TEACHING RESOURCES

SCHEMES OF WORK
DEVELOPING A SPECIFICATION
COMPONENT FACTSHEETS
HOW TO SOLDER GUIDE

ADD AN AUDIO MESSAGE TO YOUR PRODUCT WITH THIS

RECORD & PLAYBACK KIT

Version 2.1

Index of Sheets

Introduction

About the project kit

Both the project kit and the supporting material have been carefully designed for use in KS3 Design and Technology lessons. The project kit has been designed so that even teachers with a limited knowledge of electronics should have no trouble using it as a basis from which they can form a scheme of work.

The project kits can be used in two ways:

1. As part of a larger project involving all aspects of a product design, such as designing an enclosure for the electronics to fit into.
2. On their own as a way of introducing electronics and electronic construction to students over a number of lessons.

This booklet contains a wealth of material to aid the teacher in either case.

Using the booklet

The first few pages of this booklet contains information to aid the teacher in planning their lessons and also covers worksheet answers. The rest of the booklet is designed to be printed out as classroom handouts. In most cases all of the sheets will not be needed, hence there being no page numbers, teachers can pick and choose as they see fit.

Please feel free to print any pages of this booklet to use as student handouts in conjunction with Kitronik project kits.

Support and resources

You can also find additional resources at www.kitronik.co.uk. There are component fact sheets, information on calculating resistor and capacitor values, puzzles and much more.

Kitronik provide a next day response technical assistance service via e-mail. If you have any questions regarding this kit or even suggestions for improvements, please e-mail us at:

support@kitronik.co.uk

Alternatively, phone us on 0845 8380781.

Schemes of Work

Two schemes of work are included in this pack; the first is a complete project including the design & manufacture of an enclosure for the kit (below). The second is a much shorter focused practical task covering just the assembly of the kit (next page). Equally, feel free to use the material as you see fit to develop your own schemes.

Before starting we would advise that you to build a kit yourself. This will allow you to become familiar with the project and will provide a unit to demonstrate.

Complete product design project including electronics and enclosure

Hour 1	Introduce the task using 'The Design Brief' sheet. Demonstrate a built unit. Take students through the design process using 'The Design Process' sheet. Homework: Collect examples of audio equipment or / and items for remembering things. List the common features of these products on the 'Investigation / Research' sheet.
Hour 2	Develop a specification for the project using the 'Developing a Specification' sheet. Resource: Pictures or samples of similar products. Homework: Using the internet or other search method, find out what is meant by 'design for manufacture'. List five reasons why design for manufacture should be considered on any design project.
Hour 3	Read 'Designing the Enclosure' sheet. Develop a product design using the 'Design' sheet. Homework: Complete design.
Hour 4	Using cardboard, get the students to model their enclosure design. Allow them to make alterations to their design if the model shows any areas that need changing.
Hour 5	Split the students into groups and get them to perform a group design review using the 'Design Review' sheet.
Hour 6	Using the 'Soldering in Ten Steps' sheet, demonstrate and get students to practice soldering. Start the 'Resistor Value' and 'Capacitor Basics' worksheets. Homework: Complete any of the remaining resistor / capacitor tasks.
Hour 7	Build the electronic kit using the 'Build Instructions'.
Hour 8	Complete the build of the electronic kit. Check the completed PCB and fault find if required using the 'Checking Your Record Playback PCB' section and the fault finding flow chart. Homework: Read 'How the Record Playback Module Works' sheet.
Hour 9	Build the enclosure. Homework: Collect some examples of instruction manuals.
Hour 10	Build the enclosure. Homework: Read 'Instruction Manual' sheet and start developing instructions for the voice memo product.
Hour 11	Build the enclosure.
Hour 12	Using the 'Evaluation' and 'Improvement' sheet, get the students to evaluate their final product and state where improvements can be made.

Additional Work

Package design for those who complete ahead of others.

Electronics only

Hour 1	Introduction to the kit demonstrating a built unit. Using the 'Soldering in Ten Steps' sheet, practice soldering.
Hour 2	Build the kit using the 'Build Instructions'.
Hour 3	Check the completed PCB and fault find if required using 'Checking Your Record Playback PCB' and fault finding flow chart.

Answers

Resistor questions

1st Band	2nd Band	Multiplier x	Value
Brown	Black	Yellow	*100,000 Ω*
Green	Blue	Brown	*560 Ω*
Brown	Grey	Yellow	*180,000Ω*
Orange	White	Black	*39Ω*

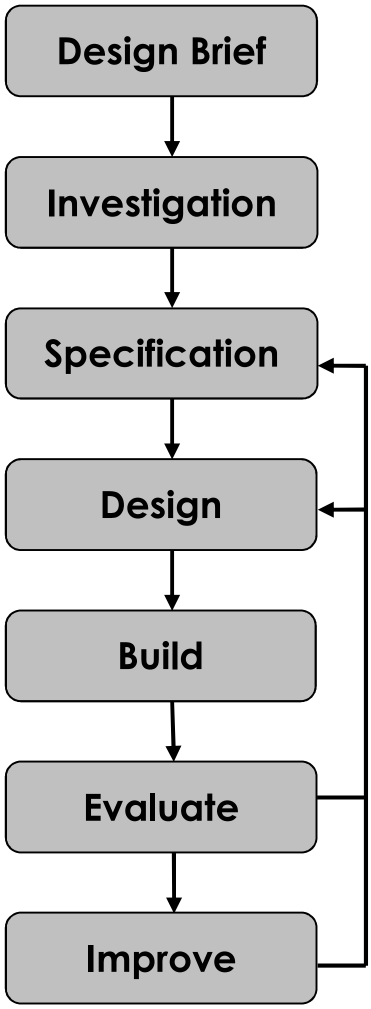
Value	1st Band	2nd Band	Multiplier x
180 Ω	Brown	Grey	*Brown*
3,900 Ω	Orange	White	*Red*
47,000 (47K) Ω	Yellow	Violet	*Orange*
1,000,000 (1M) Ω	Brown	Black	*Green*

Capacitor Ceramic Disc values

Printing on capacitor	Two digit start	Number of zero's	Value in pF
222	22	00	2200pF (2.2nF)
103	10	000	10000pF (10nF)
333	33	000	33000pF (33nF)
473	47	000	47000pF (47nF)

The Design Process

The design process can be short or long, but will always consist of a number of steps that are the same on every project. By splitting a project into these clearly defined steps, it becomes more structured and manageable. The steps allow clear focus on a specific task before moving to the next phase of the project. A typical design process is shown on the right.



Design brief

What is the purpose or aim of the project? Why is it required and who is it for?

Investigation

Research the background of the project. What might the requirements be? Are there competitors and what are they doing? The more information found out about the problem at this stage, the better, as it may make a big difference later in the project.

Specification

This is a complete list of all the requirements that the project must fulfil - no matter how small. This will allow you to focus on specifics at the design stage and to evaluate your design. Missing a key point from a specification can result in a product that does not fulfil its required task.

