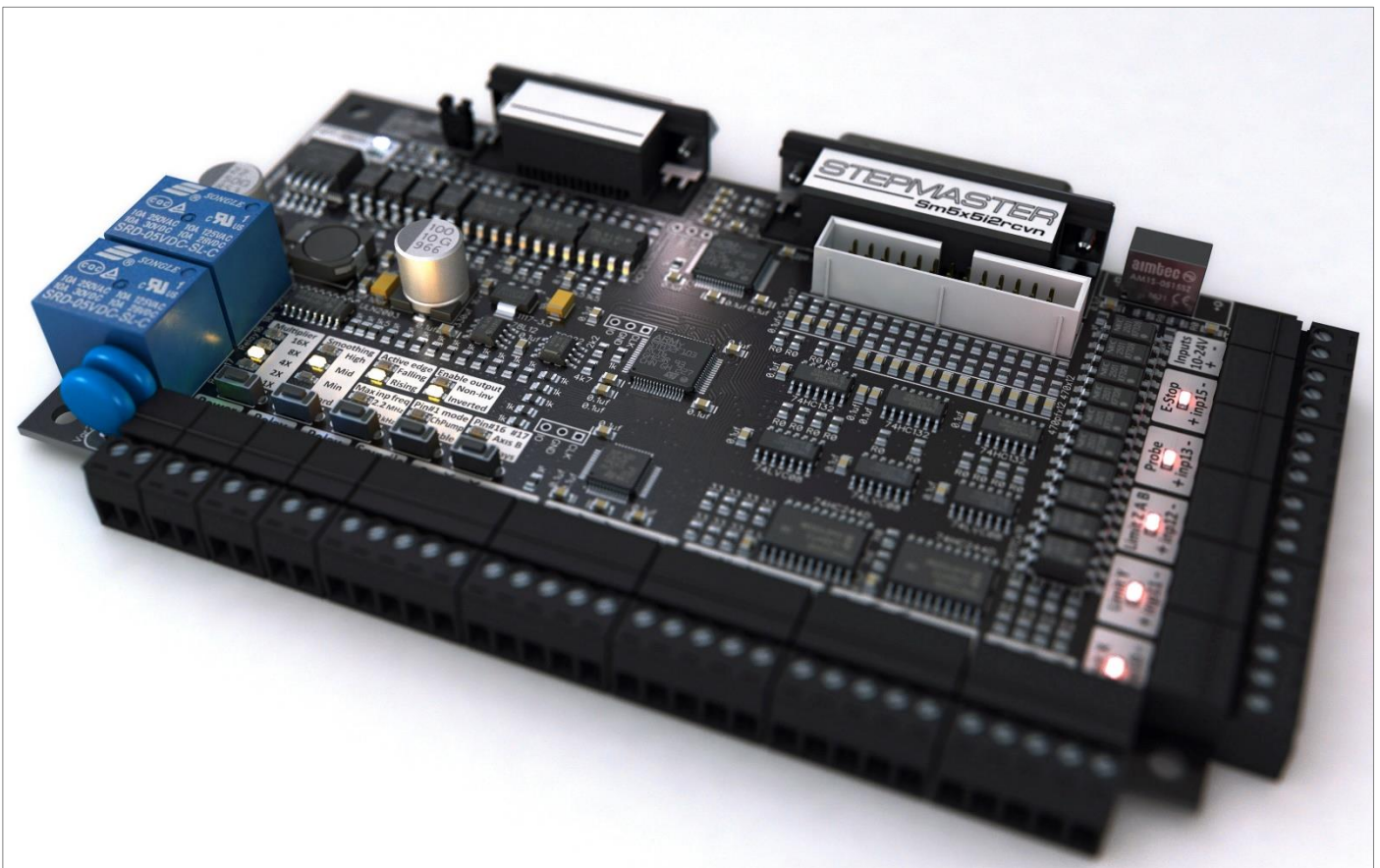


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**StepMaster ver 2.5**  
**Cortex M3 microcontroller based**  
**CNC interface board for LPT port or NCStudio5**  
**With digital signal processing**

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**User Manual**



## Overview:

StepMaster is a **5-axis** interface board.

Compatible with **Mach3**, **LinuxCNC**, **TurboCNC** and **NCStudio** (requires NCStudio5 PCI control card).

Designed to connect stepper or servo drives with Step/Direction connection.

**Five opto-isolated inputs with separate power supply** for connecting inductive sensors, tool length calibration probe, and buttons.

**Two relays** to turn on the spindle and additional equipment.

High linearity **analog output (0-10V)** to control the spindle speed.

Automatic input signal selection (LPT / NCStudio).

