# ESP32 Utility Driver

Annotated Schematics
Revision 1.1

## 1 Introduction

### 1.1 This document

This document provide info about ESP32 Utility Driver needed to program and operate the device and is intended for developers and more advanced users.

### 1.2 Content

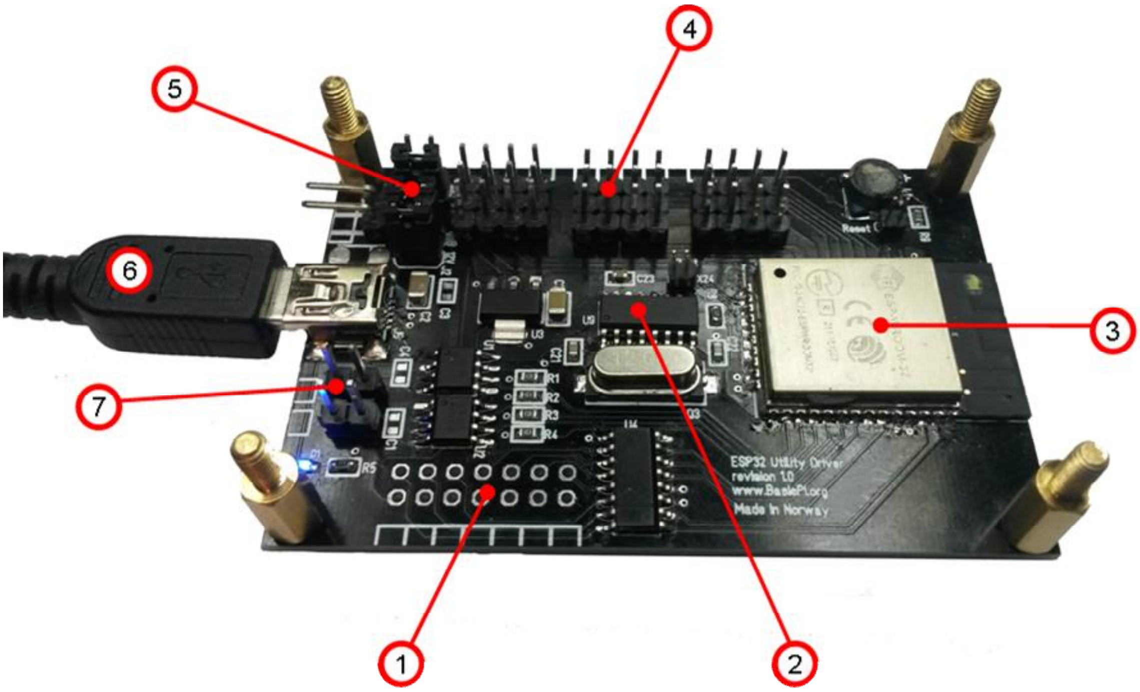
## 1.3 Revisions

| | | |
|---|---|---|
| 1.0 | | Original Prototype |
| 1.1 | 11.Mar.2018 | 1. Fixed missing rx/tx crossing between ESP32 and CH340G<br>2. Added logic for automatic download.<br>3. Removed 1A coil on 3.3V - not needed.<br>4. Cleaned up PSU/USB Jumpers. |

