

Amulet Motion Controller

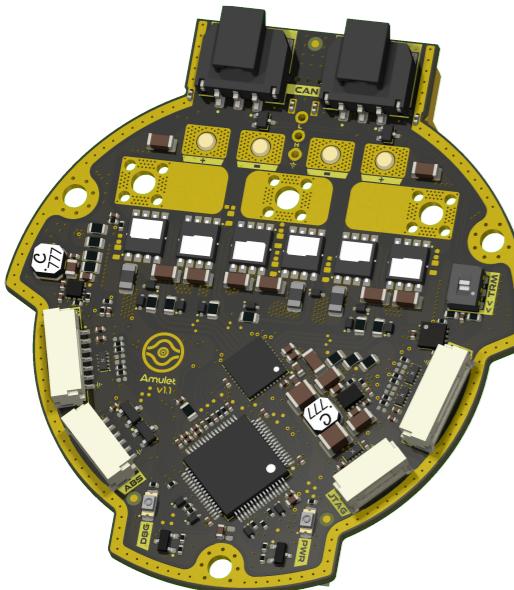
Variant: NO_SNUBBER

2024-11-19

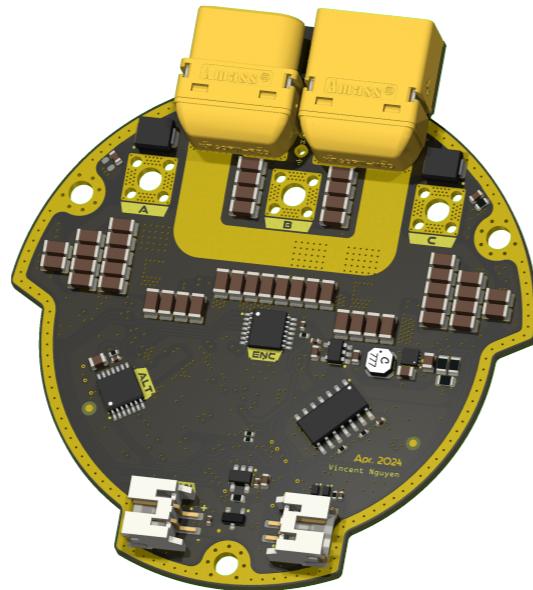
Rev 1.1

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TOP VIEW



BOTTOM VIEW



DESIGN CONSIDERATIONS

DESIGN NOTE:
Example text for informational design notes.

DESIGN NOTE:
Example text for debug 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.

NOTES

Schematic based off Josh Pieper's moteus controllers.

Not fitted components are marked as

DRAFT - Very early stage of schematic, ignore details.

PRELIMINARY - Close to final schematic.

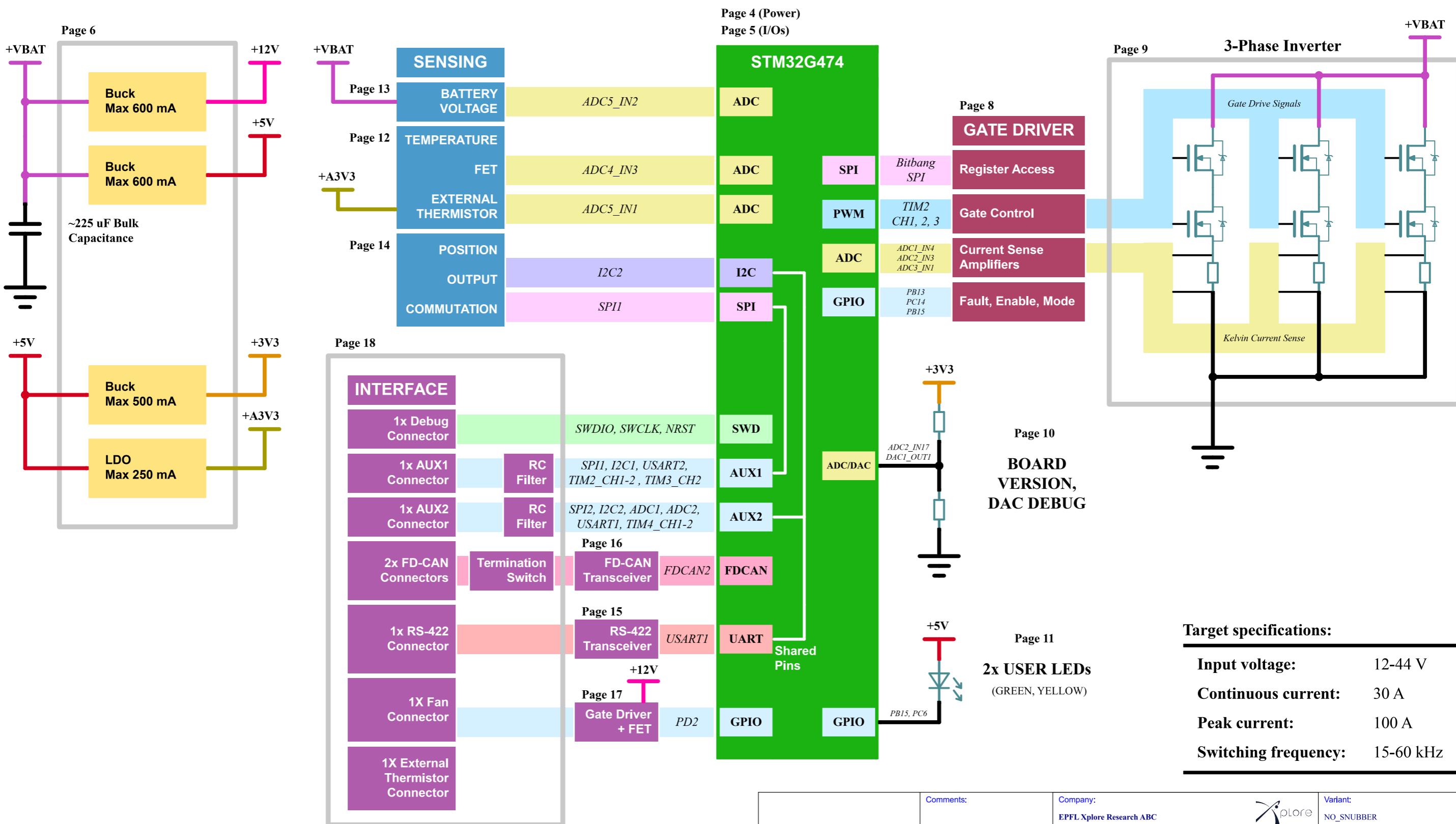
CHECKED - There shouldn't be any mistakes. Contact the engineer if you find any.

RELEASED - A board with this schematic has been sent to production.

Date: 13-APR-2024

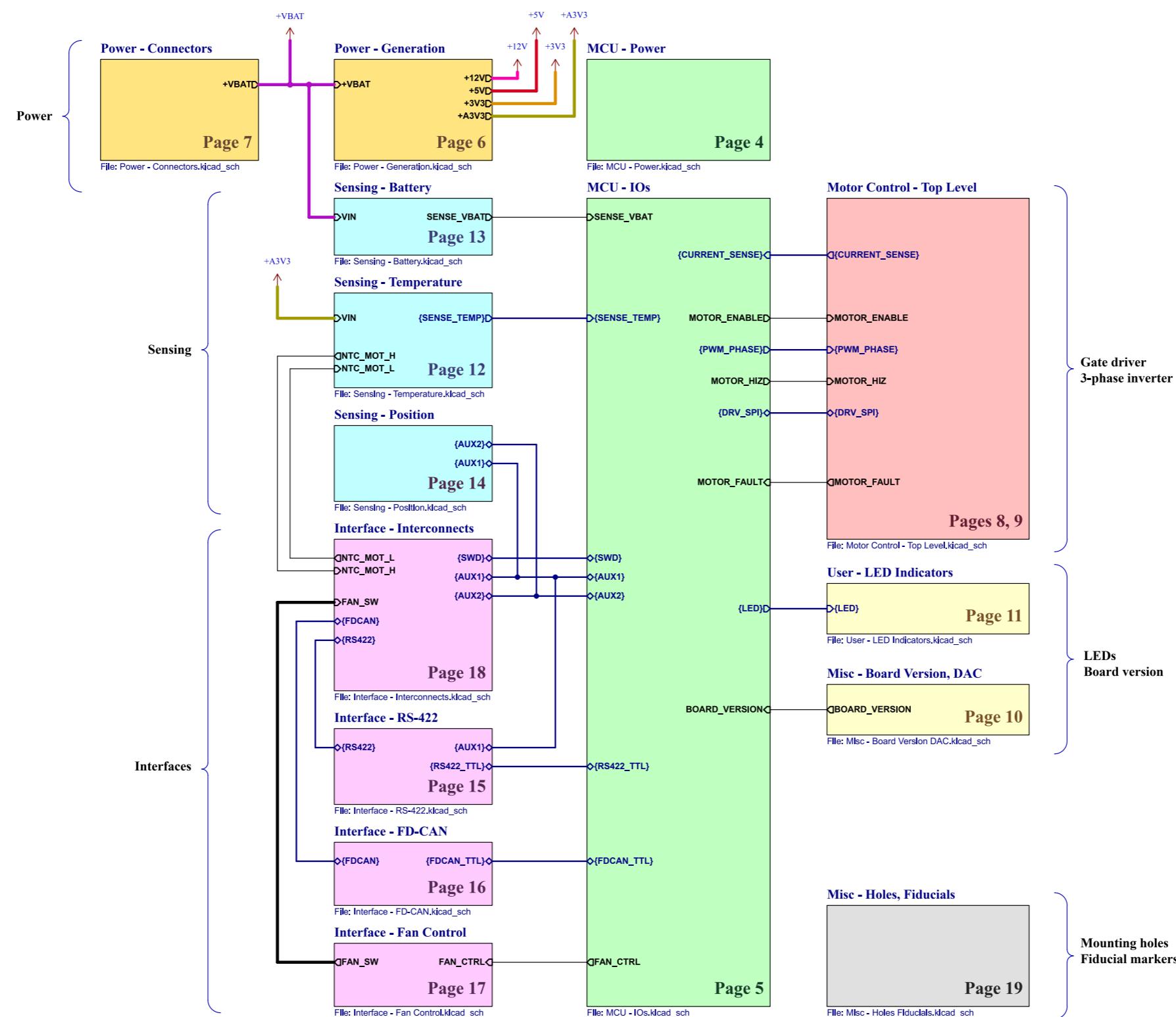
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	Board Name: Amulet Motion Controller	Project Name: Chienpanzé	
Sheet Title: Cover Page	File Name: amulet_controller.kicad_sch	Designer: Vincent Nguyen	Date: 2024-04-13
Sheet Path: /	Reviewer:	Size: A3	Revision: 1.1
		Sheet: 1 of 21	

