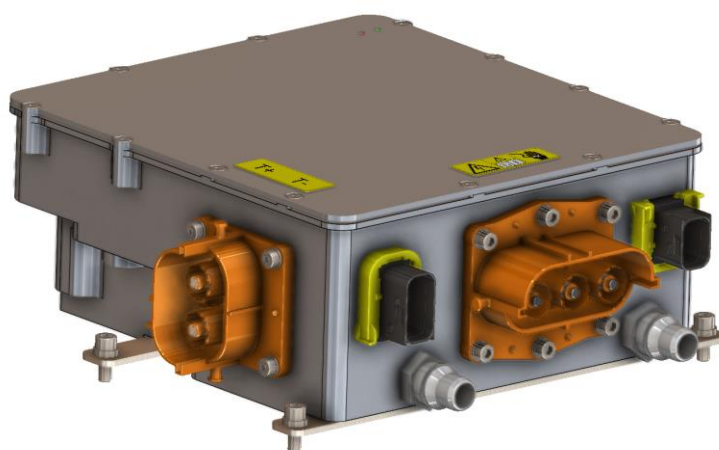


emDrive H20

PM-motor controller

Preliminary datasheet V0.7



Important Notice

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- This guide contains proprietary information belonging to Emsiso d.o.o.
- The text and graphics included in this manual are for the purpose of illustration and reference only. The specifications on which they are based are subject to change without notice.
- Information in this document is subject to change without notice. Corporate and individual names and data used in examples herein are fictitious unless otherwise noted.

General

- Intended use:
 - Electric and hybrid powertrains (traction or auxiliary):
 - On road vehicles
 - Off road vehicles (tractors, bulldozers, special off road cars, etc.)
 - Utility or municipality vehicles
 - High performance EV motorcycle
 - EV conversions
 - EV Boats
 - Heavy duty pumps for industrial, agriculture and construction machinery
- Design:
 - Automotive ready
 - Compact, cost-effective
 - Well suited for EV OEMs

Mechanical design

- Casted aluminium enclosure
- IP protections class IP6K9K
- HV battery and AC motor connectors
- Conduction cooled film capacitor bank

HV motor connector

- 3 phase connectors with interlock on front side. Recommended straight connector on cable side.
- Possible cable cross sections between 16 and 50 mm²
- TE HVP800 (mating: TE: 4-2325013-1, coding A)
- IP6K9K rating, full shielding



HV DC connector

- Connector for HV DC voltage, recommended right angle connector on cable side.
- Possible cable cross sections between 16 and 50 mm²
- TE HVP800 (mating: TE: 2141227-1)
- HV interlock loop
- IP6K9K rating, full shielding



Coolant connector

- VDA Quick connector according to standard EU VDA PS3



NORMA Quick PS3 Connector

Software motor control features

- Vector control (FOC) in 4 quadrant operation
- Torque, velocity control and position control
- Advanced control algorithm for optimal power module usage and efficiency:
 - Adjustable field weakening operation
 - Configurable MTPA
 - Sensor-less operation, optional with efficient transition from sensed (low RPM) to sensor-less mode (at higher RPM)
 - Sensor-less operation at 0 RPM for IPMSM (requires motor with sufficient saliency)
- Look up tables (LUT) motor control
 - Optimal control of highly nonlinear motors (IPM)
 - High dynamic response
 - Operation at high field weakening and on MTPV limit
 - Self correction for motor parameter variations

- Supported motor types:
 - PMSM ○ IPMSM
 - Induction (optional)
- *Optional: ASC – active short circuit – option for IPM motors*

Motor sensors

- Available rotor position sensors:
 - Resolver
 - 5 V analogue SIN / COS with differential or single ended signals
- *Optional rotor position sensors:*
 - Absolute digital SSI encoder with RS422 interface
 - *Incremental A, B (replacement for SSI). For induction machines*
 - *Hall + index (replacement for SSI); For avionics with propeller homing functionality*
- 2 x temperature sensor input
 - Dual range
 - Supports PT100, PT1000, KTY84, NTC 10k

