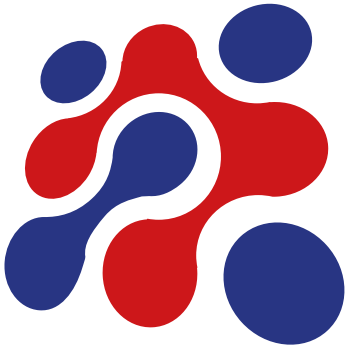
UNIVERSITY OF Southampton



UK Electronics
Skills Foundation

Logic and Arithmetic
User Guide for Teachers

A-Level Computer Science
Electronics Kit

www.ecs.soton.ac.uk/kits

Introduction

This **Logic and Arithmetic** kit enables students to explore aspects of Boolean operations, logic gates, and base-2 number systems and arithmetic. The kit includes light emitting diodes (LEDs) to indicate the logic values throughout, and has been designed to provide a practical, hands-on tool to deliver some of the fundamental electronics parts of the A-Level Computer Science curriculum.

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

www.ukesf.org | info@ukesf.org

/UKESF | @theUKESF

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.

- Ranked in the top two for Electrical and Electronic Engineering for nearly a decade (Guardian University Guide).
- Offering a range of degrees in electronic and electrical engineering, including mechatronic, aerospace and biomedical electronics.
- A research led degree including advanced theory underpinned by practical experiments and project work in our £8M+ teaching labs.

www.ecs.soton.ac.uk

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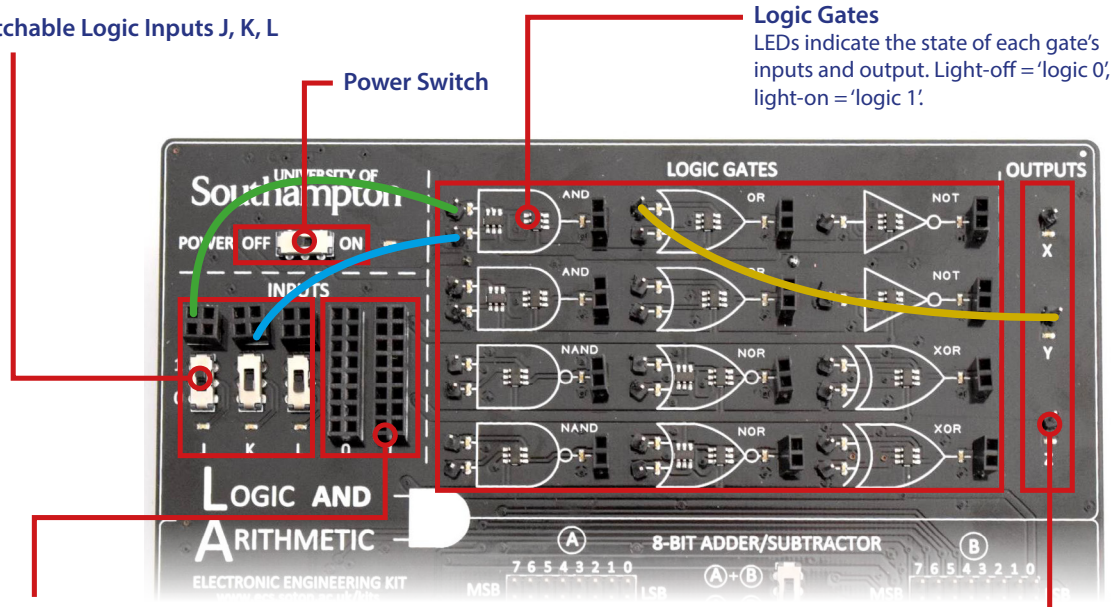
Overview

