

MACCON

MOTION UNDER CONTROL

Servomotors and Drives

Torque- and Linear Motors

Stepper and SR Motors

Digital Servocontrollers

Actuators and Sensors

Motion Control Systems

DESIGN & MANUFACTURE - ELECTRICAL MACHINES

CUSTOM MOTORS

www.Electromotors.de



MACCON

The Mechatronics Company

CUSTOM MOTORS

Frameless Kit-motors

Cover

Top right: this photo shows the stator of the curved-linear, segmented, air-gap winding motor of the main telescope of the SOFIA-program (NASA/DLR). In total there are 24 such stators mounted around the central hydrostatic bearing. SOFIA is an optical 2m-Telescope, which is installed in a Boeing 747 and performs astronomical observations of space in the IR-spectrum.

Center: a frameless switched reluctance motor (8/6 poles, 4 phase) from our special SR motor program.

Bottom left: a customised BLDC motor with protected rotor magnets used in a "brake-by-wire" system.

BLDC outer-rotor motor for an automotive application: "steer-by-wire".



Motor Technologies

We develop and manufacture motors and electromagnetic actuators in different technologies, primarily:

- BLDC - permanent-magnet brushless DC-motors (electronically commutated)
- SR - switched reluctance motors
- AC - asynchronous motors

These motors may be either rotary or linear and may have either inner- or outer-rotors. Outer-rotor designs can be preferential in many servo- and direct drive systems, because they offer:

- higher continuous torque rating for identical outer dimensions
- better mechanical integration - in particular for rollers and rotary tables.

In the case of linear motors we supply either long or short stator configurations, depending on the application.

We support our customers by providing an impartial and technically justified evaluation of the relative merits of different motor types in the application under investigation. After selection we support with design and manufacturing services. At this stage we take special account of specific application requirements, such as:

- highest possible energy efficiency
- reduction of torque ripple; air-gap windings can be employed to totally eliminate this effect
- winding adaptation to make best use of voltage and current under the most critical operating conditions
- cooling
- mechanical adaptation
- sensors (resolver, Hall-effect, encoder, temperature sensors, etc.)

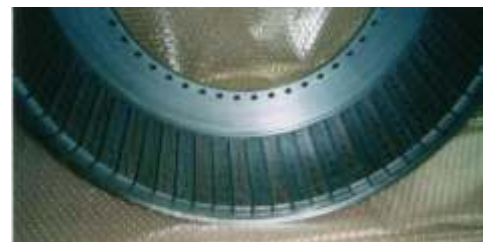


BLDC Outer-rotor motor
20Nm cont. torque (OD 300 mm)

We offer our customised motors either in kit-form or housed (complete motors and actuators).



Thin ring stator of a BLDC
inner-rotor motor (OD 180 mm)



Rotor of a BLDC outer-rotor motor;
rotary table with 2000Nm (OD 570 mm)

Housed Motors and Actuators

Actuators



*BLDC traction motor
with water cooling*

Our clients often require more than just a motor. We are frequently asked to supply the motor integrated with mechanics. We willingly serve in this way.

Many different configurations are possible:

- motors with sensors in special housings
- motors with gearboxes
- motors with ball-screws
- complete housed motors and actuators to user specification

Examples are illustrated on this page.

*BLDC inner-rotor motor with a high resolution
encoder and integrated bearings*



*Rotary actuators with 800 Nm torque
BLDC-Motors mit HD-gearboxes*



2kW SR-Motor (4 phase)

Embedded Motion (EM)

designates applications with high production volumes in which the electric motor and electronics (power and control) become a fully integrated part of the target system.

MACCON supports its clients in the initial critical stages of EM-design projects. Typical application are:

- automotive. - car and truck
- HEVAC (Heating, ventilation, air-conditioning)
- white goods
- electric tools



Special motor (automotive)

"Steer-by-wire" actuator



Design and Analysis

Computer-aided Design

We employ modern and proven CAE-design tools for the design and analysis of our customised motors:

- **SPEED (Speed Lab.):** analytical program for the design of brushless DC- (PC-BDC), switched reluctance/SR- (PC-SRD), asynchronous/AC- (PC-IMD) and brush DC- (PC-DCM), universal motors (PC-WFC)
- **FLUX (Cedrat):** FEM program for calculating magnetic, electrical and thermal fields in 2D and 3D
- **MotorCAD (Motor Design):** analytical program for the analysis of heat losses and distribution in BLDC-, SR-, AC- and DC-motors
- **Matlab/Simulink** for dynamical system analysis

Electrical Machines

Motor design is performed to customers requirements with various objectives:

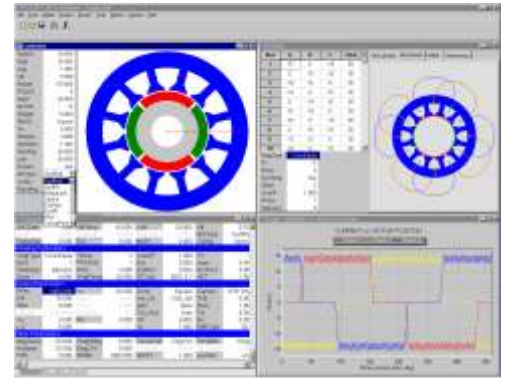
- to perform a feasibility or a comparative motor technology study
- to develop a design, which can be produced by the contractor
- for MACCON to manufacture a prototype motor
- to prepare for series or volume production, either by MACCON or by the contractor or by a third-party manufacturer.

