



National Unit Specification: general information

UNIT Electronic Test Equipment and Measurement (SCQF level 5)

CODE F5DC 11

SUMMARY

The Unit is intended for candidates with little or no prior knowledge or skills in using electronic test equipment. The Unit is suitable for those candidates training to be an electronic craftsperson. The Unit is also suitable for candidates whose primary trade is not electronics but who require knowledge and skills in electronic test equipment and measurement. The aim of the Unit is to provide candidates with the knowledge and skills to set up electronic test equipment and carry out measurements and tests on electronic circuits. Candidates will perform measurements on both analogue and digital circuits and verify correct circuit operation.

This Unit may form part of a National Qualification Group Award or be offered on a free standing basis.

OUTCOMES

- 1 Safely and effectively use analogue and digital multimeters to carry out and record measurements in electronic circuits.
- 2 Safely and effectively use an oscilloscope to display, measure and record waveforms in electronic circuits.
- 3 Safely and effectively use function generators to provide test signals.
- 4 Safely and effectively use a logic probe to measure and record digital signals through a combinational logic circuit.

RECOMMENDED ENTRY

While entry is at the discretion of the centre, candidates would normally be expected to have attained one of the following, or equivalent:

- ◆ Standard Grade in a Science or Technology subject — General Level

Administrative Information

Superclass: XL

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CREDIT VALUE

1 credit at SCQF level 5 (6 SCQF credit points at SCQF level 5*).

**SCQF credit points are used to allocate credit to qualifications in the Scottish Credit and Qualifications Framework (SCQF). Each qualification in the Framework is allocated a number of SCQF credit points at an SCQF level. There are 12 SCQF levels, ranging from Access 1 to Doctorates.*

CORE SKILLS

There is no automatic certification of Core Skills in this Unit.

This Unit provides opportunities for candidates to develop aspects of the following Core Skill:

- ◆ Problem Solving (SCQF level 5)
- ◆ Working with Others (SCQF level 5)

These opportunities are highlighted in the Support Notes of this Unit Specification.

National Unit Specification: statement of standards

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Acceptable performance in this Unit will be the satisfactory achievement of the standards set out in this part of the Unit Specification. All sections of the statement of standards are mandatory and cannot be altered without reference to SQA.

OUTCOME 1

Safely and effectively use analogue and digital multimeters to carry out and record measurements in electronic circuits.

Performance Criteria

- (a) The selection of measurement instrument is appropriate for a given task.
- (b) The connection of the instrument to the circuit is correct.
- (c) The measured values are recorded accurately.
- (d) The candidate uses measurement instruments in a safe manner.

OUTCOME 2

Safely and effectively use an oscilloscope to display, measure and record waveforms in electronic circuits.

Performance Criteria

- (a) The adjustment and calibration of an oscilloscope is correct.
- (b) The connection of an oscilloscope to the circuit under test is correct.
- (c) The measurement and recording of the displayed waveform is correct.
- (d) The candidate uses the oscilloscope in a safe manner.

OUTCOME 3

Safely and effectively use function generators to provide test signals.

Performance Criteria

- (a) The selection of a function generator is appropriate for a given task.
- (b) The adjustment of controls to obtain a specified output is correct.
- (c) The specified waveform is verified.
- (d) The candidate uses the function generator in a safe manner.

National Unit Specification: statement of standards (cont)

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OUTCOME 4

Safely and effectively use a logic probe to measure and record digital signals through a combinational logic circuit.

Performance Criteria

- (a) The selection of a logic probe is appropriate for a given task.
- (b) The use of a logic probe to measure digital signals is correct through given combinational logic circuits.
- (c) The candidate uses the logic probe in a safe manner.

EVIDENCE REQUIREMENTS FOR THIS UNIT

Evidence is required to demonstrate that candidates have achieved all Outcomes and Performance Criteria.

Performance evidence supplemented with an assessor observation checklist as well as written and/or recorded oral evidence is required which demonstrates that the candidate has achieved all Outcomes to the standards specified in the Outcome and Performance Criteria.

