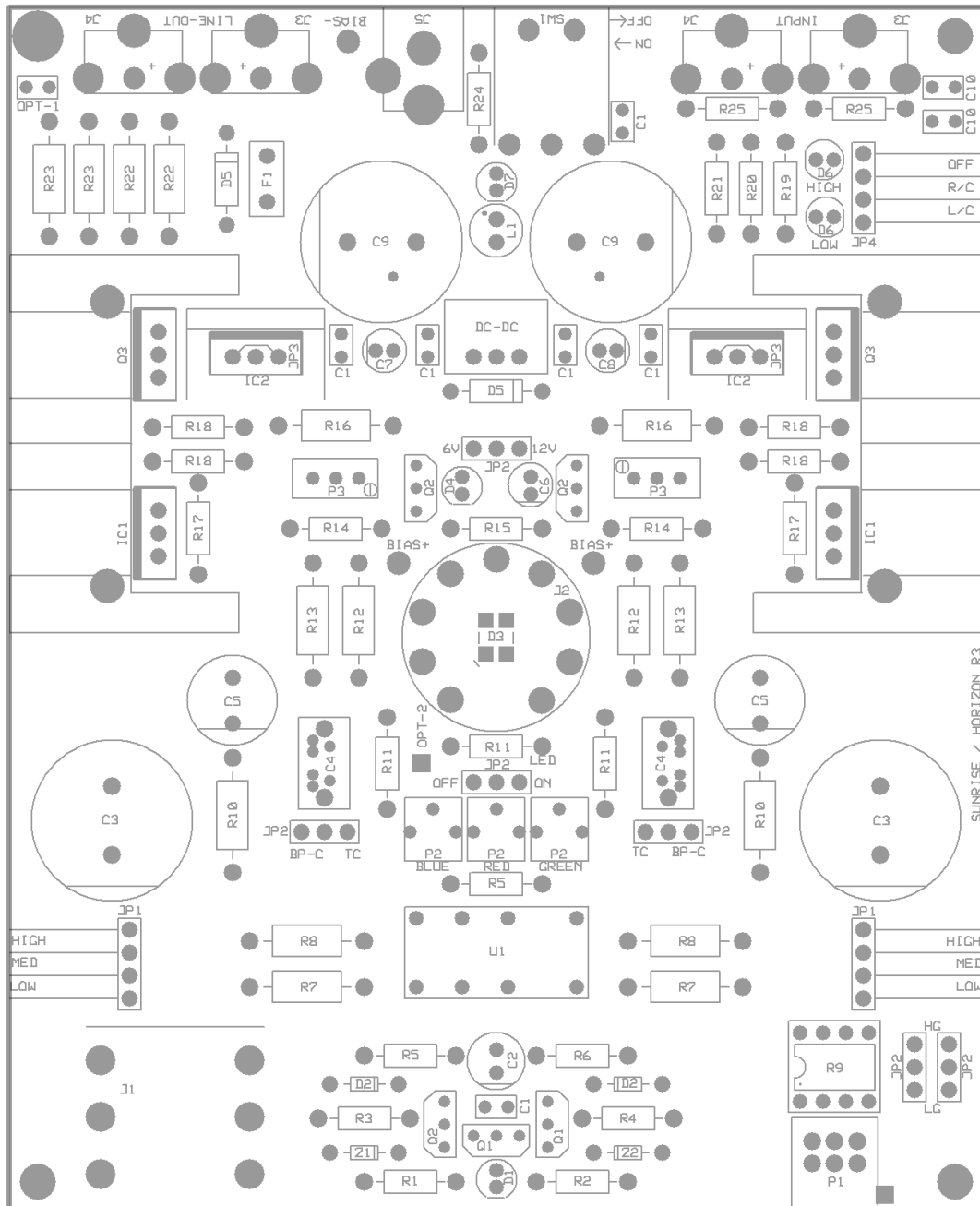


Project Sunrise

USER MANUAL FOR VERSION III AMPLIFIERS

SEPTEMBER 25th 2014

WWW.GARAGE1217.COM



Specifications

- Single ended OTL class-A output stage.
- Power consumption: 13W continuous, 19W peak.
- Power supply: 24VDC (0.55A cont, 0,8A peak)
- Input Resistance: 11k Ω / 31k Ω dependant on setting and module
- Input Sensitivity (6N23): 270mV (dependent on tube)
- Gain: 14-26dB (selectable and dependent on tube)
- Max Output voltage 6.3V into 120 Ω
- Output Resistance: Selectable – 1.5 Ω , 32 Ω or 69 Ω
- Frequency Response: 10 Hz – 150 KHz (-0.5dB) with 32 Ω load
- Frequency Response: 4 Hz – 350 KHz (-3dB) with 32 Ω load
- Signal to Noise ratio: 91dBA (dependent on tube)
- Crosstalk: -88dB (dependent on tube)
- THD: > 0.013% (dependent on tube)
- Suitable for: 32 - 300 Ω Headphones

OUTPUT POWER INTO:	OUTPUT RESISTANCE		
	1.5R	32R	69R
16 Ω	480mW	80mW	25mW
32 Ω	1w	280mW	210mW
64 Ω	550mW	240mW	125mW
120 Ω	280mW	170mW	110mW
300 Ω	120mW	90mW	70mW
600 Ω	65mW	60mW	50mW

Tubes / Valves that can be used in Project Sunrise

6V TUBES:

- 6922
- 7308
- 8223
- 6AQ8
- 6DJ8
- 6GU7
- 6CG7
- 6BQ7A
- 6H23
- 6H23N
- 6L12
- 6N11
- 6N23
- 6N1P
- 6N2P
- 6N6P
- 6N30P
- B719
- Cca
- CV2492
- CV2493
- CV5358
- E88CC
- E89CC,
- E188CC
- E189CC
- E288CC
- ECC85
- ECC88
- ECC89
- ECC188
- ECC189
- ECC288
- ECC289
- JAN 7308
- 6GM8
- 6N27P
- ECC86

12V TUBES:

- 5751
- 5814
- 5814A
- 5963
- 6189
- 6201
- 6681
- 7025
- 7058
- 7729
- 6L13
- 12AD7
- 12AT7
- 12AU7
- 12AX7
- 12BH7(A)
- 12DF7
- 12DM7
- 12DT7
- A2900
- B152
- B309
- B329
- B339
- B749
- CV0455
- CV0491
- CV0492
- CV4024
- E81CC
- E82CC
- E83CC

12V TUBES CONTINUED:

- E181CC
- E183CC
- E283CC
- E811CC
- E812CC
- E813CC
- E2157
- E2163
- E2164
- ECC81
- ECC82
- ECC83
- ECC181
- ECC182
- ECC182
- ECC801
- ECC803
- ECC803S



- Both 300mA to 600mA heater current tubes can be used
- 6V and 12V heater voltage tubes can be used

WARNING:

Although Project Sunrise runs at a generally safe 24VDC, Injury from improper assembly is quite possible. The main danger comes from installing the polarized capacitors backwards as they can only be installed in one direction much like a battery (more detail on capacitor installation comes later in this manual) If a capacitor is installed backwards, it may burst resulting in burns or eye injury. **If you are not experienced in electronics or electronic kit assembly, it would be wise to have an experienced electronics person review your work before powering the unit on.** Upon first power up, wear eye protection and be wary of any burning smells or electrical noises such as loud pops or buzzes. If you followed this installation guide properly and all components are in their proper places and were installed in their proper orientation, you will soon be enjoying your amplifier without issue!

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Thank you for purchasing the Project Sunrise Headphone Amplifier Kit. This kit requires minimal electronics and soldering knowledge. The layout is easy to follow and setup is a snap! Please make sure to follow the instructions outlined in this guide and you will be enjoying your amp in no time. First, lets go over the tools and items required for your build which are as follows:

Required Assembly Tools:

- Soldering iron, 25W minimum – Variable temp soldering station preferred with 1.5 – 2mm wide chisel tip
- .032 diameter 60/40 or 63/37 Tin/Lead solder is recommended. Lead free is difficult to work with and not recommended
- Magnifying glass (recommended but not required)
- Rubber Gloves (recommended but not required)
- 3M Green or Red Scotch Brite (recommended but not required)
- 3/32th Allen Key
- 5/64th Allen Key
- Flush cuts
- 90% Isopropyl alcohol (recommended but not required)
- Paper Towels (recommended but not required)
- Digital Multi Meter (DMM or DVOM)

