

Autonomous Star Sensor **ASTRO APS**

The Jena-Optronik **ASTRO APS** is an Autonomous Star Sensor with the most advanced radiation hard CMOS Active Pixel Sensor detector technology for long-term missions on Telecom, Science and Earth Observation satellites.



The ASTRO APS has been designed with compact dimensions, low mass, and low power consumption. Since July 2013, the ASTRO APS has been accumulating space heritage operating flawlessly on board of Alphasat.

Features

- Lifetime on orbit >18 years
- Radiation design for 25 years GEO environment
- APS design with space qualified CMOS detectors
- Full performance with Moon in the field of view
- Very robust against solar flare environment and false star objects
- Data fusion between several ASTRO APS star sensors for full 3-axes attitude measurement, improved agility performance, and autonomous FDIR capabilities

ASTRO APS Highlights

- Autonomous compensation of White Spots, DSNU, FPN and Dark Current
- LSFE fully compensated over entire lifetime due to smart self-calibration
- Both "lost in space" attitude acquisition and attitude tracking possible w/o Peltier cooling over entire operational temperature range
- Integrates either APS HAS2 or STAR1000 detector chips depending on mission demands

Size & Mass		
Dimensions	154 mm x 154 mm x 237 mm	including baffle
Mass	approx. 2 kg	including baffle, GEO-shielding, DC/DC-converter, MIL1553
Imaging System Design		
Optics	refractive, focal length 43 mm, f/1.2	aspherical lens technology, rad-hard glass material
Detector Resolution	1024 x 1024 pixels	
Field of View	20 deg	circular
Detector Options	HAS2	APS CMOS radiation tolerant
	STAR1000	APS CMOS radiation hard
Temperature Range		
Operational	-30 °C ... +60 °C	typical cooler controller set point at TAPS=+30°C
Non-operational	-40 °C ... +70 °C	
Attitude Performance		
Random Error	< 1 arcsec [1σ], across boresight < 8 arcsec [1σ], boresight	includes LSFE, HSFE, TE
Bias Error	< 5 arcsec, all axes	over full operational temperature range
Acquisition Time	< 10 sec, after switch-ON < 5 sec, re-acquisition "lost in space"	direct entry to attitude tracking with apriori information
Slew Rate & Acceleration	< 0.3 deg/sec, ≤ 0.3 deg/sec²	full performance
	≤ 3.0 deg/sec, ≤ 2.0 deg/sec²	STAR1000 single head capability
	≤ 5.0 deg/sec, ≤ 7.0 deg/sec²	HAS2 single head capability
Sensitivity	6.0mi G0-reference star	end of life performance
Sampling Rate	10 Hz 16 Hz	others up to 32 Hz on demand
Stray Light	Sun: 26 deg exclusion angle	half cone
	Earth: < 20 deg	depending on orbit height and Earth illumination conditions
	Moon: accepted in field of view	
Interfaces		
Data	MIL-STD-1553B RS422	optional selectable, others on demand
Power	28V nominal 50V nominal 100V nominal	optional selectable for either regulated or unregulated primary power s/c bus architectures other voltages on demand
Power Consumption		
MIL-STD-1553B	< 6 W, Peltier Cooler OFF	end of life
data interface	< 12 W, Peltier Cooler ON _{MAX}	
RS422	< 5 W, Peltier Cooler OFF	end of life
data interface	< 11 W, Peltier Cooler ON _{MAX}	
Operations		
Reliability	460 FIT, T _{TF} =20°C	with Class 1 EEE parts
Operational Modes	Boot	fully autonomous mode switching from Power-ON to NAT
	Standby-Mode	by software parameter set-up possible
	Autonomous Attitude Determination (AAD)	
	Nominal Attitude Tracking (NAT)	
	Photo, Upload/Download, Self-Test	