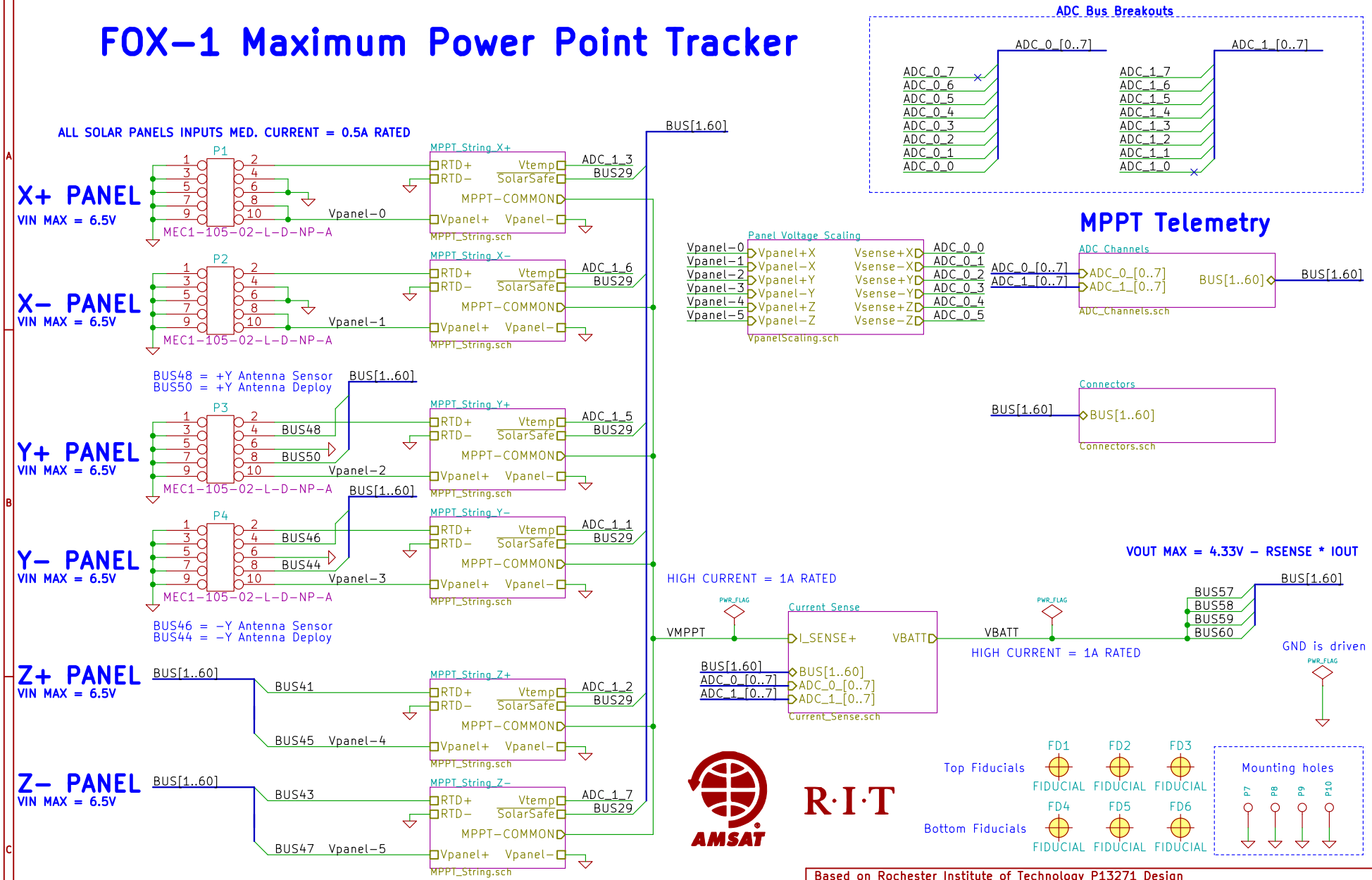
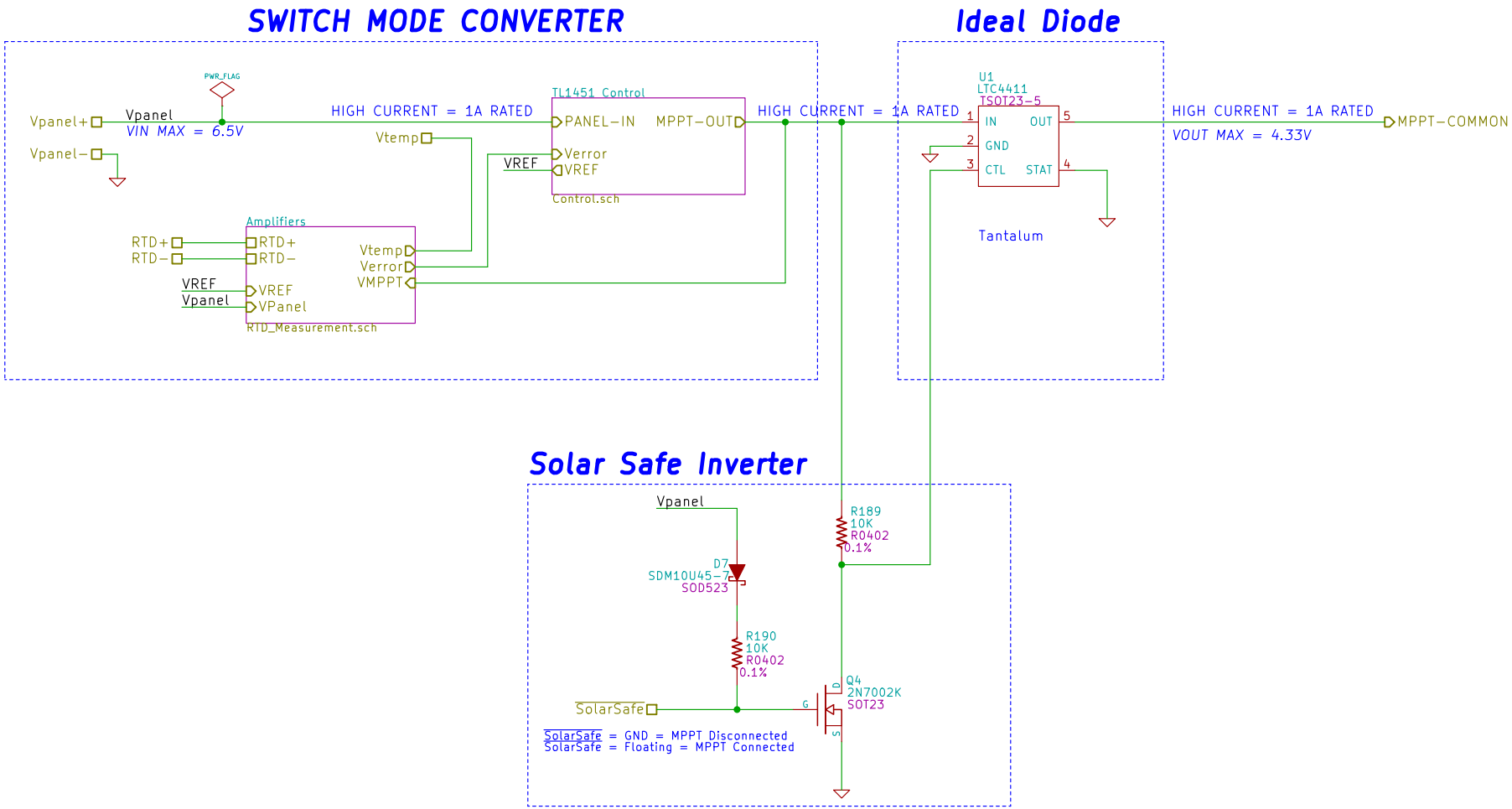
FOX-1 Maximum Power Point Tracker



NOTES

* This MPPT implements a set-point constant voltage tracking algorithm based on panel temperature.
* RIT MPPT Team: Brenton Salmi (KB1LQD), Bryce Salmi (KB1LQC), Ian MacKenzie (KB3OCF), Daniel Corriero.
* NASA derating taken into account, not gauranteed

Based on Rochester Institute of Technology P13271 Design	
Brent Salmi, KB1LQD	
Bryce Salmi, KB1LQC	
The Radio Amateur Satellite Corporation	
File: TL1451_MPPT_Flight_Rev1.sch	
Sheet: /	
Title: Fox-1 Maximum Power Point Tracker	
Size: USLetter *Date: 30 nov 2015*	*Rev: 2.0*
KiCad E.D.A.	Id: 1/37



NOTES

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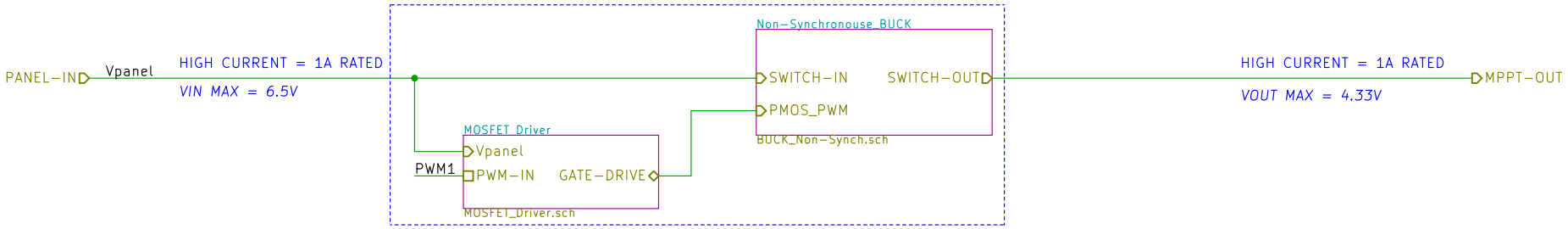
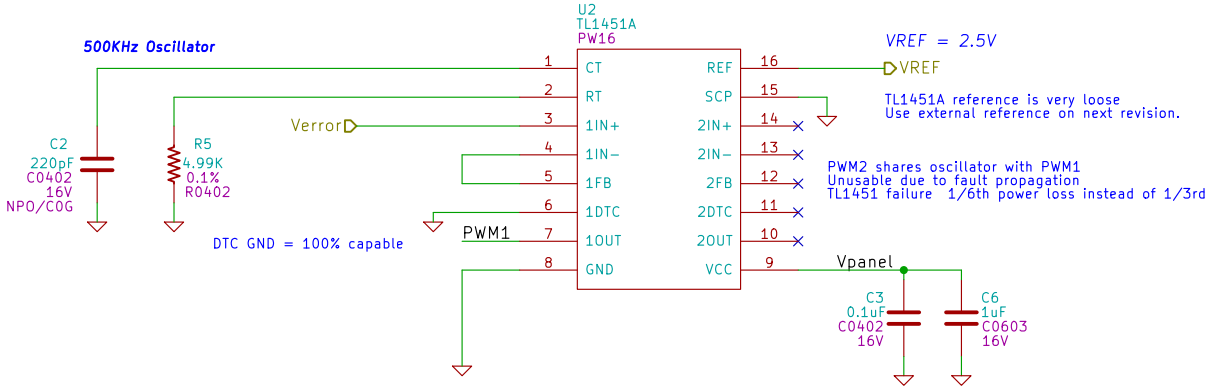
* NASA derating taken into account, not gauranteed

Based on Rochester Institute of Technology P13271 Design		
Brent Salmi, KB1LQD		
Bryce Salmi, KB1LQC		
The Radio Amateur Satellite Corporation		
File: MPPT_String.sch		
Sheet: /MPPT_String_X+/		
Title: Fox−1 Maximum Power Point Tracker		
Size: A	*Date: 30 nov 2015*	*Rev: 2.0*
KiCad E.D.A.		Id: 2/37

Switch Mode Converter





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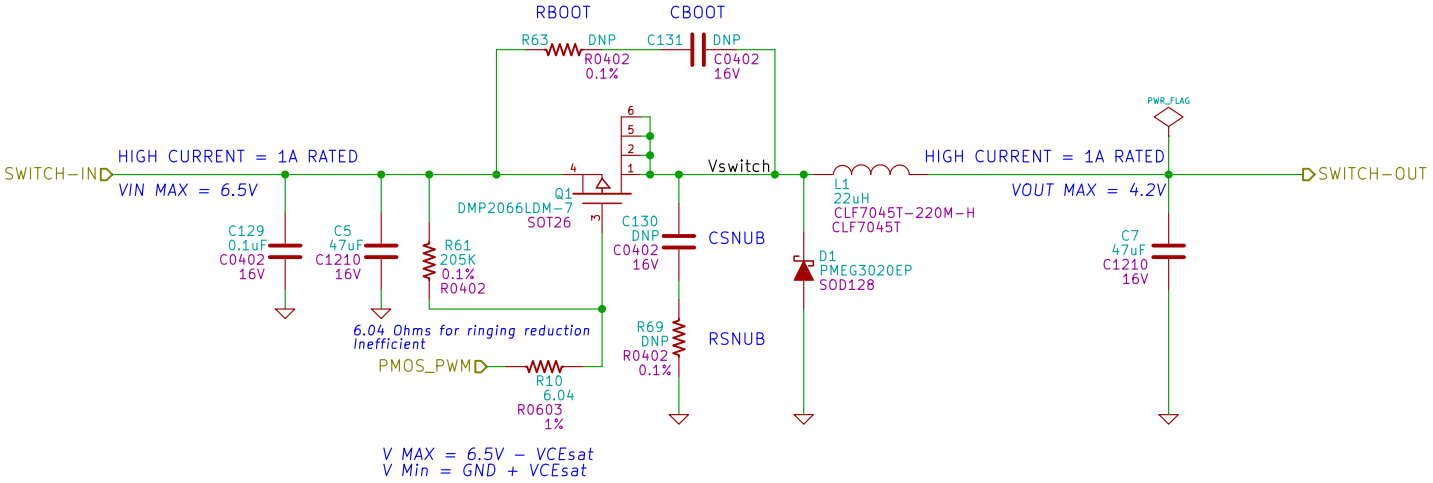
Based on Rochester Institute of Technology P13271 Design		
Brent Salmi, KB1LQD		
Bryce Salmi, KB1LQC		
The Radio Amateur Satellite Corporation		
File: Control.sch		
Sheet: /MPPT_String_X+/TL1451 Control/		
Title: Fox-1 Maximum Power Point Tracker		
Size: A4	*Date: 30 nov 2015*	*Rev: 2.0*
KiCad E.D.A.		Id: 3/37

500 KHz Step-Down Buck Converter



NOTES

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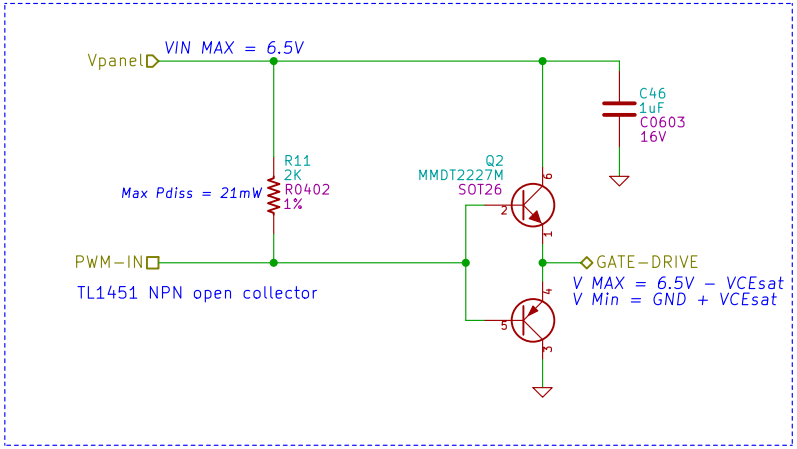
* Parts not yet NASA derated.

