Daughter Board Schematic Design Review

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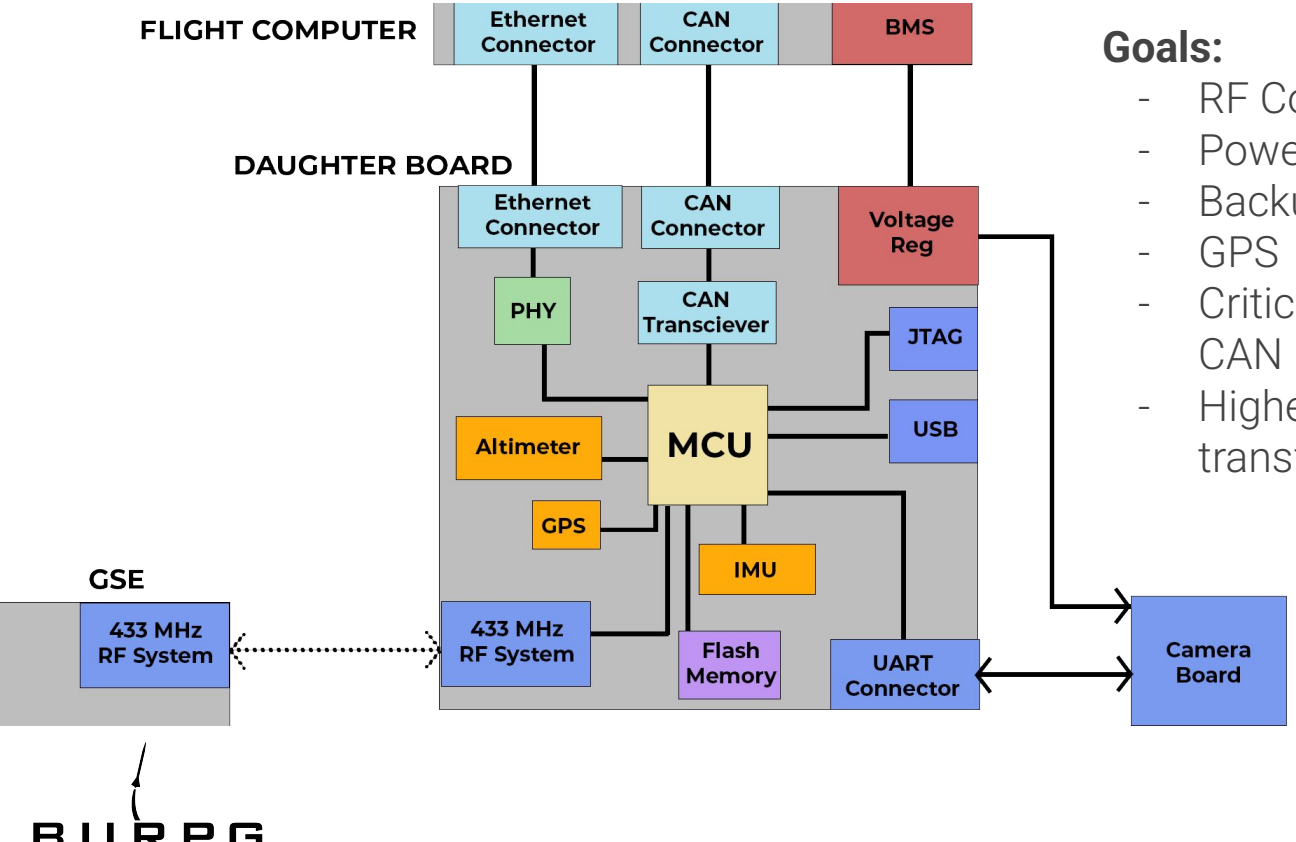
Last Edited: 3/20/2026

System Overview

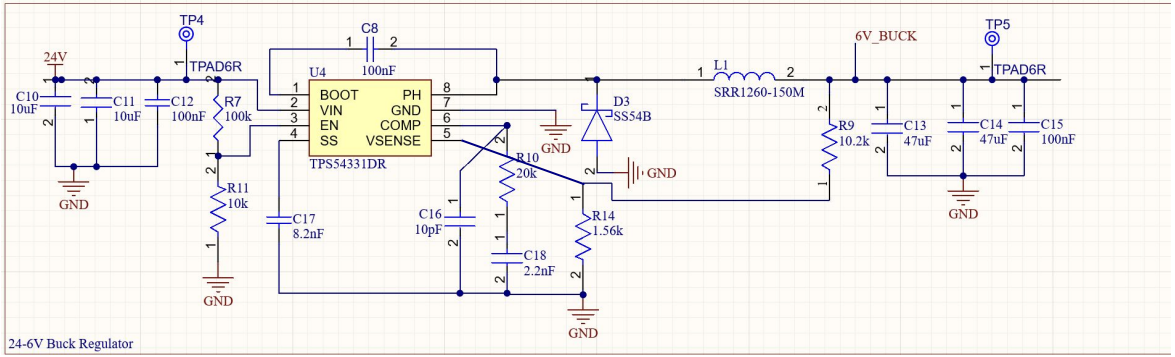


Goals:

