

Building The PC-89



Using the
Heathkit H89
System

MAIN IDEA:

Use the H89 motherboard in an old IBM (type) PC Cabinet, large enough to hold 3 diskette drives, and connect the serial ports to the PC Cabinet to allow use of the Heathkit H19 terminal and serial interface printers.

OCTOBER 15, 2008

I wanted to use the motherboard from a Heathkit H89 that could be connected to an H19 terminal. The cabinet should be large enough to hold 3 diskette drives, which was the maximum number of drives that could be connected to the Hard Sector Diskette Controller.

STEP 1 - CHOOSING THE CABINET

I chose a full size tower cabinet in order to be able to hold 3 drives. The cabinet only has 5 half-height slots for drives, so I can use 2 full height drives, and 1 halfheight drive. If I can find enough halfheight drives on EBAY, I would prefer to use them.

STEP 2 - MOUNTING THE MOTHERBOARD

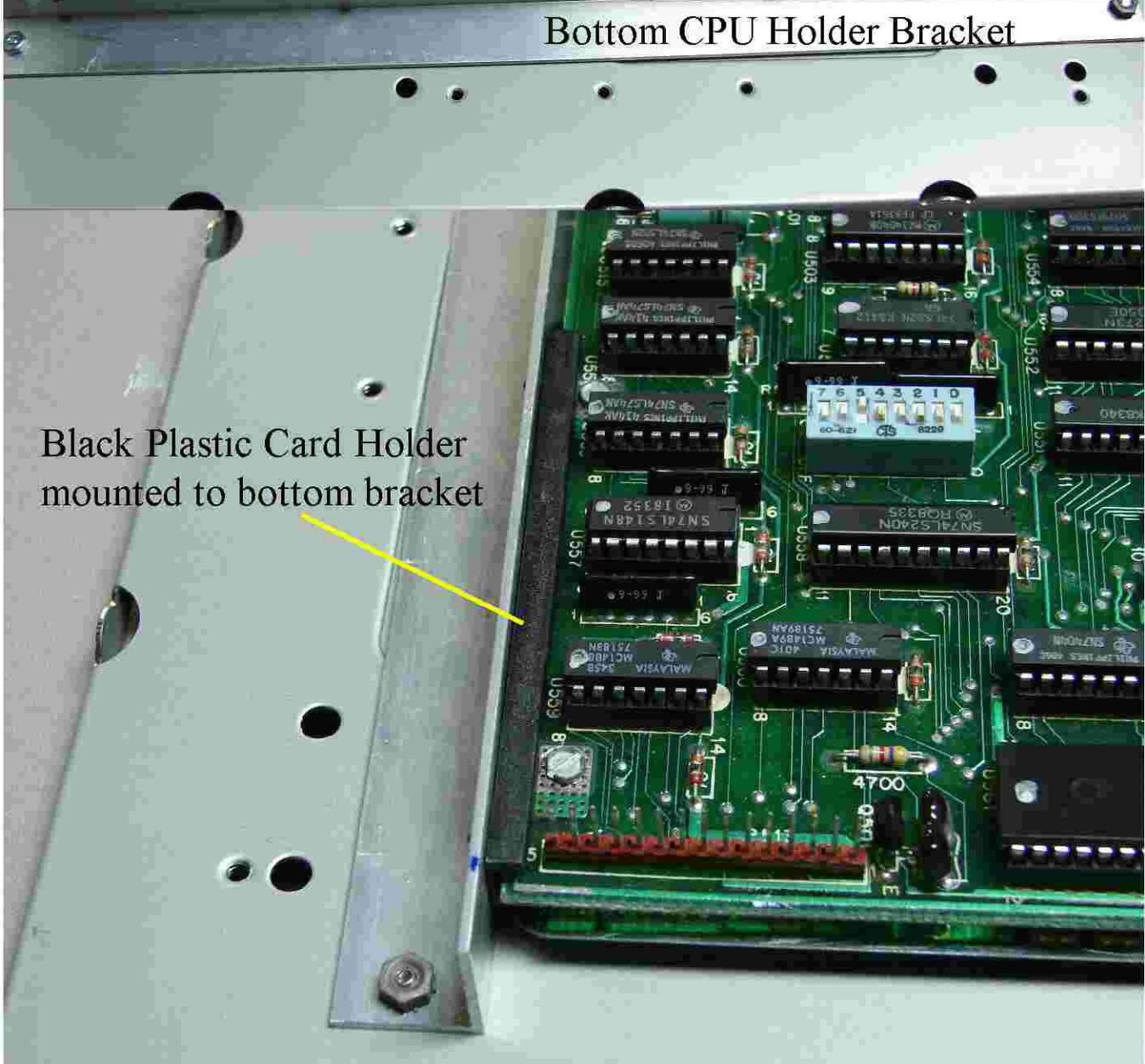
I chose the full height tower for another reason besides being able to put drives in it. This tower cabinet allowed the removal of the metal wall that was used for mounting a PC Motherboard. This just made it easier to work with. The Heath H89 CPU board was held in originally by 2 screws. I decided to mount the top of the board to the PC cabinet with L Brackets, also called corner braces. These were purchased from the local hardware store. Below is a picture of the CPU board with the L Brackets.



Mounting the top was much easier than mounting the bottom of the board. There was nothing that was easily accessible. My solution was to create a bottom bracket using angle aluminum, and some old plastic card holders that were often used in early PCs. Holes were drilled in the angle aluminum to hold the plastic card holders, and also to mount it to the PC metal wall. The photo on the next page shows the bottom CPU card holding bracket.