Based on Rochester Institute of Technology P13271 Design		
Brent Salmi, KB1LQD		
Bryce Salmi, KB1LQC		
The Radio Amateur Satellite Corporation		
File: BUCK_Non-Synch.sch		
Sheet: /MPPT_String_X+/TL1451 Control/Non-Synchronouse_BUCK/		
Title: Fox-1 Maximum Power Point Tracker		
Size: A4	*Date: 30 nov 2015*	*Rev: 2.0*
KiCad E.D.A.		Id: 4/37

TOTEM POLE MOSFET DRIVER



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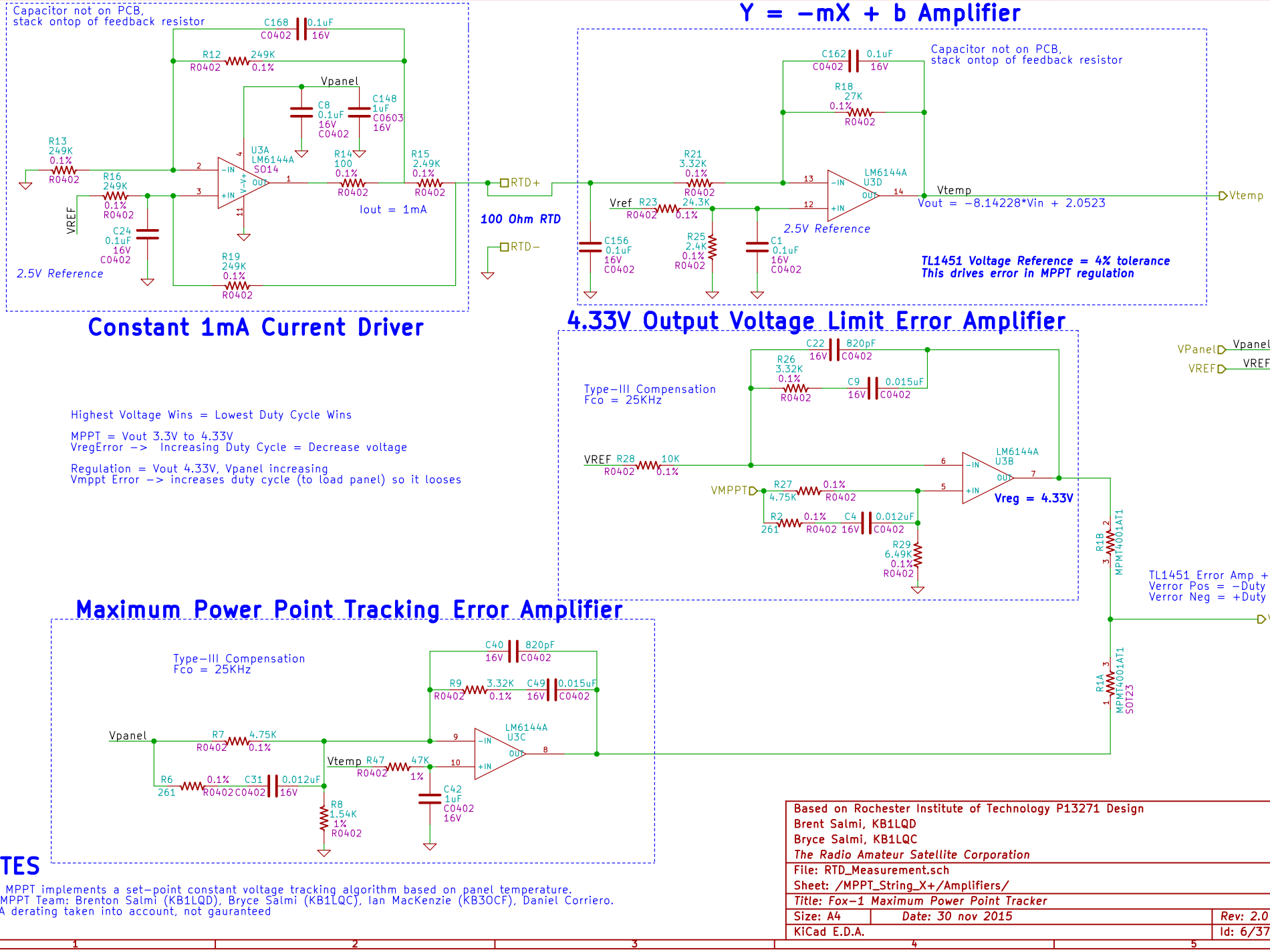
* Parts not yet NASA derated.

Based on Rochester Institute of Technology P13271 Design		
Brent Salmi, KB1LQD		
Bryce Salmi, KB1LQC		
The Radio Amateur Satellite Corporation		
File: MOSFET_Driver.sch		
Sheet: /MPPT_String_X+/TL1451 Control/MOSFET Driver/		
Title: Fox-1 Maximum Power Point Tracker		
Size: A4	*Date: 30 nov 2015*	*Rev: 2.0*
KiCad E.D.A.		Id: 5/37


Capacitor not on PCB,
stack ontop of feedback resistor
C168 0.1uF C0402 16V
R12 249K R0402 0.1%
Vpanel
C8 0.1uF 16V C0402
C148 1uF C0603 16V
R13 249K 0.1% R0402
R16 249K 0.1% R0402
U3A LM6144A SO14
R14 100 0.1% R0402
R15 2.49K 0.1% R0402
Iout = 1mA
VREF
C24 0.1uF 16V C0402
2.5V Reference
R19 249K 0.1% R0402
RTD+
100 Ohm RTD
RTD−
Y = −mX + b Amplifier
C162 0.1uF C0402 16V
Capacitor not on PCB,
stack ontop of feedback resistor
R18 27K 0.1% R0402
R21 3.32K 0.1% R0402
Vref R23 24.3K R0402 0.1%
LM6144A U3D
Vtemp
Vout = −8.14228*Vin + 2.0523
Vtemp
2.5V Reference
C156 0.1uF 16V C0402
R25 2.4K 0.1% R0402
C1 0.1uF 16V C0402
TL1451 Voltage Reference = 4% tolerance
This drives error in MPPT regulation
Constant 1mA Current Driver
4.33V Output Voltage Limit Error Amplifier
C22 820pF 16V C0402
R26 3.32K 0.1% R0402
C9 0.015uF 16V C0402
Type−III Compensation
Fco = 25KHz
VPanel Vpanel
VREF VREF
VREF R28 10K R0402 0.1%
LM6144A U3B
VMPPT
R27 4.75K 0.1% R0402
R2 261 0.1% R0402
C4 0.012uF 16V C0402
R29 6.49K 0.1% R0402
Vreg = 4.33V
R1B MPM14001AT1
TL1451 Error Amp + PMOS:
Verror Pos = −Duty Cycle
Verror Neg = +Duty Cycle
Verror
R1A MPM14001AT1 SOT23
Highest Voltage Wins = Lowest Duty Cycle Wins
MPPT = Vout 3.3V to 4.33V
VregError −> Increasing Duty Cycle = Decrease voltage
Regulation = Vout 4.33V, Vpanel increasing
Vmppt Error −> increases duty cycle (to load panel) so it looses
Maximum Power Point Tracking Error Amplifier
Type−III Compensation
Fco = 25KHz
C40 820pF 16V C0402
R9 3.32K 0.1% R0402
C49 0.015uF 16V C0402
Vpanel
R7 4.75K R0402 0.1%
LM6144A U3C
Vtemp R47 47K R0402 1%
R6 261 0.1% R0402
C31 0.012uF C0402 16V
C42 1uF C0402 16V
R8 1.54K 1% R0402
NOTES
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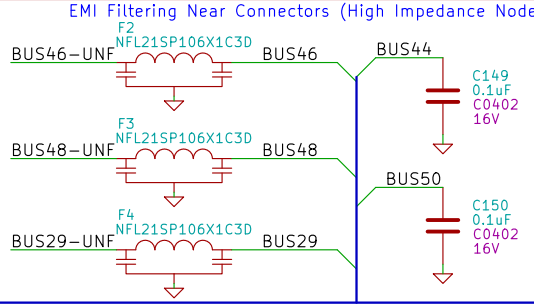
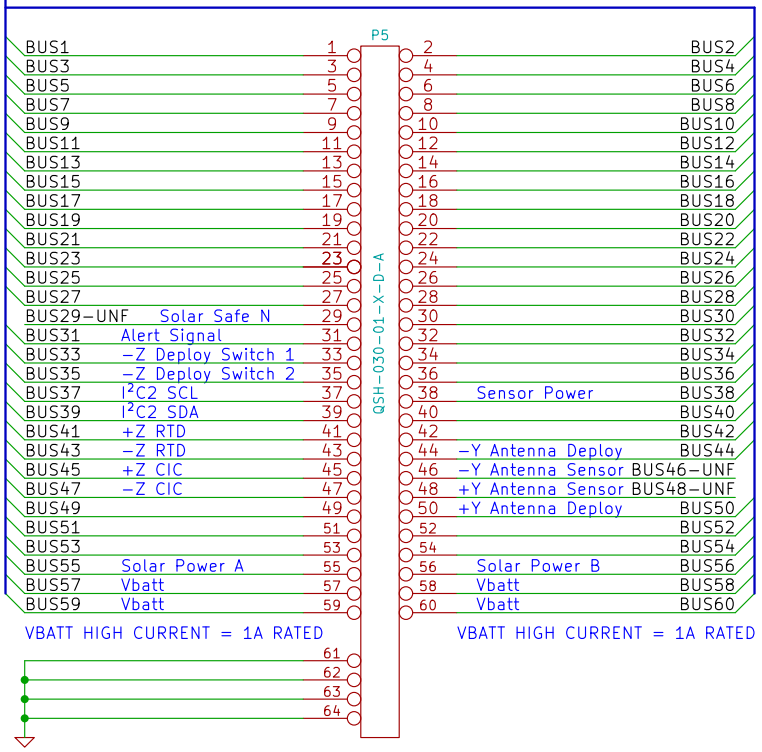
* NASA derating taken into account, not gauranteed
Based on Rochester Institute of Technology P13271 Design
Brent Salmi, KB1LQD
Bryce Salmi, KB1LQC
The Radio Amateur Satellite Corporation
File: RTD_Measurement.sch
Sheet: /MPPT_String_X+/Amplifiers/
Title: Fox−1 Maximum Power Point Tracker
Size: A4
Date: 30 nov 2015
Rev: 2.0
KiCad E.D.A.
Id: 6/37

+Y Antenna Deploy & −Y Antenna Deploy
Deploy resistors = 6.98 Ohms
Imax = 4.2V/6.98V = 602mA
Pmax = 2.53W

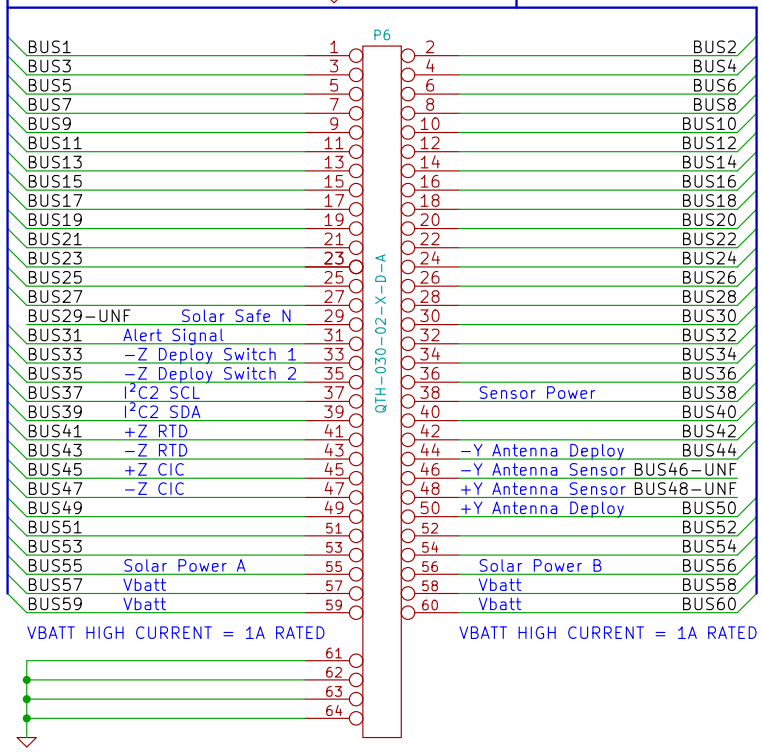
EMI Filtering Near Connectors (High Impedance Nodes)



BUS[1..60]



BUS[1..60]



BUS38 Sensor Power is driven by the IHU PCB

NOTES

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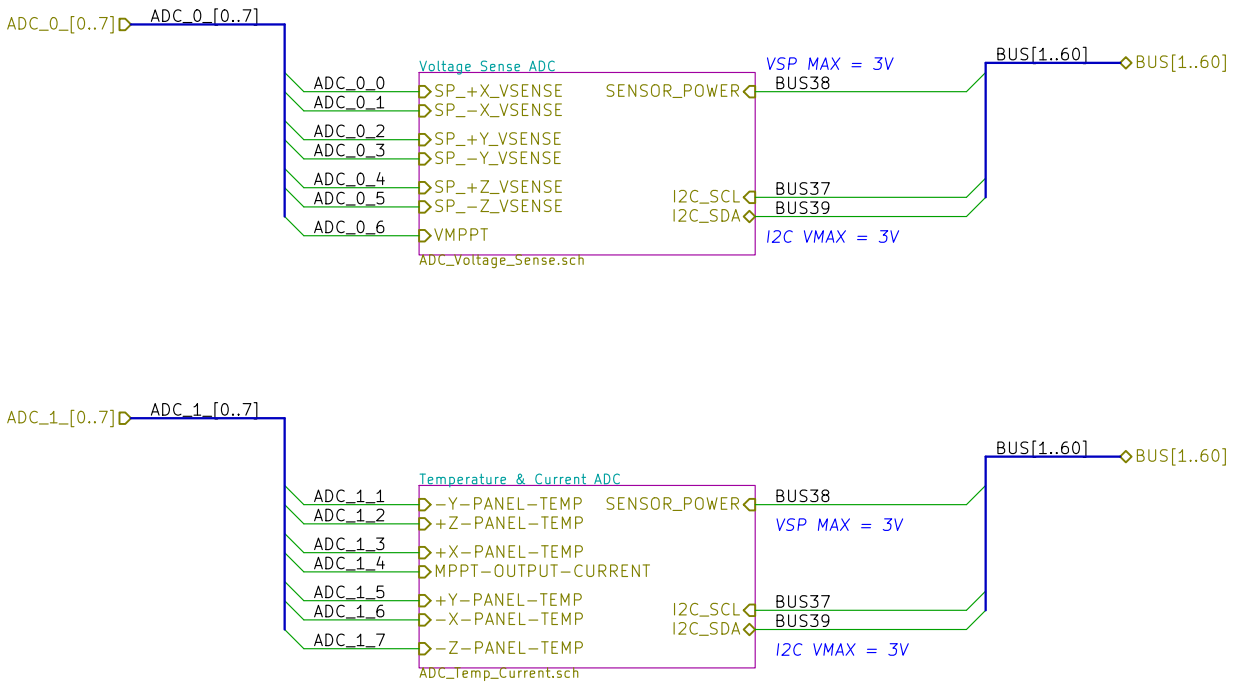
Based on Rochester Institute of Technology P13271 Design		
Brent Salmi, KB1LQD		
Bryce Salmi, KB1LQC		
The Radio Amateur Satellite Corporation		
File: Connectors.sch		
Sheet: /Connectors/		
Title: Fox−1 Maximum Power Point Tracker		
Size: A4	*Date: 30 nov 2015*	*Rev: 2.0*
KiCad E.D.A.		Id: 7/37



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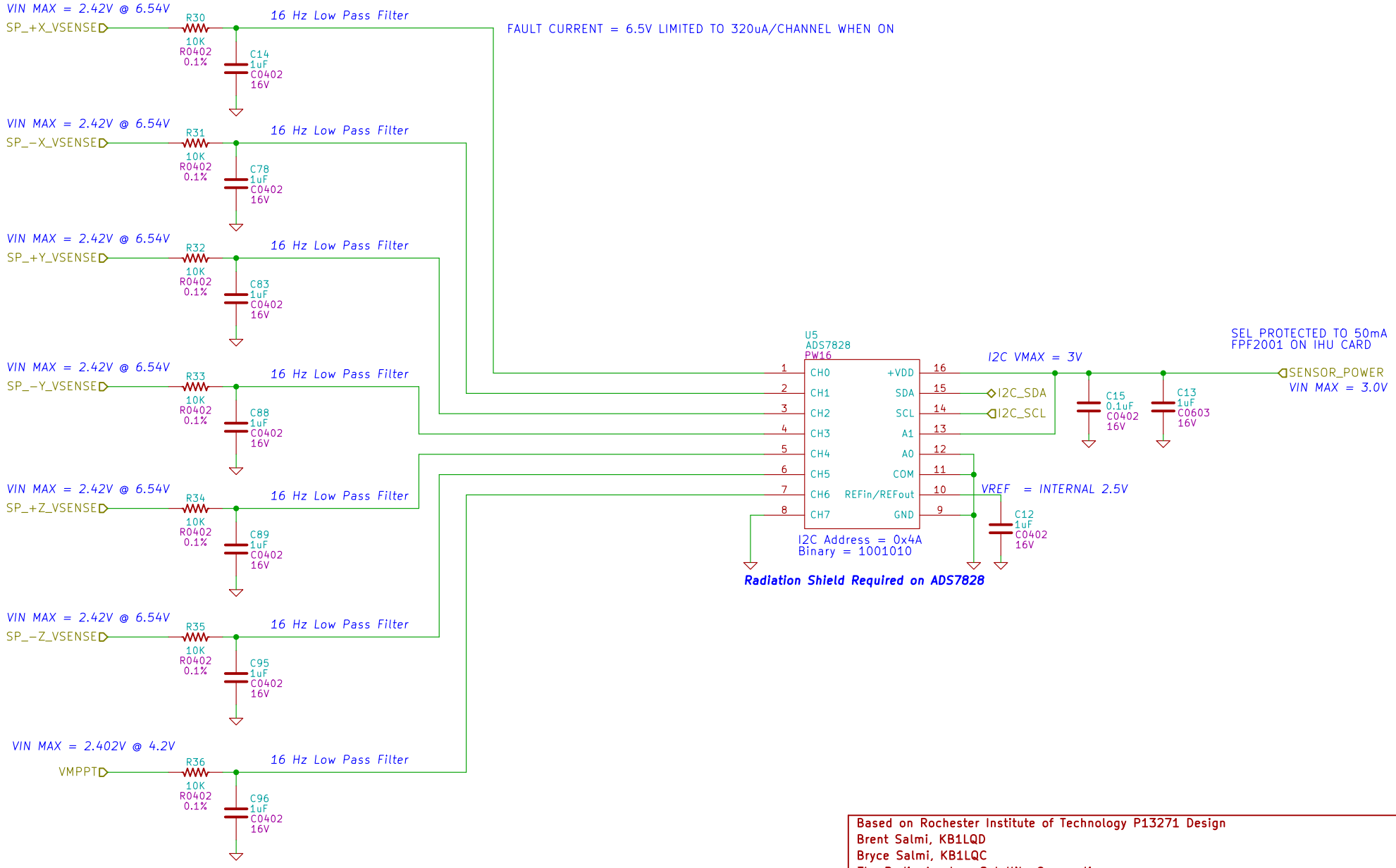
* NASA derating taken into account, not gauranteed

