



Coversheet

Electrical Safety Form Template

**Has to contain the heading “Electrical Safety Form FSE2011”,
University Name, Car number.**

Feel free to add team logo, car picture, and the like.

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

Read the document “How to pass ESF&FMEA” which is available in the “Rules & Important Documents” section.

If you are unsure with respect to feedback of the reviewer, do not hesitate to write an e-mail and ask.

Every single part/heading of the ESF Template must be filled with content. If the respective part is not relevant for your concept, describe shortly why not.

The table of contents should be hyperlinked.

The generated PDF should contain hyperlinked bookmarks.

Make use of internal reference links. For example when describing wiring and mentioning a figure in the text, please link it to the figure.

Do not just copy all of your datasheets in the appendix, e.g. we do not need to know what you have to do to program your motor controller; we do not need the whole user manuals of microcontrollers to review your ESF, etc.

Single pages extracted from the complete datasheet showing the important parameters, figures, etc. are usually sufficient, but the source/link to the complete datasheet has to be provided. If the datasheet describes more than one type, please mark in the datasheet to which type you are referring / which type you plan to use.

Datasheets should only be used as a reference. Please cover the important data in your text by using tables, etc.

Links from the text to the respective datasheet and links back from the datasheet to the text section will be appreciated!

For example a link in the motor controller section “The datasheet can be found here (clickable)” and a link above the motor controller datasheet in the appendix “The section covering the motor controller can be found here (clickable)”.

Following these guidelines will guarantee a swift review process.

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I List of Figures

Should be hyperlinked!

II List of Tables

Should be hyperlinked!

III List of Abbreviations

1 System Overview

- Short description of the system's concept
- Rough Schematic (blocks) showing all parts affected with the safety and function of the tractive-system
- No detailed wiring

Table containing the following parameter

- Maximum Tractive System voltage
- Nominal Tractive System voltage
- Control System voltage
- Motor type (eg, permanent excited synchronous motor)
- Total number of motors and the corresponding driven wheels
- Maximum combined motor power in kW
- Combined accumulator capacity in kWh

2 Safety Systems

2.1 Safety Circuit

2.1.1 Description/concept

Describe your concept of the safety circuit, the master switches, shut down buttons, brake over travel switch, etc.

2.1.2 Wiring / additional circuitry

Describe wiring and additional circuitry, show extra schematics for example if additional transistors etc. are used, also describe the function of additional circuitry and make good use of figures.

2.1.3 Position in car

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

2.2 IMD

2.2.1 Description (type, operation parameters)

Describe the used IMD, use a table for the common operation parameters, like supply voltage, temperature, etc. Also describe how the IMD indicator light is wired, etc.

2.2.2 Wiring/cables/connectors/

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

2.2.3 Position in car

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

2.3 Driver acknowledgement for IMD and BMS

2.3.1 Description/circuitry

Describe the concept and circuitry of the driver acknowledgement system.

2.3.2 Wiring/cables/connectors

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

2.3.3 Position in car

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

2.4 Tractive system active light

2.4.1 Description/circuitry

Describe the used tractive system active light and additional circuitry.

2.4.2 Wiring/cables/connectors

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

2.4.3 Position in car

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

2.5 Measurement points**2.5.1 Description**

Describe the used housing and how it can be accessed, etc.

2.5.2 Wiring, connectors, cables

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

2.5.3 Position in car

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

2.6 Pre-Charge circuitry**2.6.1 Description**

Describe your concept of the pre-charge circuitry.

2.6.2 Wiring, cables, current calculations, connectors

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

2.6.3 Position in car

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

2.7 Discharge circuitry**2.7.1 Description**

Describe your concept of the discharge circuitry.

2.7.2 Wiring, cables, current calculations, connectors

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

2.7.3 Position in car

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

2.8 HV Disconnect (HVD)

2.8.1 Description

Describe your concept of the HVD and how it can be operated.

