MINI-IO/IO-MODULE KIT

Input/Output Module

Simplicity Counts, Detail Matters.

Last Revision: February 16, 2008

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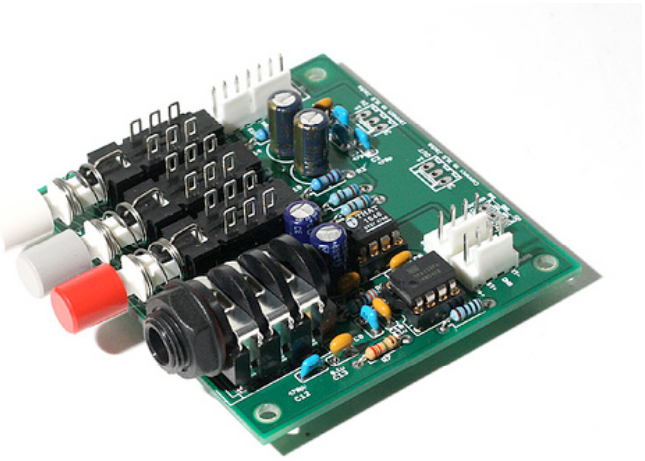
Input/Output Module

Congratulations and thank you for your purchase of the MINI-IO Module (or IO-MODULE) Kit.

Countless hours has been spent in the design, manufacturing and packaging of this kit to deliver to you an Input/Output Module Kit at a very affordable price!

There are no special, expensive tools or techniques required to assemble this kit. All you need is the ability to follow instructions, use common sense, and the confidence in knowing that YOU can do this. **PLEASE READ THIS DOCUMENT COMPLETELY BEFORE YOU ASSEMBLE YOUR MINI-IO MODULE KIT.**

I know people sometimes don't want to read manuals. But unlike software, there is NO UNDO for this project. **READ THIS DOCUMENT COMPLETELY FIRST.** Take your time, and ask questions if you are unsure of something. Work methodically and carefully. I promise you, you'll be rewarded with a great working Active DI and IO-Module kit when you're finished. And you'll have pride and joy when you tell others that "Yes, I built this!"



Features, Advantages and Benefits of the MINI-IO Module Kit

- Built-in Active DI circuit for High-Impedance electric guitars, basses
- Mic/Instrument selection switch
- True-balanced Active DI output using THAT 1646 balanced driver chip
- Burr-Brown JFET-input opamp for High-impedance buffering
- RFI input protection for mic inputs
- -20dB pad switch
- Polarity reverse switch
- Easy to assemble, easy to troubleshoot design
- Each component carefully labeled, protected and packed in separate zip bags
- Low Parts Count, Very affordable!!!
- Hooks up easily to your SC-1 preamp or other preamp via the Input and Output connections

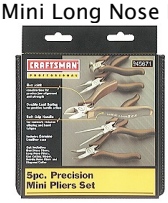
Basic Tools Required

A few basic tools are required to build this kit.

1. Soldering iron – adjustable temperature recommended, but not necessary. Your soldering iron must have a sharp conical tip. I do not recommend a "flat-head, screwdriver-type" soldering iron. DO NOT USE A SOLDERING GUN. They are usually rated at 100Watts and are overkill for this project.

2. Mini Pliers Cutter – to cut component leads, wires, strip insulation off wires (if you don't have a wire-stripper tool).

3. Mini Long Nose Pliers – to bend component leads, use as a heatsink, hold components, tighten bolts.



4. Manual Solder sucker pump – sucks up solder when you made a mistake soldering components on the PCB. Primitive operation, but it works… kind of.

5. Multitester – A simple meter/tester to measure resistance, and voltages. A digital read-out is a big help.

6. Soldering Lead – 60/40 lead or lead-free solder

7. Magnifying glass – to see what you're doing! Especially when soldering IC pins and the Grayhill selector switch.

8. Clean and well-lighted work area – Lots of good lighting, clean work area. You want to be able to leave your work-in-progress without packing everything away.

Extra Tools (Nice to have, but not required)

1. Desoldering pump – if you make a mistake, you need to pull out the component from the PCB
2. Component lead bender – bend component leads like resistors uniformly and evenly
3. PanaVise – to hold PCB while you're working on it
4. Tweezers – to pick tiny things
5. Masking tape – to hold components on the PCB while working
6. Wire-stripper – for cutting wires and stripping its insulation

MINI-IO Module Parts Identification and Assembly Notes

For the newbies, this is not meant to be a full tutorial about electronics. But I want you to be able to identify components, recognize them and know what their basic functionality is.

