Scheme of work – R048 Making and testing electronic circuits

## About this scheme of work

**Our redeveloped Cambridge National in Engineering Programmable Systems J824 is for first teaching from September 2022.**

This qualification provides lots of flexibility, allowing you to find the best route to suit your centre’s needs.Our curriculum planner shows you at a high level how you could teach the course over two or three years. Our schemes of work provide examples of how you could deliver each unit, integrating the knowledge and understanding learned in the externally assessed unit.

All schemes of work should provide an opportunity for integrating the knowledge and understanding learned from the externally assessed unit content alongside the NEA assessment content. This scheme of work provides one example for delivery of this unit. You may find that a different approach would work better in your centre. We have provided a blank template should you wish to create your own or adapt one of the approaches provided.

You’ve given us lots of feedback on what you need from a scheme of work, so we’ve made sure this resource features:

* a **unit-specific** and **lesson by lesson** approach
* **simple** and **editable** Word format – or you can use our [blank template](https://www.ocr.org.uk/Images/639549-scheme-of-work-template.docx) to create your own version
* links to our [curriculum planner’s first model](https://www.ocr.org.uk/Images/619714-curriculum-planner.docx) which is one teacher teaching the qualification over two years, broken down into half terms
* each lesson’s **key words**
* **ideas** for teaching and learning with useful **links**
* some ‘warm up’ teaching ideas if you’re teaching over three years.

**Our redeveloped Cambridge Nationals can be tailored to suit your needs – so this scheme of work and the lesson ideas are only suggestions.**


## Units and guided learning hours

Here is a reminder of the **three mandatory units** in the redeveloped Cambridge National in Engineering Programmable Systems:

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| **Unit** | **Unit title** | **Guided learning hours (GLH)\*** | **How are they assessed?** | **Mandatory or optional?** |
| R047 | Principles of electronic and programmable systems | 48 | E | M |
| **R048** | **Making and testing electronic circuits** | **36** | **NEA** | **M** |
| R049 | Developing programmable systems | 36 | NEA | M |

\*GLH (guided learning hours) is the approximate time that the teacher will spend supervising or directing study time and assessment activities.

## Assumptions

* You will adapt the SOW and lesson content to match your own timetabling arrangements and will choose how to spread the 36 GLH over the two years as best fits your needs. We have worked on the basis that the average lesson time is around 45 minutes.
* Students can access some resources outside of lessons for any online homework or extension tasks.
* You will refer to the [specification](https://www.ocr.org.uk/Images/610948-specification-cambridge-nationals-engineering-programmable-systems-j824.pdf) as the key document for detailed insight into the qualification’s content and assessment requirements.

Summary of software/other equipment in this scheme of work

* Circuit (Computer Aided Design (CAD)) software (e.g. for drawing and simulation circuits, and printed circuit boards (PCB) layout).
* PCB manufacturing equipment and supplies (e.g. etching with chemicals, CAM milling, blank PCBs, etc.).
* Electronic components to construct circuits, interconnecting wire.
* Circuit constructions tools (e.g. soldering iron, pliers, side cutters, helping hands, etc.).
* Electronic test equipment (e.g. power supply, multimeter, oscilloscope, signal generator, logic probe, etc.).

## Week by week scheme of work with time allowed for working on NEA at end of delivery and practice.

## NEA work could be undertaken in parallel with delivery to shorten total delivery and assessment time.

## Term 1 can start when required (starts beginning of Year 10 in curriculum planner).

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| Term 1 |
| **Summary of what you will cover from the** [**curriculum planner**](https://www.ocr.org.uk/Images/619714-curriculum-planner.docx)**:** | **Drawing and simulating circuits** |

| Lesson no. | Topic areas/sub topic areas  | Lesson ideas and activities | Lesson key words | Lesson outcome(s)At the end of the lesson, students will be able to: | Useful links/resources | How does this link to other units? |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | TA1Drawing and simulating electronic circuits1.1 Use CAD software to produce diagrams and electronic circuits | You could begin this unit with an introduction to the context of the unit being highly practical in which students will learn practical skills in using circuit CAD software, circuit simulation, construction, and testing.In this lesson you could:* introduce students to circuit diagrams and component symbols
* show students how circuit CAD software can be used to draw and simulate circuits
* use a demonstration to show a simple circuit being schematically drawn and simulated in software.

