

Music Mixer

User Guide for Teachers

Contents

Introduction	2
Overview	3
Teaching Resources	4
Support	4
Safety Information	5
Non-RoHS Substance Declaration	6
Infographic	10

Introduction

The **Music Mixer** circuit board incorporates core electronics concepts suitable for A-level Physics students. The circuit combines two audio signals, for example music from mobile phones, enabling users to control the volume by experimenting with different electronic components, learn about electronic sensors (e.g. LDRs) and resistor dividers. The design aims to expose all components and demystifies electronics for students. The board also has dedicated sections for determining Planck's constant – by measuring and plotting the voltage and current through four differently coloured LEDs – and experimenting with capacitor discharge.

UKESF

The UKESF's mission is to encourage more young people to study Electronics and to pursue careers in the sector.

In the UK, the Electronics sector is big, valuable and growing; however, the demand for capable, employable graduates is currently outstripping supply. The UKESF is an educational charity, launched in 2010, with both public and private seed-corn funding. It operates collaboratively with major companies, leading universities and other organisations to tackle the skills shortage in the Electronics sector.

The UKESF ensures that more schoolchildren are aware of Electronics and the opportunities available, helping them to develop their interest through to university study. At university, it supports undergraduates and prepares them for the workplace.

Registered charity number: SC043940

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University of Southampton

The University of Southampton is a global centre for excellence in research and education, and a founding member of the prestigious Russell Group. Southampton graduates are highly regarded by leading employers and the university works closely with industrial partners, both in teaching and research.

- We build on over 70 years' expertise across electronics and computer science to develop technologies for an ever more connected and automated world;
- Our range of electronic engineering and computer science degrees are informed by our research, and advanced theory is underpinned by hands-on application in our state-of-the-art labs;
- Through our research led teaching and exceptional industry connections, we prepare our students for future challenges not yet imagined and jobs not yet thought of.

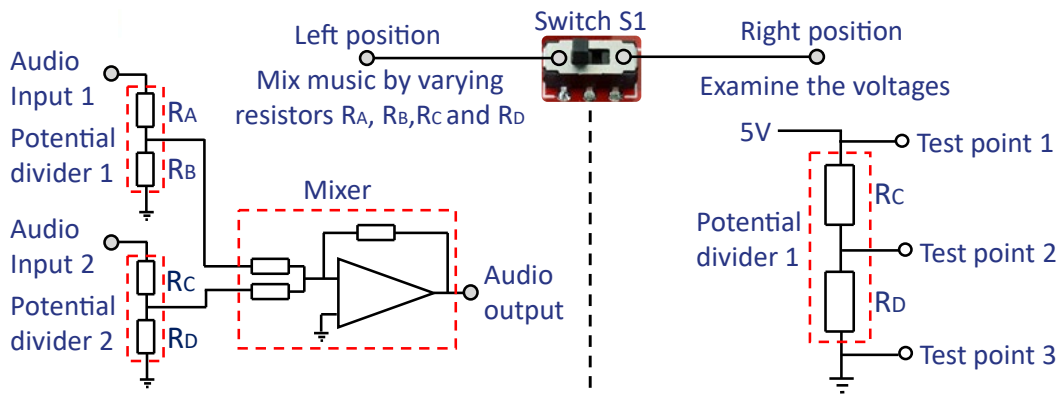
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Overview



1. Turn on the power
2. Ensure switch S1 is pushed to the left
3. Plug audio signal into audio input 1 and 2
4. Vary resistors R_A , R_B , R_C and R_D to vary the output audio level
5. Push switch S1 to the right, measure the voltages at the test points and compare with the sound level



Capacitor Discharge

1. Connect capacitors to circuit by placing jumpers in configuration a, b, or c
2. Place 1 or more jumpers across J3-J6
3. Move switch S2 to the left, then to the right
4. Monitor the voltage at test point 2 (TP2)

Planck's Constant

Measure Planck's constant using light emitting diodes (LEDs)

1. Connect an ammeter between TP6 and TP7, and a voltmeter between TP8 and TP9.
2. Attach a jumper above LED1 and adjust the current flowing through the LED by rotating the variable resistor (VR1).
3. Measure the voltage across the LED at currents of 1, 2, 3, 4 and 5mA and repeat for each LED.