**Step frequency multiplication up to 16X.**

**Digital filtering** for the control signal (Hard, Minimum, Medium and High smoothing level).

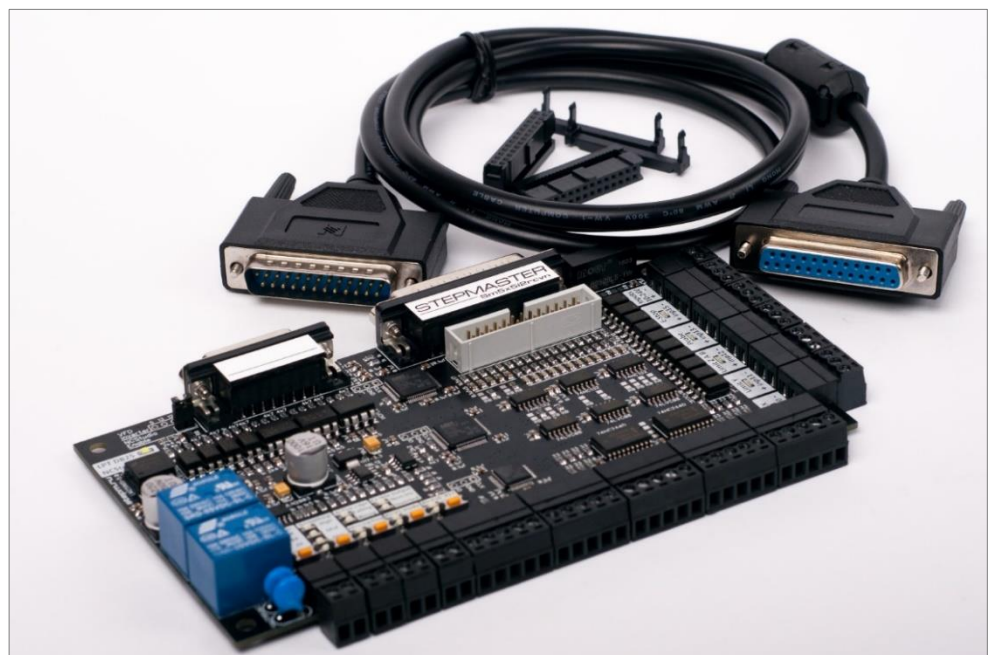
**Charge-Pump** signal support.

Compatible  
NCStudio cards:



## Complete set:

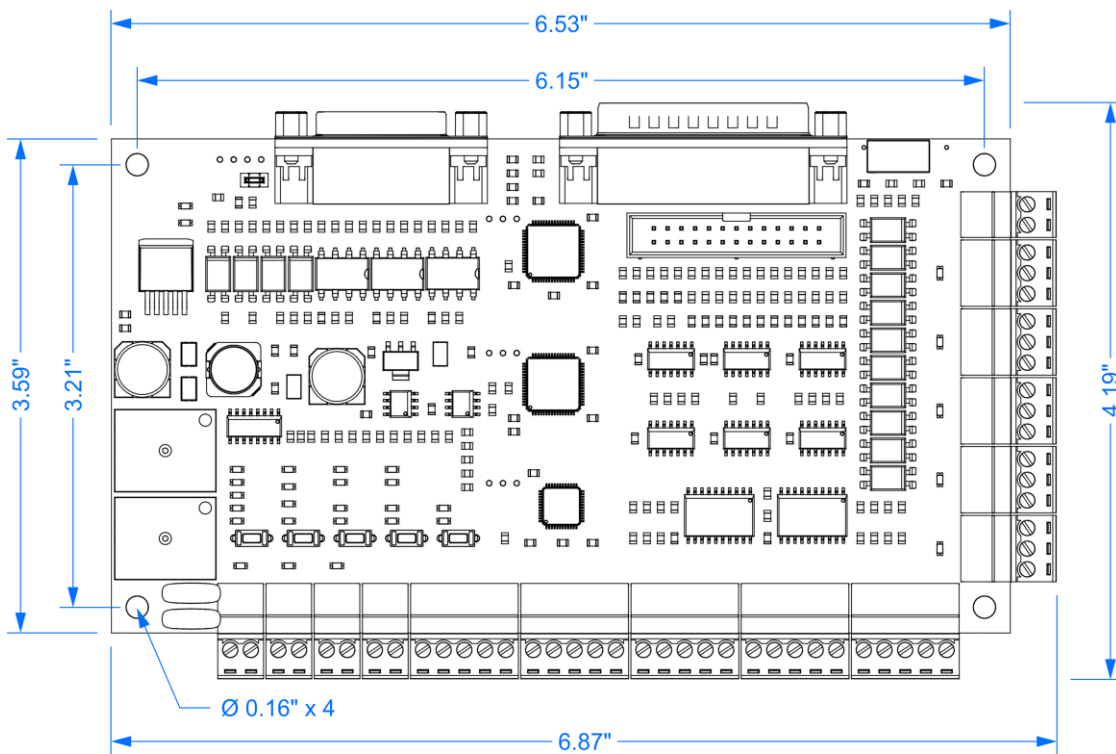
- StepMaster interface board
- DB25 Cable 1.4 m
- Ferrite for DB25 cable



