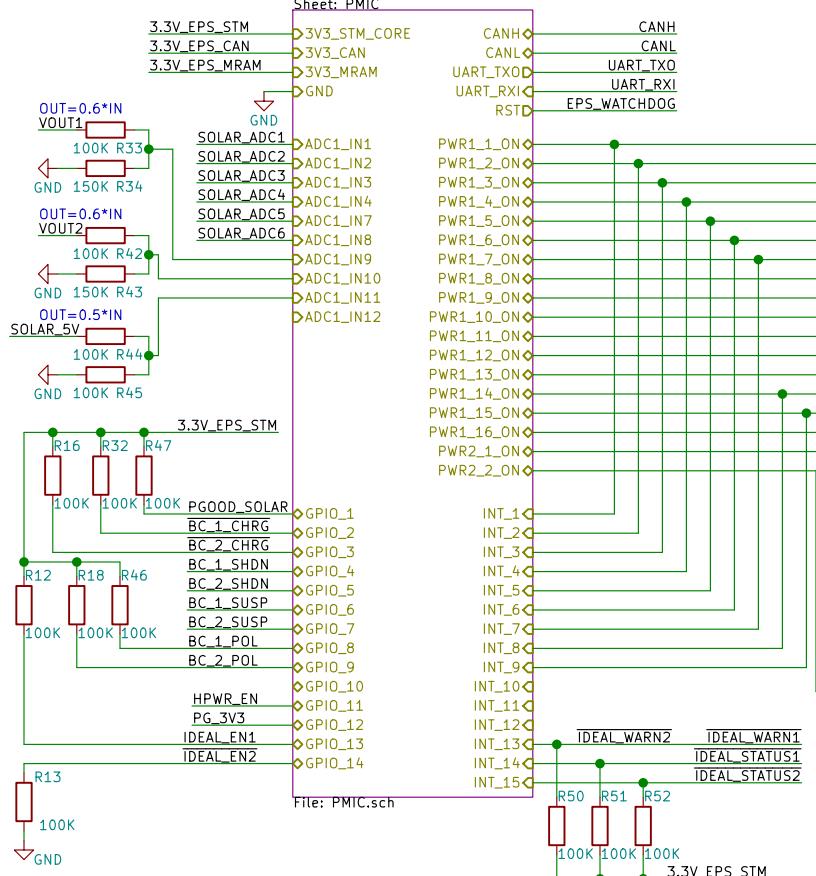
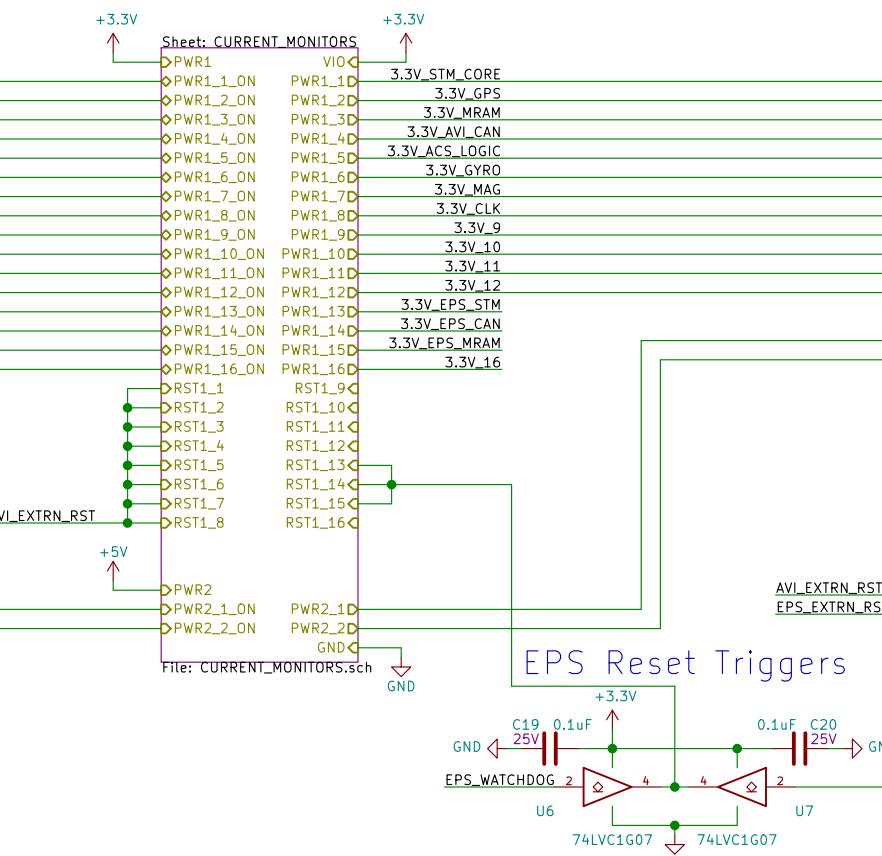


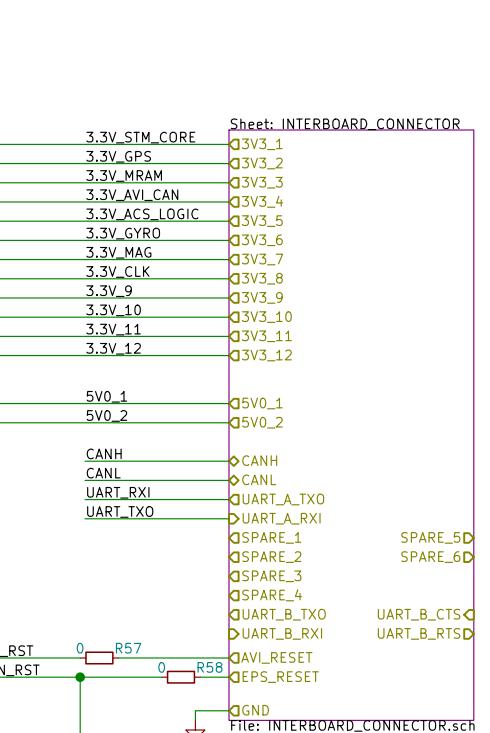
Power Management IC (PMIC)



Current Monitors & Load switching

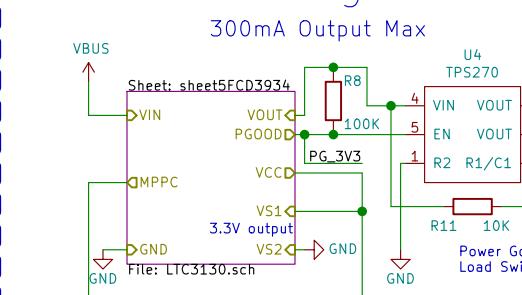


Interboard Connector

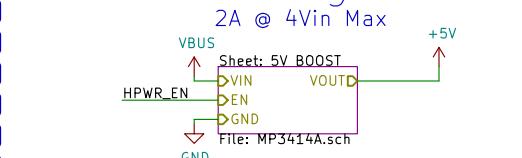


Voltage Regulators

3.3V Regulator



5.0V Regulator



5V BOOST



EPS

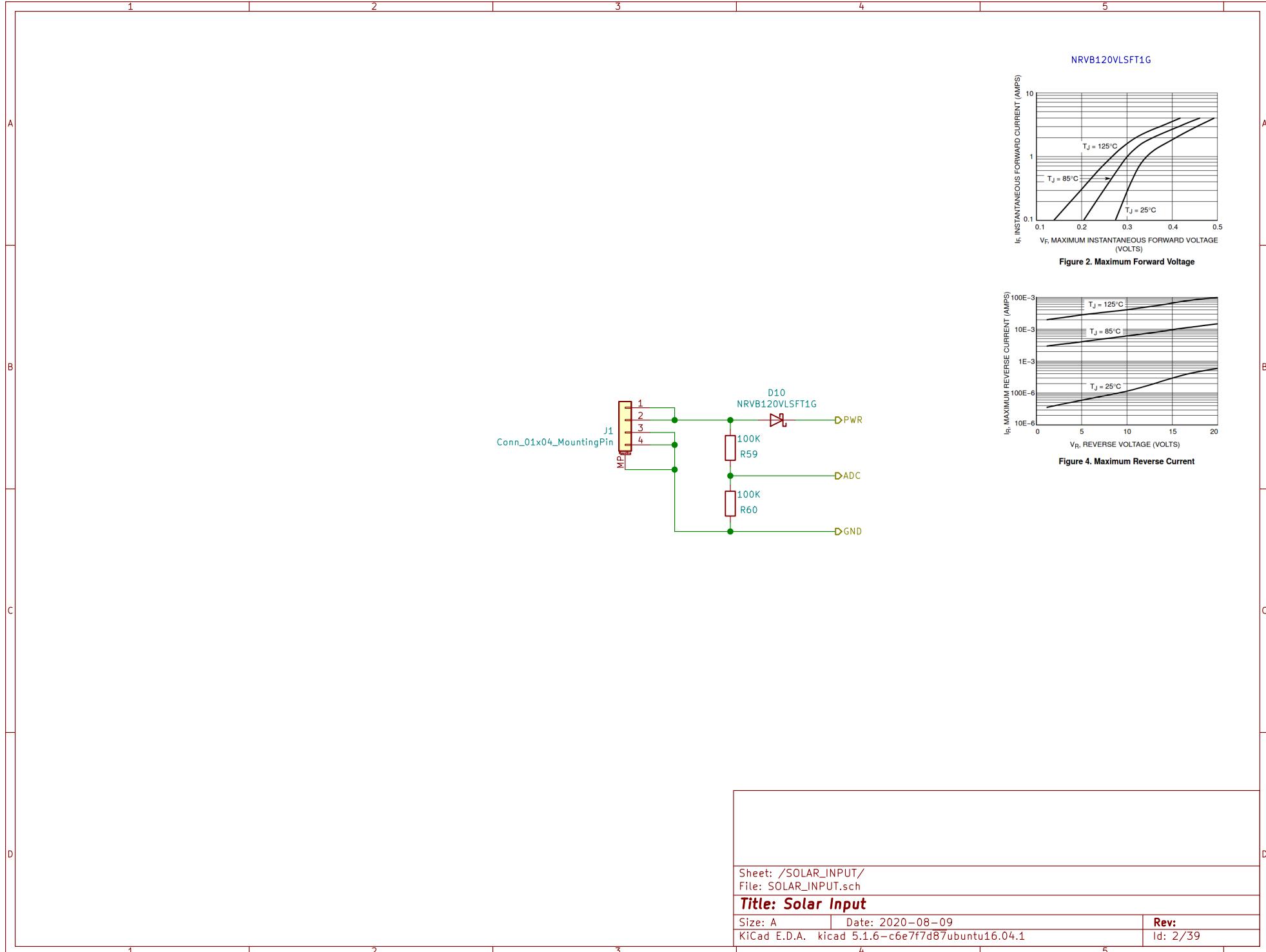
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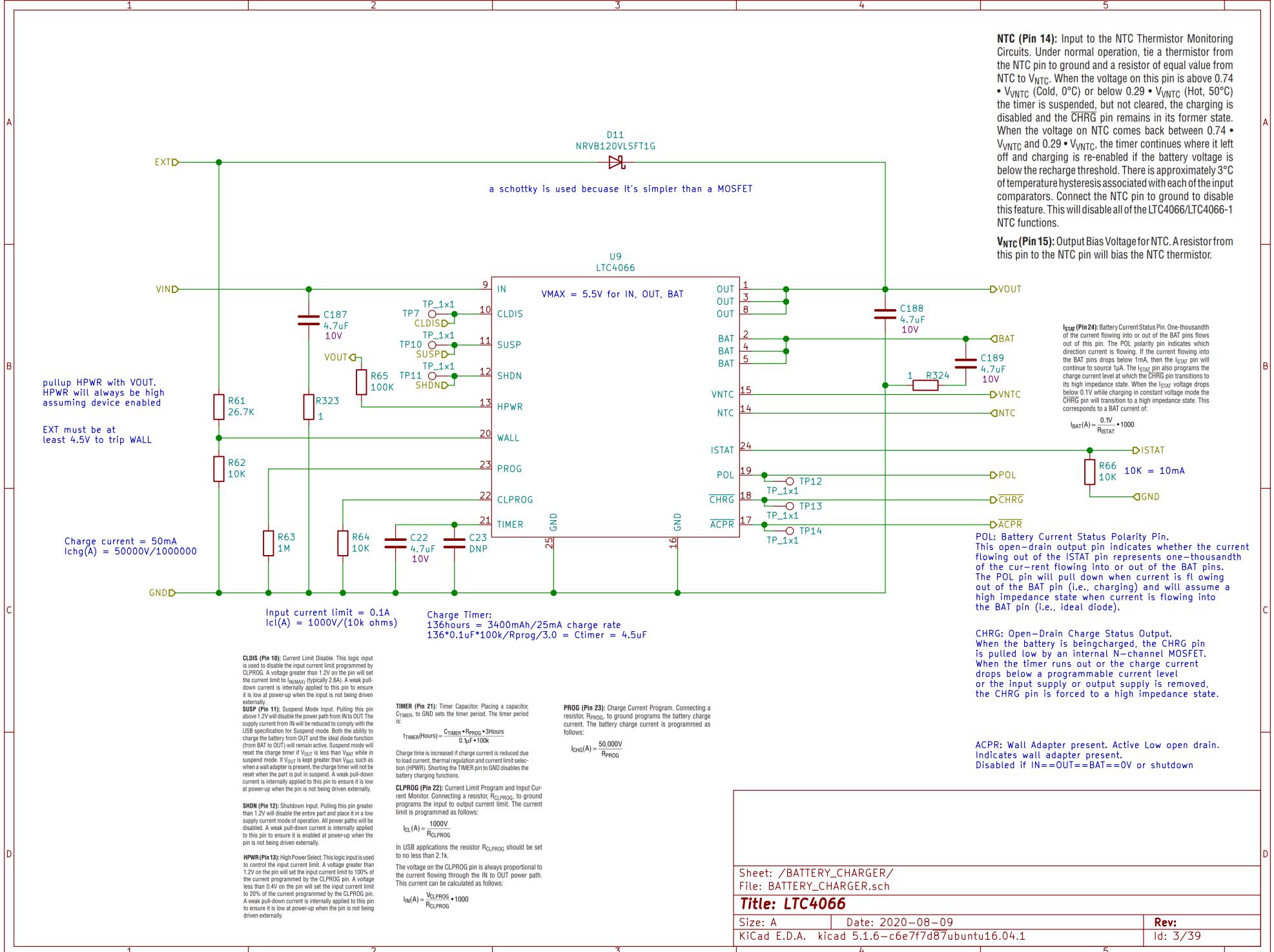
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EPS Title

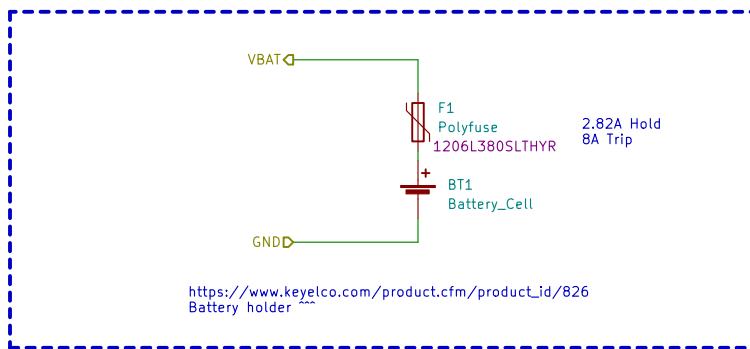
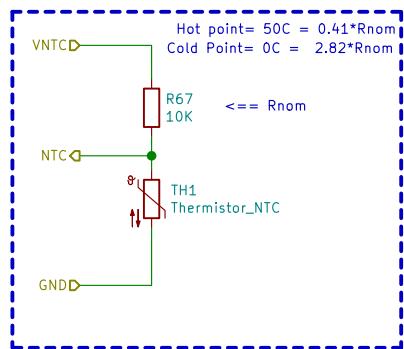
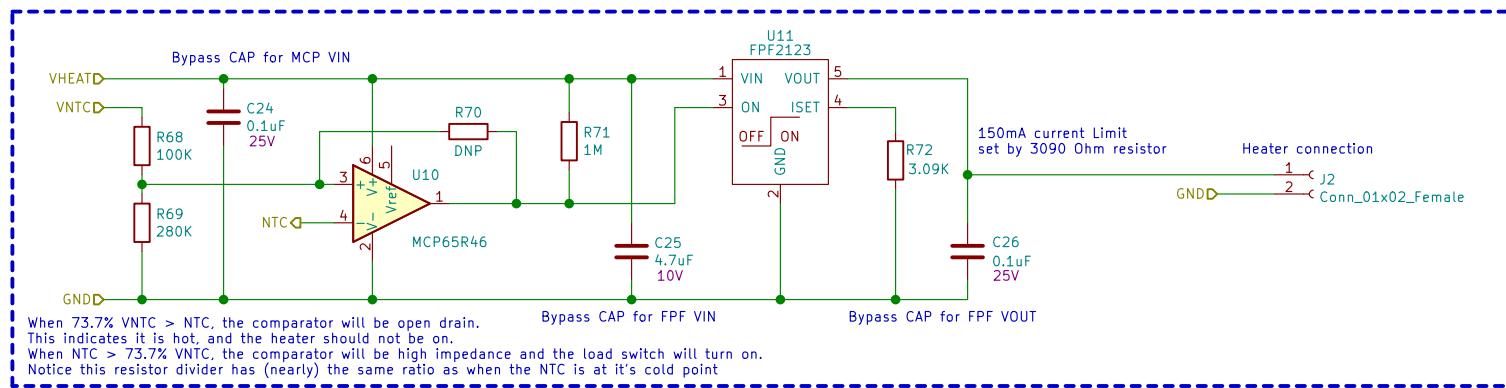
Size: B Date: 2020-10-11 Rev:

KiCad E.D.A. kicad 5.1.6-c6e7f7d87ubuntu16.04.1 Id: 1/39





Battery heater control circuit



NTC output for battery charger
and heater circuit (see above)