2.8.2 Wiring, cables, current calculations, connectors

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

2.8.3 Position in car

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

2.9 Ready-To-Drive-Sound (RTDS)

2.9.1 Description

Describe your concept of the RTDS, how is the sound produced, what are the parameters for activating the RTDS, etc.

2.9.2 Wiring, cables, current calculations, connectors

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

2.9.3 Position in car

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

3 Accumulator

3.1 Accumulator pack 1

3.1.1 Overview/description/parameters

Describe concept of accumulator pack, provide table with main parameters like number of cells, cell configuration, resulting voltages->minimum, maximum, nominal, currents, capacity etc.

3.1.2 Cell description

Describe the used cell type and chemistry, provide table with main parameters.

3.1.3 Cell configuration

Describe cell configuration, show schematics, cover additional parts like intercell fuses etc.

3.1.4 Cell temperature monitoring

Describe how the temperature of the cells is monitored, where the temperature sensors are placed, how many cells are monitored, etc. Show schematics, cover additional parts, etc.

3.1.5 Accumulator insulation relays

Describe the used AIRs and their main operation parameters, use tables, etc.

3.1.6 Fusing

Describe the used fuses and their main operation parameters, use tables, etc.

3.1.7 Battery management system

Describe the used BMS, show wiring, provide tables with operation parameters e.g. at which upper and lower voltage and temperature levels the BMS does react and how, etc.

3.1.8 Accumulator indicator

Describe the indicator, show wiring, provide tables with operation etc.

3.1.9 Wiring, cables, current calculations, connectors

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

3.1.10 Charging

Describe how the accumulator will be charged. How will the charger be connected? How will the accumulator be supervised during charging? Show schematics, CAD-Renderings, etc., if needed

3.1.11 Mechanical Configuration/materials

Describe the concept of the container, show how the cells are mounted, use CAD-Renderings, show data regarding used materials, etc.

3.1.12 Position in car

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

3.2 Accumulator pack 2

...

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

4 Energy meter mounting

4.1 Description

Describe where the energy meter is mounted and how, etc.

4.2 Wiring, cables, current calculations, connectors

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

4.3 Position in car

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

5 Motor controller

5.1 Motor controller 1

5.1.1 Description, type, operation parameters

Describe important functions, provide table with main parameters like resulting voltages->minimum, maximum, nominal, currents etc.

5.1.2 Wiring, cables, current calculations, connectors

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

5.1.3 Position in car

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

5.2 Motor controller 2

...

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

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6 Motors

6.1 Motor 1

6.1.1 Description, type, operating parameters

Describe the used motor, provide table with main parameters like resulting voltages->minimum, maximum, nominal, currents, resulting motor power, use figures to show important characteristics.

6.1.2 Wiring, cables, current calculations, connectors

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

6.1.3 Position in car

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

6.2 Motor 2

...

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

7 Torque encoder

7.1 Description/additional circuitry

Describe the type of the used torque encoder(s), 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 is detected.

7.2 Wiring

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

7.3 Position in car/mechanical fastening/mechanical connection

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

8 Additional LV-parts interfering with the tractive system

8.1 LV part 1

Describe those parts here , 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 or a DC/DC-Converter providing power for the LV-system from the HV-system, etc.

8.1.1 Description

Describe the used part and its circuitry, and provide main operation parameters, use tables or figures, etc.

8.1.2 Wiring, cables,

Describe the wiring, show schematics, etc.

8.1.3 Position in car

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

8.2 LV part 2

...

9 Firewall(s)

9.1 Firewall 1

9.1.1 Description/materials

Describe the concept, layer structure and the used materials of the firewall. Show how the low resistance Control System ground connection is achieved.

9.1.2 Position in car

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

9.2 Firewall 2

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10 Appendix

Numbering according to chapter 1 to 9

A datasheet for motor controller one for example has to have the numbering 10.5.1.1