## Specifications:

Power	<b>12 – 30 V</b> <b>2.5 W</b> Requires a separate power supply
Relays	<b>Two relays</b> <b>250 V, 7 A</b>
Step/Direction signal	<b>Input frequency – up to 2 MHz</b> <b>Output frequency – up to 32 MHz</b>
Step and Direction signals timing parameters	Direction signal switching - at the low level of Step signal Delay before Direction signal switching - 50 µs Delay after Direction signal switching - 100 µs
Digital filter parameters	Step frequency multiplier (micro-step fragmentation): <b>1X, 2X, 4X, 8X, 16X</b>  4 levels of signal filtering: <b>Hard, Min, Mid, High</b>  Step signal active edge selection - <b>Falling edge / Rising edge</b>  Input signal frequency range selection - <b>280 kHz / 2.25 MHz</b>
Additional features	<b>ChargePump</b> (switch off relays, analog output, and Enable signal)  Selection of direct or inverted Enable signal  Choice between the relays and <b>B-Axis</b> Relays can be controlled by #16, #17 LPT lines ( <b>B-Axis</b> disabled) or can function automatically ( <b>B-Axis</b> enabled)
Analog output for the spindle speed control	Output voltage <b>0-10 V</b> max current – <b>80 mA</b>
Inductive sensors power	Isolated power supply <b>9 V</b> <b>1 W (110 mA)</b>
Output signal parameters	<b>5V TTL, 20 mA</b>

## Dimensions:

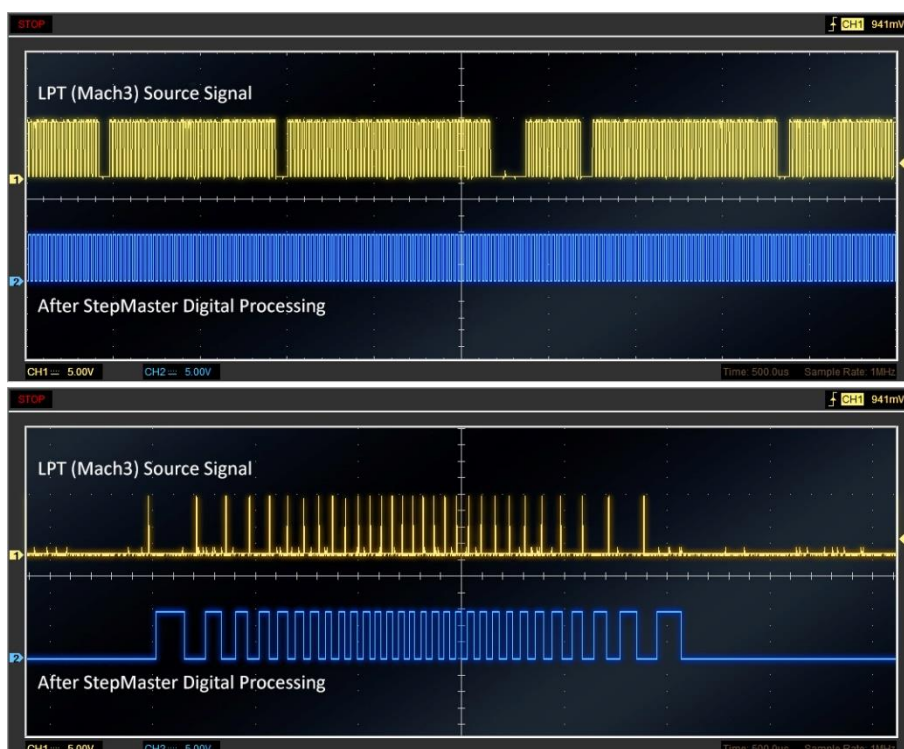


## Digital filter:

StepMaster has three **ARM Cortex-M3** micro-controllers which process step/direction control signal.

The digital filter removes the signal gaps, eliminates bursts of machine acceleration and speed and makes movement smoother and more accurate. Digital filter adjusts the output frequency every 100 microseconds (10 000 times per second). After processing, the output signal frequency changes more smoothly than the original signal. The machine runs much more stable.

StepMaster allows you to scale the Step signal frequency that lets you to use a smaller micro-step for smoother movement.





