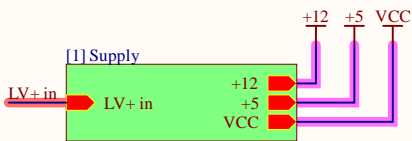
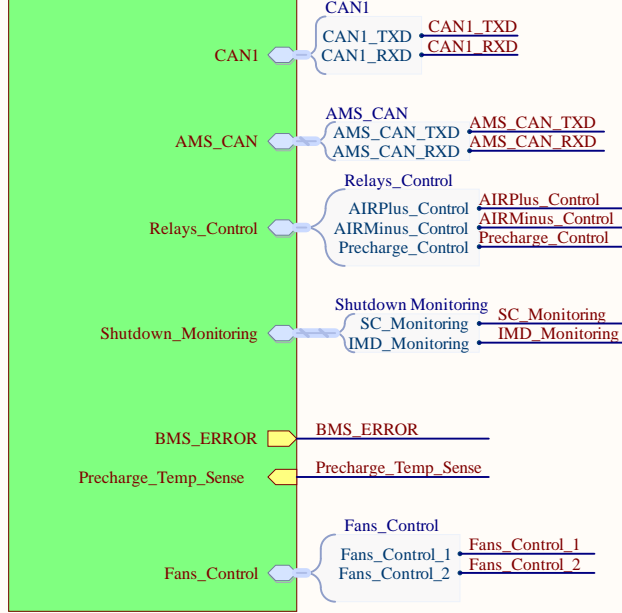


[2] MCU



AMS Master

This PCB is the AMS (BMS) Master ECU of the 2022-23 Accumulator from e-Tech Racing Formula Student Team.

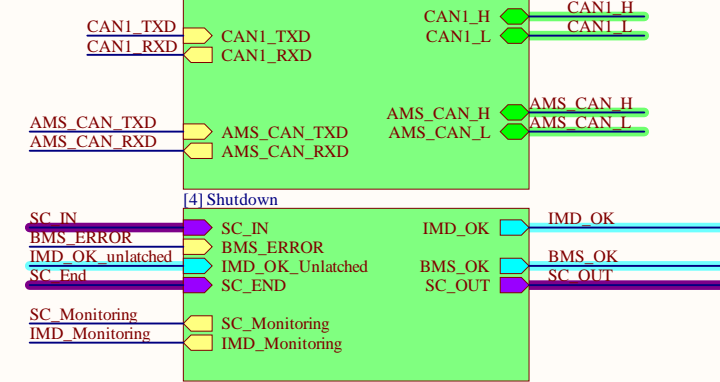
It is capable of communicating with two CAN buses and through UART. The MCU is from the 16-bit dsPIC33 family and firmware can be loaded using a PICKit3.

This ECU also controls the AIRs and precharge relays and the TSAL.

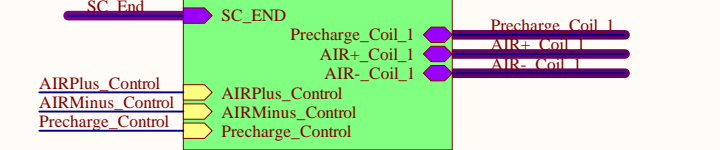
A LEM CAB300 current sensor is needed.

Green: CAN
Cyan: External signal
Orange: High Voltage
Red: Untreated supply
Pink: Treated supply
Purple: Shutdown chain

