

ELECTRICAL SAFETY FORM

Part 1

Version: 2



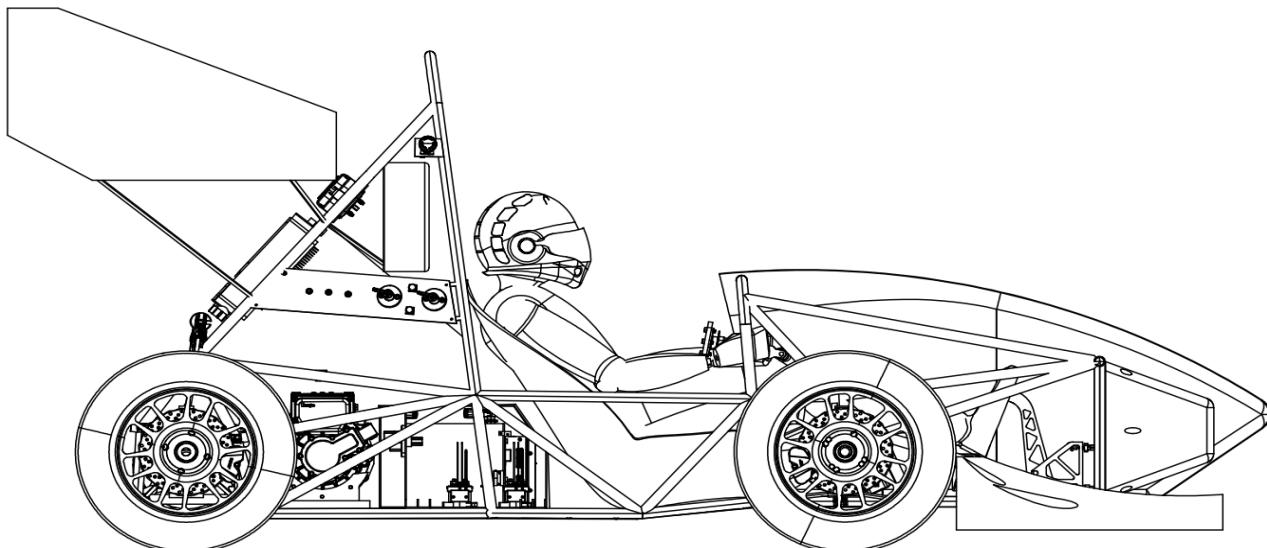
CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------



Electrical Safety Form FB2025

IITK Motorsports

E13



Indian Institute of Technology

Kanpur

Contact:

Tanmay Soni +91 8949072236
Rishi Baghel +91 7225043669

ELECTRICAL SAFETY FORM

Part 1

Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------

Contents

Shutdown Circuit	4
General Information	4
Accumulator Isolation Relay	4
AMS and IMD	4
Inertia Switch	4
Shutdown Buttons	4
Interlocks	5
BOTS	5
Additional Action to close Shutdown Circuit	5
CAD Rendering	6
Schematic	6
Datasheet	6
Master Switches	7
General Information	7
CAD Rendering	7
Datasheets	7
BSPD	8
General Information	8
CAD Rendering	8
Schematic	8
Datasheets	8
Precharge Circuit	9
General Information	9
CAD Rendering	9
Schematic	9
Datasheets	9
Discharge Circuit	11
General Information	11
CAD Rendering	11
Schematics	11
Datasheets	11
TSAL	13
General Information	13
CAD Rendering	13
Schematics	13
Datasheets	13
Measuring Point	14
General Information	14
CAD Rendering	14
Schematic	14

ELECTRICAL SAFETY FORM

Part 1

Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------

Datasheets	14
Grounding	16
General Information	16
Datasheets	16
Firewall	17
General Information	17
CAD Rendering	17
Datasheets	17
Energy Metre / Data Logger	18
General Information	18
CAD Rendering	18
Ready to Drive	19
General Information	19
CAD Rendering	19
Schematics	19
Datasheets	20
Torque Encoder	21
General Information	21
CAD Rendering	21
Schematics	21
Datasheets	21
Low Voltage Supply	22
General Information	22
CAD Rendering	22
Datasheets	22
Abbreviations	
Changelog	

ELECTRICAL SAFETY FORM

Part 1

Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------

Shutdown Circuit

General Information

Accumulator Isolation Relay

Attributes	Comment (Team)
Accumulator Isolation Relay	Datasheet Littlefuse DCNHR250QFA
Nominal Coil Current	Value: 0.25A
Nominal Coil Voltage	Value: 12V DC
Total Number of AIRs	Value: 2
Additional part consumption (Addition load drawing current from shutdown path)	Load 1 Value: 0.25A approx.
Total current through the shutdown path	Value: 0.75A (approx. theorised)
All power stage are able to handle the max load current	Yes
The voltage drop across all power stage is small enough to maintain voltage requirement	Yes

AMS and IMD

Attributes	Comment (Team)
AMS is in accordance with EV5.8	Yes
Show how the AMS is able to open the shutdown circuit, Latches and drive the AMS indicator light	Schematics
All signal influencing Shutdown circuit, Indicators are SCS	Yes
Show how the IMD is able to open the shutdown circuit, Latches and drive the IMD indicator light	Schematics

ELECTRICAL SAFETY FORM

Part 1

Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------

IMD Type	Datasheet
IMD is in accordance with EV6.3	Yes
Response Value	500*96V (Max TS Voltage) = 48000Ω
All signal influencing Shutdown circuit, Indicators are SCS	Yes

Inertia Switch

Attributes	Comment (Team)
Inertia Switch Type	Datasheet
Inertia Switch Should be directly acting. External Relay circuit are prohibited	Yes

Shutdown Buttons

Attributes	Comment (Team)
Shutdown Buttons	Datasheet
Outer Diameter (mm)	Value: 40mm
One button must be located on each side of the vehicle behind the driver's compartment at approximately the level of the driver's head. The minimum allowed diameter of the shutdown buttons on both sides of the vehicle is 40 mm. The buttons must be easily reachable from outside the vehicle.	Yes
Cockpit's Shutdown Button	Datasheet
Outer Diameter (mm)	Value: 30mm
One shutdown button serves as a cockpit-mounted shutdown button and must <ul style="list-style-type: none"> • have a minimum diameter of 24 mm • be located in easy reach of a belted-in driver 	Yes

ELECTRICAL SAFETY FORM

Part 1

Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------

<ul style="list-style-type: none"> be alongside of the steering wheel and unobstructed by the steering wheel or any other part of the vehicle 	
The international electrical symbol consisting of a red spark on a white-edged blue triangle must be affixed in close proximity to each shutdown button.	Yes
Shutdown buttons must be rigidly mounted to the vehicle and must not be removed during maintenance.	Yes

Interlocks

Attributes	Comment (Team)
Every TS connector outside of a housing must include a pilot contact/interlock line which is part of the shutdown circuit. Housings only used to avoid interlocks are prohibited.	Yes
High Voltage Disconnect	Datasheet
High Voltage Connector for Accumulator	Datasheet
Interlock 2 (Used at)	Datasheet

BOTS

Attributes	Comment (Team)
BOTS	Datasheet
A brake pedal over-travel switch must be installed on the vehicle as part of the shutdown circuit. This switch must be installed so that in the event of a failure in at least one of the brake circuits the brake pedal over-travel will result in the shutdown circuit being opened. This must function for all possible brake pedal and brake balance settings without damaging any part of the vehicle. Repeated actuation of the switch must not close the shutdown circuit, and it must be designed so that the driver cannot reset it. The brake over travel-switch must be a mechanical single pole, single throw switch, commonly known as a two-position switch, push-pull or flip type; it may consist of a series connection of switches.	Yes

ELECTRICAL SAFETY FORM

Part 1

Version: 2

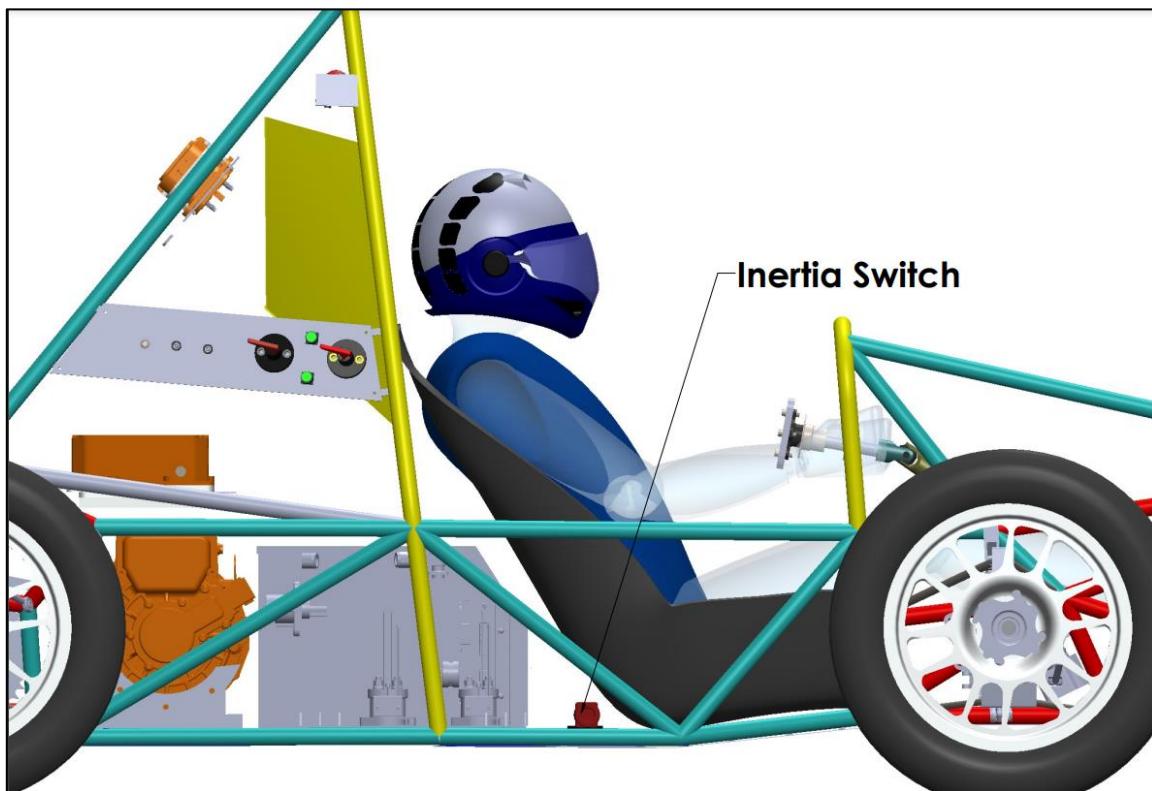


CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------

Additional Action to close Shutdown Circuit

Attributes	Comment (Team)
Show how the additional logic is able to close the shutdown	Schematics
Closing the shutdown circuit by any part defined in EV7.1.2 must not (re-)activate the tractive system. Additional action must be required.	Yes

CAD Rendering



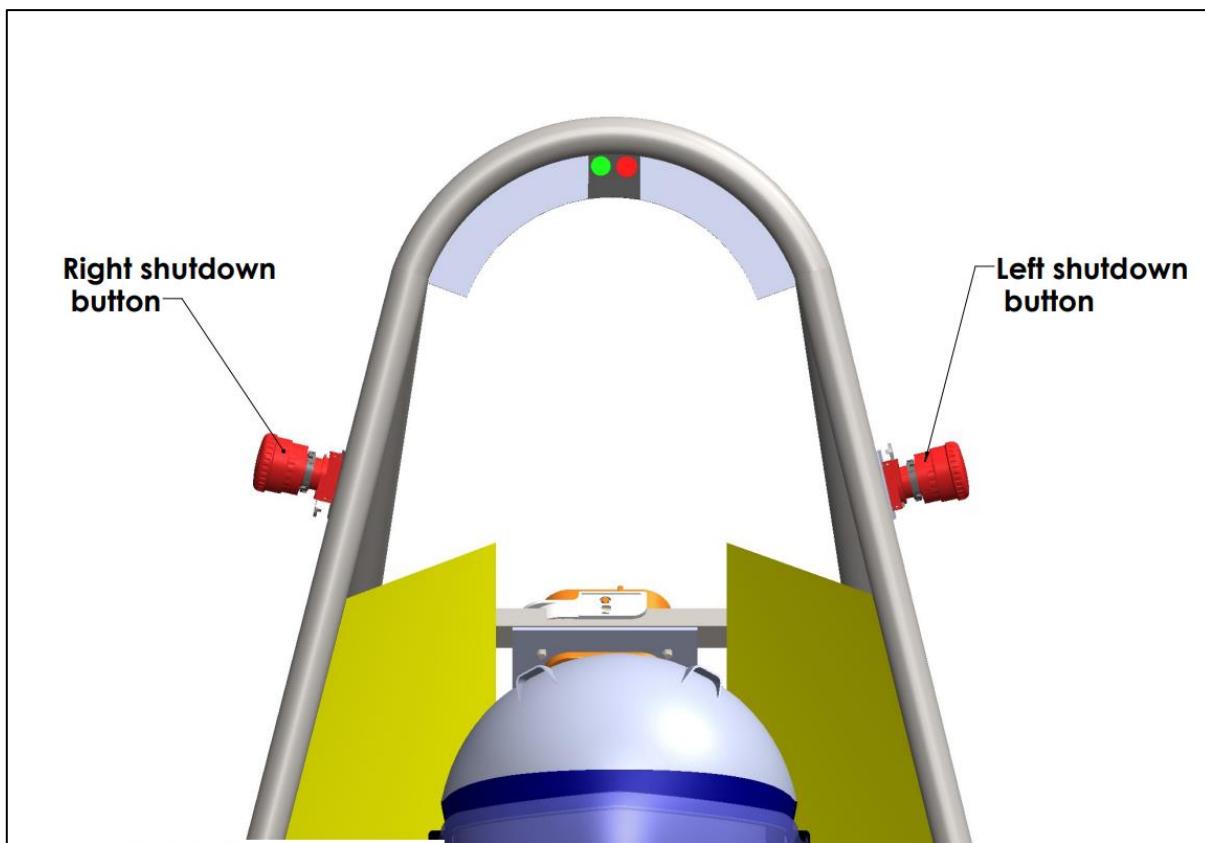
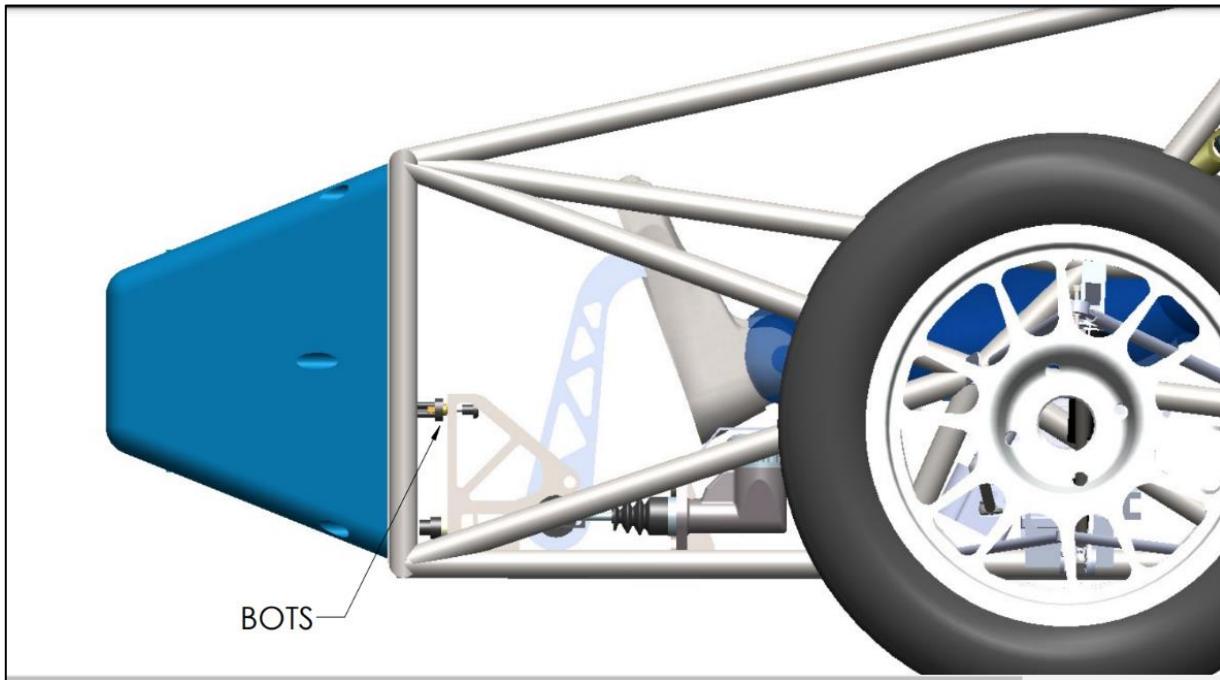
ELECTRICAL SAFETY FORM

Part 1

Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------



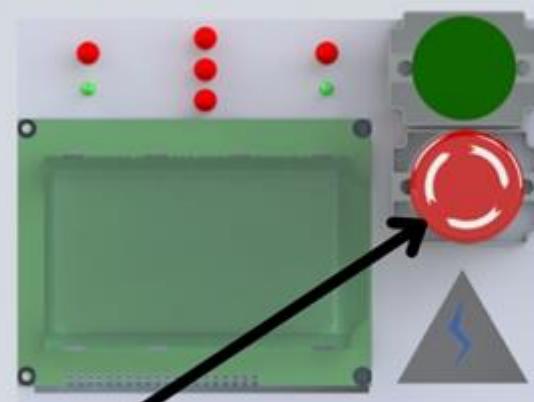
ELECTRICAL SAFETY FORM

Part 1

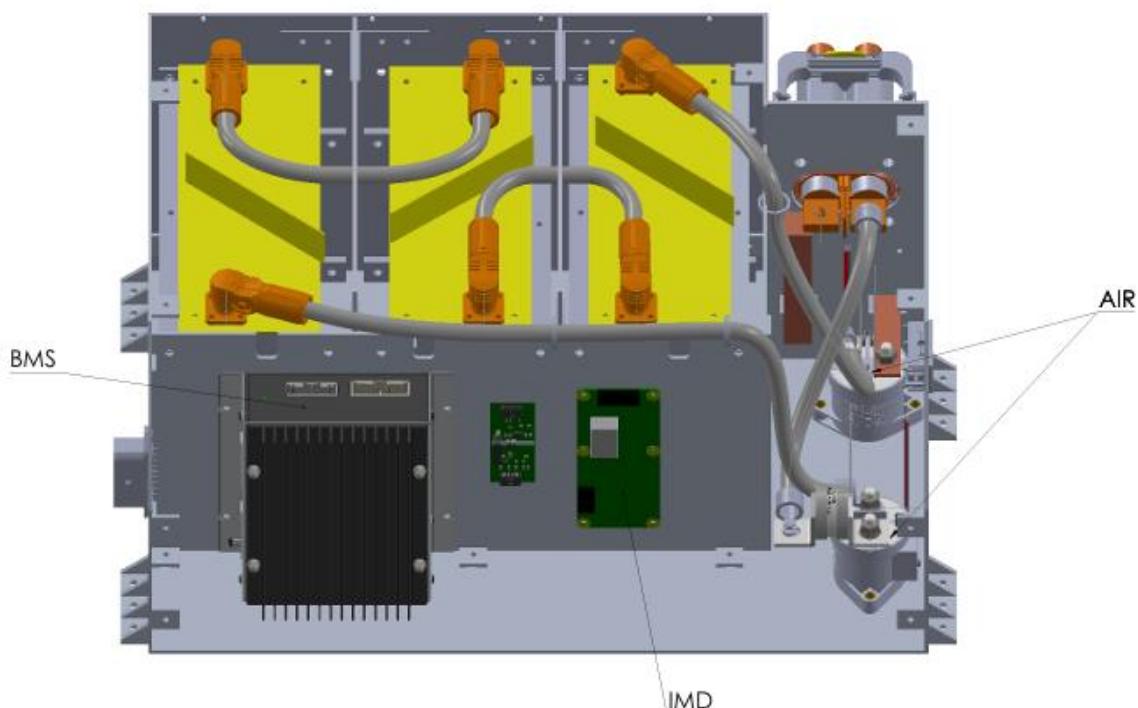
Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------



Cockpit Shutdown Button



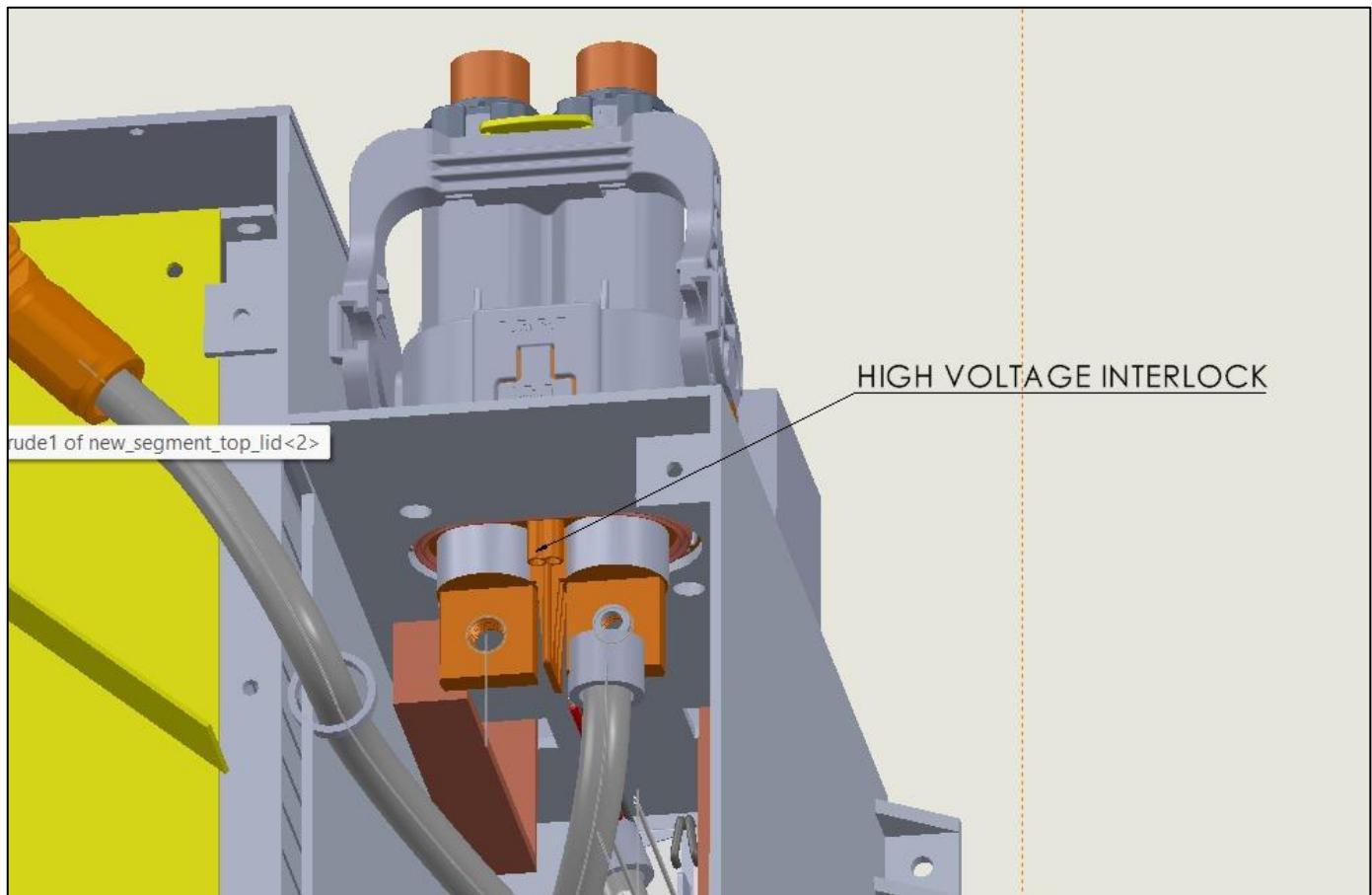
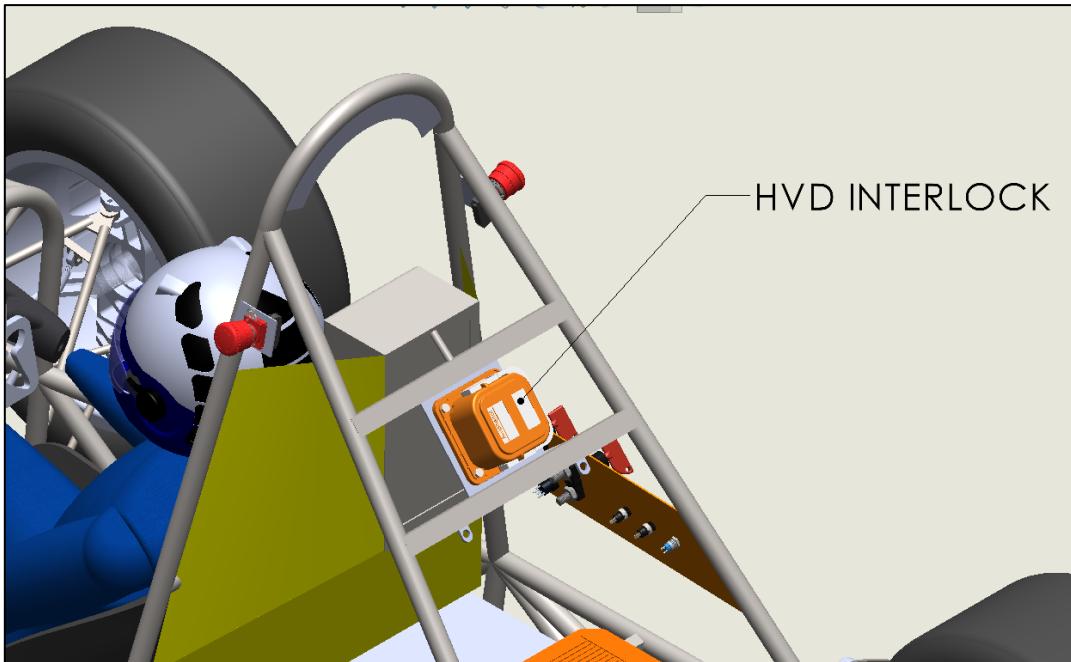
ELECTRICAL SAFETY FORM

