

Amulet Motion Controller

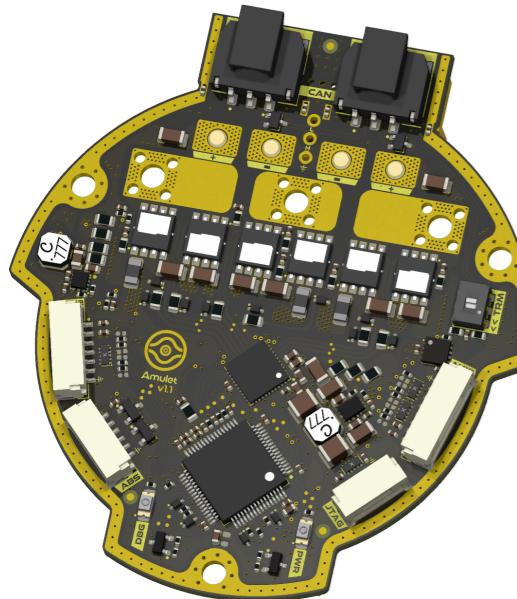
Variant: Released

2024-10-14

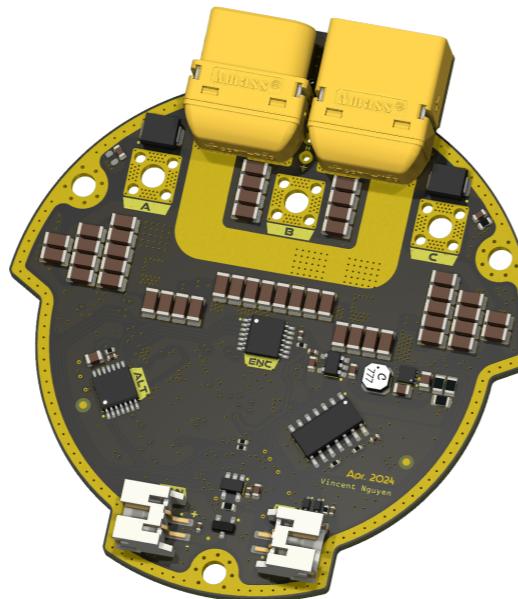
Rev 1.1

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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.

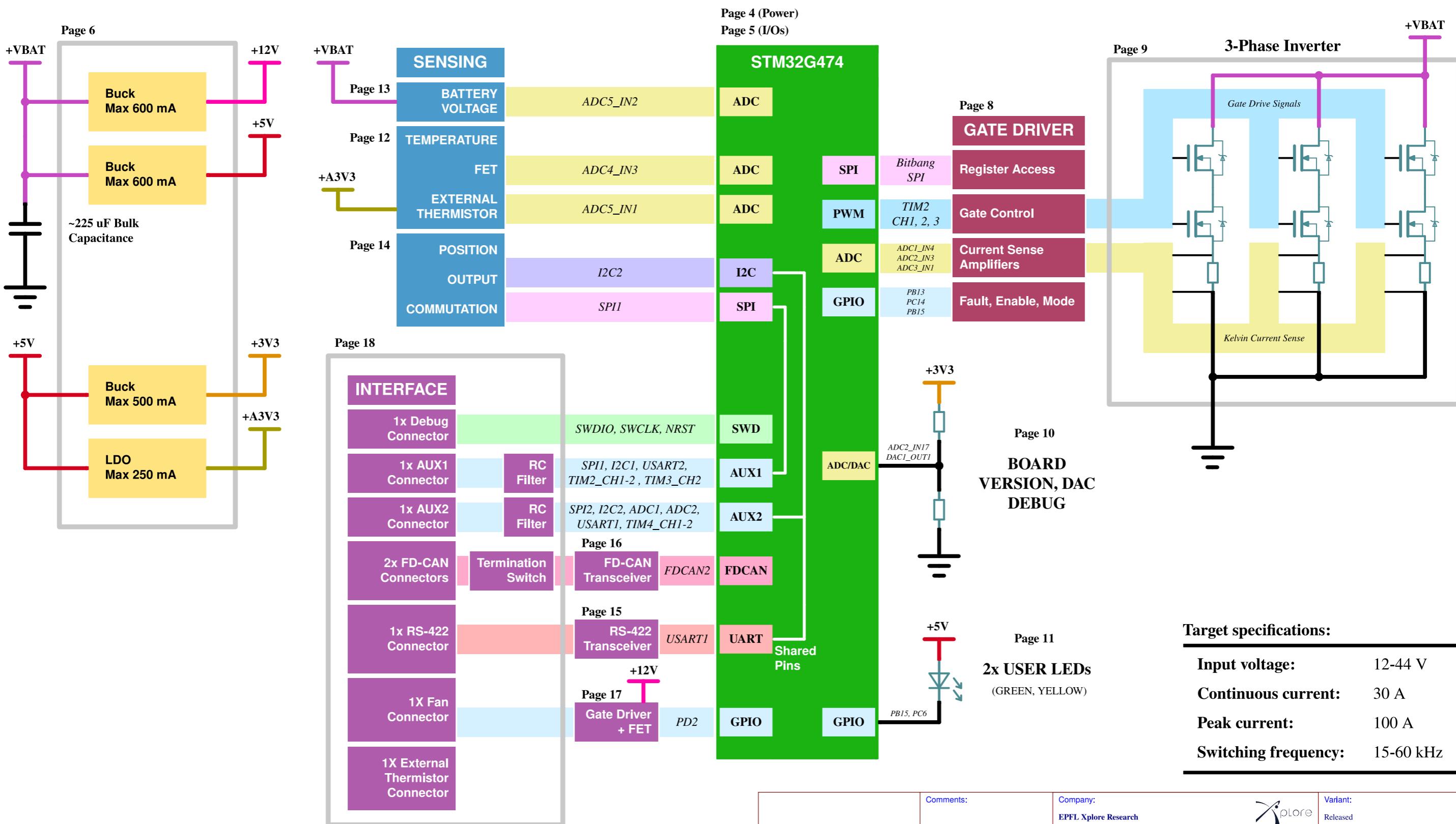
CHECKED - There shouldn't be any mistakes. Contact the engineer if you find any.

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

Released 13-APR-2024

	Comments:	Company: EPFL Xplore Research	Variant: Released
	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

[2] Block Diagram

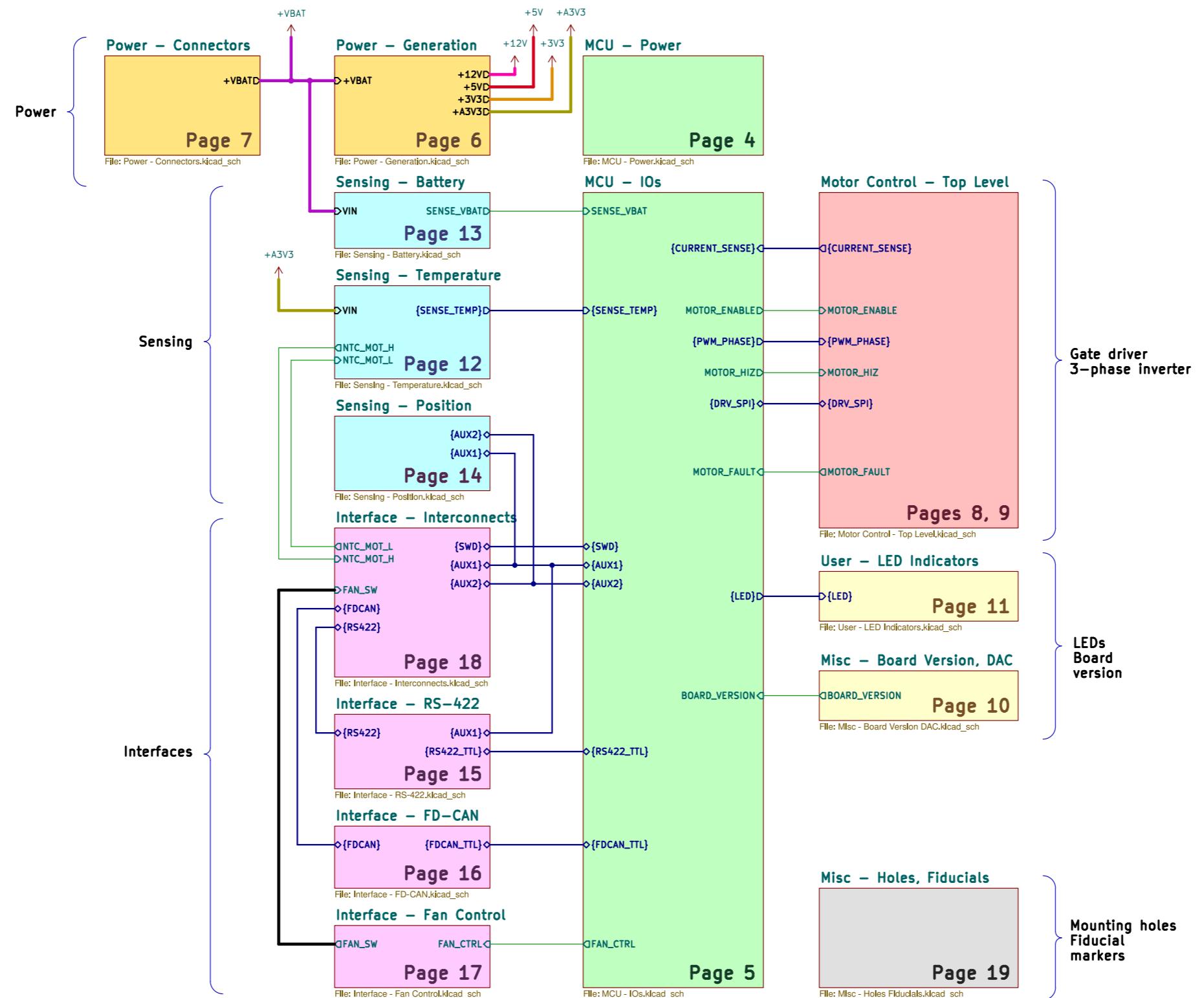


Target specifications:

Input voltage:	12-44 V
Continuous current:	30 A
Peak current:	100 A
Switching frequency:	15-60 kHz

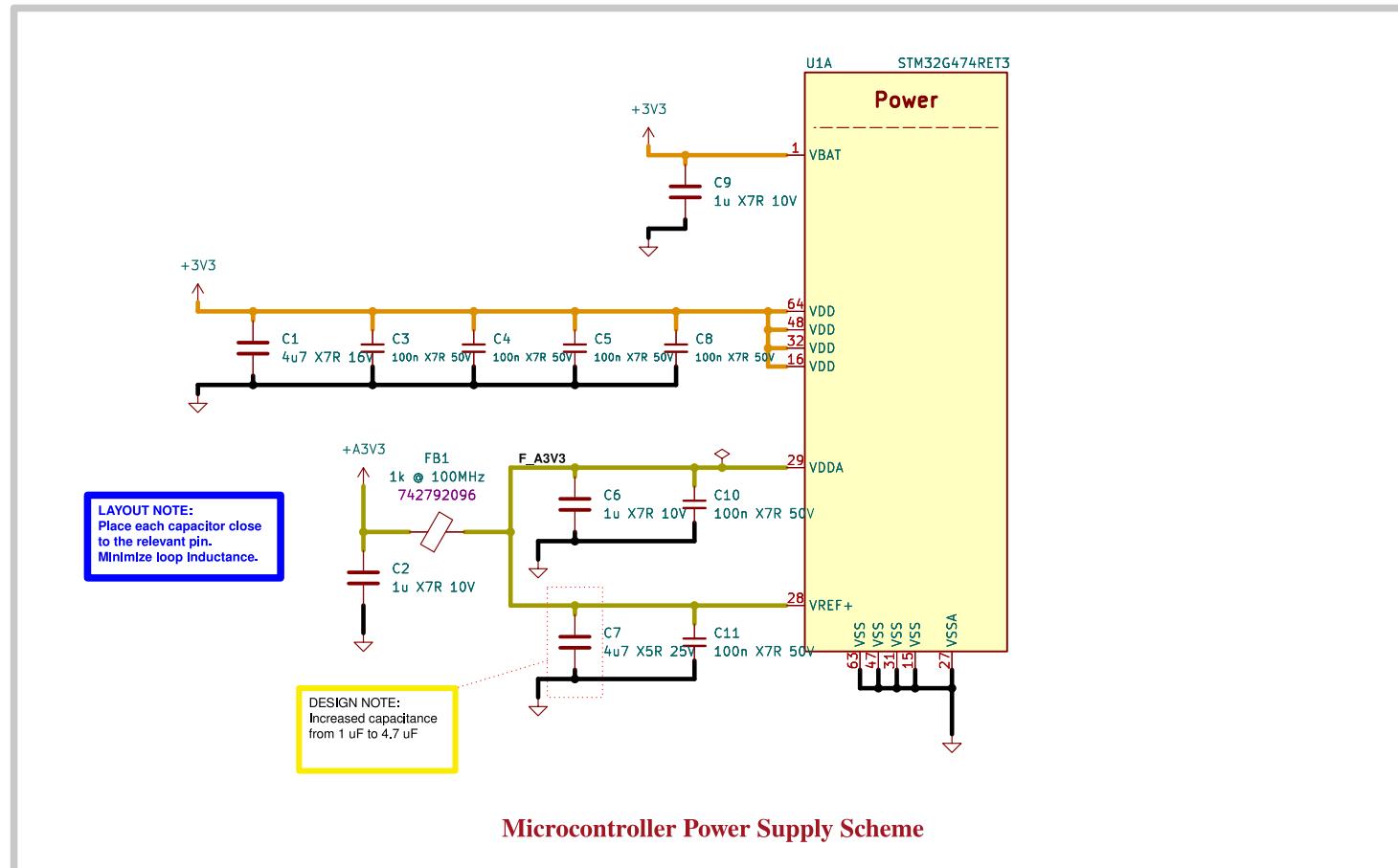
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		Board Name:	Project Name: Amulet Motion Controller Chienpanzé
Sheet Title: Block Diagram	File Name: Block Diagram.kicad_sch	Designer: Vincent Nguyen	Date: 2024-04-13 Revision: 1.1
Sheet Path: /Block Diagram/	Reviewer:	Size:	A3
Sheet:		2	of 21

[3] Project Architecture



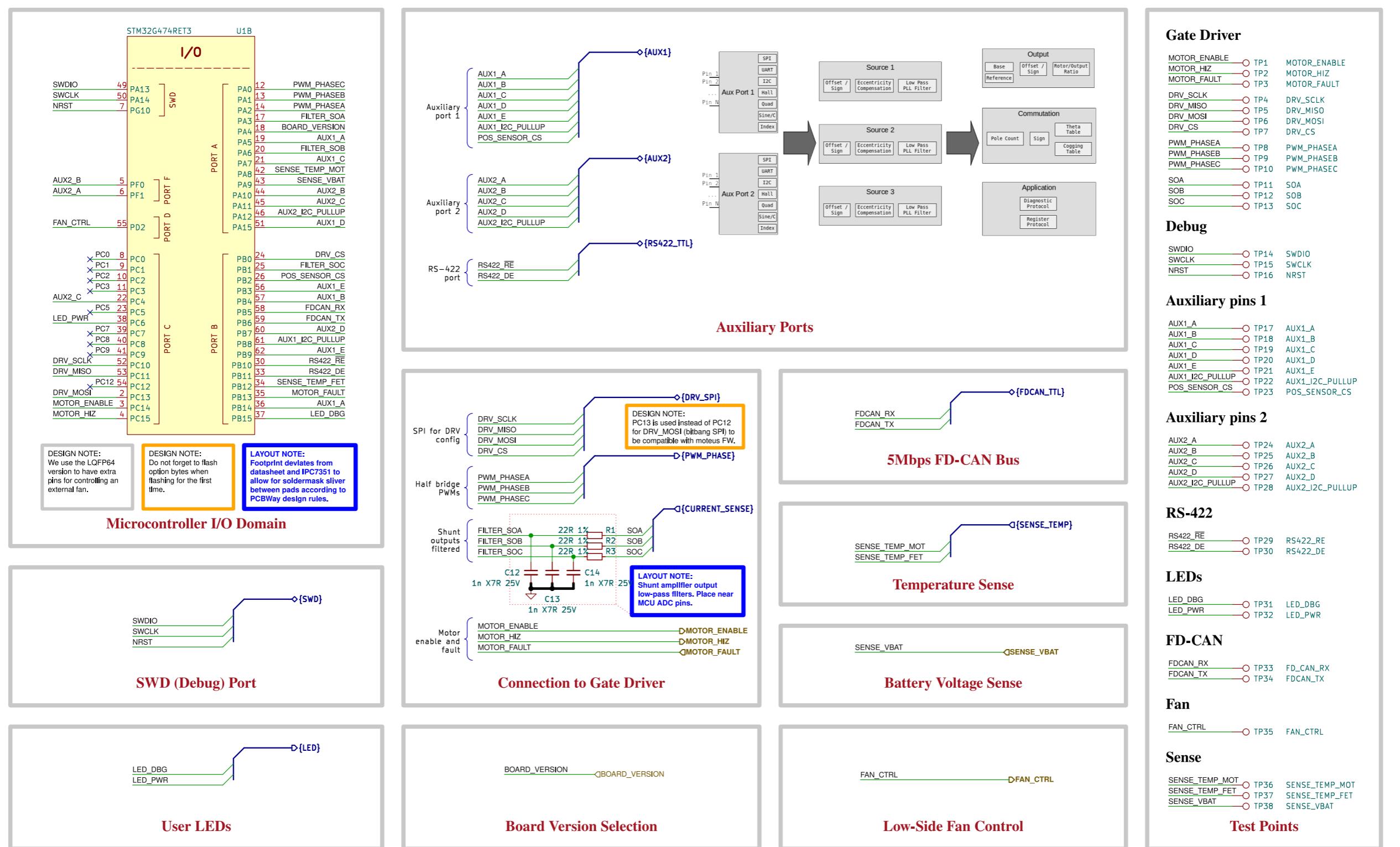
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	Board Name: Amulet Motion Controller	Project Name: Chienpanzé	
Sheet Title: Project Architecture	File Name: Project Architecture.kicad_sch	Designer: Vincent Nguyen	Date: 2023-12-22
Sheet Path: /Project Architecture/	Reviewer:		Revision: 1.1
	Size: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