[2] Block Diagram



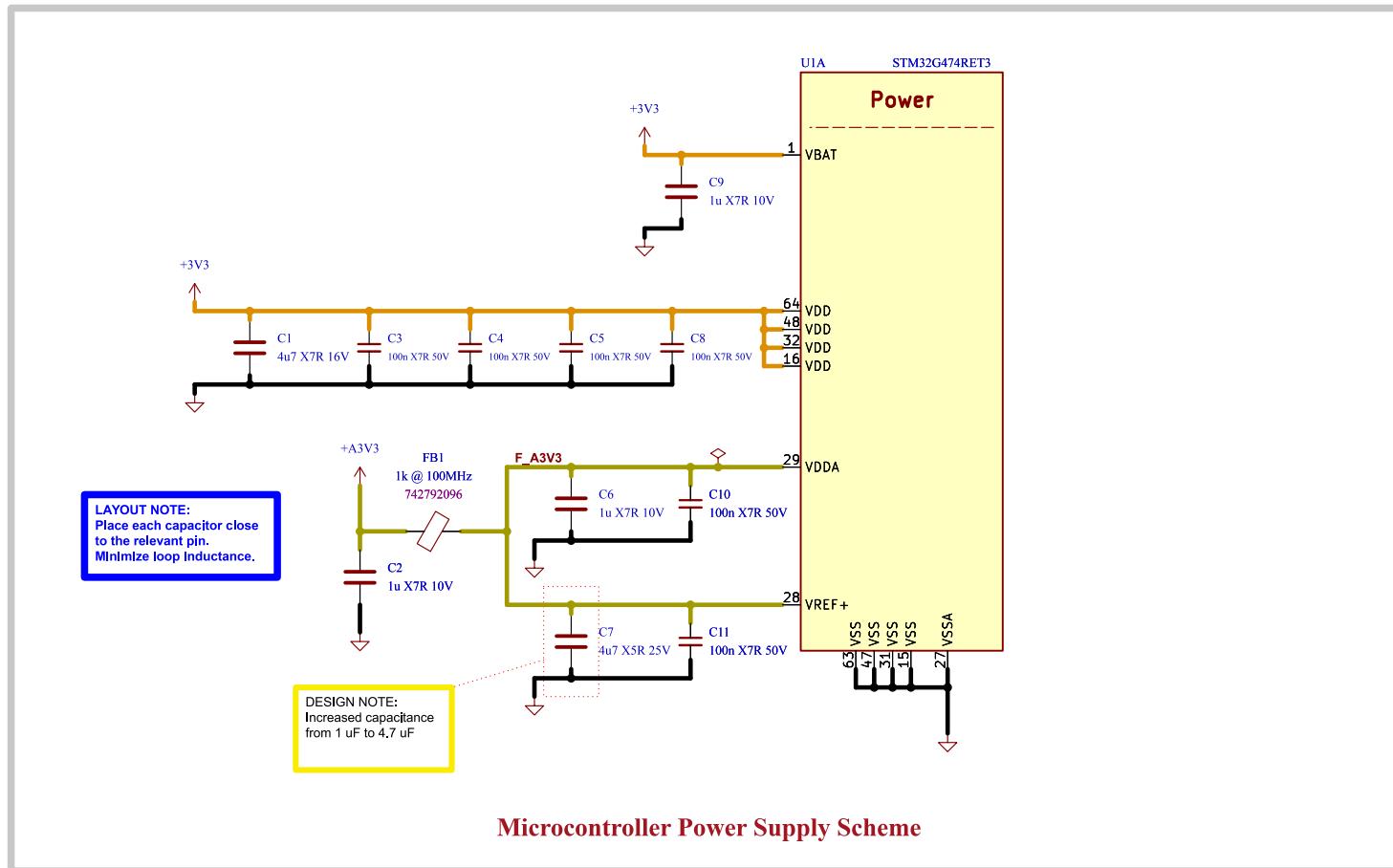
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	Board Name: Amulet Motion Controller		Project Name: Chienpanzé
Sheet Title: Block Diagram	File Name: Block Diagram.kicad_sch		Date: 2024-04-13
Sheet Path: /Block Diagram/	Designer: Vincent Nguyen		Revision: 1.1
Reviewer:	Size: A3		Sheet: 2 of 21

[3] Project Architecture



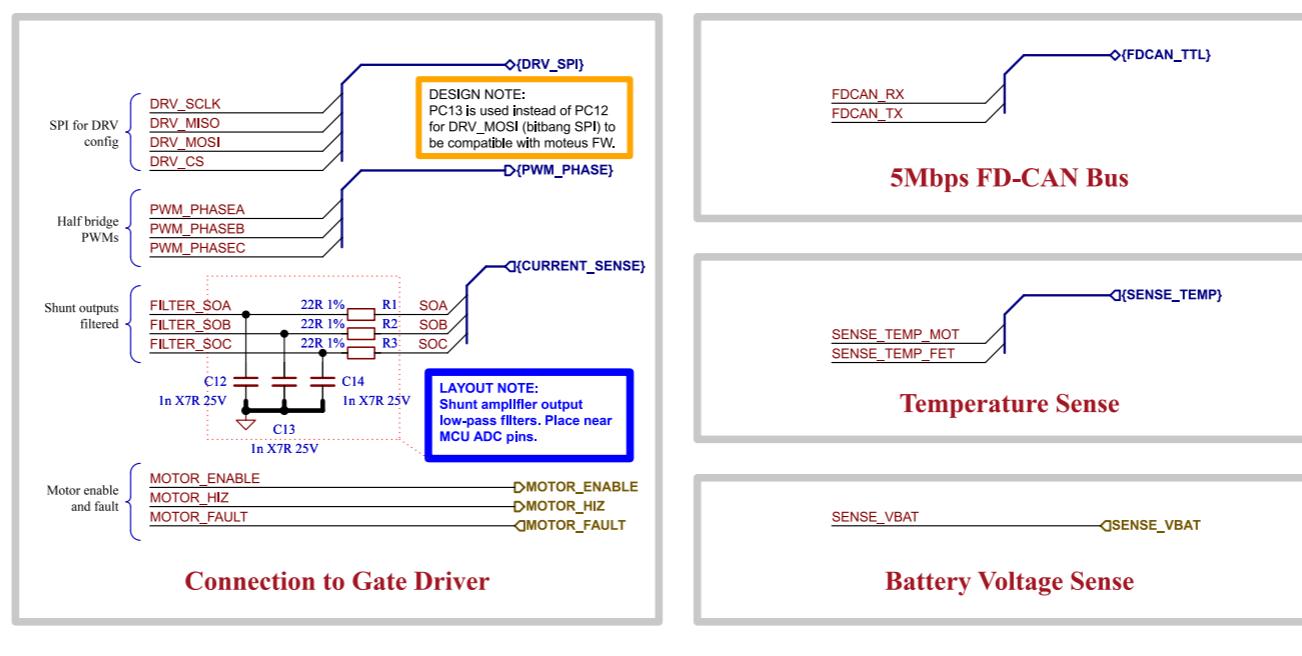
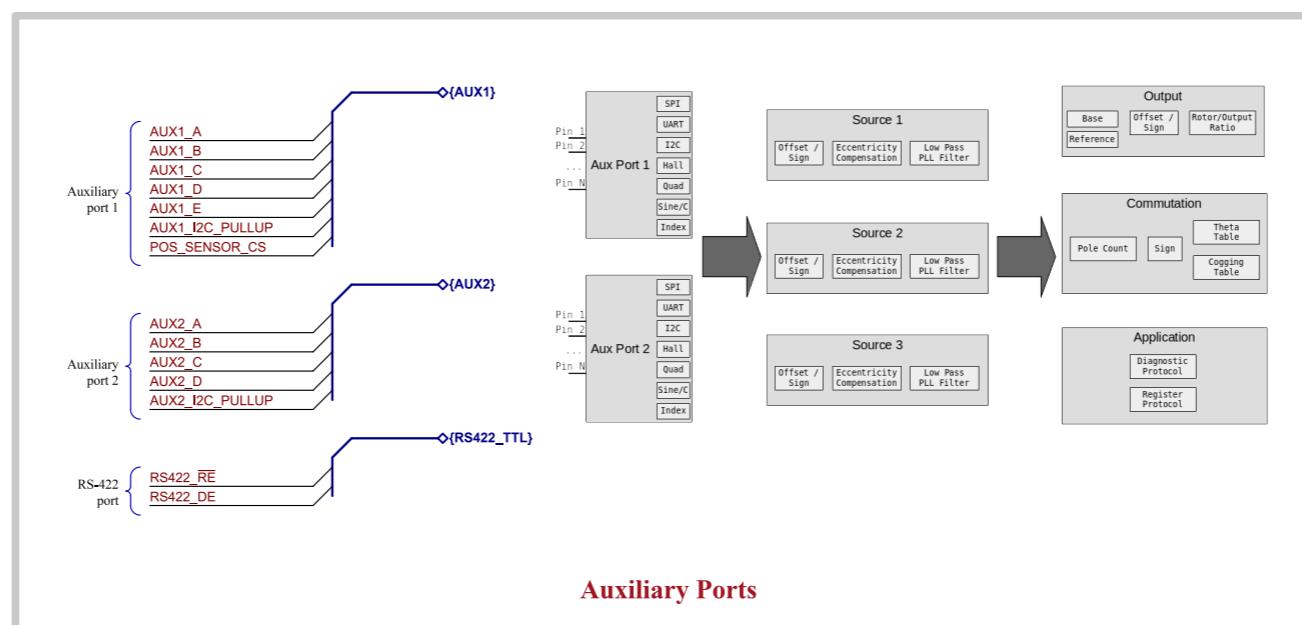
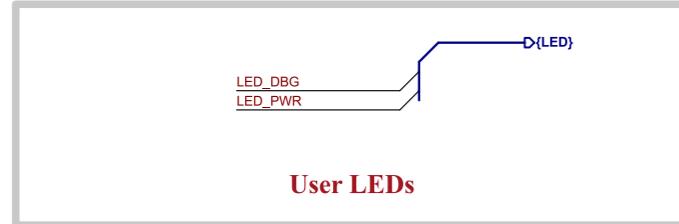
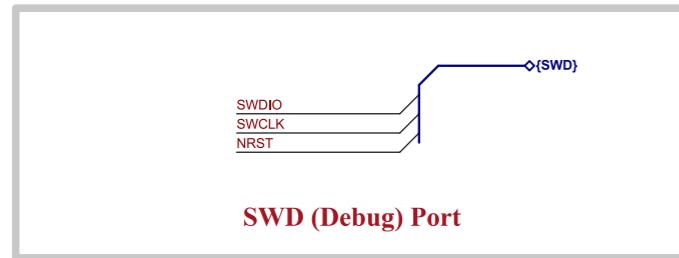
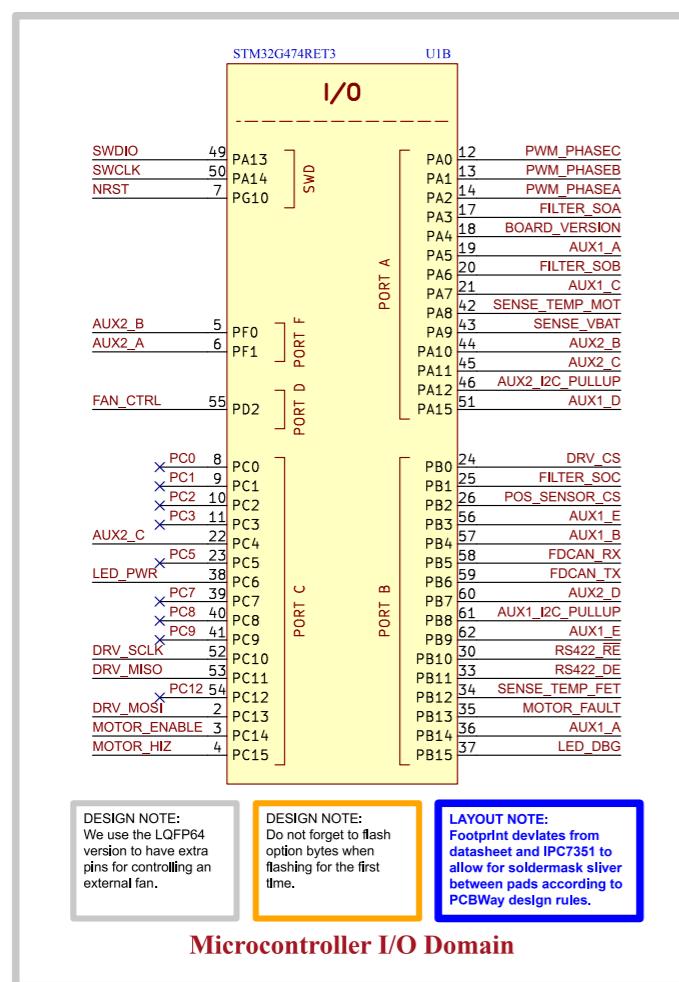
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	Board Name: Amulet Motion Controller	Project Name: Chienpanzé	
Sheet Title: Project Architecture	File Name: Project Architecture.kicad_sch	Designer: Vincent Nguyen	Date: 2023-12-22
Sheet Path: /Project Architecture/	Reviewer:		Revision: 1.1
	Size: A3	Sheet: 3 of 21	

