Carnivore2 User Guide

English version

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Русская версия находится здесь: Инструкция по эксплуатации Carnivore2

About the project

Carnivore2 is the multi–functional cartridge for the MSX platform that was created in 2017 by RBSC. The project is still supported — new firmware for FPGA is being released, as well as the software — the tools for working with the cartridge, the Boot Menu (boot block), etc. The website of RBSC can be found here.

Carnivore2 features

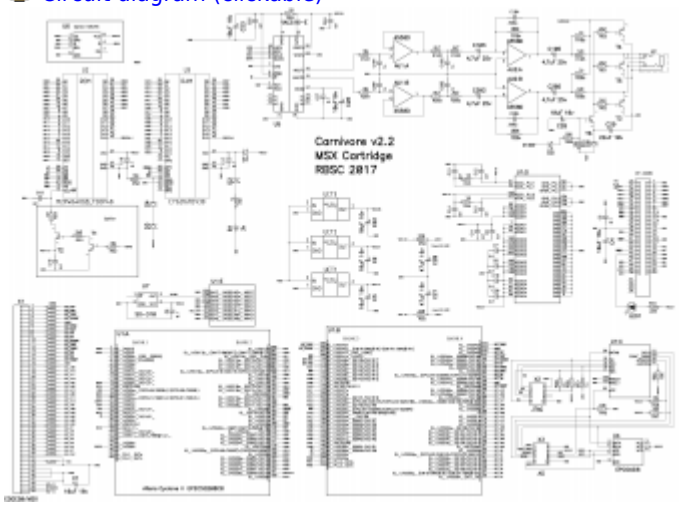
- External storage: CF card (CompactFlash)
  - Nextor is used as DOS (built-in support for FAT12/16, maximum partition size: 4 GB)
  - High read and write speeds

    - Supports SD and MicroSD card adapters
    - Nextor supports floppy disk emulation with DSK files
    - Utilities compatible with MSX-DOS versions 1 and 2
    - The cartridge can be configured as a RAM extension, IDE disk, FMPAC and SCC/SCC+ sound cards, or a combination of these devices
- RAM: 2048 Kb (2 Mb)
    - Includes:
        - 1024 Kb main RAM with mapper
        - 256 Kb for ROM shadowing
        - 720 Kb additional RAM with a mapper, similar to MegaRAM
        - 4 Kb (in the last 64 Kb–block) for the FMPAC SRAM (a backup battery is needed to save data after turning off the power)
- Flash memory (FlashROM): 8 Mb capacity, 64 Mb/s
    - The first 256 Kb are used for service information and ROM BIOSes
    - Mapper emulation:
        - Linear 64 Kb mode
        - ASCII8
        - ASCII16
        - Konami4
        - Konami5 (SCC/SCC+)
        - Custom mapper
- Sound
    - PPI and PSG emulation
    - Konami SCC and SCC+ emulation
    - OPLL emulation (YM2413, MSX – Music), BIOS IU translated to English
    - Volume setting for all emulated audio devices
    - PSG and PPI can be enabled and disabled in the user interface
- Additional features
    - Boot menu with a choice of games and configurations saved in flash memory
        - Sorting of directory records
        - Customizable user interface (colors, sorting, key repeat speed, fade effects)
        - Help system
        - Joystick and joypads support
        - 50/60Hz instant switching support
        - Selectable Turbo or R800 modes
        - Auto-Start of configuration entries and ROMs with a startup delay
        - Allows to run 2 ROMs at the same time in the Dual-Slot screen
        - Mono/stereo modes for FMPAC output
        - Allows to set the default startup frequency (50 or 60Hz)
    - The device is designed in the form factor of the standard MSX cartridge
    - It operates at the standard frequency of 3.58 MHz, as well as turbo frequencies up to 7.11 MHz
    - Implemented on FPGA (EP2C5Q208C8 Altera Cyclone II)
    - Special software is used to control all functions
        - Download programs in ROM format to flash memory and RAM
        - Backing up flash memory, configuration RAM settings, and FMPAC RAM contents
        - Program for testing the IDE interface, etc
    - Easy setup and user–friendly interface

Links to important Carnivore2 documents and websites

The below table contains the links to important Carnivore2 documentation and websites.

CF card and adapter compatibility reference	List of compatible cards and adapters
Detailed technical description of the cartridge	Internal blocks and data layout
Changelog	Version-based list of changes
Partslist	List of components and their nominals

Circuit diagram (clickable) 	Schematics
Link to official site	RBSC's website
Repository on GitHub	Source code, board files, documentation
Article on MSX Wiki	Official MSX Wiki article

List of authorized distributors

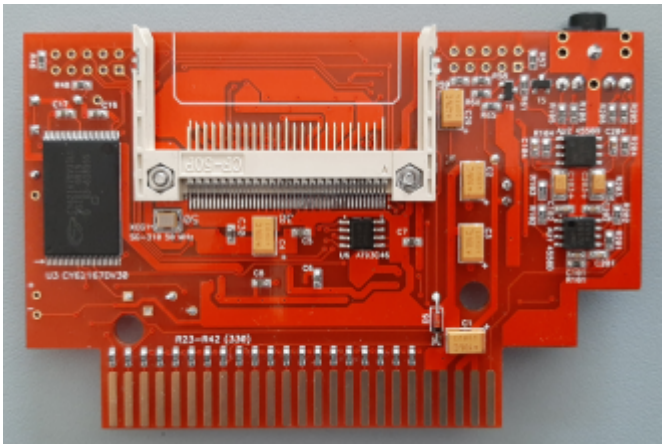
The below table contains the list of authorized Carnivore2 manufacturers and distributors.

Order from Maxiol (RBSC)	Official distributor in Russia
Purchase from 8bits4ever online store	Official distributor in Spain
Purchase from Retro Game Restore online store	Official distributor in Taiwan
Order from Carmeloco	Official distributor in Spain

Photos of the cartridge board

The board from a test batch, assembled by RBSC:

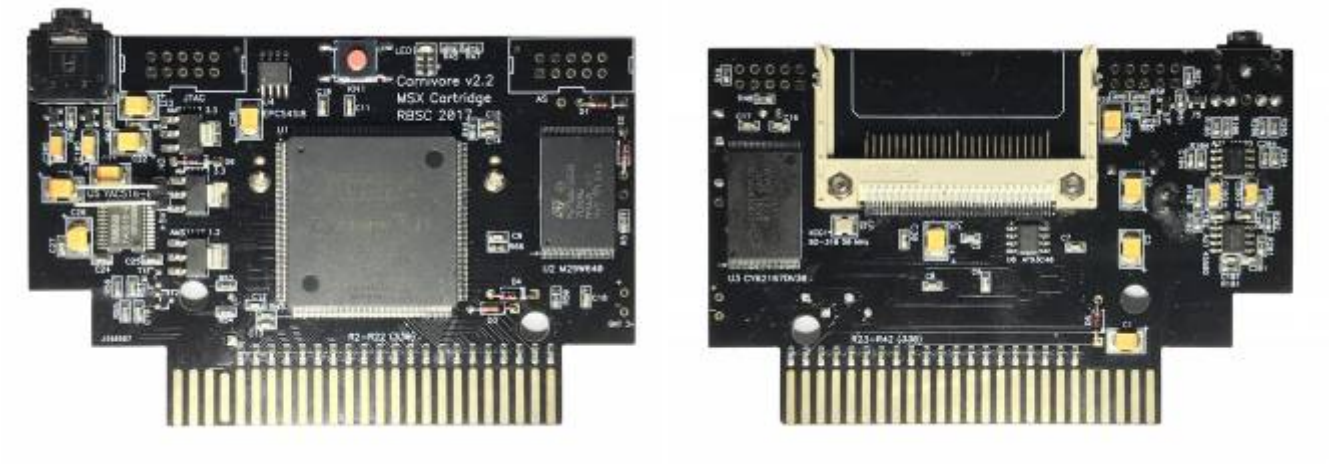
The board assembled by 8bits4ever (authorized manufacturer/seller, Spain):



The board assembled by Maxiol (authorized manufacturer/seller, Russia):

The board assembled by Carmeloco (authorized manufacturer/seller, Spain):

The board assembled by Retro Game Restore (authorized manufacturer/seller, China):



Note: on the board produced by Maxiol some tantalum capacitors were replaced with ceramic ones, also the audio socket was moved to the back of the board.

