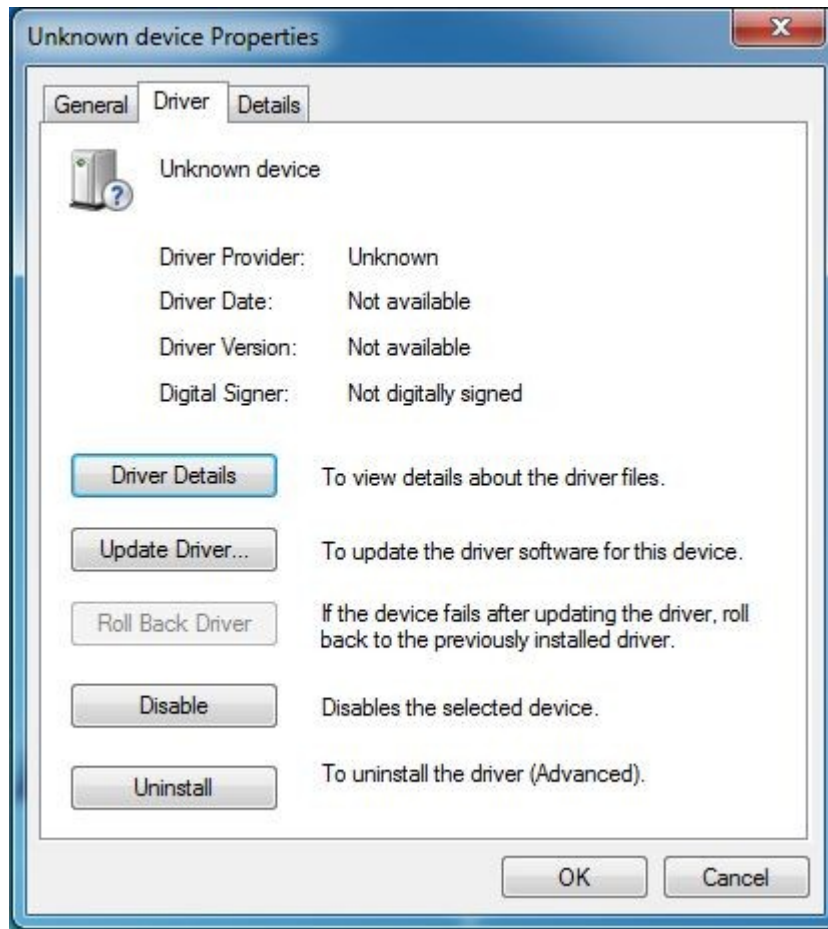
Close this screen and open the following entries in the Windows System manager.



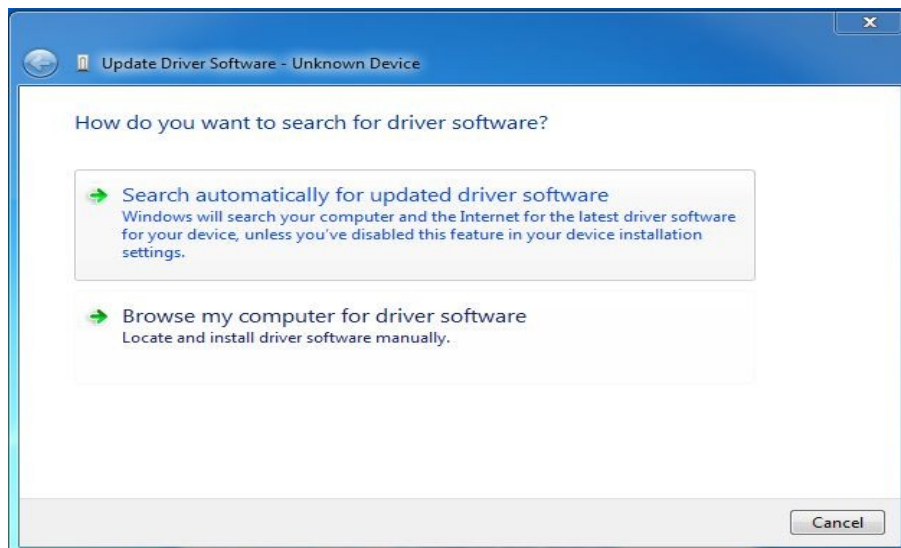
Double left click on the “UC100 CNC motion controller” row in the list and the following screen will popup:



Select the Driver TAB page.



