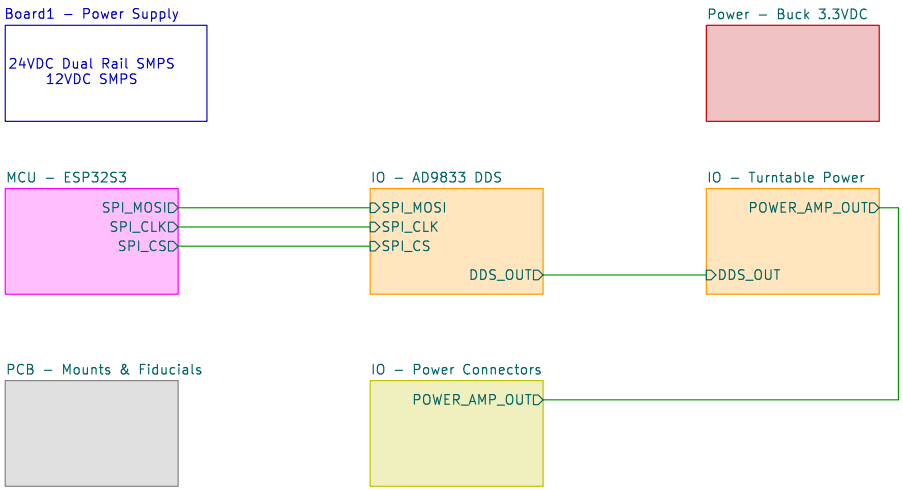
ES-Speed-Box32 - Controller

Issued 2025-07-15

Status: PROTOTYPE

Rev 1.0

PROJECT ARCHITECTURE



PROJECT DESCRIPTION

A speed controller to suit Pro-Ject Turntables with 16VAC synchronous motors (Expression 3, etc). A clone of sorts of the off the shelf line of Pro-ject "SpeedBox" devices that allows for 33RPM and 45RPM speed selection electronically instead of changing the belt/pulley beneath the turntable platter.

Speed selection is controlled in software using a DDS (direct digital synthesis) IC to generate a sinusoidal waveform of the appropriate frequency (~50Hz for 33RPM, ~67 for 45RPM). An I2C header allows for an optional external OLED screen to display speed selection. An 18VDC output provides power to a Pro-Ject Phonobox. The device can be WiFi enabled to allow the speed to be controlled remotely using MQTT auto-discovery via HomeAssistant.

Power to the circuit is controlled via an SSR (solid state relay) and is intended to be connected to a 12V amplifier trigger output. Thus the device has no phantom power draw and only powers the turntable when the amplifier trigger output is on.

PROJECT GOALS/NOTES

1. Powered on when the ampflifer is on/phono aux input is on.
2. Provide power to both the turntable but also an Phono Box II pre-amp.
3. I2C interface to allow connection of an OLED screen to display speed and amp volume (amp volume via Yamaha API).
4. Low profile design to fit in a small rack mountable case.

DESIGN NOTES KEY

DESIGN NOTE:
Example text for informational design notes.

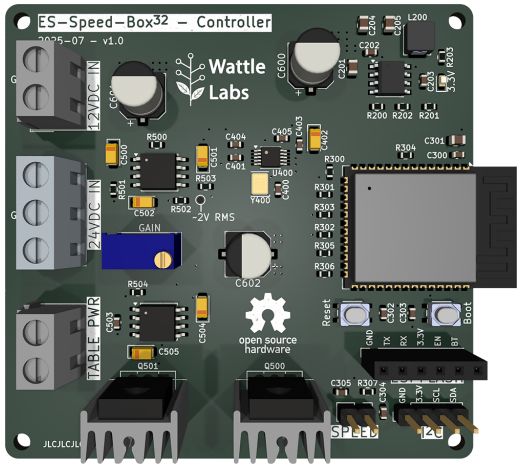
DESIGN NOTE:
Example text for cautionary design notes.

DESIGN NOTE:
Example text for critical design notes.

LAYOUT NOTE:
Example text for critical layout guidelines.

DRAFT - Very early stage of schematic, ignore details.
PRELIM - Close to final schematic.
PROTOTYPE - Untested in its built form.
TESTED - A board with this schematic has been built and tested.