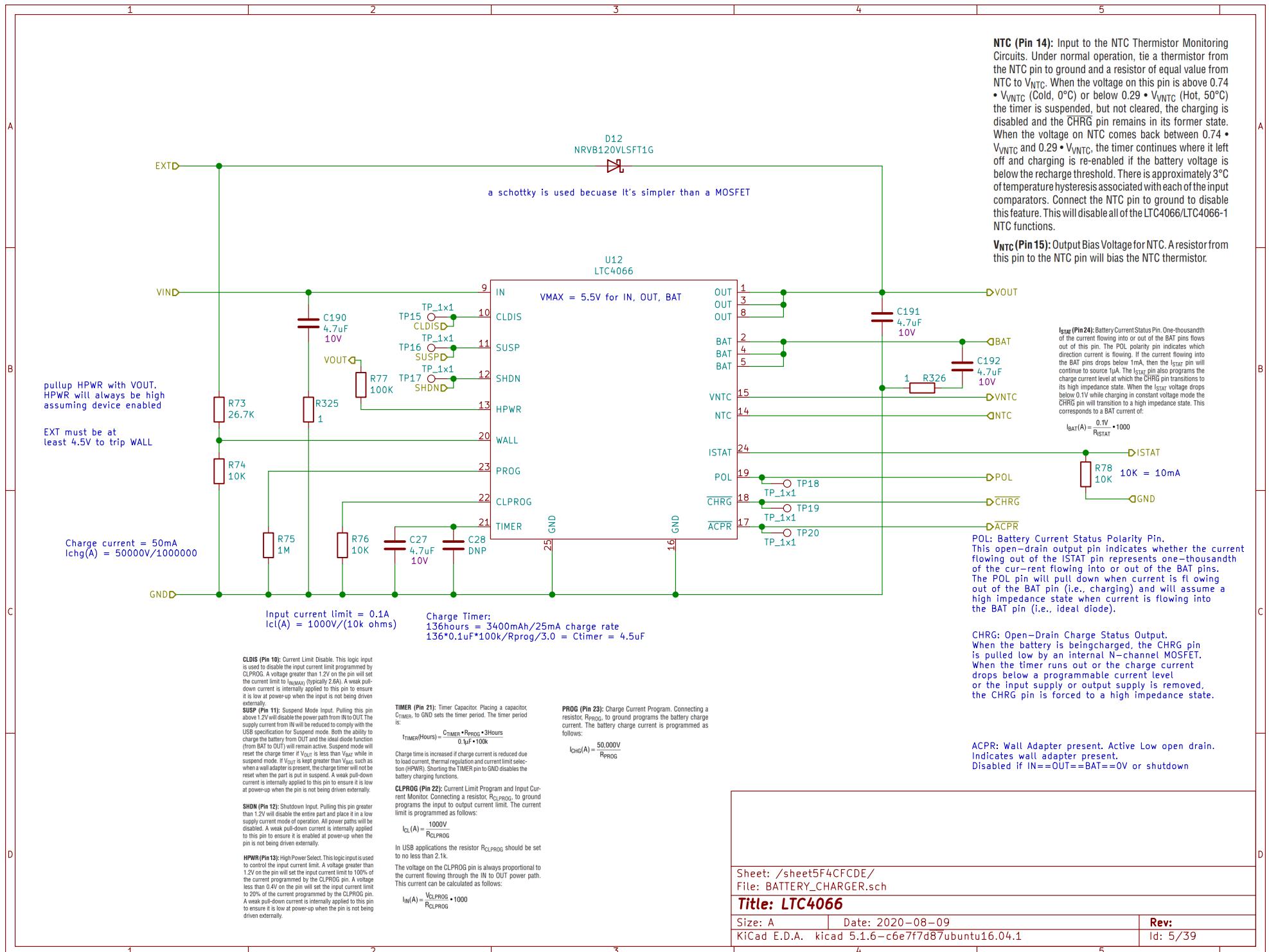
Battery & Fuse

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File: BATTERY.sch

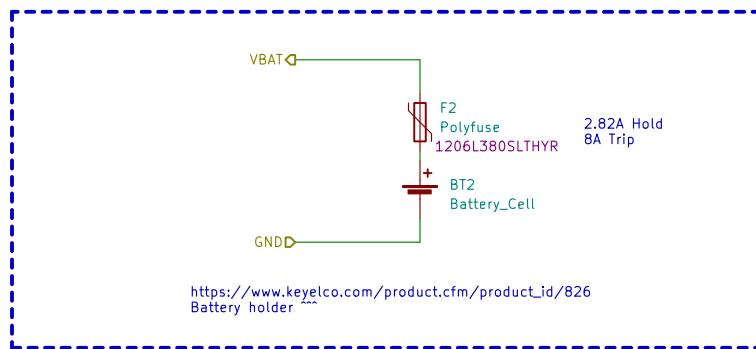
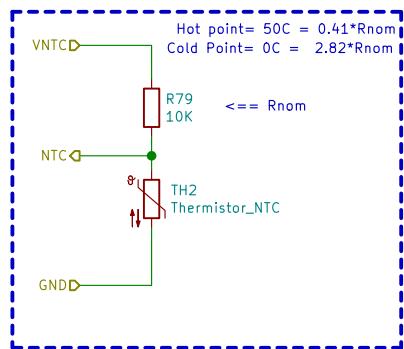
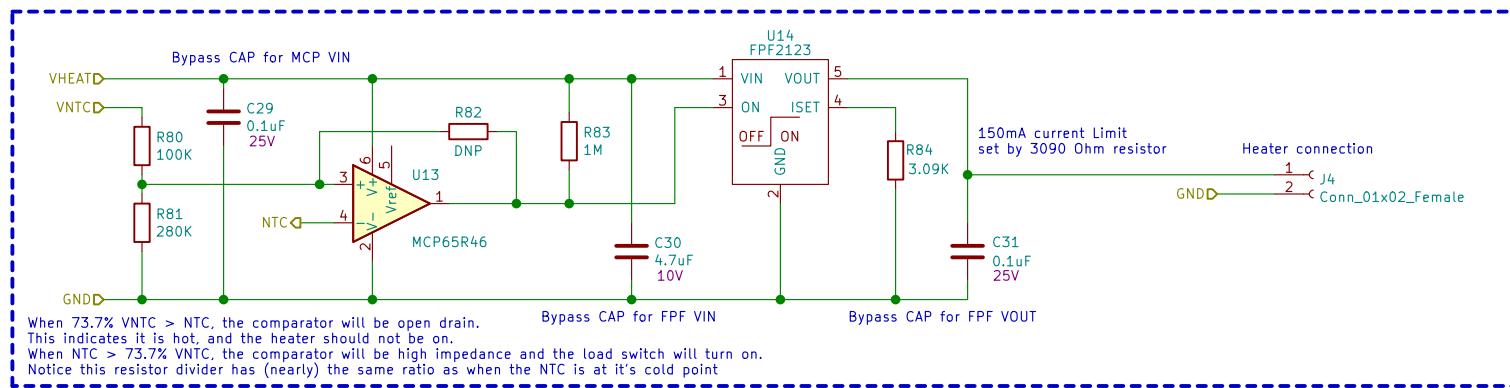
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Size: A Date: 2020-08-11
KiCad E.D.A. kicad 5.1.6-c6e7f7d87ubuntu16.04.1

Rev:
Id: 4/39



Battery heater control circuit



NTC output for battery charger
and heater circuit (see above)

Battery & Fuse

Sheet: /sheet5F4CFCDF/
File: BATTERY.sch

Title: Battery, Battery Heater, NTC

Size: A Date: 2020-08-11
KiCad E.D.A. kicad 5.1.6-c6e7f7d87ubuntu16.04.1

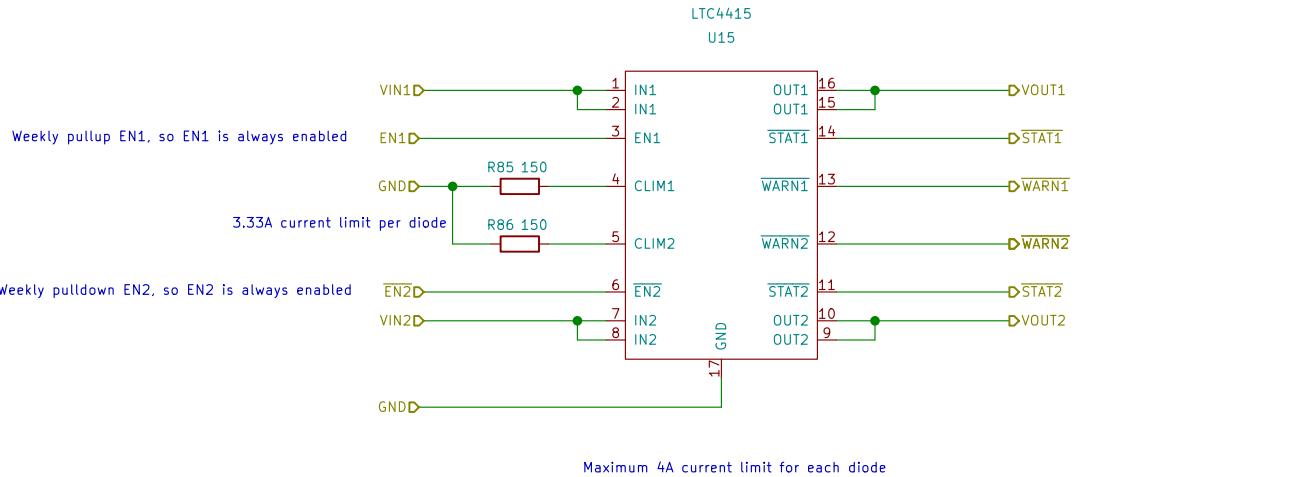
Rev:
Id: 6/39

A

A

STAT
Open-drain output pulls down during forward diode conduction.
This pin can be left open or grounded when not used.

WARN
Open-drain output pulls down when the diode current exceeds its
current limit or die temperature is close to thermal shutdown.



Voltage Thresholds for the Enable pins:
V_{enth} = 0.8V with V_{ehyst} = 0.055V

Current Limit Setting

The output current limit of each diode can be set independently by connecting resistors from the current limit adjust pins CLIM1 and CLIM2 to ground. The current set of the CLIM1 and CLIM2 pins are 1/1000 of the ideal diode output currents I_{Q1} and I_{Q2} respectively. When the load currents increase so that the CLIM1 or CLIM2 pin voltages exceeds 0.5V, the LTC4415 detects an overcurrent condition and regulates the current to a fixed value. The required value of resistor R_{CLIM} for output current limit of I_Q is calculated as follows:

$$R_{CLIM} = \frac{0.5V}{I_{Q}}$$

The allowed range of R_{CLIM} is 125Ω to 1000Ω unless the CLIM1/CLIM2 pins are shorted to GND, in which case the LTC4415 limits the load current using a fixed internal current limit of 6A.

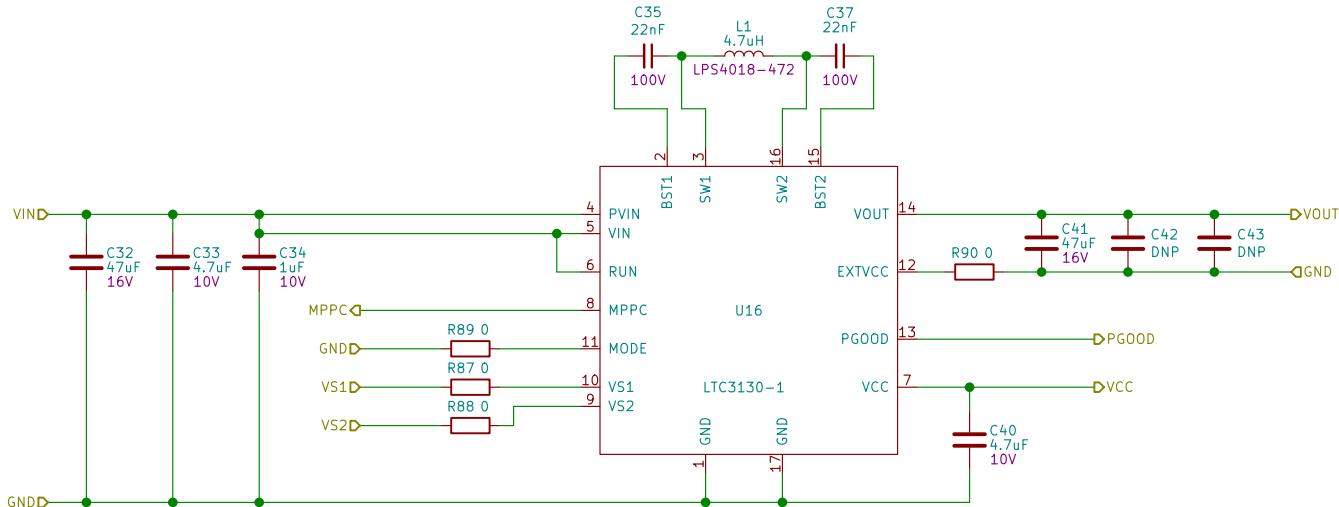
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File: IDEAL_DIODE.sch

Title: LTC4415

Size: A Date: 2020-09-06
KiCad E.D.A. kicad 5.1.6-c6e7f7d87ubuntu16.04.1

Rev: Id: 7/39

A



B

Maximum Power Point Control (MPPC)

The MPPC input of the LTC3130/LTC3130-1 can be used with an optional external voltage divider to dynamically adjust the commanded inductor current in order to maintain a minimum input voltage when using high resistance sources, such as photovoltaic panels, so as to maximize input power transfer and prevent V_{IN} from dropping too low under load.

Referring to Figure 4, the MPPC pin is internally connected to the noninverting input of a g_m amplifier, whose inverting input is connected to the 1.0V reference. If the voltage at MPPC, using the external voltage divider, falls below the reference voltage, the output of the amplifier pulls the internal VC node low. This reduces the commanded average inductor current so as to reduce the input current and regulate V_{IN} to the programmed minimum voltage, as given by:

$$V_{IN(MPPC)} = 1.00V \left(1 + \frac{R5}{R6} \right)$$

Note that external compensation should not be required for MPPC loop stability if the input filter capacitor, C_{IN} , is at least 22μF.

The MPPC divider resistor values can be in the MΩ range so as to minimize the input current in very low power applications. However, stray capacitance and noise pickup on the MPPC pin must also be minimized. If the MPPC function is not required, the MPPC pin should be tied to V_{CC} .

Beware of adding a noise filter capacitor to the MPPC pin, as the added filter pole may cause the MPPC control loop to be unstable.

Note that because Burst Mode operation will be inhibited if the MPPC loop takes control, the converter will be operating in fixed frequency mode, and will therefore require a minimum of about 6mA of continuous input current to operate. For operation from weaker sources, such as small indoor solar panels, refer to the Applications Information section to see how to add a resistor to the MPPC pin to control the converter in a hysteretic manner while providing an effective MPPC function by maintaining V_{IN} at the desired voltage. This technique can be used with sources as weak as 3.5V (enough to power the IC in UVLO and the external RUN divider).

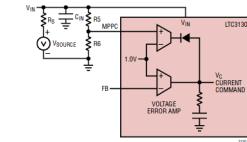
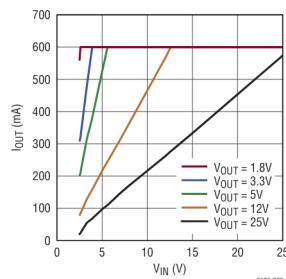


Figure 4. MPPC Amplifier with External Resistor Divider

Maximum Output Current vs V_{IN} and V_{OUT} 

PGOOD is open drain.
Pulled low when V_{OUT} is less than 7.5% programmed value
High-Z when V_{OUT} is within 5% programmed value

MODE (Pin 11/Pin 11): Mode Select Pin.

MODE = Low (ground): Enables automatic Burst Mode operation

MODE = High (tie to V_{CC}): Fixed frequency PWM operation

Table 1. V_{OUT} Program Settings for the LTC3130-1

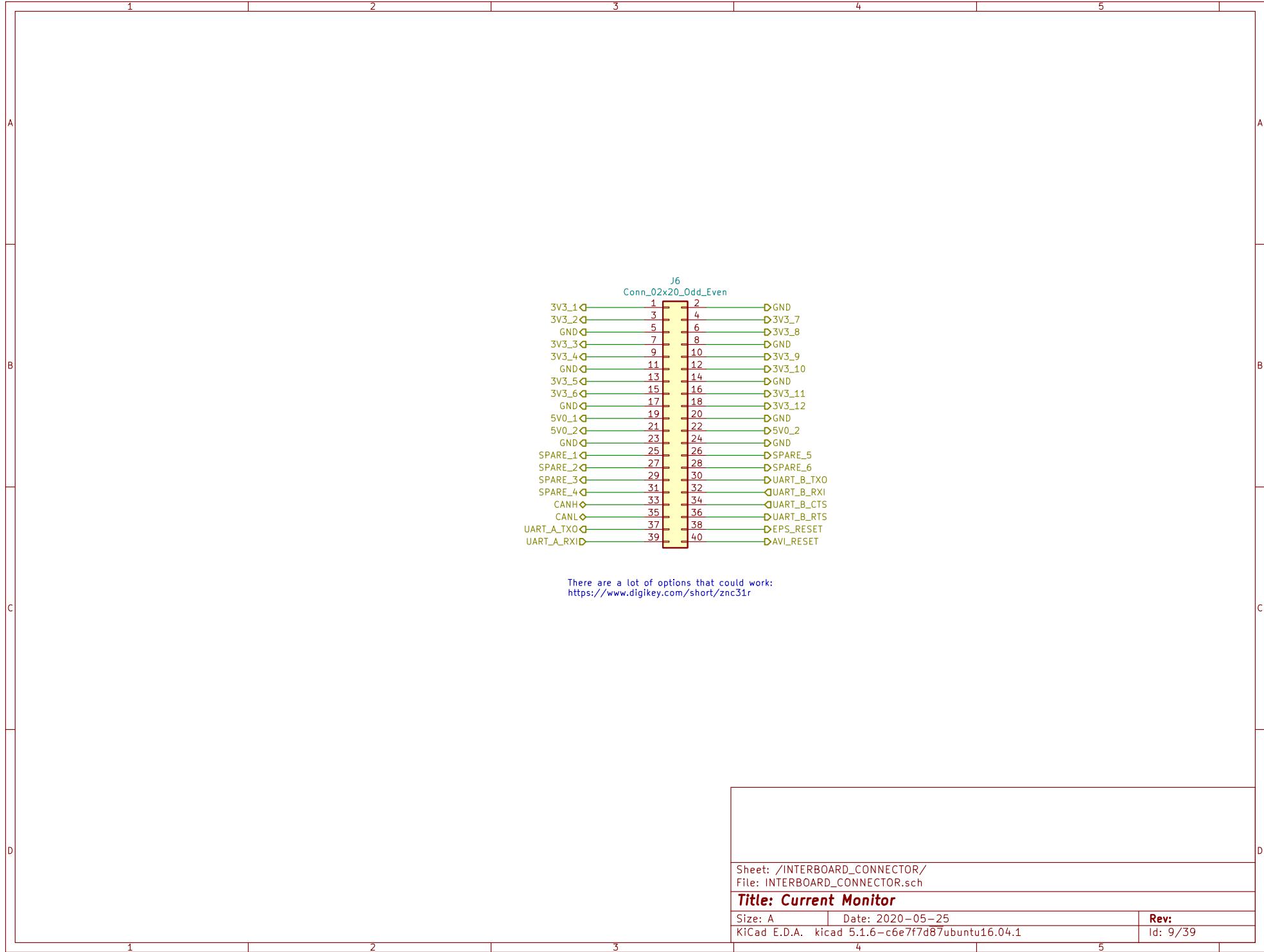
VS2	VS1	V_{OUT}
0	0	1.8V
0	V_{CC}	3.3V
V_{CC}	0	5.0V
V_{CC}	V_{CC}	12V

