

# Unit 36: Understanding Computer Application and Control in Land-based Technology

<b>Unit code</b>	<b>J/601/4270</b>
<b>QCF Level 3:</b>	<b>BTEC National</b>
<b>Credit value:</b>	<b>10</b>
<b>Guided learning hours:</b>	<b>60</b>

## ● Aim and purpose

This unit aims to introduce learners to the skills and knowledge in land-based computer application and control systems and how these can be applied in practice. It is designed for learners in centre-based settings looking to progress into the sector or onto further/higher education.

## ● Unit introduction

The need to improve the efficiency and productivity of agricultural cropping has led to the development of more complex application machinery which is reliable and effective in operation. Those employed in the maintenance, fault diagnosis and repair of land-based application equipment must have the knowledge and skills to undertake complex repair activities for repair computerised application and control systems.

In this unit learners will develop the knowledge and skills needed to understand the function and operation of computerised application and control system assemblies and components. They will identify the improved efficiency of the land-based equipment and components and the health and safety issues encountered when carrying out service and repair activities will be stressed during the delivery of this unit.

On completion of this unit, learners will have investigated the application and operation of components used in land-based computer control systems. They will also have studied the function and operation of assemblies used in land-based computer application and control systems.

Learners should be able to set-up, calibrate, test and repair land-based computer application and control systems. They are expected to undertake practical studies to gain experience in computer application and control service repair. Learners will interpret land-based computer application and control workshop manuals and carry out service and repair tasks safely and efficiently.

### **On completion of this unit a learner should:**

- 1 Understand the application and operation of components used in land-based computer application and control systems
- 2 Understand the function of land-based computer application and control systems
- 3 Be able to set and adjust land-based computer application and control systems
- 4 Be able to test and repair land-based computer application and control systems.

## Unit content

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### 1 Understand the application and operation of components used in land-based computer application and control systems

*Processes:* types of processes capable of being controlled and/or monitored eg position control, draft control, velocity, temperature, level, mass, flow, rev/min, sequences of operation; health and safety

*Component parts:* typical sensors fitted to land-based machines eg position, force, pressure, proximity, displacement, velocity, vibration, shock, temperature, flow, strain RPM; need to change signal type (signal conditioning systems) within a system eg voltage-to-voltage, voltage-to-current, analogue-to-digital, digital-to-analogue; block diagrams

*Displays:* typical display types eg light emitting diode, liquid crystal, video display unit, bar graph, analogue meter

*Digital controller:* function of the main blocks in a digital controller eg central processor unit, memory, input output interfaces

### 2 Understand the function of land-based computer application and control systems

*Function:* input and output signals of each of the blocks in a typical digital control system eg level control, speed sensing, position sensing, and temperature control

*Display:* quantity being controlled eg seven segment displays, liquid crystal, video display unit

*Operation:* interaction of component parts within a system; potential malfunction conditions; health and safety

### 3 Be able to set and adjust land-based computer application and control systems

*Initial settings/calibration:* field settings; adjustments; health and safety

*Calibration/adjustment of a typical system:* eg position control sensor calibration; position control, level control, speed sensing, temperature control

### 4 Be able to test and repair land-based computer application and control systems

*Digital instruments:* use of instruments eg multi-meter, oscilloscope, fault code readers, gas analysers

*Fault diagnosis:* common faults eg faults in power supply, sensor, transducer; malfunction indicator lamps; diagnostic trouble codes; manufacturers' recommended testing procedures; health and safety

## Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:	To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:
<b>P1</b> identify the main component parts of given digital control systems [SM, IE]	<b>M1</b> produce labelled block diagrams of given working systems showing the expected signal ranges at each point	<b>D1</b> produce a diagram of a selected working system, including an explanation of how each block functions
<b>P2</b> explain the operation and interaction of given digital control systems [RL]		
<b>P3</b> explain the function of selected application and control systems [RL]	<b>M2</b> distinguish and explain selected systems inputs and outputs	
<b>P4</b> explain the operation of selected application and control systems [RL]		
<b>P5</b> set and adjust given digital control systems. [SM, IE]	<b>M3</b> identify and carry out settings and adjustments of selected digital control systems to optimise performance in accordance with manufacturers' service procedures	
<b>P6</b> carry out test procedures in given computer application and control systems [SM, IE, CT, RL]	<b>M4</b> recognise and review the results of a given incorrectly adjusted digital control system.	
<b>P7</b> repair faults found in given computer application and control systems [SM]		
<b>P8</b> collect and collate test data to assess the condition of selected computer application and control components. [SM, IE, CT]		

**PLTS:** This summary references where applicable in the pass criteria, in the square brackets, the elements of the personal, learning and thinking skills. It identifies opportunities for learners to demonstrate effective application of the referenced elements of the skills.

<b>Key</b>	IE – independent enquirers	RL – reflective learners	SM – self-managers
	CT – creative thinkers	TW – team workers	EP – effective participators

# Essential guidance for tutors

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## Delivery

Delivery of this unit will involve practical assessments, written assessment, visits to suitable collections and will link to industrial experience placements.

Tutors delivering this unit have opportunities to use as wide a range of techniques as possible. Lectures, discussions, seminar presentations, site visits, supervised computer application and control practicals, internet and/or library-based research and the use of personal and/or industrial experience would all be suitable. Delivery should stimulate, motivate, educate and enthuse learners.

Work placements should be monitored regularly in order to ensure the quality of the learning experience. It would be beneficial if learners and supervisors were made aware of the requirements of this unit before any work-related activities so that naturally occurring evidence can be collected at the time. For example, learners may have the opportunity to carry out maintenance and repair activities, and they should be encouraged to ask for observation records and/or witness statements to be provided as evidence of this. Guidance on the use of observation records and witness statements is provided on the Edexcel website.

Visiting expert speakers could add to the relevance of the subject for learners. For example, land-based machinery technicians or workshop managers could talk about their work and the techniques they use.

Whichever delivery methods are used, it is essential that tutors stress the impact computer application and control technologies have on the efficiency of land-based equipment.

Health and safety issues relating to working in repair workshops must be stressed and reinforced regularly, and risk assessments must be undertaken before practical activities and before learners visit any workshop. Adequate personal protective equipment (PPE) must be provided and used following the production of suitable risk assessments.

Tutors should consider integrating the delivery, private study and assessment for this unit with other relevant units and assessment instruments learners are taking as part of their programme of study.

Learners will be aware of the use, and understand the function and operation, of land-based computer application and control systems and their components. This is likely to be delivered through formal lectures, discussion, site visits and independent learner research.

Learners will develop the skills needed to set and adjust computer application and control systems. Learners will look at the methods commonly used to calibrate and locate faults in modern land-based computer application and control systems. Delivery techniques should be varied and can be linked to delivery of other learning outcomes. These are likely to include formal lectures, discussion, supervised practical sessions, site visits and independent learner research.

## Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan gives **an indication of the volume of learning it would take the average learner** to achieve the learning outcomes. It is **indicative and is one way of achieving the credit value**.

Learning time should address all learning (including assessment) relevant to the learning outcomes, regardless of where, when and how the learning has taken place.

## Topic and suggested assignments/activities and/assessment

Introduction and review of unit; testing of previous knowledge.

Theory and demonstration session – applications of digital control systems.

Theory and demonstration session – digital control system components.

Practical session – tracing control system layouts and components.

### **Assignment 1: Digital Control Systems** (P1, P2, P3, P4, M1, M2, D1).

Tutor introduces the assignment brief.

Theory and practical session – drawing system layouts and common symbols.

Theory session – function and operation of digital control systems.

