

SQA Advanced Unit Specification

General information for centres

Unit title: Electronic Testing Skills

Unit code: HP3M 47

Unit purpose: This Unit is designed to enable candidates to gain knowledge of standard electronic test instruments and testing techniques. In addition, candidates will gain the opportunity to practice basic fault finding techniques.

On completion of this Unit, the candidate should be able to:

1. Make measurements safely and accurately in electronic circuits, using analogue and digital multimeters
2. Perform tests on electronic circuits safely and accurately, using oscilloscopes, function generators and frequency meters
3. Perform tests on digital circuits using a logic probe, pulse generator and multimeter.
4. Identify short circuit and open circuit faults in simple electronic circuits.

Credit value: 1 SQA Credit at SCQF level 7: (8 SCQF credit points at SCQF level 7*)

**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 National 1 to Doctorates.*

Recommended prior knowledge and skills: Candidates should have some knowledge and understanding of electronic components, their symbols and schematic diagrams. This may be evidenced by the possession of a Higher Electronics (C027 12), Intermediate II Electronic and Electrical Fundamentals (C025 11), or the following National Qualification Units: Introduction to Electronic Test Equipment and Measurement (E9S9 11), Electronic Components and Circuit Assembly Techniques (E9S6 11), Fault Diagnosis on Basic Electronic Circuits (EE9K 12).

Core skills: There may be opportunities to gather evidence towards Core Skills in this Unit, although there is no automatic certification of Core Skills or Core Skills components.

Context for delivery: This Unit was developed for the SQA Advanced Certificate/ Diploma in Electronics. If the Unit is used in another group award, it is recommended that it be taught and assessed in the context of that particular group award.

SQA Advanced Unit Specification

Assessment: Candidates should be assessed on their ability to use electronic test instruments. Centres should provide instruction in measurement techniques, the application of instruments and their specifications. Candidates should measure parameters from a range of suitable electronic circuits, under supervised conditions. For Outcomes 1, 2 and 3, a concise report should be submitted for each practical exercise. This should contain a discussion about the instruments used and measurements made. Candidates may make use of notes, handouts or textbooks when composing the report. Outcomes 1 and 2 may be assessed together. Outcome 4 should be assessed under controlled, supervised conditions. Candidates are required to identify faults in at least 2 simple electronic circuits, one with a short circuit fault, and the other with an open circuit fault.

Unit specification: statement of standards

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The sections of the Unit stating the Outcomes, knowledge and/or skills, and evidence requirements are mandatory.

Where evidence for Outcomes is assessed on a sample basis, the whole of the content listed in the knowledge and/or skills section must be taught and available for assessment. Candidates should not know in advance the items on which they will be assessed and different items should be sampled on each assessment occasion.

Outcome 1

Make measurements safely and accurately in electronic circuits, using analogue and digital multimeters

Knowledge and/or skills

- ◆ Specifications and operation of analogue multimeters
- ◆ Specifications and operation of digital multimeters
- ◆ Circuit loading effects of multimeters
- ◆ Continuity and resistance measurements.
- ◆ Measurements of direct and alternating voltages
- ◆ Measurements of direct and alternating currents

Evidence requirements

Evidence of candidates' abilities to use multimeters safely and accurately should be generated by them undertaking a series of practical laboratories. Centres may utilise checklists to record performance details, but written evidence is required of candidates' knowledge of multimeter specifications and operation.

Assessment guidelines

The range of circuits utilised should match those used in Units elsewhere in the programme. The series of practical laboratories can be arranged so that this Outcome may be assessed in associations with Outcome 2. Written reports, covering at least 1 dc circuit and 1 ac, must be identifiable as the candidate's own work.

Outcome 2

Perform tests on electronic circuits safely and accurately, using oscilloscopes, function generators and frequency meters

Knowledge and/or skills

- ◆ Specifications and operation of oscilloscopes
- ◆ Specifications and operation of function generators

SQA Advanced Unit Specification

- ◆ Specifications and operation of frequency meters
- ◆ Calibration and set up of oscilloscopes
- ◆ Measurement of direct and alternating voltages
- ◆ Timing measurement using an oscilloscope
- ◆ Phase measurement using an oscilloscope
- ◆ Frequency measurement using an oscilloscope
- ◆ Frequency measurement using a frequency meter

Evidence requirements

Evidence of candidates' abilities to use oscilloscopes, function generators and frequency meters safely and accurately should be generated by them undertaking a series of practical laboratories. Centres may utilise checklists to record performance details, but written evidence is required of candidates' knowledge of instrument specifications and operations.

Assessment guidelines

The range of circuits utilised should match those used in Units elsewhere in the programme. The series of practical laboratories can be arranged so that this outcome may be assessed in associations with Outcome 1. Written reports, covering at least 1 suitable circuit, must be identifiably the candidate's own work.

