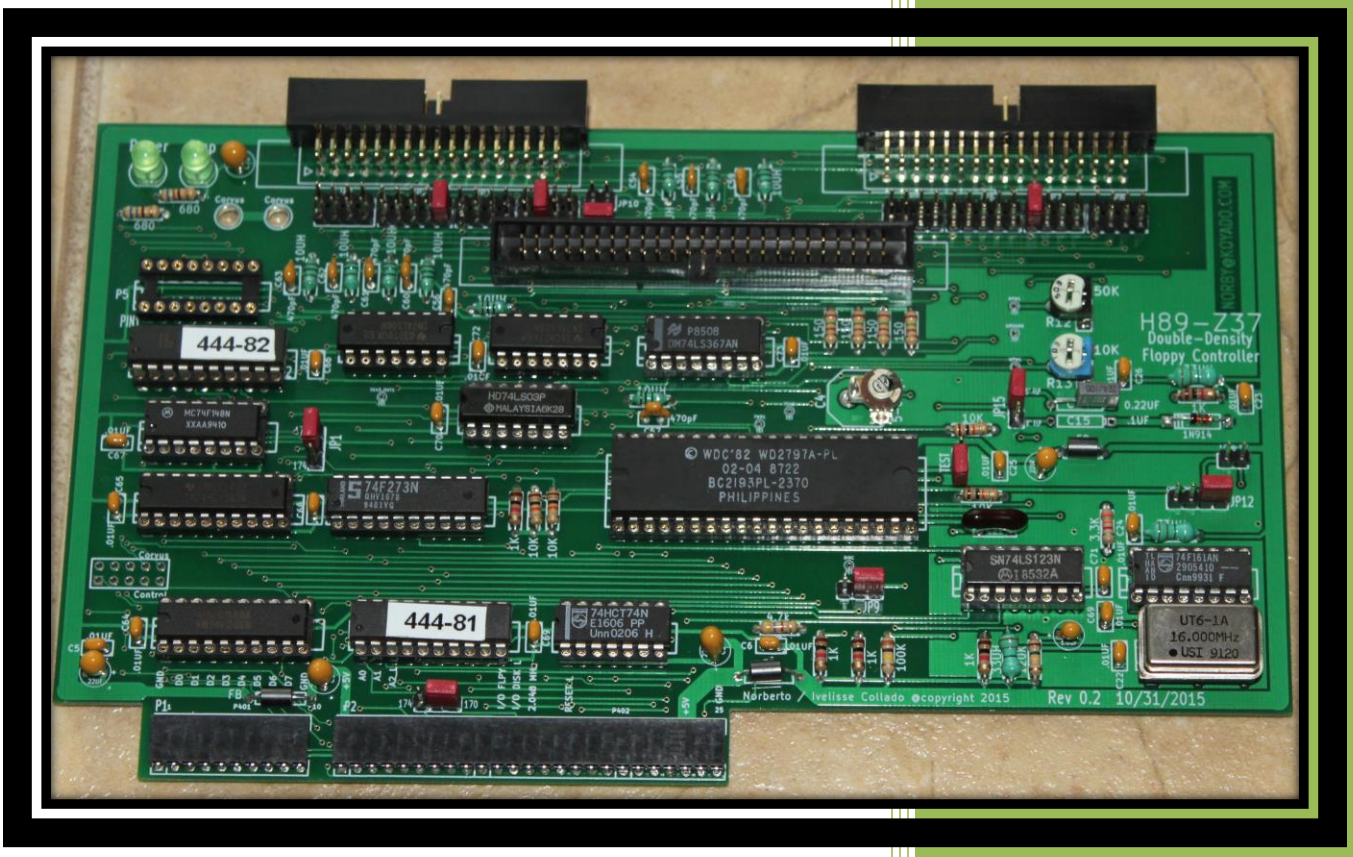
2015

H89-Z37 DOUBLE-DENSITY FLOPPY CONTROLLER



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Revision History and Disclaimer

Revision History		
Revision	**Date**	**Comments**
1.0	05/03/2015	Initial draft by Norberto Collado
1.1	06/06/2015	Added feedback from Terry G.

The purpose of this document is to “SUPPORT” those who still use these great Heathkit machines and to preserve the information of those who made a difference.

Also this document is to allow the surviving classic computers to continue to function. Without the proper software support, the hardware cannot be seen in action, and a piece of our digital history is lost. I have not included any material in this document which I believe has current commercial value. Most of the material in this document is the intellectual property of other companies or individuals. However many of the companies are no longer in existence, and I do not have current contact information to obtained permission to include them.

Please don't use any of this material for any purpose other than personal hobby/interest without checking with the owner of the material.

Thank you for your understanding and consideration.

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Introduction

This document provides an overview on the H89-Z37 floppy controller board design by Norberto Collado for the Heathkit H89 Computer. The H89-Z37 Double Density Disk Controller allows double-density operation with your H88, H89, H89A-SBC, Z-89, or Z90 series computers.

HOST COMPUTER REQUIREMENTS

Programming Ports

JP1 and JP2 – Select port 170Q or 174Q (both jumpers must be at 170Q, and both jumpers must be at 174Q). Default is 170Q if the board is installed in P510 and P504 connectors; the left connector in the right expansion area. Refer to the following link for visual details:

http://sebhc.lesbird.com/documentation/hardware/QuickData/Z89_Z90-pictorials.pdf

http://sebhc.lesbird.com/documentation/hardware/QuickData/QuikData-H_Z37_H89-clone.pdf

Interrupt Cable

Route the 16-conductor cable from the H89 Z80 CPU board to the H89-Z37 board and plug the loose end into the DIP socket marked CPU Interface (P5). Be sure that pin1 on the 16 pin DIP lines up with pin number one of the socket.

Firmware

1. MTR-90 Boot ROM (444-84) 2732A
2. I/O decoder ROM – 444-61
3. Hard drive decoder – 444-83
4. Memory decoder to support 64K of RAM – 444-66

H89-Z37 DISK CONTROLLER

The H89-Z37 controller contains a soft-sector, double density disk controller for 3.5” and 5.25” disk drives. The H89-Z37 controller is operable at any CPU speed up to 8 MHz, and it supports four bootable floppy drives. The H89-Z37 Floppy Disk Controller mounts inside the H89 computer cabinet. It supports double-sided, double-density disk for both 5.25-inch and 3.5-inch floppy drives. This new design uses a WD2797 that is a super set of the WD1797. Two Programmable GAL’s Logic devices were used to reduce chip count to keep the board size small. The H89-Z37 is fully compatible with HDOS and CP/M operating systems stock drivers. The H89-Z37 hardware also supports 8” floppy densities with the availability of a floppy driver. A 50 pin connector is provided to support such configuration.

CONTROLLER CARD PORTS CONFIGURATION

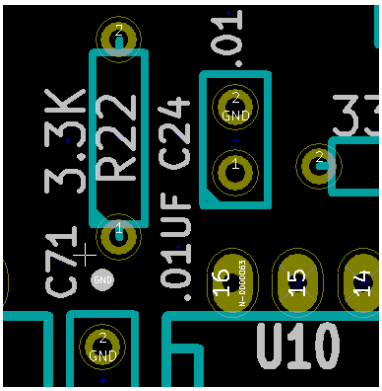
The following is a table summary of the controller ports configuration. Documentation can be obtained at the following website; http://www.lesbird.com/sebhc/index.html

CONTROLLER CARD	PORT
H17	7CH (174Q)
H89-Z37	78H (170Q)
H67	78H/7CH (170Q – 174Q)

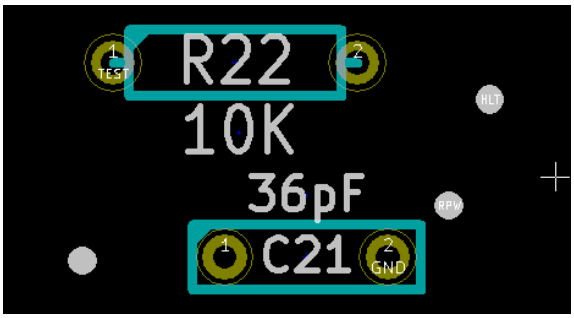
Assembly Notes:

1. JP1 is used in two places; for PORT control and for drive selection (below J1 floppy 3.5" connector).
2. C69 .01uF capacitor designation repeated twice.
3. **C21 – 36pF capacitor should be a .01uf capacitor for proper timing**

4. **R22** designation repeated twice. Install a 3.3K resistor on **R22** next to U10.

