

# Unit 18: Application of computer control (LEVEL 2)

## Learning outcomes

By completing this unit candidates will develop knowledge and understanding of how computer control can be used in a variety of situations.

Candidates will be able to:

- investigate applications of computer control and their effects
- explain the role of feedback in control systems
- create control programs using a series of commands
- design a control system to meet a given brief
- construct a control system
- test a control system
- evaluate a control system
- describe the health and safety issues related to computer control.

**It is anticipated that a candidate will require 60 guided learning hours to complete this unit.**

Assessment objectives	Knowledge, understanding and skills
1 Investigate applications of computer control and their effects	<p>Candidates must investigate <b>at least one</b> computer controlled system eg:</p> <ul style="list-style-type: none"><li>• factory/production automation, where parts of a production line may be automated</li><li>• manufacturing processes, where a process is monitored and controlled completely by a computer system</li><li>• security and access systems</li><li>• environmental control systems</li><li>• control systems in everyday devices</li><li>• systems to aid people with disabilities</li></ul> <p>Investigation to include:</p> <ul style="list-style-type: none"><li>• the objectives of the system</li><li>• brief description of the operation of the system(s)</li><li>• hardware used, including <b>at least two</b> different sensors and the output device(s)</li></ul> <p>Describe effects of the use of computer control in these applications eg:</p> <ul style="list-style-type: none"><li>• advantages</li><li>• disadvantages</li><li>• limitations on all those affected, eg workers, owners/companies, customers</li></ul>
2 Explain the role of feedback in control systems	<ul style="list-style-type: none"><li>• identify the feedback in <b>at least one</b> system</li><li>• describe the purpose of the feedback</li><li>• draw a feedback loop to describe the system</li></ul>

Assessment objectives	Knowledge, understanding and skills
3 Create control programs using a series of commands	<ul style="list-style-type: none"> <li>• use straightforward output commands, eg to control a screen turtle or buggy accurately</li> <li>• understand the use of loops, variables and procedures to make programs more efficient</li> </ul>
<b>Assessment objectives 4 to 7 are based on a control system designed, created, tested and evaluated by the candidate</b>	
4 Design a control system to meet a given brief	<ul style="list-style-type: none"> <li>• state the purpose of the system</li> <li>• choose appropriate sensors</li> <li>• choose appropriate output devices</li> <li>• choose whether it is appropriate to use a PC or PLC</li> <li>• create a simple block diagram to show the chosen hardware components</li> <li>• choose suitable locations for each device</li> </ul>
5 Construct a control system	<ul style="list-style-type: none"> <li>• construct a virtual or physical model of the system</li> <li>• describe how the model was constructed</li> <li>• create a program using either flowchart or command line software</li> <li>• print out program(s) and annotate to describe purpose of different procedures</li> </ul>
6 Test a control system	<ul style="list-style-type: none"> <li>• create a test plan</li> <li>• test the system using a range of normal, abnormal and extreme inputs</li> <li>• produce evidence of results</li> </ul>
7 Evaluate a control system	Evaluation to include: <ul style="list-style-type: none"> <li>• advantages</li> <li>• disadvantages</li> <li>• possible improvements</li> <li>• limitations of the system created</li> </ul>
8 Describe the health and safety issues related to computer control	To include: <ul style="list-style-type: none"> <li>• ways in which computer control aids health and safety</li> <li>• health and safety issues in applications studied</li> <li>• safety considerations when constructing a control system using electrical signals</li> <li>• recommendations on how to avoid potential problems</li> </ul>

## Assessment

This unit is centre assessed and externally moderated.

In order to achieve this unit, candidates must produce a portfolio of evidence showing that they have met all of the assessment objectives.

Portfolios of work must be produced independently. They will need to be made available, together with witness statements and any other supporting documentation, to the OCR Visiting Moderator when required.

Centres must confirm to OCR that the evidence produced by candidates is authentic. An OCR Centre Authentication Form is provided in the Centre Handbook and includes a declaration for assessors to sign. It is a requirement of the QCA Common Criteria for all Qualifications that proof of authentication is received.