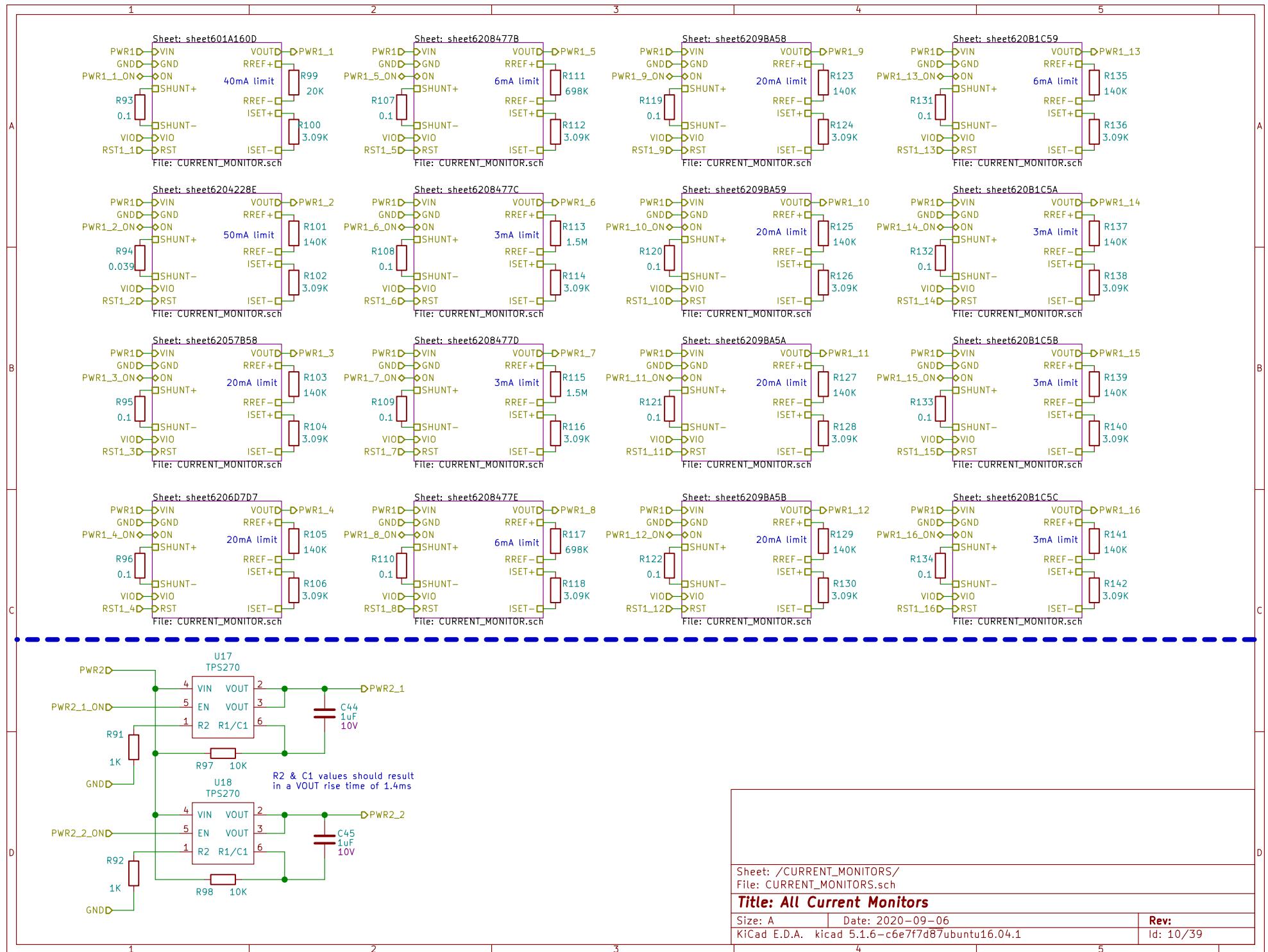
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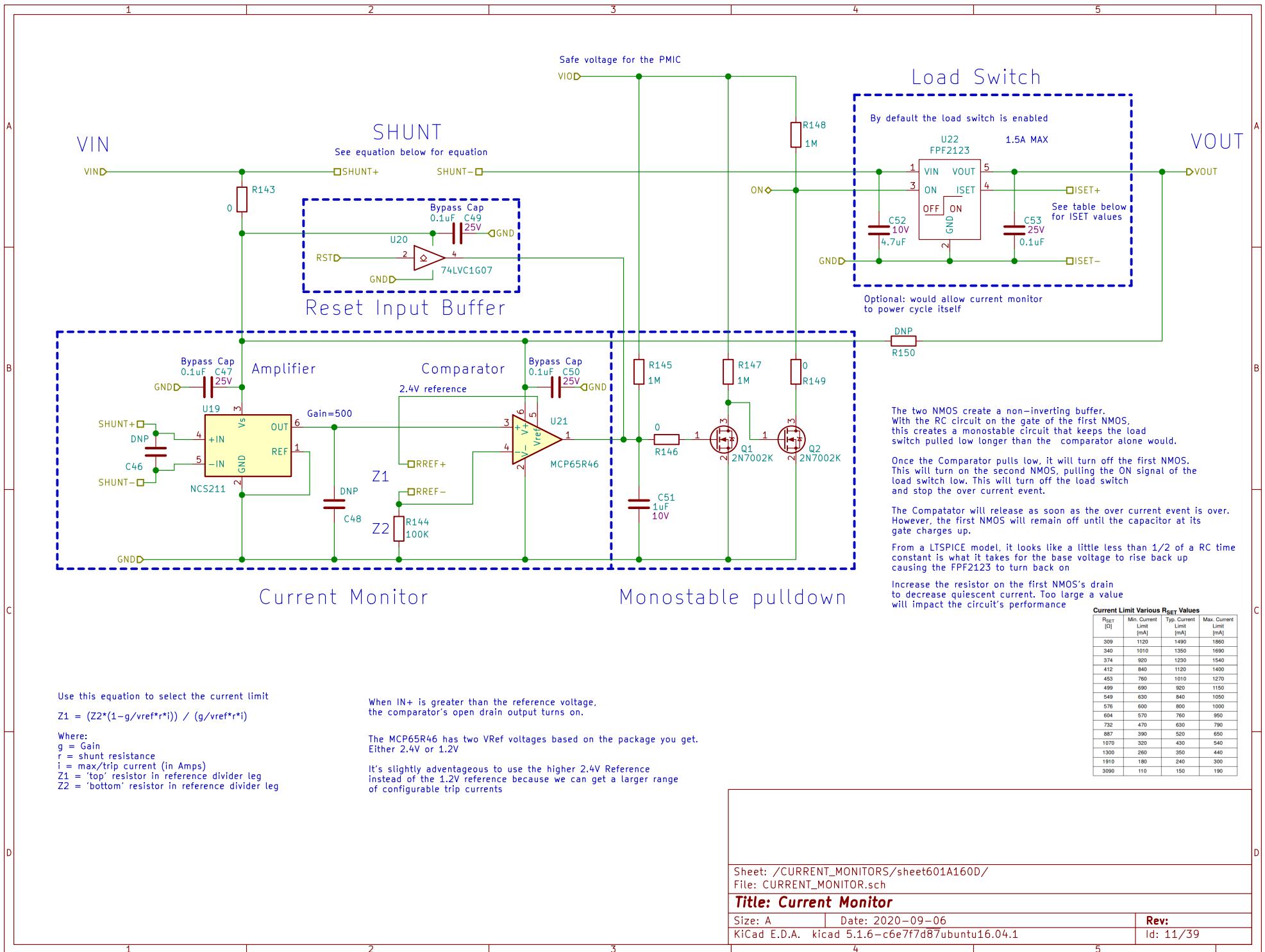
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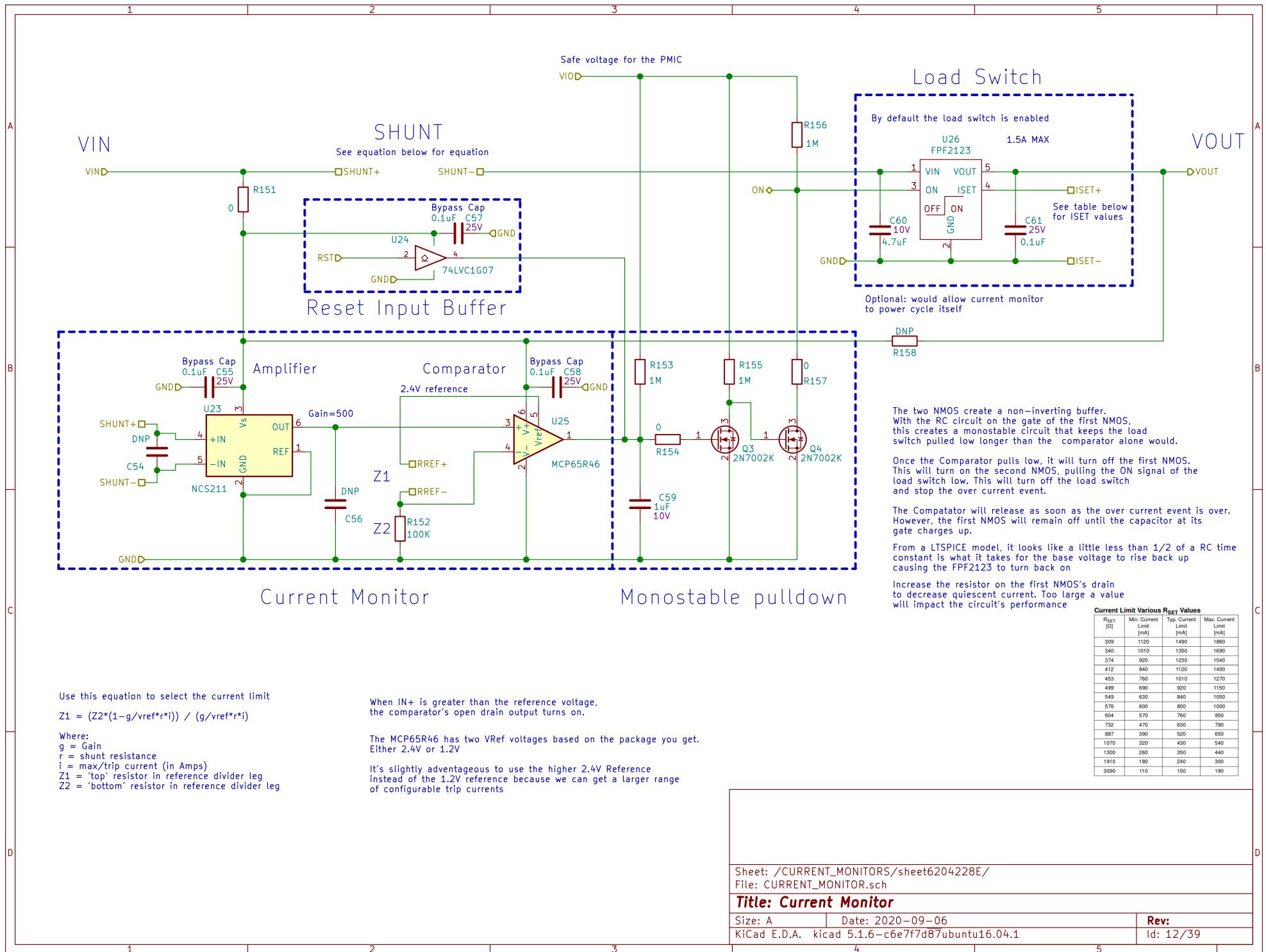
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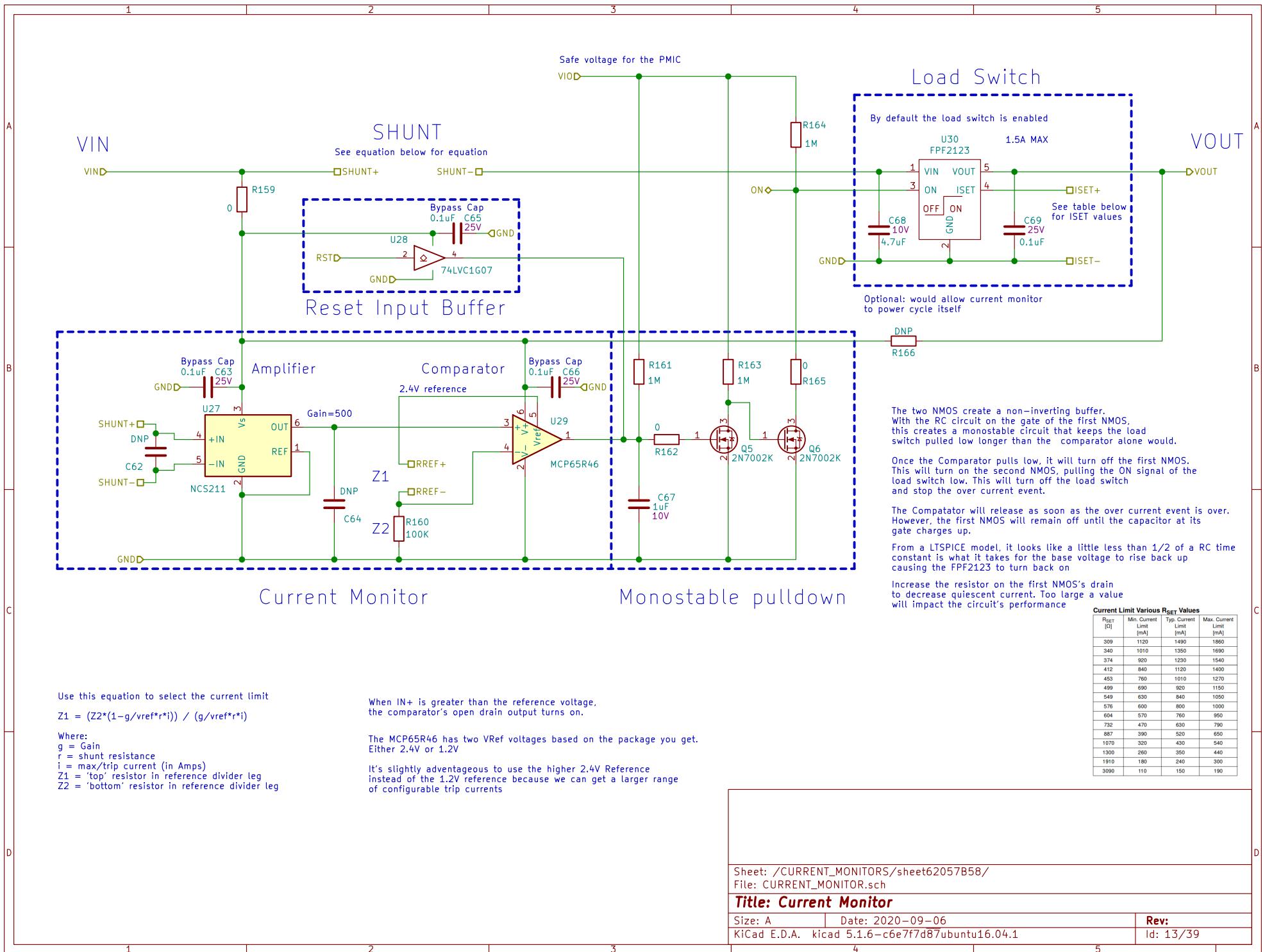
Rev:
Id: 8/39