Based on Rochester Institute of Technology P13271 Design Brent Salmi, KB1LQD Bryce Salmi, KB1LQC *The Radio Amateur Satellite Corporation*		
File: ADC_Channels.sch Sheet: /ADC Channels/		
Title: Fox-1 Maximum Power Point Tracker		
Size: A4	*Date: 30 nov 2015*	*Rev: 2.0*
KiCad E.D.A.		Id: 8/37



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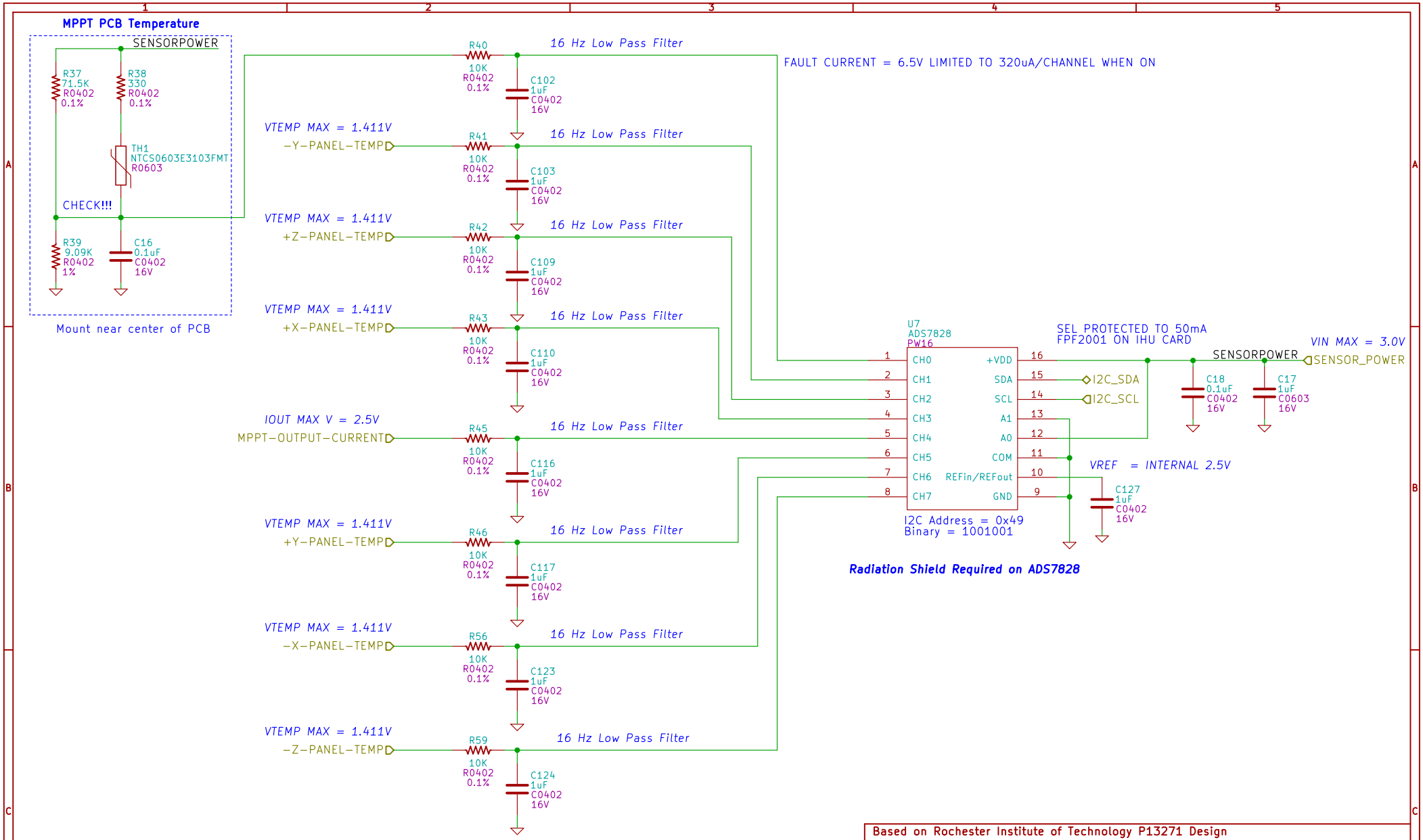
Based on Rochester Institute of Technology P13271 Design		
Brent Salmi, KB1LQD		
Bryce Salmi, KB1LQC		
The Radio Amateur Satellite Corporation		
File: ADC_Voltage_Sense.sch		
Sheet: /ADC Channels/Voltage Sense ADC/		
Title: Fox-1 Maximum Power Point Tracker		
Size: A4	*Date: 30 nov 2015*	*Rev: 2.0*
KiCad E.D.A.		Id: 9/37



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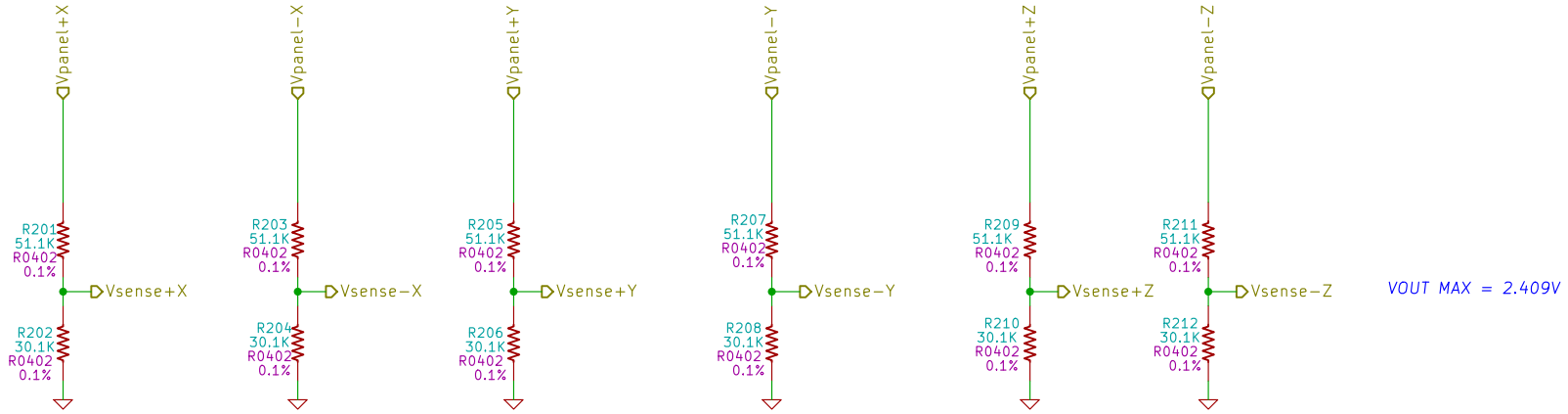
Based on Rochester Institute of Technology P13271 Design		
Brent Salmi, KB1LQD		
Bryce Salmi, KB1LQC		
The Radio Amateur Satellite Corporation		
File: ADC_Temp_Current.sch		
Sheet: /ADC Channels/Temperature & Current ADC/		
Title: Fox-1 Maximum Power Point Tracker		
Size: A4	*Date: 30 nov 2015*	*Rev: 2.0*
KiCad E.D.A.		Id: 10/37

PANEL VOLTAGE TELEMETRY ADC SCALING

VIN MAX = 6.5V



VOUT MAX = 2.409V

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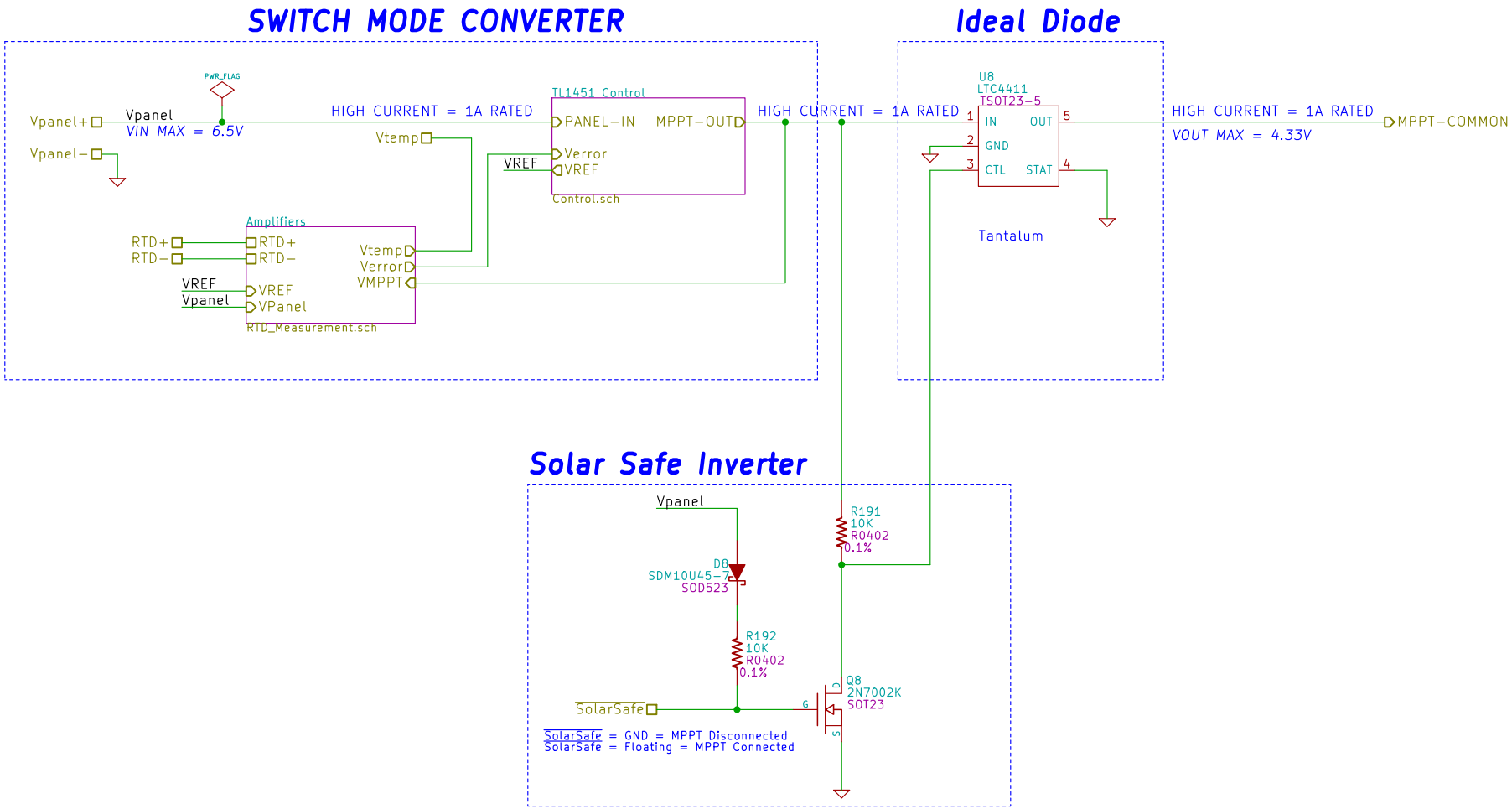
Based on Rochester Institute of Technology P13271 Design		
Brent Salmi, KB1LQD		
Bryce Salmi, KB1LQC		
The Radio Amateur Satellite Corporation		
File: VpanelScaling.sch		
Sheet: /Panel Voltage Scaling/		
Title:		
Size: A4	*Date: 30 nov 2015*	*Rev: 2.0*
KiCad E.D.A.		Id: 11/37



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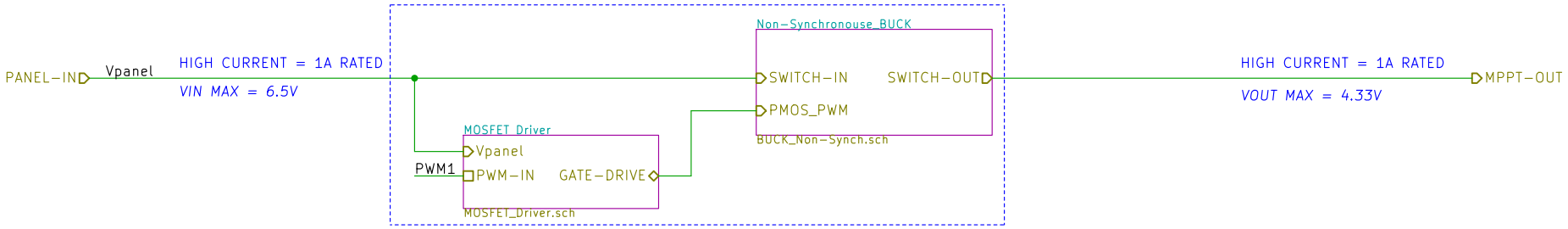
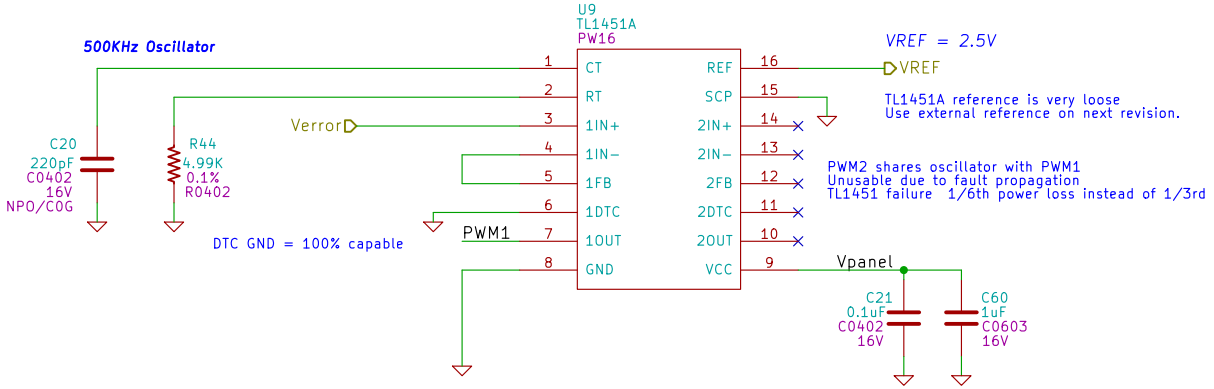
Based on Rochester Institute of Technology P13271 Design		
Brent Salmi, KB1LQD		
Bryce Salmi, KB1LQC		
The Radio Amateur Satellite Corporation		
File: MPPT_String.sch		
Sheet: /MPPT_String_X−/		
Title: Fox−1 Maximum Power Point Tracker		
Size: A	*Date: 30 nov 2015*	*Rev: 2.0*
KiCad E.D.A.		Id: 12/37