Resistors

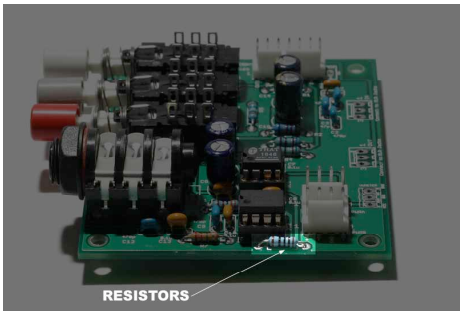
All resistors used in the Mini-IO Module Kit are 1/4 watt Metal-Film type, 1% resistors.

Resistors provide resistance, and are measured in OHMS, the unit of resistance.

1,000 OHMS = 1 KOHMS (pronounced KiloOhms, where kilo = 1,000)

If you see a resistor value marked "1K", it means 1 Kiloohm. Sometimes, you would see values written as 6K8, or 3K3.

6K8 is also the same as writing 6.8 Kohm. The decimal point position is implied by the "K" letter.



3K3 is also the same as 3.3 Kohm, or 3,300 Ohms.

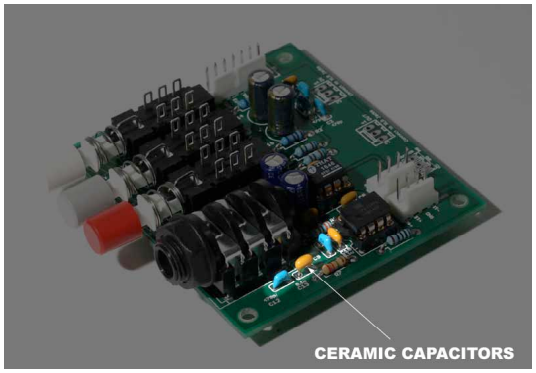
I don't need to teach you how to read resistor color codes since all the SC-1 parts are already labeled for you. But if you're curious on what those bands of wonderful technicolors mean, you can go here.
http://www.samengstrom.com/nxl/10116/5_band_resistor_color_code_page.en.html

Capacitors
There are two kinds of capacitors used in the project. We'll discuss the different types here.

Microfarads (mF)	Nanofarads (nF)	Picofarads (pF)
0.000001	0.001	1
0.00001	0.01	10
0.0001	0.1	100
0.001	1	1000
0.01	10	10000
0.1	100	100000
1	1000	1000000
10	10000	10000000
100	100000	100000000

Ceramic Capacitors
Ceramic capacitors look like the picture on the left. On the kit, these are colored "yellow" and are very small in size. Ceramic capacitors are non-polarized, and therefore it does not matter what orientation they go in.

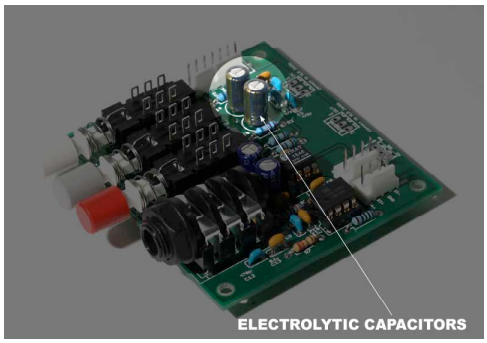
They are rated in microfarads (abbreviated as "uf"). They also have a voltage rating (abbreviated as "V"). In a design, the voltage rating must not be exceeded. Otherwise, you'll ruin the capacitor. Either short it out, or blow it open.



Capacitor parts are therefore rated with their capacitance (in microfarads, uf) and voltage… specified like this:
0.1uf 100V

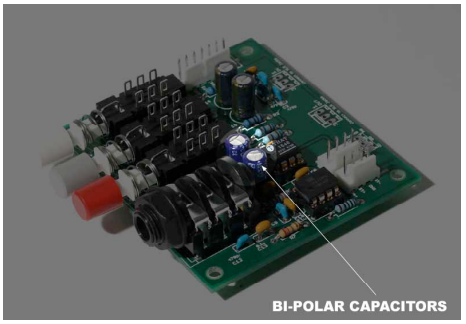
Capacitance values may be expressed in microfarads (uf), nanofarad (nf) or picofarads (pf). The conversion between these units are shown on the table above.

Electrolytic Capacitors



Electrolytic capacitors are cylindrical in construction. Unlike ceramic capacitors, electrolytic capacitors USUALLY/MOSTLY have polarity. One side is marked with the (-) sign, also called the cathode, or negative side.

