

# MaxESP V3

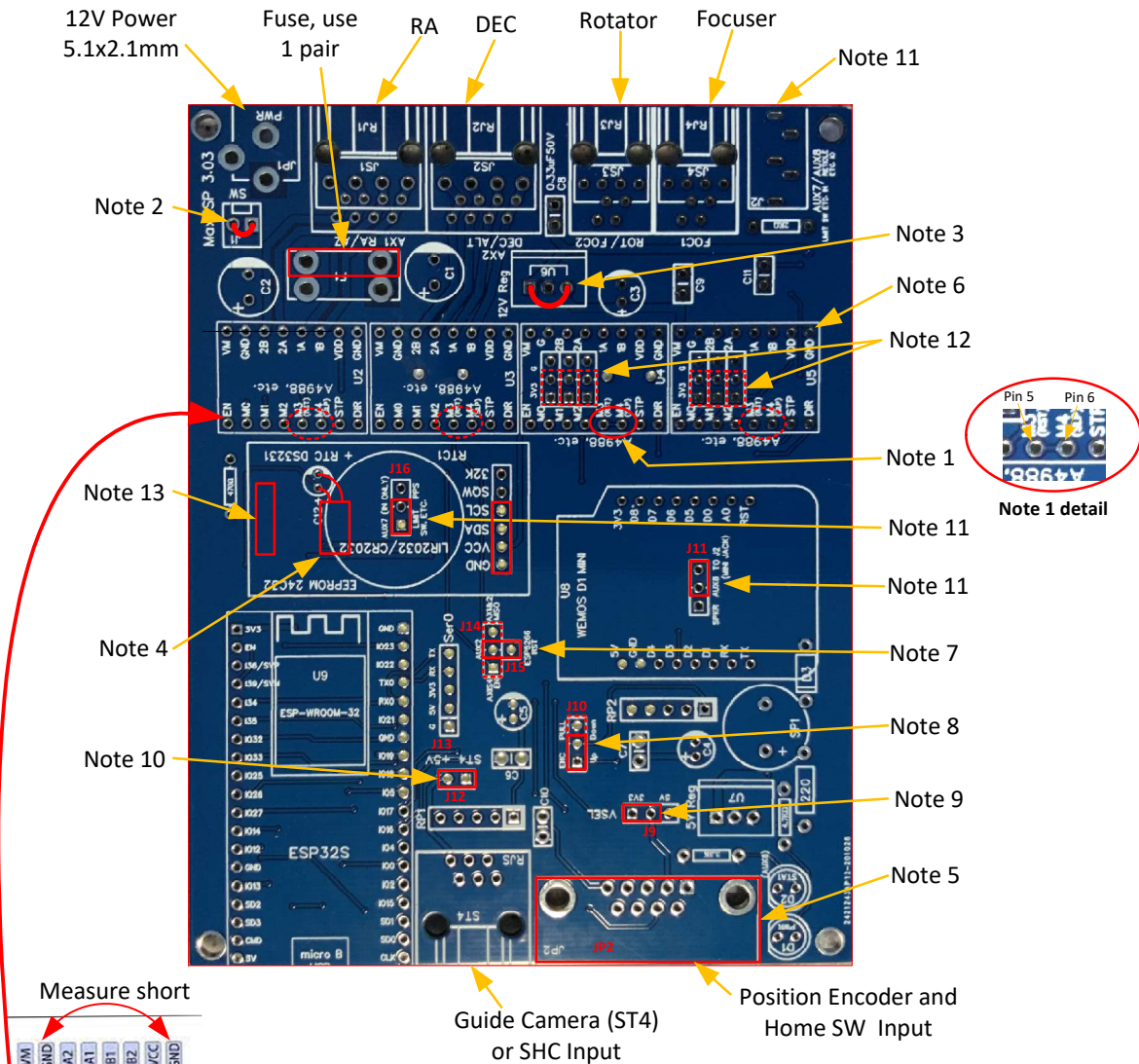
Baseline

## Supplemental Assembly Instructions

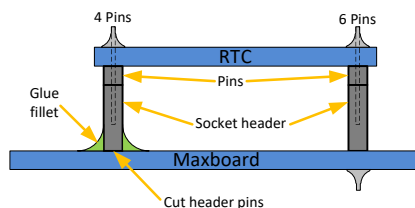
For Kits using the NodeMCU-32S processor in the OnStep and Smart Hand Controller, the  
LOLIN (WEMOS) D1 Mini Pro Wifi module, and various stepper drivers

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12/22/2021  
Version 1

# MaxESP V3 PCB Assembly Notes



Typical Driver. White box around lower left pin is enable (EN). Orient as shown. Not all drivers are marked this way! Confirm by measuring a short between ground pins on opposite side, or match pictures on Driver Reference page.



