Z-100 LifeLine
Since 1989

April 2022

#WEB

This article was first published in issue #86, April 2003

Z-205 RAM Disk

by Steven W. Vagts
Editor, 'Z-100 LifeLine'

Z-205 RAM Disk

Background:

I've always put off adding a Z-205 Memory Expansion Board to the Z-100, having been satisfied with the 768K of RAM on the motherboard, the speed of the computer at 8 MHz (and even more at 10 MHz), and not having any real use for it. I also suspect that many of you have been intimidated by having to make the hardware modifications necessary to make it really useful.

Well, as changes to the Z-100 Monitor ROM and Z-DOS version 4 needed to be tested, without burning new ROMs for each modification, he loaded the ROM into his RAM disk and ran it as a firmware substitute to the Z-100's actual ROM. While it had some limitations, this method permitted testing about 99% of the new ROM without actually installing a new programmed (burned) ROM! You just could not test older versions of DOS and CP/M.

John convinced me that I also needed to check out his new ROM before actually burning new ones and that required me to finally install a Z-205 RAM disk. This article is to report my findings and encourage you to finally take the same trip. If finding or modifying the Z-205 board is a problem, I have many available and I can make the modifications for you. Just give me a call.

Hardware Changes:

To best use a Z-205 Memory Expansion Board with 256K RAM or 1M RAM in a Z-100 with 768K RAM on the motherboard, we need to make a few hardware changes.

CAUTION: Only make this modification if addressing the Z-205 card above 768K!!!

This modification is actually in two parts; the Port Enable Modification and the RAM Chip Upgrade Modification.

Z-205 Port Enable Mod - This is to allow the Z-205 Board to be disabled so that DOS cannot see the RAM memory which is addressed above 768K until we want it to, via software. If DOS does not recognize the Z-205 memory, it will not over-write it. This eliminates the need for a pro-gram, such as RAMLIM, to limit DOS's access to it. Also, alternate operating systems unable to deal with memory above 768K, such as CP/M, will not choke because it will not see the extra memory.

Note: The Boot Monitor and Diagnostics Disk will no longer see the Z-205 RAM unless the card is manually enabled and the Z-100 manually reset {CTRL-RESET}. Booting MS-DOS also sets the card to OFF. However, for Z-DOS v4 users, DRIVECFG can be set so BIOS will utilize high memory on the Z-205 card. In that case, booting MS-DOS will not turn the Z-205 card OFF. You must either turn the card off "manually" or power cycle the machine as described below.

However, most importantly, this modification permits memory "swapping". What is memory swapping, you ask?

Well, the designers of the Z-100 allowed disabling the memory addresses used for video and ROM to permit addressing an additional 256K of RAM above the motherboard's 768K of RAM and stay within the one megabyte memory limit. Therefore, the RAM from these modified Z-205 cards could be swapped into this addressable area and used, than swapped out with memory from other modified Z-205 cards, or the video memory could be reenabled.

This "swapping" gives us a great deal of flexibility in memory management and is the primary reason for this entire article.

Using standard wire-wrap wire and a 25 watt soldering iron, add the following jumpers to the underside (solder side) of the Z-205 256K Memory Expansion Card:

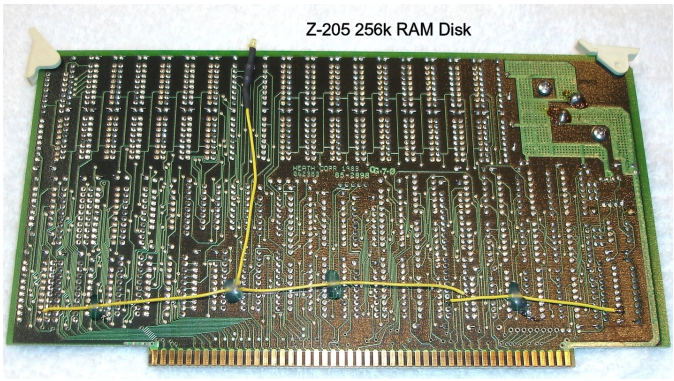

Photo 1.
Solder Side of Z-205 256k RAM Disk.

Notes:
- The ICs are positioned upside down.
- A Pad refers to the board area where IC socket pins are soldered.