Students will learn about components, circuits and using software for circuit simulation in Unit R047 and so you could use this to complement this unit.Centres will use their own selected circuit simulation software throughout this unit. | **Drawing electronic circuits****Circuit schematics** | Recall basic principles of using software to schematically draw and simulate circuits. | [units-and-symbols.pdf](https://www.theiet.org/media/4173/units-and-symbols.pdf)(theiet.org)Useful for electrical units, and common circuit symbols[Circuit Simulation - Electronic Systems Video Lecture](https://www.allaboutcircuits.com/video-lectures/circuit-simulation/) (allaboutcircuits.com)[Top Ten Online Circuit Simulators](https://www.electronics-lab.com/top-ten-online-circuit-simulators/)(electronics-lab.com)[Online circuit simulator & schematic editor](https://www.circuitlab.com/)(circuitlab.com)[Online Circuit Simulator with SPICE](https://www.partsim.com/simulator)(partsim.com)[Yenka Electronics](https://www.yenka.com/en/Yenka_Electronics/)(yenka.com)[DesignSpark](https://www.rs-online.com/designspark/home)(rs-online.com)You will find many free and subscription circuit design and simulation software packages available, some of which can be run online and some that require software installation. | R047Students will learn about circuit theory and electronic components, the prototyping and simulation using software and virtual test equipment. |
| 2 | TA1Drawing and simulating electronic circuits1.1 Use CAD software to produce diagrams and electronic circuits | Over the following series of lessons students could practise using circuit CAD software to draw circuits schematically.In this lesson you could:* explain and show the basic features in the software
* show students how to use component libraries to select and place components
* allow students to practise using software.

You could use existing simple circuit diagrams for students to replicate. | **Drawing electronic circuits****Circuit schematics** | Draw circuits schematically using software. | [units-and-symbols.pdf](https://www.theiet.org/media/4173/units-and-symbols.pdf)(theiet.org)Useful for electrical units, and common circuit symbols | R047Students will learn about circuit theory and electronic components, the prototyping and simulation using software and virtual test equipment. |
| 3 | TA1Drawing and simulating electronic circuits1.1 Use CAD software to produce diagrams and electronic circuits | In this lesson students could continue to practise using circuit CAD software.For this lesson you could:* explain how components are wired/connected
* show students how to wire/connect components together
* allow students to practise using software.

Again, this could be done using existing simple circuits for students to replicate. | **Drawing electronic circuits****Circuit schematics** | Draw circuits schematically using software. | [units-and-symbols.pdf](https://www.theiet.org/media/4173/units-and-symbols.pdf)(theiet.org)Useful for electrical units, and common circuit symbols | R047Students will learn about circuit theory and electronic components, the prototyping and simulation using software and virtual test equipment. |
| 4 | TA1Drawing and simulating electronic circuits1.1 Use CAD software to produce diagrams and electronic circuits | In this lesson, students could consolidate their knowledge of using circuit CAD software.This could be done by:* providing students with simple circuits to draw within circuit software
* tasking students, working in pairs, to check their circuits within software match those provided.
 | **Drawing electronic circuits****Circuit schematics** | Draw circuits schematically using software. | [units-and-symbols.pdf](https://www.theiet.org/media/4173/units-and-symbols.pdf)(theiet.org)Useful for electrical units, and common circuit symbols | R047Students will learn about circuit theory and electronic components, the prototyping and simulation using software and virtual test equipment. |
| 5 | TA1Drawing and simulating electronic circuits1.2 Use CAD software to simulate/test circuit schematics | Over the next series of lessons, you could extend the use of circuit CAD software to performing circuit simulation.In this lesson you could:* provide a basic introduction to how circuit software can be used to simulate circuit operation
* demonstrate a simple circuit simulation within the selected software
* allow students to use software to perform a simple simulation.
 | **Drawing electronic circuits****Circuit simulation** | Perform basic simulation of electronic circuits using software. | [units-and-symbols.pdf](https://www.theiet.org/media/4173/units-and-symbols.pdf)(theiet.org)Useful for electrical units, and common circuit symbols | R047Students will learn about circuit theory and electronic components, the prototyping and simulation using software and virtual test equipment. |

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| Term 2 |
| **Summary of what you will cover from the curriculum planner:** | **Drawing and simulating circuits** |

| Lesson no. | Topic areas/sub topic areas  | Lesson ideas and activities | Lesson key words | Lesson outcome(s)At the end of the lesson, students will be able to: | Useful links/resources | How does this link to other units? |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | TA1Drawing and simulating electronic circuits1.2 Use CAD software to simulate/test circuit schematics | In this lesson students could continue to use circuit CAD software to perform simulation.For this lesson you could:* show how simulation allows circuit functionality to be tested
* show how simple virtual instruments can be used to measure voltages or signals in the circuit
* allow students to practise using software to perform simulation.