## Guidance on assessment and evidence requirements

Candidates may provide portfolio evidence for this unit using a range of suitable and appropriate techniques. These may include written data, printouts of programs, the use of photographs, video, audio presentation and presentation within the body of the portfolio and display evidence. Where presentations, demonstrations or displays have taken place for which evidence cannot be easily included within the portfolio evidence assessor testimony/witness statements must be included, signed by the assessor(s), and supported by appropriate evidence (handouts, slides etc).

For Assessment Objective 1 candidates should study real applications of computer control. Research may be by first-hand observation or experience, or may be from case-study material. Merit and Distinction candidates need to study examples using a range of sensors. These may be all different aspects of the same system, or two or more discrete studies. Examples of systems that might be studied include:

- manufacturing factories, eg car plants
- process control, eg drinks production, chocolate making
- alarm systems, eg fire and intruder alarms
- access control systems, eg offices and hotels
- environmental control systems, eg air conditioning in offices, greenhouse control systems, fish tanks
- control systems in vehicles, eg cars, aeroplanes, trains
- control systems in a modern washroom or kitchen
- intelligent houses and offices.

Descriptions should include the types of sensor and output devices, the type of controller and how these operate together. Detailed technical descriptions of how each device works are not required, but there should be a description of how the system works, including the type of data captured by the sensors and how and when the system responds with output.

Candidates should produce a written report or illustrated talk to show the results of their research. The report and/or printouts of slides with speaker notes should be include in the portfolio.

For Assessment Objective 2, one of the systems studied should involve a closed feedback loop, where the result of previous actions becomes input, so affecting the next action. Candidates should show an understanding that this is a continuous process rather than a simple sequence of input-process-output. This can be shown in a feedback loop diagram in the form shown in Fig.1, although candidates should identify the specific devices used in the system being described.

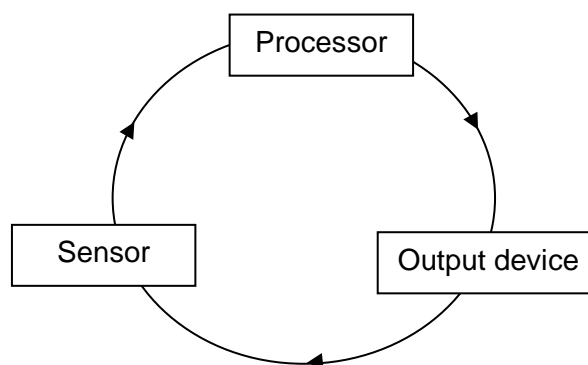


Fig.1

Although candidates may choose to use a program with a flowchart interface to create their own system in Assessment Objective 4 to Assessment Objective 7 they must also have an

understanding of the basic structure of a control program. Evidence for Assessment Objective 3 may consist of a series of simple programs to control a screen turtle or buggy, with no input. Alternatively it may be one complex program displaying all the required structures. If candidates use a command line programming language to construct the program for their own system in Assessment Objective 4 to Assessment Objective 7 they may cover all, or some, of this objective without the need for additional programs specifically created for Assessment Objective 3. Candidates should include listings of the programs they create, with explanation showing an understanding of the purpose of each procedure and program, and the significance of the different structures used. This explanation may be as separate page(s) and/or annotation on the program listing.

Where candidates carry out discrete activities to achieve Assessment Objective 3 they may create programs to carry out tasks specified by the Centre. These may be the creation of specified patterns and/or routines for a screen turtle. Suitable tasks might include:

- simple paths using Forward, Backward, Left and Right with right angles for Pass candidates
- more complex paths using a variety of angles and wider range of commands, eg, Penup, Pendown, for Merit and Distinction candidates.

Merit and Distinction candidates must also show a more extensive use and greater understanding of different structures to improve the efficiency of programming. These requirements are detailed in the grading grid.

