Chapter 11

Appendix F: Connecting a 0-10V Spindle Speed Control
11.1 Introduction

In this chapter we explain how you can connect a 0-10V Spindle Speed Control. A 0-10V Spindle speed control is a small PCB which is able to interface with USBCNC V3, V4 and V5B; allowing USBCNC software to control a (Delta) Variable Frequency Drive (VFD) which in its turn can control a (Tekno)motor HF - or electrospindle.

In order to install the 0-10V Spindle Speed Control PCB it is highly recommended to first read and perform Appendix E: Setup of a Delta VFD and a Teknomotor.

By doing so the user can control the (Tekno)motor without USBCNC, which might already exclude any errors.

After the user has performed the entire Appendix E procedure, the system can be prepared in the following sequence:

First the **hardware connection** procedure will be discussed:

1. **I have a DamenCNC RTR Performance (standard with 0-10V Spindle Speed Control) set and a Delta VFD with a cable assembly**

2. **I have a DamenCNC RTR without a 0-10V Spindle Speed Control Delta VFD**

3. **I have a USBCNC CPU V4.0 and a Delta VFD**

Afterwards the **software setup** is explained. The software setup consists of the setup of the DELTA VFD, and the setup of USBCNC V5.
11.2 Hardware Connection procedure

1. I have a DamenCNC RTR Performance (standard with 0-10V Spindle Speed Control) set and a Delta VFD with a cable assembly

Observe the RTR set: The connection for the 0-10V Spindle Speed Control is located as follows:

![Figure 11.1: Connection for the 0-10V Spindle Speed Control on the RTR set](image)

Visually verify that the connections are as follows:

![Connect the 0-10V Spindle Speed Control to the DELTA VFD by plugging the 5-pole connector which is assembled to the DELTA VFD, into the 5-pole bus outside the RTR system as shown in the figure 11.1.](image)
The cable which is connected to the DELTA VFD has the following wiring scheme, when shown from above:

![Figure 11.2: Wiring scheme from above: black, blue, purple, red, grey](image)

On the other end of the cable, where the cable is introduced in the DELTA VFD, there are two different layouts. For the VFD 015 and the VFD 022 the wiring scheme is as follows:

- AVI - Grey
- GND - Brown
- 17V - Black
- M0 - Blue
- M1 - Red
- GND (left) - Purple
- GND (right) - Brown (solder to cable shielding, connect with purple)

This concludes the hardware setup. Please proceed to the test section.
2. I have a DamenCNC RTR without a 0-10V Spindle Speed Control Delta VFD

When there is no 0-10V Spindle Control PCB already built in the RTR system, it has to be build in first.

Connect the 0-10V Spindle Control PCB cable to the lower left socket of the interface print (view from inside the RTR system) using the supplied cable, as can be seen in figure 11.3.

The 0-10V Spindle Control PCB itself should be fixed using sticky feet on the bacsde of the USBCNC CPU holder (in figure 11.3, far left on the image on the right).

![Figure 11.3: Plug the 0-10V Spindle Control PCB cable in the lower left cable slot](image)

When you have an older version of the RTR, there might be not a interface print as shown in the photo above.

In this case one has to be make a custom connection.

This custom connection can be seen in the subsection which discusses

I have a USBCNC CPU V3.0 or V4.0 and a Delta VFD.
Connecting the 0-10V Spindle speed control PCB to a USBCNC CPU

The OUT signal from the USBCNC CPUV4.0 has to be connected to USBCNC CPU V4.0 socket from the 0-10V Spindle Control as shown in figure 11.4:

![USB CNC V4.0](image)

**Figure 11.4: Terminal for USBCNC CPU V4.0**

The OUT signal from the USBCNC CPU4.0 is connected to the same 10P ribbon cable which controls the relais PCB which controls Tool/Flood/Aux/Mist settings.

When this component is built in correctly, and you have a Delta VFD cable assembly, follow the steps of

**I have a DamenCNC RTR Performance (standard with 0-10V Spindle Speed Control) set and a Delta VFD with a cable assembly.**
If you do not have a Delta VFD cable assembly, you can create one using preferably a 5 x 0.25mm² shielded cable.

This cable should have the wiring scheme presented in figure 11.2:

![Wiring scheme](image)

Figure 11.5: Wiring scheme for connecting the 0-10V Spindle speed control PCB to the Delta VFD

Be sure to connect RTR connector 3 to both Ground (GND) terminals on the Delta VFD.

