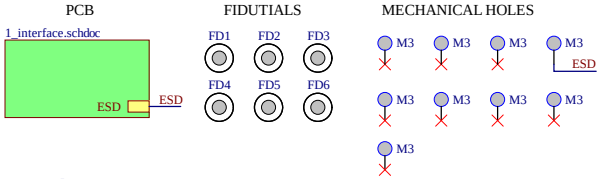
Rev	Description	Date	Author
0.1	- Initial release - Update beacon radio output - General updates for compliance with the SpaceLab hardware development standards	28-Aug-2020	Andre M. P. Mattos
0.2	- Added variant types for test and flight models, draftsman source and PDF output - Updated schematic templates - Updating battery monitor and minor fixes	16-Jun-2021	Yan C. de Azeredo

Revision History



PCB Elements

EPS2 Hardware:

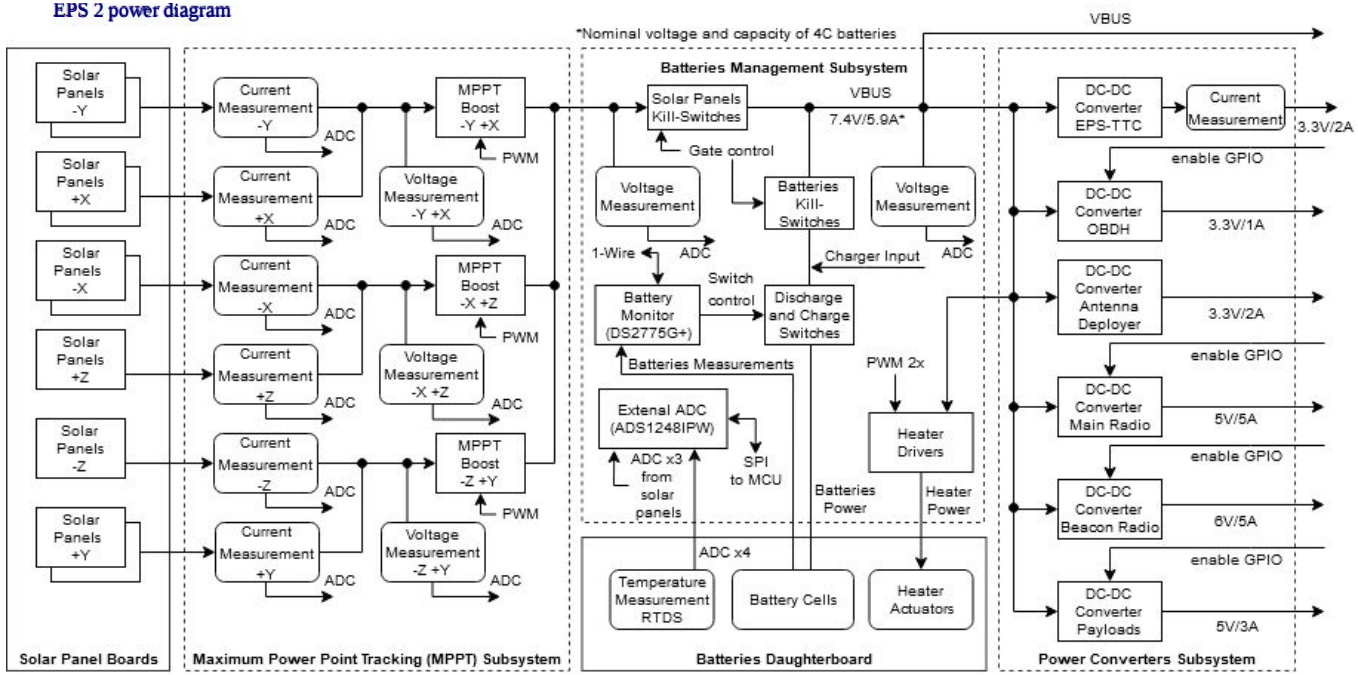
- Drawn by: André M. P. Mattos (updates from FloripaSat-I EPS)
- Based on FloripaSat-I OBDH designed by: Sara V. Martinez
- Reviewers: Kleber Gouveia and Yan C. Azeredo
- Support: Gabriel M. Marcelino

Project Contributions

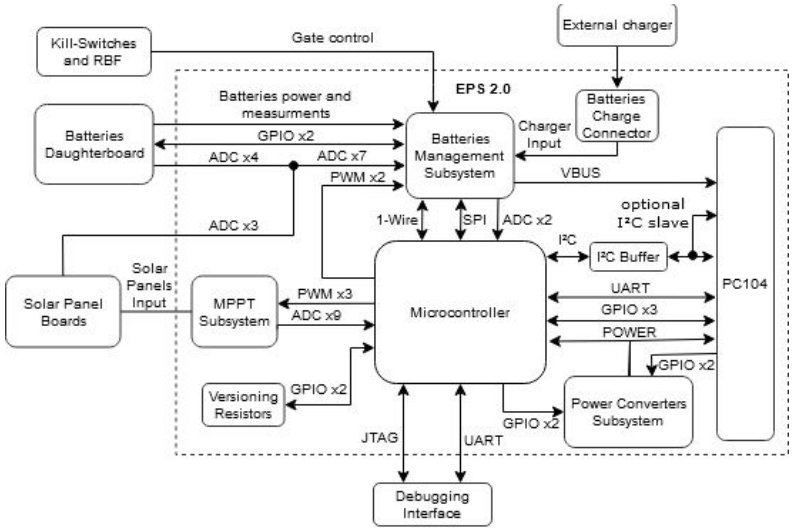
Github repository: https://github.com/spacelab-ufsc/eps2

Project Information

EPS 2 power diagram

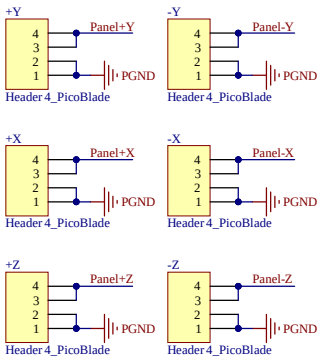


EPS 2 MCU diagram

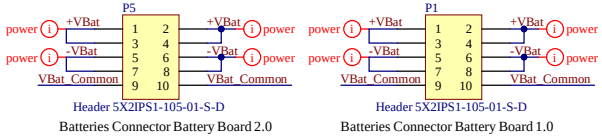


SpaceLab - Federal University of Santa Catarina			
Project: *eps2_project.prjpcb / [No Variations]*			
Title: *Block diagram*			
Engineer: *André M. P. Mattos*			Project Code: *EPS2*
Date: 23/10/2022	Revision: *v0.2*	Sheet *1* of *11*	Size: A3

