FSR 2026 ESF
v260316

Template

Coversheet

The Coversheet must contain the following:

- **Heading “Electrical System Form FSR 2026”**
- **University and Team Name**
- **Car number**

Feel free to add team logo, car picture, and so one.

Requirements (delete this section after you have read and understood it):

1. Complete all sections and tables of the ESF. Do not hesitate to add additional tables and pictures if needed.
2. If a section is not applicable to your design state that in the document, **do not delete any sections**.
3. Remove instructions (gray text) from document as you complete the sections. If necessary, you can easily change text style by clicking right mouse button on selected text, clicking “Styles” button, and choosing “Default” style.
4. Provide **hyperlinks** to all datasheets. All datasheets must be accessible via Internet.
5. Ensure that all Figures and Tables are included in Table of Figures and Table of tables.
6. If you are unsure with respect to feedback of the reviewer, do not hesitate to ask the judges via sport@fstudent.ru
7. Parts of the ESF which are changed because of reviewer’s feedback must be marked in **red**.
8. Export the final document to **PDF** and send it to sport@fstudent.ru.
9. Following these guidelines will guarantee a swift review process.

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Abbreviations

AIR – Accumulator Insulation Relay
AMS – Accumulator Monitoring System
BOTS – Brake-Over-Travel-Switch
BSPD – Brake System Plausibility Device
GLV – Grounded Low Voltage
GLVMP – Ground Low Voltage Measurement Point
HV – High Voltage
IMD – Insulation Monitoring Device
TS – Tractive System
TSAL – Tractive System Active Light
TSMP – Tractive System Measurement Point

1 System Overview

Include brief description of vehicle (1 paragraph).

Complete the information in the table below.

Maximum Tractive System Voltage:	1000VDC
Nominal Tractive System Voltage:	960VDC
Nominal Tractive System Current:	500A
Peak Tractive System Current:	1000A
Battery configuration	75s3p
Cell chemistry / Capacity	NMC / 20Ah
Number of Accumulator Containers:	2
Total Accumulator Capacity:	20kWh
Motor Type:	AC Induction
Number of Motors:	Total 4, one per wheel
Maximum Combined Motor Power:	150kW
Grounded Low Voltage System Voltage:	2.5VDC

Table 1-1 - High Level Specifications

Insert a system overview block diagram showing major electrical components and system interactions.

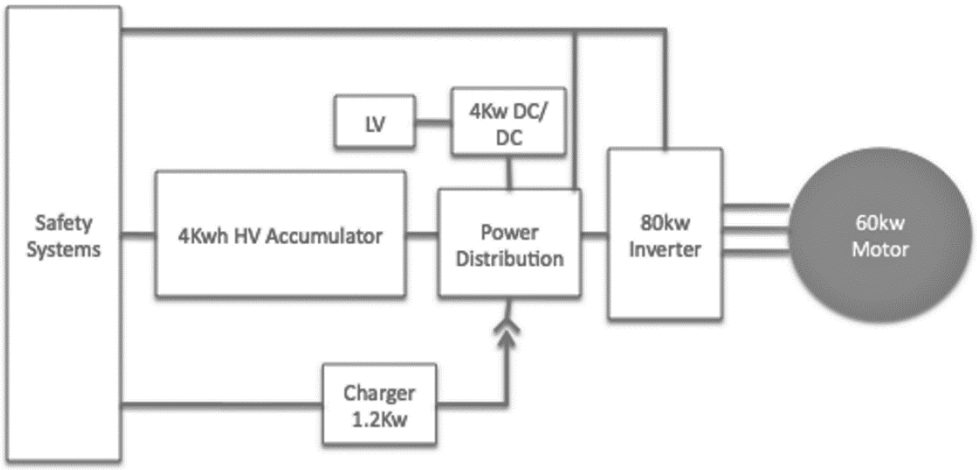

Figure 1-1 – System Block Diagram

1.1 System Critical Signals (SCS)

Add an overview of System Critical Signals handling concept for the whole vehicle. Provide details for both analog and digital signals. Add details of which systems are enabled when the vehicle is in safe state.

2 Tractive System Schematics

2.1 Tractive System Schematic (Power Electronics ONLY)

Include brief description of Tractive System.

Insert a large (full page) schematic of the HV system. This schematic should focus on the components that are not within the accumulator. Provide boxes and 1st level interfaces when details will be provided later in this document. Some detail of components within the accumulator may be included for better understanding (ie AIRs).

