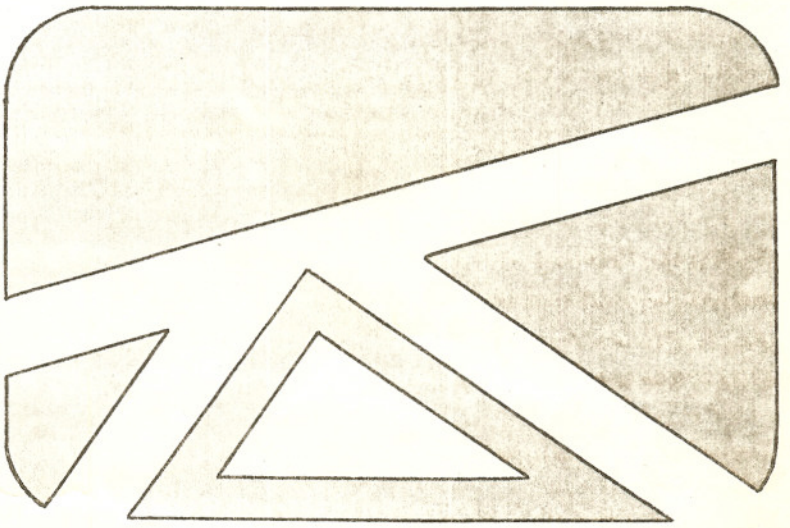
VIO-X



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VIO-X VIDEO TERMINAL

The VIO-X Video I/O Interface for the S-100 bus provides features equal to most intelligent terminals both efficiently and economically. It allows the use of standard keyboards and CRT monitors in conjunction with existing hardware and software. It will operate with no additional overhead in S-100 systems regardless of processor or system speed.

Through the use of the Intel 8275 CRT controller with an onboard 8085 processor and 4k memory, the VIO-X interface operates independently of the host system and communicates via two ports, thus eliminating the need for host memory space. The screen display rate is effectively 80,000 baud.

The VIO-X1 provides an 80 character by 25 line format (24 lines plus status line) using a 5x7 character set in a 7x10 dot matrix to display the full upper and lower case ASCII alphanumeric 96 printable character set (including true descenders) with 32 special characters for escape and control characters. An optional 2732 character generator is available which allows an alternate 7x10 contiguous graphics character set.

The VIO-X2 also offers an 80 character by 25 line format but uses a 7x7 character set in a 9x10 dot matrix allowing high-resolution characters to be used. This model also includes expanded firmware for block mode editing and light pen location. Contiguous graphics characters are not supported.

Both models support a full set of control characters and escape sequences, including controls for video attributes, cursor location and positioning, cursor toggle, and scroll speed. An on-board Real Time Clock (RTC) is displayed in the status line and may be read or set from the host system. A checksum test is performed on power-up on the firmware EPROM.

Video attributes provided by the 8275 in the VIO-X include:

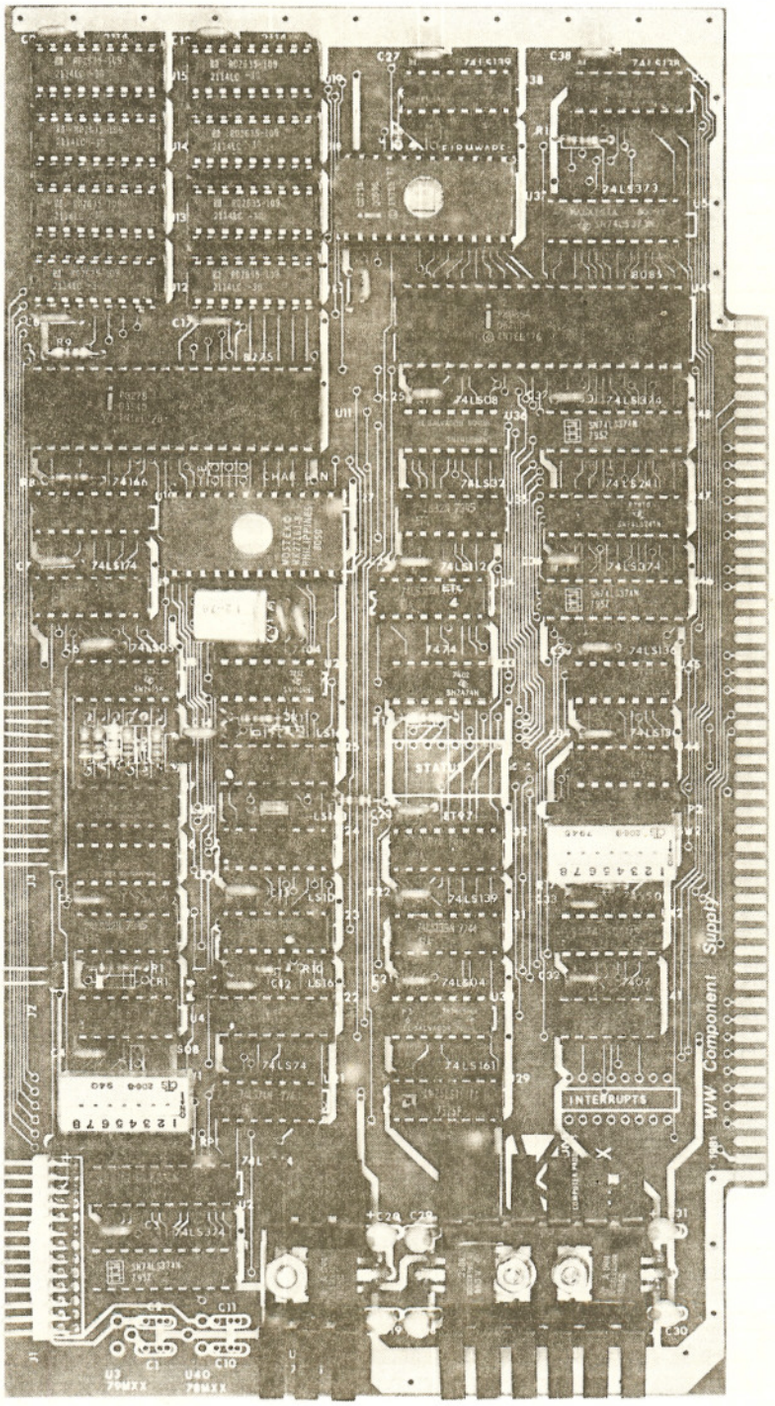
* FLASH CHARACTER
* INVERSE CHARACTER
* UNDERLINE CHARACTER or
* ALT. CHARACTER SET
* DIM CHARACTER

The above functions may be toggled together or separately.

The board may be addressed at any port pair in the IEEE 696 (S-100) host system. Status and data ports may be swapped if necessary. Inputs are provided for parallel keyboard and for light pen as well as an output for audio signalling. The interrupt structure is completely compatible with Digital Research's MP/M (TM).

Additional features include:

*HIGH SPEED OPERATION
*PORT MAPPED IEEE S-100 INTERFACE
*FORWARD/REVERSE SCROLL or
*PROTECTED SCREEN FIELDS
*CONVERSATIONAL or BLOCK MODE (opt)
*INTERRUPT OPERATION
*CUSTOM CHARACTER SET
*CONTROL CHARACTERS
*ESCAPE CHARACTER COMMANDS
*INTELLIGENT TERMINAL EMULATION
*TWO PAGE SCREEN MEMORY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INTERRUPTS
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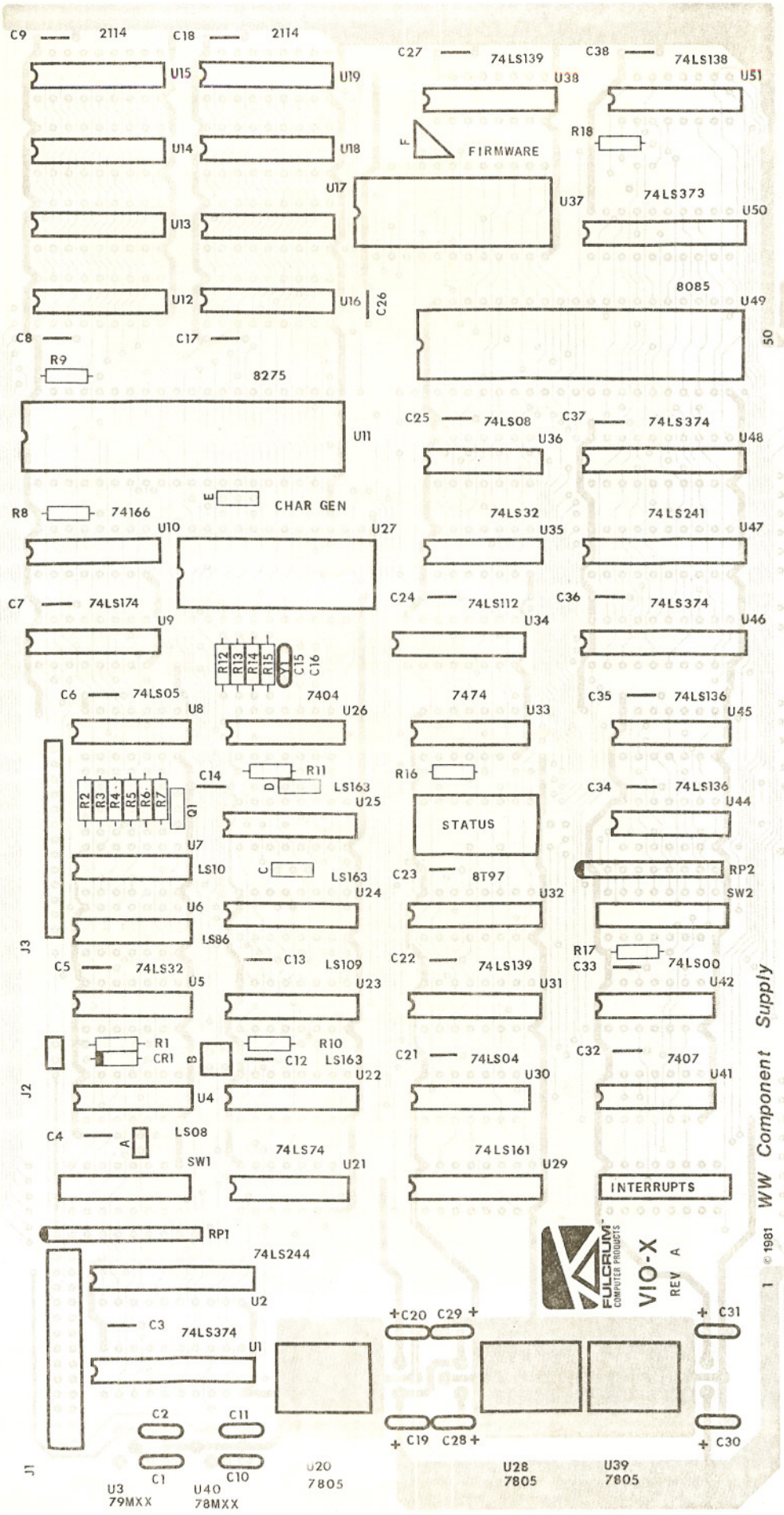
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4.

Software Interface

There are three different ways for the host to make the terminal do something:

1) Send a normal character.
2) Send a control character.
2a) Send an escape sequence.

Normal Characters

There are 96 normal characters, i.e., the entire ASCII character set. Transmitting any of these characters to the terminal results in the character appearing on the screen at the cursor position. The cursor then moves one position to the right. If the cursor is at the right side of the screen when this occurs, it wraps to the left side, moving down one line. If the cursor is at the bottom right corner, it will move to the bottom left corner and the screen will scroll up, leaving a blank line at the bottom.

Control characters

There are 32 control characters in the ASCII character set. The terminal responds to some (but not all) of them. The characters which the terminal notices are:

Char	Hex	Meaning	Action Taken
@	00H	NULL	Ignored by terminal ***
D	04H	ROLL DOWN	Scrolls screen down one line
G	07H	BELL	Beeps Beeper
H	08H	BACKSPACE	Bumps cursor to the left
J	0AH	LINE FEED	Bumps cursor down one line
K	0BH	CURSOR UP	Bumps cursor up one line
L	0CH	CURSOR RIGHT	Bumps cursor to the right
M	0DH	CAR RETURN	Returns cursor to left side
U	15H	ROLL UP	Scrolls screen up one line
Z	1AH	CLEAR SCRN	Clears the screen to blanks
[	1BH	ESCAPE	Initiates an escape sequence
^	1EH	HOME	Returns cursor to upper left
_	1FH	NEW LINE	Combined CR/LF

While the terminal does not respond to any other control characters, you can generate any of them by holding down CTRL and hitting the appropriate key. The terminal will then transmit that control character to the host.

ESCAPE SEQUENCES

An escape sequence consists of at least two characters, the first being the ESC character (1BH). The second character determines which escape sequence is to be executed. Some escape sequences need more characters as part of their processing, but there is always a minimum of two.