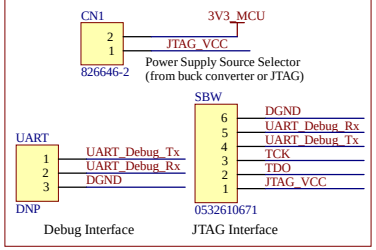
SOLAR PANNELS POWER INTERFACES



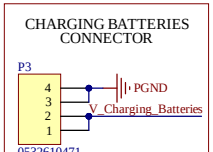
BATTERY BOARD POWER INTERFACES



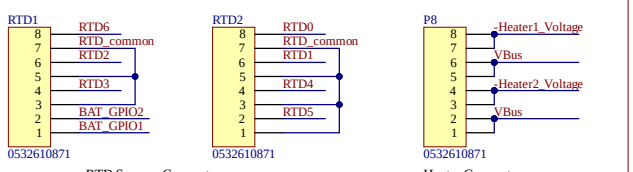
DEBUG AND PROGRAMMING INTERFACES



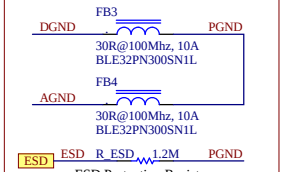
CHARGING BATTERIES CONNECTOR



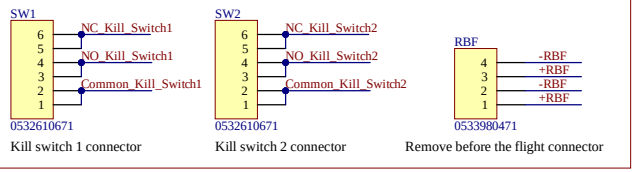
BATTERY BOARD SENSORS AND CONTROL INTERFACES



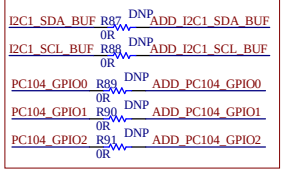
GROUNDING



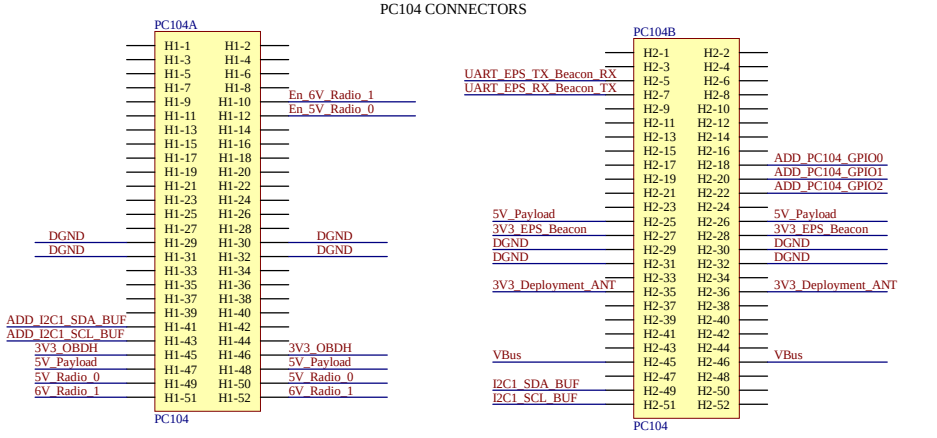
EXTERNAL SWITCHES INTERFACES