Figure must include the following:

- Wire Size (AWG or mm^2)
- Relative fuse location (end of wire vs middle)
- Fuse rating (Amperage and Voltage)
- Motor controller (1st level interfaces...inputs & outputs)
- Motor
- Inline connectors and interfaces for charging
- TSMP and relative current limiting resistor locations
- Show enclosures as dashed lines

The figure must include the following if not within the accumulator:

- IMD
- DC/DC converter if used
- Precharge and Discharge circuit
- Energy Meter
- HVD

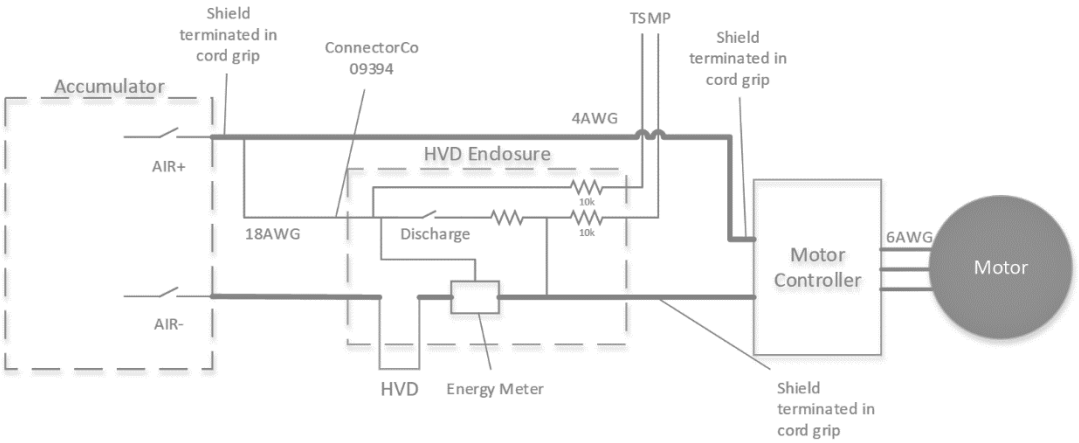

Figure 2-1 – HV System Schematic

2.2 Fusing Diagram

Include a fusing tree diagram like the one shown below.

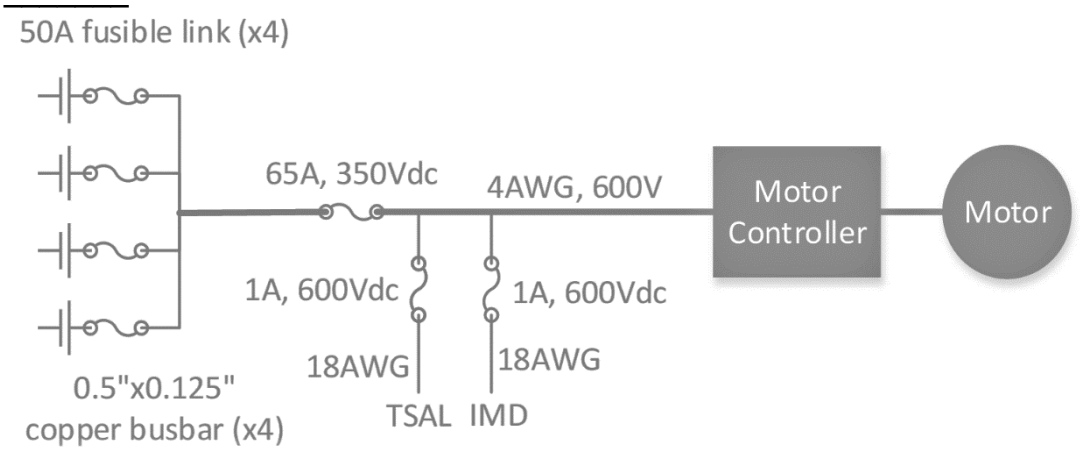

Figure 2-2 – Fuse Tree Diagram

2.2.1 Fuse Specifications

Complete the information in the table below.

Model/Name	Fuse Location	Voltage Rating	Current Rating nominal/max	Datasheet
Fusefuse 123a	LV battery connection	24V	2A/5A@10s	Datasheet

Table 2-1 – Fuse Specifications

2.2.2 Conductor Specifications

Complete the information in the table below.

Model/Name	Conductor Location	Size	Voltage Rating	Current Rating nominal/max	Datasheet
Wirewire AB2C	LV connections	24AWG	600V	2A/5A@10s	Datasheet
Wirewire AC3B	Motor connection	15 mm2	600V	150A/250A@1min	Datasheet

Table 2-2 – Conductor Specifications

2.2.3 Connector Specifications

Complete the information in the table below.

