minimig firmware manual

Release version
YQ090421

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Introduction

This manual describes operation of the new MCU and FPGA firmware for the Minimig computer. It is the result of several months of improvements and new developments from Jakub Bednarski, building upon the work started by Denis van Weeren.

We hope that you enjoy using this new Minimig release and that it fosters a new dawn for the Amiga hardware platform. Suggestions and bug reports are always welcome in a quest to further improve the Minimig design for future releases.

Thanks go to Loriano Pagni, Darrin Lanchbury, Richard Graver, Edwin Cini, Sascha Budgenbach, Peter Czidlina and others for their help, support, ideas, testing, bug reports and feature requests. This release wouldn't be what it is without them.

Navigation

Configuration and operation of the Minimig computer is carried out through a special OSD menu.

The current firmware implements substantial changes from previous versions in an effort to improve user friendliness. It is possible to access and navigate the OSD menu using the keyboard or a joystick connected to port JOY 2. The MENU button on the Minimig board can be used to toggle the OSD menu On or Off.

F12/MENU/Joy Up + Down	Toggle the OSD menu On or Off
Enter/Space/Joy Fire	Select or change the highlighted option
Esc/F12/MENU/Joy Fire2	Go back to the previous menu level
Arrow Keys, Joy Up/Down	Change selection
Arrow Keys, Joy Left/Right	Change sub-menu (only when allowed)

You can modify your joystick for simultaneous activation of up and down direction signals. This would be equivalent to pressing the MENU button.

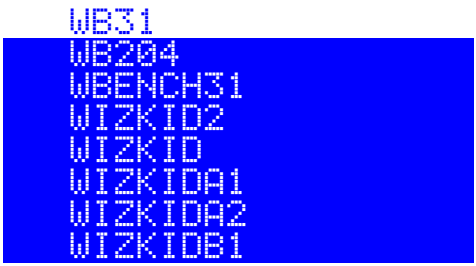
Minimig Main Menu

This is the top level menu. It is displayed when the OSD menu is invoked. Depending on the MCU installed, it displays two or four virtual floppy drives.

Virtual floppy drives

The text "--------" is displayed next to the floppy drive name to indicate that there is no disk in the drive.

To insert a disk, highlight the drive name using the Up/Down arrow keys or joystick and select the drive name. A list showing the disk images available on the SD/MMC card is displayed.



The list shows only those files with an ADF extension. Note that sub-folders and long file names are not supported. The system supports standard 880 KB ADF files. Other disk image formats cannot be used.

You can make your selection by moving up/down one disk at a time using keyboard or joystick. You can also press a key with a letter or digit to quickly jump to the next file whose name begins with the selected character.

Select the highlighted disk to insert into the virtual floppy drive. The screenshot below shows the main menu after inserting a disk.

To eject a disk select a floppy drive with displayed ADF file name and the disk will be removed from the drive. The text "--------" will appear.

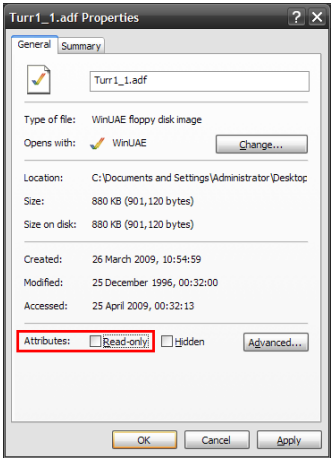
The PIC MCU supports two floppy drives, however it is possible to disable the second floppy drive. One might want to disable it to maximize the amount of free memory available to the Amiga operating system. Take a look at the section describing the ***Settings*** menu to find out how to do this. Remember that changing the number of active floppy drives requires a reset to take effect.

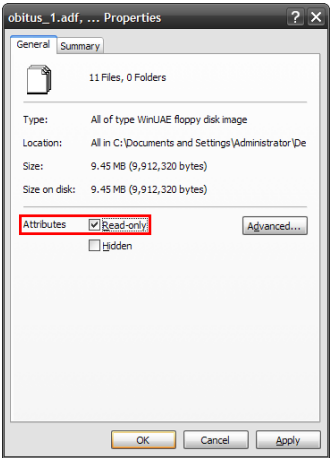
If the second floppy drive is turned off, the text *"disabled"* will be displayed next to the drive name. In such a case the drive cannot be selected.

