Z-100 LifeLine
Since 1989

February 2023

#140

A Professional Journal Exclusively for the Heath/Zenith Z-100 Computer

~~~~~~

Z-100 LifeLine Web Site: https://z100lifeline.swvagts.com

HOWGOZIT **1**

The Z-207 Floppy Controller That Could Not Control! **3**

The Memory Card That Could Not Remember! **6**

Z-205 RAM Card User's Manual . . . . . **Insert**

~~~~~~

HOWGOZIT

Well, it has been 8 months since I last played with the Z-100 and my website. I wish to thank those who have been calling me these recent months to check on how I am doing. To the rest, I wish to explain just how this last year has been the worst for us.

As most of you already know, I love to garden - and we have our home surrounded by them. And by the end of 2021, Myra and I finally had everything the way we wanted it. And being retired, we could now just sit back and enjoy our little piece of paradise - NOT!

2022 began simple enough - had to replace my gas grill and a few other issues, but no big deal. But by March, I had noticed that my septic tank was backing up into the yard - that is never a good sign.

I tried the usual septic tank repair and root treatment chemicals recommended online, but by June it was apparent that this was not going to work and I had the tank pumped again (it was just pumped out in October 2021). I got a Septic Repair Permit from the county and they determined I needed a new septic field. To make a long story short, I had to remove my gardens, salvaging what I could, and trees just below my home, install new septic lines, replant grass and the moved shrubs, and create a new sun garden in the months that followed.

The kicker? When the County Inspector came out to approve the completed septic work, we found that the septic tank filter was plugged up!

Filter? I've had a septic tank all these years in North Carolina and never even heard of a septic tank filter. And when the tank was pumped out over the last twenty years we have been here, no septic people ever checked or told me about a filter!

$20,000 dollars spent on a new system, thanks!

If you have a septic system, I suggest that the next time you have it pumped that you insist on them checking the filter!

Anyway, we also needed to finally dismantle and dispose of the pool's solar heater that I had constructed many years ago shortly after moving here. It had begun rotting out and with global warming we felt it was no longer necessary.

With my grandson's help, removal only took a weekend in September. Nevertheless, I barely got the new grass and gardens done and everything the way we wanted it before winter frost put an end to fall.

Meanwhile, in 2021 I had noticed that my right hip was giving me considerable pain and in 2022 I finally decided that it needed to get looked at and replaced. We scheduled the operation for late October! This created the time limitations on the septic field and gardens work.

The one good thing that came from all this gardening was that I had lost some weight and toned (if you can call it that) my muscles for the operation, but my hip was killing me by now!

Then, suddenly in October, my younger sister by two years passed away when she was about to walk her dog. Just dropped dead from a suspected heart attack on her front yard!

As eldest and only two hours away, I needed to clean out her home of all perishables and make all arrangements for handling her cremation and preparing her estate! Thankfully, I had Myra to assist and help keep everything on track! I was eventually named her Administrator and as of this printing, I'm still trying to get a grip on her finances!

The hip replacement operation was successful and within 4 weeks I was able to walk around without a walker or cane. However, while the hip pain was gone and the surgical site was not a problem, I was still experiencing pain down my right

~~~~~~
~~~~~~

leg, especially on each side of the knee. We were told this was a common complaint because there is a muscle down the inside of the leg from the hip to the ankle that the surgeon must move to the side to get access to the hip joint.

However, while I was being too aggressive with my recovery exercises, I pulled a tendon on the inside of my thigh. The pain was terrible, but I was told by the physical therapist that it was a common occurrence. I received some medication from the surgeon, and limped around for months! Even now, 4 months after the operation, I still have a painful limp!

Finally, on December 10th, about the time that a new home up the street was being hooked up to either cable or phone, our AT&T DSL land line went out. True to form, the AT&T service technicians on the phone could find nothing wrong from their end and we needed to schedule a service call, with the first available appointment 15 days later!! No internet or emails for 15 days!

As it turns out, AT&T called the next day reporting an outage in the area and reported that it would be fixed within two days, which it was. Yeah!

I was finally relieved of the funk and self-pity I was in when in mid-January I was asked if I had two Z-120's for sale. Of course, I still had 6 or 8 in boxes in the garage, and I replied that I could find two that would be perfect for him, but it would, however, take me a few weeks to thoroughly check them out.