Note 13 RTC support detail

## Assembly Notes:

1) This board is wired for the A4988 driver. For many other drivers, the short between pins 5&6 on the PCB must be removed. The standard recommendation is to cut the clock pin on the module (pin 6 on PCB). A big note here: the pin numbering on some of the drivers are different from the numbering on the MaxESP board. Sometimes Pin 3 on the module correlates to pin 6 on the board. Refer to the "Driver Reference" or the datasheet for your particular driver type. In addition, some drivers may need pin 6 pulled low. For example, TMC5160 V1.1 requires a cut pin and a pulldown, V1.2, V1.3 does not require a pulldown (pulldown is already incorporated on the driver). Again, may different drivers can be used, but not all drivers are pin for pin compatible. Do your research!

2) Either use a wire jumper (use the molex if desired) or wire directly to these pads for a power switch

3) Secondary bus motor driver regulator for split voltage/driver systems. Axis 1&2 uses the primary bus (VM) and Axis 3&4 uses a secondary bus (VM2). This regulator is for Axis 3&4 (the secondary bus), and is used where you wish to use higher voltage rated drivers and corresponding bus voltage on Axis 1&2, but the drivers used in Axis 3&4 cannot withstand that higher voltage. All newer drivers can withstand 35V minimum. Most users typically use 24V primary bus voltages, thus, for most applications the regulator is not used, and simply jumpered across.

4) Check the height of this cap, the one provided may be too tall to provide proper clearance from RTC board. If so, lay this capacitor (C12) on its side. Tack down with hot melt glue or silicon rubber. See Note 7.

5) Be sure to use female sockets on the DE-9 to prevent bare exposed male pins connected to the WEMOS processor.

6) Use 8 pins sockets when possible. Cutting and trimming larger socket strips is tedious and can damage sockets. If the ends are not filed properly, there will be an interference fit between sockets strips (the tolerance is tight). **You cannot fit in one long strip**; The module pins spacing is 0.1" and the pin spacing between modules is 0.12"

7) Aux2 selection:

\*TMC2130/TMC5160 status and error detection, shunt Aux2 selection to Axis1&2 MISO;

\*WEMOS ESP8266 RST control, shunt Aux2 to RST; WEMOS pass thru programming. **This function is to be deprecated.**

\*Focuser1 DC motor enable, shunt Aux2 to AXIS4 EN, typically used for servo motors, otherwise not required.

**Background:** The WEMOS pass through programming is rarely used and has not been thoroughly tested. This function may be deprecated in the future and the code may be removed from SW.

**NOTE**, the focus driver does not need the Aux2 focuser enable input to operate a stepper. The enable line is pulled down internally and outputs are active unless you pull it high. This function is more of focuser "disable" to prevent DC motor runaway while the Onstep is booting. The wiki does not describe the exact advantage of using an enable for the Axis focuser. I do not believe this focuser DC motor function has been fully vetted on the MaxESP.

8) For position encoders, signal pull up or pull down. See Note 9. Check encoder data sheet.

9) VSEL: If using encoders, must be set to 3.3V or 5V. Note: WEMOS is not 5V tolerant, you must insure encoder signal pins do not put out more than 3.3V if powered by 5V. Many encoders are TTL output, i.e. 5V supply, Vout minimum = 2.4V, but maximum is still 5V. This is still enough to damage the WEMOS. Check on the Onstep boards for recommendations.

