VFD Pump Tuning Tool · User Guide

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Introduction

What This Tool Does

The VFD Pump Tuning Tool is a free, web-based wizard that helps you set up your water pump system so it **automatically keeps water pressure steady** throughout your home or building. Instead of the pump running at full blast every time someone opens a tap and then shutting off abruptly, a properly tuned system adjusts the pump speed smoothly to deliver exactly the pressure you need -- no more, no less.

The tool walks you through the entire setup process, step by step. You enter information about your equipment, take a few simple measurements, and the tool calculates every setting you need to program into your pump controller.

What You Will Need

Before you begin, make sure you have the following equipment installed and ready:

1. **A booster pump with a Variable Frequency Drive (VFD)** -- The VFD is the electronic control box that adjusts how fast your pump motor spins. It is usually a rectangular box mounted near the pump with a small screen and buttons on the front. This tool is designed for the **9600 Series** VFD, but also supports generic drives.
2. **A membrane pressure tank** -- This is the large tank connected to your water system (sometimes called an expansion tank or bladder tank). It has a rubber membrane inside that separates the air from the water and helps smooth out pressure changes.
3. **A 4-20 mA pressure sensor** -- A small device screwed into your water pipe that measures water pressure and sends an electrical signal to the VFD. The "4-20 mA" part refers to the type of electrical signal it uses (you do not need to worry about the details -- the tool handles that).
4. **A potentiometer (speed control knob)** connected to the VFD -- This is a manual knob that lets you control pump speed by hand. You will use it during the setup process to take measurements.
5. **A pressure gauge or the pressure reading from the tank's air valve** -- You will need to read the air pressure in your tank. A tire pressure gauge that fits a standard valve stem works fine.
6. **Access to the VFD's programming menu** -- You will need to navigate the VFD's on-screen menus to enter settings and read values.

What You Will Get

At the end of this process, you will have a **complete list of settings** to program into your VFD, including:

- Motor configuration
- Pressure sensor calibration
- Automatic pressure control (PID) parameters
- Energy-saving sleep and wake settings
- A printable summary for your records

Before You Start

Gather Your Motor Information

Find the **motor nameplate** -- a small metal plate attached to the side of your pump motor. Write down these values:

Value	What It Looks Like	Example
Rated Power	Listed in kW (kilowatts)	1.5 kW
Rated Voltage	Listed in V (volts)	230 V
Rated Current	Listed in A (amps)	6.8 A
Rated Frequency	Listed in Hz (hertz)	50 Hz
Rated Speed	Listed in RPM (revolutions per minute)	2850 RPM

> **Tip:** If the nameplate is dirty or hard to read, try taking a photo with your phone and zooming in. These values are critical for correct setup.

Know Your Building

- How many floors (stories) does your building have? (The tool supports 1 to 4 stories.)
- What water pressure do you want at the highest floor?
- What is the maximum safe pressure your pipes can handle? (If you are unsure, the default values in the tool are a good starting point.)

Have Your Tools Ready

- A **multimeter** or **tire pressure gauge** for reading the tank's air pressure
- A screwdriver or wrench if you need to access wiring terminals

Safety First

> **WARNING:** Make sure the pump is **OFF** and, if possible, **disconnected from power** before touching any wiring. Water and electricity are a dangerous combination. If you are not comfortable working with electrical connections, please ask a qualified electrician for help with Step 2.

Step-by-Step Guide

Step 1: Enter Your System Information

Open the tool at https://rafalnoga.pythonanywhere.com/ and click **"Get Started"** on the welcome page.

You will see a form with several sections. Fill in each one:

Pump Section

- **Pump Type** -- Currently set to "Centrifugal" (the most common type for home water systems). Leave this as-is.
- **Motor Frequency** -- Enter the frequency from your motor nameplate, usually **50 Hz** (Europe, Asia, most of the world) or **60 Hz** (North America, parts of South America).
- **Maximum Flow Rate (Q max)** -- Enter the maximum flow your pump can deliver, in liters per minute. The tool automatically converts between l/min, m3/s, and GPM (US gallons per minute) -- just enter the value in whichever unit you know.