[3] CAN



[5] Relays_Control



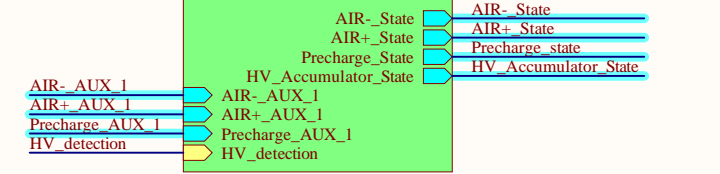
[6] Precharge



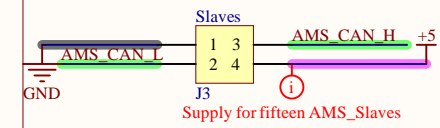
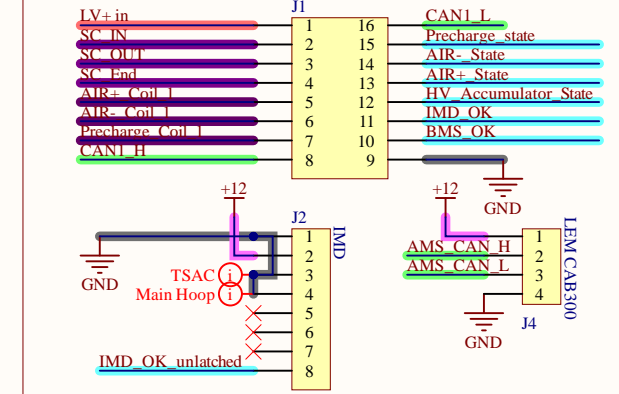
[7] High_Voltage



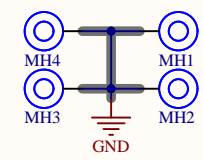
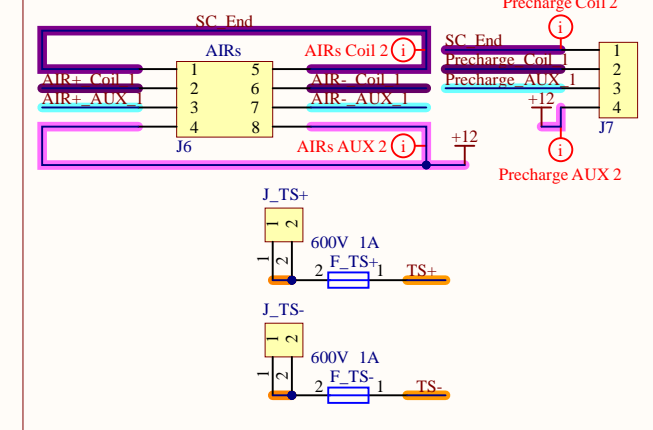
[8] TSAL



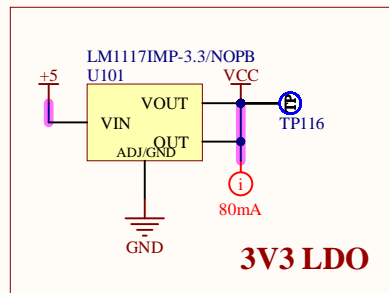
External connector



Connectors



Company: e-Tech Racing		e-techracing.es	
Project: AMS_Master		Variant: ETR-08	
Size:	Page Contents:		Version: 3.1
-	AMS_Master.SchDoc		Department: Accumulator-BMS
Author: David Redondo		dredondovinolo@gmail.com	
Checked by: David Redondo		Date: 16/07/2023	



