



BackBit Pro Cartridge Documentation

Includes legacy cartridge details. Updated May 21, 2024 .

[For the latest version of this document, visit https://backbit.io](https://backbit.io)

What is it?

The BackBit Pro cartridge is unlike any other cartridge available for vintage computers. Instead of being paired with a single machine, it functions on multiple machines by attaching an appropriate adapter. Load all of your favorite games instantly from a MicroSD card.

Support for more systems is being added all the time and firmware is regularly updated. Designed for ease of use, all you have to do is plug and play!

Core Features

- Just **plug and play!** All you have to do is insert the cartridge and adapter, and a MicroSD card full of programs (SD card not included, but inquire at [BackBit Forum](#) for content suggestion);
- Upgradeable via MicroSD card (not included). Just place the upgrade file on the card and updating is instant & secure;
- Easy to use menu system can be navigated via joystick or keyboard. Unified interface is common to all hardware;
- BackButton™ allows for easy navigation back to menu interface;
- Loading is **instant** in most configurations. No need to take a coffee break while your program is loading;
- Built-in versioning system preserves your original files;
- Supports cartridge images up to **1MB** in size;
- **Real-time-clock** remembers date & time even after shutoff. Useful when creating new files or versions;
- One-button **diagnostic** mode helps you identify system faults;
- Sturdy 3D printed ABS case.

Supported Systems

- Acetronic MPU 1000/2000 / Radofin 1292/1392 Advanced Programmable Video System
- Amstrad GX4000 / CPC+ (w/ ACID bypass) **may require case alteration on CPC+*
- APF M1000/MP1000
- Apple II+/IIe/IIgs Slot
- Atari 2600
- Atari 5200
- Atari 7800 (w/ POKEY emulation)
- Atari 400 / 800 / XL / XE / XEGS
- Bally Astrocade / Professional Arcade / Computer System / Home Library Computer
- BBC Micro B (ROM adapter for 28-pin ZIF socket)
- ColecoVision/Adam
- Commodore 16 / +4
- Commodore 64 / 128 (incl. C64, C64C, C64GS, SX64, C128, C128D)
- Commodore VIC 20 / VC20
- CreatiVision / Dick Smith Wizzard
- Emerson Arcadia 2001 / Soundic MPT-03
- Epoch Super Cassette Vision
- Fairchild Channel F
- IBM PCjr
- Interton VC 4000 (Radofin APVS clone)
- Magnavox Odyssey² / Philips Videopac (w/ Voice emulation)
- Mattel Aquarius (w/ Mini Expander)
- Mattel Intellivision
- MSX 1 / 2 (w/ SCC emulation)
- RCA Studio II / III
- Sega Master System, SG-1000, Sega Mark III, etc.
- Tandy Color Computer / 2 / 3 (incl. Dragon 32/64)
- Tandy Micro Color Computer (MC-10)
- Timex Sinclair 2068
- TI-99/4A
- Tomy Tutor/ひょう太
- Vectrex (GCE / Milton Bradley)
- ZX81 / Timex Sinclair 1000 / Timex Sinclair 1500
- ZX Spectrum 48K / 128K / +2 (w/ Kempston support)

Supported ROM and RAM Configurations

Note that this is not an exhaustive list. If there is anything you'd like supported that you don't see here, feel free to inquire at the [BackBit Forum!](#)

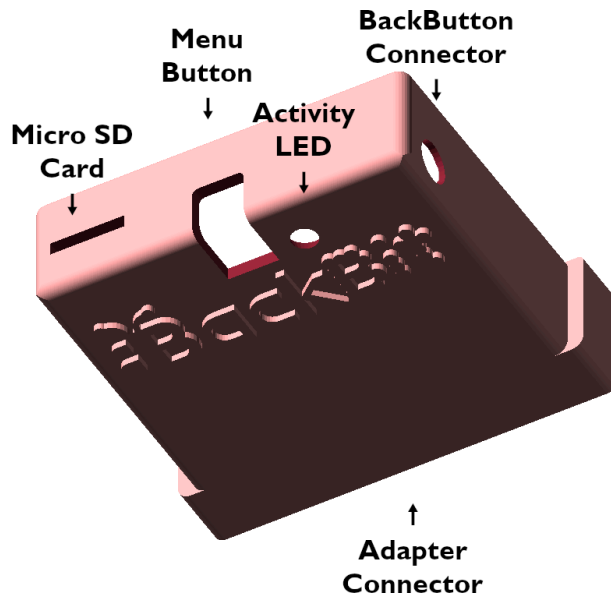
- Acetronic MPU 1000/2000 / Radofin 1292/1392 APVS / Interton VC 4000
 - BIN (up to 7 KB) w/ RAM expansion support
- Amstrad GX4000 / CPC+
 - BIN / CPR (up to 1MB)
- APF M1000 / MP1000
 - BIN (up to 8KB) w/ RAM expansion support
- Apple II+ / IIe
 - DSK / DO / PO (140KB)
 - Binary appended disks to facilitate disk swapping
- Atari 2600
 - A26 / BIN (up to 1MB)
 - Mappers supported: 3E, 3F, AR, CV, DPC, DPCP (partial), E0, E7, F0, F4, F4SC, F6, F6SC, F8, F8SC, FA, FC, FE, UA
- Atari 5200
 - A52 / BIN (up to 512KB)
 - Mappers supported: MegaCart (up to 512KB), BountyBob
- Atari 7800
 - A78 (up to 1MB)
 - Mappers supported: Absolute, Activision, MirrorRAM, SuperGame, SuperGame+RAM
- Atari 400 / 800 / XL / XE / XEGS
 - CAR / ROM (up to 1MB)
 - XEX
 - Mappers supported: AtariMAX, AtariMega, BountyBob, Williams, XEGS
- Bally Astrocade / Professional Arcade / Computer System / Home Library Computer
 - BIN (up to 8KB)
 - WAV (8-bit, for cassette-based programs)
- BBC Micro B
 - BIN (up to 16KB)
 - SSD (up to 200KB)
- ColecoVision / Adam
 - COL / ROM (up to 1MB)

- Commodore 16 / Plus 4
 - BBT (BackBit multi-drive format)
 - BIN (up to 32KB)
 - CRT
 - D64, D71, D81, D8B
 - P00, PRG, T64 (up to 62KB)
- Commodore 64 / 128
 - BBT (BackBit multi-drive format)
 - CRT (up to 1MB)
 - D64, D71, D81, D8B (read & write support, PRG/SEQ/REL/USR files, built-in Burn & Rip feature)
 - FRZ, VSF (snapshots)
 - KOA, KLA (Koala multicolor viewer)
 - P00, PRG, T64 (up to 62KB, w/ freezer support)
 - SID (built-in music player)
 - Mappers supported: C64GS, Comal 80, Dinamic, EasyFlash, Epyx Fastload, Final Cart 3, Funplay, Gmod 2, Mach 5, Magic Desk, Ocean, Prophet 64, Simon's BASIC, Super Games, Warp Speed, Zaxxon
 - CP/M diskettes supported
 - KERNAL override (in conjunction with PLaster PLA replacement)
 - Note: If you have a 326298 board (original rev C64 breadbin), it requires a [reset fix](#).
- Commodore VIC 20 / VC20
 - BBT (BackBit multi-drive format)
 - 20, 40, 60, 70, A0, B0 (extension specifies first bank where cartridge loads to, binary append all banks sequentially)
 - CRT
 - D64, D71, D81, D8B
 - P00, PRG, T64 (up to 24KB)
 - RAM expansion of 3K, 8K, 16K, 24K, 32K or 35K
- CreatiVision / Dick Smith Wizzard
 - ROM (up to 32KB)
- Emerson Arcadia 2001 / Soundic MPT-03
 - BIN (up to 8KB)
- Epoch Super Cassette Vision
 - BIN (up to 128KB)
 - Mappers supported: BASIC, Pole Position 2, PC5/PC6
- Fairchild Channel F
 - BIN (up to 62KB)
- IBM PCjr
 - BIN, JRC (up to 128KB)
 - COM (up to 64KB)
 - IMG (160KB, 180KB, 320KB, 360KB, 720KB, 1.2MB, 1.44MB)