Important information

WARNING! To avoid damage to the Carnivore2 cartridge and your MSX computer hardware never insert or remove the cartridge when a computer is powered on! Always power off your computer before inserting or removing any cartridges!

If any of your CF cards or SD-to-CF adapters no longer work with Carnivore2, try to replace the IDE bios with an alternative version. To do this, rename BIDECMFC.ALT into BIDECMFC.BIN and write the IDE BIOS into Carnivore2 with the C2MAN or C2MAN40 utility.

CF card and adapter compatibility reference

The correct operation of the Carnivore2 cartridge is not guaranteed in the R800 mode on Panasonic Turbo-R computers. There may be various anomalies in this mode, for example the games that require a system restart as well as the configuration entries won't work correctly. So for such games and configuration changes it's not recommended to enable the R800 mode in the Boot Menu. Certain features of Carnivore2 may not work correctly on computers with less than 16kb of RAM (for example on Casio PV-7).

Carnivore2 is incompatible with Yamaha's network modules:

- network module KYBT (installed into Yamaha YIS-503IIR)
- network module KYBT2 — Yamaha Serial I/O Unit (CB55448) (installed in Yamaha YIS-503IIIR and Yamaha YIS-805-128R2)

If those modules are detected, Carnivore will show a warning message and halt a system to prevent conflicts. In this case you need to remove the network module from a computer and also remove the network ROM cartridge from the front slot of the YIS-503II MSX1.

Certain MSX computers activate the built–in software after power–on and this prevents Carnivore2's Boot Menu from being started. To bypass the built–in software it's usually enough to hold the defined key during a computer's startup. For example Panasonic A1 (as well as on A1 MK2), you need to hold the DEL key until the Boot Menu appears or MSX-DOS is loaded.

Certain games with the so–called “delayed start”, for example Metal Gear 2 and King's Valley 2, will not work on the Yamaha YIS-503IIIR because of incompatibility with the built–in CP/M. It is advised to removed the CP/M from the SubROM on these computers, by writing this file into the 27c256 chip and replacing the Subrom chip on the board. Alternatively you can use a different file with Subrom and `TESTRAM`. This file can be downloaded from here.

When a computer is just powered on with the Carnivore2 cartridge inserted into a slot, it may reboot twice. This is normal and was implemented to make sure that the cartridge is fully initialized after the cold boot. You can enable the dual–reboot feature in the Configuration settings.

The Boot Menu can detect that it is running on Korean or Arabic MSXs and in case it is not compatible with those systems, it will output a message and will try to boot to DOS after 10 seconds. In such a case a compatible Boot Menu (`BOOTCMFC.BIN`) should be installed into the cartridge (see the “Special” subfolder in the repository for the compatible version of the boot menu).

The Setup

If you purchased the already assembled and configured cartridge, you don't need to do the firmware and BIOS uploading.

After assembling, the cartridge needs to be programmed in order to function properly. The following steps are necessary:

1. Upload the Altera's firmware
2. Initialize the directory
3. Write the Boot Menu
4. Write the IDE BIOS
5. Write the FMPAC BIOS
6. Restart MSX

The below described features are supported in the Boot Menu and FPGA firmware starting from version 2.40; in the older versions, these features may be missing or have different functionality.

How to prepare the CF card

The CF card needs to be formatted in the `FDISK` program and needs Nextor's files to be copied onto it.

Partitioning of CF memory card must be done in Carnivore2 cartridge!

1. Insert CF memory card into the cartridge and start the computer
2. When the boot menu appears, press the Esc button to boot using the default configuration
3. The computer boots into the MSX-BASIC
4. Type `CALL FDISK` and press Enter ⏎ to run the partitioning program
5. Create one or more partitions using the `FDISK` interface
6. When finished, restart the computer
7. You need to write the Nextor system files so that you can boot into MSX-DOS2 from the card. To do this, copy the files from the archive or disk image that are available here and here (as disk image) into the root directory of the CF card
8. Example of copying files from a floppy disk to the main section of a CF memory card using a GoTek–based drive emulator:

```
copy "b:\*.*" to "a:\"
```

   - `a:` — mounted CF card's partition
   - `b:` — another drive (GoTek emulator, a physical 720kb drive, a disk of another IDE controller)

How to upload the firmware

Before uploading the firmware please make sure that the CF card is not inserted!

For updating/uploading of the firmware you will need:

1. Quartus II Web Edition (Free) 15.0 software
2. Byte Blaster or USB Blaster programmer (can be purchased on Ebay or AliExpress)

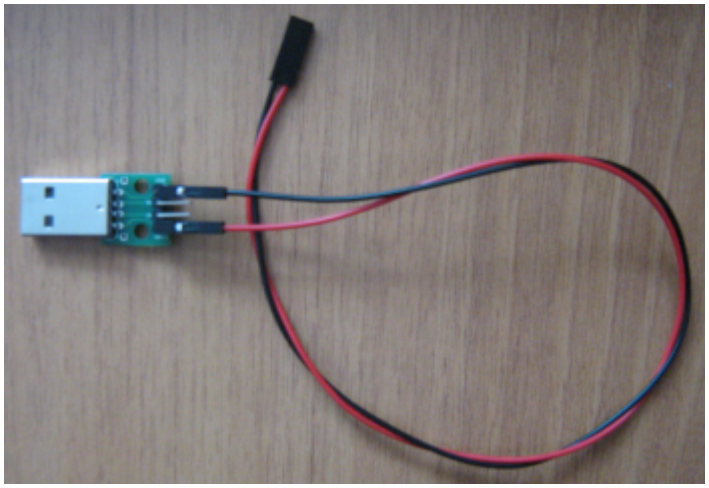
From the `Individual Files` tab please download and install the following software:

- `Quartus II Software (includes Nios II EDS)`
- `Cyclone IV device support`

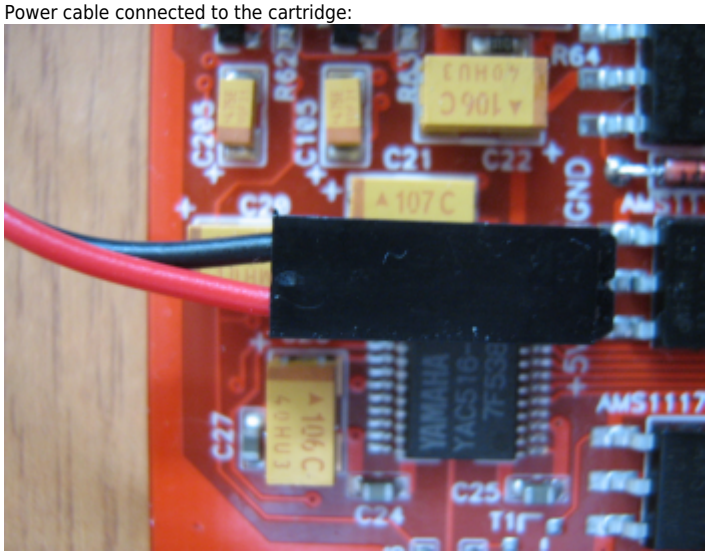
The following actions need to be performed:

1. Connect the USB Blaster programmer to the PC
2. Run the program `Quartus II Web Edition`
3. Select menu item `Tools/Programmer`
4. In the `Programmer` window:
   - Click Hardware setup
     - in the `Hardware setup → Hardware Settings → Currently selected hardware` choose your programmer device
     - Click Close
   - The device's name will be displayed to the right of the Hardware setup button and to the right of the `Mode` field, there you need to select `Active Serial Programming`
   - Click Add Device
     - in the `Select Devices` chose the `EPCS4` device
     - Click Ok
   - Right click on the device, chose `Change File` and select the desired firmware file with the `.pof` extension from your hard disk
   - Make sure to check these options:
     ✔ `Program/Configure`
     ✔ `Verify`
     ✔ `Blank-Check`
   - Supply 5 volts to the cartridge board (mind the polarity!)