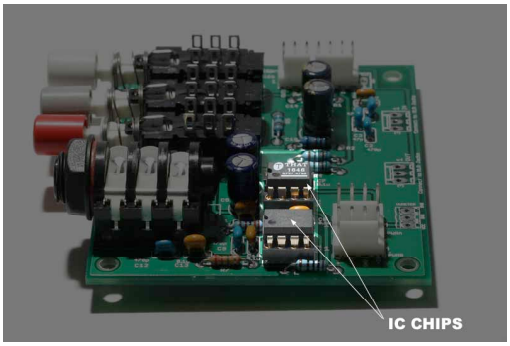
Just like ceramic capacitors, they are also measured in microfarads (uf) and have a maximum voltage rating.



WARNING: It is VERY IMPORTANT not to insert them backwards, or in the wrong polarity orientation. Doing so may cause the capacitor to explode. Do not the let the small size fool you. Even a small capacitor can explode with a lot of force.

The two blue capacitors nearest the THAT1646 chips are Bi-Polar Electrolytic capacitors. That means, they don't have any polarity and can be inserted either way.

IC Chip

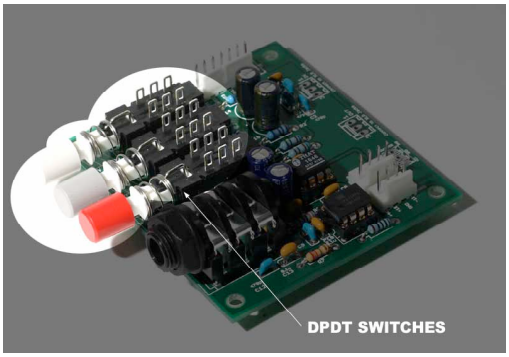


There are (2) IC chips used in the MINI-IO Module kit.

One of the chip is a Burr-Brown SoundPlus High Performance OpAmp chip. These are ultra-low distortion, low noise opamps fully specified for audio applications. It has true FET input stage for superior sound quality, high output drive capability and excellent DC performance. They are free from phase inversion and overload problems. They are unity-gain stable and provide excellent dynamic behavior. They are used as high impedance buffering circuit for the Active DI circuit.

The output of the Active DI circuit is unbalanced and electronically balanced using the THAT 1646 balanced driver chip. These chips are a new generation of differential line drivers offering improved performance. They have low noise and distortion, high slew rate, and wide output swing. They are stable even when driving difficult loads and have short circuit protected outputs.

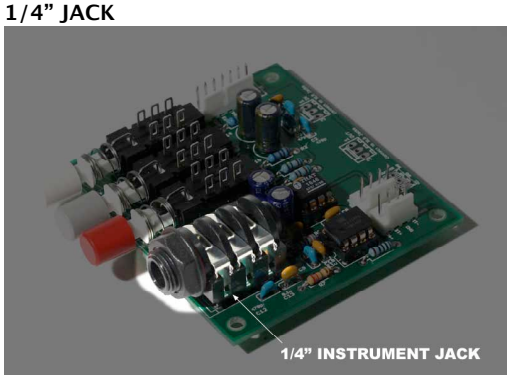
DPDT Switches
There are (3) PCB mounted DPDT switches. Looking at the photo above, from left to right, are:



Polarity Reverse
-20dB Pad
Mic/Instrument select

The polarity reverse switch reverses the polarity of the balanced signal lines on the OUTPUT.
The -20dB pad is applied before the signal goes to the preamp. (Note: The Active DI output can be affected by this switch.)
The Mic/Instrument select allows you to select which is the active input. Either the XLR mic input, or the Instrument plugged into the 1/4" Jack.

1/4" JACK



Plug your electric guitar or bass into the front 1/4" jack. Press the Mic/instrument select switch (RED) to switch between mic inputs and Instrument input.

If you switch to Instrument input with no instrument plug attached, there is an internal shorting mechanism in the 1/4" jack to prevent noise. (i.e. the inputs are shorted automatically).

Assembly and Soldering Tips

Use a clean soldering iron tip. Heat the component lead AND PCB pad at the same time, then apply the solder to the component lead while heating both with your iron. Do not apply the solder only to the iron.

Do not remove all the parts from the zip bags until you are ready to solder them. I've taken the time to sort them out; do not make a big unsorted pile out of them.

The holes on the PCB are plated through. This is also a double-sided PCB. Solder needs to make good contact inside the holes and on both sides of the PCB. Check that some solder flowed on the other side of the PCB, or that the holes are completely filled.