Now you can proceed to the software setup.
3. I have a USBCNC CPU V3.0, V4.0 or V5.0 and a Delta VFD

Connection to USBCNC CPU
Connect the supplied 10 pole connector to the SV6 port of USBCNC CPU V3 PCB or for USBCNC CPU V4 users on the OUT slot of CPUV4.

Connect the other end to the 0-10V output card on the respective slot for your USBCNC CPU; see figure 11.6 for your correct terminal.

Figure 11.6: Terminals for USBCNC CPU V3.0 and USBCNC CPU V4.0
Connecting a 0-10V Spindle Speed Control PCB to a Delta VFD

Make sure the Delta VFD and the RTR set are both turned off while making these connections. The wiring scheme can be seen in figure 11.7 and figure 11.8:

Figure 11.7: Wiring scheme for connecting a 0-10V Spindle speed control PCB to a Delta VFD

<table>
<thead>
<tr>
<th>0-10V PCB</th>
<th>Delta VFD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>17 V</td>
</tr>
<tr>
<td>2</td>
<td>OUT 1</td>
</tr>
<tr>
<td>3</td>
<td>OUT 2</td>
</tr>
<tr>
<td>4</td>
<td>OUT 3</td>
</tr>
<tr>
<td>5</td>
<td>GND</td>
</tr>
</tbody>
</table>

Be sure to attach 0-10V PCB pin 5 (GND) to both ground terminals on the Delta VFD connector.

Figure 11.8: Wiring scheme for connecting a 0-10V Spindle speed control PCB to a Delta VFD
Note:
Use a (twisted) shielded cable for the above mentioned connections.

The shielding of the used cable should only be connected at the connector at the side of the drive (or the RTR side of the cable).

Always connect the shielding of the used cable to the Earth terminal on the DamenCNC motor interface card.

Now you can proceed to the software setup.
11.3 Software setup

The software setup consists of two parts.

1. Setup of the Delta VFD
2. Setup of USBCNC Software
Software setup of the Delta VFD

The Delta VFD should be set up such that there is a communication between the USBCNC Software and the Delta VFD. This communication can be established by performing the following steps:

Unplug the connection between the Delta VFD and the 0-10V Spindle speed control PCB.

Apply power to the VFD; please bear in mind that you should always use the Delta VFD in an environment where your 220V socket is NOT attached to a group which supplies power to any important electronic (data) devices. This is because the Delta VFD might trigger your RCD (Dutch: aardlekschakelaar)!

In addition, NEVER use the 220V socket from your RTR set; instead use a separate wall socket!

Usually a VFD obtains its inputs from the potentiometer and the interface. Since we want to control the speeds via a 0-10V input we need to change the parameters of the drives such that it takes the speed input at the 0-10V input. In table 11.1 one can find the parameters which need to be adjusted. After table 11.1 we explain how you can adjust each parameter.
Table 11.1: Parameters which need to be changed for the Delta VFD

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Factory</th>
<th>18.000 RPM</th>
<th>24.000 RPM</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-00</td>
<td>D0</td>
<td>D1</td>
<td>D1</td>
<td>0-10V speed control</td>
</tr>
<tr>
<td>2-01</td>
<td>D0</td>
<td>D1</td>
<td>D1</td>
<td>External start / stop</td>
</tr>
<tr>
<td>1-00</td>
<td>D60</td>
<td>D300</td>
<td>D400</td>
<td>Maximum operating frequency</td>
</tr>
<tr>
<td>1-01</td>
<td>D60</td>
<td>D300</td>
<td>D400</td>
<td>Maximum frequency</td>
</tr>
<tr>
<td>1-09</td>
<td>D10</td>
<td>D3</td>
<td>D3</td>
<td>Acceleration time in seconds</td>
</tr>
<tr>
<td>1-10</td>
<td>D10</td>
<td>D3</td>
<td>D3</td>
<td>Deceleration time in seconds</td>
</tr>
</tbody>
</table>

**Setting a parameter**

In this example it is explained how you can change the first parameter 2-00; analogous to all other parameters.

1. Apply power by inserting the 220V plug in a socket which is **NOT** attached to a group which supplies power to any important electronical (data) devices or your RTR set; the Delta VFD might trigger your RCD (Dutch: aardlekschakelaar)!