Motor Section

Enter all values from your motor nameplate (the ones you wrote down earlier):

- **Motor Type** -- Choose the option that matches your motor:

- **"Standard motor"** -- The most common type, also called an induction motor. If you are not sure, choose this one.
- **"Variable speed motor"** -- A motor specifically designed to work with a VFD. The label may say "inverter duty" or "variable speed."
- **"Permanent magnet motor"** -- A special high-efficiency motor. You will know if you have one because it is typically more expensive and the label will say "PM" or " permanent magnet."

- **Rated Power, Voltage, Current, Frequency, Speed** -- Enter exactly what is printed on the motor nameplate.
- **Auto-tuning** -- Leave this at the recommended setting. The tool selects the right option based on your motor type. Auto-tuning lets the VFD measure your motor's electrical characteristics for better performance.

  Tip: If your motor nameplate shows two voltages (for example, 230/400 V), use the voltage that matches your building's electrical supply.

Air Tank Section

- **Tank Type** -- Set to "Membrane" (the standard type with a rubber bladder inside).
- **Volume** -- Enter the tank volume in liters. This is usually printed on the tank label.
- **Max Pressure** -- Enter the maximum rated pressure from the tank label. You can enter it in either **psi** or **bar** -- the tool converts automatically.

Drive Section

- **Drive Type** -- Select **"9600 Series / NF9600"** if you have a 9600-series VFD. If you have a different brand or model, select **"Generic (other)"** and enter the model name for your records.

Building Section

- **Number of Stories** -- Select how many floors your building has (1 to 4).
- **Static Pressure** -- The water pressure you want at the highest floor. The default of 3.0 bar (43.5 psi) works well for most homes. Increase it if you want stronger water flow upstairs.
- **Max Pipe Pressure** -- The maximum safe pressure for your plumbing. The tool will never set a target pressure above this value. If your pipes are older or you have plastic piping, you may want to keep this conservative.

Click **"Next"** when all fields are filled in.

Step 2: Check Electrical Connections

This step shows you how to wire the pressure sensor and enable the VFD to run.

> **WARNING:** Make sure the pump is **OFF** and power is **disconnected** before making any wiring changes.

Make the following connections at the VFD's wiring terminals:

1. **Pressure sensor positive (+) wire** --> connect to VFD terminal marked **"24V"**
2. **Pressure sensor negative (-) wire** --> connect to VFD terminal marked **"AI2"**
3. **Short wire from "ACOM" to "DCOM"** -- Connect these two VFD terminals together with a short piece of wire
4. **Short wire from "DCOM" to "FWD"** -- Connect these two VFD terminals together with a short

piece of wire

What do connections 3 and 4 do? These two short wires tell the VFD that it is allowed to run. Without them, the VFD will not start the pump even if everything else is set up correctly. Think of them as a "permission to operate" signal.

Double-check all connections, then restore power to the VFD.

Click **"Connections Verified"** to continue.

Step 3: Set Tank Air Pressure

The pressure tank needs the correct amount of air inside it to work properly. Too much or too little air will cause the pump to cycle on and off unnecessarily.

Follow these steps carefully:

1. **Turn OFF the pump**
2. **Open the lowest water tap** in your building (for example, a basement or ground-floor faucet) and let all the water drain out
3. **Wait until water stops flowing completely** -- this means the tank is empty of water and you can now get an accurate air pressure reading
4. **Check the air pressure** at the tank's air valve -- this is the small valve at the top or side of the tank that looks like a car tire valve (called a Schrader valve). Use a tire pressure gauge.
5. **Enter the reading** in the tool (in psi or bar)

The tool will compare your reading to the ideal pressure for your system and tell you what to do:

- **"Pressure is too low"** -- Use a bicycle pump or air compressor to add air through the valve until you reach the target pressure
- **"Pressure is too high"** -- Press the pin in the center of the valve briefly to release small amounts of air until you reach the target
- **"Pressure is correct"** -- You are good to go!

Tip: Take your time with this step. Getting the tank pressure right makes a big difference in how smoothly your system operates.

