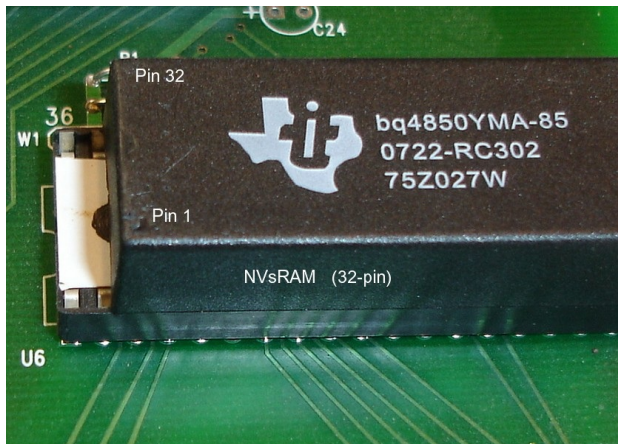




This article is a compilation of a series of troubleshooting events.



## IDE NVsRAM Battery Replacement

by Charles Hett & Steven Vagts  
"Z-100 LifeLine" Staff

### IDE NVsRAM Battery Replacement!

#### Written in early 2024:

We have known for years that these battery-backed NVsRAM units would not last - they have an advertised life of only 10 years - and now Charles Hett has reported the first inoperative unit. The symptoms are fairly simple:

- \* The clock will not keep time, cannot be set, or the DOS system clock is not updated.
- \* The NVsRAM is reported as corrupt and/or cannot be reprogrammed.

I have a stock of about 12 spare BQ4850YMA NVsRAM units that I bought back in January 2024. While these are no longer manufactured, these are new units purchased through Digikey Electronics and have not been used, so they should last their advertised 10 year life.

A newer 'N' model is also discontinued, but when I checked in January, Digikey reported they had in excess of 5000 available, but for \$70+ each. So they are, apparently, still available.

My current price is \$60.00, shipping included, reserved only for known "Z-100 LifeLine" IDE Controller owners. I will continue to watch the market.

I do NOT recommend purchasing these from E-bay as they are probably used and either their clock has already failed (making them useless) or they only have a portion of the advertised 10 year life remaining. Buy ONLY new, from a reputable source.

As an alternative, Charles Hett has looked into what it would take to just replace the battery in existing NVsRAM units, as he had with the SmartWatch batteries. And he has been successful again. The following is a report of his procedures.

**CAUTION:** This battery replacement is hazardous in that it requires the permanent disconnection of the existing battery by grinding out the connection at the battery and soldering a connection from the new battery to the existing battery's tab. There is a high chance of damaging the NVsRAM and existing battery, creating a leak of corrosive material or even possible explosion! AND, there is no guaranty of success! If you are not electronics savvy or handy with tools, it would be best to order a new NVsRAM.

#### Z-100 BQ4850 NVsRAM Dead Battery Exploration by Charles Hett, Lenexa, KS, January 18, 2024.

I mounted the BQ4850 in a small vise and installed a Dremel 561 cutter bit in the drill press. The drill speed was set to 1,326 RPM.

I carefully plowed around the top of the device edges, but the area was found to be solid potting near the surface. I plowed the bottom near the ground pin 16. I hit some metal. A small round copper object and a small steel object were found. A little farther to the other side of the device a copper plane was found. The steel object and the copper plane had continuity to ground pin 16. I did not find anything that looked like a battery here. See Photo 1.

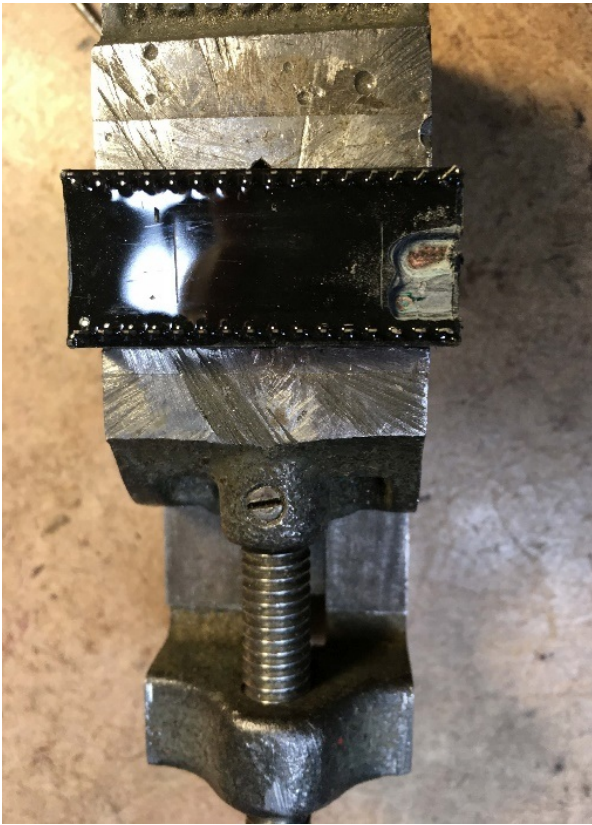


Photo 1. BQ4850 Bottom Exposure

I went back to the top near the ground pin end and eventually found the battery. (0.6" diameter - probably a CR16XX - I don't know the thickness). This large round area was not connected to ground pin 16 so I assumed this was the positive side of the battery. I found the tab inline between pins 10 and 11. See Photo 2.



