Soft-Touch Relay Bypass

mas-effects.com/relay-bypass

v1.49 and later

MAS EFFECTS

INTRODUCTION

Typical 3PDT latching mechanical switches are noisy, hard to press, and prone to mechanical failure after repeated use. A controller board with a relay is a great alternative, and provides some other really great options you couldn't otherwise do.

This tiny and featureful relay bypass board can do a LOT.

- Soft touch, momentary switches can toggle your DIY guitar pedal, using a relay to provide true bypass.
- Quick tap to switch between engaged and bypass, or hold the foot switch to temporarily toggle until you release it
- Fits easily in a tiny 1590A enclosure
- Remembers state when powered off

- Optional optocoupler muting can be enabled with a switch or jumper to mute any popping your circuit might exhibit while switching
- Hold when powering on to toggle auto-on/auto-off
- Passes signal when powered off
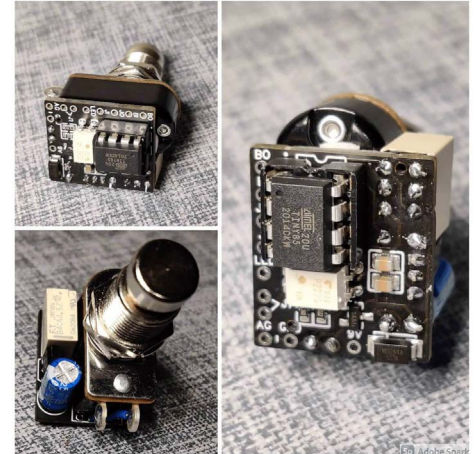
GENERAL-PURPOSE SWITCHING

This relay module is designed specifically for pedal true bypass, and connects your board's input to GND when bypassed, and is labeled for easier hook-up.

If instead you want a general-purpose switch for use anywhere, check out our digitally-controlled relay switch module instead:
mas-effects.com/relay-switch

SPECIFICATIONS

Input voltage:	6V to 12V DC
Typical current:	4.7mA
Typical switching current:	15mA
Max switching current:	22mA
Required foot switch or button:	SPST, momentary, normally-open

GETTING HELP

For any questions or problems, visit our forum at
mas-effects.com/support

USAGE INSTRUCTIONS

TOGGLE ENGAGE/BYPASS

When bypassed, the sound signal will go directly from your input to your output jacks. Tap the foot switch to engage the effect and route the signal to your audio PCB. When engaged, tap the foot switch again to switch to bypass.

TEMPORARILY ENGAGE/BYPASS

Holding the foot switch while the effect is engaged will temporarily bypass it, and it will re-engage when you lift your foot. Similarly, holding the foot switch while bypassed will temporarily engage it.

BUILDING INSTRUCTIONS

1. INSTALL MICROCONTROLLER

Solder the microcontroller to the PCB. Optionally solder an 8-pin DIP socket instead, and install the microcontroller in the socket.

Ensure the dot or the half-circle on the microcontroller is oriented the same as the one drawn on the PCB.

You may have received either an ATtiny13 or an ATtiny85. The differences don't matter for this application.

2. INSTALL RELAY

Flip the PCB over and insert and solder the relay.

Its orientation is important, but the non-symmetric spacing of its 1st and 8th pins ensure you install it correctly.

3. INSTALL REMAINING PARTS

Install the capacitor, and (for version 1.49 and earlier) the voltage regulator.

1.5 and later have a pre-soldered regulator.

4. POWER

Connect a 6V to 12V DC power supply to the VCC and GND connectors.

A 9V battery, or a 2.1mm DC jack are popular options.

OPTOCOUPLER MUTING

By default, no muting is done.

However, you may find you have a noisy audio circuit that tends to pop when engaged or disengaged. When this occurs you can add the optional U1 optocoupler and connect the "MUTE" jumper pads to temporary soften the volume (~35ms) when engaging and bypassing. You can either directly connect them with a wire or solder, or use a switch.

This behavior needs to be enabled in the firmware, and you must specifically request it when ordering a MAS Effects kit. By default it is disabled since it adds a necessary lag to the switching.

It's our firm recommendation that you try to solve the root cause of the noise rather than mask it. This method does not always help, anyway.

ANALOG AND DIGITAL GROUNDS

The analog ground (AG pad) and digital ground (GND pad) on the PCB are connected, and are all part of a single ground. You can simply use the AG pad as an additional GND pad if you'd like.

If, however, you want to separate your audio and digital grounds, e.g. because you're joining them elsewhere in your pedal, then carefully cut the trace between the AG and GND pads. There is a small line drawn in the silk layer showing where to cut. Then solder wires between these pads and your other grounding points.