**Note**: Doc revisions are kept 1:1 with PCB/Electronics revisions.

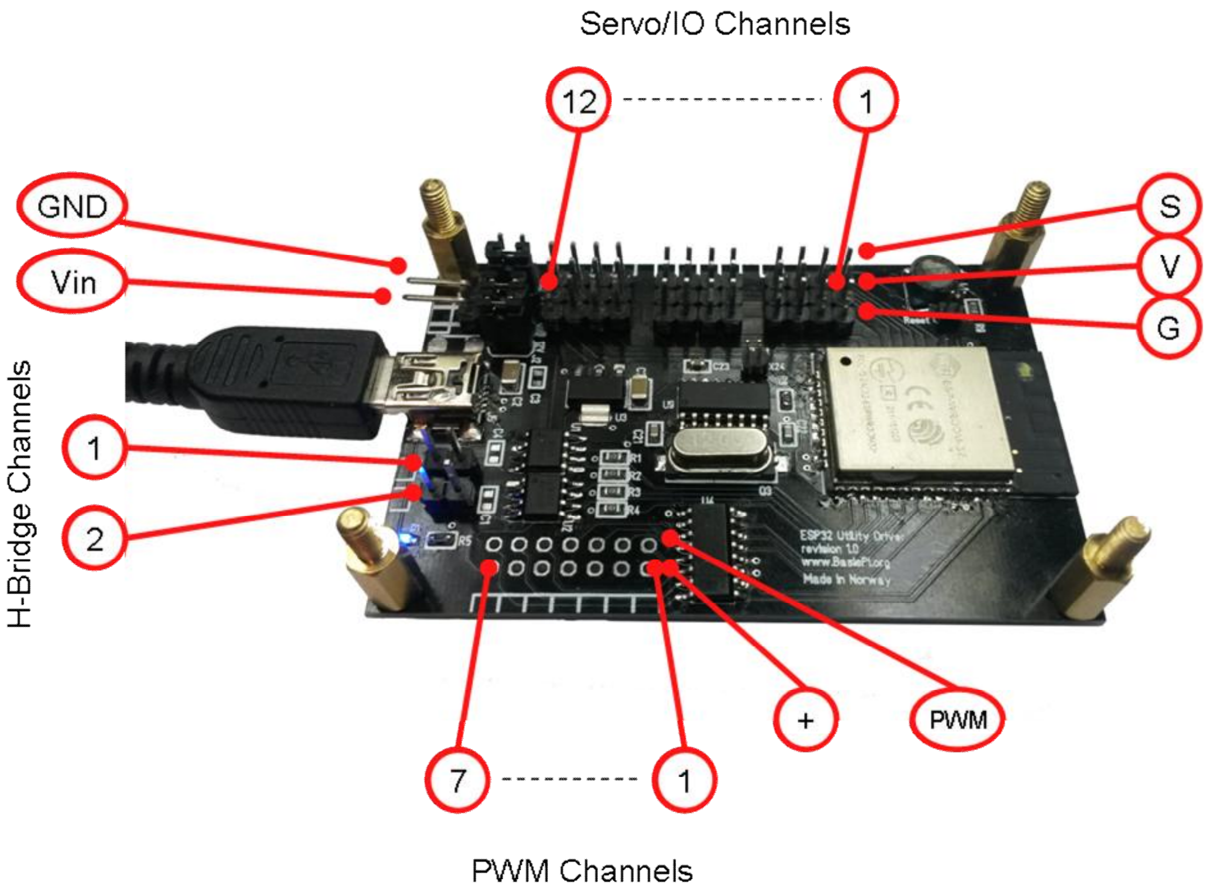
## 1.4 Overview

ESP32 Utility Driver combines the powerfully ESP32, Arduino IDE and provide 12 x Servo/IO channels, 7 x PWM channels and 2 x H-Bridge channels for DC motors. Combined with the Wifi & Bluetooth capabilities of ESP32 this becomes a very powerfully controller.



ESP32 Utility Driver is a small IO board based on ESP-WROOM-32 breakout that contains the amazing ESP32 MCU. Note that the picture is a revision 1.0 board.

| # | Description |
|---|---|
| 1 | 7 x PWM Output's. 0,5A 5-12V driven by a ULN2003. |
| 2 | CH340G providing Serial USB. |
| 3 | ESP32 - ESP-WROOM-32 breakout board. |
| 4 | 12 x Servo or IO ports. |
| 5 | PSU Jumpers |
| 6 | USB Connector |
| 7 | 2 x H-Bridge Connectors |



The picture above illustrate channel locations. See Programmers Reference chapter for programming info of each channel.

VIN is 5 to 12V.

## *1.5 Known Issues*

| | |
|---|---|
| Firmware Download on Rev 1.0 | Revision 1.0 lack the logic to support automated firmware download. This is fixed in Revision 1.1. Revision 1.0 needs to set the boot jumper and reset/re-power manually for each download. |
| Rev 1.0 PSU | Revision 1.0 can only use Servo, PWM or Motors if connected to an external PSU with both jumpers set to 12V. This is an unintended limitation that is fixed in Revision 1.1. |

# 2 Programming Reference

The ESP32 Utility Driver can be programmed the same way as any ESP32 based dev kit though the serial port & Arduino IDE. Please refer to internet pages for setting up Arduino IDE and tool-chain.

