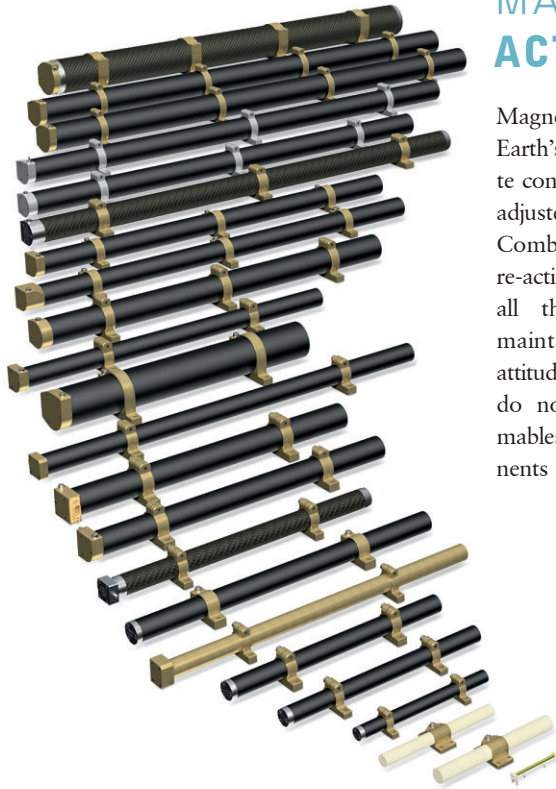


A large satellite with a gold-colored body and multiple blue solar panel arrays is shown in orbit above the Earth. The Earth's blue and white horizon is visible against the black background of space filled with stars. Other smaller satellites are visible in the distance.

COMPONENTS FOR
ATTITUDE CONTROL

**INTELLIGENT
SOLUTIONS**
TO REDUCE SPACE
MISSION COSTS



MAGNETIC TORQUER ACTUATORS FOR GNC

Magnetic Torquers interact with Earth's magnetic field and create control torque, which can be adjusted to the required value. Combined with one or more re-action wheels, they provide all the control needed to maintain the spacecraft's attitude. Unlike thrusters torquers do not need valuable consumables, are low power components and highly reliable.

Design Features

- ▶ Internal coil fixation to eliminate mechanical and thermal stress
- ▶ Nickel-alloy cores with special treatment
- ▶ Aluminium brackets (custom designs available)
- ▶ Aluminium-alloy or composite housing tube
- ▶ Heavy grade coil wire insulation
- ▶ Simultaneous winding of redundant coils
- ▶ ESCC non-magnetic connectors or flying leads
- ▶ Titanium bolts and housing parts
- ▶ Air coil systems using aluminium or CFRP are available

Our production process satisfies the highest standards for performance and workmanship with excellent quality control.

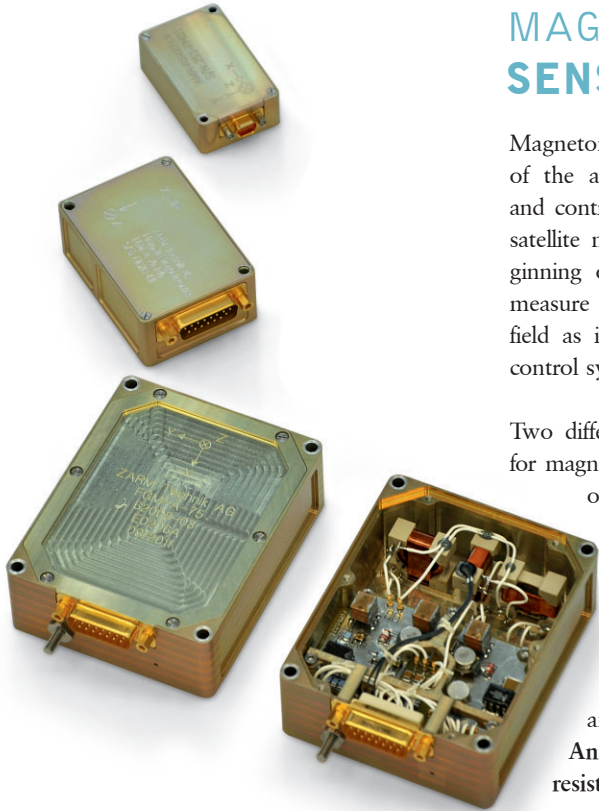
PHILOSOPHY

“IN THE PAST 15, YEARS ZARM TECHNIK AG HAS GAINED A LARGE FLIGHT HERITAGE ...

and design experience for magnetic torquers with a dipole range of 0.1 Am^2 up to 1.000 Am^2 and can therefore offer for nearly all application a suitable solution. Nevertheless, if this should not be the case, ZARM Technik is offering as a free-of-charge service the customization of individual units. Therefore, we would only request your technical requirements and will provide a customized magnetic torquer design.”

ZARM Technik Magnetic Torquers supported more than 100 international satellite missions. Not a single magnetic torquer out of over 500 units has ever failed. For more than 15 years we produce and improve intelligent technical solutions to reduce space mission costs. Our experience led to an outstanding flight heritage and satisfied clients all over the world.

MAGNETOMETER SENSORS FOR GNC



Magnetometers have been part of the attitude determination and control system (ADCS) of satellite missions since the beginning of space flight. They measure the external magnetic field as input for the attitude control system.

Two different sensor concepts for magnetic field measurement onboard the satellites are available: **Fluxgate** magnetometer with noise below one nT which is built with high reliable components and a well-prized **Anisotropic Magneto-resistive (AMR)** based magnetometer with lower

resolution but compact size and low mass.