[4] MCU - Power



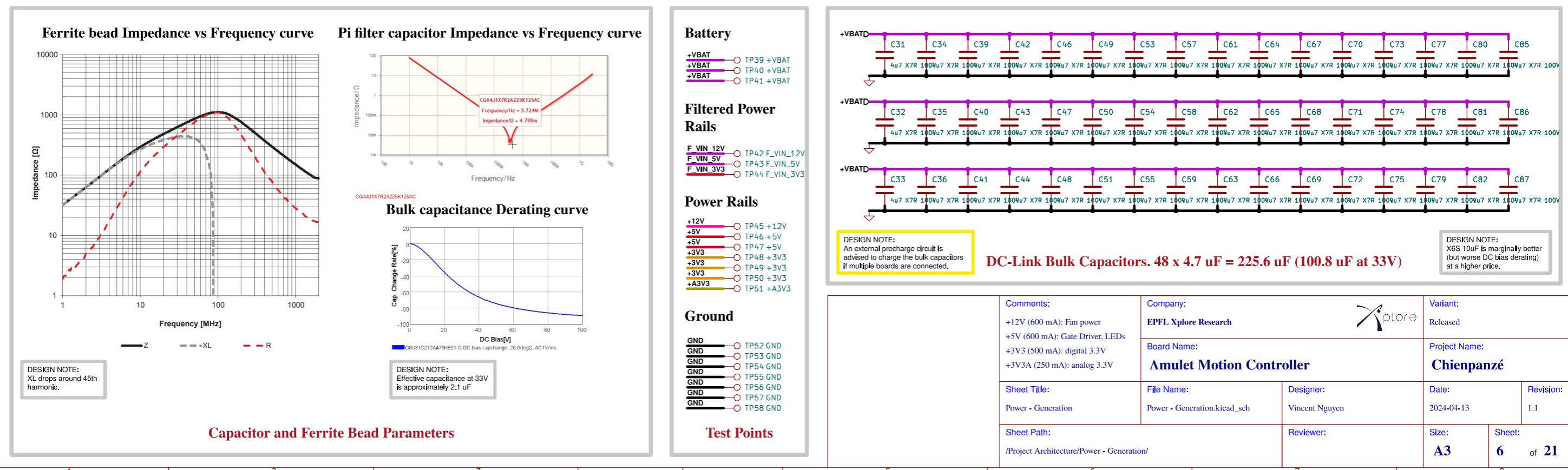
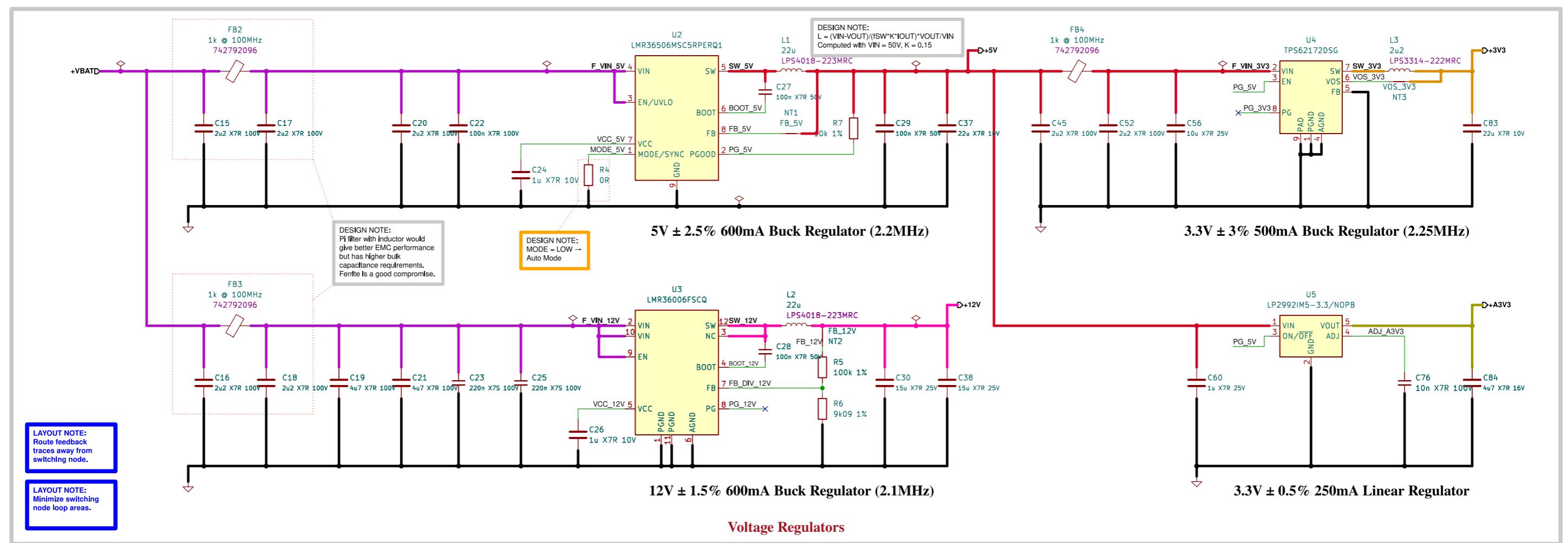
	Comments: AN5346 STM32G474 Datasheet p.81 J. Pleper ADC Investigation	Company: EPFL Xplore Research	Variant: Released
	Board Name: Amulet Motion Controller		
	Sheet Title: MCU - Power	File Name: MCU - Power.kicad_sch	Designer: Vincent Nguyen
	Sheet Path: /Project Architecture/MCU - Power/	Reviewer:	Date: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

[5] MCU - I/Os

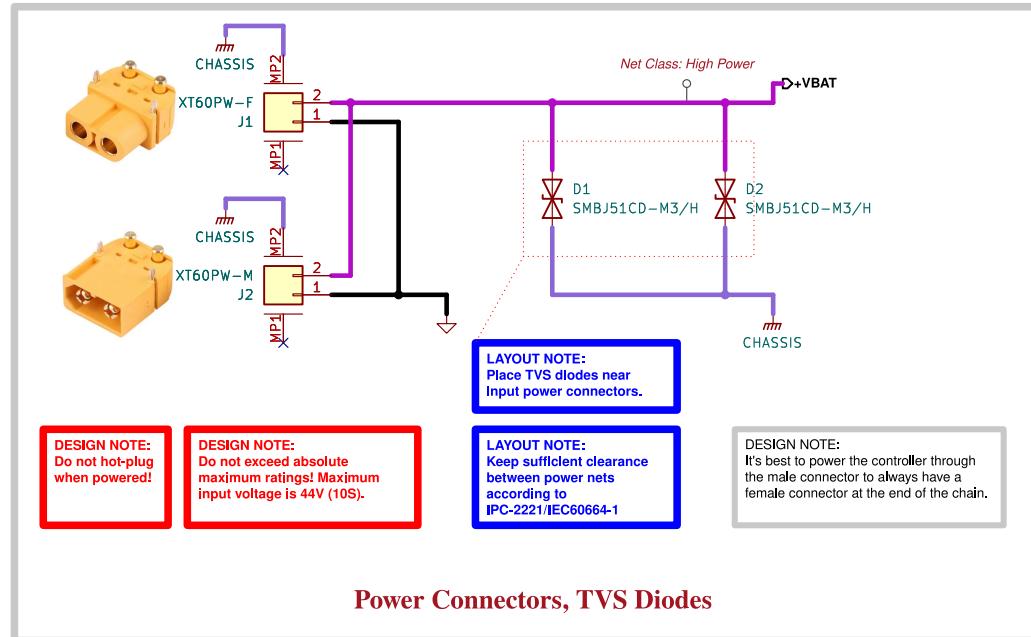


Comments: References: Flexible I/O worked examples Flexible I/O source configuration	Company: EPFL Xplore Research	Variant: Released
Board Name: Amulet Motion Controller	Project Name: Chienpanzé	
Sheet Title: MCU - I/Os	File Name: MCU - IOs.kicad_sch	Date: 2023-12-20
Sheet Path: /Project Architecture/MCU - IOs/	Reviewer: Vincent Nguyen	Revision: 1.1

