Sidereal Technology Step/Direction Controller
Instruction Manual for Version 1.3 Configuration Software and 6.6 Firmware
2023-05-09

There are several reason for this product:
1. There are many older telescopes that have existing motion controllers to move the telescope axes. Many of these telescopes have old DOS or Windows computers, and special PCI cards to control the motion controllers. Most of these controllers have step and direction inputs.
If that is the case for you, then this is an ideal product.
Just upgrade your computer to a new Windows or Linux computer, install our Step/Direction controller, and you've got a working telescope again!

2. You have a very large telescope, but none of our four telescope dual servo controllers provide enough voltage or current to drive the motors, but your existing motion controllers have step and direction inputs, add our Step/Direction controller, and you've got a working telescope again.

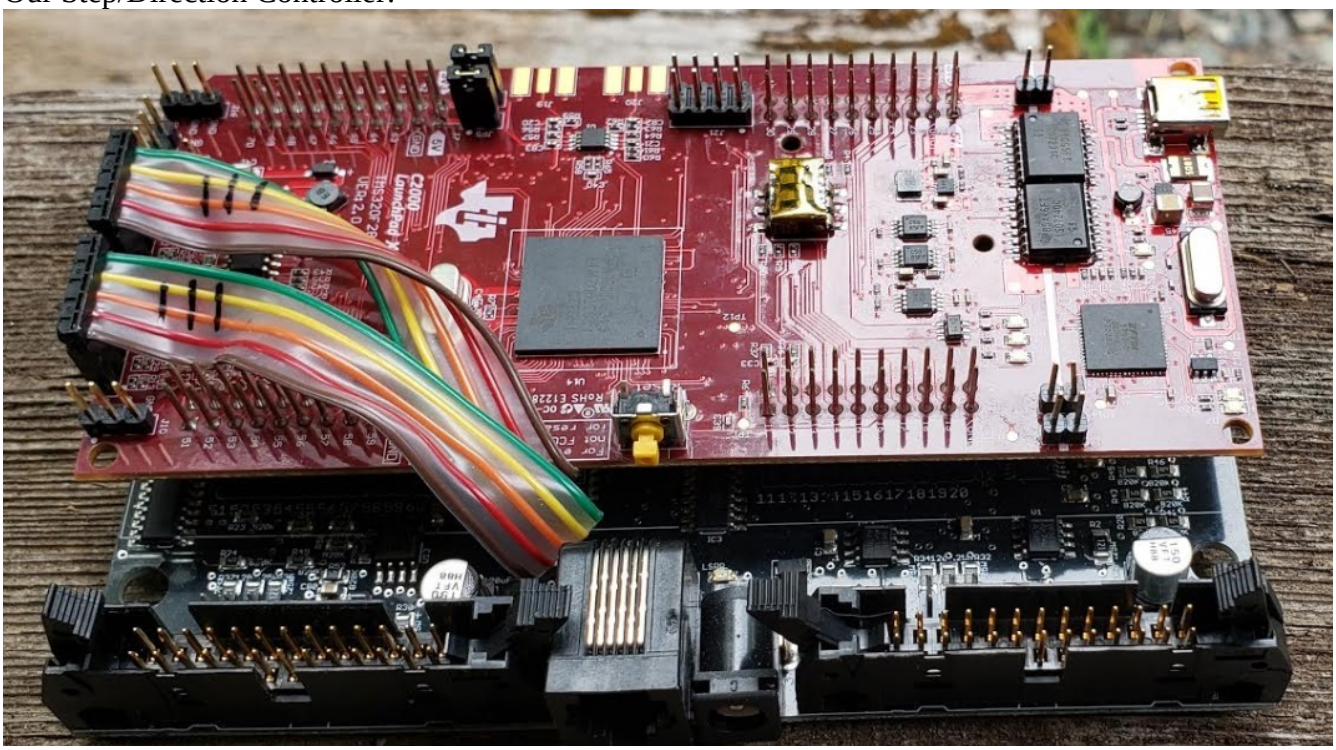
3. You have a telescope with stepper motors, and controllers with Step/Direction inputs. Just add our controller, and you have a working telescope with incredible software.

