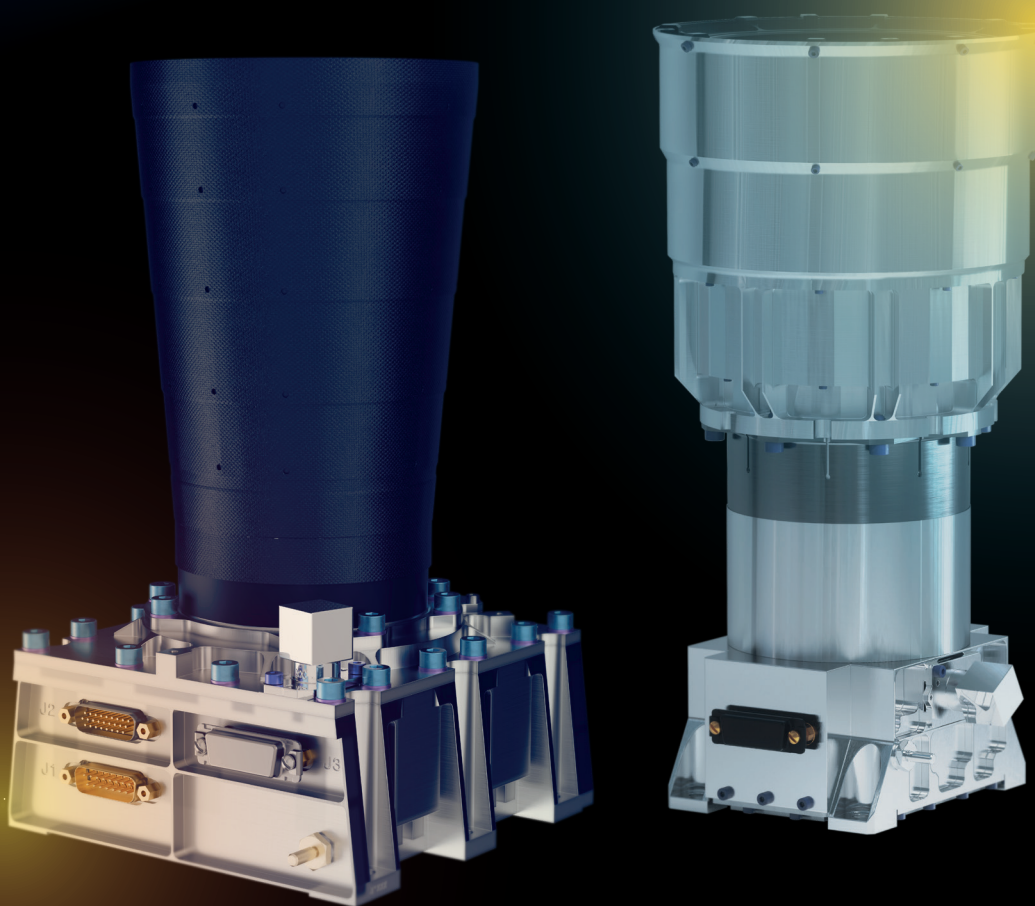


# HIGH PERFORMANCE STAR TRACKERS

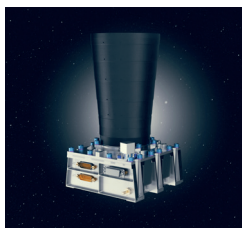
THE WORLD LARGEST STAR TRACKER PORTFOLIO,  
FROM OFF-THE-SHELF TO CUSTOMIZED SOLUTIONS



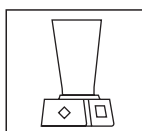
9+ MILLION HOURS OF SUCCESSFUL OPERATIONS  
230+ OPTICAL HEADS LAUNCHED

# HIGH PERFORMANCE LINE UP

## HORUS - SINGLE BOX HIGH PERFORMANCE STAR TRACKER

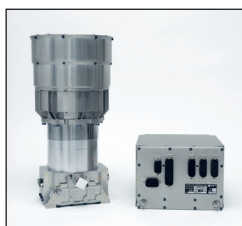


Total noise XY/Z @3 $\sigma$	4.6 / 33 arcsec
Max slew rate (acquisition)	$\leq 6$ deg/s
Max slew rate (tracking)	$\leq 8$ deg/s



