Z-100 LifeLine
Since 1989

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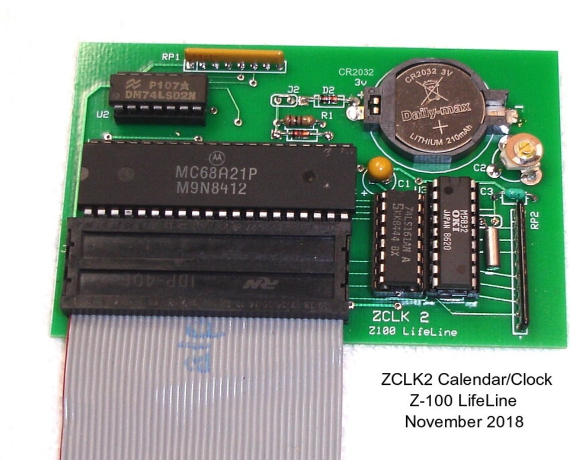
Z-100 Real Time Clocks

While CP/M, as a whole, did not make use of Date or Time functions, Zenith DOS for the Z-100 always made excellent use of Date and Time for file management. And having a Real Time Clock was a popular addition to the Z-100.

This article covers the two most popular Real Time Clocks that were produced for the Z-100 -- the ZClock and the Smartwatch. Other boards, such as the Scottie Board and the *Z-100 LifeLine* IDE Controller also had integral Real Time Clocks installed on them, but I will leave these for other articles.

ZClock Real Time Clock

The Z-100 ZClock or ZCLK was a calender/clock circuit board for the Z-100 series of desktop computers. It installed on the Z-100 main circuit board and did not require a S-100 bus expan-sion slot. Installation was simple and did not permanently alter the Z-100 computer.



ZCLK2 Calendar/Clock
Z-100 LifeLine
November 2018

ZCLK shared the 68A21 Peripheral Interface Adaptor (PIA) IC (U114) used by the Z-100 for the Parallel Printer Interface (and other things). With ZCLK installed, the ability of the computer to sense the state of the printer /ERROR line was lost. But, this was of little consequence, since most software did not check for this error and, if any did, the ZCLK would return a no-error state. Most printers have an alternative means of indicating error conditions as well.

ZCLK used the OKI Semiconductor MSM5832 microprocessor real-time clock and calender IC. The MSM5832 contains registers as follows:

TIME	MONTH	DATE	YEAR	WEEKDAY
23:59:59	12	31	99	7

A long-life CR2032 lithium battery maintained the date/time in the ZCLK during computer power off periods.

Originally, the ZCLK board replaced the 68A21 PIA IC by plugging into the U114 socket direct-ly, then the PIA was plugged into the ZCLK board. But this was found to interfere with the popular Gemini PC-emulator board, which also had to be mounted on top of the Z-100's motherboard. So a version quickly came out with a flat ribbon cable that moved the ZCLK circuit board to above the Gemini board.

The original ZCLK was copyrighted 1984 by FBE Research Company, Inc. According to the inter-net, on December 18, 1998, ownership of FBE Research Company, Inc., was donated to the Brockman/Smedley Charitable Remainder Unitrust. Early in 1999, the corporation was dissolved and the proceeds were invested by the trustee, the Washington State University Foundation.

I have recently recreated this RTC and called it ZCLK2. The new ZCLK2 uses the identical circuit as ZCLK, but on a redesigned circuit board. It is offered only in a model that uses a short length of flat ribbon cable to avoid interfering with the EasyPC or Gemini PC-emulator installa-tions. I hope that FBE Research will forgive my attempt to again offer a real-time clock to Z-100 owners at a fair price and due recognition to FBE.

ZCLK2 Circuit Board Installation

When ZCLK2 is installed, the 68A21 Peripheral Interface Adaptor (PIA) IC (U114) on the Z-100's main circuit board is removed from its socket and installed in the socket labeled U1 on the ZCLK2 circuit board. The ZCLK2 board's ribbon cable then plugs into the PIA socket on the Z-100's main circuit board, with the ZCLK2 board extending toward the rear card cage. The board can either be laid back over its own cable, laid back over any installed PC-emulator board, or placed within the card cage, if there is room.

WARNING: Do NOT short the battery. Battery power conductors are exposed on the ZCLK2 circuit board. **Do NOT lay the ZCLK2 on an electrically conductive (metallic) surface!** Shorting the battery may cause it to burst or release dangerous materials.

WARNING: Some of the integrated circuits used in the ZCLK2 and in the Z-100 are sensitive to static electricity and may be permanently damaged if mishandled. To minimize the chance of
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damage, ground yourself by touching the computer chassis during the first three steps and proceed as carefully as possible.

