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OHB

SPACE SYSTEMS

TET

The Small Satellite Series

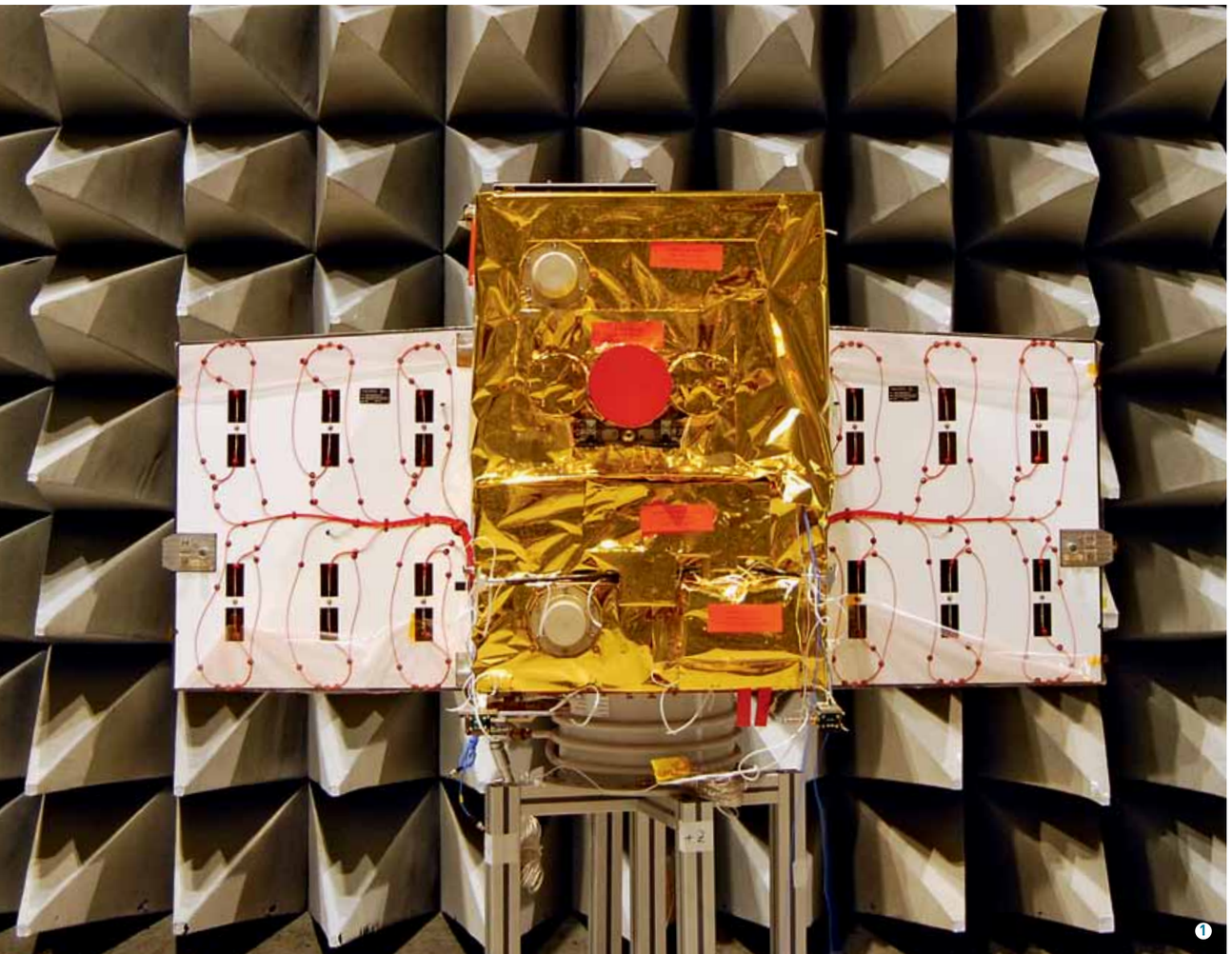
TET
A FAMILY OF SATELLITES

The German Technology Experiment Carrier TET-1 represents the core element of DLR's On-Orbit Verification Program (OOV) and was successfully launched July 22, 2012 with a Soyus-Fregat that injected the satellite into its destined orbit at about 510 km.

After a successful Early Operations and Commissioning Phase, the eleven payloads on board have been tested in a space environment over a one year period. End of October 2013, the main OOV-mission has been successfully completed and since then TET-1 is employed in DLR's FireBird mission mainly for forest fire detection and monitoring. With a DLR agreement the OOV-mission has been extended in parallel for selected payloads.