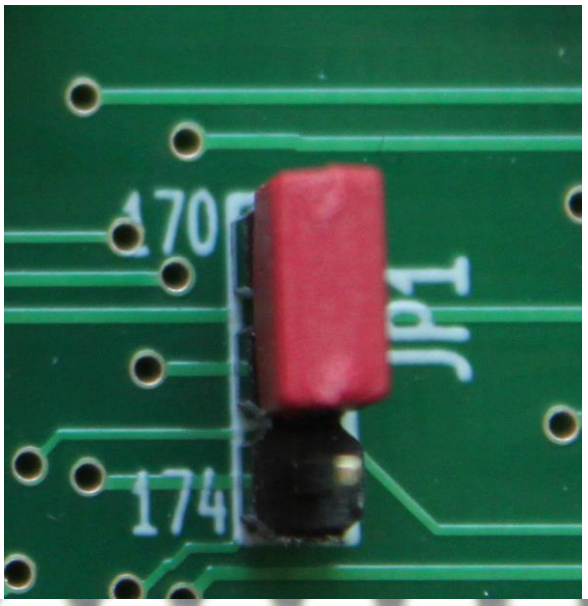


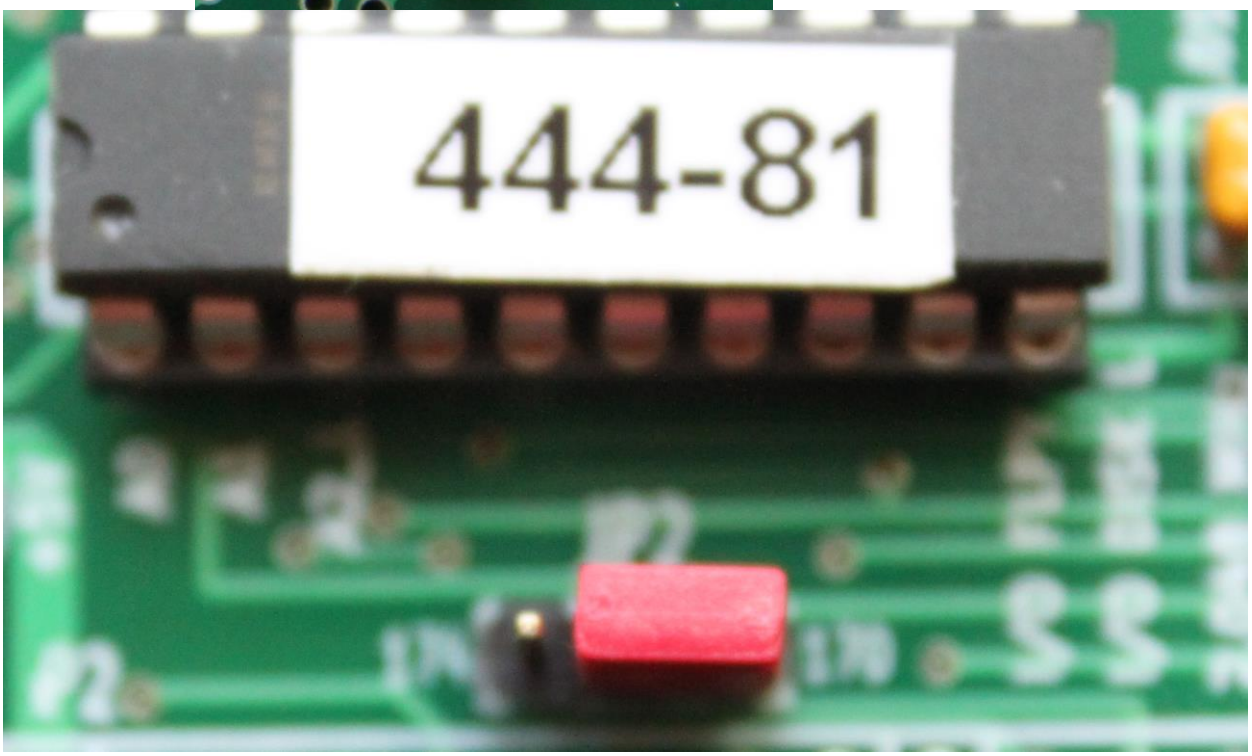
5. Install a 10K resistor on **R22** next to C21.



H89-Z37 Jumper Configuration

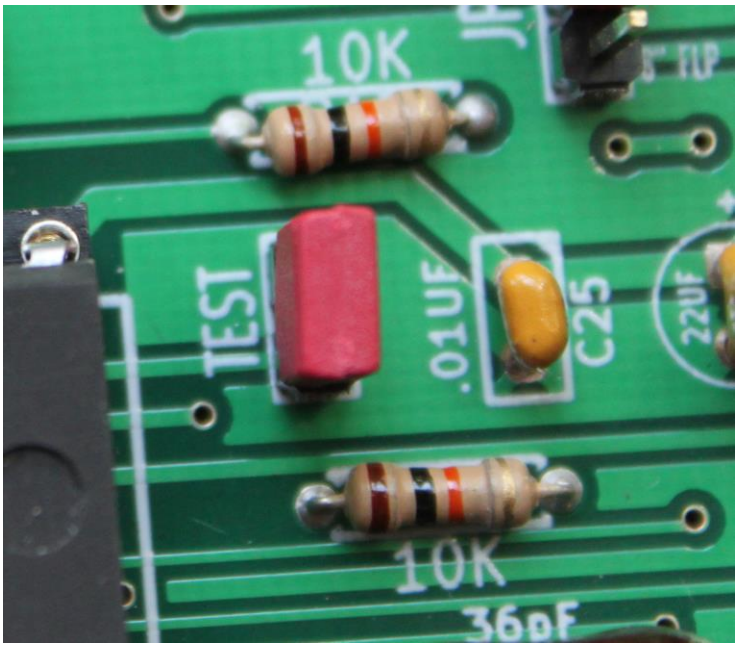
( ) Insert jumpers (default address 170Q) as shown below on JP1 and JP2



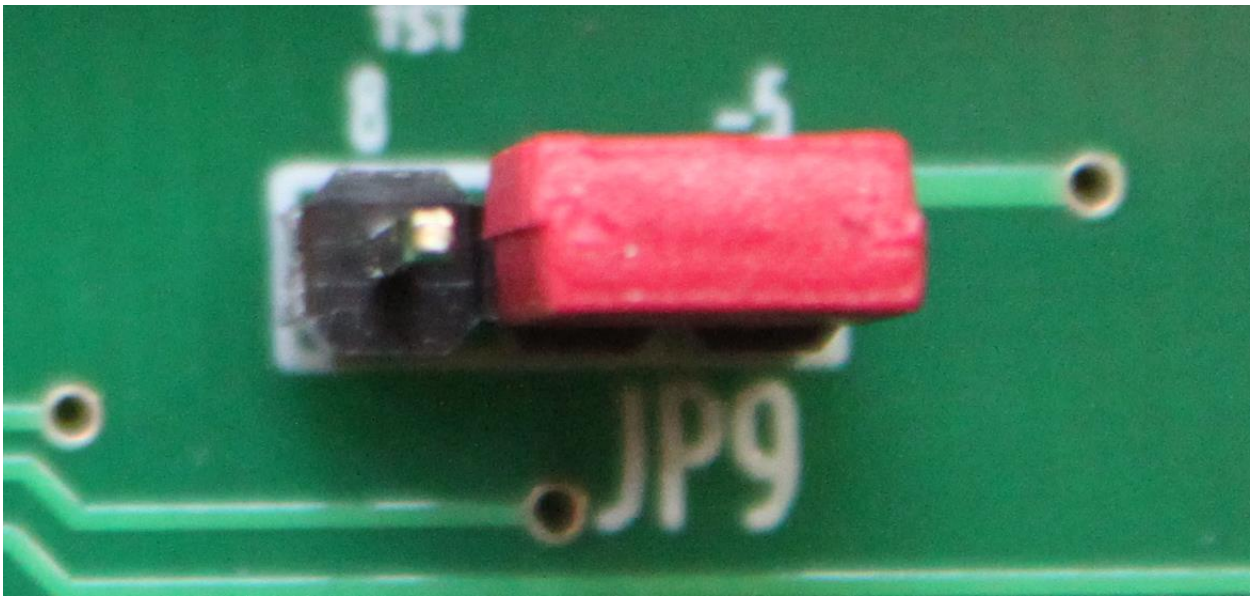


( ) Jumper “JP12” is used to select the Floppy Controller clock. It requires a free-running 50% duty cycle square wave clock for internal timing reference, 2 MHz ± 1 % for 8" drives, 1 MHz ± 1 % for mini-floppies - 5 ¼ “. Default configuration is 1 MHz as shown below to support the mini-floppies. **Do not install a jumper across GND and the 2MHz pin which might cause damage to U10 74LS161 IC.** The ground pin was added in case we need to control the 1 and 2 MHz clocks remotely by means of a coaxial cable.

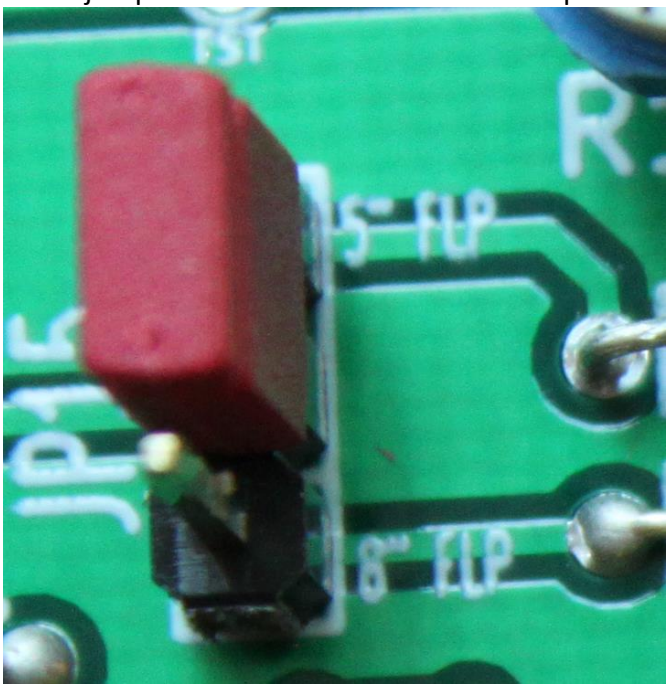
( ) The “TEST” jumper (JP13) is only used when calibrating the board. Refer to the following web site on how to calibrate the H8-Z37 board (koyado.com). **Please remove the “TEST” jumper for normal operation.**



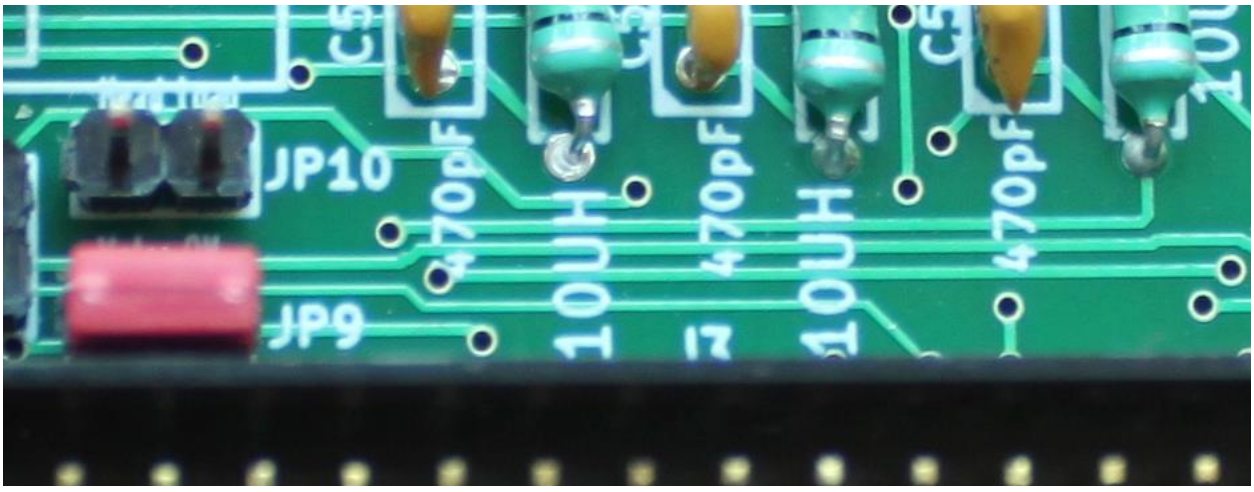
( ) Jumper “JP9” is used for 5 1/4”, 8" select (-5 for 5 ¼ “and 8 for 8” floppy drives). This jumper selects the internal VCO frequency for use with 5 ¼ “drives or 8" drives. Please select “-5” position for normal operation.



