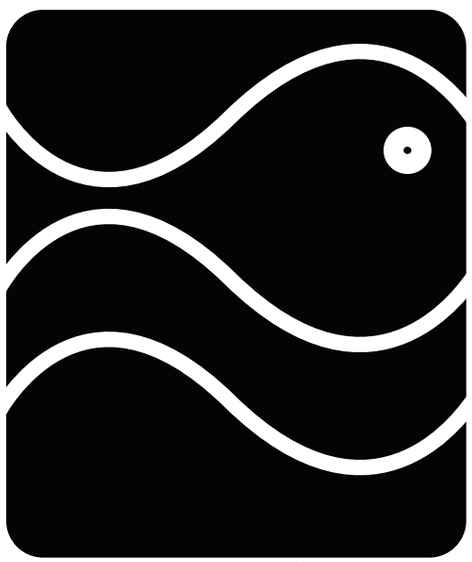
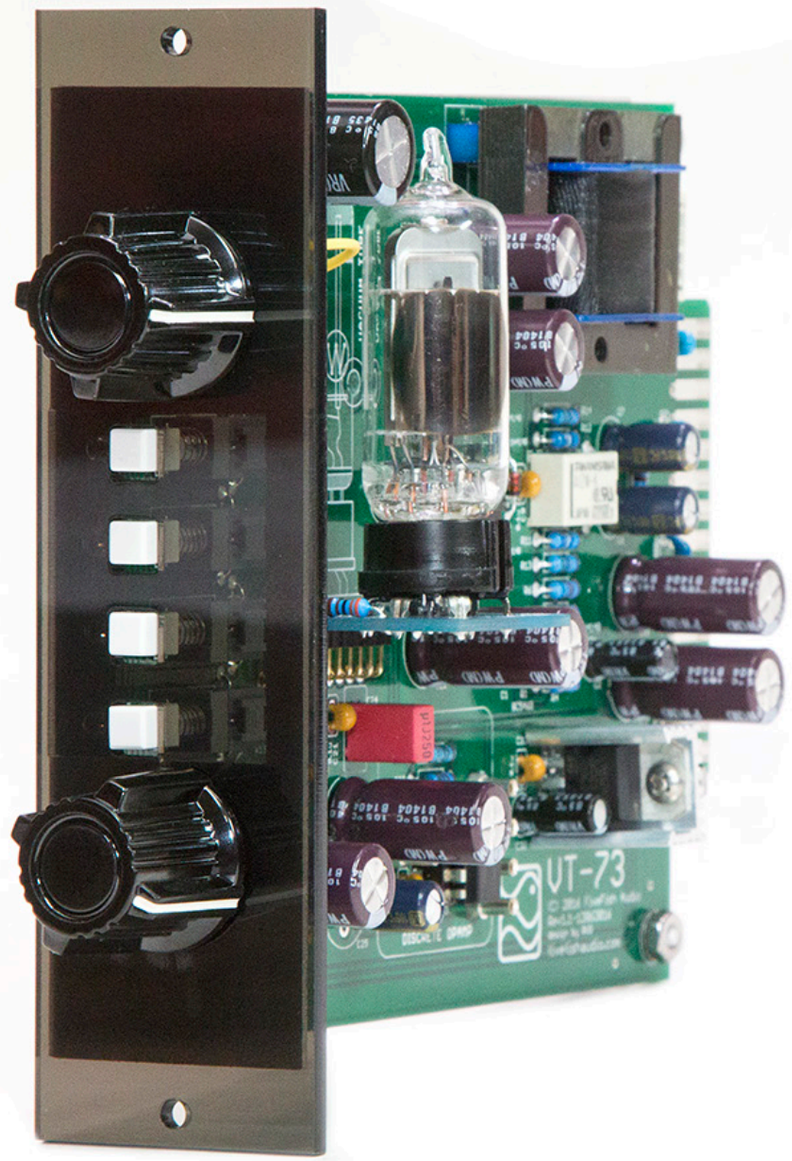
FiveFish



Studios

VT-73 Hybrid-Tube Mic Preamp Kit
Assembly Guide



Assembly Guide Revision 1.2 - 201760804

FiveFish Studios

FiveFish Audio

www.fivefishaudio.com

Dear Customer,

Thank you for purchasing our VT-73 Hybrid Tube Mic Preamp Kit.

Great care has been taken to make this assembly guide complete and as accurate as possible. Our goal is to make your assembly work easy and trouble-free, and deliver to you a working, reliable, and high-performance mic preamplifier.

This assembly guide is a work in progress and we're continually working to improve it. As always, we welcome the input of the DIY community if you have any comments, suggestions, or additional information that you think will be helpful for inclusion in this assembly guide.

If you have any questions that are not covered by this assembly guide, please feel free to contact us at www.fivefishaudio.com, or via our facebook page.

Sincerely,

FiveFish Team

SAFETY CONSIDERATIONS

GENERAL

This assembly guide must be reviewed for familiarization with safety markings and instructions before assembly of the Mic Preamp kit.

BEFORE APPLYING POWER

Verify that all components and parts are inserted in the right location and correct orientation. Visually inspect that there are no cold solder joints, or short-circuits.

WARNING

The WARNING sign denotes a hazard. Pay attention to the procedure, instructions, or the like, which if not correctly performed could result in damage to your equipment, electronic component or personal injury.

WARNING

Any interruption or disconnection, or lack of connection of the protective earth terminal/safety ground may cause a potential electric shock hazard that could result in personal injury. (Grounding one conductor of a two conductor outlet is not sufficient protection).

This mic preamp module is designed to be plug-in into an API 500 series rack or compatible unit. DC Power is supplied by the 500 series rack to this module.

It is strongly suggested that you use a lab power supply the **first-time** *you power your mic preamp project. If you made any mistake during assembly of this kit (for example: components inserted in wrong location, wrong orientation, short-circuit in your soldering job, etc.) you will not be subjecting the built-in power supply of your rack to the problem, and avoid damaging your power supply.*

If you don't have a lab power supply and instead will be using your rack to power directly this project the first time, I recommend using an extender card with built-in fuses to protect your rack power supply from accidental shorts or over-current. (The in-line fuses will blow if there is overcurrent or short-circuit condition, thus protecting the rack power supply).

GENERAL INFORMATION

1. DESCRIPTION

The VT-73 Mic Preamp Kit is a Hybrid Solid-State/Vacuum Tube mic preamp designed for use with API 500 Series lunchboxes or racks.

The VT-73 design uses a high-performance THAT amplifier chip as the primary First Stage amplifier. This allows us to have a very quiet, balanced input front end without the need for an Input Transformer. Voltage gain for the First Stage is set using a single-turn potentiometer to allow for a wide and continuous range of dB gain. There is also RFI input and output protection and built-in 48V short-circuit protection to protect the preamp from damage.

The output of the First Stage is fed to the Second Stage Tube amplifier, for additional signal processing. This Second Stage also generates the Second-Order Harmonics added to our original signal. Second Stage output is controlled by a second potentiometer that can limit the output level of the Mic Preamp. A Third Stage amplifier allows for an optional +12dB Signal Boost, and also drives our Output Transformer for a Balanced Output.

The VT-73 uses separate push-button switches for 48V Phantom Power, -20dB Pad, Polarity Reverse, and Gain Boost. The kit builder can also wire optional 3mm LED indicators for each switch to indicate when the function is enabled.

The VT-73 requires a dual power supply (+/-15V to +/-18 Volts) and +48Volts for phantom power for proper operation.

2. TOOLS & EQUIPMENT REQUIRED

A few basic tools and equipment are required to assemble this kit. These basic tools are not supplied with the kit.

2.1. Soldering Iron and Lead - We recommend a temperature adjustable soldering iron. DO NOT USE A 100 WATT SOLDERING GUN. A small to medium-sized soldering tip is required to solder the small parts. You may use Lead-free or 60/40 lead-based solder.

2.2 Cutter - You will need a cutter to cut component leads and wires.

2.3. Solder Sucker Pump - If you made a mistake and need to desolder a component, you'll need one.

2.4. Multitester - Used for measuring resistance, continuity, and voltages.

2.5. Magnifier & Lamp - I recommend a clean and well-lighted space for your assembly area.

2.6. Other Tools (not required, but nice to have) - Component lead bender, vise, tweezers, wire stripper.

3. ASSEMBLY GUIDE

BEFORE YOU BEGIN: Pick a clean work area where you can leave your work-in-progress unattended if you need to.

Keep individual components in their labeled zip bag until you're ready to solder them. Kit components have been sorted and labeled for your convenience. The labeled components lessens chances of insertion errors, inserting the wrong component into the wrong location. Keeping the components in their zip bags also reduces chance of small parts getting lost or misplaced.

Best practice is to solder the smallest and/or shortest components first. Then solder the taller and larger components next. Big bulkier components like switches, jacks, big capacitors are soldered last.

NOTE: The photos shown on this assembly guide are Rev.1.1 PCBs.
Your PCB Revision may be later but assembly instructions are generally the same.

There are ERRATA corrections for the Rev 1.1 PCB version.
Please visit Section 4.0 for details.

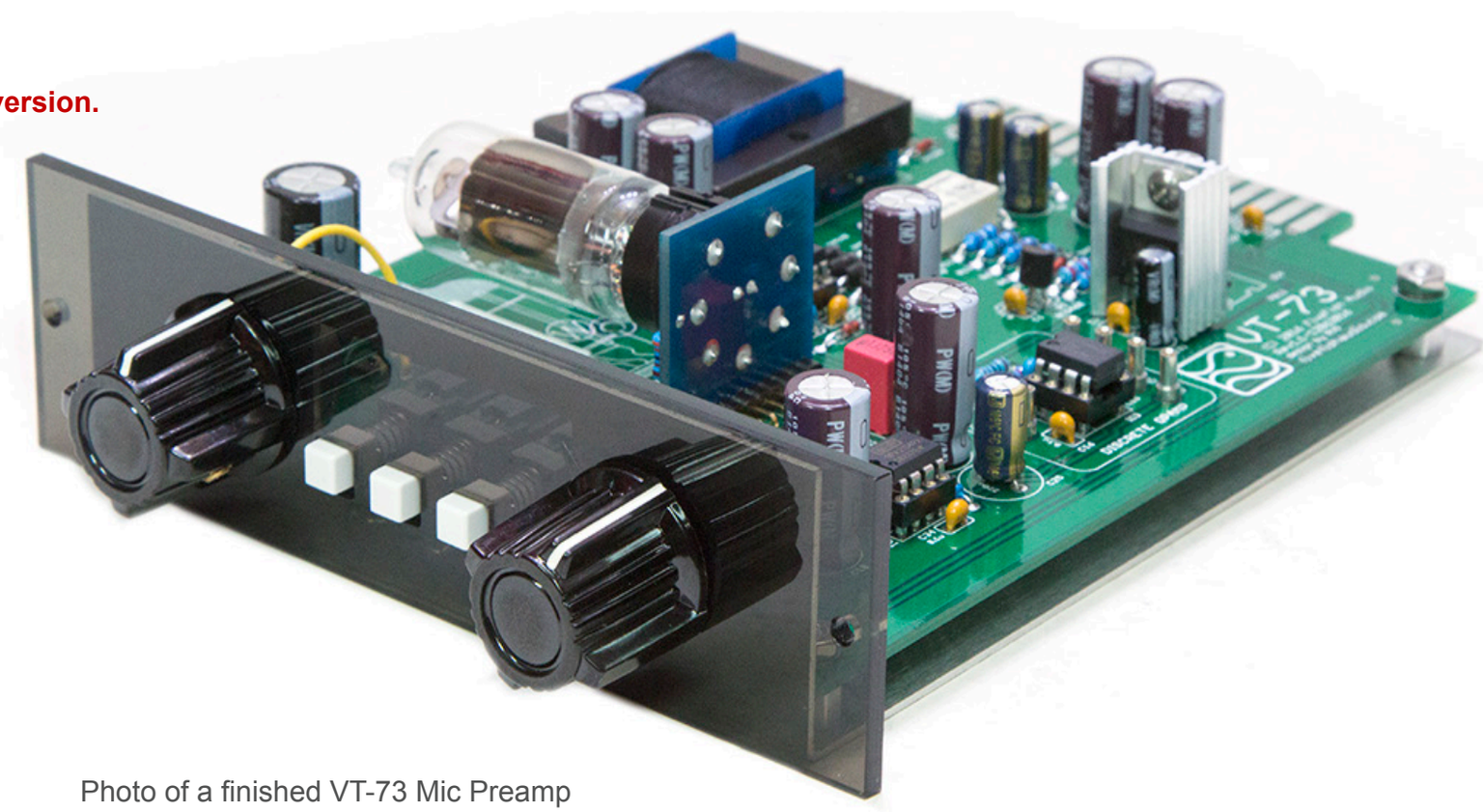
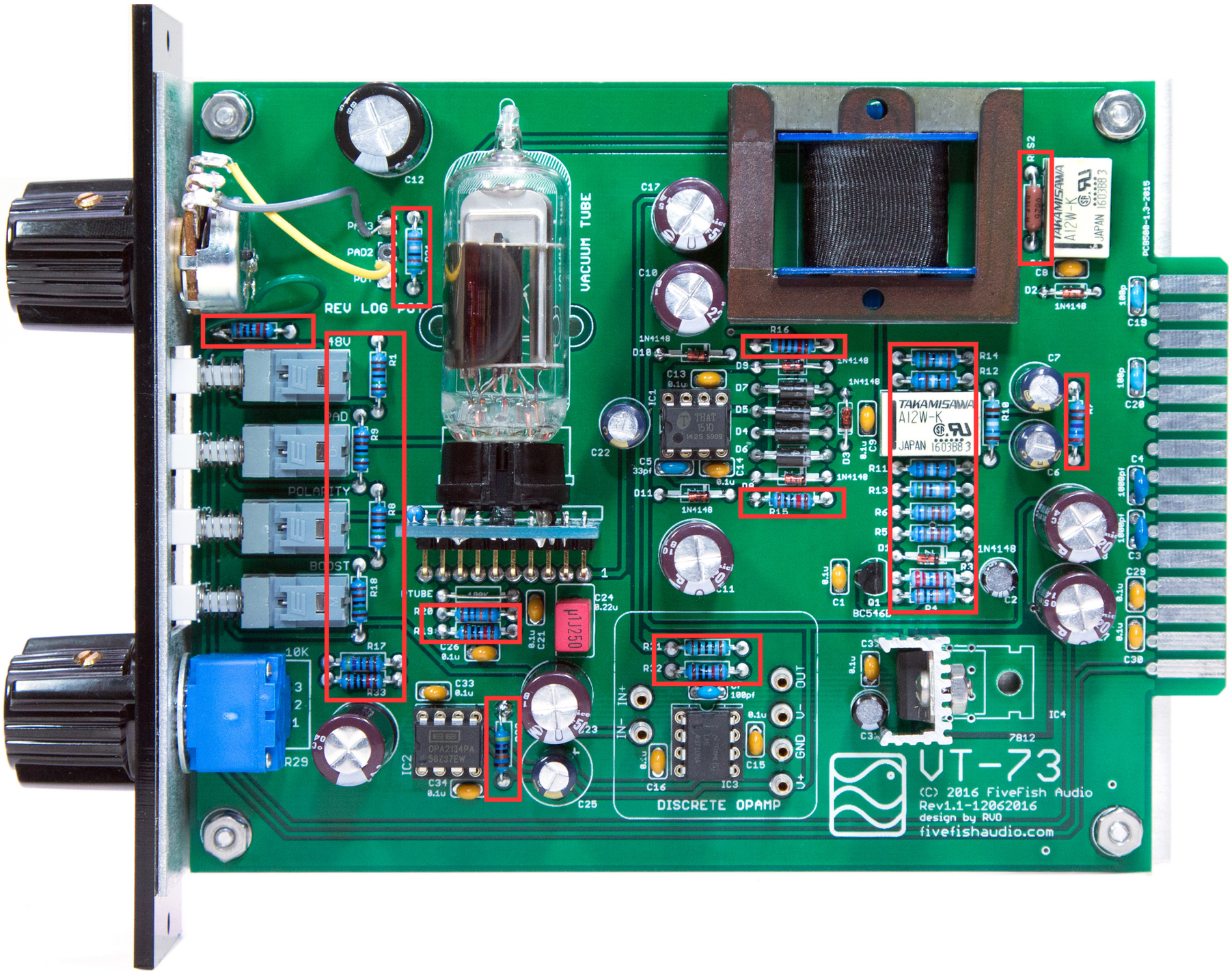