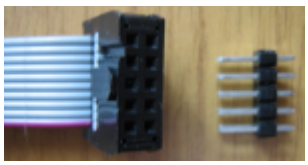
     A simple USB cable to power–up the cartridge:

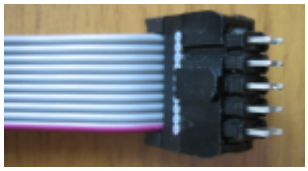


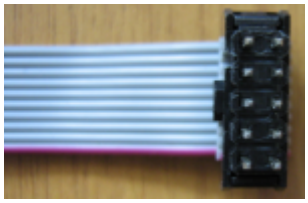
Power cable connected to the cartridge:



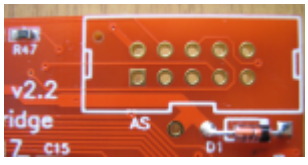
- Connect the programmer's cable to the cartridge's AS connector (make sure the cable is connected correctly!)
  To connect the programmer to the AS connector on the cartridge, you need a dual–row pin header (PLD 2 × 5, 2.54 mm) that must be inserted into the programmer cable's connector:

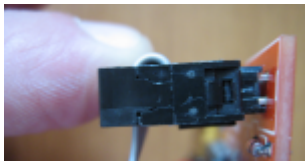


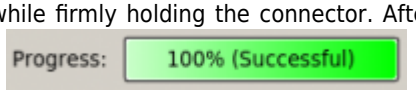




Then the programmer’s connector must be inserted into the AS connector of the cartridge and slightly tilted to ensure good contact between the pins and the board:



5. Click Start and follow the programming and verification process while firmly holding the connector. After successful completion of the firmware uploading you should get this message: 

6. When the operation is complete, disconnect the cables from the cartridge in the following order:
    - programmer cable from the AS connector
    - power cable

How to enable the cartridge and install BIOS ROMs

Please always use the latest version of the C2MAN and C2MAN40 utilities to write necessary software into the cartridge!

The freshly–assembled Carnivore2 cartridge will not boot to MSX-DOS2 without the specific software that needs to be loaded into the FlashROM chip from any disk drive.

Insert the cartridge into the MSX slot, preferably into the first slot. Power up MSX and check if it works well. If the computer doesn't work properly, remove and inspect the cartridge. To fully configure the cartridge the following actions need to be performed:

1. Make sure that all 3 BIN files (`BIDECMFC.BIN`, `BOOTCMFC.BIN`, `FMPCCMFC.BIN`) are in the same folder with the utilities
2. Run the `C2MAN.COM` or `C2MAN40.COM` (for MSX1 only) utility
3. When asked, enter the slot number where the cartridge is located (for example “10” for first slot, “20” for second slot, etc.)
4. From the main menu select “Open cartridge's Service Menu” using the 9 key
5. With the 7 key select “Fully erase FlashROM chip” and confirm twice; if you are only updating the cartridge, this step may be skipped
6. With the 3 key select “Init/Erase all directory entries” to initialize the directory
7. With the 4 key select “Write Boot Menu (BOOTCMFC.BIN)” to write the Boot Menu
8. With the 5 key select “Write IDE ROM BIOS (BIDECMFC.BIN)” to write Nextor IDE BIOS
9. With the 6 key select “Write FMPAC ROM BIOS (FMPCCMFC.BIN)” to write the English FMPAC BIOS
10. If there were no errors during the steps 5–9, then power down and start your MSX

There's also another way to write the Boot Menu and BIOSes into the FlashROM chip. This can be done on a diskless MSX computer by loading the necessary files via the cassette interface and copying them from the specially formatted CF card into the FlashROM chip. Please see the file. Be advised that after this operation you need to update the Boot Menu and BIOSes to the latest versions downloaded from the repository.

Usage instructions

The program that serves as the main interface of the Carnivore2 cartridge after a computer is powered on is called the Boot Menu. It can be also referenced as “Boot Block” or “bootblock”.

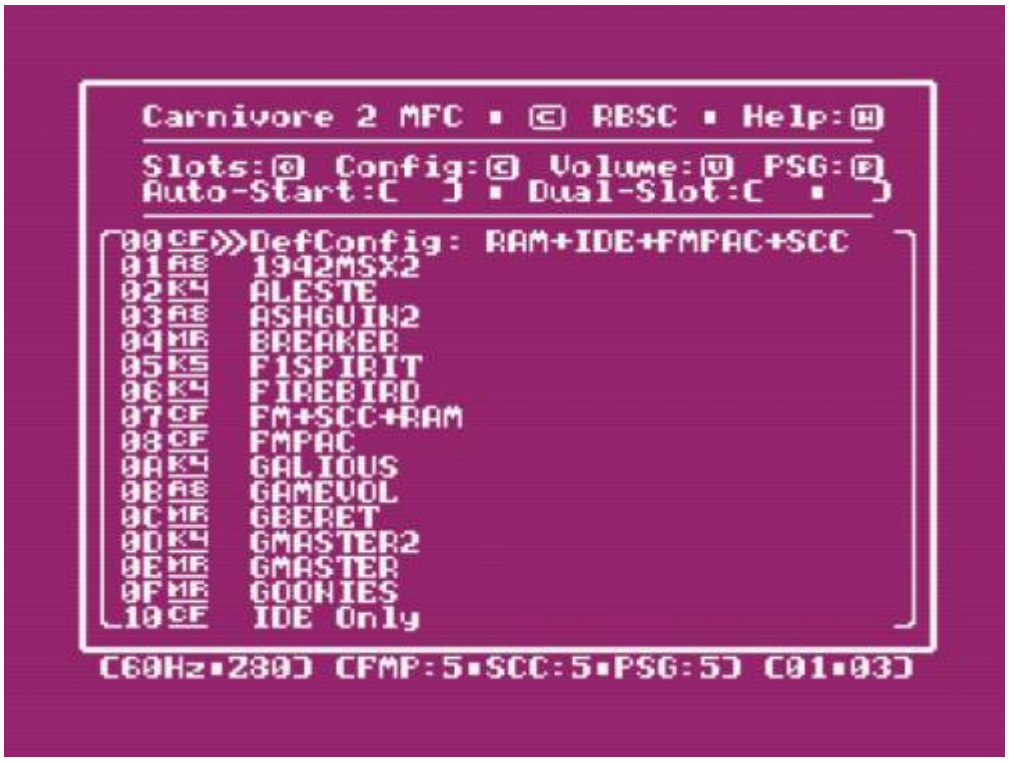
If the cartridge is inserted into slot 3, the system will be halted immediately. In this case please power down the system and insert the cartridge into another free slot..

If the Boot Menu version is incompatible with the MSX computer, the following warning message will be shown and the cartridge will try to boot into MSX-DOS2 within the next 10 seconds. In this case please write the special version of the Boot Menu into the cartridge (see the Special folder in the repository).

If there's a network module from KYBT or KYBT2 system (Yamaha–based computer classes that were distributed in USSR), the following warning message will be shown and the system will be halted. In this case please remove the network module from the computer.

How to work with Boot Menu

The Boot Menu allows to start the ROMs from the FlashROM chip and to restart the cartridge with the desired configuration. After a computer shows its boot logo, the cartridge's Boot Menu should appear and you should see the main menu with the list of directory entries.



Navigating the menu is very easy. Here are the key assignments:

Esc	boot MSX using the default configuration: all enabled
←, →	previous/next page
↑, ↓	select ROM/CFG entry

Space	start selected entry (single slot configuration)
G	start an entry directly
R	reset MSX and start an entry
Enter ⏎, O	Dual-Slot setup page
1	select entry for the master slot
2	select entry for the slave slot
A	select entry for autostart
D	clear Auto-Start & Dual-Slot settings
F	toggle 50Hz or 60Hz frequency
T	toggle Turbo or R800 mode
C	customize configuration
P	setup PSG and PPI Clicker
V	volume settings of FMPAC and SCC sound cards
H	help
L	jump to the last used directory entry
M	toggle background music playback
S	toggle help scroller

The main menu also supports the built–in joypads and external joysticks connected to any of the 2 joystick ports. The joystick's stick movements and pressing the buttons are interpreted as follows:

←, →	same as cursor keys
↑, ↓	same as cursor keys
A	start an entry (same as Space on keyboard)
B	exit from Boot Menu (same as Esc on keyboard)

All other joystick directions are ignored.