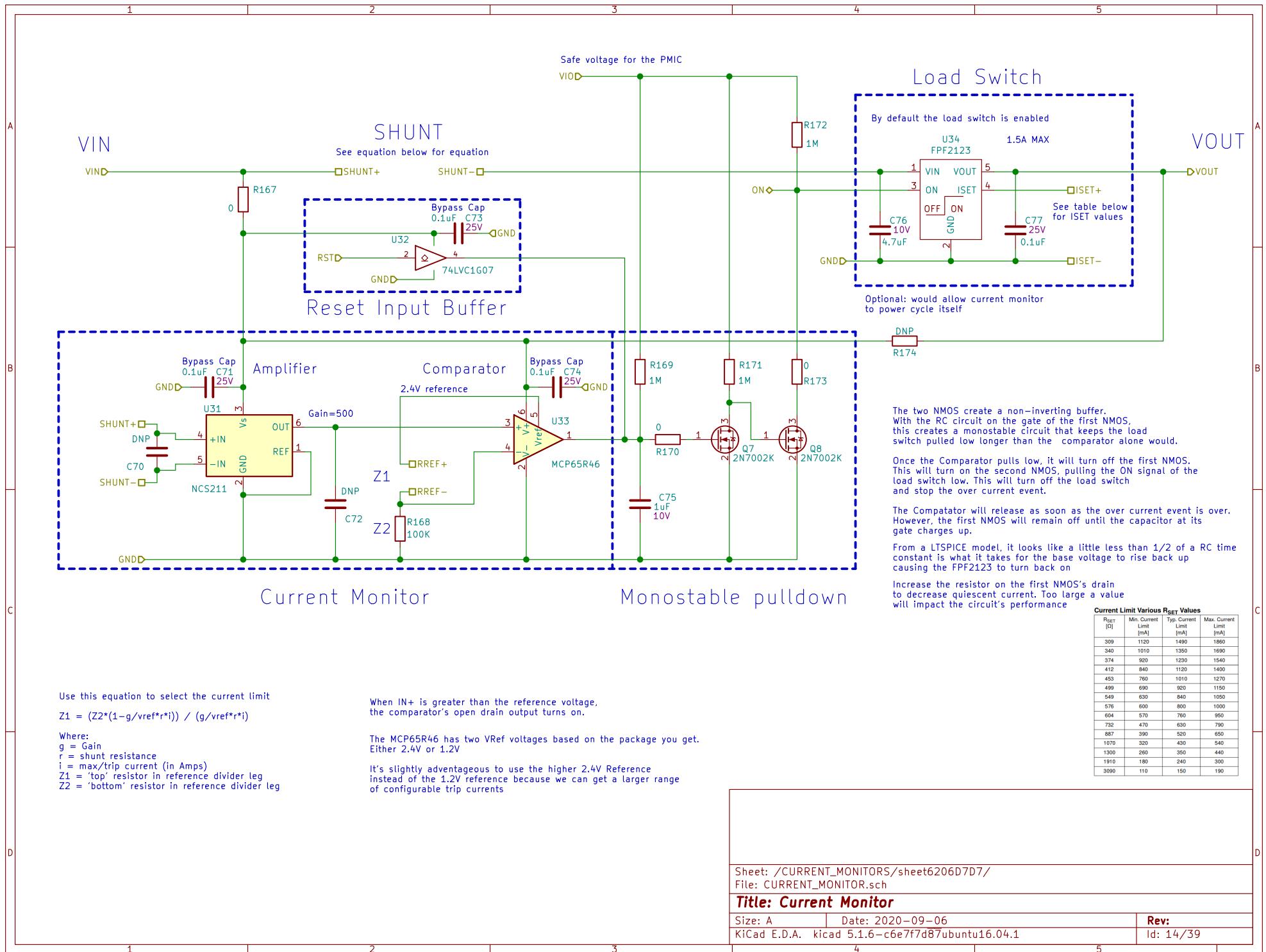


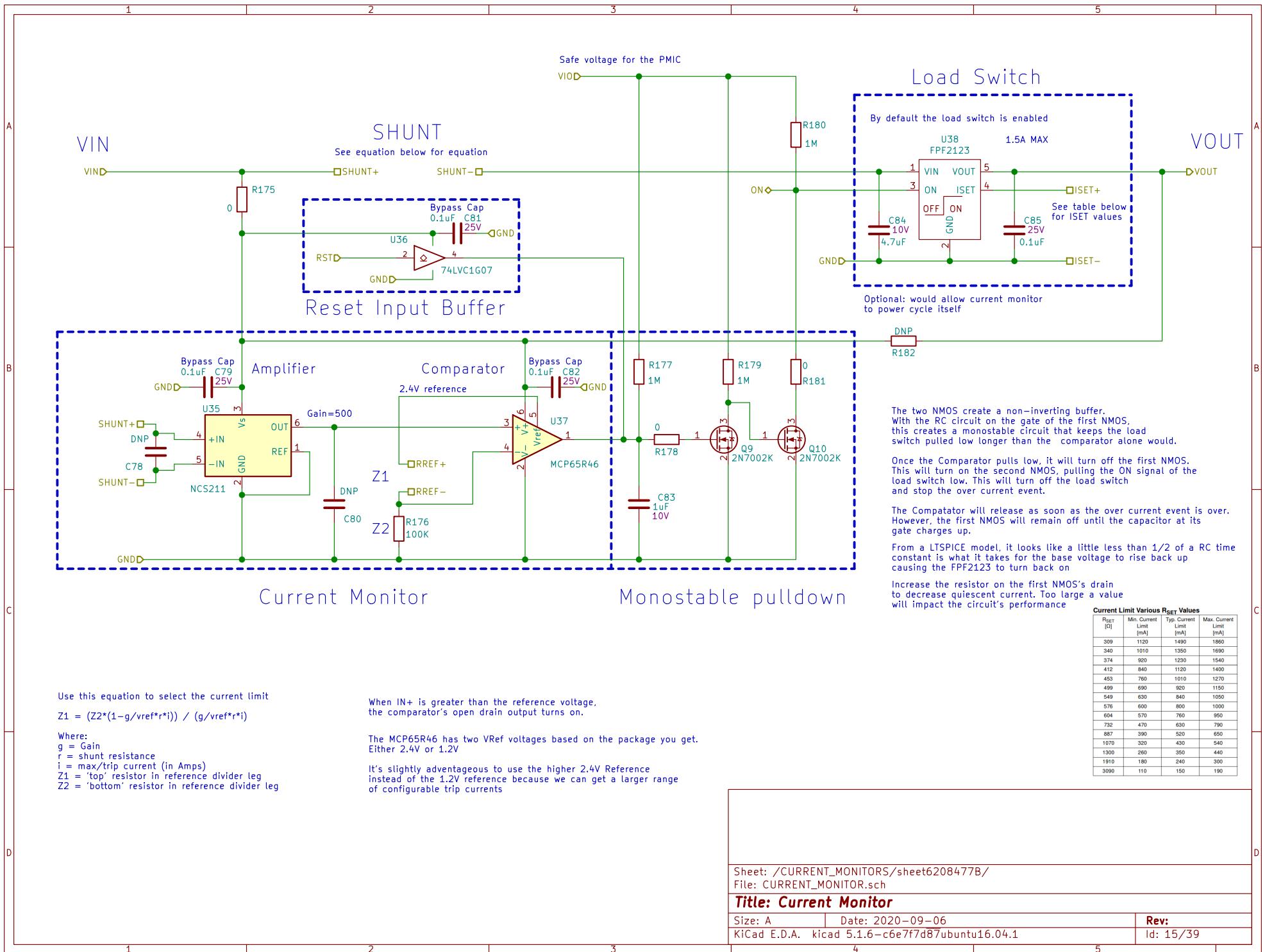


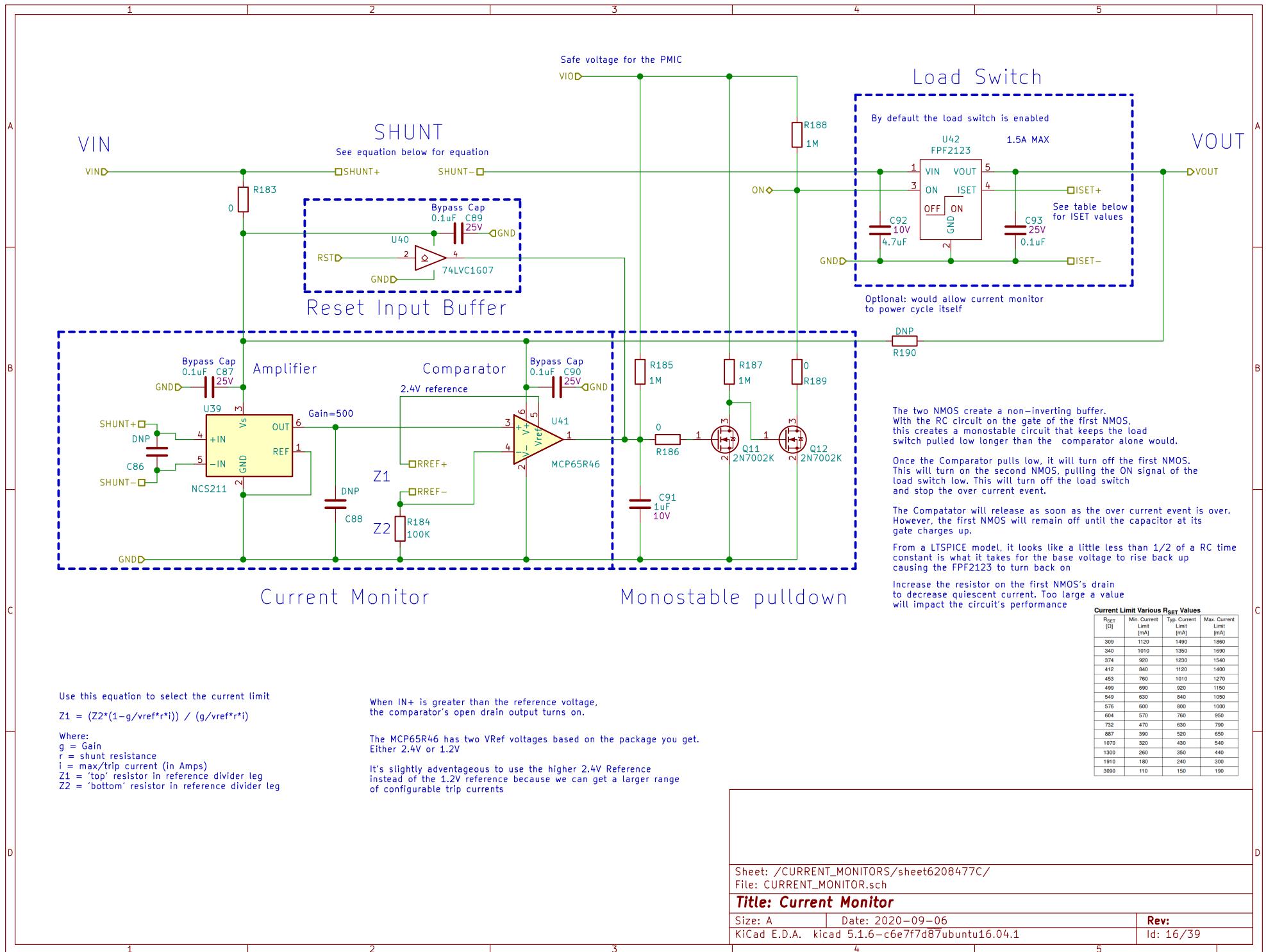


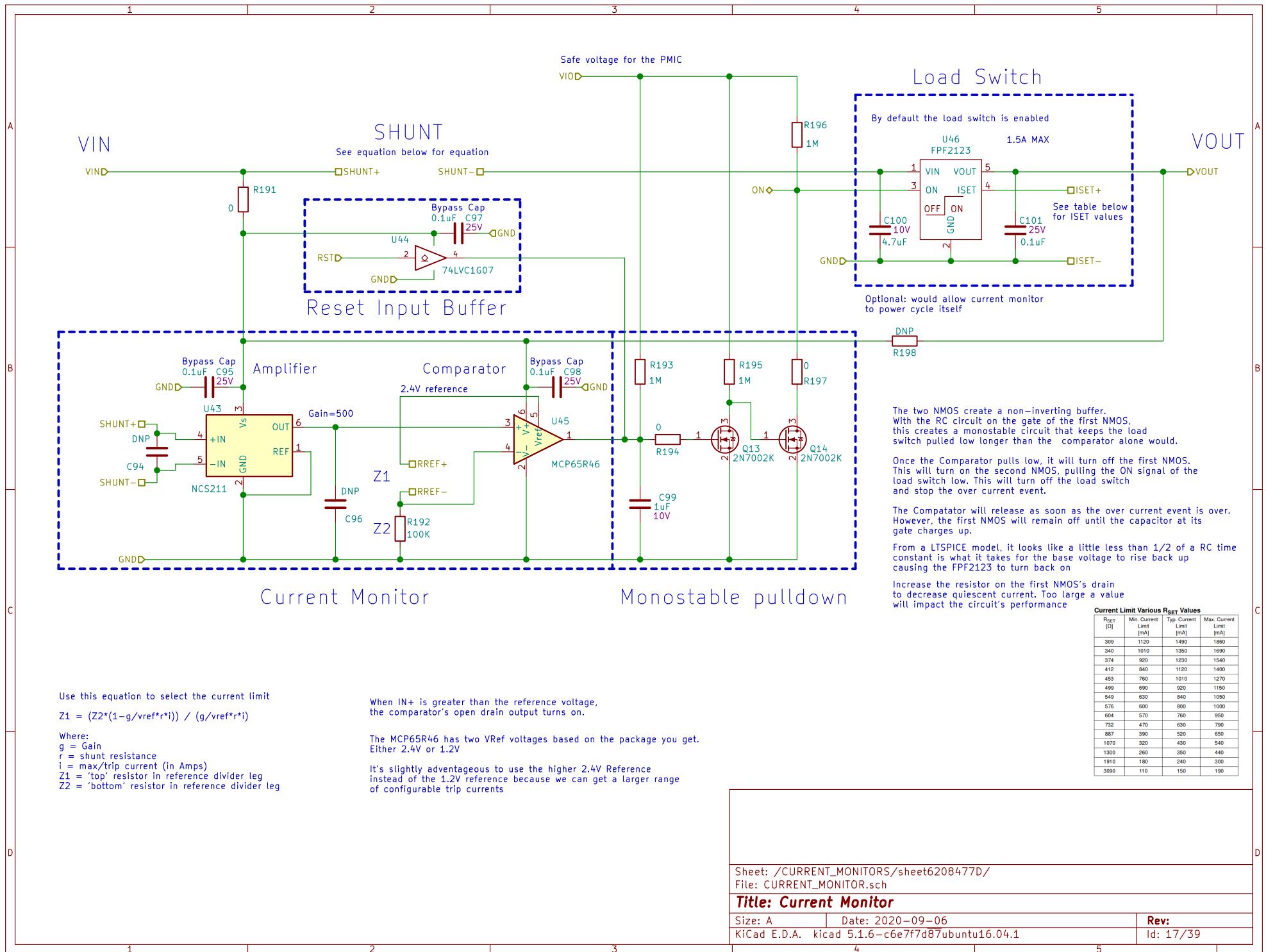


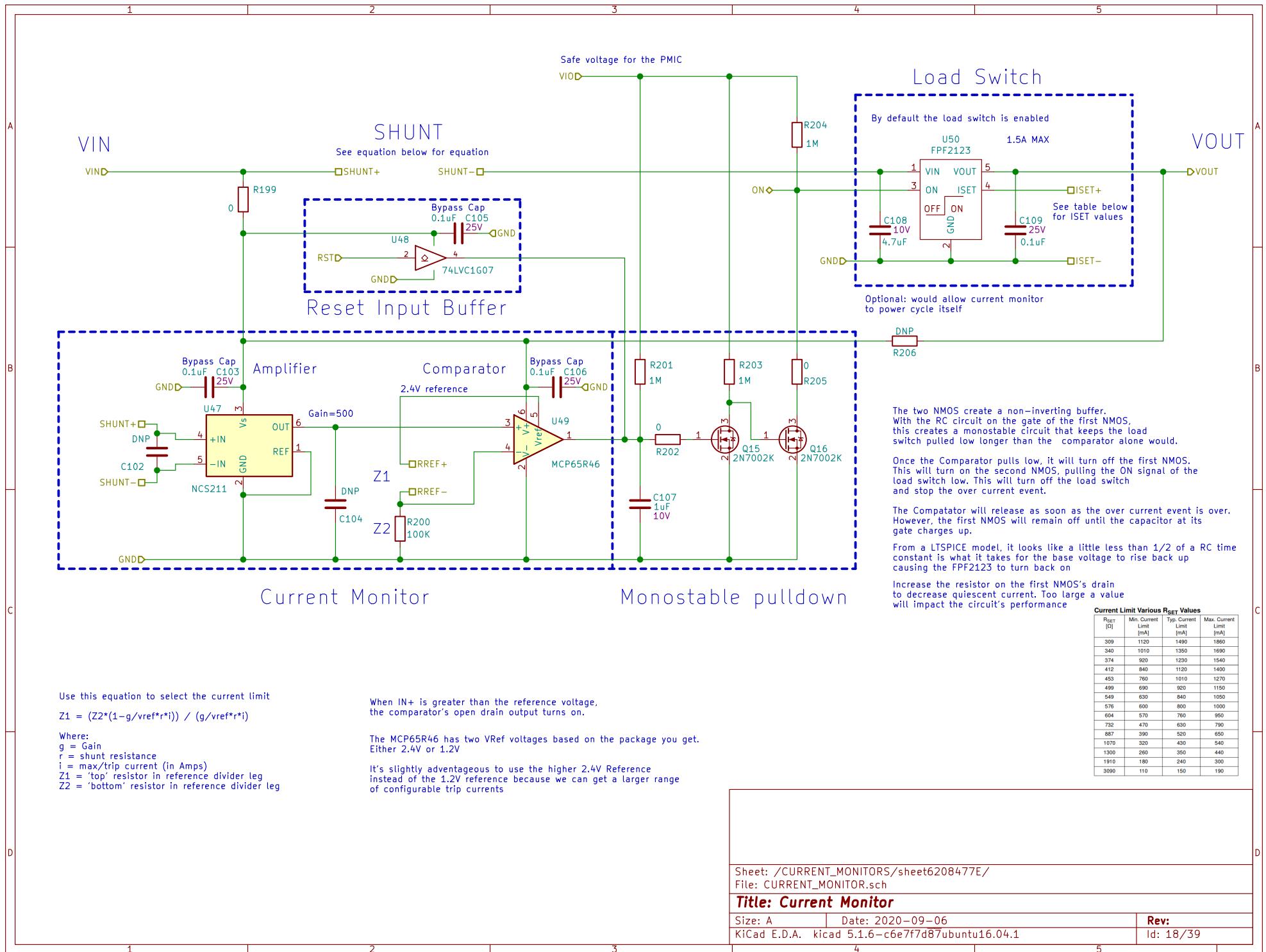


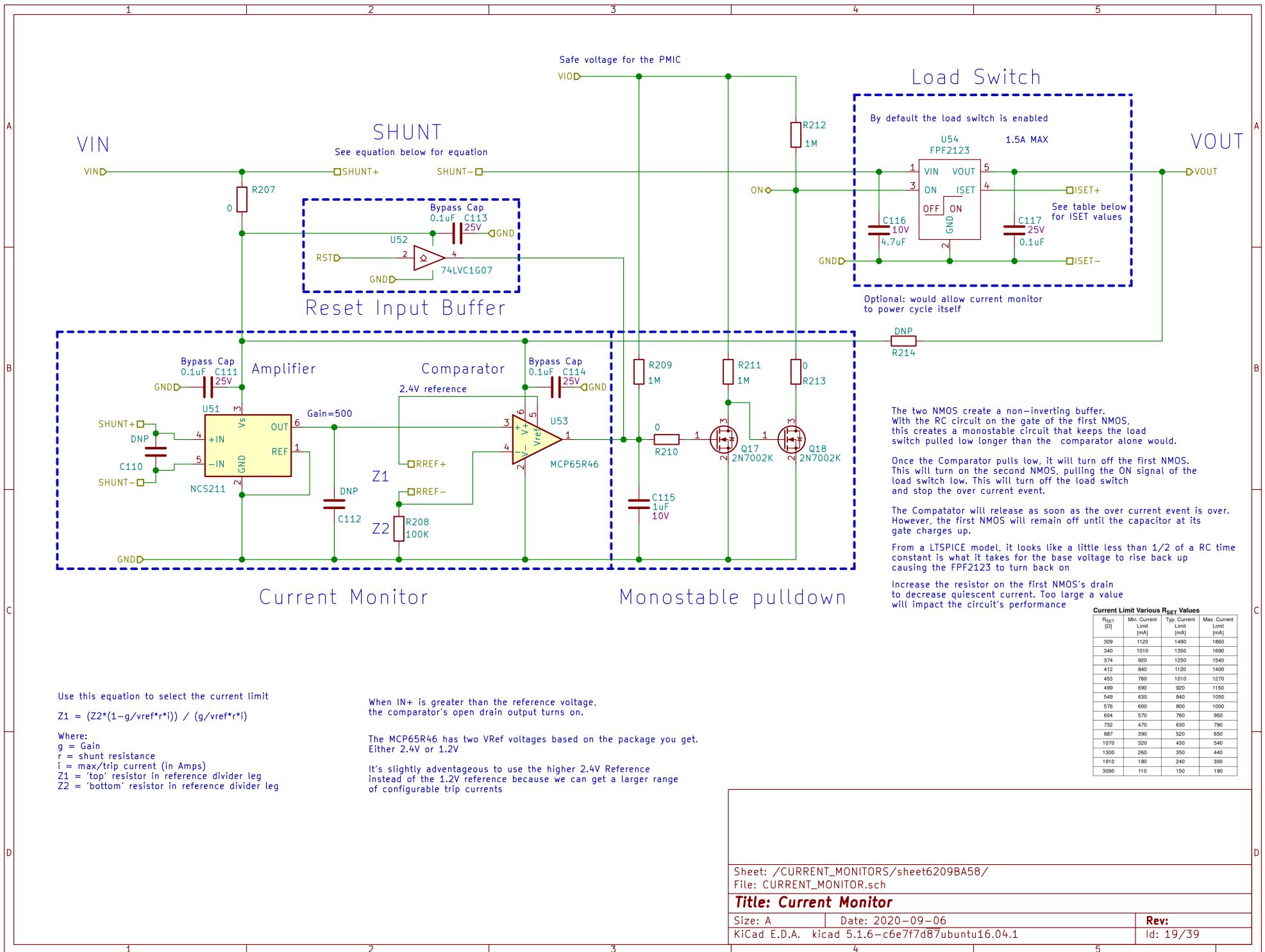


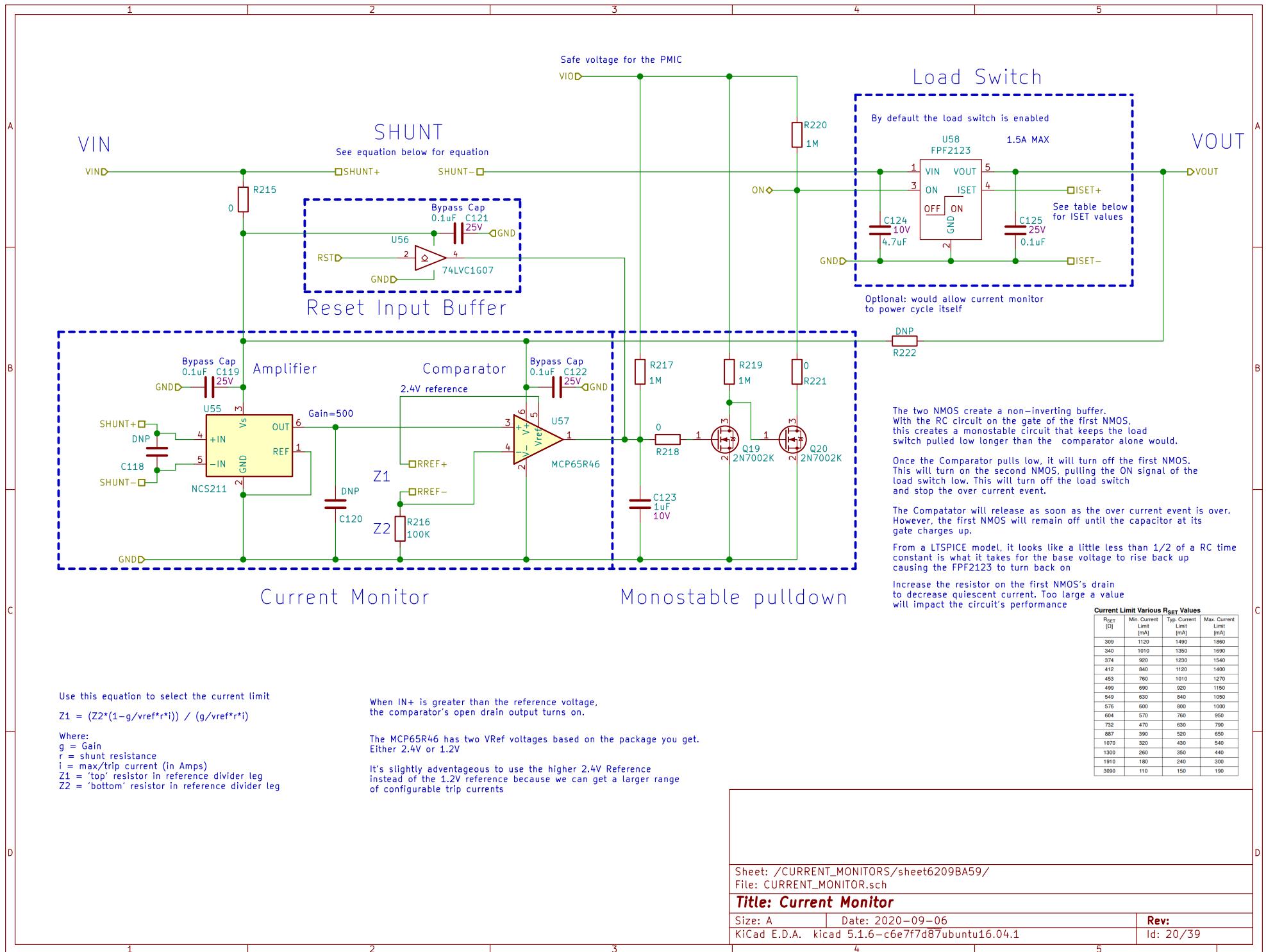


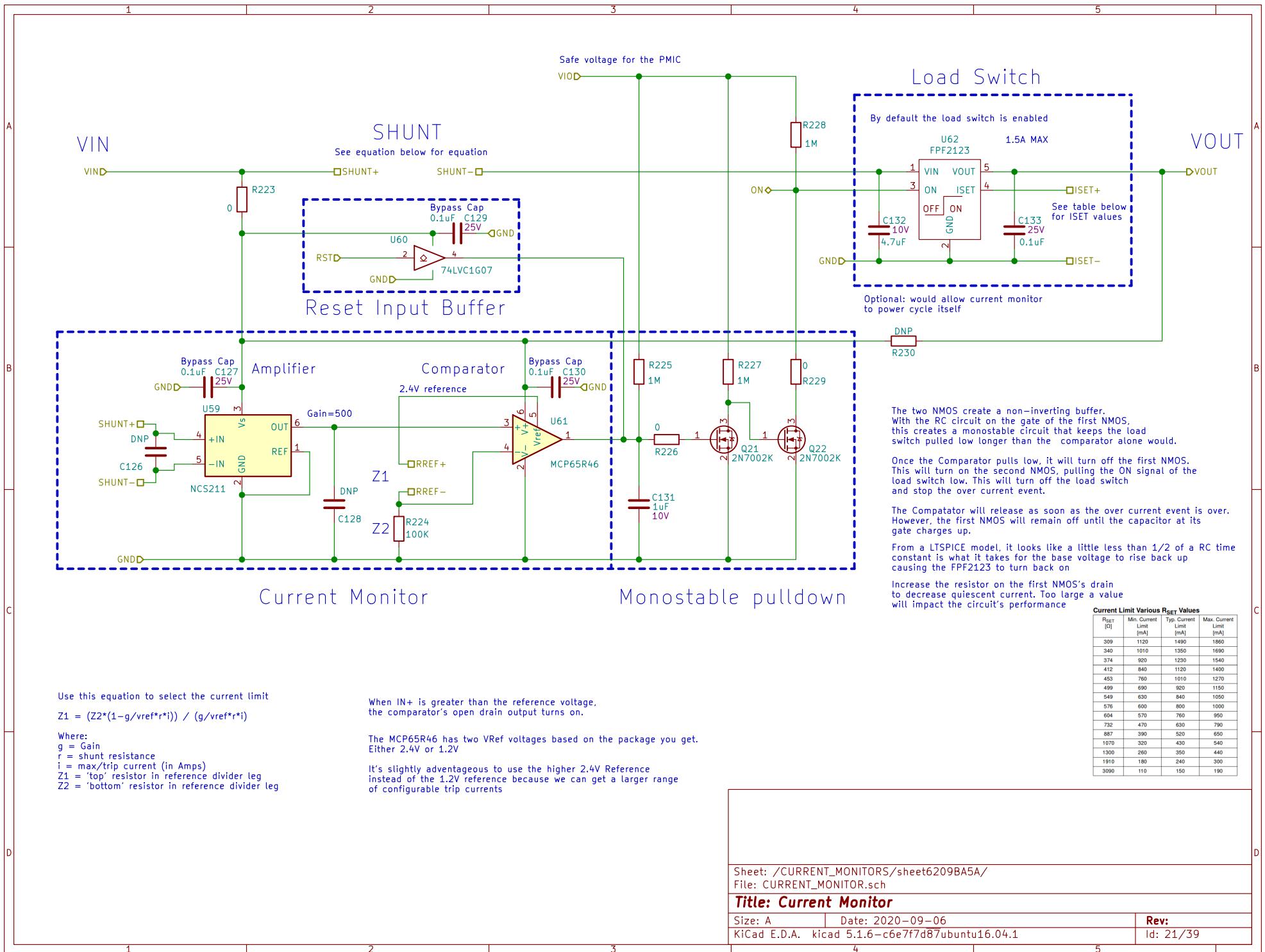


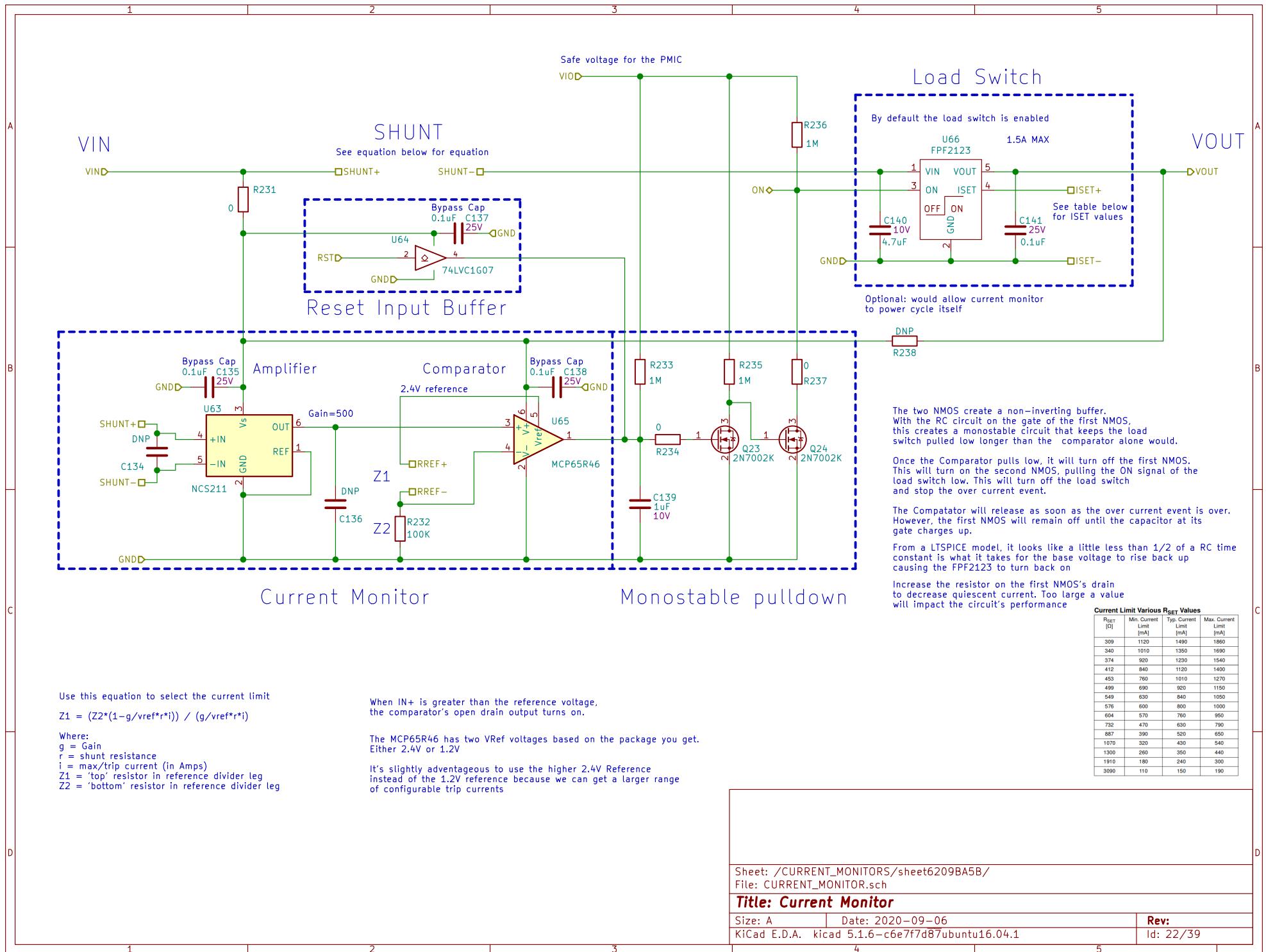


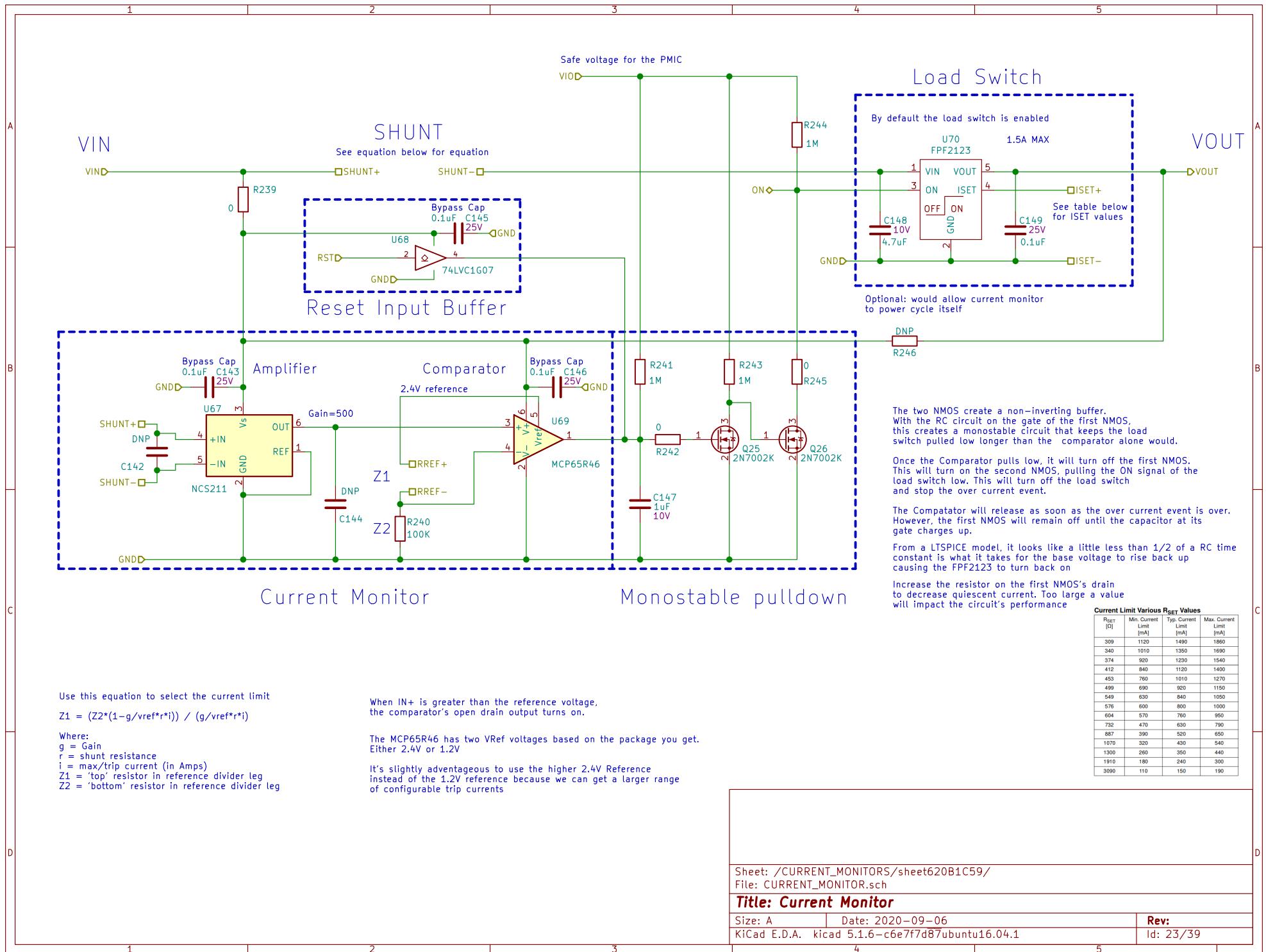


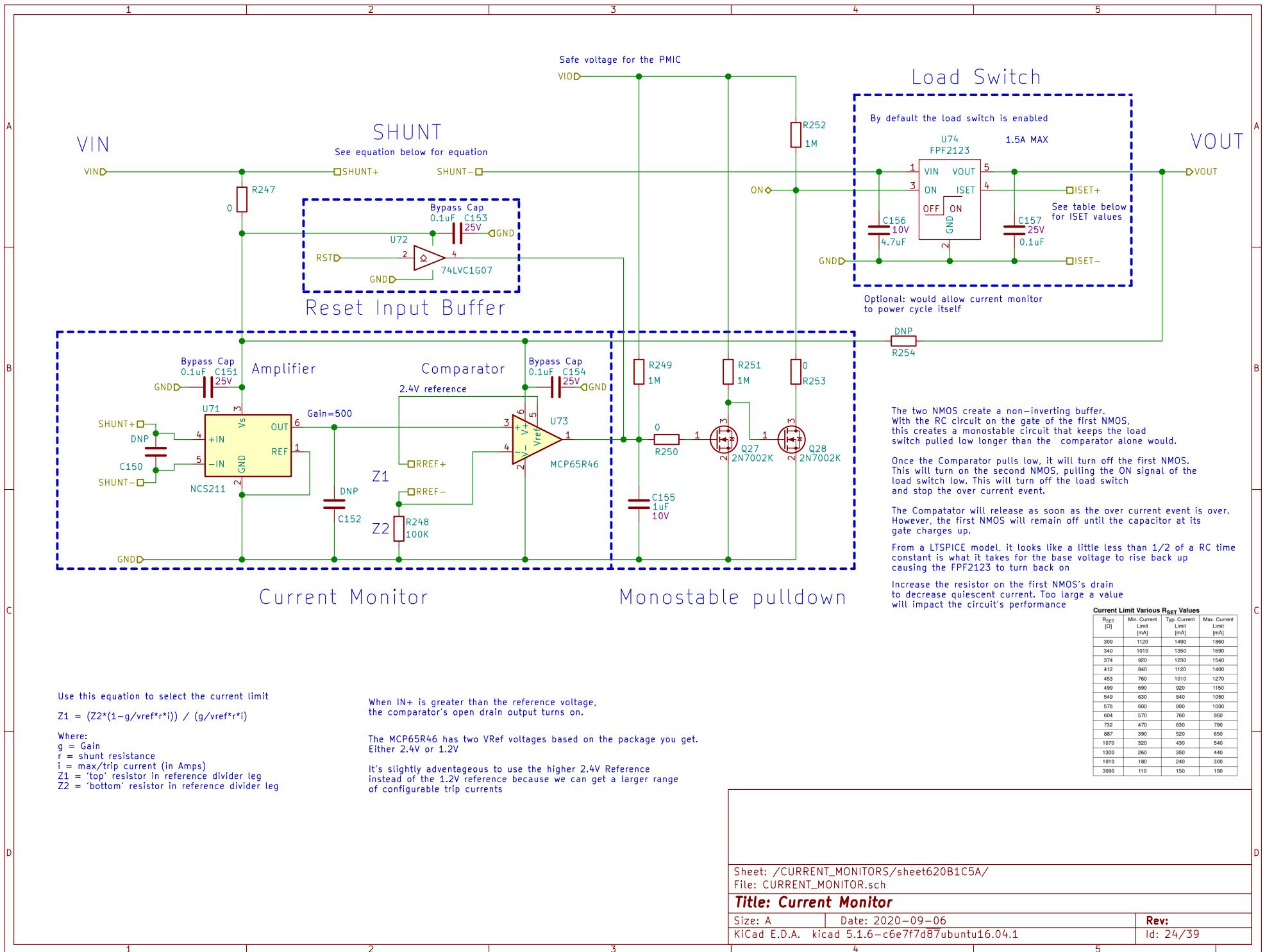