Photo of a finished VT-73 Mic Preamp

3.1 Solder all 1/4 watt Resistors.

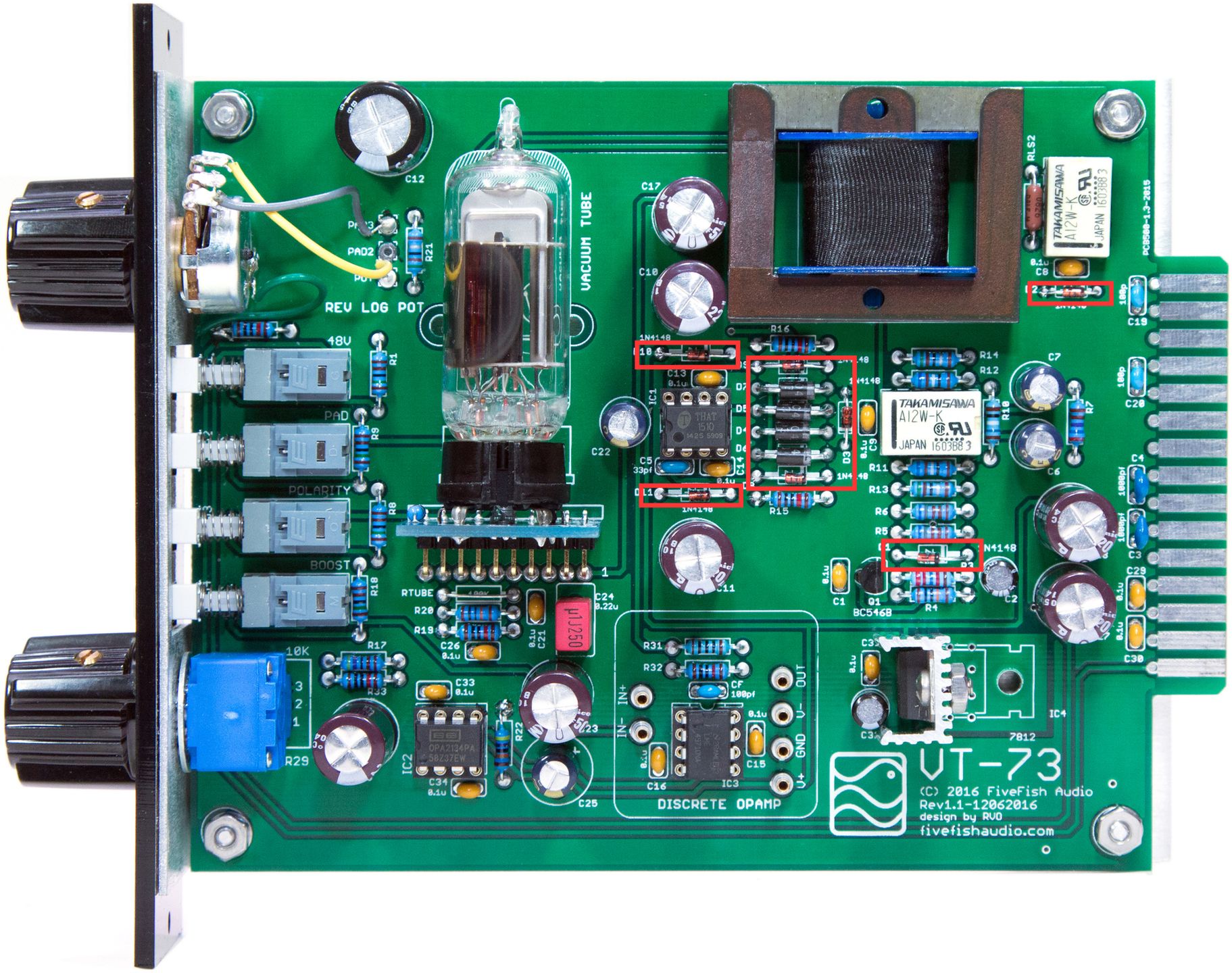
ERRATA: Solder a jumper wire across RTUBE resistor location.

See Section 4.0 for other ERRATA corrections (R20, R21, R22)

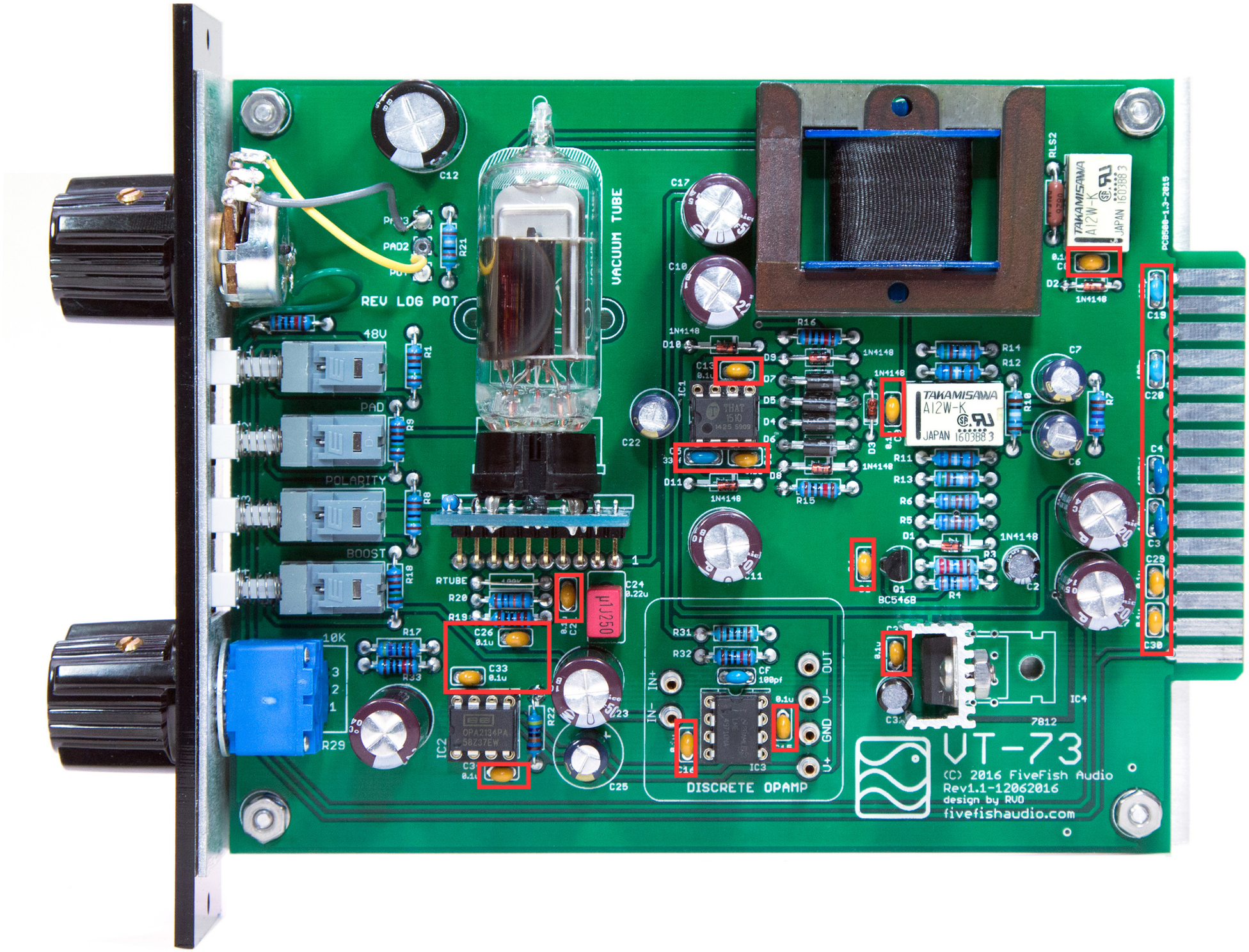


3.2 Solder all Signal Diodes and Rectifier Diodes.

IMPORTANT: Diodes must be installed in the correct orientation. Observe where the “white band” is located on the board silkscreen marking, and orient the Diodes to follow the same direction.

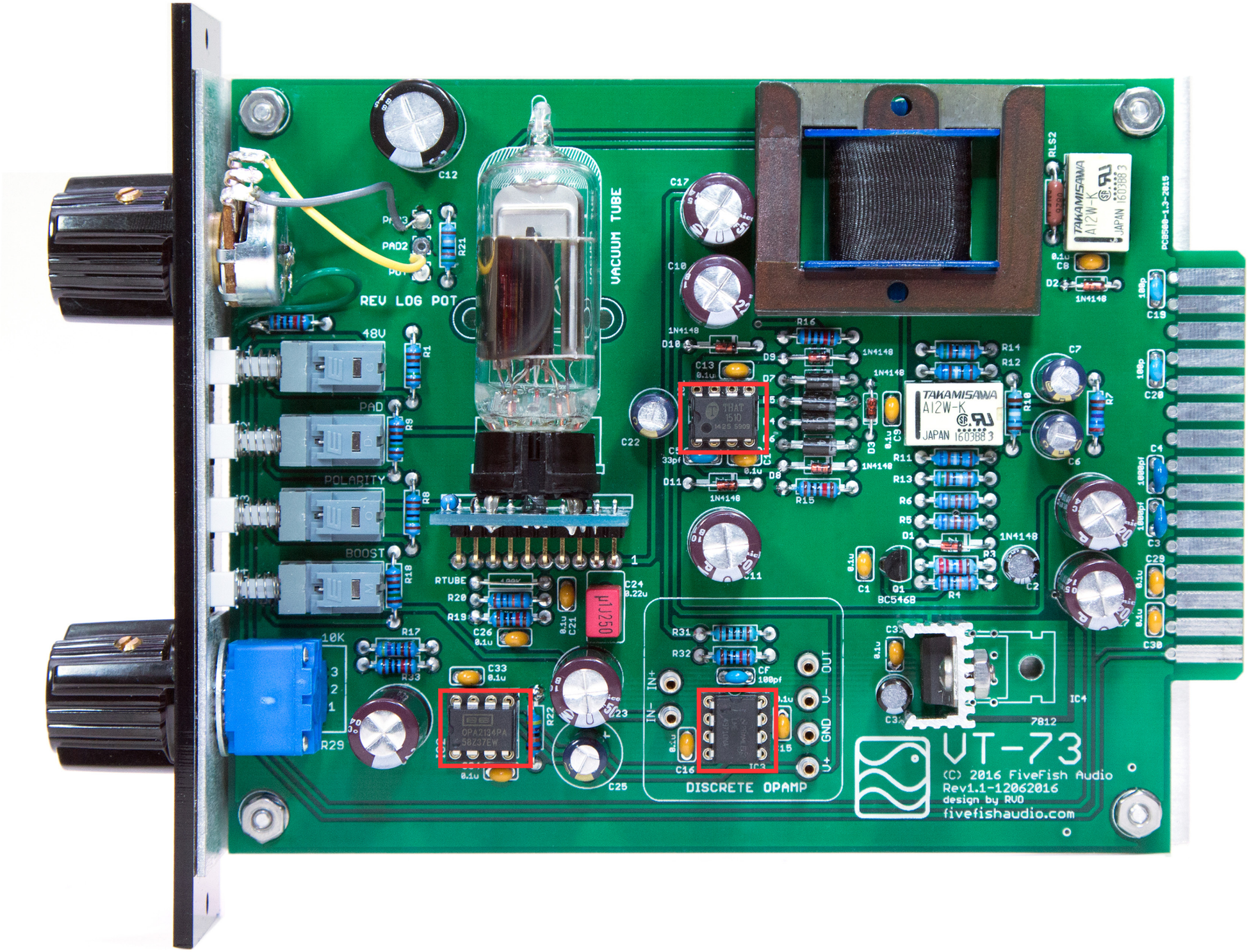


3.3 Solder all Ceramic capacitors.



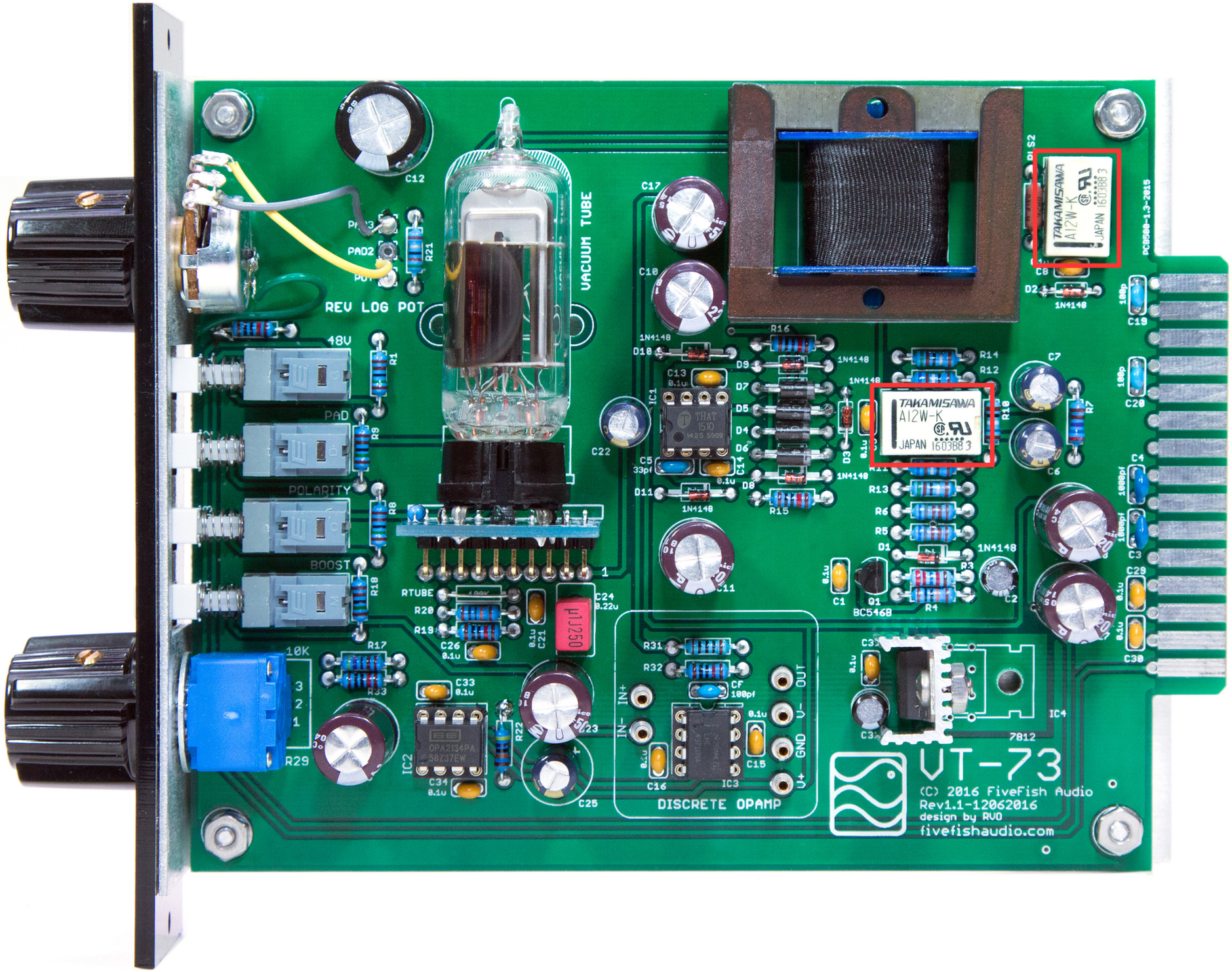
3.4 Solder the (3) IC Sockets.

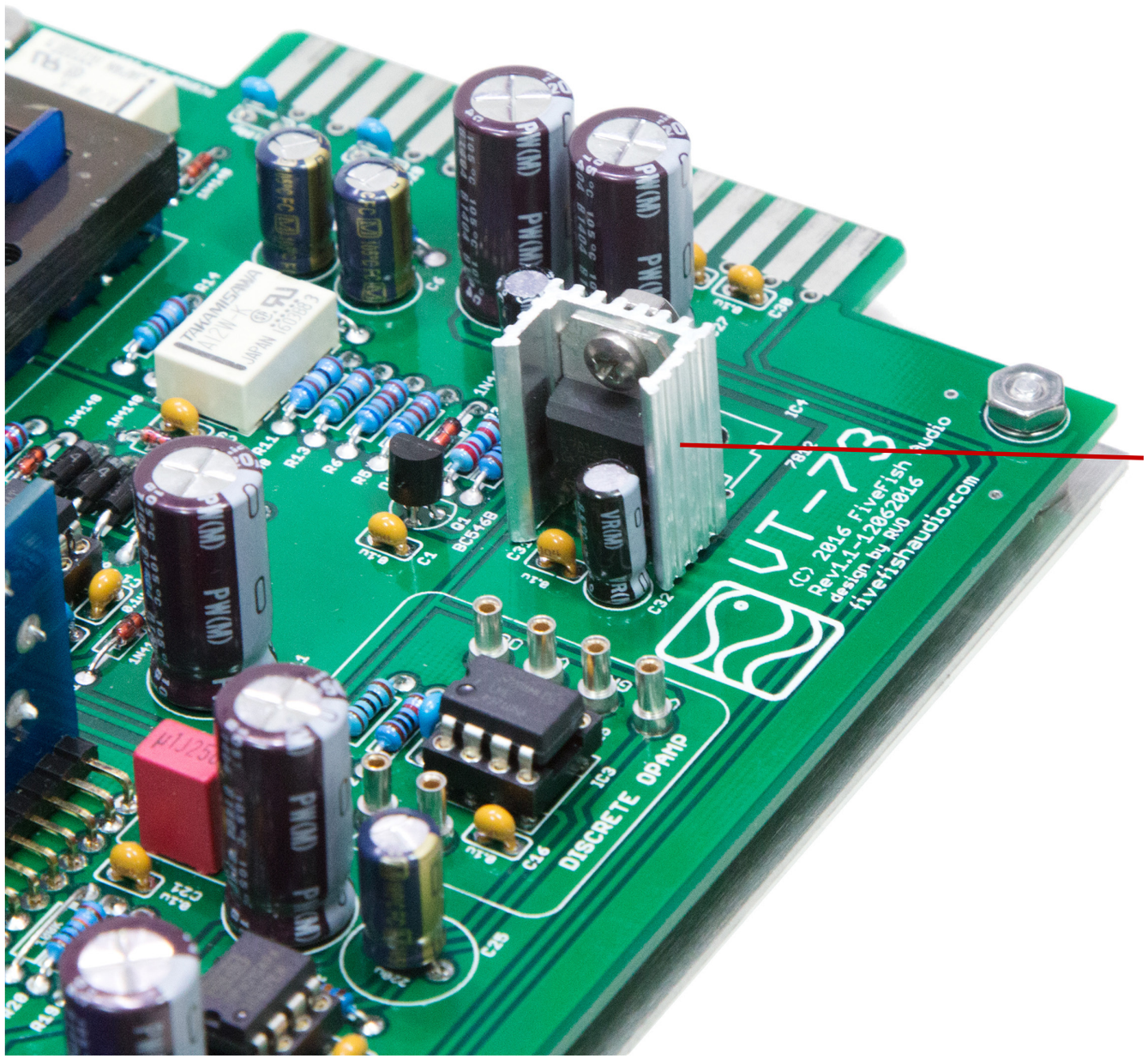
TIP: One side of the IC socket will have a notch. Position this notch on the left-side, or on top for use as a guide for Pin1 location.