Assessment Objective 4 requires candidates to design a control system to meet a brief given by the Centre. This must involve data being collected by a sensor (more than one for merit and distinction candidates) and at least one output device being controlled as a result of this input. Examples of suitable scenarios might include:

- a greenhouse requiring a constant temperature and humidity to be maintained
- a building that needs a security system to activate alarms if intruders are detected
- an exhibition where exhibits react to passing visitors.

Appropriate scenarios should include opportunities for merit and distinction candidates to design and construct more complex systems that make use of counted and/or conditional loops. Suitable examples might be the requirement to sound an alarm for a given length of time, or to make a light flash until something is detected.

Candidates should include a consideration of whether it is appropriate to use a personal computer (PC) with an interface or a dedicated Programmable Logic Controller (PLC). They will need to research suitable sensors and output devices using, for example, current catalogues and websites. Whilst brand names may be used in the description of the design, candidates should also include evidence of an awareness of the type of device chosen. Common types of device include:

- temperature sensors
- light sensors
- sound sensors
- angular position sensors
- pH sensors
- pressure sensors/switches
- PIR sensors
- tilt switches
- microswitches and pushbuttons

- magnetic reed switches
- actuators
- motors
- lights and LEDs
- bells, buzzers and sirens.

Merit and Distinction candidates will need to give reasons for their choices of hardware. For distinction, candidates must justify their choices including why they have rejected other possibilities.

Candidates should summarise their choice of hardware by creating a block diagram to represent their system. This should show sensors, controller and output devices with lines showing their interconnections. An appropriate layout is shown in Fig.2 below, although candidates should show the specific type of sensor(s), controller and output device(s) they have chosen.

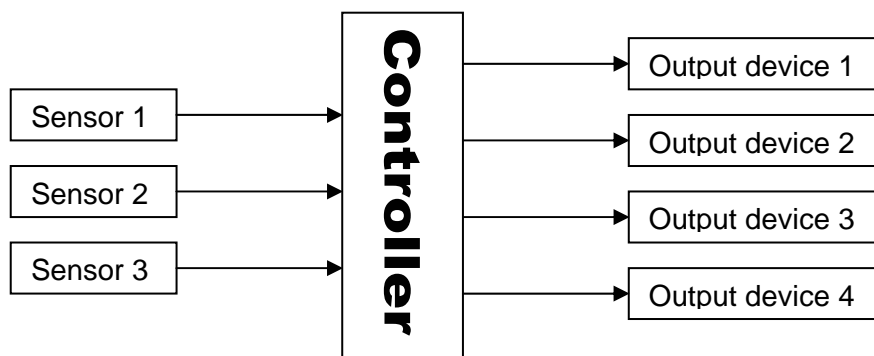


Fig.2

For Assessment Objective 5, candidates must then produce a model of their system. They might build a physical model using real sensors and output devices, although alternative sensors and output devices may be used to represent the selected ones if these are not available. Similarly a PC may be used to represent a PLC. Alternatively a virtual model can be built, using a form of virtual control software that allows suitable models to be built and tested. A photograph might be included in the candidate's portfolio as evidence of a physical system, or a printout from virtual control software. Merit and Distinction candidates must describe how they constructed their model. Evidence for Assessment Objective 5 will also include a printout of the program created by the candidate. This may be a single program to control all the features, or it may be a separate program/procedure for each feature. The printout will show either a program listing or flowchart according to the type of software used. Merit and distinction candidates will annotate their printout to show what the significant sections of the program do. This annotation may be added after printing or may make use of comments within a program. Merit candidates need only identify the different sections or procedures but Distinction candidates should give a fuller annotation, identifying all the key features of the program.

For Assessment Objective 6 candidates must create a test plan and then test their system to ensure it works. Evidence may include photographs or video clips but candidates must also give a written summary of their results which may include entries into the test plan. Teacher witness statements may be used to verify these statements. Evidence for Assessment Objective 7 must be a written evaluation by the candidate. For distinction candidates need to suggest possible improvements to their system. These improvements may include increased functionality and ease of use and need not necessarily require candidates to comment on the correction of faults. Candidates should be discouraged from including deliberate errors.

