Z-DOS v4 and ZROM v4 Development

by Steven Vagts
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Note: This first section was adapted from Paul Herman's article in "*Z-100 LifeLine*" issue #25. I was not actively involved in this early work on Z-DOS v4, ZROM v4, or on the "*Z-100 LifeLine*" SCSI Host Adapter. So, I must rely on what was previously written by Paul Herman as to what transpired. If I have missed someone, or some event, that provides a more accurate portrayal of these events, please do not hesitate to correct me. Thank you.

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Background

When Zenith and Microsoft support moved on from supporting the Z-100 series computer to developing PC hardware and software in the late 1980s, it quickly became apparent that any additional work on the Z-100 would have to be done within the Z-100 community. This was the driving factor for Paul Herman to begin publishing the "*Z-100 LifeLine*" in 1989. The purpose of the "*LifeLine*" was (and still is) to provide a central point for dissemination of information and development between venders, research teams and the ultimate users.

One of the first projects was the development of a new "*Z-100 LifeLine*" SCSI Host Adapter, later referred to as the LLSCSI Controller Board, to replace the aging "Winchester" MFM hard drives of the Z-100. A full list of the proposed features and expected costs was provided in *LifeLine* issue #15. A full team of volunteers began work on this project in 1990:

Paul F. Herman	Project Coordinator, EEPROM programming, Marketing
Robert F. Hassard	Engineering design, Prototype development
Robert W. Donohue	MTR-100 ROM and BIOS programming
William E. Flanagin	SCSI programming
Travis J. Barfield	Parts acquisition & Manufacturing
Michael Zinkow	Z-DOS development
John Beyers	BIOS programming & Z-DOS utilities

Today, we will just concentrate on the firmware and software that would be required to enable use of this new SCSI Controller Board. But a full description of this board was published as an insert to LifeLine issue #87.

Obviously, the new LLSCSI Controller Board would require changes to the Monitor ROM (MTR-100, or now more commonly referred to as ZROM) and new programmable ROM (EEPROM, the brains of the new board) routines would need to be added.

Mike Zinkow gradually got new Microsoft MS-DOS versions to work on the Z-100, successfully modifying COMMAND.COM and most of the DOS utilities of MS-DOS v3.2, then v3.3. Monitor ROM version 3 and 3.1 was successfully developed by Bob Donohue and the original EEPROM routines by Bob Hassard. John Beyers joined the project in early 1992 by writing a modified BIOS to support the later versions of Z-DOS and adding a whole host of new features. The new LLSCSI Controller Board was successfully deployed in 1992.

Mike Zinkow and John Beyers introduced the first trial Z-DOS version 4.01 in early 1993. Developed from MS-DOS versions 4 through 6, it was a complete diversion from the normal operation of the Z-100.

After the BIOS completed its initialization and checks during the new boot-up routine, it displayed a screen of information which showed the system configuration, Monitor ROM version, amount of system and video RAM, the DOS and BIOS versions, and the drive configuration.

Z-DOS v4 Capabilities

The new v4.00 BIOS (IO.SYS) now had the ability to support a variety of new block device (drive) formats, including:

* 3-1/2" Double Density floppy drive (720Kb format)
* 3-1/2" High Density floppy drive (1.44Mb format)
* 5-1/4" Double Density floppy drive (320Kb & 360Kb formats)
* 5-1/4" High Density floppy drive (1.2Mb format, PC or Zenith)
* 8" High Density floppy drive (1.2Mb Zenith format)
* Z-217 Winchester MFM hard drive partitions
* LifeLine EEPROM Device
* Imaginary drives

Drive configuration was easy. This DOS version introduced a program named **DRIVECFG.COM,** which displayed a screen identical to the new boot-up configuration screen. To delete or modify a system device, you just needed to highlight the desired line (using the up/down arrow keys or by simply typing the drive letter) and press ENTER.

To add a new drive, you just select the line that says, "***Next Available Drive to Assign***" and follow the prompts. A menu of valid choices would be displayed at the right side of the screen and all you did was hit the function key for the desired device type. Then follow the necessary prompts to configure that device.