3.5 Solder the (2) PDIP Relays. Take note of the Relay part number that came with your kit and follow the next step.

IMPORTANT: Insert Relays in proper orientation. Match the “white band” on PCB silkscreen with the Relay’s line markings.

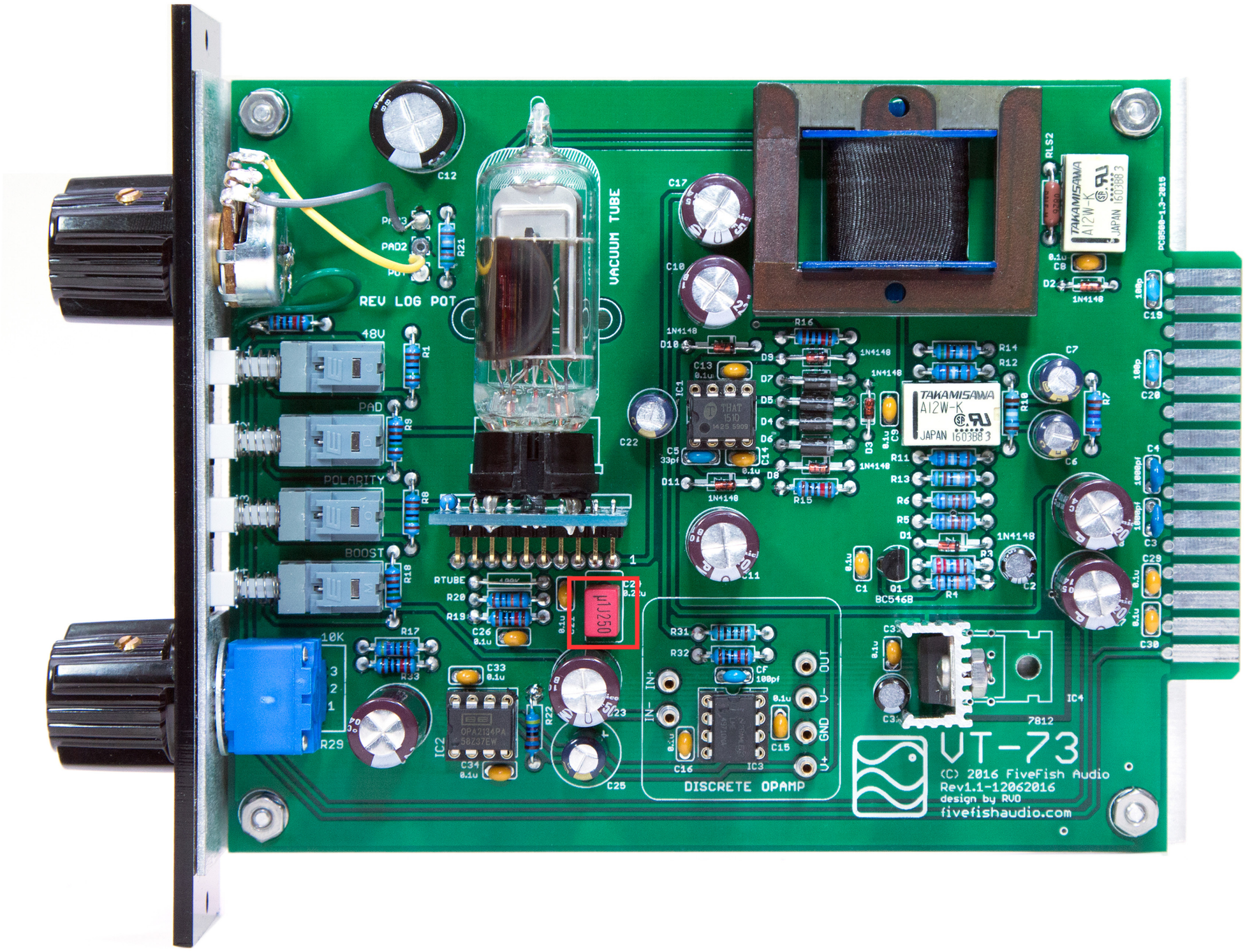




If your kit came with A12W-K Relays, solder the 7812 Voltage Regulator at IC4 location. You can use the heatsink provided and mount it vertically, or bend the legs and secure 7812 metal tab with machine screw and nut flat on the PCB board.

If your kit came with A18W-K Relays, Do NOT install the 7812 Voltage Regulator. Instead, solder a JUMPER wire across pin 1 and pin 3 of IC4 location.

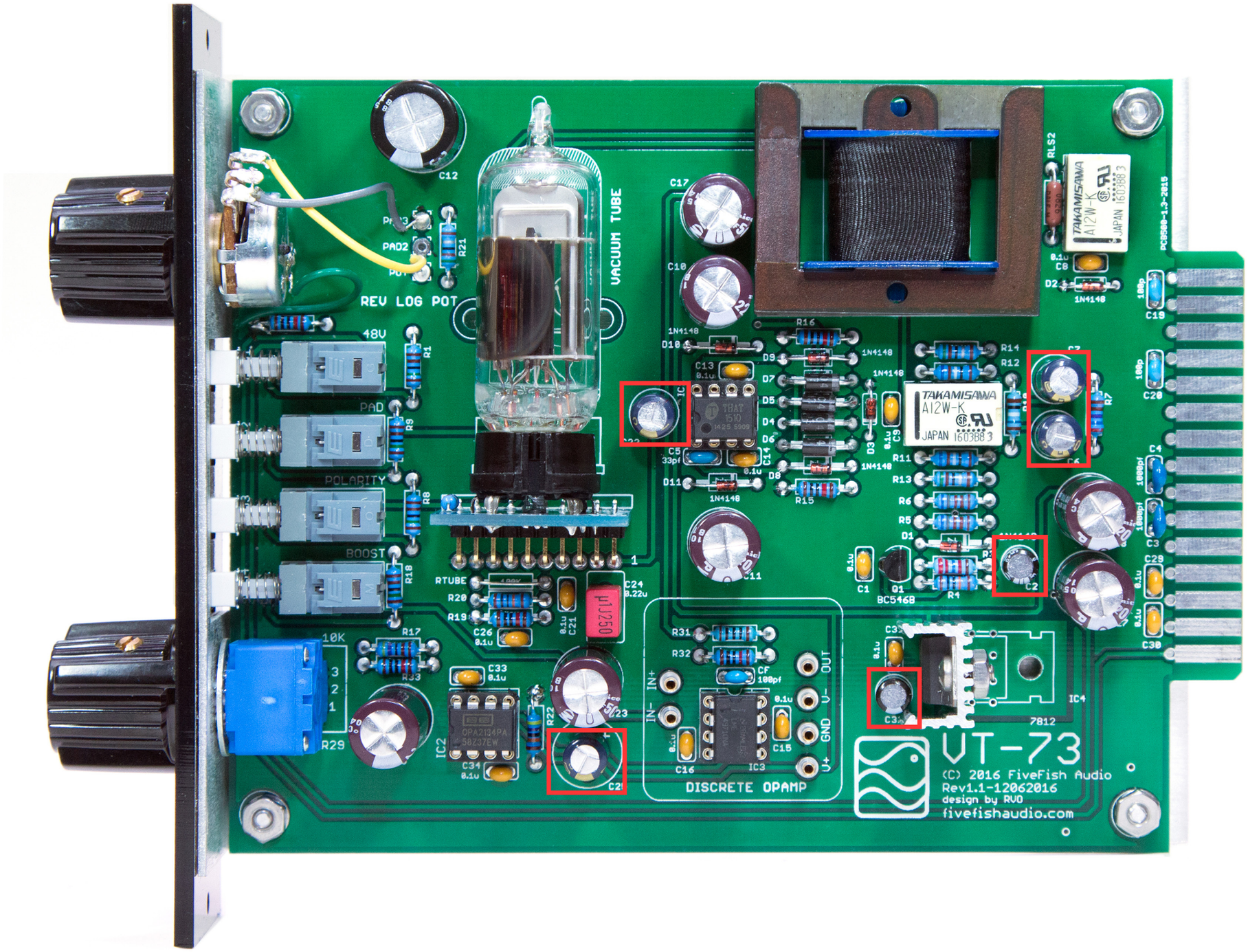
3.6 Solder the 0.1uf WIMA, C24 capacitor (Color Red).



3.7 Solder all small Electrolytic Capacitors. These capacitors have polarity markings, one lead is (+) and the other lead is (-).

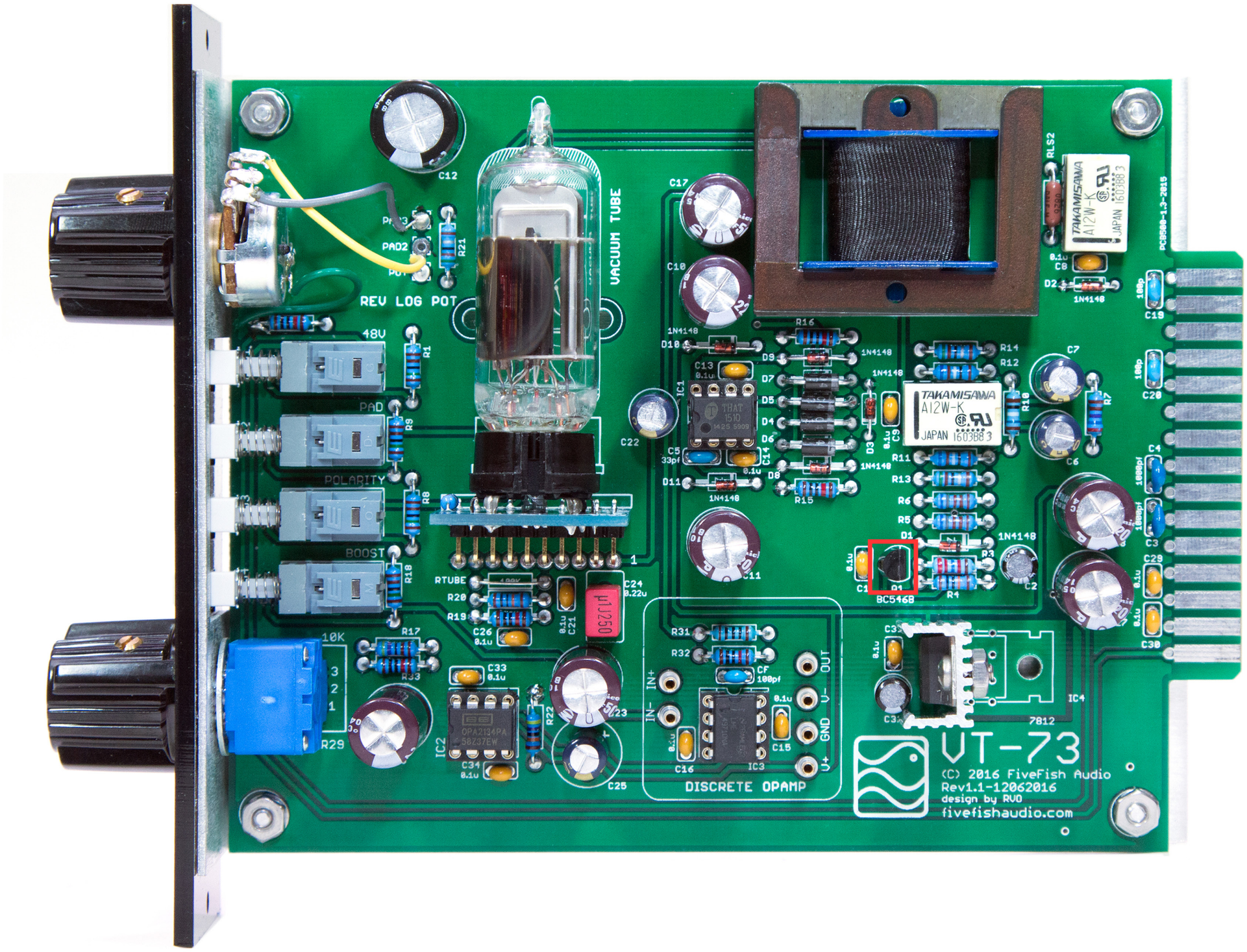
ERRATA: Use 47uf/50V for C25 location.

IMPORTANT: Observe the proper polarity when inserting these capacitors. Match polarity with PCB silkscreen markings. All negative (-) leads of electrolytic capacitors are orientated facing downwards.



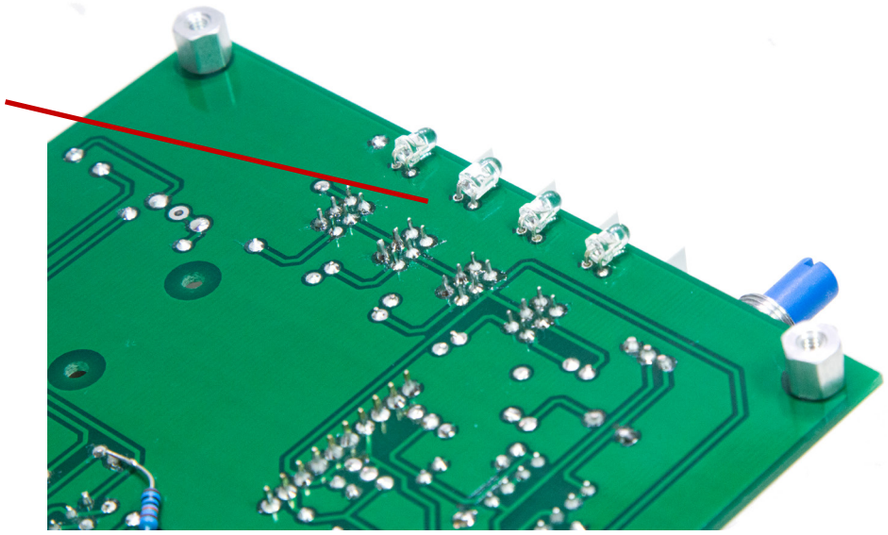
3.8 Solder Q1 Transistor.

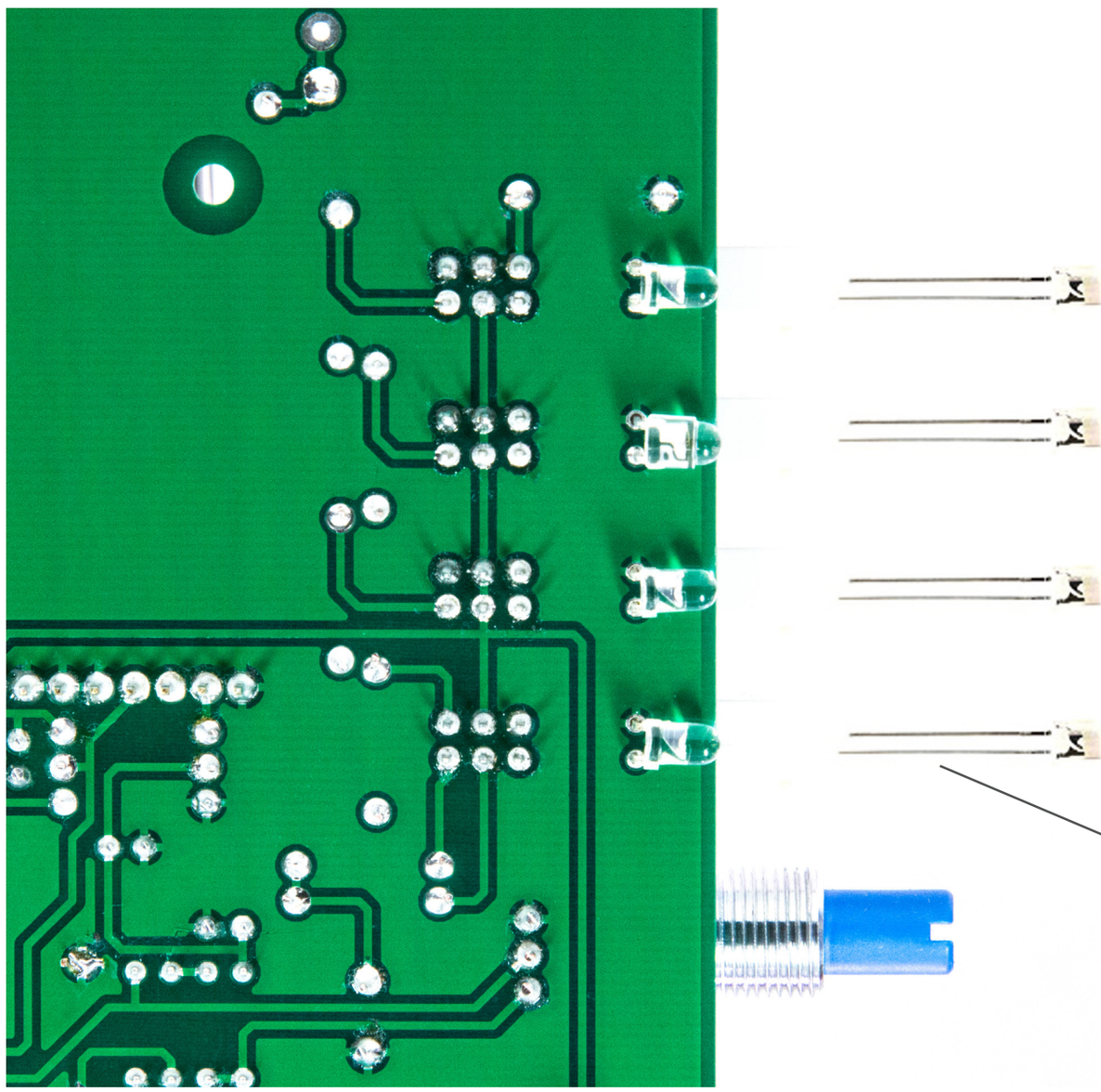
IMPORTANT: Observe proper orientation and the direction transistor is facing. Follow the PCB silkscreen markings.



