sys2WHEEL
co2 free city logistics

Integrated components, systems and architectures for efficient adaption and conversion of commercial vehicle platforms to 3rd generation BEVs for future CO2-free city logistics

Webinar 3:
IN-WHEEL SYSTEM FOR N1 CATEGORY VEHICLES

Elaphe

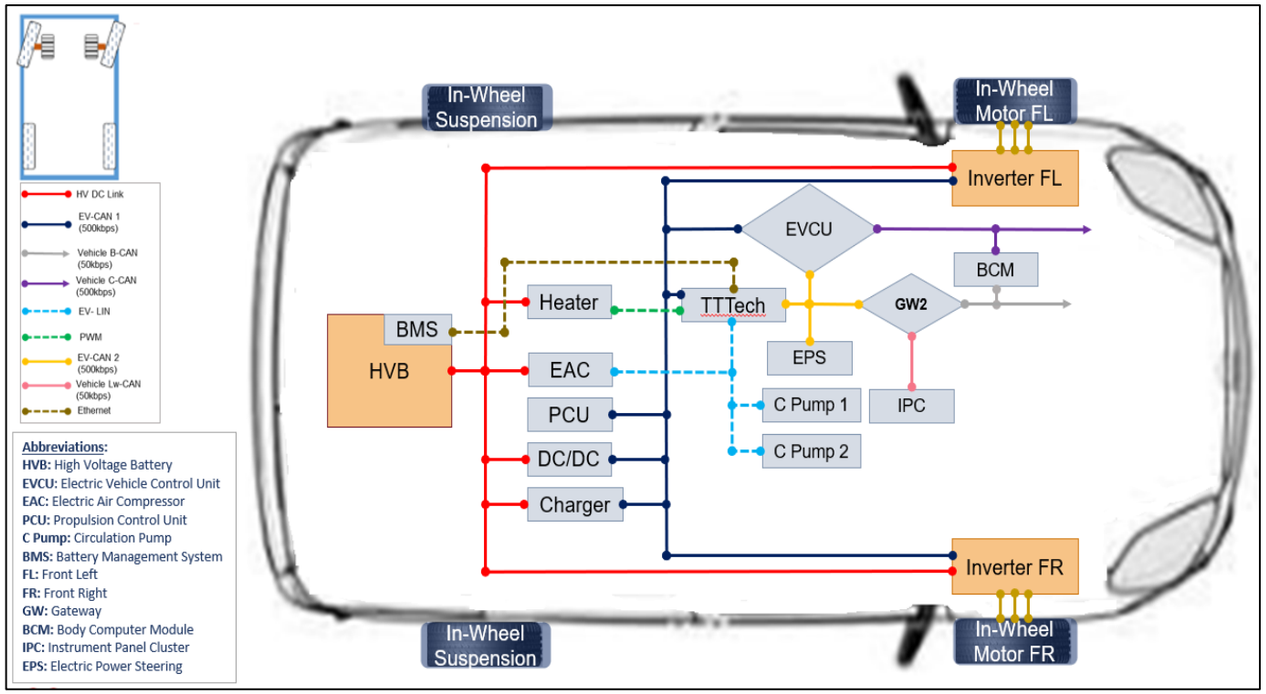
virtual vehicle
IVECO
FPT POWERTRAIN TECHNOLOGIES
LANCIA FIAT Jeep
TOFAŞ TÜRK OTOMOBİL FABRİKASI A.Ş
AVL
Applus IDIADA
elaphe Propulsion Technologies
UNIVERSITY OF SURREY
TTTechAuto
IESTA
HiWi tronics
SOFTWHEEL

Contents and Guidelines

The main objective for Elaphe was to have a fully functional N1-category demonstration vehicle where developed new in-wheel technology and subsystems are implemented. Thus, project objectives and expected impacts were assessed on this demonstrator platform.

The main objective was reached by means of:

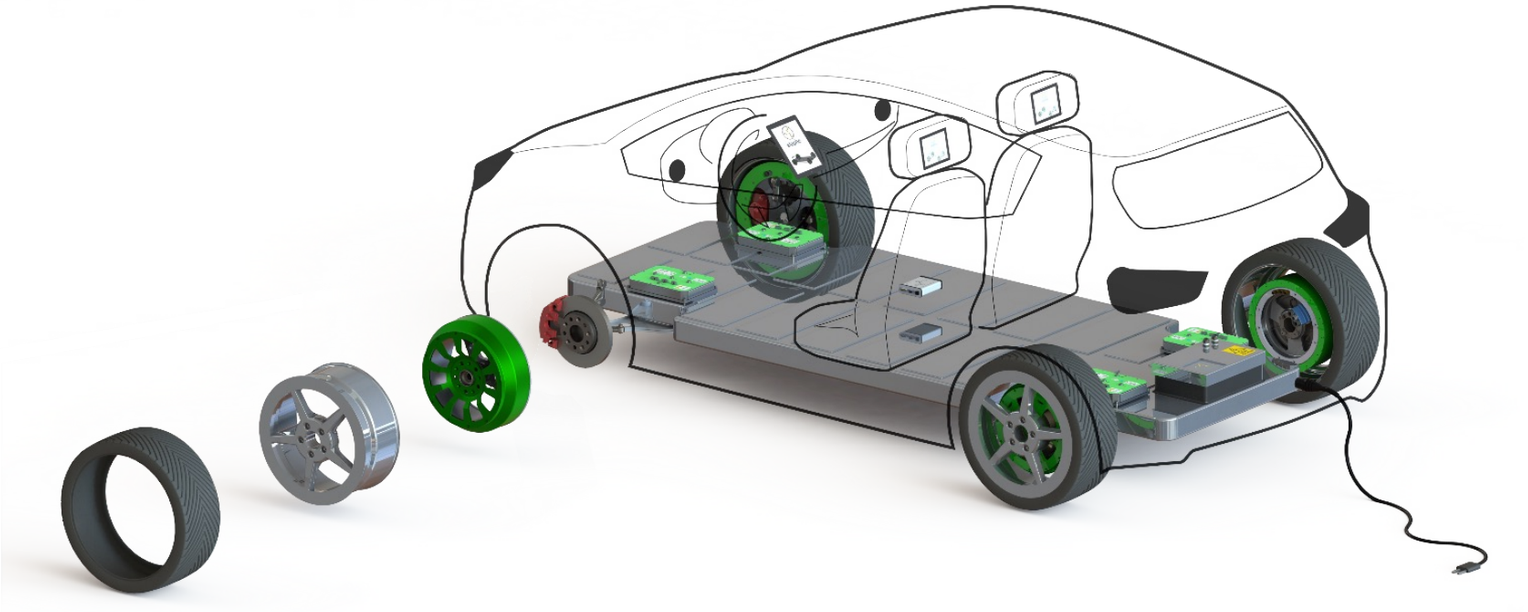
· Development and Build-up of demonstrator platform
· Integration of newly developed in-wheel system components and subsystems
· System and Vehicle-level functional tests