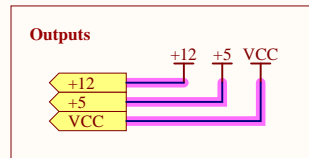
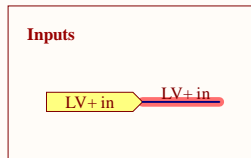
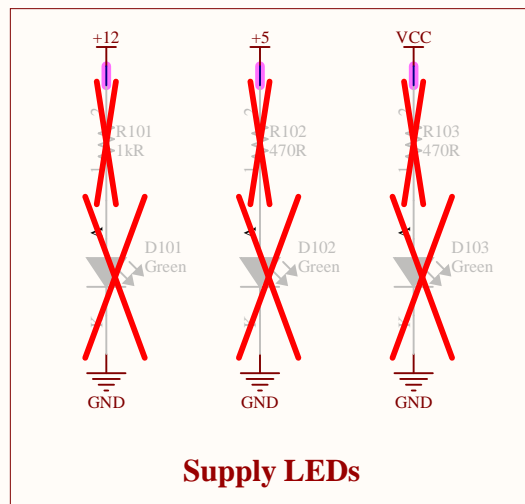
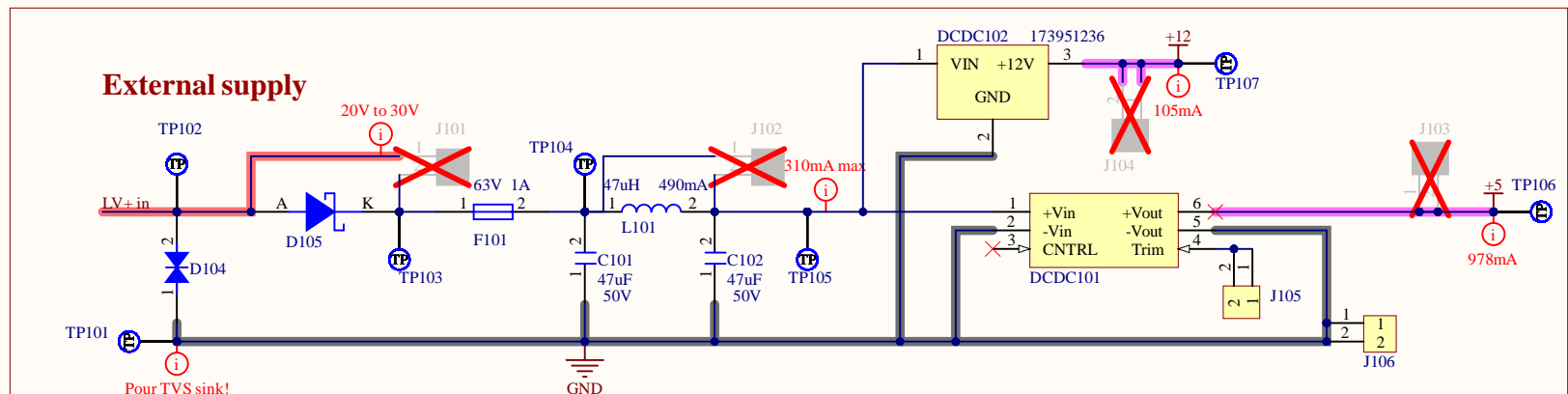
In order to read AMS CAN without the car or charger, the user must supply 5V externally directly to the 5V rail, for instance, using USB supply.

Issupp
 - (+5): 2mA (U401) + 52mA (U302) + 10mA (D102, D103) + 2mA (U701) + 832mA (U301) + 16mA (D103) + 60mA (U201) = 978mA --> It turned out to be way more than that (2.5A approx) due to supplying the whole slave boards with this rail.

- (+12): 80mA (J4) + 5mA (D101) + 10mA ([4] & [6]) + 150mA (J2) = 245mA

Pdiss
 - (U101): (5V-3.3V)*0.3A = 0.51W

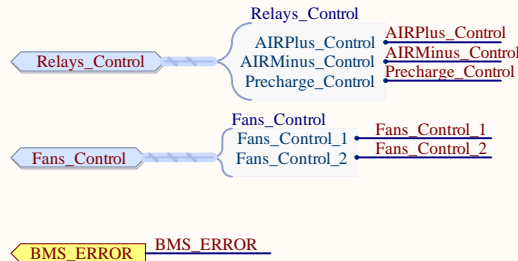
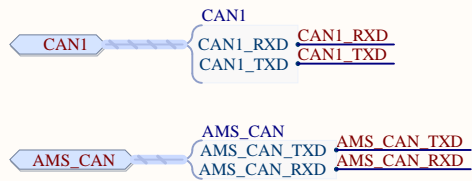
Pi filter:
 $f_0 = 1/(\pi * (L * C)^{(1/2)}) = 1/(\pi * (47\mu * 47\mu)^{(1/2)}) = 6.773\text{kHz}$



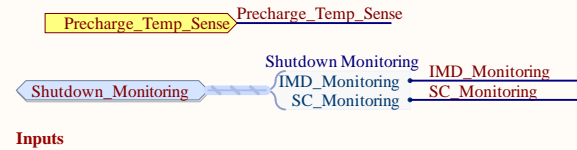
Company: e-Tech Racing		e-techracing.es	
Project: AMS_Master		Variant: ETR-08	
Size: -	Page Contents: [1] Supply.SchDoc		Version: 3.1
			Department: Accumulator-BM
Author: David Redondo dredondovinolo@gmail.com			Sheet 2 of 10
Checked by: David Redondo			Date: 16/07/2023

