DSN Research and Technology Support

E. B. Jackson
R. F. Systems Development Section

The activities of the Development Support Group in operating and maintaining the Venus Station (DSS 13) and the Microwave Test Facility (MTF) are discussed and progress noted. Major activities include support of testing of the 100-kW transmitters to be installed into the overseas 64-m antennas, testing and modification required for the 400-kW X-band radar system, testing of station automation and pulsar observation, installation of new Faraday rotation polarimeters, and clock synchronization transmissions. Other activities include Pioneer 10 and 11 science support, sky survey, and weak radio source observations.

During the two-month period ending June 15, 1974, the Development Support Group, in its operation of the Venus Station (DSS 13) and the Microwave Test Facility, made progress on various projects as discussed below.

I. In Support of Section 331

A. Station Automation (Pulsars)

As part of the overall DSN Station Automation Project (RTOP 68, "Station Monitor and Control"), a demonstration is planned using the Venus Station to perform a pulsar track under remote control from JPL in Pasadena. To provide the necessary station control, modifications have been made to the station computers to provide bilateral communications between the two SDS-910's and the "master" computer, the SDS-930. Additionally, the SDS-910 dedicated to pointing the 26-m antenna had a complete PIN–POT chassis added, while the SDS-930, requiring expansion of its interrupt capability, had 8 interrupts added to bring the total available to 16. With successful communication now established between the three station computers and the computer at JPL, 70 hours of automation software and hardware testing was done during this period. Also, 85¼ hours of pulsar observations were performed, during which the pulsars tabulated in Table 1 were observed at 2388 MHz, left circular polarization (LCP), using the 26-m antenna and the SDS-930 for data taking.

II. In Support of Section 333

A. Weak Source Observation

During the 59¼ hours devoted to routinely observing weak radio sources (Ref. 1), the sources tabulated in Table 2 were observed at 2295 MHz with the 26-m antenna set to receive right circular polarization (RCP).

B. Radio Star Calibration

With the receiver tuned to 2278.5 MHz, and the 26-m antenna adjusted for right circular polarization, flux measurements of radio sources 3C123, 3C218, NGC 4258, Cassiopeia A, and Cygnus A were made during 48½ hours of observing.

C. Sky Survey

With the 26-m antenna fixed at a 180-deg azimuth and progressively positioned between 84.4- and 85.7-deg elevations in 0.1-deg increments, 548½ hours of data were automatically collected during the night and weekend hours when the station was not manned.

D. Faraday Rotation Data Collection

A decision has been made to install ionospheric monitoring equipment at each of the overseas 64-m antenna complexes in support of the Helios and Viking 1975 missions. To provide an opportunity for competitive evaluation, two complete Faraday Rotation Receiving Systems (polarimeters) have been installed at DSS 13, and data are being recorded from each system onto punched paper tape, digital printer, and analog chart recorder. A discussion of this system and evaluation procedures are presented by A. L. Price elsewhere in this volume.

III. In Support of Section 335

A. X-Band Planetary Radar

The DSS 14 Transmitter Control System has been modified by the installation of additional cabinets with which two klystrons can be simultaneously controlled, along with other modifications to the S-band control system. Correct operation of the modified S-band system has been demonstrated and the X-band modification is substantially completed, lacking only some additional wiring. A similar modification to the DSS 13 transmitter control system is 50% completed.

A waveguide switch, which will handle 400 kW in the final system, has satisfactorily completed three continuous hours of testing at 200 kW, and one hour of testing at 300 kW, switching immediately and satisfactorily after each test was completed in the Traveling-Wave Resonator (TWR). Additionally, the feedhorn to be used for this system was tested at 160 kW using the VA-949J klystron.

It is apparent that additional cooling of the waveguide flanges, which carry 400 kW, will be necessary. In order to evaluate various cooling schemes, a device for simulating RF heating of the waveguide, using circulating heated oil, is being assembled at the Microwave Test Facility.

B. DSS 63 100-kW Transmitter Testing

The DSS 43 1.1-MW Transformer/Rectifier was temporarily installed into the test system to verify its capability. A 24-hour heat run at 1 MW dc was satisfactorily completed.

Radio frequency testing of the klystron cabinet has commenced at the 100-kW power level, completion of which will wind up the DSS 63 system testing and packaging, and shipment to Spain will follow. Three additional members of the DSS 63 staff have undergone training at DSS 13 and have returned to Spain.