3.9 Solder all 3mm LED indicator lamps from bottom of board. These LED lamps are optional and not required.
You can arrange the LED colors any way you want. But for consistency, use the same color arrangement on all mic preamp kits you'll build.

NOTE: LEDs are installed from the bottom.
Bend LED legs as shown on photos.





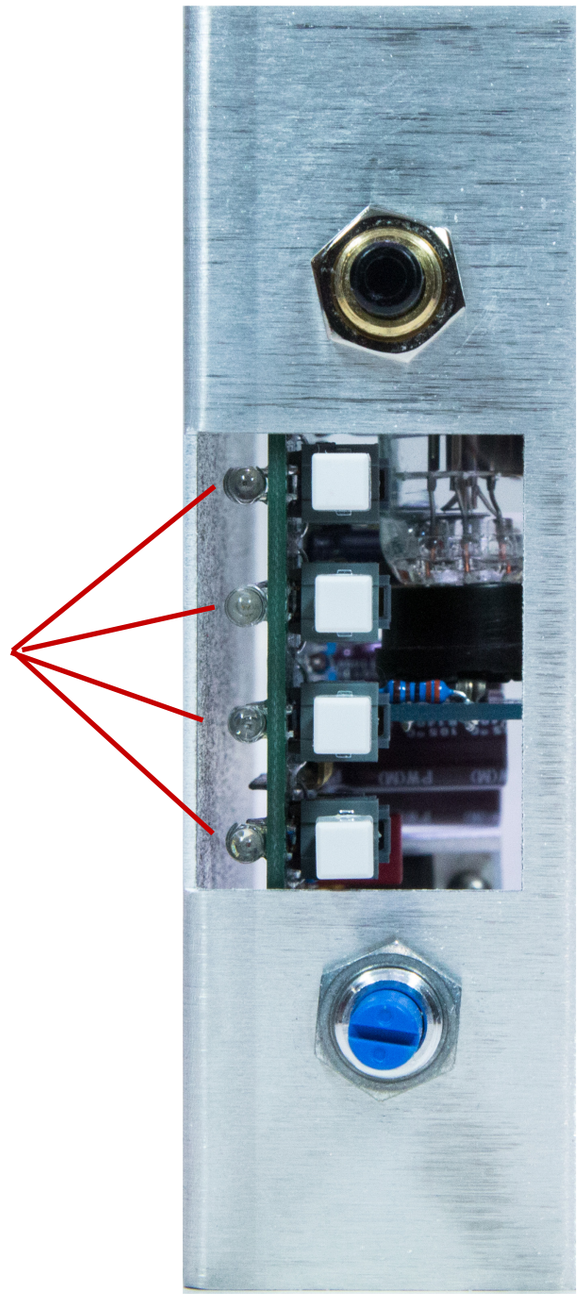
A typical color arrangement may be

GREEN - for phantom power switch,
BLUE - for 20dB Pad,
YELLOW - for polarity reverse,
RED - for +12dB Boost

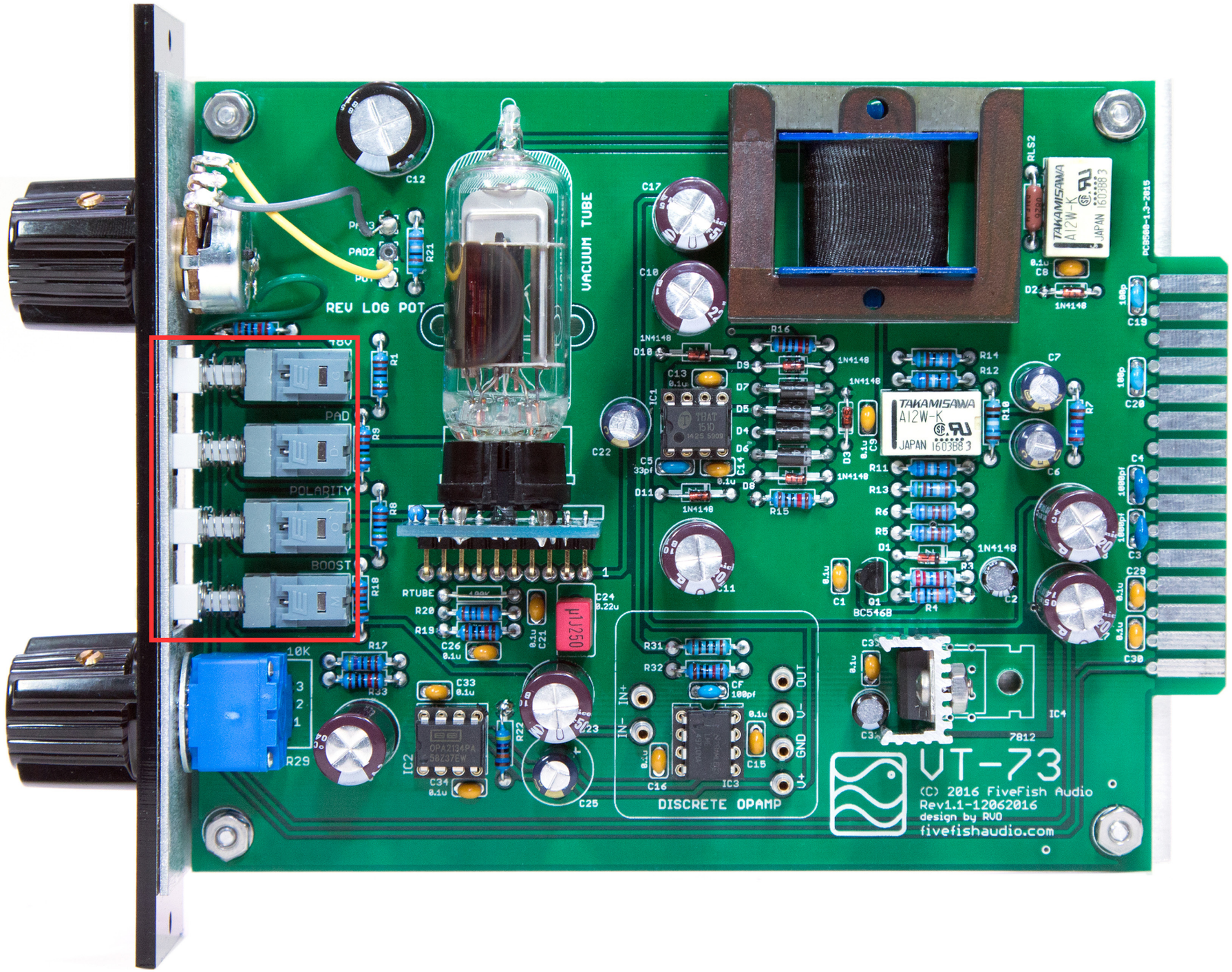
IMPORTANT: LONG LEG of the LED must be oriented at the BOTTOM position as shown.

3.10 Photo showing how the (4) LEDs will show through the Aluminum cut-out panel. Note: Do NOT attach the panel yet.

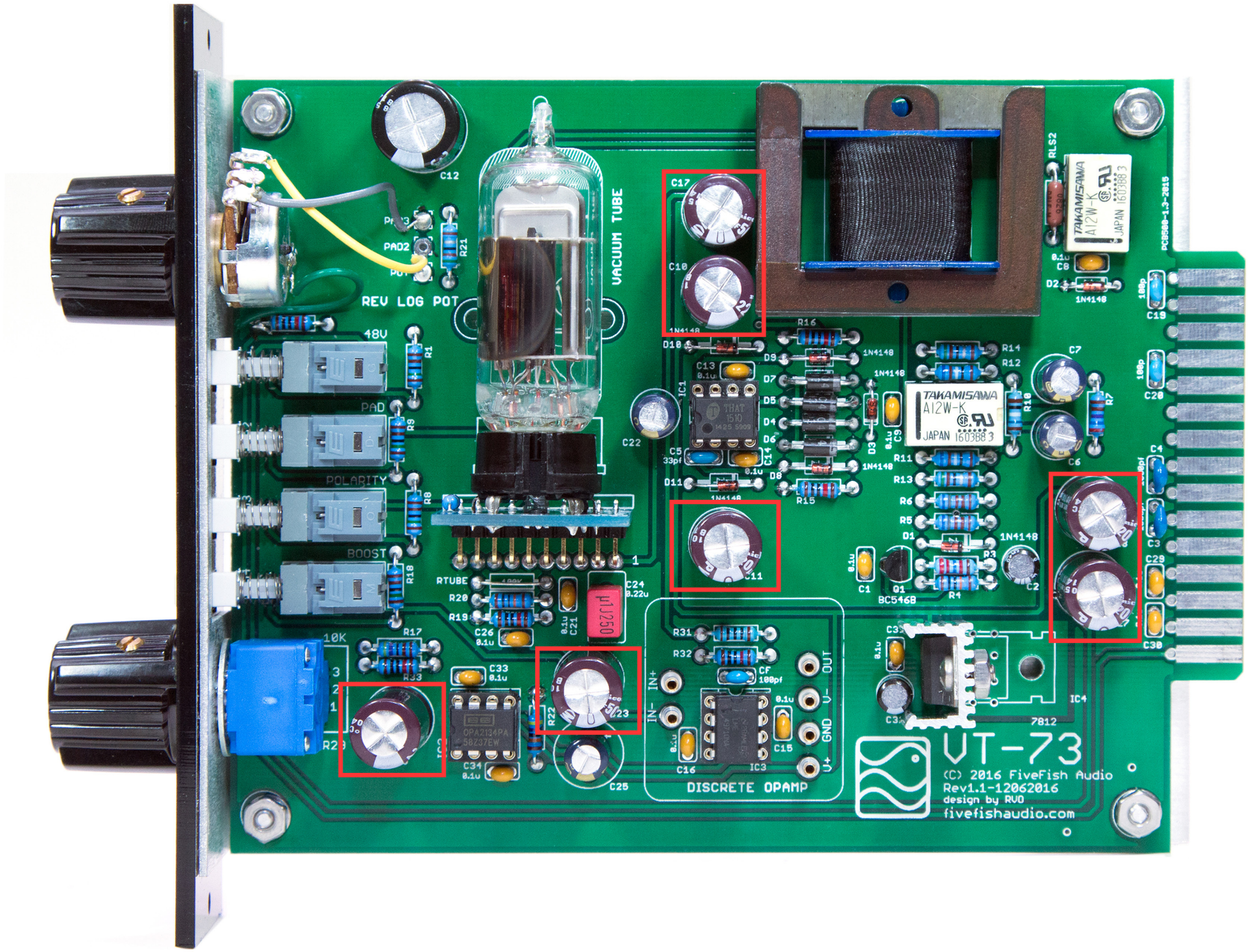
NOTE: LEDs are mounted at the bottom of the PCB.



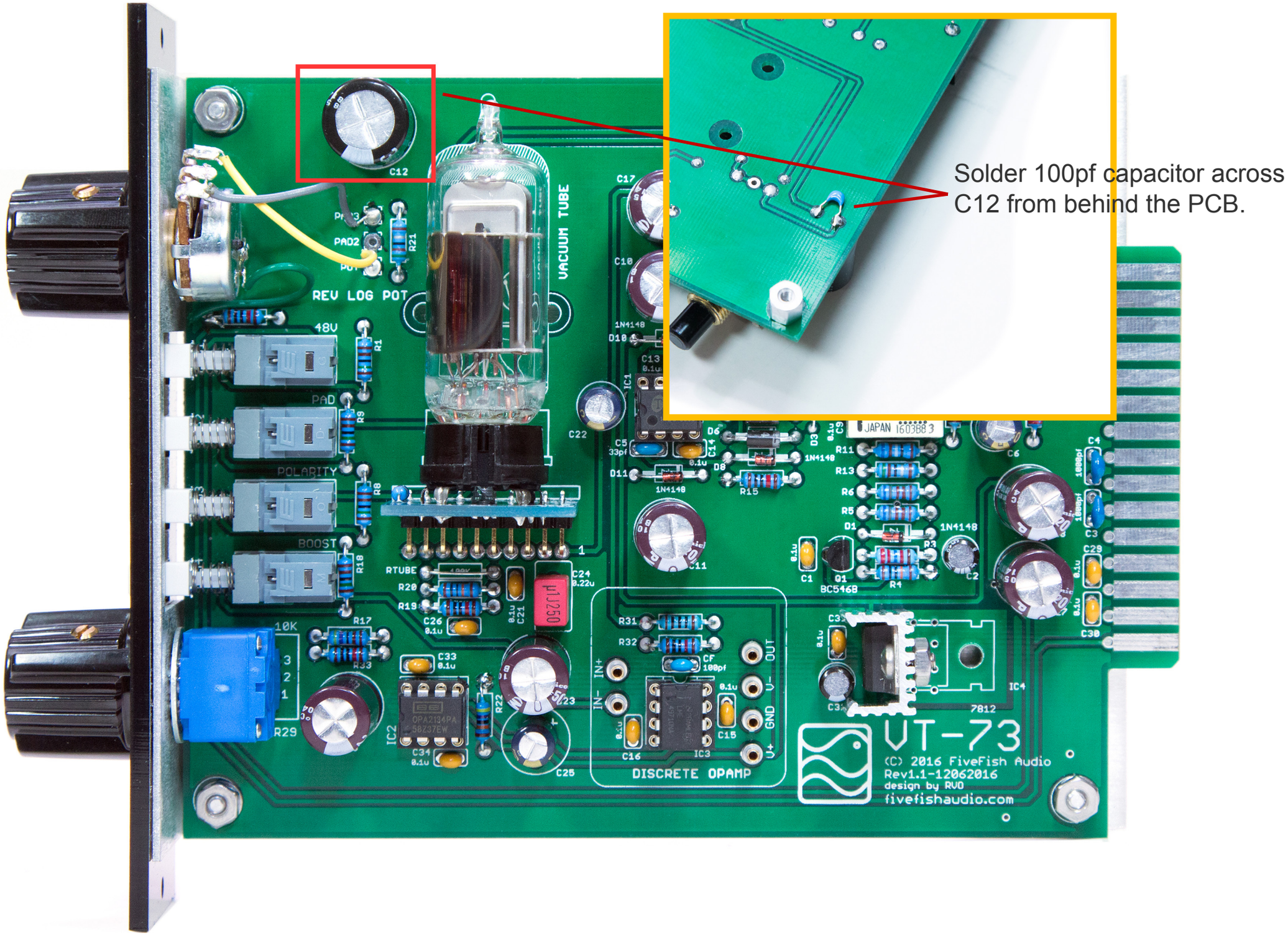
3.11 Solder the (4) Push-Button switches. Make sure they're mounted horizontally level and not crooked or mis-aligned.
TIP: You may use masking tape to hold the switch secure in it's place while you solder. Solder only one of the switch terminals and review if the switch is still horizontally level. If everything looks good, solder the rest of the switch terminals.



