



## BackBit Chip Tester Documentation v1.2.3

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

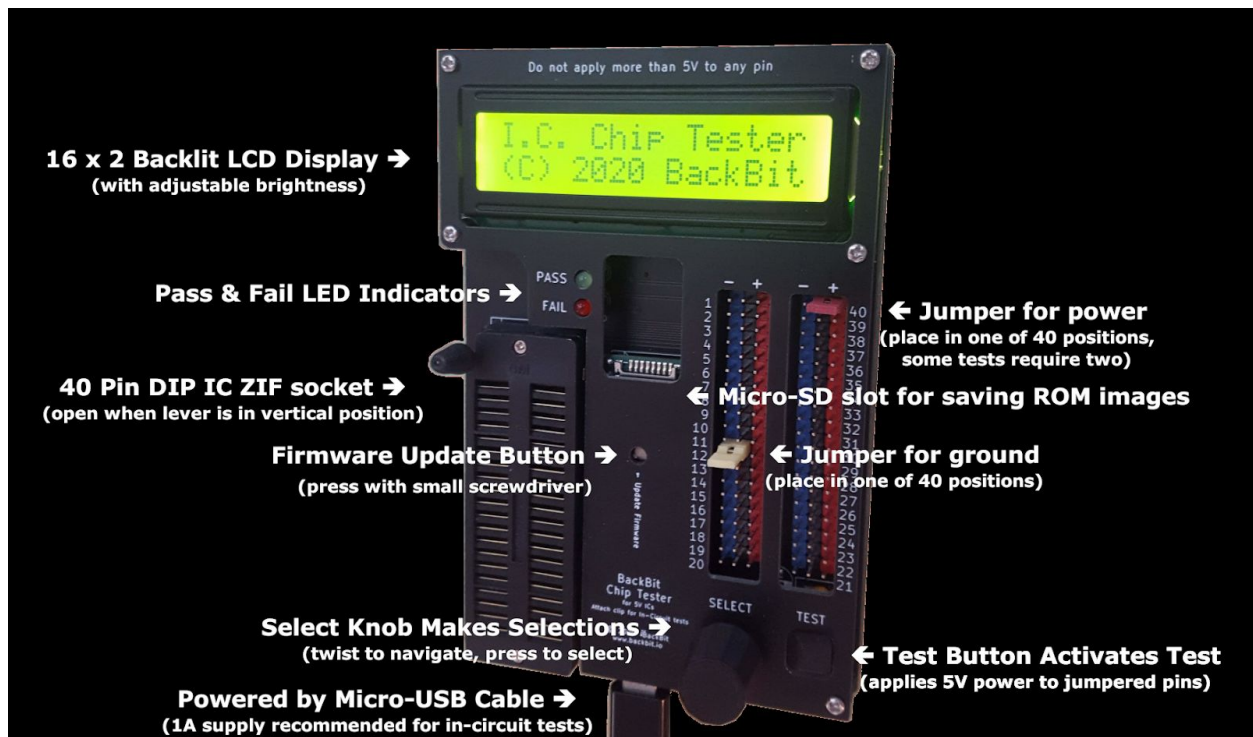
**⚠ WARNING: DO NOT OPERATE CHIP TESTER ON LIVE HARDWARE CONNECTED TO WALL OUTLET/MAINS.**

The 40 I/O pins on the tester can be damaged permanently by voltage over 5V, so never connect them to any powered items, batteries, or any devices that are plugged in.

### Summary of Features

- Micro-USB powered;
- Tests most chips present in Commodore 64, VIC 20 and related computers;
- Loose chip testing for DIP IC's up to 40 pins;
- In-Circuit chip testing of **unpowered & unplugged** devices;
- Backlit 16x2 character LCD display with adjustable brightness, contrast and dimmer;
- Bright pass & fail LED indicators;
- Rotary control with push button selection;
- Push button control to activate tests;
- Apply 5V and GND to chip via jumpers;
- Ripping of ROM images to SD card;
- Ability to update firmware via USB.