1) Jumper (wire A) U150 pad-19 (photo 2) to U1 pad-17 (photo 3) (BIT 7 to Inverter)
2) Jumper (wire B) U1 pad-3 to SW2 pad-1 (Photo 3) (Inverter to A23 Compare)
3) Move SW2 position 7 to OFF (Now controlled by Port BIT 7)

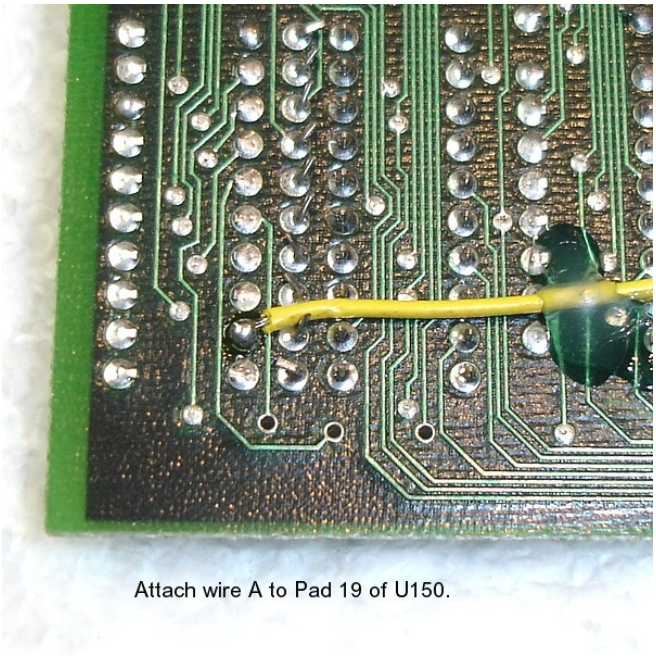

Photo 2.
Attaching Wire A to U150.

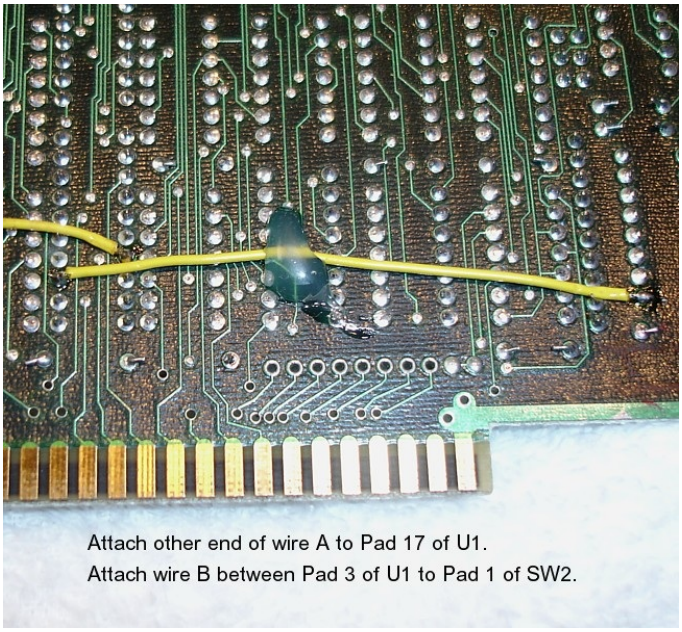

Photo 3.
Attaching Wires to U1 and SW2.

A RAMDISK Access LED can be easily added to the top of the board (Photo 1) or to the front panel (a flat rectangular LED wedges nicely in the face plate air vents) by wiring a 220 ohm resistor in series with the LED (+) to U150 pad-19 and the LED (-) to U150 pad-10 or any other convenient grounded pad.

A Power-On-Reset or an OUT value of 0h to the Z-205 Control Port (set by SW1, Default=98h) will turn the Z-205 OFF. An OUT value of 80h to the Port will turn the Z-205 ON. Note that the other bits of the control port are used for Parity and ERROR interrupt control. Also note that the modification does not really turn the Z-205 OFF, it just moves it far above the 1M address space of the 8088.

Z-205 RAM Chip Upgrade Mod (OPTIONAL) - This second part of the modification, allows the Z-205 board to use 256Kx1 DRAM chips. It does NOT need to be performed if 64Kx1 DRAM chips will still be used. This mod works best when used with the Z-205 Port Enable Mod described above.

Code support for Z-205 with 1 Megabyte was added. Previously, RAMDISK could only access one 256K mod bank at a time (for four 256K RAMDRIVES I:, J:, K:, & L:). The bank to access was set by BIT 0 & BIT 1 of the card's control port.

Using standard wire-wrap wire and a 25 watt soldering iron, perform the following steps to the Z-205 256K Expansion Card:

Notes:
- The ICs are positioned upside down.
- Pin refers to the IC's "legs".
- Pad refers to the PCB area where IC sockets are soldered.