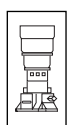
- One optical head embedding electronics and software
- **Compact and economic high performance solution**
- Low weight, autonomous standalone star tracker
- Lifetime of 10 years in LEO orbit and 18 years in GEO orbit
- Embedded Star Catalog and Algorithms
- Baffle protection with Sun Exclusion Angle 24°
- Including Thermo Electric Cooler (TEC) for optimum performance at end of life

## HYDRA STAR TRACKER - HIGH PERFORMANCE AND MODULAR STAR TRACKER SOLUTION



Total noise XY/Z @3 $\sigma$	4.1/ 32 arcsec
Max slew rate (acquisition)	$\leq 6$ deg/s
Max slew rate (tracking)	$\leq 8$ deg/s

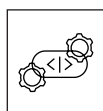
- Available in several form factors according to customer needs
- 8 million hours of successful operation
- Lifetime of 10 years in LEO orbit and 18 years in GEO orbit



### OPTICAL HEAD (OH)

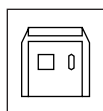
- Rapid acquisition and accuracy of a few arcsec with CMOS detector
- Sun Exclusion Angle 26° • With or without Thermo-Electric Cooler (TEC)

### SOFTWARE



- Software can be implemented either on Hydra Electronic Unit (EU) or on the satellite On Board Computer (OBC).
- S/W library is available for customer's processors.

### ELECTRONIC UNIT (EU) • OPTIONAL

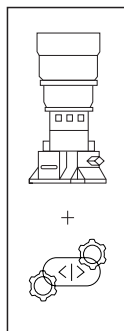
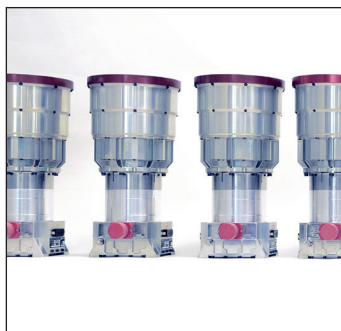


Three electronic unit versions available

- **EU-LEO** : Baseline
- **EU-GEO** : with improved radiation shielding
- **EU-TC (two channels)** : with electronic hot or cold redundancy inside a single housing

# HYDRA CONFIGURATIONS

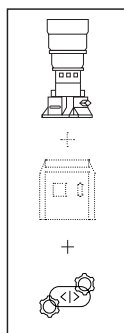
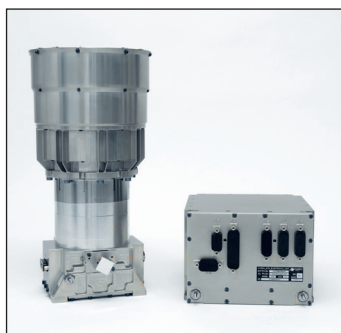
## HYDRA ACCESS • OFF-THE-SHELF CONFIGURATION BEST AFFORDABILITY



Configuration	Hydra Access
Optical head (OH)	1 to 3 Hydra OH
Electronic Unit (EU)	None (centralised processing - software embedded in OBC)

- Batch manufacturing, available off-the-shelf - 8 week lead time - Lower price point
- Standard test plan includes vibration, thermal vacuum tests and calibration

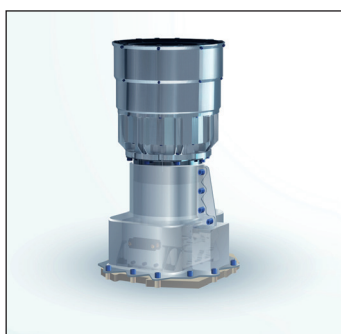
## HYDRA • MODULAR SUITE



Configuration	Hydra CP	Hydra Baseline	Hydra TC
Optical head (OH)	1 to 3 OH	1 to 4 OH	2 OH
Electronic Unit (EU)	None (centralised processing)	EU-GEO or EU-LEO	EU-TC

