RC2014

Mini CP/M Upgrade kit
## assembly guide and getting started

Introduction

The RC2014 Mini CP/M Upgrade Kit transforms a standard RC2014 Mini in to a CP/M machine with 64k of RAM, pageable ROM, compact flash storage and even adds an expansion slot too.

As the Operating System of choice before the IBM PC and MSDOS took the lead, there is a wealth of CP/M software available from programming languages such as Pascal or BBC BASIC, to office productivity tools like Wordstar and dBase II, and games including Zork or Hitchhikers Guide To The Galaxy, and lots lots more.

Full schematic available at
   https://rc2014.co.uk
or last page if viewing
this doc digitally
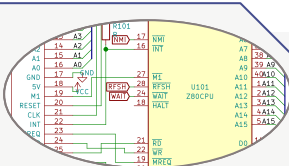
Kit's content

The RC2014 Mini CP/M Upgrade Kit consists of

x1 40 pin header
x2 40 way SIL socket
x2 2 pin header
x1 3mm Green LED
x2 28 pin DIL socket
x4 14 pin DIL socket
x1 16 pin DIL socket
x1 62256 RAM
x1 27C512 EPROM CP/M
x2 74HCT32
x1 74HCT04
x1 74HCT393
x1 74HCT138
x2 1N4148
x1 330Ω resistor
x4 1kΩ resistor
x3 10kΩ resistor
x6 100nf ceramic capacitor
x1 Compact Flash Socket
x1 Compact Flash 128Mb
x1 6 pin long socket
x4 20mm M3 screw
x4 M3 nut
x4 11mm PCB spacer
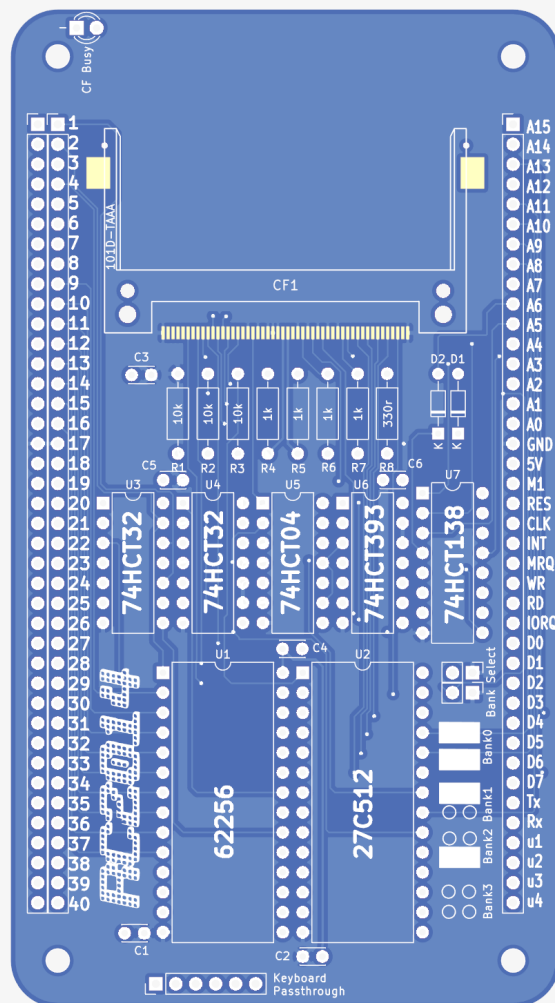
Resistors, crystals, and ceramic capacitors have no 'polarity'. That is, they can be soldered in any direction. Pay attention to polarity for LEDs, diodes, and electrolytic capacitors that normally have an indication on the soldering direction

Preparation

If you haven't built your RC2014 Mini, then do this first. A working RC2014 Mini is an important prerequsite for this upgrade kit. It also helps if you are familiar with how to use it too.