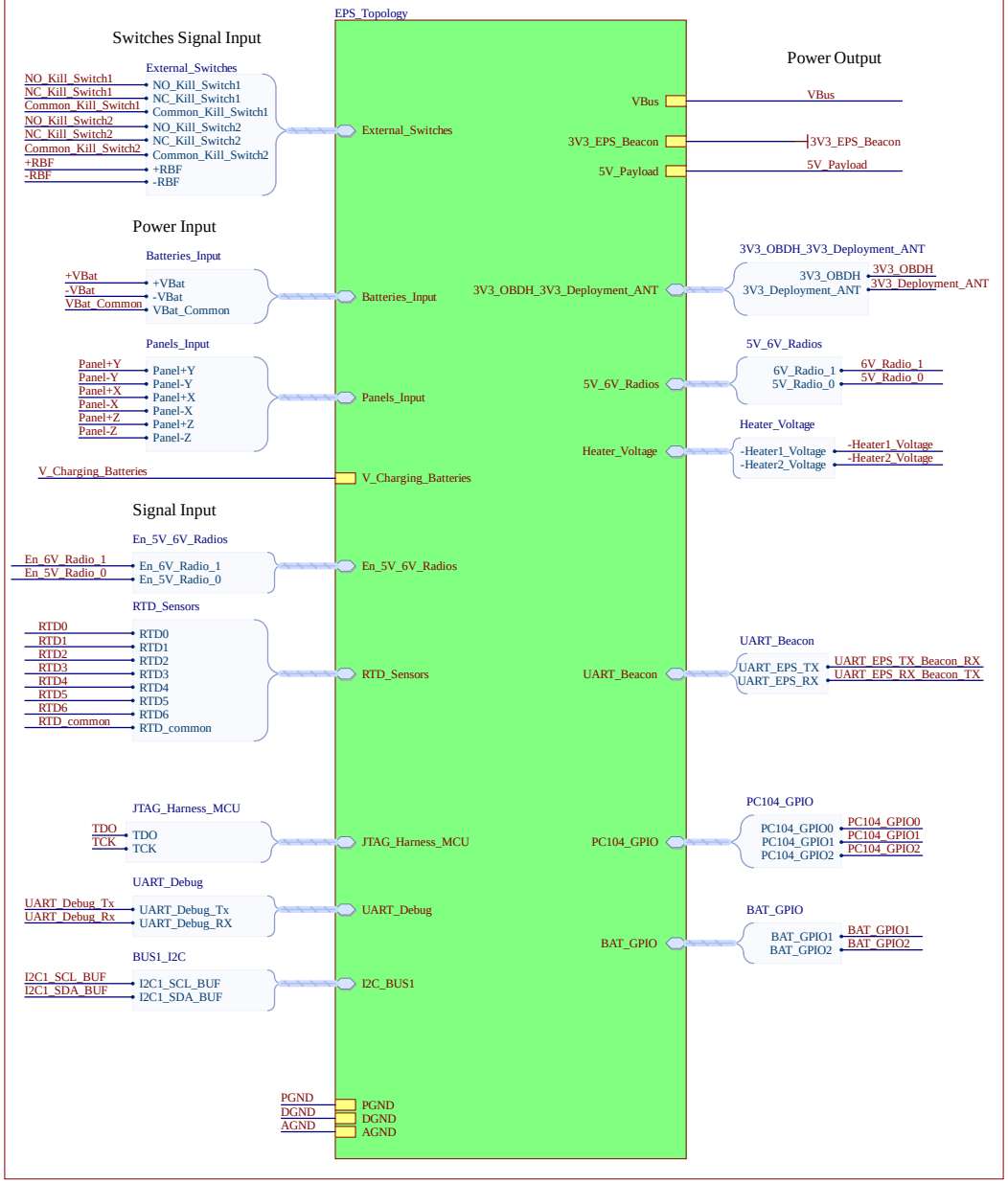
ADDITIONAL INTERFACES



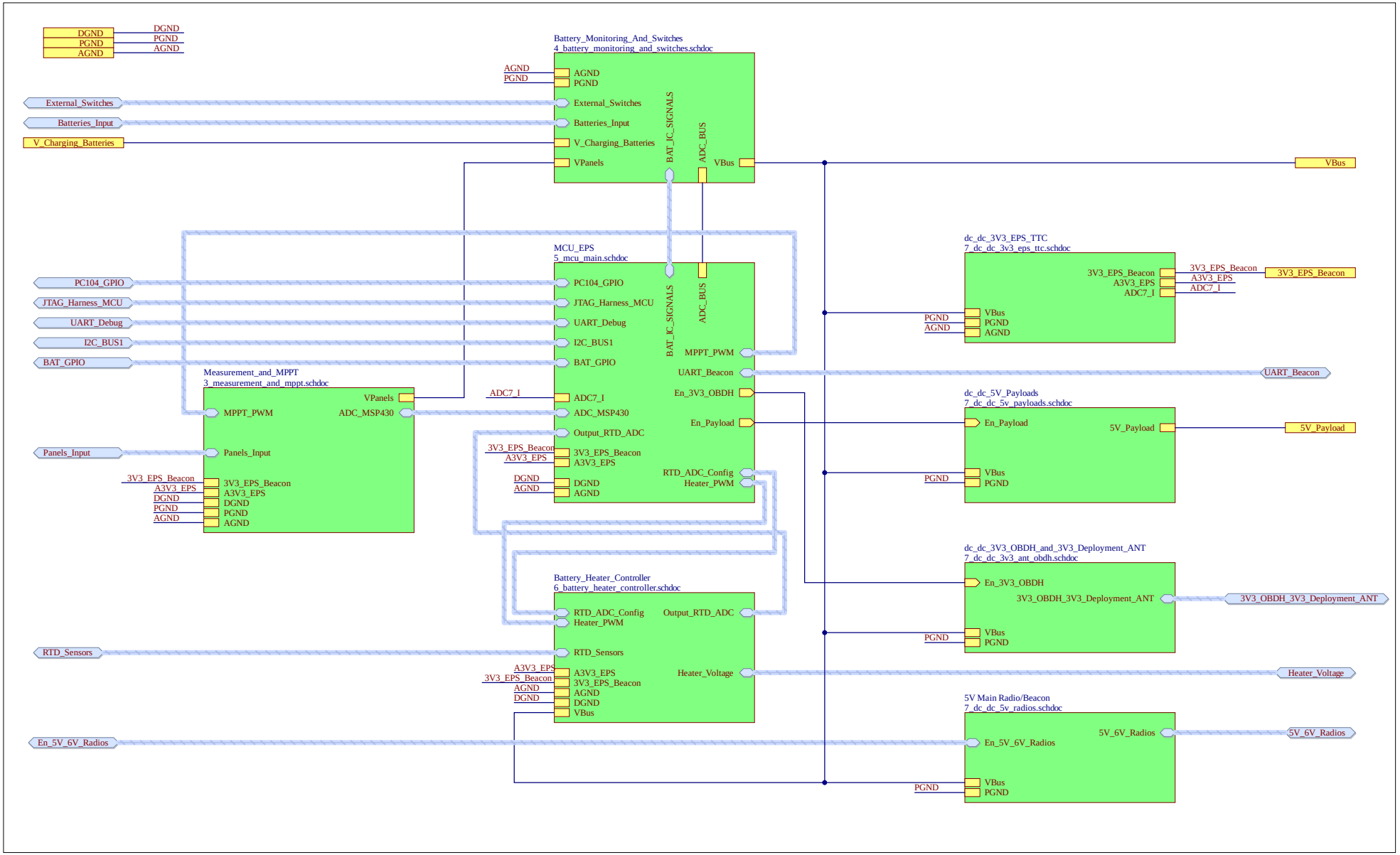
PC104 CONNECTORS



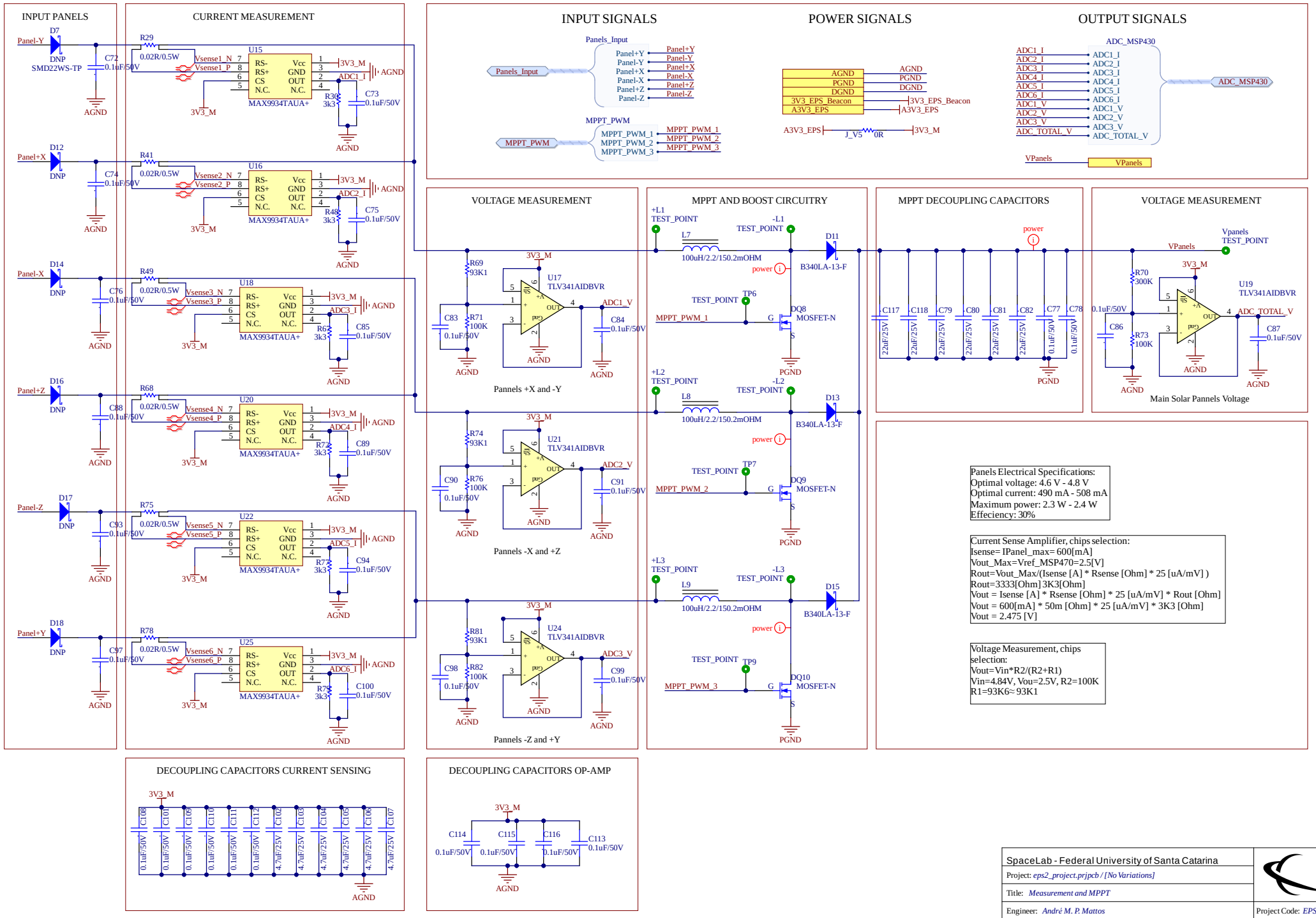
ELECTRICAL POWER SYSTEM TOPOLOGY INTERFACES



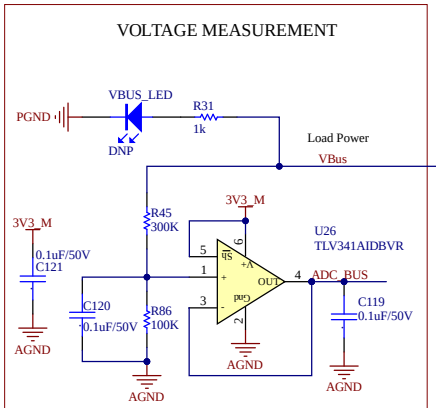
SpaceLab - Federal University of Santa Catarina			
Project: *eps2_project.prjpcb / [No Variations]*			
Title: *EPS Interface*			
Engineer: *André M. P. Mattos*			Project Code: *EPS2*
Date: 23/10/2022	Revision: *v0.2*	Sheet *2* of *11*	Size: A3