Note that students are required to use circuit CAD software to measure voltage, current, resistance and signal waveforms. | **Drawing electronic circuits****Circuit simulation** | Perform simulation of electronic circuits using software. | [units-and-symbols.pdf](https://www.theiet.org/media/4173/units-and-symbols.pdf)(theiet.org)Useful for electrical units, and common circuit symbols | R047Students will learn about circuit theory and electronic components, the prototyping and simulation using software and virtual test equipment. |
| 2  | TA1Drawing and simulating electronic circuits1.2 Use CAD software to simulate/test circuit schematics | In this lesson, students could consolidate their knowledge of using circuit CAD software for simulation.You could do this by:* providing students with simple circuits to draw and simulate within circuit CAD software
* tasking students, working in pairs, to check the functionality of their circuits within software.
 | **Drawing electronic circuits****Circuit simulation** | Perform simulation of electronic circuits using software. | [units-and-symbols.pdf](https://www.theiet.org/media/4173/units-and-symbols.pdf)(theiet.org)(Useful for electrical units, and common circuit symbols) | R047Students will learn about circuit theory and electronic components, the prototyping and simulation using software and virtual test equipment. |
| 3 | TA1Drawing and simulating electronic circuits1.1 Use CAD software to produce diagrams and electronic circuits | Over the next series of lessons students could learn how to use circuit CAD software to produce PCB layouts.In this lesson you could:* explain how the software allows a PCB layout to be created using component libraries
* demonstrate using the software to produce a simple PCB layout
* show students the corresponding physical PCB
* allow students to begin practising using software to create a PCB layout.
 | **Drawing electronic circuits****Circuit simulation** | Create PCB layout from schematic circuit diagram using software. | [units-and-symbols.pdf](https://www.theiet.org/media/4173/units-and-symbols.pdf)(theiet.org)Useful for electrical units, and common circuit symbols | R047Students will learn about commercial PCB production. |
| 4 | TA1Drawing and simulating electronic circuits1.1 Use CAD software to produce diagrams and electronic circuits | In this lesson students could practise using circuit CAD software.You could do this by:* showing students how to create track and component views for a PCB from a corresponding circuit diagram
* providing simple circuits for students to use to create a PCB layout, or using circuits drawn previously
* allowing students to practise using the software.
 | **PCB layout** | Create PCB layout from schematic circuit diagram using software. | [DesignSpark PCB Software](https://www.rs-online.com/designspark/pcb-software)(rs-online.com)[Yenka Electronics](https://www.yenka.com/en/Yenka_Electronics/)(yenka.com)[Best PCB Design Software in 2021: Compare Reviews on 50+](https://www.g2.com/categories/pcb-design)(g2.com)There are many free and subscription PCB layout software packages available. You should try and use one that integrates with the circuit CAD software being used to draw and simulate circuits. | R047Students will learn about commercial PCB production. |
| 5 | TA1Drawing and simulating electronic circuits1.1 Use CAD software to produce diagrams and electronic circuits | For this lesson, students could consolidate their knowledge of using circuit CAD software to produce a PCB layout.You could do this by:* providing students with simple circuits to draw within software and to produce a PCB layout from
* tasking students, working in pairs, to check their PCB layout matches the circuit diagram.

You could conclude this lesson by showing students how they can export their PCB layout from the software in preparation for manufacture. | **PCB layout****PCB schematic export** | Create PCB layout from schematic circuit diagram using software.Export PCB layout ready for manufacture. | [DesignSpark PCB Software](https://www.rs-online.com/designspark/pcb-software)(rs-online.com)[Yenka Electronics](https://www.yenka.com/en/Yenka_Electronics/)(yenka.com)[Best PCB Design Software in 2021: Compare Reviews on 50+](https://www.g2.com/categories/pcb-design)(g2.com) | R047Students will learn about commercial PCB production. |

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| Term 3 |
| **Summary of what you will cover from the curriculum planner:** | **Constructing circuits - PCBs** |