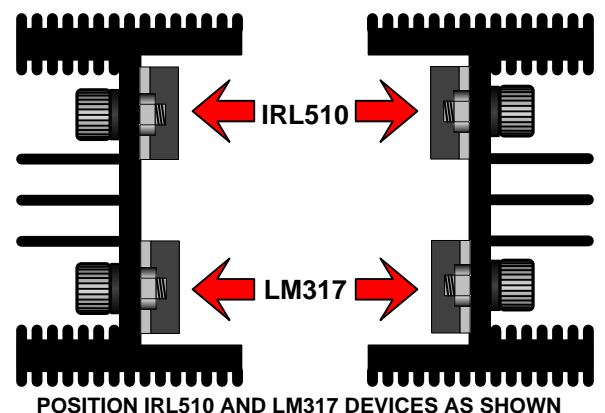
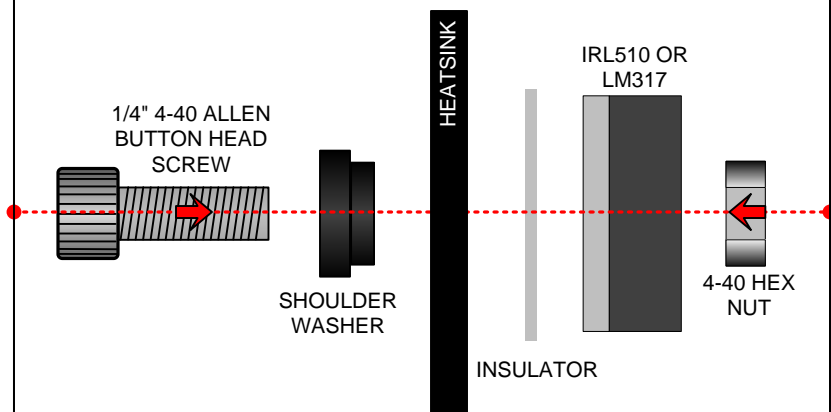
Before You Start Soldering:

Prep work needs to be done. Wash your hands thoroughly and dry. Put on the recommended rubber gloves and scrub down the PCB (circuit board) on both the front and back side with 90% isopropyl alcohol to clean any residuals off of the board from manufacturing. Once the board has been cleaned, set it on a dry paper towel out of the way. Try to use the rubber gloves during the entire assembly process to keep oils off of the board and solder joints.

Heatsink Assembly Preperation:

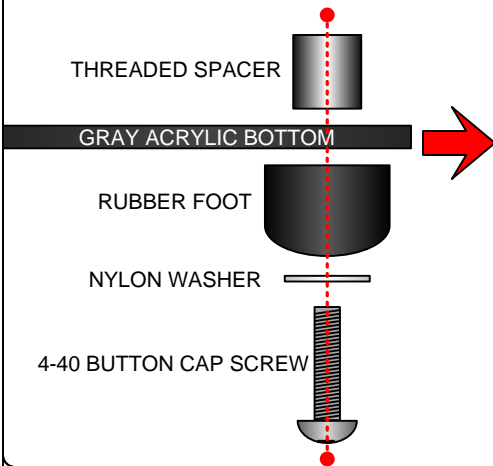
Pre-assemble the heatsinks as shown below. The insulators and shoulder washers **MUST** be used appropriately and as shown or a short will occur, damaging the amplifier. Do not over tighten the allen bolts. They should be tightened down securely without crushing the insulating shoulder washer. Make sure the IRL510 and LM317 devices are pointing straight down once secured. After each heatsink is completed, set it on its side so the leads that go into the PCB are not bent.

IRL510 AND LM317 DEVICES MUST BE ATTACHED TO THE HEATSINK IN THE FOLLOWING ORDER. FAILURE TO DO SO WILL RESULT IN DAMAGE TO THE AMPLIFIER



Bottom Chassis Prep / Final Chassis Assembly:

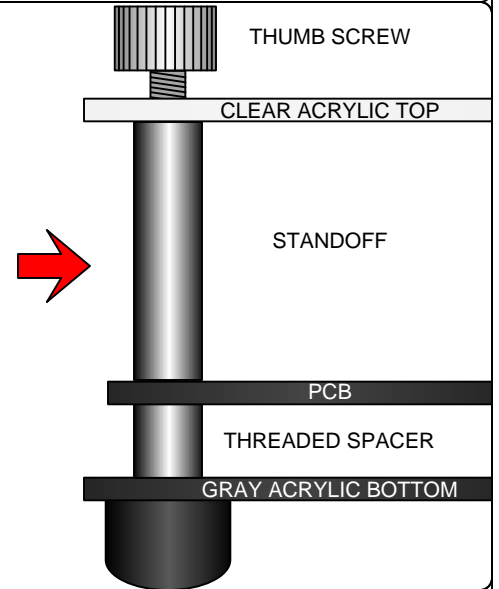
ASSEMBLE EACH OF THE 4 RUBBER FEET AS SHOWN, ATTACHING EACH FOOT TO THE GRAY SMOKED ACRYLIC BOTTOM CHASSIS



- ONCE THE PCB HAS BEEN ASSEMBLED, SET IT ONTO THE FOUR THREADS STICKING OUT OF THE BOTTOM GRAY ACRYLIC CHASSIS THAT YOU PREVIOUSLY ASSEMBLED.

- THREAD ON EACH OF THE FOUR HEX STANDOFFS ONTO THE THREADS THAT ARE NOW PROTRUDING THROUGH THE PCB, SECURING THE PCB TO THE GRAY ACRYLIC CHASSIS BOTTOM. PROCEED TO POWER ON THE UNIT (AS DESCRIBED ON PAGE 2, WEARING EYE PROTECTION AND AT A SAFE DISTANCE IN CASE OF A MISTAKE IN ASSEMBLY)

- ONCE THE AMPLIFIERS FUNCTIONALITY HAS BEEN TESTED AND THE UNIT HAS HAD A CHANCE TO FULLY WARM UP FOR 30 MINUTES, SET THE BIAS AS DESCRIBED LATER IN THIS MANUAL BEFORE PLACING THE TOP CLEAR ACRYLIC COVER IN PLACE

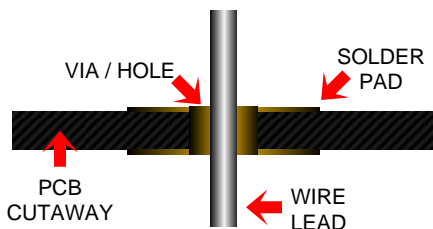


Proper soldering is key to a quality final product. If you are new to soldering, here are some basic guidelines to follow. It would be wise to buy a copper project board and a few cheap resistors or other components to practice with before starting this project.

Soldering and Solder Joints:

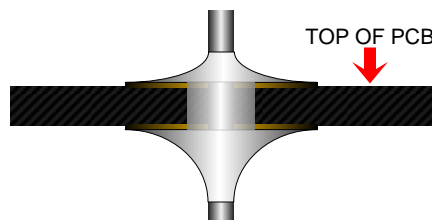
- For best results and maximum conductivity of any component, Wipe each lead down using Scotch Bright. Only one or two passes are required, making sure all of the surface has been cleaned. This removes oxidation or any other build up on the metal that has accumulated over time. Once cleaned, it is a good idea the further clean the wire leads with 90% isopropyl alcohol. Make sure all alcohol has evaporated prior to soldering as alcohol is VERY FLAMMABLE.
- Do not use too much or too little solder on each joint. See images below to get an idea of what you should be looking for
- The idea is to heat the pad and the component wire lead quickly and efficiently so that solder flows to each equally. Wetting the tip of your iron with a very small amount of solder will aid in quickly heating up the pad and wire lead.
- Having to heat the component for long periods of time, especially capacitors is not a good thing. When soldering capacitors, heat them only long enough to ensure a quality joint and let the unit cool down for a few minutes before soldering the other side (especially on small capacitors)
- The solder joint should look bright and metallic. A dull or dark gray looking joint is referred to as a "cold solder joint" Cold solder joints may not pose a problem initially, but can show up later in the amps life.
- After every solder joint, make sure to clean the flux off your soldering iron tip with a wet sponge that should be provided with your soldering iron kit.

CUTAWAY OF A VIA AND SOLDER PAD PRIOR TO SOLDERING:



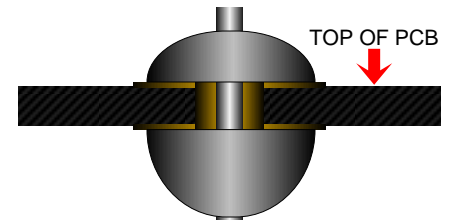
PROPER SOLDER JOINT:

- Solder is bright and shiny. It is curved smoothly starting at the edge of the solder pad until it reaches the lead from the component
- Solder should fill the via and flow through the board slightly. It is ok to add solder to the top side of the board, however it is not required



IMPROPER SOLDER JOINT:

- A large blob of solder, often dull in color is not desired. The solder may not flow into the via hole and cause a poor connection or failure later in the amplifiers life.



