Unit 89: Further Aircraft Electronic Circuits and Avionic Systems

Unit code: Y/600/7324

QCF Level 3: BTEC Nationals

Credit value: 20

Guided learning hours: 120

Aim and purpose

This unit will provide learners with an understanding of a range of aerospace electronic circuits and avionic systems including automatic flight and landing systems, flight instrument alerting, warning and indication systems and gas turbine engines and their associated control systems.

Unit introduction

This unit will broaden learners' knowledge of aircraft electronic circuits and devices and aircraft logic circuits. Learners will study electronic diodes, transistors and amplifiers, together with their associated circuits and circuit applications, including rectifier, switching circuits and operational amplifiers. The nature and testing of printed circuit boards is also covered.

The unit will introduce learners to automatic flight systems, where automatic flight control, auto-throttle and automatic landing systems are covered. Learners will then extend their knowledge of aircraft instrument systems through the study of electronic flight instrument alerting, warning and indication systems. The final part of the unit will give learners the knowledge of gas turbine engines required by avionic engineers. In particular learners will study the constructional arrangement and basic operation of various types of gas turbine engine, together with the methods of electronically controlling the engine, particularly the fuel system.

This unit, together with *Unit 84: Aircraft Electrical Systems* completely covers the underpinning knowledge required for the European Aviation Safety Agency (EASA) Part 66 Module 14. When taken with the prerequisite units and the other electrical and electronic units, this unit also completes all the necessary systems knowledge for Module 13 of the Part 66 syllabus. The unit will also be useful for those seeking a career as an avionic maintenance technician with the armed forces.

Learning outcomes

On completion of this unit a learner should:

1 Understand basic logic circuit fundamentals, multiplexers and integrated circuits

2 Understand the parameters, characteristics and operation of semi-conductor diodes and diode circuits

3 Understand the symbols, construction, operation and testing of transistors and the types and operating principles of transistor circuits

4 Understand amplifier circuit fundamentals, amplifier circuit arrangements and the operation and characteristics of operational amplifiers

5 Know the nature of printed circuit boards and their testing in electronic circuits

6 Understand the fundamental theory, function and operation of aircraft automatic flight and landing systems

7 Understand the function and operation of electronic flight instrument alerting, warning and indication systems

8 Know about the constructional arrangement and operation of gas turbine engines and understand, their associated control systems.

Unit content

1 Understand basic logic circuit fundamentals, multiplexers and integrated circuits

Basic logic circuit fundamentals: identify and interpret common logic elements (AND, OR, exclusive-OR, NAND, NOR, and NOT gates) and symbols; logic families/components (characteristics of TTL, LS-TTL and CMOS devices); logic tables and equivalent circuits

Multiplexers: operation, application and interpretation in logic diagrams of multiplexers (data selectors) and de-multiplexers

Integrated circuits: function, use and operation of different encoders and decoders; medium, large and very large integration

2 Understand the parameters, symbols, characteristics and operation of semi-conductor diodes and the arrangement, function and operation of diode circuits

Semi-conductor diodes: basic diode parameters (peak, inverse voltage, maximum forward current, temperature, frequency, leakage current, power dissipation); symbols; characteristics and operation eg of rectifier diodes, zener diodes, silicon-controlled rectifiers, light emitting diodes, photoconductive diodes, varactor diodes, Schottky diodes, signal (detector) diodes

Diode circuits: use of series and parallel diode circuits; operation and function eg of clippers, clampers, full-wave/half-wave/bridge rectifiers, power controllers, over-current and over voltage protection, radio frequency interference, voltage multipliers (doublers and triplers)

3 Understand the symbols, construction, operation and testing of transistors and the types and operating principles of transistor circuits

Transistors: operation and configuration (base, collector, emitter) of PNP and NPN transistors and appreciation of field-effect transistors (FET); testing of transistors

Transistor circuits: types eg bias, decoupling, feedback and stabilisation; multistage circuit operation eg cascades, push-pull, oscillators, multi-vibrators, flip-flop circuits