Click **"Next"** to continue.

Step 4: Calibrate the Speed Control Knob

In this step, you teach the VFD what "minimum" and "maximum" mean on your potentiometer (the manual speed control knob).

1. **Turn the knob all the way to the left** (counter-clockwise, fully closed)
2. On the VFD screen, navigate to **U0-21** (this shows the voltage coming from the potentiometer)
3. **Read the voltage** displayed and enter it in the tool's **"U0-21 at left position"** field
4. **Turn the knob all the way to the right** (clockwise, fully open)
5. **Read the new voltage** and enter it in the **"U0-21 at right position"** field

Tip: The left (minimum) value is typically around 0.3 to 1.0 V, and the right (maximum) value is typically around 9.0 to 10.0 V. If your values are outside this range or the maximum is not higher than the minimum, double-check that the potentiometer is connected properly.

Click **"Next"** to continue.

Step 5: Program Motor Settings into the VFD

The tool now displays a table of settings to enter into your VFD. These configure the motor parameters and set up manual speed control through the potentiometer.

> **IMPORTANT:** Enter the settings in the **exact order shown** in the table. Do not skip ahead or change the sequence -- some settings depend on earlier ones being in place.

The settings are organized in two groups:

First group -- Motor setup:

Setting	What It Does
PP-01 = 1	Resets the VFD to factory defaults (gives you a clean starting point)
P1-00	Sets your motor type
P1-01 through P1-05	Enters your motor nameplate values
P1-37	Starts the auto-tuning process

After entering the **P1-37 (auto-tuning)** setting:

> **ACTION REQUIRED:** Press the **RUN** button on the VFD front panel. The VFD will now automatically measure your motor's electrical characteristics. Wait for it to finish -- the screen will indicate when auto-tuning is complete. This usually takes 10 to 30 seconds.

Second group -- Potentiometer setup:

Setting	What It Does
P4-13	Sets the potentiometer minimum voltage (from your Step 4 reading)
P4-15	Sets the potentiometer maximum voltage (from your Step 4 reading)
P4-16	Maps the knob's full-right position to maximum motor frequency
P0-03 = 2	Tells the VFD to take its speed command from the potentiometer (AI1)

After entering all settings, the pump speed will follow your potentiometer position: left = stopped, right = full speed.

Click **"Ready to Measure"** to continue.

Step 6: Take Pressure Measurements

In this step, you will slowly increase pump speed using the potentiometer and take pressure readings at two specific target pressures that the tool displays on screen.

> **WARNING: Do NOT turn the knob back to the left** once you start this step! Only turn it further to the right. If you accidentally turn it too far and need to go back, you must: stop the pump, turn the knob fully left, open the lowest faucet, drain all water completely, and restart from the beginning of this step.

Follow this procedure:

1. **Close all water taps** in your building (you need a zero-flow condition)
2. **Slowly turn the potentiometer to the right** -- you will hear the pump start and see pressure begin to build on the VFD screen
3. **When pressure reaches the first target** (displayed on screen, typically a few psi above your tank preload pressure), stop turning the knob and read three values from the VFD:
   - **Drive frequency** (in Hz -- shown on the main VFD display)
   - **Pressure** at the tank's Schrader valve (use your gauge, enter in psi or bar)
   - **U0-10** (the AI2 voltage display -- navigate to U0-10 on the VFD screen)
4. **Enter all three values** in the tool and click **"Add Measurement"**

5. **Turn the knob further to the right** until pressure reaches the **second target** (your desired system pressure, also shown on screen)
6. **Take another set of readings** (frequency, pressure, U0-10) and add this measurement too

   Tip: You need at least **2 measurements** to continue, but adding more (3 or 4 at different pressures) improves the accuracy of the calculations. Each additional point helps the tool better understand how your specific pump and sensor behave.

When you have at least 2 measurements, the **"Calculate Parameters"** button becomes active. Click it to proceed.

The tool will analyze your measurements and calculate all the remaining VFD settings automatically.

