

ibm-capsense-usb
Installation: Solenoid-Driver-Rev2

Tom Wong-Cornall
tom@wongcornall.com

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1 Compatibility

The Solenoid-Driver-Rev2 is designed for use with the expansion headers on any of the following controllers:

- Beamspring-USB-Rev4
- Beamspring-Displaywriter-USB-Rev1
- Model-F-USB-Rev1 & Model-F-USB-Rev2

It is designed to drive solenoids at 9V with coil resistances down to about 25–30 ohms. The original solenoids fitted to the Beamspring keyboards are around 33 ohms, which translates to just under 300mA. The solenoid driver is current limited, so lower coils with lower resistance will still work, but may not be as “snappy”.

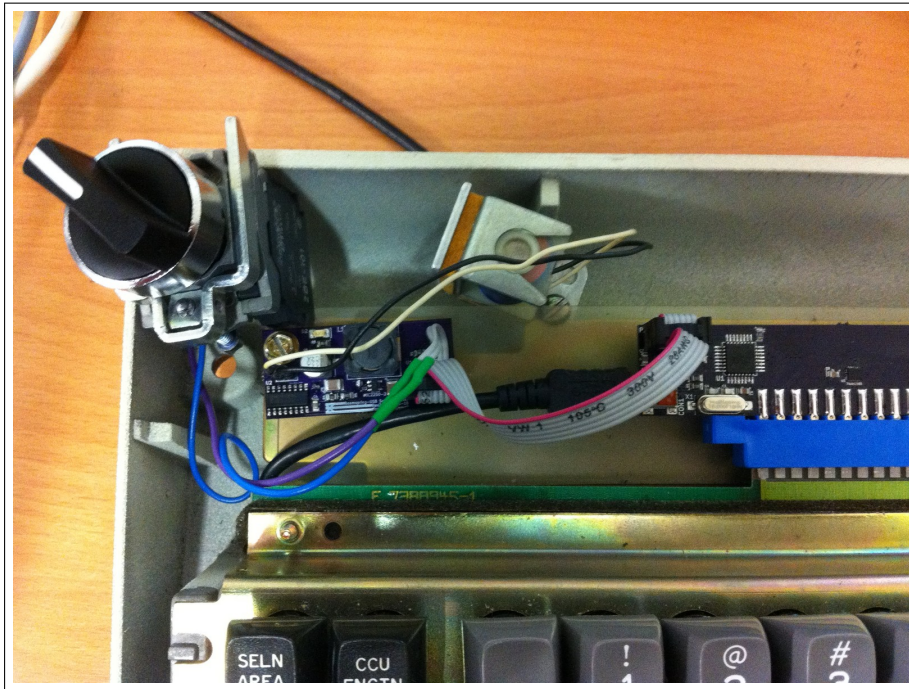


Figure 1: Solenoid driver installed into 3727 Beamspring keyboard, showing external Lock switch

2 Required parts and tools

In addition to the Solenoid-Driver-Rev2 and a compatible keyboard controller, you will need a medium flat-head screwdriver.

The solenoid driver should be supplied with a ribbon cable to attach it to the keyboard controller.

In addition, the USB software utility (“IBM Capsense USB Util”) will be required to set solenoid parameters (see the installation manual for your controller).

3 Precautions

Both the solenoid driver and the keyboard controller are reasonably robust, but some common-sense must be used. Be sure to observe the following points.

3.1 Mis-connection and hotplugging

Always make sure the ribbon cable is orientated correctly. Check Section 5 on page 4 for details. The controller and/or the solenoid driver can be damaged irreparably instantly if they are powered up with the ribbon cable backwards or offset at either end.

Never connect or disconnect ribbon cables or solenoids, or unscrew/attach the solenoid driver PCB itself while there is power present. Unplug the USB