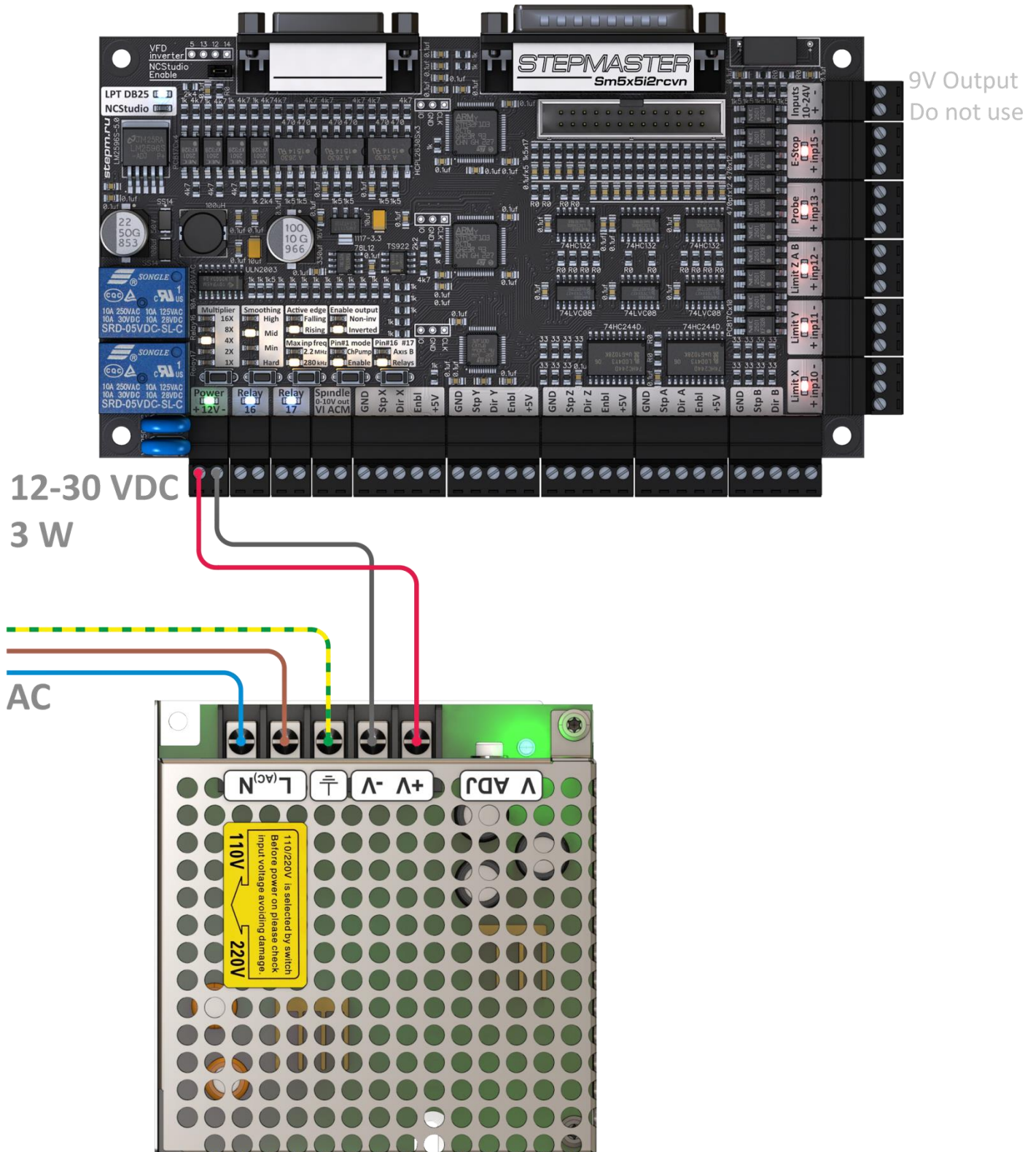
LPT cable length should be less than 3 meters. Do not use extension cords or non-standard cables.



- 5

## Power Connection:

Requires 12-24V power supply, 3 W or more.





Output signal: 5V TTL, 20 mA.



## Spindle frequency inverter Connection:

It is recommended to use relay # 17 to start and stop the spindle

This relay is controlled by LPT port line #17 (if B-Axis disabled), or automatically activated when the PWM signal is present on line #14 (B-Axis enabled).

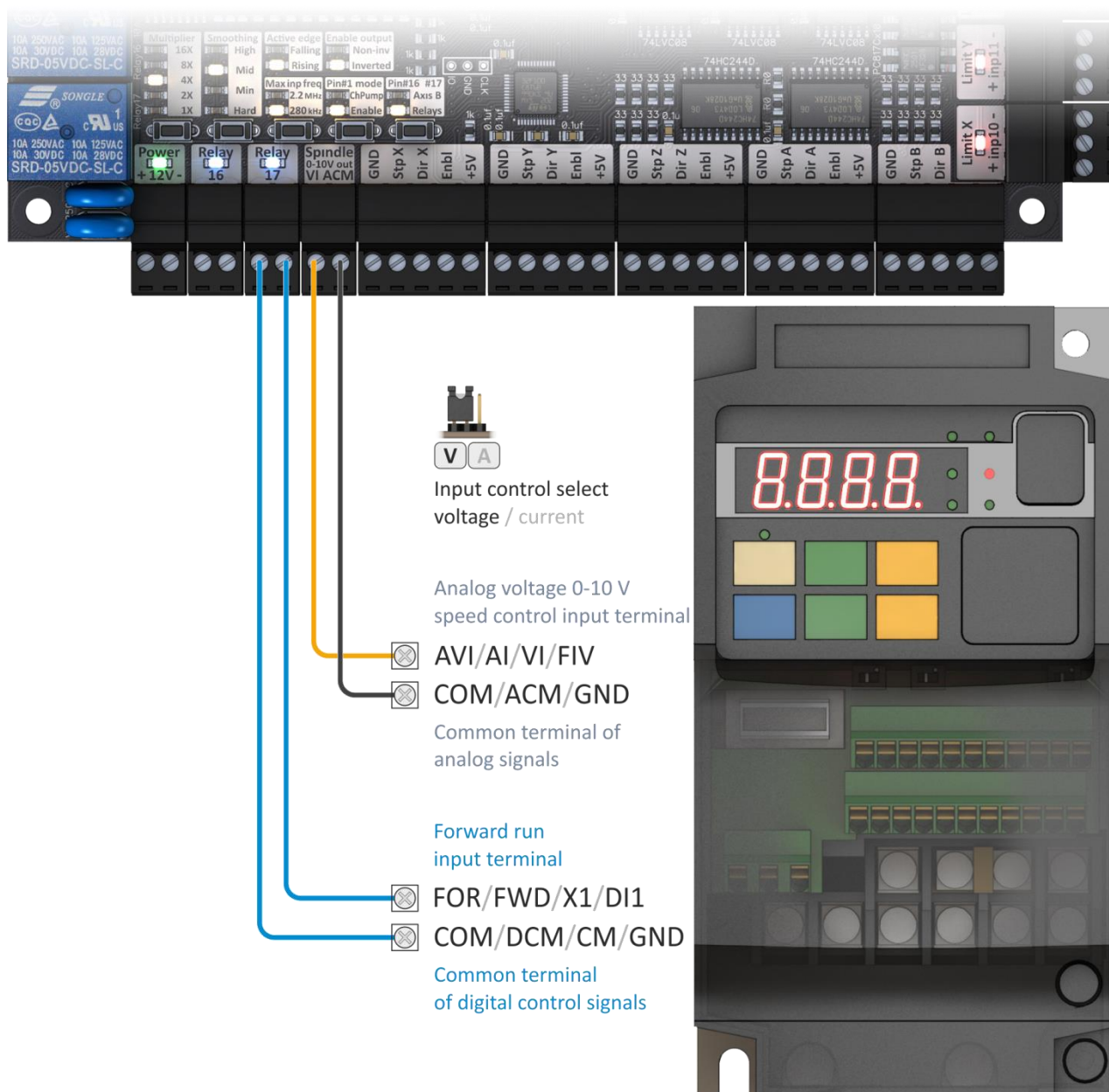
When using NCStudio relay #17 turns on automatically.

