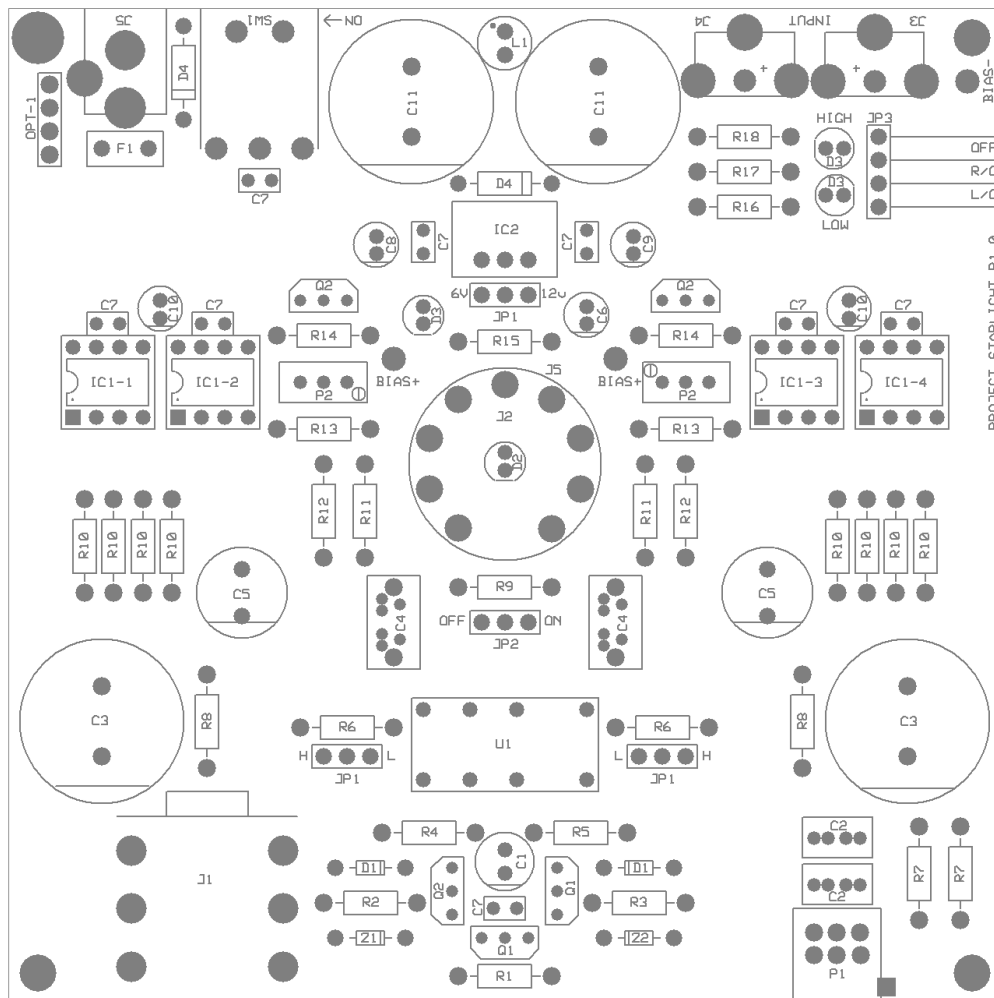


Project Starlight

USER MANUAL – SEPTEMBER 25TH 2014

WWW.GARAGE1217.COM



WARNING:

Although Project Starlight 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!

GARAGE1217.COM IS NOT RESPONSIBLE OR LIABLE FOR INJURY, PROPERTY LOSS OR DAMAGE AS THE RESULT OF ASSEMBLY OR USE OF THIS "DO IT YOURSELF" KIT. STARLIGHT IS CONSIDERED A HOBBY LEVEL PRODUCT. IT CONTAINS NO ELECTRICAL CERTIFICATIONS AND IS NOT ADVERTISED AS SUCH. USE AT YOUR OWN RISK.

Project Starlight

Specifications

- Opamp output stage
- Power consumption: 7.2W peak.
- Power supply: 24VDC (0.3A peak)
- Input Resistance: 30k Ω
- Input Sensitivity (6N23): 270mV (dependent on tube)
- Gain: 16dB (dependent on tube)
- Max Output voltage (no load): 7Vrms at 120 Ω
- Output Resistance: Selectable 2.5, 70 Ω
- Frequency Response: 15Hz – 80 KHz (-0.5dB) with 32 Ω load
- Frequency Response: 4Hz – 230 KHz (-3dB) with 32 Ω load
- Signal to Noise ratio: 91dBA (dependent on tube)
- Crosstalk: -87dB (dependent on tube)
- THD: > 0.015% (dependent on tube)
- Suitable for: 16-300 Ω Headphones

Tubes / Valves that can be used in Project Starlight

6V TUBES:

6922
7308
8223
6AQ8
6DJ8
6GU7
6CG7
6BQ7A
6H23
6H23N
6L12
6N11
6N23
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

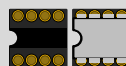


Verified Opamp options and info

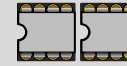
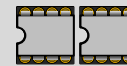
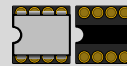
Several opamp options outside of the default 4562's can be used. To the right is a list of opamps verified to work in dual / quad configurations in Project Starlight.