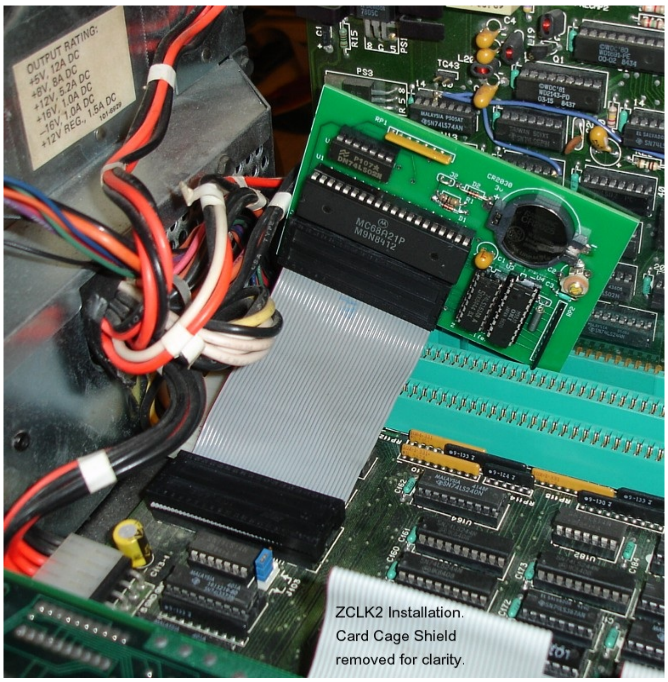
Detailed installation instructions will be included with the purchase of the ZCLK2, or may be requested separately.

However, a brief version follows:

1. Disassemble the Z-100, including removal of any EasyPC or Gemini PC-emulator board, if installed, to gain access to the 40-pin 68A21 integrated circuit at U114.

2. Carefully remove the 68A21 IC from its socket using an IC removal tool or a small screwdriver. Hold the IC in your hand and do not lay it down on your work surface.

3. Carefully align the pins of the 68A21 IC with the empty socket on the ZCLK2 board. Make sure that the Pin 1 end of the IC (the end with a notch or small dot in the IC) is towards the short edge of the ZCLK2 board nearest the socket. Push the 68A21 into the socket.



ZCLK2 Installation.
Card Cage Shield
removed for clarity.

4. Position the ZCLK2 board toward the card cage and insert the ribbon connector into the empty 68A21 socket.

5. Carefully install the CR-2032 battery in the battery holder, with the positive side (+) up.

6. Reinstall any PC-emulator (Easy-PC or Gemini) board that you may have removed, using their respective procedures.

7. Rest the ZCLK2 board, now inverted, over the top of the motherboard or emulator board and insulate the two boards from each other with a layer of plastic.

This completes the installation of your ZCLK2. Now, reassemble the computer by reversing the disassembly process and proceed to the **Software Installation**, next.

Software Installation

For Z-DOS and Zenith's later MS-DOS versions (also now commonly referred to as Z-DOS):

Boot up and copy ZCLK.COM from the distribution disk onto your bootable system disk. For automatic date/time setting on bootup, your bootable system disk must have an appropriate AUTOEXEC .BAT file. If your system disk does not have this file, one is provided for you on the distribution disk. Copy it from the distribution disk to your system disk. If your system disk already has an AUTOEXEC.BAT file, use an editor (e.g., EDLIN) to add the command line "ZCLK" to the file in place of the "DATE" and "TIME" command lines, if they exist.

When the ZCLK.COM program runs, it reads the date/time from the ZCLK, sets the Z-DOS date /time, and displays the date/time on the console. Type ZCLK{RETURN} to run the program. If the date/time from the ZCLK is not acceptable to Z-DOS, the "bad" date/time error will be displayed along with a request that the ZCLK be reset.

ZCLK.COM is also used to set the correct date /time into the ZCLK and to process a Daylight Saving Time adjustment. Type ZCLK{space}{RETURN} to display operating instructions for the program. If the ZCLK contains a "bad" date or time, display and read the instructions and then set the correct date/time into the ZCLK. To set the date and time, use the command; ZCLK MM DD YY HH MM{RETURN}. For example:

ZCLK 12 15 18 09 25{CR}

(Use one space between data elements)

For PC-DOS:

The procedures are identical to those for Z-DOS, except the file to load is PC-ZCLK.COM. PC-ZCLK has the corrected I/O ports defined to access the clock. After copying PC-ZCLK.COM to the boot disk, change the name to ZCLK.COM.

Note: Presently, ZCLK does not work with the Gemini PC-emulator. It does, however, work with the EasyPC emulator package. I am presently trying to address this issue with the Gemini board.

CP/M Software:

The source file for a **CP/M-86** version of ZCLK .COM is supplied on the Z-DOS/MS-DOS distribution disk.

Use the RDDOS utility program to copy the files ZCLK.A86 and READ.ME to your CP/M-86 system. Consult the READ.ME file for details.