- Magnavox Odyssey² / Philips Videopac
 - BIN (up to 16KB)
 - O2VOICE.TAR must be in root for The Voice emulation
- Mattel Aquarius
 - BIN (up to 16KB)
 - PRG (up to 34KB)
 - Built-in 32K RAM expansion
- Mattel Intellivision
 - BIN / INT (up to 512KB)
 - ECS ([see here](#))
 - ROM (incl. RAM support)
 - JLP acceleration support (RAM, CRC, Mult/Div)
- MSX 1 / 2
 - ROM (up to 1MB)
 - Mappers supported: ASCII8, ASCII16, GameMaster, Generic8, Konami, KonamiSCC
 - DSK (360KB, 720KB)
- RCA Studio II / III
 - ST2 (up to 62KB)
- Sega Master System / SG-1000 / SC-3000
 - SG / SMS (up to 1MB)
 - Mappers supported: Generic, Codemasters
- Tandy Color Computer / 2 / 3
 - CAS
 - CCC (up to 256KB)
 - DSK (160KB, 180KB, 360KB, 720KB)
- Tandy Micro Color Computer MC-10 / Alice
 - C10
- Timex Sinclair 2068
 - DCK (up to 64KB)
 - TAP (for ZX Spectrum emulation)
- TI-99/4A
 - C / BIN (up to 1MB, BIN with optional GROM component, append C+D+G together to a single BIN file)
 - G (GROM-only)
 - CTG (V1/V2)
 - 379 (inverted mapper)
 - Mappers supported: GROM, GROM+8K ROM, GROM+16K ROM, ROM
- Tomy Tutor
 - BIN (up to 40KB)

- Vectrex (GCE / Milton Bradley)
 - BIN (up to 64KB) w/ PB6 bankswitching
- ZX81 / Timex Sinclair 1000 / Timex Sinclair 1500
 - P (up to 16KB)
 - Built-in 16KB RAM expansion
- ZX Spectrum 48K / 128K / +2
 - TAP (multi-load support)
 - Z80

Anatomy



The **Micro-SD Card** slot accepts any microSD card formatted to FAT32 or FAT16 and allows you to load programs or upgrade firmware.

The **Menu Button** allows you to return to the menu once a program is running (on most systems).

The **Activity LED** lets you know when the cartridge is busy.

The **BackButton Connector** lets you attach a BackButton wired remote to activate the menu button at a distance.

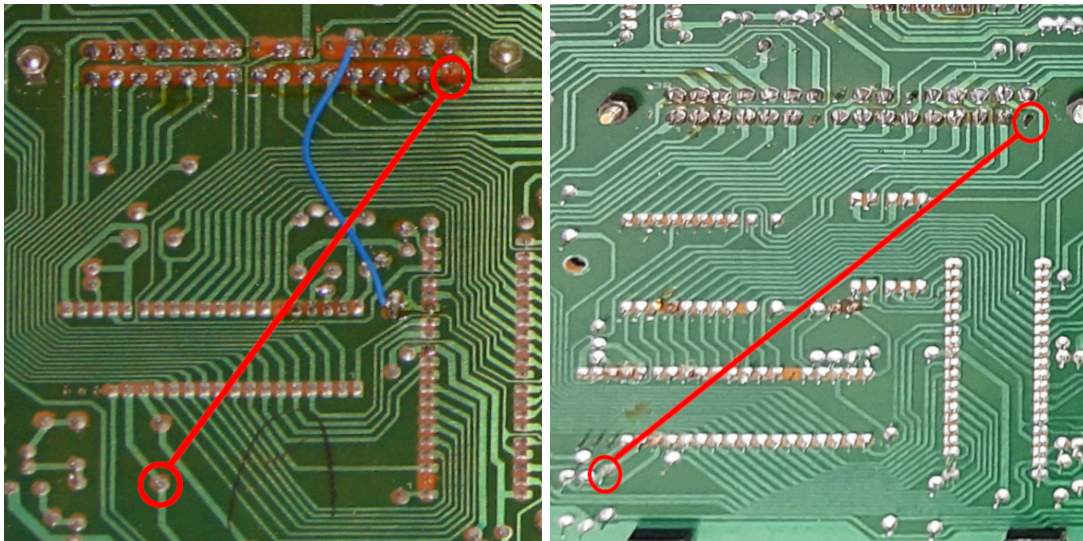
The **Adapter Connector** lets you adapt your BackBit Pro to a variety of systems.

Additional Wiring Required

Some systems require additional wiring to automate reset and/or power functionality, or to work at all in certain cases. Here is a list of those systems, followed by a pictorial guide to specific systems. If your system is not listed here, feel free to inquire on the BackBit Forum (forum.backbit.io).

- **Acetronic MPU 1000 / 2000, Radofin 1292 / 1392 APVS**

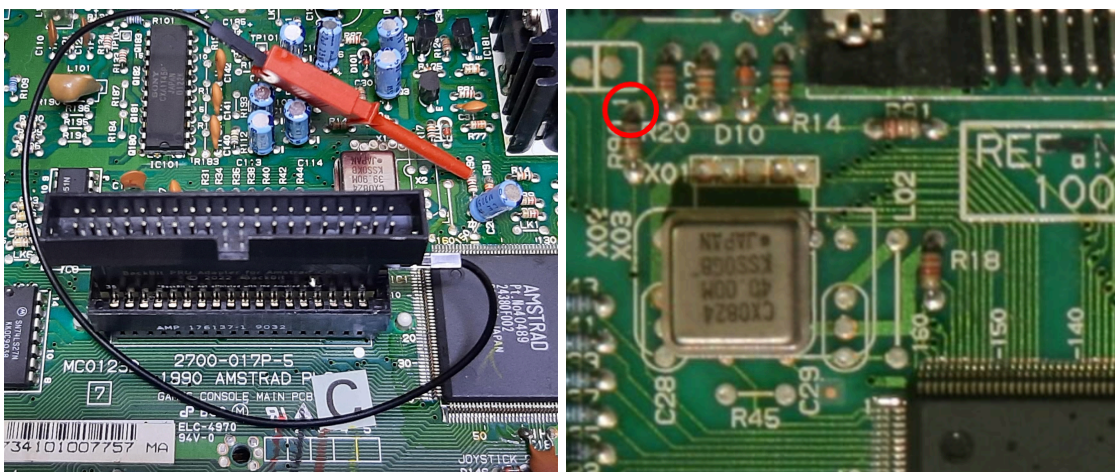
Optional to facilitate one-button reset. Solder reset button to cartridge pin 16.



