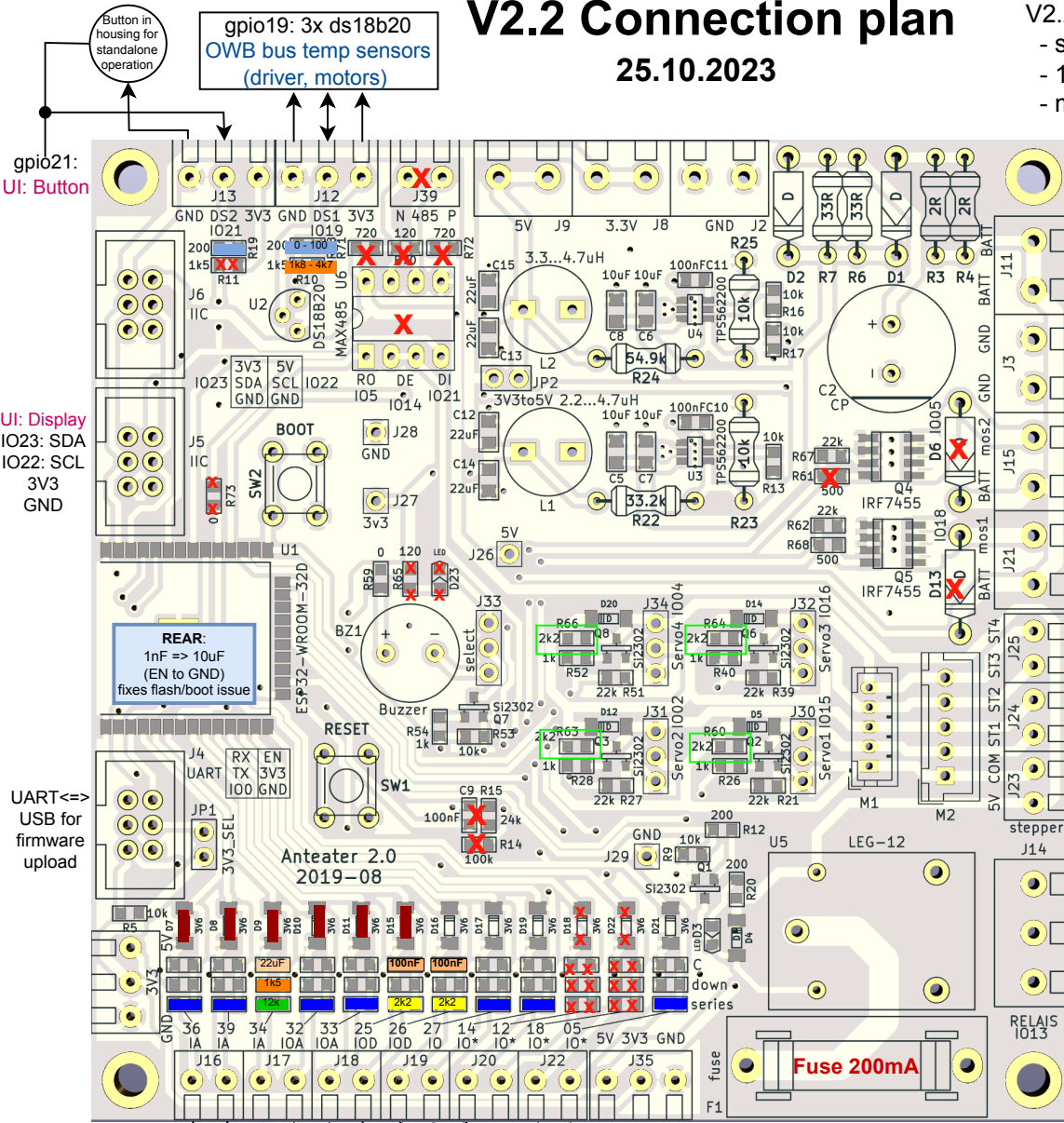# V2.2 Connection plan
25.10.2023

V2.2 summary:
- single board
- 1x sabertooth 2x60A driver
- modified board 'motorctl' from V2.1

Button in housing for standalone operation

gpio21: UI: Button

gpio19: 3x ds18b20
OWB bus temp sensors (driver, motors)

UI: Display
IO23: SDA
IO22: SCL
3V3
GND

UART<=> USB for firmware upload

Board labels / silkscreen:

- J13: GND DS2 3V3 GND DS1 3V3 — IO21 / IO19 — N 485 P — 720 120 720
- R11 200 1k5 xx — R10 200 1k5 1k8-4k7 — R19
- U2 DS18B20 — MAX485 U0
- J6 IIC
- 3V3 SDA GND IO23 — 5V SCL GND IO22 — RO DE DI — IO5 IO14 IO21
- J5 IIC
- BOOT SW2
- J28 GND — J27 3v3 — R73
- REAR: 1nF => 10uF (EN to GND) fixes flash/boot issue
- ESP32-WROOM-32D
- Anteater 2.0 2019-08
- RESET SW1
- J4 UART: RX TX EN 3V3 I00 GND
- JP1 3V3_SEL
- R5 10k
- BZ1 Buzzer + — — R59 0 R65 120 LED D23
- J33 select — J34 1004 — J32 1016 — Servo4 / Servo3
- J31 1002 — J30 1015 — Servo2 / Servo1
- R66 2k2 Q8 Si2302 R52 1k 22k R51 — R64 2k2 Q6 Si2302 R40 1k 22k R39
- R63 2k2 Q3 Si2302 R28 1k 22k R27 — R60 2k2 Q? Si2302 R26 1k 22k R21
- Q7 Si2302 R54 1k R53 10k
- M1 / M2
- J26 5V
- C9 R15 100nF 24k — R14 100k
- GND J29 R9 10k Q1 Si2302 R20 200 R12 200
- U5 LEG-12
- J14 RELAIS IO13
- Fuse 200mA F1
- 5V 3V3 GND J35

