H8-Z80-64 Rev 2

The H8-Z80-64 Rev 2 is a CPU card for the H8 computer. This document explains how to configure the card for your system.

CURRENT STATE OF THE BOARD

The H8-Z80-64 Rev 2 was designed as a replacement for the 8080 CPU board. It offers a clockable Z80 CPU and circuitry necessary to support it on the Heathkit H8 system.

CLOCKING

If you are using the recommended 16.384 MHz clocking chip (ECS-300CX-16.384 Mouser part# 520-DCO1638-X) the board can be configured using the onboard jumpers to operate at 1, 2, 4, 8 or 16 MHz. For 16 MHz operation, just move the jumper next to the clocking chip to the "NO DIV" position which will bypass the divider output. I have not been able to clock higher than 4MHz with my setup. Also note that at higher than 2MHz there may be software and hardware incompatibilities. In addition to the ECS-300CX clocking chip you can also use a standard 2.048MHz half can oscillator. Just put a jumper on the middle pins of the top 2 rows and leave the 3rd (bottom) row unused.

ONBOARD RAM

The Rev 2 board supports onboard RAM. The recommended SRAM chip is the Alliance AS6C1008 in the 32pin DIP package. Set the RAM CONFIG jumper to PCB when using onboard RAM. No other RAM card is necessary when using onboard RAM so you can remove them if they are installed in your system.

REQUIREMENTS

The H8-Z80-64 Rev 2 card requires no other installed cards to operate. However, you'll most likely want to have a serial interface for communicating with the computer and the H17 disk drive controller for booting to an operating system. This card has GIDE support built-in which means it'll work with any IDE hard drive. At this time you still need to boot from a floppy to take advantage of the hard drive storage.

H8-Z80-64 Rev 2

BOARD JUMPER SETTINGS

The card has several jumpers on it that may not be clear so I will try to explain what they do. Refer to the diagram on the next page.

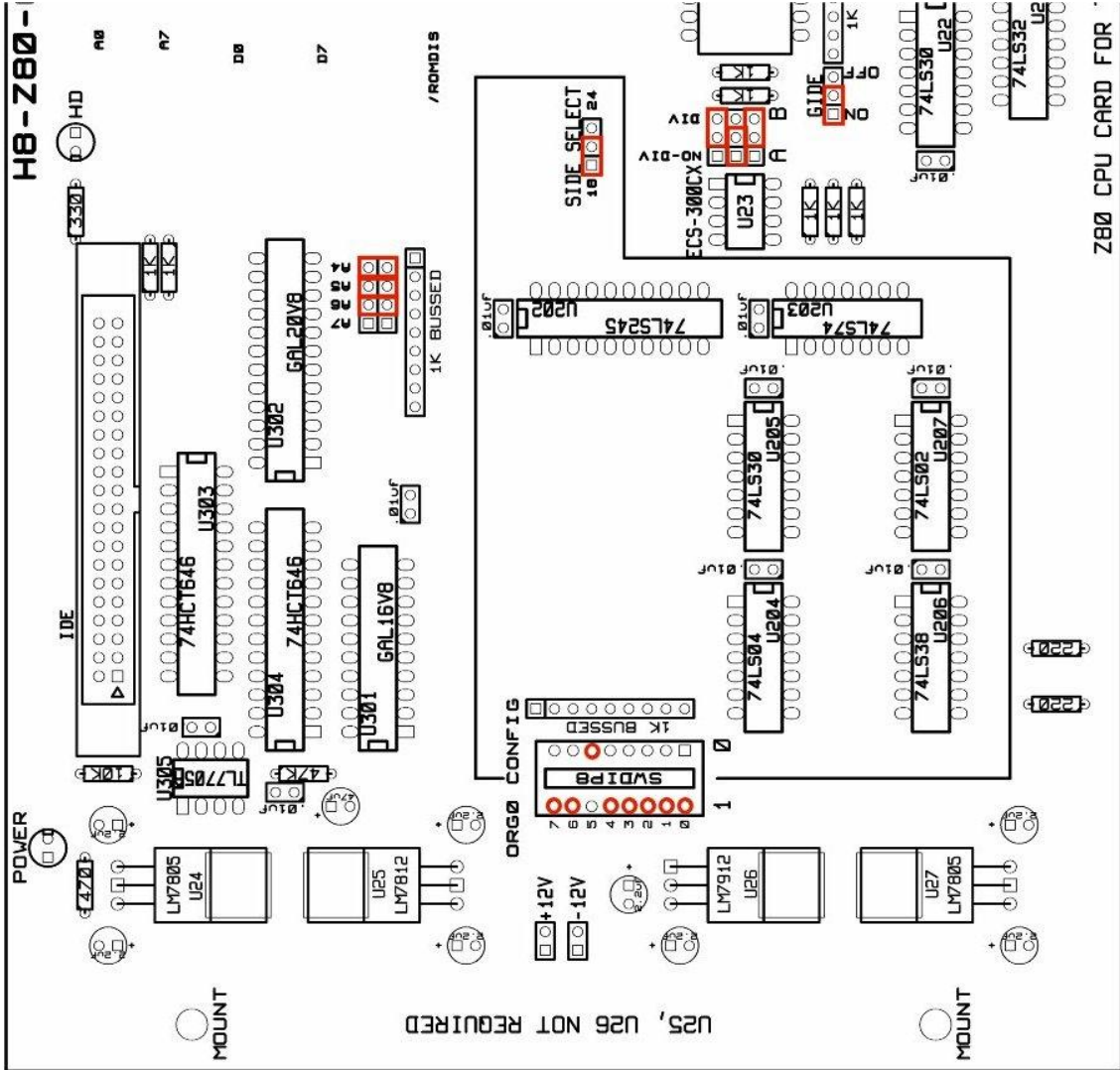Normal configuration of the jumpers are as follows:

Y1-Y2, Z1-Z2, PCB, LM, EI, U3-1, U4-2, /CS1, /CS2, /OE, /WE, A16, A18

DESCRIPTION

ROM DECODER: Y1-Y2 sets pin 2 of the ROM DECODER chip (U7) high. If you jumper **Y2-Y3** address line A11 will be decoded on pin 2 and if you jumper **Y2-Y4** A12 will be decoded. **Z1-Z2** ties pin 1 on the ROM decoder chip (U7) high and a jumper on pins **Z2-Z3** will tie pin 1 to A10. Decoding these address lines is not normally necessary except when using dual ROMs or a ROM other than a 2732. The ROM decoder (U7) is used to enable the onboard ROM when memory is accessed in the lower region below 8K. The memory below 8K on the Heathkit H8 computer was reserved for system ROMs. All other memory access above 8K will be routed to the 64K RAM chip. If using a 4K x 8 system ROM such as a 2732 you want a jumper on **Y1-Y2** and **Z1-Z2**. **RAM CONFIG:** When **PCB** is selected for the RAM CONFIG all access to memory regions above 8K will be directed to the onboard RAM. Setting this to **BUSS** will direct all memory access above 8K to a card installed in the system. **RESET CONFIG:** The **LM** jumper uses the onboard timer (LM555 at U11) for controlling the reset pin of the CPU. This adds a slight delay and holds the pin low for a short period of time whenever the system is powered up or RST/0 is pressed on the front panel. Moving the jumper to **FP** will by-pass the LM555 and system reset is controlled directly from the front panel. **INTERRUPT ENABLE: IE** connects the output of the interrupt enable circuitry (U18 thru U22) to P201 pin 3. This turns the front panel ION light on when interrupts are enabled on the CPU. The circuitry decodes instructions on the data bus of the Z80 and determines if interrupts are enabled or disabled by looking for the EI and DI instructions. The Z80 does not have an INTE pin like the 8080 does so this circuitry is necessary. If you set the jumper to **DI** the ION light will always be on and single stepping from the front panel monitor will not work.

Refer to the following diagrams for jumper settings for a typical H8 configuration with an H17 controller, 64K RAM and XCON8 ROM.