10) +5V to the ST4 connector. +5V required for the Smart Hand Controller

11) See Wiki. Aux7: Input only, PPS or Limit input. Aux8: I/O Buzzer or Reticle driver. Both may simultaneously connect to J2

12) Microstepping mode options for A4988 and similar drivers

MS1	MS2	MS3	Microstep Resolution
Low	Low	Low	Full step
High	Low	Low	Half step
Low	High	Low	Quarter step
High	High	Low	Eighth step
High	High	High	Sixteenth step

13) The RTC is unsupported on this side. Recommend installing 4 pins into RTC module. Plug these pins into a 4 pin socket header. Cut socket header PCB pins, leave the metallic socket intact (there are no pad/holes on the Max board). Install the module and apply epoxy or Gorilla glue to the OUTSIDE of the header where it interfaces with the Max board. Do not apply under the header, it may wick up into the socket/pins (apply a tiny piece of cellophane tape to cover the bottom of the header).

### Jumper Descriptions

J1: Power header; switch or jumper

J2: Not used, not implemented

J3,4,5: Microstepping selection for A4988 type drivers Axis 3

J6,7,8: Microstepping selection for A4988 type drivers Axis 4

J9: 3.3V or 5V selection for position encoder power (3.3V default)

J10: Encoder pull up (+V) or pull down (gnd) for encoder signals (pullup Voltage per J9)

J11: Aux\* function. Either buzzer or 1/8" jack (tip) reticle driver

J12: +5V for ST4 connector. Required if using smart hand controller

J13: Test points.

J14/15: Aux2 to WEMOS RST, axis 4 enable, or MISO

J16: Aux7 to PPS or from 1/8" jack (ring) limit input

### Aux Descriptions

Aux 1 N/A

Aux 2 Reset for Wemos or SPI for TMC5160 driver status, or DC motor focuser enable

