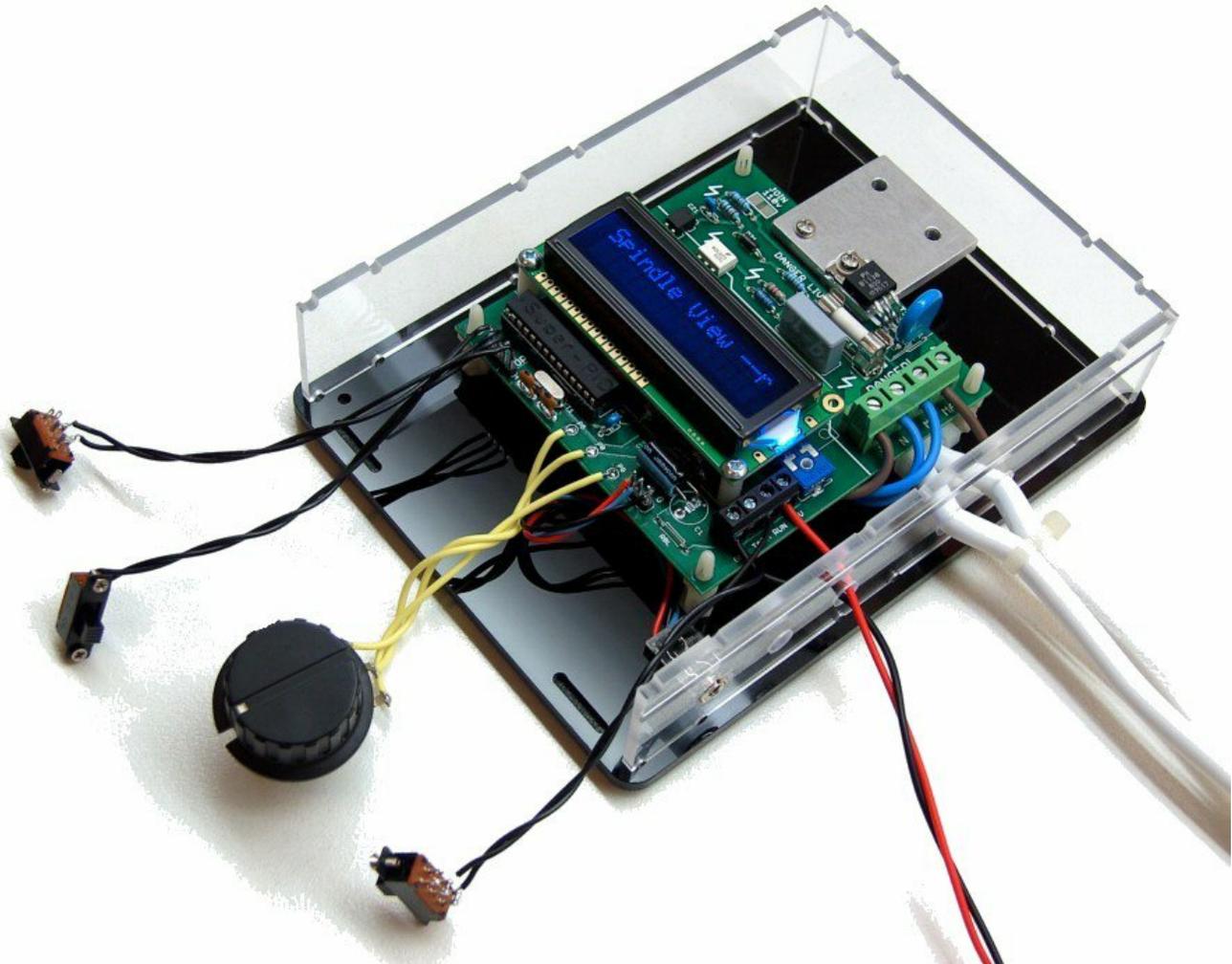


Super-PID v1

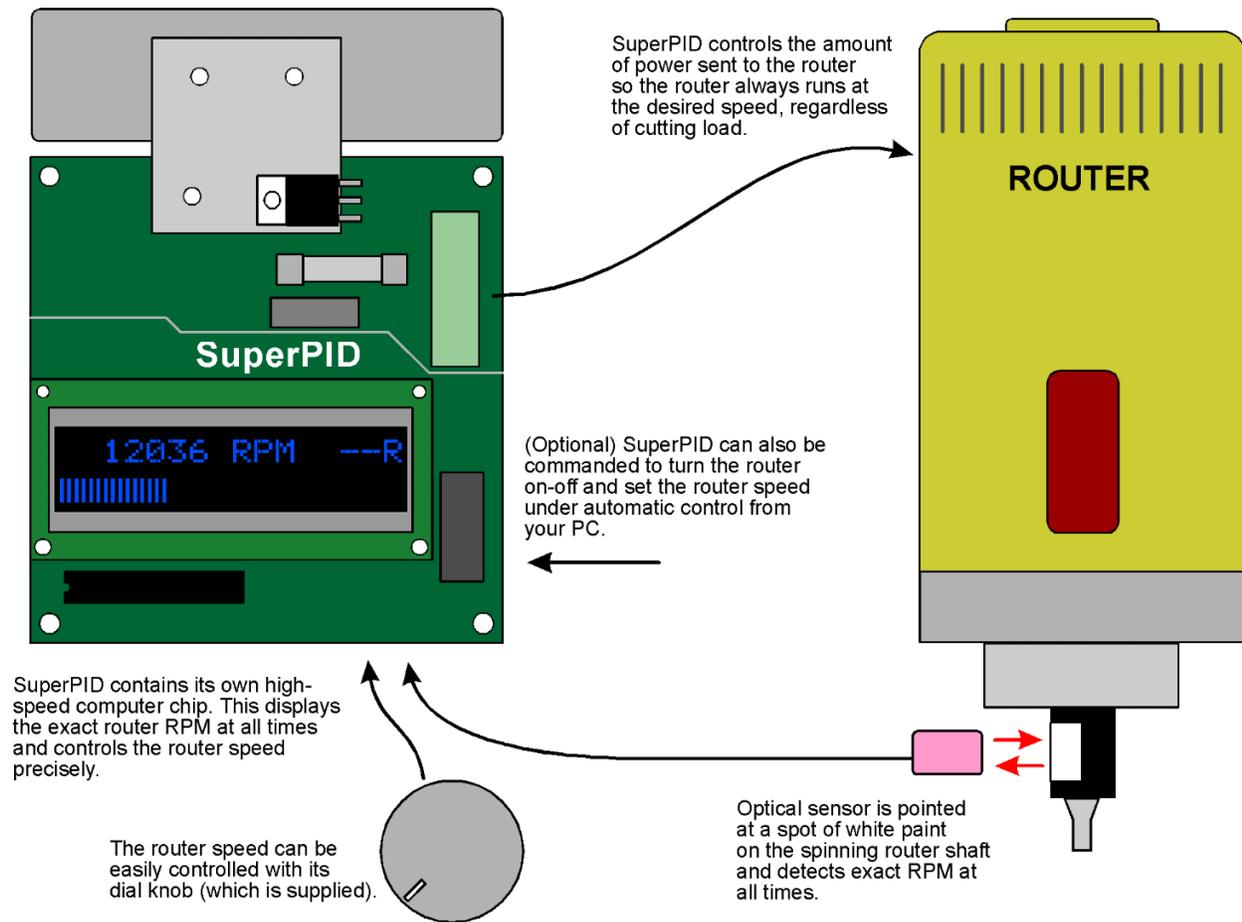
Closed-loop router speed controller



Overview - what is Super-PID?

Super-PID is a speed controller for routers and other power tools. It is closed loop, which means it monitors the actual RPM of the router and controls the power supplied to the router to make it run at an exact speed. This means the router can be run at lower than normal speeds and still produce excellent cutting power. It also means the router speed will not be affected by load so it will maintain a constant speed even when cutting.

Overview of closed loop speed control.



When running, the Super-PID display shows the exact router RPM and also shows a bargraph indicating the power sent to the router, (as a percentage of full power).

Super-PID also has some advanced features that allow it to be connected to a PC and controlled by most standard PC software for CNC, including Mach3 and EMC software.

Specs and requirements

Super-PID specs;

Models available for 120 volt and 240 volt AC mains to suit all countries
Suitable for routers up to 1800 Watt (120v) and 2000 Watt (240v)
Rated for continuous production use
Opto-isolation for electronic inputs
Closed loop router speed range; 5000 to 30000 RPM
Tacho display accuracy; typically +/- 1 RPM
Open loop router speed range; 0 to MAX
Size; 94 x 120mm (3.7 x 4.75 inches)

Super-PID requirements;

120v or 240v AC mains power (not a portable generator)
Regulated +5v DC power supply, minimum 150 mA
Speed control pot (supplied)
Small heatsink (generally a 94 x 25 x 6 mm aluminium bar)
A safe insulated box
Small 40mm or 50mm fan recommended with larger routers
Wiring suitable for a mains powered router

Router requirements;

The Super-PID works with any router or power tool that has a "universal motor". These motors are identified by having 2 brushes, being noisy and air cooled with their own internal rotor fan, and running from AC mains. This means all typical routers.

The other type of common AC motor used on drill presses is not suitable! These motors are normally made from cast metal, are much larger and heavier, and have no brushes.