Anyone who has owned a Z-100 for some time realizes that you may have a few issues when taking a Z-100 from lengthy storage. Things often do not work as they should when turning them on for the first time.

And while the computers were checked out before being boxed up for storage, that was back in 1994 when I retired from the Coast Guard. Since then, they had been moved from California to Elizabeth City, NC, and then to Hendersonville, NC, without seeing the light of day! I fully expected a disaster!

As with any computer coming from long storage, I first disassembled the entire computer, removing everything down to the bottom chassis. I dismantled the power supply to check for cleanliness, check solder joints, and reassemble. Both of these were found in fantastic shape.

I visually checked all the circuit boards and these were also in great shape. The keyboards were also cleaned, careful not to let any cleaning fluid get into the keys' bases.

When satisfied that I had checked everything, I finally attached the motherboard to the power supply and applied power. Amazingly, they both worked!

I attached a small monitor (not ready to attach the internal CRT and drive assembly yet) and performed the keyboard and memory checks on each system.

I had to repair one inoperative key. I also tested the 192Kb motherboard memory at 8 MHz to ensure I found any shaky integrated circuits. I even checked out two modified Smartwatch clocks (they were modified for separate CR2032 battery cells), in case they were desired.

I next disassembled the monitor and drive assemblies for visual checks and cleaning as necessary. I had to replace a scratched frame around one of the CRTs and removed each drive tower. Next, I attached the internal CRTs to their computer bases and applied power. Great screen displays!

Next, it was time to turn attention to the S-100 bus boards - Z-205 Memory Board, Z-207 Floppy Controller, and Z-217 hard drive controller that each computer would have.

I visually checked all the boards front and back for bad solder joints, broken or damaged resistors, capacitors, etc., and for badly installed integrated circuits. I also checked the voltage regulators with an ohmmeter. All looked great.

When satisfied that all was well, I installed the Z-207 Floppy Controller and attached a separate 5.25" floppy drive off to the side. Both computers booted without incident.

Since I had these computers spread out across the dining room table, now was also a good time to check out the stack of bad boards that I had been setting aside all these years. I wanted to give the computers plenty of run time, and this was the perfect time to do that.

I also ran full disk-based diagnostics (Zenith's DIAG program) on the RAM boards, floppy controllers and the floppy drives. Finally, I also used cleaning disks to clean the heads on the drives. The trouble reports from some of these board checks are discussed separately, next.

Finally, I tackled the hard drive controllers and their hard drives. Following the visual checks, I PREPped each 10Mb hard drive, ran PART to ensure both Z-DOS and CP/M partitions were formed, ran FORMAT on each partition and then loaded the desired software.

I now had two, perfectly functioning Z-120 all-in-one computers ready for operation!

The Z-207 Controller That Could Not Control!!

Some of you may recall that a Field Service Bulletin, FSB-Z100-31, explained about a mis-print on the silk screening for capacitor C35 on Z-207 floppy disk controllers having the number "85-2807-1". If the tantalum capacitor was installed in accordance with this incorrect silk screen, the capacitor would probably fail.

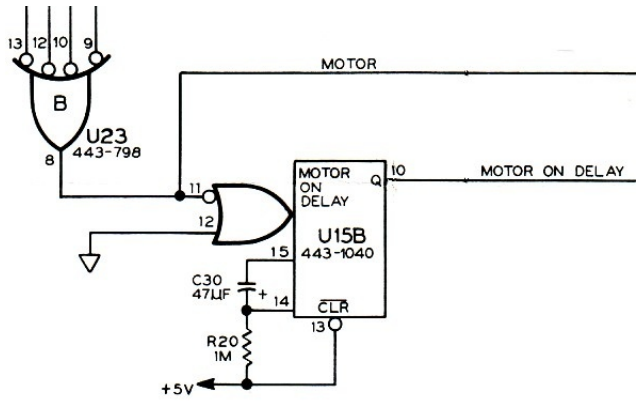
The first on the stack was an inoperative Z-207 Floppy Controller Board that stalled during boot-up after moving the drive head to track zero. Upon accessing the controller for a read, the drive LED would light and the disk spin, but the drive head would NOT move, except to track zero (if the head was elsewhere) and the Boot operation would stall. I ran the Zenith disk-based diagnostics from the hard drive and during the controller test, I would receive the error:

"HEAD LOAD TIME ERROR"
"CONTROLLER 0"
"CHECK CONTROLLER CHIPS U33, U15"
"REPLACE Z@)& CONTROLLER"

Well, whenever I have a board with a problem, I replace the chip(s) in question. If replacing these do not correct the issue, which is quite expected because it is only the most probable failed chips, I do a visual check of the board.

