

# Amulet Motion Controller

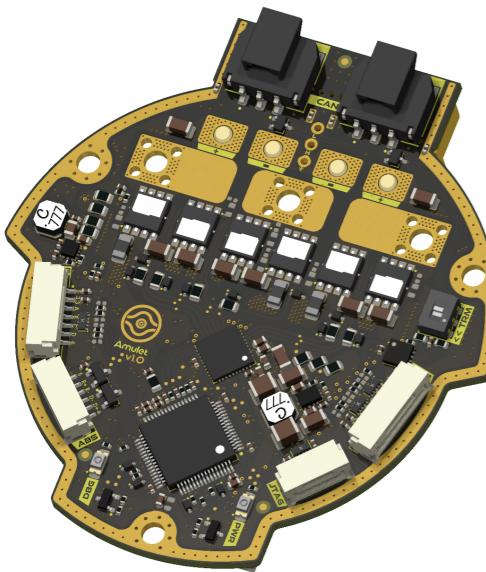
Variant: Checked

2024-01-25

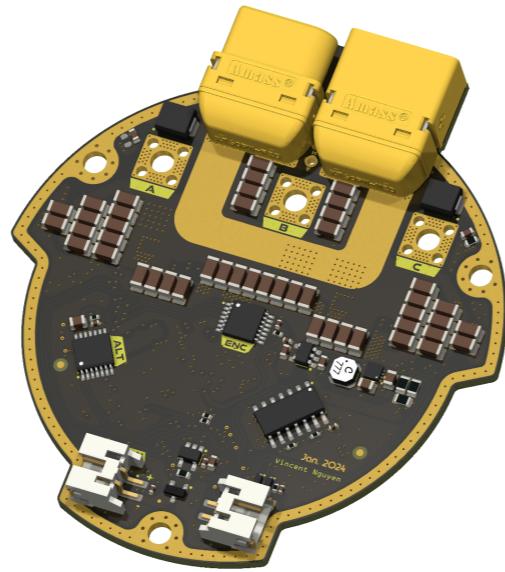
Rev 1.0

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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.

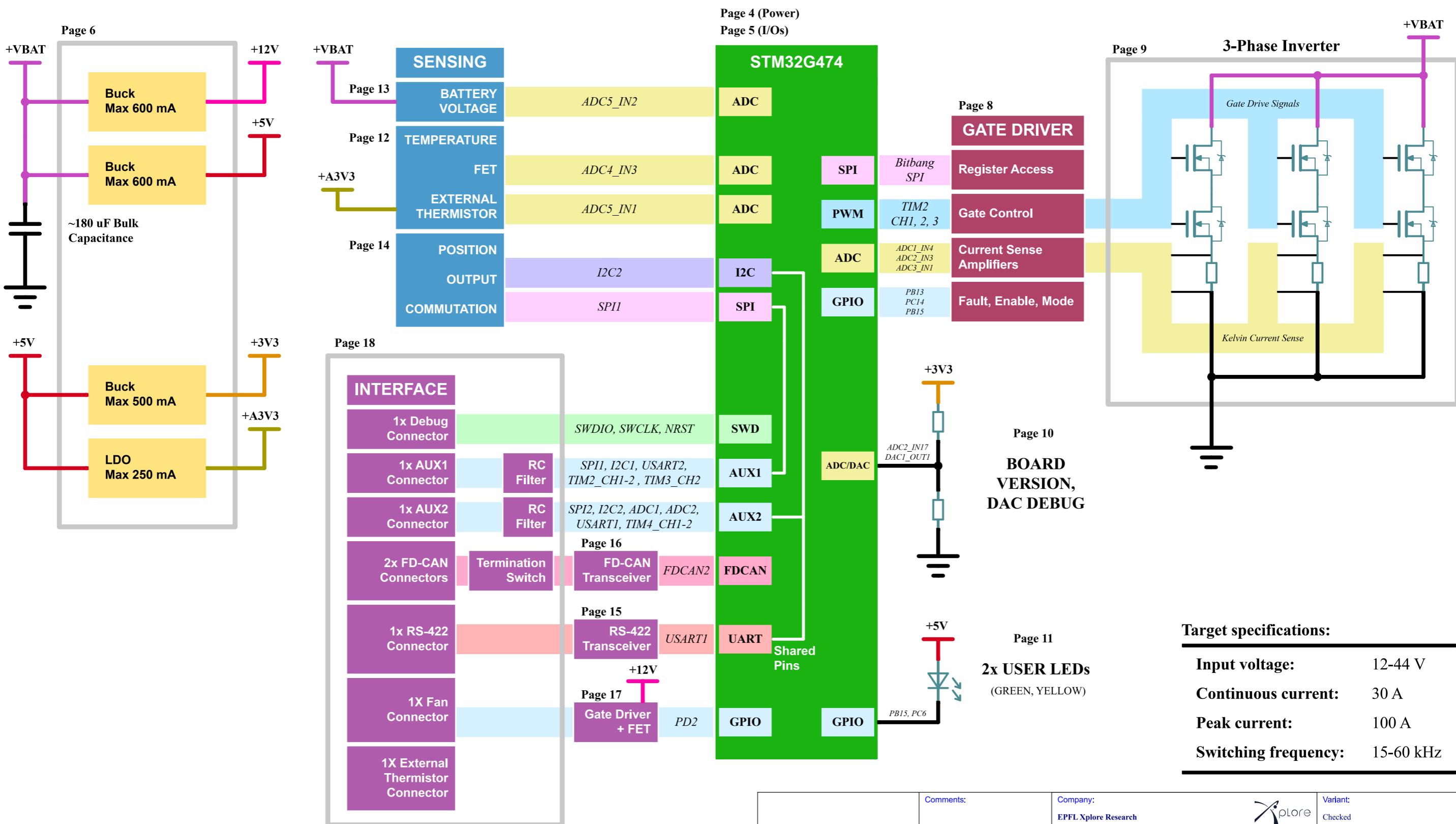
CHECKED - There shouldn't be any mistakes. Contact the engineer if you find any.

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

Checked 25-JAN-2024

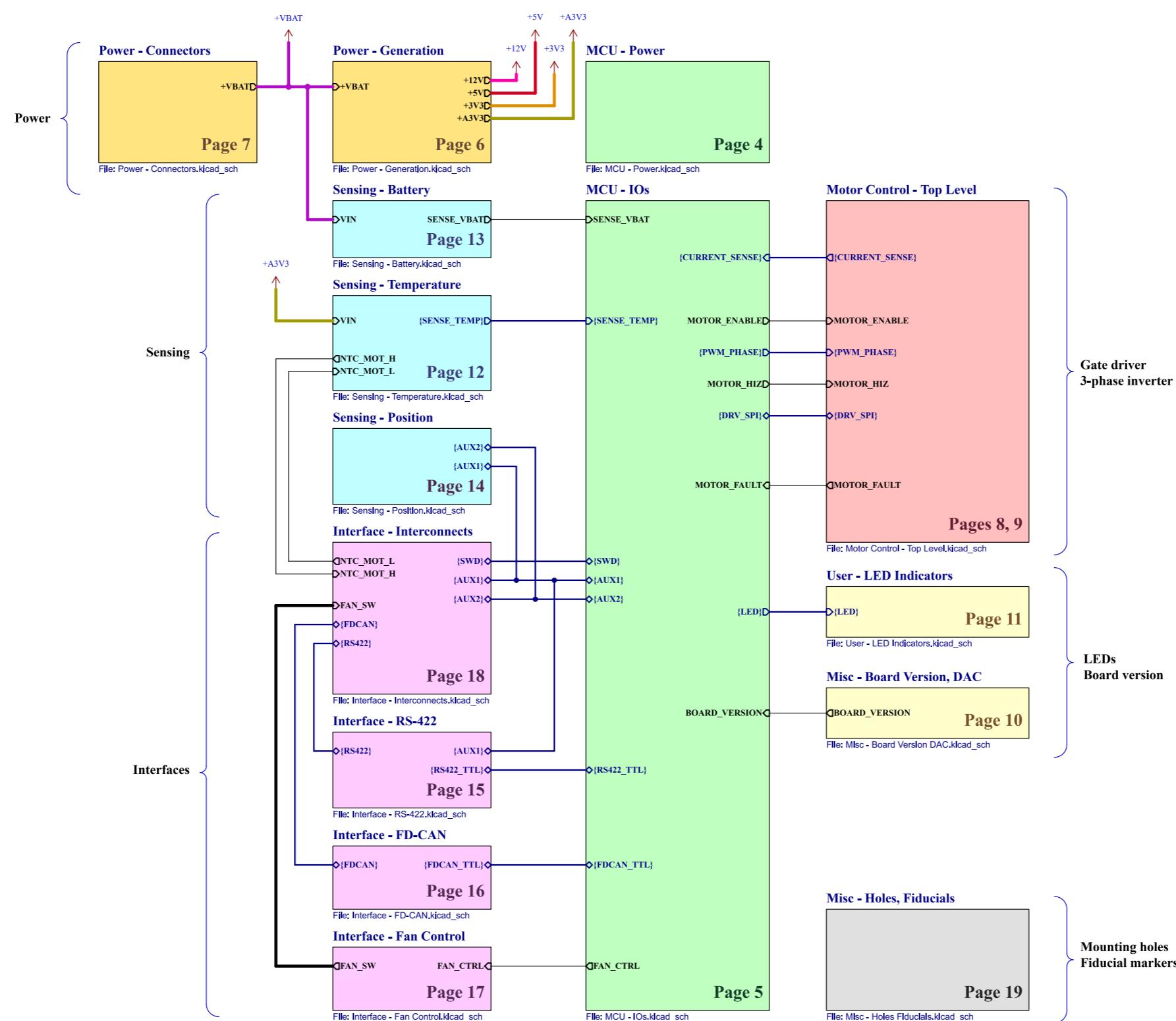
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	Board Name: <b>Amulet Motion Controller</b>	Project Name: <b>Chienpanzé</b>	
	Sheet Title: Cover Page	File Name: amulet_controller.kicad_sch	Designer: Vincent Nguyen
	Sheet Path: /	Reviewer:	Date: 2023-12-23 Revision: 1.0
		Size: A3	Sheet: 1 of 21