## 2.1 GPIO Pin Usage

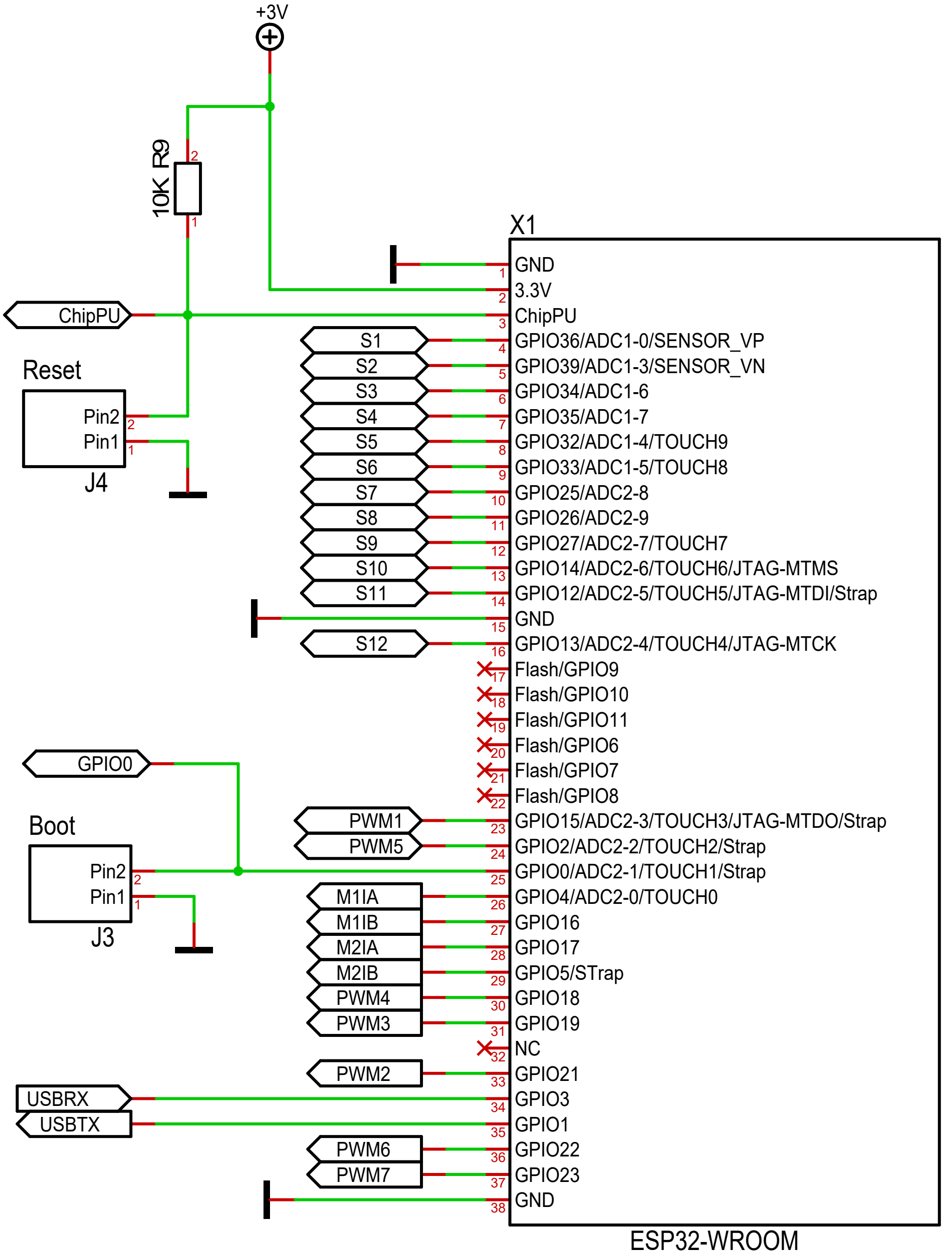
The info provided here is meant to speed up development, but can also be read through the schematics.

| Channel | Pin | Capabilities |
|---|---|---|
| Servo Ch1/IO1 | GPIO36 | PWM, ADC, Digital IO ++ |
| Servo Ch2/IO2 | GPIO39 | PWM, ADC, Digital IO ++ |
| Servo Ch3/IO3 | GPIO34 | PWM, ADC, Digital IO ++ |
| Servo Ch4/IO4 | GPIO35 | PWM, ADC, Digital IO ++ |
| Servo Ch5/IO5 | GPIO32 | PWM, ADC, Digital IO ++ |
| Servo Ch6/IO6 | GPIO33 | PWM, ADC, Digital IO ++ |
| Servo Ch7/IO7 | GPIO25 | PWM, ADC, Digital IO ++ |
| Servo Ch8/IO8 | GPIO26 | PWM, ADC, Digital IO ++ |
| Servo Ch9/IO9 | GPIO27 | PWM, ADC, Digital IO ++ |
| Servo Ch10/IO10 | GPIO14 | PWM, ADC, Digital IO ++ |
| Servo Ch11/IO11 | GPIO12 | PWM, ADC, Digital IO ++ |
| Servo Ch12/IO12 | GPIO13 | PWM, ADC, Digital IO ++ |
| H-Bridge 1 A | GPIO4 | H-Bridge/PWM |
| H-Bridge 1 B | GPIO16 | H-Bridge/PWM |
| H-Bridge 2 A | GPIO17 | H-Bridge/PWM |
| H-Bridge 2 B | GPIO5 | H-Bridge/PWM |
| PWM 1 | GPIO15 | PWM, Digital Out |
| PWM 2 | GPIO21 | PWM, Digital Out |
| PWM 3 | GPIO19 | PWM, Digital Out |
| PWM 4 | GPIO18 | PWM, Digital Out |
| PWM 5 | GPIO2 | PWM, Digital Out |
| PWM 6 | GPIO22 | PWM, Digital Out |
| PWM 7 | GPIO23 | PWM, Digital Out |