[4] MCU - Power



	Comments: AN5346 STM32G474 Datasheet p.81 J. Pieper ADC investigation	Company: EPFL Xplore Research ABC	Variant: NO_SNUBBER
	Board Name: Amulet Motion Controller		
	Sheet Title: MCU - Power	File Name: MCU - Power.kicad_sch	Designer: Vincent Nguyen
	Sheet Path: /Project Architecture/MCU - Power/	Reviewer:	Date: 2023-12-18 Revision: 1.1

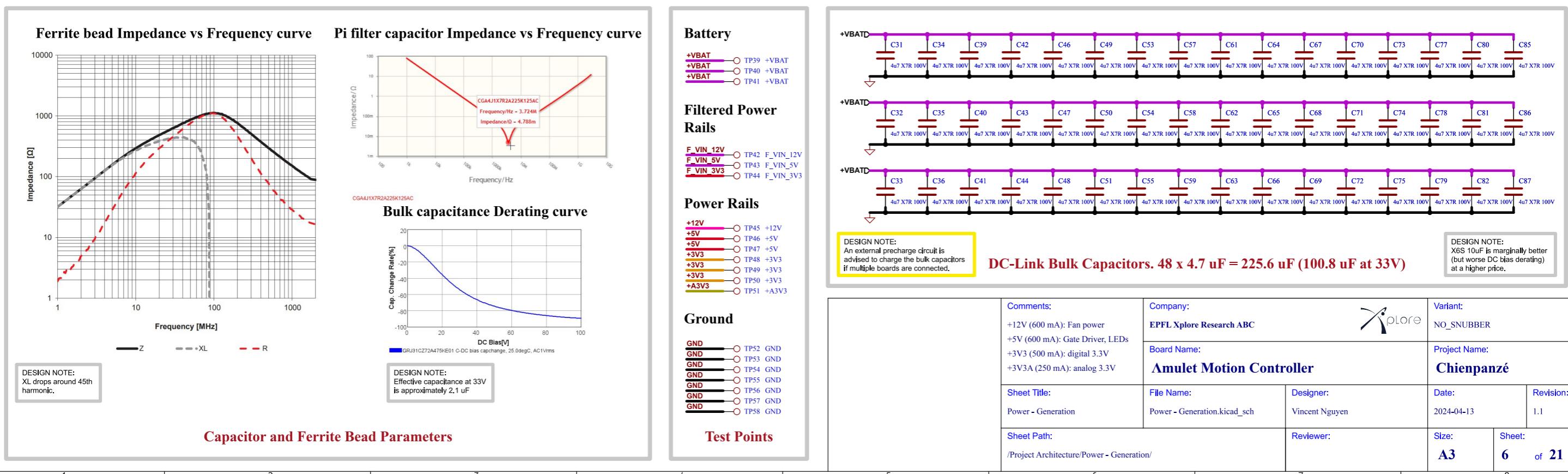
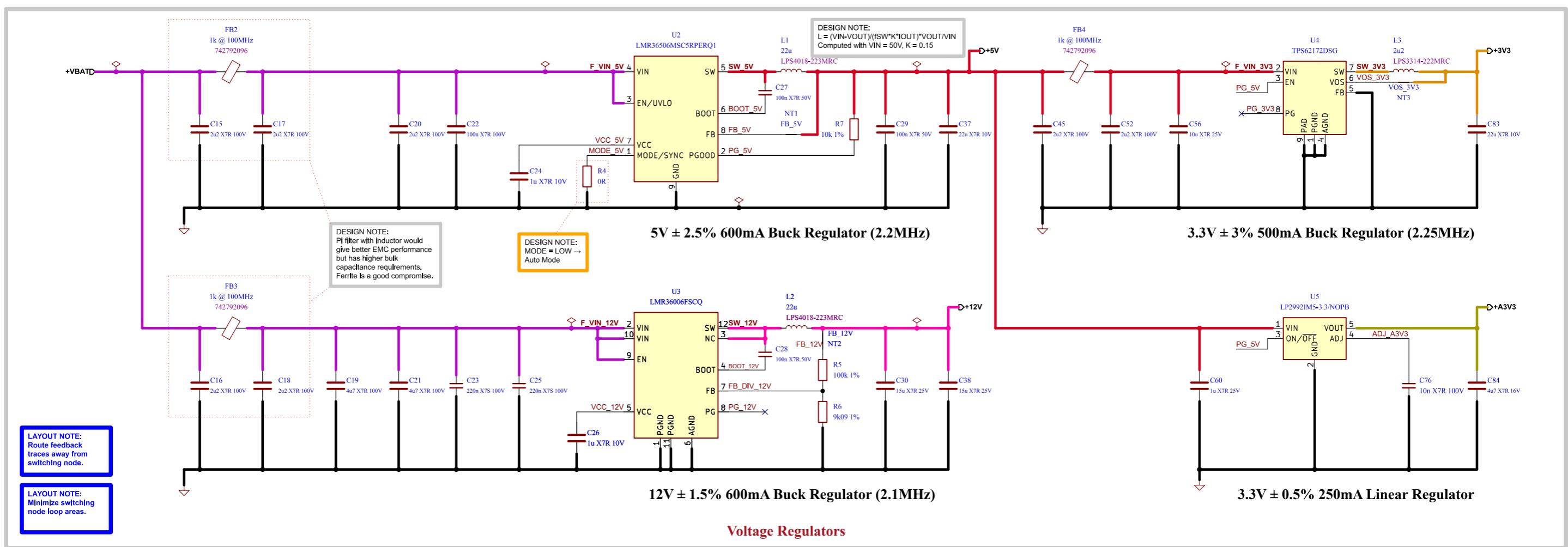
[5] MCU - I/Os



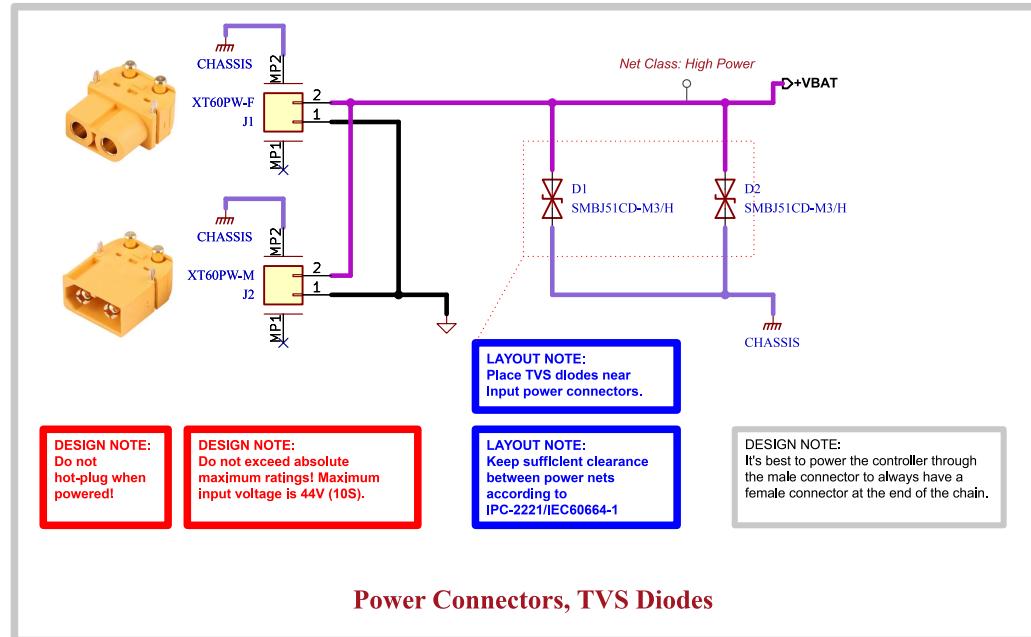
Gate Driver	
MOTOR_ENABLE	TP1
MOTOR_HIZ	TP2
MOTOR_FAULT	TP3
DRV_SCLK	TP4
DRV_MISO	TP5
DRV_MOSI	TP6
DRV_CS	TP7
PWM_PHASEA	TP8
PWM_PHASEB	TP9
PWM_PHASEC	TP10
SOA	TP11
SOB	TP12
SOC	TP13
Debug	
SWDIO	TP14
SWCLK	TP15
NRST	TP16
Auxiliary pins 1	
AUX1_A	TP17
AUX1_B	TP18
AUX1_C	TP19
AUX1_D	TP20
AUX1_E	TP21
AUX1_I2C_PULLUP	TP22
POS_SENSOR_CS	TP23
Auxiliary pins 2	
AUX2_A	TP24
AUX2_B	TP25
AUX2_C	TP26
AUX2_D	TP27
AUX2_I2C_PULLUP	TP28
RS-422	
RS422_RE	TP29
RS422_DE	TP30
LEDs	
LED_DBG	TP31
LED_PWR	TP32
FD-CAN	
FDCAN_RX	TP33
FDCAN_TX	TP34
Fan	
FAN_CTRL	TP35
Sense	
SENSE_TEMP_MOT	TP36
SENSE_TEMP_FET	TP37
SENSE_VBAT	TP38
Test Points	

Comments: References: Flexible I/O worked examples Flexible I/O source configuration	Company: EPFL Xplore Research ABC		Variant: NO_SNUBBER	
	Board Name: Amulet Motion Controller		Project Name: Chienpanzé	
Sheet Title: MCU - I/Os	File Name: MCU - IOs.kicad_sch	Designer: Vincent Nguyen	Date: 2023-12-20	Revision: 1.1
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[6] Power - Generation