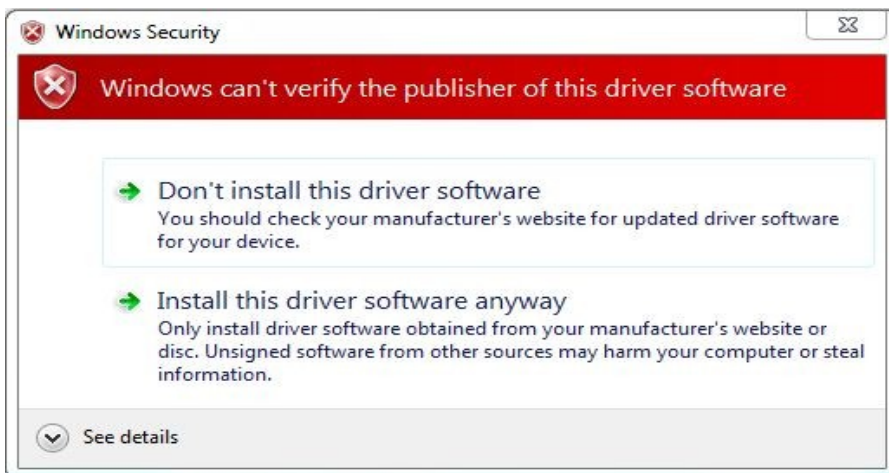
Select the 'Update Driver' and the following screen will popup:



Select the 'Browse my computer for driver software' and browse the save location of the UC100 drivers which were downladed earlier and press the "next button".



The following warning screen will popup.



Select the 'Install this driver software anyway' item link.

The following screen appear will confirm the successful drivers installation:



- Installing the UC100 plugin to Windows 7 operating system

After the successful USB drivers installation it is time to install the plugin to Mach3. To install the plugin browse the earlier downloaded .mp3 plugin file and double left click it. The plugin will automatically install without the need of any user interaction. A .dll file gets automatically inserted to the Mach3/plugins directory

**Important notice: After the plugin installation check that only one UC100 plugin must be installed, if more versions were installed earlier these .dll files must be manually removed and deleted from the Mach3/plugins installation folder.**

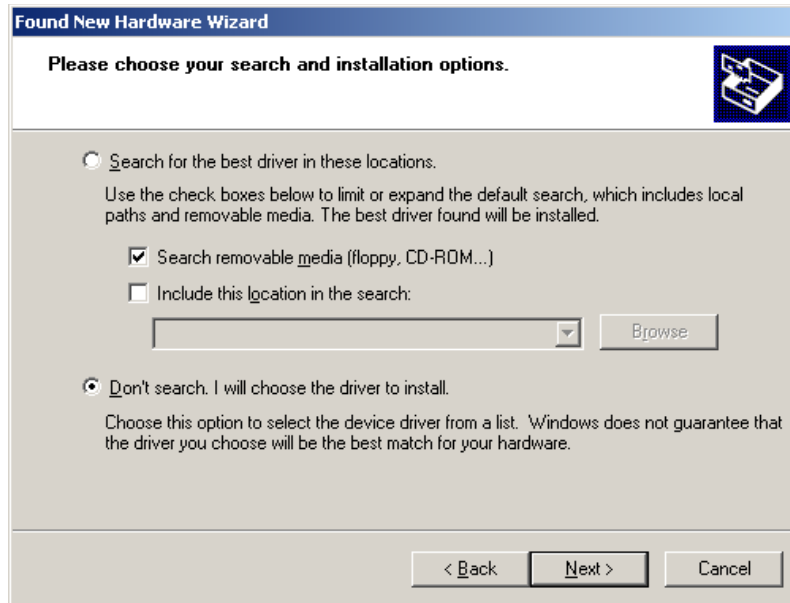
- Installing the USB drivers to Windows XP operating system

First download the UC100 USB drivers and the up to date UC100 plugin from our website.