| Lesson no. | Topic areas/sub topic areas  | Lesson ideas and activities | Lesson key words | Lesson outcome(s)At the end of the lesson, students will be able to: | Useful links/resources | How does this link to other units? |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | TA2Constructing electronic circuits2.1 Safely produce PCBs | Over the next term, you could show students how to produce a PCB in preparation for constructing a working circuit.In this lesson you could:* introduce the type of PCB manufacturing in centre (i.e. etching or CAM milling)
* explain how the selected method is used to produce a physical PCB from a previously created PCB layout
* show students the manufacturing facility, including highlighting any safety issues.
 | **PCB manufacture** | Recall process for selected methods for making a prototype PCB. | [PCB Design: How to Create a Printed Circuit Board From Scratch](https://www.build-electronic-circuits.com/pcb-design/)(build-electronic-circuits.com)[Circuit Skills: Circuit Board Etching](https://www.youtube.com/watch?v=tWnfnt2rNO0) (YouTube)[CNC Milling PCB using Eagle, Flatcam and GRBL](https://www.youtube.com/watch?v=yho0H7x6BEQ)(YouTube) | R047Students will learn about prototyping methods and commercial PCB production. |
| 2  | TA2Constructing electronic circuits2.1 Safely produce PCBs | In this lesson students could plan for manufacturing a PCB.For this lesson you could:* explain in detail the steps required to make a PCB using the selected method
* explain the hazards and risks associated with PCB manufacture
* provide a health and safety briefing
* task students to undertake a simple risk assessment activity
* task students to produce a simple plan for making a PCB.
 | **PCB manufacture****Health and safety****Risk assessment** | Prepare for making a PCB using selected method.Undertake risk assessment. | [Managing risks and risk assessment at work – Overview](https://www.hse.gov.uk/simple-health-safety/risk/index.htm) (hse.gov.uk)[Health and Safety at Work etc Act 1974 – legislation explained](https://www.hse.gov.uk/legislation/hswa.htm)(hse.gov.uk)[Safety signs and signals. The Health and Safety Regulations 1996. Guidance on Regulations - L64](https://www.hse.gov.uk/pubns/books/l64.htm) (hse.gov.uk)[What are the five steps to risk assessment?](https://worksmart.org.uk/health-advice/health-and-safety/hazards-and-risks/what-are-five-steps-risk-assessment)(worksmart.org.uk)[Health and safety in engineering](https://www.hse.gov.uk/engineering/)(hse.gov.uk)Includes a booklet of health and safety in the engineering workshop to download | R047Students will learn about prototyping methods and commercial PCB production. |
| 3 | TA2Constructing electronic circuits2.1 Safely produce PCBs | In this lesson students could begin to manufacture their PCB.In this lesson students could:* take a previously created PCB layout or exported file
* setup equipment to manufacture a PCB
* safely operate or use equipment.

The process is dependent on the method selected by the centre. For etching students will require a photo-ready copy of the PCB layout and will use a UV light box and photo sensitive PCB. This will then need to be safely etched using chemicals.For CAM milling students will require a suitable export file of a PCB layout and will need to safely setup and operate the milling machine. | **PCB manufacture**  | Use selected method to safely make a PCB ready to populate with components. | [Circuit Skills: Circuit Board Etching](https://www.youtube.com/watch?v=tWnfnt2rNO0) (YouTube)[CNC Milling PCB using Eagle, Flatcam and GRBL](https://www.youtube.com/watch?v=yho0H7x6BEQ)(YouTube) | R047Students will learn about prototyping methods and commercial PCB production. |
| 4 | TA2Constructing electronic circuits2.1 Safely produce PCBs | In this lesson students could:* use previously created PCB layouts
* continue to safely use equipment to manufacture a physical PCB.
 | **PCB manufacture**  | Use selected method to safely make a PCB ready to populate with components. | [Circuit Skills: Circuit Board Etching](https://www.youtube.com/watch?v=tWnfnt2rNO0)(YouTube)[CNC Milling PCB using Eagle, Flatcam and GRBL](https://www.youtube.com/watch?v=yho0H7x6BEQ)(YouTube) | R047Students will learn about prototyping methods and commercial PCB production. |
| 5 | TA2Constructing electronic circuits2.1 Safely produce PCBs | In this final lesson on PCB manufacture students could:* use previously created PCB layouts
* continue to safely use equipment to manufacture a physical PCB
* perform a basic visual check to make sure their PCB layout and connections match those on the associated circuit diagram.
 | **PCB manufacture**  | Use selected method to safely make a PCB ready to populate with components. | [Circuit Skills: Circuit Board Etching](https://www.youtube.com/watch?v=tWnfnt2rNO0)(YouTube)[CNC Milling PCB using Eagle, Flatcam and GRBL](https://www.youtube.com/watch?v=yho0H7x6BEQ) (YouTube) | R047Students will learn about prototyping methods and commercial PCB production. |