Part 1

Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------



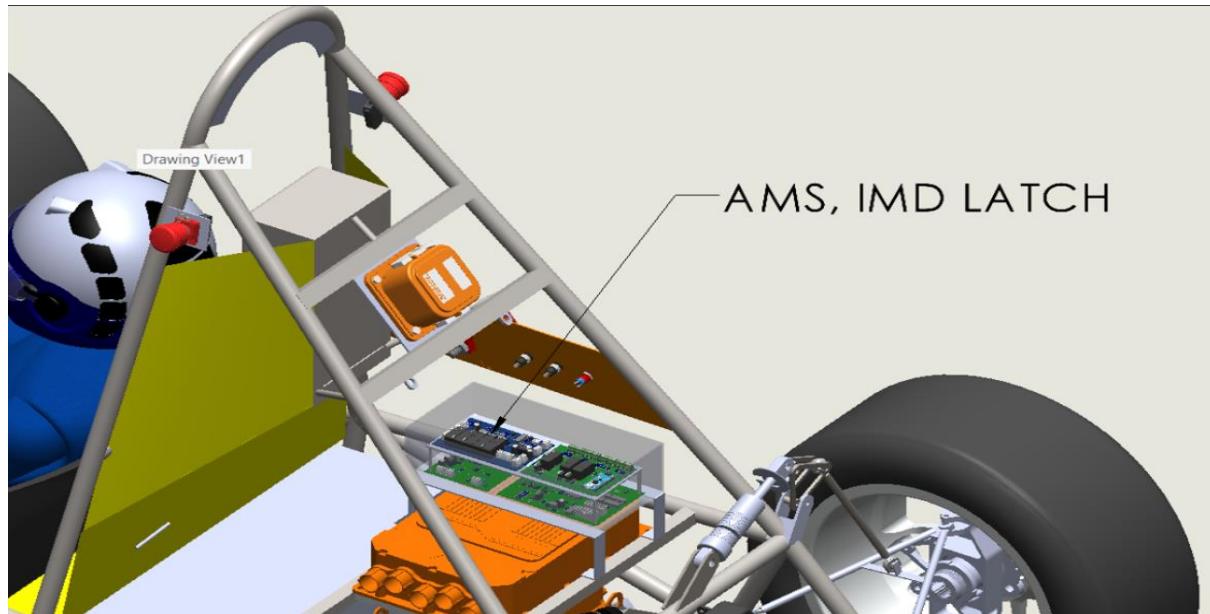
ELECTRICAL SAFETY FORM

Part 1

Version: 2



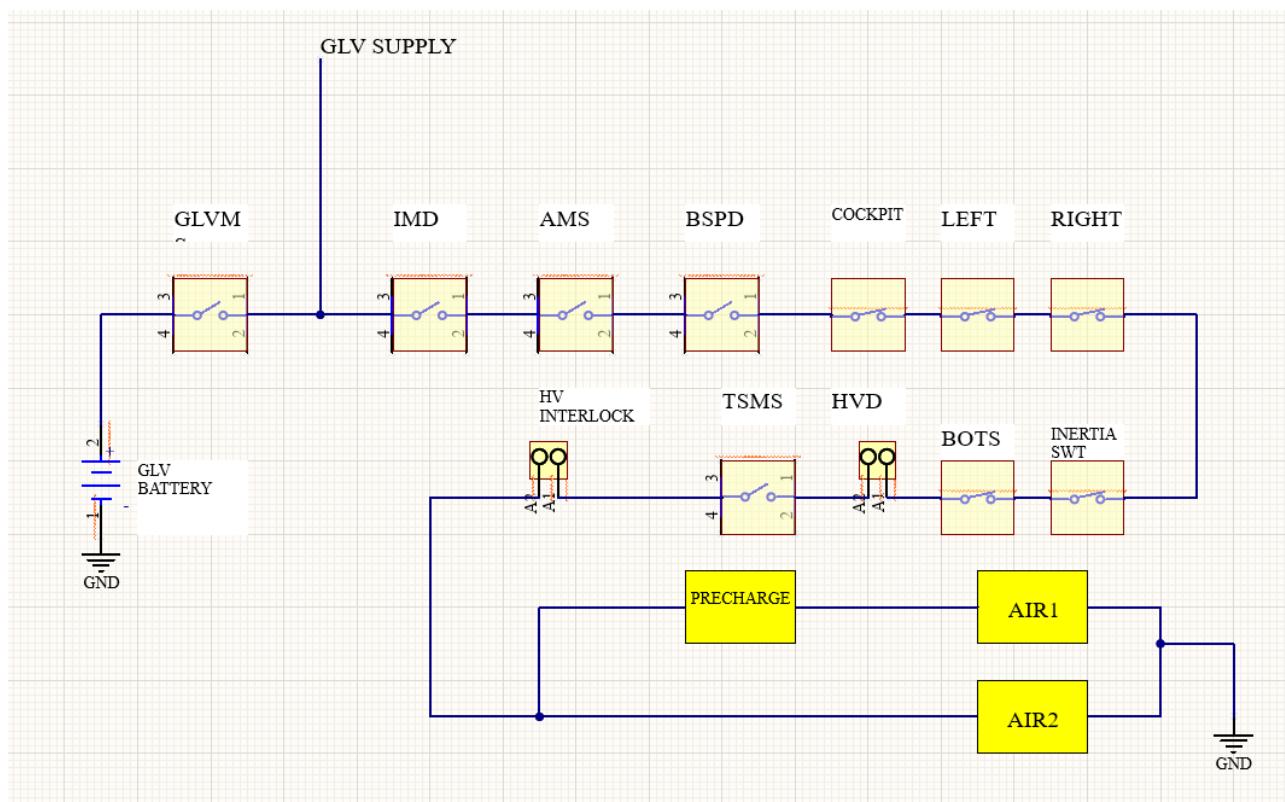
CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------



Schematic

- Full Shutdown Path/Component (Refer figure 21) from Rulebook

Schematic



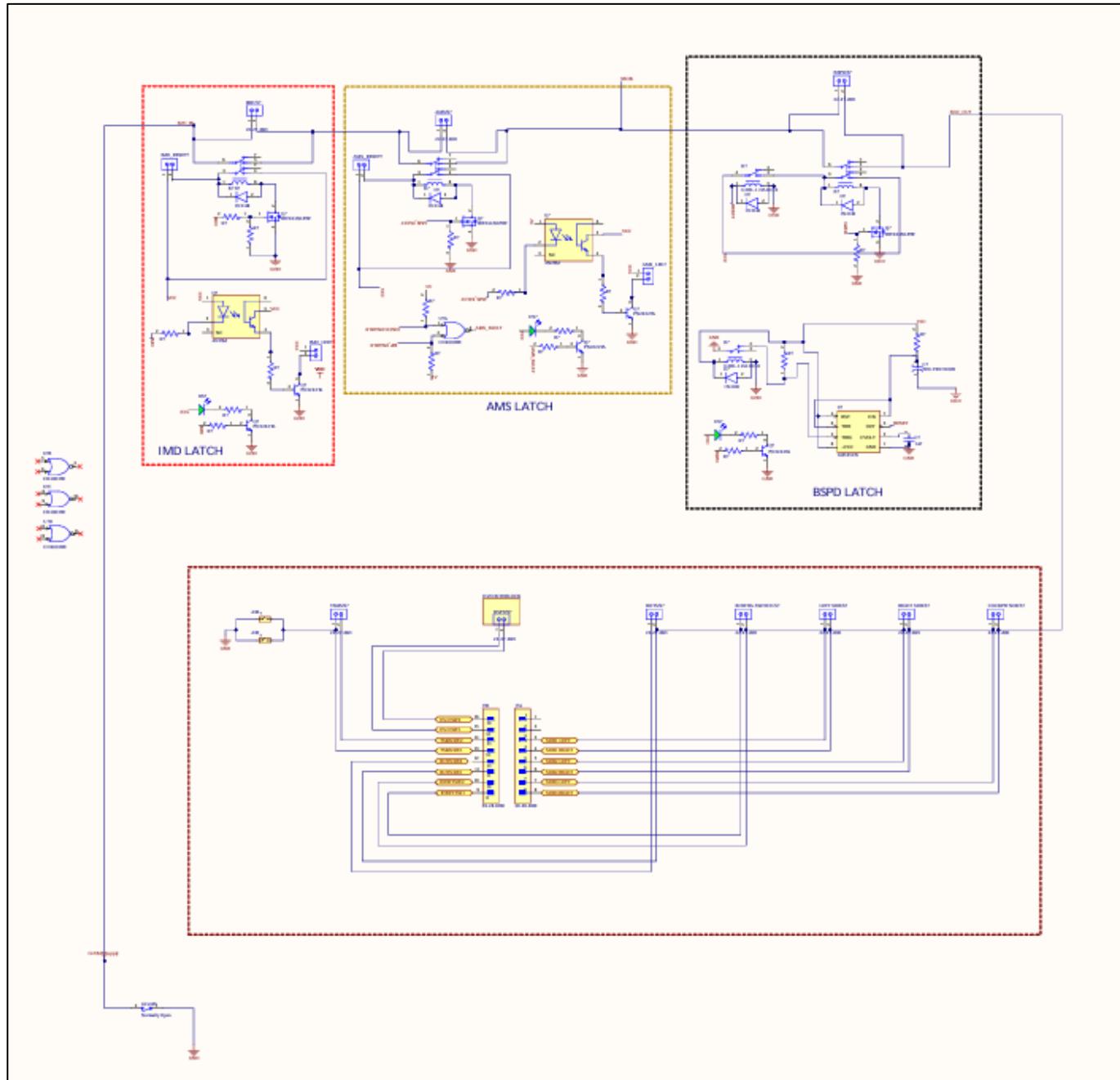
ELECTRICAL SAFETY FORM

Part 1

Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------



ELECTRICAL SAFETY FORM

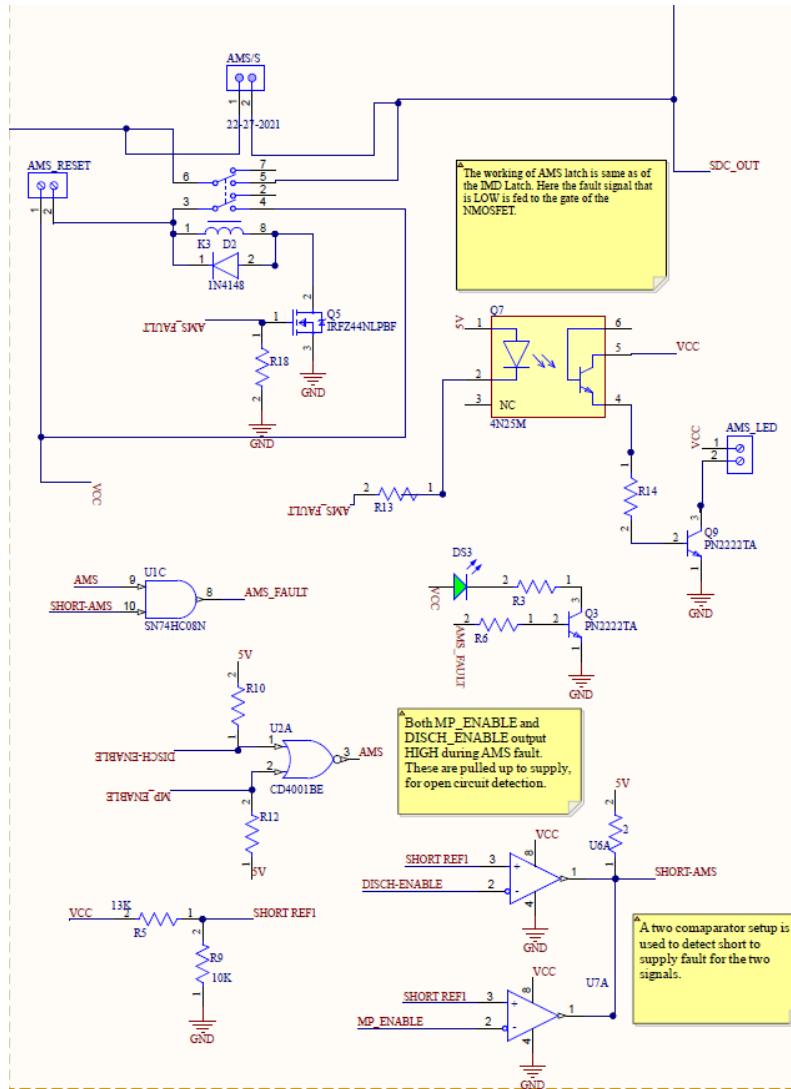
Part 1

Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------

- AMS and IMD Latching Circuits



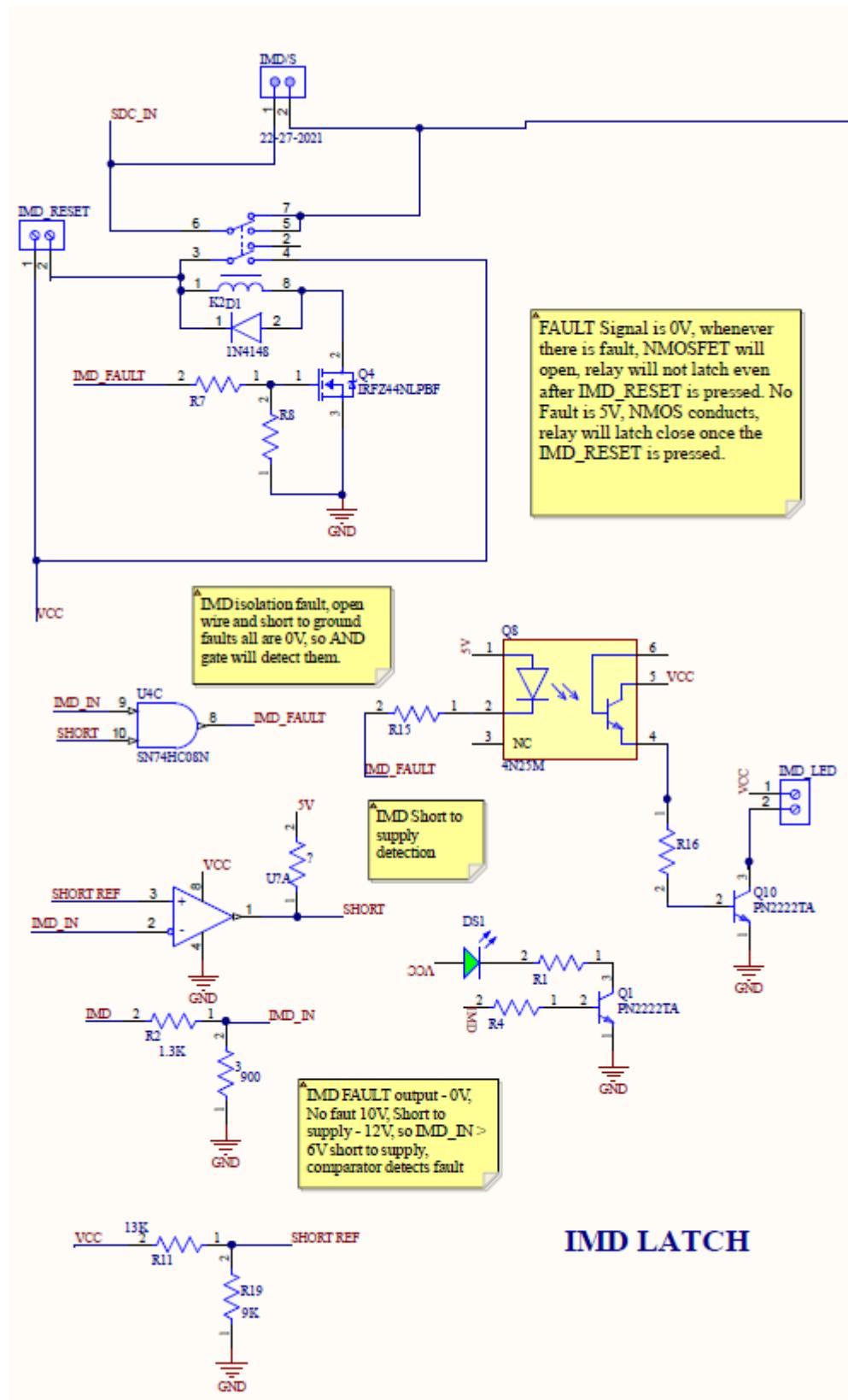
ELECTRICAL SAFETY FORM

Part 1

Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------



ELECTRICAL SAFETY FORM

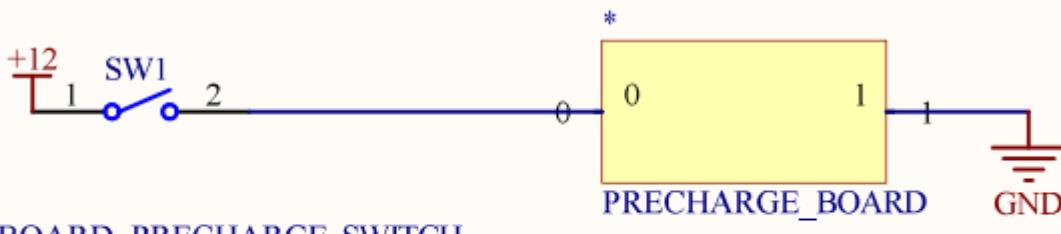
Part 1

Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------

Additional Action Logic Circuits



Datasheet

1. AIR: DCNHR250QFA

Specifications

Max Voltage Rating (V DC): 900

Current Rating Continuous (A): 20-500

Ingress Protection: 20-100: IP67
150-300: Main contacts IP67
PWM circuit IP54

Operating Temperature (°C): -40 to +85

Approvals:

UL File Number: E47258 Recognized

CE: EN 60947-4-1, 2018

COIL DATA				
Voltage Rating (V DC)	12	24	48	9-36
DCNHR20,DCNHR30 DCNHR40	9	18	36	/
DCNHR50, DCNHR100	8.4	16.8	33.6	/
DCNHR150, DCNHR200 DCNHR250, DCNHR300	/	/	/	9
DCNHR20,DCNHR30 DCNHR40	1	2	4	/
DCNHR50, DCNHR100	1	2	4	/
DCNHR150, DCNHR200 DCNHR250, DCNHR300	/	/	/	6
DCNHR20,DCNHR30 DCNHR40	0.3	0.15	0.073	/
DCNHR50, DCNHR100	0.51	0.26	0.13	/
DCNHR150, DCNHR200 DCNHR250, DCNHR300	/	/	/	0.25@12V DC
DCNHR20, DCNHR30 DCNHR40	3.5	3.5	3.5	/
DCNHR50, DCNHR100	6.5	6.5	6.5	/
DCNHR150, DCNHR200 DCNHR250, DCNHR300	/	/	/	Start Up/Hold 45/3

AIR Datasheet

ELECTRICAL SAFETY FORM

Part 1

Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------

2. IMD: ISOMETER IR155-3203/IR155-3204

Insulation coordination acc. to IEC 60664-1		Measuring range
Protective separation (reinforced insulation)		0...10 MΩ
between (L+/L-) – (Kl. 31, Kl. 15, E, KE, M_{HS} , M_{LS} , OK_{HS})		
Voltage test	AC 3500 V/1 min	Undervoltage detection 0...500 V default setting: 0 V (inactive)
Supply/IT system being monitored		Relative uncertainty SST (≤ 2 s) good $> 2 * R_{an}$; bad $< 0.5 * R_{an}$
Supply voltage U_S	DC 10...36 V	Relative uncertainty DCP (default setting 100 kΩ) 0...85 kΩ ▶ ±20 kΩ
Max. operating current I_S	150 mA	(100 kΩ...10 MΩ ▶ ±15%)
Max. current I_k	2 A	Relative uncertainty output M (fundamental frequency) ±5 % at each frequency (10 Hz; 20 Hz; 30 Hz; 40 Hz; 50 Hz)
HV voltage range (L+/L-) U_h	AC 0...1000 V (peak value) 0...660 V RMS (10 Hz...1 kHz)	Relative uncertainty undervoltage detection $U_h \geq 100$ V ▶ ±10 %; at $U_h \geq 300$ V ▶ ±5 %
Power consumption	DC 0...1000 V < 2 W	Relative uncertainty (SST) "Good condition" $\geq 2 * R_{an}$ "Bad condition" $\leq 0.5 * R_{an}$

IMD Datasheet

Features:

- Unique magnet restrained mass inertia mechanism
- Rated at 10 Amps electrical load
- Manually resettable

- Shock calibration ranges available between 8g and 30g
- Stops fuel pump or electrical system operation
- Secondary circuit provides additional function

3. Inertia Switch: SENSATA RESETTABLE CRASH SENSOR

Inertia Switch Datasheet

4. Shutdown Buttons

ELECTRICAL SAFETY FORM

Part 1

Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------

Mechanical Characteristics:

Function indicator		Front viewing: Arrow marking provided on knob
Terminal Capacity		: NA
Terminal marking		: NA
Terminal Torque	Nm	: NA
Contact material		: NA
Operation		: NA
Operating torque	Nm	: 0.3
Operating force	N	: 14-20
Positive operation		: NA
Conforming to IEC/EN 60947-5-1 Appendix K		
Operating travel	mm	: 5
Mechanical life		: 0.1million operations
Ambient	°C	: -40 to +70
Storage	°C	: -40 to +40
Overall Dimensions with sketch (LXBXH)	mm	:
Vibration resistance	Hz	: 8g acceleration; frequency 40-500Hz
Conforming to IEC 60068-2-6		
Shock resistance		: 3 shocks at 15g acceleration & 11ms; total 18 shocks
Conforming to IEC 60068-2-27		
Viewing Angle	°	: NA
Optical Axial intensity	mcd	: NA
Weight	gms	: Actuator: 64 Pushbutton: 64 +10 for every single element

[Shutdown Buttons Datasheet](#)

5. Cockpit Shutdown Buttons

Mechanical Characteristics:

Function indicator		Front viewing: Arrow marking provided on knob
Terminal Capacity		: NA
Terminal marking		: NA
Terminal Torque	Nm	: NA
Contact material		: NA
Operation		: NA
Operating torque	Nm	: 0.3
Operating force	N	: 14-20
Positive operation		: NA
Conforming to IEC/EN 60947-5-1 Appendix K		
Operating travel	mm	: 5
Mechanical life		: 0.1million operations
Ambient	°C	: -40 to +70
Storage	°C	: -40 to +40
Overall Dimensions with sketch (LXBXH)	mm	:
Vibration resistance	Hz	: 8g acceleration; frequency 40-500Hz
Conforming to IEC 60068-2-6		
Shock resistance		: 3 shocks at 15g acceleration & 11ms; total 18 shocks
Conforming to IEC 60068-2-27		
Viewing Angle	°	: NA
Optical Axial intensity	mcd	: NA
Weight	gms	: Actuator: 64 Pushbutton: 64 +10 for every single element

[Cockpit Shutdown Buttons Datasheet](#)

6. Interlocks: AMPHENOL PCD SHENZHEN MSDF000F

ELECTRICAL SAFETY FORM

Part 1

Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------

WITH FUSE:	
Current rating	based on fuse selected
Voltage rating	690V AC
WITHOUT FUSE:	
Current rating	230A
Voltage rating	1000V DC max

APPLICATION:	
Battery manual service disconnect used for servicing PHEV system	
MECHANICAL:	
Durability	≥ 50 mating cycles
ELECTRICAL:	
Fuse specification	up to 630A

HVD Datasheet

APPLICATIONS	
xEV Battery	
Inverters	
Junction boxes	
Power distribution boxes	
MECHANICAL	
Durability	≥ 50 mating cycles
Wire range	25 to 70 mm ²
ELECTRICAL	
Rated voltage	1000V DC
Rated current	250A Max @ ambient temperature 70°C
Insulator resistance	> 200MΩ
Dielectric withstand voltage	3000V AC

ELECTRICAL SAFETY FORM

Part 1

Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------

HV Connector for Accumulator Datasheet

7. BOTS: SWITCH LONG THREAD A01-0322

SPECIFICATIONS OVERVIEW:

Positions	: 2 positions - Pressed (OFF), Pulled (ON)
Terminations	: 2 Screws
Voltage Rating	: 5A at 12v
Material	: Plastic and plated steel
Weight	: 25gms

BOTS Datasheet

Master Switches

General Information

Attributes	Comment (Team)
LVMS and TSMS Datasheet	Datasheet
Placement within Shutdown Path	Schematics
Accordance with T11.2, T11.3, EV6.2	Yes
Explain Tagout/Lockout mechanism for TSMS	Explanation: A Lockout tab with a keyhole is mounted near the OFF position of the Master Switches, also the Switch handles have a keyhole that matches the lockout tab, through which a tagout hook along with a padlock can be used to lock the Master Switch in OFF position with the lockout tab.

CAD Rendering

1. CAD Render should contain:

- Placement and positioning of master switches.
- Calculation and Height from ground for both master switches satisfying T 11.2.2
- All necessary marking and Background requirement
- ON/OFF orientation

ELECTRICAL SAFETY FORM

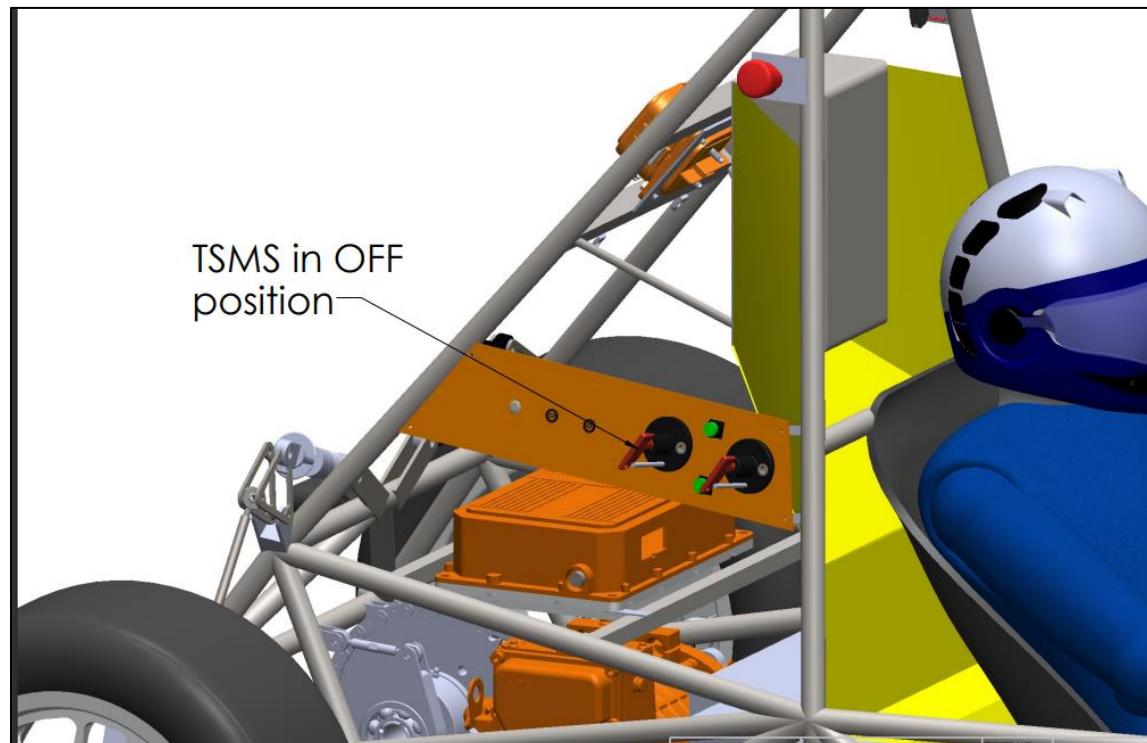
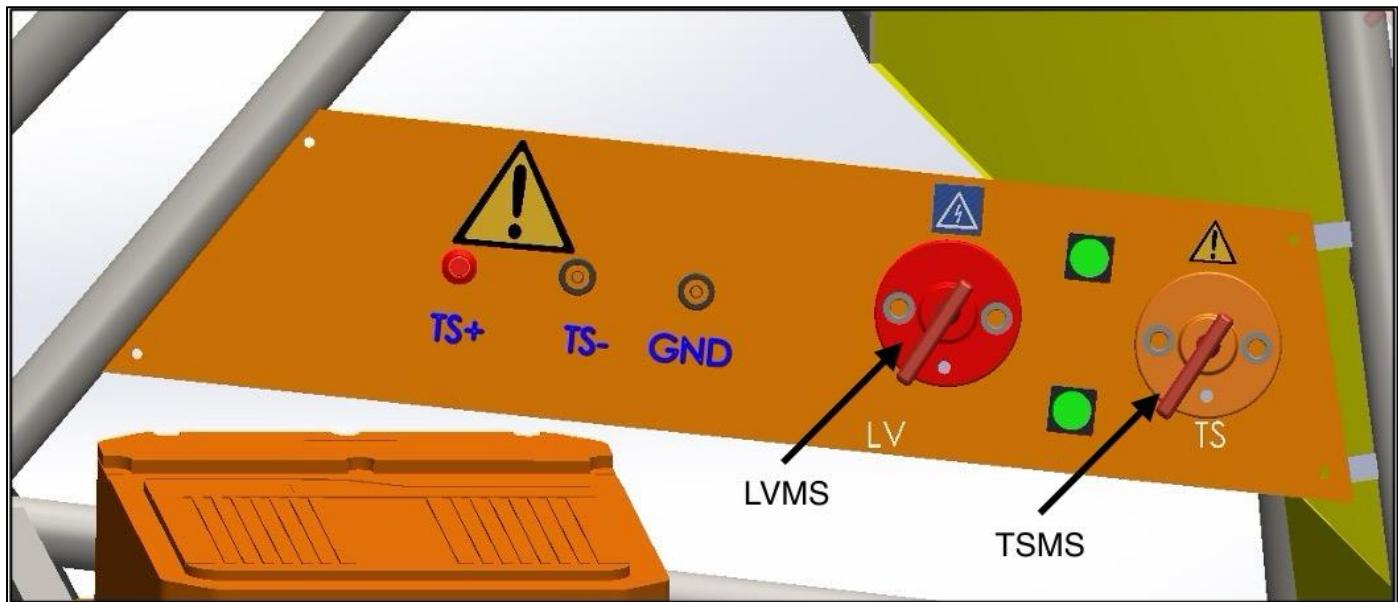
Part 1

Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------

- Lockout/Tagout capability



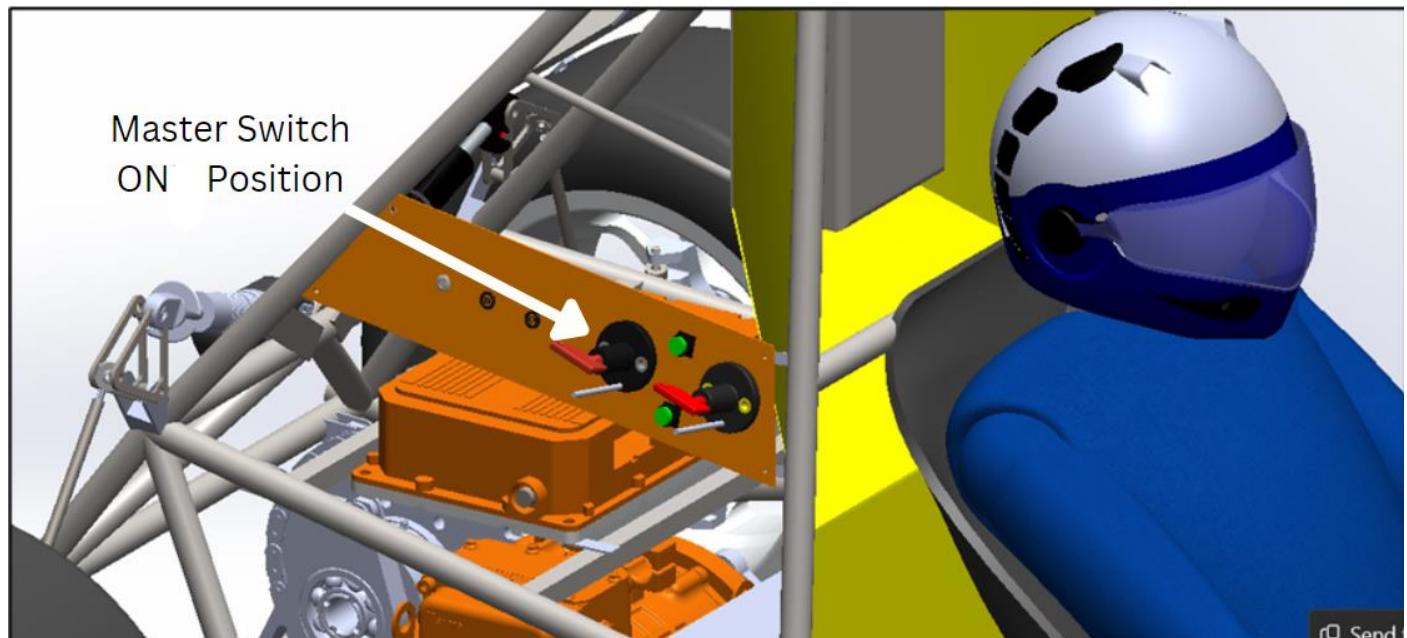
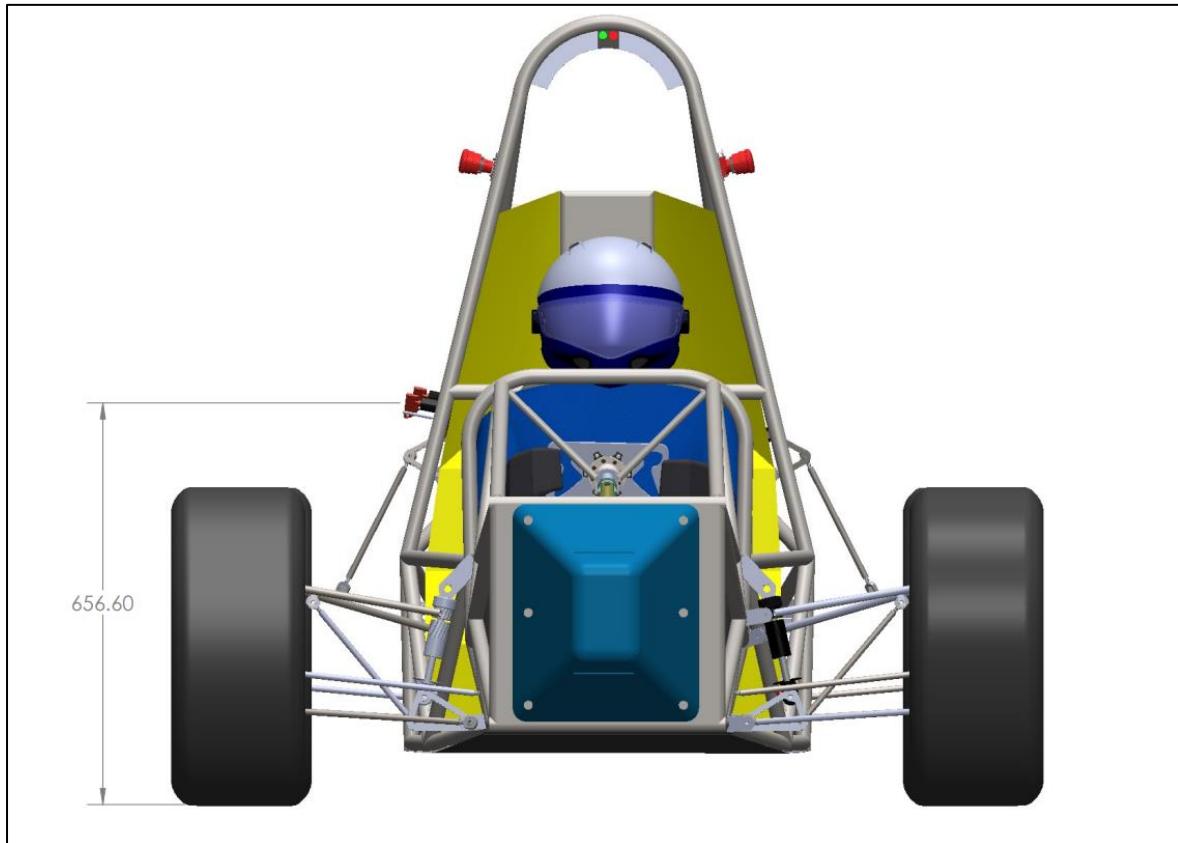
ELECTRICAL SAFETY FORM

Part 1

Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------



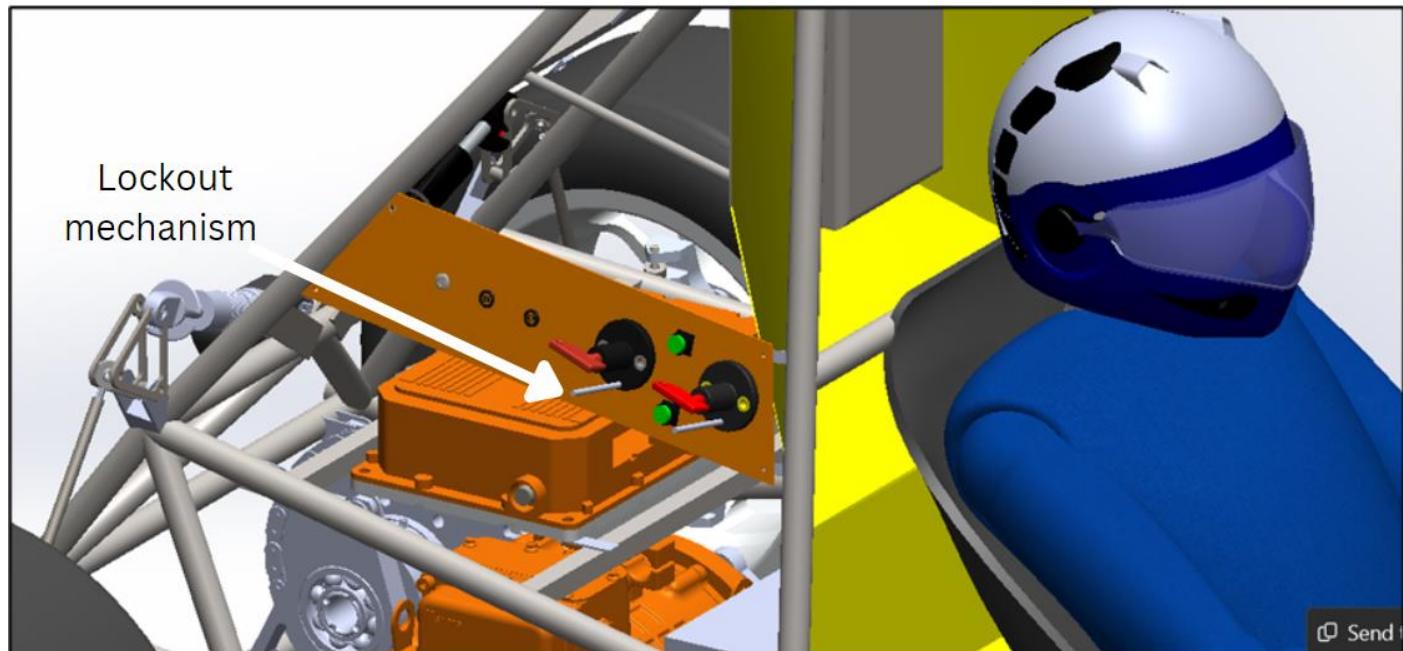
ELECTRICAL SAFETY FORM

Part 1

Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------



Send!

Tagout/Lockout Kit

Date	Correct as of 28th Jun 2019
Brand	Kasp
Product	K81300
Description	Electrical Lockout Kit
Barcode	5013969245325
Commodity code	8301500000
Country of origin	CN



Datasheet Master Switches

Details -	Features-
Brand - Hella	1. For battery main lead.
Material - Plastic	2. Connection to either positive or negative lead.
Category - Electricals	3. Switch key removable in 'off' position only.
Weight - 135 gms	4. Current supply interrupted when key removed.
CAD Available: Yes	5. M10 screw contacts.
Things Included -	6. 2 switch positions: 0= off, 1=on
1. Main Body x1	7. Max load:
2. Key x1	8. 1000A at 12V (10 sec.), 500A at 24V (10 sec).
3. M10 thin nut x 2	9. IP Rating: DIN 40 050 - IPX2
4. M10 Split Washers x 2	

ELECTRICAL SAFETY FORM

Part 1

Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------

Master Switch Datasheet

BSPD

General Information

Attributes	Comment (Team)
Schematics	Schematics
Datasheet of used Current Sensor	Datasheet
Datasheet of used Brake pressure Sensor	Datasheet
Accordance with T11.6.	Yes
All signals to follow SCS checks.	Yes
Current sensor output and its calculation which represent 5kW power	Sensor Output Value: 2.8255V Calculation: $I = 5\text{KW}/V_{max} = 52.08\text{A}$ $V = 2.5 + 0.625(1/100) V_{out} \text{ at } 52.08\text{A} = 2.8255\text{V}$
Brake pressure output and its calculation for BSPD pressure threshold which is below 30bar	Sensor Output Value: 2.9V Calculation: $V_{out} = V_{cc}(0.16(P) + 0.1)$ $P = 30\text{bar} = 3\text{MPa}$ $V_{cc} = 5.0\text{V}$ $V_{out} = 2.9\text{V}$

CAD Rendering

- Placement of Sensors (Current Sensor and Brake Pressure sensor)

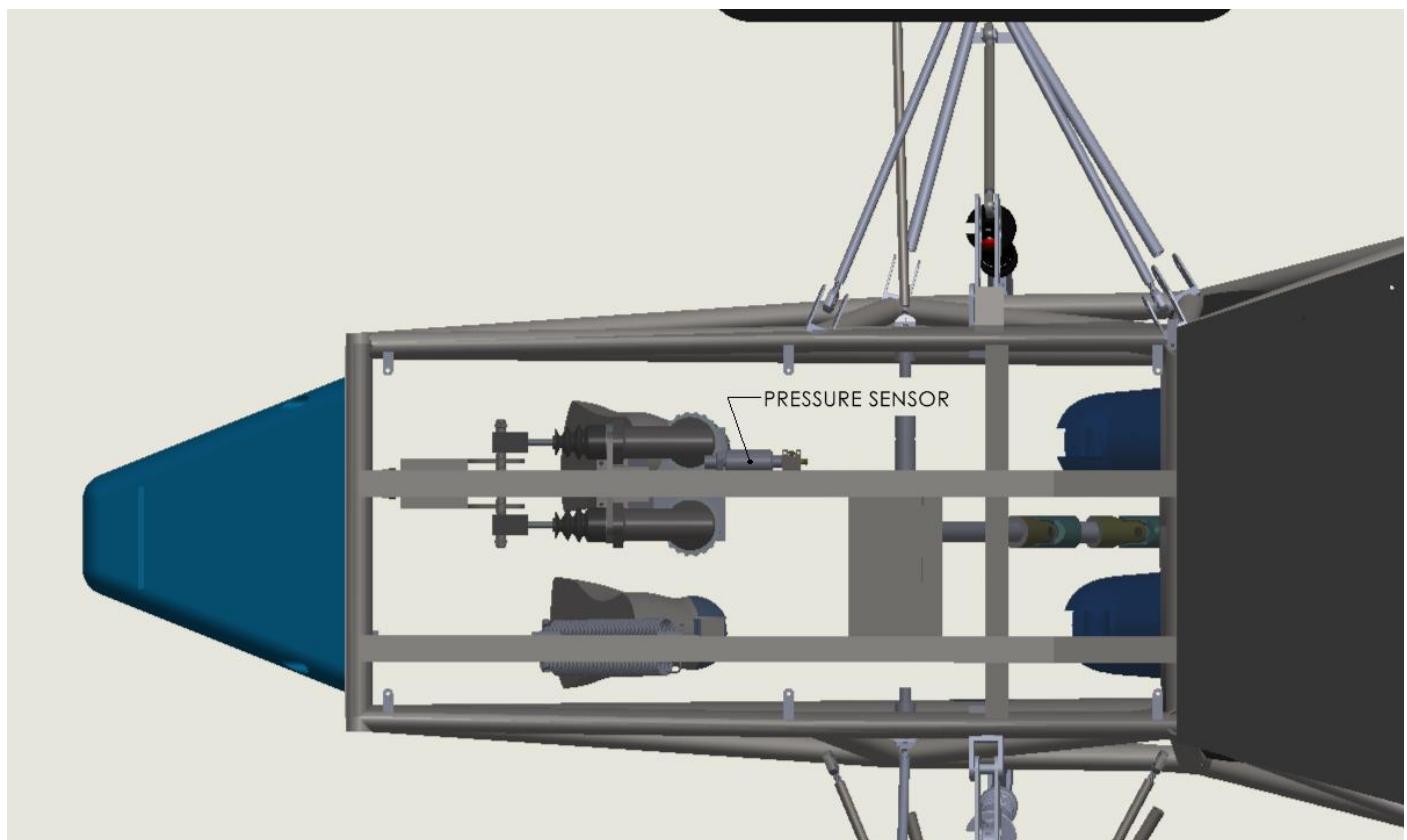
ELECTRICAL SAFETY FORM

Part 1

Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------



2. Placement of BSPD standalone board

Curiosum Tech Private Limited

Released: August 2, 2023

24/68

Revised: July 9, 2024 S.S.

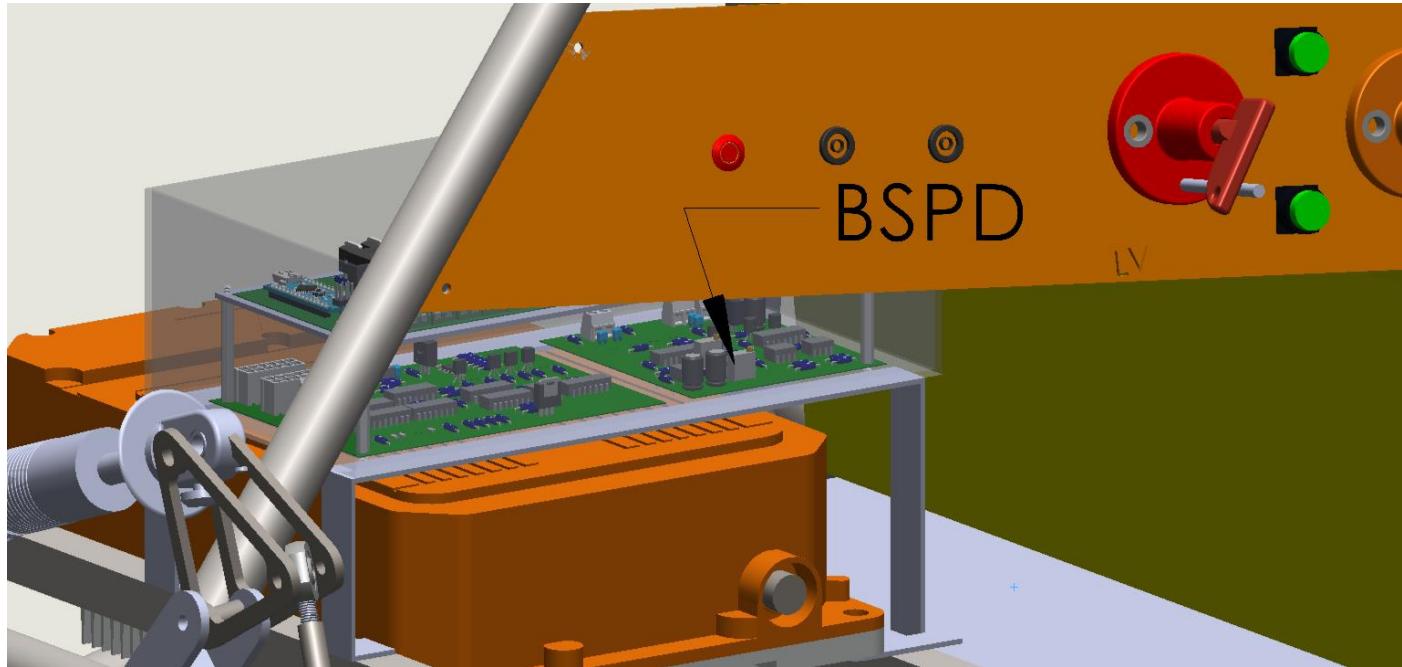
ELECTRICAL SAFETY FORM

Part 1

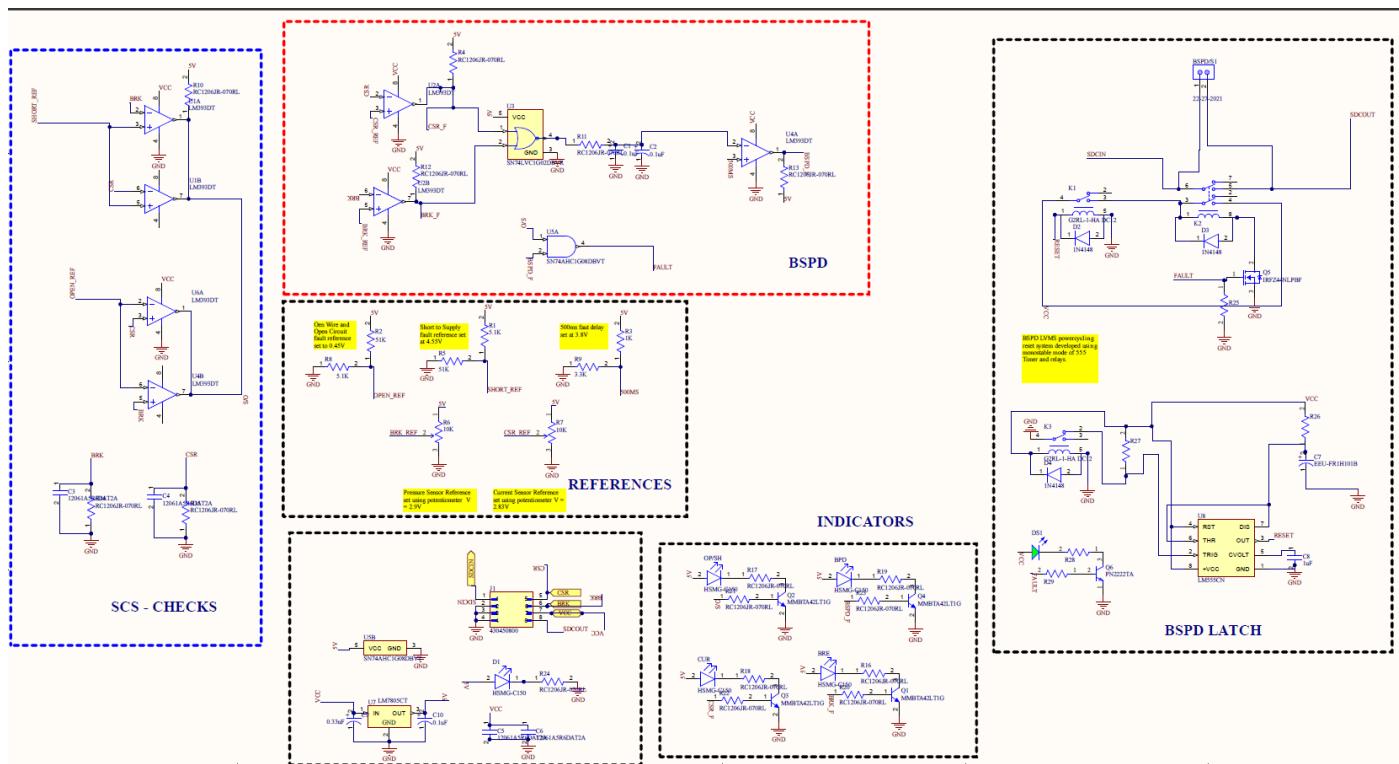
Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------



Schematic



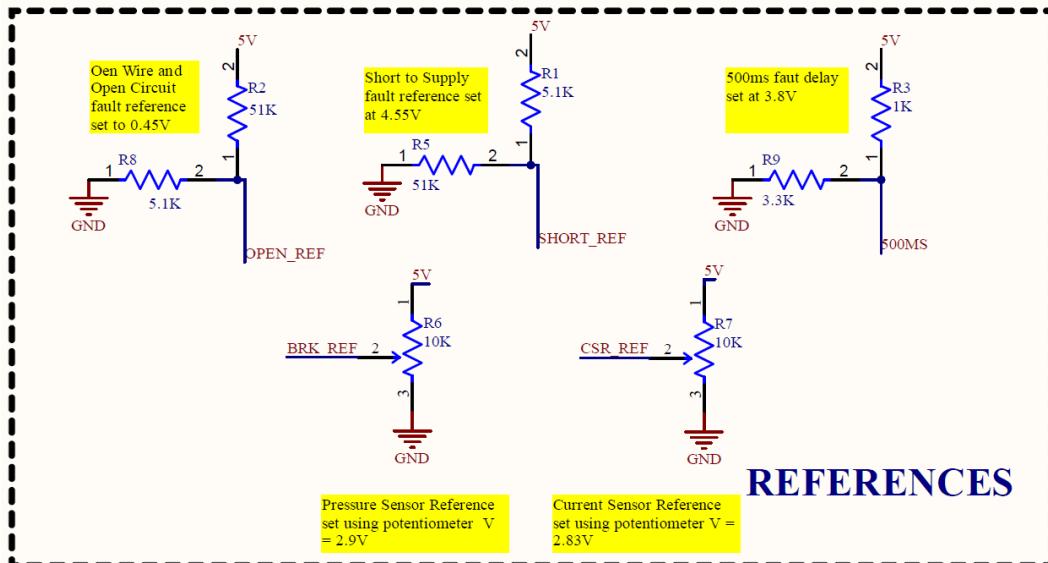
ELECTRICAL SAFETY FORM

Part 1

Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------



Datasheets

1. Current Sensor

Primary Nominal DC & AC Current I_{PN} (A.t.RMS)	Primary AC Current Max. Peak Value ¹⁾ I_p (A)	Output voltage (Analog) V_{OUT} (VDC)	Type
100	600	0-10	DHR 100 C10
200	600	0-10	DHR 200 C10

[Current Sensor Datasheet](#)

2. Brake Pressure Sensor

- 0-5V or 4-20mA output
- Pressure ranges from -14.5 to 5800 psi

[Brake Pressure Sensor Datasheet](#)

Precharge Circuit

General Information

Attributes	Comment (Team)
Builtin Precharge Circuit (motor controller)?	Yes Explain: When initially connecting a battery to a load with capacitive input, there is an inrush of current as the load capacitance is charged up to the battery

ELECTRICAL SAFETY FORM

Part 1

Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------

	<p>voltage. In our application using a large battery and powerful load, this inrush current is very high. The pre-charge circuit is required to charge the circuitry between the accumulators and the motor controller to 95% of the maximum operating voltage before closing the second AIR. This must be done to protect the motor controller and other components from the very large inrush current.</p> <p>The Pre-charge circuit consists of:</p> <ul style="list-style-type: none"> • A pre-charge resistor, to limit the inrush current. • A contactor (high power relay) across the pre-charge resistor
Precharge Circuit Information`	<p>Max TS Voltage: 96V</p> <p>Precharge Resistor: 100Ω</p> <p>Power Rating of precharge resistor: 100W</p> <p>Intermediate capacitor value: 11mF</p> <p>Precharge Time: 3.2391s</p>
Accordance with EV 5.7	Yes
Precharge Resistor Datasheet	Datasheet
Precharge Relay Datasheet	Datasheet
Datasheet for Any other component (Parts of TS/LV)	Datasheet
HV Path Precharge Schematics	Schematic
LV control for Precharge	Schematic

ELECTRICAL SAFETY FORM

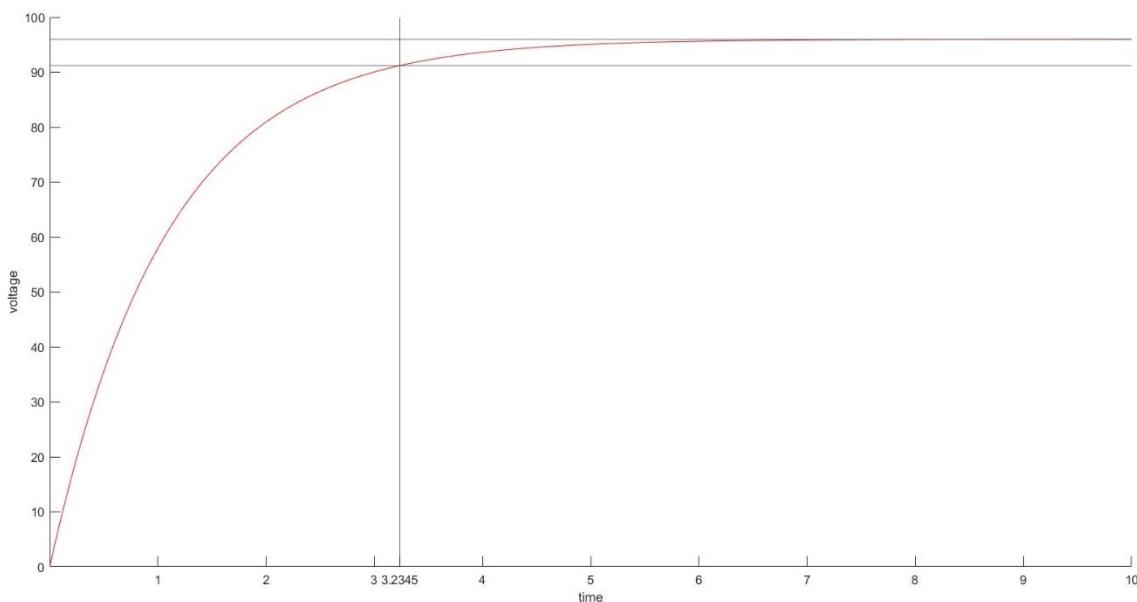
Part 1

Version: 2



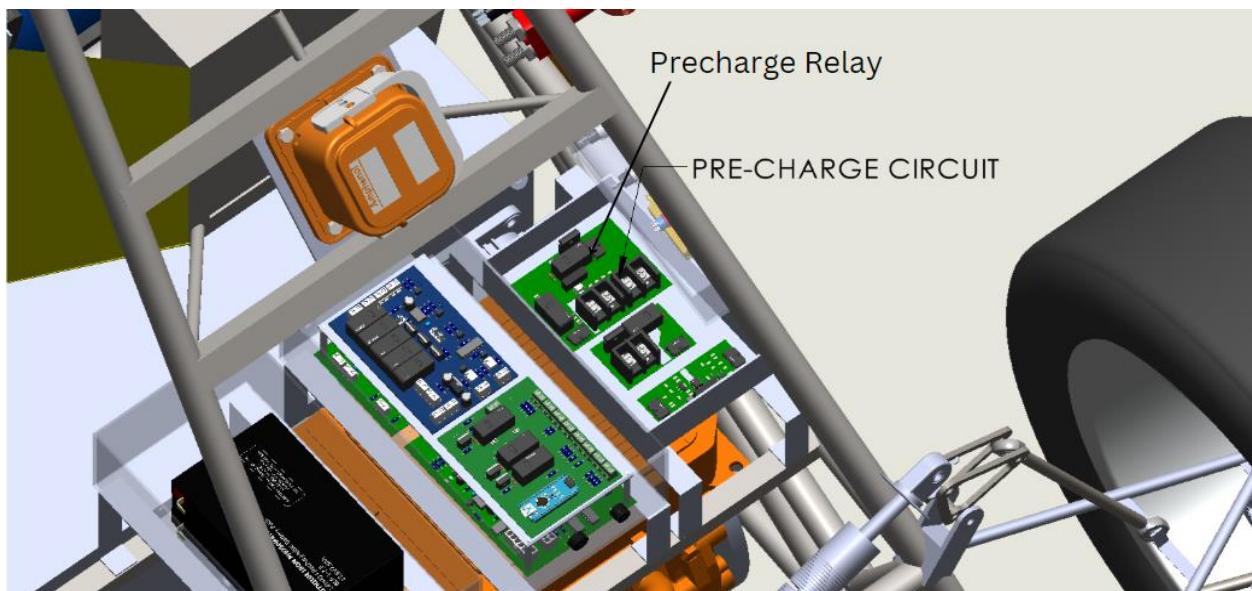
CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------

Can team provide proof of 95% precharging of DC link capacitor (By any mean: DSO, Simulation, etc)	Yes Simulation Reason: (If no)
--	---



CAD Rendering

- Placement of TS Component like Precharge Resistor, Precharge Relay and Voltage sensors that measures intermediate circuit:



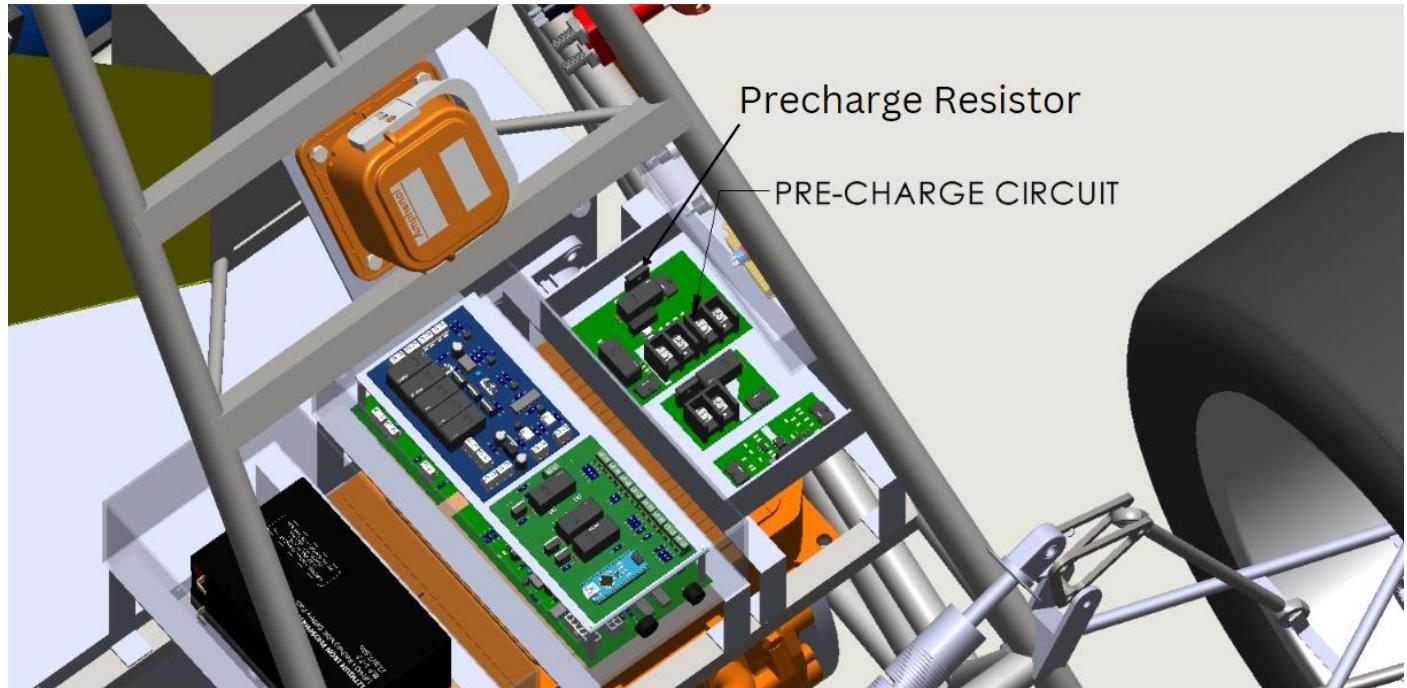
ELECTRICAL SAFETY FORM

Part 1

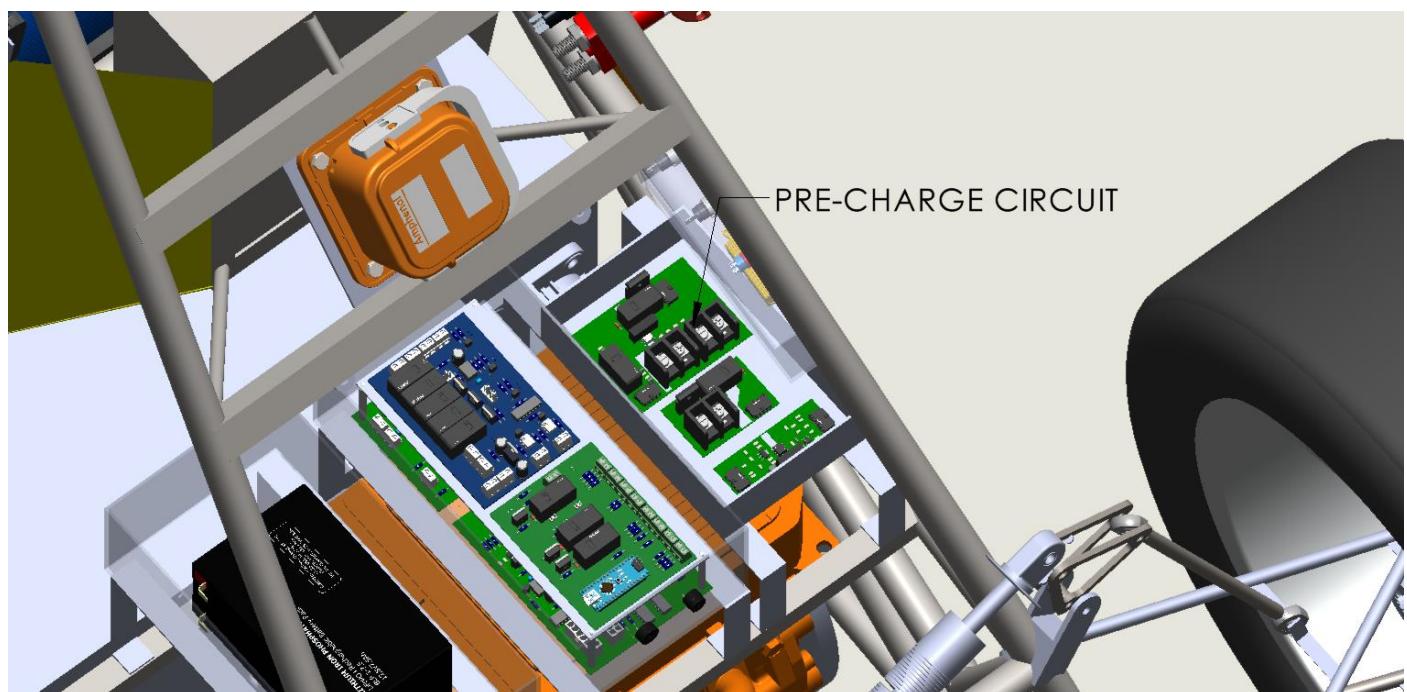
Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------



- Placement of circuit that controls the actuation of Precharge Relay



Schematic

- Schematics showing Precharge Resistor and Relay in High voltage path. All TS connection and LV Connection to be provided:
- Schematics showing LV circuit that controls Precharge Relay

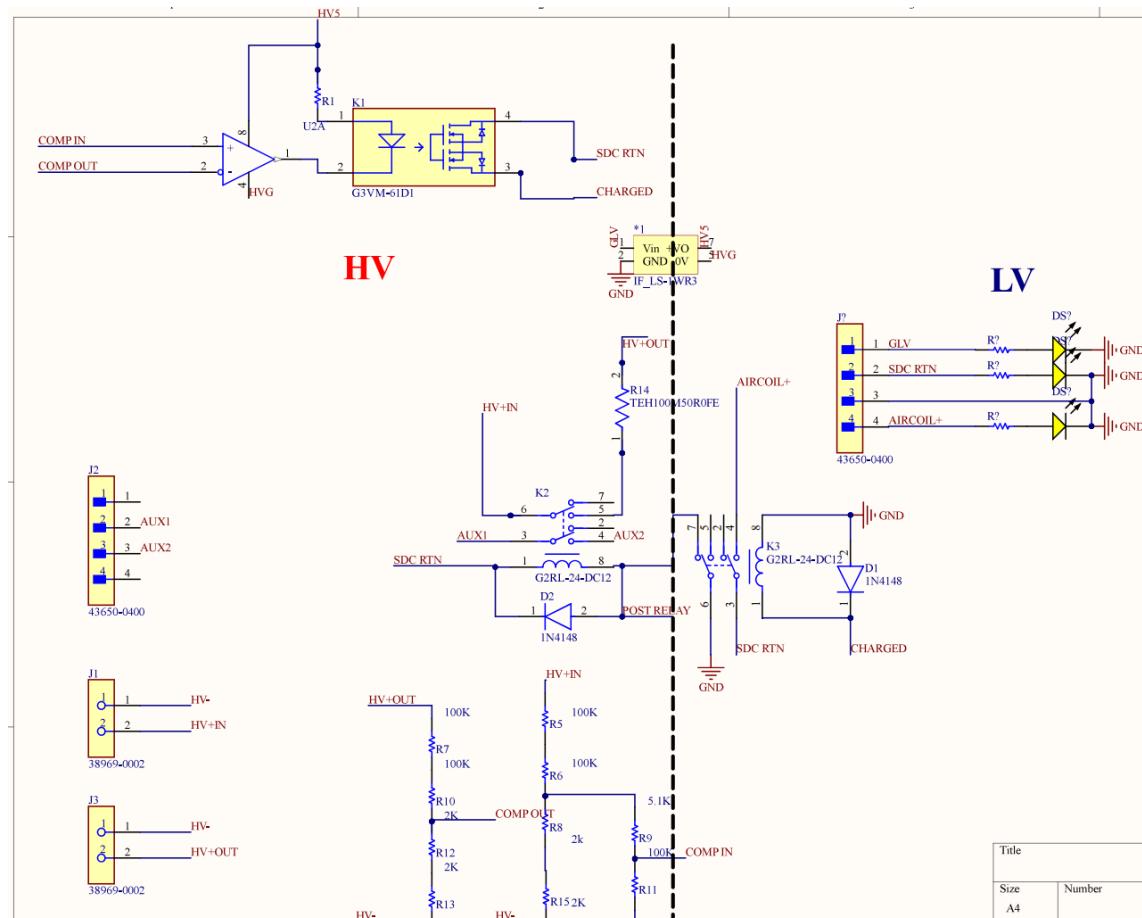
ELECTRICAL SAFETY FORM

Part 1

Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------



Common Schematic showing both HV and LV path for Pre-charge circuit

Pre-charge Resistor Divider Calculation:

We measure 1.96% of the output bus voltage (COMP OUT), and 95.14% of 1.96% of the input voltage (COMP IN). At our max battery pack voltage (96V), COMP IN will be 1.79V.

This sets the 95% Voltage the comparator will trip at

$$COMP\ IN\ MAX = 96 * (4k / (100k + 100k + 4k)) * ((100k) / (100k + 5.1k)) = 1.79V$$

Since COMP OUT is set at 1.96% of our pack voltage, at max pack voltage the comparator will trip when HV+ OUT is 91.29V

$$HV+OUT = COMP\ OUT * ((100k + 100k + 4k) / 4k) = 2.9 * ((100k + 100k + 4k) / 4k) = 91.29V$$

This is rule compliant as 91.29 V > 0.95 * 96V = 91.2V

ELECTRICAL SAFETY FORM

Part 1

Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------

Datasheets

1. Precharge Resistor

CHARACTERISTICS		
Resistor	thick film on alumina	
Case	high temperature plastic	
Lead Material	Tinned Copper	
Installation, max. Torque	0.9 Nm using an M3 screw and a compression washer	
Derating	linear, 100% at 25°C to 0% at 175°C	
Resistance range	0.05Ω to 1MΩ, other values on request	
Resistance tol.	±1%, ±2%, ±5%, ±10%	
Max. working voltage	350V	
Temperature Coefficient	>10Ω: 50ppm/°C, ref. to 25°C 3 to 10Ω: 100ppm/°C 1 to 2.99Ω: 250ppm/°C <1Ω: 500-1000+ppm/°C (Contact factory for exact values below 1Ω)	
		Test Conditions Of Test
		Load life MIL-R-39009D 4.8.13 , 2,000 hours at rated power $\Delta R \leq \pm(1.0\% + 0.0005\Omega)$
		Moisture resistance -10°C - +65°C, RH>90%, cycle 240 h $\Delta R \leq \pm(0.50\% + 0.0005\Omega)$
		Short time overload 1.5 times rated power and V(DC) ≤ 1.5Vmax for 5 seconds $\Delta R \leq \pm (0.50\% + 0.0005\Omega)$
		Thermal shock GJB360A-96 method 107, Cond. F $\Delta R \leq \pm(0.50\% + 0.0005\Omega)$
		Dielectric strength GJB360A-96 method 301, (1,800V AC, 60s) $\Delta R \leq \pm (0.15\% + 0.0005\Omega)$
		Terminal strength GJB360A-96 method 211, Cond. A (Pull Test) 2.4N $\Delta R \leq \pm(0.20\% + 0.0005\Omega)$
		High frequency vibration GJB360A-96 method 204, Cond. D $\Delta R \leq \pm(0.40\% + 0.0005\Omega)$
		Derating

Precharge Resistor Datasheet

2. Precharge Relay



- A wide variety of single pole, double pole, high-capacity (16 A) type and high-sensitivity type (250 mW) relays are available.
- IEC/EN 60335-1 conformed. (-HA Model)
- Satisfies ambient operating temperature requirement of 85°C and 105°C (-CV Model).
- Clearance and creepage distance: 8 mm / 8 mm min.
- G2RL-1(A)-E-ASI: TV3 rating models available.
- IEC/EN 60079-15 conformed (Except G2RL-1(A)-H, G2RL-1A-E-CV(-HA) Models).
- Reduced power consumption with voltage holding and pulse width modulation (PWM) control (only for G2RL-□-PW1 model).

Precharge Relay Datasheet

ELECTRICAL SAFETY FORM

Part 1

Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------

3. Any other component (Parts of TS/LV)

LM393, LM393A, LM2903, LM2903V DUAL DIFFERENTIAL COMPARATORS

- Single Supply or Dual Supplies
- Wide Range of Supply Voltage
 - Max Rating . . . 2 V to 36 V
 - Tested to 30 V . . . Non-V Devices
 - Tested to 32 V . . . V-Suffix Devices
- Low Supply-Current Drain Independent of Supply Voltage . . . 0.4 mA Typ Per Comparator
- Low Input Bias Current . . . 25 nA Typ
- Low Input Offset Current . . . 3 nA Typ (LM193)
- Low Input Offset Voltage . . . 2 mV Typ
- Common-Mode Input Voltage Range Includes Ground
- Differential Input Voltage Range Equal to Maximum-Rated Supply Voltage . . . ± 36 V
- Low Output Saturation Voltage
- Output Compatible With TTL, MOS, and CMOS

[Datasheet of Voltage comparator](#)

ELECTRICAL SAFETY FORM

Part 1

Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------

Discharge Circuit

General Information

Attributes	Comment (Team)
Builtin Discharge circuit (motor controller)? Note: Discharge time for builtin discharge circuit to be below 5sec	No Explain: discharge process in detail (if yes)
Discharge Circuit Information	Max TS Voltage: 96V Discharge Resistor: 100Ω ² Power Rating of Discharge resistor: 100W Intermediate capacitor value: 11mF Discharge Time: 0.517s
Accordance with EV 4.9	Yes
Discharge Resistor Datasheet	<u>Datasheet</u>
Discharge Relay Datasheet	<u>Datasheet</u>
Datasheet for Any other component (Parts of TS/LV)	NA
HV Path Discharge Schematics	<u>Schematic</u>
LV control for Discharge	<u>Schematic</u>
Can team provide proof of discharging of DC link capacitor (By any mean: DSO, Simulation, etc)	Yes Reason: (If no)

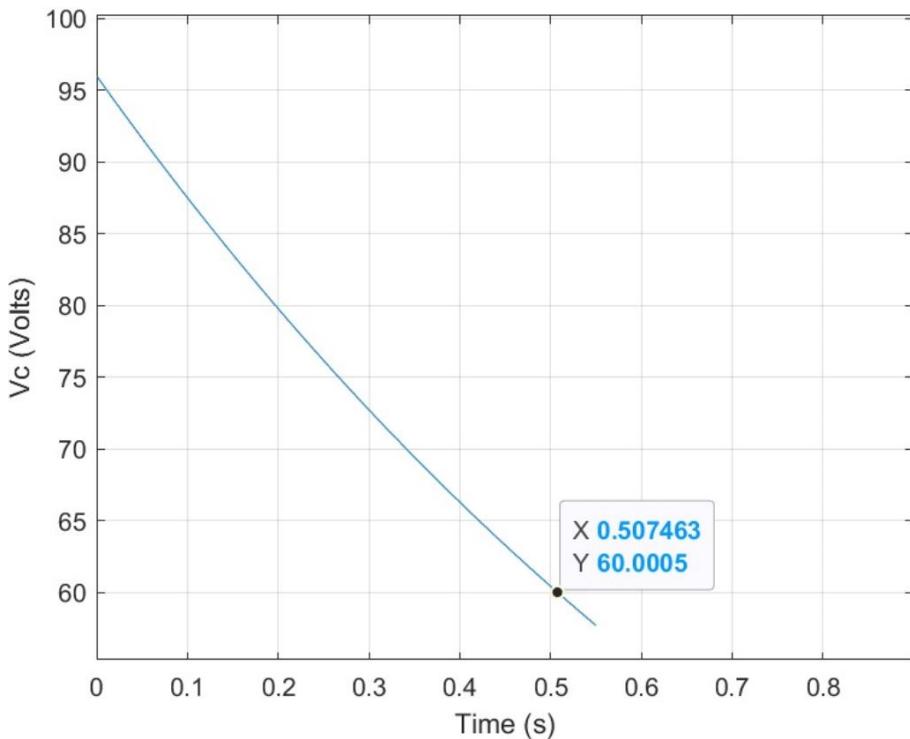
ELECTRICAL SAFETY FORM

Part 1

Version: 2

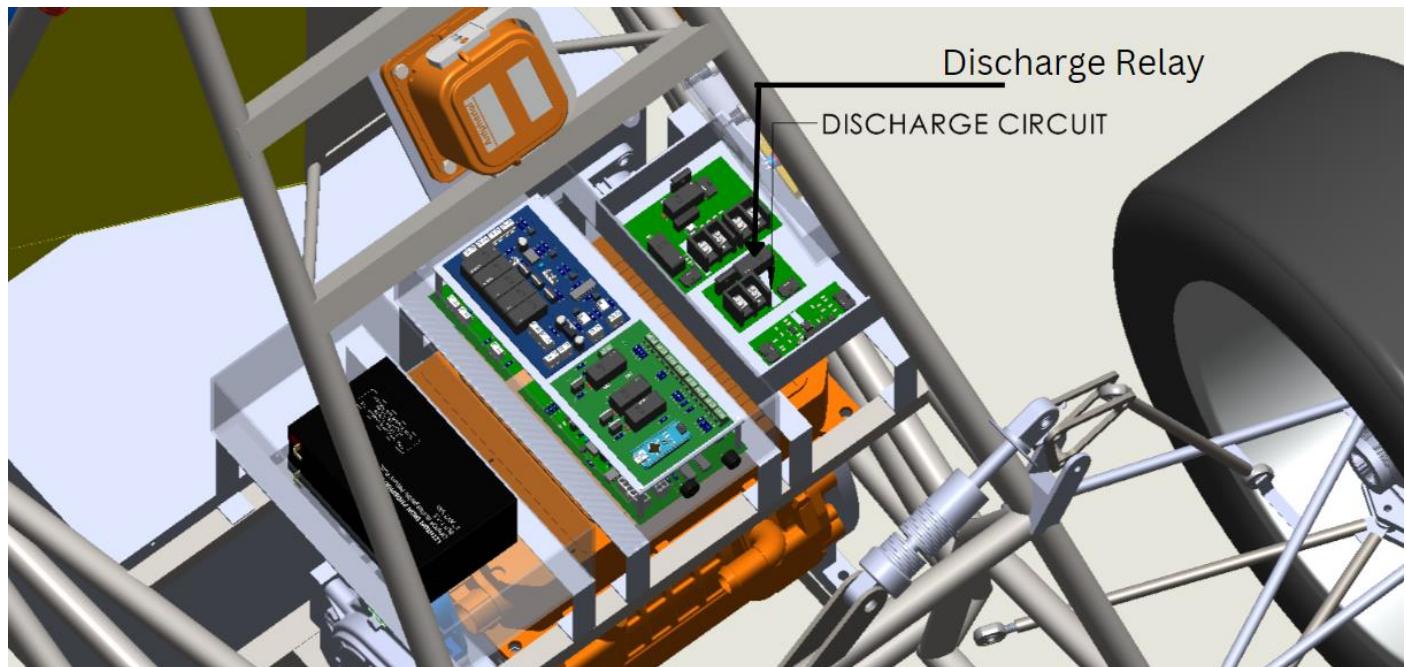


CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------



CAD Rendering

- Placement of TS Component like Discharge Resistor, Discharge Relay:



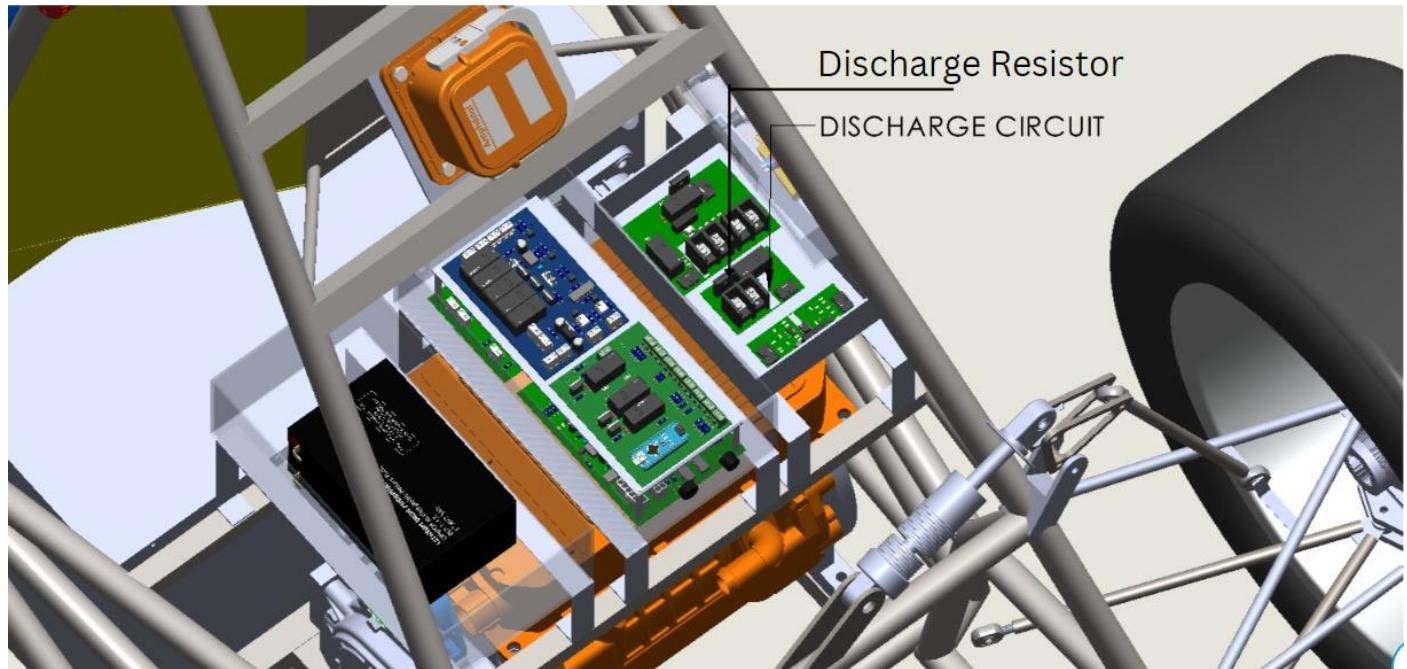
ELECTRICAL SAFETY FORM

Part 1

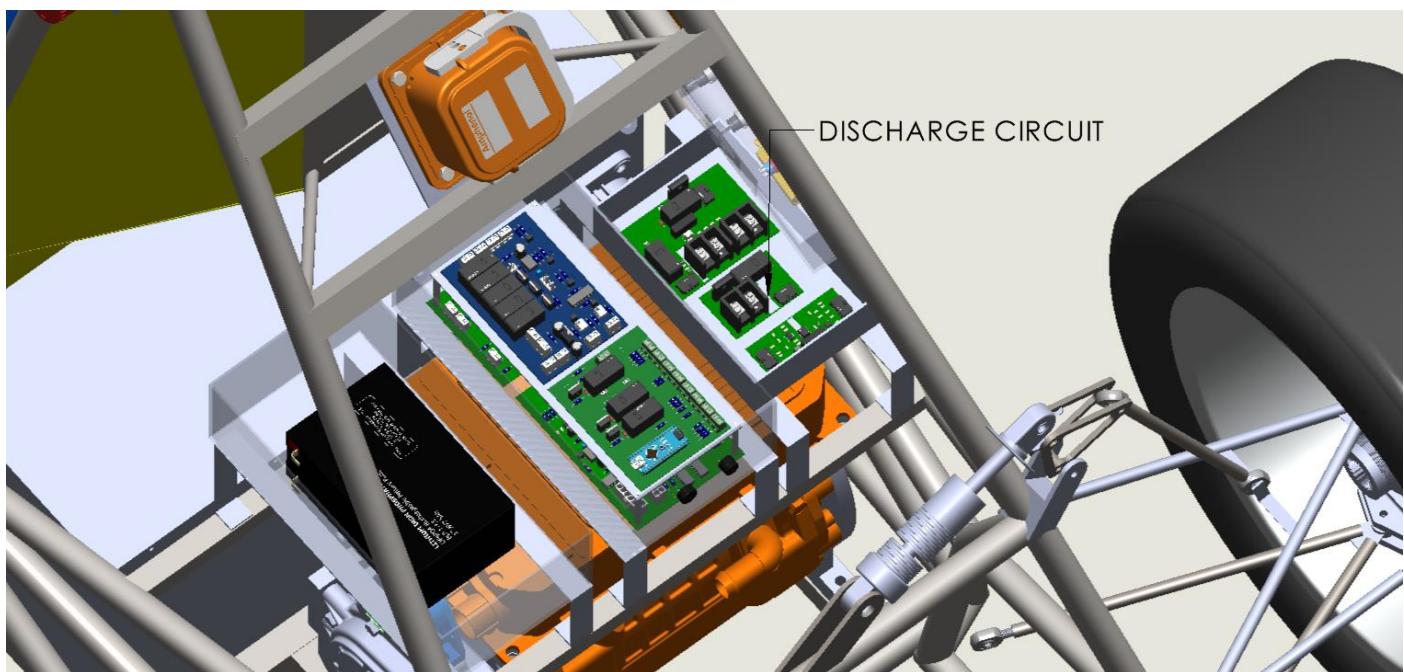
Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
--------------	-----	------------------	------------------	--------------	---------------------	---------------------	-------------	----------------------	------------------------



2. Placement of circuit that controls the actuation of discharge relay



ELECTRICAL SAFETY FORM

Part 1

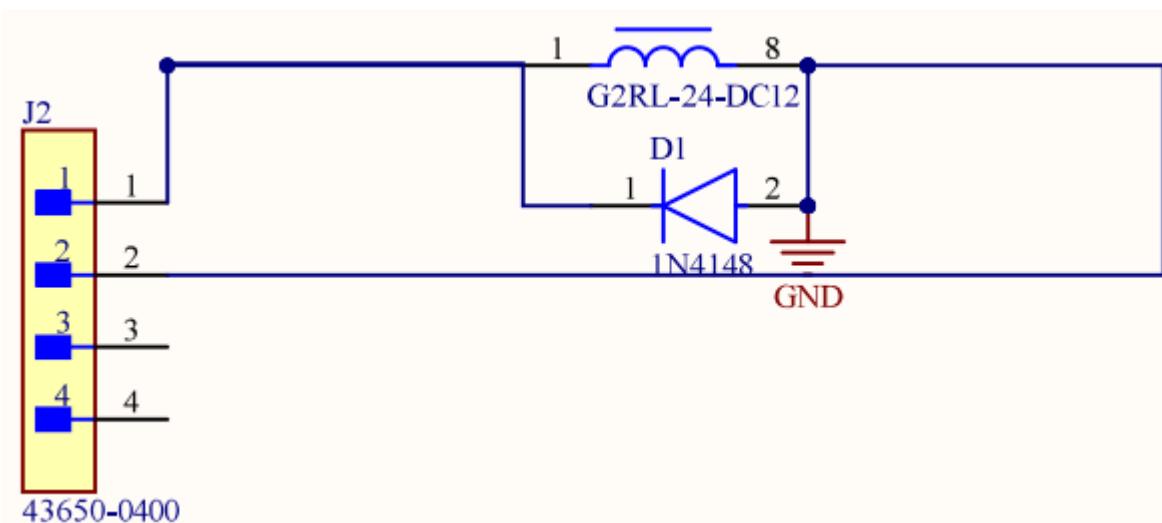
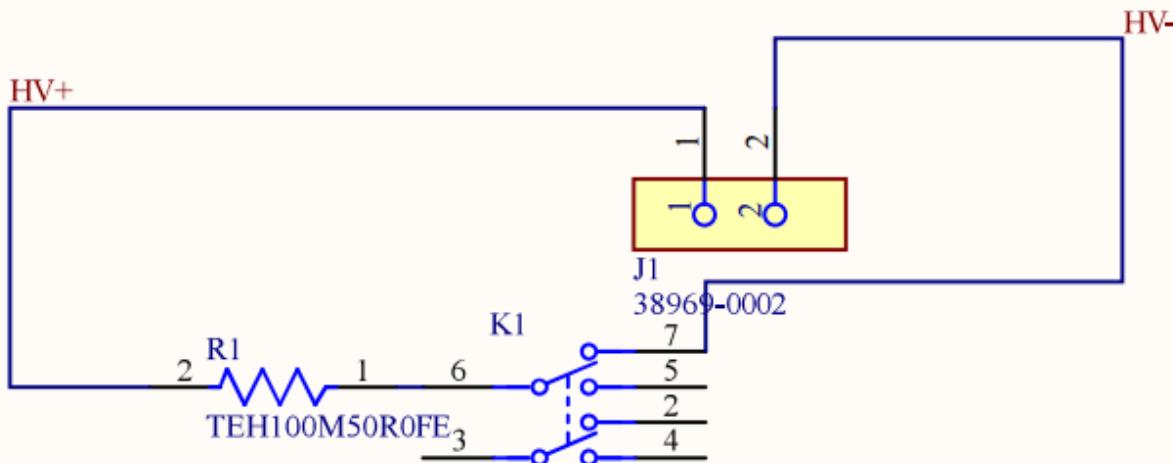
Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------

Schematics

Provide Complete Schematic supporting rules EV 4.9.2 and EV 4.9.3. All TS connection and LV connection to be provided



ELECTRICAL SAFETY FORM

Part 1

Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------

Datasheets

1. Discharge Resistor

CHARACTERISTICS		
Resistor	thick film on alumina	
Case	high temperature plastic	
Lead Material	Tinned Copper	
Installation, max. Torque	0.9 Nm using an M3 screw and a compression washer	
Derating	linear, 100% at 25°C to 0% at 175°C	
Resistance range	0.05Ω to 1MΩ, other values on request	
Resistance tol.	±1%, ±2%, ±5%, ±10%	
Max. working voltage	350V	
Temperature Coefficient	>10Ω: 50ppm/°C, ref. to 25°C 3 to 10Ω: 100ppm/°C 1 to 2.99Ω: 250ppm/°C <1Ω: 500-1000+ppm/°C (Contact factory for exact values below 1Ω)	
Test	Conditions Of Test	Performance
Load life	MIL-R-39009D 4.8.13 , 2,000 hours at rated power	ΔR ≤ ±(1.0% + 0.0005Ω)
Moisture resistance	-10°C - +65°C, RH>90%, cycle 240 h	ΔR ≤ ±(0.50% + 0.0005Ω)
Short time overload	1.5 times rated power and V(DC) ≤1.5Vmax for 5 seconds	ΔR ≤ ± (0.50% + 0.0005Ω)
Thermal shock	GJB360A-96 method 107, Cond. F	ΔR ≤ ±(0.50% + 0.0005Ω)
Dielectric strength	GJB360A-96 method 301, (1,800V AC, 60s)	ΔR ≤ ± (0.15% + 0.0005Ω)
Terminal strength	GJB360A-96 method 211, Cond. A (Pull Test) 2.4N	ΔR ≤ ±(0.20% + 0.0005Ω)
High frequency vibration	GJB360A-96 method 204, Cond. D	ΔR ≤ ±(0.40% + 0.0005Ω)
	Derating	

[Discharge Resistor Datasheet](#)

2. Discharge Relay



- A wide variety of single pole, double pole, high-capacity (16 A) type and high-sensitivity type (250 mW) relays are available.
- IEC/EN 60335-1 conformed. (-HA Model)
- Satisfies ambient operating temperature requirement of 85°C and 105°C (-CV Model).
- Clearance and creepage distance: 8 mm / 8 mm min.
- G2RL-1(A)-E-ASI: TV3 rating models available.
- IEC/EN 60079-15 conformed (Except G2RL-1(A)-H, G2RL-1A-E-CV(-HA) Models).
- Reduced power consumption with voltage holding and pulse width modulation (PWM) control (only for G2RL-□-PW1 model).

