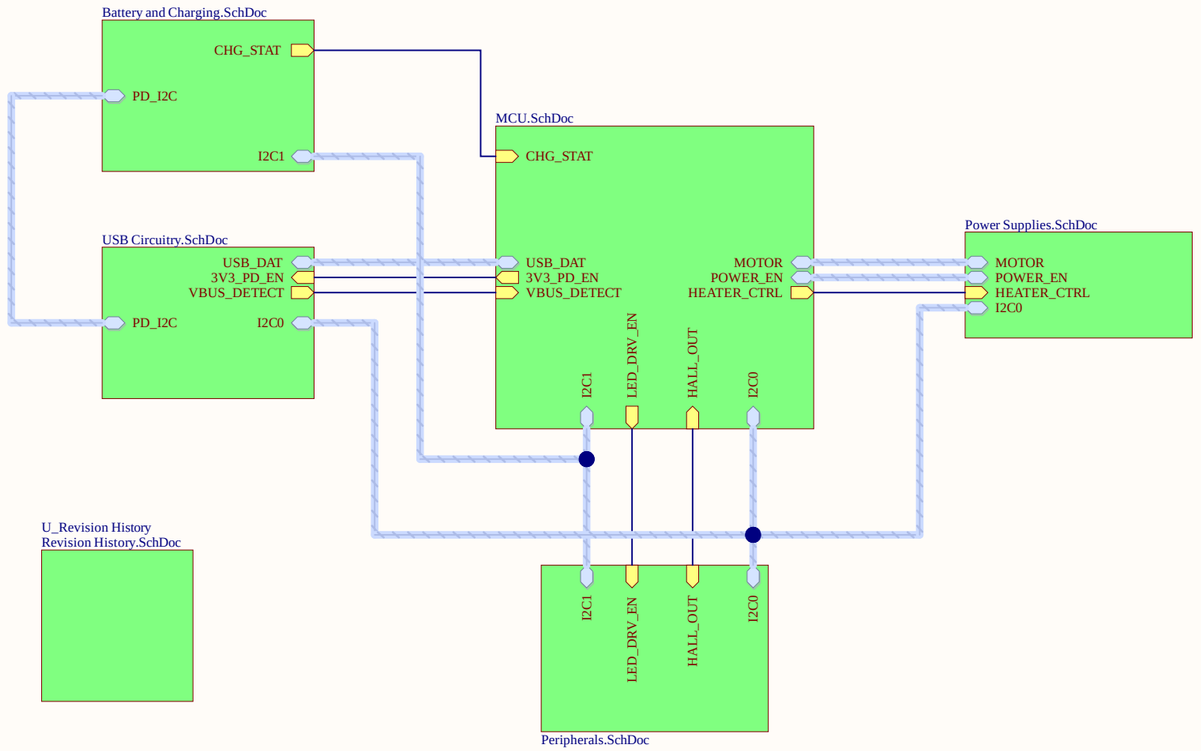
REVISION	DESCRIPTION	DATE	APPROVED

Contents

Block Diagram



Testpoint Circle Table

Ref. Des.	Net	Schematic Sheet	Description
TP1	P1.12	2	MCU spare
TP2	P1.13	2	MCU spare
TP3	P1.14	2	MCU spare
TP4	P1.15	2	MCU spare
TP5	GND	2	GND clip
TP6	P1.10	2	MCU spare
TP7	P1.11	2	MCU spare
TP11	MS_PGOOD	5	Motor supply power-good output
TP12	I2C0_SCL	2	I2C0 SCL line
TP13	I2C0_SDA	2	I2C0 SDA line
TP14	I2C1_SCL	2	I2C1 SCL line
TP15	I2C1_SDA	2	I2C1 SDA line
TP18	HEATER_CTRL	5	PWM signal for heater temperature control
TP19	3V3	5	3.3V system/logic supply output
TP20	3V3_SW	5	Switched 3.3V system/logic supply rail
TP21	VCC_MOTOR	5	24V motor supply rail
TP22	MOTOR_FG	5	Motor speed output
TP23	MOTOR_PWM	5	PWM signal for motor speed control
TP24	VBUS	3	VBUS pin on J7 USB connector
TP25	5V	3	Output of 5V LDO powered by VBUS. Powers MCU USB PHY
TP27	3V3_PD	3	Switched 3.3V system/logic supply rail for powering the PD controller
TP28	HALL_OUT	6	Hall Effect sensor output for door open/close detection
TP29	MOTOR_POWER_EN	5	Signal to enable motor power supply

I2C Address Table

Device	Ref. Des.	Base Addr.	Write Addr.	Read Addr.	Bus	Bus Master	Pullup Rail
USB PD Controller	U10	0x23	0x46	0x47	I2C0	nrf5240	3V3_SW
Temperature Sensor	J2	0x77	0xEE	0xEF	I2C0		
LED Driver	U14	0x64	0xC8	-	I2C0		
Fuel Gauge	U5	0x6C	0xD8	0xD9	I2C1	nrf5240	3V3_SW
RTC	U3	0x51	0xA2	0xA3	I2C1		
EEPROM	U12	0x50	0xA0	0xA1	PD	PD Controller	PD_LDO_3V3
Battery Charger	U4	0x6B	0xD6	0xD7	PD		

