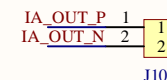
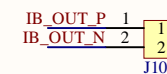


## LV Connectors



AMS Slave

This PCB is the AMS (BMS) Slave ECU of the 2023-24 Accumulator from e-Tech Racing Formula Student Team. 3 AMS Slaves are placed on each stack, two of them reading 10 voltages and one of them reading 8. Hence, 15 AMS Slaves are placed on the Accumulator, reading 140 voltages and 120 temperatures in total.


The IC used for the cells voltage monitoring is LTC6811-1, in addition to a multiplexer to monitor 8 NTCs using LTC6811's GPIOs.

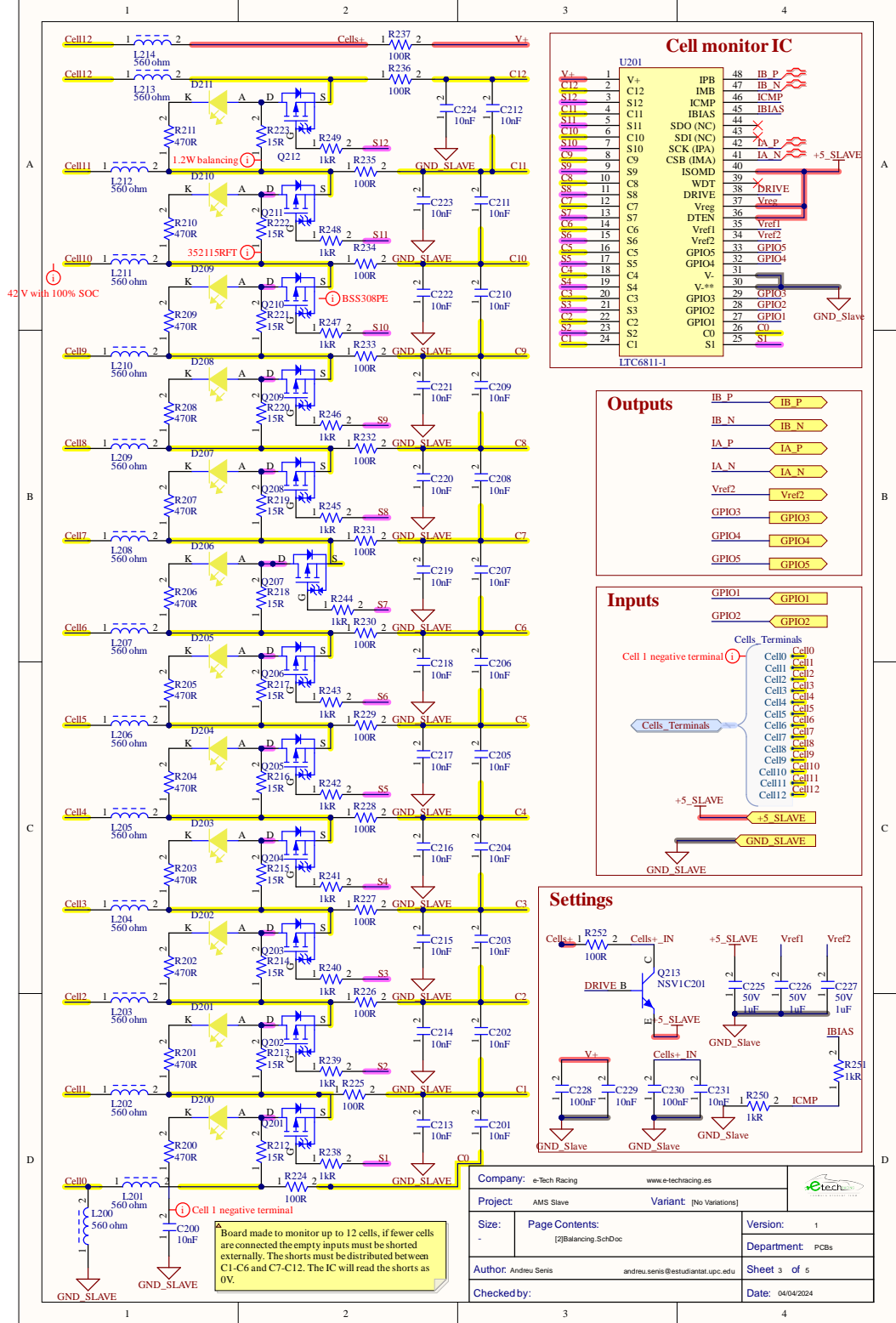
The board is capable of reading and processing up to 12 cell voltages and 8 temperature measurements.