Design

Develop your ideas and produce a design that meets the requirements listed in the specification. At this stage it is often normal to prototype some of your ideas to see which work and which do not.

Build

Build your design based upon the design that you have developed.

Evaluate

Does the product meet all points listed in the specification? If not, return to the design stage and make the required changes. Does it then meet all of the requirements of the design brief? If not, return to the specification stage and make improvements to the specification that will allow the product to meet these requirements and repeat from this point. It is normal to have such iterations in design projects, though you normally aim to keep these to a minimum.

Improve

Do you feel the product could be improved in any way? These improvements can be added to the design.

Record Playback Teaching Resources

www.kitronik.co.uk/2149

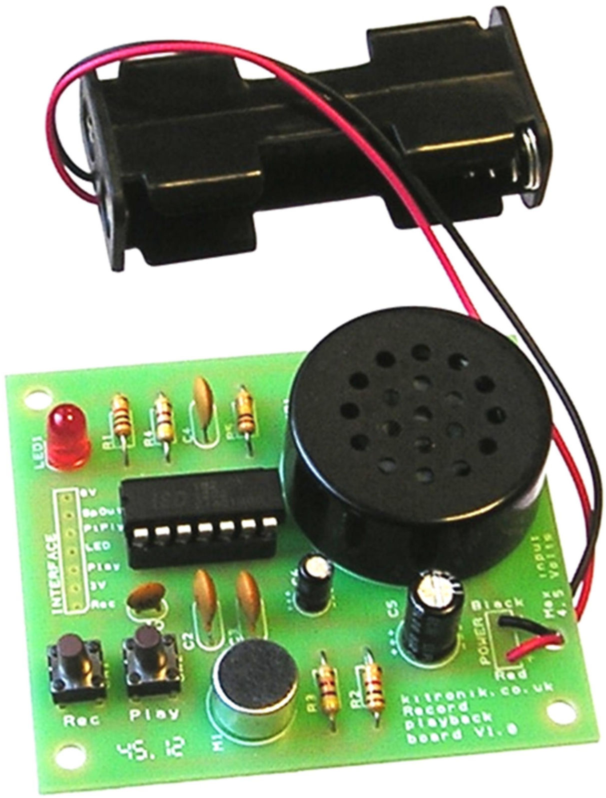
The Design Brief

An audio equipment manufacturer has developed a record playback module, which allows a short memo to be recorded and played back. The circuit has been developed to the point where they have a working Printed Circuit Board (PCB). Although they are used to the design of stereo equipment, they have not designed a case for a voice memo unit before.

The manufacturer would like ideas for an enclosure for the PCB and batteries to be mounted in. The manufacturer has asked you to do this for them. It is important that you make sure that the final design meets all of the requirements that you identify for such a product.

Complete Circuit

A fully built circuit is shown below.



Investigation / Research

Using a number of different search methods, find examples of similar products that are already on the market. Use additional pages if required.

Name……………………………………………… Class……………………………

Developing a Specification

Using your research into the target market for the product, identify the key requirements for the product and explain why each of these is important.

Name…………………………………………………………… Class…………………………………

Requirement	Reason
Example: The enclosure should have some holes.	Example: So that the microphone can pick up the sound.

Design

Develop your ideas to produce a design that meets the requirements listed in the specification.

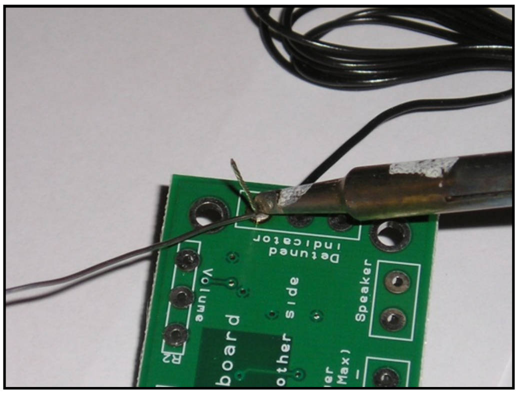
Name…………………………………………………… Class……………………………….

Design Review (group task)

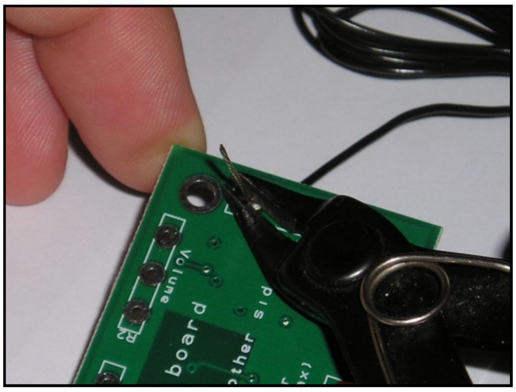
Split into groups of three or four. Take it in turns to review each person's design against the requirements of their specification. Also look to see if you can spot any additional aspects of each design that may cause problems with the final product. This will allow you to ensure that you have a good design and catch any faults early in the design process. Note each point that is made and the reason behind it. Decide if you are going to accept or reject the comment made. Use these points to make improvements to your initial design.

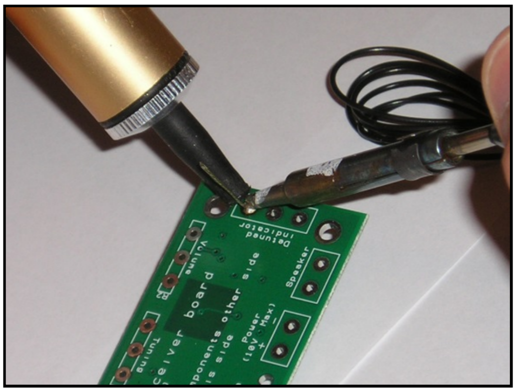
Comment	Reason for comment	Accept or Reject

Soldering in Ten Steps

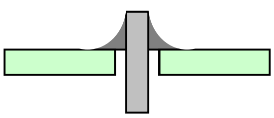


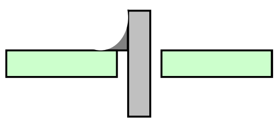
1. Start with the smallest components working up to the taller components, soldering any interconnecting wires last.
2. Place the component into the board, making sure that it goes in the right way around and the part sits flush against the board.
3. Bend the leads slightly to secure the part.
4. Make sure that the soldering iron has warmed up and if necessary, use the damp sponge to clean the tip.
5. Place the soldering iron on the pad.
6. Using your free hand, feed the end of the solder onto the pad (top picture).
7. Remove the solder, then the soldering iron.
8. Leave the joint to cool for a few seconds.
9. Using a pair of cutters, trim the excess component lead (middle picture).
10. If you make a mistake heat up the joint with the soldering iron, whilst the solder is molten, place the tip of your solder extractor by the solder and push the button (bottom picture).