- RF Communication with GSE
- Power and control camera
- Backup Altimeter and IMU
- GPS
- Critical communications with FC via CAN
- Higher speeds + larger data transfers with FC via Ethernet

Power System

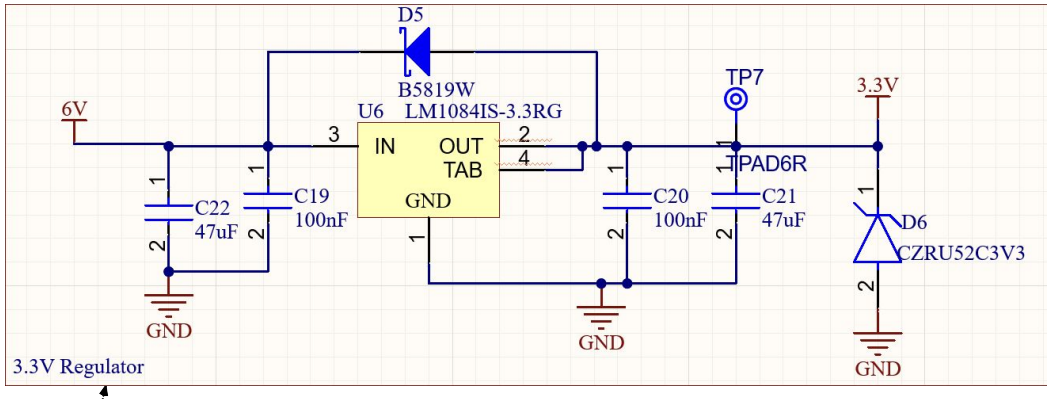
24V -> Buck Converter -> 6V (for camera) -> LDO -> 3.3V



- Copied from FC 24V to 5V buck
- Output changed by changing R5 and R6:

$$V_{OUT} = V_{REF} \times \left(\frac{R5}{R6} + 1\right)$$

$$0.8\left(\frac{10.2}{1.56} + 1\right) = 6.030$$

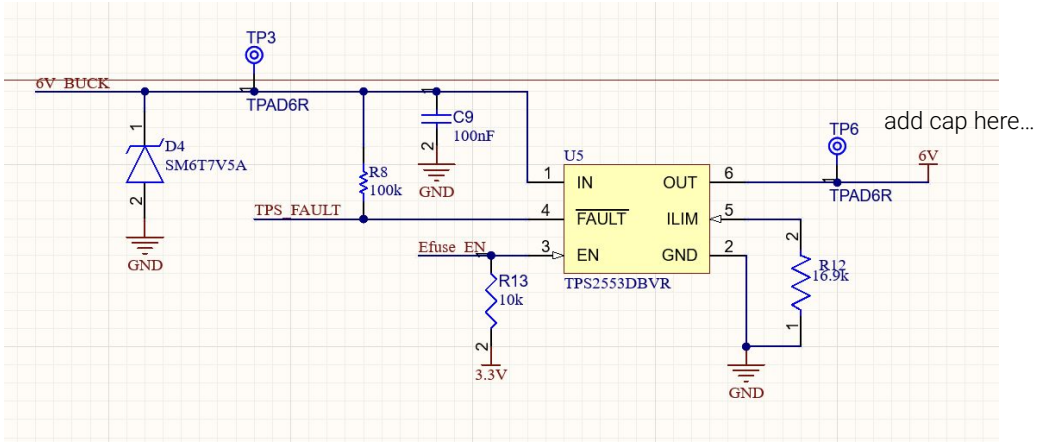


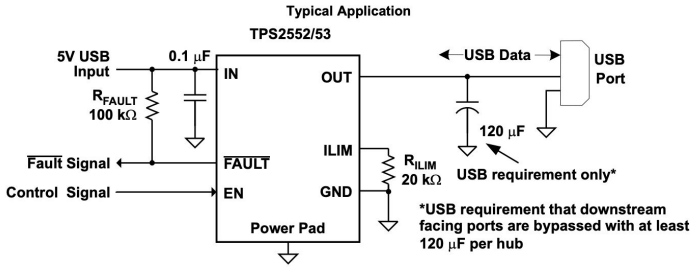
- Copied from FC 5V to 3.3V converter
- |Vout-Vin| = 2.7V, within limit