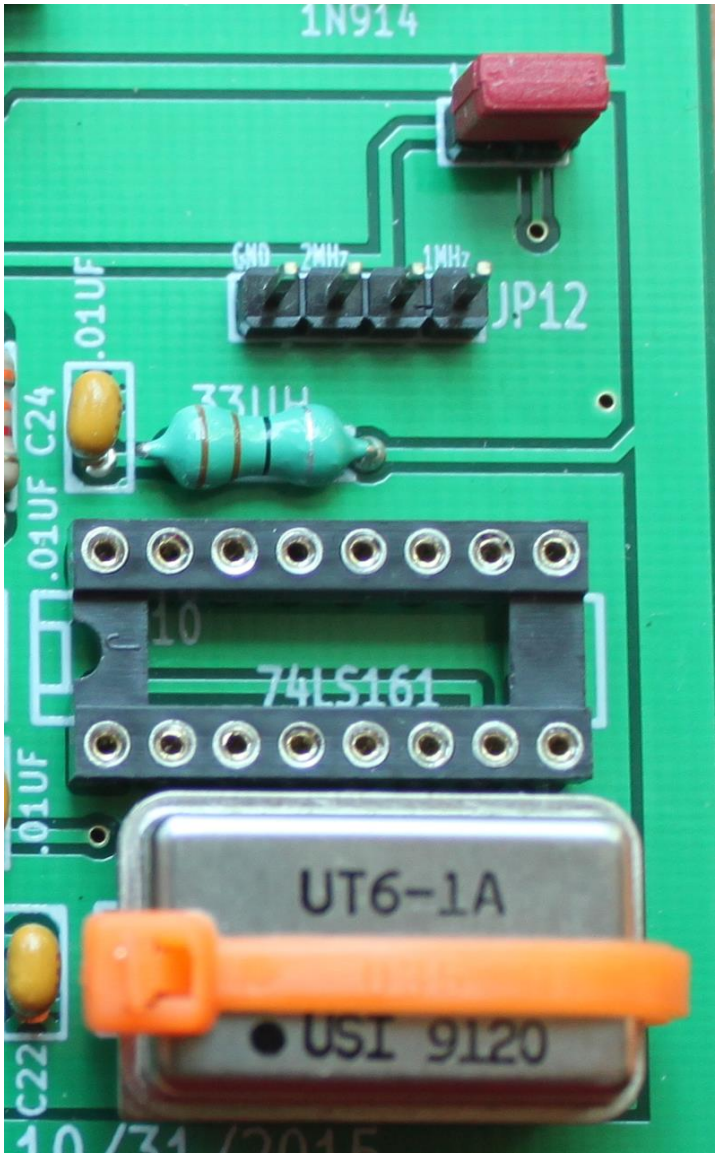
( ) Jumper “JP15” is used to select the Floppy Controller filter capacitor. The filter capacitor value is 0.22uF since 5 1/4" drives operate at exactly one-half the data rate (250 Kb/sec). Please insert jumper as shown below for normal operation.



( ) Jumper “JP9” and “JP10” are used to control the 8” floppy drive motor on feature. Depending on the 8” disk drive configuration install only one jumper. The default is “JP9” as shown below.



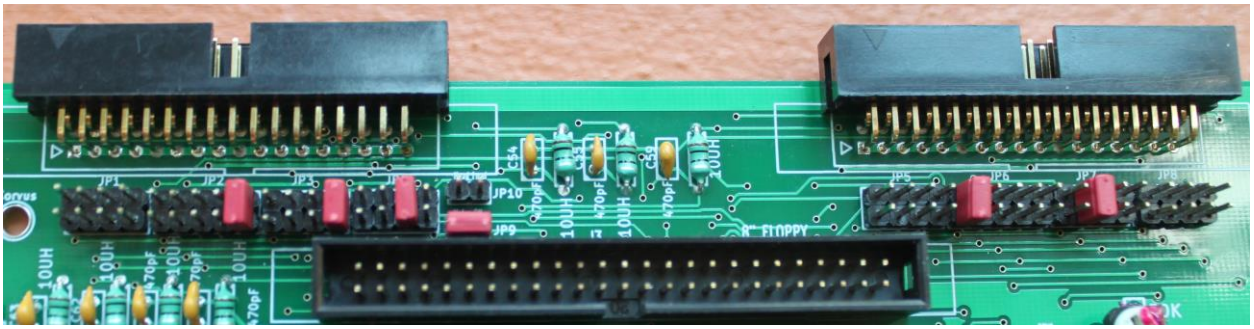
( ) Jumper “1/2MHz OSC” is used when we are “**only**” installing a 1 or 2 MHz oscillator. Install jumper if only using a 1 or 2 MHz oscillator and remove jumper across “JP12”, and also removed U10 “74LS161” as shown below.



( ) Jumpers “JP1, JP2, JP3, JP4, JP5, JP6, JP7, and JP8” are for floppy drive selection. It allows two 3.5” floppy drives on any given connector and two 5.25” drives on any given connector (J1, J2).

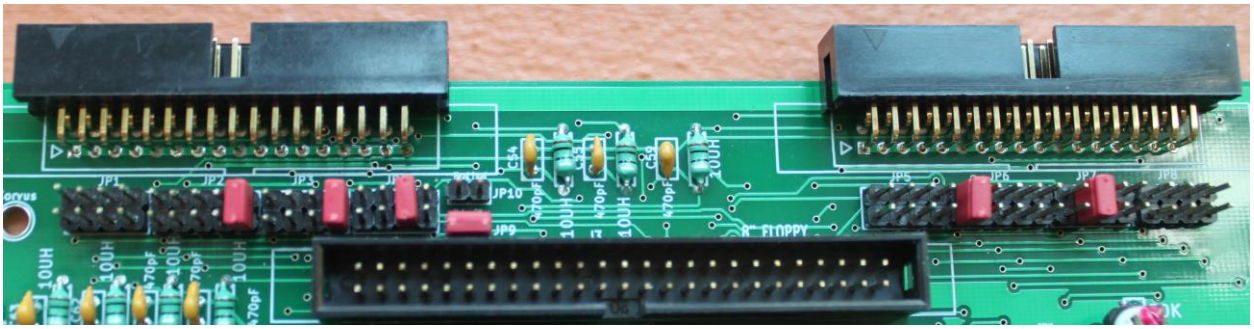
As shown below, the board is configured to use two 3.5” floppy drives on J1 (left connector) and two 5.25” floppy drives on J2 connector (right connector).

For further information refer to the following schematic at the following link; koyado.com



MTR-90 Monitor Drive Selection

In order to setup properly the jumpers “JP1, JP2, JP3, JP4, JP5, JP6, JP7, and JP8” for floppy drive selection, please use the H89 MTR-90 Monitor as follows;



Port address = **170**Q

Drive 0 = 020Q

Drive 1 = 040Q

Drive 2 = 100Q

Drive 3 = 200Q

For example to select Drive 0, type the following commands.

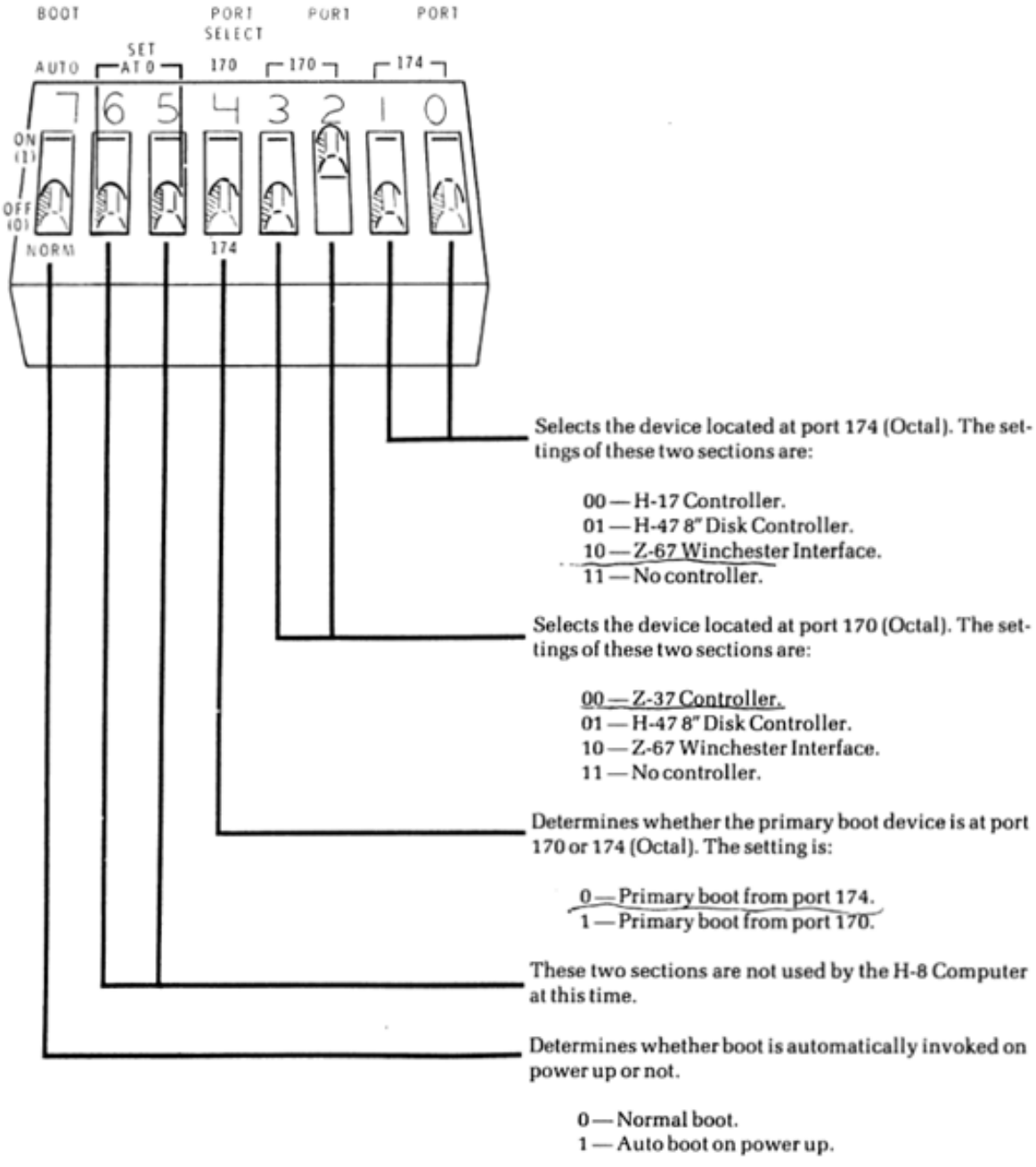
1. H: O(ut) 170,**020** <cr>
2. Insert a jumper until Drive 0 floppy drive green LED turns ON as shown below
3. H: B(oot) S(D) <cr> ; to boot from drive 0

Operation

Switch Configuration

If section 7 of switch SW1 on the H89 Z80 CPU board is set to **1**, the system will automatically boot from hardware unit **0** on the primary device when you turn the power on or perform a master clear reset.

