Circuit for Communication Over Power Lines

This technique can be used in vehicle sensors, building sensors, and other industrial control applications.

John H. Glenn Research Center, Cleveland, Ohio

Many distributed systems share common sensors and instruments along with a common power line supplying current to the system. A communication technique and circuit has been developed that allows for the simple inclusion of an instrument, sensor, or actuator node within any system containing a common power bus. Wherever power is available, a node can be added, which can then draw power for itself, its associated sensors, and actuators from the power bus all while communicating with other nodes on the power bus.

The technique modulates a DC power bus through capacitive coupling using on-off keying (OOK), and receives and demodulates the signal from the DC power bus through the same capacitive coupling. The circuit acts as serial modem for the physical power line communication. The circuit and technique can be made of commercially available components or included in an application specific integrated circuit (ASIC) design, which allows for the circuit to be included in current designs with additional circuitry or embedded into new designs.

This device and technique moves computational, sensing, and actuation abilities closer to the source, and allows for the networking of multiple similar nodes to each other and to a central processor. This technique also allows for reconfigurable systems by adding or removing nodes at any time. It can do so using nothing more than the *in situ* power wiring of the system.

This work was done by Michael J. Krasowski, Normal F. Prokop, Lawrence C. Greer III, and Jennifer Nappier of Glenn Research Center. Further information is contained in a TSP (see page 1).

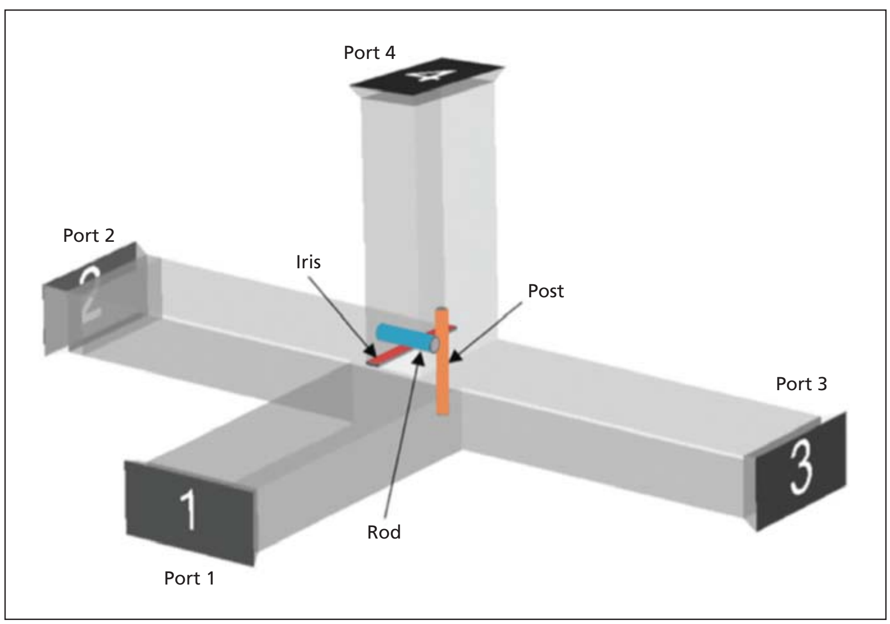
Inquiries concerning rights for the commercial use of this invention should be addressed to NASA Glenn Research Center, Innovative Partnerships Office, Attn: Steven Fedor, Mail Stop 4–8, 21000 Brookpark Road, Cleveland, Ohio 44135. Refer to LEW-18631-1.

High-Efficiency Ka-Band Waveguide Two-Way Asymmetric Power Combiner

This device is applicable for use with high-power MMIC solid-state amplifiers.

John H. Glenn Research Center, Cleveland, Ohio

NASA is planning a number of Space Exploration, Earth Observation and Space Science missions where Ka-band solid-state power amplifiers (SSPAs) could have a role. Monolithic microwave integrated circuit (MMIC) based SSPAs with output powers on the order of 10 W at Ka-band frequencies would be adequate to satisfy the data transmission rate requirements at the distances involved. MMICs are a type of integrated circuit fabricated on a GaAs wafer, which operates at microwave frequencies and performs the function of signal amplification. The highest power Ka-band (31.8 to 32.3 GHz) SSPA to have flown in space had an output power of 2.6 W with an overall efficiency of 14.3 percent. This SSPA was built around discrete GaAs pHEMT (high electron mobility transistor) devices and flew aboard the Deep Space One spacecraft. State-of-the-art GaAs pHEMT-based MMIC power amplifiers (PAs) can deliver RF power at Ka-band frequencies anywhere from 3 W with a power added efficiency (PAE) of 32 percent to 6 W with a PAE of 26 percent. However, to achieve power levels higher than 6 W, the output of several MMIC PAs would need to be combined using a high-efficiency power combiner. Conventional binary waveguide power combiners, based on short-slot and magic-T circuits, require MMIC PAs with identical amplitude and phase characteristics for high combining efficiency. However, due to manufacturing process variations, the output powers of the MMIC PAs tend to be unequal, and hence the need to develop unequal power combiners.



Transparent view of **Asymmetric Combiner** showing port configuration and relative orientation of rod, post, and iris.