4. You're building a massive telescope, and our Servo Controllers aren't large enough to drive it. In this case, purchase a pair of Servo Controllers that are large enough which have step/direction inputs, and you've got yourself a control system.

5. You have an existing working telescope, but you want to use our software which is second to none, has every concealable feature for controlling a telescope, mount modeling using PointXP (by Dave Rowe and courtesy of Planewave Instruments), extremely accurate satellite tracking, built in simple SkyView with complete database, tracking asteroids or comets, and many other features. Our software can control 4 kinds of mounts, Fork Equatorial, GEM, Alt/Az, and Alt/Alt.
In this case, you may be able to re-use your existing computer, and simply add our step/direction controller.

If you fit in one of the categories above, read on!

Our Step/Direction Controller:



Capabilities of the Sidereal Technology Step Direction controller:
The communication protocol of our Step/Direction controller responds just like any of our servo controllers. This means you can use SiTechExe, our flagship telescope control software to control your mount.

The USB serial connection is electrically isolated from the Step/Direction controller. There is no chance of spikes or ground loops between the servo controller(s), the Step/Direction controller and the and your computer.

The outputs to your servo controller are RS422, or differential current based outputs. This means we can send out pulses as fast as 1MHz for each axis. There are two wires for an RS422 differential output. If your servo controller has a TTL input, you simply use one of the two wires (probably the +).

There is an acceleration setting in our configuration software, so the steps will ramp up and down at your desired acceleration.

You can connect high speed, high resolution incremental or absolute (BissC protocol) scope encoders. There are 5 digital inputs and 1 analog input per axis.

The digital inputs per axis are used as follows:
Drive Enabled Input
Limit Plus
Limit Minus
Homing switch,
PEC synch switch (Primary axis only)

The analog input can be used as a “poor persons” absolute encoder. If a good quality absolute encoder from USDigital, or a high quality potentiometer is used on the axis, and configured correctly, the software will know where the axis is within about a degree or two. It could also protect your mount from a false sync to the wrong star.

Digital outputs per axis are as follows:
RS422 Drive Enable Output (this will enable the servo controller drive)
RS422 Direction Output (tells your servo controller which direction to move)
RS422 Step Output (each positive transition will move your motor by one step as defined by the configuration of your servo controller).

There is a handpad connector for connecting one of our handpads to control the telescope manually.

As you can see in the picture, there are two 26 pin IDC header connectors on the Step/Direction controller. The left connector is for the Secondary axis, and the right connector is for the Primary Axis.

The configuration software is extremely simple, with only a handful of settings.
Following is a screenshot. The settings are on the left side of the window, and the data/control is on the right side. The arrow buttons will move your axis. You can also enable or disable the drive with the Auto/Manual buttons. The handpad keys turn red when the given limit switch is activated.

There is a barrel connector with center pin +12 volts. This powers the Step/Direction controller.

Settings:
It’s worth mentioning on the velocity parameters, and the acceleration paramenter: You can enter either the raw value (larger number) or the engineering unit value. When you change one, it automatically changes the other. If you change your ticks per revolution, the engineering unit velocities will change. The engineering units are degrees per second, minutes per second, seconds per second (for Slew/Pan or Guide modes), and degrees per second per second for the velocity.

Most settings are self explanatory. Keep in mind that the slew speed can be no faster than the maximum frequency step input specification of your servo controller. When you change the slew speed or the offTime parameters, the slew speed frequency is displayed in the (read only) text boxes below the slew speed.

