T1 STAR TRACKER

Miniaturized Optical Head and Electronic Unit

STAR-TRACKER-ON-A-CHIP TECHNOLOGY
The T1 Optical Head (OH) is based on the sensor chip Faintstar-2 developed under ESA contracts. The Faintstar-2 is a CMOS Active Pixel Sensor with a suite of integrated on-chip functionality supporting a complete new class of miniaturized high performance star trackers.

Terma has taken the miniaturization challenge as far as possible, without compromising the accuracy required from a state-of-the-art star tracker.

The T1 Optical Head has been designed with very few components, for high reliability and low recurrent cost. The Optical Head is offered with SpaceWire interface, enabling an optimal solution for mass, power and cost savings, by connecting the Optical Head directly to the S/C on board computer, without the need for the dedicated Electronic Unit.

FEATURES
- Rad-hard aspherical large aperture optics with outstanding straylight attenuation
- Completely separated baffle and camera for best thermal stability
- Kinematic mounting legs, compatibility to any S/C panel CTE
- Extremely low recurrent cost at larger quantities

SALES OPTIONS
- Optical Head stand alone
- Optical Head + Software library
- Optical Head + Electronic Unit (fully autonomous)

QUALIFICATION STATUS
- T1 Optical Head is at TRL 8
- The optics and baffle are at TRL 9
- Electronic Unit is at TRL 8

Optical Head	T1
Accuracy	See next page
Power consumption	0.75 W
Interface CMD/Data	SpaceWire, 80 MHz
Maximum Update Rate	10 Hz
APS Resolution	1024 x 1024
Camera Head Mass	310 g
Optical Head Dimension	Footprint Ø92 mm Height 68 mm
Straylight Baffle Options (SEA, Dimension, Mass)	45 deg, Ø99 mm, total OH height 104 mm, 163 g 30 deg, Ø125 mm, total OH height 165 mm, 230 g 26 deg, Ø155 mm, total OH height 213 mm, 315 g
Supply Voltage	5.0 V
Operating Temperature	-40 °C to +30 °C (full performance) +30 °C to +50 °C (reduced performance)
Survival Temperature	-40 °C to +70 °C
Lifetime	12 years in LEO @ 1000km 15 years in GEO
Lenses	Aspherical, radiation hard glasses
Field of View	20 deg circular, full moon accepted in FOV
Failure rate in FITS (10e-9 failure/hour)	46
Architecture	LEON3-FT
Dimensions	100 x 100 x 40 mm3
Mass	450 g
Power consumption excl. OH	2.5 W
Supply Voltage	Redundant +28 V (20 V to 36 V)
Spacecraft Interface (TC/TM)	Redundant SpaceWire or RS422
Camera Head Interfaces	SpaceWire (maximum 2 OHs)
SAA & SEU Tolerance worst case GEO flux (25k protons/cm2/s)	Acquisition & tracking full performance
Slew Rate	< 0.5 deg/sec full performance < 3.0 deg/sec reduced performance
Acquisition time	< 10 s
Failure rate in FITS (10e-9 failure/hour)	323

T1 STAR TRACKER ACCURACY

Performance	BOL (EOL: 15 years GEO)
Bias	10
Thermal Stability	0.1
Spatial Error (FOV)	2.1
Spatial Error (Pixel)	1.3 (1.7)
Temporal Noise (rate < 0.5 deg/sec)	+30 C: 1.7 (2.2) & +50 C: 6.7 (9)
Temporal Noise (rate < 1.5 deg/sec)	+30 C: 5 (6) & +50 C: 20 (26)
Temporal Noise (rate < 3.0 deg/sec)	+30 C: 18 (24) & +50 C: 74 (95)

General remark: All parameters are quoted for normal to Line of Sight (LOS) directions. Along LOS values are a factor of 7 higher, except for the Bias and Thermal stability parameters.

ORDERING INFORMATION

The T1 star tracker components can be ordered according to the table below.

Legend:

- EU: Electronics Unit (computer)
- OH: Optical head (camera part)
- A component is identified by a part number and dash variant according to xxxxxxx-yyy
- A component can be ordered as an engineering model (EM) or flight model (FM)
- EEE screening level is per default grade 2 (QML-Q). Grade 1 (QML-V or S grade) screening level possible on request.

Component	P/N [xxxxxxx]	EM [-yyy]	FM [-yyy]
EU, redundant RS422 TCTM and PPS, 1 OH interface (Both HW and SW for this configuration is fully qualified)	1148219	-203	-003
EU, redundant RS422 TCTM and PPS, 2 OH interfaces (The HW for this configuration is fully qualified however the SW remains currently under development)	1148219	-201	-001
T1 OH with alignment cube, 26 mm aperture (fully qualified)	1141039	-226	-026
T1 OH with alignment bore-holes, 26 mm aperture (fully qualified)	1423506	-226	-026
26 deg Sun exclusion Baffle (for 26 mm aperture optics) (fully qualified)	856722	-226	-026
30 deg Sun exclusion Baffle (for 26 mm aperture optics) (fully qualified)	856722	-230	-030
EM EU-OH cable harness (zzz = length in cm)	1596276-zzz	1596276-zzz	1596276-zzz
FM EU-OH cable harness (zzz = length in cm)	1193922-zzz	1193922-zzz	1193922-zzz
Dynamic OGSE, 26 deg SEA Baffle interface	1423511-026	1423511-026	1423511-026
Dynamic OGSE, 30 deg SEA Baffle interface	1423511-030	1423511-030	1423511-030
Static OGSE, 26 deg SEA Baffle interface	903964-026	903964-026	903964-026
Static OGSE, 30 deg SEA Baffle interface	903964-030	903964-030	903964-030

Interested parties are invited to contact the lead engineer, Peter Davidsen, pd@terma.com
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