A

A



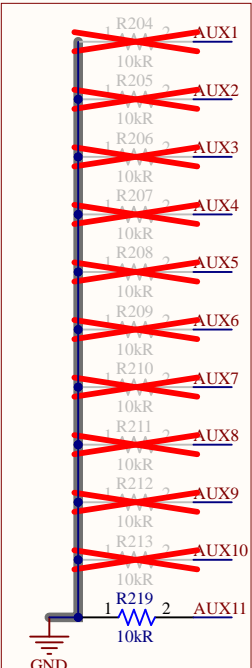
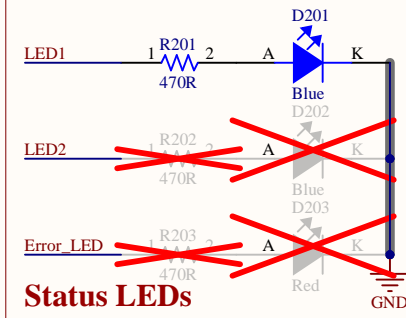
Outputs



Inputs

C202 & C203 are dependant on trace/pad Cstray, 5pF to 15pF
CLoad = 2 * (CL_datasheet - CStray) ≈ 15pF

U201 dsPIC33EP256GM604-I/PT-ND intended be compatible with 2019-2022 FW except for pin swappings.



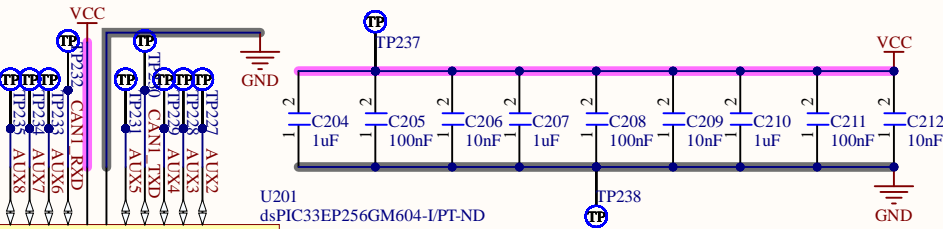
MCU

Pin swaps with respect to 2019 version:

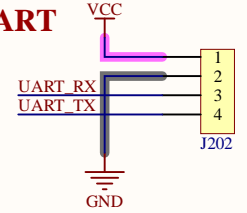
BMS_OK ↔ AMS_CAN_Control

CANTX_AMS, CANRX_AMS ↔ CANTX_1, CANRX_1

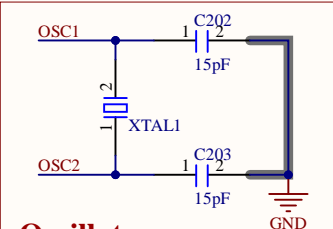
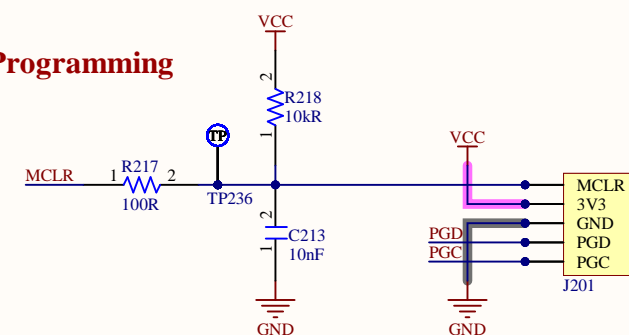
Interlock monitoring not needed