### **Assignment 2: Digital Control System Repair** (P5, P6, P7, P8, M3, M4, D2).

Tutor introduces the assignment brief

Theory session- setting and djusting digital control systems.

Practical session- setting and adjusting digital control systems.

Practical session- in-field trials and operation.

Theory session and demonstration: testing digital control systems.

Practical session- testing digital control systems.

Practical session: repairing digital control systems/component replacement and retesting.

Theory session- common faults and issues with digital control systems and their application and how to minimise these.

Assignment and self-study.

Unit review.

## Assessment

For P1, learners must identify the main component parts of given digital control systems. Tutors should identify the systems or agree them through discussion with learners. Where possible, to ensure fairness of assessment the size and complexity of the tasks should be the same for all learners. Evidence could take the form of a pictorial presentation with notes (possibly using appropriate software or an overhead projector), or an annotated assignment. Alternatively, learners could be assessed verbally using appropriate visual aids within a workshop environment.

P2 requires learners to explain the operation and interaction of given digital control systems. Tutors should identify the application and control systems or agree them through discussion with learners. Where possible, to ensure fairness of assessment the size and complexity of the tasks should be the same for all learners. Evidence could take the form of a pictorial presentation with notes (possibly using appropriate software or an overhead projector), or an annotated assignment. Alternatively, learners could be assessed verbally using appropriate visual aids within a workshop environment.

For P3, learners must explain the function of selected application and control systems. Tutors should identify the application and control systems or agree them through discussion with learners. Where possible, to ensure fairness of assessment the size and complexity of the tasks should be the same for all learners. Evidence could take the form of a pictorial presentation with notes (possibly using appropriate software or an overhead projector), or an annotated assignment. Alternatively, learners could be assessed verbally using appropriate visual aids within a workshop environment.

In P4 learners must explain the operation of selected application and control systems. Tutors should identify the application and control systems or agree them through discussion with learners. Where possible, to ensure fairness of assessment the size and complexity of the tasks should be the same for all learners. Evidence could take the form of a pictorial presentation with notes (possibly using appropriate software or

an overhead projector), or an annotated assignment. Alternatively, learners could be assessed verbally using appropriate visual aids within a workshop environment.

For P5, learners are required to set and adjust given digital control systems. Tutors should identify the systems or agree them through discussion with learners. Where possible, to ensure fairness of assessment the size and complexity of the assemblies should be the same for all learners. P5 could be assessed directly by the tutor during practical activities. If this format is used then suitable evidence from guided activities would be detailed observation records completed by learners and the tutor. If assessed during a placement, witness statements should be provided by a suitable representative and verified by the tutor.

For P6, learners must carry out test procedures found in given computer application and control systems. Tutors should identify the application and systems or agree them through discussion with learners. Where possible, to ensure fairness of assessment the size and complexity of the tasks should be the same for all learners. Learners need to test a range of land-based computer application and control systems ensuring health and safety procedures are adhered to at all times. Where appropriate and safe, assessors could create faults for learner to diagnose and repair. Evidence may be in the same format as suggested for P3.

For P7, learners must repair faults found in given computer application and control systems. Tutors should identify the application and systems or agree them through discussion with learners. Where possible, to ensure fairness of assessment the size and complexity of the tasks should be the same for all learners. Learners need to repair faults in a range of land-based computer application and control systems ensuring health and safety procedures are adhered to at all times. Where appropriate and safe, assessors could create faults for learner to diagnose and repair. Evidence may be in the same format as suggested for P3.

In P8 learners must collect and collate test data to assess the condition of selected computer application and control systems. Tutors should identify the application and components or agree them through discussion with learners. Where possible, to ensure fairness of assessment the size and complexity of the tasks should be the same for all learners. Learners should test computer application and control systems by testing components and assemblies prior to dismantling. The type and degree of the testing should be determined by the manufacturers' recommendations. Evidence may be in the same format as for P4.