# [2] Block Diagram



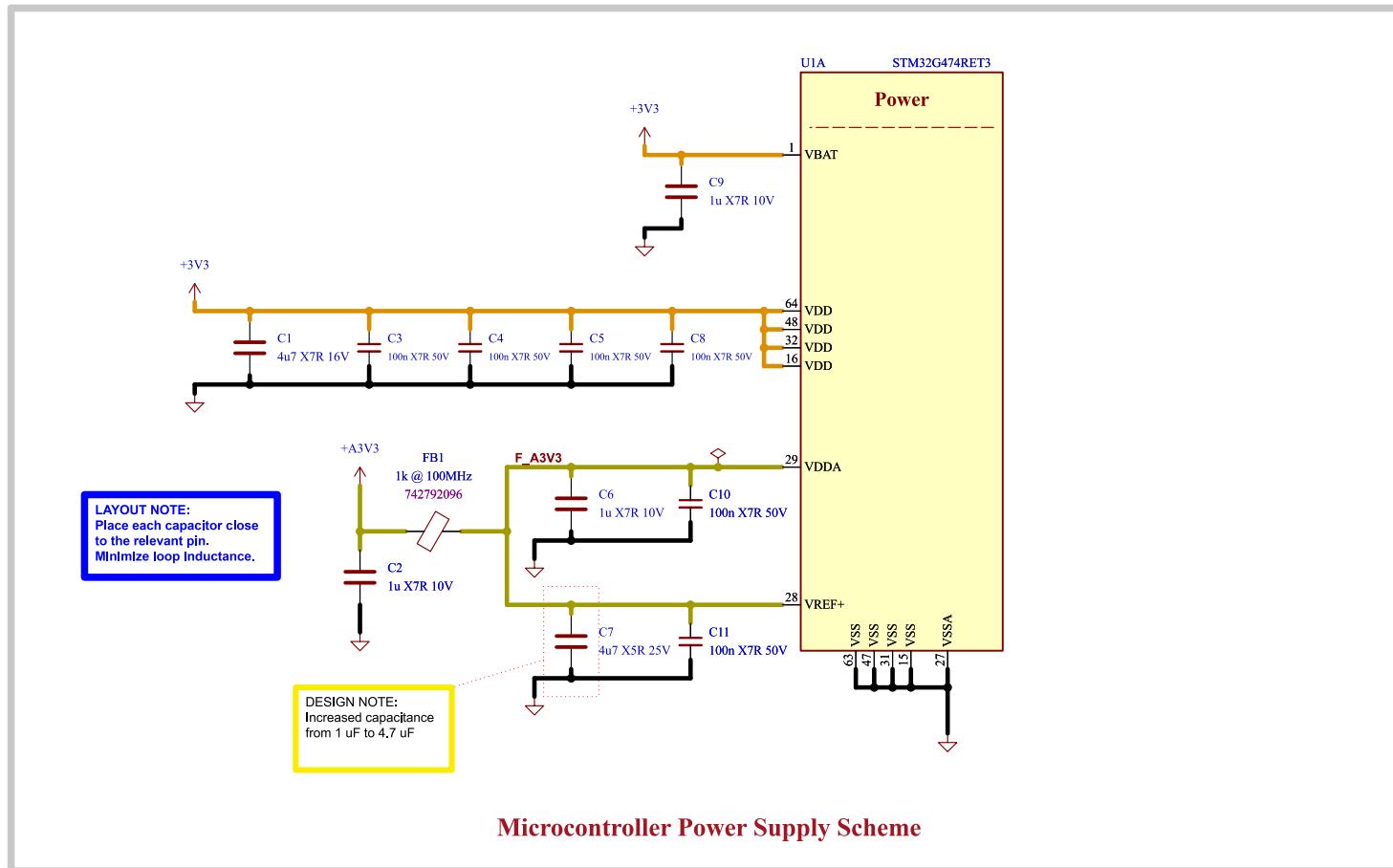
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		EPFL Xplore Research	xplore	Variant: Checked
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	Sheet Title:	File Name:	Designer:	Date: 2024-01-03 Revision: 1.0
	Block Diagram	Block Diagram.kicad_sch	Vincent Nguyen	
	Sheet Path:	/Block Diagram/	Reviewer:	Size: A3 Sheet: 2 of 21

# [3] Project Architecture



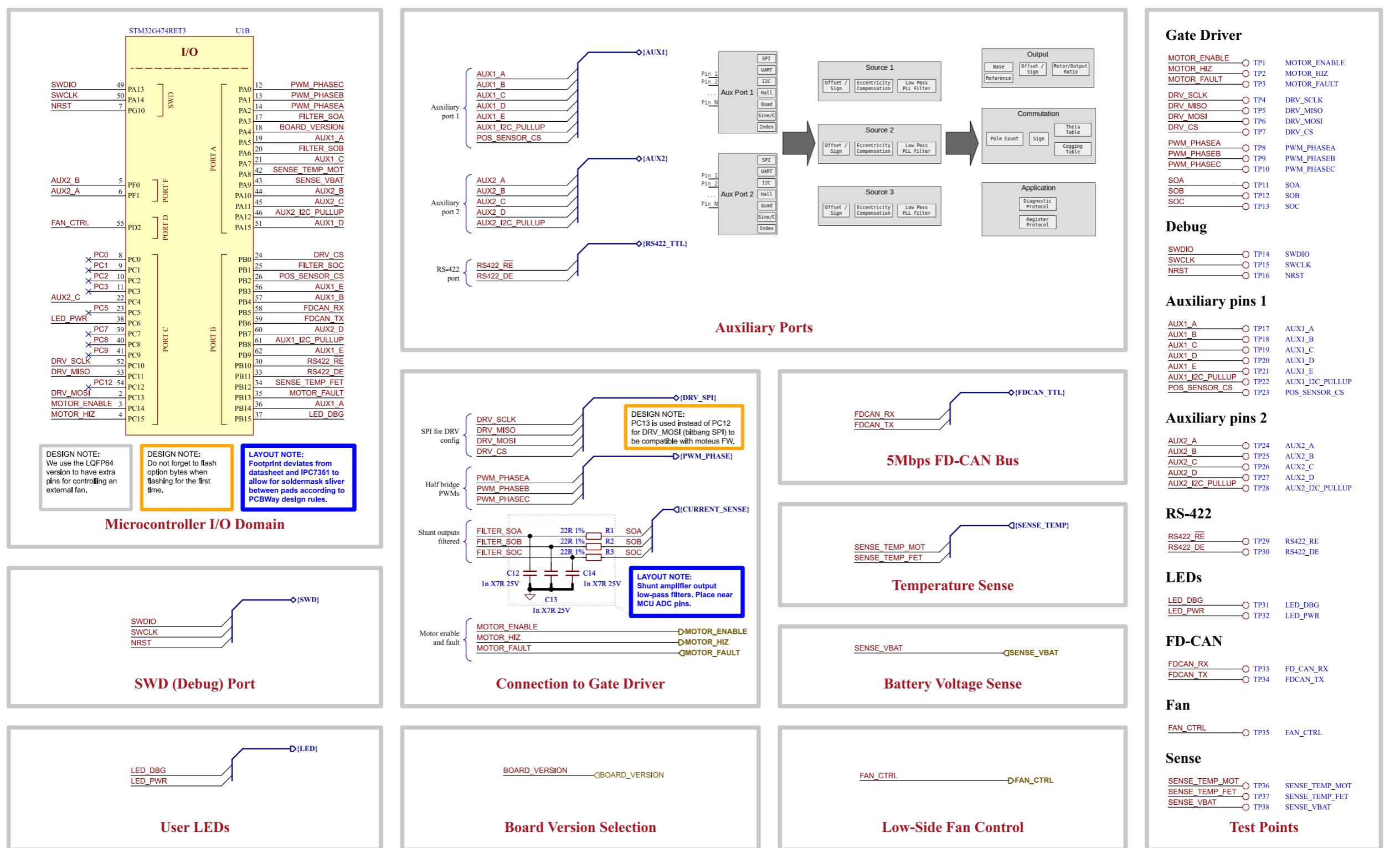
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	Board Name: <b>Amulet Motion Controller</b>	Project Name: <b>Chienpanzé</b>	
Sheet Title:	File Name: Project Architecture	Designer: Vincent Nguyen	Date: 2023-12-22
Sheet Path:	/Project Architecture/	Reviewer:	Revision: 1.0
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## [4] MCU - Power