When an ADF is inserted, the text **RW** or **RO** is displayed. This indicates the write protection status of the floppy disk image. If a disk is write enabled, the text **RW** is shown, meaning that it is possible to Read and

Write to it. Likewise, if a disk is write protected, **RO** is displayed, indicating that it is a Read Only disk.

It is not currently possible to change disk read/write protection from within the Minimig. In order to change protection you have to change the file attribute from a PC. In Windows, right click the file and select **Properties**. Check the **Read Only** attribute to write protect the ADF image, and un-check it to write enable. It is also possible to select multiple files and change their Read-only attribute all in one go. See images below for reference.





Due to limited memory resources of the PIC MCU, files on the SD/MMC card are not sorted alphabetically. Instead they are displayed as their entries appear within the directory. Generally they are displayed in the order they were created.

You can use a tool like **FATCleaner**[1] to sort the entries on your SD/MMC card so that the files are displayed in alphabetical order. It must be used after you write anything new to the memory card or after renaming a file. **FATCleaner** also removes long file names, effectively increasing the maximum number of stored files. FAT16 volumes can have maximum 512 entries in the root directory.

1 – Download location for **FATCleaner**
http://www.minimig.net/yaqube/tools/FATCleaner.exe

Settings

The settings menu is divided into four sub-menus. These are grouped into functional categories which allow you to set related parameters for the Minimig.

You can go directly to a sub-menu by selecting the appropriate menu item from the main settings menu.

Saving settings

The Minimig is equipped with a small amount of EEPROM non-volatile memory inside the PIC MCU. Every time the PIC is booted it reads the initial settings from this memory.

To save current settings so they are stored permanently, move the menu cursor to the **exit** entry at the bottom of the settings menu as shown below.

Move down once again so that the bottom menu item changes to **save**. You can select the **save** entry to save settings to the PIC's EEPROM memory.

If you do not wish to save, move the menu cursor up to exit the menu or change the settings again.

Every time you save settings, only the items which have been changed are written to the EEPROM to reduce memory wear. Should you wish to change and save settings often, don't worry too much about damaging the PIC EEPROM – it is guaranteed for at least 1,000,000 erase / write cycles.

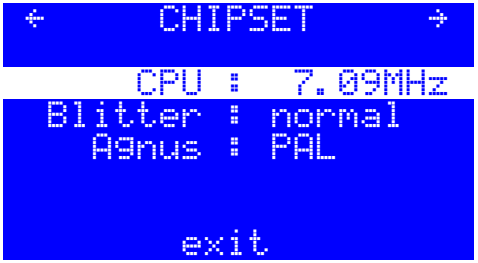
You can easily switch between settings sub-menus by moving to the left or right using the arrow keys or joystick. This is possible when small arrows (←,→) are shown at the top menu line.

Settings:Chipset

This sub-menu allows you to change the CPU clock speed, Blitter speed and PAL/NTSC video mode.

CPU

This setting changes the CPU clock frequency. The CPU clock speed may be set to **7.09MHz** or **28.36MHz**. The second option also switches on faster memory access to the Chip RAM so that chipset DMA activity does not slow down the CPU too much. Only the Blitter running in fast and nasty mode can entirely prevent the CPU from getting any bus access.



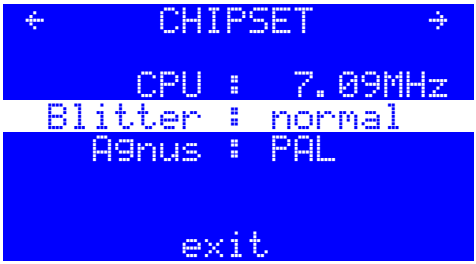
The CPU clock is changed immediately, there is no need to reboot or power cycle to enable it.

Although officially there are no MC68SEC000 CPUs rated at 28 MHz, all tested devices worked at 28.36 MHz flawlessly. Even 16 MHz rated devices will happily overclock to this speed without a hitch. At these low speeds and power levels, there is no risk of reducing the CPU lifetime through overclocking.