H8-Z80-64 Rev 2

54 CPU/GIDE

Rev 2.1

2009 Les Bird

THE HEATHKIT H8 COMPUTER

74LS30 U7
74LS540 U6
74LS10 U5
74LS10 U8
74LS00 U9
74LS540 U10
74LS540 U13
74LS32 U12
74LS32 U14
74LS540 U15
74LS148 U16
74LS540 U17
74LS74 U18
74LS00 U19
74LS04 U20

444-140 PAM-37 U4
444-70 XCON-8 U3
AS6C1008 128K×8 U2
Z80 CPU U1

/ROMSEL1
/ROMSEL2
/RAMEN
RAM CONFIG
PCB / BUSS
/DATAEN
/IOR
/MEMR
/MEMW
/IORQ
/MREQ
/INTA
/BUSACK
/RST
MEMR
HOLD
IOR
HLDA
MEMW
/02
IOW
/RDIN
M1

D0 D1 D2 D3 D4 D5 D6 D7

1N4149
22pf
68K
4.7K
2.2K
1.1K
1K

A+A=8MHz
B+A=4MHz
A+B=2MHz
B+B=1MHz

BUSSED
1K BUSSED

X Y Z

H37
LM
FP
R18
R16
CS2
A17
/OE
/CS1
P201
EI3
D1

+18V -18V

H8-Z80-64 Rev 2

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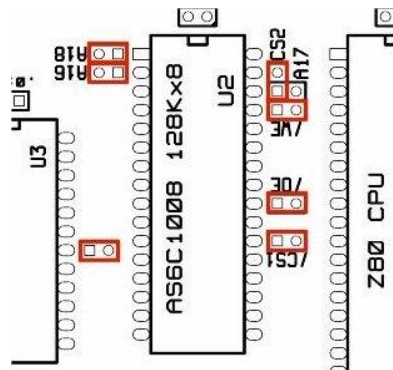
ONBOARD RAM CONFIGURATION

There are several jumpers for configuring the onboard RAM. The RAM chip can be any 32pin SRAM that is pin compatible with the Alliance AS6C1008. Although the AS6C1008 is a 128K chip, only 64K will be used. To configure the RAM using the jumpers, see below:

/CE, /OE, and **/WE** should be jumpered for all chip types.

A16, CS2 should be jumpered if a 128K (AS6C1008) chip is used.

A16, A18, and **CS2** should be jumpered for a 256K (AS6C2008) chip.

A16, A17, A18 should be jumpered if a 512K (AS6C4008) chip is used.


When using onboard RAM be sure to uninstall any memory cards in your H8 as they are no longer needed.

H8-Z80-64 Rev 2

DIP SWITCH SETTINGS

The DIP switch on the Z80 card is for configuring the ORG-0 settings.
The ORG-0 option was available when the HA8-8 (or my H8-8-8) Extended
Configuration card was installed. With the H8-Z80-64 Rev 2 CPU card
the ORG-0 functionality is integrated so you do not need to install
the Extended Configuration card in your system.
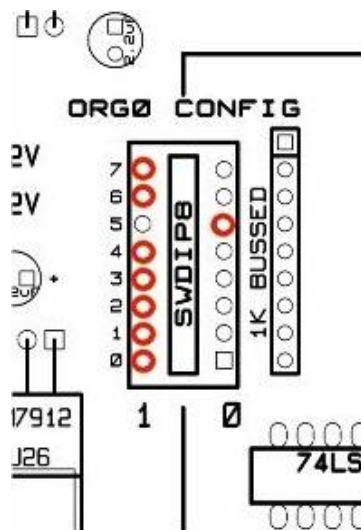
Switch	Description (ON = 1, OFF = 0)
1,0	1:ON, 0:ON = Port 174Q has an H17 type disk controller (default) 1:ON, 0:OFF = Port 174Q has an H47 type disk controller
3,2	3:ON, 2:ON = Port 170Q is not in use (default) 3:ON, 2:OFF = Port 170Q has an H47 type disk controller
4	ON = Boots from device at 174Q (default) OFF = Boots from device at 170Q
5	ON = Perform memory test on power up (not supported w/XCON8) OFF = Do not perform memory test on power up (default)
6	ON = Set console to 9600 baud (default) OFF = Set console to 19200 baud (not supported w/XCON8)
7	ON = No auto-boot on power up (default) OFF = Auto-boot on power up

H8-Z80-64 Rev 2

ASSEMBLY

IMPORTANT NOTICE: Please use a 10K resistor pack for the ORG-0 CONFIG
section next to the dip switch. It is labeled on the PCB as a 1K
BUSSED resistor array but should actually be a 10K BUSSED array.