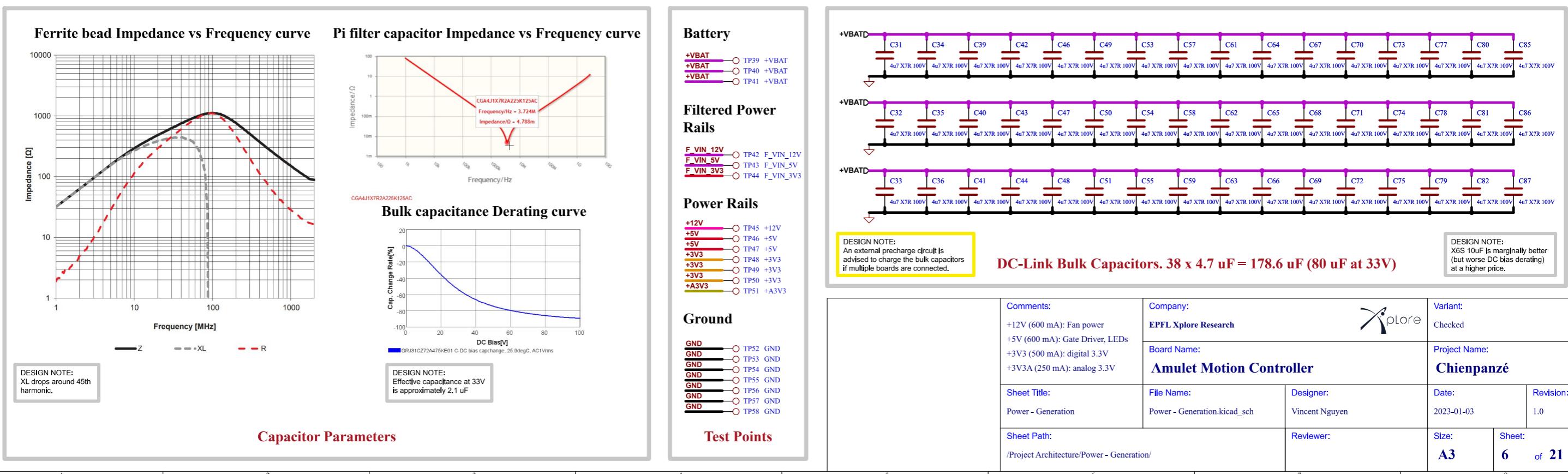
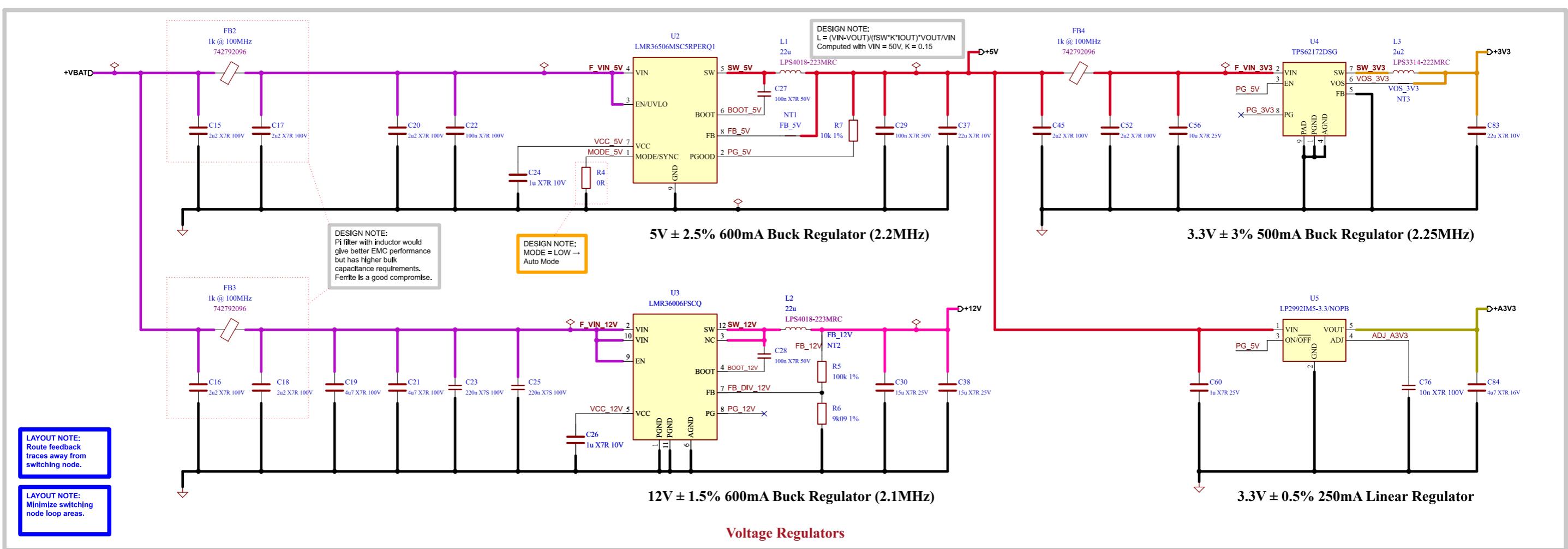
	Comments: AN5346 STM32G474 Datasheet p.81 J. Pieper ADC investigation	Company: EPFL Xplore Research 	Variant: Checked
	<b>Board Name:</b> <b>Amulet Motion Controller</b>		
	Sheet Title: MCU - Power	File Name: MCU - Power.kicad_sch	Designer: Vincent Nguyen
	Sheet Path: /Project Architecture/MCU - Power/	Reviewer:	Date: 2023-12-18    Revision: 1.0

# [5] MCU - I/Os

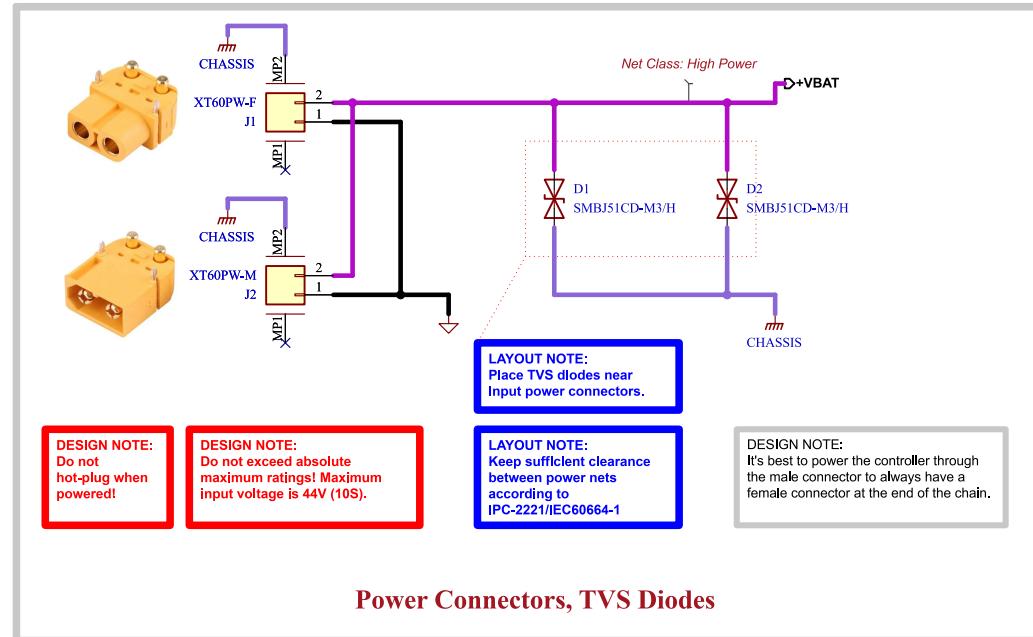


Comments: References: Flexible I/O worked examples Flexible I/O source configuration	Company: EPFL Xplore Research		Variant: Checked
	Board Name: <b>Amulet Motion Controller</b>	Project Name: <b>Chienpanzé</b>	
Sheet Title: MCU - I/Os	File Name: MCU - IOs.kicad_sch	Designer: Vincent Nguyen	Date: 2023-12-20
Sheet Path: /Project Architecture/MCU - IOs/	Reviewer:	Size: <b>A3</b>	Sheet: <b>5</b> of <b>21</b>