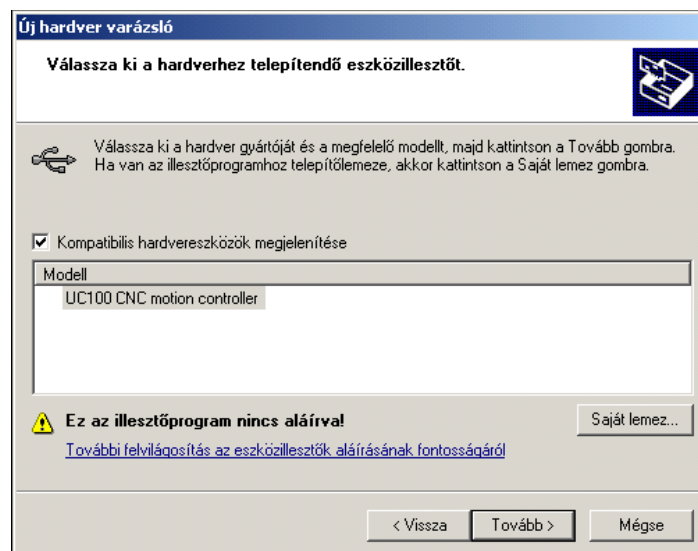
Plug the UC100 to the USB port of the computer and the following screen will popup:



Select the “install from a list or specific location (Advanced)” and press next.



Select the “Don't search. I will choose the driver to install” and press next.



Click the “use own disk” button and browse the UC100 drivers location on the hard drive where it was downloaded earlier and press next.



The following screen indicating the successful driver installation:



- Installing the UC100 plugin to Windows XP operating system

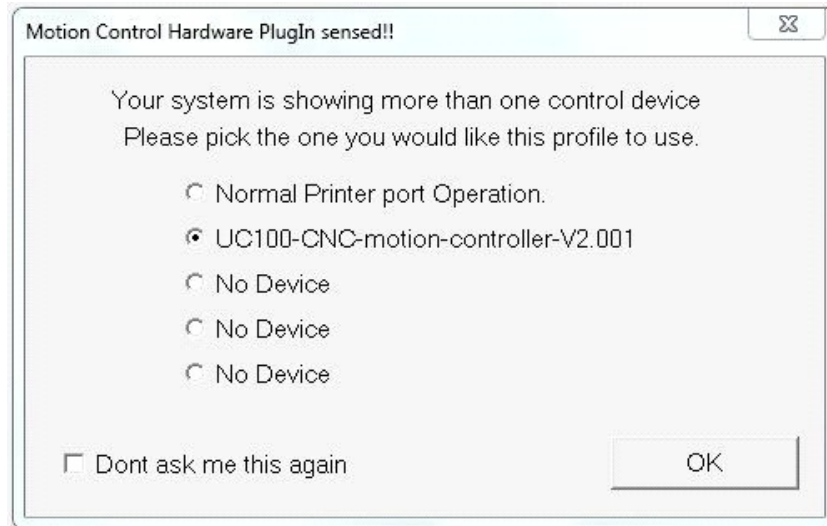
After the successful USB drivers installation it is time to install the plugin to Mach3. To install the plugin browse the earlier downloaded .mp3 plugin file and double left click it. The plugin will automatically install without the need of any user interaction. A .dll file gets automatically inserted to the Mach3/plugins directory

**Important notice:** After the plugin installation check that only one UC100 plugin must be installed, if more versions were installed earlier these .dll files must be manually removed and deleted from the Mach3/plugins installation folder.

### 3. System setup.

#### a.) The first run

Start Mach3 and the following screen will popup indicating the UC100 motion controller as an alternative selection over the LPT port drivers.



Select the UC100 CNC motion controller from the list.

If selecting the “Dont ask me this again” then this screen will not popup anymore when starting Mach3 and the default driver will be the UC100 in this case.

If once the “Dont ask me this again” was selected and if for any reason the LPT port drivers will need to be used at a later time then pressing the “CFG's->Reset device sel...” menu item in Mach3 will reset this popup screen and at the next start of Mach3 the LPT port drivers will become selectable again.

In the bootup procedure the plugin automaticly checks the actual firmware version in the UC100 motion controller. The firmware and the plugin versions must be matched, so if Mach3 finds an incompatible (forexample an older version) of firmware in the UC100 which is not compatible with the installed plugin then Mach3 will popup a warning screen and will download the compatible drivers to the UC100 automaticly.