Switch Mode Converter





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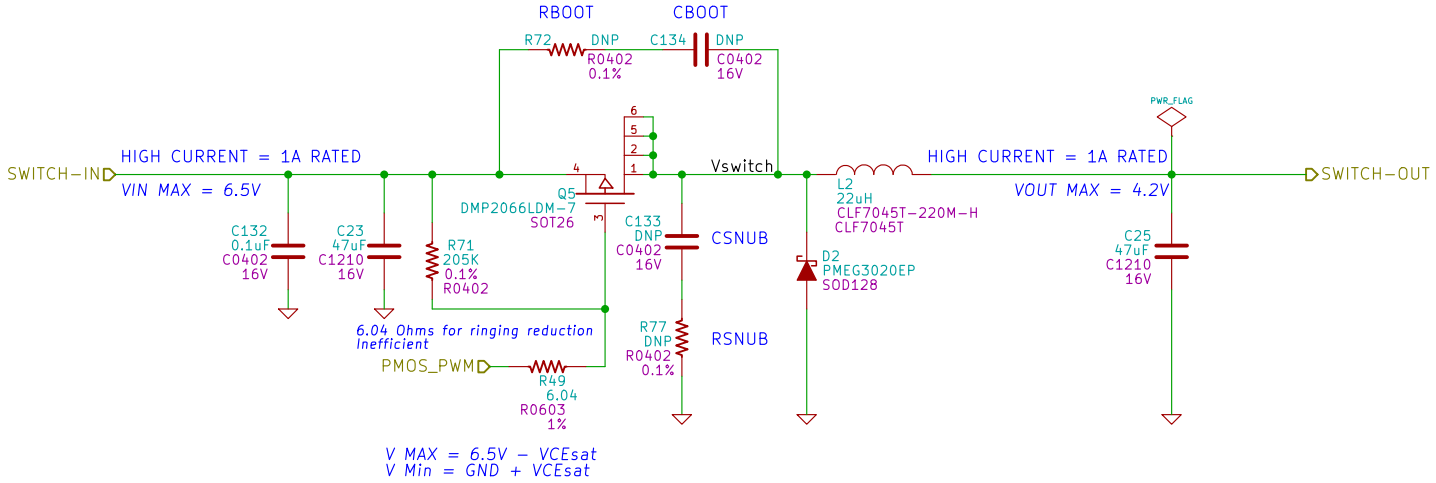
Based on Rochester Institute of Technology P13271 Design		
Brent Salmi, KB1LQD		
Bryce Salmi, KB1LQC		
The Radio Amateur Satellite Corporation		
File: Control.sch		
Sheet: /MPPT_String_X-/TL1451 Control/		
Title: Fox-1 Maximum Power Point Tracker		
Size: A4	*Date: 30 nov 2015*	*Rev: 2.0*
KiCad E.D.A.		Id: 13/37

500 KHz Step-Down Buck Converter



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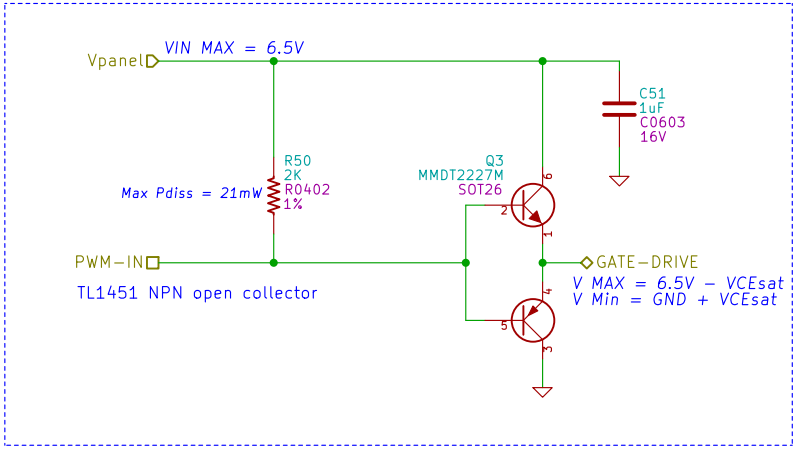
* Parts not yet NASA derated.

Based on Rochester Institute of Technology P13271 Design		
Brent Salmi, KB1LQD		
Bryce Salmi, KB1LQC		
The Radio Amateur Satellite Corporation		
File: BUCK_Non-Synch.sch		
Sheet: /MPPT_String_X-/TL1451 Control/Non-Synchronouse_BUCK/		
Title: Fox-1 Maximum Power Point Tracker		
Size: A4	*Date: 30 nov 2015*	*Rev: 2.0*
KiCad E.D.A.		Id: 14/37

TOTEM POLE MOSFET DRIVER



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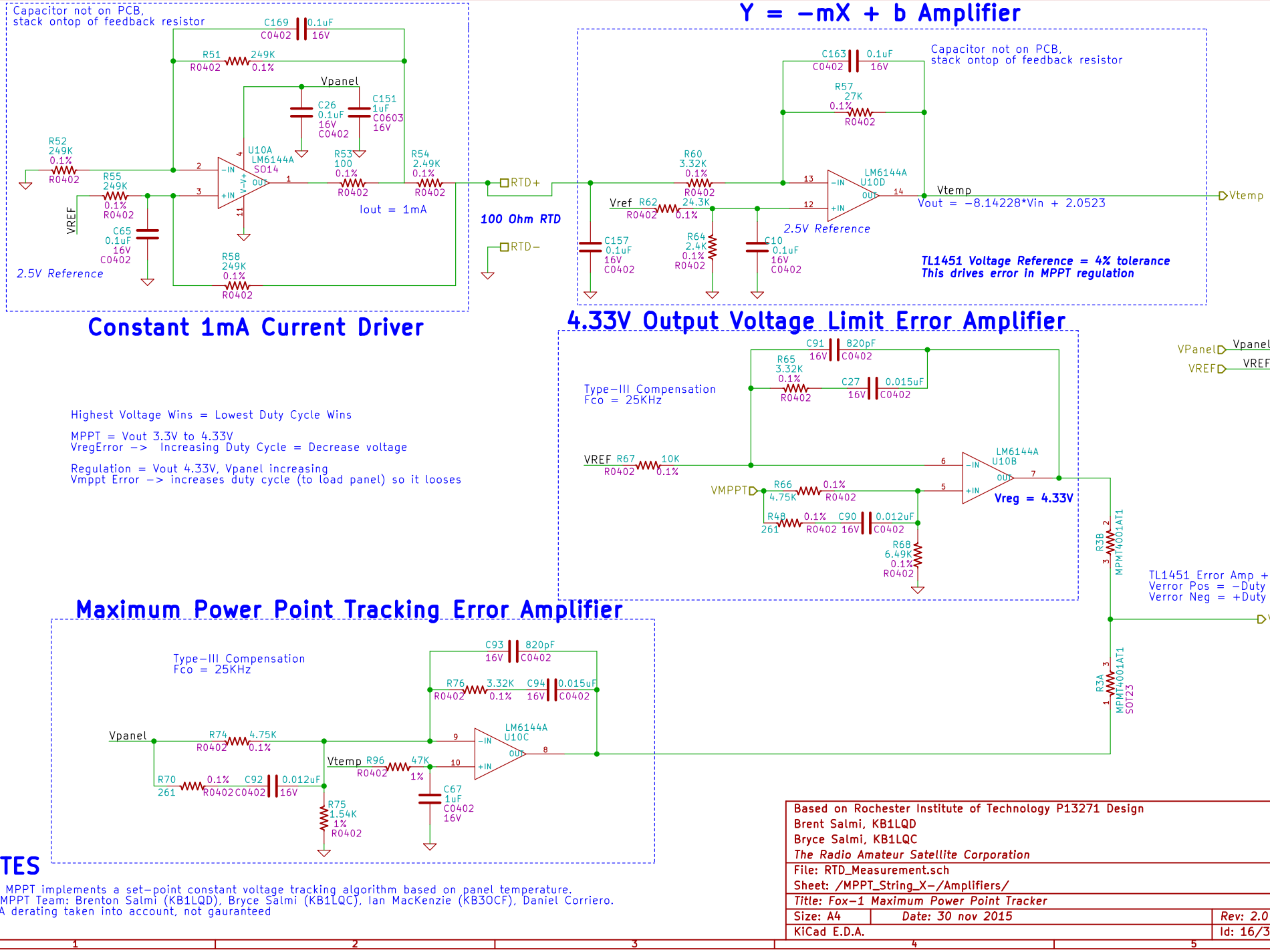
Based on Rochester Institute of Technology P13271 Design		
Brent Salmi, KB1LQD		
Bryce Salmi, KB1LQC		
The Radio Amateur Satellite Corporation		
File: MOSFET_Driver.sch		
Sheet: /MPPT_String_X-/TL1451 Control/MOSFET Driver/		
Title: Fox-1 Maximum Power Point Tracker		
Size: A4	*Date: 30 nov 2015*	*Rev: 2.0*
KiCad E.D.A.		Id: 15/37



NOTES

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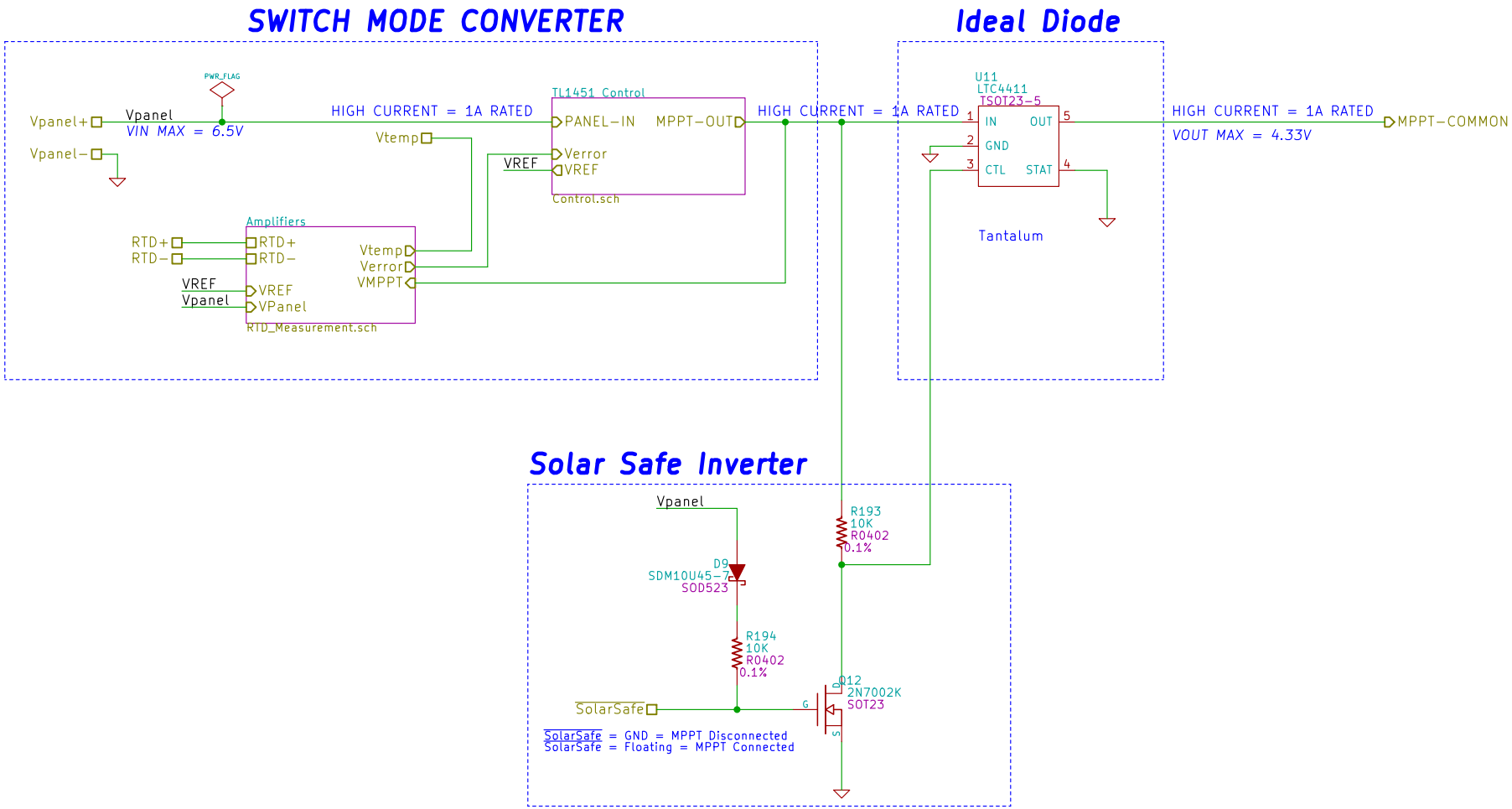
Based on Rochester Institute of Technology P13271 Design		
Brent Salmi, KB1LQD		
Bryce Salmi, KB1LQC		
The Radio Amateur Satellite Corporation		
File: RTD_Measurement.sch		
Sheet: /MPPT_String_X−/Amplifiers/		
Title: Fox−1 Maximum Power Point Tracker		
Size: A4	*Date: 30 nov 2015*	*Rev: 2.0*
KiCad E.D.A.		Id: 16/37



NOTES

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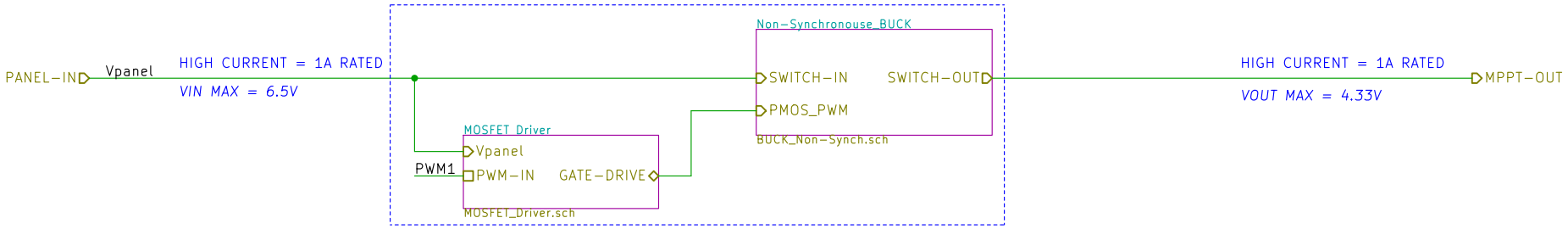
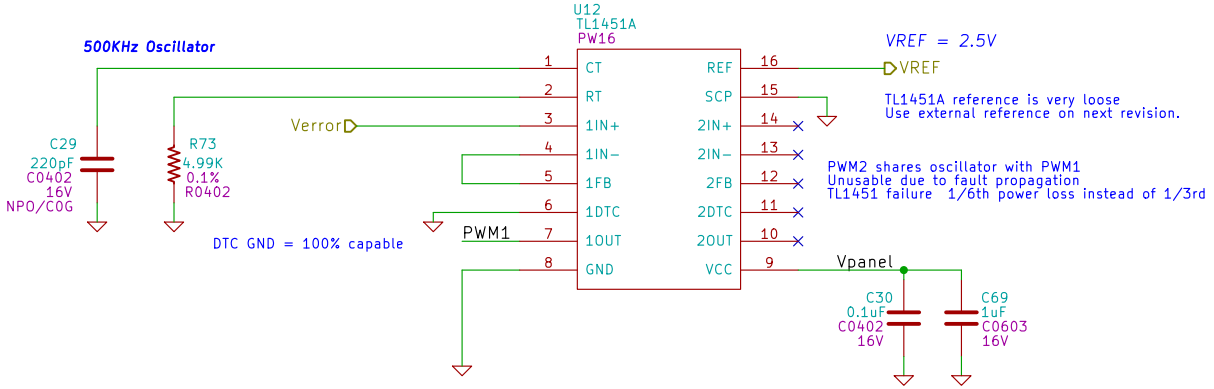
Based on Rochester Institute of Technology P13271 Design		
Brent Salmi, KB1LQD		
Bryce Salmi, KB1LQC		
The Radio Amateur Satellite Corporation		
File: MPPT_String.sch		
Sheet: /MPPT_String_Y+/		
Title: Fox−1 Maximum Power Point Tracker		
Size: A	*Date: 30 nov 2015*	*Rev: 2.0*
KiCad E.D.A.		Id: 17/37