While this Z-207 controller, marked "85-2807-2 & 072883", was correctly silk screened, it had the factory installed C30, 47uF 6v tantalum capacitor installed reversed. I had another, similarly numbered controller, but the capacitor was installed correctly, so I thought it must have been a fluke.

The C30, 47uF capacitor is a timing capacitor for U15B, a 96LS02 (Heath part #443-1040) multi-vibrator that provides a Motor-on Delay. As you may recall, this delay was meant to keep the motor running for only about 15 seconds after the last disk access, then the motor was meant to stop when the capacitor was discharged.

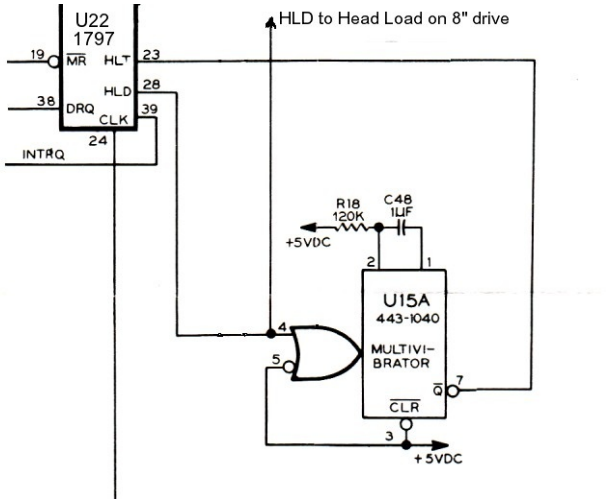


If you look at the schematic of U15B, you can see that C30 gets its power through R20, a 1 Megohm resistor to the +5Vdc power supply. However, you may also note that the capacitor symbol is upside down, the curved part should be negative, flat side to positive, but we are being picky.

Anyway, I reversed the C30 capacitor, per the schematic. In the past, there have been several complaints that the floppy drive would run forever (See LifeLine issue #62). This trouble was found to be a leaky, but not shorted nor open C30. It also occurs if the capacitor is installed reversed!

If you suspect that your floppy drives are running too long, you can do a simple check by observing the drive rotation after doing a "DIR" command. The drive should stop rotating within about 15 seconds.

During the visual inspection I also found that R18 was a precision 150K ohm resistor instead of the 120K ohms specified:



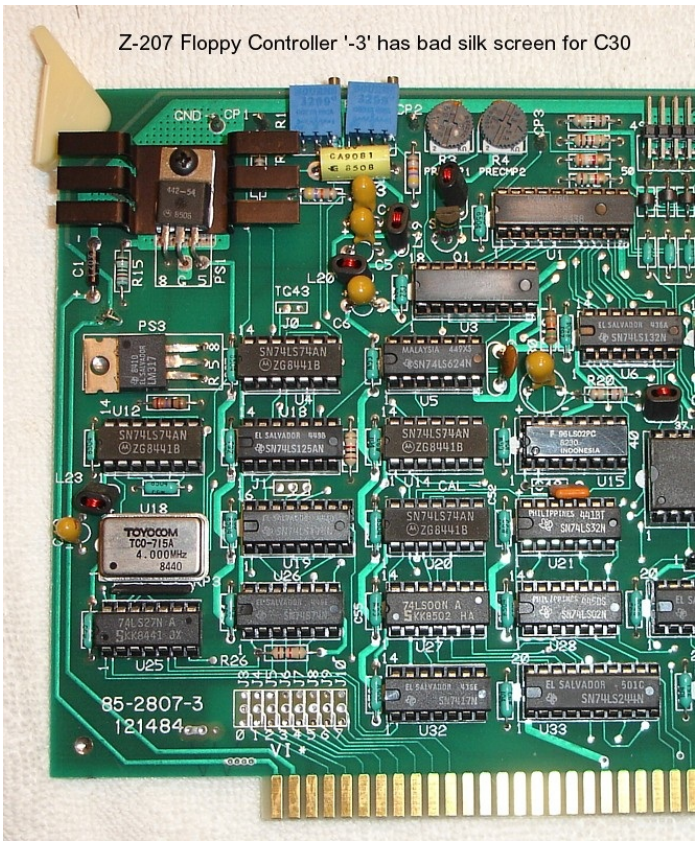
This resistor is in the timing circuit of U15A, a multi-vibrator which provides the Head Load Timing (HLT) signal to U22, the 1797 Floppy Controller, which controls the Head Load signal to the 8" drive connector. When the Head Load Timing signal is low, the drive head is not engaged.