A pair of opamps can be run VS. quads to keep costs lower when rolling or trying new types (quads increase output power)

Verified Opamps:
- LM4562 (default)
- NMJ4556
- OPA2132
- OPA2134
- OPA2227
- NE5532



If running a pair of opamps (1 per channel) only use the inner sockets IC1-2 and IC1-3



Example of quad opamps installed

Project

Starlight

Thank you for purchasing the Project Starlight 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, let's 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:

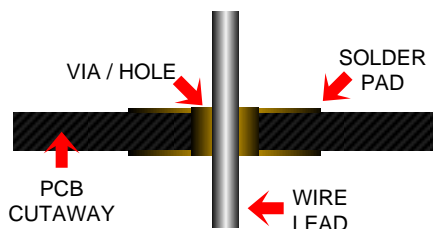
Prep work needs to be done. Wash your hands thoroughly and dry. Put on the recommended rubber gloves and scrub down the PCB (circuit board) on both the front and back side with 90% isopropyl alcohol to clean any residuals off of the board from manufacturing. Once the board has been cleaned, set it on 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.

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:

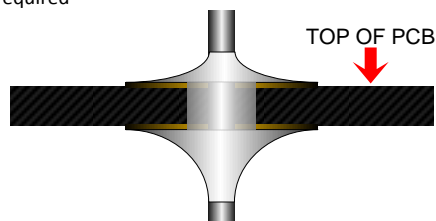
- For best results and maximum conductivity of any component, Wipe each lead down using Scotch Bright. Only one or two passes are required, making sure all of the surface has been cleaned. This removes oxidation or any other build up on the metal that has accumulated over time. Once cleaned, it is a good idea to 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 amp's 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:



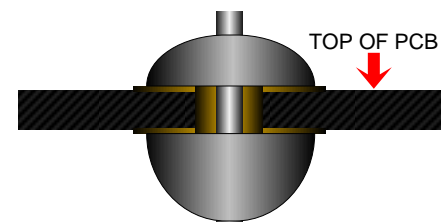
PROPER SOLDER JOINT:

- 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 amplifier's life.



Project Starlight

Project Starlight Operation Guide:

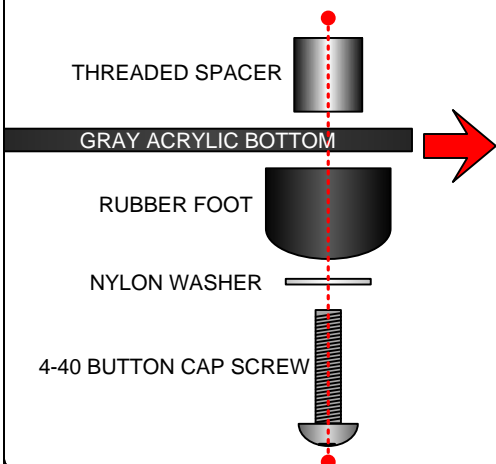
Normal Operation and Notes:

- 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 amplifier will enter a protection state for approximately 45 seconds while the tube warms up
- When the protection circuit activates and de-activates, a slight click may occur
- 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 Starlight with a volume setting of 9 o'clock or greater
- 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 Starlight 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 Starlight 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 Starlight 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 *Starlight*

Bottom Chassis Prep / Final Chassis Assembly:

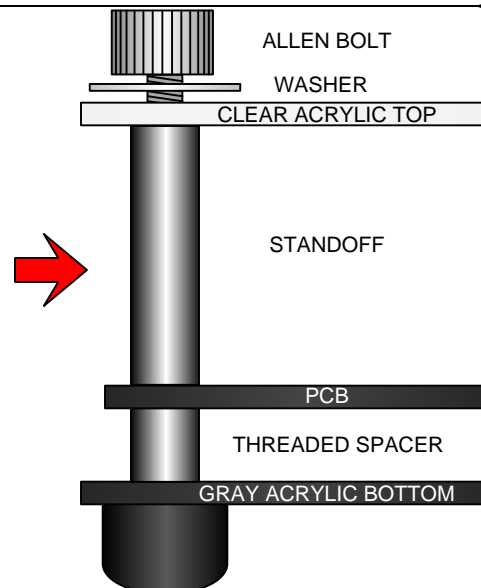
ASSEMBLE EACH OF THE 4 RUBBER FEET AS SHOWN, ATTACHING EACH FOOT TO THE GRAY SMOKED ACRYLIC BOTTOM CHASSIS