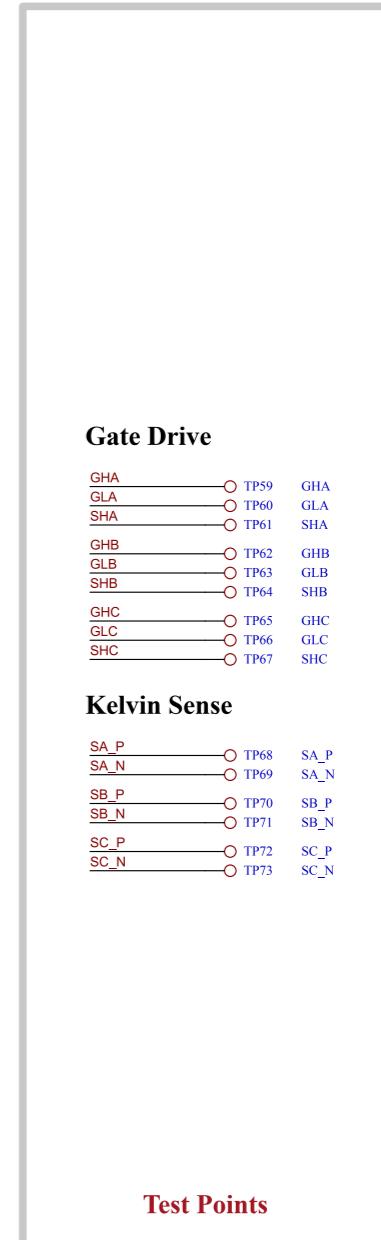
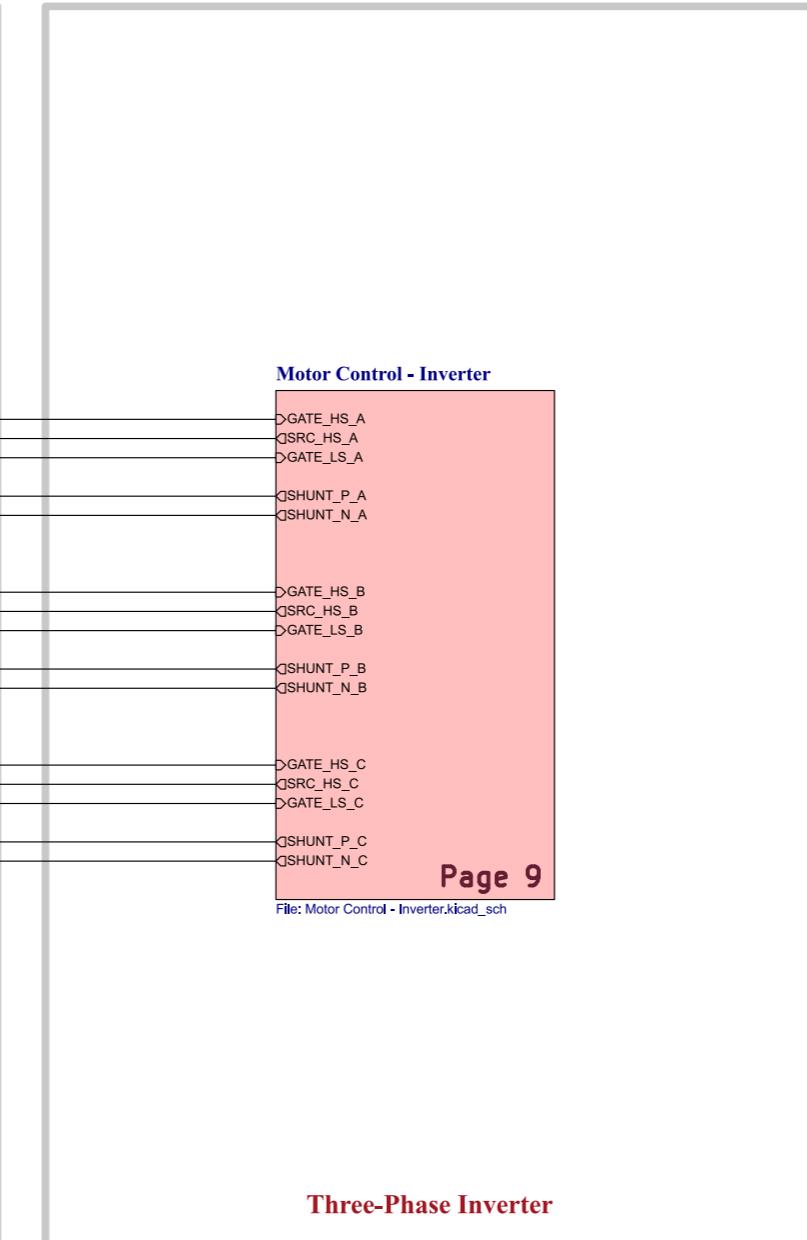
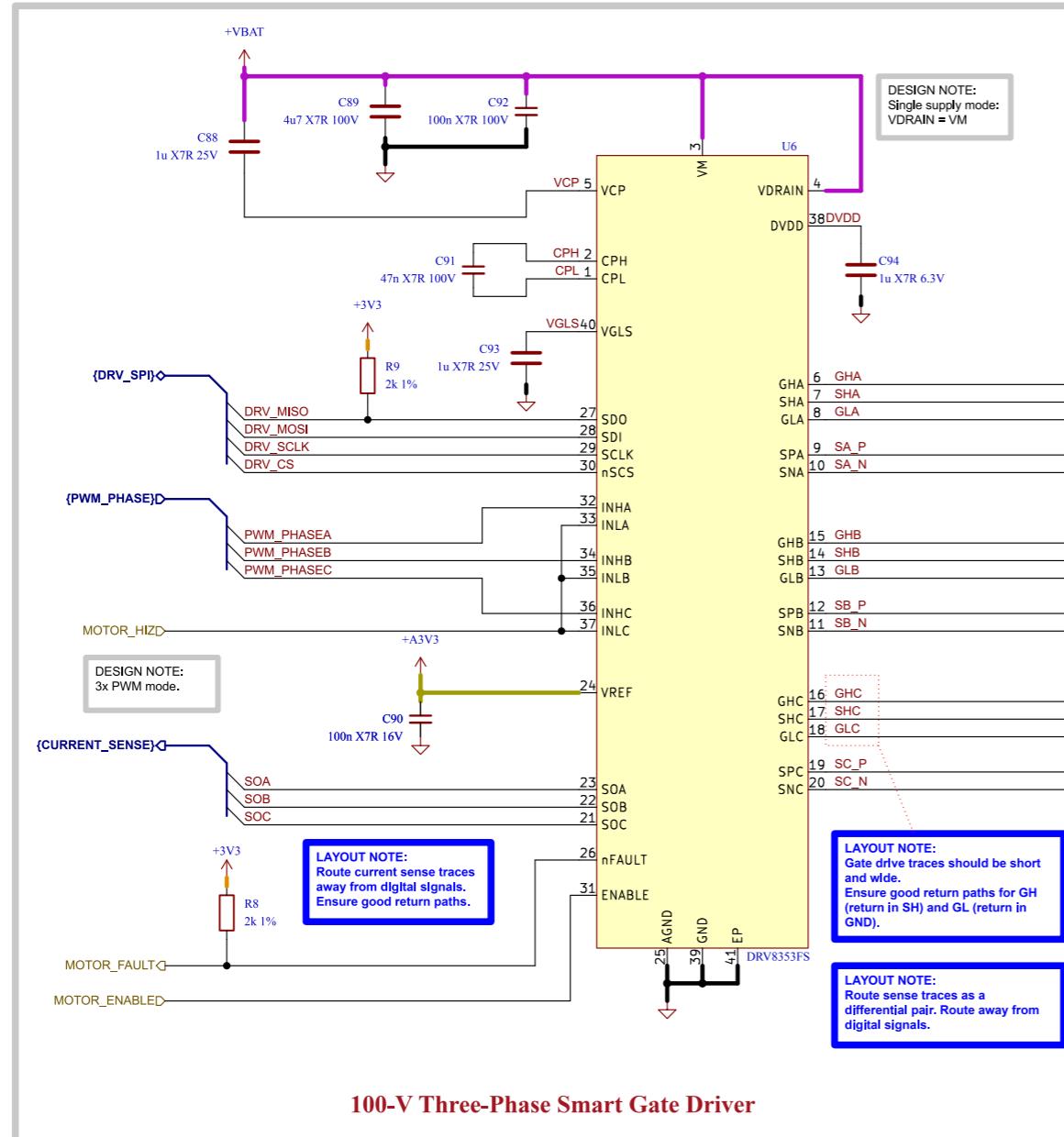


[7] Power - Connectors



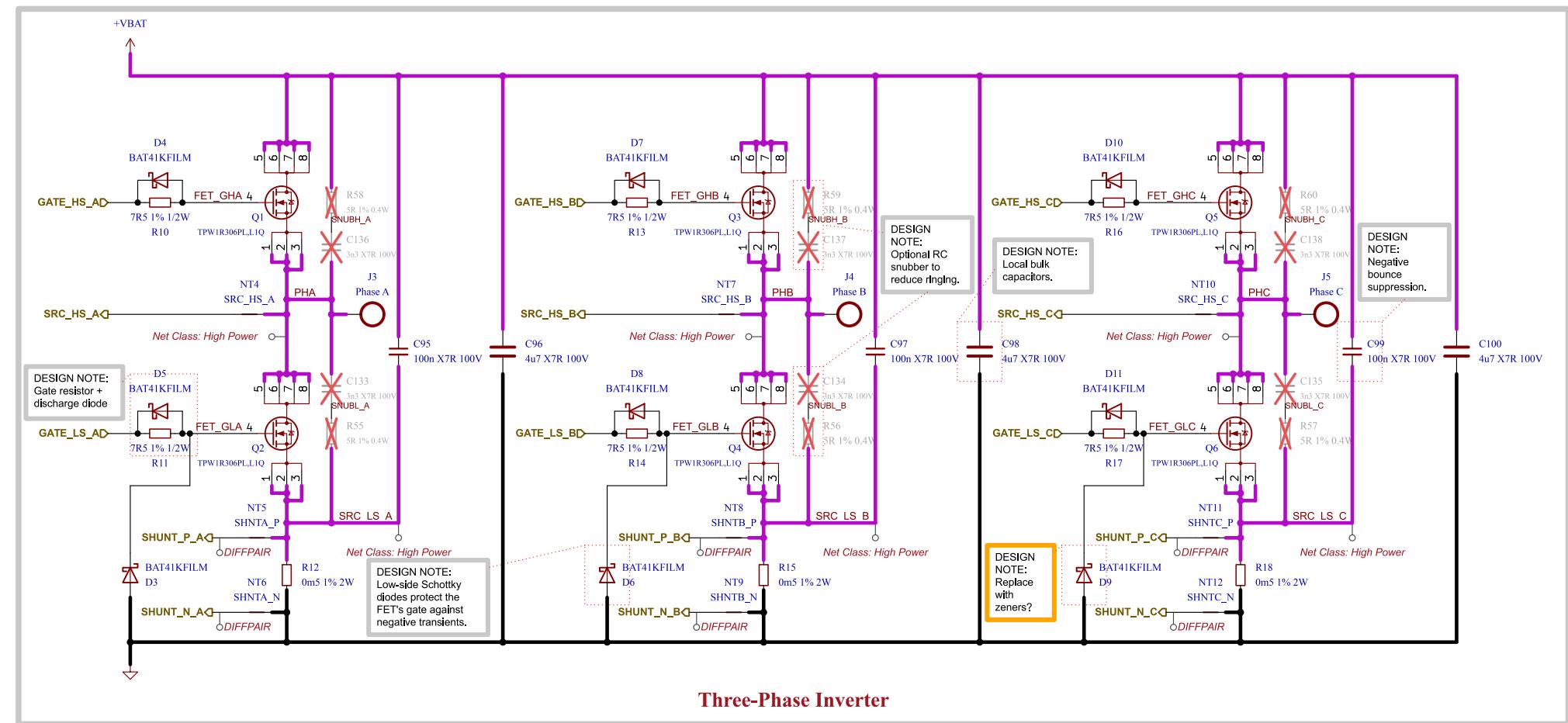
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	Sheet Title: Power - Connectors	File Name: Power - Connectors.kicad_sch	Designer: Vincent Nguyen
	Sheet Path: /Project Architecture/Power - Connectors/	Reviewer: 	Date: 2023-12-31
		Size: A4	Sheet: 7 of 21

