Sheet: InverterControlAndIsolation

File: InverterControlAndIsolation.sch

Sheet: MscPowerInput

File: MscPowerInput.sch

Sheet: PIC16MCU

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Sheet: RS232-UART

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Sheet: ModemPower

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File: RPiPowerControl.sch

Sheet: BattVoltageDetect

File: BattVoltageDetect.sch

Sheet: RTCModule

File: RTCModule.sch

Revision Notes:
--- REV B ---
B1. Replaced USB connector with Molex Minifit-JR 4.2mm 2x2 socket
B2. Replaced DB9 connector with 10 pin IDC Header (polarized)
B3. Replaced Main Pi header with 16 pin IDC Header (polarized)
B4. Replaced 5V Buck Converter with new controller as per TI Webench
B5. Removed the 5V Buck Converter relay in place of controller enable pin
B6. Added RTC Module with backup battery
B7. Added Tri-state buffer to the common RTC/ADC/MCU/PI SPI bus to prevent bus collisions (disabling MCU access to RTC while Pi is active.
B8. Changed voltage divider and added voltage buffer / amplifier before ADC to provide safer reading
B9. Added VBAT Inrush Current Limiter, 4A Min-Blade Auto Fuse, 24VDC MOV, and reverse voltage shutoff PMOS Transistor
B10. Added low current indicator LEDs.
B11. Replaced 3V3 Buck Converter with more efficient, higher power version.
B12. Moved MCU net pins around for better routing.

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Sheet: /
File: SiteControl.sch

Title: Telescope Base Station Control Board

Size: A4	Date: September 27, 2016	**Rev:** B
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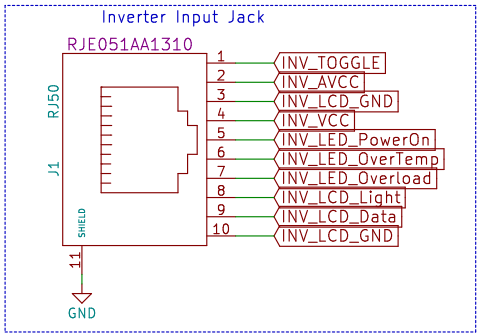