Aux 3 DEC home Switch, or I2C for RTC

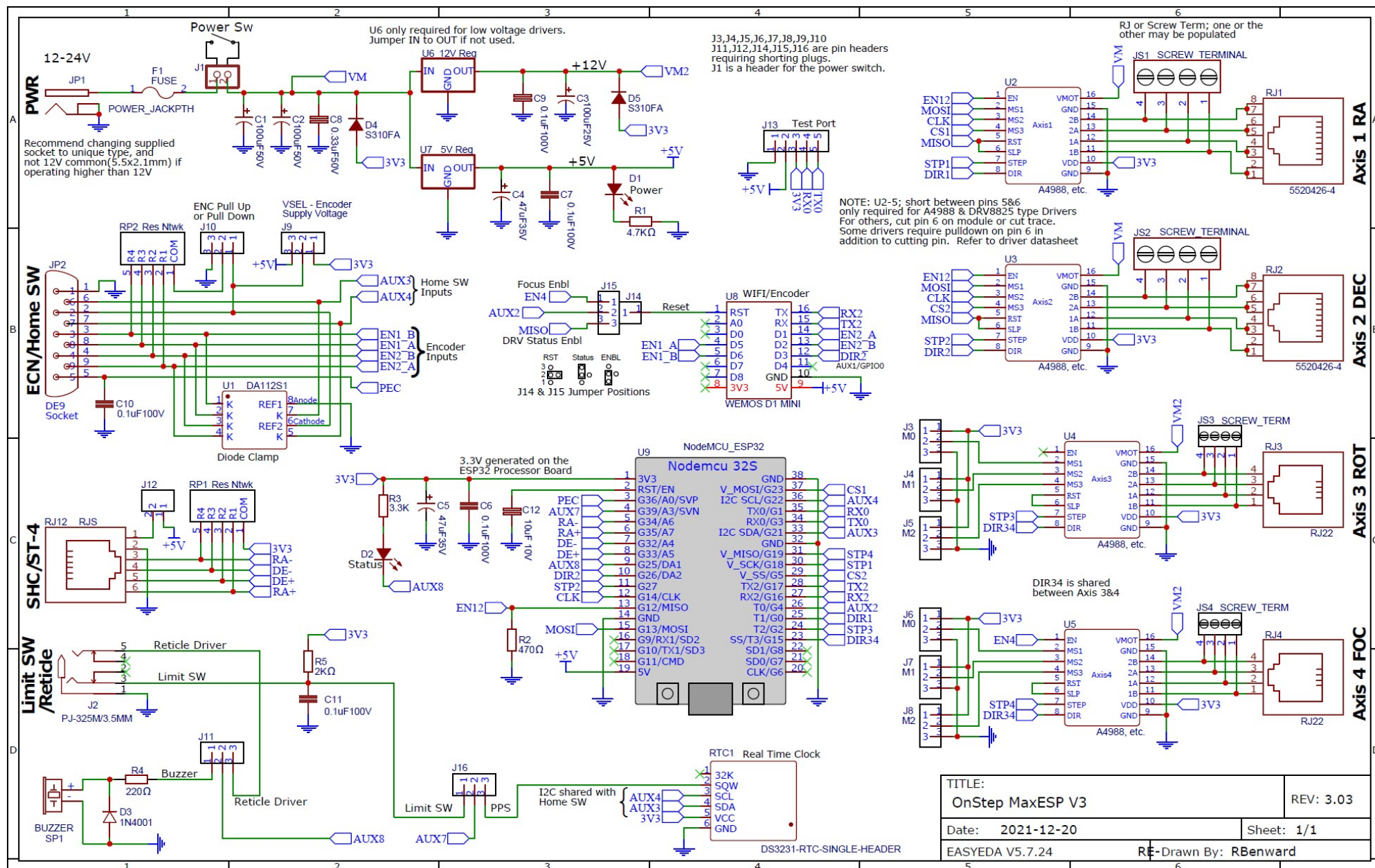
Aux 4 RA Home Switch, or I2C for RTC

Aux 5 N/A

Aux 6 N/A

Aux 7 Limit SW or PPS from RTC

Aux 8 Recticle driver or Buzzer



TITLE:		REV: 3.03	
OnStep MaxESP V3			
Date:	2021-12-20	Sheet:	1/1
EASYEDA V5.7.24		RE-Drawn By: RBenward	