Photo 2. BQ4850 Top Exposure

I looked for a second battery on the other end, but I found none. That is not to say there isn't one somewhere.

I pried the tab loose from the case with a small scribe so that there was no continuity between the tab and the case, also shown in Photo 2.

I soldered a wire from the tab to the positive side of a CR2032 coin battery and a wire from the copper ground plane on the bottom to the negative side of the battery. See Photos 3 and 4.

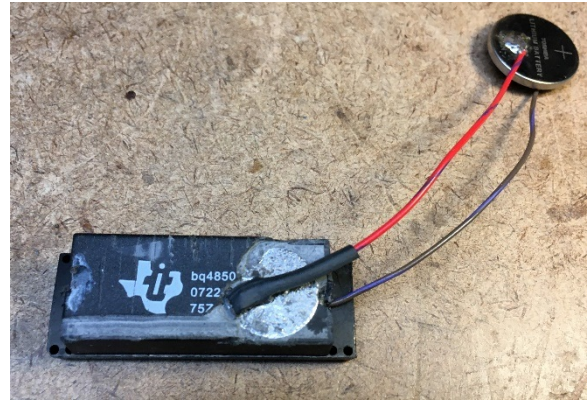


Photo 3. BQ4850 Positive Battery Connection

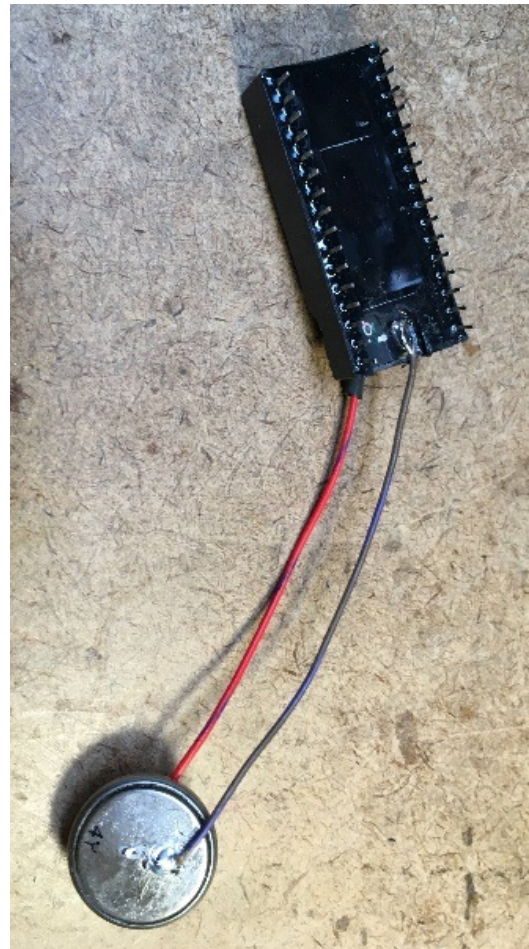


Photo 4. BQ4850 Negative Battery Connection

**Note:** The negative connection to the NVsRAM is not necessary, as the negative side of the battery just needs connection to the computer's ground plane.

**Note:** Soldering to the battery cell is **not** recommended as the cell could explode! It was used here ONLY for the purpose of proof of concept. ALWAYS use a proper cell holder.

I installed the NVsRAM in the IDE Controller Board, programmed it, and it still worked at that point.

Now for the final test. I turned the computer off, waited a few minutes, and turned it back on and ..... IT WORKED!

**January 19, 2024**

I found that the real time clock function of the BQ4850 was not being saved at power down. After some head scratching I thought about measuring the voltage on the backup battery. It was only 2.53vdc. Too low. I had pulled out a used battery that I thought was good enough but obviously, it wasn't.

I replaced it with a fresh one that measured 3.25vdc when installed. Now all the NVsRAM functions, including the Real Time Clock (RTC), worked properly.

I guess the RTC module requires a slightly higher voltage than the RAM to be able to retain data. As a future experiment, I could probably try a variable supply to determine where the breakdown point is, but I think I will just leave well enough alone.

In Photo 5, I added insulation for the battery. I think a more permanent solution should be to install a two-pin right angle header in the prototype area and install a proper coin battery socket, connecting the two by a short cable.