Switch Mode Converter



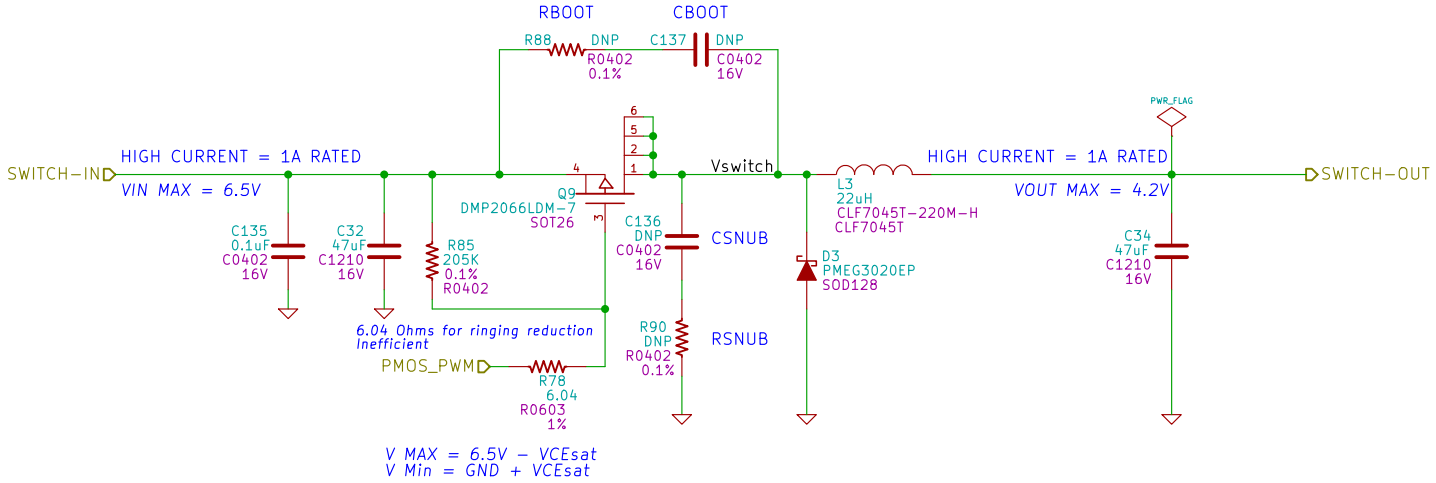


NOTES

* This MPPT implements a set-point constant voltage tracking algorithm based on panel temperature.
* RIT MPPT Team: Brenton Salmi (KB1LQD), Bryce Salmi (KB1LQC), Ian MacKenzie (KB3OCF), Daniel Corriero.
* NASA derating taken into account, not gauranteed

Based on Rochester Institute of Technology P13271 Design		
Brent Salmi, KB1LQD		
Bryce Salmi, KB1LQC		
The Radio Amateur Satellite Corporation		
File: Control.sch		
Sheet: /MPPT_String_Y+/TL1451 Control/		
Title: Fox-1 Maximum Power Point Tracker		
Size: A4	*Date: 30 nov 2015*	*Rev: 2.0*
KiCad E.D.A.		Id: 18/37

500 KHz Step-Down Buck Converter

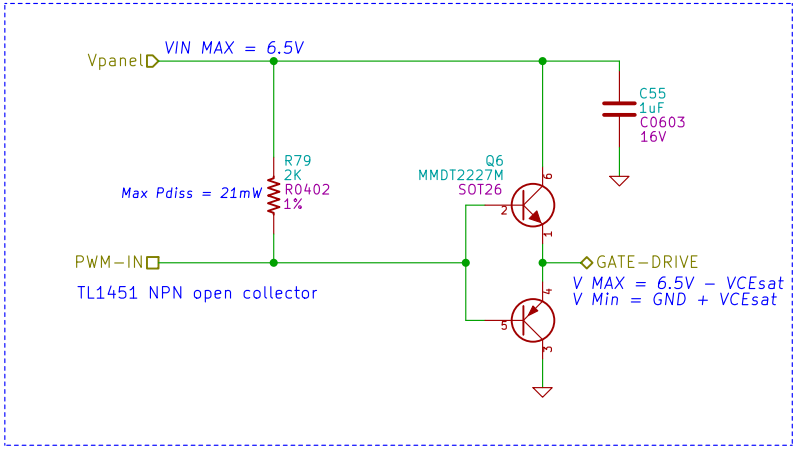


NOTES

* This MPPT implements a set-point constant voltage tracking algorithm based on panel temperature.
* RIT MPPT Team: Brenton Salmi (KB1LQD), Bryce Salmi (KB1LQC), Ian MacKenzie (KB3OCF), Daniel Corriero.
* Parts not yet NASA derated.

Based on Rochester Institute of Technology P13271 Design		
Brent Salmi, KB1LQD		
Bryce Salmi, KB1LQC		
The Radio Amateur Satellite Corporation		
File: BUCK_Non-Synch.sch		
Sheet: /MPPT_String_Y+/TL1451 Control/Non-Synchronouse_BUCK/		
Title: Fox-1 Maximum Power Point Tracker		
Size: A4	*Date: 30 nov 2015*	*Rev: 2.0*
KiCad E.D.A.		Id: 19/37

TOTEM POLE MOSFET DRIVER



NOTES

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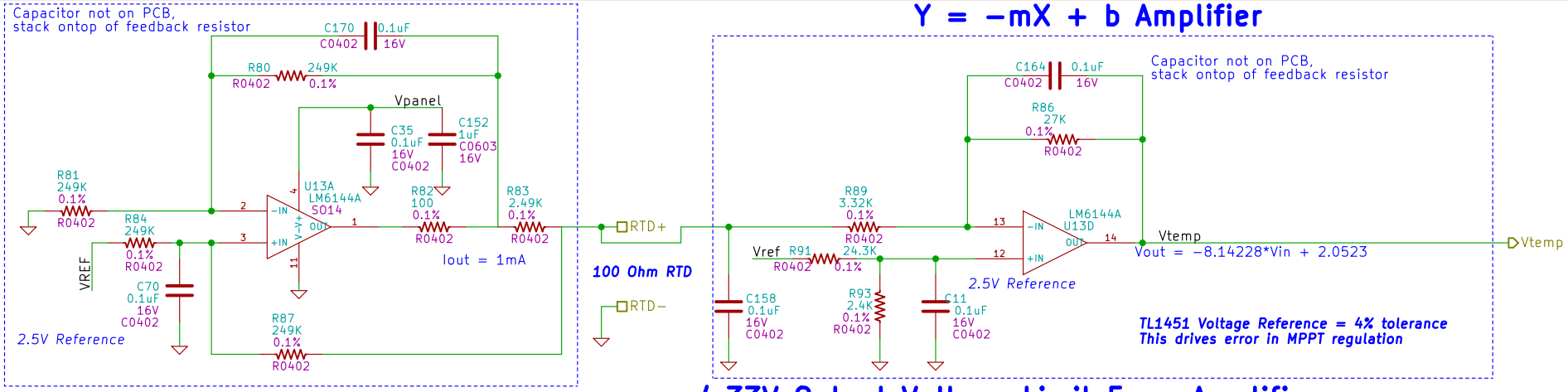
* Parts not yet NASA derated.

Based on Rochester Institute of Technology P13271 Design		
Brent Salmi, KB1LQD		
Bryce Salmi, KB1LQC		
The Radio Amateur Satellite Corporation		
File: MOSFET_Driver.sch		
Sheet: /MPPT_String_Y+/TL1451 Control/MOSFET Driver/		
Title: Fox-1 Maximum Power Point Tracker		
Size: A4	*Date: 30 nov 2015*	*Rev: 2.0*
KiCad E.D.A.		Id: 20/37

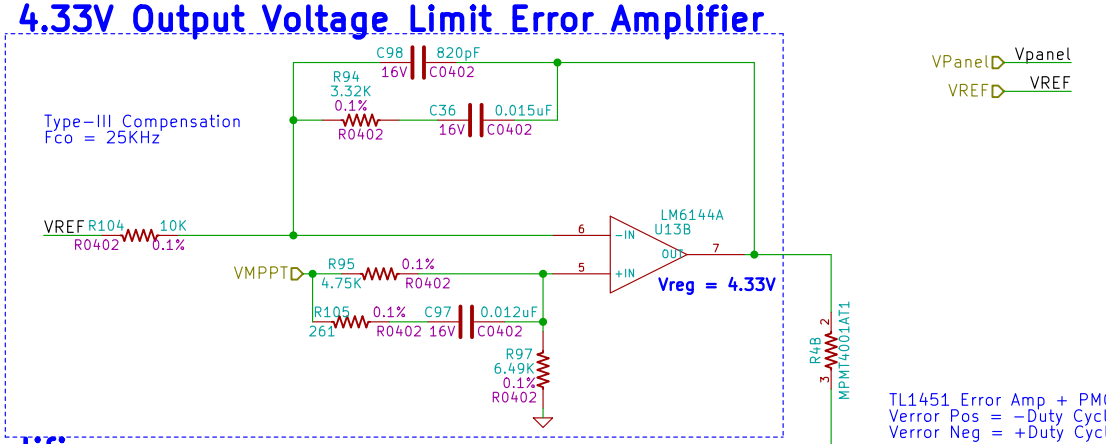


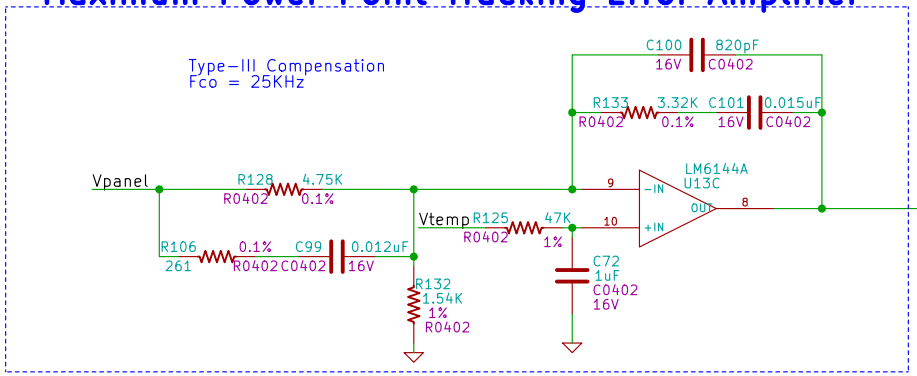
Constant 1mA Current Driver

Highest Voltage Wins = Lowest Duty Cycle Wins

MPPT = Vout 3.3V to 4.33V
VregError −> Increasing Duty Cycle = Decrease voltage

Regulation = Vout 4.33V, Vpanel increasing
Vmppt Error −> increases duty cycle (to load panel) so it looses





NOTES

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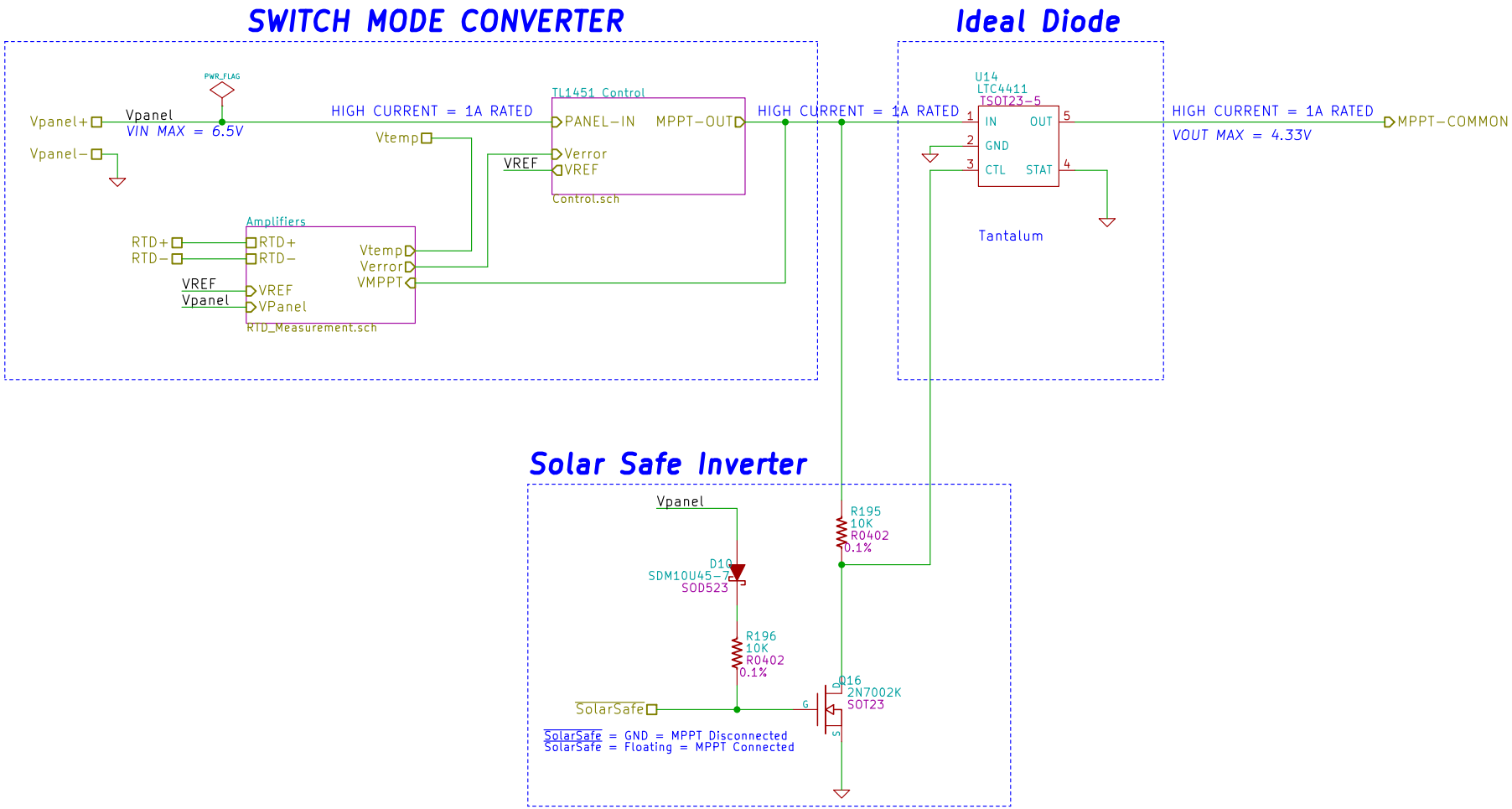
* NASA derating taken into account, not gauranteed

Based on Rochester Institute of Technology P13271 Design		
Brent Salmi, KB1LQD		
Bryce Salmi, KB1LQC		
The Radio Amateur Satellite Corporation		
File: RTD_Measurement.sch		
Sheet: /MPPT_String_Y+/Amplifiers/		
Title: Fox−1 Maximum Power Point Tracker		
Size: A4	*Date: 30 nov 2015*	*Rev: 2.0*
KiCad E.D.A.		Id: 21/37



NOTES

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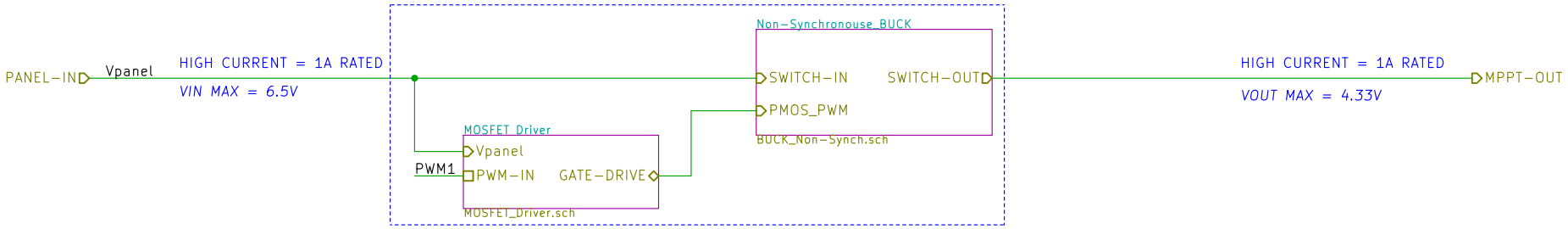
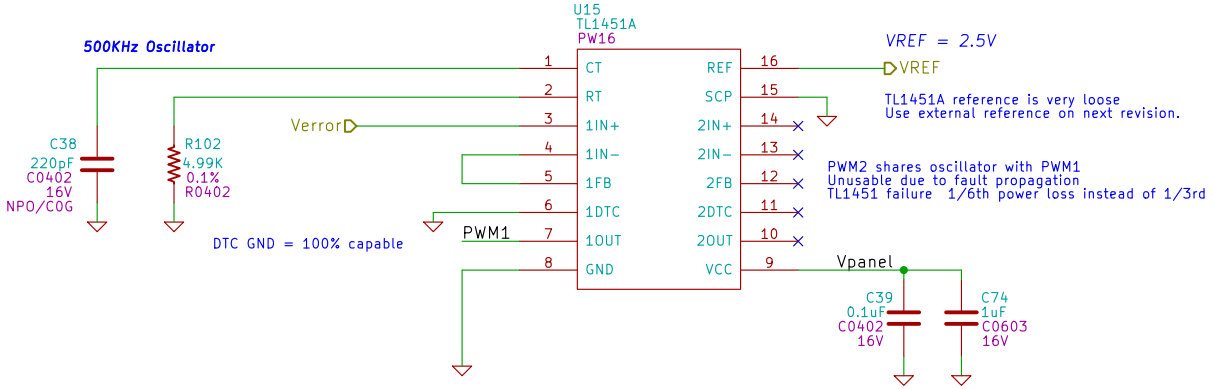
* NASA derating taken into account, not gauranteed