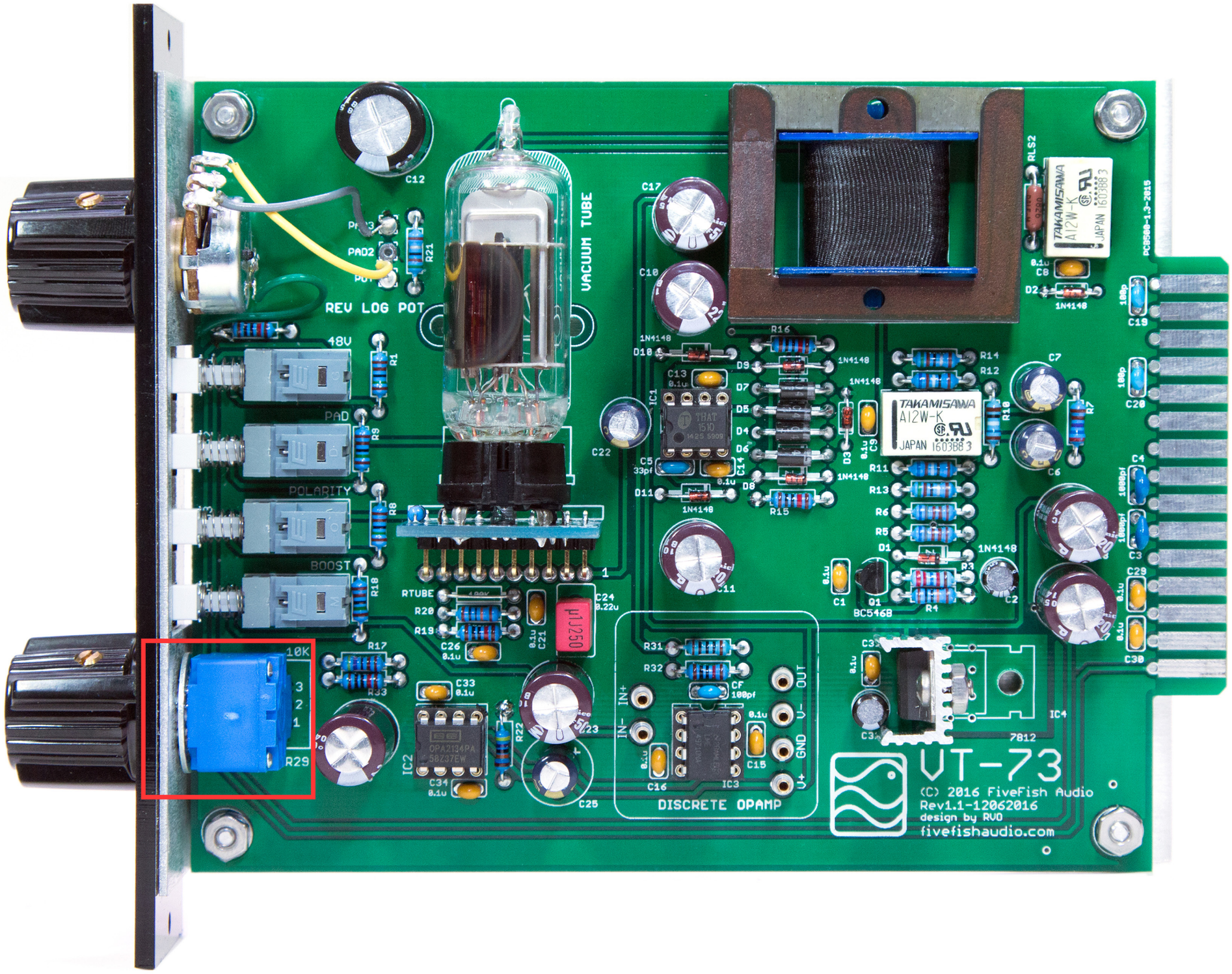
3.12 Solder all medium-sized 220uf electrolytic capacitors.
IMPORTANT: Observe proper polarity and orientation of (+) and (-) leads.



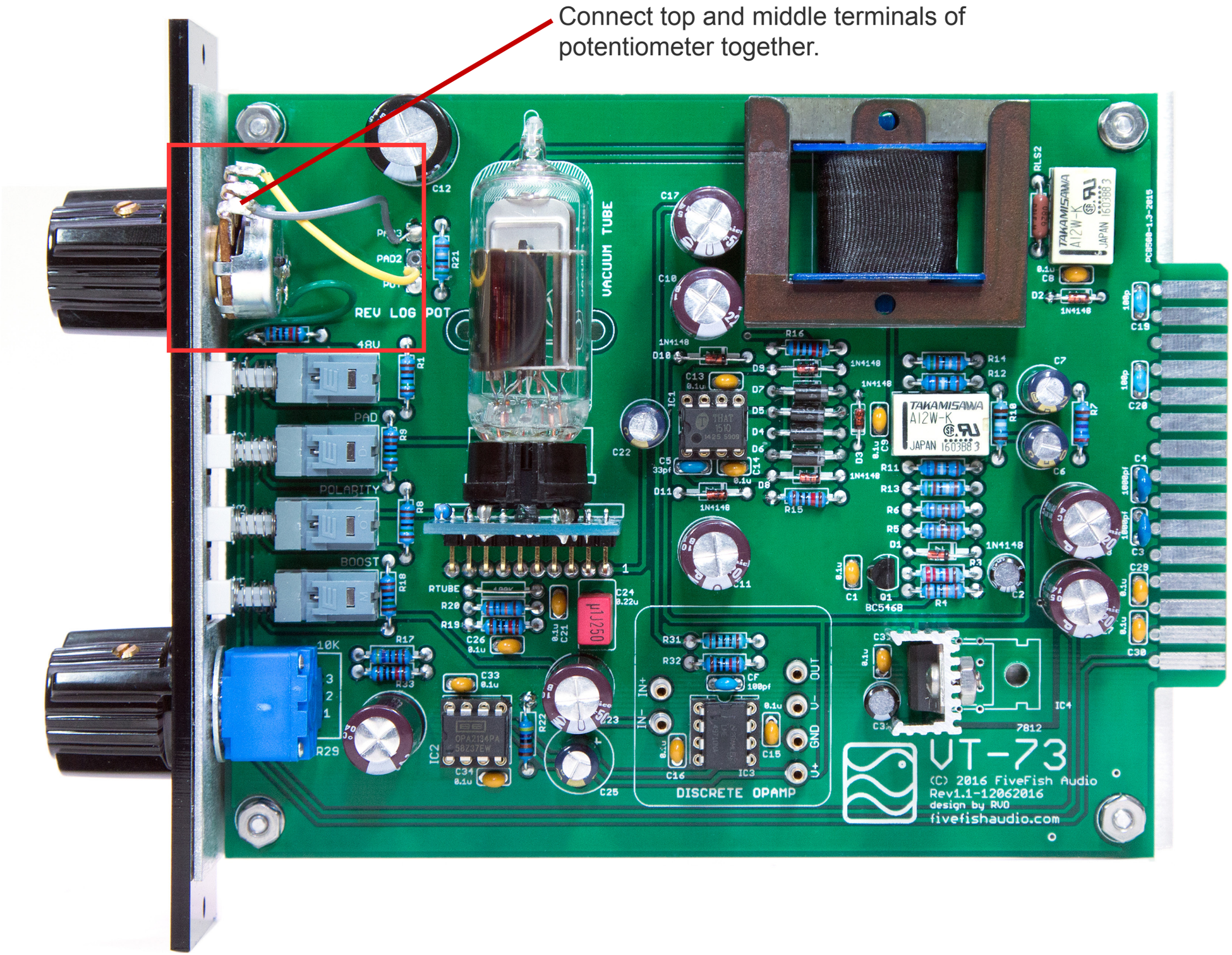
3.13 Solder the large C12, 3300uf capacitor.
NOTE: Solder 100pf capacitor in parallel to C12, from the bottom side of PCB.



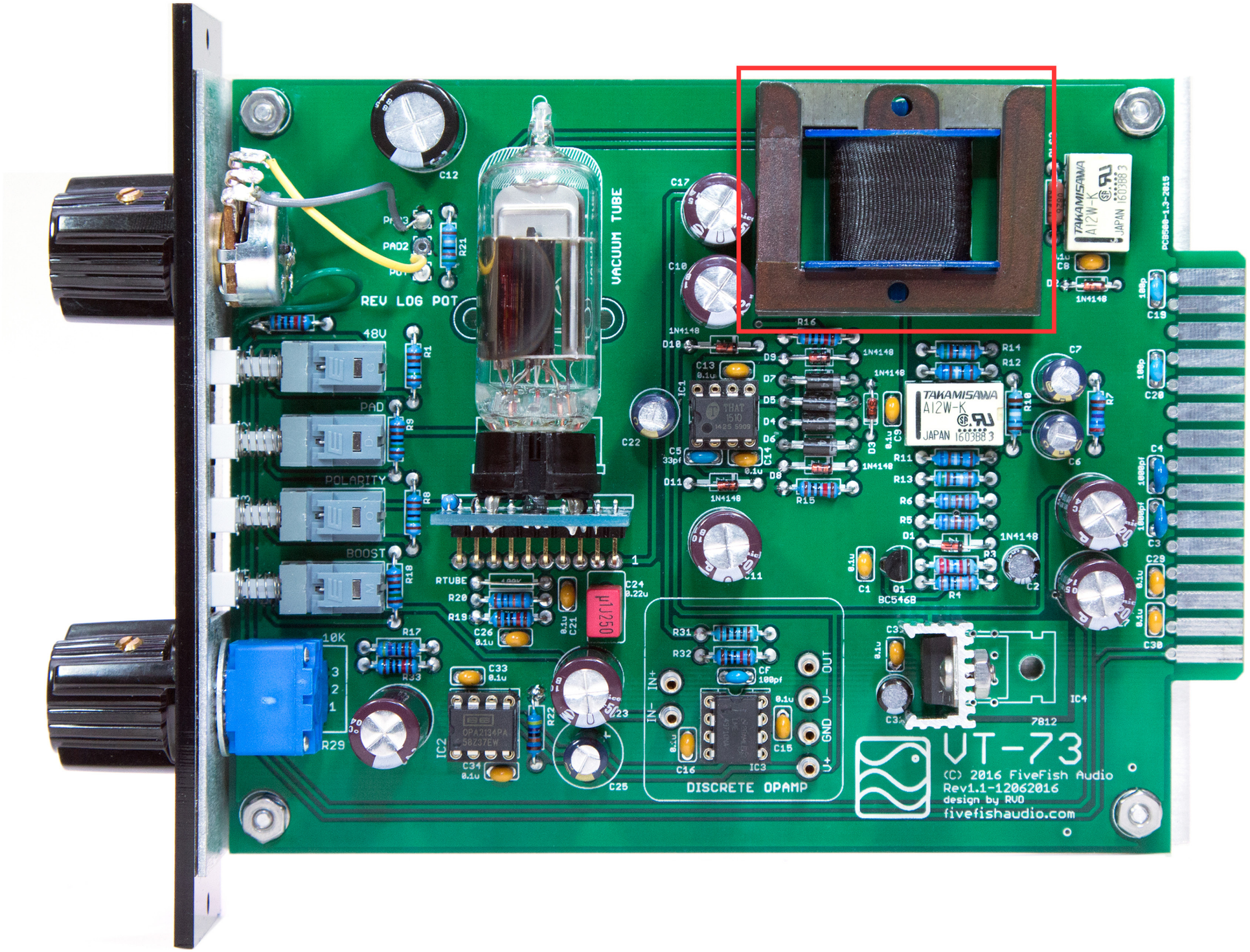
3.14 Solder the Bourns Potentiometer. Make sure to mount potentiometer level and flat as possible with the PCB.



3.15 Solder the 10K Potentiometer as shown below. Take note orientation of the wires and how they go into the PCB.
IMPORTANT: Use as short as possible pieces of wire to connect potentiometer to the board to minimize RFI noise pickup.



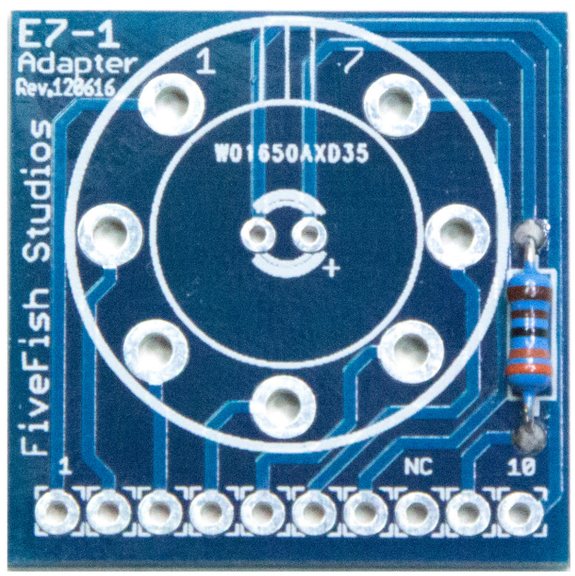
3.16 Install the Output Transformer. **NOTE:** Do not just duplicate the orientation of the transformer you see on this page. Instead, rely on the keyed PCB pins of the transformer. It only goes easily/correctly in one direction. If the transformer pins don't align with the PCB holes, turn the transformer around and try again.

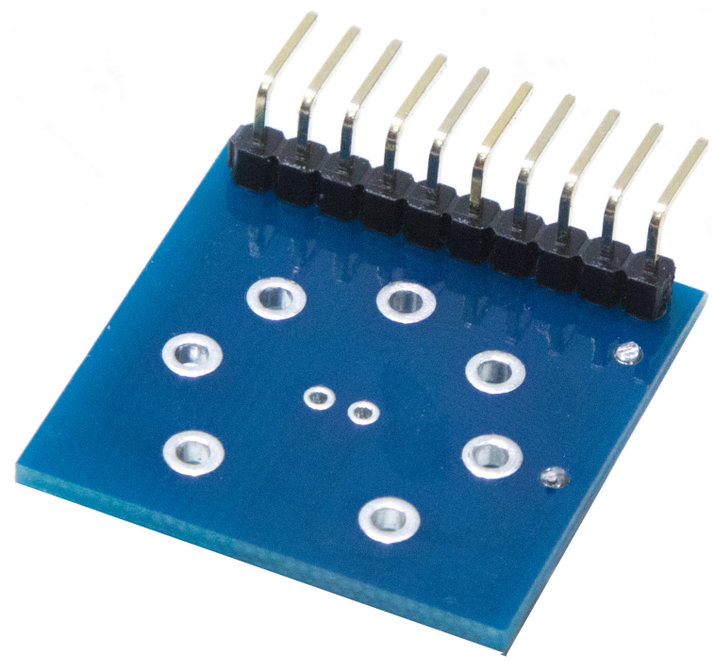


3.17 Now, let's assemble the Vacuum Tube PCB Adapter board. Our Vacuum tube will be mounted in a tube socket for easy future replacement. The PCB Adapter board is then soldered to the main board using right-angle headers, making the tube orientation vertical once the 500-series preamp is inserted into the rack.

First step is to solder the current-limiting resistor for the LED.

Next, solder the Right-Angle Headers to the board as shown. Turn over the PCB, and solder the headers from the component side of the board. Take note that the shorter leg is soldered to the PCB!





3.18 A. Insert (but DO NOT SOLDER) the Red LED into the Adapter Board.
Make sure to follow the proper orientation. The “Longer” leg of the LED goes to the hole marked with a (+) sign.
Do not solder the LED yet!

B. Insert and solder the Vacuum Tube socket. Solder all (7) pins to the board.

C. After you’ve soldered the Vacuum Tube socket, position the Red LED into the center hole of the Tube socket. Then solder the LED leads.

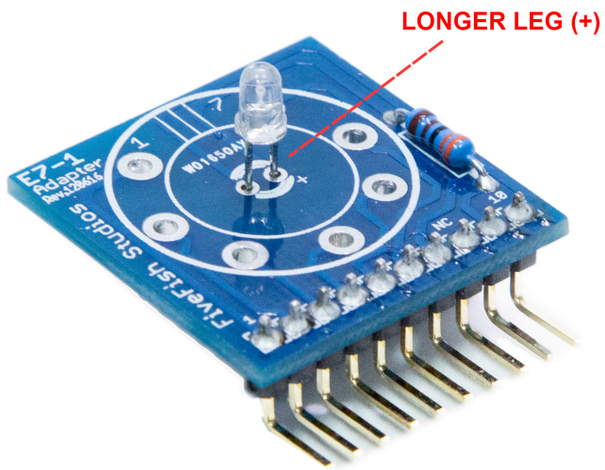


Figure 3.18 A

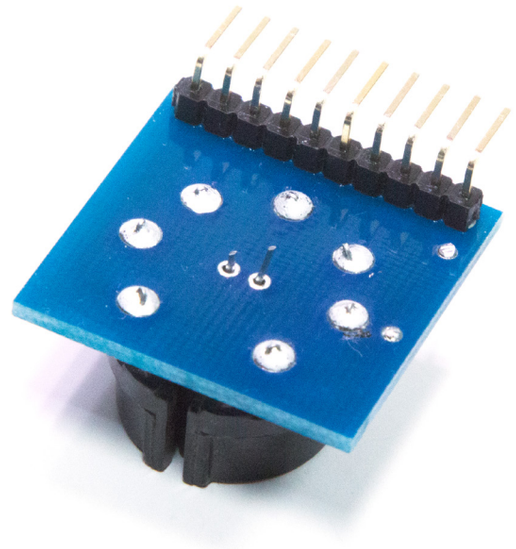
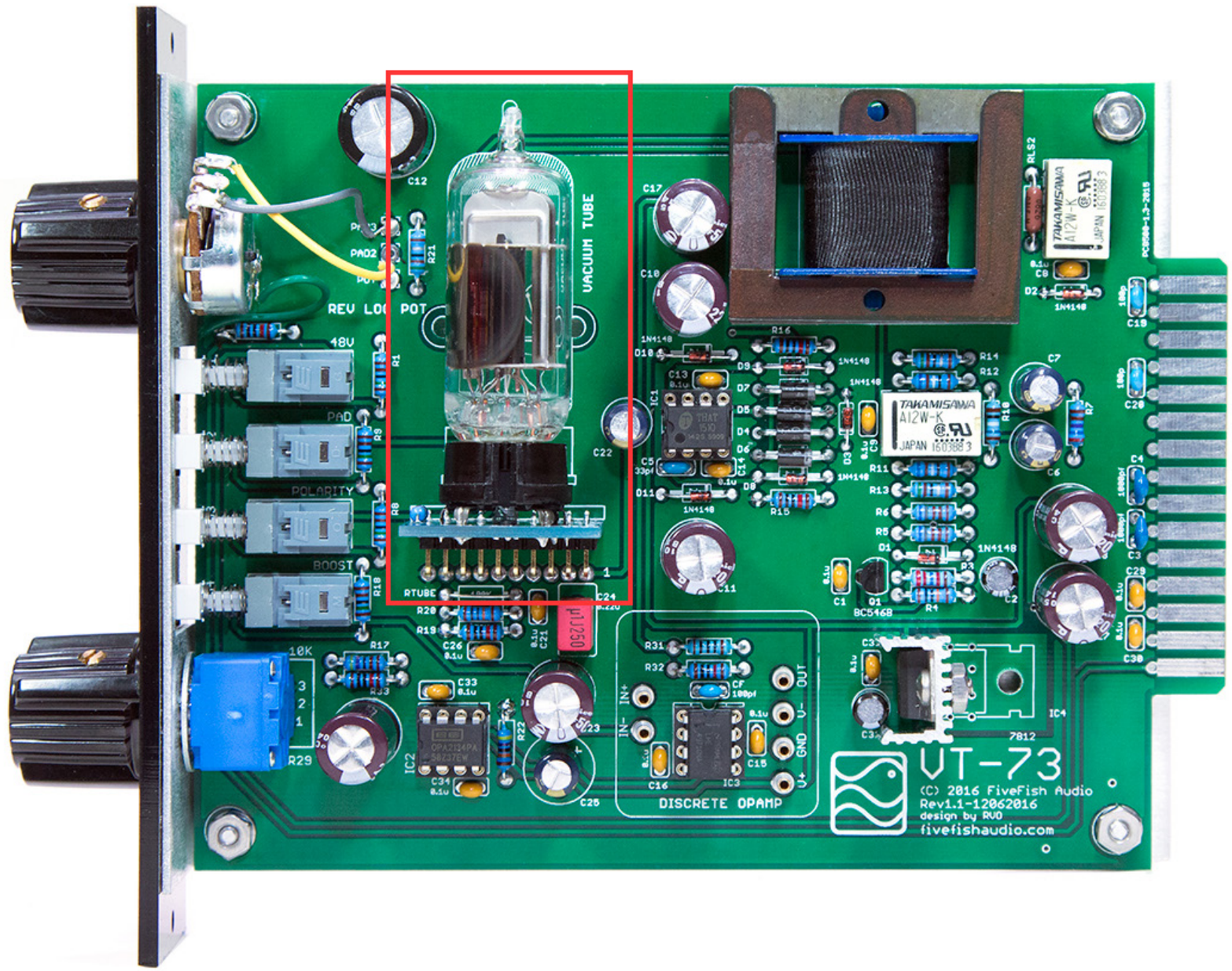