SpaceLab - Federal University of Santa Catarina			
Project: *eps2_project.prjpcb / [No Variations]*			
Title: *EPS Topology*			
Engineer: *André M. P. Mattos*			Project Code: *EPS2*
Date: 23/10/2022	Revision: *v0.2*	Sheet *3* of *11*	Size: A3

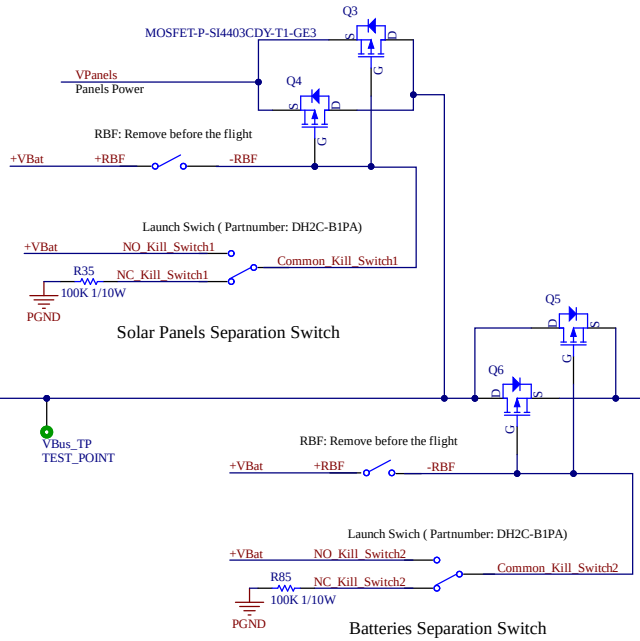

INPUT PANELS
CURRENT MEASUREMENT
INPUT SIGNALS
POWER SIGNALS
OUTPUT SIGNALS
VOLTAGE MEASUREMENT
MPPT AND BOOST CIRCUITRY
MPPT DECOUPLING CAPACITORS
VOLTAGE MEASUREMENT
Pannels +X and -Y
Pannels -X and +Z
Pannels -Z and +Y
Main Solar Pannels Voltage
DECOUPLING CAPACITORS CURRENT SENSING
DECOUPLING CAPACITORS OP-AMP
Panels Electrical Specifications:
Optimal voltage: 4.6 V - 4.8 V
Optimal current: 490 mA - 508 mA
Maximum power: 2.3 W - 2.4 W
Effeciency: 30%
Current Sense Amplifier, chips selection:
Isense= IPanel_max= 600[mA]
Vout_Max=Vref_MSP470=2.5[V]
Rout=Vout_Max/(Isense [A] * Rsense [Ohm] * 25 [uA/mV])
Rout=3333[Ohm] 3K3[Ohm]
Vout = Isense [A] * Rsense [Ohm] * 25 [uA/mV] * Rout [Ohm]
Vout = 600[mA] * 50m [Ohm] * 25 [uA/mV] * 3K3 [Ohm]
Vout = 2.475 [V]
Voltage Measurement, chips selection:
Vout=Vin*R2/(R2+R1)
Vin=4.84V, Vou=2.5V, R2=100K
R1=93K6≈ 93K1
SpaceLab - Federal University of Santa Catarina
Project: eps2_project.prjpcb / [No Variations]
Title: Measurement and MPPT
Engineer: André M. P. Mattos
Project Code: EPS2
Date: 23/10/2022
Revision: v0.2
Sheet 4 of 11
Size: A3

VOLTAGE MEASUREMENT



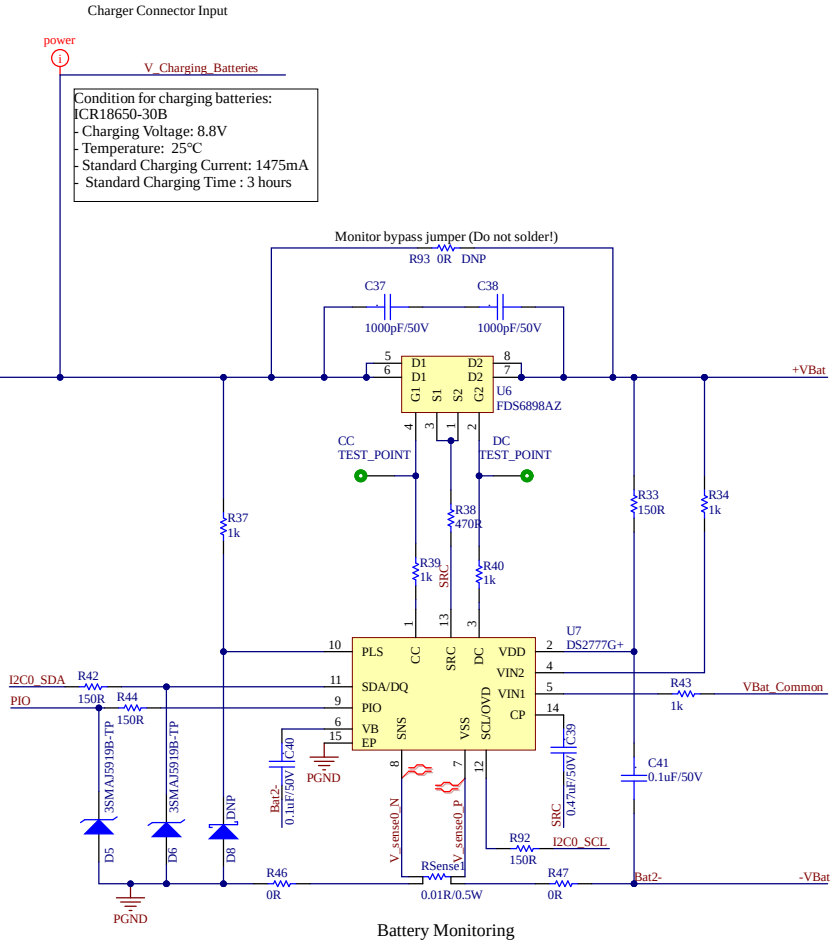
Bus Voltage Measurement, chips selection:
Vout=Vin*R2/(R2+R1)
Vin=10V, Vou=2.5V, R2=100K
R1=300K