# [6] Power - Generation

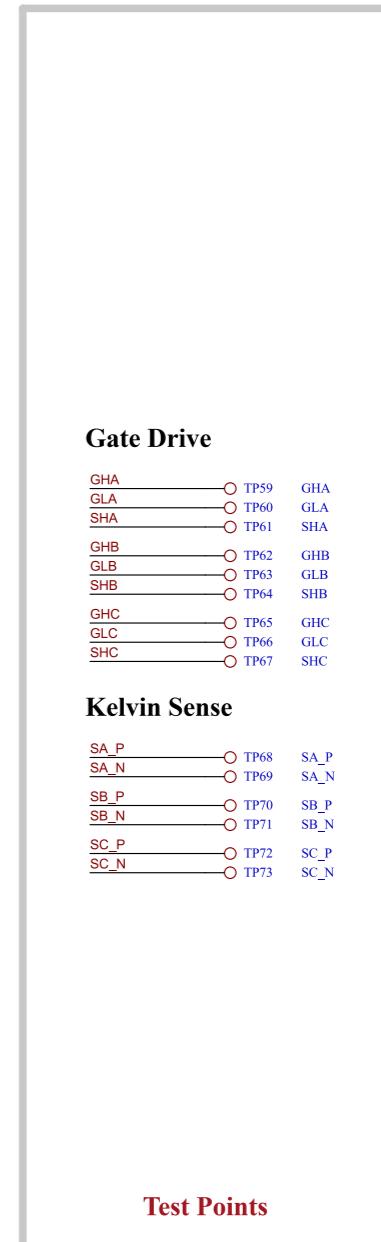
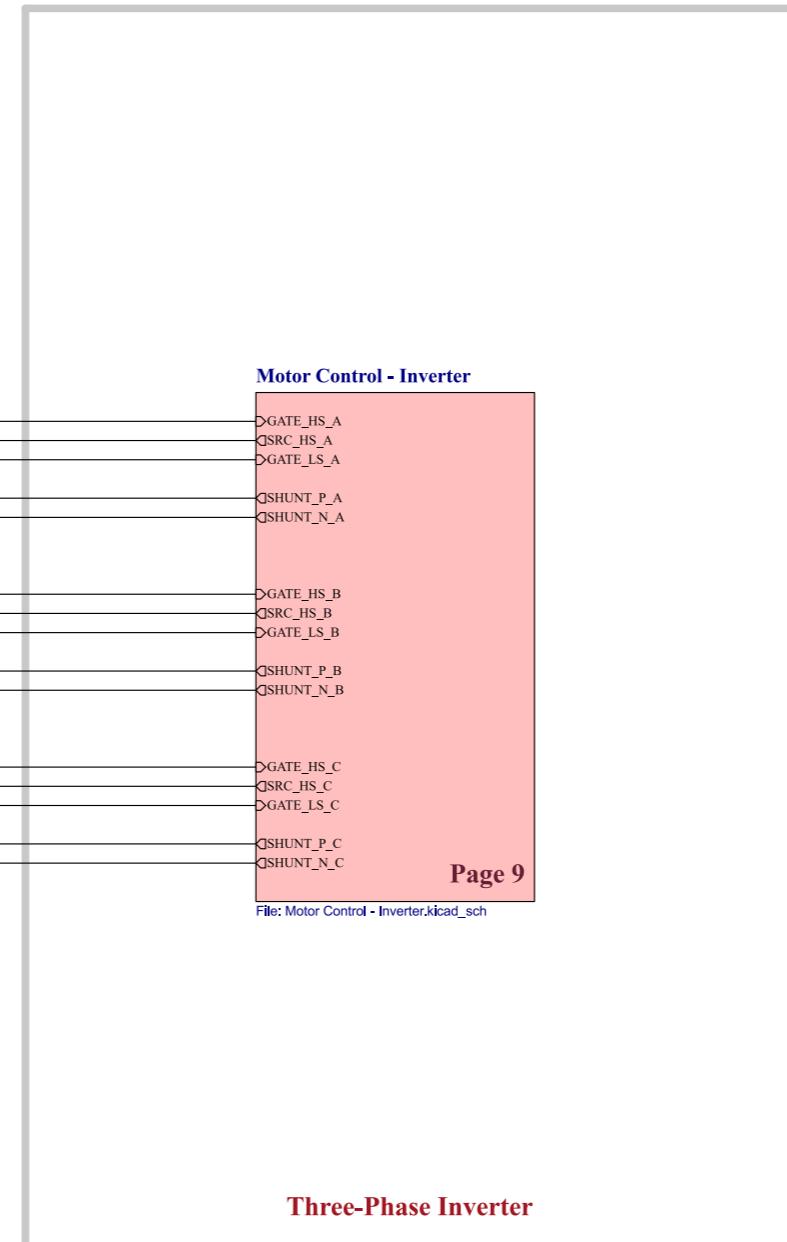
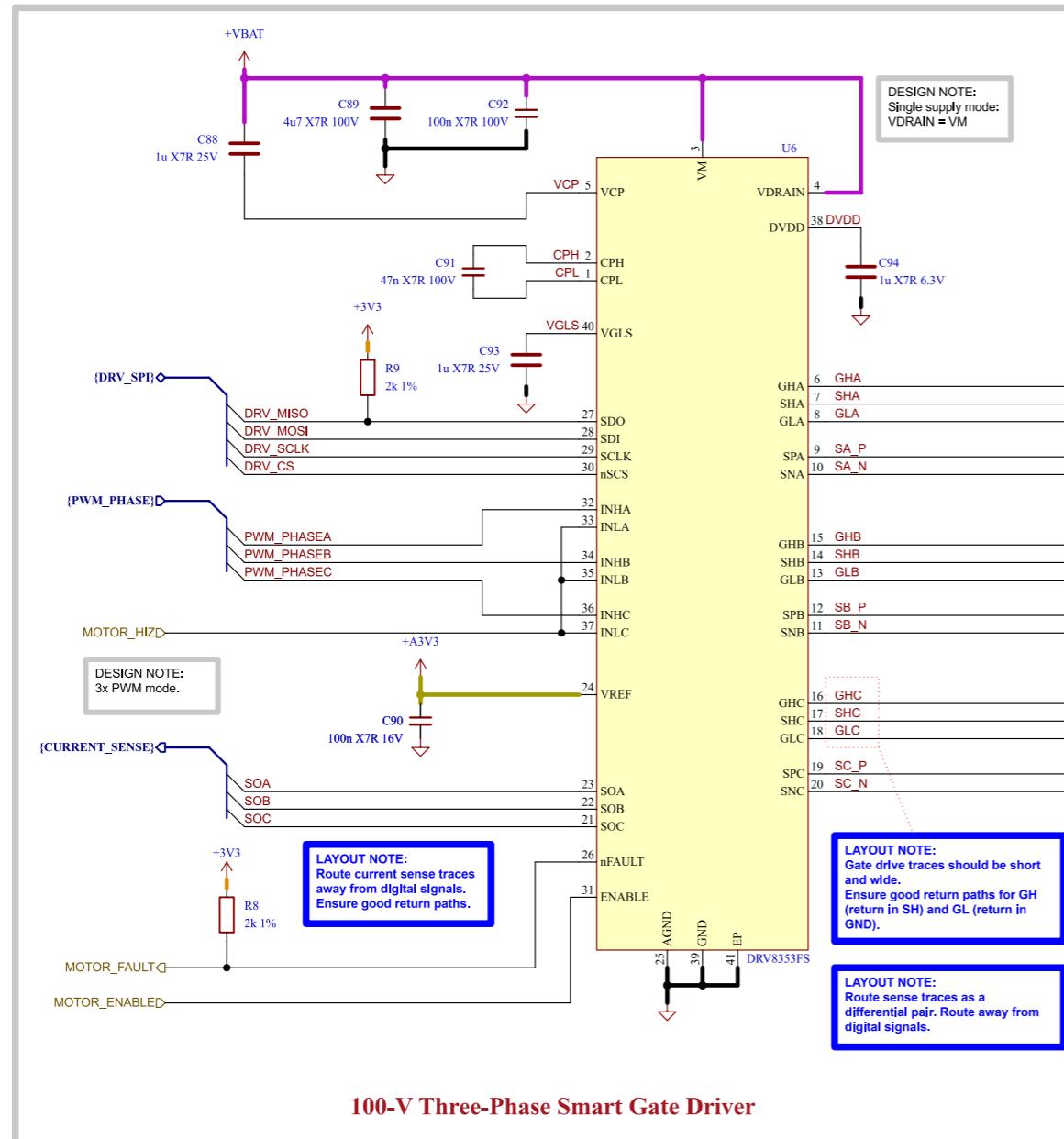


