ELECTRONICS & DEFENSE

RAFS

THE RAFS IS A COST-EFFECTIVE, ULTRA-HIGH-PERFORMANCE, SPACE-QUALIFIED RUBIDIUM FREQUENCY STANDARD.

The RAFS is a cost-effective, ultra-high-performance, space-qualified rubidium frequency standard.

It's designed with the latest technologies, providing advanced features, such as long lifetime, high reliability, lightweight and ultra low phase noise, for next-generation space applications.

Key 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.
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Safran Electronics & Defense is with you every step of the way, building in the intelligence that gives you a critical advantage in observation, decision-making and guidance.

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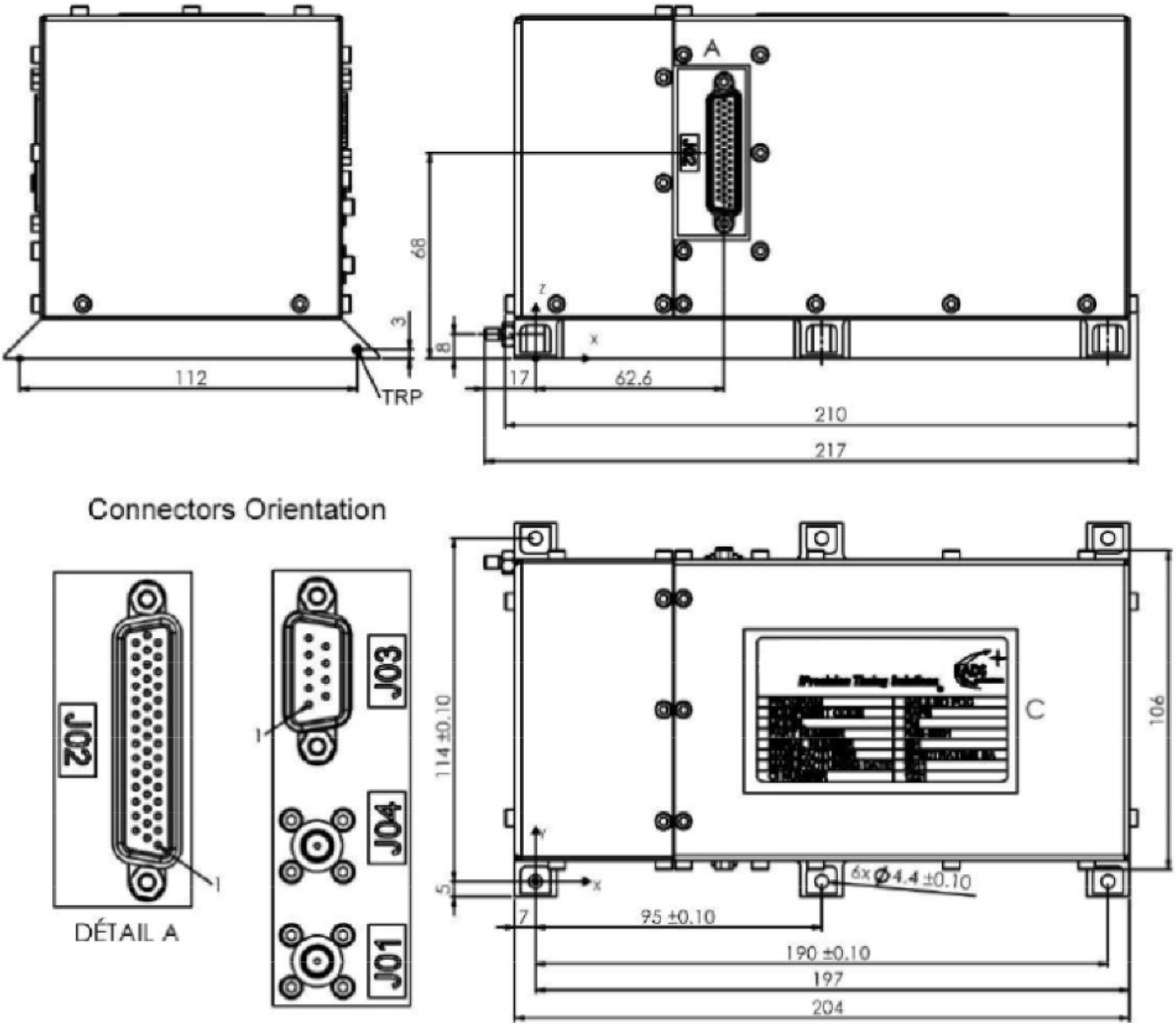
Product Characteristics

