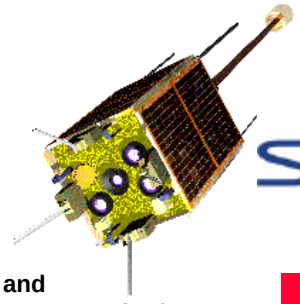
Surrey Missions: TiungSAT-1



Multispectral imaging, cosmic ray detection, digital store and forward communications and on-board GPS navigation are among the features that make the low cost, 50 kg TiungSAT microsatellite a remarkable achievement.

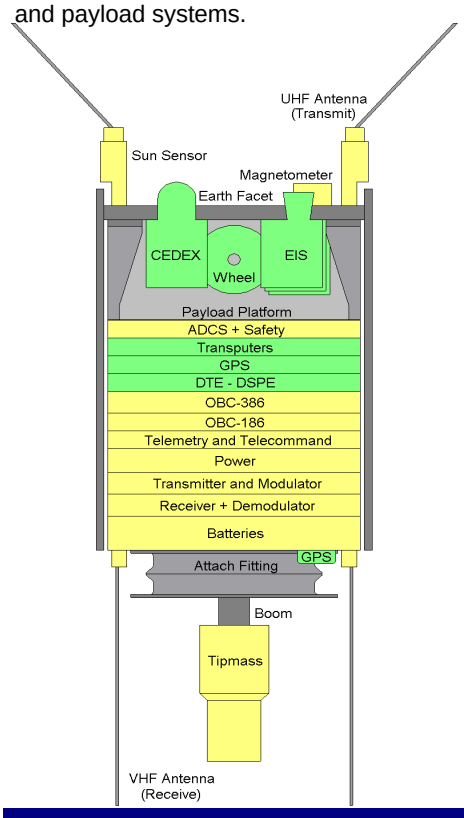
The TiungSAT-1 Mission

TiungSAT-1 is the first micro-satellite for the Astronautic Technology (M) SDN. BHD. Company (ATSB) in Kuala Lumpur, Malaysia. It was built by SSTL, at the Surrey Space Centre under a UKP8.4m contract (1997), within a Know-How Technology Transfer Programme between the UK and Malaysia, including the installation of a satellite control centre in Malaysia.

The mission objectives of the satellite are: advanced remote sensing and digital store and forward communications. Other payloads include a digital data transfer experiment, positioning using an on-board GPS receiver and a cosmic ray detection TiungSAT-1 uses Radio Amateur Frequencies, thereby giving the Radio Amateur Society access to its Earth images and communications capabilities. TiungSAT was launched on a DNEPR launch vehicle into a 650km orbit in September 2000 under the auspices of the Russian Space Agency. The first images from its Earth imaging cameras were obtained within just one week of launch.

The TiungSAT-1 Spacecraft

Based on SSTL's proven modular microsatellite bus, the TiungSAT-1 structure comprises eleven module trays which are used to house the electronics for the bus and payload systems.



The battery box is the space facing facet. On the outside of this module are the VHF telemetry and command receivers, GPS patch antennas for orbit determination and a gravity gradient boom. The attitude determination and control system is based upon the proven gravity gradient and magnetorquer systems developed by SSTL. Autonomous functions, safe modes and data are handled by two on-board computers (OBC-186 and OBC-386). Four body mounted GaAs solar panels provide 35 W per panel. The Earth facing spacecraft facet is the Earth Observation Platform (EOP). As well as EO instruments, the EOP contains the attitude sensors, UHF transmit antennas, momentum wheel and the CEDEX instrument.

Applications

- Earth Observation - Imaging, Meteorology, Environmental
- Digital Store and Forward Communications
- Technology Demonstration
- Space Science
- Amateur Radio Access

Payloads

- Earth Imaging System
- GPS Navigation & Attitude
- Data Transfer Experiment (DTE)
- Digital Signal Processing
- Cosmic Ray Detection Experiment (CEDEX)
- Momentum Wheel

Qualification

- Platform Similar to the following missions: UoSAT-3, -4, -5, KITSAT-1, S80/T, HealthSat, POSat, FASAT-Alfa, CERISE, FASAT-Bravo, TMSAT, CLEMENTINE, Tsinghua-1
- Due for Launch: PICOSat