Blitter

The Blitter can work in **normal** mode for higher compatibility with existing software, or in **fast** mode for better use of memory bandwidth.

Fast mode effectively speeds up the graphics operations like window moving or line drawing. It may also fix graphics problems like slowdowns in some games and demos.

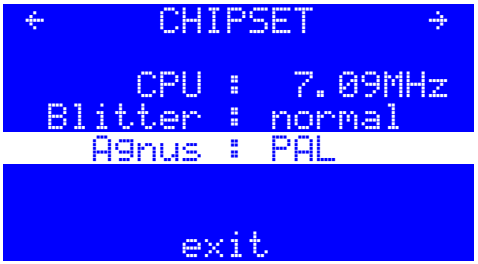


The Blitter mode setting is changed immediately. There is no need to reboot or power cycle to enable it.

When the CPU or the Blitter run in fast mode some programs may misbehave or some graphics corruption may be visible. In such a case it's advised to change Blitter and CPU settings to normal. The Blitter timing model in the current firmware is still not perfect, so some applications may still fail to run properly.

Agnus

With this option, you can switch between **PAL** and **NTSC** video modes. This setting also changes the ID of the Agnus chip between PAL and NTSC so the machine will boot in the desired mode.



The Minimig incorporates some of the most often used features of the ECS Agnus. It supports switching between PAL and NTSC video modes through software. Some games and demos change the video mode themselves and this setting may be overridden.

This setting requires a reset to take effect.

Caution is advised if you have a monitor which cannot display the PAL video mode (50 Hz vertical sync). If you change video mode to PAL and save the settings, the change will take place the next time you reset or switch on the Minimig. You will then not be able to see any display on your monitor.

It is possible to override stored PAL/NTSC settings while the FPGA configuration is being uploaded. This takes place when the DRIVE LED is rapidly blinking after switching on the power. Press and hold the [F1] key to force the display to NTSC mode. Press and hold the [F2] key to force PAL mode. Remember to save these settings to set current video mode as default.

Settings:Memory

This sub-menu allows you to change the size of Chip RAM, Slow RAM, select Kickstart image file and enable or disable Action Replay.

The firmware supports up to 3.5 MB of RAM if additional SRAM chips are installed. Such a modification[2] requires good soldering skills and is not recommended for people not familiar with soldering SMD components.

CHIP memory

This sub-menu allows you to change the amount of memory to be allocated as Chip RAM.

The Chip RAM size can be set to **0.5 MB**, **1.0 MB**, **1.5 MB** or **2.0 MB**. To support 2.0 MB of Chip RAM, the Minimig must be equipped with the SRAM mod, and at least one additional SRAM chip must be installed.

This setting requires a reset to take effect.

2 – For more information about this mod, visit:
http://www.minimig.net/yaqube/ramexp/ramexp.html

SLOW memory

This sub-menu allows you to change the amount of memory in the Minimig to be allocated as Slow RAM which is equivalent to a trap-door expansion card.

The Slow RAM size can be set to **none**, **0.5 MB**, **1.0 MB**, **1.5 MB**.

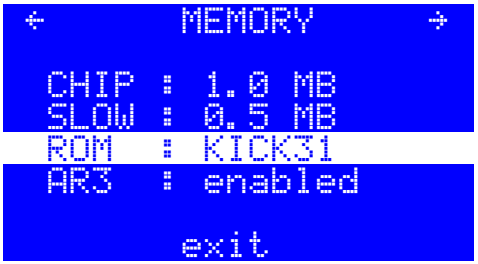
When the Action Replay ROM has been loaded, it takes 0.5 MB of RAM and the memory pool decreases to 1.0 MB on a stock Minimig.

This setting requires a reset to take effect.

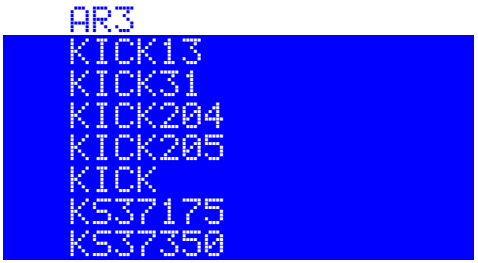
It is possible to configure settings that try to allocate more memory than is actually available in the Minimig. RAM is allocated according to specific priorities. After allocating ROM space for Kickstart and Action Replay (if enabled), the system allocates Chip RAM and finally Slow RAM.