Power System

Circuit Protection

- Diode: V_{BR} = 7.5V
  It was used for 5V rail on FC where max current limiter input was 5.5V (switch to 6.8V for 7V limit on this current limiter?)
- Current limit = ~1.5A (approx safeguard to not completely fry anything) **15 kΩ ≤ R_{ILIM} ≤ 232 kΩ.**

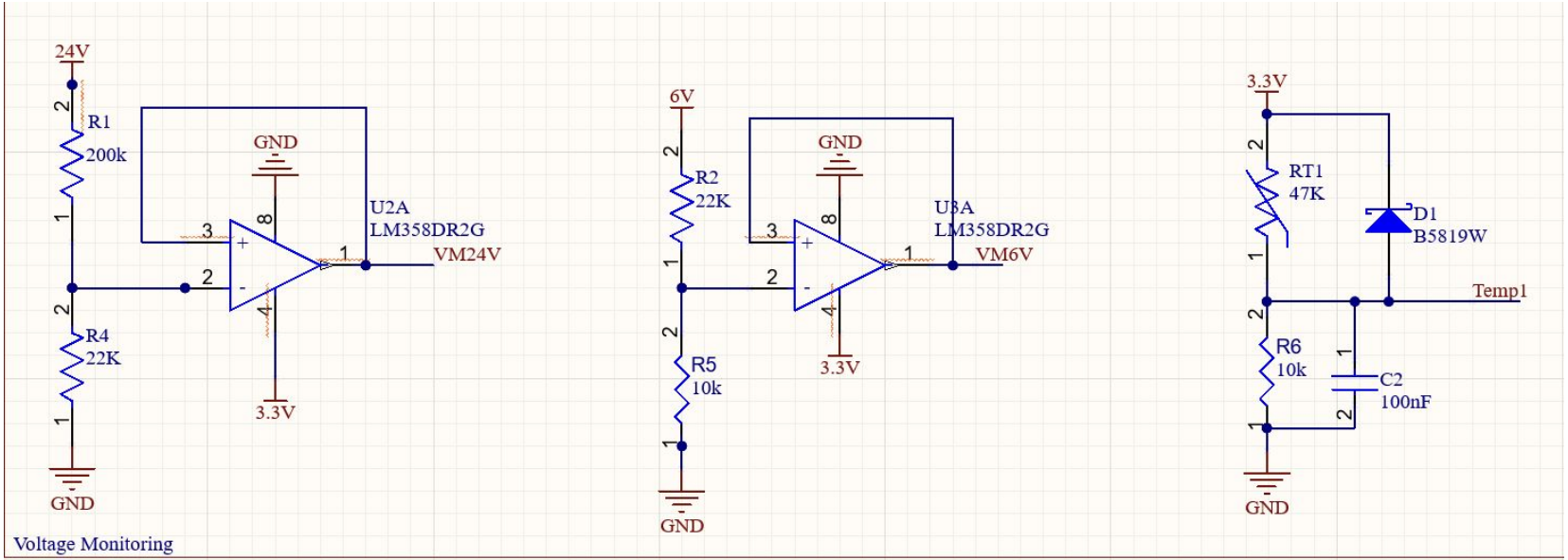




Power System

Voltage/Temp Monitoring

- Copied from FC, VM6V value changed

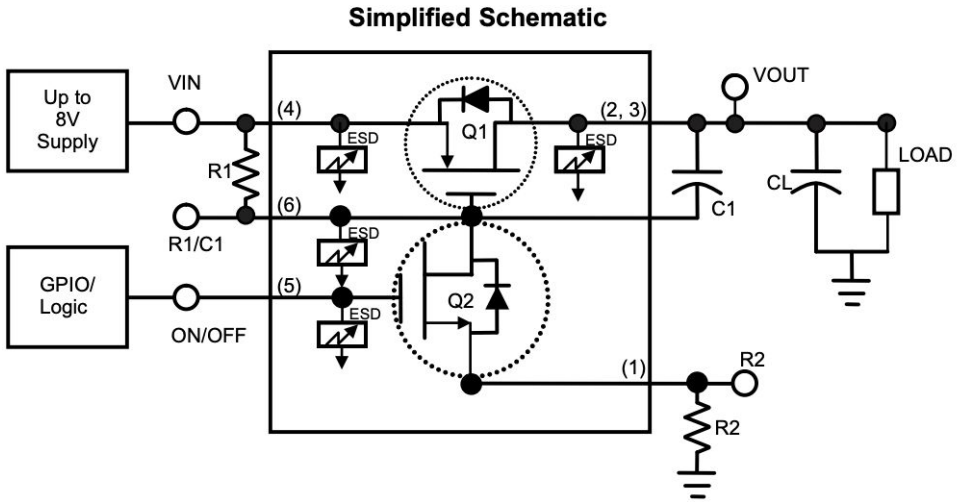


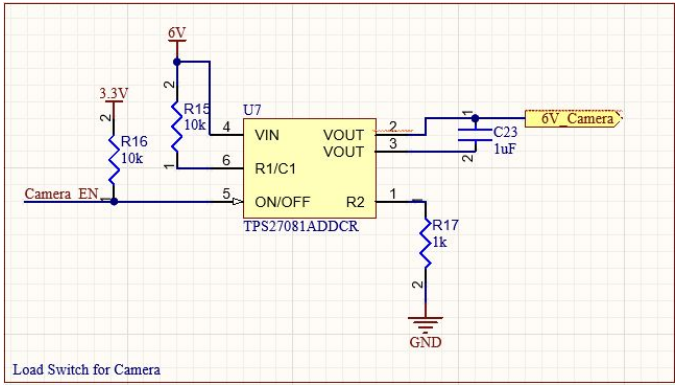
Expected:

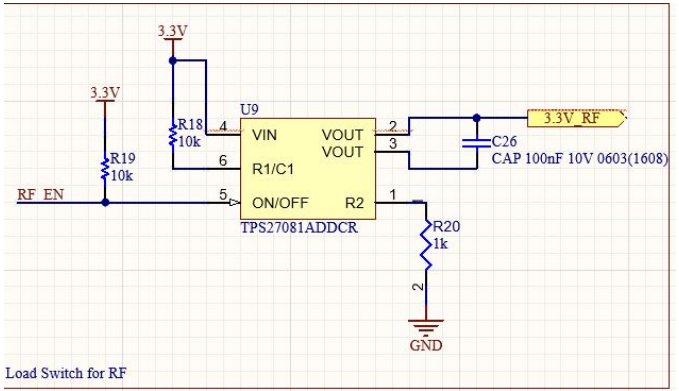
VM24V = 2.38V, VM6V = 1.875V Temp1 = 0.579V (at 25C)

Power System