The slave communicates via isoSPI in a daisy chain to the master board, which performs all the calculations and controls the safety of the battery. The majority of the design is based on the LTC6811 datasheet, the DC2259A development board and previous versions of the AMS of the team. In order to comply with FSG rules this board must be coated with a UL94-V0 material.

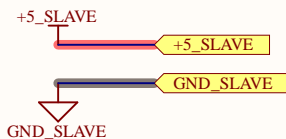
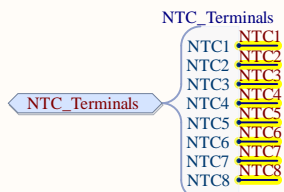
Green: isoSPI  
Yellow: Measurements  
Pink: Balancing  
Red: Supply  
Gray: GND

Maximum Input current [U201] is 30mA for the Vreg pin and 0.55 mA for the V+ pin, and 1uA for [U301]. All traces can be 0.2 mm, given that this width can withstand 1 A and all inputs are fused at this value. The board is supplied by the cells it is monitoring, when the LV isn't active, the monitoring IC's enter the sleep mode, reducing their current consumption to 1.9 uA through the V+ pin.

<b>Company:</b> e-Tech Racing      www.e-techracing.es		
<b>Project:</b> AMS Slave <b>Variant:</b> [No Variations]		
<b>Size:</b> -	<b>Page Contents:</b> [1]SLAVE_HW.SchDoc	<b>Version:</b> 1
		<b>Department:</b> PCBs
<b>Author:</b> Andreu Senis      andreu.senis@estudiantatupc.edu		<b>Sheet</b> 1 <b>of</b> 5
<b>Checked by:</b>		<b>Date:</b> 04/04/2024



## Inputs

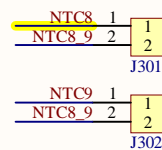


## Outputs

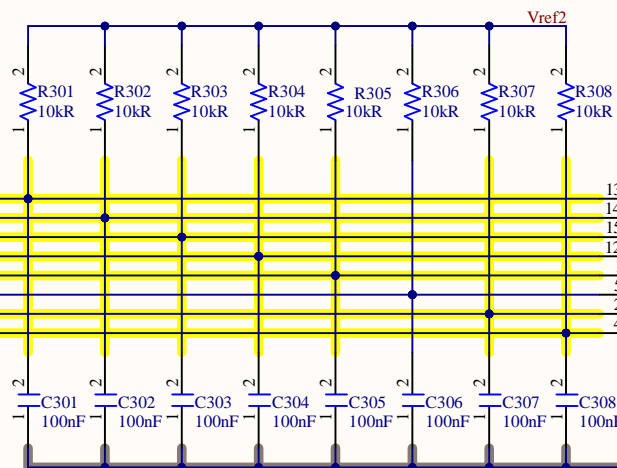
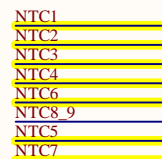


30% of the cells are monitored, using NTCs, each measuring 2 cells.  
30% · 700 / (2 cells per sensor · 15 slaves) = 7.

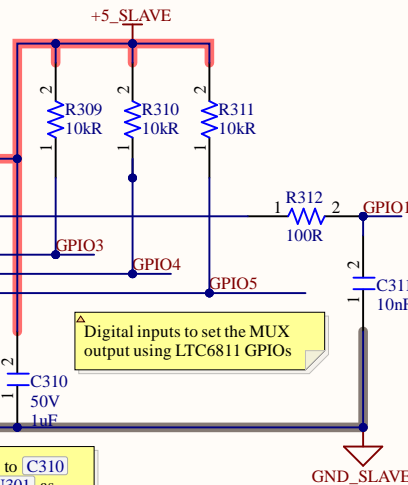
## Multiplexer



Jumpers in order to choose which NTC is read, either one in the stack or one in the balancing resistors