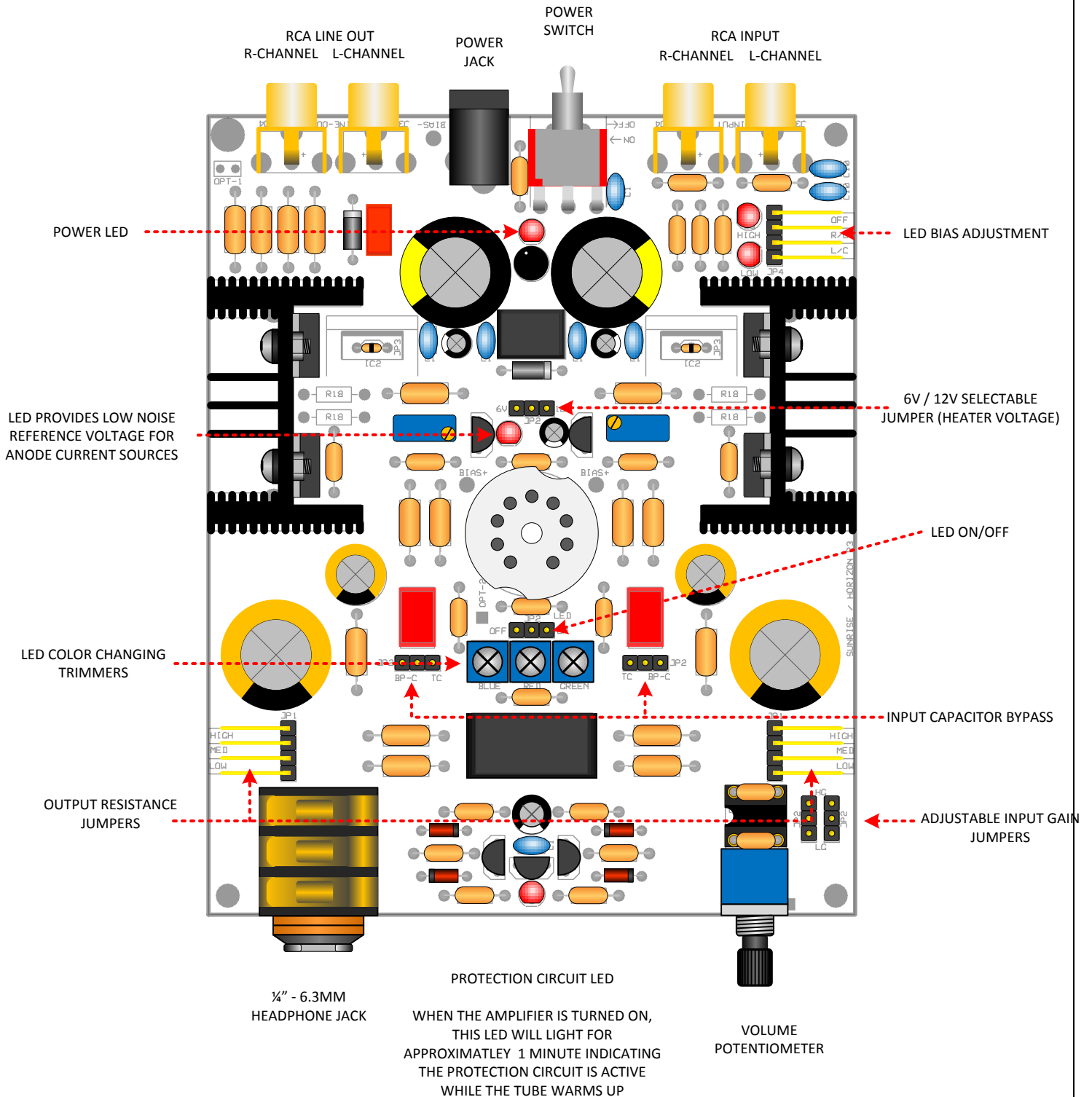


Project Sunrise Operation Guide:

Normal Operation and Notes:

- Plug in the amplifier and then the power supply (in that order). Make sure the tube, headphone jack and input RCA's are secure. Once the amplifier is turned to the ON position, the front red LED (closest to the volume knob and headphone jack) will illuminate red for approximately 1 minute. This indicates the protection circuit is active while the tube is warming up. It may take several minutes for the tube to fully warm up depending on the tube type used
- When the protection circuit activates and de-activates, a slight click may occur
- When the power switch is turned on and the amplifier is plugged in, the red power LED at the back of the amplifier will illuminate
- Depending on the tube type chosen and the sensitivity of headphones used, background noise (hiss) may be present. Choosing a higher output impedance setting, or a lower gain tube can generally eliminate any background noise with sensitive headphones. This does not mean a high gain tube cannot be used in our designs. Selecting a higher output resistance or lower input gain setting will reduce noise with higher gain tubes. We advise you experiment with several tubes to find out what you like best
- Some channel imbalance below 9 o'clock on the volume potentiometer is normal. We recommend you adjust your source output levels and use Project Sunrise with a volume setting of 9 o'clock or greater
- If input capacitors are bypassed, you will hear a scratching sound when adjusting the volume potentiometer
- Some faint scratch when turning the volpot is normal. This does not indicate a bad volpot – just a micro amount of DC that is present with certain tubes. This type of scratch is generally only heard with no music playing / rotating the volpot
- Cell phones, radio frequency devices or cheap SMPS power supplies in close proximity to Project Sunrise may create noise that is audible when listening to music (generally clicks or digital noises) Amplifiers with exposed / visible tubes are susceptible to these types of noises.
- Clean your Project Sunrise with a microfiber cloth and plastic cleaner (dusting with a microfiber cloth is generally all that is required). Compressed air is also great option for dust.
- Project Sunrise can supply 1A of heater current to the chosen tube ensuring even the hardest to power tubes such as a 6n6p or 6n30p can be used
- Hot swapping tubes is not recommended (swapping tubes while the amplifier is on). Even though it does not cause technical errors or malfunctions it could damage headphones rated for 1W or less.

Project Sunrise Assembly Guide



STEP 1: POPULATE ALL SMALL COMPONENTS ON THE BOARD SUCH AS RESISTOS, RIGHT ANGLE JUMPERS, DIODES AND SMALL CAPACITORS. THROUGHOUT YOUR BUILD, ALWAYS INSTALL THE SMALLER PARTS FIRST, WORKING YOUR WAY UP TO THE LARGER COMPONENTS

