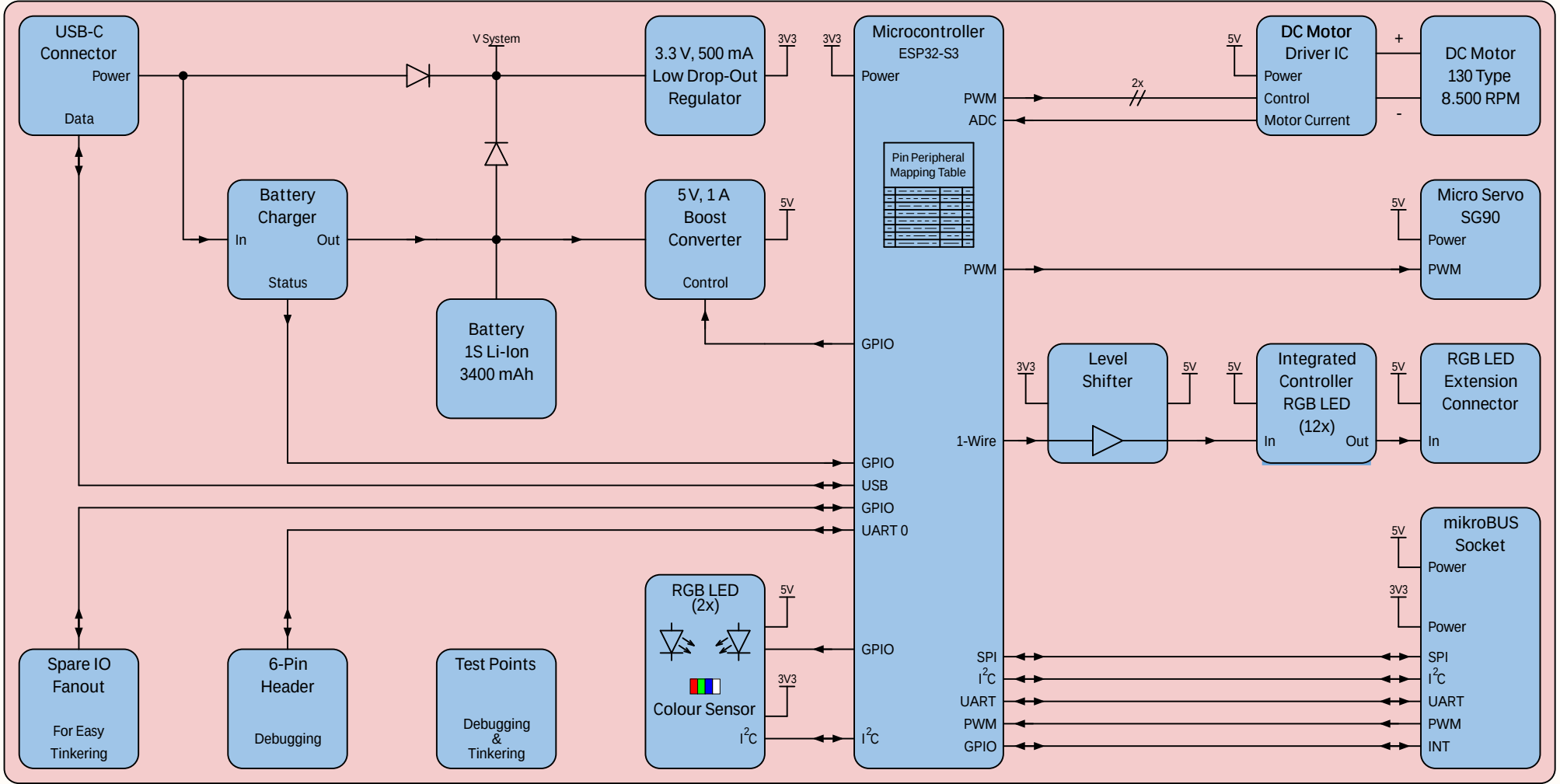


A

B

C

D



Project		Circuit Cruiser (Beursgadget E&A 2025)			
Section		Block Diagram			
Revision	V2.1.1	PCB Revision	2	Schematic Revision	1
Variant		Prototype			Sheet
Release Status		Released for Production			Total Sheets
		Released for Production			
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A

