

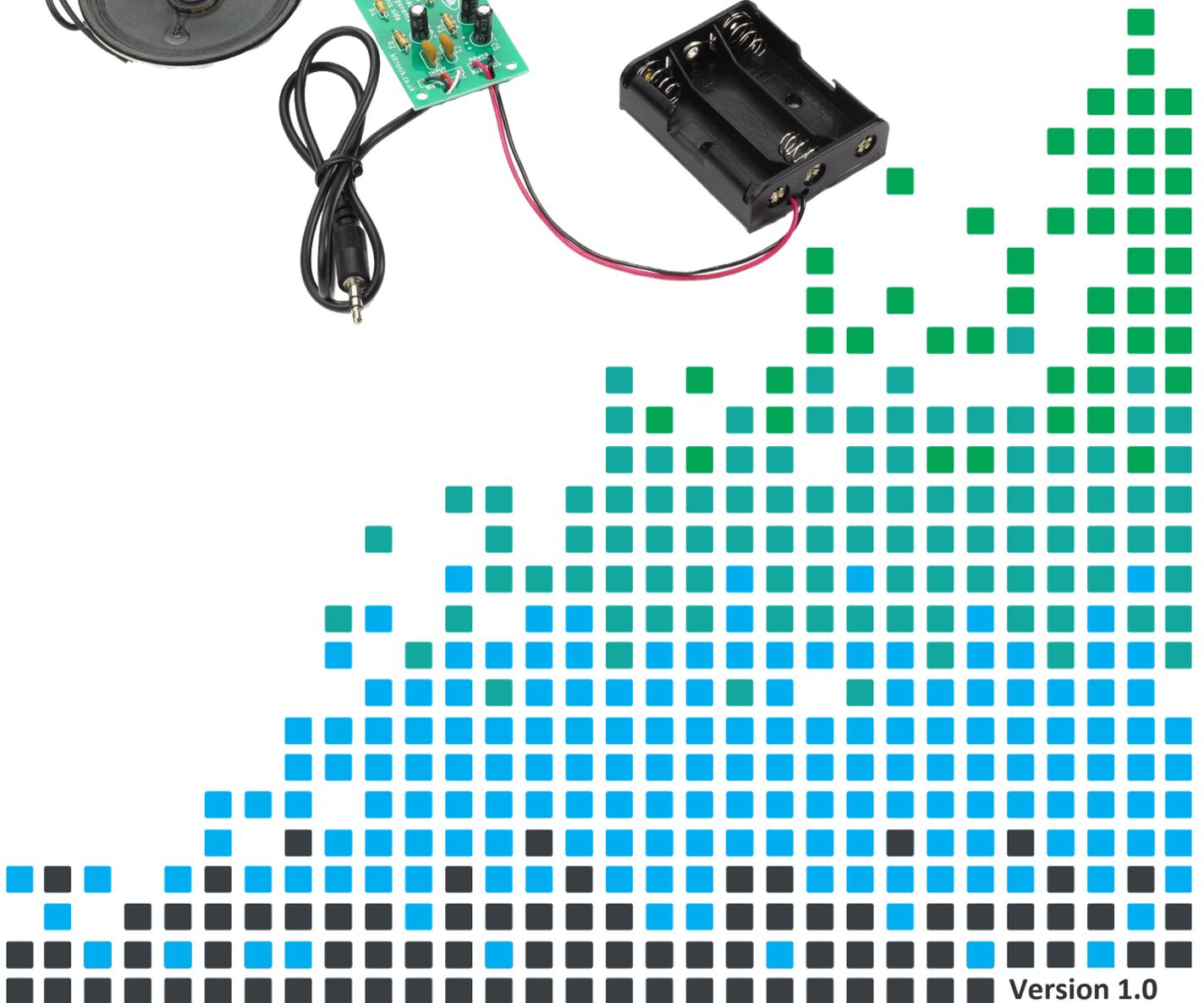
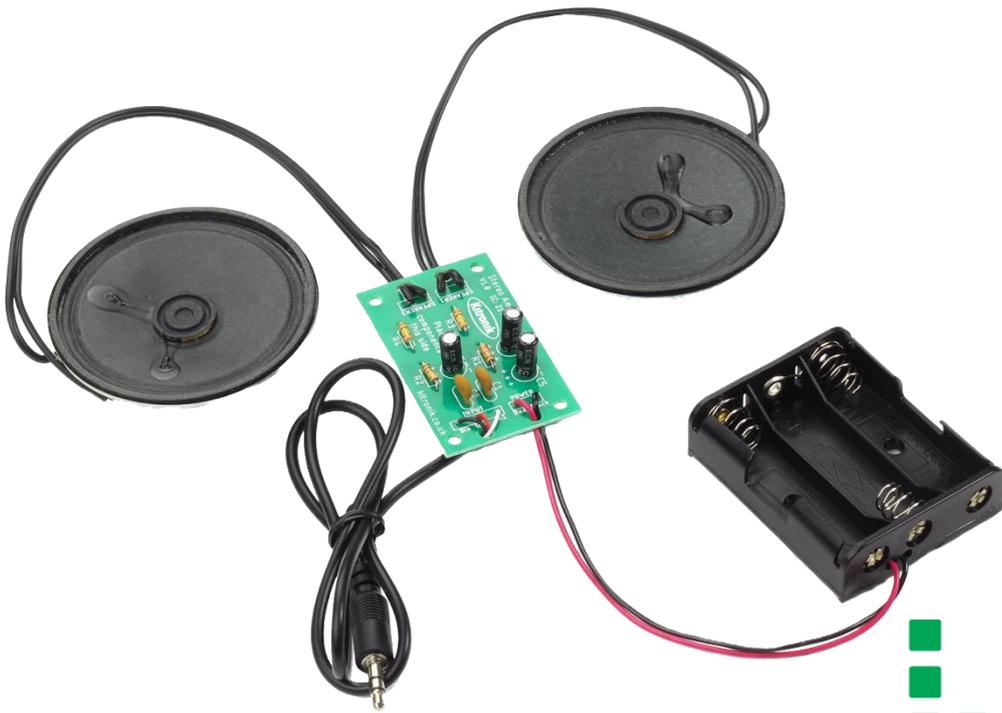