1) Piggyback a 74F153 onto the IC at U35 (also a 74F153):
   - Bend up Piggy IC pins 5, 6, 7, 9, 10, 11, 12, 13
   - Remove IC at U35 (this becomes the Bottom IC)
   - Put the Piggy IC on top of the Bottom IC

   - Solder Piggy IC pins 1, 2, 3, 4, 8, 14, 15, 16 to Bottom IC
   - Solder blob Piggy IC pins 9, 10, 11, 12, 13 to each other
   - Insert this into the U35 socket
2) Remove the IC at U150, bend up pins 2 and 5, and reinsert
3) Jumper U150 IC bent pin-5 to Piggy IC bent pin-5
4) Jumper U150 IC bent pin-2 to Piggy IC bent pin-6
5) Solder a 33 ohm resistor with leads cut short to Piggy IC bent pin-7
6) Remove all 64Kx1 DRAMs at U53-U88
7) Jumper together all the pad-1s of U53-U88 on the solder side of the card. An easy method is to place a small solder blob on each pad-1. Using a single strand of wire-wrap wire, use the soldering iron tip to burn off a bit of the wire's insulation and tack solder the wire in place.
8) Jumper the free end of the 33 ohm resistor to the socket pad-1s from step 7. Pass the jumper wire through a clear feed-through hole from the component to the solder side of the card.
9) Insert 36 256Kx1 120nsec DRAMs (good for 8MHz operation) at U53-U88. For 10MHz operation, use 100nsec or faster.

Note: For a 10MHz Z-100, U14, a 74LS74 chip on the Z-205 card, is subject to failure and TESTZ205 reports all the RAM as bad! Replace U14 with a 74ALS74, 74S74, 74AS74, or 74F74.

Z-205 Configuration:

The Z-100 is able to use up to three Z-205 256K Memory Boards. This was to allow the initial Z-100 with only 192K memory on the motherboard to add memory without adding chips to the main board. So, we need to set the address of the Z-205 RAM Board(s) with its DIP switches.

CAUTION: There are two popular switch types in use. The older boards used a 0 marking to reflect OFF. The newer boards used an ON marking in this position. To avoid confusion, the following tables reflect the 0/1 setting for the older boards and On/Off setting for the newer boards.

Switch SW1 - The Z-205 card uses one I/O port to control and monitor the parity error circuitry. Switch SW1 is an 8-position switch that permits you to select any one of the 256 possible address locations as the I/O port.

To set port address 98(hex) for the **first** card, where 1001=9 and 1000=8, set **SW1** to:

Position:	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Addr Bit:	A7	A6	A5	A4	A3	A2	A1	A0
Port 98h:	1	0	0	1	1	0	0	0
New Board:	Off	On	On	Off	Off	On	On	On

Similarly, to set the port address for the **second** card, you must set **SW1** to port 99h, where 1001=9:

Position:	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Addr Bit:	A7	A6	A5	A4	A3	A2	A1	A0
Port 99h:	1	0	0	1	1	0	0	1
New Board:	Off	On	On	Off	Off	On	On	Off

And for the **third** card, you must set **SW1** to port 9Ah, where: 1001=9 and 1010=A:

Position:	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Addr Bit:	A7	A6	A5	A4	A3	A2	A1	A0
Port 9Ah:	1	0	0	1	1	0	1	0
New Board:	Off	On	On	Off	Off	On	Off	On

Switch SW2 - The Z-205 board is addressed as a single (64K, 128K, 192K, or 256K) block of contiguous memory starting on a 64K boundary. The starting address is selected by the 8-position switch SW2. Those boards modified to accommodate 1 Megabyte of RAM uses four 256K banks of RAM.

Therefore, **to add 256K RAM cards to a Z-100 with 192K RAM on the motherboard (starting with address location 30000h)**, you would set **SW2** to the following for each card added:

Position:	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
First Z-205 256K Board added, where 0000=0 and 0011=3:								
Addr 030000h:	0	0	0	0	0	0	1	1
New Board:	On	On	On	On	On	On	Off	Off
Second Z-205 256K Board added, where 0000=0 and 0111=7:								
Addr 070000h:	0	0	0	0	0	1	1	1
New Board:	On	On	On	On	On	Off	Off	Off
Third Z-205 256K Board added, where 0000=0 and 1011=B:								
Addr 0B0000h:	0	0	0	0	1	0	1	1
New Board:	On	On	On	On	Off	On	Off	Off

To add Z-205 RAM cards to a Z-100 with 768K RAM on the motherboard, however, things get considerably easier. With the modification discussed earlier, these boards will only have "swappable" RAM. Therefore, each 256K card, or on the one megabyte cards, each 256K block of RAM, will begin at address 0C0000h, where 0000=0 and 1100=C.

For each card used, you would set **SW2** to the following:

Position:	7	6	5	4	3	2	1	0
Addr 0C0000h:	0	0	0	0	1	1	0	0
New Board:	On	On	On	On	Off	Off	On	On

Z-205 Jumper Settings:

There are also jumpers to be set on the Z-205 Memory Expansion Card. Jumpers J1 and J2 set the amount of memory (in banks) on the card.

