

1 TS_Error Latching

Once the state of $\overline{\text{TS_Error}}$ is reached for more then 1s (to prevent noise causing error), the latch U8 (74LVC1G74) will be triggered (page. ??). This cannot be reset, unless the LVS power cycle is carried out. The backup pull-down resistor R9 for discharging the capacitor can also be placed if the CLR pin does not discharge fast enough.

2 SCS signal implementation

2.1 Relay states

As shown on page ?? the relay state is measured through a set of voltage dividers and a windows comparator. The **Closed** signal is used for the state detection logic (which controls the TSAL green LEDs). When the aux cable are open, it is the same as the $\overline{\text{Closed}}$ state, which will keep the green TSAL off.

The "short to GND" state can be ruled out by the comparator which compares the signal with a 0.3 V reference.

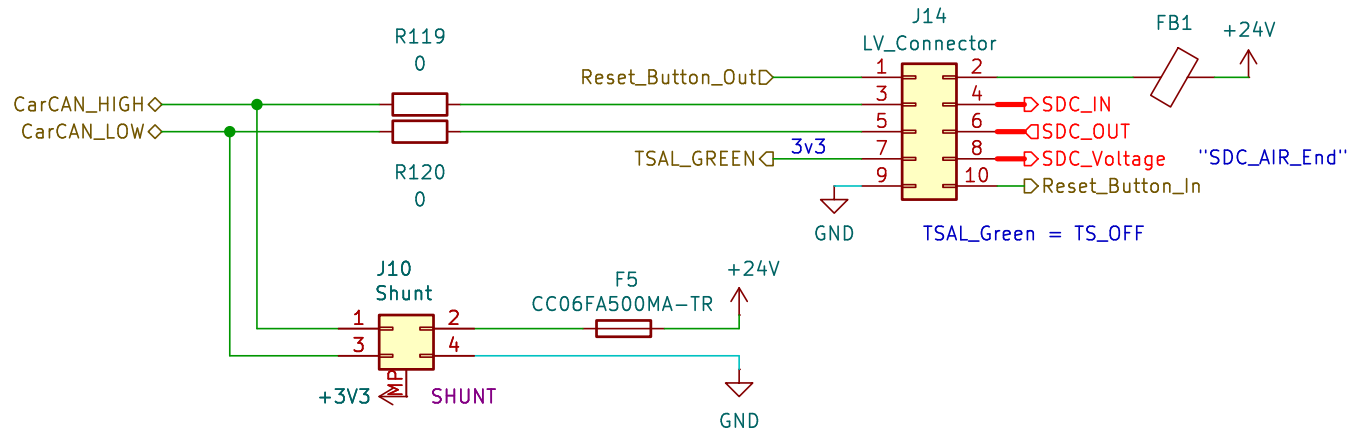
Since we do not have aux connections with our precharge relay, the circuit works differently then the AIRs. (page. ?? Here, the TS voltage on the inverter side is measured to check whether the precharge or AIR+ is closed or not. This signal is then compared with the AIR+ and precharge control signal to check if a mismatch is present. The rule T 11.9.2 does not apply here since no additional wires are used (all circuits are integrated on the PCB.)

2.2 TS_Off/TSAL_Green

The TS_Off (also shown as TSAL_Green in the schematics) are sent out to the TSAL through a wire connection (as seen on page ??). If the wire is disconnected the pull-down resistor will ensure that the constant current driver IS32LT3178 is disabled.

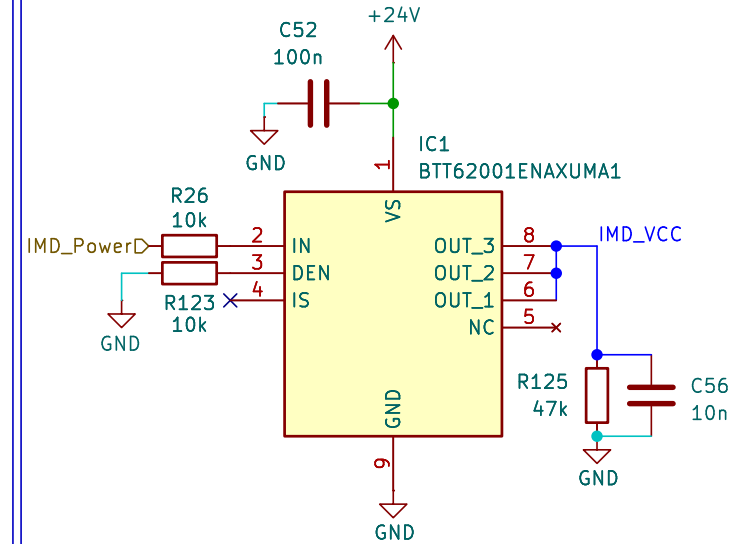
The TS_Off LED (and also the AMS_Error and IMD_Error LEDs) on the dashboard is controlled through a microcontroller, the default state (as shown in page ?? is set, so that the TS_Off LED will be off and the other two will be on (due to the additional NOT gate.)