C. Block IIIC Receiver–Exciter

The planned installation of the Block IIIC Receiver–Exciter at DSS 13 has been delayed because of manpower requirements in other areas. Preliminary groundwork has been completed, however. The Block IIIC system will be installed, intact, with only modifications to update it. The present Mod IV R&D receiver will be reduced in size from three equipment cabinets to one. The 2388-MHz phase-locked loop, as well as the 455-kHz loop and one open-loop channel, will be retained. The present auxiliary receiver cabinet will remain unchanged.

Some cabinet rearrangement will be necessary in the operations building to accommodate the nine additional cabinets in the Block IIIC system.

IV. In Support of Section 422

A. Clock Synchronization Transmissions

Two transmissions to DSS 51, three transmissions to DSS 43, and three transmissions to DSS 63, for a total of

8¼ hours, were made as scheduled by DSN scheduling. The 100-kW X-band transmitter klystron body current is normally monitored with a current sensing probe (transformer) which sees the difference between beam current and collector current. These units output two signals, a fast body fault protection signal, and a slow body metering signal. The slow body portion of both of the X-band transmitters' body current probes have failed while on loan to a development project.

To allow clock synchronization transmissions to continue, the transmitter has been modified slightly. A 1-Ω, 100-W resistance has been placed between the high-voltage positive return path and system ground. Current through this resistance is body current and is used to furnish the slow body signal to the transmitter metering and slow body protection circuits (Fig. 1). The fast body protection is still provided with a body current probe. The second current probe has been returned to the manufacturer for repair.

B. DSN Klystron Testing

The DSN High-Power Transmitter Maintenance Facility at DSS 13 tested a DSN 400-kW klystron (X-3075) S/N H1-101-R1. It did not pass acceptance testing and was returned to the manufacturer, Varian Associates, for rework as necessary.

V. In Support of Section 825

A. Pioneer 10 and 11 Science Support

Approximately 10 hours per week of routine observing are being provided. Observations of the radiation from Jupiter and radio source calibrators tabulated in Table 3 were made at 2295 MHz with the 26-m antenna adjusted to receive right circular polarization. Observations were made for a total of 80 hours during the two months ending June 15, 1974.

B. Interstellar Molecular Line Search

The 64-m antenna at DSS 14 has been used to search for emission lines from hydrogen and carbon recombination in interstellar space in the vicinity of 2275 MHz. Thirty-four hours of experimental observations were made with the DSS 13 26-m antenna to evaluate usability for this purpose. Searches were made in the direction of Orion A, NGC 2023, LKHA 208, NGC 2068, M431R, 3C286, and 3C295; initial data results indicate the 26-m antenna will be useful for these observations.

Reference

1. Jackson, E. B., "DSN Research and Technology Support," in *The Deep Space Network Progress Report 42-20*, Jet Propulsion Laboratory, Pasadena, Calif., Apr. 15, 1974.

Table 1. Pulsars selected for test observation at DSS 13

0031−07	0823+26	1818−04
0329+54	0833−45	1911−04
0355+54	1133+16	1933+16
0525+21	1237+25	2021+51
0628−28	1604−00	2045−16
0736−40	1642−03	2111+46
		2218+47

Table 2. Weak radio sources observed at DSS 13

3C123	3C286	3C461
3C138	3C309.1	NGC 4218
3C147	3C348	NRAO 530
3C218	3C353	Virgo A

Table 3. Radio source calibrators used for Pioneer science support

3C48	3C147	CTA 21
3C123	3C348	PKS 0237-23
3C138	3C353	

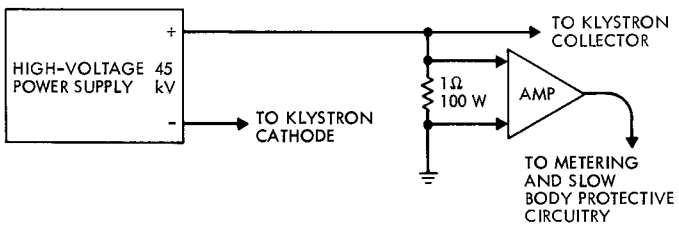

Fig. 1. Simplified slow body current circuit