

# 2140 Low-Pass Filter (LPF) Manual

The 2140 Low-Pass Filter (LPF) uses the SSI2140 IC i.e. the official successor to the legendary SSM2040 IC; considered by many to be one of the best sounding filters of all time.

To preserve the sonic qualities of the SSM2040, the input signal of the 2140 LPF can be overdriven via the front panel signal level control to unleash the classic analog character that it was known for.

In addition to standard frequency and resonance controls, a wide range of modulation possibilities are available, including FM and resonance CV.

A switch on the front panel also allows the user to switch on Q compensation, to avoid a loss in signal gain as resonance is increased. Alternatively, this can be switched off to give a standard, classic uncompensated filter.

## Features

- SSI2140 IC continuing the legacy of its iconic predecessor; the SSM2040.
- Four-pole 24dB/octave low-pass filter.
- Input signal can be overdriven to obtain the classic sonic character the SSM2040 was famed for.
- Switchable Q compensation. Can also be switched off to leave a classic, uncompensated filter.
- Manually controllable resonance and cutoff frequency.
- Frequency range greater than audio range (> 20Hz to 20kHz).
- Capable of self-oscillation i.e. producing a sine wave output.
- Thermally compensated 1V/octave input.
- Numerous modulation possibilities including FM and resonance CV inputs (0V to 10V input range).
- Ergonomic design.

- Hand-built and tested in the UK.

## Front Panel Overview



- **1. Signal input level attenuator** – allows manual attenuation of the signal input. Unity-gain is achieved when the knob is set to approximately 7. When the knob is rotated above approximately 8, the signal begins to overdrive the input, producing some interesting timbres.
- **2. Frequency control** – provides manual control of the cutoff frequency of the filter.
- **3. Resonance control** – allows manual control of resonance amount. At higher levels, it will cause the filter to self-oscillate i.e. produce a sine wave output. Also acts as an attenuator for the

Resonance CV input **(11)** from 0 to 1 (unity gain), when an input signal is present.

- **4. Q compensation switch** – turns on or off the Q (resonance) compensation. When switched on, the gain of the filtered signal remains constant as resonance is increased. When turned off, the filter acts more like a classic design, in which the signal gain reduces with increasing resonance.
- **5. FM 1 control** – attenuates the level (up to unity gain) of the FM 1 input **(9)**.
- **6. Tracking control** – allows attenuation of the filter tracking i.e. varies the 1V/OCT input **(12)** from 0V/octave (fully CCW) to 1V/octave (fully CW).
- **7. Signal input** – input for the audio signal to be filtered.
- **8. Signal output** – output for the filtered audio signal. Also outputs a sine wave when the filter is in self-oscillation.
- **9. FM 1 input** – allows a CV source, such as an LFO or envelope etc. to modulate the cutoff frequency of the filter.
- **10. FM 2 input** – allows a CV source, such as an LFO or envelope etc. to modulate the cutoff frequency of the filter.
- **11. Resonance CV input** – allows a CV source, such as an LFO or envelope etc. to modulate the resonance level of the filter.
- **12. 1V/OCT input** – allows a 1V/octave source, such as a sequencer or keyboard to control the cutoff frequency of the filter. It also controls the frequency of the sine wave output when the filter is in self-oscillation. **Note: if using a device that only outputs MIDI, then you will require a MIDI to CV converter.**

## Installation

To install the module, simply locate it where desired in your Eurorack case (10HP space required), then plug it into the power distribution board of your case, using a standard 16-pin to 10-pin ribbon power cable. All of our modules feature shrouded power inputs to prevent the power cable from being plugged in the wrong way round.

Once the power cable has been plugged into the module, align the mounting holes of the panel with the holes in the case and secure it using four M3 x 6mm screws.

## Calibration

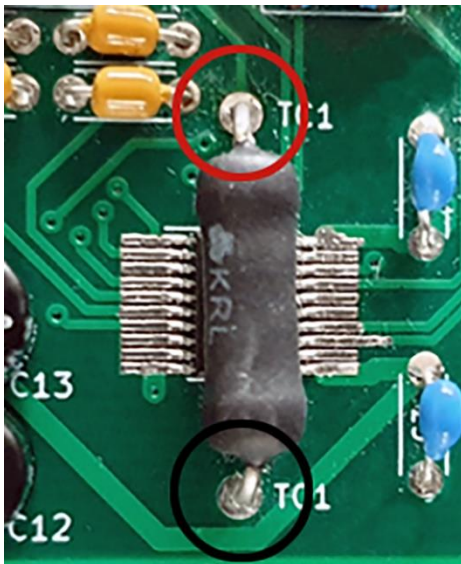
The 2140 LPF is pre-calibrated to track 1V/octave during manufacture, so calibration by the user should not be necessary. However, if required for whatever reason, it is a relatively straightforward procedure.

A frequency measuring device, such as an oscilloscope, a digital multimeter and a 1V/octave source are required to carry out the following procedure:

1. Power up the module and allow it to warm up for 5-10 minutes.
2. Ensure the signal level attenuator **(1)** is turn fully CCW, the resonance control **(3)** is fully CW and the tracking control **(6)** is fully CW.
3. Connect your 1V/octave source e.g. keyboard into the 1V/OCT socket **(12)** of the module.
4. Connect the filter output **(8)** to your oscilloscope and apply a positive voltage into the 1V/OCT input that provides a frequency of approximately 1kHz, as indicated on the oscilloscope. A sine wave

should be displayed i.e. the filter should be in self-oscillation. The exact note used is not important at this stage. Use the frequency knob **(2)** as necessary to set the frequency to exactly 1kHz.