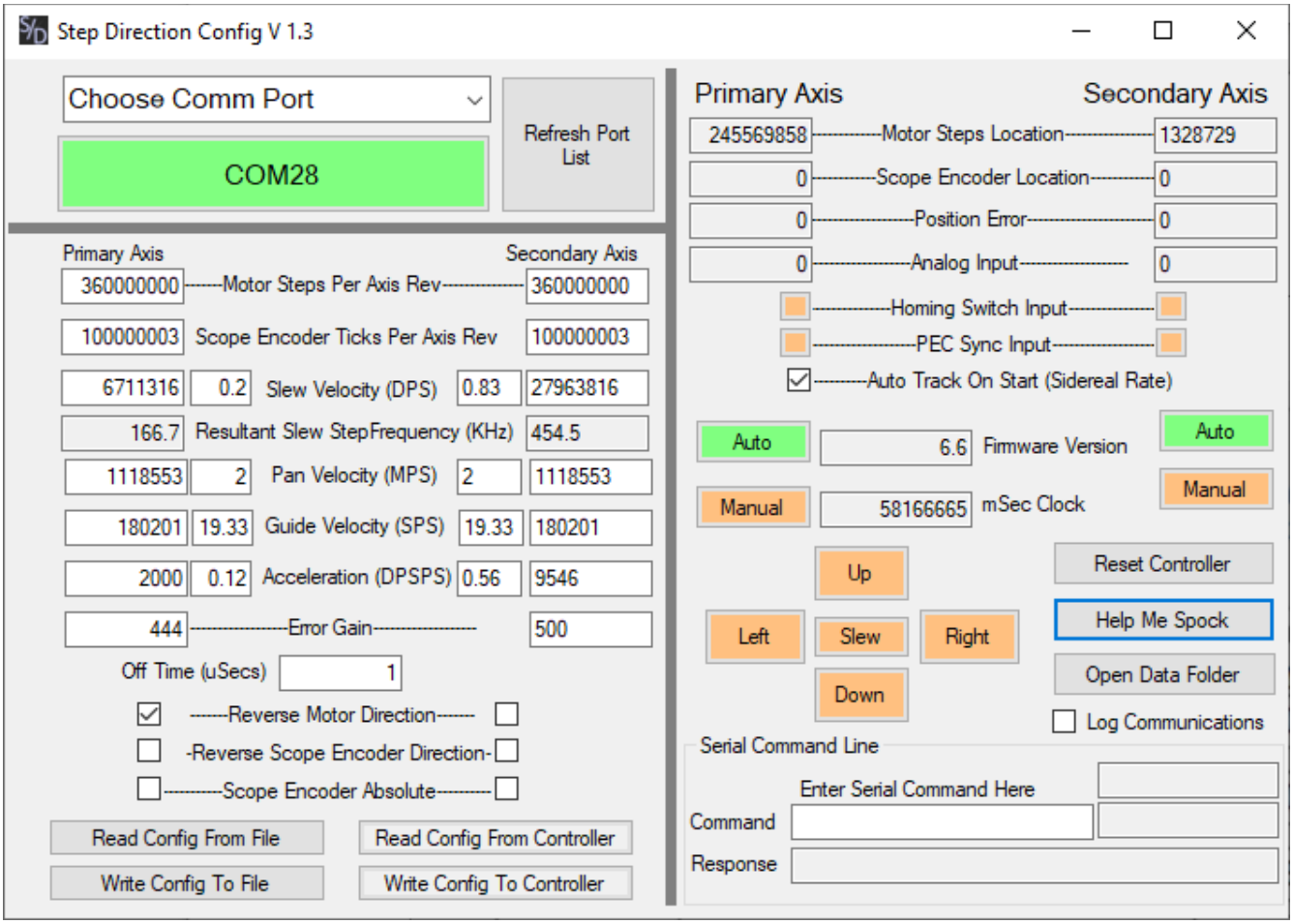
The “Error Gain” setting is used to keep the position error down. The Step/Direction controller amplifies the error, and applies this to the timing to decrease the position error. You can watch the position error on the right side of the screen labeled “Position Error”. A higher number reduces the position error. Start with about 500-1000, and that may be just fine.

Off Time is another important feature. This is in uSecs. Once configured, the off time will always be the same as your setting. This could also limit the maximum frequency. You must set this long enough for the minimum off time step input specification of your servo controller.

In version 1.6 of the configuration software, there is a checkbox labeled “Auto Track On Start (sidereal rate”. If you have an equatorial telescope and want the right ascension (primary axis) to run automatically on startup, check this box, and make sure the primary axis right “Motor Steps Per Axis Rev” configured correctly. If selected, on power up, the Right Ascension motor will start turning at the sidereal rate.

