

Big Green Breadboard

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An Odd but Fun Way to Build a Computer Certainly it seems strange to lay out a big printed-circuit board not to fabricate a circuit but to allow people laboriously to *breadboard* the circuit. But we have found this process gratifying.

0.1 What the Board Does for Us

The board makes it possible to breadboard a tidy computer. It does this by hiding long lines on traces on the *underside* of the board. Here is an unusually tidy lab computer. A display board and keypad are shown attached; these are devices separate from the big breadboard.

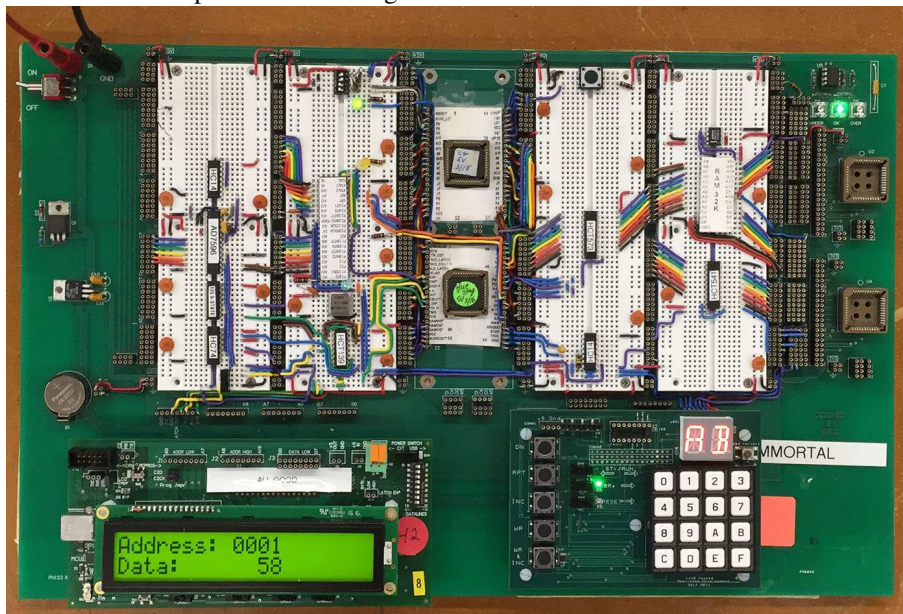


Figure 1: Traces on underside allow a complex circuit to be tidy

We like, also, the fact that the breadboard makes *buses* not just abstractions but a wiring system that is

material, its operation obvious. Here is what the underside of the breadboard looks like. 24 of the long traces lines are address and data buses; the remainder are uncommitted general-purpose lines.

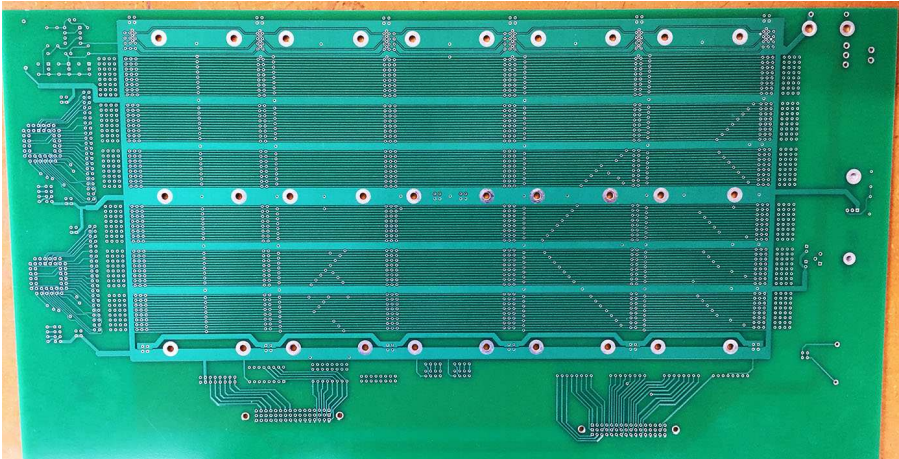


Figure 2: Underside of breadboard shows the bus lines: mostly address and data, but also general-purpose, uncommitted lines

