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*Torque, Linear and Custom Motors*

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*Stepper, Servo and Traction Motors*

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*Drive Electronics and Controllers*

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*Actuators and Sensors*

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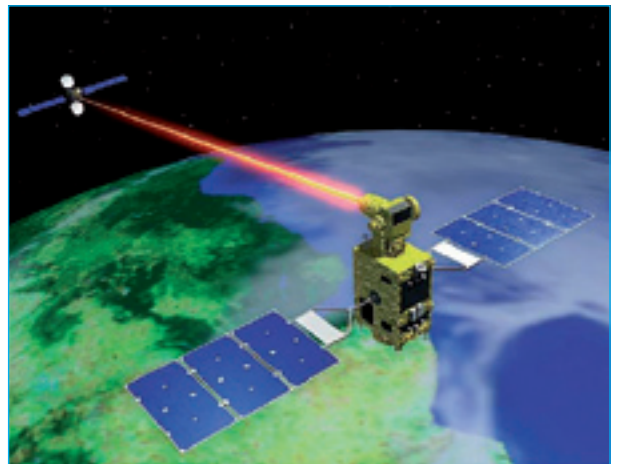
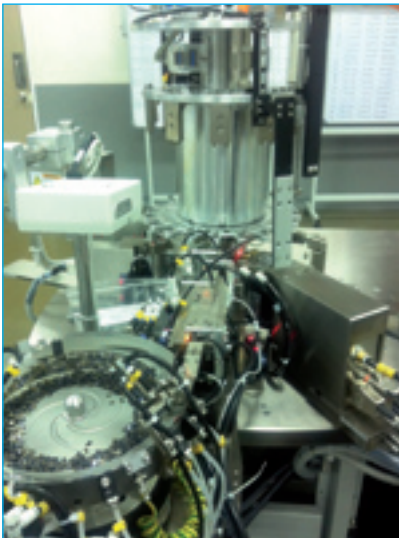
*CAE Tools and Engineering*

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*Motion Control Systems*

## **MOTION CONTROL**

*Partnership in Motion*



*Multi-axis*  
**Motion Control**

# MACCON – PARTNERSHIP IN MOTION

## MOTION CONTROL

### Our Capabilities

#### Cover Page

- Precision

*The LCT, Laser Communication Terminal supports gigabit-communications between satellites in space by means of a laser. It points the laser beam from one satellite to another with great accuracy, over many thousands of kilometers.*

- Dynamic response

*All electronic components must be tested before they are soldered onto printed-circuit boards. The EXIS 250 can perform these tests on 40,000 devices an hour. MACCON provides the main turret motor, which indexes each individual component under the test probe.*

- Smooth motion

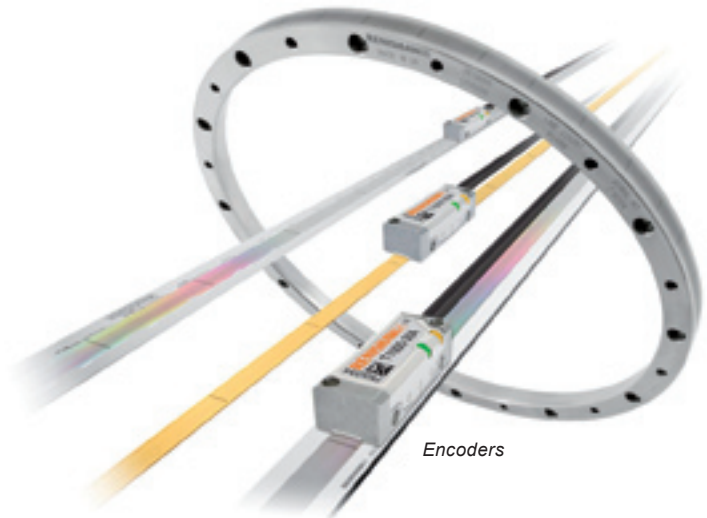
*It is also challenging to achieve very smooth and slow motion. Telescopes are an extreme case, where movement may be as low as one revolution per day; MACCON controls many telescopes. The GMRT (Giant Microwave Radio Antenna) in Pune, India is an example; not only can the tracking speed be very low but also the movement of up to 30 dishes can be coordinated simultaneously.*

MACCON controls motion. Whenever

- Precision
- Dynamic response
- Smooth motion

are important, MACCON has a solution to offer. The Motion Control capabilities presented here are implemented as control algorithms and special features of our drive electronics. To view the many hardware options we offer, please refer to our brochure “Drives & Controllers”. A full overview of our Motion Control products and partners is provided in our brochure “Motion Control Products”.