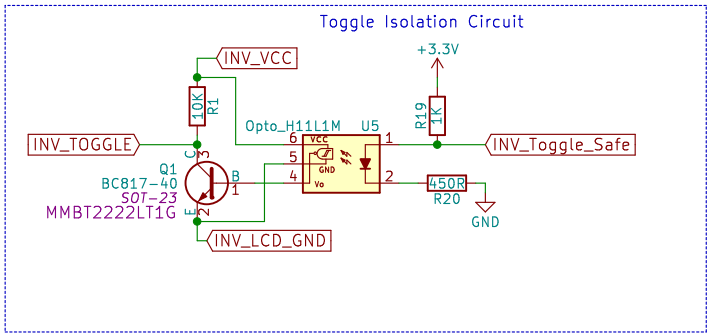

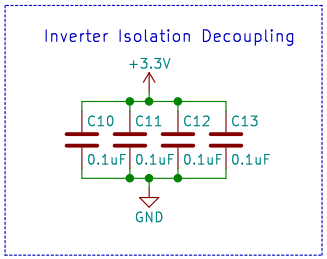

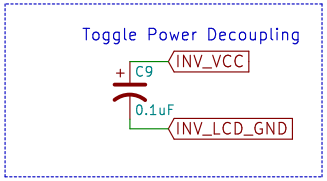

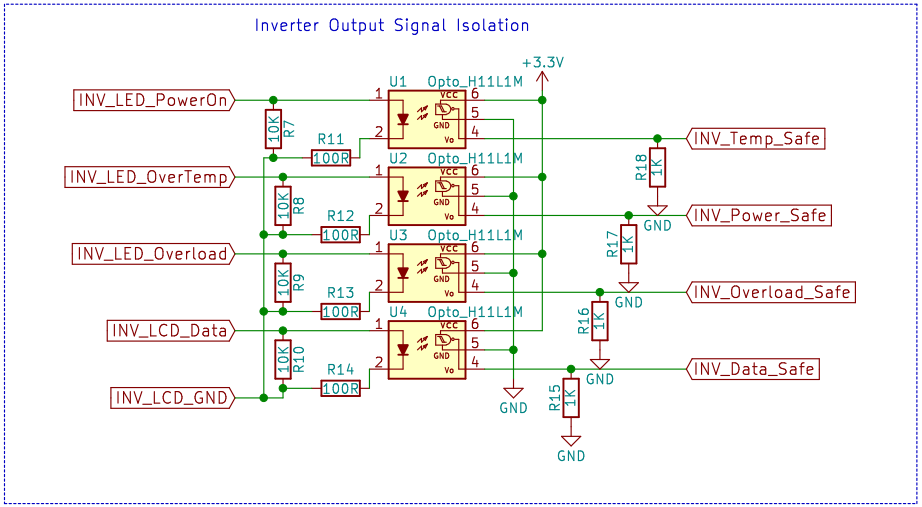

NOTES: The Samlex PST2000-12 inverter contains an RJ50 jack for interfacing with the RC-200 remote control. The engineers at Samlex have kindly provided application circuits for the basic circuitry within the RC-200 which will allow us to improvise our own controller which can be directly connected to the PIC 16 and thus the Raspberry Pi and RF Modem. This will allow us to remotely (from a distance of several km) activate and de-activate the inverter, as well as monitor information such as voltage, temperature, and power consumption.

Since the inverter RJ50 jack contains inverter main board level voltages (supposedly VBATT), the circuit will be isolated from the rest of the control board via opto-isolators. The metal case of the RJ50 jack will, however, be grounded to the chassis ground.

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Sheet: /InverterControlAndIsolation/
File: InverterControlAndIsolation.sch

Title: Telescope Base Station Control Board

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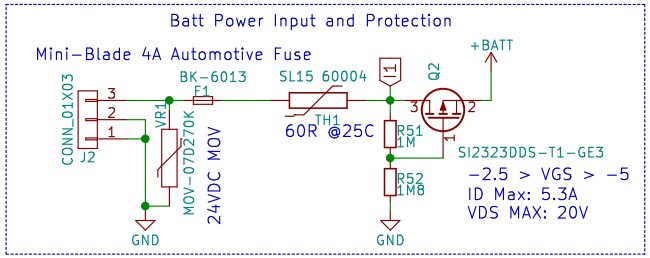

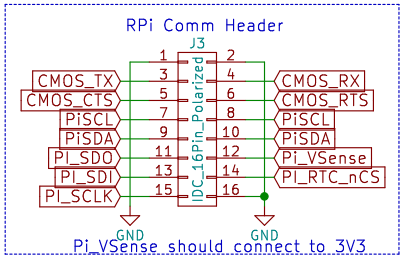

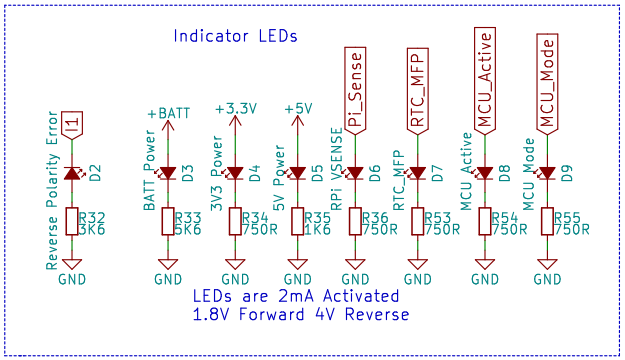

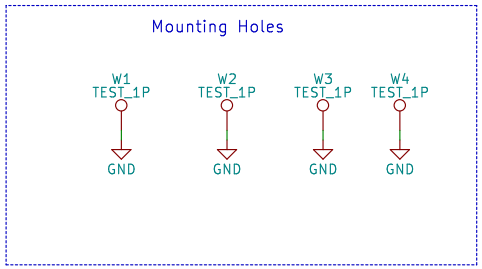

NOTES: The main power input terminal contains a second ground to allow for electrical connection with the enclosure. Since the board should be attached to a metal case (for shielding) via standoffs, and the mounting holes are grounded, this electrical connection should already be accomplished.