Be careful that you do not solder resistors in the wrong locations

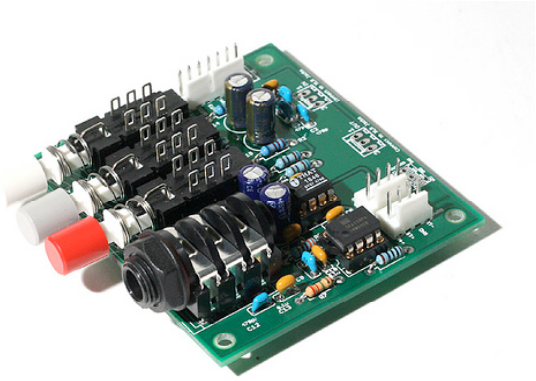
Note the orientation of LEDs, IC chips, voltage regulator and electrolytic capacitors. There is only one correct way to mount them. Do NOT mount electrolytic capacitors backwards. Do not mount the IC chip and voltage regulator backwards too.

When soldering multiple-pin devices (like trimmers, headers, IC chips, voltage regulators) solder one leg/pin first. Then check if the device is still flushed to the board, straight and not crooked. If crooked, re-heat the leg and straighten with your fingers while the solder is still soft/melted. (DO NOT STRAIGHTEN THE PINS AFTER THE SOLDER BECOMES HARD. You'd risk ruining the PCB or breaking the part.)

I sometimes use masking tape to hold the component in place on the board, while I solder the leads on the other side. This is very useful when soldering resistors, and small parts, etc…

Use a magnifying glass when soldering. This prevents you from using too much solder and let's you see what you're doing. Also, the IC chip has very fine pin spacing. You need good eyesight to solder all pins properly without shorting them together.

MINI-IO MODULE Assembly Guide



The general guideline in electronics assembly is to solder the smallest/shortest component first (resistors), and solder the bigger/taller components last (ceramic capacitors, electrolytic capacitors, headers, etc).

IMPORTANT NOTE: Observe the orientation of the IC chips!!!

NOTE: The photos on this Assembly guide may not exactly match the PCB you received. But the instructions are still valid.

Follow this checklist during your construction.

STEP 1. Solder all 1/4-watt resistors to the PCB. The orientation does not matter.

STEP 2. Solder all ceramic capacitor to the PCB. The orientation does not matter. These are the yellow and blue tiny capacitors.

STEP 3: Solder the (2) IC Sockets. Note the orientation of pin1. There is a half-circle cutout on one side of the IC socket. Align this side with Pin1.

STEP 4. Solder all electrolytic capacitors. Note orientation of (-) leg. The Bi-Polar capacitors have no orientation and can go in either way.

STEP 6: Solder the DPDT switches. You may want to use a masking tape to hold the switch in place while soldering it.

IMPORTANT: Solder one leg first, then check for proper alignment. Reheat joint and adjust if necessary. When everything is set properly, solder the other (5) pins.

STEP 7: Solder the jack. Just like with the DPDT switches, use a masking tape to hold the jack in place temporarily.

IMPORTANT: Solder one leg first, check for alignment before soldering the other pins.

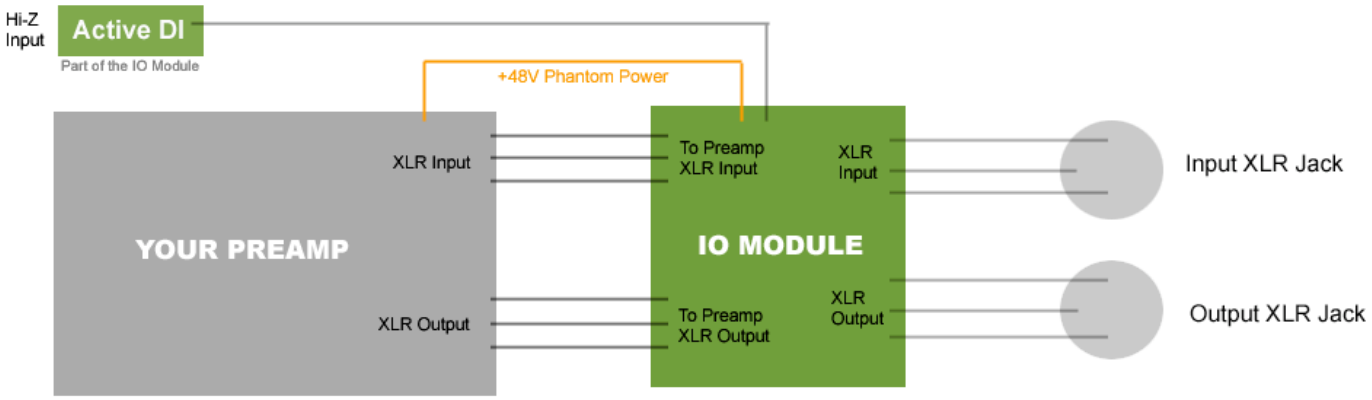
Step 8: Insert the ICs into their corresponding IC sockets. The THAT1646 chip should be inserted into the IC socket next to the (2) Bi-Polar electrolytic capacitors. Pin 1 is on the left side. The OPA134 should be inserted into the IC socket closest to the edge of the PCB. Pin 1 is on the left side.

