

Cambridge **TECHNICALS LEVEL 3**

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# ***ENGINEERING***

**Unit 6**

**Circuit Simulation and Manufacture**

**Model assignment**

**M/506/7272**

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Please note:

You can use this assignment to provide evidence for summative assessment, which is when the learner has completed their learning for this unit and is ready to be assessed against the grading criteria.

You can use this assignment as it is, or you can modify it or write your own; we give more information in this document under Guidance for tutors.

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# Guidance for tutors on using this assignment

## General

OCR Cambridge Technical model assignments are available to download from our website: [www.ocr.org.uk](http://www.ocr.org.uk).

The purpose of this assignment is to provide a scenario and set of tasks that are typical of how engineers would use circuit simulation and manufacturing techniques to enable you to assess your learner against the requirements specified in the grading criteria. The scenario and its tasks are intended to give a work-relevant reason for applying the skills, knowledge and understanding needed to achieve the unit.

This assignment will not instruct learners how to meet the highest grade. Whether learners achieve a pass, merit or distinction will depend on what evidence they produce.

You can modify the scenario we provide in this assignment to make it more relevant to your local or regional needs. Please refer to the information under 'Modifying the model assignment' later in this section.

You don't have to use this assignment. You can use it as a guide to help you to design your own assignment, and we provide an assignment checking service. You'll find more information on these matters in section 8 of the qualification handbook.

In the tasks, we'll refer to the format of evidence. Learners are **not** required to follow that format **unless** we tell them otherwise.

It's essential that the work every learner produces is their own. Please make sure you read through the information we give on authenticity in section 8 of the qualification handbook and make sure that your learners and any staff involved in assessment understand how important authenticity is.

**We provide this assignment to be used for summative assessment. You must not use it for practice or for formative assessment.**

## Before using this assignment to carry out assessment

Learners will need to take part in a planned learning programme that covers the knowledge, understanding and skills of the unit.

When your learners are ready to be assessed, they must be provided with a copy of the following sections of this assignment:

- General information for learners
- Assignment for learners
- Evidence Checklist

They may carry out preparation prior to undertaking the tasks and there is no time limit for this.

## When completing the assignment

**You should use this assignment in conjunction with the unit specification and qualification handbook.**

**Please note** – if learners are completing this model assignment as part of the Extended Diploma qualification they will be required to complete the synoptic unit 25: Promoting continuous improvement. Before your learners complete this model assignment, you must refer to the specification and model assignment requirements for unit 25, so if applicable you can ensure learners gather the appropriate feedback on their own performance and performance of the system, process or artefact that they will produce in this model assignment.

## Resources to complete the tasks

There are resource requirements for this assignment. Every learner will need access to the following resources:

- For task 1 learners will require access to suitable software to enable schematic circuit entry, circuit simulation and printed circuit board (PCB) layout production. This software should include a sufficient library of components in order to be able to complete the set circuit task, or task set by the centre if the circuit is modified or substituted.
- For task 2 learners will require access to facilities to manufacture a PCB, and components, parts and tools to construct the PCB. They will also require access to suitable safety equipment to perform circuit assembly. Learners will require access to suitable test equipment in order to test their completed and assembled PCB. You may need to provide an electronic circuit with known faults to enable learners to complete fault identification and rectification in D2.

## Tutor information to support the scenario/tasks

You can use the circuit provided in this scenario or provide a suitable alternative, please the section on modifying this scenario below.

In task 1 learners should use the standard library of components that are defined in the software used. When analysing and evaluating the circuit and circuit board layout design, learners should consider the points listed in the teaching content in LO1 and LO2.

In task 2 for D2 learners need to identify and rectify faults, if they do not identify faults through the testing of their own circuit you should provide an alternative electronic circuit which will allow learners to meet this criterion.

## Health and Safety and the use of resources

Health and safety will need to be considered for any of the tasks, or parts of the tasks that are undertaken as practical activities. This should include appropriate risk assessments, safe working methods statements and the use of appropriate personal protective equipment (PPE). Learners should be encouraged to take part in assessing risk before conducting any practical activity.

## Time

You should plan for learners to have 12–15 hours to complete this assignment.

Learners must be allowed sufficient time to complete all the tasks. The amount of time may vary depending on the nature of the tasks and the ability of individual learners. To help with your planning, against each of the tasks we've given an indication of how long it should take.

Learners can produce evidence in several sessions.

## Format of evidence

Learners have to produce evidence that demonstrates how they have met the grading criteria. At the very least they must produce evidence that meets all of the pass criteria.