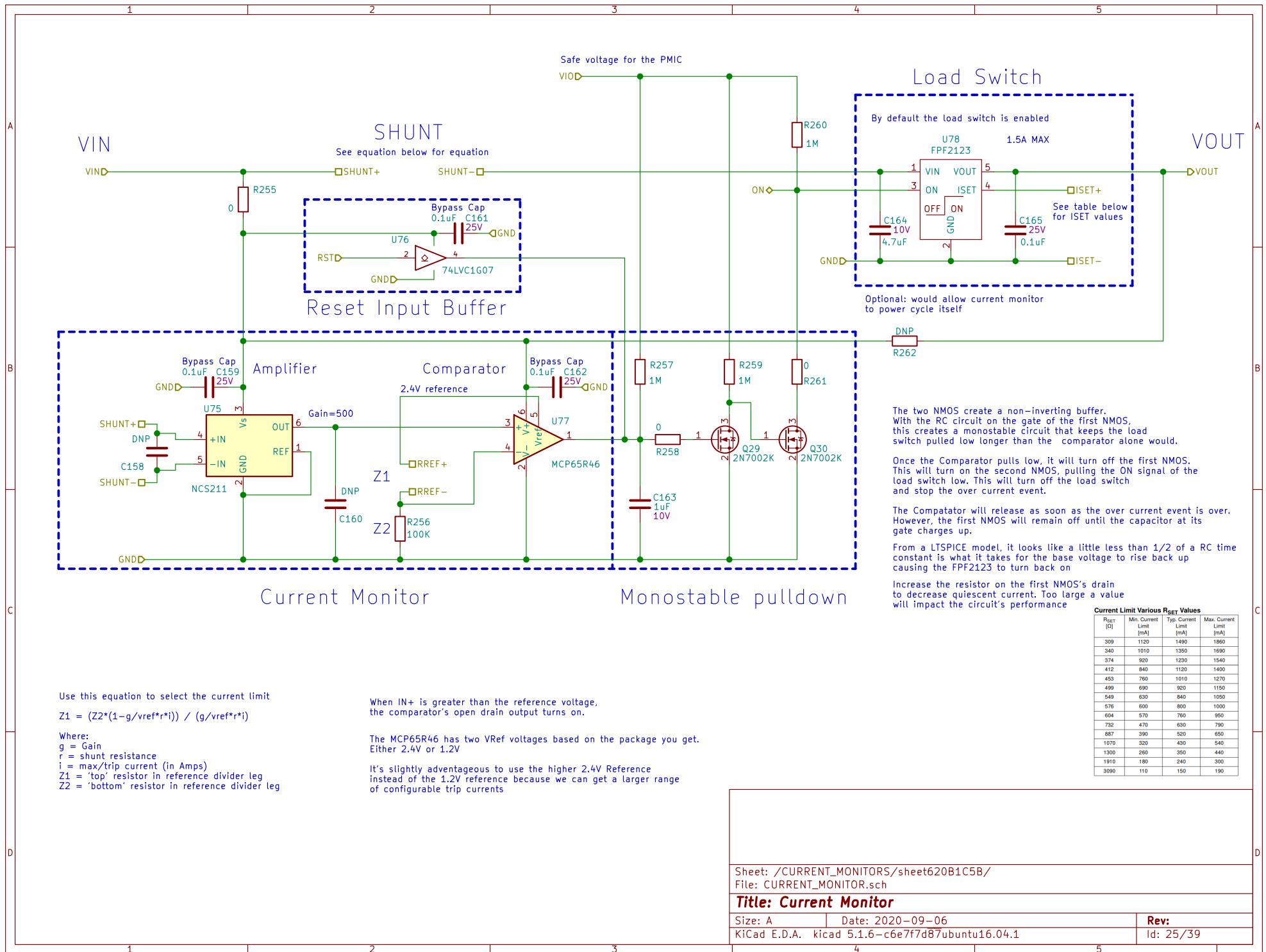


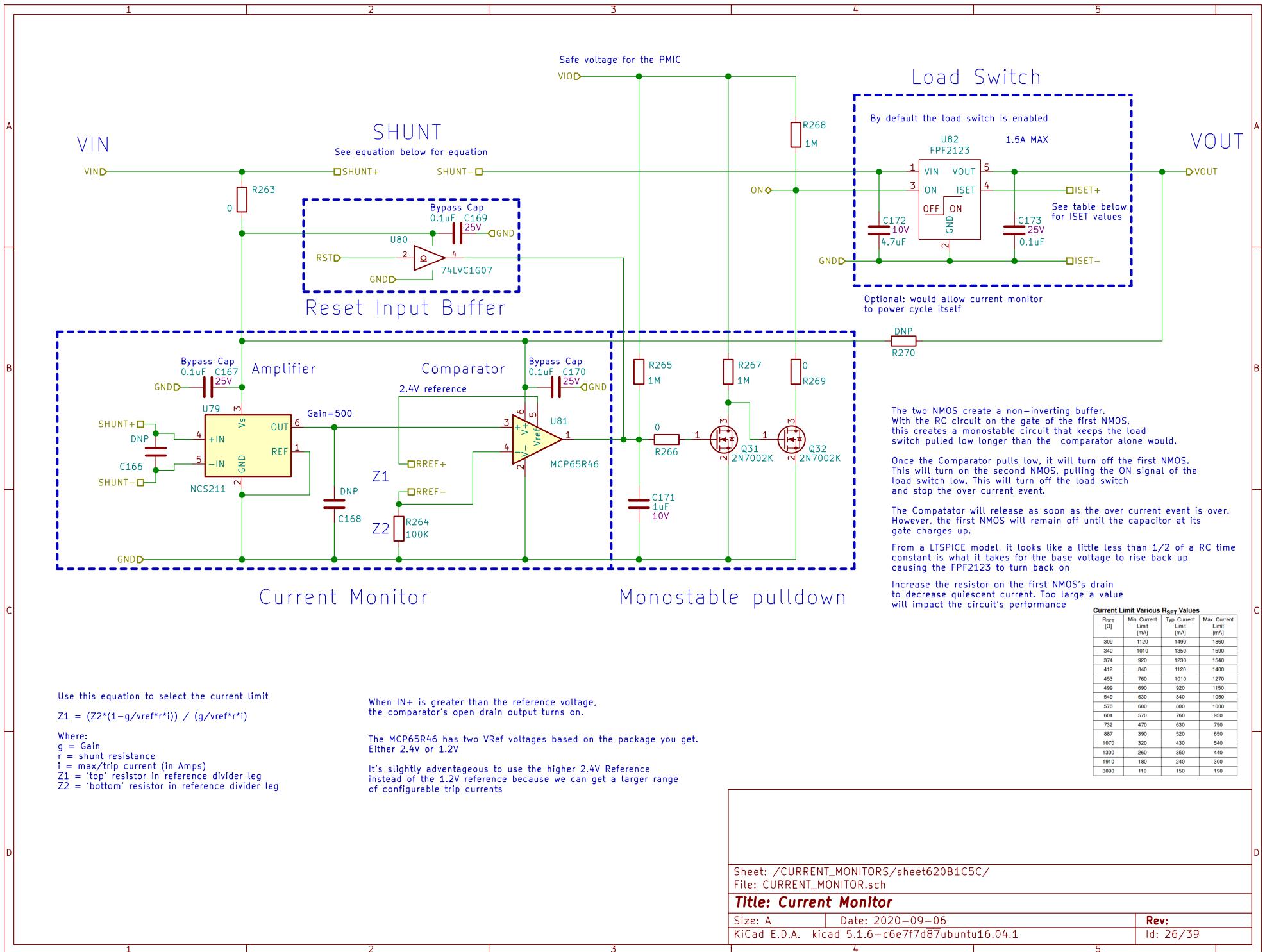


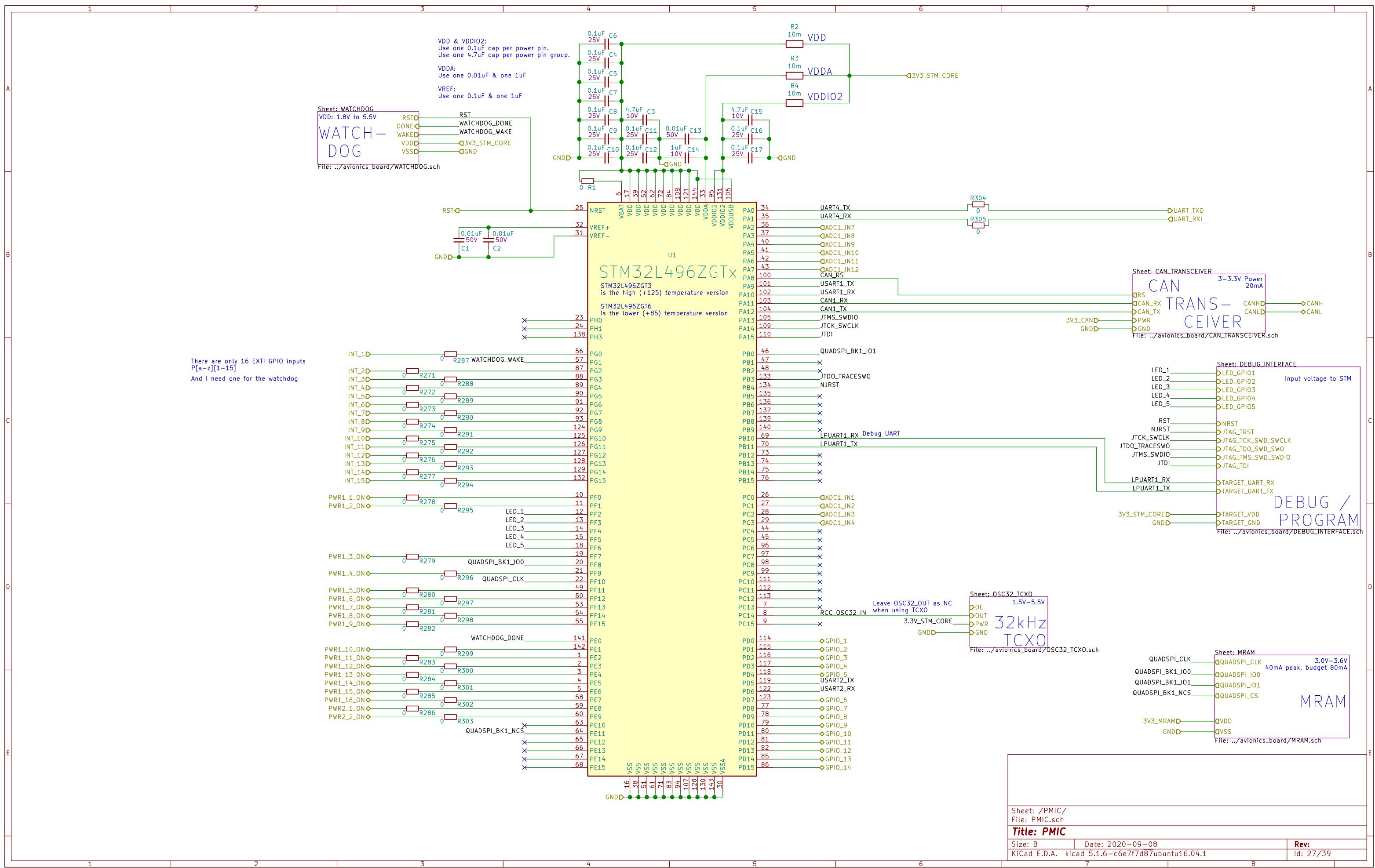


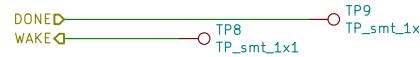




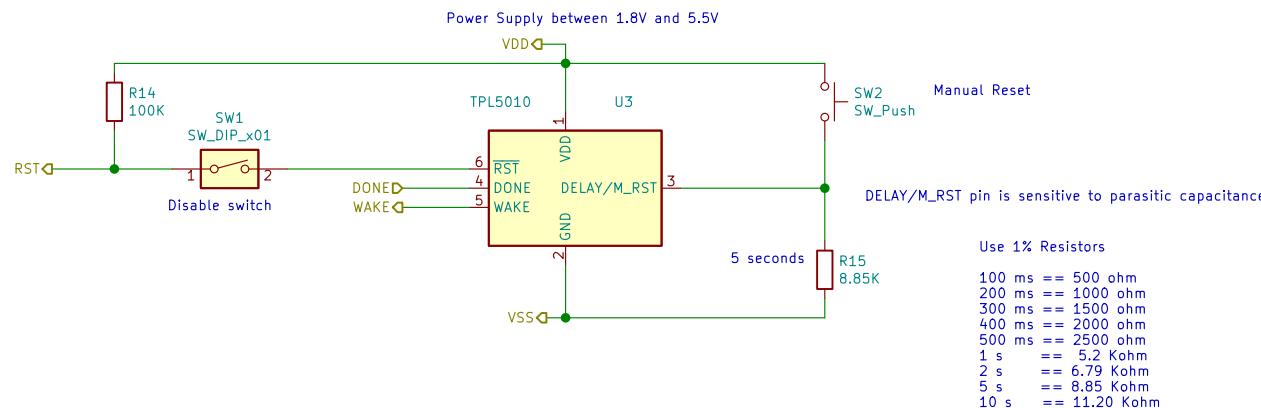




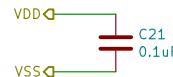




The DONE, WAKE, and RSTn signals are used to implement the watchdog function. The TPL5010-Q1 is programmed to issue a periodic WAKE pulse to a µC which is in sleep or standby mode. After receiving the WAKE pulse, the µC must issue a DONE signal