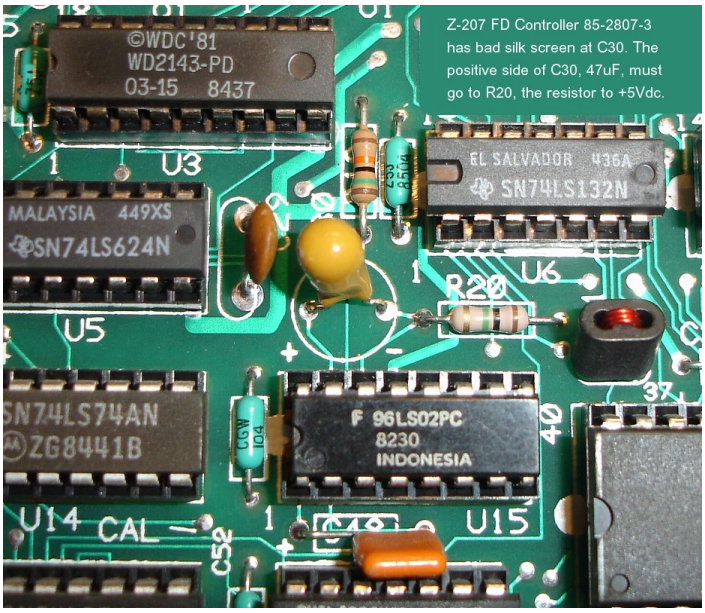
I have found no reason for the R18 value change mentioned anywhere. But if you are using 8" drives, this may provide some help.

I also replaced this with the correct size, but neither 'fix' had any affect on my problem.

I have since found that a later Z-207 Floppy Controller board "85-2807-3" (also on the inop stack) that I had has the capacitor silk screen for C30 "+" on the left side instead of the

right side shown on the "-2" board. It also had a precision 150Kohm resistor as I had found on the "-2" board. So I guess that both of these 'mistakes' had been on purpose, but WRONG, at least for the C30 capacitor!





You can clearly see the traces in the closeup. If you compare this with the circuit above, you can see that this is clearly wrong. Also, I checked the card's operation and the motor for the floppy drive never stopped! I reversed the capacitor and now the drive motor lasts about 18 seconds. Please note, and check your 85-2807-3 circuit boards!

Back on subject, this board was visually one of the best ones I have ever seen - all solder joints and IC chips immaculate. Not even any black IC pin discoloration from corrosion. So, I really needed to find the issue.

I will not embarrass myself by saying how many hours I spent on the board, but let me show you the thought process that I use to troubleshoot **any** circuit board (it does NOT always work, however).

First, replace the chips called for by DIAG, if used. - Done.

Next, remove the board and do a thorough visual inspection. On the solder side, look for cracked solder joints, particularly around any of those large electrolytic capacitors, huge heat sinks, and anything that may suffer from heat expansion and contraction cycles, if installed. Monitors and televisions are particularly sensitive to these heat cycles. You are also looking for unsoldered connections, solder bridges, etc.

On the component side, look for discolored, chipped, or missing (blown) components. When looking at a board full of integrated circuits (ICs), if you reflect a bright light off the line of IC pins (one side at a time), you can generally locate any bent pins that stand out from the others. On the Z-207 controller, you can sight along an entire row of ICs at a time. Also, check the polarity of capacitors and the markings on the resistors and ICs. - Done.

