The pre-charge and main contactor relay drivers of the inverter cannot be used to drive the relays directly as the AIRs must be powered by the shutdown loop

The driver outputs are high-side drivers where:
- Active: 12V
- Inactive: floating

J3 Inverter

J4 BMS

Pins 2 connects to a "charging interlock" which may only be installed when the TSAC is outside the car. The goal here is to make it impossible for the AIRs to accidentally be closed by the charge enable signal when the TSAC is inside the car. Under no circumstances should CHG_EN_INTERLOCKED be connected at the same time as the inverter!

H1 MountingHole
H2 MountingHole
H3 MountingHole
H4 MountingHole

This board goes in the TSAC. Just about everything inside the TSAC is standardised to M4, so use M4 mounting holes.

TS_ENABLED
INV_CLOSE_PCHG_RLY
INV_FAULT_INDICATOR
INV_CLOSE_MAIN_CONTACTOR
BMS_DISCHG_EN
CHG_EN_INTERLOCKED

BMS outputs are all open drain so must be pulled up

+12V
D1 LED
R1 3k3
R2 10k
R7 10k
R8 10k
R4 10k
R6 10k
GND

The fault indicator blinks a fault code by providing a ground connection

The signal is latched low by the control logic to handle blinking, opening the AIRs and pre-charge relay

The inverter will also command the +AIR and pre-charge relay open in a fault condition, so this is more a redundancy

SW1
R5 10k

J2 Control
1 TS_ON_INPUT
2 EXT_FAULT_INPUT
3
4

R3 10k

The EXT fault input is an active high external fault source, in case we ever need it. When used, the jumper (switch) should be set to pull up so that if the input is disconnected, it faults. When unused, the jumper should be set to pull down ("always OK").

Control Logic

Inputs:
CHG_EN_INTERLOCKED
DISCHG_EN
INV_CLOSE_MAIN_CONTACTOR
INV_CLOSE_PCHG_RLY
INV_FAULT
TS_ON_INPUT
EXT_FAULT
TS_ENABLED

Outputs:
CHG_EN
CLOSE_PCHG_RLY
CLOSE_POS_AIR
CLOSE_NEG_AIR
TS_READY

File: control.kicad_sch

[RELAY_STATES]
CHG_EN
CLOSE_PCHG_RLY
CLOSE_POS_AIR
CLOSE_NEG_AIR

These are to go to the HV sense "intended relay states" inputs

J5 States
4 CLOSE_NEG_AIR
3 CLOSE_POS_AIR
2 CLOSE_PCHG_RLY
1

TS ready goes to VCU, when on the VCU can allow driver to press "TS On" button

Relays

CHG_EN
CLOSE_PCHG_RLY
CLOSE_POS_AIR
CLOSE_NEG_AIR
SHDN_IN

POS_AIR
NEG_AIR
PCHG_RLY+
PCHG_RLY-

File: relays.kicad_sch

AIR outputs go to one side of relay coil, other side of coil goes to GND

J6 Relays
1 POS_AIR
2 NEG_AIR
3 PCHG_RLY+
4 PCHG_RLY-

Power

PWR J1
4 SHDN_IN
3
2
1

Don't need 4 pins, but less parts to stock

D2 SS14+

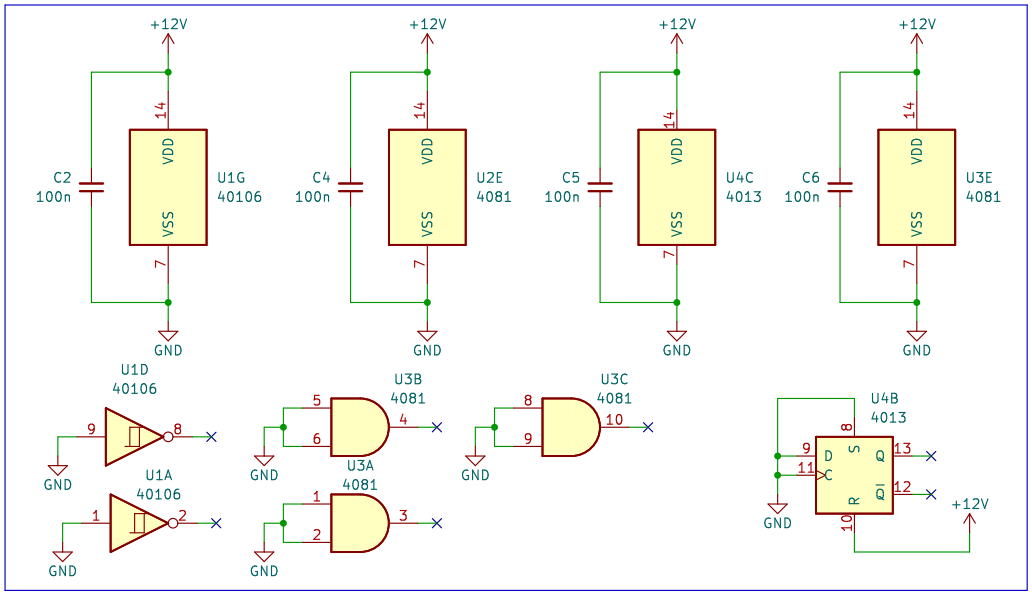
Diode prevents capacitors from powering the shutdown loop when the shutdown loop opens, without it the capacitors on the 12V supply of this board would keep the AIRs on for a short time after the loop opens