Note: Software for **CP/M-85** is not included with the ZCLK because CP/M-85 does NOT support a system-level date/time function.

Note: Software for **CP/M-Plus** is not presently included as it has yet to be developed. I hope to do this as a project as soon as I can find the time.

Accuracy Adjustment

The timekeeping accuracy of the ZCLK is determined by the frequency of a quartz crystal oscillator on the ZCLK circuit board. The frequency of this oscillator may be adjusted with the trimmer capacitor (C2) on the ZCLK board. If the ZCLK is running fast, increase the capacitance by turning the trimmer capacitor clockwise. If it is running slow, decrease the capacitance by turning counter clockwise.

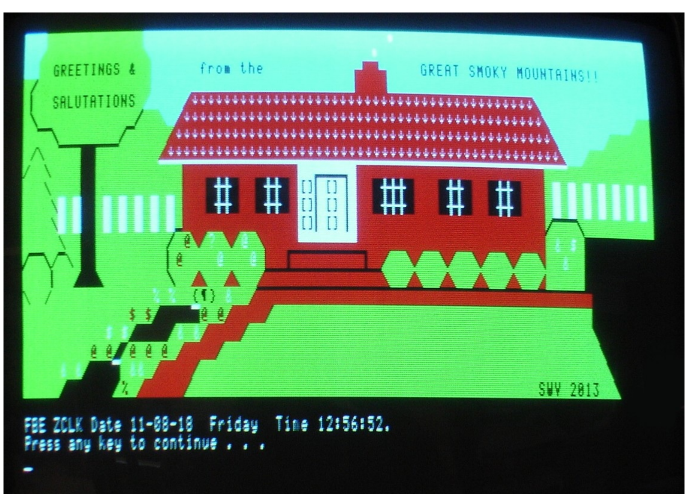
Replacing the Battery

Obtain a replacement CR2032 battery (a 3V lithium cell). A similar, but slightly smaller CR2025 will NOT work reliably. Gain access to the ZCLK following the procedures given earlier, and proceed as follows:

1. Insert a toothpick or similar non-conductive object into the slot at the right edge of the holder and pry the battery to the left and upwards until it clears the lip edge of the battery holder. Slide the battery out of the holder and discard.

2. Wipe the contact surfaces of the new battery with a soft, clean cloth to remove any contaminants. Slide the new battery into the slot at the left and press the battery into the holder until it clips into the right edge.

WARNING: Lithium, the active material of the battery, will burn if exposed to water. Do NOT mutilate, incinerate, or disassemble the battery. Do NOT attempt to charge the battery. Do NOT place the battery in water or heat it above 100 degrees centigrade. Do NOT solder directly to the battery.



In Case of Difficulty

So far, the only experience that I have had with ZCLK2 was two bad 74LS161's. The symptoms are bad clock bits returned; that is, the date could not be set or kept changing randomly, while the month, year and time, were fine. In the second case, the hour stayed at 10 o'clock all the time.

The last picture is a shot of my "Greetings" with the ZCLK date and time displayed beneath.

The ZCLK2 costs $55.00, offered only from the *"Z-100 LifeLine"*.

SMARTWATCH Real Time Clock

The SmartWatch was an integrated circuit (IC) manufactured by Dallas Semiconductor. Easily installed in the Z-100 series of computers, it automatically sets the MS-DOS date and time and keeps time to 1/100 of a second. It could also display a calendar with the day, date, month, and year. It compensated for months with less than 31 days and even corrected for leap years.

Lithium energy cells, which are built into the SmartWatch, maintain the calendar time up to ten years in the absence of power. To achieve this low current drain, the SmartWatch integrated circuit was designed using very low power CMOS logic. This CMOS process also generated very little heat, which makes the component particularly reliable. To further improve reliability, the lithium cells within the clock module are double-hermetically sealed, virtually eliminating the possibility of battery leakage. Accuracy was within one minute a month.

It was mounted under the ROM IC (Read Only Memory Integrated Circuit), U190 in the Z-100, thus it involved no other circuit boards. However, in the Z-100, three spacers were needed to increase the height of the standoffs supporting the video logic circuit board.

Specifications

The SmartWatch was available in several different model numbers. For the Z-100, the proper number was DS1216E. The SmartWatch is now considered obsolete and is out of production.

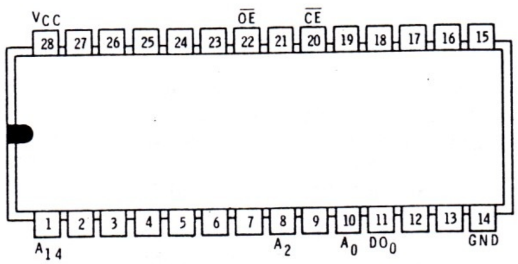
The DS1216E SmartWatch/ROM 64/256K was a 28-pin, 600 mil-wide DIP socket with a built-in CMOS time-keeper function and an embedded lithium energy source to maintain time and date. Its features included:

* Kept track of hundredths of seconds, seconds, minutes, hours, days, date of month, months, and years.