Model/Name	Connector Location	Voltage Rating	Current Rating nominal/max	Includes Interlock	Datasheet
Connector UniPlug 2	TSAC to Motor controller	600V	200A/350A@1min	Yes	Datasheet
Connector UniPlug 1	LV battery connector	600V	5A/10A@1min	Yes	Datasheet

Table 2-3 – Connector Specifications

3 Shutdown Circuit

3.1 Shutdown Circuit Schematic

Insert a large (full page) schematic of the shutdown circuit.
The schematic must include the following:

- All shutdown circuit switches/devices (indicate Normally Open or Closed)
- Safety interlocks associated to connectors or HVD
- AMS connection to shutdown circuit
- BSPD connection to shutdown circuit
- IMD connection to shutdown circuit (include path from output of IMD OKHS to shutdown circuit, additional detail may be provided in second figure)
- BOTS
- Inertia switch
- AIR coils including resistance of coil and voltage rating or economizer details
- Pre-charge relay coil
- GLV battery
- Fuse(s)
- Wire Size (AWG or mm^2)

Figure 3-1 – Shutdown Circuit Schematic

3.1.1 Switch Locations

Provide CAD-rendering(s) showing the shutdown circuit master switches, shutdown buttons, BOTS, other switches. Mark the parts in the renderings, if necessary. Include your design intent wire harness routing path.

Complete the information in the table below.

Device	Model/Name	Type	Voltage Rating	Current Rating	Datasheet
Master switches					Datasheet
Shutdown buttons					
BOTS					
Other switches					

Table 3-1 – Switches Data

Figure 3-2 – Shutdown Circuit Switch Locations

Figure 3-3 – Shutdown Circuit Switch Locations

3.2 Wiring

3.2.1 Shutdown Circuit Current

Complete the information in the table below.

Total Number of AIRs:	10
Current per AIR:	0.5A
Additional parts consumption within the shutdown circuit:	2A
Total current:	7A

Table 3-2 – Shutdown Circuit Loads

3.3 IMD

3.3.1 IMD Specifications

Complete the information in the table below.

Make / Model	Bender IR12345
Supply voltage	2VDC

Environmental temperature range:	45..55°C
Self-test interval:	every 20 ms
High voltage range:	DC 0..10V
Set response value:	30kΩ (500Ω/Volt)
Max. operation current:	500mA
Approximate time to shut down at 50% of the response value:	80s
Datasheet	Datasheet

Table 3-3 – IMD Specifications

3.3.2 IMD Fault Latching

Include schematic and brief description of how latching circuit for IMD operates. Also include the IMD status indicator in the figure.

Figure 3-4 – IMD Latch Circuit Schematic

3.3.3 IMD Location

Describe the location of the IMD.
Describe the location of the IMD indicator.
Describe the location of the reset button or include a CAD rendering or photograph to show its location.

3.4 Inertia switch

3.4.1 Inertia switch sensor

Complete the information in the table below.

Make / Model:	Acme Sensor Co. ABC123
Switch type:	Push/pull
Acceleration threshold:	20G
Datasheet:	Datasheet

Table 3-4 – Inertia Switch Specifications

3.5 Brake System Plausibility Device

3.5.1 BSPD Current Sensor

Complete the information in the table below.

Make / Model:	Acme Sensor Co. ABC123
Current input range:	+/- 150A
Output range:	0-50V
Datasheet:	Datasheet

Table 3-5 – BSPD Current Sensor Specifications

3.5.2 Brake Pressure Sensor

Complete the information in the table below.

Make / Model:	Braking Sensor Co.
Type:	Hydraulic
Output range:	0-5V
Datasheet:	Datasheet

Table 3-6 – BSPD Current Sensor Specifications

3.5.3 BSPD Setpoint

Complete the information in the table below.

Trip Current	62A
Current sensor output @Trip Current	35V
Delay time	200ms

Table 3-7 – BSPD Operation Details

3.5.4 BSPD Schematic

Include schematic of BSPD. Clearly show current sensor input, brake input and shutdown circuit output. Be sure schematic includes details addressing latching and timing.
Include brief description to clarify how BSPD works.

Figure 3-5 – BSPD Schematic

3.5.5 BSPD Location

Describe the location of the BSPD and reset button or include a CAD rendering or photograph to show its location.

Figure 3-6 – BSPD Component Location

3.5.6 BSPD Demonstration

Describe the method you will use to demonstrate the BSPD device at competition.

3.6 Accumulator Management System

3.6.1 AMS Faults

Describe what faults/conditions will cause the AMS to open the shutdown circuit.

3.6.2 AMS Fault Latching

Describe the method used to latch the AMS fault, include a schematic if appropriate.
Describe the location of the reset button or include a CAD rendering or photograph to show its location.
Describe the location of the AMS indicator or include a CAD rendering or photograph to show its location.

4 Safety Systems

4.1 TSAL

4.1.1 TSAL Specifications

Complete the information in the table below.