- 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



Project Starlight

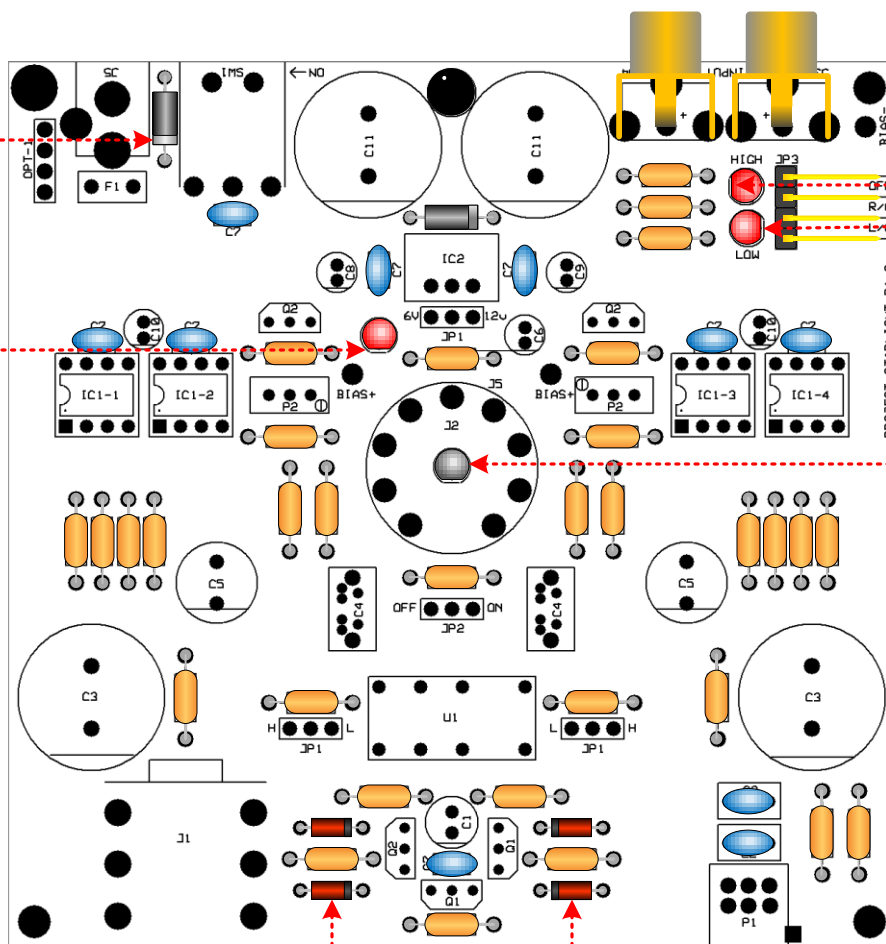
STEP 1: POPULATE ALL SMALL COMPONENTS ON THE BOARD SUCH AS RESISTORS, RIGHT ANGLE JUMPERS, DIODES AND SMALL CAPACITORS. THROUGHOUT YOUR BUILD, ALWAYS INSTALL THE SMALLER PARTS FIRST, WORKING YOUR WAY UP TO THE LARGER COMPONENTS

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 TUBE SOCKET AS SHOWN

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

INSTALL LED COLOR OF YOUR CHOICE HERE (CHOSEN AT TIME OF PURCHASE)

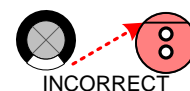


PAY CLOSE ATTENTION TO THE BLACK BAND ON EACH OF THESE FOUR DIODES AS THEY ARE DIRECTIONAL

Project Starlight

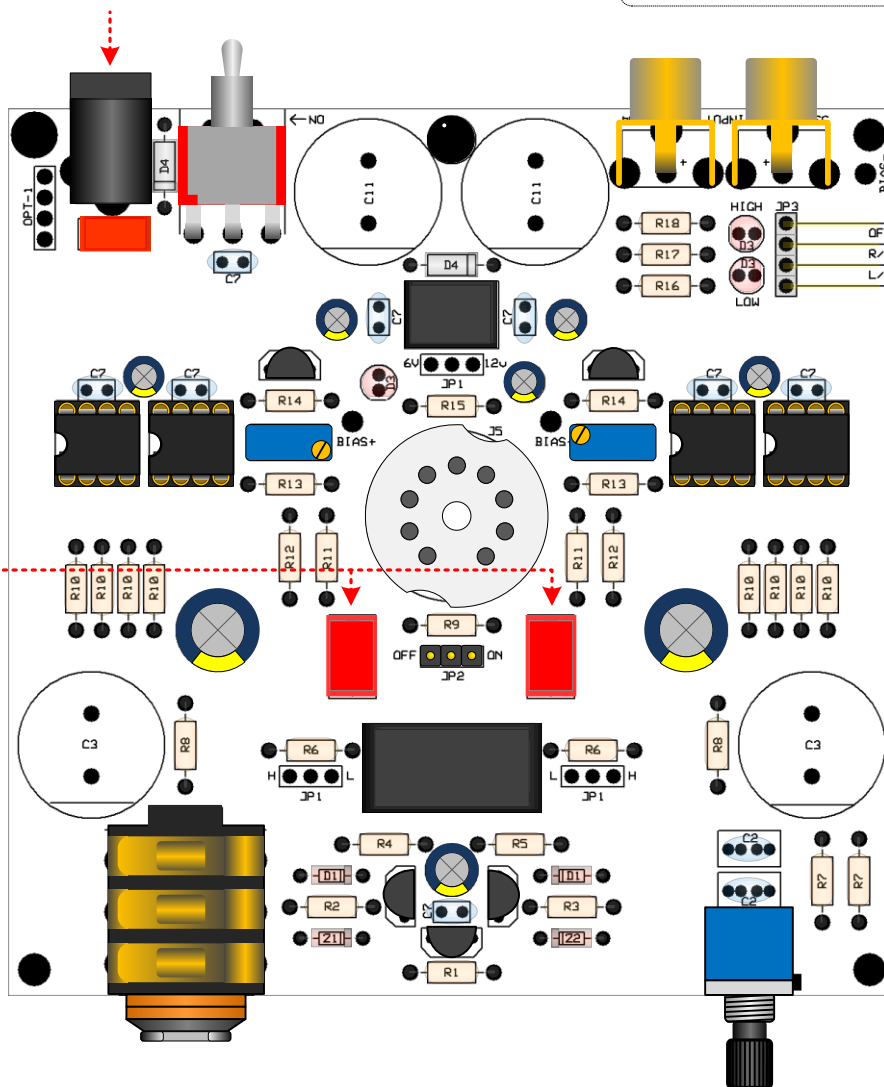
STEP 2: POPULATE ALL MID SIZE COMPONENTS SUCH AS RCA'S, POWER COMPONENTS, SMALL CAPACITORS, TUBE SOCKET, RELAY, TRIMMERS AND SO FORTH