# MaxESP Bill of Material

ID	QTY	Description	Mfr	Part number or value	Reference Designator	Footprint	Comments
1	2	Capacitor, Polarized, radial lead	generic	100uF 50V	C1,C2	CAP-D8.0XF3.5	8x3.5mm
2	1	Capacitor, Polarized, radial lead	generic	100uF 25V	C3	CAP-D6.3XF2.5	6x2.5mm
3	2	Capacitor, Polarized, radial lead	generic	47uF 35V	C4,C5	CAP-D5.0XF2.0	5x2mm
4	1	Ceramic, epoxy dipped	generic	0.33uF 50V	C8	CAP-PTH-SMALL-KIT	
5	5	Ceramic, epoxy dipped	generic	0.1uF 100V	C6,C7,C9,C10,C11	CAP-PTH-SMALL-KIT	
6	1	Capacitor, Polarized, radial lead	generic	10uF 10V	C12	CAP-D4.0XF2.0	
7	1	LED3/5mm same color or red/green	generic		D1, D2	LED3/5MM	
8	1	Diode, axial lead	generic	1N4001	D3	DO-41	
9	2	Diode, surface mount	On Semi	NRVBS310FA	D4,D5	SOD-123F	
10	1	Fuse holder	TE Connectivity	35684	F1	FUSEHOLDER_MINI_BLADE	
11	1	1x2 pin header, locking, MOLEX KK 1X2	MOLEX	22-23-2021	J1	MOLEX KK 1X2	
12	1	3.5mm Audio Jack (PJ-325M)	CUI inc	SJ1-3533NG	J2	AUDIO-PJ325	
13	11	1x3 pin header	generic		J3,4,5,6,7,8,9,10,11,15,16	1X3 HEADER	
14	1	1x2 pin Header	generic		J12	1x2 HEADER	
15	1	1x5 pin header	generic		J13	1X5 HEADER	
16	1	1x1 pin Header	generic		J14	1X1 HEADER	
17	1	1x6 socket header (RTC)	generic			1X6 HEADER	
18	10	1x8 socket header (drivers & WEMOS)	generic			1X8 HEADER	
19	2	1x19 socket header (ESP32)	generic			1X19 HEADER	
20	1	POWER_JACK 5.5mm x 2.1mm			JP1	POWER_JACK_PTH	
21	1	DE9 RT PCB Female	Amphenol	D09S33E4GV00LF	JP2	DB9	
22	2	4POS_SCREW_TERMINAL_3.5mm, (ALT to RJ style motor connectors)	TE Connectivity	1776275-4	JS1,JS2	4POS_SCREW_TERMINAL_3.5MM	
23	2	4POS_SCREW_TERMINAL_2.54mm, (ALT to RJ style motor connectors)	TE Connectivity	282834-4	JS3,JS4	4POS_SCREW_TERMINAL_2.54MM	
24	1	Resistor, axial, 4.7KΩ, 0.1W	generic		R1	AXIAL-0.3	
25	1	Resistor, axial, 470Ω, 0.1W	generic		R2	AXIAL-0.3	
26	1	Resistor, axial 3.3KΩ, 0.1W	generic		R3	AXIAL-0.3	
27	1	Resistor, axial, 220Ω, 1/4W	generic		R4	AXIAL-0.4	
28	1	Resistor, axial, 2KΩ, 0.1W	generic		R5	AXIAL-0.3	
29	2	Motor Jack, RJ style, 8P, axis 1&2	TE Connectivity	5520426-4	RJ1,RJ2	5520426-4	
30	2	Motor Jack, RJ style, 4P axis 3&4	TE Connectivity	5555980-1	RJ3,RJ4	5555980-1	
31	1	ST4 guiding jack, RJ style 6P	TE Connectivity	5569026-2	RJS	6P6C	
32	2	4 Resistor Network 5 Pin, 2.0K bussed	Bourns	4605X-101-202LF	RP1,2	4 RESISTOR ARRAY	
33	1	DS3231-Real Time Clock (RTC Module)	Aliexpress or Amazon	DS3231 RTC	RTC1	DS3231-RTC-24C32-EEPROM-SINGLE-HEADER	
34	1	BUZZER, Piezo	CUI inc	CEM-1203	SP1	BUZZER-12MM-KIT	
35	1	Diode array, ESD Protection, (optional)	ST micro	DALC112S1RL	U1	S08	
36	4	Stepper Driver, A4988 compatible, DRV8825, TCM2130, TCM5160, etc.	Various		U2,U3,U4,U5	GENERIC STEPPER MOTOR DRIVER CARRIER	
37	1	LM78xx style switching reg. 12V Reg	Murata Power Solutions	OKI-78SR-12/1.0-W36-C	U6	OKI78SR	Requires 24Vmax, 15Vmin. Not used when powering from 7-15V (jumped out).
38	1	LM78xx style switching reg. 5V Reg	Murata Power Solutions	OKI-78SR-5/1.5-W36-C	U7	OKI78SR	
39	1	Processor, WeMos D1 Mini Pro		LOLIN (WeMos) D1 Mini-Pro	U8	WEMOS_D1_MINI Pro	
40	1	Processor, NodeMCU, ESP32S-narrow		NodeMCU-32S	U9	NODEMCU-ESP32S-NARROW	

# Motor Driver Information

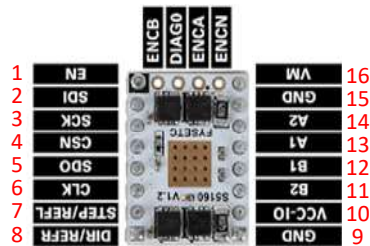
## CONFIRM ALL INFORMATION ON THIS PAGE!

- All drivers rotated for pin 1 EN in the upper left and pin 9 GND in the lower right. Some pin text may be upside down.
- PIN 6 CLK: The default procedure is to cut pin 6 on the driver module. If a pull down is also required, it may be easier to cut the trace between pin 5&6 on the MaxESP board and add the pulldown there. Note: Some drivers with CLK have internal fallback protection; they revert to internal CLK when signal is lost (or when it is left floating). Which means a pulldown may not be required. Refer to the driver module datasheet.
- For the purposes of these drivers, VCC = VDD = VIO = VCC-IO
- Motor Connections: In the end it doesn't matter; if the direction is wrong, you can swap terminals on one winding, or change it in Onstep SW, or in the SWS. All drivers are pin for pin compatible (pins 11 thru14) for the MOTOR WINDINGS! Refer to the motor winding page.