# Anatomy



## Included Items

- 6' Micro-USB cable;
- 4x Jumpers for configuring power & ground;
- 1x Clip Adapter (for easy wiring to a chip clip for in-circuit testing);
- Quick reference card.

# In-Circuit Testing



The **Clip Adapter** (one included with tester, additional clips available for purchase) provides a convenient way to attach a chip clip for in-circuit testing. You will need both a clip adapter and jumper extension wire for each chip clip you want to use.

The minimum set of clips to test most chips in the Commodore 64 is are:

- 20-pin 0.3" width clip
- 24-pin 0.6" width clip
- 40-pin 0.6" width clip

[Check out this 3M catalog for a full listing of clips.](#)

***You can use a longer clip to test a shorter chip, but it must be the correct width, and the larger the clip, the more likely it will be blocked by other components.*** I'm considering making an option in the tester to place a clip at different vertical offsets (or upside-down) to allow more options for fitting a overhanging clip

Older stock clips may be branded "A P Products".

Make sure you get the right clips:

- Do not use "nail head" clips, as these will be difficult to attach to extension wire;
- Make sure you get the correct width through-hole clips. Get 0.3" width for clips 20-pins and smaller, and 0.6" width for clips 24-pins and larger;
- You can often find clips cheaper used or old stock.

You will also need jumper extension wire. I recommend these wires with configurable headers. You can put several of them in a row. Avoid the wires with individual headers on each pin, as they will get crowded and difficult to put in long rows. Here are the products I've used:

<https://www.adafruit.com/product/3633>

<https://www.digikey.com/product-detail/en/adafruit-industries-llc/3145/1528-2179-ND/7244965>

# Firmware Upgrade

It is possible to upgrade the firmware via the USB cable. You will need a small screwdriver to complete this process.

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

The first time you upgrade, you will have to download some software:  
<https://www.pjrc.com/teensy/loader.html>

Instal the Teensy software as instructed for your operating system. Just download the program, you don't need the LED Blink example program. Once it is downloaded, you may want to copy it to a more accessible place (Applications for OSX or start menu for Windows).

Plug in the USB cable—one end to your computer and the other end to the USB port on the chip tester.

Now use the small screwdriver and gently press the “update firmware” button on the chip tester (see anatomy diagram).

Go to the File menu and click Open HEX File. Select the .HEX firmware file you downloaded (it will need to be extracted from the .ZIP container). Click the **Auto** button until it is lit bright green. You should see a progress bar indicating the firmware is transferring to the chip tester. If not, select **Program** from the Operation menu.

To verify the firmware version, wait a few seconds on the title screen and you will see it flash..

**Troubleshooting:** If the Teensy application does not recognize the device, you may have to try rebooting your computer or using another cable.

# Getting Started

1. Plug in the chip tester to an adequate USB power supply. 1A supply or more is recommended for in-circuit testing.

On startup you will see a bright green screen that says “The Chip Tester © 2020 BackBit”. If you wait a few seconds you will see the firmware version # flash.

2. Twist the “SELECT” knob or press it down to exit the title screen.
3. Now you are in the main menu. Use the “SELECT” knob to choose a test. If you navigate before the first or after the last test, it will bring up the option “Go To Options”. Push the knob to go to the options menu. A shortcut to go to the options menu from the test is by holding the SELECT button for 1 second.
4. Once in the options menu, use the “SELECT” knob to choose any of the following:
  - About: displays version information
  - Brightness: changes LCD backlight brightness
  - Contrast: changes LCD text contrast
  - Dimmer: sets timeout after which the backlight will dim until the knob is adjusted

Press the knob again to exit the individual choice, and choose “Return To Main” to go back to the main menu.