And here is an annotated image of the top of the printed circuit board:

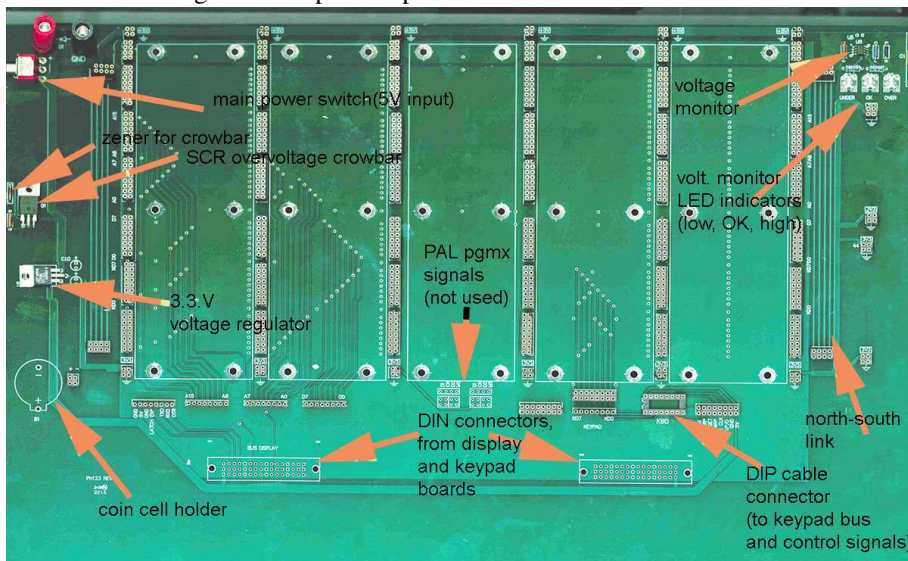


Figure 3: Top side of printed circuit board, annotated

0.2 What's on the Board

In addition to tidying up the wiring, the board does us a few more favors:

Power Supplies It accepts a 5-volt supply, and with it does some useful checks that make it hard to destroy one's computer by mis-applying power. **Protections:**

- a power diode clamps reverse-voltage that one might carelessly apply
- a voltage monitor warns when the 5-volt supply is too low ($\approx 4.75\text{V}$) or too high ($\approx 5.25\text{V}$), lighting warning LED's in those cases (yellow for low, red for high, green for correct)
- a "crowbar" SCR clamps the 5V supply to about 1V if the supply exceeds about 5.75V

Second Supply:

- a regulator delivers a 3.3V supply derived from the 5V input. This is necessary for the PALs, and may be useful for future versions of other parts, as more functions move to reduced supplies

Connections to LCD Board and Keypad Two DIN connectors, into which display board and keypad are plugged, connect these devices, internally, to appropriate lines.

- display board is connected to address and data buses
- display board's serial lines (Dallas version) are connected to DTR, TXD and RXD lines on the big board
- keypad is connected to the 8-bit KPD bus on the board (different from the more general *data* bus), and to the keypad's several control signals (ADCLK, WR, etc.)

Here is an annotated image of the bare board, showing parts that need to be soldered in, and the single-strip breadboards not yet attached.