The main input terminal contains the following input protection:
- 24VDC MOV Surge Protection
- 4A Replacable Mini-Blade Auto Fuse
- 60 Ohm 4.5A NTC Inrush Current Limiter
- PMOS low ESR Reverse VBAT Detection Circuit

The above should prevent damage under the conditions of: 1) An electrical short, 2) a lightning strike, 3) inrush current surge from connecting the main battery, 4) accidental battery polarity mismatch

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Sheet: /MscPowerInput/
File: MscPowerInput.sch

Title: Telescope Base Station Control Board

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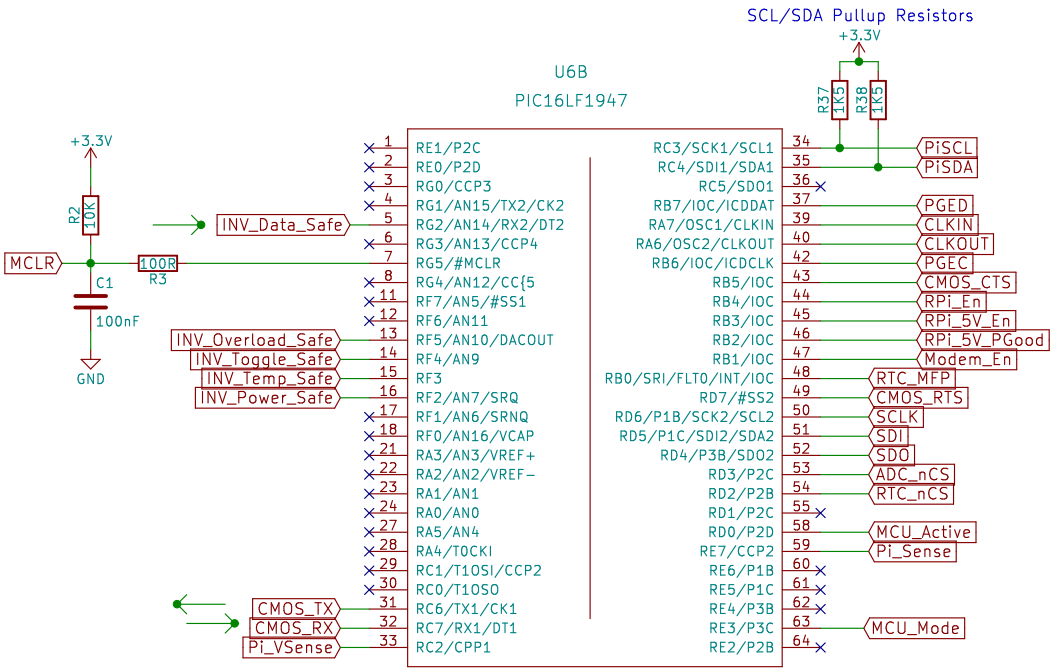

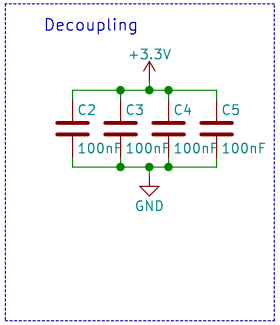

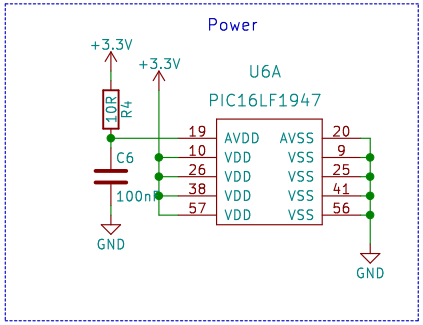

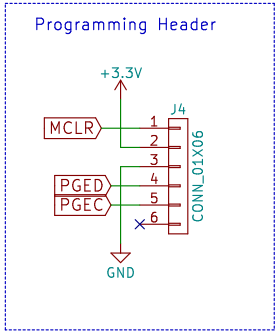

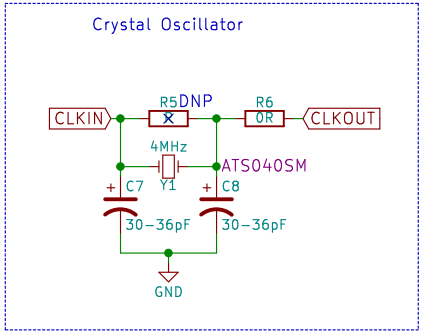

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Sheet: /PIC16MCU/
File: PIC16MCU.sch