The following data is displayed on the status line of the screen:

- VDP Frequency
- CPU mode
- volume:
  - FMPAC
  - SCC
  - PSG
- Directory page numbers, in the following format: `CP•TP`
  - `CP` — current page
  - `TP` — total pages

Directory entry icons

The symbols that are displayed near the names of directory entries indicate the following:

K5	Konami5 (SCC) mapper
K4	Konami4 mapper
A8	ASCII8 mapper
A16	ASCII16 mapper
MR	mini ROM (8, 16, 32, 48 and 64kb ROM without mapper)
CF	configuration entry
UN	unknown mapper

–	for other mappers

On Arabic and Korean MSXs there will be the following indication (prior to Boot Menu v2.40):

K	Konami5 (SCC) mapper
k	Konami4 mapper
a	ASCII8 mapper
A	ASCII16 mapper
M	mini ROM (8, 16, 32, 48 and 64kb ROM without mapper)
C	configuration entry
U	unknown mapper

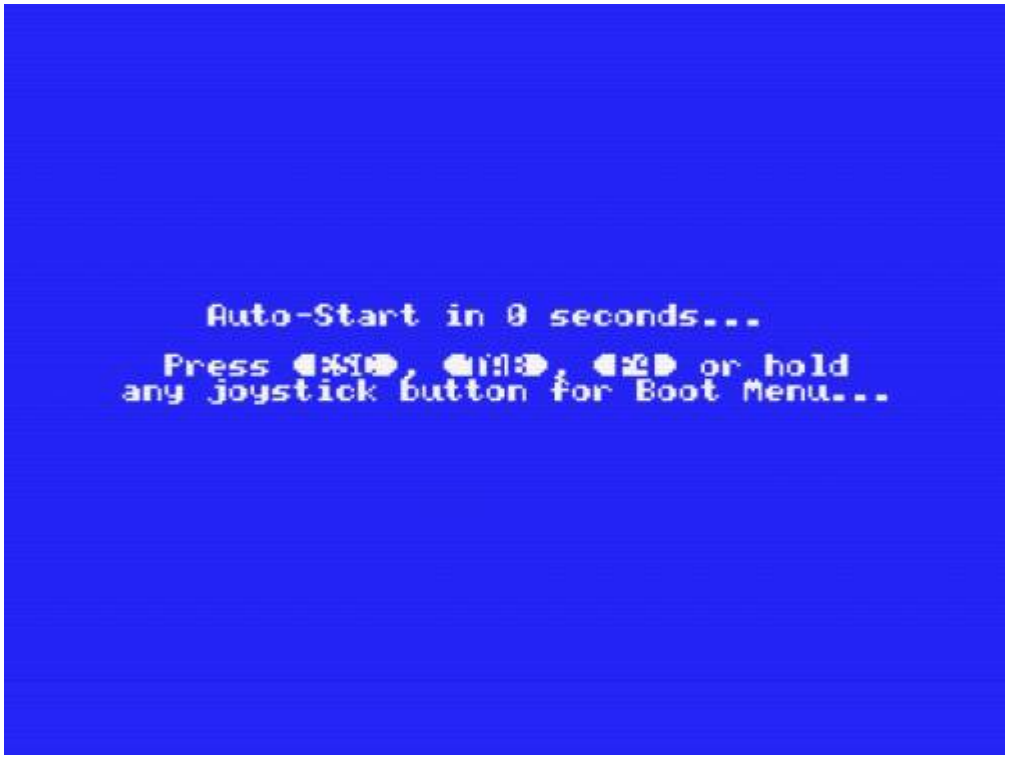
Please keep in mind that some ROMs may require alternative starting method, so if pressing Space doesn't start the ROM, try starting the ROM directly or after reboot.

Auto-Start

The Auto-Start option allows to start any configuration entry or ROM image when a computer is powered on. Starting from version 2.40 of the Boot Menu, the record number for the auto–start feature is saved into the configuration EEPROM, so this chip must be installed on the Carnivore2's board. The selection of an entry for auto–start is done with the A key from the main menu. To cancel auto–start for an entry, press the D key.

There are several keys that can affect the cartridge's functionality at boot level. Certain keys can cancel the auto–start, other keys can skip the Boot Menu:

F3	use default UI settings
F4	cancel auto–start
F5	skip Boot Menu



When auto–start is set for any entry, after reboot a message will be shown and there will be a 3 second delay before this entry is activated. During these 3 seconds a user can abort autostart with Esc, Tab, F4 keys. If any of these keys are pressed during the 3 seconds countdown, the autostart will be skipped and the main menu will be shown. Pressing Space will skip countdown and start the selected directory entry. During the boot sequence with autostart the following joystick button

actions are possible:

A	skip countdown and start selected entry
B	cancel autostart

Please hold a joystick's button for at least 1 second to cancel the autostart and go to the main menu or to start the selected directory entry. This works the same way when the message about the incompatible Boot Menu is shown.

VDP frequency

The F button only temporarily changes the VDP frequency to the desired value. Use the “Frequency at startup” setting in the Configuration screen to control what frequency you would like the computer to boot with and what frequency should be used to start ROM images. The frequency setting is saved into the configuration EEPROM and is restored even after the computer is powered on again.

CPU mode

The Turbo mode can be enabled with the T button only on Panasonic MSX2+ computers and R800 mode can be enabled only on Panasonic Turbo-R computers with the same button. On other computers this functionality does not work. The status of the Turbo or R800 mode is not saved into the configuration EEPROM and it is not restored at the start of the Boot Menu after the power was switched off and back on. However the Turbo/R800 mode is still set for ROMs that require a reset to start.

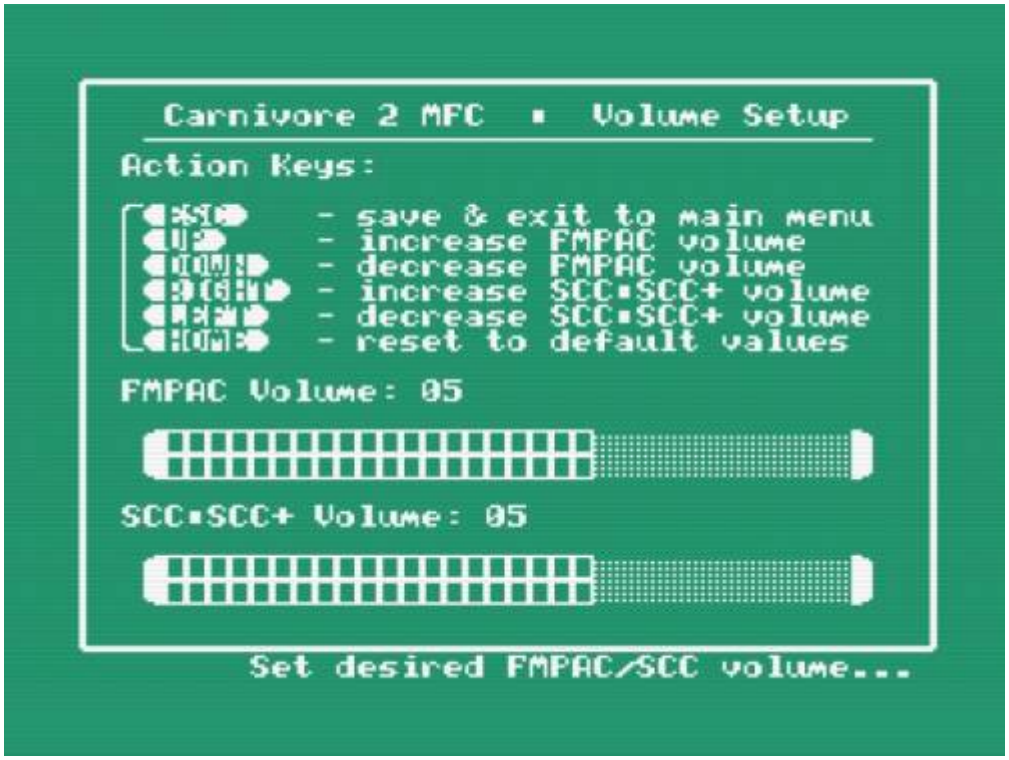
The current mode is displayed in the status screen:

Z80	Z80 mode (default)
T2+	Turbo mode for Panasonic MSX2+
R8x	R8x — R800 mode for Panasonic Turbo-R

Sound settings

The Boot Menu supports setting the volume for FMPAC and SCC sound cards. Use the V key to enter the volume control screen from the main menu. The following keys can be used in this screen:

Changing the volume for FMPAC and SCC sound cards:



Esc	save & exit to main menu
↑	increase FMPAC volume
↓	decrease FMPAC volume
→	increase SCC/SCC+ volume
←	decrease SCC/SCC+ volume
Home	reset to default values

The volume's value is stored within the small EEPROM on the cartridge board. The value is saved when Esc key is used to return to the main menu. If the small EEPROM is not present, then the volume setting is only preserved until the power–off. So setting the volume once allows to play games and listening to the music until the computer is completely switched off.

