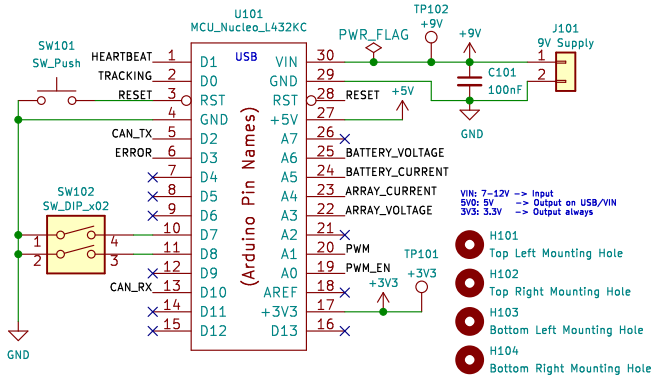
MCU

Powered and controlled by USB through STLink UART.

STM32L432KC Nucleo is the microcontroller unit of the PCB.
Requires A7 (PA2) and A2 (PA3) to be reserved for STLink UART-USB communication.
Can be powered through the following:
- 10.8-13.2VDC (Car Power)
- 7-12VDC (External 9V Supply)
- 5VDC (Nucleo USB)



power_regulation

+12V
+5V
+9VA

File: sunscatter_power_regulation.kicad_sch

boost_converter

+ARR
-ARR
+BATT
-BATT
DRIVE_PWM

File: sunscatter_boost_converter.kicad_sch

sensors

ARRAY_VOLTAGE
ARRAY_CURRENT
BATTERY_VOLTAGE
BATTERY_CURRENT

File: sunscatter_sensors.kicad_sch

gate_driver

PWM
PWM_EN
DRIVE_PWM

File: sunscatter_gate_driver.kicad_sch

can_driver

CAN_TX
CAN_RX

File: sunscatter_can_driver.kicad_sch

leds

HEARTBEAT
TRACKING
PWM
CAN_TX
CAN_RX
ERROR

File: sunscatter_leds.kicad_sch

Sunscatter MPPT

v3.4.0

Praise the sun. A student designed maximum power point tracker custom built for the Longhorn Racing Solar car.
Optimized to run the latest and greatest MPPT algorithms.

Errata

v3.2.0
Schematic:
- Reannotated all component labels and reverted rescued schematic symbols.
- Rearranged schematic and cleaned up component positioning.
- Created Array.lib for array-relevant schematic symbols.
- Swapped out zener diodes going into the uC from 3.6V to 3.9V.
- Updated the LEDs and resistors for Xx_live indicators.
- Added Error indicator LED.
- Shifted pins for voltage/current sensors to accomodate STLink UART2.
- Added fuse on the array side.
- Added unity gain filter to voltage sensors.
- Errata: swapped 0.22uF and 10uF capacitors on CAN circuit to correct positions.

Layout:
- Created MPPT-PrimaryPCB.pretty for custom footprints.
- Specified that board should be 2oz copper/ft.
- Re-specified snubber circuit footprints.
- Comprehensive redesign of layout.

v3.3.0
Schematic:
- BoM consolidation to JLCPCB.
- BoM merged into schematic component fields.
- Removed RC filters from voltage sensors.
- Replaced MAX chip with LM358.
- Downshifted 3.9V zeners to 3.3V.
- Removed general purpose switching diodes.

Layout:
- Moved footprints from MPPT-PrimaryPCB.pretty to Footprints.
- Dropped copper weight down to 1oz/ft.
- Places JLCPCB passives on same side.
- Reduced power path area.
- Moved sensor paths away from high power current path.
- Stitching vias and secondary GND plane for thermal and EMI improvement.

v3.3.1
Schematic:
- Vout and GNDout pins swapped to correct pins for IES01_PDS1 (U4).
- EN pin for UCC37321 given an MCU DIO to be SW ambiguous to UCC37321, UCC37322 (U3).
- Maxim Integrated 40075 voltage op amp switched to TI OPA990 to run on +9VA.

Layout:
- Slight changes around power, gate driver routing.

v3.4.0
Schematic:
- Broke out schematic into hierarchical sheets and re-enumerated all components.
- Fixed ERC power pin checks.

Layout:
- Updated silkscreen.

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Matthew Yu
Longhorn Racing Solar

Sheet: /
File: MPPT.kicad_sch

Title: Sunscatter

Size: A4	Date: 2022-06-05	**Rev: 3.4.0**
KiCad E.D.A. kicad (6.0.1)		Id: 1/7

Power Regulation

The power regulation circuit manages three supply voltages: +12V, +5V, and +9VA.

