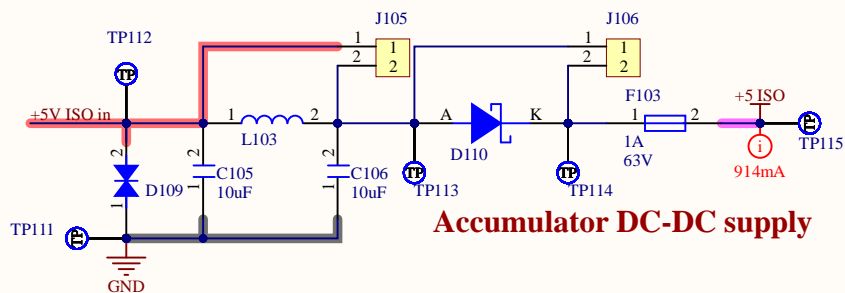
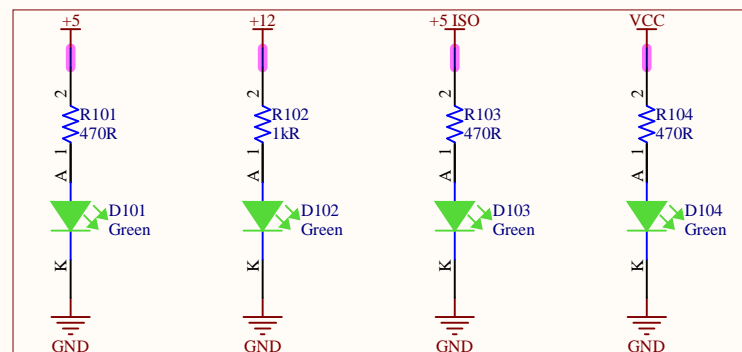


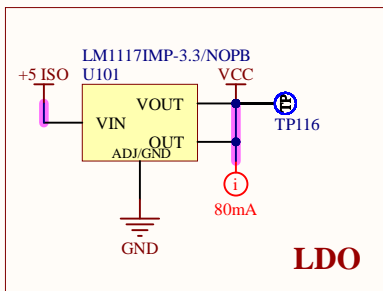
External supply



Accumulator DC-DC supply



Supply LEDs



LDO

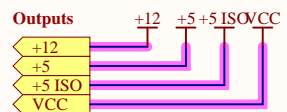
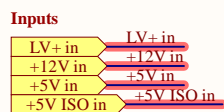
MCU is supplied from battery cells (see [6])


Isupp

- +5 : 2mA (LM339D)+52mA (ISO1050) + 10mA (D101) = 64mA
- +5 ISO : 2mA (LM339D)+832mA (ISO1050*16) + 20mA (D103,4) + 60mA (dsPIC) = 914mA
- +12 : 80mA (LEM CAB300) + 5mA (CANLogger) + 10mA ([4] & [5]) + 10mA (D102) = 105mA

Pdiss

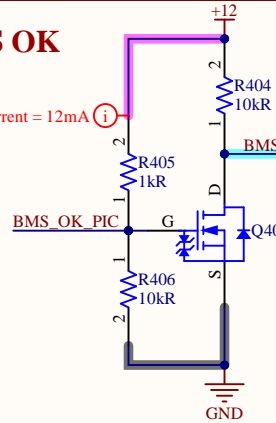
- U101 : (5V-3.3V)*0.3A = 0.51W
- D106 : 0.430V*0.064A = 27mW
- D108 : 0.430V*0.105A = 45mW