In order to configure a dual density drive, you must have modified your Z-207 Floppy Controller Board. There were two modifications that were offered, the "Hughes" modification or the "Barfield" modification.

The **"Hughes"** modification was one presented in LifeLine issue #13. It routed the signals for both transfer rates to the 34-pin connector on the Z-207 Floppy Controller. This allowed the use of dual density drives, but limited the number of drives on each Z-207 controller to 4, because it eliminated the use of the 8" drives at the same time.

The **"Barfield"** modification was published as an insert to LifeLine issue #76 and allowed either transfer rate to be accessed via the 34-pin connector, but did not interfere with the normal operation of the 50-pin connector. The transfer rate selection for the 34-pin connector was determined by the state of the 5" FASTEP signal.

This modification allowed the use of up to 8 floppies (the normal 4 on the 34-pin connector and 4 on the 50-pin connector) on each Z-207 Floppy Controller.

The new BIOS, FORMAT program, and Winchester utilities offered distinct advantages over Zenith's versions when it came to hard disk support. You could have up to 4 hard disks for each Z-217 Hard Drive Controller card and a primary and secondary controller were permitted (however, the Z-217 Controller does NOT have jumpers to set primary or secondary controller). Each drive could have an unlimited number of partitions (using drive letters up to 'Z').

Each hard drive partition could be any size, limited only by the 21-bit number used to pass the sector number to the Z-217 Controller (about 32Mb). There was no reason to use larger than 512-byte sectors for large partitions, although you could still use the '/K' PREP switch if you desired. The cluster size would be automatically calculated so the entire partition was accessable (there is a limit of 65535 clusters). Or, you could specify the cluster size, if desired.

The Z-217 MFM Hard Disks now used a PC-compatible partition table and boot loader table, however. This meant that Norton and other utilities would now be able to provide correct information about the start sector of each partition.

One of the aggravating limitations of Zenith's Z-217 support was that if any sector in the first 32 was bad, you got the message, "*Drive is Unusable*". Of course, this was not absolutely true, but there was nothing we could do about it. The new V4.00 BIOS and utilities eliminated this problem. The boot table and partition table were at non-fixed locations, so that drives with bad sectors in the first few tracks were still usable.

LifeLine SCSI/EEPROM Support

The LifeLine SCSI host adapter was supported as an installed device. Partitions assigned by the LLSETUP program were recognized and accessed just as with previous versions of DOS.

The EEPROM device on the LLSCSI Controller could be made bootable by installing the new version of DOS on it. This was done by following the instructions included with the SCSI/EEPROM board, using a new version of the EEMDISK driver, which included a PC-compatible boot table.

Imaginary Drives

For those with single drive systems, you are familiar with Zenith's "*Please insert Disk B in Drive A*" message. BIOS v4.00 also supported imaginary drives, and does it in a much better fashion. Although the concept of imaginary drives is very useful, Zenith's implementation left much to be desired.

The biggest problem was that there was no way to prevent the BIOS from trashing the screen with the disk change message whenever an imaginary drive was accessed, causing many problems with applications that were not expecting it.

In v4.00 of the BIOS, this problem had been corrected. You could create as many imaginary drives as you want. They are handy for copying files from one disk to another when you only have one disk drive of a particular type. If you create one imaginary drive, it is also possible to use it with any of your "real" drives. This eliminated having to have separate imaginary drives for each type.

The disk change message now consisted of a small disk-shaped icon which flashed on the screen, instructing you to change disks. After the swap, the icon disappeared, and the screen was restored.

Drive letter assignments used the **DRIVECFG** program and you could assign any device to any drive letter. You could even have a system with only drive Z, if you wanted. There was no set pattern of reserved drive letters any more. Z-217 Winchester partitions could be drive A; your 360Kb floppy drive could be drive E. It did not matter to the BIOS how you wanted your drive configuration.

There was one thing to remember when assigning drive letters in crazy orders. If you use out-of-order drive letter sequences, the "hole" in the drive letter map will be unassigned, but unaccessible by installable device drivers, such as the LLSCSI device driver. You must allow enough drive letters after your last BIOS device for all of your block device drivers to use. So, if you had two partitions on your SCSI hard disk, you should allow the LLSCSI driver at least two drive letters (Y and Z).