J1 is open for 256K RAM (4 banks) on the board; short for 64K (1 bank) and 128K RAM (2 banks). J2 is open for 128K and 256K RAM; short for 64K RAM.

In tabular form:

J1	J2	64K chips	256K chips
0	0	256K	1 Meg RAM (4 Banks)
1	0	128K	Not defined
0	1	Not defined	Not defined
1	1	64K	Not defined

The hardware modifications require that J1 and J2 be left open for modified 256K or 1 Meg Cards and **ALL BANKS MUST BE USED.**
J3 adds 3 wait states for memory access.
J4 adds 2 wait states.
J5 adds 1 wait state.
J6 adds 0 wait states.

Note: Wait states are needed depending upon the speed of the computer's CPU. If you use more than one jumper, the Z-205 card will respond to the highest number of wait states you selected. If you get read/write errors from the Z-205 card, you may try changing the wait state.

Move the Jumper Block on left side of card to:
J6 For 5MHz Z-100
J4 For 8MHz Z-100
J3 For 10MHz Z-100

CAUTION: See the sidebar on Setting Wait States at the end of this article.

Jumper J7 has jumpers set on pins 2,3 and 4,5 for normal (8-bit or 16-bit) operation. Place jumpers on pins 1,2 and 3,4 for 64K (8-bit only; with 1 bank of RAM on the card) operation.

DOS v2.x & v3.x Software:

Users of DOS v2.x or v3.x have several options, using MDISK.DVD variants, or a Z205DISK.SYS version, developed by John Beyers and distributed in 1992, that is used similar to the procedures under Z-DOS v4.

They can initialize the Z-205 RAM Disk as described in the article of issue #38 using utilities similar to MDISK.DVD (from the Zenith DOS Programmer's Utilities Pack with numerous changes by John Stetson), RAMDISK .DVD (a better MDISK from Mike Zinkow) and RAMLIM.COM (a utility that limits the amount of DOS RAM to protect the data in a RAM Disk).

MDISK.DVD and RAMDISK.DVD are utilities used by CONFIG.SYS to reserve an area of the computer's RAM to establish a RAM Drive. The RAM Drive is then used in the same manner as a disk drive, but which has much faster access.

As there are several different configurations possible, let's briefly address each.

RAM Drive using only one Z-205 256K Card:

To initialize a RAM Drive, add the following line, or something similar, to CONFIG.SYS:

DEVICE=RAMDISK.DVD SIZE=256 START=C000

When the driver is run by CONFIG.SYS, the RAM Drive is defined using the size and starting parameters provided and given the drive letter 'I'.

How do you determine the SIZE and START parameters?

Well, with 256K RAM chips on the Z-100 mother board (768K RAM total max), it is possible to address a Z-205 memory card at 768K (that's the 0C0000h). Adding a single 256K Z-205 Card would then result in useable system RAM up to 992K (the Monitor ROM in the top 32K overrides the RAM higher than 992K).

Assuming that the memory from 976K to 992K is reserved for protecting the transient portion of COMMAND.COM, a variety of different RAM disk starting addresses and sizes can be used.

The following table summarizes several different RAMDISK sizes:

START:	END:	SIZE:	ADDRESS:	DESCRIPTION:
768K	976K	208K	C000-F3FF	Smallest size
464K	976K	512K	7400-F3FF	
336K	976K	640K	5400-F3FF	Largest size

But, WAIT! We only added a 256K board. How can a size of 512K or larger be made? Well, that can be more clearly seen with the next situation...

RAM Drive using a part of motherboard memory:

This example will work the same with or without an additional 256K Z-205 Card. So let us assume that we have one Z-205 256K RAM card, but we want a 512K RAM disk.

If we chose to initiate a 512K RAM disk but only installed one 256K Z-205 card, we would place the following line in CONFIG.SYS:

DEVICE=RAMDISK.DVD SIZE=512 START=7400

The following table summarizes the resulting memory allocation scheme:

START:	END:	SIZE:	ADDRESS:	DESCRIPTION:
992K	1024K	32K	F800-FFFF	MTR-100 ROM
976K	992K	16K	F400-F7FF	COMMAND.COM
		(transient)		
464K	976K	512K	7400-F3FF	RAMDISK.DVD
000K	464K	464K	0000-73FF	System RAM

Then, to keep DOS from overwriting the RAM disk memory area, we must use the RAMLIM.COM program. This program reserves the upper portion of system RAM so that DOS and well-behaved application programs will not attempt to access

memory above the specified limit. This capability provides the following functions:

1) Protects a RAM or memory Disk in high memory.
2) Protects the transient part of COMMAND .COM from being overlaid by application programs.
3) Controls the use of the Z-205 Memory Expansion Board.