5. Once back in the main menu, the last activated test will be selected. Choose a test for a loose chip that you have. Note that some chips have different tests for LOOSE or IN-CIRCUIT configurations. To change the configuration, rotate the SELECT knob. You can specify a clip offset by rotating the knob further to the right. The clip offset specified as “In-Circuit (+5)” is the vertical offset for attaching a chip, which makes it easier to access chips when using a clip that is larger than the chip.
6. You will see a message to place the MINUS jumper at a particular position. Place the jumper on the segment matching that number, bridging the center pin to the blue pin on the left. If you do not see this message, the jumper may already be placed, or there is something in the socket interfering with the auto-detection.
7. After placing the minus jumper, you will see the message “Release Chip & Press TEST”. Do as indicated, **making sure the chip is released/removed**, and pressing the button marked “TEST”. While held down, you will see a message to place the PLUS jumper at a particular position (or multiple positions). Release the button and place the jumper(s) in the matching segment, bridging the center pin to the red pin on the right.. After placing the jumper(s), press the “TEST” button again.

8. Assuming the jumpers are all properly placed and no chip is present in the tester, you will see a message that says "Ready To Test". Once you release the TEST button, you will see a screen that says "Pin Shorts" with a number, and a message that says "Lock & Hold TEST". "Pin Shorts" indicates the number of shorted pins detected, if any. You can generally disregard this for loose chip tests.
9. Now is the time to place your loose chip in the socket. Make sure the ZIF socket's lever is in the vertical position before placing the chip. **Inserting a chip while the lever is horizontal can damage the chip and/or socket.** Once the chip is placed in the proper orientation (with notch upwards) and completely flat, you can lower the lever to the horizontal position.
10. Now press and hold the "TEST" button. You will see the result of the test, in addition to a GREEN or RED light indicating a pass or failure. Once you see the light, the test has completed. If you continue to hold down the TEST button, the test will repeat. As soon as you release the TEST button, power will be cut from the tested chip.
11. Raise the lever to the vertical position to release the chip. To test another chip with the same test, go back to step 9. To test a different chip, press the SELECT button and go back to step 5.
12. In-circuit testing works much the same way as loose chip testing, except that you place a clip adapter in the socket instead of a loose chip. Instead of releasing the chip when configuring the test, you can simply release any chip from the attached clip.
13. For more help, please ask questions in the BackBit Forum ([forum.backbit.io](http://forum.backbit.io)).

## Supported Chips

Family	Chip & Details
Timers	<b>556</b> Dual Timer Tests that timer can alternate. Not exhaustive.
CD	<b>4066</b> Quad Bilateral Switch Tests that gates short if and only if they should. Bus contention is common with in-circuit test.
74LS	<b>00-03,08,09,32,37,38,86,132,136</b> Quad 2-Input Tests that gates perform correct operation. Bus contention is common with in-circuit test.
74LS	<b>04-07,14,17</b> Hex 1-Input Tests that gates perform inversion/buffering. Bus contention is common with in-circuit test.
74LS	<b>10,11,27</b> Triple 3-Input Tests that gates perform correct operation. Bus contention is common with in-circuit test.
74LS	<b>42</b> Decimal Decoder Tests that address decodes properly.
74LS	<b>74</b> Dual Flip-Flop Tests that flip flops behave properly.
74LS	<b>133</b> 13-Input Tests that gates perform correct operation. Bus contention is common with in-circuit test.
74LS	<b>139</b> Dual 2-Line to 4-Line Decoders Tests that gates perform proper decoding.
74LS	<b>177/197</b> 4-Stage Ripple Counter Tests that counter loads, resets & counts. Failure codes: I = load, a = x2 counter, b = x8 counter, x = reset
74LS	<b>193</b> 4-Bit Counter Tests that counter loads, resets, counts up and down, carries and borrows. Failure codes: I = load, u = count up, d = count down, x = reset
74LS	<b>245</b> 8-Bit Bus Transceiver Tests that gates exhibit proper traffic.
74LS	<b>257/258</b> Quad 2-Input Selectors Tests that gates perform proper selecting. These chips are the same except that 258 has inverted outputs