SEPARATION SWITCHES



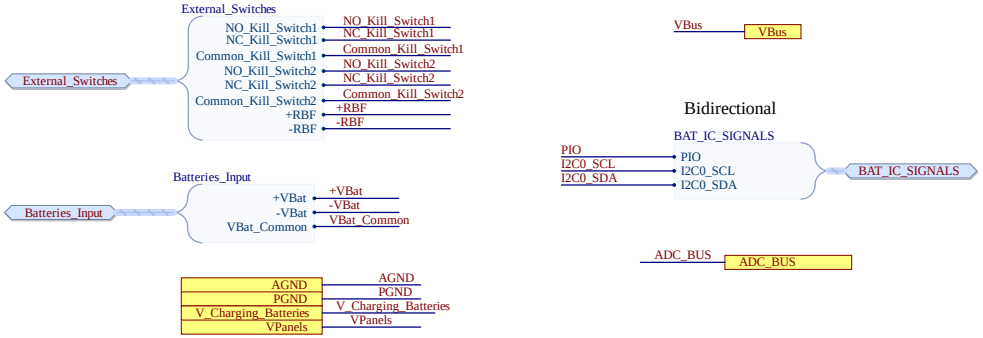
RBF	Switch(NC)	Switch(NO)	MOSFET	EPS POWER
1	X	X	OPEN	Cut-off
0	1	0	CLOSE	ON
0	0	1	OPEN	Cut-off (launch moment)

BATTERY MONITOR CIRCUITRY



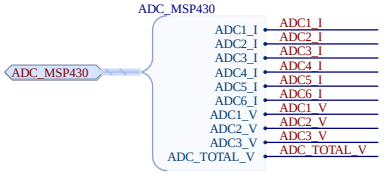
Battery Monitoring

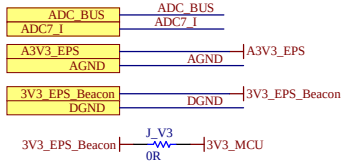
Rsenser for battery monitoring:
(Datasheet : DS2775, pag 17)
Rsense=10mOhms (LVK12R010DER)
Current Range: ± 5.12A
ACR Resolution = 625µAh
ACR Range = ±40.96Ah



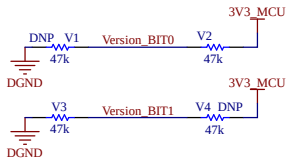
SpaceLab - Federal University of Santa Catarina	
Project: *eps2_project.prjpcb / [No Variations]*	
Title: *Batteries Monitor and Power Switches*	
Engineer: *André M. P. Mattos*	Project Code: *EPS2*
Date: 23/10/2022 · Revision: *v0.2* · Sheet *5* of *11*	Size: A3

MICROCONTROLLER CIRCUITRY (MCU)