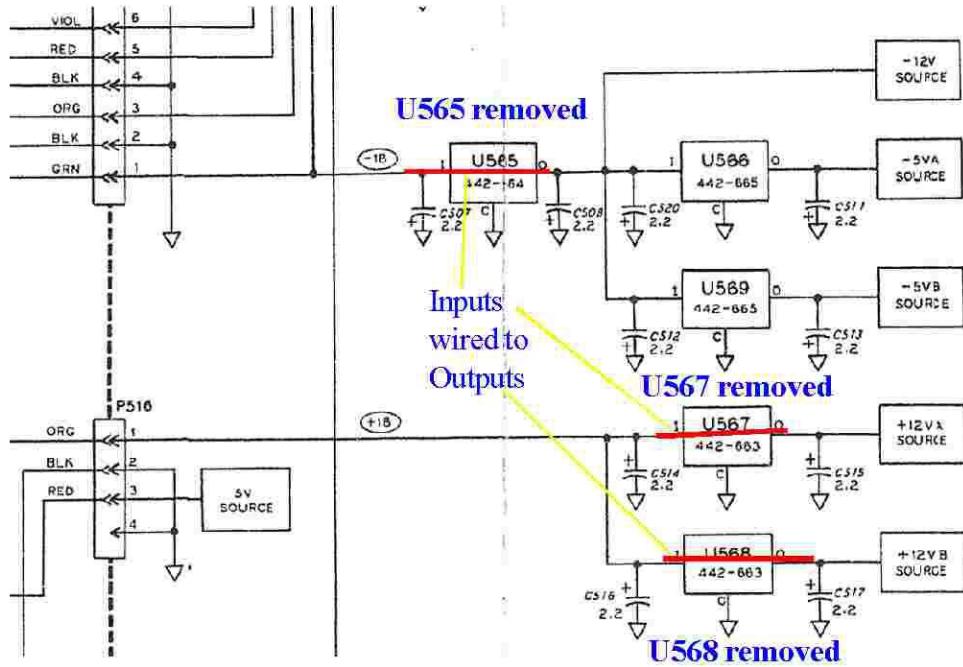
Bottom CPU Holder Bracket



Black Plastic Card Holder
mounted to bottom bracket

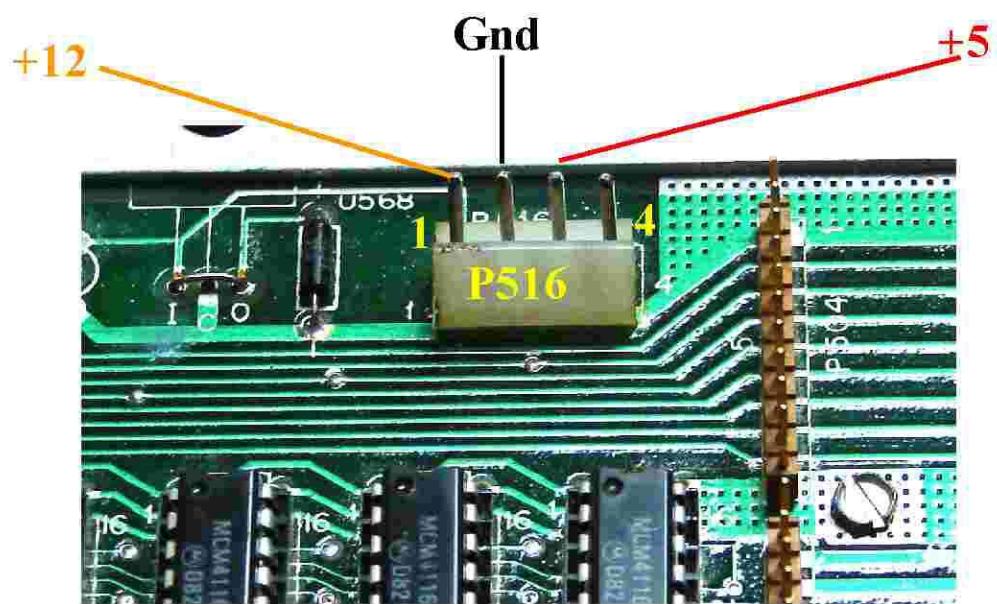
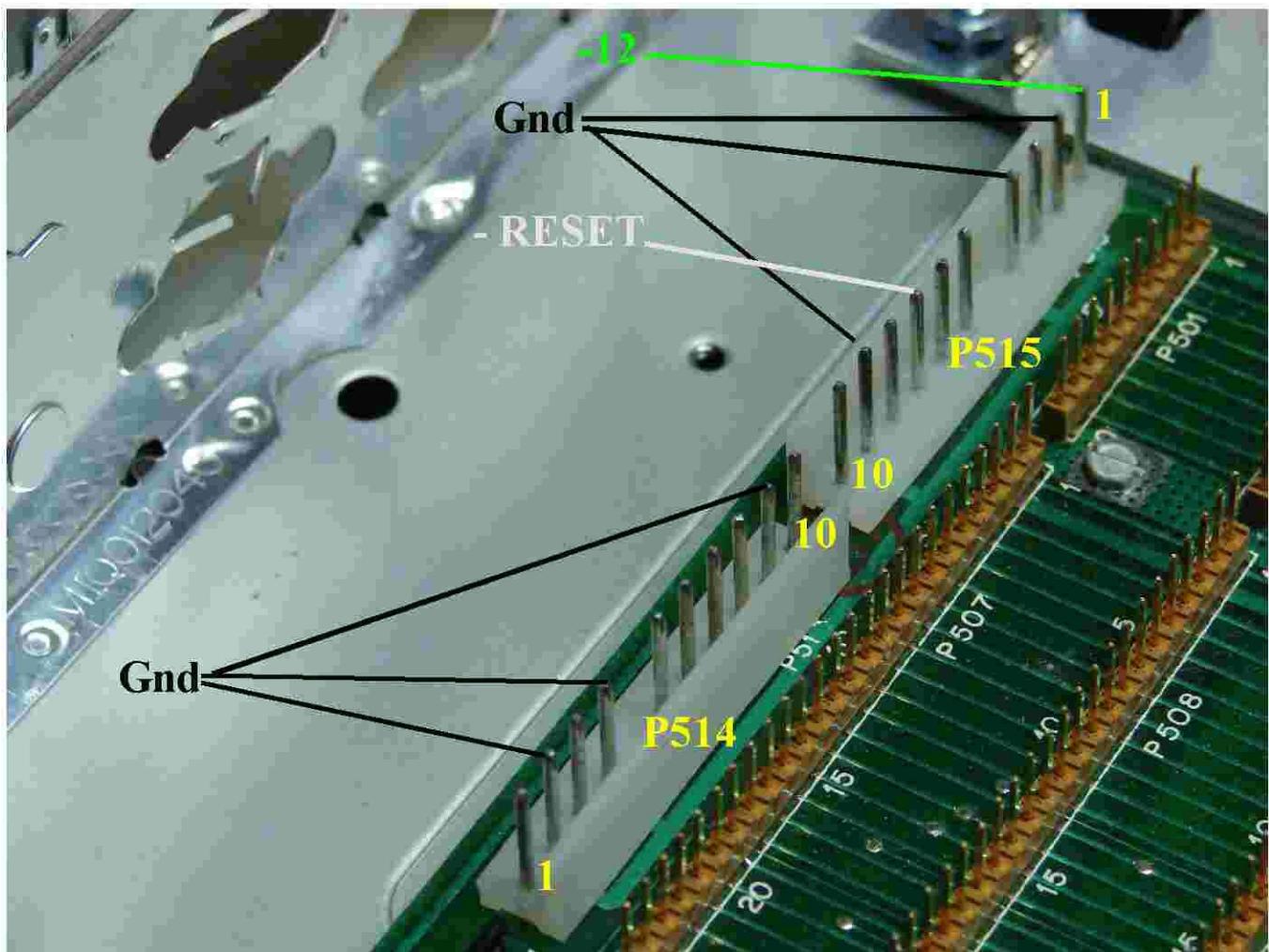
STEP 3 - POWERING THE BOARD