- J16: 36 IA — 39 IA — J17: 34 IA — 32 IOA — J18: 33 IOA — 25 IOD — J19: 26 IOD — 27 IO — J20: 14 IO* — 12 IO* — J22: 18 IO* — 05 IO*
- 22uF 1k5 — 12k — 2k2 2k2 — 100nF 100nF — C down series

Right side connectors:
- J11 BATT — J3 GND: 12V from stepdown/fuse / GND from stepdown
- J15 [disabled]
- J21 FREE — 12V to Relay COM
- J25: gpio 04: relay legrest up
- J24: gpio 16: relay leg-rest down
- gpio 02: relay back-rest up
- J23: gpio 15: relay back-rest down
  => control 4x relay for chair adjustment in future
- ST1 ST2 ST3 ST4 5V COM — stepper
- gpio13: Relay
  - NC
  - COM 12V ("Batt" / stepdown)
  - NO   driver: 12V fan

Right chip area: D / 33R 33R / D / 2R 2R — R25 — D2 R7 R6 D1 R3 R4 — R16 R17 10k — C2 CP + I — D6 IO05 Q4 IRF7455 BATT mos2 — D13 IO18 Q5 IRF7455 BATT mos1 — R67 R61 500 22k — R62 R68 500 22k — 3.3...4.7uH L2 — 3V3to5V 2.2...4.7uH L1 — TPS562200 U4 / U3 — 100nF C11 / C10 — 54.9k R24 — 33.2k R22 — R13 10k

Bottom pin labels (vertical):

- gpio 36: ADC UI: Joystick Y
- gpio 39: ADC UI: Joystick X
- gpio 34: ADC Battery voltage (stepdown) [29.4 -> 3.27V]
- gpio 32: ADC driver: Current sensor motor-left
- gpio 33: ADC driver: Current sensor motor-right
- gpio 25: driver: RS232 RX 2x60A Sabertooth driver
- gpio 26: UI: Encoder A
- gpio 27: UI: Encoder B
- gpio 14: [RS485] optical encoder right axle
- gpio 12: [LED/BUZZER] FREE
- gpio 18: [MOS1]
- gpio 05: [MOS2] optical encoder left axle

---

cable configuration

control-box => driver-box
Oelflex 12x0.5
gn: GND (driver)
01. 5V (reserve)
02: 3V3
03: RX/S1 Sabertooth driver
04: S2 Sabertooth driver (reserve)
05: current-sensor left
06: current-sensor right
07: fan 12v from relay
08: ds18b20 owb
09: GND (current-, ds18b29-sensors)
10: GND (reserve)
11: GND (reserve)

control-box => UI-arm
D-Sub 9 pin
green: GND
red: 3V3
brown: Joystick X
purple: Joystick Y
yellow: encoder A
blue: encoder B
black: encoder switch
gray: display SDA
orange: display SDC