WIRING GUIDE

- **BO** (*Board Output*)
  Connect this to the "Output" of your audio PCB.
- **BI** (*Board Input*)
  Connect this to the "Input" of your PCB.
- **JO** (*Jack Output*)
  Connect this to the tip of your Output jack.
- **JI** (*Jack Input*)
  Connect this to the tip of your Input jack.
- **LED**
  Supplies 5V when effect is engaged. See "Adding LEDs" below.
- **MUTE**:
  These two pads can be connected to enable optocoupler muting, if and only if it's enabled in your firmware as well.
- **GND**
  Connect this with all the other ground points of your pedal.
- **AG**
  This is another GND pad, but can be used to isolate analog and digital grounds. See notes above.
- **SW1**
  Connect one of the two lugs of a SPST, normally open, momentary foot switch or button.
- **SW2**
  Connect to the other lug of the foot switch. This is technically another GND pad.
- **9V**: Connect to a 6V to 12V power supply.

ADDING LEDS

The LED pad will supply 5V when the effect is engaged, and 0V when bypassed..

OPTION 1: DIRECT

The LED pad is capable of driving a **single LED**. The simplest way to hook this up is shown here:
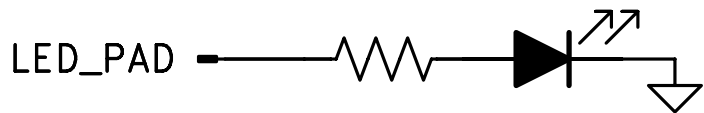
LED_PAD ———————⋀⋀⋀———▷|———▽

The anode (+) side of the LEDs connects through a resistor to the LED pad on the PCB.

The size of the resistors will depend on the color and size of your LEDs. Experiment to find a suitable value.

The cathode (-) side of the LEDs should be tied to a GND point such as your power supply's negative side.

OPTION 2: TRANSISTOR

Use transistors to drive **multiple LEDs** or other types of indicators or situations that require high current or voltages above 5V. Here's an example of how you might do that.

VCC

LED_PAD ———⋀⋀⋀— B
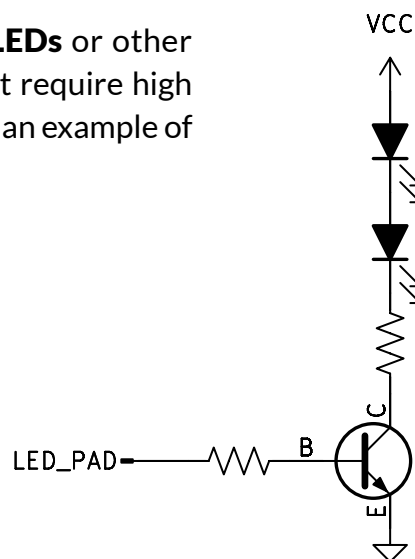
CUSTOMIZING

MULTIPLE KITS WITH ONE BUTTON OR SWITCH

You can use a single switch to control multiple relay bypass kits.

Connect each PCB's VCC and GND to your power source.

Connect one side of your button or switch to SW1 on each PCB.

Connect the other side of your button or switch to SW2 on at least one of the PCBs. It does not need to be connected to each PCB since SW2 is actually a GND pad, and their GND net should already be connected for the power.

CHANGING BOOT MODE

When powering up the module, by default, it will remember and boot into the most recent state. To change this, hold down the button while plugging in power and it will cycle to the next mode and blink the LEDs to indicate its current mode.

To change it again, unplug and repeat.

- 3 blinks: boot with effect ENGAGED
- 4 blinks: boot with effect BYPASSED
- 5 blinks: REMEMBER bypass/engage state

OTHER CUSTOMIZATIONS

Some operational parameters can be easily tweaked before programming the microcontroller. e.g., switch timing, whether or not "hold for momentary" is enabled, etc. You can modify the source and customize it yourself (see appendix). Alternatively, reach out and we may be able to customize any kits you plan to order.

 Some changes may require a fee, but most do not.

Reach out directly at mas-effects.com/contact or start a discussion in our forum at mas-effects.com/forum.