There is a USB mini connector on the right side of the CPU board. Our enclosure has an opening for this.
For the USB to serial driver, you need to download and install this:
https://software-dl.ti.com/ccs/esd/documents/xdsdebugprobes/emu_xds_software_package_download.html

Screen shot of our Configuration Software:



Controller LED Meanings:
There are 2 LED's on the main board, one on the very bottom left corner, and one on the very bottom right corner. The Left one will be on steady when the enable signal to the Secondary Axis servo controller is in the enabled position. We call this the Auto mode. The Right one is the same, except it's for the primary axis.

There are 3 LED's to the left side of the handpad connector. The Red LED indicates its in the Slew mode. The Yellow LED indicates it's in the Pan mode. The Green LED indicates it's in the Guide mode. This only effects the motion by the real handpad (not the virtual handpad).

On the CPU board (the red board), there are 3 LED's adjacent to the jumper pins on the white line, near the bottom right of the board. The Green LED should be on, it indicates power. The Red LED should be flashing, that indicates that the CPU1 is running. The Blue LED should be on steady. This indicates that CPU2 is running.

On the CPU board (the red board), there are 2 LED's on the very bottom right. The Red LED (flashing) indicates it's receiving communication on the serial port. The Blue LED indicates that the controller is sending communications on the serial port (flashing).

Jumpers:
The three jumpers on the right side of the CPU board that are on top of the white line, must NOT be on. This is how the USB is isolated from the Step/Direction controller.

Jumper should be on: J6 pin 56 and 57. This is how the firmware can reset itself if commanded via the serial port.

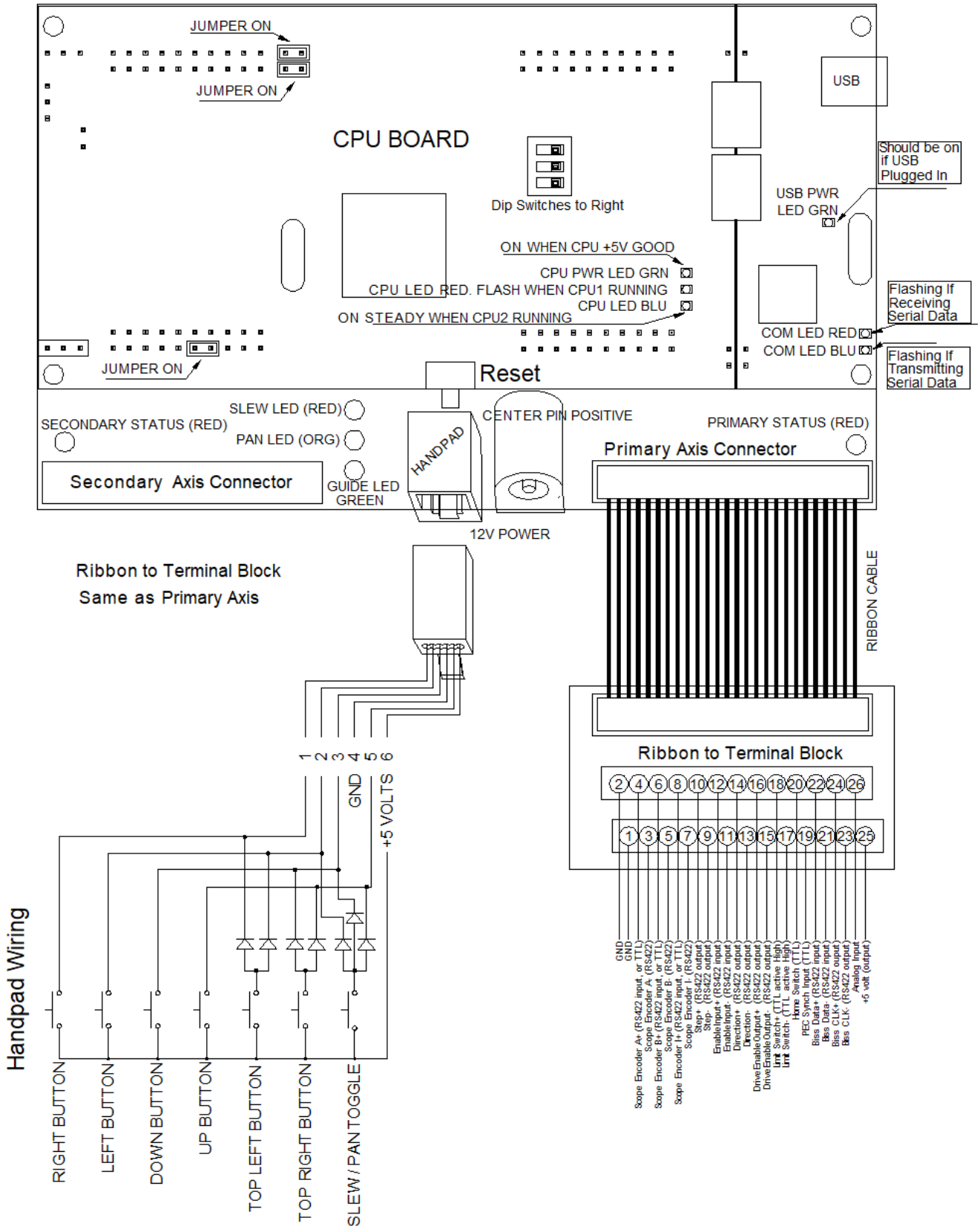
Wiring:

You'll need two 26 pin ribbon to terminal blocks such as this:
https://www.aliexpress.com/item/4000280359376.html

The secondary axis connector is on the left side.
It's wired like this:
01 - GND
02 - GND
03 - Scope Encoder A+ (RS422 input, or TTL)
04 - Scope Encoder A- (RS422)
05 - Scope Encoder B+ (RS422 input, or TTL)
06 - Scope Encoder B- (RS422)
07 - Scope Encoder I+ (RS422 input, or TTL)
08 - Scope Encoder I- (RS422)
09 - Step+ (RS422 output)
10 - Step- (RS422 output)
11 - EnableInput+ (RS422 input)
12 - EnableInput- (RS422 input)
13 - Direction+ (RS422 output)
14 - Direction- (RS422 output)
15 - DriveEnableOutput+ (RS422 output)
16 - DriveEnableOutput- (RS422 output)
17 - Limit Switch+ (TTL active High)
18 - Limit Switch- (TTL active High)
19 - Home Switch (TTL)
20 - PEC Synch Input (TTL)
21 - Biss Data+ (RS422 input)
22 - Biss Data- (RS422 input)
23 - Biss CLK+ (RS422 ouput)
24 - Biss CLK- (RS422 output)
25 - Analog Input
26 - +5 volt (output)

The primary axis connector is on the right side.
It’s wiring is identical to the secondary axis connector.