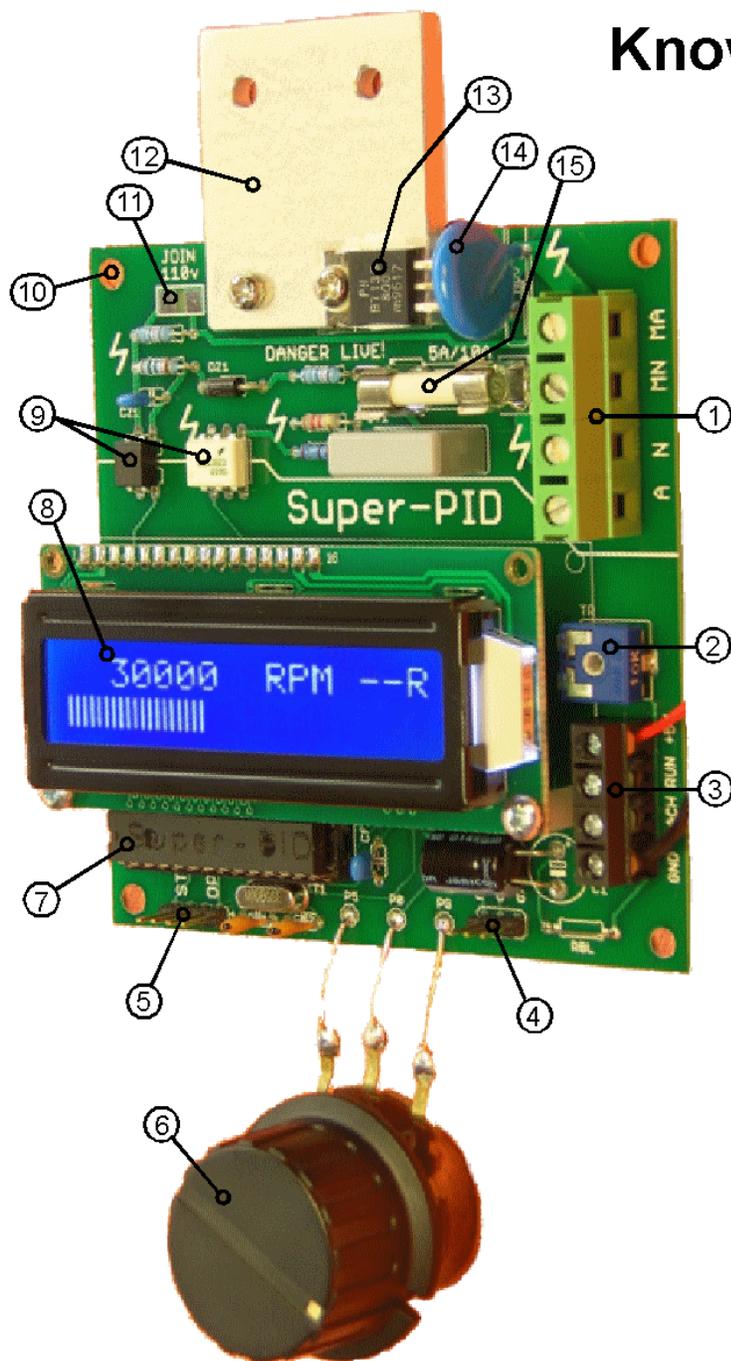
Router modification;

Many routers will work directly with the Super-PID. However, any router that has internal electronics needs to have this electronics removed or bypassed. This electronics includes any form of speed control, or any electronics called "soft start feature".

Modifying the router is usually a very straightforward procedure, and around 70 percent of Super-PID owners are using routers that have been modified this way. Please see the section **Router speed control bypass or removal**.

The other router modification that is required by all users is to add a white-black area on the router shaft so the Super-PID optical sensor can detect the router RPM. This can be as easy as putting some white paint on the router's black shaft, or a more complex procedure to put the optical sensor near the top of the router as many users prefer. Please see the section **Spindle RPM sensor**.

Know your Super-PID



Know your Super-PID

Components;

1. AC mains voltage connector
2. LCD contrast adjust
3. Low voltage connector
4. Spindle RPM sensor
5. Optional features connector
6. Speed control pot
7. Microcontroller
8. LCD display
9. Opto isolation
10. PCB mounting holes
11. Selector jumper for 110v AC
12. Heatsink Bracket
13. Triac
14. MOV surge protector
15. Mains fuse, slow-blow, 6A (240v models) or 12A (110v models)

Warning!

Some areas of the Super-PID PCB operate at lethal mains voltages. The Super-PID PCB must be enclosed in a safe plastic case before use so it cannot be touched by the user.

The heatsink bracket and heatsink should be treated as live!

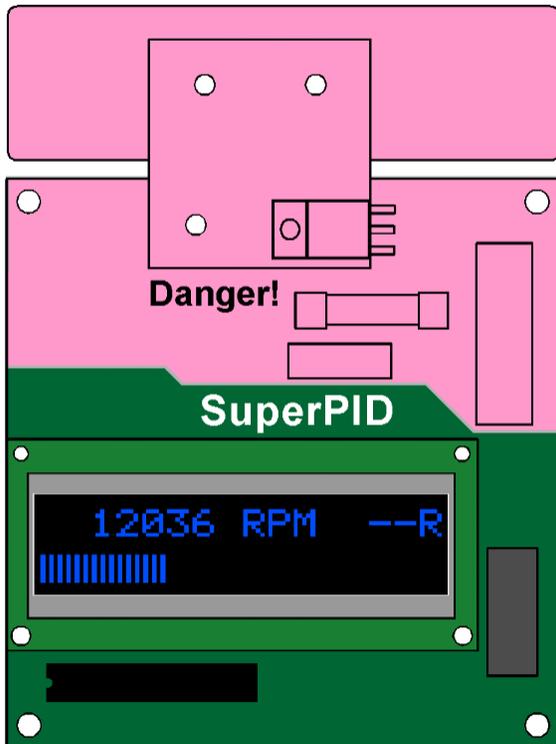
All wiring to the AC mains connector must be rated for mains voltages and minimum 10 amps.

High voltage safety!

Important! Some parts of the Super-PID PCB are at mains voltage, this will be 120v AC or 240v AC depending on your country.

Please read this section carefully as it is important for the Super-PID to be treated as live equipment.

Super-PID high-voltage section



All the wiring in the high voltage section and every part of the RED area is at mains potential and it should be ensured that this can never be touched by the user.

These parts should be fully enclosed in an electrically insulated enclosure.

AC out to router
AC mains power

All the wiring in the low voltage section is low-voltage and safe and can be directly attached to other equipment like a PC or break out board.

Super-PID low-voltage section

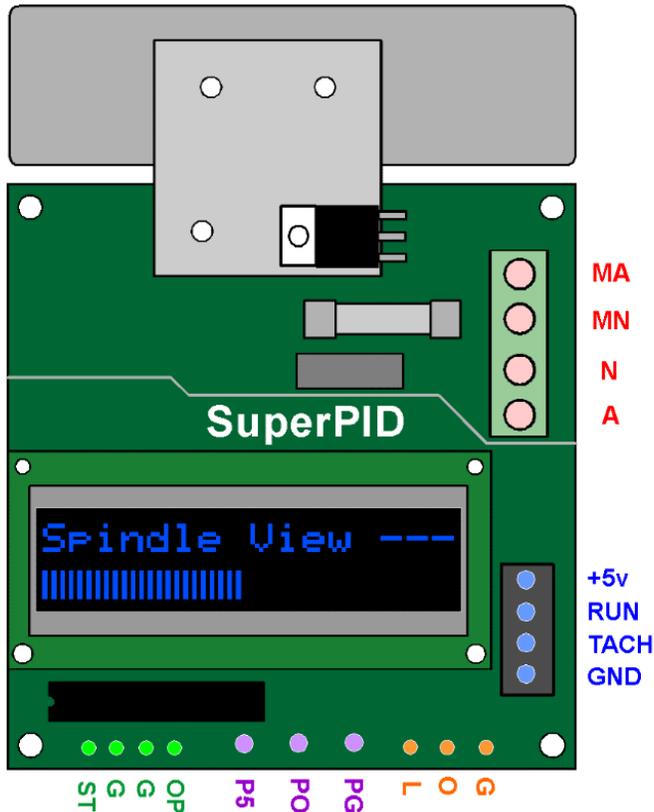
Good safety requires that the Super-PID is fully enclosed in an insulated enclosure, made from plastic or some safe material that cannot conduct electricity. This enclosure may have small holes for wiring and air cooling as needed, but it should be ensured that the user can never come in contact with the mains voltages.

The Super-PID has opto-isolation, so the wiring to the low voltage section is safe and can be directly connected to a PC or other equipment. Even though the low voltage wiring is safe it is best to treat the entire Super-PID board as live equipment and have it fully enclosed.

If after receiving this product you do not feel confident that you can install and use this product safely please return it (unused) for a full refund.

Super-PID Terminals

Please refer to the diagram below for what each terminal does. Some connections are optional and do not need to be connected.



SuperPID v1 Terminals

MA output, Motor Active (Live or Line) AC

MN output, Motor Neutral AC

N AC Mains power, Neutral

A AC Mains power, Active (Live or Line)

+5v Regulated +5v DC power to SuperPID

RUN input, 0v = RUN, 5v = STOP

TACH output pulse, 1 pulse per rev

GND Regulated supply Ground

G Spindle Sensor ground

O Spindle Sensor signal, white wire

L Spindle Sensor LED, red wire

PG Ground connection to pot

PO input, wiper (signal) from Pot

P5 +5v supply to pot

OP input, selects Open-Loop mode

G ground

G ground

ST input, selects Stable mode

Notes; If using Mach3 speed control from a PC, connect a filtered speed control voltage (ranging from 0v to 5v DC) into the **PO** terminal and disconnect the pot.

Terminal details;

MA, MN These are the two wires that supply power **out** to the router. These must be rated for full router power, generally 120v 15 amps (or 240v 10 amps).

N, A These are the two mains power wires that bring AC power **in** to the Super-PID. These must be rated for full router power, generally 120v 15 amps (or 240v 10 amps).

+5v This is the regulated +5v DC power supply that supplies the Super-PID circuitry, and powers the microcontroller and display etc. This power supply must be **regulated** which means it is suitable for computer power because it is a smooth, precise 5 volts.

(continued)

RUN This is an input that controls the router ON - OFF. This is normally driven from a logic level signal where 5v = router RUN and 0v = router OFF. If nothing is connected to this terminal the router will RUN.

TACH This is a logic level square wave output. It pulsates in time with the spindle RPM, and can be connected to an external tacho display. It can also be connected to a PC. This output will drive logic level (0v to 5v) inputs.

GND This is the Ground for the regulated 5v DC supply. Normally this is connected to the main ground as used by all the other control electronics on the machine. If the 5v supply comes from a PC this ground is normally the PC case ground.

G This is a ground terminal used for the spindle RPM sensor ground.

O This is an analog input from the spindle RPM sensor signal (white wire).

L This is power out to the infra-red LED used in the spindle RPM sensor (red wire).

PG This is the ground terminal for the speed control pot.

PO This is the speed control voltage input to the Super-PID that controls router speed. This voltage should be in the range 0v to 5v. Normally this connects to the middle (wiper) of the pot, but it could instead receive a speed control voltage from another device.

P5 This is the +5v output to the speed control pot.

OP This logic level input selects Open-Loop mode when it is at 0v (or is connected to ground).

G This is a convenient ground to connect OP to.

G This is a convenient ground to connect SP to.

ST This logic level input selects Stable mode when it is at 0v (or is connected to ground).

(Please see the following sections for details regarding specific terminals).