OHB System AG continues to accompany the verification of technology for later space applications and arranges flight opportunities for national and international organisations and companies. OHB System and its partners also have worked on the successor mission under a DLR contract.

A family of TET satellites is being designed to enable institutional and commercial customers to select a satellite best suited to their requirements. Because of its modular design, the TET satellite can be easily adapted to suit different mission needs. Such missions include ongoing OOV applications, classical Earth observation missions like early detection of forest fires, as well as dedicated missions.



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TET-X AND TET-XL PLATFORMS
TWO SMALL SATELLITE LINES

Expanding on the TET-1 heritage there are now two small satellite lines: TET-X and TET-XL. While TET-X is aiming for a maximum re-use of existing platform technologies but with improvements of the power subsystem and telemetry and command system, the TET-XL is a more ambitious evolution focusing more on providing maximum performance at a given platform size but its components and subsystems are still based on TET-1 / TET-X platform technologies. TET-XL is providing higher payload capacities with higher mass and larger dimensions. This allows for significant increase in the performance parameters compared to TET-1 / TET-X.

TECHNICAL DATA TET-X

- **Compact Satellite Design**
- **580 mm × 880 mm × 670 mm (W × H × D)**
- **3-axes stabilized (4 reaction wheels)**
- **Service module fully redundant**
- **3 solar panels (1 fixed plus 2 deployable)**
- **Ample payload resources**
- **Mass: 120 kg for total S/C, 50 kg for P/L**
- **Volume: 320 dm³ for S/C, 90 dm³ for P/L**
- **Pointing Accuracy: typ. 2 arcmin**
- **Pointing Knowledge: typ. 10 arcsec**
- **Positioning Knowledge: < 10 m**
- **Payload Power Continuous: 80 W (or more, depending on selected orbit and heat rejection possibilities)**
  Payload Power Peak: max. 160 W for 20 min.
- **Communication: S-Band, TC 4 – 256 kbit/s, TM 2,2 – 6 Mbit/s**
- **Typical orbit: 450 km – 850 km altitude, 53° – sun synchronous inclination**
- **Designed life-time: 3 – 5 years in-orbit.**

OPTIONS

- **5 Solar Panels**
- **Payload Data Downlink: 100 Mbit/s (X-Band)**
- **Micro Propulsion System**
- **Encryption / Decryption**
- **Authentication**

TECHNICAL DATA TET-XL

- **Compact Satellite Design**
- **800 mm × 845 mm × 800 mm (W × H × D)**
- **3-axes stabilized (4 reaction wheels)**
- **Service module fully redundant**
- **3 solar panels (1 fixed plus 2 deployable)**
- **Ample payload resources**
- **Mass: 200 kg for total S/C, 80 kg for P/L**
- **Volume: 520 dm³ for S/C, 170 dm³ for P/L**
- **Pointing Accuracy: typ. 2 arcmin.**
- **Pointing Knowledge: typ. 10 arcsec.**
- **Positioning Knowledge: < 10 m**
- **Payload Power Continuous: max. 150 W (depending on selected orbit and heat rejection possibilities)**
- **Payload Power Peak: max. 460 W for 25 min.**
- **Communication: S-Band, TC 4 – 256 kbit/s, TM 6 Mbit/s**
- **Typical orbit: 450 km – 850 km altitude, 53° – sun synchronous inclination**
- **Typical Δv: 60 m/s (for 250 kg s/c mass)**
- **83 m/s (for 150 kg s/c mass)**
- **Designed life-time: up to 7 years in-orbit.**

OPTIONS

- **5 Solar Panels**
- **Payload Data Downlink: 400 Mbit/s (X-Band)**
- **Payload Data Downlink: 1.2 Gbit/s (Ka-Band)**
- **Encryption / Decryption**
- **Authentication**

❶ TET-1 at IABG test house: EMC test ❷ TET-1 integration in a clean room at OHB System AG

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TET FOR ON-ORBIT VERIFICATION
FIRST OOV MISSION

The OOV Program of the German Space Agency DLR aims at testing new space technologies in orbit over a period of one year, thus qualifying them for application in space projects. Due to the high safety standards in the space sector, every new product must complete a verification process before qualifying for operation in a space system. Within the verification process, the payload undergoes a series of tests which prove that it is in accordance with mission requirements in terms of function, reliability and safety. Consequently, TET-X is a means to demonstrate that a product or technology functions under space conditions since these cannot or can only be partially simulated on ground.