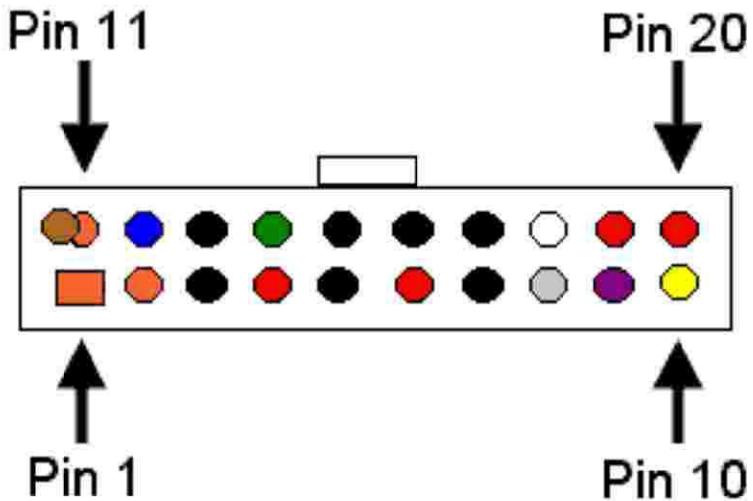
I have decided that I want to use a standard ATX type switching power supply to power the H89 CPU board. This will require modification to the board. The CPU board as originally configured takes a +18 and -18 volts from the power supply and regulate these to +12 and -12 with regulators U565, U567 and U568. These three regulators will be removed, and jumpered from input to output. This is because the ATX power supply already produces the +12 and -12 volts needed. On the CPU card, U566 and U569 regulates the -12 volts down to minus 5 volts. Although the ATX supply already has a -5 output, it is easier to leave these 2 regulators on the CPU board. Below is a picture of the regulator schematic.



STEP 4 - DECODING THE POWER CONNECTIONS

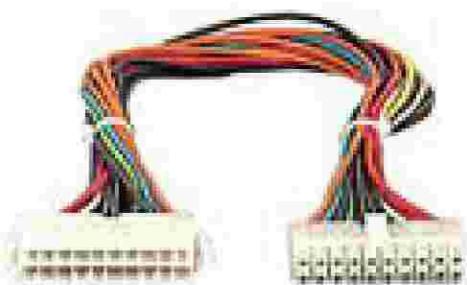
The next step will be to locate the power input pins on the CPU card.





515-1	-12	ATX	12	Blue
515-2	Gnd	ATX	3	Black
515-4	Gnd	ATX	5	Black
515-7	Reset	P/B		
515-9	Gnd	ATX	7	Black
516-1	+12	ATX	10	Yellow
516-2	Gnd	ATX	17	Black
516-3	+5	ATX	4,6	Red
	+5 Stnby	ATX	9	Purple
	PS/On	ATX	15	Green

I ordered this extension ATX power cable from Jameco, P/N 170238. I used the wires to attach to the .156" connector used by the H89 CPU board. This cable was 15", but a 6" cable would have been long enough.



Pin	Signal	Wire Color
1	+3.3Vdc	Orange
2	+3.3Vdc	Orange
3	GND	Black
4	+5Vdc	Red
5	GND	Black
6	+5Vdc	Red
7	GND	Black
8	PWR-OK	Gray
9	+5Vdc VSB standby Voltage	Purple
10	+12Vdc	Yellow
11	+3.3Vdc {brown is 3.3Vdc sense}	Orange
12	-12Vdc	Blue
13	GND	Black
14	PS-ON	Green
15	GND	Black
16	GND	Black
17	GND	Black
18	-5Vdc	White
19	+5Vdc	Red
20	+5Vdc	Red

STEP 5 - Building the ATX power-up and CPU reset board.

The ATX power supply powers up when pin 14 is brought to a TTL ground level. I want to create a circuit which will require you to hold the power switch depressed for 2 or 3 seconds to power the system up and down. This is so that bumping the switch will not cause a power change.

There is also the need to create a RESET for the CPU board. On the H89, the CPU can be reset from the keyboard. I will use the RESET switch on the PC cabinet.

This power-up and reset board will be powered by the +5 volt stand-by supply from the ATX power supply. This 5 volts is present as long as the power supply is plugged into the 120 VAC wall outlet. This stand-by power comes from pin 9, the purple wire, on the ATX supply.

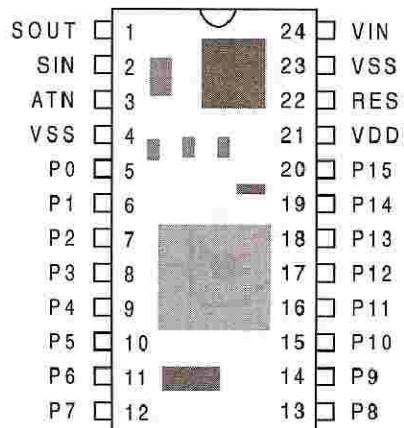
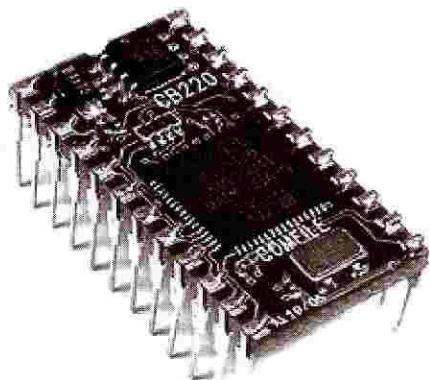
Page 9 will show the power control card I built. It was built using a Radio Shack 276-168 blank board. Page 8 is information about the CB220 chip.

I tried several types of circuit designs to make the power on controller, but had problems with them, or else they were requiring more ICs than I wanted to use. The simplest, but expensive, choice was to use a PIC. Since I don't yet know how to program PICs, I did the next best thing and used a CUBLOC programmable microcontroller. It is almost like the BASIC STAMP, but is more powerful.

I used the CUBLOC CB220 controller. Writing code is easier than building circuits. This is probably like shooting mice with a shotgun, but it was faster than building hardware only circuits.