[Discharge Relay Datasheet](#)

3. Any other component (Parts of TS/LV)

*INSERT RELEVANT PART OF DATASHEET HERE.
ALSO, PROVIDE LINK TO FULL DATASHEET HERE.*

ELECTRICAL SAFETY FORM

Part 1

Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------

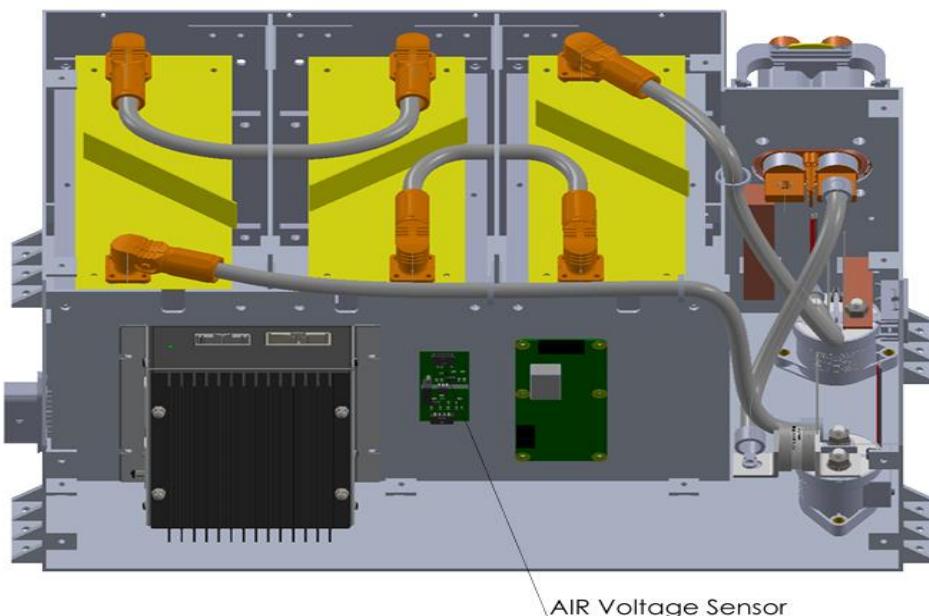
TSAL

General Information

Attributes	Comment (Team)
Schematic	Schematics
Accordance with EV 4.10	Yes
Datasheet of voltage sensor measuring voltage across accumulator output	Datasheet
Datasheet of voltage sensor measuring voltage motor controller input (DC link)	Datasheet
Mechanical State detection for most positive AIR, Most negative AIR, Precharge Relay	Yes
TSAL Green and Red controls are independent of each other	Yes
Explain latching circuit required for EV 4.10.15	Schematics
All signal influencing TSAL must have SCS Checks	Yes

CAD Rendering

- Placement of all sensors



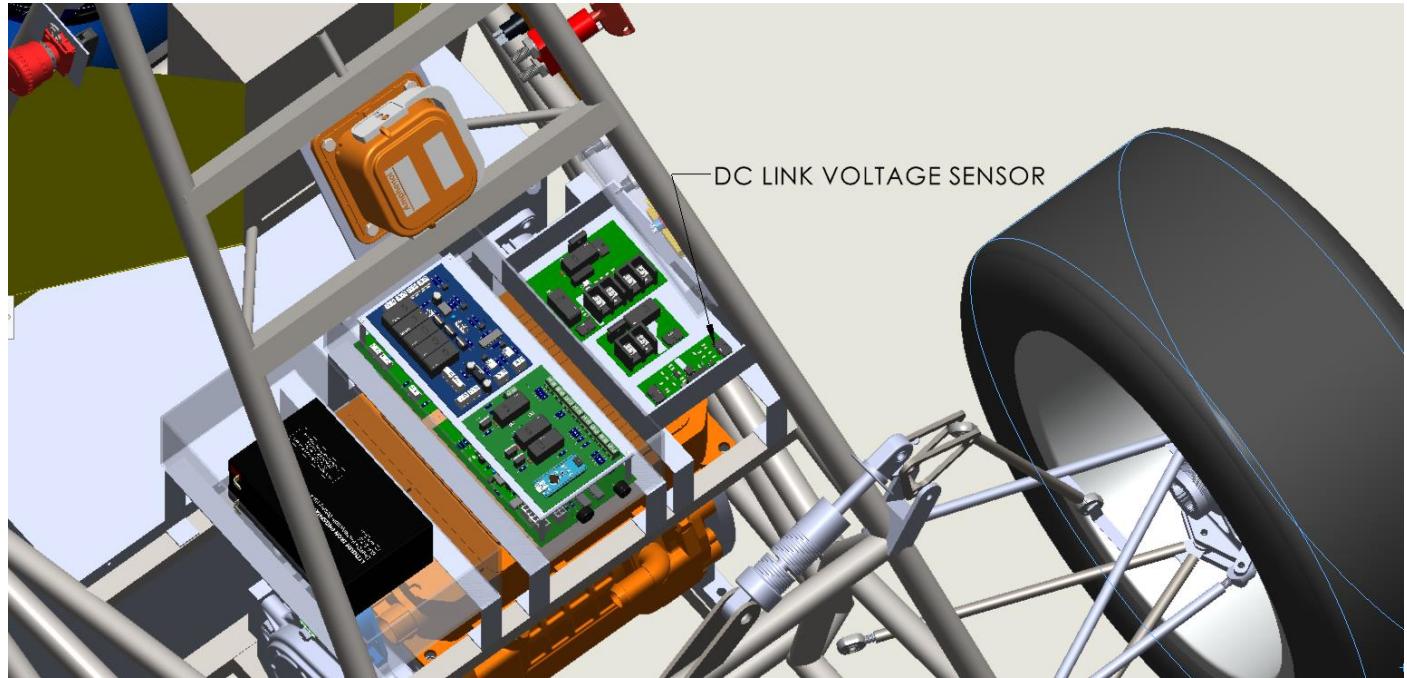
ELECTRICAL SAFETY FORM

Part 1

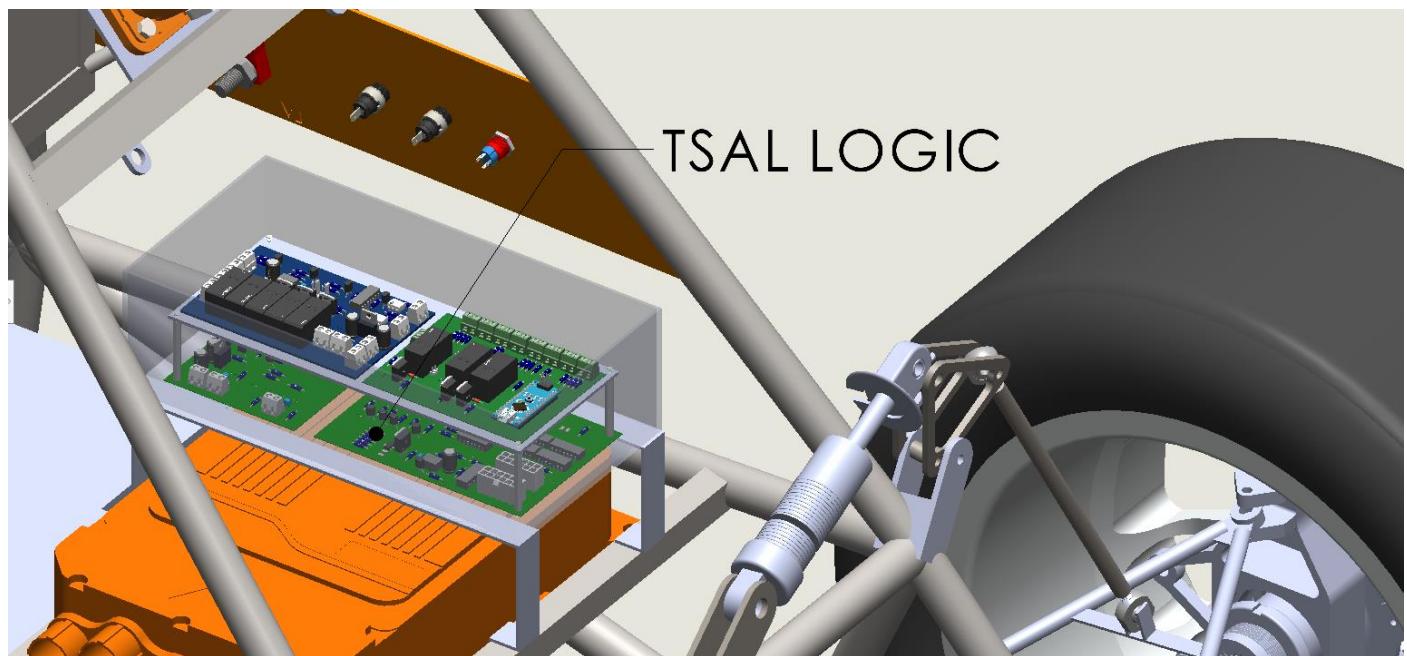
Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------



2. Placement of TSAL PCB



ELECTRICAL SAFETY FORM

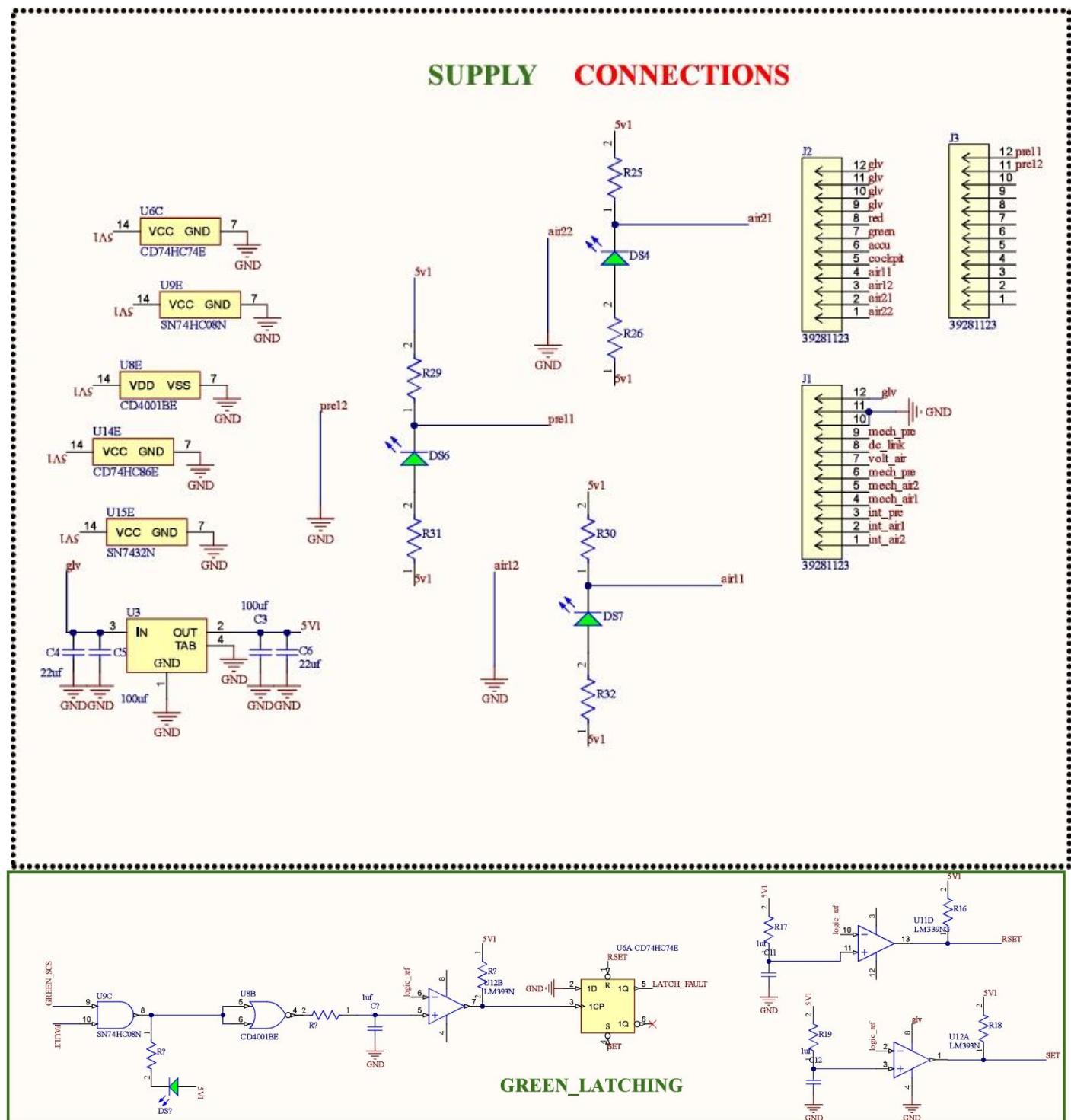
Part 1

Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------

Schematics



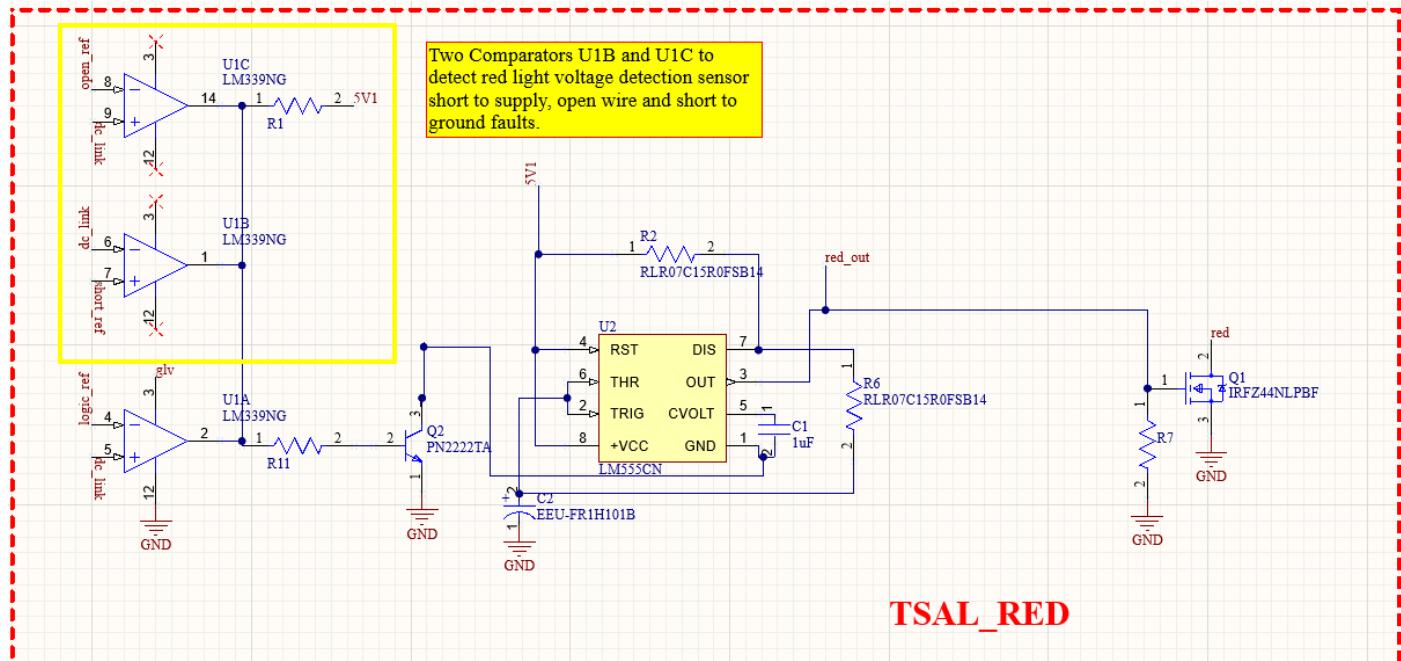
ELECTRICAL SAFETY FORM

Part 1

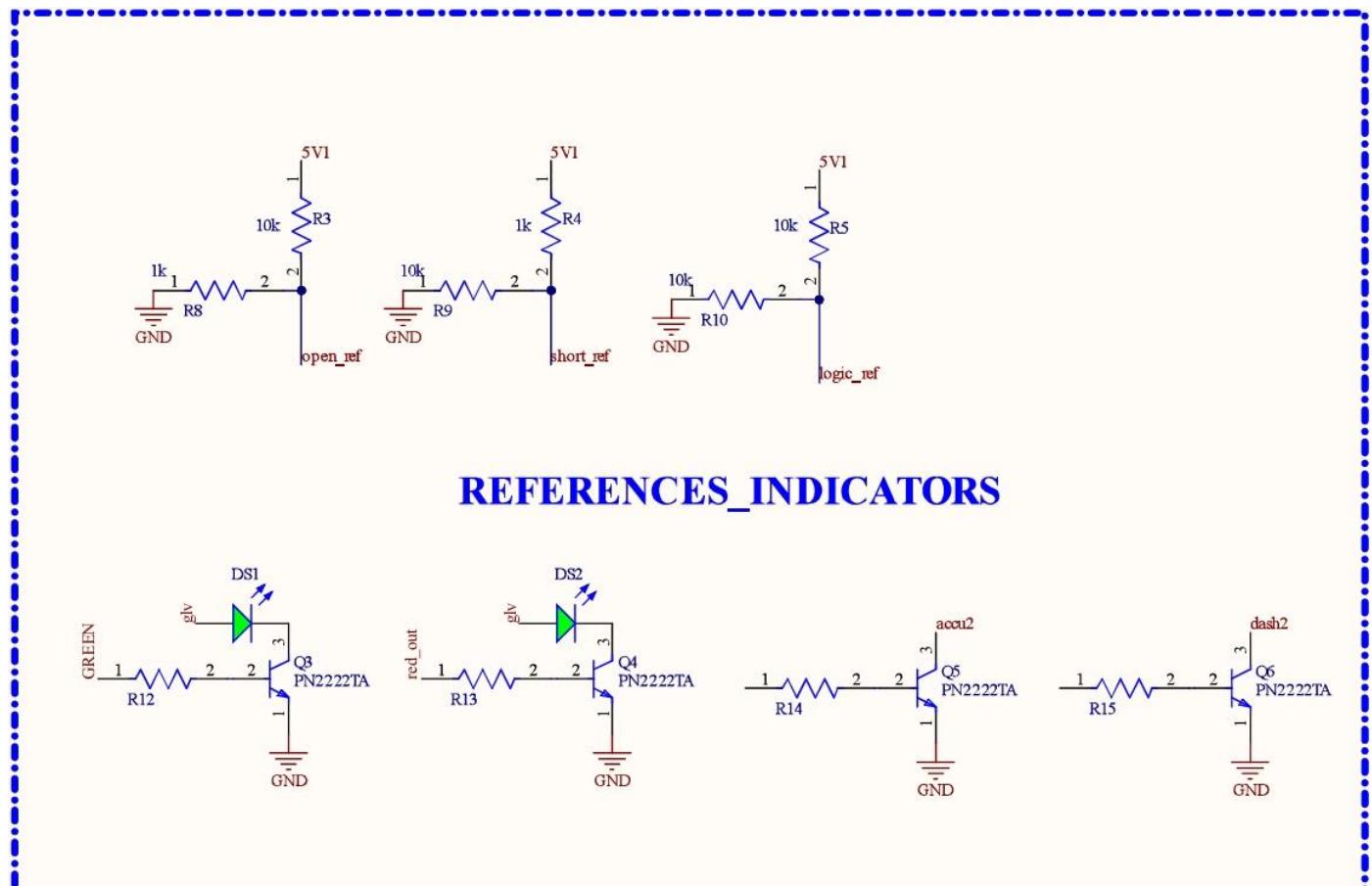
Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------



TSAL RED LIGHT CIRCUIT



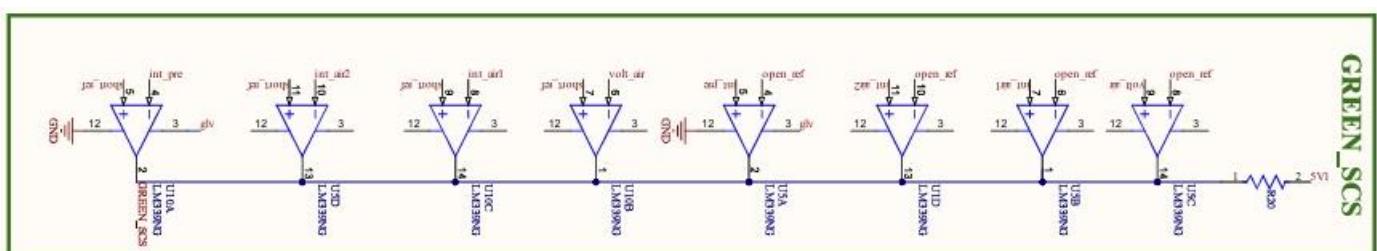
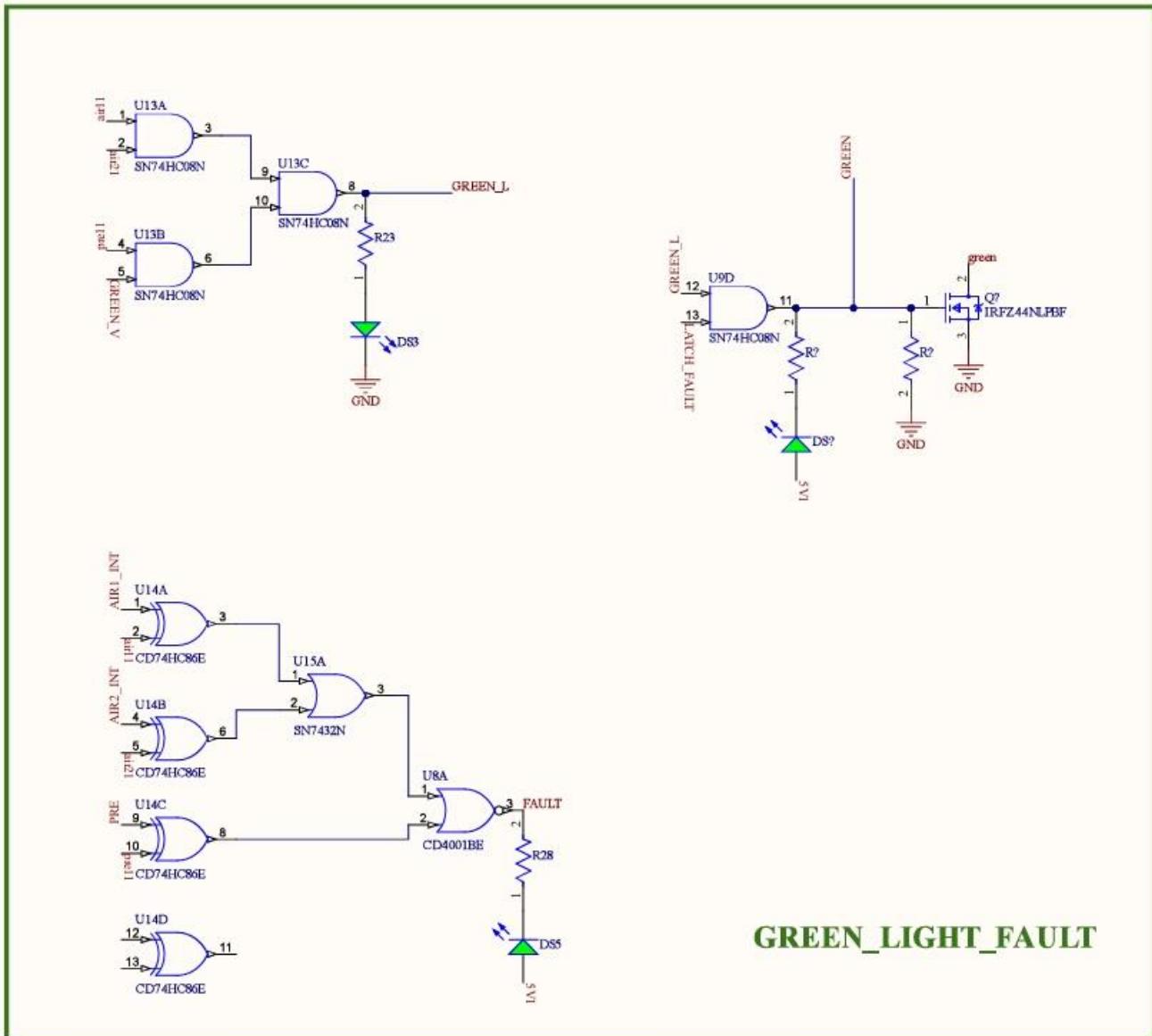
ELECTRICAL SAFETY FORM