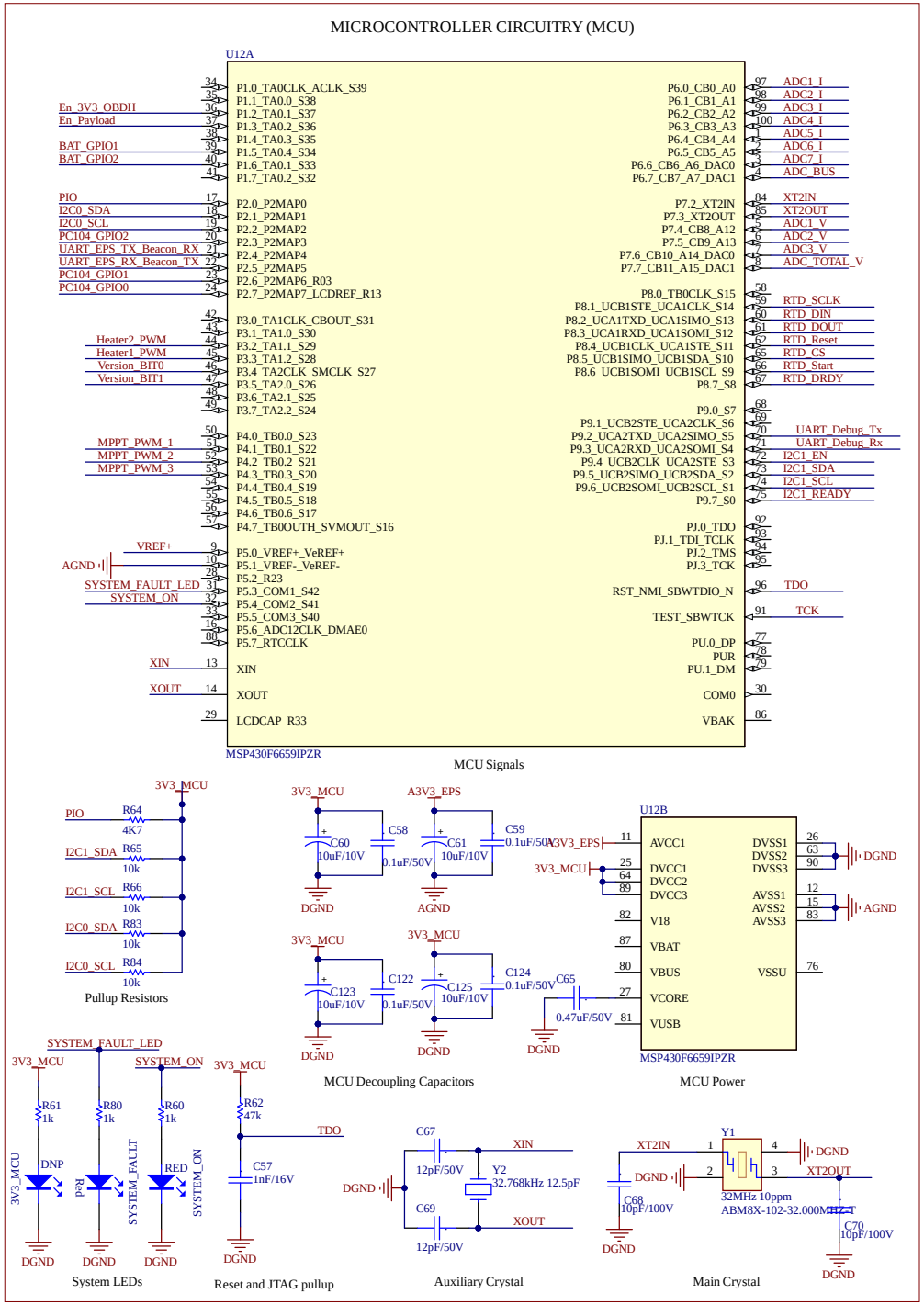




VERSIONING RESISTORS



Configuration for version v0.2



MCU Signals

Pullup Resistors

MCU Decoupling Capacitors

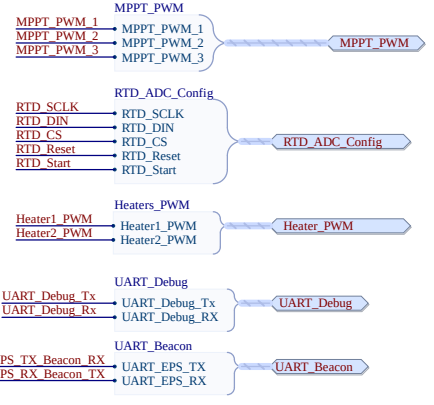
MCU Power

System LEDs

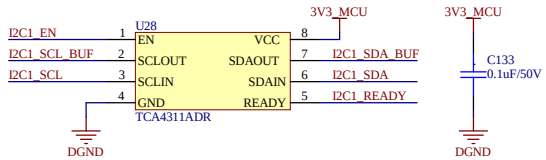
Reset and JTAG pullup

Auxiliary Crystal

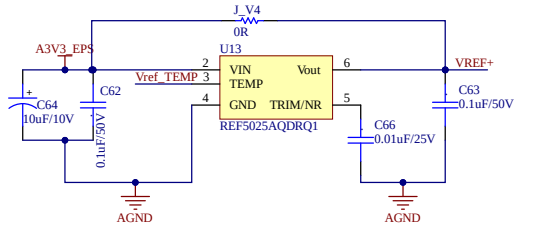
Main Crystal



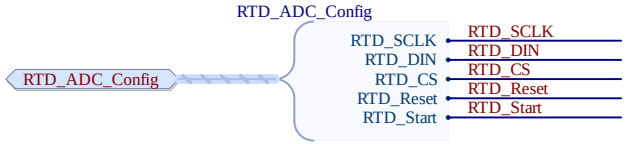
I2C BUFFER CIRCUIT

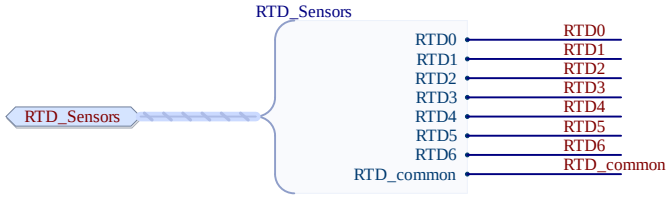


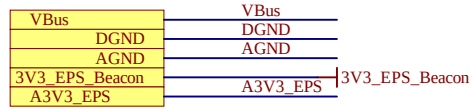
VOLTAGE REFERENCE CIRCUIT

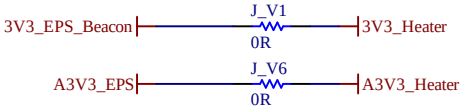


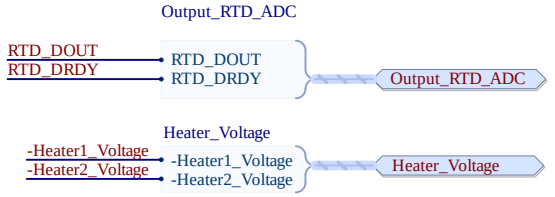
SpaceLab - Federal University of Santa Catarina			
Project: *eps2_project.prjpcb / [No Variations]*			
Title: *EPS MCU Main*			
Engineer: *André M. P. Mattos*			Project Code: *EPS2*
Date: 23/10/2022	Revision: *v0.2*	Sheet *6* of *11*	Size: A3