Distinction candidates need to include normal, abnormal and extreme data in their tests, for example if a temperature in a fish tank is to be maintained between 28 and 32 degrees:

- normal data would be any value between 28 and 32 degrees

- abnormal data would be less than 28 or more than 32 degrees
- extreme data would be 28 and 32 degrees.

It is not recommended that evidence for Assessment Objective 8 should be created as a discrete piece of work. It is more likely that health and safety issues will be covered in the candidates' reports on control applications for Assessment Objective 1 and in the design and/or evaluation of their own systems in Assessment Objective 4 and/or 7. Where a virtual system is constructed, candidates need to consider the issues involved in setting up the real system represented by their virtual model. It is acceptable to assess this objective if it has been submitted as a separate piece of work. Distinction candidates need to explain giving reasons, the health and safety issues.

## Signposting to Key Skills

- ✓ The unit contains opportunities for developing the Key Skill, and possibly for generating portfolio evidence, if teaching and learning is focused on that aim.

Key Skill reference		Key Skill reference		Key Skill reference	
C2.1a	✓	ICT2.1	✓	N2.1	✓
C2.1b	✓	ICT2.2	✓	N2.2	✓
C2.2	✓	ICT2.3	✓	N2.3	
C2.3	✓				

## Mapping to National Occupational Standards

National Occupational Standards	Reference ID	Title
IT Users (e-skills UK)	EI2	Evaluate the impact of IT Level 2
Contact Centres (e-skills UK)	CCIWC	Interpersonal and written communication
IT Users (e-skills UK)	MSU2	Make selective use of IT Level 2
IT Users (e-skills UK)	PS2	Presentation software Level 2
IT Professionals (e-skills UK)	ICTSDCC2	Software development - component creation Level 2
IT Professionals (e-skills UK)	ICTSDDD2	Software development – design Level 2
IT Professionals (e-skills UK)	ICTTEST2	Testing ICT systems Level 2

## Resources

---

This section provides suggestions of suitable resources. The list is neither prescriptive nor exhaustive, and candidates should be encouraged to gather information from a variety of sources. Some suggested resources are intended for Tutor use. The resources in this section were correct at the time of production.

### Websites

[www.windmill.co.uk/education](http://www.windmill.co.uk/education)

Simulation software to help explain control

[www.el.media.mit.edu/logo-foundation](http://www.el.media.mit.edu/logo-foundation)

Information and resources for learning and teaching logo

## Grading

Assessment Objective	Pass	Merit	Distinction
<b>AO1</b> Investigate applications of computer control and their effects	Candidates state the objectives of at least one computer control system they have studied, in basic terms. They describe the use of at least two different sensors and the output device(s) that are controlled. They give a brief description of the operation of each system. They list at least two advantages of at least one system.	Candidates state the objectives of computer control system(s) they have studied, in detail. They describe the use of at least three different sensors and at least two different output devices that are controlled, and identify the type of controller used. They describe how each complete system operates. They describe the advantages and disadvantages of at least one system to at least two groups of people affected.	Candidates comprehensively state the objectives of computer control system(s) they have studied. They describe the use of at least four different sensors and at least two different output devices that are controlled, and identify the type of controller used. They explain why each system meets the needs of the user and give reasons why the specific items of hardware are appropriate. They describe how each complete system operates. They describe any limitations of at least one system. They describe the advantages and disadvantages of at least one system to all those affected.
<b>AO2</b> Explain the role of feedback in control systems	Candidates identify a system where feedback is used. They show a basic understanding of the continuous nature of feedback.	Candidates describe the way feedback is used in a system. They identify the input(s) and output(s) of the system and draw a diagram to show a feedback loop in the system. They show some understanding of the purpose of feedback in the system.	Candidates explain the way feedback is used in a system. They identify the input(s) and output(s) of the system and draw a diagram to show a feedback loop in the system. They explain the purpose of feedback in the system.