Title: Telescope Base Station Control Board

Size: A4	Date: September 27, 2016	**Rev:** B
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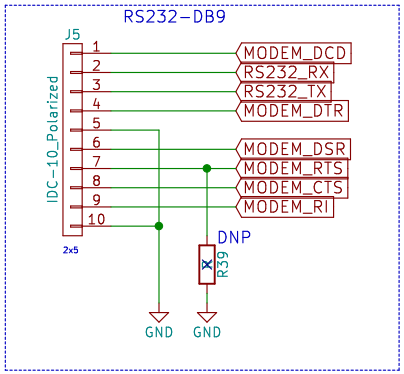

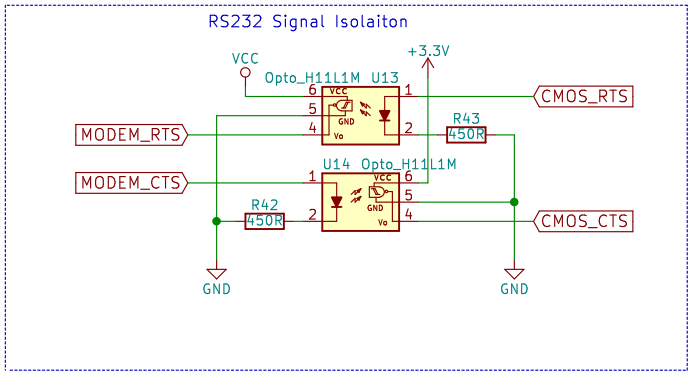

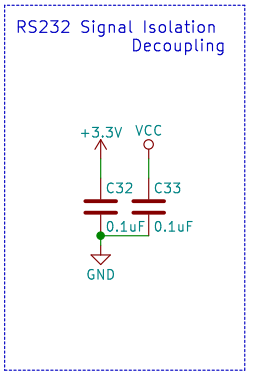

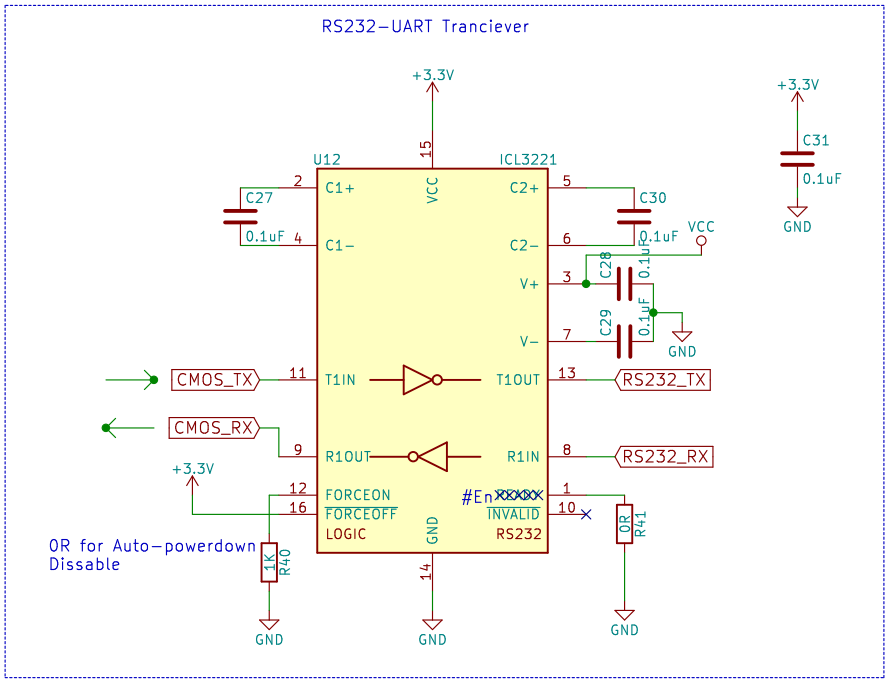

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Sheet: /RS232-UART/
File: RS232-UART.sch

