



Variant: Released

Integrated Actuators Laboratory (LAI)

Semester project: 02/2025 - 06/2025

Student: Théo Heng - theoheng@icloud.com

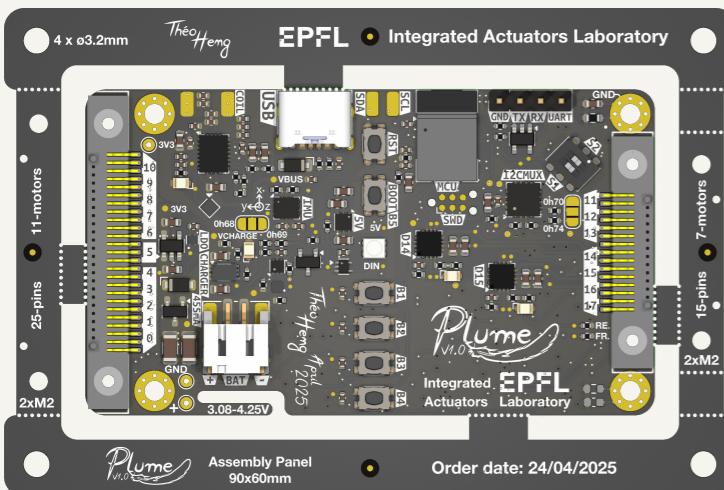
Supervisors: Maël Dagon, Paolo Germano

2025-05-27

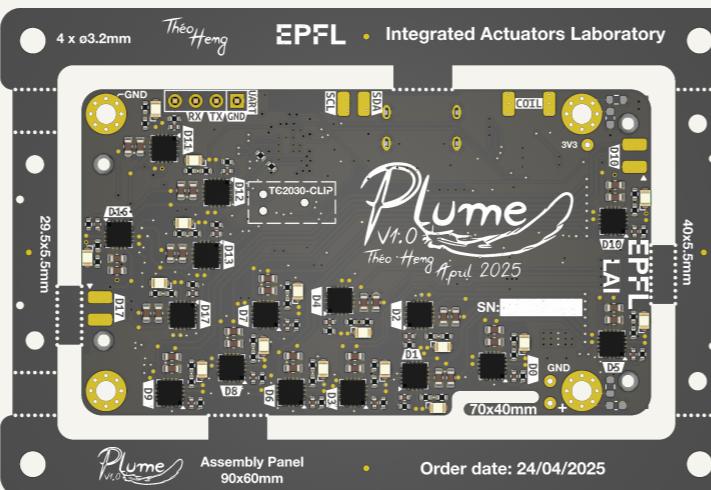
Rev 1.0

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TOP VIEW



BOTTOM VIEW



DESIGN CONSIDERATIONS

DESIGN NOTE:
Example text for informational design notes.

DEBUG 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

MULTIPLE MOTOR CONTROLLER WITH SENSORLESS POSITION CONTROL

Not fitted components are marked as X

DRAFT - Very early stage of schematic, ignore details.

PRELIMINARY - Close to final schematic.

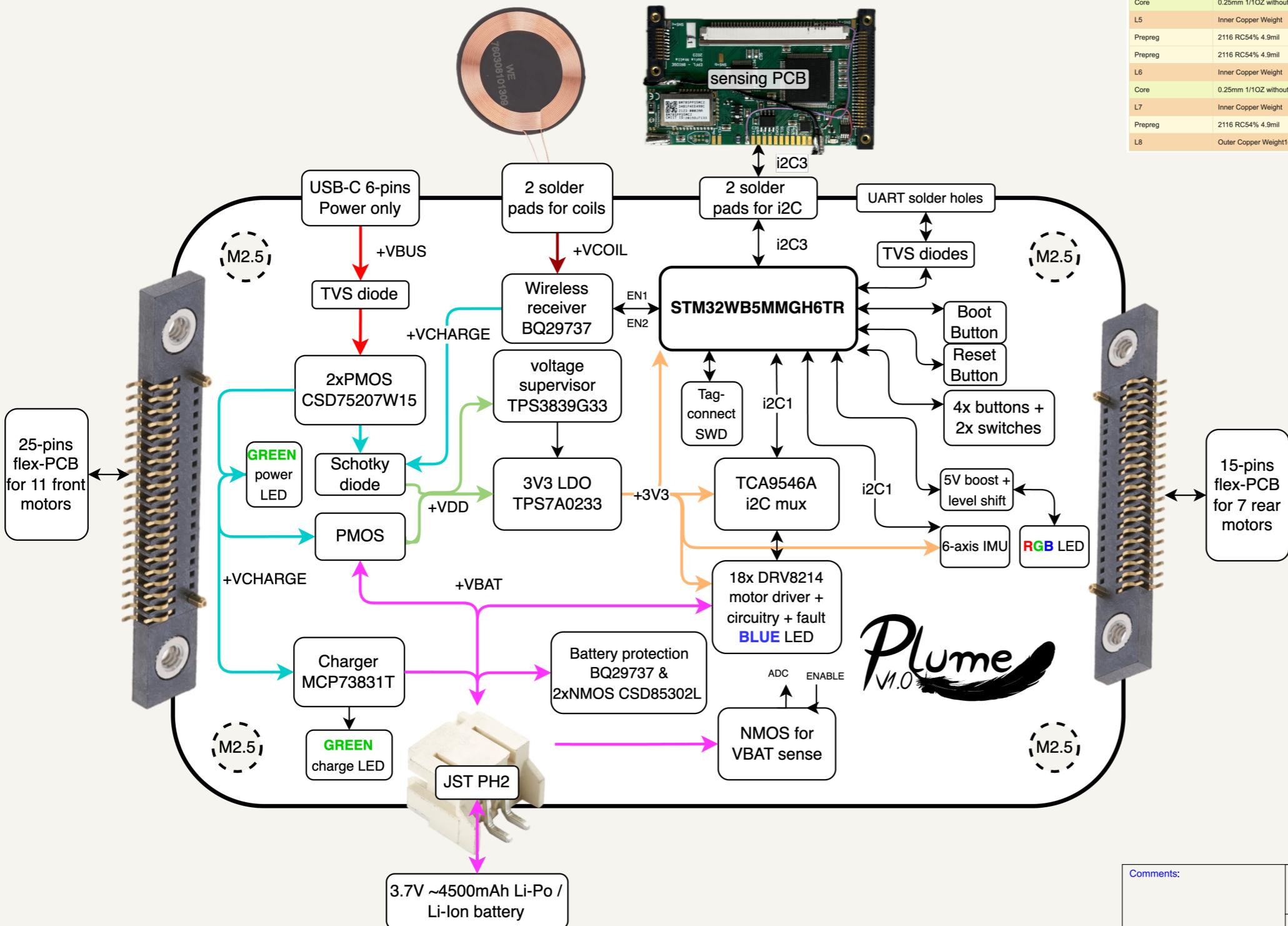
CHECKED - There shouldn't be any mistakes. Contact the engineer if you find any.

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

Released - 24/04/2025

Comments: KiCad Template by Vincent Nguyen	Laboratory: Integrated Actuators Laboratory	Variant: EPFL	
Board Name: Plume		Project Name: Plume	
Sheet Title: Cover Page	File Name: Plume.kicad_sch	Designer: Théo Heng	Date: 2025-04-24
Sheet Path: /	Supervisor: Maël Dagon, Paolo Germano	Size: A3	Sheet: 1 of 31

[2] Block Diagram



JLC081611-7628(Special/Finished thickness 1.59mm±10%)		JLC081611-2116(Standard /Finished thickness 1.65mm±10%)		JLC081611-2116(Standard /Finished thickness 1.65mm±10%)	
Impedance (Ω)	Type	Signal Layer	Top Ref	Bottom Ref	Trace Width
50	Single Ended (Non coplanar)	L1	/	L2	/
Layer	Material	Thickness (mil)		Thickness (mm)	
L1	Outer Copper Weight 1oz	1.38		0.0350	
Prepreg	2116 RC54% 4.9mil	4.29		0.1090	
L2	Inner Copper Weight	1.18		0.0300	
Core	0.25mm 1/1OZ without copper	9.84		0.2500	
L3	Inner Copper Weight	1.18		0.0300	
Prepreg	2116 RC54% 4.9mil	4.29		0.1090	
L4	Inner Copper Weight	1.18		0.0300	
Core	0.25mm 1/1OZ without copper	9.84		0.2500	
L5	Inner Copper Weight	1.18		0.0300	
Prepreg	2116 RC54% 4.9mil	4.29		0.1090	
L6	Inner Copper Weight	1.18		0.0300	
Core	0.25mm 1/1OZ without copper	9.84		0.2500	
L7	Inner Copper Weight	1.18		0.0300	
Prepreg	2116 RC54% 4.9mil	4.29		0.1090	
L8	Outer Copper Weight 1oz	1.38		0.0350	

Current Recommended Stackup:

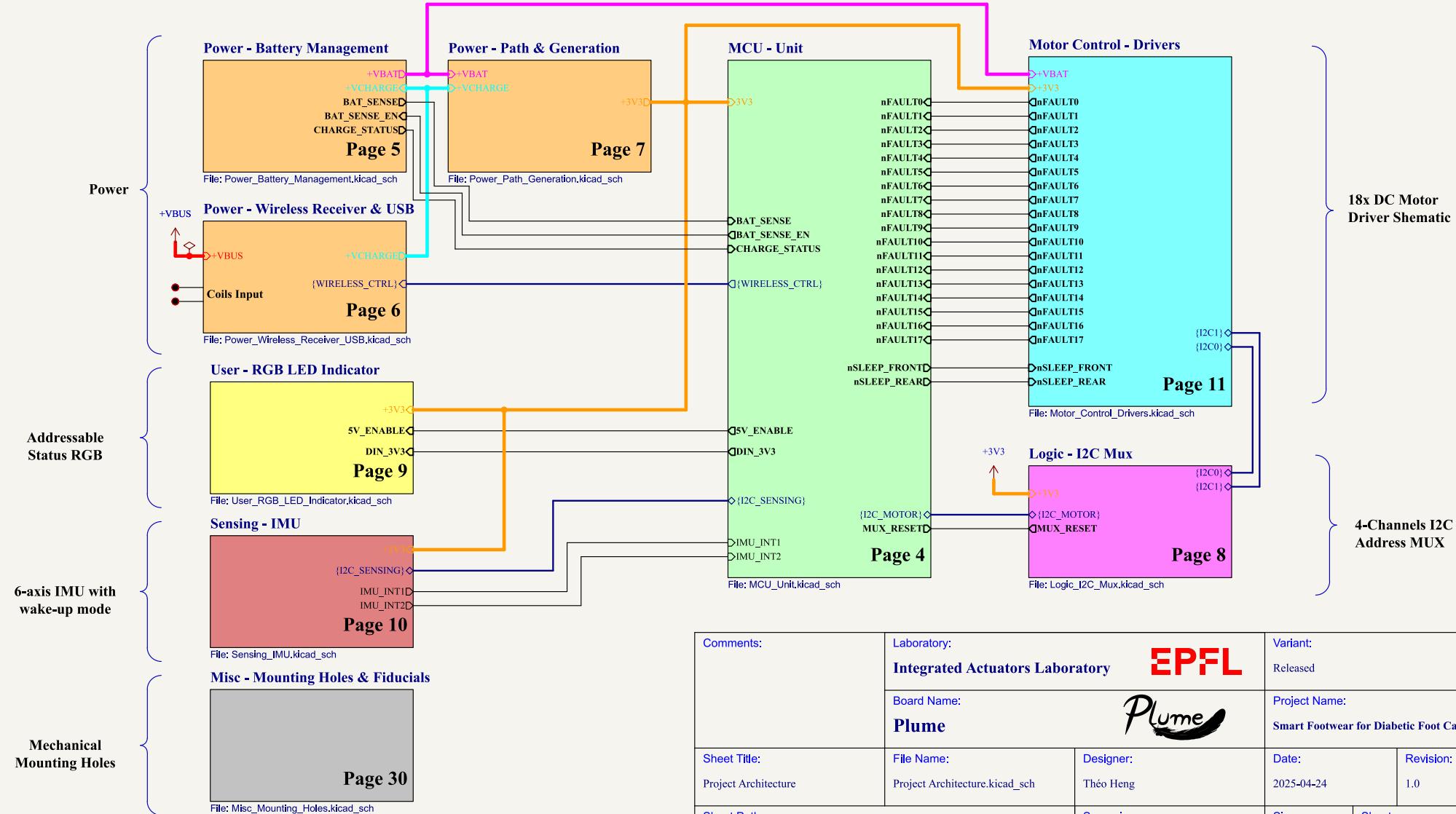
8 layer, 1oz out/1oz:
JLC081611-2116 (Finished thickness 1.65mm±10%)

Target specifications:

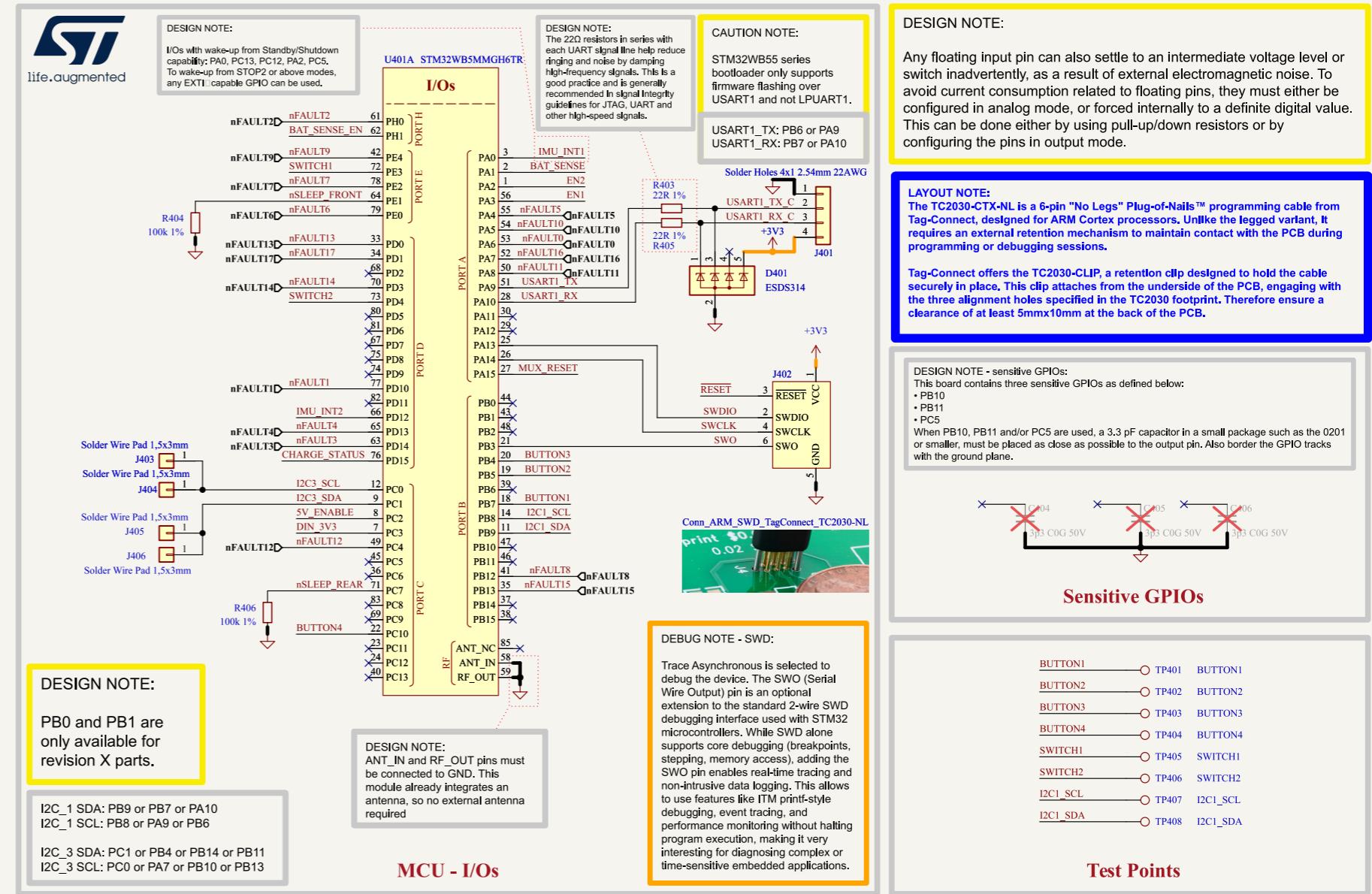
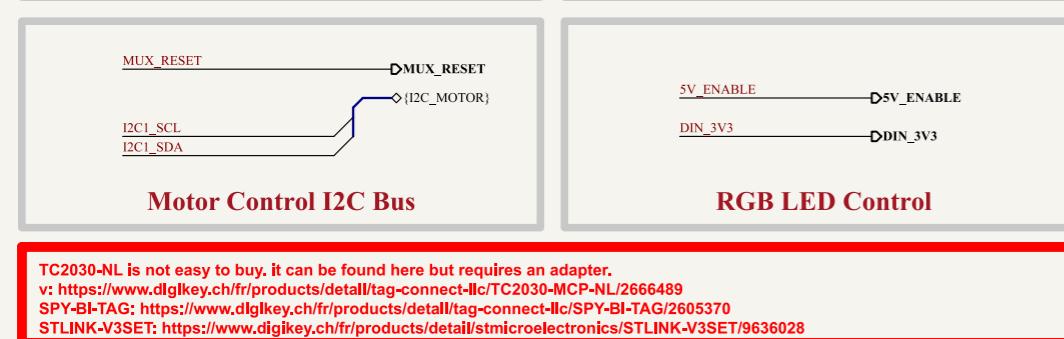
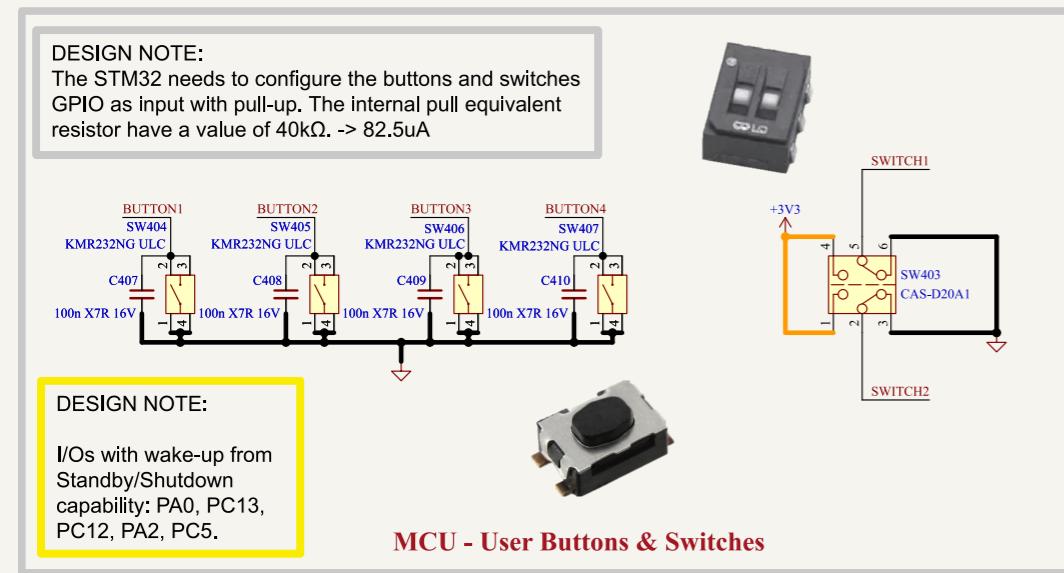
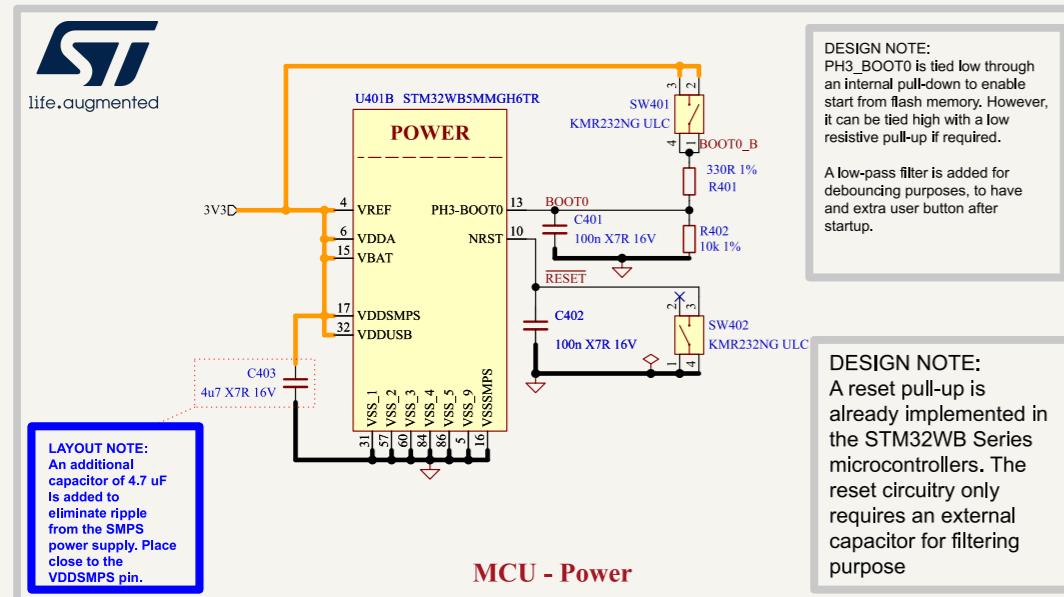
Battery Input voltage:	3.08 - 4.25 V
Max charge current:	455 mA
Nb of controlled motors:	18
Max load current:	4.54 A
Standby Current:	50 mA
Sleep Current:	15 uA

Comments:	Laboratory: Integrated Actuators Laboratory	Variant: Released
Board Name: Plume	Project Name: Plume	Smart Footwear for Diabetic Foot Care
Sheet Title: Block Diagram	File Name: Block Diagram.kicad_sch	Designer: Théo Heng
Sheet Path: /Block Diagram/	Supervisor: Maël Dagon, Paolo Germano	Date: 2025-04-24
		Revision: 1.0
		Size: A3
		Sheet: 2 of 31

[3] Project Architecture



[4] MCU - Unit



Comments: AN5165 Application Note: How to develop RF hardware using STM32WB microcontrollers AN2606 Application Note: STM32 microcontroller system memory boot mode Debounce a Switch - Texas Instrument	Laboratory: Integrated Actuators Laboratory Board Name: Plume Sheet Title: MCU - Unit File Name: MCU_Unit.kicad_sch Sheet Path: /Project Architecture/MCU - Unit/ Supervisor: Maël Dagon, Paolo Germano	Variant: Released Project Name: Smart Footwear for Diabetic Foot Care Date: 2025-04-24 Revision: 1.0 Size: A3 Sheet: 4 of 31
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[5] Power - Battery Management

Current analysis:

Normal:
BQ29737: 4uA
MCP73831: 100nA

Shutdown:
BQ29737: 100nA
MCP73831: 100nA

DESIGN NOTE - gate-source resistors:

TI recommends placing a high impedance 5MO across the gate source of each external FET to deplete any charge on the gate-source capacitance.

DESIGN NOTE - EXTERNAL PROTECTION FETs:

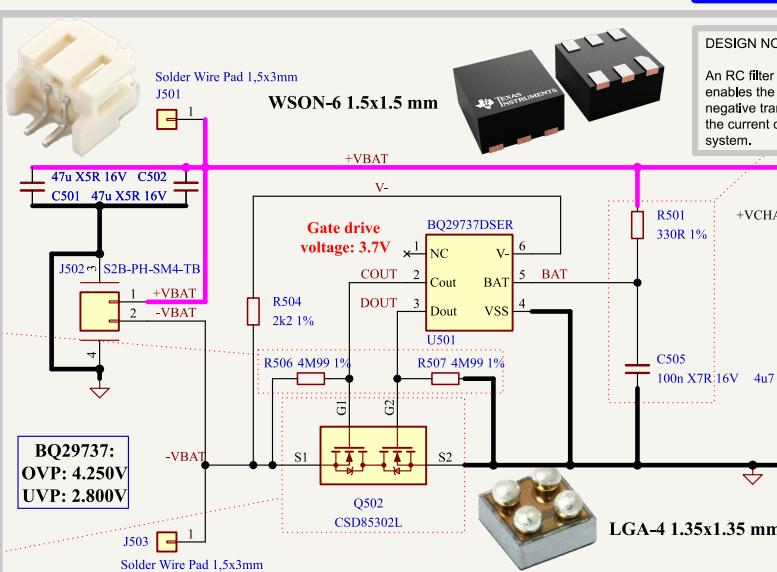
The external FET selection is important to ensure the battery pack selection is sufficient and complies to the requirements of the system.

BQ29737 charge overcurrent threshold: -50mV
BQ29737 discharge overcurrent threshold: 100mV

The CSD85302L when driven at 3.7V at the gate, have a source to source resistance of ~22 mΩ.

Resulting charge overcurrent protection:
50mV / 22mΩ ≈ 2.27A

Resulting discharge overcurrent protection:
100mV / 22mΩ ≈ 4.54A

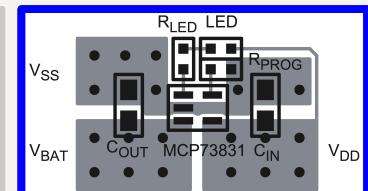


Voltage and Current Protection Integrated Circuit for Single-Cell Li-Ion and Li-Polymer Batteries and Miniature Single-Cell, Fully Integrated Li-Ion, Li-Polymer Charge Management Controller

COUT	TP501	COUT
DOUT	TP502	DOUT
CHARGE_STATUS	TP503	CHARGE_STATUS
BAT_SENSE_EN	TP504	BAT_SENSE_EN
BAT_SENSE	TP505	BAT_SENSE
-VBAT	TP506	-VBAT
-VBAT	TP507	-VBAT
+VBAT	TP508	+VBAT
+VBAT	TP509	-VBAT

Test Points

DESIGN NOTE - CHARGE STATUS LED:
APT1608CGCK has a typical luminous intensity of 50mcd (millicandela) @20mA, and 25mcd @10mA. Typ. VI = 2V @10mA
Typ. If = (5V - 2V)/330Ω ≈ 9 mA
P = 2V × 9mA ≈ 18 mW < 75 mW (max rating)

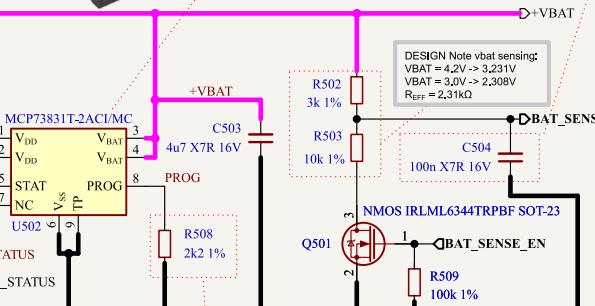


DESIGN NOTE - VBAT RC filter:

An RC filter is required on the BAT for noise, and enables the device to operate during sharp negative transients. The 330Ω resistor also limits the current during a reverse connection on the system.



LAYOUT NOTE:
Place the capacitor as close as possible to the ADC pin of the STM32. Route the BAT_SENSE trace away from switching elements.



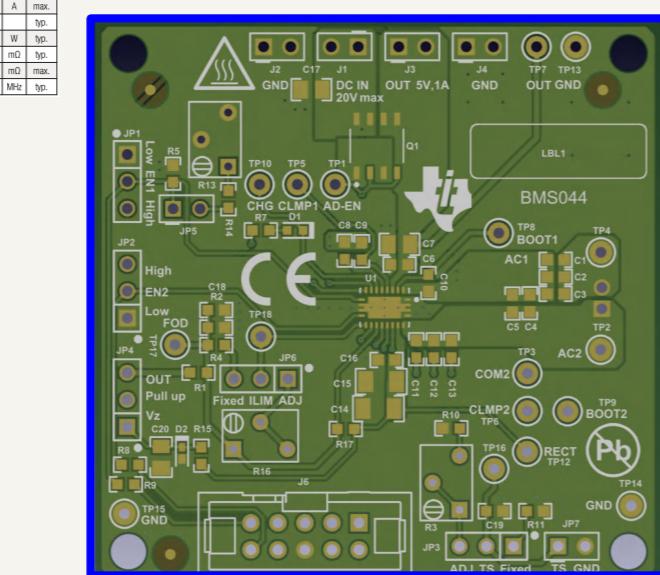
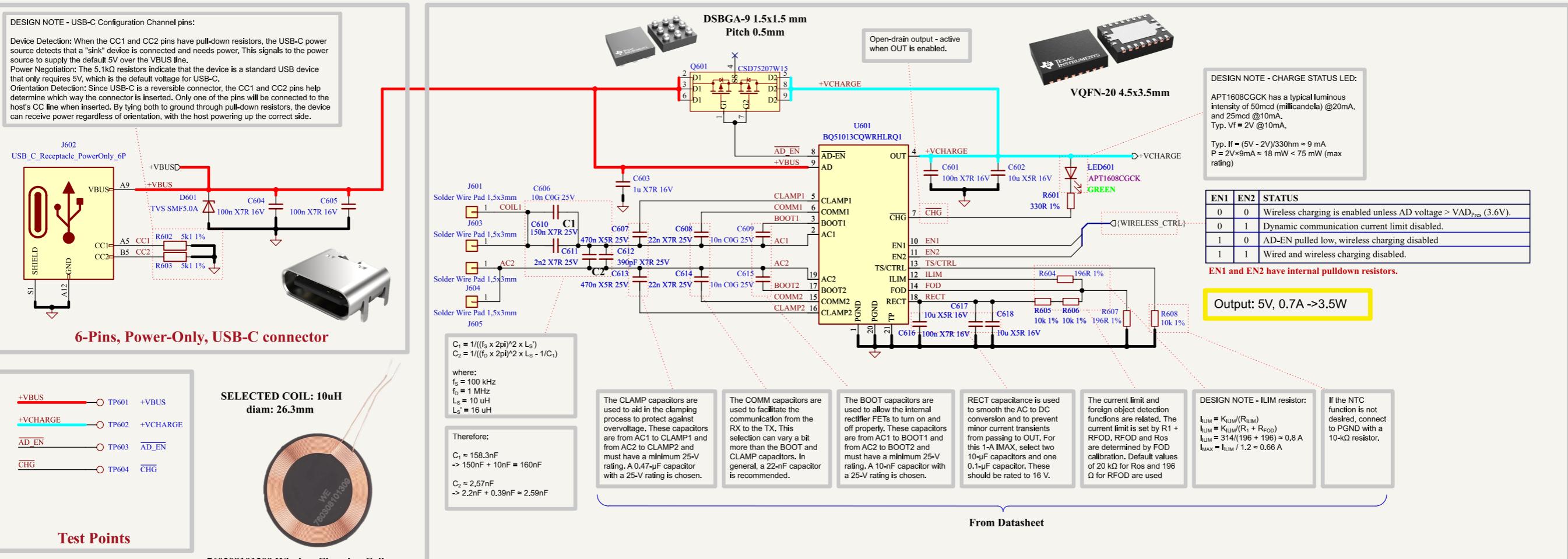
DESIGN NOTE - PROG RESISTOR:
Fast charge current regulation can be scaled by placing a programming resistor (R_Prog) from the PROG input to VSS. The program resistor and the charge current are calculated using the following equation:

$$I_{REG} = 1000V / R_{PROG}$$

$$I_{REG} = 1000V / 2200 = 455mA$$

Comments:	Laboratory: Integrated Actuators Laboratory	Variant: Released
Board Name: Plume	Project Name: Smart Footwear for Diabetic Foot Care	
Sheet Title: Power - Battery Management	File Name: Power_Battery_Management.kicad_sch	Designer: Théo Heng
Sheet Path: /Project Architecture/Power - Battery Management/	Supervisor: Maël Dagon, Paolo Germano	Date: 2025-04-24
	Size: A4	Revision: 1.0
	Sheet: 5	of 31

[6] Power - Wireless Receiver & USB



Suggested layout from BQ51013CQWRHLRQ1 evaluation board.