[6] Power - Generation



[7] Power - Connectors



A

A

B

B

C

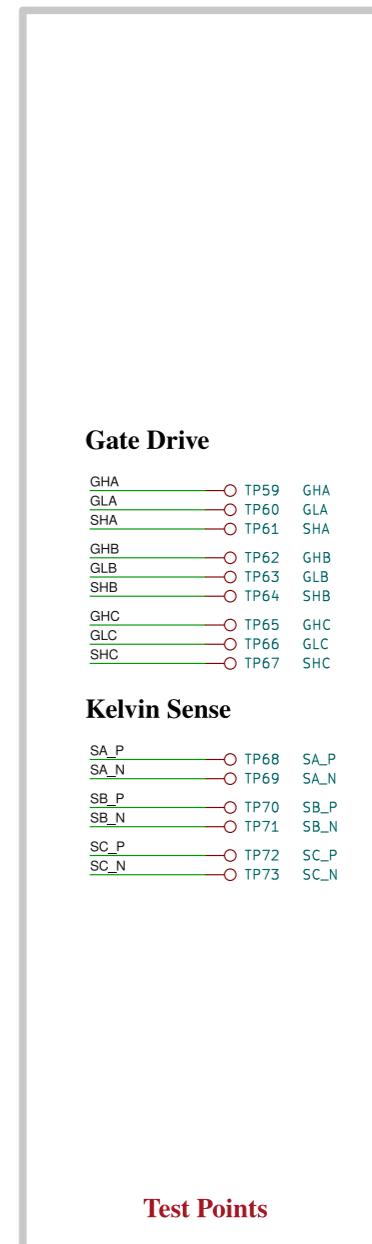
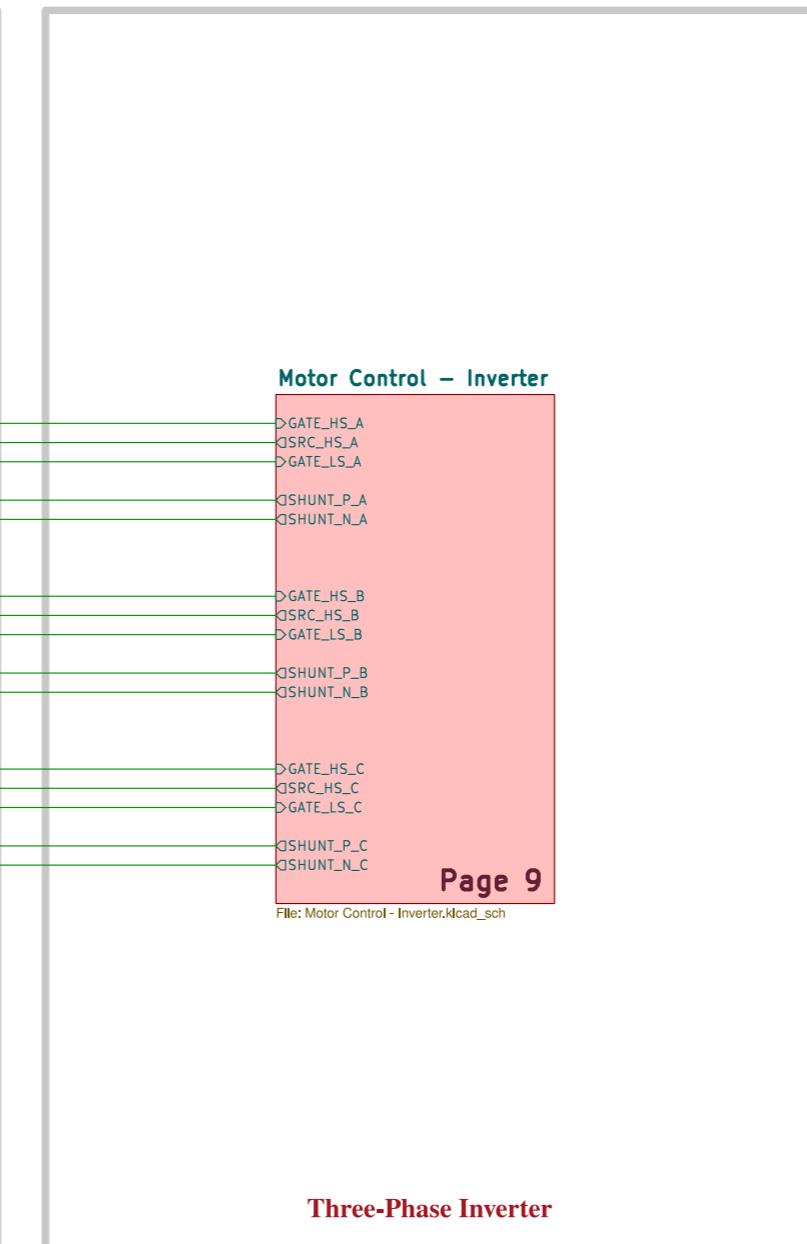
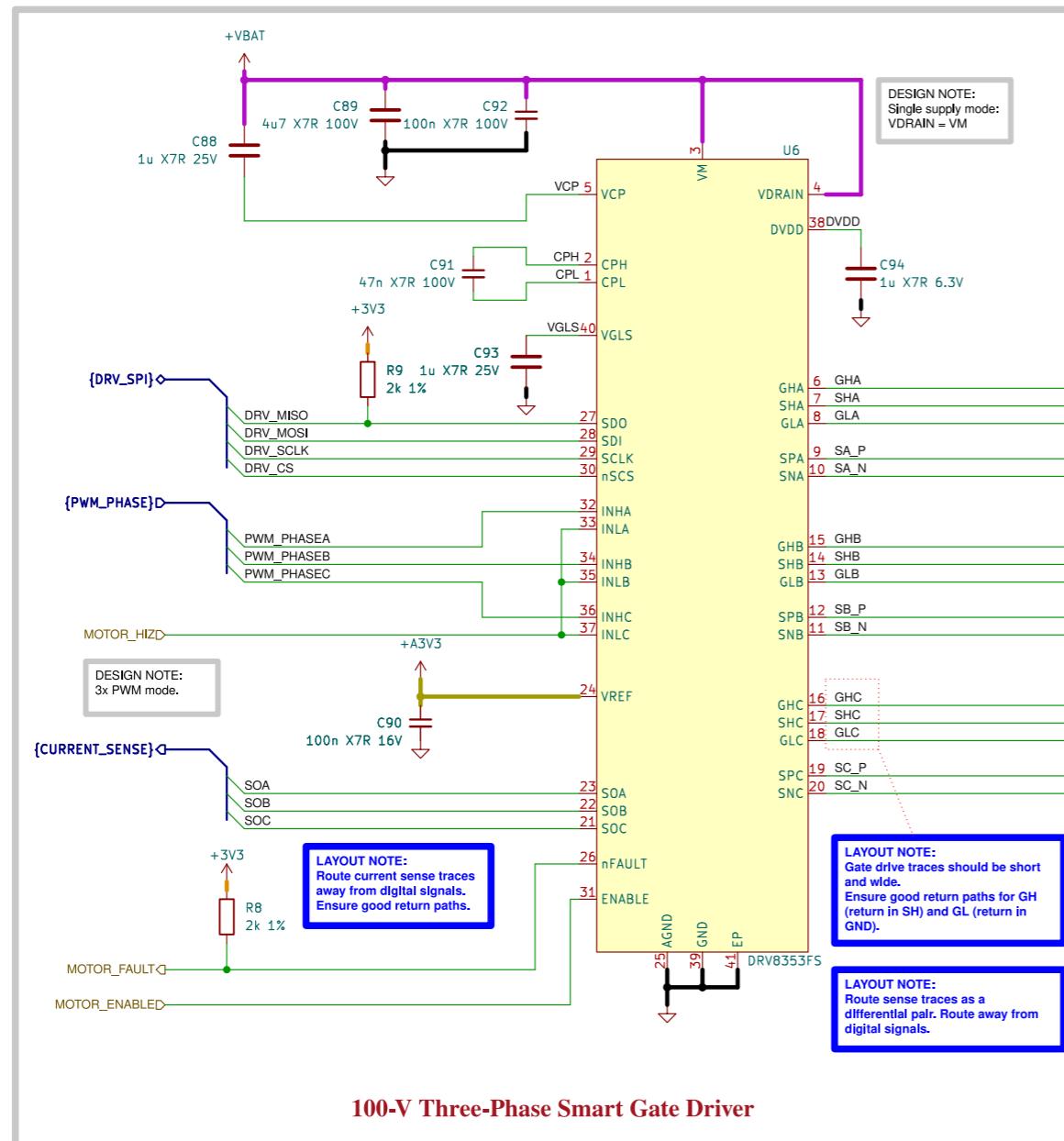
C

D

D

	Comments:	Company: EPFL Xplore Research	Variant: Released
	Board Name: Amulet Motion Controller		
	Sheet Title: Power - Connectors	File Name: Power - Connectors.kicad_sch	Designer: Vincent Nguyen
	Sheet Path: /Project Architecture/Power - Connectors/	Reviewer:	Date: 2023-12-31 Revision: 1.1
		Size: A4	Sheet: 7 of 21

[8] Motor Control - Top Level



Page 9

File: Motor Control - Inverter.kcad_sch

Comments: Company: EPFL Xplore Research Variant: Released

Board Name: Project Name:

Amulet Motion Controller Chienpanzé

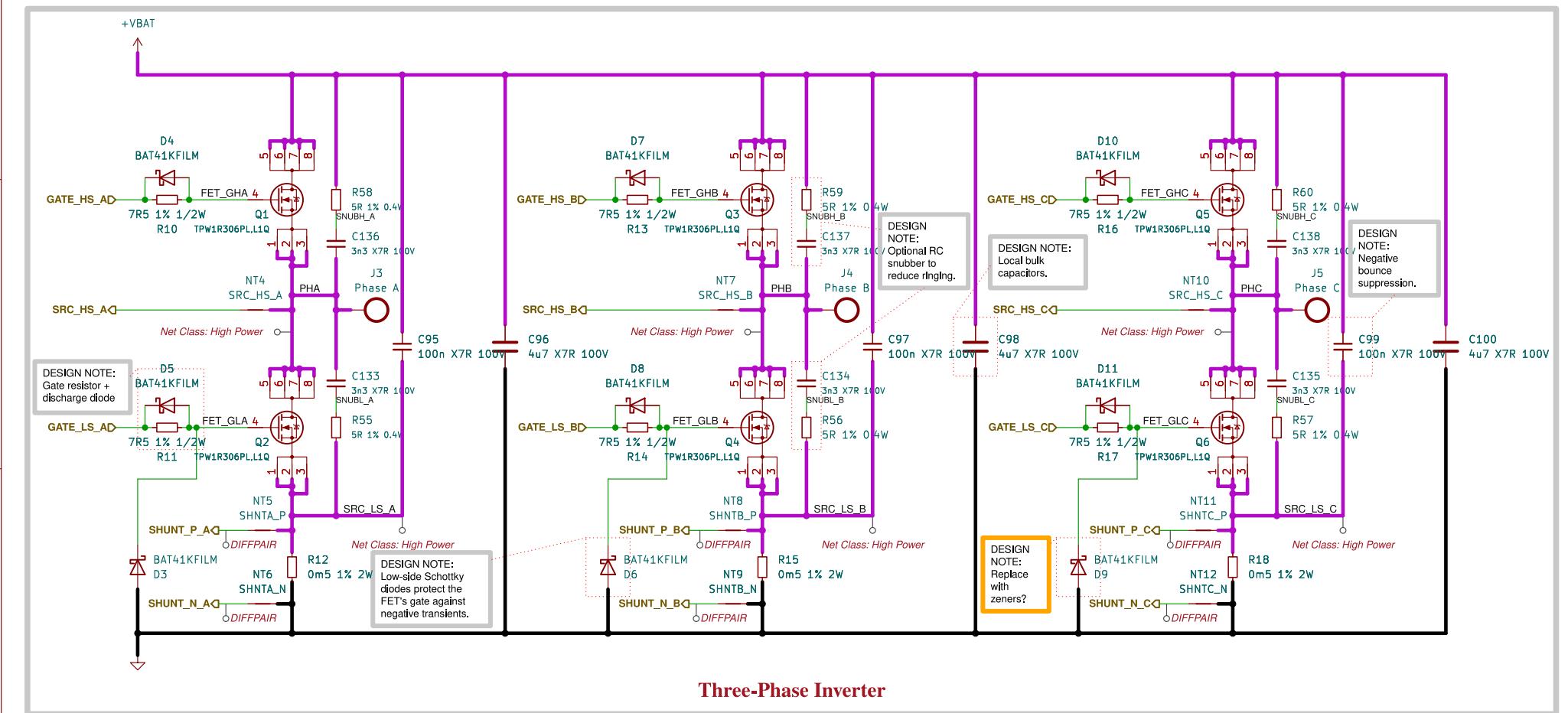
Sheet Title: File Name: Designer: Date: Revision:

Motor Control - Top Level Motor Control - Top Level.kcad_sch Vincent Nguyen 2023-12-20 1.1

Sheet Path: Reviewer: Size: Sheet:

/Project Architecture/Motor Control - Top Level/ A3 8 of 21

[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

Company:
EPFL Xplore Research



Variant:
Released

Board Name:
Amulet Motion Controller

Project Name:
Chienpanzé

Sheet Title:
Motor Control - Inverter

File Name:
Motor Control - Inverter.kicad_sch

Designer:
Vincent Nguyen

Date:
2024-01-25

Revision:
1.1

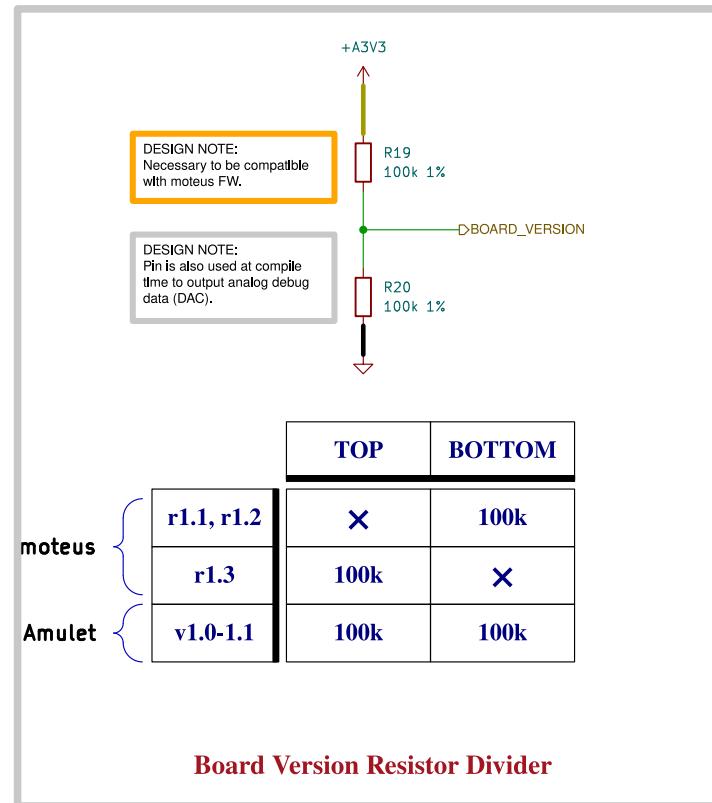
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Reviewer:

Size:
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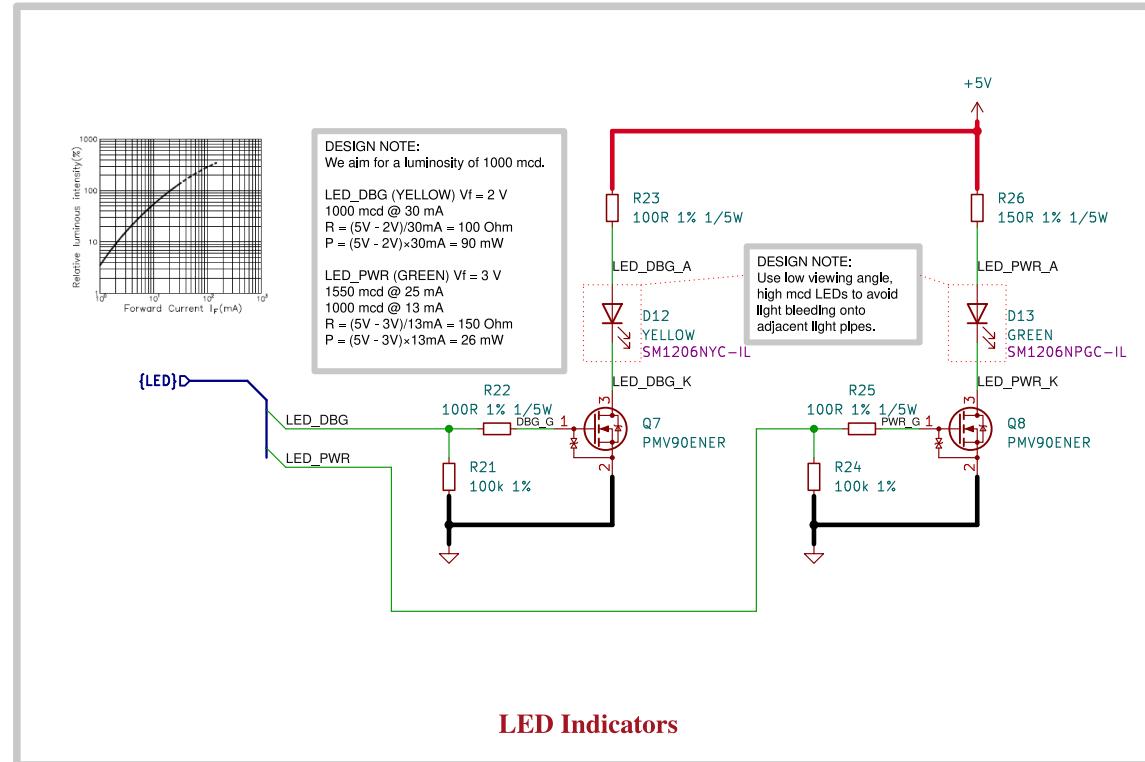
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9 of **21**