2. Press **Prog data** button

3. Using the **Up** and **Down** buttons browse and select **2**

4. Press **Prog data** button

5. The display should now read 2-00

6. For the first parameter you do not need to change the values after the **2-**, press **Prog data** button again

7. The factory setting for the speed control is **D0**.
   Using the **Up** and **Down** buttons browse and select **D3**

8. Press **Prog data** button

9. The display should now display **END**, which indicates that this parameter is programmed.

All other respective parameters can be set by repeating step 2-9.
There are two jumpers pre installed on a Delta VFD. These jumpers must be set such that 0-10V - and NPN are connected, as can be seen in figure 11.9:

![Figure 11.9: Jumper settings on 0-10V and NPN](image)

Please proceed to the software setup of USBCNC Software.
Software setup of USBCNC Software

The Software setup of USBCNC consists of three steps.

1. Set the correct outputs
2. Testing without a Teknomotor
3. Testing with a Teknomotor
1. Set the correct outputs

Navigate in the USBCNC environment to the Tab Setup.

Make sure that under the Spindle box the parameters PWM is checked.

The term Ramp up time indicates the time the spindle needs to start. The Ramp up time varies per spindle, but usually 0.5 to 2 seconds is sufficient. Furthermore Max S is the maximum allowable RPM of the spindle. In the case of a Teknomotor this is either 18000RPM or 24000RPM (this depends on the type of Teknmotor used).

It is also possible to indicate a minimum RPM value, as can be seen in figure 11.10.

As the name implicates, the option proportional ramp up time allows the user to proportionally vary the acceleration time as a function of the required RPM value. So if you set the start up time to 2 seconds, it will require 2 seconds to reach 24000RPM; and 1 second to reach 12000RPM.

It might be required to adjust the USBCNC Software **Invert IO** functions. Ensure that the Tool Dir option is checked, and PWM is unchecked, as can be seen in figure 11.10.

![Figure 11.10: USBCNC V5 Setup tab: it is important to check Tool Dir, and uncheck PWM. Indicate the correct Teknomotor limits in the Spindle menu](image)
2. Testing without a Teknomotor

In order to test the communication between USBCNC Software and your Delta VFD, follow this procedure:

1. Disconnect your Teknomotor from the Delta VFD

2. Connect your USBCNC CPU to your PC and connect the 0-10V Spindle speed control PCB to the Delta VFD

3. Apply power by inserting the 220V / 380V plug in a socket which is NOT attached to a group which supplies power to any important electronical (data) devices or your RTR set; the Delta VFD might trigger your RCD (Dutch: aardlekschakelaar)!

4. Open the MDI (Manual Data Input; F12; F6 in the Operate Tab) function. If you use a 18000RPM Teknomotor, input "M3 S18000" + Enter; as can be seen in figure 4

![Figure 11.11: Open your MDI and type: "M3 S18000" + Enter](image)

Figure 11.11: Open your MDI and type: "M3 S18000" + Enter
5. When the software is set to M3 S18000, the display on the VFD should read 300. If this is not the case please adjust the trim-potentiometer (the blue component with the bronze screw on your 0-10V Spindle speed control PCB) such that the value 300 is acquired.

![Spindle speed control PCB with trim-potentiometer highlighted]

6. On the VFD-Display the RUN LED should be lit, and also the FWD LED

7. If you use a 24000RPM Teknomotor, the display of the Delta VFD should read 300 when you input "M3 S24000" + Enter in the MDI.

![VFD-Display with LED indicators]

8. Now input M4 S18000 in the MDI (F12; F6)

9. On the VFD-Display the RUN LED should be lit, and also the REV LED

10. With the M5 command the spindle is turned off

If all of the above checks are correct you can continue to the next step: Testing with a TeknoMotor.
3. Testing with a Teknomotor

First remove the clamping nut from the Teknomotor spindle.

Afterwards open the MDI (F12; F6), and prompt the following sentence: M3 S4000.

Verify that the spindle rotates in the anti clockwise direction (if seen from the front of the spindle) as can be seen in figure 11.3:

![Teknomotor](image)

**Figure 11.12: The arrow indicates the correct forward rotating direction**

In the case that the Teknomotor rotates the reverse direction, unplug the 220V / 380V plug.

After a few minutes you can unscrew the plastic Delta VFD protection plate and switch the motor cable U with the motor cable W. Be sure to leave terminal V intact.

This operation will reverse the Teknomotor’s direction of rotation. Mount the plastic Delta VFD protection plate again and plug in your 220V / 380V plug, and try again. The system should now rotate in the correct direction.

**Note:**
Always make sure the Emergency Stop of the machine is working properly and run the machine with limit and home switches active.

Even a 1.6 kW motor can cause serious hazard to operators and spectators.