Another issue with moving your drives around, you must remember that this drive assignment by DRIVECFG ONLY applied to the new Z-DOS V4 operating system. All other operating systems, including earlier versions of DOS, still expect to see the normal drive configuration that they require.

Other Enhancements and Improvements

The greatest advantage of developing our own Z-100 MTR-ROM (aka ZROM) was gaining full control of every conceivable programmable function possible on the Z-100. A keystroke from the BIOS V4 menu could now give us access to functions that most of us did not even know existed! Thanks to the imagination and talents of John Beyers, here is a partial list of more enhancements made in the V4.00 BIOS:

  * A ROM Help Screen (Hand Prompt) that gave us full control of Z-100 features at a key click.

  * A PC type boot loader table is used across all devices supported by the BIOS. This makes disks compatible between the Z-100 and IBM clones. However, do not expect some of the possible strange disk formats that you can now create to be readable on a PC clone.

  * A different method of checking the status of drives allows much faster disk response when first accessing a drive. You no longer have to wait for long periods when trying to read an unformatted disk, or when accessing a drive with no disk in it.

  * Memory is allocated dynamically at boot time. This eliminated wasted space for unused drive configurations (as in the Zenith version). In addition, the BIOS now returns all the BINIT code spaces to the memory pool.

  * Characters output to the console by the BIOS now use the PC graphic characters from the MTR-100 v3 or V4 ZROM, if they are above ASCII code 7Fh.

  * A built-in screen saver is included. The delay interval before blanking the screen may be changed from 1 to 10 minutes. And you may choose whether you want the first key struck (which activates the screen again) to get eaten or not.

  * A special hot key is defined (CTRL-SHIFT-^) by default) that enables you to view the previous 24 lines of screen display. Pressing the hot key again restores the original screen. This allows you to look at lines which scroll off the screen. However, this does NOT work in interlace mode.

  * Included dummy devices for LPT1, LPT2, COM1, and COM2 which allows access of these PC device names. Access to LPT1 or LPT2 are routed to the parallel port (PRN), and access to COM1 or COM2 are routed to serial port A and serial port B.

  * The Interrupt Table was now updated at boot time to point to the PC interrupt routines in the MTR-100 v3 monitor ZROM.

  * IO.SYS and MSDOS.SYS no longer needed to be in the first clusters of a disk. They still needed to be the first and second directory entries, and need to be contiguous, but they may be physically located anywhere on the disk.

  * The BIOS jump table at segment 40h is duplicated at 40:100h. This allows Z-100 programs and utilities that make BIOS calls to run under PC mode of ZPC.

  * CONFIG.SYS file chaining capability had been added. Using a **"ALTCFG=pathname"** command in the CONFIG.SYS file causes another configuration file to be executed. This is handy in boot environments (like the EEPROM device) where it is not convenient to make modifications to the primary CONFIG.SYS file.

  * Screen output speed has been improved by about one third over previous Zenith BIOS versions.

In addition to these enhancements, the following bugs or weaknesses in Zenith's BIOS were corrected in this version:

* Large block device data transfer requests (greater than 64Kb) are now handled correctly, instead of wrapping around into the buffer area.

* Z-205 RAM board initialization was now done correctly. Zenith's version did a partity check that trashed any data in the Z-205 RAM when doing a warm boot.

* Sets the system memory that DOS sees at boot time to 768Kb maximum. This keeps the copy of COMMAND.COM loaded in high memory from trashing Z-205 RAM data.

System Requirements

Z-DOS v4.x and BIOS v4x should run on any Z-100. Even the minimum memory configuration of 128K should be plenty to boot and run some application programs.

While a few special Z-DOS v4.00 configurations permitted use with earlier monitor ROM chips, to my knowledge, later versions of Z-DOS v4.x requires ZROM v4.x to obtain the full benefits of the software. However, the monitor ROM, ZROM v4.x, will permit running all previous versions of Zenith DOS and CP/M without difficulty.