1. If you didn't attach the 40 way SIL socket that came with your Mini kit when you built it, do this now.
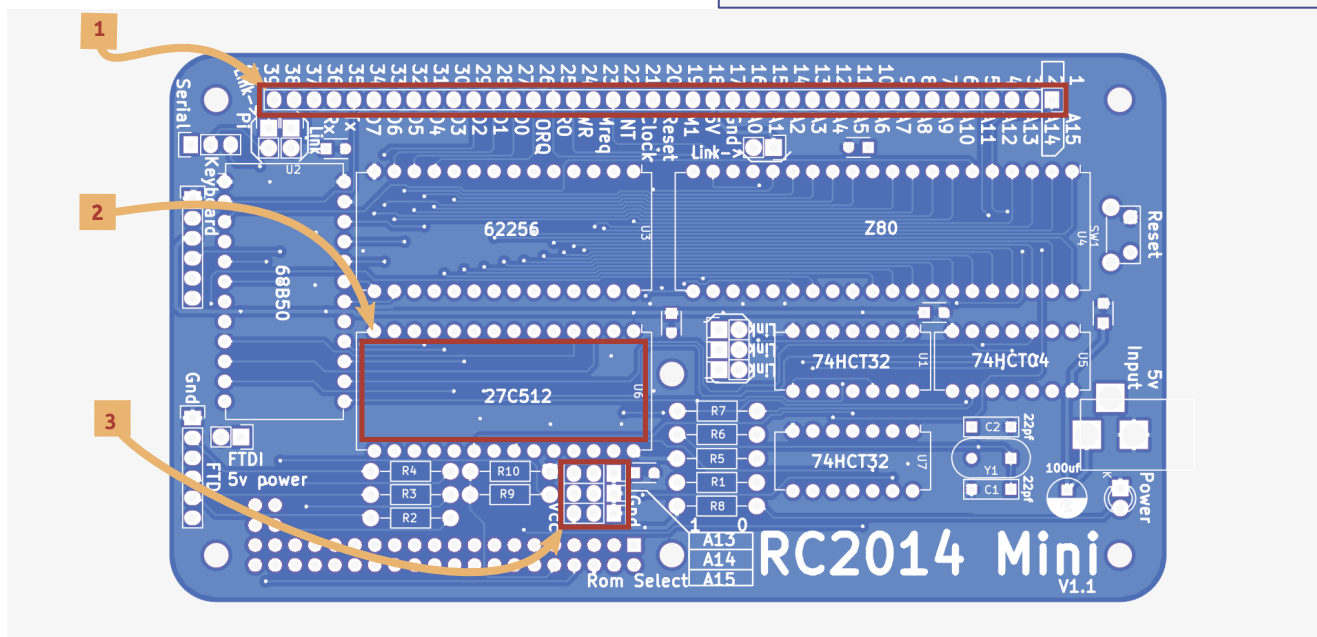
2. Remove the 27C512 ROM by gently inserting a flatbladed screwdriver at each end and wiggling it gently until it lifts out. You may find it slightly easier if you remove the 68B50 first. You won't be needing this any more, but it doesn't take up much space so is worth hanging on to.
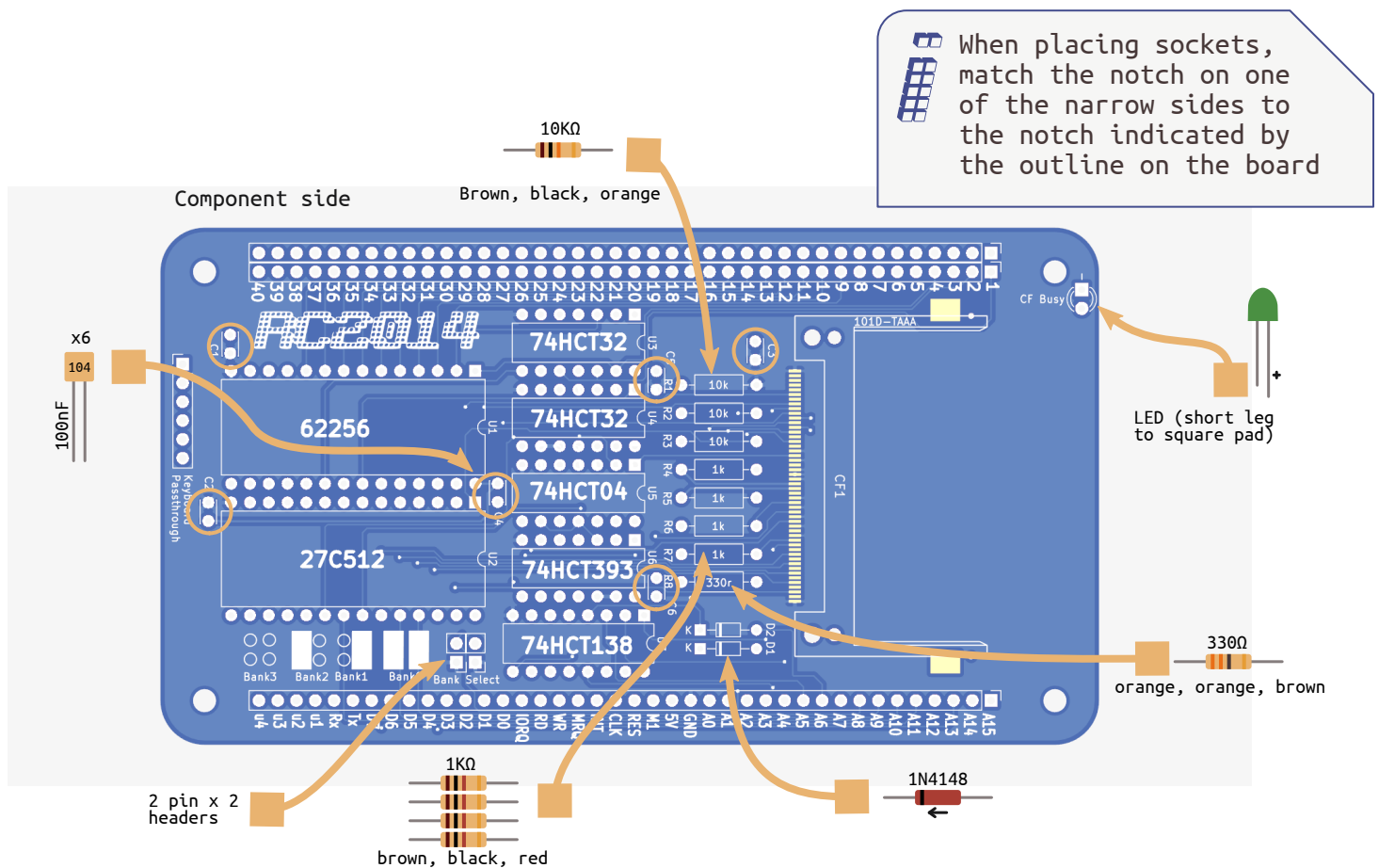
3.Remove the 3 jumpers and put them to one side. You will need those later