Step 9: Optional: The holes for the XLR jacks, power, etc. are 0.1" pins. You can use 4-pin, 3-pin and 8-pin headers for these holes. (Note: Headers are not included in the kit.) Or you may just solder the wire directly to these holes.

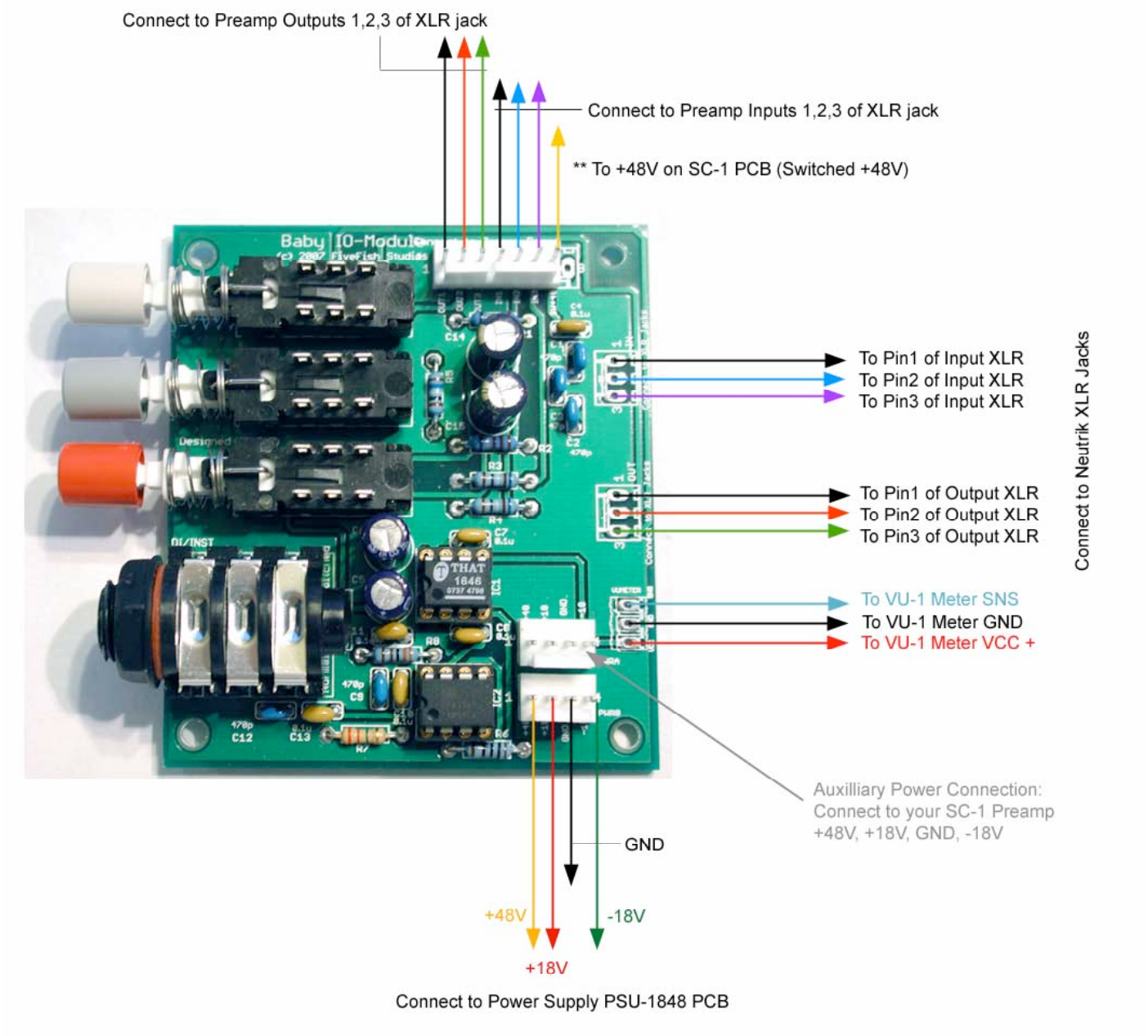
And you're done!