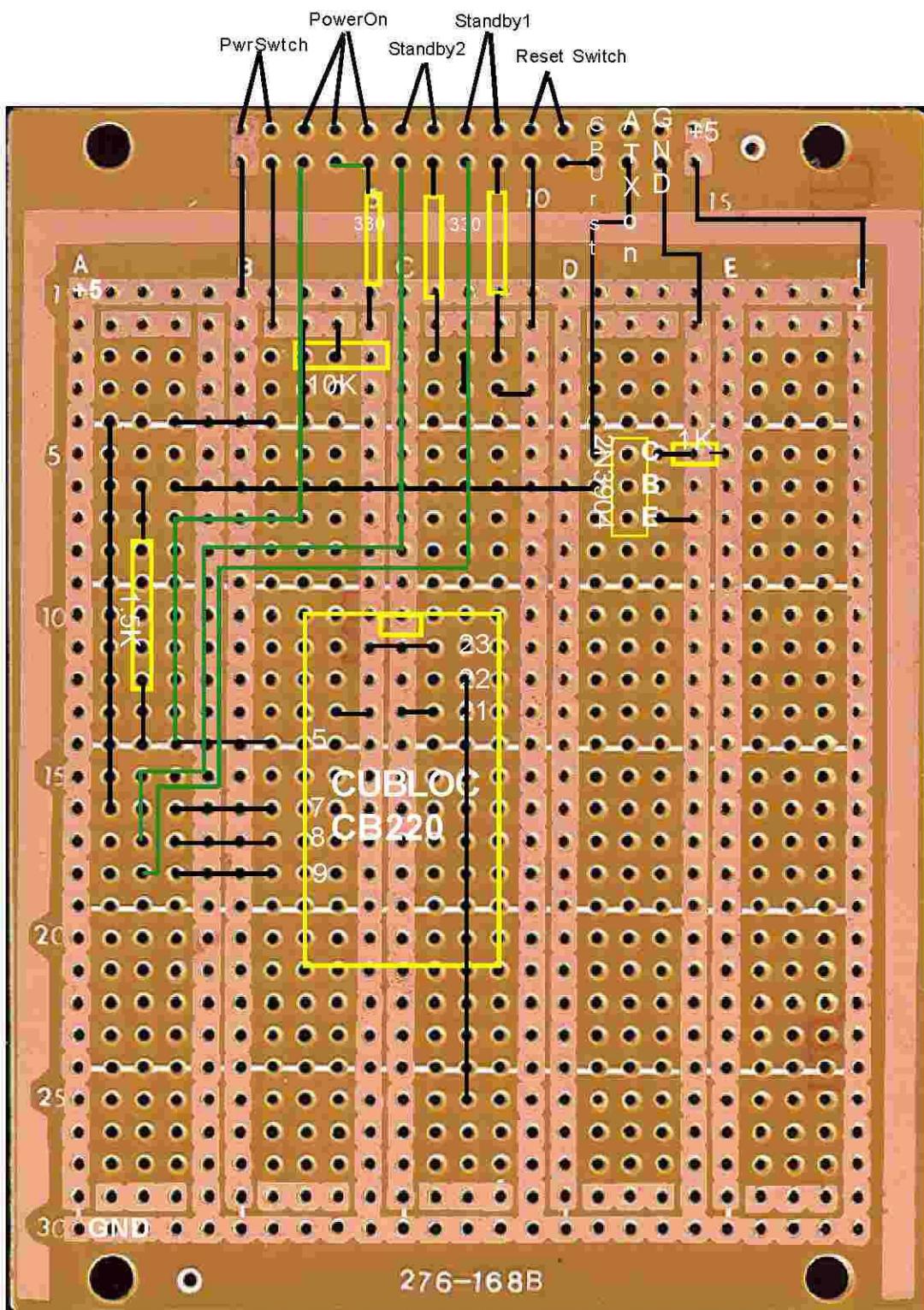
CB220

CB220 is comes as a 24pin DIP type package. It has 16 I/O ports and a 5V power regulator.



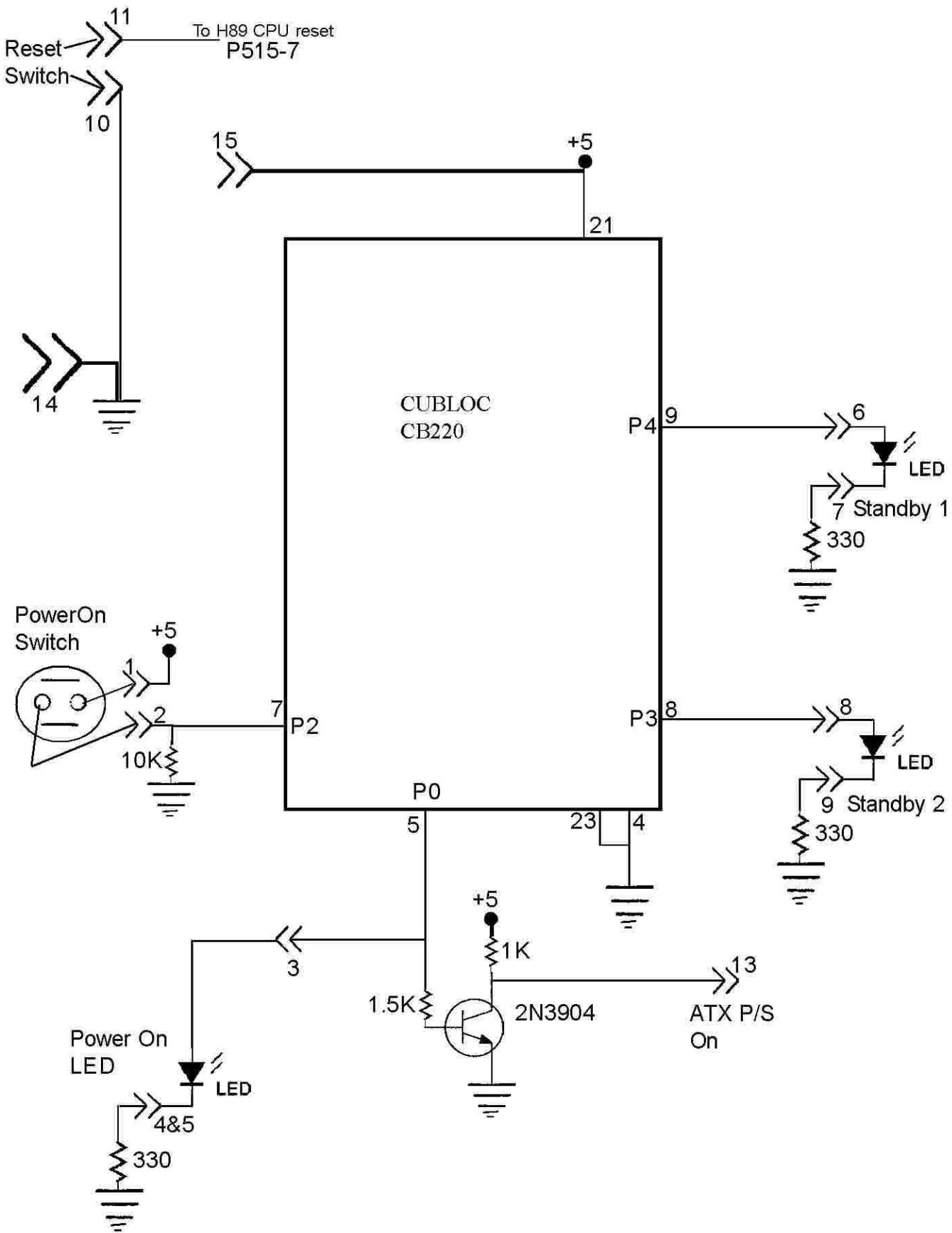
Pin	Name	I/O	Port Block	Explanation
1	SOUT	OUT		DOWNLOAD SERIAL OUTPUT
2	SIN	IN		DOWNLOAD SERIAL INPUT
3	ATN	IN		DOWNLOAD SERIAL INPUT
4	VSS	POWER		GROUND
5	P0	I/O	Block 0	ADC0 / SPI SS
6	P1	Input		ADC1 / SPI SCK
7	P2	I/O		ADC2 / SPI MOSI
8	P3	I/O		ADC3 / SPI MISO
9	P4	I/O		ADC4
10	P5	I/O		PWM0 / ADC5
11	P6	I/O		PWM1 / ADC6
12	P7	I/O		PWM2 / ADC7
13	P8	I/O	Block 1	CuNET SCL
14	P9	I/O		CuNET SDA
15	P10	I/O		RS232C Channel1 RX / INT2
16	P11	I/O		RS232C Channel1 TX / INT3
17	P12	I/O		
18	P13	I/O		
19	P14	I/O		HCOUNT1
20	P15	I/O		HCOUNT2
21	VDD	I/O		5V Output/Input
22	RES	IN		RESET Input (LOW signal resets!)
23	VSS	IN		GROUND
24	VIN	IN		5.5V~12V Input Power

