

# IMP-SPST – 2<sup>nd</sup> Generation

## Installation and Usage

This document describes the installation and usage of the Imp-SPST MIDI mod of the 2<sup>nd</sup> generation. For a description of the product, its features and further information visit <https://oscillatordevices.com/imp>

### Electrical Properties

Electrical Properties	Min	Typ	Max	
Supply Voltage (+9V Terminal)	7	9	20	VDC
Current Consumption	3		20	mA
Maximum voltage at LED, RLY and CTL terminal			5	VDC
Output voltage at SW terminal			5	VDC

The Imp-SPST has reverse polarity protection at the +9V terminal. Be careful nonetheless to not reverse polarity upon installation, as long as other wires are connected. Negative currents could flow through the microcontroller and damage it.

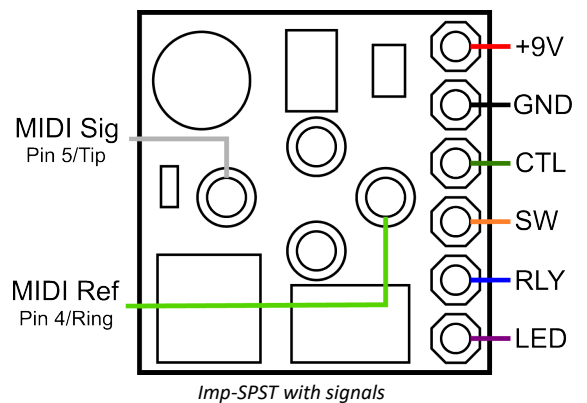
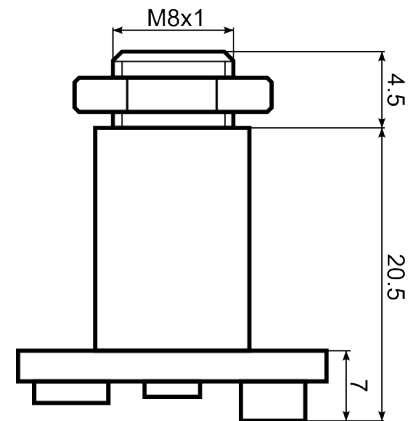
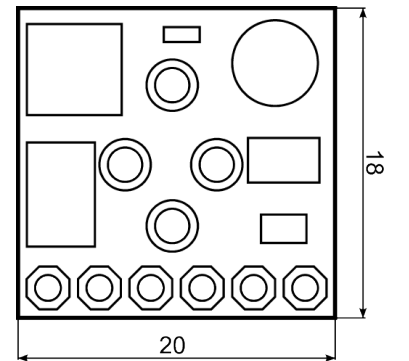
**Attention:** Digital signals, such as MIDI signals, can lead to crosstalk on other lines. This particularly applies to effects with multiple gain stages (distortion, fuzz, etc.). Pay attention to keep the MIDI wires as far away from the analog circuit as possible. Otherwise it can happen that a click can be heard in the audio signal with every MIDI command. To further reduce possible crosstalk, use shielded wires.

### Overview

The Imp-SPST is made to take control over effects devices that are controlled with a non latching SPST (or (ON)-OFF) switch. The original switch is connected to the Imp and the Imp is connected to the effects devices. The Imp then emulates a switch. The effects device can then be triggered via MIDI or foot switch. Here's a quick overview over the connections:

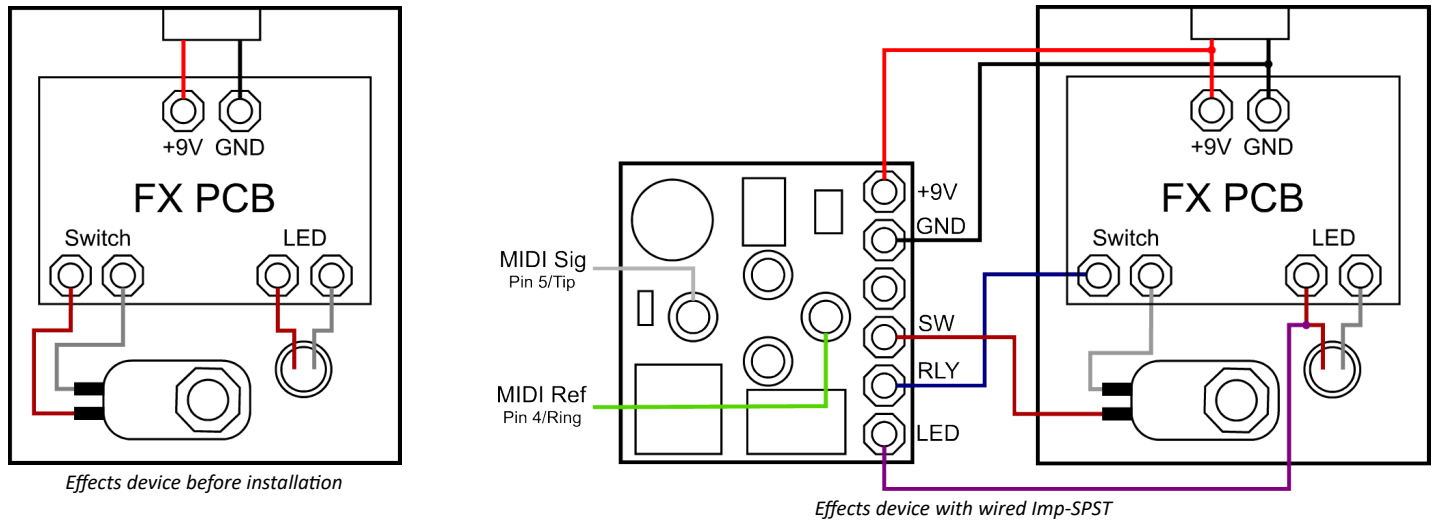
- **+9V/GND:** This is the power supply. Connect them directly to the DC jack of the guitar pedal.
- **SW:** This is where one side of the foot switch is connected. The other side has to be connected to GND.
- **RLY:** This is the connection to the guitar effects. Connect it to where the foot switch was originally connected. It emulates the foot switch.
- **LED:** This is the connection for the status monitoring. It has to be connected to a voltage that represents the state of the guitar effects. The Imp measures this voltage to determine the state. Most of the time it is connected to one side of the LED.
- **CTL:** This is an additional output for controlling auxiliary switch connections, like the JHS Red Remote, or tap tempo inputs. Leave open if not used.
- **MIDI Sig:** This is the active MIDI signal. It is connected to **Pin 5** of a DIN 5-PIN MIDI Connector, or **Tip** if a TRS connector according to MIDI standard (Type A) is used.
- **MIDI Ref:** This is the reference MIDI signal. It is connected to **Pin 4** of a DIN 5-PIN MIDI Connector, or **Ring** if a TRS connector according to MIDI standard (Type A) is used.

### Mechanical Properties



# Installation

In the images below you can see an example of a typical non latching SPST guitar effects, such as EQD, Walrus, or Wampler. The image on the left depicts the device before the installation. The image on the right shows how the Imp-SPST is wired for that case.



Let's have a look what the single connections do.

## Switch Connection (SW)

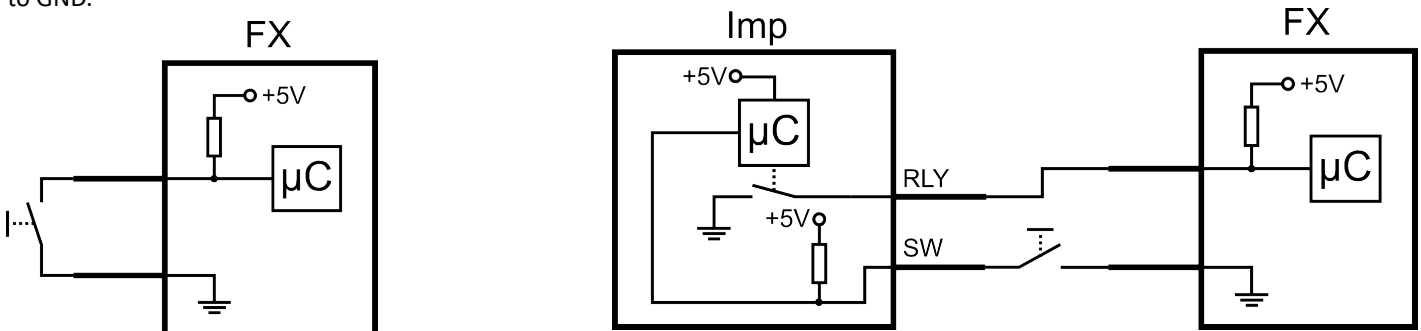
The connection SW is for connecting a non latching SPST switch. It has an internal 5V pull up. The other side of the switch has to be connected to GND.

For regular cases, like the one above, the active (or high) side of the switch has to be disconnected from the effects device and connected to the Imp, while the GND side stays connected. Measure both sides with a DMM and do not rely on wire colors.

Most switches are normally open. In rare cases there are normally closed switches. Refer to **Configuration** for further information.

## PCB connection (RLY)

The connection RLY emulates a switch. For that it connects to GND for a brief moment. In the picture on the left you can see a typical effects device switching scheme. A microcontroller detects the switching, when the 5V line is pulled to GND via the switch. On the right you can see how the Imp connects to that scheme. Instead of the switch, the internal microcontroller of the Imp pulls the line to GND.