MINI-IO MODULE Installation Guide

Please study the diagram below on how to properly wire the MINI-IO Kit. Basically, the MINI-IO Kit sits in between your XLR input and output jacks and your Preamp. The MINI-IO Kit then gives you the following functionalities: Polarity Reverse, -20dB Pad, Mic/Instrument Select and Active DI.



THE IO-MODULE SIGNAL FLOW



Note: ** Please see diagram on next page on where to connect the Switched +48V line to your SC-1 preamp.

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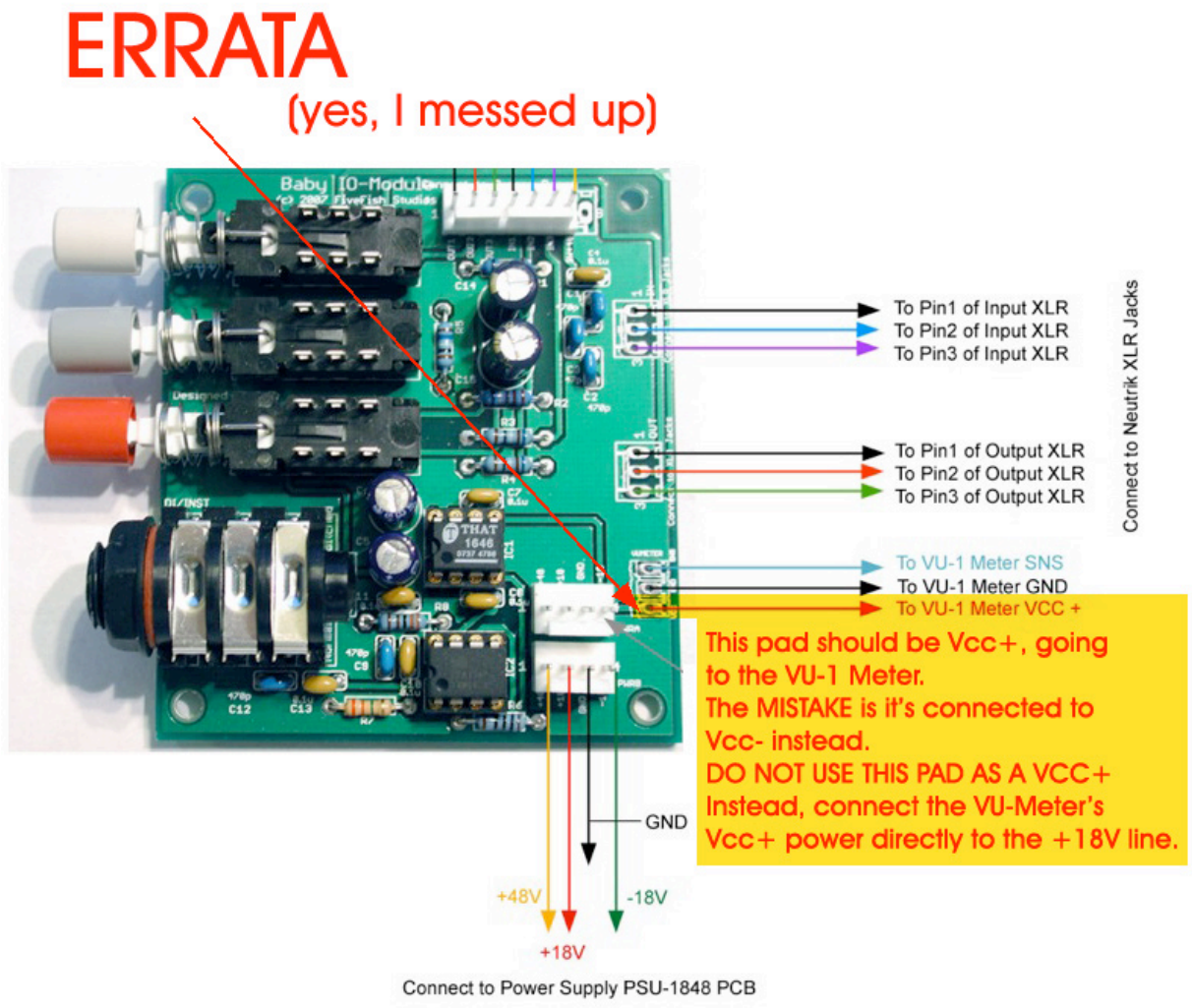
ERRATA:

(In other words, I messed up.)

If you have a MINI-IO PCB or IO-MODULE PCB, there is a mistake on the PCB connection to the VU Meter.



Please connect the Vcc+ of the VU meter directly to the Power Supply's +18V instead.

Your may also solder it to the +18V pad on the Mini-IO (or IO-Module) PCB. See diagram above for location of +18V pad.