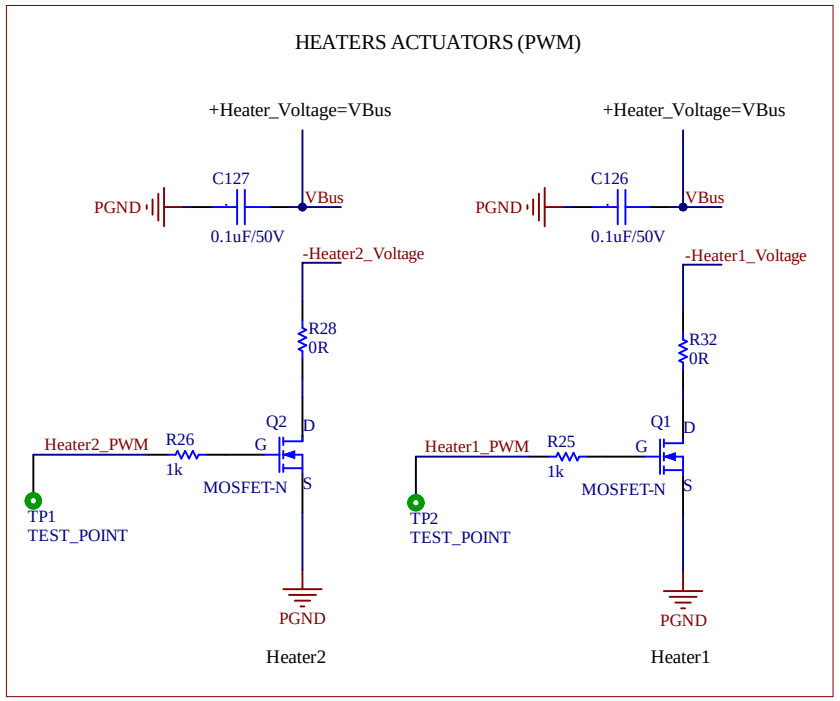


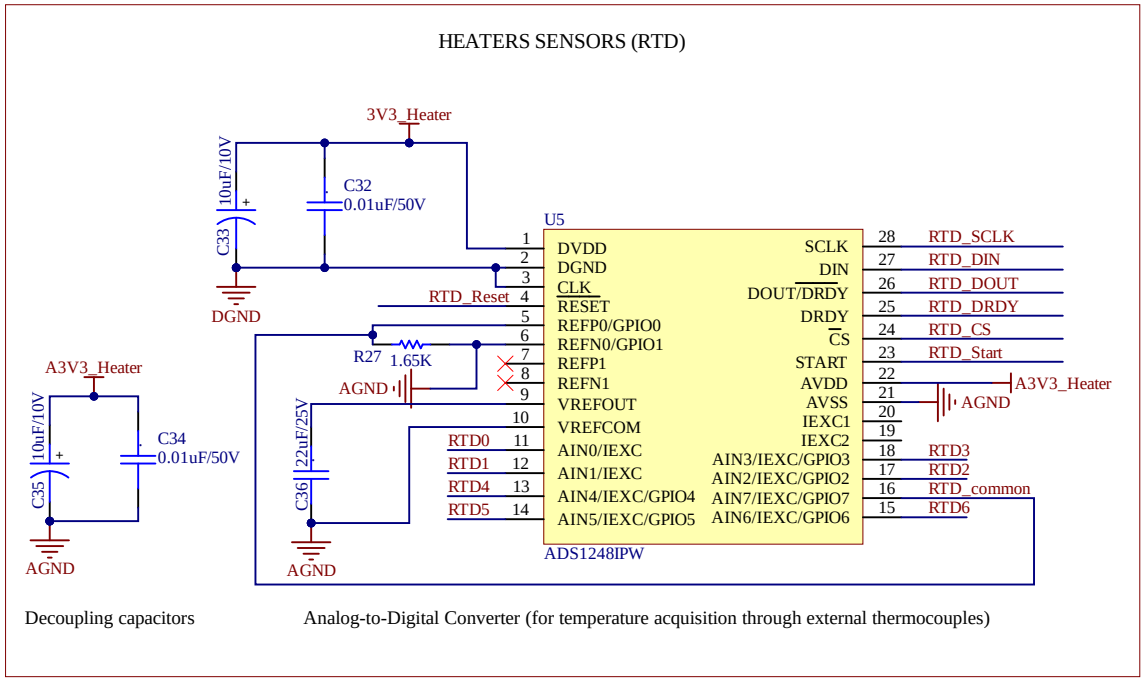






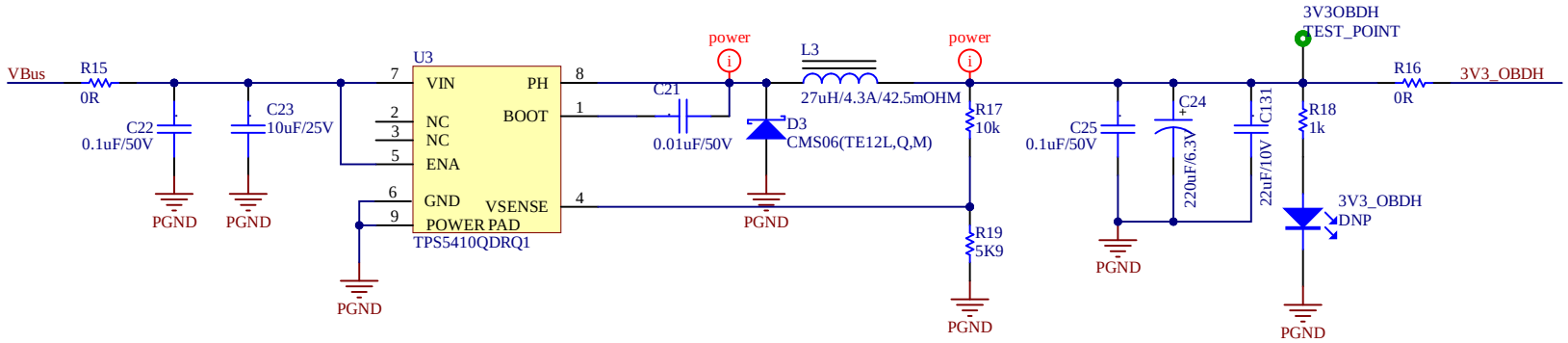






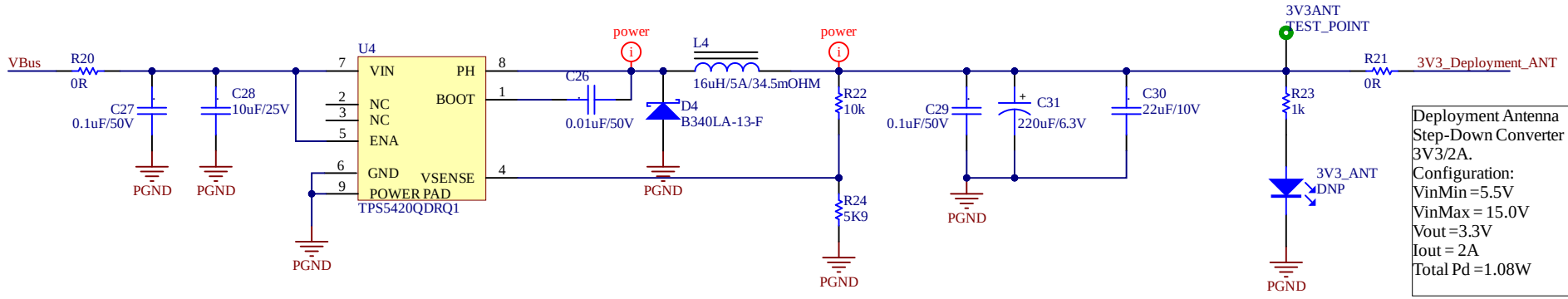
SpaceLab - Federal University of Santa Catarina			
Project: *eps2_project.prjpcb / [No Variations]*			
Title: *Batteries Heater Controller and RTD ADC*			
Designed by: *André M. P. Mattos*			Project Code: *EPS2*
Date: 23/10/2022	Revision: *v0.2*	Sheet *7* of *11*	Size: A4

OBDH STEP-DOWN CONVERTER 3V3/1A



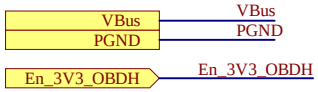
OBDH Digital dc/dc converter 3V3/1A.
Configuration:
VinMin = 6.5V
VinMax = 15.0V
Vout = 3.3V
Iout = 1A
Pd = 0.58W

ANTENNA DEPLOYER STEP-DOWN CONVERTER 3V3/2A



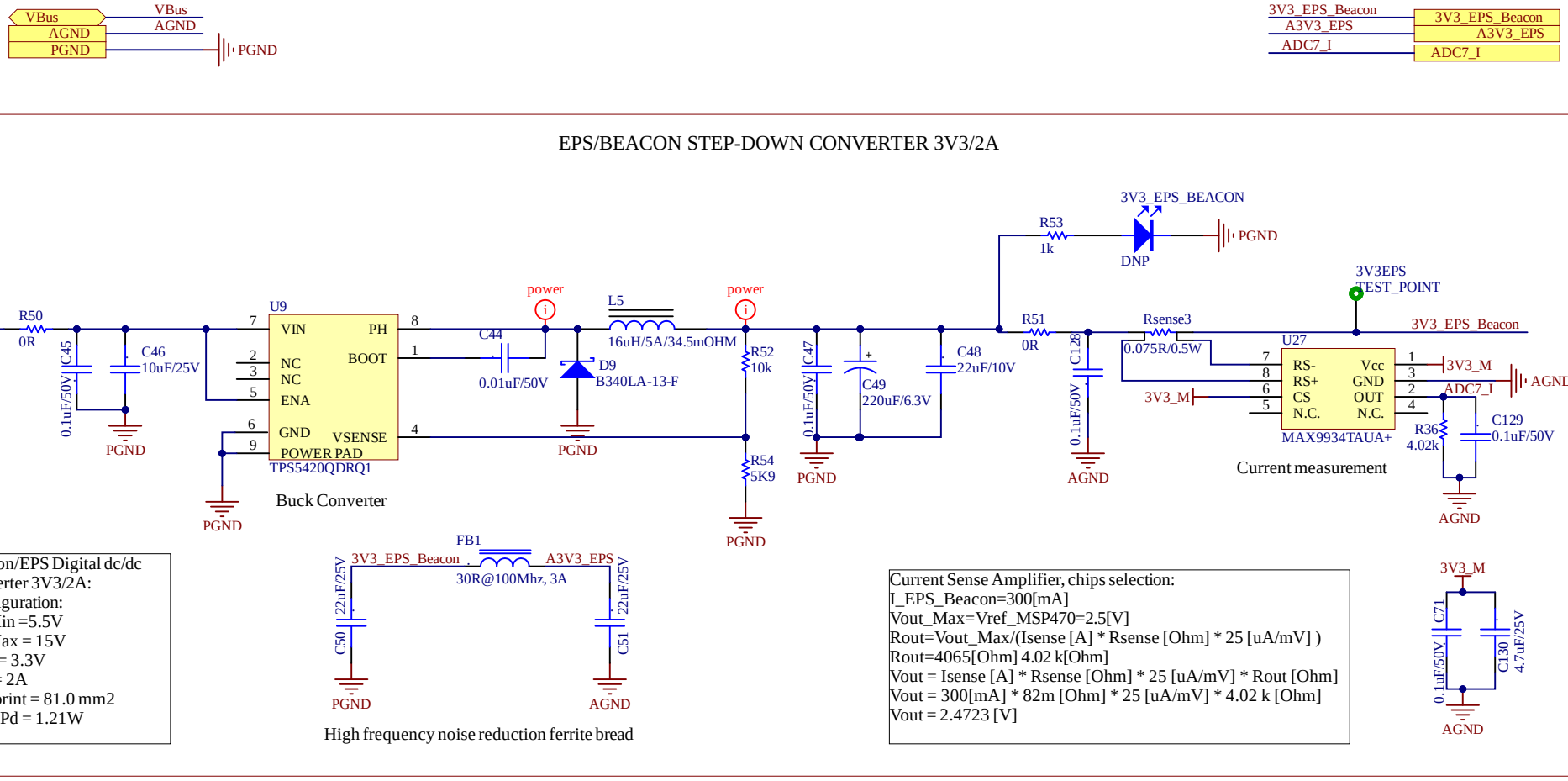
Deployment Antenna Step-Down Converter 3V3/2A.
Configuration:
VinMin =5.5V
VinMax = 15.0V
Vout =3.3V
Iout = 2A
Total Pd =1.08W