Joystick pinout
JST connector 5 pin
(pins stick order left to right)
red: VCC (3V3)
orange: GND
brown: X (analog 0-3V)
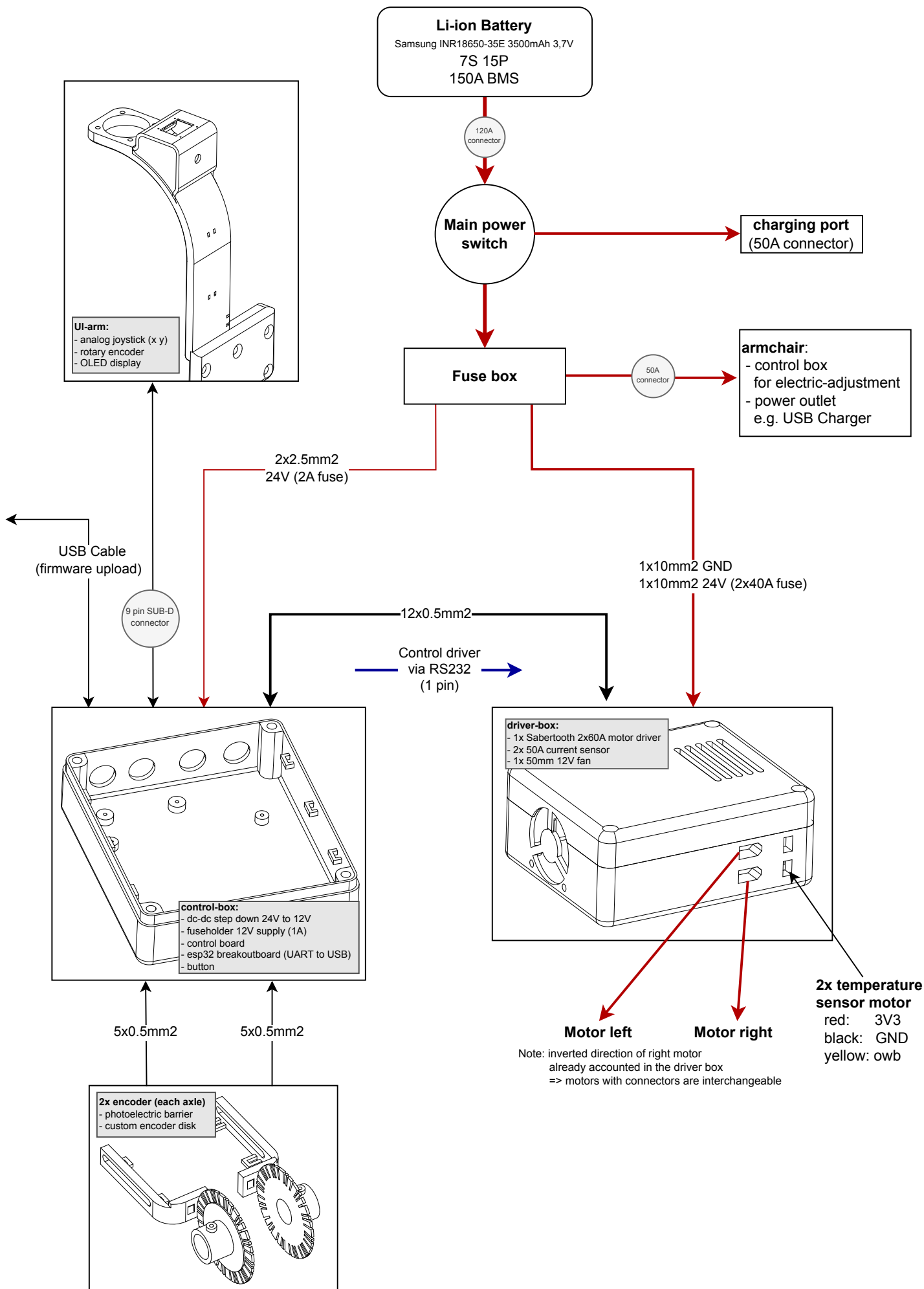white: n.c.
black: Y (analog 0-3V)

optical-sensor axle => control-box
2 cables (one for each axle): Oelflex 5x0.5
gn: GND
01: 3V3 [unused]
02: 5V
03: Sensor out (drain) / pulses
04: [unused]
05: [unused]

control-box => relay board chair
Mini-DIN 6 connector (PS/2 6 pin cable)
01: GND
02: 12V
03: relay leg-support UP
04: relay leg-support DOWN
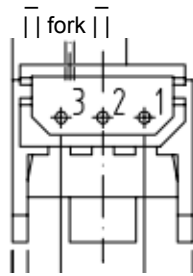05: relay back-support UP
06: relay back-support DOWN

driver configuration
DIP switches:
"simplified serial, 9600 Baud"
101011 (1=up)

Legend pcb
- 0 Ohm Resistor
- 3v3 Z-Diode
- 0 Ohm Optional
- [xxx] Conflicting Component
- xx nopop

V2.2 Wiring-plan

25.10.2023

Li-ion Battery
Samsung INR18650-35E 3500mAh 3,7V
7S 15P
150A BMS

120A connector

Main power switch

charging port
(50A connector)

Fuse box

50A connector

armchair:
- control box
  for electric-adjustment
- power outlet
  e.g. USB Charger

UI-arm:
- analog joystick (x y)
- rotary encoder
- OLED display

2x2.5mm2
24V (2A fuse)

USB Cable
(firmware upload)

9 pin SUB-D connector

1x10mm2 GND
1x10mm2 24V (2x40A fuse)

12x0.5mm2

Control driver
via RS232
(1 pin)

control-box:
- dc-dc step down 24V to 12V
- fuseholder 12V supply (1A)
- control board
- esp32 breakoutboard (UART to USB)
- button

driver-box:
- 1x Sabertooth 2x60A motor driver
- 2x 50A current sensor
- 1x 50mm 12V fan

2x temperature sensor motor
red: 3V3
black: GND
yellow: owb

Motor left   **Motor right**

Note: inverted direction of right motor
     already accounted in the driver box
     => motors with connectors are interchangeable

5x0.5mm2   5x0.5mm2

2x encoder (each axle)
- photoelectric barrier
- custom encoder disk

measure rotational speed + direction

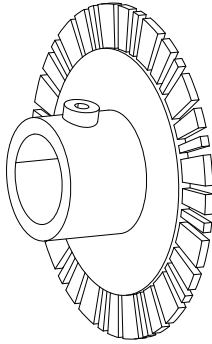**Transmissive Optical Sensor**
TCYS5201

‾ ‾
| | fork | |

1: GND
2: out
   - low when not interrupted
   - floating when interrupted
   => pullup needed
3: (2.9V) - 5.5V

optical-sensor axle => control-box

2 cables (one for each axle):
Oelflex 5x0.5

gn: GND
01: 3V3 [unused]
02: 5V
03: Sensor out (drain)
04: [unused]
05: [unused]

