KIT No. 1033

Hi-Fi POWER AMPLIFIER 60 Watt

GENERAL DESCRIPTION

This is a very well designed power amplifier that will give you true Hi-Fi quality and the satisfaction that it comes from your personal work. The circuit is very stable, protected from over loading and short circuits and has really Hi-Fi characteristics. This amplifier is part of a full Hi-Fi audio range of kits from Quasar Electronics and as it is naturally expected it works well with all the other kits in the same range. Ask your retailer for more information.

TECHNICAL SPECIFICATIONS

Output power: ..... 60 W in 8 ohm and 80 W in 4 ohm
Supply voltage: ..... +/- 40 V
Quiescent current: ..... 50-60 mA
Maximum current: ..... 4 A
Sensitivity: .....0-1 dBm (0.707 - 1.5 V)
Amplification factor: 24
Frequency response: ..... 5 - 35000 Hz for low THD
Distortion THD: ..... 0.05 % at 1 KHz
0.08 % at 10 KHz
0.1 % at 20 KHz
The circuit also incorporates a protection stage for the output transistors.

HOW IT WORKS

The two transistors TR2 and TR3 form a differential amplifier. Their two emitters are connected together and are supplied from the positive rail through the same resistor the R3. As they share the same resistor the same current flows through both transistors. The differential amplifier is supplied through D1. This diode is there to ensure that no current flows back towards the output stage. The capacitor C2 is charged through R2 and is there to act as a reservoir for the differential amplifier. Effectively, if the supply drops suddenly because the output transistors have drawn an excessively large current, the voltage across the capacitor C2 will stay constant because it cannot discharge through D1 and the input stage draws very little current. Keeping the supply always constant means that the gain of the stage remains constant even if the amplifier is working near overload. In other words the amplifier has a linear response under most conditions. The collector of TR2 is connected to the negative supply rail through the resistor R5 and any change in the input voltage (signal) appears on R5 as a voltage drop across it. This voltage drop is used to drive TR4 that is used here as a voltage amplifier. The BOOTSTRAP circuit R1, R11, C6 is used to increase excessively the voltage gain. Larger voltage amplification means in this case lower distortion. The capacitor C7

across the collector-base junction of TR4 is acting as a BLUMLEIN integrator to limit the frequency response of the circuit. This has as a result the reduction of harmonic distortion. The harmonic distortion produced by a power amplifier is mainly caused by the voltage amplifier, and if the voltage amplifier has low distortion, then the amplifier as whole will have low distortion too. The output of TR4 is used to drive the output transistors, through R13, D3 and D4. The output transistors are connected in the circuit in a DARLINGTON configuration. This type of circuit gives greater current amplification and linearity. In the output stage there are two transistor pairs of which only the drivers are complementary. This arrangement is known as QUASI-COMPLEMENTARY. The diode D5 and the resistor R17 are used to balance the two pairs. As the two pairs are driven symmetrically the clipping if it occurs will also be symmetrical resulting in better overall quality. The two resistors R15,16 are used to limit the current through TR8, TR9 in order to protect them from over loading. The resistors R8,R9 are used to drive the transistors TR7 and TR1 respectively. These two transistors are the electronic protection circuit for the output transistors. Let us see how it works in practice. When current flows through TR8, and consequently through R15 as well, there will be a voltage drop across R15. This voltage drop is transferred through R9 and R10 to the base of TR1. If the voltage at the base of TR1 is higher than 0.707 V the transistor is turned ON and the signal is shorted to earth through D2. This removes the drive from the out put pair and the current flow logically ceases. The same happens with TR7 and the other pair of output transistors is also cut off. The feedback loop is formed by R6, R7 and C5. The trimmer P1 is used to adjust the quiescent current of the amplifier to the desired level.