Load Switches: Ability to isolate and turn off RF and Camera modules to conserve power







- C_1 slows voltage rise (1ms for camera, 0.1ms for RF)
- Naturally ON -> switch to OFF

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Camera Interface

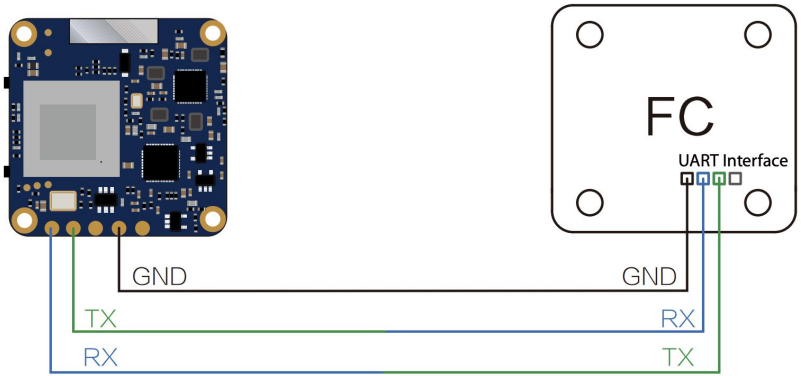
UART Communication with Camera Module

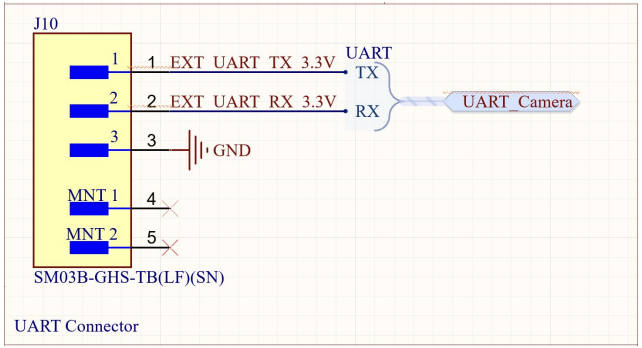
Camera takes 5-20V, we're supplying 6V

Camera current limit = 450mA

1ms rise time controls for inrush current

Additional current protection: Swap camera load switch for current limiting load switch? Add fuse? Its an $80 camera