Both signals are transmitted every 50 ms over the CAN bus. If the Dashboard does not receive a CAN message from the AMS Master within 150 ms, it will reach timeout and the default state will be reached. Since CAN bus has checksum already integrated in the protocol, the timeout will also be reached if data corruption happens for a prolonged period.



Main Connector

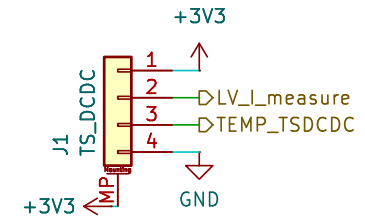
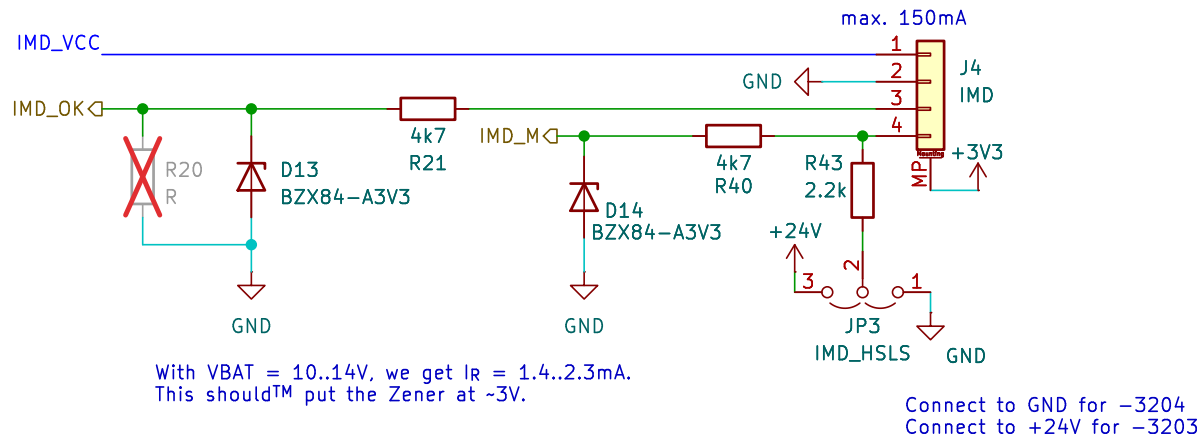
IMD Supply



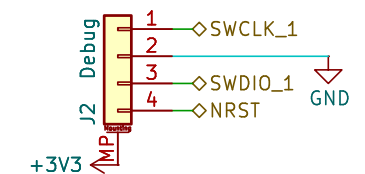
IMD Connector

IMD - Datasheet

https://www.bender.de/fileadmin/content/Products/d/e/IR155-32xx-V004_D00115_D_XXEN.pdf



