

UC100

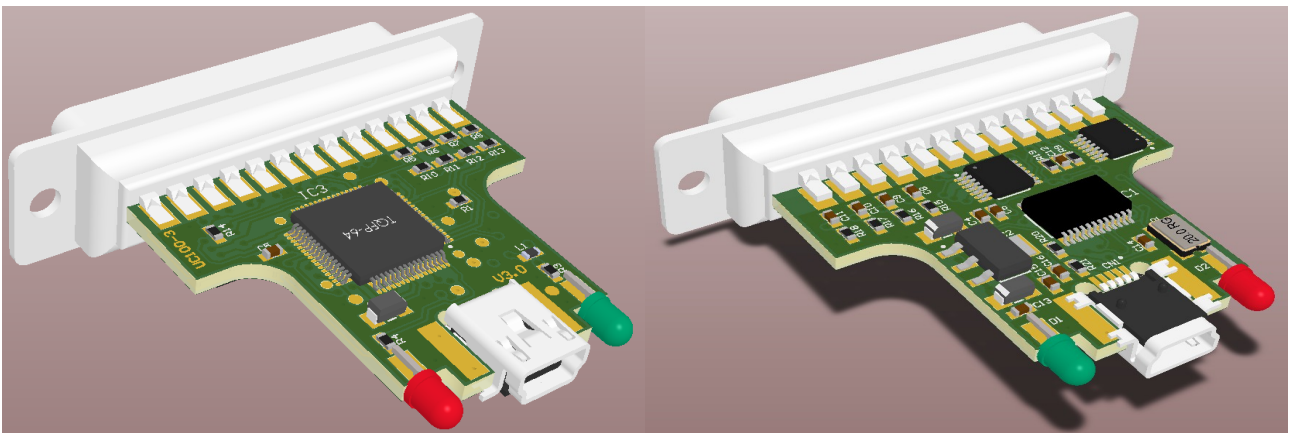
USB CNC motion controller
to use with MACH3 software

Current plugin version: V2.145



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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 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:

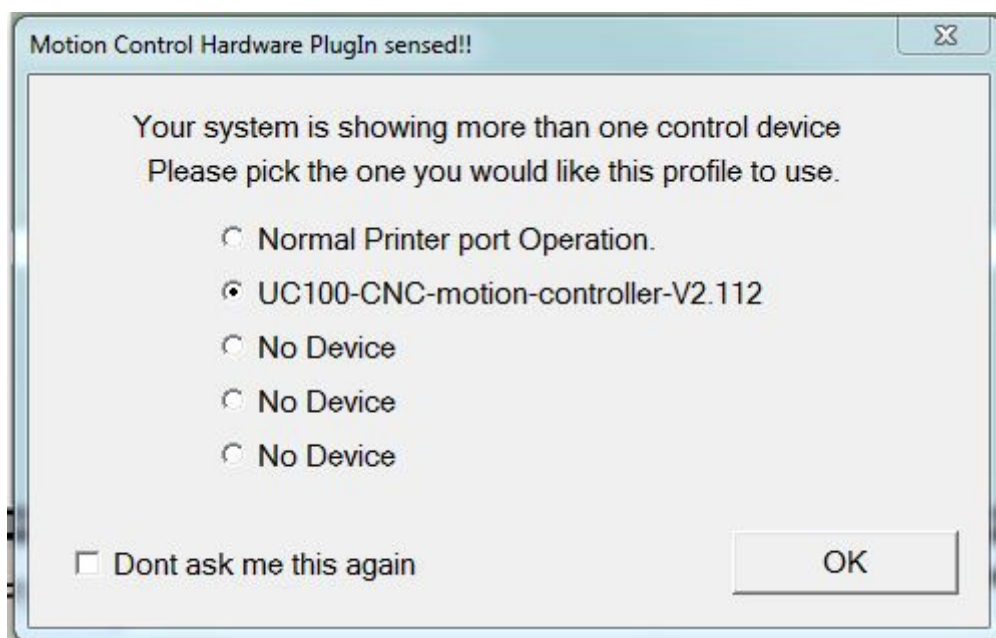
- Windows XP.
- Windows 7. 32bit and 64bit versions.
- Windows 8. 32bit and 64bit versions.
- Windows 8.1. 32bit and 64bit versions.
- Windows 10. 32bit and 64bit versions.

Our drivers are now WHQL certified by Microsoft.

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 automatically 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 automatically.

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.

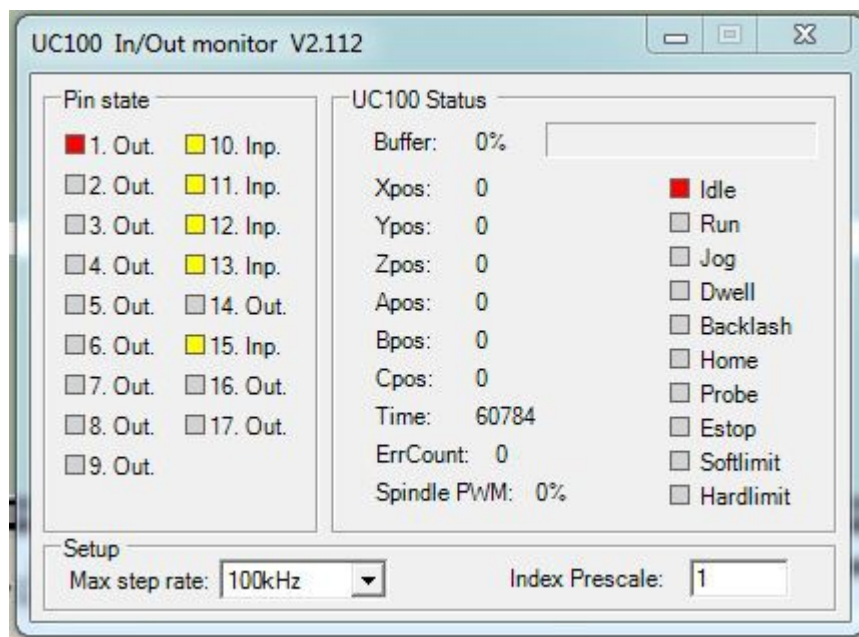
There is an option to set the maximum step output kernel frequency.

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 prerequisite for running the UC100 controller plugin. The framework can be downloaded from the UC100 product page, here: <http://cncdrive.com/UC100.html> or from Microsoft's website. The .Net framework 2.0 is part of Windows7 and therefore 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 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 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.