### Lettered Winding Nomenclature

Winding A, term 1&2  
Winding B, term 1&2

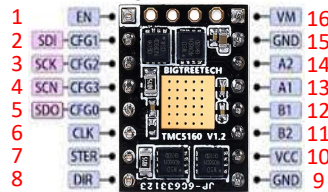
#### Silent5160 Fysetc



Gnd pin 6

#### TMC5160 V1.2 to V1.3

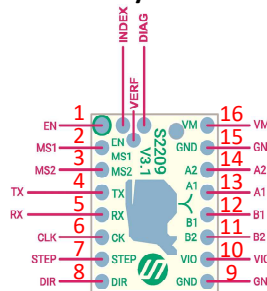
BigTreeTech



Gnd pin 6: V1.1  
Float pin 6 V1.2, V1.3

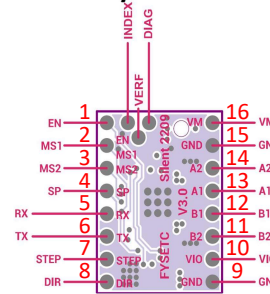
### Driver needs Pin 6 open (short removed)

#### S2209 Fysetc V3.1



Gnd pin 6

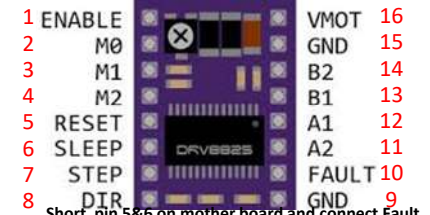
#### S2209 Fysetc V3.0



Float pin 6

### Driver needs Pin 5&6 shorted

#### DRV8825

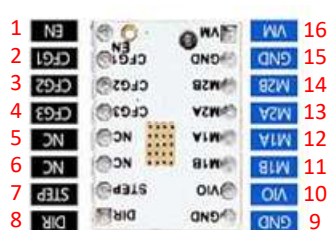


Short pin 5&6 on mother board and connect Fault pin 10 to VDD (Pin 10 already wired to VDD on all sockets).

### Numbered Winding Nomenclature

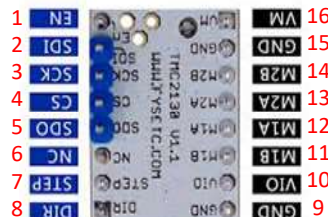
Winding 1, term A&B  
Winding 2, term A&B