TSDCDC Connector



Debug Connector

FASTTUBE

Title: Input/Output

Project: Master_FT25

Author: Lene Marquardt

Rev: V1

Date: 2025-03-09

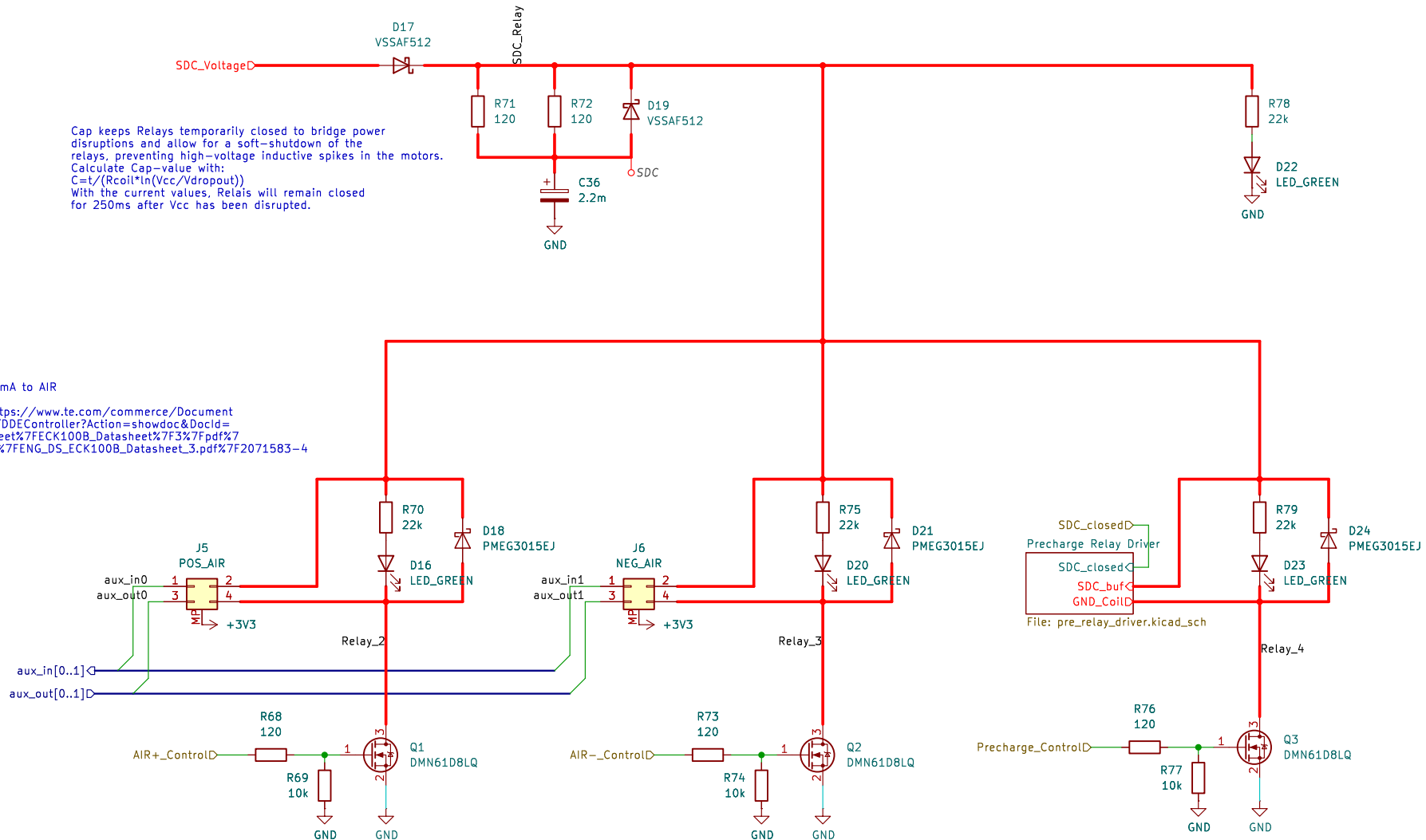
Exp. Date: 2025-04-27

Size: A5 Page: 13/15

Cap keeps Relays temporarily closed to bridge power disruptions and allow for a soft-shutdown of the relays, preventing high-voltage inductive spikes in the motors.
Calculate Cap-value with:
 $C = t / (R_{coil} * \ln(V_{cc} / V_{dropout}))$
With the current values, Relais will remain closed for 250ms after Vcc has been disrupted.

max 500mA to AIR

siehe: https://www.te.com/commerce/DocumentDelivery/DDEController?Action=showdoc&DocId=Data+Sheet%7FECK100B_Datasheet%7F3%7Fpdf%7FEnglish%7FENG_DS_ECK100B_Datasheet_3.pdf%7F2071583-4



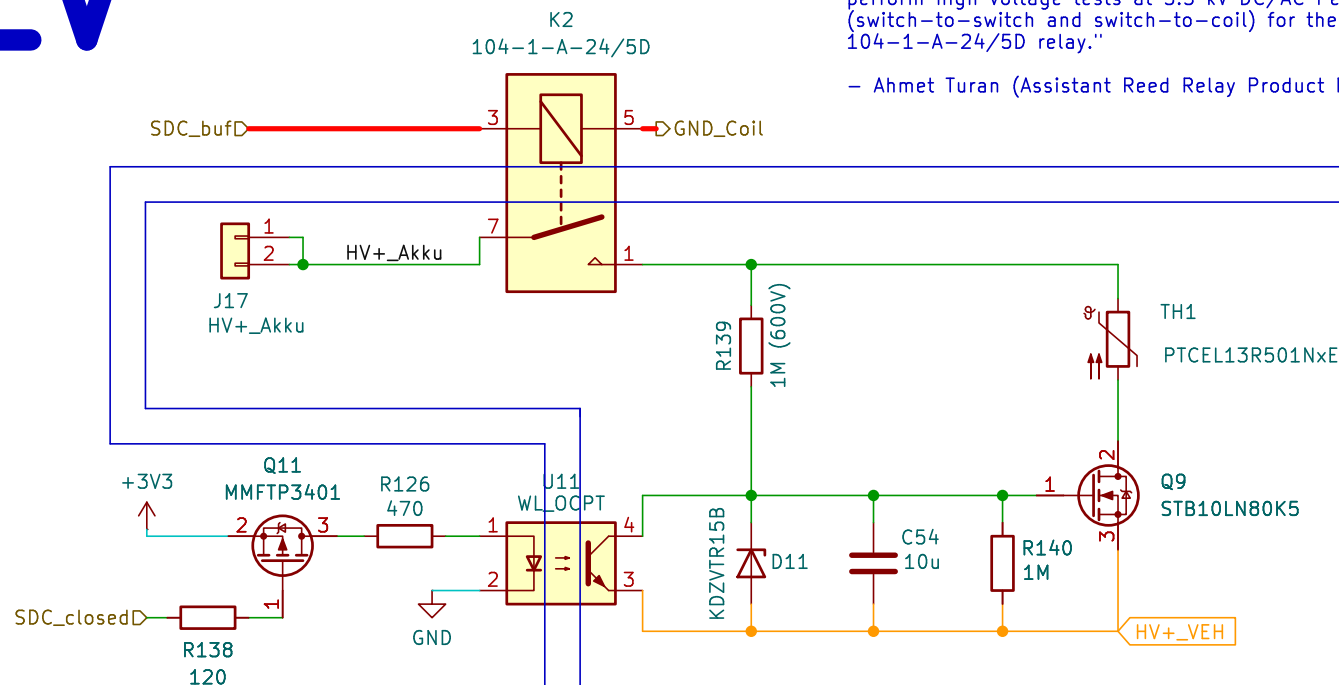
The MOSFETs act as a low-side switch for the Power-relais used. The diodes protect the MOSFETs from inductive voltage spikes caused by the Relais-coils when powered off.