Make/Model:	Flashy Light Co. SprBrt12
Color:	Purple
Flash Rate:	18Hz
Powered By:	GLV
Controlled By:	TS
TS Turn On Voltage:	60
TS Turn Off Voltage:	58

Table 4-1 – TSAL Specifications

4.1.2 TSAL Schematic

Include a schematic showing the overall control circuit for the TSAL. The schematic should include all components from HV sense input to light. If team designed PCB is used with TS and GLV circuits provide CAD rendering or photograph showing spacing for TS/GLV separation.

Figure 4-1 – TSAL Circuit Schematic

4.1.3 TSAL Voltage Monitoring

Include a schematic showing the control circuits for the TSAL which are responsible of voltage monitoring in both vehicle and accumulator sides.

4.1.4 TSAL AIRs State Monitoring

Include a schematic showing the control circuits for the TSAL which are responsible of all accumulator relays state detection.

4.1.5 TSAL Location

Provide CAD-rendering(s) showing the TSAL parts. Mark the parts in the renderings, if necessary.

Figure 4-2 – TSAL Component Locations

4.1.6 TSAL Demonstration

How will you proof the correct functionality of the TSAL during Scrutineering?

4.2 TSMP

4.2.1 TSMP Specifications

Complete the information in the table below.

Make / Model:	Acme Connect Co P88943
Voltage Rating:	600V
Datasheet:	Datasheet

Table 4-2 – Measurement Point Specifications

4.2.2 TSMP Location

Provide CAD-rendering(s) showing the measurement points. Mark the parts in the renderings, if necessary.

Figure 4-3 – Measurement Point Location

4.2.3 TSMP Protection

Describe how the backs of the TSMPs are protected from being touched.
Describe how the fronts of the TSMPs are protected from rain entering and how the cover is removed for testing.

4.2.4 Body Protection Resistor

Complete the information on the table below.

Make / Model:	ResistorsRUs R10K5W
Resistance:	10,000Ω
Voltage Rating:	1000V
Power Rating:	5W
Datasheet:	Datasheet

Table 4-3 – TSMP Protection Resistor Specifications

4.2.5 Body Protection Resistor Location

Provide CAD-rendering(s) showing the body protection resistor location. Mark the parts in the renderings, if necessary.

Figure 4-4 – Body Protection Resistor Location

4.3 HVD

4.3.1 HVD Specifications

Complete the information in the table below.

Make / Model:	Best HVD Company HVD111
Ampacity:	45A
Voltage rating:	1000V
Datasheet:	Datasheet

Table 4-4 – HVD Specifications

If the HVD is not an “off the shelf design” describe how it works and include a CAD rendering.
Which contacts make/break first (high current or interlock)?

4.3.2 HVD Location

Provide CAD-rendering(s) showing the HVD. Mark the parts in the renderings, if necessary.
Describe the physical distance (cm) from the road surface to the bottom of the HVD.

Figure 4-5 – HVD Location

4.3.3 HVD Connections

Describe how the electrical connections are made to the HVD. How are these protected from rain and touch?

4.4 Ready to Drive Sound

4.4.1 RTDS Device and Control

Describe how the RTDS is controlled (what device controls it). Complete the information in the table below.

Make / Model:	Loud Alerts 12VBzr95
Control Voltage:	14V
SPL at 2m:	86 dBA
Datasheet:	Datasheet

Table 4-5 – RTDS Specifications

4.4.2 Ready to Drive Mode Demonstration

Describe numbered steps required to put the vehicle into ready-to-drive mode.

4.5 Discharge Circuit

4.5.1 Discharge Circuit Concept

Describe your discharge circuit and how it was designed.
Provide the discharge voltage and current curves with calculations.

4.5.2 Discharge Circuit Component Specifications

Complete the information in the tables below.

Make / Model:	ResistorsRUs 500R10W
Resistance:	500Ω
Voltage:	800V
Power:	10W
Power @15sec:	80W
Datasheet	Datasheet

Table 4-6 – Discharge Resistor Specifications

Make / Model:	RelayCo ABCD876

Contact Current Rating:	1A
Contact Voltage Rating:	750V
Datasheet:	Datasheet

Table 4-7 – Discharge Relay Specifications

What is the capacitance of the TS bus (include DCDC converter if part of design)? How long does it take to discharge to <60V?

If semiconductor elements are used include schematics and provide datasheets of the most relevant components.

4.5.3 Discharge Circuit Location

Describe location or provide CAD-rendering(s) or photographs showing the discharge components. Mark the parts in the renderings, if necessary.

Figure 4-6 – Discharge Circuit Component Locations

4.5.4 Discharge Circuit Control

Describe how the discharge relay is controlled.

5 Accumulator

5.1 Accumulator Schematic

Insert a large image (top or nearly top view) of the complete accumulator assembly without cover.
Figure must include the following:

- Separation walls (both at cells and HV electronics sections)
- >50% attachment points to car chassis
- Cell segments
- HV electronics (at least one PCB mock-up)
- AIRs
- Main fuse
- Maintenance plugs
- Main power connector

(additional images may be needed to provide clear views of all elements).