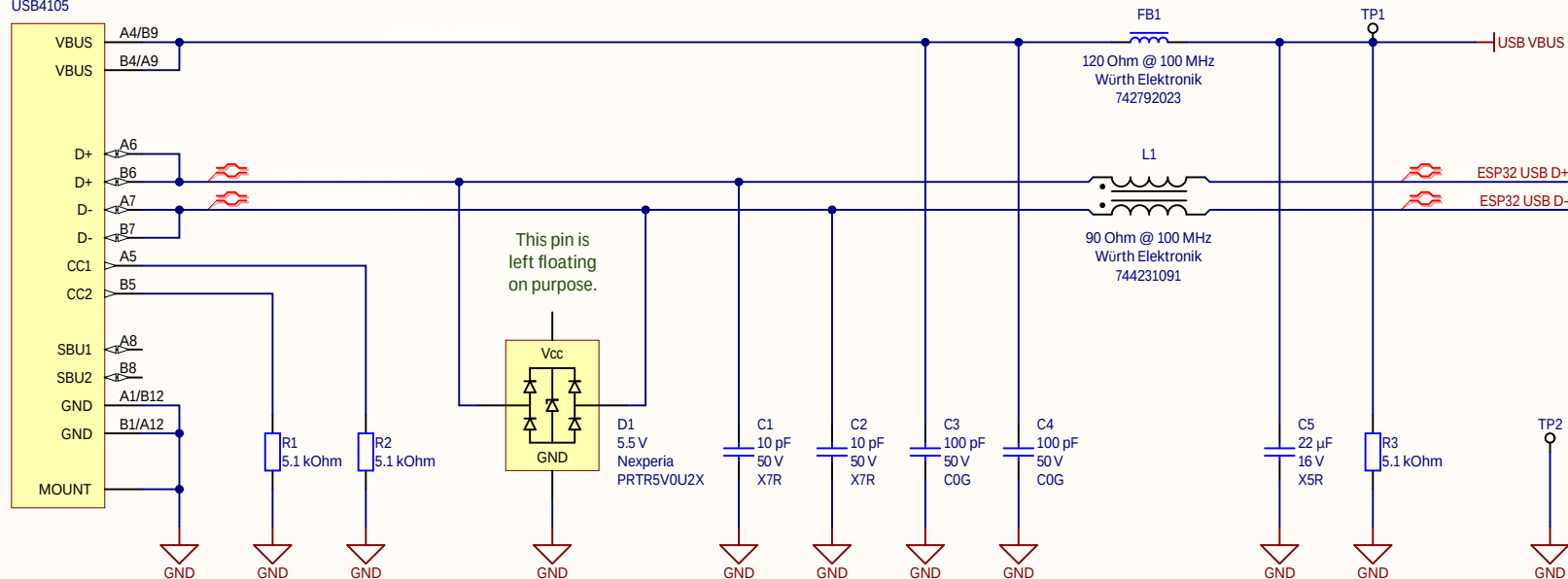
B

C

D

J1
GCT
USB4105

USB Interface



J3
2 Pins
JST
S2B-PH-SM4-TB(LF)(SN)

Battery Interface



A piece of 500 µm width trace acts as an 'if-all-else-fails' fuse for the battery.



J2 & J4 comprise a makeshift power switch.



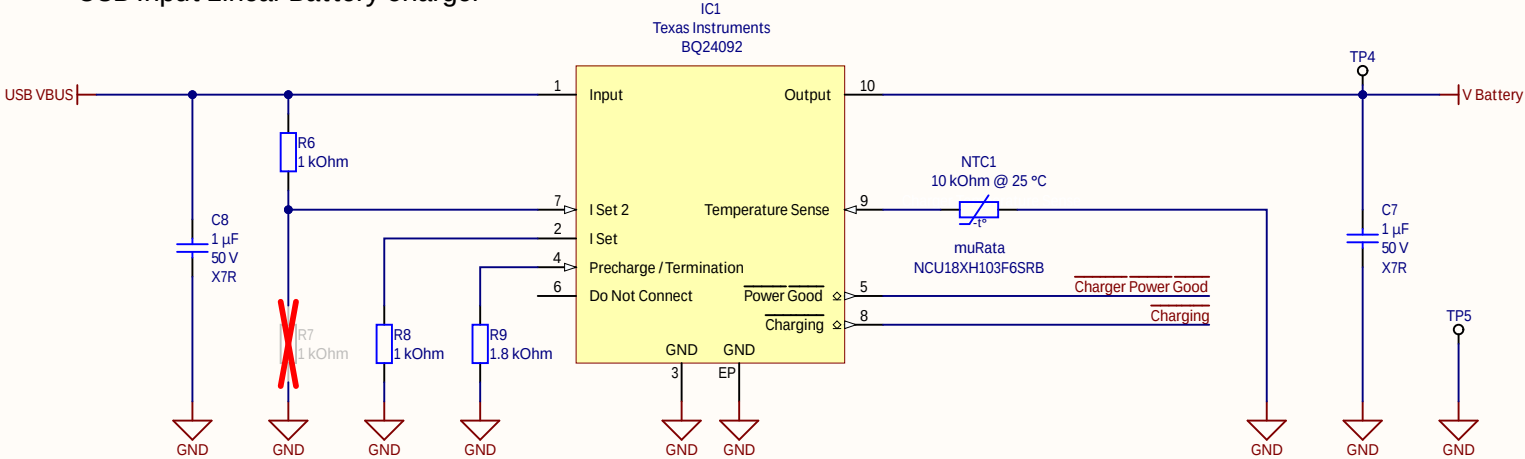
For factory programming, V System can be supplied via USB VBUS.



Q1 prevents current flowing from USB to the battery when USB VBUS is present.

