



This article was published in issues #106 & #107, Aug & Oct 2006

# ZPC

## ZPC v4.0 Z-100 PC Emulator

By Steven W. Vagts  
Editor, "Z-100 LifeLine"

### ZPC v4.0 Z-100 PC Emulator

Originally developed by Patrick Swayne of the Heath Users' Group (HUG), ZPC has been modified several times over the years to take advantage of monitor ROM enhancements and Z-100 software improvements.

This software and documentation is copyrighted material originally written by Patrick Swayne and modified for use with the Z-100's monitor ROM v3 by Robert Donohue and Paul Herman. It was later modified again by John Beyers for use with the latest Monitor ROM (MTR-ROM or ZROM) v4 and Z-DOS v4.06.

Originally sold under license from HUG, it is now provided to those persons who have purchased the newer monitor ROMs.

#### Section 1 -- Introduction

ZPC is a background utility that uses software to emulate certain features of an IBM PC or compatible computer on a Heath/Zenith H/Z-100 computer. It allows the H/Z-100 to run many IBM PC and compatible programs that it could not normally run.

ZPC emulates the color/graphics adapter card, monochrome adapter card, keyboard, printer I/O, and I/O of the IBM PC.

**Note:** For the purposes of this documentation, all IBM PC compatible computers produced by Heath or Zenith, including the H/Z-150 series, H/Z-160 series, Z-138, Z-148, etc., sometimes referred to as the "Z-100 PC series", will be designated "Z-150" in this document. The H/Z-100 dual processor computer series will be design-

ated "Z-100". Programs designed for use on a Z-150 or IBM PC computer will be referred to as "IBM PC programs" or just "PC programs".

**Note:** Before you attempt to use ZPC, you should be familiar enough with your computer and operating system that you can copy files, make system disks, run programs, etc. If you come across a term in this document that you are not familiar with, and it is not defined in this document, chances are that you will find it explained in your MS-DOS user's manual.

**Note:** A software version of this document has been included with ZPC on the Z-DOS v4.06 distribution disks as "ZPC4.DOC".

#### System Requirements:

In order to make best use of improvements in ZROM and Z-DOS, ZPC has become very BIOS specific. The version of ZPC distributed with Z-DOS v4.05 can only be used with that version of DOS. This version of ZPC requires Z-DOS v4.06 and MTR-ROM v4.3 or later.

The computer must have at least 768k RAM, so memory management works (altered arena headers). The Video Board must be fully populated with 64k chips so paging will work.

**Note:** A small version of ZPC (for machines with less than 768K of RAM) is no longer supported. See "**ZPC Memory Usage**" in the Technical Section of this document for an explanation as to why 768K of RAM is required.

**Note:** If you have more than 768k of addressable memory in your system, earlier versions of ZPC would not work properly, because any memory beyond 768k overlapped video memory. This limitation has been corrected in the present version, as long as the extra RAM is installed as a RAM drive. For example, ZPC itself has been

run successfully while temporarily loaded on a 256K RAM disk. For an explanation on using a modified Z-205 card as a RAM disk, see the article entitled "**Z-205 RAM Disk**" on this Website.

#### **ZPC Hardware Requirements:**

There are several hardware enhancements that were made during the development of ZPC. The first was the ZHS (ZPC Hardware Support) Board, also developed by Patrick Swayne. This hardware circuit was also incorporated in the subsequent "Scottie Board".

Modifications were also made to the Z-100's video and mother boards to improve the Z-100's PC-emulation. These modifications were addressed in an insert entitled "**SCOTTIE BOARD PC-emulation for the Z-100**" to issue #74 of the "Z-100 LifeLine". Also, look for a future article, "Scottie Board" on the Website.

#### **ZPC Distribution Files:**

SOURCE.ZIP	- Assembly source code
COMMAND.ZIP	- Altered COMMAND.COMs for DOS V3.1, DOS V4.01 and later so "CLS" command will work in both Z-100 and PC modes
CS.COM	- Program to change screen colors in PC and Z-100 modes
DEMO.COM	- Demonstration program
GRAPHIC1.PIC	- Graphic file for DEMO.COM
GRAPHIC2.PIC	- Graphic file for DEMO.COM
PC.COM	- Pgm to enter PC modes 0-7
SCRNCLK.COM	- Clock utility
Z-100.COM	- Program to exit PC modes and return to Z-100 mode
ZTOPC.COM	- Program to convert Z-100 software so it MIGHT also run in PC modes
ZPC.COM	- The basic defaulted ZPC version for distribution
ZPC_FULL.COM	- A special version of ZPC
ZPC4.DOC	- ZPC v4 documentation

**Note:** Different versions of ZPC.COM are possible, depending upon the configuration you want. These can be delineated by adding a suffix to the ZPC filename, such as ZPCU.COM for UP/DOWN mode or ZPCAHU.COM for ANSI enabled, High Memory, UP/DOWN mode.

#### **Special ZPC:**

ZPC\_FULL.COM - enables MS-DOS access to Memory overlapping Video. This version has the 'USE-HIGHMEM' boolean set to TRUE in COND.ACM. In the default version of ZPC, it is set to false.

Access to High Memory, like a Z-205 card, is normally disabled above "PC" video to provide MS-DOS with an unbroken memory map. It might be possible for some programs to utilize this memory even though MS-DOS does not. This might slow down video writes slightly in certain circumstances.

**NOTE:** If you wish to use this full implementation, rename ZPC.COM to something else and rename ZPC\_FULL.COM to ZPC.COM.

ZPC can now be configured in several different modes to meet your specific software needs by compiling with special options set and saving the filename with specific ZPC+ suffixes. The following modes are available for compiling your version of ZPC. It is recommended that you append one or more of these following letters to the filename, to help you keep the various versions less confusing:

**A** - Shows that the new ANSI driver is included in ZPC. With the new ANSI driver internal to ZPC, programs can position the cursor, set screen colors, change video modes, remap the definition of the keyboard, and clear the screen with "ESCAPE sequences" using only DOS character output.

**D** - Indicates that the code for Dual Color Black and White has been included. This will slow down all screen I/O considerably, but looks nicer in modes 0,2, and 7.

**H** - Indicates High Memory support. Access to High memory, like a Z-205 card, is normally disabled above "PC" video to provide DOS with an unbroken memory map. It might be possible for some programs to utilize this memory even though DOS does not. This will slow down video writes slightly in certain circumstances.

**F** - Indicates Interrupt 10h, function 0FEh and 0FFh support.

**5** - Shows 50 line mode support.

**L** - Indicates ZPC will load itself into high memory if it finds memory @ 0F000h 0F800h.

**M** - Indicates the internal MOUSE driver code has been included.

**P** - Indicates PC mode Mouse Driver only (Z100MOUSE=FALSE).

**S** - Shows that the Screen Clock code has been included.

**T** - Indicates that the PC hardware and software Timer Interrupts are in ZPC and therefore can not be in the BIOS (IO.SYS). These can only be removed from ZPC if you have a new version of BIOS that has been compiled with PCTIMER=TRUE in the file PARMS.ASM.

**U** - Indicates the UP/DOWN keyboard is being used.

**Z** - Indicates that the code for the ZHS (ZPC Hardware Support) board supporting Video and Keyboard Port addressing has been included. It does not hurt to have this code if you do not have the ZHS board (it only takes up memory).

Each of these options can be turned on or off in COND.ACM and affects the amount of memory required, and the speed of all screen I/O. There are further explanations in the file COND.ACM, for those who are interested.

#### New Features:

\* DOS handle and string functions 9h and 40h now write a complete line of text directly to PC video memory before a screen update is performed. This results in noticeably faster screen I/O, especially with the DOS "TYPE" command.

\* Earlier versions had a problem with the display of characters when the background color was the same as bright foreground color. A character is now correctly displayed on the screen using its correct background color.

\* ZPC now has its own internal MOUSE driver in both Z-100 and PC modes. This eliminates the need for both ZPCMOUSE and ZMOUSE and the overhead that was associated with them.

In fact, most software that uses a mouse will run faster in PC modes now, because the MOUSE driver helps optimize the frequency of screen updates. The software will usually have an option for "MOUSE.COM"; this is what you will need to use. You may select from the setup screen; Serial Port B(J2), Serial Port A(J1), Scottie COM1, or Scottie COM2. For Port A(J1) you will need a "null modem gender changer". You also select a 2 button MicroSoft compatible or 3 button PC mouse (most others) from the setup screen.

It is NOT necessary to run CONFIGUR.COM to set up the AUX port in order for Port A(J1) to be selected. This allows you to connect your modem to the "AUX" port and your mouse to the other serial port.

ZPC also now supports a software TEXT sprite for the mouse in Z-100 mode. If Z100MOUSE has been set to FALSE, ZPC only traps the serial port and INT 33h when in PC modes, so another mouse driver may be used in Z-100 mode, but it will need to be loaded BEFORE installing ZPC.

In TEXT modes, PC software can select either a "software" or "hardware" mouse sprite (via an INT 33h function). If the PC software selects the "hardware" option, the Z-100 hardware cursor is used. Otherwise, the MOUSE driver "writes to PC video memory" the user selected software shape.

Since the default software text shape is identical to the Z-100 hardware cursor, in 80 CPL text modes you may map this default selection to the Z-100 hardware cursor from the setup screen. This will speed up the movement of the sprite, as no writes to PC video memory are necessary.

In all cases where the Z-100 hardware cursor is used for the sprite, you may also select whether it should blink or not from the setup screen.

\* It is no longer necessary to load a separate ANSI driver for ZPC.

With the new ANSI driver internal to ZPC, programs can position the cursor, set screen color, change video modes, remap the definition of the keyboard, and clear the screen with "ESCape sequences" using only DOS character output.

For example, the DOS command:

```
ECHO {ESC}[2J{RETURN}
```

will clear the screen and the DOS command:

```
ECHO {ESC}[0;133;"dir";13p{RETURN}
```

will remap the F11 key to display the contents of the current default directory.