Figure 3.18 B

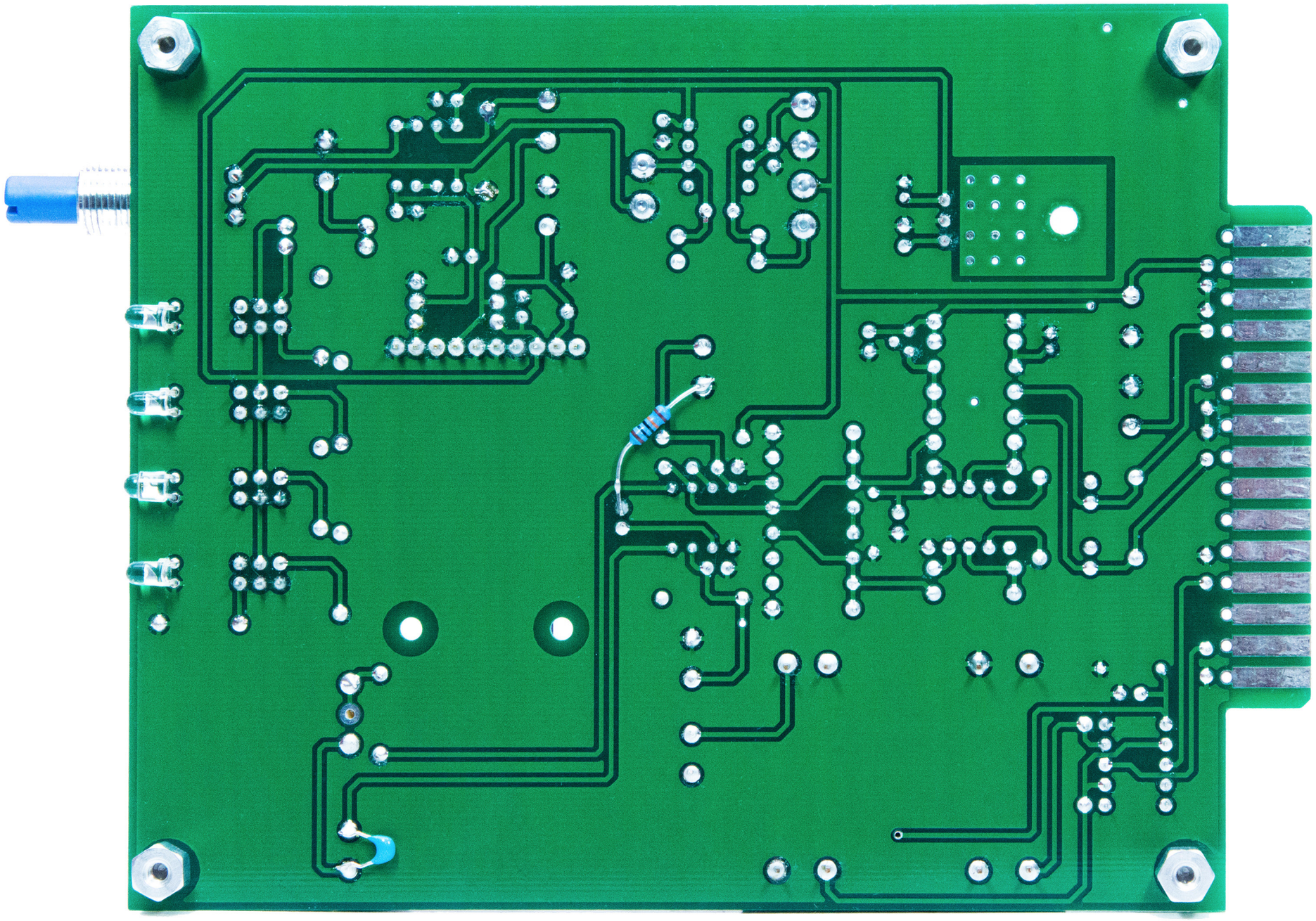
Figure 3.18 C

3.19 Insert Vacuum Tube into socket, firmly but carefully. For easier insertion, wiggle the tube side-by-side as you insert it. Then mount the complete Vacuum Tube PCB Adapter assembly to the main board, and solder the right-angle headers.

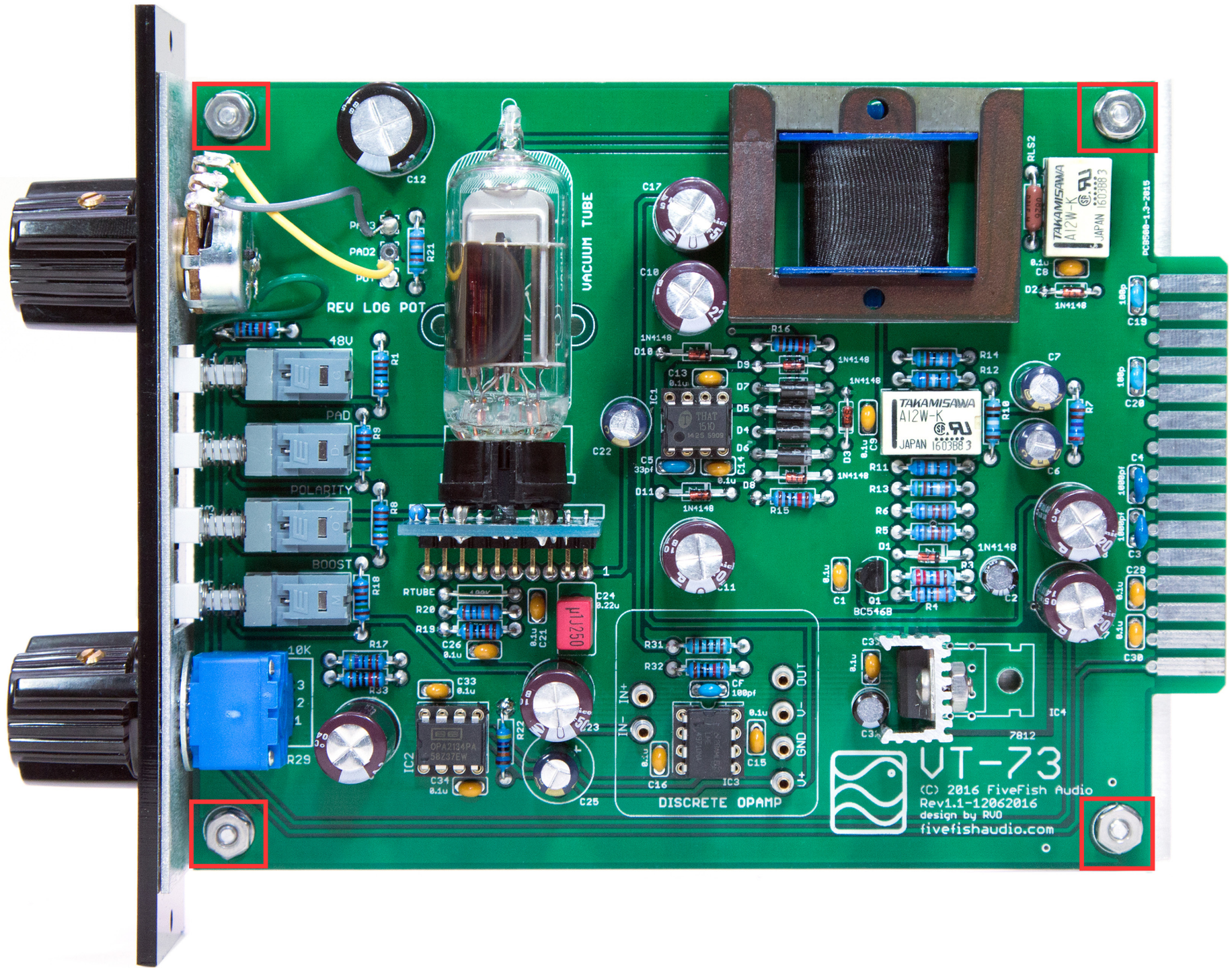
NOTE: The vacuum tube can have varying degrees of microphonic vibrations that can be heard with your audio signal. To reduce these vibrations, insert the rubber tube damper over the glass body. You may also tie and secure the tube to the PCB using a short string or cut piece of rubber band to further reduce vibrations.



3.20 ERRATA: Solder a 100K resistor to bottom of PCB as shown in photo below. Make sure you also have a 100pf capacitor soldered in the location below.

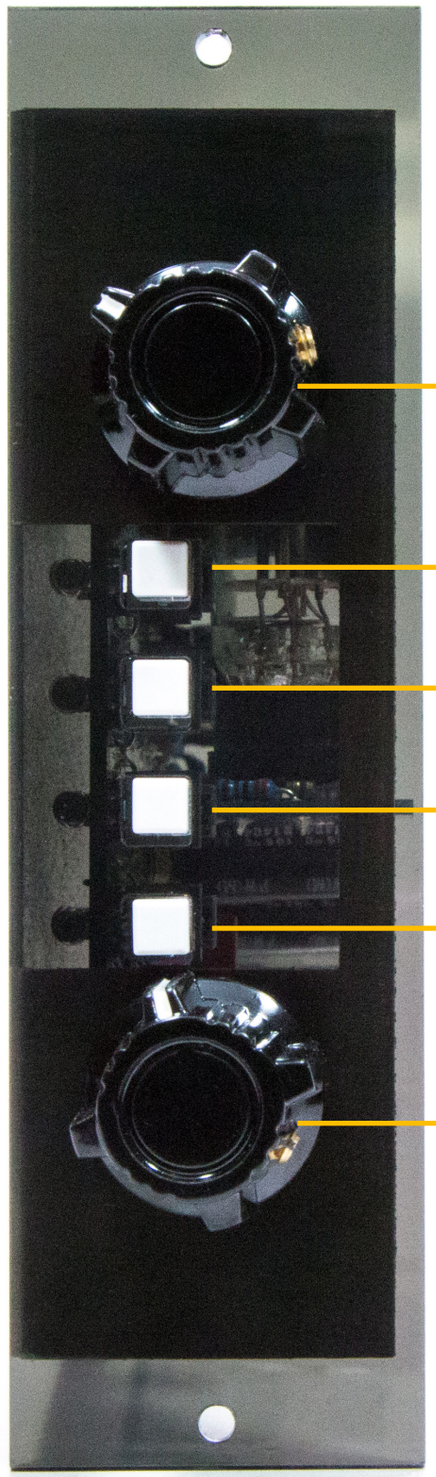


3.21 Install mounting spacers to PCB using the Aluminum Male-Female Hex Spacers and 4-40 nuts. Then mount PCB to aluminum sled using the provided small screws.



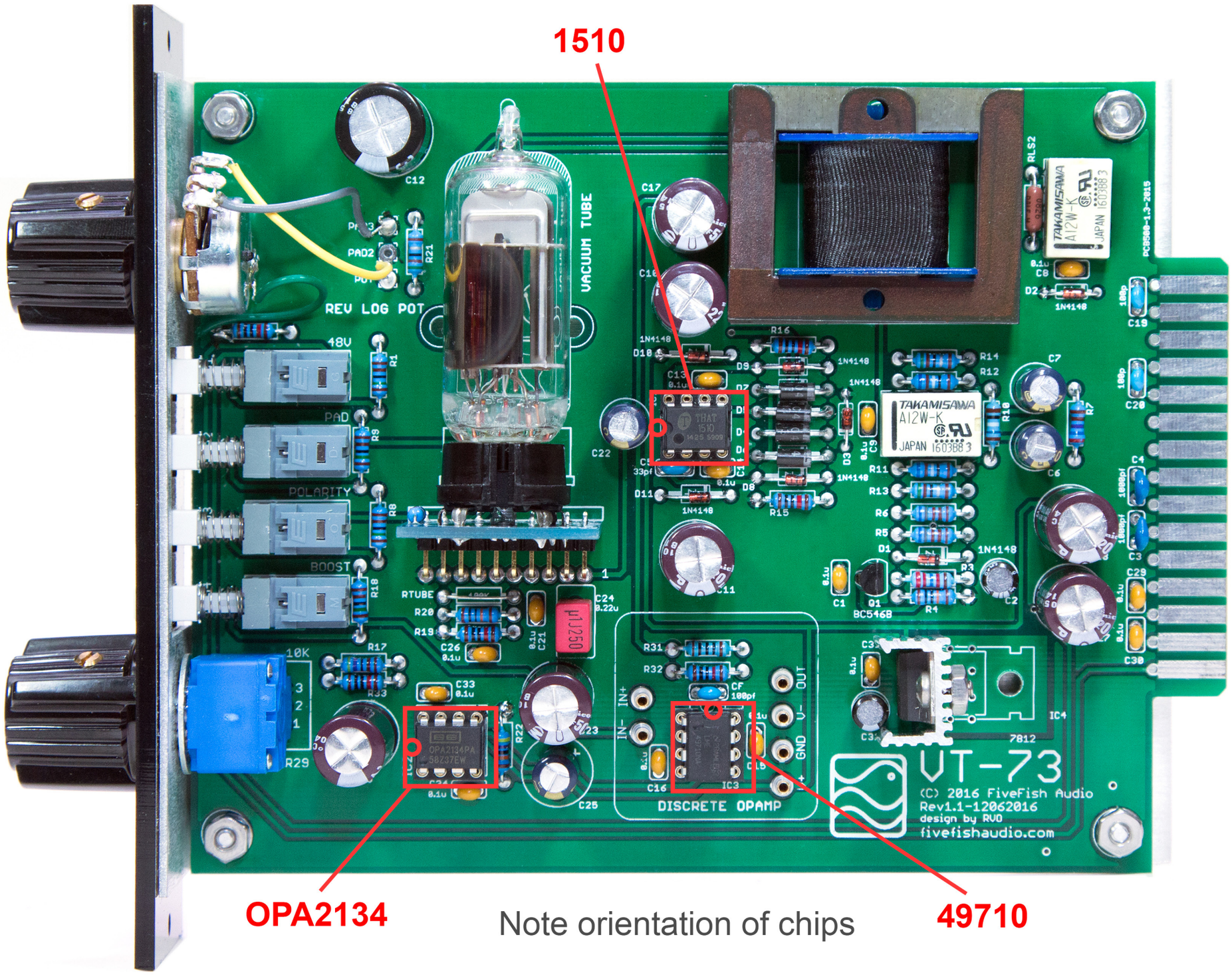
3.22 Attach the transparent acrylic front panel. Tighten nuts of potentiometers securely.
IMPORTANT: Do not overtighten nuts to avoid cracking the Acrylic Front Panel.
Then install knobs by tightening the set screw on knob.

NOTE: Anodized 0.125” aluminum CNC-engraved Front Panels are also available as an upgrade option. Contact FiveFish Audio for details.



NOTE: VT-73 Mic Preamp Kit comes with a 3mm Transparent Gray Acrylic front panel.
The lighted LEDs show through very nicely through the tinted transparent front panel.