# [7] Power - Connectors



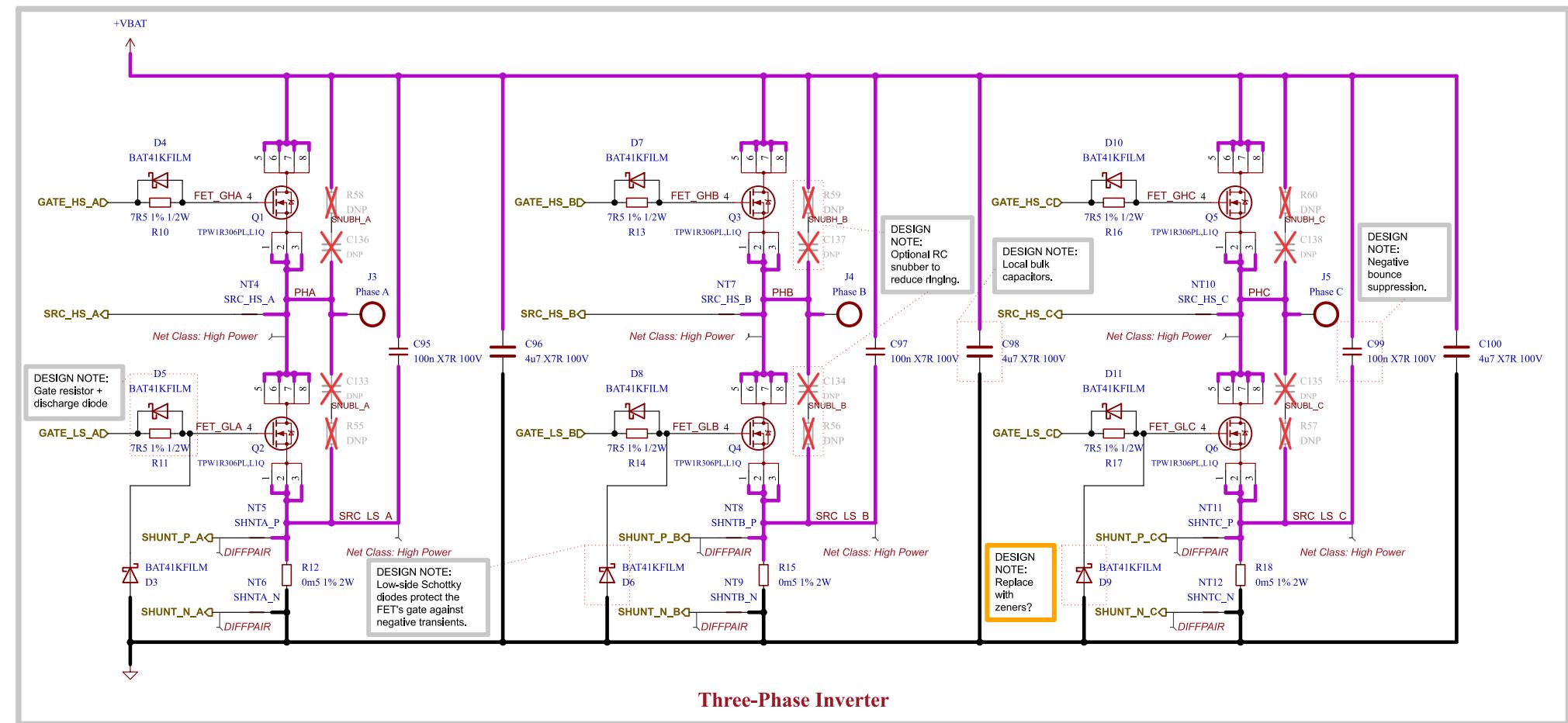
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	Sheet Path:  /Project Architecture/Power - Connectors/	Reviewer:	Size: <b>A4</b> Sheet: <b>7</b> of <b>21</b>

# [8] Motor Control - Top Level



	Comments:	Company: EPFL Xplore Research	Variant: Checked
	Board Name: <b>Amulet Motion Controller</b>	Project Name: <b>Chienpanzé</b>	
	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: 1.0

# [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

**Board Name:**  
**Amulet Motion Controller**

**File Name:**  
Motor Control - Inverter.kicad\_sch

**Designer:**  
Vincent Nguyen



**Variant:**  
Checked  
**Project Name:**  
**Chienpanzé**

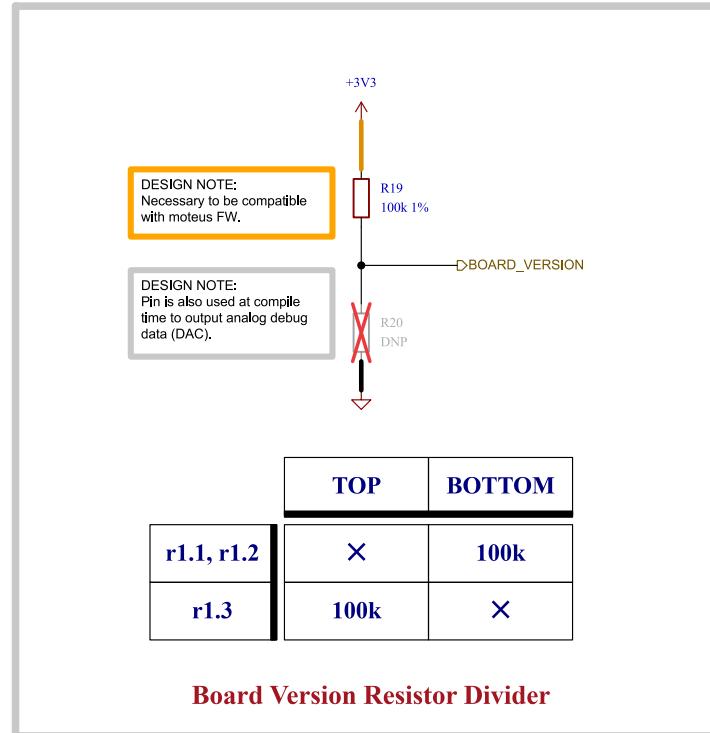
**Date:**  
2024-01-25

**Revision:**  
1.0

**Size:**  
**A4**

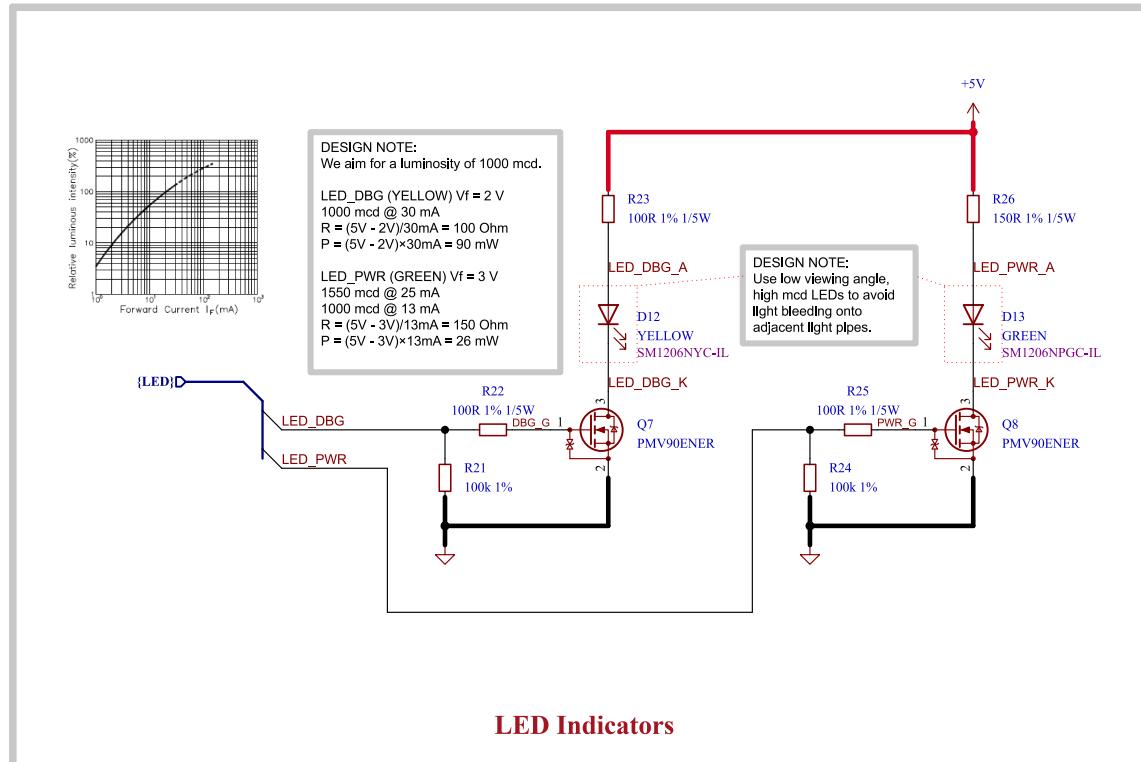
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**9** of **21**

# [10] Misc - Board Version, DAC



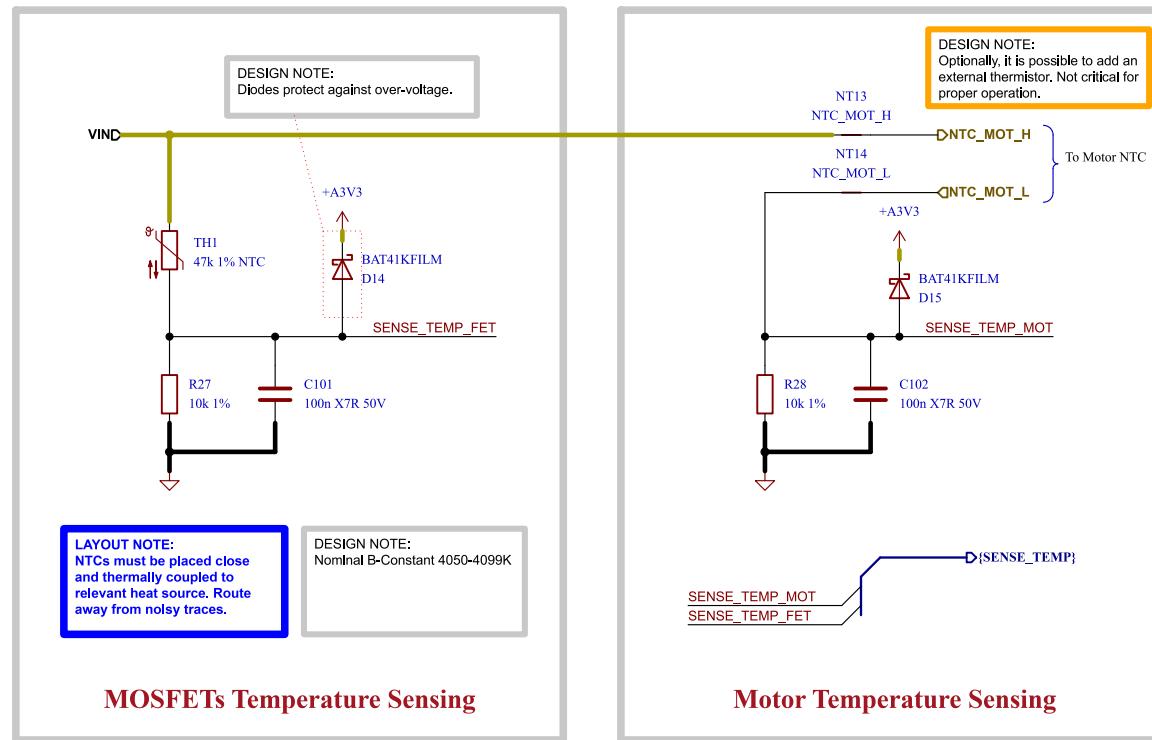
	Comments:	Company: EPFL Xplore Research	Variant: Checked
	Board Name: <b>Amulet Motion Controller</b>	Project Name: <b>Chienpanzé</b>	
	Sheet Title: Misc - Board Version, DAC	File Name: Misc - Board Version DAC.kicad_sch	Designer: Vincent Nguyen
	Sheet Path: <a href="#">/Project Architecture/Misc - Board Version, DAC/</a>	Reviewer:	Date: 2023-10-14 Revision: 1.0
		Size: A4	Sheet: 10 of 21