U25 and **U26** and the accompanying 2.2uf capacitors are not needed.
These are for the +12V and -12V supplies which are not used on this
card. They are here for future expansion.

Building the H8-Z80-64 Rev 2 is simple. All parts are easy to solder
and commonly available from many suppliers. Recommended suppliers for
the components to build the Z80 card are listed below:

Semiconductors and passives: http://www.mouser.com

IDE 40 pin 2 x 20 boxed header: Mouser part # 517-D2540-6002-AR

25 pin Molex receptacles: http://www.heilind.com part #22-16-2251

GIDE chip set: tgcons@cfl.rr.com

Approximate cost for all components (including GIDE chips) is about
$50.

Contact me and I can forward you a Mouser shopping cart with all the
components you need except for the GIDE chips. You can then click the
BUY button and have the parts shipped straight to your doorstep.

My e-mail address is lesbird@bellsouth.net. Or visit my website at
http://www.lesbird.com/sebhc and click the e-mail link.

On the following page is a list of parts needed to construct the Z80
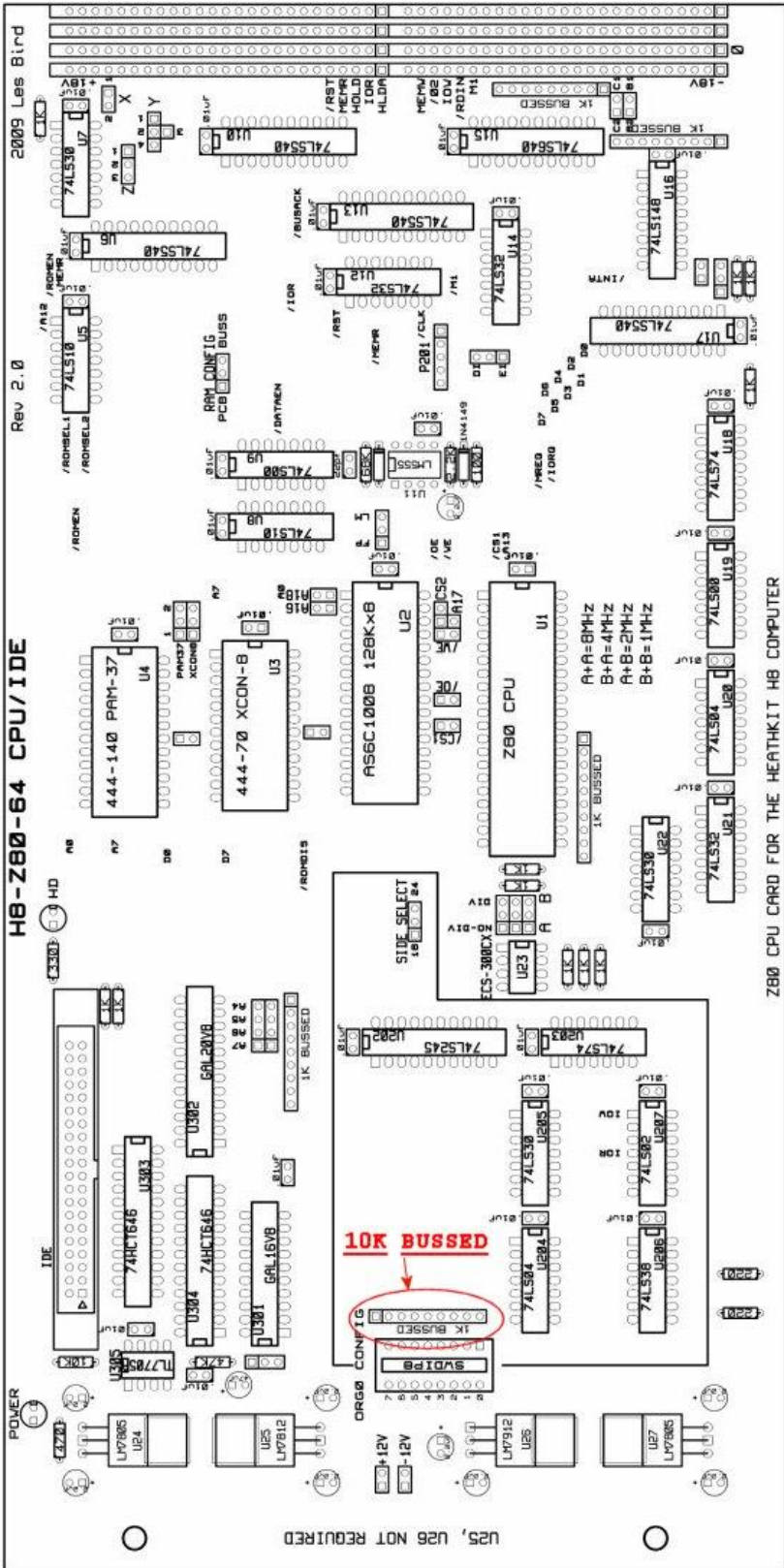card.

