High-Power Transmitter Automation – Part II

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This report describes the current status of the transmitter automation development. The work being done is applicable to all transmitters in the Deep Space Network. New interface and software designs are described which improve reliability and reduce the time required for subsystem turn-on and klystron saturation.

I. Introduction

The benefits of transmitter automation are the reduction of life cycle costs and increased availability. Life cycle costs will be reduced not only by the requirement for fewer operators, but also by more effective preventive maintenance through increased and more accurate reporting of critical subsystem parameters. Increased availability will be provided by eliminating the need for operations personnel on evening and weekend shifts. Automatic fault diagnosis and programmed recovery procedures will also increase availability.

The development work currently being done for the DSS 13 100-kW S-band transmitter is applicable to all other known or planned transmitters in the Deep Space Net (DSN) including the X-band uplink development at DSS 13. The difference in operational parameters of the various transmitters is provided for by including a configuration table installed on an individual PROM (programmable read-only memory) for each klystron (or multiple klystrons) at an individual station. Since each klystron has its own table, a change of klystron due to failure, repair, or replacement requires only a single PROM programmed and delivered to the station with the klystron. This will allow the PROM to be installed directly at the klystron in the future. The configuration table (shown in Fig. 1) was discussed in Ref. 1.

II. History

Prior history was discussed in Ref. 1. Current equipment used includes the latest multibus microprocessors (ICS-80) using an 80/20-4 CPU with 9 k-bytes of RAM, 24 digital output lines, and a PROM card for program storage. Communication is provided by a SBC-534 module with four RS-232C ports. A SBC-519 input-output card provides for 72 digital input signals. A 32-channel differential input multiplexer and analog-to-digital converter is used for analog inputs (only 16 channels are used in the transmitter at this time). This controller is located in the Local Control Console (LCC), with a second controller (without the interfaces) located at the control room in the Remote Control Console (RCC), where this controller acts solely as a communications buffer for the 15-line standard interface to the Station Controller.

III. New Hardware

The new controller is based on the Intel Industrial Control Series (ICS), changing only the package design from an ICS-80 chassis to an ISBC 660 chassis, which still uses the standard ISBC 640 power supply. The interface modules have been changed from the Intel ICS 910 and 920, to a common distributed plug-in type module having a higher driving capability. The interface between the transmitter controllers is a serial interface (RS-232C) through short haul modems as shown in the block diagram of the transmitter controller (Fig. 2).

The automation of the heat exchangers is complete and operational, with the louvers thermostatically controlled upon demand of the system. The heat exchanger at DSS 13 is in three bays and has a separate set of louvers for each bay (see Fig. 3). As the system power increases, the heat exchanger automatically adds more cooling capability to the heat exchanger by opening another set of louvers and turning on another cooling fan.

IV. Software

The software conforms to the top-down structured methodology, using 100% PL/M. The communications is being investigated with regard to the use of an RMX-80 interrupt system, which may speed up the communications and allow better access to the program through the CRT. A composite top-level flow chart is shown in Fig. 4. The programs are separated into three parts consisting of the RMX, XMTR, and COMM programs. The RMX program resides in PROMs on the CPU board and provides the communications and control of the priorities of the individual tasks. The XMTR program is the operating program of the system and operates the transmitter and verifies the operating parameters. The COMM program resides in PROMs on a CPU board and provides the communications between the main controller and the remote controller.

V. Present Status

Testing of the controller with the transmitter simulator is presently being conducted in order to improve the operating system and add engineering changes into the programs. Also being added are system calibrations, using new temperature sensors and water flow devices.

Reference

1. Gosline, R., "High-Power Transmitter Automation," in *The TDA Progress Report 42-57*, March and April 1980, pp. 71-81, Jet Propulsion Laboratory, Pasadena, Calif., June 15, 1980.