MACCON controls motion – with the help of electric motors, sensors, electronics, mechanics and software. Whenever precise and dynamic movement is required or high energy-efficiency, we have a solution to offer. Our main motor technology is the permanent-magnet, DC-brushless or synchronous PM-BLDC motor; however, our drives also control AC, DC, SR, SyR and Hybrid stepper motors. MACCON offers extensive design & simulation services for all these motor types. Please ask for our brochure “Motor Design & CAE”.



Encoders



Motors



Controllers

# MACCON – PARTNERSHIP IN MOTION

## MOTION CONTROL

### Standard Features

#### Bandwidth

A servo-control system needs a high bandwidth to ensure both dynamic response but also good electronic damping. There are two important factors to consider when maximizing this figure, the electrical and mechanical time constants. The mechanical time constants. the mechanical time constant is the ratio of peak torque to inertia (or force to mass); this is the physical limit of load response; its value is normally in the range of a few hz. The electrical time constant (the ratio of the supply voltage to winding inductance) is also significant. For good servo- control this figure should be 10+ times higher than the mechanical time constant.

#### Multi-axis Control

Our controllers support synchronised motion in many axes. This may be achieved through simultaneous initiation of predefined and locally stored motion sequences. Alternatively the controllers become the direct slaves of a multi-axis controller which dictates the exact position of each axis at every moment of time. The commands to the Individual motor controllers are transmitted via RS232, USB or Field-bus interfaces. This capability is particularly required in machine tools, robots and other contour-following applications.

In all our motor controllers we employ modern control techniques, employing proven and stable algorithms, which ensure precision, dynamic response and smooth motion.

#### Cascade Control

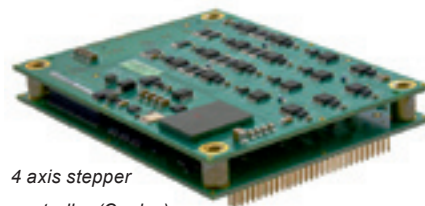
- Torque, speed and position
- Internal trajectory management
- Feedback: resolvers, encoders etc.

#### Commutation

- Sine/Block
- Resolvers, encoders, Hall-Effect, AMR
- Observer and sensorless based
- Vector control, field weakening (Id/Iq)
- Single-phase: DC, LATs, voice-coil actuators

#### Hardware Implementation

- Drives with integrated servo-control
- Multi-axis controllers
- Sensors



4 axis stepper controller (Copley)



Multi-axis controller (OMRON)



EtherCAT master (ACS)



Precision encoder (Heidenhain)



## MACCON – PARTNERSHIP IN MOTION

### MOTION CONTROL

#### Advanced Features

For demanding motion control applications, we can implement more advanced features in our drive hardware, examples are:

##### Advanced Control Algorithms

- Dual-loop
- Observer based
- Predictive control
- Non-linear control

##### Resonance Damping and Avoidance

- Accelerometer feedback
- Inverse load (plant) simulation
- Notch-filter implementation
- Backlash compensation
- Profiling to avoid harmonic injection

##### Sensorless Control

- Robust under extreme conditions
- Together with an encoder, sensorless control provides redundancy
- Cost-effective as no encoder or cabling is needed