Part 1

Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------



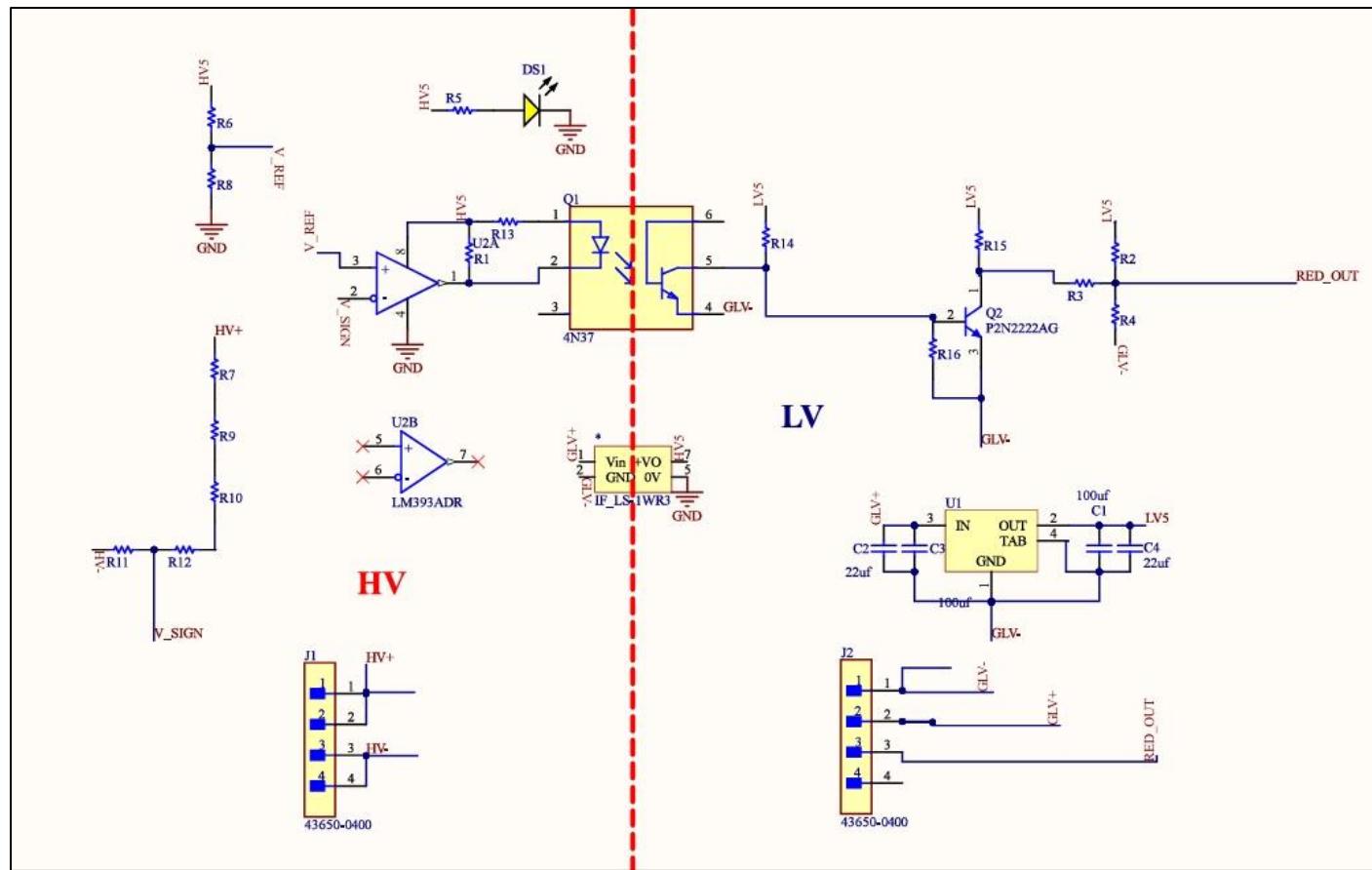
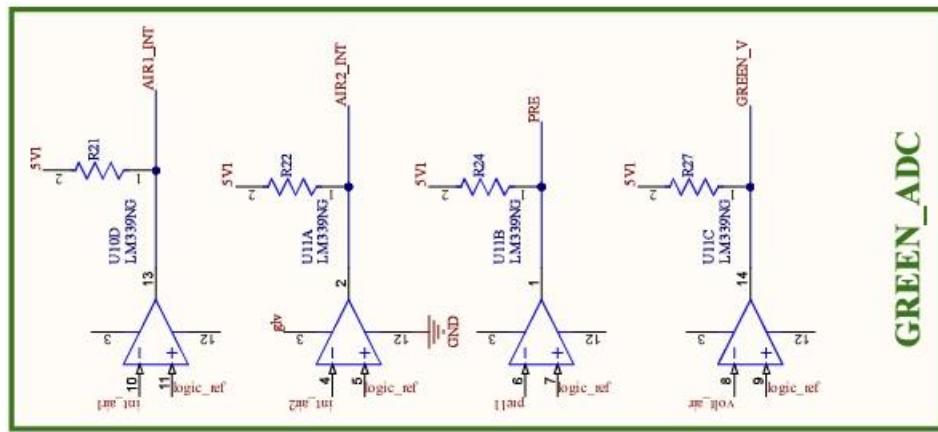
ELECTRICAL SAFETY FORM

Part 1

Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------



ELECTRICAL SAFETY FORM

Part 1

Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------

Datasheets

1. Voltage sensor measuring voltage across accumulator output

**LM393, LM393A, LM2903, LM2903V
DUAL DIFFERENTIAL COMPARATORS**

- Single Supply or Dual Supplies
- Wide Range of Supply Voltage
 - Max Rating . . . 2 V to 36 V
 - Tested to 30 V . . . Non-V Devices
 - Tested to 32 V . . . V-Suffix Devices
- Low Supply-Current Drain Independent of Supply Voltage . . . 0.4 mA Typ Per Comparator
- Low Input Bias Current . . . 25 nA Typ
- Low Input Offset Current . . . 3 nA Typ (LM193)
- Low Input Offset Voltage . . . 2 mV Typ
- Common-Mode Input Voltage Range Includes Ground
- Differential Input Voltage Range Equal to Maximum-Rated Supply Voltage . . . ± 36 V
- Low Output Saturation Voltage
- Output Compatible With TTL, MOS, and CMOS

[Self designed HV sensor](#)

2. Voltage sensor measuring voltage motor controller input (DC link)

**LM393, LM393A, LM2903, LM2903V
DUAL DIFFERENTIAL COMPARATORS**

- Single Supply or Dual Supplies
- Wide Range of Supply Voltage
 - Max Rating . . . 2 V to 36 V
 - Tested to 30 V . . . Non-V Devices
 - Tested to 32 V . . . V-Suffix Devices
- Low Supply-Current Drain Independent of Supply Voltage . . . 0.4 mA Typ Per Comparator
- Low Input Bias Current . . . 25 nA Typ
- Low Input Offset Current . . . 3 nA Typ (LM193)
- Low Input Offset Voltage . . . 2 mV Typ
- Common-Mode Input Voltage Range Includes Ground
- Differential Input Voltage Range Equal to Maximum-Rated Supply Voltage . . . ± 36 V
- Low Output Saturation Voltage
- Output Compatible With TTL, MOS, and CMOS

[Self designed HV sensor](#)

ELECTRICAL SAFETY FORM

Part 1

Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------

3. Any other component (Parts of TS/LV)

8.4 Device Functional Modes

Table 8-1. Function Table

INPUTS				OUTPUTS	
PRE	CLR	CLK	D	Q	\bar{Q}
L	H	X	X	H	L
H	L	X	X	L	H
L	L	X	X	H ⁽¹⁾	H ⁽¹⁾
H	H	↑	H	H	L
H	H	↑	L	L	H
H	H	L	X	Q ₀	\bar{Q}_0

(1) This configuration is nonstable; that is, it does not persist when PRE or CLR returns to its inactive (high) level.

[DLATCH Datasheet](#)

ELECTRICAL SAFETY FORM

Part 1

Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------

Measuring Point

General Information

Attributes	Comment (Team)
TMSP in accordance with EV 4.7	Yes
Value of body protection resistor	Value: 5kΩ
Power Rating of body protection resistor	Value: 750mW
Datasheet of body protection resistor	Datasheet
Datasheet of other component used for Body Protection resistor	N/A
Datasheet of wire used	Datasheet
Datasheet of TSMP Non-conductive housing for protection	Datasheet
Datasheet of 4mm banana jack 1000V CAT III	Datasheet
Explain implementation of EV4.7.5	<p>Explanation: - Here's a breakdown of what these requirements might entail:</p> <ul style="list-style-type: none"> Non-Conductive Housing: The housing should be made from a material that does not conduct electricity. This is important to prevent electrical interference or damage to the TSMPs inside. Tool-Free Access: Users or technicians should be able to open the housing without the need for specialized tools. This could involve latches, clips, or other mechanisms that are easily manipulated by hand. Mechanical Link to the Vehicle: The housing should be securely attached to the vehicle in a way that it cannot become detached accidentally during normal vehicle operations. This could involve

ELECTRICAL SAFETY FORM

Part 1

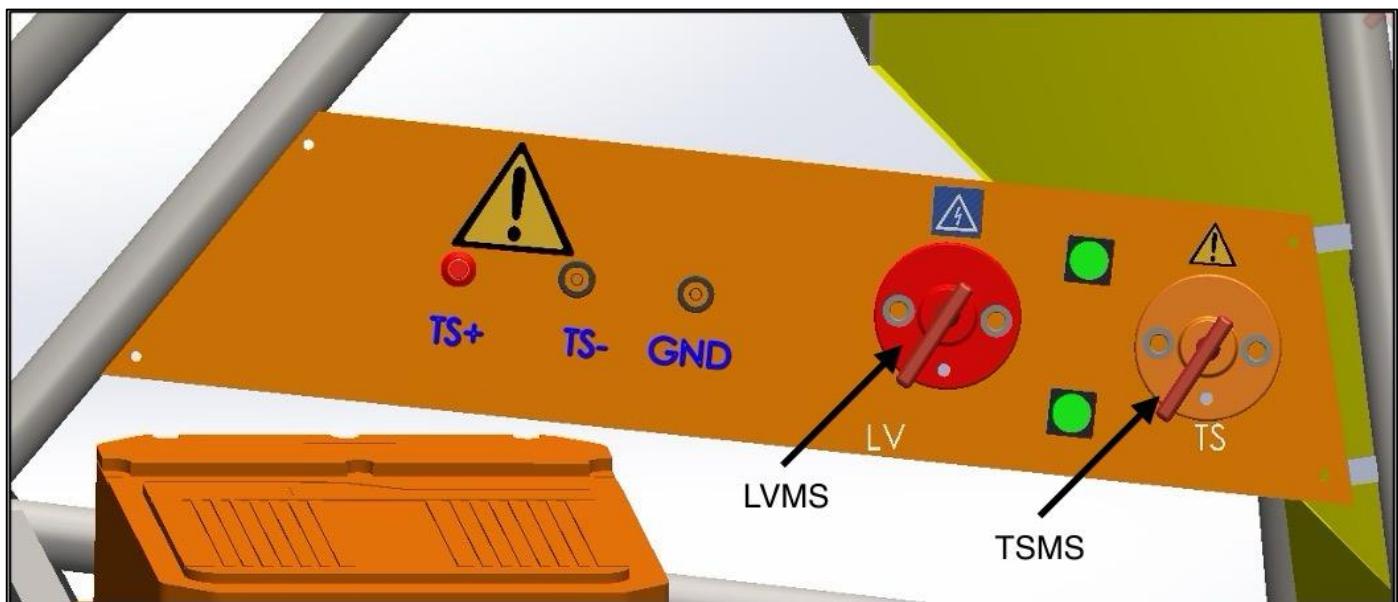
Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
					fasteners, brackets, or other securing methods.				
					<ul style="list-style-type: none"> • Protection: The primary purpose of the housing is to protect the TSMPs inside. This protection could be from environmental factors (dust, moisture, etc.) or physical damage (vibrations, impacts, etc.). 				
Next to the TSMPs a LVS ground measuring point must be installed. A 4 mm black shrouded banana jack must be connected to LVS ground and must be marked "GND".					Yes				

CAD Rendering

1. Placement of TS and LV GND measuring point near Master switch showing:
 - Label like TS+, TS-, GND
 - Non-conductive Housing for TSMP
 - Orange Background TSMP
 - HV Symbol/Sticker according to EV4.2.1



ELECTRICAL SAFETY FORM

Part 1

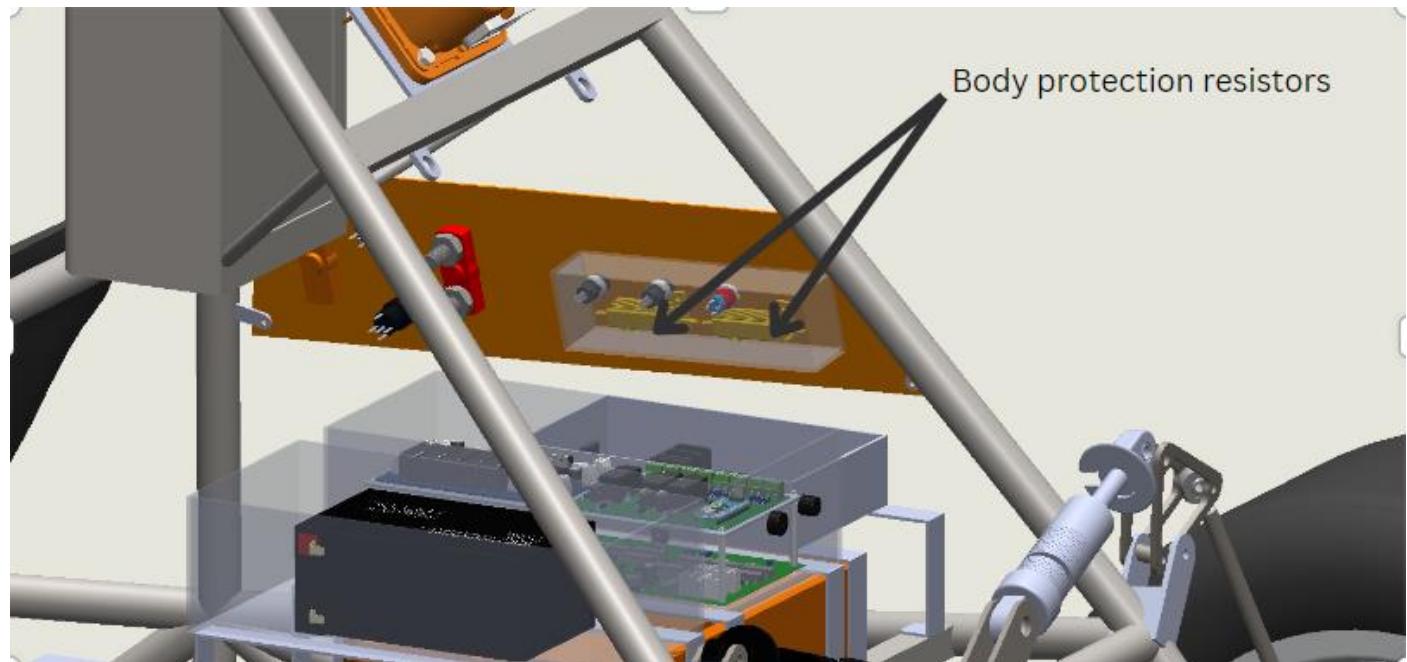
Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------



2. Placement of Current Limiting Resistor/PCBS



Schematic

Provide Schematic supporting rules EV 4.7.2 and EV 4.7.6

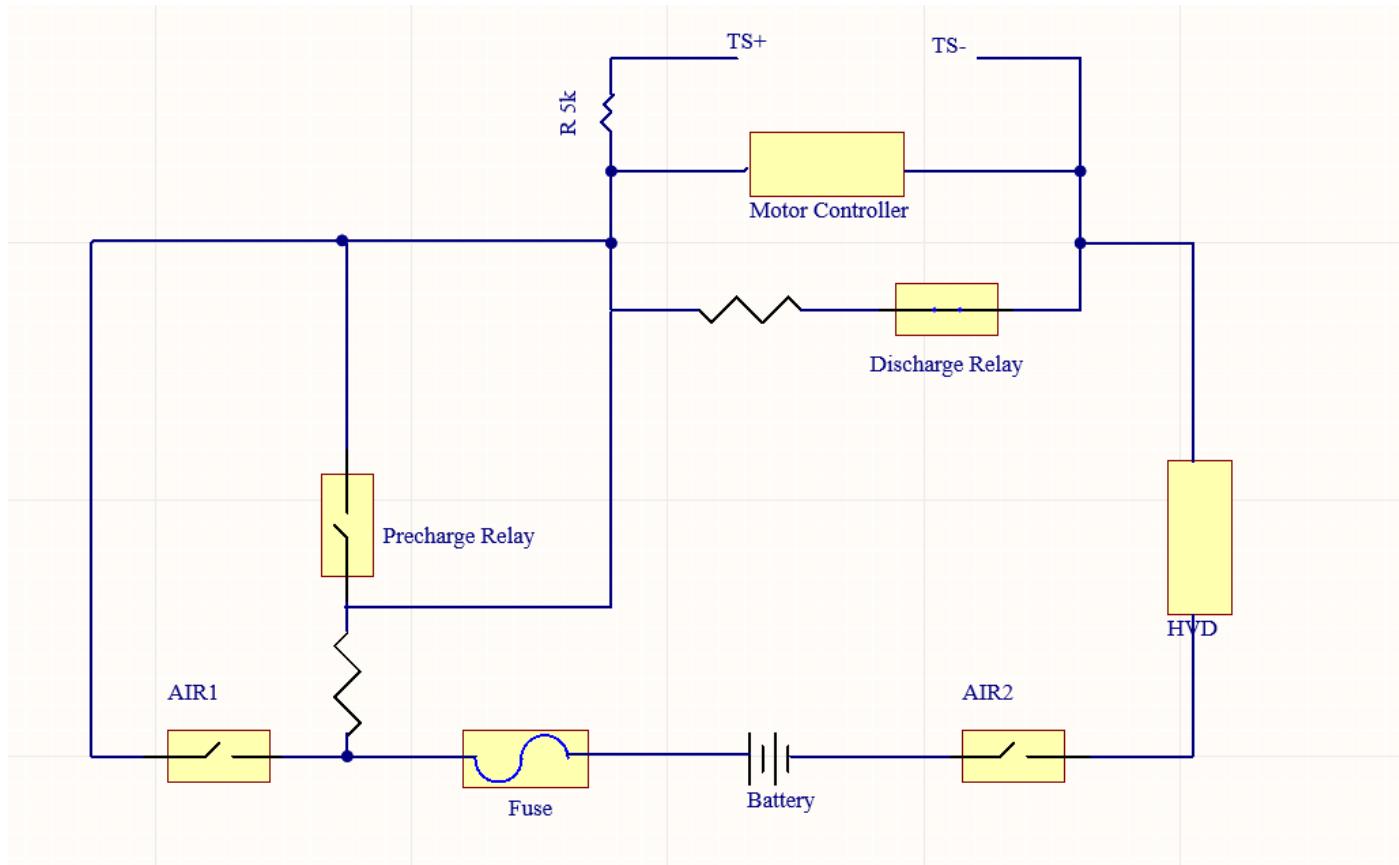
ELECTRICAL SAFETY FORM

Part 1

Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------



Datasheets

1. Current Limiting Resistor

PERFORMANCE CHARACTERISTICS

Characteristics	Condition	Compliance
Tolerance (Tighter tolerance available on request)	For Values less than 1Ω For Values greater than 1Ω	± 5% ± 0.25% to ±5%
Temperature Co-efficient	Dry/Normal	100 PPM/°C max
Insulation Resistance		> 10 GΩ
Endurance	1.5Hrs ON, 0.5Hrs OFF for 1000Hrs @Room Temperature	ΔR < 1% +OR05
Short Term Overload	5 x Rated Power or Isolation Voltage (Whichever is Lesser of the two Voltages)	ΔR < 1% +OR05
Termination Robustness	20N Tensile Force	ΔR < 0.25% +OR05
Resistance to Soldering Heat	260°C, 10 Seconds	ΔR < 0.25% +OR05
Rapid Change of Temperature	-55°C/200°C, 5 Cycles	ΔR < 0.25% +OR05
Bump	4000 Bumps at 40g	ΔR < 0.25% +OR05
Vibration	10Hz to 500Hz, 10g, 6 hrs	ΔR < 0.25% +OR05

Datasheet

2. Other PCB Component for Current limiting Resistor (if any)

ELECTRICAL SAFETY FORM

Part 1

Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------

N/A

3. Wires

*1. The high-voltage wire adopts a flame retardant wire with a temperature resistance level of 180° C. A corrugated tube with a temperature resistance of 180° C must be added outside the high-voltage wire. The wire meets the withstand voltage value: AC2500V, the leakage current is not greater than 5mA, the insulation value: DC1000V, insulation The value is not less than 200MQ, and the wire harness performance conforms to QC/T 1037-2016;

[Datasheet](#)

4. TSMP Non-conductive housing for protection

MATERIAL:

COVER AND BODY ____ MOLDED IMPACT RESISTANT ABS

FINISH:

(SUFFIX -B) COVER AND BODY _____ BLACK
(SUFFIX -G) COVER AND BODY _____ GRAY

FOUR (4) M2.5 x 17.5mm LG. SCREWS ARE SUPPLIED
FOR ASSEMBLY.

NOTE: ALL DIMENSIONS HAVE ±0.015 TOLERANCE
UNLESS OTHERWISE SPECIFIED.

MOUNTING BOSSES USE EITHER M2.5 METRIC OR
#4 STD. SHEET METAL SCREWS x 0.187" LG.
(NOT SUPPLIED)

[Datasheet](#)

5. 4mm Banana Jack (1000V CAT III)

Specifications

Max Current	36A
Max Voltage	1000 V CAT III
Max Resistance	Less than 5 m Ω

[Datasheet](#)

ELECTRICAL SAFETY FORM

Part 1

Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------

Grounding

General Information

Attributes	Comment (Team)
Accordance with EV3.1	Yes
Mention all the material used to ensure ground (example: Wire/Al tape/Cu tape/Conductive mesh)	List here: Steel

Datasheets

1. All material used for Grounding

<i>Typical Chemical Composition:</i>													
	C	Si	Mn	S	P	Cr	Ni	Mo	V	Al	Cu	Sn	
Min	0.28	0.15	0.40			0.80		0.15		0.01			
Max	0.33	0.35	0.60	<0.025	0.025	1.10	<0.5	0.25	<0.02	0.04	<0.35	<0.035	

<i>Typical Mechanical Properties: At room temp, heat treated to 18-22HRc</i>							
	Tensile Strength	Yield (0.2%)		Elongation	Reduction of area	Hardness	Charpy
	KSI	KSI		%	%	HRc (HB)	-46C -60C
Min	95	60		20	40	18 [217]	42 27
Max	130	110				22 (235)	

[Dimension of Ground Plate](#)

[Steel Material Datasheet](#)

ELECTRICAL SAFETY FORM

Part 1

Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------

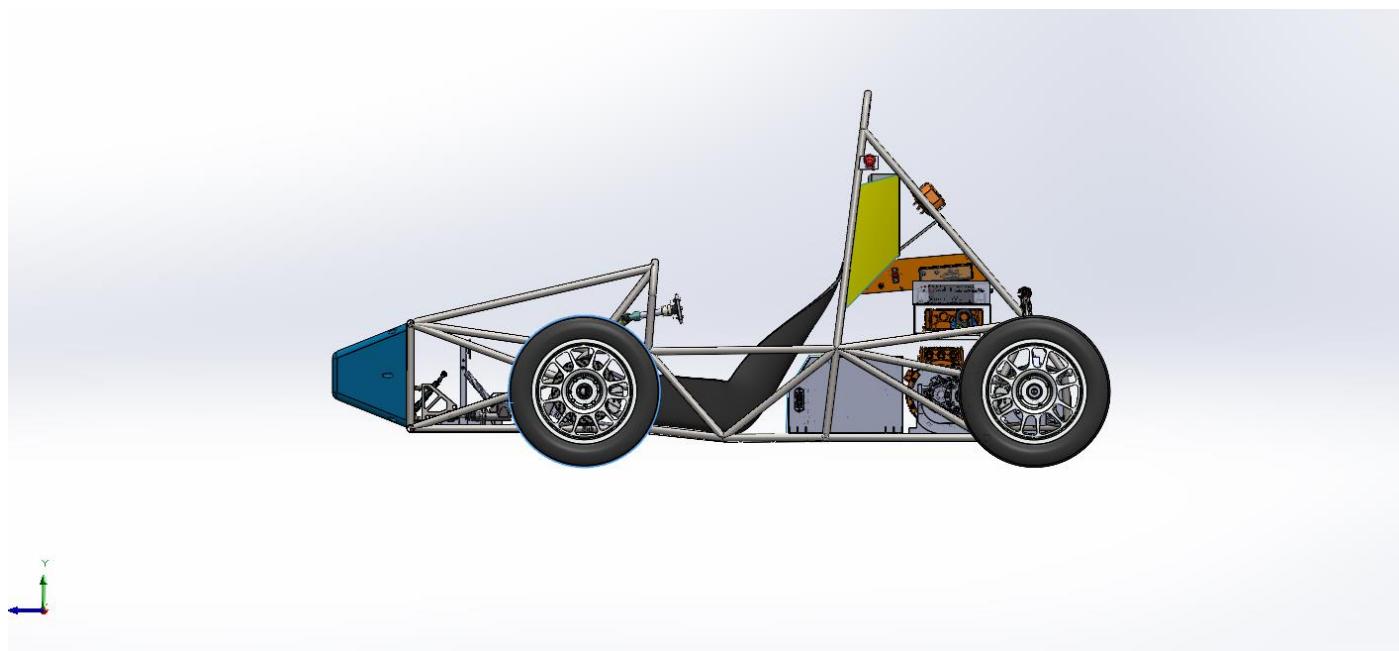
Firewall

General Information

Attributes	Comment (Team)
Accordance with EV4.8	Yes
How team is attaching Aluminium and Insulating material Layer with each other	Explanation UL 94 V-0 approved flame-retardant structural epoxy adhesive is used to adhere Aluminium layer with Nomex insulating material. Adhesive model is MG 9200FR. Datasheet

CAD Rendering

1. CAD Render should contain:
 - Wire passing through grommets
 - Supporting EV 4.8.1
 - In different views (sufficient to understand design)



