Kaypro Emergency Monitor ROM
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Introduction

The purpose of the monitor is to help debugging a broken Kaypro. Replace the normal boot/BIOS ROM with a EPROM created from this monitor image. The Kaypro will now interact using the serial port (“Serial I/O” on early models, “Serial Data” on later models). No other hardware will be initialized, which means the display and keyboard will not work, nor will the disk. The display will usually be filled with random characters, or at least will not be cleared.

There is also a emergency memory test ROM available, for cases when the monitor ROM won’t even work.

The ROM Image

The monitor binary image may be downloaded here: http://sebhc.durgadas.com/kaypro/monitor.bin. Note that this is a 2K image, the same size as the 2716 EPROMs used for the Kaypro II and Kaypro IV (2/83, 4/83) models. It may also be put in larger EPROMs (2732 or 2764) for use with the Kaypro 10 and */84 models. When using larger EPROMs, it should not be necessary to replicate the image throughout the extra space (this needs to be confirmed). Note that the Kaypro IV/83 model (may also apply to some later Kaypro II) has a jumper-selectable ROM socket that takes either 2716 or 2732. Be certain to set the jumpers appropriate for whatever EPROM is being installed. The Kaypro 10/83 has a socket wired exclusively for the 2732. The */84 models should work with either 2732 or 2764 without changing any configuration.

Note that the AT28C16 EEPROM (FLASH) should work in place of the 2716 in Kaypro circuits. The AT28C64 should work in place of the 2764.

Using The Monitor

The monitor ROM does not depend on any hardware besides the SIO1 channel A serial port (and associated baud generator). However, it does provide a “heartbeat” indicator on the drive select LEDs on */84 (and 10) models – provided that the sysport is operating correctly. On */83 models, this heartbeat will be in the form of the first character on the display alternating between ‘A’ and ‘B’ – provided that the video is working. The heartbeat ceases after the first command is entered.

The monitor prompt is the colon character (‘:’). When the system is RESET the monitor will initialize the serial port and print a signon string and then prompt for input. Input lines may be edited using the Backspace key. Ctrl-C will abort the input and go back to the prompt. Upon pressing RETURN, the input line is then parsed by the monitor. Pressing RETURN at the prompt (empty input line) will just re-prompt.

Note that while the ROM is enabled by the sysport, Low memory addresses contain the ROM contents and are not writeable. The exact boundary between ROM and RAM depends on the model. Also, the Kaypro II and IV models map the video RAM into addresses 3000-3BFF. In order to access the RAM at low addresses, a special program must be used to transfer control into high memory and update the sysport to turn off ROM (and video RAM). On */83 models, the sysport is implemented in a Z80-PIO which must be initialized before it can be used.

The command ‘?’ will print a brief list of commands with some help text.

The following commands are implemented:

D *start end*

Dump memory in hex. Both *start* and *end* are required, and are interpreted as hexadecimal. Up to 16 bytes are displayed per line, with ASCII representation following the hexadecimal byte values.

S *start*

Substitute memory content interactively. The current address (initially *start*) and byte are displayed in hex and a single character of input is accepted. Pressing RETURN will go to the next address (+1) without changing the current byte. Pressing dash (‘-’) will go to the previous (-1) address without changing the current byte. Pressing period (‘.’) will end the command and return to the monitor prompt. Entering hex digits and RETURN will replace the current byte with the new value and advance to the next address (+1).

G *start*

Go (jump) to *start* and begin executing the code there. If the code executes any RST instruction, control will be returned to the monitor, where the message “*** RST” and the calling address (after the RST instruction) will be printed. No registers are saved and the code may not be resumed.

F *start end data*

Fill memory with the byte *data* repeated throughout the range.

M *start end dest*

Move a block of memory. If *start end* overlaps with *dest* then the results are undefined.

I *port* **[** *num* **]**

Input from *port* xxx and display the value in hex. If *num* is given, then the same port is read that number of times, and each value displayed. Both *port* and *num* are hexadecimal. There is no delay between inputs, other than the time it takes to print the value in hex.

O *port data* **[** ... **]**

Output *data* to *port*. If more than one data bytes are given, then those values are successively output to *port*. There is no delay between outputs, other than the time it takes to parse the next value.