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PROJECT: GHL NAATOS Sample Prep Main Board RevC ODIC.PrjPcb

TITLE: Title Page

SIZE	PROJECT ID	DWG NO.	REV
B	263-03	GHL-1-21002	C

FILE NAME: Title Page.SchDoc

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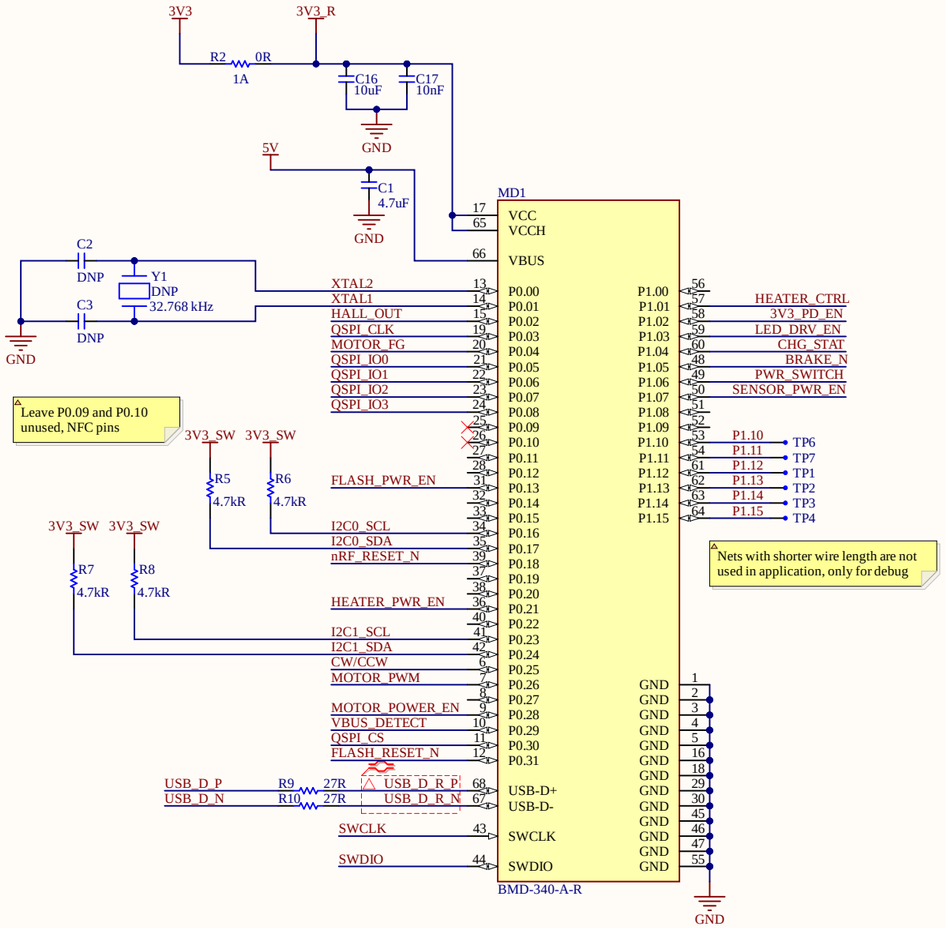
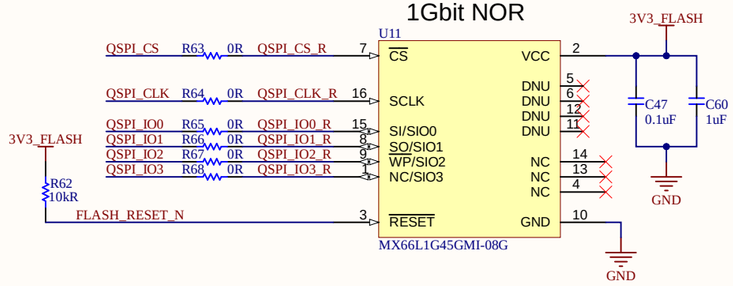
REVISION	DESCRIPTION	DATE	APPROVED

nRF52840 Module

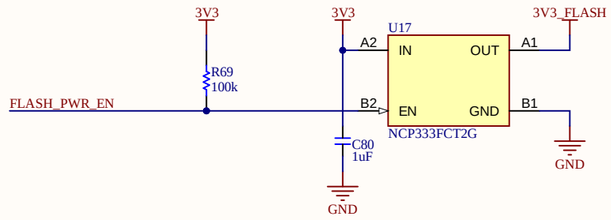


QSPI Flash

1Gbit NOR

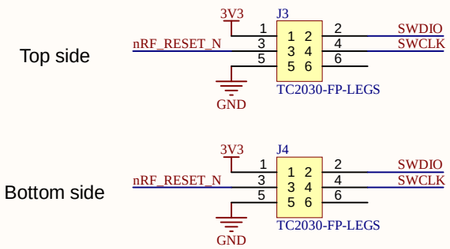


Flash Power

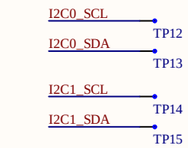


Programming and Debug

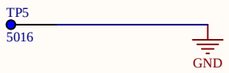
Programming Headers (TAG Connect)