LV

TS-LV isolation via relay pn distance (10.16mm)

"Regarding your questions about our testing process, we perform high voltage tests at 5.5 kV DC/AC Peak (switch-to-switch and switch-to-coil) for the 104-1-A-24/5D relay."

- Ahmet Turan (Assistant Reed Relay Product Manager)



TS

FASTTUBE

Title: Precharge Relay Driver

Rev: V1

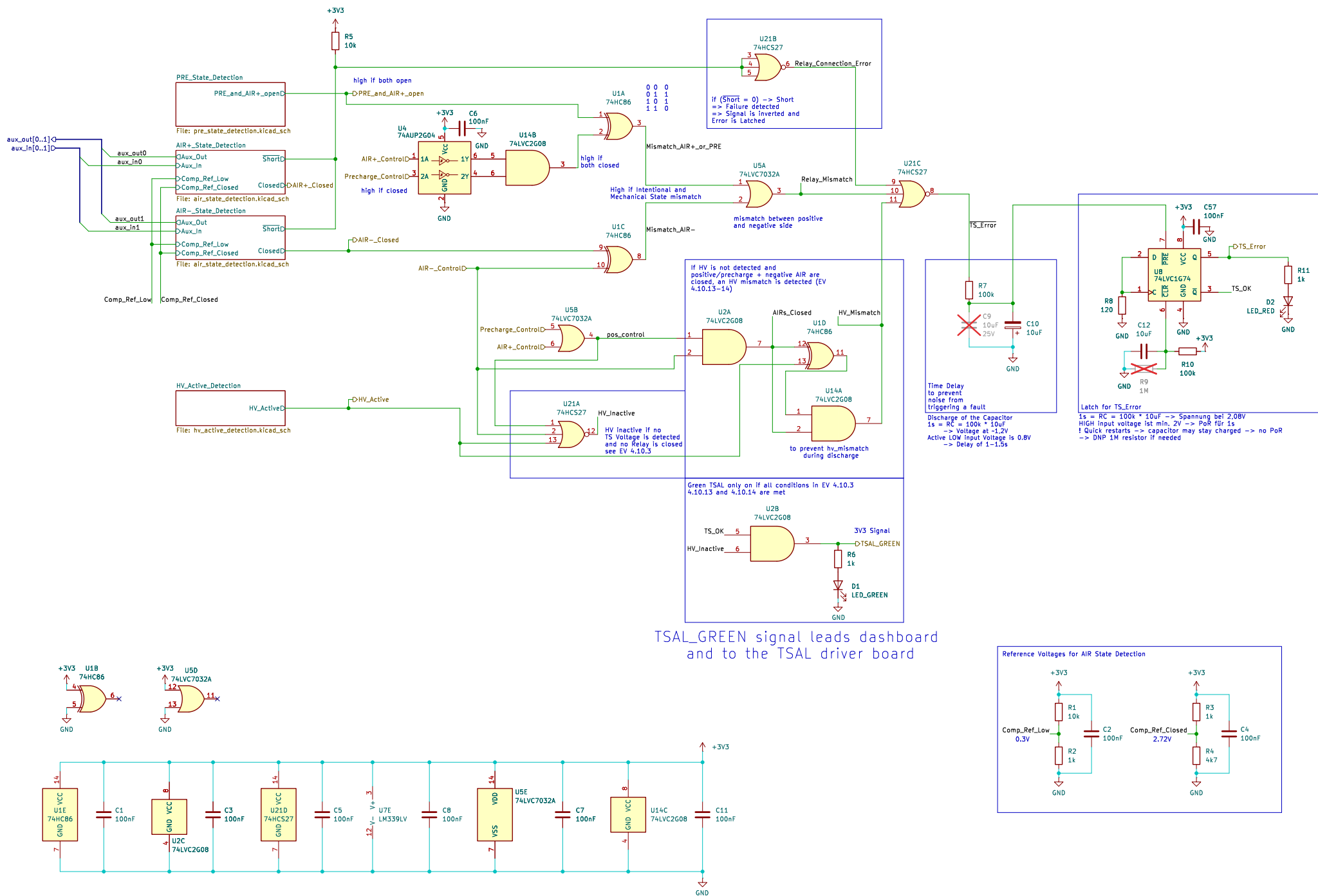
Date: 2025-03-09

Project: Master_FT25

Exp. Date: 2025-04-27

Author: Lene Marquardt

Size: A5 | Page: 10/15



FASTTUBE

Title: TSAL Logic

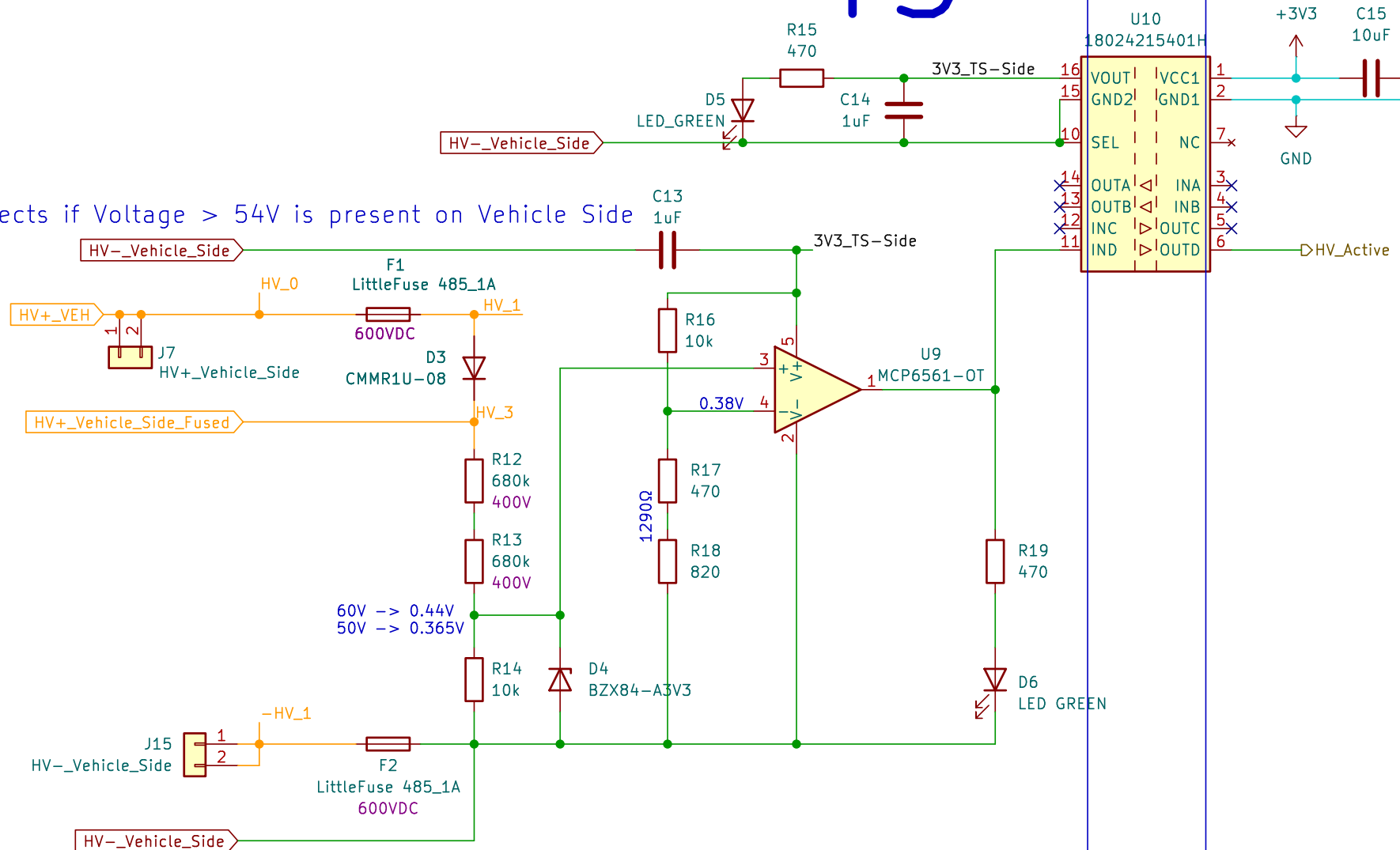
Project: Master_FT25
 Author: Lene Marquardt

