Fraunhofer
IFAM

FRAUNHOFER INSTITUTE FOR MANUFACTURING TECHNOLOGY AND ADVANCED MATERIALS IFAM

1 *Electric motor test bench with protection housing.*

ELETRIC MOTOR TEST FIELD

Fraunhofer IFAM has been conducting research in the field of electric drive technology for more than 10 years. The institute's wide-ranging portfolio combines expertise in the development of electric drives with materials research and production technology. A test bench for electrical machines is available for testing the performance of new technologies, developments or concepts in electrical drives. We offer flexible usage options in terms of project scheduling and testing capacity (e.g. the test specimen can remain equipped in case of interruption) as well as the research questions to be investigated during development.

Our testing service

- Power and efficiency measurements
- Evaluation of thermal management system
- Comparative qualification and falsification of novel parts, components and concepts
- Experimental special setups (e.g. special cooling methods, rotor telemetry)
- Analysis of machine parameters and features
- Performance tests
- Combination of development and testing services within research projects

Project example: EXTREMO

In order to achieve the maximum torque density in electric motors, methods for direct conductor cooling are being developed at Fraunhofer IFAM. In the EXTREMO project, a prototype permanent-magnet synchronous machine with direct liquid conductor cooling was applied.
During the final bench testing, the focus was on investigating the thermal behavior. Can the specified phase currents be reached and what torque is finally achieved with the prototype built at Fraunhofer IFAM?

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These and other findings about the operation of the machine provided the scientists with more than 40 sensors in and on the electric machine. An inverter from a project partner was applied at the test bench of Fraunhofer IFAM. After the machine had passed through the thermal limit characteristic curve, the data was analyzed and evaluated with the partners. The continuous current density of up to 48 A/mm² was achieved.

The R&D project led to far-reaching findings on the design and dimensioning of synchronous machines with very high current density and direct conductor cooling, while maintaining sufficient application efficiency. The advantages of direct conductor cooling were demonstrated on the testing facility. For example, pump drives with demanding installation space situations can benefit from direct conductor cooling compared to conventional windings.

Test stand performance and equipment

Dynos:

- Two load machines, 500 Nm each
- Speed range up to 8000 min-1
- Power: 131 kW

Battery simulation:

- DC source/sink: 0-1000 V, ±600 A, max. power: 120 kW

Test item conditioning:

- Water-glycol (up to 6 bar), other fluids possible
- Heating: 8 kW / Cooling: 10kW
- Separate pressure controlled cooling circuit for the inverter

Residual bus simulation:

- Vector VN8900 (2CH CAN & IOs)
- CANopen

Optional „in house" inverter with separate cooling circuit:

- Aradex VP600-18W161-HF
- Max. Phase current (S1) @400V,10kHz, 250 A RMS
- Max. Phase current (10s) @400V,10kHz, 380 A RMS

Measurement technology:

- Power measurement: 2x Yokogawa WT1800E (9 channels)
- Zero sequence transformer IT-700-S or comparable
- Torque: HBM T40B or HBM T12HP
- Data logger: HBM QuantumX MX1615, MX840, MX440 (e.g. 32x PT100 or 11x NTCs; freely assignable)
- Additional high quality measurement technology depending on project planning (e.g. measurement of the winding resistance EATON / Sefelec MGR10; e.g. additional system currents DANISENSE DSSIU-6-1U)