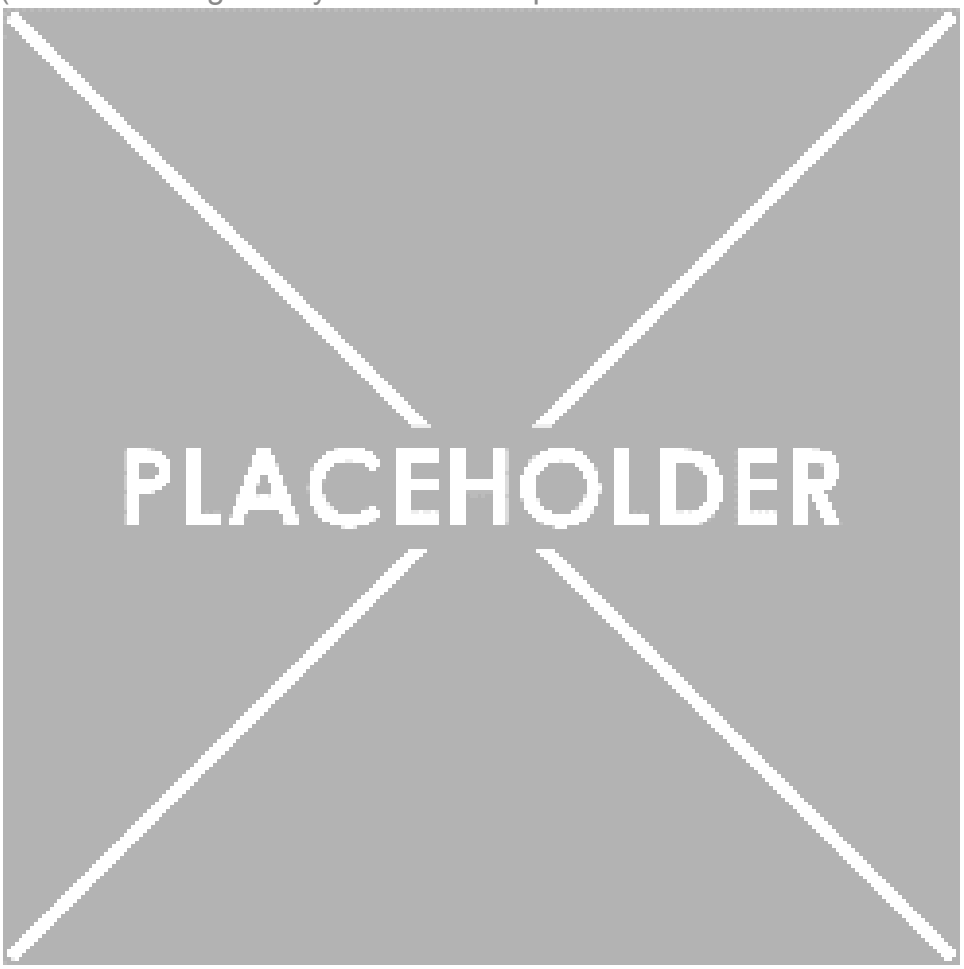

Figure 5-1 – Accumulator Schematic

5.2 Accumulator container

5.2.1 Accumulator Enclosure

Provide details of walls materials and thickness. If cooling openings are required provide details of how these openings are protected from dust and water.

5.2.2 Segments fixations

Describe how the segments are fixed inside the container in all 3 directions. Provide loads paths and calculations of all elements under shear or buckling stress.

5.2.3 AIRs and fuse fixations

Provide images of how the AIRs and the main fuse are attached to the container.

Figure 5-2 – AIR and Fuse Detail

5.3 Cells

5.3.1 Cell Specifications

Complete the information in the table below.

Cell Make / Model / Style:	Kokam XYZ pouch, cylindrical, or metal can
Cell nominal capacity:	5.4 Ah
Maximum Voltage:	4.2 V
Nominal Voltage:	3.7V
Minimum Voltage:	2.8V
Maximum output current:	20C for 10s
Maximum continuous output current:	15C
Maximum charging current:	5C
Maximum Cell Temperature (discharging)	65°C
Maximum Cell Temperature (charging)	55°C
Cell chemistry:	LiFePO4
Datasheet	Datasheet

Table 5-1 - Cell Specifications

5.4 Segments

5.4.1 Segment Overview

Insert a large image of the complete segment assembly. Describe segment materials and how design provides a safe environment from dropped tools.

5.4.2 Segment Specifications

Complete the information in the table below.