ROM selection

This sub-menu allows you to select the Kickstart ROM file to load on boot.



After selecting the ROM menu item, a list of files having a ROM extension is displayed. The ROM files must be unencrypted and 256 KB or 512 KB in size. 256 KB images are internally mirrored by the boot loader to occupy a full 512 KB Kickstart space.



After selection of the chosen ROM file, the system will fall back to the boot loader screen and load the new ROM image. If the new ROM file works correctly you can save settings, so the next time the system is switched on the new ROM file is loaded automatically.

Kickstart images intended for 68020 and higher CPUs do not work. Loading an Action Replay ROM file as a Kickstart will have unpredictable results.

If the selected ROM file is not present on the SD/MMC card (e.g. if it has been deleted or a different card is inserted), the system attempts to load a default ROM file named ***KICK.ROM***.

AR3 module

This sub-menu allows you to disable or enable loading of the Action Replay III ROM[3].

If the AR3 module is enabled, the boot loader tries to locate a file **AR3.ROM** in the root folder of SD/MMC card. If present, it is loaded and 0.5 MB of RAM are allocated to the AR3 module.

This setting requires reconfiguration of the FPGA. It only comes into effect when the system is powered on or after resetting the PIC MCU.

To invoke the AR3 press [Ctrl] + [Break] simultaneously.

The Action Replay ROM may be temporarily prevented from loading by pressing down and holding the MENU button when the loading of its ROM file should take place (just after loading Kickstart image file).

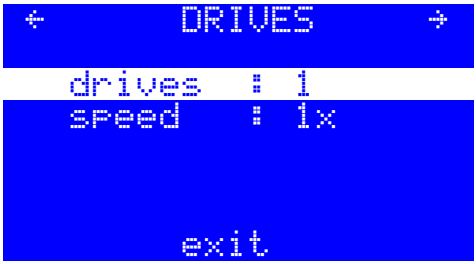
3 – Manual for Action Replay III can be downloaded from these sites:
http://amiga.resource.cx/exp/actionreplay
http://kgwhd.whdownload.com/files.php

Settings:Drives

This sub-menu allows you to change the number of active floppy drives and their transfer speed.

Drives

You can set the number of active virtual floppy drives to **1** or **2**.

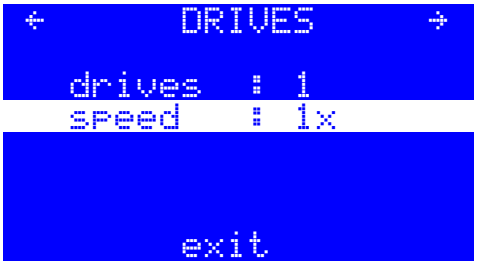


This setting requires a reset to take effect.

Every extra floppy drive requires system memory for its buffers and decreases the available memory for other programs. That's why disabling it may sometimes come in handy.

Speed

This feature increases the floppy drive transfer speed and shortens loading times. Extra data transfers take place during refresh DMA slots and do not affect other chipset timings.



This setting requires a reset to take effect.

Settings:Video

This sub-menu allows you to switch on and off the interpolation filters and scan-line effect.

These settings are only effective when the video output operates in VGA scan-doubled mode (**VIDEO** jumper on Minimig is set to **31KHz** position).

Filters

The Minimig's scan-doubler module is equipped with a special feature that allows it to increase the resolution of the output video signal.

The filters' interpolation mode can be set to **HOR** (horizontal), **VER** (vertical) or **H+V** (both). Filtering mode can be set individually for high and low resolution screens.

The filters operate differently in low and high resolution modes. It is possible to encounter custom screen modes that change line resolutions within a single frame. In such situations, the filtering module will automatically apply the appropriate filter according to each individual line's resolution.

When horizontal filtering is applied to a low resolution line, the horizontal resolution is doubled inside the filter, effectively turning it into a high resolution line. The colour value of every other output pixel is calculated as an arithmetic average of the colour values of the two source pixels (horizontal linear interpolation).