TOP VIEW



Title: ES-Speed-Box32 - Controller			Wattle Labs
Sheet: / File: ES-Speed-Box-Controller.kicad_sch			
Rev: 1.0	Date: 2025-07-15	Id: 1/8	KiCad E.D.A. 9.0.3

Revision History

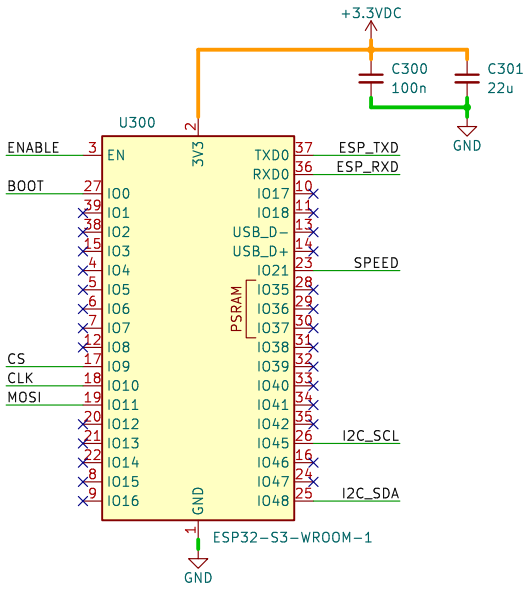
xx-xxx-20xx - Rev 0.0
Status: ???

xx-xxx-20xx - Rev 0.0
Status: ???

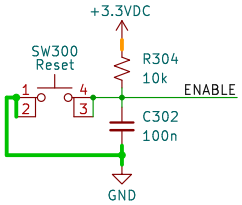
xx-xxx-20xx - Rev 0.0
Status: ???

Title: Revision History			Wattle Labs
Sheet: /Revision History/ File: project history.kicad_sch			
Rev: 1.0	Date: 2025-07-15	Id: 8/8	KiCad E.D.A. 9.0.3

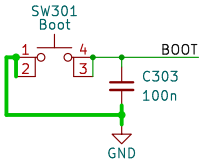
[3] MCU – ESP32-S3-WROOM-1 Module



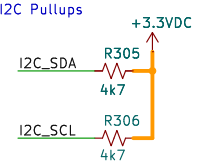
ESP32 Reset



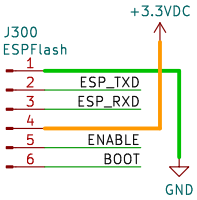
ESP32 Boot



I2C Pullups



ESPFlash Header

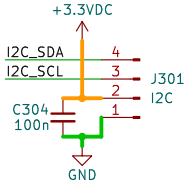


DESIGN NOTE:

Refer https://www.superhouse.tv/espflash

Refer https://github.com/colwilliamsnz/YAOEF

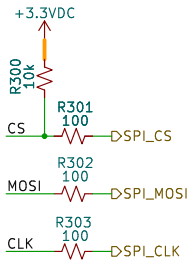
I2C Connector



DESIGN NOTE:

Future use. Eg, to drive an SSD1306 128X64 pixel 0.94 or 1.5" OLED as a remote display to display selected speed/Amp volume?

SPI Bus to AD9833 DDS

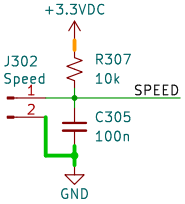


DESIGN NOTE:

1. Series resistors added to reduce ringing (best practise SPI).

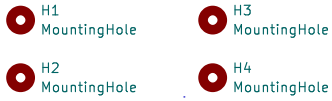
2. 10K pullup on CS to ensure slave not in an ambigious state at startup.

Speed Selector Switch Connector



Title: MCU – ESP32-S3-WROOM-1 Module			Wattle Labs
Sheet: /MCU – ESP32S3/ File: sch_mcu_esp32s3wroom1.kicad_sch			
Rev: 1.0	Date: 2025-07-15	Id: 3/8	KiCad E.D.A. 9.0.3