The command:

```
ECHO {ESC}[0;133;0;133p{RETURN}
```

will reset function key F11.

See your DOS documentation for a complete list of commands.

When ANSI is included, it is always enabled just like on a real PC machine. This doesn't decrease the speed too much, but does add to the memory requirement (about 1K plus the size of the keyboard remapping buffer). This is a totally separate ANSI driver from the one now included in BIOS.

**Note:** You may still use a separate ANSI device driver in Z-100 mode via the CONFIG.SYS "device=" command.

\* ZPC now provides the user with a separate DOS "PROMPT" in PC modes. It searches the "system environment" each time you enter/exit modes, and remaps the PROMPT definition (use the DOS command "SET" to look at the current definitions). To get a separate PC prompt, you will need to set an environment variable called PCOMPT with a DOS command while you are in Z-100 mode. For example:

```
SET PCOMPT=$p$g{RETURN}
```

**Note:** A more complicated PC prompt is possible with the new ANSI driver installed. For example, the DOS command:

```
SET PCOMPT=$e[s$e[1;81f$e[11D  
$e[7m$t$e[7m$e[u$p$g{RETURN}
```

will display the time in reverse video in the upper right hand corner of the screen, as well as the default drive and directory in the normal manner.

If you need to increase the default amount of environment space allocated by DOS, you can add the command:

```
SHELL=\COMMAND.COM /P/E:#
```

to your CONFIG.SYS file; where # is for the number of 16 byte paragraphs you want. The default value is 10.

\* ZPC can now be configured in several different modes to meet your specific software needs by compiling with special options set and saving the filename with specific ZPC+suffixes. The additional letters define the options that have been included at compile time.

For example,

**A** = ANSI support included inside ZPC  
**D** = Dual Color Black and White support  
**H** = High Memory Available  
**F** = Int 10h Functions 0FEh and 0FFh  
**5** = 50 line support  
**L** = Load ZPC high if possible  
**M** = Mouse driver in ZPC both PC and Z-100 modes  
**P** = PC mode Mouse Driver only  
**S** = Screen Clock in ZPC  
**U** = UP/DOWN Keyboard Mode  
**Z** = ZHS Video and Keyboard support

\* I/O redirection (a feature of MS-DOS v2 and above) was disabled in earlier versions of ZPC, while ZPC was in the PC mode. You had to return to the Z-100 mode when you wanted to use that feature. I/O redirection now works properly in both modes.

\* All NUM PAD function keys are activated to work on a memory buffer of commands for DOS command line template editing:

**PAGE UP** goes to the first command  
**PAGE DOWN** to the last  
**UP ARROW** to the previous  
**DOWN ARROW** to the next  
**HOME** = CTRL-U  
**END** = F3  
**LEFT ARROW** = BACKSPACE  
**RIGHT ARROW** = F1

\* DOS screen I/O has been improved when BREAK is OFF and the CONSOLE is in BINARY/RAW mode.

\* CTRL-C now works correctly on BATCH files.

\* ZPC now includes a "Z-100 print screen", as well as the PC print screen routine, so it is no longer necessary to load PSC for Z-100 print screen to work. This feature can be disabled in COND.ACM, or replaced by loading a subsequent print screen utility after ZPC is loaded, as it uses INT 5 to trap the request.

**Note:** Several keys have changed in ZPC:

- + The **PRINT SCREEN key** is now {SHIFT}-{F0}.
- + The **SCROLL LOCK key** is now {BREAK}.
- + The **NUM LOCK key** is now {HELP}.

\* SCROLLING has been changed to modify the CRTC. When a program uses a status line (top or bottom), the screen is still shifted and the unchanged lines are rewritten. PAGING is activated in mode 7 (if anyone tries to use it) and now uses both pages of Z-100 video memory, if the CRTC has not been modified.

\* INT 10h routines now properly write to and scroll on non-active pages.

\* In Graphics Modes 4-6, 8 scan lines are programmed in the CRTC, not 9. This allows for shifting of the CRTC in scrolling routines.

**Note:** If your screen is not steady, try changing the default RASTER ADJUST value from 6 to any value between 0 and 1Fh with ZPC/s.

\* The screen is now updated from "Top to Bottom", not every other scan line.

\* Setting the "Background color" in mode 6 now correctly changes the foreground color displayed.

\* In COND.ACM you may now set a visible graphics cursor in DOS only (DEFAULT).

\* The "BIOS DATA" area has been expanded and now includes more information and the PC Keyboard buffer. This allows many more PC TSR programs to work.

\* DEMO has been changed slightly to allow palette and background color changes with the function keys. It also turns on the mouse so you can move it around on the screen. ZPC must contain the new ANSI driver for it to run properly.

\* ZPC now performs a faster clear screen procedure. Instead of writing 0's to all memory locations, ZPC now modifies the video registers to perform a "hardware" clear screen.

\* INT14h supports 5 serial ports, COM1 - COM5. If a Scottie Board exists and contains both serial ports, then COM1 and COM2 are the Scottie Board's COM ports and COM3, COM4 and COM5 are the BIOS's Logical Devices AUX, COM1 and PRN. If the Scottie Board only contains one serial port, then COM2, COM3 and COM4 are the BIOS's Logical Devices.

\* INT17h now supports LPT1-LPT3, and uses the BIOS's Logical Devices PRN, AUX, and COM1.

\* ENHON.COM and ENHOFF.COM are programs to turn the ENHANCED keyboard emulation ON or OFF without having to run the setup program (ZPC/s). They have been provided only to ease the (E)nabling and (D)isabling of the ENHANCED feature. They do exactly the same thing as the setup screen function. The programs can be used in BATCH files to ensure the keyboard is set correctly for the software that is to be used.

\* CS.COM (source is COLORSET.ASM) is a program to set the foreground, background, or palette colors. Issue DOS command "**CS xy**" where "**x**" is the foreground color and "**y**" is the background color in PC TEXT and Z-100 modes. In graphics, "**x**" is the background color and "**y**" is the palette number. In mode 6, "**x**" actually controls the color of all displayed pixels.

\* ZPC now "remembers" your Z-100 color settings and therefore does not reset to white on black as it used to.

\* ZTOPC.COM is a program that should be used with extreme CAUTION. It is used to convert Z-100 software so it MIGHT also run in PC modes. It will attempt to find far calls to the jump table at the beginning of BIOS and translate them to the actual offsets necessary to allow the program to run in PC modes under ZPC.

**Note:** This will make the software completely BIOS DEPENDENT, so you should be sure to make a copy before you use this program. It will also print a message if it finds possible configuration table lookups. These will need to be patched (if necessary) by you.

The advantage to converting a program is in a case like FORMAT.COM that can be executed from inside PC software, but does not work because of its far calls to the BIOS jump table. It may also fix some Z-100 TSR software so it will work in PC modes. Right Hand Man is the only one tested, and it works well.

To run the program, issue the DOS command:

```
ZTOPC [drive:][path]filename.  
ext{RETURN}
```

Remember the original file will be overwritten if any far calls to BIOS are found, so make a backup before converting it. None of the changes will affect the operation in Z-100 mode, but again the software will only run on the version of BIOS that is loaded when ZTOPC is used to convert the software. If you change versions of BIOS, you will need to start over with the original software and convert it again.

\* **PC.COM PC z{RETURN}** - PC.COM and Z-100.COM now return the current "mode" in the DOS variable ERRORLEVEL. Refer to your DOS documentation on "IF ERRORLEVEL" for a full explanation on how to use ERRORLEVEL in a batch file.

This can be helpful when retention of the current system state is necessary for resetting the mode to its old condition. It is best used when a batch file could be started from either Z-100 or PC modes, and you want to exit the batch file in the same state (Z-100 mode is ERRORLEVEL 255).

Here is an example of a batch file to run XTREE GOLD, which might be started from DOS, a PC program, or a Z-100 program:

```
echo off  
e:\zpc\PC 3  
if errorlevel 8 goto Z-100  
e:\xtgold\XTG/zs  
goto end  
:Z-100  
e:\xtgold\XTG/zs  
e:\zpc\Z-100  
:end
```

#### Known Bugs:

\* Unfortunately, the **LifeLine EEPROM/SCSI controller board** only decodes the lower 8 bits of the port address (0C0h-0C8h), resulting in at least 2 Port conflicts:

The first is with the **Scottie Board Clock** baseport address. The original Scottie Board Clock Base Port Address is 2C0h. A hardware modification is necessary to change the Scottie Board Clock Base Port Address to 220h. This fix was provided in issue #37 of the "*Z-100 Life-Line*".

The second problem is quite severe and will result in the **corruption of the EEPROM on the LifeLine SCSI Controller Board**. When running with ZPC compiled for 50 line mode support, even if you are not in 50 line mode, some programs think we are an EGA monitor, not a CGA. When the program attempts a direct write to an EGA video card (3C0h-3CFh), the EEPROM's data is destroyed and must be re-programmed.

Other unknown affects on the SCSI hard drives are possible, so be careful. No one has been able to fix this problem with the LifeLine EEPROM/SCSI controller board.

\* Sometimes, in repeated remove, recompile, and install processes, one handle is lost (but not always). This one has not been figured out yet, but has not happened in a long time, so it may have been inadvertently fixed with other changes.

## Section 2 -- Installation & Operation

### Installing ZPC:

The defaulted version of ZPC.COM now runs in the UP/DOWN mode.

If you wish to tailor your version of ZPC to better meet your needs:

- Remember, never modify files directly on a distribution disk. Copy the files to a working disk or hard disk BEFORE making modifications.
- Select the modes desired in the ZPC.ASM file, and reassemble. Name the file using the above codes to differentiate the various versions.
- Then issue the following DOS command:

```
[drive:][\path]ZPC or  
[drive:][\path]ZPCxx
```

(where **xx** represents a special version)

- Prepare a system (bootable) disk and copy the ZPC.COM file to it. Also copy PC.COM, Z-100.COM, and SETZPC.COM from the ZPC distribution disk to the new system disk. Label the new disk "ZPC System Disk". If you have a Winchester disk, you can copy the above files to a directory on it instead of preparing a ZPC system disk.

