**USING THE MACHINE**

Connect the board to a 5V regulated supply capable of supplying at least 250mA (or 500mA if you have a PC keyboard connected).

The board is set up for 115200 Baud, hardware handshake, 1 stop bit and no parity.   
Connect it to a PC or similar running a terminal program set to these parameters, then press the reset button.

|  |
| --- |
| **Press [SPACE] to activate console** |

...is displayed on both serial ports (or serial port and tv/monitor if designed that way). Only one is active at any time, so a spacebar press on the terminal/keyboard will allow the board to determine which port is to be used for the console I/O.

Once spacebar is pressed, the following is displayed...

|  |
| --- |
| **CP/M** **Boot ROM 2.0 by G. Searle BC or BW - ROM BASIC Cold/Warm X        - Boot CP/M (load $D000-$FFFF) :nnnn... - Load Intel-Hex file record Gnnnn    - Run loc nnnn  >** |

**BC**  
This starts the Microsoft BASIC ROM interpreter in "Cold" mode (ie. clears memory)

You will see

|  |
| --- |
| **Memory top?** (press ENTER for full RAM usage)  **Z80** **BASIC Ver 4.7b Copyright (C) 1978 by Microsoft 52755 Bytes free Ok** |

BASIC is then ready for programming

**BW**  
This starts the Microsoft BASIC ROM interpreter in "Warm" mode (ie. doesn't clear memory, so a program already in memory will remain)

**X**  
Boots CP/M  
You will see

|  |
| --- |
| **Boot CP/M?** |

displayed. Press "Y" to allow CP/M to be loaded from the disk. This will also turn off the boot ROM, allowing full 64K RAM access to CP/M.  
**If a properly initialised and CP/M-installed disk is present (see [below](http://searle.x10host.com/Multicomp/cpm/fpgaCPM.html" \l "InstallingCPM) for instructions)**, the following is then displayed...

|  |
| --- |
| **Loading CP/M...** screen clears here, so you may not see the above line **Z80 CP/M BIOS 2.0 by G. Searle 2013  CP/M 2.2 Copyright 1979 (c) by Digital Research  A>** |

CP/M is then loaded and ready to use.

**INSTALLING CP/M**

Installing CP/M onto a new card is a straightforward process, and involved firstly formatting the card then transferring the CP/M system to the first sectors on the card.  
The board will need to be connected to a PC (or whatever) which has a terminal program and contains the ".HEX" files needed for the installation.  
Reset the machine, and press spacebar, as described above. The machine is then ready to load Intel-Hex files if they are transferred from the terminal.  
The following steps require Intel-Hex files to be loaded. To do this, open the ".HEX" file in something like notepad, select the whole contents (CTRL-A) then "Copy" to clipboard. In the terminal, paste the contents into the window - the board will automatically load them to the appropriate locations specified in the HEX file. Dots will be shown on the terminal for each byte loaded. Once the end of the hex file is reached, "File loaded" will be displayed.  
If for any reason something fails, simply cold-reset the machine and repeat the steps.

**PART 1. FORMATTING THE DRIVE**  
Load the Intel-HEX dump of FORMAT into memory by copying the contents of FORM128.HEX (for 128MB SD utilisation) into the terminal window.   
FORMAT resides at $5000 when loaded.  
Executing address $5000 will start the FORMAT program which will then initialise the directory structures (ie. a quick format, as that is all that is needed on an SD card) for ALL of the logical drives on the flash card.

Once loaded, type **G5000** then press ENTER.

You will see...

|  |
| --- |
| **CP/M Formatter by G. Searle 2012** Then the following will appear in sequence (only takes a few seconds) **ABCDEFGHIJKLMNOP** Finally **Formatting complete  >** |

Each drive is 8MB so 128MB on the card will have drives A: to P:

**PART 2. "PUTSYS"**  
CP/M is "installed" on the first track of a disk. When the disk is then booted, the first track is read into the correct area of memory then executed.  
To write the CP/M system to the disk, it is firstly loaded into memory, then a program is executed to write the memory to the first sectors on the flash disk.