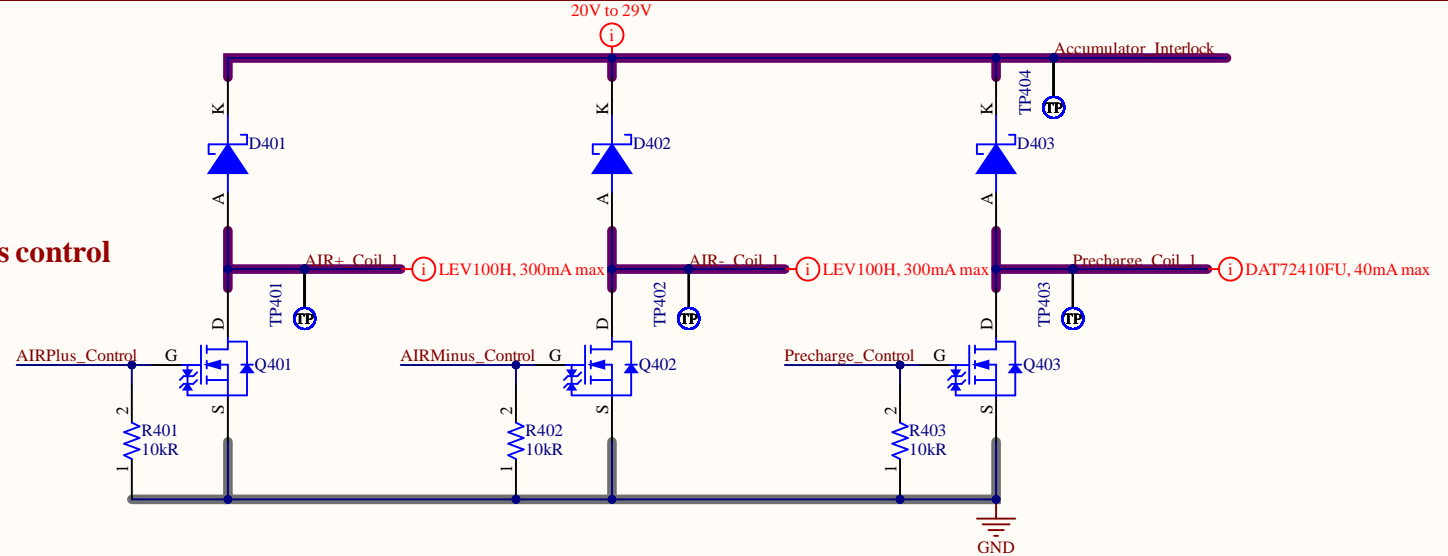
Company: e-Tech Racing		e-techracing.es		
Project: AMS_Master		Variant: [No Variations]		
Size: -	Page Contents: [1]Supply.SchDoc		Version: 3.0	
			Department: Accumulator-BM	
Author: David Redondo		dredondovinolo@gmail.com		Sheet of
Checked by:			Date: 11/08/2022	