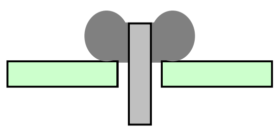




Solder joints


Good solder joint

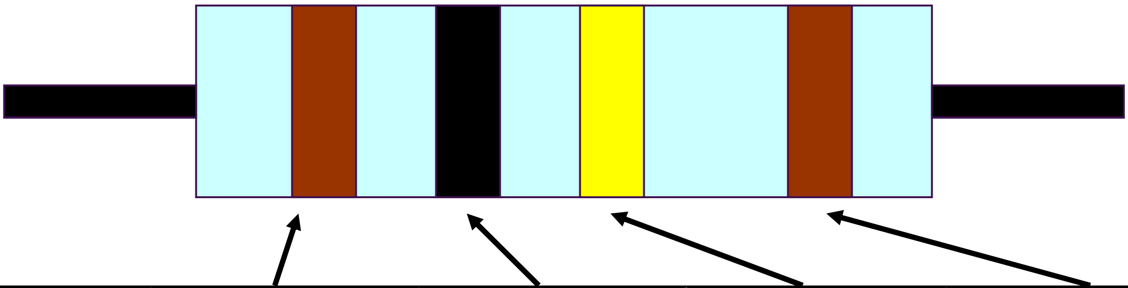

Too little solder


Too much solder

Resistor Values

A resistor is a device that opposes the flow of electrical current. The bigger the value of a resistor, the more it opposes the current flow. The value of a resistor is given in Ω (ohms) and is often referred to as its 'resistance'.

Identifying resistor values



Band Colour	1st Band	2nd Band	Multiplier x	Tolerance
Silver			÷ 100	10%
Gold			÷ 10	5%
Black	0	0	1	
Brown	1	1	10	1%
Red	2	2	100	2%
Orange	3	3	1000	
Yellow	4	4	10,000	
Green	5	5	100,000	
Blue	6	6	1,000,000	
Violet	7	7		
Grey	8	8		
White	9	9		

Example: Band 1 = Red, Band 2 = Violet, Band 3 = Orange, Band 4 = Gold

The value of this resistor would be:
2 (Red) **7** (Violet) x **1,000** (Orange) = 27 x 1,000
= **27,000** with a 5% tolerance (gold)
= **27KΩ**

Too many zeros?

Kilo ohms and mega ohms can be used:

1,000Ω = 1K

1,000K = 1M

Resistor identification task

Calculate the resistor values given by the bands shown below. The tolerance band has been ignored.

1st Band	2nd Band	Multiplier x	Value
Brown	Black	Yellow	
Green	Blue	Brown	
Brown	Grey	Yellow	
Orange	White	Black	

Calculating resistor markings

Calculate what the colour bands would be for the following resistor values.

Value	1st Band	2nd Band	Multiplier x
180 Ω			
3,900 Ω			
47,000 (47K) Ω			
1,000,000 (1M) Ω			

What does tolerance mean?

Resistors always have a tolerance but what does this mean? It refers to the accuracy to which it has been manufactured. For example if you were to measure the resistance of a gold tolerance resistor you can guarantee that the value measured will be within 5% of its stated value. Tolerances are important if the accuracy of a resistors value is critical to a design's performance.

Preferred values

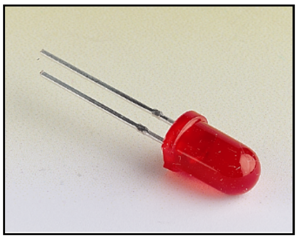
There are a number of different ranges of values for resistors. Two of the most popular are the E12 and E24. They take into account the manufacturing tolerance and are chosen such that there is a minimum overlap between the upper possible value of the first value in the series and the lowest possible value of the next. Hence there are fewer values in the 10% tolerance range.

E-12 resistance tolerance (± 10%)											
10	12	15	18	22	27	33	39	47	56	68	82

E-24 resistance tolerance (± 5 %)											
10	11	12	13	15	16	18	20	22	24	27	30
33	36	39	43	47	51	56	62	68	75	82	91

LEDs & Current Limit Resistors

Before we look at LEDs, we first need to start with diodes. Diodes are used to control the direction of flow of electricity. In one direction they allow the current to flow through the diode, in the other direction the current is blocked.



An LED is a special diode. LED stands for Light Emitting Diode. LEDs are like normal diodes, in that they only allow current to flow in one direction, however when the current is flowing the LED lights.

The symbol for an LED is the same as the diode but with the addition of two arrows to show that there is light coming from the diode. As the LED only allows current to flow in one direction, it's important that we can work out which way the electricity will flow. This is indicated by a flat edge on the LED.

For an LED to light properly, the amount of current that flows through it needs to be controlled. To do this we use a current limit resistor. If we didn’t use a current limit resistor the LED would be very bright for a short amount of time, before being permanently destroyed.

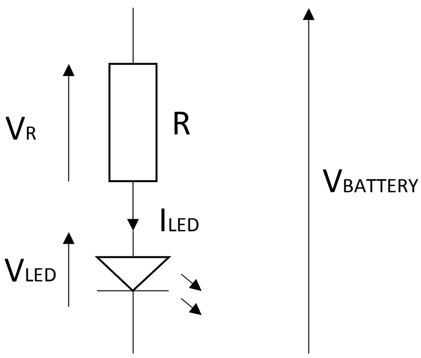
To work out the best resistor value we need to use Ohms Law. This connects the voltage across a device and the current flowing through it to its resistance.

Ohms Law tells us that the flow of current (I) in a circuit is given by the voltage (V) across the circuit divided by the resistance (R) of the circuit.

$$I = \frac{V}{R}$$

Like diodes, LEDs drop some voltage across them. For a high brightness white LED this is 3.5 volts.

Suppose this LED is run off a 5V supply there must be a total of 5 volts dropped across the LED (V_{LED}) and the resistor (V_R). As the LED manufacturer’s datasheet tells us that there is 3.5 volts dropped across the LED, there must be 1.5 volts dropped across the resistor. ($V_{LED} + V_R$ = 3.5 + 1.5 = 5V).



LEDs normally need about 10mA to operate at a good brightness. Since we know that the voltage across the current limit resistor is 1.5 volts and we know that the current flowing through it is 0.01 Amps, the resistor can be calculated.

Using Ohms Law in a slightly rearranged format:

$$R = \frac{V}{I} = \frac{1.5}{0.01} = 150\Omega$$

Hence in this circuit we would need a 150Ω current limit resistor.

LEDs Continued

Packages

LEDs are available in many shapes and sizes. The 5mm round LED is the most common. The colour of the plastic lens is often the same as the actual colour of light emitted – but not always with high brightness LEDs.