• Volume	2.5 liters
• Thermal sensitivity over -10°C to +14°C	< 2E-14 / °C typical
• Stability	< 3E-14 / 10'000sec typical
• Long term stability	< $1x10^{-10}$ year
• Power supply with DC-DC optional conv.	compatible with 28V or 50V power bus
• Output frequency	10MHz

Package (all dimensions in millimeters)



Technical Specifications

Parameter	value		Unit
PERFORMANCES			
Frequency (sine)			
Main	10.00		MHz
Auxiliary	10.00		MHz
Frequency accuracy			
after launch & commissioning phase :	≤ 2×10^{-10}		
Under vacuum conditions at delivery	≤ 1×10^{-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)	< 1×10^{-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
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
TM/TC INTERFACE			
TC List			
RAFS ON	HLC		
RAFS OFF	HLC		

STRUCTURAL & MECHANICAL INTERFACES		
Surface Finish-Flatness		
Overall contact area	< 0.2	mm
Local flatness	< 0.1/100	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 2x10-14 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.

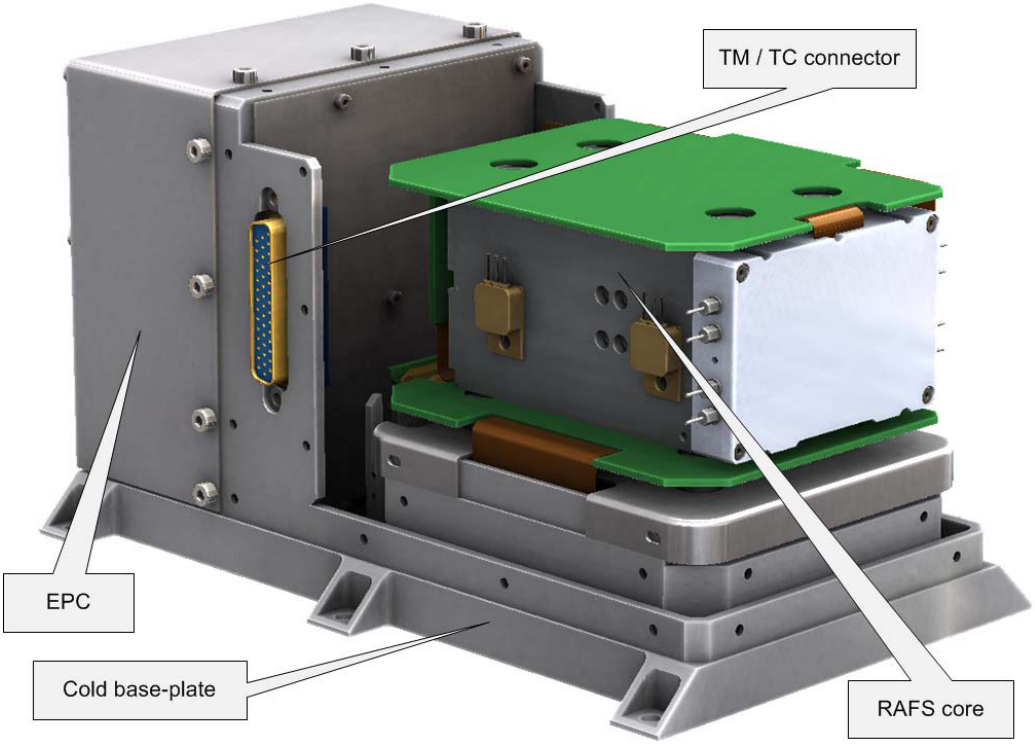
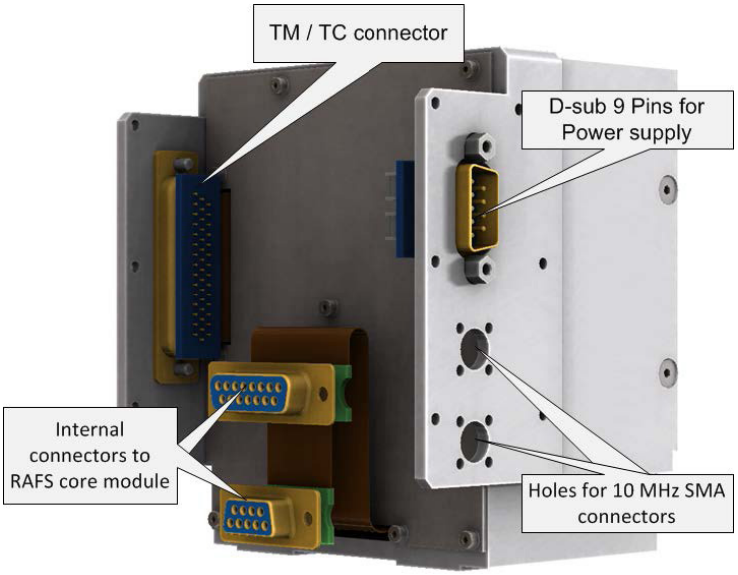