This automatic checking procedure at each Mach3 startup guarantees that the firmware in the UC100 and the plugin in Mach3 will be always compatible with eachother.

**It is important to note again that only one .dll plugin file have to be installed to the Mach3/plugins folder. If more UC100 plugin .dlls are installed the old and not used versions must be removed and deleted manually from the Mach3/plugins folder!**

## b.) Setting up Mach3 with the UC100 controller

Because the UC100 has the same pinout as an LPT port the setup is the same as when using the LPT port drivers.

To setup the inputs and outputs set the port number to 1 always and the pin numbers are the same as in an LPT port.

To check the status of the pins the “Plugin control->UC100 I/O monitor” screen can be used.

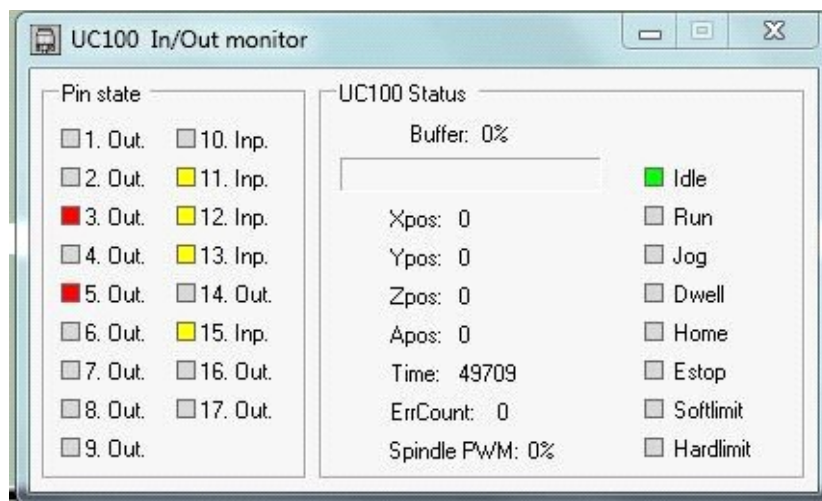
There is an option to set the maximum step output kernel frequency.

The 3 selectable options are currently the 25, 50 and 100kHz.

Important to note that changing to a different step kernel frequency Mach3 must be restarted for the changes to take effect and the trajectories must be retuned in the Config->motor tuning menu in Mach3.

There is also an extra option which the standard Mach3 LPT driver not implements and this is the following:

It is possible to use an encoder or a more than one pulse per revolution electronics feedback signal for the spindle speed feedback to Mach3. The number of pulses per revolution data can be set in the UC100 setup window and the controller will divide and count with the number of this setting when measuring and calculating the real speed of the spindle motor.



The UC100 I/O monitor screen.

## 4. LED feedback signals on the UC100 controller.

There are 2 LEDs located and floating out of the UC100 DSUB backshell.

These LEDs providing informations about the UC100 working states and these states are the following:

- The green (power LED) lighting continiously indicates normal operation and that the UC100 is up and running normally.
- The green (power LED) blinking with about 5Hz frequency indicates a firmware error.
- The green (power LED) blinking slow, with about 1Hz indicates a firmware update in progress and in this case wait till the firmware update procedure ends and the green LED returns to a continuous lighting state.
- The blue (communication LED) if on indicates that the connection between Mach3 and the UC100 controller is active. The LED sometimes blinks (mostly on slower computers) and sometimes lights continiously (mostly on fast computers).



The 2 LEDs on the backshell of the UC100 controller.

## 5. Errors and installation debugging.

If the following screen pops up when starting Mach3:



then the .NET framework was not installed on the computer. The .NET framework 3.5 is the prerequisite for running the UC100 controller plugin. The framework can be downloaded from Microsoft's website for free of charge.

The download link: <http://download.microsoft.com/download/6/0/f/60fc5854-3cb8-4892-b6db-bd4f42510f28/dotnetfx35.exe>

The following popup screen indicates that Mach3 is unable to establish the connection with the UC100 controller, check the USB connections and the LED states of the UC100 and restart Mach3.

If the error does not go away then check and if necessary reinstall the USB drivers.