Note: Auto boot feature is only for Hard Drives. On floppy drives, the diskette could be accidentally erased during the power-on sequence inside the Computer.



H89-Z37 Board Assembly

( ) – A soldering iron drawing **30W** is plenty powerful for this job. Don't go any higher or else you'll risk damage to the board and/or components. Make sure you have a narrow tip.

( ) - Latest BOM is at the following website; BOM

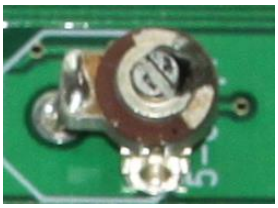
( ) – Solder all - 0.01uF caps.

( ) – Solder all – 470pF caps

( ) – Solder C14 - 0.22uF cap

( ) – Solder C15 - 0.1uF cap

( ) – Solder C4 – 5-60 pF variable capacitor



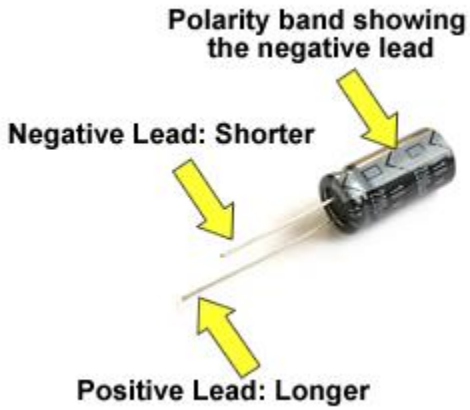
( ) – Solder C21 – labeled 36pF Mica with a **0.01uF** capacitor

Note: a 36pF cap the reset pulse is 2.32us and the minimum per spec is 50us. A value of 0.01uF produces a pulse of 328us which is above specs.

( ) – Solder C1, C2, C3, and C70 - 22uF caps (observed polarity)

( ) – Solder C35 - 1uF caps (observed polarity)

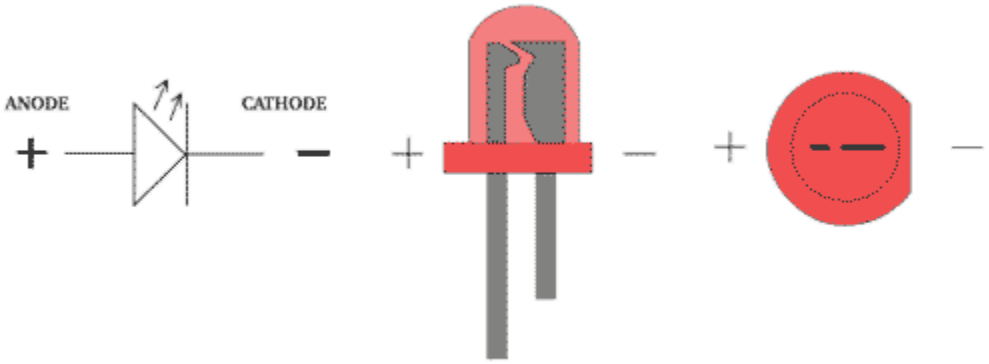
( ) – Solder C65 – 22uF cap (observed polarity)

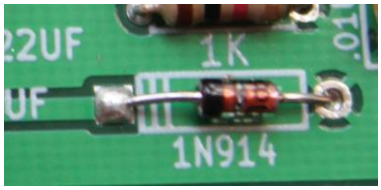


( ) – Solder a GREEN LED - LED1 (Power)

( ) – Solder a BLUE LED – LED2 (Step) – optional and no added value.

( ) – Solder an IN914 diode on D1





Resistor Band Color Reference

Color	*Band 1*	*Band 2*	*Multiplier*	*Tolerance*
Black	0	0	x 1	not used
Brown	1	1	x 10	not used
Red	2	2	x 100	not used
Orange	3	3	x 1000 = 1K	not used
Yellow	4	4	x 10000 = 10K	not used
Green	5	5	x 100000 = 100K	not used
Blue	6	6	x 1000000 = 1M	not use
Violet	7	7	not used	not used
Gray	8	8	not used	not used
White	9	9	not used	not used
Gold	not used	not used	divide by 10	±5%
Silver	not used	not used	divide by 100	±10%
None	not used	not used	not used	±20%

( ) – Solder R20, R23 – 680 OHM resistors

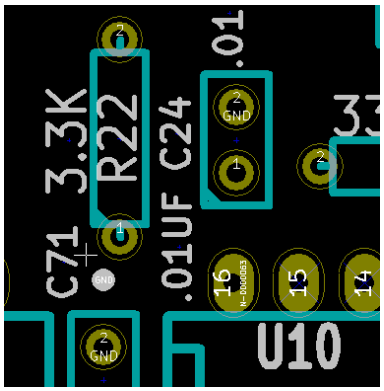
( ) – Solder R8, R9, R10, R11 – 150 OHM resistors

( ) – Solder R6 – 100K OHM resistor

( ) – Solder R2, R3, R15, **R22** – 10K OHM resistors

( ) – Solder R1, R4, R5, R14, R17 – 1K OHM resistors

( ) – Solder **R22 – 3.3K** OHM resistor



( ) – Solder R21 – 120K OHM resistor

( ) – Solder R24 – 4.7K OHM resistor

( ) – Solder all IC SOCKET, 14PIN

( ) – Solder all IC SOCKET, 16PIN

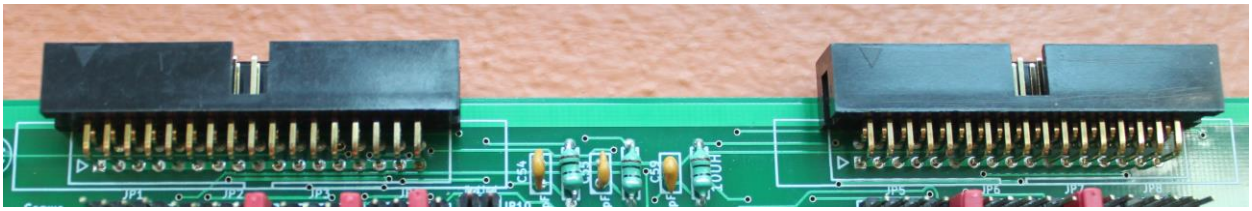
( ) – Solder all IC SOCKET, 20PIN

( ) – Solder a single IC SOCKET, 40PIN

( ) – Solder all ferrite beads

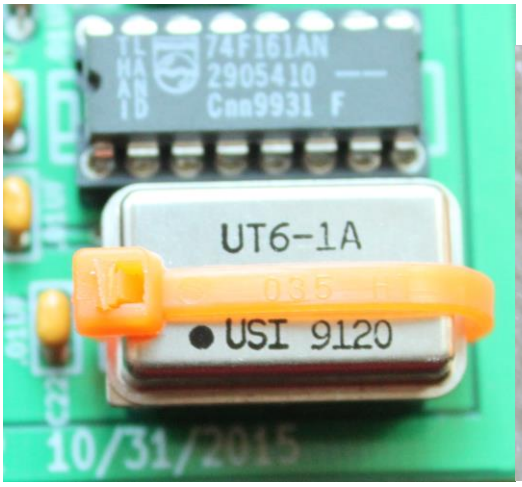
( ) – Solder all 33uH inductors

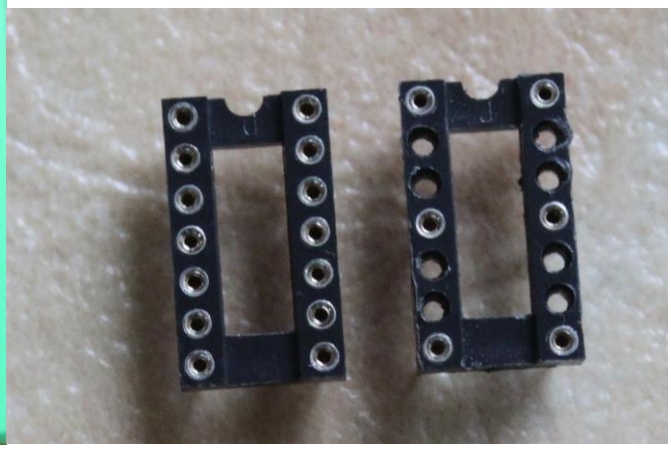
( ) - Solder 34 pin male connectors on J1 (left side) and J2 (right side) locations - HEADER, LP, SHROUDED, 34PIN, MALE (RIGHT ANGLE). Minimum force is required to insert the connectors into the board. Also you can use the straight angle connectors.



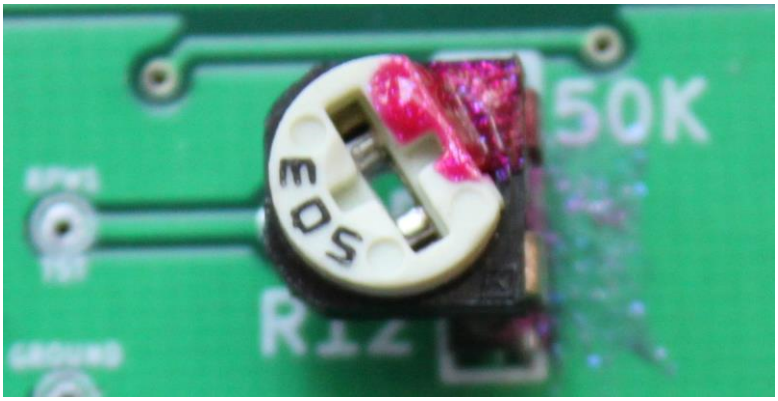
( ) - Using the soldering iron on a “14 Pin Machine Tooled Low Profile Soldertail” socket (JAMECO P/N: 37197), remove pins 2, 3, 5, 6, 9, 10, 12, 13. Solder part into U9 (74LS161) position. This socket allows using half or full can oscillators.

( ) - Install 16MHZ OSC into socket and add a tie-wrap to keep oscillator in place.