# of Segments:	5
Cells per segment:	15
Cell configuration in segment:	5S3P
Energy in segment:	2.8MJ / 0.78 kWh

Table 5-2 – Segment Specifications

5.4.3 Cell Mounting

Describe how cells are mounted in the accumulator container. Provide CAD rendering or photograph to show mounting mechanism. Provide details on how cells are retained without compromising insulation and supporting isolation integrity.

Figure 5-3 – Cell Mounting in Accumulator

5.4.4 Cell Connections

Describe how the electrical connections are made to the cells (welded/bolted/clamped)? Define what kind of weld (resistance/laser), what kind bolt (copper w/deforming nut), material of clamp. If bus bars are used what is the cross-sectional area and ampacity?

Include CAD rendering.

Figure 5-4 – Cell Connections Detail

5.4.5 Maintenance Plugs

Describe how maintenance plugs are implemented in between the segments. If off the shelf components are used provide link to datasheet.
If custom components are used provide detailed images of them.
If bought, complete the information in the table below.

Make / Model:	Connector Co. SQV436
Ampacity:	180A
Voltage:	750V
Datasheet:	Datasheet

Table 5-3 – Maintenance Plug Specifications

Describe how positive locking is provided for maintenance plugs such that they cannot unintentionally come loose.
How is isolation provided at maintenance plug boundaries?

Describe how maintenance plugs are designed such they cannot be installed or removed incorrectly.

Figure 5-5 – Maintenance Plug Locations

5.4.6 Temperature sensors

Provide images showing where the temperature sensors are placed and how they are in direct contact with the negative cell tab. How many sensors are used and which percentage of cells is monitored?
Complete the information in the table below.

Make / Model:	NTC thermistor ABC
Ampacity:	2A
Resistance:	150k
Datasheet:	Datasheet

Table 5-4 – Temperature Sensors Specifications

Figure 5-6 – Temperature Sensor Location

5.5 Precharge Circuit

5.5.1 Precharge Circuit concept

Describe your precharge circuit and how it was designed. What is the bus capacitance? How long will it take to recharge? How does your system determine the end of the precharge process?

Provide the precharge current and voltage curves with calculations.

5.5.2 Precharge Circuit Component Specifications

Complete the information in the tables below.

Make / Model:	ResistorsRUs 500R01W
Resistance:	500Ω
Voltage:	650V
Power:	0.1W
Power @15sec:	1W
Datasheet	Datasheet

Table 5-5 – Precharge Resistor Specifications

Make / Model:	RelayCo ABCD876
Contact Current Rating:	1A
Contact Voltage Rating:	750V
Datasheet:	Datasheet

Table 5-6 – Precharge Relay Specifications

If a constant current precharge is used include schematics and datasheets of the relevant components.

5.5.3 Precharge Circuit Location

Provide CAD rendering(s) or photographs showing the pre-charge components. Mark the parts in the renderings, if necessary.

Figure 5-7 – Precharge Circuit Location

Explain how the power sinking elements of the precharge circuit are cooled.

5.6 AMS

5.6.1 AMS Specifications

Describe the AMS that has been selected.
What is the BMS manufacturer?
What is the BMS architecture?
Describe key specifications and communication interfaces used.
Show the GUI or software used to configure the AMS. Show that it meets the single overview requirements.

5.6.2 Voltage Monitoring

Provide details of the voltage measurement system (accuracy, acquisition frequency, …).
How and where the voltage sense leads are overcurrent protected (fused).
What size are the sense leads? What is their ampacity?
If your sense leads are not fused, please reason why and how your system detects a malfunction of one of the measurements?

5.6.3 Temperature Monitoring

Provide details of the temperature measurement system (accuracy, acquisition frequency, …). Give details of the temperature sensors used.

5.6.4 AMS Limits

Complete the table below.

Max Cell Voltage:	6.8V
Min Cell Voltage:	4.2V
Max Temperature:	60°C
Min Temperature:	-5°C

Table 5-7 – AMS Setpoints

5.6.5 AMS Response times

Complete the table below:

System	Failure type	Time to open SDC
Voltage monitoring	Open wire	2s
	Short to supply voltage	2s
	Short to GND	2s
	Implausibility due to out of range	2s
	Failure of digitally transmitted signals	2s
Temperature monitoring	Open wire	2s
	Short to supply voltage	2s
	Short to GND	2s
	Implausibility due to out of range	2s
	Failure of digitally transmitted signals	2s
Current measurement	Open wire	2s
	Short to supply voltage	2s
	Short to GND	2s
	Implausibility due to out of range	2s
	Failure of digitally transmitted signals	2s

Table 5-8 – AMS Response times

5.7 AMS Current Sensor

Complete the information in the table below.