### Initial ZPC Run:

Boot up your ZPC system disk or log onto the hard disk directory containing ZPC, then run ZPC.COM by entering:

```
ZPC{RETURN}
```

at the system prompt.

**Note:** The braces {} here, and in other locations where they are used, indicate a single key press of that name.

### Setup Screen:

If this is the first time you are installing ZPC, the computer displays the first line in double-high, double-wide letters:

```
-ZPC FIRST TIME INSTALL-
```

followed by:

```
Searching MTR ROM for Z-100 CHARACTERS  
The NUM LOCK KEY is HELP, the SCROLL LOCK  
KEY is BREAK.  
You will need to "WRITE CHANGES TO DISK"  
to eliminate this procedure.  
Type "ZPC/r" to remove, "ZPC/s" to set  
DEFAULT conditions.
```

Please

and the computer continues with the display of Figure 1, the ZPC Default Settings:

```
~~~~~  
SET DEFAULT CONFIGURATION VARIABLES FOR ZPC
```

```
Default video MODE is          3 -- 80 column color.  
BLINKing video emulation is    Enabled.      Mode   Default Foreground Color  
Graphic mode CURSOR is        Disabled.    0      White  
Non BLINKing CURSOR is        Disabled.    1      White  
Default NUM LOCK State is     Off.        2      White  
Current RASTER ADJUST value is 02H         3      White  
ANSI emulation is             Enabled.    6      White  
Current PRINT SCREEN Key is    SHIFT-F0   7      White  
Current PAGE UP Key is CONTROL-^, and SOFTWARE INTERRUPT Key is CONTROL-_  
Current MOUSE is 2 Button Microsoft. Serial Port B(J2). Z-100 mouse ACTIVE  
SCREEN CLOCK is Enabled at COL 48h, STATUS LINE is Enabled at COL 26h.  
Timer Freq's: TextLOW: 04H TextHIGH: 0BH GrLOW: 07H GrHIGH: 16K GrMODE6: 07H  
Current PSD - Current MTR Print Screen Device    HIGH IBM CHARACTERS Disabled.
```

```
Hit the letter or number highlighted, RETURN for no change, CTRL-C to exit.  
Enter default video MODE (0-7): _
```

**Figure 1. ZPC Default Settings**

```
~~~~~
```

Next, you are given the option of changing some of these default conditions to make best use of your particular Z-100 configuration and to tailor the ZPC installation to your particular preferences. It is not necessary to change any of them if you do not want to. Simply press {RETURN} to all the questions. As you answer each one, the next configurable parameter is asked.

The process begins with the parameter posed in Figure 1:

*Enter default video MODE (0-7):*

This is the mode that will be used if no mode is specified when switching to PC modes. The default is Mode 3 -- 80 column color.

*Enable/Disable BLINKing video emulation:*

This will enable a dotted line under a character to indicate a "blinking" attribute.

*Enable/Disable Graphic mode CURSOR:*

Enable this if you always want a cursor in modes 4,5,6. You may keep this disabled and still have a cursor in DOS command line editing.

*Enable/Disable NON BLINKing CURSOR:*

Enabling this will cause the cursor to remain always on.

*Enter default NUM LOCK State (0=Off, 1=On):*

Set this for the condition you would like when PC modes are first entered. A blinking line in the upper left corner now indicates that NUM LOCK is active.

*Change GRAPHICS RASTER ADJUST (Yes/No)?*

If you press {Y}, the computer displays:

*This value controls register 5 on the CRTIC. When ZPC is in graphics modes the CRTIC is reprogrammed to display 8 scan lines instead of 9. Sometimes this causes "screen wiggle". You may use this value to try and fix it. Input HEX VALUE(00-1F) for RASTER ADJUST (CR for NO CHANGE)*

If your screen is not steady, try changing the default RASTER ADJUST value from 6 to any value between 0 and 1Fh.

**ANSI** emulation is Enabled - While this is listed in the table, it is not a parameter to change, so there is no question pertaining to it. It is only an indicator for showing whether or not the new ANSI driver has been included in the currently loaded version of ZPC.

*Change default MODE COLORS (Yes/No)?*

If you respond {Y} here, the computer displays:

*What MODE for color chg (0-3,6,7,CR when DONE)?*

Responding with any number 0-7, causes the question:

*New PC Color # (1-7)?*

to be added on the same line. These questions allow you to select the default foreground color that you want for each mode. Use PC color values which are:

1 = Blue	2 = Green
3 = Cyan	4 = Red
5 = Magenta	6 = Yellow
7 = White	

**CAUTION:** Do not choose 0 (Black) or there will be no display.

**Note:** In color TEXT modes 1 and 3, the Default Mode Color just sets the initial color. Modes 4 & 5 use default Palette 1.

The same questions are posed until you press {RETURN} so you can change any or all of the values.

*Change MOUSE settings (Yes/No)?*

Pressing {Y} here causes the computer to respond with:

*ZPC now has an internal mouse driver. It traps the Z-100 Hardware Serial Interrupt and Interrupt 33H in both Z-100 and PC modes. All mouse drivers that are installed before ZPC will be inactive until ZPC is removed. For more information on the mouse driver see the ZPC4.DOC file. Serial Port A(J1), B(J2) COM1 or COM2?*

This is where you select Serial Port A(J1), Port B(J2), COM1, or COM2 on the Scottie Board to let ZPC know where your mouse is plugged in. Upon a response, the next question is:

*Microsoft 2 button or PC 3 button MOUSE?*

Select whether you have a 2 button MicroSoft compatible, or a 3 button PC mouse. Upon pressing a {2} or {3}, the computer asks:

*Map software 80 CPL TEXT sprite to Z-100 HARDWARE CURSOR (Yes/No)?*

Here, you have the option of mapping the default TEXT sprite to the Z-100 hardware cursor. If you respond {Y}, the computer asks whether you would like it to blink or not:

*Mouse BLINKING hardware sprite (Yes/No)?*

Upon responding, you are next asked:

*Change default TIMER FREQUENCY'S (Yes/No)?*

If you press {Y}, the computer adds:

*The rate at which the screen is checked for changes in PC modes is now adjustable by the user. This will allow many programs to run faster if they are CPU intensive. There are*

two values to set. The first is the number of clock tics (each tic is 1/60th of a second) before the next check after a change is detected. The second value (HIGH value) is used as a upper limit when no changes have occurred for awhile. Each time the screen is checked and no change is detected, the clock check value is incremented until the HIGH value is reached. If the HIGH and LOW values are set to the same value this feature will be effectively disabled. In High Resolution Graphics mode 6 only one value is necessary because the screen is completely rewritten at this regular interval. The original ZPC values were about 4 for TEXT modes and 7 for GRAPHICS modes. Values above F0h might disable all checks.

Timer Freq's TextLOW: 04H TextHIGH: 0BH  
GrLOW: 07H GrHIGH: 16H GrMODE6: 07H

Input HEX Value (00-F0) for TEXT LOW  
(CR for NO CHANGE)

The Timer Frequency option has been added in an effort to speed up software that is CPU intensive, like a spreadsheet program doing many recalculations. Use these values to control the frequency of screen checks by the timer INT 50 routine.

As you enter a HEX value or {RETURN}, each of the following questions is asked in succession:

Input HEX Value (00-F0) for TEXT HIGH  
(CR for NO CHANGE)  
Input HEX Value (00-F0) for GRAPHICS LOW  
(CR for NO CHANGE)  
Input HEX Value (00-F0) for GRAPHICS HIGH  
(CR for NO CHANGE)  
Input HEX Value (00-F0) for MODE 6  
(CR for NO CHANGE)

The LOW value is used after a change has been detected. The value is then incremented when no change is detected, until the HIGH value is reached. If the LOW value and HIGH value are the same, screen updates will occur at regular intervals.

**Note:** Mode 6 has only one value because no check is made for changes. The screen is completely updated at the rate indicated. Each count is 1/100th of a second.

Change MODE MAPPING (Yes/No)?

If you press {Y} here, the computer displays:

This function is primarily intended to replace the need for the TSR program M2TO3, which mapped black and white mode 2 to 3 and mode 0 to 1. ZPC can now be used to map any mode to any other mode. Remember, mode 7 can not be used unless it is the first mode selected when switching from Z-100 mode.

Original MODE	0	1	2	3	4	5	6	7
Mapped to	0	1	2	3	4	5	6	7

What MODE to change (CR when DONE)?

After pressing any number 0-7, the computer further asks:

New MODE (0-7)?

Again, after pressing a number 0-7, the computer repeats the first question until you press {RETURN} for no more changes.

Change SCREEN CLOCK options (Yes/No)?

Pressing {Y} here causes the computer to display:

A Screen Clock is now included with ZPC to eliminate the need for a separate TSR program and to ensure it works properly in both Z-100 and PC modes. It traps Interrupt 28h and checks the time with a call to BIOS. You can configure ZPC to ENABLE or DISABLE the clock upon installation, whether to check for and use the Status Line in Z-100 mode, and which columns the clock should use. After installation, the Screen Clock can be enabled with the command "SCRNCLK" or disabled with "SCRNCLK ?" (anything on the command line will do).

SCREEN CLOCK is Enabled at COL 48h,  
STATUS LINE is Enabled at COL 26h.

Enable or Disable SCREEN CLOCK on install?

If you press {E} to Enable, the computer asks, in sequence:

Input HEX VALUE (00-48) for COLUMN at TOP  
(CR for NO CHANGE)  
Input HEX VALUE (00-48) for COLUMN at BOTTOM  
(CR for NO CHANGE)  
Enable or Disable STATUS LINE clock if Screen Clock Enabled?

Change Print Screen Device (Yes/No)?