Protection functions

- Temperature sensing for motor current derating and alarms:
 - Motor thermal protection with optional motor temperature model
 - Controller thermal protection (IGBT, coolant and capacitor temperature monitoring)
 - Real-time IGBT-die temperature calculation and protection
- Battery under/over voltage protection
- Peak phase current protection – prevents prolonged operation at peak current
- Instant protections mechanisms:
 - Rotor angle sensor failure
 - DC link overvoltage
 - Communication fault detection
- Full self-check at power up

High voltage safety

- LV123 standard
- Insulation designed for operation up to 500 V
- No internal fuses
- Passive HV discharge circuit (HV < 60 V in < 2 min)
- Active HV discharge (via CAN or HVIL) with integrated internal discharge circuit (HV < 60 V in < 5 sec).
- High voltage interlock line (HVIL) monitoring and actuation in case of removed HV connectors

Functional safety ISO 26262

- ISO 26262 ready solution:
 - Safety certified CPU
 - Design follows best practices in gate driver, power supply and CAN modules
 - Independent HW torque shut down

Advanced diagnostic capabilities

- System for internal data acquisition and storage
- Fast data acquisition functionality – virtual oscilloscope (recording values every FOC cycle) with various trigger settings

Real-time data acquisition and parametrization

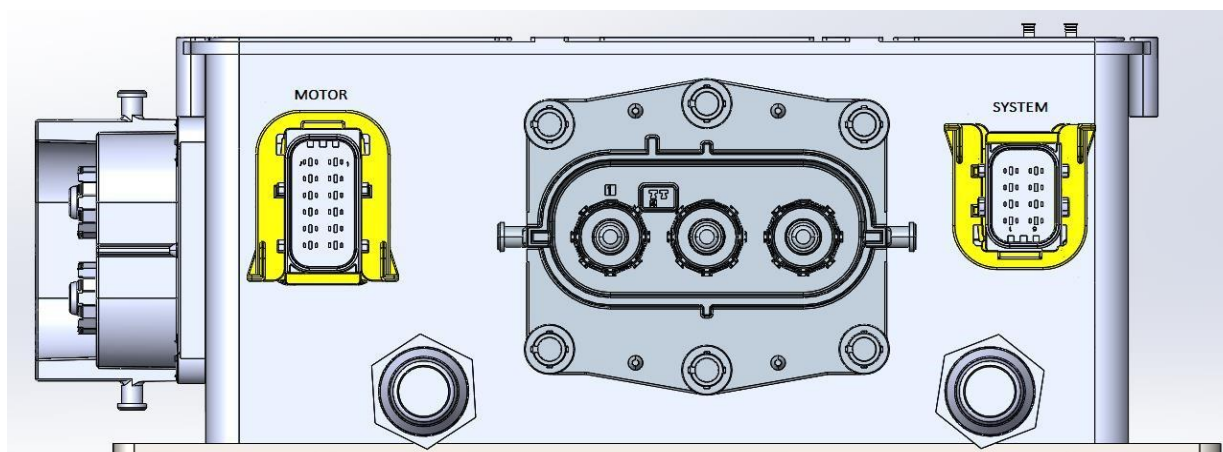
- CAN 2.0, CANOpen protocol (DSP402 compatible)
- XCP support (optional)
- Settings are adjusted with text commands or GUI configuration SW
- Crypted Firmware upgrade over CAN

Housing

- Moulded aluminium enclosure with integrated liquid cooling
- Dimensions (Height x Width x Length) 103.5 x 280.5 x 282.5 mm, weight 5 kg
 - IP protections class IP6K9K

Connectors

- Power supply
- Enable line (KL15)
- 1x CAN 2.0B interface
- CAN FD optional (transceiver TLE9250). No termination, no isolation.
- Secondary CAN (optional)
- HVIL
- System connector TE HDSC 8 pin (mating: TE: 1-1564416-1)
- Motor feedback TE HDSC 12 pin (mating: TE: 1-1564520-1)