For M1, learners must produce labelled block diagrams of given working systems showing the expected signal ranges at each point. Tutors should identify the systems or agree them through discussion with learners. Where possible, to ensure fairness of assessment the size and complexity of the tasks should be the same for all learners. Evidence may be in the same format as for P1.

For M2, learners must distinguish and explain selected systems' inputs and outputs, indicating interactions between the components. Tutors should identify the systems or agree them through discussion with learners. Where possible, to ensure fairness of assessment the size and complexity of the assemblies should be the same for all learners. Evidence may be in the same format as suggested for P1.

For M3, learners must identify and carry out settings and adjustments of selected digital control systems to optimise performance in accordance with manufacturers' service procedures. Tutors should identify the systems or agree them through discussion with learners. Where possible, to ensure fairness of assessment the size and complexity of the assemblies should be the same for all learners. Learners should calibrate a range of land-based computer application and control systems, ensuring health and safety procedures are adhered to at all times. They are required to interpret manufacturers' service procedures and make necessary adjustments. Evidence may be in the form of written reports or in a similar format to that suggested for P3.

For M4, learners are required to recognise and review the results of a given, incorrectly adjusted digital control system. Tutors should identify the system or agree it through discussion with learners. Where possible, to ensure fairness of assessment the size and complexity of the computer application and control system should be the same for all learners. To enable learners to obtain accurate review facts they should operate and/or discuss with experienced operators the indicators of incorrectly adjusted computer application and control systems. Evidence could be in a format similar to that suggested for D2. Alternatively, oral evidence could be given during practical activities using observation records and/or witness statements.

For D1, learners must produce a diagram of a selected working system, including an explanation of how each block functions. Tutors should identify the system or agree it through discussion with learners. Where possible, to ensure fairness of assessment the size and complexity of the computer application and control system should be the same for all learners. Evidence could be in the format of tabulated data, notes from discussions and written reports.

For D2, learners are required to discuss conditions that would create a malfunction in a selected system operation and subsequent consequences. Tutors should identify the system or agree it through discussion with learners. Where possible, to ensure fairness of assessment the size and complexity of the computer application and control system should be the same for all learners. Learners need to operate and/or discuss with experienced operators the malfunctions experienced within computer application and control systems. Evidence could be in the format of tabulated data, notes from discussions and written reports.

### Programme of suggested assignments

The following table shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Edexcel assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1, P2, P3, P4, M1, M2, D1	Digital Control Systems	You are a fitter in an agricultural engineering workshop and three machines are brought in for repairs to faulty computer application and control systems. You must identify the main components of the systems explaining their function.	Verbal and/or written report and/or presentation.
P5, P6, P7, P8, M3, M4, D2	Digital Control System Repair	Test, repair, reset and adjust the digital control systems explaining to the operator/owner how these are affected by operating conditions.	Practical observation and assessment.

### Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC land-based sector suite. This unit has particular links with:

Level 2	Level 3
Service and Repair Electrical Systems on Land-based Equipment	Maintain Electronic Control and Monitoring Systems on Land-based Equipment

### Essential resources

Learners will need access to manufacturers' service and repair manuals for a range of land-based machines and equipment that use computer application and control systems. Learners should also have access to computer control systems and test equipment as well as be given the chance to relate these to their industrial setting. They should also have access to current equipment that utilises computer application and systems covered.

Tutors delivering this unit should be familiar with digital technology and control systems as used by current equipment manufacturers.



## Employer engagement and vocational contexts

It is essential that this unit is delivered in an applied and vocational context. Work-based experience will also be important. The unit will be enhanced by contact with employers. Centres are encouraged to develop links with local businesses, manufacturers, machinery dealers and workshops, who can support the breadth and application of this unit. Employers can provide real work practical exercises and guest speakers and experts to support the learning experience. Employer engagement will ensure the use of technically up-to-date information and processes.