F1 0.5A 0448.500MR

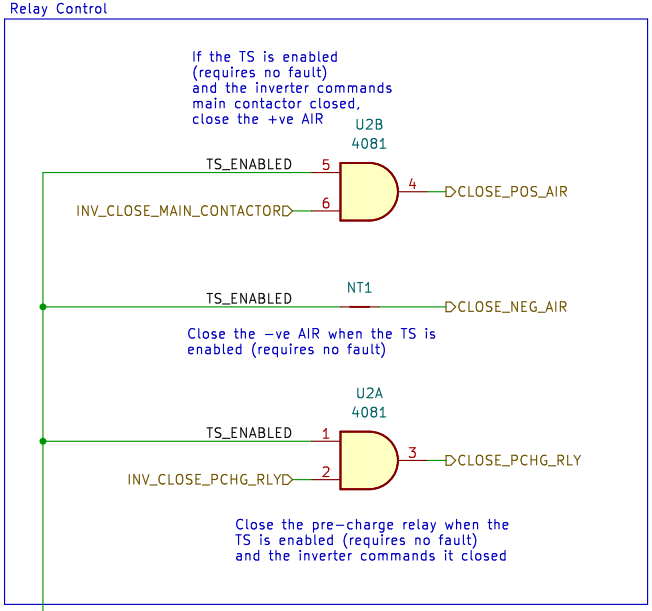
+12V
PWR_FLAG
C1 100u
GND

Vehicle: STAG 9	
Drawn By: Tim Brewis	
Checked By: Max O'Brien, Marek Frodyma	
CAD Part:	
SUFST – Southampton University Formula Student Team	
Sheet: /	
File: trc.kicad_sch	
Title: TSAC Relay Controller	
Size: A4	Date: 2023-04-27
KiCad E.D.A. kicad 7.0.1-0	**Rev: 2.0.0**
	Id: 1/3