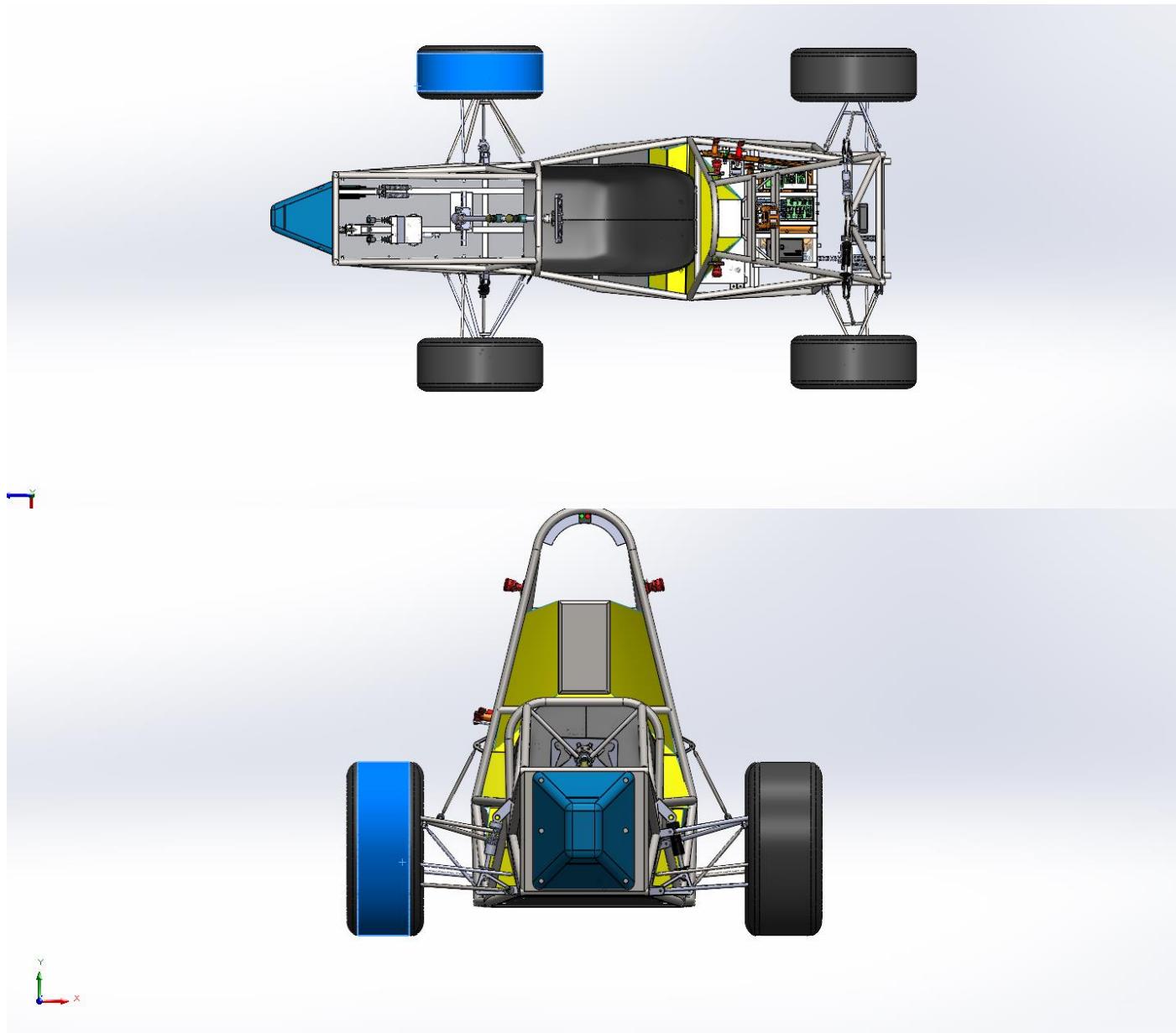
ELECTRICAL SAFETY FORM

Part 1

Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------



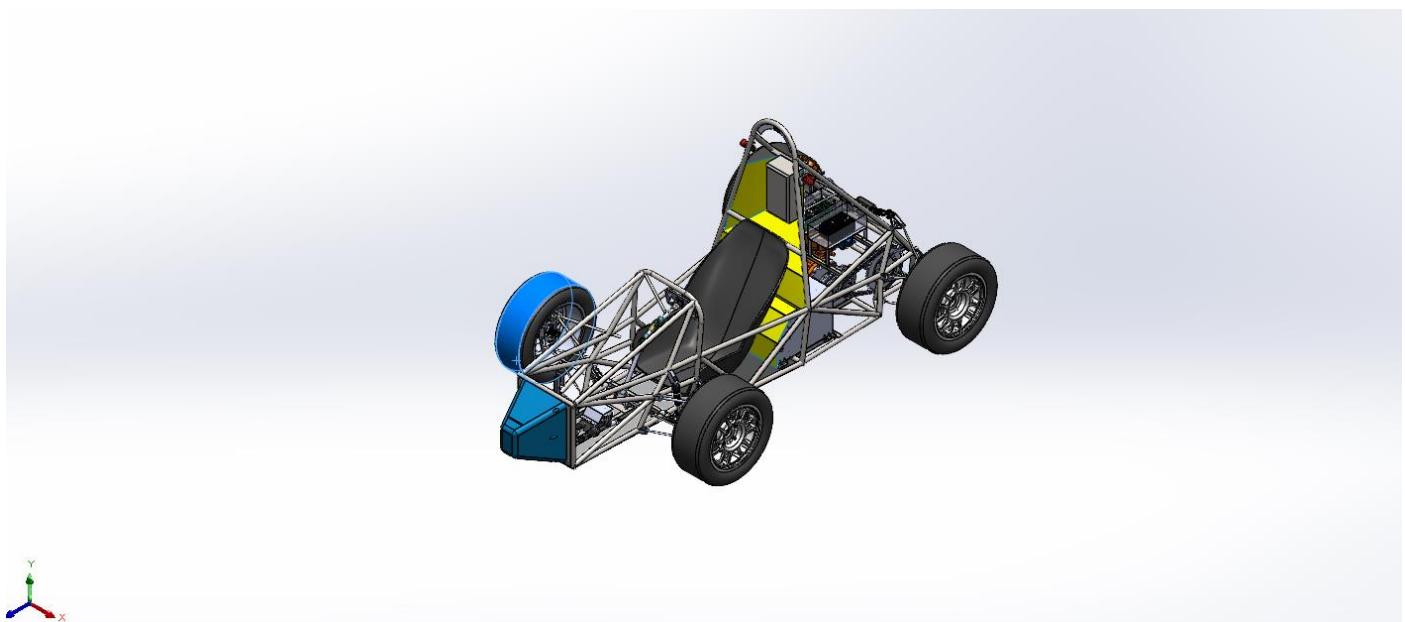
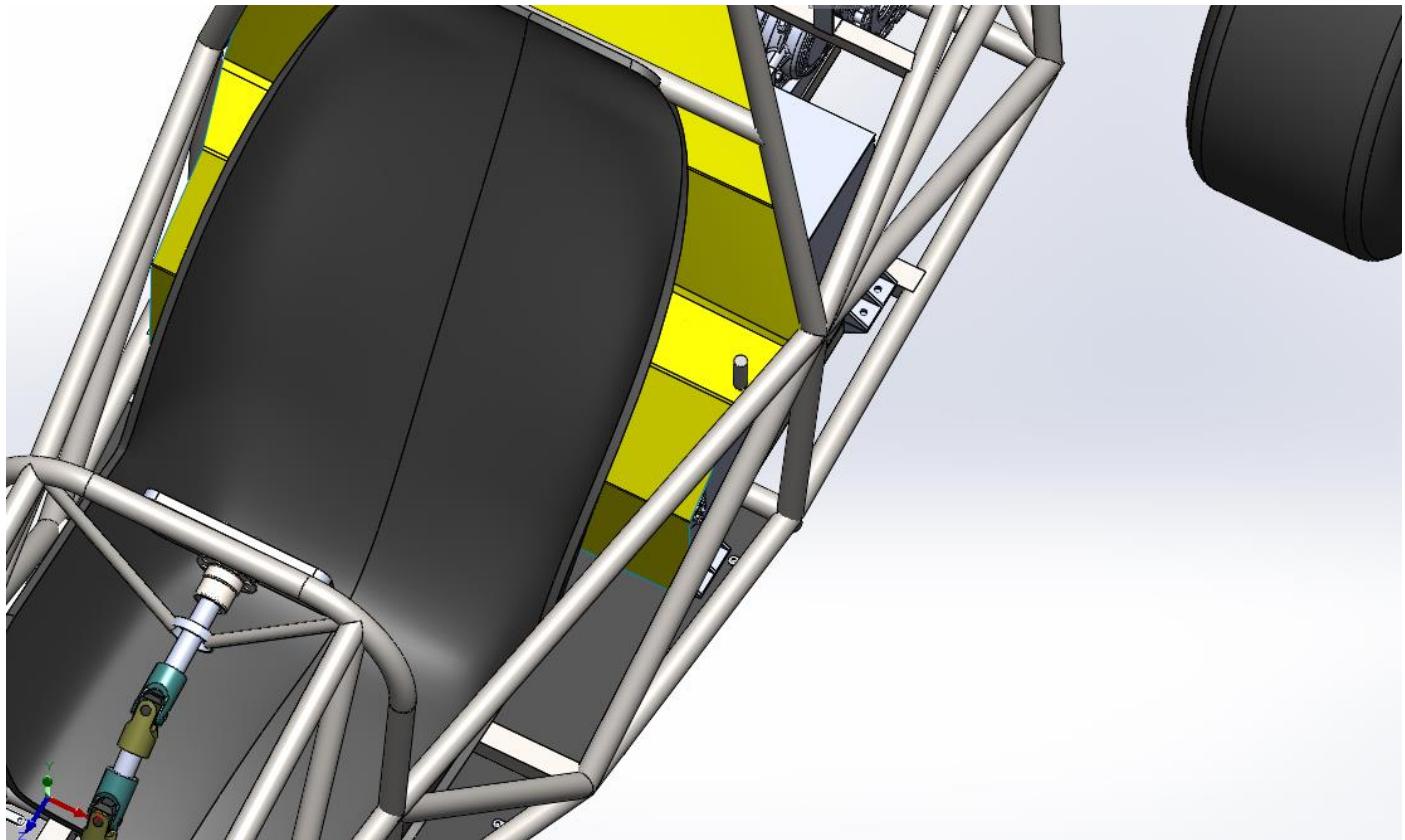
ELECTRICAL SAFETY FORM

Part 1

Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------



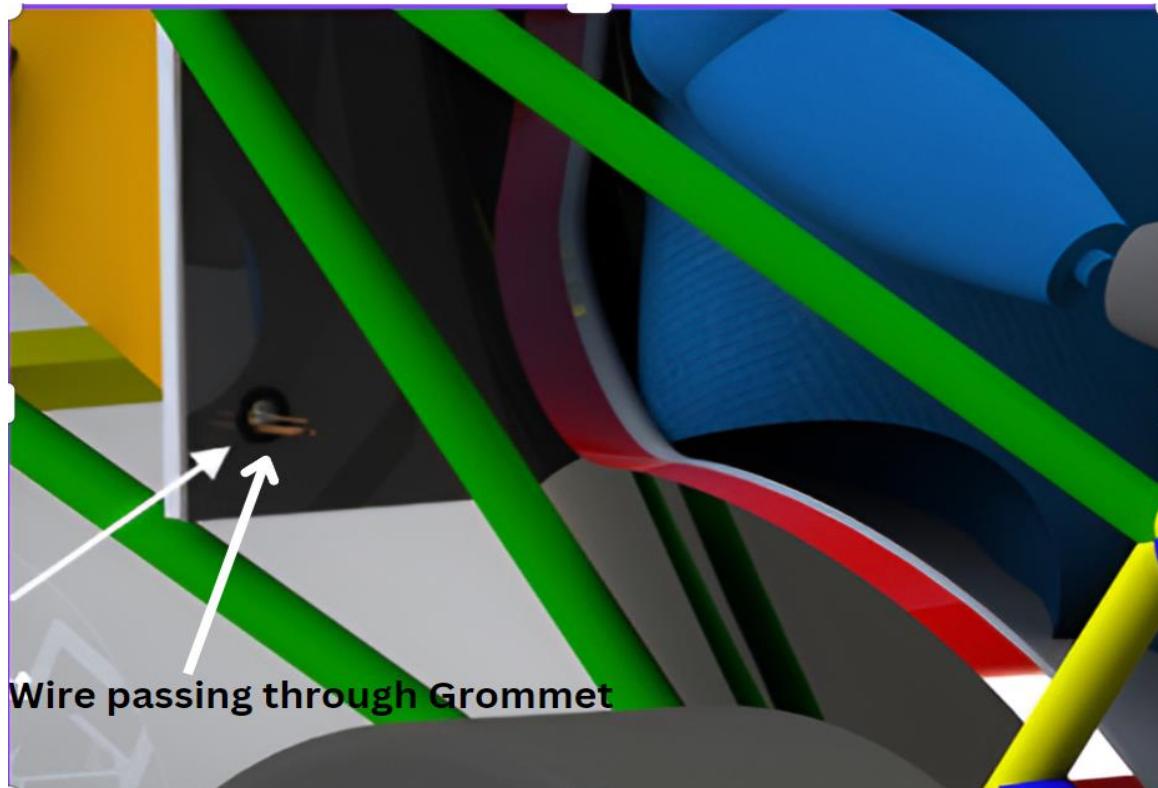
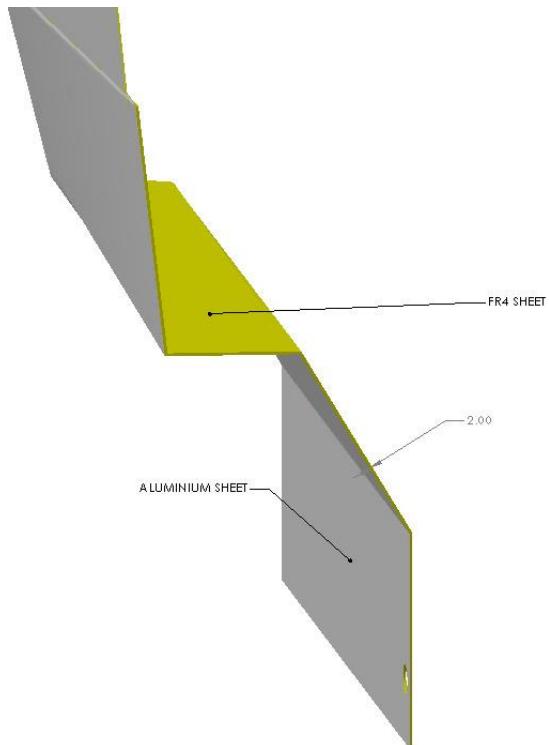
ELECTRICAL SAFETY FORM

Part 1

Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------



Wire passing through Grommet

ELECTRICAL SAFETY FORM

Part 1

Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------

Datasheets

1. Insulating material used (Material Datasheet and invoice)

Insulating Material Datasheet

2. Aluminium (Material DataSheet and invoice)

GENERIC PHYSICAL PROPERTIES		BS EN 485-2:2008 Sheet and Treadplate 0.2mm to 6.00mm	
Property	Value	Property	Value
Density	2.68 g/cm³	Proof Stress	130 Min MPa
Melting Point	605 °C	Tensile Strength	210 - 260 MPa
Thermal Expansion	23.7 × 10⁻⁶ /K	Hardness Brinell	61 HB
Modulus of Elasticity	70 GPa		
Thermal Conductivity	138 W/m.K		
Electrical Resistivity	0.0495 × 10⁻⁶ Ω .m		

Aluminium layer Datasheet

Description	Dimensions (Inch)						Part Number
	A	B	C	D	E	F	
Rubber Grommet	0.125	0.062	0.188	0.25	0.344	0.0785	BG-901
	0.188	0.063	0.188	0.313	0.438	0.0625	BG-2286
	0.188	0.063	0.25	0.313	0.5	0.0935	BG-8051
	0.25	0.062	0.25	0.375	0.5	0.094	BG2902
	0.25	0.125	0.25	0.375	0.5	0.0625	BG2903
	0.281	0.156	0.344	0.375	0.625	0.094	BG-921
	0.312	0.062	0.281	0.438	0.625	0.1095	BG505
	0.375	0.062	0.25	0.5	0.625	0.094	BG230
	0.438	0.063	0.25	0.563	0.75	0.09375	BG-1787
	0.5	0.063	0.281	0.625	0.812	0.1094	BG230-060
	0.563	0.063	0.313	0.75	1	0.125	BG-915
	0.625	0.0625	0.313	0.875	1.125	0.125	BG-2285
	0.687	0.078	0.375	1	1.312	0.1485	BG-1032

3. Grommet for Wiring harness.

Grommet Datasheet

4. Any other relevant part.

N/A

ELECTRICAL SAFETY FORM

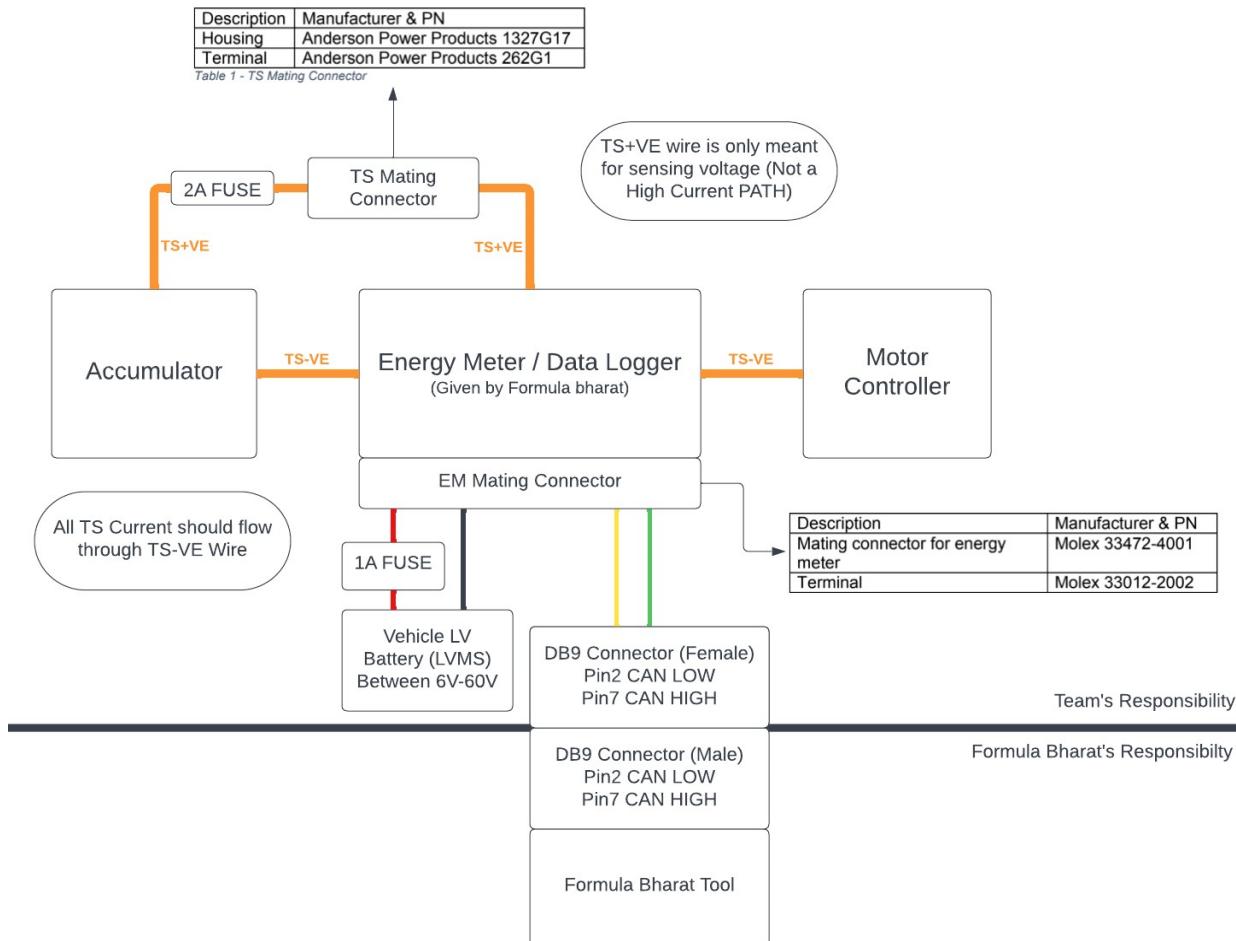
Part 1

Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------

Energy Metre / Data Logger



General Information

Attributes	Comment (Team)
The above diagram and requirement from the team is cleared.	Yes
Accordance with EV4.6	Yes

CAD Rendering

- Placement of Energy Meter

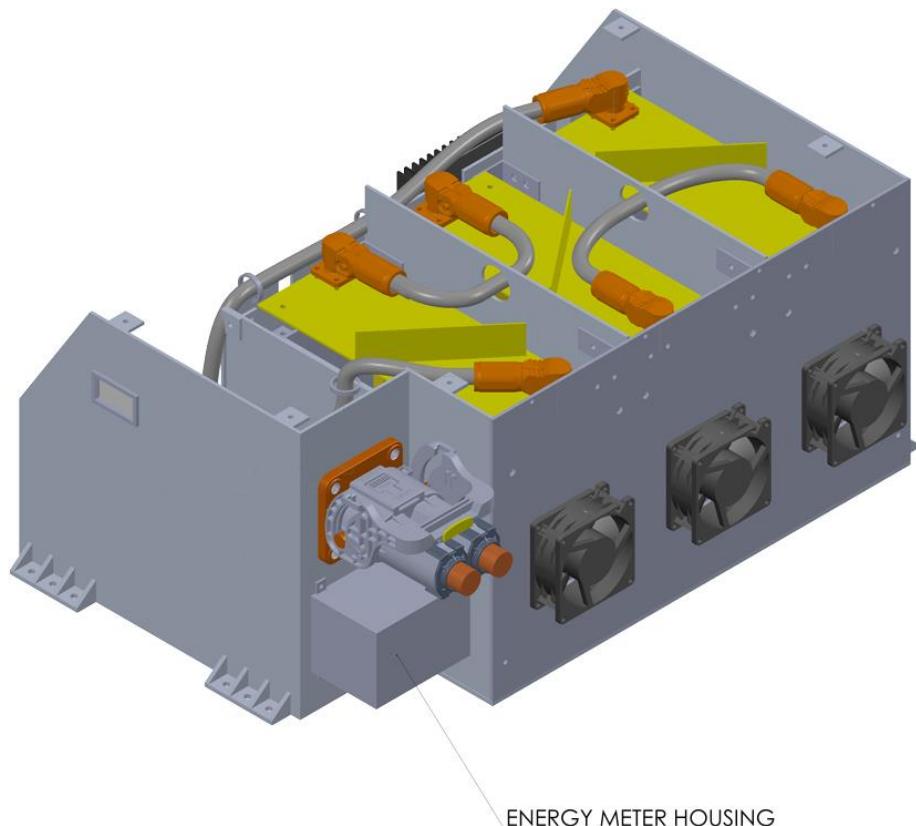
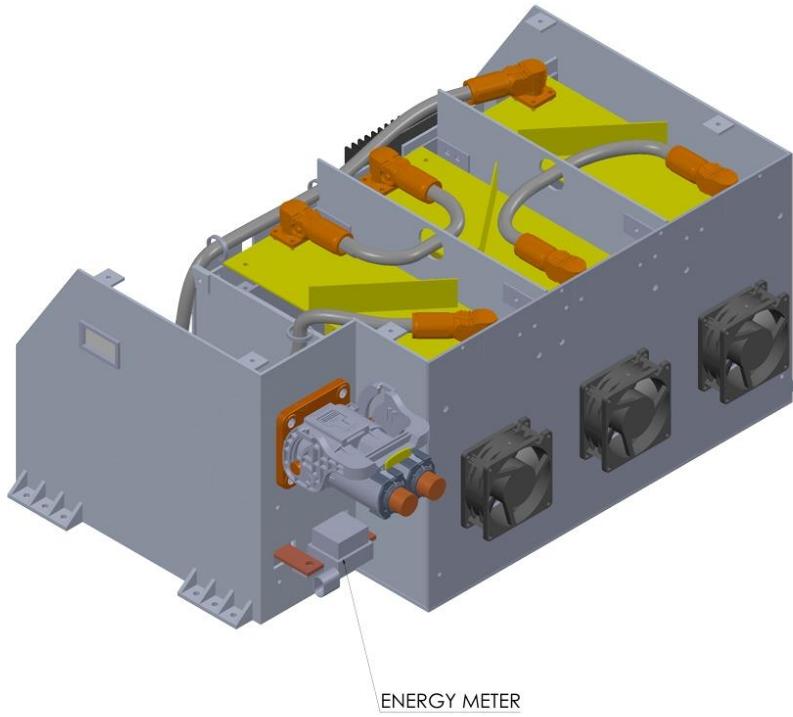
ELECTRICAL SAFETY FORM

Part 1

Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------



ELECTRICAL SAFETY FORM

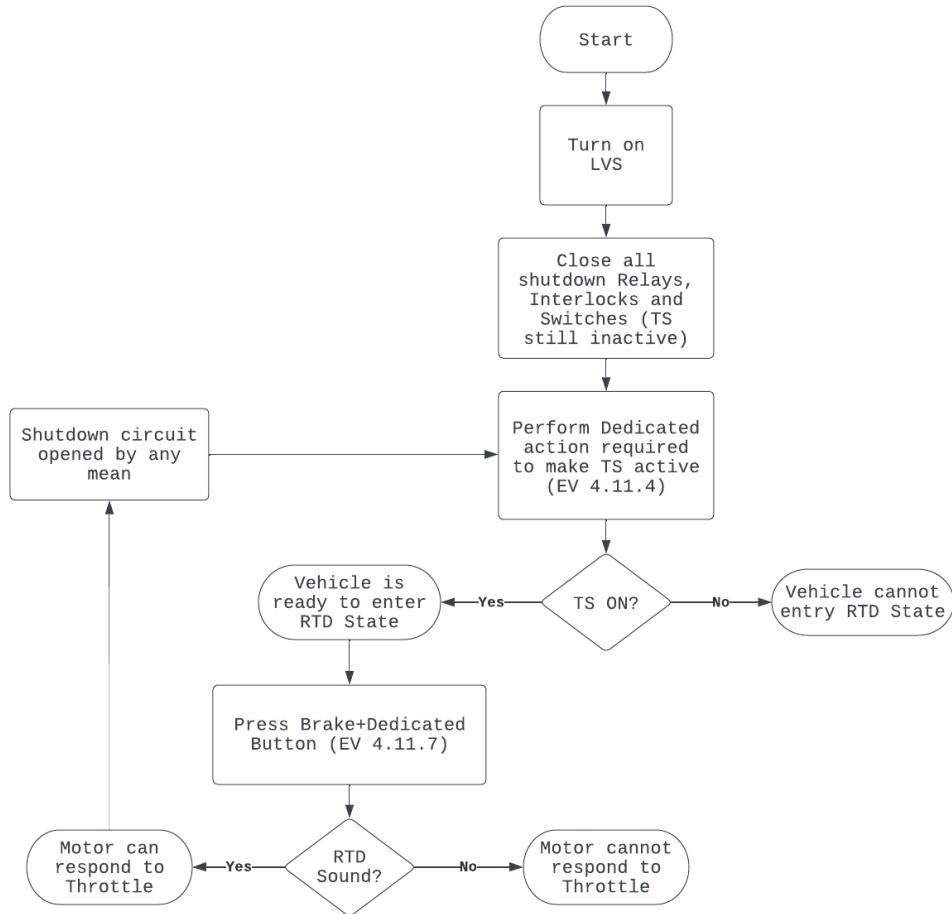
Part 1

Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------

Ready to Drive



General Information

Attributes	Comment (Team)
RTD implemented as per above flowchart	Yes
Accordance with EV4.11	Yes
Datasheet of RTD Buzzer/Speaker	Datasheet SPL(0.3m) = 105dBA SPL(2m) = 105dB A - 20*log(200/30)= 88.5dB A
Datasheet of other relevant part	Datasheet

ELECTRICAL SAFETY FORM

Part 1

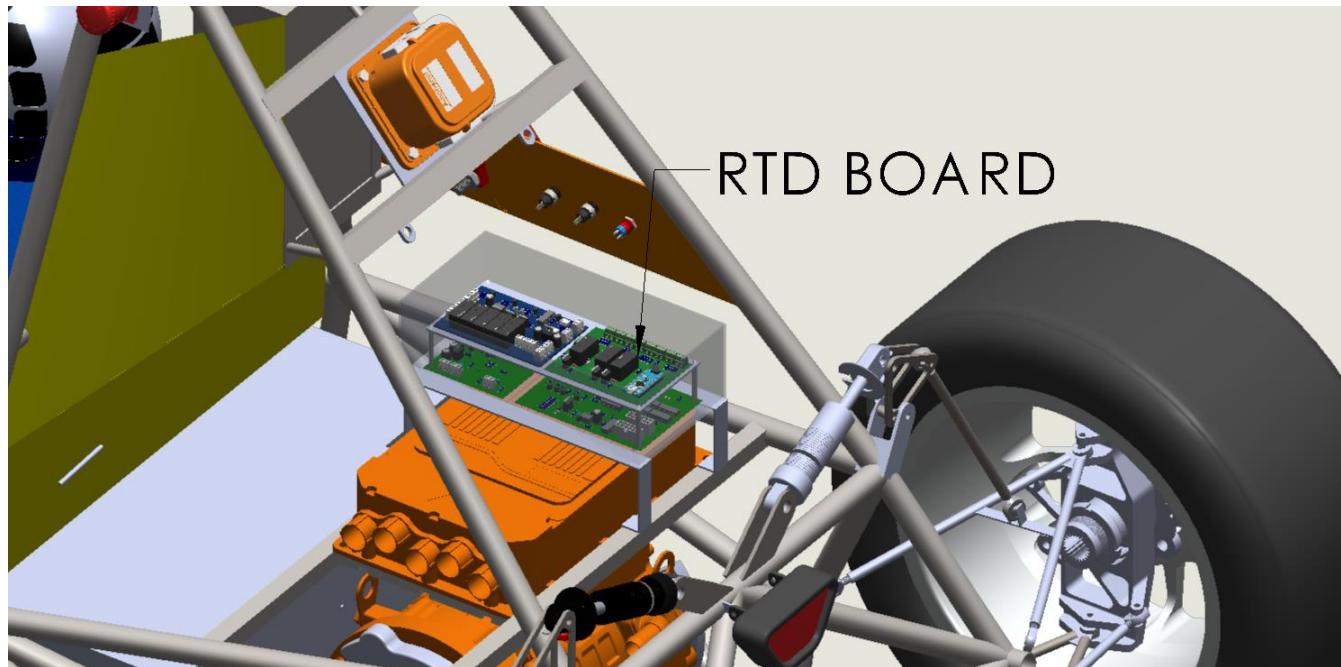
Version: 2



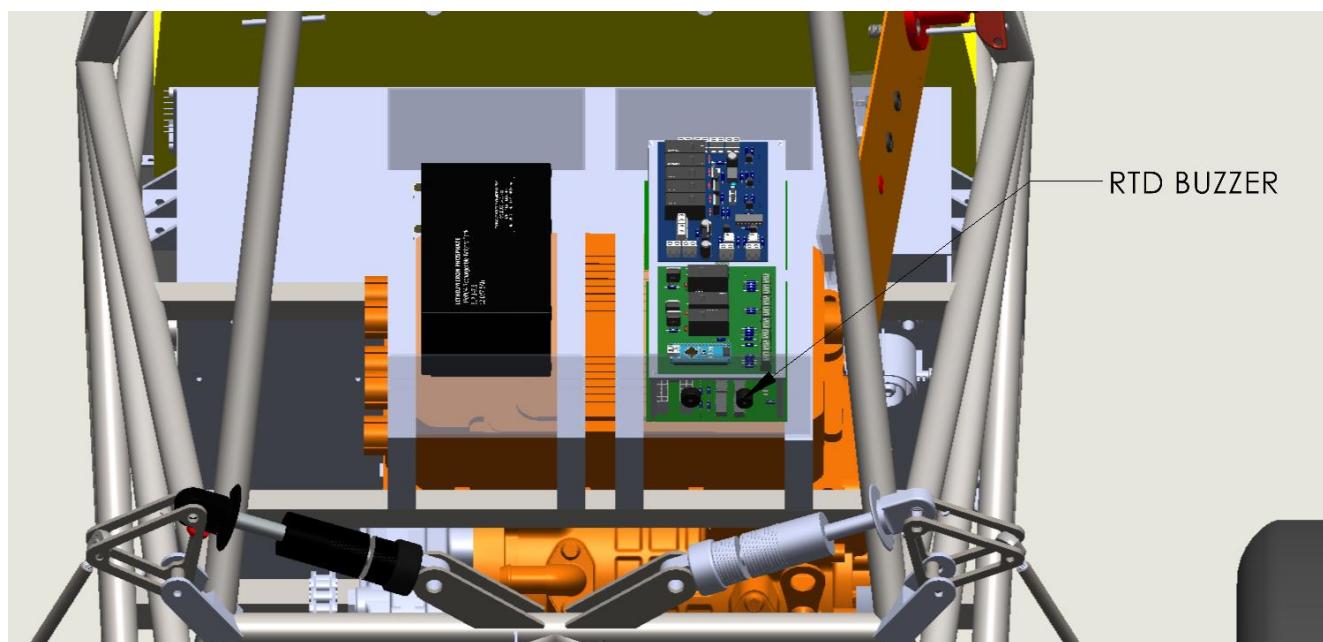
CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------

CAD Rendering

- Placement of Board controlling RTD Speaker/buzzer:



- Placement of RTD Speaker/Buzzer



3.

