



ZCLK 2 Calendar/Clock Package Documentation

The original ZCLK was copyrighted 1984 by FBE Research Company, Inc. However, the other clock alternative of the time was the SmartWatch and their internal batteries are reaching their limited lifespan, and being installed internally, cannot be replaced. Therefore, 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.

Note: According to the internet, 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.

Section 1 - User's Guide

Description

ZCLK was a calendar/clock circuit board for the Z-100 series of desk-top computers. It installs on the Z-100 main circuit board and does not require an S-100 bus expansion slot. Installation is simple and will not permanently alter the Z-100 computer.



ZCLK2 Calendar/Clock
Z-100 LifeLine
November 2018

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 installations.

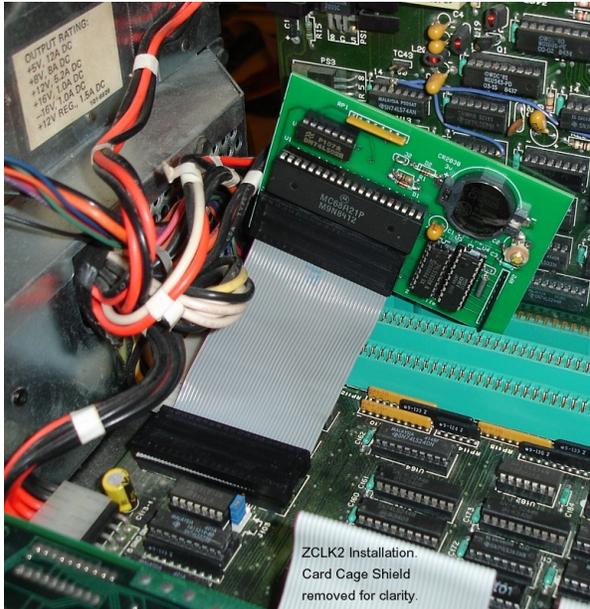
ZCLK2 shares the 68A21 Peripheral Interface Adaptor IC (U114) used by the Z-100 for the Parallel Printer Interface (and other things). With ZCLK2 installed, the ability of the computer to sense the state of the printer /ERROR line is lost. But, this is of little consequence since most software does not check for this error and, if any did, the ZCLK2 would return a no-error state. Most printers have an alternative means of indicating error conditions as well.

ZCLK2 uses the popular OKI Semiconductor MSM5832 microprocessor real-time clock and calendar IC. The MSM5832 contains registers as follows:

<u>TIME</u>	<u>MONTH</u>	<u>DATE</u>	<u>YEAR</u>	<u>WEEKDAY</u>
23:59:59	12	31	99	7

A long-life CR2032 lithium battery maintains the date/time in the ZCLK2 during computer power-off periods.

ZCLK2 Circuit Board Installation



When the 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, or laid back over any installed PC-emulator board, or placed within the card cage, if there is room.

To perform the installation, follow the step-by-step procedures applicable to your model of Z-100 (All-In-One or Low-Profile) as listed next.

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.

All-In-One Installation Procedure

1. Unplug the Z-100 power cord from the AC outlet.
2. Remove the cabinet top as shown in the Zenith manual.
3. Remove the rear screw of each cover latching slide.
4. Pivot each slide outward.
5. Remove the five screws which hold the drive/video subassembly to the base assembly.
6. Carefully lift the drive/video subassembly up and to the front of the computer about 4 or 5 inches and set it back down.
7. Unplug the signal/power cable from the video board.
8. Unplug the floppy disk and any hard drive controller cables from their controller boards.
9. Unplug the power cables from each disk drive.
10. Remove the drive/video subassembly and set it aside.
11. Proceed to **Final Installation**, following.

Low-Profile Installation Procedure

1. Unplug the Z-100 power cord from the AC outlet.
2. Remove the cabinet top as shown in the Zenith manual.
3. Remove the rear screw of each cover latching slide.
4. Pivot each slide outward.
5. Remove the four screws and two locking pins that hold the drive subassembly to the base assembly.
6. Carefully lift the drive/video subassembly up and to the front of the computer about 2 inches and set it back down.
7. Unplug the floppy disk and any hard drive controller cables from their controller boards.
8. Unplug the power cables from each disk drive.
9. Remove the drive subassembly and set it aside.
10. Proceed to **Final Installation**, as provided next.

Final Installation

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 damage, ground yourself by touching the metal computer chassis during the first three steps and proceed as carefully as possible.