RAMLIM requires that the size and starting address of the memory to be reserved be specified as command line parameters.

For our example, RAMLIM should be installed in your AUTOEXEC.BAT file, like this:

RAMLIM SIZE=528 START=464

The SIZE parameter may range from 16K to 864K. The START parameter may range from 128K to 976K. SIZE + START must be less than or equal to 992K.

Care must be taken when selecting the SIZE and START values or system memory may become fragmented. A gap of 32 bytes between the upper end of system RAM and the memory area reserved by this program is created so that the FAT of a memory disk starting at this point is not overlaid by DOS.

The reason we need to use 528 for the SIZE is that RAMLIM thinks that the Z-100 only has 992K of memory, since it does not recognize the ROM area as needing any protection.

Installing this RAMDISK driver will provide a 512K RAM disk in the top one half megabyte of the Z-100's address space.

Multiple RAM Drives using two Z-205 256K Cards, or up to two Z-205 1M Cards:

As we have discussed, with "swappable" Z-205 cards, we can add more than one. However, each 256K card, or each 256K bank of a 1M card, has to be controlled (swapped) separately. To do this, we must configure each card as discussed above. The first card uses port 98h and the second uses port 99h. All cards use the 0C0000h starting address.

The software becomes a mess. Each card will require its own driver, configured for that card. Therefore, the source code, RAMDISK.ASM must be modified and reassembled.

Modification is a simple one byte change, but before you do that, copy the original file, RAMDISK.ASM to RAMDISK1.ASM. I also made a copy to RAMDISK0.ASM and copied the original RAMDISK.DVD to RAMDISK0.DVD.

And, while we are in the programming mood, if you are going to use a 1M modified Z-205 card, you might just as well make the following files also:

Copy RAMDISK.ASM to RAMDSKM0.ASM thru RAMDSKM3 .ASM. Rename the existing RAMDISK.DVD to RAMDSKM0.DVD. Each 256K bank on the 1M card will require its own driver file!

Now, in each .ASM file, there are two lines of importance, lines 11 and 12. They read:

```
bank   equ  0 ; bank (0-3) if 1M mod installed
card   equ  0 ; card (0-1) for up to two Z-205
                cards
```

For our 256K cards, change the **card** line to equal 1, save, reassemble as RAMDISK1.COM, and rename to RAMDISK1.DVD. Notice that we are limited to two 256K cards we can add.

For our 1M card, change the **bank** line to equal 1, save, reassemble as RAMDSKM1.COM, and rename to RAMDSKM1.DVD. Do the same for banks 2 and 3. If adding two 1M Z-205 cards, you will need to do another set of four files with the **card** line also changed to 1. I would name these as RAMDSKM4 thru RAMDSKM7.

Now that we have the files modified, we must use separate device commands in the CONFIG.SYS file, one for each board:

```
DEVICE=RAMDISK0.DVD SIZE=256 START=C000
DEVICE=RAMDISK1.DVD SIZE=256 START=C000
```

For each 1M Z-205 card, you would have four of these DEVICE lines:

```
DEVICE=RAMDSKM0.DVD SIZE=256 START=C000
DEVICE=RAMDSKM1.DVD SIZE=256 START=C000
...
```

The RAMDISKx.DVD or RAMDSKMx.DVD drivers will make the cards drives I:, J:, K:, etc. Notice that I specified 256K for the size of each.

Single RAM Drive Using Z205DISK.SYS

Finally, John Beyers developed Z205DISK.SYS which simplified the setup and use considerably. Z205DISK.SYS would automatically test the RAM available, above the motherboard's 768K, and assign it to create just one RAM drive, drive 'I'. However, it had some specific requirements:

- All Z-205 cards require the Port Enable Modification to be made "swappable".
- The motherboard requires 768K of RAM.
- The first card must be set to port 98h, the second to 99h, third to 9Ah, etc.
- All cards must be set to address 0C0000h.
- Only one card could be less than 1M (4 banks of 64k for 256K Card) and it must have the highest port address.

All RAM drives exist above the 768K RAM of the motherboard and RAMLIM is not used. John also developed TESTZ205.COM to be used to test all these "swappable" cards.

To load Z205DISK.SYS, enter into your CONFIG .SYS file something like the following, where Z205DISK.SYS is assumed to be in the \SYS sub-directory:

```
Rem  Z-205 Memory disk driver
Device=\SYS\Z205DISK.SYS
```

During boot-up, Drive I: will be assigned the total amount of RAM found on the Z-205 cards.

DOS v4.x Software:

Now, with Z-DOS v4, John's Z205DISK has been updated to Z205DSK.SYS and uses the added versatility of Z-DOS v4. The requirements of Z205DISK are unchanged.