4 Understand amplifier circuit fundamentals, amplifier circuit arrangements and the operation and characteristics of operational amplifiers

Amplifier circuits fundamentals: basic terminology (voltage gain, current gain, power gain, input resistance, input impedance, frequency response, lower-cut-off frequency, upper cut-off frequency, bandwidth); power circuit types and operation (such as A, B and C classes)

Circuit operation and coupling arrangements: circuits eg simple and stabilised common-emitter bipolar junction transistor (BJT) amplifier circuits, coupling, decoupling and bias stabilisation, multi-stage amplifiers and coupling arrangements (R-C, L-C, transformer and direct coupling), positive and negative feedback

Operational amplifiers: symbols, characteristics and operation eg inverting, non-inverting, voltage follower, integrator, comparator and differential, amplifier circuits

5 Know the nature of printed circuit boards and their testing in electronic circuits

Nature: use and description of printed circuit boards eg single and multi-layer boards, conventional and surface mounted components, printed circuit board headers and connectors, decoupling, land and ground areas, coatings

Testing: procedures and related safety precautions eg correct circuit inputs/outputs, continuity, component security/integrity, correct operation

6 Understand the fundamental theory, function and operation of aircraft automatic flight and landing systems

Automatic flight: fundamentals of auto-flight control (working principles/terminology, command signal processing); function and operation eg of stability augmentation system in helicopters, automatic trim control, yaw damping, autopilot navigation aids interface, auto-throttle

Automatic landing systems: modes of operation (approach, glide slope, land, go-round), operating principles and system monitoring and failure conditions

7 Understand the function and operation of electronic flight instrument alerting, warning and indication systems

Alerting and warning systems: function and operation eg of altitude reporting/alerting, stall protection, instrument warnings (such as master warning systems, centralised warning systems), use of air data computers

Indication systems: function and operation eg fuel quantity indication systems, flight data recording systems, electronic flight instrument systems (attitude director indicator, horizontal situation indicator), vibration measurement and indication

8 Know about the constructional arrangement and operation of gas turbine engines and understand, their associated control systems

Gas turbine engines: constructional arrangement and operation eg of basic gas generator, turbojet, turbofan, turbo-shaft and turbo-propeller engines

Engine control: operation and arrangement of electronic engine controller (EEC); full authority digital engine control (FADEC) fuel metering system

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:**	
P1	identify the basic logic elements by their symbols and produce logic truth tables for these elements when used in combination in simple logic circuits	**M1**	explain the importance of emerging technology in the development and use of medium, large and very large integration, for aircraft electronic systems	**D1**	using a given unlabelled circuit diagram of a transistor master-slave JK flip flop system, explain its operation from the clock/JK inputs to the outputs
P2	draw up a table that compares the characteristics and relative advantages of TTL, LS-TTL and CMOS logic components [IE3, IE4]	**M2**	draw the circuit diagram of a diode circuit set-up as a voltage tripler and explain its operation using example quantitative values	**D2**	using given circuit diagrams explain the operation and characteristics of diode circuit/s used for aircraft generator over current and over voltage protection
P3	identify, interpret and explain the operation of a multiplexer and de-multiplexer with the aid of a given logic diagram	**M3**	draw a circuit diagram for a Schottky diode circuit, detail the characteristics of this diode and explain its operation and use	**D3**	solve quantitative problems on operational amplifier circuits for voltage and current gain, when set up in cascade and as an integrator and differentiator
P4	explain the function of two different encoder and decoder types in aircraft digital electronic circuits and explain for one encoder and one decoder, its operation	**M4**	compare the advantages and disadvantages of positive and negative feedback and draw a circuit diagram and explain the operation of a series voltage feedback amplifier	**D4**	investigate the full authority digital engine control (FADEC) fuel metering system and report on its operation, physical arrangement and system interfacing.
P5	define all basic diode parameters and draw the symbols, state the characteristics and explain the operation of rectifier diodes, zener diodes and photo conductive diodes	**M5**	explain the operation and interfacing of the autopilot navigation aids and auto-throttle		
P6	state the characteristics and explain the operation of rectifier diodes, zener diodes and photo conductive diodes	**M6**	report on the use for air data computer inputs into two typical electronic flight instrument systems and explain the operation of these systems		