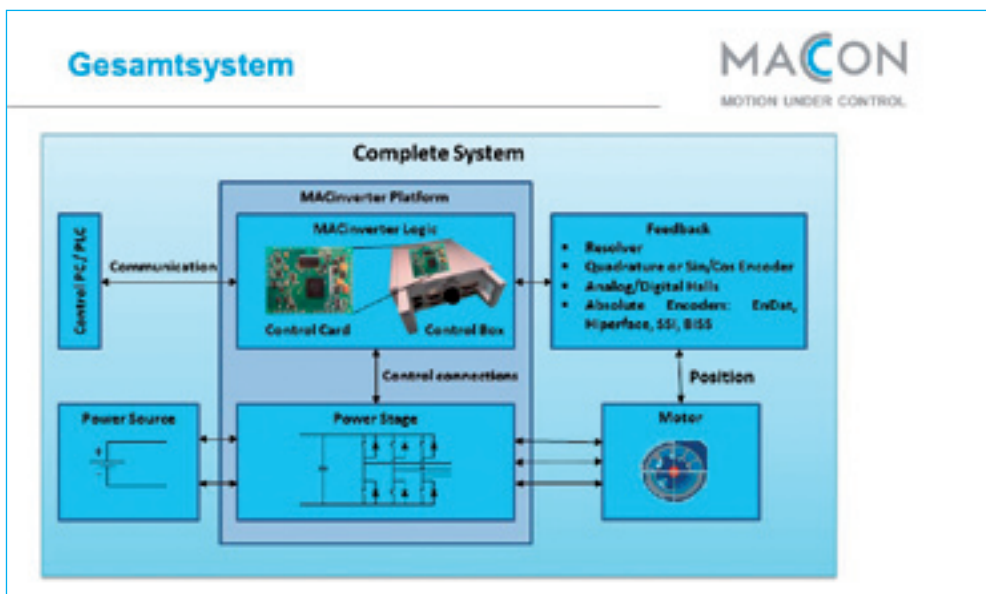
##### Self-commissioning of AC machines

- Self-Identification of system parameters.
- Automatic tuning and optimisation of torque, speed and position controller.
- Manually adjusting the dynamic control characteristics through the MACCON auto-tuner optimisation.

##### Configuration Tools (HMI; GUI)

The control of our drives is based on micro-controllers and FPGAs; these support direct digital communication with the host. We supply PC-based tools, which communicate directly with the drive, to configure, optimise and monitor operation.

An example is the CME2: a Java-based configuration software and indexer sequence tool, which also includes a 6 channel oscilloscope, CAM tables, auto-Tuning, auto-Phasing, error log and control panel.



##### Rapid Prototyping & Hardware in the loop, HiL

- Short development cycles
- High code efficiency through verified models and algorithms

##### System Simulation

- Designs are supported with system models
- Simulink (MATLAB), Activate (Altair), Portunus (Adapted Solutions)

Copley Controls CME2 screen



##### CMO/CML/C++

Our partner Copley Controls provides other tools:

- CMO - Motion C++ Libraries
- CML - C++ Source-Code Motion Libraries for EtherCAT and CANopen



# MACCON – PARTNERSHIP IN MOTION

## MOTION CONTROL APPLICATIONS

### Motion under Control

#### System Integrator

MACCON is not only a supplier of drive components but a **Motioneering** partner. The word "Motioneering" is the combination of the user **Motion** Control problem with our **engineering** services and know-how. We specify, procure, integrate and commission all the products needed to solve the application problem. When required we also provide bespoke motors and drives, as well as optimised control software.

#### Artificial Intelligence, AI

MACCON is also working on new technologies for:

- Automatic and secure drive and machine commissioning
- Identification of unknown machines and loads
- Monitoring of wear and service intervals
- Time saving for the commissioning and service engineer

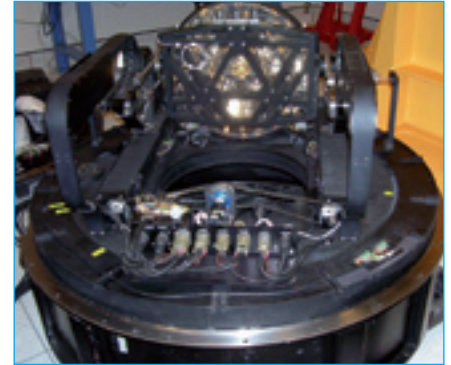
#### Resolut

Our partner company, Resolut in Halle, is specialist for real-time and safety-critical software. They support us in all of our high-tech programs with major software content. See: [www.resolut.de](http://www.resolut.de)