# 3 Schematics

This chapter will illustrate parts of the schematics needed to understand the design and program the board. Not all schematics are included as we leave duplicated channels etc out for simplicity.

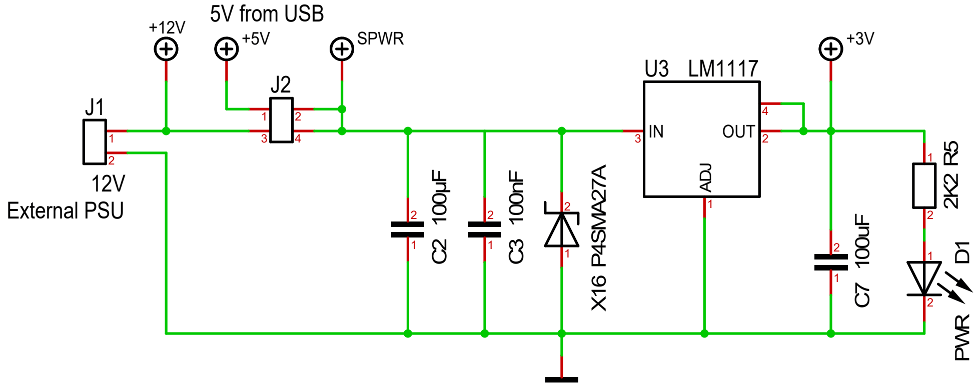
## 3.1 ESP32



This shows the ESP-WROOM-32 and it's pin-out. Notice that ESP-WROOM-32 is a breakout with schematics of it's own. 1.27 jumpers are provided for Reset and Boot. The UART needs to be on GPIO1 & 3 since this is the default location used by the bootloader. Flash pin's are not really available as they also are used to connect to the serial Flash.

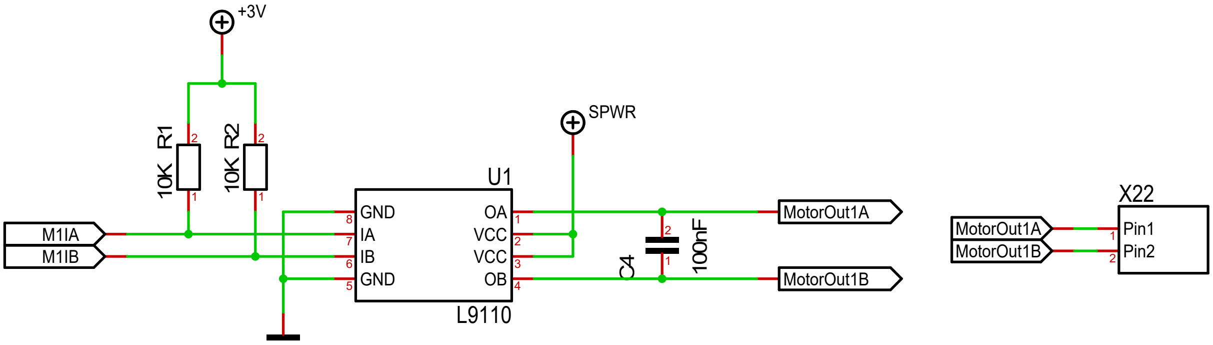
Notice that all Servo/IO channels also have ADC capabilities allowing them to be used for a combination of Servo, ADC In, Digital In, Digital Out or PWM out.