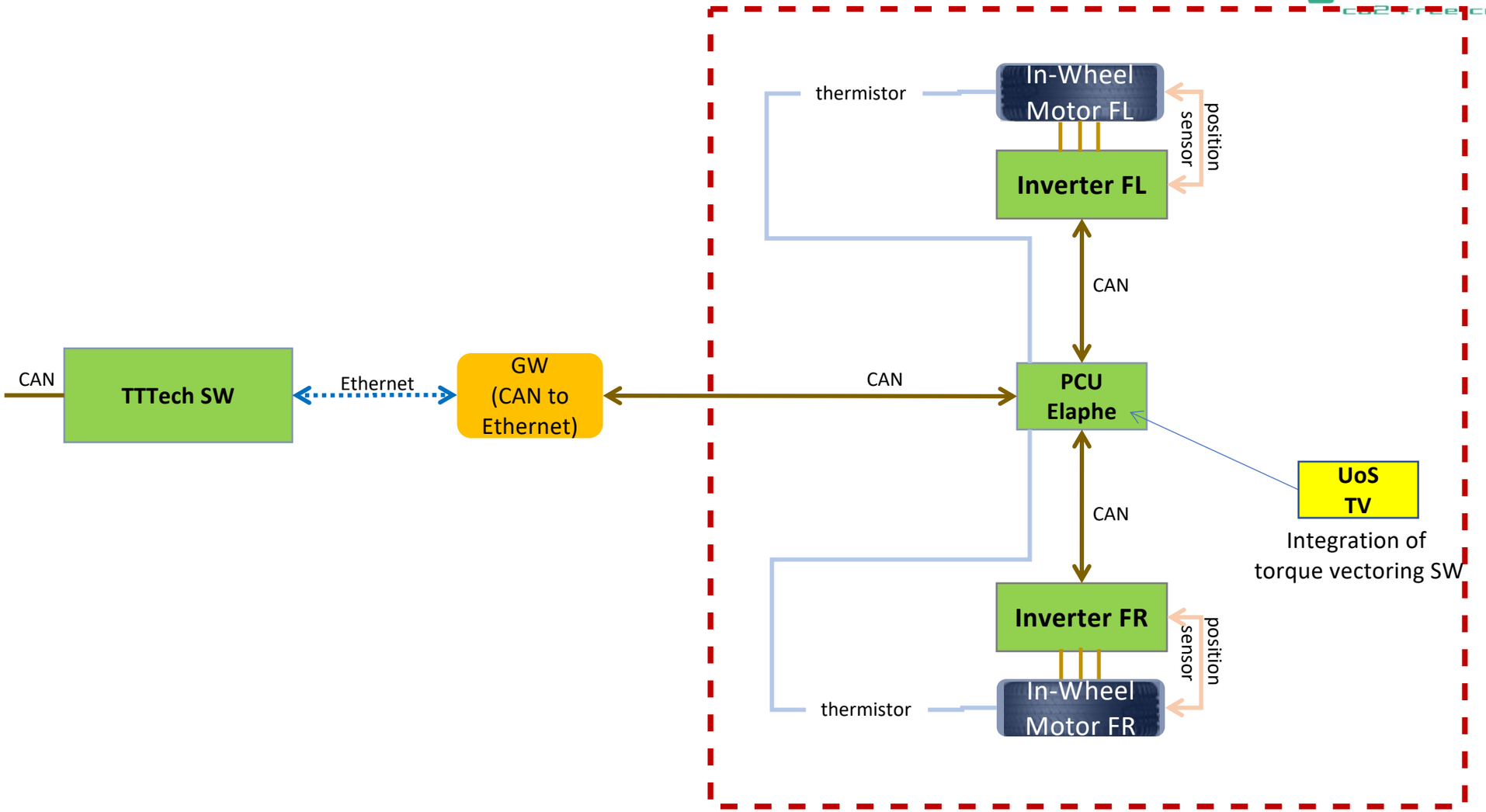
Main tasks

The development work was executed in following task structure:

- Basic Development for N1-category Demonstrator
- Development & Integration of ABS sensor into a COTS IWM
- Development & Integration of powertrain with 2x IWM + Inverter + PCU to Fiat Doblo
- Functional testing of testbed demonstrator