Custom Encoder disk
mounted on each Axle

To be able to detect the direction of rotation
the disk has 12 groups of segments with 3
different lengths (ratio 1:2:3) with a constant
gap between each segment

V2.1 Board 1: control
07.09.2023 [dropped]

UART => motorctl pcb
IO21:RX - IO19:TX - GND

V2.1 summary:
- two boards
- 2x HC240A driver
- brake resistors
- UART communication
=> dropped due to driver change
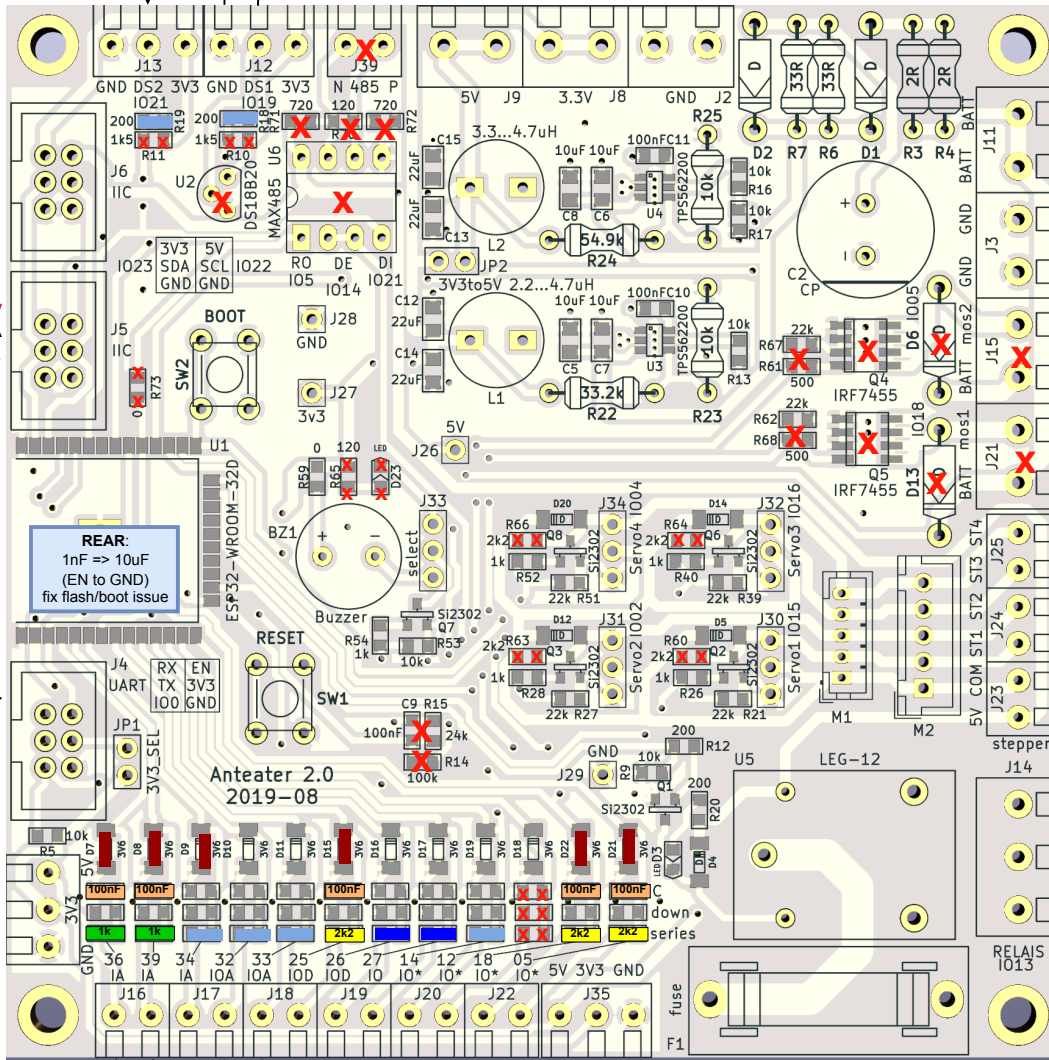
12V from pcb motorctl
GND from pcb motorctl

gpio 04: **FREE**
gpio 16: **FREE**
gpio 02: **FREE**
gpio 15: **FREE**
5V (signal pullup)

gpio13 Relay
NC:
COM: **FREE**
NO:

UI: Display
IO23: SDA
IO22: SCL
3V3
GND

UART<=>
USB for
firmware
upload

UI: Display
3V3
GND

note: esp32 internal
pullup = 10k - 100k

REAR:
1nF => 10uF
(EN to GND)
fix flash/boot issue

ESP32-WROOM-32D

Anteater 2.0
2019-08

BOOT SW2
RESET SW1

Buzzer BZ1

Bottom connector labels (J16–J35)