First connection

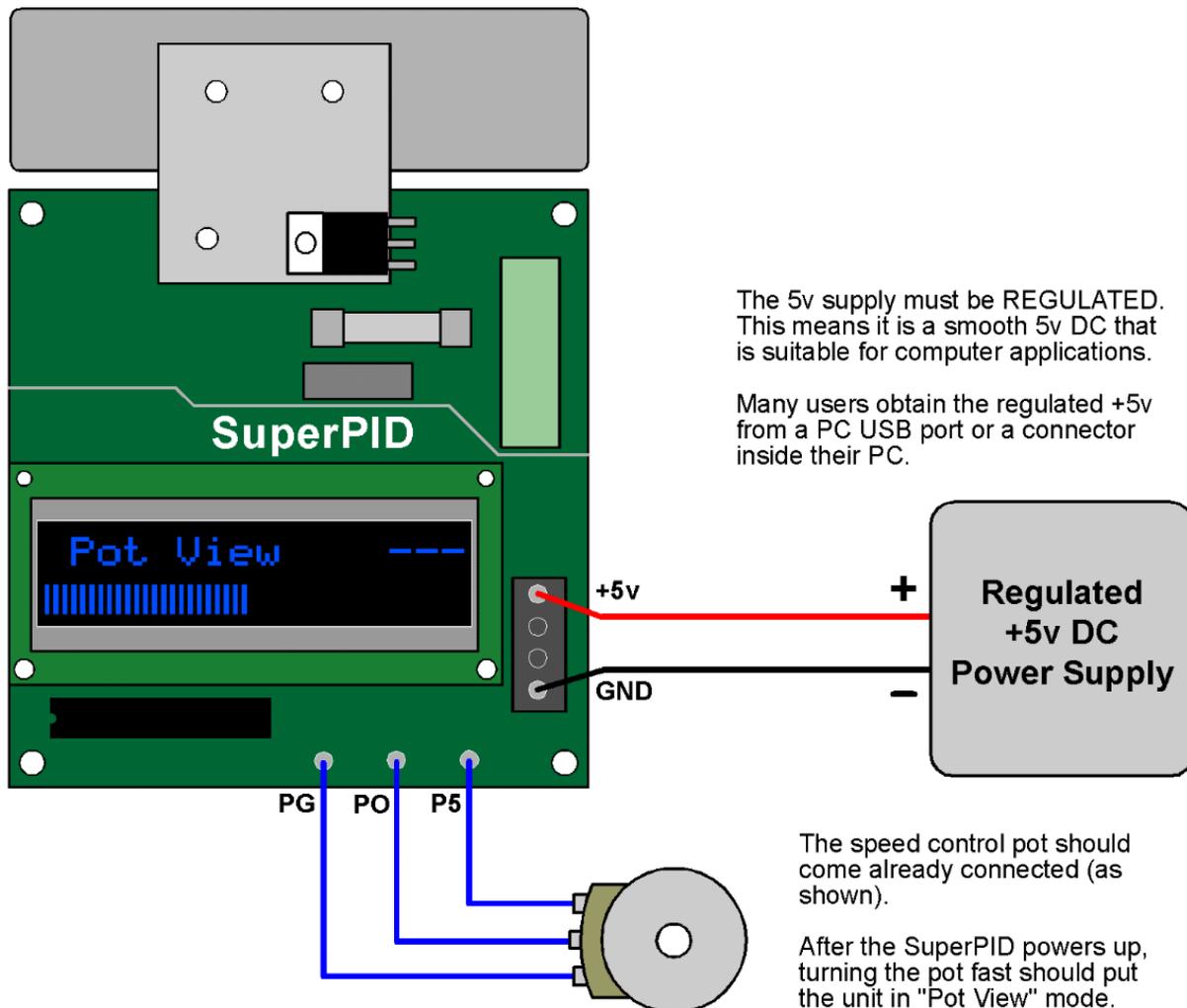
Super-PID can be first set up with no mains voltages connected. We suggest you first connect your Super-PID to a regulated +5v DC supply and get to know it's features.

This first connection will also allow you to check and adjust the spindle RPM sensor and (if connected) calibrate the temperature sensor.

Regulated +5v DC supply.

It is important that the +5v DC supply be regulated. A regulated +5v DC supply is available from a PC USB port, or some users obtain it from a hard drive connector inside their PC. If you use another power supply or plug-pack (wall-wart) you must make sure it specifies that it is a **regulated** +5v DC supply.

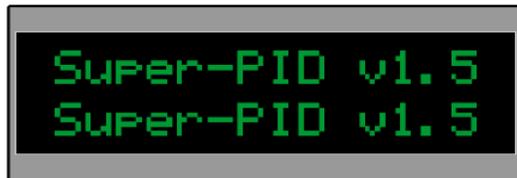
To setup and test the SuperPID all you need is a 5v DC supply.



Boot up sequence

Once the +5v supply is connected the Super-PID will go through a boot up sequence. This is normal and happens every time it is powered up (every time the +5v DC supply is turned on).

It is not necessary at this point for the AC mains to be connected, and we advise for safety that the mains is not connected at this point until after you have set up your Super-PID and become familiar with its operation.



During power-up the firmware version number is displayed.

v1.1 = Knob mode
v1.5 = PC speed control (Mach3) mode



Next the mains frequency is tested, to determine if you have 50 Hz or 60 Hz mains.

If the mains is detected it is shown.



If there is no mains detected, the display will say "No Mains". This is ok as the mains will be tested again later.

Firmware version.

The firmware versions are the same apart from the speed control curve. Please see the section **Speed control knob modes** for more details.

Testing mains.

This is a normal procedure that is done when booting up, it checks if the mains is present and if so, measures the mains frequency and synchronises to it.

Spindle View mode.

After the boot up sequence is complete the Super-PID will remain in the "Spindle View" mode. This is the normal display whenever the router is not running. This is explained later in the section **Spindle RPM sensor connecting**.

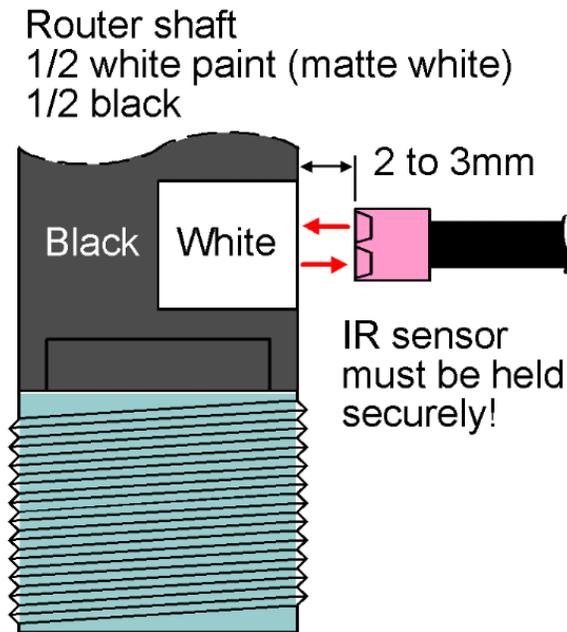
Pot View mode.

If the speed control pot is turned fast the Super-PID will go into "Pot View" mode. This allows you to see the pot setting on the bargraph, to see that the pot is working correctly.

Spindle RPM sensor

The **spindle RPM sensor** supplied as standard with your Super-PID is a reflective IR (Infra-Red) type.

It bounces a tiny Infra-Red beam off a surface and can detect if the surface is black or white. If this surface is a spinning shaft, the sensor can detect its RPM with great accuracy.



Sensor mounting.

There are a number of options for mounting the RPM sensor. In many cases you can paint white paint on a black router shaft so that the sensor sees half white and half black as the shaft spins.

The sensor will tolerate a wide ratio of white to black, so it will still work correctly with 1/4 white and 3/4 black.

However it is **important** that there is only one white area and one black area, to ensure only **one pulse** per rotation.

Paint types.

It is important to use a highly reflective white paint, matte white is best and many people use the commonly available fast drying white "correction paint" like Liquid Paper or Wite-Out. However gloss white paint also works well and may be more durable.

The black paint is not as important, any dark surface like black paint or a black metal shaft will work fine.

Sensor adjustment.

There is no electronic adjustment for the sensor. The sensor has been designed and pre-calibrated to detect white and black from around 2mm to 3mm distance.

The sensor may be adjusted mechanically simply by changing its distance from the surface to give the best sensor reading. Once this has been done the sensor can be securely mounted at that distance.

Connecting the spindle RPM sensor

The spindle RPM sensor is usually supplied already connected, as it was tested during the manufacturing testing procedure.

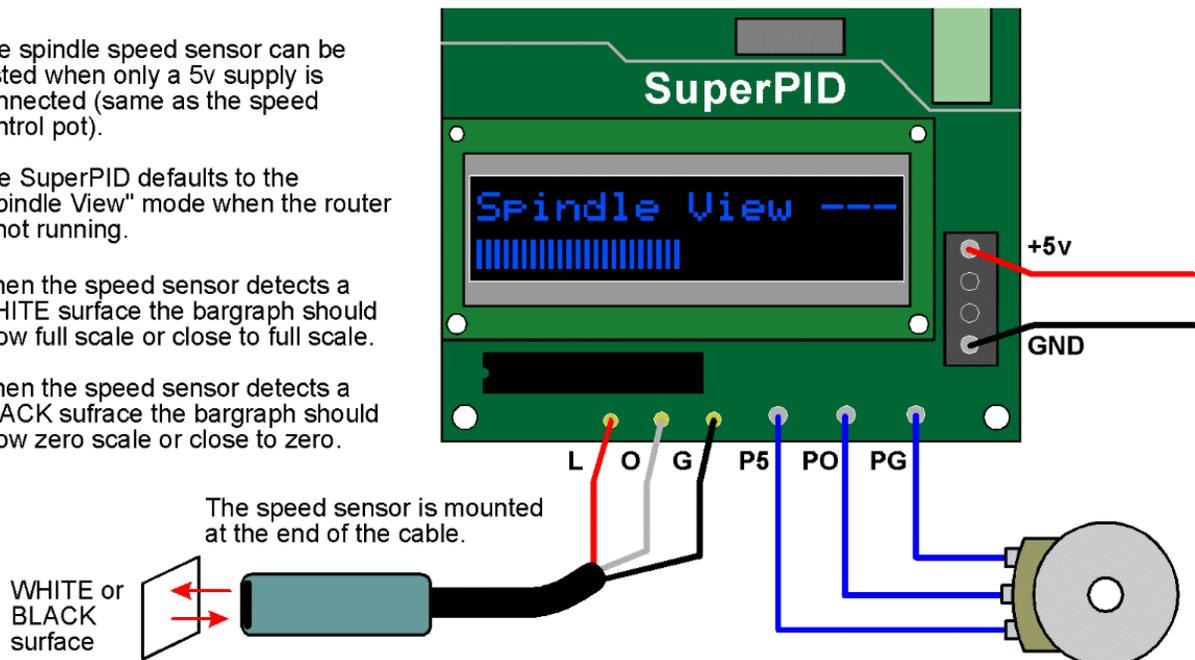
If your sensor cable is an optional long length type it may be supplied separately and needs to be connected as shown below.

The spindle speed sensor can be tested when only a 5v supply is connected (same as the speed control pot).

The SuperPID defaults to the "Spindle View" mode when the router is not running.