To install, the following steps are needed in this order:  
1. Load the Intel-HEX dump of CP/M into memory by copying the contents of CPM22.HEX into the terminal window. This will take about 10 seconds to load.  
2. Load the Intel-HEX dump of CBIOS into memory by copying the contents of CBIOS128.HEX (for 128MB total drive space) into the terminal window. This takes about 3 seconds to load.  
3. Load the Intel-HEX dump of PUTSYS into memory by copying the contents of PUTSYS.HEX into the terminal window.  
  
PUTSYS resides at $5000 when loaded.  
Executing address $5000 will start the PUTSYS program which will copy the CP/M and CBIOS from memory to the flash drive.  
Type **G5000** then press ENTER.

You will see...

|  |
| --- |
| **CP/M System Transfer by G. Searle 2012  System transfer complete  >** |

Once these are complete, CP/M is then installed on the disk and can be booted. Applications will then need to be installed.

**INSTALLING APPLICATIONS**

To install files, a small client application needs to be installed on the A: drive on the board. Once this is done, the windows program to package the files is used to create a text file which is then pasted into the terminal window.  
  
**PART 1 - The CP/M client application installation**

The installation of the client application only needs to be done once (provided it is not deleted) on each flash card.

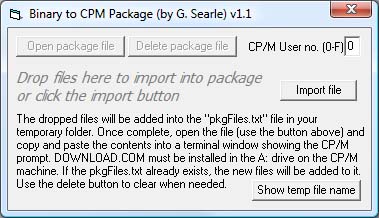
1. Install CP/M as shown above then boot from CP/M (press X and then Y at the monitor prompt, as described above).  
2. Press the cold reset button to get back to monitor  
3. Paste DOWNLOAD2.HEX (a relocated DOWNLOAD.HEX) to terminal window. This will load the download client into high memory. This normally resides at 0100, but as the ROM is active, this area is not available.  
4. Type **GFFE8** and press ENTER (this will relocate RAM 4100-->0100 and restart CP/M)  
6. When in CP/M, **SAVE 2 DOWNLOAD.COM** and press ENTER

A full terminal session of this is shown here...

|  |
| --- |
| <<<PRESS COLD RESET>>> Press [SPACE] to activate console <<<PRESS SPACE>>> **CP/M** **Boot ROM 2.0 by G. Searle BC or BW - ROM BASIC Cold/Warm X        - Boot CP/M (load $D000-$FFFF) :nnnn... - Load Intel-Hex file record Gnnnn    - Run loc nnnn  >X**<=== Type char Boot CP/M? <<<PRESS Y>>> Loading CP/M... **Z80 CP/M BIOS 2.0 by G. Searle 2013**  CP/M 2.2 Copyright 1979 (c) by Digital Research  A> <<<PRESS COLD RESET>>> Press [SPACE] to activate console <<<PRESS SPACE>>> Z80 Monitor Type ? for options <<<PASTE THE DOWNLOAD2.HEX FILE INTO THE TERMINAL WINDOW>>> >................................ >................................ >................................ >................................ >................................ >................................ >................................ >................................ >................................ >................................ >................................ >................................ >................................ >................................ >Load complete.  >**GFFE8** <=== Type chars and press ENTER Screen clears here **Z80 CP/M BIOS 2.0 by G. Searle 2013**  CP/M 2.2 Copyright 1979 (c) by Digital Research  A>**SAVE 2 DOWNLOAD.COM   <=== Type chars and press ENTER** A> |

DOWNLOAD.COM is now present on the A: drive, and the machine is now ready to be loaded with application files. There is no need to repeat the above steps unless the DOWNLOAD.COM file is deleted from the A: drive.  
  
**PART 2 - Using the Windows packager program**  
This can be used as many times as required and can transfer single or multiple files into the current drive that is active in the terminal window.

