

# *Academy Audio Inc.*

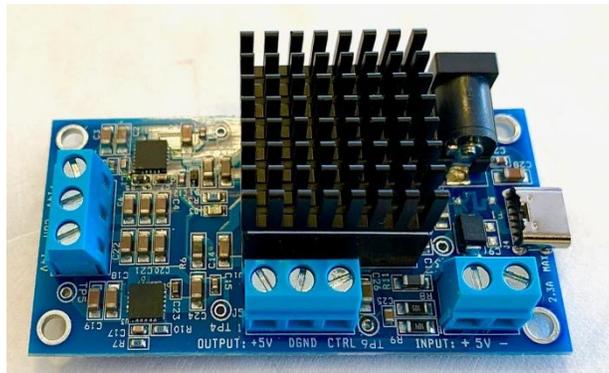
discovering the soul of music<sup>®</sup>

## LPS9 Ultra Low Noise Power Supply for Hi-End Audio

Ver. 01

### User Manual

Rev. 01



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## 1. Introduction

A power supply is one of the most important parts of an audio system, which immediately affects the system performance. Yet, it is often neglected.

The LPS9 Board was designed to provide a high quality ultra low noise power source for audio circuitry. The 9W power rating is sufficient to power a complete audio pre-amp. The very low noise on the power rails makes it suitable for highly sensitive circuits such as phono stages and head amplifiers for moving coil phono cartridges.

It is also a quick and efficient way to integrate our Hi-End MUSES® enabled products into an existing or a newly built Hi- End audio system.

The LPS9 board provides dual clean power rails of +/-14V, which are **isolated** from the input voltage to block the noise from the external wiring entering the system. An auxiliary +5V output provides filtered power for the digital circuitry.

Designed and built in the United States.

## 2. What's Inside the Box

The LPS9 Board package includes the following items:

- LPS9 Board with a heatsink.

## 3. Specifications

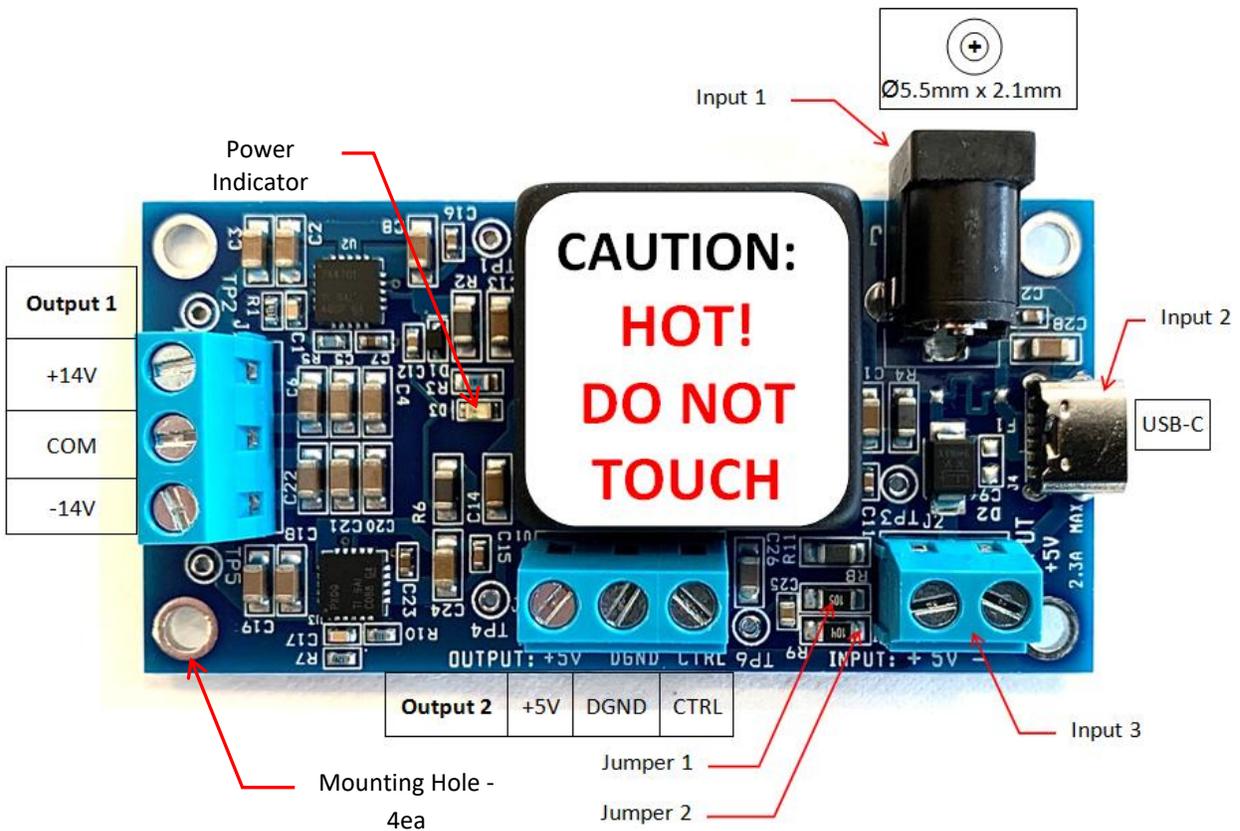
- Vin: +5Vdc
- Vout1+: +14V ± 1%, 330mA max
- Vout1-: -14V ± 1%, 330mA max
- Vout2: +5V ± 6%, 1000mA max
- Noise Level (Vout1): 6uVrms max (10Hz – 20kHz)
- Efficiency 76%
- Idling Current\* 50mA max (35mA typ)
- Standby Current\* 500uA max (350uA typ)
- Dimensions: 3.00" x 1.50" x 1.00" (including heatsink)
- Weight: 1.7 Oz (including heatsink)
- Protection:
  - Short circuit
  - Undervoltage
  - Overheating