Title: Telescope Base Station Control Board

Size: A4	Date: September 27, 2016	**Rev:** B
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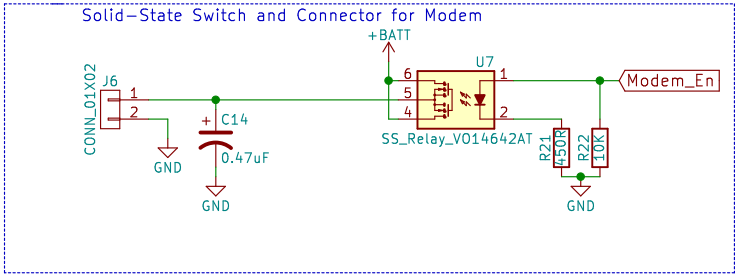

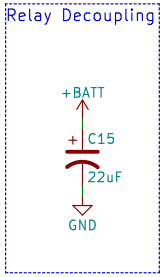

NOTES: The modem can be powered by anything between 9 VDC and 16 VDC indicating an internal power supply / regulator. This means that we can simply pipe battery power directly to the modem (after a switch / relay allowing for hard reset / power consumption)

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Sheet: /ModemPower/
File: ModemPower.sch

Title: Telescope Base Station Control Board

Size: A4 | Date: September 27, 2016 | **Rev:** B
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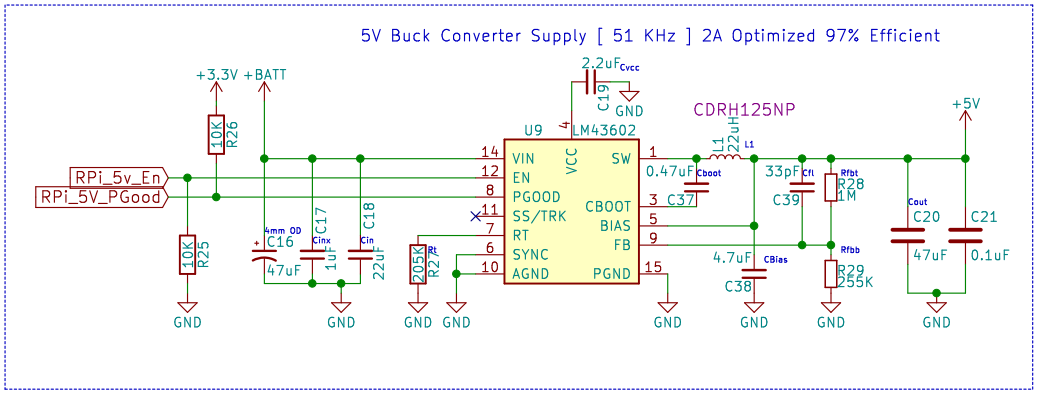