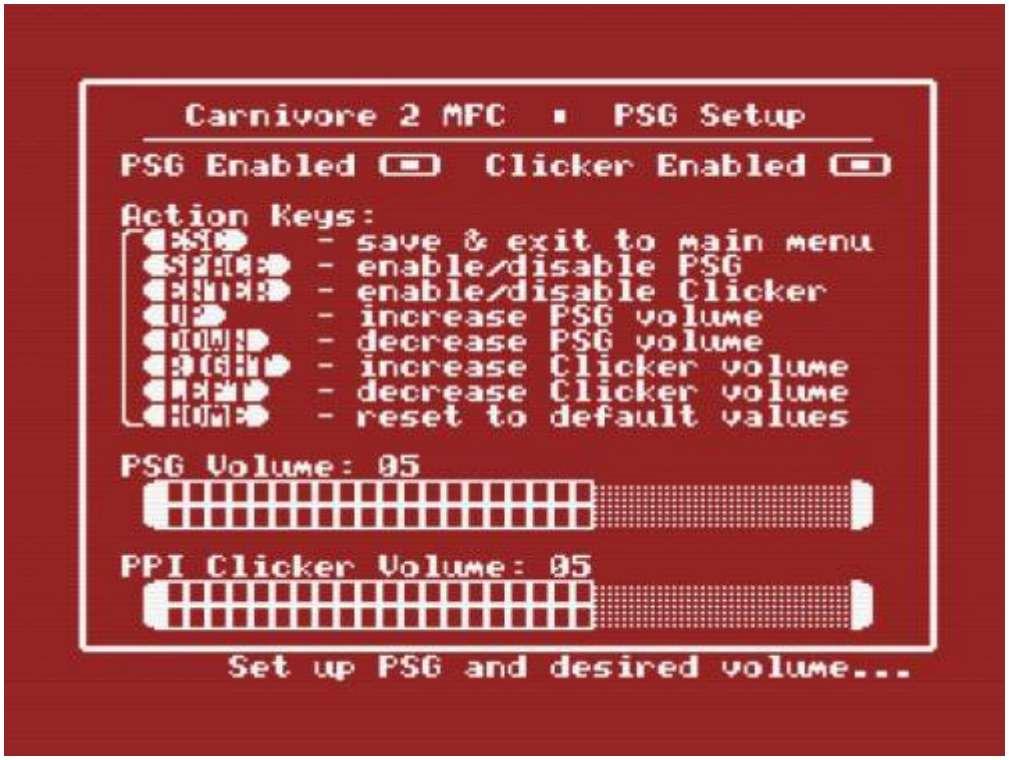
This screen also supports joystick. The joystick's movements and buttons are interpreted as follows:

←, →	increase/decrease SCC/SCC+ volume
↑, ↓	increase/decrease FMPAC volume
A, B	apply changes and exit (same as Esc on keyboard)

It is also possible to disable the default FMPAC stereo mode using the setting in the Configuration screen. This will enable the mono mode for FMPAC's sound output through the Carnivore2's audio socket.

PSG/PPI clicker settings

The Boot Menu also supports enabling or disabling the internal PSG and PPI's Clicker emulation as well as setting the volumes for both of them. Use the 'P' key to enter the PSG control screen from the main menu. The following keys can be used in this screen:



Esc	save & exit to main menu
Space	enable/disable PSG
Enter⏎	enable/disable PPI Clicker
↑	increase PSG volume
↓	decrease PSG volume
→	increase Clicker volume
←	decrease Clicker volume
Home	reset to default values

The volume's value is stored within the small EEPROM on the cartridge board. The value is saved when Esc key is used to return to the main menu. If the small EEPROM is not present, then the volume setting is only preserved until the power–off. So setting the volume once allows to play games and listening to the music until the computer is completely switched off.

This screen also supports joystick. The joystick's stick movements and buttons are interpreted as follows:

←, →	increase/decrease PPI Clicker volume
↑, ↓	increase/decrease PSG volume
A	enable or disable PSG (same as Space on keyboard)
B	apply changes and exit (same as Esc on keyboard)

Configuration screen

Starting from version 2.10 the Boot Menu can be customized and the custom settings will be stored in the configuration EEPROM.

To customize the configuration please use the C key from the main menu. Beside the cursor keys, the following keys can be used in configuration screen:

Esc	save & exit to main menu
Space	change selected value
Home	reset to default values

A user can customize various configuration settings including directory sorting, fade in/out effects, keyboard/joystick delay as well as the colors (font and background) for the main menu, help screen, volume control screen and PSG setup screen. In addition, a user can enable or disable the dual–reboot, disable stereo output for FMPAC and select what frequency to use at startup (50Hz, 60Hz or default VDP's frequency).

Pressing Home at any time will restore all customized values to default settings. Holding F3 key at the Boot Menu's startup allows to use the default settings for the UI — all custom settings will be ignored for the current session.

Please note that editing of the palette on MSX computers with v991x or v992x video processors will be disabled. Also if the directory sorting is enabled or disabled, the current auto–start entry as well as the master/slave slot assignments are cleared to prevent a mix–up.

The directory sorting is a complex operation, so if there are many entries in the Boot Menu's directory, then it may take a few seconds to completely sort all of them. The sorting only happens at the Boot Menu's startup and when the sorting gets enabled in the configuration screen. If the delay is too uncomfortable for you, please disable the directory sorting option.

This screen also supports joystick. The joystick's stick movements and buttons are interpreted as follows:

A	toggle setting (same as Space on keyboard)
B	apply changes and exit (same as Esc on keyboard)

How to run 2 ROMs at the same time

Starting from Boot Menu's version 2.30 and the Altera's firmware version 2.30 it is possible to run 2 ROMs at the same time. This functionality is called “Dual-Slot”. The dual–slot setup screen can be called with the O key or by pressing Enter ⏎ in the main menu.

The new setup screen allows to run dual–slot configuration with flexible options selection for the master slot (you can choose what Carnivore2 built–in devices to enable). You can select 2 ROMs to run simultaneously. The only restriction for the slave slot is that it can run games with `Konami4` and `Konami5` mappers as well as small games up to 32kb without mapper. The slave slot becomes available if there's one unused physical slot found in a computer and this slot is not occupied by another device. If there are no available slots in a system, then you can use one of the master slot's subslots to emulate the slave slot (staring from Boot Menu v2.40).

The Boot Menu identifies whether there's a suitable free slot in the MSX and then shows this slot as “slave” in the settings. The working slots will have their numbers shown on the left side. If only one slot was identified as usable, running 2 ROMs at the same time will be possible only after enabling the “Slave Slot as Master's Subslot” option. This option is enabled automatically if no free slots are found in a system.

In order for the slave slot to work as a subslot of the master slot, the master slot must be expanded. If using the subslot of a master slot is enabled in the settings, the master slot automatically becomes expanded. If the master slot's expansion gets

disabled by a user, then the “Slave Slot as Master's Subslot” option will be disabled too.