Project		Circuit Cruiser (Beursgadget E&A 2025)					
Section		USB & Battery Connectors					
Revision	V2.1.1	PCB Revision	2	Schematic Revision	1	Document Revision	1
Variant		Prototype			Sheet		2
Release Status		Released for Production			Total Sheets		11
• Pink Fluffy Unicorns BV • Stationsweg 23-25 • 8131 DG • Wijnje •							

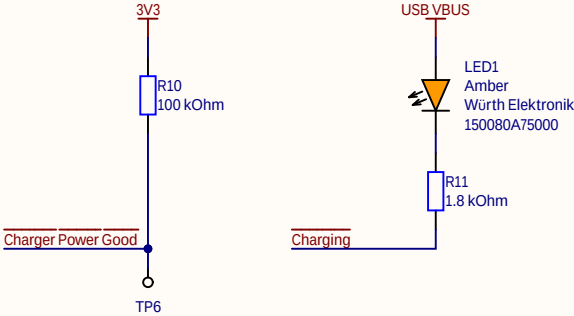
USB Input Linear Battery Charger



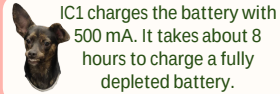
Battery Charger Specifications

Charge Voltage Limit	4.20 V	
Charge Current Selection	500 mA	R6 placed, R7 not placed
	100 mA	R6 & R7 not placed
	540 mA	R6 not placed, R7 placed
Precharge Current	90 mA	$I_{\text{PRECHARGE}} = \frac{I_{\text{CHARGE}} \cdot (R9/100)}{100}$
Termination Current	45 mA	$I_{\text{TERMINATION}} = \frac{I_{\text{CHARGE}} \cdot (R9/199)}{100}$
Battery Temperature Protection	$T \leq 0\text{ }^{\circ}\text{C}$ $0\text{ }^{\circ}\text{C} < T < 10\text{ }^{\circ}\text{C}$ $45\text{ }^{\circ}\text{C} < T < 60\text{ }^{\circ}\text{C}$ $T \geq 60\text{ }^{\circ}\text{C}$	No Charging ½ Charging Current 4.06 V Voltage Limit No Charging
Charge Timer Protection	10-hour Safety Timer	

Status Signalling



Local Fiducial Markings



IC1 charges the battery with 500 mA. It takes about 8 hours to charge a fully depleted battery.



The battery charger will not work whenever J2 is removed from J4. See sheet 2.



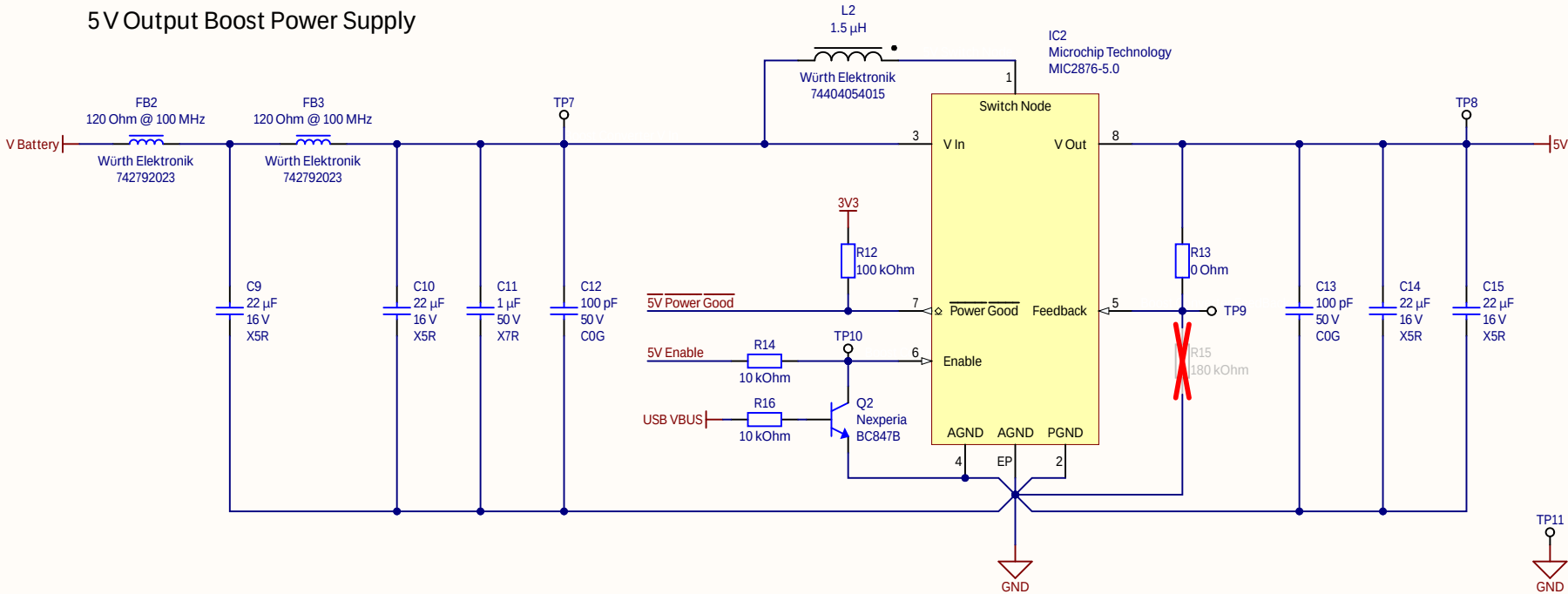
NTC1 should be placed in good thermal contact with the battery.



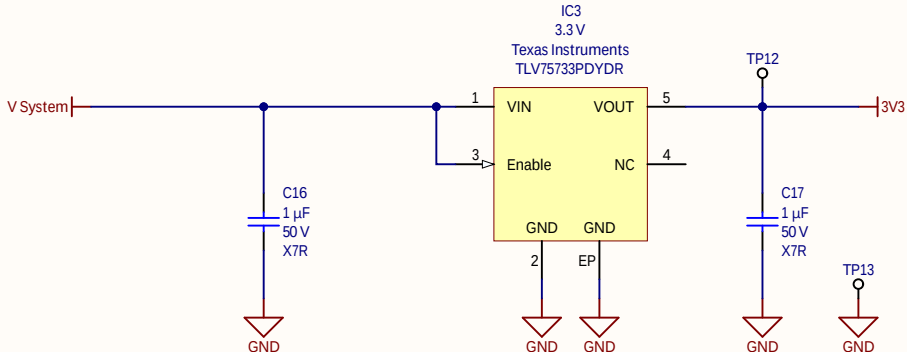
The local fiducial marks allow for more accurate placement of IC1.

