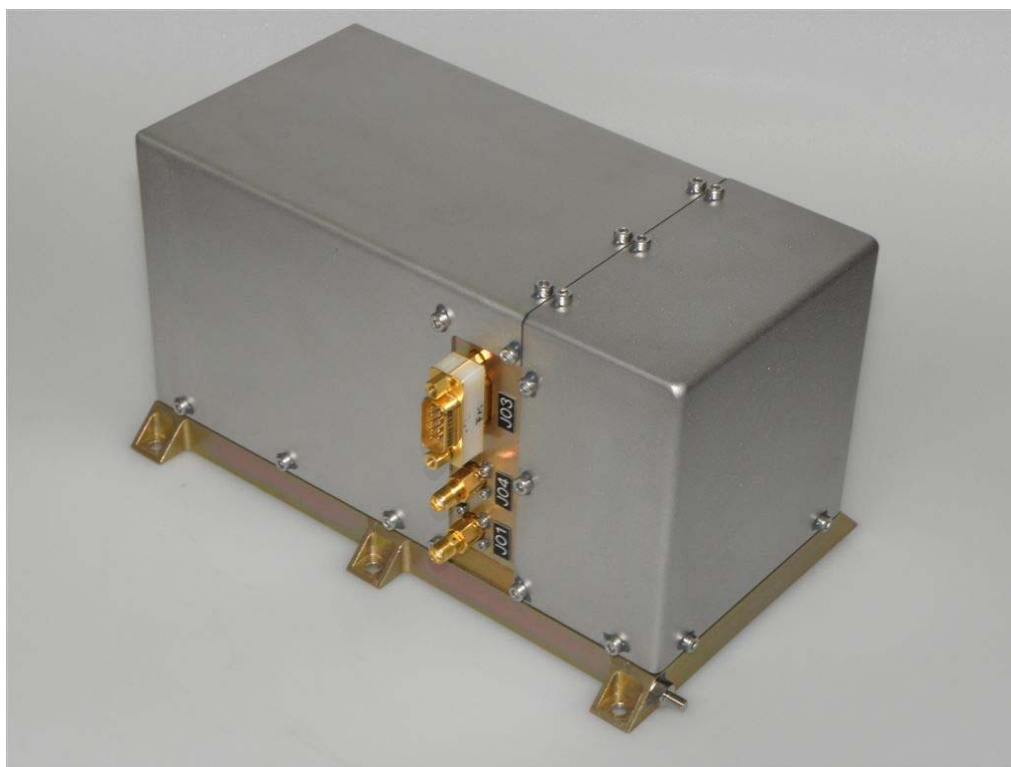


Rubidium Atomic Frequency Standard (RAFS)

High Precision & Performance Source



Applications:

Navigation and Science | Space

Product Characteristics:

- Volume 2.5 liters
- Thermal sensitivity: -10°C to +15°C : < 2E-14 / °C typical
- Stability < 3E-14 / 10'000sec typical
- Long term stability < 1x10⁻¹⁰ / year
- Power supply range compatible with 28V or 50V power bus
- Output frequency 10MHz