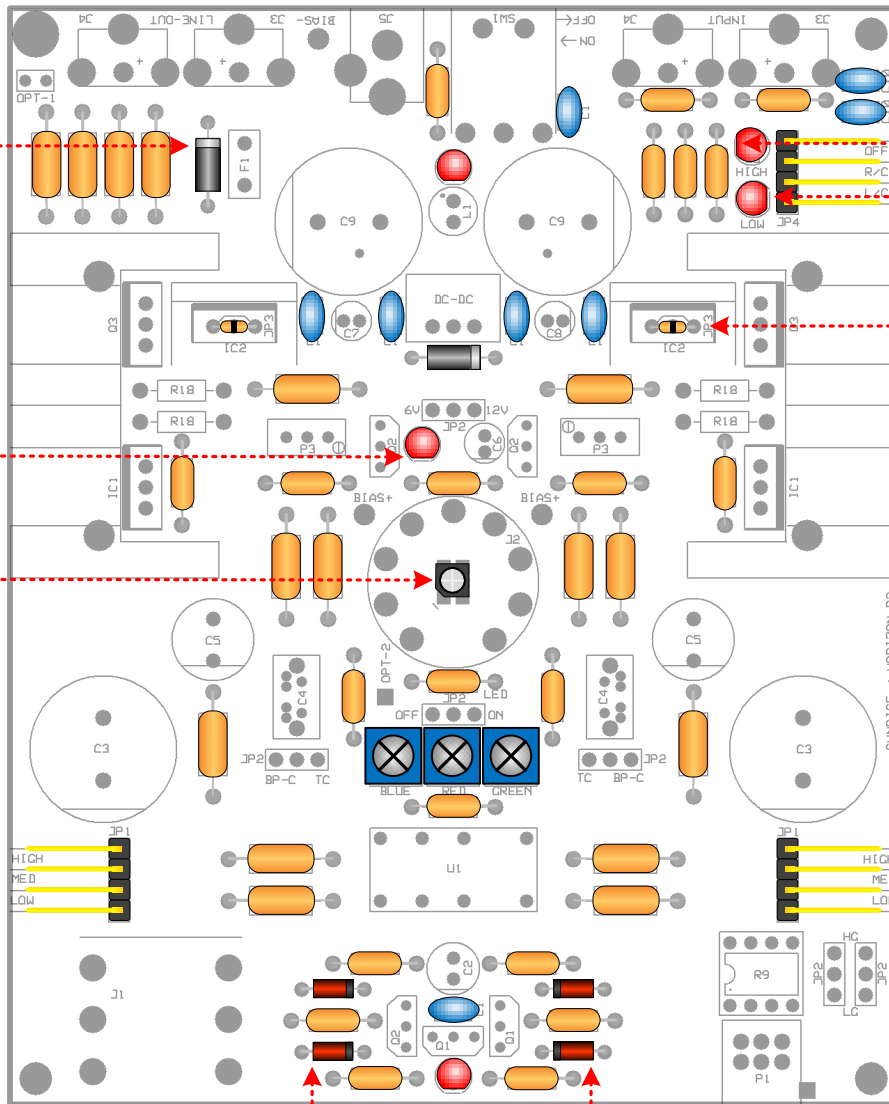
PAY CLOSE ATTENTION TO THE GRAY BAND ON EACH DIODE AS THEY ARE DIRECTIONAL

FLAT SPOT OR THE SHORT LEAD ON RED LED (INDICATES NEGATIVE SIDE OF LED) MUST FACE EXACTLY AS SHOWN

FLAT SPOT OR THE SHORT LEAD ON RED LED (INDICATES NEGATIVE SIDE OF LED) MUST FACE TUBE SOCKET AS SHOWN

SOLDER OR JUMPERS AS SHOWN

NOTCH ON THE RGB LED (ORIENTATION MARKING) MUST FACE THE WHITE MARKING ON THE PCB AS SHOWN



PAY CLOSE ATTENTION TO THE BLACK BAND ON EACH OF THESE FOUR DIODES AS THEY ARE DIRECTIONAL

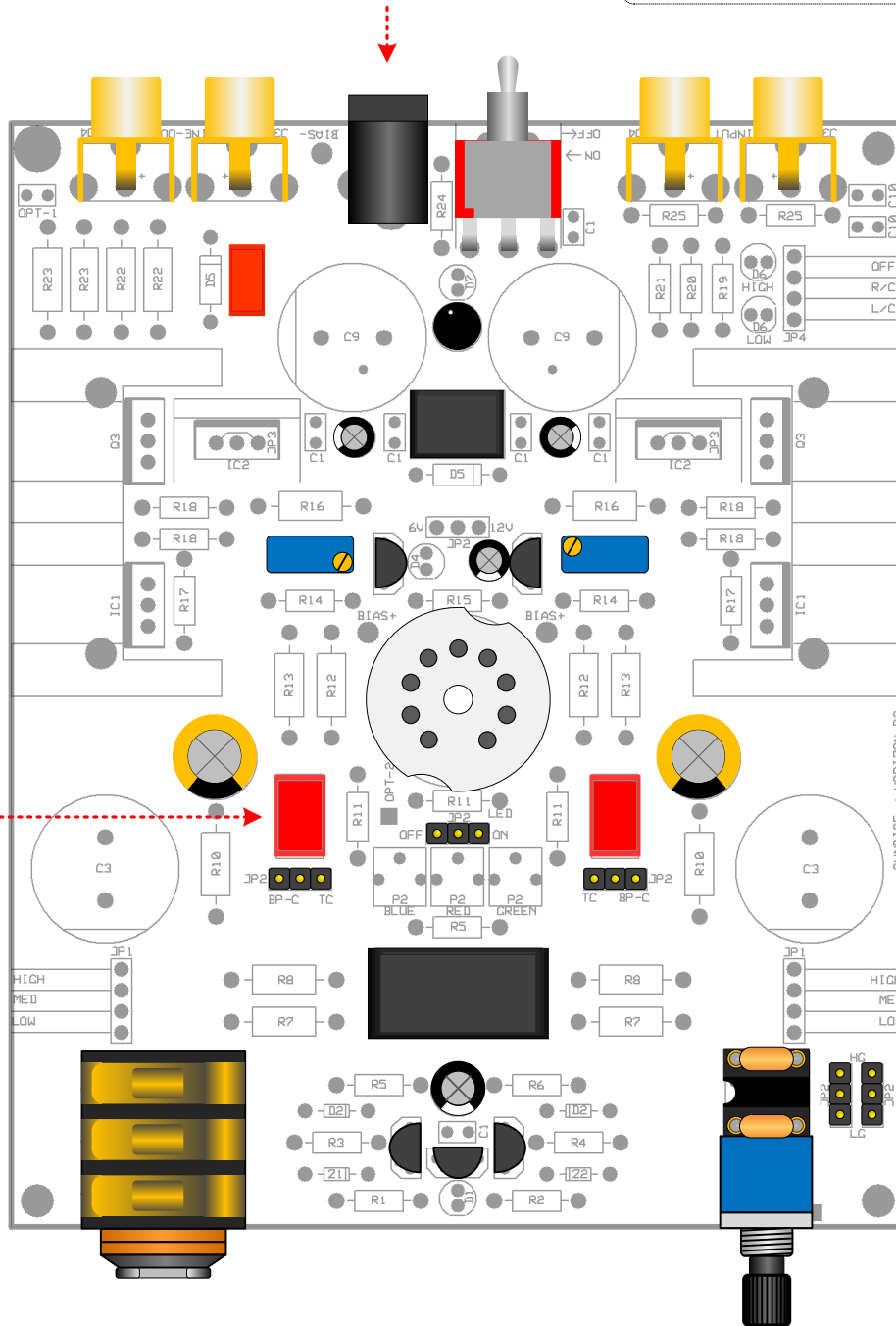
STEP 2: POPULATE ALL MID SIZE COMPONENTS SUCH AS RCA'S, POWER COMPONENTS, SMALL CAPACITORS, TUBE SOCKET, RELAY, TRIMMERS AND SO FORTH

POLARIZED CAPACITORS MUST BE INSTALLED IN THE CORRECT DIRECTION (WILL HAVE A STRIPE DOWN THE SIDE DESIGNATING POLARITY) INSTALL THIS STRIPE FACING THE FLAT SPOT ON THE CAPACITOR OUTLINE ON THE BOARD

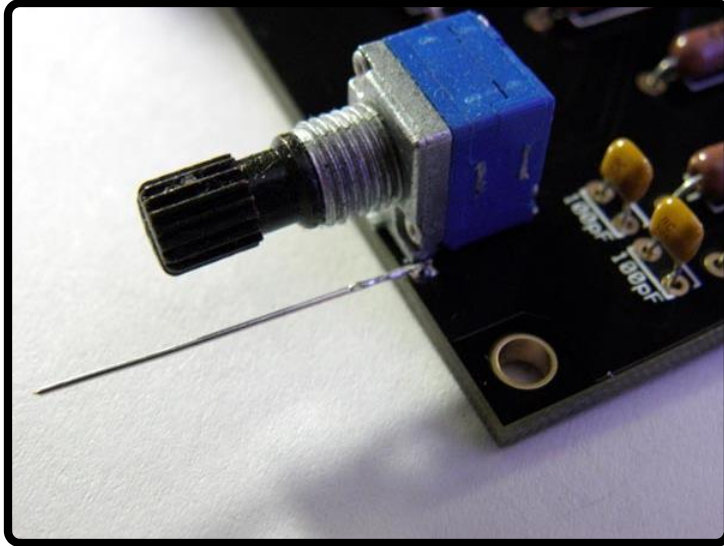


PLEASE NOTE: CENTER PIN OF DC SOCKET IS POSITIVE / 24VDC+

INPUT CAPACITORS ARE NON-POLAR MEANING THEY HAVE NO STRIPE AND CAN BE INSTALLED IN EITHER DIRECTION



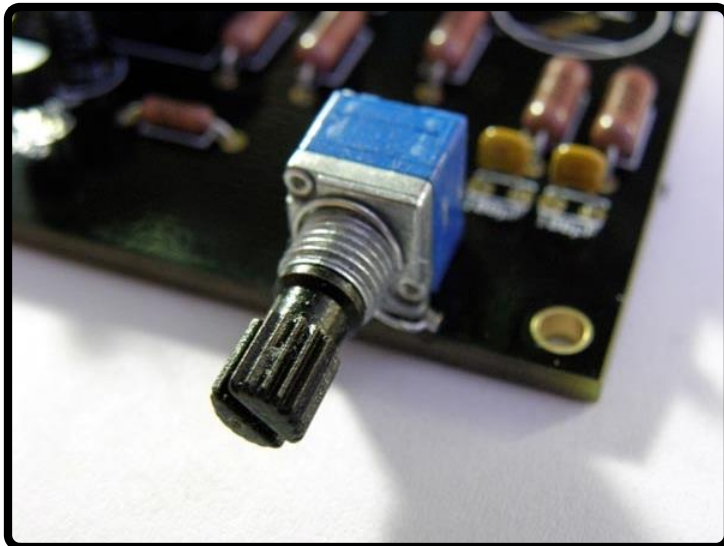
VOLPOT GROUNDING



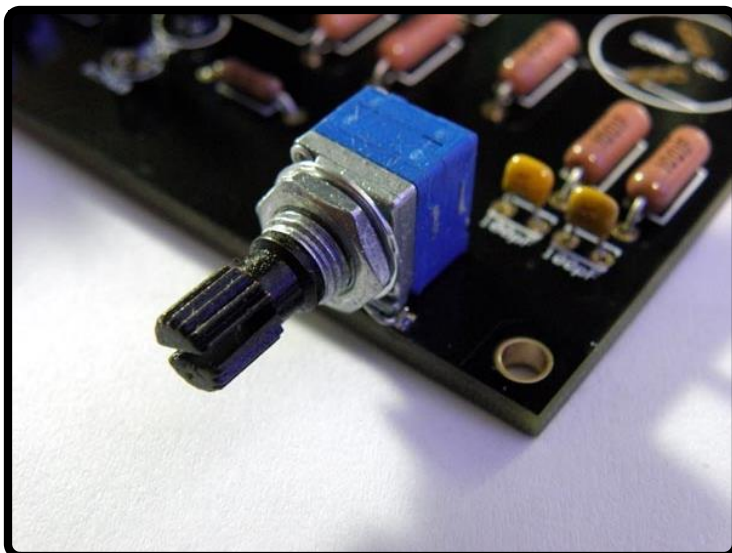
GROUNDING THE VOLUME POTENTIOMETER IS REQUIRED AS WITHOUT IT, THE AMPLIFIER MAY BE SUBJECTED TO NOISE / INTERFERENCE.