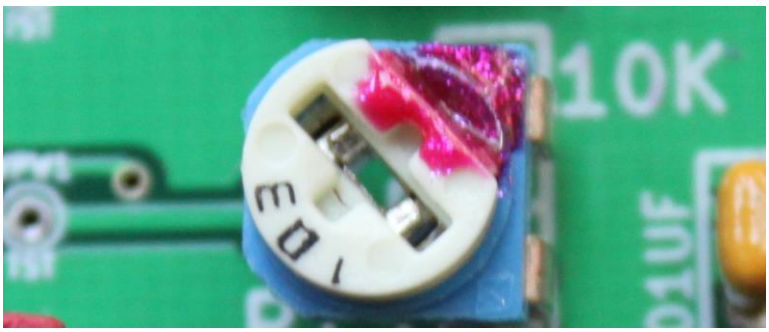




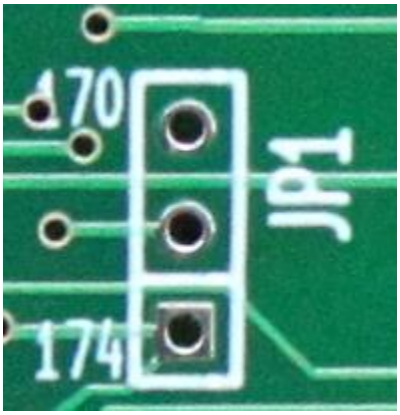
( ) – Solder 50K potentiometer – R12

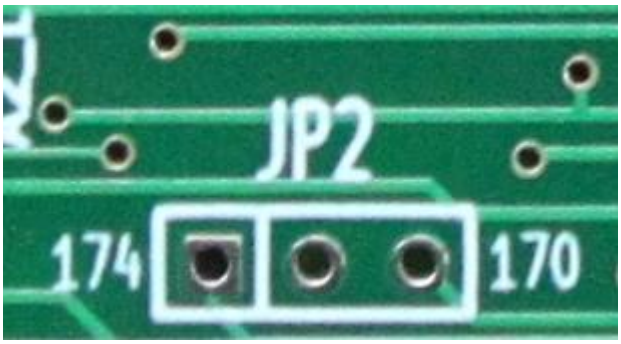


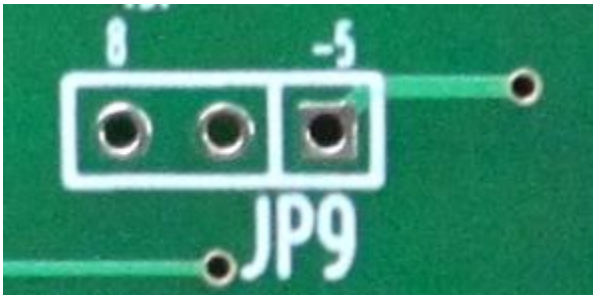
( ) – Solder 10K potentiometer – R13

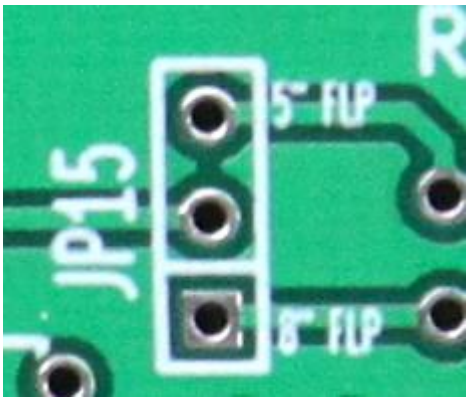


( ) – Solder a 3 pin header at the following locations; JP1, JP2, JP9, JP15

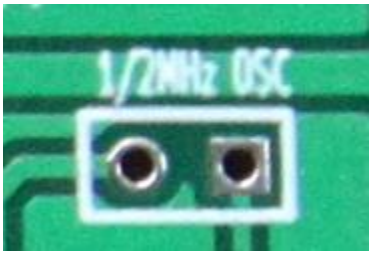




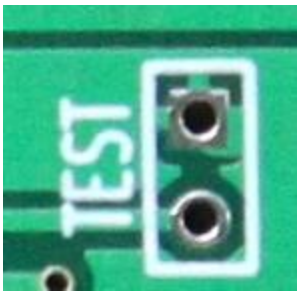




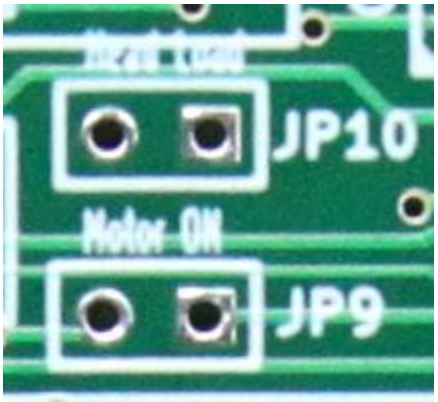
( ) – Solder a 2 pin header at the following location: 1/2MHz OSC



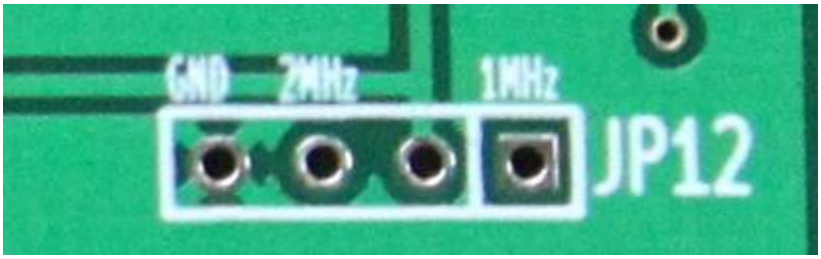
( ) – Solder a 2 pin header at the following location: TEST



( ) – Solder a 2 pin header at the following location: JP9, JP10

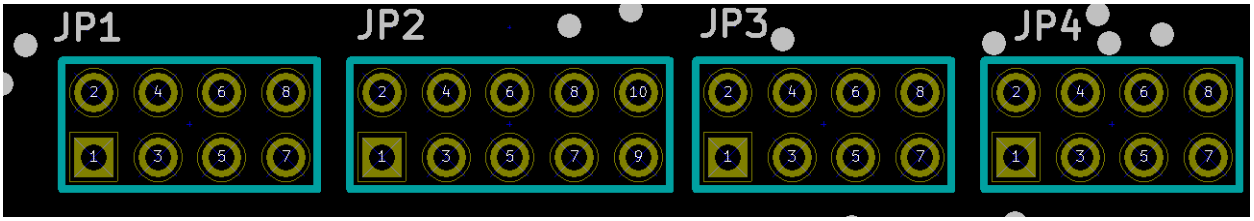


( ) – Solder a 4 pin header at the following location; JP12



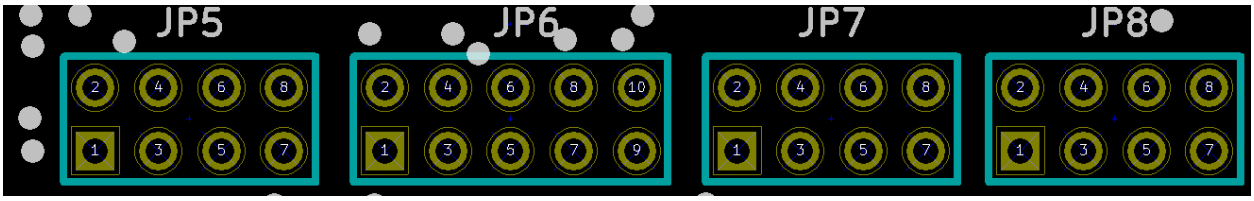
( ) – Solder two 4 pin header at the following location; JP1, JP2, JP3, JP4

( ) – Solder a 5 pin header at the following location; JP2



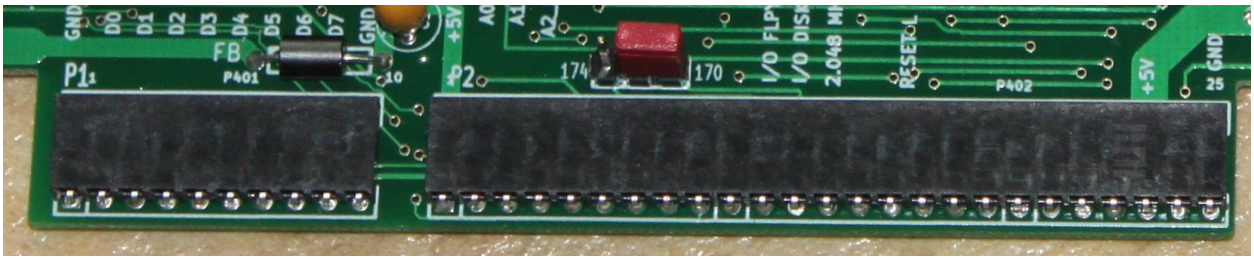
( ) – Solder two 4 pin header at the following location; JP5, JP6, JP7, JP8

( ) – Solder a 5 pin header at the following location; JP6

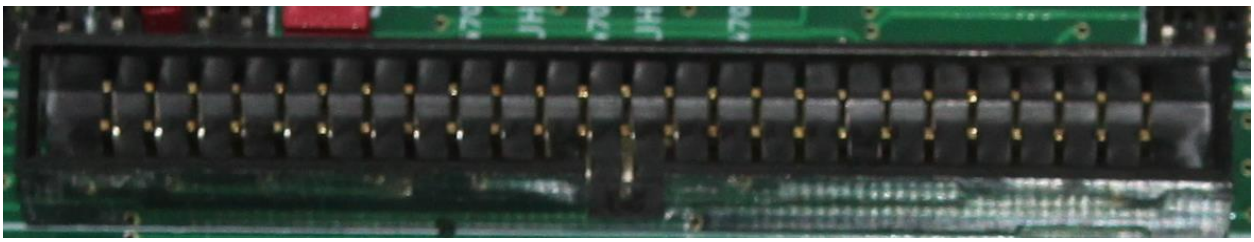


( ) – Build the CPU Interface 16 pin cable connector. Make sure that the cable length is no more than “14” inches to avoid noise on the interrupts lines. Label pin1 on both sides of the 16 pin cable connectors.