Comments: EVM User's Guide: BQ51013C-Q1EVM BQ51013C-Q1 Evaluation Module	Laboratory: Integrated Actuators Laboratory 	Variant: Released
Board Name: Plume 	Project Name: Smart Footwear for Diabetic Foot Care	
Sheet Title: Power - Wireless Receiver & USB	File Name: Power_Wireless_Receiver_USB.kicad	Date: 2025-04-24
Sheet Path: /Project Architecture/Power - Wireless Receiver & USB/	Designer: sdhéo Heng	Revision: 1.0
Supervisor: Maël Dagon, Paolo Germano	Size: A3	Sheet: 6 of 31

[7] Power - Path & Generation

Design Note - Simple Power-Path with PMOS and Schottky diode:

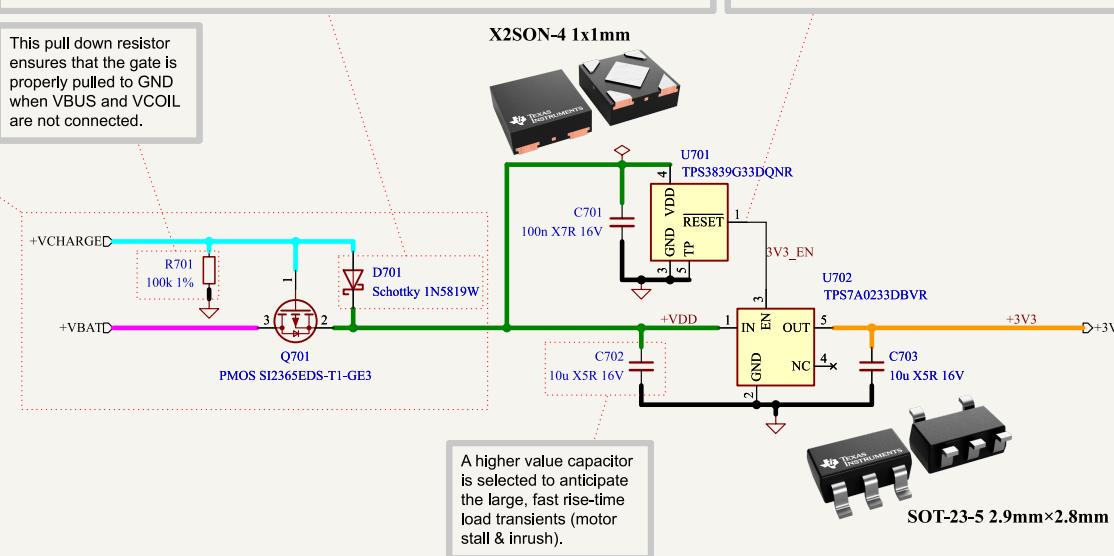
When no USB-C supply nor coil power is present, this simple circuit will by default conduct the battery to the LDO, through the PMOS.

But if USB-C supply or coil power is active, the PMOS will turn off, and the LDO will use the power from the external power supply through the schottky diode.

Design Note - Power Path Schottky diode:

A diode is required to prevent reverse current from flowing to the power source. Selecting the right diode can minimize the leakage current and the forward voltage drop from the power source to the system load. A schottky diode, which has lower forward voltage drop, is recommended. Forward voltage @ If = 200mA: 420mV Reverse current @ Vr = 5V: 70nA

This pull down resistor ensures that the gate is properly pulled to GND when VBUS and VCOIL are not connected.



Active-low reset output, RESET has a push-pull output drive and is capable of directly driving input pins. RESET is low as long as VDD remains below the factory threshold voltage of **3.08V**, and until the delay time ($t_d = 200\text{ms}$) elapses after VDD rises above the threshold voltage.

Current analysis:

Normal:
TPS3839: 150nA
TPS7A02: 25nA
PMEG60T20ELR: 65nA

Shutdown:
TPS3839: 150nA
TPS7A02: 3nA
PMEG60T20ELR: 60nA

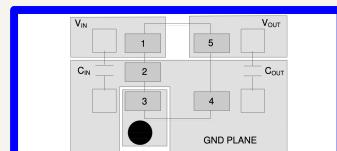


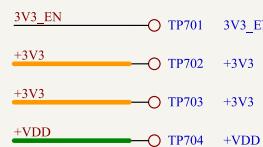
Figure 8-7. Layout Example for the DBV Package

3.3V current draw estimation:

STM32 absolute max: <= 130mA
Pull-ups: 33uA/Pull-up -> max 1mA
I2C MUX: <1mA
I2C Pull-ups: 2.2mA x 2 ~5mA
Fault LEDs: 2mA/LED -> max 36mA
RGB LED: (1mA + 3x5mA)x1.25 = 20mA
IMU: max 1mA

Total Max: 194mA < 200mA

Nanopower IQ, 25-nA, 200-mA, Low-Dropout Voltage Regulator With Fast Transient Response paired with 150-nA, Ultralow Power, Supply Voltage Monitor



Test Points

Comments:	Laboratory: Integrated Actuators Laboratory	Variant: Released
	Board Name: Plume	Project Name: Smart Footwear for Diabetic Foot Care
Sheet Title: Power - Path & Generation	File Name: Power_Path_Generation.kicad_sch	Designer: Théo Heng
Sheet Path: /Project Architecture/Power - Path & Generation/	Supervisor: Maël Dagon, Paolo Germano	Date: 2025-04-24
		Revision: 1.0
	Size: A4	Sheet: 7 of 31

[8] Logic - I2C Mux

A DESIGN NOTE - I2C pull-up resistors:

$R_{MIN} = (VDD_{MAX} - VOL_{MAX}) / IOL$
 System I/O voltage: VDD = 3.3V +- 5% => 3.47V
 Low level output voltage (I2C specs): VOL_{MAX} = 0.4V
 Low level output current (I2C specs): IOL = 3mA
 $R_{MIN} = (3.47V - 0.4V) / 3mA \approx 1k\Omega$

$R_{MAX} \approx (1.18 \times t_{RMAX}) / C_{bMAX}$
 Standard mode (I2C specs): $t_{RMAX} = 1000\text{ns}$
 Fast mode (I2C specs): $t_{RMAX} = 300\text{ns}$

The maximum bus capacitance for an I2C bus must not exceed 400 pF for fast-mode operation. The bus capacitance can be approximated by adding the capacitance of the STM32, C_{STM} , the TCA9546A, C_{TCA} , the capacitance of wires/connections/traces, C_{TRACE} , and the capacitance of each individual slave (driver) on a given channel C_{DRV} . If multiple channels will be activated simultaneously, each of the slaves on all channels will contribute to total bus capacitance.

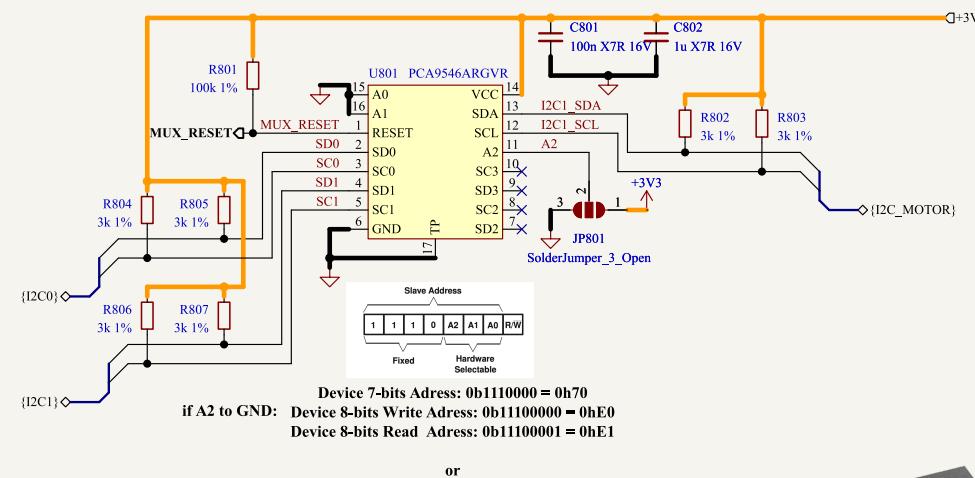
C_{STM} worst case = (not specified in the datasheet, we assume 10pF x 2 = 20pF)
 C_{TCA_IN} worst case = 19pF x 2 = 38pF on the SCL, SDA lines
 C_{TCA_OUT} worst case = 8pF x 2 = 16pF on the SC3-SC0, SD3-SD0 lines
 C_{DRV} worst case = (not specified in the datasheet, we assume 8pF x 2 = 16pF)
 C_{TRACE} = nb of traces x (length of a trace / 25mm) X 2.5pF
 C_{TRACE} = 2 x (75mm / 25mm) X 2.5pF = 15pF

For one active channel:
 $C_{bMAX} = C_{STM} + C_{TCA_IN} + C_{TCA_OUT} + 9 \times C_{DRV} + C_{TRACE}$
 $C_{bMAX} = 20pF + 38pF + 16pF + 9 \times 16pF + 15pF \approx 233pF$
 $\rightarrow R_{MAX} = (1.18 \times 300\text{ns}) / 113pF \approx 1519\Omega$

To be safe, a value of 1k50 is chosen. Since both the master I2C lines and fanned channels need pull ups, there will be 2 resistors in parallel, when a channel is activated. Therefore, 3kΩ resistors are chosen, in order to get 1k50.

For two active channel:
 $C_{bMAX} = C_{STM} + C_{TCA_IN} + 2x C_{TCA_OUT} + 18 \times C_{DRV} + 1.66 \times C_{TRACE}$
 $C_{bMAX} = 20pF + 38pF + 32pF + 18 \times 16pF + 25pF \approx 403pF > 400$

Therefore, only one channel can be enabled at a time, meaning that 9 drivers only can be driven simultaneously.
 Smaller resistors decrease rise time but increase power consumption. In our case: $I = 3V3 / 1500 \approx 2.2\text{mA}$



Low Voltage 4-Channel I2C and SMBus Switch with Reset Function

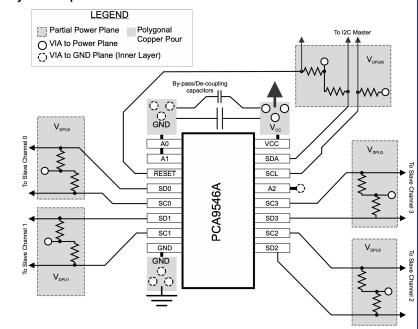
D Current analysis:

Normal:
 PCA9546A = 3uA
 Pull-ups = $(3.3/1500) \times 2 \times 0.5 = 2.2\text{mA}$
 Standby:
 PCA9546A = 1uA
 Pull-ups = 0uA

MUX_RESET — TP801 — MUX_RESET

Test Points

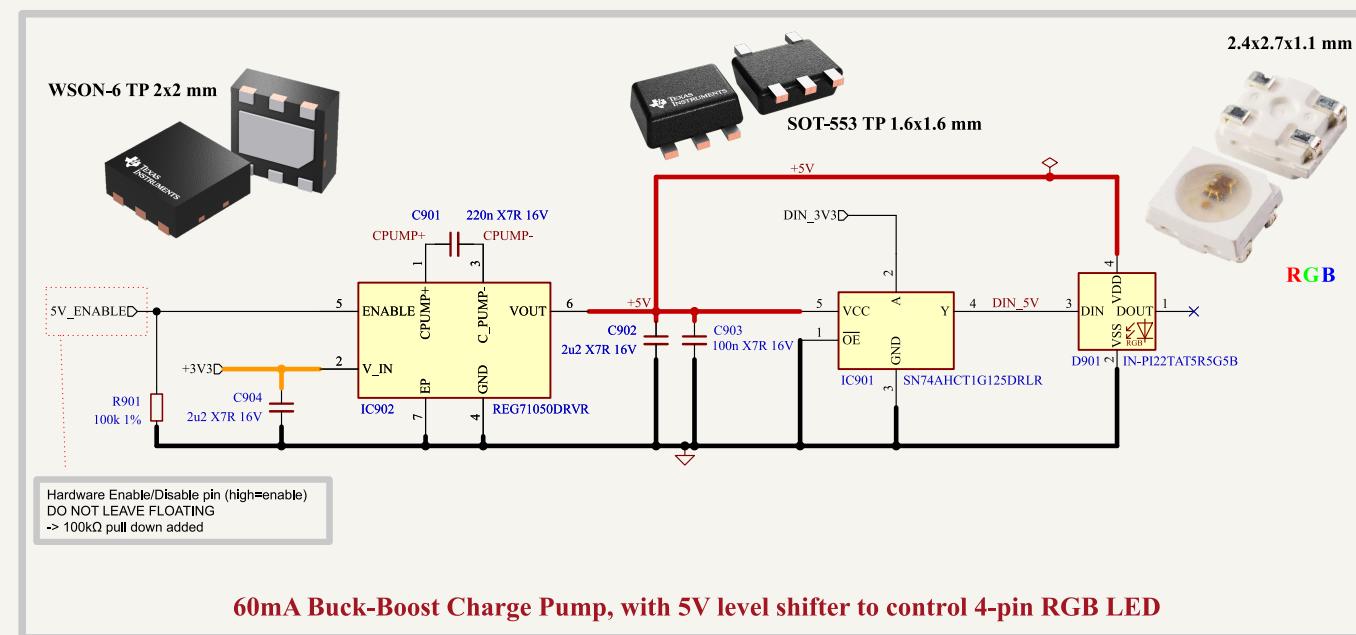
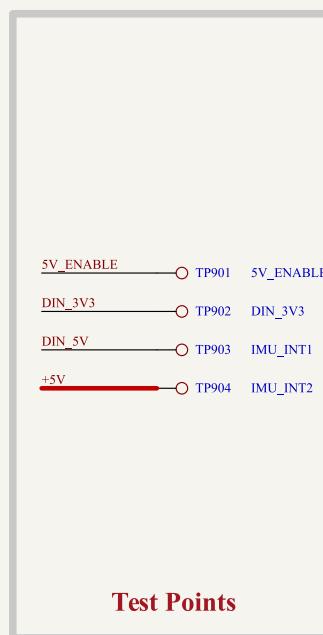
E 11.2 Layout Example



F Comments:

Laboratory: Integrated Actuators Laboratory	Variant: Released
Board Name: Plume	Project Name: Smart Footwear for Diabetic Foot Care
Sheet Title: Logic - I2C Mux	File Name: Logic_I2C_Mux.kicad_sch
Designer: Théo Heng	Date: 2025-04-24
Supervisor: Maël Dagon, Paolo Germano	Revision: 1.0
Size: A4	Sheet: 8 of 31

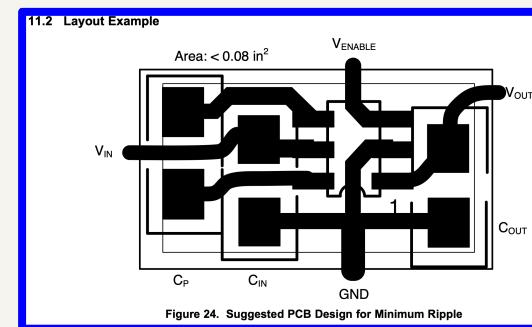
[9] User - RGB LED Indicator



Current analysis:

Normal:
REG71050: 65µA
SN74AHCT1G125: 10µA
IN-PI22TAT5R5G5B: 1mA

Shutdown:
REG71050: 10nA
SN74AHCT1G125: OFF
IN-PI22TAT5R5G5B: OFF



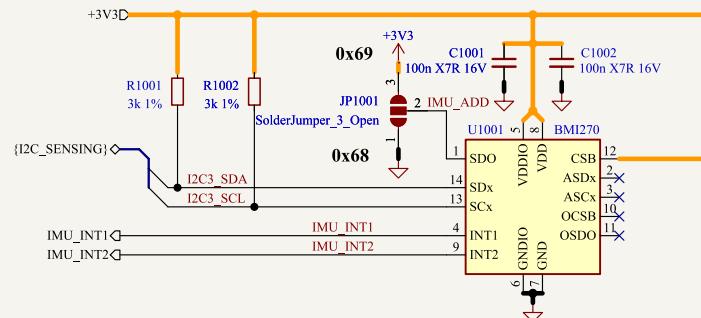
Comments:
This LED was chosen as it is relatively small compared to other well-known alternatives (e.g. WS2812B). The saved space is used to provide proper 5V supply and logic. This LED might work with 3V3 but this approach is safer.