## Indicative reading for learners

### Textbooks

Bolton W – *Instrumentation and Control Systems* (Newnes, 2004) ISBN 0750664320

Bolton W – *Programmable Logic Controllers, 5<sup>th</sup> Edition* (Newnes, 2009) ISBN 1856177511

Crispin A – *Programmable Logic Controllers and Their Engineering Applications, 2nd Edition* (McGraw-Hill Education, 1996) ISBN 0077093178

Incorporated Analog Devices – *Transducer Interfacing Handbook: A Guide to Analog Signal Conditioning* (Analog Devices Inc, 1980) ISBN 0916550052

### Journals

*Farmers Guardian*

*Farmers Weekly*

*Profi International*

### Website

[www.howstuffworks.com](http://www.howstuffworks.com)

HowStuffWorks

## Delivery of personal, learning and thinking skills (PLTS)

The following table identifies the PLTS opportunities that have been included within the assessment criteria of this unit:

Skill	When learners are ...
<b>Independent enquirers</b>	carrying out test procedures in given computer application and control systems collecting and collating test data to assess the condition of selected computer application and control components
<b>Creative thinkers</b>	carrying out test procedures in given computer application and control systems collecting and collating test data to assess the condition of selected computer application and control components
<b>Reflective learners</b>	explaining the operation and interaction of given digital control systems explaining the function of selected application and control systems
<b>Self-managers</b>	identifying the main component parts of given digital control systems setting and adjusting given digital control systems carrying out test procedures in given computer application and control systems.

Although PLTS opportunities are identified within this unit as an inherent part of the assessment criteria, there are further opportunities to develop a range of PLTS through various approaches to teaching and learning.

Skill	When learners are ...
<b>Team workers</b>	identifying the main component parts of given digital control systems setting and adjusting given digital control systems carrying out test procedures in given computer application and control systems repairing faults found in given computer application and control systems collecting and collating test data to assess the condition of selected computer application and control components.

## ● Functional Skills – Level 2

Skill	When learners are ...
<b>ICT – Use ICT systems</b>	
Select, interact with and use ICT systems independently for a complex task to meet a variety of needs	<p>carrying out test procedures in given computer application and control systems</p> <p>collecting and collating test data to assess the condition of selected computer application and control components</p>
Use ICT to effectively plan work and evaluate the effectiveness of the ICT system they have used	
Manage information storage to enable efficient retrieval	<p>carrying out test procedures in given computer application and control systems</p> <p>collecting and collating test data to assess the condition of selected computer application and control components</p>
Follow and understand the need for safety and security practices	
Troubleshoot	<p>carrying out test procedures in given computer application and control systems</p> <p>collecting and collating test data to assess the condition of selected computer application and control components</p>
<b>ICT – Find and select information</b>	
Select and use a variety of sources of information independently for a complex task	identifying the main component parts of given digital control systems
Access, search for, select and use ICT-based information and evaluate its fitness for purpose	
<b>ICT – Develop, present and communicate information</b>	
Enter, develop and format information independently to suit its meaning and purpose including: <ul style="list-style-type: none"> <li>● text and tables</li> <li>● images</li> <li>● numbers</li> <li>● records</li> </ul>	collecting and collating test data to assess the condition of selected computer application and control components
Bring together information to suit content and purpose	<p>carrying out test procedures in given computer application and control systems</p> <p>collecting and collating test data to assess the condition of selected computer application and control components</p>
Present information in ways that are fit for purpose and audience	giving presentation to peers
Evaluate the selection and use of ICT tools and facilities used to present information	

Skill	When learners are ...
Select and use ICT to communicate and exchange information safely, responsibly and effectively including storage of messages and contact lists	
<b>English</b>	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	explaining the operation and interaction of given digital control systems explaining the function of selected application and control systems explaining the operation of selected application and control systems
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	explaining the operation and interaction of given digital control systems explaining the function of selected application and control systems explaining the operation of selected application and control systems.