\* At no load at the Auxiliary output.

**CAUTION:** Exceeding maximum values listed in the Specifications may severely degrade the performance of the LPS9 board, and cause intermittent operation. Prolonged operation of the LPS9 board under overload conditions may substantially reduce the board reliability.

## 4. Description

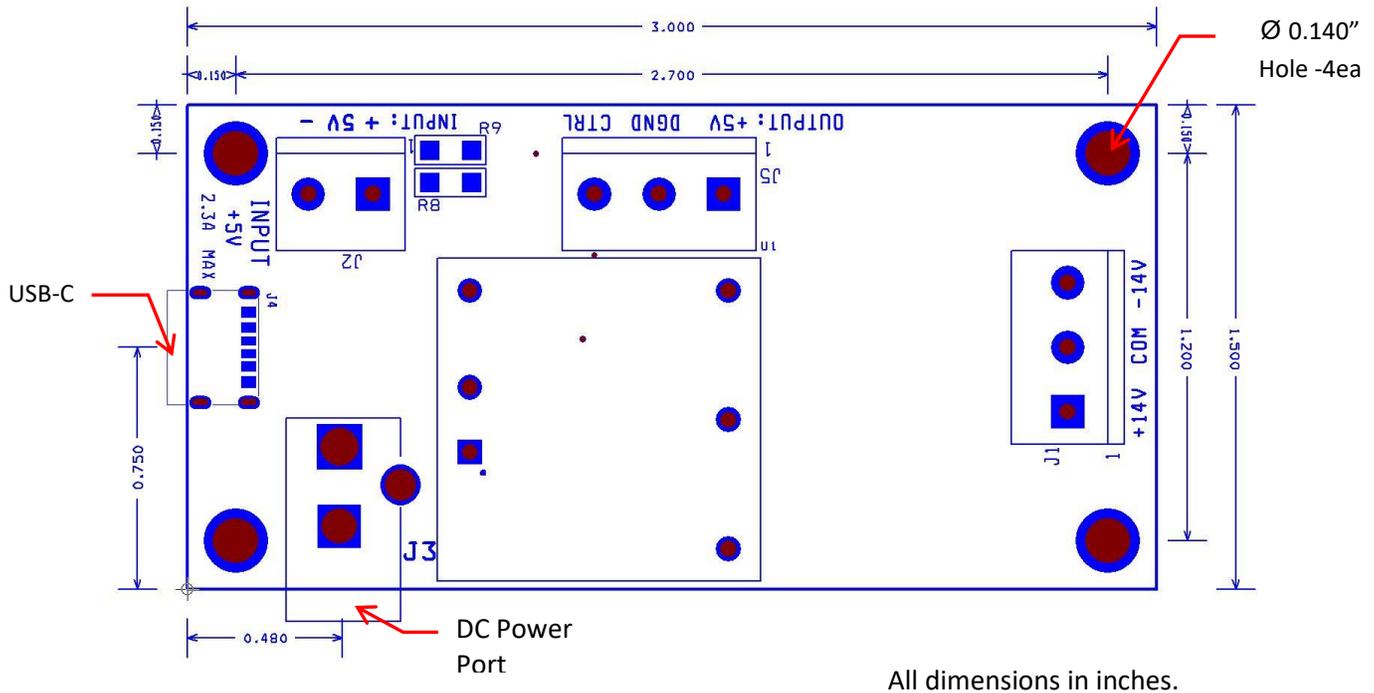
Referring to Figure 1, the LPS9 board features two input power connectors and a terminal block for connection of the external +5Vdc power supply, a Power On LED indicator, and two output terminal blocks – one for dual +/-14V stable voltages and one for the auxiliary +5V. Separate grounds for analog and digital circuits are provided to eliminate noise contamination from digital circuitry.