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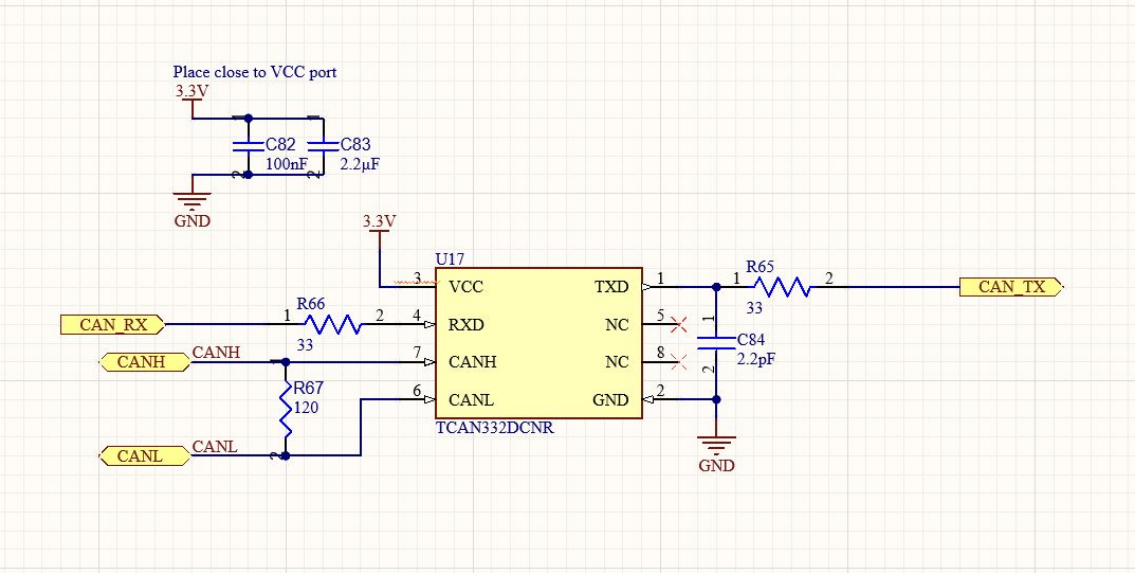
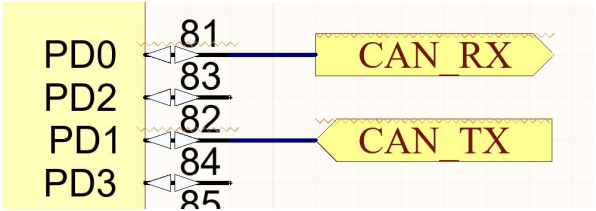
CAN (TCAN332DCNR)

Copied directly from FC:



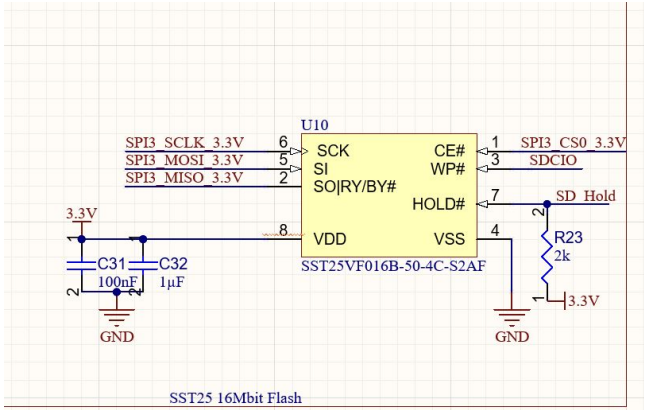
RX to RX, TX to TX:

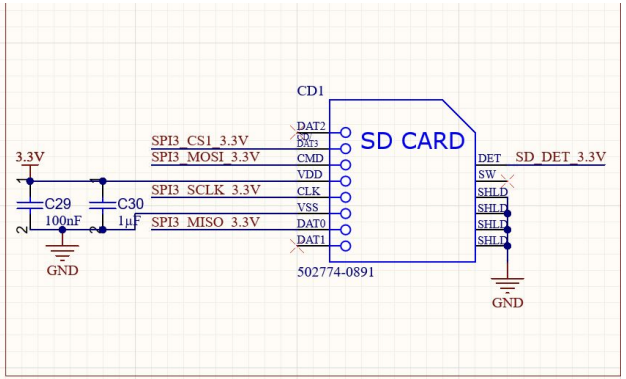
PD0	I/O	FT	-	FSMC_D2/CAN1_RX/ EVENTOUT
PD1	I/O	FT	-	FSMC_D3 / CAN1_TX/ EVENTOUT



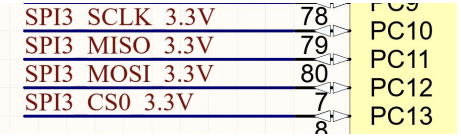
Flash Memory (SST25)

Copied directly from FC:





STM32 Connections:



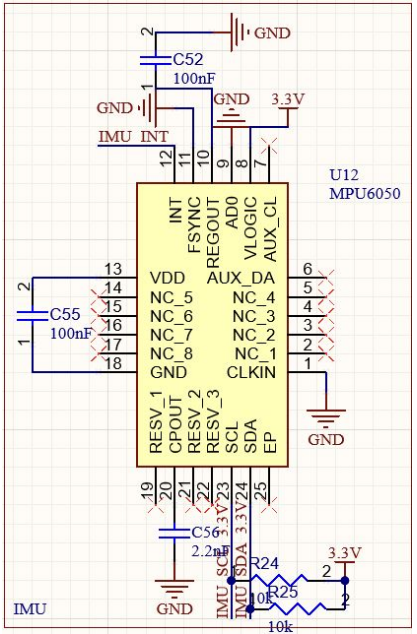
SPI3:

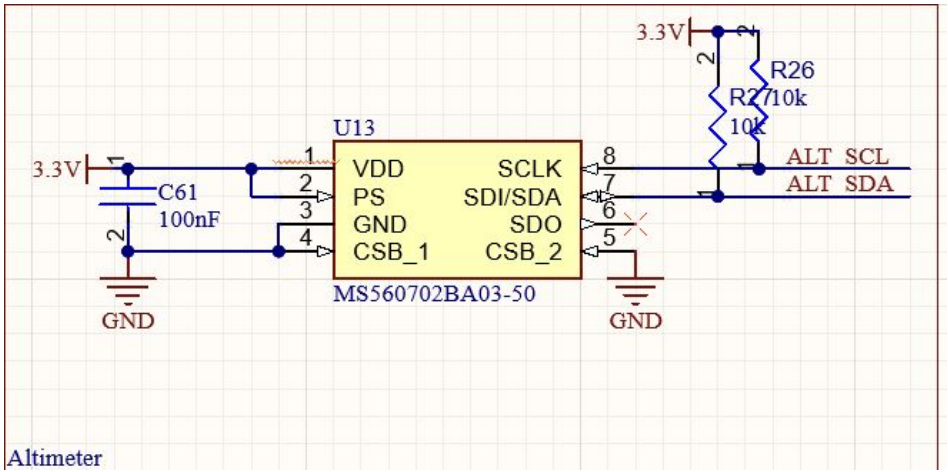
PC10	I/O	FT	-	SPI3_SCK / I2S3_CK/ UART4_TX/SDIO_D2 / DCMI_D8 / USART3_TX/ EVENTOUT
PC11	I/O	FT	-	UART4_RX/ SPI3_MISO / SDIO_D3 / DCMI_D4/USART3_RX / I2S3ext_SD/ EVENTOUT
PC12	I/O	FT	-	UART5_TX/SDIO_CK / DCMI_D9 / SPI3_MOSI /I2S3_SD / USART3_CK/ EVENTOUT