After enabling the “Slave Slot as Master's Subslot” option, you need to select what subslot of the main slot should be used to emulate the slave slot. This can be done by putting the cursor onto one of the Carnivore2's devices — RAM, IDE or FMPAC and pressing Space. The name of the device will change to “Slave Slot” and the number of the slave slot will change to N1.N2 where N1 is the number of the master slot and N2 is the number of the emulated subslot.

Be aware, that some cartridge, for example SCC, MegaRAM and other ones that do not modify the slot's area in any way will not be detected by the Boot Menu, so the slave slot will be available even if it should not be. If Carnivore2 configures the slave slot as the same slot that is occupied by another device, this may cause conflicts and potentially damage your MSX. So please make sure that you do have enough free slots before enabling the dual–slot configuration. If you are not sure that you have a free physical slot to be used as the emulated slot, it is advised to enable the “Slave Slot as Master's Subslot” option and use one of the master slot's subslots to emulate the slave slot.

Beside the cursor keys, the following keys are usable in the Dual-Slot setup screen:

Esc	exit to the main menu
Space	change or toggle setting, select ROM or SCC+ mode, enable or disable device, assign subslot for slave emulation
Enter ⏎	apply changes and restart

The ROMs for the dual–slot configuration can be selected from the main menu. The entry for the master slot can be selected by pressing 1, the entry for the slave slot can be selected by pressing 2. The D key clears the selection as well as the Auto-Start entry. The selection will be visible in the “Dual-Slot” area above the list of ROMs, to the right from the “Auto-Start”.

Also the ROMs can be selected with the Space key in the Dual-Slot screen. Pressing space bar will allow to cycle through the compatible ROMs for each slot. After the full cycle there will be an “Empty” selection to keep the slot vacant.

The “Expand” option for each slot allows to expand this slot individually. The expanded master slot allows to use all built–in Carnivore2 devices as well as to emulate the slave slot as one of the master's subslots. The slave slot can be expanded as well, but **we recommend to keep the slave slot always non–expanded to avoid conflicts with other hardware.**

In addition, the master slot can also use the “Konami SCC+” configuration. So you can run SCC+ games in the slave slot and enjoy SCC+ and a game on a single cartridge. It is recommended to use SCC+ mode only with certain games that support it. It should be kept in mind that “Konami SCC+” selection makes it impossible to use the built–in Carnivore2 devices — RAM, IDE and FMPAC as well as to use the master slot's subslot to emulate the slave slot. So to run the SCC+ configuration with a ROM image, the ROM image must be selected at the slave slot and the slave slot must be standalone.

This screen also supports joystick. The joystick's stick movements and buttons are interpreted as follows:

↑, ↓	same as cursor keys
←, →	apply selected configuration and restart
A	change or toggle setting, select ROM or SCC+ mode, enable or disable device, assign subslot for slave emulation (same as Space on keyboard)
B	exit to the main menu (same as Esc on keyboard)

Help screens

The two help screens provide a complete list of keys and their assignments as well as information on the joystick's stick and key assignments. By pressing any key you go to the next screen and on the last help screen pressing any key will return you to the main menu.

Also the help scroller can be enabled in the main menu by pressing the S button.

Notes for SCC+ mode

The Carnivore2 cartridge supports both SCC and SCC+ modes. Certain games started from the cartridge's IDE device may not like the SCC+ being in the expanded slot, so there will be no sound. In this case such games can be started from a different IDE device and the Carnivore2 cartridge can be configured as the SCC+ sound cartridge. To do this a new configuration entry must be created. It's necessary to start the `C2MAN` or `C2MAN40` utility, enter the directory editing mode and do the following:

1. Edit the first configuration entry “DefConfig: RAM+IDE+FMPAC+SCC”
2. Rename it to “Config: SCC+ Cartridge”
3. Select “Save/load register preset” and then choose “Load register preset file”
4. Load the provided `SCCPLUS.RCP` file by typing `SCCPLUS` and pressing Enter ⏎ key
5. Save the configuration entry and exit the utility

Put the Carnivore2 cartridge that you want to use as the SCC+ device into the first MSX slot and the device to load games from into the second slot. Start your MSX and when the Carnivore2's cartridge menu appears, select the newly created “Config: SCC+ Cartridge” entry.

The computer will reboot and start loading a game or an operating system from the device in the second MSX slot. If the device in the second slot is configured to load a game that uses SCC+ (for example Snatcher), it will use the Carnivore2 cartridge working as SCC+ device for the output.

This functionality has been verified to be working with “Snatcher” and “Konami Game Collection” volumes 1–4 and also with the special game volume.

Alternatively, the SCC+ mode could be enabled in the Dual-Slot configuration screen. This allows to enable the SCC+ mode and run a ROM file in the slave slot (dual–slot configuration) at the same time. It is also possible to set the SCC+ configuration for the master slot. A computer will need to boot from another device because Carnivore2's IDE device will not be enabled. This way you can run disk games with SCC+ mode of Carnivore2. Please see the “How to run 2 ROMs at the same time” section for more info.

Utilities

Utilities in repository on GitHub

C2MAN

If you find it difficult to add ROM images into Carnivore2 using the C2MAN and C2MAN40 command line utilities, please switch to using SofaRun. This software has native support for Carnivore2 and is very user-friendly. The software can be downloaded from here:

https://www.louthrax.net/mgr/sofarun.html

The C2MAN utility allows to initialize the cartridge, add ROMs into the FlashROM, create custom configuration entries, edit the cartridge's directory. The Service Menu allows to see the FlashROM block usage, erase and optimize the directory, upload the Boot Menu as well as IDE and FMPAC BIOSes into the FlashROM; it also allows to completely erase the FlashROM chip.

The `C2MAN` utility works only on MSX2 and later computers, it sets the 80 character mode by default. On MSX1 computers this utility shows an incompatibility note and exits.

For MSX1 computers the `C2MAN40` utility must be used. This utility, however, will also work on MSX2 and later computers in 80 character mode, but all messages will be truncated for the 40 character mode.

Both utilities will automatically reboot a computer after uploading a ROM into the FlashROM chip if the /a and `/r` command line options are used.

The utility supports the following command line options:

```
C2MAN [filename.rom] [/h] [/v] [/a] [/r] [/su]
```

`/h` — help screen
`/v` — verbose mode (show detailed information)
`/a` — automatically detect and write ROM image (no user interaction needed)
`/r` — automatically restart MSX after flashing ROM image
`/su` — enable Super User mode (allows editing all registers and overriding IDE BIOS write lock when BIOS shadowing is off)

The utility is normally able to find the inserted cartridge by itself. If the utility can't find the cartridge, you will need to input the slot number manually and press Enter ⏎. The slot number is “10” for first slot, “20” for second slot, and so on.

Main menu

List of menu options:

```
Main Menu
---------
 1 - Write ROM image into FlashROM
 2 - Create new configuration entry
 3 - Browse/edit cartridge's directory
 4 - Restart the computer
 9 - Open cartridge's Service Menu
 0 - Exit to MSX-DOS [ESC]
```

The main menu allows to:

1	write new ROM image into FlashROM
2	create new configuration entry
3	browse/edit cartridge's directory
4	restart a computer
9	open cartridge's service menu
Esc	exit to MSX-DOS

The menu options should be selected with the corresponding numeric buttons.

Adding a ROM file into the FlashROM

To add a new ROM file into the FlashROM chip, select the “Write new ROM image into FlashROM” option. Follow the on–screen instructions until the ROM is successfully written into the chip and the main menu re–appears. The large ROMs' mappers should be normally detected automatically by the utility, but on some ROMs autodetecting may fail. In this case the utility will ask you to choose the mapper. The ROM will not start with incorrect mapper settings, so if your setting didn't work, try to change the mapper type.

The FlashROM chip contains 128 blocks by 64kb (8mb in total). The first 4 blocks are occupied by the Boot Menu, directory, IDE BIOS and FMPAC BIOS. Other blocks are available for a user to add the ROMs. The ROMs that are smaller than 64kb are grouped into one block. For example two 32kb ROMs will be written into the same 64kb block, eight 8kb ROMs will be grouped into the same 64kb block and finally four 16kb ROMs will be grouped written into the same 64kb block. All this is done automatically.