The Mini-IO/IO-Module PCB will be corrected in the next revision.

Note: This mistake does not affect operation of the Mini-IO/IO-module PCB in any way. It just prevents the VU meter from using that 3rd pad as a Vcc+ connection. Instead, you must connect the VU meter's Vcc+ line directly to the +18V of the PSU.

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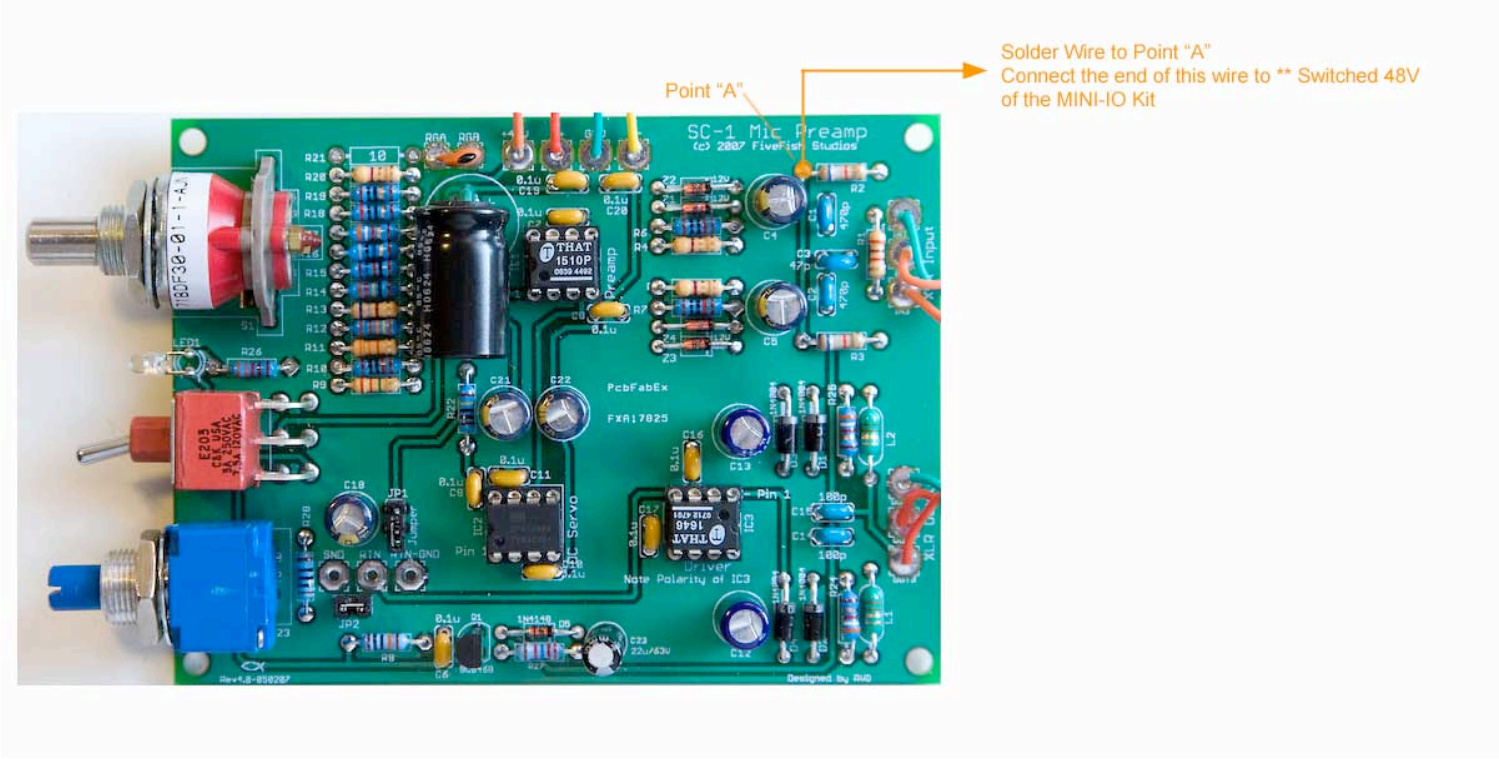


MINI-IO MODULE Troubleshooting Guide

Well, hopefully you won't need this part.

"Measure twice, cut once"… as they say. Take your time assembling the kit, don't be in a hurry, work carefully and methodically and you won't need this troubleshooting guide

Problem: Preamp works without the IO-Module. But there's no sound after I connected the IO-Module.

