



The assembled prototype **Three-Frequency Feed** is shown, with the low-frequency combiner absent, along with a half-dollar coin for scale. The overall size of the feed, including the combiner block, is approximately 1×1.25×1.5 in. ($\approx 2.5 \times 3.2 \times 3.8$ cm).

The half-flare angle for the feed is approximately 30°. Analysis and optimization of the overall feed design employed a combination of finite element and mode-matching tools.

The illumination requirements and relative frequency spacing for this application are similar to those required for the Scanning Multichannel Microwave Radiometer (SMMR) on Seasat, the (TOPEX)/Poseidon, and the Jason missions. However, in this particular application the required fractional bandwidth is larger. Thus, while the three-frequency feed horn described here shares many features in common with the feed previously developed for the above missions, enhancements are necessary in order to achieve broad band performance and manufacturability in the millimeter-wave bands.

This work was done by Daniel J. Hoppe, Behrouz Khayatian, John B. Sosnowski, Alan K. Johnson, and Peter J. Bruneau of Caltech for NASA's Jet Propulsion Laboratory. For more information, contact iaoffice@jpl.nasa.gov. NPO-48528

Capacitance Probe Resonator for Multichannel Electrometer

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A multichannel electrometer voltmeter has been developed that employs a mechanical resonator with voltage-sensing capacitance-probe electrodes that enable high-impedance, high-voltage, radiation-hardened measurement of an Internal Electrostatic Discharge Monitor (IESDM) sensor. The IESDM is new sensor technology targeted for integration into a Space Environmental Monitor (SEM) subsystem used for the characterization and monitoring of deep dielectric charging on spacecraft.

The resonator solution relies on a non-contact, voltage-sensing, sinusoidal-varying capacitor to achieve input impedances as high as 10 petaohms as determined by the resonator materials, geometries, cleanliness, and construction. The resonator is designed with one dominant mechanical degree of freedom, so it resonates as a simple harmonic oscillator and because of the linearity of the variable sense capacitor to displacement, generates a pure sinusoidal current sig-

nal for a fixed input voltage under measurement. This enables the use of an idealized phase-lock sensing scheme for optimal signal detection in the presence of noise.

This work was done by Brent R. Blaes, Rembrandt T. Schaefer, and Robert J. Glaser of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1). NPO-47335

Inverted Three-Junction Tandem Thermophotovoltaic Modules

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An InGaAs-based three-junction (3J) tandem thermophotovoltaic (TPV) cell has been investigated to utilize more of the blackbody spectrum (from a 1,100 °C general purpose heat source — GPHS) efficiently. The tandem consists of three vertically stacked subcells, a 0.74-eV InGaAs cell, a 0.6-eV InGaAs cell, and a 0.55-eV InGaAs

cell, as well as two interconnecting tunnel junctions.

A >20% TPV system efficiency was achieved by another group with a 1,040 °C blackbody using a single-bandgap 0.6-eV InGaAs cell MIM (monolithic interconnected module) (30 lateral junctions) that delivered about 12 V/30 or 0.4 V/junction. It is expected that a

three-bandgap tandem MIM will eventually have about 3× this voltage (1.15 V) and about half the current. A 4 A/cm² would be generated by a single-bandgap 0.6-V InGaAs MIM, as opposed to the 2 A/cm² available from the same spectrum when split among the three series-connected junctions in the tandem stack. This would then be about a 50%

increase ($3 \times V_{oc}$, $0.5 \times I_{sc}$) in output power if the proposed tandem replaced the single-bandgap MIM.

The advantage of the innovation, if successful, would be a 50% increase in power conversion efficiency from radioisotope heat sources using existing thermophotovoltaics. Up to 50% more

power would be generated for radioisotope GPHS deep space missions. This type of InGaAs multijunction stack could be used with terrestrial concentrator solar cells to increase efficiency from 41 to 45% or more.

This work was done by Steven Wojtczuk of Spire Semiconductor for Glenn Research Cen-

ter. Further information is contained in a TSP (see page 1).

Inquiries concerning rights for the commercial use of this invention should be addressed to NASA Glenn Research Center, Innovative Partnerships Office, Attn: Steven Fedor, Mail Stop 4-8, 21000 Brookpark Road, Cleveland, Ohio 44135. Refer to LEW-18909-1.