This is the circuit board used to make the power controller. (Component side)

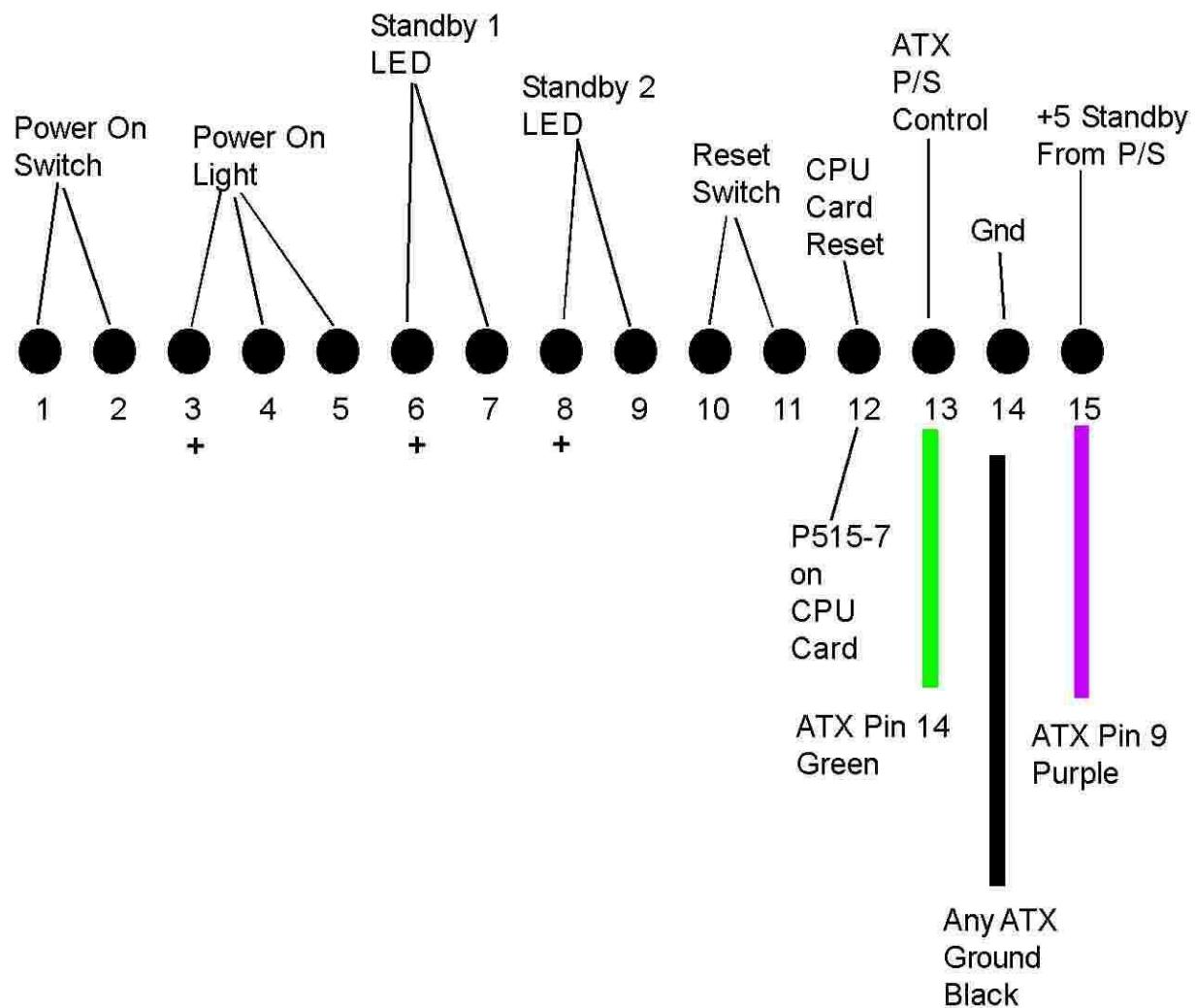


— Black lines are bare jumpers

— Dark Green lines are insulated jumpers



Control Card Connector



Here is the listing for the CB220 chip

```
'This program is the intellectual property of
'Dr. Carroll Waddell
'This program may be modified, sold, or used by
'any member of SEBHC

Const Device = CB220
Ramclear
Dim A AS Byte   'temporary data holder
Dim ATXcontrol AS BYTE  'this port will turn the ATX power supply on
Dim PowerSwitch AS BYTE  'this port will read the status of the power switch
Dim Standby1 AS BYTE  'this port is the 1st standby light
Dim Standby2 AS BYTE  'this port is the 2nd standby light
Dim Stime AS INTEGER  'this counter counts the number of loops for which the
power on switch has been pressed

'As a word of explanation, the original cabinet that I used
'to build the PC89 had 2 HDD Activity LEDS. If you have a cabinet
'that only has 1 HDD LED, then you can connect it to either standby port
'The standby lights blink alternately whenever the ATX power supply is
'plugged up.

PowerSwitch = 2
ATXcontrol = 0
Standby1 = 3
Standby2 = 4

Output ATXcontrol  'sets this as an output port
Output Standby1  'sets this as an output port
Output Standby2  'sets this as an output port
Input PowerSwitch  'sets this as an input port