This is a small Microsoft Windows application that will allow BINARY CP/M files to be dropped onto it, which will then add them to a package text file. If you prefer, you can use the "import" button to select a file instead of dropping files onto the window.



NOTE: The "pkgFiles.txt" file will be created in the temporary folder of your machine. Only limited error handling has been added to this program, so if it fails please re-run.  
Once all files that are to be transferred into a particular drive have been dropped, the package file can then be opened.   
Copy the COMPLETE contents of this file and paste it into the terminal window of the machine.  
The terminal must be showing the CP/M prompt. This can be on any drive. The packaged files will be created in the current drive on the CP/M machine.  
The "DOWNLOAD.COM" file on A: drive on the CP/M board will then start and read the HEX byte stream, storing it in a file.  
Multiple files are permitted in a package file, allowing you to transfer a complete application containing many files in a single operation.  
Partial contents of this file are, as an example...

|  |
| --- |
| A:DOWNLOAD BBCBASIC.COM   <==== Command to create a file BBCBASIC.COM in the current drive U0  <==== User selection :C33401C37B01C3A501C3CA01C37A01C37301C38501C37201DDE5F   <==== Data stream, starts with a colon CB5FD21003CCA120FC5E5CDD209E1CDD50ACC9209C179B7CA990   <==== Data stream 36F7E0>0085   <==== Data stream, ends with a greater-than symbol, followed by a checksum A:DOWNLOAD STAT.COM   <==== Command to create second file STAT.COM in the current drive U0  <==== User selection :C33304202020436F707972696768742024576363456E2342EEA2   <==== Data stream for second file, starts with a colon B0E0ECD4C14C9212A15702B712A2915EB0E015CD3805C6414F   <==== Data stream A1A1A1A1A1A1A1A>80DD   <==== Data stream, ends with a greater-than symbol, followed by a checksum |

An example terminal session showing these files being loaded is shown here...

|  |
| --- |
| **Z80 CP/M BIOS 2.0 by G. Searle 2013**  CP/M 2.2 Copyright 1979 (c) by Digital Research  A>**C:** <=== Select drive where files are to be loaded and press ENTER <<<PASTE CONTENTS OF PKGFILES.TXT>>> C>A:DOWNLOAD BBCBASIC.COM <== Start of pasted text ..............................................  <=== Import progress of first file .............................................. OK  <=== Successful import of a file completed C> C>A:DOWNLOAD STAT.COM .........................................  <=== Import progress of second file OK  <=== Successful import of second file completed C> C>**DIR**   <=== A DIR command will show the created files C: BBCBASIC COM : STAT COM C>**BBCBASIC**  <=== Running one of the imported files BBC BASIC (Z80) Version 3.00 (C) Copyright R.T.Russell 1987 > |

You can, of course, install your own transfer program using the above then use that.

*The format of my transfer files is simple so you can also create your own program to build the transfer text files if you don't want to use my Windows app.  
You need to create a text file with the following contents (also refer to my example above)*

*First line:****A:DOWNLOAD <filename>****where <filename> is the CPM file that is required. Must be a space between DOWNLOAD and the filename.  
Second line:****U0****This is the "user" number that can see the destination file. If you are not familiar with CP/M users, then always use U0  
Third line:****A continual stream of HEX values****(must be 2 chars each) for each byte in the file, followed by a****>****character, followed by the****checksum***

*Each line is terminated with a carriage return / linefeed ($0D, $0A) as standard for text files*

*The checksum is two pairs of HEX values:  
The first one is the low-byte of the length of the file being uploaded. Because CP/M files are normally saved in blocks of 128, this is normally "80" or "00", but doesn't need to be.  
The second one is the low-byte of the SUM of each byte being uploaded.  
The checksum is very simple, but more than adequate for confirming a simple data transfer, as it can detect missing, extra or changed characters.*

*If multiple files are to be transferred, then all can be included in the same text file immediately after one another, with each following the three line format shown above.*