THE IMAGES ARE OF THE PREVIOUS GENERATION SUNRISE, HOWEVER THE GROUNDING PRINCIPAL IS EXACTLY THE SAME.

FIRST, INSERT A WIRE LEAD INTO THE RIGHT SIDE VIA NEXT TO THE VOLPOT AND SOLDER IN PLACE.



WRAP THE WIRE LEAD AROUND THE THREADED PORTION OF THE VOLPOT AS SHOWN.



PUT ON WASHER AND NUT INCLUDED IN THE KIT. ONCE TIGHT, THE VOLUME KNOB MAY BE INSTALLED.

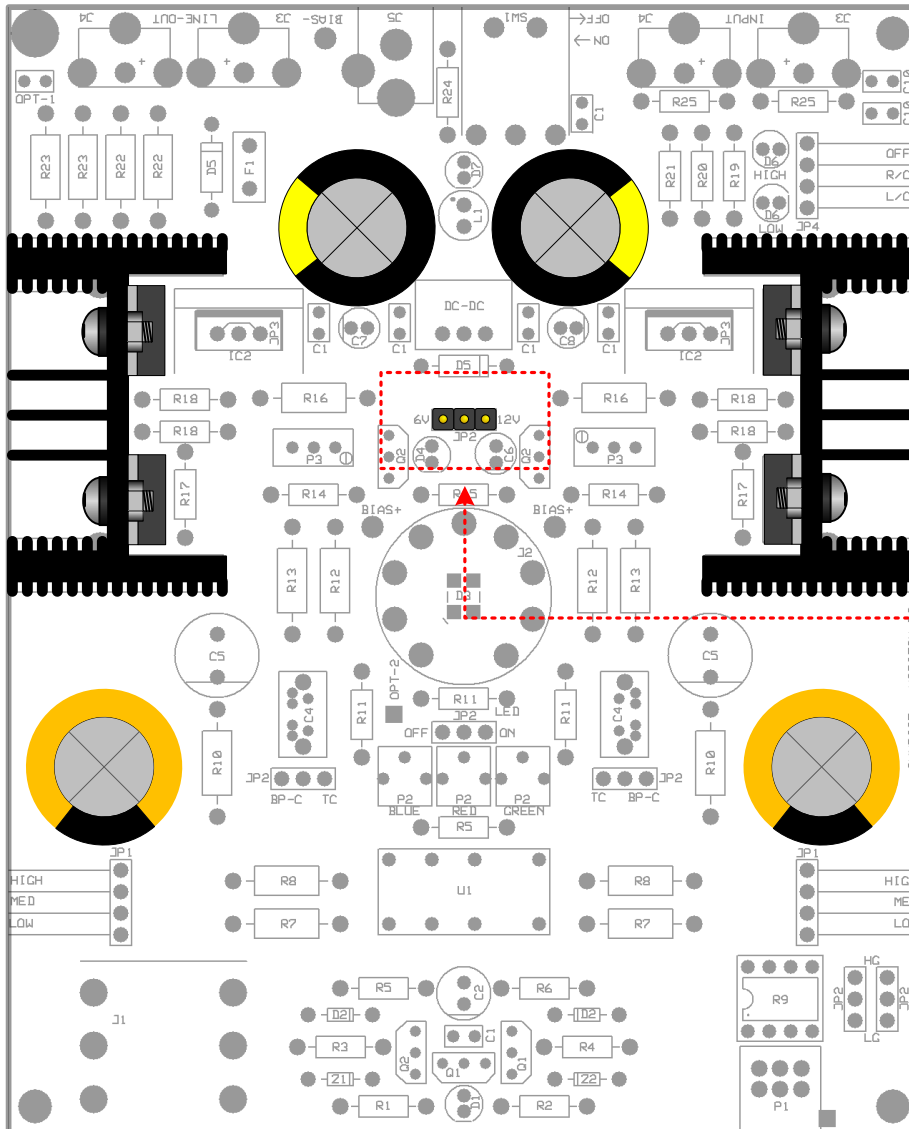
STEP 3: POPULATE ALL LARGE SIZE COMPONENTS SUCH AS LARGE CAPACITORS, HEATSINK ASSEMBLIES AND EXTENDED JUMPER

PAY ATTENTION TO THE POSITION OF THE IRL510 AND LM317'S ATTACHED TO THE HEATSINKS! THE IRL510'S SHOULD BE TO THE REAR / LM317'S TO THE FRONT OF THE AMPLIFIER. THIS IS THE #1 OOPS BY DIY BUILDERS ON THIS DESIGN