CONSTRUCTION

First of all let us consider a few basics in building electronic circuits on a printed circuit board. The board is made of a thin insulating material clad with a thin layer of conductive copper that is shaped in such a way as to form the necessary conductors between the various components of the circuit. The use of a properly designed printed circuit board is very desirable as it speeds construction up considerably and reduces the possibility of making errors. The boards are pre-drilled and have the outline of the components and their identification printed on the component side to make construction easier. To protect the board during storage from oxidation and assure it gets to you in perfect condition the copper is tinned during manufacturing and covered with a special varnish that protects it from getting oxidised and also makes soldering easier. Soldering the components to the board is the only way to build your circuit and from the way you do it depends greatly your success or failure. This work is not very difficult and if you stick to a few rules you should have no problems. The soldering iron that you use must be light and its power should not exceed the 25 Watts. The tip should be fine and must be kept clean at all times. For this purpose come very handy specially made sponges that are kept wet and from time to time you can wipe the hot tip on them to remove all the residues that tend to accumulate on it. DO NOT file or sandpaper a dirty or worn out tip. If the tip cannot be cleaned, replace it. There are many different types of solder in the market and you should choose a good quality one that contains the necessary flux in its core, to assure a perfect joint every time. DO NOT use soldering flux apart from that which is already included in your solder. Too much flux can cause many problems and is one of the main causes of circuit malfunction. If nevertheless you have to use extra flux, as it is the case when you have to tin copper wires, clean it very thoroughly after you finish your work. In order to solder a component correctly you should do the following:

- Clean the component leads with a small piece of emery paper.

- Bend them at the correct distance from the component body and insert the component in its place on the board.
- You may find sometimes a component with heavier gauge leads than usual, that are too thick to enter in the holes of the p.c. board. In this case use a mini drill to enlarge the holes slightly.
- Do not make the holes too large as this is going to make soldering difficult afterwards.
- Take the hot iron and place its tip on the component lead while holding the end of the solder wire at the point where the lead emerges from the board. The iron tip must touch the lead slightly above the p.c. board. - When the solder starts to melt and flow wait till it covers evenly the area around the hole and the flux boils and gets out from underneath the solder. The whole operation should not take more than 5 seconds. Remove the iron and allow the solder to cool naturally without blowing on it or moving the component. If everything was done properly the surface of the joint must have a bright metallic finish and its edges should be smoothly ended on the component lead and the board track. If the solder looks dull, cracked, or has the shape of a blob then you have made a dry joint and you should remove the solder (with a pump, or a solder wick) and redo it. - Take care not to overheat the tracks as it is very easy to lift them from the board and break them.
- When you are soldering a sensitive component it is good practice to hold the lead from the component side of the board with a pair of long-nose pliers to divert any heat that could possibly damage the component. - Make sure that you do not use more solder than it is necessary as you are running the risk of short-circuiting adjacent tracks on the board, especially if they are very close together. - When you finish your work cut off the excess of the component leads and clean the board thoroughly with a suitable solvent to remove all flux residues that still remain on it.

As you see all the components are already marked on the component side of the p.c. board. The construction is made this way much simpler. Start the construction from the pins, continue with the resistors and the capacitors and last solder in place the semiconductors. Check each resistor before soldering it, to see if its colours match those in the component list. Be careful with the electrolytic capacitors because their polarity should be respected. The polarity of those capacitors is marked on their bodies and on the component side of the p.c. board. Take care when you are soldering the semiconductors because if you overheat them they can be damaged. The output transistors should be mounted on the heatsink that is included in the kit. Take care not to short circuit them with the heatsink and we recommend that you use some HTC between the transistor body and the sink in order to improve the heat dissipation. Follow the diagram for the mounting of the power transistors as it shows clearly how to insert the insulators and the screws. In order to get the best performance from your power amplifier use heavy gauge wires for the connection of the output transistors and the p.c. board and keep their length as short as possible. When you finish the construction of your project clean the board thoroughly with a solvent to remove all flux residues and make a careful visual inspection to make sure there are no mistakes, components missing and short circuits across adjacent tracks on the board. If everything is OK you can make the following connections:

Point 1: ..... +40 VDC
Point 3: ..... 0 VDC
Point 6: ..... -40 VDC
Point 5: ..... Input signal (core)
Point 2: ..... Input common (shield)
Point 4: ..... Speaker +
Point 3: ..... Speaker -

Connect a milliammeter in series with the power supply, short circuit the input of the amplifier, turn the power ON and adjust the trimmer P1 so that the quiescent current is between 50 and 60 mA. When you finish this adjustment remove the shunt from the input and connect the output of a preamplifier to it. Connect the preamplifier to a suitable source and turn everything ON. The signal should be heard from the speakers clear and undistorted.

