

SHM Qualification for ACES: Performance and Environmental Tests

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The Atomic Clock Ensemble in Space (ACES) is a pioneering mission led by ESA which will place ultra-stable atomic clocks on the International Space Station to provide a stable and accurate time base for different areas of research.

The Space H-Maser (SHM), one of the two atomic clocks onboard ACES payload, is developed by Safran Timing Technologies (STT, former Spectratime) under Airbus/ESA contract with funding provided by the Swiss Space Office, to provide excellent medium-term stability to ACES.

The development of the 45kg lightweight active hydrogen maser for space applications has been 15 years so far since 2008 starting from the development of engineering models. The Proto Flight Model (PFM) was firstly delivered in 2018 for ACES. Since Oct. 2021, SHM PFM refurbishment has been carried out after a high vacuum level issue observed in 2020. Over the last two and half years, activities including SHM dismounting, key parts manufacturing, manufacturing processes robustification, SHM re-mounting and finally the acceptance testing, have been accomplished. The refurbished SHM has been formally delivered recently with the successful acceptance review and released for the ACES Integrated System Test (IST). The final acceptance of the SHM PFM will be concluded from successful IST.



Fig. 1: SHM installed (with holding tool) into the ACES payload at Airbus.

In this paper, we will present the SHM qualification status providing with latest results of SHM PFM test campaign after the refurbishment, including the full performance test under thermal vacuum, environmental tests (vibration, thermal vacuum cycle, EMC) for the verification of proper workmanship and the validation of the refurbishment, as well as the final SHM tuning at ACES payload configuration to optimize SHM performances. Characterization of frequency sensitivities to the environment (e.g. temperature, magnetic field, voltage) will be provided.