**Please make sure your learners realise that missing just one pass criterion means they will not pass the unit, even if they have successfully met the merit and distinction criteria.**

We don't have specific requirements for the format of evidence in this assignment. We've said what format the evidence could take for each task. For example, if we say 'You could include a report on ...', the evidence doesn't have to follow any specific reporting conventions. You can modify the format of the evidence, but you must make sure the format doesn't prevent the learner from accessing the grading criteria.

It's possible that certain formats for evidence can naturally cover several grading criteria and avoid the need for excessive amounts of evidence. For example, a report can be a good way to pull together evidence to meet several grading criteria.

For more guidance on generation and collection of evidence, please refer to the section 8 'Internal Assessment', in the qualification handbook.

## Group work

This assignment hasn't been written to include group work. If you plan to ask learners to work in a team to complete work for assessment, you need to determine at which point in an assessment task learners can work together.

You must be sure that each learner can produce evidence of their own contribution to each grading criterion. You can give constructive feedback to learners about working as a group and direct them on team working skills because evidence of team working skills is not required by the unit. See our information on authentication, including group work and feedback to learners, in section 8 of the qualification handbook.

If witness statements are used to support learners' evidence, you'll need to complete an individual statement for each learner.

## After completing the assignment

Once the learner has submitted their work to you to be assessed, you must judge or 'mark' the work against the grading criteria for the unit and identify one grade for the unit. For further information about assessment, please refer to section 8 of the qualification handbook.

Your assessment decisions must be quality assured across the cohort of learners in your centre who are being entered for the same unit. This must be done through an internal standardisation process. We give information on internal assessment and standardisation in the qualification handbook.

## Reworking the assignment

If you and the learner feel they've not performed at their best during the assessment, the learner can, at your discretion, improve their work and resubmit it to you for assessment. If a learner is working on improving their work before it is resubmitted, you and the learner must continue to make sure the work is the learner's own.

Any feedback you give to the learner must not direct them on how to improve their work. You can identify what area of the work could be improved but you cannot give the learner any details about how they could improve it. You must follow the guidelines given in section 8 of the qualification handbook under 'Authenticity of learner work'.

## Modifying the model assignment

The tasks in this assignment allow learners access to the full range of grades detailed in the grading criteria of this unit.

If you modify this assignment you must not change the grading criteria provided in the tasks for the learner or in the evidence checklist. These grading criteria are taken from the unit.

You can modify the scenario to suit your local or regional needs and the tasks may be contextualised to match any changes you have made to the scenario. If you supply your own schematic diagram to support a different scenario, this must be sufficiently detailed for learners to complete the tasks.

You can modify the type of evidence and the format it takes, unless we expressly state that evidence must take a specific format.

You must also make sure that you avoid discrimination, bias and stereotyping and support equality and diversity. For more information, please see the section 'Designing your own assignments for internally assessed units' in section 8 of the qualification handbook.

**If modifications are made to the model assignment, whether to the scenario alone, or to both the scenario and individual tasks, it's your responsibility to make sure that all grading criteria can still be met and that learners can access the full range of grades.**

If you're using this model assignment and delivering the Foundation Diploma, Diploma or Extended Diploma you have an opportunity to secure meaningful employer involvement by working with an employer to modify it.

# General information for learners

**Q** *What do I need to do to pass this assignment?*

**A** You need to produce evidence to meet the requirements of **all** the pass criteria for the unit this assignment relates to. If you miss just one pass criterion, you will not achieve this unit and will receive an unclassified result.

**Q** *What do I need to do if I want to get a merit or distinction for this assignment?*

**A** For a merit, you need to produce evidence to meet the requirements of **all** the pass criteria for the unit this assignment relates to **and** you need to produce evidence to meet **all** the merit criteria.

For a distinction, in addition to the above, you also need to meet **all** the distinction criteria for this unit.

**Q** *What help will I get?*

**A** Your tutor will support you when completing this assignment and will make sure that you know what resources or facilities you need and are allowed to use. We've given your tutor information about how much support they can give you.

**Q** *What if I don't understand something?*

**A** It's your responsibility to read the assignment carefully and make sure you understand what you need to do and what you should hand in. If you are not sure, check with your tutor.

**Q** *I've been told I must not plagiarise. What does this mean?*

**A** Plagiarism is when you take someone else's work and pass this off as your own, or if you fail to acknowledge sources properly. This includes information taken from the internet.

It's not just about presenting a whole copied assignment as your own; you will also be plagiarising if you use the ideas or words of others without acknowledgement, and this is why it's important to reference your work correctly (see Q&A below for more information on referencing).