Input



Output

SpaceLab - Federal University of Santa Catarina			
Project: *eps2_project.prjpcb / [No Variations]*			
Title: *OBDH and Antenna Deployment Step-Down (3V3/1A and 3V3/2A)*			
Designed by: *André M. P. Mattos*			Project Code: *EPS2*
Date: 23/10/2022	Revision: *v0.2*	Sheet *8* of *11*	Size: A4



SpaceLab - Federal University of Santa Catarina			
Project: *eps2_project.prjpcb / [No Variations]*			
Title: *EPS/Beacon Step-Down Converter (3V3/2A)*			
Designed by: *André M. P. Mattos*			Project Code: *EPS2*
Date: 23/10/2022	Revision: *v0.2*	Sheet *9* of *11*	Size: A4

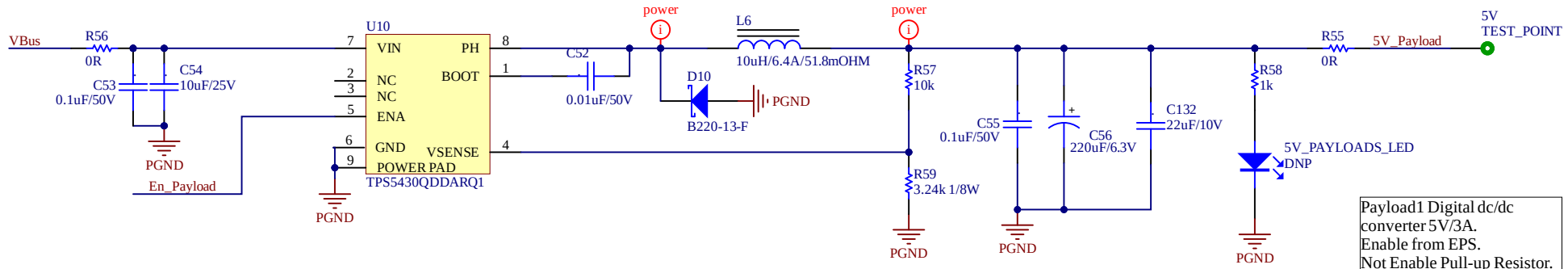
Input

VBus
PGND
En_Payload

Output

5V_Payload

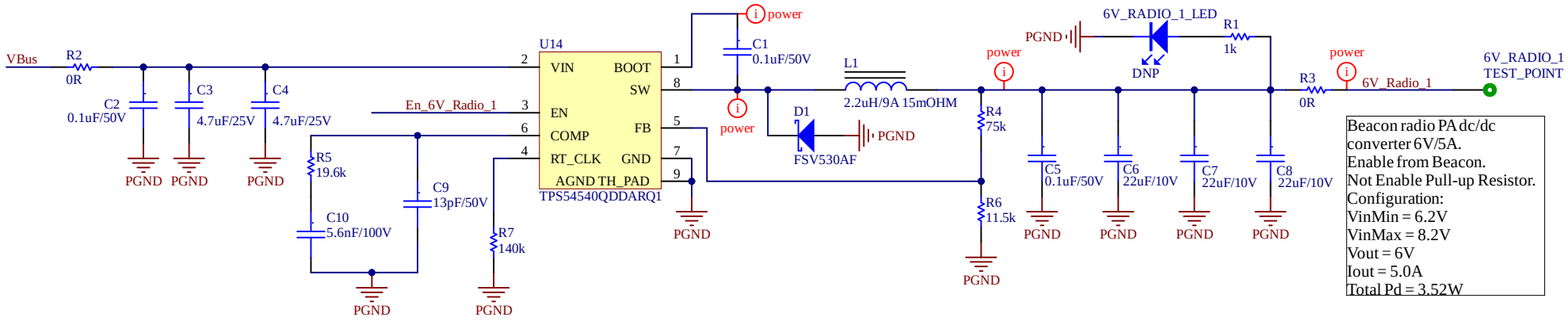
PAYLOAD STEP-DOWN CONVERTER 5V/3A



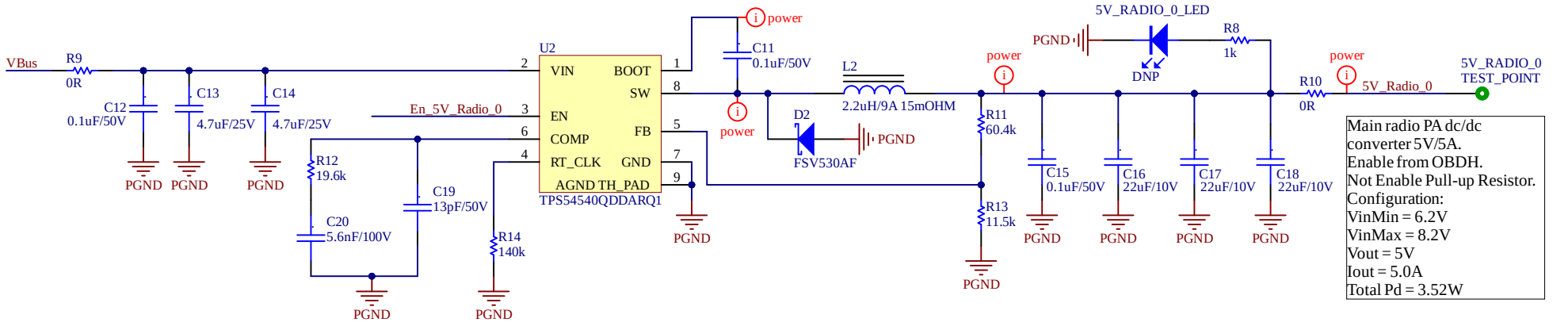
Payload1 Digital dc/dc converter 5V/3A.
Enable from EPS.
Not Enable Pull-up Resistor.
Configuration:
VinMin = 6.2V
VinMax = 8.4V
Vout = 5.0V
Iout = 3.0A
Total Pd = 1.83W

SpaceLab - Federal University of Santa Catarina			
Project: *eps2_project.prjpcb / [No Variations]*			
Title: *Payloads Step-Down Converters (5V/3A)*			
Designed by: *André M. P. Mattos*			Project Code: *EPS2*
Date: 23/10/2022	Revision: *v0.2*	Sheet *10* of *11*	Size: A4

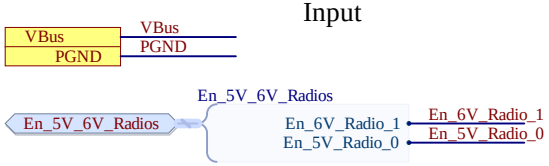
"RADIO 1" STEP-DOWN CONVERTER 6V/5A



"RADIO 0" STEP-DOWN CONVERTER 5V/5A



Input



Output

SpaceLab - Federal University of Santa Catarina			
Project: *eps2_project.prjpcb / [No Variations]*			
Title: *Beacon and Main Radio Step-Down Converters (6V/3A and 5V/3A)*			
Designed by: *André M. P. Mattos*			Project Code: *EPS2*
Date: 23/10/2022	Revision: *v0.2*	Sheet *11* of *11*	Size: A4