to the TPL5010-Q1 at least 20 ms before the rising edge of the next WAKE pulse. If the DONE signal is not asserted, the TPL5010-Q1 asserts the RSTn signal to reset the µC. A manual reset function is realized by momentarily pulling the DELAY/M_RST pin to VDD



Layout Note: Decoupling



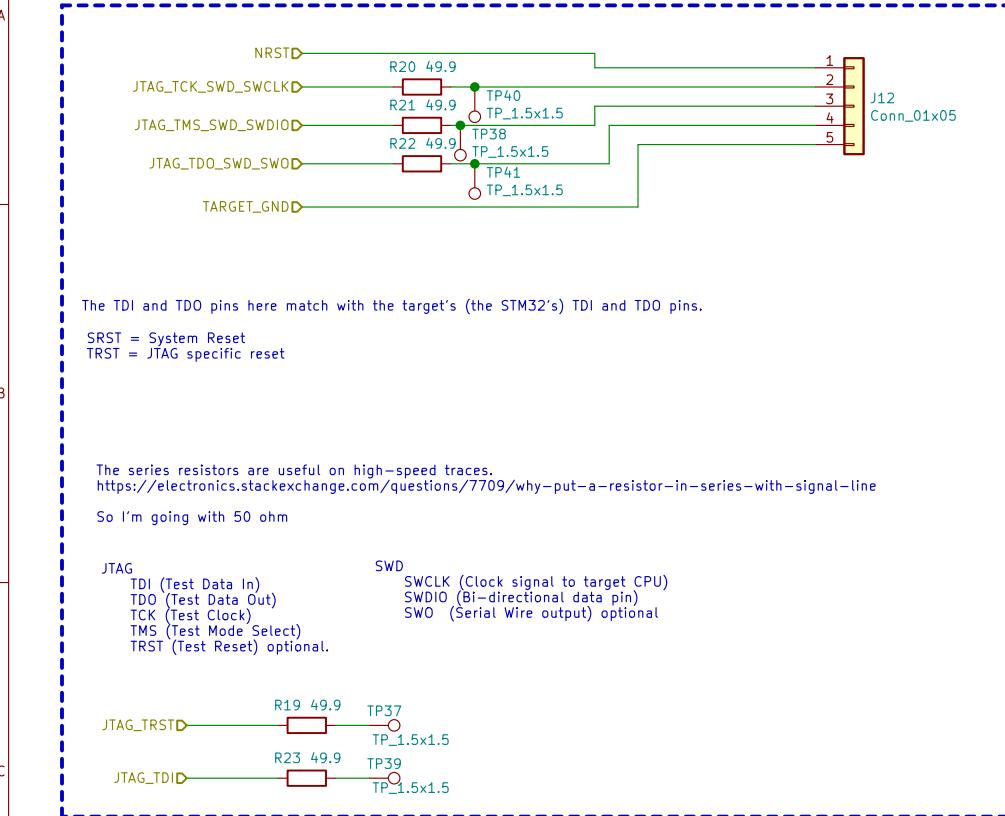
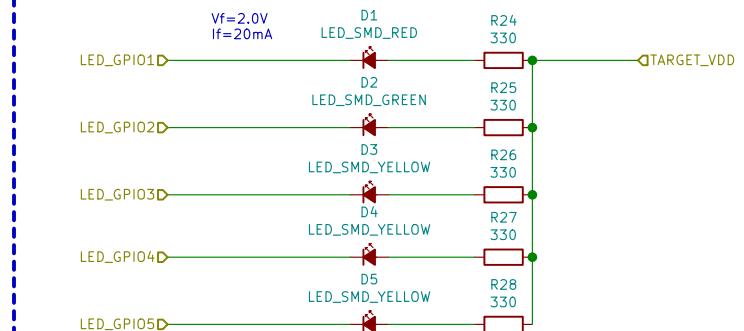
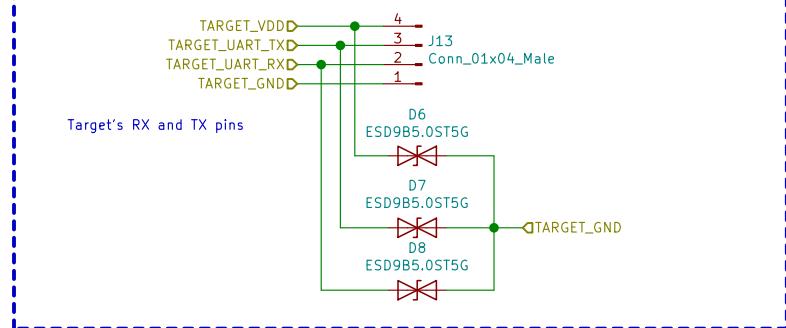
A multilayer ceramic bypass X7R capacitor of $0.1\mu\text{F}$ is recommended.

