X-Band Radar Development

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A high-power X-band radar is under development for use on the 64-m-diameter antenna at DSS 14. The 400-kW transmitter will operate at 8.495 GHz. Ground testing of portions of the transmitter will start early in 1973.

I. Introduction

A high-power X-band radar is under development for use on the 64-m-diameter antenna at DSS 14. This radar will provide the deep space communication and tracking technology necessary to support requirements for wider bandwidth at increased ranges. The increased antenna gain of 6.5 dB will decrease the observation time by a factor of 20, and the wider bandwidth will permit faster range codes for improved ranging.

II. Radar System

The X-band radar will be equipped with both a receiver and a transmitter (see Fig. 1). Initially, it will operate as a monostatic system, alternately transmitting and receiving the microwave signal for one round-trip time of flight.

The radar transmitter, receiver, microwave, and feed will be assembled into a new Cassegrain cone to be mounted in the upper or R&D position of the tricone at DSS 14. Excessive transmission losses will be avoided by operating the transmitter in close proximity to the feed.

III. Radar Transmitter

The transmitter (see Fig. 2) will have the following characteristics:

Power output—400 kW CW.
Center frequency—8.495 GHz, fixed tuned.
Instantaneous bandwidth—50 MHz at −1 dB.

Two 250-kW klystron amplifiers of an existing design will be used, and a four-port hybrid will combine the two outputs into one waveguide. Remote phase monitoring and control will permit combining at maximum efficiency. The RF loads will allow operation of either or both power amplifiers without radiation from the antenna.

IV. High-Voltage Power

The transmitter will use the existing high-voltage power supply at DSS 14, which now provides power

for either the 400-kW DSN or the 450-kW R&D transmitters. The installed 400-Hz generating capacity at DSS 14 will produce only 1 MW of dc high voltage. The X-band klystrons are approximately 40% efficient; hence only 400 kW total RF power can be developed, although each klystron is capable of 250 kW at full voltage.

V. Cooling System

The DSS 14 cooling system will be modified to supply the new transmitter. The piping will be extended to module 3 of the tricone, and additional valves will be installed.

VI. Plans and Progress

The klystrons will be delivered early in 1973. Design of the transmitter is in process, and some of the components are being procured, including couplers, RF loads, waveguide parts, and coolant parts. A sufficient portion of the transmitter will be fabricated to allow ground testing the klystrons at DSS 13.

Techniques for controlling and monitoring the phasing of the two power amplifiers will be studied at low power using commercial waveguide components. Because of power handling and higher-order mode considerations, the high-power microwave components will use the special WR-125 waveguide size. (See article by H. R. Buchanan in this volume.)

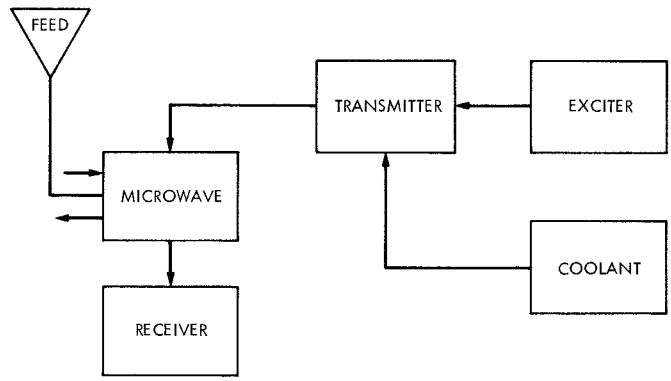

Fig. 1. X-band radar block diagram

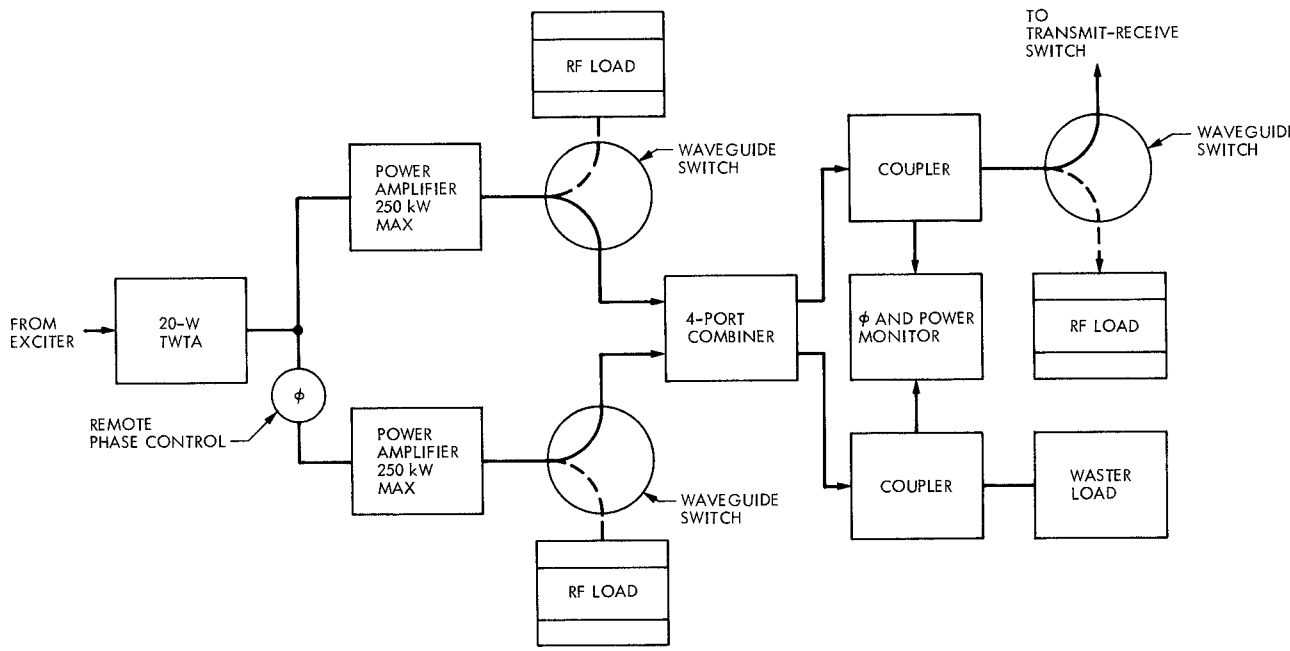

Fig. 2. 400-kW X-band radar transmitter