- High performance solution
- Available with one or 2 EU

## HYDRA CUSTOM • SUITED FOR SPECIFIC MISSIONS

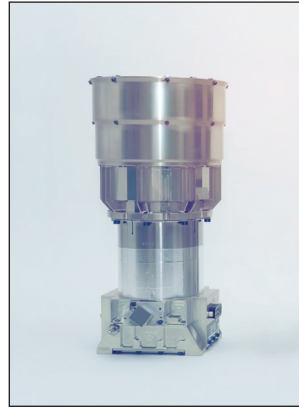
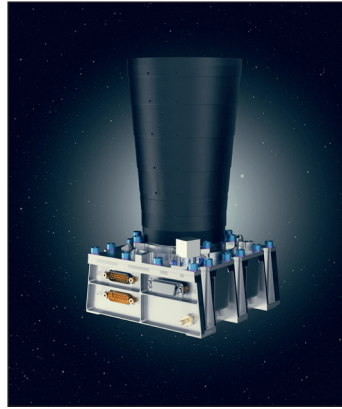


- On demand development
- Recent developments performed for missions including: JUICE, EUROPA CLIPPER
- Possibility of
  - Low power version : Hydra-M
  - Additional shielding
  - Hardware or software customization
  - Additional studies and specific support during mission life

We can adapt to your specification - please contact Sodern at:

**SALES-DEPARTMENT@SODERN.FR**

# MAIN CHARACTERISTICS



No performance degradation with full moon in the field of view and during solar flares

## PERFORMANCE END OF LIFE CONDITIONS

	HORUS	HYDRA
Bias (worst case)	< 11 arcsec	
Thermo-elastic error (worst case)	< 0.055 arcsec/°C	
Low Frequency Spatial Error @ 3σ	0.8 (XY) / 5.8 (Z) arcsec	0.6 (XY) / 4.6 (Z) arcsec
High frequency Spatial error @ 3σ	3.5 (XY) / 25 (Z) arcsec	3.4 (XY) / 27 (Z) arcsec
Temporal noise on XY/Z @ 3σ	3 (XY) / 22 (Z) arcsec	2.3 (XY) / 18 (Z) arcsec
Time from lost-in-space (typ)	2.9 s	2.2s
Slew rate	≤6 deg/s in Acquisition ≤8 deg/s in Tracking	≤6 deg/s in Acquisition ≤8 deg/s in Tracking
Acceleration	≤1 deg/s <sup>2</sup> in Acquisition ≤2 deg/s <sup>2</sup> in Tracking	<ul style="list-style-type: none"> <li>• ≤2 deg/s<sup>2</sup> in Acquisition</li> <li>• ≤3 deg/s<sup>2</sup> in Tracking (10Hz)</li> <li>• ≤2 deg/s<sup>2</sup> in Acquisition</li> <li>• ≤10 deg/s<sup>2</sup> in Tracking (30Hz)</li> </ul>
Sun/Earth Exclusion Angle (SEA/EEA)	24 deg / 18 deg	26 deg / 18.5 deg



## ELECTRICAL INTERFACES

	HORUS	HYDRA			
		ACCESS - CP	ELECTRONIC UNIT		
			LEO	GEO	TC
Power supply	24-50 V or 70-105 V	5V±10%	21V to 52V		23V to 55V
Power consumption	7W typ (TEC OFF)	0.7W typ (TEC OFF)	7.7W typ. (TEC OFF)		9.3W typ. (TEC OFF)
Output data	MIL-STD-1553B	SpaceWire (MIL 1355)	MIL-STD-1553B or RS422 (AS/CS16) (As an option for TC EU)		
Output rate	8 or 10 Hz	8 or 10 Hz	8Hz, 10Hz, 12Hz, 16Hz, 20Hz, 30Hz		

## MECHANICAL INTERFACES

	HORUS	HYDRA			
		OPTICAL HEAD	ELECTRONIC UNIT		
			LEO	GEO	TC
Size	Ø 141 x 250 mm	Ø 147 x 283 mm	170 x 146 x 103 mm	177 x 158 x 109 mm	194 x 166 x 159 mm
Mass	1.6 kg	1.4 kg	1.8 kg	2.6 kg	3.9 kg