Rev: V1
 Date: 2025-03-09
 Exp. Date: 2025-04-27
 Size: A3 | Page: 2/15

TS

LV

Detects if Voltage > 54V is present on Vehicle Side



FASTTUBE

Title: TSAL HV Detection

Rev: V1

Date: 2025-03-09

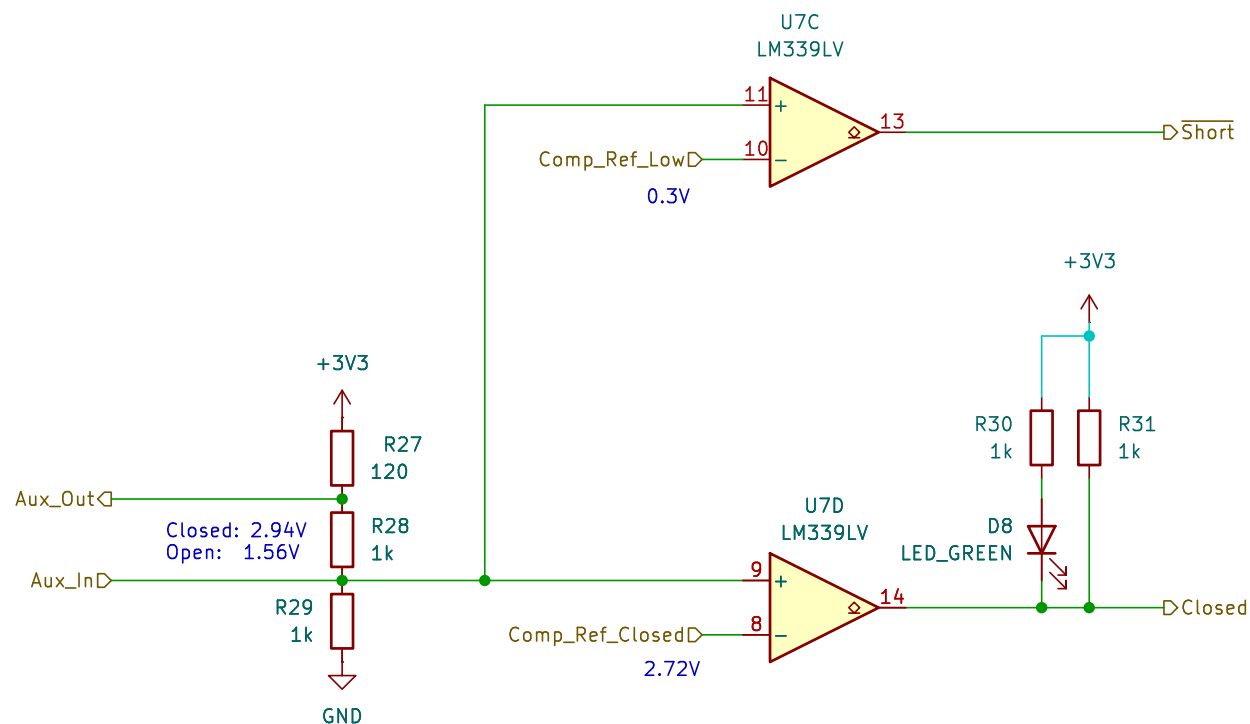
Project: Master_FT25

Exp. Date: 2025-04-27

Author: Lene Marquardt

Size: A5 | Page: 3/15

Accumulator TSAL – Relay state detection



FASTTUBE

Title: AIR Relay State Detection

Rev: V1

Date: 2025-03-09

Project: Master_FT25

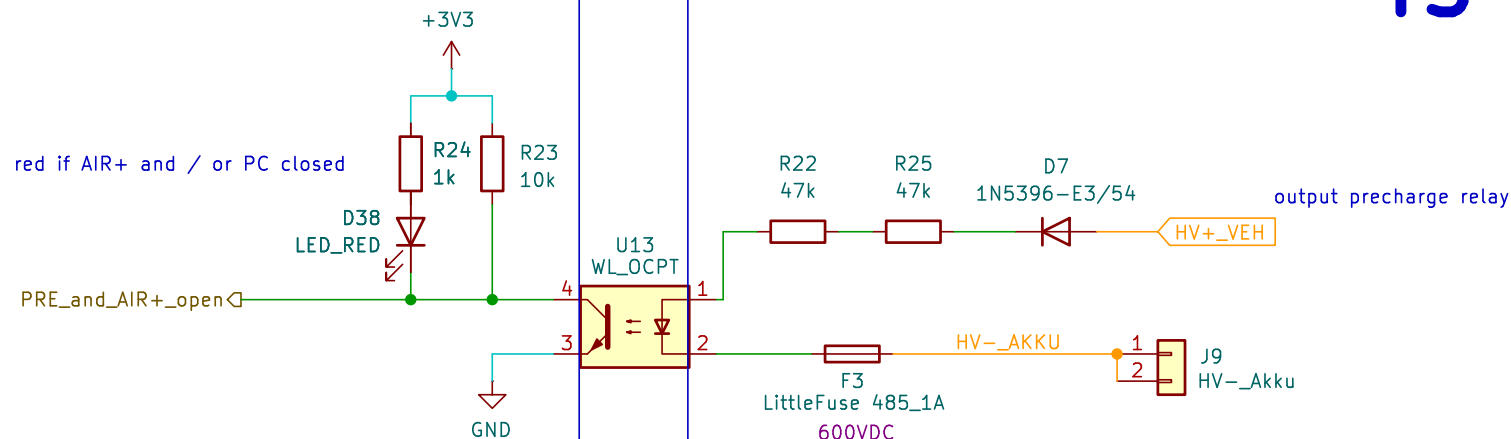
Exp. Date: 2025-04-27

Author: Lene Marquardt

Size: A5 | Page: 4/15

LV

TS



Detects if Precharge or Positive AIR are closed:
 PRE_AIR+_open = 3V3 if both Relays are Open
 PRE_AIR+_open = 0V if one or both are Closed