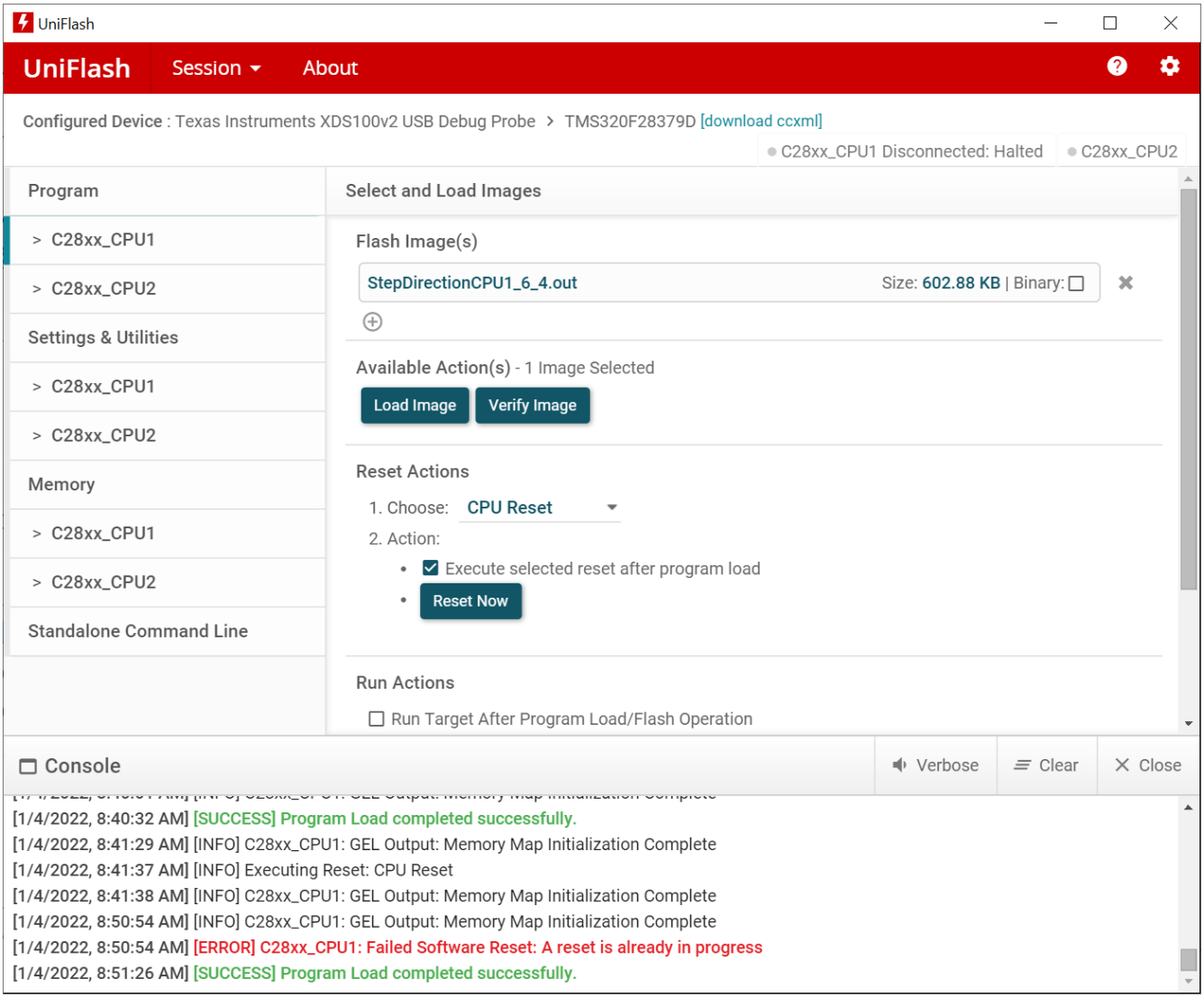
Drawing of Controller with connections:



Upgrading the firmware:
We're assuming you've installed the serial port driver, listed above.
Plug the USB to cable between the powered up CPU board and a USB port on the computer.

First, you need to download and install Uniflash:
http://software-dl.ti.com/ccs/esd/uniflash/uniflash_sl.5.0.0.2289.exe

Run Uniflash. It looks like this:



Under the "Choose Your Device" select "TMS320F28379D"
Under "Choose Your Connection" select "Texas Instruments XDS100V2 USB Debug Probe"
Click the start button.

IMPORTANT: Make sure you don't put CPU2 firmware in CPU1 or vice versa.
Updating CPU2:

Under program, click on C28xx_CPU2.
Now over on the right side, click on the "Browse" button, and select the CPU2 firmware image.
Now click on "Load Image"
Watch the status at the console, near the bottom.
Once successfully done, it should say with green text “[SUCCESS] Program Load Completed successfully”

Updating CPU1
On the right side, click on the "Browse" button, and select the CPU1 firmware image I'm attaching.
Now click on "Load Image"
Watch the status at the console, near the bottom.
Once successfully done, it should say with green text “[SUCCESS] Program Load Completed successfully”

That should do it.
Power the board down, then back up.