Computer Display and Entry Panel

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The computer display and entry panel is a programmable high-speed numerical display and entry device for use with XDS 900 series computers. It contains additional sense switch and sense light capability along with a system interrupt. This type of device is expected to find application in troubleshooting DSIF minicomputers in the Network Repair Facility, in developing DSIF minicomputer software, and as a status display device for the DSN Network Operations Control Facility.

I. Introduction

The computer display and entry panel (DEP) is an auxiliary high-speed control panel for XDS 900 series computers. The numerical information may be program selected to represent octal or decimal numbers. The DEP increases the number of sense lights and sense switches available to the operator of the XDS 900 series computers and adds one system interrupt. When the DEP is installed in a XDS 900 series computer and its instructions are included within a program, an operator has an easily interpreted monitoring, entering, and testing device.

II. Problem

A method of displaying numerical information in real time and altering that information is desired. The numerical information may represent octal or decimal numbers, depending upon data requirements. The XDS 900 series computers have a limited number of sense switches and no sense lights; increasing the sensing capability will enhance computer interactions. Such capability is widely

needed in the DSN. It will help troubleshoot minicomputers in the Network Repair Facility, when minis become commonplace in the Network. The display capability will facilitate standard minicomputer software development and checkout as well. The DSN Network Operations Control Facility (NOCF) needs a permanent operational display system of low cost and minimum software burden. Finally, this capability is needed to conduct DSN development demonstrations and support flight project planning by conducting Planetary Radar experiments.

III. Hardware

The DEP (Fig. 1) is a simple program controlled device that allows an operator to see numeric information presented octally or decimally or to enter numeric information octally or decimally. The DEP also contains sense lights and sense switches which can be used in a variety of ways, such as to check the progress of large programs or to sense changes an operator may wish to make within a program.

The display portion of the panel consists of eight HP 5082-7000 solid-state numeric indicators and a HP 5082-7018 plus/minus sign. The display may represent eight octal digits or eight decimal digits plus sign. The mode octal/decimal is programmable and indicated by sense lights at the center of the panel. The sign is not used in the octal mode.

The entry portion of the panel consists of eight thumb-wheel switches and a sign toggle switch. The entry mode octal/decimal for the switches is program selectable and is indicated by sense lights at the center of the panel. The sign switch has no effect in the octal mode.

Sixteen sense lights and sixteen sense switches are provided at the bottom of the DEP. The lights can be individually turned on or off by the computer program and the states can be seen by both the operator and computer. The states of the sense switches can also be seen by the computer program so that test and skip commands can be used in programming. The sense switches are not buffered but are directly connected to a decoder. Care in programming to insure that the switch bounce does not interfere with the operation of the program should be observed.

Two other items on the panel allow added convenience to the operator. An interrupt push-button, which supplies a 3.2 μs pulse, and can be plugged into any open system interrupt position on the system interrupt card. Also a switch labeled "ST" is supplied. With ST in the ON position, the computer start switch will reset the DEP display blanking all digits. With ST in the OFF position the computer start switch has no effect on the displayed information.

Figure 2 is a block diagram of the display and entry panel. A pair of standard interface boards has been designed for the PIN and POT slots of the XDS 930 computer. The PIN card acts as a receiver buffer for the PIN lines to the computer. The POT card acts as a buffer transmitter for the POT lines from the computer. Figures 3 and 4 illustrate details of the PIN and POT interface cards.

As can be seen on the block diagram, signals flow from the POT interface card to the DEP for decoding and control. Information to be displayed on the light emitting diode (LED) display is stored in a 32-bit hold register and selected by quad 2-input multiplexers for presentation as octal or decimal numbers. Information to the computer from the thumb wheel switches is similarly processed and sent to the PIN interface card.

IV. Software

Table 1 is a list of EOM POT and EOM PIN instructions for displaying and entering octal or decimal numbers. The decimal numbers appear as two 24-bit words for eight numbers plus sign. The six low order numbers are packed BCD. The two high order numbers plus sign are packed BCD right justified with the sign appearing at the most significant bit position of the 24-bit word. In programming, for entering octal numbers, care should be taken in not placing the thumbwheel switches on decimal numbers, for these will be truncated and result in wrong answers.

Table 2 is a list of EOMs for setting and resetting the 16 sense lights and a list of SKS instructions for testing the set and reset states of the 16 sense lights and 16 sense switches. The position for the set state of the sense switches is up, the reset state is down. Meta symbol mnemonics are available upon request.

Programming of the interrupts is described in the XDS 930 computer reference manual. The interrupt can be plugged into any one of the presently available system interrupt positions so its priority and effects can vary as ordered by the operator.

V. Conclusion

One DEP is permanently installed in the XDS 930 at JPL. A second unit is to be installed on or before May 1, 1972 at DSS 13. A third unit is under construction and planned for installation at DSS 14 before the end of 1972.