When the speed sensor detects a WHITE surface the bargraph should show full scale or close to full scale.

When the speed sensor detects a BLACK surface the bargraph should show zero scale or close to zero.



It is not necessary to get a perfect reading for the white or black surfaces, but you should aim to get results similar to those shown below. If you cannot get these exact results then adjust the sensor distance to get the black bargraph as low as possible and the white bargraph as high as possible. Super-PID is quite tolerant of an imperfect sensor.



A black surface should give a low bargraph reading like this.



A white surface should give a high bargraph reading like this.

Mounting the spindle RPM sensor

Bottom mounting on the output shaft.

This is the easiest option on many routers, and all you need to do is paint some white paint on the black router shaft and mount the sensor pointed at it.

However this option makes the sensor more exposed to damage from wrenches used on the shaft collet nut, and as the sensor is closer to the cutting job it will need more frequent cleaning especially if you cut MDF or other materials that make fine wood dust and do not have dust extraction.

Top mounting.

Top mounting involves a little more work and the sensor is mounted inside or partially inside the top dust cover of the router, pointed at some spinning part of the router shaft. About two out of three Super-PID users prefer top mounting.

Note! Some router types are better suited for one particular mounting method.

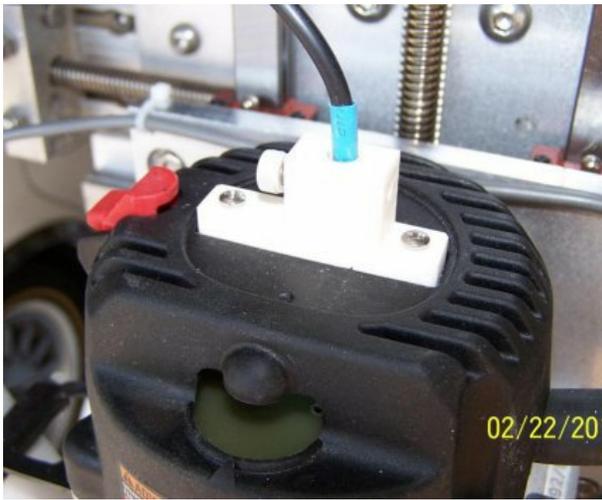
Sensor mounting tube.

Super-PID is now supplied with a plastic tube (impact resistant poly carbonate) that can simplify sensor mounting. The mounting option is up to you, but most people glue or clamp the tube in the right place and slide the sensor down the tube. Once the sensor distance has been tested then glue or other means can secure it at the correct distance. It can be used for top or bottom mounting.

Photos of SuperPID user's mountings.

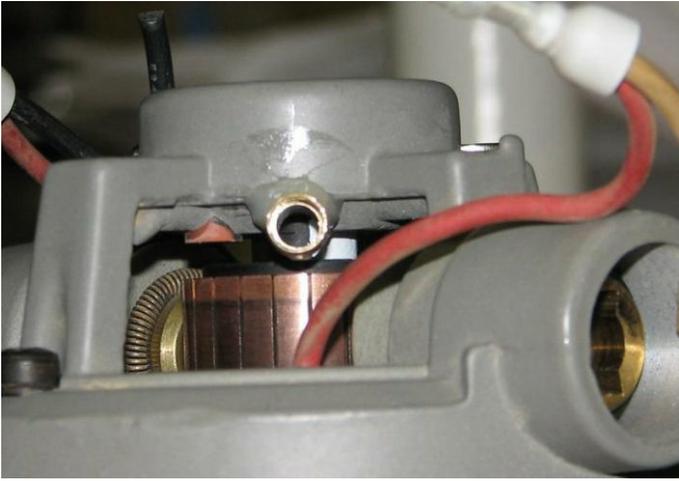
Following you can see some sensor mounting setups on common routers.





Here are some spindle RPM sensor mountings, at the top or bottom of the router.





Router speed control bypass or removal

If your router has an internal electronic speed control it must be bypassed or removed.

Some electronic speed controls where the dial has a "click" at the fastest speed setting already have an inbuilt disable switch, so they do not need to be modified. Generally if your router has a speed control dial, or has a "soft start feature" that means it has internal electronics and this needs to be bypassed or removed.

Tech support is available through the www.SuperPID.com web site.

Bypassing the router electronics.

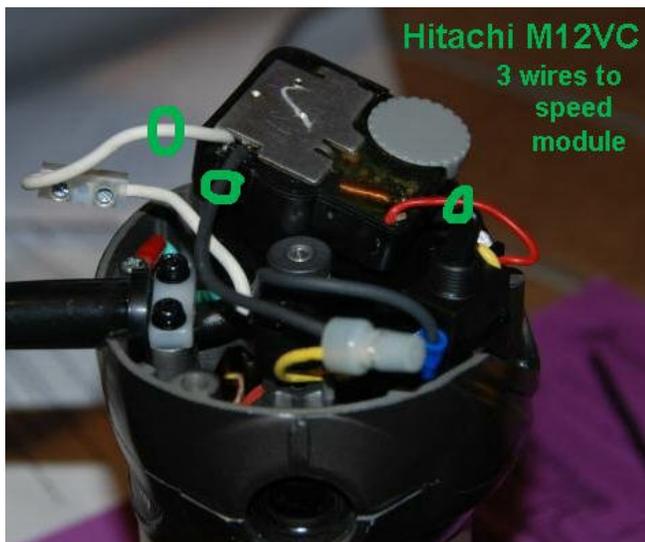
Bypassing the router electronics is usually quite straightforward. Normally there is a large black 3-pin TRIAC device that can be bypassed by joining all 3 legs of the TRIAC device together with solder. Many Super-PID users choose this method of bypassing their routers.

This is also an easy modification to reverse if you want to return your router to original condition at a later date. See photos below.

Removing the router electronics.

Some users prefer to remove the electronics module from their router. This is usually quite simple and can help provide room to put the SuperPID spindle RPM sensor inside the top of the router and improve airflow through the router.

The router's speed control module usually has 3 wires. To remove it, the 2 large wires that carry motor current are joined together, and the smaller wire is simply disconnected and made safe so it cannot touch anything. See photos and diagrams below.





Colt PR20EVS
Join TRIAC pins



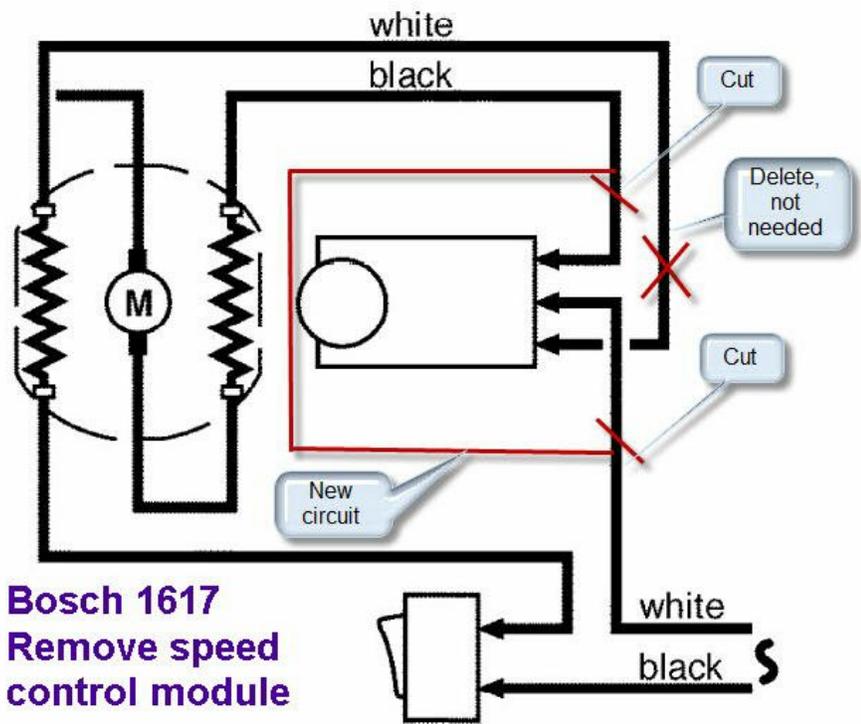
JOIN 3 TRIAC LEGS

Kress FM6990
after removing some epoxy



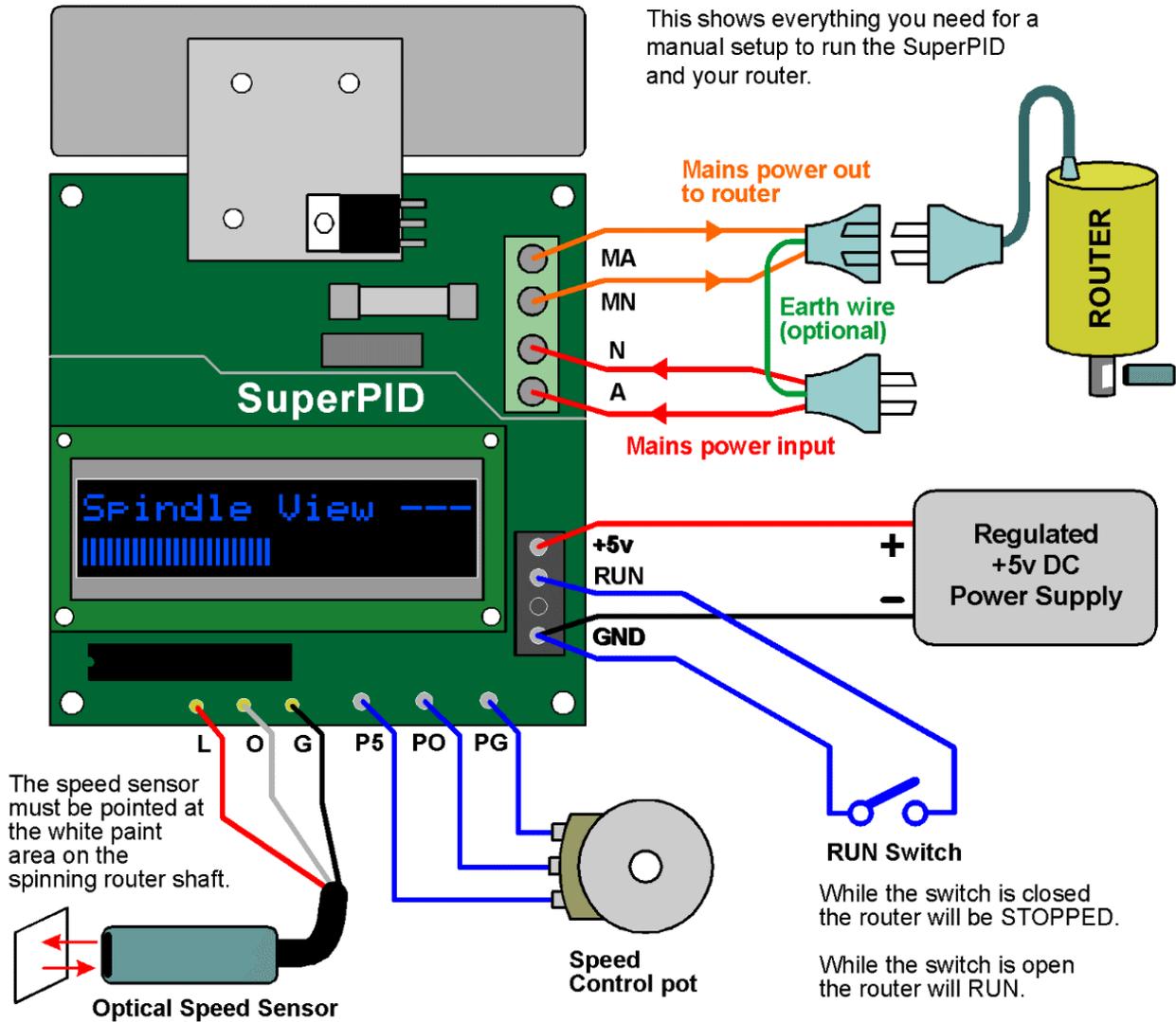
PC7518
Join 3 TRIAC legs

Model 7518 Variable Speed Production Router
(75192 Motor)
120 V~ 60 Hz 15 A
n_s 10000-21000/min (RPM)
TYPE 3
NOMANCE