Laboratory:	EPFL	Variant:
	Plume	Released
Board Name:	Project Name:	
User - RGB LED Indicator	Smart Footwear for Diabetic Foot Care	
Sheet Title:	File Name:	Date:
User - RGB LED Indicator	User_RGB_LED_Indicator.kicad_sch	2025-04-24
Sheet Path:	Designer:	Revision:
/Project Architecture/User - RGB LED Indicator/	Théo Heng	1.0
Supervisor:	Size:	Sheet:
Maël Dagon, Paolo Germano	A4	9 of 31

[10] Sensing - IMU

IMU_INT1 → TP1001 IMU_INT1
IMU_INT2 → TP1002 IMU_INT2

Test Points



6-axis, smart, low power Inertial Measurement Unit for high-performance applications



LGA-14 2.5x3x0.83 mm

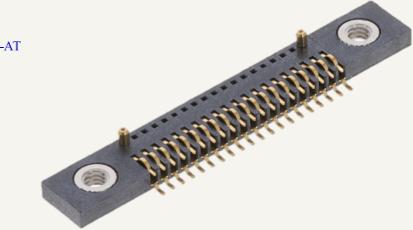
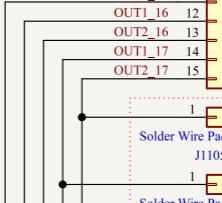
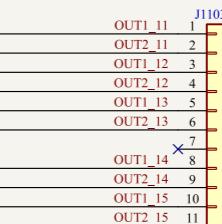
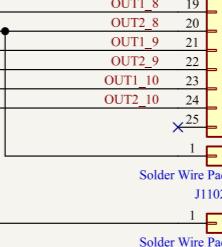
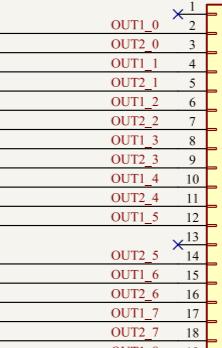
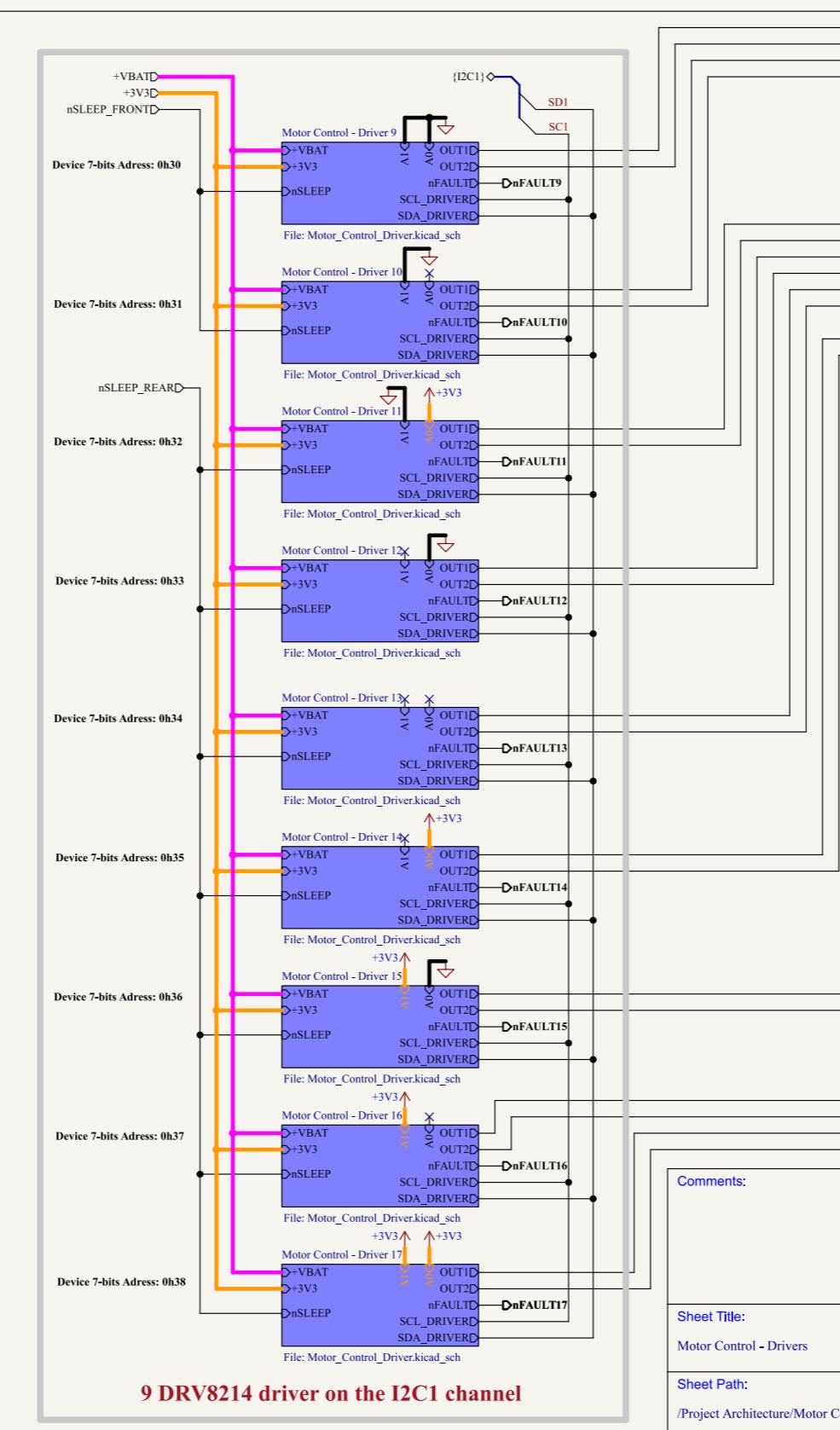
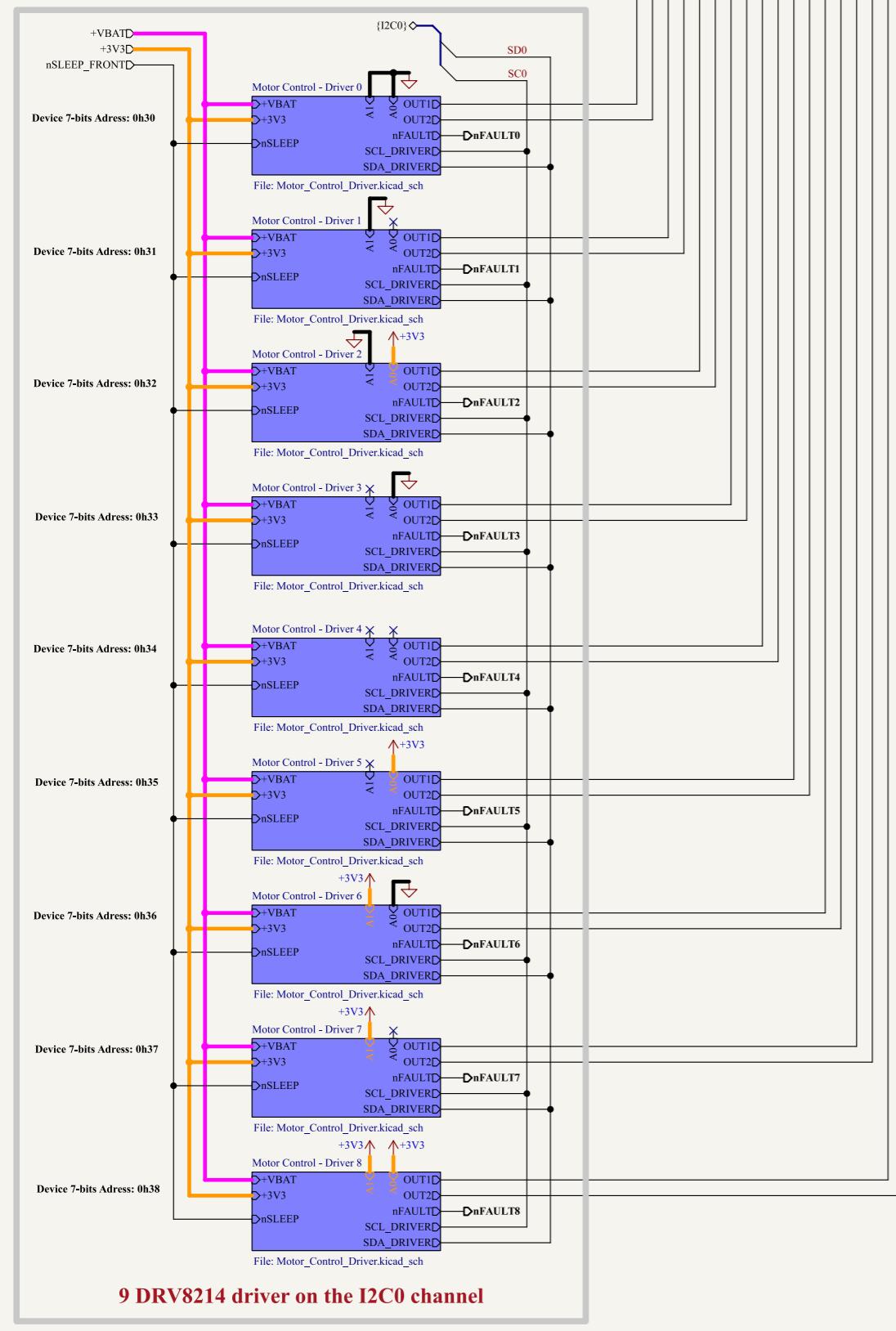
Current analysis BMI270:
Normal: A+G Performance mode: 970uA
Wake-up mode: 5uA
Sleep: 3uA

DESIGN NOTE - I²C address:

The default I²C address of the device is 0b1101000 (0x68). It is used if the SDO pin is pulled to 'GND'. The alternative address 0b1101001 (0x69) is selected by pulling the SDO pin to 'VDDIO'.

Comments:	Laboratory:		Variant:
	EPFL Plume		Released
Board Name:	Project Name:		
Plume	Smart Footwear for Diabetic Foot Care		
Sheet Title:	File Name:	Designer:	Date: Revision:
Sensing - IMU	Sensing_IMU.kicad_sch	Théo Heng	2025-04-24 1.0
Sheet Path:	Supervisor:	Size:	Sheet:
/Project Architecture/Sensing - IMU/	Maël Dagon, Paolo Germano	A4	10 of 31

[11] Motor Control - Drivers x18



30 positions with screw: 44.48mm wide
25 positions with screw: 39.48mm wide
15 positions with screw: 29.48mm wide

DEBUG NOTE:
The specific Samtec connectors used on this PCB are not usually in stock on Mouser/Digikey so they are directly ordered from Samtech's website.

LAYOUT NOTE:
Use the "Replicate Layout" KiCad Plugin to layout copy-paste the layout of each driver unit.

DESIGN NOTE:
This first iteration implements 18 drivers module, with 11 of them used at the front of the foot, and 7 at the rear.

Each module is similar, with the DRV8214RTER IC, decoupling and bulk capacitors, test points, fault LED, and current sense resistor.

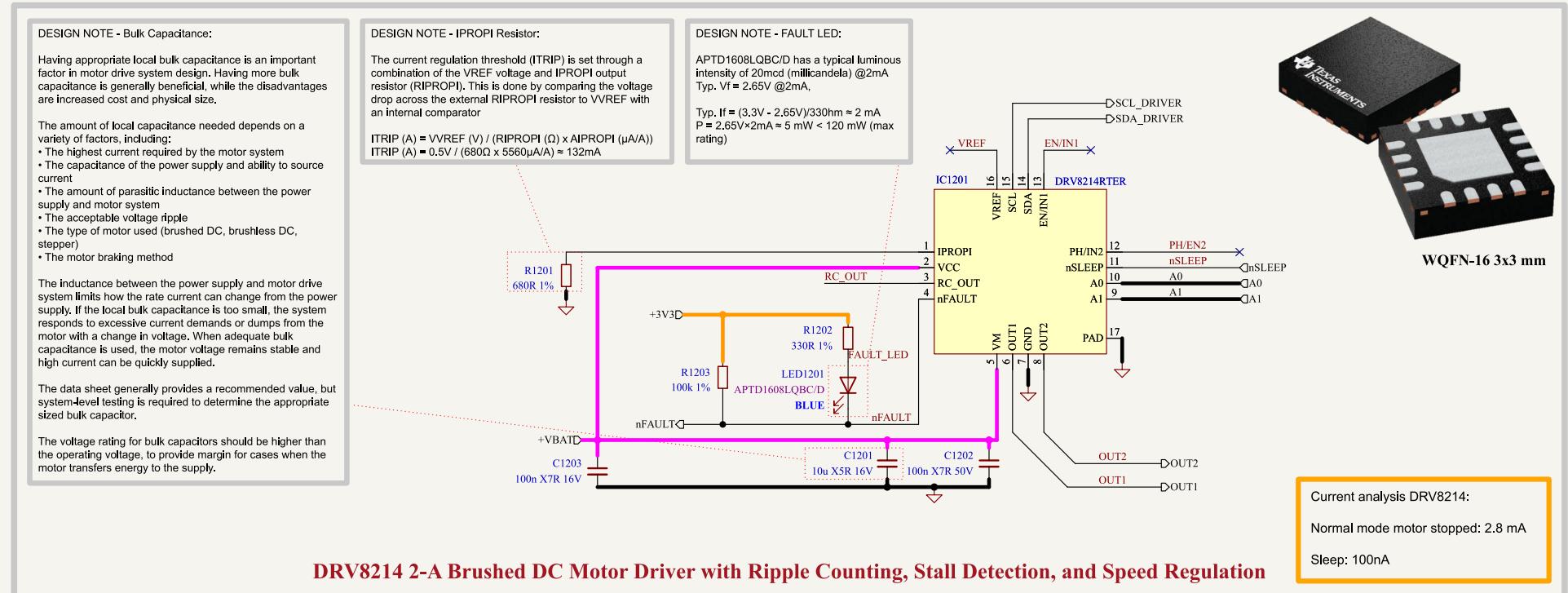
For the layout, every module are routed in the exact same way.

nSLEEP_FRONT	TP1101	nSLEEP_FRONT
nSLEEP_REAR	TP1102	nSLEEP_REAR
SD0	TP1103	SD0
SC0	TP1104	SC0
SD1	TP1105	SD1
SC1	TP1106	SC1

Test Points

Comments:	Laboratory: Integrated Actuators Laboratory	Variant: Released
Board Name: Plume	Project Name: Smart Footwear for Diabetic Foot Care	EPFL
Sheet Title: Motor Control - Drivers	File Name: Motor_Control_Drivers.kicad_sch	Designer: Théo Heng
Sheet Path: /Project Architecture/Motor Control - Drivers/	Supervisor: Maël Dagon, Paolo Germano	Date: 2025-04-24
		Revision: 1.0

[12] Motor Control - Driver 12

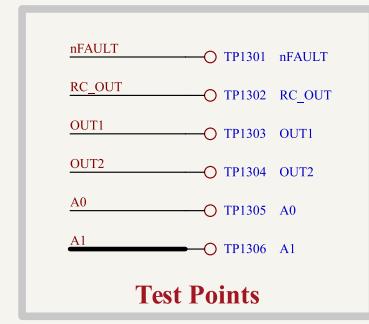
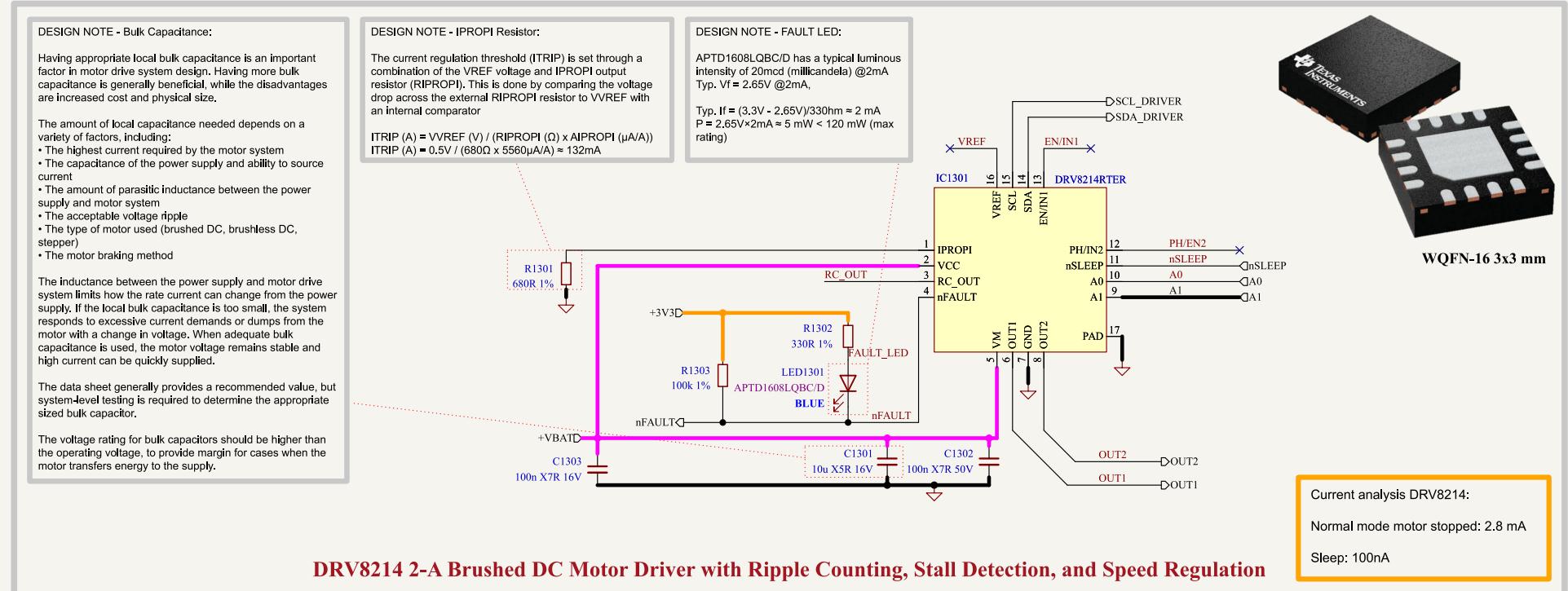