Warning

Quasar Electronics kits are sold as stand alone training kits.
If they are used as part of a larger assembly and any damage is caused, our company bears no responsibility.

While using electrical parts, handle power supply and equipment with great care, following safety standards as described by international specs and regulations.

If it does not work

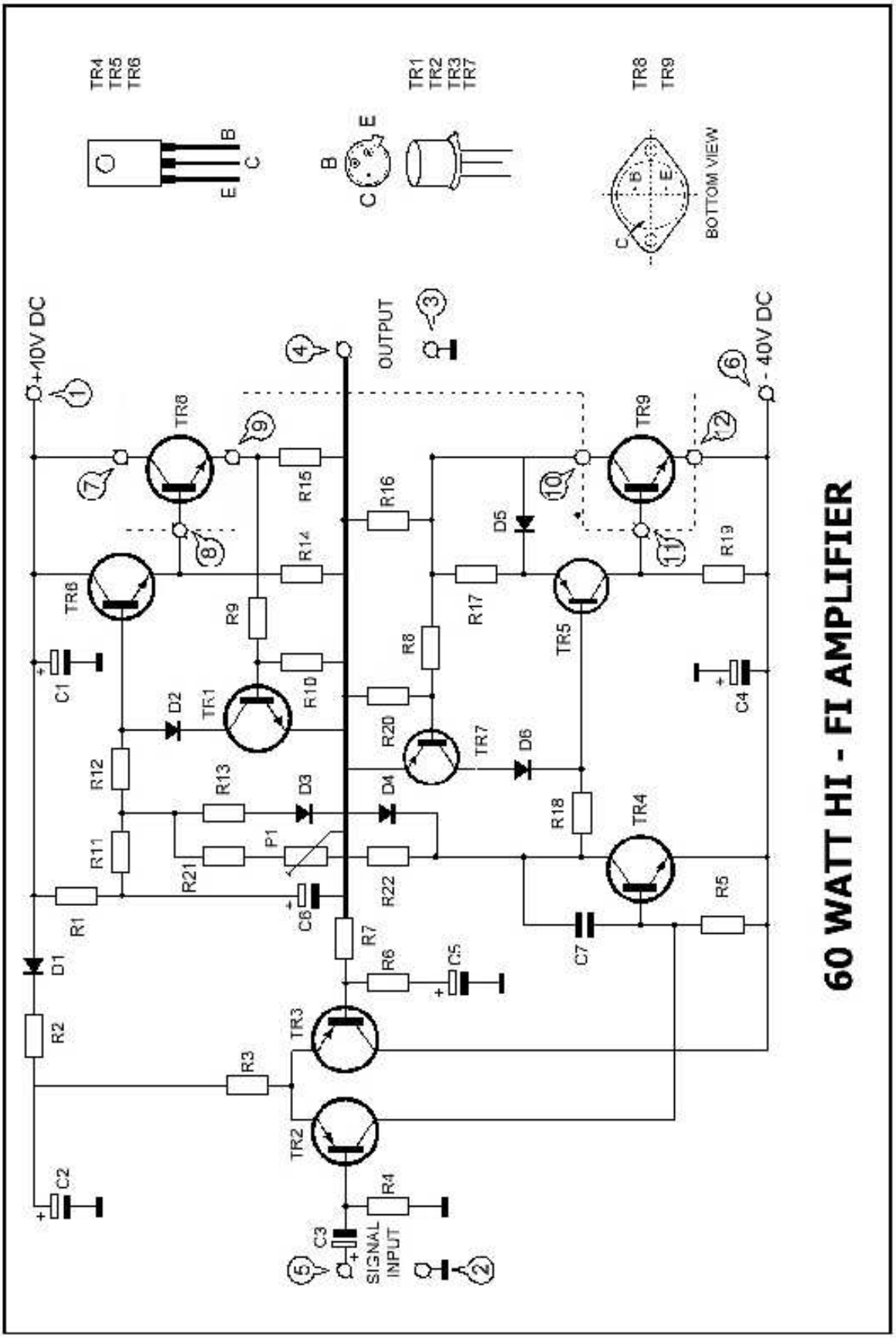
- Check your work for possible dry joints, bridges across adjacent tracks or soldering flux residues that usually cause problems.
- Check again all the external connections to and from the circuit to see if there is a mistake there.
- See that there are no components missing or inserted in the wrong places.
- Make sure that all the polarised components have been soldered the right way round.
- Make sure that the supply has the correct voltage and is connected the right way round to your circuit.
- Check your project for faulty or damaged components.