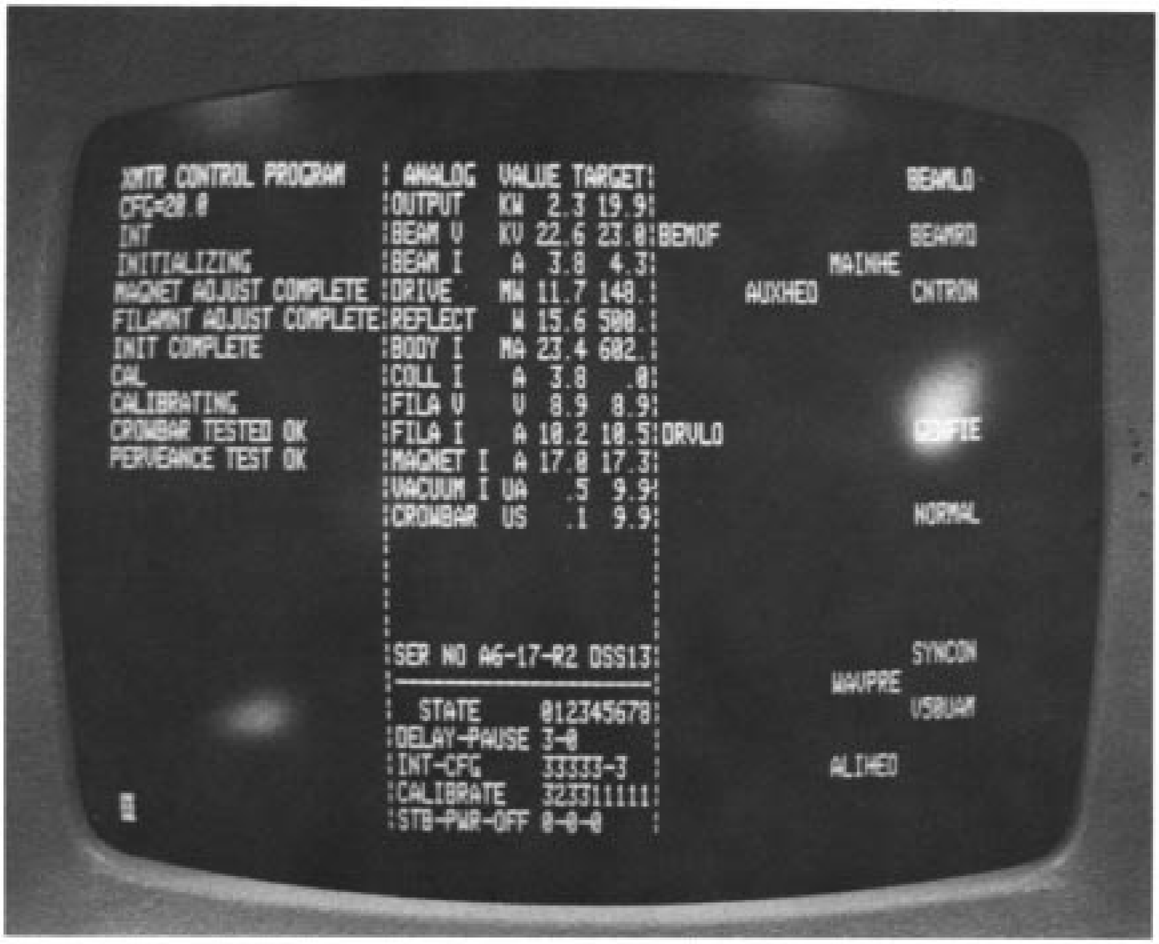

Fig. 1. Configuration table

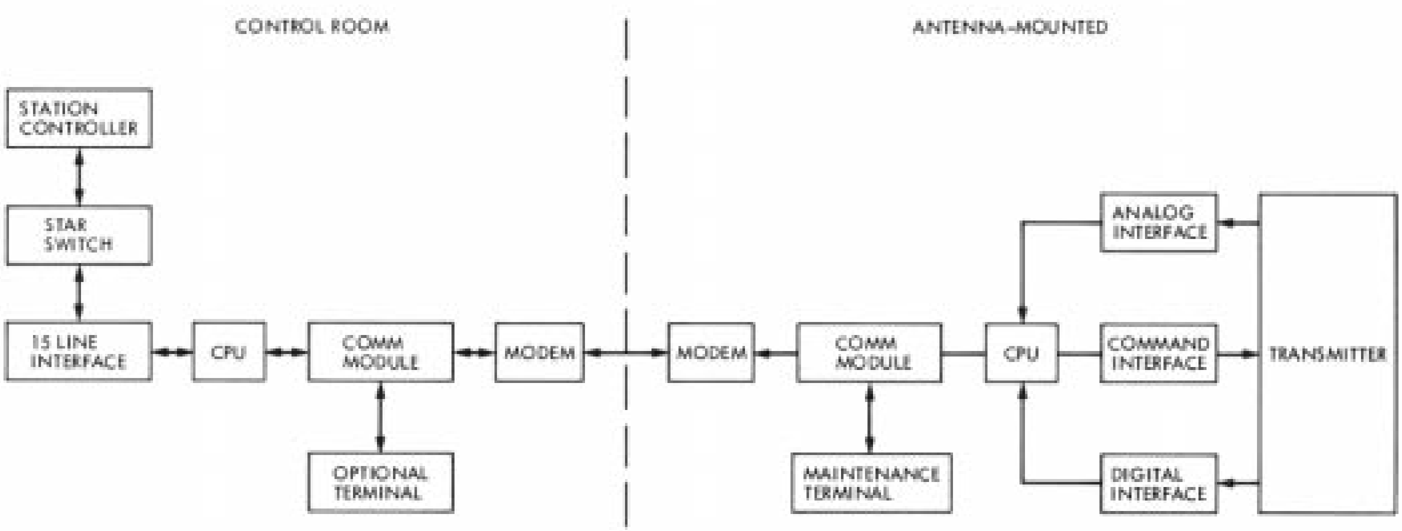

Fig. 2. Transmitter controller block diagram