(a) 1 capacitor

(b) 2 parallel capacitors

(c) 2 series capacitors

○ Teaching Resources ○

The Music Mixer board has been designed to support the delivery of the A-Level Physics curriculum in Key Stage 5. The board covers three specific experiments and related extension work. More generally, it helps students learn important Electronics concepts and how they can be applied to design and engineering. Resources to support the experiments and more information can be found at: www.ecs.soton.ac.uk/kits

○ Support ○

If the Music Mixer does not work, first of all:

- Check the power is switched on; the power LED will be lit. If the power LED does not light, replace battery (rechargeable batteries are fine) and remove all wires from board. Ensure you do not directly connect "V" to "GND".
- LED1-4 will only light when an ammeter is connected between TP6 and TP7 and a jumper is connected above the LED.
- Check that the audio inputs and output jacks are firmly seated.

If the Music Mixer still does not work then please visit www.ecs.soton.ac.uk/kits for more troubleshooting information.

Additional help is available via email: kits@ecs.soton.ac.uk

Please contact kits@ecs.soton.ac.uk about the return of any unwanted or unserviceable Music Mixer boards.

Safety Information

There are a number of potential hazards when using the Music Mixer. These are detailed below, along with the mitigation.

Electrocution:

- The design of the circuit board only uses low voltage (dc) and there is no mains (ac) connectivity. Therefore, the risk from electrical shock or electrical burns is extremely low. No external power supply should be connected to the device.
- Teachers and/or technicians should check and carry out a function test of all the circuit boards prior to initial use and then, at least, termly.
- The boards should be subjected to a simple visual inspection for damage prior to each use and correctly stored, in their boxes and away from any sources of heat, when not in use.
- The Music Mixer boards are only intended for use by KS5 pupils studying Physics as part of the curriculum, supervised by qualified teachers in a clean and dry environment.

Hazardous Fumes:

- If the circuit board overheats, or is exposed to sources of heat, there is a possibility that hazardous fumes may be produced.
- The boards should be subjected to a simple visual inspection prior to use. Any potentially faulty boards should not be used.
- Boards should be stored correctly in their boxes, away from any sources of heat.

Scratches and Cuts:

- On the reverse of the circuit boards there are some sharp points where the through-board components have been soldered.
- The circuit boards should be handled carefully and students briefed on how to handle the boards prior to use.
- The boards should be used on a flat, safe surface.

Battery Leakage:

- There is a potential hazard from leakage of chemicals from battery if the boards are in long-term storage.
- Batteries should be removed from the circuit boards if they are to be stored for longer than 1 month.
- Checking the batteries for leakage should be part of the pre-use visual checks.

Risk of Eye Injury:

- If the LEDs are incorrectly connected, it is possible to connect 5V across any of the LEDs, which exceeds the maximum operating voltage. This will damage the LEDs and could cause them to explode, with the debris potentially causing an eye injury.
- To avoid this, only use the 'Planck's Constant' section in isolation. Do not connect the 5V source (TP1,P1,TP4) to the LED connection directly (TP7,TP8).
- To further minimise risk, no flying leads should be provided with the kit to minimise the chance of this occurring (not possible with any configuration of jumpers).
- Do not place boards on metal surfaces that could cause short circuits.

Burns from Overheated Components:

- Do not connect the 5V source directly to ground.
- To further minimise risk, no flying leads should be provided with the kit to minimise the chance of this occurring (not possible with any configuration of jumpers).
- Do not place boards on metal surfaces that could cause short circuits.

Non-RoHS Substance Declaration

This declaration is being made as we have been aware that the Light Dependent Resistor (LDR) supplied as one of the loose components with the "Electronics Everywhere" Music Mixer kit is non-compliant with the RoHS directive.

The Restriction of Hazardous Substances Directive (RoHS) prohibits the use of hazardous materials in the manufacture of electronic and electrical equipment. While all other parts of the Music Mixer kit are RoHS compliant, the LDR contains a cadmium compound. Cadmium is restricted by the RoHS directive.

The LDR is a commercially procured component. It is sealed and encased in a resin glue which prevents skin contact. To the best of our knowledge and belief it does not present a hazard to anyone handling or using the component. Provided that the sealed LDR component is intact, then the only potential hazard is through ingestion.