- **Amstrad CPC+ / GX4000**

Required to facilitate ACID bypass. Connect jumper to internal reset.

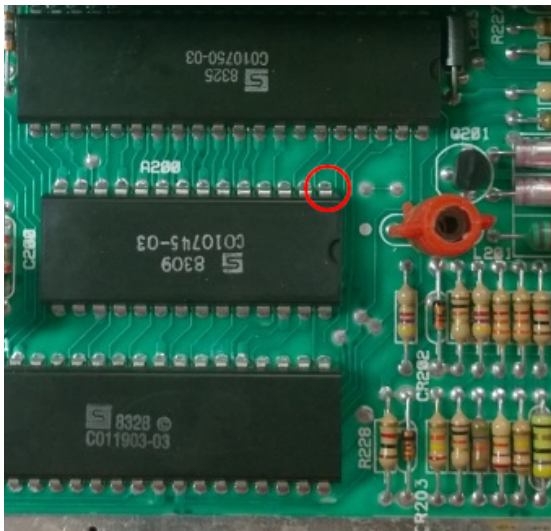
Located at intersection of R90 & R17/D10 (or R190 & R117/D110 on some models)



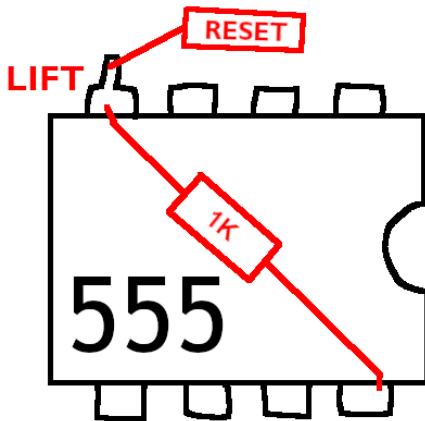
- **Atari 2600**

Optional for reset capability. Connect jumper to internal reset.

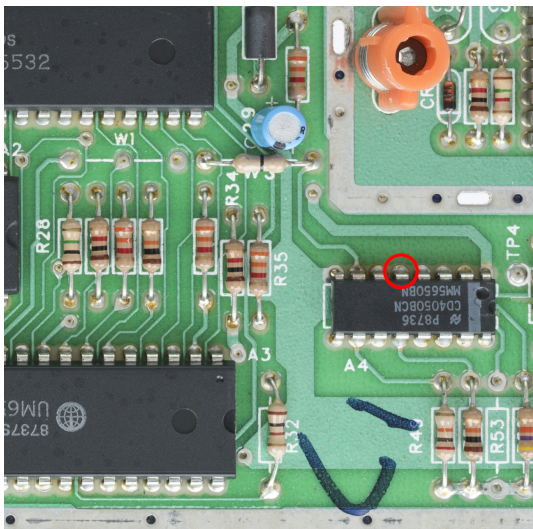
2600 Rev 1-15: Located at 6507 pin 1



2600 Rev 16+: Lift pin 4 of 555 chip & connect to reset. Add 1K resistor as shown.



2600 Jr: Located at CD4050 pin

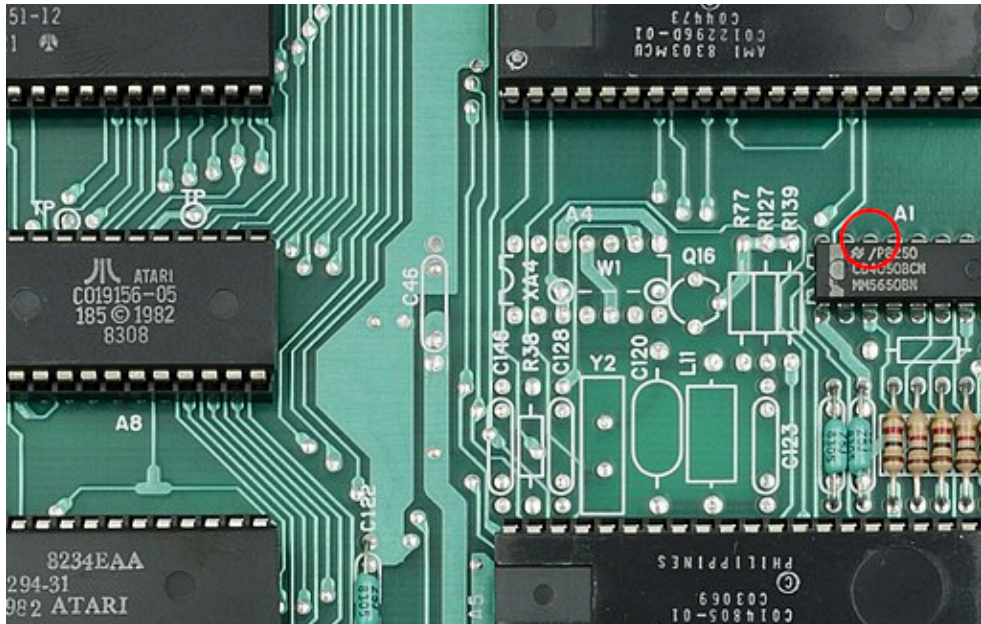


- **Atari 5200 (early revision 4-port models only)**

Optional for reset capability. Note that 2-port models and “universal” 4-port models need no additional wiring; Just set jumper on adapter to “Hard Reset”.

If you have an early-revision 4-port model, one of these solutions is required for reset:

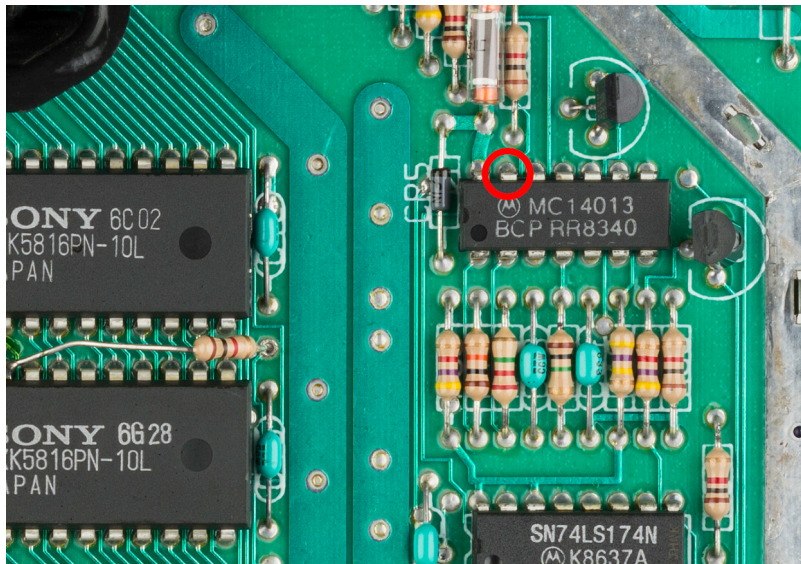
- 1) “Hard Reset”: Solder DC input to cartridge pin 11 to “upgrade” your machine
- 2) “Soft Reset” w/ ext. wire: Attach jumper wire to CD4050 pin 14, as pictured
- 3) “Soft Reset” w/ int. wire: Solder wire from CD4050 pin 14 to cartridge pin 28, and solder “Spare Reset” jumper on adapter



- **Atari 7800**

Optional for reset capability. Connect jumper to internal reset.