To load Z205DSK.SYS, enter the following into your CONFIG.SYS file, where Z205DSK.SYS is assumed to be in the \SYS sub-directory:

```
Rem  Z-205 Memory disk driver
Device=\SYS\Z205DSK.SYS
```

The drive letter is the next available drive as assigned by DRIVECFG. Finally, DRIVECFG can also assign any 256K bank of RAM from these cards to be added to the 768K of motherboard RAM to give DOS a total of 992K RAM (upper 64K not available) for its use.

So, what can we do with this capability?

Functional Use:

To my knowledge, little has been written about the functional use of a RAM Disk. So let us review how we can put this RAM Disk to productive, functional use.

The obvious advantage of a RAM Drive is its fast speed - no spinning heads, moving parts, etc. Any application that requires numerous disk accesses, such as database applications, would obviously benefit from using a RAM Drive. You simply load your database into the RAM Drive, run your application making all the changes, then copy the database back to its permanent drive.

The only disadvantage is that the RAM Drive is NOT permanent storage. A power loss will destroy all data in the RAM Drive!

Just for the record, however, the data loss is NOT instantaneous. While it probably varies from machine to machine, I find that a power loss of only 15 seconds leaves the data virtually intact. After 30 seconds, I loose about 30% of the characters. After 45 seconds, the files are gone.

Another popular application is for shelling COMMAND.COM, or alternate COMMAND.COMs, which is called for every DOS command. All the transient commands must be loaded before the command is invoked, so loading from a RAM Drive would be considerably faster.

A program called SHELLX.COM can be run from the CONFIG.SYS file during the boot process. It copies COMMAND.COM from the boot drive to the RAM Drive, which it assumes is drive I:, and then invokes I:\COMMAND.COM with the /P option to make it permanent in memory. This causes COMMAND.COM to always be reloaded from the RAM Drive instead of the boot drive.

To have DOS invoke this program at system boot, put SHELLX.COM in the root directory of your boot drive and place the following in your CONFIG.SYS in the same directory:

```
SHELL=SHELLX.COM
```

John Beyers suggested another usage. Place the following 3 lines in your AUTOEXEC.BAT file:

```
SETZ205
IF NOT exist %Z205%:command.com copy
   command.com %Z205%:
IF exist %Z205%:\command.com set
   comspec=%Z205%:\command.com
```

These three lines will cause an error at boot time if no Z-205 RAM disk exists, but it will not disable the system. The program SETZ205 sets an environment variable Z205 to the drive letter allocated when the config.sys command, DEVICE=Z205DSK.SYS, is executed.

The second line copies COMMAND.COM to the RAM drive, if it is not already there. The last line sets the environment variable COMSPEC to COMMAND.COM on the RAM drive if it exists. This process will cause all programs, including DOS, to use COMMAND.COM from the RAM drive whenever it is needed.

Note: Some books talk about using COMMAND.COM with a /P switch to place a copy of COMMAND.COM in memory and use that copy. However, that copy is using valuable motherboard memory. COMSPEC specifies the use of COMMAND.COM located on the RAM drive.

John also suggested using the environment variables TMP and TEMP. Many application programs, such as WordPerfect, check the environment for these variables, and will function quite a bit faster if temporary disk files are on a RAM drive.

Use of TMP and TEMP is quite simple. After determining which is used by your application program, use a batch file to begin that application. For example, WordPerfect uses TEMP. Create a batch file that:

- Makes a TEMP directory on the RAM drive:
  MD I:\TEMP
- Sets the environment variable TEMP:
  SET TEMP=I:\TEMP
- Sets the RAM drive as the default:
  I:
- Invokes WordPerfect
  E:\WP\WP

I probably surprised you with that third line. It sets the RAM drive as the default drive.

Why?

When executing DOS commands and programs, if the RAM drive is the default, any command that needs temporary disk space, such as the MORE command, will often use the default drive.

Remember to save your work periodically to a real drive. WordPerfect can be configured to do timed backups of your work. I recommend that these continue to be set to save to your hard drive or floppy.

Finally, the RAM Drive is very handy for testing alternate ROM devices, such as our proposed changes for ROM v4.03. It requires Z-DOS v4 and John Beyers had written several support programs to ease the process:

- **RMT.COM** swaps a 256K block of Z-205 card memory down into existance, copies the MTR-ROM.BIN file to be tested into it, disables the normal ROM chip, acts as an ESCape-J command to jump to the boot code, and returns us to an **inverted** Z-100 Hand Prompt under the control of the simulated MTR-ROM.

Note: RMT is ROM code specific in that the simulated ROM code is actually placed in RMT when RMT is compiled.

From this inverted hand prompt, nearly all the functions of the simulated MTR-ROM can be checked out, including booting to a hard drive, floppy drive, and the LLSCSI/EEPROM board.