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| Term 4 |
| **Summary of what you will cover from the curriculum planner:** | **Constructing circuits – PCBs and circuit construction** |

| Lesson no. | Topic areas/sub topic areas  | Lesson ideas and activities | Lesson key words | Lesson outcome(s)At the end of the lesson, students will be able to: | Useful links/resources | How does this link to other units? |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | TA2Constructing electronic circuits2.2 Safely use tools and equipment to populate and assemble PCBs with components | Over the following series of lessons, students could be shown how to construct and practise constructing circuits.In this lesson you could:* introduce students to the tools and facilities available for PCB construction
* explain the hazards and risks associated with circuit construction and the use of tools
* provide a health and safety briefing
* task students to undertake a simple risk assessment activity.
 | **Circuit construction** | Recall techniques required to populate a PCB with components and construct a circuit.Undertake risk assessment. | [How to Build Circuits : 16 Steps (with Pictures)](https://www.instructables.com/How-to-Build-Circuits/)(instructables.com)[Tools and Equipment for the DIY Electronics Hobbyist](https://www.circuitbasics.com/electronic-tools-and-equipment/)(circuitbasics.com) | R047Students will learn about electronic components and prototyping methods. |
| 2  | TA2Constructing electronic circuits2.2 Safely use tools and equipment to populate and assemble PCBs with components | In this lesson you could show students the process of soldering.You could do this by:* explaining the soldering process
* explaining the associated hazards and risks, and use of PPE
* demonstrating soldering
* allowing students to practise soldering.
 | **Circuit construction****Soldering** | Use appropriate techniques to safely populate PCB and construct circuits. | [How To Solder: A Complete Beginners Guide](https://www.makerspaces.com/how-to-solder/)(makerspaces.com)[Electronics Assembly](https://learn.sparkfun.com/tutorials/electronics-assembly/manual-soldering)(learn.sparkfun.com) | R047Students will learn about electronic components and prototyping methods. |
| 3 | TA2Constructing electronic circuits2.2 Safely use tools and equipment to populate and assemble PCBs with components | In this lesson students could continue to practise soldering and begin to use hand tools.Students could:* continue to practise soldering components to a stripboard or to a PCB
* be shown how to use production aids (e.g. ‘helping hands’ for holding the circuit board or PCB)
* safely use tools to form component leads, or to cut excess leads off (i.e. pliers and side-cutter).

Students could use PCBs previously manufactured for this activity. | **Circuit construction****Soldering****Using hand tools****Using ‘helping hands’** | Use appropriate techniques to safely populate PCB and construct circuits. | [How To Solder: A Complete Beginners Guide](https://www.makerspaces.com/how-to-solder/)(makerspaces.com)[Electronics Assembly](https://learn.sparkfun.com/tutorials/electronics-assembly/manual-soldering)(learn.sparkfun.com)[How to use Side Cutters](https://www.youtube.com/watch?v=UyA8v8W7pXg) (YouTube)[KNIPEX Electronics Pliers Line](https://www.youtube.com/watch?v=YNqx8Y4XM9s) (YouTube)[Soldering Helping Hands Tool - Helpful for Soldering work](https://www.youtube.com/watch?v=8eGSkPim3eE)(YouTube) | R047Students will learn about electronic components and prototyping methods. |
| 4 | TA2Constructing electronic circuits2.2 Safely use tools and equipment to populate and assemble PCBs with components | For this lesson, students could continue to practise constructing circuits.In the lesson, students could:* continue to practise soldering components to a stripboard or to a PCB
* be shown how to use production aids, such as a heatsink when soldering temperature sensitive components.
 | **Circuit construction****Using heatsinks** | Use appropriate techniques to safely populate PCB and construct circuits. | [How To Use A Heat Sink When Soldering: A Quick Guide](https://weldingmastermind.com/how-to-use-a-heat-sink-when-soldering-a-quick-guide/) (weldingmastermind.com) | R047Students will learn about electronic components and prototyping methods. |
| 5 | TA2Constructing electronic circuits2.2 Safely use tools and equipment to populate and assemble PCBs with components | In this lesson students could continue to practise safe circuit construction.Students could:* continue to practise soldering components to a stripboard or to a PCB
* be shown how to make external connections to the circuit, e.g. using wires, plugs and sockets, etc.
* practise making external connections.
 | **Circuit construction****External connections** | Use appropriate techniques to safely populate PCB and construct circuits. | [118C - Terminal Soldering](https://www.youtube.com/watch?v=I_DAhAXARuI) (YouTube)[Soldering Wires to External Components & the PCB | Tips & Methods |](https://www.youtube.com/watch?v=2RP9A3Aj0fg)(YouTube) | R047Students will learn about electronic components and prototyping methods. |