- gpio 36: ADC UI: Joystick Y
- gpio 39: ADC UI: Joystick X
- gpio 34: ADC UI: Joystick X
- gpio 32: ADC **FREE**
- gpio 33: ADC **FREE**
- gpio 25: ADC **FREE GPS?**
- gpio 26: UI: encoder switch
- gpio 27: UI: Display SCL
- gpio 14: UI: Display SDA
- gpio 12: [RS485] **FREE**
- gpio 18: [LED/BUZZER]
- gpio 05: [MOS1] UI: encoder B
- [MOS2] UI: encoder A

Legend pcb

- 0 Ohm Resistor
- 3v3 Z-Diode
- 0 Ohm Optional
- [xxx] Conflicting Component
- xx nopop

cable configuration

control-box => UI-arm

D-Sub 9 pin

green:	GND
red:	3V3
brown:	Joystick X
purple:	Joystick Y
yellow:	encoder A
blue:	encoder B
black:	encoder switch
gray:	display SDA
orange:	display SDC

Joystick pinout

JST connector 5 pin
(pins stick order left to right)

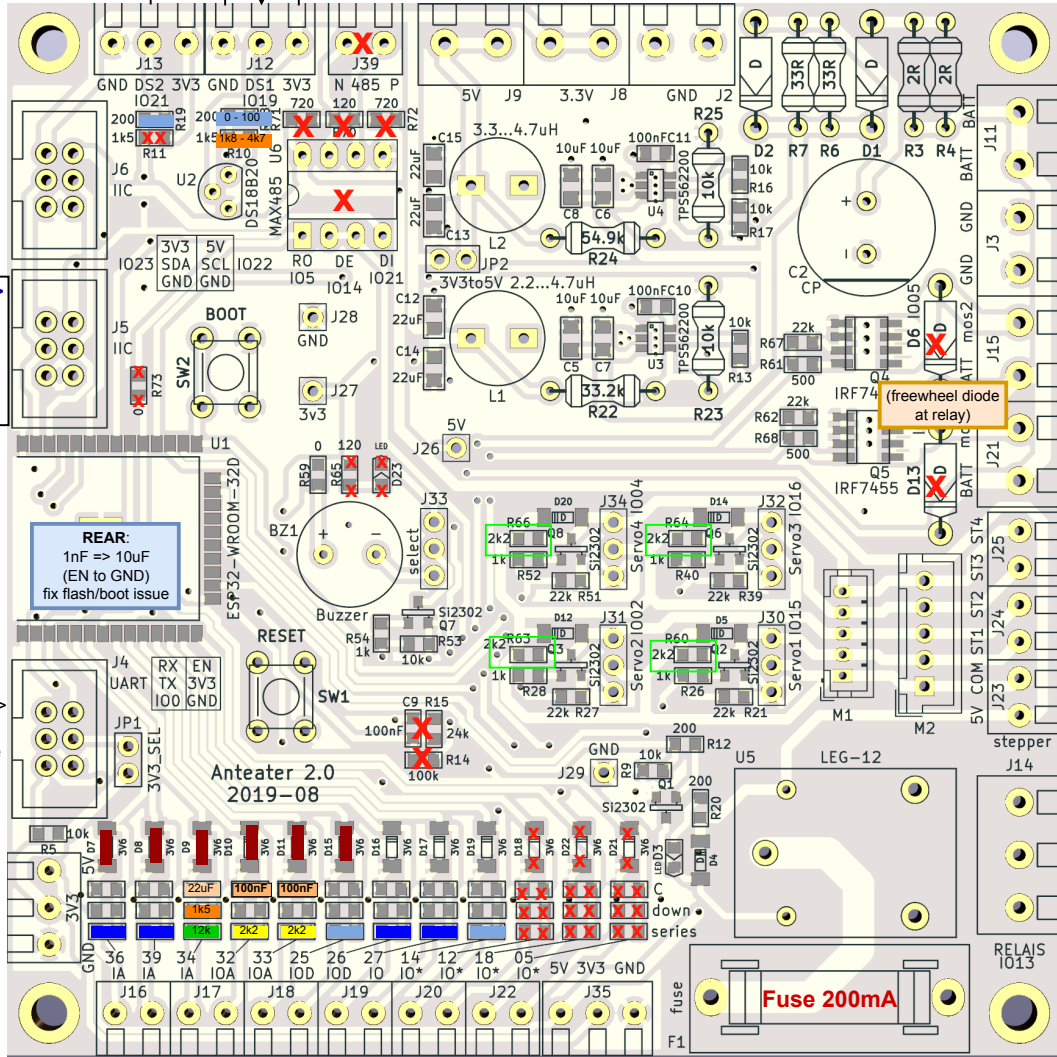|	
red:	VCC (3V3)
orange:	GND
brown:	X (analog 0-3V)
white:	n.c.
black:	Y (analog 0-3V)

V2.1 Board 2: motorcontrol
07.09.2023 [dropped]

gpio19: 6x ds18b20
OWB bus temp sensors
(drivers, motors, brakes)

gpio21: **FREE**

REAR:
1nF => 10uF
(EN to GND)
fix flash/boot issue

UART =>
Control
pcb
IO23 RX
IO22 TX
GND

UART<=>
USB for
firmware
upload

12V to pcb control
12V from stepdown
GND from stepdown
GND to pcb control

brake relay left (24V)

brake relay right (24V)