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



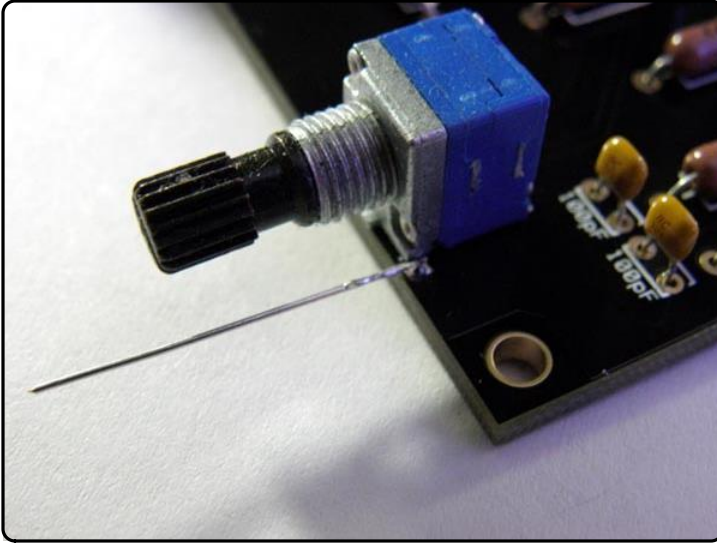
PLEASE NOTE: CENTER
PIN OF DC SOCKET IS
POSITIVE / 24VDC+

INPUT CAPACITORS ARE
BIPOLAR MEANING THEY
HAVE NO STRIPE AND
CAN BE INSTALLED IN
EITHER DIRECTION



Project Starlight

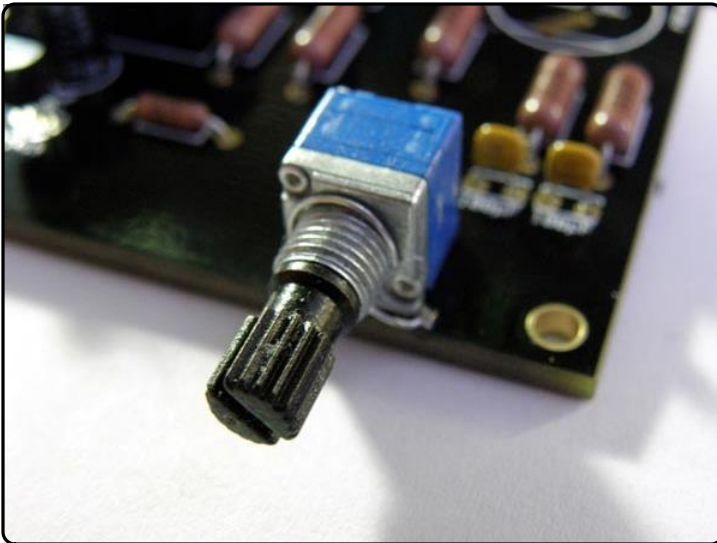
VOLPOT GROUNDING



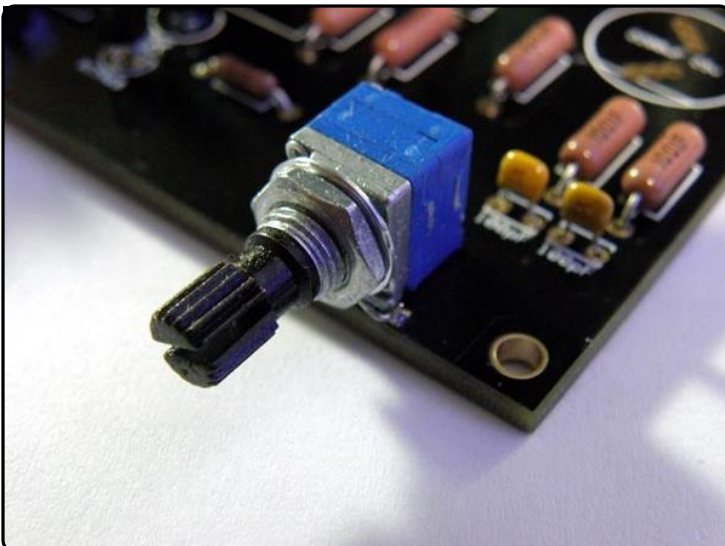
GROUNDING THE VOLUME POTENTIOMETER IS REQUIRED AS WITHOUT IT, THE AMPLIFIER MAY BE SUBJECTED TO NOISE / INTERFERENCE.

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.



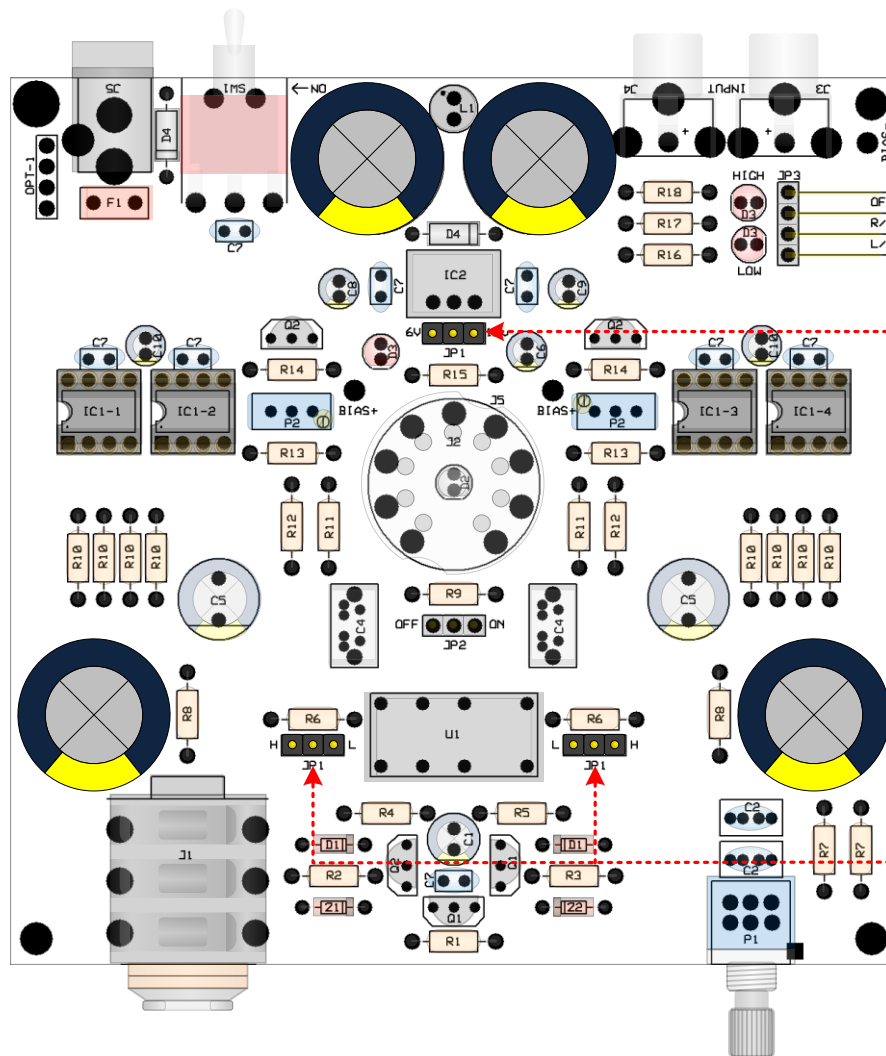
WRAP THE WIRE LEAD AROUND THE THREADED PORTION OF THE VOLPOT AS SHOWN.