# [11] User - LED Indicators



	Comments:	Company: EPFL Xplore Research	Variant: Checked
	Board Name: <b>Amulet Motion Controller</b>	Project Name: <b>Chienpanzé</b>	
	Sheet Title: User - LED Indicators	File Name: User - LED Indicators.kicad_sch	Designer: Vincent Nguyen
	Sheet Path: <a href="#">/Project Architecture/User - LED Indicators/</a>	Reviewer:	Date: 2023-12-19 Revision: 1.0

## [12] Sensing - Temperature



	Comments:	Company: <b>EPFL Xplore Research</b>	 xplore	Variant: Checked
		Board Name: <b>Amulet Motion Controller</b>	Project Name: <b>Chienpanzé</b>	
	Sheet Title: Sensing - Temperature	File Name: Sensing - Temperature.kicad_sch	Designer: Vincent Nguyen	Date: 2023-10-14
	Sheet Path: /Project Architecture/Sensing - Temperature/	Reviewer:	Size: <b>A4</b>	Sheet: <b>12</b> of <b>21</b>

# [13] Sensing - Battery

A

B

C

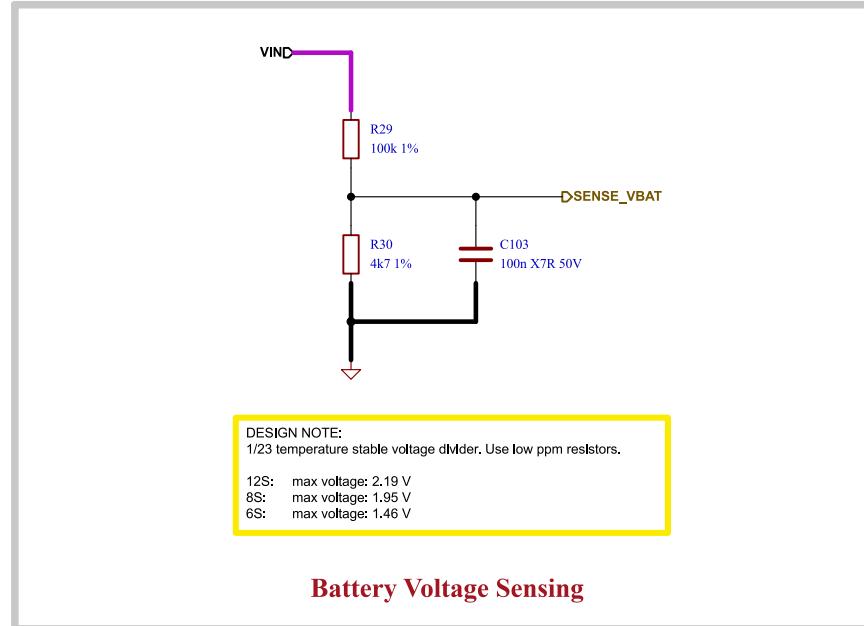
D

A

B

C

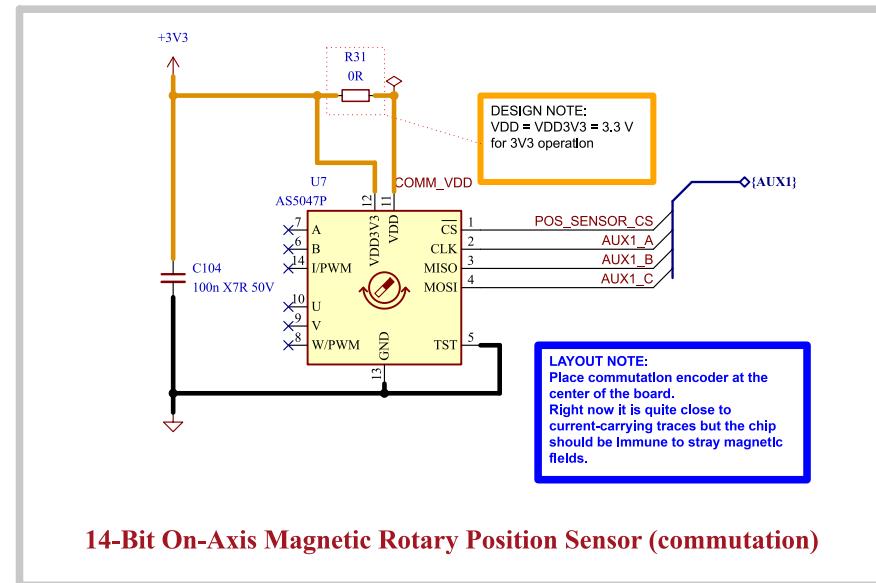
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	Comments:	Company: EPFL Xplore Research	Variant: Checked
	Board Name: <b>Amulet Motion Controller</b>		
	Sheet Title: Sensing - Battery	File Name: Sensing - Battery.kicad_sch	Designer: Vincent Nguyen
	Sheet Path: /Project Architecture/Sensing - Battery/	Reviewer:	Date: 2023-10-14 Revision: 1.0
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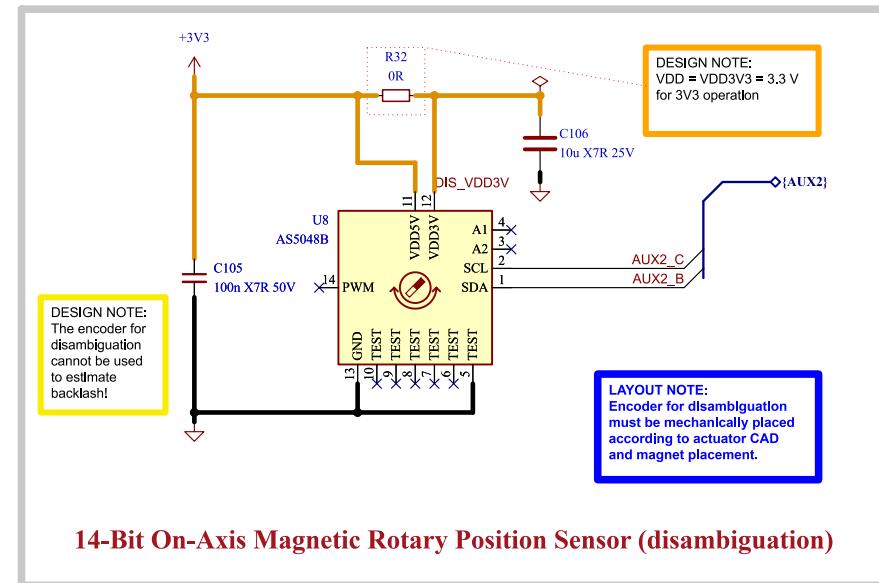
# [14] Sensing - Position

A



14-Bit On-Axis Magnetic Rotary Position Sensor (commutation)