**Figure 1.** LPS9 Ultra Low Noise power supply.

The LPS9 board uses a dual stage voltage regulation for improved ripple rejection. The first stage employs a low noise isolated DC/DC converter that generates +15Vdc and -15Vdc, which are further regulated by two ultra low noise LDOs to provide clean analog rails of +14Vdc and -14Vdc. An isolated design prevents the external power cable noise from entering the system. A sophisticated filtering circuit placed before the LDOs removes all switching artifacts. A very high switching frequency of 350kHz of the DC/DC converter ensures that residual noises, if any, will show up way above the audio band. The Auxiliary +5V output provides filtered power for digital circuitry free from the switching noise of the DC/DC converted. A control terminal puts the system in a standby mode, with +5V output active, and the analog rails disabled.

## 5. Mechanical & Installation



**Figure 2.** LPS9 Board Dimensions.

Refer to Figure 2 for mechanical dimensions and mounting holes location. The LPS9 board may be installed either horizontally or vertically. Use at least 0.150" long stand-offs for installation.

Use **only one** of the input connectors J2-J4 to supply DC power to the LPS9 board. The available input power connectors are described in Table 1 below:

**Table 1.** Input Power Connectors

Connector Ref Des	Description	Comment
J2	2-Pos Screw Terminal, I <sub>max</sub> = 5A	
J3	DC Power Connector, Barrel Type, Central Positive, I <sub>max</sub> = 5A	
J4	USB-C Power Only Connector, I <sub>max</sub> = 3A	No Data Connection

To use the J3 or J4 on-board connectors, install the LPS9 board next to the access panel of the housing with an appropriate cutout for the connector. To use the J2, install the board anywhere on the housing. Provide at least 2 inch space between the power supply and sensitive audio circuitry.

**Table 2.** Output 1 Connector

Pin	Label	Description	Comment
1	+14V	+14V, I <sub>max</sub> = 330mA, short protected	
2	COM	Isolated analog ground	
3	-14V	-14V, I <sub>max</sub> = 330mA, short protected	

**Table 3.** Output 2 Connector

Pin	Label	Description	Comment
1	+5V	+5V, I <sub>max</sub> = 1000mA, filtered, fuse protected at 5A	Valid only at V <sub>in</sub> =+5V
2	DGND	Non-isolated Digital Ground	
3	CTRL	ON/Standby Control Terminal	

Use twisted wires for all input and output connectors to reduce noise pickup.

