Stack Memory Expansion

The original Stack180 was designed to access only 1MB of RAM - the maximum allowed by the Z8S180's internal Memory Management Unit. Later versions, starting with the Rev E CPU board, can access up to 4.5MB of RAM through the use of bank switching. Note that a **Rev E CPU** board (or higher) is required for memory expansion beyond the original 1MB.

The Stack's memory design has a 'lower' and 'upper' 512K RAM chip, providing the maximum of 1MB of RAM. The built-in bank switching allows the 'upper' RAM to be switched out of context, logically replaced by a different 512K RAM. A fully populated memory array with this design would have a total of eight 512K RAM chips that could serve as the 'upper' chip, with a single 'lower' chip, for a total of 4.5MB of RAM.

The Stack Memory Expansion adapter doesn't go quite that far. Instead, an adapter board with up to 2MB of RAM was designed. Combined with the original 1MB, this allows for a 3MB machine. There is a 1MB RamDisk driver under StackOS that takes advantage of the added memory, freeing up a large portion of the 1MB 'main' memory for other uses. Additionally, the EEPROM code will include it in the initial capacity check, and will test it in the RAM Test.

Unlike other Stack hardware modules, the 2MB Memory Expansion is completely assembled and tested. This is mainly due to the SMD memory chips being used - the .05" pin spacing is half of the typical DIP pin spacing, making the possibility of solder shorts very real. However, there is a modification to the CPU board that will be accomplished by the user; the required part is included with the memory expansion.

The CPU board's original 10-pin terminal connector is inserted from the top. With the memory expansion board in place, you will not be able to install the terminal connector. To correct this, a right angle 10-pin connector is included - simply remove the old connector and replace with the new one. (NOTE: The modification is not required for CPU PCBs manufactured after 1 January 2012 - the right angle header is already installed.)

Parts List

Sockets
1 - 20-pin @ U5
2 - 1x14 SIP machined socket for @ U2
2 - 1x14 SIP machined male-female extension for U2
2 - 1x10 SIP machined male-female extension for U5

Capacitors
5 - .1ufd monolithic bypass @ C5, C11-C14
3 - 47ufd filters @ C105-C107

Misc
1 - Memory Expansion PCB w/1, 2, or 4 512Kx8 SRAM chips installed
1 - 28-pin socket extension
1 - 20-pin socket extension

Optional components
1 - 16V8-7 Memory Decoder GAL @ U5
1 - 28C256 EEPROM @ U2
1 - 10-pin, shrouded RA header

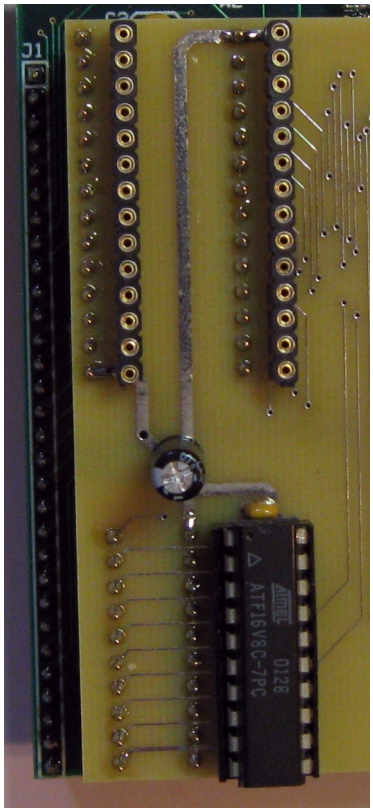
Construction

Construction is straightforward with no surprises or unusual techniques needed. The RAM chips are already installed, so you need only install the sockets and capacitors.