To control the spindle speed, connect a **Spindle 0-10V** analog output to a frequency inverter.

StepMaster uses a high-precision 12-bit DAC to output the analog signal.

When using NCStudio - spindle speed has only eight positions (0, 6000, 10000, 12000, 15000, 18000, 20000, 24000 RPM).

Inverters can be controlled, by voltage or by current signal. Switch the inverter control input to the voltage mode. Incorrect connection or setup can result in inaccurate or unstable speed control.



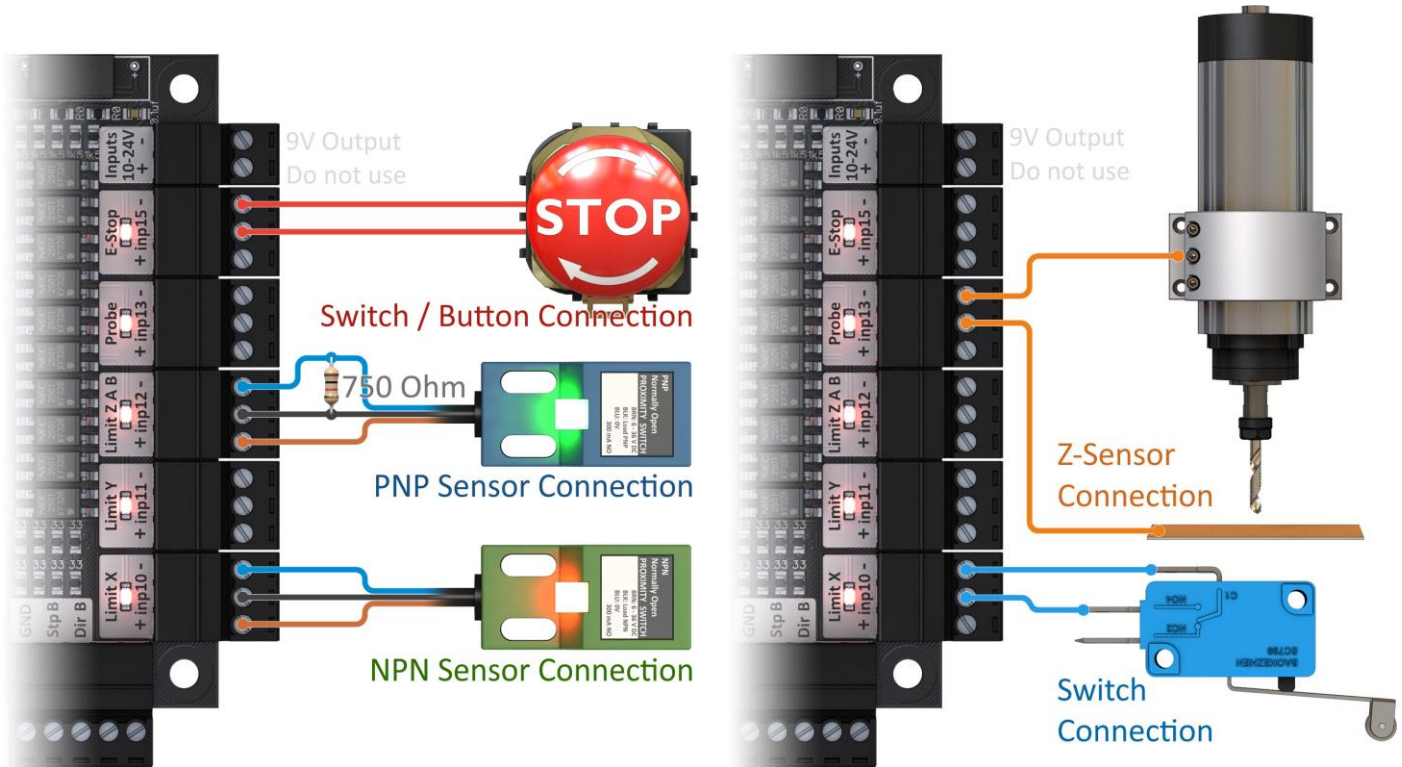


## Sensor and button connection:

**NPN type inductive sensors (Recommended)** can be connected directly to the StepMaster board without any additional components.