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

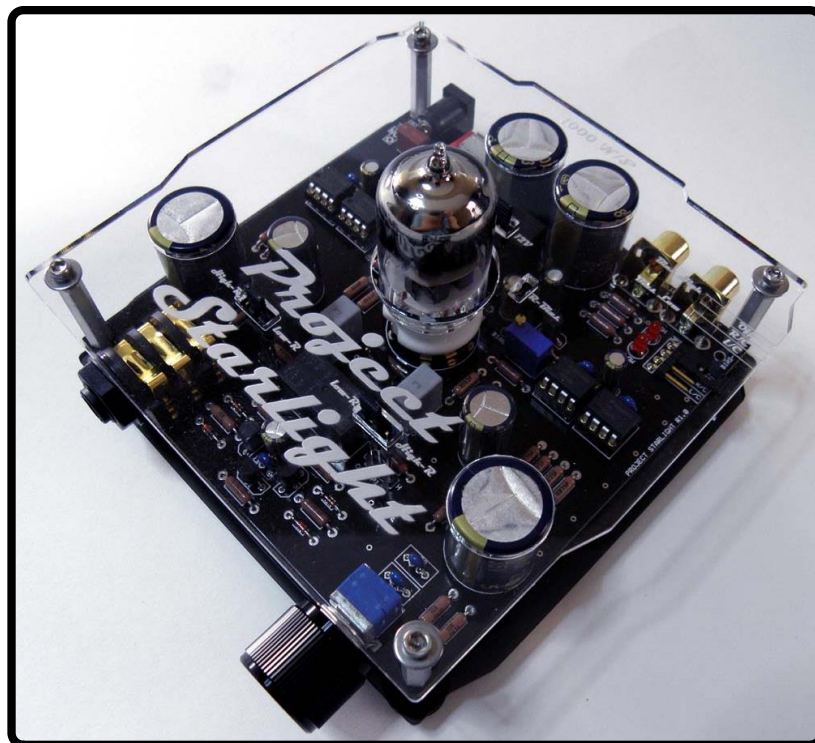
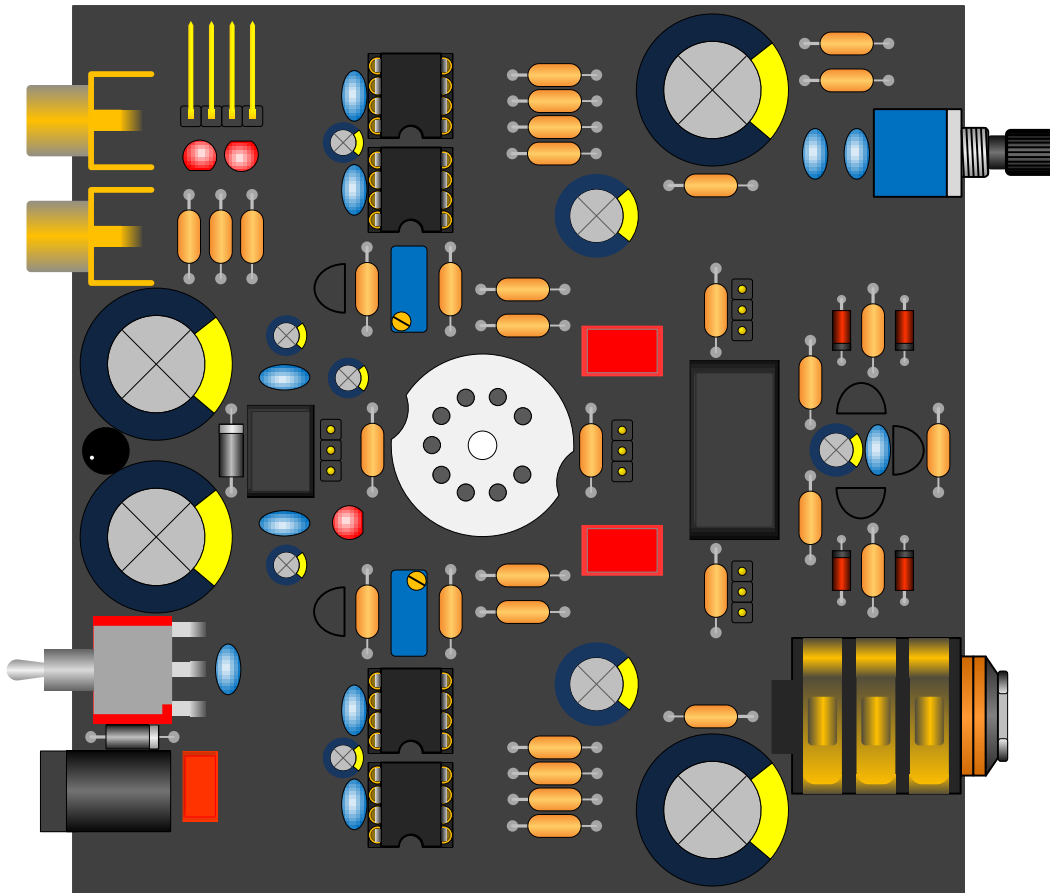
Project Starlight