IRL510

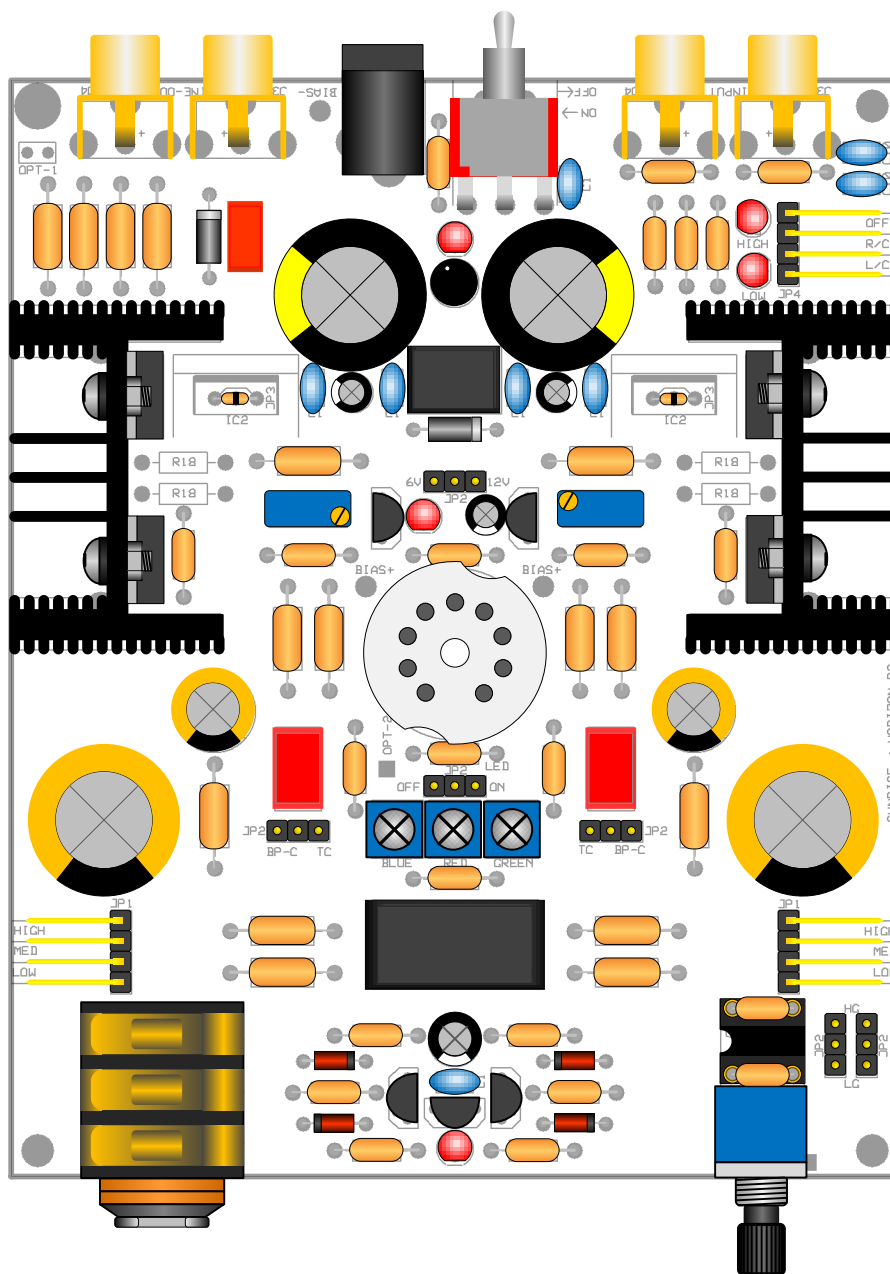


LM317



USE THE EXTENDED 3 PIN HEADER IN THIS LOCATION VS A SHORT 3 PIN HEADER

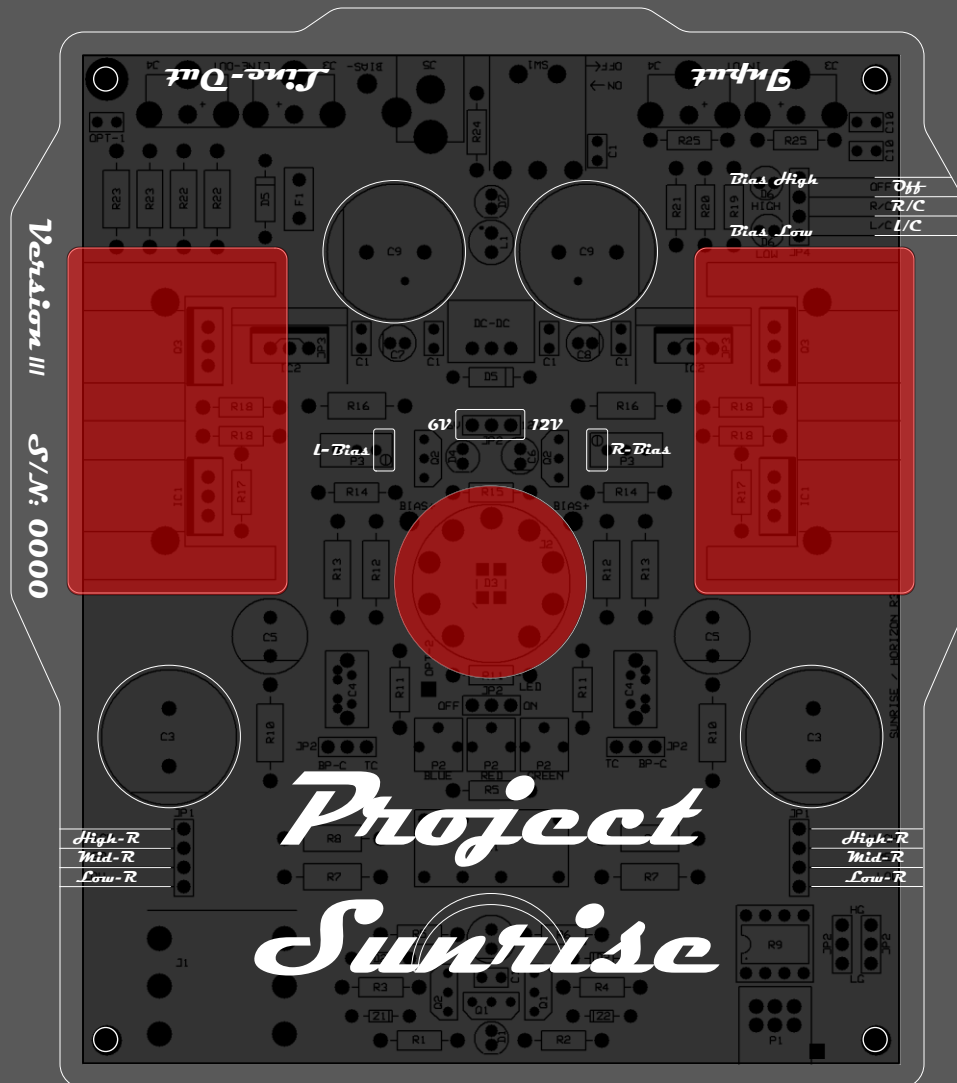
COMPLETED SUNRISE LAYOUT AND PHOTO:



Project Sunrise runs in Class A operation generating high temperatures on the heatsink assemblies. Never touch the heatsink assemblies or tube during operation or severe burns may occur. Temperatures in excess of 70C / 158F are common in these areas.

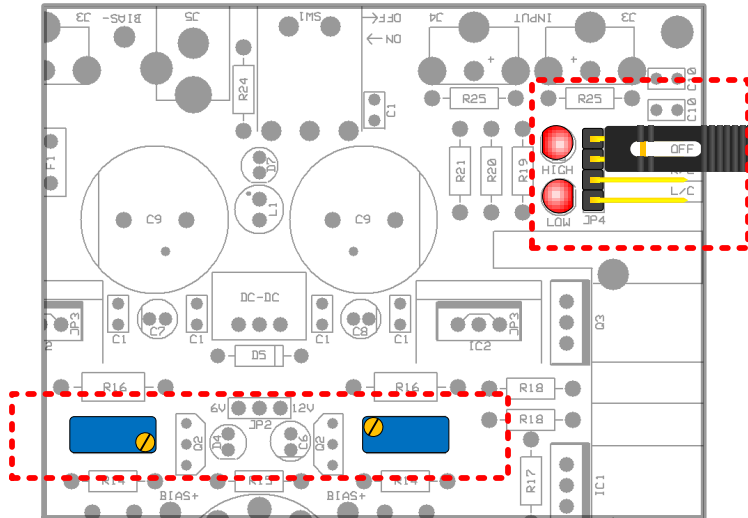
ONLY OPERATE THE AMPLIFIER IN A WELL VENTILATED AREA!
NEVER COVER THE AMPLIFIER OR OPERATE IN A CLOSED OR CONFINED SPACE SUCH AS A CABINET!

See areas of caution below highlighted in red.

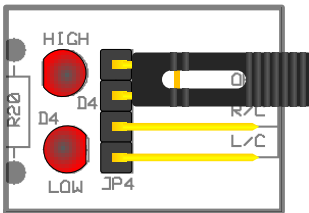


Easy Set Bias Adjustment

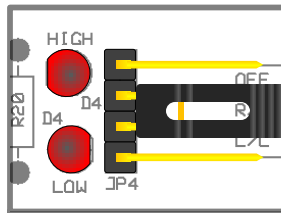
Easy set bias makes adjusting tube bias quick and easy. You can access the channel selector for the Easy Set Bias from the outside of the chassis without having to take off the top cover. Dial in the bias by turning the blue trimmers clockwise if bias for the channel is low or counter-clockwise if the bias for the channel is high. Rotate trimmer until both LED's turn off. To set, make sure to turn off any music source playing into the amp and turn the volume down to its lowest setting