You can add a ROM into the chip without user interaction. The following command line should be used:

```
C2MAN file.rom /a
```

The utility will try to automatically detect the ROM's mapper, check whether any free space is available and then it will write the selected ROM into the FlashROM chip. If you add the `/v` option, the utility will show additional information about the chip and the ROM that is being added as well as the map of the free chip's blocks.

The map of FlashROM chip blocks can be viewed from the “Service Menu”. Just select the “Show FlashROM chip's block usage” option.

Adding a custom configuration entry

To add a new configuration entry select the “Create new configuration entry” option. You will be asked to enter the name of the entry and then you will need to answer 5 questions:

```
Enable extended slot? (y/n)
Enable RAM and Mapper? (y/n)
Enable FMPAC? (y/n)
Enable IDE controller? (y/n)
Enable SCC and MultiMapper? (y/n)
```

The utility will ask:

- whether the slot should be expanded or not (if you want to enable more that one internal device, the slot must be expanded),
- whether to enable one or more of the 4 built–in devices:
    - RAM + mapper,
    - FMPAC,
    - IDE controller
    - MultiMapper + SCC.

You can select any combination you want. The cartridge can work as pure SCC or FMPAC sound cartridge, as a 1MB RAM expander or as a disk drive. Or as a combination of those devices.

The configuration entries will have the “C” symbol close to their names. Once the configuration entry is selected, the MSX will restart to take the new configuration into effect.

The configuration entries don't occupy any space in the FlashROM chip, so they can be created as long as there's free space in the cartridge's directory.

Editing or deleting directory entries

To edit the cartridge's directory select the “Browse/edit cartridge's directory” option. This will open the screen with the list of directory entries, 10 per page. The key assignment is similar to the Boot Menu with the exception that you can't start the entry.

An entry can be edited or deleted. Follow the on–screen instructions for editing a directory entry. Please keep in mind that the very first entry called “DefConfig: RAM+IDE+FMPAC+SCC” can't be deleted.

In the directory editor you can change almost all fields of an entry, select a different mapper, enable or disable the internal devices or expanded slot (some games don't like being in the expanded slot). The editor has the context based help that is displayed at the bottom of the screen.

With the Super User mode you can edit any register you want, but be advised, that you may damage the directory beyond repair and you will need to initialize it to continue using the cartridge.

When you finish editing, you need to save the entry. The utility will offer you to replace the older entry or to create a copy of the edited entry. The new entry will be located in the end of the list. The name of the entry will be the same if you didn't rename it while editing.

The number of directory entries is limited to 254. If the utility can't find an empty directory entry, it will ask you whether the directory should be optimized. If you select “Yes”, then there's a big chance that unused directory entries will be found and deleted and you will have the possibility to add new ones.

Loading and saving RCP files

The RCP stands for “Register Configuration Preset”. It is a small data file with the settings for certain non–standard games or

configurations.

When a ROM file doesn't start properly after being detected by the `C2MAN` utility, there may be a need to adjust its configuration. This can be done either manually — by editing the configuration registers or by loading an RCP (Register Configuration Preset) file. We are providing a few RCP files for the ROM files that are not working correctly with default configuration.

To load the RCP file manually you need to run the `C2MAN` utility, enter the directory editor and start editing the selected ROM entry. When editing, select the “Save/load register preset” option and then use “Load register preset file”. When asked, enter the preset's file name and it will be loaded for the entry you are editing. Just save the entry with the new settings and your ROM will start working correctly.

When you are making your own configuration settings for a selected ROM file, you can always save them into RCP file. You need to select the “Save/load register preset” option and then use “Save register preset file”. When asked, entry the name of the RCP file and it will be saved for future use.

The latest versions of `C2MAN`, `C2MAN40` and `C2RAMLDR` utilities try to automatically find the matching RCP file when a ROM is being loaded. For example if a user writes the `TEST.ROM` file into the cartridge, the utilities will try to locate the `TEST.RCP` file and ask a user whether he/she wants to load and use the data from that RCP file. When a ROM file is loaded with the `/a` command line option, the data from the matching RCP file is automatically applied.

Service menu

To enter the cartridge service menu, press 9 in Main menu.

List of menu options:

```
Service Menu
------------
 1 - Show FlashROM's block usage
 2 - Optimize directory entries
 3 - Init/Erase all directory entries
 4 - Write Boot Menu (BOOTCMFC.BIN)
 5 - Write IDE ROM BIOS (BIDECMFC.BIN)
 6 - Write FMPAC ROM BIOS (fmpcmfc.bin)
 7 - Fully erase FlashROM chip
 0 - Return to main menu [ESC]
```

The following options are available here:

1	show FlashROM's block usage
2	optimize directory entries
3	init/erase all directory entries
4	write Boot Menu
5	write Nextor IDE BIOS
6	write FMPAC BIOS
7	fully erase FlashROM chip
0, Esc	return to main menu

Show FlashROM's block usage

```
Map of FlashROM chip's 64kb blocks (FF = reserved, 00 = empty):

     00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F
     -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
00 | FF FF FF FF FF 00 00 00 00 00 00 00 00 00 00 00
10 | 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
20 | 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
```

```
30 | 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
40 | 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
50 | 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
60 | 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
70 | 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

Press any key to continue
```

Optimize directory entries

Optimization of directory entries updates the default configuration entry “DefConfig: RAM+IDE+FMPAC+SCC” so that the cartridge could be detected by the utilities. This also removes the gaps between the entries. This operation should be performed, for example, after deleting a few directory entries.

Init/Erase all directory entries

The service menu option “Init/Erase all directory entries” allows you to delete all directory entries. In this case, the correct DefConfig record is automatically created, which is necessary for the correct detection of the cartridge by utilities.

Write Boot Menu

This service menu option updates the Boot Menu program. Without this program, the cartridge will work as the IDE controller and RAM module, FM Basic will also be available. With the missing Boot Menu, it will be impossible to start ROMs as well as configuration entries. The Boot Menu is one of the most important programs for Carnivore2. To write the Boot Menu, you need the `BOOTCMFC.BIN` file

The latest version is available here.

Write Nextor IDE BIOS

This service menu option writes the ROM of the disk controller into the cartridge. Disk drive functionality will not be available without this component. Updating Nextor IDE BIOS requires the `BIDECMFC.BIN` file.

The latest version is available here.

Write FMPAC BIOS

This option of the service menu writes the FMPAC BIOS into the cartridge so that the FMPAC sound card is properly detected by different programs and that the FM Basic could become available. To update the FMPAC BIOS you need the `FMPCCMFC.BIN` file

The latest version is available here.

Fully erase FlashROM chip

This option allows the contents of the FlashROM chip to be completely erased! After this operation, the cartridge will be unusable until the Boot Menu and at least the IDE BIOS are written into it and until the directory is initialized. This will be possible only after booting into MSX-DOS from another cartridge, for example, from the Sunrise IDE controller (Maxiol or similar) or from a floppy drive or Gotek emulator. If you cannot start MSX-DOS from another device, do not erase the FlashROM!

C2RAMLDR

`C2RAMLDR.COM` — the utility to load ROMs into the cartridge's RAM.

It is possible to use the cartridge as a MegaRAM — for loading ROM images into the cartridge's own RAM and starting them after reboot. The `C2RAMLDR.COM` utility allows to copy ROM images up to 1mb into the cartridge's RAM and it also creates a directory entry for the copied ROM with the “RAM:” prefix before the name.

This utility is similar to `C2MAN.COM` utility — it has a menu that allows user to select copying the ROM image into RAM with or without protection. If the ROM is copied without protection, it will be able to write into its own address space. Some games that have copy–protection will corrupt their data and won't work. So it's always recommended to apply protection for the copied ROM image in RAM. The utility can be also used from the command line to automatically load the ROM image into RAM without any user interaction.

The utility has a feature to restart a computer after loading a ROM image into the cartridge's RAM. This can be either done from the utility's main menu or by specifying the `/r` command line option together with the `/a` option.