1. Remove any EasyPC or Gemini PC-emulator board, if installed, to gain access to the 40-pin 68A21 integrated circuit at U114. It is located near the power supply and just forward of the S-100 Bus card cage.
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. Make certain that none of the pins "rolled under" when the IC was pushed in. If any did, remove the IC, straighten the pin, and try again.
4. Position the ZCLK2 board toward the card cage in a location that would be clear of any PC-emulator board and insert the ribbon connector into the empty 68A21 socket, making sure that the pins are fully inserted.
5. Carefully install the CR-2032 battery in the battery holder, with the positive side (+) up.
6. Locate Jumper "J2" on the ZCLK2 circuit board (it is near the battery) and ensure it is installed over both pins. This step connects the battery power to the ZCLK2 board circuitry.
7. Inspect the installation. Verify that the pins of the ribbon cable connector are properly inserted into the U114 socket on the main circuit board. Verify that the pins of the 68A21 IC are properly inserted into the socket on the ZCLK2 circuit board.

8. Reinstall any PC-emulator (Easy-PC or Gemini) board that you may have removed, using their proper procedures. Rest the ZCLK2 board, now inverted, over the top of the emulator board and insulate the two boards from each other with a layer of plastic tape.

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

Software Installation

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

Bootup 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.

This picture shows my opening screen after booting up. The graphics screen was drawn using my graphics program PAINT100, then saved as HELLO.SCN. A line in the AUTOEXEC.BAT has the screen displayed by the command:

```
TYPE HELLO.SCN
```

Then ZCLK is run and the time displayed under the graphics screen, as shown.

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 have a similar opening screen displayed for PC-DOS.

CP/M-86 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.

CP/M-85 Software:

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

CP/M-Plus Software:

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.

Software License

The programs that you receive with your ZCLK2 calendar/clock module are yours. There is no license agreement. However, the programs were copyrighted by FBE Research Company, Inc. And you may not sell exact copies of the programs for profit. You may modify the programs and sell the results as long as you include FBE Research's copyright notice.

Section 2 - Programmer's Interface

This section provides the information needed to write a program which directly accesses the ZCLK. The information applies to either microprocessor used in the Z-100.

Peripheral Interface Adaptor

The ZCLK interfaces to the Z-100 through the 68A21 Peripheral Interface Adaptor (PIA) used for the parallel printer interface. The PIA contains two Data/Direction Registers and two Control Registers. All registers are read/write and are addressed as I/O ports as follows:

<u>Z-DOS</u>	<u>PC-DOS</u>	<u>Name:</u>	<u>Function:</u>
<u>I/O Port:</u> 0E0h	<u>I/O Port:</u> 378h	ADATA	A Data/Direction Register
0E1h	379h	ACTL	A Control Register
0E2h	37Ah	BDATA	B Data/Direction Register
0E3h	37Bh	BCTL	B Control Register

The Data Register bits connect to pins of the PIA and are identified as PA0-PA7 and PB0-PB7. Each pin may be an input or an output as programmed by the Direction Registers.

To access a Direction Register, set bit 2 of the associated Control Register to zero. Each bit of the Direction Register applies to the like bit of the Data Register. A zero bit in the Direction Register programs the Data Register bit as an input. A one bit programs an output. To access a Data Register, change bit 2 of the Control Register back to a one.

The ZCLK uses the data bits of the PIA as follows:

PIA Bit:	Signal Name:	ZCLK Function:
PA0	PD1	Read Strobe (Low Active)
PA1	PD2	Write Strobe (Low Active)
PB1	/ERROR	ZCLK Enable (Low Active)
PB2	PD3	Address Counter Clock
PB4	PD5	Data Bus Bit 0 (LSB)
PB5	PD6	Data Bus Bit 1
PB6	PD7	Data Bus Bit 2
PB7	PD8	Data Bus Bit 3 (MSB)

Initial State

Initially, bit 2 of both Control Registers is set to a one which allows access to the Data Registers. The Z-100 monitor program initializes the PIA such that PA0, PA1, and PB2-PB7 are outputs and PB1 is an input.

Accessing the ZCLK Board

Until access is enabled, the ZCLK will not respond to the READ (PA0) or WRITE (PA1) Strokes or other signals present on the PIA pins it shares with the printer interface. To enable access to the ZCLK, perform the following steps:

1. Set bits PA0 and PA1 in the A Data Register to ones.
This causes the READ and WRITE Strokes signals to go high.
Do NOT alter any of the other bits.
2. Set bit 2 of the B Control Register to zero.
This allows access to the B Direction Register.
Do NOT alter any of the other bits.
3. Write 0FEh to the B Direction Register.
This makes PB1 an output.
4. Set bit 2 of the B Control Register to a one.
This restores access to the B Data Register.
Do NOT alter any of the other bits.
5. Write a zero byte to the B Data Register.
This enables read/write access to the ZCLK board by making PB1 a zero.
It also asserts (high) the HOLD signal of the MSM5832, enables the Address Counter, and sets the Address Counter Clock signal (PB2) to a zero.
6. Pause for 150 microseconds or more to allow the HOLD signal to take affect.