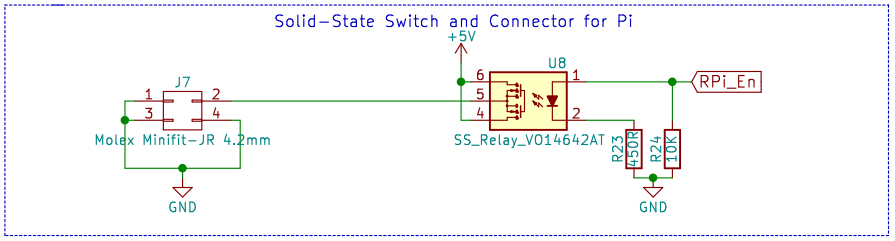

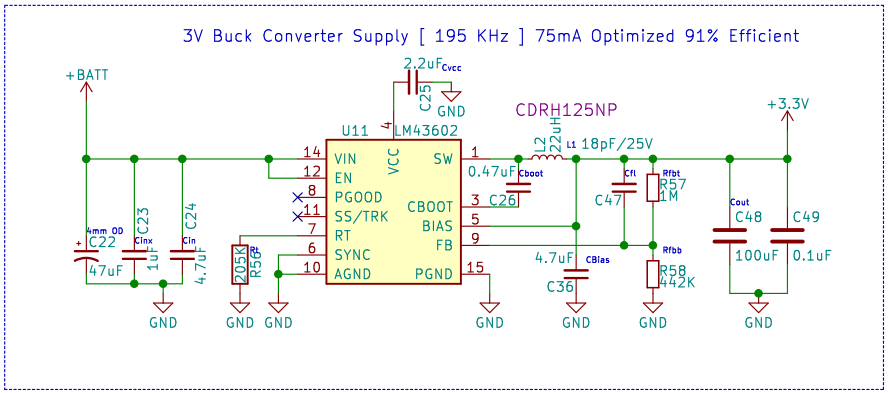

3V3 Rail:
- LEDS: 8 mA
- RTC: 5 mA
- RS232 Module: 1 mA
- ADC: 0.5 mA
- PIC16 Core XT: 0.5 mA
- Opto-Isolators: 25 mA
- PIC16 Sinks: 30 mA
- OpAmp: 1 mA
- Total: 71 mA (Safe: 142 mA)

NOTES: This power supply should supply up to 1.8 A @ 5 VDC. The Raspberry Pi B+ only consumes 350 mA under heavy load, however, the Raspberry Pi 3 consumes 1.2 A under heavy load. Allowing for up to 1.8 A supply allows for a future move to a Raspberry Pi 3 without replacing this circuit.

The buck converter circuits were taken obtained via the Texas Instruments Webench design and optimization software.

The relay control of the buck converter has been changed given the enable signal in the converter controller. This allowed us to remove the 5V enable relay, while maintaining the output relay to quickly hard cycle the Pi, as well as allow for a soft start without prematurely powering the Pi. The PGood signal will be used to determine when the Pi can be safely powered on.

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Sheet: /RPiPowerControl/
File: RPiPowerControl.sch

Title: Telescope Base Station Control Board

Size: A4	Date: September 27, 2016	**Rev:** B
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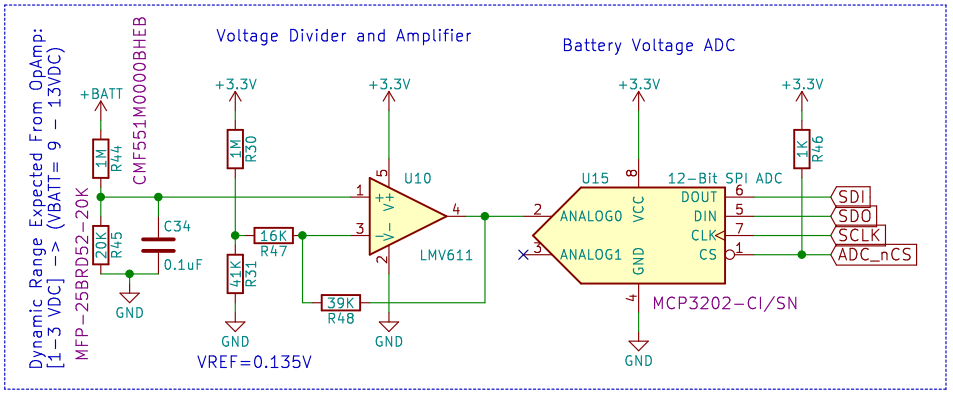

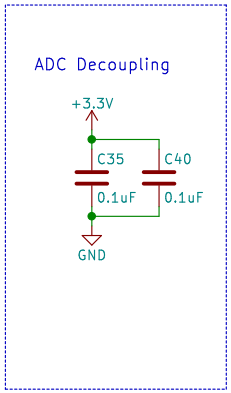

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Sheet: /BattVoltageDetect/
File: BattVoltageDetect.sch