If you need support please contact us at support@quasarelectronics.co.uk.

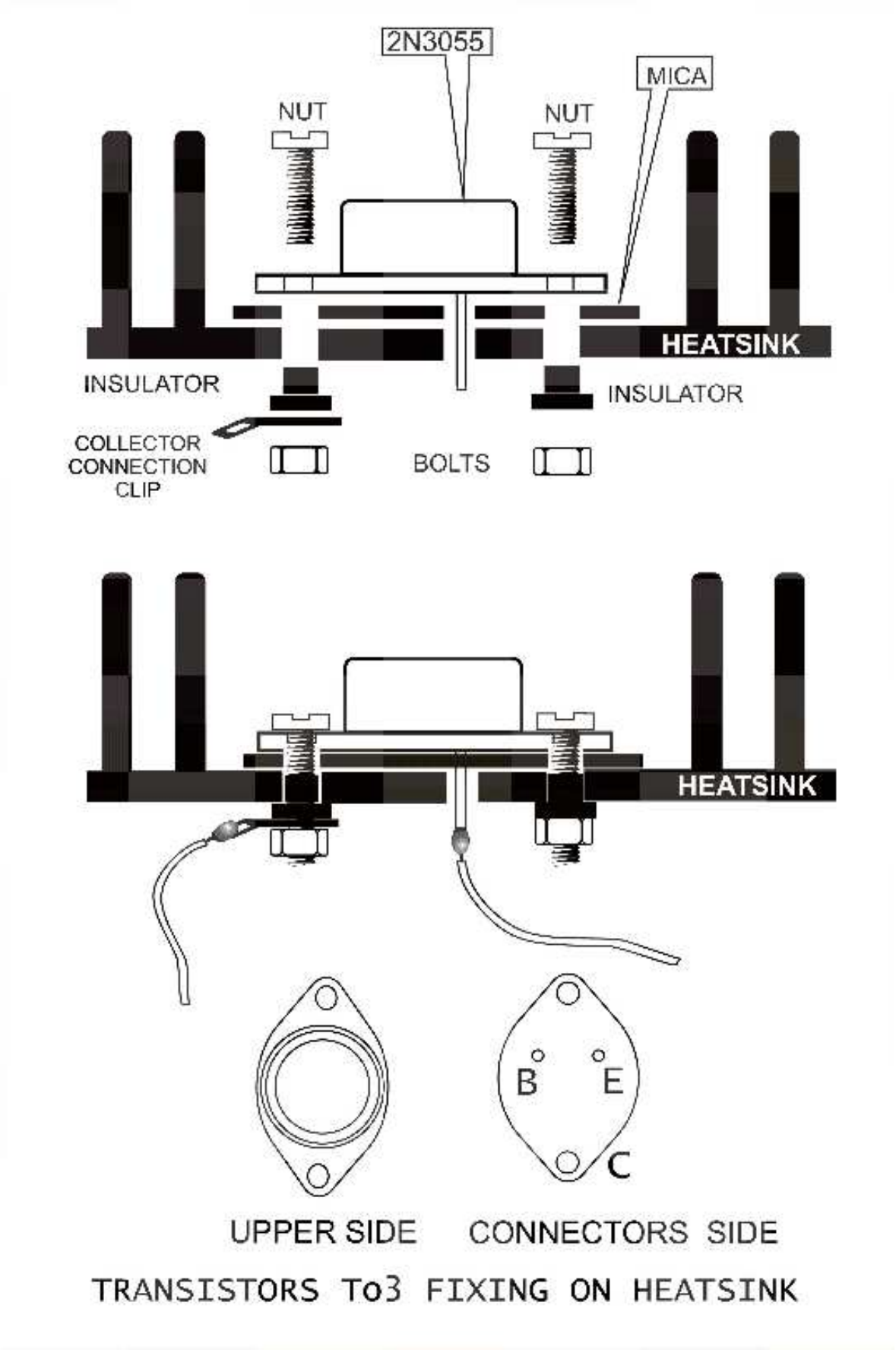
Parts List

All components including printed circuit board, assembly instructions including schematics and detailed parts list are supplied when you purchase the kit.