[10] Misc - Board Version, DAC



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

[11] User - LED Indicators



A

B

C

D

A

B

C

D

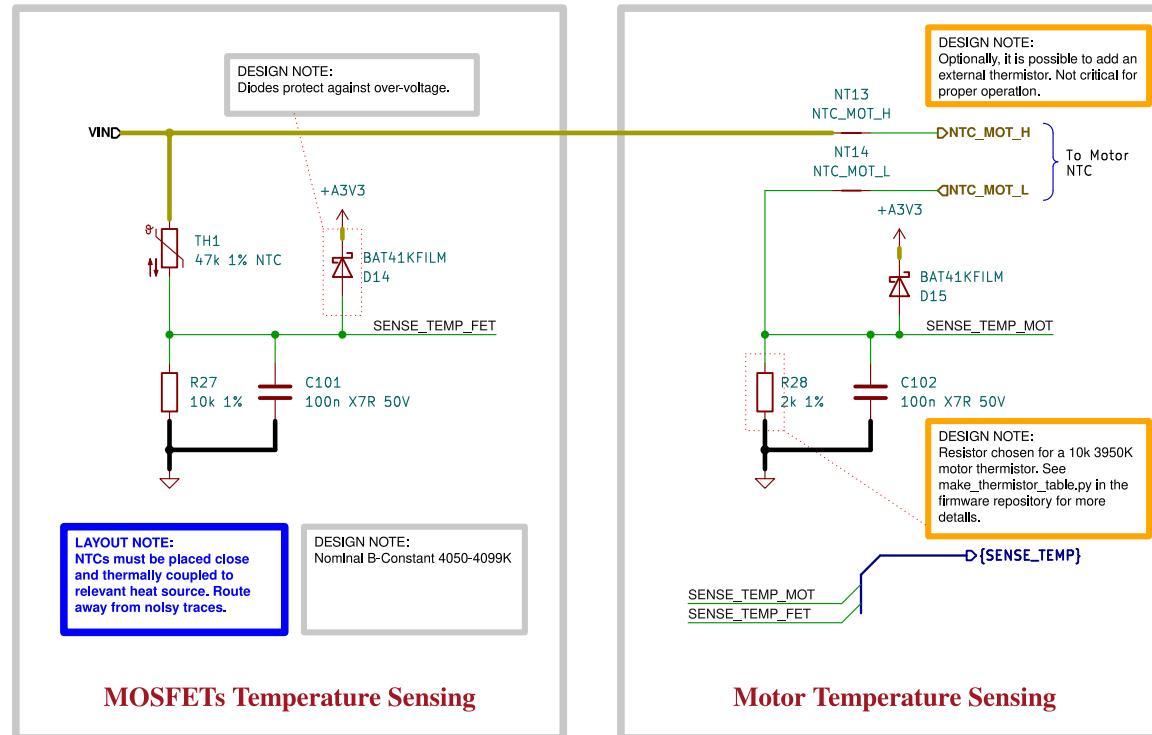
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	Board Name: Amulet Motion Controller		
	Sheet Title: User - LED Indicators	File Name: User - LED Indicators.kicad_sch	Designer: Vincent Nguyen
	Sheet Path: /Project Architecture/User - LED Indicators/	Reviewer:	Date: 2023-12-19 Revision: 1.1



Project Name:
Chienpanzé

Size: **A4** Sheet: **11 of 21**

[12] Sensing - Temperature



	Comments:	Company: EPFL Xplore Research	Variant: Released
	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

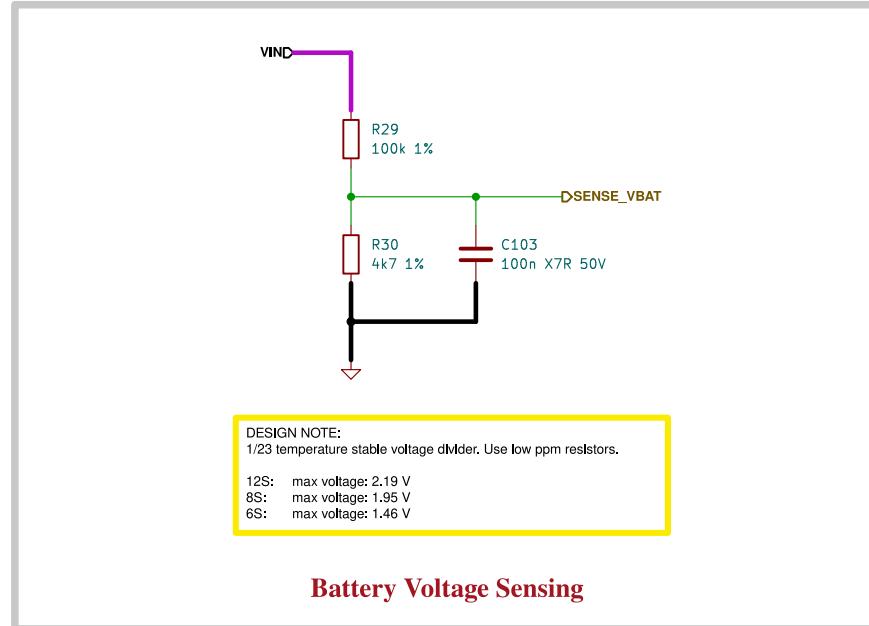
B

C

C

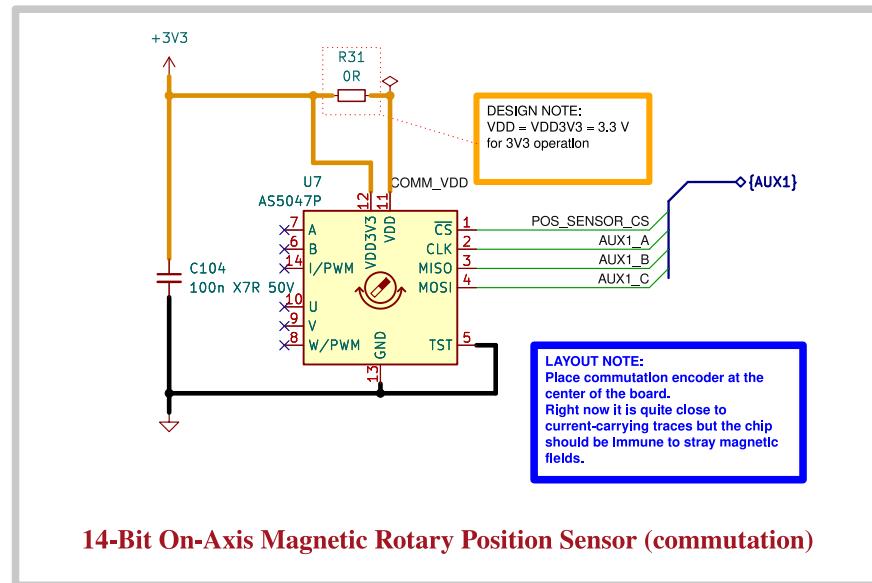
D

D

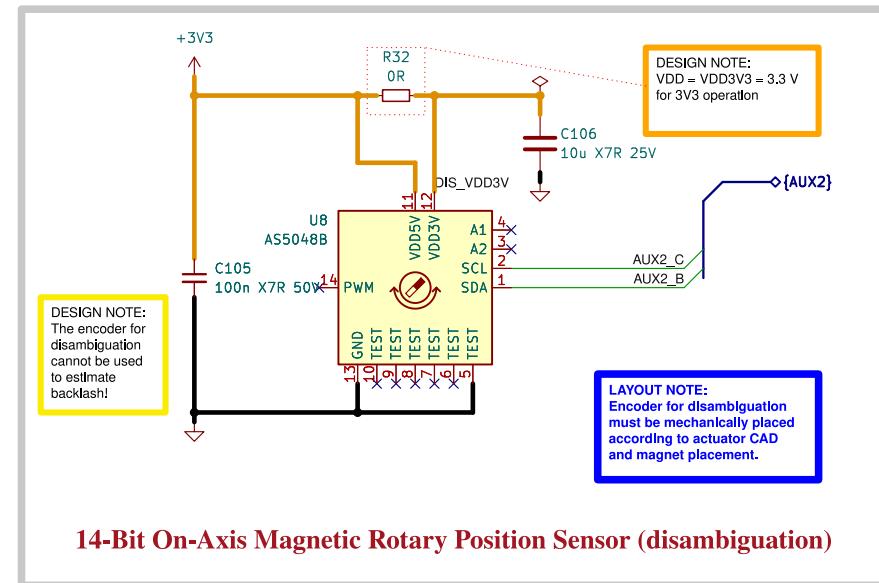


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	Board Name: Amulet Motion Controller		
	Sheet Title: Sensing - Battery	File Name: Sensing - Battery.kicad_sch	Designer: Vincent Nguyen
	Sheet Path: /Project Architecture/Sensing - Battery/	Reviewer:	Date: 2023-10-14 Revision: 1.1

[14] Sensing - Position

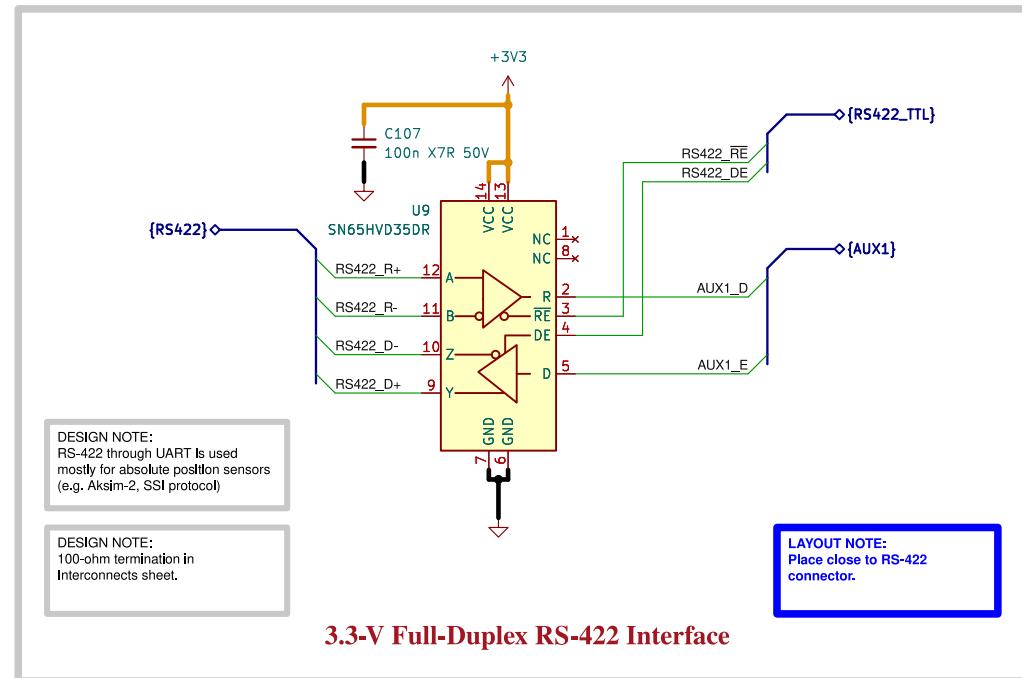


DESIGN NOTE:
AS5047P senses magnet mounted on planetary sun gear, for commutation.
AS5048B senses magnet mounted on shaft with same reduction factor as planetary gearbox for disambiguation.