74LS	<b>373 8-Bit Latch</b> Tests that gates perform proper latching.
MOS	<b>CIA 6526 / 8520 / 8521</b> Rigorous test of features, including registers, data ports, time of day, timers, alarm, and interrupts. Failures reported: <b>a</b> = data port A, <b>b</b> = data port B, <b>1</b> = timer A, <b>2</b> = timer B, <b>t</b> = time of day, <b>i</b> = interrupts Use PrivateEyes™ to reduce bus contention during in-circuit test.
MOS	<b>CLOCK 7701 / 8701</b> Tests both PAL and NTSC functionality of clock generator. Does not work in-circuit due to crystal interference.
MOS	<b>CPU 6502</b> Loose test checks for correct clock signal and walks wide range of addresses, while in-circuit test checks for correct reset sequence addressing.
MOS	<b>CPU 6510</b> Loose test checks for correct clock signal and walks wide range of addresses, while in-circuit test checks for correct reset sequence addressing.
MOS	<b>CPU 7501</b> Loose test checks for correct clock signal and walks wide range of addresses, while in-circuit test checks for correct reset sequence addressing.
MOS	<b>PLA (U17)</b> Full logic test with reporting on specific bit results in case of inexact result. In order, results list CASRAM, BASIC, KERNAL, CHAR, GRW, I/O, ROML & ROMH with codes f=fail, p=pass, and g=good (good means that formulas are correct but results don't pass bitwise)
MOS	<b>SID 6581 / 8580</b> Tests a wide variety of performance cases, though cannot test voice 1 & 2 or filters. Failures reported: <b>x</b> = x-potentiometer, <b>y</b> = y-potentiometer, <b>e</b> = voice 3 envelope, <b>o</b> = voice 3 oscillator test, <b>t</b> = voice 3 triangle, <b>s</b> = voice 3 sawtooth, <b>p</b> = voice 3 pulse/square, <b>n</b> = voice 3 noise, <b>v</b> = voltage detected on audio output
MOS	<b>PIA 6520</b> Tests registers, data ports, timers, and interrupts. Failures reported: <b>a</b> = data port A, <b>b</b> = data port B, <b>i</b> = interrupts Use PrivateEyes™ to reduce bus contention during in-circuit test.
MOS	<b>VIA 6522</b> Tests registers, data ports, timers, and interrupts. Failures reported: <b>a</b> = data port A, <b>b</b> = data port B, <b>1</b> = timer A, <b>2</b> = timer B, <b>i</b> = interrupts Use PrivateEyes™ to reduce bus contention during in-circuit test.



MOS	<b>VIC 6560 / 6562</b> Tests that registers properly retain data and correct # of raster lines Reports <b>PAL / NTSC</b> . Failures reported: <b>r</b> = registers, <b>I</b> = raster lines
MOS	<b>VIC-II 6567 / 6569 / 856X</b> Tests that registers properly retain data, IRQ works, correct # of raster lines, active color signal, active luma signal, and row/column strobes. Reports <b>PAL / NTSC</b> . Failures reported: <b>r</b> = registers, <b>i</b> = IRQ, <b>I</b> = raster lines, <b>c</b> = color, <b>b</b> = brightness/luma, <b>y</b> = RAS, <b>x</b> = CAS
SRAM	<b>2114</b> (512 byte) Exhaustive test that chip retains data properly. Use PrivateEyes™ to reduce bus contention during in-circuit test.
SRAM	<b>6116</b> (2KB) Exhaustive test that chip retains data properly. Use PrivateEyes™ to reduce bus contention during in-circuit test.
DRAM	<b>4164 / 4264</b> (8KB) <i>and</i> <b>41256</b> (32KB) Exhaustive test that chip retains data properly. Use PrivateEyes™ to reduce bus contention during in-circuit test.
DRAM	<b>4464 / 41464</b> (32KB) Exhaustive test that chip retains data properly. Use PrivateEyes™ to reduce bus contention during in-circuit test.
DRAM	<b>4256 / 4258</b> (128KB) Use PrivateEyes™ to reduce bus contention during in-circuit test.
ROM	24-Pin ( <b>2332</b> 4KB / <b>2364</b> 8KB) Tests that chip enable pins work (loose test only) and that data repeatedly matches a known ROM. Unrecognized ROMs can be saved. Use PrivateEyes™ to reduce bus contention during in-circuit test.
ROM	28-Pin ( <b>23128</b> / <b>27128</b> 16KB) Tests that chip enable pins work (loose test only) and that data repeatedly matches a known ROM. Unrecognized ROMs can be saved. Use PrivateEyes™ to reduce bus contention during in-circuit test.

