Performance of IRAFS on-board NVS-01 NavIC Satellite

Atomic Clock Development Division
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Rubidium Atomic Frequency Standard

ISRO RAFS for Indian Navigation Program

**Development Status:**
- RAFS is fully qualified
- First FM flown in NVS01/IRNSS1J satellite in May-2023
- In service since first week of July 2023. UERE specification of NVS01 achieved with IRAFS.

**Highlights:**
- Indigenous design and development at SAC-ISRO
- Physics Package: Lamp pumped with integrated filter cell, custom magnetic shields
- Digital Design for Lock-in Amplifier and Temperature Controller, DDS for tuning RF frequency
- Low phase noise OCXO with Multiplier based RF synthesizer
IRAFS : On-board Performance

IRAFS On-board TM

<table>
<thead>
<tr>
<th>TM</th>
<th>Ground T&amp;E</th>
<th>On-board</th>
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</thead>
<tbody>
<tr>
<td>LTM(V)</td>
<td>3.58 V</td>
<td>3.62 ± 0.00063 V</td>
</tr>
<tr>
<td>STM(V)</td>
<td>1.86 V</td>
<td>1.9 ± 0.00063 V</td>
</tr>
<tr>
<td>Lamp Current(V)</td>
<td>2.31 V</td>
<td>2.28 ± 0.04 V</td>
</tr>
<tr>
<td>OCXO(V)</td>
<td>2.22 V</td>
<td>2.18 ± 0.04 V</td>
</tr>
</tbody>
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16th June

10th Oct.
IRAFS : On-board Performance

IRAFS On-board Frequency Stability

Relative Drift: 2.4E-13 / day

Relative Drift: 2E-12 / day

From Onboard Phasemeter Data (Redundant SAFRAN RAFS – IRAFS)
QM unit successfully qualified for space use

- Successfully completed qualification tests:
  - Bench Test (IBT)
  - 7-days burn-in Test
  - Hot and cold storage tests
  - Sine vibration tests
  - Random vibration tests
  - EMI / EMC test
  - Long-term thermovac test (6-weeks)
  - Life Test completed
  - Shock Test
- Demonstrated $<5\times10^{-14}$ stability @ 10,000 sec.
Conclusions / Key takeaways:

- First indigenous RAFS was flown on-board in NVS01 satellite.
- IRAFS is functioning satisfactorily on-board.

Thank You