Project		Circuit Cruiser (Beursgadget E&A 2025)					
Section		Battery Charger					
Revision	V2.1.1	PCB Revision	2	Schematic Revision	1	Document Revision	1
Variant		Prototype			Sheet		3
Release Status		Released for Production			Total Sheets		11
• Pink Fluffy Unicorns BV • Stationsweg 23-25 • 8131 DG • Wijnhe •							

5 V Output Boost Power Supply



3.3 V Output Linear LDO Power Supply



3V3 Power Supply Specifications

Output Voltage	3.3 V ±1.5 %
Output Current	1 A
Load Regulation	±69 mV
Dropout Voltage	≤ 500 mV
Quiescent Current	≤ 40 µA
Undervoltage Lockout	≤ 2.5 V

5 V Power Supply Specifications

Output Voltage	5.0 V ±3.5 %
Output Current	2 A max.
Load Regulation	±0.2 %
Switching Frequency	2 MHz ±20 %
Quiescent Current	109 µA (Enable = Low)
Undervoltage Lockout	≤ 2.5 V

Local Fiducial Markings



The 3V3 supply current will probably be limited to less than 1 A because of heat dissipation.

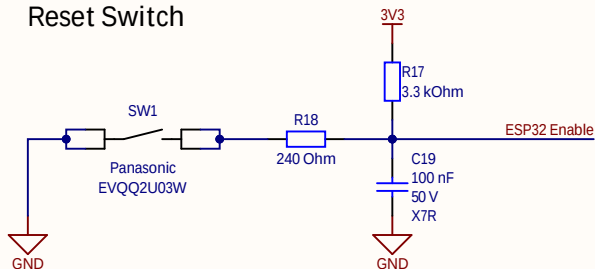
The summed capacitive load on IC3 may not exceed 200 µF.

The 5V is switched off by R16 and Q2 whenever USB is connected.

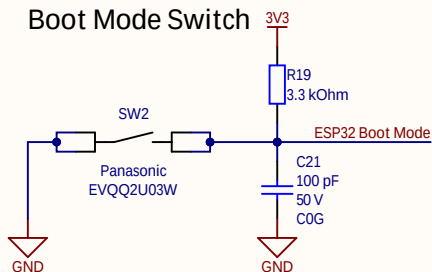
IC2 can also be a MIC2876-A. In that case, replace R13 for 820 kOhm and place R15 (180kOhm).

Project	Circuit Cruiser (Beursgadget E&A 2025)		
Section	Power Supplies		
Revision	V2.1.1	PCB Revision	2
		Schematic Revision	1
		Document Revision	1
Variant	Prototype		Sheet
			4
Release Status	Released for Production		Total Sheets
			11
• Pink Fluffy Unicorns BV • Stationsweg 23-25 • 8131 DG • Wijnhe •			