I2C Testpoints

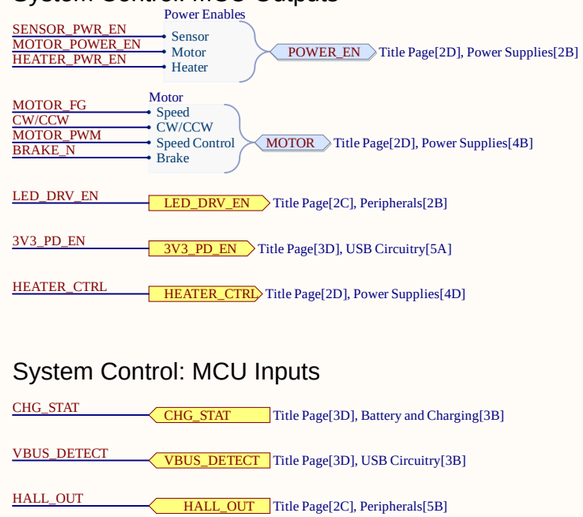


GND Clip



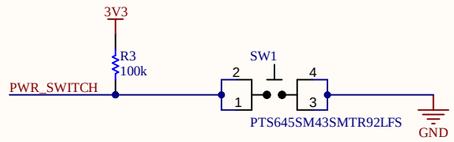
Inter-IC Busses

System Control: MCU Outputs



System Control: MCU Inputs

System On/Off Button



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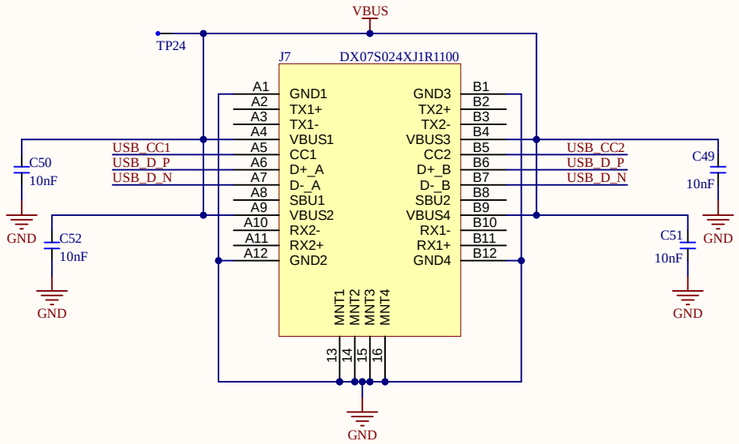
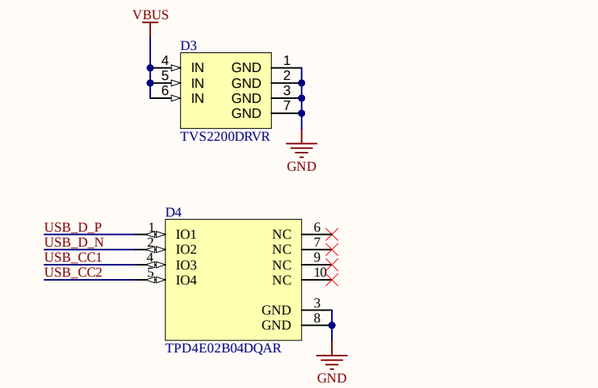
		TITLE	MCU
APPROVALS	DATE	SIZE / PROJECT ID / DWG NO. / REV	B / 263-03 / GHL-1-21002 / C
DRAWN: DD	5/22/2025		
CHECKED: *			
APPROVED: *		FILE NAME MCU.SchDoc	SHEET 2 OF 7