This evidence will be produced under supervised, controlled conditions at appropriate points throughout the Unit either on an Outcome by Outcome basis or as integrated assessments, for example Outcomes 2 and 3. All calculations and measurements should be given using the relevant SI units of measurement.

An assessor observation record/checklist must be used to record the candidate performance in all Outcomes during the given tasks and be retained by the centre as well as the candidate producing a record of measurements taken.

The required written and/or oral evidence generated under open-book conditions for all Outcomes is as follows:

- ◆ the candidate will be required to record all measurements to the relevant degree of accuracy on the worksheets provided
- ◆ the candidate will be required to explain the waveforms displayed on the oscilloscope
- ◆ the candidate will be required to record the verification of given electronic circuits on the worksheets provided

The performance evidence generated under supervised controlled conditions is as follows:

For Outcome 1 the candidate is provided with two pre constructed circuits each to include a three resistor network (two resistors in parallel with one in series).

National Unit Specification: statement of standards (cont)

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The resistor networks should be connected to both direct current (dc) and alternating current (ac) power supplies, in turn. The candidate must:

- ◆ correctly carry out a total of nine measurements from each circuit, three each of voltage, current and resistance

For Outcome 2 the candidate is provided with an oscilloscope where the controls have been incorrectly set. The candidate must:

- ◆ correctly adjust the controls to obtain a signal trace
- ◆ calibrate the oscilloscope using the external controls available
- ◆ correctly measure the periodic time and peak to peak voltage of two sinusoidal waveforms
- ◆ correctly measure the periodic time, peak to peak voltage and mark to space ratio of two square waveforms
- ◆ correctly measure the periodic time, peak to peak voltage of two triangular waveforms

For Outcome 3 the candidate is provided with function generators where the controls are incorrectly set. The candidate must:

- ◆ correctly set the function generator controls to produce two sine waveforms of given voltage and frequency
- ◆ correctly set the function generator controls to produce two square waveforms of given voltage and frequency
- ◆ correctly set the function generator controls to produce two triangular waveforms of given voltage and frequency
- ◆ correctly set the function generator controls to produce a suitable input signal for a given pre constructed electronic circuit

For Outcome 4 the candidate is provided with two pre constructed combinational logic circuits (one each of TTL and CMOS) containing three two input logic gates. The candidate must:

- ◆ be given layout and circuit schematic diagrams.
- ◆ be informed of the test equipment available and the number of measurements to be made.

The Assessment Support Pack for this Unit illustrates the type of electronic circuits that should be used to carry out measurements using the appropriate test equipment. An assessor observation checklist is also included in the Assessment Support Pack. Centres wishing to design their own instruments of assessment should refer to the Assessment Support Pack to ensure a comparable standard.

National Unit Specification: support notes

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This part of the Unit Specification is offered as guidance. The support notes are not mandatory.

While the exact time allocated to this Unit is at the discretion of the centre, the notional design length is 40 hours.

GUIDANCE ON THE CONTENT AND CONTEXT FOR THIS UNIT

This is a mandatory Unit within the National Certificate in Electronic Engineering at SCQF level 5 but can also be delivered as a free-standing Unit.

The Unit may be taught in conjunction with other Units that make up the award, this may allow the candidate further opportunities to develop knowledge and skills. Electronic circuits designed, simulated and/or constructed in other Units could be used as test circuits.

The aim of this Unit is to introduce candidates to a range of electronic test equipment and to develop the skills and techniques for carrying out measurements and tests in electronic circuits.

Safety regulations and safe working practices and procedures should be observed at all times. Candidates will work on a range of practical electronic tasks which will enable them to develop the skills and techniques for setting up electronic test equipment and perform measurements and tests to the given specification.

The function of each measurement instrument should be explained and demonstrated by the tutor before the candidate is exposed to any of the practical tasks in the Unit.

Outcome 1

Precautions to be taken before connecting measuring instruments to electronic circuits should be explained and demonstrated by the tutor. Use of moving coil and electronic multi range instruments for the measurement of ac (alternating current) and dc (direct current) should be demonstrated. Resistance measurements should also be carried out on electronic components and circuits. Zero setting and accuracy, to include parallax error. Range selection and scale factor. Electronic circuits may include 3 resistor networks connected to both ac and dc power supplies.