[8] Motor Control - Top Level



	Comments:	Company: EPFL Xplore Research ABC	Variant: NO_SNUBBER
	Board Name: Amulet Motion Controller	Project Name: Chienpanzé	
	Sheet Title: Motor Control - Top Level	File Name: Motor Control - Top Level.kicad_sch	Designer: Vincent Nguyen
	Sheet Path: /Project Architecture/Motor Control - Top Level/	Reviewer:	Date: 2023-12-20 Revision: 1.1

[9] Motor Control - Inverter



LAYOUT NOTE:
High current traces must be carefully designed. Ensure ground return path does not cross sensitive parts of the board. Use multiple planes for higher current carrying capacity.

LAYOUT NOTE:
Keep sufficient clearance between power nets according to IPC-2221/IEC60664-1.

DESIGN NOTE:
A gate drive current that is too large can damage the FETs!

Comments:
System Design Considerations for High-Power Motor Driver Applications
Best Practices for Board Layout of Motor Drivers
Proper RC Snubber Design for Motor Drivers

Sheet Title:
Motor Control - Inverter

Sheet Path:
/Project Architecture/Motor Control - Top Level/Motor Control - Inverter/

Company:
EPFL Xplore Research ABC

Board Name:
Amulet Motion Controller

File Name:
Motor Control - Inverter.kicad_sch

Designer:
Vincent Nguyen



Variant:
NO_SNUBBER

Project Name:
Chienpanzé

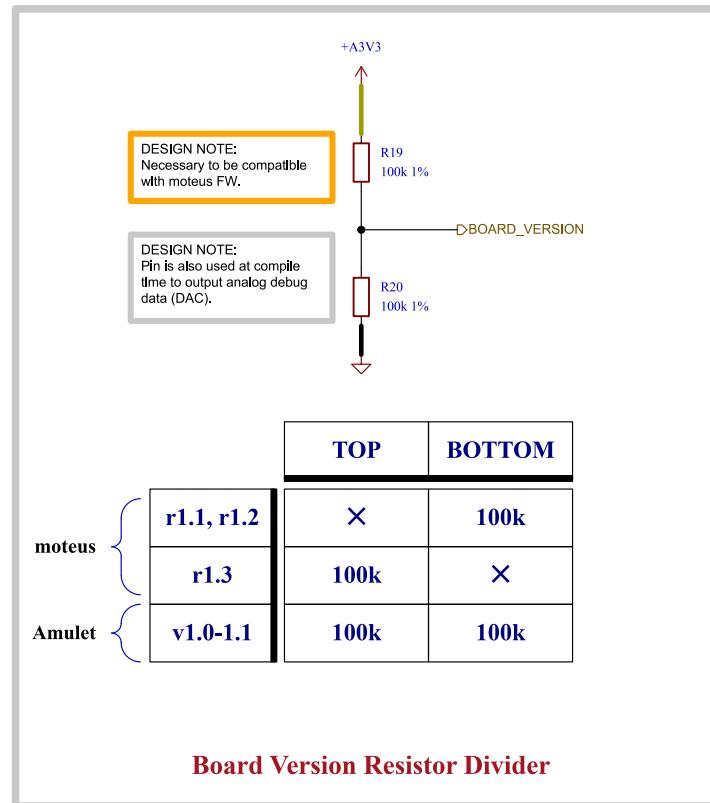
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2024-01-25

Revision:
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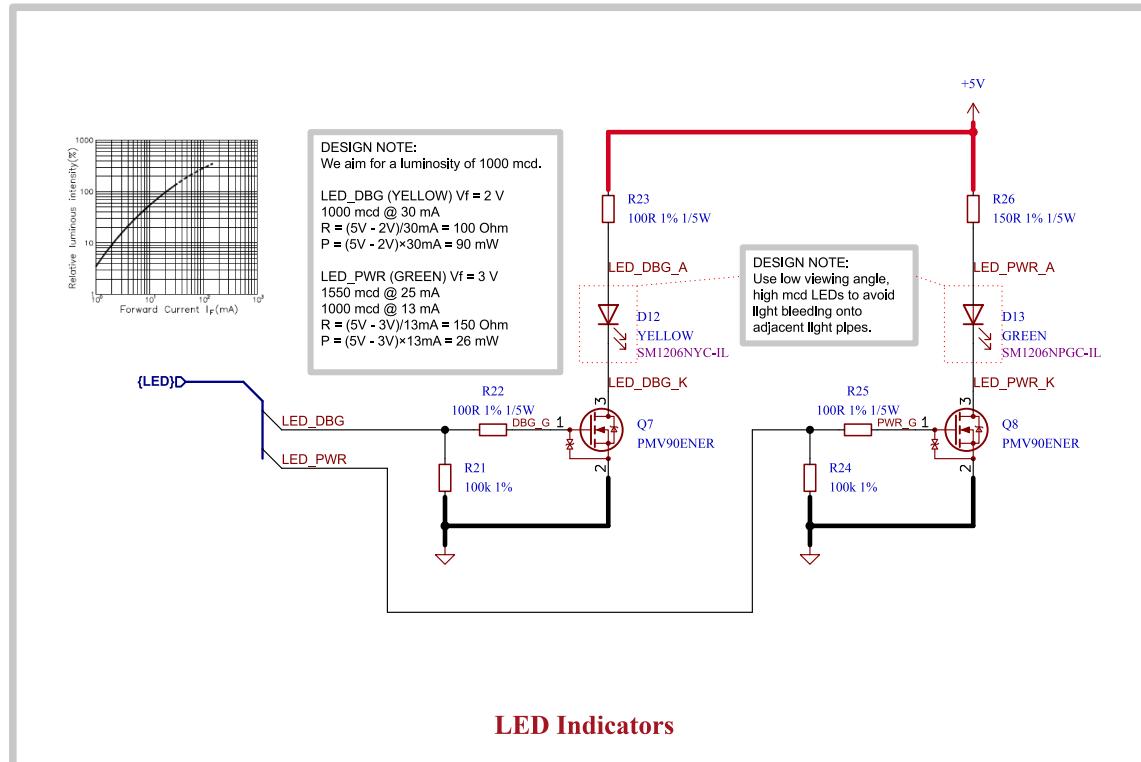
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9 of **21**

[10] Misc - Board Version, DAC



	Comments:	Company: EPFL Xplore Research ABC		Variant: NO_SNUBBER	
		Board Name: Amulet Motion Controller		Project Name: Chienpanzé	
	Sheet Title: Misc - Board Version, DAC	File Name: Misc - Board Version DAC.kicad_sch	Designer: Vincent Nguyen	Date: 2024-04-13	Revision: 1.1
	Sheet Path: /Project Architecture/Misc - Board Version, DAC/		Reviewer:	Size: A4	Sheet: 10 of 21

[11] User - LED Indicators



A

A

B

B

C

C

D

D

	Comments: 	Company: EPFL Xplore Research ABC	Variant: NO_SNUBBER
	Board Name: Amulet Motion Controller		Project Name: Chienpanzé
	Sheet Title: User - LED Indicators	File Name: User - LED Indicators.kicad_sch	Designer: Vincent Nguyen
	Sheet Path: /Project Architecture/User - LED Indicators/	Reviewer: 	Date: 2023-12-19
		Size: A4	Sheet: 11 of 21

[12] Sensing - Temperature

A

B

C

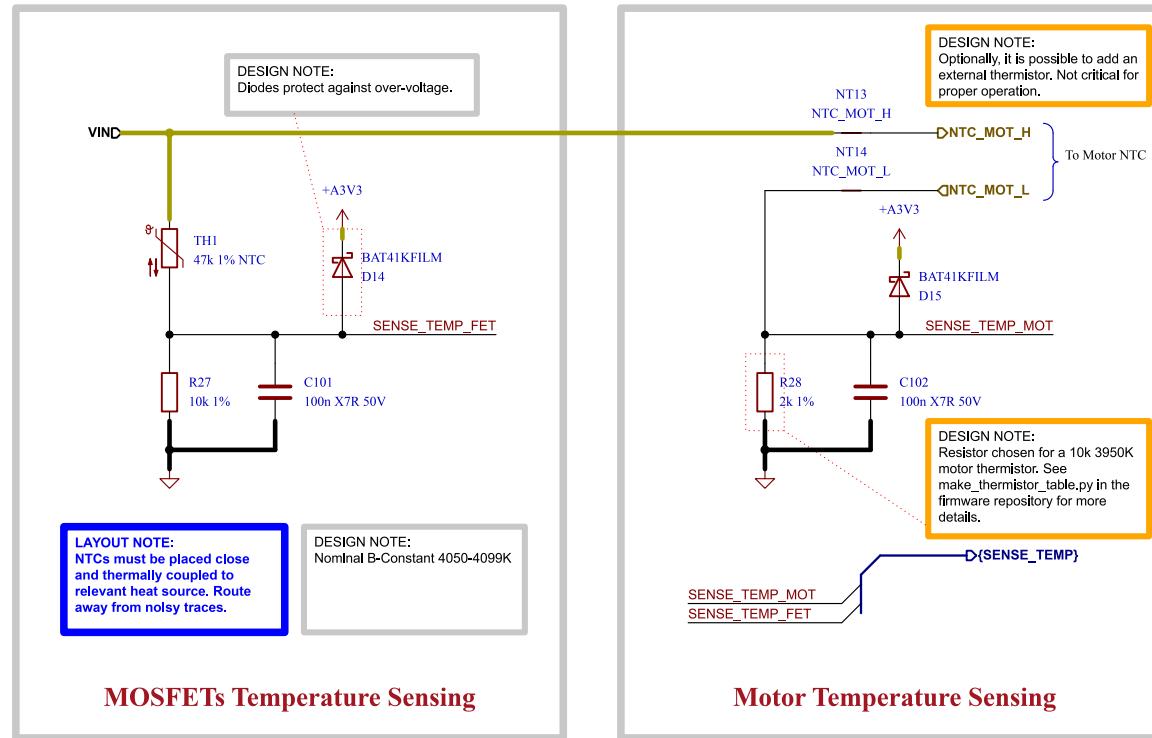
D

A

B

C

D



	Comments:	Company: EPFL Xplore Research ABC	Variant: NO_SNUBBER
	Board Name: Amulet Motion Controller		
	Sheet Title: Sensing - Temperature	File Name: Sensing - Temperature.kicad_sch	Designer: Vincent Nguyen
	Sheet Path: /Project Architecture/Sensing - Temperature/	Reviewer:	Date: 2024-04-13 Revision: 1.1