Design Procedure

- The CAE program is used for initial design and documentation purposes.
- Detailed analysis of the electro-magnetic design including its topology (PCB-motors, linear motors, transversal-flux motors etc.) is performed with FLUX 2D/3D.
- System simulation is made under Matlab/Simulink. A direct link between Simulink and this FEM-program (FLUX2D) is available in order that a thorough dynamic analysis of extreme operating conditions can be executed.

Studies

We perform design studies under contract. Alternative motor designs for the application



SPEED: PC-BDC

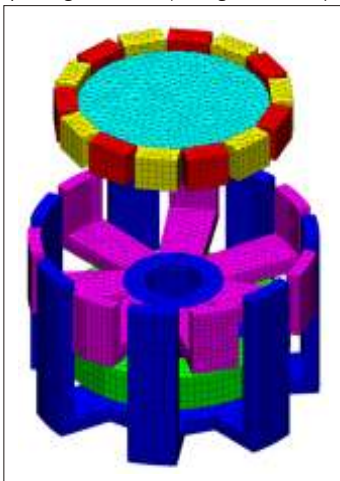
Design and analysis of BLDC-machines

are critically analysed, e.g. with regards to their performance criteria and expected production costs. The resulting motor designs can be made available to the contractor in electronic form for design maintenance purposes (see column left).

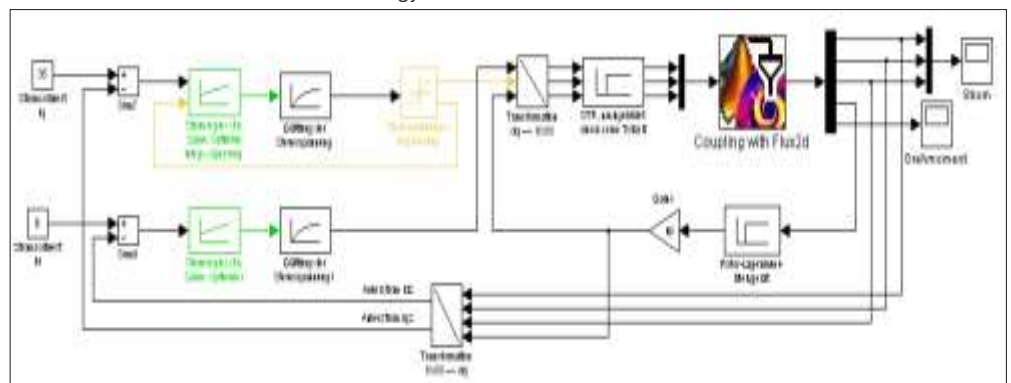


Motor design at MACCON

Detailed analysis of a multi-pole generator (using FLUX 3D)



System simulation with FLUX-Matlab/Simulink technology



CUSTOM MOTORS

Manufacture and Test

Production

MACCON develops customised motors according to user specification. Manufacturing is performed by one of our production partners in Germany and abroad - depending on technology, motor size and production volume.

Until delivery and acceptance MACCON remains your contractual partner and ensures that both performance and quality conform to the specified requirements of the application.

We can manufacture BLDC-, SR- and AC-machines between 50 W and 500 kW. We are particularly strong in the manufacture of direct drives with large diameters, even over 1.5 m. Any specialised actuator employing electro-magnetics can be produced to customer requirements.

Facilities

Our production plants employ modern machines and equipment, for example:

Winding a torque-motor stator



Assembly of small machines

- automatic winding machines
- needle winders
- tape winding machines
- rotation impregnation equipment with curing under current/UV-light
- balancing machines
- vacuum chambers
- CNC lathes and hydraulic presses
- test department with dynamic load facilities under computer control

Photos

The photographs on this page were taken at the plant of our production partner in Berfel (D) - Ramme Elektromaschinenbau GmbH.

Automatic winding machines



BLDC-stator with high slot fill (automotive)

Quality Control

MACCON and its motor manufactures are certified according to ISO9000. Data and test results are documented at all stages of productions.

Our motors are subject to a final inspection and test before delivery. The test procedure is often specified together with the customer.

MACCON ISO9001:2000