When soldering and building this project use all appropriate safety equipment. We also recommend using ESD protection in order to not damage the components.

Assembly

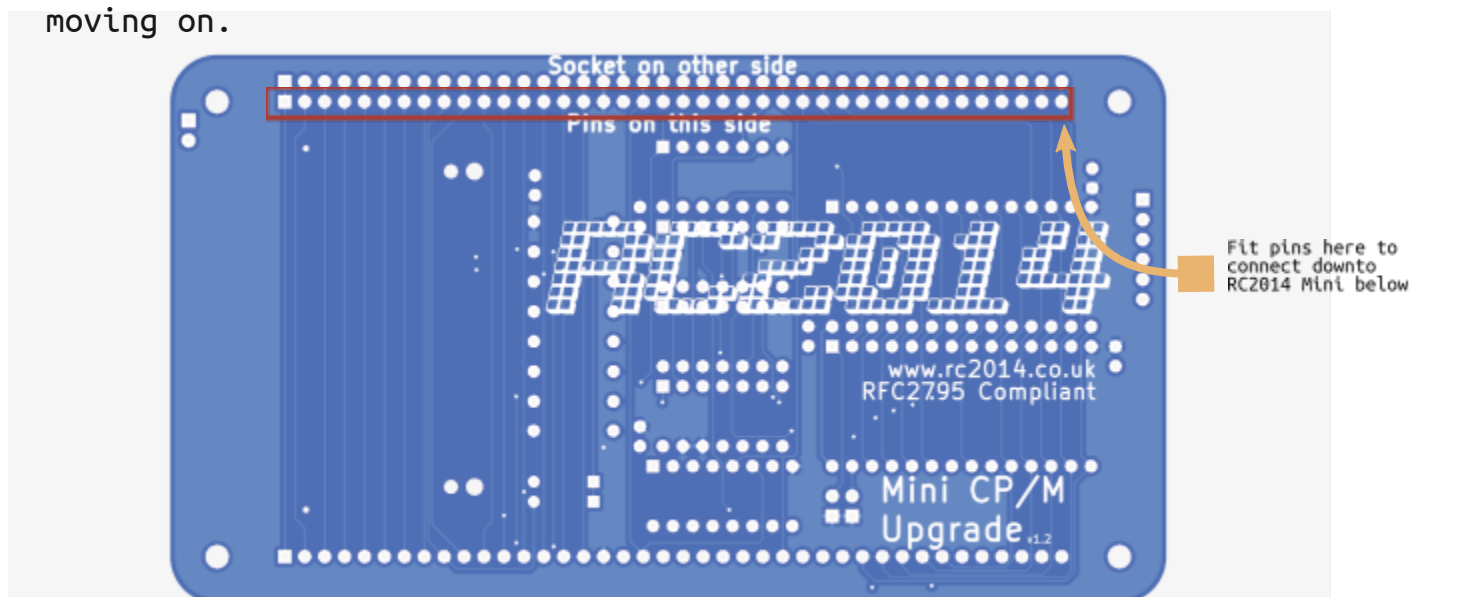Assembly of the CP/M Upgrade Kit follows pretty much the same pattern as with the RC2014 Mini. The values and types of components are indicated on the PCB silkscreen. We suggest you start with the lowest components, resistors and diodes, then work up through capacitors, LED and IC sockets. However, **do not solder any headers at this stage**.