Make / Model:	Acme Sensor Co. ABC123
Current input range:	+/- 150A
Output range:	0-50V
Datasheet:	Datasheet

Table 5-9 – AMS Current Sensor Specifications

5.8 AIRs

5.8.1 AIRs Specifications

Complete the information in the table below.

Make / Model:	RelayCo DaBIG1
Contact Current:	345A
Contact Voltage:	350V
Datasheet:	Datasheet

Table 5-10 – AIR Specifications

5.9 Accumulator Indicator

5.9.1 Accumulator Indicator Schematic

Provide schematic of accumulator indicator circuit. Give details of the HV supply for the LED and the activation threshold voltage. Provide specifications and links to datasheets for key components.

Figure 5-8 – Schematic of Accumulator Indication

5.10 Charging

5.10.1 Charger Specifications

Complete the information in the table below.

Make / Model:	ElectronPusher Inc 100V200
Power:	0.082kW
Output Voltage:	300V
Output Current:	0.273A
Input Voltage:	120V
Input Current:	1A
Datasheet:	Datasheet

Table 5-11 – Charger Specifications

Add description of the charger system.
Provide images of the charger assembly and charging setup as it'll be used during the events (include both accumulator handcart and charger assembly if they are not integrated).

5.10.2 Charging Shutdown Circuit

Describe charging process routine.
Insert a schematic of the shutdown circuit while charging. Include all required components for the charging shutdown circuit.

Figure 5-9 – Charging Shutdown Circuit Schematic

5.10.3 Charging TS Circuit

Insert a schematic of the TS connections when charging, show the energy path and how charging is controlled/interrupted.

Figure 5-10 – Charging TS Schematic

5.10.4 Charger Control

Describe how the AMS can control the charger, especially how it can stop the charger.

5.10.5 Charger Demonstration

Describe numbered steps you would use to demonstrate the safe operation of charging, include how to connect, and how to disconnect. Include any safe use practices, as well as what to look for proper operation vs. a faulted condition.

5.11 External Data Connection

Describe external data connections with the charger assembly/accumulator that will be used to get real time data, in particular on systems isolation.

6 Motor controller

6.1 Motor controller 1

6.1.1 Description, type, operation parameters

Describe important functions, provide table with main parameters like resulting voltages: (minimum, maximum and nominal), currents etc.
Fill out the following table:

Motor controller type:	ABC Controller
Maximum continous power:	60kW
Maximum peak power:	75kW for 10s
Maximum Input voltage:	600VDC
Output voltage:	250VAC
Maximum continuous output current:	100A
Maximum peak current:	200A for 5s
Control method:	PWM, analog signal...
Cooling method:	Air, water, oil...
Auxiliary supply voltage:	24VDC
Datasheet:	Datasheet

Table 6-1 – Motor Controller Specifications

6.1.2 Wiring, cables, current calculations, connectors

Describe the wiring, show schematics, provide calculations for currents and voltages and show data regarding the cables and connectors used.
Additionally fill out table:

Wire type:	Company A, 0.205 mm²
Current rating:	150A
Maximum operating voltage:	800V
Temperature rating:	150 °C
Datasheet:	Datasheet

Table 6-2 – Wire Specifications

6.1.3 Position in car

Provide CAD-renderings showing the relevant parts. Mark the parts in the rendering, if necessary.

Figure 6-1 – Motor Controller Position

6.2 Motor controller 2

If identical parts are used, just refer to the corresponding sections, don’t copy and paste.

7 Motors

7.1 Motor 1

7.1.1 Description, type, operating parameters

Describe the motor used, provide table with main parameters like resulting voltages->minimum, maximum, nominal, currents, resulting motor power, use figures to show important characteristics. Describe the casing and if the casing rotates the finger guards used.
Additionally fill out table:

Motor Manufacturer and Type:	ABC Motor
Motor principle	Asynchronous, permanently excitated
Maximum continuous power:	25kW
Peak power:	70kW for 5s
Input voltage:	250VAC
Nominal current:	50A
Peak current:	70A
Maximum torque:	60Nm
Nominal torque:	20Nm
Cooling method:	Water, oil, air,...
Datasheet:	Datasheet

Table 7-1 – Motor Controller Specifications

Give a plot of power vs. RPM including a line for nominal and maximum power.

Figure 7-1 – Power vs. RPM

Give a plot of torque vs. RPM including a line for nominal and maximum torque.

Figure 7-2 – Torque vs. RPM

7.1.2 Wiring, cables, current calculations, connectors

Describe the wiring, show schematics, provide calculations for currents and voltages, and show data regarding the cables and connectors used.

7.1.3 Position in car

Provide CAD-renderings showing all relevant parts. Mark the parts in the rendering, if necessary and clearly identify the structure used to protect all relevant parts.

Figure 7-3 – Motor Position

7.2 Motor 2

If identical parts are used, just refer to the corresponding sections, don’t copy and paste.