Based on Rochester Institute of Technology P13271 Design		
Brent Salmi, KB1LQD		
Bryce Salmi, KB1LQC		
The Radio Amateur Satellite Corporation		
File: MPPT_String.sch		
Sheet: /MPPT_String_Y−/		
Title: Fox−1 Maximum Power Point Tracker		
Size: A	*Date: 30 nov 2015*	*Rev: 2.0*
KiCad E.D.A.		Id: 22/37

Switch Mode Converter





NOTES

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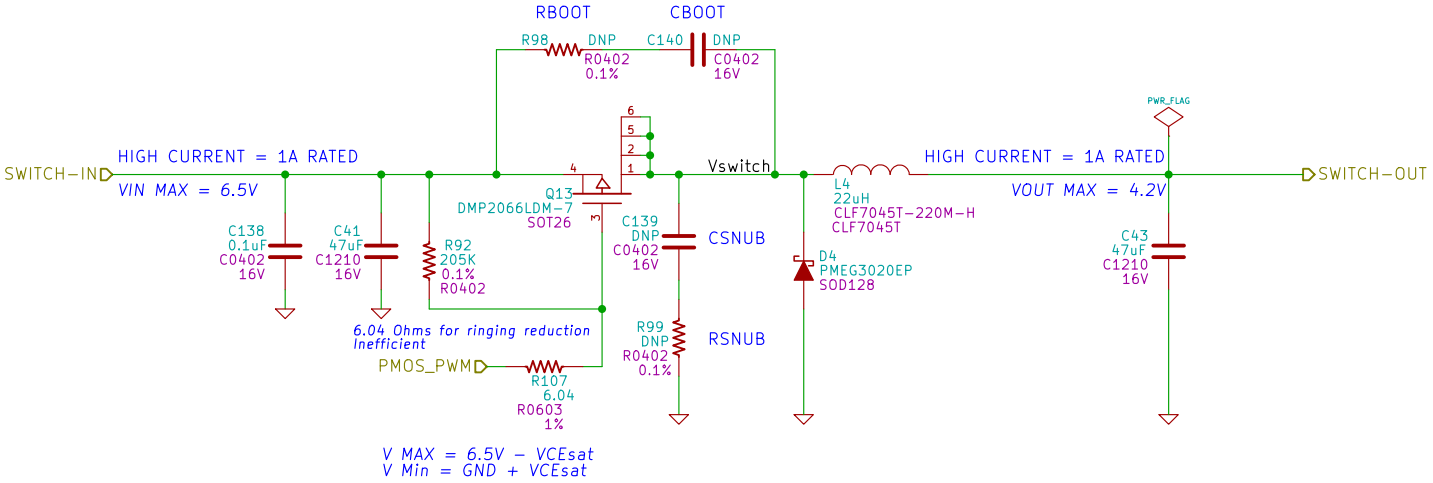
* NASA derating taken into account, not gauranteed

Based on Rochester Institute of Technology P13271 Design		
Brent Salmi, KB1LQD		
Bryce Salmi, KB1LQC		
The Radio Amateur Satellite Corporation		
File: Control.sch		
Sheet: /MPPT_String_Y-/TL1451 Control/		
Title: Fox-1 Maximum Power Point Tracker		
Size: A4	*Date: 30 nov 2015*	*Rev: 2.0*
KiCad E.D.A.		Id: 23/37

500 KHz Step-Down Buck Converter



NOTES

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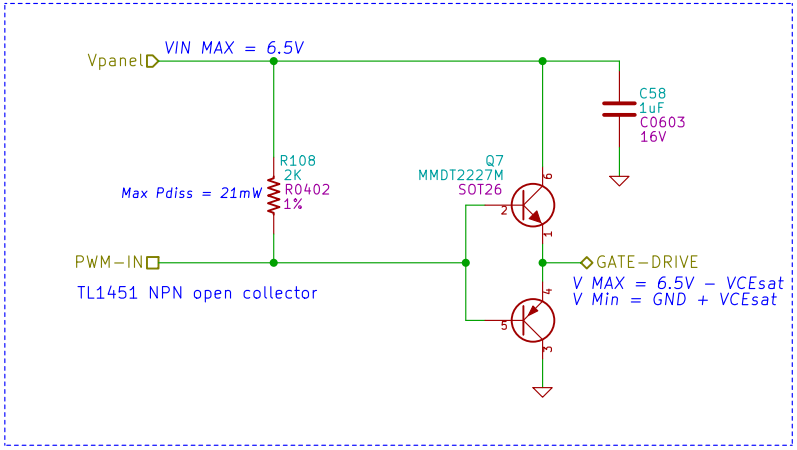
* RIT MPPT Team: Brenton Salmi (KB1LQD), Bryce Salmi (KB1LQC), Ian MacKenzie (KB3OCF), Daniel Corriero.
* Parts not yet NASA derated.

Based on Rochester Institute of Technology P13271 Design		
Brent Salmi, KB1LQD		
Bryce Salmi, KB1LQC		
The Radio Amateur Satellite Corporation		
File: BUCK_Non-Synch.sch		
Sheet: /MPPT_String_Y-/TL1451 Control/Non-Synchronouse_BUCK/		
Title: Fox-1 Maximum Power Point Tracker		
Size: A4	*Date: 30 nov 2015*	*Rev: 2.0*
KiCad E.D.A.		Id: 24/37

TOTEM POLE MOSFET DRIVER



NOTES

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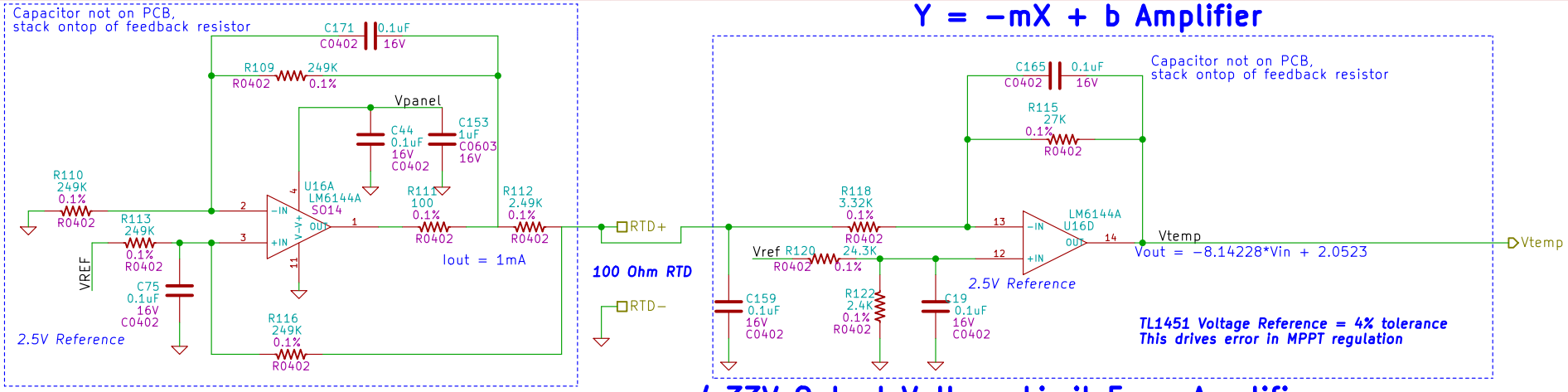
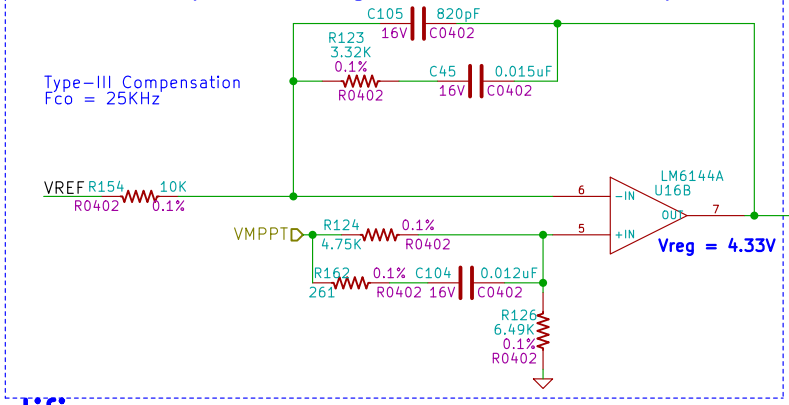
* RIT MPPT Team: Brenton Salmi (KB1LQD), Bryce Salmi (KB1LQC), Ian MacKenzie (KB3OCF), Daniel Corriero.
* Parts not yet NASA derated.

Based on Rochester Institute of Technology P13271 Design		
Brent Salmi, KB1LQD		
Bryce Salmi, KB1LQC		
The Radio Amateur Satellite Corporation		
File: MOSFET_Driver.sch		
Sheet: /MPPT_String_Y-/TL1451 Control/MOSFET Driver/		
Title: Fox-1 Maximum Power Point Tracker		
Size: A4	*Date: 30 nov 2015*	*Rev: 2.0*
KiCad E.D.A.		Id: 25/37



Constant 1mA Current Driver

4.33V Output Voltage Limit Error Amplifier

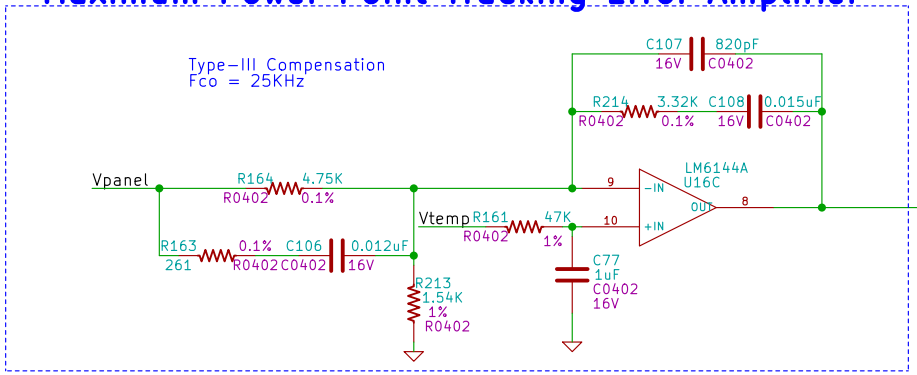


Highest Voltage Wins = Lowest Duty Cycle Wins

MPPT = Vout 3.3V to 4.33V
VregError −> Increasing Duty Cycle = Decrease voltage

Regulation = Vout 4.33V, Vpanel increasing
Vmppt Error −> increases duty cycle (to load panel) so it looses

Maximum Power Point Tracking Error Amplifier



NOTES

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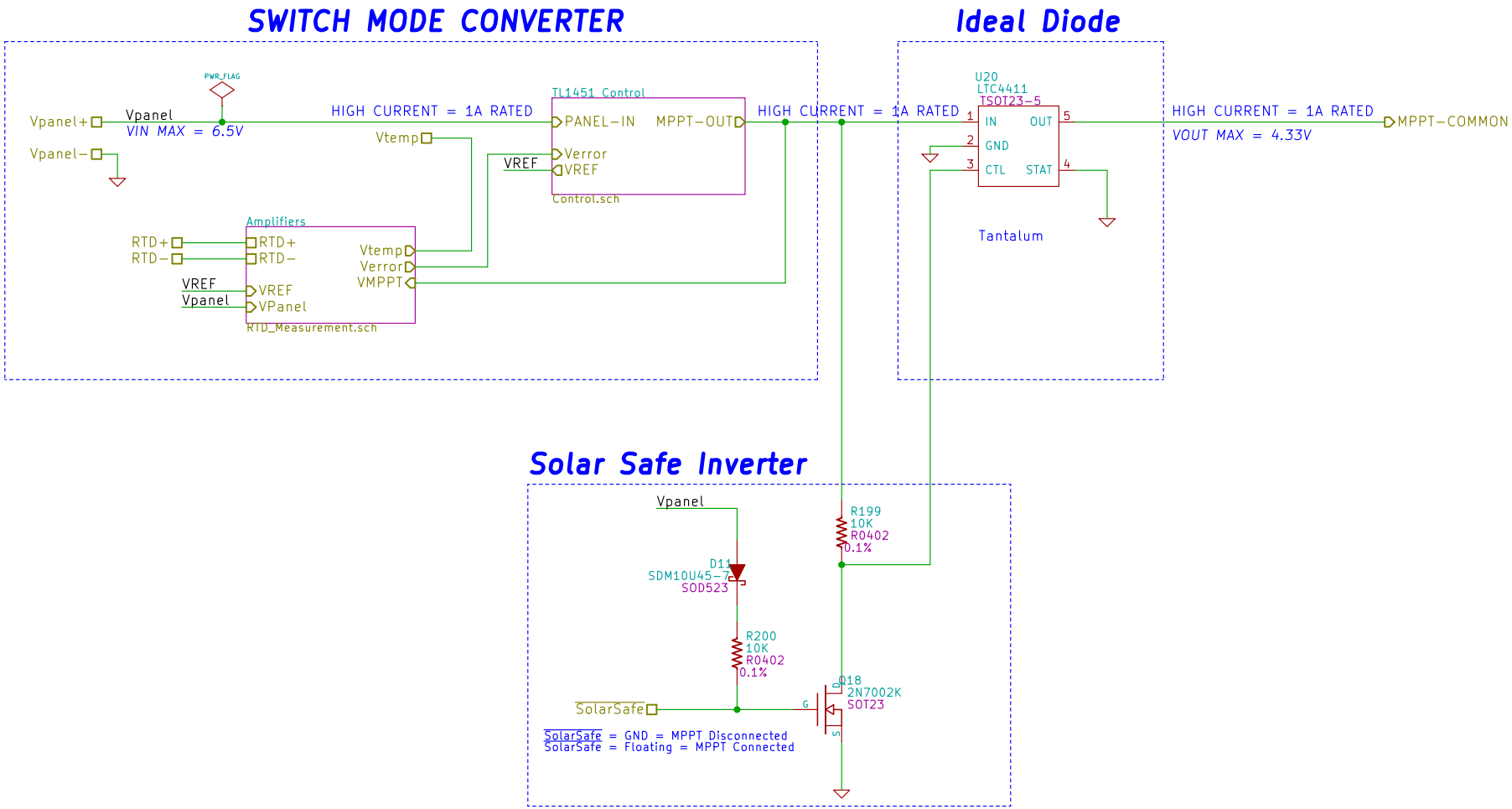
* NASA derating taken into account, not gauranteed

Based on Rochester Institute of Technology P13271 Design		
Brent Salmi, KB1LQD		
Bryce Salmi, KB1LQC		
The Radio Amateur Satellite Corporation		
File: RTD_Measurement.sch		
Sheet: /MPPT_String_Y−/Amplifiers/		
Title: Fox−1 Maximum Power Point Tracker		
Size: A4	*Date: 30 nov 2015*	*Rev: 2.0*
KiCad E.D.A.		Id: 26/37



NOTES

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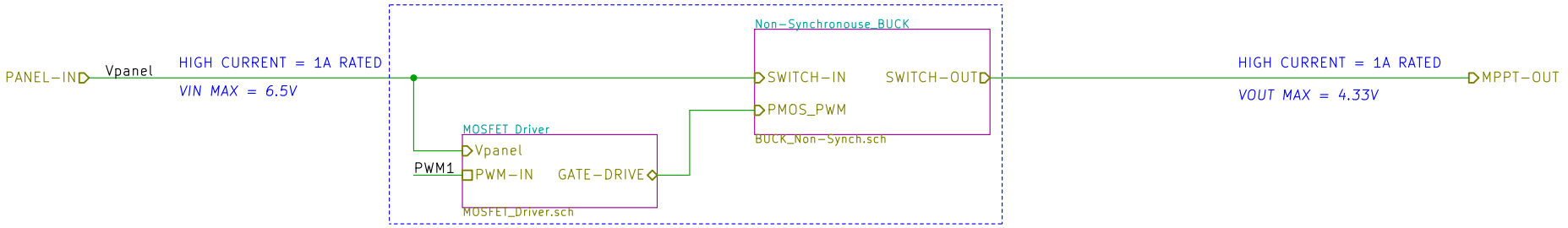
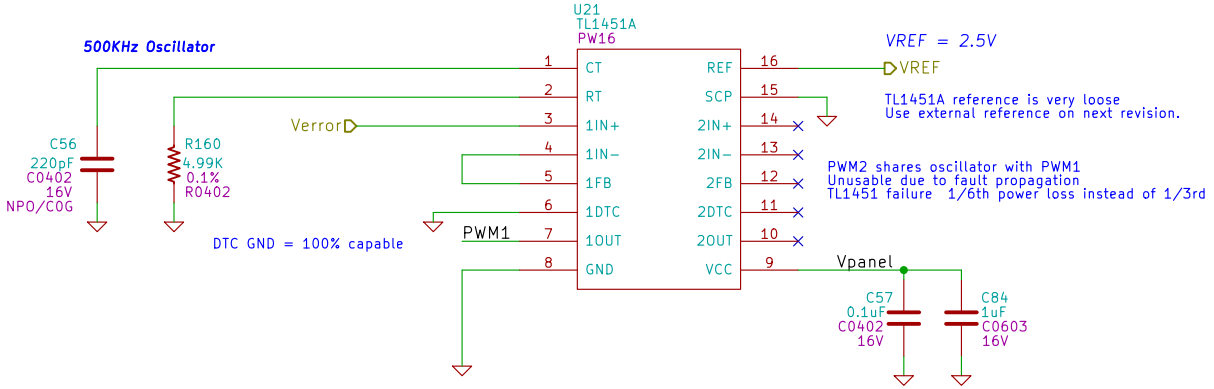
Based on Rochester Institute of Technology P13271 Design		
Brent Salmi, KB1LQD		
Bryce Salmi, KB1LQC		
The Radio Amateur Satellite Corporation		
File: MPPT_String.sch		
Sheet: /MPPT_String_Z−/		
Title: Fox−1 Maximum Power Point Tracker		
Size: A	*Date: 30 nov 2015*	*Rev: 2.0*
KiCad E.D.A.		Id: 27/37