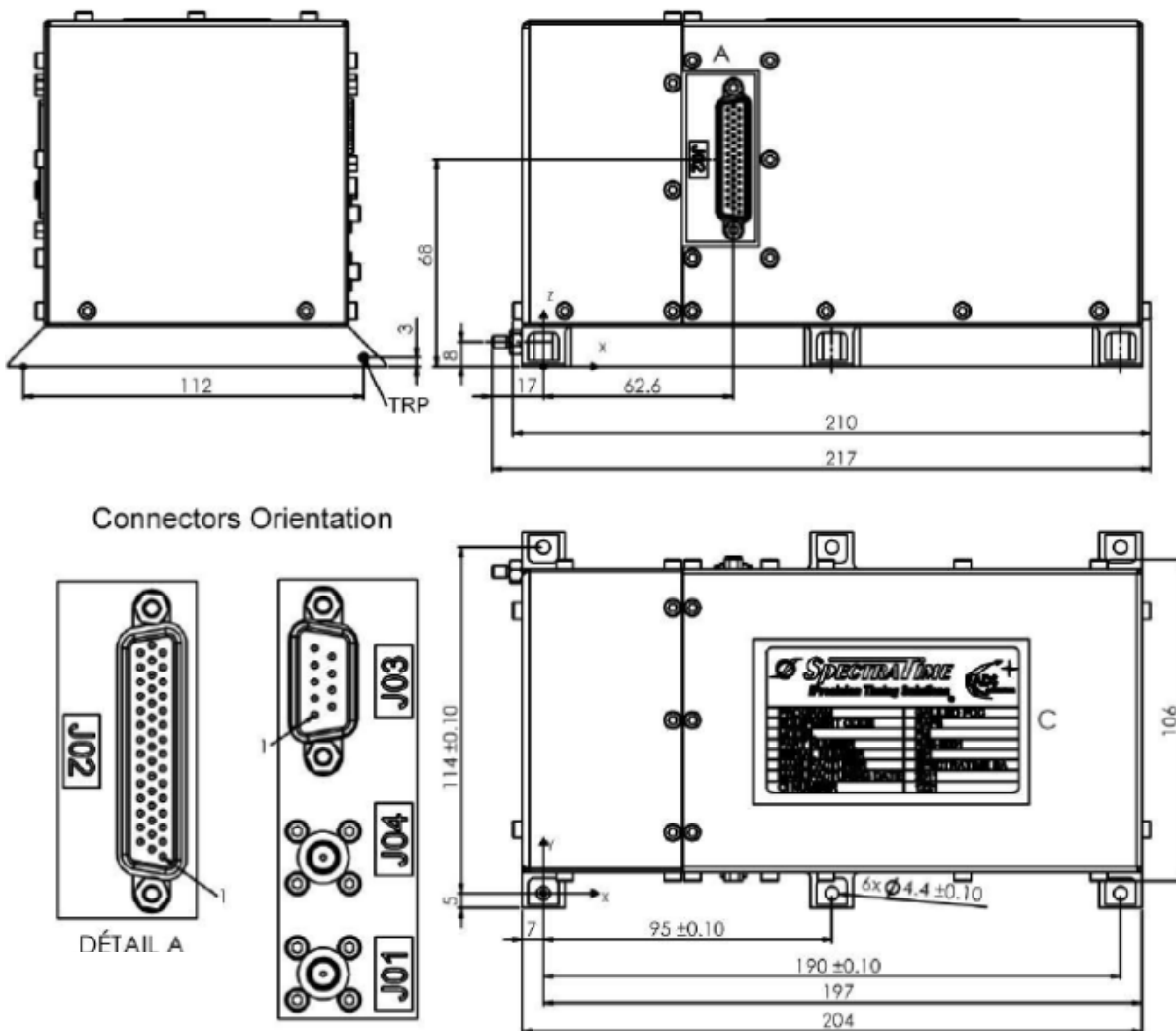
Main Features:

- Very low temperature sensitivity
- Excellent short term stability
- Small volume
- Rb lamp extended life expectancy (>20 years)

Main Applications:

- Navigation satellites
- Space scientific missions
- Military communication satellites
- Tracking and guidance control
- Advanced low orbit digital communication sat.