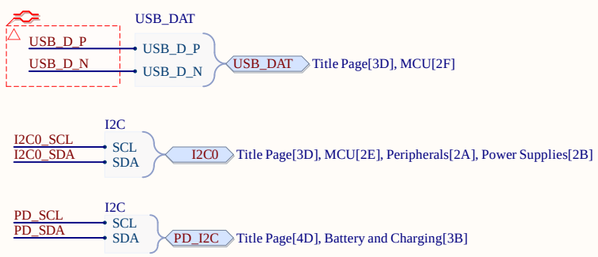
REVISION	DESCRIPTION	DATE	APPROVED

USB-C 2.0 Port

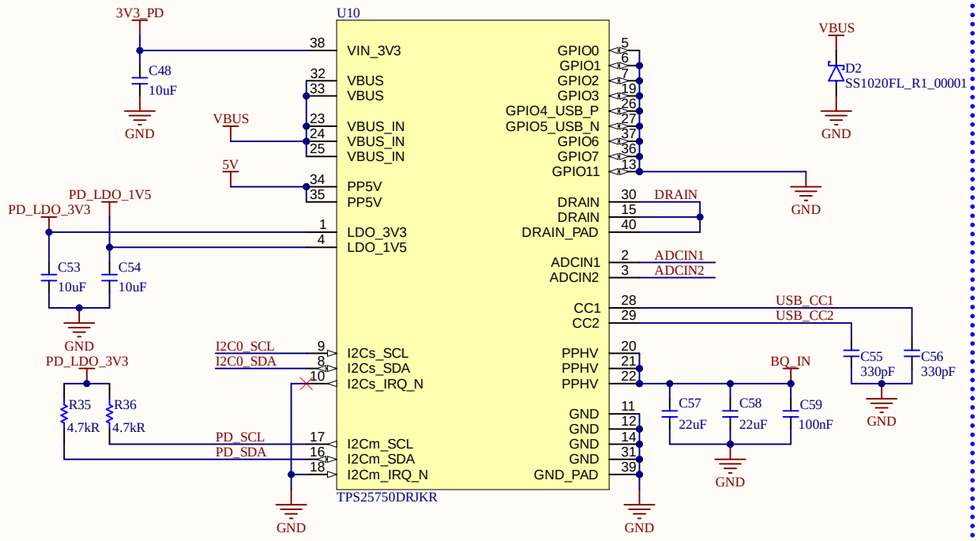


ESD Protection

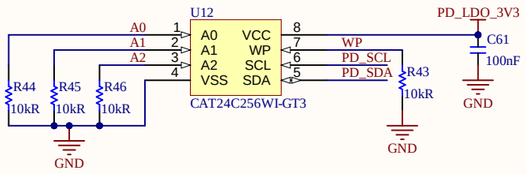




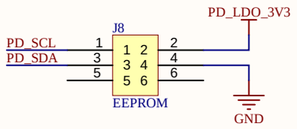
USB PD Controller



EEPROM

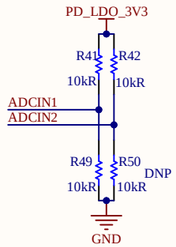


EEPROM Programming Header

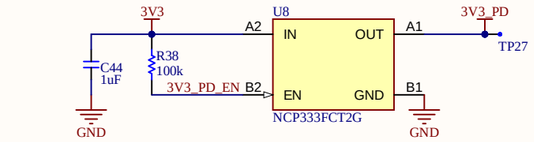


Dead Batt. Config.

SafeMode, I2C Addr. Index #4



PD Controller Load Switch



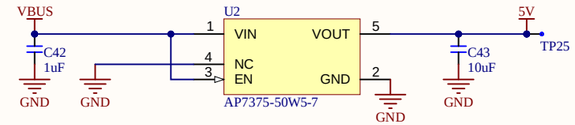
Title Page[3D], MCU[2D] 3V3_PD_EN → 3V3_PD_EN

U8 : Enables MCU to switch off the PD controller. Switch defaulted to ON

PD-Voltage Tolerant LDO for USB PHY Supply and USB Detect

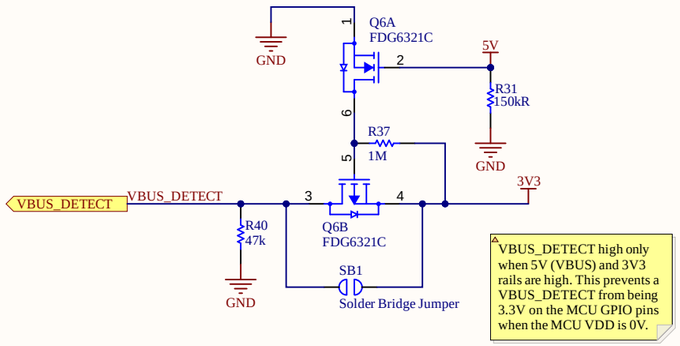
USB PHY 5V LDO

5 - 45V Input Range



VBUS Detect Circuit

USB Connection Sense Line



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PROJECT: GHL NAATOS Sample Prep Main Board RevC ODIC.PrjPcb

TITLE: USB Circuitry

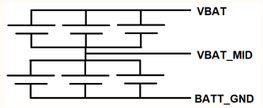
SIZE	PROJECT ID	DWG NO.	REV
B	263-03	GHL-1-21002	C

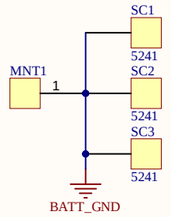
FILE NAME: USB Circuitry.SchDoc — SHEET 3 OF 7

REVISION	DESCRIPTION	DATE	APPROVED

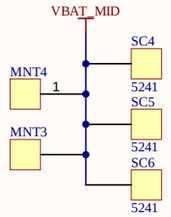
Battery Connectors

6x 21700 cells, 2s3p configuration

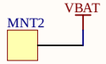




Battery pack ground



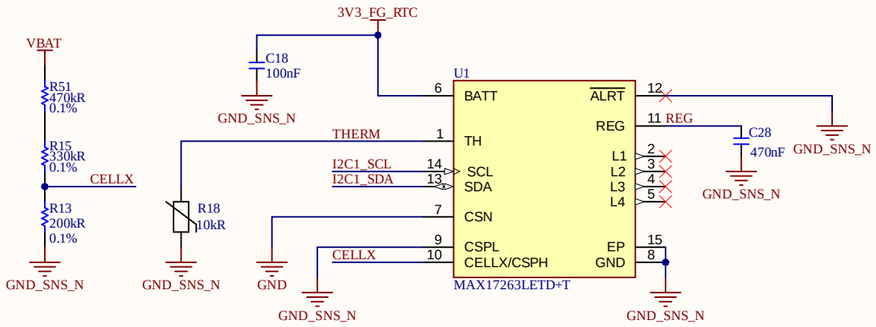
Node connecting the two series stacks of batteries



