



## Test Waveform Applications for JPL STRS Operating Environment

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This software demonstrates use of the JPL Space Telecommunications Radio System (STRS) Operating Environment (OE), tests APIs (application programming interfaces) presented by JPL STRS OE, and allows for basic testing of the underlying hardware platform. This software uses the JPL STRS Operating Environment ["JPL Space Telecommunications Radio System Operating Environment," (NPO-4776) *NASA Tech Briefs*, commercial edition, Vol. 37, No. 1 (January 2013), p. 47] to interact with the JPL-SDR Software Defined Radio developed for the CoNNeCT (COmmunications, Navigation, and Networking rEconfigurable Testbed) Project as part of the SCan Testbed installed on the

International Space Station (ISS). These are the first applications that are compliant with the new NASA STRS Architecture Standard.

Several example waveform applications are provided to demonstrate use of the JPL STRS OE for the JPL-SDR platform used for the CoNNeCT Project. The waveforms provide a simple digitizer and playback capability for the S-Band RF slice, and a simple digitizer for the GPS slice ["CoNNeCT Global Positioning System RF Module," (NPO-47764) *NASA Tech Briefs*, commercial edition, Vol. 36, No. 3 (March 2012), p. 36]. These waveforms may be used for hardware test, as well as for on-orbit or laboratory checkout.

Additional example waveforms implement SpaceWire and timer modules, which can be used for time transfer and demonstration of communication between the two Xilinx FPGAs in the JPL-SDR. The waveforms are also compatible with ground-based use of the JPL STRS OE on radio breadboards and Linux.

*This work was done by James P. Lux, Kenneth J. Peters, Gregory H. Taylor, Minh Lang, Ryan A. Stern, and Courtney B. Duncan of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1).*

*This software is available for commercial licensing. Please contact Dan Broderick at [Daniel.F.Broderick@jpl.nasa.gov](mailto:Daniel.F.Broderick@jpl.nasa.gov). Refer to NPO-48028.*

## Pneumatic Proboscis Heat-Flow Probe

Applications include measuring heat flow in areas on Earth where optimal thermal isolation of heaters/temperature sensors is of paramount importance.

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Heat flow is a fundamental property of a planet, and provides significant constraints on the abundance of radiogenic isotopes, the thermal evolution and differentiation history, and the mechanical properties of the lithosphere. Heat-flow measurements are also essential in achieving at least four of the goals set out by the National Research Council for future lunar exploration. The heat-flow probe therefore directly addresses the goal of the Lunar Geophysical Network, which is to understand the interior structure and composition of the Moon.

A key challenge for heat flow measurement is to install thermal sensors to the depths  $\approx 3$  m that are not influenced by the diurnal, annual, and longer-term fluctuations of the surface thermal environment. In addition, once deployed, the heat flow probe should cause little disturbance to the thermal regime of the surrounding regolith.

A heat-flow probe system was developed that has two novel features: (1) it

utilizes a pneumatic (gas) approach, excavates a hole by lofting the lunar soil out of the hole, and (2) deploys the heat flow probe, which utilizes a coiled up tape as a thermal probe to reach  $>3$ -meter depth.

The system is a game-changer for small lunar landers as it exhibits extremely low mass, volume, and simple deployment. The pneumatic system takes advantage of the helium gas used for pressurizing liquid propellant of the lander. Nor-



The Next-Generation Heat Flow Probe Concept. At left, the conceptual design of the heat flow probe mounted on the spacecraft landing system; at right, deployment of the heat flow probe.