Note: To set a bit of a register to a one without disturbing any of the other bits, first read the contents of the register, then “OR” the contents with the bit to set and write the contents back to the register. Similarly, to set a bit of a register to zero, first read the contents of the register, then “and” the contents with the complement of the bit to set and write the contents back to the register.

De-accessing the ZCLK Board

To disable access to the ZCLK and to restore the PIA to its “normal” state, perform the following steps:

1. Set bit 2 of the B Control Register to zero.
This allows access to the B Direction Register.
Do NOT alter any of the other bits.
2. Write 0FCh to the B Direction Register.
This forces the B Direction Register to its original state and makes PB1 an input.
3. Set bit 2 of the B Control Register to a one.
This restores access to the B Data Register.
Do NOT alter any of the other bits.

ZCLK Data Register Contents

The ZCLK board uses an MSM5832 clock/calendar IC containing 13 addressable registers defined as follows:

Addr	Name	Data Bus				Range	Notes
		D3	D2	D1	D0		
Seconds							
0	S1	*	*	*	*	0-9	S1 and S10 are reset to zero on write to address.
1	S10		*	*	*	0-5	
Minutes							
2	MI1	*	*	*	*	0-9	
3	MI10		*	*	*	0-5	
Hours							
4	H1	*	*	*	*	0-9	A=1 for 24 hour format
5	H10	A	B	*	*	0-2	A=0 for 12 hour format B=1 for PM, B=0 for AM
Day of Week							
6	W		*	*	*	0-6	
Date							
7	D1	*	*	*	*	0-9	
8	D10		C	*	*	0-3	C=0 for 28 day February C=1 for 29 day February
Month							
9	MO1	*	*	*	*	0-9	
10	MO10				*	0-1	
Year							
11	Y1	*	*	*	*	0-9	
12	Y10	*	*	*	*	0-9	

All registers are read/write. *, A, B, or C means that data is valid as a one or zero bit. A blank means that the bit does not exist (zero when read and ignored when written).

The register address for the MSM5832 comes from the Address Counter (U3) which is held reset when the ZCLK is not being accessed (PB1=1) so that addressing always starts with register zero after the ZCLK is accessed. The Address Counter is advanced by setting bit PB2 to a one and then to a zero. **Do NOT alter PB1 during this operation.**

Reading Data From the ZCLK Board

The intended procedure for reading the ZCLK is to read all 13 registers into a buffer. Since the MSM5832 is in the HOLD state when the ZCLK is accessed, the time/date registers will not be updated while they are read. The entire readout process must be completed in one second or less to avoid affecting timekeeping accuracy of the ZCLK module. To read the ZCLK registers, perform the following steps:

1. Enable access to the ZCLK as previously described.
2. Set bit 2 of the B Control Register to zero.
This allows access to the B Direction Register.
Do NOT alter any of the other bits.
3. Write 00Eh to the B Direction Register.
This will keep PB1 an output and make PB4-PB7 inputs.

4. Set bit 2 of the B Control Register to a one.
This restores access to the B Data Register.
Do NOT alter any of the other bits.
5. Set bit PA0 in the A Data Register to a zero.
This asserts the READ Strobe signal, enabling the contents of the MSM5832 register currently addressed by the Address Counter onto the ZCLK data bus (bits PB4-PB7).
Do NOT alter any of the other bits.
6. Pause for at least six microseconds to allow the register contents to stabilize.
7. Read the PIA B Data Register. The MSM5832 register contents are in bits PB4-PB7. Reposition and mask the bits as required and store for later use.
8. Set bit PB2 in the B Data Register to a one and then back to a zero.
This advances the Address Counter to the next address.
Do NOT alter any of the other bits.
9. Repeat steps 6 through 8 twelve times, then de-access the ZCLK board as previously described.

Writing Data to the ZCLK Board

Writing to the ZCLK is similar to reading. The data to write is assumed to be stored in a buffer. To write to the ZCLK registers, perform the following steps:

1. Enable access to the ZCLK as previously described.
2. Get the data to be output to the register currently addressed by the Address Counter. Position and mask the data, as required, and output it to bits PB4-PB7, the ZCLK data bus, in the PIA B data Register.
Do NOT alter any of the other bits.
3. Set bit PA1 in the A Data Register to a zero and then back to a one at least one microsecond later. This generates the WRITE Strobe signal.
Do NOT alter any of the other bits.
4. Set bit PB2 in the B Data Register to a one and then back to a zero.
This advances the Address Counter to the next address.
Do NOT alter any of the other bits.
5. Repeat steps 2 through 5 twelve times, then de-access the ZCLK board as previously described.

