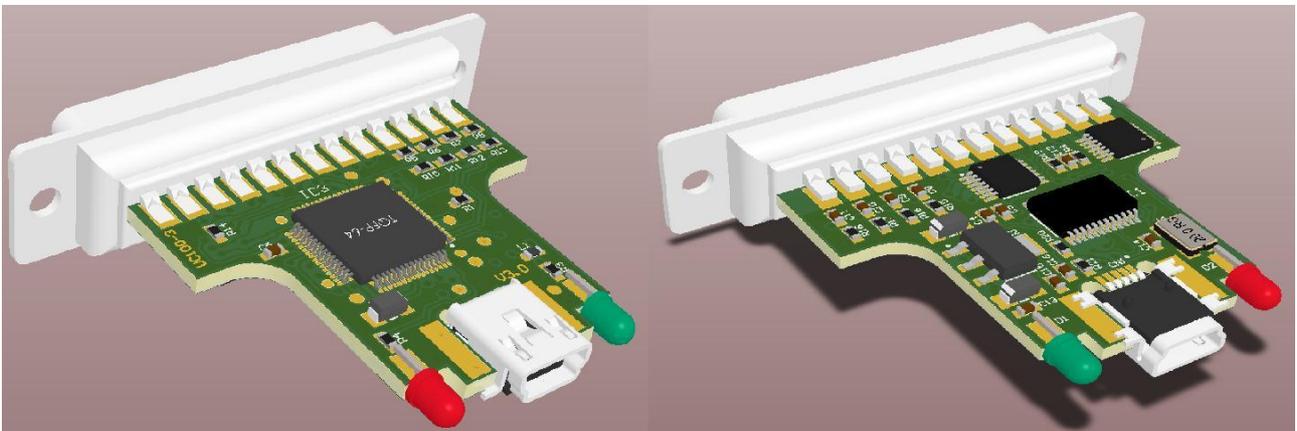# UC100

USB CNC motion controller
to use with MACH3 software

Current plugin version: V2.133

Contents:

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 other software(s) 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 today's 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 today's 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 therefor the UC100 has a DSUB-25 female connection interface to the enviroment 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, Windows 7 and Windows 8.
The installation can be done easily with our automatic installer
software: 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 is working under the following operating systems:
- – Windows XP
- – Windows 7 32bit and 64bit versions.
- – Windows 8 32bit and 64bit versions. Note: For Windows8/64bit users on newer computers which has secure boot function implemented in the BIOS, this function must be disabled for the USB drivers to install. With the secure boot function enabled the USB drivers might fail to install on some computers.

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.
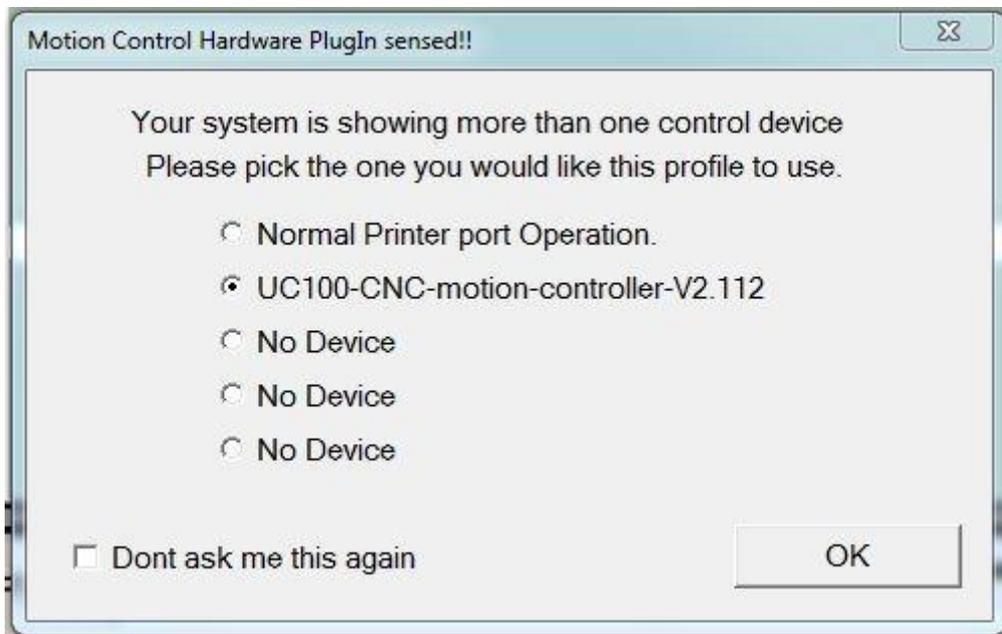
Select the UC100 CNC motion controller from the list.
If selecting the "Dont ask me this again" then this screen will not popup anymore when starting Mach3 and the default driver will be the UC100 in this case.
If once the "Dont ask me this again" was selected and if for any reason the LPT port drivers 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 uncompatible (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.