If you press {Y} here, the computer displays:

Current PSD - Current MTR Print Screen Device  
HIGH IBM CHARACTERS Disabled.  
You now have several options for which device to use when Print Screen (sF0) is selected. If MTR Print Screen Device is selected, no call to BIOS is made so its buffers are not in effect.

Please choose one of the following options:

- 0 - Current MTR Print Screen Device
  - 1 - INT 17h LPT0 - BIOS PRN device
  - 2 - INT 17h LPT1 - BIOS AUX device
  - 3 - INT 17h LPT2 - BIOS COM1 device
  - 4 - INT 14h COM1 - Scottie Board COM1
  - 5 - INT 14h COM2 - Scottie Board COM2
  - 6 - INT 14h COM3 - BIOS AUX device
  - 7 - INT 14h COM4 - BIOS COM1 device
  - 8 - INT 14h COM5 - BIOS PRN device
- What Print Screen Device (0 - 8)?

This option allows you to choose what port you would like Print Screen (Shift-F0) to use. This has been added to allow changes in "PC" modes that do not affect what happens in "Z-100" mode.



**Note:** Choice 0 will cause Print Screen to function just as it does in Z-100 mode, by using the current MTR-ROM Print Screen Device. If this choice is made, the BIOS buffers selected by CONFIGUR will NOT be in effect. Each of the other choices will use either PC interrupt 14h (Serial) or 17h (Parallel) so TSR programs like PRINT can have knowledge of the pending character output request.

When you respond, the computer displays:

```
Use HIGH IBM CHARACTERS on Print Screen
Device (Yes/No)?
```

You may choose to send the full PC character set to the Print Screen Device, as many new printers have all 256 characters in their standard font.

The last question is:

```
Write changes to DISK?
```

You will need to answer {**Y**} to eliminate the setup screen from the NEXT installation process.

Once all the parameters have been reviewed, ZPC will complete the installation and indicate that it has installed itself. ZPC will remain installed until you reboot your computer or you run "**ZPC/r**".

After the initial installation, any time that you reboot and you need to use ZPC again, just enter the command:

```
ZPC{RETURN}
```

at the system prompt. The computer will respond with a simple report:

```
ZPC Version B4.06 is now installed.
Copyright (C) 1986 by Heath/Zenith
```

If you were to run ZPC again, after either installation, you would be greeted with a message that indicates the status of all the configurable options. For example, if you left all the default options on the initial installation, running ZPC would report the following:

```
ZPC is already installed.
With ANSI driver.
With HIGH MEMORY available.
With INT 10h functions 0FEh and 0FFh.
With 50 LINES per screen capability.
With MOUSE driver in Z-100 and PC modes.
With Load ZPC into F000-F800 if possible.
With SCREEN CLOCK.
With UP/DOWN keyboard support.
With ZHS support.
Type "ZPC/r" to remove, "ZPC/s" to
set DEFAULT conditions.
```

Even though ZPC is now loaded, however, the system is still in the Z-100 mode at this point.

#### **ZPC/s Setup Command:**

SETUP can also be accessed by the command "**ZPC/s**". This enters the same routine as the Initial ZPC Installation, beginning with the display of Figure 1 and the same configuration questions.

This also permits us to use redirected input to set everything from the command line. For example:

```
ZPC/s <FILENAME.EXT{RETURN}
```

Here the /s switch sets certain parameters in ZPC from a file, filename.ext. All line feeds are ignored and SETUP is terminated if it detects a CTRL-C or CTRL-Z.

#### **ZPC/r Command:**

ZPC is now removable from memory with the command "**ZPC/r**", so you can actually use the version of ZPC that is compatible with the software you are running.

#### **PC Mode:**

Before running a PC program on the Z-100, ZPC must be loaded and the IBM PC mode must be selected. To select the IBM PC mode, run PC.COM by entering:

```
[drive:] [\path]PC{RETURN}
```

at the system prompt. The screen will clear, and the system prompt will appear in the upper left corner of your screen.

The character font will be the same as that used in Z-100 mode, but the cursor will be a double underline.

With ZPC in the PC mode, you can now run the demonstration program provided with ZPC. It is a very impressive program that shows the full text and graphics capability of the Z-100 in the PC mode. You won't want to skip this. To run the demo program, use the command:

```
[drive] [\path]Demo{RETURN}
```

at the system prompt.

**Note:** Earlier versions of ZPC required that ANSISYS, an ANSI driver program, be loaded to enable ANSI ESCape sequences. MTR-ROMs versions 3 and higher now recognize these ANSI ESCape sequences and ANSISYS is no longer required.

While the demo runs, press the space bar or another key to continue the program whenever it pauses.

Once you have completed working with the PC program or application, to return your H/Z-100 to the Z-100 mode of operation, issue the command:

```
[drive] [\path]Z-100{RETURN}
```

or

**[drive][\path]PC Z{RETURN}**

at the system prompt. The screen will clear and the cursor appearance will return to normal.

**Note:** Do not attempt to run Z-100 specific programs while you are in the IBM PC mode. You should especially avoid running FORMAT or DISKCOPY while in the PC mode. Return to the Z-100 mode first, then run any Z-100 program.

**Automatic ZPC Installation:**

If you wish, you can install ZPC automatically when you boot your computer by including a line containing:

**ZPC**

in your AUTOEXEC.BAT file.

**Section 3 -- Video Emulation, Emulation Control**

**Selecting PC Video Modes:**

The PC.COM program, which is used to select the IBM PC operation, can also select the various video modes supported by the color/graphics adapter. To select a specific mode, enter:

**[drive:][\path]PC [n]{RETURN}**

at the system prompt. The letter **n** represents the number of the mode desired. The square brackets **[]** show that inserting a number is optional.

The supported modes are:

<u>Mode#</u>	<u>Mode</u>
0	40 column text, monochrome (or black & white)
1	40 column text, color
2	80 column text, monochrome
3	80 column text, color
4	320 x 200 graphics, color
5	320 x 200 graphics, color
6	640 x 200 graphics, monochrome
7	Monochrome Video Card Mode

Running PC.COM without specifying a mode number will enter the PC mode, using the default video mode. As supplied, the default mode is 3, 80 column text, color.

If you are already in the PC mode, and you run PC without specifying a mode number, it will indicate what the current mode is, and not change anything.

**Note:** To use mode 7, you must be in Z-100 mode before issuing the command "**PC 7**". This is because less memory is reserved by ZPC in modes 0-6 (31K more is available for the user).

If you need help remembering the mode options, a table of all the valid video modes will be displayed, along with a description of each mode, if you type:

**PC ?{RETURN}**

at the DOS prompt while in PC mode.

Most IBM PC programs that require a video mode other than the default mode will set that mode themselves, and restore the default mode when they exit. However, if a program does not restore the default mode, you can run PC to restore it. If a program alters some other display factor, such as leaving the cursor turned off, you can still restore things by running PC (with a mode specified).

**Special Video Attributes:**

When a Z-150 or IBM PC is operated in a text mode, it can support intense video and blinking attributes. The upper 8 of the 16 colors supported in the text modes are the lower 8 with the intense attribute set. In the color text modes, ZPC emulates intense colors by mixing white and color pixels. This is illustrated in the demonstration program provided with ZPC.

ZPC interprets some of the video modes differently from the Z-150. On a Z-150, the monochrome text modes are identical to the color text modes, and can produce color displays. The monochrome modes are a carry-over from the IBM PC, which could support output to a black and white television set. However, neither the Z-100 nor the Z-150 were designed to use a television set for their display.

In the ZPC monochrome text modes, all combinations of foreground and background colors are translated to light color on a black background, or black against a light background. If you have color memory in your computer, the light color will be green or yellow (configurable) for normal colors, and white for intense colors. If you do not have color memory, the light color will always be white.

The monochrome text modes run faster than the color text modes, so if you want a program such as a word processor to write to the screen faster, set one of the monochrome text modes.

The two 320x200 graphics modes in ZPC are identical, and both can produce color displays. This is the way the Z-150 works. As with the monochrome text modes, the monochrome 320x200 mode was originally provided to support a black and white television set.

When ZPC is in the monochrome card emulation mode (mode 7), it works like the 80 column monochrome text mode, except that the underlining attribute is supported.

## Section 4 -- The Keyboard

### UP/DOWN ZPC Key Definitions:

With the implementation of the UP/DOWN keyboard in PC modes, the key definitions have been changed to more closely resemble a PC keyboard. Hopefully all PC keycodes to emulate the enhanced 101 keyboard are now possible.

With a few exceptions, all labels on the Z-100 keyboard now correspond to their PC counterparts. CONTROL, SHIFT, and ALT now function as they should, you simply hold down the key like you normally do in Z-100 mode. CAPS LOCK now also functions as on a PC, if the CAPS LOCK is depressed and a shift key is also depressed, a lower case character will now be displayed. It is no longer necessary to turn off enhanced keys.