H8-Z80-64 Rev 2

SEMICONDUCTORS

QTY	DESCRIPTION
2	74LS10
3	74LS30
4	74LS540
3	74LS32
2	74LS00
1	74LS148
2	74LS74
2	74LS04
1	74LS640
1	74LS02
1	74LS38
1	74LS245
1	ECS-300CX-16.384
1	Z80 CPU
1	128K x 8 SRAM (AS6C1008)
1	LM555CN
2	7805 5V regulator

PASSIVES

QTY	DESCRIPTION
11	1K ¼ watt resistor
1	68K ¼ watt resistor
2	1N4149 diode
1	2.2uf electrolytic radial capacitor
1	100 ohm ¼ watt resistor
1	22pf ceramic disc capacitor
30	.01uf filter capacitor
5	2.2uf tantalum radial capacitor
4	1K x 9 pin bussed resistor pack
1	10K x 9 pin bussed resistor pack
2	220 ohm ¼ watt resistor
1	470 ohm ¼ watt resistor
1	330 ohm ¼ watt resistor
1	10K ¼ watt resistor
1	47K ¼ watt resistor
2	5mm LED lamp (red and yellow)

CONNECTORS

QTY	DESCRIPTION
2	25 pin molex part #22-16-2251
1	IDE 40-PIN (2x20) header
2	1 x 1 single pin header
6	1 x 2 header (2.54mm spacing)
8	1 x 3 header (2.54mm spacing)
2	2 x 3 header (2.54mm spacing)
3	2 x 2 header (2.54mm spacing)
1	1 x 5 header (2.54mm spacing)
1	2 x 4 header (2.54mm spacing)

H8-Z80-64 CPU/IDE   Rev 2.0   2009 Les Bird

Z80 CPU CARD FOR THE HEATHKIT H8 COMPUTER

U25, U26 NOT REQUIRED

Z80 CPU — U1
AS6C1008 128Kx8 — U2
444-70 XCON-8 — U3
444-140 PAM-37 — U4

A+A=8MHz
B+A=4MHz
A+B=2MHz
B+B=1MHz

74LS30 U7
74LS540 U6
74LS10 U5
74LS540 U10
74LS540 U15
74LS14B U16
74LS540 U13
74LS32 U14
74LS32 U12
74LS540 U17
74LS00 U9
74LS10 U8
74LS574 U18
74LS08 U19
74LS04 U20
74LS32 U21
74LS30 U22
74LS245 U202
74LS574 U203
74LS30 U205
74LS02 U207
74LS04 U204
74LS30 U206
GAL20V8 U302
74HCT646 U303
74HCT646 U304
GAL16V8 U301

RAM CONFIG
PCB   BUSS

SIDE SELECT
ORG0 CONFIG

10K BUSSED
1K BUSSED

ECS-300CX
U23
DIV
NO-DIV
A B

/ROMEN /MEMW U12
/A12
/ROMSEL1 /ROMSEL2
/ROMEN
/ROMDIS
/DATMEN

/RST /HEMR /IOR
/MREQ /IORQ
/INTM
/INTA

POWER
LM7805 U24
U25 LM7812
LM7912 U26
U27 LM7805
+12V -12V

IDE
HD

1N4148