

## MEM8PLUS v2f Update to enable battery-backed RAM Operation

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Background: The original design worked, and the boards went for fabrication. However, it was discovered several weeks later that the batteries on the prototype were dead. Upon investigation of this problem, excessive drain was discovered on the 2032 coin cells. This was determined to be caused by the bias current to Q1 through R1 and the output of de-energized U5A. This was compounded by the current through the forward-biased Base-Emitter junction of Q1 and R2 to keep Q1 turned on to pass current to the 32K RAM chips. The design, as such, was necessary to ensure that Q1 would cut-off completely when the input of U5A was low for when 512K RAM chips were used, and would be turned on hard for 32K chips in order to pass enough current to power the chip. However, the current back through the output of de-energized U5A was not considered.

The fix for this has turned out to be rather simple. The best news is this design update does not require any changes to the layout of existing MEM8PLUS v2f boards. Instead of using a current-controlled switch, the 2N3906 transistor, the update uses a voltage-controlled switch. Q1 (and Q3) gets replaced by a P-Channel Enhancement-Mode MOSFET to eliminate the current through the forward-biased Emitter-Base junction. The redesign of the driver circuit takes care of the other wasted current through R1 by eliminating R1 and replacing the 74LS04 with a CMOS version. The CMOS inverter, by design, outputs nearly to the power supply rails, and is perfect to drive the MOSFET. The MOSFET has been chosen to be a drop-in replacement for the 2N3906, and has satisfactory parameters like  $R_{dsOn}$  and  $I_{dsMax}$  to meet this need. To update boards already built:

1. Remove the 2N3906 transistors at Q1 and Q3.
2. Remove the 4K7 resistors at R1 and R3.
3. Remove the 74LS04 at U5.
4. Install a TP2104 MOSFET at Q1 and Q3, in exactly the same orientation as the 2N3906 was installed. Source to Emitter, Gate to Base, and Drain to Collector. (ZVP2106A has also been tested as an alternative.)
5. Install a 74HC04 at U5.

No other changes are required. Now the DS1210 chips and CR2032 batteries can be installed (don't forget to remove jumpers J2, J3, J4 and J5), and the RAM battery backup function will work without draining the batteries prematurely. Calculations show that a single 2032 battery can keep data in a set of RAM chips at least 3 years. There are two batteries on the board for redundancy. The DS1210 will only use one battery, and switch to the second if the first gets too low. You can choose to use one or two. Dallas has an algorithm for determining the health of the batteries.

If you have not built your Mem8Plus board yet, you can simply make the adjustment to your BOM and build it with the update as shown above.

Regards,

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