

Atomic clocks continuous development and production capability for navigation at SELEX ES

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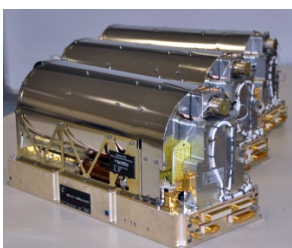
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On-board atomic clocks represent the key technology for the success of any satellite navigation system mission, and their development has been continuously supported by European Space Agency (ESA). The Passive Hydrogen Maser (PHM) has been selected as master clock of the Galileo Navigation Payload and three years of continuous observation on board of GIOVE-B satellite has confirmed the outstanding performance in terms of frequency stability and negligible drift. Results coming from ground life testing have given important feedbacks on the PHM technology capability to comply with the required 12 years of lifetime.

The above was the starting point for the development of other Atomic Clocks solutions like POP Rubidium clock and Mini PHM (mPHM). The main target is to preserve the excellent PHM frequency stability performance with a reduction of the overall mass, power consumption and more in general constraints for their usage on Navigation Payloads (i.e. environmental sensitivity, maintenance..).

SELEX ES have started activities in the area of atomic clocks for navigation back in 2000 with the development of the Passive Hydrogen Maser for Galileo being involved as prime contractor, instrument integrator and electronics developer and with the collaboration of Spectratime as physic package developer. In 2005 the first qualification model was successfully tested making it possible to fly the first PHM on board GIOVE-B in 2008. Today 28 FM models have been delivered to the Galileo constellation and eight of them are flying on board IOV satellites. To integrate and align such instruments very specialized testing team need to operate in areas free of environmental disturbances. The expected production rate for Galileo of 2 PHM flight models every 6 weeks has been reached thanks to a dedicated 600sqm testing area fully dedicated to the production of atomic clocks for navigation.

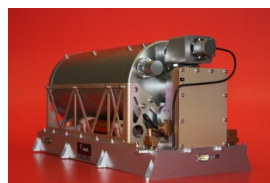
This paper presents an overview of the atomic clocks time stability central role in a Navigation Satellite System mission, an overview of POP and mPHM main performances and characteristics, the topics of the Selex-ES industrial approach leading to the industrialization of PHM clocks for space and the establishment the manufacturing and testing facilities at Nerviano premises.



PHM



Atomic Clocks Integration&Test Area



miniPHM