BMS OK

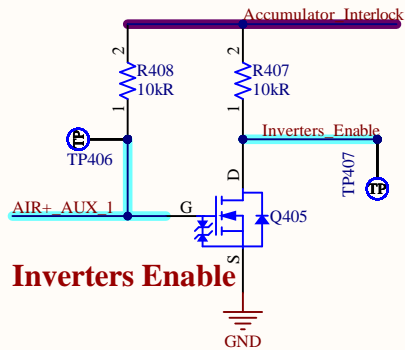
Max current = 12mA



Relays control



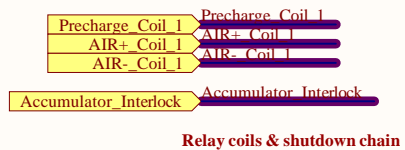
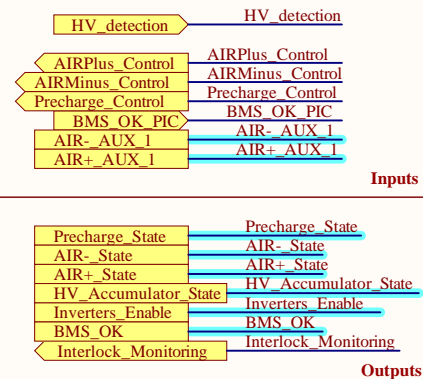
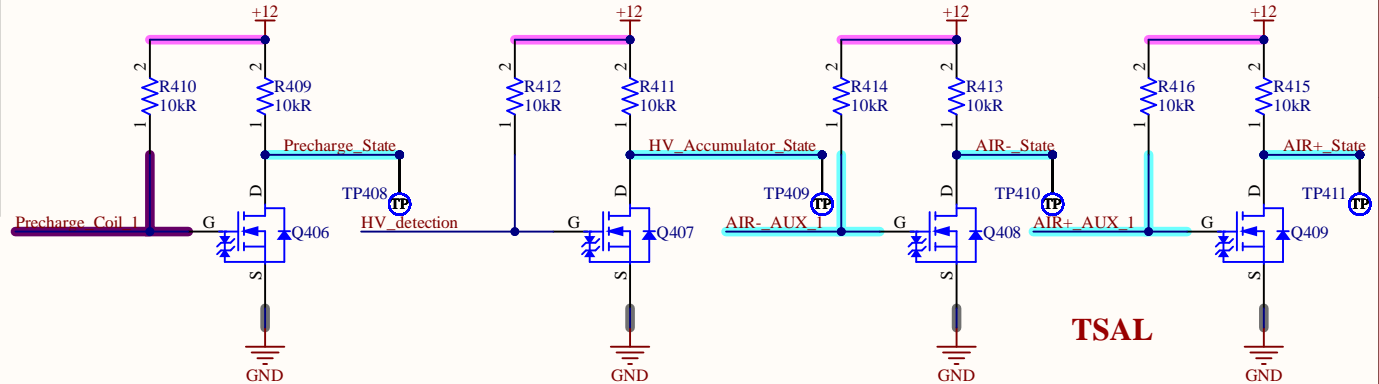
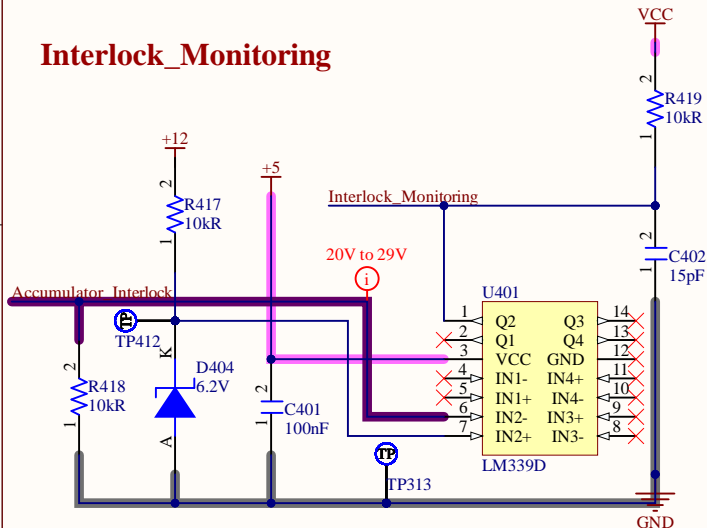
Inverters Enable



BMS_OK: to Shutdown PCB with latching on low state.
BMS_OK_PIC = 3V -> BMS_OK = 0V & viceversa
BMS_OK_PIC = HiZ -> BMS_OK = 0V
Pull-up < pull-down configuration ensures desired HiZ behaviour

Inverters_Enable: Bamocar D3 HW enable, 10 to 30V, given after precharge is done.
AIR+_AUX_1 = 0V -> Inverters_Enable LV+