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| Term 5 |
| **Summary of what you will cover from the curriculum planner:** | **Constructing circuits, testing circuits** |

| Lesson no. | Topic areas/sub topic areas  | Lesson ideas and activities | Lesson key words | Lesson outcome(s)At the end of the lesson, students will be able to: | Useful links/resources | How does this link to other units? |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | TA2Constructing electronic circuits2.2 Safely use tools and equipment to populate and assemble PCBs with components | For this lesson students could continue to practise safe circuit construction.Students could:* continue to practise soldering components to a stripboard or to a PCB
* be shown how to use a de-soldering method or tool to remove components from a PCB
* practise de-soldering.
 | **Circuit construction****De-soldering** | Use appropriate techniques to safely populate PCB and construct circuits. | [Collin’s Lab: Desoldering](https://www.youtube.com/watch?v=N_dvf45hN6Y) (YouTube) | R047Students will learn about electronic components and prototyping methods. |
| 2  | TA2Constructing electronic circuits2.2 Safely use tools and equipment to populate and assemble PCBs with components | In the remaining two lessons on circuit construction, students could:* use a previously manufactured PCB to safely construct a circuit
* make external connections to the circuit in preparation for testing.
 | **Circuit construction** | Use appropriate techniques to safely populate PCB and construct circuits. | [How To Solder: A Complete Beginners Guide](https://www.makerspaces.com/how-to-solder/)(makerspaces.com) | R047Students will learn about electronic components and prototyping methods. |
| 3 | TA2Constructing electronic circuits2.2 Safely use tools and equipment to populate and assemble PCBs with components | In the final lesson on circuit construction, students could continue to:* use a previously manufactured PCB to safely construct a circuit
* make external connections to the circuit in preparation for testing.
 | **Circuit construction** | Use appropriate techniques to safely populate PCB and construct circuits. | [How To Solder: A Complete Beginners Guide](https://www.makerspaces.com/how-to-solder/)(makerspaces.com) | R047Students will learn about electronic components and prototyping methods. |
| 4 | TA3Testing electronic circuits3.1 Safely test and evaluate electronic circuits | In the final series of lessons, you could cover functional testing and fault-finding methods.In this lesson you could:* introduce functional testing and fault-finding methods
* explain how visual inspection is one of the most basic methods
* show examples of how visual inspection can be used to identify, for example:
	+ missing or misplaced components
	+ incorrect orientation of components
	+ broken PCB tracks
	+ poor solder joints (dry joint)
	+ bridged solder joints or tracks
* provide examples for students to visually examine to identify common faults.
 | **Circuit testing****Visual inspection** | Recall basic methods for physically testing circuits.Perform a visual inspection of a circuit. | [How To Repair Broken PCB TRACE - Learn 4 Different Methods](https://www.youtube.com/watch?v=sXhyMUO4q3A) (YouTube)[Repairing a Dry, Cold or Cracked Solder Joint & how to identify it - 2021](https://www.youtube.com/watch?v=5F4sX2Pn-Iw)(YouTube) | R047Students will learn about electronic components and prototyping methods. |
| 5 | TA3Testing electronic circuits3.1 Safely test and evaluate electronic circuits | In this lesson you could begin to introduce physical test equipment used for circuit testing.For this lesson you could:* introduce students to the purpose of a range of test equipment and other equipment used when testing circuits, for example:
	+ power supply
	+ multimeter
	+ continuity tester
	+ oscilloscope
	+ signal generator
	+ logic probe
* show in more detail how to safely setup and use a multimeter to measure voltage, current and resistance
* provide a practical activity where students use a multimeter to take readings and compare them with expected values.

The type of test equipment covered will depend on the resources available within centre and the types of circuit being constructed. | **Circuit testing****Measuring equipment****Multimeter** | Safely use testing methods and equipment to test circuits. | [Test Equipment 101 - The Basics of Electronic Testing](https://www.circuitbasics.com/test-equipment-101-the-basics-of-electronic-testing/) (circuitbasics.com)[Testing & Test Equipment](https://www.electronics-notes.com/articles/test-methods/) (electronics-notes.com)[How to Use a Multimeter](https://learn.sparkfun.com/tutorials/how-to-use-a-multimeter/all)(learn.sparkfun.com)[How to Use a Multimeter](https://www.youtube.com/watch?v=SLkPtmnglOI) (YouTube) | R047Students will learn about physical testing using test equipment. |