nFAULT	TP1201	nFAULT
RC_OUT	TP1202	RC_OUT
OUT1	TP1203	OUT1
OUT2	TP1204	OUT2
A0	TP1205	A0
A1	TP1206	A1

Test Points

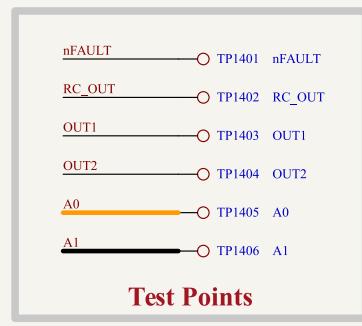
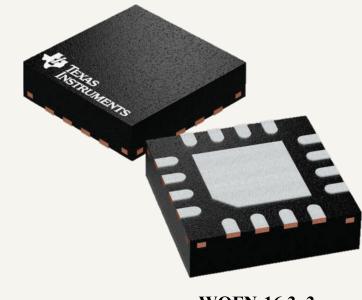
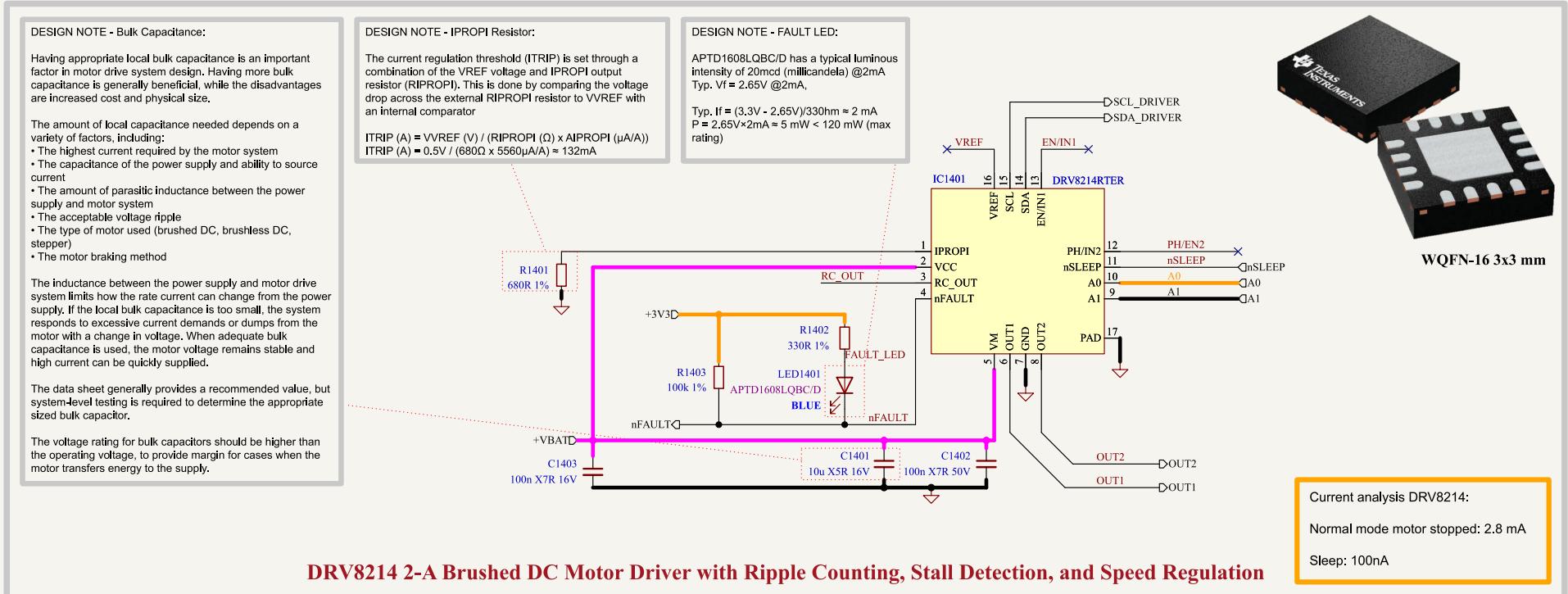
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Board Name:	Project Name:	
Plume	Smart Footwear for Diabetic Foot Care	
Sheet Title:	File Name:	Date:
Motor Control - Driver	Motor_Control_Driver.kicad_sch	Théo Heng 2025-04-24
Sheet Path:	Designer:	Revision:
/Project Architecture/Motor Control - Drivers/Motor Control - Driver 0/	Maël Dagon, Paolo Germano	1.0
Supervisor:	Size:	Sheet:
	A4	12 of 31

[13] Motor Control - Driver 13



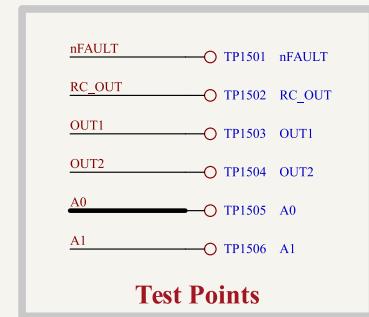
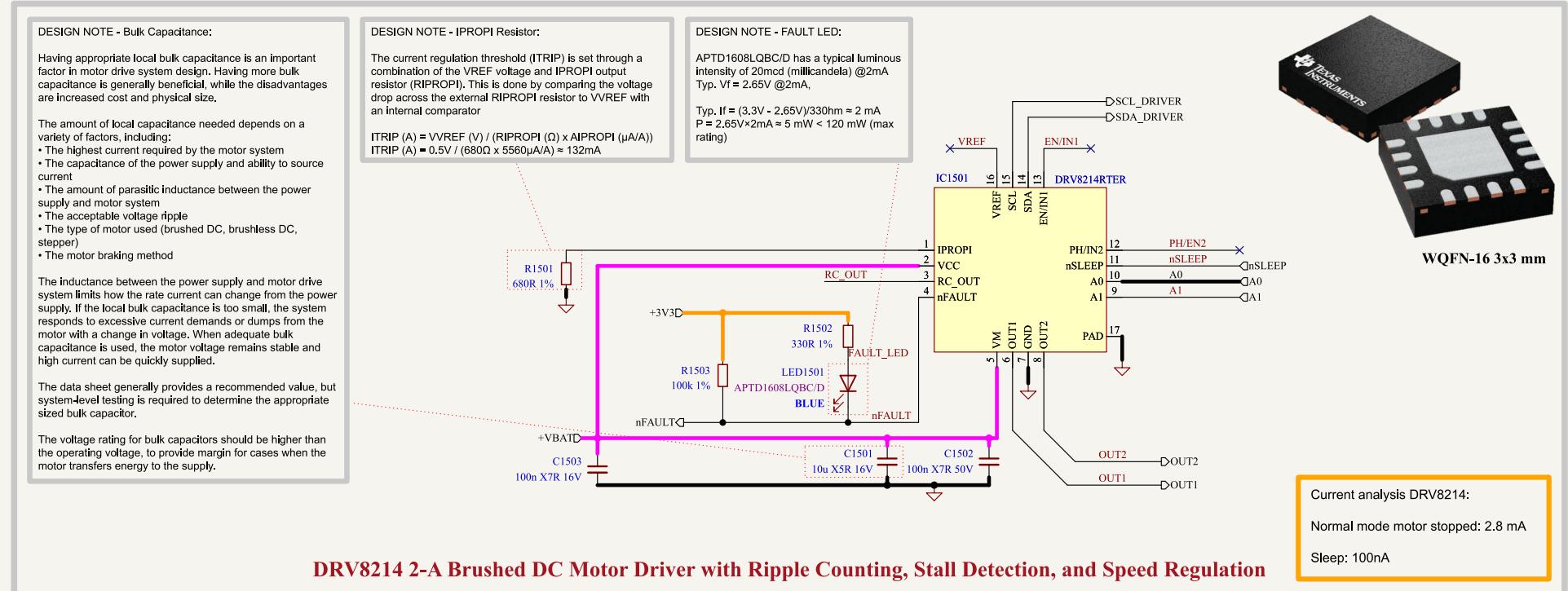
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Plume	Smart Footwear for Diabetic Foot Care	
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/Project Architecture/Motor Control - Drivers/Motor Control - Driver 1/	Maël Dagon, Paolo Germano	1.0
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	A4	13 of 31

[14] Motor Control - Driver 14



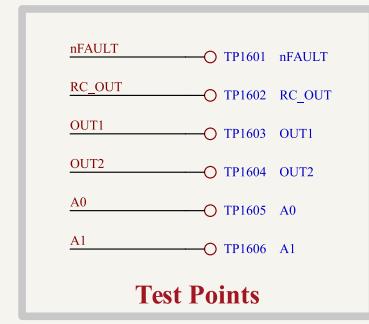
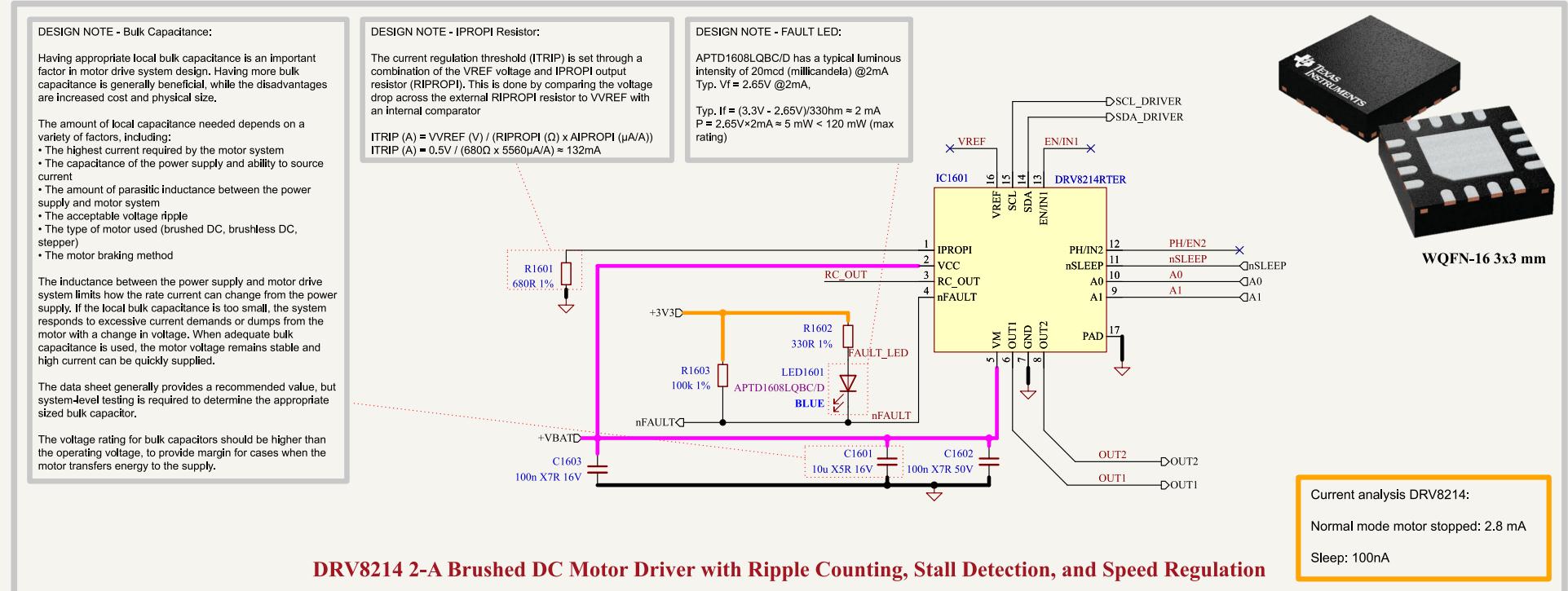
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Plume	Smart Footwear for Diabetic Foot Care	
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/Project Architecture/Motor Control - Drivers/Motor Control - Driver 2/	Maël Dagon, Paolo Germano	1.0
	Supervisor:	Size:
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[15] Motor Control - Driver 15



Comments:	Laboratory:	Variant:
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Board Name:	Project Name:	
Plume	Smart Footwear for Diabetic Foot Care	
Sheet Title:	File Name:	Date:
Motor Control - Driver	Motor_Control_Driver.kicad_sch	Théo Heng 2025-04-24
Sheet Path:	Designer:	Revision:
/Project Architecture/Motor Control - Drivers/Motor Control - Driver 3/	Maël Dagon, Paolo Germano	1.0
	Supervisor:	Size:
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		Sheet:
		15 of 31

[16] Motor Control - Driver 16



Comments:	Laboratory:	Variant:
	EPFL Plume	Released
Board Name:	Project Name:	
Plume	Smart Footwear for Diabetic Foot Care	
Sheet Title:	File Name:	Date:
Motor Control - Driver	Motor_Control_Driver.kicad_sch	Théo Heng 2025-04-24
Sheet Path:	Designer:	Revision:
/Project Architecture/Motor Control - Drivers/Motor Control - Driver 4/	Maël Dagon, Paolo Germano	1.0
	Supervisor:	Size:
		A4
		Sheet:
		16 of 31

[17] Motor Control - Driver 17

A DESIGN NOTE - Bulk Capacitance:

Having appropriate local bulk capacitance is an important factor in motor drive system design. Having more bulk capacitance is generally beneficial, while the disadvantages are increased cost and physical size.

The amount of local capacitance needed depends on a variety of factors, including:

- The highest current required by the motor system
- The capacitance of the power supply and ability to source current
- The amount of parasitic inductance between the power supply and motor system
- The acceptable voltage ripple
- The type of motor used (brushed DC, brushless DC, stepper)
- The motor braking method

The inductance between the power supply and motor drive system limits how the rate current can change from the power supply. If the local bulk capacitance is too small, the system responds to excessive current demands or dumps from the motor with a change in voltage. When adequate bulk capacitance is used, the motor voltage remains stable and high current can be quickly supplied.

The data sheet generally provides a recommended value, but system-level testing is required to determine the appropriate sized bulk capacitor.

The voltage rating for bulk capacitors should be higher than the operating voltage, to provide margin for cases when the motor transfers energy to the supply.

B DESIGN NOTE - IPROPI Resistor:

The current regulation threshold (I_{TRIP}) is set through a combination of the V_{REF} voltage and I_{PROPI} output resistor (R_{PROPI}). This is done by comparing the voltage drop across the external R_{PROPI} resistor to V_{REF} with an internal comparator

$$I_{TRIP} (A) = V_{REF} (V) / (R_{PROPI} (\Omega) \times A_{PROPI} (\mu A/A))$$

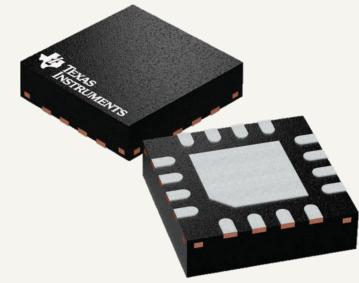
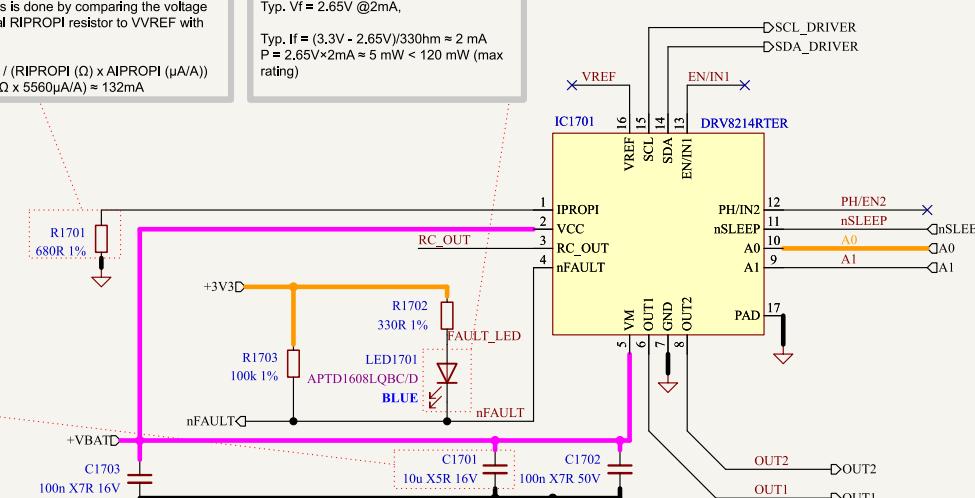
$$I_{TRIP} (A) = 0.5V / (680\Omega \times 5560\mu A/A) \approx 132mA$$

C DESIGN NOTE - FAULT LED:

APTD1608LQBC/D has a typical luminous intensity of 20mcd (millilumen) @2mA
Typ. V_f = 2.65V @2mA,

$$Typ. I_f = (3.3V - 2.65V)/330hm \approx 2 mA$$

$$P = 2.65V \times 2mA \approx 5 mW < 120 mW (max rating)$$


WQFN-16 3x3 mm
Current analysis DRV8214:

Normal mode motor stopped: 2.8 mA
Sleep: 100nA

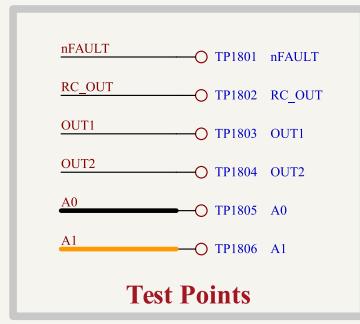
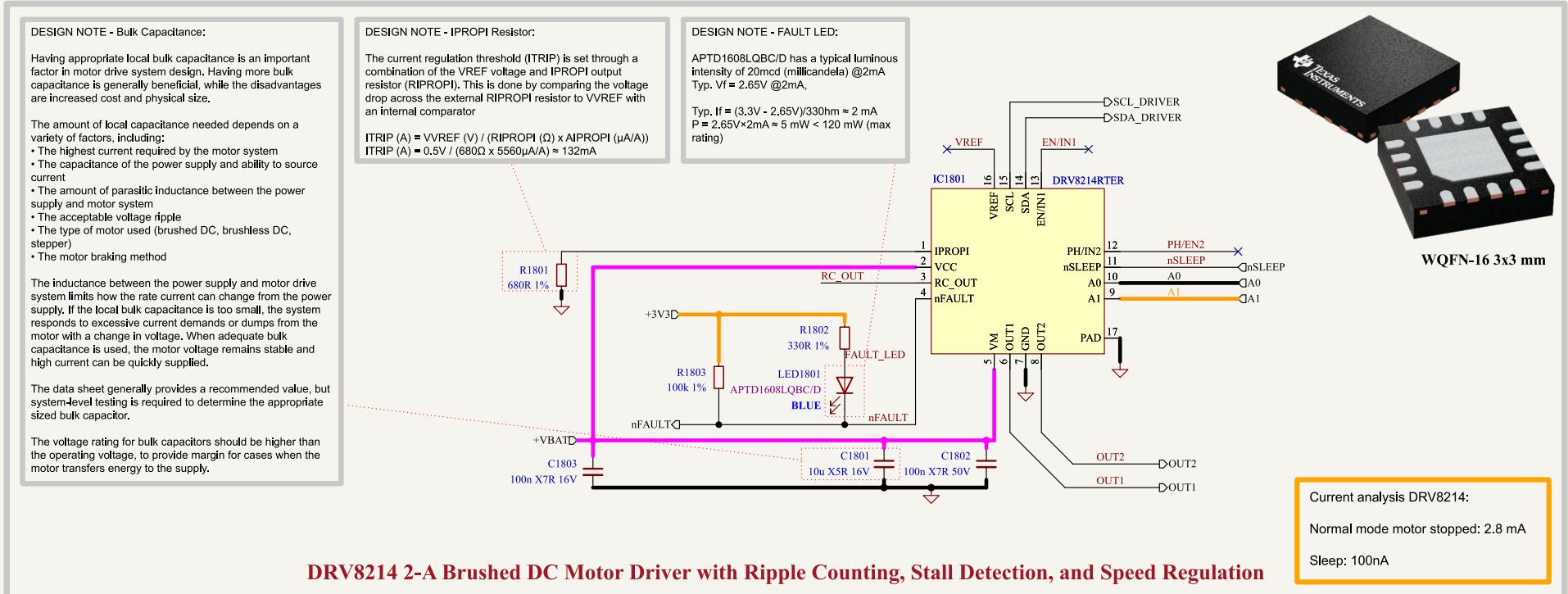
DRV8214 2-A Brushed DC Motor Driver with Ripple Counting, Stall Detection, and Speed Regulation

nFAULT	TP1701	nFAULT
RC_OUT	TP1702	RC_OUT
OUT1	TP1703	OUT1
OUT2	TP1704	OUT2
A0	TP1705	A0
A1	TP1706	A1

Test Points

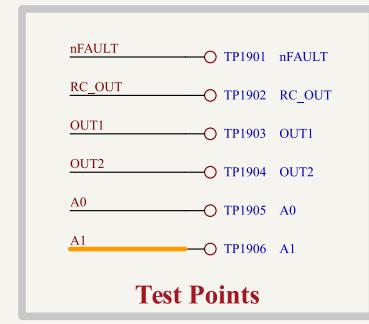
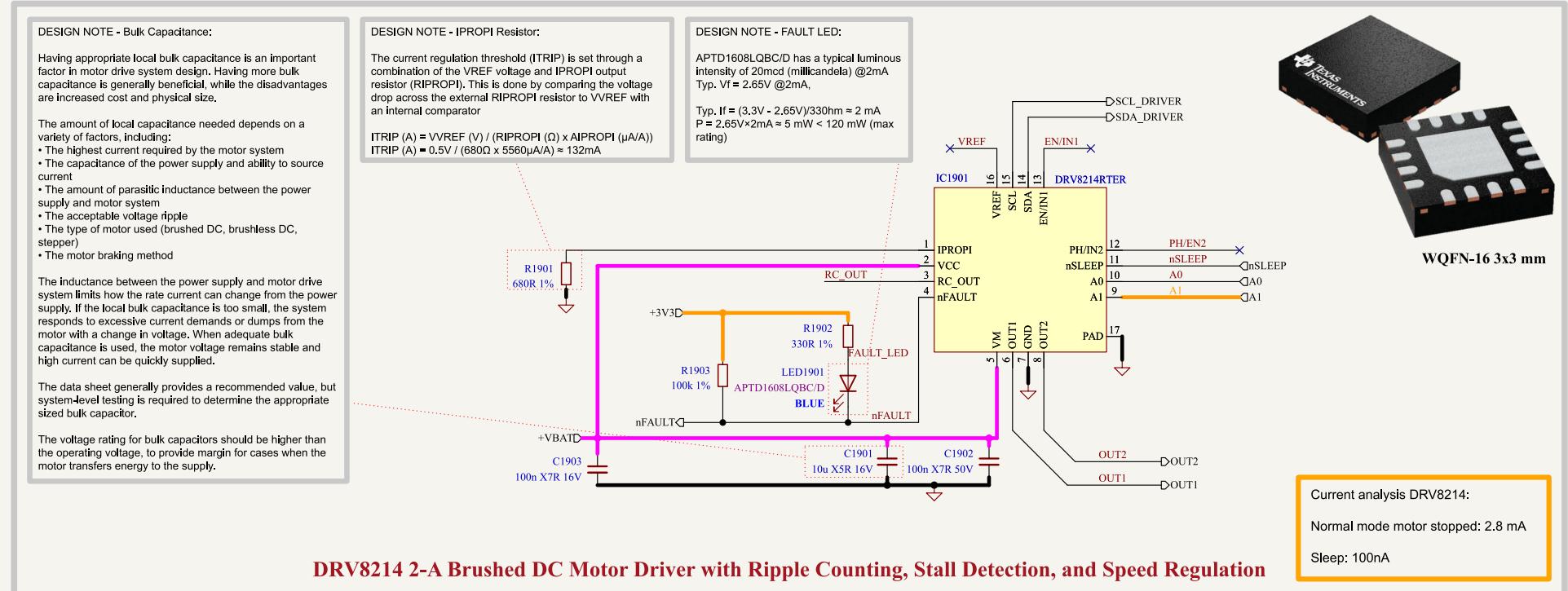
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Sheet Path: /Project Architecture/Motor Control - Drivers/Motor Control - Driver 5/	Supervisor: Maël Dagon, Paolo Germano	Date: 2025-04-24
	Size: A4	Revision: 1.0

[18] Motor Control - Driver 18



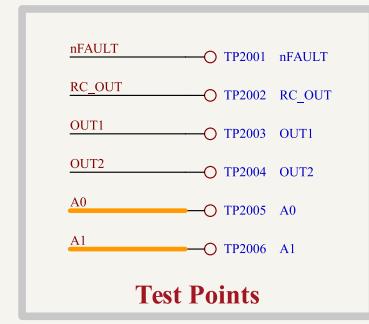
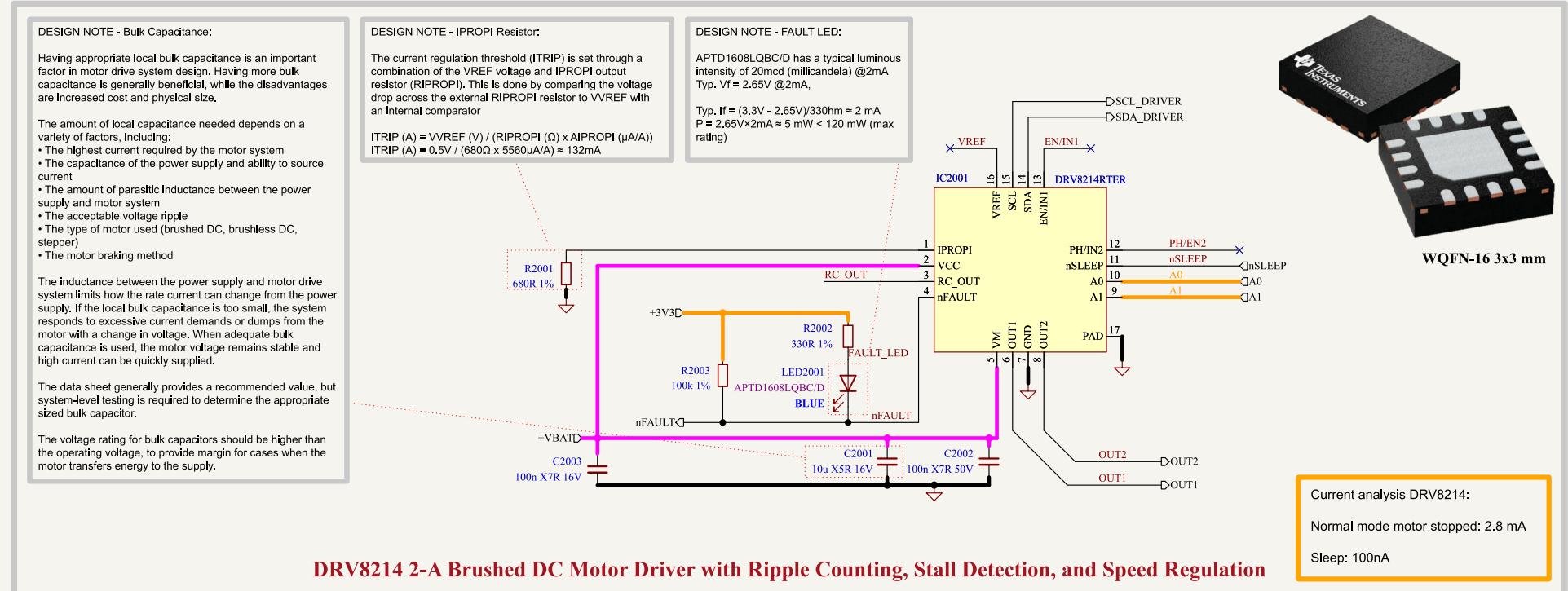
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Plume	Smart Footwear for Diabetic Foot Care	
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/Project Architecture/Motor Control - Drivers/Motor Control - Driver 6/	Maël Dagon, Paolo Germano	1.0
	Supervisor:	Size:
	Maël Dagon, Paolo Germano	A4
	Sheet:	18 of 31

[19] Motor Control - Driver 19



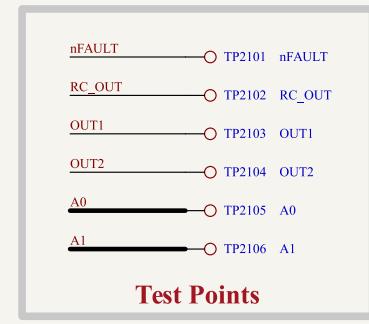
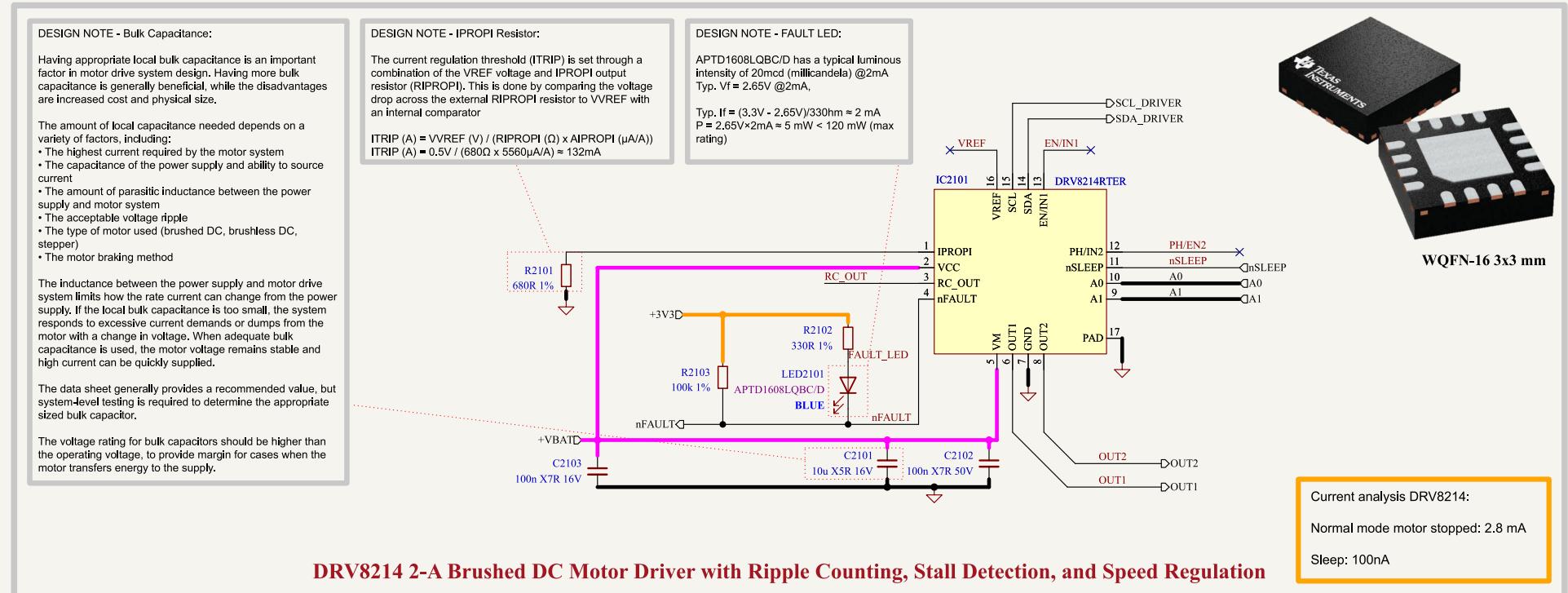
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Plume	Smart Footwear for Diabetic Foot Care	
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Sheet Path:	Designer:	Revision:
/Project Architecture/Motor Control - Drivers/Motor Control - Driver 7/	Maël Dagon, Paolo Germano	1.0
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	Maël Dagon, Paolo Germano	A4
	Sheet:	19 of 31

[20] Motor Control - Driver 20



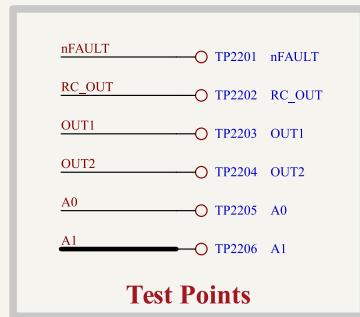
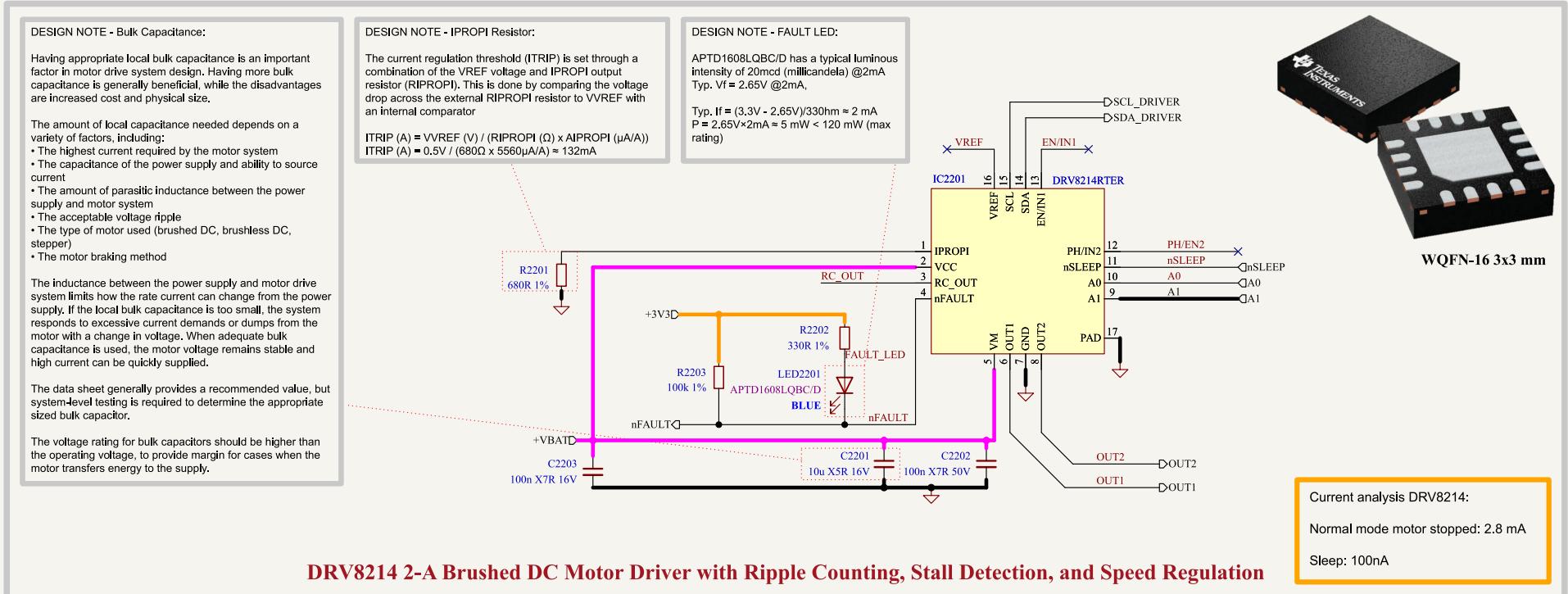
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Plume	Smart Footwear for Diabetic Foot Care	
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Sheet Path:	Designer:	Revision:
/Project Architecture/Motor Control - Drivers/Motor Control - Driver 8/	Maël Dagon, Paolo Germano	1.0
Supervisor:	Size:	Sheet:
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[21] Motor Control - Driver 21