Assessment Objective	Pass	Merit	Distinction
<b>AO3</b> Create control programs using a series of commands	Candidates create a program to control a real or virtual output device, eg a screen turtle, using a sequence of simple commands. Their program accurately carries out the tasks required.	Candidates create a program to control a real or virtual output device, eg a screen turtle, using a range of available commands. Their program accurately carries out the tasks required. They make appropriate use of at least one loop and call at least one procedure more than once from within their main program. They define and use at least one variable. They show some understanding of at least one way in which the use of loops, variables and/or procedures make programs more efficient.	Candidates create a program to control a real or virtual output device, eg a screen turtle, using a range of available commands. Their program accurately and efficiently carries out the tasks required. They make appropriate use of at least one loop and call at least one procedure more than once from within their main program. They define and use at least one variable. They pass at least one parameter into the program. They demonstrate an understanding of ways in which the use of loops, variables and procedures make programs more efficient.
<b>AO4</b> Design a control system to meet a given brief	Candidates state the purpose of a system. They identify at least one sensor and at least one output device. They identify locations for each device. Their choices will all be reasonable although there may be more effective solutions. They create a simple block diagram to show their chosen hardware components.	Candidates state the purpose of a more complex system. They describe at least two different types of sensor and at least two different types of output device, giving reasons for their choices. They choose, with reasons, whether it is appropriate to use a PC or PLC. They describe, with reasons, appropriate locations for each device. Their design will be an appropriate solution to the brief. They create a simple block diagram to show their chosen hardware components.	Candidates state the purpose of a more complex system. They describe at least two different types of sensor and at least two different types of output device. They choose whether it is appropriate to use a PC or PLC. They describe appropriate locations for each device. They justify their choice of devices and the locations chosen for each including why they have rejected other possibilities. Their design will be an appropriate solution to the brief. They create a simple block diagram to show their chosen hardware components.

<b>Assessment Objective</b>	<b>Pass</b>	<b>Merit</b>	<b>Distinction</b>
<b>AO5</b> Construct a control system	Candidates construct a virtual or physical model of the system they have designed. They write an appropriate program or programs using either flowchart or command line software. They print out their program(s).	Candidates construct a virtual or physical model of the system they have designed and describe how this was done. They write an appropriate program or programs using either flowchart or command line software. Their program will include the use of either a counted or conditional loop. They print out their program(s) and annotate their printout(s) to show the purpose of different procedures and/or sections of program.	Candidates construct a virtual or physical model of the system they have designed and describe how this was done. They write an appropriate and efficient program using either flowchart or command line software. Their program will include the use of both a counted and a conditional loop. They print out their program(s) and annotate their printout(s) to describe the purpose of different procedures and the main commands used.
<b>AO6</b> Test a control system	Candidates create a test plan including at least two tests of the system. They carry out the tests and provide evidence of the results.	Candidates create a test plan that tests each part of the system, identifying normal and abnormal conditions. They carry out the tests and provide evidence of the results.	Candidates create a test plan that thoroughly tests each part of the system, identifying normal, extreme and abnormal conditions. They carry out the tests and provide evidence of the results.
<b>AO7</b> Evaluate a control system	Candidates evaluate their system, giving advantages and at least one disadvantage or limitation of the system they have created.	Candidates give a thorough evaluation of their system, giving advantages, disadvantages and limitations of the system they have created.	Candidates give a thorough evaluation of their system, giving advantages, disadvantages and limitations of the system they have created. They suggest possible improvements.

Assessment Objective	Pass	Merit	Distinction
<b>AO8</b> Describe the health and safety issues related to computer control	Candidates identify at least one way in which an application of computer control aids health or safety. They describe at least one safety issue that must be considered when constructing a control system using electrical signals.	Candidates describe at least two ways in which applications of computer control aid health and/or safety. They describe at least one safety issue that must be considered when constructing a control system using electrical signals, including any issues that are appropriate to the system they construct	Candidates explain at least three ways in which applications of computer control aid health and safety. They explain at least two safety issues that must be considered when constructing a control system using electrical signals, including any issues that are appropriate to the system they construct. They give clear recommendations about the ways to avoid the potential problems they identify.