Therefore, teachers are recommended to:

- Ensure that the LDRs are intact and that there are no signs of any leakage or damage before the component is used. If the LDR appears to be damaged, then it should be disposed of, while avoiding contact with skin, in accordance with local instructions for dealing with hazardous waste.
- Be cognizant about the potential hazard through ingestion. If an LDR is ingested, then medical attention should be sought.

For any further queries please contact: electronics.everywhere@ukesf.org

○ With Thanks To ○



We acknowledge the generous donations from these organisations to enable this project.

○ Find out more ○

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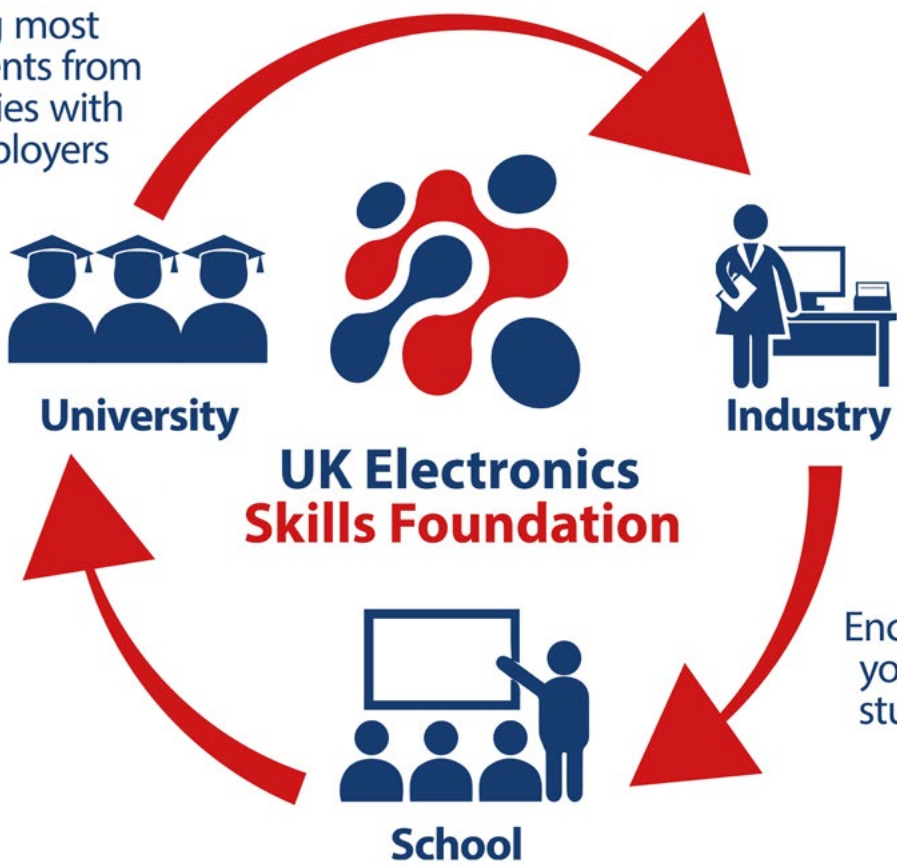
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Encouraging more young people to study Electronics





UK Electronics Skills Foundation

1,000,000+ related jobs



The UK has the 6th largest Electronics industry in the world

£98 billion annual turnover



21% of all UK Engineering graduates studied Electrical & Electronic Engineering



Top technology trends all depend on Electronics: Internet of Things, autonomous vehicles, augmented reality, wearables, renewables

78.5% of UK Engineering graduates go into employment



11% of Engineering graduates go onto further study



The Electronics sector contributes 6% to the UK GDP

235 postgraduates achieved a doctorate in Electronics or Electrical Engineering in 2014

23% of the overall total for Engineering & Technology



Over 90% of smart phones contain Electronics designed in the UK



£26,644 is the mean starting salary for Electrical & Electronic Engineering graduates



14 of the world's top 20 semiconductor companies have a design and/or manufacturing site in the UK



84% of female engineers are very happy with their career choice



61% of employers in the Electronics sector are currently recruiting engineering and technology staff

69% say lack of available candidates is a problem when recruiting graduates

Find out more at www.ukesf.org All figures correct as of Summer 2016.

Sources: Engineering UK2016 Report, ESCO Report, The IET Skills Survey 2015, Top 10 Strategic Technology Trends 2016.