8 Other Items

8.1 GLV supply

Briefly describe your design of GLV supply, GLV battery and a DC/DC-Converter providing power for the GLV-system from the HV-system, if used.

8.1.1 Description

Describe type and design of your GLV battery, what type of chemistry it uses.
Fill out the table:

Type of chemistry:	Lead-acid
Configuration:	1s1p
Nominal Voltage:	12V
Nominal current:	3A
Nominal capacity:	7Ah
Datasheet:	Datasheet

Table 8-1 – GLV Battery Specifications

If made from Li-Ion, additionally include description about the cells (according to paragraph 5.3), AMS (according to paragraph 5.6), temperature sensors (according to paragraph 5.4.6) and overcurrent protection.
Describe the charging process.

8.1.2 Wiring, cables, schematics

Describe the wiring, connectors, show schematics, etc.

Figure 8-1 – GLV Battery Schematics

8.1.3 Position in car

Provide CAD-renderings showing the relevant parts. Mark the parts in the rendering, if necessary.

Figure 8-2 – GLV Battery Position

8.2 APPS

8.2.1 Description/additional circuitry

Describe the type of the APPS used, provide tables with main operation parameters, and describe additional circuitry used to check or manipulate the signal going to the motor controller. Describe how the system reacts if an implausibility or error (eg. short circuit or open circuit or equivalent) is detected. Provide details on how rule's EV 2.3 is met.

APPS manufacturer and type:	ABC Encoder
APPS principle:	potentiometer
Supply voltage:	5V
Maximum supply current:	20mA
Operating temperature:	-20..180 °C
Used output:	0-5V
Datasheet:	Datasheet

Table 8-2 – APPS Specifications

8.2.2 Wiring

Describe the wiring, show schematics, show data regarding the cables and connectors used.

Figure 8-3 – APPS Wiring Schematics

8.2.3 Position in car/mechanical fastening/mechanical connection

Provide CAD-renderings showing all relevant parts and discuss the mechanical connection of the sensors to the pedal assembly. Mark the parts in the rendering, if necessary.

Figure 8-4 – APPS CAD-rendering

8.3 Brake Light

8.3.1 Description

Describe the brake light circuitry, provide main operation parameters and datasheet if bought, use tables or figures, etc.

8.3.2 Wiring, cables,

Describe the wiring, show schematics, etc.

8.3.3 Position in car

Provide CAD-renderings showing the relevant parts. Mark the parts in the rendering, if necessary.

Figure 8-5 – Brake Light Position

8.4 Control devices

Describe those controllers which interfere or influence the tractive system, for example a controlling unit that measures wheel speeds and steering angle and calculates a target torque for each motor, etc.

8.4.1 Description

Describe the parts used and their circuitry, provide main operation parameters and datasheets, use tables or figures, etc.

8.4.2 Wiring

Describe the wiring between control devices.

8.4.3 Position in car

Provide CAD-renderings showing the relevant parts. Mark the parts in the rendering, if necessary.

8.5 Energy Meter

8.5.1 Energy Meter Location

Provide CAD rendering(s) or photographs showing the energy meter location and the download connector location. Mark the parts in the renderings, if necessary.

Figure 8-6 – Energy Meter Location

8.5.2 Energy Meter GLV Supply

Describe how the Energy meter GLV power is supplied.

8.5.3 Energy Meter HV Sense

Describe how the Accumulator Voltage is sensed by Energy meter. Include fusing, wire gage, terminals used.

8.6 Firewall

8.6.1 Firewall Layer Specifications

Complete the information in the table below.

Aluminum layer thickness:	0.2mm
Insulating layer thickness:	2mm
Insulating Material Make / Model:	Conductive Co. FLDPRDCT

Insulating Material Datasheet:	Datasheet
Insulating layer side:	Driver

Table 8-3 – Firewall Specifications

8.6.2 Firewall Grounding

Provide details of how firewall's detachable parts grounding is ensured (if any).

8.6.3 Firewall Location

Provide CAD rendering(s) or photographs showing the firewall components. Mark the parts in the renderings, if necessary.

Figure 8-7 – Firewall Location

8.7 Grounding

8.7.1 Composite Grounding

Describe how any composites will be grounded to meet the required grounding level.

8.7.2 TS enclosure Grounding

If TS enclosure is made from conductive materials, show how solid layer will be grounded.

8.7.3 Suspension & Wheel Assembly Grounding

Describe how parts near the wheel motors (if any) will be grounded.

8.8 Other Components

Add additional sections here to discuss other unique aspects of your design that you feel are appropriate for the ESF. For example, DC/DC converters, details of team designed motor controller, GLV battery chargers, wheel speed sensors, steering wheel sensors, etc.