Low ATXcontrol  'be sure the power supply is OFF

High Standby1  'turn standby LED 1 on
Low Standby2  'turn standby LED 2 off

On Timer(200) Gosub standbylight  'cause an interrupt every 2 seconds to flip the
standby LEDS

Sloop:  ' wait for button to be pushed
    Stime=0  'reset counter to 0 on each loop
    A = Keyinh(PowerSwitch,10)  'check for the switch going high
    If A = 0 Then Goto Sloop  'button has not been pressed

Ploop:
    'if here, then button has been pressed
    Incr Stime
    A = Keyinh(PowerSwitch,10)
    If A = 0 Then Goto Sloop
    If Stime = 300 Then Goto DoaToggle  '300 represents about 3 seconds
    Goto Ploop

DoaToggle:
    'this loop will cause the ATX power supply control to toggle for on to off or from
```

```
off to on
    A = Outstat(ATXcontrol)
If A=0 Then
    High ATXcontrol
    On Timer(75) Gosub StandbyLight
Else
    Low ATXcontrol
    On Timer(200) Gosub StandbyLight
End If

Do While Keyinh(PowerSwitch,10) = 1 'wait for the power switch to be released
Loop

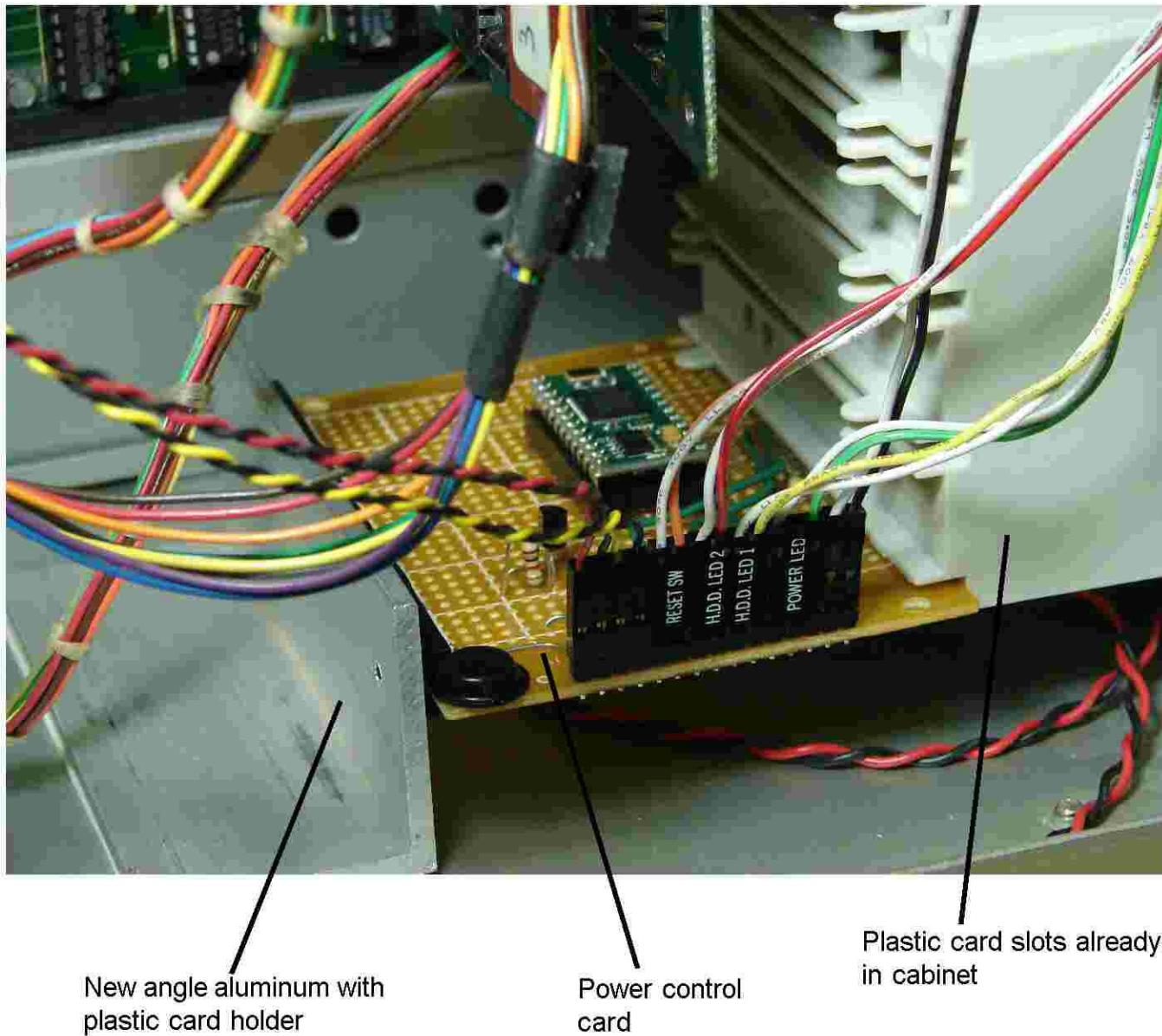
Goto Sloop 'go back when power switch is released

Standbylight: 'this routine is entered on a timer interrupt
A = Outstat(Standby1) 'this reads the status of the output port
If A = 0 Then
    High Standby1
    Low Standby2
Else
    Low Standby1
    High Standby2
End If

Return
```