[13] Sensing - Battery

A

A

B

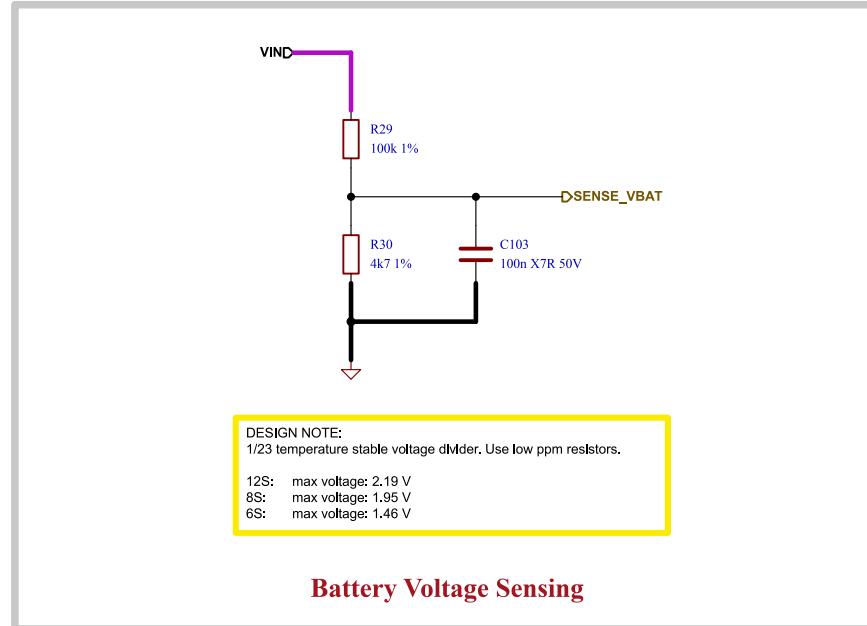
B

C

C

D

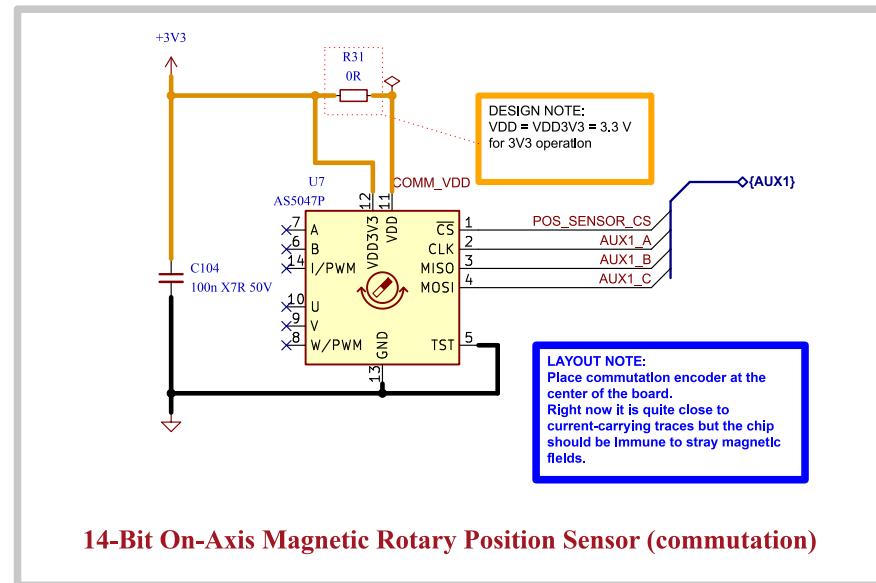
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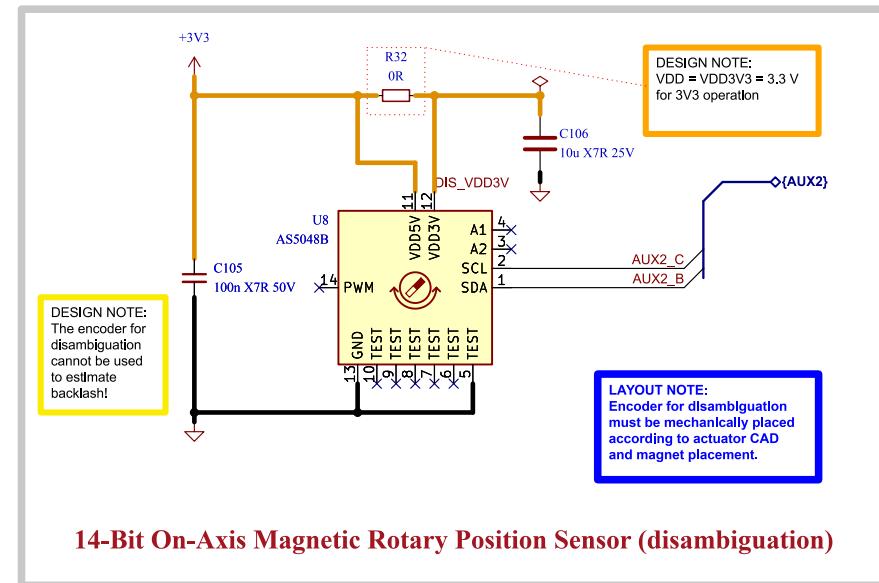
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	Sheet Title: Sensing - Battery	File Name: Sensing - Battery.kicad_sch	Designer: Vincent Nguyen
	Sheet Path: /Project Architecture/Sensing - Battery/	Reviewer:	Date: 2023-10-14 Revision: 1.1

[14] Sensing - Position

A



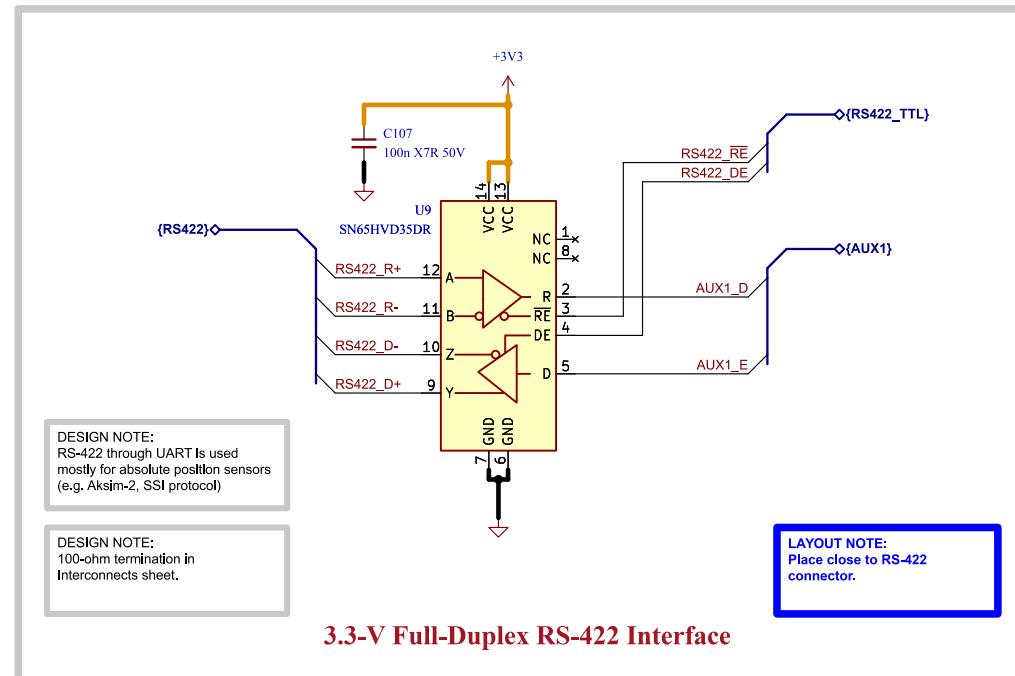
DESIGN NOTE:
AS5047P senses magnet mounted on planetary sun gear, for commutation.
AS5048B senses magnet mounted on shaft with same reduction factor as planetary gearbox for disambiguation.



B

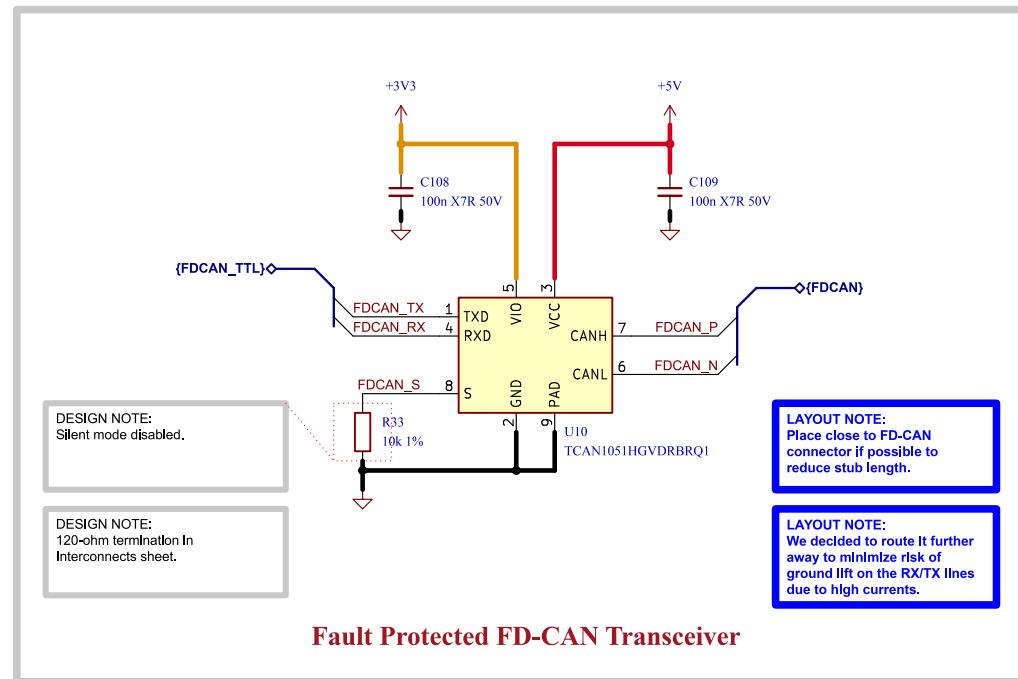
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		Board Name: Amulet Motion Controller		
		Sheet Title: Sensing - Position	File Name: Sensing - Position.kicad_sch	Designer: Vincent Nguyen
		Sheet Path: /Project Architecture/Sensing - Position/		Reviewers: Size: A4
				Sheet: 14 of 21