STEP 3: POPULATE ALL LARGE SIZE COMPONENTS SUCH AS LARGE CAPACITORS AND EXTENDED JUMPERS



Project Starlight

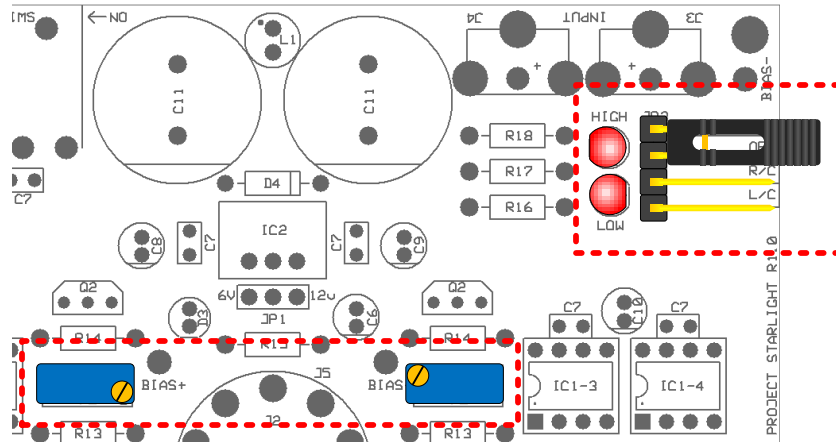
COMPLETED STARLIGHT LAYOUT AND PHOTO:



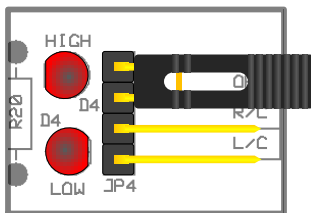
Project Starlight

Easy Set Bias Adjustment

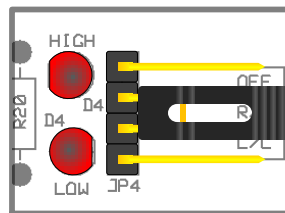
- Easy set bias makes adjusting tube bias quick and easy. You can access the channel selector for the Easy Set Bias from the outside of the chassis without having to take off the top cover. Dial in the bias by turning the blue trimmers clockwise if bias for the channel is low or counter-clockwise if 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



