**CCS 2422 fixes**

Submitted by Rich Camarda to Herb Johnson on Feb 3 2007. Last updated Feb 6 2007. For more information go to [my CCS Web page.](http://www.retrotechnology.com/herbs_stuff/d_ccs.html) - Herb Johnson

**CCS 2422 Controller Hang up Fix # 1**

Discovered and documented by Paul Zander, July 1983

Note: The IC numbers reference to the rev. "B" board, the changes also apply to the rev. "A" board.

(1) The buffer, which drives the data-in bus, U40, has to drive 8 lines at the same time. Depending on the configuration of the rest of the system, it may have a peak current of 1/2 amp or more for a few nanoseconds.

Although this IC is close to the S-100 ground pins (50 and 100), this current has to flow through traces, which are common to the rest of the board. This current surge can cause a voltage spike of 2 volts. This can, and does, cause false inputs to many of the other IC's on the board.

The solution is to cut the trace on the topside of the board to U40, pin 10. Next, on the back side, connect U40, pin 10 by a piece of insulated wire to the ground trace near pin 100, and continue the wire around the edge of the board to the top side near pin 50. Number 28 or 30 wire-wrap wire is sufficient.

(2) Although the ground traces appear at first glance to be connected together, there are several places where a ground trace starts at one side of the board, goes to several IC's and then stops in the middle of the board. Your DC ohmmeter will measure continuity, because long paths around the edge of the board connect the traces. More reliable operation of the 2422 can be achieved if these "dangling ends" are connected together. The candidates for connection are as follows:

U7 pin 7 to U8 pin 20

U20 pin 7 to U21 pin 8

U13 pin 10 to U14 pin 7

U35 pin 7 to U44 pin 8

U39 pin 10 to S-100 pin 50

If your system uses the S-100 pins 20 and 70 as grounds, they should be connected in as well.

(3) This corrects one of the symptoms of the inadequate grounding mentioned in 1 and 2. Historically, it was found first, because the board would often hang up in an "Auto-wait" state when using the monitor EPROM. Short spikes on SOUT or SINP propagate the logic to the clock U42A when the CPU is really accessing a memory address of F733. This change prevents short spikes from clocking the Auto wait flip-flop but has no adverse effect on the desired operation.

Cut the +5v trace going to U42 pin 2. It is on the back of the board and you do not have to remove the IC or the socket to get to it. Now connect pin 2 to U35 pin 11. This is the logical OR of SOUT and SINP. In the case of a short spike, this point will be back in the logic low state before the clock signal gets to the flip-flop.

(4) Some boards did not work with some of the Western Digital IC's. The problem was most pronounced with 5 1/4 inch drives. The problem is that the board design requires the WD1793 to operate outside of its specified range. In particular, the data sheet requires that the data inputs be held for 70 ns after the end of the write pulse. However, the 2422 actually switches off the data bus buffer before sending the write pulse to the 1793 or the control latches. It is only the PC board capacitance, which causes the circuit to work!

The solution is to keep U39 turned on a little longer. There are several solutions, but the most reliable is to substitute an unused section of open-collector NAND gate U5 for the section of U20, which drives U39 pin's 1 and 19. Connect U20 pin's 4 and 5 to U5 pin's 12 and 13 respectively. Cut the trace to U20 pin 6 and connect a wire form that trace to U5 pin 11. Connect a 1K pull-up to U5 pin 11, and somewhere along that trace connect an 80 to 100-pF capacitor to ground. This will slow down the rising edge of the signal to U39 pin 1.

**CCS 2422 Controller Hang up Fix # 2**

\*\* 5 1/4" / 8" Drive Problem Fix for CCS 2422 \*\*

Reported by Mike Niswonger, Sept 1985

This information originally compiled by Joe Wright at Alpha Systems - the creator of Z3-Dot-Com. Joe found the hardware bug, and contacted CCS; they acknowledged that they knew about it and took Joe's fix.

The CCS 2422 disk controller has a problem switching the 1Mhz and 2Mhz oscillator inputs to the WD179X controller; this appears to the user as an occasional lockup of the board when both 5 1/4" and 8" drives are active. The only way out of this condition is to reboot the system (often not a very promising alternative). The problem is that the standard board switches freqs on the wrong edge of the clock. This can be remedied as follows:

(1) Isolate the clocks to U38 (pins 3 and 11) so that they are no longer clocked by the RCLK signal, but make sure that there is still a path to U8 pin 26 from U18 pin 9. On the Rev B boards (and possibly others) this can be easily done by cutting an etch below U38 where the signals to pins 3 and 11 combine and go through the board. By making the cut at the correct place, you can reduce the number of necessary jumpers to two.

(2) Run the 1Mhz signal from U15 pin 12 through a spare inverter at U28 pin 9 (or any other spare inverter) and take the output from U28 pin 8 to U38 pins 3 and 11 (the clock inputs just isolated).

This mod has been running on at least three systems for anywhere from 2 years to 3 months, with no known problems.