* Added timekeeping to any 28-pin JEDEC bytewide memory location.

* Embedded lithium energy cell maintained calendar time for more than 10 years in the absence of power.

* Timekeeping function is transparent to memory operation.
* Month and year determine the number of days in each month.
* Proven gas-tight socket contacts.
* Full +/- 10% Vcc operating range.
* Operating temperature range 0 - 70°C.
* Accurate to within +/- 1 minute/month @ 25°C.



SmartWatch IC Pinout

Figure 1.

Pin 1 A_{14} - Address Bit 14 (RESET)
Pin 8 A_2 - Address Bit 2 (READ/WRITE)
Pin 10 A_0 - Address Bit 0 (Data Input)
Pin 11 DO_0 - I/O_0 (Data Output)
Pin 14 GND - Ground
Pin 20 CE - Conditioned Chip Enable
Pin 22 OE - Output Enable
Pin 29 Vcc - +5 Vdc to the socket

Note: All pins, except pin 20, pass through to the socket.

Figure 1. shows the SmartWatch pinout.

The SmartWatch monitors its supply voltage, Vcc, for a low voltage condition and switches to an internal lithium energy source to prevent loss of watch data in the event of low power.

The SmartWatch uses pins 1, 8, 10, 11, 20, and 22 for timekeeper control. All pins pass through to the socket receptacle except for pin 20, which is inhibited during the transfer of time information.

The SmartWatch provides timekeeping information including hundredths of seconds, seconds, minutes, hours, days, date, month, and year information. The date at the end of the month is automatically adjusted for months with fewer than 31 days, including correction for leap years. The SmartWatch operates in either 24-hour or 12-hour format with an AM/PM indicator.

Operation

For a full explanation of SmartWatch operation, including information on the registers, please see "*Z-100 LifeLine*" issue #58, August 1998.

Installation

Before you begin:

* Be sure your computer operates properly **before** you install the SmartWatch.
* If you have a hard drive installed in your computer, run the SHIP utility before you proceed. (Refer to the MS-DOS documentation for instructions.)
* Disconnect the computer power line cord plug from the AC outlet.
* Disconnect any peripherals that are attached to the computer.

You will need the following tools to install the SmartWatch:

1/4" flat-blade screwdriver
Phillips screwdriver
1/4" nut driver
Long-nose pliers
IC puller
3 Spacers about 1/4" tall

The SmartWatch will fit under the monitor ROM on the motherboard of the Z-100 (U190). Refer to Figures 2 and 3.

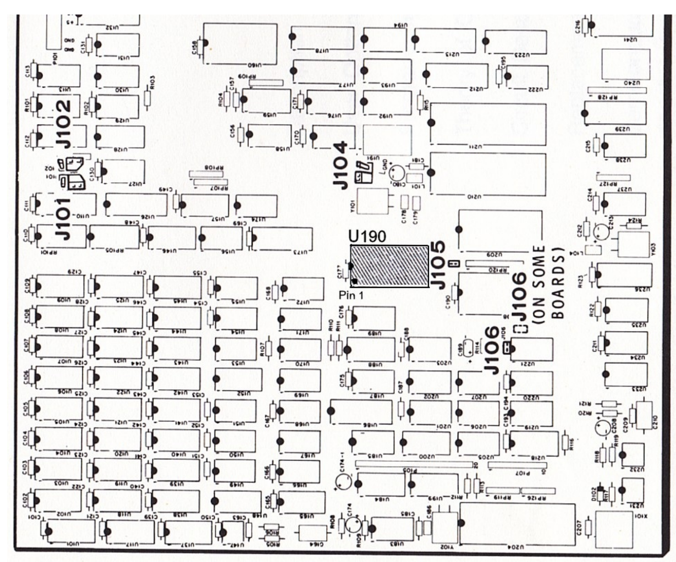


Figure 2.
Monitor Rom at location U190
on the Motherboard.