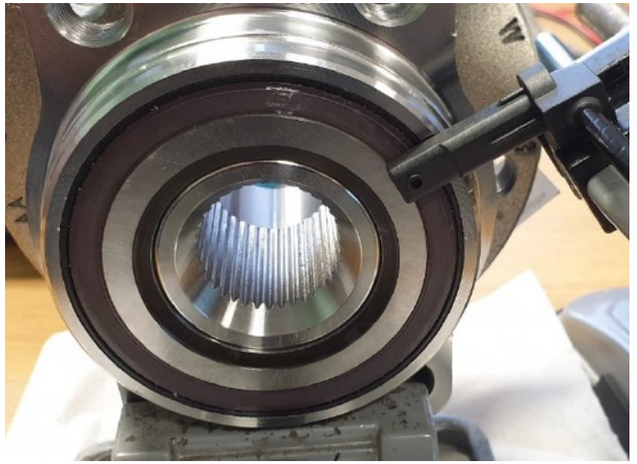
Sys2Wheel – Electrical architecture

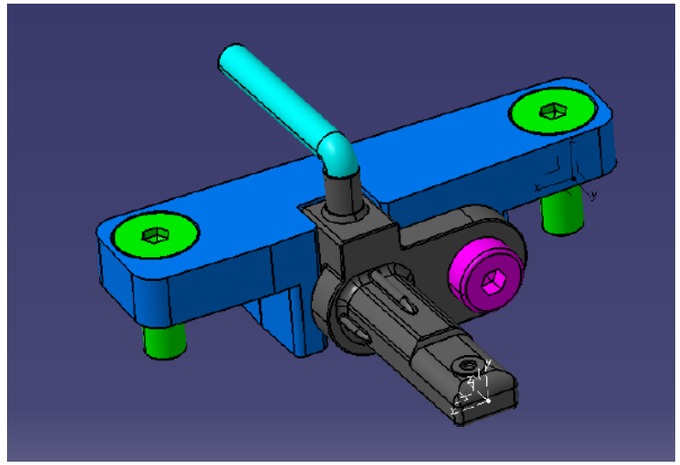


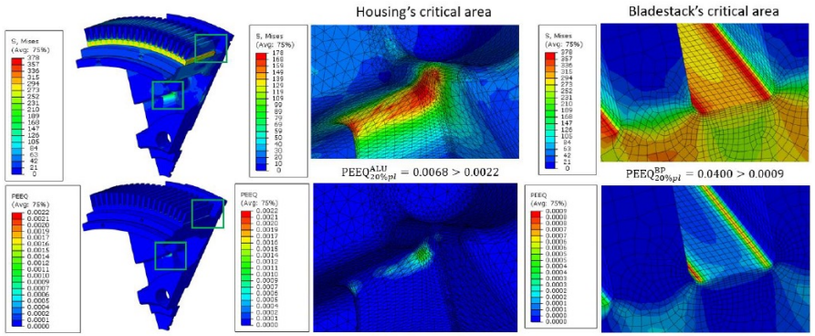
Elaphe PCU-Inverter-IWM system

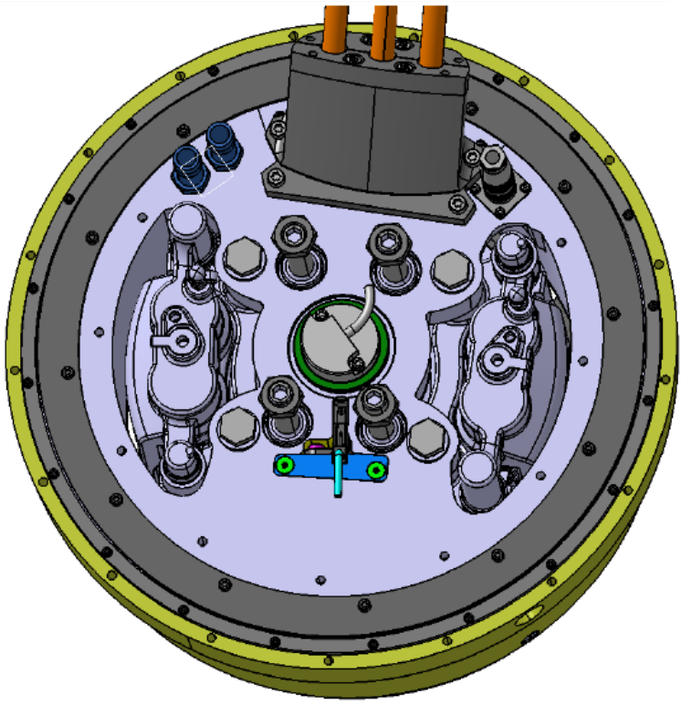
Development tasks

- New development of motor electromagnetic parts to improve fit to requirements
- Reverse engineering of ABS actuator properties
- Identification of ABS encoder compatible with Fiat Doblo
- Identification of tolerance range for encoder Vs. actuator
- Mechanical design of encoder alignment into existing IWM
- CAE simulations for fatigue loads
- Re-machining of existing components
- ABS encoder and adaptor installation
- ABS encoder integration and validation