Step 7: Program the Remaining VFD Settings

The tool now displays a complete set of calculated parameters organized into clear groups. Enter them into your VFD in the **exact order shown**.

The parameter groups are:

- **AI2 Scaling (Pressure Sensor)** -- Tells the VFD how to interpret the pressure sensor signal
- **Frequency Settings** -- Sets speed limits and acceleration/deceleration times
- **Sleep/Wake (Energy Saving)** -- Allows the pump to go to sleep when no water is being used, saving energy and reducing wear
- **PID Control (Automatic Mode)** -- The heart of the system: these settings control how the VFD automatically adjusts pump speed to maintain your target pressure

  IMPORTANT: The very last setting is **P0-03 = 8**, which switches the VFD from manual potentiometer control to **automatic PID pressure control**. Once you enter this setting, the VFD takes over and manages pump speed on its own.

After entering all the settings, your pump should now be controlling pressure automatically. Open and close a few taps to watch it respond -- the pump speed should increase when you open taps (pressure drops) and decrease when you close them (pressure rises).

> **Tip:** It is normal for the system to take a few seconds to respond to pressure changes. If the pressure swings up and down repeatedly, see the Troubleshooting section below.

Click **"View Summary"** to continue.

Step 8: Summary

The final screen shows a **complete overview of every setting** that was configured, organized by category:

- System summary (building info, target pressure)
- Motor parameters
- Tank preload pressure
- AI1 scaling (potentiometer)
- AI2 scaling (pressure sensor)
- Frequency settings
- Sleep/wake settings
- PID control parameters

Save a copy for your records:

Click the **"Print"** button to open your browser's print dialog. You can print it on paper or save it as a PDF file. Keep

this record in a safe place -- you will need it if you ever need to reprogram the VFD (for example, after a replacement or factory reset).

> **Tip:** Consider taping a printed copy to the inside of the VFD enclosure door or keeping it with your building maintenance documents.

Troubleshooting

Pressure swings up and down repeatedly

The automatic control is reacting too aggressively. The **proportional gain (PA-05)** may be set too high for your specific system. This is the most common issue and may require a professional to fine-tune. Try reducing PA-05 in small steps (for example, from 100 down to 80, then 60) until the pressure stabilizes.

Pump cycles on and off rapidly

The pump keeps starting and stopping in quick succession. This is usually caused by the **sleep/wake settings** being too aggressive, or the **tank air pressure** being incorrect. Check that:

- The tank air pressure matches the value from Step 3
- The sleep delay (P8-52) is long enough (10 seconds or more)
- The wake delay (P8-50) is appropriate for your needs

Pump does not start at all

Go back to Step 2 and verify all wiring connections:

- Is the pressure sensor connected to **24V** and **AI2**?
- Is **ACOM** connected to **DCOM**?
- Is **DCOM** connected to **FWD**?
- Is the VFD powered on and not showing an error code?

If the VFD shows an error code, look it up in your VFD's user manual.

"Need at least 2 measurements" error

You need to add more measurement points in Step 6. Make sure you click **"Add Measurement"** after entering each set of values (frequency, pressure, and U0-10).

Tool shows wrong pressure values

Make sure the pressure sensor is properly connected to the correct terminals (24V and AI2). Navigate to **U0-10** on the VFD screen and verify that the voltage changes when you change the pressure in the system. If U0-10 shows zero or does not change, the sensor wiring may be incorrect or the sensor may be faulty.

VFD shows an error after entering settings

If you see an error code on the VFD screen after programming:

1. Write down the error code
2. Look it up in your VFD user manual
3. Common errors include overcurrent (motor wiring issue) and communication faults (sensor wiring issue)

4 You can reset the VFD by setting **PP-01 = 1** (factory reset) and starting the process over

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Disclaimer

This tool is provided **"as is"** without any warranty, express or implied. The calculated parameters are **suggestions only** and must be verified by a qualified professional before use. The authors accept no liability for any damage, injury, loss, or malfunction resulting from the use of this tool or the application of its output. **Use entirely at your own risk.**

Electrical work should always be performed by or supervised by a qualified electrician in accordance with local building codes and regulations.