Outcome 2

Practical demonstrations and activities should include: adjustment of oscilloscope controls to obtain a trace with no signal input, oscilloscope calibration, selection of suitable 'Y' input sensitivity and 'X' time division scale settings for a particular measurement, adjustment of triggering controls. Precautions to be taken before connecting oscilloscope to electronic circuits should be explained and demonstrated by the tutor.

The measurement of dc, sinusoidal, square, pulse and triangular waveforms should be carried out. The measurement of peak to peak values, periodic time, and mark to space ratio for each of the waveforms should be carried out and recorded on worksheets.

National Unit Specification: support notes (cont)

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Electronic circuits that may be used could include: resistor/capacitor (RC) and capacitor/resistor (CR) passive networks, circuits constructed around the 555 timer integrated circuit, electronic oscillators or common emitter transistor amplifiers.

The candidate should be given a brief description of the function and operation of any circuit he/she is to test or verify. Examples of test probe types available should be demonstrated.

Outcome 3

Practical demonstrations and activities may include selection of a suitable function generator to carry out specific tasks.

Adjustment of function generator controls to obtain a specific frequency, voltage and waveform. Precautions to be taken before connecting function generator to electronic circuits should be explained and demonstrated by the tutor.

This Outcome may be taught in conjunction with Outcome 2.

Outcome 4

Practical demonstrations and activities may include selection of suitable logic probe to carry out specific tasks.

Precautions to be taken before connecting logic probe to electronic circuits should be explained and demonstrated by the tutor.

Measurement of input and output logic levels in TTL and CMOS combinational logic circuits should be demonstrated, then candidates provided with practical tasks on electronic circuits.

The candidate should be given a brief description of the function and operation of any circuit he/she is to test or verify. The use of truth tables to record logic levels should also be explained.

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

This Unit should be taught in a workshop/laboratory environment.

Candidates should be given the opportunity to work both individually and in small teams. Safety regulations and safe working practices and procedures should be explained and demonstrated to the student before he/she is allowed access to the test equipment to be used.

Where this Unit forms part of an Engineering award it should be used to further develop the knowledge and skills gained in other Units, opportunities may also exist to integrate assessment. Circuits to be used for measurement and testing may have been designed and constructed in other Units within the award.

Outcomes 2 and 3 may be integrated using the function generator as a signal source and the oscilloscope to obtain signal measurements from the circuit under test.

National Unit Specification: support notes (cont)

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In all Outcomes the use of pre constructed circuit boards could be used allowing the student maximum time in measurement and testing activities.

OPPORTUNITIES FOR CORE SKILL DEVELOPMENT

Elements of the Core Skill of *Problem Solving*, that is, Critical Thinking, Planning and Organising, can be developed as candidates carry out complex measurements and test electronic circuits. They have to consider regulations and safety factors before selecting methods and techniques suited to a series of practical tasks. They perform measurements and tests safely and accurately to the given specification, recording and explaining results. As correct functions are evaluated and verified candidates could be given constructive feedback to encourage analytical evaluation of achievement.

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

Opportunities for the use of e-assessment

E-assessment may be appropriate for some assessments in this Unit. By e-assessment we mean assessment which is supported by information and communications technology (ICT), such as e-testing or the use of e-portfolios or e-checklists. Centres which wish to use e-assessment must ensure that the national standard is applied to all candidate evidence and that conditions of assessment as specified in the Evidence Requirements are met, regardless of the mode of gathering evidence. Further advice is available in *SQA Guidelines on Online Assessment for Further Education (AA1641, March 2003)*, *SQA Guidelines on e-assessment for Schools (BD2625, June 2005)*.

DISABLED CANDIDATES AND/OR THOSE WITH ADDITIONAL SUPPORT NEEDS

The additional support needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments, or considering whether any reasonable adjustments may be required. Further advice can be found on our website www.sqa.org.uk/assessmentarrangements