12V to Relay COM

gpio 04: driver: motor-left A
gpio 16: driver: motor-left B
gpio 02: driver: motor-right A
gpio 15: driver: motor-right B
5V (signal pullup)

2k2 pullup required for driver

gpio13 Relay
NC:
COM: 12V ("Batt" / stepdown)
NO: driver: 2x fan

Fuse 200mA

Anteater 2.0
2019-08

Pin labels (bottom connectors)

gpio 36: ADC driver: Current sensor motor-left
gpio 39: ADC driver: Current sensor motor-right
gpio 34: ADC driver: Battery voltage (stepdown) [29.4 -> 3.27V]
gpio 32: ADC encoder left axle
gpio 33: ADC encoder right axle
gpio 25: FREE
gpio 26: driver: motor-left PWM
gpio 27: driver: motor-right PWM
gpio 14: [RS485]
gpio 12: [LED/BUZZER]
gpio 18: [MOS1] [brake relay right]
gpio 05: [MOS2] [brake relay left]

cable configuration

control-box => driver-box

Oelflex 12x0.5

gn: GND
~~01: 5V~~
01: 3V3

02: bridge-left A
03: bridge-left B
04: bridge-left PWM

05: bridge-right A
06: bridge-right B
07: bridge-right PWM

08: current-sensor left
09: current-sensor right

10: fan 12v from relay
11: ds18b20 owb

optical-sensor axle => control-box

2 cables (one for each axle):
Oelflex 5x0.5

gn: GND
01: 3V3 [unused]
02: 5V
03: Sensor out (drain) / pulses
04: [unused]
05: [unused]

control-box => Brake Relays

Oelflex 9x0.5

gn: GND
01: 3V3 (temp sensors)
02: 24V (BATT -> relays)
03: Brake Relay left (MOS / GND)
04: Brake Relay right (MOS / GND)
05: ds18b20 OWB resistors

Legend pcb

0 Ohm Resistor
3v3 Z-Diode
0 Ohm Optional

[xxx] Conflicting Component
xx nopop

(freewheel diode at relay)

V2.1 Wiring-plan (2 boards)

07.09.2023 [dropped]

Li-ion Battery
Samsung INR18650-35E 3500mAh 3,7V
7S 15P
150A BMS

120A connector

Main power switch

charging port
(50A connector)

Fuse box

50A connector

armchair:
control box for
electric-adjustment

UI-arm:
- analog joystick (x y)
- rotary encoder
- OLED display

2x 2.5mm2
24V (2A fuse)

4x 2.5mm2
- 2x gnd
- 1x 24V (40A fuse)
- 1x 24V (40A fuse)

USB Cable
(fw upload)

9 pin sub-d connector

12x 0.5mm2

Control each driver
via 3 GPIO Pins
10khz PWM, A, B

Board "control"

UART

Board "motorctl"

driver-box:
- 2x 200A H-bridge
- 2x 50A current sensor
- 2x 50mm 12V fan

control-box:
- dc-dc step down 24V to 12V
- fuseholder 12V supply (2A)
- board control
- board motorctl
- esp32 breakoutboard (UART to USB)

2x 2.5mm2
driver -> relay

2x 2.5mm2
relay -> connector

Motor left
straight: negative
angular: positive

Motor right

ds18b20 sensor motor
red: 3V3
black: GND
yellow: owb

Note: inverted direction of right motor
   already accounted in the driver box
   -> motors with connectors are interchangeable

optical
sensor
left axle

optical
sensor
right axle

9x 0.5mm2

Brake-Plate
- 2x 1Ohm 100W Brake resistor
- 2x 80A 24V 5-pin relay
- 2x ds18b20 sensor

V2.1 Driver box overview

07.09.2023 [dropped]