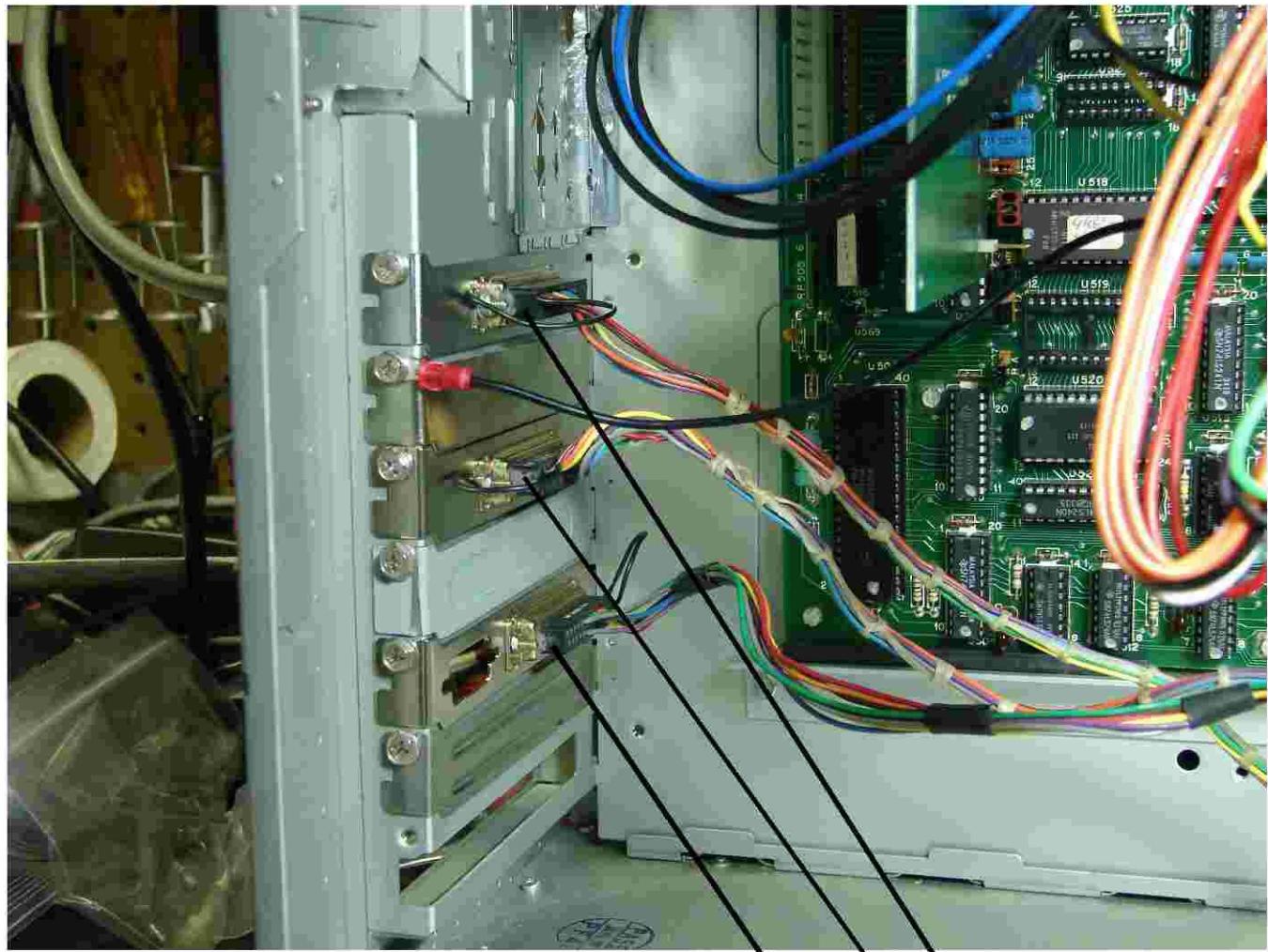
Step 6 - Connecting it all together

Now that all the parts have been installed in the cabinet, it is time to wire all the parts together. In the PC cabinet that I used, there were some plastic card slots used to hold very long circuit cards. These were often found on very old PC's but not now. At any rate, one of these card slots was used to hold the power control card. I cut a piece of 1 1/2" angle aluminum, and mounted another of the plastic card holders that I had used to mount the H89 CPU card. This is pictured below.



This angle bracket was put in the cabinet with thick double sided sticky foam tape.

The serial port cables that were in the original H89 were recycled and used in the PC89. They were connected to the rear of the cabinet where circuit card connectors would be found. They are pictured below.



Serial Port Connectors



OCTOBER 31, 2008

My creation is ready to breathe for the first time. (since burial as an H89)

I connect my H19 terminal. I press the power on key.

NOTHING!

What did I do wrong? I check the heart beat on the Z80 processor. It's good. I check the RAM address lines. They're all good. I had checked the H19, and it types from the keyboard just fine. OH YEAH! To type from the keyboard, I had to take the terminal OFF LINE.

I put it back on line, and fearfully press the RESET key.

ZOUNDS! The terminal goes BEEP BEEP, and I get the H: prompt.

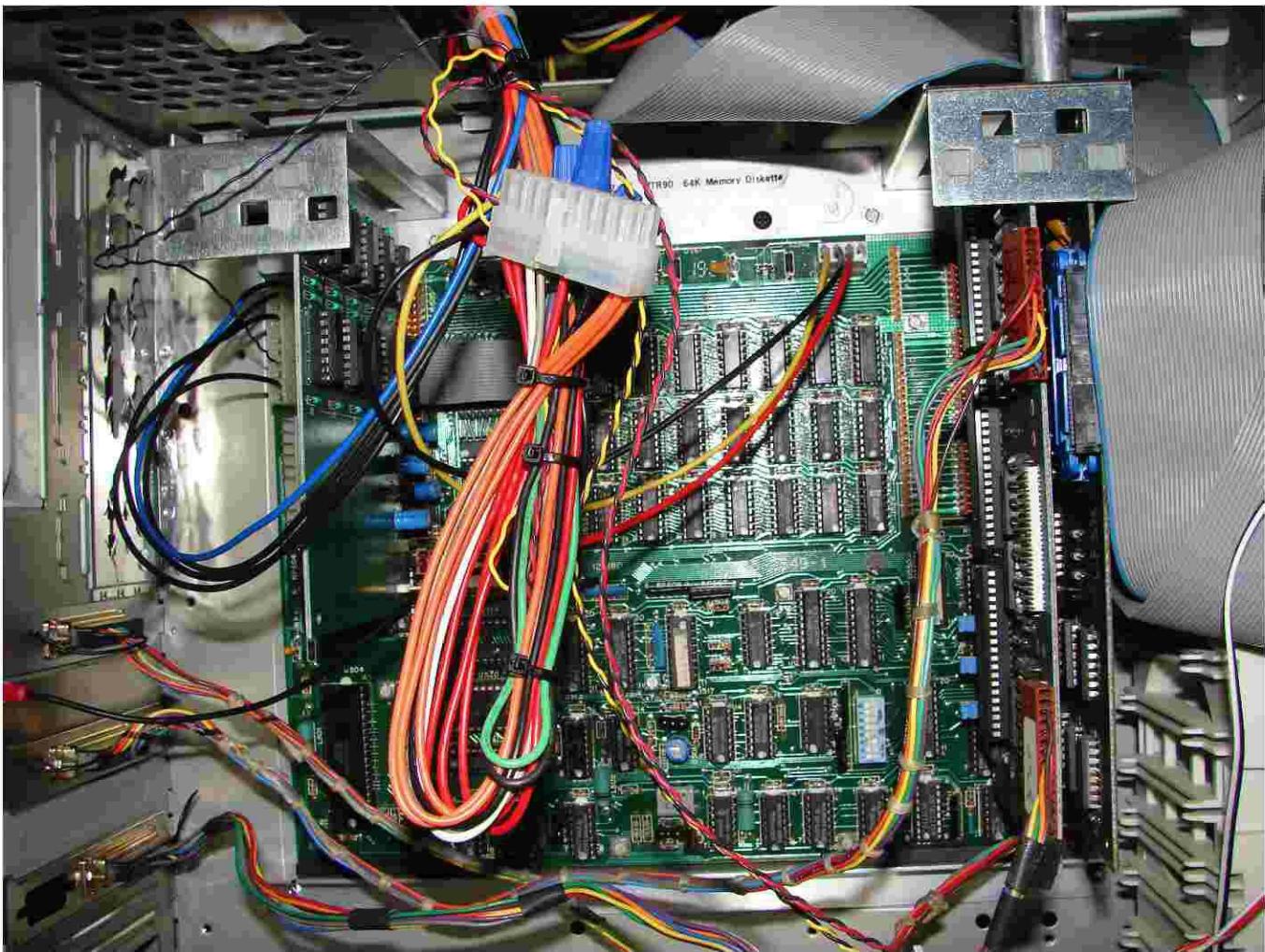
IT'S ALIVE! HAH HAH HAH

OK already. Enough with the junk. Everything works. BUT. . . will it boot properly?