ELECTRICAL SAFETY FORM

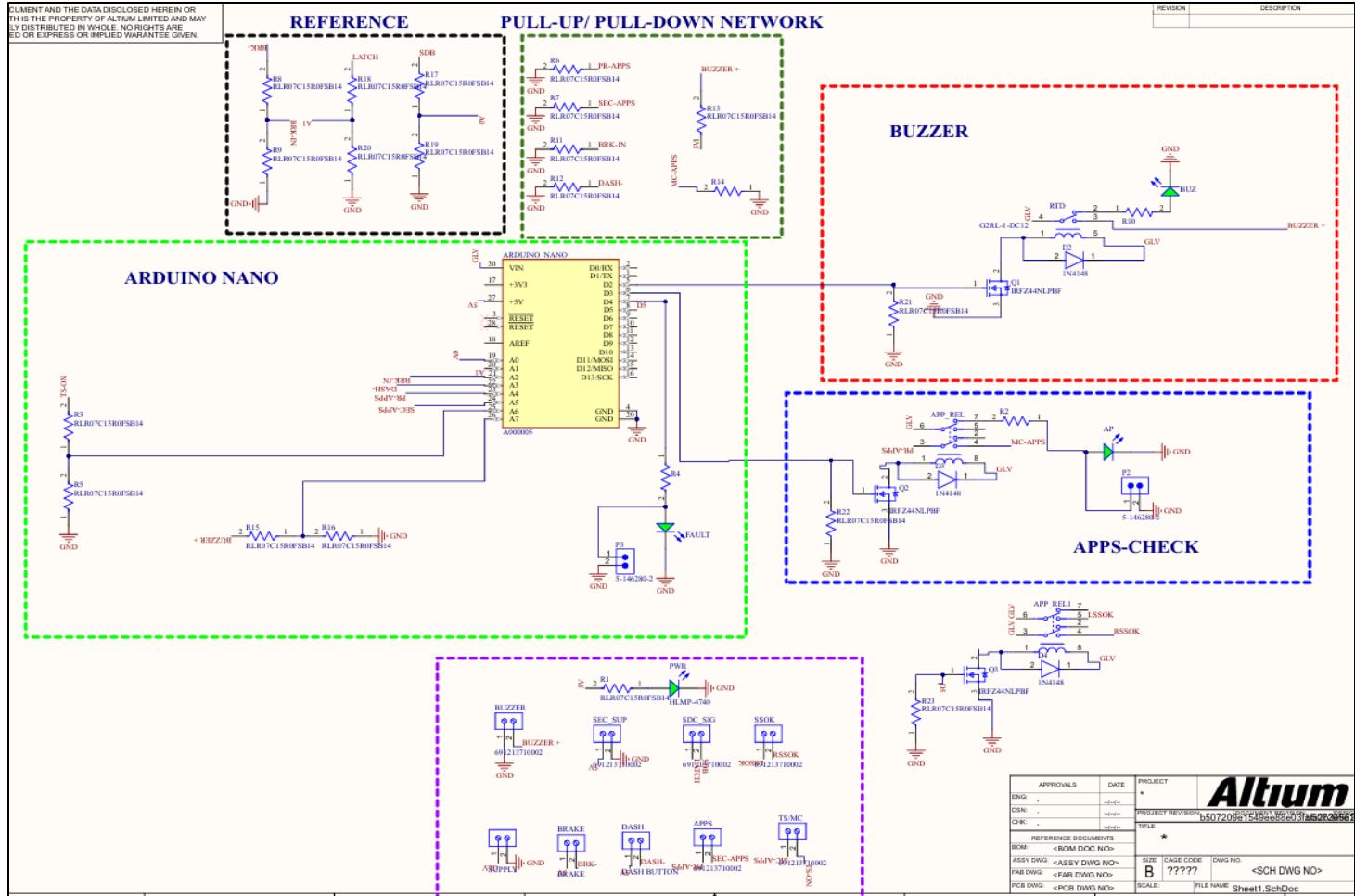
Part 1

Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------

Schematics



Code: RTD board programmed as per the above flowchart

```

void check(const int pin1, const int pin2, const int D2, const int D3, const int A5) {
    float tract_sys;
    bool conditionMet = false;
    unsigned long startMillis = millis();
    float dashboard_rtd_button = analogRead(pin1) * (5.0 / 1023.0);
    float is_brake_on = analogRead(pin2) * (5.0 / 1023.0);
    while (millis() - startMillis < 2000) {
        if (dashboard_rtd_button >= 4.5 && is_brake_on >= 4.5) {
            conditionMet = true; // both brake pressed and RTD button pressed together
        }
        delay(100); // Short delay to avoid reading too frequently
    }
    if (conditionMet) {
        unsigned long buzzerStart = millis();
        while (millis() - buzzerStart < 3000) {
            digitalWrite(pinD2, HIGH);
            delay(20); // Adjust for 2-3 Hz buzz
            digitalWrite(pinD2, LOW);
            delay(20); // Adjust for 2-3 Hz buzz
        }
        digitalWrite(pinD3, HIGH); // RTD mode engaged
        return ;
    }
}

```

ELECTRICAL SAFETY FORM

Part 1

Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------

```

if (tract_sys >=1.5) {
    check(pinA0, pinA1, pinD2, pinD4,tract_sys);
} // Vehicle not RTD if tractive system off
else{
    digitalWrite(pinD4, LOW);
    Serial.println("Tractive System OFF");
}

```

Datasheets

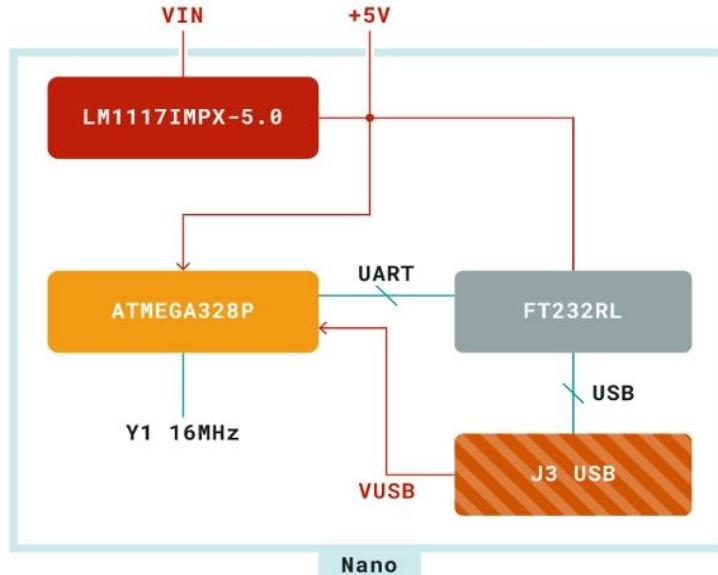
1. RTD Speaker/Buzzer

Specifications

Tone Nature	: Continuous, Normal and Fast pulse
Operating Voltage	: 6V AC to 28V AC
Rated Voltage	: 12V DC
Current at Rated Voltage	: 25mA (Max.)
Resonant Frequency	: 2,900 ±500Hz
Sound Output at 30cm, at rated voltage	: 105dB
Operating Temperature	: -20°C to +70°C
Storage Temperature	: -30°C to +80°C
Housing material	: PBT (White)
Lead Wires	: 26AWG
Weight	: 20g

[Datasheet](#)

2. Arduino Nano:



[Datasheet](#)

ELECTRICAL SAFETY FORM

Part 1

Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------

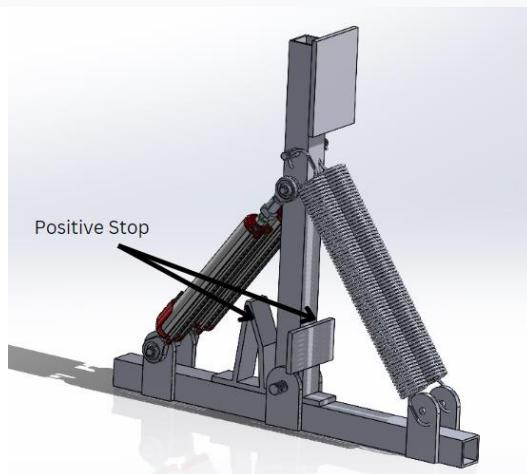
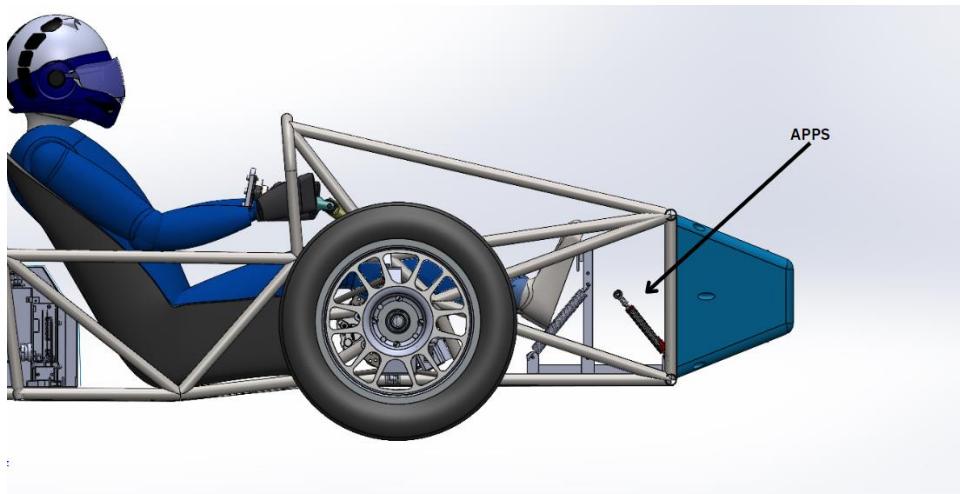
Torque Encoder

General Information

Attributes	Comment (Team)
RTD implemented as per above flowchart	Yes
Accordance with T11.8, EV2.3	Yes
Transfer Curve	Link

CAD Rendering

1. Placement of APPS on car



ELECTRICAL SAFETY FORM

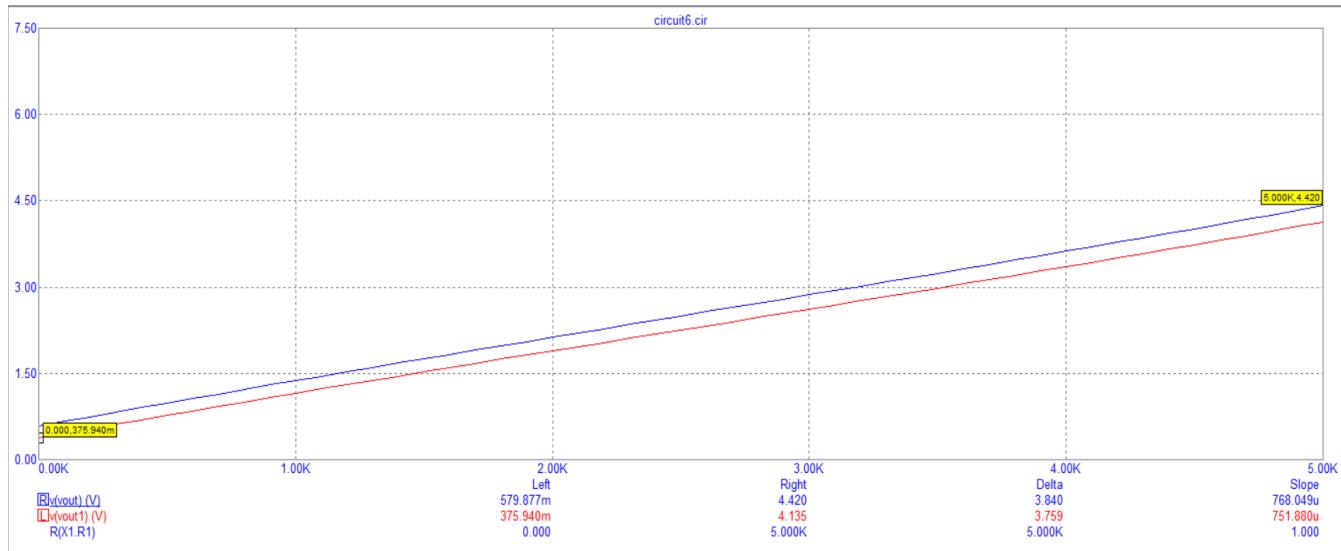
Part 1

Version: 2



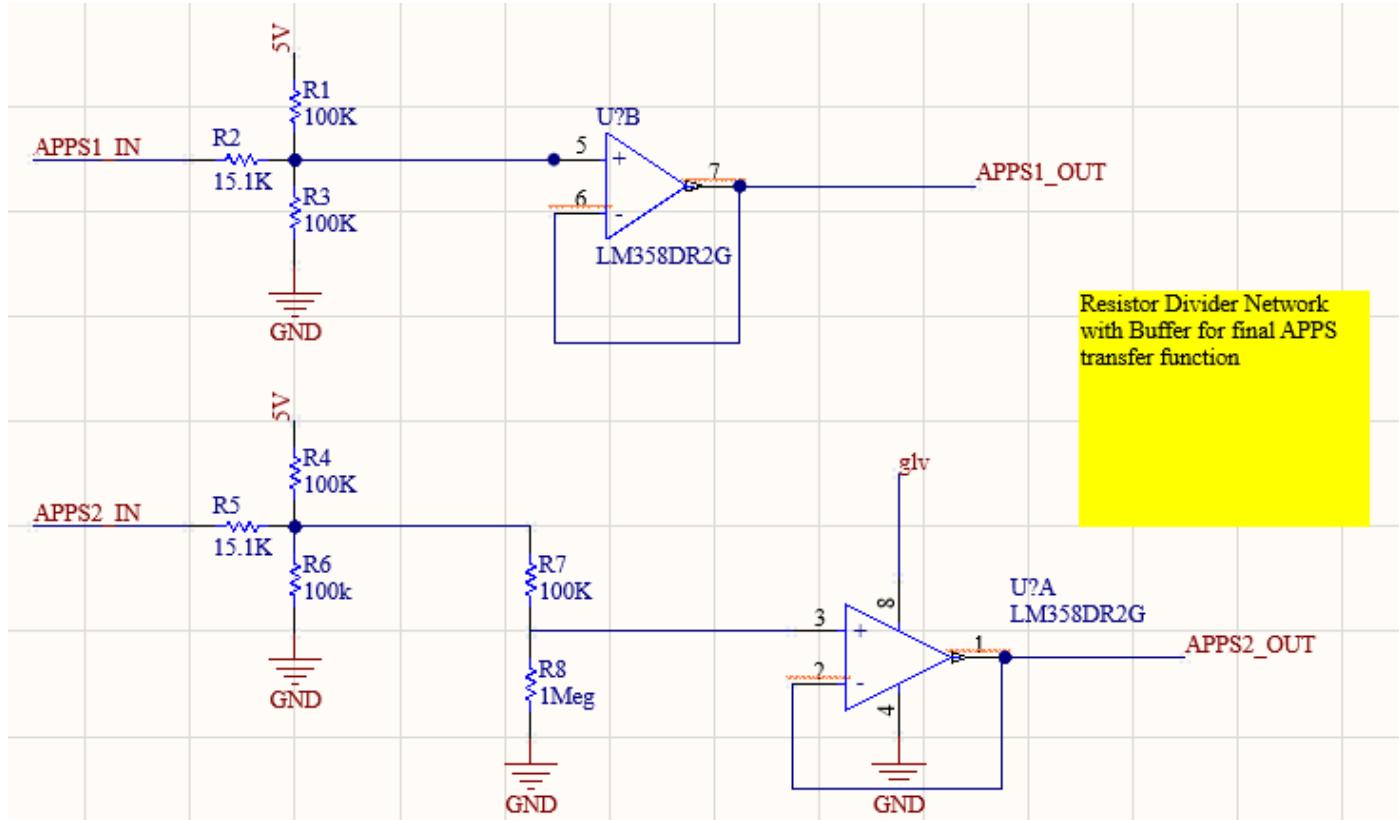
CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------

2. Sensor Output v/s Percentage Travel Plot



Schematics:

APPS buffer and transfer function circuit



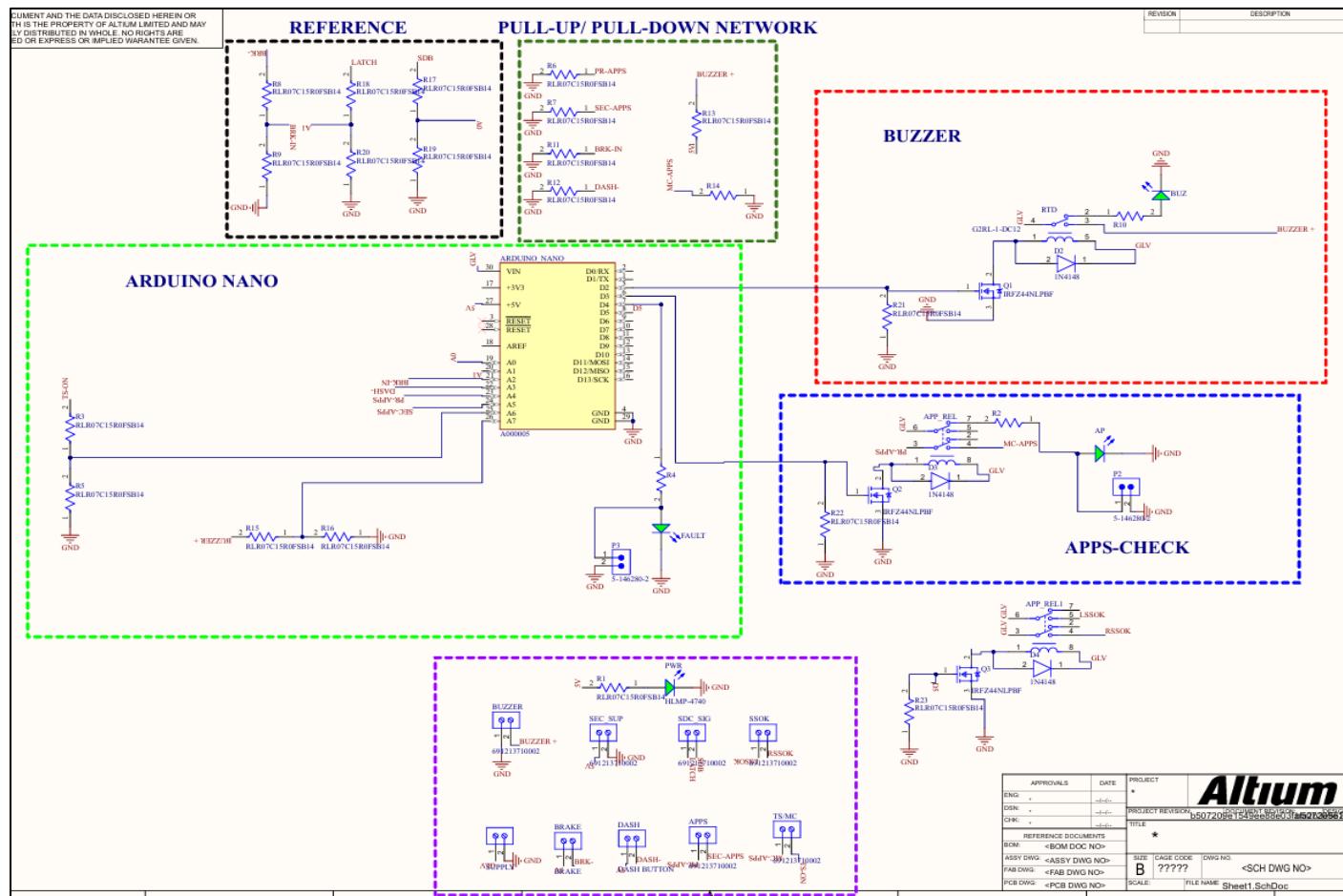
ELECTRICAL SAFETY FORM

Part 1

Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------



Code:

```

void check_apps(const float apps1, const float apps2, const int apps_relay_control) {
    digitalWrite(apps_relay_control, HIGH);
    // voltage to pedal percentage conversion
    const float apps1_low = 0.376;
    const float apps1_high = 4.135;
    const float apps2_low = 0.580;
    const float apps2_high = 4.420;
    const int apps1_V2percent = 100*((apps1-apps1_low)/(apps1_high-apps1_low));
    const int apps2_V2percent = 100*((apps2-apps2_low)/(apps2_high-apps2_low));
    if ((apps1 == 0 || apps1 == 5 || apps1<(apps1_low-0.1) || apps1>(apps1_high+0.1)) && (apps2 == 0 || apps2 == 5 || apps2<(apps2_low-0.1) || apps2>(apps2_high+0.1))){
        digitalWrite(apps_relay_control, LOW); // T11.9 SCS rules implementation
    }
    if ( (apps1_V2percent - apps2_V2percent) > 10 ){
        digitalWrite(apps_relay_control, LOW);
    } // T11.8.9 implausibility implementation
}

```

ELECTRICAL SAFETY FORM

Part 1

Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------

Datasheets

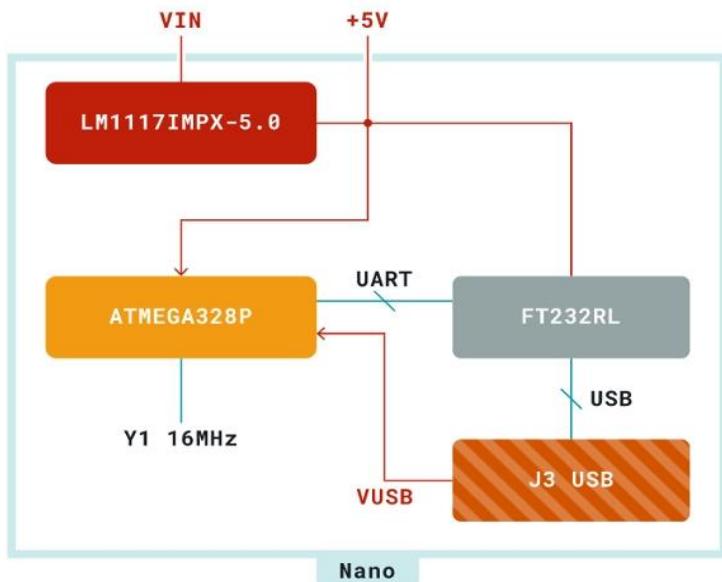
1. APPS

Technical specifications	
Measurement stroke	10 - 400 mm
Linearity	$\pm 0,05$ (>200 mm), $\pm 0,1$ (130-200) $\pm 0,02$ (75-130), $\pm 0,5$ (<75 mm)
Repeatability	< 0,01 mm
Resolution	Infinite
Resistance	2 kOhm : 10 - 50 mm 5 kOhm : 75 - 400 mm
Resistance tolerance	± 20
Load resistance	100 kOhm min.
Recommended wiper current	<1 μ A
Permissible applied voltage	28 VDC max.
Electrical connections	Connector or 1 m cable output
Displacement speed	< 5 m/s
Mechanical life	100 million movement
Case dimensions	Ø18 mm
Case material	Anodized aluminium
Rod material	Stainless steel
Rod diameter	Ø5 mm
Mechanical fixing	Ball joints on the both sides
Protection level	IP 65 - EN 60529
Operating temperature	-20°C ... +80°C
Storage temperature	-30°C ... +90°C

[APPS Datasheet](#)

2. Any other relevant part:

Arduino Nano



[Datasheet](#)

ELECTRICAL SAFETY FORM

Part 1

Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------

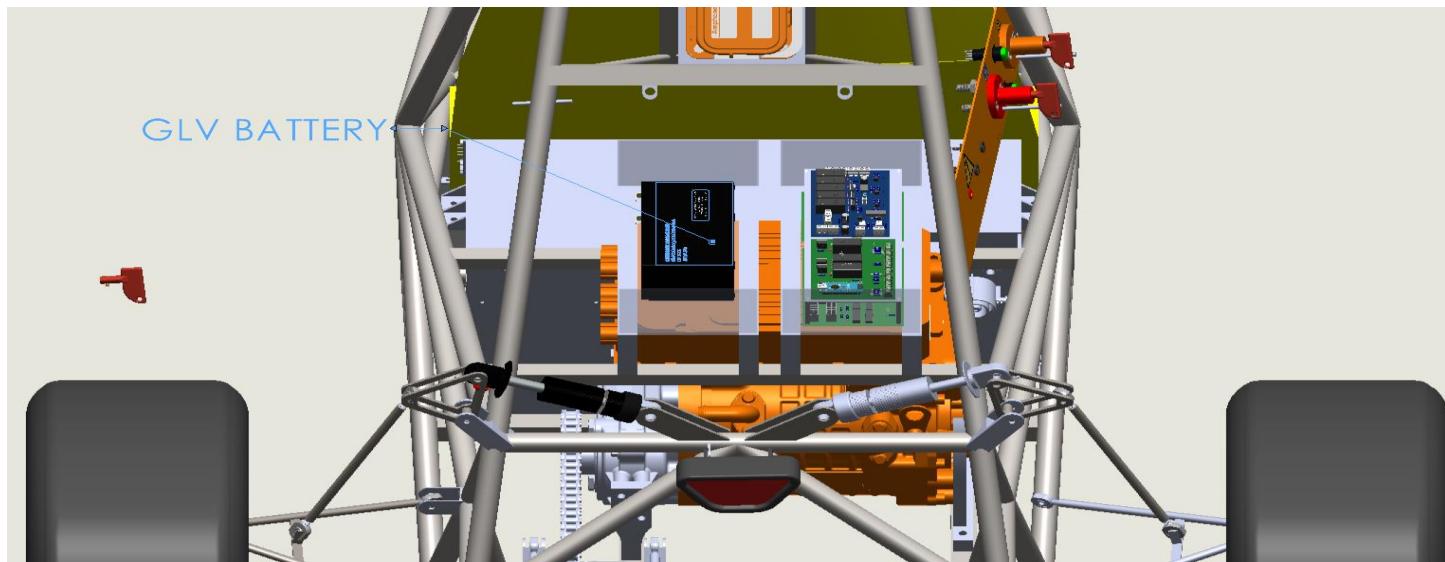
Low Voltage Supply

General Information

Attributes	Comment (Team)
DC-DC Powered by TS / bought LV Battery / Self Designed LV Battery	Bought 12V LFP battery
Cell Chemistry and Battery Configuration	LiFePo4 cells in 4S2P configuration
LV Supply max and nominal voltage	Value (max): 14.6V Value (nominal): 12V
Capacity	12Ah
Max Continuous Discharge Current	12A
Operating temperature	-10°C to 70°C

CAD Rendering

- Placement of LV Battery:



- CAD Model of Self designed battery pack in all view (if any):
INSERT RENDER HERE.

ELECTRICAL SAFETY FORM

Part 1

Version: 2



CAR #	E13	TEAM NAME	IITK Motorsports	EVENT	Formula Bharat 2025	CONTACT NAME	Tanmay Soni	CONTACT EMAIL	tanmaysoni66@gmail.com
-------	-----	-----------	------------------	-------	---------------------	--------------	-------------	---------------	------------------------

Datasheets

1. Datasheet of DC-DC powered by TS / Bought LV Battery:

Battery Specification :

Nominal Characteristics			
Nominal Voltage /V			12V
Nominal Capacity /Ah (0.2C)			≈12Ah
Operating Voltage Range			10V-14.6V
Thermal Protection	Charging	50	°C
	Discharge	70	°C
	Low Temperature	-10	°C

[Datasheet](#)

2. All relevant part if LV battery is self-designed (if any):

*INSERT RELEVANT PART OF DATASHEET HERE.
ALSO, PROVIDE LINK TO FULL DATASHEET HERE.*