- Shut down your Stack180 and remove the CPU board. Early CPU boards had a 10-pin, shrouded, straight header for terminal output. This header will have to be changed to a Right Angle header so the terminal pigtail departs the CPU board on edge instead of upwards. Stack180 CPU kits sold after 8/1/2010 have the correct, right angle header; units sold prior to that date have the straight header, which will have to be replaced. In this case, remove the original header and install the new, right angle header. This can be difficult, and you can easily damage the CPU board, so be careful. If you would prefer, send the CPU board to TG Consulting and we'll perform the change for the cost of return shipping. If you make arrangements to send the CPU board to us when you order the RAM Expansion, we'll return it with the RAM Expansion installed - eliminating one of the two shipping charges. We'll also update the GAL and EEPROM code, if necessary.

- Remove the EEPROM (U2) and Memory Map Decoder (U5) from the CPU board. Set them aside for later reinstall.

- Refer to this photo prior to installing the IC sockets:



- The memory adapter board uses male-to-male header pins to achieve the connection to the CPU board. The male-male headers are soldered to the Memory Expansion board. A second set of header pins (male-to-female) are used to provide further separation between the two boards. Finally, the male side of the male-female headers plug in to the sockets on the CPU board. This arrangement is used for both the 20-pin GAL and 28-pin EEPROM. For this step, install the male-

male header pins from the BOTTOM SIDE OF THE ADAPTER BOARD; solder them from the top of the board. Note that the 20-pin header and socket are side-by-side, while the 28-pin header and socket are interleaved. You can easily check this by overlaying the memory expansion board on top of the CPU board. MAKE SURE YOU USE THE RIGHT SET OF HOLES.

- Install 20-pin IC socket at U5.

- The 28-pin socket at U2 is formed with two, 1x14 SIP headers installed ON THE TOP SIDE of the board. To ensure correct spacing and alignment, you should insert the EEPROM prior to soldering. Solder from the bottom of the board.

- Install five .1ufd monolithic caps at C5 and C11-C14.

- Install three 47ufd electrolytic caps at C105-C107. They can stand up or lay flat.

- Test fit the adapter board to the CPU board. Install the 2@ 1x10 and 2@ 1x14 male-female SIP extensions on the male-male headers previously installed, then align and insert the two socket extensions onto the CPU board at U2 and U5.

- The new right angle serial header on the CPU board should be well clear of the memory expansion board. There will be no contact between the two boards, except for the two sockets, of course.

NOTE:

Depending on the code versions you already have, you may not need the two optional IC chips. If your EEPROM is version 2.01.01 (or higher) dated 04/14/10 (or later) your EEPROM is good, although updates may still be available. The Memory Map Decoder GAL @ U5 must be version SMDMEM 1.6 (or higher.)

If you require updated chips and can burn them yourself, the code files are easily obtained from TG Consulting. The Stack is designed to be able to burn the EEPROM in place, so this is a fairly easy process. The GAL, however, requires a burner.

For either chip, you can do any of the following:

* Burn them yourself,
* Buy new chips with the latest files installed, or
* Return your chip(s) for the update(s).

Initial Power On Tests

- Install the EEPROM and Memory Map Decoder chips (removed from the CPU board) into the Memory Expansion Adapter at U2 and U5. Be certain the Memory Map Decoder GAL is version 1.6 or later.

- Install the CPU board in the Stack computer case. Connect the remote power LED and reset leads.

- After verifying that everything is plugged in properly, power up the Stack. The initialization page should begin with something like this:

Base RAM Capacity Check: 32 Banks of 32K Present (EEPROM Shadowed in Bank 0)
Banked RAM Capacity Check: 64 Banks of 32K in Banked RAM.

The first line displays the main RAM capacity @ 1MB in this case. This includes the 'lower' 512K RAM and the 'upper' 512K at Bank 0. The second line shows the number of 32K banks that were found in 'Banked' RAM, excluding BANK 0, which was included in Base RAM. In this case, 512K Banks 1-4 were present, providing 64 banks of 32K. Each 512K chip will provide 16 banks of 32K, so a 1MB expansion would show 32 banks; a 512K expansion would show 16 banks.