Plagiarism has serious consequences; you could lose the grade for this unit or you may not be allowed to achieve the whole qualification.

**Always remember that the work you produce must be your own work. You will be asked to sign a declaration to say that it is.**

**Q** *What is referencing and where can I find out more information about it?*

**A** Referencing is the process of acknowledging the work of others. If you use someone else's words and ideas in your assignment, you must acknowledge it, and this is done through referencing.

You should think about why you want to use and reference other people's work. If you need to show your own knowledge or understanding about an aspect of subject content in your assignment, then just quoting and referencing someone else's work will not show that **you** know or understand it. Make sure it's clear in your work how you are using the material you have referenced **to inform** your thoughts, ideas or conclusions.

You can find more information about how to reference in *The OCR Guide to Referencing* available on our website: <http://www.ocr.org.uk/Images/168840-the-ocr-guide-to-referencing>

Q ***Can I work in a group?***

A Yes. However, if you work in a group at any stage, you must still produce work that shows your individual contribution. Your tutor can advise you how to do this.

Q ***Does my work for each task need to be in a particular format?***

A You can present your work in a variety of ways – it can be handwritten, word-processed, on video or in digital media. What you choose should be appropriate to the task(s) and your tutor can advise you. There may be times when you need proof that you have completed the work yourself: for example, if you do something during work placement that you want to use as evidence, the tutor might ask the employer to provide a witness statement.

Make sure you check the wording in each task carefully. For each task, we'll tell you if your evidence has to be in a specific format:

- If we say use the word '**must**', for example 'You must produce a report' or 'Your evidence/work must include a diagram', then you must produce the work in the stated format.
- If we use the word '**could**', for example 'You could include sketches of your ideas' or 'You could do this by annotating your diagram', this means that you are not required to follow the format we have given, but you must make sure that the work you do produce allows you to demonstrate the requirements of the grading criteria.

If you are unsure about what evidence you need, please ask your tutor.

Q ***Can I ask my tutor for feedback on my work?***

A Yes, but they can't give you detailed feedback.

We have given your tutor instructions on what kind of feedback they can give you. For example, they are **not** allowed to tell you exactly what to do to make your work better, but they **can** remind you about what they've taught you and you can use this additional learning to try and improve your work independently. They can say what they've noticed might be wrong with your work, for example if your work is descriptive where an evaluation is required, but your tutor can't tell you specifically what you need to do to change it from a description to an evaluation – you will need to work out what you need to do and then do it for yourself.

Q ***When I have finished, what do I need to do?***

A If you have included the personal details (such as name, address or date of birth) of someone other than yourself in your work, this must be blanked out (anonymised) – your tutor will tell you how to do this. You don't need to do this for information contained in references.

You can complete the evidence checklist to show your tutor where they can find the evidence for each grading criterion in your work.

You should make sure your work is labelled, titled and in the correct order for assessing.

Hand in the work that you've completed for each task to your tutor. They might ask to see your draft work, so please keep your draft work in a safe place.

Q ***How will my work be assessed?***

A Your work will be marked by someone in your centre who has been authorised to do so. They will use the information in the grading criteria to decide which grade your work meets. The grading criteria are detailed in each unit and are also given in the tasks within this assignment. Please ask your tutor if you are unsure what the grading criteria are for this assignment.