[7] PCB – Mounts & Fiducials



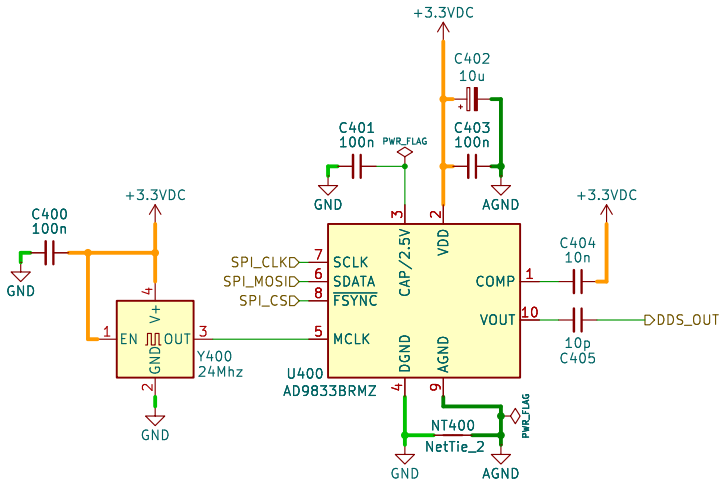
Title: PCB – Mounts & Fiducials			Wattle Labs
Sheet: /PCB – Mounts & Fiducials/ File: sch_pcb_mounts.kicad_sch			
Rev: 1.0	Date: 2025-07-15	Id: 7/8	KiCad E.D.A. 9.0.3

[4] IO – AD9833 DDS

DESIGN NOTE:

The AD9833 is a DDS (direct digital synthesis) IC controllable via SPI bus.

This is used to generate an appropriate sine wave to drive the turntables AC motor at appropriate speeds (eg. 33 or 45 RPM).



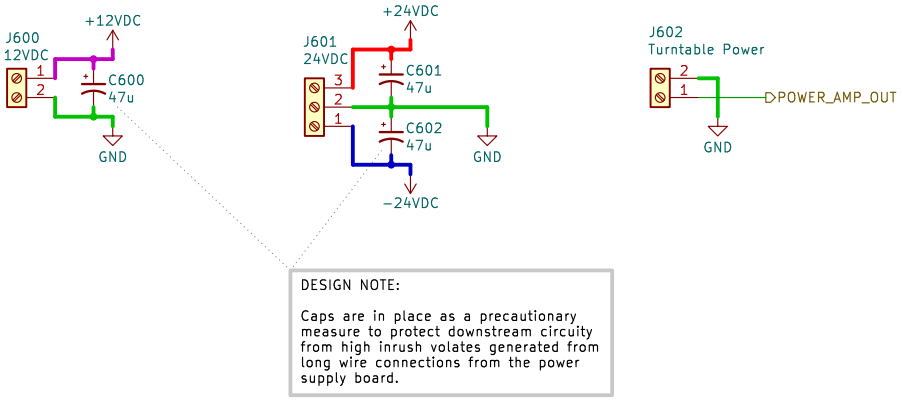
LAYOUT NOTE:

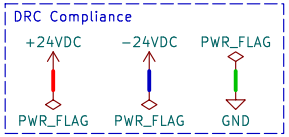
1. Ensure a ground plane below the AD9833, avoiding digital signals directly below it.

2. GND & AGND should be connected as close as possible to the IC.

Title: IO – AD9833 DDS			Wattle Labs
Sheet: /IO – AD9833 DDS/ File: sch_io_ad9833.kicad_sch			
Rev: 1.0	Date: 2025-07-15	Id: 4/8	KiCad E.D.A. 9.0.3

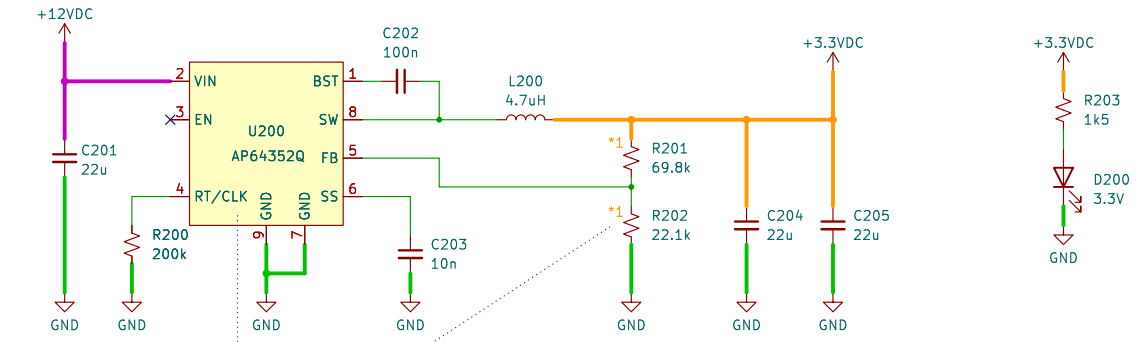
[6] IO – Power Connectors





Title: IO – Power Connectors			Wattle Labs
Sheet: /IO – Power Connectors/ File: sch_io_power.kicad_sch			
Rev: 1.0	Date: 2025-07-15	Id: 6/8	KiCad E.D.A. 9.0.3