The DEP at JPL was used to aid in the 1971 *Viking* Mars radar experiment range/doppler data reduction because of its capability to display rapidly changing numbers. It has also been used to simulate time display of a DSN station during program checkout. The DEP has been used as a debugging and troubleshooting aid in new hardware checkout, and in the development of new 930 software. Finally, the DEP is an integral part of the 1972 Venus radar two-station tracking experiment.

## Table 1. EOM PIN and EOM POT instructions for thumbwheel switches and numeric display

Instruction	Code	Followed by instruction	Function
EOM	30021	POT	Load octal: loads contents of computer 'C' register into DEP select register and displays the number.
EOM	30121	POT	Load decimal (low order): loads contents of computer 'C' register into DEP select register and displays it as a 6-digit BCD number.
EOM	30221	POT	Load decimal (high order): loads the six LSB and "CO" into the DEP select registers and displays it as the two MSDF and sign.
EOM	30321	PIN	Load octal: loads the contents of the thumbwheel switches into the computer 'C' register as an octal number.
EOM	30421	PIN	Load decimal (low order): loads the contents of the six LSB thumbwheel switches as a BCD number into the computer 'C' register.
EOM	30521	PIN	Load decimal (high order): loads the content if the two MSD thumbwheel switches and sign switch into the computers 'C' register 'CO' and eight LSBs.