Switch Mode Converter





NOTES

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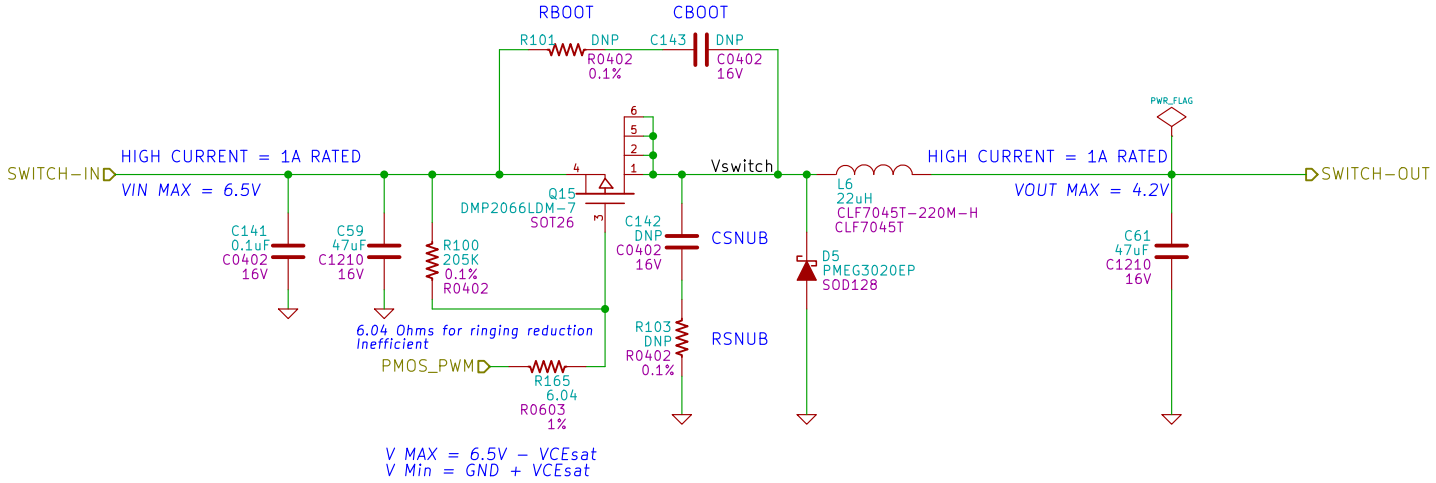
Based on Rochester Institute of Technology P13271 Design		
Brent Salmi, KB1LQD		
Bryce Salmi, KB1LQC		
The Radio Amateur Satellite Corporation		
File: Control.sch		
Sheet: /MPPT_String_Z-/TL1451 Control/		
Title: Fox-1 Maximum Power Point Tracker		
Size: A4	*Date: 30 nov 2015*	*Rev: 2.0*
KiCad E.D.A.		Id: 28/37

500 KHz Step-Down Buck Converter



NOTES

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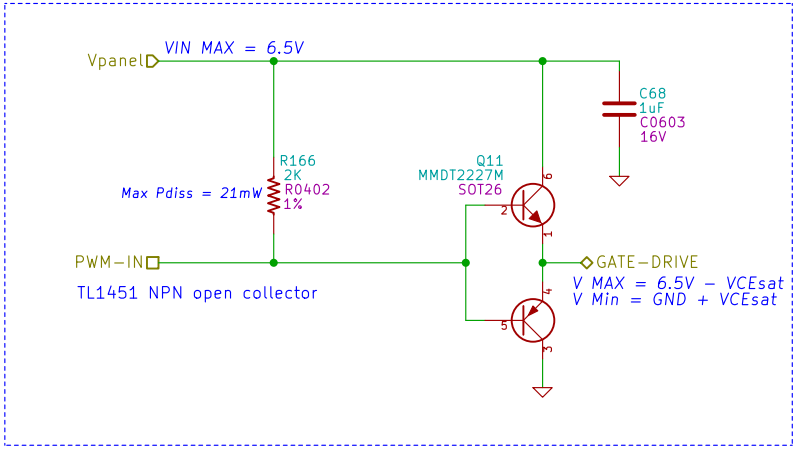
* RIT MPPT Team: Brenton Salmi (KB1LQD), Bryce Salmi (KB1LQC), Ian MacKenzie (KB3OCF), Daniel Corriero.
* Parts not yet NASA derated.

Based on Rochester Institute of Technology P13271 Design		
Brent Salmi, KB1LQD		
Bryce Salmi, KB1LQC		
The Radio Amateur Satellite Corporation		
File: BUCK_Non-Synch.sch		
Sheet: /MPPT_String_Z-/TL1451 Control/Non-Synchronouse_BUCK/		
Title: Fox-1 Maximum Power Point Tracker		
Size: A4	*Date: 30 nov 2015*	*Rev: 2.0*
KiCad E.D.A.		Id: 29/37

TOTEM POLE MOSFET DRIVER



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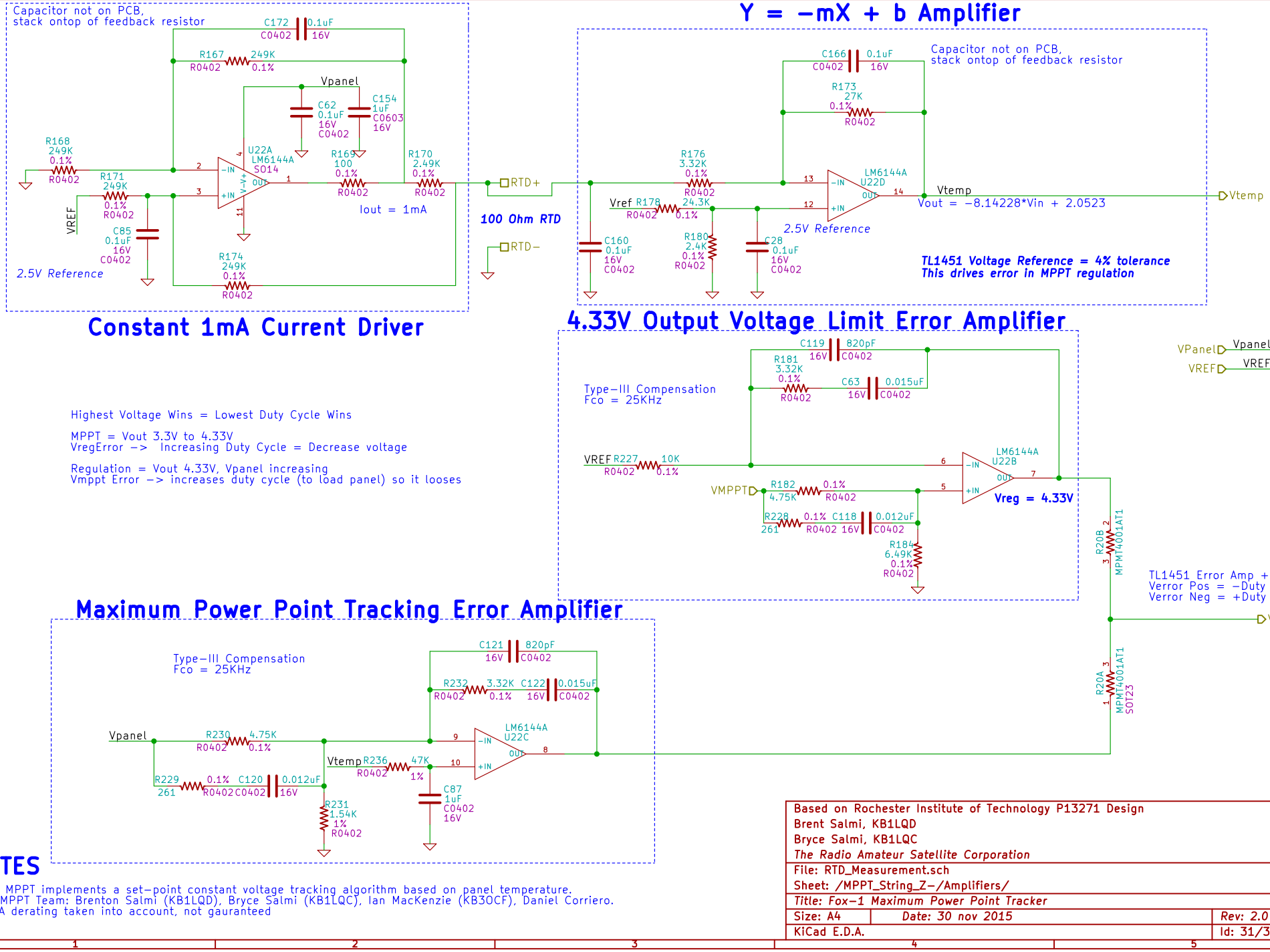
Based on Rochester Institute of Technology P13271 Design		
Brent Salmi, KB1LQD		
Bryce Salmi, KB1LQC		
The Radio Amateur Satellite Corporation		
File: MOSFET_Driver.sch		
Sheet: /MPPT_String_Z-/TL1451 Control/MOSFET Driver/		
Title: Fox-1 Maximum Power Point Tracker		
Size: A4	*Date: 30 nov 2015*	*Rev: 2.0*
KiCad E.D.A.		Id: 30/37



NOTES

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Based on Rochester Institute of Technology P13271 Design		
Brent Salmi, KB1LQD		
Bryce Salmi, KB1LQC		
The Radio Amateur Satellite Corporation		
File: RTD_Measurement.sch		
Sheet: /MPPT_String_Z−/Amplifiers/		
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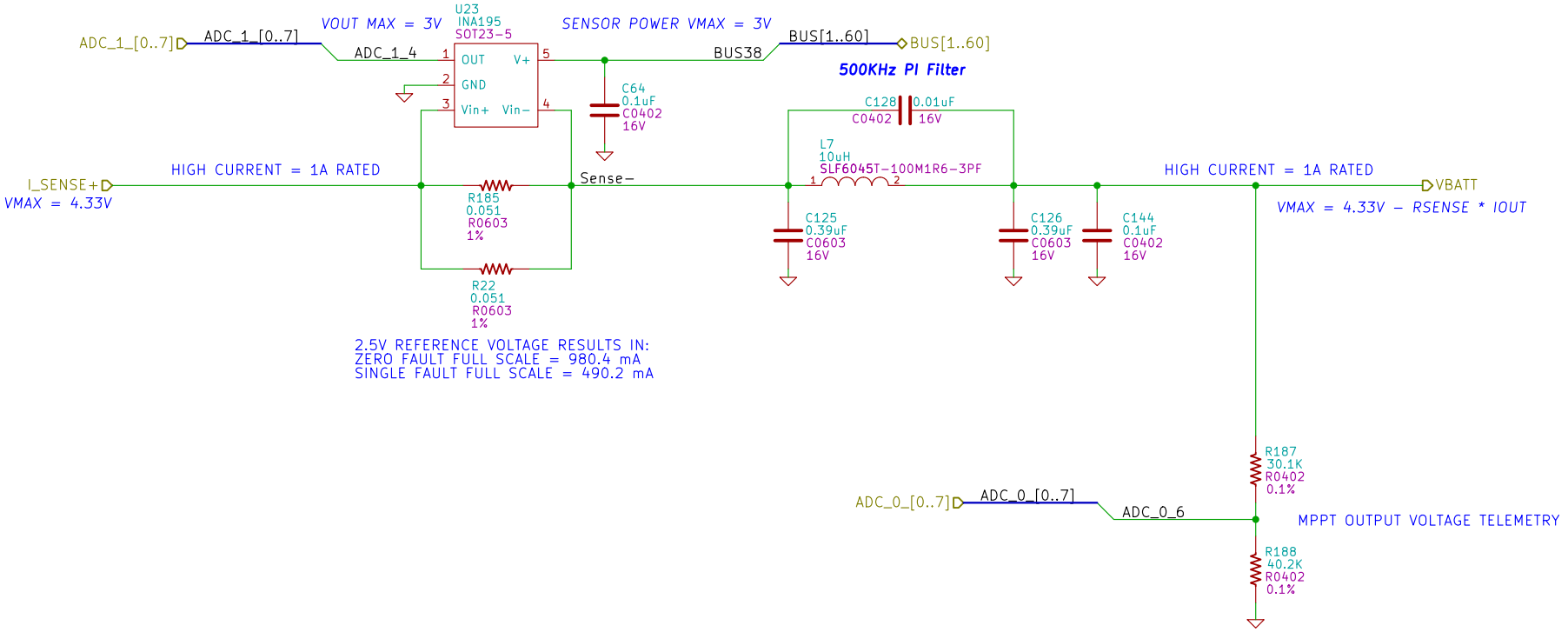
Size: A4	*Date: 30 nov 2015*	*Rev: 2.0*
KiCad E.D.A.		Id: 31/37



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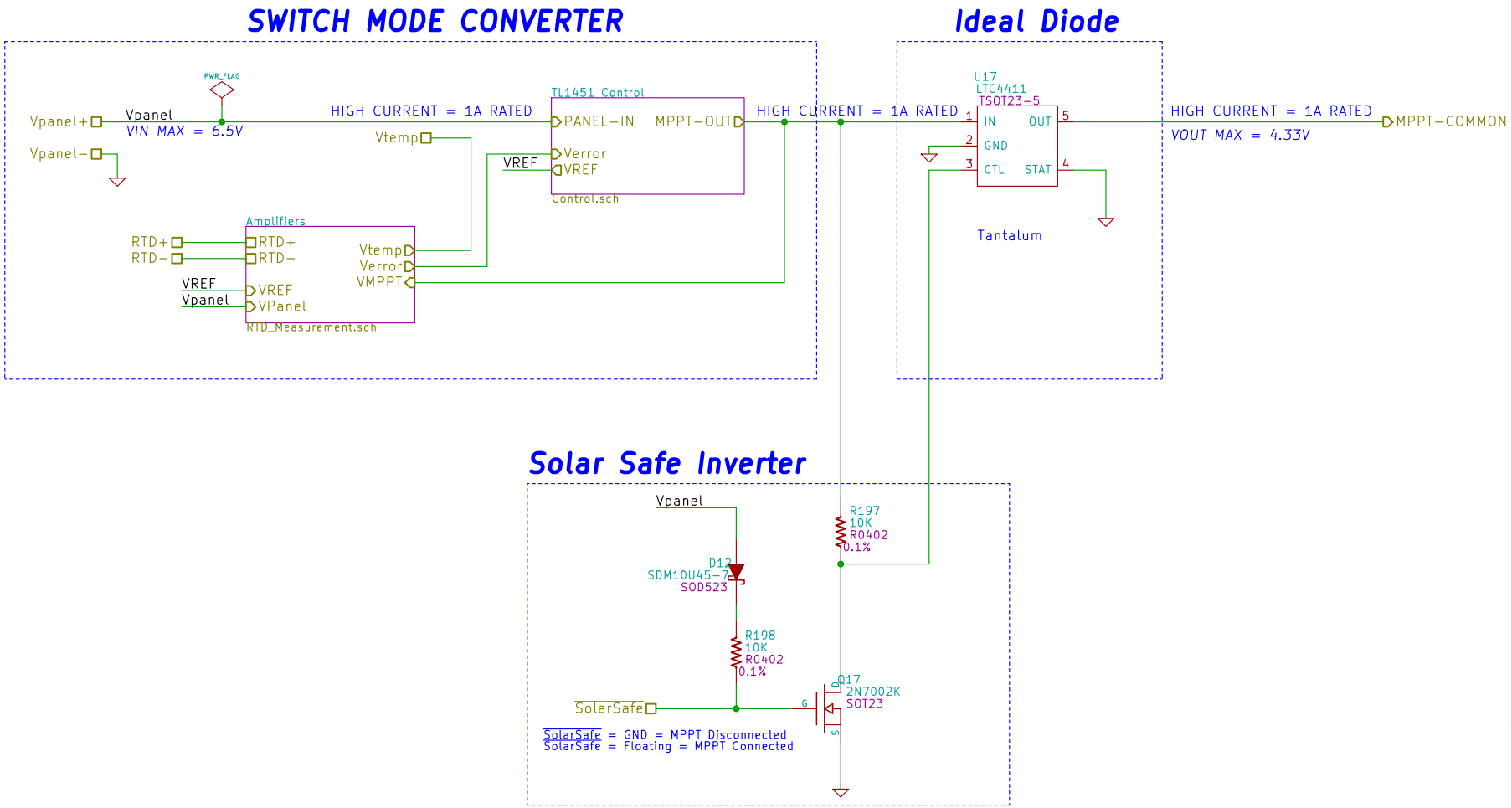
Based on Rochester Institute of Technology P13271 Design		
Brent Salmi, KB1LQD		
Bryce Salmi, KB1LQC		
The Radio Amateur Satellite Corporation		
File: Current_Sense.sch		
Sheet: /Current Sense/		
Title: Fox-1 Maximum Power Point Tracker		
Size: A4	*Date: 30 nov 2015*	*Rev: 2.0*
KiCad E.D.A.		Id: 32/37