Bosch 1617
Remove speed
control module

Basic connection - no PC

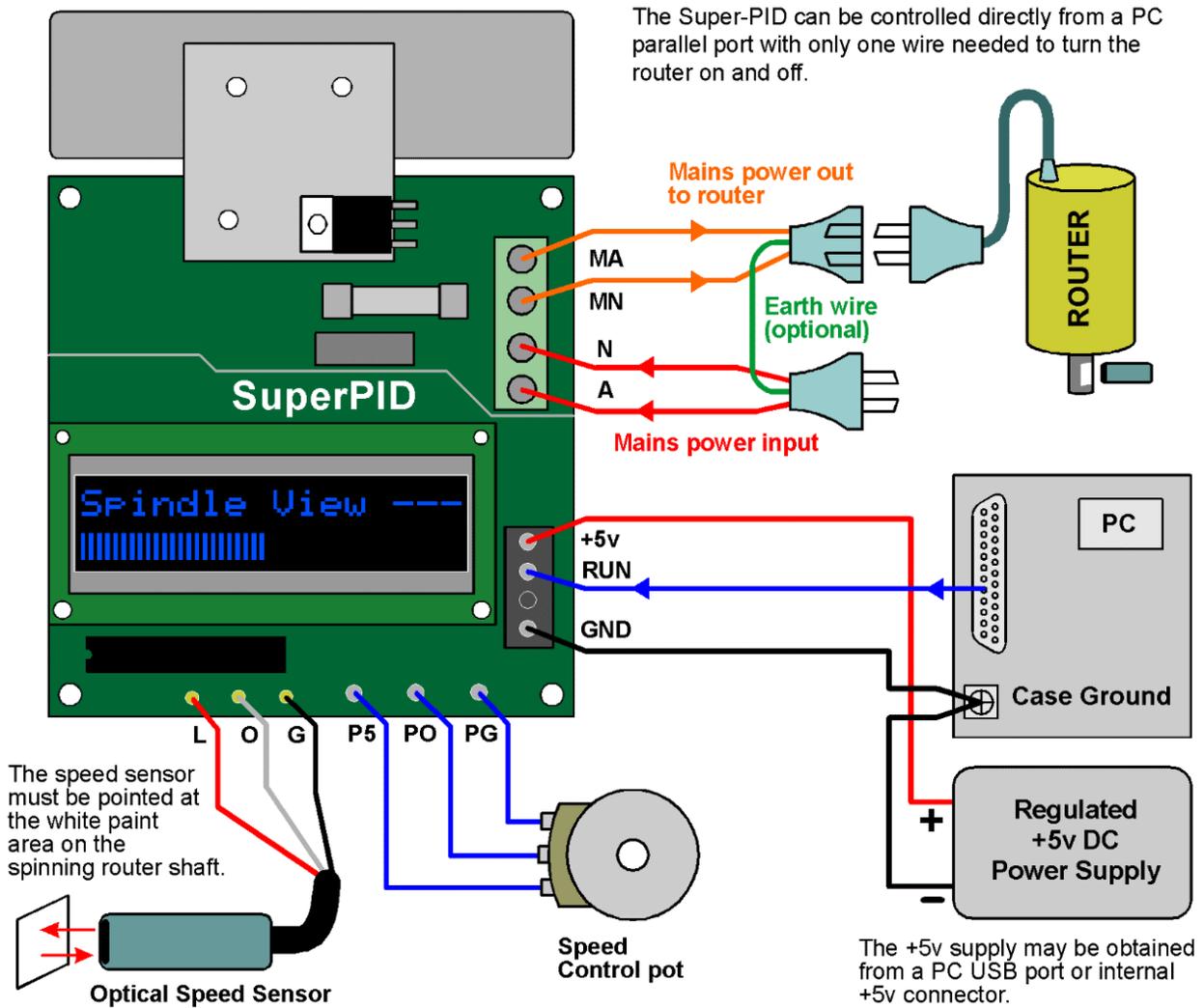


This is the minimum setup to operate the Super-PID manually.

You need to supply a "RUN" switch which can be any small toggle or slide switch.

The speed control pot and optical sensor are supplied with the Super-PID.

Typical PC connection



This is a popular method of connecting the Super-PID. The PC can turn the router on and off, but the speed control is still adjusted by hand.

The regulated +5v DC supply must share the same ground as the PC. Since many users get the +5v DC from the PC (USB port, or PC hard drive connector etc) this is standard.

A single wire is needed from one of the PC parallel port pins, to the "RUN" input on the Super-PID. Please see your PC CNC software instructions for Mach3 or EMC etc. to select the right parallel port pin.

Speed control knob modes

Super-PID version 1 has two speed control modes;

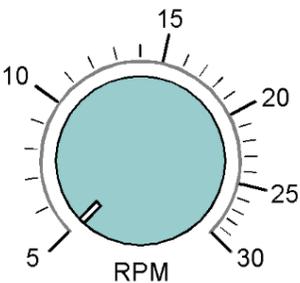
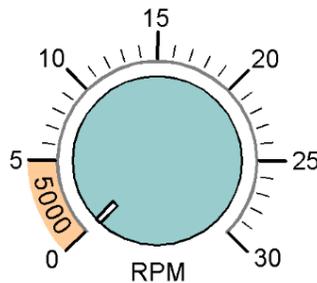
Firmware v1.1 This is the speed curve optimised for manual (knob) use.

Firmware v1.5 This is the speed curve optimised for PC speed control.

These firmware versions are programmed into the microcontroller on the Super-PID. They were supplied with the version that was ordered and cannot be changed. A chip-exchange program may be instituted in the future to allow users to change their firmware type. Please contact www.SuperPID.com for details.

Super-PID speed knob curve for each firmware type

The only difference between firmware v1.1 and firmware v1.5 is the curve used for the speed

firmware v1.1 for manual use	firmware v1.5 for Mach3 use
	
<p>The knob uses a semi-log curve. This is optimised to give excellent feel and ease of control. The range is expanded around the important 7000 - 17000 RPM range giving the ability for fine speed adjustment in that range.</p> <p>This also gives a similar percentage speed change for similar knob rotation - a very "human" feel.</p> <p>Definitely recommended if you will be manually using the knob as your main speed control.</p>	<p>This speed curve is linear by RPM over the entire range 0 - 30000 RPM. This is the way a computer likes it.</p> <p>The range below 5000 RPM is fixed at 5000 RPM.</p> <p>This allows direct speed control from PWM software like Mach3 and others, so the Super-PID responds accurately and linearly to the PWM control voltage.</p> <p>This does not give good feel or ease of control for manual knob use, but may still be usable if a large enough diameter knob is used.</p>

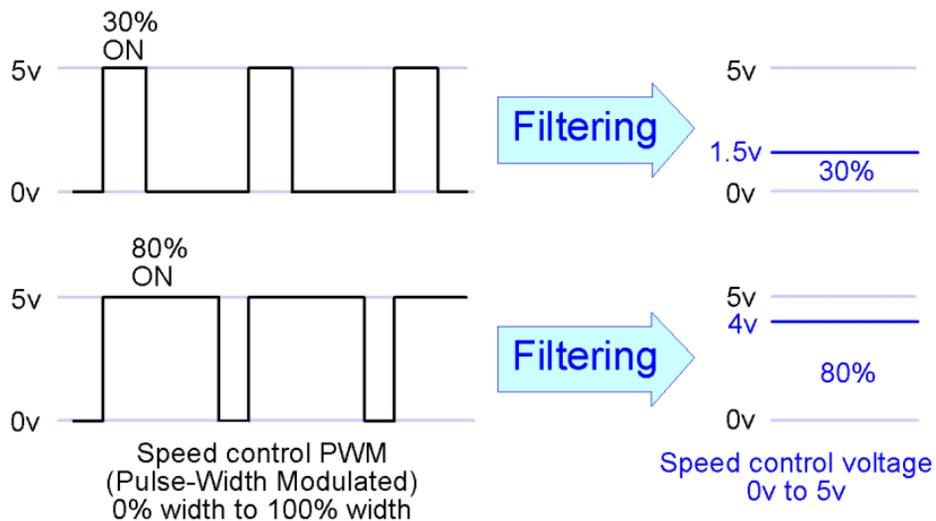
These modes set the speed curve used for the speed control system. One curve is best suited for manual use (with a knob) the other curve is optimised for computerised speed control using Mach3 or EMC or other PC CNC software.

PC speed control and PWM

Super-PID version 1 accepts a smoothed, filtered speed control voltage in the range 0v to 5v DC. Normally this speed control voltage comes from the middle connection of the speed control pot.

However it is also possible to control the router speed from another device, like a PC. To do this you need to derive a filtered DC voltage between 0v and 5v from the PC signal.

Most PC CNC software like Mach3 and EMC will produce a PWM speed control signal. This is a pulsating signal that can be filtered to produce an average DC voltage, which can then control the router speed.