Futher Enhancements of Later ZROM v4 & Z-DOS v4 Versions

Somewhere since the first version of Z-DOS v4, John Beyers added the capability of having screen displays up to 50 lines on the Z-100 screen. While the default is now 25 lines with the 26th being a comment line, some of the higher line settings could get somewhat strange.

But when it increased the ability to see more lines of a program at a time, John could not refuse using this new ability. So he created the utility LSET (later becoming SETLPS), which permitted setting the Z-100's lines per screen up to 50.

Then, as reported in LifeLine issue #69, John Beyers made several revisions to many of the DOS utilities:

ZDIR.COM Enhancements

With the ability to have screen displays of up to 50 lines, John wanted the ZDIR utility to adapt itself to make use of the screen's new capabilities. As before, it listed the files in two columns and can sort files by name, extension, date/time, or size. For a complete review of this newer version of ZDIR.COM, check out LifeLine issue #69 and an update in issue #92.

LOOK.COM Enhancements

As with ZDIR, John wanted LOOK.COM, a popular file viewer, to work properly with a 50 line display.

Z-207 Floppy Controller DIP Switch

ZROM v3 and early versions of Z-DOS v4 had redefined section 1 of the Z-207 Floppy Controller DIP Switch to configure the Z-100 for use with 96 tpi, 5-1/4" drives.

However, John Beyers found a means to identify a drive type by stepping in two tracks and reading the track to see if it was track one or two. If the track was track one, we know that we need to double step the drive.

Then he developed a new version of the FORMAT program to install this new boot loader, which would be DIP switch blind, in that it did not care how the Z-207 Controller DIP switch was configured! So, with the new Z-DOS v4.06, it does not matter what drives were placed where.

However, for Z-DOS v4 users that still occasionally boot up DOS v3 or CP/M, you must still remember that the DIP switch must remain configured properly for those versions of software to work properly. Additional information can be found in LifeLine issues #80 and #81.

MTR-ROM (ZROM) v4 Character Sets

There are actually three character sets loaded in ZROM v4; S - Single, D - Double, and O - Old. The Old is the original Zenith single-dot character set. The Single font is a single-dot, modified Old font, but including many more of the PC's characters. The Double font is a double-dot font form of the single font, but intended to emulate the look of the original PC's font. The symbols of the character map can be displayed on the screen of the Z-100 two ways by using the Escape Code, 'g':

At the System Prompt, type ECHO {F8}{g}, OR At the Hand Prompt, press {N_echo}{ESC}{g}. For further information on the character sets, refer to LifeLine issues #104 and #105. The actual character set chart is given as an insert of LifeLine issue #104. The H/Z-100 Key Code Chart is provided as the insert for LifeLine issue #105.

Z-DOS V4 Help System

While previous versions of DOS referred you to the DOS User's Manual to learn how a command worked, later versions of DOS in the PC world kept improving. One improvement was adding a help screen to every DOS command. And a second was adding a HELP system, where a person could type a command, and get a full description of the use of each command.

John added each to Z-DOS v4. The system is fully described as an insert to LifeLine issue #69, and it has been added as an article to the Website.

New or Updated Commands

Numerous commands have been updated or are new to the latest version on Z-DOS since V4.01. I have left the references to the original "*Z-100 LifeLine*" articles, but all of these have been updated and are listed as their own articles on the "*Z-100 LifeLine*" Website.

DRIVECFG.COM

DRIVECFG is a Z-DOS v4 configuration utility for disk drive selection created by John Beyers.

This utility will configure a disk copy of the BIOS (IO.SYS) for the physical or imaginary drives connected to the Z-207 Floppy Controller, the physical drives connected to the Z-217 MFM Hard Drive Controller, a RAM drive, the EPROM on the LLSCSI Controller, and the NVsRAM on the new LLIDE Controller. For complete information on DRIVECFG, see the insert to LifeLine issue #112.

CONFIGUR.COM Utility

The CONFIGUR Utility configures the Z-100 serial and parallel I/O ports to use printers, modems, and other devices which make use of either a Centronics parallel signal or RS-232 serial signals. For a full description on this Z-DOS v4 utility, please refer to the insert of LifeLine issue #94.

ZFMT207.COM

Another new utility from John Beyers, we needed a FORMAT program with more flexibility to create weird disk formats for experimentation.