Advantages of using LEDs over bulbs

Some of the advantages of using an LED over a traditional bulb are:

Power efficiency	LEDs use less power to produce the same amount of light, which means that they are more efficient. This makes them ideal for battery power applications.
Long life	LEDs have a very long life when compared to normal light bulbs. They also fail by gradually dimming over time instead of a sharp burn out.
Low temperature	Due to the higher efficiency of LEDs, they can run much cooler than a bulb.
Hard to break	LEDs are much more resistant to mechanical shock, making them more difficult to break than a bulb.
Small	LEDs can be made very small. This allows them to be used in many applications, which would not be possible with a bulb.
Fast turn on	LEDs can light up faster than normal light bulbs, making them ideal for use in car break lights.

Disadvantages of using LEDs

Some of the disadvantages of using an LED over a traditional bulb are:

Cost	LEDs currently cost more for the same light output than traditional bulbs. However, this needs to be balanced against the lower running cost of LEDs due to their greater efficiency.
Drive circuit	To work in the desired manner, an LED must be supplied with the correct current. This could take the form of a series resistor or a regulated power supply.
Directional	LEDs normally produce a light that is focused in one direction, which is not ideal for some applications.

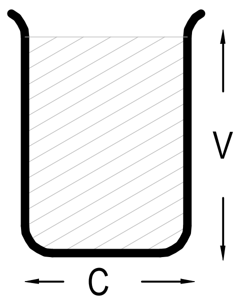
Typical LED applications

Some applications that use LEDs are:

- Bicycle lights
- Car lights (break and headlights)
- Traffic lights
- Indicator lights on consumer electronics
- Torches
- Backlights on flat screen TVs and displays
- Road signs
- Information displays
- Household lights
- Clocks

Capacitor Basics

What is a capacitor?

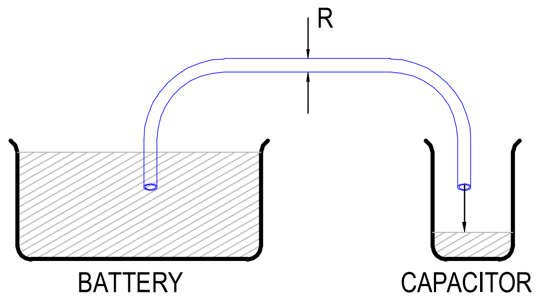


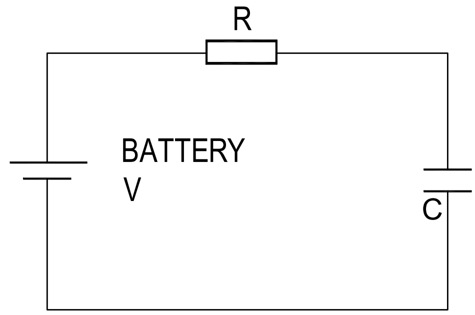
A capacitor is a component that can store electrical charge (electricity). In many ways, it is like a rechargeable battery.

A good way to imagine a capacitor is as a bucket, where the size of the base of the bucket is equivalent to the capacitance (C) of the capacitor and the height of the bucket is equal to its voltage rating (V).

The amount that the bucket can hold is equal to the size of its base multiplied by its height, as shown by the shaded area.

Filling a capacitor with charge

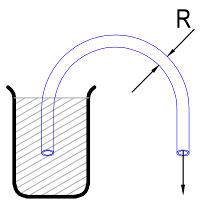




When a capacitor is connected to an item such as a battery, charge will flow from the battery into it. Therefore the capacitor will begin to fill up. The flow of water in the picture above left is the equivalent of how the electrical charge will flow in the circuit shown on the right.

The speed at which any given capacitor will fill depends on the resistance (R) through which the charge will have to flow to get to the capacitor. You can imagine this resistance as the size of the pipe through which the charge has to flow. The larger the resistance, the smaller the pipe and the longer it will take for the capacitor to fill.

Emptying (discharging) a capacitor

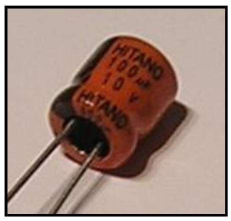


Once a capacitor has been filled with an amount of charge, it will retain this charge until it is connected to something into which this charge can flow.

The speed at which any given capacitor will lose its charge will, like when charging, depend on the resistance (R) of the item to which it is connected. The larger the resistance, the smaller the pipe and the longer it will take for the capacitor to empty.

Maximum working voltage

Capacitors also have a maximum working voltage that should not be exceeded. This will be printed on the capacitor or can be found in the catalogue the part came from. You can see that the capacitor on the right is printed with a 10V maximum working voltage.



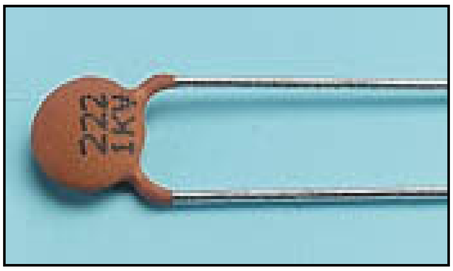
Ceramic Disc Capacitors

Values

The value of a capacitor is measured in Farads, though a 1 Farad capacitor would be very big. Therefore we tend to use milli Farads (mF), micro Farads (μF), nano Farads (nF) and pico Farads (pF). A μF is a millionth of a Farad, 1μF = 1000 nF and 1nF = 1000 pF.

1F	= 1,000mF
1F	= 1,000,000μF
1F	= 1,000,000,000nF
1F	= 1,000,000,000,000pF

The larger electrolytic capacitors tend to have the value printed on the side of them along with a black band showing the negative lead of the capacitor.



Other capacitors, such as the ceramic disc capacitor shown on the right, use a code. They are often smaller and may not have enough space to print the value in full, hence the use of the 3-digit code. The first 2 digits are the first part of the number and the third digit gives the number of zeros to give its value in pF.

Example: 104 = 10 + 0000 (4 zero's) = **100,000 pF** (which is also 0.1 μF)

Work out what value the four capacitors are in the table below.

Printing on capacitor	Two digit start	Number of zero's	Value in pF
222			
103			
333			
473			

Instruction Manual

Your Record & Playback module is going to be supplied with some instructions. Identify four points that must be included in the instructions and give a reason why.

Point to include: Reason:	Point to include: Reason:
Point to include: Reason:	Point to include: Reason:

Evaluation

It is always important to evaluate your design once it is complete. This will ensure that it has met all of the requirements defined in the specification. In turn, this should ensure that the design fulfils the design brief.

Check that your design meets all of the points listed in your specification.

Show your product to another person (in real life this person should be the kind of person at which the product is aimed). Get them to identify aspects of the design, which parts they like and aspects that they feel could be improved.

Good aspects of the design	Areas that could be improved

Improvements

Every product on the market is constantly subject to redesign and improvement. What aspects of your design do you feel you could improve? List the aspects that could be improved and where possible, draw a sketch showing the changes that you would make.

Packaging Design

If your product was to be sold in a high street electrical retailer, what requirements would the packaging have? List these giving the reason for the requirement.