Check that you did not reverse the input and output connections. Review carefully the diagram above. Note the colors on the Input/Output XLR connections and the Preamp Input/Output connections. Basically, the IO-Module sits in between your XLR jacks and your preamp. See block diagram above.

Problem: Active DI does not work.

Check that you have +18, -18 power applied to the Mini-IO module. The polarity reverse and -20dB pad switches will work even without power applied to the Mini-IO Module. But the ACTIVE DI requires power.

Check that you have the proper input selected using the Mic/Instrument select switch.

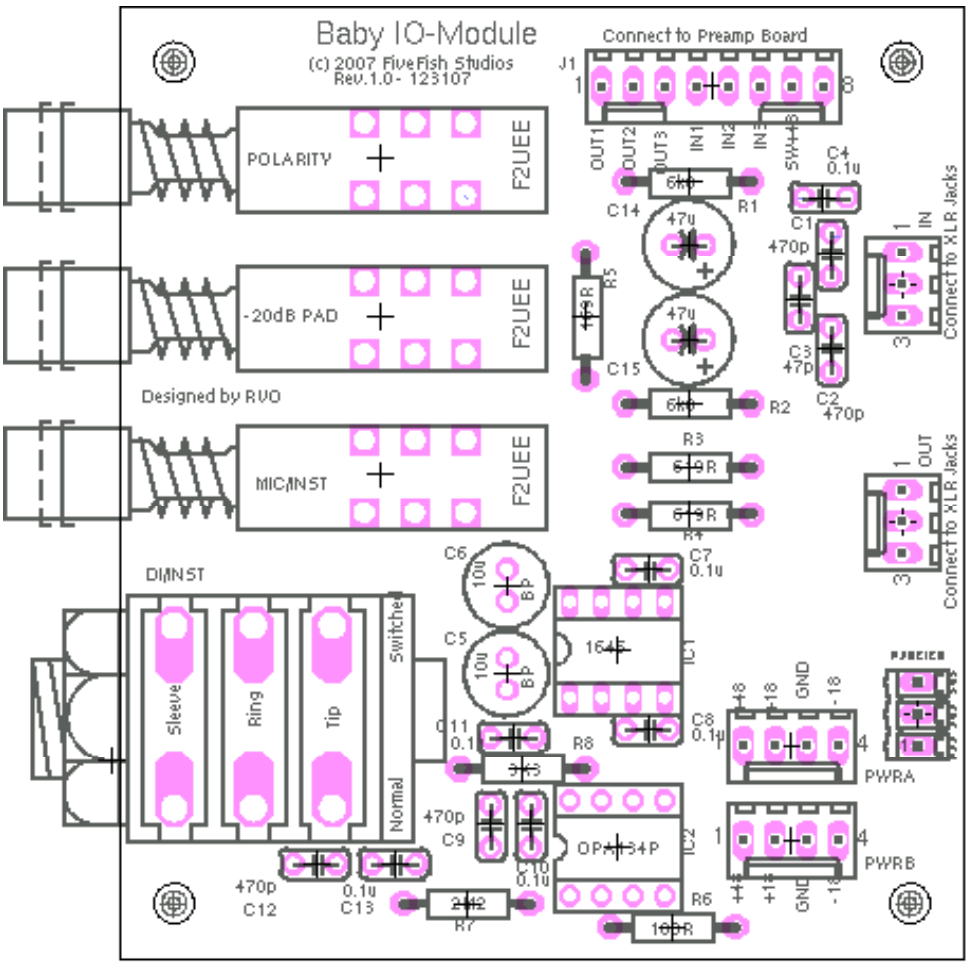
Problem: Hum and other Noise

Make sure that you twist all input and output wire connections tightly, going to the XLR jacks and going to your preamp's input and output terminals. Otherwise, hum pickup and RF noise may become a problem. Practice good wiring and grounding techniques. Keep wires away from AC power lines inside your case.

Problem: Weak Input Signal

Do you have the -20dB pad switched engaged?

MINI-IO MODULE Component Layout Guide



MINI-IO MODULE Bill of Materials

Part	Value
R1,R2	6K81
R3,R4	619R
R5	169R
R7	2M2
R6	100R
R8	3K32
c1,c2,C9,C12	470pf/50V
c3	47pf/50V
c4,C7,C8,C10.C11.C13	0.1uf / 100V
C5,C6	10uf 50V Bipolar
C14,C15	47uf / 50V
IC1	OPA134P
IC2	THAT 1646
S1,S2,S3	PB DPDT Switch PCBmount
redcap	Red Cap
whitecap	White Cap
graycap	Gray Cap
J1	TRS Jack
IC Sockets	8-pin IC socket .300 GOLD
PCB	Custom PCB