Battery pack positive

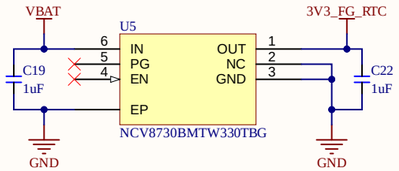
MNT1 and MNT4 are 4mm holes to receive banana plug for benchtop testing of board

Battery Fuel Gauge

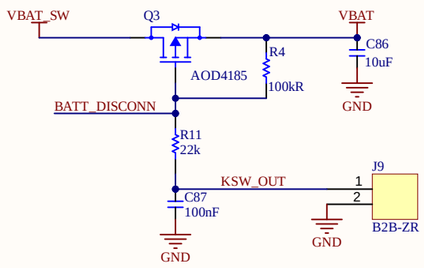


LDO for FG/RTC Power

150mA max output, 38V max input, 1uA Iq



Ship-Mode/Kill Switch

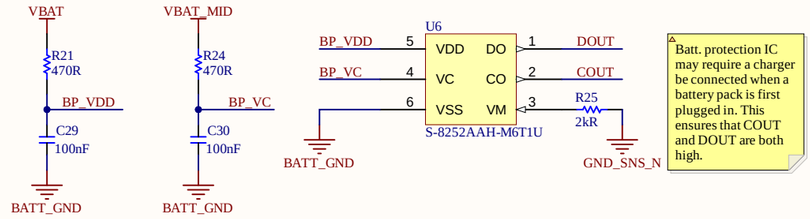


Kill switch open: battery discharge path interrupted at Q3

Kill switch closed: battery discharge path uninterrupted

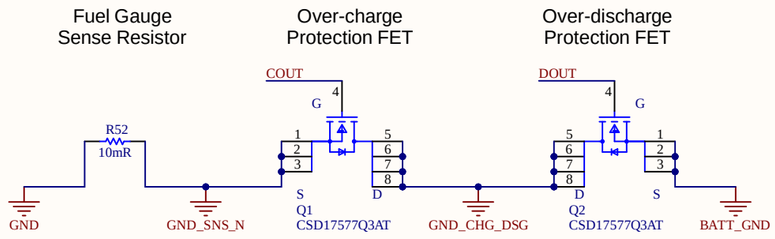
Battery Protection IC

UVLO: 3V, release @ 3V. OVLO: 4.25V, release @ 4.1V (per cell)



Batt. protection IC may require a charger be connected when a battery pack is first plugged in. This ensures that COUT and DOUT are both high.

Board GND — *Discharge Current* → Battery Pack Negative

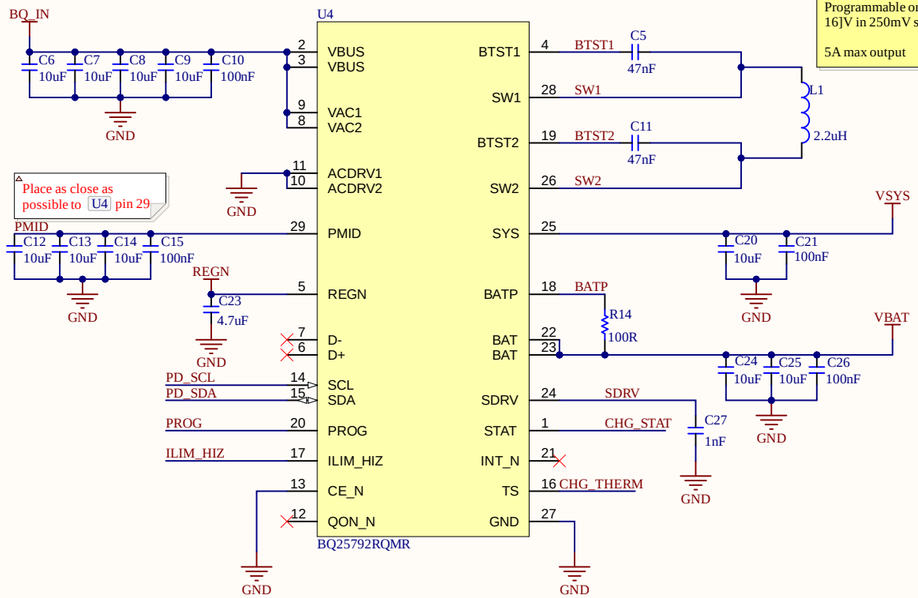


Battery Charger

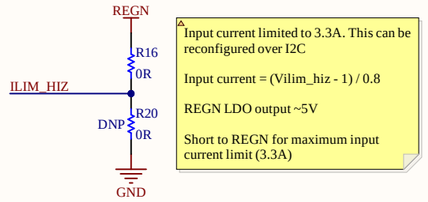
SYS output unused on this design

VSYS_MIN default = 3.5V Programmable on [2.5, 16]V in 250mV steps

5A max output



Input Current Set



Input current limited to 3.3A. This can be reconfigured over I2C

Input current = (Vilim_hiz - 1) / 0.8

REGN LDO output ~5V

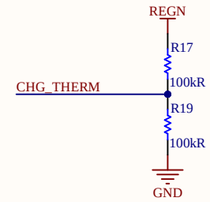
Short to REGN for maximum input current limit (3.3A)