Package: (all dimensions in millimeters)



SPECIFICATIONS

Parameter	value	Unit
PERFORMANCES		
Frequency (sine)	Main Auxiliary	MHz MHz
	10.00 10.00	
Frequency accuracy after launch & commissioning phase : Under vacuum conditions at delivery	$\leq 2 \times 10^{-10}$ $\leq 1 \times 10^{-10}$	
Freq. Stab Short Term (max / Typical)	Max: Typical:	
1 sec	5×10^{-12} 3×10^{-12}	
10 sec	1.3×10^{-12} 1×10^{-12}	
100 sec	5×10^{-13} 3×10^{-13}	
1000 sec	1.8×10^{-13} 6×10^{-14}	
10000 sec (drift removed)	5×10^{-14} 3×10^{-14}	
flicker floor (drift removed)	5×10^{-14} 2×10^{-14}	
Freq. Stab Long Term (typical)	$< 1 \times 10^{-10}$	Per year
Outputs Signal Level	13 ± 1	dBm
Return loss power ON conditions (nominal output impedance 50 Ω)	> 20	dB
Spurious Signals (band +/- 2MHz)	< -80	dB
Outside	< -60	dB
Harmonics	< -40	dBc
Phase Noise (TBD MHz)		
1Hz	-90	dBc
10 Hz	-120	dBc
100 Hz	-130	dBc
1000 Hz	-140	dBc
10000 Hz	-145	dBc
100000 Hz	-145	dBc
PHYSICAL CHARACTERISTICS		
Envelope and dimensions	L=217 W=124 H=117	mm mm mm
Mass	max. 3.4	Kg
Stiffness	> 100	Hz
OPERATIONAL REQUIREMENTS		
Design Lifetime	> 15	Years
INTERFACES		
ELECTRICAL POWER INTERFACE		
Normal Power Line Voltage	28 V nominal Or 50 V nominal	V V
TM/TC INTERFACE		
TC List	RAFS ON RAFS OFF	HLC HLC
TM List	RAFS ON/OFF (isolated) RAFS Lock Indication RAFS Rb Light RAFS Rb Signa RAFS VCXO control	Relay/Switch Digital 0 or 5 0-5 0-5 0-5
		V V V V

Parameter	value	Unit
I/P Main Bus Voltage	0-5	V
Main Bus Current	0-5	V
TCB Temperature	NTC	
EPC Temperature	NTC	
STRUCTURAL & MECHANICAL INTERFACES		
Surface Finish-Flatness		
Overall contact area	< 0.2	mm
Local flatness	< 0.1/100	mm/mm
Roughness	< 3.2	µm
Interconnections		
RF outputs	SMA (J01 + J04)	
TM/TC Interface	SUB-HD 44 (J02)	
Power Interface	SUB-D 09 (J03)	
ENVIRONMENTAL & THERMAL INTERFACE		
Interface Heat Flux	< 0.3	W/cm ²
Power dissipation		
During warm-up	< 60	W
During nominal operation	< 35	W
Temperature limits		
Operating	-5 to +10	°C
Short-term variation	<= ± 1	°C
Acceptance	-10 to +15	°C
Qualification	-15 to + 20	°C
Cold start	-21	°C
Non-operating	-15 to + 70	°C
PRODUCT ASSURANCE		
Reliability figure (MEO)	< 1200	FIT
IN ORBIT ENVIRONMENTS		
Vacuum level	10 ⁻⁵	mbar
Magnetic field	< ± 0.5	Gauss
Radiation Environment.	LEO/MEO/GEO orbits	

RAFS Description

The Rubidium Atomic Frequency Standard (RAFS) is a state-of-the-art ultra-stable atomic clock able to deliver a frequency stability of about 2×10^{-14} over averaging intervals of 10'000 s.

The RAFS unit is composed of two main parts. The clock it-self named "RAFS core" and the Electronic Power Conditioning name "EPC" which includes the DC/DC converter and the electrical interface to the satellite.

The EPC design could be adapted to the satellite need.

