
Cheapocabra NES Flash Cartridge

Features

- 512kByte Program FlashROM, 32kB page size
- 16kByte Character Pattern RAM, 8kB page size
- 8kByte Nametable RAM, 4kB page size
- 4-screen nametable memory, there is no mirroring jumper to solder
- Non-volatile save data supported with FlashROM
- Inexpensive discrete logic mapper using 74HC10, 74HC02, and 74HC377
- 2 mapper-controlled indicator LEDs, red and green
- Includes multi-region CIC by krikzz
- Optional debug output connector supports RS232, USB, and Bluetooth serial modules
- Hard gold over nickel plated edge connector
- Power supply layout and decoupling follows best practices for reliable operation

Cheapocabra is a low-end Flash cartridge, suitable for game releases, and for use as part of a low-cost devkit. It is supplied as a fully-assembled and tested cartridge. For bulk orders, the following are optional: cart shells, CIC programming, functional test, and pre-loading with your supplied program (you must own copyright or have a license I can verify).

Using the Mapper

The mapper control has 4 separate functions combined into one writable register. Unlike most discrete logic mappers which overlap the ROM and may cause bus conflicts, writing to this mapper requires no special precautions. Because the register is not readable, it is recommended you keep a shadow copy of the register in RAM. See application note (TBD) for code examples.

CPU Page Select lets you select a 32kB page of ROM to map into CPU memory. This is in an undetermined state during power-up and reset, see application note (TBD) for a code library supporting various boot options. It is also possible to use a 16kB page size, with the other 16kB (upper or lower) being a fixed bank, and the fixed bank must be specified at the time the cartridge is programmed. When operating in 16kB page mode, due to interleaving, the available memory is reduced by half, from 512kB to 256kB.

PPU Pattern Select chooses one of the two 8kB pages of CHR-RAM that are available for sprite object and background tiles. The second set may be used for displaying more background tiles using a split-screen effect, or for double-buffering larger updates to CHR-RAM.

PPU Nametable Select allow you to use 2 different sets of 4 nametables each. When doing 8-way scrolling with a split screen, the two sets can be used for the separate areas of the screen. This makes updating the nametables much easier while scrolling. This cartridge disables the NES's internal 2kB VRAM and provides 4kB to the PPU, allowing all 4 nametables to be supported. Thus, there is no need for a mirroring option, and games can scroll in all directions without the usual problem of the attribute table wrapping around the edge of the mirrored axis.

Mapper Register	Type	Data Bits 76543210	Control Function
\$5000-\$5FFF \$7000-\$7FFF (mirror)	(write-only)	edcbaaaa	a = CPU \$8000-\$FFFF Page Select b = PPU \$0000-\$1FFF Page Select c = PPU \$2000-\$3EFF Page Select d = Red LED - 0:On 1:Off e = Green LED - 0:On 1:Off

Programming the Cartridge

A completely blank cartridge may be programmed via a few existing methods: CopyNES, software-upgraded Game Genie, or Kazzo. Additionally, the FlashROM is self-programmable by the NES. A bootloader may be used in conjunction with a controller port to USB communication adapter to reprogram the cartridge with no additional hardware. In the future, the cartridge will be available pre-loaded with this bootloader. You may include this bootloader in your own program, if you want your cartridge to remain rewritable with the communication adapter.

Development and Debugging Features

When used with an NES to USB communication adapter (available separately), which connects to the NES controller port, the cartridge is usable for developing and testing NES programs. In the future, some NES code and a PC program will be provided, so

you can run a command on your PC to easily load your program onto the cartridge. In most cases it may be possible to remotely reset the NES from your PC.

The LEDs may be used as a simple form of output during debugging. For example, you may choose to turn the LEDs on, off, or flash a pattern when a certain part of your program has been reached. Or you may choose to disable an LED when entering an idle loop, and enable it during program execution, and this will result in the LED brightness being modulated by your program's CPU availability.

The debug output connector provides 2 outputs from the mapper, which are shared with the LEDs. The connector is intended for use with a TTL-to-serial adapter module, similar to the NES to USB communication adapter. This port is output-only. You would connect it to a PC, and access it through a COM port with a standard terminal program. This can be used to display or log ASCII text and binary data on your PC, from within your NES program. This connector is normally not installed on the board, but may be included on request. If you want to install one yourself, the recommended type is a Molex KK 7478, right angle 4-position connector. To fit inside the cart shell, it is required to bend the pins straight and lay them flat against the board.

FUQ (Frequently Unasked Questions)

Can this cartridge be used for making reproductions?

No, this cartridge is designed for newly-developed software. If you do have the legal right to release someone else's game, but don't have the source code, contact me. I may be able to modify the program to suit this board, or another.

I just want to make an NROM program, is this board overkill?

While it's true that only the very largest NES games used a 512kB ROM, those were made over 20 years ago. It's quite likely that the actual silicon die of a 512kB FlashROM is smaller than the 32kB MaskROMs used in early NES releases. Sizes smaller than 512kB are not significantly cheaper. And the savings from removing the mapper entirely are little consolation when it means that you can no longer reprogram the Flash in-system. The difference in cost is expected to be negated by producing a larger quantity of one design, because it has a wider range of applications.

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Document History

v1.0	10-31-2015	Initial release
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