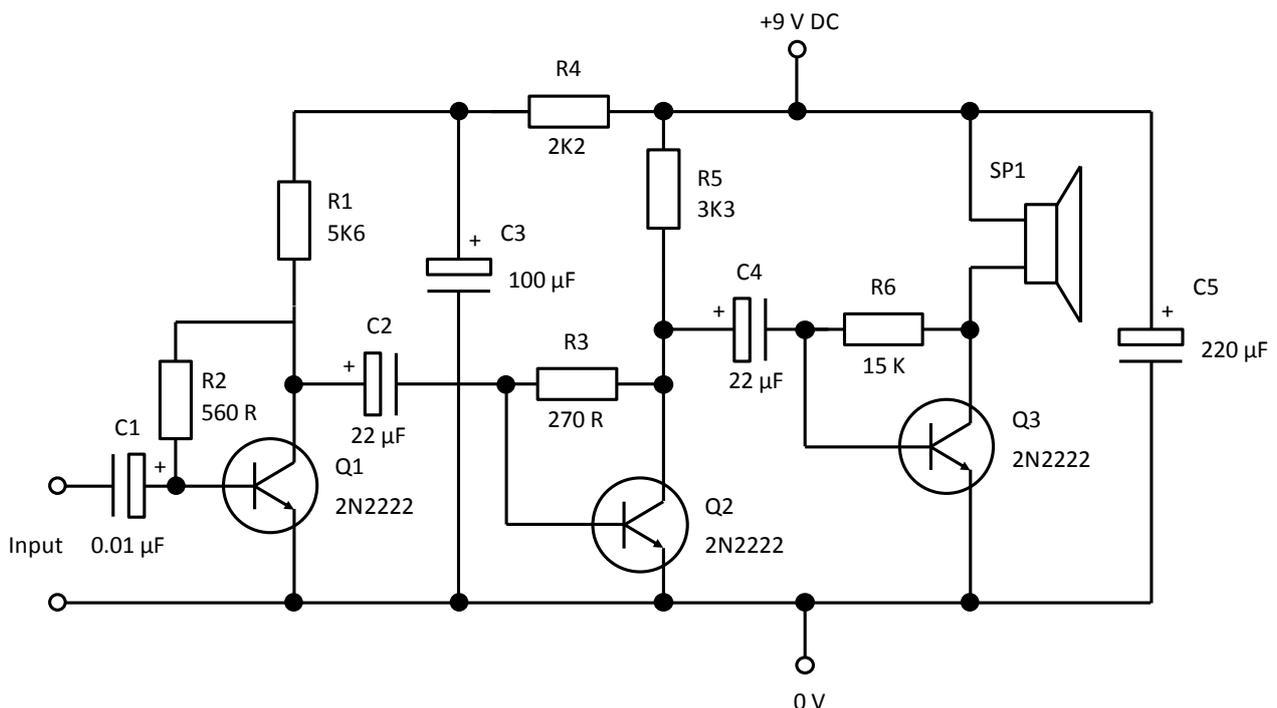
# Assignment for learners

## Unit 6: Circuit Simulation and Manufacture

### Scenario

### Circuit Simulation and Manufacture – Audio Amplifier

The circuit below shows an example of a low-power audio amplifier used to amplify the signal from an MP3 player or smart phone.



### Design notes:

- this circuit can be powered by a 9 V PP3 battery or a mains adapter power supply
- all resistors are ¼ watt
- all electrolytic capacitors are rated 10 V or 15 V
- transistors of a similar rating to 2N2222 can be used
- the speaker can be 64 Ω or greater.

The circuit is to be simulated using CAD software and a prototype manufactured prior to it being commercially produced.

# The tasks

## Task 1: Circuit simulation and PCB design

(This task should take between 5 and 6 hours.)

**Learning Outcome 1:** ‘Be able to use Computer Aided Design (CAD) for circuit design and simulation’ and **Learning Outcome 2:** ‘Be able to use Computer Aided Design (CAD) to design printed circuit boards (PCBs)’ are assessed in this task.

Your task is to use CAD software to produce a schematic diagram and simulate the audio-amplifier circuit and produce a PCB layout for both track and component views.

You should use CAD methods including virtual instrumentation to analyse and evaluate the operation and functionality of the circuit and circuit board layout. You should make appropriate design modifications based on your analysis and evaluation.

Pass	Merit	Distinction
P1: Produce circuit schematic diagram drawings using CAD software.	M1: Perform circuit analysis including the use of virtual instrumentation.	D1: Evaluate circuit operation and associated printed circuit board layout using CAD software, implementing appropriate design modifications.
P2: Carry out circuit simulation using CAD software.		
P3: Produce PCB layouts using CAD software to include track and component views.	M2: Analyse functionality of printed circuit board layout using CAD software.	
<b>Evidence</b>		
<p>You must show clearly how you used CAD software to reproduce and simulate the circuit and how you have made appropriate design modifications. You should also show how you have produced a printed circuit board (PCB) layout.</p> <p>Your evidence <b>must</b> include:</p> <ul style="list-style-type: none"> <li>• circuit schematic diagram drawings from a CAD package this could be in the form of printed diagrams or screen shots.</li> <li>• PCB layouts from a CAD package that include both track <b>and</b> component views this could be in the form of printed diagrams or screen shots.</li> </ul> <p>You evidence should include:</p> <ul style="list-style-type: none"> <li>• annotated screen shots from the CAD software showing the circuit diagram and design modifications</li> <li>• results (graphical and numerical) from circuit simulation</li> <li>• a written technical evaluation of circuit operation, simulation results and circuit board layout</li> </ul>		

## Task 2: Manufacturing, assembling and testing a PCB

(This task should take between 5 and 6 hours.)

**Learning Outcome 3:** 'Be able to manufacture and construct electronic circuits safely' and **Learning Outcome 4:** 'Be able to test and perform fault-finding on electronic circuits' are assessed in this task.