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:**
P7 give one use each for diode circuits connected in series and in parallel and explain the use and operation of half-wave, full wave and bridge rectifiers	**M7** sketch the constructional arrangement and compare the operating principles and parameters of turbojet and turbofan engines.	
P8 explain, using circuit symbols the operation of PNP and NPN transistors and state the use and properties for field-effect transistors (FET)		
P9 carry out functional tests on PNP and NPN transistors using lead pair conduction techniques		
P10 sketch and label a transistor feedback circuit and explain the operation of a typical oscillator circuit using a given circuit diagram		
P11 define the basic amplifier terms and describe the relative merits and application for class A, B and C amplifier circuit arrangements		
P12 sketch and explain the operation of a coupled BJT amplifier circuit		
P13 sketch and explain the operation of an amplifier circuit set up to act as a differentiator		
P14 describe the arrangement of a typical surface-mounted, multi-layered circuit board, give one aircraft system use for such a board and detail the procedure for checking the board for correct inputs and outputs		
P15 explain the fundamental principles and current terminology used for auto-flight control		

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:**
P16 state the function and with the aid of a given diagram, explain the operation of automatic trim control		
P17 describe the operating modes and with the aid of a given diagram, explain the principles of operation, system monitoring methods and failure conditions for an aircraft automatic landing system		
P18 state the functions and explain with the aid of a given circuit diagram the operation of an aircraft stall warning system		
P19 state the function and explain with the aid of a given circuit diagram the operation of an aircraft fuel contents indication system		
P20 sketch and describe the constructional arrangement of the basic gas turbine generator and the turboprop engine		
P21 sketch the arrangement and describe the operation of an electronic engine controller.		

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

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

Essential guidance for tutors

Delivery

The learning outcomes would be best delivered in order. The first 4 learning outcomes will expand learners' existing knowledge of digital and micro-electronics. This will enable them to fully understand the application of these subjects in aircraft electronic and avionic systems in the second half of the unit. The more in-depth treatment of logic, diodes, transistors and amplifiers and their associated circuits will enable learners to more fully understand the avionic systems covered in *Unit 76: Aircraft Computers and Electronic Systems* and *Unit 87: Avionic Systems*.

Throughout the delivery of this unit, learners should have access to the relevant aircraft components and systems hardware, particularly for learning outcomes 5, 6, 7 and 8. Tutors should also note that learners need to cover all the unit content listed as 'egs' in order to fully meet EASA Part 66 knowledge requirements. This will require learners to undertake additional self-study outside the tutor guided learning hours given for the unit.

Learning outcome 1 covers some of the logic fundamentals and logic circuits that learners will not have covered previously, such as data selectors and integrated circuits using encoders. This knowledge gives learners an example overview of electronic circuit integration that will help them appreciate the electronic devices that follow in outcomes 2, 3 and 4 of the unit. When delivering this learning outcome it is therefore important to stress that the structural building blocks for these logic circuits are the semi-conductor devices that they will study in detail.

When delivering learning outcome 2, tutors should ensure that learners know all the diode parameters listed and the symbols for all the diodes under the 'eg' content. When talking about the use for series and parallel diode circuits, emphasis should be placed on their use in high power applications, where a single device is inadequate. Learners will need to know about the operation and function of diode rectifier, power controller, voltage regulation and voltage multipliers and be aware of the function and application of the other devices listed.

Learning outcome 3 covers transistor theory, testing and applications. The operation and configuration of PNP and NPN transistors needs to be covered in detail and mention made of the properties and use of other transistors such as the FET. Example PNP and NPN transistors will need to be made available for testing each pair of leads for conduction using a multimeter or simple tester consisting of a battery, resistor and LED. When talking about the types and operation of transistor circuits, their use in aircraft microprocessors and computers needs to be emphasised.