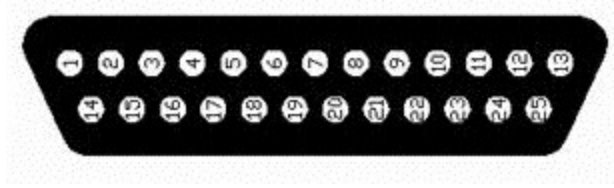
The following popup screen appears if Mach3 loosing the connection with the UC100 meanwhile it is operating. This event may happen if the USB cable is broken or if the cable connector was accidentally slipping out from the UC100 or from the PC. The workaround is checking the USB cable connections and plug it back and restart Mach3.



If Mach3 triggers the E-stop event and if the “UC100 Sync Error!” message appears in the statusbar of Mach3 then the UC100 lost the communication synchronisation with Mach3, this can happen if the computer is too slow or if the PC is so much overloaded with running other software in the background that there is not enough CPU or memory resources for Mach3 to keep the step with the UC100. Also the indication of this kind of error is that the blue LED in the UC100 backshell is blinking slowly with about 1Hz frequency only. The workaround is to check and close the running processes in Windows which overloads the PC too much, or if the PC itself is too slow and does not comply the minimal requirements to run Mach3 then exchange the PC to another, faster one.



## 6. DSUB-25 connector pinout.



Pin number	Signal direction
1	Output
2	Output
3	Output
4	Output
5	Output
6	Output
7	Output
8	Output
9	Output
10	Input
11	Input
12	Input
13	Input
14	Output
15	Input
16	Output
17	Output
18-25	Ground

## 7. Known limitations and bugs.

Known limitations:

There are no known limitations in the current firmware version.

Known bugs:

There are no known bugs in the current firmware version.

## 8. Parameters and functions summary

### General properties:

- Automatic firmware checking and firmware update.
- Motion control on upto 6-axis (X, Y, Z, A, B, C).
- Configurable maximum stepping frequency, the options are 25kHz(with 20usec pulse length), 50kHz(with 10usec pulse length), 100kHz(with 5usec pulse length).
- On the fly configurable 12 pieces of 5Volt (TTL level) buffered outputs. The current sink/source capability is 20mA max. per output.
- On the fly configurable 5 pieces of 5V (TTL level) schmitt triggered and filtered inputs. The input internal pullup resistance to 5Volts is 4.7kOhms.
- About 1 second long communication buffer.
- 100% LPT port compatible pinout.

### Supported Mach3 functions:

- Jog.
- Reference inputs.
- E-stop input.
- Softlimits.
- Limit switch inputs.
- Limits override.
- Index input (extended function supports multi slot sensors).
- Spindle speed PWM control output.
- Step and direction spindle control output.
- Spindle and coolant relay control.
- Charge pump safety signal output (configurable to active/inactive when in E-stop).
- Charge pump adjustable frequency (12.50kHz in normal or 5kHz in laser mode).
- All signals configurable to active High/Low.
- General purpose I/O signals handling.
- Offline mode.
- MPG1 and MPG2 support.
- Slave axis.
- Backlash compensation.
- Digit/probe input.
- THC control inputs.

## 9. Safety notes.

! It is important to install and use optical isolation between the environment and the computer, therefore it is recommended to connect the UC100 to the motor drives and external sensors on the machine via signal isolators, e.g. via an optically isolated breakout board. A good example for this is our HDBB and HDBB2 breakout boards, the datasheet of these devices can be found and downloaded on our website.

! Use the UC100 motion controller product only if you understand it's working and also understand the risk of working with machine tools.

! It is important to comply the safety standards like installing the external E-stop button, limit switches, charge pump safety circuit.

! The UC100 motion controller is built into an enclosed DSUB-25 shell, but this enclosure is not meant to protect the device from falling chips or liquid, protect the device from taint damage.

! Protect the device from direct intensive sunshine beams and from extreme temperature levels and from extra high humidity.

! In electrically noisy environment it is advised to place and install the UC100 controller into the same electric cabinet where the motor drives are installed to.

! Keep the UC100 controller away from high Voltage parts and cables of the installation.



The actual look of the UC100 motion controller product.

**For more informations please visit us at:**  
**<http://www.CNCdrive.com>**