Z-100 keystrokes required for the PC keys that do not exist on the Z-100:

<u>PC Key:</u>	<u>Z-100 KEYSTROKE(S):</u>
Left Alt	FAST REPEAT
Right Alt	LINE FEED
Num Lock	HELP
Ctrl-Num Lock	CTRL-HELP(Pause Screen Display)
Scroll Lock	BREAK
Ctrl-Break	CTRL-BREAK(Interrupt Pgm Exec)
Print Screen	SHIFT-F0
NUM PAD *	F0
NUM PAD +	SHIFT-NUM PAD -
NUM PAD /	SHIFT-NUM PAD ENTER
en End	SHIFT-HOME
en Page Down	INS LINE
en Page Up	DEL LINE (SHIFT-INS LINE)
en Insert	I CHR
en Delete	DELETE or D CHR (SHIFT-I CHR)

Normal and Enhanced NUM PAD cursor control  
(CTRL & ALT definitions)

Enter	RETURN
Ctrl-Enter	CTRL-RETURN
Ctrl-Shift-Enter	CTRL-SHIFT-RETURN
Alt-Enter	(FAST REPEAT or LINE FEED)-RETURN
NUM Enter	ENTER
Ctrl-NUM Enter	CTRL, ENTER
Alt-NUM Enter	(FAST REPEAT or LINE FEED)-ENTER
Home	NUM PAD 7
Ctrl-Home	CTRL- NUM PAD 7
Alt-Home	(FAST REPEAT or LINE FEED)-HOME
en Home	HOME
Ctrl-en Home	CTRL-HOME
End	NUM PAD 1
Ctrl-End	CTRL- NUM PAD 1
Alt-End	(FAST REPEAT or LINE FEED)-SHIFT-HOME
en End	SHIFT-HOME
Ctrl-en End	CTRL-SHIFT-HOME

CTRL and ALT are same as above

Page Up	NUM PAD 9
Page Down	NUM PAD 3
en Page Down	INS LINE
en Page Up	DEL LINE (SHIFT-INS LINE)
Insert	NUM PAD 0 (Toggle typeover)
en Insert	I CHR
Delete	NUM PAD .
en Delete	DELETE or D CHR (SHIFT-I CHR)
Left Arrow	NUM PAD 4
en Left Arrow	LEFT ARROW

Right Arrow	NUM PAD 6
en Right Arrow	RIGHT ARROW
Up Arrow	NUM PAD 8
en Up Arrow	UP ARROW
Down Arrow	NUM PAD 2
en Down Arrow	DOWN ARROW

### UP/DOWN ZPC Notes:

**Note:** Some programs, such as Microsoft Word, handle the state of Num Lock independently of what it might be set to when the program is entered. If you enter Microsoft Word with Num Lock either ON or OFF, Word will consider it to be OFF, and the keypad keys will not produce numbers until you press Num Lock again after entering Word. It works this way under ZPC or on a real PC. Microsoft Word will also NOT allow you to use the separate arrow keys when Num Lock is ON, but when it is OFF, you can use either the 2, 4, 6, 8 keys or the separate arrow keys to move the cursor.

Most programs, however, will allow you to use the separate arrow keys and other separate functions regardless of the state of Num Lock. The state of Num Lock as indicated on the screen will always be a true indication, regardless whether it was toggled by you or a program.

### OLD ZPC Key Definitions:

ZPC can still be compiled without the UP/DOWN keyboard support, although many programs will not work properly. The only reason for running ZPC without UP/DOWN support is when a Z-100 TSR program requiring keyboard input must be accessed in PC modes.

When ZPC is compiled without UP/DOWN support the philosophy of emulating the PC keyboard is still the same as in the ZPC documentation. The {HELP} key is still Alt and the {F0} key is still Ctrl.

The biggest differences are in the Num Lock key, now {LINE FEED}, the Print Screen key, now {SHIFT}-{BREAK}, the Scroll Lock key, now {BREAK}, and the fact that the number key pad now sends the codes for the ENHANCED PC keyboard (0E0h). This enables the F11, F12, and the other enhanced cursor control functions.

This is only important when a program can utilize these enhanced codes. If your program does not perform separate functions for the enhanced cursor control keys you should (D)isable them from the setup screen.

Here is a complete list of the PC keys and the Z-100 key strokes required to emulate them if ZPC is NOT using UP/DOWN mode:

<u>PC Key:</u>	<u>Z-100 KEYSTROKE(S):</u>
Alt	HELP
Num Lock	LINE FEED (Toggle)
Scroll Lock	BREAK (Toggle)
Print Screen	SHIFT-BREAK
	(PC & Z-100 modes)
UNshifted Print Scrn(*)	SHIFT-F0, SHIFT-BREAK
SPECIAL CONTROL	F0 (Function & Cursor ctrl)
SPECIAL SHIFT	SHIFT-F0
	(Unusual key combos)
Shift-Tab (Back tab)	SHIFT-HELP
Ctrl-Num Lock	F0, LINE FEED
	(Pauses all CPU functions)
Ctrl-Scroll Lock	F0, BREAK
	(Execs CTRL-BREAK Int 1Bh)
Alt-Break	HELP, BREAK
	(Clears type ahead buffer)
NUM PAD *	SHIFT-F0, SHIFT-BREAK
NUM PAD +	SHIFT-NUM PAD -
NUM PAD /	SHIFT-NUM PAD ENTER
Ctrl-Backspace	DELETE
Ctrl-[ M J I H 6 2 * Tab	F0, [ M J I H 6 2 * TAB
NUM PAD - + / 5	NUM PAD - + / 5
Ctrl-A thru Z(exc above)	CTRL-A thru Z
Ctrl-Functn Key(F1-F12)	F0, Function key
Alt- / , . \ ; ' ` = - Tab	HELP, / , . \ ; ' ` = - TAB
0-9 NUMPAD - + /	Keybrd 0-9 NUMPAD - + /
Alt-A thru Z	HELP, A thru Z
Alt-Functn Key(F1-F12)	HELP, Function key
Shift-Functn Key(F1-F12)	SHIFT-(F1-F12)
KEYCODES (0-255)	HELP, Decimal Value on NUM PAD, Any other key

Normal and enhanced cursor control  
(CTRL & ALT definitions)

Enter	RETURN
Ctrl-Enter	F0, RETURN
Ctrl-Shift-Enter	SHIFT-F0, F0, RETURN
Alt-Enter	HELP, RETURN
NUM Enter	ENTER
Ctrl-NUM Enter	F0, ENTER
Alt-NUM Enter	HELP, ENTER
Home	NUM PAD 7
Ctrl-Home	F0, NUM PAD 7
Alt-Home	HELP, HOME
en Home	HOME
Ctrl-en Home	F0, HOME
End	NUM PAD 1
Ctrl-End	F0, NUM PAD 1
Alt-End	HELP, SHIFT-HOME
en End	SHIFT-HOME
Ctrl-en End	F0, SHIFT-HOME

CTRL and ALT are same as above

Page Up	NUM PAD 9
Page Down	NUM PAD 3
en Page Down	I CHR
en Page Up	D CHR (SHIFT-I CHR)
Insert	NUM PAD 0 (Toggle typeover)
en Insert	INS LINE
Delete	NUM PAD .
en Delete	DEL LINE (SHIFT-INS LINE)
Left Arrow	NUM PAD 4
en Left Arrow	LEFT ARROW
Right Arrow	NUM PAD 6
en Right Arrow	RIGHT ARROW
Up Arrow	NUM PAD 8
en Up Arrow	UP ARROW
Down Arrow	NUM PAD 2
en Down Arrow	DOWN ARROW

#### OLD ZPC Notes:

The {F0} key is used as a special control and shift key for combinations not normally supported on the Z-100.

For example, if a program required you to press {Ctrl}-{F1}, you should press {F0} followed by the key {F1}, because control-function keys are not directly supported by the Z-100 keyboard. Similarly, if a program asks for {Shift}-{Enter}, you can press {SHIFT}-{F0} followed by the {RETURN} key.

On a Z-150 or IBM PC, the {Alt} key is like a {Shift} key. It is held down while another key is pressed, to produce the alternate code for that key. Under ZPC, the Alt {HELP} key is momentary. It should be pressed and released, and then the second key should be pressed.

For example, if a program asked you to press {Alt}-{F1}, you would press the {HELP} key followed by the {F1} key. The program would "see" the same code as with {Alt}-{F1} on an IBM PC.

A special use of the {Alt} key on an IBM PC is to enter ASCII codes as decimal numbers. If you press the {Alt} key, type a number (0-225) on the keypad while {Alt} is held down, and then release the {Alt} key, that number is sent to whatever program is running (as an ASCII code) as if a key with the same code had been pressed.

Because the emulated {Alt} key under ZPC is momentary, the procedure for emulating that process is a little different. You press the Alt {HELP} key, type the digits on the keypad, and press the {HELP} key again.

For example, the ASCII code for the letter Z is 90 (in decimal). If you press the Alt {HELP} key, type 90 on the keypad, and Alt {HELP} again, a Z will be entered, as if you had actually typed Z.

#### Special Key Combinations:

Figure 2 has a list of special key combinations that you are likely to encounter in various PC programs, and the equivalent keys supported by ZPC while it is in the PC mode.

<u>IBM PC keys:</u>	<u>UP/DOWN ZPC:</u>	<u>OLD ZPC keys:</u>	<u>Notes:</u>
Ctrl-Num Lock	CTRL-HELP	F0, LINE FEED	Note 1
Ctrl-Scroll Lock (Break)	CTRL-BREAK	F0, BREAK	Note 2
Alt-Break	FAST REPEAT-BREAK LINE FEED-BREAK	HELP, BREAK	Note 3
Ctrl-[ Print Screen	CTRL-[	F0, then [ SHFT-F0, SHFT-BREAK	Note 4 Note 5
Shift-Print Screen	SHIFT-F0	SHIFT-BREAK	Note 6
Shift-Tab (back tab)	SHIFT-TAB	SHIFT-HELP	
Ctrl-Return	CTRL-RETURN	F0, RETURN	

Figure 2. Special Key Codes

**NOTES:**

1. This combination suspends program operation temporarily. It can be used like {CTRL}-{S} to suspend listing on the screen, except that it always works, where {CTRL}-{S} might not. After suspending operation, type any key to resume.

2. This combination is used to halt the execution of a program (executes CTRL-BREAK Int 1Bh) and return to the system. You can usually use {CTRL}-{C} instead.

3. This combination empties the type-ahead buffer. The {BREAK} key by itself does this on a Z-100.

4. Control-[ is normally the same as an ESCape, but Control-[ produces a different scan code from ESCape, so you should use {F0} and {[} when a program specifies Control-[.

5. {SHIFT}-{F0}, {SHIFT}-{BREAK} produces an asterisk (\*), the same as the unshifted Print Screen key on a PC. The scan code (a special code generated by each key) is different for this key than for the other asterisk, {SHIFT}-{8}, so you should use {SHIFT}-{F0}, {SHIFT}-{BREAK} whenever a program explicitly specifies the unshifted Print Screen key.