Charles Hett, Lenexa, KS, January 19, 2024

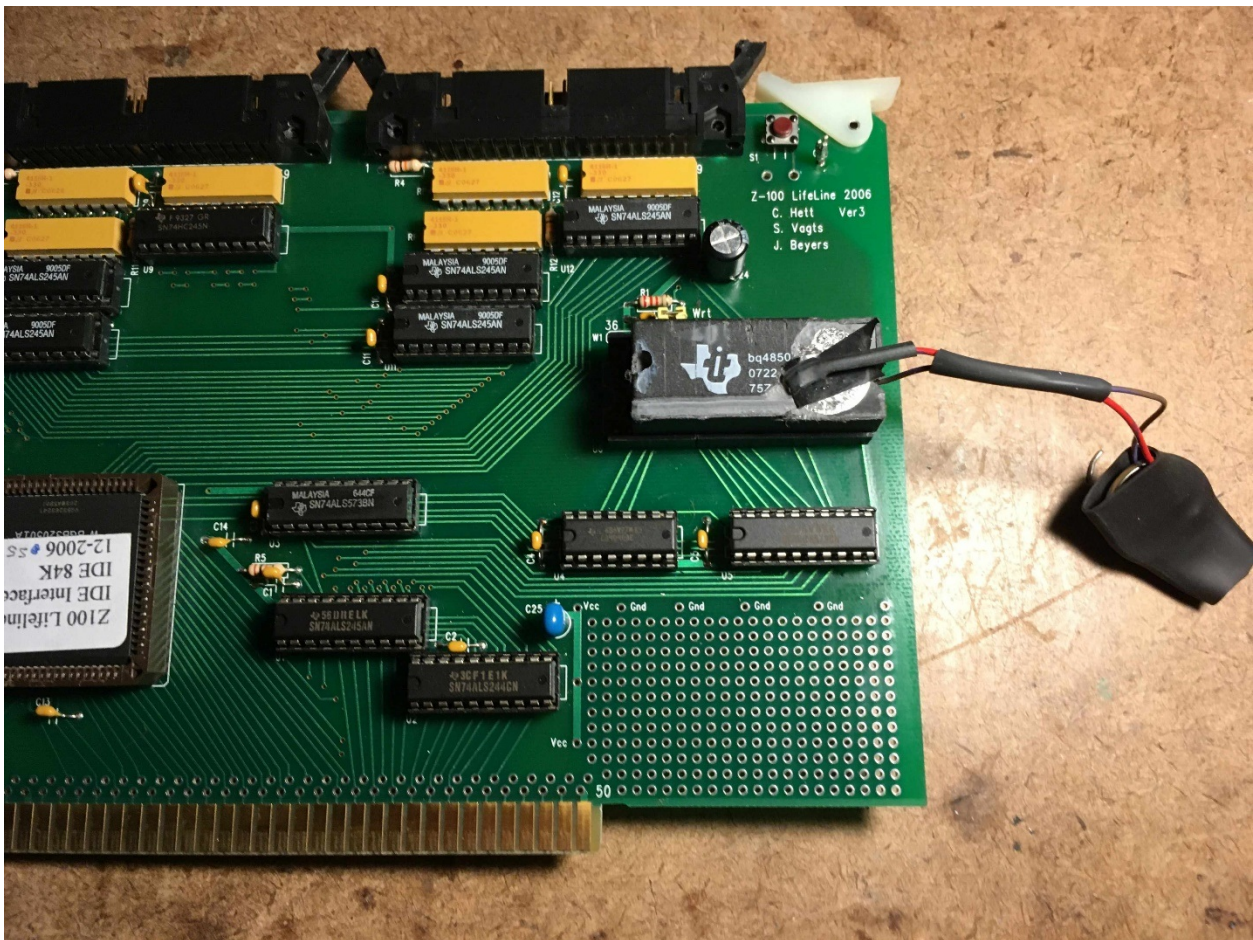


Photo 5. The Final Photo.

Research is continuing. On a second attempt to replace a dead battery, Charles was less successful. He felt he either had a malfunctioning NVsRAM, or overheated the unit when he attempted to solder a wire too close to it.

The new battery and NVsRAM worked flawlessly; could be updated and programmed, and would boot fine. However, the DOS clock would not recognize the clock and update its time while booting! We have not been able to figure this one out, but work continues.

I have also found an NVsRAM with an inoperative clock in my testbed computer, shortly after Charles reported his. I had installed a ZCLK2, for testing, on the testbed that has my IDE controller. So I never noticed that the IDE clock was bad. But when Charles reported his issue, I thought I would check out the NVsRAM clock. It read sometime in September 2023, probably the last time I had used that computer!