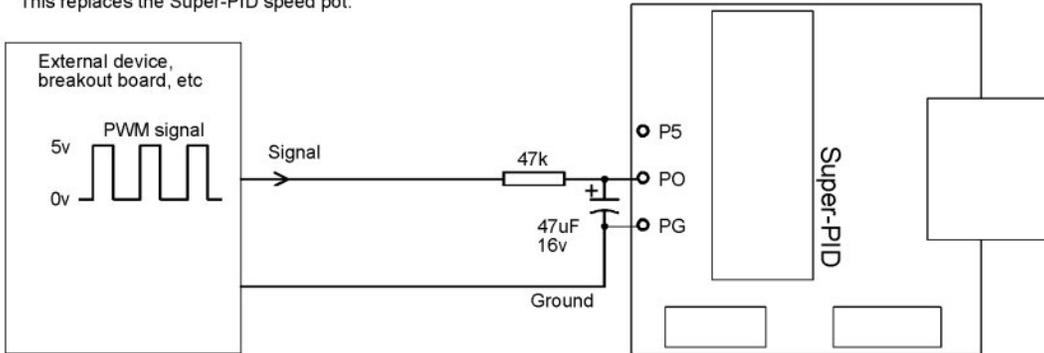
If you have a PWM signal from a CMOS logic level pin (like most breakout boards, Smoothstepper etc) it can be filtered with a simple resistor and capacitor, and the filtered signal applied to the Super-PID "PO" terminal instead of the signal from the pot.

If you need to derive the speed control voltage from the parallel port, you need a CMOS buffer device or an adapter device to generate the filtered 0v to 5v control voltage.

Please see the schematics on the following pages for some possible connection options.

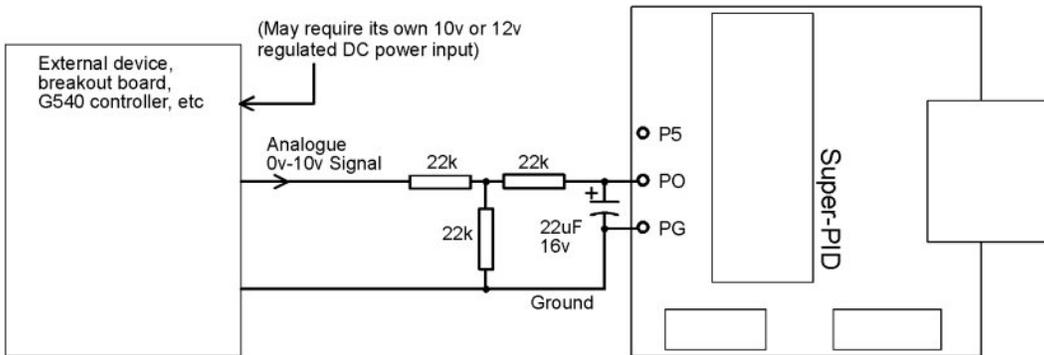
Connecting an external 0v to 5v speed-control voltage to Super-PID, instead of the speed control pot.

The external device must produce either a PWM signal generated by a CMOS buffer IC, switching between 0v and 5v, or must produce an analog voltage output somewhere between 0v and 5v. This replaces the Super-PID speed pot.



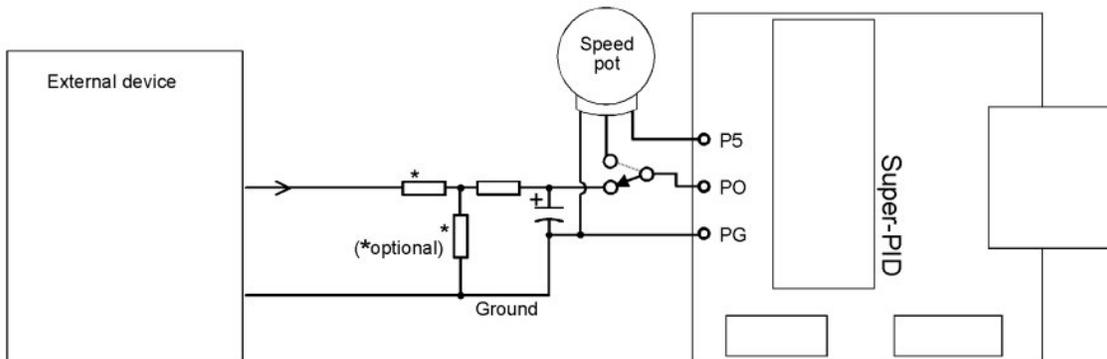
Connecting an external 0v to 10v speed-control voltage to Super-PID, instead of the speed control pot.

The external device must produce an analog voltage output somewhere between 0v and 10v (or 0v and 12v). This replaces the Super-PID speed pot.



Switching between an external speed-control voltage and Super-PID's own speed control pot.

The external device should be configured as one of the options shown above. A standard SPDT change-over switch can be used to select between the external control and the pot. The motor should be brought to a standstill before operating the change-over switch.



PWM filter schematic

The schematics on the previous page require PWM from a CMOS driver (like a break out board) that produces 0v to 5v PWM, or they require a filtered 0v to 5v DC speed control voltage.

However, if you only have PWM from a PC parallel port, this does not produce a full 5v pulsating signal. The parallel port generally produces a "TTL level" PWM signal of about 1v to 3.5v.

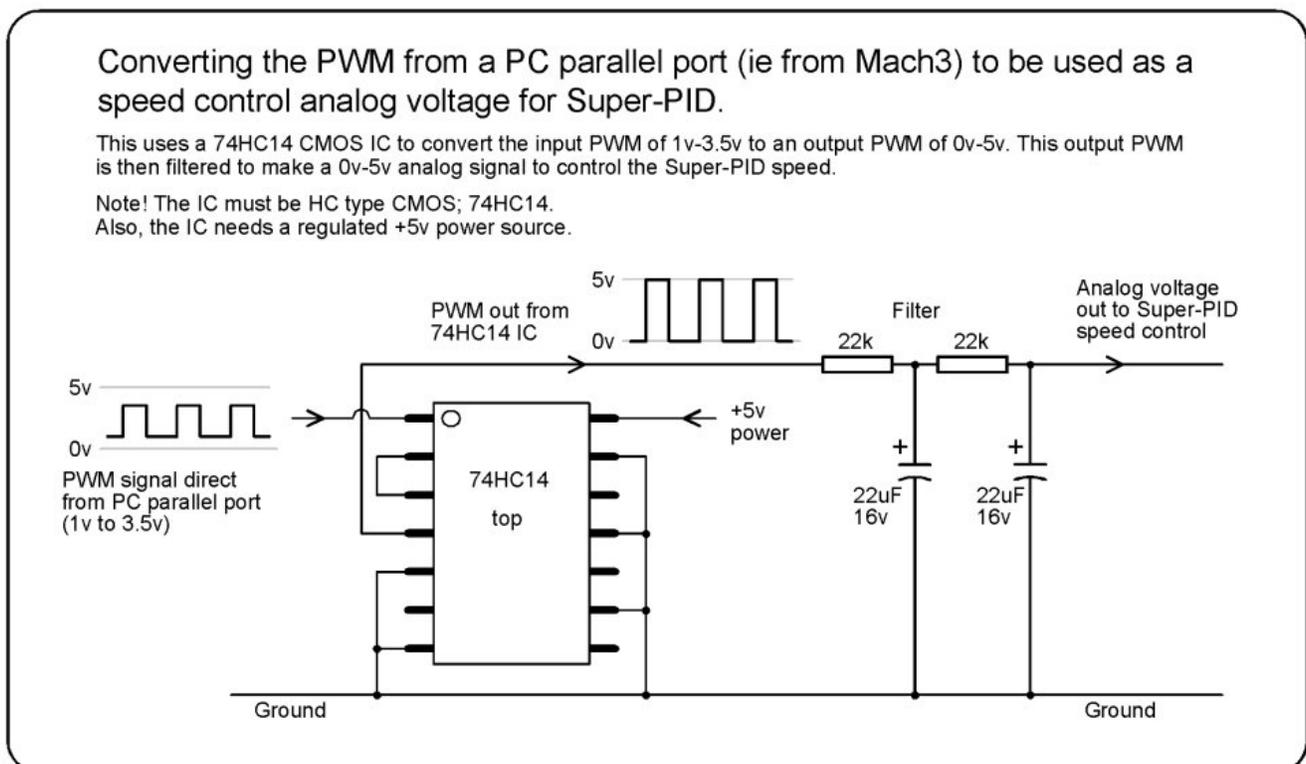
The circuit below was designed to allow people to take PWM directly from a PC parallel port and convert it to a filtered 0v to 5v DC speed control voltage which can go direct to the Super-PID speed control terminal (the "PO" terminal).

Filter Kit.

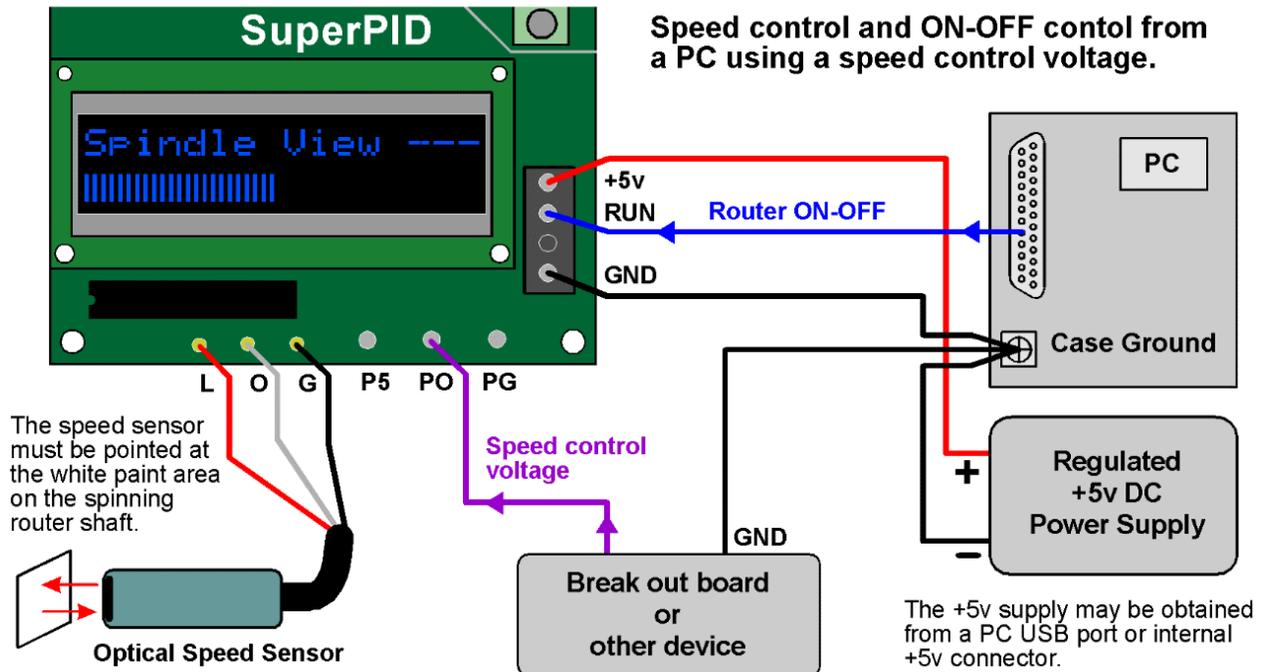
The circuit below, including all parts and a small prototyping PCB is available as a kit of parts from www.SuperPID.com for the cost of a few dollars.