Located at CD4013 pin 13

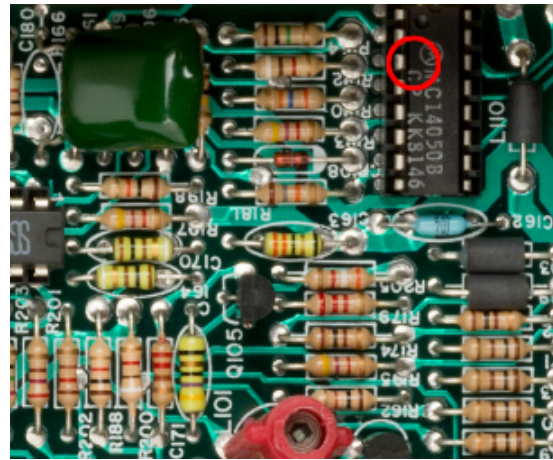
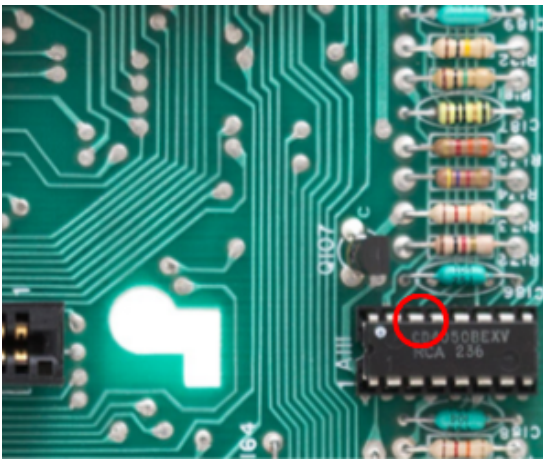


- **Atari 400/800**

Optional to facilitate single-button reset. Connect jumper to internal reset.

400: Located at CD4050 pin 14

800: Located at CD4050 pin 3

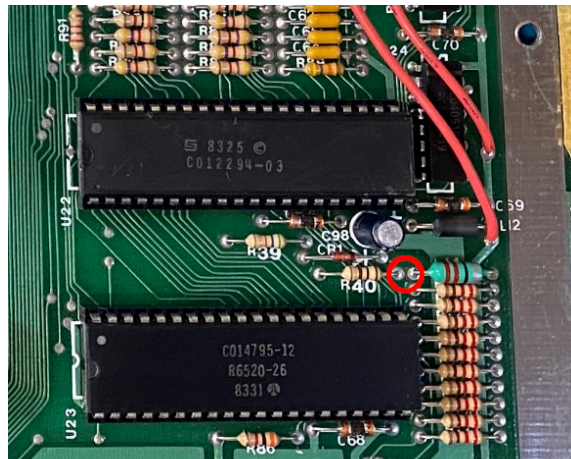
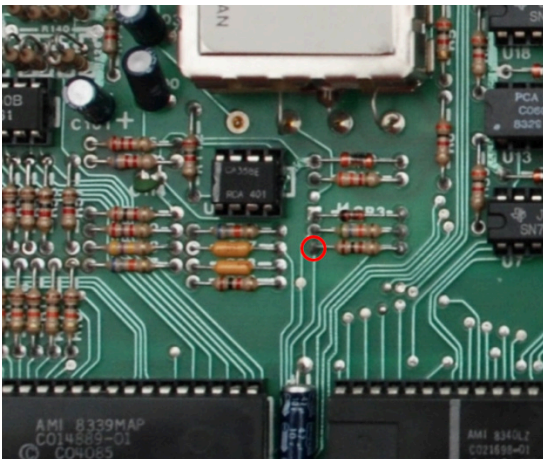


- **Atari XL/XE**

Optional to facilitate single-button reset. Connect jumper to internal reset.

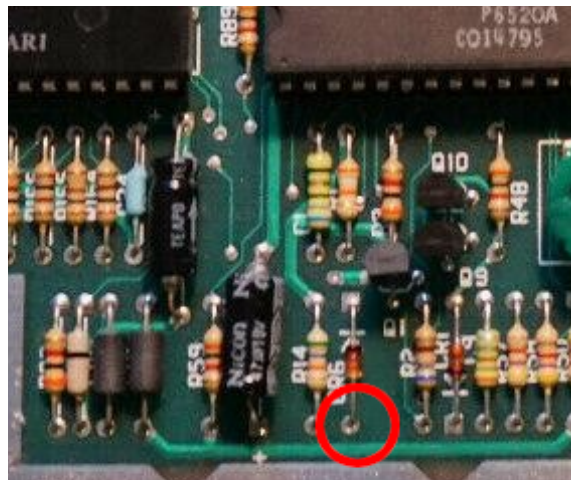
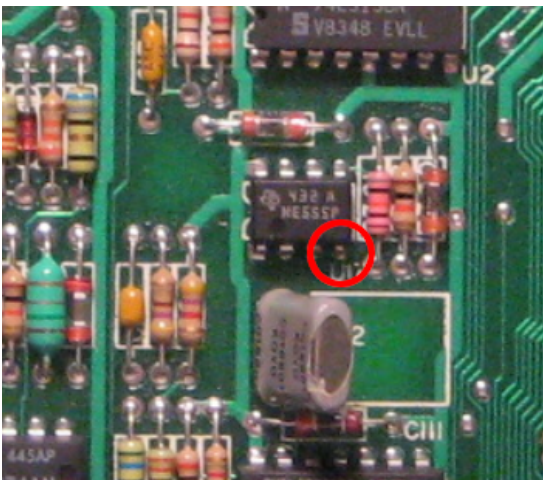
600XL: Located at R45 (lefthand side)

800XL: Located between R40 and L14



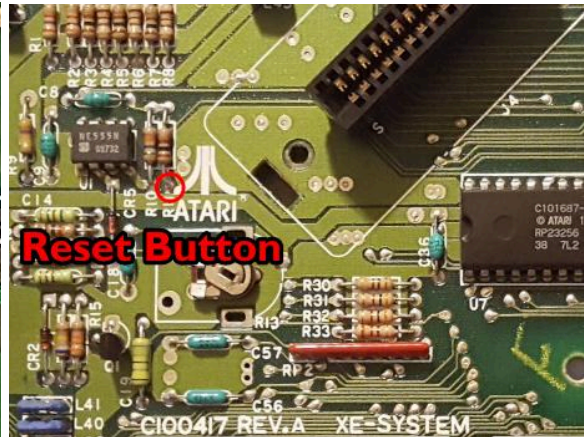
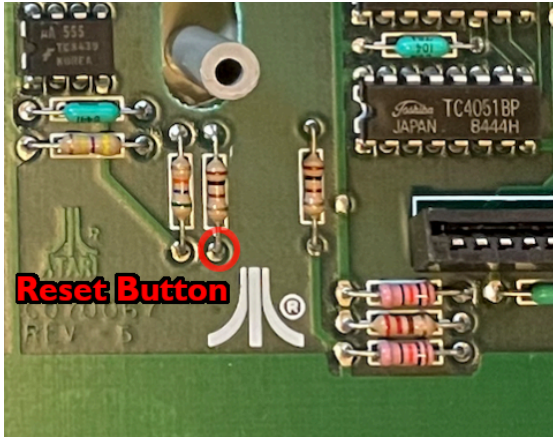
800XLF: Located at U17 pin 4