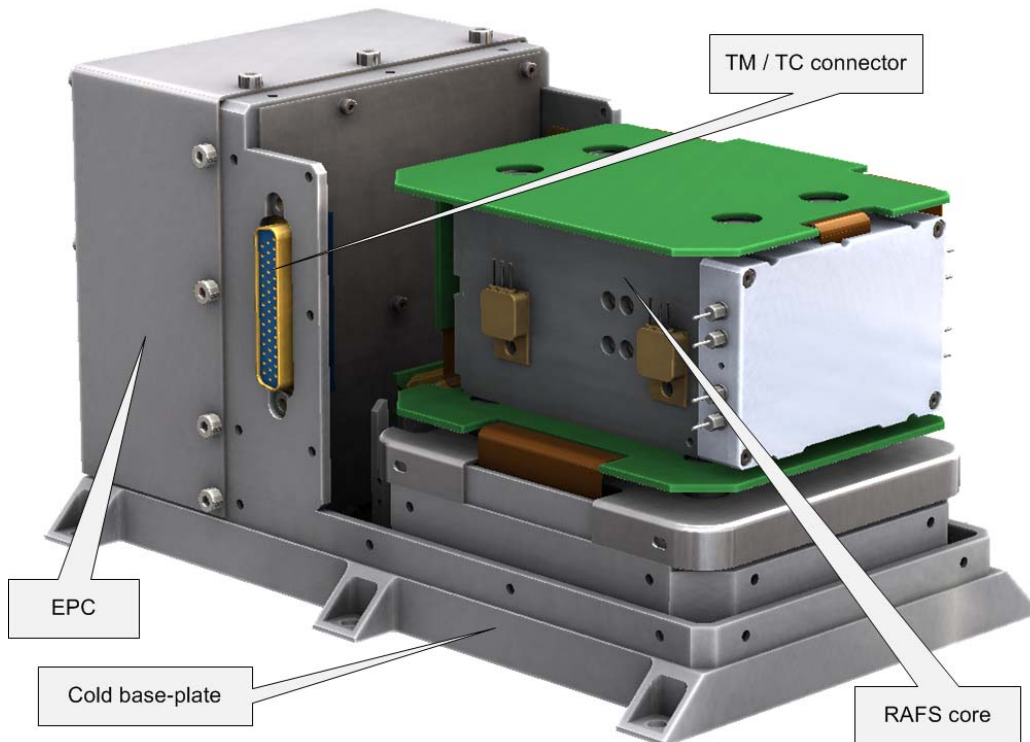


Figure 1: RAFS unit

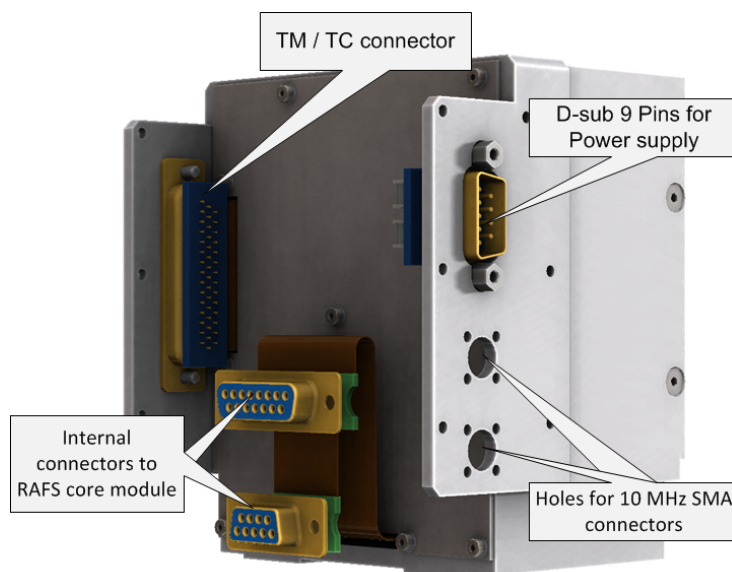


Figure 2: EPC Module housing

RAFS general function and diagram

The RAFS is a Rb clock. The Rb clock essentially consists of a voltage-controlled crystal oscillator (VCXO) which is locked to a highly stable atomic transition in the ground state of the Rb87 isotope. While the frequency of the VCXO is at the convenient standard frequency of 10 MHz, the Rb clock frequency is at 6.834 GHz in the microwave range. The link between the two frequencies is done through a phase-stabilized frequency multiplication scheme whereby a synthesized frequency is admixed to enable exact matching.