As well as all the amplifier terms in learning outcome 4, learners should be aware of power circuit types and their operation and the coupling arrangements and operation of multi-stage amplifiers. These should be emphasised during delivery, giving examples of their use in aircraft circuits, perhaps by asking learners to study aircraft circuit diagrams taken from maintenance manuals and other information sources. Learners will also need to understand the characteristics and operation of a range of operational amplifiers and their use, particularly in aircraft closed-loop control systems and servomechanisms.

Learning outcome 5, in terms of content, is the smallest outcome and the time allocated to its delivery should reflect this. Learners need to be able to describe the layout of a variety of circuit boards and detail the use of a variety of types. Therefore a selection of circuit boards, used in a variety of aircraft electronic components should be made available for learners to view, together with manufacturers' instructions (or similar) detailing the function and testing methods for these boards.

Learning outcome 6 builds on and broadens the knowledge covered in learning outcome 3 of *Unit 87: Avionic Systems*. Therefore a reminder of this prerequisite material would be a good way of introducing automatic flight and landing system fundamentals, emphasising the component interfacing and command signal

processing route. The function and operation of the chosen systems from the 'eg' material might best be delivered by learners studying and interpreting manufacturers' and/or maintenance manual system schematics and circuit wiring diagrams. This approach could also be used to deliver the content for automatic landing systems. Learners would benefit from having practical access to relevant systems hardware and displays, or possibly studying videos of system components, layout and displays.

Learning outcome 7 might best be delivered in a similar way to learning outcome 6, where the chosen alert, warning and indicating systems are viewed for real as well as being studied through the use of schematic and circuit wiring diagrams. Learners will need to separately study those systems not covered during the formal delivery time, with priorities being based on the nature and requirements of the cohort being taught.

Learning outcome 8, together with the content contained in learning outcome 3 of *Unit 84: Aircraft Electrical Systems* and learning outcome 3 of *Unit 85: Aircraft Instruments and Indicating Systems*, provides all the theory concerning gas turbine engines and their control needed to satisfy Part 66 Module 14. Learners will need to have an understanding of the constructional arrangement and basic operation of a gas turbine generator and the additions required for turbojet, turbofan, turbo-shaft and turbo-propeller engine variants. In addition, from both an avionic and mechanical perspective learners will need an in-depth understanding of electronic engine controllers and in particular, the FADEC fuel metering system. Again, learners should have access to the engine and system hardware or at least be able to view appropriate videos showing the construction and operation of gas turbines and their control systems.

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 demonstrates one way in planning the delivery and assessment of this unit.

Topic and suggested assignments/activities and/assessment
Whole-class teaching: • introduction to unit content, scheme of work and methods of assessment • explain logic elements, families, components and logic tables and equivalent circuits • explain operation and application of multiplexers • explain the function, operation and application of integrated circuits. *Individual learner activities:* • individual study/research of logic circuits
Prepare for and carry out **Assignment 1: Logic Circuits and Integrated Circuits** (P1, P2, P3, P4, M1)
Whole-class teaching: • explain parameters, characteristics and operation of a range of semi-conductor diodes • identify and explain use of symbols for diodes • describe the use of series and parallel diode circuits including their use in high power applications • explain the operation and function of diode circuits, focussing on diode rectifier, power controller, voltage regulation and voltage multipliers. *Individual learner activities:* • individual study/research of semi-conductor diodes and diode circuits .
Prepare for and carry out **Assignment 2: Semi-conductor Diodes, Diode Circuits** (P5, P6, P7, M2, M3 and D2)