Switching Freq. Set

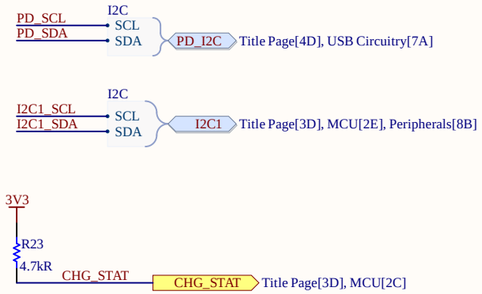
8.2k pulldown configures charger for 750kHz inductor switching frequency, 2s cell config.

Use 1% or 2% resistor

Batt. Thermistor



No captive battery thermistor on this design. CHG_THERM value is set such that it never prevents charging



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PROJECT: GHL NAATOS Sample Prep Main Board RevC ODIC.PrjPcb

TITLE: Battery and Charging

SIZE	PROJECT ID	DWG NO.	REV
B	263-03	GHL-1-21002	C

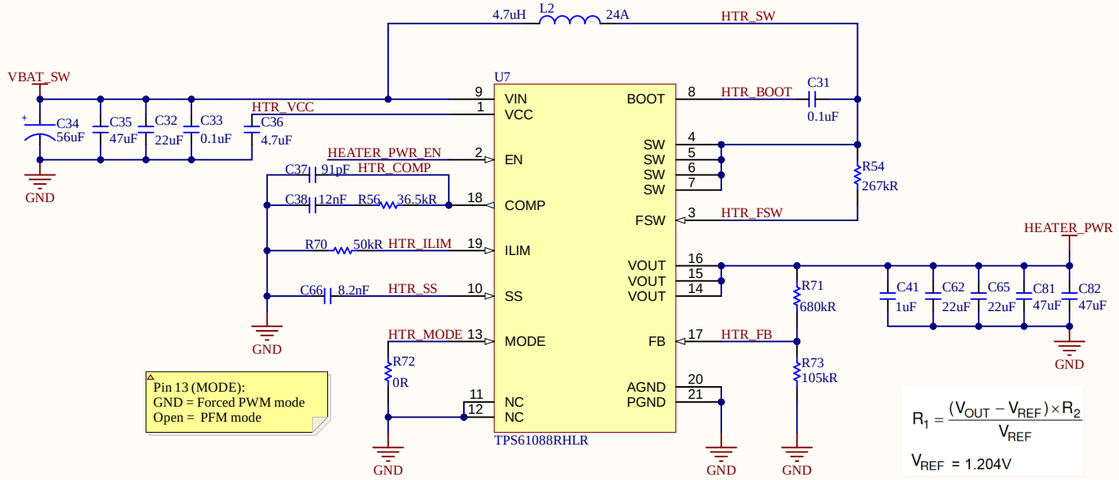
FILE NAME: Battery and Charging.SchDoc

SHEET 4 OF 7

REVISION	DESCRIPTION	DATE	APPROVED

Heater Boost Supply

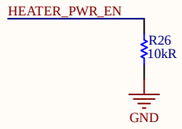
9V output, 5A max



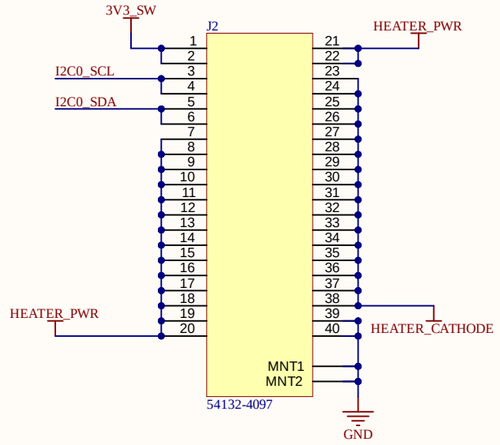
$$R_1 = \frac{(V_{OUT} - V_{REF}) \times R_2}{V_{REF}}$$