The next step varies. From past experience, integrated circuits of this generation often go bad and DIAG generally only gives a best guess as to where to look first. I find capacitors and resistors rarely drift off value enough to warrant a look at this early stage. So I begin replacing IC chips, beginning with the 40-pin controller first. On this board, I replaced all of them twice - and even placed them on a known good board. No dice, no affect!

Next, I tried resistance checks, comparing a good board with the bad board. Normally, these will have some differences because different manufacturers of IC chips will have some differences in resistance values, but we are mostly interested in whether a value is shorted or open. If shorted or open, remove any nearby ICs to determine if it is, or they are, a factor. These two boards matched nearly perfectly. - Done.

Next, continuing with the resistance checks, compare the circuit board with the schematic (if available) and account for every trace.

I am sure you are aware that all these Z-100 circuit boards are multi-layered, with power and ground traces, and possibly some other traces, often run internally. You also may have seen some wiring from the factory-made boards that were installed because a trace was found open - manufacturing defects in the traces found during testing. Whenever we solder on one of these boards, there is a chance that we may burn out an internal trace.

Finally, it is time to play with those parts not so easily removed - those tantalum capacitors, transistors, and those rheostats or potentiometers. Test what you can in circuit, but eventually they may require removal.

On the Z-207 controller, Q1 is just such an animal, an N-JFET device where the S and D pins appear shorted and affects the values of R3 and R4 of the pre-compensation circuit. I removed Q1 and tested it on my Transistor Tester. It tested fine. I also checked the other resistor values in that area while it was removed.

I finally found the culprit - AT LAST! I really should have checked out everything around the U33 and U15 integrated circuits found suspect by DIAG first thing, or a least second thing.

I also should have checked out this type of capacitor early on, as it is the same type, at C26, that often blows (just from age and non-use) that is located just to the left of the PS2 12v regulator at the top edge of the Z-207 controller.

I have reported on this common failure many times in the past. In fact, that same day, I found another Z-207 Floppy Controller that had not been used for 20 years or more. Sure enough, as soon as I applied power, C26 exploded with a flash and a puff of smoke - quite impressive!

Well, there are several of these notorious tiny cylindrical black capacitors on the Z-207 Controller and one is located just below the U15 IC, C48, a 1uf unit similar to that at C26! This one was shorted to about 2K resistance. Replacement (watch the polarity!) fixed the problem.

Before we leave the subject, while checking a few more Z-207 Floppy Controller Boards, I suddenly found myself with seemingly bad floppy controllers and/or floppy drives. I went through three known good controllers and three what I thought were good drives before I discovered the problem!

The first symptom was a familiar “PRIMARY Z-207 CONTROLLER ERROR” during bootup when I started a new testing sequence one afternoon. I continued to boot the hard drive to run the disk-based diagnostics. DIAG’s list of errors went like this:

> “FLOPPY CONTROLLER ACCESS FAILURE”
> “CONTROLLER 0"
> “CHECK Z207 CONTROLLER PORT ADDRESS SWITCHES”
> “CHECK Z207 CONTROLLER PORT CHIPS U29, U22"
> “REPLACE CONTROLLER”

I changed U22, the 1797 Controller chip, and tried again. Same “PRIMARY Z207 CONTROLLER ERROR”. Booted to the hard drive and ran DIAG again. To keep it brief, I’ll just list the errors, without all the surrounding text. I pressed {SPACE} to continue after each error was displayed and noted:

> Address Mark Detection Error - Check U30
> CRC Generator Detection Error - Check U30
> RPM = 300; Formatted the drive...
> Side Selection Error - Check U30
> Seek Errors galore...

I changed the controller... Same as above!
I changed the drive... Same as above!
I changed the computer... Same as above!

By now, I was getting desperate! I had changed everything, including the cables.

Back to the original test bed computer, but I decided to use a different test floppy - the only common factor not yet eliminated. BINGO!

Could it be? I had never run across this before. But, it was indeed a BAD floppy disk! I had used the disk many times in the past, but whatever went bad certainly had a devastating affect on everything else.