UART



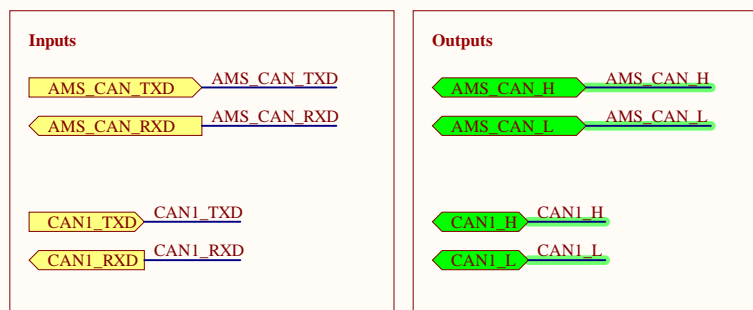
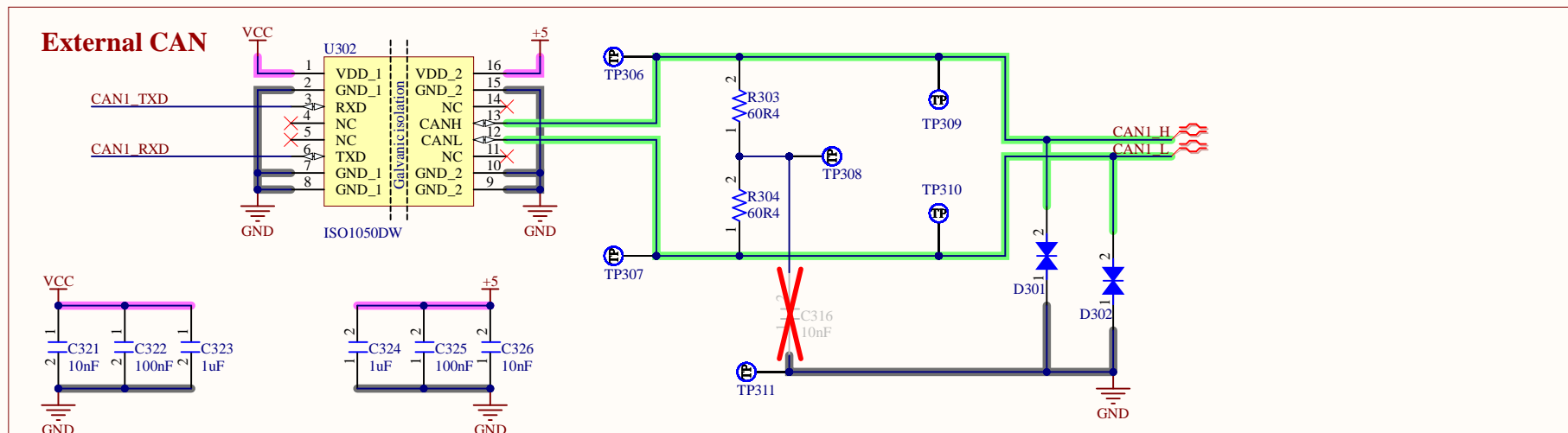
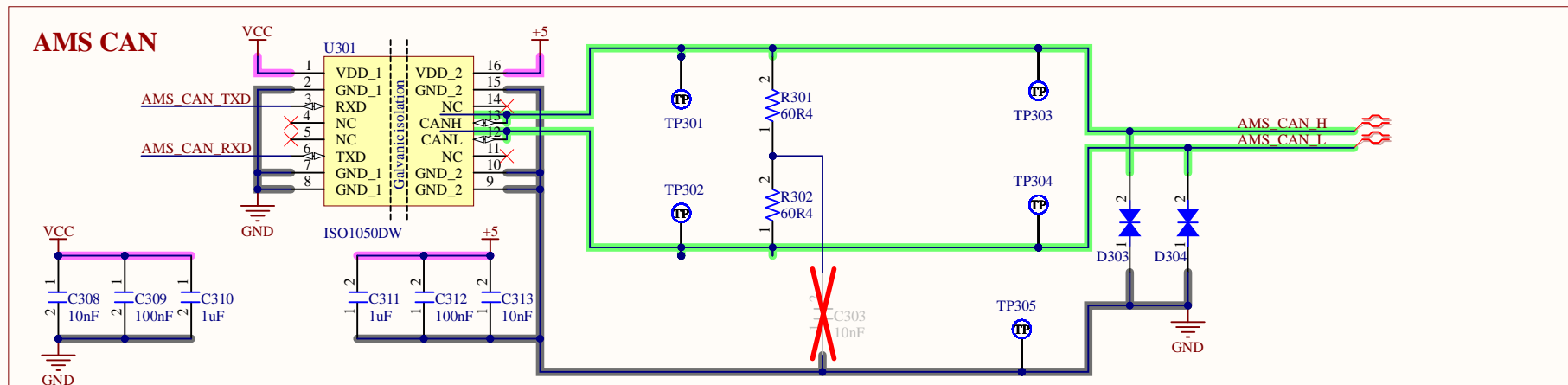
Programming



Company: e-Tech Racing		e-techracing.es	
Project: AMS_Master		Variant: ETR-08	
Size: -	Page Contents: [2] MCU.SchDoc		Version: 3.1
			Department: Accumulator-BMS
Author: David Redondo		dredondovinolo@gmail.com	Sheet 3 of 10
Checked by: David Redondo		Date: 16/07/2023	