This is a table of all the escape sequences:

Char	Meaning	Action Taken
*	Clear Screen	Clears screen to blanks
+	Clear Screen	Clears screen to blanks
(	Bright att on	Sets active attribute to normal
)	Dim att on	Sets active attribute to dim
,	Status on	Turns on 25th line status field
.	Status off	Turns off 25th line status field
>	Set time	Sets 25th line clock
<	Read time	Reads time from 25th line clock
#	Lock keyboard	Disables keyboard
"	Unlock keyboard	Enables locked keyboard
=	Load cursor	Cursor moves to selected position
?	Read cursor	Cursor position transmitted to host
8	Write 25th line	Writes to 25th line user area
9	25th line att	Sets the 25th line video attribute
D	Set LF delay	Sets delay between line feeds
E	Insert line	Inserts blank line at cursor
H	Cursor off	Turn off cursor
K	Cursor on	Turn on cursor
R	Delete line	Deletes line under cursor
T	Erase line	Clear to end-of-line
U	Set Trans. mode	Turns on Transparent mode
Y	Erase page	Clear to end-of-page
Z	Set video att.	Sets video attribute
DEL	Read version	Transmit firmware version number

KEYBOARD

The VIO-X has no control over what type of keyboard is plugged into it. However, in order to function properly the keyboard must meet certain requirements.

Naturally, its connector must match the VIO-X pinout (refer to the hardware description and schematic). The IMSAI IKB-1 is compatible with this pinout.

If your keyboard needs voltages other than +5, this can be accomplished by installing regulators and capacitors in the area near the keyboard connector. For details, you had best consult the factory.

The keyboard must be a fully encoded ASCII keyboard. Either positive true or negative true data will work, provided the switch on the terminal board is set properly. Functions such as N-key rollover and repeat must be handled by the keyboard, since the terminal has no control over them.

The normal condition of bit 7 must be "false" (low for positive true data, high for negative true data) or the keyboard will not work right.

The keyboard strobe can be either positive or negative true, again set by a switch on the board. The hardware description goes into more detail on this.

An optional but desirable feature is a key which turns on bit 7, independent of which other key is being typed (the IKB-1 has such a key, labeled "FLAG I"). The presence of this key allows special local functions to be performed by the number keys at the top of the keyboard (assuming a standard layout). Holding this special key down will activate these functions when the proper number key is pressed:

CODE	KEY	FUNCTION
B1H	1	Roll screen down
B2H	2	Roll screen up
B3H	3	Turn 25th line status field on or off
B4H	4	Turn transparent mode on or off
B5H	5	Set line feed delay (see note)
	6-9	Unused
B0H	0	Clear screen

These functions are local, i.e., they do not transmit anything to the host, and they do not require any echo from the host.

Additionally, holding FLAG I and typing CTRL-A (resulting code is 81H), does a soft reset to the terminal, identical to power-on. (If a severe glitch happens and the terminal is "out to lunch", this may or may not work. Its main reason for existence is due to certain edit programs leaving the terminal in a funny mode when they exit).

If your keyboard has special keys for some or all of the above functions, they will function properly iff they emit the code indicated in the table.

Note: The Set Delay function requires that a second character be typed which indicates how long a delay to execute (See ESC D description in the ESCAPE SEQUENCES section). This character must be typed while still holding the FLAG I key down. Also, you should not try to set the line feed delay while characters are coming in from the host, because the first character which happens to show up after the FLAG-I 5 is hit will be interpreted as the delay character.

HARDWARE

The advent of CRT controllers in an LSI package has allowed the development of an intelligent video interface to the S-100 bus. The Intel 8275 CRT controller chip was selected because of its features and for compatibility to the 8085 processor. Port mapped I/O was chosen over memory mapped I/O to decrease the system overhead and allow interfacing with virtually any type of system.

The design of the VIO-X is based on the single chip INTEL 8275 CRT Controller which is a programmable NMOS-LSI device. It provides display row buffering, raster timing, cursor timing, light pen detection and visual attribute decoding. It can generate a screen format size of from 1 to 80 characters per row, 1 to 64 rows per screen and 1 to 16 lines per character row.

For compatibility, speed, and ease of implementation, the INTEL 8085 microprocessor was chosen for the on-board processor. The processor clock is derived from dividing the dot clock by 2. The 8085's ability to directly interface with memory and other system components thus minimizing chip count was an important factor in its selection.