Do not solder the header on the top of the PCB until the end of the build

When placing sockets, match the notch on one of the narrow sides to the notch indicated by the outline on the board

Component side

10KΩ
Brown, black, orange

x6
104
100nF

2 pin x 2 headers

1KΩ
brown, black, red

330Ω
orange, orange, brown

LED (short leg to square pad)

1N4148

When all of the components are in place, it is time to solder the pin header that connects the CP/M Upgrade Kit to the RC2014 Mini. In order to assure correct alignment, push the 40 pin header in to the 40 way SIL socket on the Mini, then place the CP/M Upgrade Kit on top of the pins, ensuring they line up with the **inner row of holes** and pin 1 matches. Use the screws and spacers to make sure the two PCBs are aligned and parallel, the solder all 40 pins on the upper side of the CP/M Upgrade Kit.

Once the header pins are soldered, you can remove the CP/M Upgrade Kit from the RC2014 Mini. Check that you are happy with your soldering before moving on.

Socket on other side
Pins on this side

Fit pins here to connect downto RC2014 Mini below

www.rc2014.co.uk
RFC2795 Compliant

Mini CP/M Upgrade

If you wish to expand your RC2014 Mini CP/M machine with other RC2014 modules, you can fit the 2 40 way SIL sockets on the top side of the board now.

If you wish to use the RC2014 Micro Keyboard, then you can fit the 6 way long socket through the Keyboard Passthrough pads on the CP/M Upgrade Kit. Note that there is no electrical connection to the CP/M Upgrade Kit, but soldering the header gives mechanical rigidity.

Now that we have everything soldered, let's connect the CP/M Upgrade Kit to the RC2014 Mini. But first it's a good idea to inspect all the PCBs for shorts, bad solder joints, and check that the ICs were inserted in the right orientation (notch-to-notch). Then, **carefully insert the Upgrade Kit into the expansion slot on the Mini**. The 'Pin 1' marking on both boards should line up. Slide the compact flash card in to the slot with the label facing upwards

ROM Selection

The ROM labelled R0881099 supplied with the CP/M Upgrade Kit is a 64k 27C512 that is logically divided in to 4 16k banks. You can choose which bank to boot from depending on how you want to use your RC2014 Mini.

Use the jumpers you set aside earlier to select which bank to boot from using the headers
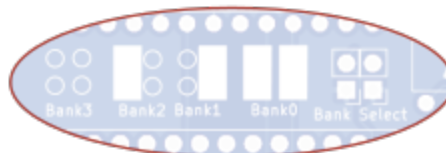
Bank 0	R0	Microsoft BASIC for 32k RAM
Bank 1	88	Small Computer Monitor (SCM) R4
Bank 2	10	CP/M 2.2
Bank 3	99	Small Computer Monitor (SCM) R1

The ROM has a sticker on it indicating what firmware was loaded onto it. Decoding information is here:

https://rc2014.co.uk/1515/decoding-rom-labels

First power-up!

For power either use the jack with 5V or use the FTDI cable by putting a jumper on the 2-pin FTDI Power header of the RC2014 Mini. When power is applied the green LED on the Mini PCB will turn on.

Now connect the FTDI cable, matching the black cable to the Gnd pin on the FTDI header

Connect the FTDI cable to a computer and launch your favourite terminal emulator (putty, minicom, tera term etc.). Set the appropriate port to 115200bps and 8-N-1. Press the reset button and you should get a welcome screen.