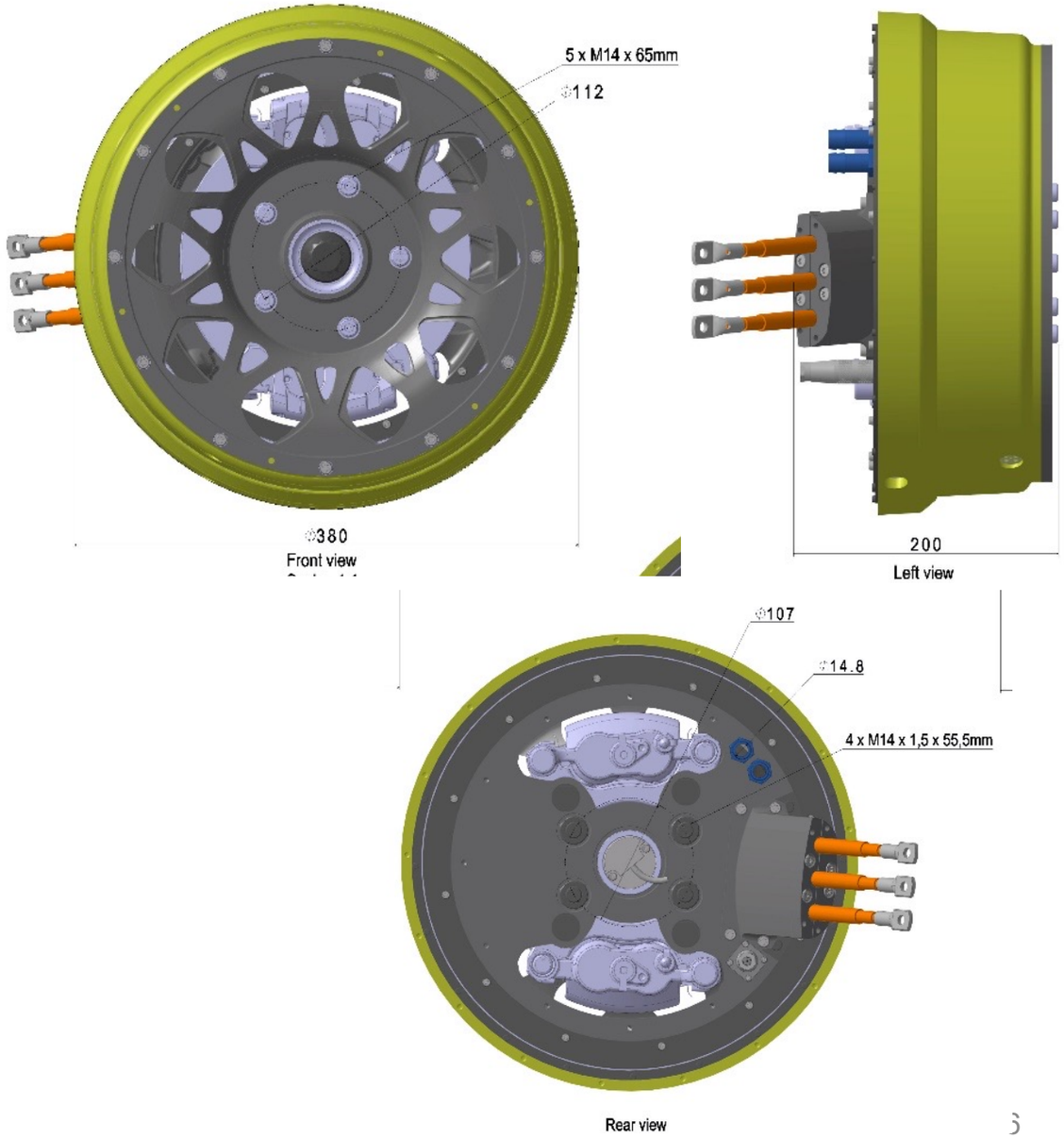




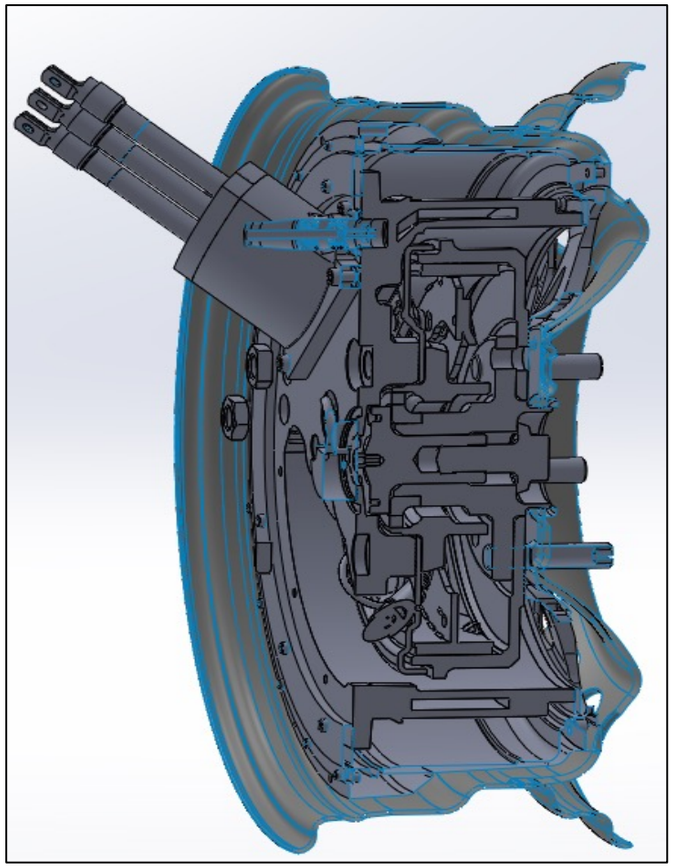


Integration tasks

- Identification of a compatible rim
- Interference with vehicle
- Knuckle design
- Cooling system design
- Phase cables routing
- Energy harvesting device implementation
- Inverter mounting, Connections
- PCU mounting, Connections



Identified rim compatible with M700 and FWD Fiat Doblo



Phase cable routing

In-wheel motor: Phase cables routing

Cable selection

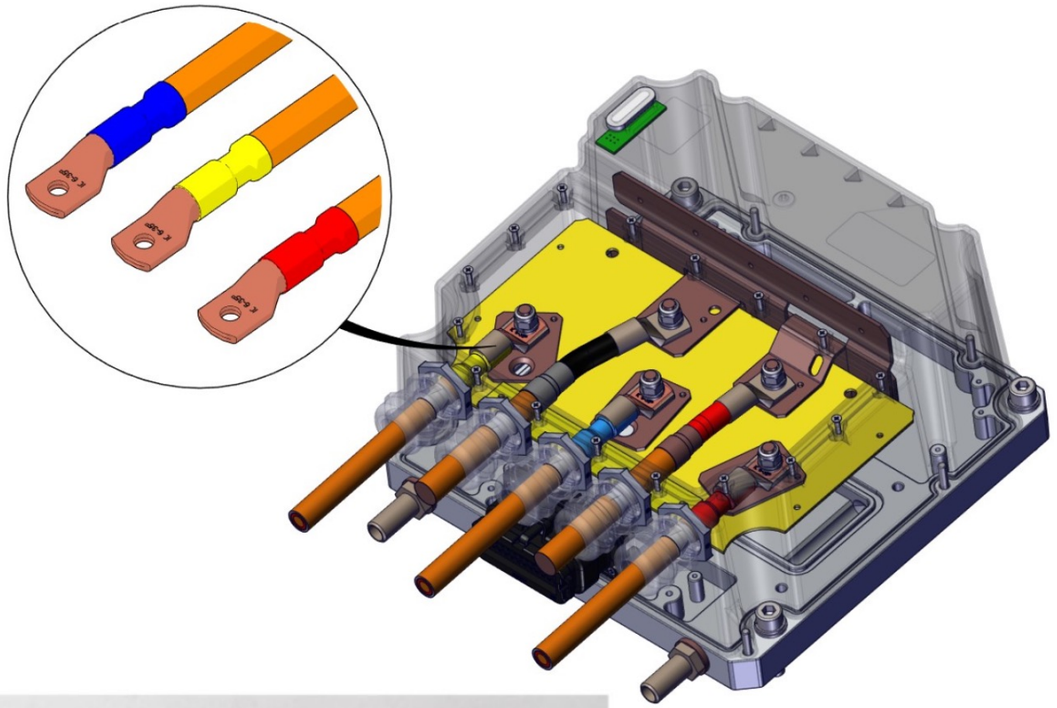
- Detailed evaluation of the loads and definition of requirements
- Multiple supplier solutions tested
- High flexible automotive grade cables used
- Validation on shakers and several vehicles