GPIOs: CS0, CS1, SD_Det, SD_Hold, SDCIO

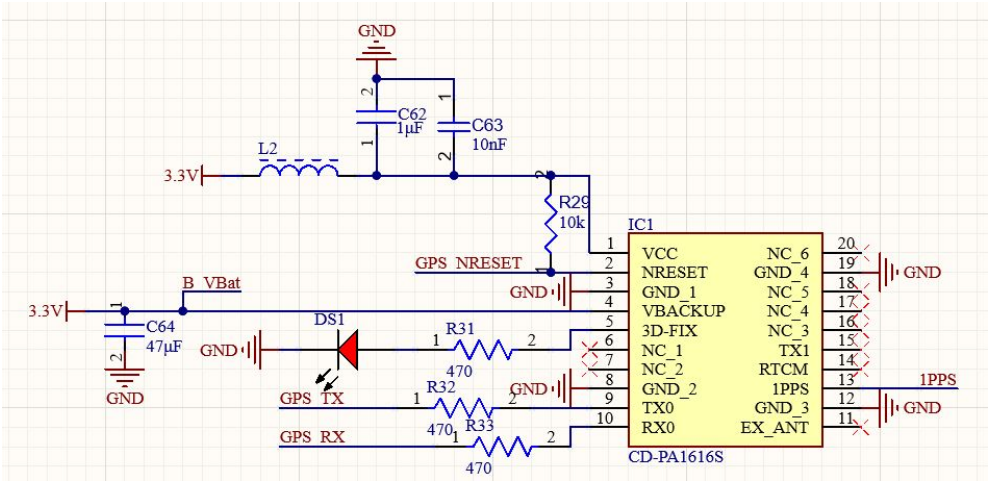
Altimeter + IMU

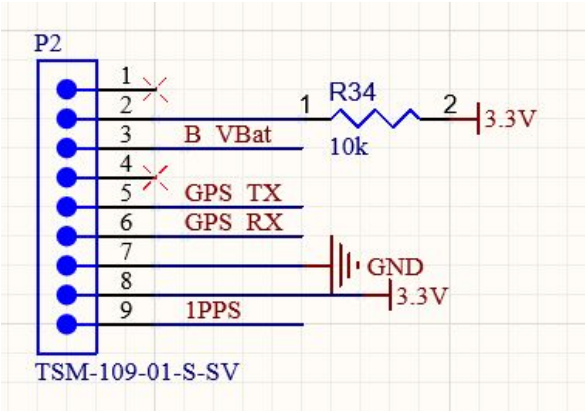
Copied directly from FC





GPS Module (CD-PA1616S)





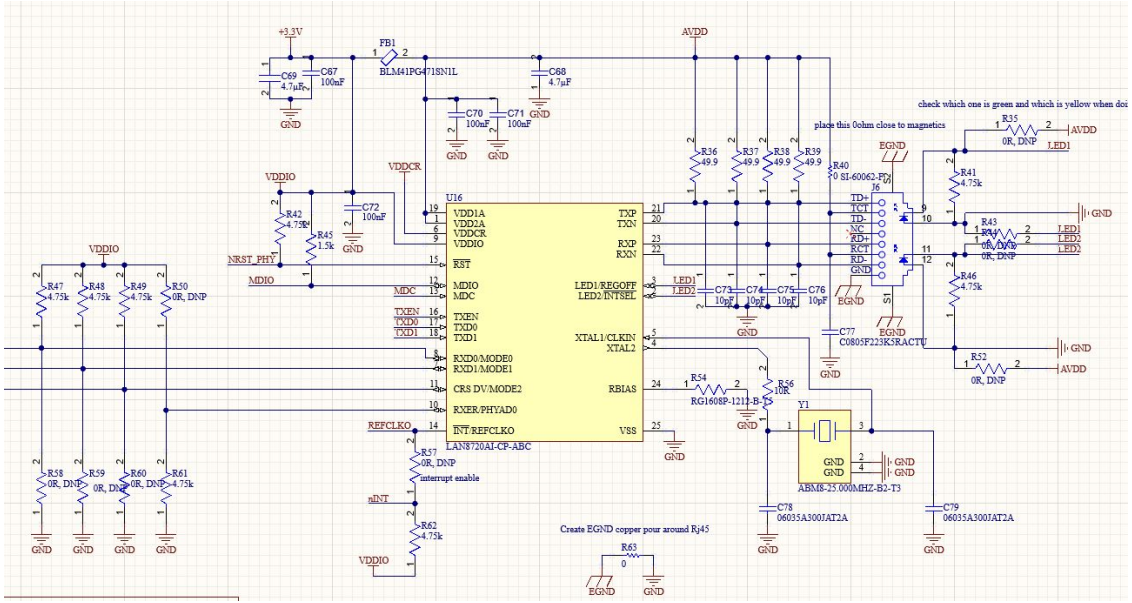
1pps - indicates the start of a second

3D-Fix - indicates satellites connection status

Similar module to Icarus, previous module no longer manufactured, has available breakout board

PHY Module (LAN8720)

- Needs new code, but has RMII, is faster, has better application notes
- 25Mhz clock to 50Mhz REFCLKO Output (interrupt function has to be disabled for this, must poll PHY registers…)
- Generally copied directly from information sheet



DNP pull-up/pull-down resistors for all settings + RMII Test Header + ENC28J60 Breakout

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PHY Module (LAN8720)

MODE[0], MODE[1], MODE[2] = 1
-> all auto negotiation enabled

PHYAD[0] = 0

25.000MHz Crystal Clock Source Enabled	Interrupt Function must be disabled in this configuration.
25MHz Crystal Clock Source Disabled, with Offboard 50MHz Clock Source Provided on TXCLK	Interrupt Function must be enabled in this configuration.
25MHz Crystal Clock Source Disabled, with Offboard 50MHz Clock Source Provided on RXCLK	Interrupt Function must be enabled in this configuration.
25MHz Crystal Clock Source Disabled, with Onboard 50MHz Clock Source Provided on RXCLK	Interrupt Function must be enabled in this configuration.
25MHz Crystal Clock Source Disabled, with Onboard 50MHz Clock Source Provided on RXCLK via REFCLK0	Interrupt Function must be disabled in this configuration.