Before connecting the Imp it is important to control, that the voltage on the effects device does not exceed 5V. Everything below is fine.

## Status monitoring connection (LED)

With the connection SW and RLY the FX device can be switched by the Imp. But the Imp doesn't know if the effects device is On or Off. To switch to a certain state (On/Off) this information is crucial. For that the Imp can measure the voltage on the LED connection and determine the state with that. The only thing needed for that is a voltage that changes with the state of the effects device and is not higher than 5V. In most cases the voltage of the LED is perfect for that. Here is how it works:

1. Switch the effects device on and measure the voltage on both pins of the LED to GND.
2. Switch the effects device off and measure the voltage on both pins of the LED to GND.
3. On one of the pins the voltage changes. Write down the voltages and connect this pin to LED on the Imp.

Here is a real world example of the EQD White Light. Two pins of the LED (called A and B) are measured to GND:

	Effects device on	Effects device off
Pin A	0V	0V
Pin B	1.8V	0V

For that example, Pin B would be used for the LED connection. LED polarity is “High Active” because when the effects device is active, the voltage is high. The LED threshold would be 0.9V.

## Auxiliary switch connection (CTL)

There is an additional output that can be used to control secondary functions. It depends on the effects device if it can be used and what it can do. Internally it is the same as the RLY output. It is either open or connected to GND. That means it can be used to emulate a switch. Here are a few examples:

- Controlling of Red Remote sockets of JHS effects, or other channel switches.
- Controlling of tap tempo switches by syncing to MIDI clock.
- Controlling of other external switch connections.

Just connect the socket or switch to CTL. Please check if 5V are not exceeded.

## Recommended order

This was a lot of information. Here’s a short guide how to get started with the installation:

1. Disassemble the effects device, find the positive and negative pins on the supply voltage and connect the +9V and GND connections to it.
2. Measure the connections of the foot switch and find the “active side” i.e. the pin of the switch that changes its voltage when the switch is pressed. Desolder the wire from the active side of the foot switch. Connect the loose end to RLY and connect the free pin of the foot switch to SW.
3. Measure both pins of the LED in the on and off state. Find the pin, that changes it’s voltage when changing state, connect the LED connection of the Imp there. Determine LED polarity and LED threshold like in **Status monitoring connection (LED)**.
4. With the collected data figure out the configuration (if necessary) and send the configuration commands. Test.
5. Mount the Imp and assemble the pedal.

# Configuration

In order to be able to adapt the Imp to the conditions of as many effects devices as possible, various parameters can be set via the configuration. The configuration is always carried out via MIDI CC messages and consists of 4 messages per parameter. The actual configuration message, two passcode messages and a save message. The configuration messages are described below. For passcode and save message, see **Saving the Configuration**.

## LED Threshold

The Imp monitors the voltage of the LED connection. Depending on whether the threshold is exceeded or not, the status is recognized as "on" or "off". Since LED voltages can vary greatly, the threshold can be set. Take the value that is halfway between the measured values from chapter **Status monitoring connection (LED)**.

CC	#	Function
18	n	LED threshold in 0.05V steps. Default is 24 (=1.2V)

There is a [spreadsheet](#) to help with calculation of the LED threshold.

## LED Polarity

Sometimes the voltage on LED is “off” higher than “on”. In that case the LED polarity needs to be changed to “Low Active”.

CC	#	Function
17	0	Low Active
	1	High Active (Default setting)

## Configuration bits

The following configuration bits are only necessary in extremely exceptional cases. They allow more in-depth configuration, or setting more parameters with fewer messages. The following parameters are set with a 7-bit word.

CC	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2-0
	POL-LED	FX-DRIV	POL-RLY	POL-SW	Not used
19	Polarity of the LED 0 = Low Active 1 = High Active (*)	Driver function of port 0 = Push Pull 1 = Open Drain (*)	Polarity of FX 0 = Normally Closed 1 = Normally Open (*)	Polarity of Switch 0 = Normally Closed 1 = Normally Open (*)	

(\*) = Default setting

- **POL-SW:** Switch polarity. Normally open switches are used most of the time.
- **POL-RLY:** Polarity of the emulated switch on RLY. Usually this value is set to the same value as POL-SW.
- **FX-DRIV:** The FX side (connection RLY) usually expects a +5V line, which is briefly pulled to GND in order to switch the effect. If this is not the case the Imp can drive +5V itself. To do this, set this bit to Push Pull.
- **POL-LED:** The LED Polarity. Same as **LED Polarity** above.

It should be noted that these settings must always be set together. The entire word is always used.