To connect **PNP type sensors**, you must install an additional 750 Ohm resistor.

**Mechanical switches, buttons** and **tool length sensor** can be connected without any additional components.

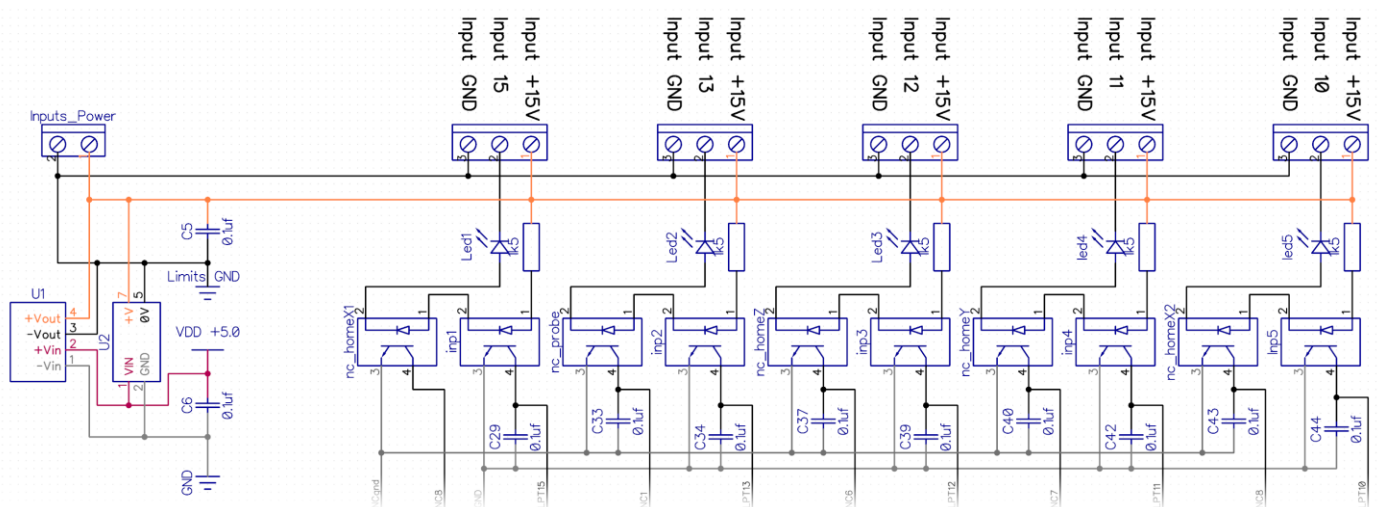


Inputs are opto-isolated and have a separate power supply 9V 1W.

### Warning!

Avoid contact closure "+" and "-". It will cause the inputs power supply unit to break down!

If this happens, you need to break off a DC-DC converter and connect the power to the board from a separate power supply unit (10-24 V) to "inputs 10-24V" terminal.



## Settings:



### Multiplier:

You can select a Step signal frequency multiplier.

This function allows you to increase the frequency of output signal for smaller micro-stepping and smoother machine movements.

For example, the maximum NCStudio step frequency - 47 kHz. If you choose a 4X multiplier maximum output frequency will increase up to 188 kHz.

### Smoothing:

Increasing the stability of step signal.

Signal filtering eliminates jerks in the machine motion and makes it work more smoothly, as well as significantly increases stability, maximum operating speed, and acceleration of the machine.

**High** smoothing - for poor-quality, unstable steps signal.

**Mid** mode is optimal for most tasks.

**Min** smoothing mode can be used at high precision machining, and accelerations more than 1000 mm/sec<sup>2</sup>, but creates a high load on the machine mechanics.

In the **Hard** mode StepMaster has minimal effect for the step signal.

### Active edge:

Choosing Falling / Rising edge Step allows you to select the active edge of the input Step signals.

If you are using LPT - no matter which mode is selected.

In other cases, it is recommended to set the Rise Step mode.

### Maximum input frequency:

This option allows you to filter out high frequency noise.

When using StepMaster board with LPT or NCStudio you should set 280 kHz option.

### Non-inverted / Inverted Enable Output:

Setup allows you to invert or not invert the output Enable signal.

This setting can be useful when using ChargePump mode to match the configuration of drivers and connection.

You may need to change settings when using NCStudio. NCStudio does not work with Enable signal. StepMaster changes Enable signal when connected to an active NCStudio board.

If you need the drivers powered on constantly, even when the computer is power off - disconnect the Enable terminals from the drivers.

### Pin#1 mode - Enable / Charge Pump:

You can select **Enable** mode or **Charge-Pump** mode.

In the first case, the Enable signal can be controlled by changing LPT pin #1.

Using **ChargePump** mode and to activate drivers and relays you should send a frequency signal (50 Hz or more) to the #1 LPT pin.

Without such signal, StepMaster disables the Enable outputs, disables both relays (regardless of relays control signals) and sets zero voltage on the analog output.

This mode prevents activation of machine electronics during PC startup and immediately turns off the machine if the control program “freezes”.