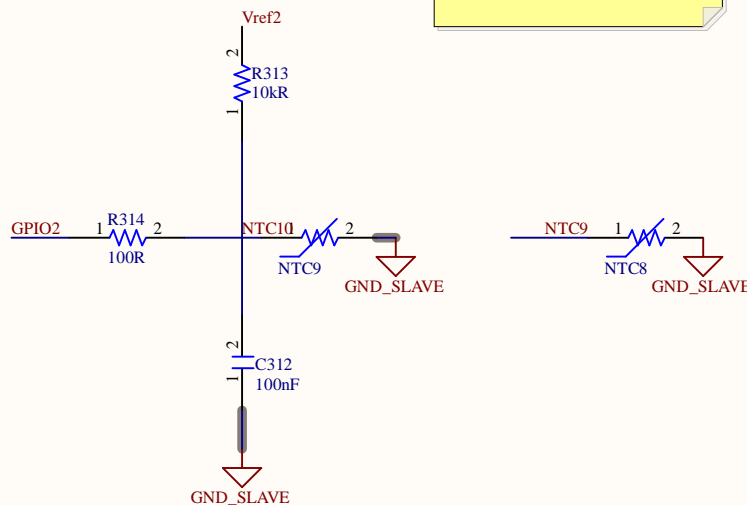


Place C301 to C310 as close to U301 as possible, while C311 and C312 as close to U201 as possible.



Digital inputs to set the MUX output using LTC6811 GPIOs

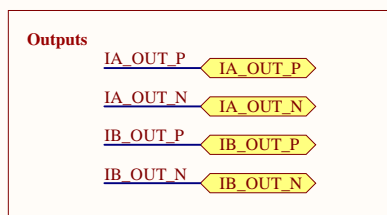
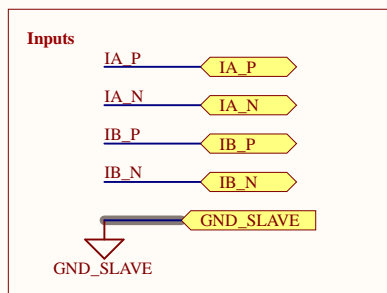
## Balancing NTCs



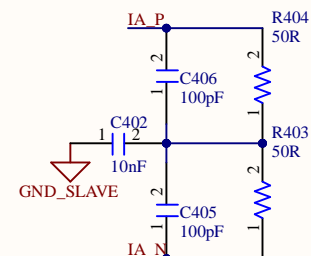
2 NTC are added to measure the balancing resistors temperature

Company: e-Tech Racing		www.e-techracing.es	
Project: AMS Slave		Variant: [No Variations]	
Size:	Page Contents:		Version: 1
-	{3}Temperatures.SchDoc		Department: PCBs
Author: Andreu Senis		andreu.senis@estudiantat.upc.edu	
Checked by:		Date: 04/04/2024	
Sheet 4 of 5			

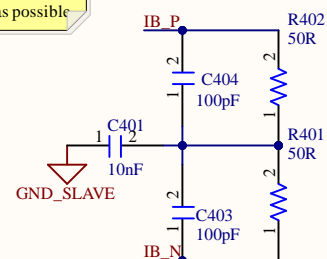




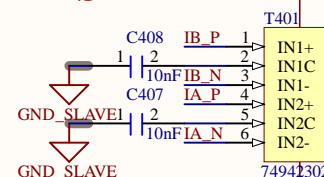
## Isolation



Place C403, C404, C405 and C406 as close to U201 as possible



## TS




TS and LV must be separated by 4 mm over surface and coated

## LV

isoSPI traces should be as direct as possible and isolated from the rest of the circuitry by ground metal or space. No traces should cross the isoSPI signal lines unless separated by a ground plane or an inner layer.

Place T401, less than 2cm away from J103 and J104. U201 should be close but at least 1-2 cm away from the

A V- plane should not extend under T401, J103, J104 or between them.

Company: e-Tech Racing		www.e-techracing.es		
Project: AMS Slave		Variant: [No Variations]		
Size: -	Page Contents: [4]Communication.SchDoc			Version: 1
				Department: PCBs
Author: Andreu Senis andreu.senis@estudiantat.upc.edu				Sheet 5 of 5
Checked by:				Date: 04/04/2024