CAUTION: Doing a {**CTRL**}-{**RESET**} at any time while under control of the simulated MTR-ROM will crash the Z-100 and require a power off/on cold boot to recover.

- **ROM.COM** will discontinue testing under the test MTR-ROM, clear the screen, emit a click, and return us to a normal hand prompt.

- **TESTZ205.COM** will do a memory test of the Z-205 memory chips and report which chip is bad.

The procedure to use the new test MTR-ROM:

- Boot normally. If you have not done so yet, run TESTZ205.COM to ensure the RAM Drive is operating properly.

- Run RMT.COM. This will cause the Z-100 to click, clear the screen, emit two beeps, display the MTR-ROM Help Screen, and display an inverted hand prompt. Nearly all functions of the MTR-ROM can be completed, including booting. However, there are some precautions to be aware of:

    -- Some programs, which access the ROM directly, will NOT work properly.
    -- Performing a {**CTRL**}-{**RESET**} will only crash the system, requiring a full shutdown and restart.

- When testing is complete, there are three ways to EXIT this simulation:

    -- Run ROM.COM from the DOS prompt. This will emit a click, clear the screen, and return us to a normal hand prompt.
    -- If at the inverted hand prompt, type **OUT 98,0{CR}**, which will crash the system, but then a {**CTRL**}-{**RESET**} will work properly.
    -- Power down the system and power up normally.

While we are discussing the new MTR-ROM, there are two very noticeable differences, from earlier versions, found while booting:

- The first was mentioned above; instead of just displaying a normal hand prompt on a blank screen, the new MTR-ROM will clear the screen and display the initial Help Screen showing the commands available, followed by the hand prompt.

- Upon pressing {**B**} for Boot, it will display the default boot device, such as:

"*Default Booting Primary Z207 34-pin Unit 0*"

as set by the DIP switch on the motherboard, and on the next line:

"*Input Boot string <CR>_*".

Pressing {**RETURN**} will boot from the default device shown; or enter the usual boot string to boot from another device.

Finally, in addition to the RAM drive, I mentioned that we can assign one of the banks of RAM from these Z-205 cards to DOS memory. This can be done two ways; using the OUT command at the Hand Prompt or using DRIVECFG.

HAND PROMPT:

Each Z-205 card has four banks of RAM. A 256K card has 4 banks of 64K each. However, our software will treat a 256K card as one bank of 256K RAM. It cannot be split up.

A 1M card has four banks of 256K each.

To turn ON any of the banks of a "swappable" Z-205 card, you use the **OUT** command.

The OUT command to turn ON the first bank of card 98h, for example, is:

    OUT 98,80 or OUT 98 80
    (Either a comma or a space can be used)

This command swaps the first bank of the first memory card down into DOS addressable RAM space starting at 768K and ending at 992K and turns the LED ON. Use 81, 82, or 83 to turn ON banks 1, 2, or 3, respectively.

To turn OFF the card again, use:

    OUT 98,0 or OUT 98 0

The LED will also turn off.

Note: Any RAM left above the RAM bank turned ON, including RAM cards with higher port numbers, will become unusable for a RAM drive. Therefore, always use the highest bank of Z-205 RAM.

Let's do an example. We have two 1M cards, 98h and 99h installed. We have installed the driver in CONFIG.SYS:

device=Z205DSK.SYS

Normally at boot-up, we would have a 2M RAM drive, detected automatically, and assigned the next drive letter available by DRIVECFG.

However, for a particular application, we want to have 1M of RAM for the application's use. At the hand prompt, we can use the command:

OUT 99,83

to assign the last 256K bank of the second card to DOS use. Now, at boot-up, the remaining 1.75M on the Z-205 cards would become the RAM drive!

Note: The upper limit of DOS RAM must be set to 992K in DRIVECFG for this increase to succeed. Otherwise, while the card is still turned ON, the additional RAM is still not considered usable by DOS.

At the completion of the application, if we want to change back to a 2M RAM drive, we can do a {**CTRL**}-{**RESET**} and at the hand prompt, use the command:

OUT 99,0

to turn the card OFF again, and reboot.

DRIVECFG:

This same example can be set for all boot-ups by running DRIVECFG. In the bottom portion of the screen, **F4 'DODmemLIMIT'** sets the upper limit of DOS in 32K increments. Normally set to 768K, press {**F4**} enough times to set the maximum of 992K.

Finally, press the **F12 'ALT FUNCTION'** key for the alternate set of options and press **F6 'Z205asUMB'** to enable Z205 as UMB (Upper Memory Block). This sets the upper 256K bank of Z-205 RAM for DOS use. Now, press {**ESCape**} and save to disk.