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Title: EXTERNAL WATCHDOG

Size: A Date: 2020-05-02
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Rev: Id: 28/39

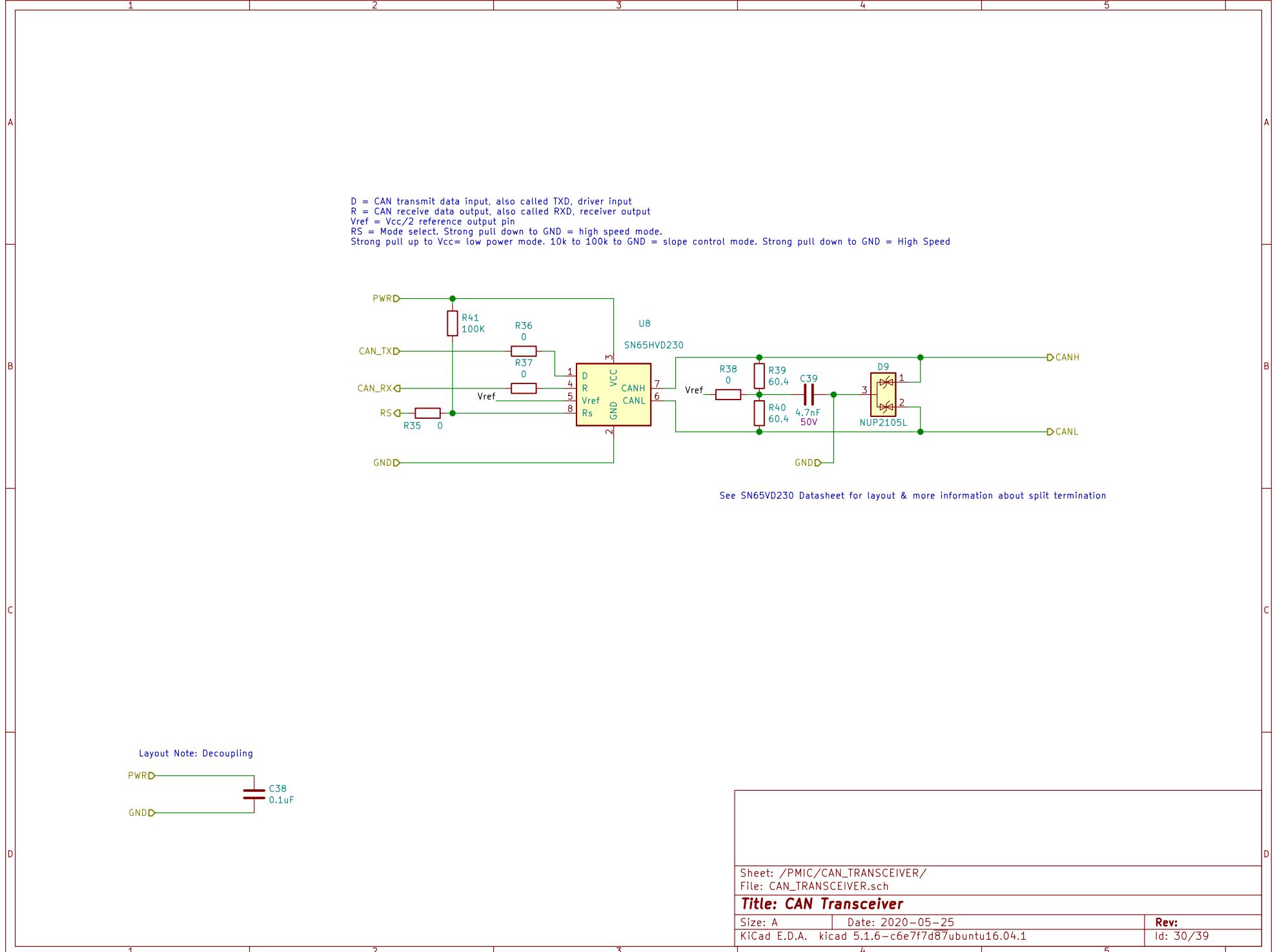
JTAG / SWD**DEBUG LED****DEBUG UART**

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Title: DEBUG INTERFACE

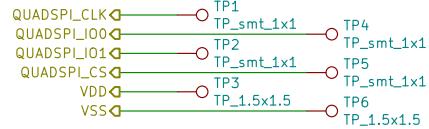
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Rev:
Id: 29/39



1 2 3 4 5

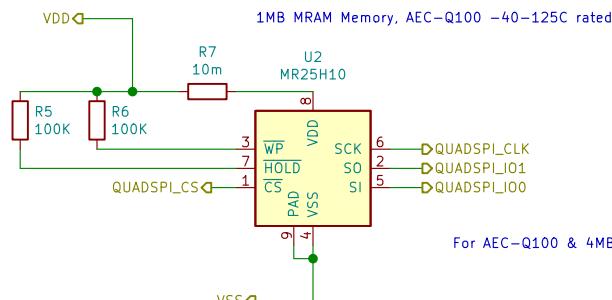
A



WP is write protect. Low active
HOLD suspends operation. Low active. Only available when CS is low
CS is chip select. Low active
SCK is SPI clock
SO is output
SI is input
VDD is from 3.0V to 3.6V
Connect pad only to VSS

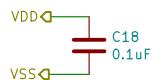
<https://www.cypress.com/file/196526/download> for layout guide

0.1uF decoupling cap



For AEC-Q100 & 4MB use: MR25H40MDF. Triple the price

Layout Note: Decoupling



D

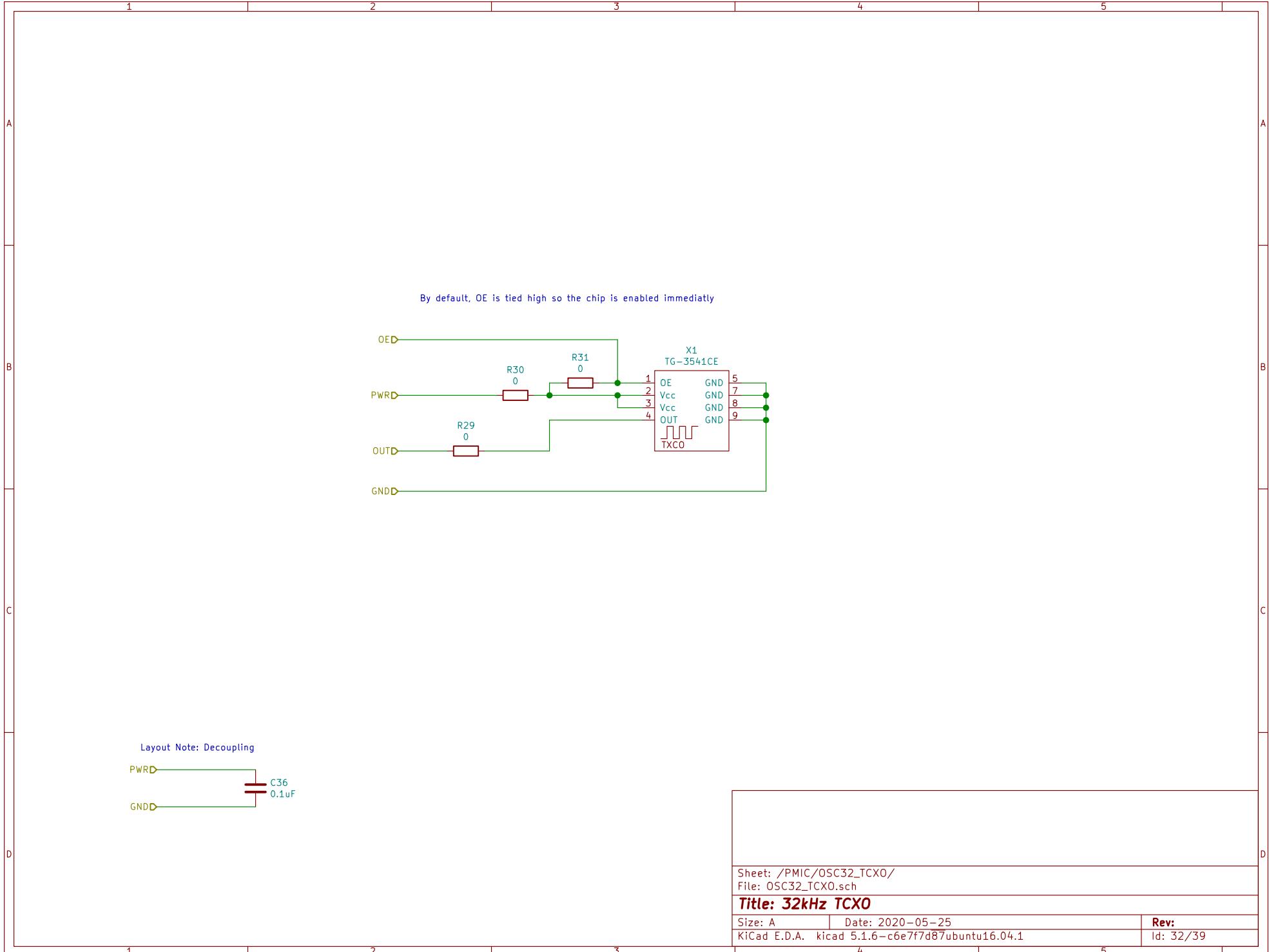
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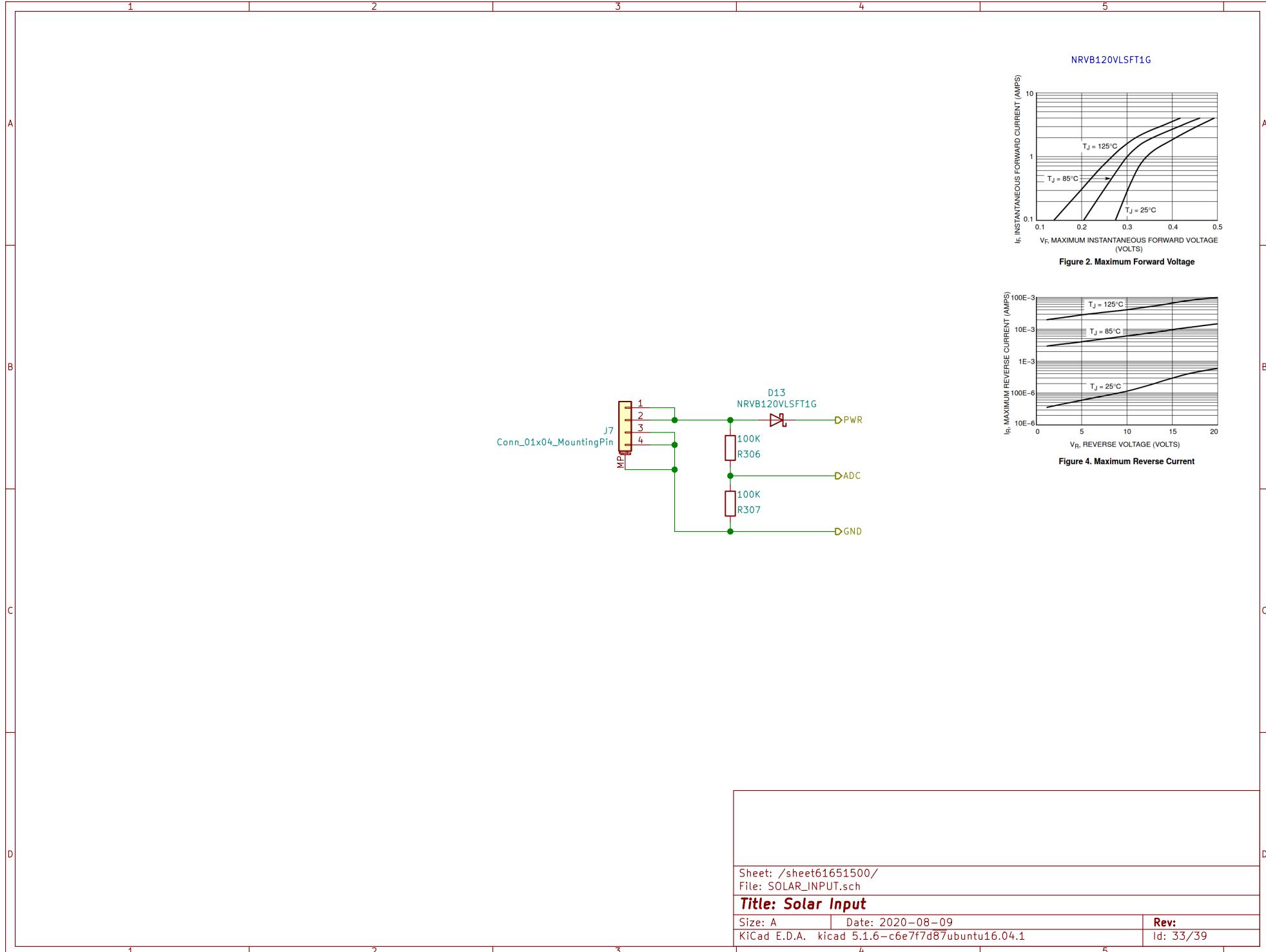
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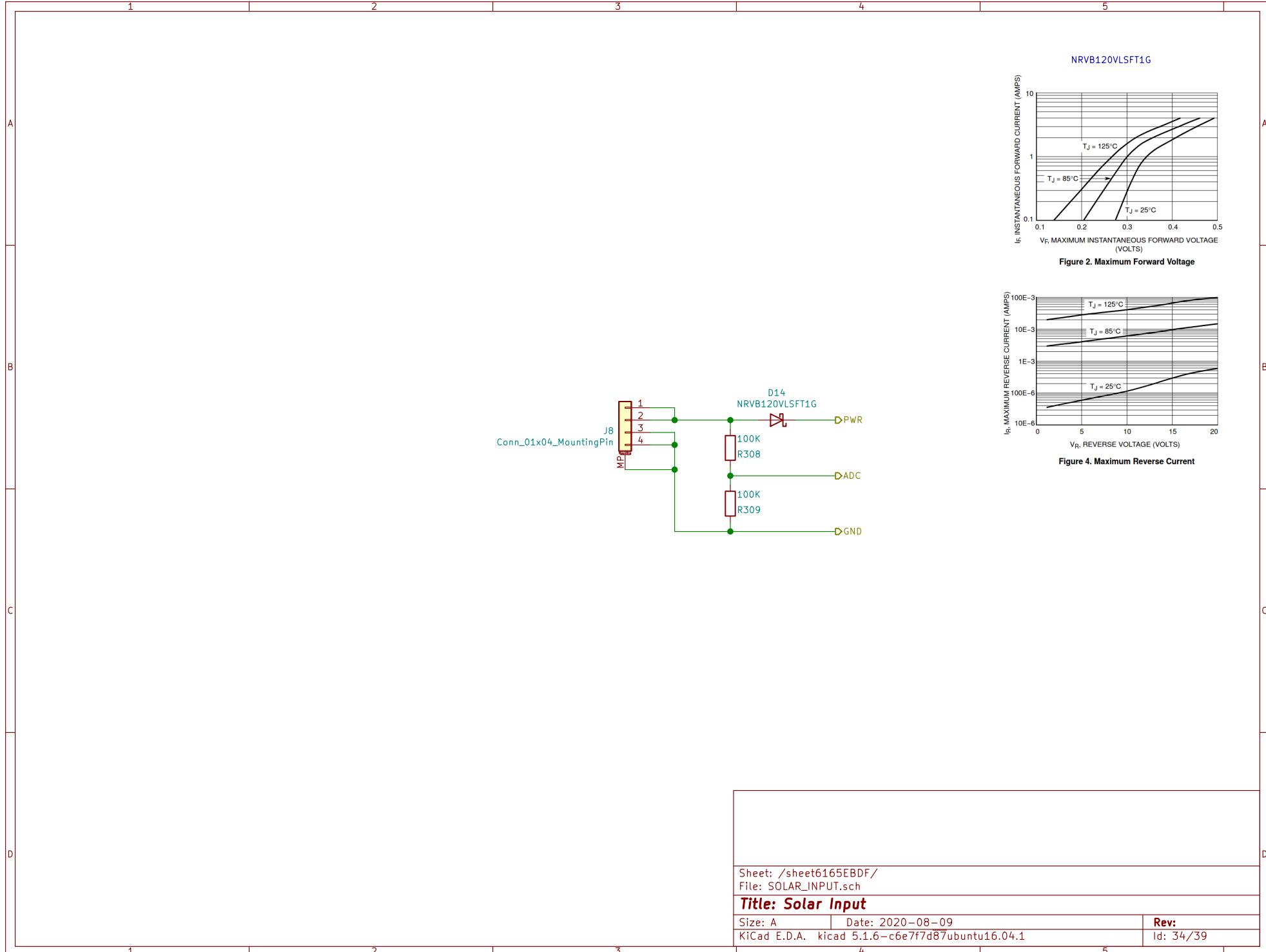
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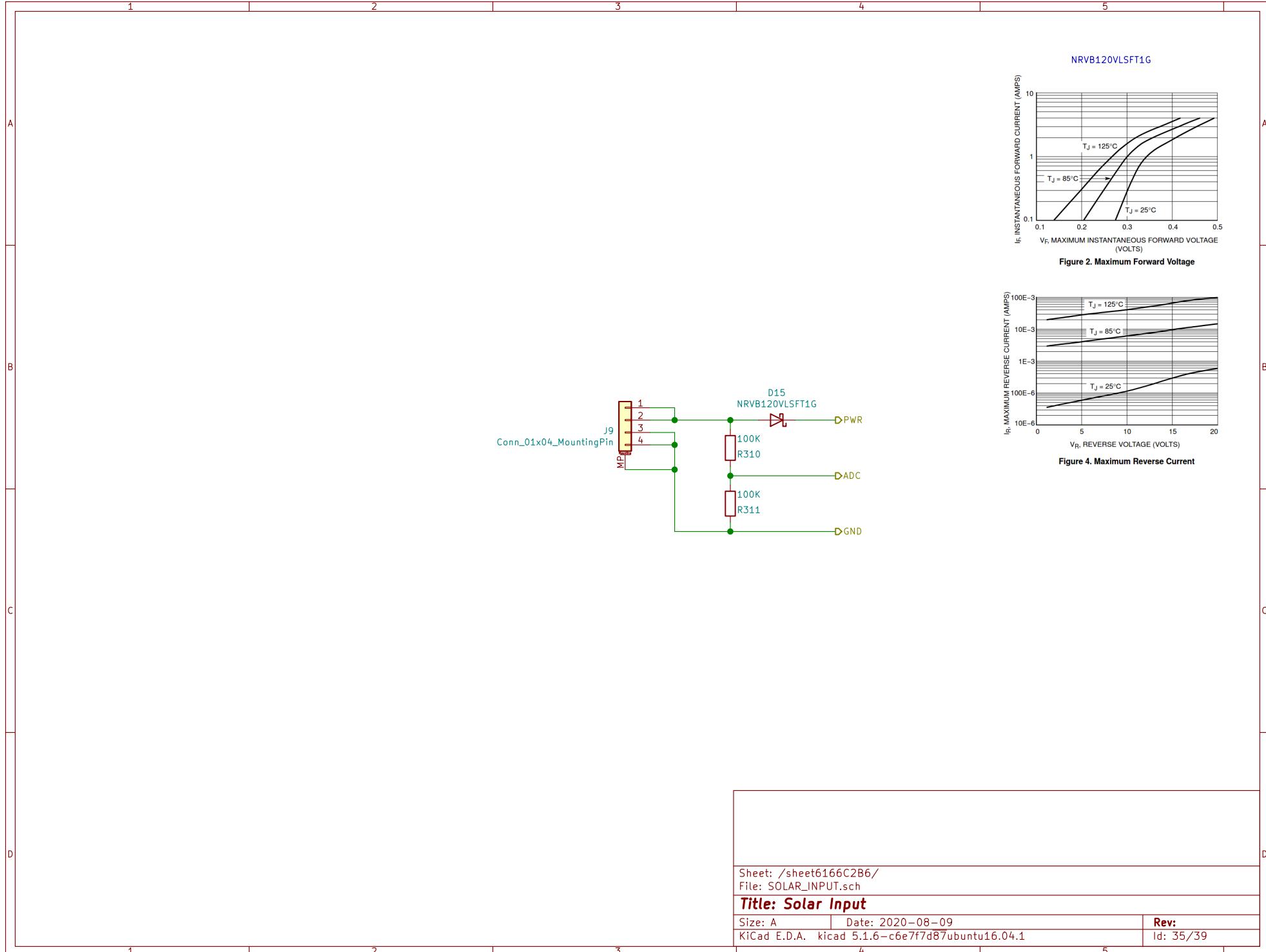
Rev:
Id: 31/39