FASTTUBE

Title: Precharge State Detection

Rev: V1

Date: 2025-03-09

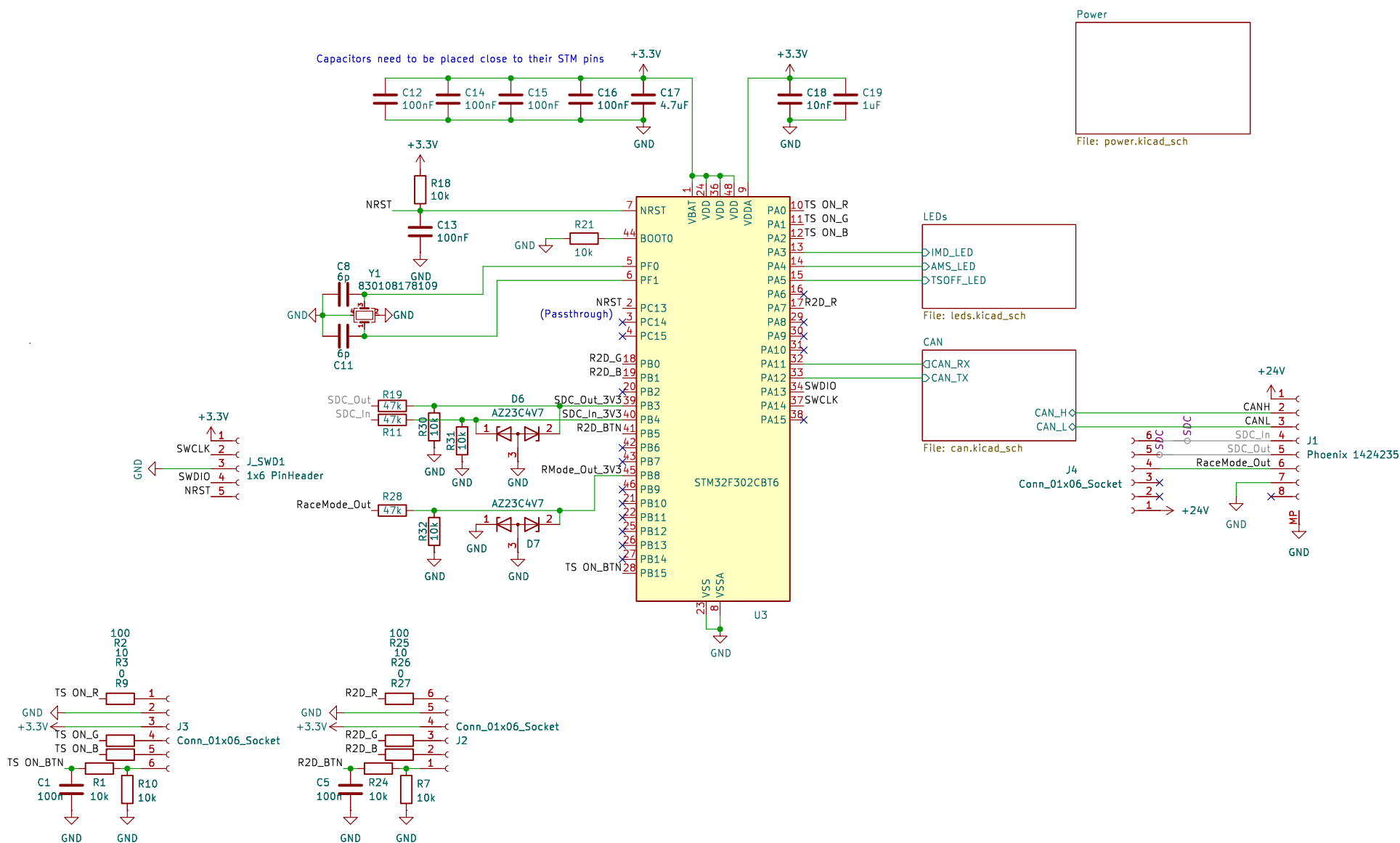
Project: Master_FT25

Exp. Date: 2025-04-27

Author: Lene Marquardt

Size: A5 | Page: 6/15

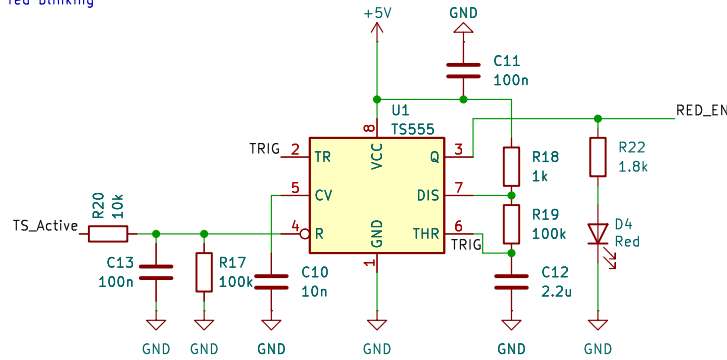
Dashboard



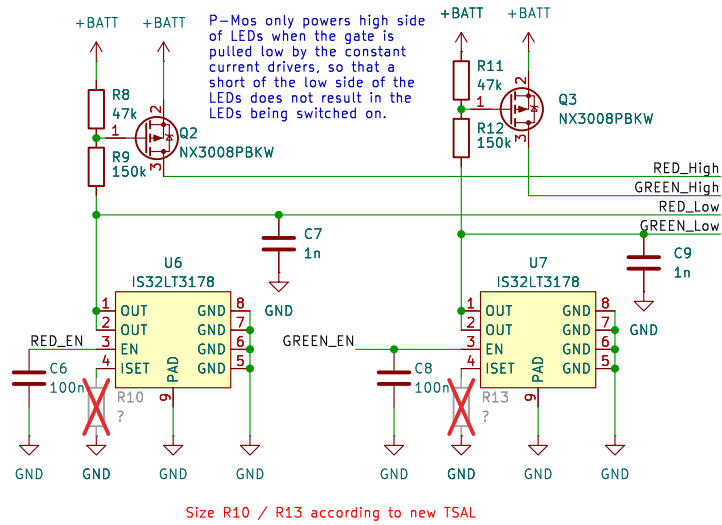
TSAL driver board and DC-link voltage detection

LV TS

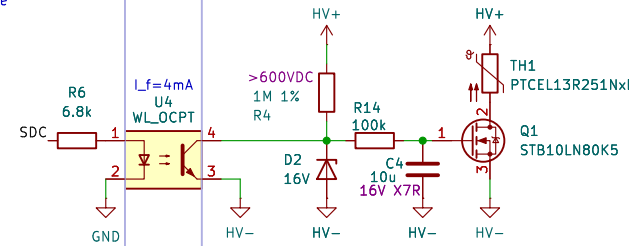
Timer for red blinking



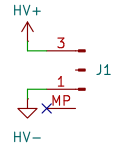
LED Drivers



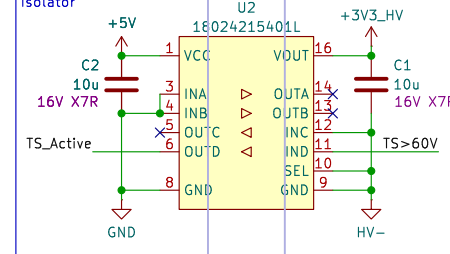
Discharge Circuit



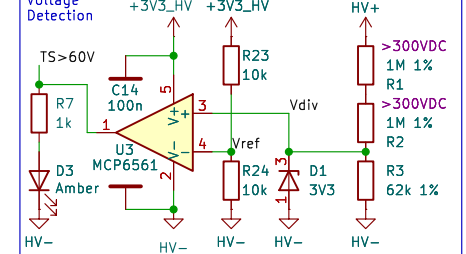