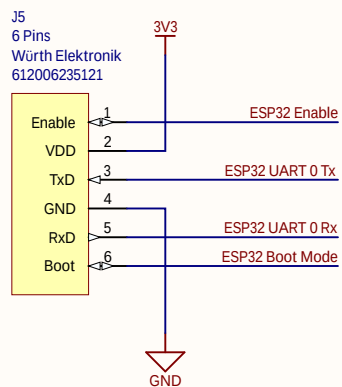
Reset Switch



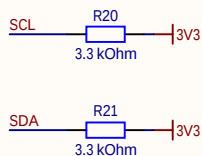
Boot Mode Switch



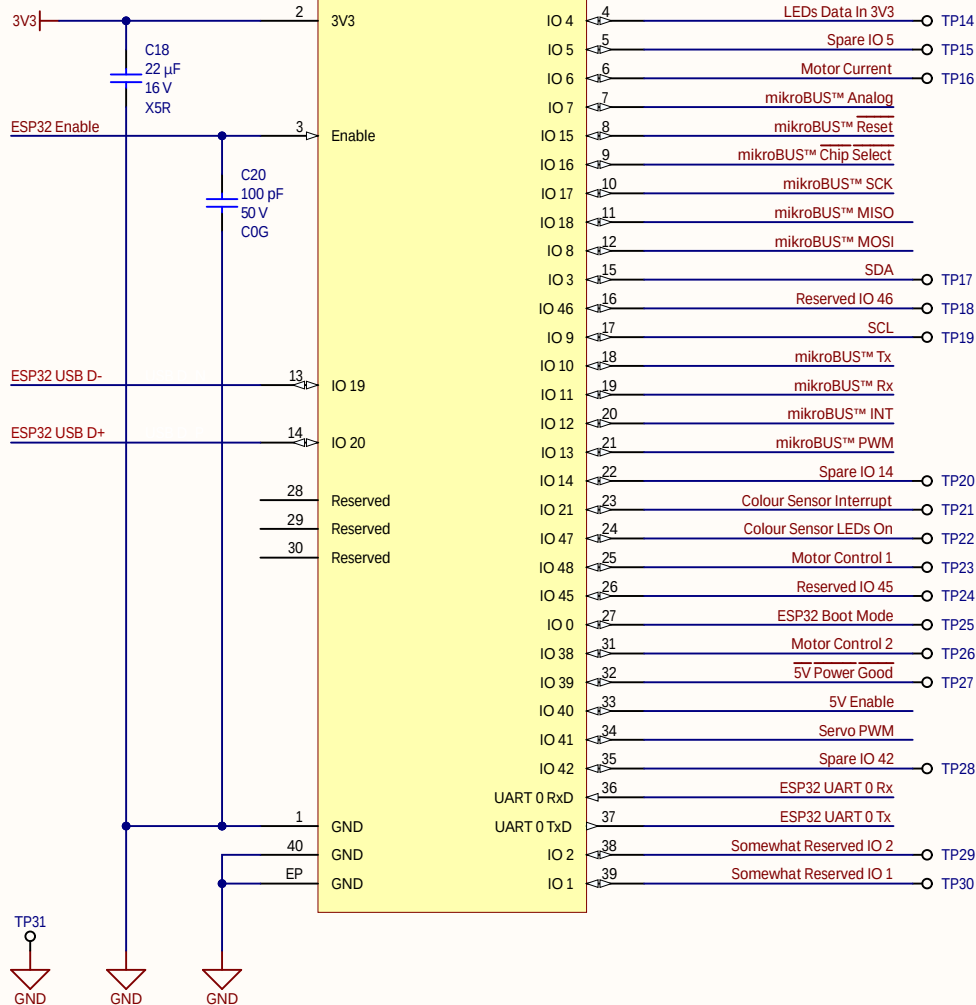
UART 0 Connector



I²C Pull-Ups



MOD1
Espressif
ESP32-S3



The test points are intended for debugging and tinkering.



Pressing SW1 while SW2 is pressed resets the device in Joint Download Boot Mode.



Some IO pins are not used to prevent inadvertent boot mode selection.



Some test points are on the bottom layer, sorry.

Project		Circuit Cruiser (Beursgadget E&A 2025)				
Section		Microcontroller				
Revision	V2.1.1	PCB Revision	2	Schematic Revision	1	
Variant		Prototype			Sheet	5
Release Status		Released for Production			Total Sheets	11
• Pink Fluffy Unicorns BV • Stationsweg 23-25 • 8131 DG • Wijnhe •						

A

A

B

B

C

C

D

D

Net Name	Pin	Function							
LEDs Data In 3V3	4	IO4	RTC_GPIO4	GPIO4	TOUCH4	ADC1_CH3			
Spare IO 5	5	IO5	RTC_GPIO5	GPIO5	TOUCH5	ADC1_CH4			
Motor Current	6	IO6	RTC_GPIO6	GPIO6	TOUCH6	ADC1_CH5			
mikroBUS™ Analog	7	IO7	RTC_GPIO7	GPIO7	TOUCH7	ADC1_CH6			
mikroBUS™ Reset	8	IO15	RTC_GPIO15	GPIO15	U0RTS	ADC2_CH4	XTAL_32K_P		
mikroBUS™ Chip Select	9	IO16	RTC_GPIO16	GPIO16	U0CTS	ADC2_CH5	XTAL_32K_N		
mikroBUS™ SCK	10	IO17	RTC_GPIO17	GPIO17	U1TxD	ADC2_CH6			
mikroBUS™ MISO	11	IO18	RTC_GPIO18	GPIO18	U1RxD	ADC2_CH7	CLK_OUT3		
mikroBUS™ MOSI	12	IO8	RTC_GPIO8	GPIO8	TOUCH8	ADC1_CH7	SUBSPICS1		
ESP32 USB D-	13	IO19	RTC_GPIO19	GPIO19	U1RTS	ADC2_CH8	CLK_OUT2	USB_D-	
ESP32 USB D+	14	IO20	RTC_GPIO20	GPIO20	U1CTS	ADC2_CH9	CLK_OUT1	USB_D+	
SDA	15	IO3	RTC_GPIO3	GPIO3	TOUCH3	ADC1_CH2			
Reserved IO 46	16	IO46	GPIO46						
SCL	17	IO9	RTC_GPIO9	GPIO9	TOUCH9	ADC1_CH8	FSPIHD	SUBSPIHD	
mikroBUS™ Tx	18	IO10	RTC_GPIO10	GPIO10	TOUCH10	ADC1_CH9	FSPICS0	FSPIIO4	SUBSPICS0
mikroBUS™ Rx	19	IO11	RTC_GPIO11	GPIO11	TOUCH11	ADC2_CH0	FSPID	FSPIIO5	SUBSPID
mikroBUS™ INT	20	IO12	RTC_GPIO12	GPIO12	TOUCH12	ADC2_CH1	FSPICLK	FSPIIO6	SUBSPICLK
mikroBUS™ PWM	21	IO13	RTC_GPIO13	GPIO13	TOUCH13	ADC2_CH2	FSPIQ	FSPIIO7	SUBSPIQ
Spare IO 14	22	IO14	RTC_GPIO14	GPIO14	TOUCH14	ADC2_CH3	FSPIWP	FSPIDQS	SUBSPIWP
Colour Sensor Interrupt	23	IO21	RTC_GPIO21	GPIO21					
Colour Sensor LEDs On	24	IO47	SPICLK_P_DIFF	GPIO47	SUBSPICLK_P_DIFF				
Motor Control 1	25	IO48	SPICLK_N_DIFF	GPIO48	SUBSPICLK_N_DIFF				
Reserved IO 45	26	IO45	GPIO45						
ESP32 Boot Mode	27	IO0	RTC_GPIO0	GPIO0					
	28	IO35	SPIIO6	GPIO35	FSPID	SUBSPID			
	29	IO36	SPIIO7	GPIO36	FSPICLK	SUBSPICLK			
	30	IO37	SPIDQS	GPIO37	FSPIQ	SUBSPIQ			
Motor Control 2	31	IO38	GPIO38	FSPIWP	SUBSPIWP				
5V Power Good	32	IO39	MTCK	GPIO39	CLK_OUT3	SUBSPICS1			
5V Enable	33	IO40	MTDO	GPIO40	CLK_OUT2				
Servo PWM	34	IO41	MTDI	GPIO41	CLK_OUT1				
Spare IO 42	35	IO42	MTMS	GPIO42					
ESP32 UART 0 Rx	36	RxD0	U0RxD	GPIO44	CLK_OUT2				
ESP32 UART 0 Tx	37	TxD0	U0TxD	GPIO43	CLK_OUT1				
Somewhat Reserved IO 2	38	IO2	RTC_GPIO2	GPIO2	TOUCH2	ADC1_CH1			
Somewhat Reserved IO 1	39	IO1	RTC_GPIO1	GPIO1	TOUCH1	ADC1_CH0			