**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.



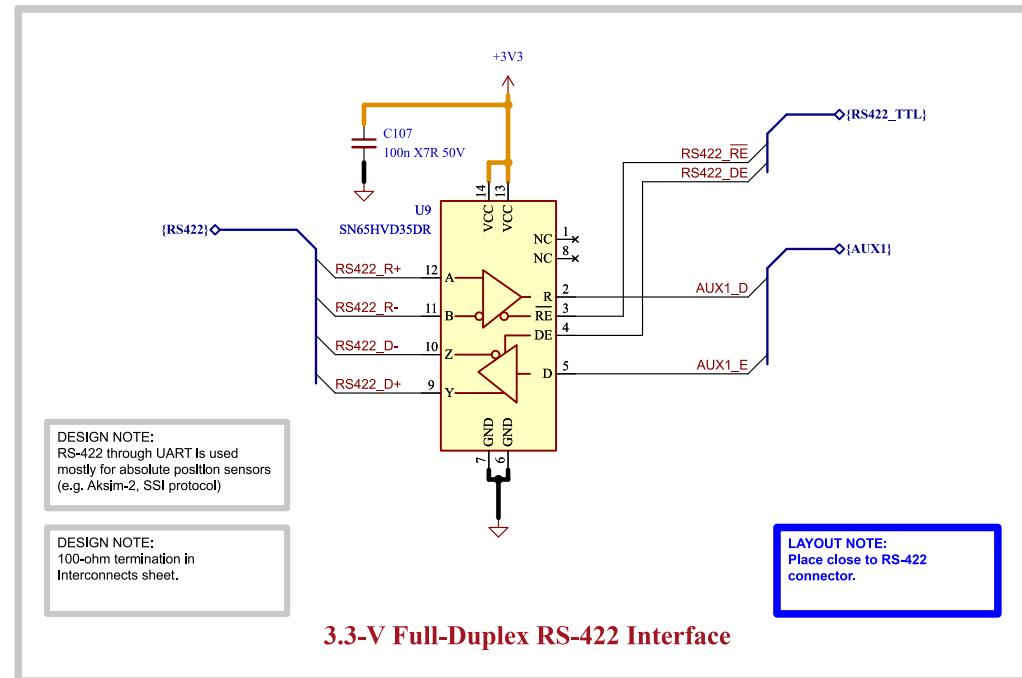
14-Bit On-Axis Magnetic Rotary Position Sensor (disambiguation)

C

D

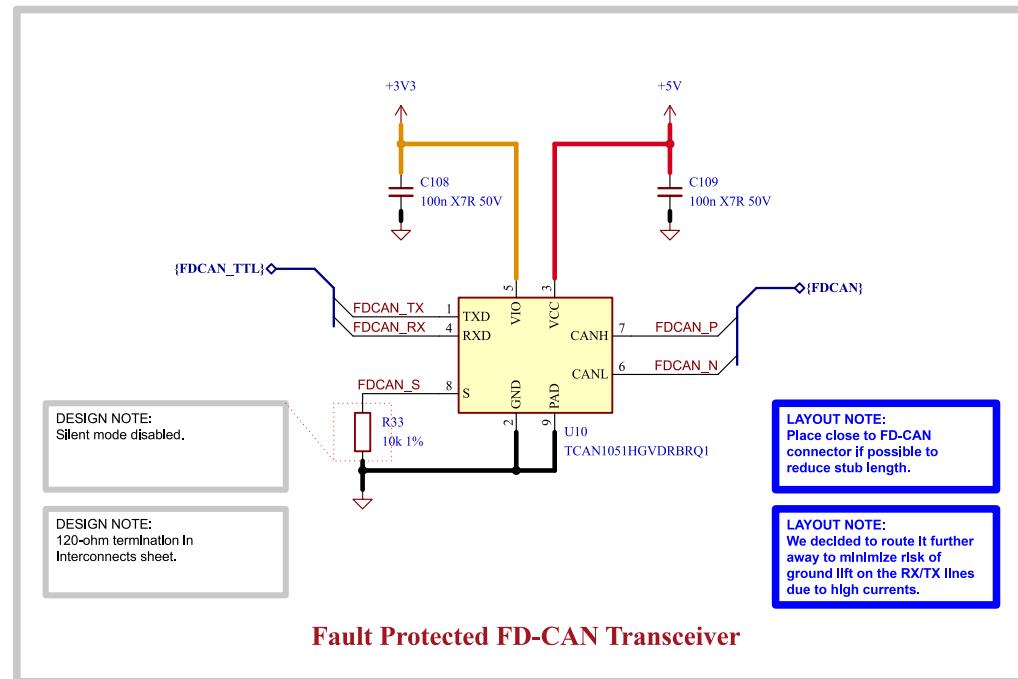
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	Board Name: <b>Amulet Motion Controller</b>		
	Sheet Title: Sensing - Position	File Name: Sensing - Position.kicad_sch	Designer: Vincent Nguyen
	Sheet Path: /Project Architecture/Sensing - Position/	Reviewer:	Date: 2023-10-14 Revision: 1.0

## [15] Interface - RS-422



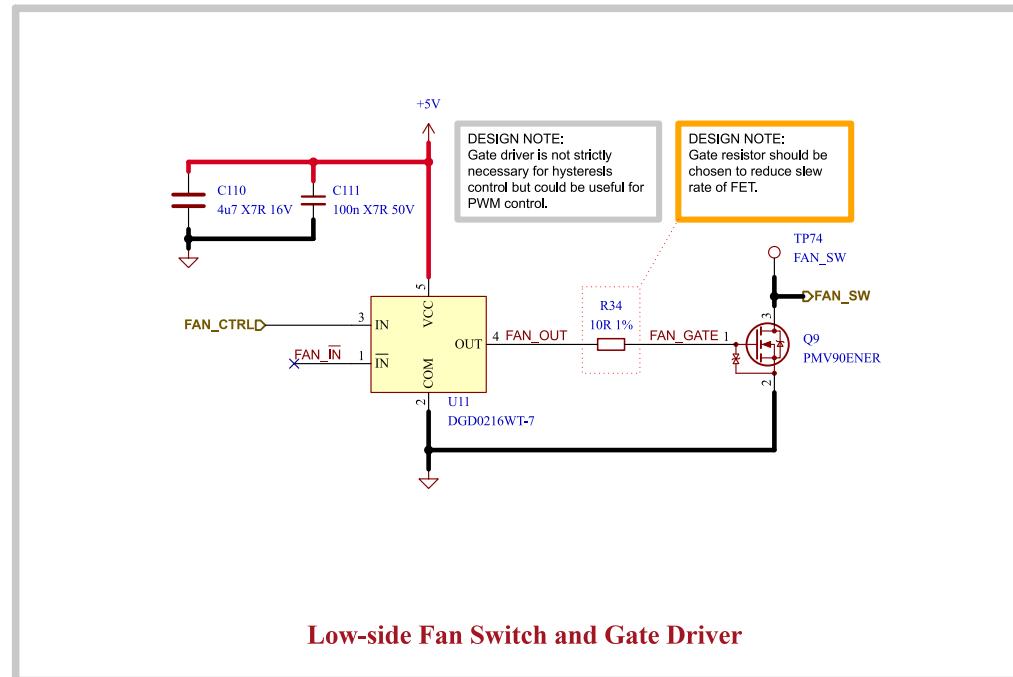
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		Board Name: <b>Amulet Motion Controller</b>	Project Name: <b>Chienpanzé</b>	
	<b>Sheet Title:</b> Interface - RS-422	<b>File Name:</b> Interface - RS-422.kicad_sch	<b>Designer:</b> Vincent Nguyen	<b>Date:</b> 2023-10-15 <b>Revision:</b> 1.0
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# [16] Interface - FD-CAN



