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EARLY IN-ORBIT PERFORMANCE OF GPS BLOCK IIR RUBIDIUM CLOCKS

W.J. Riley
EG&G Frequency Products
35 Congress Street
Salem, MA 01970 USA

Abstract

The first Block IIR GPS navigation satellite, placed in orbit on July 22, 1997, carried a new generation of rubidium clocks. Since then, two of these clocks have been activated, and both are performing well. This paper reports on those early results, and compares the in-orbit performance with ground acceptance test data.

EG&G has delivered about two-thirds of the 66 Rubidium Atomic Frequency Standards (RAFS) needed for the Block IIR GPS program. Composite frequency and time stability plots are presented for all delivered units, and more detailed acceptance test stability data are shown for the two RAFS that are operating on-board SVN43. In addition, similar life test data are shown for the two units that are undergoing life testing at NRL.

In-orbit stability and drift data are presented for RAFS S/N 005 and 006 using all available 15-minute precise ephemeris/clock data from the National Imagery and Mapping Agency (NIMA). RAFS S/N 006 was turned on 8/13/97 and was used as the active clock until 9/26/97. RAFS S/N 005 was turned on 8/22/97 and became the active clock on 9/26/97 at the beginning of a 2-month extended navigation test. Both are showing excellent stability and early drift stabilization.

INTRODUCTION

The first successfully launched Block IIR GPS navigation satellite was placed in orbit on July 22, 1997 carrying a new generation of rubidium clocks. Since then, two of these clocks have been activated, and both are performing well. This paper reports on those early results, and compares the in-orbit performance with ground acceptance test data.

RAFS PRODUCTION STATUS

EG&G has delivered about two-thirds of the 66 Rubidium Atomic Frequency Standards (RAFS) units needed for the Block IIR GPS program. Each of the 21 Block IIR space vehicles has three RAFS, two RAFS are undergoing ground life testing at the Naval Research Laboratory (NRL), and one unit is a spare. Composite Allan and time deviation plots showing the stability of all delivered units are shown in Figures 1 and 2. All units show negative drift with logarithmic stabilization that settles to below $-1\text{x}10^{-13}$/day in 1-2 months, and have a typical stability of $\sigma_y(\tau) = 2\text{x}10^{-12}\tau^{-1/2} + 2\text{x}10^{-14}$.