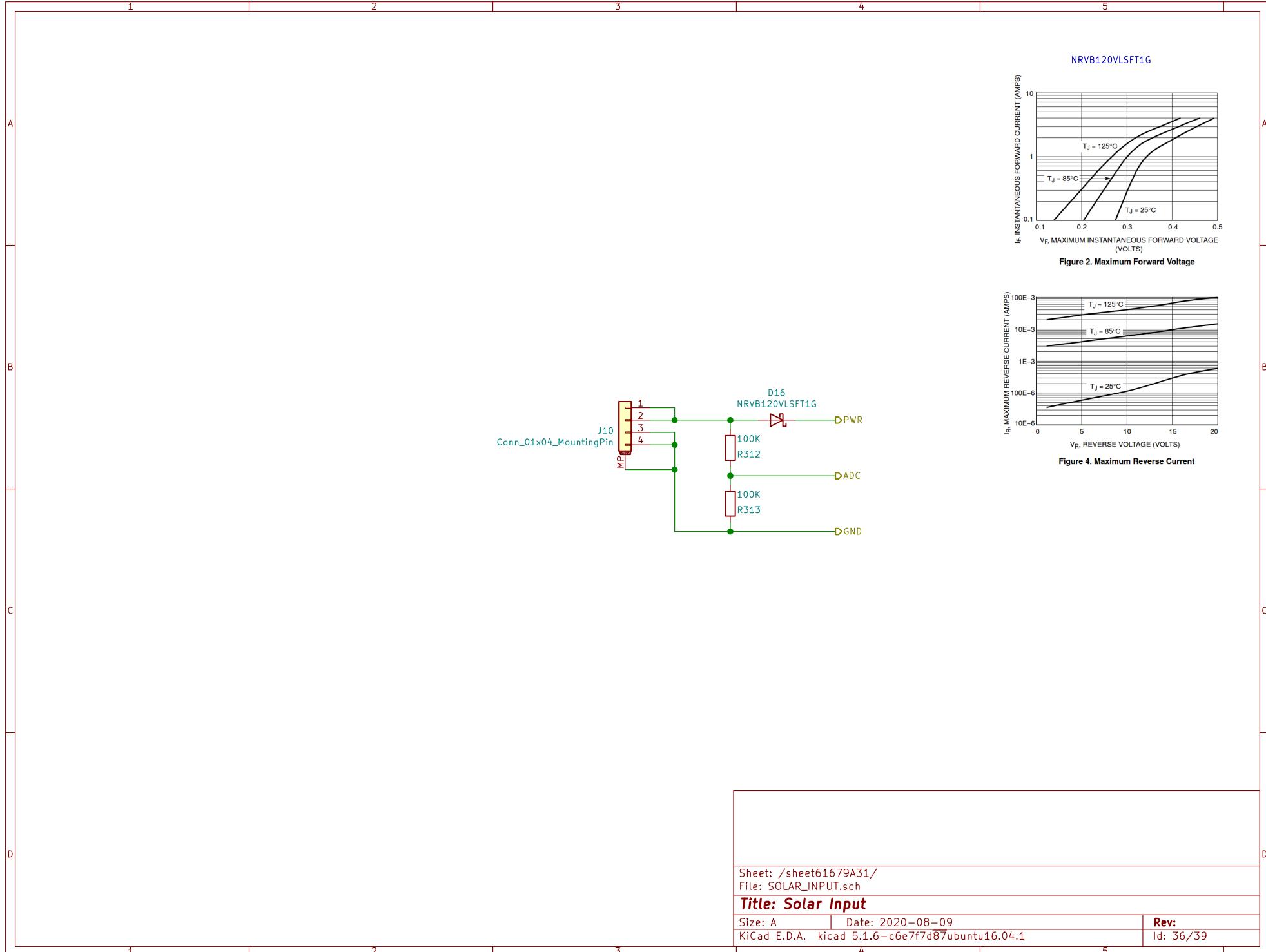
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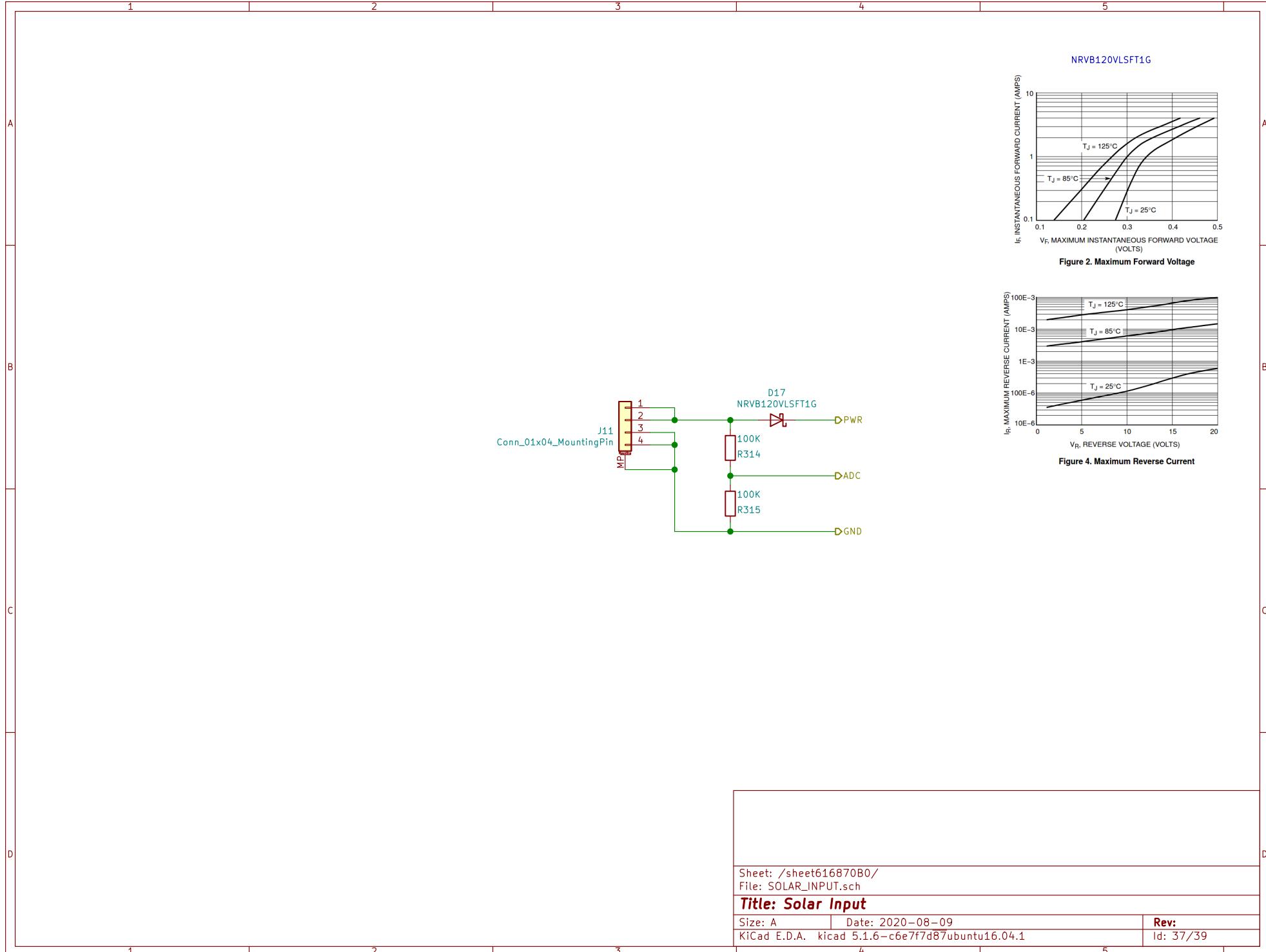


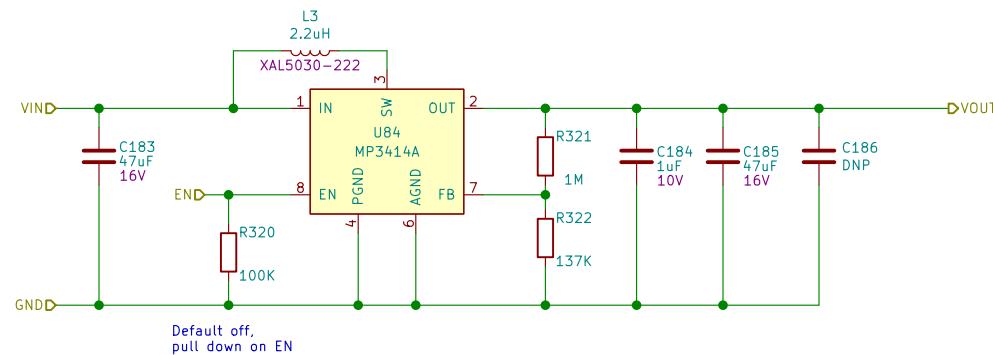
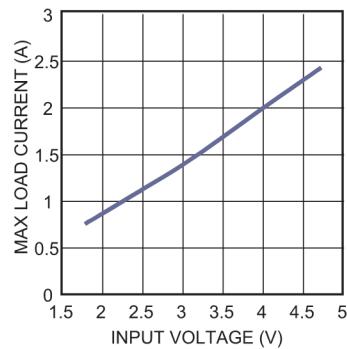










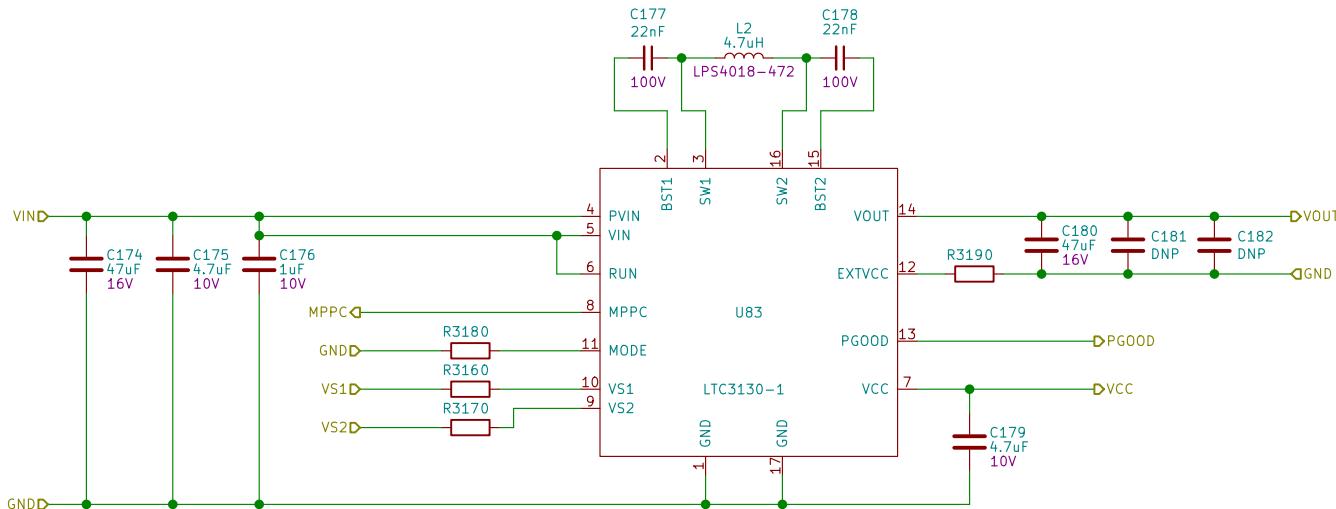
**Load Capability
vs. Input Voltage⁽⁷⁾**


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File: MP3414A.sch

Title: 5V Boost

Size: A | Date: 2020-10-04
KiCad E.D.A. kicad 5.1.6-c6e7f7d87ubuntu16.04.1

Rev:
Id: 38/39

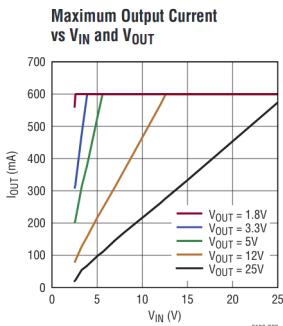

MODE (Pin 11/Pin 11): Mode Select Pin.

MODE = Low (ground): Enables automatic Burst Mode operation

MODE = High (tie to V_{CC}): Fixed frequency PWM operation

Table 1. V_{OUT} Program Settings for the LTC3130-1

VS_2	VS_1	V_{OUT}
0	0	1.8V
0	V_{CC}	3.3V
V_{CC}	0	5.0V
V_{CC}	V_{CC}	12V



PGOOD is open drain.
Pulled low when V_{OUT} is less than 7.5% programmed value
High-Z when V_{OUT} is within 5% programmed value

Maximum Power Point Control (MPPC)

The MPPC input of the LTC3130/LTC3130-1 can be used with an optional external voltage divider to dynamically adjust the commanded inductor current in order to maintain a minimum input voltage when using high resistance sources, such as photovoltaic panels, so as to maximize input power transfer and prevent V_{IN} from dropping too low under load.

Referring to Figure 4, the MPPC pin is internally connected to the noninverting input of a g_m amplifier, whose inverting input is connected to the 1.0V reference. If the voltage at MPPC, using the external voltage divider, falls below the reference voltage, the output of the amplifier pulls the internal VC node low. This reduces the commanded average inductor current so as to reduce the input current and regulate V_{IN} to the programmed minimum voltage, as given by:

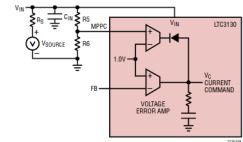
$$V_{IN(MPPC)} = 1.00V \left(1 + \frac{R_5}{R_6} \right)$$

Note that external compensation should not be required for MPPC loop stability if the input filter capacitor, C_{IN} , is at least 22μF.

The MPPC divider resistor values can be in the MΩ range so as to minimize the input current in very low power applications. However, stray capacitance and noise pickup on the MPPC pin must also be minimized. If the MPPC function is not required, the MPPC pin should be tied to V_{CC} .

Beware of adding a noise filter capacitor to the MPPC pin, as the added filter pole may cause the MPPC control loop to be unstable.

Note that because Burst Mode operation will be inhibited if the MPPC loop takes control, the converter will be operating in fixed frequency mode, and will therefore require a minimum of about 6mA of continuous input current to operate. For operation from weaker sources, such as small indoor solar panels, refer to the Applications Information section to see how the MPPC function can be used to control the converter in a hysteretic manner while providing an effective MPPC function by maintaining V_{IN} at the desired voltage. This technique can be used with sources as weak as 3.5V (enough to power the IC in UVLO) and the external RUN divider.


Figure 4. MPPC Amplifier with External Resistor Divider