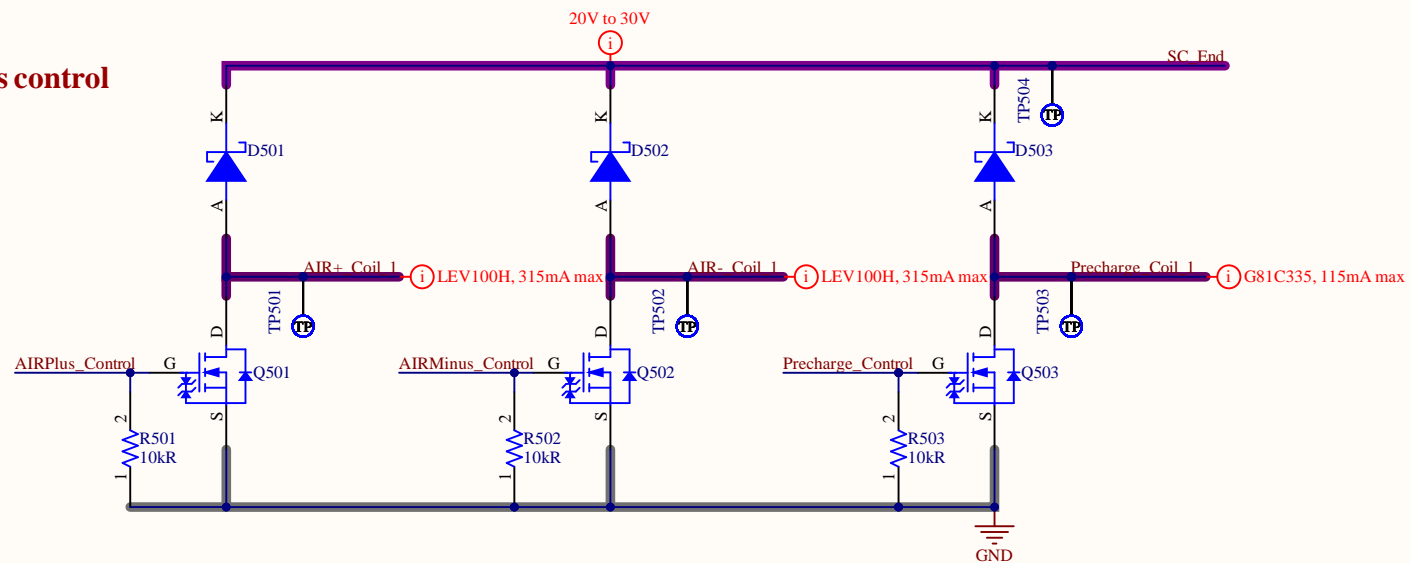
D

D

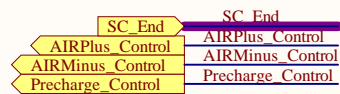


Company: e-Tech Racing		e-techracing.es		
Project: AMS_Master		Variant: ETR-08		
Size:	Page Contents:		Version:	3.1
-	[3] CAN.SchDoc		Department:	Accumulator-BM
Author: David Redondo			Sheet 4 of 10	
Checked by: David Redondo			Date: 16/07/2023	

Relays control

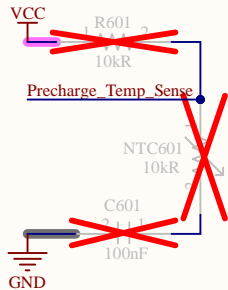


Relays' coils are connected to the end of the shutdown chain on one side (Coil 2), so when any of the N-MOS switches, the other coil lead (Coil 1) is connected to GND, and thus current flows through it and the relay is closed.



Company: e-Tech Racing		e-techracing.es	
Project: AMS_Master		Variant: ETR-08	
Size: -	Page Contents: [5] Relays_Control.SchDoc	Version: 3.1	Department: Accumulator-BMS
		Sheet 6 of 10	
Checked by: David Redondo		Date: 16/07/2023	

Precharge temperature sense




NTC601 :for sensing R_precharge. Mounted only when testing, it's not a rules compliant design because the sensor needs to be installed in contact with the resistor (TS) but is connected to LV without leaving space.