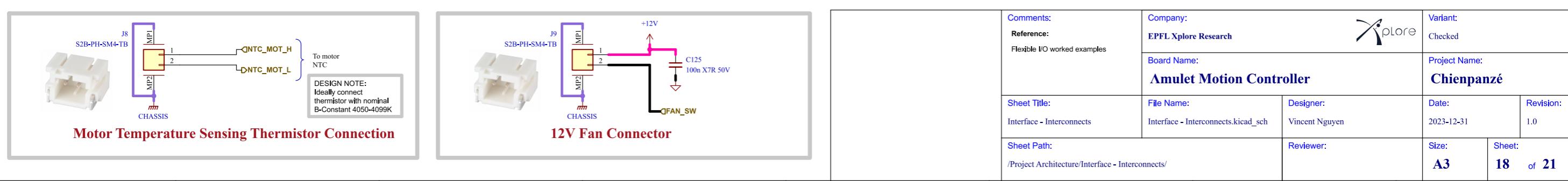
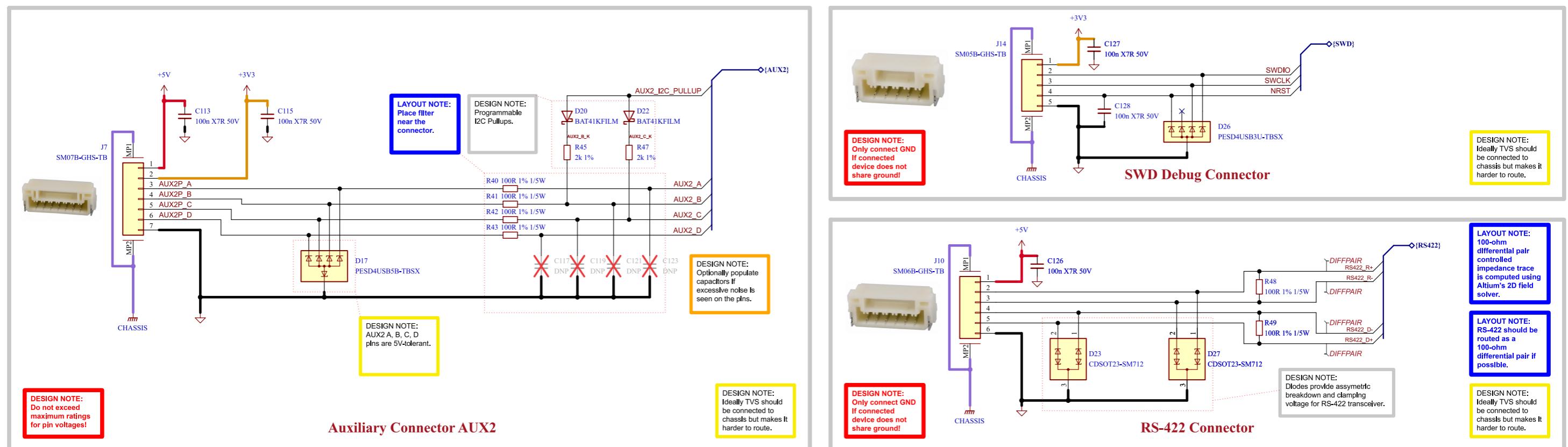
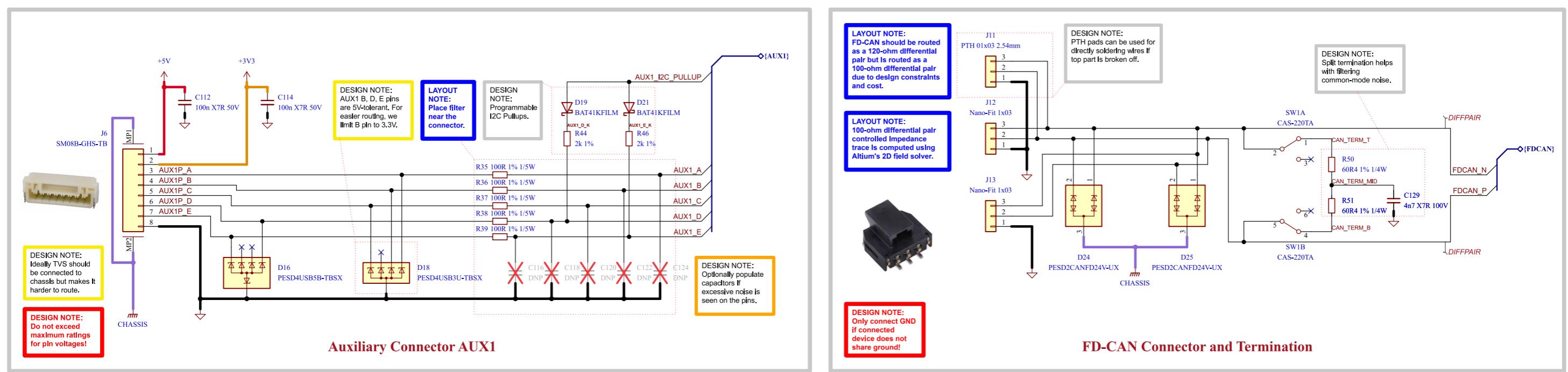
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	Board Name: <b>Amulet Motion Controller</b>		
	Sheet Title: Interface - FD-CAN	File Name: Interface - FD-CAN.kicad_sch	Designer: Vincent Nguyen
	Sheet Path: /Project Architecture/Interface - FD-CAN/	Reviewer:	Date: 2023-10-15      Revision: 1.0

# [17] Interface - Fan Control



	Comments:	Company: EPFL Xplore Research	Variant: Checked
	Board Name: <b>Amulet Motion Controller</b>		
	Sheet Title: Interface - Fan Control	File Name: Interface - Fan Control.kicad_sch	Designer: Vincent Nguyen
	Sheet Path: <a href="#">/Project Architecture/Interface - Fan Control/</a>	Reviewer:	Date: 2023-11-19 Revision: 1.0

# [18] Interface - Interconnects



# [19] Misc - Holes, Fiducials

A

A

B

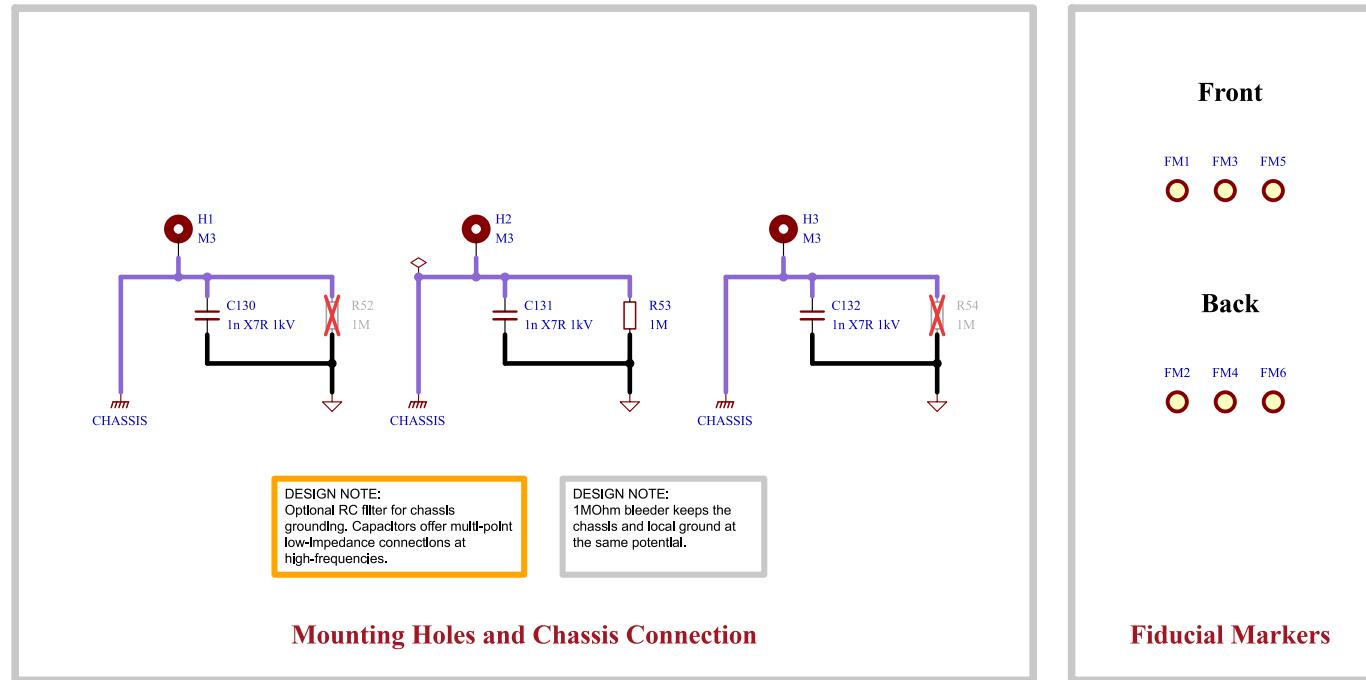
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C

C

D

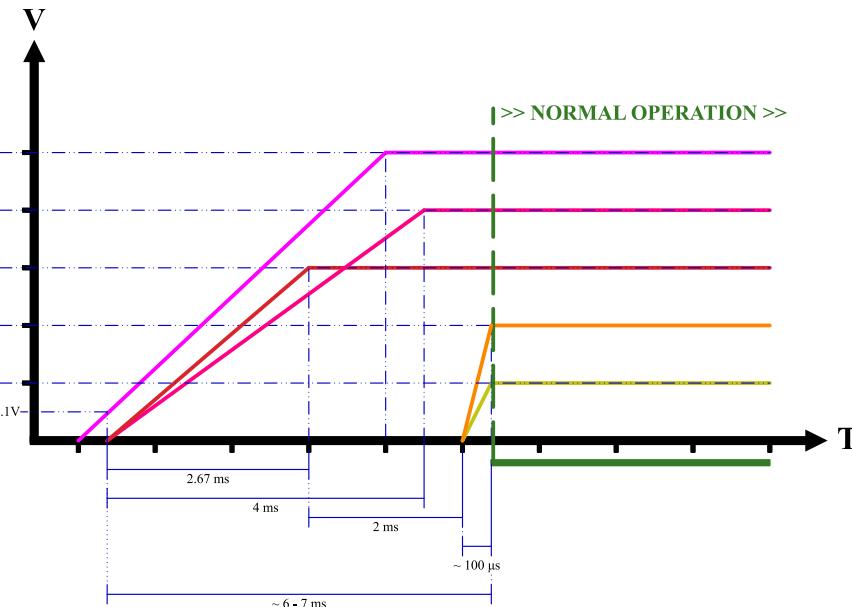
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	Comments:	Company: EPFL Xplore Research	Variant: Checked
	Board Name: <b>Amulet Motion Controller</b>	Project Name: <b>Chienpanzé</b>	
	Sheet Title: Misc - Holes, Fiducials	File Name: Misc - Holes Fiducials.kicad_sch	Designer: Vincent Nguyen
	Sheet Path: /Project Architecture/Misc - Holes, Fiducials/	Reviewer:	Date: 2023-10-22 Revision: 1.0

# [20] Power - Sequencing

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: EPFL Xplore Research		Variant: Checked	
		Board Name: <b>Amulet Motion Controller</b>		Project Name: <b>Chienpanzé</b>	
	Sheet Title: Power - Sequencing	File Name: Power - Sequencing.kicad_sch	Designer: Vincent Nguyen	Date: 2023-01-03	Revision: 1.0
	Sheet Path: /Power - Sequencing/		Reviewer:	Size: <b>A4</b>	Sheet: <b>20</b> of <b>21</b>

## [21] Revision History

A	12-DEC-2023 - Initial Release	Variant: v1.0 Preliminary	
B			
C			
D			
1	2	3	4
A	B	C	D