[2] Power – Buck 3.3VDC



DESIGN NOTE:

VIN: 3.8V–40V

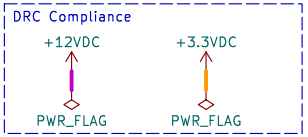
VOUT: Variable. Max 3.5A

*1 – DESIGN NOTE:

0.1% Resistors will give more accurate voltage output

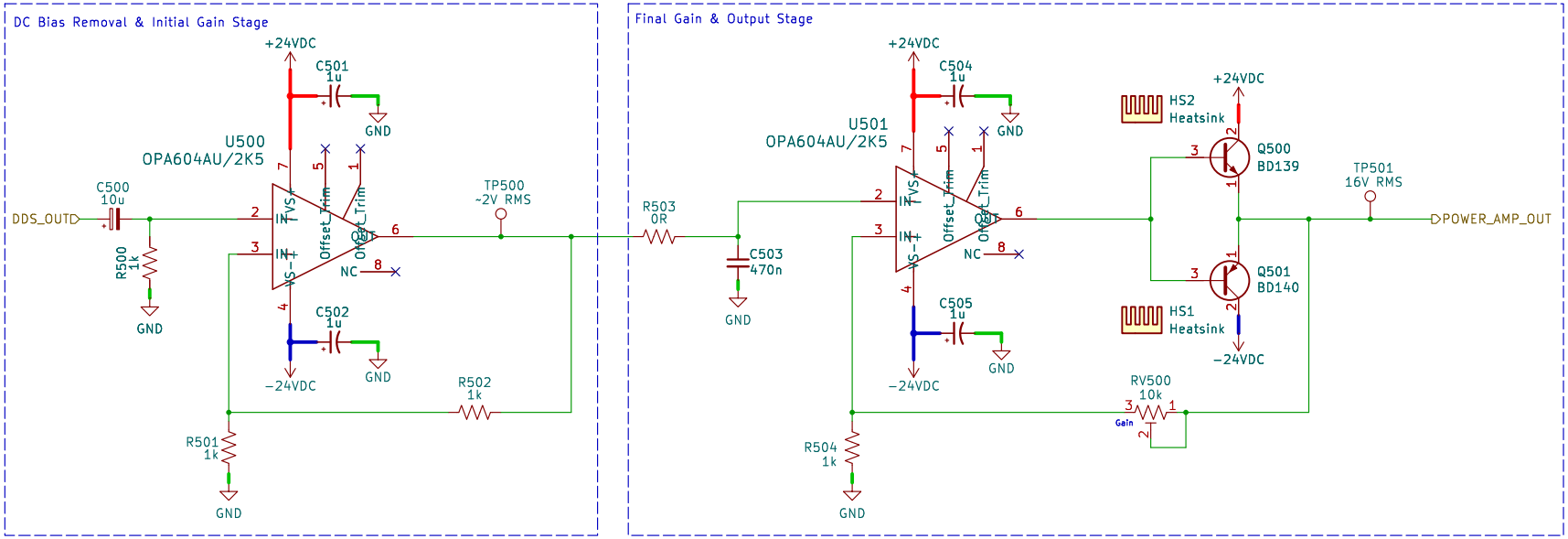
DESIGN NOTE:

The 3.3VDC power rail powers the MCU and AD9833.



Title: Power – Buck 3.3VDC			Wattle Labs
Sheet: /Power – Buck 3.3VDC/ File: sch_power_buck_3v3vdc.kicad_sch			
Rev: 1.0	Date: 2025-07-15	Id: 2/8	KiCad E.D.A. 9.0.3

[5] IO – Turntable Power



DESIGN NOTE:

The Pro-ject AC synchronous motor is 16V RMS, 2W.
Current draw calculation:
A = W/V
= 2W / 16V
= 0.125 A

Title: IO – Turntable Power			Wattle Labs
Sheet: /IO – Turntable Power/ File: sch_power_amp.kicad_sch			
Rev: 1.0	Date: 2025-07-15	Id: 5/8	KiCad E.D.A. 9.0.3