ESSENTIAL INFORMATION

BUILD INSTRUCTIONS
CHECKING YOUR PCB & FAULT-FINDING
MECHANICAL DETAILS
HOW THE KIT WORKS

CREATE YOUR OWN SPEAKER DOCK WITH THIS

STEREO AMPLIFIER KIT



Version 1.0

Build Instructions

Before you start, take a look at the Printed Circuit Board (PCB). The components go in the side with the writing on and the solder goes on the side with the tracks and silver pads.

1 SOLDER THE RESISTORS

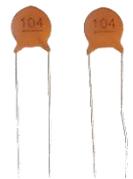
Start with the four resistors. The text on the PCB shows where R1, R2 etc go. Ensure that you put the resistors in the right place. It does not matter which way round they go. Once you are happy with them, solder in place.



PCB Ref	Value	Colour Bands
R1 & R2	15kΩ	Brown, green, orange
R3 & R4	100kΩ	Brown, black, yellow

2 SOLDER THE CERAMIC DISK CAPACITORS

There are two ceramic disc capacitors (as shown right). These should be soldered into C1 and C2. It does not matter which way round they go.



3 SOLDER THE ELECTROLYTIC CAPACITORS

Now solder in the three electrolytic capacitors (an example is shown right). They should be soldered into C3, C4 and C5. Make sure that the capacitors are the correct way round. The capacitors have a '-' sign marked on them, which should match the same sign on the PCB.



4 CONNECT THE SPEAKERS

The kit is supplied with a meter of twin cable. This cable will be used to connect the two speakers to the PCB. You will need to cut this to the required length for each speaker in your enclosure design.

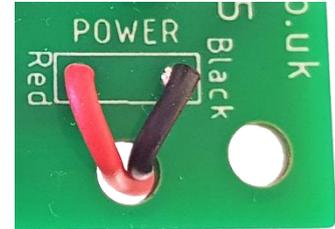
Take each piece of wire that you have cut off and strip the ends of the wire. Solder one end of each wire to the two terminals on the speaker (shown right). Solder the other end of each wire to the terminals on the PCB marked 'SPEAKER1' and 'SPEAKER2', after feeding it through the strain relief hole. It does not matter which way around these connections go.



5

ATTACH THE BATTERY CAGE / USB POWER LEAD

The battery cage should be attached to the terminals labelled 'POWER'. Solder the red wire to '+' and solder the black wire to '-' after feeding it through the strain relief hole.



6

CONNECT THE AUDIO CABLE

The stereo Jack lead should be soldered to the 'INPUT' terminal. First, feed the wires through the strain relief hole. The black wire should be soldered to the terminal labelled 'BLK'. The other two can go to either of the two remaining inputs.



Checking Your PCB

Check the following **before** you insert the batteries:

Audio equipment may become damaged if connected to an incorrectly built amplifier.