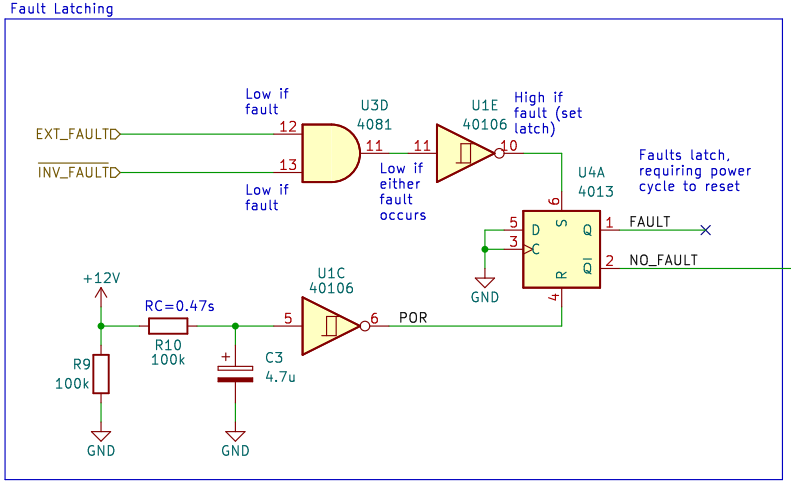
IC Power and Unused



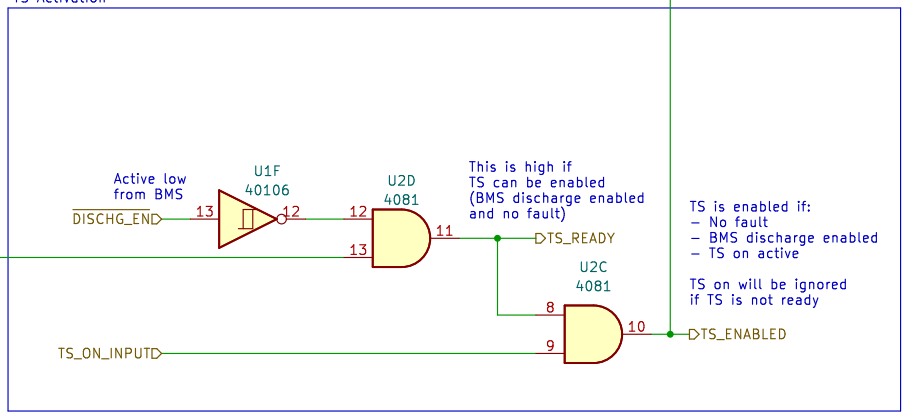
Relay Control



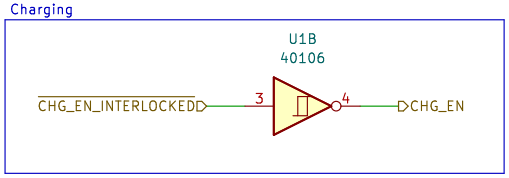
Fault Latching



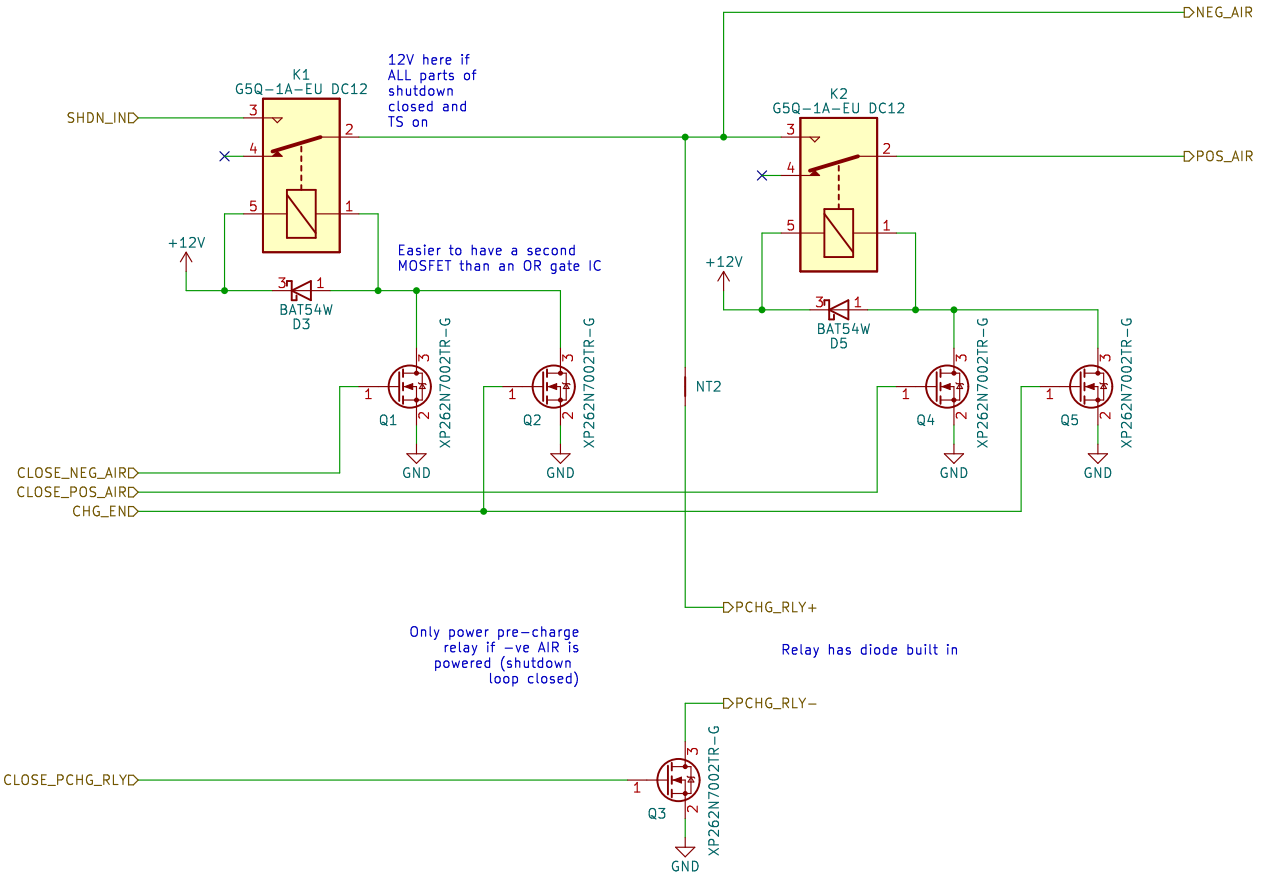
TS Activation



Charging



Vehicle: STAG 9	
Drawn By: Tim Brewis	
Checked By: Max O'Brien, Marek Frodyma	
CAD Part:	
SUFST – Southampton University Formula Student Team	
Sheet: /Control Logic/	
File: control.kicad_sch	
Title: TSAC Relay Controller	
Size: A4	Date: 2023−04−27
KiCad E.D.A. kicad 7.0.1−0	**Rev: 2.0.0**
	Id: 2/3



Vehicle: STAG 9	
Drawn By: Tim Brewis	
Checked By: Max O'Brien, Marek Frodyma	
CAD Part:	
SUFST – Southampton University Formula Student Team	
Sheet: /Relays/	
File: relays.kicad_sch	
Title: TSAC Relay Controller	
Size: A4	Date: 2023-04-27
KiCad E.D.A. kicad 7.0.1-0	**Rev: 2.0.0**
	Id: 3/3