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 devide and count with the number of this setting when measuring and calculating the real speed of the spindle motor.
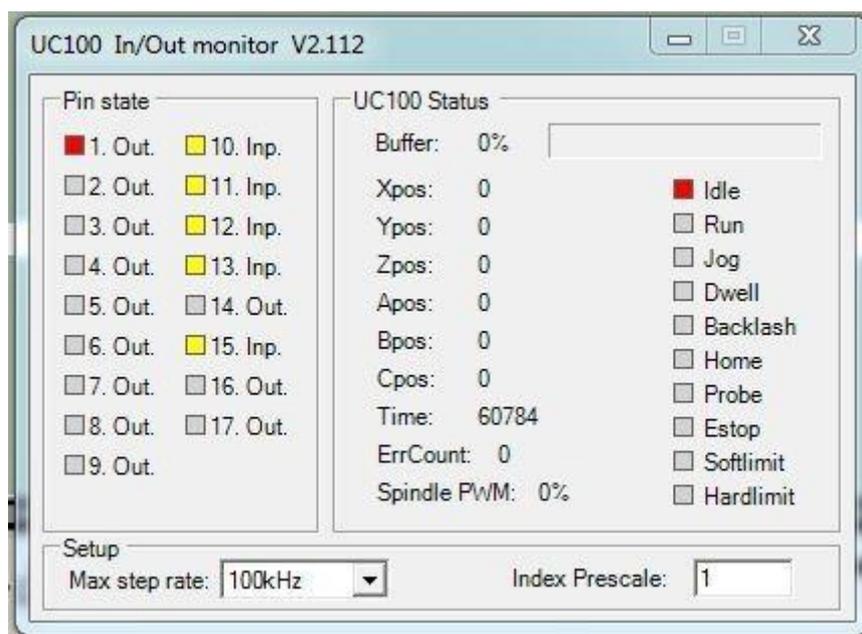
The UC100 I/O monitor screen.

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 2.0 is the prerequirement for running the UC100 controller plugin. The framework can be downloaded from Microsoft's website. The .Net framework 2.0 is part of Windows7 and therefor it is not required to install it on Windows 7 operating systems. It is only required to install it on Windows XP as it not containing this tool by default, it must be installed separately, by the user on the Windows XP operating system.
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 nessessary 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 syncronisation 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
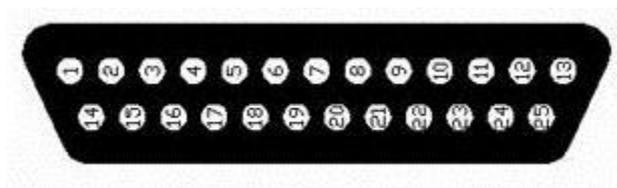
Pin number	Signal direction
1	Output
2	Output
3	Output
4	Output
5	Output
6	Output
7	Output
8	Output
9	Output
10	Input
11	Input
12	Input
13	Input
14	Output
15	Input
16	Output
17	Output
18-25	Ground

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 spindle sensors, for Mach3-mill only, not for Mach3-turn!).
- 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.
- All MPGs and encoders support. (2pcs maximum one time)
- 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, therefor 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 understood it's working and also understood 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 ment 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 adviced 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.

http://www.CNC1.eu

Appendix A. : New functions and bug fixes:

Plugin version	Description of change(s)
V2.105	- Initial release for international sales start. Functions were missing in previous version and were added in this release: 1.) Lathe spindle speed syncronisation with the index pulse. 2.) 5kHz laser mode charge pump PWM. Bug fixes in this release: 1.) In the home settings in some cases the output bits numbers got corrupted. Bug fixed.
V2.106	Functions were missing in previous version and were added in this release: 1.) Software limits handling. Bug fixes in this release: 1.) FTDI chip errorous PC sleep case handling for the Rev.3.0 boards only. Bug fixed. Note: This bug was fixed before the boards got released for sales.
V2.107	Functions were missing in previous version and were added in this release: 1.) Handling all MPGs and encoders in Mach3.(maximum 2pcs one time.) Bug fixes in this release: 1.) External manual MPG pulse generator missing pulses. Bug fixed.
V2.110	Bug fixes in this release: 1.) Direction output not working correctly for the spindle control if the spindle set in PWM output control mode. Bug fixed. 2.) On spindle on/off switching the controller not waiting the set time period, switching the output immediately. Bug fixed. 3.) If the limit and home switch input pin configuration is the same then the home function may not function properly in some cases. Bug fixed.
V2.111	Bug fixes in this release: 1.) The THC inputs handling for plasma cutters the direction changes not working correctly. Bug fixed. 2.) "Allow THC UP/DOWN Control event if not in THC Mode" setable in the "Port & Pins / Mill Option" function not working. Bug fixed.
V2.112	Bug fixes in this release: 1.) When probing with G31 the measurement value, Var 2002 parameter not passed through to Mach3 correctly which could lead getting uncorrect measurement value. Bug fixed.
V2.114	Functions were missing in previous version and were added in this release: 1.) Slow zones handling in working area implemented. Bug fixes in this release: 1.) When homing the acceleration was not working as set in the motor tuning in Mach3, this function was corrected and now working with the set correct acceleration profiles. Bug fixed 2.) When straight probing (G31) the decceleration was not working correctly, now using the set decceleration profile. Bug fixed. 3.) In the soft limits settings the offsets were not counted in, now the soft limits are based on the machine coordinates with the offsets also counted in. Bug fixed. 4.) Persistent DRO function was not working and Mach3 was not saving the coordinates after closing and restarting Mach3 the coordinates were all zero. Now these saves and reloads are done as nessessary. Bug fixed. 5.) In some newest release of Mach3 after feed holding the program continue execution was only possible if pressing stop and after start. This is now working correctly, no need to press the stop button anymore. Bug fixed.
V2.117	Functions were missing in previous version and were added in this release: 1.) Internal communication protocol was reworked for even more robustness. 2.) Selectable "topmost" property on the UC100 I/O monitor window. Bug fixes in this release: 1.) Spindle PWM missing some pulses when backlash compensation is set and when backlash compensation movement is in progress. Bug fixed. 2.) G31 straight probing not working other than with pin10. input, now it works with all input pins. Bug fixed. Update in the automatic installer: 1.) Windows 7 x64 support was added, now the installer works also on 64 bit Operating Systems.

V2.121	Bug fixes in this release: 1.) G28.1 stuck the program execution if executed from G-code program. Bug fixed. 2.) Jog function was not working on B and C axis. Bug fixed 3.) In plasma mode the index prescale value was not shown in the plugin. Bug fixed. Update in the automatic installer: 1.) Windows 8 x86 and x64 support was added, now the installer works on Windows 8 OP systems.
V2.123	Functions were missing in previous version and were added in this release: 1.) M10P1/M11P1 and E0P1/M1P1 fast output codes were implemented. (Useful function for example for laser machines.) Bug fixes in this release: 1.) Modifications in the handling of G28.1 and G30 codes. 2.) Modifications in G04 delay code to work more precisely in the milliseconds range. Note: the minimal executable setting is 200msec, lower value parameters will execute as 200msec.
V2.124	Bug fixes in this release: 1.) The spindle output PWM produced a very short extra pulse when Mach3 going into E-stop mode. This pulse was removed. Bug fixed. 2.) Plugin default jog mode on installation was MPG mode which caused doubts for some customers, we changed the default jog mode now to continous mode in this plugin. This was not a bug though, just a comfort issue.
V2.125	New installer and common drivers for UC100, UCR200 and UC300 was released.
V2.127	Bug fixes in this release: 1.) It was possible to switch the spindle on when e-stopped with a short pulse going out on the spindle output signal. This bug was fixed.
V2.128	Functions were missing in previous version and were added in this release: 1.) Added jog to motor tuning window. Now after entering the motor tuning window and changing the motor parameters and after pressing the Apply button the new settings can be tested with the keyboard jog keys without leaving the motor tuning window. This makes axis calibration faster and more comfortable. 2.) Errors indication on the UC100 I/O monitor window's bottom side. Bug fixes in this release: 1.) Index prescaler only appeared if loading the default (Mach3mill.xml), the prescaler now appears with all Mach3 xml's. Bug fixed. 2.) At the end of the G-code program executions if the jogging was executed, the G-code line pointer was jumped to random line locations. Bug fixed. 3.) Probing was working with errors in some cases. Bug fixed. 4.) SetMachZero() function was not working correctly, it did not zero the axis. Bug fixed. 5.) Issue with Master/Slave homing if set to home separately was not working. Bug fixed. Notes: This plugin version was not officially released, the V2.129 plugin was released after the V2.127.
V2.129	Bug fixes in this release: 1.) Program execution stopped in some cases if a slave axis was setup. Bug fixed. 2.) The THC inputs for plasma were not working via software control like via brains. Bug fixed.
V2.133	Bug fixes in this release: 1.) In specific circumstances the position DRO's stopped to update. Bug fixed. 2.) E-stop event in Mach3 to charge pump output release got better syncronisation. 3.) Grammatical text error fixed on the plugin update screen.
	Having a problem, found a bug? Inform us and we will fix it quickly!