MG003 Non Volatile RAM

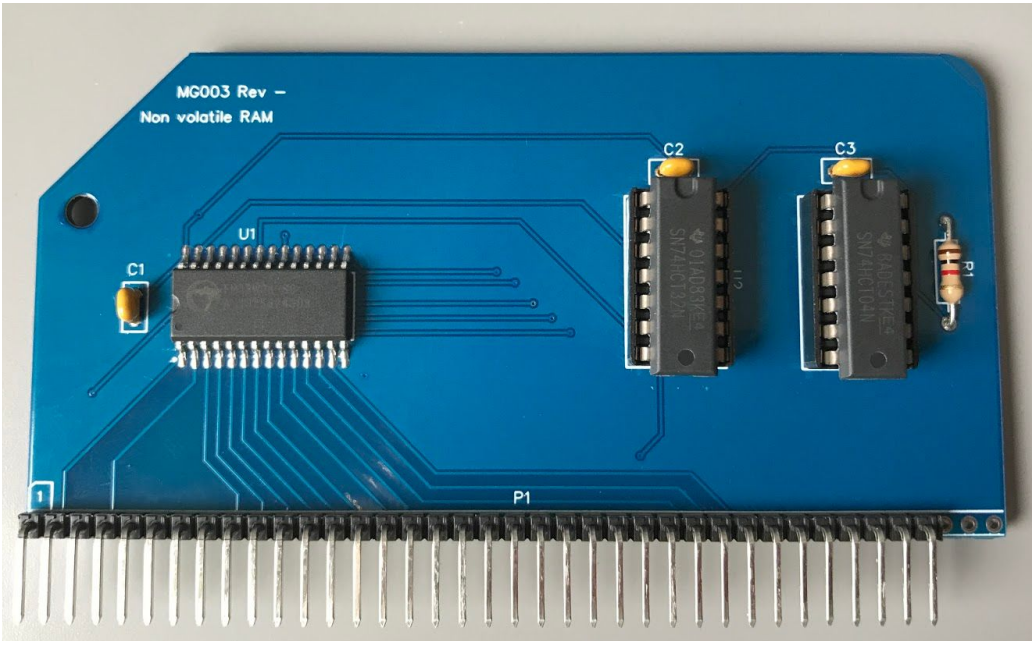
What is it?

MG003 is a non volatile RAM module designed for RC2014. It is designed to be used in place of the standard RC2014 32k RAM module, and behave in exactly the same way except that it will retain any data stored on it when powered off. Simply put, the user will no longer need to keep power applied in order for programs to be retained.

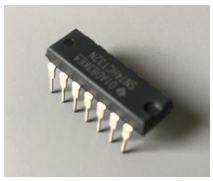
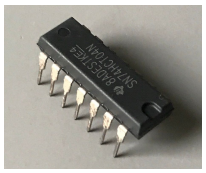
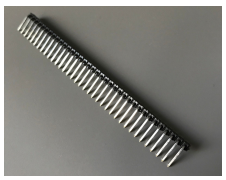
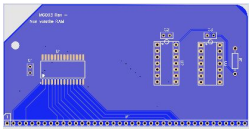
The MG003 is designed for the retro (1980's tech) RC2014 series of computers, but cannot claim to be fully authentic 1980's technology:

- It uses Ferroelectric Random Access Memory or F-RAM, which only really emerged on the market in the late 1990's
- F-RAM memory is now only manufactured in SOIC surface mount form factor, surface mount was only just getting going in the 1980's

Having said that, I think the advantages and convenience make the non-authenticity well worth accepting.



What's in the kit?

Name	Quantity	Description	Picture	Present?
C1-3	3	Capacitor, ceramic, 100 nF		☐
U1	1	FM18W08		☐
U2	1	74HCT32		☐
U3	1	74HCT04		☐
U2, U3 socket	2	14-pin DIP socket		☐
R1	1	1k Resistor, 250mW		☐
P1	1	Pin Header, Right Angle		☐
PCB	1	MG003 PCB		☐

How do I build it?

Given that surface mount soldering is involved, enough background experience to be fully comfortable with "normal" (through hole) soldering will be needed.

Recommended tools include:

- Soldering iron (ideally temperature controlled, 1mm or smaller bit for U1)
- Multicore solder (0.5mm or smaller for U1)
- Small snips to cut off leads
- Small pliers
- Desoldering pump and/or braid
- Anti-static wrist strap (or steer clear of materials that cause static and touch a grounded object every now and then).

The normal rule of thumb is to solder the lowest height components first, working up:

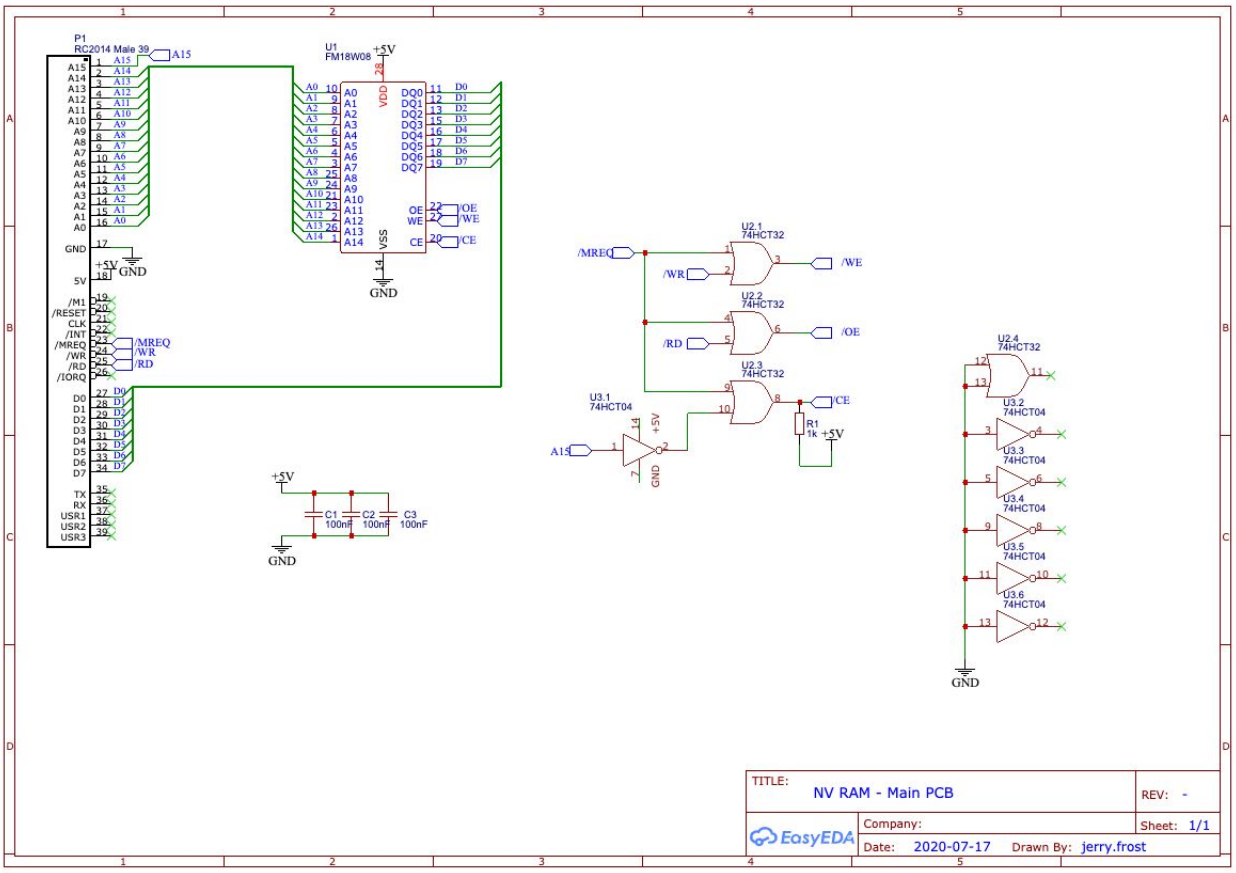
- U1. This needs to be soldered directly to the PCB. It's surface mount, but it's SOIC, which is pretty much as easy as surface mount IC soldering gets:
    - Apply a small layer of solder to two diagonally opposite corner pads for U1 on the PCB
    - Hold U1 in place (make sure it's the right way round), and apply the soldering iron to one of the above corner pins to make it "stick"
    - Do the same for the opposite corner - U1 should now be firmly in place and properly aligned, if not remove and try again
    - Make a final check that U1 is the right way round
    - Solder all the remaining pins, and finally resolder the first two corners
    - If this is your first time soldering SOIC, then it's worth continuity checking all pins:
        - Check that no adjacent pins are shorted to each other
        - Check all pins are connected to their end destination. Many end destinations can be traced visually, some will need you to look at the circuit diagram
- R1. Orientation doesn't matter.
- P1. This is supplied with 40 pins, therefore one needs to be carefully cut off using a sharp knife. Then, solder one joint only, check the

alignment, melt solder and correct alignment if required before soldering remaining joints
- C1-3. Orientation doesn't matter
- Sockets for U2-3 (do not fit ICs yet). Similarly to P1, solder two opposite corners, check the socket is flat on the board before continuing. Make sure the notches at the end of the sockets match with the PCB graphics, to reduce the risk of installing the ICs the wrong way round

If you have flux cleaner, clean all joints. Now inspect them carefully for issues (a magnifying glass of some sort can be very helpful, the camera on some phones works quite well).

The final step prior to plugging into the host system and testing is to fit U2 and U3 into their sockets. The IC legs will probably need a bit of gentle bending on a table or similar surface, to bring the two rows a little closer to each other. Pay attention to orientation (even after all this hard work, it's easy to get wrong).

How does it work?



U1 is the F-RAM IC, and is connected directly to the RC2014 data bus, and A0 to A14 of the address bus.

U2.1 and U2.2 take /MREQ and /WR and /RD signals from RC2014 and tell U1 when a write or read operation is being requested. U3.1 inverts the most significant address line A15, providing a logic zero to select U1 when the upper 32k of address space is selected (which is where the standard RC2014 expects to find its RAM).

That just leaves a couple of small things that are required by F-RAM (as opposed to "normal" RAM):

- F-RAM needs each memory access to have a LOW transition of /CE, so the /A15 signal is gated with /MREQ by U2.3
- Chip enable /CE is held high by R1 to ensure U1 is not enabled when power comes on/is turned off

How do I use it?

Easy. Remove the existing RC2014 32k RAM card and replace it with MG003. No special actions or coding are required for memory retention to work.

Acknowledgements/Legal

MG003 has been designed for RC2014 with reference to the RC2014 Module Template. All pinouts used and the physical outline are in compliance with the RC2014 Module Template.

RC2014 is a trademark of RFC2795 Ltd.

MG003 has been designed for hobbyist use only and is not to be used for safety or business critical applications.