So I tested the clock and reset it, but when I checked it later, it did not change the time while it was shutdown. So an hour later, it was an hour off. The next day, the NVsRAM was a day off! It did still boot properly. So, I thought Charles was probably correct with his assessment that it must be a voltage level issue. I found it interesting that it still had enough power to keep the programming and even the last updated time.

My main concern was that there may still be a second battery, and it may pose an explosive risk if we tried grinding away at the NVsRAM.

Since we knew that one day the battery would fail, I had been thinking of carefully sanding off the unit from the top looking for a void and figuring out the total layout as I ground it off. That was the reason I was looking for a dead unit, but Charles got the jump on me. We have since confirmed that there is only one battery in these Texas Instruments BQ4850 units.

I have not checked on my other NVsRAMs being used yet, but I hesitate to play with one until it no longer functions. Even then, it would not be fully discharged!

On **February 5, 2024**, I continued my experiments and reported to Charles on my own NVsRAM findings:

It appears that the NVsRAM retains all its last programming BEFORE the battery died. The battery runs the clock and is only used to change the NVsRAM programming.

This is most intriguing as the NVsRAM may keep its programming forever and if you want to use the clock, it can be changed at bootup from another clock, but after power is off, it no longer runs. This is similar to the date/time being updated on a floppy disk. As long as we do NOT need to reprogram the NVsRAM, it appears the NVsRAM is still usable, AS IS.

If anyone wishes to confirm these findings on their own NVsRAM, here are my testing procedures:

- Booting to the NVsRAM, Boot F4s, worked fine. This particular NVsRAM was programmed for a system that did NOT use an MFM drive.

- I booted to my Hard Drive using the command: Boot {F3}:ZDOS4 (My hard drive can boot to CPM, Gemini (if board installed), ZDOS3 or ZDOS4).

- CD \EEPROM0 (this directory holds my files for programming the NVsRAM for use in systems without a hard drive).

- Ran ICLKTST: Jan 15, 2024 with time running (the last time I updated this NVsRAM clock).

- Ran ICLKSET to update the NVsRAM clock from DOS Date/Time (which had been updated from my ZCLK2). You could update the DOS clock with the usual DOS DATE/TIME commands, then run ICLKSET.

- Ran ICLKTST: Clock was updated and running.

- Ran EPCPPFILE to compare the NVsRAM programming with the EPTEST.DAT file saved previously in the EEPROM0 directory. It was ok.

**Note:** If you purchased an IDE device (an IDE hard drive or Compact Flash Card) from me when you bought your IDE Controller, these directories have been saved on it somewhere.

- I changed to the other directory, \EEPROM1, which is used to program the NVsRAM for systems using and recognizing the MFM hard drive.

- Ran EPCPPFILE to compare with this other EPTEST.DAT file - all differences, as expected.

- Ran EPWRFFILE to change the NVsRAM programming. Normally, this works great, and I got the message, "EEPROM successfully written from image file."

- Ran EPCPPFILE again... STILL ALL ERRORS! (Power was never shutdown & apparently battery power is required to actually change the programming)

- I changed back to the \EEPROM0 directory and ran EPCPPFILE again... it was ok and unchanged.

- I rebooted the system to the NVsRAM again, and nothing was changed. The BOOT was fine, and the clock (which was shutdown while I wrote this email) was 35 minutes off.

Very interesting results! Apparently, the NVsRAM itself requires battery power to change programming, yet the clock can be changed with system power, BUT needs the battery to continue running when the computer is turned off.

Raises the question again - separate batteries for different functions, or separate functions using a single battery and circuitry to accomplish?

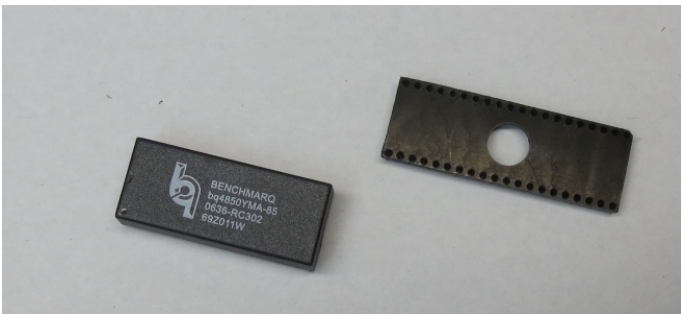
We have since found that there is apparently only one battery in these Texas Instruments BQ4850 units.

I love the fail safe programming, which makes the NVsRAM programming permanent for those manufacturers that never change the programming and do not need a clock! **Update** in 2026 - while the NVsRAM keeps most of the programming, over time, some changes to the programming do creep in, so it does **not** reliably retain its programs.