ESP32

adc gpio32

gpio02 —0 / 3.3V→ A
gpio14 —0 / 3.3V→ B
gpio27 —PWM 10kHz→ PWM
gnd → gnd

HC240A-PWM DC motor driver

M_A
M_B

+ -

Fuse

7S 15P liion Battery
22 - 29.4 V
150A BMS

Brake resistor

24V/80A Relay with Fuse

connector Motor

350W Brushed DC Motor

Hall-sensor -50 - 50A
ACS758LCB-050B

gnd
3v3
out 0 - 3.3V
P +
P -
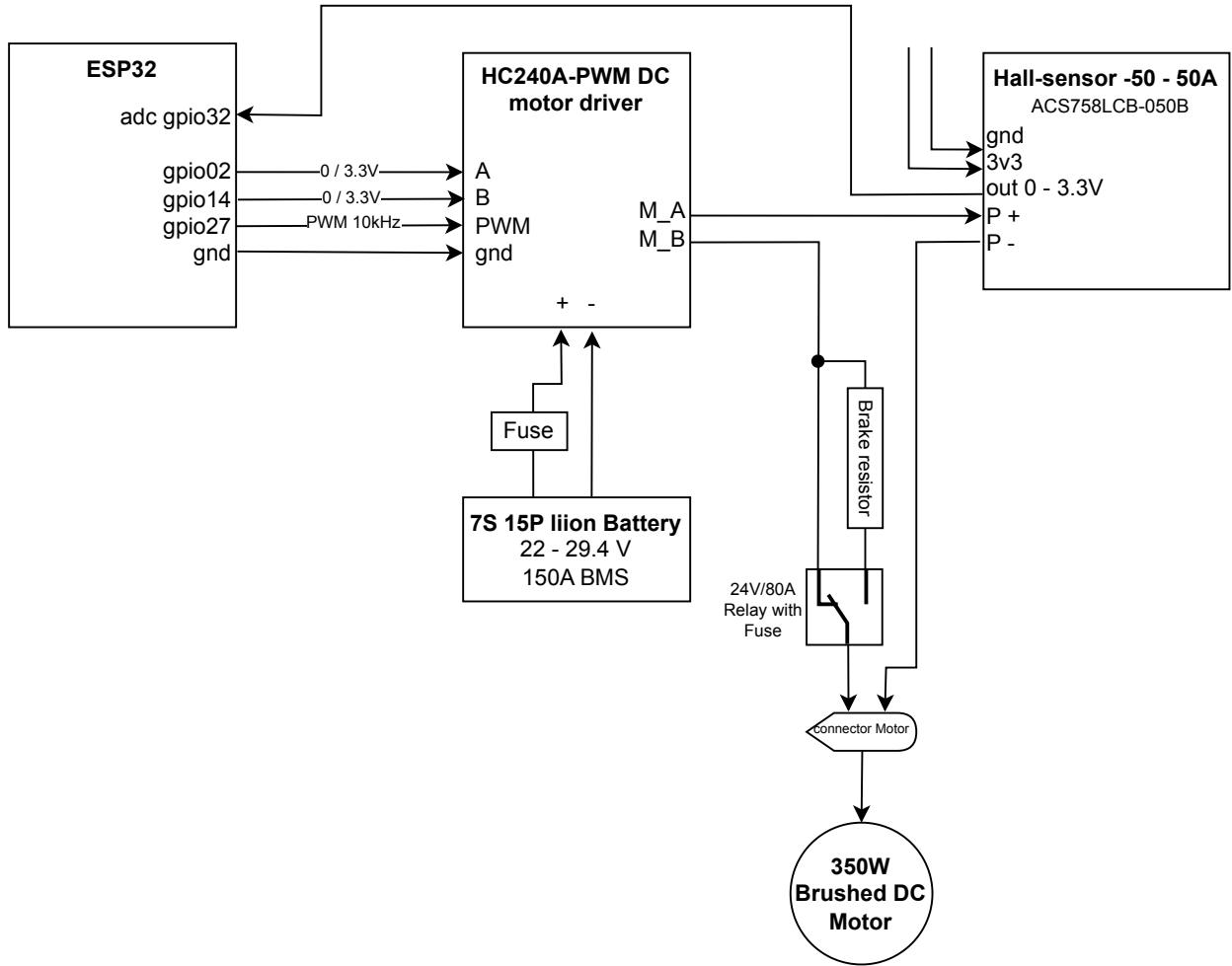
V2.0 Connection plan (single board)
22.08.2023 [dropped]

gpio19: 4x ds18b20
OWB bus temp sensors
(drivers, motors)

gpio21: **FREE**

V2.0 summary:
- amost the same as V1.0 with a few additions
- 2x HC240A driver
=> dropped due to pin limitation
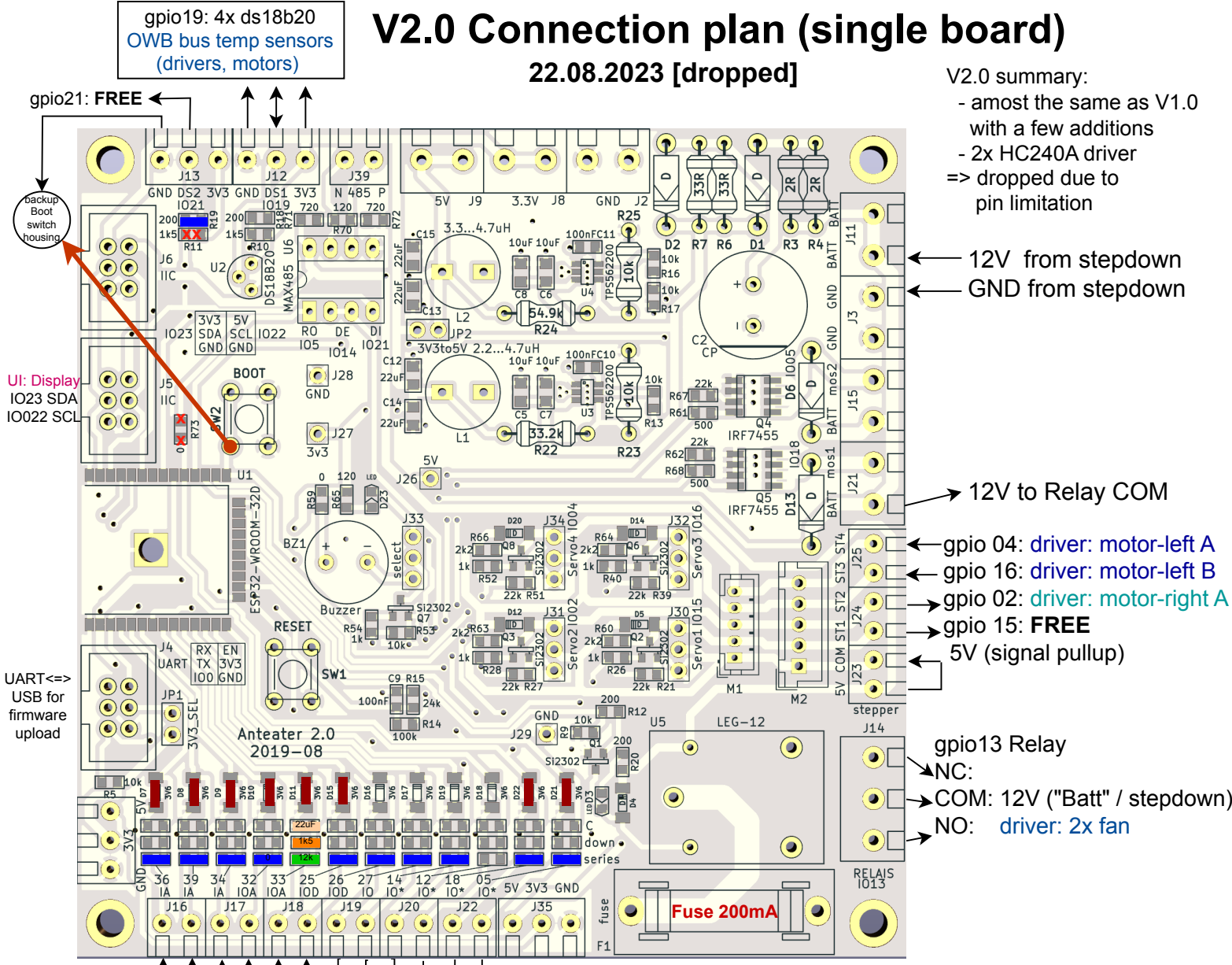
12V from stepdown
GND from stepdown