## ENVIRONMENTS

ENVIRONMENTS	HORUS	HYDRA			
		OPTICAL HEAD	ELECTRONIC UNIT		
			LEO	GEO	TC
Random vibrations	31 gRMS	30 gRMS	28 gRMS		18 gRMS (XY) / 28 gRMS (Z)
Shocks	1000 gSRS	2000 gSRS	2000 gSRS		1600 gSRS
Temperature Range	- 30°C / + 50°C (Operation) / - 40°C / + 70°C (Storage)	-30°C / +60°C (Operation)   -40°C / +70°C (Storage)			

## RELIABILITY

RELIABILITY	HORUS	HYDRA			
		OPTICAL HEAD	ELECTRONIC UNIT		
			LEO	GEO	TC
EEE parts class	Level 1 & Level 2*				
Lifetime (years)	10 in LEO / 18 in GEO				
Reliability @ 30°C MIL-HDBK-217F	Level 1: 430 FIT Level 2: 700 FIT	Level 1: 110 FIT Level 2: 190 FIT	Level 1: 585 FIT Level 2: 866 FIT	Level 1 465 FIT Level 2: 606 FIT	

\*Hydra Access configuration only available in Level 1

# OPTIONS

A FULL SET OF OPTIONS TO SUPPORT DESIGN,  
VERIFICATION AND OPERATIONAL REQUIREMENTS

## TECHNICAL SUPPORT

- Training with our experts to become knowledgeable on Sodern star tracker and ground support equipment, on site or remotely
- Mission-specific radiation and performance assessments
- Technical support for software integration

## GROUND SUPPORT EQUIPMENT

- Engineering model • Star tracker numerical performance model
- Static or dynamic optical ground support equipment
- Electrical ground support equipment for H/W in the loop testing

## MANAGEMENT & REVIEWS

**Dedicated project management and manufacturing teams !**

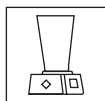
Several levels of management and reviews are proposed according to statement of work

- Standard or customised management

## TEST & ANALYSIS

Standard test plan includes performance and environmental tests. EMC, Straylight Measurements, Burn-in, specific environments, thanks to our state of the art facilities.

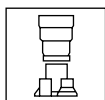
## HORUS CONFIGURATIONS



**HORUS** Star Tracker is configurable to best suit your platform:

- Power supply : 24-50V or 70-105V
- EEE parts Level 1 or Level 2
- Communication interface : 1553 in baseline – RS422 UART in option
- With or without Thermo-Electric Cooler
- Alignment cube orientations

## HYDRA CONFIGURATIONS



In addition to the broad choice of configurations available in the HYDRA line-up:

- EEE parts level 1 or level 2
- With or without Thermo-Electric Cooler
- Alignment cube orientations
- Software options are available to enhance performances, please contact us for more informations

**We can adapt to your specification - please contact Sodern at:**

**SALES-DEPARTMENT@SODERN.FR**

# INDUSTRIAL PRODUCTION

- 500+ Hydra optical heads manufactured and delivered
- 10 Hydra access off-the-shelf at all time
- Up to 120 high-end star tracker optical heads/year
- 100% in house production and test
- Clean rooms from ISO level 5 to 7
- Sodern is certified EN9100 and ISO 9001
- World-class optical testing and calibration facilities

## FLIGHT HERITAGE

- 9+ million hours of operation
- 230+ Hydra optical heads successfully operating in orbit
- Flight-proven algorithm: more than eight millions hours of successfull operation
- Horus replaces the well-known SED26 star tracker (more than 230 units flying)
- Horus embedded star catalog and algorithms are inherited from 50 years of experiences and from Hydra star tracker
- Large heritage with worldwide customer base