Requirement	Reason

Develop a packaging design for your product that meets these requirements. Use additional pages if required.

ESSENTIAL INFORMATION

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

ADD AN AUDIO MESSAGE TO YOUR PRODUCT WITH THIS

RECORD & PLAYBACK KIT

Version 2.1

Build Instructions

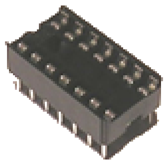
Before you start, take a look at the Printed Circuit Board (PCB). The components go in the side with the writing on and the solder goes on the side with the tracks and silver pads.

1 PLACE RESISTORS

Start with the five resistors:
The text on the PCB shows where R1, R2 etc go.
Ensure that you put the resistors in the right place.

PCB Ref	Value	Colour Bands
R1&R2	1K	Brown, black, red
R3&R4	4.7K	Yellow, purple, red
R5	100K	Brown, black, yellow

2 SOLDER THE IC HOLDER



Solder the Integrated Circuit (IC) holder into IC1. When putting it into the board, be sure to get it the right way around. The notch on the IC holder should line up with the notch on the outline marked on the PCB.

3 SOLDER THE MICROPHONE

The microphone should be soldered into the board where it is marked M1. The microphone is polarized (the two pins are off centre). For it to work the part must go inside the circle marked on the PCB.

4 SOLDER THE CERAMIC DISC CAPACITORS

The four ceramic disc capacitors should be soldered into the board as follows:
C1 = 1nF marked 102
C2 – C4 = 100nF marked 104

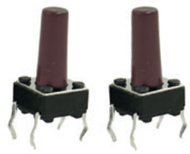
5 SOLDER THE CERAMIC DISC CAPACITORS

Now solder in the two electrolytic capacitors. Make sure that the capacitors are the correct way around. The capacitors have a ‘-’ sign marked on them, which should match the same sign on the PCB. The capacitors have text printed on the side that indicates their value. The capacitors are placed as:
C5 = 220µF
C6 = 4.7µF

6 SOLDER THE LED

The Light Emitting Diode (LED) should be soldered into the board where it is marked LED1. The LED won't work if it doesn't go in the right way around. If you look carefully one side of the LED has a flat edge, which must line up with the flat edge on the outline on the PCB. Once you are sure that it is in the right way around, solder it in place.

7 SOLDER THE SWITCHES



Solder the two switches into the board where it is labelled SW1 & SW2. Once you have got the pins lined up with the holes they can be pushed firmly into place and then soldered.

8 SOLDER THE SPEAKER

The speaker should be soldered into the board where it is labelled SP1. Whilst the board and the speaker may have a '+' indication on them, it doesn't actually matter which way around the speaker goes.

9 ATTACH THE BATTERY CAGE

The two times AA battery cage should be attached to the terminals labelled 'POWER'. Feed the wires through the strain relief hole from the bottom of the board then connect the red wire to '+' and the black wire to '-'and solder in place.

10 INSERT THE IC INTO HOLDER

The IC can now be placed into the IC holder. When doing this, make sure that the notch on the IC lines up with the notch on the IC holder.

Checking Your Record Playback PCB

Carefully check the following before you insert the batteries:

Check the bottom of the board to ensure that:

- All holes (except the 4 large (3mm) holes in the corners and the interface connections) are filled with the lead of a component.
- All the leads are soldered.
- Pins next to each other are not soldered together.

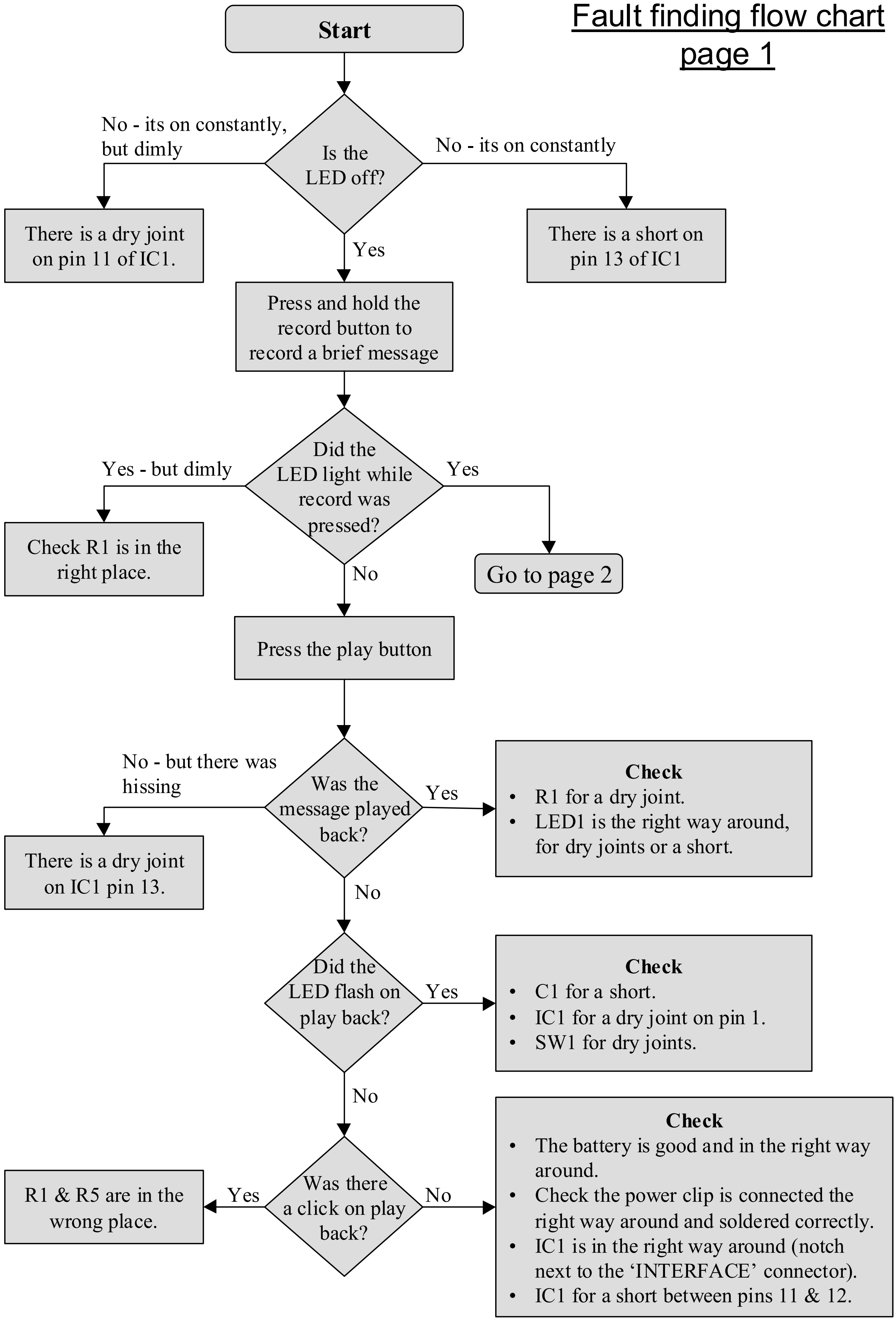
Check the top of the board to ensure that:

- The '-' on the electrolytic capacitors match the same marks on the PCB.
- The colour bands on R1 & R2 are brown, black, red.
- The colour bands on R5 is brown, black, yellow.
- The LED matches the outline on the PCB.
- The battery clip red and black wires match the red and black text on the PCB.
- The notch on the IC is next to the interface connections.