1200XL: Located at CR6 anode



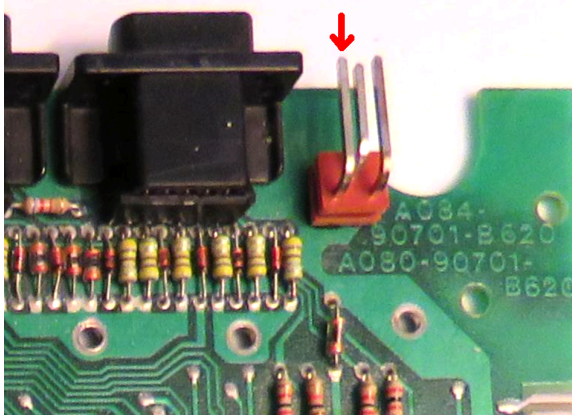
65XE/130XE: Between R40 and L14

XEGS: Located at R11 (bottom side)



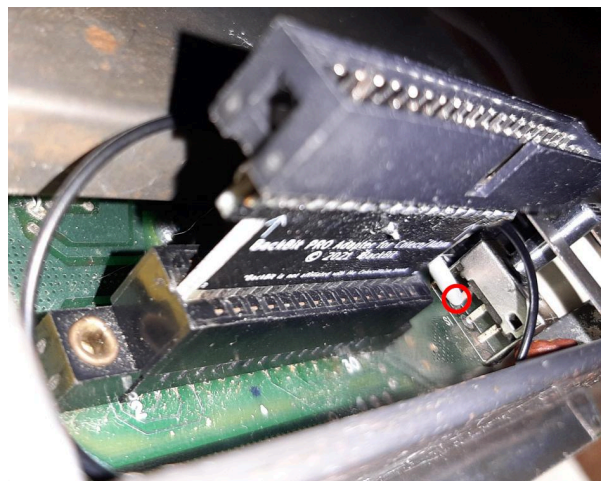
- **Bally Astrocade**

Optional to supply power (otherwise must use USB-C power source). Connect jumper to left hand pin of light gun port (when facing front of system) which supplies 5V power.



- **ColecoVision / Adam**

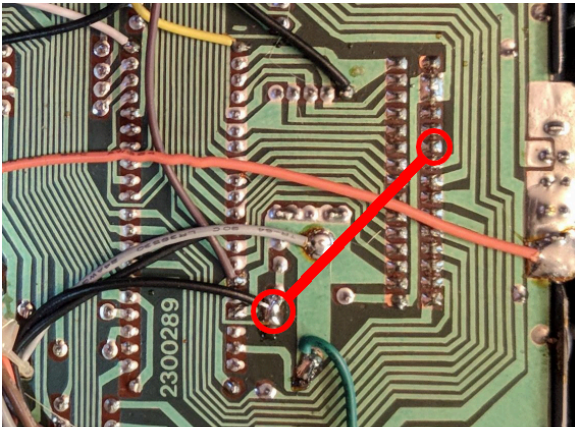
Optional to facilitate one-button reset. Connect jumper to internal reset. On Adam, required to show browser at startup without pressing Coleco reset. ColecoVision: R9 as shown (or C3 +) Adam: S1 as shown



- **Emerson Arcadia 2001**

Optional to facilitate one-button reset.

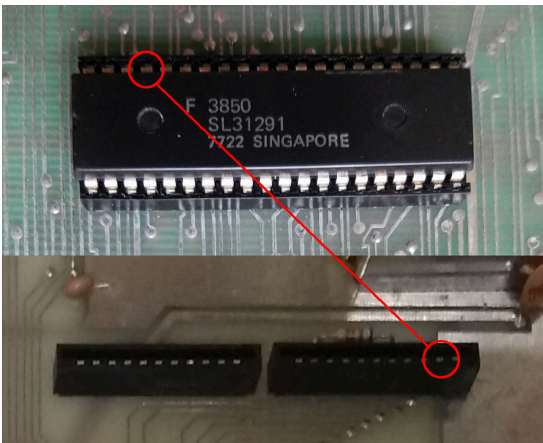
Solder reset to cartridge pin 19, and solder “Reset on Pin 19” jumper on adapter.



- **Fairchild Channel F**

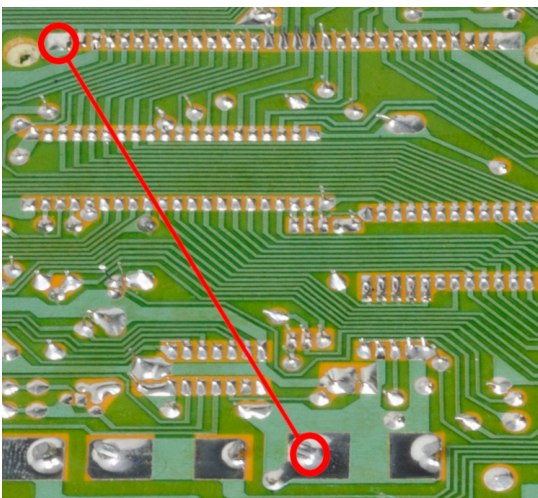
Optional to facilitate one-button reset. Solder reset button to cartridge pin 21

Solder 3850 pin 37 (or physical reset button) to cartridge pin 21



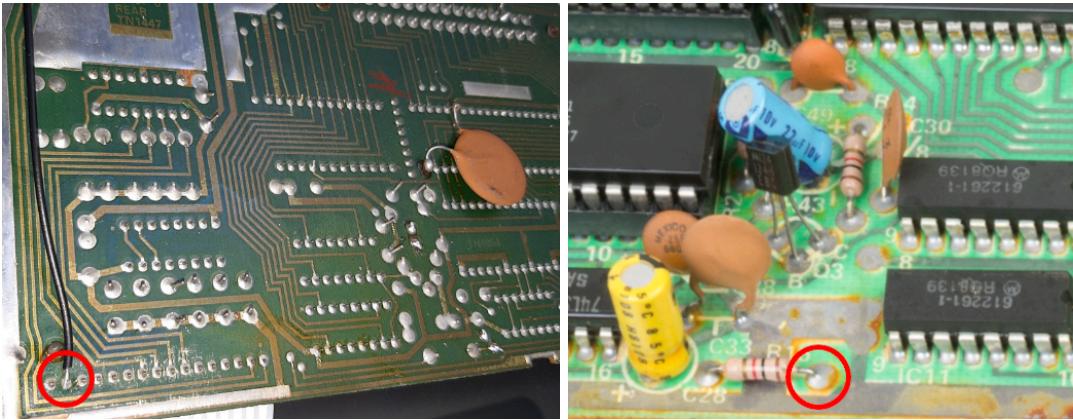
- **Interton VC4000**

Optional to facilitate one-button reset. Solder reset button to cartridge pin 31.