2002  
FIRST SED16  
LAUNCH

2012  
FIRST HYDRA  
LAUNCH

2015  DIRECTV  
DIRECTTV-15  
Telecom mission

2021  
PLEIADE NEO  
Earth observation  
mission

2023  
EUCLID   
Science mission

2023  
 JUICE  
Science mission



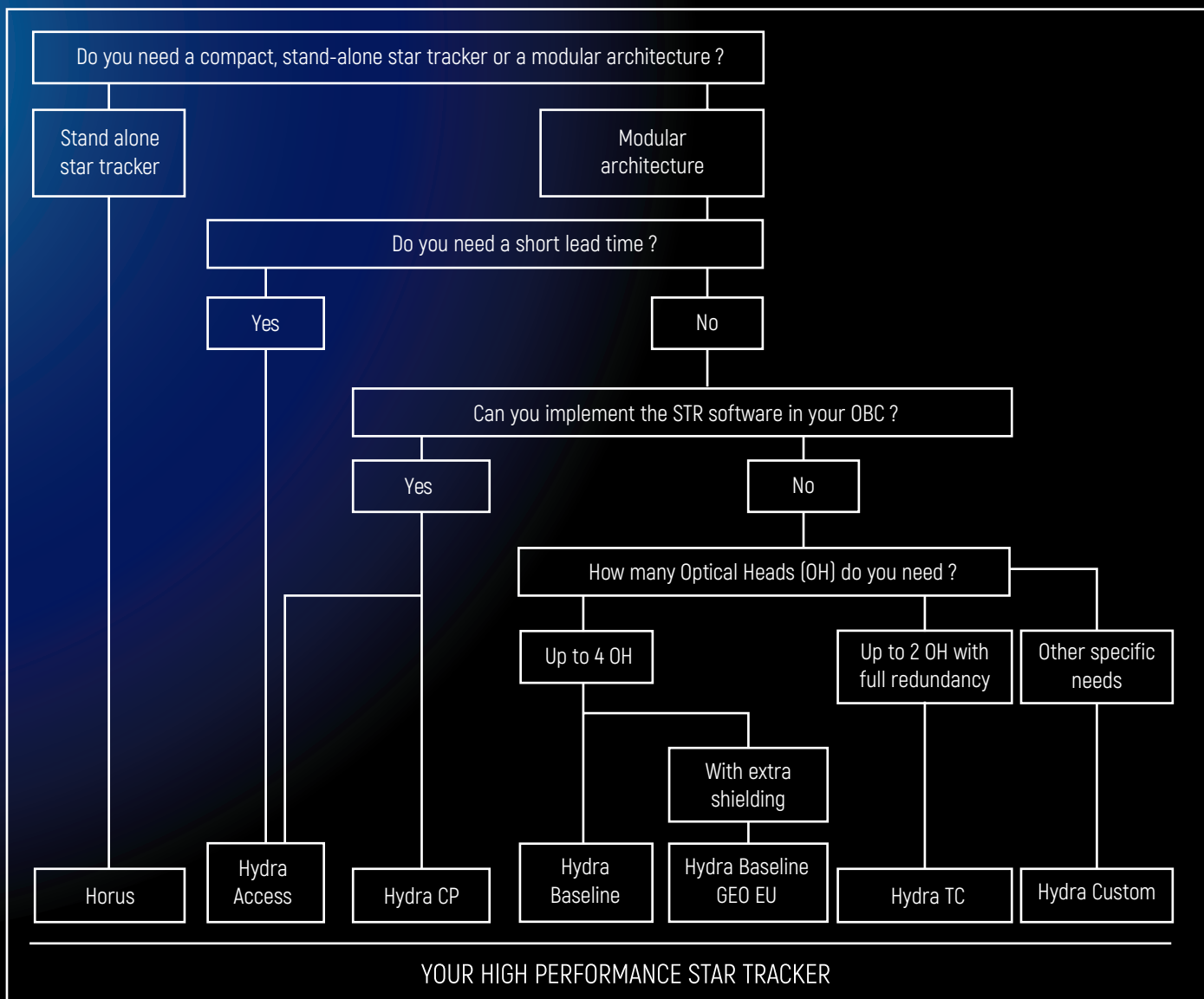
2024  
EUROPA CLIPPER

Science mission

2025+  
HORUS  
FIRST FLIGHT  
Baseline for Airbus  
D&S Onesat platform

# SELECTION CHART

WHICH CONFIGURATION IS SUITABLE?



We are available to discuss your mission requirements  
and provide pricing & technical proposals:

**CONTACT US: [SALES-DEPARTMENT@SODERN.FR](mailto:SALES-DEPARTMENT@SODERN.FR)**

20 avenue Descartes  
94451 Limeil-Brévannes  
Cedex France

**SODERN.COM**