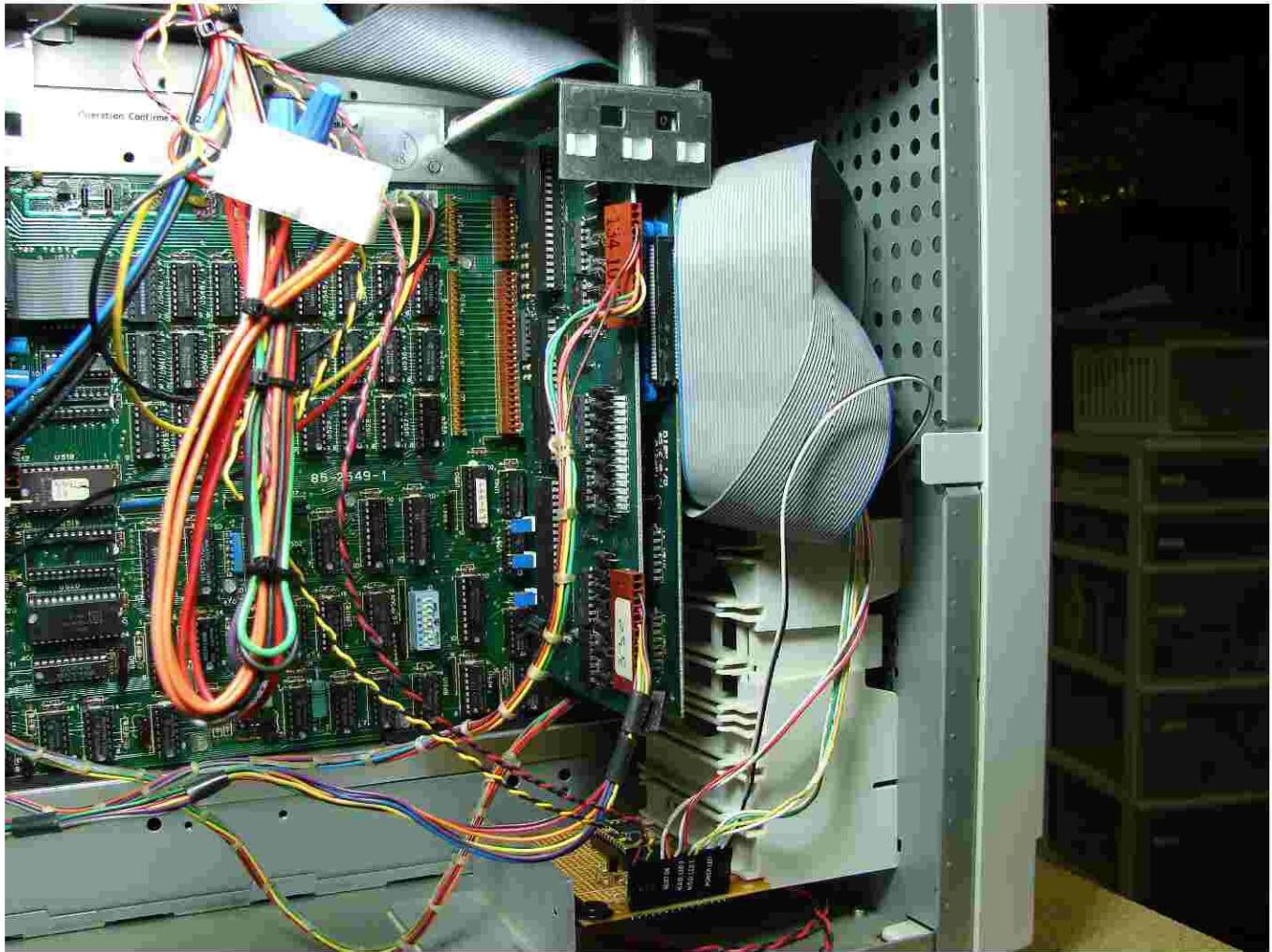
I put in the CP/M boot diskette and press the Bkey on the terminal. It boots correctly. 64K CP/M is ready. HDOS also works fine. Now I have an H89 with 3 internal diskette drives.

I love it when a plan comes together.

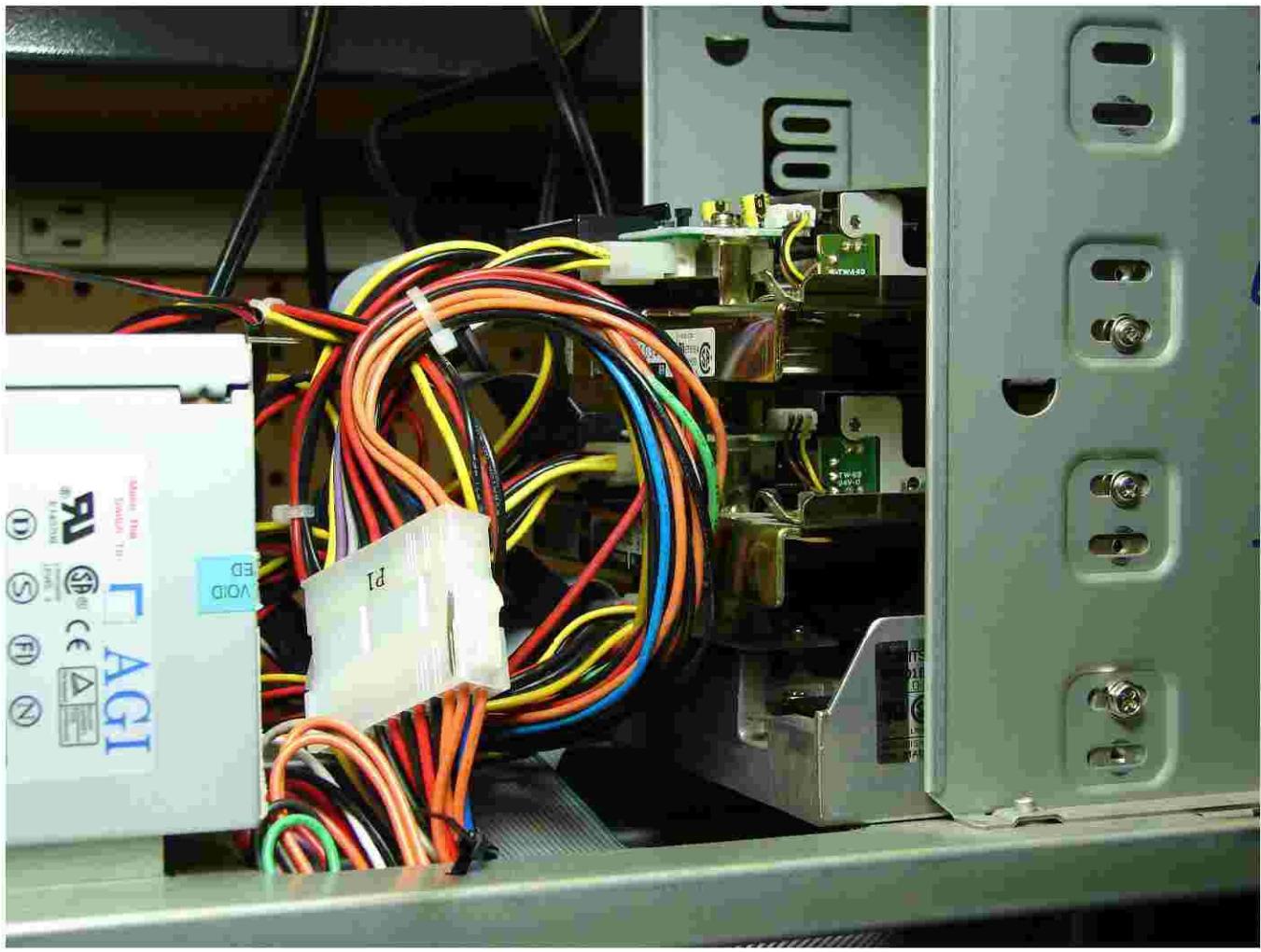
P.S. There is probably some insanity in my family somewhere.



Inside view of the PC89



Diskette controller card and 3 port serial card.



3 Diskette drives shown above.



H19 terminal showing boot success with DIR



Front view of PC89