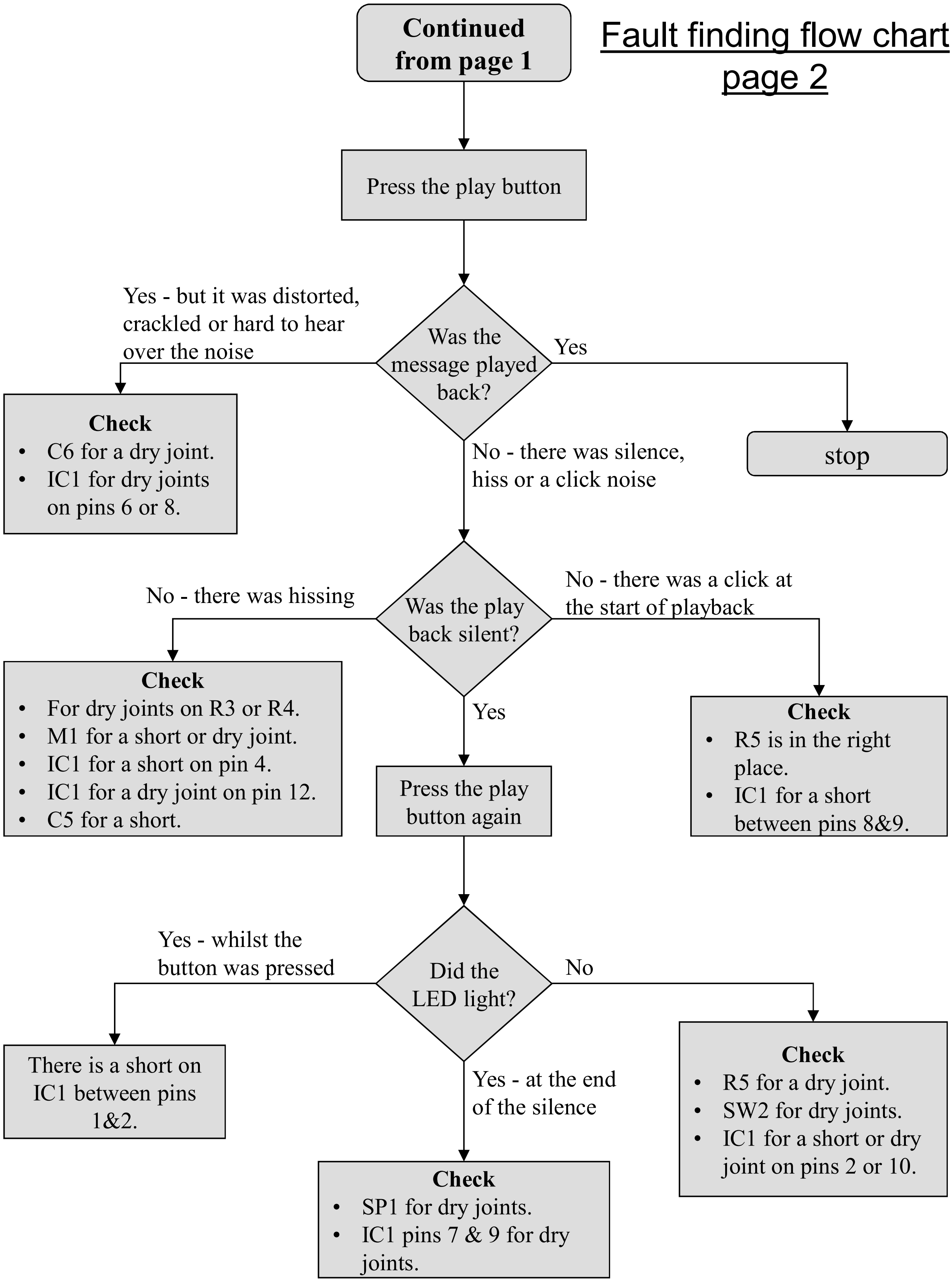
Record Playback Essentials

www.kitronik.co.uk/2149

Fault finding flow chart page 1

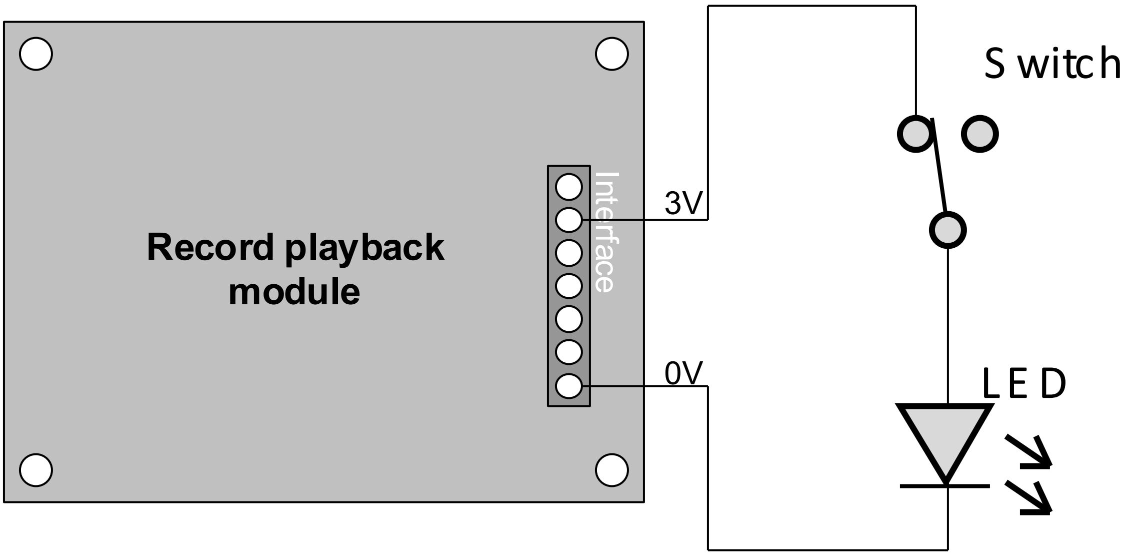


Fault finding flow chart page 2



Adding a Flashing 'Memo Recorded' LED

It is possible to use your Record Playback module as a memo, when doing this you might want to add a flashing LED to indicate that there is a recorded memo that should be played back. The kit doesn't include the parts to do this, however you only need a flashing LED and a slide or toggle switch to do this. The board includes an interface connector and this will be used to connect the LED and the switch to the batteries. The flashing LED is designed to run from a 5V supply and will work at 3V and doesn't need a current limit resistor. The diagram below shows how to make the connections:



When connecting the LED make sure that the flat edge / short lead is connected to the 0V connection on the interface connector. The switch should be connected to the 3V connection.