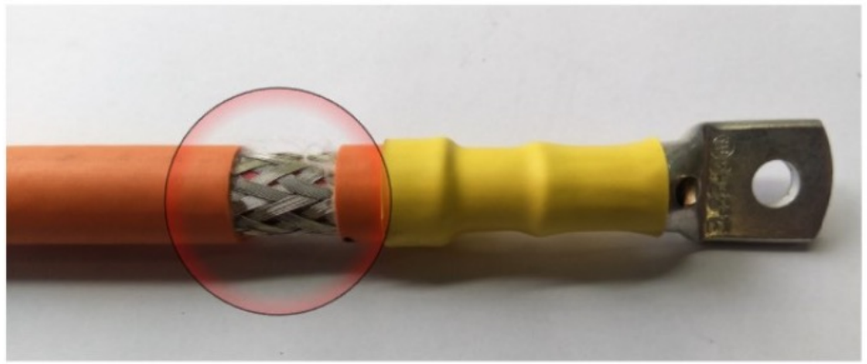
Cable integration

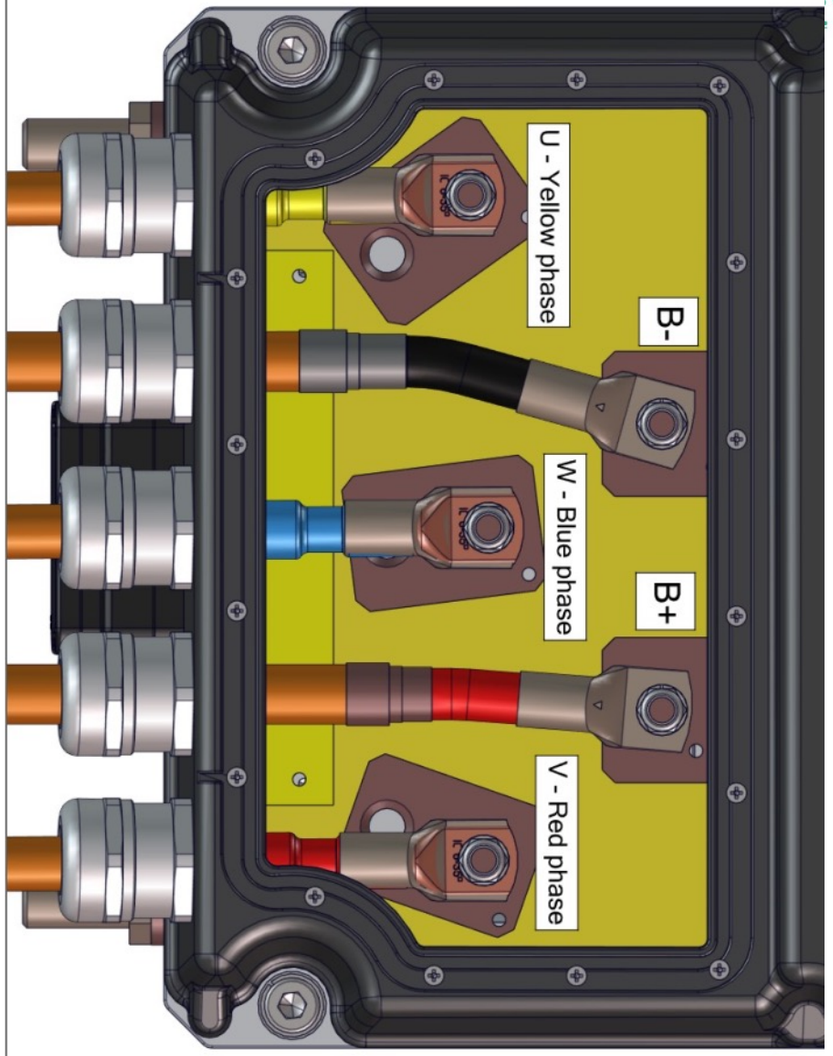
Vehicle specific routing solution depending on the vehicle chassis and corner (suspension, steering, knuckle, cooling, brake connection, sensor connections)

- Cable mounting adaptors to prevent twisting and interferences.
- Motor contact box designed and oriented in a way to ease cable integration