Outcome 3

Perform tests on digital circuits using a logic probe, pulse generator and multimeter

Knowledge and/or skills

- ◆ Specifications and operation of logic probes
- ◆ Specifications and operation of pulse sources
- ◆ Testing of combinational logic circuits

Evidence requirements

Evidence of candidates' abilities to test digital circuits safely and accurately should be generated by them undertaking a series of practical laboratories. Centres may utilise checklists, but written evidence is required of candidates' knowledge of instrument specifications and operation.

Assessment guidelines

The range of combinational logic circuits utilised for the practical laboratories should match those used in Units elsewhere in the programme. Written reports, covering at least 1 suitable circuit, must be identifiably the candidate's own work.

Outcome 4

Identify short circuit and open circuit faults in simple electronic circuits

Knowledge and/or skills

- ◆ Determination of normal circuit conditions through analysis or documentation

SQA Advanced Unit Specification

- ◆ Identify and perform tests and measurements
- ◆ Detect short circuit fault conditions in simple electronic circuits
- ◆ Detect open circuit fault conditions in simple electronic circuits

Evidence requirements

Candidates must correctly identify the fault in each circuit, written evidence is required of measurements taken for each faulty circuit.

Assessment guidelines

This assessment must be undertaken in controlled, supervised conditions. Candidates should have access to a set of the test instruments utilised in the Unit. Faults in circuits should not be visible. The types of circuit utilised should be similar to those used in the practical exercises, and centres should have a variety sufficient to minimise the risk of collusion between candidates.

SQA Advanced Unit Specification

Administrative information

Unit code:	HP3M 47
Unit title:	Electronic Testing Skills
Superclass category:	XL
Date of publication:	August 2017
Version:	01
Source:	SQA

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SQA acknowledges the valuable contribution that Scotland's colleges have made to the development of SQA Advanced Qualifications.

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SQA Advanced Unit Specification

Unit specification: support notes

Unit title: Electronic Testing Skills

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

The Unit has been written to allow candidates to develop knowledge, understanding and skills in the following areas of electronic testing:

1. Analogue and digital multimeters.
2. Oscilloscopes, function generators.
3. Logic probes and pulse generators.
4. Basic fault finding.

The Unit has been developed to complement the Units in Principles/Technology section of the SQA Advanced Certificate/Diploma in Electronics framework. It is also intended to complement the SQA Advanced Unit Electronic Construction Skills.

The content reflects the need for candidates to be able to utilise standard test equipment accurately and without risk to themselves or the equipment, both while studying and when in employment. Safe and efficient use requires knowledge and understanding of instrument principles and limitations.

Guidance on the delivery and assessment of this Unit

This Unit should be delivered predominantly using practical exercises which will allow candidates to learn and develop safe and efficient testing skills using standard electronic instruments. Allocated times are given for guidance purposes only. For candidates following the SQA Advanced Certificate/Diploma in Electronics programme it may prove possible for centres to integrate the teaching and assessment of this Unit with others in the Principles/Technology section. For candidates on other programmes suitable circuits may be obtained or devised for delivery and assessment purposes.

Outcome 1 (10 hours)

Make measurements safely and accurately in electronic circuits, using analogue and digital multimeters

Specifications and operation of analogue multimeters

- ◆ moving coil operation
- ◆ selection of function
- ◆ ranges
- ◆ mechanical alignment of pointer
- ◆ accuracy & scale interpretation

SQA Advanced Unit Specification

Specifications and operation of digital multimeters

- ◆ digital meter operation
- ◆ selection of function
- ◆ ranges
- ◆ accuracy

Circuit loading effects of multimeters

- ◆ effective resistance of analogue voltmeters
- ◆ effective resistance of digital voltmeters
- ◆ voltage drop of analogue ammeters
- ◆ voltage drop of digital ammeters
- ◆ lead and terminal resistances

Continuity and resistance measurements.