Figure 1: RAFS unit



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.

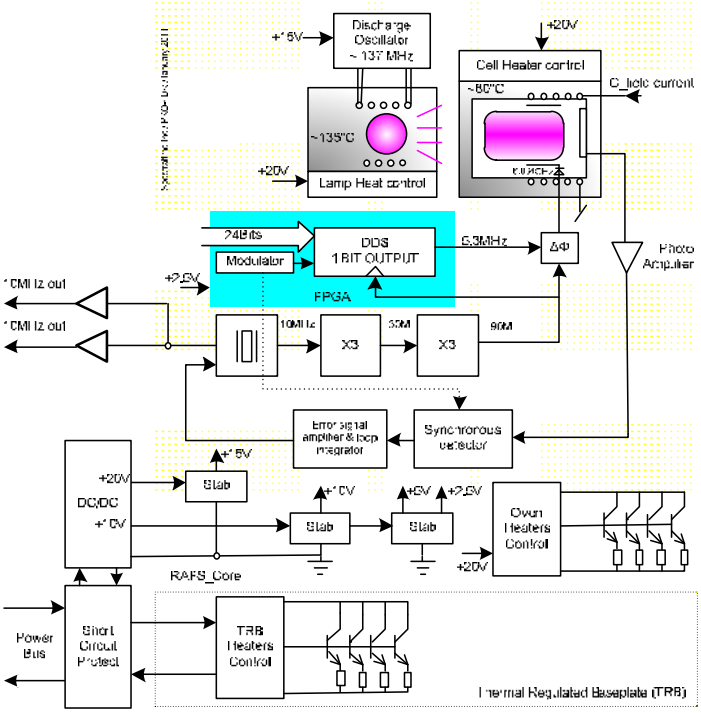


Figure 3: Overall electrical block diagram

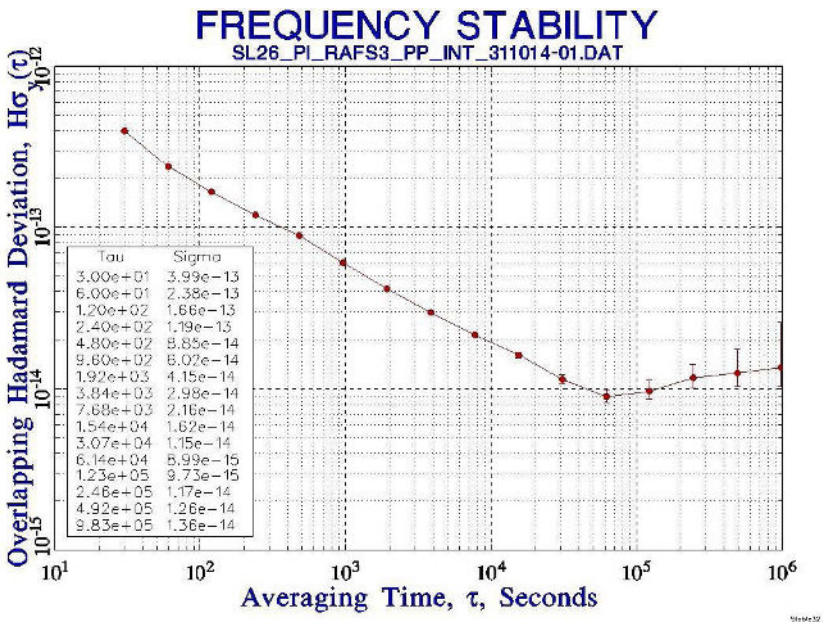


Figure 4: RAFS typical stability

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