Note! This kit requires mid-level electronics skills to build, and is not suitable for a beginner.

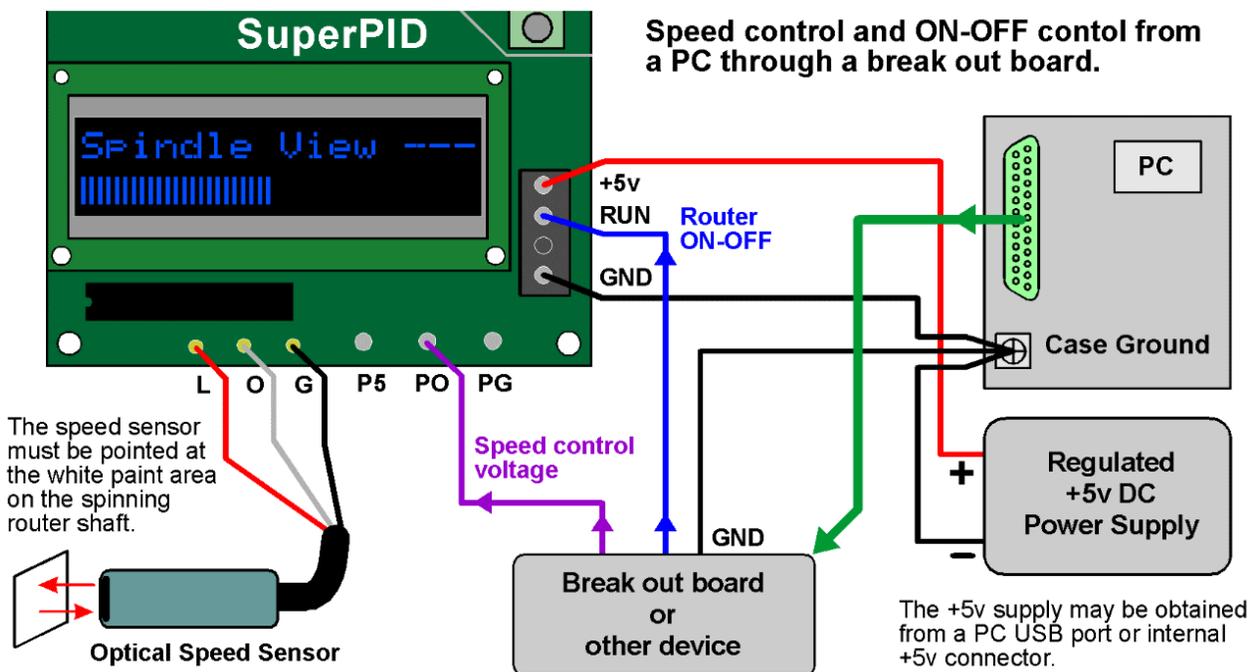
In most cases this filter circuit is NOT needed, as seen on the previous page there are other options that may be an easier choice for your machine setup.



PC speed control using control voltage

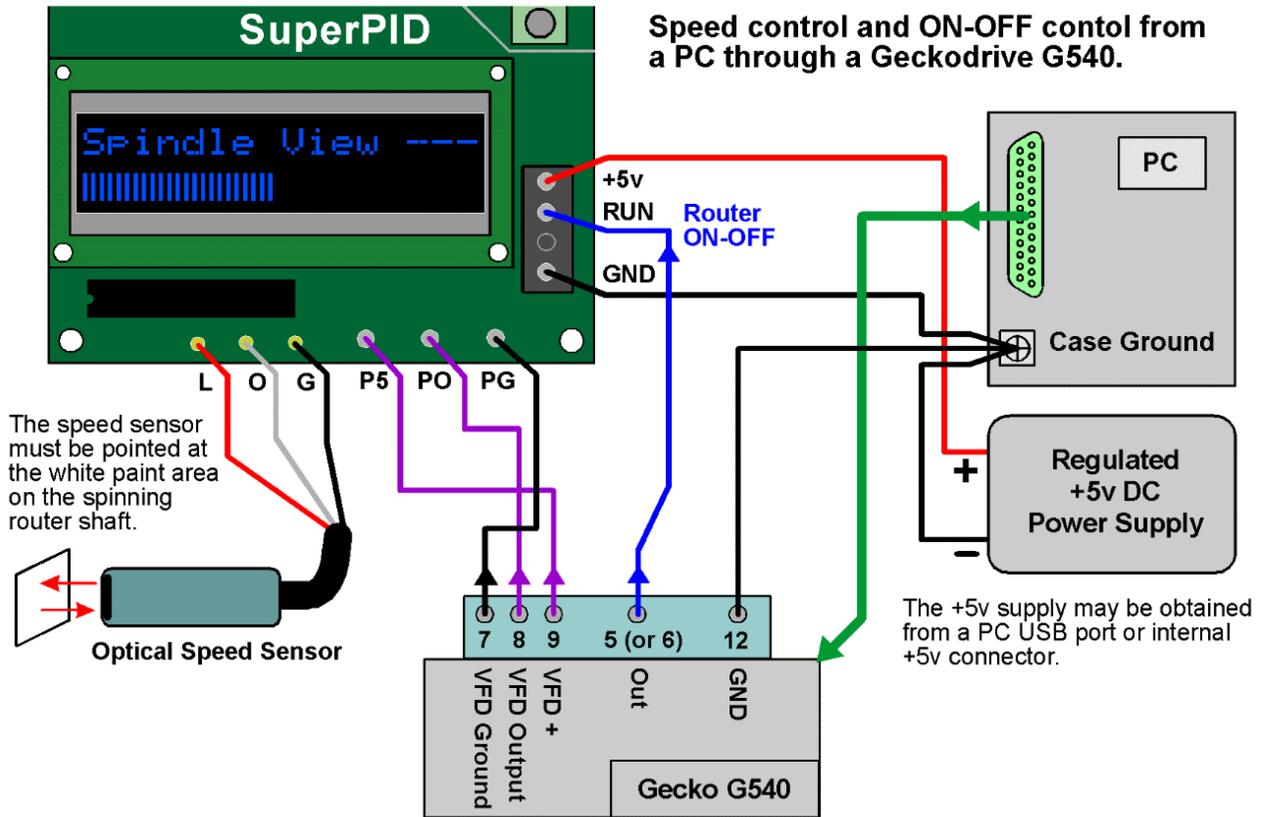


This shows connection to a PC parallel port to provide router ON - OFF control, and to a separate device that produces the 0v to 5v speed control voltage, sometimes called a "VFD control voltage". Below shows a popular alternative connection where both signals are produced by the break out board or other device.



PC speed control from Gecko G540

Owners of the Gecko G540 stepper motor driver can connect it directly to the Super-PID using the wiring shown below;



This is a common and popular setup where the G540 produces the 0v to 5v speed control voltage and also produces the router ON - OFF control signal.

This requires that the G540 power ground (its pin 12) is connected to the PC ground and +5v supply ground.

This setup allows the G540 to control machine E-stop function in the normal way and means that the Super-PID will turn the router OFF when E-stop is activated.

Setting up Mach3 for speed control

Note! Please refer to the Mach3 software instructions or Mach3 technical support for more details, as this procedure may change with different versions of the Mach3 software.

The Mach3 software provides support for spindle ON - OFF control and for PWM spindle speed control.

Please refer to section 5.3.6 of the Mach3 manual; "Configuring the Spindle" specifically the screenshot (Figure 5-7) showing "Spindle setup tab of the ports and pins dialog". You need to select "Use spindle motor output" and select "PWM Control". Then set the "PWM base freq" to 50 (which is 50 Hz).

Then refer to section 5.5.5 "Spindle motor speed control setup" and specifically 5.5.5.2 "Pulse width modulated spindle controller" for more information.

Then see figure 5-21 "Config > spindle pulleys... Dialog" and set the pulley max speed to about 30000 RPM. This figure may need to be tweaked slightly to get the calibration exact.

Many users are reporting that values like these work well;

Pulley Min = 0 to 300 RPM

Pulley Max = 30100 to 30200 RPM

Setting up other PC software

Your PC CNC software needs to be set to produce a PWM output signal that is proportional to the desired spindle RPM. This will usually be done with a calibration value. Super-PID calibration needs the max PWM (100%) to correspond with 30000 RPM, and the minimum PWM (0%) corresponds with 0 RPM.

You may also need to set up a spindle ON - OFF output, Super-PID will turn the router ON when this output is 0v, and turn the router OFF when this output is 5v.

Spindle calibration (all PC software)

The RPM tacho on the Super-PID display is quite accurate. Calibrating your PC software can be done simply by setting the RPM on the PC software, then checking what the actual router RPM is on the Super-PID tacho.

Then the PC software calibration value can be adjusted (if needed) to give a good correlation between the desired RPM and the actual RPM.

Advanced connections

TACH - output terminal

The TACH output terminal outputs a logic level (0v to 5v) pulsating signal that matches the RPM signal from the spindle RPM sensor. Like the spindle sensor, this is one pulse per rotation so at 6000 RPM it outputs 6000 pulses per minute or 100 pulses per second. The TACH output is an optional output, it is not needed for normal Super-PID operation but it is provided to allow the connection of an external RPM tacho display. Also, some users connect the TACH output back to the PC to allow real-time RPM display on the PC screen.

OP - Open-Loop mode input terminal

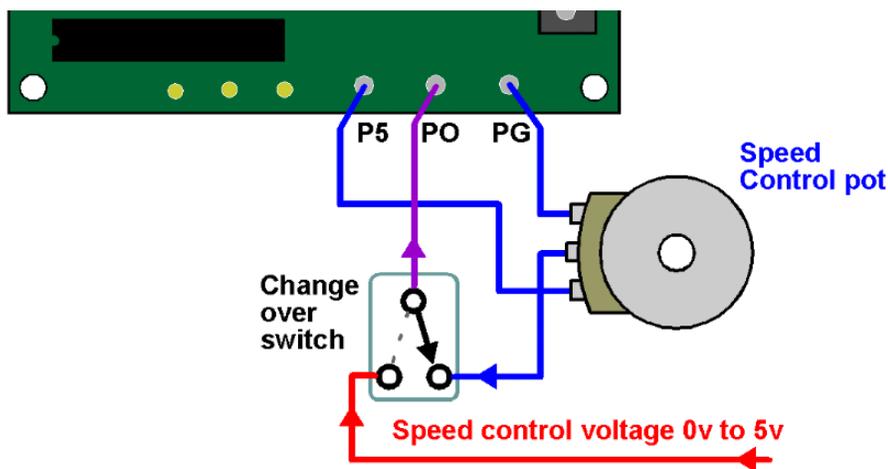
If the OP terminal is connected to ground (usually to the ground terminal next to it) the Super-PID is put into Open-Loop mode. This can be done at any time, even when the router is running. Open-loop mode means the Super-PID ignores the spindle RPM sensor, and does not require the spindle RPM sensor. It is a simple mode where the amount of power supplied to the router depends on the speed knob position. This is similar to many old fashioned motor speed controllers. Open-loop mode can be used for testing, or for emergencies to run the router if the spindle RPM sensor has failed or become fouled.