**January 31, 2024, Rev. July 16, 2024**  
**By Charles Hett, Lenexa, KS**  
**NVSRAM BQ4850 2.0 Coin Cell Modification**

- Before working on this NVsRAM unit, the memory was still being satisfactorily backed up on a power cycle, but the clock was not; but it was not known if the clock ever worked correctly on this unit on a power cycle.

I mounted the unit on an antistatic pin protector to keep the pins from getting damaged during rework. Something like this is highly recommended.



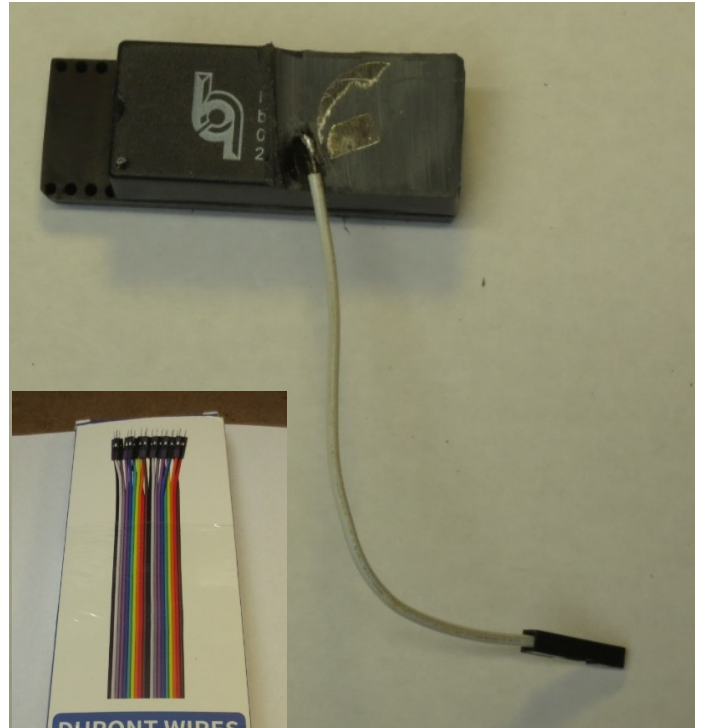
I sanded off the right side of the top of the chip to gain access to the coin cell tab using the sanding disc attached to my wood lathe. I held the unit by hand while sanding.



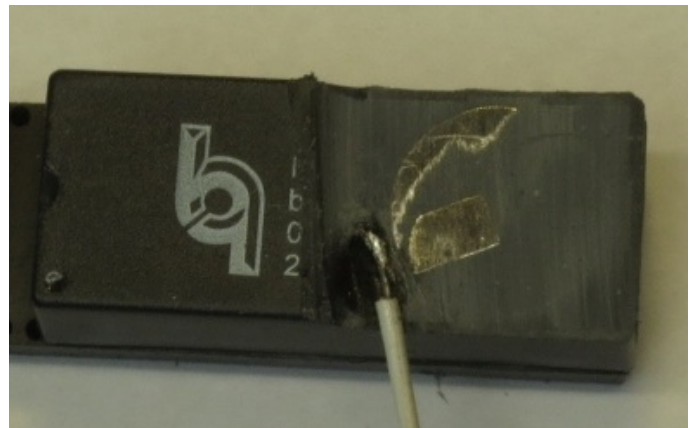
As you can see, I sanded a little too far and caused the tab fastened to the cell to separate from the unit. More on this later. The positive side of the battery is shown here. The coin cell measured 2.79 Vdc between this side and pin 16 of the NVsRAM unit.

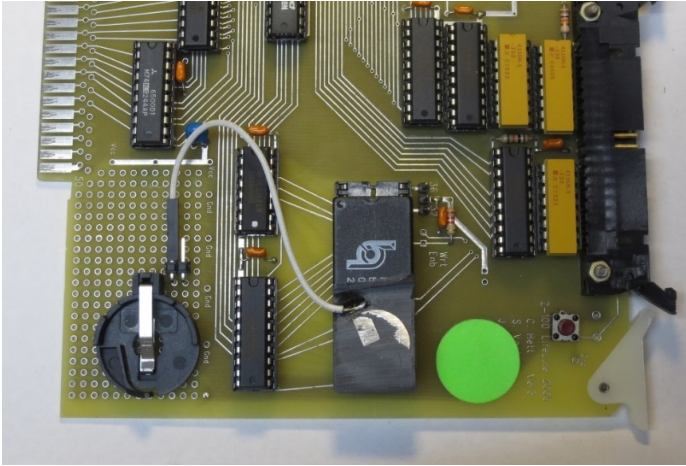
Using an XACTO knife, I dug out enough of the

epoxy to the left of the tab coming up from the unit to solder a wire to it.



The wire was white (there was no particular reason for white other than it isn't red or black), cut from a Dupont Wires item.