> *Never power the RC2014 Mini from both the power jack and the FTDI cable!*

> Official FTDI colours are
> * Black   GND
> * Brown   CTS
> * Red   VCC
> * Orange   TXD
> * Yellow   RXD
> * Green   CTS
> You may need to match the signals if you have different colours

Bank 0 - Microsoft BASIC

This is the same version of BASIC supplied with your RC2014 Mini, so you should be familiar with this already. See the RC2014 Mini documentation for more information.

```
Z80 SBC By Grant Searle

Cold or warm start (C or W)? C            ← Press C
                                          ← Press ENTER
Memory top?                               ← Start typing BASIC :)
Z80 BASIC Ver 4.7b
Copyright (C) 1978 by Microsoft
32382 Bytes free
Ok
10 for a=1 to 5
20 print "RC2014 is cool"
30 next a
run
```

Bank 1 - SCM R4

Type ? for list of options

Note that BASIC, WBASIC and CPM are all available options

Type cpm if you want to boot in to CP/M Alternatively you can boot BASIC, use the Z80 monitor or upload an intel hex file

```
Small Computer Monitor - RC2014
*?
Small Computer Monitor by Stephen C Cousins (www.scc.me.uk)
Version 1.0.0 configuration R4 for Z80 based RC2014 systems

Monitor commands:
A [<address>]   = Assemble       | D [<address>]   = Disassemble
M [<address>]   = Memory display | E [<address>]   = Edit memory
R [<name>]      = Registers/edit | F [<name>]      = Flags/edit
B [<address>]   = Breakpoint     | S [<address>]   = Single step
I <port>        = Input from port| O <port> <data> = Output to port
G [<address>]   = Go to program
BAUD <device> <rate>             | CONSOLE <device>
FILL <start> <end> <byte>        | API <function> [<A>] [<DE>]
DEVICES, DIR, HELP, RESET
BASIC      Grant Searle's adaptation of Microsoft BASIC
WBASIC     Warm start BASIC (retains BASIC program)
CPM        Load CP/M from Compact Flash (requires prepared CF card)
*cpm

Z80 CP/M BIOS 1.0 by G. Searle 2007-13
RC2014 port by Mitch Lalovic 2017

CP/M 2.2 Copyright 1979 (c) by Digital Research

A>
```

Bank 2 - CP/M 2.2

```
Press [SPACE] to activate console

Press [SPACE] to activate console




Z80 SBC Boot ROM 1.1 by G. Searle
RC2014 port by Mitch Lalovic
Type ? for options

>X
Boot CP/M?
Loading CP/M...

Z80 CP/M BIOS 1.0 by G. Searle 2007-13
RC2014 port by Mitch Lalovic 2017

CP/M 2.2 Copyright 1979 (c) by Digital Research

A>
```

Press Space

Press X

Press Y

Bank 3 - SCM R1

Type ?
for list
of options

```
Small Computer Monitor - RC2014
*?
Small Computer Monitor by Stephen C Cousins (www.scc.me.uk)
Version 1.0.0 configuration R1 for Z80 based RC2014 systems

Monitor commands:
A [<address>]  = Assemble      | D [<address>]   = Disassemble
M [<address>]  = Memory display| E [<address>]   = Edit memory
R [<name>]     = Registers/edit| F [<name>]      = Flags/edit
B [<address>]  = Breakpoint     | S [<address>]   = Single step
I <port>       = Input from port| O <port> <data> = Output to port
G [<address>]  = Go to program
BAUD <device> <rate>            | CONSOLE <device>
FILL <start> <end> <byte>       | API <function> [<A>] [<DE>]
DEVICES, DIR, HELP, RESET
*
```

Start coding
in Z80, or
upload an
Intel .ihx
hex file

SCM R1 is similar to SCM R4, however, it does not allow booting to BASIC or CP/M

> The compact flash card supplied with this kit includes CP/M 2.2 along with transient applications. For full details, including transferring new files, see rc2014.co.uk

Troubleshooting

Check if power is applied correctly (5V and LED is on). Check that the correct ICs are pluged into their respective sockets and that they are in correct orientation. Check the orientation of the FTDI cable and port settings. Try presseing the pushbutton again; does anything appear on the screen? Additional help is at rc2014.co.uk/troubleshooting/