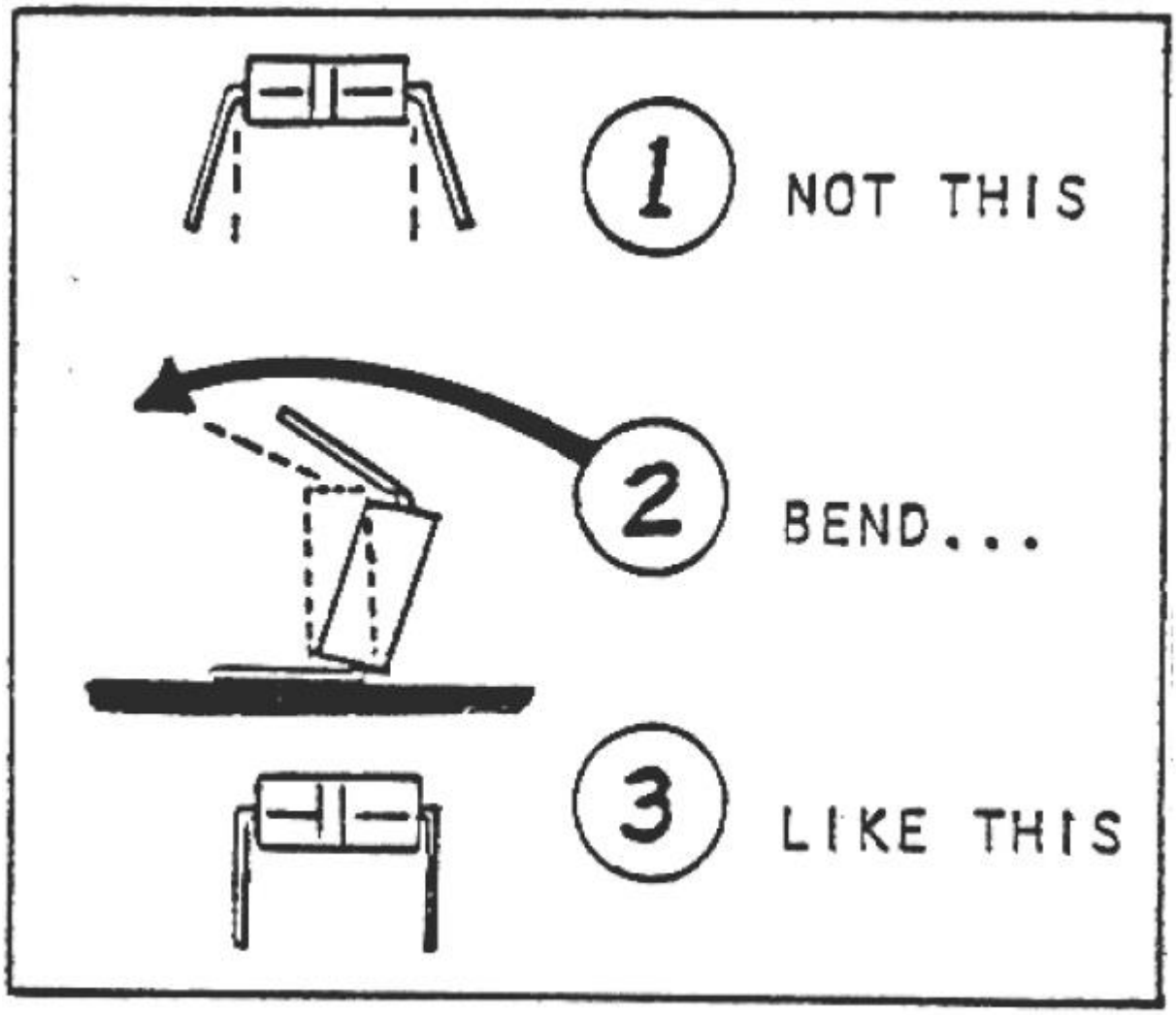
( ) – Solder P1 (10 PIN MB Connectors) and P2 (25 PIN MB Connectors) female connectors.



( ) – Solder 50 pin male connector straight angle to support 8” floppy drives. This is optional.

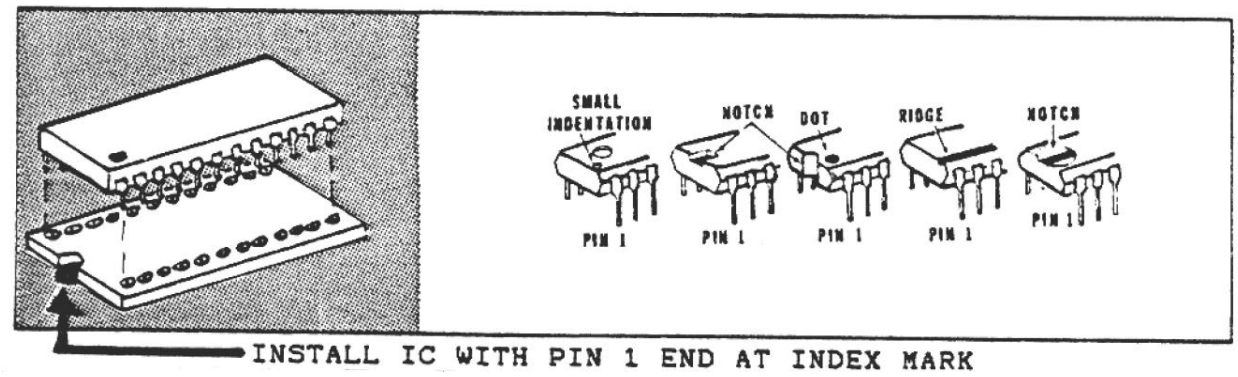


( ) – Straighten any bend pins on the IC's. The pins should be parallel to each other and at right angles to the case. Some IC's may have their pins spread out slight as shown below. If so, align the pins by gently pressing against a table top and bending as shown below.



STRAIGHTEN THE LEADS

( ) – When installing the IC's, align the notch and/or dot with the index mark on the board as shown below. Be sure all the pins enter the holes of the socket, and then press the IC into its socket.



( ) – Install U19, U20 – 74LS06

( ) – Install U7 – 74LS74 OR 74HCT74 FOR HIGH SPEED BUS

( ) – Install U10 – 74LS161

( ) – Install U5 – 74LS03

( ) – Install U8 – 74LS123

( ) – Install U6 – 444-81 (GAL-16V8-15)

( ) – Install U4 – 444-82 (GAL-16V8-15)