3.23 Insert the (3) IC chips into their sockets. There is a proper orientation for each chip. Take note of the half-circle cutout on the Chip Body, and orient the IC chip as shown in the photo below.
IC1 = THAT 1510; IC2 = OPA2134; IC3 = LME49710



Note orientation of chips

3.24 Take a coffee break!

4. ERRATA / MANUAL CHANGE INFORMATION

The following changes are required for PCB version 1.1

4.1 Use a wire/jumper across RTUBE location.

4.2 Use 470K for R22 location.

4.3 Solder 100K resistor at bottom of PCB as shown in Step 3.20

4.4 Use 47uf/50V for C25 location.

4.5 Solder a 100pf capacitor in parallel to C12, from the bottom side of PCB as shown in Step 3.13

4.6 Use 100K resistor for R20 location.

4.7 Use 220R resistor for R21/RPOT location.

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5. PRE-FLIGHT CHECK

Before applying power to the unit, please review your work one last time.
Go over Step 3, and in particular review the following specific items:

5.1 Perform a visual inspection. Check for any cold solder joints, or short circuit bridges.

5.2 Check if all diodes are installed in correct orientation.

5.3 Check if all polarized electrolytic capacitors are installed in correct orientation.

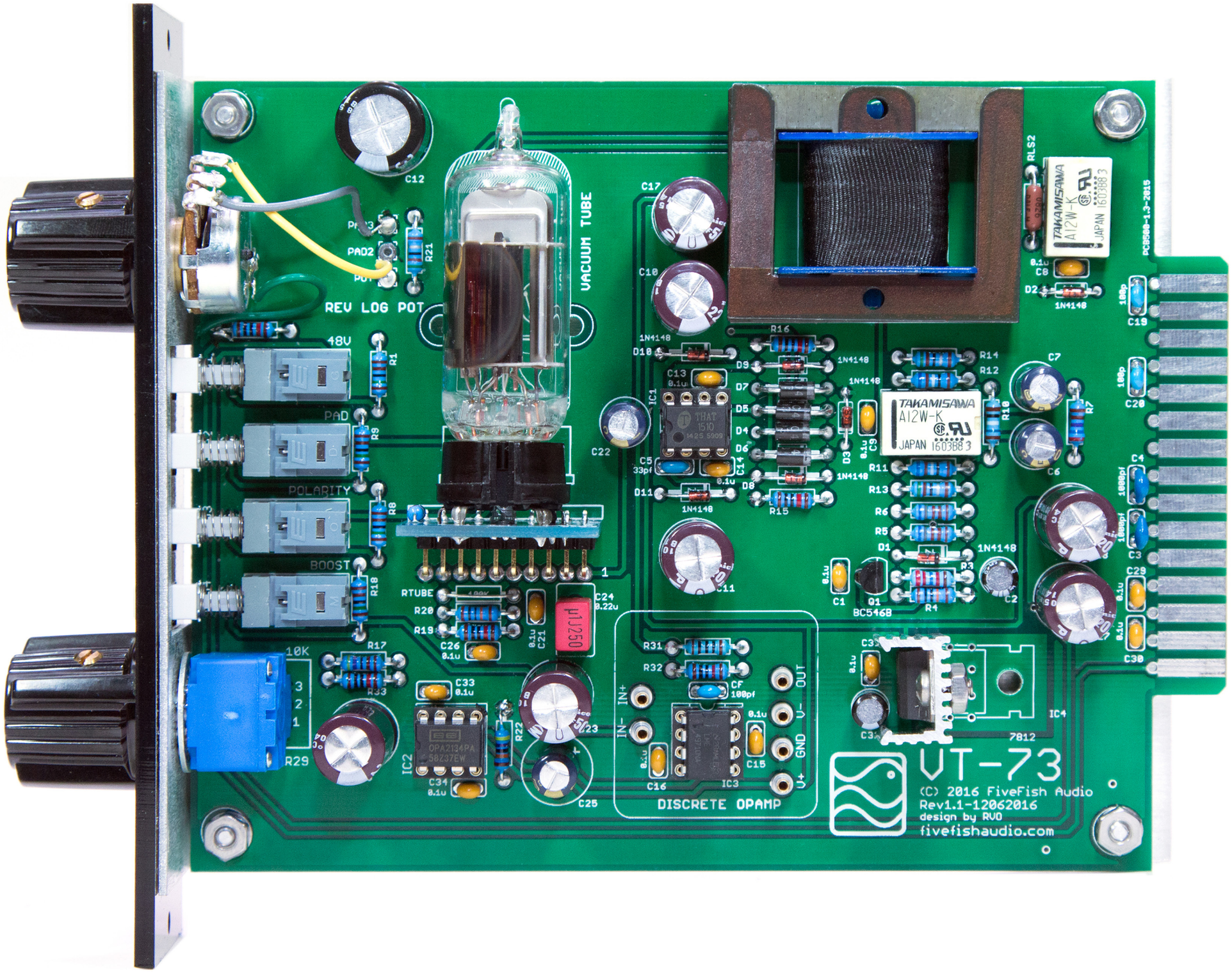
5.4 Check if all relays are installed in correct orientation.

5.5 Check if jumper to bypass IC4 is required (only required if using A12W-K Relays).

5.6 Check if IC1, IC2, and IC3 are inserted in their correct locations and oriented correctly.

5.7 Check if 100pf capacitor is soldered, as instructed in Step 3.13

5.8 Check if 100K resistor is soldered, as instructed in Step 3.20



6. PARTS LIST

VT-73 Mic Preamp Kit

PCB Rev1.1

Last update: 08.04.17

QTY	REFERENCE	VALUE
1	PCB	FIVEFISH AUDIO VT-73 PCB
	RESISTORS	
1	RTUBE	JUMPER
3	R13, R14, R21	5R1
1	R31	100R
1	R10	169R
1	RLS	604R
2	R11, R12	619R
4	R1, R8, R9, R18	1K5
1	R7	2K67
1	R17	4K7
2	R5, R6	6K8
6	R2, R19, R32, R33, R15, R16	10K
1	R3	22K6
3	R-Bottom, R4, R20	100K
1	R22	470K
1	R29	10K BOURNS LINEAR POT
1	RGAIN	10K REVERSE LOG POT
	CAPACITORS	
1	C5	33pf / 50V
4	C19, C20, CF, C-Bottom	100pf / 100V
2	C3, C4	1000pf / 50V
14	C1, C8, C9, C13, C14, C15, C16, C21,	0.1uf / 100V
	C26, C29, C30, C31, C33, C34	
1	C24	0.1uf / 250V WIMA
2	C2, C32	22u / 50V
4	C6, C7, C22, C25	47uf / 50V
7	C10, C11, C17, C18, C23, C27, C28	220uf / 50V
1	C12	3300uf / 10V

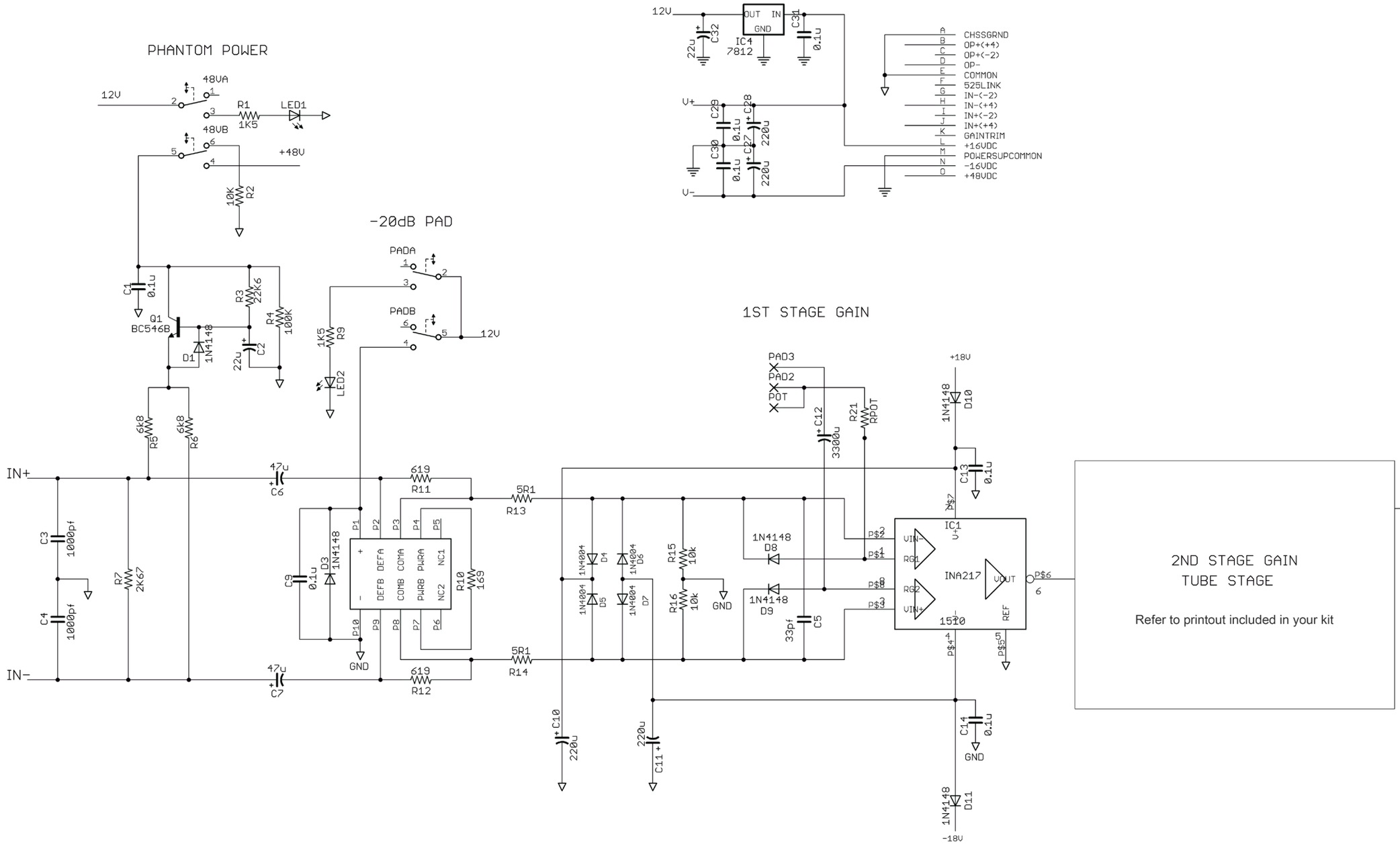
VT-73 Mic Preamp Kit

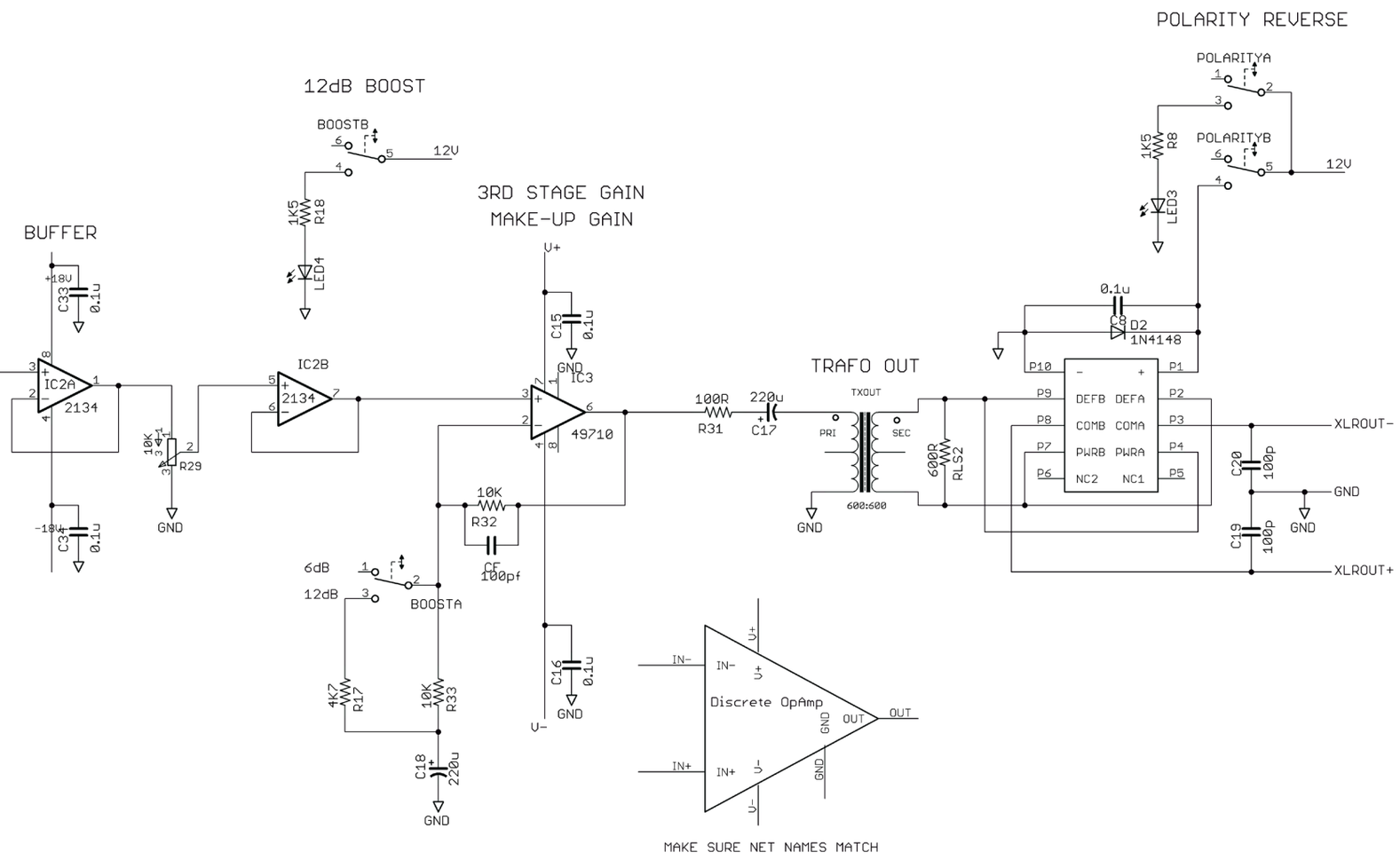
PCB Rev1.1

Last update: 08.04.17

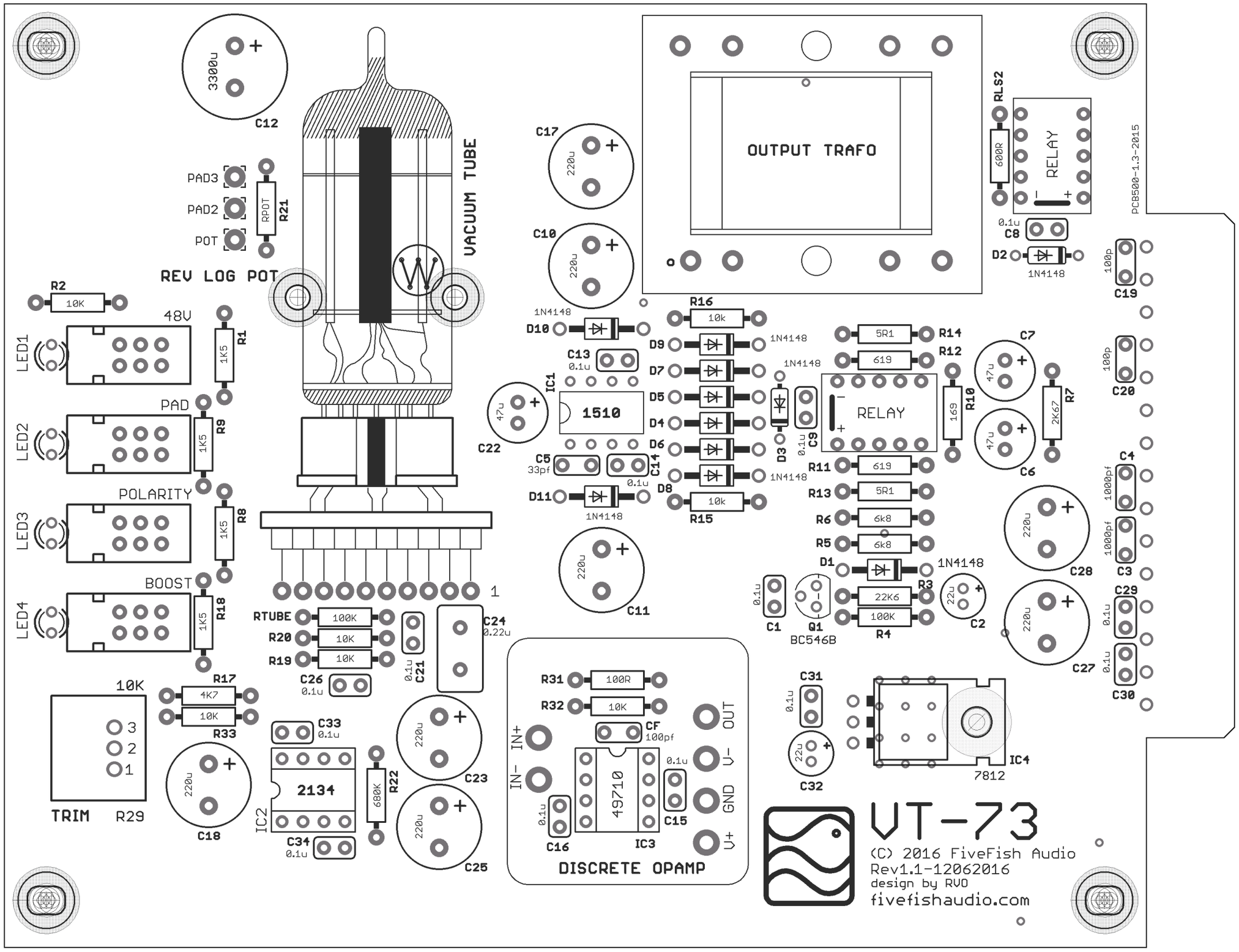
QTY	REFERENCE	VALUE
	SEMICONDUCTORS	
1	IC1	THAT 1510
1	IC2	OPA2134P
1	IC3	LME49710
1	IC4	7812
0	DOA	DOA-12
1	Q1	BC546B
7	D1, D8, D9, D10, D11, D2, D3	1N4148
4	D4, D5, D6, D7	1N4004
	MISCELLANEOUS	
1	TXOUT	600:600 TRANSFORMER
4	SW1, SW2, SW3, SW4	DPDT PUSH BUTTON SWITCH
4	LED1, LED2, LED3, LED4	3mm LED, VARIOUS COLORS
2	RELAY1, RELAY2	A12W-K RELAY
	HARDWARE	
1	ALUMINUM SLED	ALUMINUM SLED
1	ACRYLIC FRONT PANEL	FRONT PANEL, LASER CUT
4	0.25" STANDOFFS	HEX .187X.250 ALUM M/F
4	LOCK WASHERS	LOCK WASHERS
4	NUTS 4-40	NUTS 4-40
4	UNDERCUT SCREWS	UNDERCUT SCREWS
2	KNOBS	BLACK KNOBS
1	4-40 x 1/4" MACHINE SCREW	FOR 7812 REGULATOR
1	NUTS 4-40	NUTS 4-40
1	TO-220 HEATSINK	FOR 7812 REGULATOR
3	8P IC SOCKET	8P DIP MACHINE
	TUBE PCB ADAPTER	
1	PCB ADAPTER	FIVEFISH AUDIO PCB ADAPTER
1	VT1	VACUUM TUBE 12A
1	RTUBE-LED	3K3
1	TUBE-LED	RED 3MM LED
1	RIGHT-ANGLE HEADERS	10P RIGHT-ANGLE HDRS
1	TUBE SOCKET	7-PIN MINI-TUBE SOCKET

7. SCHEMATIC DIAGRAM





8. COMPONENT GUIDE - REV1.1 PCB



9. WHAT THE FAQ? (FREQUENTLY ASKED QUESTIONS)

I imagine these will be some of your questions... so I'm answering them now.