Pinout

Motor connector 12 pin

Pin	FUNCTION 1 SSI	FUNCTION 1 RESOLVER	FUNCTION 1 SIN/COS	FUNCTION 1 HALL/ENCODER*
1	Temperature GND	Temperature GND	Temperature GND	Temperature GND
2	Sensor GND	Resolver EXC -	Sensor GND	Sensor GND
3	Feedback 5V supply Max. 200mA	Resolver EXC +	Feedback 5V supply Max. 200mA	Feedback 5V supply Max. 200mA
4	Shield	Shield	Shield	Shield
5	CAN 2 H	CAN 2 H	CAN 2 H	CAN 2 H
6	CAN 2 L	CAN 2 L	CAN 2 L	CAN 2 L
7	Temperature 1	Temperature 1	Temperature 1	Temperature 1
8	Temperature 2	Temperature 2	Temperature 2	Temperature 2
9	SSI Data + (RS422)	Resolver SIN +	SIN +	HALL input 1 / Enc A
10	SSI Data - (RS422)	Resolver SIN -	SIN -	HALL input 2 / Enc B
11	SSI Clock + (RS422)	Resolver COS +	COS +	HALL input 3
12	SSI Clock - (RS422)	Resolver COS -	COS -	HALL input 4 / Enc Z

* Optional for induction motor

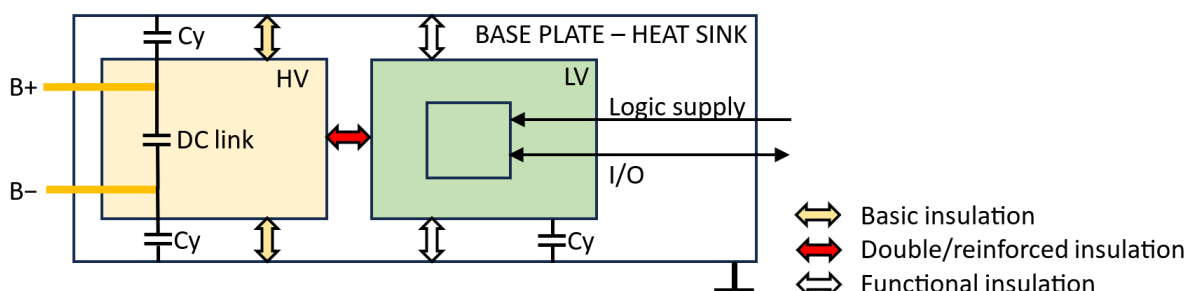
System connector 8 pin

Pin.	Name	Description
1	KL 30	Logic supply. Input range 9 – 16 VDC
2	KL 31	GND
3	KL 15 / enable	Ignition switch
4	GPIO	Digital In: $V_{ON_typical} = 4,8\text{ V}$, $V_{OFF_typical} = 3,8\text{ V}$, $BW = 100\text{ Hz}$ Digital Out (Low side switch): $I_{max} = 2,8\text{ A}_{DC}$ Current limit min = 6 A_{DC} Analogue In: $0 - 16\text{ V}_{DC}$
5	CAN 1 High	System CAN High
6	CAN 1 Low	System CAN Low
7	HVIL +	High Voltage Interlock Loop positive. 20 mA current loop
8	HVIL -	High Voltage Interlock Loop negative. 20 mA current loop

Insulation

- 1,45 kV (1 min DC) between power terminals and case. **Basic insulation.**
- 2,9 kV* (1 min DC) between power terminals and control terminals. **Double/reinforced insulation.**
- 200 V (1 min DC) between control terminals and case. **Functional insulation.**

* Note: Type test is performed without Cy capacitors, otherwise Cy capacitors are overstressed and could be damaged during the test.



Environment

- -40 °C to 85°C operation
- Liquid cooling inlet temperature max 60°C without derating
- IP6k9k (pending)
- Vibration ISO16750-3, Test IV, Passenger car, sprung masses (vehicle body) (pending)
- Shock ISO16750-3, chapter 4.2.2, 500m/s² 6ms half sine (pending)
- Free fall ISO16750-3, chapter 4.3, 1m (pending)
- Operation altitude 4000 m