Topic and suggested assignments/activities and/assessment
Whole-class teaching: • explain operation, configuration and testing of transistors *Practical workshop activities:* • testing PNP and NPN transistors using a multimeter or similar *Whole-class teaching:* • explain the different types of transistor circuits and their application in aircraft microprocessors and computers *Individual learner activities:* • individual study/research of transistors and transistor circuits
Whole-class teaching: • explain the basic terminology related to amplifier circuits • explain the operation of different power circuit types • explain the operation and arrangements of amplifier circuits • explain the use of relevant symbols, the characteristics and operation of operational amplifiers and their application in aircraft closed-loop control systems and servomechanisms *Individual learner activities:* • individual study/research of amplifier circuit types and their operation, using aircraft circuit diagrams
Prepare for and carry out **Assignment 4: Amplifiers and Amplifier Circuits** (P11, P12, P13, M4, D3)
Whole-class teaching: • describe and explain the use of PCBs • explain testing procedures for PCBs and related safety precautions *Practical workshop activities:* • practical investigation and testing of a range of circuit boards used in aircraft electronic components.
Prepare for and carry out **Assignment 3: Transistors, Transistor Circuits and Circuit Boards** (P8, P9, P10, P14 and D1)
Whole-class teaching: • review of work carried out in Unit 87: Avionic Systems • explain the working principles/terminology and command signal processing of auto-flight control • explain the function and operation of auto-flight control systems • explain the operation, system monitoring and failure conditions for automatic landing systems *Individual learner activities:* • interpreting manufacturers' and/or maintenance manual system schematics and circuit diagrams *Practical workshop activities:* • practical investigation of system hardware and components *Individual learner activities:* • individual study/research of automatic flight control and landing systems
Prepare for and carry out **Assignment 5: Automatic Flight** (P15, P16, P17, M5)

Topic and suggested assignments/activities and/assessment
Whole-class teaching: • explain the function and operation of alerting and warning systems • explain the function and operation of flight instrument indication system. *Individual learner activities:* • interpreting manufacturers' and/or maintenance manual system schematics and circuit diagrams *Practical workshop activities:* • practical investigation of system hardware and components. *Individual learner activities:* • individual study/research of alerting, warning and indication systems.
Prepare for and carry out **Assignment 6: Electronic Flight Instruments** (P18, P19 and M6)
Whole-class teaching: • explain the construction and operation of aircraft gas turbine engines and engine variants • explain the construction and operation of electronic engine controllers, focussing on FADEC fuel metering systems. *Practical workshop activities:* • practical investigation of engine, system hardware and components. *Individual learner activities:* • individual study/research of alerting, warning and indication systems.
Prepare for and carry out **Assignment 7: Gas Turbine Engines and Control** (P20, P21, M7 and D4)
Feedback on assessment and unit review

Assessment

The assessment evidence for this unit can be developed through a combination of theoretical/practical assignments, investigations and formal written assessments.

The method of assessment preferred by national legislative bodies relative to the aerospace industry involves the use of multiple-choice questions. Many centres may have existing banks of multiple-choice questions designed to prepare and test learners for EASA Part 66 avionic module examinations. Where learners are aiming to achieve recognised licensed status, this method of assessment could be adopted as a means of supporting and checking learning. Multiple-choice questions should not, however, be used as assessment instruments for the purposes of this unit.

With the large number of criteria required to satisfy this double unit, it is likely that at least seven assessment instruments will be needed. The assessment strategy should be carefully considered so that it does not place an unduly heavy assessment burden on learners or the tutor.

Clearly, the ability to work safely in an aircraft electronic/avionic environment should be paramount and centres should ensure that learners are adequately briefed concerning the hazards that exist.

The seven assessment instruments could be based on:

- logic, logic circuits, integrated circuits (providing evidence that will contribute to P1, P2, P3, P4, M1)
- semi-conductor diodes, diode circuits (providing evidence that will contribute to P5, P6, P7, M2, M3 and D2)
- transistors, transistor circuits and circuit boards (providing evidence that will contribute to P8, P9, P10, P14 and D1)
- amplifiers and amplifier circuits (providing evidence that will contribute to P11, P12, P13, M4, D3)
- automatic flight (providing evidence that will contribute to P15, P16, P17, M5)
- electronic flight instruments (P18, P19 and M6)
- gas turbine engines and their control (P20, P21, M7 and D4).