Note that registers S1 and S10 (seconds) will be set to zero regardless of the data written to them.

Section 3 - Maintenance and Repair

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 battery. Suitable batteries (BR-2325, CR2032, or other similar 3V lithium cell of the same dimensions) are available from many sources. 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 upwards until it clears the edge of the battery holder.
2. Slide the battery out of the holder and discard.
3. Wipe the contact surfaces of the new battery with a soft, clean cloth to remove any contaminants.
4. Slide the new battery into the slot at the left and press the battery into the holder until it clips into the right edge.

SAFETY NOTE: 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.

Replacement Parts List

<u>ID:</u>	<u>Component Description:</u>
U1	Existing IC, 68A21, PIA from socket U114
U2	IC, 74LS02, Quad 2-Input NOR Gate
U3	IC, 74LS161A, 4-bit Binary Counter
U4	IC, MSM5832, Clock/Calendar
R1	Resistor, 100 Ohm, 1/4 Watt
RP1	Resistor Pack, 5 or 7 (6 or 8-pin) by 10K Ohms
RP2	Resistor Pack, 9 (10 pin) by 10K Ohms
C1	Capacitor, 33 uf 6v Tantalum
C2	Capacitor, adjustable 3-26pf
C3	Capacitor, 22 pf Mica
Y1	Crystal, 32.768 KHz
D1	Diode, IN4148 (or equivalent)
D2*	Diode, Low Leakage, 1N914B or 1N4446 (or equivalent)
BATT	Battery, Lithium, 3Volts, 150 MAH

Note *: Suitable substitutes for D2 include the SK-3100 or NTE-519. These have a maximum reverse current of .025uA. This diode prevents reverse current from flowing into the lithium battery when the ZCLK is operating from computer power. Excessive current flowing into the battery may cause it to burst or vent dangerous materials.

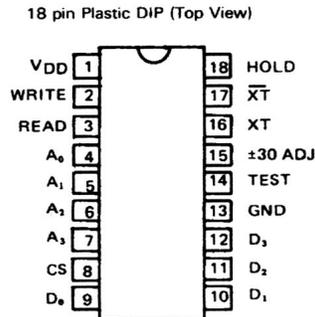
OKI Semiconductor MSM5832 Real Time Clock Chip

General Description:

The MSM5832 is a metal-gate CMOS Real Time Clock/Calendar for use in bus-oriented microprocessor applications. The on-chip 32.768Hz crystal controlled oscillator time base is divided to provide addressable 4-bit I/O data of SECONDS, MINUTES, HOURS, DAY-OF-WEEK, DATE, MONTH, and YEAR. Data access is controlled by 4-bit address, chip select, read, write and hold inputs. Other functions include 12H/24H format selection, leap year identification and manual +/-30 second correction.

OKI Semiconductor MSM5832
Real Time Clock & Calendar

A0 to A3	: Address Inputs
WRITE	: Write Enable
READ	: Read Enable
HOLD	: Count Hold
CS	: Chip Select
D0 to D3	: Data Input Output
TEST	: Test Input
±30 ADJ	: ±30 Second Correction Input
XT & XT	: xtal oscillator connections
VDD	: +5V Supply
GND	: Ground



The MSM5832 normally operates from a 5vdc supply. Battery backup operation down to 2.2vdc allows continuation of time keeping when main power is off. The MSM5832 is offered in an 18-lead dual-in-line plastic (RS suffix) package.

Features:

- * 7 Function - SECOND, MINUTE, HOUR, DAY, DAY-OF-WEEK, MONTH, YEAR
- * Automatic leap year calendar
- * 12 or 24 hour format
- * +/-30 second error correction
- * 4-BIT DATA BUS
- * 4-BIT ADDRESS
- * READ, WRITE, HOLD, and CHIP SELECT inputs
- * Reference signal outputs - 1024, 1, 1/60, 1/3600Hz
- * 32.768kHz crystal controlled operation
- * Single 5vdc power supply
- * Back-up battery operation to Vdd = 2.2v
- * Low power dissipation: 90uW Max at Vdd = 3v, 2.5 mW Max at Vdd = 5v
- * 18-pin plastic DIP (DIP18-P-300)

In Case of Difficulty

So far, the only experience that I've 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.

Repair Policy

Should you have difficulty with your ZCLK2, feel free to contact me at Z-100 LifeLine. Should your ZCLK2 require repair, please ship it to me at Z-100 LifeLine with a check for \$15 to cover shipping. Include a brief statement describing the problem along with a return address and a telephone number. I'll do my best to repair or replace the ZCLK2 with another, if I have another - Steven W. Vagts