Not meant to replace FORMAT, which does a superb job formatting standard floppies and hard drives, ZFMT207 was to be used for formatting and thoroughly checking diskettes only. It could be used to create some pretty bizarre disk formats, including some with higher disk capacities than the standard ones we use now. For more information, please refer to the insert of LifeLine issue #99.

DSKCOPY4.COM

DSKCOPY4 was written by John Beyers as a DOS version replacement to the previous DISKCOPY program, with two MAJOR enhancements.

The first is the addition of a critical archival capability - of making a disk file image of any 8", 5.25", or 3.5" floppy disk's data and track structure. This disk file could then be used by DSKCOPY4 to re-create the exact duplicate at some future time.

The second is the addition of some data recovery capabilities through the use of several programming switches. For more information, check out LifeLine issue #100.

PREP.COM v4

This Zenith Z-217 "Winchester" hard drive initializing utility needed an update for Z-DOS version 4. As you are aware, PREP is the first piece of software that must be run on an MFM hard drive in order to make it usable by other software.

One of the biggest changes to this version of PREP was the attempt to make previously 'unusable' drives usable.

Another addition was necessary to update to a PC-type boot code. For more information, check out the insert to LifeLine issue #101.

PART.COM v4

This Zenith Z-217 "Winchester" hard drive partitioning utility needed an update for Z-DOS version 4. As you are aware, PART is the second piece of software that must be run on an MFM hard drive in order to create partitions for use by other software.

This new PART makes best use of larger capacity hard drives. The partitions created are ready to FORMAT for use by any version of DOS or CP/M. For more information, check out the insert to LifeLine issue #103.

DETECT.COM v4

The DETECT version 4 utility examines your hard disk drive for any bad sectors (media imperfections) that have occurred since PREP was last used. It then records these bad sectors in the Bad Sector Table to prevent any further use.

This version adds more control to users by adding additional functions. For further information, check out the insert to LifeLine issue #104.

ZIMAGE.COM

ZIMAGE.COM was written by John Beyers to create a backup file of the critical areas of your Winchester hard drives. It was intended to supplement a DOS backup utility like Norton IMAGE that saves the critical DOS information contained in the FAT and ROOT Directory for each of your logical drives. Further information can be found in the insert to LifeLine issue #112.

ZVIDEO.COM

New in Z-DOS v4.01, John Beyers introduced ZVIDEO.COM, a utility that allowed us to save and restore our favorite Z-100 video configuration. This was very useful when an application program left us with the wrong screen color or incorrect number of lines displayed on the screen.

This became particularly apparent with the HELP system described just above. The standard Z-100 display has 24 lines per screen, but for HELP to work properly, the display needed 25 lines.

So, as usual John developed a program to solve this inconsistency - ZVIDEO.COM. This command is fully described as an insert to LifeLine issue #69.

Additional command references will be added as they become available.

Z-100 LifeLine IDE Controller Board

A product of the Z-100 LifeLine staff - John Beyers (software), Charles Hett (hardware), and I, the "Z-100 LifeLine" IDE (LLIDE) Controller Board was conceived in late 2003. The board enables use of IDE drives on the Z-100.

The driving force behind this project was the need to replace the aging, and increasingly difficult to find, MFM hard drives for the Z-100. In addition, the previous LLSCSI Controller was no longer available and the SCSI hard drives drives were also becoming increasingly difficult to locate.

The new board also uses a 512Kb NVsRAM with Real Time Clock (RTC) to boot the computer, removing the need for boot code from the new hard drive, and has plenty of memory for speedy access to other programs.

The new LLIDE Controller Board, ZROM v4.3, and Z-DOS v4.06 has been operational now for several years. I have heard of no difficulties with the board installation nor with its operation.

More information can be found as several articles on the Website. And don't miss the article on the First Operational IDE Controller in the Z-100.

Note: In November 2021 I sold my last spare IDE Controller Board. The new Z-DOS v4.06 operating system (now on CD-ROM) and MTR-ROM v4.3 (ZROM4.3) are still available separately.

I hope you find this information helpful. If you have any questions or comments, please email me at:
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Cheers,

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