6. This combination dumps the text on the screen to a printer. While ZPC is in the PC mode, this works even if you do not have a screen print utility loaded, but it is only a textual (not graphic) dump. If you want to dump graphics, load a Z-100 (not Z-150) graphic screen dump utility AFTER loading ZPC. But, you must patch it to run under ZPC. Just copy the utility and FIXPSC.COM (from the ZPC disk) to your system disk, log on to it, and enter:

**FIXPSC prog{RETURN}**

where prog is the name of the screen dump utility.

**Keyboard Symbols:**

On an IBM PC, some of the keyboard keys are designated by symbols rather than names. Some programs will use the symbols to designate which key to press. The following chart illustrates the symbols and the keys they indicate.

<u>Symbol:</u>	<u>Key:</u>
<-----	RETURN key
<-----	BACK SPACE key
<----- ----->	TAB key
----->	May be used for TAB key
<-----	BACK TAB

**Command Line Editing:**

ZPC supports PC style (rather than Z-100 style) command line editing with a few changes. The following chart explains the keys used in command line editing with ZPC in the PC mode. You should study the discussion on Command Line Editing in your MS-DOS manual if you do not understand the description in the table.

<u>Key Name</u>	<u>Function Description</u>
<b>F1</b>	<b>COPY1</b> Copies one character from the template.
<b>F2x</b>	<b>COPYUP</b> Copies multiple chars from the template, up to the specified character, x.
<b>F3</b>	<b>COPYALL</b> Copies all characters in template.
<b>DEL</b>	<b>SKIP1</b> Skips (deletes) 1 character in the template. <b>Note:</b> This is the PC Delete key {SHIFT}-{DEL LINE} or keypad {.] with the num lock off.
<b>F4x</b>	<b>SKIPUP</b> Skips (deletes) multiple characters in the template, up to the specified character x.
<b>CTRL-X</b>	<b>VOID</b> Voids the current input w/o affecting the template. In ZPC, the chars on the line

are removed from the screen, and the cursor is returned to the original prompt. You can also use {CTRL}-{U}.

**INS**

**INSERT**

Invokes the insert mode, such that new input does not overwrite any chars in the template. Another press of {INS} will turn the insert mode off.

**F5**

**NEW TEMPLATE**

Creates a new template. The screen indication is the same as {CTRL}-{X}.

**F6**

**CTRL-Z**

Puts a {CTRL}-{Z} (1Ah) end-of-file character in the new template.

## Section 5 -- PC Programs

### Patching PC Programs:

For many reasons most PC programs would not run on a native Z-100, often just crashing or generating the infamous **"WILD INTERRUPT"** messages that scrolled off the screen until you completed a {CTRL}-{RESET}. Over the years and through the efforts of many, software emulation programs, such as ZPC, and hardware emulators, such as the initial ZPC Hardware Support (ZHS) Circuit and PC-emulator boards have been used to remedy this problem.

This section is intended to help those who still have a need to run PC software on the Z-100 and address some of the remaining issues.

While there were several reasons for the PC programs to fail, one of the most popular was because many programs that write to video memory on an IBM PC in one of the color/graphics modes used access ports that do not exist on the Z-100.

ZPC does not require that these ports be accessed in order for the programs to work, so often the code was simply removed in some way or another.

ZPC was able to use software to emulate the PC sufficiently to permit most programs to work, but finally hardware was developed to resolve those differences that software alone was unable to accomplish.

If you purchased or built the ZPC Hardware Support (ZHS) circuit described in REMark Magazine or the better known commercial version known as the **"Scottie Board"**, you could generally run many programs without ZPC and without patching them. Other hardware PC-emulators, such as the **Gemini Board** or **EasyPC**, were also highly successful emulator packages.

Several back issues of the *"Z-100 LifeLine"* listed programs that run under ZPC or one of the emulator cards.

With the improvements made to ZPC, the Z-100 BIOS, and the monitor ROM, most PC programs can now be run successfully on the Z-100 without the expensive, full-blown, PC-emulator systems.

However, most PC programs that run in color text modes will still need to be "patched", if you do not have a ZHS "Scottie Board". If you have ZHS, support programs will run faster if they are patched, even if they run without patching.

The only programs found that will not run without a ZHS board are usually encrypted and therefore can not be patched, but often they will run in mode 7.

**Note:** There are two modifications that are easily made to the Z-100's video and mother boards that also improve the odds of success, whether or not the "Scottie Board" or another ZHS circuit is installed. These modifications were published in an insert entitled **"SCOTTIE BOARD PC-emulator for the Z-100"** to issue #74 of the *"Z-100 LifeLine"*.

But what if you still have PC software that just will not work? Let's discuss some of your options, next. Finally, if the following does not help, see **Section 6 -- Technical Section**, where the configuration problems really get down and dirty.

As mentioned several times already, most "PC" programs now work without patching if you have a ZHS "Scottie Card". However, two common programming conventions in PC programs do not work.

The first is using the keyboard and timer chip to generate sound. Many PC programs use this feature to signal an error. Most programs can be patched to simply ring our keyboard bell.

The second common feature that does not work also has to do with the PC timer chip. Some programs use the PC timer chip to perform a software delay loop, which will result in an infinite loop "lock up". You can tell when this is happening if the program simply stops responding and the system seems dead.

Both of these features are discussed in great detail in Section 6.

**Note:** The current version of ZPC no longer includes patches, because we are uncertain that they would still help, especially with ZPC now running in UP/DOWN mode, and do not have the resources to completely retest all the software. Nevertheless, our discussion would not be complete if they were not mentioned.

The PATCHIT program included with earlier versions of ZPC provided patches for programs that had been tested under ZPC, with notes indicating whether they would run unpatched in the monochrome card mode. It automatically patched certain PC programs for use with ZPC, using a data file named PATCHIT.DAT which held the patch info. See the documentation for the PATCHIT program for more information about using it to make patches. PATCHIT and other programs are available from the **"Z-100 LifeLine Software Library"**.

Once a program was patched and tested, it could be run under ZPC on your Z-100 like any other program, except that you must remember to set the PC mode first.

There are a few programs that could not be patched with PATCHIT.EXE or with other general PATCHER programs. For these programs, special patch utilities had been provided with earlier versions of ZPC. If a program does not run with the present version of ZPC, you might try one of these special patchers, available from the Z-100 Software Library.

To use one of these special patchers, copy it to your system disk, and enter:

```
SPATCH d:programe{RETURN}
```

where:

**SPATCH** is the name of the patcher pgm  
**d:** is the drive containing the program TO BE PATCHED  
**programe** is the name of the program TO BE PATCHED

The following chart lists the special patchers and what they were for.

**PatcherName: Purpose:**

<b>FIXQB.COM</b>	Patches compiled QuickBASIC programs so that they will run under ZPC. Programs must have been compiled with the /O switch.
<b>FIXPSC.COM</b>	Patches Zenith or Clarkson Z-100 graphic screen dump utilities so that they will work with ZPC.
<b>FIXFWII.COM</b>	Patches FRAMEWORK II for use under ZPC. When you run this utility, do not enter a program name ... just the drive containing System Disk 2 of the FRAMEWORK II set. The patch performed by this utility is NOT required if you have the ZHS circuit, but other standard patches are required unless you run in the monochrome card mode.

**Special Considerations:**

Here are some things that you may need to know about some programs you may want to run under ZPC. Remember - some of these may no longer apply with ZPC in UP/DOWN mode.

**\* Installation Notes** - Some programs require that you run an installation procedure before you run the program. These procedures will often attempt to make one of the disks that come with the program bootable, using the MS-DOS SYS utility. Since the Z-100 version of MS-DOS takes up more space on the disk than the PC version, the space left by the maker of the disk is usually not enough, and the SYS command will

fail and issue an error message. This does not mean that you cannot use the program. It just means that you will have to boot using another disk and then take it out and insert the program disk to run it.

**\* Turbo Pascal v3** - This will run without patching, but you should first run TINST (the installation program) and select **S** (screen type) from the main menu. Next, select **0** (default display mode) from the next menu. Next, answer **N** to the question "Does your screen blink when the text scrolls?". Finally, select **Q** from the main menu, and Turbo Pascal will be ready to run.

**\* FrameWork and FrameWork II** - If you do not have the ZPC ZHS circuit installed, the scroll lock key will not work as it should in FrameWork or FrameWork II (It may work with ZPC in the UP/DOWN mode, but it has not been tested).

Instead, use Alt = ({HELP} followed by {=}) when the scroll lock key is called for. The FIXFWII patcher must be used before Alt = will work with FrameWork II.

With either version of FrameWork, Num Lock must be OFF before the keypad + key ({SHIFT}-keypad {minus}) will work.

Before you can run FrameWork or FrameWork II, you must set the default drive to a specific existing drive. In FrameWork, you do this by editing the CONFIG.FW file using FrameWork's word processor. In FrameWork II, you must use SETUP to change the default drive. Also in FrameWork II, you must use SETUP to change all of the telecommunications ports and vectors to 0.

**\* Einstein Writer** - If you are not running the UP/DOWN version of ZPC, be sure to use {F0} and {[] when the program calls for Control-[.

**\* dBASE III plus** - Use the monochrome mode (option **m** on the first menu) to run the tutorial program (INTRO.EXE). If you run it in the color mode, it will use intense white on a white background for some symbols, which does not show up under ZPC. Make sure that the CAPS LOCK key is up (caps not locked), because INTRO does not recognize upper case letters for any of its prompts.

**\* GW-BASIC** - There is a release of Heath/Zenith GW-BASIC v2, dated 3-13-85, that does not work properly with ZPC. If you have version 1 of GW-BASIC, Control-C will not work.