Performance

- ▶ Low power consumption
- ▶ Low mass and size
- ▶ Good linearity and accuracy
- ▶ Radiation tolerant > 50 kRAD
- ▶ Adaptation to specific mission requirements is available

Design Features

- ▶ Aluminium-alloy housing
- ▶ Encapsulant protects the sensor and electronics inside the housing
- ▶ Space-grade materials and qualified EEE parts
- ▶ ESCC D-subminiature or MDM-type non-magnetic connectors

SERVICES FOR TESTING SPACE HARDWARE

▶ TVAC:

Environmental testing is mandatory for space hardware to qualify for vacuum and thermal conditions faced during the hardware's life span in space. ZARM Technik's facilities offer services required for manufacturing like Bake-out. Our qualification standards are according to ESA and NASA procedures.



▶ Vibrational Testing:

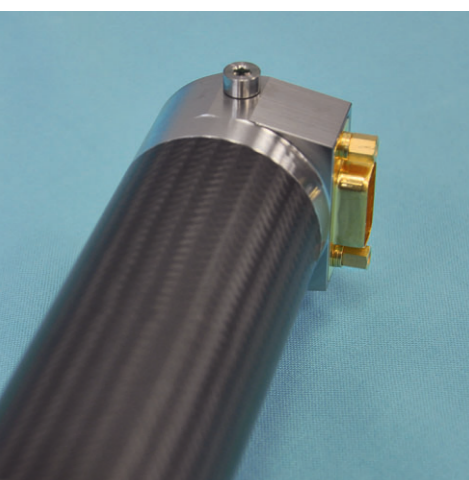
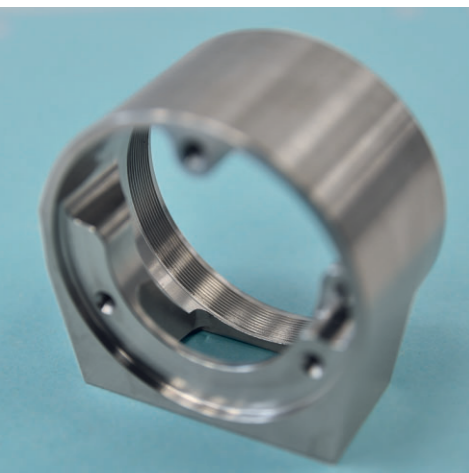
The Shaker allows the simulation of launch loads on the hardware. Ground testing and evaluating all aspects of vibrational and structural dynamic characteristics is a vital step in assuring a robust and successful design. This includes random vibrations, sine sweeps and shock conditions.



▶ Hyper-g Testing:

ZARM Technik operates the largest centrifuge in Europe offering high acceleration levels up to 30g – complementary to the drop towers zero-g environment. The testing facility enables certifications of aerospace structures and prototypes under conditions of crash survival.





► **HOUSING TUBE**

STANDARD ANODIZED MATT BLACK FINISH SHOWS OPTIMIZED THERMO-OPTICAL PROPERTIES – ADDITIONALLY AVAILABLE ARE CFRP AND PEEK.

► **UPPER HOUSING**

ACCOMMODATES CONNECTOR AND GROUNDING – AVAILABLE VARIETIES INCLUDE DIFFERENT OUTLET DIRECTIONS AND FLYING LEADS.

► **KAPTON**

CORE INSULATION.

► **SIGNATURE**

OUR UPPER HOUSING PLATE CARRIES THE TORQUERS UNIQUE ENGRAVING.

► **BRACKETS**

MOUNTING INTERFACE TO SPACECRAFT – NUMBER AND POSITION CAN BE VARIED ACCORDING TO CUSTOMER REQUEST – THERMAL COUPLING WITH SPACECRAFT.

► **ELASTOMER**

PROVIDES COIL PROTECTION AND INTERNAL FLOATING COIL FIXATION TO ELIMINATE MECHANICAL AND THERMAL STRESS.

► **MAGNETIC CORE**

OUTSTANDING MATERIAL TREATMENT ASSURES BEST MAGNETIZABILITY.

THE IMPACT ON DESIGN IS VALUED HIGH WITH OUR CUSTOMERS.

NEAR ZERO HYSTERESIS – EXCELLENT LINEARITY – HIGH MAX DIPOLE MOMENT.

► **COIL**

AT THE HEART OF OUR CUSTOM MADE TORQUERS IS THE INDIVIDUAL COMBINED DESIGN OF COIL AND CORE AND THE ADAPTION TO SPECIFIC MISSION REQUIREMENTS.

MAGNETIC TORQUER

CUSTOM-MADE FROM 0.1AM² UP TO 1000AM²

Although torquers appear to be relatively simple devices, they require thoughtful design and careful assembly. The torquer's key feature component – its core material – has been treated to ensure optimal magnetic properties. Each unit is totally encapsulated and, except for the core,

made from non-magnetic space-grade components.

Over more than 15 years numerous designs have been realised satisfying the customer's specific technical requirements by adapting power consumption, dipole range, size, and mass.



ZARM Technik AG is one of the leading suppliers for attitude control equipment. It was founded in 1997 as a spin-off company and commercial branch of the university institute ZARM.

Today ZARM Technik AG produces and delivers space technology products for small low-cost satellites as well as for large scale constellations.

ZARM Technik AG

Holger W. Oelze, CEO

Am Fallturm | 28359 Bremen | Germany

Phone +49 421 218-57770 | Fax +49 421 218-9857770

holger.w.oelze@zarm-technik.de | www.zarm-technik.de

ZARM, Center of Applied Space Technology and Microgravity, is the largest university space research center in Europe, its most outstanding facility is the Drop Tower Bremen, which provides up to 9.3 seconds of microgravity.