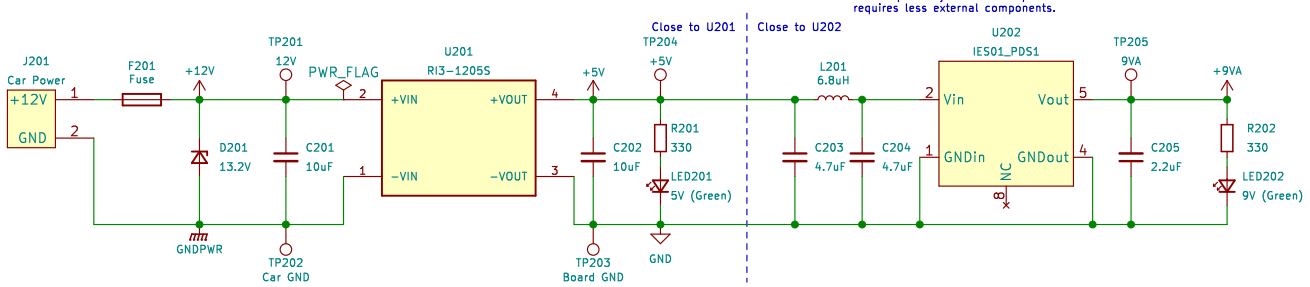
The +12V supply is a 10.8–13.2 VDC input coming from the solar vehicle. This supply is fed through a fixed output buck converter to generate the +5V line, which feeds the STM32 MCU and the isoCAN chip. This +5V line can also be generated from the STM32 MCU, regulating from its +5V USB input or 9V VIN input when the PCB is not hooked up to the solar car.

The +5V supply feeds into boost converter to generate +9VA. This +9VA is produced solely from the +5V source, and is used to power the MOSFET gate driver and all onboard sensors.

Isolated Power Regions:
* Car Power
  - +12V
  - GNDPWR
* Device/Board Power
  - +/-Arr
  - +/-Batt
  - +9VA, +5V, +3.3V
  - GND

IES0105S09
Cout=2.2uF
Imin=12mA

GND is tied across the isolated DC-DC converter to make it non isolated. This is because the sensor input to the STM32 needs to be relative to GND. This is probably overkill compared to a normal TI SEPIC converter but requires less external components.



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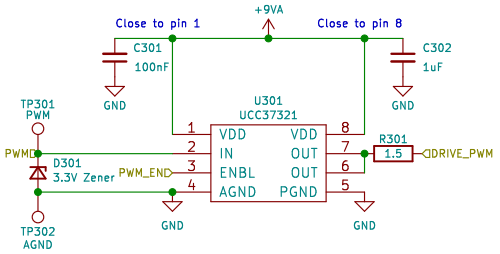
PWM Gate Driver

Drives the two DC-DC converter MOSFETs.



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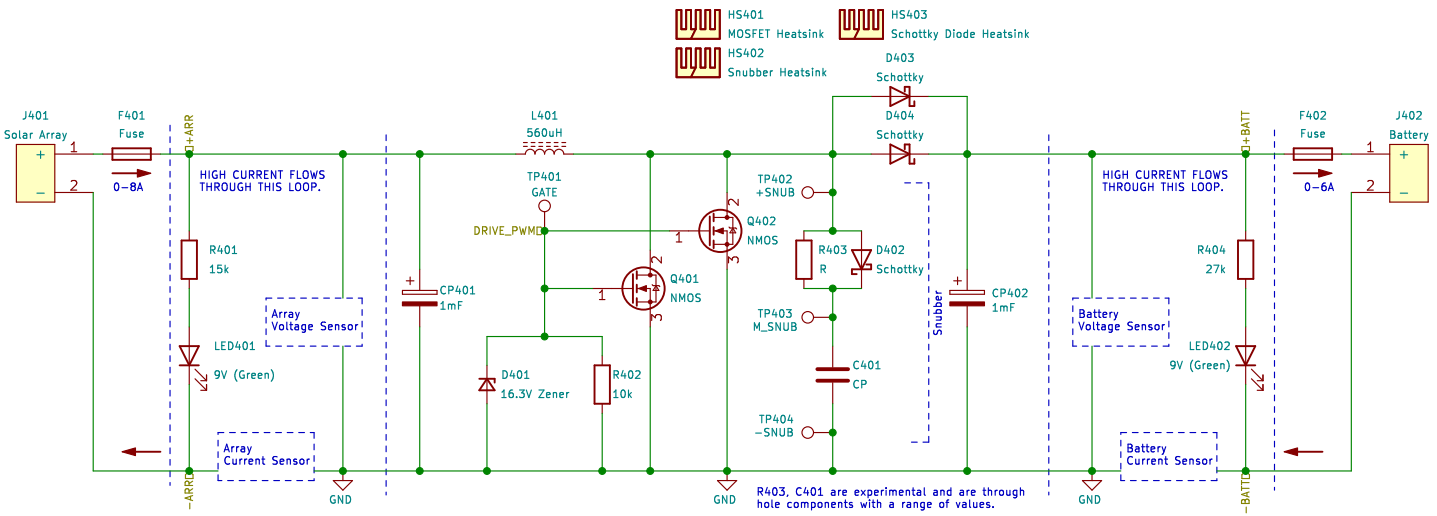
DC-DC Boost Converter

0-115V to 0-175V boost converter.
Maximum 8A current flow.