**Using Printers:**

ZPC maps the PC parallel and serial port drivers to the logical PRN and AUX devices. The first unit of each driver (LPT1 and COM1) is mapped to PRN, and the second unit of each driver (LPT2 and COM2) is mapped to AUX. This means that a PC program that is configured to use a parallel printer will actually use whatever printer your MS-DOS is CONFIGURED for, whether parallel or serial.

Most PC programs are set up to use the parallel driver, but if you cannot get a program to print properly, try changing to the serial driver. Most business programs will have some kind of setup utility for making such changes.

### Copy Protected Software:

ZPC can read some copy protected programs, including **Lotus 1-2-3 release 1A**, **Microsoft Word v2.0**, and **Word Finder**. ZPC alters certain tables in the Z-100 BIOS to accommodate a copy protected disk and then restores the tables from information saved before the disk read.

If you run a copy protected program and want to run another one after it, you should switch to the Z-100 mode and back to the PC mode between programs to make sure that ZPC restores the tables correctly for each disk.

There are many copy protected programs, particularly those using Softguard protection, that ZPC cannot read. There are commercial utilities available that can be used to remove copy protection from the more popular business programs, and after the protection is removed many of the programs can be used under ZPC. Generally, the protection removal utility must be run on a true PC compatible computer, but once the protection is removed, the unprotected version can be used under ZPC.

## Section 6 -- Technical Section

### Patching Programs - Sound Generation:

Many PC programs use the keyboard and timer chip to generate sound to signal an error. Most of these programs can be patched to simply ring our keyboard bell.

Typically, a PC program has a subroutine that looks something like this (Microsoft's CV.EXE):

```

377C:92C1 B0B6      MOV    AL,B6
377C:92C3 E643      OUT    43,AL
377C:92C5 8AC1      MOV    AL,CL
377C:92C7 E642      OUT    42,AL
377C:92C9 8AC5      MOV    AL,CH
377C:92CB E642      OUT    42,AL
377C:92CD E461      IN     AL,61
377C:92CF 0C03      OR     AL,03
377C:92D1 E661      OUT    61,AL
377C:92D3 B93C00     MOV    CX,003C
377C:92D6 51          PUSH   CX
377C:92D7 B90401     MOV    CX,0104
377C:92DA E2FE      LOOP  92DA
377C:92DC 59          POP    CX
377C:92DD E2F7      LOOP  92D6
377C:92DF E461      IN     AL,61
377C:92E1 24FC      AND    AL,FC
377C:92E3 E661      OUT    61,AL
377C:92E5 C3          RET

```

You should be careful to not confuse other accesses to port 61h that read the keyboard scan code. If you correctly identify the above routine as sound generation, it can be patched to:

```

377C:92C1 B007      MOV    AL,7
377C:92C3 E6F5      OUT    F5,AL
377C:92C5 C3          RET

```

This will beep the Z-100 keyboard and at least generate some noise.

### Patching Programs - PC Delay Loop:

Some programs use the PC timer chip to perform a software delay loop, which will result in an infinite loop "lock up". You can tell when this is happening if the program simply stops responding and the system seems dead.

One way to try and locate the code causing the problem is to hit the "software break out key" {CTRL}{SHIFT}-{\_} and enter the MTR-ROM at the hand prompt. If you use the Unassemble and Trace commands, most times you are already in the area of the problem code. It will look something like this:

```

3427:1234 E440      IN     AL,40
3427:1236 88C4      MOV    AH,AL
3427:1238 E440      IN     AL,40
3427:123A 86C4      XCHG  AL,AH
3427:123C 39D8      CMP    AX,BX
3427:123E 76F4      JBE    1234

```

It is hard to recommend a general fix to this type of code. You must decide whether you want to maintain a delay or not. You might want such a delay if the program is displaying a message to the screen for a short time, and then erasing the message.

If you do not want a delay, the fix is simple, you just need to "NOP" out the 2 bytes associated with the final JBE instruction by changing them to 90 90, using the Edit command. This should allow you to exit the MTR with the "Go" command, and the program should magically come back to life. Of course, you will have to patch the disk image of the program to make the "fix" permanent.

Most programs will not be as simple as the example above, but they will all have some things in common.

On a PC, both ports 40h and 42h can be read twice to get a word timer tic value in reverse byte order. Almost all PC programs will compare the resulting value with some predetermined value, either stored in a register or in some memory location, and then jump back up to read the port again if the required value has not been reached yet.

By "NOP"ing out the jump back up to read the port again instruction, you will prevent the code from looking forever for a value it will never find. It is possible to use our timer chip to accomplish the same result, but the time increments returned by our timer chip are different than on a PC, so the code changes are not simple if you want the same time delay.



## Patching Programs - The Video Ports:

**Note:** Most of the patches described below are not needed if you are running a PC emulator board, such as the **ZHS Scottie Board**, **EasyPC** or **Gemini**.

If you have a PC program that does not run under ZPC, the first thing you should do is try to run it in the monochrome card mode (video mode 7). If it still does not run and you would like to try to patch it using DEBUG to make it run, this section may be of help.

If the problem is that the program accesses conflicting ports, some of the things that you might see are strange flashes on the screen, or the screen goes all white, or the characters shift to odd positions. Also, the program may lock up, requiring you to reset the computer.

The video ports on the PC lie in the range 3D4h to 3DAh. Since the Z-100 only supports 8 bit ports, a write to port 3D9h, for example, is seen as a write to port 0D9h on a Z-100, which is one of the Z-100's video control ports. That is why display problems occur when the PC programs are run.

**Note:** If you have to patch an .EXE program, be sure to rename it so that the extension is not .EXE (rename it to .BIN or something). After you have patched the program with DEBUG, you can rename it back to .EXE.

Here are some actual code sections (as provided by the DEBUG Unassemble command) from programs that have been patched. These will give you an idea of what to look for.

```
40EC:1C54 EC      IN      AL,DX
40EC:1C55 A801    TEST   AL,01
40EC:1C57 75FB    JNZ   1C54
40EC:1C59 FA      CLI
40EC:1C5A EC      IN      AL,DX
40EC:1C5B A801    TEST   AL,01
40EC:1C5D 74FB    JZ    1C5A
```

Code like this will appear in nearly every program that accesses video ports. This code is used to check the status of the video system immediately before writing to or reading from video RAM. The program will lock up when it gets to this code if run under ZPC.

You can use the DEBUG Search command, and search for **EC,A8,01** to find these blocks. The program may also test for 08 instead of 01, in which case you would search for **EC,A8,08**. The entire block should usually be patched out with NOP instructions. Use the Fill command as follows:

**-F1C54,1C5E,90**

That would patch out the block shown above.

Sometimes a program will set up certain parameters of the video board by writing to a port. Here is a block of code where this is done:

```
40EC:21FB BA4000    MOV   DX,0040
40EC:21FE 8EDA      MOV   DS,DX
40EC:2200 8B166300   MOV   DX,[0063]
40EC:2204 83C206    ADD   DX,+06
40EC:2207 1F          POP   DS
40EC:2208 89164116   MOV   [1641],DX
40EC:220C 83EA02     SUB   DX,+02
40EC:220F B009      MOV   AL,09
40EC:2211 EE          OUT   DX,AL
40EC:2212 C3          RET
```

Notice that the value of the port is obtained by reading address 63h in the BIOS RAM area (the first 128 bytes at segment address 40h). If you find code like this, note where the port number is stored (1641h in this case). You can then search for that address to find other places where the port is accessed. Any place where you see an OUT DX,AL instruction, and DX contains a video port value, it should be patched out with a NOP. Sometimes the port will be specified directly (MOV DX,3D9), which will make it easier to locate areas requiring patches.

Here is a section of code found in one of the programs that was patched:

```
40EC:311A 8B16EF40   MOV   DX,[40EF]
40EC:311E EE          OUT   DX,AL
40EC:311F B00F      MOV   AL,0F
40EC:3121 8B16ED40   MOV   DX,[40ED]
40EC:3125 EE          OUT   DX,AL
40EC:3126 88D8      MOV   AL,BL
40EC:3128 8B16EF40   MOV   DX,[40EF]
40EC:312C EE          OUT   DX,AL
40EC:312D B00A      MOV   AL,0A
40EC:312F 8B16ED40   MOV   DX,[40ED]
40EC:3133 EE          OUT   DX,AL
40EC:3134 A0F240   MOV   AL,[40F2]
40EC:3137 8B16EF40   MOV   DX,[40EF]
40EC:313B EE          OUT   DX,AL
```

All of the OUT DX,AL instructions were patched to NOP instructions to make the program work.

## Patching Programs - The Graphic Character Table:

In current versions of ZPC, it is no longer necessary to patch the graphic character table address, since the table is now included in the MTR-100 v3 and later ROMs. If you have PC programs that were previously patched, you may want to remove the graphic character table patches (or start with a fresh version of the PC program).

## Patching Programs - The Keyboard Interrupt:

**Note:** This entire topic may no longer be applicable with ZPC now in UP/DOWN Mode. However, as it still applies if ZPC is not used in the UP/DOWN Mode, I left it here.

On an IBM PC or Z-150, an interrupt 9h is generated each time a key is pressed on the keyboard. A program can capture this interrupt, and access the key code by inputting from port 60h. It can also reset the keyboard hardware by accessing port 61h.

ZPC also issues an interrupt when a key is pressed, but since ports 60h and 61h do not exist on the Z-100, provision had to be made to replace them. If you have the ZPC hardware support circuitry (ZHS or Scottie board) installed, it will provide those ports.

If you do not, two software interrupts, INT 90h and 91h, are set up in ZPC to replace ports 60h and 61h. The instructions IN AL,60 and IN AL,61 can be replaced with INT 90 and INT 91 to make programs that use the keyboard interrupt work.

