Building a Replica of the MM5204 Personality Module in a SOL-20 Computer. (H. Holden 2019).

Introduction:

The SOL-20 computer carries a “personality module” containing SOLOS which is a 2048 byte file, in ROMs on the module. This is the basic operating system for the computer. One could say it is the computer’s Brain.

This program handles I/O routines for “Pseudo-ports” including Tape I/O functions. It was fairly aptly named because it does give the SOL-20 computer a personality of sorts. With this firmware the user can interface to the outside world via the serial, parallel or tape ports and also interface with the keyboard and video monitor. Also dump memory contents at will. It is a simple and elegant mini-operating platform.

Processor Technology made a number of hardware variants with different ROM IC’s on them. One module, the subject of this article, had four UV Eproms, the MM5204 each holding 512 bytes. This was the most physically attractive of the modules. Other variants included a module with four 6834 IC’s, a module with two 2708 IC’s and yet another module with only one 9216 ROM which contained the whole 2048 bytes.

The modules which had four IC’s used the 74LS155 as an address decoder, while the 2708/9216 module used a 74LS08 as the decoding was simpler.

In making the replica MM5204 module, one of the challenging tasks of programming the MM5204 was solved with Mr. Martin Eberhard’s programmer shown below:

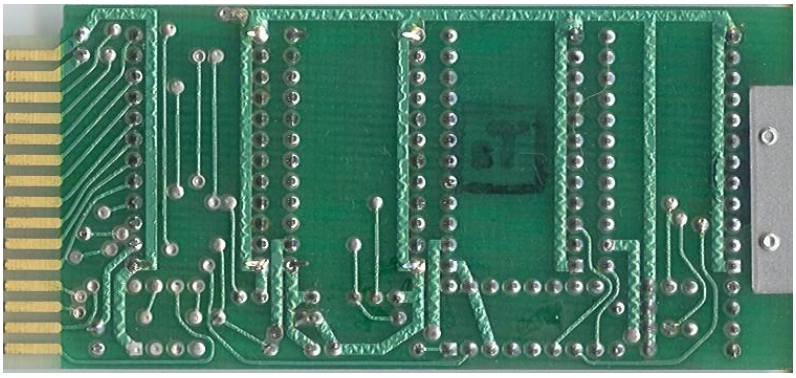
This programmer uses the p + 5p smart over-programming protocol to ensure the MM5204 IC's are properly programmed. It also has a very easy to use interface with excellent hardware, firmware and a very thorough construction and user manual too, all created by Mr. Eberhard.

(Martin Eberhard is one of the Tesla Motor Company's founders and is clearly a World leader in software & hardware applications of computer systems)

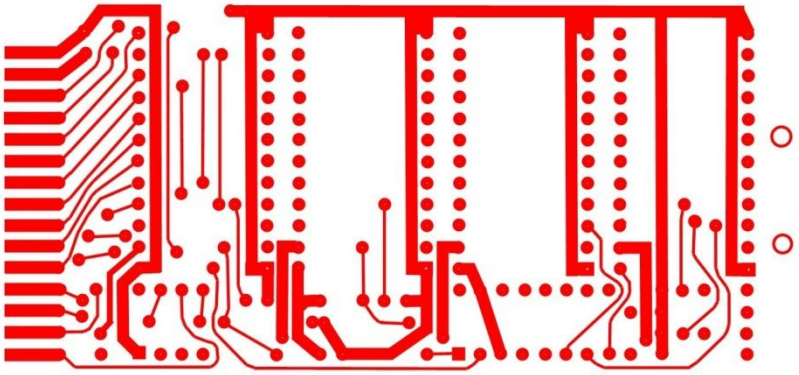
The photo below shows the original personality module which came in my SOL-20 and four MM5204's that were programmed by the Eberhard programmer:

Replica pcb:

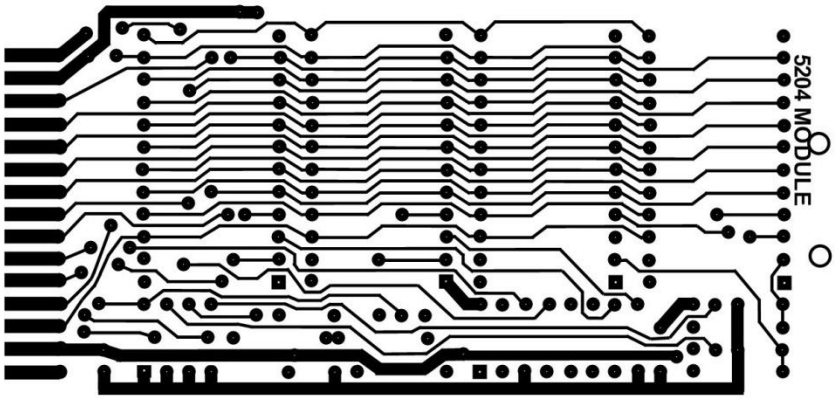
I transcribed the PCB artwork as a drawing in Microsoft Picture it. The diagrams are shown below. It was done by scanning the bottom pcb layer and drawing over that. The top layer was created by drawing over the image of the top of the PCB from the diagram of the module in the Processor technology manual. The scan of the pcb is shown below:



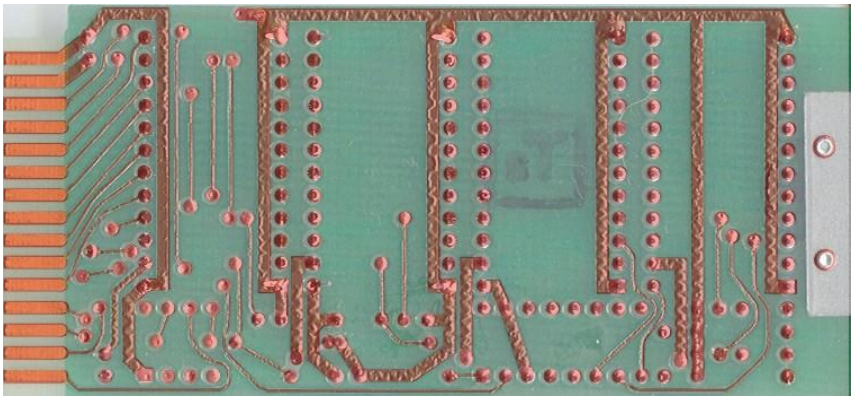
The bottom layer was drawn over this:



The image of the top layer:



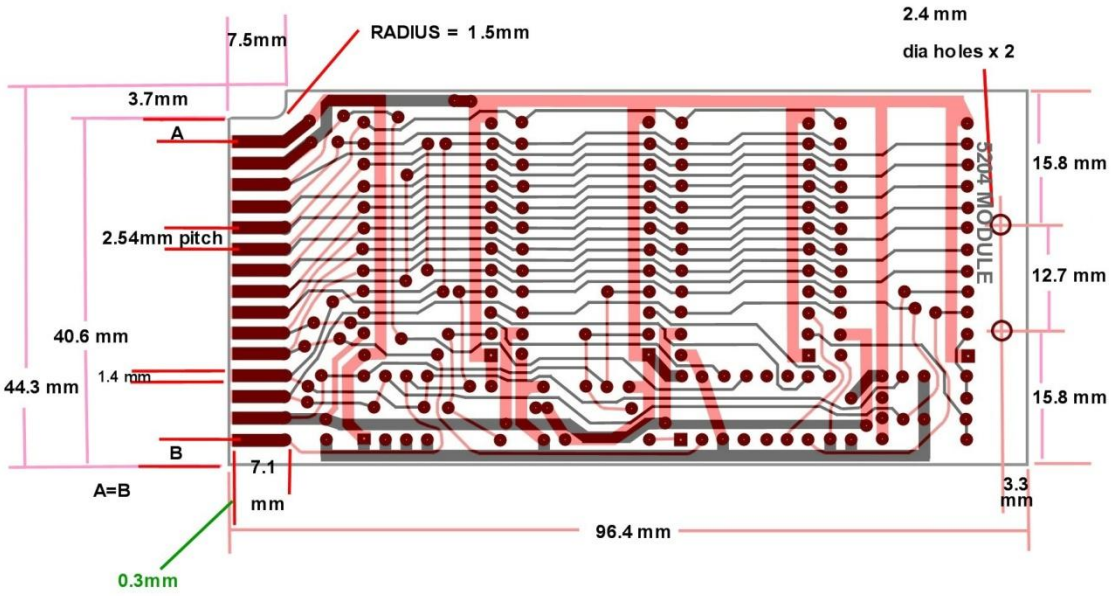
The image below shows the track artwork overlaid on the PCB scan to show it matches:



Next the layers were mixed on one diagram with instructions to help my PCB maker:

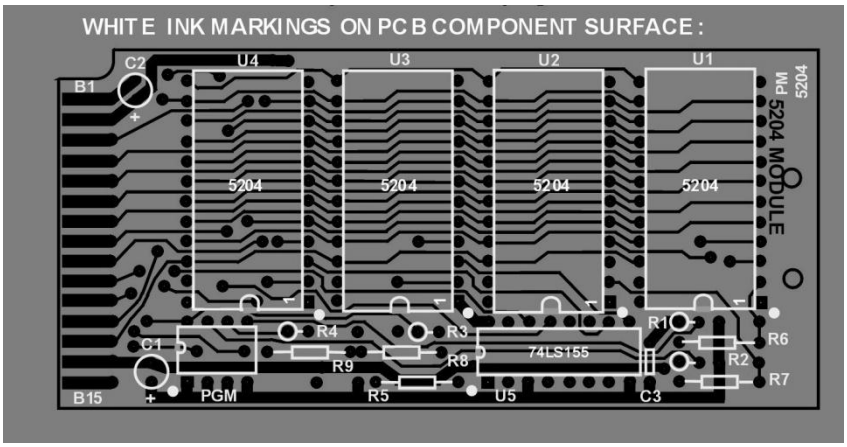
ALL LAYERS - looking through top surface - Top grey top (commonent side) pink solder side.

Pads 1.4 mm dia with 0.7 mm dia holes

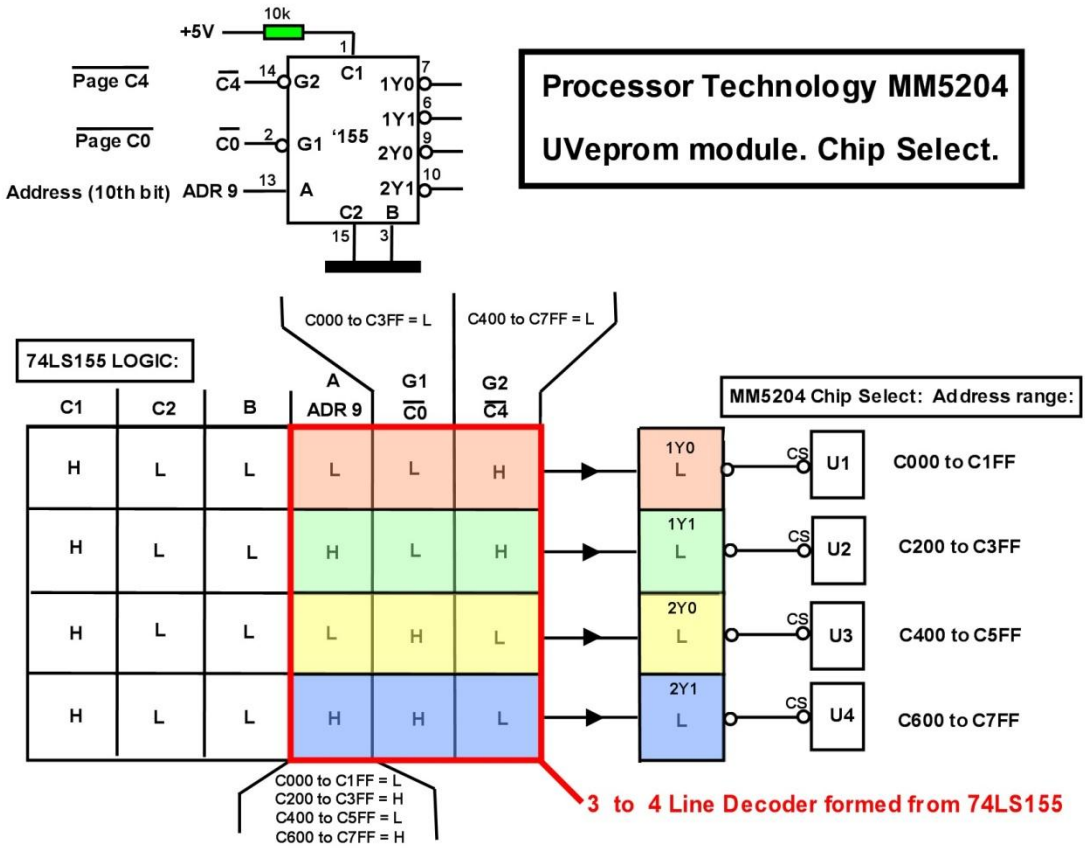


1.4 mm wide x 7.1mm long Gold plated edge connections on each side stop short of board edge by 0.3mm.