To eliminate the need for a DMA controller and at the same time use the feature provided in the 8275 for rapid data transfer, a "trick" was used to simulate the function. The SOD (Serial Output Data) line from the 8085 is used as a toggle to place the 8275 on the data bus in parallel with memory and 40 POP's are done with the display memory reading and the 8275 writing to its buffers simultaneously. The POP moves two bytes from memory to the bus and also from the bus to the 8275 buffer (when SOD is toggled on).

The character generator circuit is similar to those recommended by Intel in AP-32 and AP-62 with the addition of a capability for 2716/2732 EPROM for the character generator. A custom character set was designed for this system which displays full upper and lower case ASCII alphanumeric characters and special control characters.

The video logic section is totally digital (no one-shots) to insure a stable display. Counters are used throughout to generate horizontal and vertical blanking and sync. Both composite and separate video signals are provided as outputs.

The 8275 supports the light pen feature and provision has been made for buffered light pen input to the board. Pen position may be read through an escape command sequence.

The on-board I/O ports are internally memory mapped as follows:

ADDRESS	PORT
7000h	KEYBOARD DATA
6000h	STATUS
5000h	S-100 OUTPUT PORT
4000h	BELL OUTPUT
3000h	S-100 INPUT PORT
2000h	8275 SELECT
1XXXh	DISPLAY MEMORY
0XXXh	FIRMWARE ROM

The keyboard port (7000h) is a latch internally memory mapped to the on-board processor with status output to allow polling. The input data strobe will support both negative and positive logic. The data lines may be either positive or negative logic with the processor firmware providing inversion if required. The keyboard connects via a 26 pin header allowing use of a DB-25 type panel connector. Both +5VDC and -12VDC are provided on the connector.

The board status port (6000h) is used for reading 6 DIP switches (system function inputs), keyboard data available, and host S-100 data available. The function inputs define the mode of operation for the board, cursor type, scroll delay, and keyboard data polarity. All are power up/reset conditions some of which may be changed by command.

The S-100 output port is a latch buffer clocked from the output port select (5000h) and the S-100 port read for the port selected by the board port address switches. The status read function operates in a similar manner. The status and I/O port addresses may be swapped (even/odd) by closing an additional DIP switch.

The S-100 input port works in a similar way from input port select (3000h) and the S-100 port write for the port selected by the board port address switches.

Interrupts are available to the host S-100 system on two maskable outputs (Output Buffer Ready and Input Buffer Ready) and one non-maskable output (Data Ready (to host)). These may be strapped to any of the 8 vectored interrupts on the host S-100 bus or to the priority interrupt bus line.

To eliminate one of the problems encountered with video-keyboard systems, an additional on-board port (4000h) has been defined to allow audio signalling to the user similar to that on a terminal or Teletype input device. This signal is activated when either an ASCII BEL signal is received from the host S-100 system or on command of the on-board processor firmware.

The display memory is on-board and independent of the host system memory. A total of 4096 bytes in four banks is provided by eight 2114 type static memory devices permitting two pages of screen data to be stored. This allows forward and reverse scrolling or screen protected fields to be offered.

FIRMWARE

The firmware is contained in either a 2716 (2k) or 2732 (4k) type EPROM. The version currently offered emulates the SOROC IQ-120 with several added functions. A small change in the firmware enables the board to respond to escape and control command sequences in any way required. The expanded firmware will operate in either conversational or block mode. In conversational mode, the board runs as a full duplex terminal with all normal characters (non-command) passing transparently through the processor to the host and the host providing character echo to the screen.

Alternately, in block mode, the keyboard does not transmit to the host but rather to the screen memory, thus permitting on-board editing without involving the host system. When the data is correct, it is transmitted to the host by a block "send" command of either a line, field, or complete screen.

Protected fields are provided at the cost of reverse scrolling, as the "shadow" screen memory (where protected status flags are kept) is the second page.