When applied to a high resolution scanline, every output pixel is changed to the calculated arithmetic average of the colour values of the two neighbouring source pixels. The image appears to be more blurry and edges more smooth (moving average filter).

For vertical filtering, the doubled scan line isn't a repetition of the previous source line (classic scan-doubling) but is an arithmetic average of corresponding pixels in two neighbouring source lines (vertical linear interpolation).

When combining vertical and horizontal filtering, the effect results in bi-linear image interpolation.

Filter settings are immediate.

Scanline

This effect emulates the display of old 15 kHz CRT displays for that extra feeling of nostalgia.

You can set scanlines to **off**, **dim** or **blk**. When selecting **dim** scanlines, each scan-doubled line is displayed at half brightness. When selecting **blk**, scan-doubled lines are blanked out.

Scanline settings are immediate.

Reset

This function is accessible directly from the main menu.

This option allows you to reset the Amiga side of the Minimig. It's an equivalent of pressing simultaneously the [Ctrl]+[Alt]+[Alt] key combination.

After selecting this option a new window is displayed where you have to confirm the requested operation. This is meant to prevent unintended resets.

Upgrading the PIC firmware

Before taking advantage of this new release you need to upgrade the PIC MCU firmware. Read through this section for a step by step guide.

This procedure only works for those Minimig boards whose PIC MCU is pre-installed with a Tiny PIC bootloader. All commercial Minimig boards sold recently should have this bootloader installed.

In situations where the Minimig's PIC MCU does not have a bootloader, alternative programming methods will be required.

Required Hardware

In addition to the Minimig, the following hardware is required to upgrade the PIC's firmware:

1. A PC running Windows
2. An available serial COM port. Both on board and USB to serial types are suitable.
3. A standard null-modem serial cable.

Preparatory Tasks

Before starting the firmware upgrade, some things have to be prepared beforehand.

Download the latest version of Tiny Bootloader from its official web-site[4] and extract the archive to a suitable folder. Version 1.9.8 was used here.

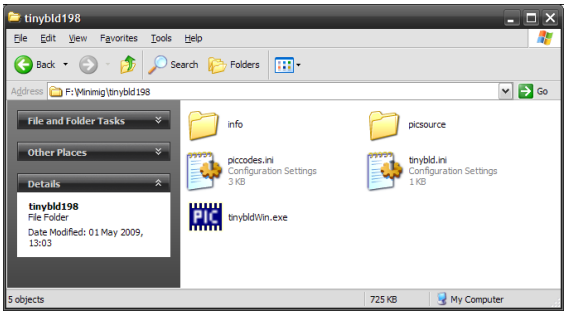
If using a USB to serial adaptor, install its drivers and ensure that it is recognized properly in Windows Device Manager.

With the board powered off, move the **SERIAL** jumper on the Minimig to the position labelled **MCU**. Connect the serial cable to the PC and the Minimig.

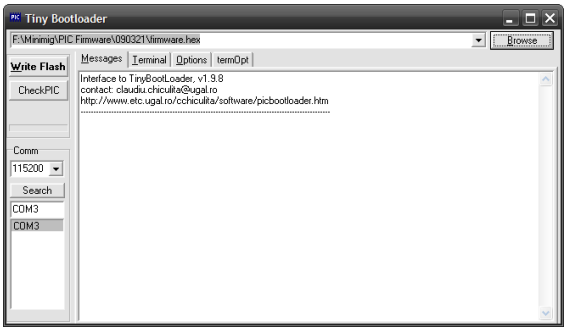
4 – Tiny PIC bootloader is available on this page:
http://www.etc.ugal.ro/cchiculita/software/tinyblddownload.htm

Upgrade Procedure

Having completed the preparatory tasks, navigate to the folder containing the Tiny Bootloader application as shown in the figure below.