The responsibilities of DLR's system prime OHB System AG (formerly Kayser-Threde GmbH) includes definition and management of the ground-, space- and launch segment; the technical support of payload suppliers; the development of the payload segment; control of the satellite bus development performed by Astro- und Feinwerktechnik Adlershof GmbH (AFW) as well as control of ground segment development performed by DLR's German Space Operations Center (GSOC).

OHB System AG will arrange flight opportunities on future OOV missions.

❶ TET-1 roll out at Baikonur launch site (credit: Thilo Kranz, DLR; also for No. 6+7) ❷ integration at Astro- und Feinwerk GmbH premises
❸ prior to transportation to launch site ❹ at IABG test house: thermal test ❺ in an integration hall at OHB System AG
❻ prior to integration on the launcher's upper stage ❼ TET-1 launched July 22, 2012.

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TET FOR DEDICATED MISSIONS
GNSS-R/PARIS AND SMRS MISSIONS

Since 2009, different studies have been funded by ESA and DLR to define follow-on projects that utilize the advantages of the TET platform. To achieve this, the flexible TET payload segment is adapted where necessary. This includes modifications to the TET payload support structure, the payload harness as well as the payload thermal control. If required, adaptations to the Payload Supply System are also undertaken. The wide range of possibilities available through TET are represented by two illustrative examples:

GNSS-R/PARIS (Passive Reflectometry and Interferometry System)
The PARIS mission is a small-class mission under study by the European Space Agency which aims at demonstrating scientific applications of the GNSS reflected signals. For GNSS-R/PARIS the baseline is an adapted TET-X platform. With particular focus on mesoscale ocean altimetry it carries a single payload, a Passive Reflectometry and Interferometry System (PARIS) Ocean Altimeter. This instrument features the correlation between the direct and reflected GNSS signals received through high gain, beam-steering antennas in order to measure e.g. sea surface heights. One application of this mission is the measurement of tsunami waves travelling in the ocean which would provide first-ever direct synoptic observations of this phenomenon.

SMRS (Space Based Maritime Reconnaissance and Surveillance Mission)
The SMRS mission is a low-cost in orbit demonstration (IOD) mission for demonstration of new sensor technologies for ship detection and tracking as well as data fusion products for value added services to the maritime situation awareness community. Core services of the SMRS mission will be provided in the areas Fishery Monitoring, Traffic Management, Maritime Safety and Border Control. The SMRS mission is based on an adapted TET platform including five solar panels.

TET FOR COMMERCIAL APPLICATIONS
CUSTOMIZED SOLUTIONS

Apart from technology demonstration, suitable applications for science, Earth observation, space situational awareness, and integrated applications, TET is also highly suitable for certain commercial projects and missions. With the heritage from the successful TET-1 satellite and its predecessors, the two satellite platform lines TET-X and TET-XL can offer a range of possibilities to suit the customer needs.

The key to TET's flexibility is its modular Payload Support System. It provides multiple electrical interfaces allowing the Maximum adaption of the platform interfaces to the payload. The redundancy of the service module and radiation resistance of the components also lead to substantial competitive advantages. Commercial projects for TET-X/TET-XL are currently under negotiations.

OHB System AG would like to thank DLR, project partners, sub-contractors and payload providers for their effective cooperation in the TET-1 project and their trust placed in the prime contractor OHB System AG. TET-1 was carried out under contract to DLR with funds from the German Ministry for Economics and Technology (Bundesministerium für Wirtschaft und Technologie) under reference number 50 RV 0801.
Project partners: Astro- und Feinwerktechnik Adlershof GmbH, German Space Operations Center (GSOC). Launch provider: Lavochkin Association.

❶ – ❸ Technology Experiment Carrier TET-1 during integration at OHB System AG premises


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About OHB System AG

OHB System AG is one of the three leading space companies in Europe. It belongs to the listed high-tech group OHB SE, where around 2,400 specialists and system engineers work on key European space programs. With two strong sites in Bremen and Oberpfaffenhofen near Munich and more than 35 years of experience, OHB System AG specializes in high-tech solutions for space. These include small and medium-sized satellites for Earth observation, navigation, telecommunications, science and space exploration as well as systems for human space flight, aerial reconnaissance and process control systems.

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