**March 10, 2026:**

We have still NOT been able to determine a reason for the Z-100 not updating the DOS date and time settings during the boot process, following a battery replacement to an NVsRAM real time clock.

So, Charles Hett has sent me his new **ICLK2DOS** utility for testing. This utility provides a means for updating the DOS date and time from the ICLK on an NVsRAM in the event the DOS date and time are not automatically updated during a boot. The new utility, ICLK2DOS could be included in the AUTOEXEC.BAT file to manually update the DOS date and time.

To accomplish the testing, I would need to create a test bed Z-100 with the IDE Controller installed and attempt to duplicate Charles' DOS failure situation.

I had two dying NVsRAMs of my own that had inoperative clocks, so the circumstances were perfect. Here is how the testing went.

I installed one of the bad NVsRAMs in a known working Z-100 LifeLine IDE Controller and began testing.

Attempting to boot the computer to the NVsRAM ended with the familiar error "EEPROM is corrupt". This means that the EEPROM has been detected, but the checksum no longer is valid. So, booting to ZDOS4 from my hard drive, I tried to troubleshoot.

As you may recall from earlier articles on programming the NVsRAM, when I shipped the Z-100 LifeLine IDE Controllers and/or shipped IDE drives (compact flash cards) I created two types of programming for the NVsRAM, for use in Z-100s with and without MFM drives. The only significant difference was that in systems with MFM drives, upon completing the boot process, the boot process included running ASGNPART 0: to detect the MFM drive and assign a drive letter to it. To speed up the boot process, this was not done in systems that did NOT use MFM drives. The subdirectories EEPROM0 (without MFM drives) and EEPROM1 (with MFM drives) contained the same files for programming the NVsRAMs, but had different AUTOEXEC.BAT files.

This particular NVsRAM had been programmed for use in a Z-100 that was not using MFM drives, so I went into the EEPROM0 subdirectory on the hard drive.

I ran EPCPFIL to check for differences between the stored EPTST.DAT file and the NVsRAM programming. Sure enough, there were about 2 dozen differences listed, but not near the quantity normally found if a different system had been installed on the NVsRAM.

I also ran ICLKTST to find if the clock was running - it was for one of the bad NVsRAMs - but with a date in DEC 2024. It did not run at all on the other bad unit. As we were on computer power now - it should be running (or oscillating) and it indicated a bigger issue.

A 20mm (CR2032) size coin cell battery holder was installed in the lower right prototype area of an IDEHD board. The ground side was wired to ground on the IDE Controller board. The Positive side was wired to one of two right angle header pins. (The second is a spare. I was told once you needed an input, an output, and a spare for every system.)

The coin cell wiring is on the back side of the board and will need to be insulated as will the coin cell and holder on the top side. Depending upon the type of holder you are using, please ensure that the Positive side of the coin cell is ultimately wired to the tab on the NVsRAM.

Always check resistances around the new wiring before installing the new coin cell. **Note:** The green dot shown is not related to this subject.

**Now for the bad news.** With the NVsRAM connected to the battery as shown, the RAM data is successfully saved with a power off/on cycle. However, the clock settings are still not retained on power up. Perhaps the modification somehow damaged the backup battery connection to the RTC circuitry. I had to heat the tab quite a bit to make the connection. The DOS clock settings are also lost if the Z100 is reset and rebooted without cycling power. Why would this be?

The NVsRAM clock settings are retained however as determined by use of the ICLK utilities. The settings just are not being transferred to the DOS clock for some reason.

So, avoid cutting the tab if possible. It is probably better to be able to pry the tab off the battery as I did with the previous attempt. Then the wire soldering step can be done farther away from the internal parts of the NVsRAM. As of July 16, 2024, It has not yet been determined if the DOS clock loading problem was caused by the tab problem described above.

Charles Hett, Lenexa, KS

I refreshed the programming of this first unit using the utility EPWRFILE (still using the EPTEST.DAT file), and reset the clock by setting the DOS DATE and TIME utilities, then running the ICLKSET utility.

I now had a fully operational NVsRAM. I did a warm boot (Shift-Reset without powering down) and the system booted fine, and the DOS clock appeared to be updated fine - though it could be just keeping its own time.

As expected, a cold boot (cycling power off/on) with the **B{F4}s** command worked fine, but the clock had not run during the few minutes it was off. The DOS date and time reflected the off time, and had been updated during the boot process.