NOTES

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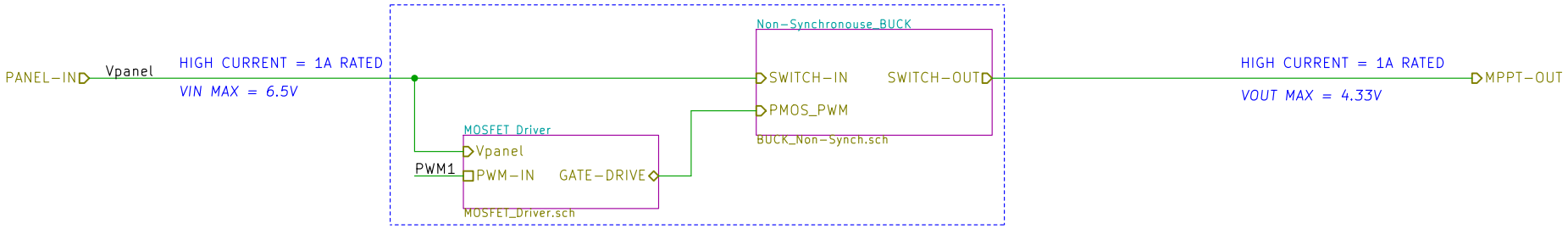
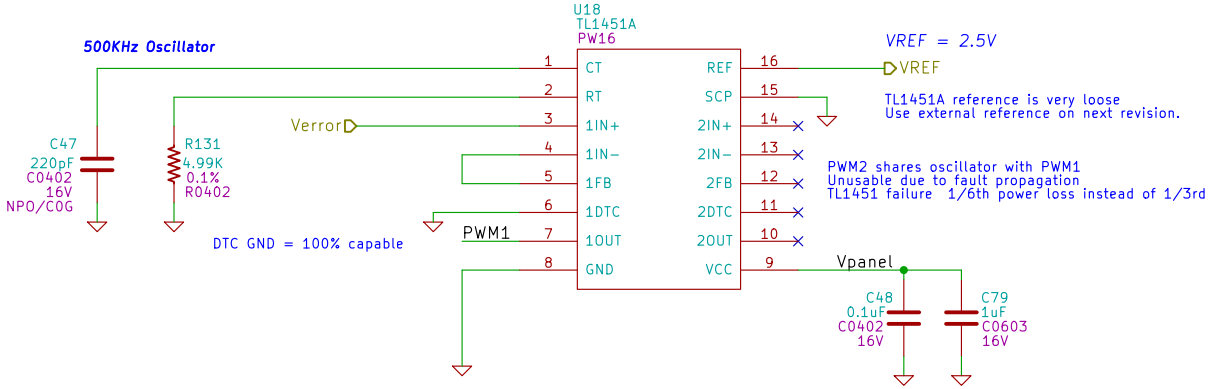
Based on Rochester Institute of Technology P13271 Design		
Brent Salmi, KB1LQD		
Bryce Salmi, KB1LQC		
The Radio Amateur Satellite Corporation		
File: MPPT_String.sch		
Sheet: /MPPT_String_Z+/		
Title: Fox−1 Maximum Power Point Tracker		
Size: A	*Date: 30 nov 2015*	*Rev: 2.0*
KiCad E.D.A.		Id: 33/37

Switch Mode Converter





NOTES

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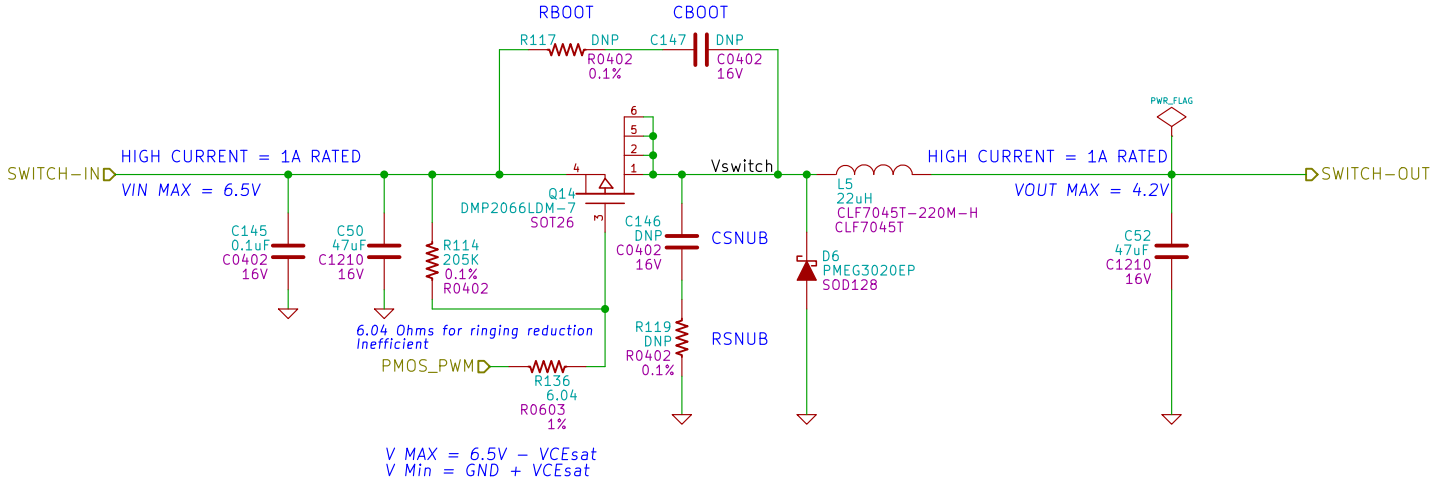
Based on Rochester Institute of Technology P13271 Design		
Brent Salmi, KB1LQD		
Bryce Salmi, KB1LQC		
The Radio Amateur Satellite Corporation		
File: Control.sch		
Sheet: /MPPT_String_Z+/TL1451 Control/		
Title: Fox-1 Maximum Power Point Tracker		
Size: A4	*Date: 30 nov 2015*	*Rev: 2.0*
KiCad E.D.A.		Id: 34/37

500 KHz Step-Down Buck Converter



NOTES

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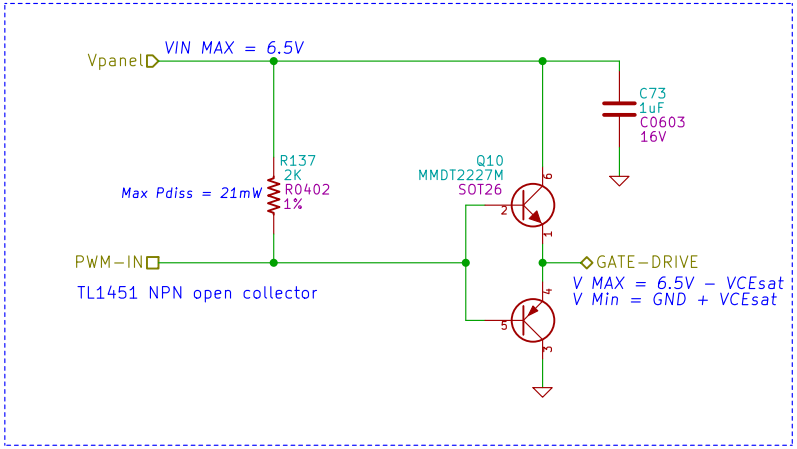
* Parts not yet NASA derated.

Based on Rochester Institute of Technology P13271 Design		
Brent Salmi, KB1LQD		
Bryce Salmi, KB1LQC		
The Radio Amateur Satellite Corporation		
File: BUCK_Non-Synch.sch		
Sheet: /MPPT_String_Z+/TL1451 Control/Non-Synchronouse_BUCK/		
Title: Fox-1 Maximum Power Point Tracker		
Size: A4	*Date: 30 nov 2015*	*Rev: 2.0*
KiCad E.D.A.		Id: 35/37

TOTEM POLE MOSFET DRIVER



NOTES

* This MPPT implements a set-point constant voltage tracking algorithm based on panel temperature.
* RIT MPPT Team: Brenton Salmi (KB1LQD), Bryce Salmi (KB1LQC), Ian MacKenzie (KB3OCF), Daniel Corriero.
* Parts not yet NASA derated.

Based on Rochester Institute of Technology P13271 Design		
Brent Salmi, KB1LQD		
Bryce Salmi, KB1LQC		
The Radio Amateur Satellite Corporation		
File: MOSFET_Driver.sch		
Sheet: /MPPT_String_Z+/TL1451 Control/MOSFET Driver/		
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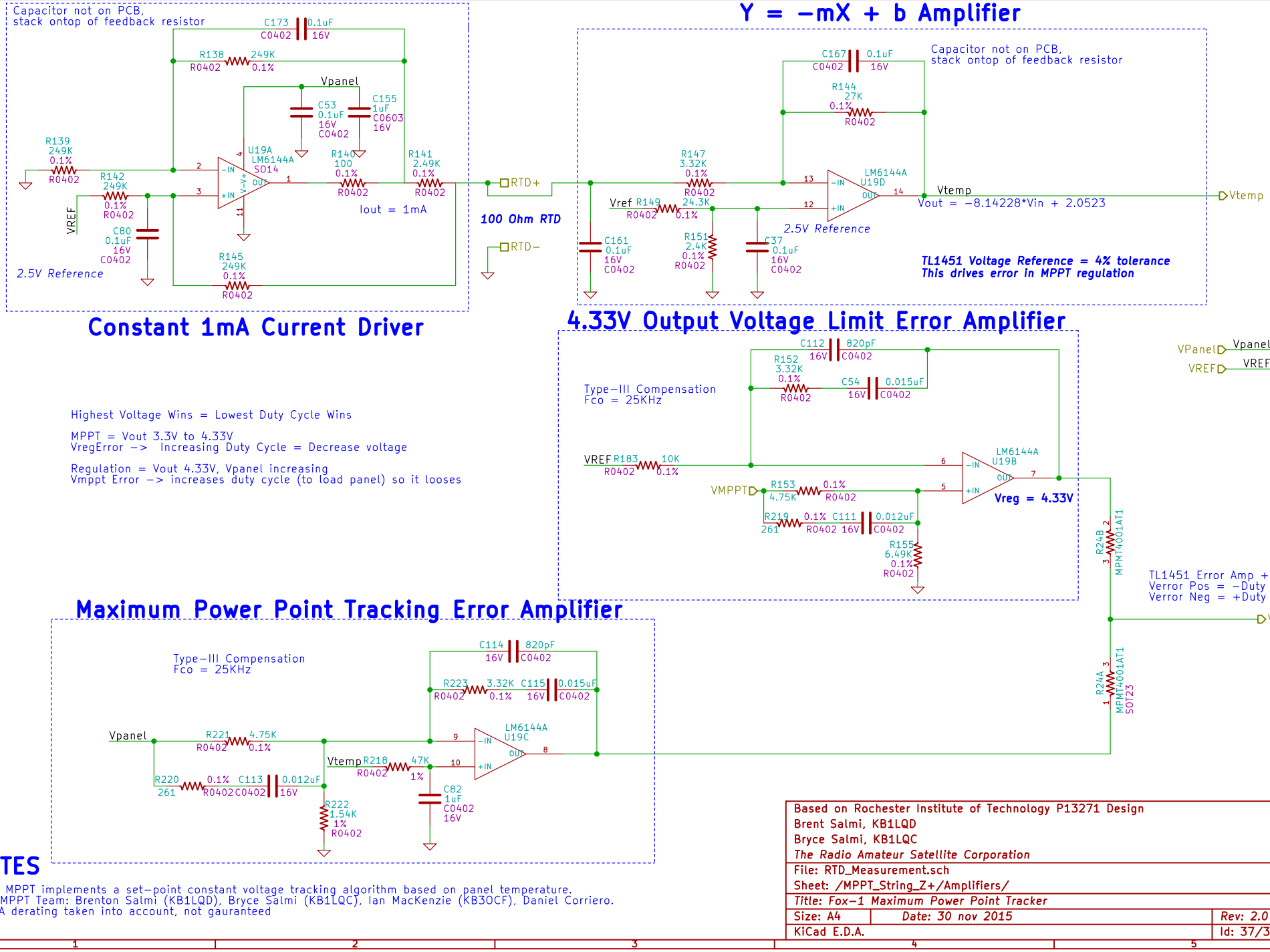
Capacitor not on PCB,
stack ontop of feedback resistor
C173 0.1uF C0402 16V
R138 249K R0402 0.1%
Vpanel
C53 0.1uF 16V C0402
C155 1uF C0603 16V
R139 249K 0.1% R0402
R142 249K 0.1% R0402
U19A LM6144A SO14
R140 100 0.1% R0402
R141 2.49K 0.1% R0402
Iout = 1mA
VREF
C80 0.1uF 16V C0402
2.5V Reference
R145 249K 0.1% R0402
RTD+
100 Ohm RTD
RTD−
Y = −mX + b Amplifier
C167 0.1uF C0402 16V
Capacitor not on PCB,
stack ontop of feedback resistor
R144 27K 0.1% R0402
R147 3.32K 0.1% R0402
Vref R149 24.3K R0402 0.1%
LM6144A U19D
Vtemp
Vout = −8.14228*Vin + 2.0523
Vtemp
2.5V Reference
C161 0.1uF 16V C0402
R151 2.4K 0.1% R0402
C37 0.1uF 16V C0402
TL1451 Voltage Reference = 4% tolerance
This drives error in MPPT regulation
Constant 1mA Current Driver
4.33V Output Voltage Limit Error Amplifier
VPanel Vpanel
VREF VREF
C112 820pF 16V C0402
Type−III Compensation
Fco = 25KHz
R152 3.32K 0.1% R0402
C54 0.015uF 16V C0402
VREF R183 10K R0402 0.1%
LM6144A U19B
VMPPT
R153 4.75K 0.1% R0402
R219 261 0.1% R0402
C111 0.012uF 16V C0402
R155 6.49K 0.1% R0402
Vreg = 4.33V
R24B MPM14001AT1
TL1451 Error Amp + PMOS:
Verror Pos = −Duty Cycle
Verror Neg = +Duty Cycle
Verror
Highest Voltage Wins = Lowest Duty Cycle Wins
MPPT = Vout 3.3V to 4.33V
VregError −> Increasing Duty Cycle = Decrease voltage
Regulation = Vout 4.33V, Vpanel increasing
Vmppt Error −> increases duty cycle (to load panel) so it looses
Maximum Power Point Tracking Error Amplifier
Type−III Compensation
Fco = 25KHz
C114 820pF 16V C0402
R223 3.32K 0.1% R0402
C115 0.015uF 16V C0402
Vpanel
R221 4.75K 0.1% R0402
LM6144A U19C
Vtemp R218 47K 1% R0402
R220 261 0.1% R0402
C113 0.012uF 16V C0402
R222 1.54K 1% R0402
C82 1uF 16V C0402
R24A MPM14001AT1 SOT23
NOTES
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* NASA derating taken into account, not gauranteed
Based on Rochester Institute of Technology P13271 Design
Brent Salmi, KB1LQD
Bryce Salmi, KB1LQC
The Radio Amateur Satellite Corporation
File: RTD_Measurement.sch
Sheet: /MPPT_String_Z+/Amplifiers/
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