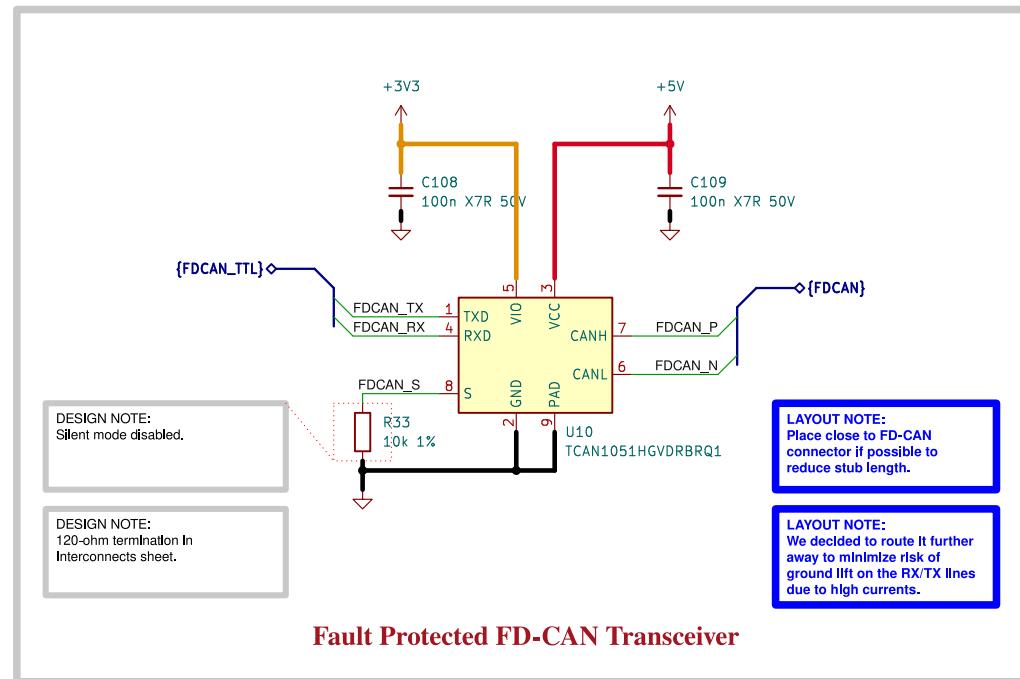
Comments:	Company: EPFL Xplore Research	Variant: Released		
Board Name: Amulet Motion Controller	Project Name: Chienpanzé			
Sheet Title: Sensing - Position	File Name: Sensing - Position.kicad_sch	Designer: Vincent Nguyen	Date: 2023-10-14	Revision: 1.1
Sheet Path: /Project Architecture/Sensing - Position/	Reviewer:	Size: A4	Sheet: 14 of 21	D

[15] Interface - RS-422



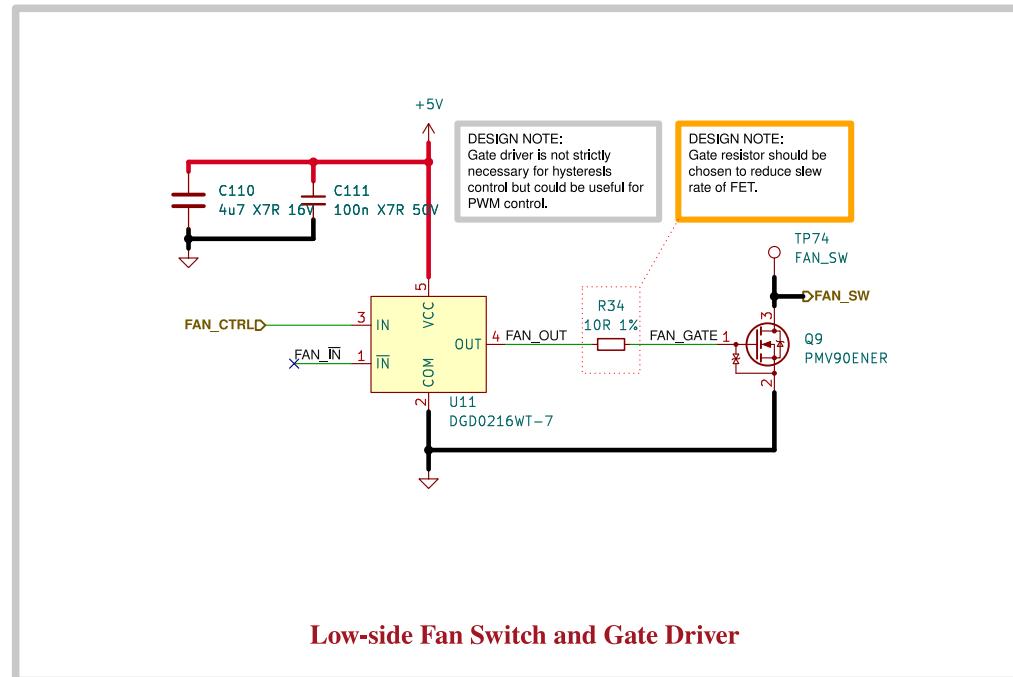
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	Board Name: Amulet Motion Controller		
	Sheet Title: Interface - RS-422	File Name: Interface - RS-422.kicad_sch	Designer: Vincent Nguyen
	Sheet Path: /Project Architecture/Interface - RS-422	Reviewer:	Date: 2023-10-15 Revision: 1.1

[16] Interface - FD-CAN



	Comments:	Company: EPFL Xplore Research	Variant: Released
	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