[15] Interface - RS-422



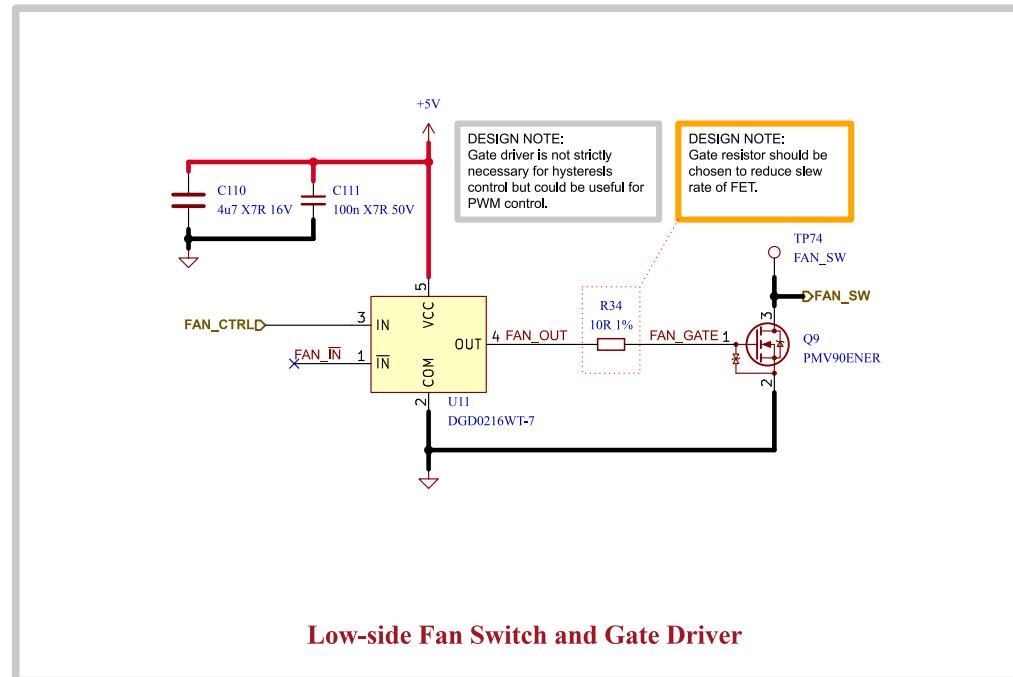
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	Board Name: Amulet Motion Controller		Project Name: Chienpanzé
	Sheet Title: Interface - RS-422	File Name: Interface - RS-422.kicad_sch	Designer: Vincent Nguyen
	Sheet Path: /Project Architecture/Interface - RS-422/	Reviewer:	Date: 2023-10-15 Revision: 1.1

[16] Interface - FD-CAN



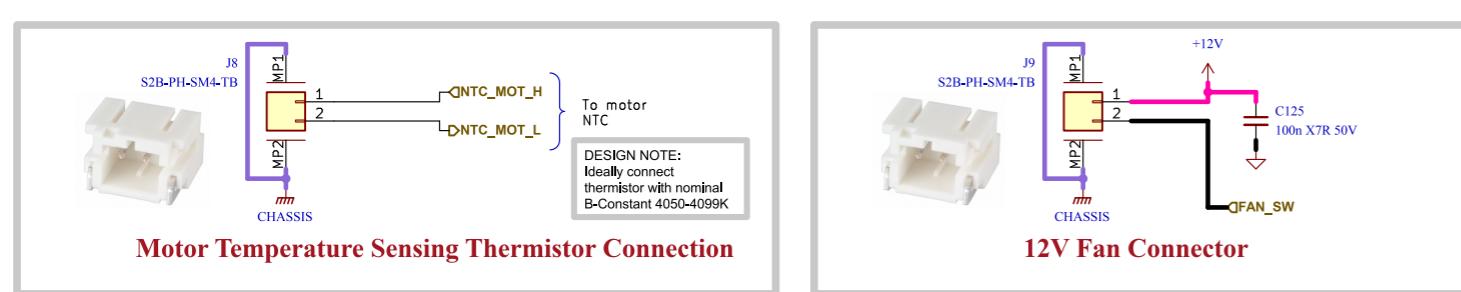
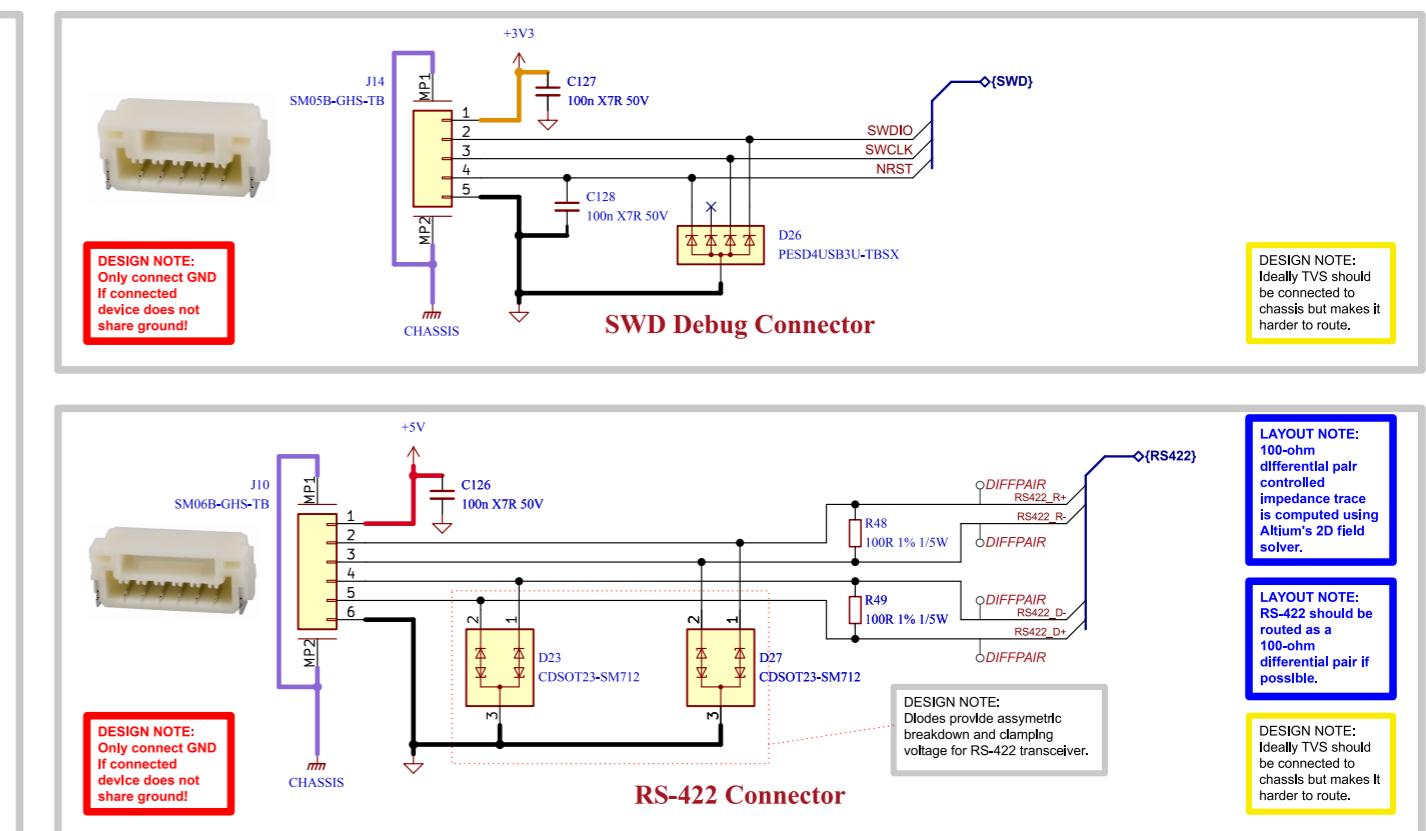
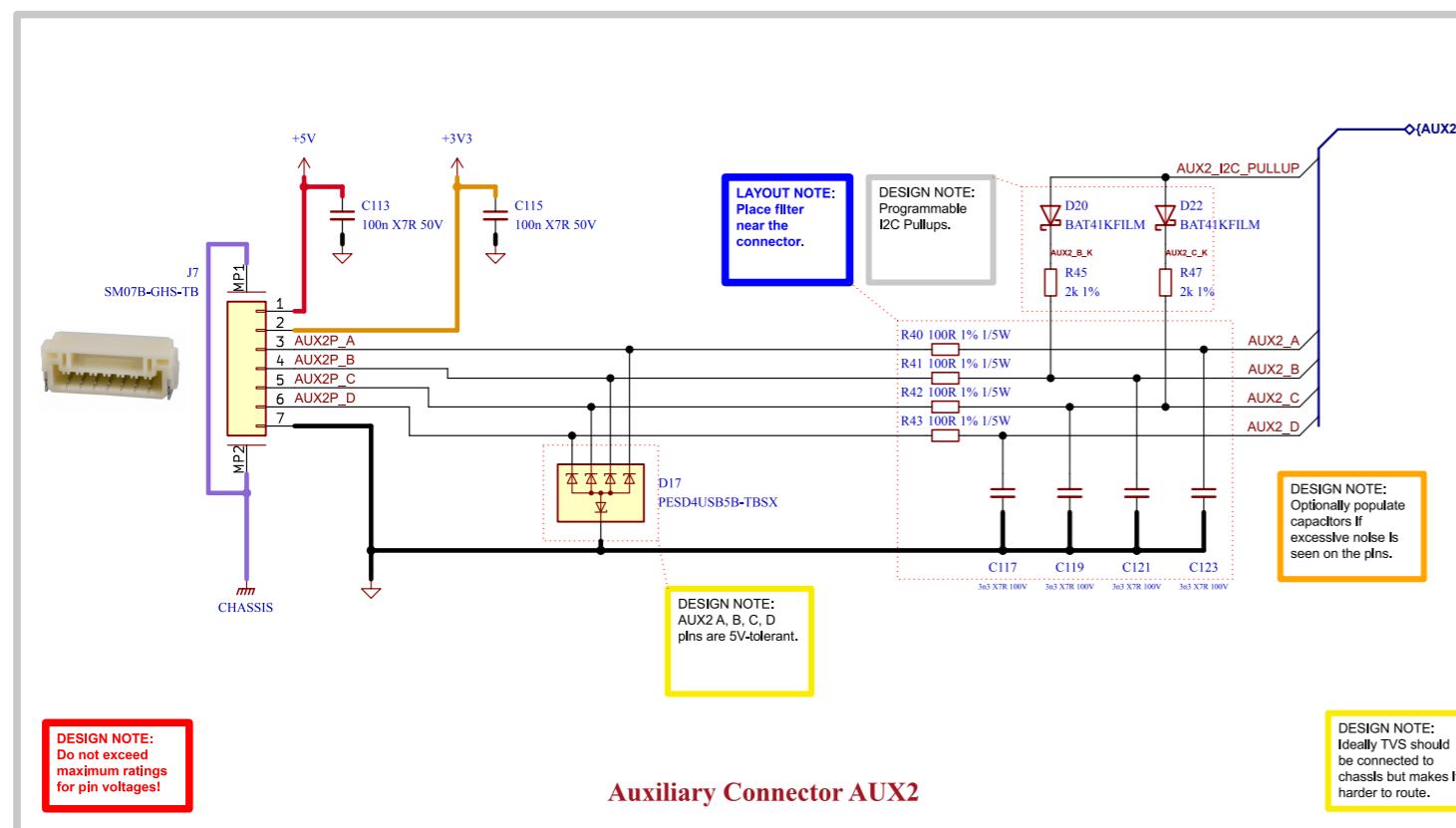
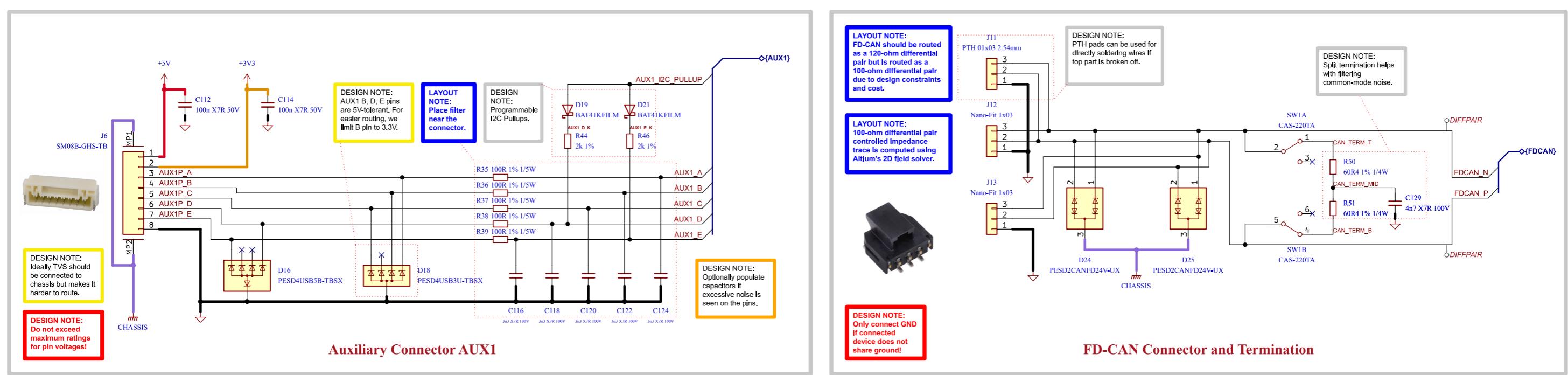
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	Board Name: Amulet Motion Controller		
	Sheet Title: Interface - FD-CAN	File Name: Interface - FD-CAN.kicad_sch	Designer: Vincent Nguyen
	Sheet Path: /Project Architecture/Interface - FD-CAN/	Reviewer:	Date: 2023-10-15 Revision: 1.1
		Size: A4	Sheet: 16 of 21