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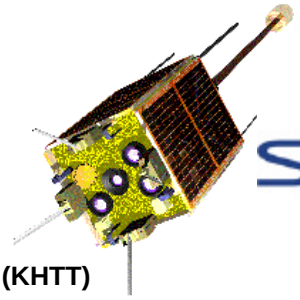

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SSTL Know How Technology Transfer Programme (KHTT)

- The aim of the SSTL KHTT Programme is to provide a world-class training programme, that results in KHTT customers receiving the tools and experience to establish their own successful Low Cost Space Programme.
- The programme offers a total-immersion space mission engineering experience, from blank sheet through academics, design, assembly, integration, test, launch and operations.
- Key Programme comprises Mission Analysis and Design,

TiungSAT-1 Platform and Payload Specifications

Mission	Customer	ATSB (Malaysia)
	Contract	UKP8.4m (1997), including spacecraft, payloads, ground-segment, production license and training.
	Design life	5 years nominal, expectancy > 10 years.
	Schedule	18 months to launch readiness
	Launch	26 Sep. 2000 into a 650 km altitude, 64° inclination orbit.
Earth Imaging System	Wide Angle Camera (WAC)	1200m GSD; Field of View 1200 x1200 km.
	Narrow Angle Camera (NAC)	3 cameras (R, G, B); 80 m GSD; FOV 80 x 80 km.
	NAC Optics	100 mm aperture diameter, 75 mm focal length.
	WAC and NAC sensors	Staring array, 1024 x 1024 pixel CCD.
CEDEX	Multichannel Analyser	512 channels, 0.05pC charge resolution
	Instrument Charge Range	0.2 pC to 24 pC equivalent to a normal incidence particle Linear Energy Transfer of ~60 MeV cm^2 g^{-1} to ~7500 MeV cm^2 g^{-1}
	Maximum Count	200,000 particles per second.
	Directional Resolution	Coincidence detector & associated logic.
Momentum Wheel	Characteristics	1 kg mass, 5 mN-m torque, 0.22 nms storage
Experimental Microsatellite GPS Data Transfer Experiment	Description	SSTL GPS Rx, developed with ESA, for on-board orbit determination Two GPS R_X patch antennas and reference source for attitude;
	Receivers	Two synthesised receivers.
	Digital Signal Processor	Two DSP, based on the Texas Instruments C31 processor.
Physical	Dimensions	360 x 360 x 690 mm, deployables stowed.
	Mass	50 kg
Power	Solar Panels	Four body mounted GaAs cell panels @36W each; Peak 50 W.
	Battery	10cell 7Ah NiCd battery.
	Dual Redundancy	BCR, Power conditioning & distribution modules.
ADCS	Stabilisation	Gravity gradient stabilised with magnetorquer contro.l
	Sensors	2-axis analogue Sun sensors (x2), 3-axis magnetometers (x2), Earth underneath / Sun overhead (UED/SOD) detector.
	Actuators	Gravity gradient boom, 3- axis magnetorquers (x2), momentum wheel
	Attitude	Nadir pointing with yaw control. GPS attitude experiment.
	Pointing knowledge	±1° roll & pitch (3σ); ±3° yaw (3σ).
	Pointing Capability	±5° of nadir roll, pitch & yaw.
Navigation	NORAD	GPS R_X option for on-board generation of Keplerian orbit elements
Command & Data Handling	Processor	80186 with 768 kB program memory and 14MB RAMDisk; 80386EX & 387 co-processor, 4MB program memory, 128 MB RAM.
	Distribution	One Data Sharing (DASH) Network and Two Control Area Networks.
	TTC	Telecommand and telemetry systems.
	Operating System	In-orbit reprogrammable.
Communications	Uplink	Three receivers at 9.6 kbps; Rx1 operates at 144.46 MHz Rx2 and Rx3 operate at 145.85, 145.925 selectable.
	Downlink	Dual redundant. 2.5 to 10 W output power; 9.6, 38.4, 76.8 kbps selectable, 437.300, 437.325, 437.350, 437.375 MHz selectable.
	Antennas	One per downlink antennas on +Z face; On +Z & -Z faces per uplink.