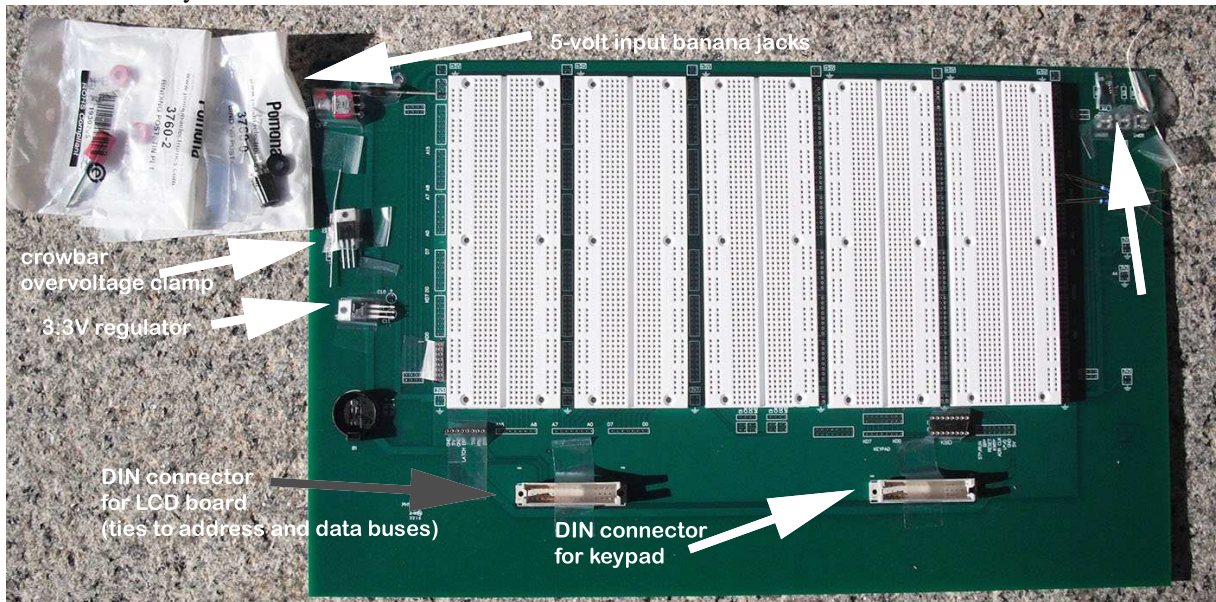


Figure 4: Bare breadboard, showing many elements

And here is what the board looks like with parts installed.¹

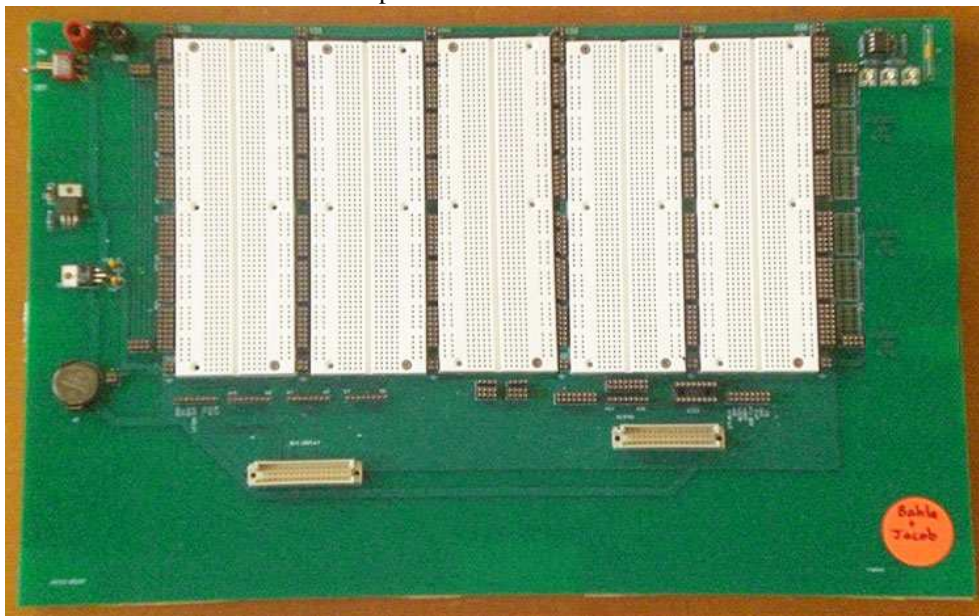


Figure 5: Bare breadboard with parts installed

¹This is not quite the current version of the board (Nov. 2016).

big_green_breadboard_description_aug19.tex; August 21, 2019