V. Operations and Facilities

A. DSN Operations

1. Radio Science Support, *T. Sato and D. Spitzmesser*

During this period, the DSN supported a general relativity experiment conducted by Doctors D. O. Muhlemann, R. D. Ekers, and E. B. Fomalont of the California Institute of Technology's Owen's Valley Radio Observatory.

The experiment was to attempt to measure, by use of interferometer techniques, the apparent change of angular separation between radio sources 3C273 and 3C279 near the time 3C279 was occulted by the sun. This occurred on October 8, 1969. The maximum-expected shift in separation due to relativity effects is 1.″7, but the maximum observable shift would be limited to 0.″3 because of the solar corona effects. The above data were obtained from the experimenters.

To implement the experiment, two Goldstone DSCC stations, DSSs 13 and 14, were configured as elements of a phase-sensitive interferometer. The system block diagram is shown in Fig. 1. The frequency of operation was 2388 MHz, and the standard 2388-MHz receivers located at each station were used as the basic elements of the interferometer. The interferometer baseline was on the order of 10^5 wavelengths.

Experimenter-supplied rubidium frequency standards were installed at each station, and these were used as the reference to synthesize all required local oscillator frequencies. This synthesis was done using the standard modules in each receiver. A 1-MHz reference signal was also microwaved from DSS 14 to DSS 13, where it multiplied to 31.440 MHz, and was phase-compared with basic DSS 13's 31.440-MHz local oscillator frequency. The phase comparison device was a standard Hewlett-Packard vector voltmeter. The phase information obtained was recorded on a strip chart recorder and one channel of a four-channel sequential digital recorder. This information will be used to determine the relative phase difference between the two standards during an observation and to attempt to correct for phase shift introduced in the DSS 14 IF signal by the microwave link.

The IF portion of the DSS 14 receiver was unmodified and the output of the final IF 455- kHz center frequency, with a noise bandwidth of approximately 330 kHz, was