This table reflects which signal is assigned to which IO pin and which peripheral.



Pins 28, 29 and 30 cannot be used, as they are used for the module's internal SPI bus.

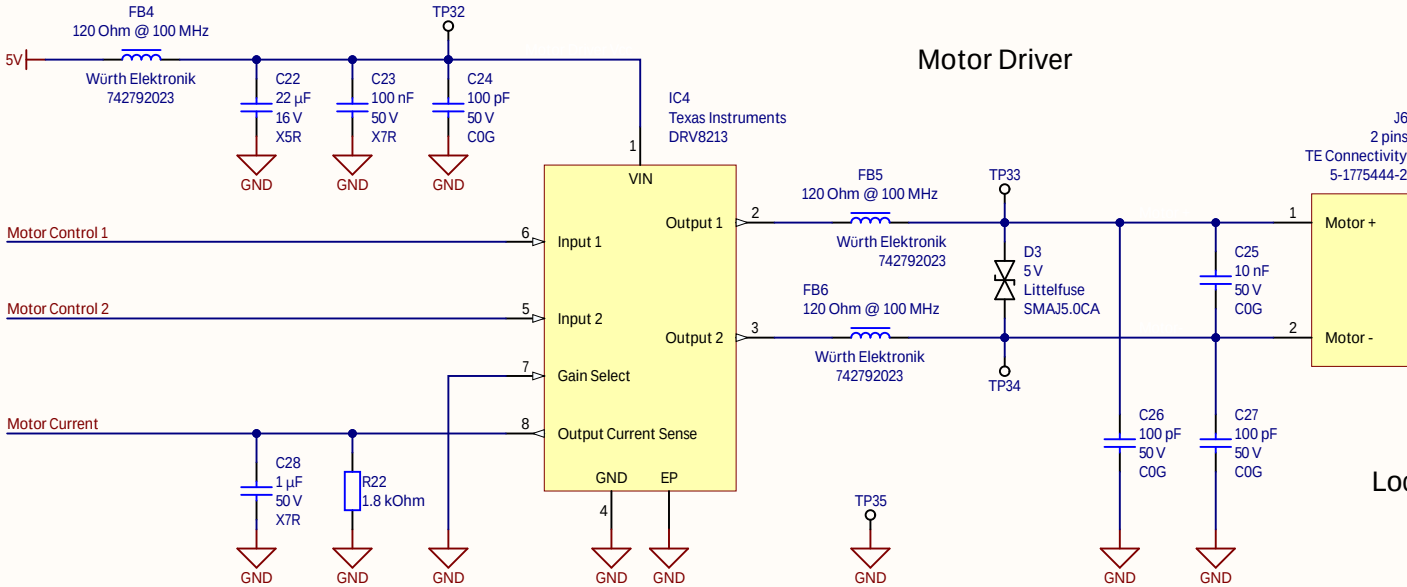


Be careful using the reserved IOs, as they might trigger unwanted boot modes.

When's Christmas ?!



Project		Circuit Cruiser (Beursgadget E&A 2025)			
Section		Microcontroller Pin Peripheral Mapping			
Revision	V2.1.1	PCB Revision	2	Schematic Revision	1
Document Revision		1			
Variant		Prototype			Sheet
					6
Release Status		Released for Production			Total Sheets
					11
• Pink Fluffy Unicorns BV • Stationsweg 23-25 • 8131 DG • Wijnje •					