### Pin#16, Pin#17 mode - AxisB / Relays 16,17:

Setup allows you to select direct relays control by #16 and #17 lines, or control the fifth B-Axis.

In 5-axis mode relays switch to automatic mode. In this case, relay #16 is on if Enable mode or ChargePump mode is active.

17 relay is activated if #14 line is active, or filling of #14 line PWM signal is greater than 1%

### NCStudio Enable jumper:

When the “NCStudio Enable” jumper is installed and cable connected to the running NCStudio PCI board, StepMaster will automatically switch to control from NCStudio. Removing the jumper disables the NCStudio control (even if the cable is connected), and switches to the LPT. You can replace the jumper with a micro-switch.

“LPT DB25” and “NCStudio” LEDs indicate which port is currently active.





## Settings for the CNC control program:

<b>Pin #1</b> – Enable	<b>Pin #10</b> – Input 10 (X limit)
<b>Pin #2</b> – Step X	<b>Pin #11</b> – Input 11 (Y limit)
<b>Pin #3</b> – Direction X	<b>Pin #12</b> – Input 12 (Z, A, B limit)
<b>Pin #4</b> – Step Y	<b>Pin #13</b> – Input 13 (Z = 0 sensor)
<b>Pin #5</b> – Direction Y	<b>Pin #14</b> – PWM to analog (0-10 V) converter
<b>Pin #6</b> – Step Z	<b>Pin #15</b> – Input 15 (E-Stop)
<b>Pin #7</b> – Direction Z	<b>Pin #16</b> – Relay 16 or Step B
<b>Pin #8</b> – Step A	<b>Pin #17</b> – Relay 17 or Direction B
<b>Pin #9</b> – Direction A	<b>Pin #18-25</b> – GND

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<http://stepm.ru/en/>

## Exemplary Mach3 Settings:

Engine Configuration... Ports & Pins

Port Setup and Axis Selection | Motor Outputs | Input Signals | Output Signals | Encoder/MPG's | Spindle Setup | Mill Options

Port #1

☒ Port Enabled

0xc378 Port Address

Entry in Hex 0-9 A-F only

Port #2

☐ Port Enabled

0x278 Port Address

Entry in Hex 0-9 A-F only

☐ Pins 2-9 as inputs

OR

MaxNC Mode

☐ Max CL Mode enabled

☐ Max NC-10 Wave Drive

Program restart necessary

Kemel Speed

☐ 25000Hz
 ☒ 35000Hz
 ☐ 45000Hz
 ☐ 60000Hz
 ☐ 65000Hz
 ☐ 75000Hz
 ☐ 100kHz

Note: Software must be restarted and motors retuned if kemel speed is changed.

Restart if changed

☐ Sherline 1/2 Pulse mode.  
☐ ModBus InputOutput Support  
☐ ModBus PlugIn Supported.  
☐ TCP Modbus support  
☐ Event Driven Serial Control

OK Отмена Применить

Engine Configuration... Ports & Pins

Port Setup and Axis Selection | Motor Outputs | Input Signals | Output Signals | Encoder/MPG's | Spindle Setup | Mill Options

Signal	Enabled	Step Pin#	Dir Pin#	Dir LowActi...	Step Low A...	Step Port	Dir Port
X Axis		2	3			1	1
Y Axis		4	5			1	1
Z Axis		6	7			1	1
A Axis		8	9			1	1
B Axis		16	17			1	1
C Axis		0	0			0	0
Spindle		14	0			1	0

OK Отмена Применить

Engine Configuration... Ports & Pins

Port Setup and Axis Selection
Motor Outputs
Input Signals
Output Signals
Encoder/MPG's
Spindle Setup
Mill Options

Signal	Enabled	Port #	Pin Number	Active Low	Emulated	HotKey
X ++		1	0			0
X --		1	0			0
X Home		1	10			0
Y ++		1	0			0
Y --		1	0			0
Y Home		1	11			0
Z ++		1	0			0
Z --		1	0			0
Z Home		1	12			0

Pins 10-13 and 15 are inputs. Only these 5 pin numbers may be used on this screen

Automated Setup of Inputs

OK
Отмена
Применить

Engine Configuration... Ports & Pins

Port Setup and Axis Selection
Motor Outputs
Input Signals
Output Signals
Encoder/MPG's
Spindle Setup
Mill Options

Signal	Enabled	Port #	Pin Number	Active Low	Emulated	HotKey
Probe		1	13			0
Index		0	0			0
Limit Ovrd		0	0			0
EStop		1	15			0
THC On		0	0			0
THC Up		0	0			0
THC Down		0	0			0
OEM Trig #1		0	0			0
OEM Trig #2		0	0			0

Pins 10-13 and 15 are inputs. Only these 5 pin numbers may be used on this screen

Automated Setup of Inputs

OK
Отмена
Применить



### Engine Configuration... Ports & Pins

Port Setup and Axis Selection | Motor Outputs | Input Signals | Output Signals | Encoder/MPG's | Spindle Setup | Mill Options

Signal	Enabled	Port #	Pin Number	Active Low
Digit Trig		1	0	
Enable1		1	1	
Enable2		1	0	
Enable3		1	0	
Enable4		1	0	
Enable5		1	0	
Enable6		1	0	
Output #1		1	17	
Output #2		1	0	
Output #3		1	0	

Pins 2 - 9 , 1, 14, 16, and 17 are output pins. No other pin numbers should be used.

