

Fly smarter and independently

HAUT IN SPACE

Because knowing your orbit and time changes everything



Spaceopal's HAUT-S is an onboard real-time orbit determination and time synchronization (ODTS) component for low Earth orbit (LEO) and low-middle Earth orbit (MEO) satellites, delivering decimeter-level orbit accuracy and nanosecond-level time synchronization for a wide range of space missions with anti-spoofing (OS NMA) and interference mitigation for enhanced resilience.



Discover how
autonomy begins

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GNSS			
Constellations	GPS, Galileo		
Signals	GPS L1C/A,L2C,L5, Galileo E1,E5a,E5b,E6 Galileo E6-B for HAS corrections		
Observations	Dual-frequency pseudoranges and carrier phases		
Corrections	Corrections provided by Galileo HAS		
Resilience	Galileo OS NMA Interference detection and mitigation		
Interfaces			
Telemetry / Telecommand	RS422, up to 921,600 Bit/s Ethernet		
Time synchronization	10 MHz reference frequency (i/o) Pulse-per-second		
GNSS antenna	RF input		
Cross-link for redundant systems	RS422		
SWaP			
Size	100x95x44 mm3		
Mass	< 0.5 kg		
Power consumption	< 5 W		
Input voltage	9 – 40 V		
Environmental Qualification			
Temperature	non-operational:	-40 – 80 °C	
Constellations	operational:	-20 – 70 °C	
Vibration	MIL-STD-810G		
Single event effects (SEE)	tested with proton irradiation up to 200 MeV		
Total ionizing dose (TID)	tested up to 35 krad		
Performance		with broadcast ephemeris	with broadcast ephemeris
continuously zenith pointing GNSS antenna, no maneuvers			
Orbit accuracy 3D RMS (nominal/committed):	at 1,300 km altitude:	< 10 cm / 11 cm	< 7 cm / 9cm
	at 780 km altitude:	< 14 cm / 15 cm	< 11 cm / 12 cm
Orbit accuracy 1D LoS	at 1,300 km altitude:	< 7 cm	< 5 cm
	at 780 km altitude:	< 9.5 cm	< 7 cm
Timing accuracy	< 1 ns		
Real-time Navigation Filter			
Type	Extended Kalman Filter		
States	Satellite position and velocity, clock bias, inter-system bias, clock drift, empirical accelerations, satellite drag and radiation coefficients, carrier-phase float ambiguities		
Measurement update period	0.1 Hz		
PVT output rate	1 Hz		
Reduced Dynamics Orbit Model			
Gravitational potential	GOCO03S up to order and degree 70, including rate terms $\dot{C}_{20}$, $\dot{C}_{21}$ and $\dot{S}_{21}$		
Third-body gravitation	Point-mass model; truncated analytical series of luni-solar coordinates		
Atmospheric drag/solid Earth	Cannon-ball model; K ₂ tides		
Empirical accelerations	Epoch-wise estimation for radial, along-track and cross-track components		
Flight heritage	SW flight heritage in Proba-V, TET, Bird, EuCROPIS missions		