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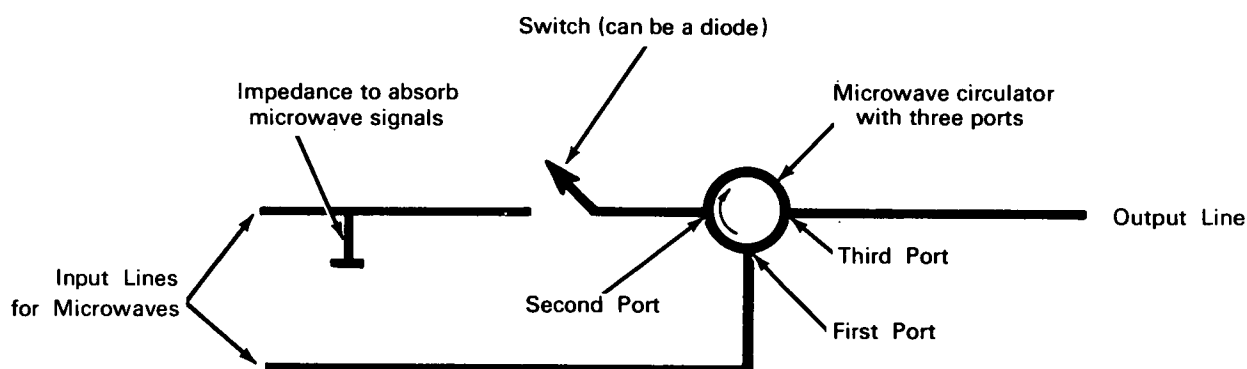
Brief 63-10258

# NASA TECH BRIEF



This NASA Tech Brief is issued by the Technology Utilization Division to acquaint industry with the technical content of an innovation derived from the NASA space program.

## Double-Throw Microwave Device Switches Two Lines Quickly



**The problem:** Switching from one to another of two microwave input lines so there is only a small period of time when both (or neither) of the two lines is connected to an output line.

**The solution:** Combining a single-throw microwave switch with a microwave circulator in a circuit. This arrangement permits the selection of the desired input line to be made by electrical means.

**How it's done:** One of the two input lines is connected to a single-throw, single-pole switch, such as a diode that can be switched on or off by a biasing current. When the switch is closed, microwaves from the first input line go through the switch, into the second port of the three-port microwave circulator, around the circulator, and out the third port to the output line.

Signals can be switched to the second microwave input line by simply opening the switch. This blocks the signals from the first input line. Microwaves from the second line enter the first port of the circulator, leave the circulator through the second port, and are reflected by the open switch. These signals next re-

enter the second port and finally go out through the third port to the output line.

An impedance, such as an antenna of the proper value, is connected to the first input line before it goes to the switch. Thus, if the switch is closed, signals from the first input line enter the first port of the circulator, exit through the second port, cross the switch, and are absorbed by the termination.

Transition time for switching from one line to another is small, since the diode switch can be opened or closed very rapidly. Partial opening time values are short.

### Note:

This circuit and equipment is suggested in applications where fast-acting microwave switching is desired or where electrical, rather than mechanical, switching is of value.

**Patent status:** NASA encourages commercial use of this innovation. No patent action is contemplated.

Source: Charles T. Stelzried and Robert Clauss  
Jet Propulsion Laboratory (JPL-410)



# NASA TECH BRIEF

The NASA Tech Briefs series is designed to provide information on technical developments in the NASA program.

## Graphic Display of a Control System



The problem is to design a control system that will maintain a desired output level in the presence of disturbances. The system is represented by the block diagram shown in Figure 1. The reference input is a step function, and the plant is a second-order system. The control system is a proportional-integral-derivative (PID) controller. The feedback signal is taken from the output of the plant and fed back to the controller. The controller output is fed back to the plant. The system is designed to have a settling time of 10 seconds and a steady-state error of 1 percent.

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