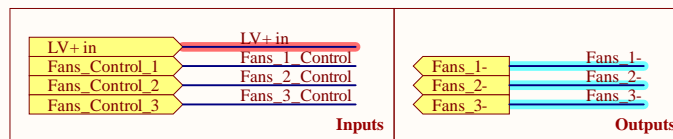
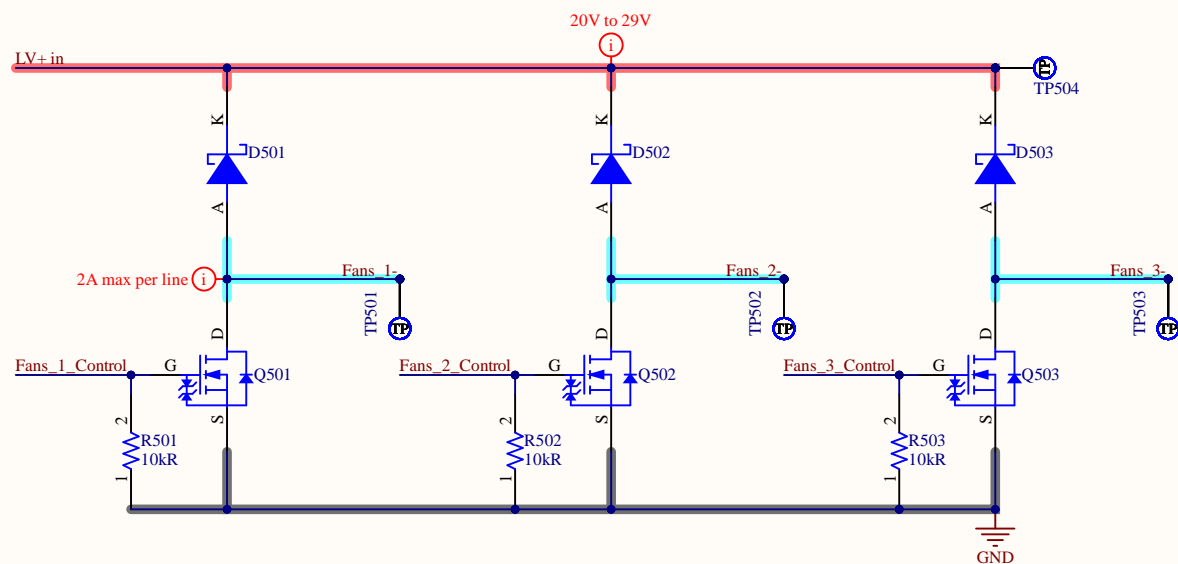
Interlock_Monitoring



D401, D402 & D403: Freewheeling diode Ipk = 10A.
TSAL: all signals pulled up, reverse logic (0/GND is active).
Interlock monitoring: reverse logic (0/GND is active).

Company: e-Tech Racing		e-techracing.es	
Project: AMS_Master		Variant: [No Variations]	
Size: -	Page Contents: [4]Relays_Shutdown_TSAL.SchDoc		Version: 3.0
Author: David Redondo		dredondovinolo@gmail.com	
Checked by:		Date: 11/08/2022	
		Department: Accumulator-BMS	





Company: e-Tech Racing		e-techracing.es		
Project: AMS_Master		Variant: [No Variations]		
Size:	Page Contents:		Version: 3.0	
-	[5] Fans_Control.SchDoc		Department: Accumulator-BMS	
Author: David Redondo			dredondovinolo@gmail.com	
Author: David Redondo			Sheet of	
Checked by:			Date: 11/08/2022	

R_precharge : Heatsink sizing guide

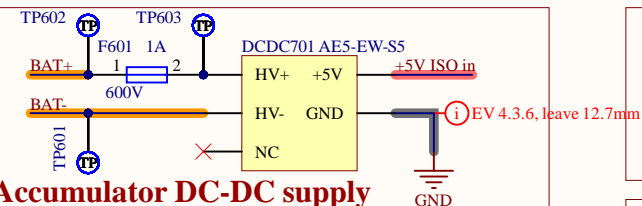
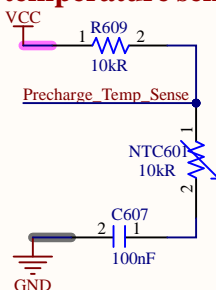
The size of the heatsink depends on how often a full precharge sequence is completed. The peak power is 184W with a 470Ω resistor, a 588V and 640µF values. The resistor can withstand the peak power (see datasheet), but if the sequence is repeatedly executed, temperature is a critical design parameter. Different times between cycles will be tabulated as a function of heatsink thermal resistance, using the average power in the specified time frame.