Phase cable routing

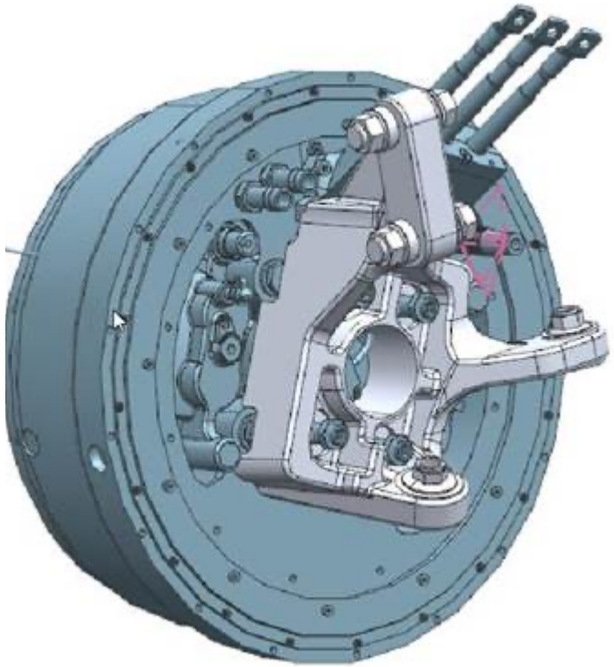


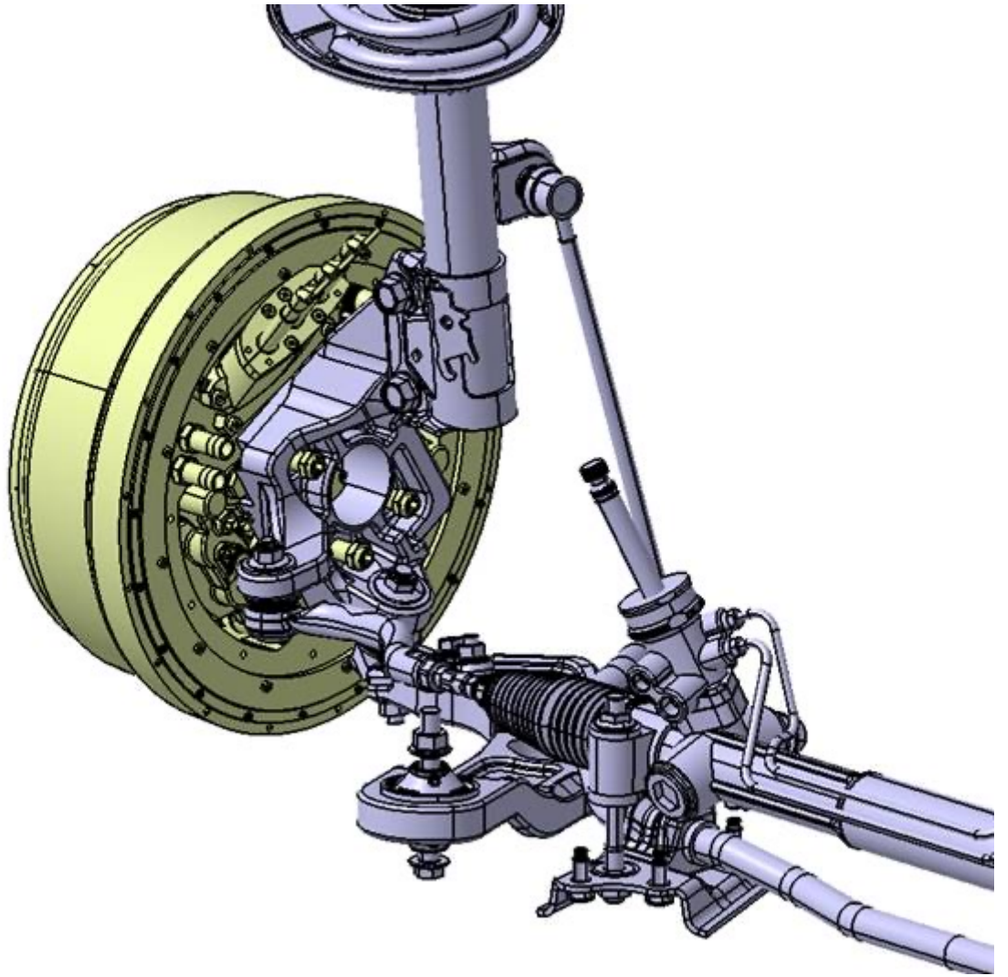




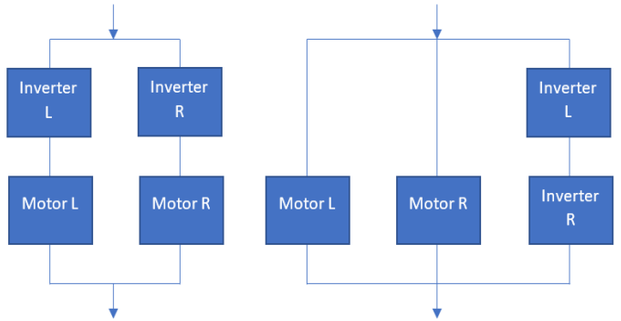
The cables and hoses shall be routed in such a way which ensures enough play for suspension movement. Sharp bending of the cables and hoses shall be avoided. If cables or hoses are in contact with sharp edges, additional protection must be added to avoid cable or hose damage.

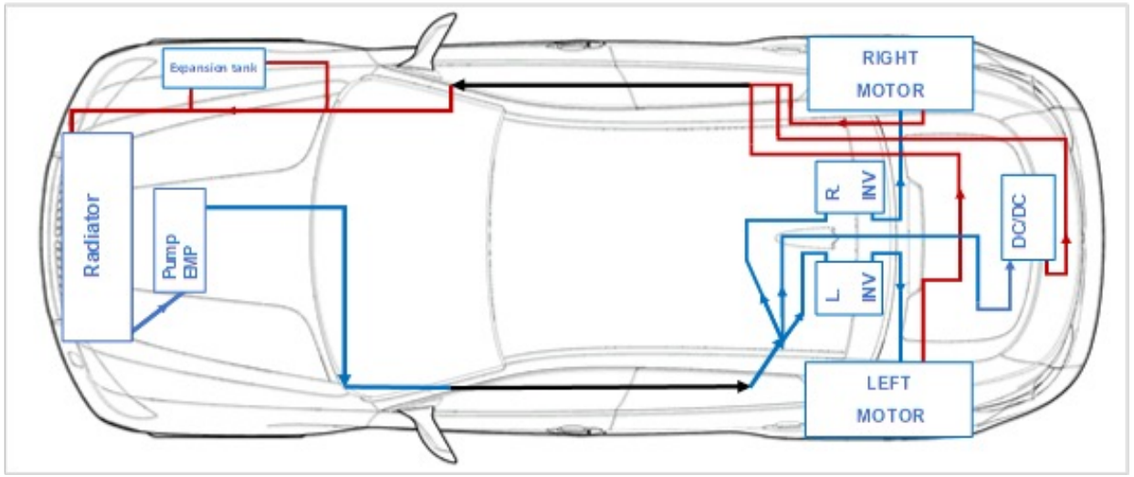
Knuckle design (by Tofas)