## Table 2. EOM and SKS instructions for sense lights and sense switches

| Instruction	Code	Function
EOM	3XX21	Where xx equals octal numbers 20 through 37; sets sense lights 1 through 16.
		Where xx equals octal numbers 40 through 57; resets sense lights 1 through 16.
SKS	3XX21	Where xx equals octal 00 through 17; skips if sense lights 1 through 16 set.
		Where xx equals octal 20 through 37; skips if sense lights 1 through 16 reset.
		Where xx equals octal 40 through 57; skips if sense switches 1 through 16 set.
		Where xx equals octal 60 through 77; skips if sense switches 1 through 16 reset.
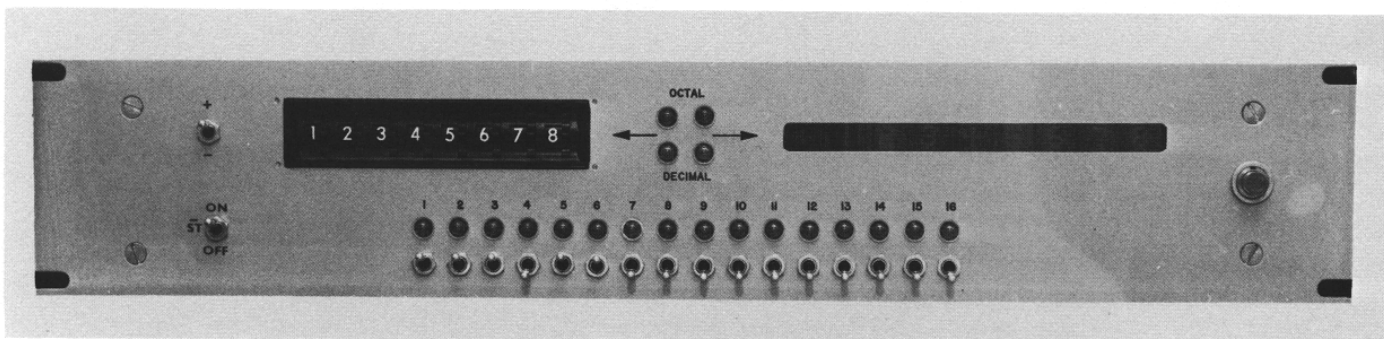
Fig. 1. Display and entry panel, front view
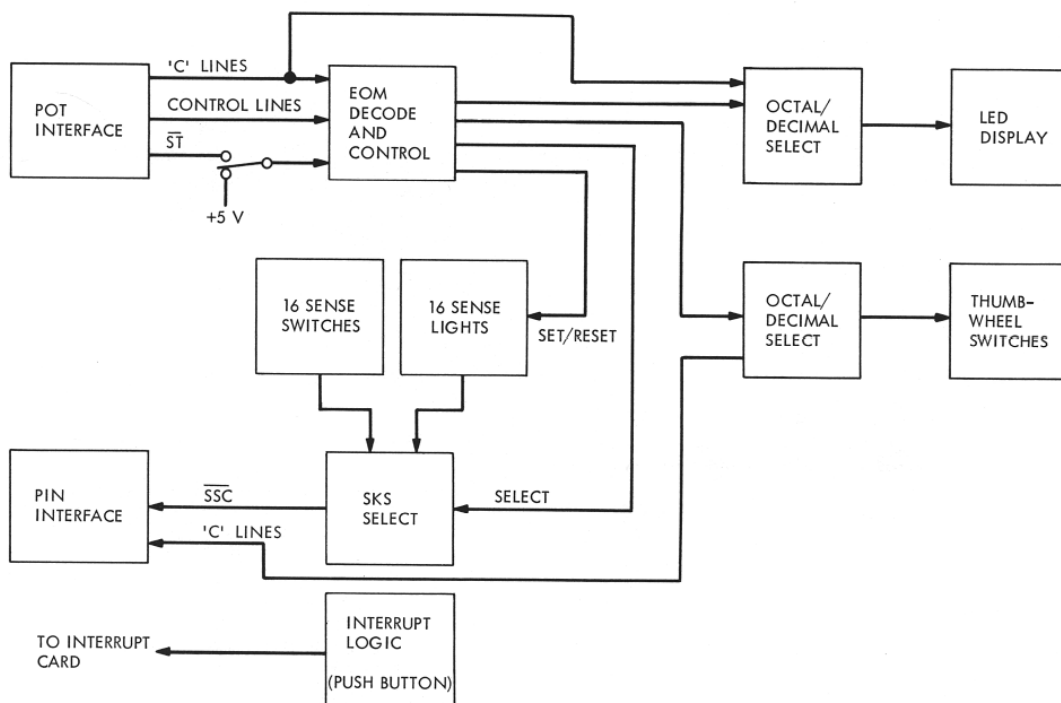
Fig. 2. Block diagram of display and entry panel
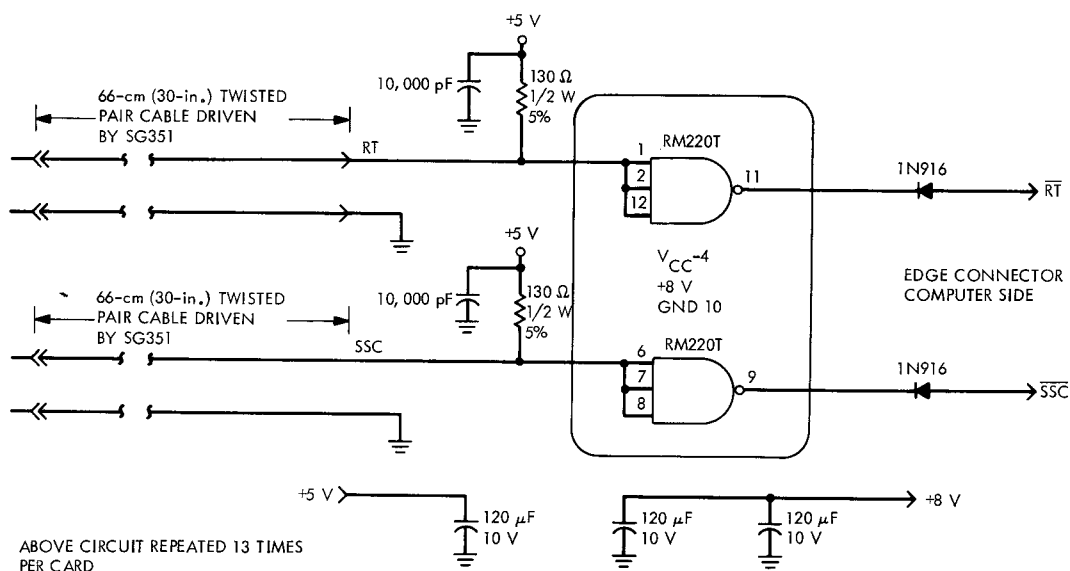
Fig. 3. Standard PIN interface for XDS 930 computer
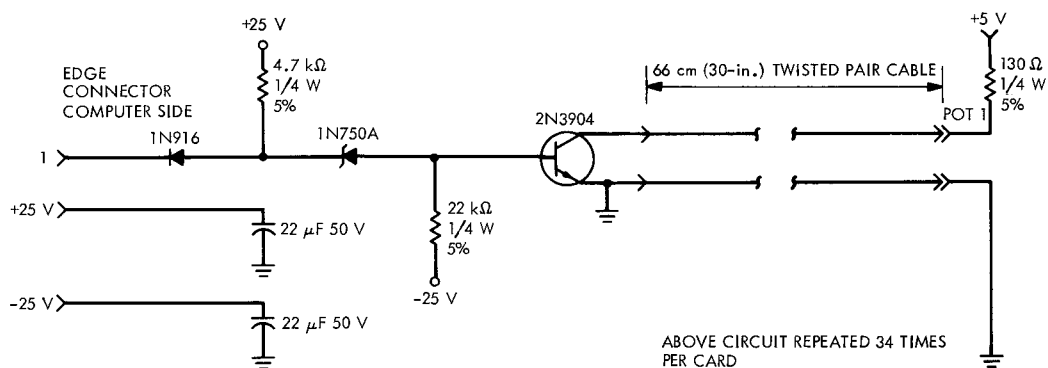
Fig. 4. Standard POT interface for XDS 930 computer