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Sheet: /boost_converter/
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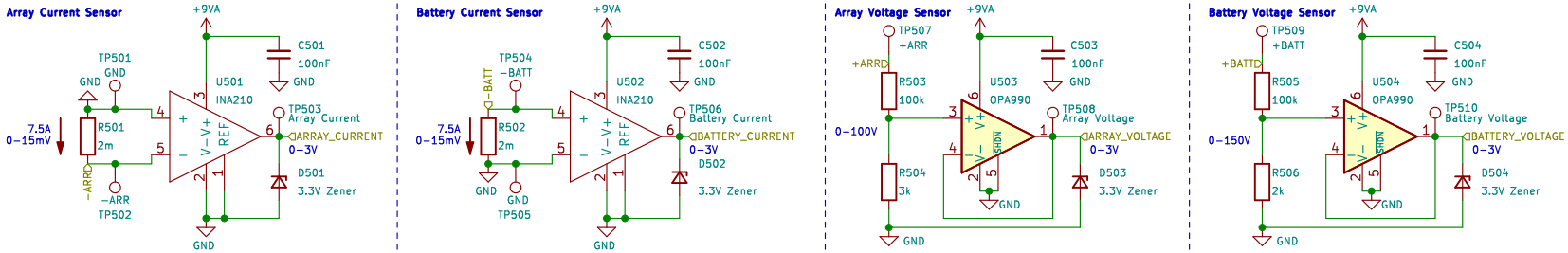
KiCad E.D.A. kicad (6.0.1)		Id: 4/7

Sensors

2 voltage sensors and current sensors, one of each for the array side and battery side.
Used for identifying DC-DC converter operation and informing MPPT operation.
8A support through current sense resistors.
100V / 150V support for voltage sensor scaling.



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File: sunscatter_sensors.kicad_sch

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Size: A4	Date: 2022-06-05	**Rev: 3.4.0**
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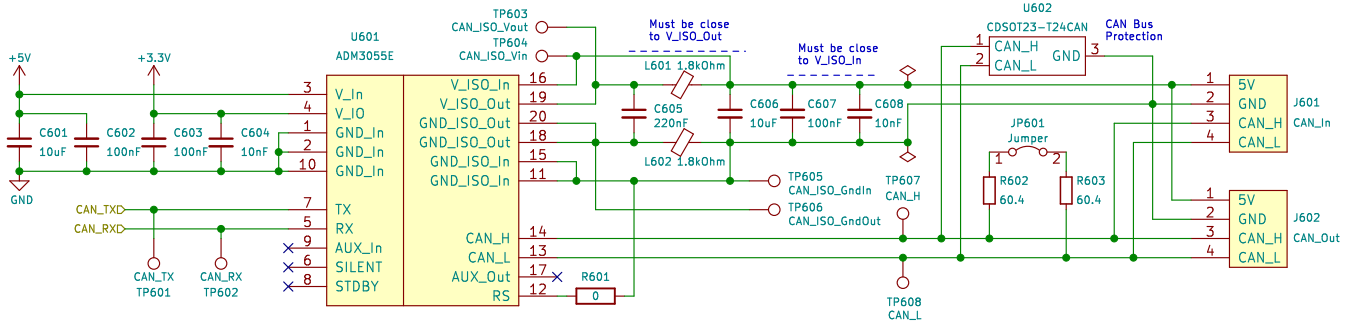
CAN

Isolated CAN chip.



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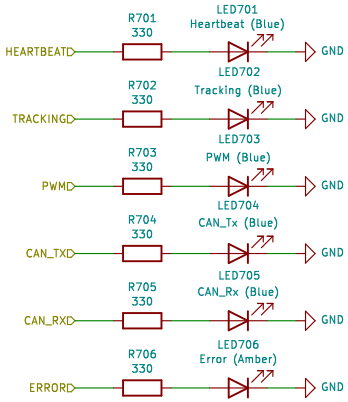
LEDs

Status LEDs for at-a-glance information



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KiCad E.D.A. kicad (6.0.1)		Id: 7/7