#### TMC2100



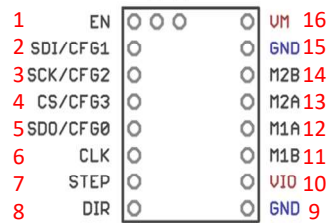
Float pin 6

#### TMC2130



Float pin 6

#### TMC5160 Watterott



V1.3 CLK, GND pin 6  
V1.4 DCO, FLOAT pin 6  
V1.5 DCO, FLOAT pin 6

#### LV8729



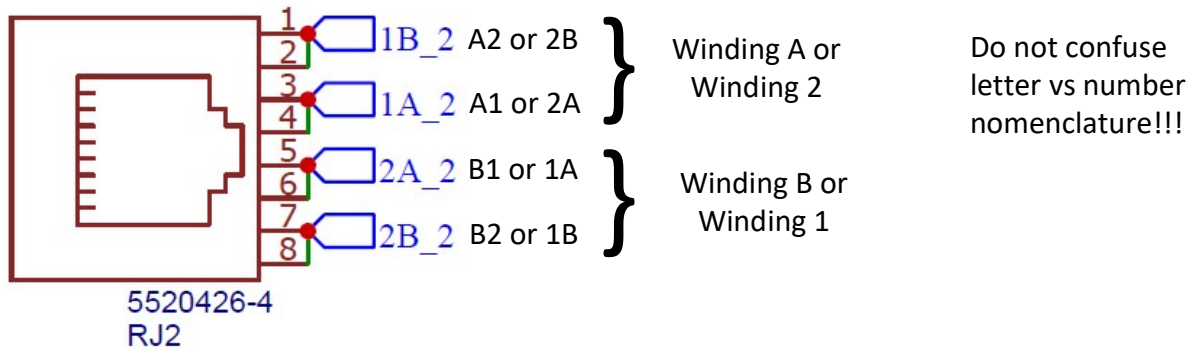
FLOAT? pin 5&6 not specified

#### A4988



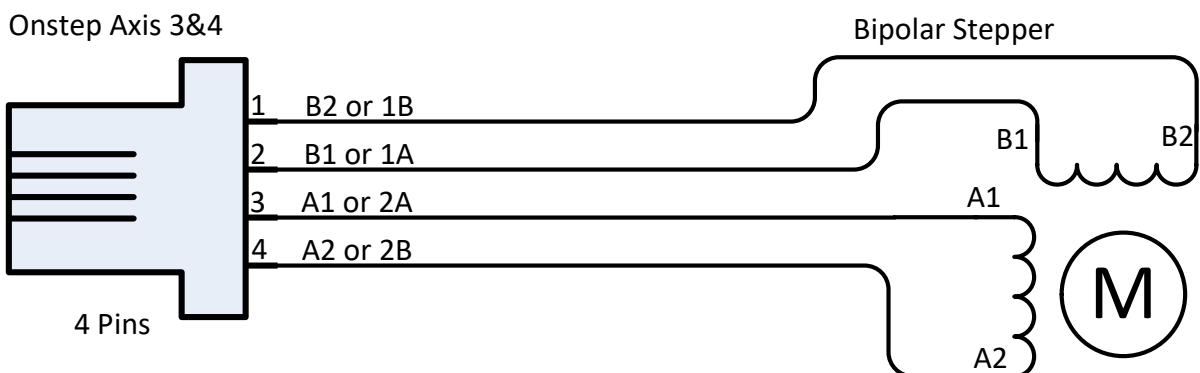
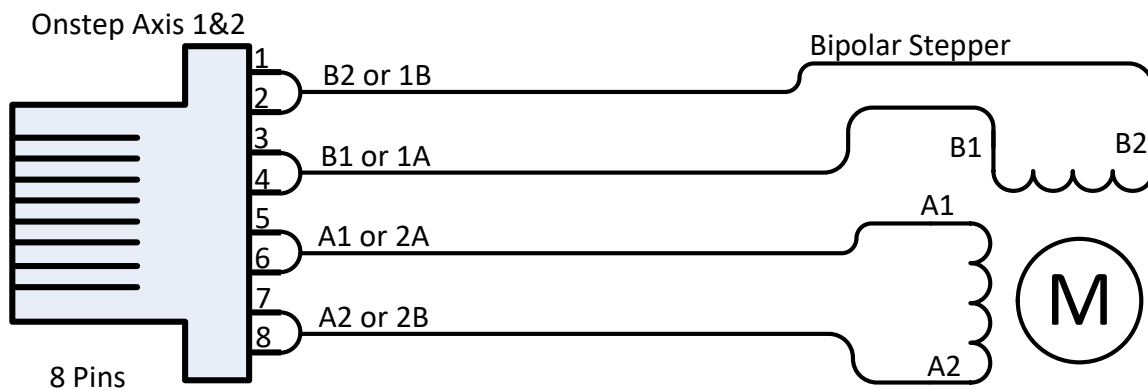
Short pin 5&6 on mother board

## Motor Driver Winding Nomenclature



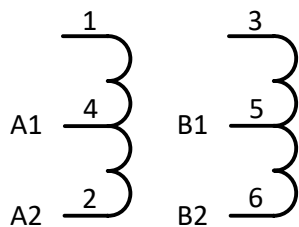
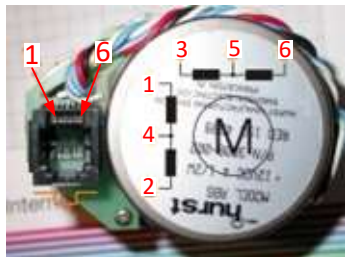
In the end, all you need to insure is that one winding is attached to the upper set of pins, and the other winding to the lower set of pins. The terminal or winding polarity is not important; you can flip motor direction in SW or just flip the winding polarities to reverse direction.