## 6. Ground Connection

The grounding arrangement is important for low noise operation. LPS9 provides all the features required for flawless low noise operation.

The LPS9 board features an **isolated** COM terminal that should be connected to the analog ground of the system. The +/-14Vdc rails are referenced to the COM terminal. The analog ground shall be connected to the star ground point of the system.

For the lowest possible noise arrangement the input voltage ground connection shall not be connected to the system ground.

If the Auxiliary +5V output is used, the DGND digital ground terminal shall be connected to the star ground point of the system.

### Attention Advanced Users:

The LPS9 features an isolated COM analog ground terminal. The isolation can withstand 1500Vdc voltage.

To prevent damage from the improper ground handling and/or ESD effects, two leakage paths were provided on the board – a 1M resistor R8 (Jumper 2) for the DC path, and a 100K R9 (Jumper 1) with 1000pF capacitor in series for the AC/surge path.

The selected values are sufficient for the audio applications to eliminate ground loops and the noise feedthrough. If better (100MΩ) isolation is required by the application, the R8 and R9 may be removed from the board. In this case the user assumes all responsibility for keeping the isolation voltage below the maximum values, and the warranty is void.

## 7. Standby Operation

A **CTRL**- On/Standby control terminal is provided to put the LPS9 in a low current standby mode, which may be useful for battery operated equipment.

The LPS9 goes in a standby mode when the CTRL terminal is connected to the digital ground DGND, or the voltage of below 1.2V is applied. The total current consumption of the LPS9 in the Standby is 500uA max (350uA typ). The Auxiliary +5Vdc output stays active in the Standby mode. Any current drawn from that output is added to the Standby current.

Leave the CTRL terminal floating for continuous ON operation.

## 8. Primary Power Source Selection

Any well regulated +5Vdc power source will work with the LPS9 board, as long as it can supply required current.

The minimum current from the primary power source can be calculated as follows:

$$I_{\min} = [(14V * I_{\text{out}1+}) + (14V * I_{\text{out}1-})] / (0.76 * 5V) + 0.05A + I_{\text{Aux}}$$

where

$I_{\text{out}1+}$  is a current from the +14V output, A

$I_{\text{out}1-}$  is a current from the -14V output, A

**0.76** is the nominal efficiency of the LPS9 (76%)

**0.05A** is the maximum idling current of the LPS9

$I_{\text{Aux}}$  is a current from the Auxiliary +5V output, A

The majority applications will be covered with a 15W – 20W power supplies capable of supplying 3A – 4A at 5Vdc. When using a plug-in or desktop switching power supplies, it is recommended to use the ones with the switching frequency 65KHz and above, and the ripple voltage not exceeding 50mV.

A USB power bank is a great source for the battery powered applications. It is advisable to use the Standby feature to extend the battery life.

## 9. Troubleshooting

The LPS9 board is designed for a continuous operation. When fully loaded the LPS board may get hot to touch, which is normal. When the Power Indicator (Green LED) is lit, the analog voltage is available.

**Table 4.** Troubleshooting hints.

<b>Problem</b>	<b>Possible Reason</b>	<b>Solution</b>
No analog power (+/- 14V). Power Indicator is off.	No power from the primary source or CTRL terminal potential is below 1.2V (Standby Mode).	<ol style="list-style-type: none"><li>1. Check the primary power source. Make sure it is on and the power cable is connected to one of the LPS9 inputs.</li><li>2. Make sure the CTRL terminal is not grounded.</li></ol>
LPS9 provides buzzing sound. Power LED may blink rapidly.	<ol style="list-style-type: none"><li>1. Primary power source overloaded.</li><li>2. LPS9 overloaded.</li></ol>	<ol style="list-style-type: none"><li>1. Make sure you the primary power source is properly rated.</li><li>2. Check the load. Make sure it is not shorted.</li><li>3. Reduce the load current to stay within the LSP9 rated output values.</li></ol>

## 10. Technical Support

For any questions regarding operation of the LPS9 board and for the latest documentation please visit us at [www.academyaudio.com](http://www.academyaudio.com).

Your audio system never sounded that well before. Happy listening!