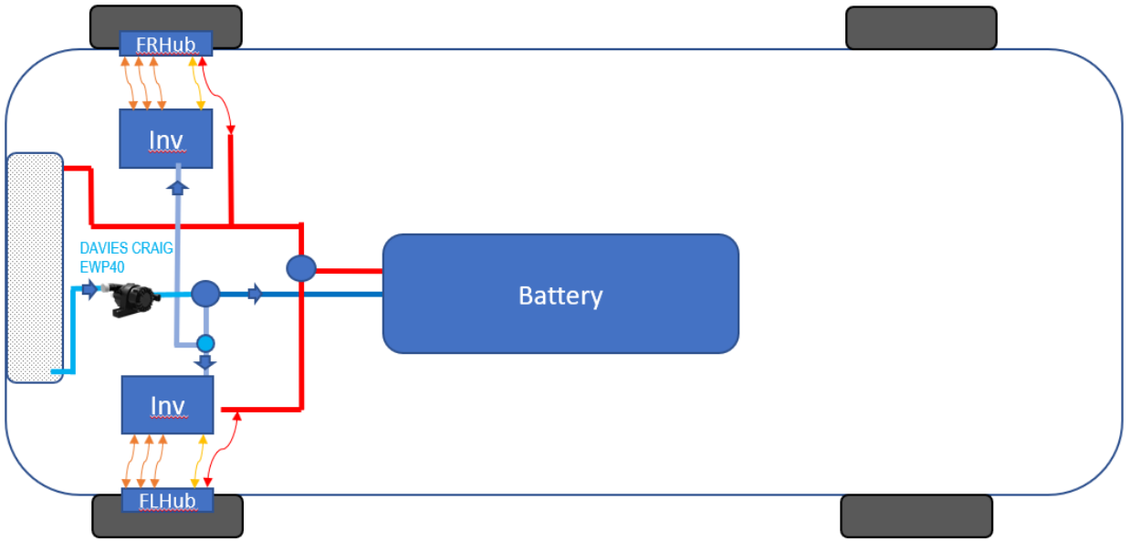




Cooling system design







Elaphe PCU – inverter IWM system

Motor - Inverter

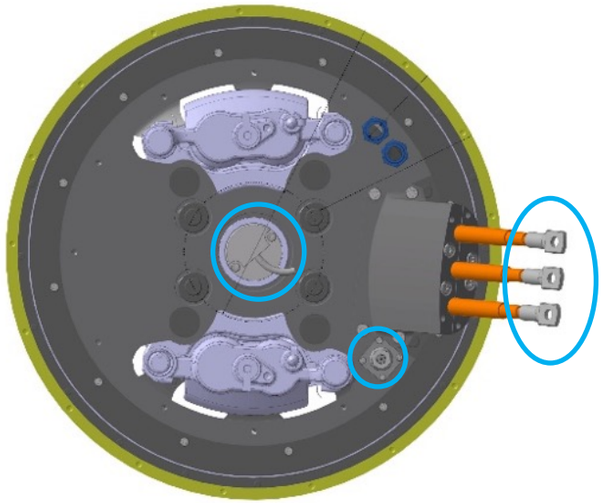
- Phase cables
- Position sensor

Motor - PCU

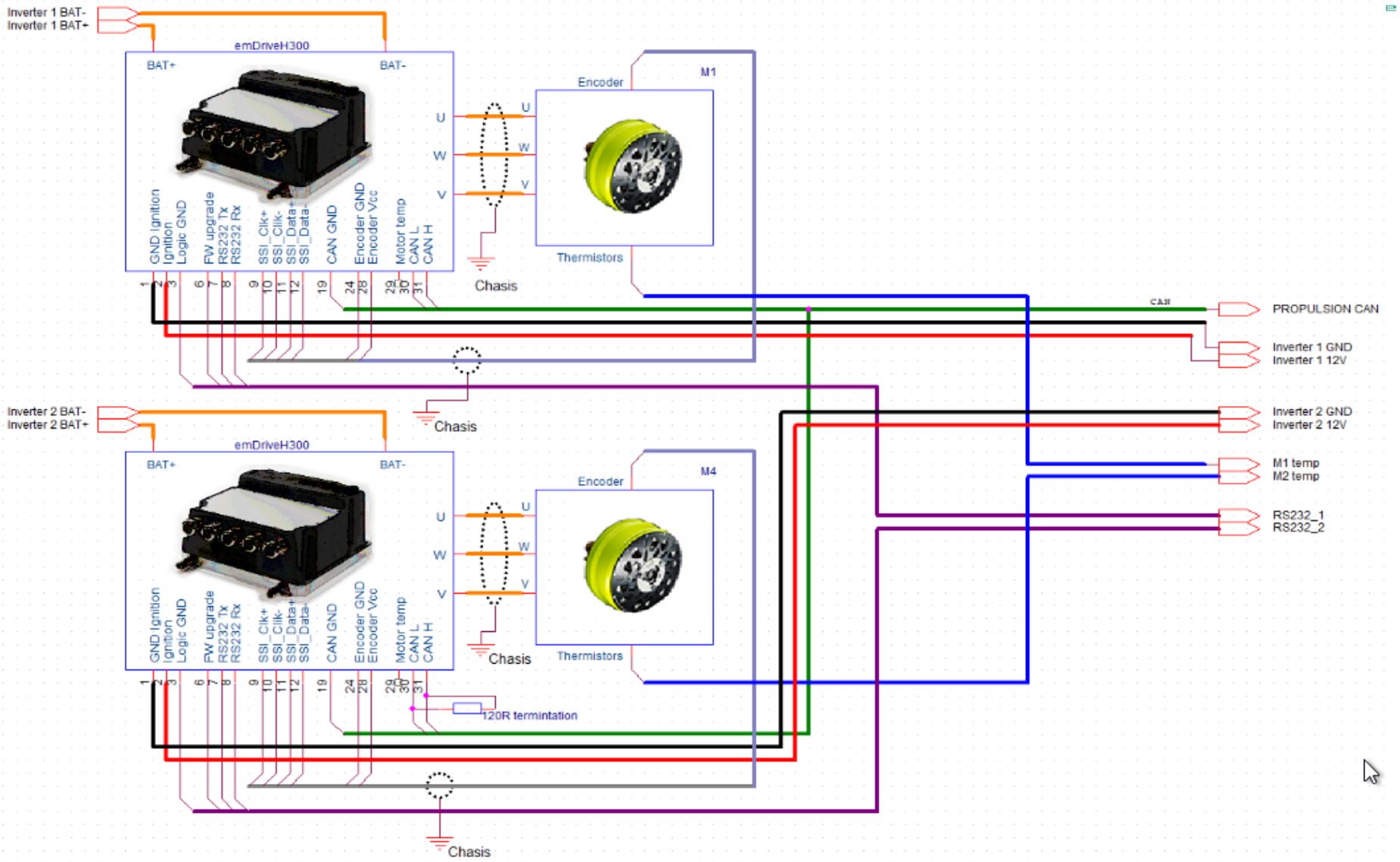
- Temperature sensor

Inverter

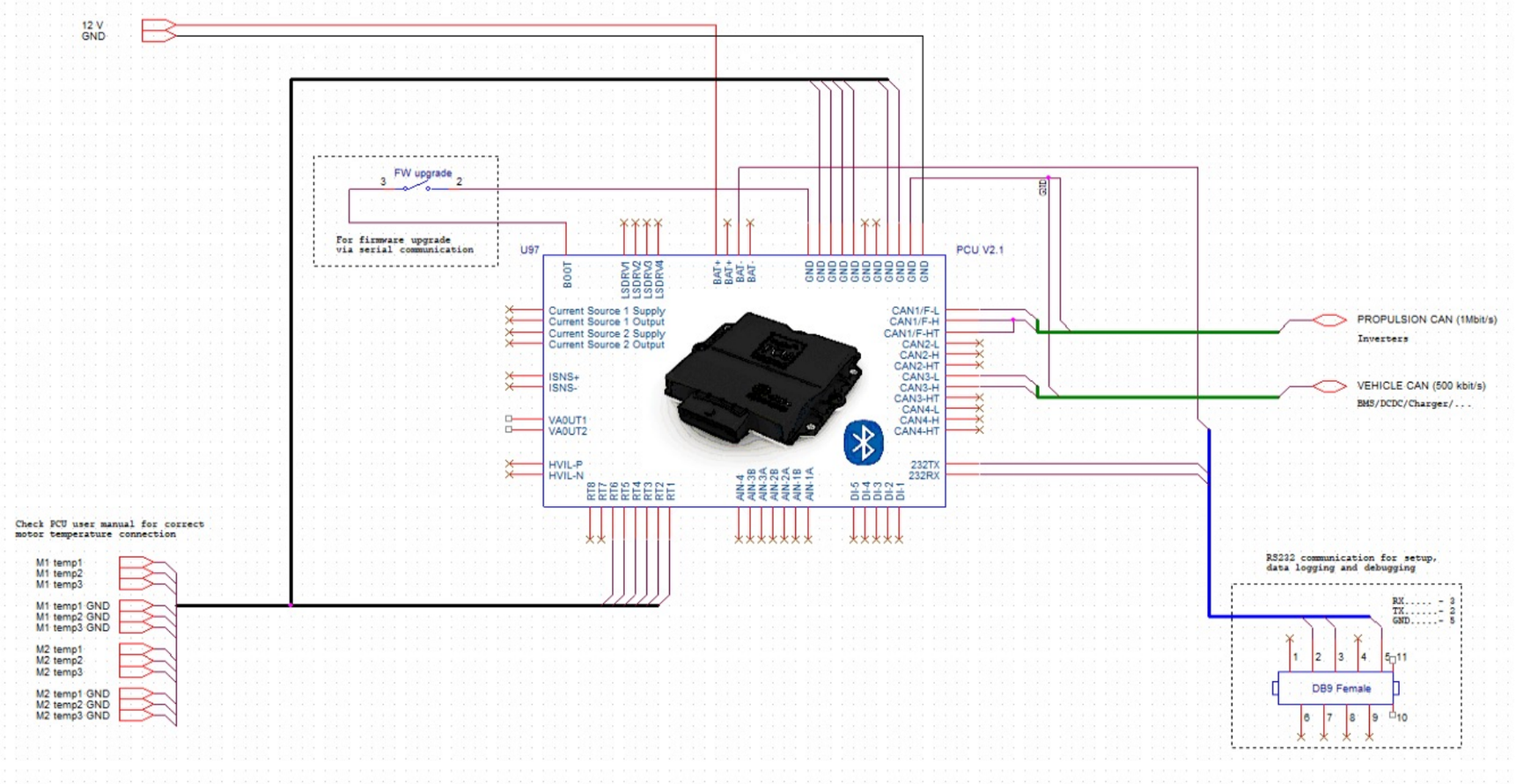
- High voltage connection
- 12 V (or 24 V) power supply
- CAN
- RS232 serial interface
- BOOT switch



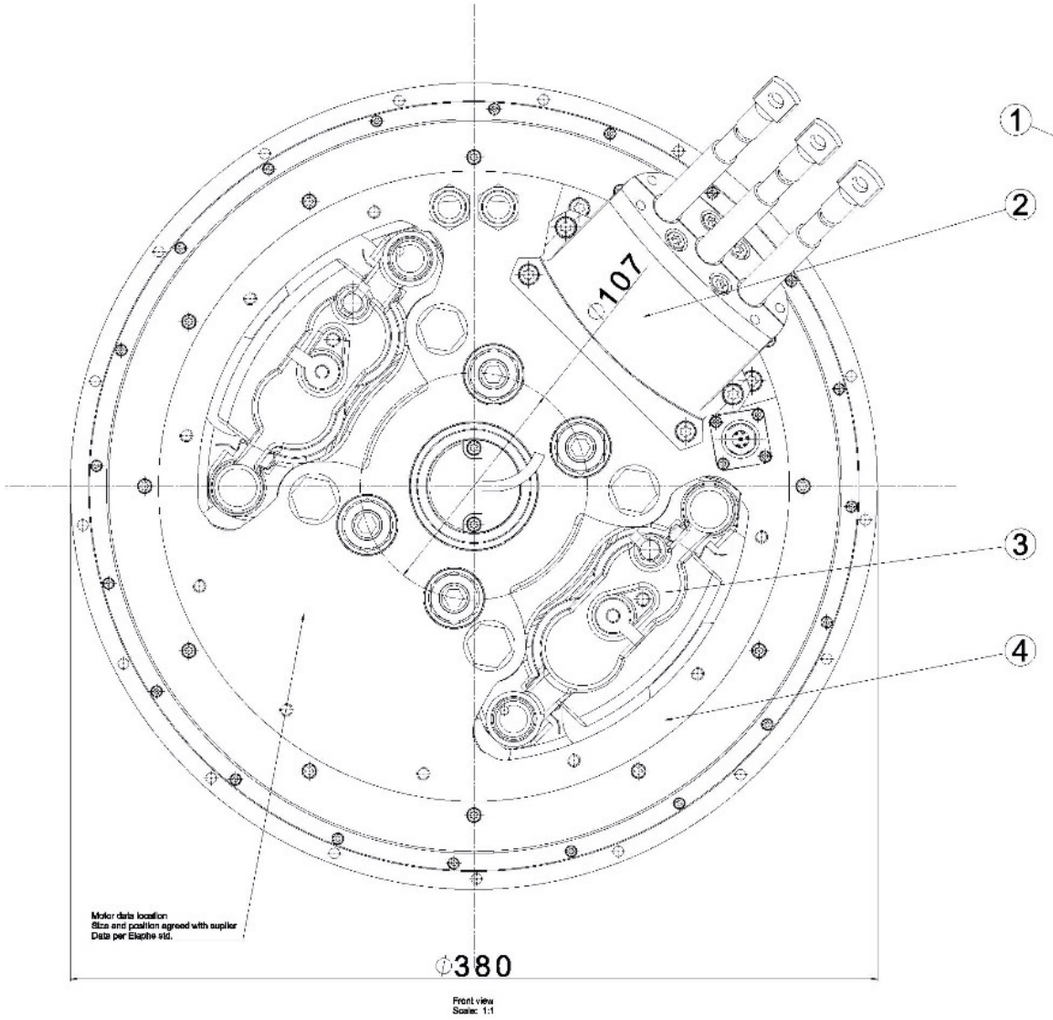
Electrical schematics



Electrical schematics - PCU



Mechanical coupling requirements



Mechanical connection of the motor to the vehicle chassis must be done with a calibrated torque wrench. The following tightening torques should be applied. Use DIN 934 class 10 nuts.

- Tightening torque for 10.9 grade, M10 bolts = 71,5 Nm
- Tightening torque for 10.9 grade, M12 bolts = 122 Nm
- Tightening torque for 10.9 grade, M15 bolts = 168 Nm

No.	Part name/installation detail
1	Rotor
2	Connection Box
3	Disc Brake A caliper configuration
4	Stator – Disc version

Outcomes from the project

- Improved efficiency on a COTS IWM
- Integrated ABS encoder into a COTS IWM
- Complete powertrain integrated to a delivery vehicle application for the first time
- Improved space for battery
- Improved retrofitting options with simplification of conversion to EV
- Reduced price of conversion to EV