When I turn the gain knob clockwise, the sound decreases instead of increasing. At minimum gain setting, I have a very loud output signal. It's backwards!
Please review Step 3.15 and look closely at how the wires are connected to the potentiometer. You need to swap the location of your 2 wires if your gain is backwards.

There is no audio output from the mic preamp.
Please review Step 4, Errata and manual changes. Also, don't forget to solder the 100K resistor at bottom of PCB in the location shown in Step 3.20

The vacuum tube is not getting warm.
Measure voltage at ouput of Voltage Regulator. You should have approximately 12Volts DC. If you're getting 12Volts, check solder connections around the vacuum tube area. Also check for proper solder on the tube socket. If the vacuum tube is still not getting warm, you have have a defective vacuum tube. Contact us for a replacement.

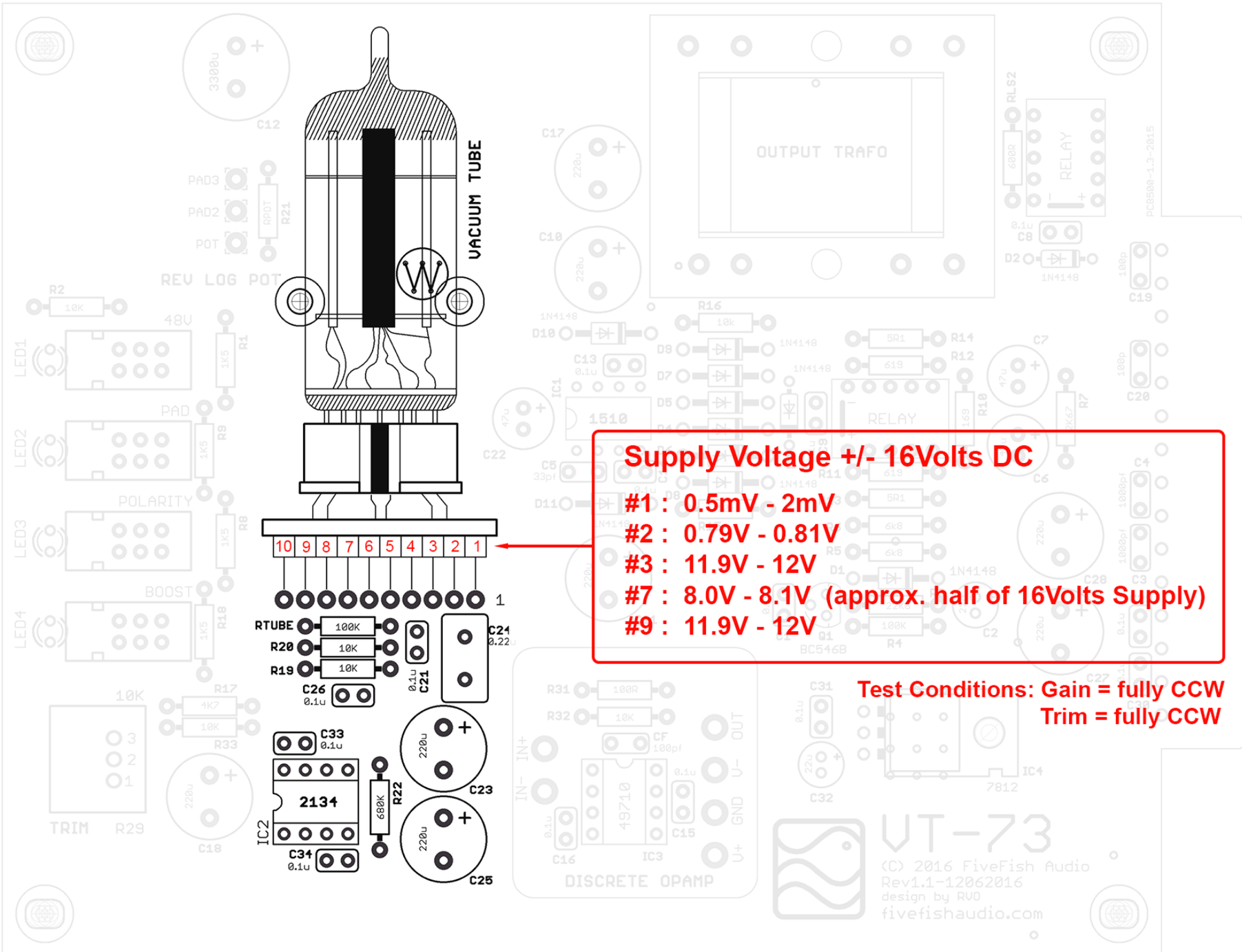
The bottom potentiometer (TRIM Knob) sounds scratchy when I first turn ON the unit.
This is normal. The vacuum tube needs to warm up before all DC voltages become stable and settle down to their optimum values. Please allow 60-90 seconds for the tube to sufficiently warmp up before using the preamp. After this alloted time, the sratchiness on the bottom potentiometer will disappear.

There is no sound coming out, but only during the first few seconds when I first turn ON the unit. After that, it operates normally.
Because this is real vacuum tube preamp. :) The vacuum tube uses a glowing heater element to emit electrons needed for it's proper operation. A cold tube does not have sufficient electrons emitted yet to work properly, thus you're not able to hear any audio output. The tube needs to warm up before all DC voltages become stable and settle down to their correct values. Please allow 60-90 seconds for the tube to sufficiently warmp up before using the preamp.

I hear "springy" sound when I bump into the unit.
These are "microphonic vibrations" caused by mechanical vibrations being picked up by the vacuum tube. To eliminate or reduce these vibrations, use a vacuum tube damper and/or mechanically secure/tie the vacuum tube to the PCB using a short piece of string or cut piece of rubber band. The amount of these microphonic vibrations can vary depending on the tube.

10. TROUBLESHOOTING - VOLTAGE MEASUREMENTS

If your preamp is not functioning, please review Section 4 ERRATA and Section 5 PRE-FLIGHT CHECK.
In addition, here are some approximate/typical voltage readings around the Vacuum Tube section. If your voltage readings are several orders of magnitude wrong, please re-check for any missing parts or parts in the wrong location.



A Tip regarding Vacuum Tubes

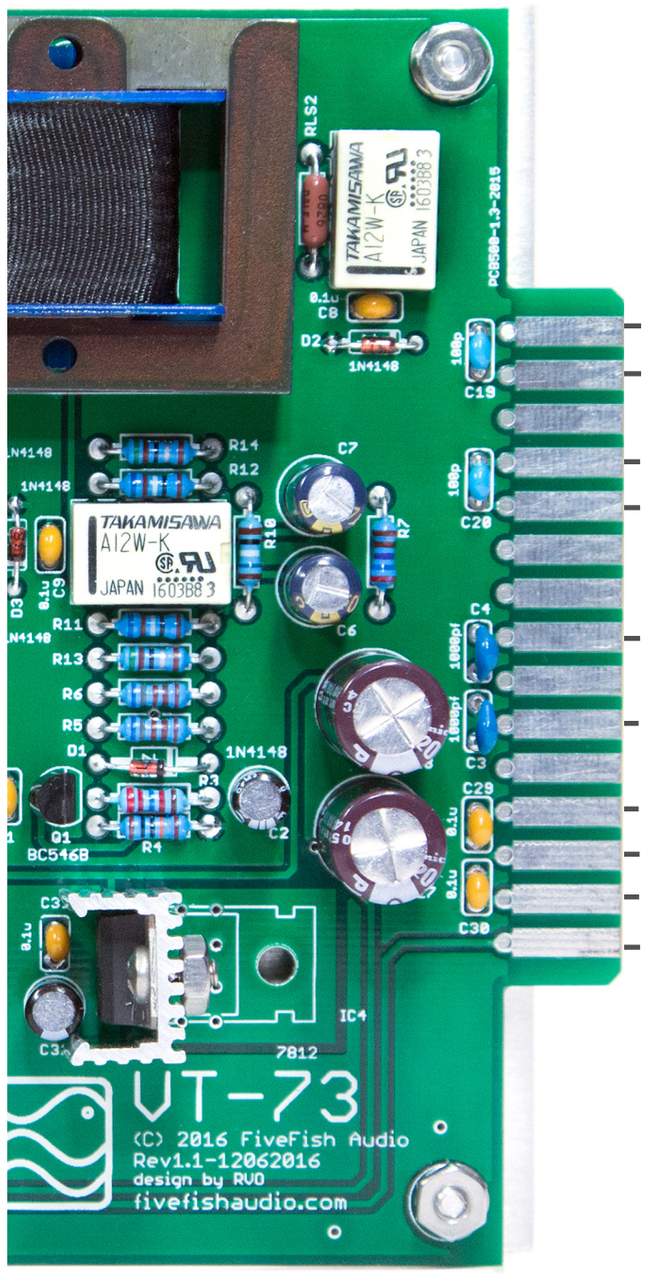
This Mic Preamp Kit uses either New or (NOS) New Old Stock Vacuum Tubes and Tube Sockets.

Due to the age of these parts, the terminals may have oxidized over time. It's recommended that you clean the Vacuum Tube terminals using either steel wool or fine sand paper or something similar to scrape off the oxidized film on the terminals that may prevent making a good electrical connection.

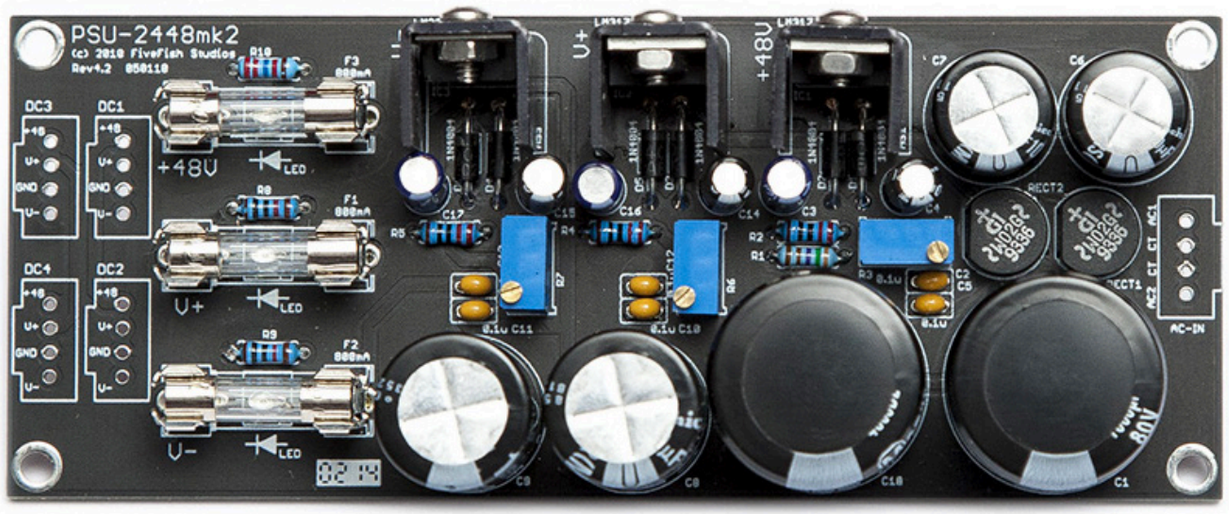
If you're getting incorrect voltage readings around the tube section (see previous page), AND you've verified all parts are soldered in the correct location and you don't have any other build mistakes, try re-seating the Vacuum Tube from it's socket, and re-inserting them again. Repeat these steps a few times. It could be the Vacuum Tube is not making a good electrical connection with the Tube Socket terminals.

11. RACK MOUNTING THE VT-73 MIC PREAMP MODULE

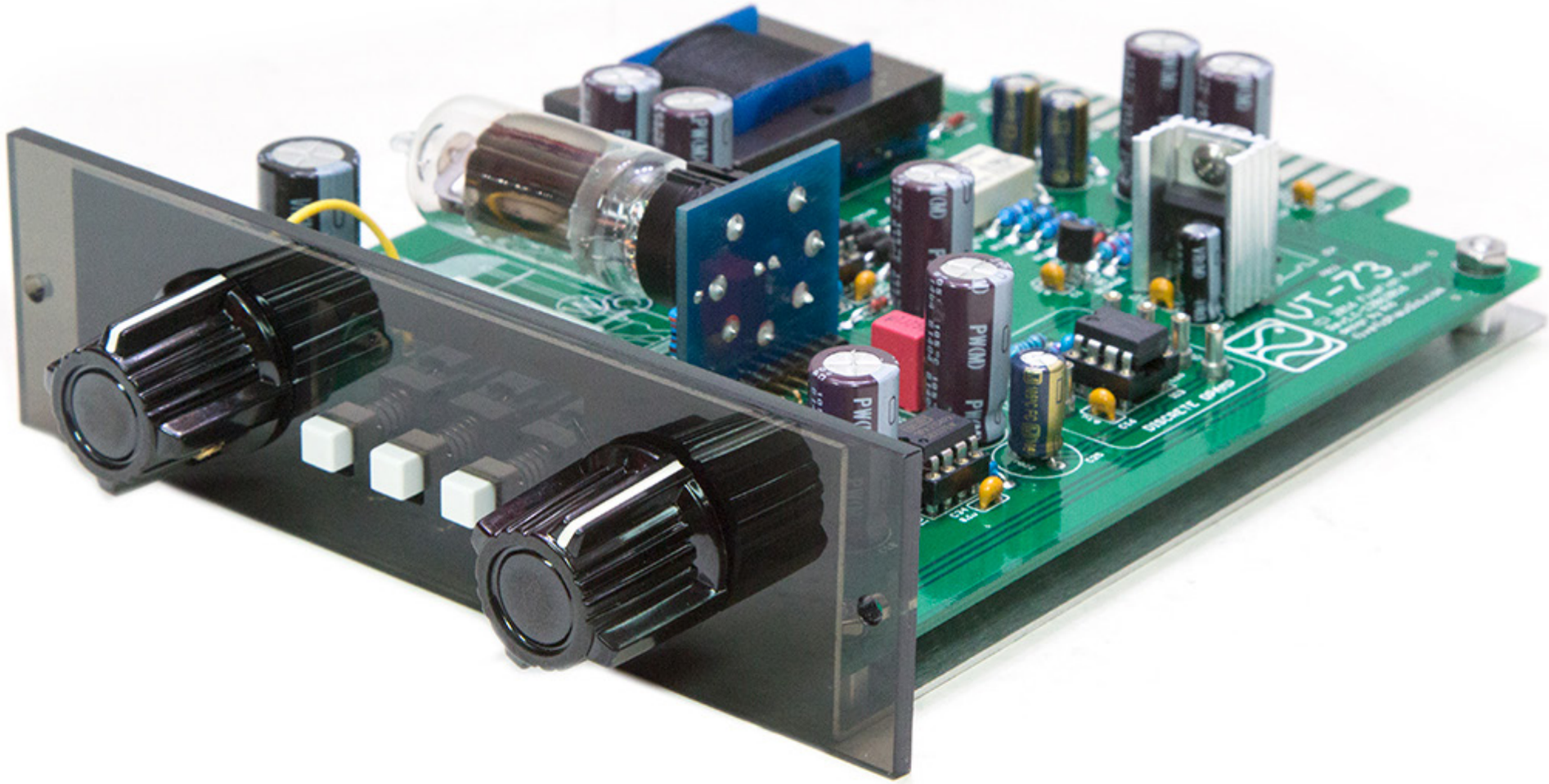
You may also mount the VT-73 Mic Preamp inside a custom 1u 19” rack case. Just supply the preamp module with the necessary +/- voltages, and connect to XLR male and female jacks. Use the wiring guide below. You can use a 15-pin EDAC connector, or solder the connection wires directly to the holes provided on rear of the board.



- CHASSIS / GND
- XLR OUT + HOT
- XLR OUT - COLD
- GND
- XLR IN - COLD
- XLR IN + HOT
- +16V to +18V DC
- GND
- -16V to -18V DC
- +48V DC



For rack mounting, we recommend a FiveFish PSU-2448 Power Supply Kit and Power Transformer to supply regulated +/- voltage and +48V phantom power to your SK-1DI module.



12. ERRATA

From bottom side of PCB, solder a 1K5 resistor between Pin 1 of the Vacuum Tube Adapter PCB and GROUND.