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| Term 6 |
| **Summary of what you will cover from the curriculum planner:** | **Testing circuits** |

| Lesson no. | Topic areas/sub topic areas  | Lesson ideas and activities | Lesson key words | Lesson outcome(s)At the end of the lesson, students will be able to: | Useful links/resources | How does this link to other units? |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | TA3Testing electronic circuits3.1 Safely test and evaluate electronic circuits | In this lesson you could continue to look at using test equipment to test and evaluate the operation of a circuit.In this lesson you could:* introduce students to a range of different test equipment
* show students how to safely use different test equipment
* provide practise activities to allow students to take readings and compare with expected values.
 | **Circuit testing****Measuring equipment** | Safely use testing methods and equipment to test circuits. | [How to Use an Oscilloscope](https://www.youtube.com/watch?v=u4zyptPLlJI)(YouTube)[How to Use an Oscilloscope](https://learn.sparkfun.com/tutorials/how-to-use-an-oscilloscope/all) (learn.sparkfun.com)[Signal generator](https://www.youtube.com/watch?v=833-uwiHnC8)(YouTube)[Operating a signal generator](https://www.youtube.com/watch?v=6hgHp84CqGA) (YouTube)[Logic Probe - special tool tips and tricks](https://www.youtube.com/watch?v=CFqf6DzgDuw) (YouTube)[Fix it Friday! - (Logic Series 01) Using a Logic Probe](https://www.youtube.com/watch?v=PbFqZk9Pyfg) (YouTube) | R047Students will learn about physical testing using test equipment. |
| 2  | TA3Testing electronic circuits3.2 Identify common faults in circuits | Over the remainder of lessons in this unit, students could practise functional testing of circuits including fault-finding.For this lesson you could:* recap faults that can be identified from visual inspection, e.g.
	+ missing or misplaced components
	+ incorrect orientation of components
	+ broken PCB tracks
	+ poor solder joints (dry joint)
	+ bridged solder joints or tracks
* explain the types of fault that can be identified by functional testing, e.g.
	+ incorrect component placement
	+ non-functioning or damaged components
	+ poor solder joints
	+ track and pad faults (open and closed circuit)
* provide practical activities in fault-finding for students to complete.
 | **Circuit testing****Common faults** | Recall how functional testing methods are used to identify common faults with selected circuits. | [Lecture 7: Electrical Testing and Fault Finding](https://www.youtube.com/watch?v=wAc8PPw-peI)(YouTube)[How to repair bridge and excess solder](https://www.youtube.com/watch?v=OaBRak0HnQs) (YouTube)[How To Repair Broken PCB TRACE - Learn 4 Different Methods](https://www.youtube.com/watch?v=sXhyMUO4q3A) (YouTube)[Repairing a Dry, Cold or Cracked Solder Joint & how to identify it - 2021](https://www.youtube.com/watch?v=5F4sX2Pn-Iw) (YouTube)[What is Continuity and How to Test for it With a Multimeter](https://www.youtube.com/watch?v=5G622WDZaHg) (YouTube) | R047Students will learn about physical testing using test equipment. |
| 3 | TA3Testing electronic circuits3.1 Safely test and evaluate electronic circuits3.2 Identify common faults in circuits | In this lesson, students could continue to perform testing and fault-finding by:* testing circuits they have previously constructed themselves in the unit
* using supplied circuits with known faults to rectify.
 | **Circuit testing****Functional testing** | Use functional testing methods to identify common faults with selected circuits. | [Lecture 7: Electrical Testing and Fault Finding](https://www.youtube.com/watch?v=wAc8PPw-peI)(YouTube) | R047Students will learn about physical testing using test equipment. |
| 4 | TA3Testing electronic circuits3.1 Safely test and evaluate electronic circuits 3.2 Identify common faults in circuits | In this lesson students could continue to test and fault-find electronic circuits.In this lesson they could:* test and fault-find external connections made to a PCB
* test and fault-find plugs and sockets if used
* test and fault-find externally connected devices, e.g. switches, speaker, lamp, LED, etc.
 | **Circuit testing****Functional testing** | Use functional testing methods to identify common faults with selected circuits. | [Lecture 7: Electrical Testing and Fault Finding](https://www.youtube.com/watch?v=wAc8PPw-peI)(YouTube) | R047Students will learn about physical testing using test equipment. |
| 5 | TA3Testing electronic circuits3.1 Safely test and evaluate electronic circuits 3.2 Identify common faults in circuits | In the final lesson on testing and fault-finding, students could consolidate their knowledge and skill of using test equipment and fault-finding methods to rectify known faults in supplied electronic circuits. | **Circuit testing****Functional testing** | Use functional testing methods to identify common faults with selected circuits. | [Lecture 7: Electrical Testing and Fault Finding](https://www.youtube.com/watch?v=wAc8PPw-peI)(YouTube) | R047Students will learn about physical testing using test equipment. |