- **Magnavox Odyssey² / Philips Videopac**

Optional to facilitate one-button reset. Connect jumper to internal reset. Solder to keyboard pin #15 -or- unscrew motherboard & jumper to R16.

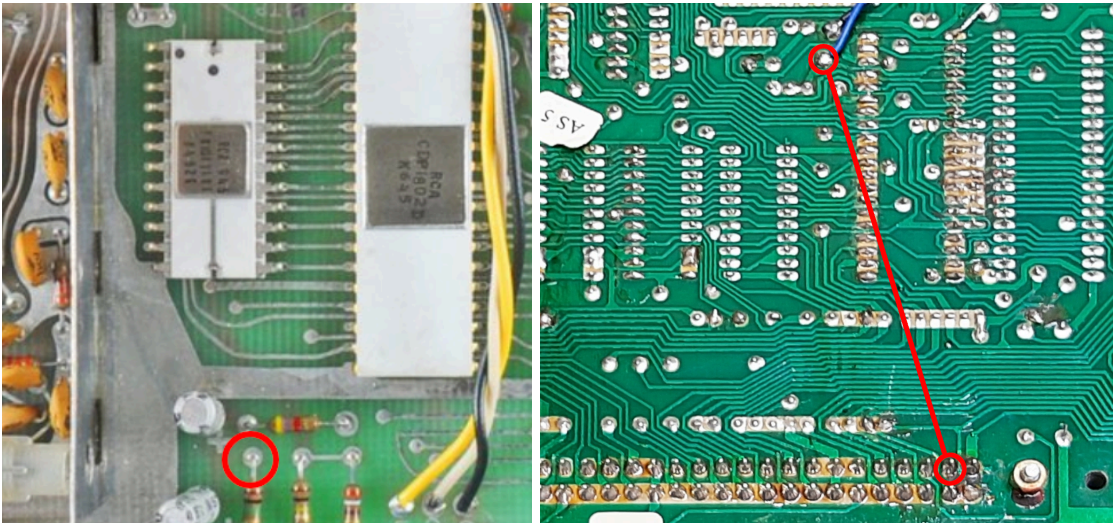


- **RCA Studio II**

Optional to facilitate one-button reset.

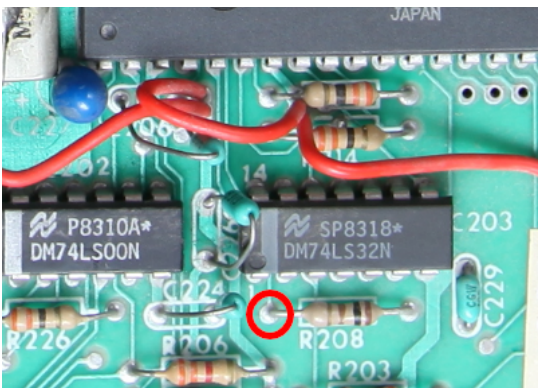
Studio II: Connect jumper to 1861 pin 8.

Studio III: Solder reset to cartridge pin B, and solder "Reset on Pin B" jumper on adapter.



- **Vectrex**

Optional to facilitate one-button reset. Connect jumper to internal reset at R208.



Firmware Upgrade

The latest firmware can be downloaded at <http://backbit.io/downloads/Firmware>.

For BackBit Pro Cartridge:

Update the firmware with SD card. Place BBPRO.UPG in the root folder of your SD card. Insert card and power cycle the attached machine. You may have to additionally power cycle or reset your machine after the upgrade is complete (wait about 5-10 seconds before doing so). Upon successful firmware upgrade, the file will be erased. If the file is read-only, you must remove the card and power cycle the machine before proceeding.

For Legacy BackBit Commodore Cartridge:

Download [Teensy Loader](#). Choose File -> Open HEX file. Plug in USB cable, highlight Auto button, and use paperclip to press the Update Firmware button.

File Browser

The BackBit file browser allows you to navigate the entire contents of your SD card. There are a couple restrictions in how your card must be arranged:

- Must be formatted in FAT32;
- Folders with over 1000 files may slow down browsing or become inaccessible; It is recommended to split up your files across multiple folders in this case.

The browser has similar inputs on all platforms:

- Up / Down Arrow: navigate items on current page
- Left / Right Arrow: navigate pages
- Button / Enter: choose selected item
- 2nd Button / Delete: navigate to previous folder
- Character keys search for a particular title in the current folder

Features specific to certain platforms:

Commodore 64/128: You can use the left and up arrow keys, in addition to the regular cursor keys to navigate. Hold SHIFT to open an item without auto-run. Press CTRL to activate an application extension (see section below for more details). Press RUN STOP to exit to BASIC.

ZX Spectrum: Hold SHIFT to open an item on a 128K machine in 48K mode. This improves compatibility with some titles.

Context Menus (not available on all platforms):

Keyboard-based systems have these menus assigned to function keys and/or “escape” key. To get started, try a few keys on your keyboard, and once you activate any menu, specific keys for other menus will be shown on the screen. Keypad-based systems have these menus assigned to keys 1 through 4.

- 1) **Utilities** for global actions & options
- 2) **Properties** about the current item (including renaming)
- 3) **Saves** of the current item (and versioning tools, if the format supports it)
- 4) **Tools** for the current item / selection (SPACE key selects multiple items)

Systems without function keys require you to hold ctrl / function / shift while pressing the number. Ask on the BackBit forum if you are stuck or need information on a particular system.

Real Time Clock

BackBit comes with a Real Time Clock. This means that even when the power is shut off, your cartridge will remember the time of day. To set the clock for the first time, choose Set Clock from the Utilities menu. Use the cursor keys to navigate the fields and modify values. Be sure to set your time zone, indicated as an offset from UTC. Press return to save changes or menu button to abort.

Rip/Burn (Commodore machines)

With BackBit and Commodore, it is possible to read and write disks with a real 1541/1571/1581 disk drive, simply by plugging the drive into your C64 at the same time the Cartridge is present.

To Rip a disk (i.e. copy the contents of a physical disk to your SD card), go to the UTILS menu (F1). First, choose a disk type in Startup Disk (D64, D71, and D81 correlate to 1541, 1571, and 1581, respectively). Note that a single-sided disk on a 1571 is still a D64. After choosing the disk type, select Rip From Disk. Choose options by pressing the underlined letter, then choose a device to read from and press return. The disk will be saved as a timestamped file beginning with an exclamation mark.

To “Burn” a disk, select this option from the tools menu (F7). Only D64 images can be written to a 1541 drive. D64 or D71 images can be written to a 1571 (single or double-sided, respectively). Only D81 can be written to a 1581. Choose options by pressing the underlined letter, then choose a device to write to and press return.

Diagnostic Mode

BackBit has a built-in diagnostic mode! To activate, **hold the button on the cart while powering on your machine**. On the Commodore 64, an additional press toggles between Dead Test, Diagnostic, and Commodore 128 modes.