There is a [spreadsheet](#) to help with the calculation of the configuration bits and LED threshold.

## Startup Delay

Some effects devices need some time after being connected to the supply voltage, before they are ready for operation. This ranges from a few milliseconds to several seconds. So the Imp can correctly restore the last state and the boot process of the effects device is not disturbed, the effects device should first be ready for operation before the Imp begins its work. Therefore a delay at the beginning can be useful.

CC	#	Function
16	n	Startup delay n*100 ms (Default n = 5)

## MIDI Channel via MIDI command

The MIDI channel can either be set via the foot switch, or a MIDI command.

CC	#	Function
15	0	Set MIDI channel to Omni (reacts to every channel)
	1...16	Set MIDI channel to channel 1...16

## Saving the Configuration

In order to save the configuration, the following three commands must be called immediately one after another. If another command is sent in between, the save sequence is aborted. The effects device must be restarted for the changes to take effect.

CC	#	Function
9	18	First passcode message for the saving sequence
9	52	Second passcode message for the saving sequence
9	Save messages:	
	0	Saving the <b>MIDI channel</b> from command CC 15
	1	Saving the <b>LED polarity and configuration bits</b>
	2	Saving the <b>LED threshold</b>
	3	Saving the <b>startup delay</b>

Example: To set an LED threshold of 1.8V, the following four commands are sent back-to-back:  
CC 18 36, CC 09 18, CC 09 52, CC 09 02.

# Operation

## Setting the MIDI Channel by using the foot switch

To change the MIDI channel with the foot switch, follow the steps below:

1. Disconnect the device from the power supply.
2. Press and hold the foot switch and connect the device to the power supply. The device starts to flash its LED.
3. Press the foot switch according to the number of the MIDI channel you wish to set (e.g. twice for MIDI channel 2). The Imp acknowledges this by emitting short flashing pulses corresponding to the number of the desired MIDI channel.
4. Once the desired channel is set, press and hold the switch until the *Imp* switches off completely.
5. Disconnect supply voltage. The next time the *Imp* is started, it reacts to the new MIDI channel.

To put the Imp in omni mode (i.e. it responds to every channel) skip step 3.

## MIDI Command Switch

CC	#	Function	#	Function
20	00	Effect Off (Bypass)	15	Toggle to the beat of the MIDI clock in 1/32 notes
	01	Effect On	16	Toggle to the beat of the MIDI clock in 1/2 notes
	02	Toggle (On to off or off to on)	17	Toggle to the beat of the MIDI clock in whole notes
	03	Hold (Corresponds to a pressed and held switch)	18	Toggle to the beat of the MIDI clock every 2nd whole note
	04	Release (Release held switch)	19	Toggle to the beat of the MIDI clock every 3rd whole note
	10	Toggle to the beat of the MIDI clock in 1/4 notes	20	Toggle to the beat of the MIDI clock every 4th whole note
	11	Toggle to the beat of the MIDI clock in 1/8 notes	21	Toggle to the beat of the MIDI clock every 5th whole note
	12	Toggle to the beat of the MIDI clock in triplet notes	22	Toggle to the beat of the MIDI clock every 6th whole note
	13	Toggle to the beat of the MIDI clock in 1/16 notes	23	Toggle to the beat of the MIDI clock every 7th whole note
	14	Toggle to the beat of the MIDI clock in dotted 1/8 notes	24	Toggle to the beat of the MIDI clock every 8th whole note

## MIDI Command CTL

The CTL connection of the Imp is a slimmed down version of the TRS port of the *Goblin* or the *Garbage Collector*. CC 40 00 opens the switch and CC 40 01 closes it. That corresponds to a latching foot switch. The single pulse commands CC 40 02 and 03 corresponds to a non latching foot switch, either normally open or normally closed.

To sync something to MIDI clock use CC 40 10 and 11. Sometimes effects devices don't like to be triggered all the time. In that case use CC 40 20 and upwards. It then only emits a few pulses until the effects device has caught on. The number of pulse is the difference to the lowest value.

CC	#	Function	#	Function
40	00	Set „Open“	20	1 pulses on MIDI clock 1/4 normally open
	01	Set „Closed“	21	2 pulses on MIDI clock 1/4 normally open
	02	Single pulse normally open	...	
	03	Single pulse normally closed	39	20 pulses on MIDI clock 1/4 normally open
	04	Toggle (On to off or off to on)	40	1 pulse on MIDI clock 1/4 normally closed
	10	Continuous pulses on MIDI clock 1/4 notes normally open	41	2 pulses on MIDI clock 1/4 normally closed
	11	Continuous pulses on MIDI clock 1/4 notes normally closed	...	
			59	2 pulses on MIDI clock 1/4 normally closed