V_{REF} = 1.204V

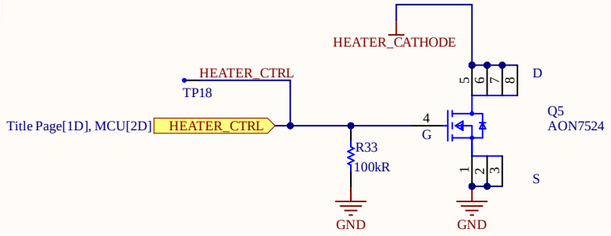
Heater Supply Enable



Heater Board FFC Connector

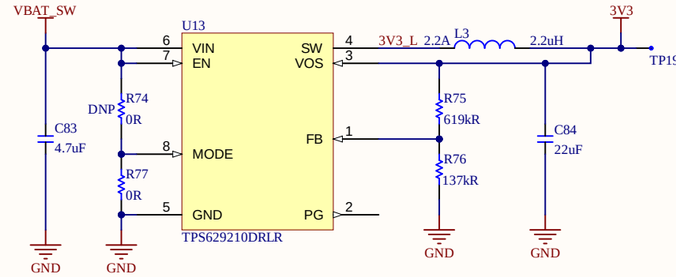


Heater Control FET



System/Logic Buck Supply

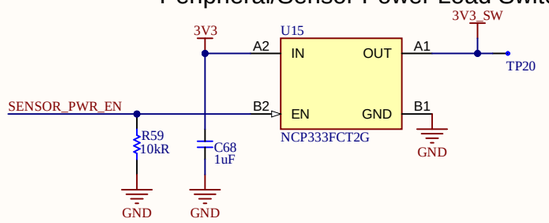
3.3V output, 1A max



$$R_1 = R_2 \times \left(\frac{VOUT}{VFB} - 1\right)$$

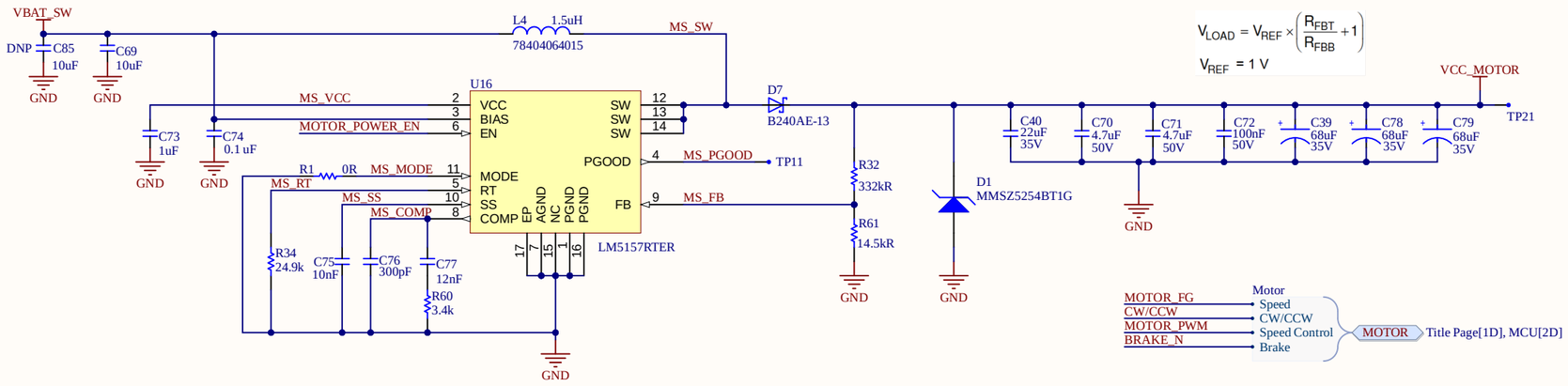
where VFB is 0.6 V.

Peripheral/Sensor Power Load Switch



Motor Boost Supply

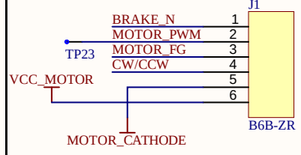
24V output



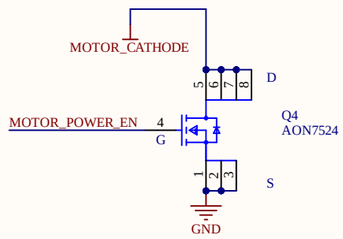
$$V_{LOAD} = V_{REF} \times \left(\frac{R_{FBT}}{R_{FBB}} + 1\right)$$

V_{REF} = 1 V

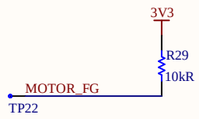
Motor Connector



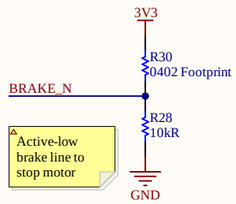
Motor Power Disconnect



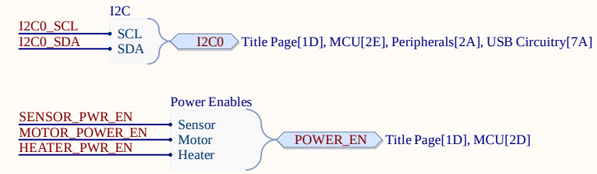
Motor Speed Output



Motor Brake Mode



Motor Supply Enable



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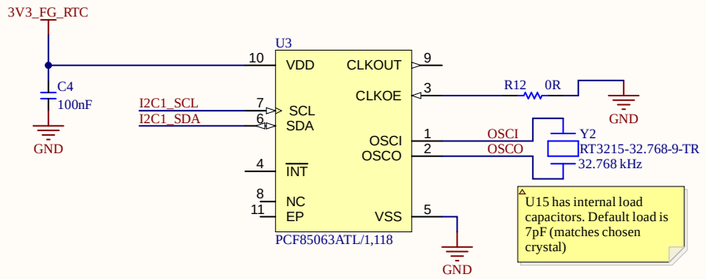
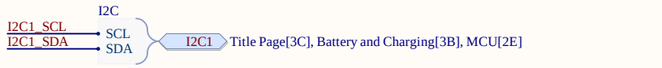
		TITLE	Power Supplies
APPROVALS	DATE	SIZE / PROJECT ID / DWG NO. / REV	B / 263-03 / GHL-1-21002 / C
DRAWN: DD	5/22/2025		
CHECKED: *		FILE NAME	Power Supplies.SchDoc
APPROVED: *		SHEET	5 OF 7