If the Banked RAM Capacity Check is either not present or shows 0 banks, verify the following:

* CPU board is Rev E or higher.
* Memory Decoder GAL is version SMDMEM 1.6 or above.
* When initialization is complete, the main sign-on page should show the EEPROM code version as 2.01.02 (or higher,) dated 02/14/10 (or later.)

If the display shows an incorrect capacity check, there is likely a soldering error on one or more of the RAM chips. Because the expansion module is supplied assembled and tested, this should never happen - be sure to contact TG Consulting immediately.

RAM Testing

EEPROM-based RAM testing will automatically test the additional RAM. The quick check during power-on initialization is used to determine how much RAM is present; the results of that check are used for RAM testing.

There may be a conflict that causes errors during the RAM test, depending on the revision level of your EEPROM code. If you have the XPORT & LCD Adapter, and it is enabled in EEPROM Setup, then a RAM test will fault out almost immediately. The RAM Test outputs the current test byte to the HEX display and the binary LED display on the LCD Adapter. It also stores the current test byte in RAM - at one of the addresses under test, causing the test to fail. The byte being output to the Binary LED display must be saved in RAM because the LCD character output routine changes the 8255 mode during the display process, and mode changes cause the 8255 output registers to reset to zero.

If you receive these errors during the RAM test, enter EEPROM Setup and disable the XPORT & LCD Adapter via Setup → C - Motherboard Parameters → 1 - Toggle LCD Enable. Save the EEPROM Setup data, reboot, and restart the RAM Test. When the test is complete, re-enable the XPORT & LCD Adapter.

Operating System RamDisk

The RamDisk under StackOS can be set to a 1MB RamDisk that uses the extended memory contained on the RAM Expansion board. File BIOSZ.Z80 in the A3: user directory contains the needed equate settings to enable the extended RamDisk.

The default OS parameters provide a 512K RamDisk in the main 1MB memory space. The following information will allow you to modify the default BIOS settings and re-compile a custom

BIOS that includes the extended memory RamDisk.

Editing the BIOSZ.Z80 file is necessary to modify the default BIOS configuration. First, find the equate 'DistroSys' and set it to FALSE. Further down the file, you'll find many of the optional configuration parameters that are surrounded by the 'DistroSys' IF-ELSE-ENDIF test. The intent is to leave the 'DistroSys' = TRUE settings alone so you can, if ever it becomes necessary, rebuild the distribution BIOS.

In the 'if DistroSys' → 'else' section, set RamDisk to false and HiRamDisk to true. Save the file back to disk, and enter the following command line from the A3: user directory:

MAKEBIOS A ← Note there is NO COLON with the A drive designator

The BIOS will build, and offer you two opportunities to skip a step in the build process. Responding with 'N' in both cases will complete the process without making any changes to the Boot Tracks. Responding with 'Y' to both cases will result in a full BIOS build and Boot Track write.

When the build is complete, enter BOOT at the command line to reboot the system. Reboot into CP/M and allow the RamDisk to load. Enter "DSTAT M:" at the command line and see the following response:

```
A0:BASE>dstat m:
DSTATS vers 1.4

Drive M:
  Directory entries...  256
  Directory size......    8k
  Block size..........    2k
  Net disk space...... 1016k
    Space used........  104k
    Free space........  912k

Directory usage:
  User/Label    Files    Entries    Size
  -------------------------------------
  M15:              9       11      104k
  M31:              1        1        0k
  -------------------------------------
  Totals:          10       12      104k
  Free:                    244      912k


[Allocation map or ^C to quit] ^C
```

This is the typical status of the 1MB RamDisk immediately after booting into CP/M. If you look at the M31: directory, you'll see the RAMDINIT.ENT directory entry. This is a zero-length file that is created during RamDisk init at Cold Boot. Subsequent cold boots will check to see if this file already exists. If so, the RamDisk will not be re-initialized. This will allow a quick reboot without having to re-load any files back onto the RamDisk, since they'll already be present.

If you have any questions or issues with the Ram Expansion board, don't hesitate to contact TG Consulting for information and assistance.