

This work furthers the recent research efforts in compact coherent receiver modules, including the development of the Q/U Imaging Experiment (QUIET) modules centered at 40 and 90 GHz, and the pro-

duction of heterodyne module prototypes at 90 GHz.

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## Coupling Between Waveguide-Fed Slot Arrays

*NASA's Jet Propulsion Laboratory, Pasadena, California*

Coupling between two waveguide-fed planar slot arrays has been investigated using full-wave analysis. The analysis employs the method-of-moments solution to the pertinent coupled integral equations for the aperture electric field of all slots. In order to compute coupling between two arrays, the input port of the first array is excited with a  $TE_{10}$  mode wave while the second one is match-terminated. After solving the moment method matrix equations, the aperture fields of all slots are obtained and

thereby the  $TE_{10}$  mode wave received at the input port of the second array is determined. Coupling between two arrays is the ratio of the wave amplitude arriving in the second array port to the incident wave amplitude at the first array port. The coupling mechanism has been studied as a function of spacing between arrays in different directions, e.g. the electric field plane, the magnetic field plane, and the diagonal plane. Computed coupling values are presented for different array geometries.

This work is novel since it provides a good understanding of coupling between waveguide-fed slot arrays as a function of spacing and orientation for different aperture distributions and array architectures. This serves as a useful tool for antenna design engineers and system engineers.

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## PCB-Based Break-Out Box

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Break-out boxes (BOBs) are necessary for all electrical integration/cable checkouts and troubleshooting. Because the price of a BOB is high, and no work can be done without one, often the procedure stops, simply waiting for a BOB. A less expensive BOB would take less time in the integration, testing, and troubleshooting process.

The PCB-based BOB works and looks the same as a standard JPL BOB, called "Gold Boxes." The only differences between the old BOB and the new PCB-based BOB is that the new one has 80 percent of its circuitry in a printed circuit

board. This process reduces the time for fabrication, thus making the BOBs less expensive. Moreover, because of its unique design, the new BOBs can be easily assembled and fixed. About 80 percent of the new PCB-based BOB is in a \$22 (at the time of this reporting) custom-designed, yet commercially available PCB.

This device has been used successfully to verify that BOB cables were properly made. Also, upon completion, the BOB was beeped out via a multimeter to ensure that all sockets on the connectors were properly connected to the respective banana jack.

When compared to the Gold Box BOBs, the new BOB has many advantages. It is much more cost efficient, it delivers equal usability at substantially lower cost of the BOB, and the Gold Box is much heavier when compared to the new BOB. The new BOB is also a bit longer and much more versatile in that connectors are easily changeable and if a banana jack is broken, it can be replaced instead of throwing away an entire BOB.

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## Multiple-Beam Detection of Fast Transient Radio Sources

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A method has been designed for using multiple independent stations to discriminate fast transient radio sources from local anomalies, such as antenna noise or radio frequency interference (RFI). This can improve the sensitivity of

incoherent detection for geographically separated stations such as the very long baseline array (VLBA), the future square kilometer array (SKA), or any other co-incident observations by multiple separated receivers.

The transients are short, broadband pulses of radio energy, often just a few milliseconds long, emitted by a variety of exotic astronomical phenomena. They generally represent rare, high-energy events making them of great