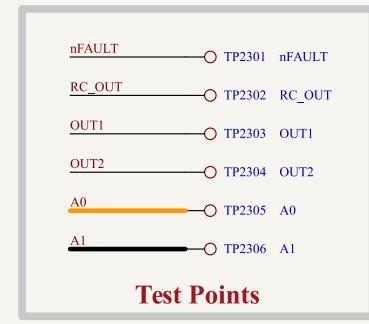
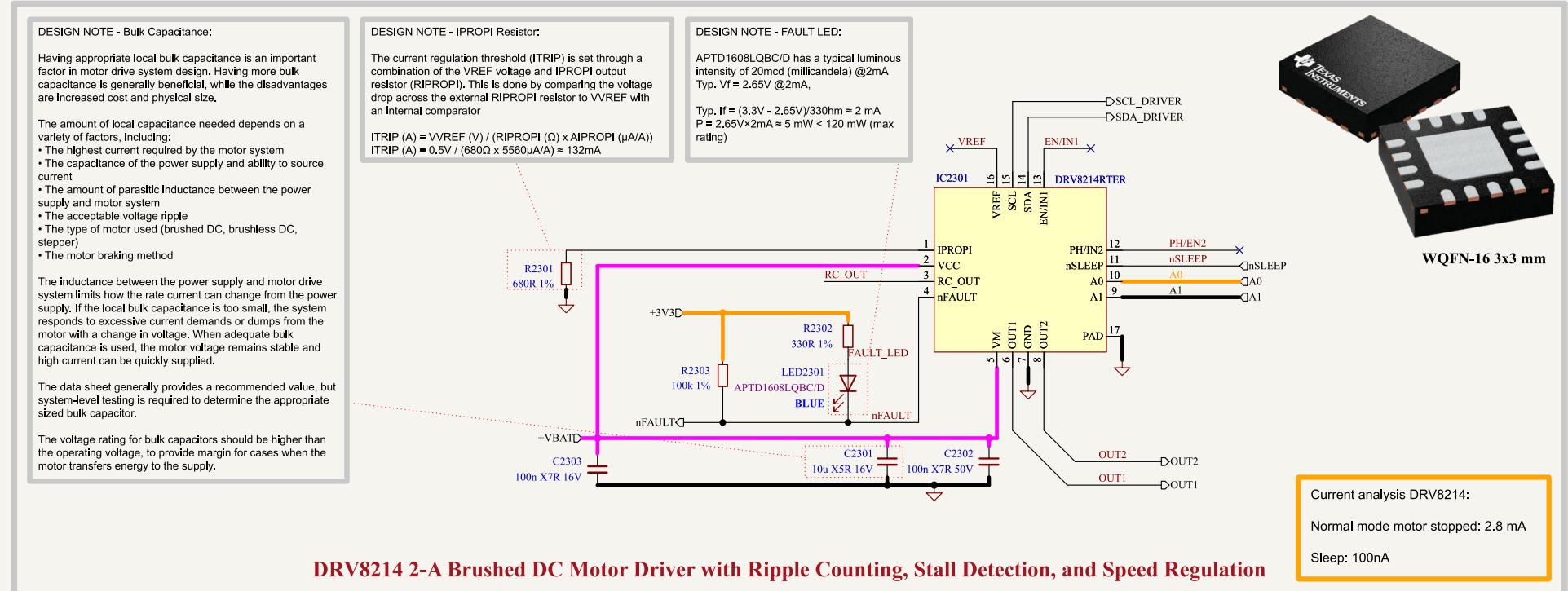
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/Project Architecture/Motor Control - Drivers/Motor Control - Driver 9/	Maël Dagon, Paolo Germano	1.0
Supervisor:	Size:	Sheet:
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[22] Motor Control - Driver 22



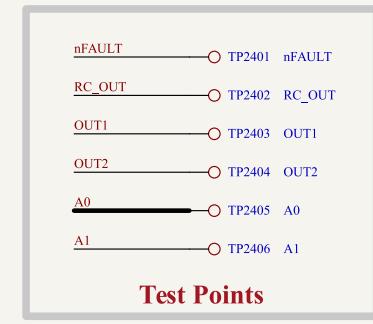
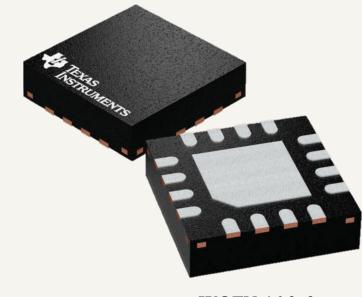
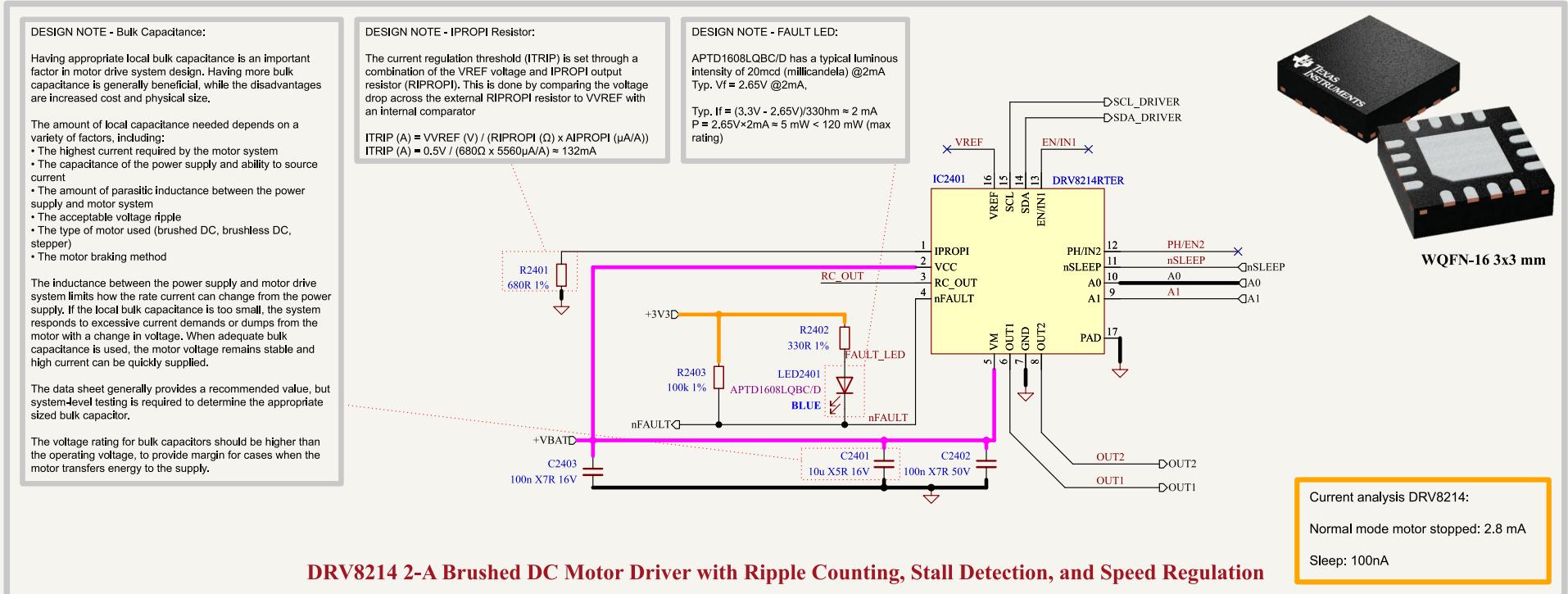
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Board Name:	Project Name:	
Plume	Smart Footwear for Diabetic Foot Care	
Sheet Title:	File Name:	Date:
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Sheet Path:	Designer:	Revision:
/Project Architecture/Motor Control - Drivers/Motor Control - Driver 10/	Maël Dagon, Paolo Germano	1.0
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[23] Motor Control - Driver 23



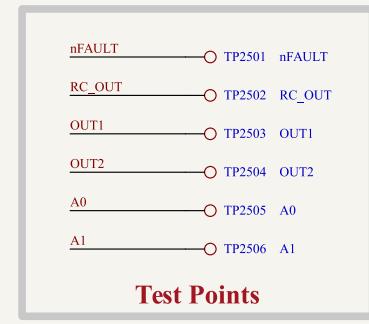
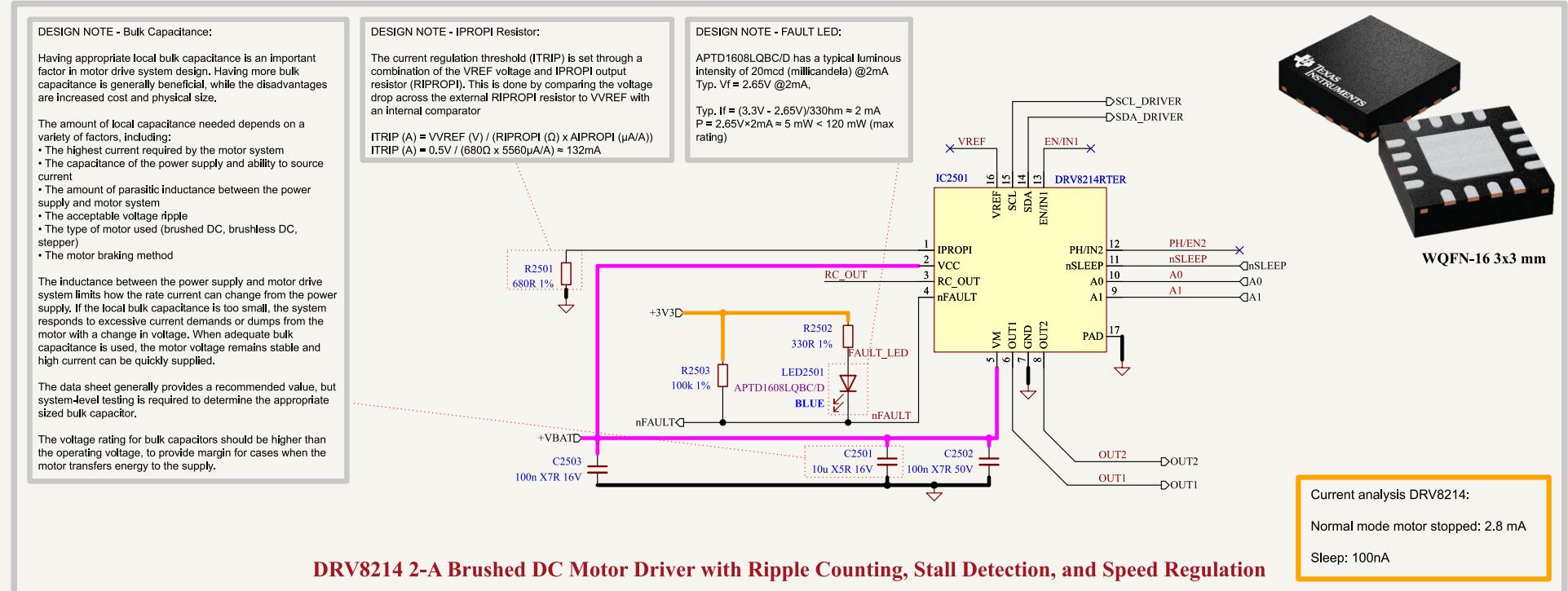
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Board Name:	Project Name:	
Plume	Smart Footwear for Diabetic Foot Care	
Sheet Title:	File Name:	Date:
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Sheet Path:	Designer:	Revision:
/Project Architecture/Motor Control - Drivers/Motor Control - Driver 11/	Maël Dagon, Paolo Germano	1.0
Supervisor:	Size:	Sheet:
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[24] Motor Control - Driver 24



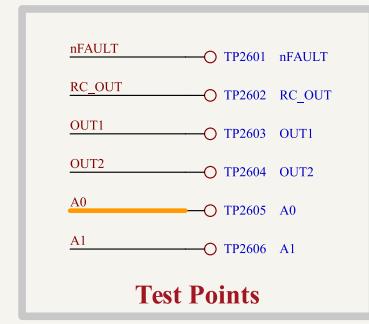
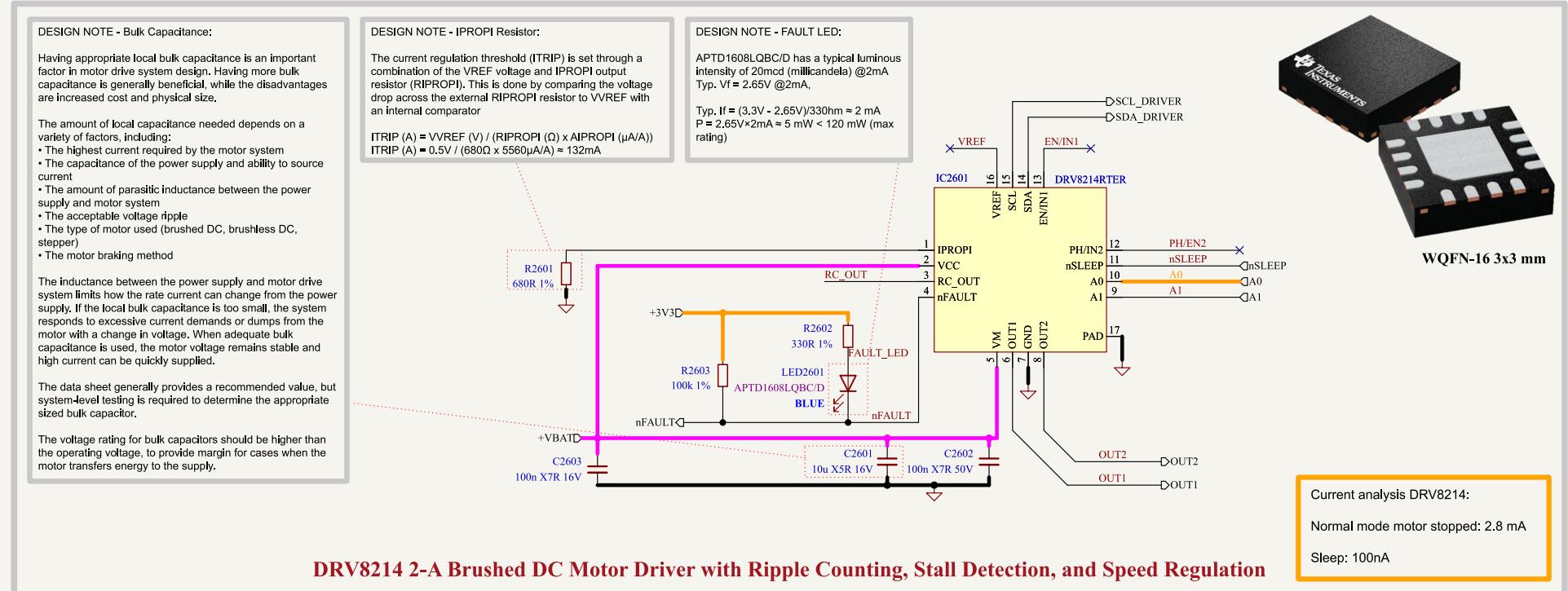
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Plume	Smart Footwear for Diabetic Foot Care	
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Sheet Path:	Designer:	Revision:
/Project Architecture/Motor Control - Drivers/Motor Control - Driver 12/	Maël Dagon, Paolo Germano	1.0
Supervisor:	Size:	Sheet:
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[25] Motor Control - Driver 25