Application Extensions (Commodore machines)

Use any media viewer/player or disk browser of your choice*. To set up, select a PRG file (i.e. SIDPlay64 or CBM FileBrowser). Press **F7** and choose **Use As Extension** then confirm **Yes**.

Next, choose any content (SID,KLA,D64,TXT, etc) and press **F7**, then select **Open With** to cycle through the available extensions, i.e. the ones you configured with **Use As Extension**.

Note that this will affect ****all**** files that have that extension, or in the case of disks, all disks (D64/D71/D81/D8B). You must do this soon after the first step, as any unused extensions will be erased on a device restart.

Once the extension has been configured, choose some content and press **CTRL + RETURN** to open it with the extension (**RETURN** still opens it normally). If the content is not already a disk, it will be converted to disk format for the extension to use (modifications will not be preserved). If you would like to load the current folder into the extension, press **CTRL + SHIFT + RETURN**.

**Note that a customized version of your player may be required to perform correctly.*

KERNAL Override (Commodore machines)

*The KERNAL override functionality requires a PLaster chip replacement with the jumper set for KERNAL Override (see [Optional Accessories](#)). To set up, select an 8K BIN file which contains a KERNAL. Press **F7** and choose **Use As KERNAL** then confirm **Yes**.*

Next, press F1 and select **KERNAL** to cycle through the available KERNALs, i.e. the ones you configured with **Use As KERNAL**. If you no longer need the selected KERNAL, choose **Remove Active KERNAL**.

Once the KERNAL has been configured, you can load programs or go to BASIC like normal, and the selected KERNAL will be loaded instead of the regular one.

**Note that some CRT format programs are not currently compatible with KERNAL override. Inquire on the [BackBit Forum](#) for possible workarounds.*

Save Management

Access the saves menu (Commodore: F5). Then choose an item with RETURN and it will show a popup menu with actions. Normally when you open a disk image, it loads the most recent modifications that have been made, such as high scores, user progress or levels. By selecting the original version here, you can load the original unmodified version of the program. You can also do many things with modified versions of the program:

- Open a specific version, i.e. an adventure game with your user's progress;
- Rename the version;
- Duplicate, i.e. fork the version;
- Erase the version;
- Export to a regular disk image, so that the version doesn't have to be associated with the original disk anymore.

Options

These options are not necessary for most users, but advanced users may find them useful. You can find them in the UTILS menu (F1).

- **C128 Mode** (*Commodore 128 Only*)
Choose between defaulting to C128 mode or C64 mode when you load a program or disk. In the “Normal” setting, you have to hold the C= key while you press RETURN to start in C64 mode (otherwise C128 mode activates). In the “Inverted” setting, you have to hold CTRL while you press RETURN to go to C128 mode (otherwise C64 mode is the default). An exception is BBT files, which load in the appropriate operating system as configured in the file regardless of this setting.
- **Freezer** (*Commodore 64 Only*)
BackBit can save the state of a PRG and then recover it later. If you enable this option, the button press to return to the menu will automatically save the state of the program if it was loaded as PRG. Then you can find the timestamped version in the F5-SAVES menu. To skip saving, use a long press upon returning to the menu. Note that this feature is experimental and may not work perfectly some of the time.
- **RAM Expansion** (*VIC 20 Only*)
Most machines that support RAM expansion have it enabled fully at all times. For the VIC 20, it may be desirable to select a particular amount of expansion so that the memory map is adjusted accordingly.
- **Virtual Disk** (*Commodore machines*)
When going to BASIC with the Run-Stop key, the default is to have a regular single-sided double-density disk compatible with a 1541 drive (i.e. D64 file). If you prefer, you can change this to a 1571- or 1581-native disk (i.e. D71/D81 file). You can also turn the virtual disk off, leaving drive 8 open to other uses.
- **Virtual Disk Type** (*Commodore machines*)
By default, the startup disk uses a D64/D71/D81 file compatible with emulators and other hardware. If you choose, you can utilize the BBT file format for saving content which allows multiple save versions of a disk to be consolidated into a single BBT file. (Normally the non-original save versions go in a hidden “.saves” folder.) Either way, you can still export versions to a D64/D71/D81 file.
- **Voice** (*Odyssey² w/ Voice emulation*)
If you have a physical The Voice module, set this to disabled so it doesn't conflict.

D8B Disk Format (Commodore machines)

Sometimes it's nice to combine a lot of files onto a single disk. It works well for programs that originally used a lot of disks. It's also analogous to how the BBT format supports up to 8 disk images. 8 disks is typically the max for 99% of programs, and that's why this number was chosen. See how the D8B format compares to other disk formats:

Format	D64	D71	D81	D8B
Tracks	35	70	80	40
Sectors	17-21	17-21	40	136
Directory Entries	144	144	296	1056
Directory Track	18	18/53	40	1
BAM Sector #	0	0	1-2	1-3
Directory Entry Sector #	1-18	1-18	3-39	4-135
BAM bytes/track	4	4	6	18
Blocks Available	664	1328	3160	5304
Capacity	164.7 KB	329.4 KB	783.8 KB	1.28 MB
Capacity vs D64	1x	2x	4.8x	7.99x

BackBit Tool (Commodore machines)

The BackBit Tool is an open source cross-platform application available for Linux (32-bit and 64-bit), Mac (64-bit) and Windows (32-bit and 64-bit). Using the tool, you can assemble BBT files which are composed of 3 parts:

1. An auto-start program, i.e. PRG file that will be executed on startup (this is optional, and if not present, a disk image must be present).
2. Up to 8 disk images (D64/D71/D81), assigned automatically to devices 8 through 15. If there is no auto-start program specified, the application will start with LOAD"*",8,1
3. A single binary file, no larger than 4GB that will be available through the API for extended data access.

The source code is available at <https://github.com/evietron/BackBit-Tool>.

The compiled application is free to download and available at <http://backbit.io/downloads>.

BackBit API (Commodore machines)

The API is made up of “peeks” and “pokes” to the I/O area in memory related to the expansion port, i.e. memory locations \$DE00-\$DFFF (\$9800-\$9FFF for VIC 20) in hex. You must have a knowledge of machine language programming to effectively implement features of this API, although it is also possible to use the BASIC programming language to work with most of these features. In that case, you will have to convert these hex numbers to decimal. Additionally, there are some custom commands available through the virtual disk.

Peek Commands

This section describes what is obtained when peeking bytes from the I/O area at \$DE00-\$DFFF (\$9800-\$9FFF for VIC 20).

Peek Commands: CODE		
C64	V20	
\$DE00 - \$DE02	\$9800 - \$9802	Identifier. These bytes always return the sequence \$BA \$CB \$17 while the cartridge is active.
\$DEFF	\$98FF	Device Number Filter. This is the maximum device # that the KERNAL emulation will bypass, so it will typically be one less than the first device # emulated, i.e. <u>\$07</u> if you are using device <u>8</u> . If KERNAL emulation is not active, this will be <u>\$FF</u> .

Peek Commands: DATA		
C64	V20	
\$DF00 - \$DFFF	\$9C00 - \$9CFF	Requested data. Data appears here in 256-byte blocks when requested from Extended Data or Real Time Clock. Poke to \$DF## to configure which 256-byte block out of up to 64K can be accessible here, i.e. \$DF00 to get the first block and \$DFFF to get the last.