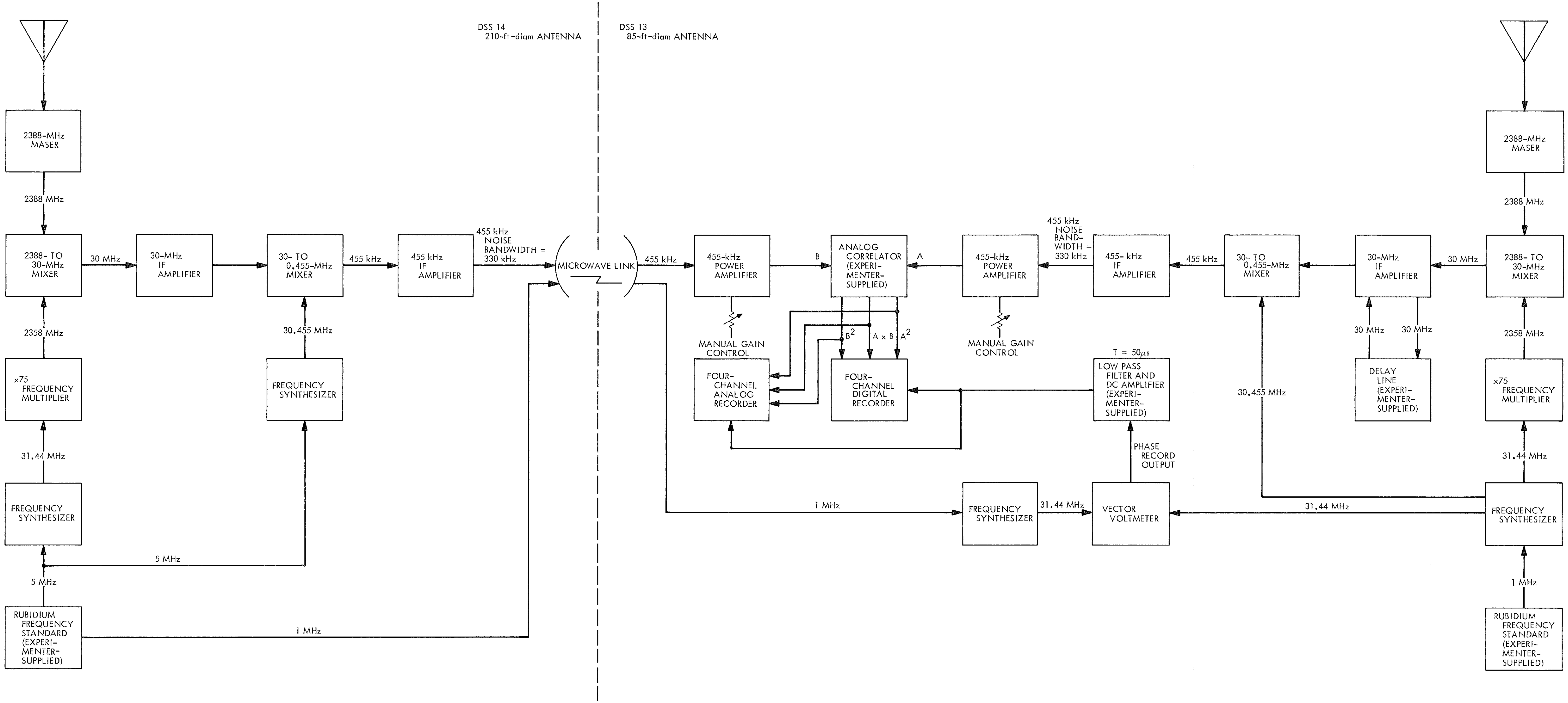

Fig. 1. General relativity experiment system configuration

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sent via the microwave link to DSS 13. The 30-MHz IF amplifier chain at DSS 13 had an adjustable delay line inserted in it. The delay line had a total delay of 126 μs adjustable in 2-μs steps from zero to maximum delay.

The final IF amplifier output at DSS 13, 455 kHz with a noise bandwidth of approximately 330 kHz, was correlated in real time with the 455-kHz signal from DSS 14 in an analog correlator. The analog output of the correlator was then recorded on another channel of the previously mentioned digital recorder. Also recorded on the remaining two channels of the digital recorder were the total power levels of the DSS 14 and DSS 13 receivers. This information may be used to obtain solar scintillation data.

The station provided the experiments with a total of seven observing periods; the first two on September 25 and 26, 1969, from 2100 to 0300 UT, and the one on October 1, 1969, from 0400 to 0900 UT, were used to check system operation. During the September 25 and 26 run, the *Mariner VI* spacecraft was tracked and fringes were observed from the *Mariner* spacecraft carrier. For this test, both stations operated at approximately 2297 MHz. The October 1 run utilized various radio sources and fringes were successfully observed on all sources tracked.

The actual experimental observations of 6 h each took place on October 2 and 3, October 4 and 5, October 6 and 7, October 10 and 11, and October 14 and 15, 1969, from approximately 2000 to 0200 UT.

The data from the general relativity experiment are being processed and evaluated by the experimenters.

B. DSIF Operations

1. RF Spectrum Analysis Technique Utilized by JPL Compatibility Test Area and Cape Kennedy Compatibility Test Station, *A. I. Bryan*

a. Introduction. One of the requirements of telecommunications compatibility testing of the spacecraft with the tracking and data system is to search the RF spectrum for extraneous, as well as expected, frequencies which are of sufficient amplitude to enable the S-band receiver to obtain phase lock.

The technique previously used to search for these RF signals required the receiver operator to manually tune the receiver and attempt to phase-lock the receiver. The receiver operator had to be able to hear a difference frequency as the receiver passed through a signal in the spectrum, and as a result, data on low-level signals were questionable. Consequently, in December 1967, a system was implemented at DSS 71 utilizing the digital instrumentation system (DIS) phase I digital computer (SDS-920) to provide: (1) S-band receiver voltage-controlled oscillator (VCO) tuning control, (2) frequency monitoring and frequency band power level measurements, and (3) RF spectrum data recorded on the line printer.

b. System configuration and description. A block diagram of the system is shown in Fig. 2. The S-band receiver heterodynes the incoming signal to produce a 10-MHz IF carrier, which is passed through a telemetry bandpass filter and is then mixed with 10.02-MHz to produce a 20-kHz carrier with telemetry subcarriers. The 20-kHz receiver output is input to a wave analyzer, which operates in the normal mode (no automatic frequency control) with a 6-Hz or 200-Hz bandpass.

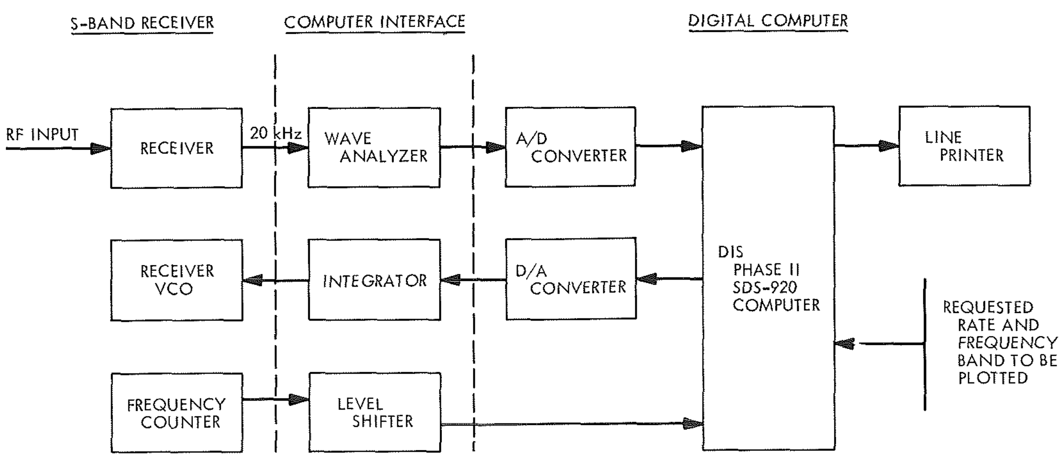

Fig. 2. Block diagram—RF spectrum analysis system