Also, the white in markings on the pcb top were duplicated:

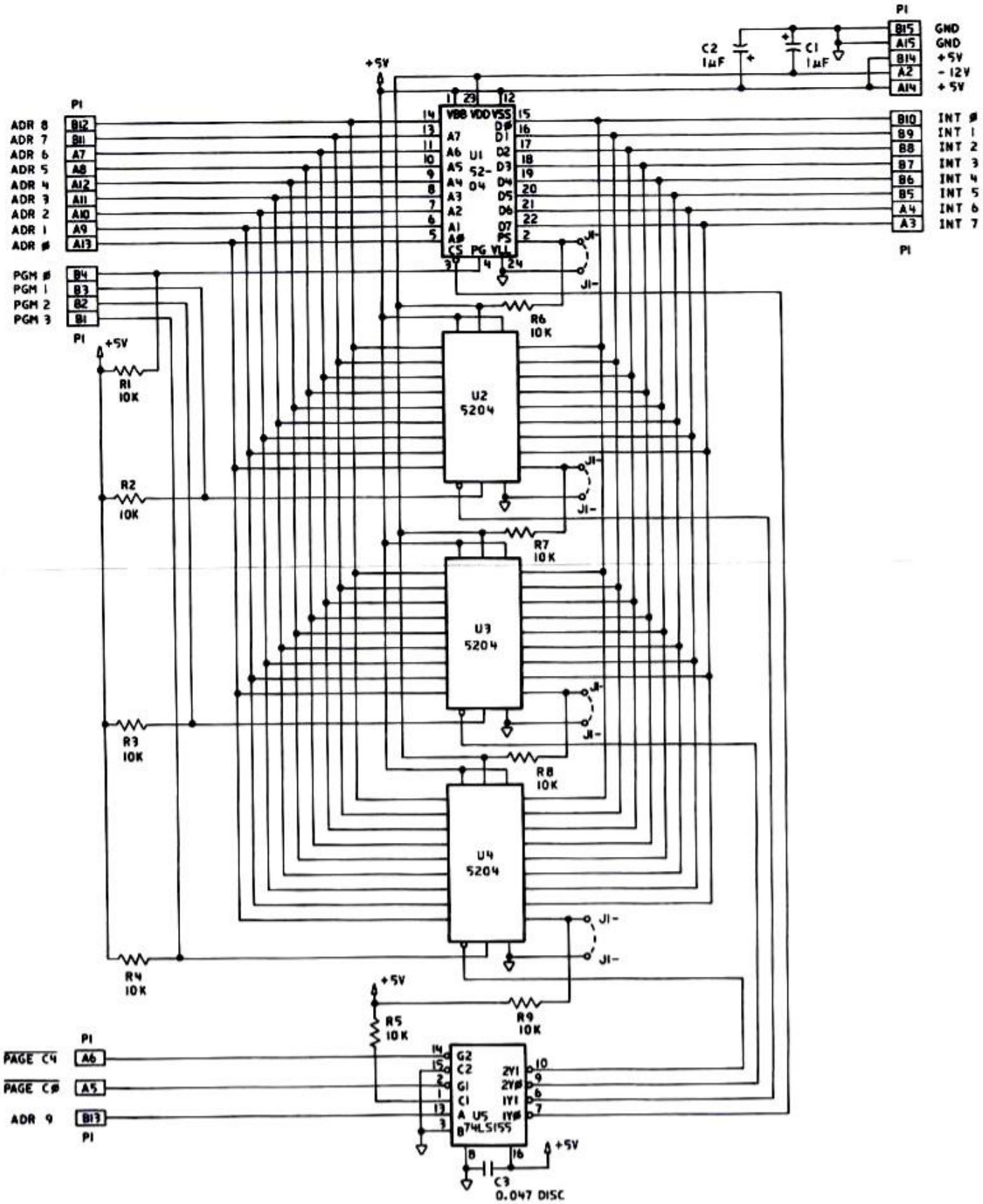


It is interesting to look at the operation of the address decoder, based on the 74LS155 IC, not a commonly used type. It has been wired to decode 3 lines into 4, so as to operate the chip select pins on the 4 MM5204's over the range C000H-C7FFH