Poke Commands

The cartridge interprets poke commands based on the address written to, **WHILE IGNORING WHAT DATA IS WRITTEN**. This means that you can interchangeably use STA, STX, or STY instructions when writing to the cartridge at \$DE00-DFFF (\$9800-\$9FFF for VIC 20), and can safely ignore the contents of the A/X/Y registers while doing so. The lower 8-bits of the address are interpreted as a command on the C64's I/O1 channel (or VIC 20's I/O2 channel) and as data on the C64's I/O2 channel (or VIC 20's I/O3 channel). For commands that require parameters, poke each parameter byte to \$DF## / \$9C##, then execute the command at \$DE## / \$98##.

When a command is executed, the cartridge will temporarily become unavailable. This does not interrupt the Commodore's CPU, but cartridge **memory, requests & KERNAL usage** become inaccessible until the command completes. To determine if the operation has completed, check for the 3-byte identifier (BA CB 17) at \$DE00 (\$9800 on VIC 20).

To prevent conflicts with programs that send non-BackBit requests to the \$DE## (\$98## on VIC 20) memory area, all commands, with the exception of disabling the cartridge memory, have a suffix of \$BB.

Poke Commands: PARAMETERS		
C64	V20	
\$DF00 - \$DFFF	\$9C00 - \$9CFF	Send parameter data. This will add the low byte of this address to the parameter buffer, i.e. \$DF00 will send \$00 and \$DF34 will send \$34. The parameter buffer is limited to 256 bytes, after which it resets and wraps around. In loader or extended data mode, the most recent parameter byte written is used to specify the high address byte.

Poke Commands: CONTROL

These requests control basic interaction with the cartridge.

C64	V20	
\$DE00	<i>n/a</i>	Disable BackBit internals. This hides BackBit from the active program, and if there is a cartridge loaded, it will become resident. Does not affect the I/O area at \$DE00-\$DFFF. <i>C64 Only.</i>
\$DE01 [BB]	<i>n/a</i>	Enable BackBit internals. This allows BackBit to hijack KERNAL routines, temporarily loading support code in ROML. <i>C64 Only.</i>
\$DE02 [BB]	\$9802 [BB]	Return to browser. Informs the cartridge that the program is done and should go back to the browser.
\$DE03 [BB]	\$9803 [BB]	Turn on LED until next request. LED remains on until next request.
\$DE04 [Y# M# D# H# M# S# Z# BB]	\$9804 [Y# M# D# H# M# S# Z# BB]	Adjust real time clock. Modifies the time to Year (+2K) / Month (1-12) / Day (1-31) Hour:Min:Second in Zone (signed, +/- UTC). Time is retained by the cartridge even after powering off the machine.
\$DE05 [BB]	\$9805 [BB]	Request real time clock. After calling, access the values here (\$9CXX on VIC 20): \$DF00 - \$DF03: Year in ASCII \$DF04 - \$DF05: Month in ASCII \$DF06 - \$DF07: Day in ASCII \$DF08 - \$DF0B: Matches values you'd expect in \$DC08 - \$DC0B. \$DF0C: Time zone (signed byte, +/- UTC).
\$DE06 [BB]	\$9806 [BB]	Rotate mounted disks. With a BBT that maps disks A,B,C to devices 8,9,10, after 1 rotation, they will be B,C,A. After 2, C,A,B, and finally after 3 rotations, back to the original order.
\$DE07 [BB]	\$9807 [BB]	Mount cartridge. With a BBT that has both a PRG and CRT, this is used to mount the CRT.

Poke Commands: EXTENDED DATA

This feature allows BackBit to access up to 4GB of persistent storage from a single program. Accessing a 64K bank typically takes around 40ms. Requested data will be available at \$DFXX with 256-byte bank switching triggered by writes to the same area. To write data, first configure the write offset, then write data 254 bytes at a time (which will increase the write offset). Data must be accessed again after writing to get updated version. Use the BackBit Tool to attach data to a BBT file which uses this feature.

C64	V20	
\$DED0 [A# BB]	\$98D0 [A# BB]	Access data. Specify 8-bit 64K bank, i.e. \$00 <u>A</u> #0000
\$DED1 [A# B# BB]	\$98D1 [A# B# BB]	Access data. Specify 16-bit 64K bank, i.e. \$ <u>B</u> # <u>A</u> #0000
\$DED2 [A# B# C# BB]	\$98D2 [A# B# C# BB]	Access data. Specify 24-bit offset, i.e. \$00 <u>C</u> # <u>B</u> # <u>A</u> #
\$DED3 [A# B# C# D# BB]	\$98D3 [A# B# C# D# BB]	Access data. Specify 32-bit offset, i.e. \$ <u>D</u> # <u>C</u> # <u>B</u> # <u>A</u> #
\$DED4 [A# B# C# D# BB]	\$98D4 [A# B# C# D# BB]	Assign write offset. Specify 32-bit offset (\$ <u>D</u> # <u>C</u> # <u>B</u> # <u>A</u> #)
\$DED5 [data... L# BB]	\$98D5 [data... L# BB]	Write data. Writes <u>L</u> # (up to 254) bytes of data at current offset

Virtual Disk Commands

There is a custom command supported in addition to commands common to standard 1541 drives. Type this line in BASIC to change the current virtual disk:

```
OPEN 15,8,15,"/IMAGE.D64":CLOSE 15
```

This will replace the currently loaded D64 with the specified filename after the slash (in this case **image.d64**). The file must be in the same directory as the original D64 file that was loaded.

Coding Examples

Example machine language program to access extended data at address \$HHMMLL:

```
STA $DFHH ; access specified 64K data bank
STA $DFBB ; send BB command suffix
SEI ; must disable interrupts if your IRQ uses the KERNAL
STA $DED0 ; extended data access command
JSR WaitForAlive ; make sure memory at $DE00...$DE02 returns $BA,$CB,$17*
; note that while waiting for process to complete, KERNAL methods are inaccessible
CLI ; re-enable interrupts as necessary
STA $DFMM ; access 256-byte block of requested data bank
LDA $DFLL ; access single byte of specified 256-byte block
*Checking all 3 bytes is optional. You can usually get away with just checking the first.
```

Note that you can make unlimited requests to data inside a 64K bank once the bank is requested, and you can make unlimited requests for a byte within a 256-byte block once it is requested. So in summary, these are the access times for any given data:

- 4-6 CPU cycles for the LDA/X/Y to access single byte (w/ optional increment and offset);
- 4-7 cycles for STA/X/Y (w/ optional increment/offset) to get next 256-byte block;
- Fraction of a second to queue up another 64K of data using command request and polling to determine when cartridge comes back online. During this time the C64 can perform other processing.

The BackBit Forum™

This cartridge is being actively supported, so if you have any trouble whatsoever, please join the public forum at <http://forum.backbit.io>.

Optional Accessories

There are many fun and useful accessories to go along with your BackBit Pro cartridge!

- BackButton™ wired remote: Allows you to reset your BackBit back to the menu without having to reach to the back of the cartridge (particularly convenient for models such as the C128D and SX-64).
- All accessories are available for purchase at <http://store.backbit.io>.