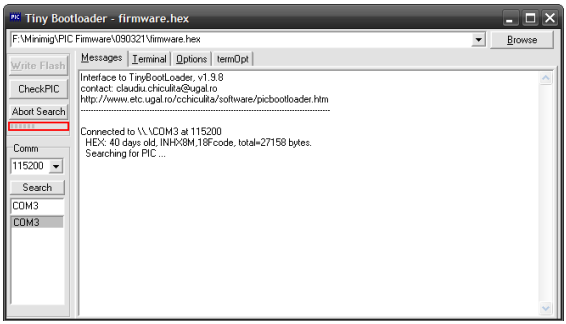


Double click the **tinybldWin.exe** application to execute. The application window below should be displayed.



Click on [Browse] and find the PIC firmware release that needs to be downloaded to the Minimig. This is usually named **firmware.hex**.

Power up the Minimig and let it boot fully. Click on the [Write Flash] button in Tiny Bootloader and, immediately afterwards, quickly press and release the **PGM RESET** button. There is a time window of a few seconds during which this operation must be performed. In order to help you in timing the press/release action, a progress bar is shown in the Tiny Bootloader window. The image below shows the progress bar highlighted in red.

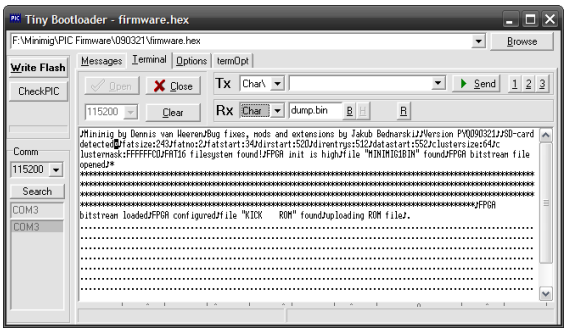


If the process is successful, the Tiny Bootloader application should report that a PIC was found. Downloading should commence and takes around 15 seconds.

When the download completes successfully, a **WRITE OK** message is displayed.

Power on/off the Minimig to enable the new firmware.

You may then exit the application. Alternatively click the Terminal tab, followed by the [Open] button, to view some extra information.



LED Flash Codes

The Drive LED on the Minimig acts as a status/error display during board initialization. This section explains the meaning of the various flashing patterns that occur during board start-up.

Before the FPGA is configured, the PIC MCU needs to mount the SD/MMC card and access its content. Sometimes errors are encountered during this initial stage, and the only easy way to communicate with the user is through the Drive LED.

Blinking is done in an infinite loop, and the PIC MCU will continuously go through the error blinking cycle. It will pause for approximately one second between each blinking cycle.

1 blink - No MMC/SD card detected
This error is due to an incompatible or an improperly inserted card.

2 blinks - MMC/SD card not formatted in FAT16 file-system
This is caused when the file-system on the card is not FAT16. The PIC MCU firmware does not support cards formatted in FAT12, FAT32 or NTFS.

3 blinks - FPGA error before configuration
This error occurs when the PIC MCU detects that the FPGA is not ready to accept configuration data (FPGA INIT pin is Low or DONE pin is High before configuration). This is most often due to soldering problems on DIY boards. It could possibly indicate a faulty FPGA or PIC MCU.

4 blinks - MINIMIG1.BIN file not found
The PIC MCU could not find **MINIMIG1.BIN** in the root folder of the SD/MMC card.

5 blinks - FPGA error after configuration
This error occurs when the PIC MCU finds that the FPGA does not acknowledge successful receipt of the configuration file. This error is most likely due to a corrupted **MINIMIG1.BIN** file. This could also be caused by soldering problems on the board or possibly a faulty FPGA or PIC MCU.

6 blinks： Kickstart file not found
This error happens when no Kickstart file is found. The firmware will first attempt to load the Kickstart file selected in the **Settings:Memory:ROM** menu. If this is not found, then it will attempt to load a file called **KICK.ROM** from the SD/MMC card root folder. If **KICK.ROM** is then not found, the PIC reports this error.

*You can get extra information about the Minimig's boot-up progress. The PIC MCU sends debug information through its serial port. Put the **SERIAL** jumper to position **MCU** and connect to a PC using a null-modem cable. Use HyperTerminal, Bray's Terminal or Tiny Bootloader's terminal mode to view the debug output. Set serial parameters to 115200 baud, 8-N-1, no handshake.*