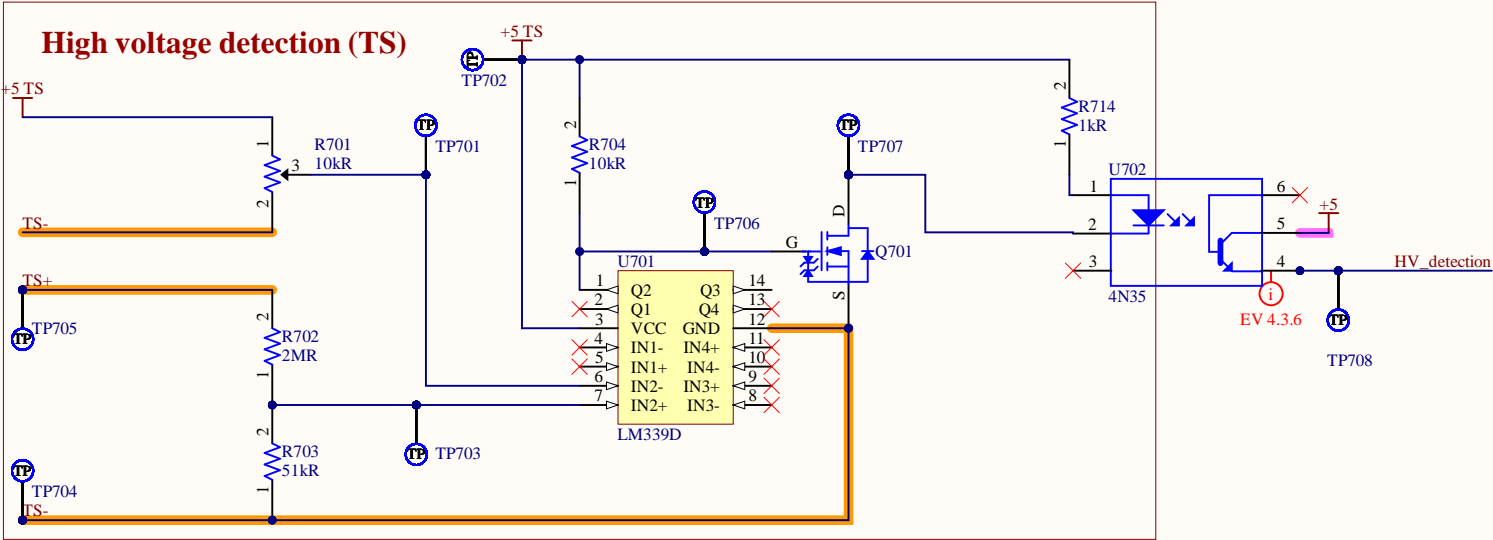
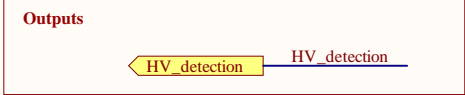
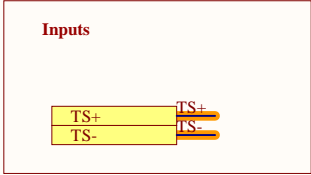
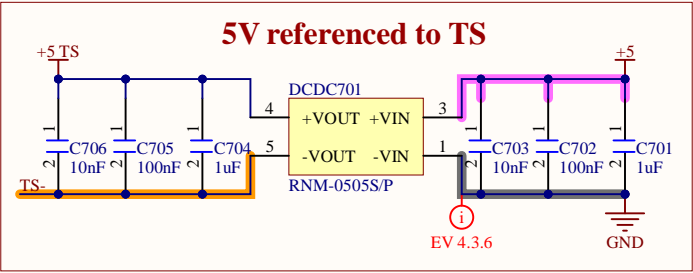
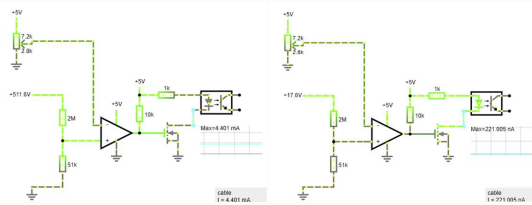
Precharge_Temp_Sense