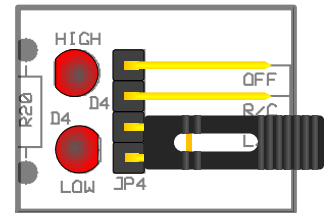
HOW TO SET BIAS USING THE EASY SET BIAS FEATURE



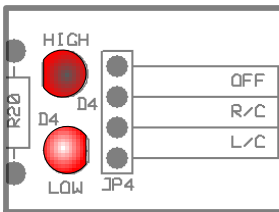
BIAS TEST OFF – LEAVE SETTING IN THIS POSITION AT ALL TIMES UNLESS TESTING BIAS



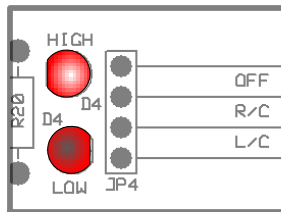
RIGHT CHANNEL BIAS TEST SETTING



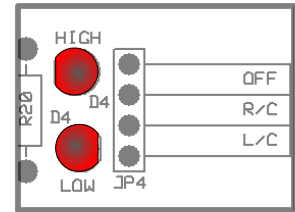
LEFT CHANNEL BIAS TEST SETTING



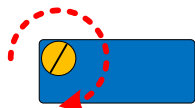
BOTTOM LED GLOWING = BIAS VOLTAGE LOW



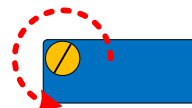
TOP LED BRIGHT = BIAS VOLTAGE HIGH



BOTH LEDS OFF = CORRECT BIAS VOLTAGE



ROTATE TRIMMER CLOCKWISE TO RAISE BIAS VOLTAGE

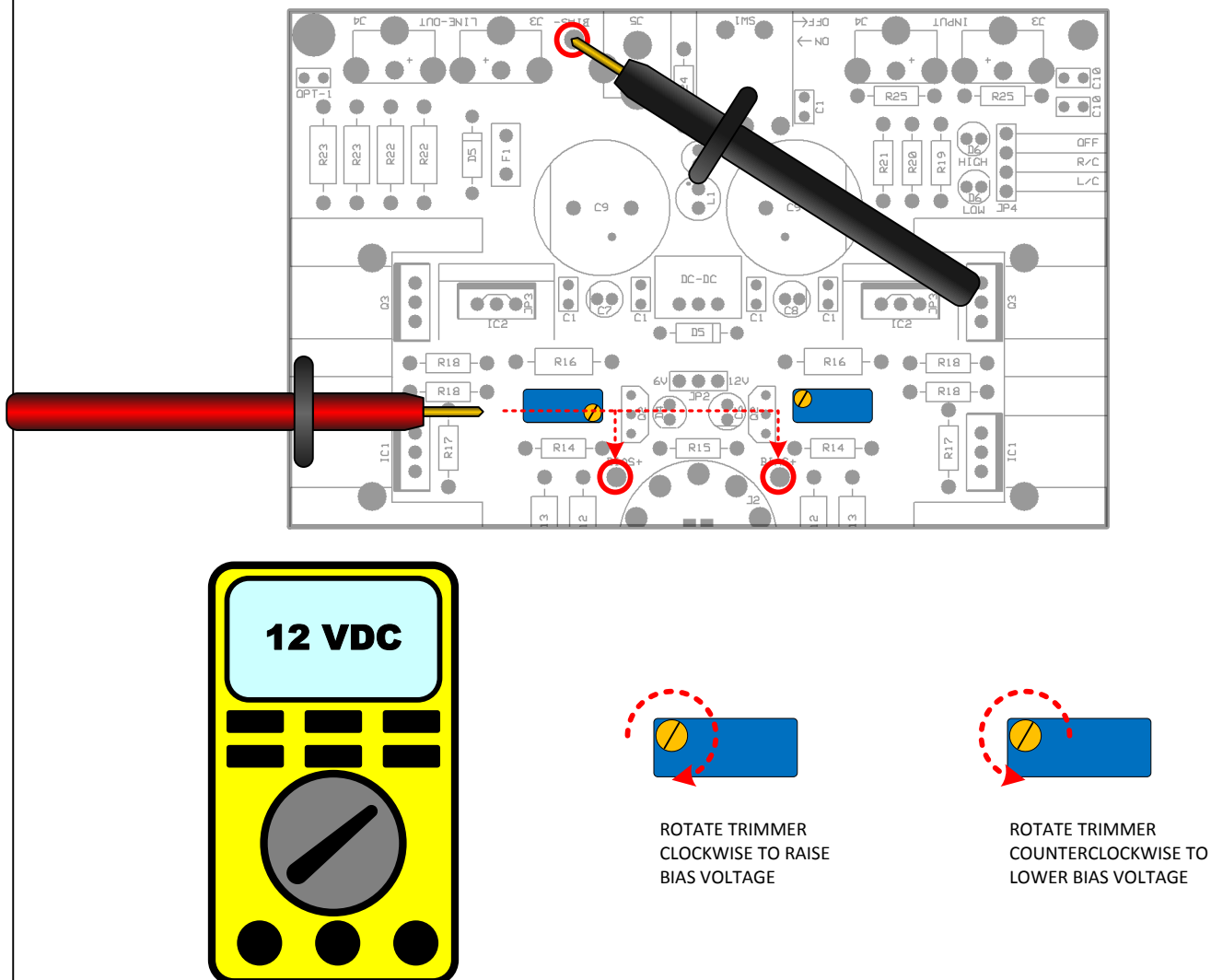


ROTATE TRIMMER COUNTERCLOCKWISE TO LOWER BIAS VOLTAGE

Manual Bias Setting Using a Multi Meter

- First, make sure no equipment such as headphones, an mp3 player or other source device is plugged into the amplifier
- Turn the volume knob down counterclockwise (its lowest setting) and make sure the power is off
- Insert your tube of choice into the amplifier and make sure all proper jumper tabs have been placed according to your tubes voltage and how you want to use the amplifier
- Set your Multi-Meter (DVOM or DMM) to voltage DC. Set the range for 20VDC. The Bias test points are large enough for you to insert the probes of most DMM's directly into the board so you do not have to hold the probes up. Make sure no metal parts of your probe touch any other components on the amplifier as a short could occur.
- Turn on the amplifier and watch the voltage for around 30 seconds. If the voltage does not appear on screen, turn each of the blue 25 turn trimmers 10 turns counterclockwise then re-check.
If it measures under 20, let the amp warm up for 15 minutes
- Once the amp is warmed up, measure each of the two positive bias points in real time while turning the adjustment screws. (Counterclockwise will lower voltage, clockwise will raise voltage) Dial in each side to around 12VDC
- Plug your music source into the RCA jacks on the back side of the amplifier. First, only use a cheap set of headphones to test the sound of the amp in case of any assembly issues. Once you are satisfied the amp is functioning properly, plug in your favorite headphones and enjoy the amp! Re-check the bias every 30 minutes for the first few hours and make any tweaks as needed. Please remember to disconnect headphones, source devices and turn the volume its lowest settings prior to tweaking bias

Once bias measures stable, every few months or longer depending on how much you listen to the amp, it may need its bias calibrated again. This is normal. Also every time you make a change such as changing tubes or changing input capacitor jumpers, you will need to re-calibrate the bias

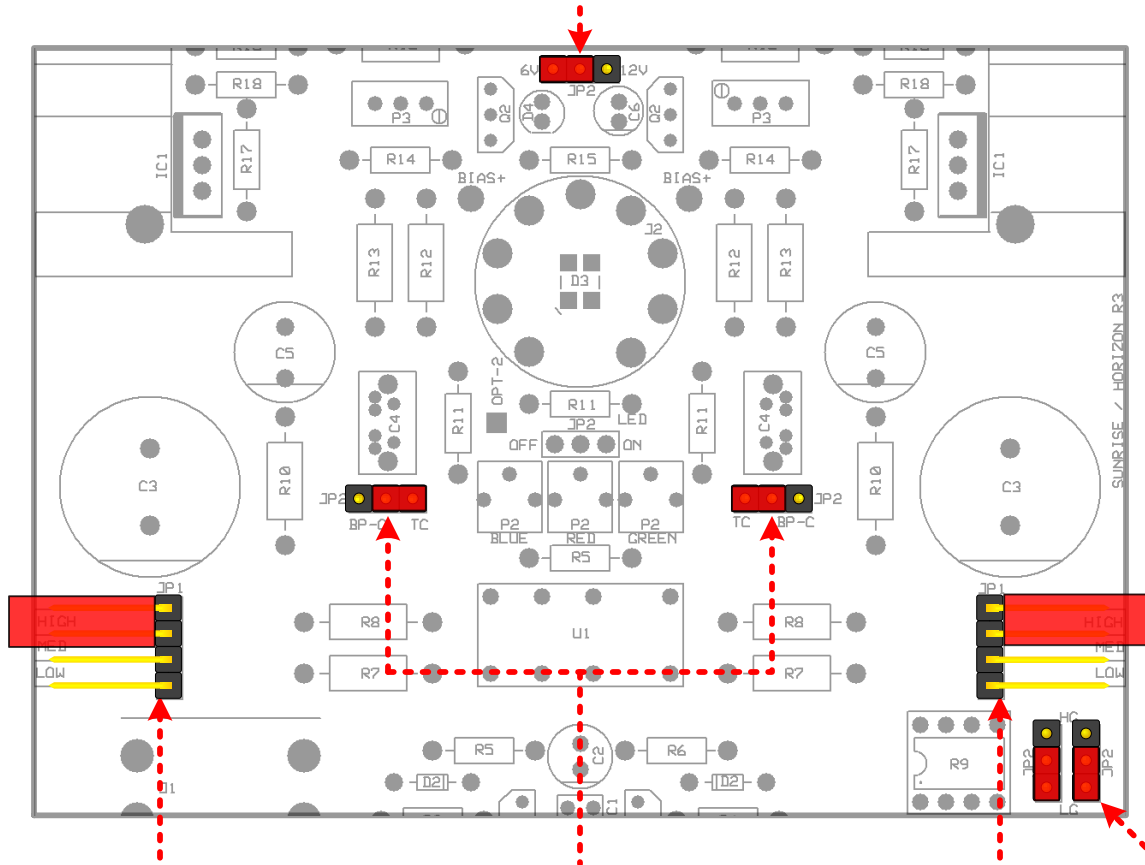


Project Sunrise has several jumpers settings to customize the amp the way you would like it. Below gives you the details on what these jumper settings do!

THE 6V / 12V JUMPER ALLOWS YOU TO USE BOTH 6 AND 12 VOLT TUBES. BEFORE POWERING ON YOUR AMPLIFIER, YOU MUST MAKE SURE WHAT VOLTAGE YOUR TUBE RUNS AT AND SET IT ACCORDINGLY VIA THE JUMPER. ATTACH THE JUMPER TAB TO THE CENTER PIN AND TO THE SIDE PIN CLOSEST TO THE VOLTAGE YOU DESIRE (6v OR THE 12v SIDE)

(EXAMPLE OF 6V SETTING IN RED)

TO NOTE: IF IN DOUBT, SET THE AMP TO 12V. IF ONLY ONE CHANNEL WORKS, CHANGE IT TO THE 6V SETTING. YOU CANNOT DAMAGE A TUBE IF SET TO THE WRONG VOLTAGE



INPUT CAPACITORS CAN BE BYPASSED PER YOUR PREFERENCE. MANY VIEW THIS AS A PURIST FUNCTION AS IT IS ONE LESS COMPONENT IN THE SIGNAL PATH. WITH INPUT CAPS BYPASSED, YOU MAY HEAR A SCRATCHY SOUND WHEN ADJUSTING VOLUME. THIS WILL NOT DAMAGE YOUR HEADPHONES OR YOUR AMPLIFIER. TO NOTE: YOU MUST RE-BIAS THE AMPLIFIER AFTER MAKING A CHANGE TO THIS SETTING

TC = THROUGH CAP (EXAMPLE SETTING IN RED)