Specifications – target data (TBD)

emDrive H20	200-300-450	130-190-800	Unit
Electrical data			
Output continuous current*	200	130	A _{RMS}
Output maximum peak current*	300	190	A _{RMS}
Input DC link max. voltage	450*	800	V
Supply voltage range (KL30 voltage)	9 to 16	9 to 16	V
Low voltage supply current max (KL30 current)	1,5	1,5	A
Switching frequency (adjustable)	rated 8 kHz (Up to 16 kHz)	rated 8 kHz (Up to 16 kHz)	kHz
Operating ambient temperature**	-40 to 85	-40 to 85	°C
Coolant temperature (derating point)	60	60	°C
Operating pressure (Pressure drop @ 10 l/min)	2 (0,2)	2 (0,2)	bar

* Depends on load and cooling

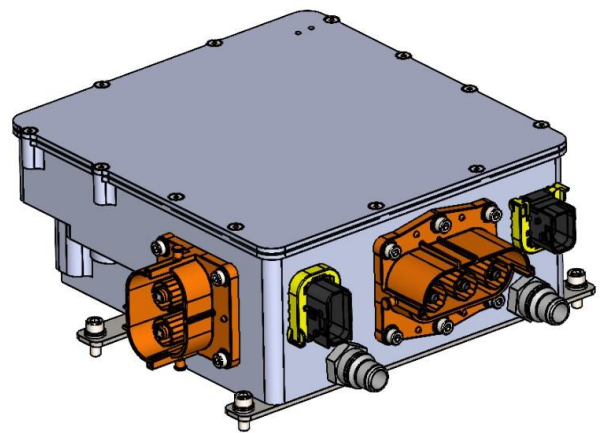
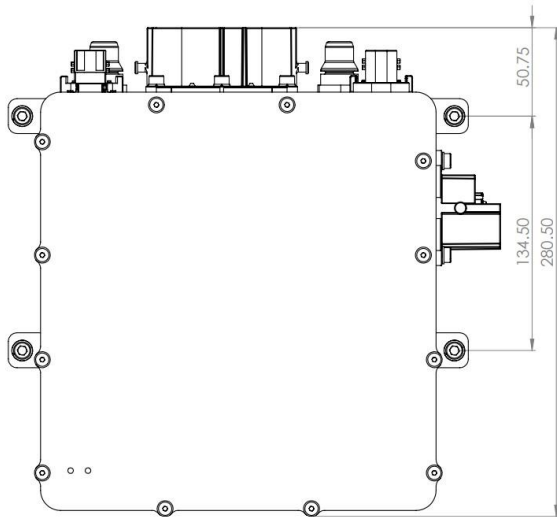
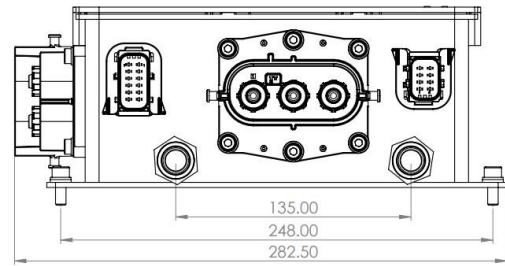
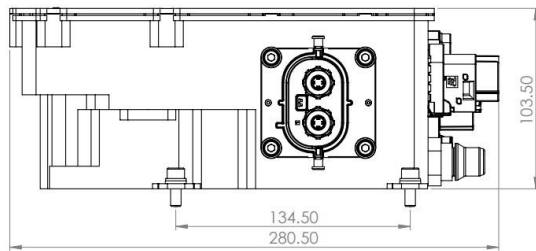
** inlet coolant temperature < 60 °C

*** Optional up to 470 V with limited operation

Certification

- EMC: UN ECE R10 (pending)
- IP6K9K (pending)

Dimensions



Mechanical installation and earth connection

Dampers:

If inverter is mounted on frame of vehicle and it is exposed to high vibrations (e.g. roller), inverter should be mounted on dampers.

Earth connection:

Earth connection must be ensured at least on one point of four mounting holes of inverter. If you can't provide the connection described above, contact our technical support team.

TBD

If you can't provide connection direct on inverter's mounting holders to the frame, additional wire with cross section min. XX mm² is required. In case where inverter is mounted on dampers, earth connection of inverter should be done with additional wiring.