ST - Stable mode input terminal

If the ST terminal is connected to ground the Super-PID goes into "Stable mode". This disables some of the finer PID speed control and although speed regulation will not be as exact the PID system will be very tolerant of load pulses. Stable mode is rarely needed, this is an emergency option to be used only if the router speed is pulsating due to a difficult cutting task. Larger routers are naturally more stable and this mode will never be needed.

Switching between speed knob control and PC speed control

Some Super-PID users prefer to have both speed control systems available. To do this you need to add a change-over switch, usually called a SPDT type switch. This switch connects either the speed control voltage from the pot (knob) or it connects the speed control voltage from the PC.



The diagram shows how to switch between a speed control voltage and the speed pot.

Speed control systems

About open loop speed control.

Open loop speed control is the most common system and is used in many low cost speed controllers and inbuilt into most modern routers.

Open loop means that the amount of power to the router is adjusted, and the router runs faster or slower as a result. Although open loop is simple and cheap it has a serious problem at lower speeds. To run the router at low speeds the router is given very little power, and then if any cutting load is applied the router speed drops dramatically or even stalls. So with open loop speed control there is very little cutting power available at low speeds. Most manufacturers will limit their open loop speed controls to about 15000 RPM as a minimum speed, and even then the router will have much less usable power at the lower speeds.

About compensated open loop speed control.

Because of the lack of power at low speeds with standard open loop control, most of the better quality speed controllers use a compensation system. They measure the motor current, and if the motor current rises (due to cutting load) the power to the router is adjusted upward in an attempt to compensate for the speed drop. This system works reasonably well with medium router speeds, and is used on most decent quality routers but is still limited to speeds of around 15000 RPM and above.

About closed loop speed control.

Closed loop means that the actual speed of the router is measured, and the power to the router is adjusted to keep the speed constant. This is quite rare in commercial routers as it requires more complex electronics inside the router, and possibly computing power. However the Hitachi router M12VC is one router known to have this type of internal speed controller. Simple closed loop controllers can suffer from instability especially at low speed where the motor is naturally much less stable, so simple closed loop controllers generally are generally still limited to about 8000 to 10000 RPM as a minimum speed.

About PID speed control.

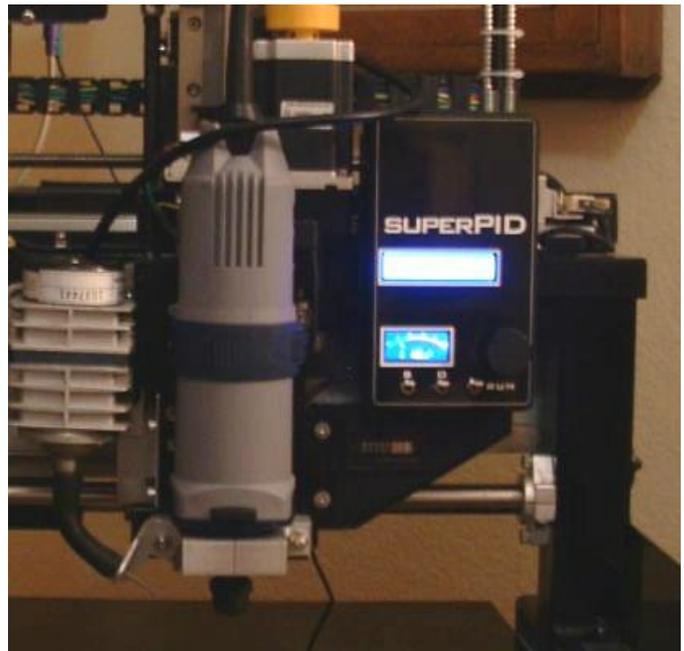
PID stands for Proportional Integral Derivative. These are three separate mathematical systems for closed loop speed control working together in a highly tuned way to maximise the strengths of the three systems and give the desired result of accurate speed control, good power at low speeds and high stability. In the past PID was an expensive option usually reserved for large industrial motors where the complexity and cost of a proper PID system would be justified.

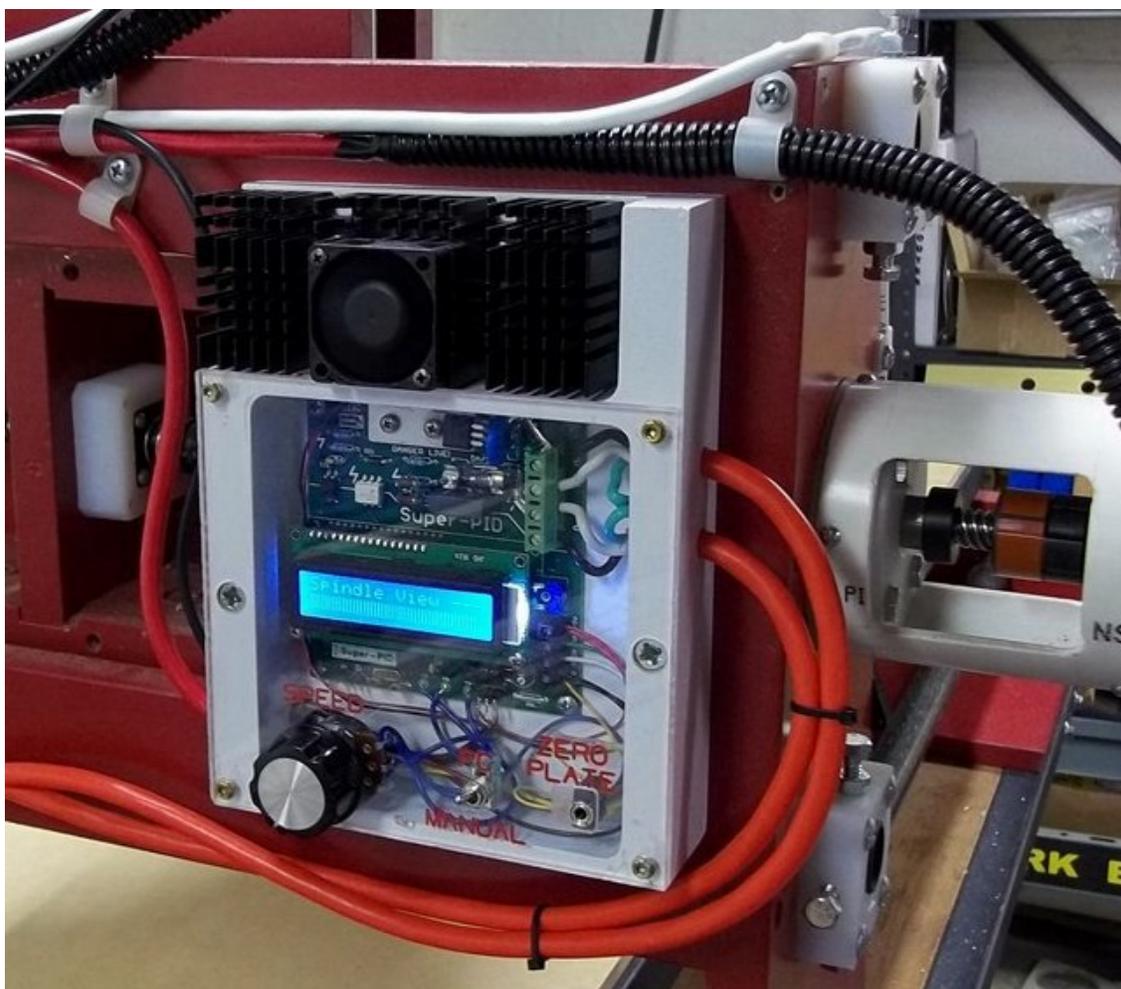
Router motors are designed for higher RPM use and 25000 to 30000 RPM is typical. To run a router motor at 5000 RPM is difficult as the router motor is inherently less stable and less powerful at these lower speeds, so it is critical to have a properly tuned PID system. The Super-PID uses a high speed microcontroller chip to constantly monitor the router speed hundreds of times a second and do the PID math in real time and almost instantly control the power to the router. The result is that the router can be run even at speeds as low as 5000 RPM and still have excellent cutting power and good stability. Furthermore the PID algorithm in the Super-PID has been carefully optimised specifically for routers, and optimised for the specific types of pulsating loads introduced by router cutting bits of 1 to 4 flutes.

User's box enclosures



Above is a clear enclosure carved out of solid perspex, and an exotic hardwood enclosure with clear perspex front. Below is a white plastic electronics enclosure to match a white machine and a black enclosure that matches a black machine.





Above shows a neat custom shaped enclosure with external heatsink.

Safety Note! If your heatsink can be touched it is necessary to make sure the heatsink is electrically insulated from the heatsink tag on the Super-PID. This means using an insulating gasket and non conductive screws. Generally the best option is to enclose the entire heatsink so it can never be touched (as seen in the examples on the previous page).

Super-PID links and resources

www.SuperPID.com

Official home site for the Super-PID product. The latest instructions can be downloaded from here.

http://www.cnczone.com/forums/diy-cnc_router_table_machines/112658-super-pid_new_low-cost_router_speed_controller.html

This is a long and informative thread on the CNC Zone forum. It covers the early development of the Super-PID and has discussions between the designer of the SuperPID and the Super-PID users. There are a lot of photos and details of user installations, router modifications and tech support. Highly recommended reading.

http://groups.yahoo.com/group/mach1mach2cnc/post?postID=nzdpBiPqs0r0JjBX1fa24Y4lhTmXzX1AddeAPY8GCBsWx9q2R1ZINW6clgL3GiHRMO4UI-sn538wld5YSK7-TH_sCkSoVw

Super-PID discussion on the Mach3 PC software forum.

http://www.youtube.com/watch?v=NIHa6_MpN7A

Video of Super-PID cutting acrylic with a 5mm endmill at 8000 RPM.

http://www.youtube.com/watch?v=oBJ4Ebo-_HU

Video of Super-PID drilling acrylic with a 1/8" drill bit at 5000 RPM.

<http://www.youtube.com/watch?v=h1s9f72dKPc>

Video of a Super-PID and a cheap 850W router easily cutting aluminium at 7000 RPM with a 5mm end mill and giving a good finish.