SCHEMATIC
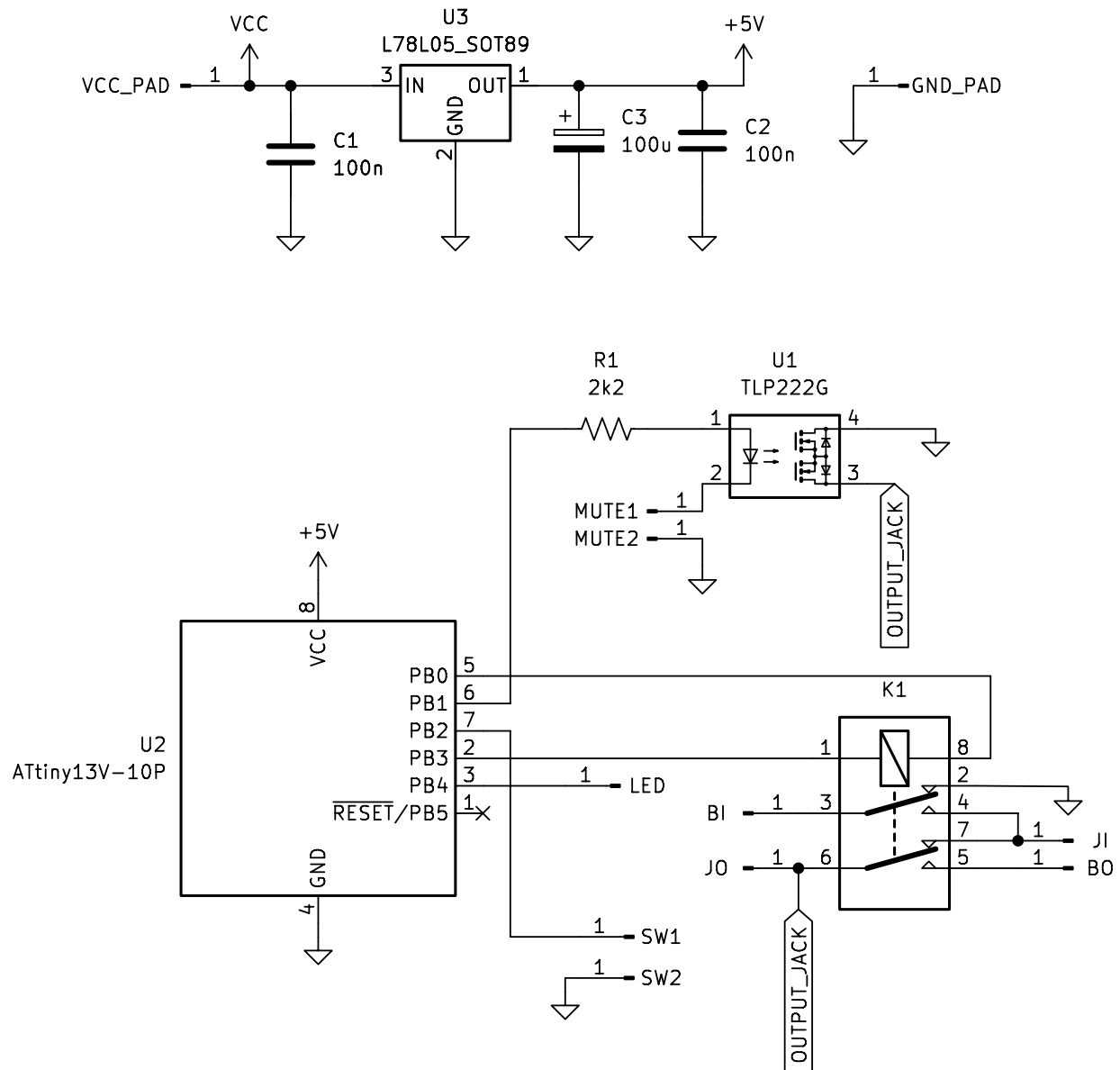
BILL OF MATERIALS (BOM)

Pre-soldered to PCB		Included with kit		Not included, Required
C1, C2	100nF	U2	ATtiny13 or ATtiny85	SPST, normally-open, momentary switch or button
R1	2.2kΩ	K1	FTR-B4CB4.5Z	
U3	L78L05	C3	100uF	**Not included, Optional** U1 TLP222G

KIT REVISIONS

1.5: Replaces through-hole voltage regulator (U4) with a pre-soldered SMD version (U3)

1.49: Uses the 1.4 PCB and same hardware setup, but adds memory to the bypass state. By default it will remember whether the effect is engaged or bypassed (and uses wear leveling to store this). Holding the switch down at startup will toggle the behavior.

1.4: No longer uses RESET pin as GPIO. Reconfigured the way the muting circuit is connected to GND, using jumper

1.3: Switched to latching relay. Not as DIY-friendly if you scratch-build (from a kit, however, it's exactly the same as V4). It requires you to write a fuse to disable the RESET pin and turn it into a GPIO pin. After doing this you can't re-program the ATtiny without special equipment. i.e. if you're not careful you may waste some microcontrollers.

1.2: Refined (details forgotten) version of the initial release. Non-latching

DOCUMENT REVISIONS

2023-07-16 Refreshed guide

2023-07-18
Added missing GND to pin 2 on relay in schematic.

Earlier versions:

1.4: mas-effects.com/relay-1.4.pdf

1.3: mas-effects.com/relay-1.3.pdf

1.2: mas-effects.com/relay-1.2.pdf

SOURCE AND LICENSE

https://github.com/mstratman/relay-bypass