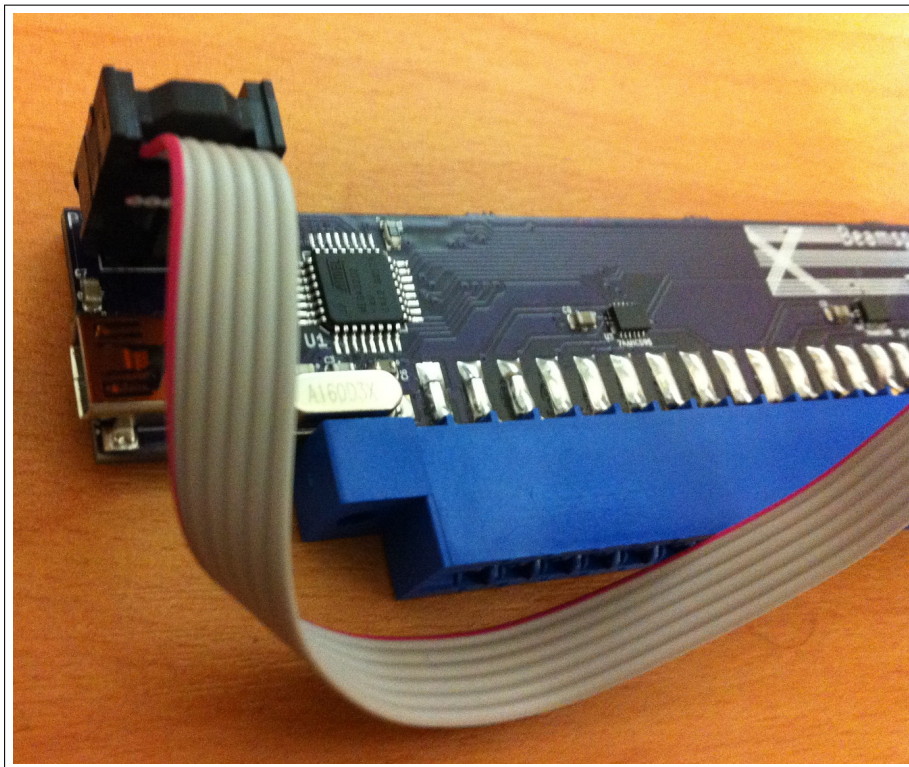


Figure 2: Ribbon cable orientation on Beamspring—note red wire at left-hand-side

cable powering the controller first. Hotplugging may lead to excess inrush current in the switched-mode power supply, or even produce sparks from the output. This can damage the solenoid driver permanently.

3.2 Static electricity

The solenoid driver is a bare circuit board, so can be damaged by static electricity. Try to keep your fingers off the components and pins, and discharge any static first by touching something big and metallic, like the top-plate of your keyboard. Be extra-cautious in low-humidity conditions, as you can build up a couple of thousand volts in static electricity simply by walking across a room.

3.3 Removing/reinstalling parts

Don't force anything. Nothing on these keyboards should be so stubborn that you need to use any strength to dismantle it.

Be careful of cross-threading screws when they are re-installed, and make sure all washers are retained.

3.4 Cabling

Don't kink or fold the ribbon cable.

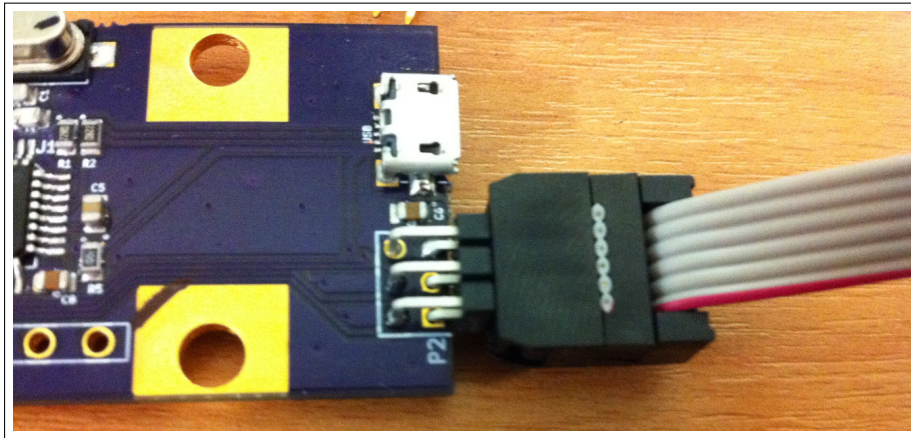


Figure 3: Ribbon cable orientation on Model F—note red wire at bottom

If there is much excess wire length on the solenoid leads, try to route them away from the controller itself. They may radiate some interference, which could cause temporary sensing glitches.

3.5 Short circuits

Ensure the solenoid driver won't come into contact with any metal parts or wires that could cause shorts.

Make sure it is secured with a screw to the top-plate of the keyboard; this will not only stop it moving around the keyboard and shorting out on parts, but is also critical in terms of reducing interference.

4 Software setup

Before performing the steps in Section 5, first make the following configuration changes:

- Start the software utility (as described in the relevant installation manual for your controller), and select “Solenoid/Buzzer” from the Mode drop-down under “Expansion header”.
- For some starting values, set “Extend time (ms)” to 40, and “Retract time (ms)” to 80. If you leave these set to the defaults 255 and 255, the solenoid driver will not react.