Precharge_Temp_Sense

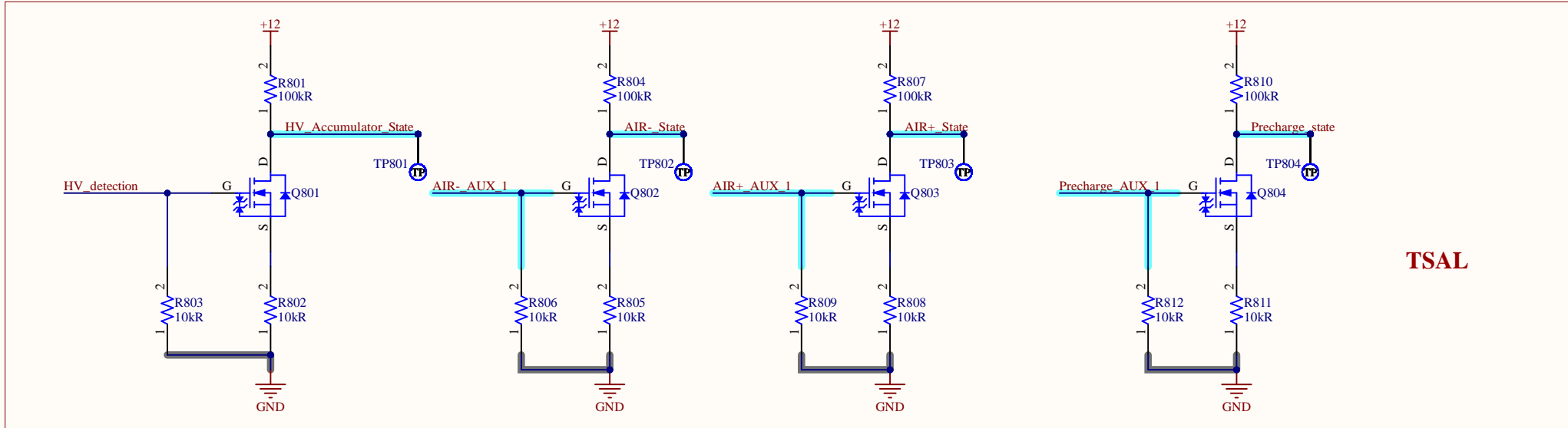
Outputs

Company: e-Tech Racing		e-techracing.es	
Project: AMS_Master		Variant: ETR-08	
Size: -	Page Contents: [6] Precharge.SchDoc		Version: 3.1
			Department: Accumulator-BMS
Author: David Redondo		dredondovinolo@gmail.com	Sheet 7 of 10
Checked by: David Redondo		Date: 16/07/2023	

Δ HV detection:
When TS>60V the LED
from the optocoupler
must be lit. To
accomplish this, a
comparator is used with a
voltage divider across TS
and a trimmer to adjust
the voltage trigger.



Company: e-Tech Racing		e-techracing.es	
Project: AMS_Master		Variant: ETR-08	
Size: -	Page Contents: [7] High_Voltage_SchDoc		Version: 3.1
Author: David Redondo		dredondovinolo@gmail.com	Department: Accumulator-BMS
Checked by: David Redondo		Date: 16/07/2023	



TSAL

△ All four states are 12V logic. The resistor pull-up/down configuration is designed according to TSAL's expected configuration and be able to detect implausibilities (they are SCS (T 11.9) with exceptions EV 4.10.13 and EV 4.10.14).

AIR_AUX_2 are intended to be connected to +12V.


AIRX circuitry is added in case a relay with auxiliary contacts is added as the precharge relay. Otherwise, an external detection circuit should be used to detect the precharge relay state.

Inputs

HV_detection	HV_detection
AIR- AUX 1	AIR- AUX 1
AIR+ AUX 1	AIR+ AUX 1
Precharge_AUX_1	Precharge_AUX_1

Outputs

Precharge_State	Precharge state
AIR- State	AIR- State
AIR+ State	AIR+ State
HV_Accumulator_State	HV_Accumulator_State

Company: e-Tech Racing		e-techracing.es		
Project: AMS_Master		Variant: ETR-08		
Size:	Page Contents:		Version:	3.1
-	[8] TSAL_SchDoc		Department:	Accumulator-BMS
Author: David Redondo			dredondovinolo@gmail.com	
Sheet 9 of 10				
Checked by: David Redondo			Date: 16/07/2023	