Fig. 3. Heat exchanger louvers, showing Bay 1 open and Bay 2 closed

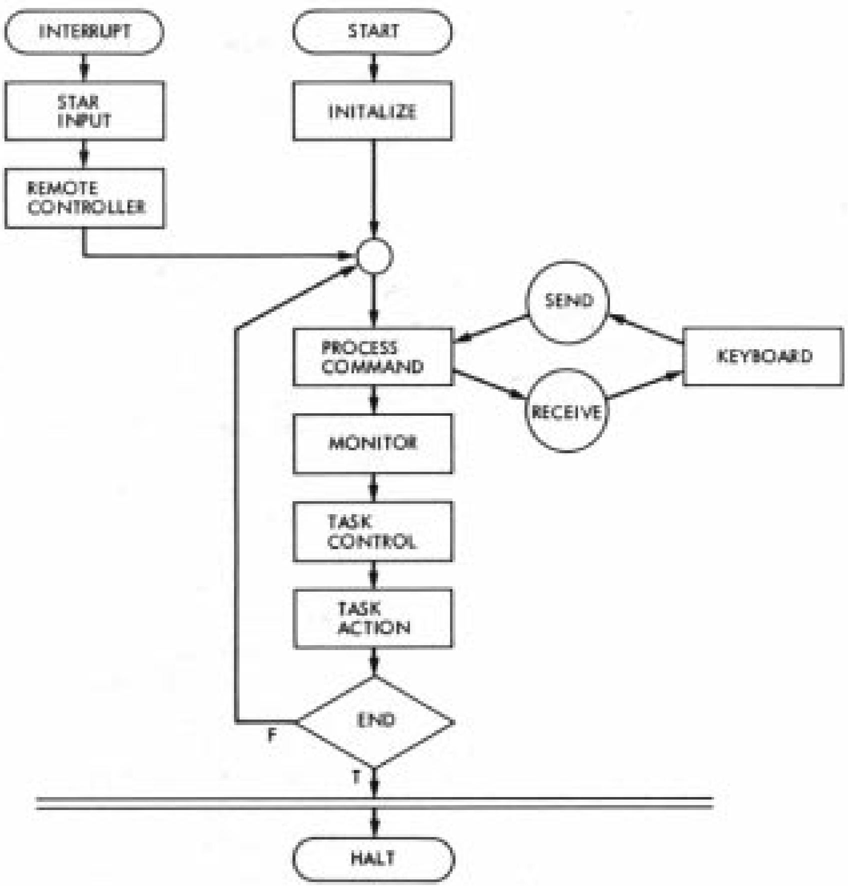

Fig. 4. Transmitter control program top-level flowchart