Note: While the card is still turned ON, if the upper limit of DOS RAM is not changed from 768K, the additional RAM is still not considered usable by DOS.

Upon the next boot-up, you will have 992K RAM accessible to DOS and a 1.75M RAM drive.

Setting Z-205 Wait States

CAUTION: Setting the wait state of a Z-205 card also affects the apparent CPU speed - the speed reported in the bootup screen!

While the CPU speed is still set by the Y103 crystal on the motherboard (one third of 15MHz, 24MHz, or 30MHz) and does not change, all memory accesses (to the motherboard or to the Z-205 card) are affected by the number of wait states selected - **the more wait states, the slower the computer!**

As you may recall, the last step of the 8MHz motherboard speedup upgrade by Zenith required installing a jumper at the W-2 pin of plug J106-1 on the motherboard to increase the wait states from 1 to 2.

Similarly, operating at a CPU speed of 8MHz, the article recommended setting jumper J4 for the addition of 2 wait states.

Whenever the card is accessed, such as during its use as a RAM drive, these wait states caused some minor delay. For infrequent accesses, this delay is imperceptible.

However, if a block of the Z-205 card is swapped down to make 992K RAM accessible to DOS, as discussed in the article, the boot-up and running speed may slow considerably because ALL DOS operations include memory use. The following table reflects this apparent boot speed for a 8 MHz Z-100:

Z-205 @ 8MHz Wait State:	**Apparent Boot Speed 8088:**	**V20:**
J6 = 0WS	7.9MHz	7.9MHz
J5 = 1WS	5.3MHz	5.9MHz
J4 = 2WS	4.8MHz	5.4MHz
J3 = 3WS	3.?MHz	5.0MHz

Yet, for some reason, the wait state became less a factor with my 1M card with fast RAM on a 10MHz Z-100:

Z-205 @ 10MHz Wait State:	**Apparent Boot Speed 8088:**	**V20:**
J6 = 0WS	9.8MHz	9.8MHz
J5 = 1WS	9.8MHz	9.8MHz
J4 = 2WS	9.8MHz	9.8MHz
J3 = 3WS	7.7MHz	6.4MHz

Note: Your results may differ from mine. The number of wait states required varies with the speed capability of the integrated circuits installed on the Z-205 board.

For those operating at CPU speeds greater than 5MHz, the number of wait states required **may** be reduced if faster TTL support chips are installed throughout the Z-205 Memory Expansion Card. Only through experimentation can you determine if your card will operate reliably with lower wait states.

Phantom RAM Drive?

During my experiments, the following situation appeared that I thought you should be aware of.

I was working on my Z-100 testbed, operating with a 5MHz motherboard with 768K of RAM, running at 8MHz and using Z-DOS v4.

I state it was a 5MHz motherboard because, as I have stated many times in the past, I have been playing with speed upgrades with minimal parts replacement, and running successfully as fast as 10MHz. This way, I get to experience many of the possible failures before you do. And, it gives me something to write about in each issue. But, I digress.

Anyway, I was running fine with one Z-205 card installed per the above article, using DOS v3 and DOS v4. However, when I added the second card, problems developed quickly.

The first thing noticed was that with two Z-205 cards installed, I could not boot Z-DOS v4. Z205DISK.SYS worked fine with DOS v3, but Z205DSK.SYS would not work with Z-DOS v4, and, as you now know, the two programs are very similar.

From a cold boot, the symptoms were:

- The DRIVECFG screen appears as normal.
- Z-205 parity was being checked, light blink on first board, then the second.
- The message that motherboard parity was being checked came on, then the computer stalled.

A warm boot would stall after only displaying the DRIVECFG-style opening screen.

With one Z-205 card installed, TESTZ205 would report testing RAM cards that did NOT exist; usually 9Bh or 9Dh, report all bad chips (no card there!) and then report all bad chips on the actual 98h card!

Finally, after I began chip substitution, I found that it was only V20 CPUs that would not boot. The 8088 chips will, but when TESTZ205 is run, it simply returns to the E: prompt without doing any checks!

It turns out that U217, a 74HC244 chip on the motherboard, was bad. While substituting with another HC244 chip, I got NO SCREEN DISPLAY at all! After throwing that chip AWAY and substituting an LS244 chip, it worked fine and fixed all the above symptoms, save one.

After testing the phantom drive, the real Z-205 card also failed because the TESTZ205 program did not properly clear the error between the tests. John Beyers has made the repair to the TESTZ205 program, but let me know if you still have an issue.

Closing

I hope you will give this upgrade a try. It will give your Z-100 a great performance boost.

If you need Z-205 boards, with or without modifications, or any of the software mentioned above, I may have what you need.

If you have any questions or comments, please email me at:
z100lifeline@swvagts.com

Cheers,

Steven W. Vagts