REVISION	DESCRIPTION	DATE	APPROVED

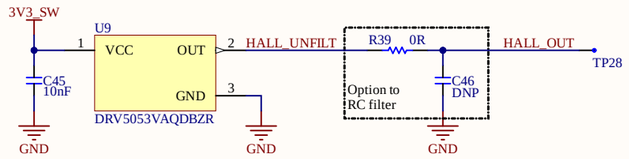
RTC/Calendar

Input voltage range: 1.8-5.5V

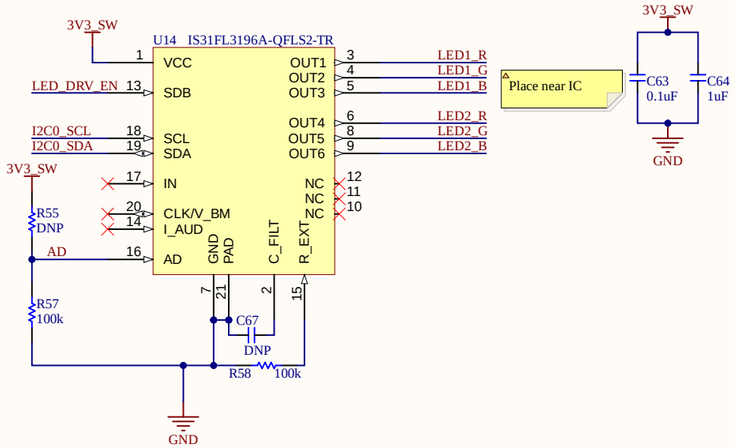


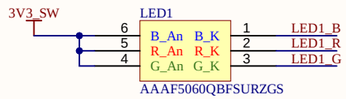


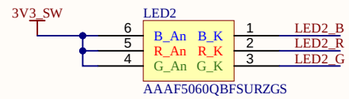
Hall Effect Sensor

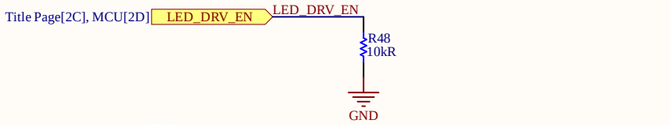


LED Driver









odic Engineered.	295 Foster St Suite 202 Littleton, MA 01460 www.odic.com	PROJECT	GHL NAATOS Sample Prep Main Board RevC ODIC.PrjPcb
		TITLE	Peripherals
APPROVALS	DATE	SIZE / PROJECT ID / DWG NO. / REV	B / 263-03 / GHL-1-21002 / C
DRAWN: DD	5/22/2025	FILE NAME	Peripherals.SchDoc
CHECKED: *		SHEET	6 OF 7
APPROVED: *			

REVISION	DESCRIPTION	DATE	APPROVED

REV	DRAWN	COMMENT	DATE
A	DD	Initial Capture	5/2/2024
B	IEO	Batteries: Changed from 1s4p 18650 configuration to 2s3p 21700 configuration. Changed battery protection IC, fuel gauge. Added kill-switch. Added LDO to power RTC and fuel gauge when kill-switch is engaged. Heater: Reworked heater boost supply. Increased heater board FFC connector pin count from 20 to 40. Motor: Reworked motor circuit to use a new motor. Other: Removed SD card, added SPI NOR flash. Reworked USB detect circuitry. Added many testpoints. Minor tweaks to improve battery life.	10/3/2024
C	IEO	RTC: Removed 32k output from RTC to MCU. Connected RTC CLKOE pin to GND. Removed interrupt line. Grounded to GND instead of BATT_GND. Fuel Gauge: Removed the ALRT output. Replaced connections to GND_SNS_P to GND MCU: Corrected wiring on nRF program header 3V3_FG_RTC LDO: Changed from TPS70933DRVR to part used to rework boards NCV8730BMTW330TBG Battery Protection IC: Changed from S-8252AAO-M6T1U to S-8252AAH-M6T1U to raise OD detection voltage to 3V Kill Switch: Replaced low-side switching scheme with a high-side switch. Wired VBAT_SW to power inputs of the Heater Boost, Motor Boost, and System/Logic Buck supplies in replacement of VBAT	11/27/24

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APPROVALS	DATE
DRAWN: DD	5/22/2025
CHECKED: *	
APPROVED: *	

PROJECT: GHL NAATOS Sample Prep Main Board RevC ODIC.PrjPcb

TITLE: Revision History

SIZE	PROJECT ID	DWG NO.	REV
B	263-03	GHL-1-21002	C

FILE NAME: Revision History.SchDoc