[17] Interface - Fan Control



	Comments:	Company: EPFL Xplore Research ABC	Variant: NO_SNUBBER
	Board Name: Amulet Motion Controller		
	Sheet Title: Interface - Fan Control	File Name: Interface - Fan Control.kicad_sch	Designer: Vincent Nguyen
	Sheet Path: /Project Architecture/Interface - Fan Control/	Reviewer:	Date: 2023-11-19
		Size: A4	Revision: 1.1
		Sheet: 17 of 21	

[18] Interface - Interconnects



Comments: Reference: Flexible I/O worked examples	Company: EPFL Xplore Research ABC		Variant: NO_SNUBBER
	Board Name: Amulet Motion Controller	File Name: Interface - Interconnects.kicad_sch	Designer: Vincent Nguyen
Sheet Title: Interface - Interconnects	File Name: Interface - Interconnects.kicad_sch	Reviewer:	Date: 2023-12-31
Sheet Path: /Project Architecture/Interface - Interconnects/	Size: A3	Sheet: 18 of 21	Revision: 1.1

[19] Misc - Holes, Fiducials

A

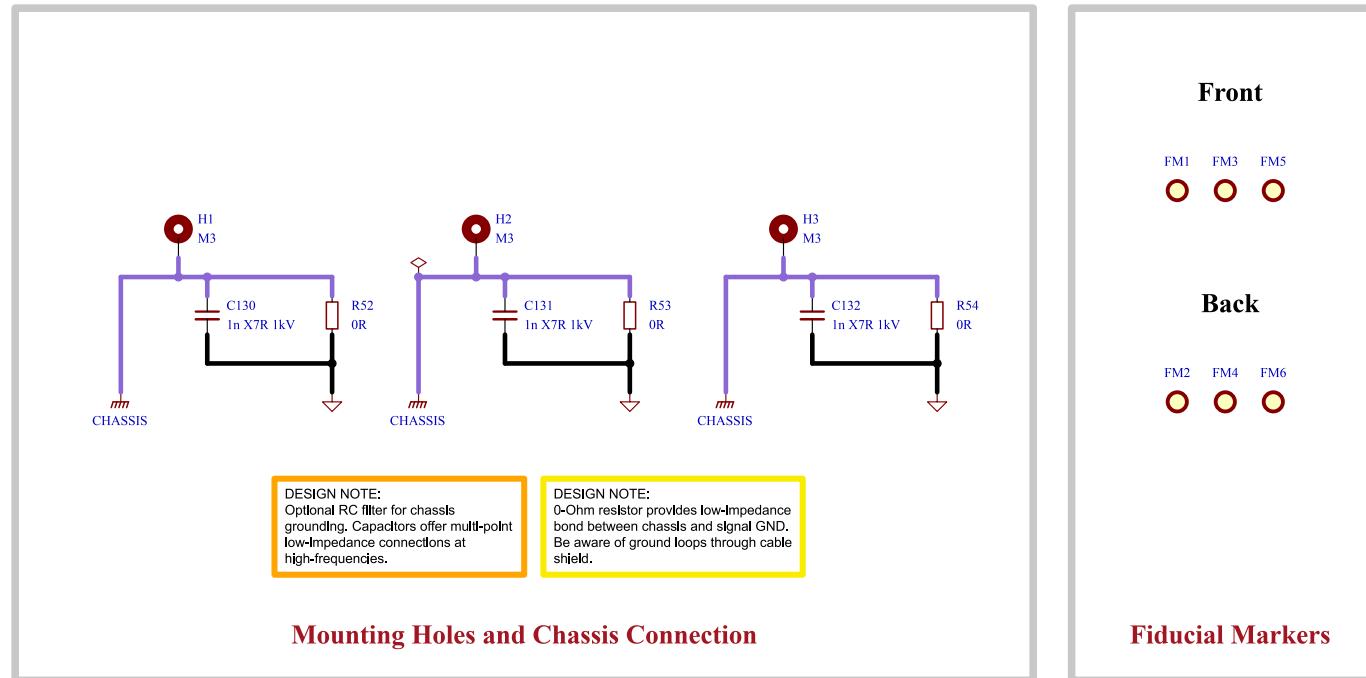
A

B

B

C

C



D

D

	Comments:	Company: EPFL Xplore Research ABC	Variant: NO_SNUBBER
	Board Name: Amulet Motion Controller	Project Name: Chienpanzé	
	Sheet Title: Misc - Holes, Fiducials	File Name: Misc - Holes Fiducials.kicad_sch	Designer: Vincent Nguyen
	Sheet Path: /Project Architecture/Misc - Holes, Fiducials/	Reviewer:	Date: 2023-10-22 Revision: 1.1



NO_SNUBBER

Project Name:

Chienpanzé

Date:

2023-10-22

Revision:

1.1

Size:

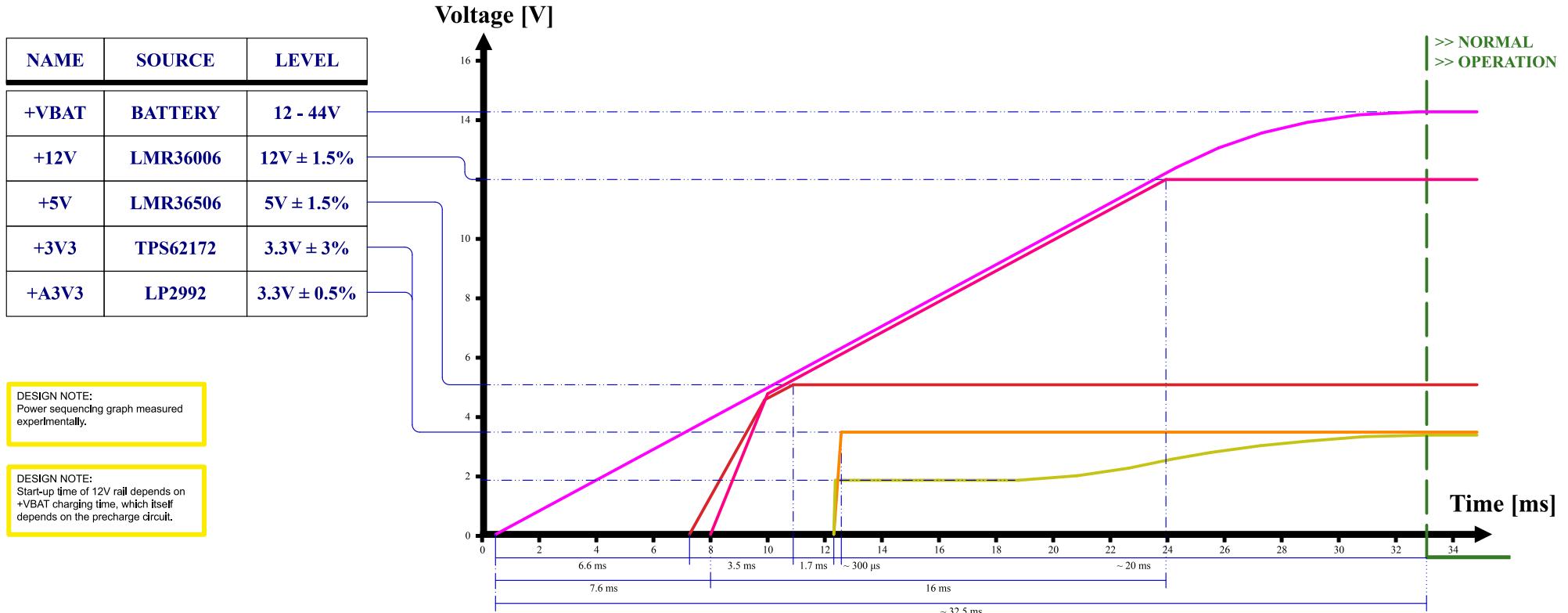
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Sheet:

19 of 21

[20] Power - Sequencing

A



B

C

D

	Comments:	Company: EPFL Xplore Research ABC	Variant: NO_SNUBBER
	Board Name: Amulet Motion Controller	Project Name: Chienpanzé	
	Sheet Title: Power - Sequencing	File Name: Power - Sequencing.kicad_sch	Designer: Vincent Nguyen
	Sheet Path: /Power - Sequencing/	Reviewer:	Date: 2024-03-12 Revision: 1.1

[21] Revision History

	Comments:	Company: EPFL Xplore Research ABC	 Variant: NO_SNUBBER		
		Board Name: Amulet Motion Controller	Project Name: Chienpanzé		
	Sheet Title: Revision History	File Name: Revision History.kicad_sch	Designer: Vincent Nguyen	Date: 2024-01-03	Revision: 1.1
	Sheet Path: /Revision History/	Reviewer:		Size: A4	Sheet: 21 of 21