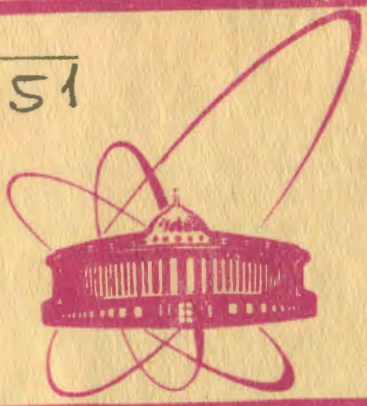

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MICROCOMPUTER BASED STORAGE TUBE DISPLAY GRAPHIC TERMINAL

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The appearance of inexpensive microprocessors and large capacity semiconductor memory components opened new possibilities in the development of graphic terminals. The application of microprocessors in graphic terminals allows essentially to reduce the expence of electronics, to improve system reliability and flexibility, to arbitrary increase the set of graphic instructions and to easily expand the possibilities of the terminal by means of connecting additional PROM's.

The graphic terminal INTER-80 includes storage tube display, a display processor, keyboard and trackball. The terminal may be linked to a network via digital modems of the CODEC type (interface CCITT V.24). A programmable parallel interface (16 or 8 bits) is used for connecting it to small computers. It is possible to use a TTY interface too. Any standard input/output register may be used for operating graphic terminal with the CAMAC system.

In the display a bistable direct view storage tube 31LN4 with parameters equivalent to the well-known Tektronix 611 tube is used.The display includes all electronics needed for CRT control and provides the following operating modes: Store, Erase, View, Nonstore and Write-Through. High image quality is achieved by means of special circuits for pincushion distortion and dynamic focus correction. The display area exceeds 21 cm x 16 cm, the number of addressable points equals 1024x 1024.

The display processor is based on microcomputer system elements of the KR580IK80 series which are fully compatible with Intel 8080 family. With the exception of functional modules common to all uP system (uP block, memory block, interrupt controller, interface blocks) the display processor also includes a block of counter registers and DAC's, a block for handling Z-signals and signals for controlling the operating modes of the display. All blocks are connected with a common bus consisting of 16 unidirectional address lines, 8 bidirectional data lines and 6 control lines.

The memory block contains 8K byte of EPROM, which serve to store the terminal's basic control programs, and 16K byte of dynamic RAM used as a buffer memory for the display file and for programs which are dynamically loaded from the host computer. Besides the drawing of static pictures in Store mode

the terminal provides the capability of drawing simple dynamically changing pictures (objects) in refresh mode (Write-Through).

The interface block provides a connection of the terminal to the host computer as well as a connection of a keyboard and trackball to the terminal. The programmable parallel interface consists of two 8255 chips, with ports A operating in input mode and ports B - in output mode. Port C - lines are used for control purposes (handshaking and interrupts). Data transfer rate in the serial interface based on the 8251 chip can be changed from 110 to 9600 baud.

The keyboard is connected to the system bus via the 8 - lines buffer register 8212 working in input mode and generating an interrupt signal. The trackball is connected to a logic unit which provides the capability to move a crosshair on the screen according to the direction of rotating the ball. The pulses from this device enter the up/down-inputs of counter registers. Interrupt signals of keyboard and trackball are connected to the 8259 interrupt controller.

The ten bits up/down-counter registers in conjunction with DAC's are used for forming analog x-, y-signals entering the deflection amplifiers of the display. The control of the display operating modes is provided by a register consisting of triggers which are set by an auxiliary address decoder where setting of one trigger causes resetting of all others.All mentioned registers may be directly addressed by the CPU.The up/down inputs of the counter registers are addressed in the same manner thus speeding up the drawing of vectors.The duration of unblanking signal Z depends on the actual display mode,the delay time depends on the difference between coordinates of the current and final beam positions. During drawing the current picture element the signal "display busy" is active.

Software for INTER-80 is written in the form of independent program modules, and consists of resident (firmware) and non-resident components.

The resident EPROM - based software provides terminal control according to commands from the host computer and the user, and performs the following major functions:

- organization of the segmented display file, graphical and arbitrary data allocation;
- graphical output to the screen of the display unit (vectors and characters are generated by software);
- input from the keyboard (typical text editing functions are provided), processing of text messages and their transfer to the host computer;
- handling of keyboard function codes input;

- implementation of inter-computer calls on the terminal site by commands from the host computer;
- arbitrary information exchange between host and terminal (graphical items, data, binary data blocks);
- locator device support (trackball), two operation modes are provided: single point coordinates fixing, and continuous points tracking;
- initialization of the user's task in the host computer (remote job entry support).

The nonresident software for INTER-80 is designed according to application conditions. This software part is intended for the nonstandard function execution by additional system or user program modules, which should be transferred from the host computer to the terminal. In this case the program module is actually an absolute object module ready for immediate execution on the terminal.

The resident program module, which realizes the data link protocol between host and terminal is written in such a way, that no intervention in other software components is required in order to include another data link protocol module into the terminal software.

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