Check the bottom of the board to ensure that:

- All holes (except the large mounting holes) are filled with the lead of a component.
- All these leads are soldered.
- Pins next to each other are not soldered together.

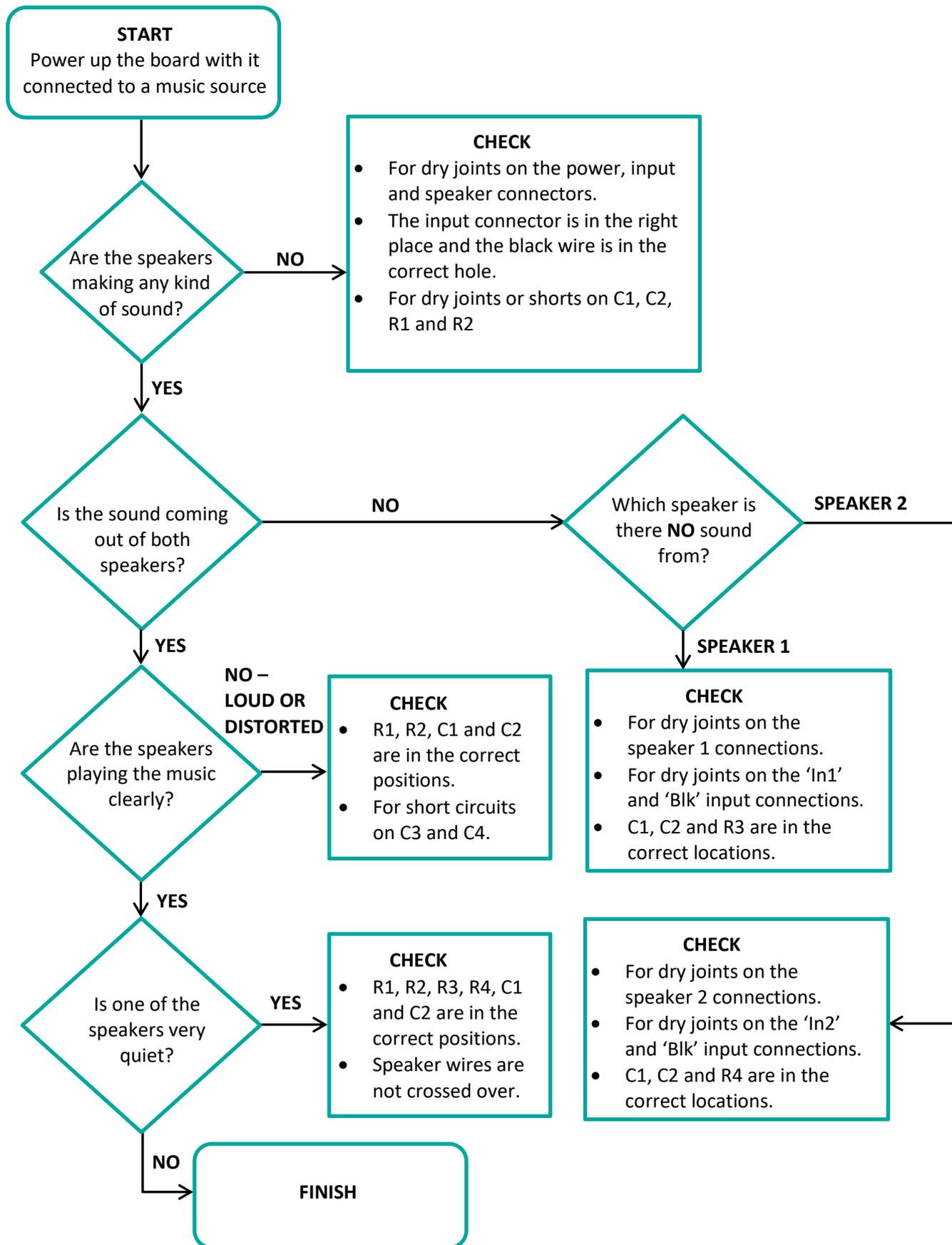
Check the top of the board to ensure that:

- The four wires are connected to the right place (power, stereo input, 2 x speaker).
- The '-' on the electrolytic capacitors match the same marks on the PCB.
- The colour bands on R1 and R2 are Brown, Green, Orange.
- The colour bands on R3 and R4 are Brown, Black, Yellow.
- C1 and C2 match the outline on the PCB.
- The battery lead red and black wires match the red and black text on the PCB.