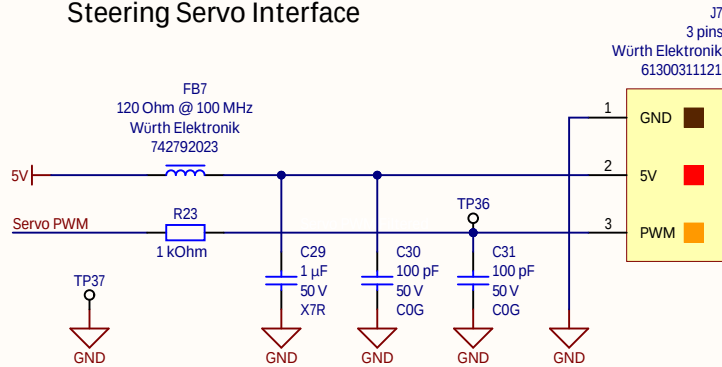
Motor Driver Specifications

Current Meter Gain	205 μ A/A
Voltage Gain	369 mV/A
Current Limit	1.38 A
f-3dB	88 Hz

Motor Driver Truth Table

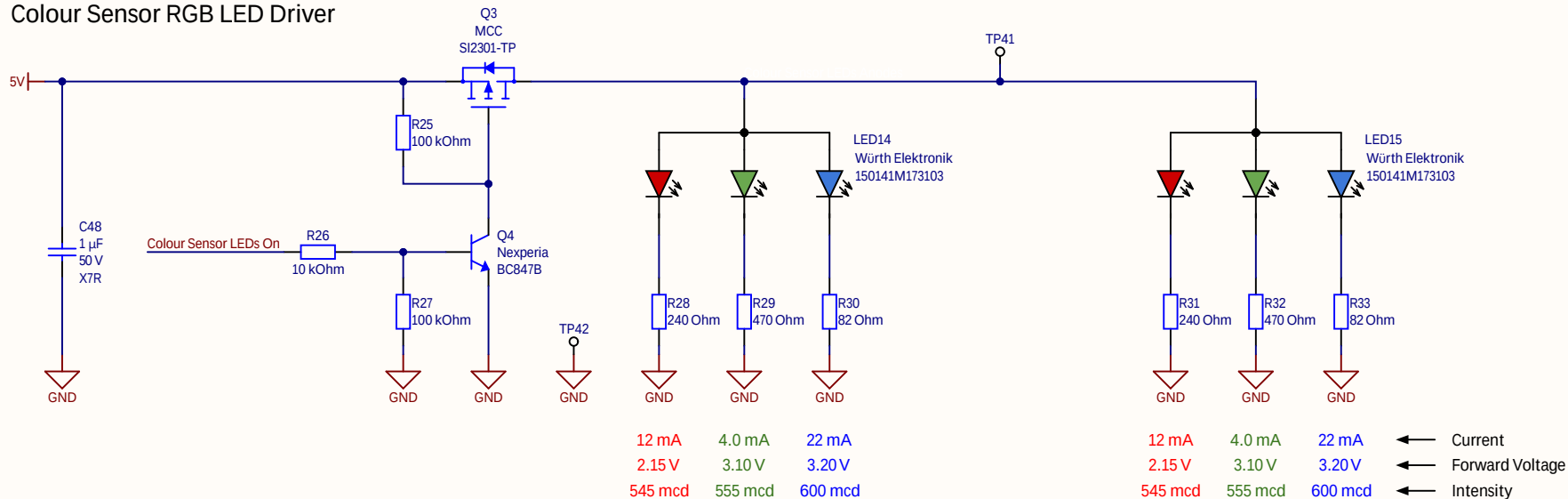
	Motor Control 1	Motor Control 2	Output 1	Output 2
Coasting	Low	Low	High-Z	High-Z
Forward	High	Low	High	Low
Reverse	Low	High	Low	High
Braking	High	High	Low	Low

Steering Servo Interface

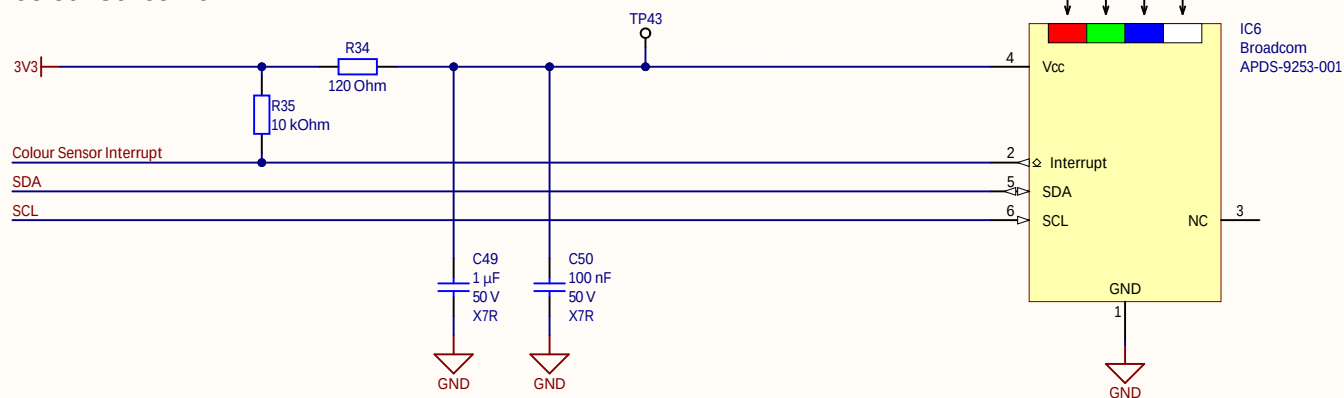


Project	Circuit Cruiser (Beursgadget E&A 2025)		
Section	Motor & Servo Connectors		
Revision	V2.1.1	PCB Revision	2
		Schematic Revision	1
		Document Revision	1
Variant	Prototype		Sheet
			7
Release Status	Released for Production		Total Sheets
			11
• Pink Fluffy Unicorns BV • Stationsweg 23-25 • 8131 DG • Wijnje •			

Colour Sensor RGB LED Driver



Colour Sensor IC



Local Fiducial Markings



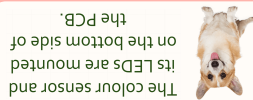
The Colour Sensor RGB LEDs can be driven continuously and simultaneously.