Note that the appropriate documentation, circuit and schematic diagrams needed to complete the assessment instruments should be readily available.

Programme of suggested assignments

The table below shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the assessment and 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	Logic Circuits and Integrated Circuits	A formal assignment requiring learners to respond to written tasks.	A written report including appropriate tables and production of a circuit diagram.
P5, P6, P7, M2, M3 and D2	Semi-conductor Diodes, Diode Circuits	A formal assignment requiring learners to respond to written tasks.	A written report including use of symbols and production of a circuit diagram.
P8, P9, P10, P14 and D1	Transistors, Transistor Circuits and Circuit Boards	A two-part assignment, consisting of set written tasks followed by practical functional testing of transistors.	A written report including appropriate circuit diagrams and a log of practical tests carried out.
P11, P12, P13, M4, D3	Amplifiers and Amplifier Circuits	A formal assignment requiring learners to respond to written tasks.	A written report including production of a circuit diagram.
P15, P16, P17, M5	Automatic Flight	A formal assignment requiring learners to respond to written tasks.	A written report.
P18, P19 and M6	Electronic Flight Instruments	A formal assignment requiring learners to respond to written tasks.	A written report.
P20, P21, M7 and D4	Gas Turbine Engines and Control	A formal assignment requiring learners to respond to written tasks.	A written report including production of circuit diagrams.

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

This unit forms part of the BTEC Engineering sector suite. This unit has particular links with:

Level 1	Level 2	Level 3
		Aircraft Computers and Electronic Systems
		Avionic Systems
		Aircraft Electrical Systems
		Aircraft Instruments and Indicating Systems

Essential resources

It is essential that learners have access to electronic devices that include logic components, diodes, transistors, transistor amplifiers and other associated electronic components. They will also need example logic circuits, circuit boards and diode, transistor and amplifier circuitry. In addition learners will require full access to all relevant aircraft maintenance specialist documentation, manufacturers' leaflets, maintenance manuals, electronic circuit diagrams and avionic system diagrams.

Employer engagement and vocational contexts

Much of the work for this unit can be set in the context of learners' work placements or be based on case studies of local employers. Further information on employer engagement is available from the organisations listed below:

- Work Experience/Workplace learning frameworks – Centre for Education and Industry (CEI -University of Warwick) – www.warwick.ac.uk/wie/cei/
- Learning and Skills Network – www.vocationallearning.org.uk
- Network for Science, Technology, Engineering and Maths Network Ambassadors Scheme – www.stemnet.org.uk
- National Education and Business Partnership Network – www.nebpn.org
- Local, regional Business links – www.businesslink.gov.uk
- Work-based learning guidance – www.aimhighersw.ac.uk/wbl.htm

Indicative reading for learners

Textbooks

Dingle L and Tooley M – *Aircraft Engineering Principles* (Elsevier, 2005) ISBN 075065015X

Eismin T – *Aircraft Electricity and Electronics* (McGraw-Hill, 1994) ISBN 0071132864

Moir I and Seabridge A – *Civil Avionic Systems* (John Wiley and Sons, 2006) ISBN 0470029293

Tooley M – *Electronic Circuits: Fundamentals and Applications* (Newnes, 2006) ISBN 0750669233

Tooley M and Wyatt D – *Aircraft Digital and Computer Systems* (Butterworth-Heinemann, 2006) ISBN 9780750681384

Delivery of personal, learning and thinking skills

The table below identifies the opportunities for personal, learning and thinking skills (PLTS) that have been included within the pass assessment criteria of this unit.

Skill	When learners are ...
Independent enquirers	analysing and evaluating information and exploring the characteristics and relative advantages of TTL, LS-TTL and CMOS logic components.

Although PLTS 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 ...
Reflective learners	setting goals with success criteria for their development and work.

Functional skills – Level 2

Skill	When learners are ...
English	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	explaining the function and operation of a range of aircraft electronic circuits and devices
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	researching and investigating aircraft electronic circuits and devices
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	explaining the function and operation of a range of aircraft electronic circuits and devices.