Stereo Amplifier Essentials

www.kitronik.co.uk/2179

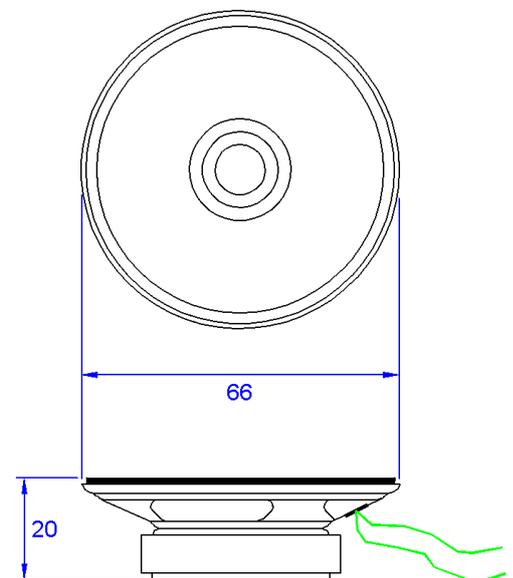
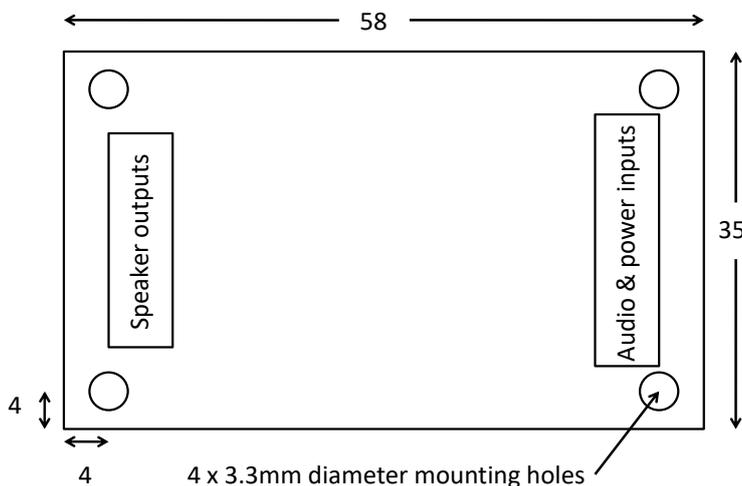


Designing the Enclosure

When you design the enclosure, you will need to consider:

- The size of the PCB (below left, height including components = 15mm).
- How big the batteries are.
- How to mount the two speakers (below right).
- How to allow the audio cable out of the box.
- Are you making the amplifier for a particular MP3 player, if so, should the MP3 player go in the box?

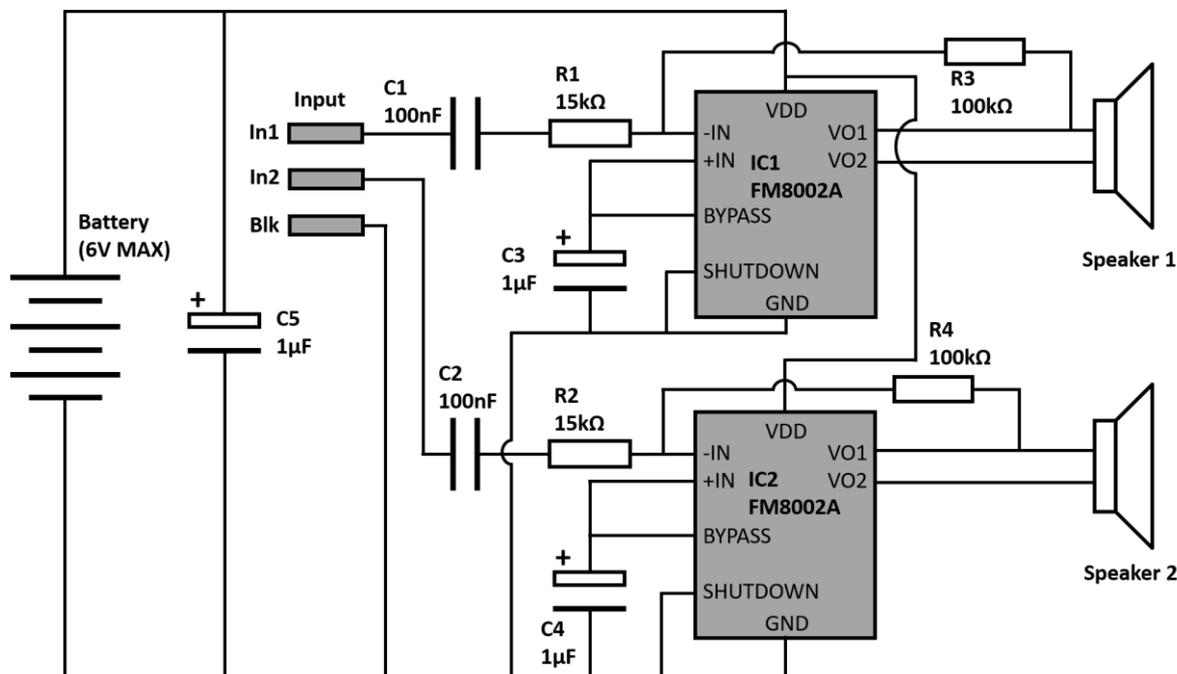
These technical drawings of the amplifier PCB and speaker should help you plan for this (all dimensions in mm).