Title: Telescope Base Station Control Board

Size: A4 | Date: September 27, 2016 | **Rev:** B
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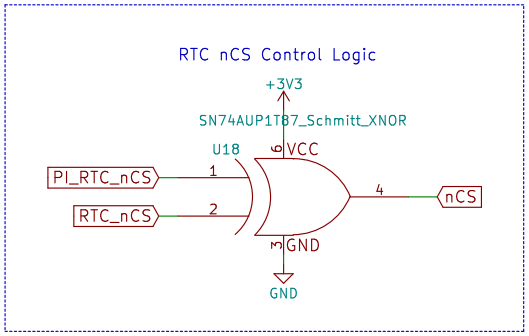

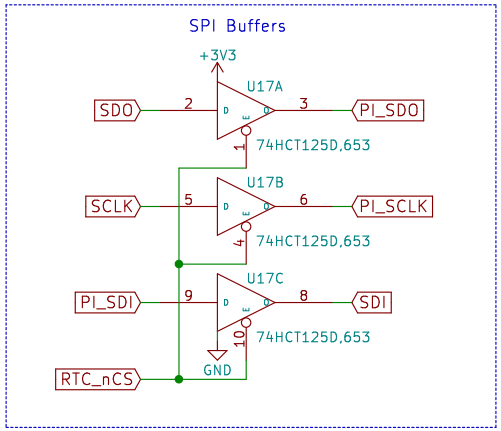

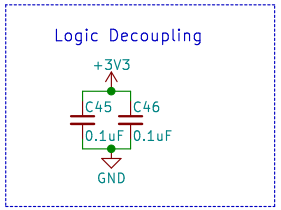

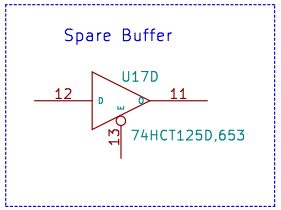

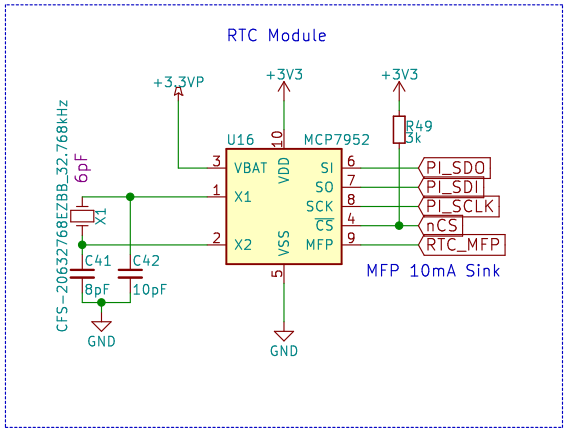

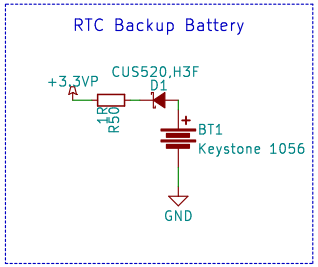

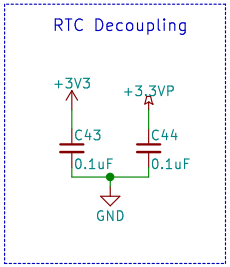

Buffer Truth Table:

Pi_nCS	MCU_nCS	EN	$\overline{EN}$	RTC_nCS
0	0	U	U	U
0	1	0	1	0
1	0	1	0	0
1	1	X	X	1

Final Logic Equations:

$\overline{EN}$ = MCU_nCS

RTC_nCS = $\overline{Pi\_nCS}$ (+) MCU_nCS

NOTES:
The RTC Module will use a CR1220 coin cell back-up battery.
Typical specs are 3V @ 36mAh for $0.62 each. The MCP7952 run on approx 700 nA stand-by current when VCC < VThrs. With a 36mAh battery, the RTC should keep time for 2083 days. Since the MCP7952 requires 1.8V min, then assume at least 800 days of operation.

The MCP7952 will have the SPI bus connected to both the Pi and the PIC MCU. This will allow the Pi to directly access the RTC, as well as allow the MCU to access the RTC while the Pi is offline.

A combined logic and tri-state buffer system will be used to allow the Pi complete access to the RTC without disrupting the MCU SPI bus with the ADC.

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Sheet: /RTCModule/
File: RTCModule.sch

Title: Telescope Base Station Control Board

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