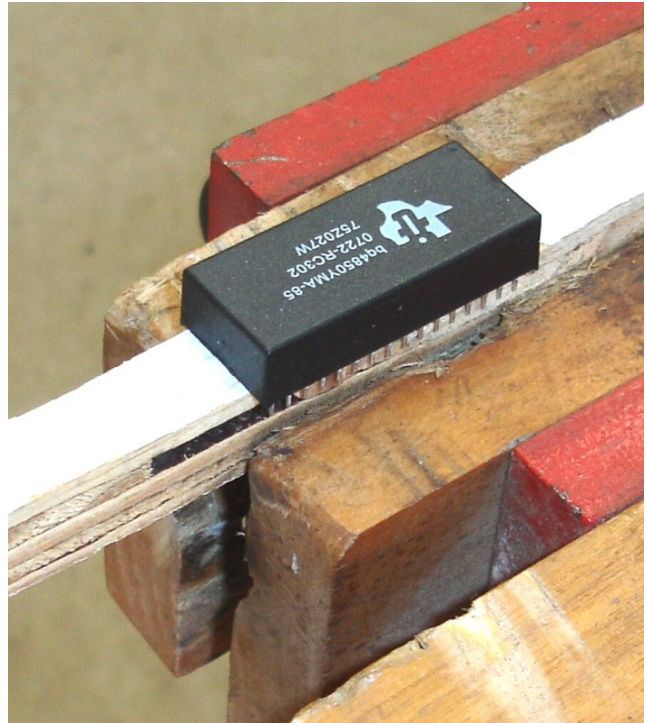
I did the same sequence of commands with the second NVsRAM installed. Again, it booted fine with the **B{F4}s** command, but the clock was again not running, the DOS date and time had been updated from the ICLK, but remained as I had set it.

I decided to operate on the NVsRAM with the dead clock first, and I am glad that I did. I did not want to place the NVsRAM in a vise as Charles had done, feeling confident that I could take my time sanding off the top without squeezing it in a vise. Bad mistake! While trying to pry up the tab from the exposed battery, I exerted too much pressure on the unprotected pins and crushed them - and they would not straighten without breaking off!



Idiot!!

I still did not wish to use the vise, but instead found a piece of scrap wood that would do great to help protect the pins, and attacked the second bad NVsRAM.



I used a sanding disk on my drill and sanded down the right half until the first flash of battery appeared.



Rather than continuing the sanding, and possibly damaging the battery case and/or tab, I found that a straight edge razor blade could easily slide between the metal of the battery and chip away the potting compound above it. In short order, I found the tab of the battery...



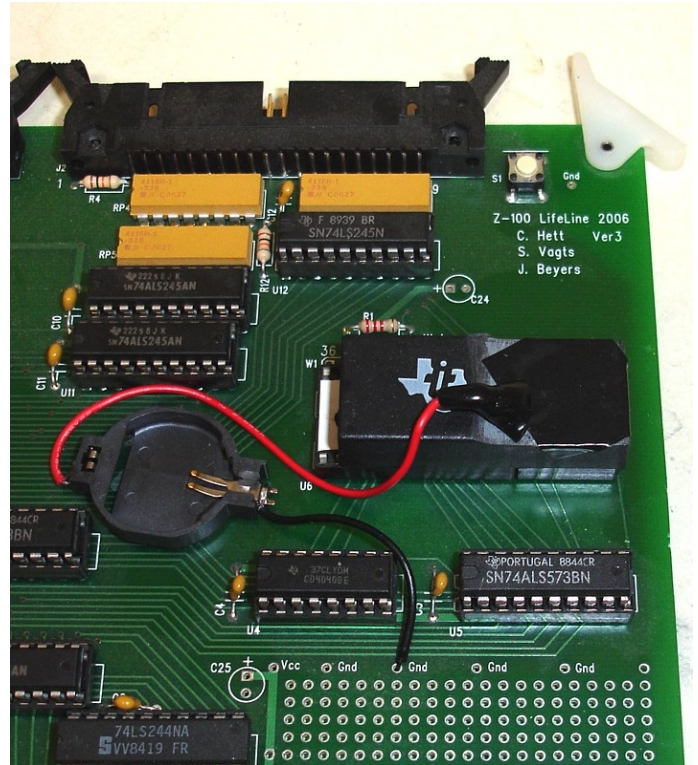
Once the tab was exposed, the razor blade can get under the tab far enough to grab the tab with a needle nose pliers and roll it back as shown.

For the record, the battery cell was a Rayovac CR2032 coin cell. Between this positive battery side and pin 16 of the NVsRAM unit, it measured only 0.4Vdc on the first NVsRAM and 0.8Vdc on this one. Yet, we shall find that even this minimal voltage is critical to the NVsRAM's performance. I also measured the resistance from the tab to the ground pin, pin 16, on both NVsRAMs to be 0.675 ohms to ground. From ground to tab, the resistance was infinite.

It is critical to ensure this tab is no longer in contact with any part of the existing battery. So while checking the voltage on the battery, also check the resistance between this tab and the battery case. Check that there is no connection - the meter should show infinity. I cut a small square of electrical tape to cover the coin cell and soldered a red wire between the exposed tab and the positive terminal of a battery case. Remember to use a section of heat shrink to cover this exposed tab and, using electrical tape, tape up the NVsRAM securely.