( ) – Install U3 – 74LS148

( ) – Install U13 – 74LS367

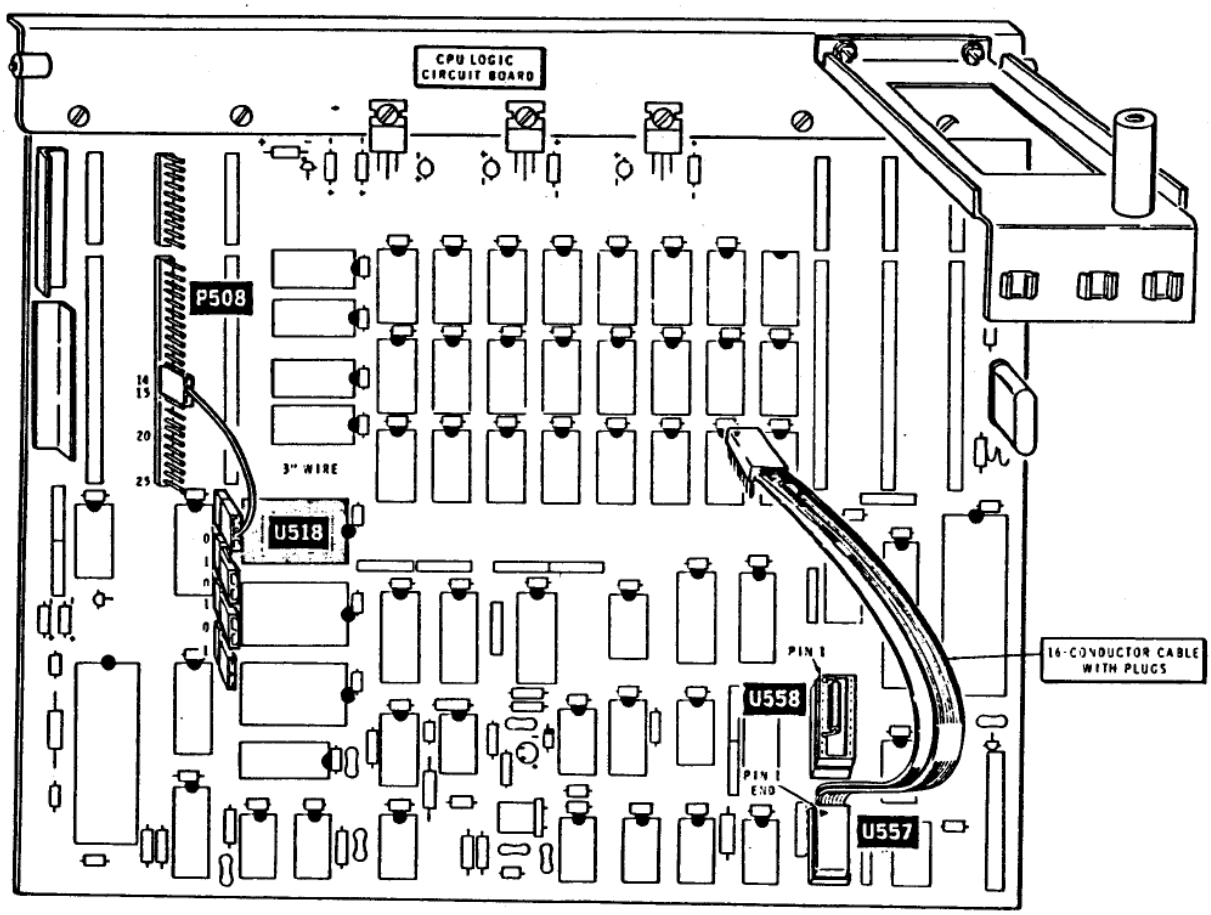
( ) – Install U2 – 74LS540

( ) – Install U1 – 74LS245

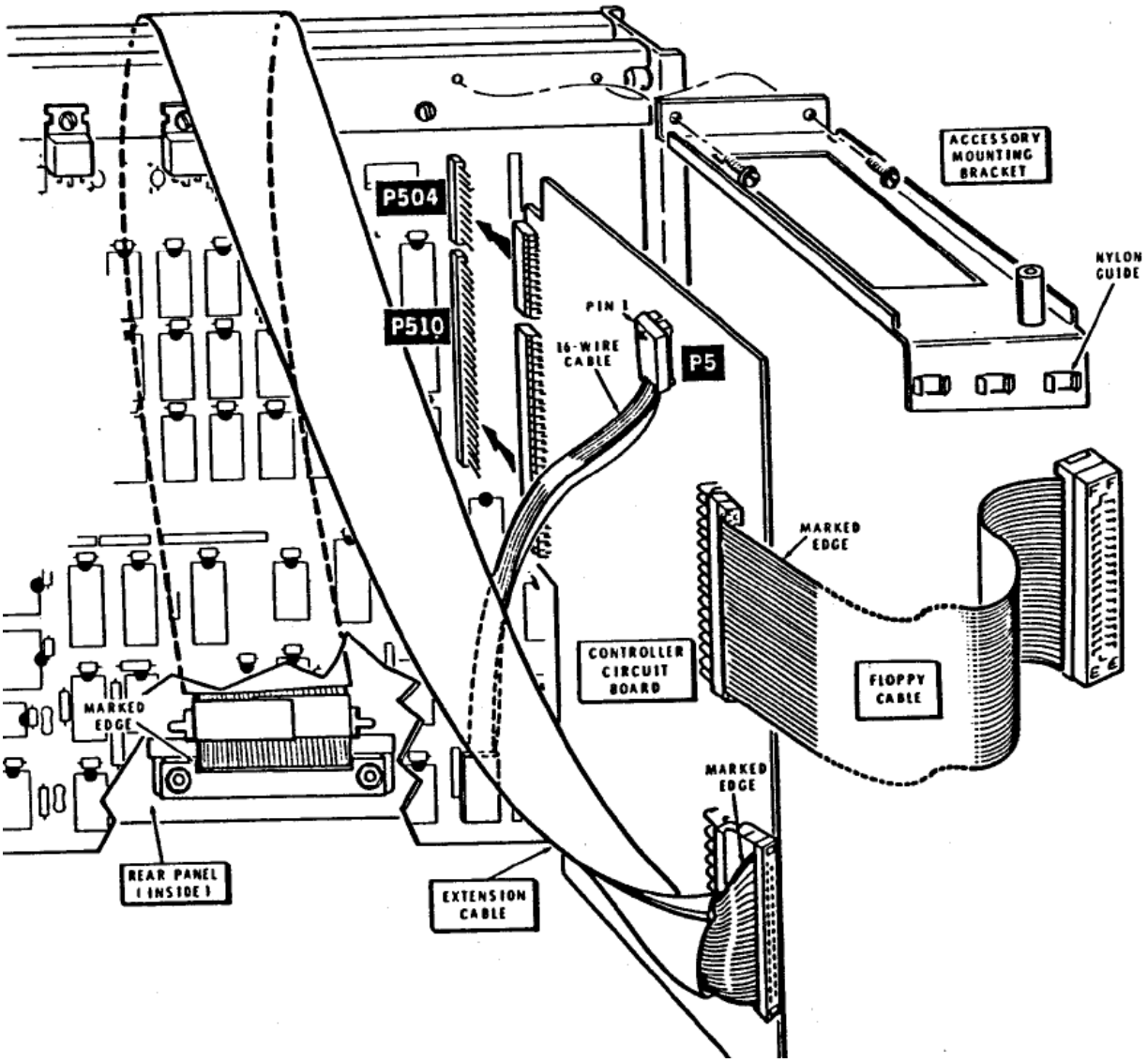
( ) – Install U11 – 74LS273

( ) – Install U12 – WD2797 Floppy Controller

( ) – Insert into the H89-Z80 CPU board U557 location the 16 pin interrupt cable. Remove IC at U558 and install a 20 pin connector with a soldered wire between pin 1 and 8 as shown below. Jumper wire between center pin of JJ506 or JJ505 and Pin 14 of P508 as shown below.



( ) – Insert into the H89-Z37 board P5 socket location the 16 pin interrupt cable

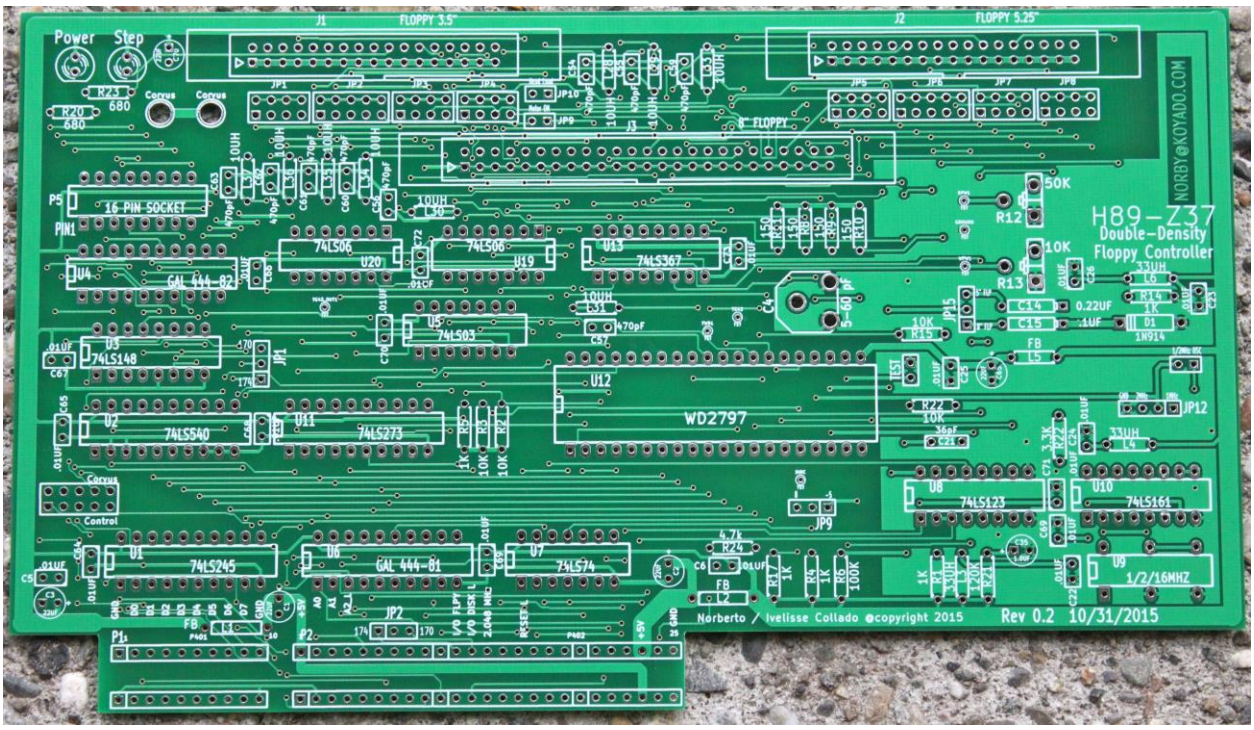


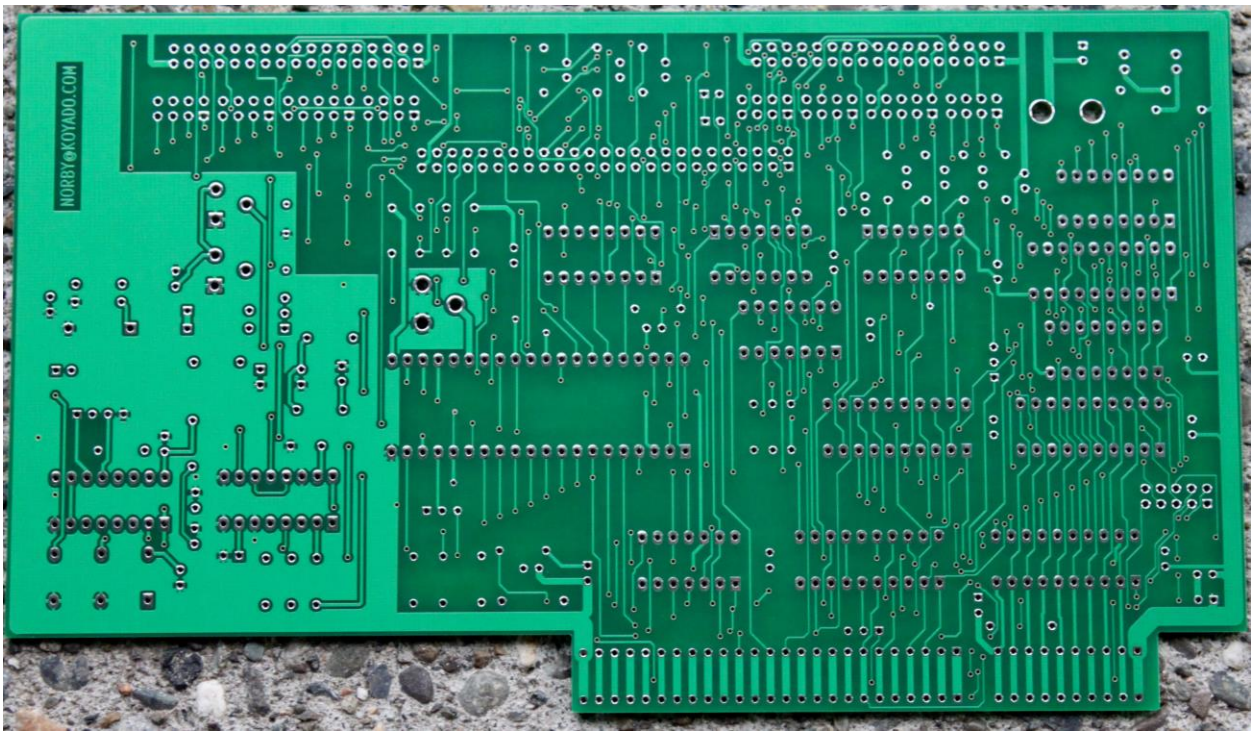
( ) – Connect the 34 pin conductor cable from the H89-Z37 board to the floppy drives.