12V to Relay COM

gpio 04: driver: motor-left A
gpio 16: driver: motor-left B
gpio 02: driver: motor-right A
gpio 15: **FREE**
5V (signal pullup)

gpio13 Relay
NC:
COM: 12V ("Batt" / stepdown)
NO: driver: 2x fan

UI: Display
IO23 SDA
IO022 SCL

UART<=> USB for firmware upload

gpio 36: ADC UI: Joystick Y
gpio 39: ADC UI: Joystick X
gpio 34: ADC driver: Current sensor motor-left
gpio 32: ADC driver: Current sensor motor-right
gpio 33: ADC Battery voltage (stepdown) [29.4 -> 3.27V]
gpio 25: UI: encoder switch
gpio 26: driver: motor-left PWM
gpio 27: driver: motor-right PWM
gpio 14: [RS485] driver: motor-right B
gpio 12: [LED/BUZZER]
gpio 18: [MOS1] UI: encoder B
gpio 05: [MOS2] UI: encoder A

cable configuration

control-box => driver-box

Oelflex 12x0.5

gn: GND
01. 5V
01: 3V3

02: bridge-left A
03: bridge-left B
04: bridge-left PWM

05: bridge-right A
06: bridge-right B
07: bridge-right PWM

08: current-sensor left
09: current-sensor right

10: fan 12v from relay
11: ds18b20 owb

control-box => UI-arm

D-Sub 9 pin

green: GND
red: 3V3

brown: Joystick X
purple: Joystick Y

yellow: encoder A
blue: encoder B
black: encoder switch

gray: display SDA
orange: display SDC

Joystick pinout

JST connector 5 pin
(pins stick order left to right)

red: VCC (3V3)
orange: GND
brown: X (analog 0-3V)
white: n.c.
black: Y (analog 0-3V)

Legend pcb

- ■ 0 Ohm Resistor
- ■ 1.5k Ohm Resistor
- ▮ 3v3 Z-Diode
- ■ 12k Ohm Resistor
- ■ 1k5 Ohm Resistor

[xxx] Conflicting Component
xx nopop

V2.0 Wiring-plan (single board)

22.08.2023 [dropped]

Li-ion Battery

Samsung INR18650-35E 3500mAh 3,7V

7S 15P
150A BMS

120A connector

Main power switch

charging port
(50A connector)

Fuse box

50A connector

armchair:
control box for
electric-adjustment

UI-arm:
- analog joystick (x y)
- rotary encoder
- OLED display

2x 2.5mm2
24V (2A fuse)

4x 2.5mm2
- 2x gnd
- 1x 24V (40A fuse)
- 1x 24V (40A fuse)

USB Cable
(firmware upload)

9 pin sub-d connector

12x 0.5mm2

Control each driver
via 3 GPIO Pins
10khz PWM, A, B

driver-box:
- 2x 200A H-bridge
- 2x 50A current sensor
- 2x 50mm 12V fan

control-box:
- dc-dc step down 24V to 12V
- fuseholder 12V supply (2A)
- control board
- esp32 breakoutboard (UART to USB)

ds18b20 sensor motor
red: 3V3
black: GND
yellow: owb

Motor left   **Motor right**
straight: negative
angular: positive

Note: inverted direction of right motor
already accounted in the driver box
-> motors with connectors are interchangeable