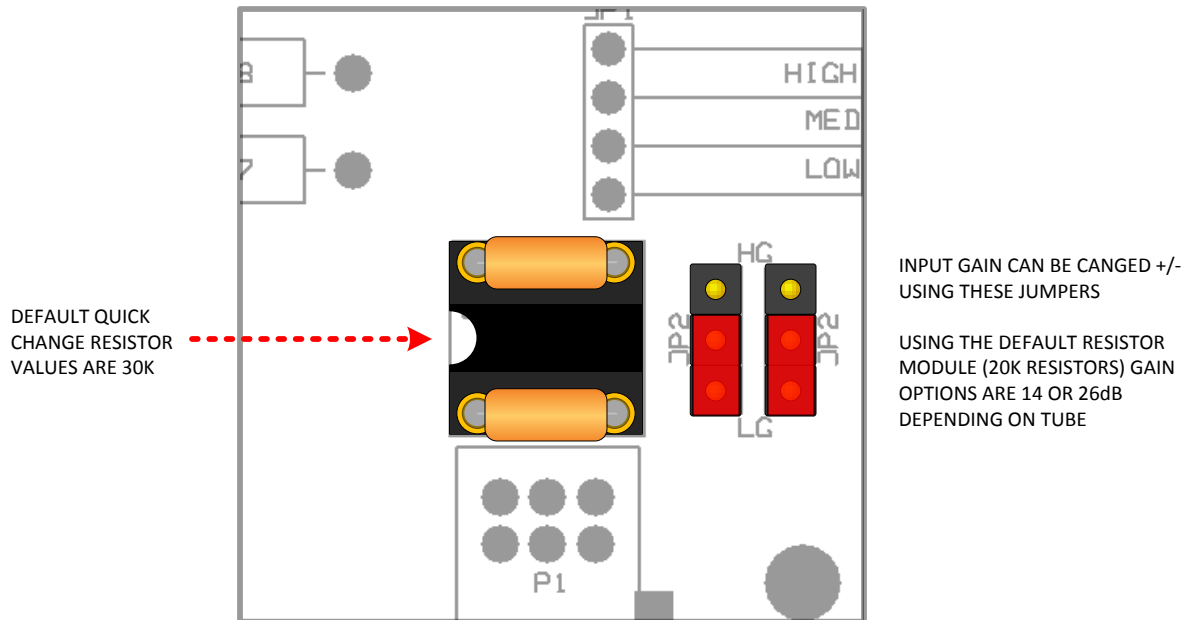
BPC = BYPASS CAPACITOR

OUTPUT RESISTANCE IS CONFIGURABLE BETWEEN 1.5, 32 and 69Ω. HIGHER OUTPUT IMPEDANCE WILL HAVE A SLIGHT EFFECT ON BASS AND TREBLE FREQUENCIES WHICH IS ALSO DEPENDANT ON YOUR HEADPHONES

(EXAMPLE OF 69Ω SETTING IN RED)

INPUT GAIN JUMPERS

Project Sunrise now features a selectable gain module which allows a quick change of input resistor values combined with jumpers for a quick high/low setting adjustments



Selecting custom resistor values to change input gain:

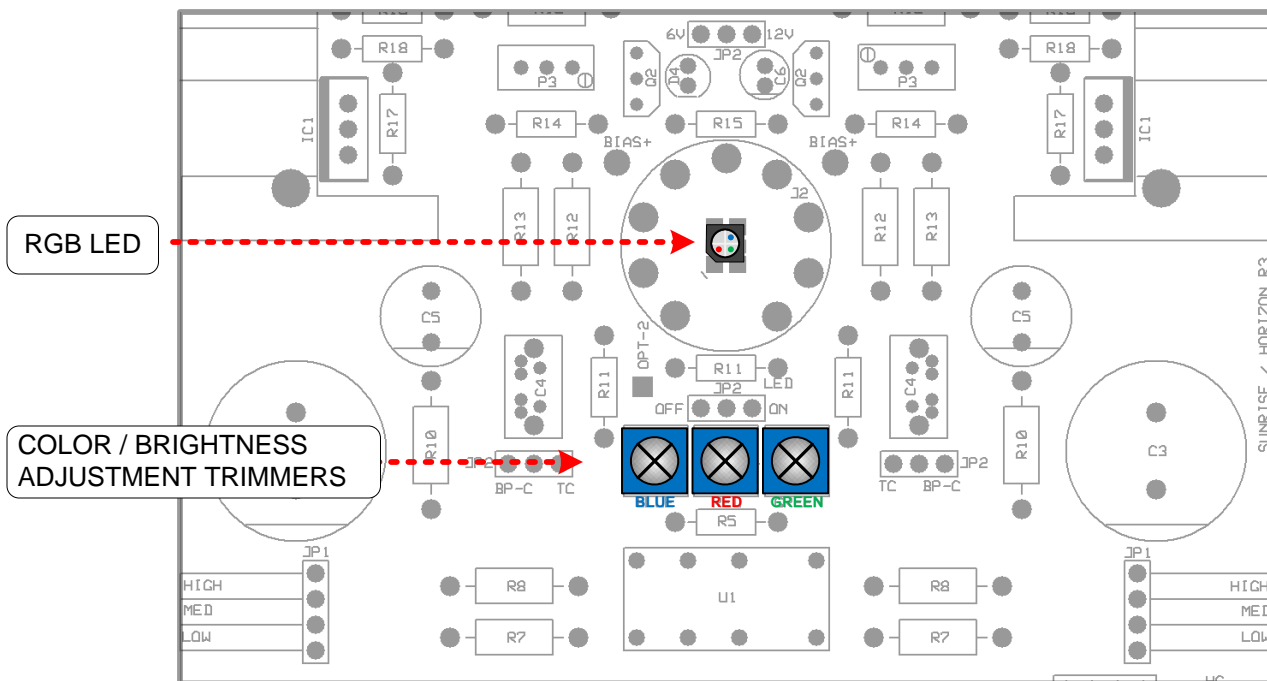
- Actual gain is tube dependant. For example, a 12AU7A will have far less gain than a 12AX7
- The high gain setting is fixed at 20dB (again variable depending on tube used – but is a good rule of thumb)

The low gain setting is defaulted at 14dB. However one may make or order custom modules to raise or lower the LG / low gain jumper setting. Examples:

- 10K resistors will increase gain by +6dB (gain of 20)
- 15K resistors will increase gain by +3dB (gain of 17)
- 30K resistors (default value for the LG setting) 0dB change (gain of 14)
- 45K resistors will further decrease gain -3dB (gain of 11)
- 60K resistors will further decrease gain by -6dB (gain of 8)

These options are made available to help mate the amplifier with the widest selection of equipment possible

LED Light Color



Another feature of Project Sunrise is an adjustable RGB (RED GREEN BLUE) LED under the tube. RGB LED's can produce almost any color desirable. Often manufacturers tie you into their specific color scheme on their products. We feel it is important for you to choose the color you desire which can set an enjoyable mood when listening to your music. Adjust the brightness and color by turning each of the trimmers with a small jewelers screwdriver.

Project Sunrise

Resistors

R1 = 100K SM X 1
R2 = 470K SM X 1
R3 = 10K SM X 1
R4 = 330K SM X 1
R5 = 330R SM X 2
R6 = 4K7 SM X 1
R7 = 68R LG X 2
R8 = 56R LG x 2
R9 = 30K SM X 2 (DIP-8 SOCKET)
R10 = 2.2K LG X 2
R11 = 220R SM X 3
R12 = 100K LG X 2
R13 = 1K LG X 2
R14 = 100R SM X 2
R15 = 12K SM X 1
R16 = 470R LG X 2
R17 = 5R6 SM X 2
R18 = NOT POPULATED
R19 = 3.3K SM X 1
R20 = 1K SM X 1
R21 = 5.1K SM X 1
R22 = 470R LG X 2
R23 = 1K LG X 2
R24 = 100K SM X 1
R25 = 1K SM X 2

Diodes

Z1 = C22 X 1
Z2 = C18 X 1
D1 = RED 3MM LED X 1
D2 = 1N4148 X 2
D3 = RGB SMD LED X 1
D4 = RED 3MM LED X 1
D5 = SB240 DIODE X 2
D6 = RED 3MM LED X 2
D7 = RED 3MM LED X 1

Capacitors

C1 = 100nF X 6
C2 = 47uF X 1
C3 = 2200uF X 2 (GOLD FG CAPS)
C4 = 1uF X 2
C5 = 470uF X 2 (GOLD FG CAPS)
C6 = 100uF X 1
C7 = 100uF X 1
C8 = 22uF X 1
C9 = 2200uF X 2 (BLACK CAPS)
C10 = 100pF X 2

Transistors

Q1 = BC546B X 2
Q2 = BC560B X 3
Q3 = IRL510 X 2

Inductor

L1 = 100uH X 1

Regulators

IC1 = LM317A X 2
IC2 = POPULATED WITH OR JUMPER
DC-DC X1

Jacks

J1 = HEADPHONE JACK X 1
J2 = TUBE SOCKET X 2
J3 = BLACK RCA JACK X 2
J4 = RED RCA JACK X 2
J5 = DC INPUT JACK X 1

Jumpers

JP1 = 4 PIN RIGHT ANGLE X 2
JP2X = 3 PIN EXTENDED HEADER X 1
JP2 = 3 PIN STRAIGHT X 5
JP3 /IC2 = 0R JUMPERS X 2
JP4 = 4 PIN RIGHT ANGLE X 1

Switches

SW1 = POWER SWITCH X 1

Fuse

F1 = 2A FUSE

Potentiometers / Trimmers

P1 = 10K VOLUME POTENTIOMETER
P2 = 50K SINGLE TURN TRIMMER X3
P3 = 50K 25T VERTICAL TRIMMER X2

Relay

U1 = 24V RELAY