[17] Interface - Fan Control



A

B

C

D

A

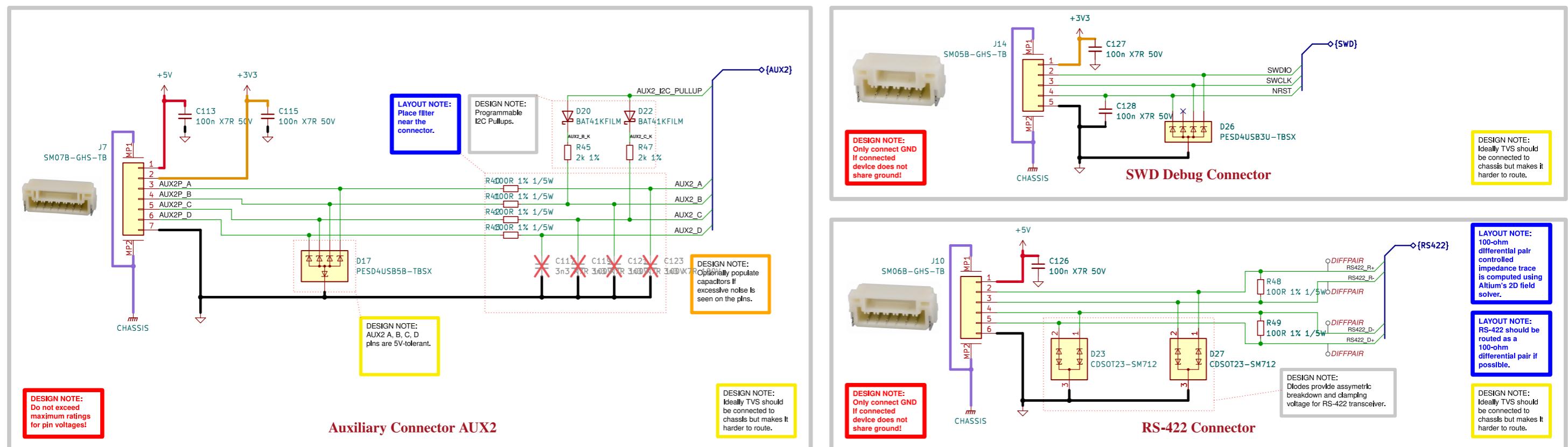
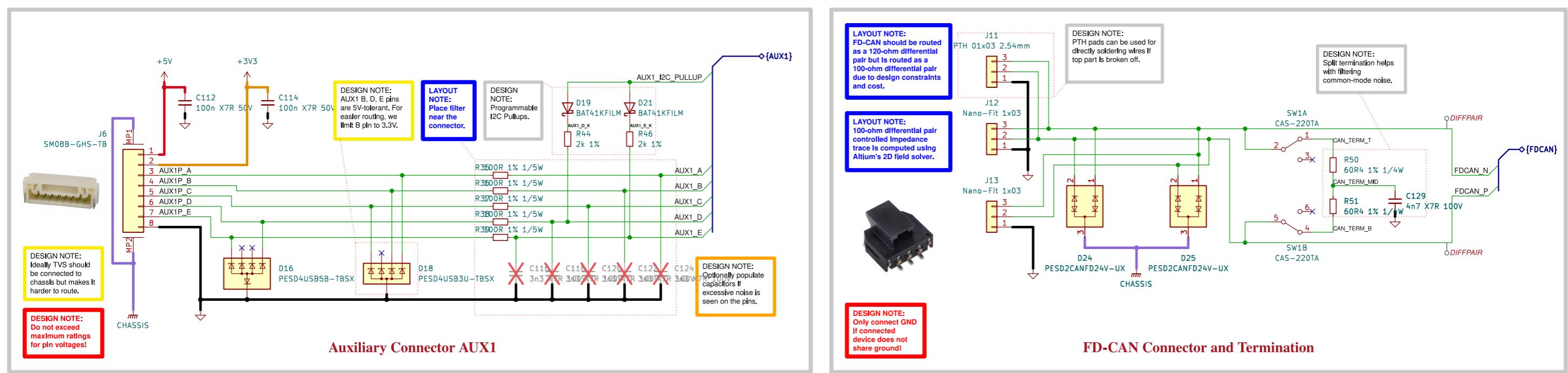
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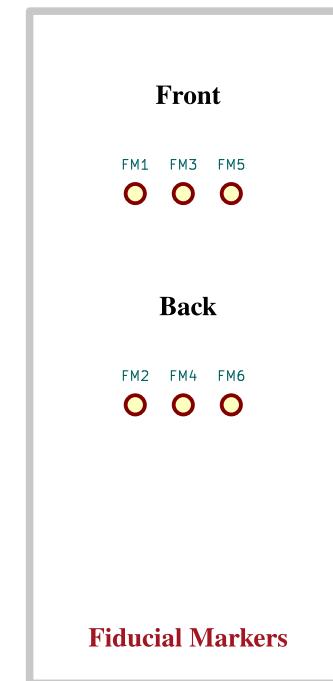
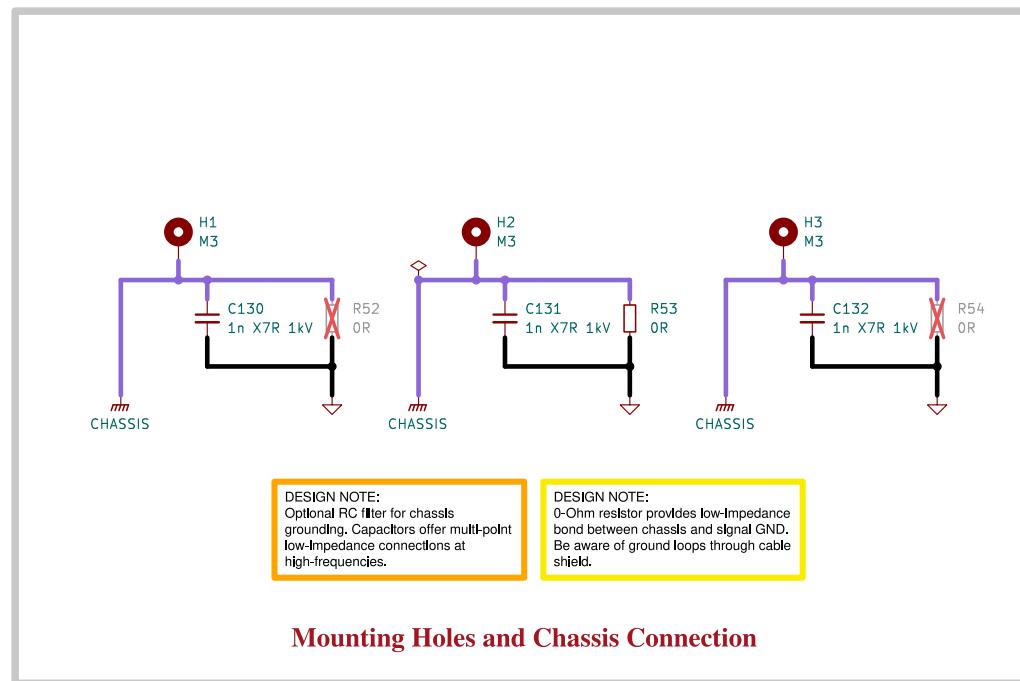
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	Board Name: Amulet Motion Controller		
	Sheet Title: Interface - Fan Control	File Name: Interface - Fan Control.kicad_sch	Designer: Vincent Nguyen
	Sheet Path: /Project Architecture/Interface - Fan Control/	Reviewer:	Date: 2023-11-19 Revision: 1.1

[18] Interface - Interconnects



[19] Misc - Holes, Fiducials



	Comments:	Company: EPFL Xplore Research	 Variant: Released
		Board Name: Amulet Motion Controller	Project Name: Chienpanzé
	Sheet Title: Misc - Holes, Fiducials	File Name: Misc - Holes Fiducials.kicad_sch	Designer: Vincent Nguyen
		Date: 2023-10-22	Revision: 1.1
	Sheet Path: /Project Architecture/Misc - Holes, Fiducials/	Reviewer:	Size: A4 Sheet: 19 of 21

[20] Power - Sequencing

A

A

B

B

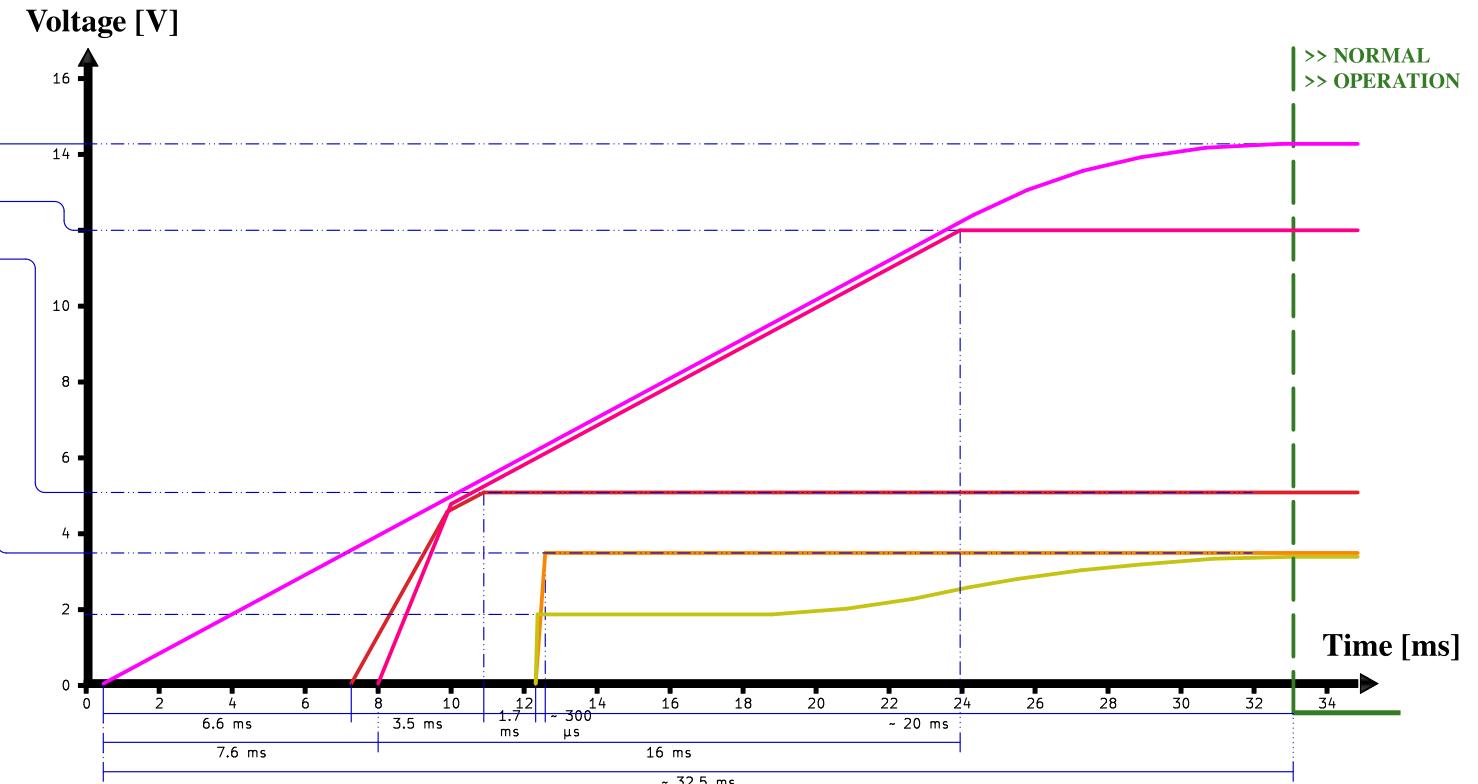
C

C

D

D

NAME	SOURCE	LEVEL
+VBAT	BATTERY	12 - 44V
+12V	LMR36006	12V ± 1.5%
+5V	LMR36506	5V ± 1.5%
+3V3	TPS62172	3.3V ± 3%
+A3V3	LP2992	3.3V ± 0.5%



			Comments:	Company:	Variant:	
				EPFL Xplore Research	Xplore Released	
			Board Name:	Amulet Motion Controller		
Sheet Title:		File Name:	Designer:	Date:	Revision:	
Power - Sequencing		Power - Sequencing.kicad_sch	Vincent Nguyen	2024-03-12	1.1	
Sheet Path:		Reviewer:		Size:	Sheet:	
/Power - Sequencing/				A4	20 of 21	

[21] Revision History

	Comments:	Company: EPFL Xplore Research	 Variant: Released	
		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