25Mhz better for EMI

MODE[2:0]	Mode Definitions	Default Register Bit Values	
		Register 0	Register 4
		[13,12,10,8]	[8,7,6,5]
000	10Base-T Half Duplex. Auto-negotiation disabled.	0000	N/A
001	10Base-T Full Duplex. Auto-negotiation disabled.	0001	N/A
010	100Base-TX Half Duplex. Auto-negotiation disabled. CRS is active during Transmit & Receive.	1000	N/A
011	100Base-TX Full Duplex. Auto-negotiation disabled. CRS is active during Receive.	1001	N/A
100	100Base-TX Half Duplex is advertised. Auto-negotiation enabled. CRS is active during Transmit & Receive.	1100	0100
101	Repeater mode. Auto-negotiation enabled. 100Base-TX Half Duplex is advertised. CRS is active during Receive.	1100	0100
110	Power Down mode. In this mode the transceiver will wake-up in Power-Down mode. The transceiver cannot be used when the MODE[2:0] bits are set to this mode. To exit this mode, the MODE bits in Register 18.7:5(see Section 4.2.9, "Special Modes Register," on page 50) must be configured to some other value and a soft reset must be issued.	N/A	N/A
111	All capable. Auto-negotiation enabled.	X10X	1111

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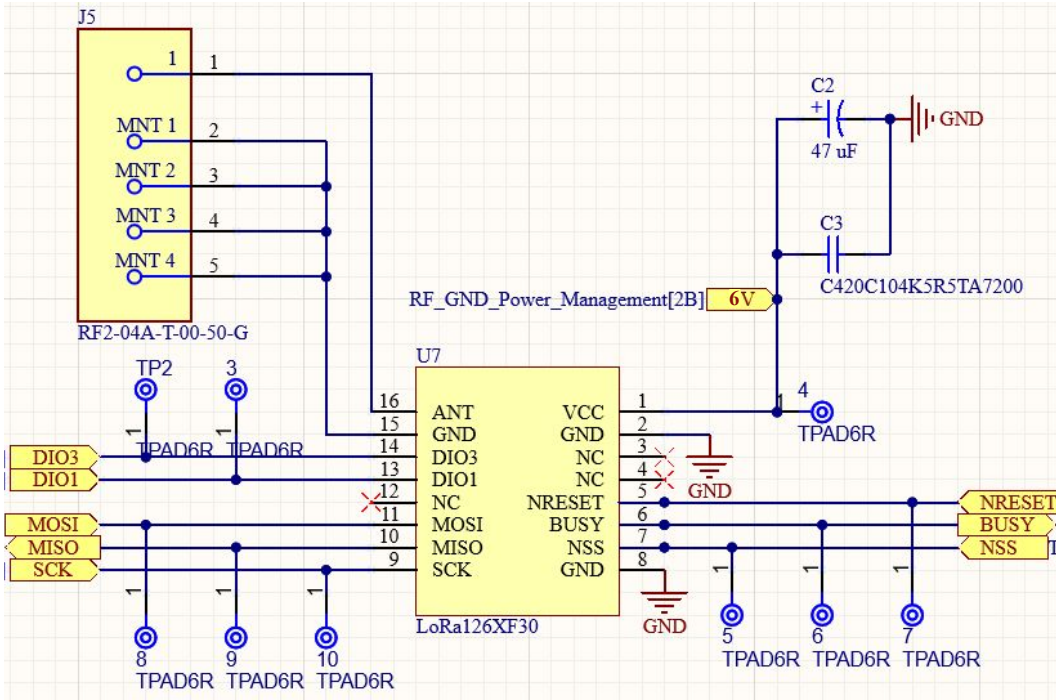
RF System

Copied from ground RF

- Power swapped from 5V to 6V for LoRa (operating conditions 3 - 6.5V)



Debugging

USB Connector:

- Powers MCU without separate power supply
- Prints to serial !!

JTAG:

- Connected to NRST (NOT NJTRST)
- Breakpoints, variable inspection, flashing

Test Points:

- Will put them everywhere after design is finalized

Breakouts/Backups

- UART, GPS, Altimeter, IMU
- PHY has RMII test connector + ENC28J60 Breakout + DNP pull-up/pull-down resistors for all settings

Approximate Cost

IO	$0.33x2 + $8.56x2 (UART+CAN) + $1.46 (JTAG) + $1.04 (USB)
MCU: STM32F407VGT6	$5.54
PHY	$1.45 + $8.78 (oscillator) + $3.96 + $11.55 (mag jack)
GPS: PA1616 + Breakout	$19.95 + $29.95
Altimeter	$3.38
IMU	$1.00
Flash Memory	$3.50 + $1.62
Power	$0.34x2 + $0.27 + $0.40 + $0.26 + $0.23
RF	$4.78 + $11.26

Parts Total:
$128.84

Thank you!