Comment	Description	Designator	Footprint	LibRef	Quantity
885012207122	Cap Cer 10000PF 100V X7R 0805	C200, C201, C202, C203, C204, C205, C206, C207, C208, C209, C210, C211, C212, C213, C214, C215, C216, C217, C218, C219, C220, C221, C222, C223, C224, C229, C231, C311, C401, C402, C407, C408	C0805FNPC-R	C10n-100V-0805FNPC- X7R	32
885012207103	Multilayer Ceramic Capacitor, Wcap-Csgp Series, 1 F, 10%, X7R, 50 V, 0805 [2012 Metric] RoHS Compliant: Yes	C225, C226, C227, C310	C0805FNPC-R	C1u-50V-0805FNPC- X7R	4
885012207128	0.1µF ±10% 100V Ceramic Capacitor X7R 0805 [2012 Metric]	C228, C230, C301, C302, C303, C304, C305, C306, C307, C308, C312	C0805FNPC-R	C100n-100V- 0805FNPC-X7R	11
885012007082	Cap Cer 100PF 100V COG/NPO 0805	C403, C404, C405, C406	C0805FNPC-W	C100p-100V- 0805FNPC-COG/NPO	4
150080YS75000	2 V Yellow LED 2012 (0805) SMD, Wurth Elektronik WL-SMCW 150080YS75000	D200, D201, D202, D203, D204, D205, D206, D207, D208, D209, D210, D211	LED_0805_WE	LEDYS-0805-120	12
61301311121	THT Vertical Pin Header WR-PHD, Pitch 2.54 mm, Single Row, 13 pins	J101	J_Pinheader_1x13	J_Pinheader_1x13	1
61301211121	THT Vertical Pin Header WR-PHD, Pitch 2.54 mm, Single Row, 12 pins	J102	J_Pinheader_1x8	J_Pinheader_1x8	1
436500215	Header 1 Row Vertical Polarizing Peg 2 Pin SMT/Glow Wire Compatible Tin Plate	J103, J104	J_MicroFit_2x1	J_MicroFit_2x1	2
61300211121	CONN HEADER 2 POS 2.54	J301, J302	J_Pinheader_1x2	J_Jumper	2
560 ohm		L200, L201, L202, L203, L204, L205, L206, L207, L208, L209, L210, L211, L212, L213, L214	L_Ferrite_bead_0805	L_Ferrite_bead_78285 3561	15
NTC_10KR		NTC8, NTC9	NTC_PCB	NTC_10KR	2
BSS308PE	Infineon's highly innovative OptiMOS™ families include p- channel power MOSFETs, SOT-23-3, RoHS	Q201, Q202, Q203, Q204, Q205, Q206, Q207, Q208, Q209, Q210, Q211, Q212	TRT-PCH-2/30-BSS	TRT-PCH-2/30-BSS	12
NSV1C201	NPN Ic~2A Vceo=100V hfe=40~360 P=800mW	Q213	TRT-NPN-2/100- SOT23_1	TRT-NPN-2/100- SOT23	1
CR0805-FX-4700GLF	Res Thick Film 0805 470 Ohm 1% 1/8W ±100ppm/°C Molded SMD SMD Paper Tape on Plastic Reel	R200, R201, R202, R203, R204, R205, R206, R207, R208, R209, R210, R211	R0805FTK	R470-0805FTK	12
352115RFT	Res Thick Film 2512 15 Ohm 1% 2W ±100ppm/°C Pad SMD T/R	R212, R213, R214, R215, R216, R217, R218, R219, R220, R221, R222, R223	R2512FTK	R15-2512FTK	12
CR0805-FX-1000ELF	Res Thick Film 0805 100 Ohm 1% 1/8W ±100ppm/°C Molded SMD SMD Paper Tape on Plastic Reel	R224, R225, R226, R227, R228, R229, R230, R231, R232, R233, R234, R235, R236, R237, R252, R312, R314	R0805FTK	R100-0805FTK	17
CR0805-JW-102ELF	Res Thick Film 0805 1K Ohm 5% 1/8W ±200ppm/°C Molded SMD SMD Paper Tape on Plastic Reel	R238, R239, R240, R241, R242, R243, R244, R245, R246, R247, R248, R249, R250, R251	R0805FTK	R1k-0805FTK	14
CR0805-JW-103ELF	BOURNS CR0805- JW-103ELF Surface Mount Chip Resistor, Thick Film, CR Series, 10 kohm, 125 mW, 5%, 150 V	R301, R302, R303, R304, R305, R306, R307, R308, R309, R310, R311, R313	R0805FTK	R10k-0805FTK	12
50R	Res Thick Film 0805 50 Ohm 1% 0.125W(1/8W) ±100ppm/°C Pad SMD Automotive T/R	R401, R402, R403, R404	R0805FTK	R50-0805FTK_1	4
74942302		T401	TFMR_74942302	TFMR_4300V_1min_7 4942302	1
LTC6811-1	Sc-Automotive Multicell Battery Stack Monitor With Addressable I2SopI Interface	U201	U_LTC6811G-2	U_LTC6811-1	1
CD4051B-Q1	CD4051B-Q1 Automotive Cmos Tripl	U301	CD4051B-Q1	CD4051B-Q1	1