5 Mechanical installation

1. Unplug the USB cable from the controller so it is not powered; you must never perform any work with the solenoid driver with power on.
2. Plug the ribbon cable into the keyboard controller. Use Figure 2 on the preceding page, Figure 3 and Figure 4 on the following page to determine

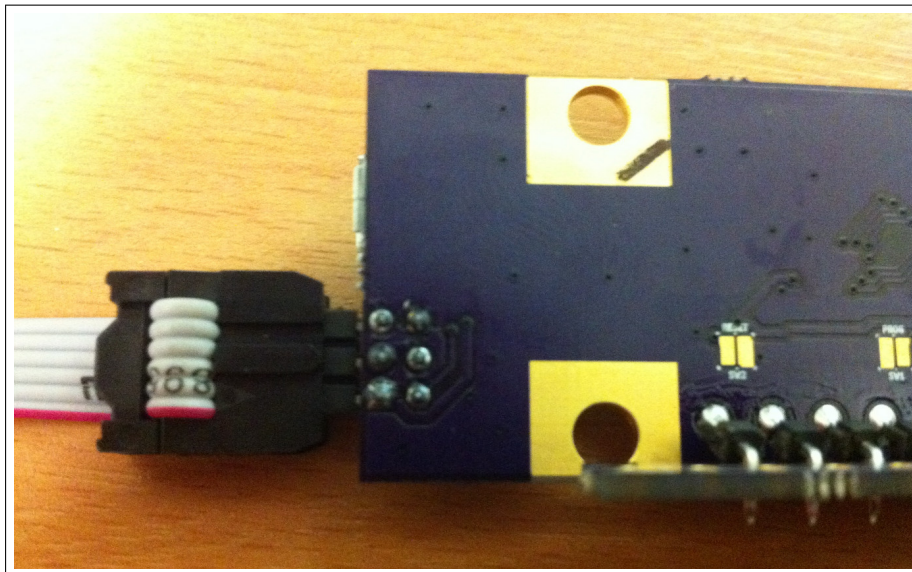


Figure 4: Ribbon cable orientation on 3178—note red wire at bottom

which way to plug it in, taking note of the red wire (denoting pin 1). If in doubt, refer to the installation manuals relevant to your controller (remembering pin 1 on the header is soldered to a square pad).

3. Screw the solenoid driver PCB to a screwhole within reach of the ribbon cable. The screwhole should be one attached to the top or bottom plate of the keyboard for good grounding.
4. Plug the other end of the ribbon cable into the male pin headers marked P1 at the bottom-right of the solenoid driver PCB (when the PCB is orientated so the text is readable). Most solenoid drivers will have one pin missing in the bottom-right, and the ribbon cable will usually have a corresponding blanking plug, but if not, the red wire on the ribbon cable should go to the left-hand-side.
5. Double-check all connections you have made so far!
6. *Don't* plug the solenoid itself in just yet—first plug the controller back into USB, and make sure the keyboard is still operating correctly.
7. Try pressing a key (other than Ctrl, Alt, GUI, Fn or Select). You should see the red LED on the solenoid driver briefly flash on. Try hitting a bunch of keys at the same time—you will see the LED will flash many times after you have stopped pressing keys.
8. Unplug the USB cable once more.
9. Now plug the solenoid wires into the 2-position male pin header marked P3 at the left-hand-side of the solenoid driver. Polarity doesn't matter.

10. Plug the USB cable back in, and try pressing a key as before. You should see both the red LED flash, and the solenoid should click. As before, try pressing a bunch of keys at once; the solenoid should carry on clicking for a while.

6 Tuning

The solenoid moves very quickly, but a fast typist—or one rolling over many keys in the middle of a word—may exceed the return spring’s ability to move the clicker back again in time.

As such, the controller will record and queue up a number of keypresses, to be “played back” by the solenoid on a time basis that suits it.

The solenoid action is governed by two parameters, *extend time* and *retract time*, both expressed in milliseconds.

These are not absolute timer numbers, but rather points along a timeline. An example of operation with extend time set to 60 ms and retract time set to 150 ms is as follows:

0 ms Key is pressed, solenoid is turned on

60 ms Solenoid is turned off

150 ms Sequence finishes, and if another key was pressed (or was queued up) then it will restart from 0 ms

If the extend time is set to a higher number than the retract time, the solenoid will never turn on, or may be held on permanently until the values are modified).

By the same token, if they are set to an identical value, the solenoid will never actuate at all.

Ideally they should be set to the smallest value possible, so that the solenoid will keep up with the fastest typing. However, because the solenoid can physically only move so fast, you will need to allow at least a minimum time.

If the values are set very high (e.g. 125 and 250), the solenoid will click very slowly and it will quickly fall behind your typing speed.

Based on the individual characteristics of your solenoid, you may have to experiment with different values. In practice, values of 40 and 80 have worked well.