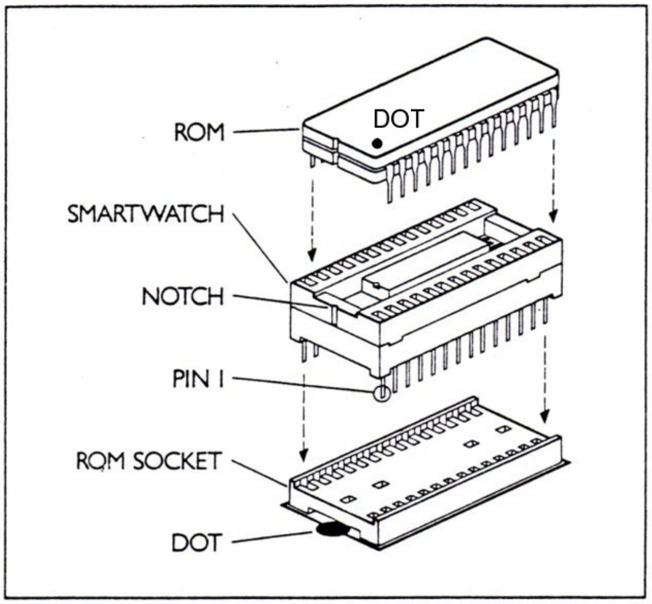


Figure 3.
Installing the SmartWatch

Removing the Monitor ROM

Since the SmartWatch will be installed under the monitor ROM, the monitor ROM must be removed. After the SmartWatch is installed, the monitor ROM is installed on top of it. See Figure 3.

CAUTION: The ROM IC and SmartWatch IC can be damaged by static electricity. Once you pick up an IC, either from a board or the conductive foam in which it is shipped, do NOT lay the IC down or let go of it until you install it in its socket or place it on the conductive foam.

When you have identified the monitor ROM that you need to remove to install the SmartWatch, use an IC puller to remove the monitor ROM, as described in the next step.

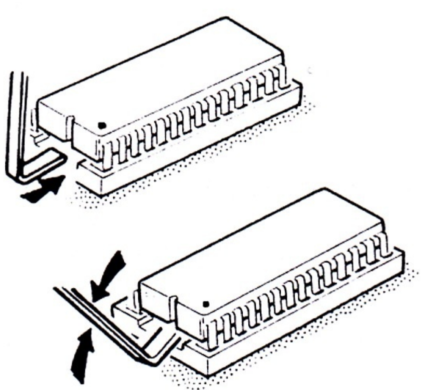


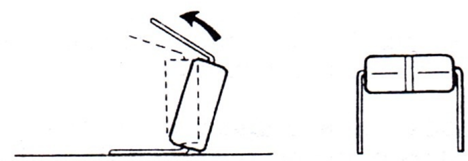
Figure 4.
Removing an Integrated Circuit

[ ] Insert the tool beneath the monitor ROM IC as shown in Figure 7 and gently rock the tool back and forth until you are able to lift it. Be very careful not to bend the pins on the IC as you remove it. Place the IC in the conductive foam that's supplied with the SmartWatch.

When you install the SmartWatch IC and reinstall the monitor ROM IC, the pins of the monitor ROM IC must line up with the holes of the socket.

Note: If the pins do not line up, you may need to straighten the leads of the IC (See Figure 5). To straighten the leads, hold the IC in one hand and place the other hand on the work surface before you touch the IC to that surface. This will equalize the static electricity between the work surface and the IC.

Then, still holding the IC, lay it down on its side as shown in Figure 5. and very carefully roll it towards the pins to bend the lower pins into line. Then turn the IC over and bend the pins on the other side in the same manner.



Straightening IC Pins.

Figure 5.

Referring back to Figure 3, identify the pin 1 location of the socket on the board.

Next, identify the pin 1 end of the SmartWatch. The pin 1 end of the SmartWatch must be installed into the pin 1 location on the motherboard.

To install the SmartWatch:

[ ] Make sure that all the pins are started into the socket. Then press down gently, but firmly.

Note: An IC pin can become bent under the IC and it will appear as though it is correctly installed in the socket. Be careful that this does not happen. If you have a problem after installation, check the IC (remove it, if necessary) to be certain that all pins are correctly inserted.

Reinstalling the Monitor ROM

Now that you have the SmartWatch IC installed, install the monitor ROM IC on top of the SmartWatch IC. Once again, make certain the pin 1 end is positioned correctly. First, identify pin 1 of the monitor ROM. Install the monitor ROM as shown in Figure 3.

Refer once again to your computer manual for reassembly instructions.

This completes the installation of the SmartWatch IC.

Making the SmartWatch Work

Note: You are going to need a floppy disk containing SmartWatch files to set the operation of SmartWatch. The software is not provided when you buy the SmartWatch IC from most electronics parts locations. However, if you need such a disk, send $1.00 to cover expenses to me, Steve Vagts, at the "**Z-100 LifeLine**", and I'll send you the disk with the latest files needed.

Turn on your computer and boot up the MS-DOS operating system.

Next, place the SmartWatch disk in the floppy drive and access the drive.

These are the files this disk contains:

CLOCK.EXE -- This file is used to set the MS-DOS date and time in your system, set the SmartWatch date and time, and display the current date/time from the SmartWatch.

RDCLOCK.COM -- This is a subset file of CLOCK; it will only set the MS-DOS date and time from the SmartWatch.