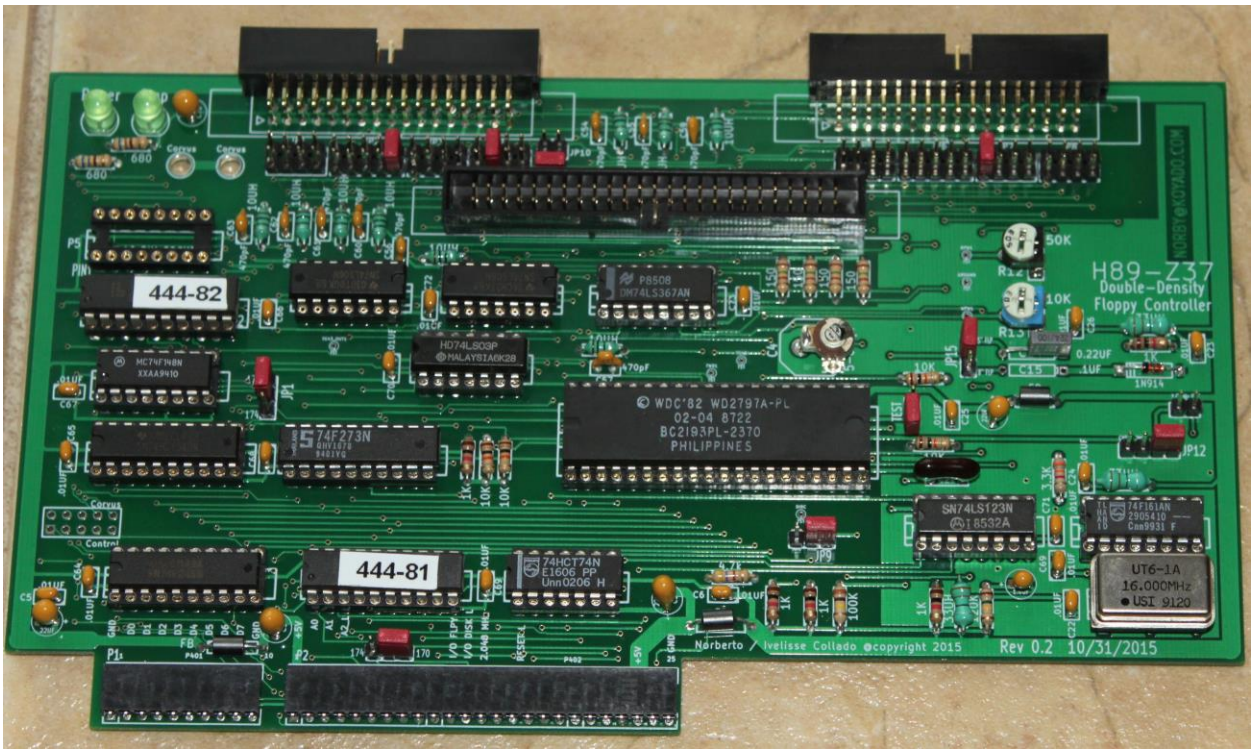
( ) – Apply power to the H-89 system after inserting the H89-Z37 board.

( ) – Calibrate the H89-Z37 board. Follow the instructions at the following link; koyado.com

( ) – Boot from CP/M or HDOS floppy media




NORBY@KOYADO.COM


444-82
444-81
H89-Z37
Double-Density
Floppy Controller
WDC'82 WD2797A-PL
02-04 8722
BC2193PL-2370
PHILIPPINES
74F273N
74HCT74N
SN74LS123N
74F161AN
UT6-1A
16.000MHz
USI 9120
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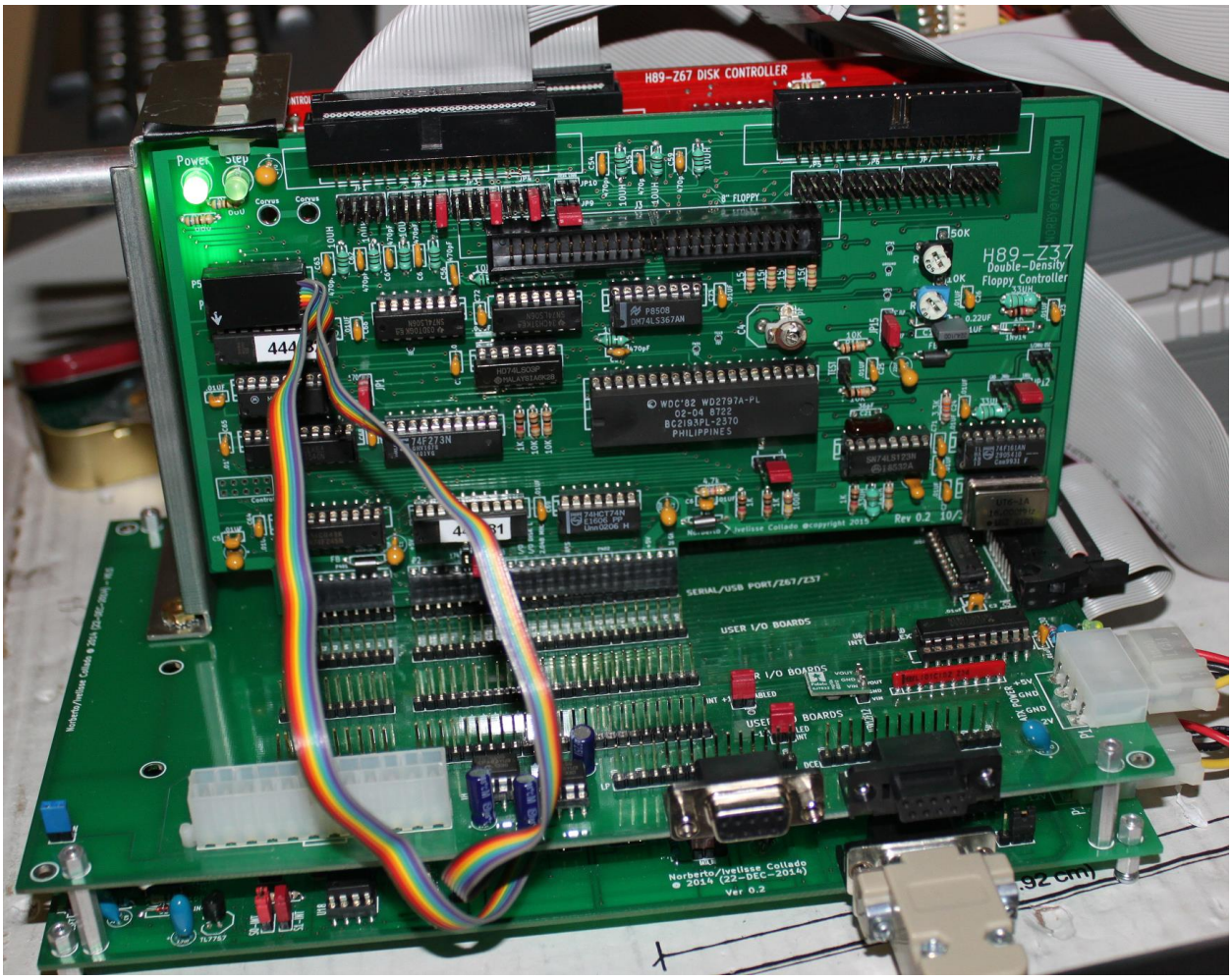
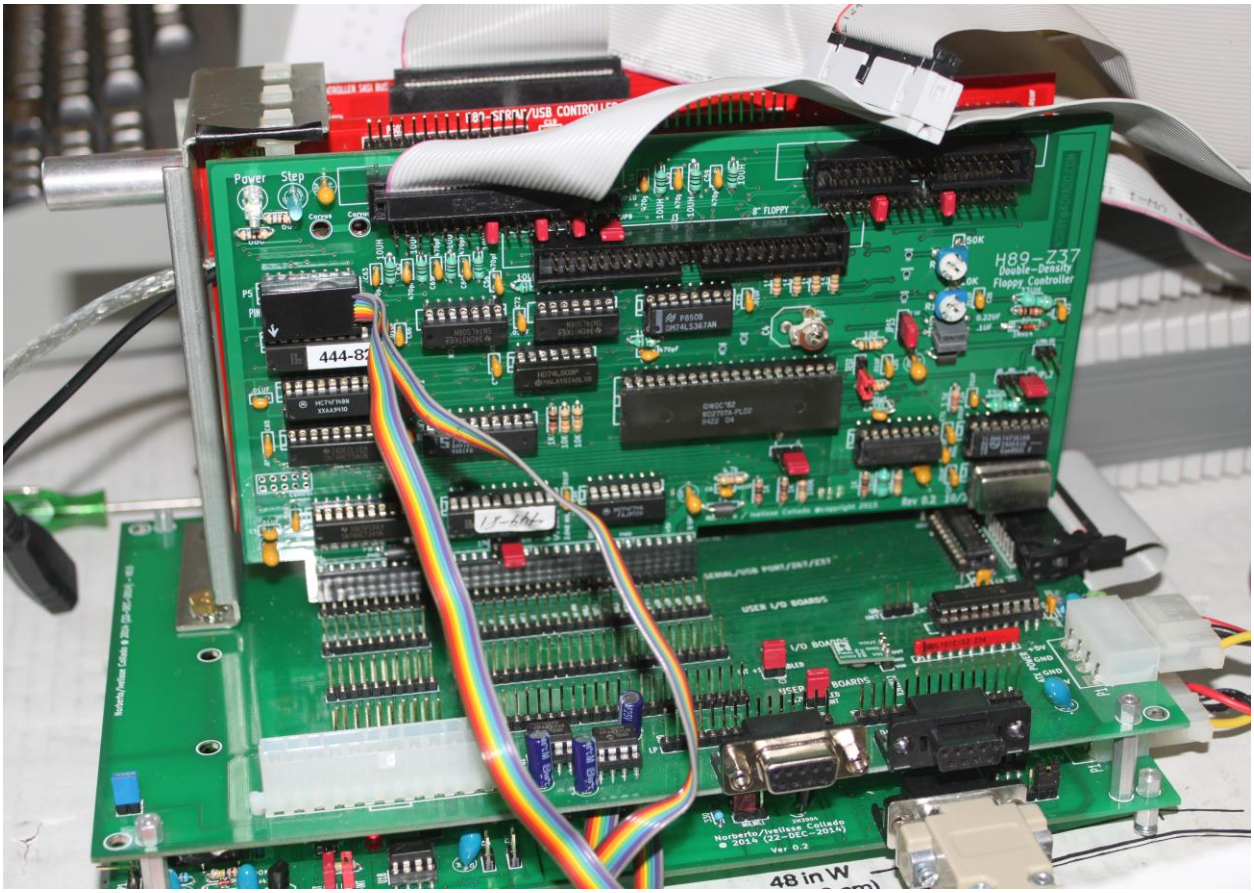
Rev 0.2 10/31/2015


H89-Z67 DISK CONTROLLER
H89-Z37
Double-Density
Floppy Controller
SERIAL/USB PORT/Z67/Z37
USER I/O BOARDS
Norberto/Ivellisse Collado
© 2014 (22-DEC-2014)
Ver 0.2

DOUBLE DENSITY
444-82
444-81
H89-Z37
Double-Density
Floppy Controller


Power
Step
8" FLOPPY
H89-Z37
Double-Density
Floppy Controller
USER I/O BOARDS
I/O BOARDS
Norberto/Ivelisse Collado
© 2014 (22-DEC-2014)
Ver 0.2
48 in W