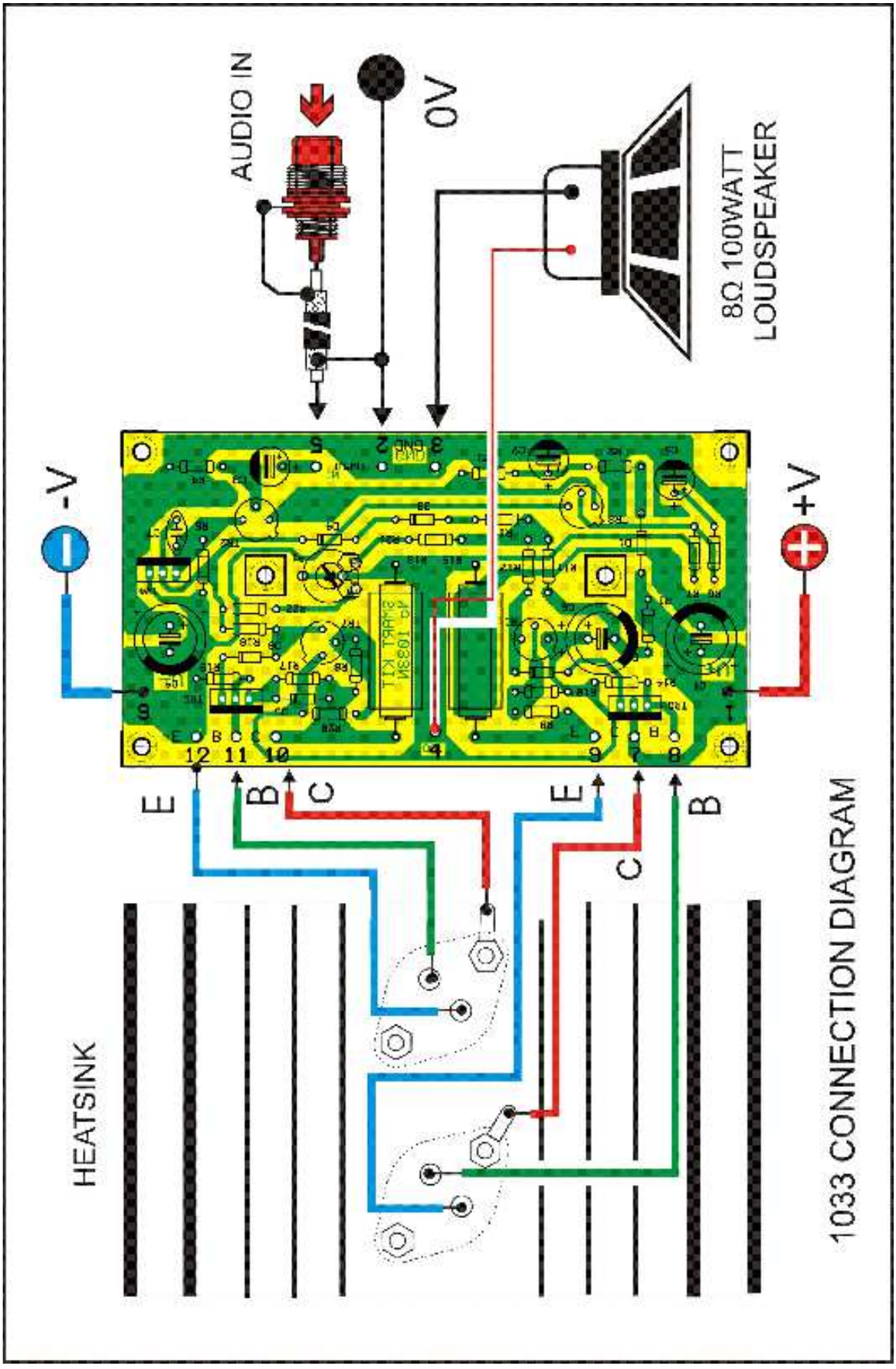
Schematic Diagram



Heatsink Assembly Diagram



Connection Diagram



Ordering

For pricing info and online ordering please visit:

www.quasarelectronics.co.uk/1033.htm

For further info please contact us by e-mail:

sales@quasarelectronics.co.uk