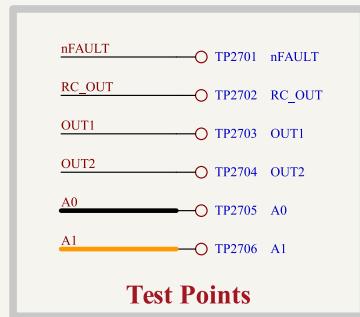
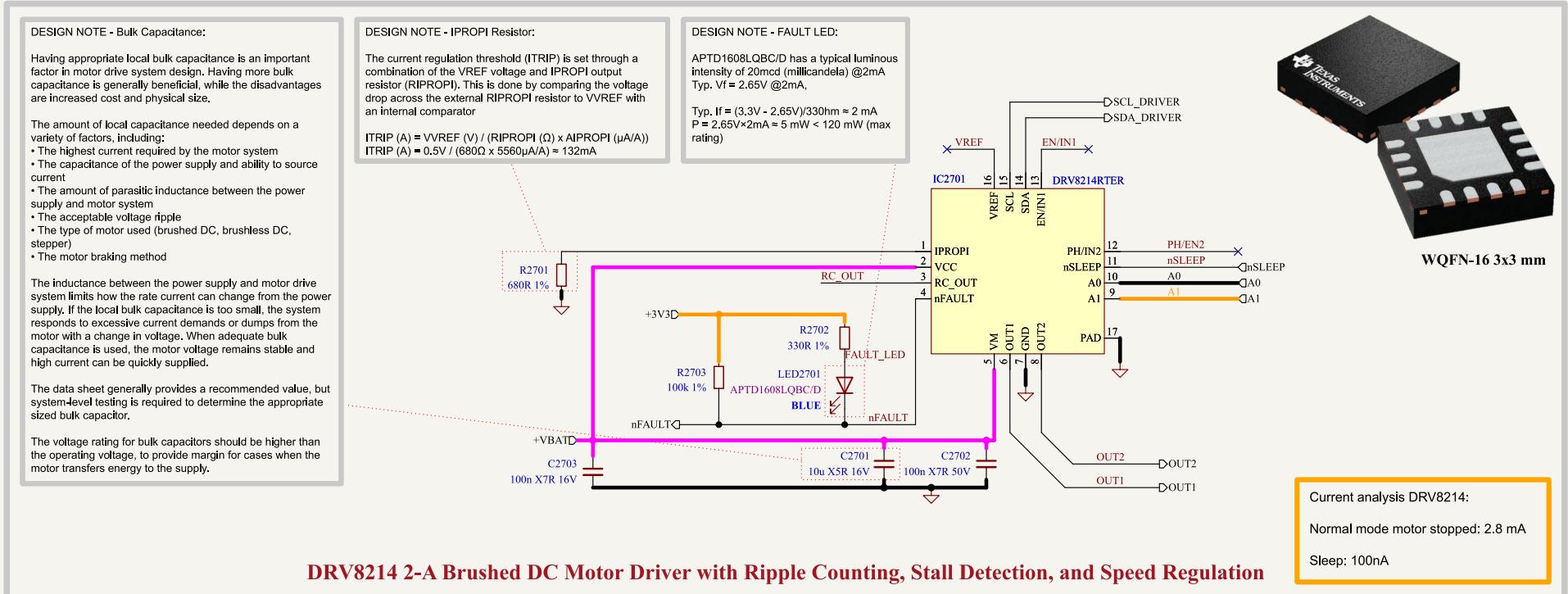
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Plume	Smart Footwear for Diabetic Foot Care	
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Sheet Path:	Designer:	Revision:
/Project Architecture/Motor Control - Drivers/Motor Control - Driver 13/	Maël Dagon, Paolo Germano	1.0
Supervisor:	Size:	Sheet:
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[26] Motor Control - Driver 26



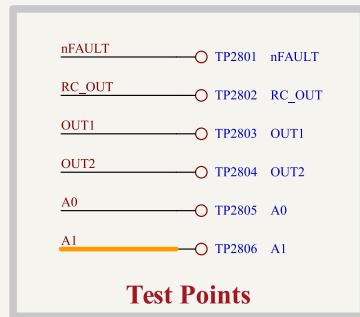
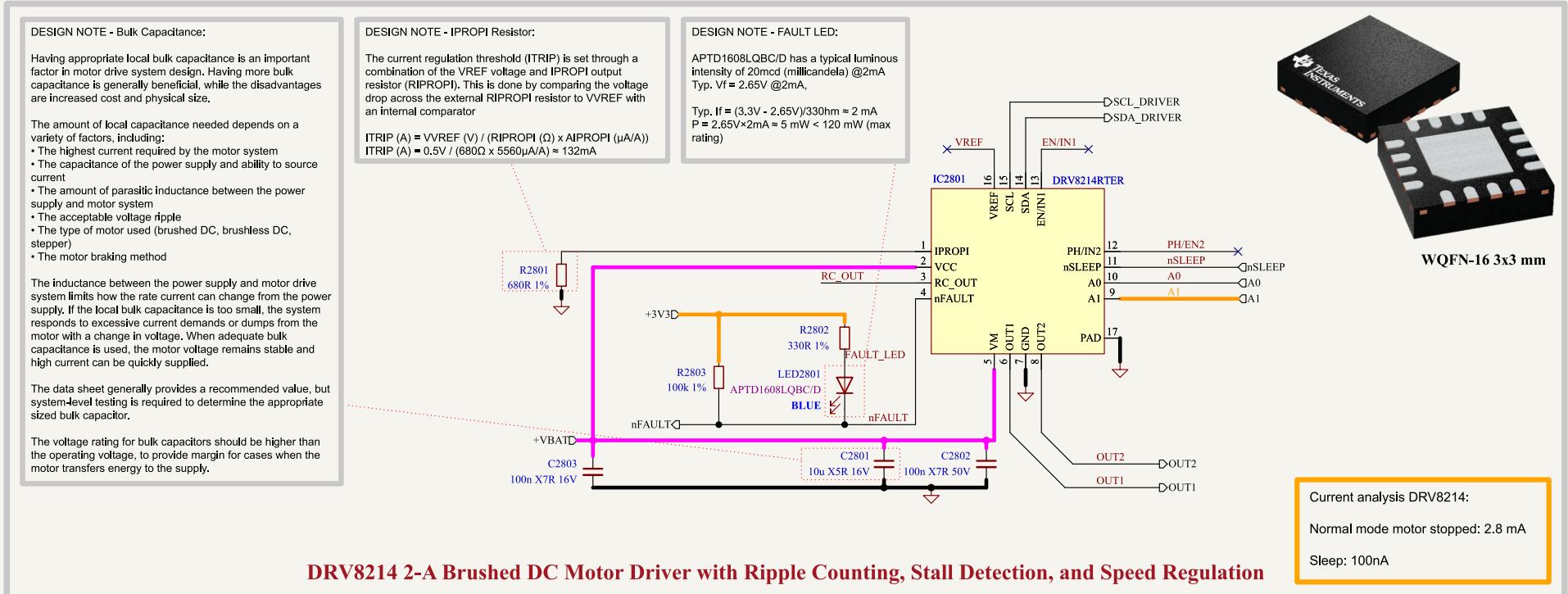
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Plume	Smart Footwear for Diabetic Foot Care	
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/Project Architecture/Motor Control - Drivers/Motor Control - Driver 14/	Maël Dagon, Paolo Germano	1.0
Supervisor:	Size:	Sheet:
	A4	26 of 31

[27] Motor Control - Driver 27



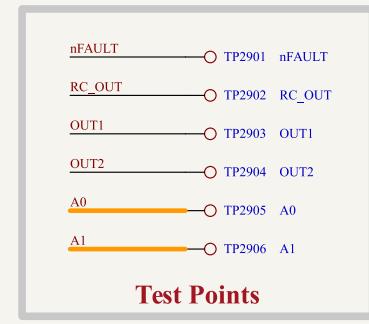
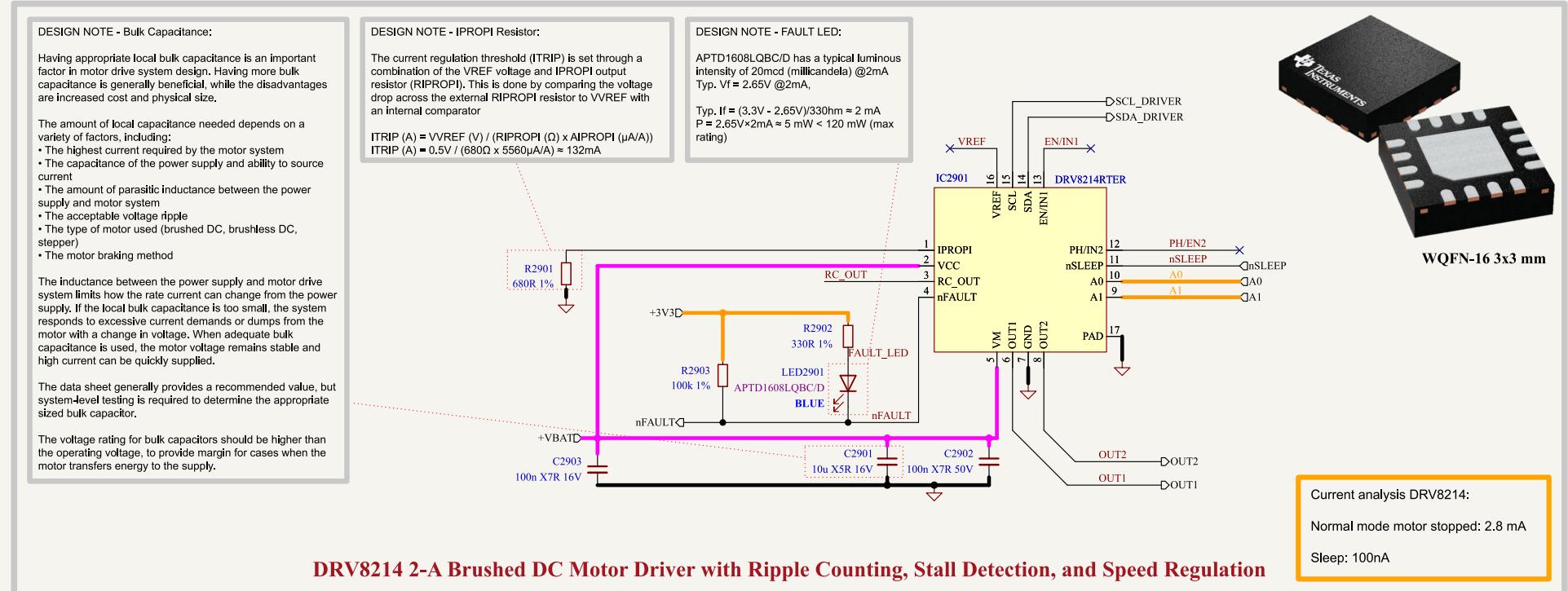
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Plume	Smart Footwear for Diabetic Foot Care	
Sheet Title:	File Name:	Date:
Motor Control - Driver	Motor_Control_Driver.kicad_sch	Théo Heng 2025-04-24
Sheet Path:	Designer:	Revision:
/Project Architecture/Motor Control - Drivers/Motor Control - Driver 15/	Maël Dagon, Paolo Germano	1.0
	Supervisor:	Size:
	Maël Dagon, Paolo Germano	A4
	Sheet:	27 of 31

[28] Motor Control - Driver 28



Comments:	Laboratory:	Variant:
	EPFL Plume	Released
Board Name:	Project Name:	
Plume	Smart Footwear for Diabetic Foot Care	
Sheet Title:	File Name:	Date:
Motor Control - Driver	Motor_Control_Driver.kicad_sch	Théo Heng 2025-04-24
Sheet Path:	Designer:	Revision:
/Project Architecture/Motor Control - Drivers/Motor Control - Driver 16/	Maël Dagon, Paolo Germano	1.0
Supervisor:	Size:	Sheet:
	A4	28 of 31

[29] Motor Control - Driver 29



Comments:	Laboratory:	Variant:
	EPFL Plume	Released
Board Name:	Project Name:	
Plume	Smart Footwear for Diabetic Foot Care	
Sheet Title:	File Name:	Date:
Motor Control - Driver	Motor_Control_Driver.kicad_sch	Théo Heng 2025-04-24
Sheet Path:	Designer:	Revision:
/Project Architecture/Motor Control - Drivers/Motor Control - Driver 17/	Maël Dagon, Paolo Germano	1.0
Supervisor:	Size:	Sheet:
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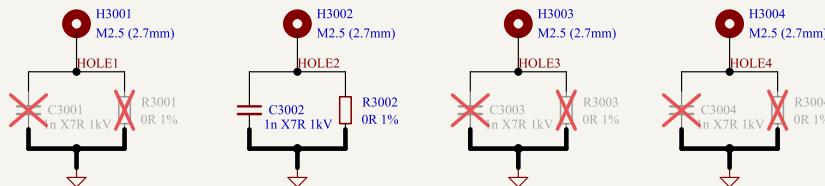
[30] Misc - Mounting Holes

DEBUG NOTE:

HOLE 1 is connected to GND and can be very useful if used as a GND reference for multimeter debug.

DESIGN NOTE:

Fiducials are omitted due to space constraints and are in any case unnecessary in the foreseeable future because manual assembly is required since the DRV8214 ICs, among others, are unavailable on JLCPCB parts store.



Mechanical Mounting holes

- FID3001 Fiducial
- FID3002 Fiducial
- FID3005 Fiducial
- FID3006 Fiducial

Fiducials Front

- H3005 MountingHole
- H3006 MountingHole
- H3007 MountingHole
- H3008 MountingHole

Assembly Frame Mounting Holes

DESIGN NOTE:

In general, do not ground mounting holes that are connected to chassis if there is a risk that the chassis sends current into the PCB and damages it or if the PCB works with high voltage and there is a risk for the user which is in contact with the chassis.

For a PCB in a metallic enclosure, the enclosure can act like a big antenna. The cavities (space between the ground plane on the PCB and the bottom metallic plane of the enclosure) cause capacitive coupling. This is because we have two metallic planes separated by a dielectric, at a separated potential, causing common mode noise, and result in the noise being amplified by the metal enclosure. Ideally, in this case, the case should be grounded. But the grounding will cause multiple return paths if multiple mounting holes are connected to GND. In that case, some current will flow in the enclosure and can give a little shock when the user touches it. This can be fine for small battery-operated devices.

The best option is therefore to ground only one mounting hole.

- FID3003 Fiducial
- FID3004 Fiducial
- FID3007 Fiducial
- FID3008 Fiducial

Fiducials Rear

Comments: Inspired by Amulet controller Schematics by Vincent Nguyen How to connect mounting holes. PCB Mounting Holes	Laboratory: 		Variant: Released	
	Board Name: 		Project Name: Smart Footwear for Diabetic Foot Care	
Sheet Title: Misc - Mounting Holes	File Name: Misc_Mounting_Holes.kicad_sch	Designer: Théo Heng	Date: 2025-04-24	Revision: 1.0
Sheet Path: /Project Architecture/Misc - Mounting Holes & Fiducials/	Supervisor: Maël Dagon, Paolo Germano	Size: A4	Sheet: 30 of 31	

[31] Revision History

DD.MM.YYYY - xxx Revision
Variant: V1.0 -> V1.1

Ordered 24/04/2025: 5 PCB for 232.48\$
Components for 4 PCB on Mouser: 300 CHF

- - Changed Silkscreen for motor testpoints from D10 to D8
 - ✗ - GND test point next to battery connector isn't actually a GND test point -> changed to BAT-
 - ✗ - Make the slot for the battery cables wider, move the connector further inside the PCB.
 - ✗ - Move R & C of holes further in the bottom
 - ✗ - Power LED is not ON when VBUS is present
 - ✗ - Paste mask of the STM32 MCU is bad apparently
 - ✗ - Need to short +VBAT and DOUT/COUT to enable the device
 - ✗ - Switch 1 and switch2 needs to be routed to different GPIO to have them as interrupt

DD.MM.YYYY - xxx Revision
Variant: xxx

DD.MM.YYYY - xxx Revision
Variant: xxx

DD.MM.YYYY - xxx Revision
Variant: xxx

A

A

B

B

C

C

- Done
- ✗ Not done yet

Comments:	Laboratory: Integrated Actuators Laboratory	EPFL	Variant: Released
	Board Name: Plume		Project Name: Smart Footwear for Diabetic Foot Care
Sheet Title: Revision History	File Name: Revision History.kicad_sch	Designer: Théo Heng	Date: 2025-04-24
Revision History			Revision: 1.0
Sheet Path: /Revision History/	Supervisor: Maël Dagon, Paolo Germano	Size: A4	Sheet: 31 of 31