**resolut**

Here we present just some of many application examples for our Motion Control Know-how, technology and services. They come from every field of engineering, including:

- Astronomy
- Air & Sea Defence
- Military Vehicles
- Automotive
- Industry & Medicine
- Space
- Science



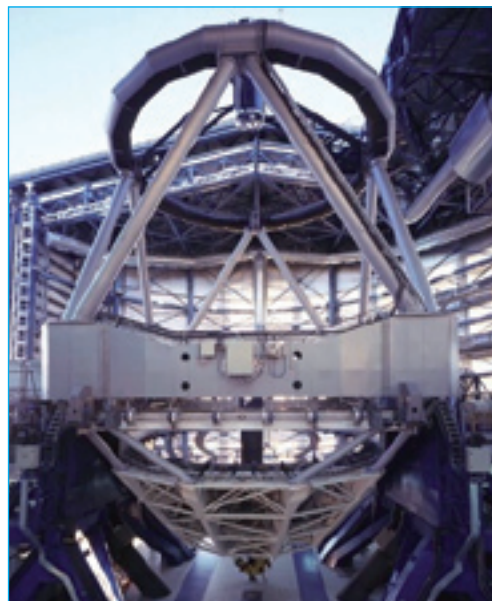
Gemini telescopes, Hawaii & Chile



MASS Ship Defense System (Rheinmetall)



Multi-stage neuron chopper



Astronomical telescope, Gran Canaria



SOFIA telescope control



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<b>CAE Tools and Engineering</b>	sales@maccon.de
<b>Motion Control Systems</b>	www.maccon.de

### Company Portrait

MACCON is a leading supplier of electric motors, EM-actuators, drive and control electronics in the range of 1 W to 250 kW. The company was founded in 1982.

MACCON provides drive solutions to meet demanding system requirements. We co-operate with many reputable product manufacturers, combining their high-quality products with our own custom-developed designs, to create high-performance yet cost-effective drive systems.

Our mission is to serve users in solving their real-time motion control problems in machines, processes and experiments. We ensure that the target machine exhibits:

- Precise, dynamic and smooth motion
- Compatibility with electrical and mechanical interfaces as well as with the host control
- Perfect adaptation to the physical environment

We are committed to providing our customers with top quality products and performance along with expert technical support. We strive to be the technical leader in motion control systems.

### Firmenportrait

MACCON ist ein technisch führender Anbieter von Elektromotoren, EM-Aktuatoren, Antriebs- und Steuerelektronik in der Leistungsklasse 1 W bis 250 kW. Das Unternehmen wurde 1982 gegründet. MACCON löst anspruchsvolle Antriebsaufgaben, die hohe, technischen Anforderungen stellen. Wir arbeiten mit vielen renommierten Partnerunternehmen zusammen, deren hochwertige Produkte, kombiniert mit unseren eigenen Entwicklungen, die Realisierung leistungsfähiger und zugleich wirtschaftlicher Antriebssysteme ermöglichen.

Es ist unsere Aufgabe, Anwender bei der Lösung ihrer Echtzeitbewegungsprobleme in Maschinen, Anlagen und Experimenten zu unterstützen. Wir stellen in der Zielmaschine sicher:

- Eine genaue, dynamische und gleichläufige Bewegung
- Die Anpassung unserer Produkte an die Hoststeuerung sowie an die mechanischen und elektrischen Schnittstellen
- Eine perfekte Anpassung an die physikalische Umgebung

Wir sind dem Grundsatz verpflichtet, unseren Kunden sowohl eine erstklassige Produktqualität und -performance als auch eine gute technische Beratung zu liefern. Wir streben die fachliche Führung im Bereich der elektronischen Antriebstechnik an.