Suggested LEDs

3538 – 5mm flashing red
3539 – 5mm flashing green
3540 – 5mm flashing yellow
3545 – 5mm flashing blue

Suggested switches

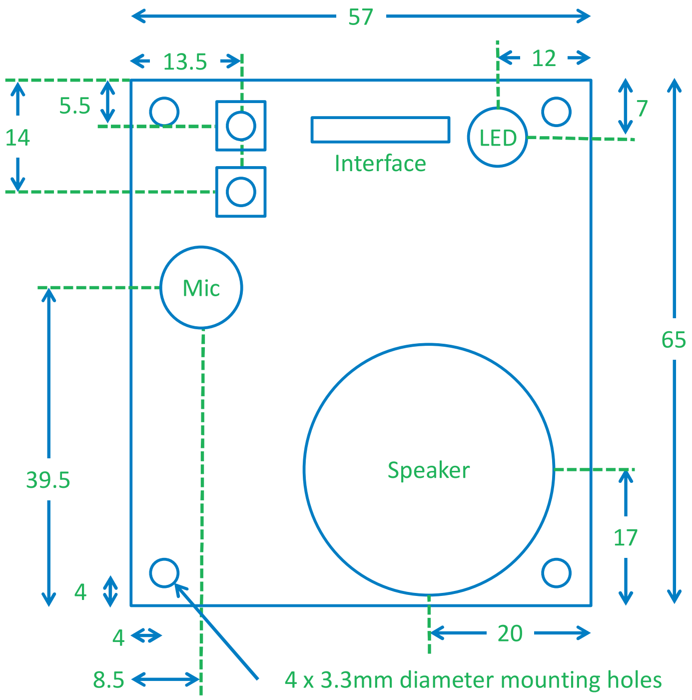
Slide switches – standard 3416, miniature 3404
Rocker switches – rectangular 3406, round 3407
Toggle switches – standard 3408, miniature 3413

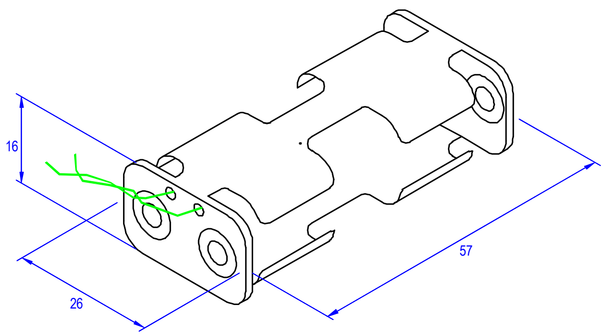
Designing the Enclosure

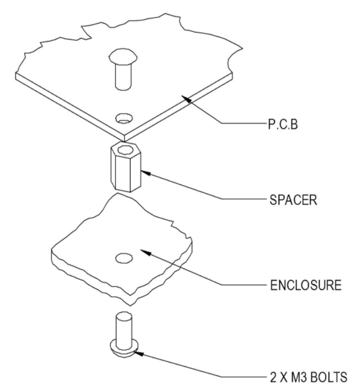
When you design the enclosure, you will need to consider:

- The size of the PCB (below, height including components = 16.5mm)
- How big the battery holder is.

These technical drawings should help you to plan this.
All dimensions are in mm.





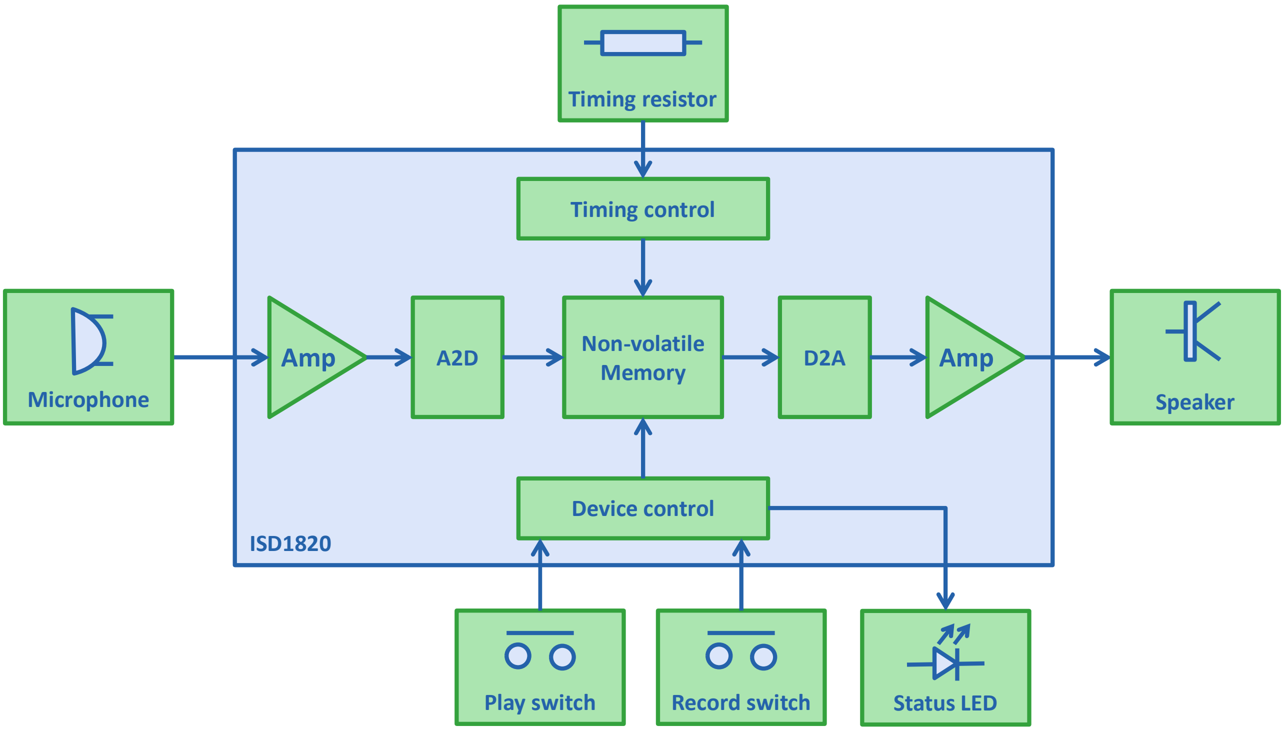


Mounting the PCB to the enclosure

The drawing to the left shows how a hex spacer can be used with two bolts to fix the PCB to the enclosure.