Your task is to manufacture, assemble and test the printed circuit board (PCB) you have produced in task one.

Components must be safely assembled to the completed PCB, and operation of the PCB tested using different test equipment and test techniques including rectifications where faults were identified. You should tell your tutor if you do **not** identify any faults and they will provide you with an alternative electronic circuit to enable you to carry out fault identification and rectification.

Pass	Merit	Distinction
P4: Interpret circuit diagram to construct printed circuit board.		D2: Safely manufacture, test and verify a fully working electronic circuit, to include identification and rectification of faults, using a variety of construction methods.
P5: Safely manufacture a printed circuit board using appropriate techniques.		
P6: Safely assemble components to printed circuit board.		
P7 Perform testing of an electronic circuit using a multimeter.	M3: Undertake testing of the operation of an electronic circuit using different physical test equipment and fault finding techniques.	
<b>Evidence</b>		
<p>This could be in the form of:</p> <ul style="list-style-type: none"> <li>annotated photographic evidence of the constructed PCB demonstrating that it has been correctly interpreted from the circuit diagram.</li> <li>a record of component assembly such as a log book supported by annotated photographs showing that you have used appropriate techniques to safely manufacture the circuit board</li> <li>annotated photographic evidence of testing taking place – including the use of a multimeter.</li> <li>results and recordings (graphical and numerical) from circuit testing, including identification and rectification of faults, to verify a fully working electronic circuit</li> </ul>		

### Task 3: Circuit simulation and PCB design

(This task should take between 2 and 3 hours.)

**Learning Outcome 5:** 'Understand commercial circuit manufacture' is assessed in this task.

Your task is to report on how a circuit such as the audio-amplifier circuit could be constructed and manufactured commercially.

Your report must consider different types of components used in commercial circuit construction and explain the benefits and drawbacks to a manufacturer of using through hole, discrete and surface mounted assembly methods.

You should report on the application and reasons for using multi-layer PCBs and consider manufacturing processes and quality assurance methods used in commercial circuit construction.

Pass	Merit	Distinction
P8: Identify applications of different component types used in commercial circuit construction.	M4: Compare manufacturing processes and quality assurance methods used within commercial circuit construction.	
P9: Explain the benefits and drawbacks to manufacturers of using surface mount components and alternatives.		
P10: Explain the use of multiple layer PCBs in commercial circuit manufacture.		
<b>Evidence</b>		
Your report could be a written document or a presentation with detailed speaker notes.		

# Evidence Checklist

## OCR Level 3 Cambridge Technicals in Engineering

### Unit 6: Circuit Simulation and Manufacture

LEARNER NAME:

For PASS have you: (as a minimum you have to show you can meet every pass criterion to complete the unit)	Where can your tutor find the evidence? Give page no(s)/digital timings, etc.
Produced circuit schematic diagram drawings using CAD software. (P1)	
Carried out circuit simulation using CAD software. (P2)	
Produced PCB layouts using CAD software to include track and component views. (P3)	
Interpreted circuit diagram to construct printed circuit board (P4)	
Safely manufactured a printed circuit board using appropriate techniques. (P5)	
Safely assembled components to printed circuit board. (P6)	
Performed testing of an electronic circuit using a multimeter. (P7)	
Identified applications of different component types used in commercial circuit construction. (P8)	
Explained the benefits and drawbacks to manufacturers of using surface mount components and alternatives. (P9)	
Explained the use of multiple layer PCBs in commercial circuit manufacture. (P10)	

For Merit have you:	Where can your tutor find the evidence? Give page no(s)/digital timings, etc.
Performed circuit analysis including the use of virtual instrumentation. (M1)	
Analysed functionality of printed circuit board layout using CAD software. (M2)	
Undertaken testing of the operation of an electronic circuit using different physical test equipment and fault finding techniques. (M3)	
Compared manufacturing processes and quality assurance methods used within commercial circuit construction. (M4)	

<b>For Distinction have you:</b>	<b>Where can your tutor find the evidence? Give page no(s)/digital timings, etc.</b>
Evaluated circuit operation and associated printed circuit board layout using CAD software, implementing appropriate design modifications. (D1)	
Safely manufactured, tested and verified a fully working electronic circuit, to include identification and rectification of faults, using a variety of construction methods.(D2)	

To find out more  
**[ocr.org.uk/engineering](http://ocr.org.uk/engineering)**  
or call our Customer Contact Centre on **02476 851509**

Alternatively, you can email us on **[vocational.qualifications@ocr.org.uk](mailto:vocational.qualifications@ocr.org.uk)**



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