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| Term 7 |
| **Summary of what you will cover from the curriculum planner:** | **Working on OCR-set assignment (supervised)** |

| Lesson no. | Topic areas/sub topic areas  | Lesson ideas and activities | Lesson key words | Lesson outcome(s)At the end of the lesson, students will be able to: | Useful links/resources | How does this link to other units? |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | Working on NEA Assessment Tasks | You could reserve a block of lessons for students to work on the Tasks within the OCR-set assignment. Alternatively, students could use this time to complete relevant assessment Tasks interleaved with other taught and practice lessons.Time allowed for working on the OCR-set assignment is typically 10-12 hours.Students must be supervised for safety purposes when undertaking any practical assessment work.In an early lesson you could:* introduce students to the OCR-set assignment brief and associated Tasks
* explain the marking criteria and how students will be assessed
* hold a class discussion to confirm the exact requirements for each Task
* task students, working in small groups, to review and discuss the OCR-set assignment brief and confirm how they will produce and present evidence for assessment.
 |  | Understand the OCR-set assignment brief including Tasks and marking criteria.Understand how to record and present evidence for assessment. | Access resources via the qualification home page including:* OCR-set assignment briefs
* Sample assessment materials
* Candidate exemplars
* Supporting the moderation process (online training)
* Examiner and moderator reports (for past series).

Note – some of the above resources will become available as the qualification develops. |  |
| 2 | Working on OCR-set assignment tasks |  Working on Tasks continues. |  |  |  |  |
| 3 | Working on OCR-set assignment tasks |  Working on Tasks continues. |  |  |  |  |
| 4 | Working on OCR-set assignment tasks |  Working on Tasks continues. |  |  |  |  |
| 5 | Working on OCR-set assignment tasks |  Working on Tasks continues. |  |  |  |  |

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| Term 8 |
| **Summary of what you will cover from the curriculum planner:** | **Working on OCR-set assignment (supervised)** |

| Lesson no. | Topic areas/sub topic areas  | Lesson ideas and activities | Lesson key words | Lesson outcome(s)At the end of the lesson, students will be able to: | Useful links/resources | How does this link to other units? |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | Working on OCR-set assignment tasks |  Working on Tasks continues. |  |  |  |  |
| 2  | Working on OCR-set assignment tasks |  Working on Tasks continues. |  |  |  |  |
| 3 | Working on OCR-set assignment tasks |  Working on Tasks continues. |  |  |  |  |
| 4 | Working on OCR-set assignment tasks |  Working on Tasks continues. |  |  |  |  |
| 5 | Working on OCR-set assignment tasks |  Working on Tasks continues. |  |  |  |  |

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| Term 9 |
| **Summary of what you will cover from the curriculum planner:** | **Working on OCR-set assignment (supervised)** |

| Lesson no. | Topic areas/sub topic areas  | Lesson ideas and activities | Lesson key words | Lesson outcome(s)At the end of the lesson, students will be able to: | Useful links/resources | How does this link to other units? |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | Working on OCR-set assignment tasks |  Working on Tasks continues. |  |  |  |  |
| 2  | Working on OCR-set assignment tasks |  Working on Tasks continues. |  |  |  |  |
| 3 | Working on OCR-set assignment tasks |  Working on Tasks continues. |  |  |  |  |
| 4 | Working on OCR-set assignment tasks |  Working on Tasks continues. |  |  |  |  |
| 5 | Working on OCR-set assignment tasks |  Working on Tasks continues. |  |  |  |  |

Teaching over three years

Some centres may choose to start their delivery of the qualification earlier in Year 9, and so deliver over three years. The following topic areas are suggestions of what could form part of early delivery.

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| Topic area | Warm up/introductory activities | Length of time activity may take |
| TA1 | Students could start to become familiar with how to use circuit CAD software to draw circuits and simulate their operation. This could include simple series and parallel circuits with basic components, e.g. battery, switch, lamp, buzzer. The activity could be extended to more complex circuits with other input, output, and process devices. | 4-5 hours |
| TA2 | Students could begin to construct and test simple practical circuits. You could use alternative prototyping methods (e.g. breadboard) to allow quick circuit assembly without the need to use tools and equipment. Circuits could be those previously drawn and simulated using circuit CAD software. Students could compare the results of simulation with the operation of the physical circuit. This could complement the circuit construction activities suggested in the warmup for Unit R047. | 3-4 hours |
| TA2 | You could introduce students to selected circuit construction techniques, such as soldering. Students could practise using a soldering iron to solder joints using stripboard. They could also practise soldering connections using wires, plugs and sockets. Safe working will be essential for this activity, and students could identify hazards, risks and produce a simple risk assessment before starting. | 3-4 hours |
| TA3 | Complementary to the warmup activity in Unit R047, students could start to familiarise themselves with the use of test equipment. You could show them how to safely use a multimeter to measure resistance, voltage and current, and they could use this to investigate circuits previously constructed using prototyping methods (e.g. breadboard).  | 3-4 hours |



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