TESTCLK.EXE -- This file displays a running clock in the center of your display. Press the {RETURN} or {ENTER} key to exit from this program.

CLOCK.C -- This is the source code for the clock program which is provided as an example of how to write programs to use the SmartWatch. (This was written using Computer Innovations C-86 C Compiler (Zenith part number CI-5063-X).

CLOCKIO.ASM -- This is the assembly source code driver routines which communicate with the SmartWatch. These low-level routines are called from within CLOCK.C.

To set the SmartWatch to the current time and date, the CLOCK.EXE program is used. An initial entry would have the following components:

    CLOCK HH:MM:SS MM/DD/YY XX

where:

    CLOCK signifies the CLOCK.EXE program,
    HH = hours (00-23)
    MM = minutes (00-59)
    SS = seconds (00-59)

    MM = month (01-12)
    DD = date (01-31)
    YY = year (last two digits only)

    XX = day of week (first two letters)

For example, if your entry was for 8:00 AM, August 2, 1998, and the day were Sunday, you would type:

    CLOCK 8:00 8/2/98 SU

and press the {RETURN} key.

The computer then prompts you to press {ENTER} to set the time. This feature allows for a precise entry of the time and date.

Once you initially set the time and date, you can change any specific entry just by typing "CLOCK" and the entry, as in CLOCK 12:54.

Note the following items:

* Dates can be entered using either slashes or hyphens, for example, enter April 9, 1998 as 04/09/98 or 4-9-98.
* If you do not supply the year, the current year will be entered; you need only the last two digits of the year, it will enter the rest. If you enter a year under 86, it will make the date 20XX (not 19XX).
* When entering the time, if you do not enter a value for seconds, it will be set to zero.
* Entries can be in any sequence; different items only need to be separated by a space.

To have the correct time entered for you when you boot up your system, it will be necessary to modify (or create) an AUTOEXEC.BAT file. This is the file that MS-DOS automatically looks for every time you boot up, so it needs to be on the disk you use to boot up. MS-DOS will run the commands that the AUTOEXEC.BAT file contains, one after another.

If you already have an AUTOEXEC.BAT file, follow the instructions in your MS-DOS manual to add a line which says "CLOCK" in the file. (If you create a new AUTOEXEC.BAT file, the existing one will be destroyed.)

If you want to create a new AUTOEXEC.BAT file, at the system prompt, type:

    COPY CON: AUTOEXEC.BAT

and press the {RETURN} key. Although nothing obvious happens, what you type will be entered in the AUTOEXEC.BAT file.

Now type:

    CLOCK

and press the {RETURN} key.

Press **F6** (CTRL-Z on the Z-100 Computer). Then press {RETURN} to close the AUTOEXEC.BAT file.

Next copy the CLOCK.EXE file onto your boot-up disk. (Refer to your MS-DOS documentation for directions.)

Now MS-DOS will run the clock function whenever MS-DOS is started.

Note: RDCLOCK is a subset of CLOCK. If you don't want the current time and date displayed when you turn on your system, or if you have limited disk space, substitute RDCLOCK for CLOCK when you modify your AUTOEXEC.BAT file.

RDCLOCK, however, cannot be used to modify the SmartWatch date or time; it will only set the MS-DOS date and time from the SmartWatch. If you use RDCLOCK instead of CLOCK, copy RDCLOCK.COM to your boot-up disk, instead of CLOCK.EXE.

The Case of the Dead SmartWatch

By now, you have probably noticed that your SmartWatch no longer keeps time! Actually, this should be no surprise, because the lithium battery was only predicted to have a life of about 10 years. As we are 40 years since the introduction of the Z-100, I am surprised the clocks lasted this long.

So what can we do with the remaining carcass?

It would be a real shame to dump the SmartWatch because of a bad battery, so I did some research and played around with one of mine.

First, the bad news. These lithium cells are dangerous, hence the following warnings:

WARNING: Do NOT go poking around a lithium cell or try to dismantle the SmartWatch. These battery cells have been known to short out and explode. I measured the voltage remaining in one of my SmartWatches and found that the voltage was still about .7 to .8 volts.

WARNING: Do NOT attempt to recharge these lithium cells either. Recharging could cause the cells to explode.

So, what to do? First, let us review some SmartWatch specifications from earlier:

The DS1216E SmartWatch is an assembly containing non-volatile (NV) RAM with a built-in CMOS watch function and one or two lithium cells contained in a 28-pin DIP socket that mounts under the monitor ROM in the Z-100.

The SmartWatch ROM sockets use the embedded lithium source to maintain the time and date only. The SmartWatch monitors the computer's +5 Vdc power at pin 28 of the ROM chip and when the voltage drops to below the battery's voltage, the internal lithium energy source is automatically switched on and write protection is unconditionally enabled to prevent loss of watch and NV-RAM data.