- ◆ continuity testing on circuits with no power
- ◆ electrical isolation of components for resistance testing

Measurements of direct and alternating voltages

- ◆ selection of appropriate test points
- ◆ safe connection practices, terminals and range selection
- ◆ frequency limitations
- ◆ non-sinusoidal waveforms

Measurements of direct and alternating currents

- ◆ safe connection practices, terminals and range selection
- ◆ insertion of ammeter into circuit
- ◆ practical limitations of current measurement
- ◆ use of Ohm's Law to establish current from measured voltage

Outcome 2 (10 hours)

Perform tests on electronic circuits safely and accurately, using oscilloscopes, function generators and frequency meters

Knowledge and Skills:

Specifications and operation of oscilloscopes

- ◆ beam generation and deflection
- ◆ chassis potential and probe connections
- ◆ timebase
- ◆ signal channels
- ◆ triggering
- ◆ DC and AC coupling
- ◆ display
- ◆ bandwidth
- ◆ channel input parameters

SQA Advanced Unit Specification

Specifications and operation of function generators

- ◆ waveform type
- ◆ frequency ranges and adjustment
- ◆ waveform symmetry
- ◆ amplitude adjustment
- ◆ DC offset
- ◆ attenuation
- ◆ output impedance

Specifications and operation of frequency meters

- ◆ range selection
- ◆ sample time
- ◆ display Units

Calibration and set up of oscilloscopes

- ◆ beam find
- ◆ focus
- ◆ calibration of Y-channels and timebase
- ◆ trigger sources and adjustment

Measurement of direct and alternating voltages

- ◆ coupling
- ◆ safe connection practices
- ◆ Y-channel setting
- ◆ trace vertical position control
- ◆ display interpretation

Timing measurement using an oscilloscope

- ◆ Timebase setting
- ◆ Trace horizontal position control
- ◆ Display interpretation

Phase measurement using an oscilloscope

- ◆ trace alignment
- ◆ display interpretation
- ◆ lissajous figures

Frequency measurement using an oscilloscope

- ◆ timebase setting
- ◆ horizontal and vertical trace positioning
- ◆ period/frequency relationship

Frequency measurement using a frequency meter

- ◆ range and input selection
- ◆ gate setting
- ◆ display interpretation

SQA Advanced Unit Specification

Outcome 3 (5 hours)

Perform tests on digital circuits using a logic probe, pulse generator and multimeter

Knowledge and Skills:

Specifications and operation of logic probes

- ◆ power supply requirements
- ◆ TTL/CMOS settings
- ◆ logic high/low/indeterminate and pulsing signal indications
- ◆ level latching
- ◆ limitations of logic probes

Specifications and operation of pulse sources

- ◆ power supply requirements of Logic pulsers
- ◆ single pulse and pulse train settings
- ◆ level sensing
- ◆ laboratory pulse generator instruments
- ◆ pulse width, frequency and delay
- ◆ pulse amplitude
- ◆ triggering

Testing of combinational logic circuits

- ◆ verification of power supply with multimeter
- ◆ measurement of signal voltages with multimeter
- ◆ logic level indication with logic probe
- ◆ signal injection from pulse source

Outcome 4 (15 hours)

Identify short circuit and open circuit faults in simple electronic circuits.

Knowledge and Skills:

- ◆ determination of normal circuit conditions through analysis or documentation
 - interpretation of schematics and circuit signal data
- ◆ identify and perform appropriate tests and measurements
 - selection and safe use of appropriate instrumentation
- ◆ detect short circuit fault conditions in simple electronic circuits
 - interpretation of recorded results to identify location of a short circuit.
- ◆ detect open circuit fault conditions in simple electronic circuits
 - interpretation of recorded results to identify location of an open circuit

Open learning

Due to the high practical content of this Unit, it is unlikely that it will be offered through Open Learning.

SQA Advanced Unit Specification

For information on normal open learning arrangements, please refer to the SQA guide *Assessment and Quality of Open and Distance Learning* (SQA 2000).

Equality and inclusion

This unit specification has been designed to ensure that there are no unnecessary barriers to learning or assessment. The individual needs of learners should be taken into account when planning learning experiences, selecting assessment methods or considering alternative evidence.

Further advice can be found on our website www.sqa.org.uk/assessmentarrangements.

General information for candidates

Unit title: Electronic Testing Skills

This Unit has been designed to allow you to gain knowledge of standard electronic test instruments and testing techniques. In addition, you will gain the opportunity to practice basic fault finding techniques. These skills will be utilised in other parts of your course and are likely to prove especially useful in many forms of employment.

The early part of this Unit deals with the safe and efficient use of multimeters for the measurement of common electronic circuit parameters. It also covers the specifications and limitations of such instruments.

Similar topics are covered for oscilloscopes, function generators and frequency meters. It is intended that you will be given many opportunities to use this equipment to carry out tests on types of common electronic circuits.

Specialised equipment is often used for the testing of logic circuits, and you will carry out tests using some of this equipment.

Basic fault finding skills are introduced, and you will practice these on the same types of circuits covered elsewhere in the Unit.

You will be assessed on your knowledge and use of the test equipment and instruments. It is likely that the centre where you take the Unit will arrange a series of practical exercises covering the first three sections, the intention being to allow you to develop your skills. The section on fault finding will be a distinct assessment, requiring you to identify two separate faults in common electronic circuits.