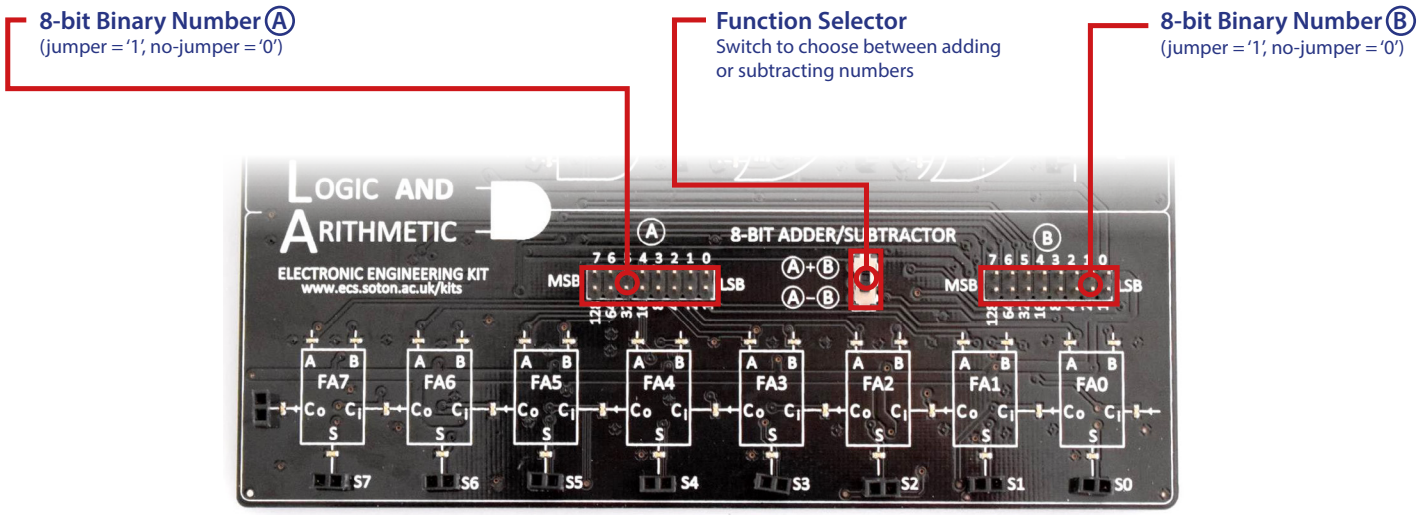
Logic Gates and Boolean Expressions



Example: Y = J • K

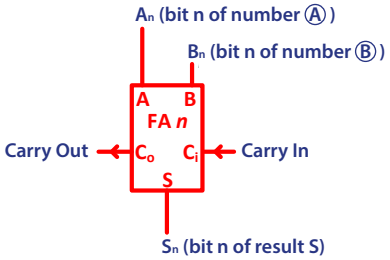
1. turn on the power
2. connect one end of a lead to the socket above the 'J' switch, and the other end to an input pin on one of the AND gates (illustrated by the green line)
3. connect one end of a lead to the socket above the 'K' switch, and the other end to the other input pin on the same AND gate (illustrated by the blue line)
4. connect one end of a lead to the output socket of the AND gate, and the other end to the 'Y' output pin. (illustrated by the orange line)
5. toggle the 'J' and 'K' switches, and observe the state of 'Y' changing (the light will
6. only be on when both 'J' and 'K' are on).

Binary Arithmetic



Example: calculating 011010102 (10610) + 001110112 (5910)

1. turn on the power
2. put jumpers on positions 6, 5, 3, and 1 of header Ⓐ
3. put jumpers on positions 5, 4, 3, 1, and 0 of header Ⓑ
4. set the function selector to the '+' position
5. observe the result, 101001012 (16510), on the S7-S0 indicators at the bottom of the board



Teaching Resources

The Logic and Arithmetic kit has been designed to support the delivery of the A-Level Computer Science curriculum in Key Stage 5. The kit covers two interrelated 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 Logic and Arithmetic kit 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 the battery (rechargeable batteries are fine) and remove all wires and jumpers from the board.
- Ensure you do not directly connect "logic 0" to "logic 1".

If the kit 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 Logic and Arithmetic.

Safety Information

There are a number of potential hazards when using the Logic and Arithmetic kit. 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 Logic and Arithmetic kits boards are only intended for use by KS5 pupils studying Computer Science 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.

Burns from Overheated Components:

- Do not connect any "logic 0" output directly to any "logic 1" output. Correct usage of the supplied male-to-female flying leads should ensure that this does not happen.
- Flying leads should not be connected to the A [designer: please use an 'A' in a circle] or B [designer: please use an 'B' in a circle] terminals of the arithmetic section of the kit; the provided jumpers should be used here instead.
- Do not place boards on metal surfaces that could cause short circuits.

With thanks to The IET

Find out more

UKESF
www.ukesf.org | info@ukesf.org
/UKESF | @theUKESF

University of Southampton
www.ecs.soton.ac.uk
/ECSUoS | @ECSUoS

UK Electronics Skills Foundation

1,000,000+ related jobs

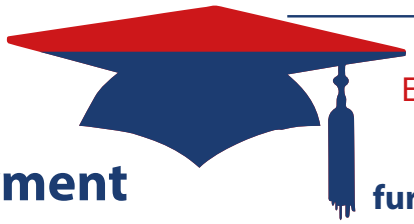
The **UK** has the **6th** largest **Electronics** industry in the world

£98 billion annual turnover

25% 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

78.4% of UK Engineering graduates go into **employment**



10% of Engineering graduates go onto **further study**

The Electronics sector contributes **6% to the UK GDP**

740 postgraduates achieved a **doctorate** in Electronics or Electrical Engineering in 2015

25% of the overall total for Engineering & Technology

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

£27,197 is the mean starting salary for **Electrical & Electronic Engineering graduates**

£46,567 is the mean full-time salary for all **Electronic Engineers in the UK**

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

66% of employers in the **Electronics sector** are **currently recruiting** engineering and technology staff

£63,000 is the average salary for a Chartered Engineer

Find out more at **www.ukesf.org** All figures correct as of Spring 2018.

Sources: Engineering UK2017 Report, ESCO Report, The IET Skills Survey 2016, Top 10 Strategic Technology Trends 2016, TechWorks Survey 2017, WES Statistics 2016.