The SmartWatch is based on the Maxim DS1315 clock controller chip with one or two energy cells, one attached to pin 4 and the other, if installed, attached to pin 14 of the DS1315 chip.

As the energy cells are ONLY attached to the clock chip, the predicted energy drain was such that the cells would last about 10 years.

Each DS1216 was shipped from Maxim with its lithium energy source disconnected, ensuring full energy capacity when finally used in the computer. When computer power is first applied at a level greater than the lithium energy source, this energy source is enabled for battery-backup operation.

During my research, I found no means to turn the cells off.

Note: The DS1216E has been discontinued and is no longer available from Maxim, but according to the Internet, some of these still appear to be out there for sale. So, a word of caution. As you have no way of knowing whether a SmartWatch has been activated (used), the SmartWatch that you receive may already be on its last legs, if not already dead.

Finally, the lithium cells are isolated from computer power, so there is supposedly no danger of charging the cells under normal use.

Further information on operation of the clock can be found on the Internet from Maxim.

Ok, enough preliminaries.

The ideal means of powering the SmartWatch would be to disconnect the energy cells from the DS1315 clock controller by cutting pins 4 and 14, then attach our own external battery to the pin stubs.

However, upon looking more closely at the SmartWatch socket, there is no chance of disconnecting the energy cells from the DS1315 chip without causing extreme damage to the socket, which surrounds the DS1315 chip quite tightly.

So, our only recourse is to simulate computer power to the SmartWatch. However, the downside of this method is that we are not only powering the SmartWatch, but also the ZROM pins and other computer circuitry. This drains any battery much faster than if we were just powering the clock oscillator. Instead of lasting years, the new battery backup may only last hours.

On the positive side, I do not use my Z-100's all that much, and when I do, I will work on any one of several for several days, with multiple power-ups each day as I test various components and configurations. Then I move on to something else and it may be weeks or months before I work on that computer again. Any battery would be long dead before I used the computer again. I just hate resetting the clock several times over the course of my work.

Rethinking the issue, I reasoned that if I could get the clock to last for about an hour, long enough to change a part or configuration, I would be happy. This would be an ideal use of a super capacitor! I had seen this as an option for the Scottie Board clock.

The new circuit is simple. We want to minimize the power drain, so we need to disconnect the SmartWatch socket's pin 28 from the computer's +5 Vdc Vcc and feed that pin separately - from our super capacitor.

Likewise, to reduce the power drain of the Monitor ROM, or ZROM, we need to disconnect pin 28 of the ZROM and feed it separately from any other +5 Vdc source - another nearby integrated circuit.

We need to insert a diode in the capacitor's charging circuit to prevent powering the computer's entire +5 Vdc bus from the freshly charged capacitor when the computer is shutdown. The internal resistance of the diode also controls the charging current.

Required Parts:

1 - 1 Farad, 5.5v Super Capacitor
1 - Diode, such as the 1N4003
4" - Black hook-up wire
20" - Red hook-up wire
1/2" - 1/8" shrink tubing
1" - 1/4" shrink tubing
1" - doublestick or electrical tape

Tools Needed: (In addition to those needed to dismantle the computer.)

IC remover or thin flat-bladed screwdriver
Solder gun or iron w/solder
Philips screwdriver
Voltmeter

Procedures:

[ ] Disassemble the computer down to the motherboard.

[ ] Remove the three screws holding the video board and fold the board back up against the card cage.

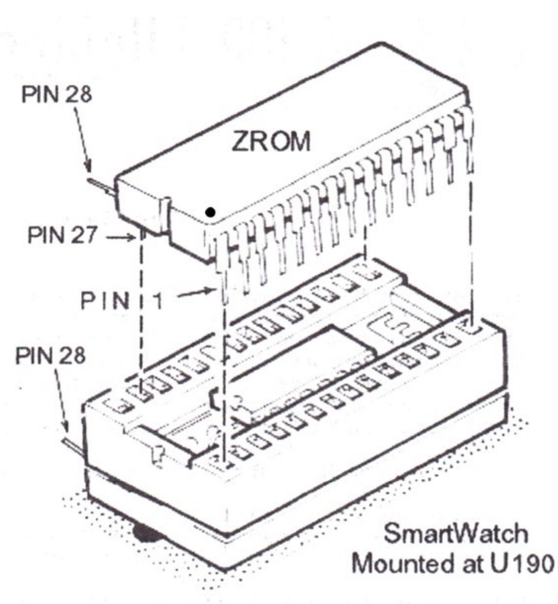


Figure 1.

[ ] Referring to Figure 1, remove the ZROM from the SmartWatch at U190, then remove the SmartWatch from the U190 socket. Bend pin 28 out on the SmartWatch socket and reinstall it into the U190 socket.