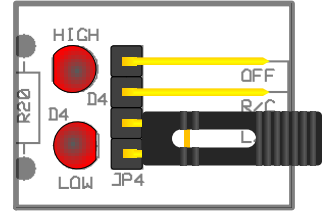
HOW TO SET BIAS USING THE EASY SET BIAS FEATURE



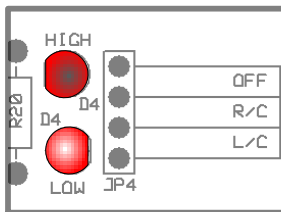
CHANNEL TESTING OFF



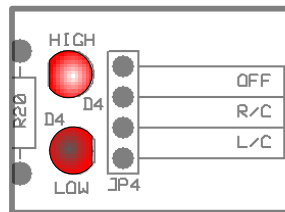
RIGHT CHANNEL BIAS
TEST SETTING



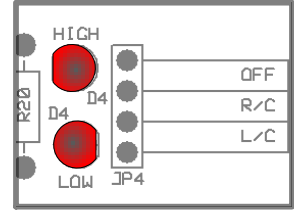
LEFT CHANNEL BIAS
TEST SETTING



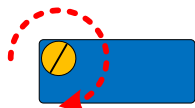
BOTTOM LED GLOWING =
BIAS VOLTAGE LOW



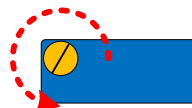
TOP LED BRIGHT = BIAS
VOLTAGE HIGH



BOTH LEDS OFF =
CORRECT BIAS VOLTAGE



ROTATE TRIMMER
CLOCKWISE TO RAISE
BIAS VOLTAGE



ROTATE TRIMMER
COUNTERCLOCKWISE TO
LOWER BIAS VOLTAGE

Project

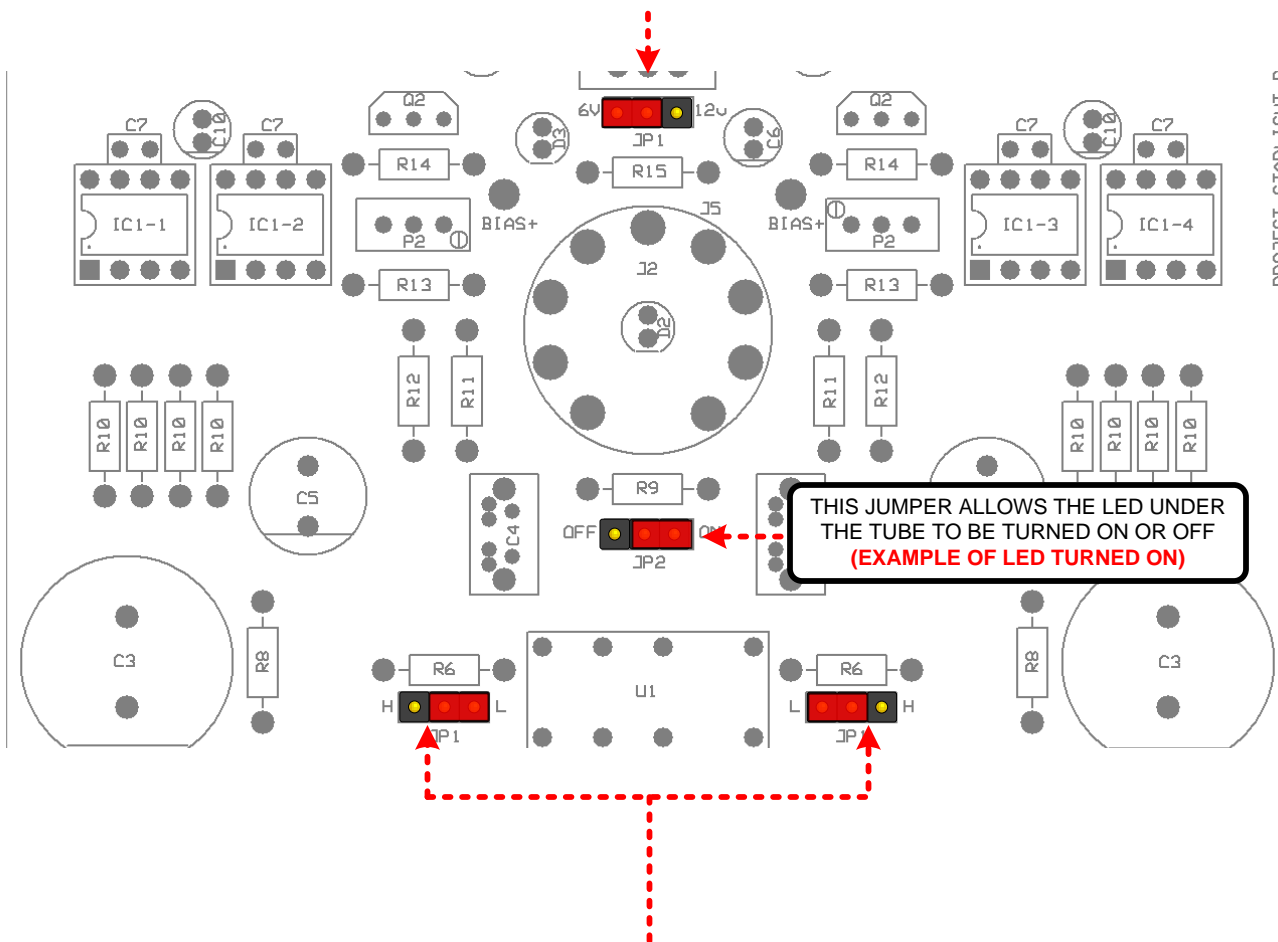
Starlight

Project Starlight 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 DESTROY A TUBE IF SET TO THE WRONG VOLTAGE



OUTPUT RESISTANCE IS CONFIGURABLE BETWEEN 1.5OHM (LOW-R) AND 68OHM (HIGH-R). HIGHER OUTPUT IMPEDANCE WILL HAVE AN EFFECT ON BASS AND TREBLE FREQUENCIES WHICH IS ALSO DEPENDANT ON YOUR HEADPHONE IMPEDANCE. CHANGE THE SETTINGS TO BEST SUIT YOUR DESIRED LISTENING EXPERIENCE

(EXAMPLE OF 1.5OHM SETTING IN RED)

Project Starlight

Resistors

R1 = 470K X 1
