

The Cerro Tololo Data System

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(read *in absentia* by D. L. Crawford)

As early as 1968, increases in the complexity of photoelectric observing programs and the variety of sophisticated photometric instruments in use at the Cerro Tololo Inter-American Observatory necessitated the acquisition of a digital data-recording and instrumentation-control system. The diversity of projects to be done with such a system and the obvious need of provisions for extensive

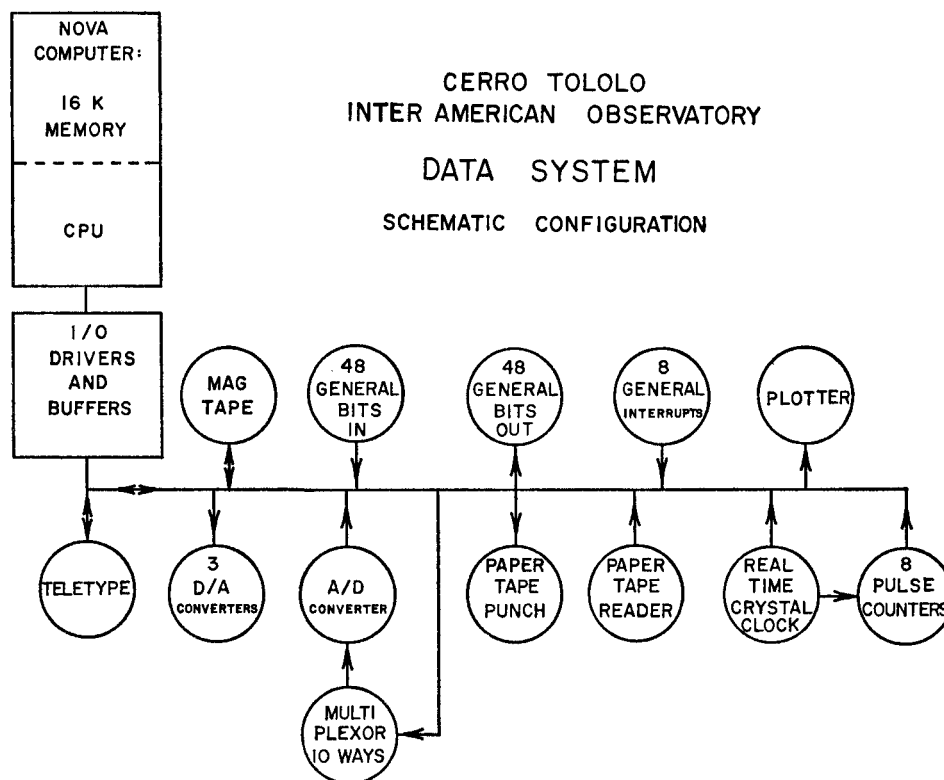


Fig. 1

future modification and expansion made apparatus oriented around hard-wired logic clumsy and uneconomical. Clearly, the heart of the system was to be a digital computer.

That Cerro Tololo is somewhat remote from the centers of computer technology was a dominant factor in the design of the system. In particular, both the computer and the peripherals had to be chosen for simplicity, reliability, and ease in stocking spare parts. For facility in handling at the observatory, the whole system was required to fit into a single rack. To minimize programming and maintenance problems, a somewhat large memory (16K) was chosen instead of a smaller configuration with disks. Furthermore, because of the obvious need to construct this system promptly, a computer with a simple input-output structure was required to minimize the difficulty of making interfaces to astronomical hardware.

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A block diagram of the configuration adopted is given in Figure 1. The major component is a Nova computer, manufactured by Data General Corp. With a few exceptions, the I/O interfaces were purchased from the computer manufacturer and only a few had to be constructed especially for this project. In the interests of simplicity, all interfaces are located inside the computer case, and no external I/O buss is needed. (A very simple shield suffices to protect the analog equipment from the noise generated by the memory-drivers.)

The pulse-counting apparatus consists of a Le Croy model 150 eight channel (50 MHz) scaler and Solid State Radiation amplifier-discriminators. The scaler subsystem, which was remounted and interfaced on one interface board, is shown in Figure 2. A similar approach was used with the analog modules, utility control and data lines, and various other interfaces built at the observatory.

Most control and data lines between the computer and external instrument pass through an exchangeable and programmable plugboard, which also contains a small amount of utility logic. Thus the electrical configuration of the system can be changed in a few minutes by exchanging prewired plugboards.

The computer system, mounted in its rack, is shown in Figure 3. Normally, the rack is located in a warm, clean environment such as the office of the 36-inch telescope. Presently a teletype at the observing position serves as the control and output device, and a chart recorder also located there can be used for "quick-look" analog information. Provisions for more informative control and indicator devices are also being made.

So far, all programming has been done at the assembly-language level. The standard programming package consists of a number of clearly identifiable machine language subroutines for performing the basic input-output, timing, and related operations as well as a few specifically astronomical arithmetic routines which supplement a rather extensive arithmetic library supplied by the manufacturer. It has been our experience that even a person relatively inexperienced in assembly-language programming can successfully piece these routines together into a useful observational routine.

So far, this system has been used for multicolor photometry, for time-series data-acquisition, and for controlling a pressure-scanned Fabry Perot interferometer; and we anticipate using it with a grating spectrum-scanner in the immediate future. In addition, the computer encounters significant but incidental daytime use solely as a numerical analysis instrument.

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