To be sure, I tested both computers, all three controllers, and all three drives... All worked flawlessly, to my great relief.

If you have run into this before, I would love to hear about it. Meanwhile, if you experience something like this, do NOT forget to change the floppy disk!

The Memory Card That Could Not Remember!

While the Z-205 RAM Expansion Boards that I found in the two Z-120 all-in-one computers that I unpacked worked flawlessly, I found one in the inop stack that had issues. After installing the board, the ROM's {S}ystem command would not recognize the additional RAM. I was able to boot to a floppy, however, and ran the disk-based diagnostics, DIAG.

I spent days troubleshooting the board, doing the visual inspection, replacing the IC's called for, etc., but was getting nowhere.

Note: For those with a full 768Kb RAM on the motherboard, this may not interest you that much, but even with 768Kb already, the Z-100 can address 1Mb of RAM, so you may wish to use another 256Kb RAM card as a RAM drive. Check out the Periodical Index on the Z-100 LifeLine Website under the topics Z205 RAM and RAMdrive for additional articles on this topic.

I was running short of these 256K RAM Cards so it was important that I not give up on this one. But, I did come very close. Here's how the testing went after the visual inspection:

Though I occasionally got a Parity or Bus Error midway through the Boot process, I was generally able to Boot to a floppy and run Zenith's disk-based diagnostics program, DIAG. After config-uring the RAM diagnostics for 64Kb chips, and banks 00-06 (the motherboard RAM has 3 banks, 00-02, and the Z-205 RAM has 4 banks, 03-06), I ran the RAM test.

DIAG's Memory Test gave a series of errors, as I pressed {SPACE} following each to continue:

"SYSTEM MEMORY FAILURE"
"BANK=03, BIT=07"
"REPLACE Z205 CHIP U80"
"REPLACE Z205 CARD"

Pressed {SPACE} to continue. Gave same again. Pressed {SPACE} again, for a new error message:

"SYSTEM MEMORY FAILURE"
"BANK=03, BIT=03"
"REPLACE Z205 CHIP U82"
"REPLACE Z205 CARD"

Pressed {SPACE} to continue, each time. Gave the same error again (4 times) before continuing with:

"SYSTEM MEMORY FAILURE"
"BANK=03, BIT=06"
"REPLACE Z205 CHIP U81,U32"
"REPLACE Z205 CARD"

Pressed {SPACE} to continue. Gave same again. Pressed {SPACE} again to show:

"SYSTEM MEMORY FAILURE"
"BANK=03, BIT=03"
"REPLACE Z205 CHIP U82"
"REPLACE Z205 CARD"

Pressed {SPACE} to continue, and finally the testing ended, with errors.

I replaced all the chips that were mentioned, but nothing changed. So I began replacing other chips in the parity circuit that I was guessing may be the answer. I finally found that U43 caused a 'fix' (actually a change in symptoms).

I replaced it with a known good chip - and could no longer Boot at all, either getting more Parity or Buss errors or stalling at that same point while booting!

About that same point, I noticed that the ROM {S}ystem command would report 192Kb continuous RAM while I could Boot with the 'Bad' U43, but I could NOT boot when the {S}ystem command reported some 64Kb boundary in the Z-205 memory board, such as: 256Kb continuous RAM, 320Kb, 384Kb or the full 448Kb RAM! The changes to the RAM displayed were coming about as I would change RAM chips.

The symptom was plain enough - it would NOT allow me to boot to either a floppy or hard drive, unless the {S}ystem command listed only 192Kb (the RAM on the motherboard)!! You can not run DIAG to check memory that is not seen by the ROM chip! So, where do you go from here?

Fortunately, I have the Z-205 Manual and it had a separate way to test the memory on a Z-205 board. I have attached my version of the Z-205 RAM Expansion Card Manual with this issue. You may want to check it out.