N *hw*

iNitialize a hardware component. *hw* may be:
KB83 – Initialize the keyboard SIO channel on a */83 model.
KB84 – Initialize the keyboard SIO channel on a */84 or 10 model.
CRTC – Initialize the CRT controller chip on a */84 or 10 model.

T *hw*

Test a hardware component. *hw* may be:
KBD – Run a simple test for receiving codes from the keyboard. Waits for keys to be pressed on the keyboard and prints the hexadecimal code that is received. To end the test, type any character on the monitor console.
CRTC – Run a simple test for CRTC update status. Tries to detect the status change three times, and prints "Update" for each. The test may be aborted, if hung, by typing any character on the monitor console.

X *hw*

eXtract hardware component state into memory at 8000H. *hw* may be:
CRTC – Extract CRTC registers 0-19.

V

Display the ROM version. This just prints the ROM signon message again, which contains the version.

Examples

In the examples, characters typed by the user are underlined. *(CR)* means pressing the RETURN key.

Getting Help

This shows the signon message and how to display the help menu.

```
Kaypro Monitor v1.8

: ?(CR)
D <start> <end> - display memory in HEX
S <start> - set/view memory
    (CR) = skip fwd, '-' = skip bkwd, '.' = done
G <start> - go to address
F <start> <end> <data> - fill memory
M <start> <end> <dest> - Move data
I <port> [num] - Input from port
O <port> <value> [...] - Output to port
N <hw> - iNitialize hardware (KB83, KB84, CRTC)
T <hw> - Test hardware (KBD, CRTC)
X <hw> - eXtract hardware to 8000H (CRTC)
V - Show ROM version
^C aborts command entry
```

```
:
```

Executing Code and Breakpoints

Set a RST 7 instruction into memory and jump to it.

```
: S8000(CR)
8000 00 FF
8001 00 .
: D8000 800F(CR)
8000 FF 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   ................
: G8000(CR)
GO 8000 ?Y
*** RST 8001

:
```

*Using SysPort on */83 Models*

Initializes the PIO channel A for use as the sysport, then alternately selects drive B and drive A.

```
: O 1C 81(CR)       (make certain BANK stays on)

: O 1D CF 8(CR)     (init and activate PIO ch A)

: O 1C 82(CR)       (turn on drive B LED)

: O 1C 81(CR)       (turn on drive A LED)

: O 1C 80(CR)       (turn off both LEDs)
```

CRTC 6545 Testing

The CRT Controller chip, 6545 or sometimes 6845E, exists only on models */84 and 10. It powers-on and RESETs to a state where the video is disabled. The following commands may be used to initialize the core video functionality, and test for the “update” status (which is used to read/write the video RAM). The first command initializes the CRTC and enables video. After this command, the display should light up and be filled with random/garbage characters (whatever is in the video RAM after power-up). The second command runs a quick test to see if the video update status bit is working. In the case that it is not working, the command will hang. Pressing any key should abort and get back to the monitor prompt.

```
: N CRTC(CR)        (display should light up)
: T CRTC(CR)
Wait... Update Update Update
:
```

Keyboard Testing

The keyboard uses SIO channel B on the same Z80-SIO chip as this monitor port is using, so that part is likely to also work. However, the keyboard itself may be tested by initializing the SIO port and running a test that will show the received codes for keys pressed on the keyboard. The keyboard initialization is slightly different for */83 models, so use the appropriate command syntax for the Kaypro model being tested. The Kaypro keyboard contains the “beep” functionality, which is activated

by sending a Ctrl-D character out to the keyboard. This can be tested using the Output command as shown in the example.

```
: N KB84(CR)          (initialize keyboard port on */84 and 10 models)
: T KBD(CR)           (start keyboard test, press keys on keyboard)
Wait... 61 73 64 66 77 65 65 72 F3 F4 (CR)Abort
: O 05 04(CR)
                      (keyboard beeps)
:
```

Memory Test ROM

The memory test binary image may be downloaded here: http://sebhc.durgadas.com/kaypro/memtest.bin. This image does not depend on RAM to run (uses no stack or RAM variables) nor does it use the serial port. It does a memory test in the range 8000H-FFFFH and will alternate drive A and B LEDs (*/84 and 10 models) or cycle through ‘0’ to ‘9’ in the first character of the display (*/83 models). If a memory error is detected, it will flash the drive A LED or alternate ‘E’ and ‘R’ in the first character of the display (depending on the Kaypro model).