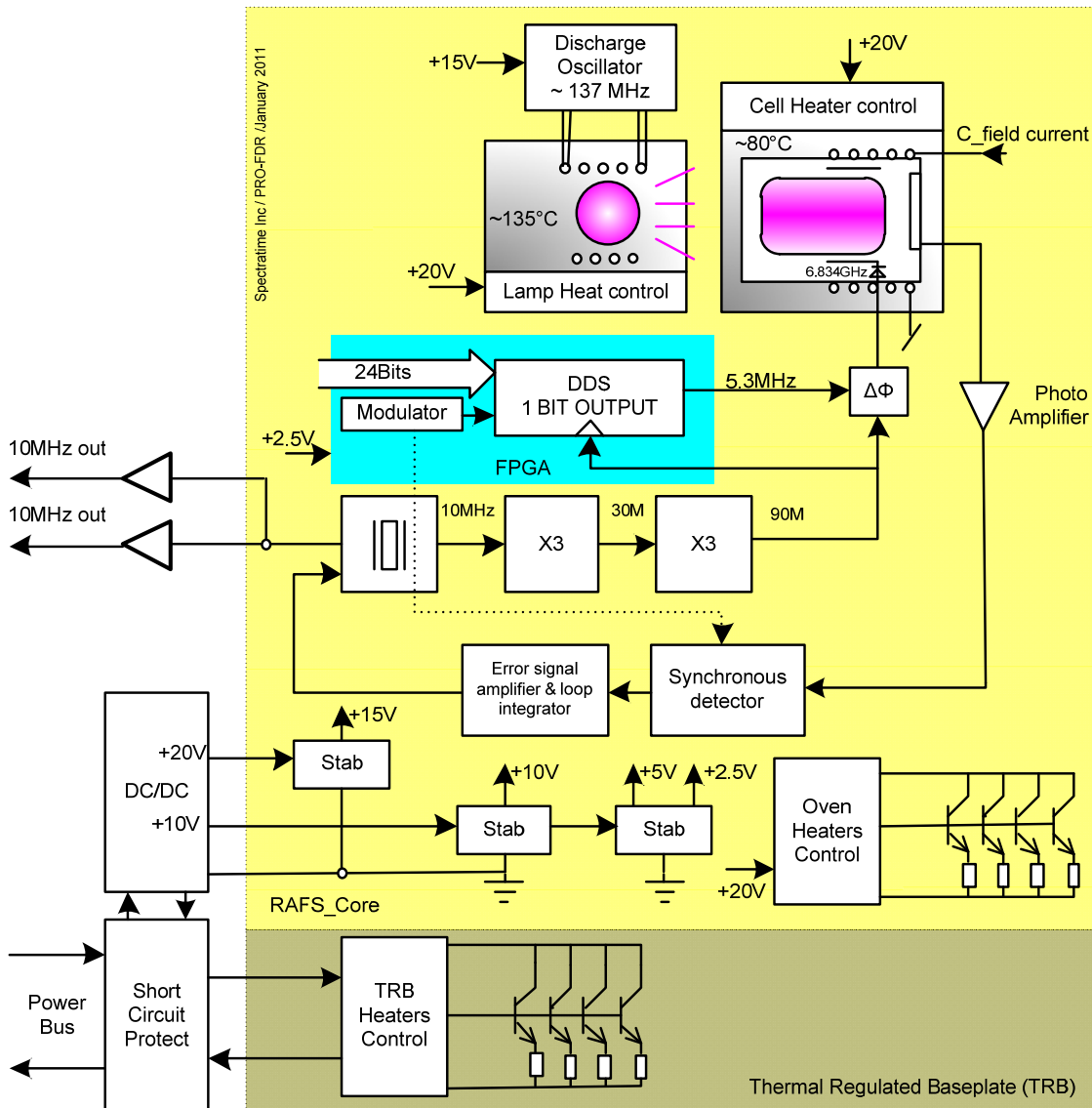
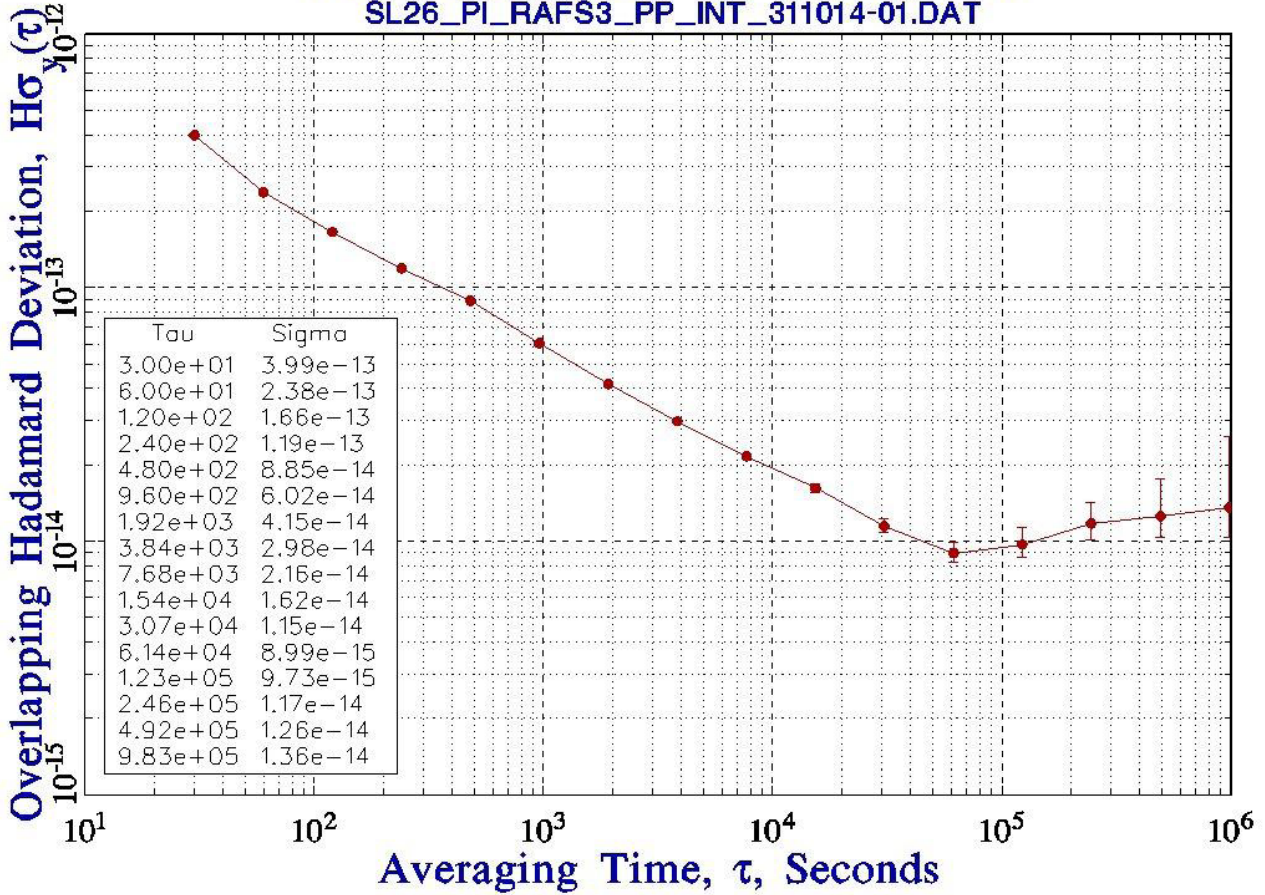


Figure 3: Overall electrical block diagram

RAFS typical stability:

FREQUENCY STABILITY

SL26_PI_RAFS3_PP_INT_311014-01.DAT



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