**Note:** As electrical tape will probably not stay in place, it may be better to paint the NVsRAM's battery and the base of the tab.

I also used a black wire to run from the negative terminal of the battery case to ground on the IDE Controller board. As these coin cell holders have different configurations, double check to ensure that the red (positive) wires go to the positive terminal of the battery. The batteries have a positive '+' sign on the larger battery side.



I repeated my NVsRAM tests before installing the new battery. The results were interesting.

**WARNING:** At power up, check **BOTH** terminals of the new battery holder for any kind of stray voltage from computer case ground. There should be **NO VOLTAGE** at either terminal at this point!! If any voltage is indicated, you need to find and eliminate the cause. **Any voltage could cause the new battery to explode!**

I tried to boot to the NVsRAM using the command B{F4}s. The computer responded with:

*"No system on EEPROM board! Device Error"*

This NVsRAM had been newly programmed before the operation. So, the NVsRAM does require a battery to work at all, even if it had a very low voltage.

I booted to ZDOS4 from my hard drive and I thought I would check if any programming remained on the NVsRAM. The EEPROM is drive J: on my system.

The command ZDIR J:/a gave the error:

*"Not Ready Reading Drive J:"  
"Abort, Retry, Fail"*

I tried the command EPWRFILE.

"Successfully written to EEPROM"

I ran the command EPCPFILE to compare the file, EPTEST.DAT, with the new programming - OK.

I set the DOS DATE and TIME, then ran ICLKSET to set the IClock.

The command ICLKTST, confirmed the clock was running.

Performing a warm boot (without a shutdown) worked as it should, and the DOS date and time was updated.

I also tried Charles' new utility, ICLK2DOS.

I first used the commands DATE and TIME to change the existing settings. Then ran ICLK2DOS, which updated the setting perfectly. I reconfirmed the new settings by rerunning DATE and TIME. OK.

#### SUMMARY:

It is not a matter of **if** these NVsRAM units will die, just a matter of **when**. By now, every unit that was sold with the distribution of the IDE Controller boards will have died. You just have not noticed yet.

As you can see from the above, there are about as many ways to get to the defective battery of the old NVsRAM as there are people - some better than others. But, of most importance, be patient, take your time, and protect the pins.

**Warning:** Do not damage the defective battery, it may still hold a charge! It may explode from an internal short if the case is damaged, or at the very least, leak chemicals that could be dangerous to you or cause damage to the circuitry.

If you have any doubts about your capability - please email me. We can work something out.

When the battery is exposed, exercise extreme caution while lifting the tab from the battery case.

After the tab is disconnected, check the residual voltage of the bad battery from the Positive (+) side of the exposed battery to pin 16 (ground) of the NVsRAM unit.

More importantly, do resistance checks:

- \* Check the tab is isolated from the battery.
- \* Check the resistance from the exposed tab to pin 16 (ground) of the NVsRAM Unit; it should be about 0.675 ohms.
- \* Check the resistance from pin 16 of The NVsRAM to the tab (the reverse of the last check. This checks that the internal diode separating the battery from the external computer power is still working. It should be infinity.

There are many ways to attach a new battery, but I do NOT recommend soldering directly to a new battery cell! The heat could damage the cell, or worse, could cause it to explode. Saving a few dollars is NOT worth the risk.

No access to a coin cell holder? The desired voltage range needed is about 3-4 volts. Even two 1.5v AA or AAA cells could work. They are just bulkier. But there is plenty of room around the computer case for a AA battery case; just use a longer wire.

Finally, **BEFORE** installing a new battery, power up the computer and check for voltage at both terminals of the new battery holder to computer case ground. There **MUST BE NO VOLTAGE** at either terminal. If any voltage is indicated, you need to find and eliminate the cause. **Any voltage could cause the new battery to explode!**

If all went well, install the battery and proceed to testing. If for some reason the new battery does not update the DOS Date and Time during boot, Charles has a new utility that can be used. Give me a call for a copy of the ICLK2DOS utility.

Assuming you have the desired parts on hand, this project takes about an hour. It does require some basic tools and some capability to solder. If you are uncertain, do not risk it. Send me an email. We have new NVsRAMs on hand that can be programmed to your specific Z-100 configuration.

If the cost is prohibitive, remove the defective unit and ship it to me. I will be happy to repair the defective unit as shown above for a fee, configure it to your computer, and ship it back. You would only need to solder the ground lead to the circuit board and after the voltage checks given above, install the new coin cell. I will include a disk providing Charles Hett's new ICLK2DOS in the event you have an issue. Add the program to your other ICLK utilities.

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

[z100lifeline@swvagts.com](mailto:z100lifeline@swvagts.com)

Cheers,

Steven W. Vagts