Calculations are based on basic thermal circuit analysis.
 $T_{amb} = 35^{\circ}\text{C}$
 $T_{j_max} = 140^{\circ}\text{C}$ (80% $T_{j_max_datasheet}$)
 $R_{th_jc} = 3^{\circ}\text{C/W}$ (TO247)
 $R_{th_amb} = 62.5^{\circ}\text{C/W}$ (TO247)

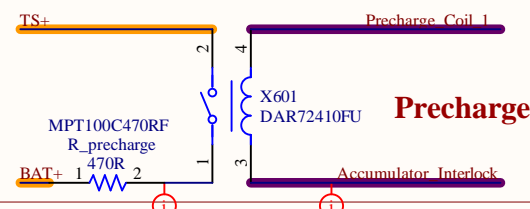
Without heatsink: 1:30min between precharge sequences
With 15°C/W heatsink: 20s between precharge sequences
With 6°C/W heatsink: 10s between precharge sequences

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 **R_precharge** (TS) but is connected to LV

Precharge temperature sense



Accumulator DC-DC supply

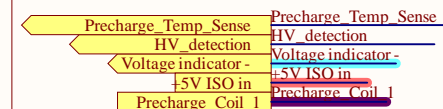


Precharge

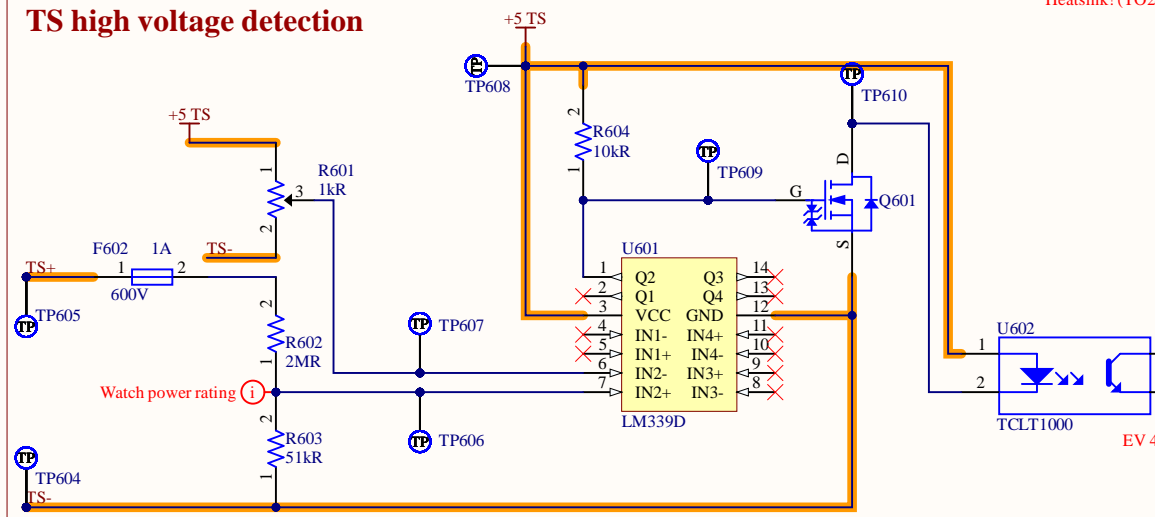
Inputs



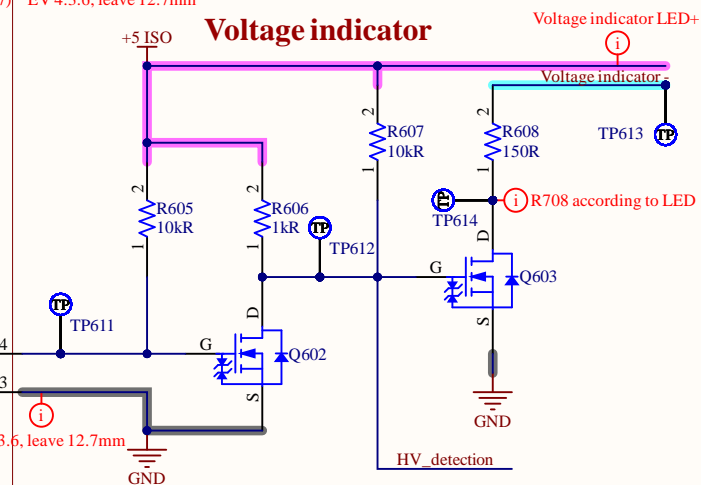
Outputs



TS high voltage detection



Voltage indicator



LED intended to use is Ermec's QRM145BXXSR 02E, 20mA at 2.2V.