Here is a section of code from a program that uses the keyboard interrupt.

```
49EC:34A4 E460      IN    AL,60
49EC:34A6 32E4      XOR   AH,AH
49EC:34A8 50        PUSH  AX
49EC:34A9 E461      IN    AL,61
49EC:34AB 8AE0      MOV   AH,AL
49EC:34AD 0C80      OR    AL,80
49EC:34AF E661      OUT   61,AL
49EC:34B1 86E0      XCHG AL,AH
49EC:34B3 E661      OUT   61,AL
49EC:34B5 58        POP   AX
```

When the IN AL,60 and IN AL,61 instructions in the above code are patched to INT 90 and INT 91, the code functions properly under ZPC. The other accesses to port 61h do not matter, since the port does not exist on a Z-100.

**Note:** An IBM PC or Z-150 actually generates two interrupts for each key press. One is generated when the key is pushed down, and one is generated when the key is released. The code obtained from port 60h when the key is released is the same as the code when the key was pushed, but with the high bit set. The Z-100 normally generates an interrupt when a key is pressed, but not when it is released. Earlier versions of ZPC generated the release interrupt when another key was pressed, before the interrupt for the new key was generated. This method of emulating the PC keyboard interrupt worked well. The present version of ZPC uses the UP/DOWN interrupt codes for better emulation.

## Supported Interrupts and Sub-functions:

ZPC supports the interrupts and sub-functions of the IBM PC (or Z-150) ROM BIOS, as listed in the following table. For a discussion of these interrupts and sub-functions, see the Z-100 PC software interface section of the Programmer's Utility Pack manual.

<u>Interrupt</u>	<u>Description</u>	<u>Sub-functions Supported</u>
<b>10h</b>	<b>Video I/O</b>	0 Set screen mode 1 Set cursor type 2 Set cursor position 3 Read cursor position 5 Select active display page 6 Scroll active page up 7 Scroll active page down 8 Read char & attribute 9 Write char & attribute 10 Write character only 11 Set color palette 12 Write pixel 13 Read pixel 14 Write char, advance cursor 15 Return current video state
<b>11h</b>	<b>Get I/O config.</b>	No sub-functions. Returns default Z-150 values.
<b>12h</b>	<b>Get memory size</b>	No sub-functions.
<b>13h</b>	<b>Disk I/O</b>	0 Reset disk system. (This func ignored in ZPC) 1 Read disk status 2 Read specified sectors 3 Write to specified sectors 4 Verify specified sectors
<b>14h</b>	<b>Serial I/O</b>	1 Send character 2 Receive character 3 Read status
<b>Note:</b> For INT 14h, serial card 0 is mapped to the PRN device, and serial card 1 is mapped to the AUX device.		
<b>16h</b>	<b>Keyboard I/O</b>	0 Get character 1 Get status 3 Get shift status
<b>17h</b>	<b>Parallel I/O</b>	0 Print character 2 Get printer status
<b>Note:</b> On a Z-150, INT 17h can be mapped to any printer, parallel or serial. Therefore, in ZPC, INT 17h is mapped to the PRN device (when it processes LPT1), which is configurable to any port by the Z-100 CONFIGUR.COM program. LPT2 is mapped to the AUX device.		

The following interrupts are not functions, and have no sub-functions;

<b>1Bh</b>	<b>Keyboard break</b>	This interrupt is generated when you press {F0} followed by {F12}. It is up to a user program to do something with it.
<b>1Ch</b>	<b>Timer tick</b>	This interrupt is generated 18 times/second.
<b>1Fh</b>	<b>Graphics chars</b>	This interrupt is just a pointer, which can point to a table defining extended ASCII chars in the graphics modes.

**BIOS RAM Locations:**

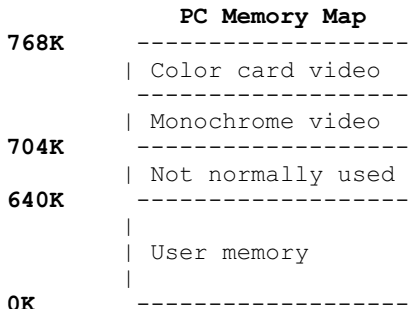
ZPC supports the following memory locations in the IBM PC BIOS RAM segment (segment address 40h).

Address Information at that Location

- 0 RS-232 addresses**  
Dummy values are used that will not conflict with Z-100 ports if a program writes to them.
  - 8 Printer addresses**  
Default Z-150 values are used.
  - 10h Equipment flag**  
This flag is set to default Z-150 values (except as noted below), and the bits in it are defined as follows;
    - 0 1 = diskette drives are present
    - 1 1 = 8087 installed. ZPC will set this bit if an 8087 is installed.
    - 3,2 00 = 64K RAM chips
    - 11 = 256K RAM chips.
    - 5,4 Initial video mode.  
Set to 10 for 80x25 color.
    - 7,6 Number of diskette drives.
    - 8 Unused
    - 11,10,9 Number of RS-232 cards (010 = 2).
    - 12 1 - Game port attached.
    - 13 Unused
    - 15,14 Number of parallel printer cards.
  - 13h Memory size in Kbytes**  
This value will either be 640 or 704, as set by SETZPC.
  - 15h I/O RAM size**  
Default Z-150 value used.
  - 17h Keyboard flag**  
The bits are defined as follows;
    - 0 Right shift key depressed
    - 1 Left shift key depressed
    - 2 Control key depressed
    - 3 Alt key depressed
    - 4 Scroll lock on/off
    - 5 Num Lock on/off
    - 6 Caps Lock on/off
    - 7 Insert on/off
- Note:** Bits 0, 1 are only partially supported.  
Bit 6 is not supported.  
Byte 2 of the keyboard flag is not supported.
- 49h Current video mode (0-7)**
  - 4Ah Number of columns on screen**
  - 50h to 5Fh Cursor position**  
Two bytes are used for each of eight possible video pages.
  - 60h Cursor mode (2 bytes)**
  - 6Ch Timer count low word**
  - 6Eh Timer count high word**

**ZPC Memory Usage:**

The following is an explanation of why ZPC requires 768K of memory in order to achieve its maximum PC compatibility. To help you understand, here is a chart of how memory is used in an IBM PC or compatible computer:



Notice that the first 640K of memory space in the PC is reserved for user memory. This is the memory used by your programs and MS-DOS. The user memory may not occupy all of this space, but if it does, the machine is said to be "fully populated".

The segment of memory stretching from 640K to 704K is not normally used in a PC, although it is possible, by replacing some chips, to use it in a Z-150.

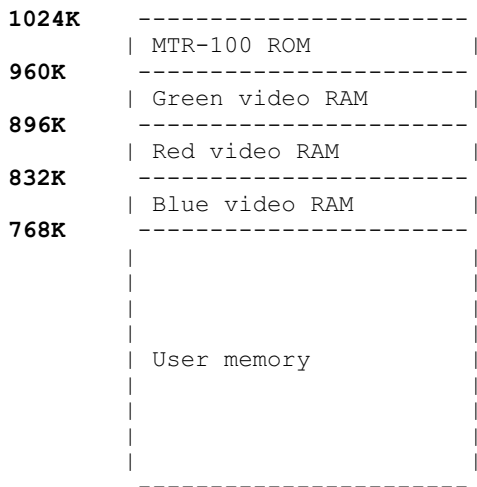
The segment from 704K to 768K is used for video cards. Each card has its own memory that can be written to or read from the same as user memory, but it is not used as space for programs.

The PC hardware is set up so that while the video card is in a text mode you can write the ASCII code for a character into a location in the video card's memory and the character will appear on the screen. If the card is in a graphic mode, writing to the video memory will produce pixel dots on the screen.

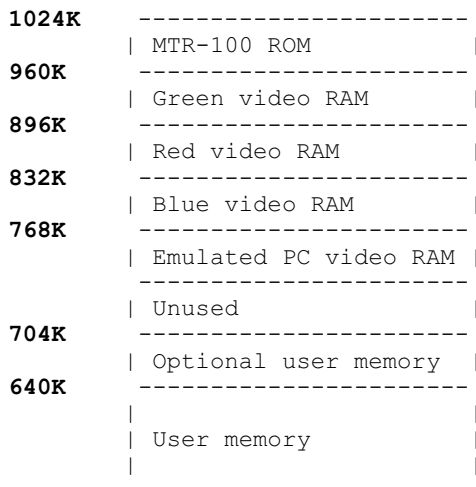
There are other ways of getting characters or pixels on the screen, but the direct memory method is the fastest, so many PC programs use this method. If you want these programs to run under an emulated environment, then you must emulate a PC video card's memory.

The following charts describe the memory in a Z-100 computer. The left chart represents normal memory usage, and the right one represents how memory is used when ZPC is in the PC emulation mode, and video modes 0-6.

**Z-100 Mode**



**ZPC PC Mode**



When ZPC is in the PC emulation mode and video mode 0-6, it emulates the color graphics video card of a real PC. ZPC emulates the PC video card's memory, and as you can see on the chart above, the emulated memory is at the same location as the memory on a real video card.

It must be there, because that is where a PC program expects it to be. That is why you must have 768K of memory in your Z-100 to run ZPC.

**Compile Time Options:**

For those of you who wish to create a "custom version" of ZPC tailored specifically to your own needs, there are quite a few options in COND.ACM. This document has explained the affect of changing each of these options in detail.

Some changes have been made to BIOS v4.06 that fully support BIOS generation of the PC hardware and software timer interrupts, and allow you to specify an alternate CONFIG.SYS file on another drive or directory.

A patch has also been made to LLSCSI.SYS to change the "WAIT" unconditionally to "WAIT" until ready. This allows people with the new SCSI drives to set the Z-100 to Autoboot and read AUTOEXEC.BAT and CONFIG.SYS off the SCSI drive at boot time, and eliminates the need to reprogram the EPROM disk for different configurations.

You will of course need an assembler and linker to make a new version of either BIOS or ZPC. This version of ZPC.COM was compiled with MASM ver 5.10b using the current settings in COND.ACM.

If you have any questions or comments, please email me at:

[Z-100lifeline@swvagts.com](mailto:Z-100lifeline@swvagts.com)

Cheers,

Steven W. Vagts