## 3.2 PSU



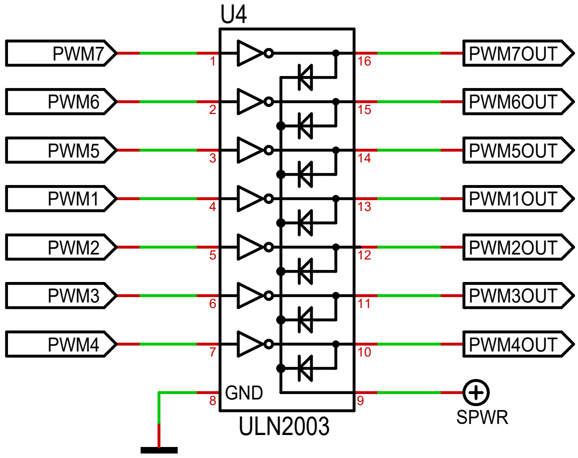
This is the Revision 1.1 PSU. Note that Revision 1.0 was different. J1 is an external PSU connection. J2 decides power is feed from external or USB. As USB power is limited it should only be used for development without full load. J2 decides what feeds the board.

## 3.3 H-Bridges

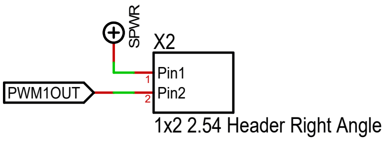


The H-Bridge is a classic L9110 that will drive a DC motor up to 12V & 800mA with peaks up to 1,5A. This is a well tested and robust circuit. This can be used 2 x DC motor drivers or 1 x Stepper Motor driver.

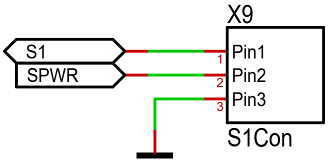
## 3.4 PWM Drivers



A classic ULN2003 is used to drive PWM signals. This circuit drive the signal from +, so the pins are + and PWM. Each channel can deliver 0,5A. Pin 1 (+) is the outer/lower pin.

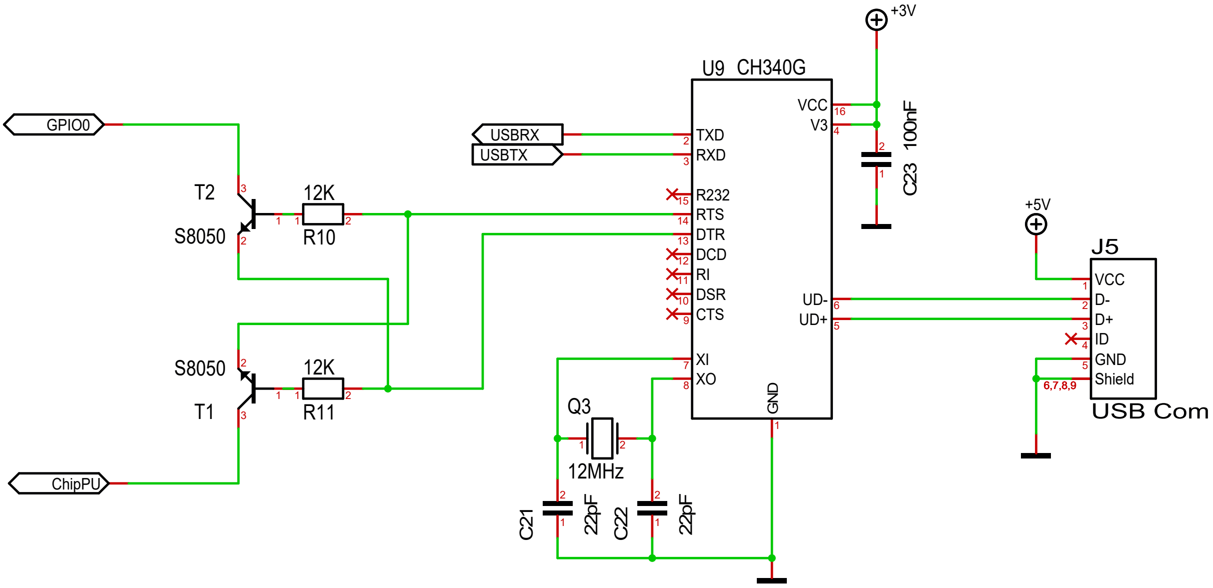


## 3.5 Servos & IO Sensors



All 12 Servo & IO channels use the setup above (SVG) that is common for Servo's. This provide Signal, Voltage and Ground. Notice that voltage is selectable by jumpers.

## 3.6 USB Programming port



CH340G grabs a UART and make it a serial USB, no programming needed. The chip is also well supported with drivers from the vendor. The added logic around T1 & T2 are needed to use the USB for programming from Arduino IDE. This logic will drag Boot down and Reset the board as we download new firmware and save us from using the Boot jumper all the time.

Note that Rev 1.0 do not have the added T1/T2 logic and thus need to use the manual jumper.