OK | Отмена | Применить

### Engine Configuration... Ports & Pins

Port Setup and Axis Selection | Motor Outputs | Input Signals | Output Signals | Encoder/MPG's | Spindle Setup | Mill Options

#### Relay Control

☐ Disable Spindle Relays

Clockwise (M3) Output #

CCW (M4) Output #

Output Signal #'s 1-6

#### Motor Control

☒ Use Spindle Motor Output

☒ PWM Control

☐ Step/Dir Motor

PWMBase Freq.

Minimum PWM  %

#### Special Functions

☐ Use Spindle Feedback in Sync Modes

☐ Closed Loop Spindle Control

P  I  D

☐ Spindle Speed Averaging

#### Flood/Mist Control

☐ Disable Flood/Mist relays

Mist M7 Output #  Delay

Flood M8 Output #  Delay

Output Signal #'s 1-6

#### General Parameters

CW Delay Spin UP  Seconds

CCW Delay Spin UP  Seconds

CW Delay Spind DOWN  Seconds

CCW Delay Spin DOWN  Seconds

☒ Immediate Relay off before delay

#### Special Options, Usually Off

☐ HotWire Heat for Jog

☐ Laser Mode. freq I

☐ Torch Volts Control

☐ Torch Auto Off

#### ModBus Spindle - Use Step/Dir as well

☐ Enabled Reg  64 - 127

Max ADC Count

OK | Отмена | Применить

### General Logic Configuration

**G20,G21 Control**

☐ Lock DRO's to setup units

**Tool Change**

☒ Ignore Tool Change

☐ Stop Spindle. Wait for Cycle Start.

☐ AutoTool Changer

**Angular Properties**

Unchecked for Linear

☒ A-Axis is Angular

☒ B-Axis is Angular

☒ C-Axis is Angular

**Pgm End or M30 or Rewind**

☐ Turn off all outputs

☐ E-Stop the system

☒ Perform G92.1

☐ Remove Tool Offset

☒ Radius Comp Off

☒ Turn Off Spindle

**M01 Control**

☒ Stop on M1 Command

**Serial Output**

ComPort #  BaudRate

☒ 8-Bit 1 Stop ☐ 7 Bit 2-Stop

**Program Safety**

☐ Program Safety Lockout

This disables program translation while the External Activation #1 input is activated.

**Editor**

GCode Editor

**Startup Models**

☐ Use Init String on ALL "Resets"

Initialization String

**Motion Mode**

☒ Constant Velocity ☐ Exact Stop

**Distance Mode** ☒ Absolute ☐ Inc

**IJ Mode** ☐ Absolute ☒ Inc

**Active Plane of Movement**

☒ X-Y ☐ Y-Z ☐ X-Z

**Jog Increments in Cycle Mode**

Position 1	<input type="text" value="1"/>
	<input type="text" value="0.1"/>
	<input type="text" value="0.01"/>
	<input type="text" value="0.001"/>
Use 999 to indicate a	<input type="text" value="0.0001"/>
Continuous Jog selection.	<input type="text" value="1"/>
	<input type="text" value="0.1"/>
	<input type="text" value="0.01"/>
	<input type="text" value="0.001"/>
Position 10	<input type="text" value="0.0001"/>

**Shuttle Wheel Setting**

Shuttle Accel.  Seconds

**General Configuration**

☐ Z is 2.5D on Output #6

☒ Home Sw. Safety

LookAhead  Lines

☐ Ignore M calls while loading

☐ M9: Execute after Block

☐ UDP Pendant Control

☐ Run Macro Pump

☐ ChargePump On in EStop

☒ Persistent Jog Mode.

☐ FeedOverride Persist

☐ No System Menu in Mach3

☐ Use Key Clicks

☐ Home Slave with Master Axis

☐ Include TLO in Z from G31

☒ Lock Rapid FRO to Feed FRO

**Rotational**

☐ Rot 360 rollover

☐ Ang Short Rot on G0

☒ Rotational Soft Limits

**Screen Control**

☒ Hi-Res Screens

☐ Boxed DRO's and Graphics

☒ Auto Screen Enlarge

☐ Flash Errors and comments.

**Inputs Signal Debouncing/Noise rejection**

Debounce Interval:  x 40us

Index Debounce

☐ Disable Gouge/Concavity Checks

☐ G04 Dwell in ms

☒ Use WatchDogs

☐ Debug This Run

☒ Enhanced Pulsing

☐ Allow Wave Files

☐ Allow Speech

☐ Set Charge Pump to 5Khz - Laser Stndby

☐ Use OUTPUT20 as Dwell Trigger

☐ No FRO on Queue

Turn Manual Spindle Incr.

Spindle OV increment

**CV Control**

☐ Plasma Mode

☒ CV Dist Tolerance  Units..

☐ G100 Adaptive NurbsCV

☒ Stop CV on angles >  Degrees

**Axis DRO Properties**

☐ Tool Selections Persistent.

☒ Optional Offset Save

☒ Persistent Offsets

☒ Persistent DROs

☐ Copy G54 from G59.253 on startup

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