5. Increase the input voltage by exactly 1V i.e. one octave and adjust the Scale Adj. trimmer until the frequency is exactly double that of the first frequency i.e. 2kHz. It may be necessary to repeat this process several times to obtain the desired result. **Please note: being a filter; the module is not designed to track 1V/octave to the same accuracy as a VCO.**
6. Once calibrated to 1V/octave, ensure the frequency knob is set full CCW and the tracking knob full CW. Press middle C (C4) on your keyboard controller and measure the voltage using your multimeter at the tempco resistor (TC1), as shown below. The red circle corresponds to the position of the red test probe and the black circle corresponds to the position of the black (COM) test probe:



7. Adjust the Freq. Offset trimmer until the voltage at the tempco measures 0mV at C4. This allows the filter to track over the optimum control scale i.e. -90mV to +90mV for the SSI2140.

## Specifications

Connections	
Signal inputs	1 x 3.5mm unbalanced jack (DC-coupled)
Signal input range	-10V to +10V
Signal input impedance	50kΩ to 100kΩ
FM inputs	3 x 3.5mm unbalanced jacks (summed): 1V/octave (DC-coupled), FM 1 (DC-coupled) and FM 2 (DC-coupled)
FM input range	0V to +10V (1V/OCT, FM 1 and FM 2)
FM input impedance	1V/OCT and FM 1: 50kΩ to 100kΩ FM 2: 100kΩ
Resonance CV inputs	1 x 3.5mm unbalanced jack (DC-coupled)
Resonance CV input range	0V to +10V
Signal outputs	1 x 3.5mm unbalanced jack (DC-coupled)  <b>Also outputs a sine wave when filter is in self-oscillation.</b>
Signal output impedance	1kΩ
Controls	
Signal input level controls	1 x rotary knob (unity-gain is achieved when knob is set to approximately 7 and input is overdriven when knob is set to approximately 8 or above)
Cutoff frequency controls	1 x rotary knob
Cutoff frequency adjustment range	Greater than audio range i.e. > 20Hz to 20kHz at 24dB/octave

FM controls	FM 1: 1 x rotary knob (up to unity-gain) 1V/OCT: 1 x rotary knob (0V/octave to 1V/octave)
Resonance controls	1 x rotary knob  <b>The resonance control is normalised to the resonance CV input. When there is no input into the resonance CV jack, the knob controls the internal resonance level. When a CV source is input into the resonance CV jack, the internal resonance is set to 0 and the knob acts as an attenuator with unity-gain for the resonance CV input.</b>
<b>Power</b>	
Power supply	Eurorack
Current draw	+12V: 30mA -12V: 30mA +5V: 0mA
<b>Physical attributes</b>	
Dimensions (from front panel)	129mm x 51mm x 40mm
Front panel width	10HP

## Safety Information

Please follow the general safety guidelines below to ensure proper operation of the module and avoid personal injury. Ignoring these instructions may void the warranty:

- The inputs and outputs of the module have undergone testing to withstand temporary shorting. Also, inputs may temporarily handle voltages above those stated in the Specifications section of this

document; up to a maximum of  $\pm 12V$  (the standard rail-to-rail voltage range for Eurorack modules). However, it is highly recommended that you do not purposely short the outputs, or exceed the specified voltage range for each input for extended periods of time. Doing so may result in damaging the module, or other devices connected to the module.

- Do not expose the module to environments that are wet or high in humidity. Water exposure can be fatal to the electronic components in the module. Additionally, operating electronic devices in such environments can potentially be hazardous to your health and may result in injury.
- Also, avoid operating the module in excessively low or high temperatures. Again; as well as possibly causing damage to the electronic components in the module, excessive temperatures may result in personal injury.
- Do not touch the electronic components in the module or handle the module whilst it is powered. Always turn off the power to the module and unplug the power cable before handling it.
- Handle the module with care when transporting. Do not drop the module or let the module fall.

## RoHS

In accordance with the 2011/65/EU European Union Directive on the Restriction of the use of certain Hazardous Substances (RoHS) and amendment (EU) 2015/863, to the best of our knowledge; all of our products are RoHS compliant.

## **REACH**

Also, in accordance with the (EC) 1907/2006 European Union Regulation concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), to the best of our knowledge; none of our products contain any of the Substances of Very-High Concern (SVHC) currently on the candidate list.

## **Warranty**

All of our products are covered by a one year manufacturer warranty from the date of delivery.

For more information, please visit [www.wavefonix.com/warranty](http://www.wavefonix.com/warranty).

## **General Information**

Designed and made in the UK.

Copying, distribution or commercial usage of any of our products or documentation is prohibited without the written permission of Wavefonix.

Product specifications are subject to change at any time, without notice.

If you have any queries, please contact us via email at: [info@wavefonix.com](mailto:info@wavefonix.com).

Please check out our other products on our website: [www.wavefonix.com](http://www.wavefonix.com).