<p>Diagram illustrating the mounting of the PCB to the enclosure. The components shown are: P.C.B., SPACER, ENCLOSURE, and 2 X M3 BOLTS. The PCB is placed on top of the enclosure, and the spacer is used to hold it in place. Two M3 bolts are used to secure the assembly.</p>	<p>Mounting the PCB to the enclosure</p> <p>The drawing to the left shows how a hex spacer can be used with two bolts to fix the PCB to the enclosure.</p> <p><i>Your PCB has four mounting holes designed to take M3 bolts.</i></p>
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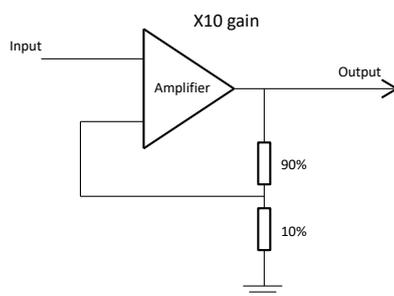


How the Circuit Works



The stereo amplifier circuit is comprised of two identical mono amplifier circuits, with one taking 'In1' as an input and then sending amplified audio out to Speaker 1, and the other taking 'In2' as an input and sending amplified audio out to Speaker 2. At the centre of each mono amplifier circuit is an audio amplifier Integrated Circuit or IC. Inside the IC are lots of transistors, which are connected together to allow the small input signal to be amplified into a more powerful output that can drive a speaker.

All amplifiers need to use feedback to ensure that the amount of gain stays the same. This allows the output to be an exact copy of the input, just bigger. The gain is the number of times bigger the output is compared to the input. So, if an amplifier has a gain of 10 and there is 1 volt on the input, there will be 10 volts on the output. An operational amplifier has two inputs, these are called the inverting (-) and non-inverting (+) inputs. The output of the operational amplifier is the voltage on the non-inverting input less the voltage on the inverting input, multiplied by the amplifier's gain. In theory, an operational amplifier has unlimited gain so if the non-inverting input is a fraction higher than the inverting input (there is more + than -), the output will go up to the supply voltage. Change the inputs around and the output will go to zero volts. In this format the operational amplifier is acting as a comparator, it compares the two inputs and changes the output accordingly.



With an infinite gain the amplifier is no good to amplify audio, which is where the feedback comes in. By making one of the inputs a percentage of the output the gain can be fixed, which allows the output to be a copy of the input but bigger. Now when the two inputs are compared and the output is adjusted, instead of it going up or down until it reaches 0 volts or V+, it stops at the point when the two inputs match and the output is at the required voltage.



Stereo Amplifier Essentials

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Looking at the circuit diagram for the audio amplifier, it can be seen that the feedback path is via resistors R3 and R4 (from VO1 to -IN on the FM8002A amplifier IC). The gain of the amplifier is calculated using the following formula:

$$Gain = 2 \times \frac{R_f}{R_i}$$

Where R_f is the feedback resistor (R3 or R4), and R_i is the input resistor (R1 or R2). Therefore, the gain of each mono amplifier section can be found to be:

$$Gain = 2 \times \frac{R3}{R1}$$

$$Gain = 2 \times \frac{100000}{15000}$$

$$Gain = 13.3$$

C5 is connected across the supply to make sure that it remains stable. The other capacitors have a filtering role, either to cut out high frequency noise or get the best out of the speaker.



Online Information

Two sets of information can be downloaded from the product page where the kit can also be reordered from. The 'Essential Information' contains all of the information that you need to get started with the kit and the 'Teaching Resources' contains more information on soldering, components used in the kit, educational schemes of work and so on and also includes the essentials. Download from:

www.kitronik.co.uk/2179



This kit is designed and manufactured in the UK by Kitronik

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