R2 = 10K X 1
R3 = 220K X 1
R4 = 34R X 1
R5 = 4K7 X 1
R6 = 68R X 2
R7 = 30K X 2
R8 = 2K2 X 2
R9 = 220R X 1
R10 = 4.75R X 8
R11 = 100K X 2
R12 = 1K X 2
R13 = 100R X 2
R14 = 2K2 X 2
R15 = 12K X 1
R16 = 5.1K X 1
R17 = 1K X 1
R18 = 5.1K X 1

Diodes

Z1 = BZX79-C22 X 1
Z2 = BZX79-C18 X 1
D1 = 1N4148 X 2
D2 = 3MM LED (YOU CHOOSE COLOR) X 1
D3 = RED LED X 3
D4 = SB240 X 2

Capacitors

C1 = 47uF 50V X 1
C2 = 47pF X 2
C3 = 2200uF 35V X 2
C4 = 1uF X 2
C5 = 470uF 10V X 2
C6 = 100uF 10V X 1
C7 = 100nF X 8
C8 = 100uF 10V X 1
C9 = 22uF 35V X 1
C10 = 10uF 50V x 2
C11 = 330uF 100V x 2

Transistors

Q1 = BC546B X 2
Q2 = BC560B X 3

Inductor

L1 = 100uH X 1

Regulators

IC1-1 = LM4562 X 1
IC1-2 = LM4562 X 1
IC1-3 = LM4562 X 1
IC1-4 = LM4562 X 1
IC2 = DC-DC X1

Jacks

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

Jumpers

JP1 = EXTENDED 3 PIN X 3
JP2 = 3 PIN STRAIGHT X 1
JP3 = 4 PIN RA X 1

Switches

SW1 = POWER SWITCH X 1

Fuse

F1 = 2A FUSE

Potentiometers / Trimmers

P1 = 10K VOLUME POTENTIOMETER
P2 = 50K 25T VERTICAL TRIMMER X 2

Relay

U1 = 24V RELAY

Misc

VOLUME KNOB
CHASSIS HARDWARE KIT
UPPER AND LOWER CHASSIS
JUMPERS X 5