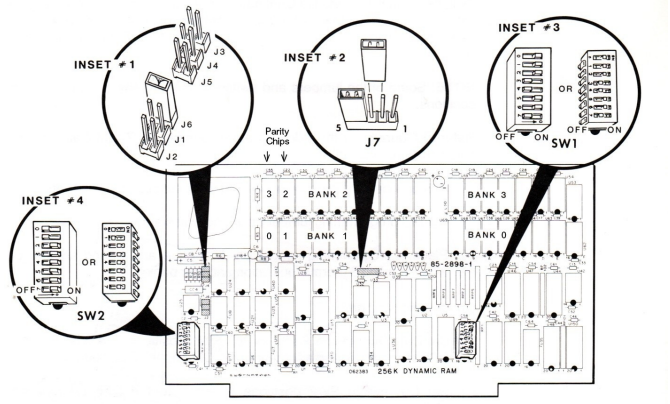
The Z-205 RAM card 'Typical Configuration' for use in the Z-100 series computer uses several jumpers. The Z-205 card uses 4 banks of 64Kb RAM chips for a possible total of 256Kb RAM. But, according to the Z-205 User's Manual, you can set the Z-205 RAM card to use RAM in different 64Kb configurations using the jumpers. Further, this can be done even if the board is fully populated with chips in all four banks.

So, by installing an additional jumper on J1, I finally settled on leaving the good U43 chip and a 128Kb configuration on the Z-205 Card. This allowed me to swap RAM chips from banks 2 & 3 into banks 0 and 1, and run the Z-205 Initial Tests from the Z-205 User's Manual.

Note: Banks 0 and 1 are not correctly shown in the Zenith Z-205 User's Manual. Banks 0 and 1 were reversed. Bank 0, the 3000h memory block, is actually located in the lower right memory section, and Bank 1, the 4000h memory block, is actually located in the lower left memory sec-

tion. I have corrected this diagram in my User's Manual and added the location of the parity chips for additional clarification. I show the corrected figure here:

Typical Z-205 RAM Card Configuration



Legend:

Bank 0	Used in 64K configuration.
Banks 0, 1	Used in 128K configuration.
Banks 0,1,2,3	Used in 256K configuration.

NOTE: It is possible to select any configuration on the fully populated card.

Jumper and Switch Locations and Settings

These tests showed that a few bad chips were showing up as alternating values in the data block on display. For example in Bank 1, an alternating 32,33,32,33,32,33... in a block in the display indicates a very bad chip that was causing all the memory reporting problems and boot issues!

When I swapped all the chips from bank 2 into 1 I found the answer and the card worked with the 128Kb configuration (for 320Kb total contiguous RAM)! Swapping out chips one at a time finally corrected the display.

Note: I have also configured some of these 256Kb RAM boards for 1Mb RAM drives. You may wish to check out those articles mentioned earlier.

Closing

I really enjoyed sharing this issue with you. It brought me back to the early days of trying to figure out all the intricacies of Z-100 repair. There is always something new to learn. I hope that you found this information useful.

As reported in the last few LifeLines, I am out of spare Z-100 LifeLine IDE Controller boards! I have received zero comments or thoughts so far, so I have left the situation in limbo. If there is anyone who still desires obtaining an IDE Controller, please let me know.

I have updated a growing number of articles for the "*Z-100 LifeLine*" Website. I have also added several covering each of the Z-100 PC emulators. All of these have been updated with more recent information and many additional photographs that were not possible when I first published them.

I hope that you find these helpful and very useful. Also, if you have an issue on which you require more information or that you feel would make a great addition to the Website, please feel free to let me know.

If you have just visited this website and have not given me an email address, please provide one to me so that I may advise you of when the next LifeLine is published, or when something new is happening. I promise - no SPAM.

Myra and I caught what we thought was a cold back in January. However, I home-tested positive for Covid! Myra got it a few days later. We never got any of the normal symptoms, just a head cold, but the symptoms lasted three weeks! Fully vaccinated, we felt extremely lucky. We have not been able to figure where the source came from, as we mask everywhere we go and avoid all crowds.

While the Covid restrictions have finally been lifted, please stay safe & take no unnecessary chances. Keep your families safe and get vaccinated as soon as you can.

Have a great spring.

'Til next time,
happy computing!

Cheers!!!

Z-100 LIFELINE
Supporting the H/Z-100 Community Since 1989

Steven W. Vagts
211 Sean Way
Hendersonville, NC 28792
(828) 685-8924
e-mail: z100lifeline@swvagts.com

Don't forget our Z-100 LifeLine Website:
https://z100lifeline.swvagts.com