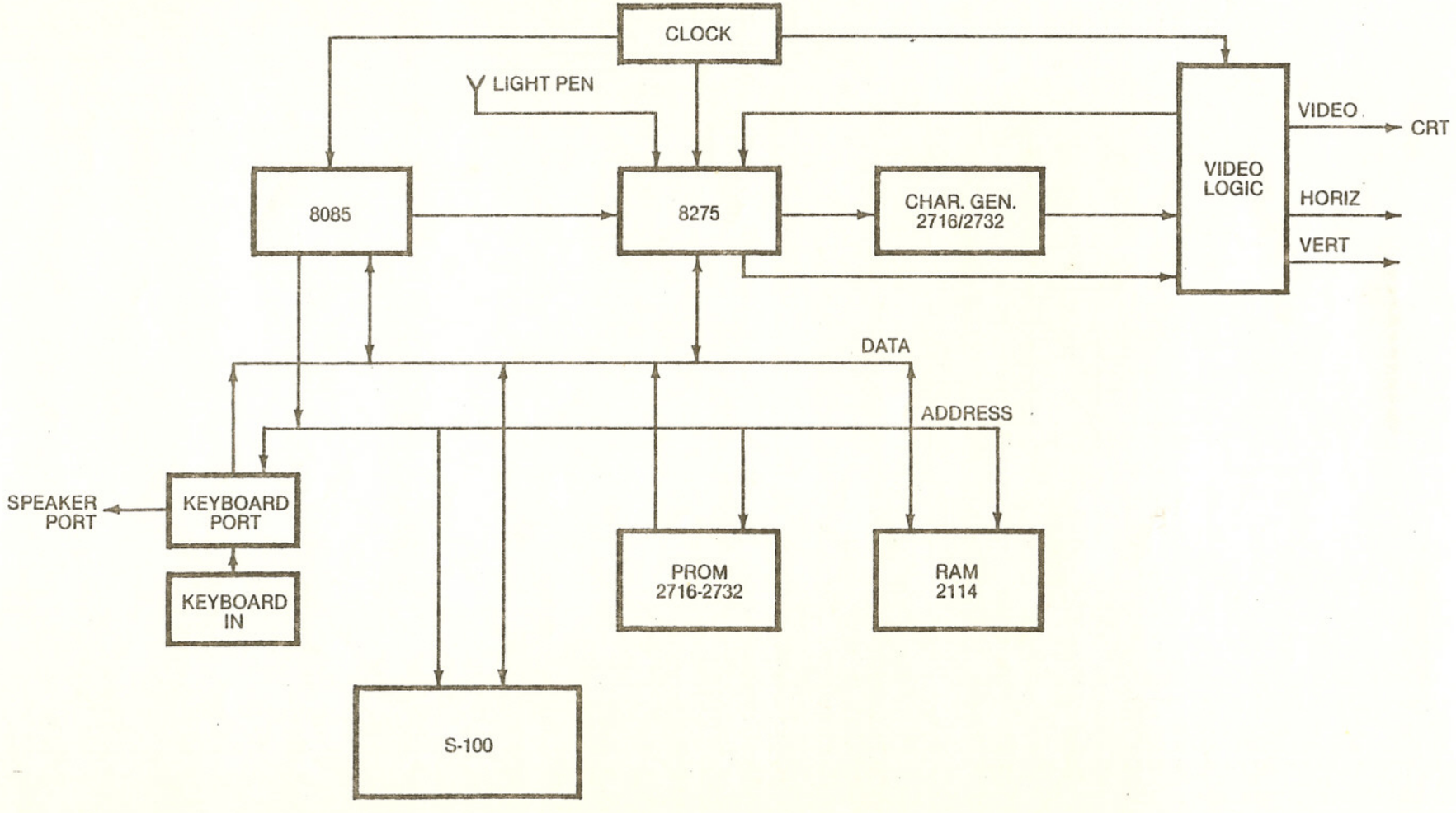
A 24 hour Real Time Clock is included as part of the firmware which shows on the 25th line (status line) and is readable and setable fron the host system.

One unusual feature was added when design tests indicated the hardware/firmware were very efficient in terms of speed. It became necessary to control the scroll rate as the board was as fast or faster that the operating systems it was connected to. When using the TYPE command in CP/M (R) or the L(IST) command in DDT (under CP/M) it was impossible to read the display due to the scroll rate, and difficult to stop the screen anywhere near the area desired. A scroll speed escape sequence command is now used to determine how fast a scroll will occur. This does not affect cursor addressable positioning or screen/ line clears, which still operate at the maximum rate.

REFERENCES

INTEL Application Note AP-32:
"CRT Terminal Design Using the INTEL(R) 8275 and 8279" by John Murray and George Alexy

INTEL Application Note AP-62:
"A Low Cost CRT Terminal Using the 8275" by John Katausky



VIO-X S-100 I/O INTERFACE