HV Connector



Isolator



Voltage Detection

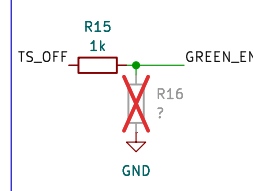
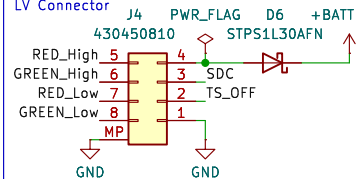


$$V_{ref_max} = 3.47V \cdot 10.1k\Omega / (10.1k\Omega + 9.9k\Omega) = 1.76V$$

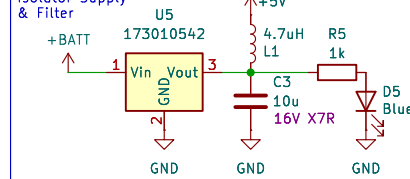
$$V_{div@60V_min} = 60V \cdot 61.38\Omega / (2 \cdot 990k\Omega + 61.38k\Omega) = 1.8V$$

$$V_{hyst_max@75deg} = 6mV < 40mV (1.80V - 1.76V)$$

LV Connector



Isolator Supply & Filter



FASTTUBE

Title: Discharge Circuit

Project: DC

Author: Karlsson Winkels

Rev: V1

Date: 2024-11-10

Exp. Date: 2025-04-27

Size: A4 Page: 1/1