The I²C address of the colour sensor IC is set to 1010010.

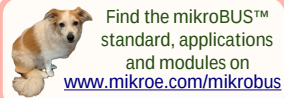
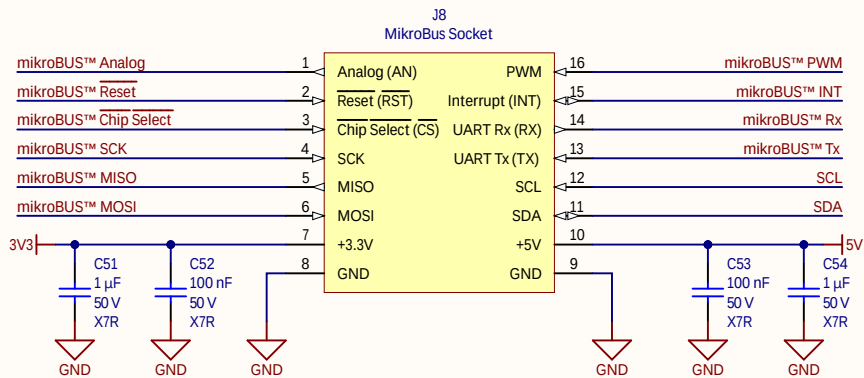


The colour sensor measures the light from the two LEDs that is reflected off the ground.



The colour sensor and its LEDs are mounted on the bottom side of the PCB.

Project		Circuit Cruiser (Beursgadget E&A 2025)					
Section		Colour Sensor & Illumination					
Revision	V2.1.1	PCB Revision	2	Schematic Revision	1	Document Revision	1
Variant		Prototype			Sheet		9
Release Status		Released for Production			Total Sheets		11
• Pink Fluffy Unicorns BV • Stationsweg 23-25 • 8131 DG • Wijke •							



Find the mikroBUS™ standard, applications and modules on www.mikroe.com/mikrobus



J9 is optional. The footprint on the PCB is mikroBUS compatible.



If you want to use a mikroBUS module, using J9 remains optional, yet recommended.



This sheet contains a lot of empty space.
Just like Odie's head.

Project		Circuit Cruiser (Beursgadget E&A 2025)			
Section		mikroBUS™ Socket			
Revision	V2.1.1	PCB Revision	2	Schematic Revision	1
Document Revision	1				
Variant	Prototype			Sheet	10
Release Status	Released for Production			Total Sheets	11
• Pink Fluffy Unicorns BV • Stationsweg 23-25 • 8131 DG • Wijkhe •					

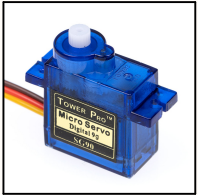
A

BAT1



DJbattery PNCR18650-1S1P
3.4 Ah

MOD2



Tower Pro SG90

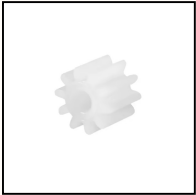
MOT1



8500 RPM

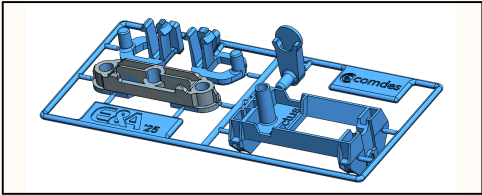
KFF-130SH-17105

MECH1



14 Teeth

MECH2



Comdes

E&A 2025 Gadget Parts

A

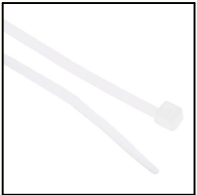
B

MECH3



Phoenix Contact 3240744
35 mm Bundle Size

MECH4



Phoenix Contact 3240744
35 mm Bundle Size

MECH5



Würth Elektronik 700971600
2.6 mm

MECH6



27 mm Diameter

MECH7



M2.5

Apra 250-602

MECH8



M2.5

Apra 250-602

MECH9



27 mm Diameter

B

C

MECH10



Phoenix Contact 3240744
35 mm Bundle Size

MECH11



Phoenix Contact 3240744
35 mm Bundle Size

MECH12



Würth Elektronik 700971600
2.6 mm

MECH13



27 mm Diameter

MECH14



42 Teeth

MECH15



2.5 mm Diameter, 75 mm Length

MECH16



27 mm Diameter

C

D

Global Fiducial Markings (Top Side)



Global Fiducial Markings (Bottom Side)



Project		Circuit Cruiser (Beursgadget E&A 2025)			
Section		Mechanical Parts & PCB Features			
Revision	V2.1.1	PCB Revision	2	Schematic Revision	1
				Document Revision	1
Variant	Prototype				Sheet
				Total Sheets	11
Release Status					
Released for Production					
• Pink Fluffy Unicorns BV • Stationsweg 23-25 • 8131 DG • Wijkhe •					

D