***More tests will be added based on available hardware & user interest.***

# Test Results

A passing test result indicates a very strong likelihood that a chip is good. However, a failing test can result from a number of circumstances. The most reliable tests are loose chip tests, but in-circuit tests can offer helpful clues when a chip is soldered onto a board. Report your results on the BackBit forum for help and feedback.

- A chip that PASSES may not actually be a good chip. The reason is that even with the most exhaustive tests, a real world test case can interpret digital voltages differently:

	LOW signal voltage	HIGH signal voltage
Chip Tester Input	0 - 1.2V	2.3V - 5V
Chip Tester Output	0V	3.3V
TTL Input	0 - 0.8V	2V - 5V
TTL Output	0 - 0.4V	2.4V - 5V
CMOS Input	0 - 1.5V	3.5V - 5V
CMOS Output	0V	5V

If a chip is damaged and outputs a voltage in between the specification for LOW and HIGH, it could behave fine in the chip tester but not in a real world application.

Therefore, it's good to confirm that a passing chip works in a real world case.

- A failure can be the result of a poor connection. Make sure no pins on the chip are bent or tarnished. In the case of an in-circuit test, make sure your wiring rig is intact (test for continuity if necessary).
- An in-circuit failure can result from a variety of conditions:
  - Damaged or shorted wiring;
  - Neighboring chips that override the data bus. Use the PrivateEyes™ PLA test chip on breadbin/longboard model C64s to reduce bus contention;
  - Signal contention due to other chips also getting power;
  - Poor connections from socketed chips;
  - Nearby components that prevent a firm physical connection.

# Ripping ROMs

It is possible to rip a ROM chip to a binary file on a Micro-SD card. This is supported for all ROM tests on the tester.

To rip a ROM, insert a FAT32-formatted SD card. Perform the ROM test, and when the same ROM data is read twice (i.e. verified), you will see a message that says "SAVED TO FILE" along with both red and green lights turned on.

Check on your SD card, and you will see a file named ROM####.BIN with the ripped data.

*Using the optional CartRip™ accessory, you can also rip a cartridge without having to desolder or clip the ROM chip. Select the CartRip™ test, and data will be saved to RIP####.BIN instead.*

## Optional Accessories

These accessories go along with your chip tester:

- Additional Clip Adapters: Allows you to attach additional chip clips with jumper extension wire to your chip tester easily without having to rewire on configuration changes;
- CartRip™: Allows you to plug a C64 or C128 cartridge into your chip tester to identify and/or extract the contents;
- CartRipVic™: Allows you to plug a VIC 20 cartridge into your chip tester to identify and/or extract the contents. Also tests RAM expansion;
- CornBit™: Multi-ROM replacement which is programmable using the tester;
- PrivateEyes™ PLA test chip: Reduces bus contention when testing a C64 breadbin/longboard;
- All accessories are available for purchase at <http://store.backbit.io>

## The BackBit Forum™

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