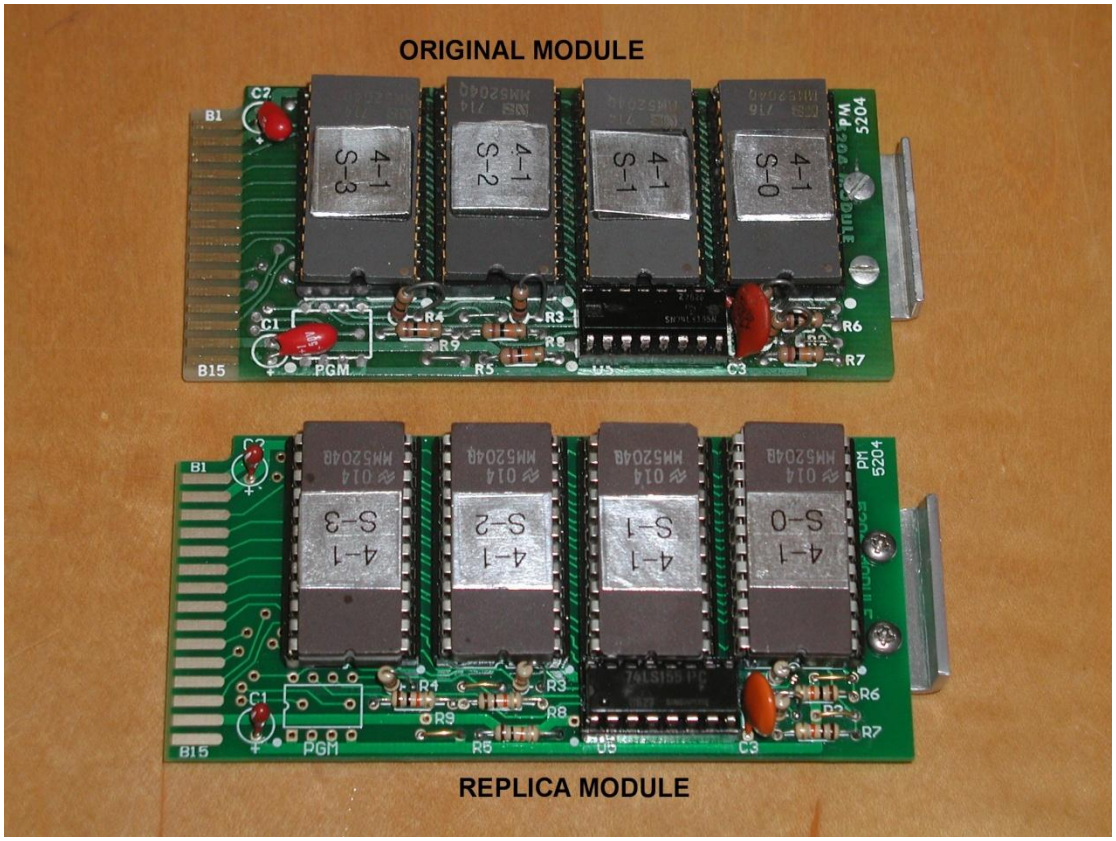


This function could have been implemented with a number of decoder IC's and the 74LS155 was an interesting choice.

The diagram below shows the schematic of the MM5204 module:


P1
B15 GND
A15 GND
B14 +5V
A2 -12V
A14 +5V
C2 1µF
C1 1µF
+5V
U1 5204
VBB VDD VSS
A7 A6 A5 A4 A3 A2 A1 A0 CS PG
D0 D1 D2 D3 D4 D5 D6 D7 PS
ADR 8 B12
ADR 7 B11
ADR 6 A7
ADR 5 A8
ADR 4 A12
ADR 3 A11
ADR 2 A10
ADR 1 A9
ADR 0 A13
B10 INT 0
B9 INT 1
B8 INT 2
B7 INT 3
B6 INT 4
B5 INT 5
A4 INT 6
A3 INT 7
PGM 0 B4
PGM 1 B3
PGM 2 B2
PGM 3 B1
R6 10K
R1 10K
U2 5204
R2 10K
R7 10K
U3 5204
R3 10K
R8 10K
U4 5204
R4 10K
R9 10K
R5 10K
PAGE C4 A6
PAGE C3 A5
ADR 9 B13
G2 C2 G1 C1 A B
1Y1 1Y0 2Y1 2Y0
74LS155
C3 0.047 DISC

The following shows the first attempt at a replica module. My pcb maker altered the profiles of some of the tracks, so this will be corrected on the next generation of pcb's.



****