Please note that the ROM's image exists in the cartridge's RAM only until the next power–off unless there's a battery installed onto the cartridge's board to always preserve the RAM's data. Don't power–off your MSX if you want to keep the ROM in the cartridge's RAM. The “RAM:” entries are also selecatable in the Dual-Slot setup screen. They will work only while the power is on.

The old directory entries with “RAM:” prefix, created by the `C2RAMLDR.COM` utility can be deleted by the `C2MAN.COM` utility. After power–off these entries become useless anyway.

C2SRAM

`C2SRAM.COM` — the utility for managing the FMPAC's SRAM data.

The FMPAC's 8kb SRAM is emulated by the cartridge at the Shadow RAM's address 0FE000h. This area is not affected by the 1mb of primary RAM in any way. This area is used by certain games to save the data. If the Carnivore2 cartridge doesn't have a backup RAM battery installed, then the data that was saved into that area will be lost when an MSX computer is switched off. As this data survives the reset, it's possible to save it to a file and load it back into RAM when needed. The utility that allows to save/load this data is called `C2SRAM.COM`. The files with the save data will have `.SRM` extension by default and these files will be found by the utility when a user selects files manually. However the file can be saved with any name and extension. In such a case when a user wants to upload the file into the emulated SRAM area, he will have to type its name manually.

To save the data it's enough to reset MSX (no power–off!), run the “C2SRAM.COM” utility and save the data to a file. Then a computer can be switched off. In case a user wants to restore the data and then run a game, the `C2SRAM.COM` utility should be used to upload the previously saved file into SRAM area. Then a computer should be reset and a game can be then started from the Boot Menu or from an emulated DSK image.

C2BACKUP

`C2BACKUP.COM` — the utility to backup and restore the contents of the FlashROM chip.

The `C2BACKUP.COM` utility allows to dump the contents of the entire FlashROM chip into a file. The size of the file is 8 megabytes, the time required for the operation is about 10 minutes. The utility also allows to copy the contents of the FlashROM's dump back into the chip. Because of the BIOS shadowing this operation can be performed live, however the system must be restarted as soon as possible after uploading the new contents into the FlashROM chip.

The utility also allows you to copy the contents of the FlashROM image back to the chip. After filling the FlashROM image into the chip, you need to restart your computer. It is possible that after restoring data from a backup you will need to update:

- IDE BIOS
- FMPAC BIOS

List of menu options:

```
Main Menu
---------
```

```
1 - Download FlashROM's contents to a file
2 - Upload file's contents into FlashROM
3 - Restart the computer
0 - Exit to MSX-DOS
```

The following features are available here:

1	save folder contents from FlashROM to a file
2	restore directory contents from a file to FlashROM
3	restart the computer
0, Esc	exit to MSX-DOS

The utility asks a user whether he would like to preserve the existing Boot Menu on the cartridge and in case of a positive answer it doesn't overwrite the existing Boot Menu with the one stored in the backup file. In this case the utility shows the «-» symbol instead of “>” when skipping writing of the Boot Menu.

WARNING! Interrupting the FlashROM's contents uploading may result in a bricked Carnivore2 cartridge! In this case the cartridge must be re–initialized. The description of the procedure can be found in the “How to enable the cartridge and install BIOS ROMs” section.

C2CFGBCK

`C2CFGBCK.COM` — the utility to backup and restore configuration settings.

The `C2CFGBCK.COM` utility allows to dump the contents of the configuration EEPROM chip into a file. The size of the file is 128 bytes. The utility also allows to copy the contents of the EEPROM's dump back into the chip. The system must be restarted after uploading the new data into the EEPROM chip for the configuration changes to be taken into use.

C2IDETST

`C2IDETST.COM` — the utility to test IDE controller's functionality.

The `C2IDETST.COM` utility is used to test IDE controller's read/write functionality. When run, it performs 16384 read/write iterations and shows the passed/failed status of any of the disk operations fail. To stop the test it's necessary to hold the Esc key. In the end the utility shows the total/success/failed counters.

Carnivore2 support in openMSX

The openMSX emulator supports Carnivore2 emulation from version 0_14_0-200. To configure the emulation, you will need special files that can be downloaded from the link below.

To add Carnivore2 device into openMSX please do the following: Put files `Carnivore.xml` and `Carnivore.rom` into the emulator's folders as specified below:

File	Target path for	
	MS Windows	Linux
`Carnivore.xml`	`\openMSX\share\extensions\`	`/usr/share/openmsx/extensions/`
`Carnivore.rom`	`\openMSX\share\systemroms\other\`	`/usr/share/openmsx/systemroms/other/`

Run “openMSX Catapult”, select `Settings`, click `Edit configuration` and OK.

The device called `Carnivore2` will appear in the list of the found devices. You can then attach a disk image to Carnivore2 by specifying the location of the `DSK` file (your own CF card's image) in the Catapult's user interface. Click on the Hard Disk button

and locate the desired image file.

If you already have `Carnivore2` in your openMSX and you only want to update the FlashROM, you may copy the `Carnivore2.rom` file into this folder as `carnivore2.flash`:

- MS Windows

  ```
  C:\Users\<user_name>\Documents\openMSX\persistent\Carnivore2\untitled1\
  ```

  where `<user_name>` is your Windows user name;

- Linux

  ```
  ~/.openMSX/persistent/Carnivore2/untitled1/
  ```

Please be advised that **all your previous data on the FlashROM will be gone!** So if you want to preserve the data, but to have the latest Boot Menu and IDE BIOS versions, you need to run openMSX, boot to MSX-DOS and use the `C2MAN` or `C2MAN40` utility to update the Boot Menu and IDE BIOS using the latest `BIN` files from the Carnivore's Github repository (in folders BIOSes and BootMenu).

Certain features of Boot Menu v2.30 will not work until the support for them is added into openMSX:

- FMPAC mono mode will not be enabled
- Dual-Slot screen will not allow to run ROMs in the slave slot
- The firmware version will not be shown correctly

The files for adding support for Carnivore2 into openMSX are available here.

Troubleshooting

The cartridge has a pushbutton to completely disable its functionality if something goes wrong. If the cartridge stops working correctly, you may need to reinitialize it like described in the How to enable the cartridge and install BIOS ROMs section.

You need to boot to MSX-DOS from another disk device or a floppy drive in order to use the `C2MAN` or `C2MAN40` utilities to initialize the Carnivore2 cartridge. A computer has to be started while holding the cartridge's pushbutton. When the DOS prompt appears, the button can be released.

Disclaimer

The RBSC provides all the files and information for free, without any liability (see the disclaimer.txt file in the repository). The provided information, software or hardware must not be used for commercial purposes unless permitted by the RBSC. Producing a small amount of bare boards for personal projects and selling the rest of the batch is allowed without the permission of RBSC.

When the sources of the tools are used to create alternative projects, please always mention the original source and the copyright!

Credits

The following individuals have contributed to the success of Carnivore2 project:

- Ptero [RBSC]
- Wierzbowsky [RBSC]
- Pencioner [RBSC]

- Greywolf [RBSC]
- DJS3000 [RBSC]
- SuperMax [RBSC]
- TNT23 [RBSC]

- SolidSnail
- Konamiman
- Mitsutaka Okazaki
- Kazuhiro Tsujikawa
- Max Iwamoto
- GDX
- Grauw
- Spark/SDM
- KOD/SDM
- Wbahnassi
- Carmeloco
- Nyyrikki
- 8bits4ever
- Robodrunk
- Vogul

We would like to thank the creators of the MSX platform for their wonderful invention that brings joy to many people for more than 30 years.

Contact information

The terms and conditions for commercial production of the cartridge can be found here:
http://rbsc.su/en/licensing/#Carnivore2

The members of RBSC group Tnt23, Wierzbowsky, Pencioner, Ptero, GreyWolf, SuperMax and DJS3000 can be contacted via the group's e-mail address:
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The group's website can be found here:
https://rbsc.su/
https://rbsc.su/ru

The RBSC's hardware repository can be found here:
https://github.com/rbsc

The RBSC's 3D model repository can be found here:
https://www.thingiverse.com/groups/rbsc/things

https://sysadminmosaic.ru/en/msx/carnivore2/carnivore2

2020-08-19 21:15