## Onstep Standard Bipolar Stepper Interface

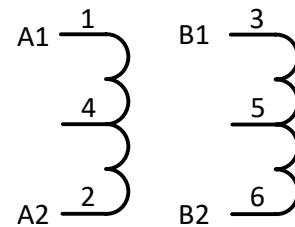


# Onstep Hookups using Original Losmandy DDS Motors

Unipolar motor hooked up in Bipolar mode



Option 1 Using half the windings

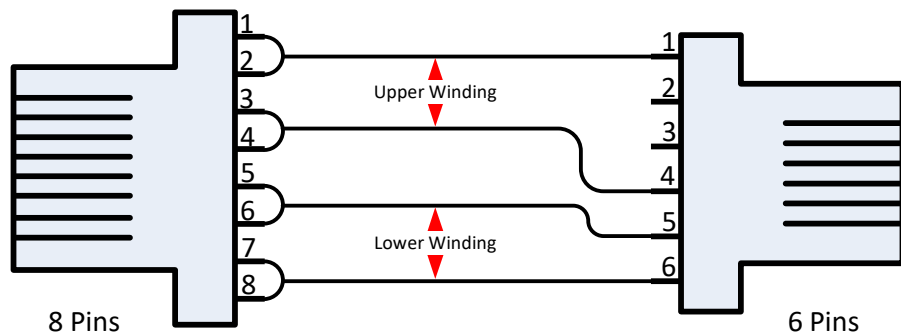


Option 2 Using the full windings

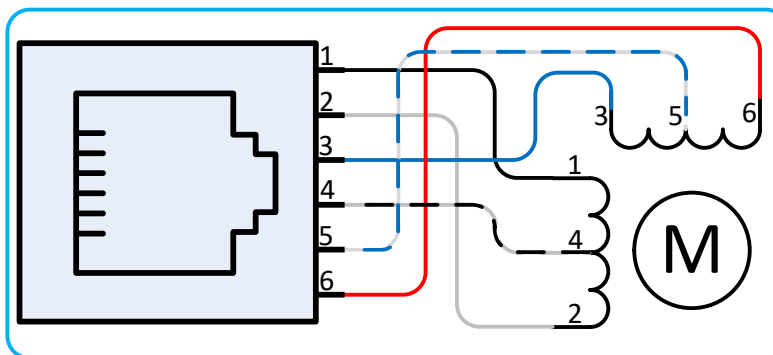
## Motor Cable Option 1 using half the windings

Onstep Mating Connector RJ45

Losmandy Mating Conn RJ12



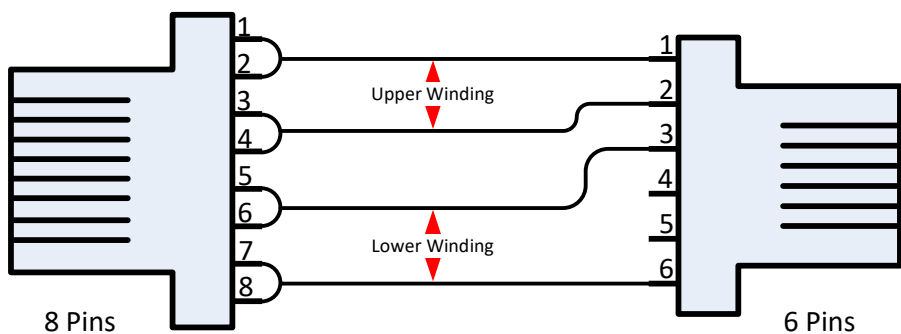
## Losmandy Hurst Motor RJ12



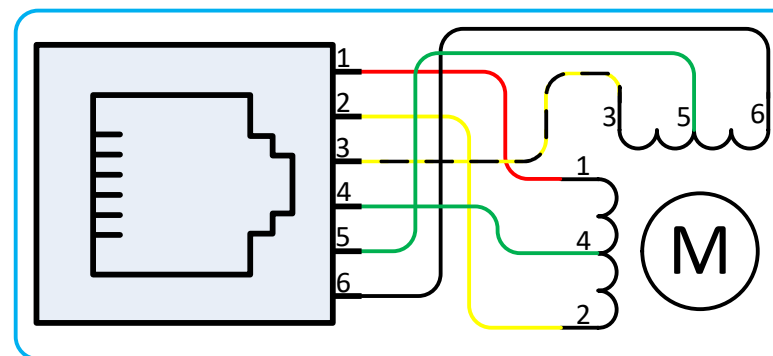
## Motor Cable Option 2, using the full windings

Onstep Mating Connector RJ45

Losmandy Mating Conn RJ12



## Losmandy SAIA Motor RJ12





# MaxESP System Block Diagram