Your PCB has four mounting holes designed to take M3 bolts

How the Record Playback Module Works



The main component in the circuit is the ISD1820, which is a Record Playback IC. This is the main boxed section in the block diagram above. During the record phase, the chip amplifies the signal from the microphone and digitizes this allowing the recording to be stored in memory. This memory is non-volatile, which means that the information is retained even when the power is removed. During playback the data is taken out of the memory, converted back from a digital signal into an analogue signal which is then amplified before it is output to the speaker.

The timing control section of the chip uses a resistor / capacitor network to set how fast the data is stored or retrieved from the on board memory. The timing resistor (R5) along with an internal capacitor sets the record / playback time to 10 seconds. This can be adjusted from 8 seconds to 16 seconds, however the longer the record time the worse the quality of the audio as the sample rate is reduced.

The device control block checks the state of both the play switch and the record switch and either plays back the current message or records a new message.

The device control block also turns the LED on to show that recording is in progress or that playback has finished. When neither record nor playback is in progress the device control block puts the whole unit into sleep where it takes virtually no current, thus allowing the battery to remain connected when the device is not in use.

The switches SW1 & SW2 are connected to the positive supply and the IC. There are internal pull down resistors for both inputs inside the IC. A 1nF capacitor (C1) is present on the record line to remove any switch bounce that could cause a brief re-record to take place as the switch is released at the end of recording. The status LED requires a current limit resistor (R1) and there is a 100nF capacitor (C4) connected across the power supply to make sure it is smooth. All the remaining resistors and capacitors are used to power the microphone and filter the audio from it.

Record Playback IC Pins on the ISD1820

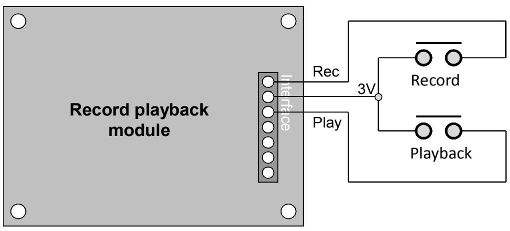
The following table indicates what each pin on the Record Playback IC does:

Pin No	Name	Description
1	REC	The record input: when taken and held high causes the device to re-record the message. The IC contains a pull down resistor on this input.
2	PLAYE	The play (edge activated) input: when taken from low to high, the device plays back the full message. The IC contains a pull down resistor on this input.
3	PLAYL	The play (level activated) input: when held high, the device plays back the message, if taken low during playback, playback stops immediately. The IC contains a pull down resistor on this input.
4	MIC	Microphone input. The microphone is AC coupled to this pin via a series capacitor. The IC contains amplification, so external amplification is not required.
5	MIC REF	Microphone reference: the negative microphone connection, used to reduce noise. This is also AC coupled through a series capacitor.
6	AGC	Automatic gain control: used to set the gain of the pre-amp. Connecting a 4.7uF capacitor between the AGC pin and Gnd, gives good all round performance.
7	SP-	Speaker out-: the negative speaker output signal, min impedance 8 ohms.
8	Gnd	Ground: the zero volts connection.
9	SP+	Speaker out+: the positive speaker output signal, min impedance 8 ohms.
10	Rosc	Resistor oscillator: the resistor that sets the oscillator speed. Connected between Rosc and Gnd. Rosc = 80K gives 8 seconds (min record time), Rosc = 160K gives 16 seconds (max record time)
11	Vcc	The positive voltage connection, typically 3V but will operate from 2.7V to 4.5V.
12	FT	Feed through: this pin is held in a low state by an internal pull down resistor in normal operation. However can be taken high if the pre-amp stage needs to be bypassed. In this case the input signal is feed through directly to the analogue to digital converter.
13	RECLED	Record LED: this output is normally high and goes low during record for the duration of the recording. It also goes low upon completion of playback and can be used to make the IC continually replay the message.
14	Gnd	Ground: the zero volts connection.

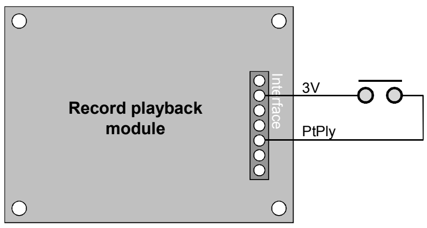
Using the Interface Connector

The interface connector allows some of the more advanced options of the IC to be accessed. It can be used to connect off board switches for Record & Playback and gives access to the pins to play part of a message or use the looped play option. The status LED is output to the connector, as is the audio output signal, which can be used with a more powerful amplifier if required. The following table explains what the seven pins on the interface connector do, along with example connections at the bottom of the page.

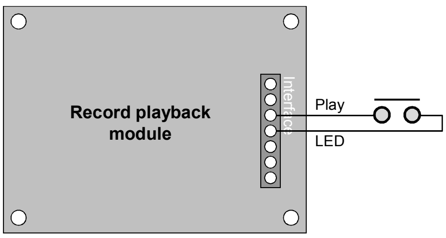
Name	Description
Rec	Record: connect a push button switch between this pin and the 3V pin to re-record a message when the button is pressed. The pin can be connected to a micro controller, when it should normally be in a low state and taken high to record.
3V	The 3V: positive connection from the batteries.
Play	Play: connect a push button switch between this pin and the 3V pin to playback the full message when the button is pressed. The pin can be connected to a micro controller, when it should normally be in a low state and briefly taken high to initiate the playback.
LED	LED out can be used to connect an external LED. The LED should be connected between 3V and the LED pin (a current limit resistor may be required). The pin can also be used as an input to a micro controller to determine when the device is full during record or to know when playback has finished. The pin is normally high, going low during record and briefly upon completion of playback.
PtPly	The part play pin can be used to play the message from the beginning until the button is released. To do this a switch should be connected between the part play pin and the 3V connection. If being driven from a micro-controller, the signal should be normally low going high when playback is required.
SpOut	Speaker out can be used to connect the audio out to a more powerful amplifier, when the speaker out pin connects to the amplifier boards audio in. The Record Playback board and the amplifier board must have a common 0V connection.
0V	0V is the negative connection from the batteries.



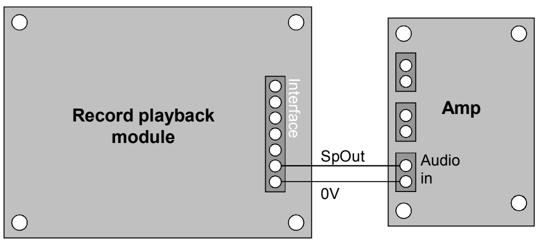
Adding an additional off board switch to record & playback a message.



Adding an off board switch to part playback the message.



Adding an off board switch to continuously loop the message.



Connecting the board to a higher power amplifier.

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/2149

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