[ ] Likewise, bend pin 28 out on the ZROM, then reinstall it into the SmartWatch socket.

Construct the following circuit using a 1 Farad super capacitor, available from Mouser and Digi-Key for less than $5.00 and pretty much any diode. I used a 1N4003 from my junk box, but nearly any diode will do. Just check that the diode's reverse resistance is as high as possible to reduce current drain.

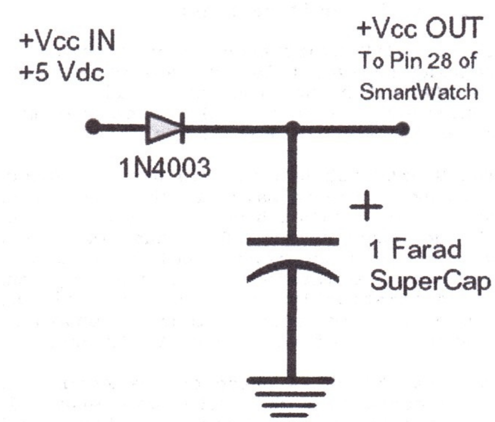


Figure 2.
New Super Capacitor Circuit

[ ] Using double stick tape or doubled over electrical tape, mount the super cap to the left side of the computer's metal bottom case in front of the power supply.

[ ] Mount the diode directly to the positive lead of the super cap. Double check that you have the polarity of the diode and capacitor correct. If the diode is reversed, the capacitor will not charge and the SmartWatch can not receive power.

CAUTION: Don't touch the leads of a charged super capacitor. While we are only playing with 5 volts DC, the current can be high enough to spark and give you quite the jolt!

[ ] Slide about 1/2" of 1/8" shrink tubing over a 4" length of black wire and solder a spade lug to one end. Attach this end to one of the two base mounting screws of the power supply.

[ ] Solder the other end to the negative lead of the super cap. Slide the shrink tubing over this lead.

Since I didn't wish to cause problems by drawing charging power from one of the integrated circuits of the motherboard, I used one of the 5 volt lines at the power supply connector for the motherboard.

It is easy to get to with the soldering iron without removing the motherboard.

[ ] Solder one end of a 7" length of red hookup wire to one of these 5 volt terminals.

[ ] Slide a 1" length of 1/4" shrink tubing over the other end of this wire and solder this end of the wire to the diode. Don't slide the shrink tubing over this yet.

[ ] Slide one end of a 10" length of red hookup wire through the shrink tubing and solder this end to the positive lead of the super capacitor. Check to ensure the diode is still soldered in place here also.

[ ] Slide the shrink tubing over this lead of the super cap and warm both pieces of tubing with the tip of the soldering iron. They will encase and protect both leads of the super cap and the entire diode.

[ ] Solder the other end of this 10" red wire to pin 28 of the SmartWatch socket.

[ ] Using a small screwdriver, pry up the left end of the integrated circuit at socket U208 to provide better access to pin 28 of the IC.

[ ] Tack solder a 2" length of red wire to the top of pin 28 of this socket. Press this IC back into its socket. This will be the source of needed power to our ZROM.

[ ] Solder the other end to the extended pin 28 of the ZROM.

[ ] Review all of the previous steps. There should be no loose wire ends nor missing IC's from their sockets.

[ ] Leave the video board leaning against the card cage, but ensure it is not shorted by the card cage. Maybe use a sheet of paper between the video board and the card cage.

[ ] Apply power to the computer and measure the voltage at the SmartWatch socket, pin 28. It should be about +4.7 Vdc, reduced slightly from the normal 5 Vdc because of the voltage drop across the diode. If you are fast, it may be lower and increasing as the super cap is charging.

[ ] Measure the voltage to the ZROM, pin 28. It should be the computer's normal Vcc, about +5 Vdc.

[ ] Power down. If successful, the installation is complete. If not, correct the error (diode? or cold solder joint) and repeat.

[ ] Reassemble the computer and boot-up. Run your clock software as normal, then note the time and shutdown.

[ ] Leave the computer off for about two hours, then reboot and note the time.

I found that the SmartWatch's clock will remain running for about 1 hour and 45 minutes after power down.

Not enough time? Add one or two more super caps to double or triple the time. Remember to connect them all in parallel, positive to positive and negative to negative.

Call or e-mail if you have any difficulty.
I can be reached at 828-685-8924 or email at: z100lifeline@swvagts.com.

Good Luck.

The Clock Series,
the "*Z-100 LifeLine*" Website

The next article in the Clock series is from Charles Hett, "Substitute Backup Battery for Dallas DS1216E SmartWatch". It literally opens up the SmartWatch module and disconnects the internal battery before attaching a replacement cell.

The third article in the Clock series builds on Charles' work, when I found that some SmartWatch modules have two (2) battery cells!

Cheers,

Steven Vagts