$$R_{608} > (5V - 2.2V) / 20mA = 140\Omega$$

Logic states when HV is present:

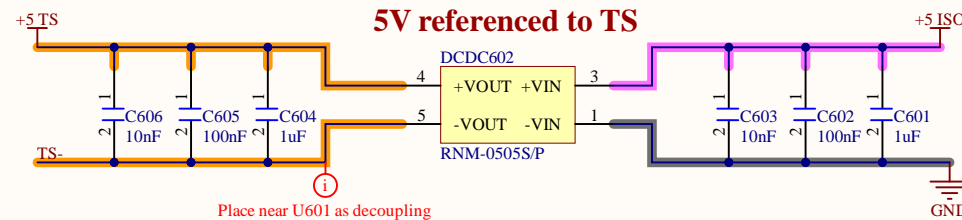
- Q601 ON
- Q602 OFF
- Q603 ON

- HV_detection
HIGH (+5V)


Logic states when HV is NOT present:

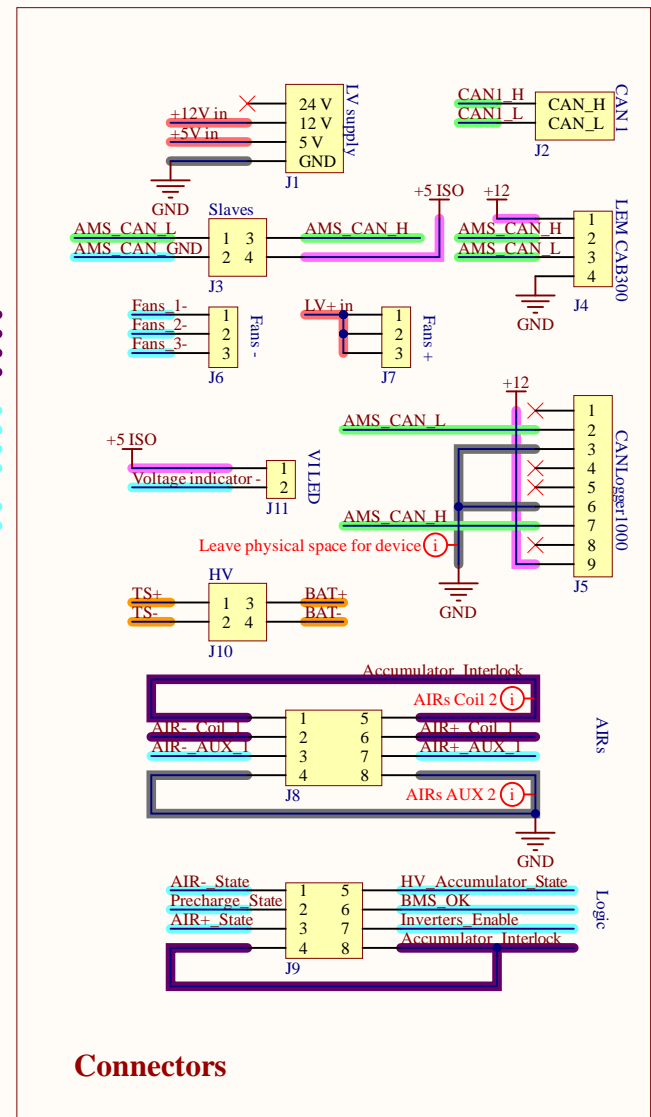
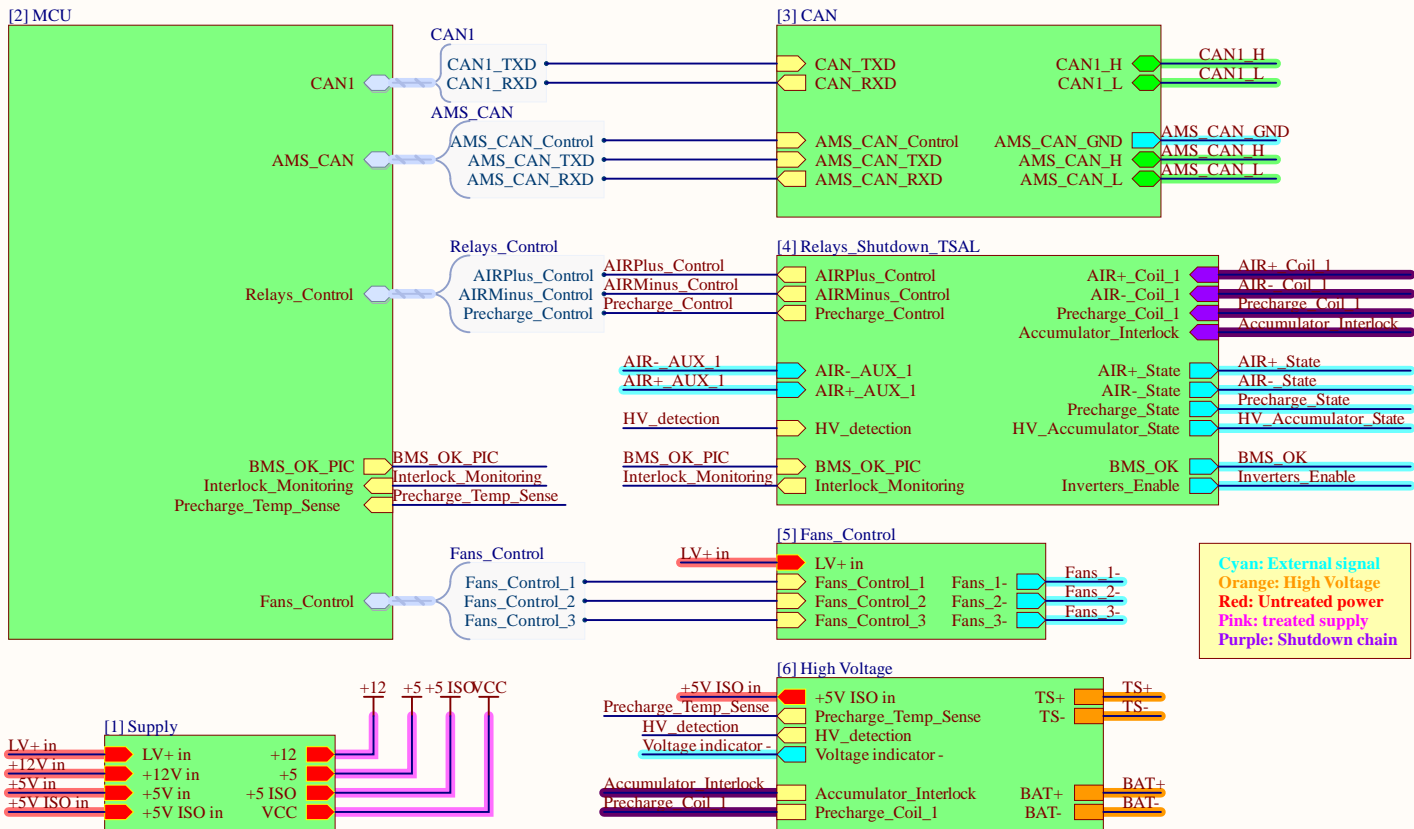
- Q601 OFF
- Q602 ON
- Q603 OFF
- HV_detection LOW(0V)

5V referenced to TS



Place near U601 as decoupling

Company: e-Tech Racing		e-techracing.es		
Project: AMS_Master		Variant: [No Variations]		
Size: -	Page Contents: [6] High Voltage_Sch.Doc		Version: 3.0	
			Department: Accumulator-BM	
Author: David Redondo dredondovinolo@gmail.com			Sheet • of •	
Checked by:			Date: 11/08/2022	



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, the battery cooling fans and the Voltage Indicator.

A LEM CAB300 current sensor is needed. A CANLogger1000 data logger can be installed to record internal messages to be further analyzed.

The Voltage Indicator LED is supplied with 5VDC and it shall not draw any more than 100mA.

Company: e-Tech Racing		e-techracing.es		
Project: AMS_Master		Variant: [No Variations]		
Size: -	Page Contents: AMS_Master.SchDoc		Version: 3.0	
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Author: David Redondo dredondovino@gmail.com			Sheet of	
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